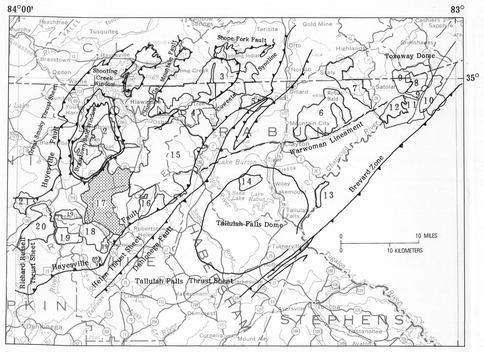


Base from U.S. Geological Survey, 1:500,000
State maps of North Carolina (1957, revised 1972) and Georgia (1962)

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 Chattahoochee 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).

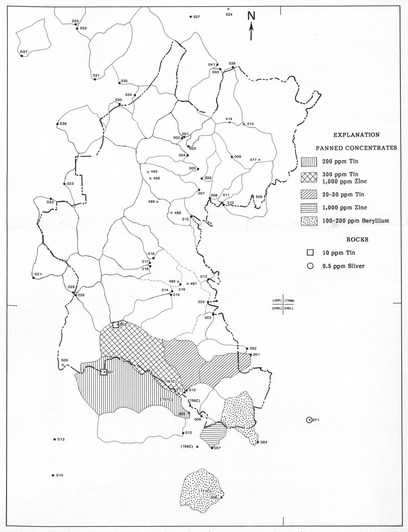
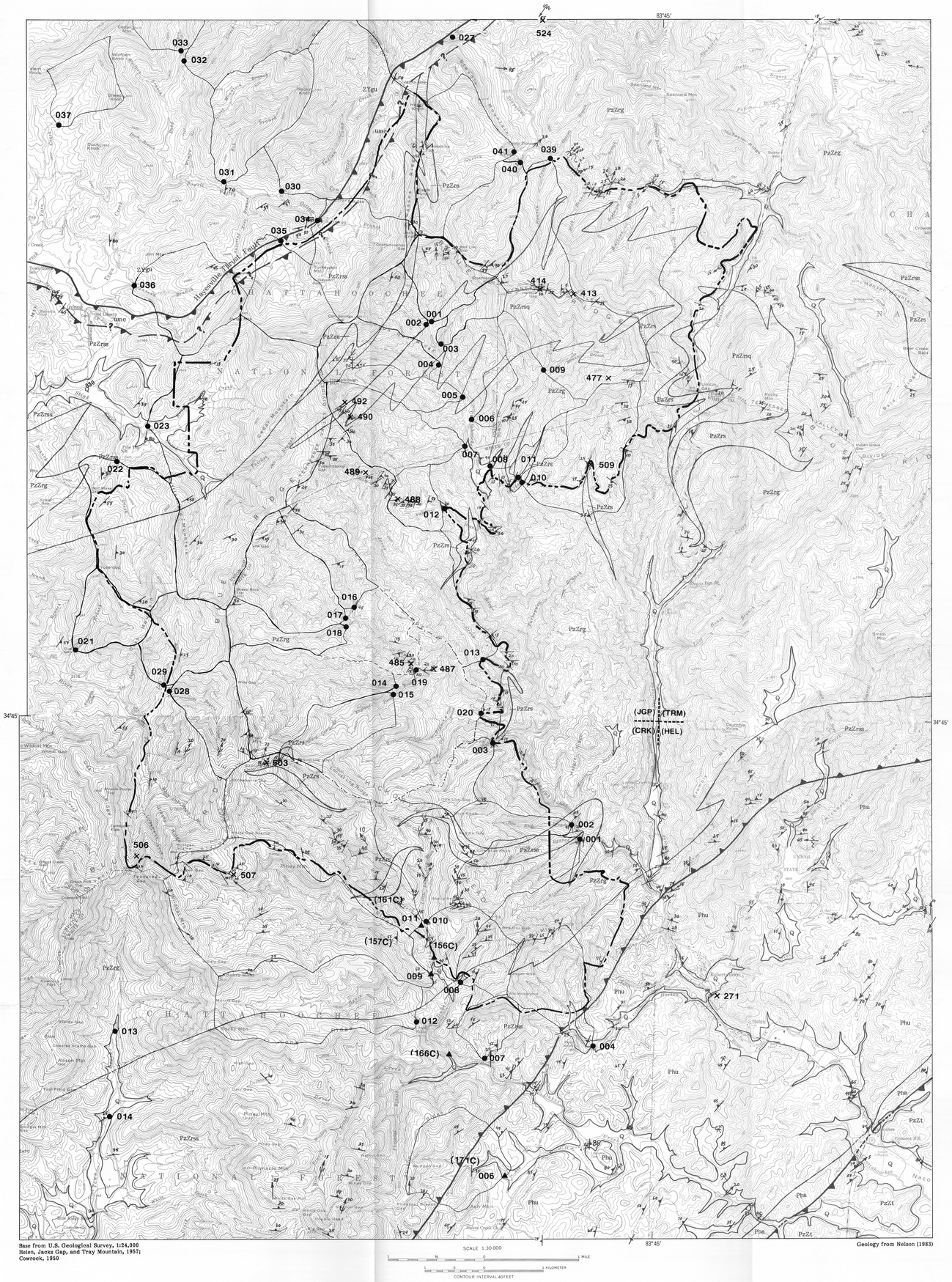


Figure 3.--Map of stream drainage basins with high concentrations of tin, zinc, and beryllium in nonmagnetic fractions of refined panned-concentrate samples of alluvial gravels, and of rocks with anomalous tin or silver. See figure 2 for explanation of other symbols used.



Base from U.S. Geological Survey, 1:24,000
Helen, Jacks Gap, and Tray Mountain, 1957;
Cowrock, 1950

Geology from Nelson (1983)

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

EXPLANATION
(For detailed descriptions of geologic map units, see Nelson, 1983)

- Q — Quaternary deposits--Unconsolidated colluvium and alluvium. Coarse bouldery and cobbly gravels, sand, and clay
- Unnamed lower Paleozoic and (or) Late Proterozoic assemblage informally called the "Richard Russell group"
- PzZrg — Biotite gneiss, metasandstone, biotite schist, muscovite-biotite schist, hornblende gneiss and amphibolite, calc-silicate layers, minor gabbroic granite, granite gneiss
- PzZrss — Metasandstone, biotite gneiss, biotite schist, muscovite-biotite schist, hornblende gneiss, amphibolite
- PzZrsq — Feldspathic quartz-rich metasandstone
- PzZrs — Biotite schist, muscovite-biotite schist, metasandstone, biotite gneiss, granite gneiss
- PzZra — Amphibolite
- PzZt — Tallulah Falls Formation--Alternating sequence of migmatitic impure metasandstone and graywacke, biotite gneiss, biotite schist, and amphibolite
- ZYgu — Undivided Late Proterozoic rocks of Great Smoky thrust sheet exposed in window through Hayesville thrust sheet--Metasandstone and mica schist
- Phu — Helen belt rocks (Proterozoic)--Metasandstone and mica schist
- ume — Ultramafic-mafic complex (age uncertain)
- Approximate boundary of roadless area
- Contact--Approximately located. Dashed where concealed
- Thrust fault--Approximately located. Sawteeth on upper plate. Dashed where concealed; queried where probable
- Strike and dip of layering and foliation
- Strike and dip of foliation
- Inclined
- Vertical
- Horizontal
- Strike and dip of cleavage
- 20 — Bearing and plunge of lineation
- 15 — Minor synform showing plunge of axis
- 15 — Minor antiform showing plunge of axis
- Minor fold showing plunge of axis
- Abandoned quarry
- Abandoned sand and gravel pit
- Prospect
- Mine
- Abandoned mine
- 004 — Outline of drainage basin--Dashed lines indicate greater order drainage basins. Dot indicates U.S. Geological Survey stream-sediment sample location. Triangle and numbers in parentheses indicate resampled basins (see text). Stream-sediment sample number should be prefixed with CRK for samples collected in the Cowrock quadrangle part of the study area, HEL for those in the Helena quadrangle, JGP for those in the Jacks Gap quadrangle, and TRM for those in the Tray Mountain quadrangle. See dashed lines on map indicating quadrangle boundaries.
- ×467 — Rock sample locality

Ultramafic-mafic rocks.--A wide variety of ultramafic-mafic rocks are present in the southern Blue Ridge Mountains as larger mappable units and as small discontinuous pods (Hadley and Nelson, 1971). The mafic-ultramafic rocks that are present near the northwest border of the study area along the northeast-trending Hayesville fault (Nelson, 1983) are now recognized as part of the Young Harris thrust slice. This slice separates the Richard Russell thrust sheet from underlying rocks of the Great Smoky Group (Nelson and others, 1987). These rocks are chiefly serpentinite, dunite, pyroxenite, gabbro, and amphibolite (Hartley, 1973). Locally, some of the rocks are rich in magnetite, corundum, and rutile. Ultramfic rocks also are exposed along the regional strike to the northeast of the roadless area. They may be locally present below or within the Richard Russell thrust sheet within the study area.

Iron and manganese

A single nonmagnetic fraction of a panned-concentrate sample from a stream in the central part of the area contained 20 percent iron and 10,000 parts per million (ppm) manganese, concentrations which are anomalous for both these metals. Analyses of additional samples collected from this locality, however, showed no enrichment for either iron or manganese. None of the rock samples from the area contained an unusually high abundance of these metals. Because we do not know the source of this anomaly, and could not duplicate it in subsequent sampling, we consider that it does not indicate a significant resource of iron or manganese.

Silver

Silver was detected spectrographically in two rock samples: a metasandstone from Horsetrough Mountain near the center of the roadless area (sample N492 on figure 3) and a schist from the Helen Group, several miles east of the area (sample N271 on figure 3). The silver-bearing sample from within the study area is anomalous because of the absence of detectable silver in other rock samples from within the area. An isolated occurrence of silver also has been reported in stream sediments along the boundary with the adjacent Tray Mountain Wilderness (Koeppen and Nelson, 1988). Silver was not detected in any other samples from the area. The significance and source of these dispersed silver anomalies is not known or understood, but do no indicate significantly mineralized rock.

Tin and zinc

Tin was detected in both heavy-mineral panned-concentrate and rock samples from the area. Panned concentrate samples (CRK009 and CRK011, table 2 and figure 3) from drainage basins along the southern border of the roadless area contain 300 and 200 ppm of tin, respectively; sample CRK009 also contains 1,000 ppm of zinc. Samples from several other nearby streams contained lower values for tin and higher values for zinc. These were the elements that showed the most well-defined distribution within the roadless area. Some samples also showed slight enrichments of lead (50-150 ppm). Resampling from these streams in 1985 also identified anomalous levels of tin (70-700 ppm) and zinc (500-1,000 ppm) (table 2 and figure 3). The tin occurs in the nonmagnetic fraction of the panned-concentrate samples, thus suggesting that the occurrence is in the form of cassiterite and not as a solid-solution component of magnetite. Only one rock sample (N503), a mica schist, contains detectable amounts of tin (10 ppm). This single tin-bearing rock sample came from the same catchment from which tin-enriched panned-concentrate samples were retrieved. The high tin content identified in the initial sampling was reproduced during resampling. This suggests that the high values probably were not a result of any analytical bias; the tin levels for all other samples from the roadless area were below the limit of determination. The clustering of tin values in the southern part of the roadless area may reflect a possible stratigraphic or structural control. Tin occurs sporadically in stream sediments derived from the Richard Russell Formation rocks (Koeppen and Nelson, 1988; Siems and others, 1988), but a source of these scattered anomalies is not known. Anomalous generally low tin values (15-30 ppm) have been identified elsewhere in the Richard Russell Formation in calc-silicate lenses (Peper and others, in press). Visible evidence of any tin mineralization in the area is not present. Therefore, these anomalous values for tin in the Chattahoochee Roadless Area are unlikely to be indicators of signifiecant economic mineralization.

Beryllium

Panned-concentrate samples from Ash Creek (CRK004) and Horton Creek (CRK006) (fig. 3) at the southeast edge of the roadless area contain 100 and 200 ppm beryllium, respectively. Both streams were resampled, but only the sample from Ash Creek (GCO2117C) produced an anomalous beryllium concentration of 10 ppm. Sheared granite and granite pegmatite occur within these stream drainages, but samples of these rocks, and all other rock samples from the study area, contained no significant beryllium (1-3 ppm). The Helen pegmatite district, located approximately 10 km to the northeast, was identified by W.R. Griffitts (1960, written commun.) as a beryllium prospective area, but we have been unable to find reports of either gemstone beryl occurrences or beryl production from this district. The absence of identified beryllium enrichment in other samples from the area indicates that the beryllium in these three panned-concentrate samples is anomalous. Although beryl mineralization is commonly associated with pegmatites, the abundant pegmatite pods and dikes in this area yielded no beryl occurrences. The source of the beryllium is not known. The available data indicate that there is little or no potential for beryllium resources in the Chattahoochee Roadless Area.

CONCLUSIONS

A few heavy-mineral panned-concentrate and several rock samples contained low, though anomalous, concentrations of certain trace metals. Anomalous concentrations of trace metals were identified in panned-concentrate samples from streams clustered near one another near the southwest corner of the area: one contains 300-700 ppm tin, three others contain 70-100 ppm tin, and several contain 500-1,000 ppm zinc. The rock samples yielded anomalous tin and silver. A mica schist sample from the same catchment where an anomalous tin-enriched panned-concentrate sample also was collected contains 10 ppm tin. A metasandstone sample contained a low concentration of silver. Several stream-sediment samples from along or near the southern boundary of the area contain low to moderate levels of beryllium; resampling confirmed the presence of beryllium although at much lower intensity than the original sampling. These anomalous metal concentrations could be related to low-grade mineralizing processes; if so, it seems unlikely that the results of these processes would be deposits of significant size or of economic importance. Further investigation involving a more thorough and detailed geochemical sampling design would be required to corroborate and determine the significance of the anomalous trace-element concentrations reported here. The available geochemical data indicate that these dispersed geochemical anomalies represent only isolated minor mineral occurrences and that there is little, if any, potential for signifiecant metallic mineral resources in the Chattahoochee Roadless Area.

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.

Hadley, J.B., and Nelson, A.E., 1971, Geologic map of the Knoxville Quadrangle, North Carolina, Tennessee, and South Carolina: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-654, scale 1:250,000.

Hartley, M.E., III, 1973, Ultramafic and related rocks in the vicinity of Lake Chatuge: Georgia Geological Survey Bulletin 85, 61 p.

Hatcher, R.D., Jr., 1978, Tectonics of the western Piedmont and Blue Ridge, Southern Appalachians; review and speculation: American Journal of Science, v. 278, no. 3, p. 276-304.

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.

Koeppen, R.P., and Nelson, A.E., in press, Geochemical survey of the Blood Mountain Raodless Area, Union and Lumpkin Counties, Georgia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1503-B.

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., 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 Ellicot 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 Chattahoochee Roadless Area, Towns, Union, and White Counties, Georgia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1502-A, scale 1:30,000.

_____1985, Major tectonic features and structural elements in the northwest part of the Greenville Quadrangle, Georgia: U.S. Geological Survey Bulletin 1643, 22 p.

Nelson, A.E., Koeppen, R.P., Welsh, R.A., Jr., and Mikolajczyk, R.W., 1983, Mineral resource potential map of the Chattahoochee Roadless Area, Towns, Union, and White counties, Georgia: U.S. Geological Survey Miscellaneous Field Studies Map MF-1502-C, scale 1:50,000.

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.

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.

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 88-663, 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.

Ward, F.N., Nakagawa, H.M., Harms, T.F., and Van Sickle, G.H., 1969, Atomic-absorption methods of analysis useful in geochemical exploration: U.S. Geological Survey Bulletin 1289, 45 p.

Williams, Harold, 1978, Tectonic lithofacies map of the Appalachian orogen: St. Johns, Memorial University of Newfoundland, scale 1:1,000,000.

Table 1.--*Statistical summary of geochemical data for the Chattahoochee 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									PANNED CONCENTRATES								ROCKS (GNEISS)							
	CHATTAHOOCHEE			AR[1]	BM[7]	SN[8]	CM[2]	ER[3]	SR[5]	TM[4]	CHATTAHOOCHEE			SN[8]	AR[1]	CM[2]	ER[3]	TM[4]	CHATTAHOOCHEE			BM[7]	CM[2]	SN[8]	ER[3]	SR[5]	Average[6,9] sandstone
	n=51			n=19	n=57	n=171	n=30	n=103	n=94	n=87	n=41			n=139	n=12	n=10	n=76	n=78	n=10			n=15	n=16	n=148	n=10	n=37	
Element	Low	High	Median	Median	Median	Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	
	PERCENT										PERCENT								PERCENT								
Calcium	0.05	0.5	0.15	0.3	0.3	0.5	0.6	0.3	1	0.3	0.1	1.5	0.15	0.2	0.3	0.07	0.5	0.2	0.15	2	0.3	1	0.7	0.5	1	1	3.9
Iron	2	7	3.	2	2	5	5	2	7	2.5	.1	20	.7	.7	.5	2	15	.3	1	7	5	10	2.5	3	5	1	5	.98
Magnesium	.1	1.5	.5	.5	1	.7	.7	.2	1	.3	.05	2	.1	.07	.2	.5	.15	.1	.3	1.5	1	1	.7	1	1	1	.7
Titanium	.2	1	.5	.5	1	1	.7	.3	.5	.4	.7	2	1.5	2	1.4	>1	>1	1.2	.03	2.0	.3	.5	.5	.5	.5	.5	.15
	PARTS PER MILLION (ppm)										PARTS PER MILLION (ppm)								PARTS PER MILLION (ppm)								
Barium	150	2,000	700	500	1,000	300	500	500	700	330	<50	300	70	50	300	125	100	90	500	1,500	1,000	700	500	500	700	1,000	300
Beryllium	<1	2	1	2	1.5	1	1.5	<1	1.5	1	<2	200	<2	<2	<2	<1	<1	--	1	7	2	2	1	1	1	1	2
Boron	<10	200	10	<10	<10	<10	10	10	15	10	<20	150	<5	20	20	20	20	--	<10	10	<10	<10	<10	10	<10	10	35
Chromium	20	70	50	70	100	70	50	20	100	50	<20	300	70	100	50	200	100	80	10	1,500	100	100	30	30	60	50	35
Cobalt	7	30	15	10	10	20	7	15	15	15	<20	20	<10	<10	<10	7	15	20	<5	15	10	10	10	10	7	10	.3
Copper	<5	50	20	20	50	15	20	7	20	20	--	--	--	<10	<10	7	<5	20	7	100	30	30	10	10	10	15	10-20
Lanthanum	20	500	150	100	300	50	150	30	100	50	<50	2,000	50	100	200	400	500	130	<20	200	150	50	30	50	50	50	7
Lead	<10	70	20	30	30	20	15	30	20	50	<20	150	20	<20	<20	<10	<10	45	20	70	30	20	13	15	40	20	7
Manganese	200	1,000	500	700	700	1,000	2,000	300	1,500	550	<50	10,000	150	100	100	300	5,000	80	30	700	500	500	700	700	500	700	500
Molybdenum	<5	--	--	<5	<5	<5	<5	<5	<5	<5	--	--	--	<10	<10	<10	<5	--	<5	<5	<5	<5	<5	<5	<5	<5	.2
Nickel	5	30	20	15	15	20	10	20	10	20	<10	50	10	<10	<10	10	<5	30	7	30	10	30	15	15	10	20	2
Niobium	<20	30	<20	<20	15	<20	<20	<20	<20	20	<50	700	100	<50	<50	25	50	70	<20	--	<20	<20	<20	<20	<20	<20	.0x[10]
Scandium	5	20	15	7	20	7	15	7	15	10	<20	300	70	<10	<10	5	30	30	<5	20	15	15	10	10	10	10	1
Strontium	<100	150	<100	<100	<100	100	200	<100	150	100	<200	300	<200	<200	200	<200	<100	--	<100	300	200	100	100	200	150	200	20
Thorium	<100	--	<100	<100	--	<100	--	<100	<100	--	--	--	<200	<200	<200	--	<100	--	<10	--	<10	<10	<10	<10	<10	<10	.x[10]
Tin	<10	--	<10	<10	<10	<10	<10	<10	<10	<10	<20	300	<20	<20	<20	<20	<10	--	<100	--	<100	<100	--	--	<100	<100	5.5
Vanadium	30	150	100	50	100	100	100	50	100	70	50	500	200	70	100	200	150	90	10	150	100	100	70	<100	85	100	20
Yttrium	15	150	70	70	100	50	70	30	50	30	70	2,000	700	100	500	50	700	600	<10	70	50	70	30	50	20	30	10
Zinc	<200	--	<200	<200	<200	<200	<200	<200	<200	260	<500	1,000	<500	<500	<500	<200	<200	650	<200	200	<200	<200	30	<200	<200	<200	16
Zirconium	100	>1,000	700	700	1,000	500	300	500	300	400	2,000	<2,000	>2,000	>2,000	>2,000	600	>1,000	>2,000	<10	500	100	700	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]BM--Blood Mountain 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)

Table 2.--*Partial analyses from the Chattahoochee Roadless Area. Tin, zinc, beryllium, and silver are spectrophotometrically determined. Analysis by D.E. Detra.*

SAMPLE NO.	TIN	ZINC	BERYLLIUM	SILVER
	PANNED CONCENTRATES			
GCO2156C	70	500	L(2)	N(1)
GCO2157C	700	N(500)	L(2)	N(1)
GCO2161C	70	700	L(2)	N(1)
GCO2168C	100	L(500)	L(2)	N(1)
GCO2171C	0	L(500)	10	N(1)
CRK004C	0	N(200)	100	N(.5)
CRK006C	0	N(200)	200	N(.5)
CRK009C	200	1,000	3	N(.5)
CRK011C	300	0	3	N(.5)
	ROCKS			
N492R	N(10)	200	2	.5
N503R	10	200	1	N(.5)
N271R	N(10)	N(200)	7	.5

Richard Russell thrust sheet.--Most of the Chattahoochee Roadless Area is underain by rocks of the Richard Russell Formation (Nelson and Gillon, 1985, p. A61). This rock assemblage includes polydeformed, highly migmatitic biotite gneiss, biotite schist, fine-grained biotite-feldspar gneiss, metasandstone, amphibolite, hornblende gneiss, granite gneiss, discontinuous pegmatite veins and pods of varying size, and many irregular granitic masses. Sillimanite, though widely distributed, generally occurs in rocks with a low muscovite content.

Helen thrust sheet.--Although rocks of the Helen thrust sheet do not occur at the surface within the Chattahoochee Roadless Area, they are exposed less than 330 ft from the southeast border of the study area. Rocks in the thrust sheet include metagraywacke, quartzite, graphite-bearing garnet-muscovite-biotite schist, biotite-feldspar metasandstone, and pegmatite veins and pods. The metasandstone is locally conglomeratic and interlayered with thin beds of muscovite schist. Thin to thick layers of amphibolite also are present.

GEOCHEMICAL SURVEY OF THE CHATTAHOOCHEE ROADLESS AREA, TOWNS, UNION, AND WHITE COUNTIES, GEORGIA

By
Robert P. Koeppen and Arthur E. Nelson

1989

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey (USGS) and U.S. Bureau of Mines (USBM) to survey certain areas of Federal Lands to determine what mineral resource potential, if any, might be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geochemical survey of the Chattahoochee Roadless Area. (U.S. Forest Service no. 08-029) in the Chattahoochee National Forest, Union, Towns, and White 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 made a reconnaisance geochemical survey of Chattahoochee Roadless Area (fig. 1) to search for unexposed mineral deposits which might be recognized by a geochemical signature in the abundance or distribution patterns of trace elements. As part of a regional geochemical reconnaissance, M. Hurst (University of Georgia) collected 51 fine-grained stream-sediment samples and 45 panned-concentrate samples of alluvial gravels in the Chattahoochee study area (see figure 1). A.E. Nelson, in conjunction with detailed geologic mapping (Nelson, 1983), collected 10 rock-chip samples for geochemical analysis in addition to a large number of hand specimens for thin-section study. In order to evaluate isolated anomalies indicated by the earlier sampling, R.P. Koeppen, D.M. Sutphin, and P.D. Schruben collected several additional panned-concentrate, stream-sediment, and rock samples from the area in 1986. Both the geologic study by Nelson (1983) and this geochemical survey provide the basis for our mineral-resource assessment of the Chattahoochee Roadless Area (Nelson and others, 1983).

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 (or) by pan concentrating the heavy minerals in alluvial gravels from the active stream channels. Rock-chip samples representative of the major lithologic units in the area also were collected for geochemical study.

Fine-grained stream sediments 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 a hand magnet to remove most magnetite. The remaining mineral was then split into magnetic and nonmagnetic fractions on a Frantz isodynamic separator, some at a setting of 1.0 amp, and some at settings of 0.5 and 1.0 amp. The two fractions were crushed and pulverized to minus 140-mesh and analyzed. Rock chips were similarly pulverized.

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 forth. The 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 data are reported in Siems and others (1988). Locations of samples and associated drainage basins are shown in figure 2. A statistical study is given in table 1. Partial geochemical data for selected samples discussed in the text is given in table 2.

DISCUSSION

Our reconnaissance geochemical survey of the Chattahoochee Roadless Area found trace-metal enrichment in panned concentrates and one rock sample. In this survey, no metallic mineral deposits were found. However, slightly enriched trace-metal levels were identified in a number of samples. Geochemical data for six elements (iron, manganese, silver, tin, zinc, and beryllium) show a few high concentrations in either stream-sediment or rock samples. Although the study area is located immediately adjacent to the Dahlonega gold belt, none of our geochemical samples contained detectable amounts of gold. The few anomalous metal concentrations found do not indicate the presence of mineral deposits. The sources of local concentrations of trace elements is not known. The geochemical data for the trace-element-enriched samples are discussed individually in the following section:

Geologic Setting

Metamorphic rocks of three major lithotectonic units form part of Blue Ridge Mountains in the southern Appalachians. They are the Great Smoky thrust sheet, the Richard Russell thrust sheet, and the Helen thrust sheet (Nelson, 1983; Nelson and Gillon, 1985; Nelson and others, 1987). Almost all of the exposed rocks in the Chattahoochee Roadless Area are part of the Richard Russell thrust sheet with the exception of a relatively narrow band of mafic and ultramafic rocks that occurs along the northwest boundary of the study area. The Richard Russell thrust sheet in the study area is underlain immediately to the northwest by rocks of the Great Smoky thrust sheet and on the southeast by rocks of the Helen thrust sheet. The Richard Russell and Great Smoky thrust sheets are separated by the southeast-dipping Hayesville fault (Hatcher and Williams, 1978; Nelson and Gillon, 1985).

Manuscript approved for publication December 29, 1988

Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government

INTERIOR--GEOLOGICAL SURVEY, RESTON, VA--1989

For sale by U.S. Geological Survey Map Distribution, Box 25286, Federal Center, Denver, CO 80225