THE GEOLOGY OF THE NORTHEASTERN PORTION OF THE DAHLONEGA GOLD BELT

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Georgia Department of Natural Resources
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Georgia Geologic Survey

BULLETIN 100

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ABSTRACT

This investigation encompasses that portion of the Dahlonega gold belt extending from Canton in Cherokee County northeastward to the Georgia-North Carolina State line, and was done to provide modern geologic information on this area of potential economic importance. Previous reports on mineral resources of the study area generally consist of site-by-site descriptions of individual mines, and, although these reports are valuable, no comprehensive studies of the geology of the entire area were made.

The Pumpkinvine Creek, Canton, and Univeter Formations of the New Georgia Group underlie the study area. The Pumpkinvine Creek Formation, the structurally lowest unit in the sequence, is composed of amphibolite with minor felsic gneiss. The Canton Formation, composed predominantly of mica-quartz schist and metagraywacke, overlies the Pumpkinvine Creek Formation and is in turn overlain by the Univeter Formation, a unit similar to the Pumpkinvine Creek Formation. One member, the Barlow Gneiss, was identified within the Pumpkinvine Creek Formation, and four members, the Proctor Creek, Palmer Creek, Chestatee, and Helen, were identified within the Canton Formation. No new members were identified within the Univeter Formation. Chemical data on amphibolites of the Pumpkinvine Creek and Univeter Formations indicate an abyssal tholeiite affinity.

The rocks in the study area were metamorphosed to staurolite-amphibolite grade approximately 365-million years ago and have been subjected to at least three fold events of progressively weaker intensity. Outcrop patterns and prominent structural features are associated with F_1 folds. The study area is bounded by the Shope Fork (pre- to synmetamorphic) and Allatoona (post-peak metamorphic) faults on the northwest and by the Chattahoochee fault (peak to post-peak metamorphic) on the southeast.

Gold was mined intermittently from placer, saprolite, or lode deposits in this area from about 1829 to 1934. Gold occurs within sulfidic quartz veins that generally conform to the foliation of the enclosing rock. These deposits occur in close association with iron formation and certain felsic gneisses and along the contacts between amphibolite and mica-quartz schist. Data strongly suggest that the gold was a primary constituent of the metavolcanic rocks and was remobilized and concentrated within veins during regional metamorphism and deformation. The weathering of the gold deposits has resulted in an apparent supergene enrichment.

This area comprises rocks that were probably deposited in a back-arc basin which experienced an initial period of volcanism followed by extensive clastic sedimentation that was occasionally punctuated by brief episodes of renewed volcanism. Deposition of gold-bearing lithologies generally marked the transitions between volcanic and sedimentary processes.

INTRODUCTION

The Dahlonega gold belt, named for the town of Dahlonega, Georgia, is a narrow sequence of rock units that can be mapped from at least the Georgia-Alabama State line northeastward to the Georgia-North Carolina State line, a distance of approximately 152 mi (approx. 243 km) (fig. 1). The belt varies in thickness from a maximum of approximately 12.8 mi (approx. 21.2 km) in Cobb and Paulding Counties to less than 0.6 mi (approx. 1 km) in Rabun County. Although generally coinciding with the New Georgia Group, the Dahlonega gold belt is actually a belt of gold occurrences rather than a distinct stratigraphic unit.

For over 100 years this area was the major gold-producing region in Georgia. Substantial increases in the price of gold over the last few years have generated renewed interest in this area. This study, which was initiated because of the need for information on the origin and geologic setting of these deposits, encompasses the area from Canton in Cherokee County northeastward to the Georgia-North Carolina State line.

Work on this project consisted of detailed geologic mapping and petrographic and geochemical studies of selected samples. Portions of seventeen 7.5-minute quadrangles were mapped between March 1982 and June 1983 and during November 1983. Geologic maps and maps delineating mine workings and unique lithologies of possible economic significance were made for each quadrangle. Those maps not included in this report are on open-file at the Geologic Survey office. Mine locations are given on plate 1, and descriptions are given in appendix 1. Detailed information on the southwestern portion of the gold belt is found in reports by McConnell and Abrams (1983, 1984).

PREVIOUS INVESTIGATIONS

Many reports have been published on the study area. Most were economic in nature and encompassed areas as small as one mine or as large as the Piedmont of the Southern Appalachians. These were mainly published during the periods 1879-1918, 1928-1952, and 1961-1984.

Many of the earliest reports were on the immediate Dahlonega area. The first of these was by Mackintosh (1879) and was followed by a general study of the gold fields of the entire southern Appalachians by Becker (1894). General studies of gold mining in the Southeast also were published by Blake and Jackson (1895) and Brewer (1895). The first site-by-site description of the gold deposits of Georgia was produced by Yeates and others (1896). Nitze and Wilkins (1897) described some Georgia gold deposits in their report on the gold deposits of North Carolina and adjacent areas. Maxwell (1901) described the Crown Mountain Mine at Dahlonega, and Eckel (1902) and Lindgren (1906) described

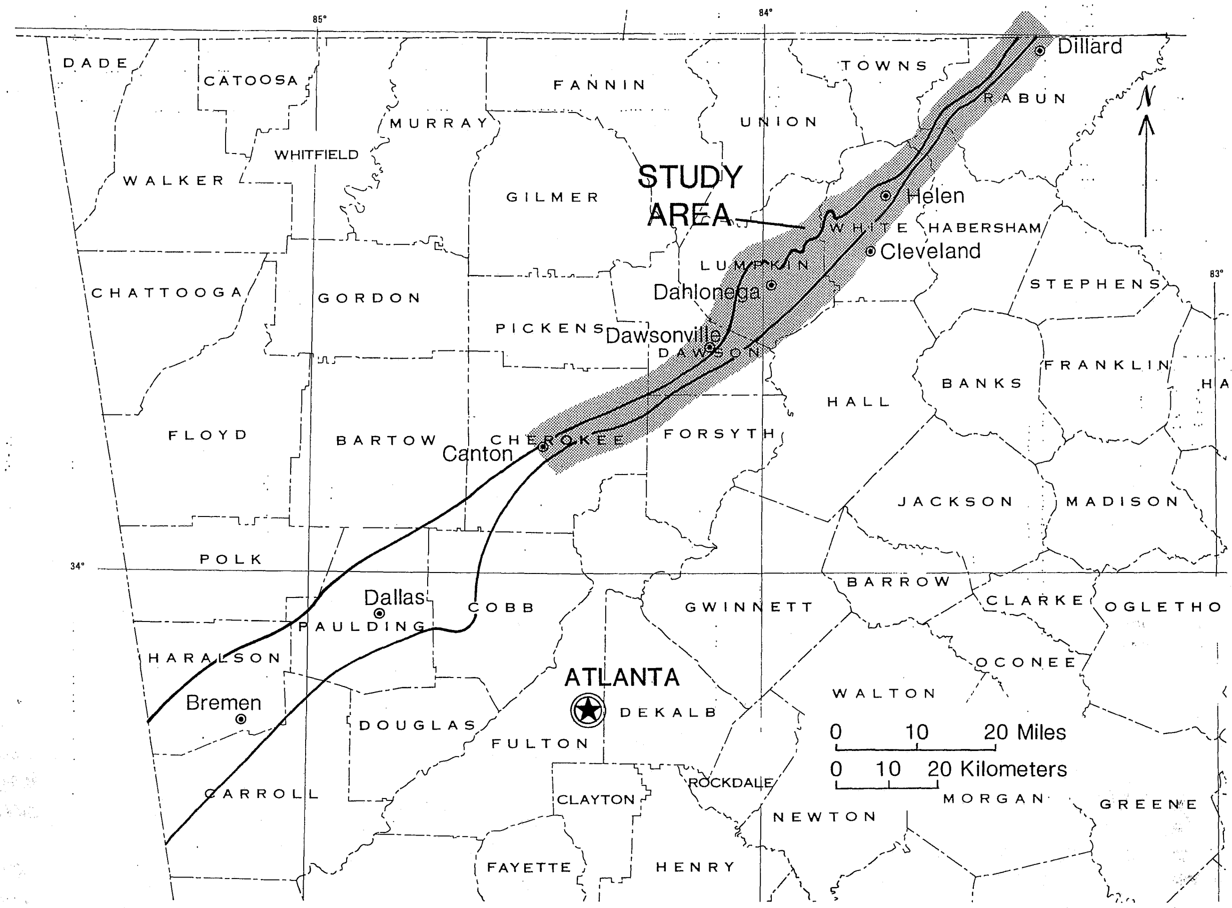


Figure 1. Geographic extent of the Dahlonega gold belt showing study area.

several deposits at Dahlonega. The first geologic map of the Dahlonega area was made by Keith (1909). Jones (1909) published a second bulletin on the gold deposits of Georgia; however, it was not as thorough as the earlier report by Yeates and others (1896). In 1918, Shearer and Hull reported on the pyrite deposits of Georgia including those in the study area. A portion of the gold belt was described by Bayley in 1928. Crickmay (1933), Wilson (1934), and Anderson (1934) gave brief overviews of gold mining within Georgia, and Park and Wilson (1936) described the deposits of the Battle Branch Mine and suggested a hydrothermal origin. A report by Pardee and Park in 1948 covered the entire Piedmont of the Southern Appalachians. They gave thorough descriptions of several important mines in Georgia and in several other states. Kline and Beck (1949) reinvestigated the massive sulfide deposit at the Chestatee Copper and Pyrite Mine. Crickmay's (1952) report on the crystalline rocks of Georgia included a brief description of a portion of the study area. Bowen (1961) and Stewart and others (1964) studied the geology of portions of Dawson County, and Sever (1964) conducted a geologic and hydrologic study of the entire county. In 1964, the mineral resources of White County were described by Hurst and Otwell, and those in Habersham County were described by Hurst and Crawford. A report by Fairley (1965) on the Murphy syncline included a portion of the study area in Cherokee County. Hatcher's (1971, 1974, 1976) works on the geology of Rabun and Habersham Counties included part of the study area. Lesure (1971) described gold mobility at the Calhoun Mine. Murray (1973) mapped a portion of the study area for his geologic map of Fulton and Forsyth Counties. Cook (1978) described the soil geochemistry at the Franklin-Creighton Mine. Works by Gillon (1982) and Nelson (1983) described the geology of a portion of the study area in White County. The geology of the Dahlonega area was described by Cook and Burnell (1983) and by Cook and others (1984), and the geochemistry of rocks in that area was described by Burnell and Cook (1984). Otwell (1984) recently described the gold deposits of White County, and McConnell and Abrams (1984) described part of the study area in their report on the Greater Atlanta area.

STRATIGRAPHY

Introduction

The study area comprises lithologies that are an extension of the New Georgia Group (McConnell and Abrams, 1984). In the study area, units in the New Georgia Group (fig. 2) exhibit considerable variability; however, mica-quartz schist, metagraywacke, and amphibolite are the most abundant. These are augmented by lesser amounts of felsic gneiss, metatrondhjemite, sericite-quartz schist, and iron formation. Thicknesses of these units are impossible to ascertain reliably due to faulting and multiple folding, but are estimated to range from less than 100 m to several kilometers. For the same reasons, stratigraphic order is problematical; however, units below are described in a probable ascending order. They are assigned a Late Proterozoic or early Paleozoic age based on radiometric age dates determined by Dallmeyer (1978).

Pumpkinvine Creek Formation

The Pumpkinvine Creek Formation is a fine-grained amphibolite with interlayered thin units of felsic gneiss and sericite phyllite (McConnell, 1980). Mapping for the present study revealed that this formation forms the core of an overturned, northwest-vergent antiform (herein called the Auraria antiform; see plate 1, cross-section AA') whose direction of plunge alternates from northeast to southwest several times along its trace. The Pumpkinvine Creek Formation plunges northeastward beneath the Canton Formation on the eastern edge of Canton, Georgia (McConnell, 1980; McConnell and Abrams, 1984) and reappears approximately 15.6 mi (approx. 25 km) to the northeast. From that point it is exposed continuously northeastward to Dahlonega where it again plunges beneath the Canton Formation. Cook and Burnell (1983) gave a similar structural interpretation regarding this formation in the Dahlonega area and referred to it informally as the Findley Ridge amphibolite. McConnell (1980) reports that the Pumpkinvine Creek Formation occupies the limbs of an antiform southwest of the study area and can be mapped intermittently to the Georgia-Alabama State line. He also reports that his formation may be correlative with the Hillabee Greenstone in Alabama.

PUMPKINVINE CREEK FORMATION UNDIFFERENTIATED

Rocks mapped as Pumpkinvine Creek Formation undifferentiated in the study area consist of fine- and medium-grained amphibolite with lesser amounts of garnet-biotite-hornblende-quartz-plagioclase gneiss ± calcite and/or staurolite, muscovite-biotite-plagioclase-quartz gneiss, and iron formation. The amphibolite is dark green to black in color with occasional light banding. It locally contains large laths of hornblende randomly oriented along the foliation (fig. 3). This rock has a simple mineralogy, consisting predominantly

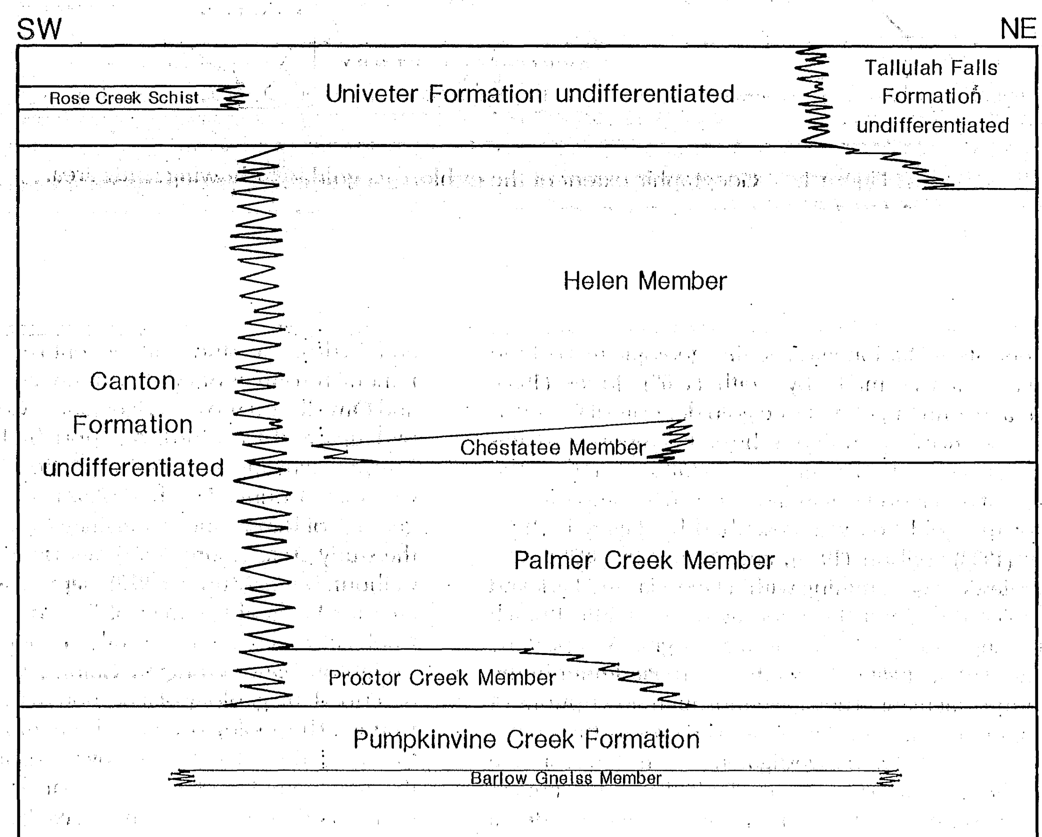


Figure 2. Diagrammatic stratigraphic section of lithologic units in the study area.

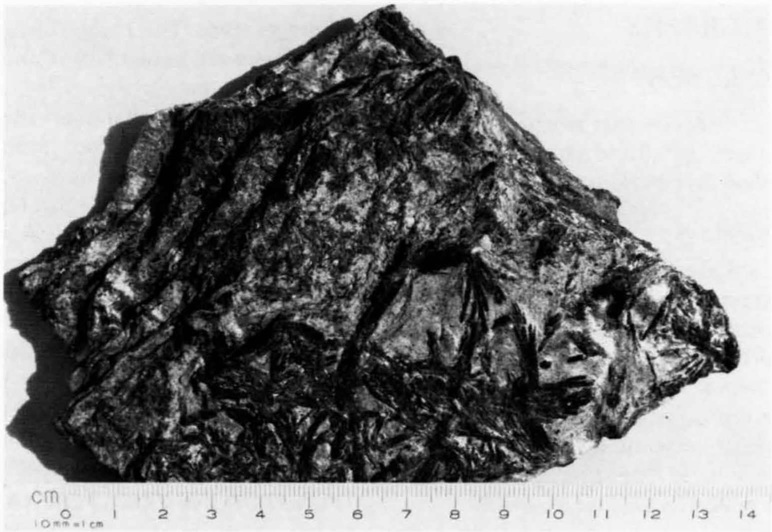


Figure 3. "Chicken track" texture of an amphibolite from the Pumpkinvine Creek Formation.

of green hornblende and plagioclase (albite/oligoclase) in nearly equal proportions (table 1, sample pcu_1). Accessory minerals are epidote, sphene, biotite, chlorite, magnetite, and calcite. Locally, chlorite may comprise up to 15 percent of the rock. The garnet-biotite-hornblende-quartz-plagioclase gneiss $\pm$ calcite and/or staurolite is locally interlayered with the amphibolite near the contact with the Canton Formation. This coarsely porphyroblastic and relatively leucocratic lithology possesses a complex mineralogy dominated by plagioclase, quartz, and hornblende (table 1, sample pcu_2). The hornblende commonly occurs as radiating laths (rosettes) several centimeters across (fig. 4). Large rolled garnets up to 1.5 cm in diameter are numerous. These large hornblende and garnet crystals are embedded in a fine-grained groundmass of quartz and plagioclase with lesser amounts of calcite, staurolite, and biotite. Muscovite, epidote, and chlorite are locally present. McKinstry and Mikkola (1954) described a remarkably similar lithology in the hangingwall of the ore body at the Elizabeth Copper Mine in Vermont.

Iron formation units associated with the Pumpkinvine Creek Formation in the study area are quartzites that locally may contain magnetite, hematite, pyrite, arsenopyrite, mica, garnet, or unidentified manganese minerals. Volumetrically, these are minor units, attaining a maximum thickness of only a few meters. However, economically, they appear to be important indicators of gold deposits since a large number of abandoned gold mines are located along their strike. Iron formation and its significance will be discussed more fully in a later section.

BARLOW GNEISS MEMBER

A mappable unit of muscovite-biotite-plagioclase quartz gneiss within the Pumpkinvine Creek Formation was previously referred to as granite by LaForge and Phalen (1913) and as a sheared granitoid dike by Pardee and Park (1948). Crickmay (1952) included this gneiss in his Wedowee-Ashland belt. This unit is herein named the Barlow Gneiss Member for exposures in the inactive Barlow Mine near Dahlonega, Georgia (Campbell Mountain and Dawsonville 7.5-minute quadrangles, fig. 5). This member is exposed in a large hydraulic cut at the indicated type locality on figure 5. The gneiss is locally interlayered with amphibolites; therefore, the boundaries of this member are the last appearances of the muscovite-biotite-plagioclase-quartz gneiss. This member is bounded by undifferentiated amphibolite of the Pumpkinvine Creek Formation. Contacts between the gneiss and amphibolites are sharp.

The Barlow Gneiss Member is a medium- to dark-gray rock that has a pin-striped appearance in most exposures. Porphyroblasts are usually present as flattened crystals or crystal aggregates of either blue quartz or plagioclase up to 0.5 cm in diameter (fig. 6) that may be recrystallized crystal fragments. Thin sections of the gneiss show slightly altered plagioclase porphyroblasts embedded in a fine-grained groundmass of quartz, plagioclase, biotite, and muscovite (table 1, sample blg; fig. 7). The amphibolites are dark green to black in color and locally exhibit light banding. Their mineralogy is principally plagioclase and hornblende with accessory epidote, sphene, magnetite, chlorite, and calcite.

The Barlow Gneiss Member is well exposed and was used as a marker horizon in deciphering the structure of the area. Its outcrop pattern defines a regional, northwest-vergent antiform and, although generally relatively thin, this member can be mapped from just southwest of Dawsonville to Dahlonega, a distance of approximately 14.7 mi (approx. 23.5 km) (plate 1).

Mineralogical and field evidence strongly suggest that the Barlow Gneiss Member represents the metamorphosed felsic phase of a predominantly mafic volcanic sequence. The areal extent, mineralogy, and texture of this member strongly suggest that its protolith was a crystal tuff. The Barlow Gneiss Member is lithologically similar to and may be correlative with the Galts Ferry Gneiss as described by McConnell (1980) and McConnell and Abrams (1984).

Table 1. Average Modal Composition of New Georgia Group Lithologies in the Study Area.

	pcu_1	pcu_2	blg	pc_1	pc_2	plc	cs_1	cs_2	h_1	h_2	unu_1	unu_2
Quartz		31	48	56	64	56	40	50	31	62	5	45
Plagioclase (albite/oligoclase)	40	23	23		3	1	50	44	tr	13	43	8
Hornblende	53	23				4					50	3
Biotite	tr	3	13	32	20	36	7		6	21		35
Muscovite		2	12	3	3	tr	3	2	43	2		
Garnet		7		8	10	2			16	1		
Chlorite	3	8		tr	tr	tr	tr	1	1		tr	3
Epidote	2	tr	2			tr				1	tr	
Sphene	2											
Magnetite	tr		tr	1		1			tr	tr	2	
Calcite	tr	3	2	tr			tr			tr	tr	5
Staurolite		1			tr				2			
Tourmaline									1	tr		
Kyanite		tr										
Pyrite								3				
Graphite									tr			

pcu - Pumpkinvine Creek Formation undifferentiated
blg - Barlow Gneiss Member
pc - Proctor Creek Member
plc - Palmer Creek Member
cs - Chestatee Member
h - Helen Member
unu - Univeter Formation undifferentiated

Figure 4. Radiating hornblende crystals in the coarsely porphyroblastic facies of the Pumpkinvine Creek Formation.

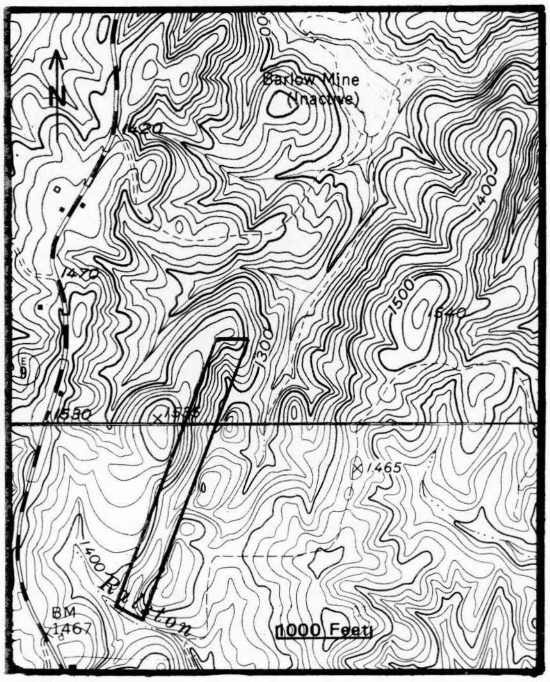


Figure 5. Type locality of the Barlow Gneiss Member of the Pumpkinvine Creek Formation (Dawsonville and Campbell Mountain, U.S. Geological Survey 7.5-minute topographic quadrangles).

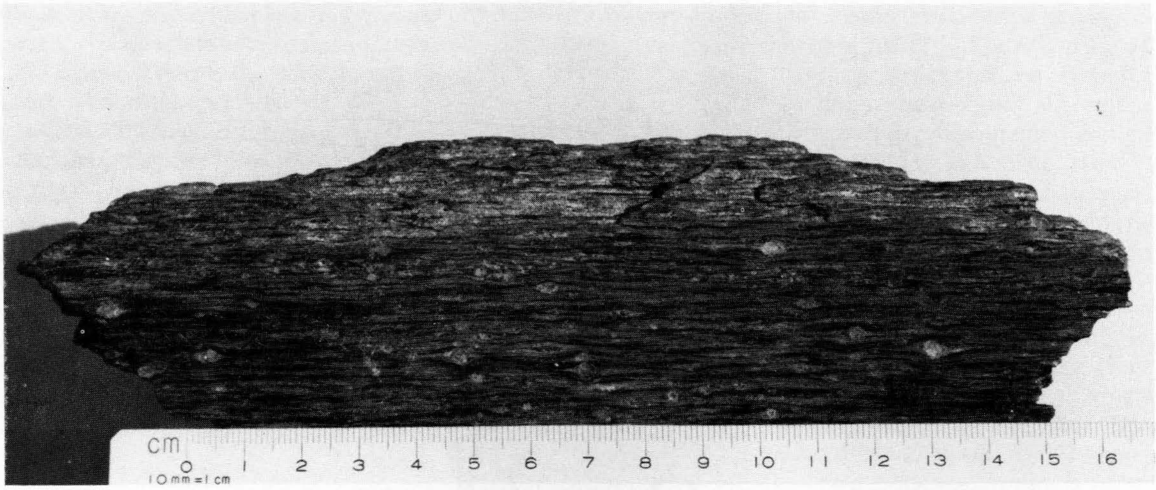


Figure 6. Sample of the Barlow Gneiss Member showing flattened porphyroblasts.

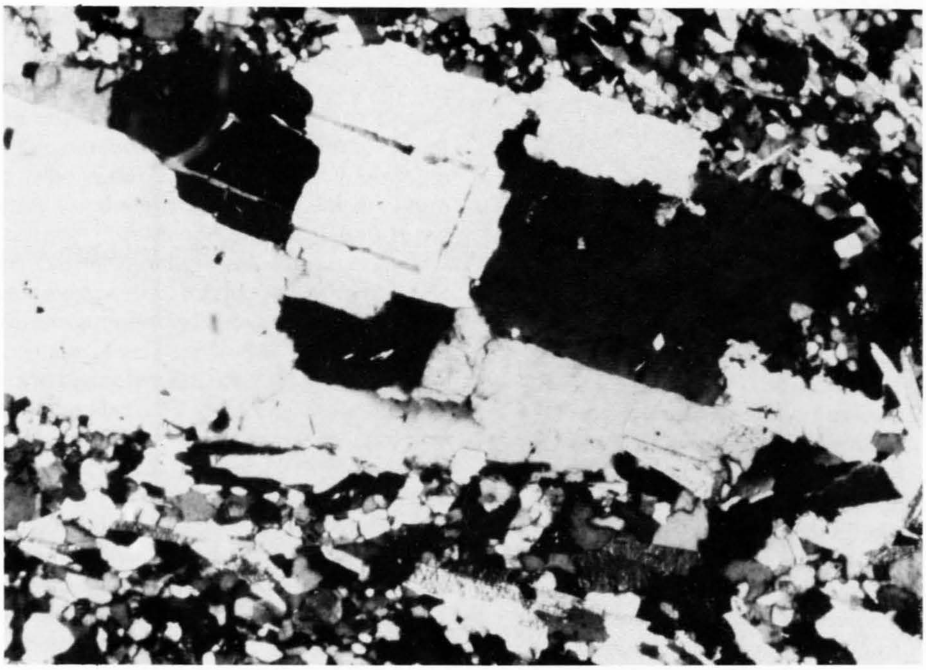


Figure 7. Polycrystalline plagioclase porphyroblast (Barlow Gneiss Member) embedded in a fine-grained matrix.

Canton Formation

The Canton Formation consists of graphitic garnet-mica schist, metagraywacke, and phyllite (McConnell and Abrams, 1984). This unit can be traced into the study area from the southwest at Canton and is traceable from there northeastward to the Lake Burton area northeast of Helen, Georgia, a distance of approximately 64 mi (approx. 107 km). Most lithologies within this unit appear to be metasedimentary in origin. In the study area the Canton Formation consists of garnet-biotite-muscovite-quartz schist, biotite-muscovite quartzite, graphitic quartz-sericite schist, hornblende-biotite-quartz schist, muscovite-biotite-quartz schist, biotite-plagioclase-quartz gneiss, plagioclase-biotite quartzite, and amphibolite.

Several of the above lithologies are individually mappable while others are components of a mappable sequence. Four members for the Canton Formation can be recognized. They are formally named and described below.

PROCTOR CREEK MEMBER

Lithologies that are herein named the Proctor Creek Member of the Canton Formation were previously mapped as Carolina Gneiss by Keith (1909) and as the Wedowee-Ashland belt by Crickmay (1952). This member is named for exposures along Proctor Creek near Dawsonville, Georgia (Dawsonville 7.5-minute quadrangle, fig. 8). The dominant lithology at the indicated type locality on figure 8 is a muscovite-garnet-biotite-quartz schist (table 1, sample pc_1). This schist has a fine- to medium-grained texture and a silvery luster on cleavage surfaces. Subhedral garnets approximately 3 to 5 mm in diameter are common. Accessory minerals include magnetite (?), chlorite, and calcite. Thin lenses of calc-silicate material (i.e., garnet-hornblende-quartz-plagioclase hornfels) 1 to 5 cm thick are common. In the Dahlonega area the schist possesses a somewhat different texture marked by coarse porphyroblasts (?) of altered plagioclase rimmed by garnet and biotite (table 1, sample pc_2) and locally is more gneissic than schistose. At several locations, distinct layers with coarse porphyroblasts 4 to 8 mm in diameter alternate with layers having fine porphyroblasts 1 to 3 mm in diameter (fig. 9). The interpreted lower boundary of the Proctor Creek Member is the first appearance of iron formation or amphibolite of the Pumpkinvine Creek Formation. This contact is sharp in most exposures and was interpreted as a fault in the immediate Dahlonega area by Cook and Burnell (1983). The interpreted upper boundary is the first appearance of darker, muscovite- and garnet-poor schist of the Palmer Creek Member (this study). This contact is poorly exposed but is believed to be gradational.

The Proctor Creek Member is exposed in the limbs of the Auraria antiform from the vicinity of the Dawson-Forsyth County line northeastward to Dahlonega (plate 1). Characteristics of this member at most exposures suggest a shale as its protolith; however, the coarsely porphyroblastic facies exposed in the vicinity of Dahlonega (fig. 9) could be interpreted as a metatuff.

Figure 8. Type locality of the Proctor Creek Member of the Canton Formation (Dawsonville, U.S. Geological Survey 7.5-minute topographic quadrangle).

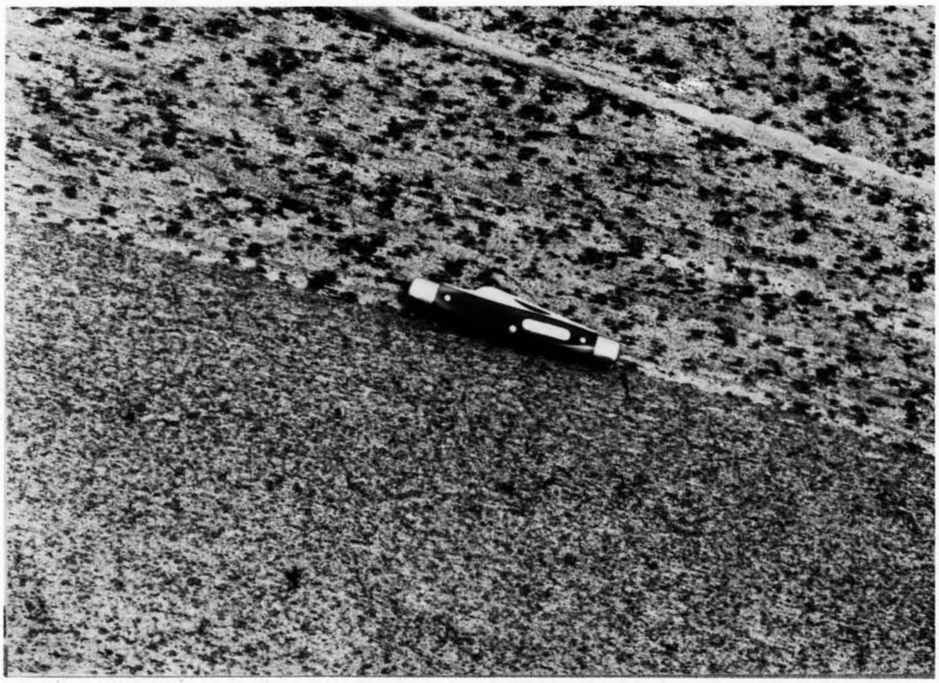


Figure 9. Banded nature of the coarsely porphyroblastic facies of the Proctor Creek Member.

PALMER CREEK MEMBER

Lithologies herein named the Palmer Creek Member of the Canton Formation were previously mapped as Carolina Gneiss (Keith, 1909) and as Wedowee-Ashland belt (Crickmay, 1952). This member is named for exposures along Palmer Creek near Dawsonville, Georgia (Dawsonville 7.5-minute quadrangle, fig. 10). At the designated type locality on figure 10, biotite-quartz schist ± hornblende and/or garnet is the dominant lithology. Garnet-biotite-muscovite-quartz schist and minor amphibolite are present locally. The biotite-quartz schist is fine- to medium-grained and cleaves readily into thin plates. It locally contains small almandine garnet crystals approximately 2 mm in diameter. Hornblende crystals locally occur as somewhat ragged laths up to 1.5 cm long randomly oriented along the foliation planes. Accessory minerals are epidote, plagioclase, magnetite (?), and chlorite (table 1, sample plc). Locally, this lithology has a gneissic texture defined by alternating bands of biotite-rich and biotite-poor zones that resemble original sedimentary features. The garnet-biotite-muscovite-quartz schist is most abundant in the Dahlonega area and is similar texturally to the biotite-quartz schist. The presence of muscovite gives this rock a lighter color and luster. Amphibolites occur as thin units composed of nearly equal amounts of hornblende and plagioclase. Most of the amphibolites are not mappable at the 1:24,000 scale.

The boundary between the Palmer Creek Member and the Proctor Creek Member is the last occurrence of the biotite-quartz schist. The boundary between the Palmer Creek Member and the Chestatee Member (this study) is the first occurrence of interlayered felsic gneiss and amphibolite. The contact with the Proctor Creek Member is gradational, whereas the contact with the Chestatee Member is a fault. Where the Chestatee Member is absent (plate 1), the Palmer Creek Member grades into the Helen Member (this study). The boundary of the Palmer Creek Member in this case is the first appearance of biotite-plagioclase-quartz gneiss (metagraywacke) of the Helen Member.

The Palmer Creek member is exposed in the limbs and hinge of the Auraria antiform from the vicinity of the Dawson/Forsyth County line northeastward to the Dahlonega area. This member probably is a metamorphosed sequence of fine-grained sediments with minor mafic tuffs or flows.

CHESTATEE MEMBER

The sequence of lithologies herein named the Chestatee Member was previously mapped as Roan Gneiss by Keith (1909) and as part of Crickmay's (1952) Wedowee-Ashland belt. This member is named for exposures along the Chestatee River in Lumpkin County, Georgia (Murrayville 7.5-minute quadrangle, fig. 11). At the indicated type locality (fig. 11), as at other exposures, several lithologies are present. They include, in order of abundance, amphibolite, hornblende-plagioclase gneiss, muscovite-biotite-quartz-plagioclase gneiss (table 1, sample cs_1), and muscovite-pyrite-plagioclase-quartz gneiss (table 1, sample cs_2). The amphibolite is dark green to black and exhibits textures ranging from finely equigranular to coarsely porphyroblastic. In the coarsely porphyroblastic rock, leucocratic porphyroblasts occur either as single plagioclase crystals resembling metamorphosed phenocrysts or as crystal aggregates of clinozoisite resembling metamorphosed amygdules. The hornblende-plagioclase gneiss appears to be a hornblende-poor variety of the amphibolite. The muscovite-biotite-quartz-plagioclase gneiss is a medium-gray rock with a generally homogeneous texture. Porphyroblasts of quartz and/or plagioclase approximately 1 to 3 mm in diameter are conspicuous. This lithology closely resembles the Barlow Gneiss Member of the Pumpkinvine Creek Formation. The muscovite-pyrite-plagioclase-quartz gneiss is a very leucocratic rock with a uniform texture. Fine laminations of pyrite and muscovite are locally present.

The Chestatee Member is in sharp contact with the Helen Member (this study) to the southeast and in fault contact with the Palmer Creek Member to the northwest (plate 1). The

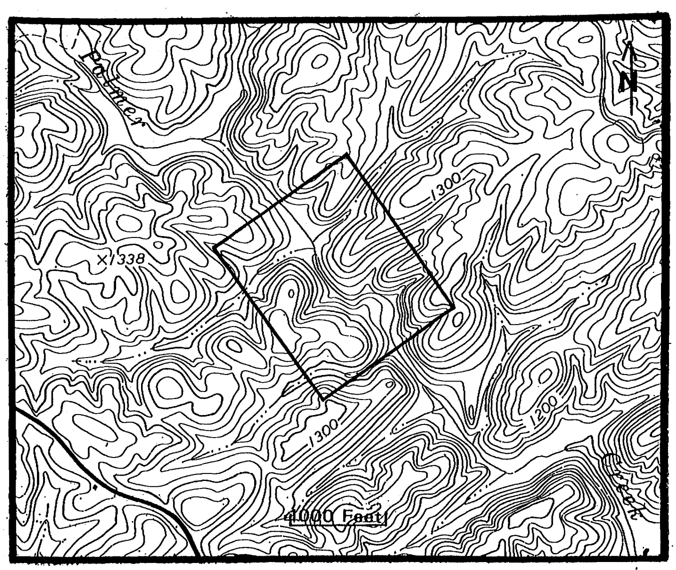


Figure 10. Type locality of the Palmer Creek Member of the Canton Formation (Dawsonville, U.S. Geological Survey 7.5-minute topographic quadrangle).

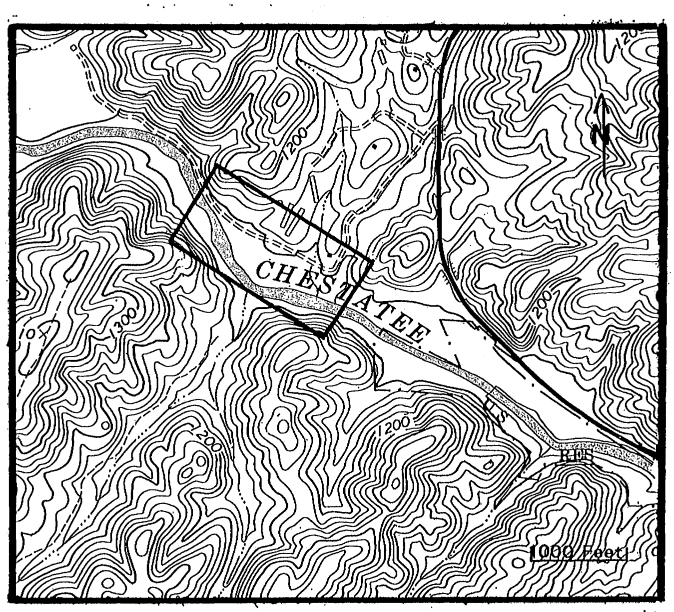


Figure 11. Type locality of the Chestatee Member of the Canton Formation (Murrayville, U.S. Geological Survey 7.5-minute topographic quadrangle).

boundaries of the Chestatee Member are the first occurrences of biotite-quartz schist of the Palmer Creek Member to the northwest and metagraywacke of the Helen Member to the southeast.

The Chestatee Member is exposed from near Dawsonville in Dawson County northeastward to the Cavenders Creek area in Lumpkin County (plate 1), and its trace forms a distinct topographic lineament. This member probably represents a metamorphosed sequence of felsic and mafic crystal tuffs and mafic flows.

HELEN MEMBER

This sequence of rocks was previously designated as part of the Carolina Gneiss (Keith, 1909) and as part of the Wedowee-Ashland belt (Crickmay, 1952). More recently, Gillon (1982) informally termed these rocks the Helen sequence for exposures in the vicinity of Helen, Georgia. This terminology was also employed by Nelson (1983) and Nelson and Zeitz (1983) for rocks in the same area. To avoid confusion the name Helen is retained for this sequence and herein named the Helen Member of the Canton Formation for exposures in the vicinity of Helen, Georgia (Helen 7.5-minute quadrangle, fig. 12). At the indicated type locality (fig. 12), and elsewhere, biotite-muscovite-quartz schist ± garnet and biotite-plagioclase-quartz gneiss (metagraywacke) are the dominant lithologies. Plagioclase-biotite quartzite and minor amphibolite may be locally present. Additional exposures may be observed at a reference locality along Georgia Highway 60 south of Dahlonega (Murrayville 7.5-minute quadrangle, fig. 13).

The biotite-muscovite-quartz schist ± garnet and the biotite-plagioclase-quartz gneiss (metagraywacke) occur as an intricately interlayered sequence where alternation of layers of equal thickness is common. The schist (table 1, sample h_1) is light gray to light brown in color and overall fine to medium grained. It is richer in garnet and muscovite in the southwestern half of its exposed length, becoming garnet-poor, slightly feldspathic, and biotite-rich to the northeast. Where garnetiferous, the largest garnets are approximately 0.5 cm in diameter, euhedral, and exhibit a rolled (pinwheel) texture. Staurolite, chlorite, magnetite (?), and tourmaline are accessory minerals. Graphite is locally abundant. The biotite-plagioclase-quartz gneiss (table 1, sample h_2) is medium gray in color with an overall "salt and pepper" appearance. The gneiss is locally conglomeratic with clasts consisting of quartz or plagioclase less than 0.5 cm in longest dimension. Matrix

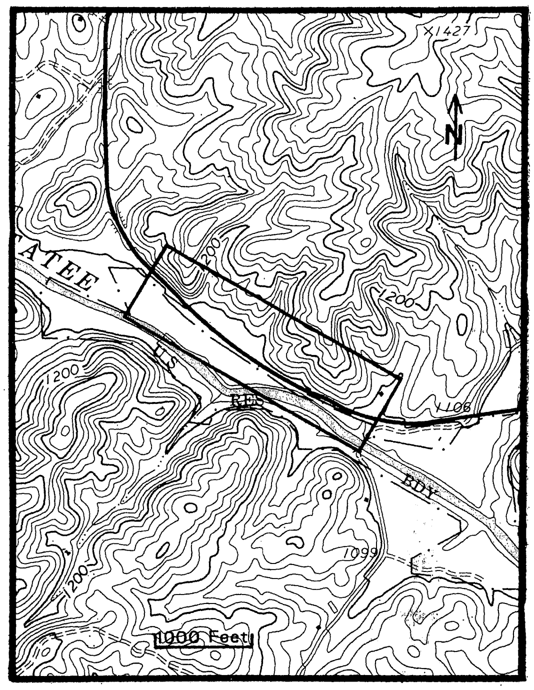


Figure 13. Reference locality of the Helen Member of the Canton Formation (Murrayville, U.S. Geological Survey 7.5-minute topographic quadrangle).

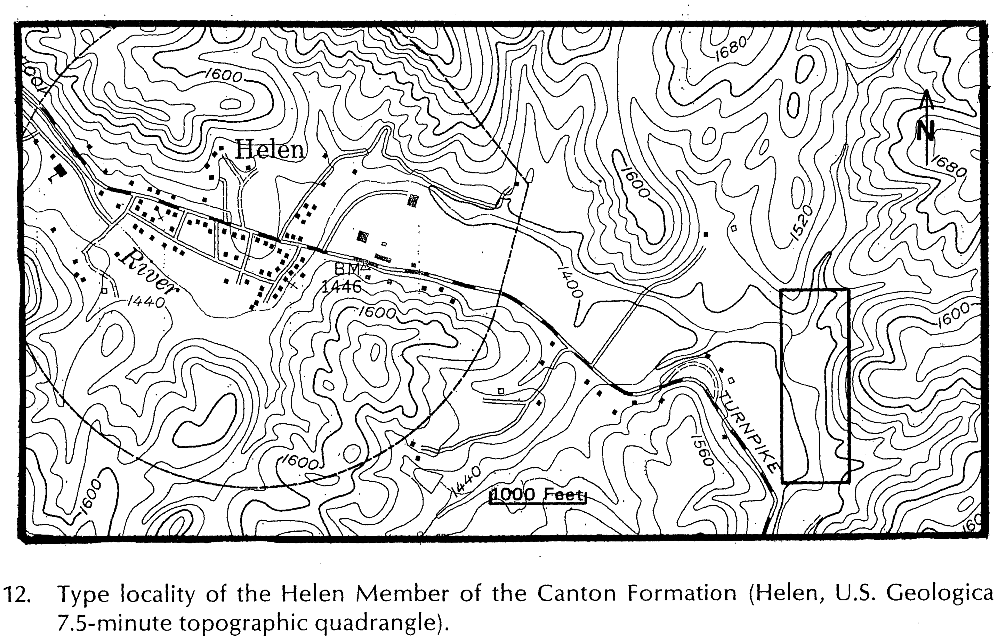


Figure 12. Type locality of the Helen Member of the Canton Formation (Helen, U.S. Geological Survey 7.5-minute topographic quadrangle).

material consists of a fine-grained mixture of quartz and plagioclase plus lesser amounts of biotite, muscovite, garnet, and epidote. Fine laminations and graded beds are observable in hand samples and thin sections. In some exposures northeast of Dahlonega, the quartz content is high enough (greater than 70 percent) to classify this lithology as a quartzite. The amphibolites occur as thin units interbedded with the above-mentioned schist and gneiss. Some amphibolites are easily mapped over long distances and, therefore, were used as stratigraphic marker horizons. Their mineralogy consists predominantly of plagioclase and hornblende with accessory sphene, epidote, chlorite, and magnetite (?). Locally, chlorite and epidote are abundant.

The Helen Member (plate 1) grades into the Univeter Formation (this study) and Hatcher's (1974) Tallulah Falls Formation to the southeast and the Palmer Creek Member and Hatcher's (1974, 1976, 1979) Coweeta Group to the northwest. It is in fault contact with undifferentiated amphibolite and schist and Gillon's (1982) Richard Russell formation to the northwest. It is in sharp contact with the Chestatee Member, also to the northwest. The boundaries of the Helen Member are defined as the last occurrence of interlayered metagraywacke and biotite-muscovite-quartz schist.

The Helen Member is exposed from just southwest of Lake Burton in Habersham County, where it pinches out, to the vicinity of the Dawson-Forsyth County line, where it is no longer distinguishable from undifferentiated Canton Formation. The mineralogy, textures, and internal stratigraphy of this member strongly suggest a predominantly sedimentary origin. The repetitive nature of the gneiss-schist sequence resembles part of a turbidite sequence. This member probably was deposited in a rapidly subsiding basin that had an occasional episode of volcanic activity.

Univeter Formation

The Univeter Formation is the most regionally extensive formation in the study area. It is exposed from near Canton in Cherokee County to Lake Burton in Habersham County, its trace forming a regional topographic lineament. Near Canton the Univeter Formation consists of amphibolite, hornblende gneiss, garnet-biotite-muscovite schist, banded iron formation, and garnet-chlorite schist and is divided into the Lost Mountain Amphibolite and Rose Creek Schist Members (McConnell and Abrams, 1984).

The Rose Creek Schist Member can be traced into the southwestern portion of the study area where it pinches out approximately 7 mi. (approx. 11 km) east of Canton. From that point to near Cleveland in White County, separately mappable units within the Univeter Formation are rare. Between these points, the Univeter consists of fine-grained amphibolite with minor interlayered plagioclase-hornblende-biotite-quartz gneiss, biotite-muscovite-quartz schists and iron formation. The amphibolite (table 1, sample unu_1) is dark green to black with a uniformly fine-grained texture. Finely detailed banding is common. Features resembling amygdules, now represented by rosettes of clinozoisite, are visible in thin section. This lithology is probably equivalent to the Lost Mountain Amphibolite Member. Plagioclase-hornblende-biotite-quartz gneiss (table 1, sample unu_2) occurs as thin layers in the amphibolite. The gneiss is pin-striped in appearance due to distinct, thin, dark and light mineral bands. At some exposures these two lithologies form an intricately interlayered sequence.

North of Dahlonega other facies within the Univeter Formation are recognizable and are mappable for short distances. These include fine-grained amphibolite, garnet-biotite-muscovite-quartz schist and biotite-plagioclase-quartz gneiss. The schist is a fine- to medium-grained rock with a silvery luster on cleavage surfaces. Mineralogically, it is very similar to the schist of the Helen Member of the Canton Formation. The gneiss is fine-grained and is weakly laminated. Accessory minerals are muscovite, epidote, garnet, and magnetite. Both the garnet-biotite-muscovite-quartz schist and the biotite-plagioclase-quartz gneiss occur sporadically, making their stratigraphic relationship to the amphibolite unclear.

Northeast of Helen, the Univeter Formation grades into rocks previously mapped as undifferentiated Tallulah Falls Formation (Hatcher, 1971, 1974) and as Great Smoky Group (Hatcher, 1976). These rocks can be traced along the western shore of Lake Burton and through Rabun County to the Georgia-North Carolina State line (plate 1). They consist of a complex assemblage of plagioclase-biotite-quartz gneiss (metagraywacke), plagioclase-garnet-biotite-muscovite-quartz schist, biotite-quartz schist ± garnet, hornblende-plagioclase gneiss, and amphibolite ± biotite and/or garnet. The overall composition of this assemblage is similar to the lowermost member of the Tallulah Falls Formation (Hatcher, 1971, 1974, 1976), but since it exhibits much variation along strike, it is designated here as Tallulah Falls Formation undifferentiated. This assemblage is intruded by a gneissic to coarsely porphyroblastic, leucocratic muscovite-biotite quartz monzonite gneiss (Rabun Gneiss of Hatcher, 1974, 1976).

Intrusive Rocks

Several types of intrusive rocks are present in the study area. They are either felsic, mafic, or ultramafic in composition and of limited areal extent. Three relatively large intrusive bodies are found in the Dahlonega area (plate 1). They consist of two micaceous "granitic" bodies and one amphibole-bearing "granitic" body. The micaceous bodies are coarsely crystalline, leucocratic rocks and have a weakly to moderately well-developed foliation. Biotite and muscovite together comprise approximately 15 percent of the rock. Sericitization and kaolinization of feldspars makes their identification difficult, although identifiable feldspars are clearly plagioclase. No K-feldspar was observed. The quartz content is high, ranging from 65 to 70 percent. The easternmost micaceous "granitic" body was referred to as the Benning granite (Jones, 1909). The amphibole-bearing body has a similar texture and mineralogy and is also altered. Amphibole makes up 10 percent of this rock. The degree of alteration and the lack of sufficient data prevent a concise classification of these bodies although they have been referred to recently as metatrondhjemites (Cook and others, 1984). These bodies crosscut rocks within the Canton Formation and are locally interlayered with the country rock.

Two biotite trondhjemite dikes are present on the Dillard Quadrangle. The dikes are unmetamorphosed, leucocratic rocks that consist of albite (72%), quartz (25%), and biotite (3%). Both dikes strike northeast and are undeformed.

Hatcher (1974) assigned them a late Paleozoic age based on their unmetamorphosed character.

Mafic intrusive bodies are represented in the study area by olivine diabase dikes. Almost all are confined to the extreme northeastern end of the study area. The dikes are clearly the youngest rocks in the study area as demonstrated by their crosscutting nature. All those examined contain from 10 to 23 percent olivine, are less than 3 m wide, and strike northwest. A few can be traced for several kilometers. A dike on the Ball Ground East quadrangle in Cherokee County cuts the trace of the Allatoona Fault.

The ultramafic bodies in the study area are found within the Tallulah Falls Formation and consist of small, isolated, deformed masses largely altered to serpentine and/or talc. Those bodies that are not thoroughly altered were recognized as enstatite and/or diopside-bearing dunites. These ultramafic bodies apparently were emplaced prior to the peak of regional metamorphism.

Rocks Northwest and Southeast of the Study Area

Units that border the study area on the southeast include the Sandy Springs Group and the Tallulah Falls Formation (plate 1). The Sandy Springs Group was described by Higgins (1966, 1968) and later defined by Higgins and McConnell (1978). The Sandy Springs Group consists of biotite gneiss, muscovite-biotite schist, amphibolite, micaceous quartzite, and kyanite-staurolite schist. Migmatization is locally intense. The Tallulah Falls Formation, as defined by Hatcher (1971, 1974, 1976), consists of amphibolite, quartz-plagioclase-biotite-muscovite gneiss, muscovite schist, muscovite-garnet schist ± kyanite ± sillimanite, and quartzite. Because of the similarities between the lithologies that make up the Sandy Springs Group and Tallulah Falls Formation, Higgins and McConnell (1978) and Hatcher (1974) considered them to be equivalent.

Those units on the northwest include the Great Smoky Group, Coweeta Group, and Richard Russell formation (plate 1). Great Smoky Group lithologies were recognized to the northwest of the study area between Canton and Dahlonega by Sever (1964), McConnell and Costello (1980, 1982), Costello and others (1982), and McConnell and Abrams (1984). The Great Smoky Group consists of metagraywacke, locally conglomeratic metasandstone, metasiltstone, muscovite-biotite-quartz schist ± kyanite, meta-arkose, and minor amphibolite. Northeast of Dahlonega the study area is bordered by a sequence of lithologies informally termed the Richard Russell formation by Gillon (1982). This unit consists of migmatitic biotite gneiss, garnet-sillimanite-biotite schist, garnet-biotite-muscovite schist, and minor amphibolite. The Coweeta Group is also found along the northwestern border northeast of Dahlonega. Hatcher (1974, 1976, 1979) defined the Coweeta Group as a sequence of muscovite-biotite-quartz-plagioclase gneiss, micaceous quartzite, muscovite-biotite-schist, metaconglomerate, and metagraywacke.

Rocks adjoining the study area due north and northwest of Dahlonega have not been studied in detail. They consist of amphibolite, biotite-quartz schist, and biotite-muscovite-quartz schist and may be correlative with Gillon's (1982) Richard Russell formation or other lithologies that comprise the Hayesville thrust sheet as described by Nelson (1983).

STRUCTURE

The structural complexity of the Dahlonega gold belt has long been recognized. Crickmay (1952) characterized this area as a complex zone of pervasive shearing and suggested the existence of extensive faulting. Because of this, he referred to this area as the Dahlonega shear zone. Observations made during the mapping phase of this study tend to corroborate Crickmay's remarks on shearing; however, the primary cause for shearing appears to be extremely tight folding rather than faulting. Faulting is present but is largely confined to the borders of the study area.

Three major faults form portions of the boundaries of the study area (plate 1). The Chattahoochee fault forms most of the southeastern boundary, whereas the Allatoona and Shope Fork faults form part of the northwestern boundary. All juxtapose significantly different geologic terrains.

The Chattahoochee fault was first proposed by Hurst (1973), and its trace was subsequently modified by McConnell and Abrams (1982). As observed in the study area, it forms a distinct boundary between the weakly to highly migmatized Sandy Springs Group and unmigmatized schists, amphibolites, and felsic gneiss of the Univeter Formation. Bowen (1961 described cataclastic textures associated with this boundary in southeastern Dawson County, and McConnell and Abrams (1984) described this boundary as a metamorphic isograd and migmatitic front. This fault was traced by the author from just southwest of Lake Burton in Habersham County southwestward to central Cherokee County. McConnell and Abrams (1984) traced it farther southwestward where it is overridden by the Blairs Bridge fault.

Hatcher (1978) proposed that one of the faults on the northwestern boundary of the study area was a continuation of the Hayesville fault which had been observed farther to the northeast in North Carolina. This fault was subsequently called the Allatoona-Hayesville fault by McConnell and Costello (1980). In this report the Allatoona-Hayesville fault is referred to simply as the Allatoona fault. Movement along this fault probably occurred shortly after the peak of regional metamorphism since it truncates the northwestern limb of the Auraria antiform (see cross-section AA', plate 1). Along the Allatoona fault, terrain of the Dahlonega gold belt with a substantial volcanic component was thrust over the predominantly sedimentary Great Smoky Group, forming a distinct boundary between dissimilar terrains. This fault terminates northeast of Dahlonega near the trace of the Shope Fork fault.

The Shope Fork fault was mapped by Hatcher (1976) through Towns and Rabun Counties and was extended into White County by Gillon (1982). Hatcher (1976, 1979) considered movement along this fault to have been pre- or synmetamorphic. The Shope Fork fault can be traced across Lumpkin County north of the study area and separates lithologies resembling the Canton Formation from the Richard Russell formation (Arthur E. Nelson, personal commun., 1984) (plate 1).

The only major fault observed within the interior of the study area is a reverse fault that extends from just southeast of Dawsonville to northeast of Dahlonega where it merges with the Allatoona fault. Movement along this fault transported the Chestatee Member to its present position and is believed responsible for the discontinuity in strikes between units on either side. This fault is probably a splay off the Allatoona fault (see cross-section AA', plate 1).

The major structural feature of the Dahlonega belt is the Auraria antiform, a large, asymmetrical, isoclinal antiform (plate 1). This fold is northwest-vergent and plunges alternately northeastward and southwestward along strike. This antiform extends from Paulding County (McConnell, 1980) northeastward to just east of Dahlonega in Lumpkin County and is responsible for the outcrop patterns of major lithologies in this area. In Paulding, Bartow, and Cherokee Counties the Auraria antiform is cored by the Galts Ferry Gneiss (McConnell, 1980; McConnell and Abrams, 1984), whereas in the study area it is cored by the structurally overlying Pumpkinvine Creek Formation.

The fabric of the lithologies in the study area reflects several episodes of deformation. Collectively, they record a succession of events of initially strong ductile deformation followed by episodes of relatively weak brittle deformation. The ductile phase is expressed by flexural flow folds, whereas the brittle phase is expressed by slickensides and small faults. These are summarized in table 2 and discussed in the ensuing text.

The earliest recognizable event (D_1) is faulting along the Shope Fork fault. Any induced fabric that may have accompanied this movement is not recognizable in the study area, probably due to subsequent over-printing.

The next recognizable deformational event (D_2) is the most intense and is responsible for the outcrop patterns and major folds (F_1) of the study area. This event produced a pervasive northeast-striking foliation that is axial planar to these folds. Minor and major folds produced during this event are extremely tight isoclines that are northwest-vergent southwest of the Dahlonega area and southeast-vergent northeast of there and plunge either southwestward or northeastward. Thickening of units in the axial areas and thinning in the limbs suggest a flexural flow type of folding.

Subsequent to D_2 was another episode of deformation (D_3) of greatly reduced, although quite widespread, intensity. This event (D_3) is characterized by small folds more open than F_1. These folds (F_2) are co-axial with F_1 folds and also plunge either southwestward or northeastward. They have a wavelength of less than 1 meter and are commonly the most easily recognizable folds at individual outcrops. These folds (F_2) are accompanied by a pervasive crenulation cleavage.

The last deformational event (D_4) had a subtle effect on the outcrop patterns of certain lithologies. This event is characterized by southeast-trending(?) open folds (F_3). This event appears to be responsible for the somewhat abrupt reversal of foliation dips northeast of Dahlonega in the vicinity of the Lumpkin-White County line (fig. 14; also, compare cross-sections AA' and BB', plate 1) and the sinusoidal trace of the Auraria antiform also in the vicinity of Dahlonega (plate 1). Also associated with this event are small, high-angle normal faults with displacements of only a few centimeters. The fault planes are generally parallel to a regional joint set and probably reflect movement along previously established joint sets. Numerous slickensides accompany these faults.

At this point it is worthwhile to compare structural fabric elements of the study area to those observed in previous investigations of adjacent areas. Table 3 summarizes and compares fabric elements observed in this study with those observed by McConnell and Abrams (1984) in the Greater Atlanta area and by Hatcher and Butler (1979) in northeastern Georgia. One interesting observation is the absence of

Table 2. Fabric Elements of the Dahlonega Gold Belt (Cherokee County to Habersham County).

Generation	Fold Style	Orientation	Type of Lineations	Timing	Significant Features
D_1				Pre-to synmetamorphic	Movement along Shope Fork fault.
D_2F_1	Tight isoclines; flexural flow folds.	NE strike; NE or SW plunge; NW or SE vergent.	Elongation	Near peak of thermal metamorphism.	Formation of Auraria antiform; major tectonic shortening; development of dominant S-surface; movement along Chattahoochee fault(?).
D_3F_2	Isoclinal to open; flexural flow folds. Crenulation cleavage.	Co-axial to F_1	Intersection; crenulation axes	Post-peak to post-metamorphic	No mesoscopic expression; movement along Allatoona fault.
D_4F_3(?)	Broad, upright	SE trend SW vergent(?)	None recognized	Post-metamorphic	Responsible for shift in dips of regional foliation NE of Dahlonega (?) and folding of Auraria antiform.

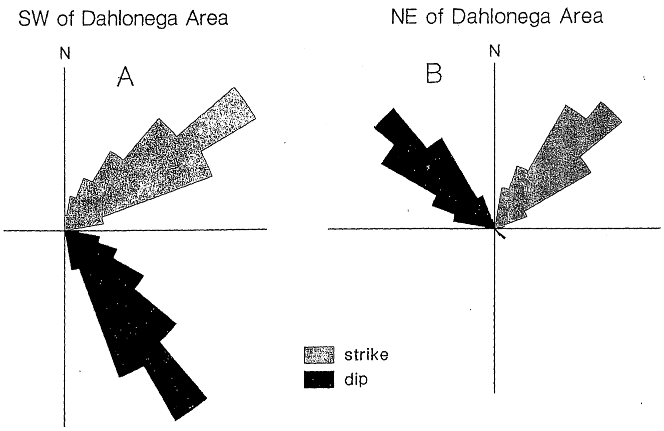


Figure 14. Comparison of foliation attitudes southwest (A) and northeast (B) of the Dahlonega area.

evidence for Hatcher and Butler's (1979) F_1 and F_2 and McConnell and Abrams' (1984) F_1 in the study area. Another is the correlation between the writer's F_1, Hatcher and Butler's (1979) F_3, and McConnell and Abrams' F_2. This strongly suggests that the extremely tight folding in the study area (F_1) may have completely obliterated any evidence of earlier folding. The correlation between the writer's F_1 and McConnell and Abrams' (1984) F_2 is also suggested when fold-induced outcrop patterns in part of the Greater Atlanta area and part of the study area are compared (fig. 15).

METAMORPHISM

Several workers have noted that the Dahlonega gold belt exhibits a distinct mineral assemblage indicative of a slightly lower metamorphic grade than the surrounding terrains (Gillon, 1982; Nelson, 1983; McConnell and Abrams, 1984). This feature is constant throughout the study area and served in the past, and in this study, as partial criteria for the delineation of the boundaries of the gold belt.

Lithologies in the study area are within the staurolite-almandine subfacies of the almandine-amphibolite facies of regional metamorphism as described by Turner and Verhoogan (1960). This subfacies is characterized by assemblages of quartz, muscovite, almandine, biotite, plagioclase, and staurolite for derivatives of pelitic rocks and by hornblende, plagioclase, almandine, and epidote for derivatives of basic rocks. Staurolite is a key mineral of this metamorphic grade, although kyanite may be rarely present in very aluminous rocks. These assemblages closely reflect those found in the lithologies of the study area. Notable deviations include the low anorthite composition of the plagioclase (An_{10} - An_{20}) compared to the norm (An_{25} - An_{45}) given by Turner and Verhoogen (1960) and the coexistence of chlorite and hornblende in some of the basic rocks. These deviations are probably vestiges of green schist facies and, therefore, represent the transition between two metamorphic facies.

One period of prograde regional metamorphism produced the mineral assemblages described above. This event reportedly occurred in the Northern Piedmont approximately 365-million years ago (Dallmeyer, 1978) and was marked by a combination of dynamic and thermal processes. Mineral textures in certain lithologies suggest that thermal metamorphism continued after the most intense deformation ceased. This is revealed in schists of the Canton Formation by garnets with deformed cores and undeformed rims (fig. 16) and by the presence of a set of anhedral and a set of euhedral garnets.

A very weak episode of retrograde metamorphism also can be observed. This episode manifests itself in the slight alteration of biotite to chlorite in the schistose lithologies (fig. 17). This alteration is present throughout the study area and was reported in adjoining terrains (Hatcher, 1979; McConnell, 1980).

Table 3. Comparison of Fabric Elements in the Study Area with those in Northeastern Georgia and the Greater Atlanta Area.

Northeast Georgia (after Hatcher and Butler, 1979)	Greater Atlanta Area (after McConnell and Abrams, 1984)	This study
F_1 Isoclinal recumbent EW-NE rend (S_1 rarely observed)	Not recognized	Not recognized
F_2 Isoclinal recumbent EW-NE trend, dominant S-surface.	F_1 Isoclinal recumbent ENE trend; dominant S-surface.	Not recognized
F_3 Upright isoclinal to open, NE trend.	F_2 Upright to overturned; isoclinal to open; NE trend; responsible for outcrop patterns.	F_1 Extremely tight isoclines; NE trend; NW & SE vergence; dominant S-surface; responsible for outcrop patterns.
F_4 Crenulation cleavage, NE trend.	F_{2a} Upright, open, NE trend.	F_2 Isoclinal to open; co-axial to F_1; crenulation cleavage.
Not recognized	F_3 Open to isoclinal; SW vergence; SE trend; mainly restricted to Blue Ridge.	Not recognized
F_5 Upright, open, NE trend.	Not recognized	Not recognized
F_6 Upright, open, NW trend.	F_4 Upright, open, NW trend.	F_3 Broad, upright, SE or NW trend.

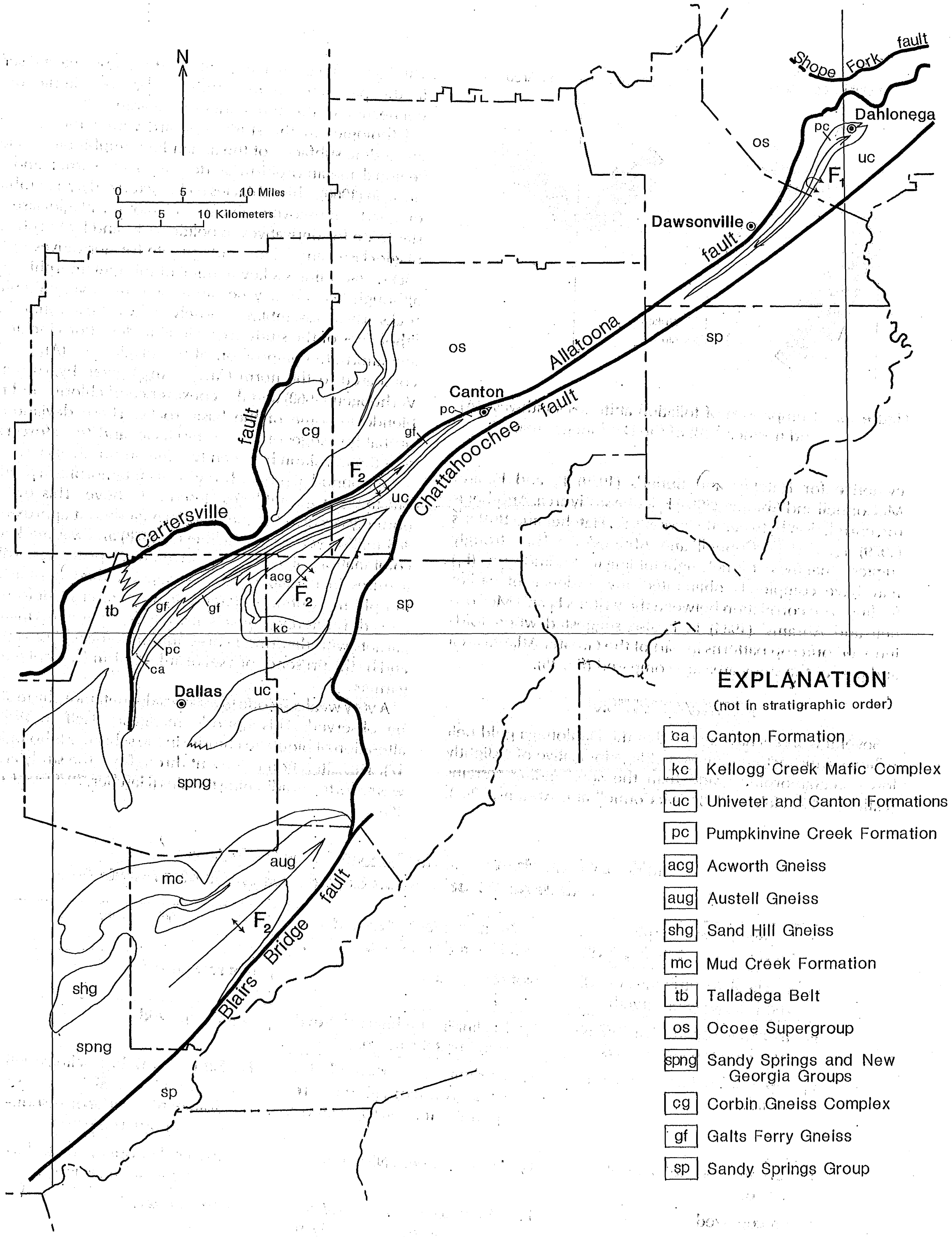
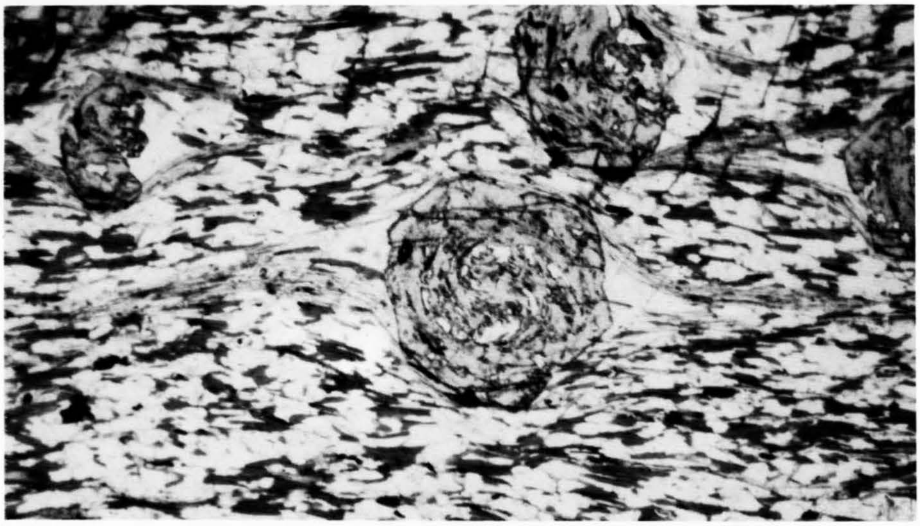
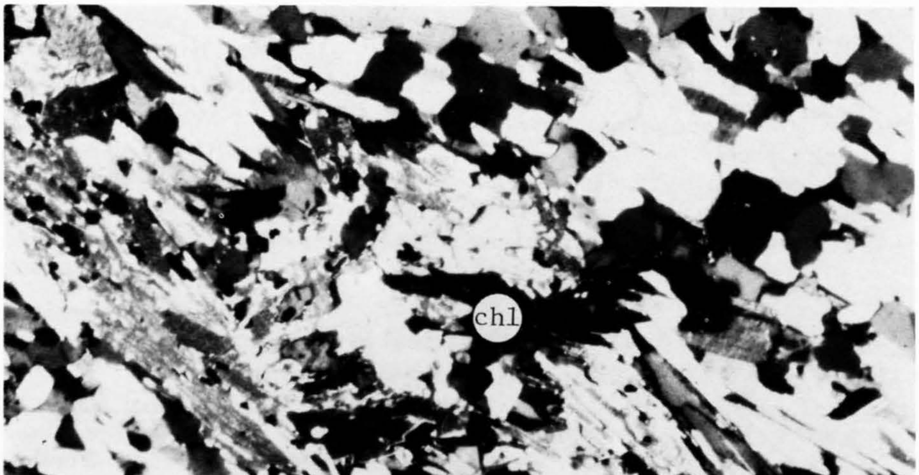


Figure 15. Part of the Dahlonega gold belt showing major structural features. F_2 outcrop patterns and unit names on the western half are after McConnell (1980) and McConnell and Abrams (1984).



1 mm

Figure 16. Garnets in schist of the Canton Formation exhibiting rotated cores with later euhedral overgrowths.



0.3 mm

Figure 17. Chlorite (chl) after biotite in schist from the Canton Formation.

ECONOMIC GEOLOGY

Introduction

Gold was mined in Georgia almost continuously from about 1829 to 1934 (Paradee and Park, 1948). The intensity of mining activity during this period varied due to the price of gold, the political climate, the depletion of certain types of deposits, and the introduction of new mining technologies. Recorded production during this period for the entire State was just over one-half million ounces (Pardee and Park, 1948). The production breakdown for specific areas of the State is not possible, but clearly the Dahlonega belt accounted for the majority of this amount. Production overall was probably considerably higher than that reported since records were not always kept.

Mining History and Methods

As in most gold-producing regions, mining methods evolved in response to the depletion of certain types of deposits and the discovery of others. Mining activity in the Dahlonega belt began as placer mining of stream gravels, and, subsequently, extensive areas in the study area were mined in this fashion; some placers were reworked several times. The initial boom associated with this type of mining lasted from 1829 to about 1834 (Pardee and Park, 1948), but the inevitable depletion of the known placer deposits resulted in a period of greatly reduced activity.

The advent in 1868 (Pardee and Park, 1948) of the Dahlonega method of hydraulic mining of saprolite resulted in a renewed surge in activity. This method involved the removal of a large volume of material by the use of a stream of water under high pressure. The relatively soft saprolite was literally washed from the hillsides into a network of sluices from which the gold was collected. Extensive open cuts were made by this method (fig. 18). Hydraulic mining seems to have remained popular up to the time production ceased in the Dahlonega belt.

In several areas extensive underground mining was undertaken, and in most instances, this phase of mining succeeded hydraulic methods once unweathered rock was reached. Underground mining in fresh rock was greatly facilitated by the development of a chlorination process for extracting gold from unoxidized sulfidic ore. It is common to see adits and shafts extending outward in numerous directions along veins at old hydraulic cuts. In other areas, however, most of the activity consisted of underground workings in both fresh rock and saprolite with only a limited amount of surface activity.

This full progression of mining methods seems to have occurred in only a few areas. Overall, placer mining was the most widespread followed by hydraulic mining of saprolite. One reason for the preponderance of these two mining methods over underground methods was that the cost of placer and hydraulic mining was much less. Another is that the weathered portions of the deposits and the placer deposits derived from them tended to contain more gold than fresh rock, probably as a result of mechanical and supergene enrichment. Lesure (1971) was able to demonstrate supergene enrichment of the weathered part of the gold deposit at the Calhoun Mine in Lumpkin County and suggested that this characteristic of the deposit determined the type of mining methods employed there. Supergene enrichment can be assumed for many gold deposits in the study area, but this does not necessarily indicate that unweathered deposits will have a gold content below ore-grade. A prime example of an unweathered, high-grade deposit is the lode at the Franklin-Creighton Mine in Cherokee County that contained gold in amounts up to 1.49 oz/ton (Jones, 1909) to a depth of several hundred feet, a depth well below the effects of weathering.

Occurrence and Genesis of Gold

The deteriorated condition of most of the abandoned mines frequently inhibited thorough observations at these old workings. For this reason the observations made by Yeates and others, (1896), Lindgren (1906), Jones (1909), and, particularly, Pardee and Park (1948) were used extensively. These early workers indicated that the gold occurs in veins that conform, in most cases, to the foliation of the enclosing rock. These veins are composed predominantly of quartz with lesser amounts of sericite, biotite, carbonate, pyrite, pyrrhotite, and garnet. Galena, sphalerite, arsenopyrite, chalcopyrite, amphibole, iron oxide minerals, and feldspar were also reported. The geometry of the veins varies widely but is generally tabular, lenticular, or in rare instances, rod-shaped or very irregularly shaped. The veins occur singly or as a zone of several bodies. More detailed descriptions can be found in the above reports.

When plotted on geologic maps, abandoned mines are concentrated in certain areas. These concentrations occur along the contacts between amphibolite and mica-quartz schist, within certain felsic gneisses, and in close association with iron formation units. This apparent lithologic association can be observed at many places throughout the study area but is best exemplified by two areas described below.

Figure 19 shows the distribution of abandoned mines associated with the Pumpkinvine Creek Formation and the adjacent rocks. Mines are concentrated along the Barlow Gneiss Member of the Pumpkinvine Creek Formation and at several points along the Pumpkinvine Creek-Canton Formation contact. These lithologies and contacts probably served as important prospecting tools for the early miners, judging from the amount of activity associated with them here and in other areas.

A notable concentration of mines can be observed north of Auraria where open-cut and underground mining was confined to the Barlow Gneiss (fig. 20). This felsic gneiss was mined at the Barlow Cut Mine for a continuous distance of approximately 1 km (0.6 mi) along strike and in intermittent areas for several more kilometers at mines to the southwest and northeast. Assays published by Pardee and Park (1948) of cores taken in and adjacent to this gneiss showed high gold values confined almost entirely to this lithology.

Another large concentration occurs along Findley Ridge at Dahlonega (fig. 21). Here, twelve mines are located along a sequence of rocks (*igf*, fig. 21) that lie between massive amphibolites of the Pumpkinvine Creek Formation and schists of the Canton Formation. Mines occur along the entire length of this sequence which consists of interlayered iron formation, biotite-plagioclase-quartz gneiss, sericite-quartz schist, and amphibolite and is interpreted to be part of the Pumpkinvine Creek Formation. Cook and Burnell (1983) also recognized this sequence and informally called it the Singleton formation.

Figure 18. Hydraulic mining near Auraria, Georgia (circa 1930).

Photo courtesy of Georgia Department of Archives and History.

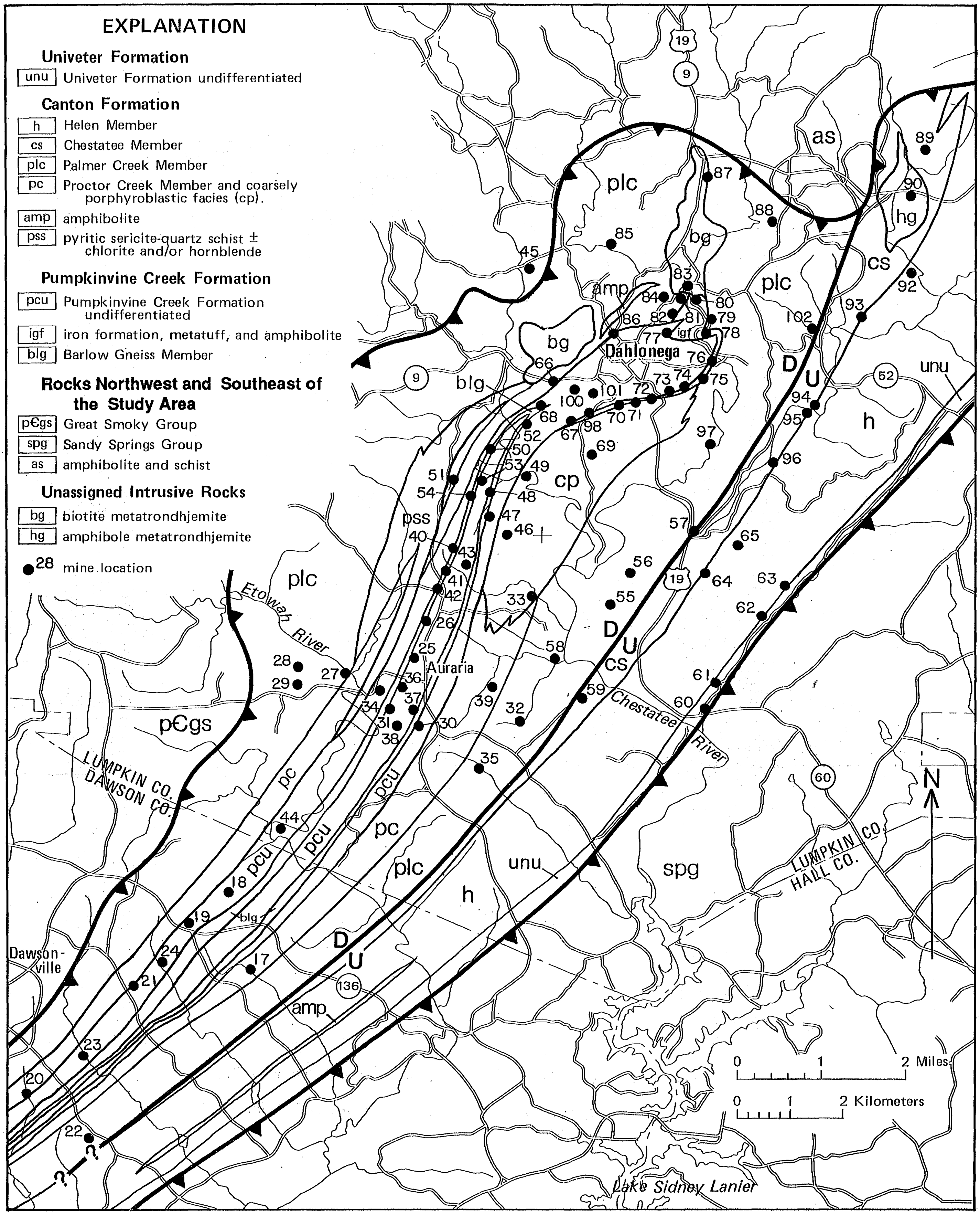


Figure 19. Relationship between abandoned gold mines and lithology—Auraria/Dahlonega area.

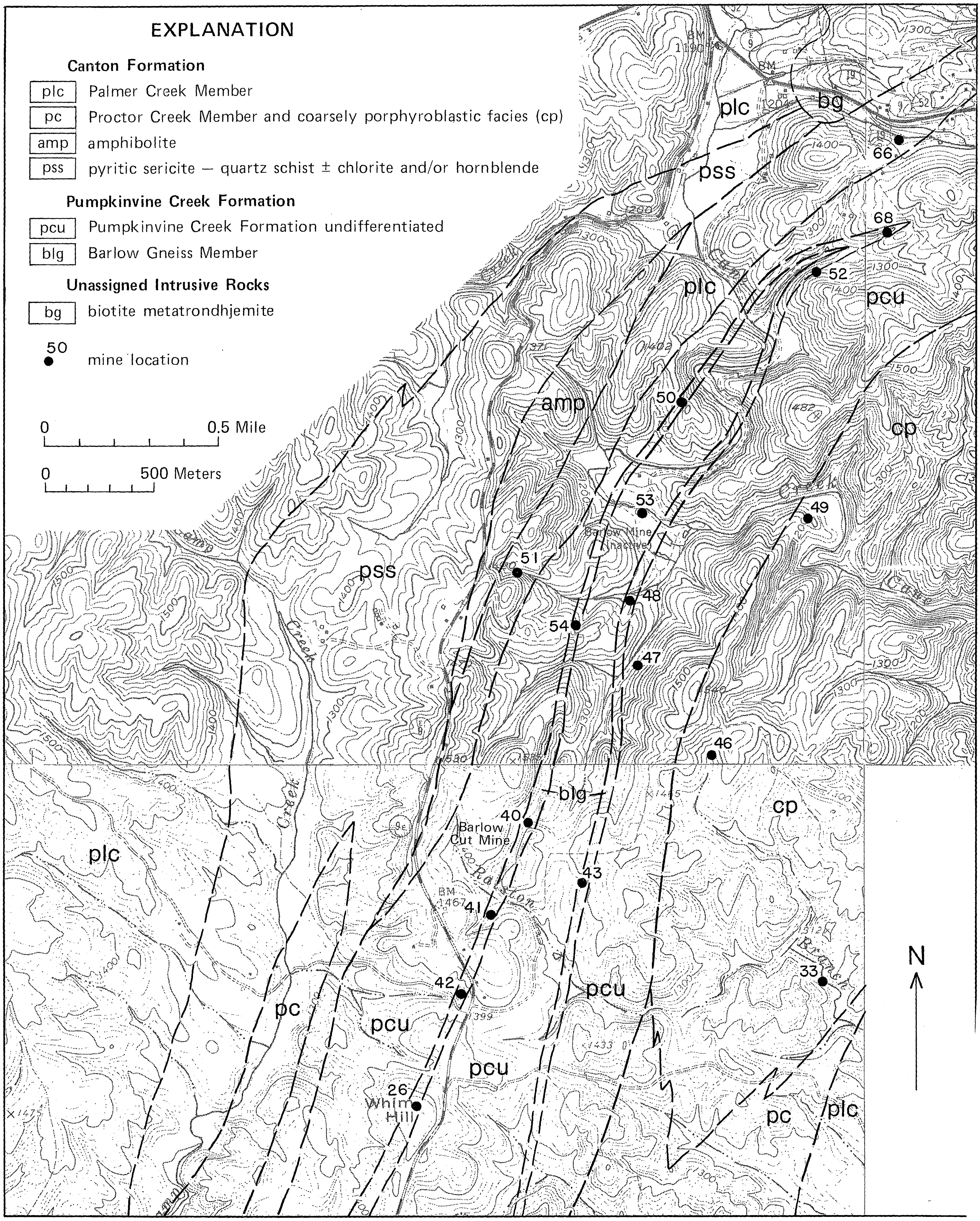


Figure 20. Concentration of abandoned gold mines along the Barlow Gneiss Member.

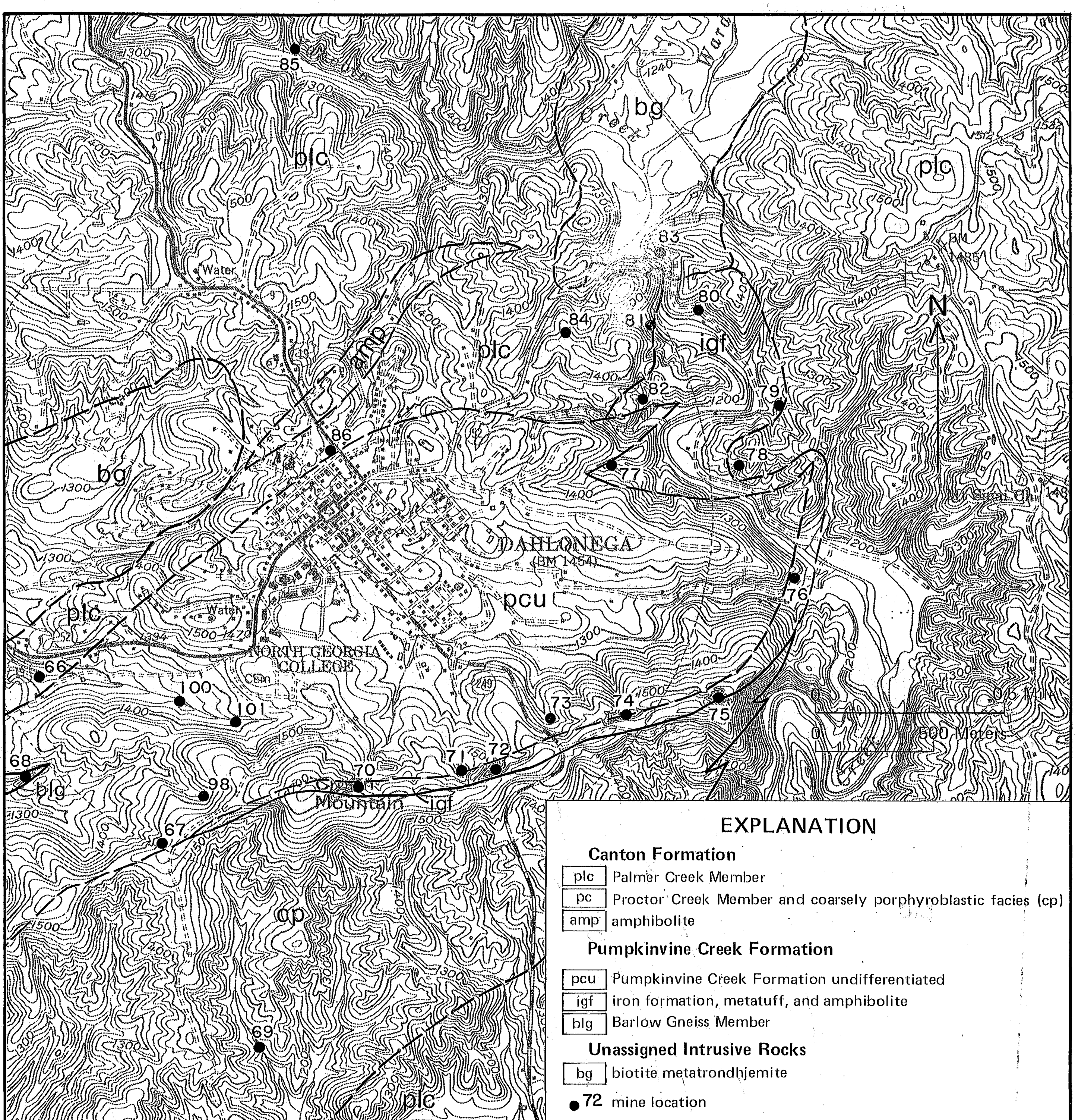


Figure 21. Concentration of abandoned gold mines in the immediate Dahlonega area.

It can also be noted from figure 19 that mining activity was concentrated along the axis of the Auraria antiform. The occurrence of gold along the antiformal axis, in addition to occurrences along certain contacts, could be interpreted that gold was selectively introduced at these structural and stratigraphic positions from some outside source during an episode of deformation. This theory in a slightly modified form was proposed by earlier workers such as Yeates (1896), Jones (1909), and Pardee and Park (1948).

An alternate interpretation, which is best supported by the data, is that the gold was syngenetic. By this interpretation, anomalously high amounts of gold that were present in the environment, probably as a result of exhalative processes, were incorporated in rocks formed in that environment. This is strongly reflected in the obvious lithologic control for most of the gold occurrences. These occurrences are within or are associated with lithologies that are interpreted to be volcanic in origin. It seems unlikely that gold would be selectively introduced into these specific lithologies during some later mineralization event.

As these volcanic lithologies were metamorphosed and deformed, the gold was remobilized and concentrated in veins. Locally, gold was concentrated in crosscutting veins, in veins parallel to the foliation, or in veins in the axes of small folds; however, the regional concentration of gold along the axis of the Auraria antiform is due to the presence of metavolcanic rocks in that position.

Massive Sulfide Deposits

In addition to gold, several massive sulfide deposits were previously mined within the study area. Three abandoned mines are located in Cherokee County and one in Lumpkin County. Those in Cherokee County include the Dickerson Mine on the Ball Ground West quadrangle and the Swift and Standard Mines on the Ball Ground East quadrangle. Shearer and Hull (1918) reported that the sulfide in the ore at the Cherokee County mines is entirely pyrite, but drilling by New Jersey Zinc Company in the mid-1950's revealed approximately one percent copper and zinc (Robert B. Cook, personal commun., 1984). Descriptions by Shearer and Hull (1918) suggest that the ore bodies are generally lenticular or tabular in shape conforming to the foliation of the host rock. Enclosing lithologies are thinly interlayered amphibolite and plagioclase hornblende-biotite-quartz gneiss ± calcite of the Univeter Formation. The Chestatee Mine (not the same as the gold mine of that name) is located on the Dahlonega quadrangle in Lumpkin County. From descriptions provided by Shearer and Hull (1918) and Kline and Beck (1949), this deposit has similar characteristics to those in Cherokee County, namely its stratabound nature, mineralogy, and geometry. The Chestatee deposit occurs in the vicinity of the contact between amphibolite of the Univeter Formation and metagraywacke, schist, and quartzite of the Helen Member of the Canton Formation. Kline and Beck (1949) noted that the ore body occurs mainly within the amphibolite and, like the ore bodies in Cherokee County, contains small amounts of copper and zinc. The massive sulfide deposits in the study area resemble the volcanogenic Besshi deposits described by Franklin and others (1981).

Unique Lithologies of Possible Economic Significance

Several minor rock types occur within the Univeter, Canton, and Pumpkinvine Creek Formations that also occur in other parts of the world in close association with base and precious metal deposits or as mineable commodities themselves. These include iron formation, tourmalinite, pyritic schist, and massive kyanite. These rock types are interspersed throughout the above formations and, in most cases, appear to be stratigraphically controlled. The conditions surrounding their occurrences and their economic significances are discussed below.

IRON FORMATION

The occurrence of iron formation in close proximity to base and precious metal deposits or as an ore of these metals has been well documented in recent years (Ridler, 1973; Fripp, 1976; Gibbins, 1979; Abrams and McConnell, 1982; McConnell and Abrams, 1983). In many instances this lithology marks the boundary between periods of tectonic stability and instability. Compositionally, iron formation is dominated by quartz and iron oxide, with varying amounts of aluminous minerals, carbonates, and sulfides. For this reason, several facies based primarily on composition have been recognized (James, 1954; Goodwin, 1956; Gross, 1980).

Iron formation units recognized in the study area are quartzites consisting of alternating bands of magnetite and quartz; disseminated magnetite and unidentified manganese minerals in quartz with varying amounts of mica; masses of microcrystalline spessartine garnet in quartz; varying amounts of pyrite, and rarely arsenopyrite(?), in quartz; and finely disseminated magnetite in a cryptocrystalline groundmass of quarts. Iron formation occurs as thin units, usually less than 1 meter thick, although folding has occasionally produced significantly thicker units of 10 or more meters. These units usually occur very near the contacts between amphibolite and schist, e.g. between the Pumpkinvine Creek and Canton Formations or the Univeter and Canton Formations (plate 2). Lateral variations in composition along strike are also discernible. As mentioned before, abandoned gold mines are clustered along these units.

TOURMALINITE

Tourmaline is a common gangue mineral associated with base and precious metal deposits. The rock tourmalinite has recently been recognized as a possible exploration tool in the search for gold or base metal deposits (Slack, 1982). Slack (1982) defined tourmalinite as a stratabound rock containing 20 percent or more tourmaline by volume. As observed in the study area, this lithology consists largely of distinct zones up to 0.5 meter thick of tourmaline, quartz, and some pyrite within thin amphibolite units. The tourmaline content of the rock commonly exceeds 50 percent. The occurrence of tourmalinite is restricted to two distinct stratigraphic positions within the Canton Formation. One is along the Helen-Chestatee Member contact and the other is within a thin amphibolite in the Helen Member (plate 2).

PYRITIC SCHIST

Pyritic schists, which occur at several locations within the study area, are composed of pyrite, sericite, quartz, chlorite, and amphibole and are locally interlayered with amphibolite. The pyrite occurs as finely disseminated crystals or in layers where it constitutes up to 50 percent of the rock (fig. 22). Small outcrops of the schist occur somewhat randomly throughout the Canton and Univeter Formations, but mappable units occur near the Pumpkinvine Creek-Canton contact. One particularly large unit is located in Lumpkin County on the Campbell Mountain and Dawsonville quadrangles, and its mineralogy is like that described above.

Several investigators have described alteration zones associated with metamorphosed massive sulfide deposits (Rui, 1973; Gjelsvik, 1968) as being composed of chlorite, sericite, quartz, and sulfides. Their descriptions of these zones bear strong similarities to the pyritic schist described above. This suggests that these units may be key lithologies associated with nearby massive sulfide deposits or are a type of disseminated sulfide deposit in themselves. An alternate interpretation is that these schists represent altered felsic and/or mafic volcanic rocks.

MASSIVE KYANITE

Two small bodies of rock composed predominantly of kyanite with various amounts of quartz and pyrite occur in the study area in Cherokee County. One is located on the Ball Ground East quadrangle and is associated with amphibolite and iron formation of the Univeter Formation, whereas the other is located on the Ball Ground West quadrangle and is associated with graphitic garnet-biotite-muscovite-quartz schist of the Canton Formation.

The massive kyanite occurrences strongly resemble the pyritic kyanite-quartz granofels at Graves Mountain, Georgia. This granofels was interpreted to have formed as a result of the metamorphism of a hydrothermally altered vitric tuff (Hartley, 1976; Carpenter, 1982). The bodies in the study area could be interpreted as small versions of those rocks found at Graves Mountain. Along strike to the southwest at Reeds Mountain, Georgia, similar rocks were also described by Abrams and McConnell (1982) and McConnell and Abrams (1983, 1984).

GEOLOGIC MODEL

The rocks that constitute the study area reflect a complex interaction between volcanic and sedimentary processes. Taken as a whole, these rocks reflect an initial period of volcanism followed by extensive sedimentation. Initially, the rocks that constitute the Pumpkinvine Creek Formation were deposited. These are now represented by felsic gneisses and amphibolites. The identification of metamorphosed pillows in the Pumpkinvine Creek Formation southwest of the study area (Hurst and Jones, 1973; McConnell and Abrams, 1984), chemical data given by McConnell (1980), Burnell and Cook (1984), and McConnell and Abrams (1984), and chemical data discussed below indicate that the felsic gneisses and amphibolites were originally interlayered subaqueous basalt flows and felsic and mafic tuffs.

After deposition of the Pumpkinvine Creek Formation, the volcanic environment changed to a largely sedimentary one. At this point deposition of the Canton Formation began with the deposition of fine-grained clastics over the volcanic

Figure 22. Sample from one of several zones in the pyritic schist (Dawsonville and Campbell Mountain Quadrangles) that contain > 50% pyrite.

sequence of the Pumpkinvine Creek Formation. These fine-grained clastics are now schists and gneisses of the Proctor Creek and Palmer Creek Members. Fine-grained clastic sedimentation was interrupted by extrusion of the Chestatee Member now consisting of interlayered amphibolites and felsic gneisses. The Chestatee Member was in turn followed by a repetitive sequence of shales and medium- to coarse-grained immature sandstones (or graywackes). This repetitive sequence, resembling part of a turbidite sequence, is now interlayered schist and metagraywacke of the Helen Member. Although the Proctor Creek, Palmer Creek, and Helen Members are predominantly sedimentary in origin, the sequence was punctuated by limited volcanic activity now represented by thin amphibolite units and iron formation. Deposition of the Univeter Formation followed deposition of the Helen Member and probably represents part of a volcanic-sedimentary cycle similar to the Pumpkinvine Creek and Canton Formations.

Chemical analyses of amphibolites of the Pumpkinvine Creek and Univeter Formations in the study area reveal an abyssal tholeiite affinity, indicating formation on an oceanic ridge or in a back-arc basin (table 4, figs. 23, 24, 25). Although efforts to distinguish between lithologies formed in these two environments based solely on chemistry have been unsuccessful (Rogers, 1982), the occurrence in the study area of an enormous amount of metamorphosed immature sediments favors a back-arc basin environment. This conclusion also was favored by McConnell (1980) and McConnell and Abrams (1984) regarding the same formations southwest of the study area and by Burnell and Cook (1984) for metavolcanic rocks in the Dahlonega area.

An interesting departure from the trend of abyssal tholeiite (back-arc basin) affinities is the island arc/active continental margin affinities of some Univeter Formation samples (figs. 24 and 25). The bimodal character is geographically controlled because samples BGE-3, C-3, and DAH-7 were collected southwest of Dahlonega, whereas samples CL-12 and H-9 were collected northeast of Dahlonega. More geochemical data are needed on amphibolites of the Univeter Formation before an in-depth interpretation of its original tectonic setting can be made.

Table 4. Major oxide and selected trace-element analyses of Pumpkinvine Creek and Univeter Formation amphibolites.

	Pumpkinvine Creek Formation					Univeter Formation				
Major Oxide	M-21	M-2	JN-20	DV-33	DV-74	BGE-3	C-3	DAH-7	CL-12	H-9
% SiO_2	47.7	47.5	45.5	47.5	47.1	52.4	48.3	58.3	46.0	48.7
% Al_2O_3	14.7	13.7	14.6	13.8	14.0	15.4	17.2	14.4	16.8	16.8
% Fe_2O_3	6.8	4.2	5.9	5.1	6.0	7.5	6.5	5.8	4.67	4.52
% FeO	7.2	8.4	5.0	5.7	6.0	5.0	8.1	4.8	4.2	3.6
% MgO	8.10	8.27	8.90	9.07	8.12	5.20	8.51	4.20	11.2	9.22
% CaO	11.8	11.5	14.2	13.1	13.4	7.44	4.20	8.80	13.8	11.1
% Na_2O	2.17	1.91	1.78	1.89	1.76	3.31	2.77	1.87	1.97	2.32
% K_2O	0.13	0.10	0.11	0.095	0.13	0.11	0.088	0.15	0.31	0.87
% TiO_2	2.24	1.85	1.49	1.36	1.49	1.30	1.55	0.65	0.77	0.40
% MnO	0.18	0.21	0.18	0.20	0.18	0.24	0.20	0.18	0.16	0.16
% P_2O_5	0.19	0.16	0.12	0.12	0.12	0.11	0.13	0.069	0.058	0.47
LOI	0.9	1.4	0.8	0.9	0.9	1.0	2.2	0.9	1.3	2.0
Total	102.1	99.2	98.58	98.8	99.2	99	99.7	100.1	101.2	100.1
Trace Element										
ppm V	80	100	55	45	75	165	240	115	50	65
ppm Cr	65	50	350	350	280	10	10	5	310	260
ppm Ni	60	60	110	100	70	20	20	15	250	170

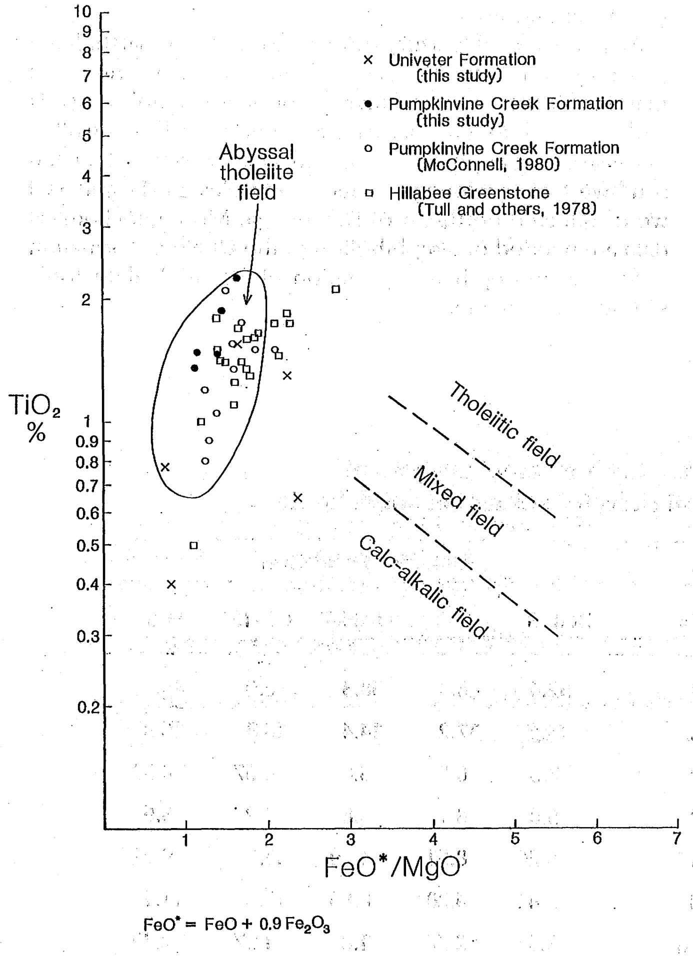


Figure 23. Determination of amphibolite protolith based on a plot of FeO*/MgO versus percentage TiO_2 (after Miyashiro and Shido, 1975). Pumpkinvine Creek Formation data after McConnell (1980) and Hillabee Greenstone data after Tull and others (1978) are plotted for comparison.

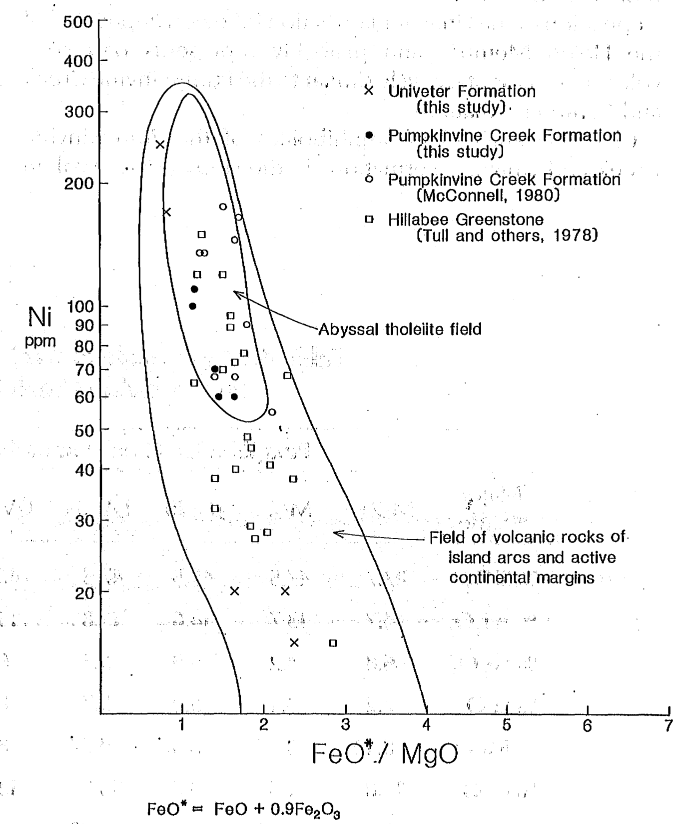


Figure 24. Determination of amphibolite protolith based on plot of FeO*/MgO versus ppm Ni (after Miyashiro and Shido, 1975). Pumpkinvine Creek Formation data after McConnell (1980) and Hillabee Greenstone data after Tull and others (1978) are plotted for comparison.

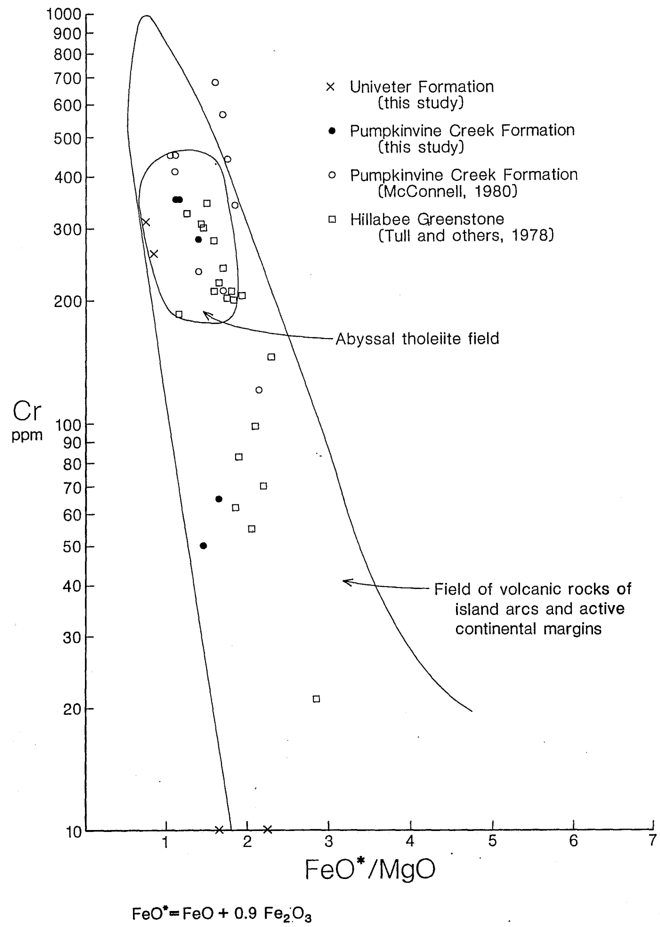


Figure 25. Determination of amphibolite protolith based on a plot of FeO*/MgO versus ppm Cr (after Miyashiro and Shido, 1975). Pumpkinvine Creek Formation data after McConnell (1980) and Hillabee Greenstone data after Tull and others (1978) are plotted for comparison.

Accompanying the deposition of the Pumpkinvine Creek, Canton, and Univeter Formations in the study area was the deposition of volcanogenic gold and massive sulfides. Gold was deposited in all of these formations but was particularly concentrated within felsic volcanic rocks, in the vicinity of iron formation, and along contacts between volcanic and sedimentary rocks, probably reflecting an exhalative origin in the vicinity of submarine volcanic vents. Venting also was probably active during deposition of the sedimentary sequences of the Canton Formation since several of the gold deposits in this formation are not directly associated with metavolcanic rocks. During regional metamorphism and deformation the gold was remobilized and concentrated in quartz veins that are generally parallel to the regional foliation. Subsequent exposure and weathering of the gold deposits accounted for an apparent supergene enrichment. Massive sulfides that were deposited in rocks of the study area were confined to the Univeter Formation or along the Univeter-Canton Formation contact. The mineralogy and stratigraphic setting of these massive sulfide deposits are similar to the Besshi deposits described by Franklin and others (1981). Similar volcanogenic origins are expressed by McConnell and Abrams (1984) for gold and massive sulfide deposits in the Pumpkinvine Creek, Canton, and Univeter Formations southwest of the study area.

At some point after their deposition, the lithologies in the study area were metamorphosed to staurolite-amphibolite grade and were deformed during three, possibly four, fold events of progressively lower intensity. Major faulting also accompanied folding and metamorphism. Field data suggest that the Shope Fork fault is the oldest fault in the study area. Movement along this fault was probably pre- to synmetamorphic. Movement along the Chattahoochee fault followed that of the Shope Fork fault and probably occurred at the peak or slightly after the peak of regional metamorphism, coinciding with the formation of the Auraria antiform (F_1). The Allatoona fault truncated the Auraria antiform and, therefore, postdates the Chattahoochee fault and the peak of regional metamorphism.

SUMMARY

The rocks that constitute the Dahlonega gold belt consist of metamorphosed volcanic and sedimentary rocks of the Pumpkinvine Creek, Canton, and Univeter Formations. These rocks in the study area are a northeastward extension of the New Georgia Group defined by McConnell and Abrams (1984) in west-central Georgia. The Pumpkinvine Creek Formation, the structurally lowest unit in the sequence, is composed of metavolcanic rocks. The Canton Formation, a predominantly metasedimentary unit, overlies the Pumpkinvine Creek Formation, and is overlain in turn by the Univeter Formation, a predominantly metavolcanic unit similar to the Pumpkinvine Creek Formation. One member, the Barlow Gneiss Member, was identified within the Pumpkinvine Creek Formation, and four members, the Proctor Creek, Palmer Creek, Chestatee, and Helen Members, were identified within the Canton Formation. No new members were defined for the Univeter Formation. The protoliths of these three formations were deposited in a rapidly subsiding basin that had substantial volcanic and sedimentary components, as in a back-arc basin. These lithologies were metamorphosed to staurolite-amphibolite grade approximately 365-million years ago during regional metamorphism and were subjected to at least three fold events. The boundaries of the gold belt are largely defined by the pre- to synmetamorphic Shope Fork fault, the peak to post-peak metamorphic Chattahoochee fault, and the post-peak metamorphic Allatoona fault.

Gold deposition was originally syngenetic and is predominantly associated with iron formation, felsic gneisses, and rocks at or near the contacts between metavolcanic and metasedimentary sequences. During regional metamorphism and deformation gold was remobilized and concentrated in sulfidic quartz veins that largely conform to the foliation of the enclosing rock. In the study area the overall occurrence of gold is lithologically controlled, whereas its local concentrations in these rocks are controlled by small-scale structures (cleavages, folds, etc.). Erosion and weathering of gold-bearing rocks has accounted for a mechanical concentration of gold in placers and an apparent supergene enrichment in saprolite.

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Appendix

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Davis	1	Cherokee	Canton	Adit, vertical shaft, and several small pits.	Occurs within muscovite-garnet-biotite-quartz schist and amphibolite of the Univeter Formation.	nr	
Dickerson	2	Cherokee	Ball Ground West	Shaft (now filled) and several pits.	Occurs within interlayered plagioclase-hornblende-biotite-quartz gneiss and amphibolite of the Univeter Formation.	nr	Massive sulfide mine.
Franklin/Creighton	3	Cherokee	Ball Ground East	Two open cuts, several pits, and a vertical shaft.	Occurs within interlayered amphibolite, biotite-hornblende-plagioclase-quartz gneiss, and biotite-plagioclase-quartz gneiss of the Univeter Formation.	Pre-Civil War: 2500 oz. from one open cut.[1] Total: 37,500-50,000 oz.[3]	Extensive underground workings reported in the literature.
Sandow	4	Cherokee	Ball Ground East	Two vertical shafts and several pits.	Occurs within biotite-muscovite-quartz schist of the Sandy Springs Group.	nr	Located southeast of gold belt lithologies.
Smith	5	Cherokee	Ball Ground East			nr	Exact location unknown.
Richards	6	Cherokee	Ball Ground East	Placer workings along Smithwick Creek and one adit.	Occurs within amphibolite of the Univeter Formation.	nr	
Latham	7	Cherokee	Ball Ground East			Pre-1895: 4 oz.[1]	Exact location unknown.
Chester	8	Cherokee	Ball Ground East			nr	Exact location unknown
Frank Burt	9	Cherokee	Ball Ground East			nr	Exact location unknown.
Standard	10	Cherokee	Ball Ground East	Two inclined shafts.	Occurs within interlayered plagioclase-hornblende-biotite-quartz gneiss and amphibolite of the Univeter Formation.	Pre-1917: 22,000 tons.[4]	Massive sulfide mine.
Swift	11	Cherokee	Ball Ground East	One inclined shaft and several pits.	Occurs within plagioclase-hornblende biotite-quartz gneiss and amphibolite of the Univeter Formation.	1906-11: 4000 tons[4]	Massive sulfide mine.
Charles	12	Forsyth	Matt	Placer workings along two tributaries of the Etowah River, two vertical shafts, and one small open cut.	Occurs within iron formation, amphibolite, and graphitic-biotite-garnet-muscovite-quartz schist of undifferentiated Canton Formation.	nr	Most workings are associated with the iron formation.

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
M'Guire	13	Dawson	Matt	One vertical shaft with an intersecting adit.	Occurs within hornblende-garnet-biotite-quartz schist of the Palmer Creek Member.	Pre-1895: 750 oz.[1]	
Looper	14	Dawson	Matt			nr	Exact location unknown.
Barrett	15	Dawson	Matt	Placer workings along tributaries of the Etowah River and Bannister Creek.	Occurs within garnet-biotite-muscovite-quartz schist of the Proctor Creek Member.	nr	
Kin Mori	16	Dawson	Matt	Placer workings along an Etowah River tributary, open cuts, and a vertical shaft with adjacent small pits.	Occurs within iron formation and garnet-biotite-muscovite-quartz schist of the Proctor Creek Member.	nr	
Palmour	17	Dawson	Dawsonville	Placer workings along Proctor Creek and some of its tributaries.	Occurs within garnet-biotite-muscovite-quartz schist of the Proctor Creek Member.	nr	
Shelton	18	Dawson	Dawsonville			nr	Exact location unknown.
Church Lot	19	Dawson	Dawsonville	Placer workings along Clear Creek and several small pits.	Occurs within iron formation, amphibolite, biotite-hornblende-staurolite-muscovite-plagioclase-quartz gneiss, and garnet-biotite-quartz-hornblende-plagioclase gneiss of the Pumpkinvine Creek Formation.	nr	Also listed by Shearer and Hull (1918) as a pyrite prospect.
Ellsworth	20	Dawson	Dawsonville	Placer workings along Mill Creek and an adit that parallels strike.	Occurs within iron formation and garnet-biotite-muscovite-quartz schist of the Proctor Creek Member.	nr	Located slightly northwest of the contact with the Pumpkinvine Creek Formation.
Magic	21	Dawson	Dawsonville	Placer workings along tributaries of Russell and Palmer Creeks and one open cut.	Occurs within iron formation, amphibolite, biotite-hornblende-staurolite-muscovite-plagioclase-quartz gneiss, and garnet-biotite-quartz-hornblende-plagioclase gneiss of the Pumpkinvine Creek Formation.	nr	Located slightly southeast of the contact with the Proctor Creek Member of the Canton Formation.
Amicalola	22	Dawson	Dawsonville	Placer workings along a tributary of Mill Creek.	Occurs within biotite-quarts schist ± garnet or hornblende of the Palmer Creek Member.	nr	

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Missing Link	23	Dawson	Dawsonville			nr	Exact location unknown.
Cooper	24	Dawson	Dawsonville	Placer workings along Russell Creek.	Occurs within amphibolite, biotite-hornblende-staurolite-muscovite-plagioclase-quartz gneiss, and garnet-biotite-quartz-hornblende-plagioclase gneiss of the Pumpkinvine Creek Formation.	Pre-1908: 4 oz.[2]	Located slightly southeast of the contact with the Proctor Creek Member of the Canton Formation.
Hedwig/ Chicago	25	Lumpkin	Dawsonville	Placer workings along a tributary of Camp Creek, open hydraulic cuts, and an adit.	Occurs within muscovite-biotite-plagioclase-quartz gneiss (Barlow Gneiss Member) and amphibolite of the Pumpkinvine Creek Formation.	nr	
Whim Hill	26	Lumpkin	Dawsonville	Adits and several small open cuts.	Occurs within muscovite-biotite-plagioclase-quartz gneiss (Barlow Gneiss Member) and amphibolite of the Pumpkinvine Creek Formation.	nr	
Battle Branch	27	Lumpkin	Dawsonville	Large open cut with several collapsed shafts.	Occurs within biotite-quartz schist ± garnet or muscovite of the Palmer Creek Member.	Pre-1895: 4000 oz.[1] 1934-35: 782 oz.[3]	Extensive underground workings are reported in the literature.
Betz	28	Lumpkin	Dawsonville	One large open cut with accompanying adits.	Occurs within biotite-quartz schist ± garnet or muscovite of the Palmer Creek Member.	nr	Occurs northwest of the main trend of abandoned mines.
McIntosh	29	Lumpkin	Dawsonville	Several small pits.	Occurs within biotite-quartz schist ± garnet or muscovite of the Palmer Creek Member.	nr	Occurs northwest of the main trend of abandoned mines.
Wells	30	Lumpkin	Dawsonville	Placer workings along a tributary of the Etowah River.	Occurs within muscovite-biotite-plagioclase-quartz gneiss (Barlow Gneiss Member) and amphibolite of the Pumpkinvine Creek Formation.	nr	
Josephine	31	Lumpkin	Dawsonville	Placer workings along a tributary of the Etowah River.	Occurs within muscovite-biotite-plagioclase-quartz gneiss (Barlow Gneiss Member) and amphibolite of the Pumpkinvine Creek Formation.	nr	
Norrell	32	Lumpkin	Dawsonville			Pre-1895: 700 oz.[1]	Exact location unknown.

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Rutherford	33	Lumpkin	Dawsonville	Placer workings along Ralston Branch.	Occurs within garnet-biotite-muscovite-quartz schist of the Proctor Creek Member.	nr	
Stegall	34	Lumpkin	Dawsonville	Placer workings along a tributary of the Etowah River.	Occurs within amphibolite of the Pumpkinvine Creek Formation.	Pre-1895: 250 oz.[1]	
Liberty Bell	35	Lumpkin	Dawsonville	Placer workings along Cane Branch.	Occurs along the contact between garnet-biotite-muscovite-quartz schist of the Proctor Creek Member and biotite-quartz schist ± garnet or hornblende of the Palmer Creek Member.	nr	
Trammel	36	Lumpkin	Dawsonville	One adit.	Occurs within amphibolite of the Pumpkinvine Creek Formation.	nr	
McClusky	37	Lumpkin	Dawsonville	Placer workings along a tributary of the Etowah River.	Occurs within muscovite-biotite-plagioclase-quartz gneiss (Barlow Gneiss Member) and amphibolite of the Pumpkinvine Creek Formation.	nr	
Logan Hill	38	Lumpkin	Dawsonville	An inclined shaft and several small pits and trenches.	Occurs within amphibolite of the Pumpkinvine Creek Formation.	nr	
Mountain Valley	39	Lumpkin	Dawsonville	One large open cut and placer workings along Town Creek and two of its tributaries.	Occurs within garnet-biotite-muscovite-quartz schist of the Proctor Creek Member.	nr	
Barlow Cut	40	Lumpkin	Dawsonville and Campbell Mountain	One large open cut with several collapsed shafts.	Occurs within muscovite-biotite-plagioclase-quartz gneiss and amphibolite of the Barlow Gneiss Member.	nr	Largest open cut in gold belt; follows strike of Barlow Gneiss.
Ralston Cut	41	Lumpkin	Dawsonville	Placer workings along Ralston Branch and one large open cut.	Occurs within muscovite-biotite-plagioclase-quartz gneiss and amphibolite of the Barlow Gneiss Member.	nr	Follows strike of Barlow Gneiss.
Gordon Cut	42	Lumpkin	Dawsonville	One large open cut.	Occurs within muscovite-biotite-plagioclase-quartz gneiss of the Barlow Gneiss Member.	nr	Follows strike of Barlow Gneiss.
Hollaway	43	Lumpkin	Dawsonville			nr	Exact location unknown.

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Etowah	44	Lumpkin	Dawsonville	Placer workings along the Etowah River and some of its tributaries plus a tunnel and vertical shaft.	Occurs within muscovite-biotite-plagioclase-quartz gneiss (Barlow Gneiss Member) and amphibolite of the Pumpkinvine Creek Formation.	nr	
Horner	45	Lumpkin	Campbell Mountain			nr	Exact location unknown.
Old Spring	46	Lumpkin	Campbell Mountain	Placer workings along a tributary of Ralston Branch.	Occurs within garnet-biotite-muscovite-quartz schist of the Proctor Creek Member.	nr	
Doghead	47	Lumpkin	Campbell Mountain			nr	Exact location unknown; probably part of Barlow Mine.
Keystone	48	Lumpkin	Campbell Mountain	Placer workings along a tributary of Cane Creek and two large open cuts.	Occurs within amphibolite and muscovite-biotite-plagioclase-quartz gneiss of the Barlow Gneiss Member.	nr	
Bunker Hill	49	Lumpkin	Campbell Mountain	Two open cuts	Occurs within garnet-biotite-muscovite-quartz schist of the Proctor Creek Member.	nr	Occurs slightly southeast of the contact with amphibolite of the Pumpkinvine Creek Formation.
Boston Cut	50	Lumpkin	Campbell Mountain	One large open cut.	Occurs within muscovite-biotite-plagioclase-quartz gneiss and amphibolite of the Barlow Gneiss Member.	nr	Cut follows strike of the Barlow Gneiss.
Barsheba	51	Lumpkin	Campbell Mountain			nr	Exact location unknown.
Rock House	52	Lumpkin	Campbell Mountain	An adit, several small pits, and placer workings in a tributary of Cane Creek.	Occurs within muscovite-biotite-plagioclase-quartz gneiss of the Barlow Gneiss Member.	nr	
Barlow	53	Lumpkin	Campbell Mountain	Placer workings along Cane Creek and some of its tributaries; several open cuts.	Occurs within muscovite-biotite-plagioclase-quartz gneiss (Barlow Gneiss Member) and amphibolite of the Pumpkinvine Creek Formation.	nr	
Pidgeon Roost	54	Lumpkin	Campbell Mountain	Placer workings along a tributary of Cane Creek and two large open cuts.	Occurs within muscovite-biotite-plagioclase-quartz gneiss (Barlow Gneiss Member) and amphibolite of the Pumpkinvine Creek Formation.	nr	

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Turkey Hill	55	Lumpkin	Murrayville	Several inclined shafts and pits.	Occurs within biotite-quartz schist ± garnet or hornblende of the Palmer Creek Member.	nr	
Calhoun	56	Lumpkin	Murrayville	Several shafts and pits.	Occurs within biotite-quartz schist ± garnet or hornblende of the Palmer Creek Member.	1845: 1200 oz.[1]	
Chestatee	57	Lumpkin	Murrayville and Dahlonega	Placer workings along the Chestatee River.	Occurs within amphibolite and felsic gneiss of the Chestatee Member.	nr	
Briar Patch	58	Lumpkin	Murrayville	Placer workings in the vicinity of the confluence of Town Creek, Bells Branch, and Ralston Branch with the Etowah River.	Occurs within biotite-quartz schist ± garnet or hornblende of the Palmer Creek Member.	nr	
Smith	59	Lumpkin	Murrayville	One open cut.	Occurs within biotite-quartz-plagioclase gneiss and amphibolite of the Chestatee Member.	nr	
Long Branch	60	Lumpkin	Murrayville			nr	Exact location unknown.
Early	61	Lumpkin	Murrayville			nr	Exact location unknown.
Skyrme	62	Lumpkin	Murrayville			nr	Exact location unknown.
Teal	63	Lumpkin	Murrayville			nr	Exact location unknown.
Cabbage Patch	64	Lumpkin	Murrayville			nr	Exact location unknown.
Crandell	65	Lumpkin	Murrayville			nr	Exact location unknown.
White Rabbit	66	Lumpkin	Dahlonega			nr	Exact location unknown.
Capps	67	Lumpkin	Dahlonega			nr	Exact location unknown.
Ivey Cut	68	Lumpkin	Dahlonega	One large open cut.	Occurs within muscovite-biotite-plagioclase-quartz gneiss of the Barlow Gneiss Member.	nr	
Fish Trap	69	Lumpkin	Dahlonega	Several open cuts and extensive placer workings along a tributary of the Chestatee River.	Occurs within plagioclase-garnet-biotite-muscovite-quartz schist of the Proctor Creek Member.	nr	

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Crown Mountain	70	Lumpkin	Dahlonega	Several open cuts.	Occurs along the contact between the Pumpkinvine Creek and Canton Formations within interlayered iron formation, biotite-plagioclase-quartz gneiss, sericite-quartz schist, and amphibolite.	nr	
Columbia	71	Lumpkin	Dahlonega	One large open cut.	Same as Crown Mountain Mine (#70)	nr	
Preacher	72	Lumpkin	Dahlonega	One large open cut.	Same as Crown Mountain Mine (#70).	nr	
Griscom	73	Lumpkin	Dahlonega			nr	Exact location unknown.
Bast Cut	74	Lumpkin	Dahlonega	Several open cuts, pits, and adits.	Same as Crown Mountain Mine (#70).	nr	
Findley	75	Lumpkin	Dahlonega	Several adits and open cuts.	Same as Crown Mountain Mine (#70).	Pre-1895: 15,000 oz.[1]	
Lochhart	76	Lumpkin	Dahlonega	One open cut and a vertical shaft.	Same as Crown Mountain Mine (#70).	nr	
Free Jim	77	Lumpkin	Dahlonega	Placer workings along a tributary of Yahoola Creek, one adit and several small pits.	Same as Crown Mountain Mine (#70).	nr	
Singleton	78	Lumpkin	Dahlonega	Placer workings along a tributary of Yahoola Creek and several open cuts.	Same as Crown Mountain Mine (#70).	1891-95: 665 oz.[1]	
Tahloneka	79	Lumpkin	Dahlonega	Placer workings along a tributary of Yahoola Creek, several open cuts, and one adit.	Same as Crown Mountain Mine (#70).	nr	
Standard	80	Lumpkin	Dahlonega	Several open cuts and one adit.	Same as Crown Mountain Mine (#70).	nr	
Yahoola	81	Lumpkin	Dahlonega	Two adits.	Same as Crown Mountain Mine (#70).	nr	
Consolidated	82	Lumpkin	Dahlonega	Placer workings in a tributary of Yahoola Creek, several open cuts, and two adits.	Same as Crown Mountain Mine (#70).	nr	

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Mary Henry	83	Lumpkin	Dahlonega	One adit	Occurs within a coarsely crystalline metatrondhjemite.	nr	
Benning	84	Lumpkin	Dahlonega			nr	Exact location unknown.
Crescent	85	Lumpkin	Dahlonega	An adit and one open cut.	Occurs within biotite-quartz schist of the Palmer Creek Member.	nr	
Lawrence	86	Lumpkin	Dahlonega			nr	Exact location unknown.
Crisson	87	Lumpkin	Dahlonega	An adit and one open cut.	Occurs along the contact between biotite-quartz schist of the Palmer Creek Member and metatrondhjemite.	nr	Presently worked on a very limited scale.
Boyd	88	Lumpkin	Dahlonega			nr	Exact location unknown.
Cavenders Creek	89	Lumpkin	Dahlonega	Placer workings along Cavenders Creek and several pits.	Occurs along the contact between muscovite-biotite-quartz schist of the Palmer Creek Member and metatrondhjemite.	Pre-1895: 7500 oz.[1]	
Cora Lee	90	Lumpkin	Dahlonega	One adit	Occurs within a metatrondhjemite.	nr	Adit was recently filled.
Jumbo	91	Lumpkin	Dahlonega	Placer workings in a tributary of Cavenders Creek and several pits.	Occurs along the contact between amphibolite of the Chestatee Member and biotite-muscovite-quartz schist and metagraywacke of the Helen Member.	nr	
Wood	92	Lumpkin	Dahlonega			nr	Exact location unknown.
Jones	93	Lumpkin	Dahlonega			nr	Exact location unknown.
Boly Field	94	Lumpkin	Dahlonega	Placer workings along the Chestatee River.	Occurs along the contact between amphibolite of the Chestatee Member and biotite-muscovite-quartz schist and metagraywacke of the Helen Member.	nr	
Beers	95	Lumpkin	Dahlonega	Placer workings along the Chestatee River.	Same as Boly Fields Mine (#94).	nr	
Dry Hollow	96	Lumpkin	Dahlonega	An inclined shaft and two pits.	Same as Boly Fields Mine (#94).	nr	
Old Columbia	97	Lumpkin	Dahlonega	Placer workings along Yahoola Creek.	Occurs within biotite-quartz schist of the Palmer Creek Member.	nr	

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Bowen Lot	98	Lumpkin	Dahlonega			nr	Exact location unknown.
Garnet	99	Lumpkin	Dahlonega	Several open cuts.	Occurs within interlayered garnet-biotite-muscovite-quartz schist and metagraywacke of the Helen Member.	nr	
Shockley Lot	100	Lumpkin	Dahlonega			nr	Exact location unknown.
Todd Lot	101	Lumpkin	Dahlonega			nr	Exact location unknown.
Buffington	102	Lumpkin	Dahlonega	Placer workings along a tributary of the Chestatee River and several pits.	Occurs along the contact between felsic gneiss and amphibolite of the Chestatee Member and biotite-quartz schist of the Palmer Creek Member.	nr	
Chestatee Copper	103	Lumpkin	Dahlonega	Seven inclined shafts.	Occurs along the contact between amphibolite of the Univeter Formation and interlayered garnet-biotite-muscovite-quartz schist and metagraywacke of the Canton Formation.	1892: 200 tons[5]; 1918-19: 48,835 tons[5].	Massive sulfide mine.
Loud	104	White	Cleveland	Placer workings along Town Creek and one of its tributaries.	Occurs along the contact between amphibolite, iron formation, and biotite-muscovite-quartz schist of the Univeter Formation and interlayered garnet-biotite-muscovite-quartz schist and metagraywacke of the Helen Member.	nr	
Old Ashbury	105	White	Cleveland	Placer workings along a tributary of Chateen Creek and four vertical shafts.	Same as Loud Mine (#104).	nr	
Courtney	106	White	Cleveland	Placer workings along a tributary of Town Creek and several open cuts.	Occurs within biotite-quartz-plagioclase gneiss of the Sandy Springs Group.	nr	Not located in gold belt lithologies.
Henderson	107	White	Cleveland	Placer workings along a tributary of Tesnatee Creek.	Occurs within biotite-muscovite-quartz schist and amphibolite of the Univeter Formation.	nr	

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Etries	108	White	Cleveland	Placer workings along a tributary of Glade Branch plus one open cut.	Occurs within interlayered garnet-biotite-muscovite-quartz schist and metagraywacke of the Helen Member.	nr	
McAfee	109	White	Cleveland	Placer workings along a tributary of Jenny Creek plus three adits.	Same as Etries Mine (#108).	nr	
Atkinson	110	White	Cleveland	Placer workings along a tributary of Jenny Creek plus several pits.	Same as Etries Mine (#108).	nr	
Matthews	111	White	Cleveland	Placer workings along a tributary of Town Creek.	Same as Etries Mine (#108).	nr	
Reaves	112	White	Cleveland			nr	Exact location unknown.
Sprague/ Blake	113	White	Cowrock	Placer workings along tributaries of Jenny Creek, two adits, an open cut, and several pits.	The placer workings occur within interlayered garnet-biotite-muscovite-quartz schist and metagraywacke of the Helen Member. The remaining workings occur within and bordering a coarsely crystalline amphibolite.	nr	
Longstreet	114	White	Cowrock	Placer working along Turner Creek and its tributaries, an open cut, and an adit.	Occurs within interlayered garnet-biotite-muscovite-quartz schist, metagraywacke, and amphibolite of the Helen Member of the Canton Formation and iron formation, biotite-plagioclase-quartz gneiss, and amphibolite of the Univeter Formation.	nr	
Wyman Hood/Allen	115	White	Cowrock	An inclined shaft and a pit.	Occurs within garnet-biotite-muscovite-quartz schist and metagraywacke of the Helen Member.	nr	
Bell	116	White	Cowrock	One adit.	Occurs within amphibolite of the Univeter Formation.	nr	
Cox/Merritt	117	White	Cowrock	One open cut.	Occurs within amphibolite of the Univeter Formation.	nr	

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Castleberry	118	White	Cowrock	Placer workings along Thurmond Creek and one of its tributaries plus several pits.	Occurs within interlayered garnet-biotite-muscovite-quartz schist and metagraywacke of the Helen Member.	nr	
Thurman	119	White	Helen	Two adits and several pits.	Occurs within amphibolite of the Univeter Formation.	nr	
White County/ Thompson	120	White	Helen	Several pits.	Occurs within biotite-plagioclase-quartz gneiss of the Univeter Formation.	nr	Mine property is now a subdivision. Extensive underground workings reported in the literature.
Yonah/ Calhoun	121	White	Helen	Placer workings along Dukes Creek and its tributaries plus several open cuts.	Workings occur over a large area within garnet-biotite-muscovite-quartz schist, metagraywacke, and amphibolite of the Helen Member; biotite-plagioclase-quartz gneiss and amphibolite of the Univeter Formation; and biotite gneiss of the Sandy Springs Group.	Pre-1895: 20,000-50,000 oz.[1]	Some of the workings between Dukes Creek and the town of Helen may be attributable to the Reynolds/ Hamby Mine.
Diltz	122	White	Helen	Two adits.	Occurs within interlayered biotite-plagioclase-quartz gneiss and amphibolite of the Univeter Formation.	nr	
Reynolds/ Hamby	123	White	Helen	Placer workings along tributaries of Dukes Creek and the Chattahoochee River, several open cuts, pits and adits.	Occurs within interlayered garnet-biotite-muscovite-quartz schist, metagraywacke, and amphibolite of the Helen Member.	nr	
St. George/ Dean	124	White	Helen	Placer workings along tributaries of the Chattahoochee River, several open cuts, and several adits.	Occurs within interlayered garnet-biotite-muscovite-quartz schist and metagraywacke of the Helen Member.	nr	
Conley	125	White	Helen			nr	Exact location unknown.
Plattsburg/ England	126	White	Helen	Placer workings along a tributary of the Chattahoochee River.	Same as St. George/ Dean Mine (#124).	nr	

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Lot 10	127	White	Helen	Several overlapping open cuts.	Same as St. George/ Dean Mine (#124).	nr	
Childs	128	White	Helen	Placer workings and an open cut along a tributary of Bean Creek.	Same as St. George/ Dean Mine (#124).	nr	
Lumsden/ Jones	129	White	Helen	Placer workings along Bean Creek and its tributaries.	Occurs within biotite-muscovite-quartz schist and amphibolite of the Univeter Formation and migmatitic biotite gneiss of the Sandy Springs Group.	nr	
Hood/ Soque Club	130	Habersham	Lake Burton			nr	Exact location unknown.
Wilson	131	Habersham	Lake Burton			nr	Exact location unknown.
Brooks	132	Habersham	Lake Burton			nr	Exact location unknown.
Williams	133	Habersham	Lake Burton	Placer workings along a tributary of Goshen Creek.	Occurs within plagioclase-garnet-biotite-muscovite-quartz schist and amphibolite of the Univeter Formation.	nr	
Kennedy	134	Habersham	Lake Burton	Placer workings along a tributary of Goshen Creek.	Occurs within amphibolite of the Univeter Formation.	nr	
Smith	135	Rabun	Lake Burton	Placer workings along Dicks Creek.	Occurs within amphibolite, plagioclase-biotite-quartz gneiss, and biotite-quartz schist of the Tallulah Falls Formation.	nr	
Stonesypher	136	Rabun	Lake Burton			nr	Exact location unknown. Probably covered by Lake Burton.
Bartley/ Barclay	137	Rabun	Hightower Bald	Two adits, a shaft, and several pits.	Occurs within muscovite-biotite-quartz-plagioclase gneiss of the Coweeta Group.	nr	Located northwest of gold belt lithologies.
Moore Girls	138	Rabun	Dillard	An open cut, an adit, and several pits.	Occurs within muscovite-biotite-quartz-plagioclase gneiss of the Coweeta Group and amphibolite, biotite-quartz schist, metagraywacke, and epidote quartzite of the Tallulah Falls Formation.	nr	

Appendix (Cont'd)

Mine	No.	County	7.5 minute quadrangle	Type of workings	Geologic Setting	Production	Remarks
Lot 190 and 191	139	Rabun	Dillard	Placer workings along a tributary of the Little Tennessee River.	Occurs within interlayered amphibolite, biotite-quartz schist, metagraywacke, and epidote quartzite of the Tallulah Falls Formation.	nr	

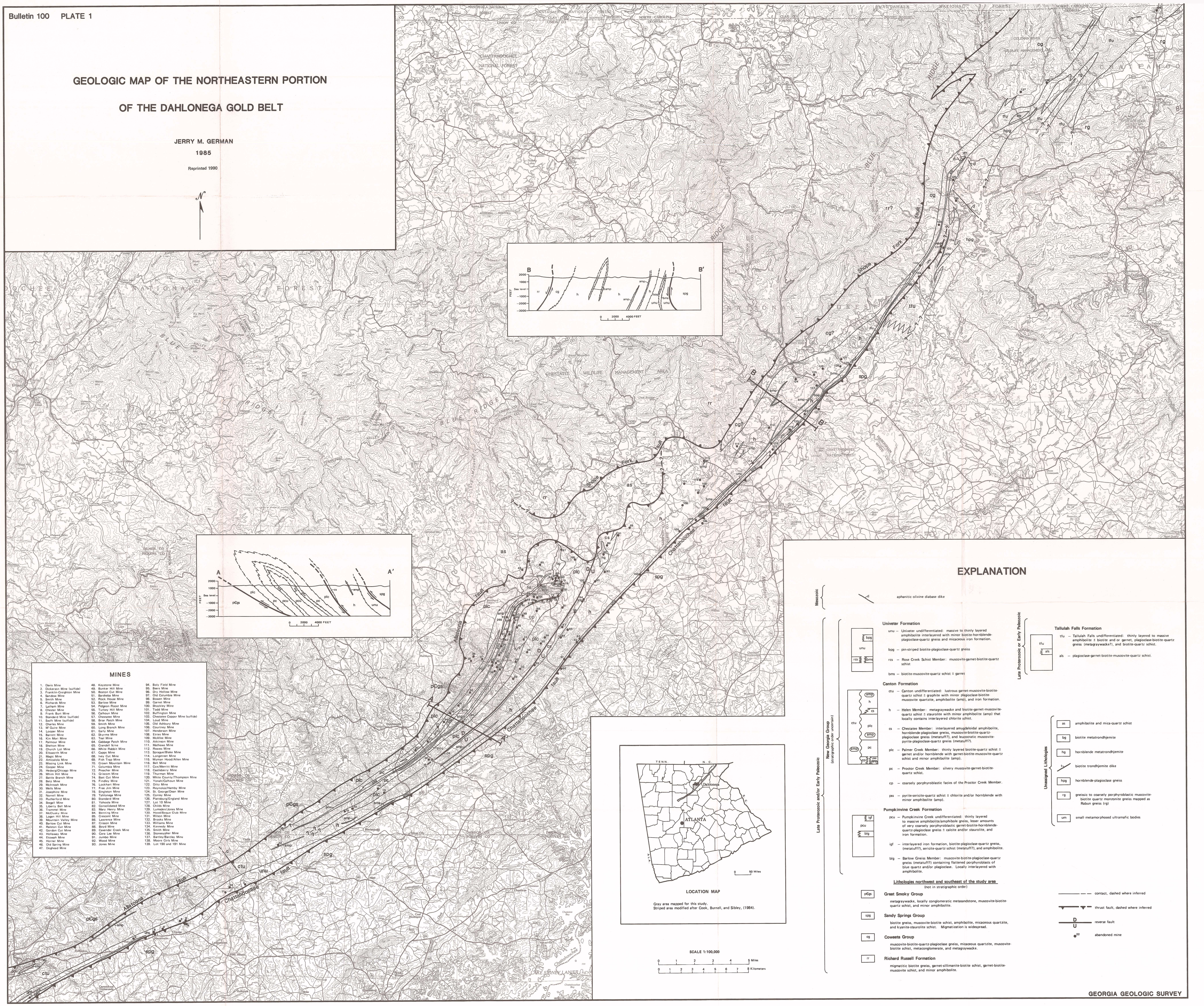
nr - not recorded
[1] Yeates and others (1896)
[2] Jones (1909)
[3] Pardee and Park (1948)
[4] Shearer and Hull (1918)
[5] Kline and Beck (1949)

GEOLOGIC MAP OF THE NORTHEASTERN PORTION OF THE DAHLONEGA GOLD BELT

JERRY M. GERMAN

1985

Reprinted 1990



MINES

1. Davis Mine
2. Dickerson Mine (sulfide)
3. Franklin-Creighton Mine
4. Sandow Mine
5. Smith Mine
6. Richards Mine
7. Latham Mine
8. Chester Mine
9. Frank Burt Mine
10. Standard Mine (sulfide)
11. Swift Mine (sulfide)
12. Charles Mine
13. M' Guire Mine
14. Looper Mine
15. Barrett Mine
16. Kin Mori Mine
17. Palmour Mine
18. Shelton Mine
19. Church Lot Mine
20. Ellsworth Mine
21. Magic Mine
22. Amicalola Mine
23. Missing Link Mine
24. Cooper Mine
25. Hedwig/Chicago Mine
26. Whim Hill Mine
27. Battle Branch Mine
28. Betz Mine
29. McIntosh Mine
30. Wells Mine
31. Josephine Mine
32. Norrell Mine
33. Rutherford Mine
34. Stegall Mine
35. Liberty Bell Mine
36. Trammel Mine
37. McClusky Mine
38. Logan Hill Mine
39. Mountain Valley Mine
40. Barlow Cut Mine
41. Ralston Cut Mine
42. Gordon Cut Mine
43. Hollaway Mine
44. Etowah Mine
45. Horner Mine
46. Old Spring Mine
47. Doghead Mine
48. Keystone Mine
49. Bunker Hill Mine
50. Boston Cut Mine
51. Barsheba Mine
52. Rock House Mine
53. Barlow Mine
54. Pidgeon Roost Mine
55. Turkey Hill Mine
56. Calhoun Mine
57. Chestatee Mine
58. Briar Patch Mine
59. Smith Mine
60. Long Branch Mine
61. Early Mine
62. Skyrme Mine
63. Teal Mine
64. Cabbage Patch Mine
65. Crandell Mine
66. White Rabbit Mine
67. Capps Mine
68. Ivey Cut Mine
69. Fish Trap Mine
70. Crown Mountain Mine
71. Columbia Mine
72. Preacher Mine
73. Griscom Mine
74. Bast Cut Mine
75. Findley Mine
76. Lockhart Mine
77. Free Jim Mine
78. Singleton Mine
79. Tahlonega Mine
80. Standard Mine
81. Yahoola Mine
82. Consolidated Mine
83. Mary Henry Mine
84. Benning Mine
85. Crescent Mine
86. Lawrence Mine
87. Crisson Mine
88. Boyd Mine
89. Cavender Creek Mine
90. Cora Lee Mine
91. Jumbo Mine
92. Wood Mine
93. Jones Mine
94. Boly Field Mine
95. Beers Mine
96. Dry Hollow Mine
97. Old Columbia Mine
98. Bowen Mine
99. Garnet Mine
100. Shockley Mine
101. Todd Mine
102. Buffington Mine
103. Chestatee Copper Mine (sulfide)
104. Loud Mine
105. Old Ashbury Mine
106. Courtney Mine
107. Henderson Mine
108. Etries Mine
109. McAfee Mine
110. Atkinson Mine
111. Mathews Mine
112. Reaves Mine
113. Sprague/Blake Mine
114. Longstreet Mine
115. Wyman Hood/Allen Mine
116. Bell Mine
117. Cox/Merritt Mine
118. Castleberry Mine
119. Thurman Mine
120. White County/Thompson Mine
121. Yonah/Calhoun Mine
122. Diltz Mine
123. Reynolds/Hamby Mine
124. St. George/Dean Mine
125. Conley Mine
126. Plattsburg/England Mine
127. Lot 10 Mine
128. Childs Mine
129. Lumsden/Jones Mine
130. Hood/Soque Club Mine
131. Wilson Mine
132. Brooks Mine
133. Williams Mine
134. Kennedy Mine
135. Smith Mine
136. Stonesypher Mine
137. Bartley/Barclay Mine
138. Moore Girls Mine
139. Lot 190 and 191 Mine

LOCATION MAP

Gray area mapped for this study.
Striped area modified after Cook, Burnell, and Sibley, (1984).

SCALE 1:100,000

EXPLANATION

Mesozoic

d — aphanitic olivine diabase dike

Late Proterozoic and/or Early Paleozoic

New Georgia Group (stratigraphic order uncertain)

Univeter Formation

umu — Univeter undifferentiated: massive to thinly layered amphibolite interlayered with minor biotite-hornblende-plagioclase-quartz gneiss and micaceous iron formation.

bpg — pin-striped biotite-plagioclase-quartz gneiss

rcs — Rose Creek Schist Member: muscovite-garnet-biotite-quartz schist

bms — biotite-muscovite-quartz schist ± garnet

Canton Formation

ctu — Canton undifferentiated: lustrous garnet-muscovite-biotite-quartz schist ± graphite with minor plagioclase-biotite-muscovite quartzite, amphibolite (amp), and iron formation.

h — Helen Member: metagraywacke and biotite-garnet-muscovite-quartz schist ± staurolite with minor amphibolite (amp) that locally contains interlayered chlorite schist.

cs — Chestatee Member: interlayered amygdaloidal amphibolite, hornblende-plagioclase gneiss, muscovite-biotite-quartz-plagioclase gneiss (metatuff?), and leucocratic muscovite-pyrite-plagioclase-quartz gneiss (metatuff?).

plc — Palmer Creek Member: thinly layered biotite-quartz schist ± garnet and/or hornblende with garnet-biotite-muscovite-quartz schist and minor amphibolite (amp).

pc — Proctor Creek Member: silvery muscovite-garnet-biotite-quartz schist.

cp — coarsely porphyroblastic facies of the Proctor Creek Member.

pss — pyrite-sericite-quartz schist ± chlorite and/or hornblende with minor amphibolite (amp).

Pumpkinvine Creek Formation

pcu — Pumpkinvine Creek undifferentiated: thinly layered to massive amphibolite/amphibole gneiss, lesser amounts of very coarsely porphyroblastic garnet-biotite-hornblende-quartz-plagioclase gneiss ± calcite and/or staurolite, and iron formation.

igf — interlayered iron formation, biotite-plagioclase-quartz gneiss, (metatuff?), sericite-quartz schist (metatuff?), and amphibolite.

blg — Barlow Gneiss Member: muscovite-biotite-plagioclase-quartz gneiss (metatuff?) containing flattened porphyroblasts of blue quartz and/or plagioclase. Locally interlayered with amphibolite.

Lithologies northwest and southeast of the study area (not in stratigraphic order)

pCgs — **Great Smoky Group**: metagraywacke, locally conglomeratic metasandstone, muscovite-biotite-quartz schist, and minor amphibolite.

spg — **Sandy Springs Group**: biotite gneiss, muscovite-biotite schist, amphibolite, micaceous quartzite, and kyanite-staurolite schist. Migmatization is widespread.

cg — **Coweeta Group**: muscovite-biotite-quartz-plagioclase gneiss, micaceous quartzite, muscovite-biotite schist, metaconglomerate, and metagraywacke.

rr — **Richard Russell Formation**: migmatitic biotite gneiss, garnet-sillimanite-biotite schist, garnet-biotite-muscovite schist, and minor amphibolite.

Late Proterozoic or Early Paleozoic

Tallulah Falls Formation

tfu — Tallulah Falls undifferentiated: thinly layered to massive amphibolite ± biotite and or garnet, plagioclase-biotite-quartz gneiss (metagraywacke?), and biotite-quartz schist.

als — plagioclase-garnet-biotite-muscovite-quartz schist

Unassigned Lithologies

as — amphibolite and mica-quartz schist

bg — biotite metatrondhjemite

hg — hornblende metatrondhjemite

— biotite trondhjemite dike

hpg — hornblende-plagioclase gneiss

rg — gneissic to coarsely porphyroblastic muscovite-biotite quartz monzonite gneiss mapped as Rabun gneiss (rg)

um — small metamorphosed ultramafic bodies

— contact, dashed where inferred

— thrust fault, dashed where inferred

D/U — reverse fault

— abandoned mine

EXPLANATION

Late Proterozoic and/or early Paleozoic

New Georgia Group (stratigraphic order uncertain)

Univeter Formation

- **unu** — Univeter undifferentiated — massive to thinly layered amphibolite interlayered with minor biotite-hornblende-plagioclase-quartz gneiss and micaceous iron formation.

Canton Formation

- **h** — Helen Member — metagraywacke and biotite-garnet-muscovite-quartz schist ± staurolite with minor amphibolite (amp).
- **cs** — Chestatee Member — interlayered amygdaloidal amphibolite, hornblende-plagioclase gneiss, muscovite-biotite-quartz-plagioclase gneiss (metatuff?), and leucocratic muscovite-pyrite-plagioclase-quartz gneiss (metatuff?).
- **plc** — Palmer Creek Member — thinly layered biotite-quartz schist ± garnet and/or hornblende with garnet-biotite-muscovite-quartz schist and minor amphibolite (amp).
- **pc** — Proctor Creek Member — silvery muscovite-garnet-biotite-quartz schist.
- **cp** — coarsely porphyroblastic facies of the Proctor Creek Member.
- **pss** — pyrite-sericite-quartz schist ± chlorite and/or hornblende.

Pumpkinvine Creek Formation

- **pcu** — Pumpkinvine Creek undifferentiated — thinly layered to massive amphibolite, lesser amounts of very coarsely porphyroblastic garnet-biotite-hornblende-quartz-plagioclase gneiss ± calcite and/or staurolite, and iron formation.
- **blg** — Barlow Gneiss Member — muscovite-biotite-plagioclase-quartz gneiss (metatuff?) containing flattened porphyroblasts of blue quartz and/or plagioclase. Locally interlayered with amphibolite.

Lithologies northwest and southeast of the study area

(stratigraphic order not implied)

- **p€gs** — Great Smoky Group — metagraywacke, locally conglomeratic metasandstone, muscovite-biotite-quartz schist, and minor amphibolite.
- **spg** — Sandy Springs Group — biotite gneiss, muscovite-biotite schist, amphibolite, micaceous quartzite, and kyanite-staurolite schist. Migmatization is widespread.

tourmalinite (thickness exaggerated)

iron formation (thickness exaggerated)

contact (exact, approximate, inferred)

thrust fault (approximate)

D / U — reverse fault (approximate)

41 — strike and dip of foliation

strike of vertical foliation

75 — strike and dip of joints

18 — plunge and trend of lineations

21, 15 — axial plunge and trend of small antiform (left) and synform

12, 25 — axial plunge and trend of overturned antiform (left) and synform

18 — abandoned gold mine or prospect (see Plate 1 for name)