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DRILLING OF AIRBORNE RADIOACTIVITY ANOMALIES
IN FLORIDA, GEORGIA, AND SOUTH CAROLINA - 1954*

By J. B. Cathcart

*This report concerns work done on behalf
of the Division of Raw Materials of the
Atomic Energy Commission.

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This report is preliminary and has not been
edited or reviewed for conformity to Geological
Survey standards and nomenclature.

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Introduction

From April 22 to May 19, 1953, airborne radioactivity surveys totalling 5,600 traverse miles were made in 10 areas in Florida (Moxham, 1954). Abnormal radioactivity was recorded in Bradford, Clay, DeSoto, Dixie, Lake, Marion, Orange, Sumter, Taylor, and Union Counties, Florida. Additional airborne surveys were made in the Spring of 1954 in Hardee and Manatee Counties, Florida, on the drainage of the Altamaha River in Georgia, and in the area of the old phosphate workings in and around Charleston County, South Carolina.

All of the areas flown in Florida either were known to contain phosphate deposits at shallow depth or were known to be areas where phosphate had been reported. Drilling to determine the cause of the anomalies was done with a mobile drill (a jeep-mounted power auger). All drill holes were cased and were logged with a gamma-ray unit. Samples were taken in some of the places where the gamma-ray logs showed high counts per minute in surficial materials, and samples of phosphate-bearing strata were taken for screening and analysis.

The drilling was done between April 5 and April 17, 1954, in most of the areas of Florida, in South Georgia, where phosphate-bearing rocks were reported, in the Altamaha drainage in Georgia and in southeastern South Carolina. Also on April 2, holes were drilled on a slight anomaly in Manatee County, Florida, and on April 3rd the anomalies in Sumter County, Florida were drilled.

All of the operating phosphate companies in the area were told of the Geological Survey drilling plans and were invited to send personnel to observe the drilling. Samples of phosphate-bearing rocks were made available for mechanical and chemical analysis; splits of the separated material are to be analyzed for uranium by the Geological Survey. All of the analytical results have not yet been received. A more comprehensive report will be written when all information is available.

Results

Manatee County, Florida--The airborne survey in April 1954 indicated a very slight anomaly approximately in sec. 13, T. 36 S., R. 22 E. The position of this anomaly was estimated from flight lines plotted on air-photos and may not be correct. On April 2, 1954 two holes were drilled in the section, one in SE $\frac{1}{4}$ SE $\frac{1}{4}$, the other in NW $\frac{1}{4}$ SE $\frac{1}{4}$. The holes caved after drilling so it was not possible to obtain gamma-ray logs. The lithologic log for the hole in NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 13 follows:

- 0-4 Sand, loose, fine-grained, white.
- 4-5 Sand, iron-cemented, brown (Hardpan).
- 5-36 Sand, loose, dark-brown, wet. Color lightens with depth to light-tan.
- 36-41 Sand, slightly clayey, gray-tan, with minor fine- to medium-grained sand-size black phosphate.
- 41-49 As above, but contains more and coarser phosphate.

Sample No. 1 (41-49 feet)

<u>Size fraction</u>	<u>Weight percent</u>	<u>Percent BPL*</u>	<u>Percent Acid Insoluble</u>	<u>Percent Uranium</u>
+14	7.0	61.6	8.2	Not available
--14 +150 (Feed)	86.1	12.2	---	"
--14 +150 (Concentrate)	---	66.9	4.2	"
--14 +150 (Tail)	---	2.2	---	"
-150 (Slime)	6.9	---	---	"

* BPL (bone phosphate of lime) = percent P₂O₅ x 2.185.

- 49-56 Sand, very clayey, only fine-grained black phosphate (no sample).
 56-62 Sand, very clayey, coarse (-14 mesh) and fine (-14-150 mesh) phosphate.
 62-68 Clay, sandy, green, phosphate as above.

Sample No. 2 (56-68 feet)

<u>Size fraction</u>	<u>Weight Percent</u>	<u>Percent BPL</u>	<u>Percent Acid Insoluble</u>	<u>Percent Uranium</u>
+14	3.2	61.8	10.4	Not available
-14 +150 (feed)	90.7	17.7	---	"
11 (concentrate)	---	63.8	11.9	"
7 (tails)	---	4.4	---	"
-150 (slime)	6.1	---	---	"

68-74 No returns, very fast drilling (loose sand?), T.D. = 74' in same material.

The thick, barren overburden (36 feet of loose sand) indicates that this hole was not drilled on the anomaly. The area is very flat and covered with loose sand. No reason could be found for the very slight anomaly.

Sumter County, Florida---Two small anomalies were detected in this country. Both correspond to small rounded hills, apparently outliers of the Hawthorn formation on a flat plain of Eocene limestone. Two holes were drilled, one in NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T. 22 S., R. 23 E., the other in NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 34, T. 21 S., R. 23 E. The logs of these holes follows:

NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 34, T. 21 S., R. 23 E.

- 0-5 Clay, very sandy, tan, with abundant soft white phosphate nodules. (Sampled.) 4-5 times background.
 5-12 Clay, sandy, tan, rust, and light grey, contains some phosphate nodules. About 2 times background.
 12-22 Clay, tan, and yellow, sticky, trace phosphate. Background.
 22-27 Clay, sandy, yellow-brown, contains abundant fine to coarse sand size phosphate nodules. (Sampled.) Background.
 27-34 Limestone, white, soft, clayey, at 34' too hard to drill further.

NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T. 22 S., R. 23 E.

- 0-9 Sand, very slightly clayey, red brown. 6-8 times background.
- 9-12 Sand, clayey, red and green mottled. 3 times background.
- 12-16 Clay, very sandy, wet, light tan; some white phosphate nodules.
2 times background.
- 23-35 Clay, calcareous, gray, green, and white nodules; some white
and brown phosphate nodules. Background.

At 35' too hard to continue. Limestone (?). Analytical data not yet available.

Marion County, Florida---Eight holes were drilled in Marion County.

Some of the holes were drilled on the anomalies, others for check purposes, on the edges. In addition, an outcrop of aluminum phosphate zone was sampled. The outcrop, in sec. 11, T. 16 S., R. 21 E., was sampled with the following results: P_2O_5 = 14.6 percent, U = 0.019 percent.

In all of the logs, background refers to the radiation intensity on the gamma-ray log of barren, loose quartz sand, and the radiation intensity of each lithologic unit was averaged and related to the background intensity.

One hole was drilled and sampled in NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 5, T. 17 S., R. 22 E.

The log follows:

- 0-2 $\frac{1}{2}$ Sand, very slightly clayey, brown, with lumps of iron-cemented sand. Slightly above background.
- 2 $\frac{1}{2}$ -8 Sand, clayey, brown, changes to gray at base. 5 times background.
- 8-11 Clay sandy, light gray. 10 times background.
- 11-16 Clay, blue-green, full of limestone fragments. 5 times background. (May be due to contamination.)

Too hard to drill at 16 feet. Limestone? Grab samples from 6'-16':
 P_2O_5 = 5.4 percent, U = 0.013 percent.

Because of the high count, (a peak of 10 times background from 3-11 ft.), a second hole was drilled about 100 yards north of the above hole, with the following results.

- 0-4 Sand, loose, brown. Background.
- 4-12 Sand, clayey, reddish-brown, with fragments of limestone.
3 times background.
- 12-18 Clay, greenish-gray, sandy, some iron-cemented sand fragments
and some limestone fragments. 4 times background.
- 18-48⁺ Clay, sandy, light-brown, with limestone fragments. 18-32' -
3 times background. 32-48' - background.
- 48-71 Clay, calcareous, tan (?). Very poor returns - unit uncertain.
Background. Too hard to drill further at 71 feet.

No samples were taken.

In addition, the following are significant drill-holes.

NE¹/₄ NE¹/₄ sec. 19, T. 16 S., R. 22 E.

- 0-4 Clay, gray, calcareous, with fragments of limestone, phosphatic.
4 times background.
- 4-7 Clay, gray, green, and brown, with fragments of phosphatized
limestone. 3 times background.

At 7' too hard to penetrate - limestone?

SE¹/₄ SE¹/₄ sec. 18, T. 16 S., R. 22 E.

- 0-2 Sand, loose, dark-brown. Background.
- 2-13 Clay, sandy, dark-brown, slightly calcareous. 2-3 times back-
ground.
- 13-22 Clay, sandy, light-brown, very calcareous, with abundant frag-
ments of limestone at 22' too hard to penetrate, Limestone?
Background.

No sample taken.

SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 11, T. 16 S., R. 21 E.

- 0-4.2 Sand, clayey, gray. 5-6 times background.
 4.2-18.0 Clay, sandy, brown and light-green. Background.
 18-27.0 Clay, sandy, gray-green. Background.
 27-29 Clay, sandy, white and light-gray, slightly calcareous.
 Background.

No samples taken.

In addition, two holes were drilled west of the anomalies, one in sec. 2, T. 15 S., R. 23 E., the other in sec. 24, T. 15 S., R. 24 E. Gamma-ray logs showed nothing above background; both penetrated only loose sand or interbedded loose sand, clayey sand, and clay.

Clay County, Florida--A large area only slightly above background was delineated by the airborne survey of 1953. One hole was drilled in the anomaly in sec. 1, T. 5 S., R. 24 E. This hole had the following log:

- 0-15 Sand, loose to slightly clayey, tan and reddish. Background.
 15-35 Sand, slightly clayey, gray. Slightly above background.
 35-46 Sand, clayey, gray with black phosphate nodules. 3-4 times background.
 46-65 Sand, very clayey, gray and green with black phosphate. Background.
 65-72 $\frac{1}{2}$ Clay, sandy, green, trace black phosphate. 2 times background.
 72 $\frac{1}{2}$ -74 Sand, brown, loose. Slightly above background.

Although this hole was drilled in the anomaly, nothing in the drill record indicates why the anomaly should have been present.

Bradford County, Florida--Two holes were drilled in the small anomalies in Bradford County. Both holes showed high gamma-ray counts at or close to the surface. Each hole penetrated about 7 feet of gray or white clayey sand, with a gamma-ray log 5-6 times background, under a thin cover of

loose sand. This material is probably the aluminum phosphate zone. Phosphate nodules occur under the clayey sand. No samples of the possible leached material were taken because of contamination during drilling, but samples of the underlying phosphate-bearing material were obtained. Analytical results are not available at the present time.

One additional hole was drilled outside of the anomalies. This hole had 22 feet of loose sand with no radiation above background, above the phosphate-bearing strata.

Union County, Florida--One hole was drilled at the north edge of an anomaly in Olustee Creek. No material above background was encountered in the drill-hole and apparently the hole was not on the anomaly. River pebble phosphate has been reported in Olustee Creek and in 1952 an outcrop of phosphate-bearing rock was found at the bridge in SW $\frac{1}{4}$ sec. 3, T. 5 S., R. 18 E. This anomaly may be due to river pebble in a small tributary to Olustee Creek.

DeSoto County, Florida--No drilling was done on the highs in DeSoto County. These anomalies were investigated by M. H. Bergendahl and R. M. Moxham of the Geological Survey, who found them to be caused by phosphate rock exposed in mining pits in the so-called river pebble area. Grab samples of the river pebbles averaged 0.013 percent equivalent uranium (Moxham, 1954, p. 3).

Taylor-Dixie Counties, Florida--A large anomaly was found along the Steinhatchee River at the boundary of these counties. A road traverse using a hand scintillation counter was run on State Highway 51 which passes through one corner of the anomaly, but no anomalous radioactivity was detected. One hole was drilled at Cooks Hammock, on the Steinhatchee River,

northeast of the area flown. The log of the hole showed 4 feet of brown loose sand, then 8 feet of gray clay, containing white phosphate fragments, which had radioactivity 2-3 times background. Hardrock phosphate crops out at Cooks Hammock, and a road traverse with the scintillometer showed the material to have radioactivity much higher than background. No uranium analysis is available.

Lake County, Florida--No drilling was done on the anomalies found in this county. However, the release of the maps of the airborne radioactivity survey stimulated interest, and some company drilling has been done in the area.

Orange County, Florida--No work has been done in the small anomaly in Orange County. River pebble phosphate is reported to occur north and east of Rock Springs Run and, therefore, it is possible that this small anomaly is caused by a concentration of river pebble in or near the run.

Altamaha River Drainage, Georgia--Anomalous radioactivity was detected in a few small areas, but the anomalies were only very slightly above background. Three holes were drilled in this drainage; none showed radioactivity above background.

Drilling in South Carolina--The complete results of the airborne radioactivity surveys in South Carolina are not yet analyzed. However, R. M. Moxham of the Geological Survey reported in a letter of June 24, 1954, that quite a few anomalous localities were picked up in the Edisto Island area, southern Charleston County.

Five holes were drilled in South Carolina; none showed anomalous radioactivity near the surface. However, three of the holes showed some high radioactivity deep in the section. One hole, in Dorchester County, on State

Highway 61, 1.4 miles south of the junction with U. S. Highway 17 Alt. was sampled. The log of the hole follows:

- 0-3 Clay, gray and rust mottled, stiff. Background.
- 3-9 Clay, dark tan to gray, firm. Slightly above background.
- 9-14 Clay, coarse, with some gravel. Slightly above background.
- 14-19 Clay, sandy, yellowish to light-tan, calcareous. Top of the weathered Cooper Marl. 2-3 times background.
- 19-39 Clay, vary calcareous, or marl, olive-green, sandy. Background, or slightly above. This interval was sampled and the sample contained 0.004 percent equivalent uranium, and 3.2 percent P_2O_5 .

Two other holes in Dorchester County showed similar radiation patterns; one of these was sampled for phosphate with the following results:

<u>Size fraction</u>	<u>Weight Percent</u>	<u>Percent BPL</u>	<u>Percent Acid Insoluble</u>
+20	3.0	11.6	17.1
-20+150	60.9	8.5	---
-150	36.1	---	---

Conclusions

Areas of abnormal radioactivity, as recorded by airborne surveys in Florida, in general were proved by drilling to be underlain, at shallow depths, by uranium-bearing phosphatic rocks. In Marion County, Florida, drilling within the areas of anomalous radioactivity showed aluminum phosphate material very close to the surface; check holes drilled outside the areas of anomalous radioactivity showed thick, barren quartz sand at the surface. However, several areas of anomalous radioactivity were drilled and checked with scintillation counter without finding any anomalous radioactivity. In the area near Olustee Creek, in Union County, Florida, and in the Steinhatchee area, the reason anomalous radioactivity was not found may be that the anomalous areas, as shown on county road maps, are mis-plotted. County roads in both cases are shown cutting across the edges of the anomalous areas, and if the line enclosing the area of anomalous radioactivity were moved only a short distance, the roads would be out of the areas and would be blank as the drilling indicated.

In Clay and Manatee Counties, Florida, and in the Altamaha River drainage in Georgia, the anomalies were very slight, only about twice background, and reasons for finding no anomalous radioactivity on the ground are not known.

In general, therefore, it would seem that anomalies which are greater than about twice background indicate the presence of uranium-bearing phosphatic rocks at or near the surface, while those anomalies which are only about twice background may or may not indicate the presence of phosphate rock.

References

- Moxham, R. M., 1954, Airborne radioactivity surveys for phosphate in Florida: U. S. Geol. Survey Circular 230.

