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U. S. DEPARTMENT OF THE INTERIOR

MONAZITE PLACERS ON SOUTH MUDDY CREEK, McDOWELL COUNTY AND SILVER CREEK, BURKE COUNTY, NORTH CAROLINA

By
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This report is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

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MONAZITE PLACERS ON SOUTH MUDDY CREEK, McDOWELL COUNTY AND SILVER CREEK, BURKE COUNTY, NORTH CAROLINA

by

L. A. Hansen[1/] and A. M. White[2/]

ABSTRACT

South Muddy Creek heads in the South Mountains in McDowell County, N. C. The flood plains in the reserve area receive drainage from about 18 square miles underlain by deeply weathered gneiss, schist, and granite.

Silver Creek rises on the northern flank of the South Mountains in Burke County, N. C. The flood plains in the reserve area receive drainage from 24 square miles underlain by gneiss, schist, and granite largely weathered to saprolite.

Since the two areas are adjacent and similar in most respects, they are included in one report. The project and report were accomplished through the joint efforts of the U. S. Bureau of Mines and the U. S. Geological Survey. A total of 15 holes was drilled; eleven on South Muddy Creek for a total of 223 feet, and four on Silver Creek for 90 feet. Drilling began on October 7, and was completed October 15, 1952.

The reserve area on South Muddy Creek contains approximately 19 million cubic yards of minable gravel in the flood plains.

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2/ Geologist, U. S. Geological Survey

The area of indicated and inferred reserves is divided into sections. Indicated by 11 drill holes are 4,800,000 cubic yards of minable alluvium containing 0.64 pound of monazite and about 5 cents in gold per cubic yard. The inferred reserves are 14,200,000 cubic yards containing 0.6 pound of monazite and 3 to 5 cents in gold per cubic yard. Indicated monazite reserves are 1,550 tons and inferred reserves 4,250 tons, for a total monazite reserve of about 5,800 tons.

Similar areas on Silver Creek contain 20 million cubic yards. Indicated by 4 drill holes are 2,200,000 cubic yards containing 0.83 pound of monazite and about 4 cents in gold per cubic yard. Inferred reserves are 17,800,000 cubic yards containing 0.6 pound of monazite and 2 to 4 cents in gold per cubic yard. Indicated monazite reserves are 900 tons and inferred reserves are 5,350 tons for a total monazite reserve of about 6,250 tons.

A brief summary of some churn drill exploration on the Catawba River, Burke County, North Carolina is appended.

INTRODUCTION

During the winter of 1951-52 the Bureau of Mines, upon the recommendation of the Geological Survey, conducted a churn drill exploration program on monazite placer deposits in the flood plains of several streams in Cleveland and Rutherford Counties in southwestern North Carolina.3/ Although tenors are good, the areas

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3/ Griffith, R. F., and Overstreet, W. C., RME-3112, Knob Creek Monazite Placer, Cleveland County, N. C., January 1953. RME-3113, Buffalo Creek Monazite Placer, Cleveland and Lincoln Counties, N. C., January 1953. RME-3114 Sandy Run Creek Monazite Placers, Rutherford County, N. C., January 1953.

are small. Larger flood plains in the general monazite area were thought likely to contain monazite because small rich tributary flood plains were mined for monazite by hand sluicing methods around the turn of the century.

The 1952-53 drilling program was planned to sample these larger flood plains as a continuation of the work begun the preceding year on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission. Preliminary investigations were made by the U. S. Geological Survey; South Muddy Creek and Silver Creek were among those areas chosen.

SUMMARY AND CONCLUSIONS

Flood plains on South Muddy Creek in McDowell County, and Silver Creek in Burke County, both in North Carolina, were explored by the U. S. Bureau of Mines, using churn drilling methods, during October, 1952. Drilling was confined to flood plains recommended by the U. S. Geological Survey. A total of 15 holes was drilled; eleven on South Muddy Creek for 223 feet, and four on Silver Creek for 90 feet. South Muddy Creek contains approximately 19 million cubic yards of minable alluvium and Silver Creek about 20 million. Both areas contain about 0.6 pound of monazite and 2 to 5 cents in gold per cubic yard. Monazite reserves are: South Muddy Creek--indicated, 1,550 tons and inferred, 4,250; Silver Creek--indicated, 900 tons and inferred, 5,350 tons. Indicated and inferred reserves of other minerals are: Ilmenite, 57,000 tons; garnet, 20,000 tons; and zircon, 13,000 tons.

DESCRIPTION OF DEPOSIT

Location

South Muddy Creek flows northeastward along the extreme eastern margin of McDowell County, North Carolina. It joins North Muddy Creek to form Muddy Creek, which flows to the Catawba River in Burke County, North Carolina. Catawba River drainage reaches the Atlantic Ocean at the South Carolina coast through the Santee River.

The flood plain drilled on South Muddy Creek is accessible from Morganton, North Carolina, over U. S. route 70 to a point 15 miles west of Morganton, then south on a paved road for a distance of 2.8 miles and south on a dirt road 4.5 miles to the upstream end of the flood plain. Farm roads give access to the flood plain, which is almost entirely cleared and under cultivation or in use as pasture. Marion, North Carolina, seat of McDowell County, is located 10 miles to the northwest. Morganton and Marion are served by the Southern Railway. The Clinchfield Railroad passes two miles east of Marion.

Silver Creek heads in southwestern Burke County, North Carolina, and flows northeastward to its junction with the Catawba River about one mile west of Morganton, N. C. The area drilled is the flood plain at the junction of Silver Creek and Clear Creek. It is readily accessible over U. S. route 70 to a point 2.2 miles west of Morganton, then southwest for 4 miles on a paved road.

Morganton, a city of about 6,000 people, is the county seat.

Farm roads provide easy access to the flood plains, except during periods of heavy rain. The Duke Power Company and the Rural Electrification Administration have power lines in the vicinity.

Physical features

The eastern part of McDowell County is within the western North Carolina Piedmont, but the terrain becomes more mountainous to the west as the Blue Ridge is approached. Relief along South Muddy Creek is low in the downstream areas but increases toward the headwaters, which rise in the South Mountains. The altitude of the flood plain drilled is about 1,100 feet; adjacent hills rise 150 or 200 feet above this. The South Mountains, which rise to a maximum altitude of 2,919 feet, lie five miles to the southeast, and the Huntsville Mountains, which attain 2,300 to 2,400 feet in altitude, are five miles to the west.

Burke County, which joins McDowell County on the east, is also in the western Piedmont. Relief in the area drilled on Silver Creek is low; the flood plain has an altitude of about 1,050 feet and the hillsides rise 150 to 200 feet above this. The South Mountains are six miles to the south. The headwaters of Silver Creek are on the northern flank of these mountains.

The flood plains and lower hillslopes of South Muddy and Silver Creeks are widely farmed, but the divides are largely in woodland. The courses of the streams and their tributaries were

straightened about 1915 by dredging and ditching to improve the bottomland for agricultural use.

Records of weather at Morganton, North Carolina are shown below. The figures from the U. S. Weather Bureau are based on 53 years of record for temperature, and 57 years of record for precipitation.

Month	Average temperature degrees F.	Monthly precipitation inches
Jan.	40.2	3.67
Feb.	41.9	4.07
Mar.	49.8	4.63
Apr.	57.6	3.62
May	66.0	3.85
June	73.4	4.92
July	76.3	5.36
Aug.	75.1	5.62
Sept.	70.0	4.73
Oct.	58.6	4.12
Nov.	48.6	2.39
Dec.	41.4	4.80
	Total	51.78

Geology

South Muddy Creek and Silver Creek drain areas of structurally complex metamorphic rocks near the western margin of the monazite-bearing zone in the western Piedmont of the southeastern states. Biotite gneiss and biotite schist of the Carolina gneiss, hornblende gneiss of the Roan gneiss, granite, and pegmatite are the common rocks. Ages of all are unknown. The Carolina gneiss and the Roan gneiss have been referred to as pre-Cambrian and the granite is thought to be pre-Carboniferous. All the rocks except

the hornblende gneiss, which is rich in epidote and barren of monazite, contain small quantities of monazite. There is no record that any rock in the drainage basins of the two streams is sufficiently rich in monazite to permit direct mining of the rock. Placer concentrations were the source of monazite formerly mined in the area.

The flood plain drilled on South Muddy Creek is 3.5 million square yards in area; is estimated to contain 19 million cubic yards of alluvium; receives drainage from 18 square miles of crystalline rock; and is ten miles downstream from the headwaters. The gradient of the stream through the drilled flood plain is 13 feet per mile. The number of hardrock outcrops in the area of the flood plain is small, but this number increases upstream. All holes drilled in the flood plain bottomed in saprolite.

Eleven holes drilled in the South Muddy Creek flood plain show that the thickness of alluvium ranges from 15.5 feet to 19.0 feet, with an average of 17.5 feet. Fine-grained sediments predominate, as shown by the following table based on logs of the churn-drill holes:

Sediment	Percent of total thickness of sediments recorded
Sand and silt	15
Sand	22
Clay and fine sand	30
Gravel	24
Gravel and fine sand	9

The predominance of fine-grained sediments in the two placers reflects the low gradients of the streams and the deep weathering of rocks underlying the drainage areas. Gravel in downstream flood plains is mainly quartz from quartz veins and pegmatite; rock fragments are rare in the coarse-grained debris. A pronounced decrease in the volume of fine sediments upstream is shown by comparing the above figures with those based on logs of drill holes sunk in fiscal year 1952 on Hall Creek, a tributary which joins Silver Creek 4.8 miles upstream from the junction of Silver Creek and Clear Creek. Of the total thickness of sediments recorded in the Hall Creek flood plain, only 22 percent is clay, silt, and fine sand. The remaining 78 percent is sand and gravel.

The dominance of fine-grained sediments along the course of Silver Creek suggests that the tenors calculated from the four churn-drill holes will decrease downstream to about 0.4 pound of monazite per cubic yard at the lower end of the site.

Flood-plain sediments on South Muddy Creek and Silver Creek can be divided into an upper unit of reddish-brown sandy silt deposited since the introduction of agriculture in the area, and an underlying sequence of grayish sediments of pre-agricultural, post-Pleistocene deposition. Slope wash from adjacent hillsides has not been important in building the flood plains.

Mineralogy

Petrographic analysis was made on a cut from a field composite of each area. Concentrates are similar in most respects from drill holes and areas.

Epidote is prominent among the heavy minerals. Ilmenite, epidote and quartz, in approximately equal proportions, constitute more than 60 percent of the concentrates. Monazite is found only as a trace in the + 35-mesh; most abundant in the -35 + 100-mesh; and diminishing quantities in the smaller sizes.

Screen analyses of drill-hole composite samples from South Muddy Creek and Silver Creek follow:

Screen Analysis of a South Muddy Creek Drill-Hole Composite Sample
(Upper Minable depth of 16 feet)

Screen Size	Sample Pounds	Sample Weight Percent	Table Concs. Pounds	Table Concs. Weight Percent	Percent minerals present: Epidote	Magnetite	Ilmenite	Garnet	Zircon	Quartz other	Monazite	Monazite Pounds	Monazite Weight Percent
+¼	23.00	10.41											
-¼ + 1/8	9.00	4.07											
-1/8 + 14	60.00	27.15											
-14 + 20	1.86	0.84	0.005	1.18	8	Tr.	2	75	Tr.	13	0.0	-	
-20 + 28	7.23	3.27	.013	3.07	13	Tr.	38	43	Tr.	4	.0	-	
-28 + 35	16.06	7.27	.020	4.73	20	Tr.	40	33	2	3	.0	-	
-35 + 48	18.97	8.59	.034	8.04	25	1	35	28	4	2	5	.0017	7.4
-48 + 65	21.09	9.52	.049	11.58	30	1	25	23	6	4	9	.0044	19.2
-65 + 100	20.85	9.43	.075	17.73	40	1	25	15	6	2	8	.0060	26.2
-100 + 150	15.11	6.84	.087	20.57	45	1	25	12	6	3	6	.0052	22.7
-150 + 200	10.60	4.80	.075	17.73	50	2	23	10	3	5	4	.0030	13.1
-200	17.23	7.80	.065	15.47	50	5	25	5	3	5	4	.0026	11.4
	221.00	99.99	0.423	100.00								.0229	100.0

Screen Analysis of a Silver Creek Drill-Hole Composite Sample
(Upper 23 feet)

Screen Size	Sample pounds	Table Concs. Weight Pounds	Table Concs. Percent	Percent minerals present: Epidote	Magnetite	Ilmenite	Garnet	Zircon	Quartz other	Monazite	Monazite Pounds	Monazite Weight Percent
+¼	36											
-¼ + 1/8	12											
-1/8 + 14	67											
-14	258											
-14 + 20		0.002	0.10	25	T	35	18	T	20	0	0.0	
-20 + 28		0.002	0.10	25	T	33	38	T	3	0	0.0	
-28 + 35		0.141	6.70	15	T	33	42	1	2	T	0.0	
-35 + 48		0.356	16.93	35	1	40	13	2	2	5	0.0178	11.6
-48 + 65		0.366	17.40	33	1	40	10	3	2	10	0.0366	23.8
-65 + 100		0.427	20.30	35	2	42	3	3	2	12	0.0512	33.4
-100 + 150		0.365	17.36	35	3	45	3	4	2	7	0.0256	16.7
-150 + 200		0.277	13.17	40	3	38	2	5	2	5	0.0139	9.0
-200		0.167	7.94	40	5	33	T	12	2	5	0.0084	5.5
	373	2.103	100.00								0.1535	100.0

Bright gold was found in both fields. Carolina gold is generally about 900 fine and in the early days of mining it is reported to have been minted and made into jewelry without refining. Most grains of gold were very small and moderately rough.

Mineral frequency, based on petrographic examinations of cuts from both field composites, are tabulated below:

	South Muddy Creek field comp.	Silver Creek field comp.
Epidote	17	18
Ilmenite	23	32
Quartz	21	11
Garnet	5	13
Fe-Mags	6	5
Magnetite	9	1
Zircon	8	6
Monazite	6.4	6.2
Rutile	0.1-0.5	2
Sillimanite-Kyanite	Tr.	4
Xenotime	1.0	0.6
Sphene	1	-

Trace amounts of pyrite, spinel, tourmaline, and mica were noted. Traces of radioactive opaque minerals were detected in the composite sample from Silver Creek.

HISTORY

Placers along South Muddy Creek were worked for monazite[4/] in the early years of production in North Carolina, but mining on South Muddy Creek was stopped by an act of the legislature prohibiting use of the waters of that stream for sluicing purposes.

4/ Pratt, J. H., 1916, Zircon, monazite, and other minerals used in the production of chemical compounds employed in the manufacture of lighting apparatus; N.C. Geol. and Econ. Survey, Bull. 25, p. 52.

Most of the upstream half of South Muddy Creek was extensively worked for gold 5/. A few localities were worked intermittently until 1935. There is no record that the flood plain drilled was mined for either monazite or gold, but local residents stated that small quantities of gold had been taken from the two small western down stream tributaries to South Muddy Creek.

Monazite was discovered in the southeastern United States in 1879 6/ by W. E. Hidden in a headwater tributary of Silver Creek at Brindle Town, N. C. Placer mining began in 1886, the first shipments were made in 1887, and mining continued until 1911. A small revival extended from 1915 to 1917. Gold was found in Brindle Creek 7/, a headwater tributary to Silver Creek, in 1828, and mining continued past the turn of the century in many upstream areas of Silver Creek. There is no record that the flood plain drilled was ever mined.

EXPLORATION

The objective of this exploration was to determine possible tenors and relative depths for each drill area with a minimum number of holes. As soon as these factors were determined the drill was to be moved to other previously selected areas, unless indicated tenors justified further drilling.

5/ Pardee, J. T., and Park, C. F., Jr., 1948, Gold deposits of the southern Piedmont: U. S. Geol. Survey Prof. Paper 213, p. 77 and pl. 14.

6/ Pratt, J. H., 1916, Op. Cit. 4/, p. 50.

7/ Pardee, J. T., and Park, C. F., Jr., 1948, Op. Cit. 5/, pl. 14.

Previous experience, gained from drilling Knob, Buffalo and other creeks on the Piedmont indicated that tenors could be inferred over relatively large areas from the results of a few strategically placed drill holes. Subsequent drilling has verified this assumption; namely, that most well developed flood plains of the larger streams on the Piedmont are remarkably uniform in the nature, distribution, and depth of their sediments.

ANALYSES

Field Estimates

Drill hole samples were weighed and dry screened to minus 10-mesh on a vibrating screen in the Bureau's field laboratory in Shelby, North Carolina. The minus 10-mesh material was concentrated as individual samples on Wilfley tables and field estimates were made of the mineral content of black sands from each sample. After drying and weighing the concentrates, a 10-gram portion was cut for examination. Magnetite, removed by a hand magnet, was weighed and recorded in percent. Ilmenite, garnet, monazite, zircon, and light fractions were estimated in percent by visual examination with a 40-x penscope. Zircon content was further checked with a mineralight. The entire sample was then checked with a field Geiger counter against standards of the same weight prepared from monazite obtained from Knob Creek. Individual hole and area samples were composited for analyzing.

The 11-hole area of South Muddy Creek contains minable depths ranging from 15.5 to 22 feet; black sand 4.03 to 14.60 pounds,

and monazite 0.28 to 0.67 pounds per cubic yard of gravel. The black sand concentrates for the area were also found to contain 23 percent ilmenite, 5 percent garnet, and 8 percent zircon.

The 4-hole area of Silver Creek was found to have minable depths ranging from 19 to 23 feet; black sand 11.11 to 14.47 pounds, and monazite 0.39 to 1.04 pounds per cubic yard of gravel. The black sand concentrates for this area were also found to contain 32 percent ilmenite, 13 percent garnet, 6 percent zircon, and a trace of radioactive opaque minerals.

The following table shows some field estimates, based on three selected drill holes.

Field Estimates, 3 Selected Drill-Holes

Hole Location	Interval (feet)	Lbs./Cu.Yd. Black Sand	Lbs./Cu.Yd. Monazite	Field estimate-percent 8/ Magnetite	Ilmenite	Garnet	Zircon	Epidote	Monazite
South Muddy Creek	0 - 2	3.12	0.12	3	30	1	2	43	4
	2 - 4½	13.77	0.28	2	18	Tr.	2	60	2
	4½-10½	4.27	0.21	2	40	Tr.	8	35	5
	10½-16½	7.03	0.91	2	43	2	12	25	13
	16½-19	0.65	0.01	2	6	1	2	80	2.2
Theoretical wt. of cuttings 583 pounds. Percent recovery 36									
South Muddy Creek	0-2½	3.06	0.12	5	45	1	3	30	4
	2½-10	3.56	0.21	5	55	3	5	15	6
	10-13½	4.83	0.34	2	58	4	5	15	7
	13½-19	5.56	0.50	2	38	18	8	15	9
	19-21	9.45	0.47	60	15	3	1	6	4
Theoretical wt. of cuttings 644 pounds. Percent recovery 52									
Silver Creek	0-3½	6.32	0.18	5	25	3	5	48	2.9
	3½-12	10.80	0.32	2	40	3	4	40	3
	12-16½	13.31	0.37	1	48	5	4	30	2.8
	16½-18½	16.87	0.49	Tr.	38	18	3	30	2.9
	18½-21	23.56	0.94	2	43	25	3	15	4
	21-23	3.04	0.33	3	30	25	4	25	11
Theoretical wt. of cuttings 706 pounds. Percent recovery 41.									

8/ Small quantities of gold found in most intervals.

Chemical and Radiometric Analyses

Chemical and radioactivity assay were run on a cut of the concentrates from a composite of each drill hole and each field composite. These analyses gave the percent ThO_2 and the percent "ThO_2 equivalent", respectively. In addition, hand-picked monazite from each field composite was analyzed for percent ThO_2 and U_3O_8. By multiplying percent U_3O_8 with a factor of 4.2, U_3O_8 is expressed in terms of equivalent percent ThO_2 and when added to chemically determined percent ThO_2, the ThO_2 equivalent percent of the monazite is determined. This value should approximate the ThO_2 equivalent percent shown by radioassay.

The percent monazite in the concentrates from each sample was determined by comparing the chemical percent ThO_2 of the concentrate with that of the pure monazite, and checked by comparing the radioassay percent ThO_2 equivalent of the concentrate with that of the calculated ThO_2 equivalent of the pure monazite.

The results from these determinations are shown in the table below which shows the minimum and maximum range limits for each area and the results from composited area samples.

Samples of Concentrates	Range Limits: Radioassay percent ThO_2 equivalent	Percent ThO_2	Percent Monazite radioassay	Percent Monazite calc. from ThO_2	Percent Monazite petrographically
11 South Muddy Creek Holes	0.19 to 0.76	0.12 to 0.56	3.3 to 13.1	2.9 to 13.1	
4 Silver Creek Holes	0.30 to 0.56	0.19 to 0.39	4.6 to 8.2	4.0 to 8.2	
South Muddy Creek field composite	0.43	0.32	7.5	7.2	7.4
Silver Creek field composite	0.45	0.31	7.8	7.3	6.8

Chemical determinations of percent ThO_2 and U_3O_8 in hand-picked monazite

	ThO_2	U_3O_8	ThO_2 Equivalent
South Muddy Creek	4.3	.36	5.8
Silver Creek	4.8	.44	6.6

Small quantities of gold occur through much of the overburden, but indications show that it is concentrated in the gravel immediately above the soft, saprolitic bedrock. Gold values were estimated by amalgamation, parting, and weighing, and by color count.

RESERVES

Mapped flood plains on South Muddy Creek contain approximately 19 million cubic yards of alluvium, of which 14,200,000 cubic yards are inferred to contain 0.6 pound of monazite and 3 to 5 cents in gold per cubic yard. Reserves indicated by 11 drill holes are 4,800,000 cubic yards containing 0.64 pound of monazite and about 5 cents in gold per cubic yard. Analogous areas on Silver Creek total 20,000,000 cubic yards of which 17,800,000 cubic yards containing about 0.6 pound of monazite and 2 to 4 cents in gold per cubic yard are inferred. Reserves indicated by four drill holes are 2,200,000 cubic yards containing 0.83 pound of monazite and about 4 cents in gold per cubic yard.

On South Muddy Creek the weighted average of the four indicated blocks is 0.64 pound of monazite per cubic yard; the lowest-tenor block is farthest downstream. The tenor probably decreases gradually from about 0.75 pound per cubic yard upstream to about 0.5 pound per cubic yard downstream. In calculating tenor and reserves this decrease was considered, and an estimate of 0.6 pound of monazite per cubic yard was made for the 14 million cubic yards of inferred ground. The estimated 0.6 pound is slightly less than the weighted average of the indicated reserves.

On Silver Creek the weighted average of the two indicated blocks is 0.83 pound of monazite per cubic yard. Increase of finer-grained sediments toward the downstream end of the placer

is expected to be paralleled by a decrease in tenor. It is estimated that the tenor at the lower end of the placer is about 0.4 pound of monazite to the cubic yard, and that the average tenor of inferred ground is 0.6 pound of monazite per cubic yard.

Indicated reserves of black sand and the weights of the separate heavy minerals are calculated by the block. Estimates of inferred reserves for the two streams are based on the geological assumption of a downstream decrease in weight of total black sand. For South Muddy Creek it is estimated that the average weight of black sand in the inferred ground is 8 pounds per cubic yard. On Silver Creek the average is estimated to be 12 pounds per cubic yard. Inferred reserves of other minerals are estimated only for those that might have current by-product sale: ilmenite, zircon, and garnet. Estimates of inferred reserves for these three minerals are based on frequency distribution in the field composites calculated on a basis of 8 and 12 pounds of black sand per cubic yard.

Four holes on South Muddy Creek and one on Silver Creek were carried to a minable depth that included from 1.5 to 3.0 feet of weathered bedrock because of the indicated gold content. Minable depths in all other holes extend to the surface of bedrock. All estimates of inferred reserves are based on minable depths extending only through the alluvium. A reserves table follows.

RESERVES

Cubic Yards Gravel	South Muddy Creek Area	Silver Creek Area	Both Areas
Indicated	4,788,000	2,198,000	6,986,000
Inferred	14,212,000	17,802,000	32,014,000
Total	19,000,000	20,000,000	39,000,000
Tons	**Monazite, ThO_2 and U_3O_8**		
Monazite Indicated 9/	1,532	912	2,444
Monazite Inferred 9/	4,264	5,340	9,604
Monazite Total 9/	5,796	6,252	12,048
ThO_2	249	300	549
U_3O_8	21	27.5	48.5
Tons Ilmenite	**Ilmenite**		
Indicated	5,290	4,480	9,770
Inferred	13,000	34,000	47,000
Total	18,290	38,480	56,770
Tons Garnet	**Garnet**		
Indicated	1,150	1,820	2,970
Inferred	3,000	14,000	17,000
Total	4,150	15,820	19,970
Tons Zircon	**Zircon**		
Indicated	1,840	840	2,680
Inferred	4,500	6,000	10,500
Total	6,340	6,840	13,180

9/ By Chemical Analysis

BENEFICIATION AND ECONOMICS

Climate, water, power, and large quantities of gravel would be favorable for year-round operations, but the tenors of radioactive and heavy minerals including gold are low.

Screen analysis indicates that all plus 35-mesh gravel which is about half of the bulk could be discarded as waste without losing monazite or gold. Greatest losses in the waste would be garnet with decreasing quantities of ilmenite, epidote and quartz, and very small quantities of zircon.

The life of the deposits would be more than 20 years if a dredge with a capacity of 5,000 cubic yards per day was used.

Other major items that would have to be considered for an economical operation in this area are: markets for heavy minerals including sand and gravel, equipment costs, operating costs, and cost of land.

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CHURN DRILL EXPLORATION ON THE CATAWBA RIVER, BURKE COUNTY, NORTH CAROLINA

Three exploratory holes were drilled to an average depth of 30 feet on the flood plains of the Catawba River near the city of Morganton, Burke County, North Carolina. The results are far from good, but they serve to establish the upstream limit for monazite exploration on the Catawba River.

The Catawba River heads in the mountain area of McDowell and Burke Counties. It flows easterly through Catawba County, then south, defining the eastern boundaries of Catawba, Lincoln and Gaston Counties and continues southward into South Carolina to become the Wateree River at the fall line near Camden. Farther south it joins the Congaree, and from there flows southeasterly to the Atlantic Ocean as the Santee River.

After drilling South Muddy Creek and Silver Creek, and while the drill was in the area, it was decided to make a brief test of the bottom gravel on some convenient flood plain along the river. Accordingly a broad section, known as Quaker Meadows, was selected and 3 holes were drilled in the area. Estimates of the total yardage were not made, but the flood plains are large.

Mineralogical analysis of black sand field composite follows:

Ilmenite	47 percent	Zircon	7 percent	Staurolite	1 percent
Quartz	17 percent	Garnet	2 percent	Magnetite	1 percent
Epidote	17 percent	Rutile	2 percent	Monazite	0.5-1.0 percent

The low percentage of monazite in black sand from this part of the Catawba River reflects the position of Quaker Meadows and the upstream drainage with respect to the western edge of the monazite belt. South Muddy Creek is near the western edge of the belt. West of that stream, monazite is sporadically distributed in very low concentrations, to the headward limit of the Catawba River. Practically, though not actually, the country is barren of monazite. Available monazite for concentration at Quaker Meadows came mainly from Silver and South Muddy Creeks draining northward to the river, and from the small southward-flowing streams emptying along the north bank of the river in the same area.

DIGEST OF DRILL LOGS AND MINERALOGICAL ANALYSIS

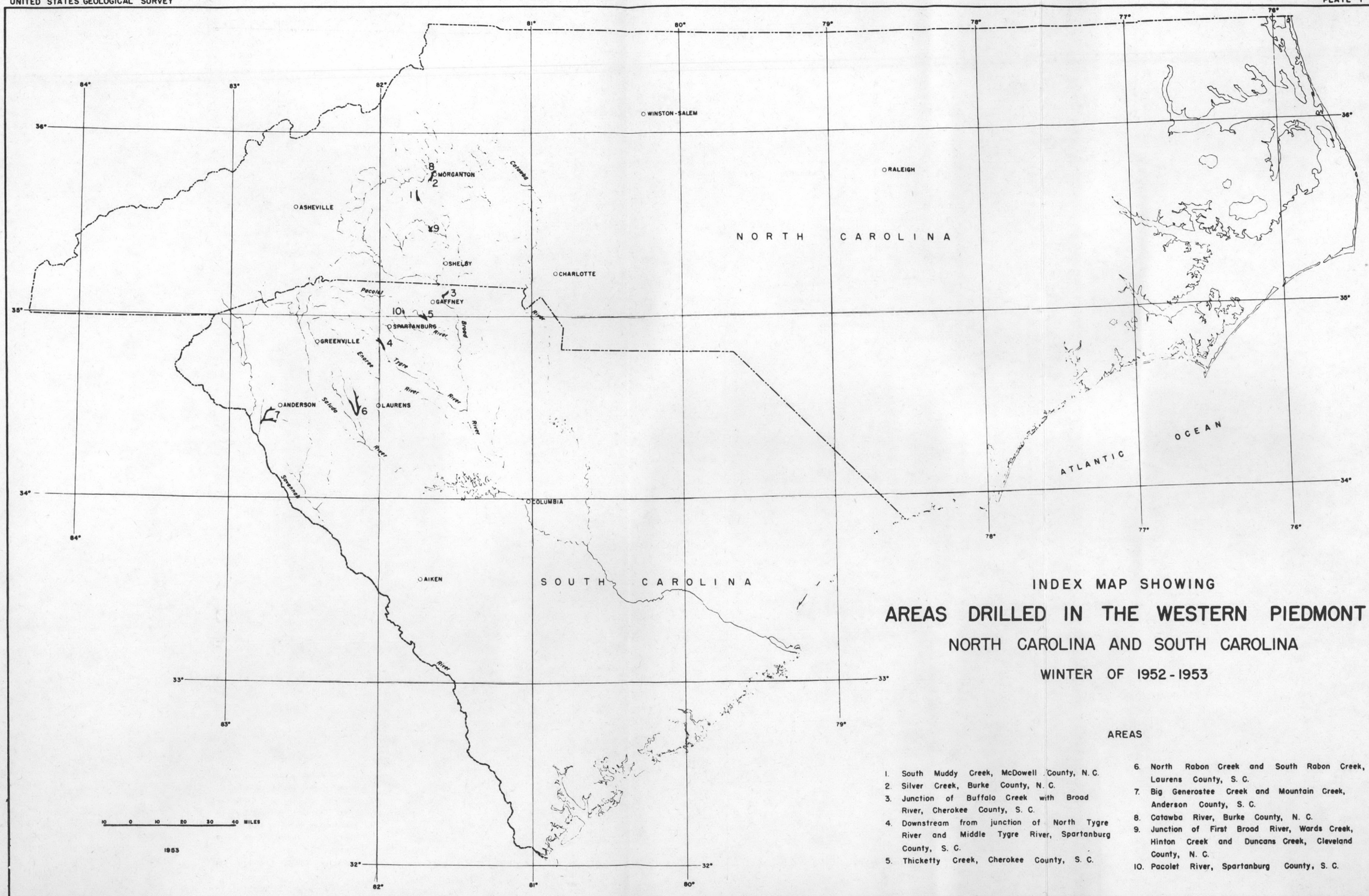
OF BLACK SAND, CATAWBA RIVER

Minimum and Maximum Ranges

Total depth feet	Minable depth feet	Wt. of samples pounds	Percent core recovery	Wt. of conc.	Lb. blk. sand yd.	Percent Monazite Petro.	Lbs. Mon. cu.yd.
23 to 34	19½ to 31	219 to 416	29 to 40	1.368 to 1.765	8.60 to 21.66	0.5 to 1.0	0.09 to 0.22

It is evident from the percent of core recovery, as shown in the above tables, that much clay and very fine sand is present in this section of the Catawba River flood plains.

The Catawba River flood plains contain tremendous tonnages of alluvium over many miles of valley. From Morganton downstream nearly to the Lincoln County-Catawba County line, most streams flowing into the river contain more than 10 percent of monazite in their concentrates.



INDEX MAP SHOWING

AREAS DRILLED IN THE WESTERN PIEDMONT

NORTH CAROLINA AND SOUTH CAROLINA

WINTER OF 1952-1953

AREAS

1. South Muddy Creek, McDowell County, N. C.
2. Silver Creek, Burke County, N. C.
3. Junction of Buffalo Creek with Broad River, Cherokee County, S. C.
4. Downstream from junction of North Tygre River and Middle Tygre River, Spartanburg County, S. C.
5. Thicketty Creek, Cherokee County, S. C.
6. North Rabon Creek and South Rabon Creek, Laurens County, S. C.
7. Big Generostee Creek and Mountain Creek, Anderson County, S. C.
8. Catawba River, Burke County, N. C.
9. Junction of First Brood River, Wards Creek, Hinton Creek and Duncans Creek, Cleveland County, N. C.
10. Pacolet River, Spartanburg County, S. C.