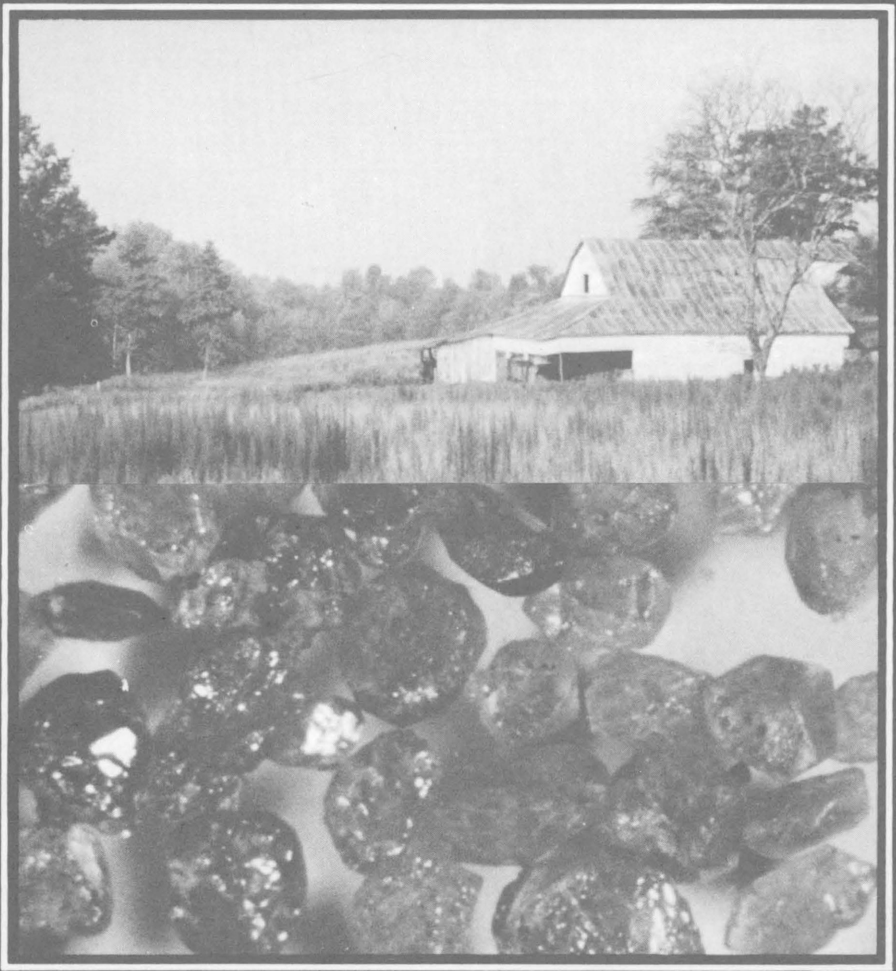

Cassiterite Occurrences in the Shelby Area, North and South Carolina

U.S. GEOLOGICAL SURVEY BULLETIN 1569

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By John P. D'Agostino and Jesse W. Whitlow

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ILLUSTRATION

Photographs by Deborah Dwornik

CASSITERITE OCCURRENCES IN THE SHELBY AREA, NORTH AND SOUTH CAROLINA

By JOHN P. D'AGOSTINO and JESSE W. WHITLOW

ABSTRACT

Coarse-grained cassiterite was identified and an abundant amount panned in Hawkins Branch, 10 km southwest of Shelby, N.C., in September 1978. Since then, coarse-grained cassiterite has been found in appreciable quantities in alluvium at 37 stream sites in an open-ended zone about 35 km long by 30 km wide southwest of Shelby. Most of the zone is between Shelby and Forest City, N.C., and extends southward to the vicinity of Cowpens, S.C. Many of the cassiterite sites are streams in the vicinity of Hawkins Branch where much prospecting was done.

The cassiterite grains are mostly 0.16 to 1.0 cm in diameter, the largest being 2.5 cm. Most grains are black or brown, although some are purple-red, gray-green, gray-white, and yellow. They are vitreous and either opaque or translucent. Some of the darker cassiterite grains are elongated and foliated nodules that seem to be of pretectonic origin whereas the light-colored cassiterite grains are about equilateral and undistorted. The stream occurrences of coarse cassiterite are associated with the uppermost appearance (or highest elevation) of bedrock in the stream course. Cassiterite was not found in samples of regolith soils or fresh bedrock. Soils are mostly thin, not exceeding 2 m in thickness. Bedrock is mostly Late Proterozoic to early Paleozoic biotite gneiss, muscovite schist, and amphibolite with many small masses of granite and Cambrian and Early Ordovician age Toluca Granite and granite of Sandy Mush. The stream-sediment samples were taken as a part of the U.S. Geological Survey's CUSMAP (Conterminous United States Mineral Appraisal Program) which evaluates the mineral potential in selected $1° \times 2°$ quadrangles. Cassiterite peaks were found in X-ray analysis of several associate supergene minerals.

INTRODUCTION

Cassiterite was first noticed in Hawkins Branch, Cleveland County, N.C., in September 1978 by Jesse W. Whitlow, who was doing reconnaissance stream-sediment sampling for the U.S. Geological Survey in the Charlotte $1° \times 2°$ quadrangle. The Charlotte $1° \times 2°$ quadrangle is part of CUSMAP, the U.S. Geological Survey's Conterminous United States Mineral Appraisal Program, which evaluates the mineral potential of selected quadrangles.

Hawkins Branch (locally named Meadow Creek) is 3.5 km long and is a south-flowing tributary of Beaverdam Creek which flows into First Broad River. At midcourse, Hawkins Branch is about 10 km southwest of Shelby, N.C., and 16 km north of Gaffney, S.C. It is about 2.5 km west of the tin-spodumene zone of the Kings Mountain Belt which lies between the Inner Piedmont Belt and Charlotte Belt (Kesler, 1942; King, 1955). Although the tin-spodumene zone is reported as part of the Kings Mountain Belt and is associated with the Mississippian Cherryville Granite, most of the tin mines, prospects, and occurrences lie between the Kings Mountain Belt and the Cherryville Granite (fig. 1) of the Inner Piedmont Belt. Some of the tin workings, including those in a small outlier pluton of Cherryville Granite, are within 2 km of the western border of the Kings Mountain Belt. The Kings Mountain Belt is composed of Late Proterozoic to Cambrian sericite phyllite or sericite schist containing minor beds of marble, quartzite, conglomerate, amphibolite, and manganiferous schist, and a small pluton of middle Paleozoic granite (Stuckey, 1965; Goldsmith and others, in press).

HISTORY

Cassiterite was first found in the city of Kings Mountain, N.C., in 1881 by Robert T. Claywell. It was identified in 1883 by W. E. Hidden or in 1884 by Dr. C. W. Dabney. In 1894, the vertical mine shaft of the Kings Mountain Mineral and Development Company struck considerable cassiterite in decomposed rock at 13 m; cassiterite was not found, however, in fresh rock, which was worked to a depth of 43 m before being abandoned. Graton (1906) listed 36 mines and prospects of which the Ross mine and adjacent placer at Gaffney, S.C., worked from 1903 until 1905, were the major producers of cassiterite. About 40 tons of cassiterite were produced from the placer, and about 90 tons of concentrate averaging 2 percent tin was produced from underground mining (Graton, 1906; Kesler, 1942).

The deepest working was at the Jones mine, which was 11 km northeast of the city of Kings Mountain, N.C., and had a vertical shaft of 58 m. The last tin mining effort was in 1941 when the Atlas Collapsible Tube Company of Chicago reopened the old Faires mine near the city of Kings Mountain (Kesler, 1942).

A total of 56 tin mines, prospects, and occurrences have been located along the western boundary of the Kings Mountain Belt. Fifty-four of the workings are in North Carolina; two are in South Carolina.

Probably all tin diggings are on pegmatites which generally contain appreciable amounts of spodumene and beryl. The two workings in South Carolina are the Ross mine and adjacent placer and the J. W. Perry tin mine at Gaffney. From Gaffney north-northeast for 24 km to the North Carolina border, no tin prospects are known though the geology is similar to that of the tin-bearing Gaffney area. Extending north-northeast 37 km from the North Carolina border are 47 known tin mines and prospects, and seven tin occurrences. Production figures are lacking, and published sources indicate mines produced only minor amounts of cassiterite.

Prospecting of the pegmatites for spodumene has been successful, and since 1951 several million tons of spodumene have been produced from a few large open pits. The spodumene-beryl-tin mines and prospects are in a broad zone of huge pegmatites, individually hundreds of meters wide, thousands of meters long, and proven by drill cores to be more than 100 m deep (Stuckey, 1965). The pegmatites are within a biotite gneiss and muscovite schist unit of late Proterozoic to early Paleozoic age. The pegmatite zone is located between the Kings Mountain Belt of metasedimentary beds and igneous bodies of Late Proterozoic to Paleozoic age on the east and the major plutons, stocks, and stringers of the Mississippian Cherryville Granite on the west (Goldsmith and others, in press).

Unlike the cassiterite, which is quite rare and brownish-black and brecciated (probably of pretectonic origin), the spodumene is commonly in large light-green crystals 15–30 cm long and undistorted (probably of post-tectonic origin). W. R. Griffitts (1954) stated that the typical ore contains 20 percent spodumene, 0.4 percent beryl, and 0.024 percent cassiterite.

Geochemical surveys of stream sediment samples by Overstreet and others (1968) and by Theobald and others (1967) listed tin values for stream sediments in the Shelby area. Cassiterite was not identified in these studies. The sampling procedure during that work was to use a number 80 mesh screen and discard all larger size material, a method that failed to recover cassiterite.

PROCEDURES

Sieves were not used in this study; all samples, including soils, were panned as bulk. Mineral identification of the lag concentrate was by microscope, X-ray diffraction, and electronmicroprobe. Sampling of the Hawkins Branch areas was done by John P. D'Agostino and Jesse W. Whitlow in the summers of 1979 and 1980, and of the area of the southwestern Charlotte $1^\circ \times 2^\circ$ quadrangle by Jesse W. Whitlow in the summer and fall of 1981. For Hawkins Branch, some of its tributaries, and some neighboring streams, the panning sites were spaced from stream mouth to stream source so as to locate cassiterite placers. At each stream site the material that filled a 14-inch-diameter pan was worked; approximately one pan-full equals 0.5 percent of a cubic meter.

MODE OF CASSITERITE OCCURRENCES

During the panning for cassiterite in the area southwest of Shelby, cassiterite placers were found to occur in discontinuous bodies along headwaters of streams. The placers occur in the streams below the point where stream banks and bottoms are saprolite and above the point where stream banks and bottoms are fresh bedrock. The placers also occur where the stream bottoms are on fresh rock and the stream banks are saprolite.

On large-scale topographic maps, most cassiterite placers plot in stream valleys in headwater areas having closely spaced contours just below widely spaced contours of nearly level interfluvial uplands. Cassiterite was found in resampling the stream adjacent to the Ross tin mine and placer at Gaffney, S.C., by panning stream sediment in the interval between fresh bedrock and saprolite. Cassiterite was not found in previous panning attempts when samples were taken upstream where the stream is only in saprolite.

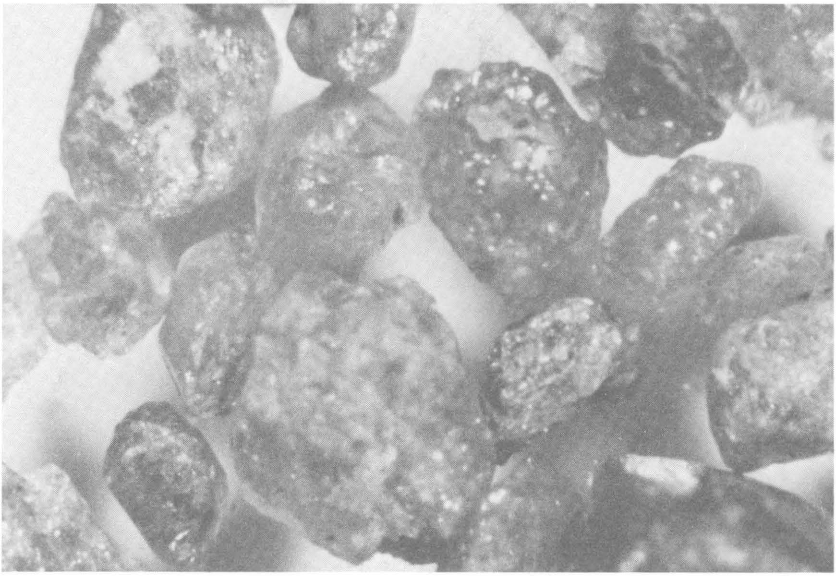
The cassiterite-bearing areas are underlain by bedrock of Late Proterozoic to Cambrian biotite gneiss, muscovite schist, sillimanite schist, amphibolite, and minor layers of calc-silicate rock, quartzite and metaconglomerate, and many small masses of granite and pegmatite (Goldsmith and others, in press). Intrusive into the rocks are numerous plutons, stocks, and stringers of Cambrian and Early Ordovician Toluca Granite. The Toluca is a massive, medium-gray, gneissic granite in which garnet is a common constituent and in which small yellowish crystals of monazite are often seen as an accessory mineral.

CASSITERITE IN HAWKINS BRANCH

About 15 kg of very coarse to fine-grained cassiterite was taken from Hawkins Branch at one stream site during a panning exhibition for property owners. The material was taken from a gravel stream bar about 10 m long, 3 m wide, and 8–23 cm thick overlying oxidized to fresh bedrock. The stream bar consisted mostly of coarse gravels, with some cobbles, fine gravels, and sands.

Most placer cassiterite grains taken from Hawkins Branch are 0.16 to 1.0 cm in diameter, many are about 1.7 cm in diameter, and the largest are about 2.5 cm in diameter. Most grains are black or brown, though shades of purple-red, gray-green, gray-white, and honey-yellow are also common. In tin mining, the black and brown cassiterite grains are known as "black tin," the purple-red as "ruby tin," the honey-yellow as "rosin tin," and the gray-white as "colorless." The grains are vitreous, either opaque or translucent. Some of the larger grains are agglomerates, composed of small individual grains of different shades of color. Many smaller individual grains abruptly show both dark and light shades of color without apparent cause. Lighter or white cassiterite has been reported to have the least impurities; however, only a trace of iron or tungsten can cause a very black color, and arsenic can cause a yellow color. Some of the darker cassiterite grains are elongated and strongly foliated nodules that may be of pretectonic origin. Most of the lighter colored cassiterite appears massive and undistorted, with sides of equal dimensions, and may be of post-tectonic origin.

Most cassiterite grains appear chipped and flaked, especially those that are foliated. The susceptibility of the cassiterite grains to flaking may help explain their smaller size and their lesser concentration downstream from placers; that is, it seems the cassiterite grains



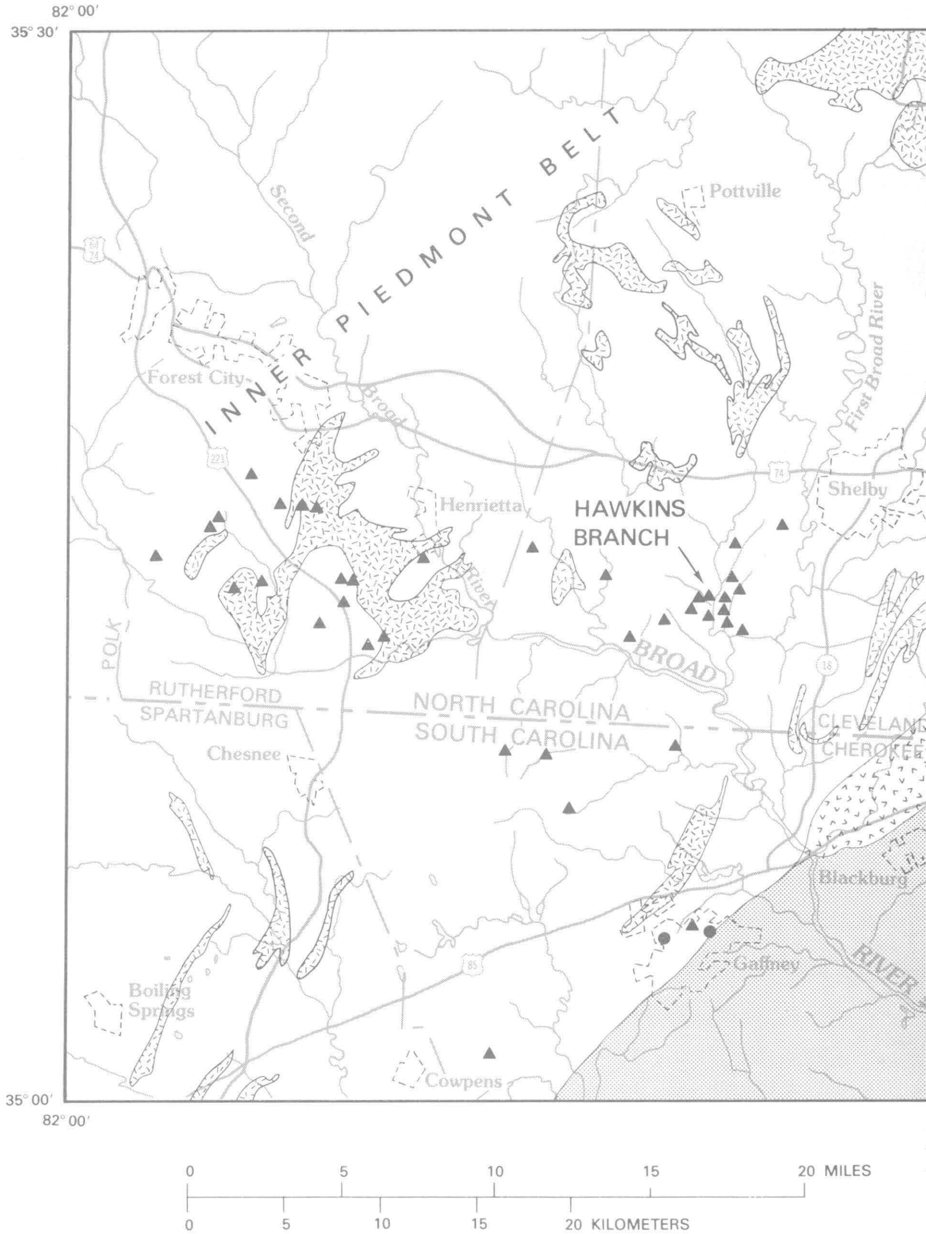
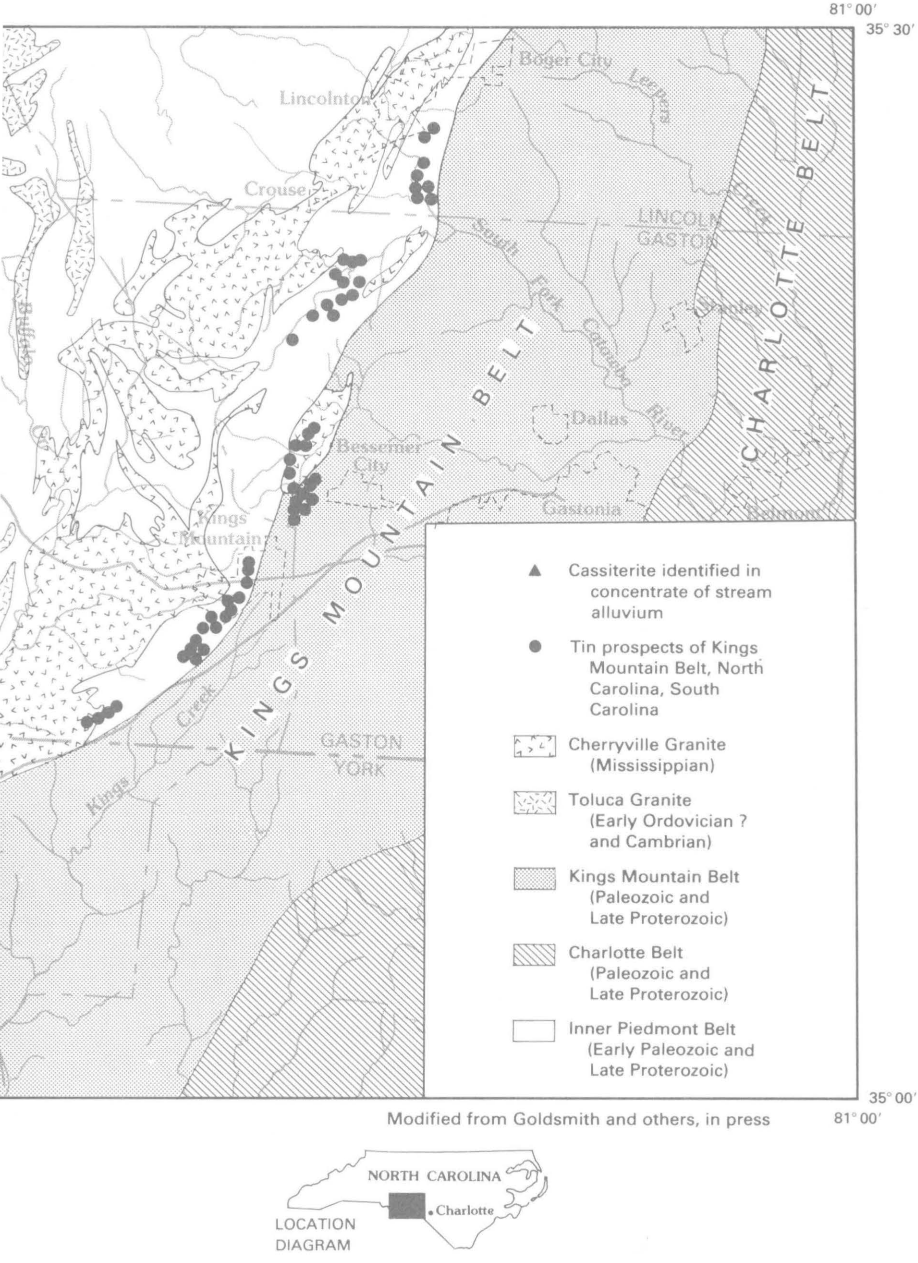


FIGURE 1.—Cassiterite occurrences and tin prospects in the Shelby area, North Carolina and South Carolina. Also shown are the Inner Piedmont belt of Early(?) Paleozoic



and Late Proterozoic age, the Kings Mountain belt of Paleozoic and Late Proterozoic age, and the Charlotte belt of Paleozoic and Late Proterozoic age.

disintegrate by chipping or flaking during stream transportation.

Accessory minerals identified in the cassiterite concentrate of Hawkins Branch are ilmenite, hornblende, limonite, hematite, maghemite, brecciated and crystalline pyrite, garnet, opaque and translucent monazite (green, gray, tan, yellow, orange, and brown), zircon, rutile, opaque and translucent tourmaline, leucoxene, anatase, xenotime, muscovite, sillimanite, kyanite, graphite, gahnite, scheelite, corundum, sapphire, and native gold.

Magnetite is absent, though it ordinarily is about 10 percent by volume of panned concentrates for streams in the Shelby region. A few nodules of strongly magnetic maghemite-hematite-limonite are present.

Major peak patterns in X-ray diffraction traces identified grains of different color as varieties of cassiterite. The procedure also identified similar but small peak patterns as a minor cassiterite constituent in several accessory minerals of Hawkins Branch. Identified cassiterite-bearing minerals were vitreous, opaque brownish-yellow monazite; dull, opaque greenish-grayish-tan monazite; translucent, greenish-black tourmaline; small, crystalline pyrite; fresh to slightly oxidized, black octahedral maghemite and hematite (probably after magnetite); and small, fresh, black to brown blebs of hematite.

Samples of soils and their panned concentrates and of bedrock from the Hawkins Branch drainage area were studied. Cassiterite was not seen in any of the panned soil concentrates or in bedrock. Soils are mostly thin, less than 2 m deep, and fresh bedrock exposures are common. The soils are mostly quartzitic and micaceous, reddish brown and tan, gravelly clayey silts derived from in situ weathering of bedrock. Lag surface gravels of maghemite-hematite-limonite nodules appear in appreciable quantities on cultivated level-to-gentle barren slopes. Accessory minerals in panned concentrates include abundant greenish-black rutile, meager amounts of reddish-brown rutile, black tourmaline, ilmenite, kyanite, sillimanite, graphite; and much green and gray monazite with minor amounts of yellow monazite, pink garnet, xenotime, zircon, and gahnite. Some of the maghemite-hematite-limonite nodules are highly magnetic; magnetite was not seen.

Neither cassiterite, greisen, quartz veins, nor open faults were seen in the bedrock of the Hawkins Branch drainage area. Bedrock as mapped by Goldsmith and others (in press) is Late Proterozoic and Cambrian biotite gneiss, muscovite schist, and sillimanite schist. The sillimanite schist underlies the western portion of the drainage basin including nearly the entire course of Hawkins Branch. The schist is grayish, well layered, garnetiferous, and biotitic. It contains numerous concordant, white, micaceous and tourmaline-bearing pegmatitic pods and lenses which are about 5–30 cm thick and as much as tens of meters long.

The schists grade into layers of darker grayish gneisses, which underlie the eastern portion of Hawkins Branch drainage area. The thin and well-layered seams of gneiss are biotitic, garnetiferous, or hornblendic. They also contain some pods and lenses of concordant pegmatite. Some layers and minerals of the schist and gneiss units show strong foliation. In addition to the micas and quartz, other common minerals identified in the bedrock are hornblende, graphite, brown and pink garnets, kyanite, and tourmaline; magnetite was not seen.

The closest known igneous bodies to Hawkins Branch are unmapped stringers of Toluca Granite found 1.1 km east and 0.8 km west of Hawkins Branch.

CONCLUSIONS

Substantial amounts of coarse cassiterite have been found in numerous streams in the vicinity of Shelby, N.C., and adjacent South Carolina. Further prospecting, especially in headwaters in zones between source and first stream bottom exposures of bedrock, may greatly enlarge the known cassiterite-containing area. Such prospecting could also locate the saprolite or bedrock sources of the cassiterite and determine the extent and grade of those sources.

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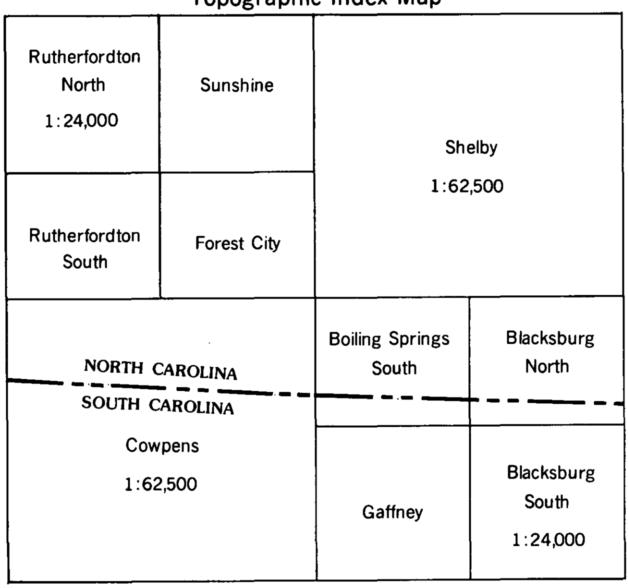
APPENDIX

List of cassiterite locations

Figure 1 shows cassiterite occurrences in alluvium at 1:500,000. To locate stream sites that contain cassiterite more specifically, detailed location information based on available topographic maps at 1:24,000 or 1:62,500 is given below.

Topographic Index Map



In each of the entries that follow, information is given in the following order: sample number, geographic coordinates, and comments.

Blacksburg North, N.C. - S.C. (1:24,000 scale)

79-BLN-17, 35°13'37", 81°37'21", lower reach Hawkins Branch, 10.2 km southwest of Shelby, N.C., 2.1 km south-southwest of Maple Springs Church.

79-BLN-18, 35°13'18", 81°36'44", southerly flowing tributary of unnamed small creek of north bank of Broad River, 10 km southwest of Shelby, N.C., 2.6 km south-southeast of Maple Springs Church.

79-BLN-19, 35°13'17", 81°36'46", southwesterly flowing tributary of unnamed small creek of north bank of Broad River, 10.3 km south-southwest of Shelby, N.C., 2.6 km south-southeast of Maple Springs Church.

79-BLN-20, 35°13'38", 81°37'26", west bank tributary of Hawkins Branch, 10.3 km southwest of Shelby, N.C., 2.05 km south-southwest of Maple Springs Church.

79-BLN-21; 35°13'32", 81°37'12", east bank tributary of lower Hawkins Branch, 10 km south-southwest of Shelby, N.C., 2.2 km south of Maple Springs Church.

CD-560, 35°13'54", 81°37'15", lower middle Hawkins Branch, 10.1 km south-southwest of Shelby, N.C., 1.5 km south of Maple Springs Church.

CD-571, 35°14'26", 81°37'01", east bank tributary of upper Hawkins Branch, 9.1 km south-southwest of Shelby, N.C., 0.5 km south of Maple Springs Church.

CD-578, 35°14'39", 81°37'02", upper reach Hawkins Branch, 8.8 km southsouthwest of Shelby, N.C., 150 m south of Maple Springs Church.

Boiling Springs, N.C. - S.C. (1:24,000 scale)

51-PK-64, 35°10'00", 81°44'46", Ashworth Creek, 2 km downstream from source, 7.5 km northwest of Grassy Pond, S.C.

52-PK-26, 35°10'05", 81°38'27", south flowing tributary of north bank of Ross Creek, 4 km northeast of Grassy Pond, S.C.

52-PK-32, 35°08'13", 81°42'20", northeast flowing tributary of south bank of Ross Creek, 3 km due west of Grassy Pond, S.C.

Boiling Springs, N.C. - S.C. --continued

52-PK-38, 35°09'55", 81°43'12", Sarratt Creek, 1.6 km downstream from source, 5.5 km northwest of Grassy Pond, S.C.

79-BSS-5, 35°13'24", 81°37'58", Yancy Creek, 1.8 km downstream from source, 3 km southeast of Boiling Springs, N.C.

79-BSS-6, 35°14'50", 81°41'29", east bank tributary of Sandy Run, 3.7 km, southeast of Boiling Springs, N.C.

79-BSS-7, 35°13'43", 81°37'58", south bank tributary of Poplar Branch, near Beaverdam Creek, 3.7 km southeast of Boiling Springs, N.C.

79-BSS-8, 35°13'45", 81°35'57", Popular Branch near juncture into Beaver dam Creek, 3.6 km southeast of Boiling Springs, N.C.

79-BSS-9, 35°13'49", 81°37'46", east bank tributary of Beaverdam Creek, 3.9 km southeast of Boiling Springs, N.C.

79-BSS-10, 35°13'00", 81°40'26", Jolly Branch, 1.6 km downstream from source, 3.4 km due south of Boiling Springs, N.C.

Forest City, N.C. (1:24,000 scale)

81-JW-20, 35°15'17", 81°47'46", lower course Hogpen Branch, 10.5 km southeast of Forest City, 0.3 km south of Henritta.

81-JW-24, 35°16'47", 81°52'23", lower course Bracketts Creek, 6 km south of Forest City, 2.8 km west-southwest of Sandy Mush

81-JW-25, 35°16'36", 81°51'30", unnamed stream east side of Floyds Creek, 6.2 km south of Forest City, 1.8 km southwest of Sandy Mush, 1 km east of Bracketts Creek.

81-JW-26, 35°16'37", 81°51'25", east side tributary of unnamed stream east side of Floyds Creek, 6.2 km south of Forest City, 1.8 km southsouthwest of Sandy Mush, 1.3 km east of Bracketts Creek.

Rutherfordton South, N.C. (1:24,000 scale)

81-JW-2, 35°15'59", 81°54'51", west bank trib of Richardson Creek, 8.6 km southwest of Forest City, 4.6 km southeast of Shiloh.

81-JW-3, 35°16'02", 81°54'46", middle course of Richardson Creek, 8 km southwest of Forest City, 4.6 km southeast of Shiloh.

81-JW-5, 35°15'09", 81°56'54", south flowing trib on east bank of Jarretts Creek, 11.7 km southwest of Forest City, 5.5 km due south of Shiloh.

81-JW-22, 35°17'38", 81°53'13", west bank trib of Floyds Creek, 9.9 km south-southwest of Forest City, 1 km due east of Danieltown.

Gaffney, S.C. (1:24,000 scale)

CD-below Ross tin mine placer, 35°05'17", 81°37'41", 2.5 km northeast of downtown Gaffney, 100 m downstream from old placer workings and north of mine shafts.

Cowpens, S.C. - N.C. (1:62,500 scale)

81-JW-8, 35°14'08", 81°53'52", south flowing trib on east bank of Dills Creek, 2.4 km west-southwest of Harris, N.C.

81-JW-9, 35°14'33", 81°53'03", west bank trib of Richardson Creek, 0.9 km west of Harris, N.C.

81-JW-11, 35°14'33", 81°49'53", Goodes Creek, 1.8 km downstream from source, 4 km due east of Harris, N.C.

81-JW-12, 35°14'26", 81°49'56", west bank trib of Goodes Creek, 3.8 km due east of Harris, N.C.

81-JW-13, 35°13'52", 81°50'06", west bank trib of Goodes Creek, 3.7 km east-southeast of Harris, N.C.

81-JW-14, 35°13'17", 81°51'11", south flowing trib on northeast bank of Floyds Creek, 3 km south-southeast of Harris, N.C.

Cowpens, S.C. - N.C. --continued

81-JW-15, 35°13'17", 81°49'45", lower course Goodes Creek, 4.7 km southeast of Harris, N.C.

81-JW-16, 35°13'19", 81°49'38", very short trib on east side of lower course Goodes Creek, 4.9 km southeast of Harris, N.C.

81-JW-31, 35°01'38", 81°45'04", middle course Little Thicketty Creek, 5 km east-northeast of Cowpens, S.C.

Shelby, N.C. (1:62,500 scale)

79-SHY-6, 35°16'12", 81°35'22", northeast flowing tributary on west bank of First Broad River, 5 km southwest of Shelby.

79-SHY-7, 35°15'37", 81°36'4", Sugar Branch, 2 km downstream from source, 8 km southwest of Shelby.

79-SHY-10, 35°16'00", 81°43'32", east-southeast flowing tributary on west bank of Grong Creek, 18 km west-southwest of Shelby, N.C.

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