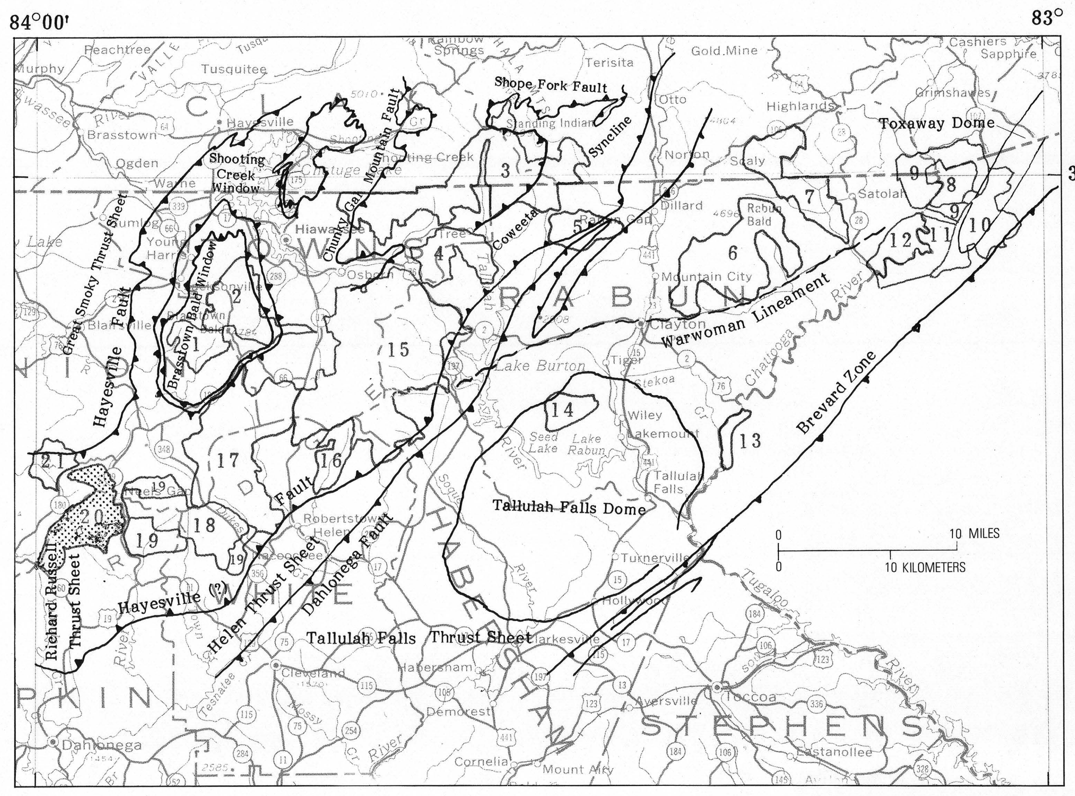
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF--1503-B



Base from U.S. Geological Survey, 1:500,000 State maps of North Carolina (1957, revised 1972) and Georgia (1963)

EXPLANATION

Wilderness Areas

3 Southern Nantahala Wilderness
8 Ellicott Rock Wilderness

Roadless Areas

1 Wolf Pen (08-149)
2 Brasstown (08-146)
4 Buzzard Knob (08-223)
5 Southern Nantahala (B8025)
6 Rabun Bald (08-147)
7 Overflow (08-026)
9 Ellicott Rock Extension (A8031)
10 Persimmon Mountain (L8116)
11 Ellicott Rock Expansion (08-112)
12 Rand Mountain (08-148)
13 Long Creek (08-113)
14 Worley Ridge (08-224)
15 Tray Mountain (08-030)
16 Anna Ruby (08-225)
17 Chattahoochee (08-029)
18 Raven Cliff (A8028)
19 Raven Cliff (B8028)
20 Blood Mountain (08-027)
21 Board Camp (08-145)

Figure 1.--Index map showing locations of wilderness and roadless areas and major structural features in northeastern Georgia and adjacent North and South Carolina. The Blood Mountain area is shown by a pattern. Number after roadless name is U.S. Forest Service identification number. Geology modified from Hatcher and Butler (1979) and Nelson and others (1987).

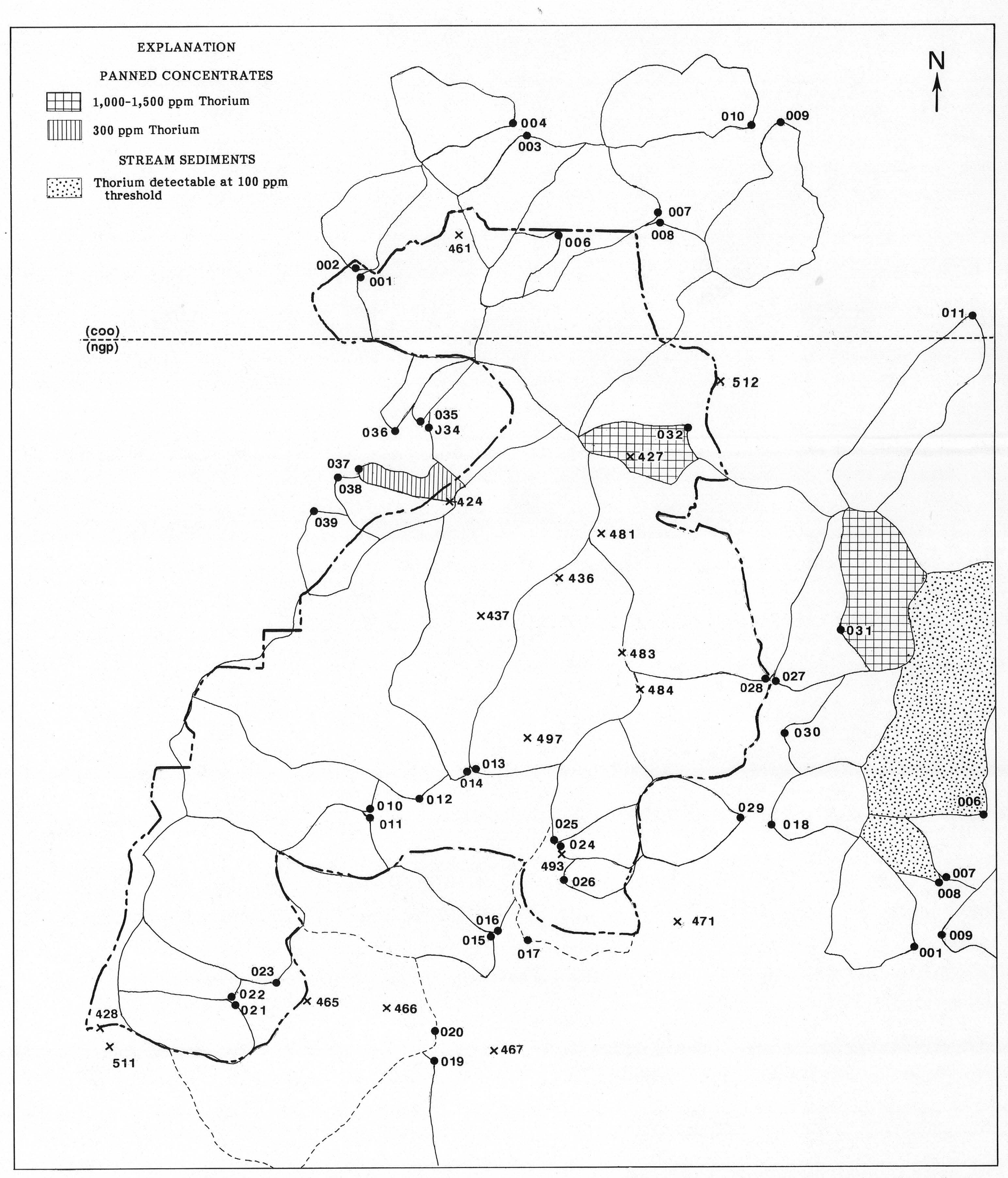
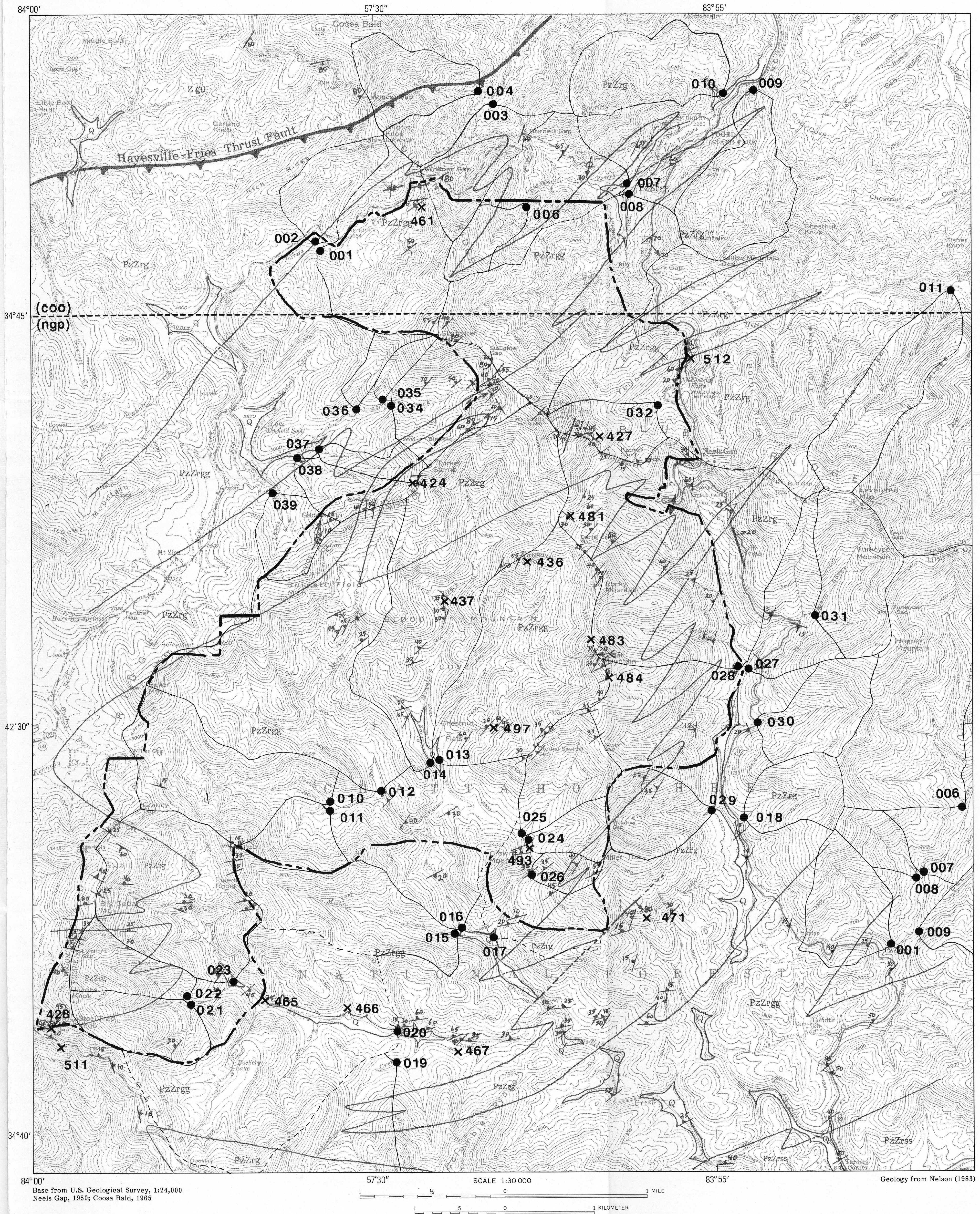


Figure 3.--Map showing locations of panned-concentrate or fine-grained sediment samples and their associated drainage basins that contain anomalous thorium. See figure 2 for an explanation of other symbols used.



Base from U.S. Geological Survey, 1:24,000 Neels Gap, 1950; Coosa Bald, 1965

Geology from Nelson (1983)

SCALE 1:30 000

CONTOUR INTERVAL 40 FEET

Figure 2.--Sample location map showing drainage basin outlines for stream-sediment and panned-concentrate samples, and major geologic units

EXPLANATION

Q — Quaternary deposits--Unconsolidated colluvium and alluvium. Coarse bouldery and cobbly gravels, sands, and clay

Rocks of the Richard Russell thrust sheet (modified from Koeppen and others, 1983)

PzZrg — Chiefly biotite gneiss variably interlayered with and gradational into metasandstone and granitic gneiss; alternates with thin to thick layers of biotite schist, muscovite-biotite schist, hornblende gneiss, and amphibolite, calc-silicate layers, and granite and dioritic gneiss. Biotite gneiss is irregularly layered to massive. Pegmatites and granite pods and veins are common

PzZrss — Mostly metasandstone variably interlayered with and gradational into biotite gneiss, interlayered with biotite schist, muscovite-biotite schist, hornblende gneiss, and amphibolite. Discontinuous pegmatite, quartz veins and pods are common

PzZrgg — Principally migmatite of biotite gneiss and granitic gneiss. Biotite and granitic gneisses mixed in all proportions from small granite veins and pods in biotite gneiss to massive granitic gneiss exposures containing only thin wisps of biotite gneiss. Commonly associated with pegmatite pods and veins, and quartzofeldspathic lenses

Zgu — Undivided Late Proterozoic rocks of the Great Smoky thrust sheet--Alternating beds of metasandstone, metaconglomerate, and mica schist; includes some bodies of granite gneiss.

Contact--Approximately located. Dashed where concealed

Fault--Dashed where approximately located; shows dip

Thrust fault--Approximately located; sawteeth on upper plate. Dashed where concealed

Approximate boundary of roadless area

Strike and dip of bedding

Strike and dip of layering and foliation

Strike and dip of foliation

Inclined

Vertical

Horizontal lineation

Bearing and plunge of lineation

Minor synform showing plunge of axis

Minor antiform showing plunge of axis

Overturned antiform showing plunge of axis

Abandoned quarry

004 — Outline of drainage basin--Dashed lines indicate greater order drainage basins. Dot indicates U.S. Geological Survey stream-sediment sample location. Stream-sediment sample number should be prefixed with either COO (for samples from the Coosa Bald quadrangle), or NGP (for samples from the Neels Gap quadrangle). See dashed line on map marking quadrangle boundary

×467 — U.S. Geological Survey rock sample

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral values, if any, that might be present. Results must be made available to the public and be submitted to the President and to the Congress. This report presents the results of a geochemical survey of the Blood Mountain Roadless Area (08-027) in the Chattahoochee National Forest, Union and Lumpkin Counties, Georgia. The area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

INTRODUCTION

The U.S. Geological Survey (USGS) made a reconnaissance geochemical survey of the Blood Mountain Roadless Area to search for unexposed mineral deposits which might be recognized by a geochemical signature in the abundance or distribution patterns of trace elements. Forty five fine-grained stream-sediment samples and 45 panned-concentrate samples were collected in the Blood Mountain study area (fig. 1). A.E. Nelson, in conjunction with detailed geologic mapping, collected 13 rock-chip samples for geochemical analysis, in addition to a large number of hand specimens for thin-section study. Nelson's geologic study (1983), combined with this geochemical survey, provide the basis for our mineral-resource assessment of the Blood Mountain Roadless Area (Koeppen and others, 1983).

Geologic Setting

The Blue Ridge Mountains of northeastern Georgia and adjoining North Carolina consist of metamorphic rocks of two major lithotectonic units: the Great Smoky thrust sheet and the Richard Russell thrust sheet (Nelson, 1983). The Richard Russell thrust sheet was emplaced by westward tectonic transport over the Great Smoky thrust sheet, along the Hayesville-Fries thrust fault, a major structural feature of the southern Appalachians. Although rocks of the Great Smoky thrust sheet underlie the area at depth, only rocks of the Richard Russell thrust sheet are exposed within the roadless area (Nelson, 1983; Nelson and Gillon, 1985).

In the Blood Mountain Roadless Area, Richard Russell thrust sheet rocks consist of biotite gneiss, granite gneiss, amphibolite, and metasandstone of the Richard Russell Formation (Nelson and Gillon, 1985). The rocks are compositionally layered, and migmatites of biotite gneiss and granite gneiss are common. Discontinuous pods and veins of pegmatite are abundant and widely dispersed throughout the area. Rocks of the area are multiply deformed and fold interference patterns commonly are seen.

All rocks in the roadless area are at the sillimanite grade of regional Barrovian metamorphism. The thermal peak of regional metamorphism in the southern Appalachian Mountains is estimated to have occurred between 450 and 480 Ma during the Taconic orogeny; the migmatite, pegmatite, and felsic segregations in the roadless area probably formed during this time.

PROCEDURES

Most of the small drainage basins within and immediately adjacent to the study area were sampled by collecting a few handfuls of the finest sediment available and by pan concentrating heavy minerals from the alluvial gravels from the active stream channels. The samples were dried and sieved to minus 80-mesh (0.006 in.), then pulverized to minus 140-mesh (0.004 in.). Panned-concentrate samples were washed in bromoform to remove light minerals, then passed by hand magnet to remove most magnetite. The remaining material was then split into magnetic and nonmagnetic fractions on a Frantz Isodynamic separator at a setting of 1.0 amp. The nonmagnetic fractions were crushed and pulverized to minus 140-mesh and analyzed. Rock chips similarly were crushed and pulverized for analysis.

Each sample was analyzed semiquantitatively for 31 elements by a six-step direct-current arc, optical-emission spectrographic method (Grimes and Marranzino, 1968) by D.F. Siems at the U.S. Geological Survey laboratories in Denver, Colo. Semiquantitative spectrographic analytical values are reported as six steps per order of magnitude (1.0, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate geometric midpoints of the concentration ranges whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, and so on. The analytical precision is shown to be within one adjoining reporting interval on each side of the reported value 83 percent of the time and within two adjoining intervals 96 percent of the time (Motooka and Grimes, 1976). The complete geochemical data for Blood Mountain Roadless Area and two adjacent study areas, Tray Mountain Wilderness and Chattahoochee Roadless Area, are reported in Siems and others (1988). Locations of samples and associated drainage basins are shown in figure 2. The statistical summary of the data is given in table 1.

DISCUSSION

A summary of the geochemical data (Siems and others, 1988) for 15 rock chips and 45 fine-grained stream-sediment samples is given in table 1; also given is data for similar samples from nearby areas for comparison. A distribution map is shown for higher values of thorium (fig. 3).

Our geochemical data for Blood Mountain Roadless Area show relatively small variations in abundance for most elements, but a few anomalies are recognized. One rock sample from the area (N424, fig. 2) contained detectable tin but at a concentration below the limit of determination (10 ppm). A panned-concentrate sample from Buggs Creek, about 2 mi east of the roadless area (and immediately beyond the edge of the map), contained 70 ppm tin; the source drainage basin for this sample is underlain by biotite gneiss and metasandstone lithologies of the Richard Russell Formation. No panned-concentrate or fine-grained sediment samples from within the Blood Mountain Roadless Area contained detectable tin. Low-grade tin anomalies occur at scattered locations both in rock and panned-concentrate samples derived from the Richard Russell Formation (Lesure and others, 1987; Koeppen and Nelson, in press), but no related source or significant mineralization has been identified. This single low value for tin in the rock is clearly anomalous but we consider that it is probably not related to significant mineralization.

Thorium contents of rock, panned-concentrate, and fine-grained sediment samples generally are below the spectrographic detection limit (100 ppm) for geologic samples in the Richard Russell thrust sheet. However, three panned-concentrate samples contained significant thorium (fig. 3); two had values between 1,000 and 1,500 ppm and a third had 300 ppm. Two fine-grained sediment samples taken from Buggs Creek and one of its small tributaries about 1.75 mi beyond the east boundary of the area contained detectable thorium (less than 100 ppm). An examination of the panned concentrates indicates that their mineralogy is dominantly zircon and monazite; the latter, or possibly fine-grained thorite, probably is the source of the thorium anomalies. Although geographically spread out, these stream-sediment samples are geologically clustered in biotite gneiss units immediately adjacent to granite gneiss, suggesting a metamorphic redistribution. The thorium enrichments may be concentration effects due to elemental mobility during migmatization within the Richard Russell Formation, but we see no evidence for significant thorium mineral concentrations or deposits.

The Blood Mountain study area is located 5 km from the Dahlonega gold belt, and gold-belt rocks may underlie the area. However, none of our geochemical samples contained measurable gold. Our data do not indicate anomalous metal concentrations in any other sample media. None of the geochemical data indicate that there are hidden mineral deposits in the Blood Mountain Roadless Area.

Table 1.--*Statistical summary of geochemical data for the Blood Mountain Roadless Area, from data in Siems and others (1988). Data from other wilderness areas shown for comparison*

All analyses in U.S. Geological Survey laboratories, Denver, Colo., by D.F. Siems using semiquantitative spectrographic methods, except for zinc in panned concentrate M1 (1.0 amp magnetic) fraction which was determined by atomic absorption methods by D.F. Siems. Spectrographic analyses are reported as six steps per order of magnitude (1.0, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate medians of geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, etc. The precision is expected to be within one adjoining reporting interval on each side of the reported value 83 percent of the time; M1, 1.0 amp magnetic fraction. Symbols used: >, amount is greater than number shown; <, amount is less than number shown; --, not detected.

STREAM SEDIMENTS

Element	BLOOD MOUNTAIN n=57 Low	High	Median	AR[1] n=19 Median	CR[7] n=51 Median	SN[8] n=171 Median	CM[2] n=30 Median	ER[3] n=103 Median	SR[5] n=94 Median	TM[4] n=87 Median
PERCENT										
Calcium	0.07	1.0	0.3	0.3	0.15	0.5	0.6	0.3	1	0.3
Iron	3	10	2	2	3	5	5	2	7	2.5
Magnesium	.3	2	1	.5	.5	.7	.5	.3	1	.3
Titanium	.5	1	1	.5	.5	1	.7	.3	.5	.4
PARTS PER MILLION (ppm)										
Barium	300	1,500	1,000	500	700	300	500	500	500	330
Beryllium	<1	1.5	1.5	2	1	1	1.5	<1	1.5	1
Boron	<10	15	<10	<10	10	<10	10	10	15	10
Chromium	70	150	100	70	50	70	50	20	100	50
Cobalt	10	30	20	10	15	10	20	7	15	15
Copper	10	70	50	20	20	15	20	7	20	20
Lanthanum	30	1,000	300	100	150	50	150	30	100	50
Lead	10	50	20	30	20	15	30	20	50	15
Manganese	300	1,500	700	700	500	1,000	2,000	300	1,500	550
Molybdenum	--	--	<5	<5	<5	<5	<5	<5	<5	<5
Nickel	10	50	15	15	20	20	20	10	20	30
Niobium	<10	50	15	<20	<20	<20	<20	<20	<20	20
Scandium	15	50	20	7	15	7	15	7	15	10
Strontium	<100	200	<100	<100	<100	100	200	<100	150	100
Thorium	--	--	--	<100	<100	<100	--	<100	<100	--
Tin	<10	--	<10	<10	<10	<10	<10	<10	<10	<10
Vanadium	70	200	100	50	100	100	100	50	100	70
Yttrium	30	500	100	70	70	50	70	30	50	30
Zinc	<200	--	<200	<200	<200	<200	<200	<200	<200	260
Zirconium	100	>1,000	1,000	700	700	500	300	500	300	400

PANNED CONCENTRATES

Element	BLOOD MOUNTAIN n=45 Low	High	Median	CR[7] n=41 Median	SN[8] n=139 Median	AR[1] n=12 Median	CM[2] n=10 Median	ER[3] n=76 Median	TM[10] n=78 Median
PERCENT									
Calcium	<0.1	0.3	0.15	0.15	0.2	0.3	0.07	0.5	0.2
Iron	.15	.7	.3	.7	.7	.5	2	15	.3
Magnesium	<.05	.2	.05	.1	.07	.2	.5	.15	.1
Titanium	<2	>2	>2	1.5	2	1.4	>1	>1	1.2
PARTS PER MILLION (ppm)									
Barium	<50	500	200	70	50	300	125	100	90
Beryllium	<2	2	<2	<2	<2	<2	<1	<1	--
Boron	<20	20	<20	<5	20	20	20	20	--
Chromium	30	500	250	70	100	50	200	100	80
Cobalt	<10	30	20	<10	<10	<10	7	15	20
Copper	--	--	<10	--	<10	<10	7	<5	20
Lanthanum	<50	>2,000	50	50	100	200	400	500	130
Lead	<20	100	20	20	<20	<20	<10	<10	45
Manganese	20	100	100	150	100	100	300	5,000	80
Molybdenum	--	--	40	<10	<10	<10	<10	<5	--
Nickel	<10	30	10	10	<10	<10	10	<5	30
Niobium	<50	1,500	300	100	<50	<50	25	50	70
Scandium	30	100	70	70	<10	<10	5	30	30
Strontium	<200	300	<200	<200	<200	200	<200	<100	--
Thorium	<100	1,500	<200	<200	<200	<200	--	<100	--
Tin	<20	70	<20	<20	<20	<20	<20	<10	--
Vanadium	150	1,000	500	200	70	100	200	150	90
Yttrium	200	1,500	700	700	100	500	50	700	600
Zinc	<500	1,000	<500	<500	<500	<500	<200	<200	650
Zirconium	>2,000	>2,000	>2,000	>2,000	>2,000	>2,000	600	>1,000	>2,000

ROCKS (GNEISS)

Element	BLOOD MOUNTAIN n=15 Low	High	Median	CR[7] n=10 Median	CM[2] n=16 Median	SN[8] n=148 Median	ER[3] n=10 Median	SR[5] n=37 Median	Average[6,9] sandstone
PERCENT									
Calcium	<0.5	2.0	1	0.3	0.7	0.5	1	1	3.9
Iron	5	15	10	5	2.5	3	5	5	.98
Magnesium	.2	3	1	1	.7	1	1	1	.7
Titanium	.3	7	.5	.3	.5	.5	.5	.5	.15
PARTS PER MILLION (ppm)									
Barium	100	1,500	700	1,000	500	500	700	1,000	300
Beryllium	1	3	2	2	1	1	1	1	2
Boron	<10	20	<10	<10	<10	10	<10	10	35
Chromium	70	200	100	100	30	30	60	50	35
Cobalt	<5	20	10	10	10	10	7	10	.3
Copper	<5	300	30	30	10	10	10	15	10-20
Lanthanum	20	200	50	150	30	50	50	50	7
Lead	<10	50	20	30	13	15	40	20	7
Manganese	100	1,000	500	500	700	700	500	700	500
Molybdenum	--	--	<5	<5	<5	<5	<5	<5	.2
Nickel	7	100	30	10	15	15	10	20	2
Niobium	<10	70	<20	<20	<20	<20	<20	<20	.0X[10]
Scandium	10	30	15	15	10	10	10	10	1
Strontium	<100	500	100	200	180	200	150	200	20
Thorium	--	--	<100	<100	--	--	<100	<100	5.5
Tin	<10	--	<10	<10	<10	<10	<10	<10	.X[10]
Vanadium	30	150	100	100	70	<100	85	100	20
Yttrium	10	150	70	50	30	50	20	30	10
Zinc	<200	300	<200	<200	<200	30	<200	<200	16
Zirconium	70	1,000	700	100	200	200	300	200	220

[1]AR--Anna Ruby Roadless Area (Lesure and others, 1987)
[2]CM--Craggy Mountain Wilderness Study Area (Lesure and others, 1982, p. 13-16)
[3]ER--Ellicott Rock Wilderness (Luce and others, 1985)
[4]TM--Tray Mountain Roadless Area (Koeppen and Nelson, 1988)
[5]SR--Shining Rock Wilderness (Lesure, 1981)
[6]Turekian (1977, p. 629)
[7]CR--Chattahoochee Roadless Area (Koeppen and Nelson, in press)
[8]SN--Southern Nantahala Wilderness (Peper and others, in press)
[9]Pettijohn (1963, p. S11)
[10]Order of magnitude (Turekian, 1977, p. 629)

REFERENCES

Grimes, D.J., and Marranzino, A.P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for semiquantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.

Hatcher, R.D., Jr., and Butler, J.R. (compilers), 1979, Guidebook for southern Appalachian field trip in the Carolinas, Tennessee, and northeastern Georgia, International Geological Correlation Program Project 27, The Caledonides in the U.S.A.: Raleigh, North Carolina Geological Survey, 117 p.

Koeppen, R.P., and Nelson, A.E., 1988, Geochemical survey of the Tray Mountain Roadless Area, northern Georgia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1347-B, scale 1:30,000.

____in press, Geochemical survey of the Chattahoochee Roadless Area, Towns, White, and Union Counties, Georgia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1502-B, scale 1:30,000.

Koeppen, R.P., Nelson, A.E., Armstrong, M.K., and Sabin, A.E., 1983, Mineral resource potential map of the Blood Mountain Roadless Area, Union and Lumpkin Counties, Georgia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1503-C, scale 1:30,000.

Lesure, F.G., 1981, Geochemical survey of the Shining Rock Wilderness, Haywood County, North Carolina: U.S. Geological Survey Miscellaneous Field Studies Map MF-1290-B, scale 1:48,000.

Lesure, F.G., D'Agostino, J.P., and Peper, J.D., 1987, Geochemical survey and mineral resource assessment of the Anna Ruby Roadless Area, White County, Georgia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1908-B, scale 1:48,000.

Lesure, F.G., Grosz, A.E., Williams, B.B., and Gazdik, G.C., 1982, Mineral resources of the Craggy Mountain Wilderness Study Area and extension, Buncombe County, North Carolina: U.S. Geological Survey Bulletin 1515, 27 p.

Luce, R.W., Bell, Henry, III, and Gazdik, G.C., 1985, Geochemical maps of the Ellicott Rock Wilderness and additions, South Carolina, North Carolina, and Georgia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1287-A, scale 1:48,000.

Motooka, J.M., and Grimes, D.J., 1976, Analytical precision of one-sixth order semiquantitative spectrographic analysis: U.S. Geological Survey Circular 738, 25 p.

Nelson, A.E., 1983, Geologic map of the Blood Mountain Roadless Area, Union and Lumpkin Counties, Georgia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1503-A, scale 1:30,000.

Nelson, A.E., and Gillon, K.A., 1985, Stratigraphic nomenclature in the Richard Russell and Helen thrust sheets, Georgia and North Carolina, *in* Stratigraphic notes, 1984: U.S. Geological Survey Bulletin 1605-A, p. A59-A62.

Nelson, A.E., Horton, J.W., Jr., and Clark, J.W., 1987, Generalized tectonic map of the Greenville 1° x 2° quadrangle, Georgia, South Carolina, and North Carolina: U.S. Geological Survey Miscellaneous Field Studies Map MF-1898, scale 1:250,000.

Peper, J.D., Lesure, F.G., Cox, L.A., and D'Agostino, J.P., in press, Geology, geochemistry, and mineral resource assessment of the southern Nantahala Wilderness and adjacent roadless areas, Rabun and Towns Counties, Georgia, and Clay and Macon Counties, North Carolina: U.S. Geological Survey Bulletin 1883.

Pettijohn, F.J., 1963, Chemical composition of sandstones, excluding carbonate and volcanic sands, *in* Fleischer, Michael, ed., Data of geochemistry, sixth edition: U.S. Geological Survey Professional Paper 440-S, p. S1-S21.

Siems, D.F., Forn, C.L., Koeppen, R.P., and Nelson, A.E., 1988, Analyses and descriptions of geochemical samples, Tray Mountain Wilderness, Chattahoochee Roadless Area, and Blood Mountain Wilderness, northeastern Georgia: U.S. Geological Survey Open-File Report 88-563, 50 p.

Turekian, K.K., 1977, Geochemical distribution of the elements, *in* McGraw-Hill encyclopedia of science and technology, 4th edition: New York, McGraw Hill, Inc, v. 4, p. 627-630.

GEOCHEMICAL SURVEY OF THE BLOOD MOUNTAIN ROADLESS AREA, UNION AND LUMPKIN COUNTIES, GEORGIA

By
Robert P. Koeppen and Arthur E. Nelson

1989

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