CORE DRILLING PROJECT
PEYTON CREEK PHOSPHATE AREA
ARKANSAS

FINAL REPORT - PHASE II

Arkansas GEOLOGICAL COMMISSION
STATE CAPITOL ■ LITTLE ROCK, ARKANSAS

NORMAN F. WILLIAMS
STATE GEOLOGIST

January 15, 1965

MEMORANDUM

To: Chief, Technical Projects Division
Area Redevelopment Administration
U. S. Department of Commerce
Washington 25, D. C.

Subject: Supplemental Conclusions to the Final Report Phase II
Contract No. Cc-6098

It is our conclusion that the drilling and other testing accomplished under the program carried out in the subject contract with your agency was adequate to establish the limits of the phosphate deposit being investigated. Since we were given to understand that the total tonnage to be required for the Mississippi Chemical Company to justify construction of a phosphoric acid or elemental phosphorus plant would have to be about three times as great as that proven by our drilling; we further conclude that the reserves present in the subject deposit are not adequate to justify the further consideration of Mississippi Chemical Company for a plant of the size they projected in their original discussions.

The Peyton Creek Phosphate Mining Company is currently producing some rock from this deposit and fine grinding it so that it can be sold for application as raw rock phosphate for appropriate agricultural purposes. The potential for an operation of this type can not be accurately established at this time since certain market and transportation considerations have not been completely explored. It is possible that a small but continuing and profitable operation of this type can be supported by the market and raw material presently known to be available.

We have been informed that additional investigations have been started and further investigations are contemplated for the purpose of establishing whether or not this material can be beneficiated to the degree necessary to make the product useable as feed for fertilizer plants in the State. It is our understanding that this work is being sponsored by the Peyton Creek Phosphate Mining Company. If these tests

show that the material can be beneficiated to a satisfactory grade at a low enough price to make it competitive with material now being shipped in from Florida, there is a substantial market available in Arkansas and a larger operation could be supplied, over the period required for the amortization of investment, by the reserves proven by the drilling and testing carried on as a part of our project under the subject contract.

Copies of this report will be kept on file by the State for inspection by interested parties.

Norman F. Williams

FINAL REPORT - PHASE II

ARA CONTRACT - Cc-6098

CORE DRILLING PROJECT
PEYTON CREEK PHOSPHATE AREA
ARKANSAS

FINAL REPORT - PHASE II

CORE DRILLING PROJECT - PEYTON CREEK PHOSPHATE AREA

SEARCY VAN-BUREN COUNTIES, ARKANSAS

INTRODUCTION:

Core drilling of the phosphate rock deposits in the Peyton Creek area of Searcy and Van Buren Counties, Arkansas has been conducted in two phases under the A.R.A. assistance program. During the first phase, October 1963 to January 1964, a total of eight holes was drilled at the Marshall deposit in Searcy County and six holes at the Ferguson deposit in Van Buren County. The results of the Phase I drilling are included in a prior report dated February 1964.

On completion of the first phase it was decided that further testing of the Marshall deposit was unjustified, and that the Phase II drilling should be used to extend the known reserves in the Ferguson deposit. The contract for the Phase II core drilling was let on April 2, 1964 to the E. J. Longyear Company of Minneapolis, Minnesota. Drilling was begun on May 1, 1964 and terminated on October 2, 1964 with the completion of nine core holes. This report summarizes the results of the Phase II drilling.

DRILLING OPERATIONS:

One Longyear core drill was utilized in the project on an eight-hour day, six-day work week basis.

The drilling contractor elected to use wire-line coring methods down to the ore zone and standard NX coring equipment for the ore interval. The result was that except for the upper few feet of hole that was drilled for setting surface casing, there was a continuous core sample for practically the full depth of each hole. Core recovery within

the ore zone itself was consistently well above the specified 85 percent in all drill holes.

SAMPLING AND ASSAYING:

In most of the drill holes the phosphate rock occurred as a single, fairly uniform layer. In holes S-8, 10 and 11, however, the phosphate zone was made up of two ore more layers of varying grade. Each of these layers was sampled and analyzed individually and the results appear in the table of chemical analyses. In the sampling process the cores were split, one half being sent to the laboratory for chemical analysis, and the remaining half returned to its proper sequence in the core box for a permanent reference. In addition adequate footages of core were retained to provide information on floor and roof conditions. All these cores are currently in storage at the office of the Peyton Creek Phosphate Mining Company at Leslie, Arkansas. All chemical analyses of the cores were made in Arkansas Geological Commission laboratory at Little Rock. Pulps of all the samples have been retained in the event check analyses are desired. Only the P_2O_5 content of the core samples was run to permit the laboratory to keep up with the drilling. Assays of the core samples are shown both on the table of analyses and on the stratigraphic logs of the individual drill holes.

RADIOACTIVE LOGGING:

As in the Phase I drilling, gamma ray logs were run in as many of the holes as possible to make certain that no important phosphate beds were overlooked in the core examination. Arrangements were made with the Water Resources Branch of the U. S. Geological Survey to use their truck-mounted logging equipment on a rental basis.

FERGUSON DEPOSIT

CHEMICAL ANALYSES OF PHASE II CORE SAMPLES

Hole No.	Sample No.	DEPTH INTERVAL (Ft.) From	To	Interval	PERCENT P_2O_5	COMPOSITE Thickness	Percent P_2O_5
S-7	1	372.6	379.3	6.7	16.3		
S-8	1	387.8	390.3	2.5	11.0	9'	23.7
	2	390.3	396.5	6.2	28.8		
S-9	1	391.5	402.7	11.2	18.4		
S-10	1	412.0	414.2	2.2	22.1		
	4	414.2	415.3	1.1	3.4	12'	19.2
	2	415.3	424.3	9.0	20.5		
	3	433.7	438.2	4.5	1.1		
S-11	1	366.5	369.7	3.2	14.6		
	2	369.7	373.2	3.5	18.3	7'	16.5
S-12	1	401.6	408.9	7.3	17.5		
S-13	1	454.3	455.3	1.0	21.2		
S-14	1	452.1	454.6	2.5	11.6		
S-15	1	378.2	383.1	4.9	12.4		

Of the nine holes drilled during Phase II an attempt was made to log all but Hole S-14 which did not have surface casing left in it. Of the remaining eight holes only four (Holes S-7, 8, 10 and 13) were logged in their entirety because of difficulties in re-entering the drill holes. Reproductions of the lower portions of the logs of these four holes appear in the Appendix.

The gamma ray logs of these holes accurately verified the phosphate layers that had previously been visually logged in the core, and they also verified that no phosphate layers had been overlooked in the core examination.

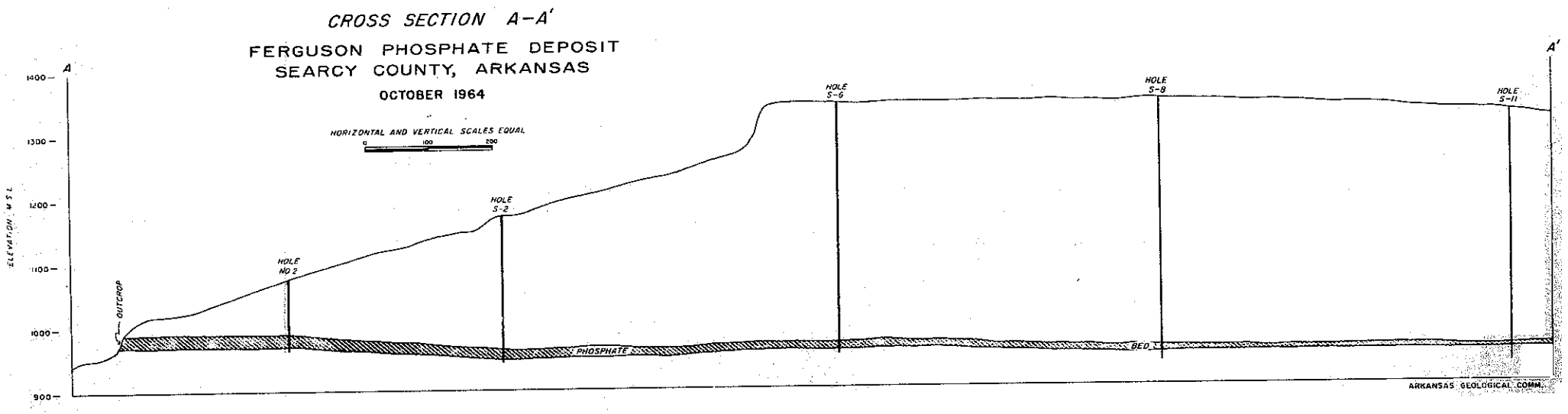
THE FERGUSON DEPOSIT:

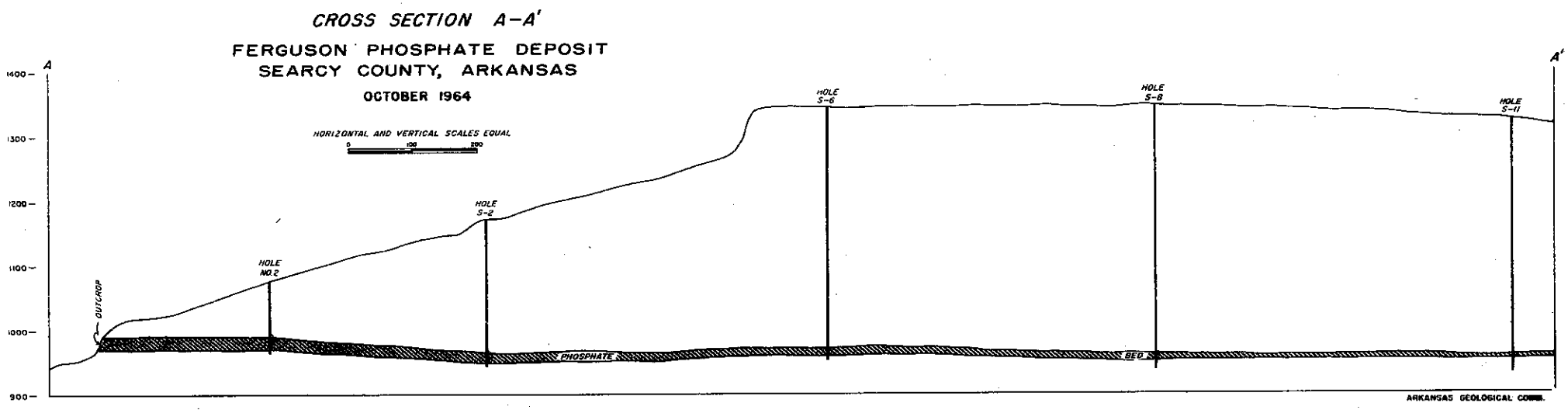
Phase I drilling established that the phosphate rock trends southward from the outcrop, and the Phase II drilling determined the extent of this trend. The nine holes drilled during Phase II revealed that the deposit has a tongue-like shape and extends southward a distance of about 2700 feet from the outcrop. The shape of the orebody suggests that it may have been deposited in a bay or estuary.

The sequence of sandstone and shales overlying the phosphate rock as well as the sandstone bed enclosing it could be readily correlated in all the drill holes. From a study of the drill cores it appears that the phosphate was deposited along with the enclosing sandstone in topographic lows, i.e. basins and channels in the Pitkin land surface.

The age of the phosphate rock is probably Mississippian, and it lies at or near the base of what the U. S. Geological Survey has designated as the Cane Hill formation in this area.

The phosphate rock cored in the Phase II drilling is essentially the same in composition and texture as that found in previous drilling and along the outcrop. It has the


CROSS SECTION A-A'
FERGUSON PHOSPHATE DEPOSIT
SEARCY COUNTY, ARKANSAS
OCTOBER 1964
HORIZONTAL AND VERTICAL SCALES EQUAL
0
100
200
ELEVATION, M.S.L.
1400
1300
1200
1100
1000
900
A
A'
OUTCROP
HOLE NO. 2
HOLE S-2
HOLE S-6
HOLE S-8
HOLE S-11
PHOSPHATE
BED
ARKANSAS GEOLOGICAL COMM.


CROSS SECTION A-A'
FERGUSON PHOSPHATE DEPOSIT
SEARCY COUNTY, ARKANSAS
OCTOBER 1964
HORIZONTAL AND VERTICAL SCALES EQUAL
0
100
200
A
A'
1400
1300
1200
1100
1000
900
OUTCROP
HOLE NO. 2
HOLE S-2
HOLE S-6
HOLE S-8
HOLE S-11
PHOSPHATE BED
ARKANSAS GEOLOGICAL COMM.

characteristic oolitic texture, calcite cement, carbonized wood fragments, pyrite, and varying amounts of quartz sand. The variations in grade are due primarily to the degree of dilution of the rock with sand grains.

ORE RESERVES - FERGUSON DEPOSIT:

Ore reserve estimates were made using the phosphate isopachs shown on the map and the average-end-area method of computation. A minimum thickness of five feet and an average grade of 19 percent P_2O_5 was established for the estimate. A unit weight of 192 pounds/cu.ft. was computed for the phosphate rock by determining the specific gravity of the core from Hole S-6. Utilizing the above factors the Ferguson deposit contains 2,800,000 short tons of phosphate rock averaging 19 percent P_2O_5 and occurring in a bed five feet or greater in thickness. It should be noted that this is a gross tonnage figure and makes no allowance for mining losses.

APPENDIX A

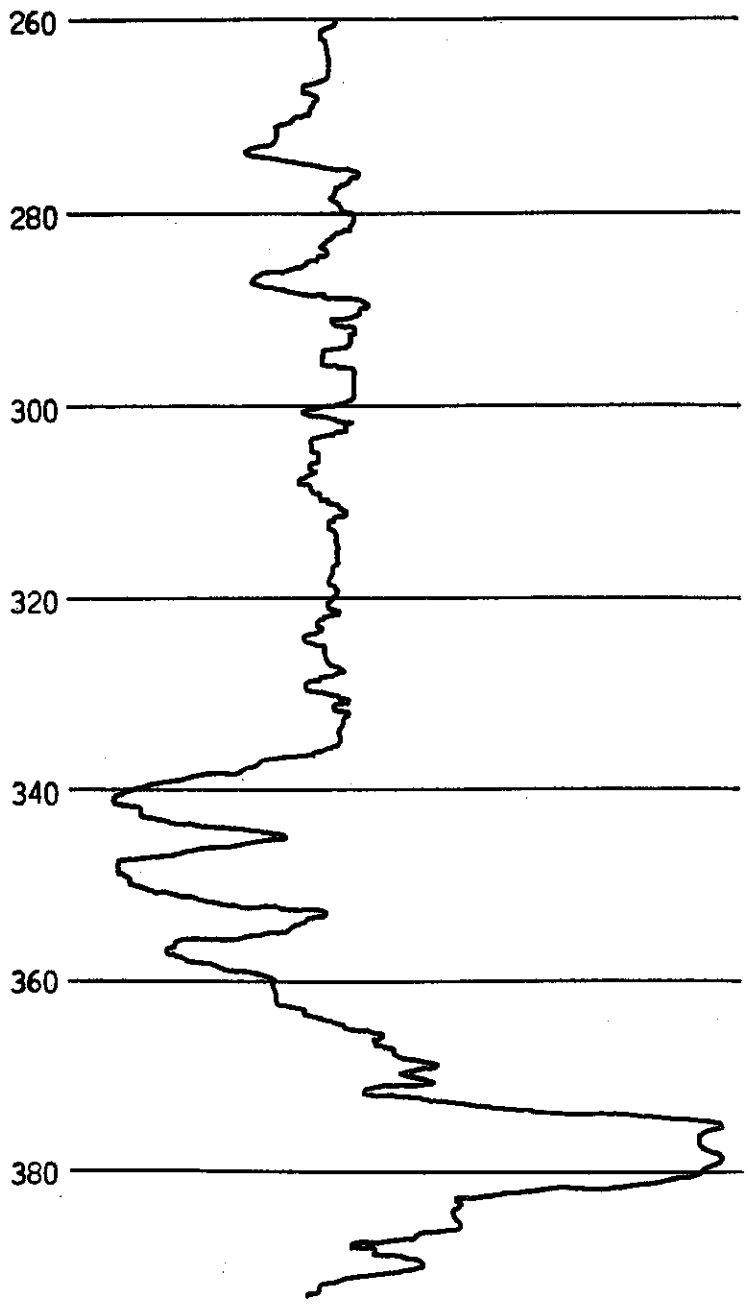
GAMMA RAY LOGS OF SELECTED DRILL HOLES

A.R.A. Phosphate Drilling Prospect

Searcy - Van Buren County, Arkansas

GAMMA RAY LOG

Hole No.	S-7
T. D.	390
Surface Elevation (msl)	1344
G. R. Scale	.025
Logging Speed	15 ft./min
Date Logged	Dec. 3, 1964



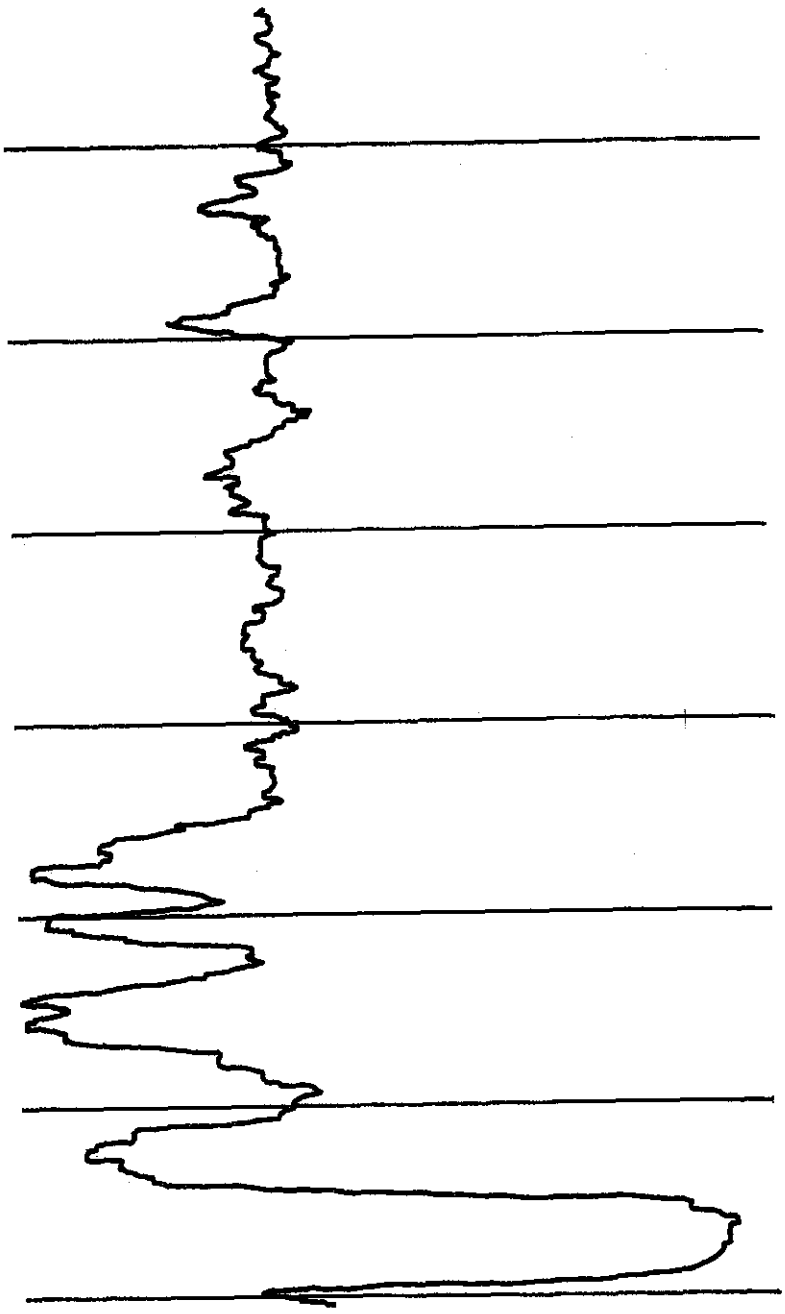
Phosphate Thickness In Feet	Percent P_2O_5
6.7	16.3

A.R.A. Phosphate Drilling Prospect

Searcy - Van Buren County, Arkansas

GAMMA RAY LOG

Hole No.	S-8
T. D.	412
Surface Elevation (msl)	1347
G. R. Scale	.025
Logging Speed	15 ft./min
Date Logged	Dec. 3, 1964



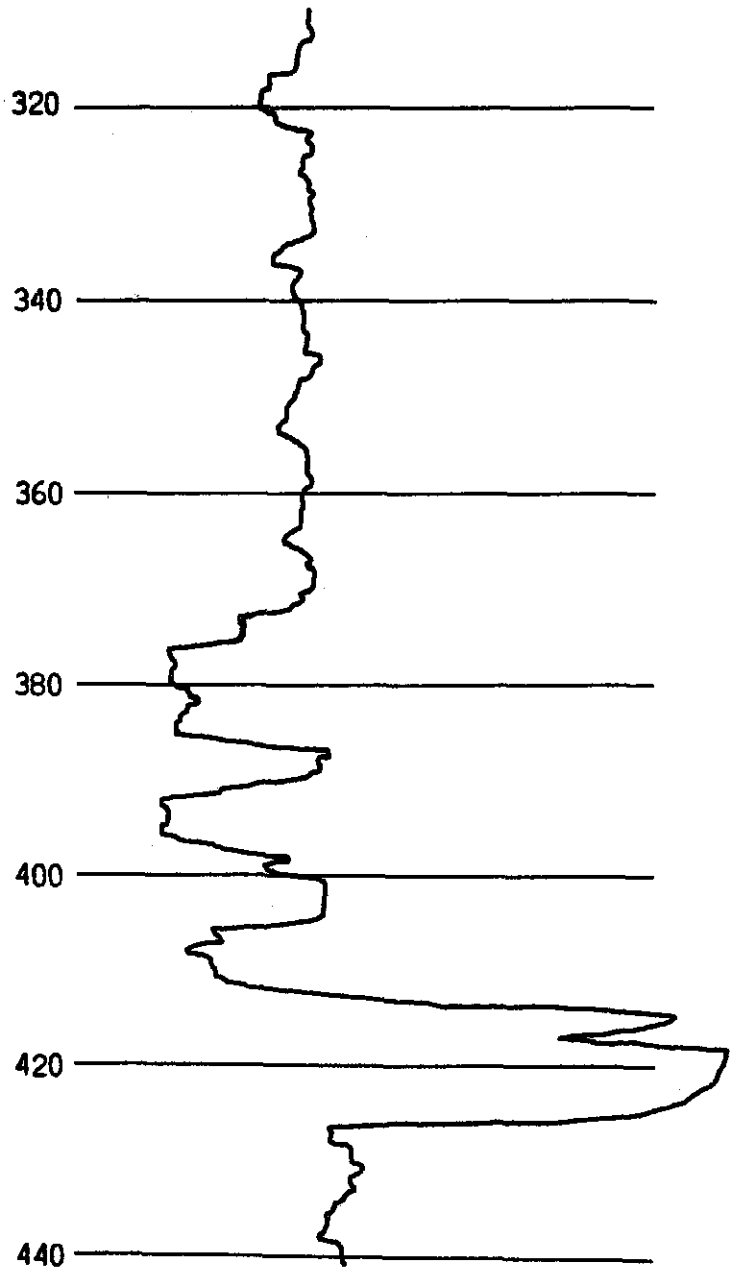
Phosphate Thickness In Feet	Percent P_2O_5
8.7	23.7

A.R.A. Phosphate Drilling Prospect

Searcy - Van Buren County, Arkansas

GAMMA RAY LOG

Hole No.	S-10
T.D.	438.5
Surface Elevation (msl)	1377
G. R. Scale	.025
Logging Speed	15 ft./min
Date Logged	Dec. 3, 1964



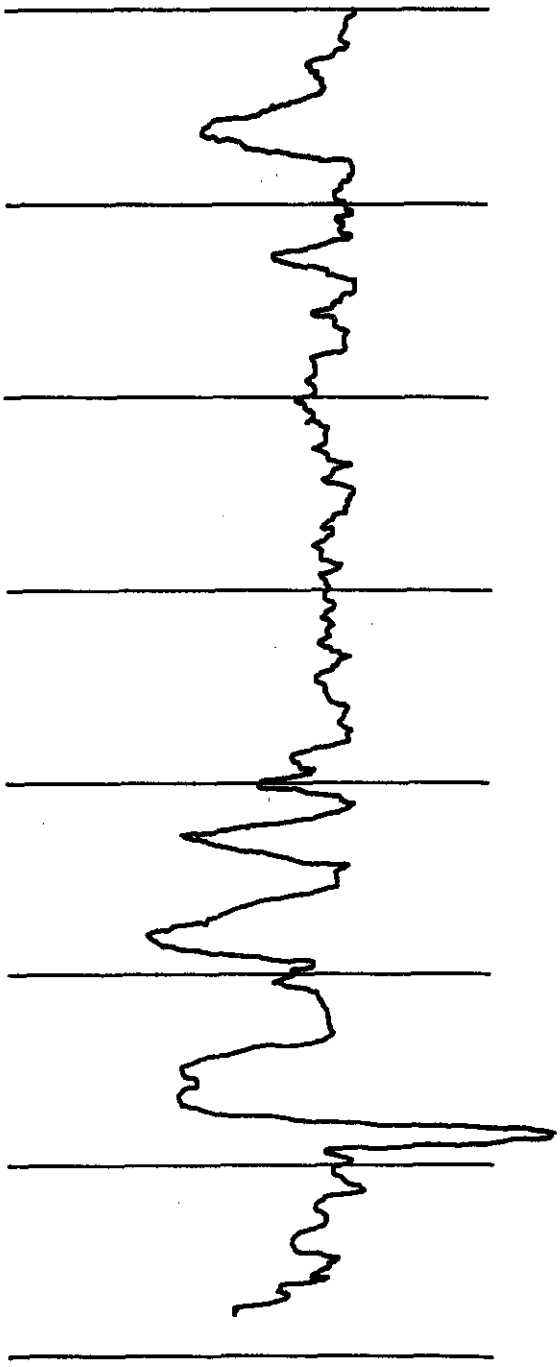
Phosphate Thickness In Feet	Percent P_2O_5
12.3	19.2

A.R.A. Phosphate Drilling Prospect

Searcy - Van Buren County, Arkansas

GAMMA RAY LOG

Hole No.	S-13
T.D.	473.3
Surface Elevation (msl)	1435
G. R. Scale	.025
Logging Speed	15 ft./min
Date Logged	Dec. 3, 1964



Phosphate Thickness In Feet	Percent P_2O_5
1.0	21.2

APPENDIX B

STRATIGRAPHIC LOGS OF CORE DRILL HOLES

A.R.A. PHOSPHATE DRILLING PROJECT
VAN BUREN COUNTY, ARKANSAS

STRATIGRAPHIC LOG

HOLE NO. S-7 **LOCATION** SW 1/4, NW 1/4 Sec. 12 T13N, R15W, Van Buren, Co.
PAGE 1 **OF** 2 **DATE** 5/1 /64 5/14/64 **COLLAR ELEV.** 1344 **NOTES BY** D.F.H.

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
0-10'		soil and soft sandstone
10'-53'		sandstone; medium-grained,
		buff , massive, porous
53'-77'		sandstone; medium-grained
		gray slightly micaceous
77'-173.5'		shale; black, clay, scattered
		lenses of gray siltstone
		(maximum thickness 1/2 inch)
		a few thin lenses of siderite
173.5'-175'		sandstone; dark gray with siderite
		pebble conglomerate at base
175'-227'		siltstone; gray micaceous
227'-227.5'		shale; black, with interbedded
		siltstone
227.5'-228'		sandstone; gray, coarse-grained,
		with shale and siderite stringers
228'-231'		shale; black, carbonaceous
231'-231.5'		conglomeratic zone -with
		fossil debris and siderite
		fragments
231.5'-234.4'		shale; black, carbonaceous
		with siltstone partings, two
		large siderite nodules at base.
234.4'-248'		shale; black, carbonaceous
248'-248.7'		debris zone; siderite and fossils
248.7'-263.4'		shale; black, carbonaceous
263.4'-263.9'		fossil debris zone
263.9'-268.8'		shale; black, carbonaceous
		with siderite nodules.
268.8'-271.8'		alternating layers of
		black shale and gray
		siltstone
271.8'-274.6'		siltstone; gray
274.6'-283.4'		shale; carbonaceous with
		siderite lenses
283.4'-284.8'		shale; black
284.8'-286.7'		siltstone; gray
286.7'-287.0'		black clay shale
287.0'-287.5'		limestone conglomerate;
		crinoidal, gray

REMARKS: Lost water in fractured sandstone at 207' never regained it.

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.
0	10	10	Rock	Bit
10	359	349	NX Wireline	
359	390	31	Standard NX	

Note: Core Recovery From 10' to T.D. Was essentially 100%

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER	% P_2O_5
372.6	379.3	6.7	S-7-1	16.3

PHASE II

A.R.A. PHOSPHATE DRILLING PROJECT

VAN BUREN COUNTY, ARKANSAS

STRATIGRAPHIC LOG

HOLE NO. S-7 LOCATION SW 1/4, NW 1/4 Sec. 12 T13N, R15W, Van Buren, Co.,

PAGE 2 OF 2 DATE 5/1 /64 5/14/64 COLLAR ELEV. 1344 NOTES BY D.E.H.

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
287.5'-335.2'		clay shale; blue black
		> same thin gray siltstone partings, siderite nodules and fossiliferous zones
335.2'-337'		siltstone; gray, wavy banding
337'-343'		sandstone; massive, gray
343'-344.5'		clayshale, black with siderite nodules and thin siltstone lenses.
344.5'-350.6'		siltstone; gray, massive; siderite pebble conglomerate at base
350.6'-353.6'		clay shale; black, with siderite lenses.
353.6'-358.0'		sandstone;-a few very thin shale partings
358.0'-363.6'		alternating layers of gray siltstone and black carbonaceous silty shale
363.6'-367.1'		black clay shale
367.1'-372.6'		siltstone; gray, with oolitic seams
372.6'-379.3'		phosphorite; contains a few thin black shale partings and sandstone seams
379.3'-384.0'		siltstone; brown gray with thin shale partings
384.0'-384.9'		interbedded gray siltstone and black shale
384.9'-387.2'		black clay shale - a few siderite lenses
387.2'-388'		siltstone; gray
388.0'-389.8'		black clay shale
389.8'-390.0'		calcareous shale; dense, hard, black

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER

A.R.A. PHOSPHATE DRILLING PROJECT

VAN BUREN COUNTY, ARKANSAS

STRATIGRAPHIC LOG

HOLE NO. S-8 **LOCATION** NE 1/4, SW 1/4, Sec 12, T13N, R15W, Van Buren, Co.

PAGE 1 **OF** 2 **DATE** 5/28/64 6/ 6/64 **COLLAR ELEV.** 1347 **NOTES BY** D.F.H. & O.A.W.

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
0-11'		soil and weathered sandstone
11-64.7'		sandstone; buff, weathered,
		massive porous, slightly friable
64.7'-85.8'		sandstone; gray massive, a few
		mica flakes
85.8'-89.2'		alternating thin layers of
		gray sandstone and black shale
		(mostly shale)
89.2'-164'		Black clay shale; with thin streaks
		of gray siltstone
164'-184.8'		black clay shale
184.8'-239.3'		siltstone; gray with numerous
		thin black shale partings
239.3'-280.5'		black clay shale (4" trash zone
		at 241', scattered 1/2" siderite
		lenses; 3" trash zone at
		250.5'; 6" Trash zone at
		274.5', 2" fossiliferous
		limestone at 277.2')
280.5'-282.6'		Black clayshale with
		alternating layers of gray
		siltstone and nodules of
		siderite
282.6'-283.3'		black clay shale
283.3'-285.8'		gray siltstone
285.8'-295.0'		black clay shale
295.0'-296.5'		gray siltstone
296.5'-297'		black clay shale
297'-297.5'		limestone; coarse-grained
		fossiliferous, dark gray
297.5'-348.0'		black clay shale; scattered
		siderite lenses and
		fossiliferous seams
348.0'-349.3'		siltstone; gray, irregularly
		banded
349.3'-354.4'		sandstone; gray, massive
		0.3' interbedded shale at
		351.3'
354.4'-355.6'		siltstone; finely-banded, gray
355.6'-356.8'		black clay shale

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.
0	11	11	Rock Bit	
11	381	370	NX Wireline	
381	411	30	Standard NX	

Note: Core Recovery Was essentially 100% from 11' to T.D.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER	% P_2O_5
387.8	390.3	2.5	S-8-1	11.0
390.3	396.5	6.2	S-8-2	28.8

Note: Weighted Average analysis on samples S-8-1 & 2 (interval 387.8-396.5) = 23.7 % P_2O_5

PHASE II

A.R.A. PHOSPHATE DRILLING PROJECT

VAN BUREN COUNTY, ARKANSAS

STRATIGRAPHIC LOG

HOLE NO. S-8 LOCATION NE 1/4, SW 1/4, Sec. 12, T13N, R15W, Van Buren, Co.

PAGE 2 OF 2 DATE 5/28/64 6/ 6/64 COLLAR ELEV. 1347 NOTES BY D.F.H. & O.

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
356.8'-360.4'		siltstone; gray, 3" siderite
		pebble conglomerate at 360
360.4'-364.8'		black clay shale; large
		siderite nodules, bottom
		0.8' interbedded siltstone
364.8'-371.2'		sandstone; gray, massive
371.2'-375.0'		interbedded gray and black
		sandstone and black carbonaceous
		shale
375.0'-379.9'		black carbonaceous shale
		scattered siderite lenses.
379.9'-387.0'		sandstone; dark gray massive
387.0'-387.3'		black clay shale
387.3'-387.8'		siltstone; dark gray
387.8'-390.3'		siltstone; gray with phosphorite
		streaks.
390.3'-396.5'		phosphorite
396.5'-403.8'		sandstone; brown-gray
		carbonaceous thin shale
		partings at the bottom
403.8'-411'		black clay shale, few thin
		gray siltstone partings
411'-411.6'		black oolitic limestone
		conglomerate

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER

PHASE II

A.R.A. PHOSPHATE DRILLING PROJECT

VAN BUREN COUNTY, ARKANSAS

STRATIGRAPHIC LOG

HOLE NO. S-9 **LOCATION** SE 1/4, NW 1/4 Sec. 12 T13N, R15W, Van Buren, Co.

PAGE 1 **OF** 3 **DATE** 5/15/64 5/27/64 **COLLAR ELEV.** 1359 **NOTES BY** DFH,OAW,PJS

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
0-15'		soil and soft sandstone
15'-22'		black shale with interbedded light gray
		sandstone stringers
22'-73'		sandstone: weathered, buff
		medium grained well sorted
		subangular to subrounded
		massive - unweathered zone
		8' thick at 68'
73'-95'		sandstone; light gray unweathered
		fine to medium grained - stylolitic
		partings filled with bituminous
		material - massive bedded
95'-181'		black shale - numerous light
		gray sandstone partings and blebs
181'-204'		black fissile shale - no sandstone
		partings
204'-204.3'		sandy conglomerate
204.3'-204.7'		siderite
204.7'-205.2'		sideritic sandstone; blebs
		and streaks of light gray sandstone
205.2'-243.0'		sandstone; light gray, fine grained,
		with dark argillaceous
		partings stylolitic in part. more
		argillaceous partings in bottom
		4 feet. conglomeratic zone at 240'.
243.0'-284.0'		shale; black, fissile, micaceous
		no sandstone partings 6" fossil
		debris at 248'. 2" dark gray
		dense fossiliferous limestone at
		262.0'. 3" fossil debris at 264.0'
		scattered thin siderite pebbles at
		268'-270'. 3" of fossil limestone
		debris, some pyrite at 278'. One
		foot of fossiliferous limestone
		debris at 281'.
284'-286'		black shale as above with
		thin sand beds up to 2" thick
286'-289'		sandstone: light gray, fine
		grained subangular to subrounded
		with carbonized wood fragments

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.
0	9	9	Rock	Bit
0	386	377	NX Wireline	
386	426	40	Standard NX	
		Core		
Note:				
Core Recovery				
From 9' to T.D.				
was essentially				
100%				

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER	% P_2O_5
391.5'	402.7	11.2	S-9-1	18.4

PHASE II

A.R.A. PHOSPHATE DRILLING PROJECT

VAN BUREN COUNTY, ARKANSAS

STRATIGRAPHIC LOG

HOLE NO. S-9 LOCATION _____

PAGE 2 OF 3 DATE _____ COLLAR ELEV. _____ NOTES BY _____

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
289'-297		shale; black fissile
297-298'		sandstone and shale as above
		interbedded
298'-299'		sandstone; light gray fine-grained
299'-304.5'		shale; black fossiliferous
		fragmental, 2" fossiliferous
		detrital limestone at 299' and
		4" at 304-304.5',
304.5'-354.7'		shale; black, fissile,
		with fossiliferous detrital
		limestone zones, 4" at 319'
		3" at 344.5'; one foot
		of thin interbedded
		siltstone layers at 346.5'
		siderite nodules throughout
		the interval
354.7'-359'		siltstone; gray, finely banded
		with thin black shale partings
		and lenses
359.0'-361.9'		black clay shale with siderite
		nodules
361.9'-362.9'		siltstone; gray finely banded
362.9'-363.2'		black clay shale
363.2'-365.0'		sandstone; gray massive
365.0'-366.6'		gray to black siltstone and
		silty shale with black
		shale partings, siderite
		fragment zone at 366.4'
366.6'-371'		black clay shale with
		siderite nodules
371'-376'		gray siltstone
376'-379'		alternating beds of gray
		siltstone black siltstone
		silty shale and black shale
379'-384.6'		black clay shale with
		siderite nodules - some
		gray and black siltstone
		seams

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER

A.R.A. PHOSPHATE DRILLING PROJECT

VAN BUREN COUNTY, ARKANSAS

STRATIGRAPHIC LOG

HOLE NO. S-9 LOCATION _____

PAGE 3 OF 3 DATE _____ COLLAR ELEV. _____ NOTES BY _____

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
384.6'-386.4'		siltstone; massive gray
386.4'-386.5'		phosphorite
386.5'-391.5'		siltstone; dark gray
		carbonaceous
381.5'-392.3'		interbedded phosphorite
		and gray siltstone.
392.3'-393.8'		phosphorite; black
393.8'-402.7'		cross bedded conglomeratic
		locally contains thin barren
		siltstone seams
402.7'-405.4'		siltstone; gray, carbonaceous
		with thin shale layers, pyrite
		seams and carbonized
		plant fragments
405.4'-413.0'		black clay shale
413.0'-414.7'		black oolitic sandy
		shale
414.7'-416.5'		limestone; black, fragmental
		fossiliferous
416.5'-416.8'		black clay shale
416.8'-417.5'		limestone conglomerate; coarse, fragmental
		oolitic, black, fossiliferous
		(base of Cane Hill)
417.5'-418.2'		black fossiliferous limestone
		and black shale
418.2'-421.7'		limestone; gray green,
		slightly oolitic fossiliferous
421.7'-422.4'		alternating black shale
		and dense fossiliferous limestone
422.4'-424.8'		limestone; dense, black
		fossiliferous oolitic
424.8'-426'		alternating limestone
		and shale

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER

PHASE II
A.R.A. PHOSPHATE DRILLING PROJECT
VAN BUREN COUNTY, ARKANSAS

STRATIGRAPHIC LOG

HOLE NO. S-10 LOCATION NE 1/4, SW 1/4, Sec. 12 T13N, R15W, Van Buren Co.
PAGE 1 OF 2 DATE 6/9 /64 6/20/64 COLLAR ELEV. 1376.8 NOTES BY DFH

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
0-10'		clay, and weathered shale
10'-37'		black clay shale; interbedded
		buff sandstone in bottom foot
37'-80'		sandstone; brown friable
		punky
80'-109.2'		sandstone; coarse grained
		gray with brown weathered
		streaks in the upper 5 feet
109.2'-213.7'		black clay shale, top 5 feet
		has sandstone interbedded
213.7'-214.1'		sandy conglomerate
214.1'-218.3'		conglomeratic zone with
		interbedded black shale and
		gray sandstone
218.3'-259.4'		sandstone; gray, fine-grained
		numerous thin shale partings
259.4'-312.9		black clay shale thin gray
		sandstone layers in top 5 feet
312.9'-315.6'		gray siltstone
315.6'-316.4'		black clay shale
316.4'-317.4'		siltstone; gray, finely banded
317.4'-321.4'		black shale-coarse grained
		fossiliferous and conglomeratic
321.4'-371.0'		black clay shale with siderite
		nodules, narrow fossil trash
		zones scattered thin gray
		siltstone layers
371.0'-374.4'		siltstone; gray, finely banded
		with some black shale partings
374.4'-385.5'		sandstone; gray, massive
		with stylolitic partings
385.5'-389.3'		black clay shale with
		large siderite nodules
389.3'-396.7'		siltstone; gray, massive to
		finely banded
396.7'-399.5'		alternating layers of gray
		and black siltstone and black
		clay shale
399.5'-403.3'		black clay shale with
		siderite nodules

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.
0	9	9	Rock Bit	
9	400	391	NX Wireline	
400	440	40	Standard NX	

Note: Core Recovery from 9'-440' was essentially 100 %

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER	% P_2O_5
412.0	414.2	2.2	S-10-1	22.1
414.2	415.3	1.1	S-10-4	3.4
415.3	424.3	9.0	S-10-2	20.5
433.7	438.2	4.5	S-10-3	1.1

Note:
Weighted average Analysis for the interval 412.0'-424.3' (Samples 1, 4 & 2) is 19.2% P_2O_5

A.R.A. PHOSPHATE DRILLING PROJECT
VAN BUREN COUNTY, ARKANSAS

STRATIGRAPHIC LOG

HOLE NO. S-10 LOCATION _____

PAGE 2 OF 2 DATE _____ COLLAR ELEV. _____ NOTES BY _____

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
403.3'	-412'	sandstone; massive brownish
		gray
412'-414.2'		phosphorite with a few thin
		barren sandstone seams
414.2'	-415.3'	sandstone-massive brown gray
415.3'	-424.3'	phosphorite - 3 thin black
		shale partings
424.3'	-426.0'	sandstone; gray with
		abundant thin shale partings
426.0'	-433.7'	black clay shale
433.7'	-438.2	limestone; dark brown
		gray oolitic with seams of
		asphaltic material and
		carbonized plant fragments
438.2'	-438.5'	limestone conglomerate,
		coarse pebbles
438.5'	-439.0'	limestone; black
		fossiliferous, crinoid,
		fragments, oolitic texture
		(Pitkin)

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER

PHASE II - A.R.A. PHOSPHATE DRILLING PROJECT
VAN BUREN COUNTY, ARK.

STRATIGRAPHIC LOG

HOLE NO. S-11 LOCATION NE¼ SW¼ Sec 12 T13N R15W Van Buren County

PAGE 1 OF 1 DATE 6-24-64 7-4-64 COLLAR ELEV. 1321.9 NOTES BY TJF, DFH

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
0-10'		Weathered sandstone
10-42'		Sandstone; reddish buff medium grained sub angular quartz sandstone limonite cement, traces of glauconite, compact, slightly micaceous
42-63'		Sandstone; very light gray, fine to medium grained sub angular grains. Local red buff splotches near top. Local thin irregular partings of mica and shale. Compact.
63-164.5'		Shale; dark gray with thin stringers of very light gray fine grained sandstone; 104.5-105' very sandy interval - very little sandstone in the lower 12' of this interval
164.5-213'		Sandstone; very light gray fine grained, abundant paper thin partings of slightly micaceous shale
213-342'		Shale; dark gray with scattered stringers of sand & fossils; 221'-222' dark gray crinoidal limestone; 235.5'-236' fossiliferous limestone conglomerate; 263.0'-264.0' sandy; 274.0'-275.5' sandy; 275.5'-276' fossiliferous conglomeratic limestone; 328'-331', 336'-338' fine grained crossbedded quartz sandstone with stylolitic shale partings; 338'-338.7' crinoidal sandstone conglomerate with large siderite pebbles
342-350.2'		Sandstone; gray, massive
350.2-358.0'		Clay shale; black, with large siderite nodules
358.0-358.7'		Siltstone; gray with thin black shale partings
358.7-366.5'		Sandstone; dark gray fine grained with a few stylolitic partings
366.5-369.7'		Sandstone; gray with abundant oolitic seams
369.7-373.2'		Phosphorite; upper 2' slightly sandy, bottom 0.2' conglomeratic, numerous shaly partings coated with pyrite and bituminous material
373.2-381.6'		Sandstone; gray, fine grained massive, lower 2' has interbedded black clay shale
381.6-393.8'		Black clay shale; thin gray sandstone partings in upper 4'
393.8-394.0'		Limestone; black, fossiliferous, oolitic coarse grained

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.
0	10	10	Rock Bit	
10	354	344	NX Wireline	
354	394	40	Standard NX	

Note: core recovery from 10' - 394' was essentially 100%.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER	% P_2O_5
366.5	369.7	3.2	S-11-1	14.6
369.7	373.2	3.5	S-11-2	18.3

Note: Weighted average analysis of samples S-11-1 & 2 = 16.5% P_2O_5

PHASE II - A.R.A. PHOSPHATE DRILLING PROJECT
VAN BUREN COUNTY, ARK.

STRATIGRAPHIC LOG

HOLE NO. S-12 LOCATION NE¼ SW¼ Sec 12 T13N R15W Van Buren County

PAGE 1 OF 2 DATE 7-7-64 8-12-64 COLLAR ELEV. 1371.3 NOTES BY TJF

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
0-20'		Weathered sandstone and shale
20-22'		Very dark gray, crumbly
22-72'		Sandstone - pale yellow, medium grained compact, trace of glauconite & mica
72-96'		Sandstone - very light gray, fine to medium-grained compact trace glauconite, trace of mica thin stylolitic partings of mica and black shale
96-102'		Shale and sandstone; about 60% very dark gray "poker chip" shale interbedded with thin layers of very light gray sandstone
102-189'		Shale; very dark gray "poker chip" shale, few thin layers of very light gray fine grained sandstone
189-198'		Shale - very dark gray to black "poker chip" shale
198-198.3'		Conglomerate; up to 1" siderite pebbles in sandstone
198.3-250'		Sandstone; very light gray fine to medium grained compact, trace of glauconite, trace of mica. Stylolitic partings of mica and black shale
250-275'		Shale; like 102-189' at 250' and 258' conglomeratic, siderite pebbles, abundant crinoids
275-296'		Shale; very dark gray "poker chip", scattered nodules and layers of siderite, several narrow fossil trash zones; very light gray sandy streaks in bottom 1' of interval
296-298'		Sandstone; very light gray fine grained quartz sandstone, cross bedded with some shaly partings, fossil zones in upper half of interval
298-306'		Shale; very dark gray, scattered siderite nodules
306-307.2'		Sandstone; like 296-298' interval
307.2-314.5'		Shale; very dark gray, abundant fossils scattered throughout - few siderite nodules - 3" crinoidal limestone at 308'
314.5-363'		Shale; very dark gray, scattered siderite nodules; scattered fossils, 7" highly contorted light gray limestone at 327'; very fossiliferous at 341' and 351'
363-366'		Sandstone; very fine to fine grained, very light gray, crossbedded. Some thin shale stringers

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.
0	20	20	Rock bit	
20	396	376	NX Wireline	
396	424	28	Standard NX	

Note: core recovery through entire interval from 20' to TD was essentially 100%.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER	% P_2O_5
401.6	408.9	7.3	S-12-1	17.

STRATIGRAPHIC LOG

HOLE NO. S-12 LOCATION NE¼ SW¼ Sec 12 T13N R15W Van Buren County

PAGE 2 OF 2 DATE 7-7-64 8-12-64 COLLAR ELEV. 1371.3 NOTES BY TJF

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
6-366.2'		Shale; very dark gray
2-367.2'		Sandstone; medium grained very light gray, compact
2-372'		Shale; very dark gray, abundant sandy stringers
2-374'		Sandstone; very light gray, fine to medium grained, glauconitic, crossbedded, fossils in top 1'
4-377'		Shale; very dark gray, scattered siderite nodules
7-387'		Sandstone; very light gray, fine to medium grained, crossbedded, very thin shale partings and stringers common
7-393.5'		Shale; very dark gray sandy near top, sandstone stringers near base
5-401.6'		Sandstone; gray, fine grained
6-408.9'		Phosphorite with interbedded gray sandstone and black shale streaks.
9-412'		Sandstone; gray, fine grained with shale interbeds
2-423.5'		Shale; black with streaks of fragmental limestone
5-424		Limestone Conglomerate; black, coarse grained, fossiliferous

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER

PHASE II - A.R.A. PHOSPHATE DRILLING PROJECT
VAN BUREN COUNTY, ARK.

STRATIGRAPHIC LOG

HOLE NO. S-13 LOCATION NW¼ SE¼ Sec 12 T13N R15W Van Buren County

PAGE 1 OF 2 DATE 8-13-64 8-29-64 COLLAR ELEV. 1435.8 NOTES BY DFH

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
0-12'		Weathered sandstone and soil
12-23.5'		Sandstone; gray medium grained, stained brown along joints
23.5-29.5'		Sandstone; brown, porous, vuggy friable
29.5-82.8'		Black clay shale; siderite lenses, thin streaks and partings of gray sandstone
82.8-126'		Sandstone; massive, brown medium grained
126-154.3'		Sandstone; gray, medium grained, massive, some interbedded black shale in bottom 6'
154.3-252.5'		Black clay shale; numerous paper thin gray sandstone partings, few scattered siderite lenses, gray sandstone 192.4-194.4'
252.5-252.7'		Conglomerate
252.7-299.5'		Sandstone; fine grained, brownish gray, slightly micaceous, thin black shale partings
299.5-300.2'		Conglomerate
300.2-349.6'		Black clay shale; scattered siderite lenses; fossil trash zones at 311.0-311.6', 325.2-325.5', and 341.4-341.7'
349.6-353.9'		Sandstone; gray with breccia zone at 351'
353.9-363'		Black clay shale with some large siderite nodules
363-364.5'		Sandstone; gray with some shale streaks and siderite nodules
364.5-414'		Black clay shale with few siderite nodules, crinoidal limestone 365.3-365.7, fossil trash zone 377.9-378.5, several other narrower fossil trash zones
414-417'		Interbedded gray and black sandstone and black shale
417-418.5'		Sandstone; gray
418.5-422.6'		Black clay shale
422.6-425.8'		Sandstone; gray
425.8-430.2'		Black clay shale with siderite nodules
430.2-436'		Sandstone; gray massive lower 1.5' finely banded
436-438.8'		Interbedded black clay shale and gray and black sandstone
438.8-445.2'		Black clay shale with 1" to 2" siderite nodules

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.
0	12	12	Rock Bit	
12	444	432	NX Wireline	
444	474	30	Standard NX	

Note; core recovery essentially 100% from 12' to T.D.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER	% P_2O_5
454.3	455.3	1.0	S-13-1	21.2

STRATIGRAPHIC LOG

HOLE NO. S-13 LOCATION _____

PAGE 2 OF 2 DATE _____ COLLAR ELEV. _____ NOTES BY _____

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
445.2-454.3'		Siltstone; brownish gray, massive
454.3-455.3'		Phosphorite
455.3-456.5'		Siltstone; gray, with thin shale partings
456.5-460.7'		Black shale; numerous thin black and gray siltstone seams interbedded
460.7-473.3'		Black clay shale
473.3-474'		Limestone; coarse-grained, black, fossiliferous

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER

Phase II

A.R.A. Phosphate Drilling Project

Van Buren County, Arkansas

STRATIGRAPHIC LOG

HOLE NO. S-14 LOCATION NE 1/4, SW 1/4, Sec. 12, T13N, R15W

PAGE 1 OF 2 DATE 9-21-64 COLLAR ELEV. 1436.1 NOTES BY D.F.H.

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
0-13'		weathered sandstone
13'-16.3'		sandstone; brown, vuggy conglomeratic
16.3'-23.5'		sandstone; brown, limonite stained, medium grained sandstone
23.5'-27.0'		sandstone; gray, medium grained, massive
27.0'-80.3'		black shale, numerous thin siderite lenses- thin gray sandstone lenses in bottom 7'
80.3'-130.0'		sandstone; massive, brown limonite stained.
130.0'-148.5'		sandstone; massive, gray unstained equivalent of preceeding interval
148.5'-154.5'		alternating layers, of gray sandstone and black shale (mostly sandstone)
154.5'-193.6'		black clay shale; few very thin gray sandstone partings
193.6'-195.0'		sandstone; gray, a few interbedded black shale layers
195.0'-258.4'		black clay shale
258.4'-261.0'		sandstone conglomerate; siderite and sandstone pebbles
261.0'-262.2'		black clay shale
262.2'-296.2'		sandstone; gray, fine-grained micaceous with numerous closely spaced black shale partings
296.2'-347.6'		black clay shale; several fossil trash zones, a few siderite lenses
347.6'-351.1'		siltstone; gray, with a few interbedded black shale layers
351.1'-359.7'		black clay shale
359.7'-360.7'		gray siltstone

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.
0	13	13	Rock Bit	
13	443	430	NX Wireline	
443	464	21	Standard NX	

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER	% P_2O
452.1	454.6	2.5	S-14-1	11.

STRATIGRAPHIC LOG

HOLE NO. S-14 LOCATION _____

PAGE 2 OF 2 DATE _____ COLLAR ELEV. _____ NOTES BY _____

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
360.7'-412.4'		black clay shale; several
		fossil trash zones, few scattered
		siderite lenses, crinoidal
		limestone 361.3'-361.6'
412.4'-415.7'		siltstone; gray, shaly,
		some interbedded black
		shale and gray siltstone
415.7'-418.0'		sandstone; gray, vuggy
		conglomeratic
418.0'-422.4'		sandstone; dark gray
		carbonaceous, abundant
		bituminous grains
422.4'-426'		gray siltstone
426'-429.4'		black shale with
		siderite nodules
429.4'-436.7'		sandstone; gray, lower
		part finely banded
436.7'-439.5'		gray sandstone and
		siltstone with a few
		interbedded black shale
		layers
439.5'-444.3'		black clay shale with
		siderite lenses
444.3'-452.1'		sandstone; brownish gray
		fine-grained
452.1'-454.6'		phosphorite
454.6'-459.5'		siltstone; gray, with
		thin black shale and pyrite
		partings
459.5'-464		black clay shale

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER

PHASE II - A.R.A. PHOSPHATE DRILLING PROJECT
VAN BUREN COUNTY, ARK.

STRATIGRAPHIC LOG

HOLE NO. S-15 LOCATION NW¼ SW¼ Sec 12 T13N R15W Van Buren County
PAGE 1 OF 2 DATE 9-22-64 10-2-64 COLLAR ELEV. 1329.2 NOTES BY DFH

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
0-10'		Weathered sandstone
10-52.5'		Sandstone; brown weathered massive medium grained
52.5-77.8'		Sandstone; gray compact slightly micaceous medium grained
77.8-179.7'		Black shale; numerous gray sandstone seams, some 3/4" siderite lenses
179.7-179.9'		Sandstone conglomerate
179.9-230.2'		Sandstone; gray, medium grained, numerous wavy thin black shale partings
230.2-232.4'		Black clay shale
232.4-235.3'		Sandstone conglomerate with siderite pebbles
235.3-273'		Black clay shale with several fossil trash zones
273-275.5'		Interbedded black clay shale and gray sandstone
275.5-279.4'		Gray sandstone
279.4-289.7'		Black clay shale with siderite lenses
289.7-291'		Interbedded gray sandstone and black shale (mostly sandstone)
291-339.1'		Black clay shale; 6" fossiliferous zone at 291.5', several narrow fossil trash zones, numerous siderite lenses
339.1-340.5'		Wavy gray siltstone
340.5-346.3'		Sandstone; gray, compact fine-grained; lower part has stylolitic shale partings
346.3-347.2'		Black clay shale
347.2-347.9'		Gray sandstone
347.9-349.2'		Black clay shale
349.2-353.9'		Sandstone; gray with numerous black shale partings
353.9-356.9'		Black clay shale; siderite nodules, bottom 1' silty
356.9-364'		Sandstone; gray, compact, medium-grained, bottom part finely banded
364-367'		Alternating black shale and gray and black siltstone
367-372.8'		Black clay shale
372.8-376.7'		Sandstone; brownish gray fine-grained compact with bituminous partings
376.7-378.2'		Sandstone; gray with thin black shale partings

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% REC
0	10	10	Rock B	
10	371	361	NX Wir	
371	401	30	Standa	

Note: Core recovery fr 10' to TD was essentia 100%.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER
378.2	383.1	4.9	S-15-1

STRATIGRAPHIC LOG

HOLE NO. S-15 LOCATION _____

PAGE 2 OF 2 DATE _____ COLLAR ELEV. _____ NOTES BY _____

LITHOLOGIC NOTES

DEPTH	PROFILE	DESCRIPTION
378.2-383.1'		Sandstone; with oolitic seams and streaks and bituminous partings
383.1-394.9'		Sandstone; brownish gray compact
394.9-400.9'		Black clay shale
400.9-401.0'		Limestone; black, dense, argillaceous

BORING NOTES

DEPTH FROM	DEPTH TO	INTERV.	CORE RECOV.	% RECOV.

SAMPLING NOTES

DEPTH FROM	DEPTH TO	INTERV.	SAMPLE NUMBER