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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TRACE ELEMENTS RECONNAISSANCE IN FLORIDA

SECTION I - RADIOACTIVITY OF SOME FLORIDA
GALLES

SECTION II - RADIOACTIVITY OF PHOSPHATES
AND OTHER ROCKS IN FLORIDA

Preliminary Report

by

A. L. Slaughter

September 1945

Trace Elements Investigations - Report No. 17

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SECTION I

RADIOACTIVITY OF SOME FLORIDA SANDS

Preliminary Report

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April 26, 1945

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Introductory summary

Samples from two companies mining Florida beach sands were obtained by Robert A. Laurence of the Geological Survey in the summer of 1944 as part of the mill-products investigation. These samples were tested for radioactivity and a further investigation of the radioactivity of the sands was made by A. L. Slaughter and S. E. Clabaugh in April, 1945.

"Ilmenite" was first produced from Florida beach sands in 1916 at Mineral City, about 4 miles south of Jacksonville Beach. At the present time, rutile and zircon are also being commercially extracted from the sands.

Only a few chemical analyses for uranium are available. Determinations of ThO_2 are by spectrographic analysis.

The deposits of heavy minerals on the beaches of Florida cannot now be considered an important source of uranium and thorium. The operation of the Humphreys Gold Corporation is by far the largest of its type in the state. They produce only 250 tons per day or about 90,000 tons per year of heavy mineral concentrate containing about 0.010 percent equivalent uranium and about 0.02 percent ThO_2 .

Location and extent of deposits

The deposits at Mineral City have been described by Martens[/] as strips

[/] Martens, James H. C., Beach deposits of ilmenite, rutile, and zircon in Florida: Fla. Geol. Survey, 19th Annual Rept., pp. 124-154, 1928

occurring on the back part of the beach at the foot of the dunes and extending out a short distance in front of them. He says that during the early period of working, the richest streak at the foot of the dunes contained 60 percent of heavy minerals for a thickness of 2 to 3 $\frac{1}{2}$ feet and a width of 25 to 35 feet. Later, however, the average of the sand as worked was around 20

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percent heavy minerals and the dimensions somewhat smaller. At the time of Hartens' writing the workings had extended for a distance of 11 miles along the beach.

Vernon- / says that the highest percent of known concentration of ilmenite,

- / Vernon, R. O., Florida mineral industry; Fla. Geol. Survey, Bull. 24, pp. 139-146, 1943.

rutile, and zircon occurs along the east coast between Jacksonville and Melbourne, but that another possible area of commercial development is in western Florida along the coast and bays, particularly along East and Escambia Bays near Pensacola.

Interest is now focused on the lower grade dune and terrace sands. The heavy minerals are not concentrated to such a high degree as on the beaches, but are much more evenly distributed over larger areas. No deposits on the beaches are being mined at present.

Mineralogy

Ilmenite, rutile, and zircon have been of principal interest heretofore. Monazite, because of its high radioactivity, now becomes important although it is one of the least abundant constituents. A substantial part of the radioactivity is contributed by zircon. Compositions vary greatly from place to place, but on the average, ilmenite is the most abundant heavy mineral, zircon second and rutile third. Monazite is the fourth most abundant heavy mineral in some places, but in others is less abundant than staurolite, epidote, and garnet. At Venice, on the Gulf coast south of Sarasota, phosphate as collophane is the most abundant constituent of the dark sand.

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Sampling and radioactivity measurements

The Humphreys Gold Corporation.

The Humphreys Gold Corporation is the successor to the Rutile Mining Company of Florida. This company is mining terrace sands from a deposit 8 miles east of Jacksonville, Fla. (fig. 1). Heavy minerals are concentrated by means of the newly-developed Humphreys spiral concentrator (wet mill). Separation of ilmenite and rutile, the only minerals being produced commercially at the present time, is made by electrostatic and magnetic separators (dry mill).

The company mines 5000 tons of sand per day which contains an average of 5 percent heavy minerals. The average composition of the heavy mineral concentrate is as follows:

ilmenite	42%
zircon	12%
rutile	8%
monazite	1-2%

The remaining 35-37 percent is composed of staurolite, epidote, garnet, kyanite and other minerals. Clean zircon concentrate can be produced and changes are planned in the dry mill which will enable the company to produce zircon commercially. Dry mill tailings which contain the previously mined zircon have been saved and the zircon will be recovered. Mr. D. G. Brown, general manager, says that monazite can also be separated in the dry mill. Possible markets for monazite are being investigated.

Detailed information concerning samples is given in the following table. Samples JH1, 2, 3, and 4 were collected by Laurence; all others were collected by Slaughter and Clabaugh. The later samples came from an entirely different part of the pit. Determinations of radioactivity expressed as equivalent uranium

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are by laboratory gamma counting. Sample SF211 is too small for equivalent uranium determination, but it probably contains considerable thorium.

List of samples, Humphreys Gold Corp.

Sample No.	Percent equiv. U	Percent U chem.	Percent ThO ₂	Tons/day of product	Description
FR1	0.058	0.010	0.03	125	Dry mill tailings; includes all heavy minerals except ilmenite and rutile.
FR2	0.001			5000	Sand as mined.
FR3	0.001			4750	Wet mill tailings, mostly quartz.
FR4	0.042	0.010	0.02	250	Wet mill concentrates, heavy mineral feed to dry mill.
SFR5	0.000			7	2nd stage tailings from wet mill.
SFR6	0.029			250	Wet mill concentrates, heavy mineral feed to dry mill, same as FR4.
SFR7	0.051			125	Dry mill tailings, same as FR1
SFR8	0.008			105	ilmenite as produced.
SFR9	0.006			20	rutile as produced.
SFR10	0.062			20	Zircon from pilot test runs.
SFR11				2½-5	Monazite from pilot test runs.

It is apparent that the radioactive material is concentrated with the heavy minerals and that it is further concentrated in that part of the heavy mineral concentrate which does not contain the ilmenite and rutile, but which does contain the zircon and monazite. On the basis of two samples, uranium is responsible for only 15 to 25 percent of the total activity.

The reserves in this deposit are not known, but the company plans continued operation and at a rate of 5000 tons per day, one year's operation would require reserves of nearly 2,000,000 tons.

The Rix Mineral Company.

The Rix Mineral Company mines sand from a deposit at the southern edge of the city of Vero Beach, Fla. (fig. 1) about one mile from Indian River. Mr. O. W. Prichard is co-owner and manager and is one of the pioneers of the industry in Florida. The company concentrator is located at Melbourne, near the site of former mining operations. The rate of mining is 170 tons per day. The pit is 11 feet deep; the concentration of heavy minerals does not extend below the natural water level where a coarse white sand is encountered. The sand as mined averages 8½% heavy minerals. Ilmenite, rutile, and zircon are being produced. Bureau of Mines production figures for December, 1944 indicate a ratio of rutile to ilmenite of about 1 to 7.

The following samples were taken by Laurence. Determinations of equivalent uranium are by laboratory gamma counting.

List of samples, Rix Mineral Company

Sample No.	Percent equiv. U	Percent U chem.	Percent ThO ₂	Tons/day of product	Description
RI13	0.001			170	Sand as mined.
RI14	0.010			9	Heavy mineral concentrates.
RI15	0.001			161	Tailings, mostly quartz.
RI16	0.008			?	Ilmenite concentrates.
RI17	0.004			?	Rutile concentrate.
RI18	0.030	0.013	0.01	?	Zircon concentrate.
RI19	0.029	0.009	0.01	?	Dry mill tailings, probably contain monazite.

Beach concentrations of heavy minerals.

Samples were taken at 5 places along the beach between Jacksonville Beach and St. Augustine (fig. 1). The greatest thickness found was 2 1/2 feet (sample F932). This sample, taken just in front of the line of dunes, contains 0.008 percent equivalent uranium by field count. The most highly radioactive sample is from a 0.25 foot layer of black sand and contains 0.050 percent equivalent uranium. The thickness, degree of concentration, and width of the deposits are very irregular. The deposits are not continuous in a north-south direction along the beach but this is the direction of their greatest dimension.

Five samples were taken from a 1 1/2 mile stretch of beach at Venice, on the Gulf coast (fig. 1). Here, small concentrations of almost pure siron were found on the surface of the dark sand. A sample of dark sand taken by Martens from this beach contained 35 percent collophane.

-/ op. cit.

Samples are listed on the following page. Locations of samples are shown on the index map.

List of samples from beach concentrations

Sample No.	Thick. ft.	Percent equiv. U		Location and description	
		field count	lab. count		
FB51	1.7	0.014		Black sands, some light layers, just N. of Ponte Vedra Beach at end of low dune.	
FB52	2.5	0.013		Black and light sand layers, just S. of Ponte Vedra Beach on beach in front of dune.	
FB53	0.3	0.022	0.022	0.005	Black sand, 2 mi. N. of St. Augustine breakwater.
FB54	0.25	0.057	0.050	0.006	Black sand 7.5 mi. N. of breakwater.
FB55	1.7	0.011			Black and light sand layers, same location as FB54.
FB56	1.5	0.010			Black sand, thin layers of light sand, on beach just in front of sea wall, due E. of Crackertown, Palm valley quadrangle.
FB57	3.0	0.005			Black sand, much quartz and light material, 75 ft. from water, just S. of Venice Inlet on the Gulf.
FB58	0.3	0.010			Black sand, much quartz and light material, 75 ft. from water, just S. of Venice Inlet on the Gulf.
FB58	0.3	0.010			Black sand, closer to water, same location.
FB59	2.5	0.005			Coarse black sand, 20 ft. from water 1 mi. S. along beach from FB57 and S.
FB510		0.019			Sample of natural concentration of zircon on surface of beach, black sand only 4 inches thick, same location as FB59.
FB511	2.3	0.008			Black sand 1 1/2 mi. S. of Venice Inlet.

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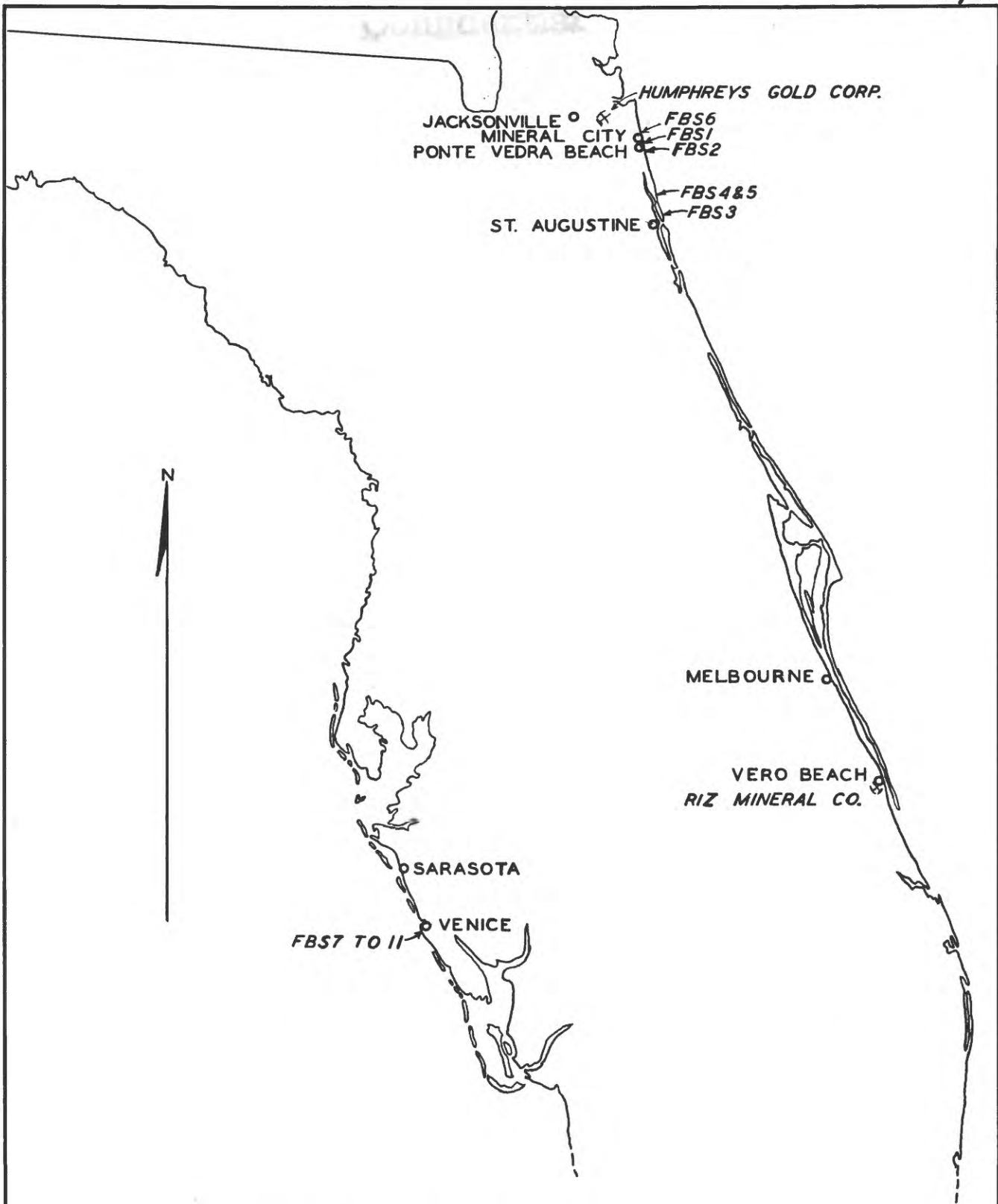
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Conclusion

On the basis of the present information, the deposits of heavy minerals on the present beaches of Florida cannot be considered an important source of uranium and thorium. The distribution of heavy minerals in the sands is too irregular to permit a large operation.

The best hope of producing uranium and thorium from Florida sands is in the in-shore deposits such as are being worked by the Humphreys Gold Corporation near Jacksonville and the Rix Mineral Company at Vero Beach. The extent of these deposits is not known but the one being worked by the Humphreys Gold Corporation must be quite large to permit the mining of 5000 tons per day. Even in an operation of this size, the radioactivity of the sand is so extremely low, that the actual amount of radioactive material recovered is not very large; 250 tons per day or 90,000 tons per year containing about 0.010 percent uranium and about 0.02 percent ThO_2 . It is quite possible that other large, low-grade deposits may be found.

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INDEX MAP OF PART OF FLORIDA
SHOWING LOCATIONS OF MINES AND SAMPLES



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SECTION II

RADIOACTIVITY OF PHOSPHATES AND OTHER ROCKS IN FLORIDA

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June 20, 1945

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- Fig. 1 - Map of part of Florida showing phosphate areas and sample locations.
- Fig. 2 - Index map, Florida main pebble phosphate field, showing locations of mines sampled.
- Fig. 3 - Columnar section of pebble phosphate bed, 4 miles northeast of Brooker, Bradford County.

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RADIOACTIVITY OF PHOSPHATES AND OTHER ROCKS IN FLORIDA

Preliminary Report

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June 20, 1945

Introductory summary

Work was begun by Robert A. Laurence of the Geological Survey who collected 30 samples from operating companies in both the pebble and hard-rock fields during the summer of 1944. Additional work was done by A. L. Slaughter and S. N. Clabaugh during April and May, 1945. The phosphate deposits were of main interest but tests were also made on peat and coquina.

The pebble phosphates are the most highly radioactive of the rocks tested. A direct relation between radioactivity and phosphate content is shown by samples collected from mines of seven companies operating in the main pebble field. The yearly production of the companies is about three million tons of phosphate rock containing 0.013 to 0.017 percent uranium, or 0.023 to 0.028 percent equivalent uranium with thorium contributing about 45 percent of the total activity. It is probable that further sampling could establish reserves of several million tons of phosphate containing 0.020 percent uranium. Reserves of phosphate rock for the main pebble field are listed by Mansfield (1942) at two billion long tons containing more than 70 percent B.P.L.

The hard-rock phosphate is low in radioactivity. Colloidal phosphate which is mined from the old hard-rock waste pits is also low in activity. Samples thought to be from the phosphatic Hawthorne limestones are not radioactive.

Samples of coquina and sandy peat were found to be very low in radioactivity.

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Phosphate Rock

Phosphate rock in Florida falls into one of three general classifications: land-pebble phosphate, river-pebble phosphate, and hard-rock phosphate. From the standpoint of production and reserves, the river-pebble deposits are of the least importance. No testing or sampling of the river pebble deposits was made during this investigation. The term "pebble phosphate" will henceforth refer solely to the land-pebble deposits.

Pebble phosphate in the main pebble field

Pebble phosphate is mined only in the main pebble field which centers in Hillsborough and Polk Counties and extends into Manatee and Hardee Counties to the south. Some prospecting has been done in the outlying pebble fields, but there has been no production from them.

Occurrence

The Bone Valley gravel of Pliocene age, which contains the pebble phosphate deposits, lies unconformably upon the Miocene Hawthorne limestone. The parts of the Bone Valley gravel which make up the phosphate deposits consist of grains and pebbles of phosphate rock in a gangue of sand and clay, all in varying proportions. The pebbles are commonly 1 $\frac{1}{2}$ inches long but the average diameter is probably between $\frac{1}{2}$ and $\frac{3}{4}$ inches. They vary in color from light gray to black. Recoverable phosphate may make up as much as 50 percent of the matrix (the term "matrix" is used to designate the phosphate, clay, sand mixture as mined), but usually constitutes 25 to 30 percent. The matrix is from 1 to 45 feet in thickness and the overburden of sand and clay may be more than 50 feet. The usual overburden-matrix ratio is about one to one, the average thickness of each being about 15 feet.

Mining and treatment

Mining of both overburden and matrix is done by drag-line excavators. The matrix is dumped into a small pit on the edge of the out where it is mixed with water and pumped to the washing plant. At the washing plants the particles coarser than $1/32$ or $3/64$ of an inch are separated by washing and screening. The size of the openings in the final screen is determined by the size of the largest sand grains. The finer particles of phosphate are separated from the sand and clay particles by hydroseparation, tabling, and flotation. The usual products of the washers and concentrating plants which go into the manufacture of fertilizers are; coarse pebble, fine pebble (often called regular rock), and the fine phosphate rock or concentrates. At some mines nearly all the phosphate can be recovered by washing and screening; most of the phosphate particles are larger than the coarsest sand grains.

Radioactivity

The equivalent uranium content of the samples was determined by gamma counting, either in the field or laboratory. Some have both field and laboratory counts. A number of the samples have been chemically analysed for uranium and some have been spectrographically analysed for thorium. The results of these determinations are given in the list of samples (table 1).

About 45 percent of the radioactivity of most of the samples is probably due to thorium. Nine samples for which both thorium and uranium have been determined are listed in table 2. Also shown is the calculated equivalent uranium, and for most of the samples this agrees well with equivalent uranium by laboratory counting.

The locations of the mines from which samples were collected are shown on the index map of the main pebble field (fig. 2). Samples of the various pro-

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ducts of the washers and flotation plants have shown that there is a definite, but not absolute, relation between phosphate content and equivalent uranium. The radioactive material is concentrated with the phosphate. The percent B.P.L. (bone phosphate of lime), percent equivalent uranium, and percent uranium in the usual products of the washers and flotation plants are shown in table 3. Some of the figures for B.P.L. content in this table are estimates given by company officials at the time the samples were collected, others are from approximate P_2O_5 determinations made in the Survey laboratory.

The pebble and the phosphate concentrate have average equivalent uranium contents of 0.028 and 0.023 percent respectively. The average uranium content of the pebble on the basis of ten samples which were chemically analyzed is 0.017 percent. The phosphate concentrate, on the basis of seven sampled, contains an average of 0.013 percent uranium. The reason for the greater activity of the pebble is not apparent as it contains less B.P.L. than the concentrate. Samples of pebble from the San Gully mine of the Southern Phosphate Co. and the South Pierce mine of the American Agricultural Chemical Co. (fig. 2) contain more than 0.020 percent uranium (table 1). The products from the Peace Valley mine of the International Minerals and Chemical Corp. are lower in radioactivity than like products from the other mines (table 1). These differences in radioactivity and uranium content in different parts of the main pebble field indicate a somewhat uneven distribution of uranium and other radioactive materials.

A sample (YP56) of super-phosphate which was obtained from the fertilizer plant of the American Agricultural Chemical Co. at Pierce contains 0.012 percent uranium and 0.019 percent equivalent uranium by laboratory count. This product contains 18 percent P_2O_5 which is equivalent to about 40 percent B.P.L.

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Reserves

Mansfield / lists reserves for the main pebble field as of 1938. Known

/ Mansfield, G. R., Phosphate resources of Florida: U. S. Geol. Survey, Bull. 934, 1942.

reserves are given by him as follows:

74 percent B.P.L. and above	•	70 to 74 percent B.P.L.
130,000,000 long tons		1,870,000,000 long tons

Annual production of phosphate from the main pebble field is about three million tons which probably contains an average of 0.013 to 0.017 percent uranium and an average of 0.023 to 0.028 percent equivalent uranium. Further sampling might establish reserves of several million tons of phosphate containing 0.020 percent uranium.

Outlying pebble fields

Three outlying pebble fields are shown on the index map (fig. 1). Attempts to find outcrops or to take samples were made only in Hamilton County. No outcrops could be found. Parts of this field have been prospected by the International Minerals and Chemical Co. of Mulberry, but no samples are available from this work.

Sellards / described the section in a sink hole in Bradford County, about

/ Sellards, E. H., Minerals industries: Fla. Geol. Survey, 2nd Ann. Rept. 1909, pp. 238-240.

four miles northeast of Brooker. Here, 39 feet of matrix containing varying amounts of pebble phosphate lies beneath 37 feet of shell marl and covered slope. This locality does not lie within any of the outlying pebble areas as outlined by Mansfield (fig. 1, samples 67, 68, and 69). The bottom 10 feet of

this section could not be reached, but outcrop readings were taken on the remainder. This is one of two places where outcrop counting was used in the Florida work. Details of outcrop counting and sampling are shown on the columnar section, (fig. 3). One five-foot bed of pebble phosphate was found to contain 0.012 percent equivalent uranium by laboratory count. The pebble is dark colored and makes up 63 percent of this bed, contains 0.015 percent equivalent uranium by laboratory count. The clay which is a binder for the pebble contains 0.006 percent. Large pebble and concretionary masses which occur at a narrow horizon near the top of this bed contain 0.017 percent uranium, 0.032 percent equivalent uranium.

Hard-rock phosphate

Occurrence

The hard-rock phosphate, usually considered of Pliocene age, is residual, resulting from the disintegration of the Hawthorne limestone and the solution and redeposition of part of the phosphate. The hard-rock field is a long narrow belt extending south from Suwannee County to Pasco County. Within this belt, the hard-rock phosphate occurs in localized deposits in fragments of different shapes and sizes, mostly boulders, irregularly distributed in a matrix of sand, clay, and soft white phosphate. The deposits may be as much as 100 feet in thickness and may be covered by as much as 50 feet of overburden. In the workable deposits, the hard-rock phosphate forms 25 to 30 percent of the material and in some places contains more than 80 percent B.P.L.

Radioactivity

Samples of hard-rock phosphate were obtained from two mines, both in Citrus County, south of Dunnellon (fig. 1, samples 1 and 2, and samples 57 to 63).

One of these, Section 12 mine of the C. & J. Camp Co., three miles south of Dunnellon, is the only mine now operating in the hard-rock field, and of the five

samples, none contains more than 0.002 percent equivalent uranium by field count. The shipping phosphate from the other mine, previously operated by the same company, contains 0.003 percent equivalent uranium and the screenings 0.007 percent, both by laboratory count.

Outcrop readings were taken on the wall of an old hard-rock pit, 4 1/2 miles north of Dunnellon, Marion County. A two-foot sample, taken at the point where the best outcrop reading was obtained (17 counts per minute), was found to contain 0.003 percent equivalent uranium by field count.

Several companies are scraping colloidal phosphate from the surfaces of old hard-rock waste ponds which are now dry. This material segregates at the far ends of the ponds. It contains 45 to 50 percent B.P.L. and is used as fertilizer without further treatment. Samples Fp62 and 63 are from an old pond adjacent to the Section 12 mine. They contain 0.003 and 0.005 percent equivalent uranium by field count. Sample Fp70, which contains 0.007 equivalent uranium by laboratory count is from the Loncala Phosphate Co., Clark, Alachua County. Fp3 is from the Bradley Estate mine at Floral City, Citrus County and contains 0.006 percent equivalent uranium by laboratory count.

Phosphatic limestone

Two samples of limestone thought to be from the phosphatic Hawthorne formation were taken in Hamilton County (fig. 1, samples 65 and 66). Both samples contain less than 0.001 percent equivalent uranium by field count.

Coquina and peat

Sample S153-522 was cut from a two-foot bed of coquina on the bank of the Indian river about 9 miles south of Melbourne, Brevard County. No radioactivity is perceptible with the field instrument.

Two samples of peat were collected at the same locality. This is a loosely-consolidated, brown, sandy material with abundant organic matter. Both are low in radioactivity. A two-foot layer of dark brown, sandy muck on the back of the beach at Venice, Sarasota County, contains 0.005 percent equivalent uranium by field count. This material grades into the beach sand below.

Table No. 1 - List of samples

Sample No.	Percent field count	equiv. U lab. count	Percent U Chem.	Percent ThO ₂ spect.	Description and location
FP1		0.003			hard rock phosphate (shipping product) C. & J. Camp Co. mine Felicia, Hernando County.
FP2		0.007			screenings
FP3		0.006			waste from washing of hard rock phosphate, Bradley Estate mine, Floral City, <u>Hernando County.</u>
FP4		0.023		0.01	75% B.F.L. concentrate, Coronet Phosphate Co., Coronet, Hillsborough County.
FP5		0.024	0.015	0.01	78% B.F.L. concentrate.
FP6		0.024	0.016	0.01	pebble phosphate, 72-73% B.F.L.
FP7		0.017	0.012	0.01	sizer tailings, 62% B.F.L.
FP8		0.008	0.006		flotation heads, 30% B.F.L.
FP9		0.003			flotation tails, less than 5% B.F.L.
FP10		0.013	0.006		matrix, 40% B.F.L., Swift & Co. Fertilizer Works, Agricola, Polk County.
FP11		0.004			flotation tailings, 95% SiO ₂
FP12		0.003			flotation tailings, 88% SiO ₂
FP13		0.017	0.009		concentrates, 77% B.F.L.
FP14		0.022	0.012	0.009	pebble phosphate, 73% B.F.L.
FP15		0.031		0.008	concentrates, 75% B.F.L., American Cyanamid Co., Eaton Park, Polk County.
FP16		0.022	0.013	0.01	concentrates, 77% B.F.L.

Table No. 1 - List of samples continued

Sample No.	Percent field count	equiv. U lab. count	Percent U chem.	Percent ThO_2 spect.	Description and location
FP17		0.002			tailings, 10% B.F.L.
FP18	✓	0.009	0.004		tailings from old piles, 25% B.F.L.
FP19	✓	0.010	0.005		matrix, 15% B.F.L., American Agricultural Chemical Co., South Pierce mine, Pierce, Polk County.
FP20		0.005	0.002		tailings, 95% SiO_2
FP21		0.036	0.013	0.02	14 mesh concentrate, 67% B.F.L.
FP22		0.021	0.009		matrix, Phosphate Mining Co. 91 mine, Bartow, Polk County.
FP23	✓	0.023	0.009	0.01	flotation concentrates, 75% B.F.L.
FP24		0.023	0.009	0.01	pebble phosphate, 70% B.F.L.
FP25		0.005			tailings, 13% B.F.L.
FP26	✓	0.010	0.006		debris from old work, 18-20% B.F.L. Pawsey mine of the Southern Phos. Co., Highland City, Polk County.
FP27		0.027	0.010	0.02	concentrates, 75% B.F.L.
FP28		0.002			tailings
FP29		0.009	0.007		washer slime, American Cyanamid Co., Eaton Park, Polk County.
FP30		0.012	0.007		matrix
FP31	0.008				clay under matrix, Peace Valley mine of the International Mineral and Chemical Corp., Polk County.
FP32	0.006	0.010			heavy clay matrix
FP33	0.010	0.015	0.012		coarse pebble from first screening 50-60% B.F.L.

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Table No. 1 - List of samples continued

Sample No.	Percent field count	equiv. U lab. count	Percent U chem.	Percent ThO ₂ spect.	Description and location
FP34	0.013	0.011			mixture of table and flotation concentrates, 75% B.P.L. or better.
FP35	0.002				flotation tails, approx. 4% B.P.L.
FP36	0.006				petrified wood and bone picked from coarse pebbles.
FP37	0.018	0.037	0.013		matrix, 58% B.P.L. 122 mine of International Mineral & Chemical Co., Polk County.
FP38	0.035				coarse pebbles, 3/8" to 1", 58% B.P.L.
FP39	0.026				fine pebble, 1mm to 3/8", 74% B.P.L.
FP40	0.002				debris, washer tailings.
FP41	0.029	0.042	0.023		coarse pebble, approx. 70% B.P.L.
FP42	0.026	0.024	0.021		fine pebble " " "
FP43	0.026	0.024	0.015		classifier product, 14-20 mesh
FP44	0.022	0.027	0.015		flotation concentrate, San Gully mine of the Southern Phosphate Corp., Polk County.
FP45	0.022	0.021	0.015		matrix, 38-40% B. P. L., South Pierce mine of the American Agricultural Chemical Co., Polk County.
FP46	0.032	0.039	0.023		coarse pebble, 65-68% B.P.L.
FP47	0.037	0.035	0.020		fine pebble, 70% B.P.L.
FP48	0.006				washer tails
FP49	0.010	0.007			flotation feed, screened from drill core, contains abund. qtz., Boyette tract of the American Agricultural Chemical Co.

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Table No. 1 - List of samples continued

Sample No.	Percent field count	equiv. U lab. count	Percent U chem.	Percent ThO ₂	Description and location
FP50	0.016	0.032	0.014		clayey matrix, 45% B.P.L., Carmichael mine of American Agricultural Chemical Co., Hillsborough County.
FP51	0.029	0.019	0.017		regular pebble, 77% B.P.L.
FP52	0.014				washer undersize, through 3/64"
FP53	0.013				flotation feed.
FP54	0.034	0.034	0.019		flotation product, 80% B.P.L.
FP55	0.002				flotation tails
FP56	0.014	0.019	0.012		super-phosphate, 18% P ₂ O ₅ , Fertilizer plant of the American Agricultural Chemical Co., Pierce, Polk County.
FP57	none				coarse product, C. & J. Camp Co. Section 12 mine (hard-rock phos.) near Dunnellon, Hernando County.
FP58	0.002				regular product
FP59	0.002				screenings
FP60	0.001				tails from washer
FP61	none				coarse rejects
FP62	0.002				colloidal phosphate from adjacent operation by Camp, 50-52% B.P.L.
FP63	0.005				colloidal phosphate, 45% B.P.L.
FP64	0.003				2.0' hard-rock phosphate from old pit 4 1/2 miles north of Dunnellon, Marion County.

Table No. 1 - List of samples continued

Sample No.	Percent field count	equiv. U lab. count	Percent U chem.	Percent ThO_2 spect.	Description and Location
FP65	0.001				limestone, Hawthorne fm (?), hwy 50, 0.6' miles north of Suwanee River bridge, Hamilton County.
FP66	0.001				Hawthorne limestone (?) at Suwanee River bridge.
FP67	0.016	0.012			5.0' pebble phosphate in light-colored clay from sink hole 5 miles east of Booker, Bradford County.
FP68	0.016	0.020	0.013		4" dark pebble layer at bottom of FP67.
FP69	0.025	0.032	0.017		large dark pebble and concretionary masses from horizon near top of FP67.
FP70	0.005	0.007			colloidal phosphate from old hard rock waste pits, Loncal's Phosphate Co. Clark, Alachua County.

Table No. 1 - List of samples continued

Samples not related to the phosphates

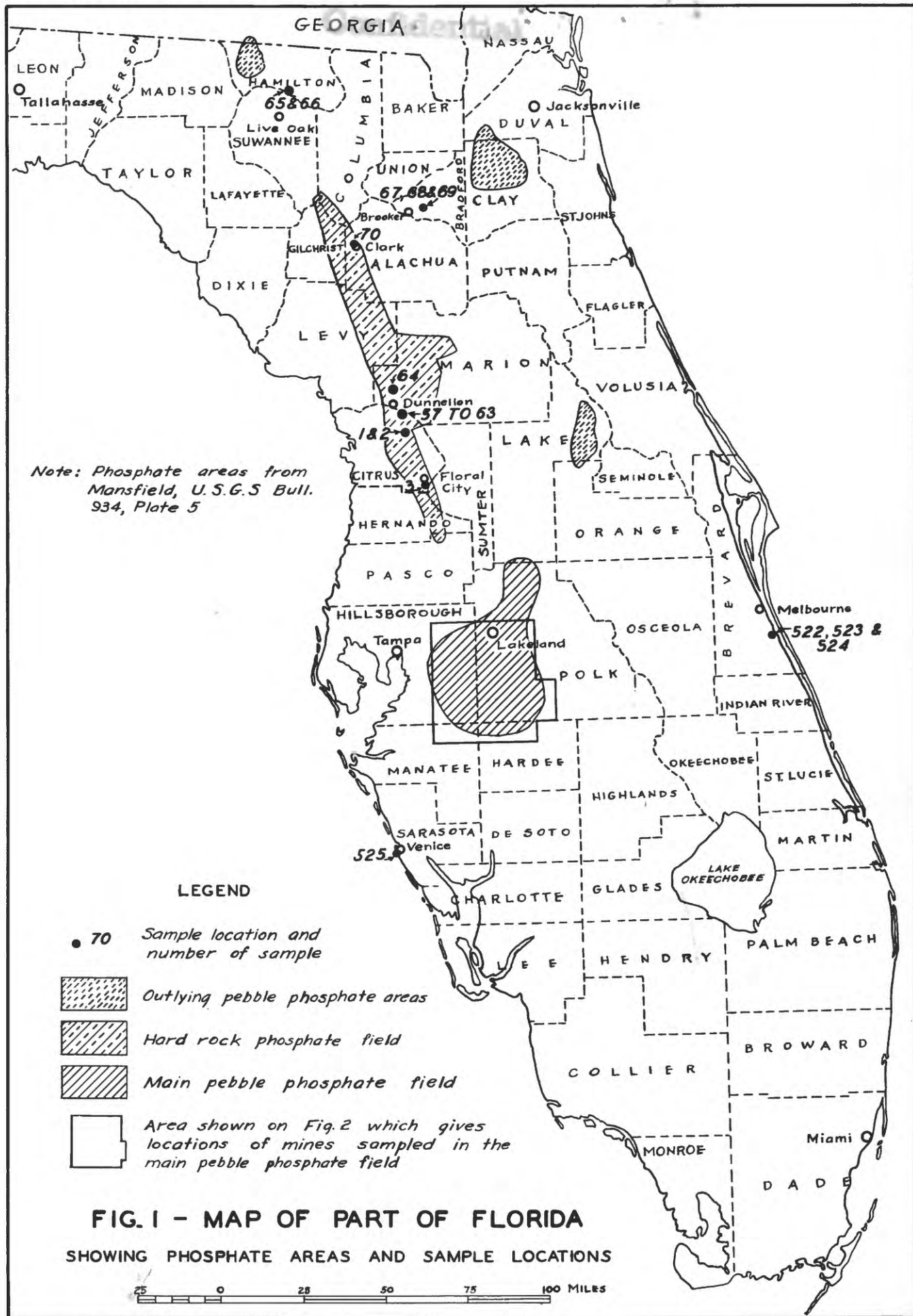
Sample	Percent equiv. U field count	Thickness feet	Description and location
S163-522	none	2.0	Coquina, 9 miles south of Welburne, Brevard County, west bank of the Indian River.
S163-523	0.002	2.0	Peat, sandy, soft, brown, same location as S163-522
S163-524	none		Peat, dark-brown, sandy, same location.
S164-525	0.005	2.0	Peat, dark-brown, sandy, beach at Venice, Fla.

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Table No. 2 - Calculation of equivalent uranium

Sample No.	Percent U chem.	Percent ThO ₂ spectro.	Percent equiv. U calculated	Percent equiv. U lab. counting
FP5	0.015	0.01	0.022	0.024
FP6	0.016	0.01	0.023	0.024
FP7	0.012	0.01	0.019	0.017
FP14	0.012	0.009	0.018	0.022
FP16	0.013	0.01	0.020	0.022
FP21	0.013	0.02	0.027	0.036
FP23	0.009	0.01	0.016	0.023
FP24	0.009	0.01	0.016	0.023
FP27	0.010	0.02	0.024	0.027

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Note: Phosphate areas from Mansfield, U.S.G.S Bull. 934, Plate 5

Table No. 3 - Radioactivity, phosphate and uranium content of products from the main pebble phosphate field

	Matrix			Pebble			Washer tails for flotation			Washer tails not floated			Concentrates			Flotation tails	
	% B.P.L.	% equiv. U	% U	% B.P.L.	% equiv. U	% U	% B.P.L.	% equiv. U	% U	% B.P.L.	% equiv. U	% U	% B.P.L.	% equiv. U	% U	% B.P.L.	% equiv. U
Coronet Phosphate Co. Coronet				73	0.024	0.016	30	0.008	0.006				75 78	0.023 0.024	0.015	5	0.003
Swift & Co. Agricola	40	0.013	0.006	73	0.022	0.012							77	0.017	0.009	5	0.003 0.004
American Cyanimid Co. Eaton Park		0.012	0.007					0.009	0.007				75 77	0.021 0.022	0.013	10	0.002
American Cyanimid Co. Brewster							25	0.009	0.004								
American Agricultural Chemical Co. South Pierce mine	38 15	0.021 0.010	0.015 0.005	70 68 67	0.035 0.039 0.036	0.020 0.023 0.013				5	0.006	0.002					
American Agricultural Chemical Co. Carmichael mine	45	0.022	0.014	77	0.029(f)	0.017		0.013(f)					80	0.034	0.019		0.002
American Agricultural Chemical Co. Boyette Tract								0.007									
Phosphate Mining Co. 91 mine, Bartow		0.021	0.009	70	0.023	0.009							75	0.023	0.009	15	0.005
Southern Phosphate Co. Pauway mine							20	0.010	0.006				75	0.027	0.010		0.002
Southern Phosphate Co. San Gully mine				70 70	0.024 0.029(f)	0.021 0.023								0.027	0.015		
International Minerals & Chemical Corp. 122 mine	58	0.018(f)	0.013	74 69	0.026(f) 0.035(f)							0.002(f)					
International Minerals & Chemical Corp. Peace Valley mine		0.010		60	0.015	0.012							76	0.011		4	0.002
Average	39	0.015		71	0.028		25	0.009		5	0.005		76	0.023			0.003

(f) equivalent uranium determination by field gamma counting, all others by laboratory counting

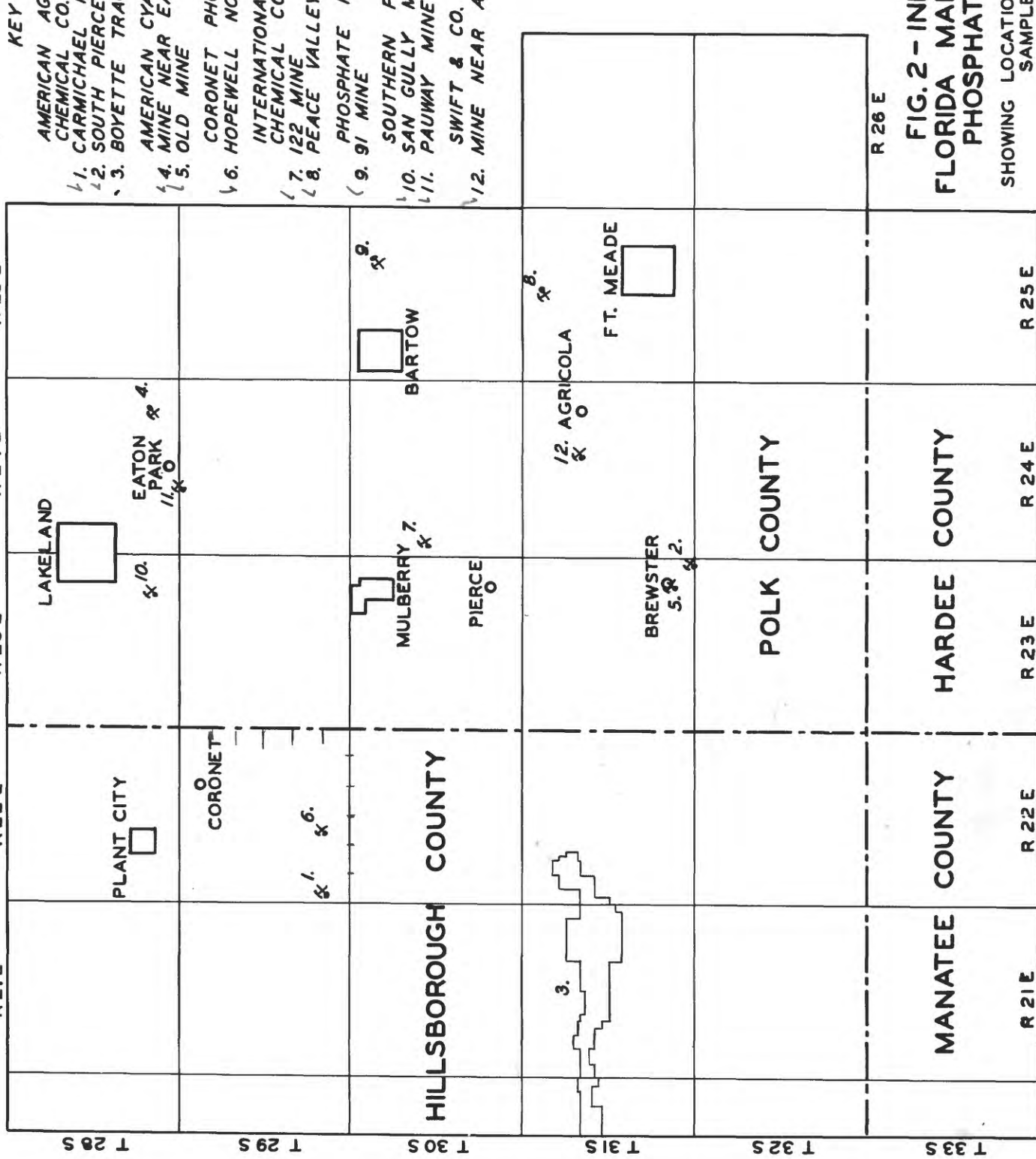
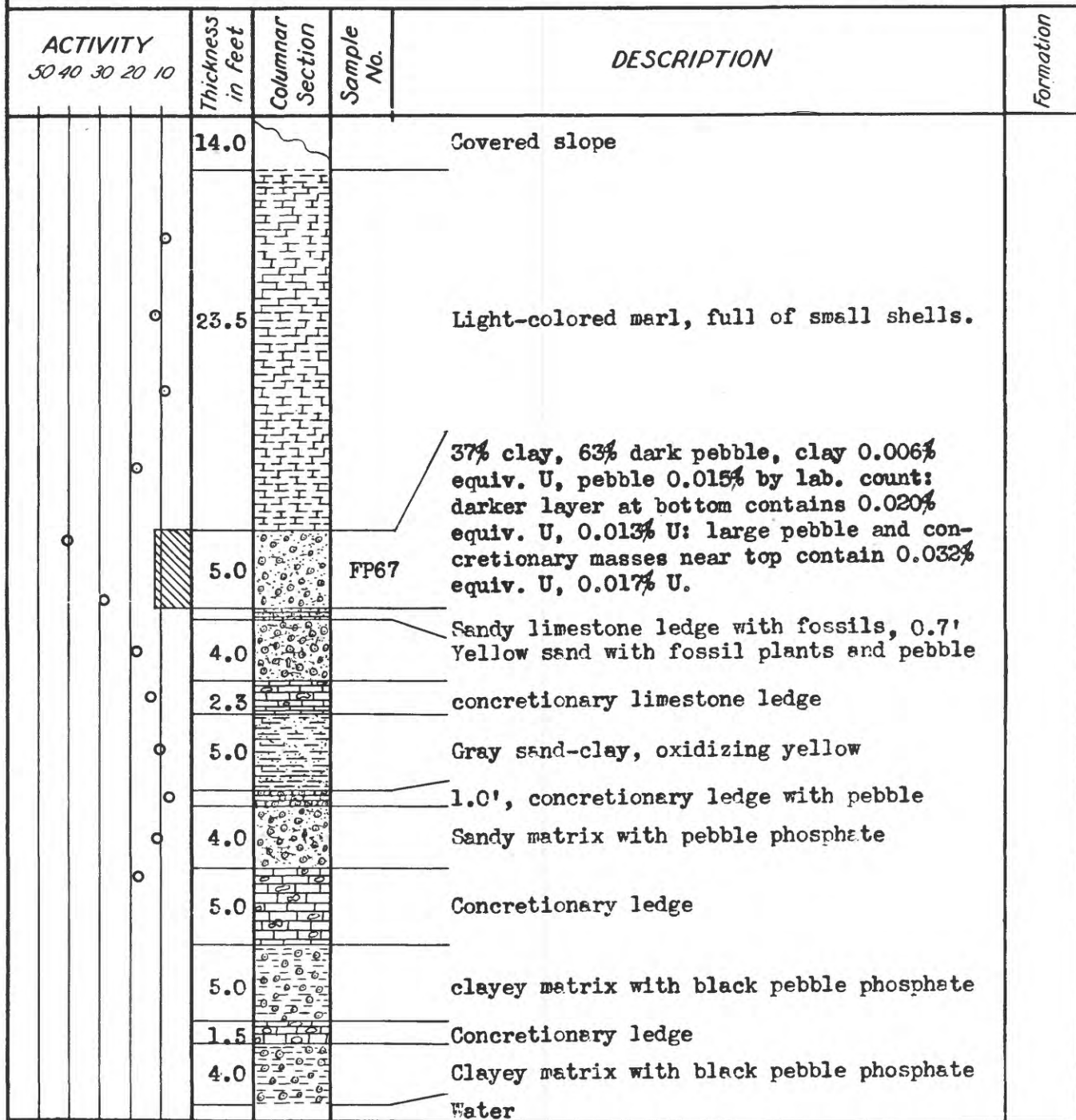



FIG. 2 - INDEX MAP
FLORIDA MAIN PEBBLE
PHOSPHATE FIELD
 SHOWING LOCATIONS OF MINES
 SAMPLED

Fig. 3
Section containing pebble phosphate beds, 4 miles north-east of Brooker, Bradford County, Fla. (after Sellards)



ACTIVITY:

o Count per minute at outcrop.

 Approximate radioactivity determined by testing (in lab.) crushed rock, expressed in thousandths of percent equivalent uranium. Not determined for all samples.

 Uranium content determined by chemical analysis, expressed in thousandths of percent.

SCALE

0 10 20 30

Measured and sampled by
A. L. Slaughter
April 30, 1945

Table No. 1 - List of samples

Sample No.	Percent field count	equiv. U lab. count	Percent U Chem.	Percent ThO spect.	Description and location
FP1		0.003			hard rock phosphate (shipping product) C. & J. Camp Co. mine Felicia, Hernando County.
FP2		0.007			screenings
FP3		0.006			waste from washing of hard rock phosphate, Bradley Estate mine, Floral City, <u>Hernando County.</u>
FP4		0.023		0.01	75% B.P.L. concentrate, Coronet Phosphate Co., Coronet, Hillsborough County.
FP5		0.024	0.015	0.01	78% B.P.L. concentrate.
FP6		0.024	0.016	0.01	pebble phosphate, 72-73% B.P.L.
FP7		0.017	0.012	0.01	sizer tailings, 62% B.P.L.
FP8		0.008	0.006		flotation heads, 30% B.P.L.
FP9		0.003			flotation tails, less than 5% B.P.L.
FP10		0.013	0.006		matrix, 40% B.P.L., Swift & Co. Fertilizer Works, Agricola, Polk County.
FP11		0.004			flotation tailings, 96% SiO ₂
FP12		0.003			flotation tailings, 88% SiO ₂
FP13		0.017	0.009		concentrates, 77% B.P.L.
FP14		0.022	0.012	0.009	pebble phosphate, 73% B.P.L.
FP15		0.021		0.008	concentrates, 75% B.P.L., American Cyanamid Co., Eaton Park, Polk County.
FP16		0.022	0.013	0.01	concentrates, 77% B.P.L.

