



MINISTRY OF ENERGY AND MINERAL RESOURCES

Al Risha Phosphate Project

Al Risha phosphate prospecting project

- **Introduction**
- **Location**
- **Thickness**
- **Phosphate Quality**
- **Boreholes Logs**
- **Geological Resource**
- **Impurities**
- **Uranium**
- **Summary**

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Introduction


The Jordanian Geological Survey team made the first discovery of phosphates in the east of the Kingdom in 2008, and subsequently published a geological map of the area (1:100,000).

The Ministry of Energy created and conducted a thorough exploration and exploration strategy, which was launched at the end of 2021.

The study focused on a 3000 km² area that was divided into 120–150 km² exploratory stages.

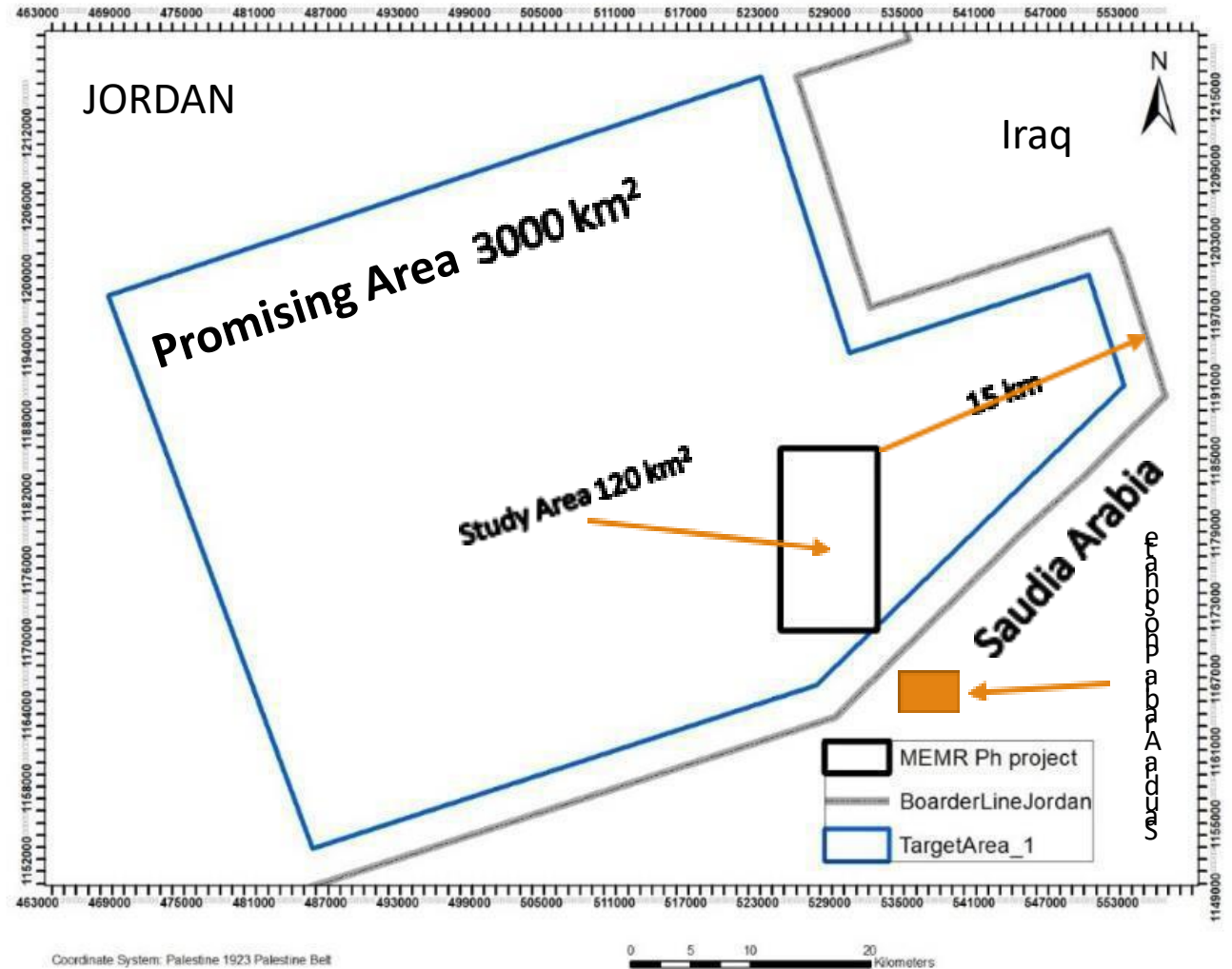
The preliminary findings from the first stage were very promising in terms of the quality and thickness of the rock phosphate present.

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Location

The study area is located in Al-Ruwaished area in the eastern part of the Hashemite Kingdom of Jordan close to borders of two adjacent countries ; the Kingdom of Saudi Arabia and the Republic of Iraq.



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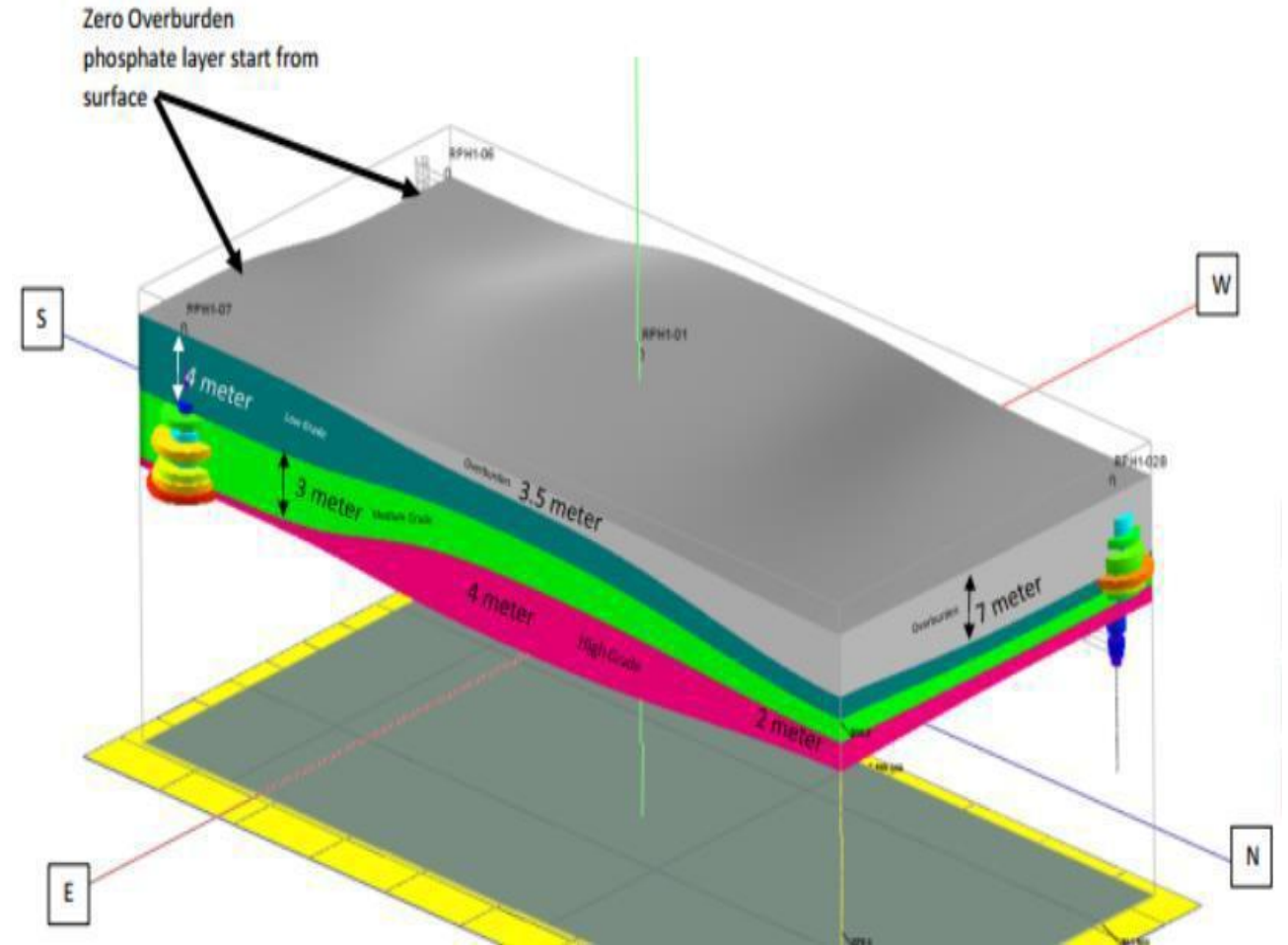
Thickness

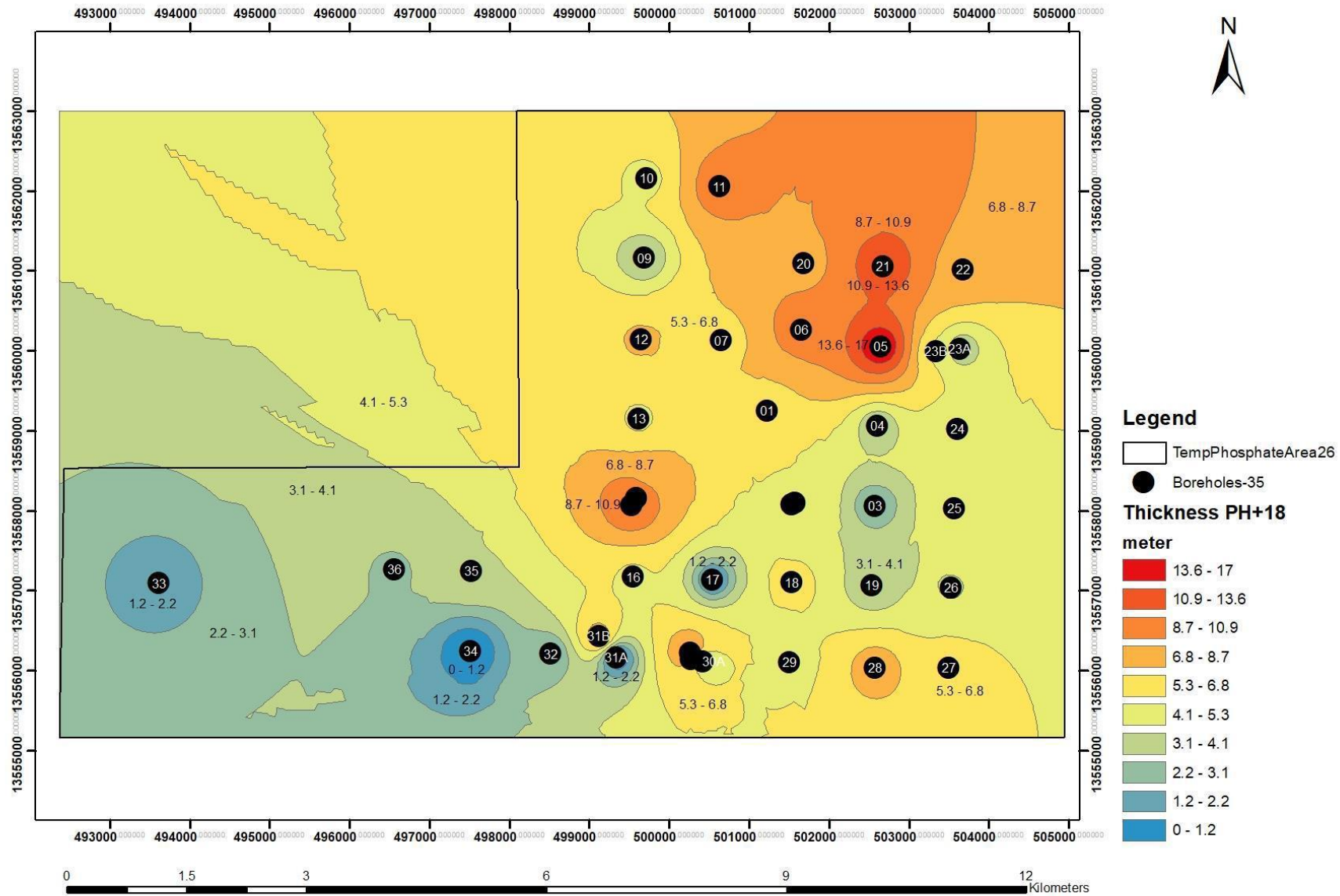
The thickness of the phosphate layers over the promising area is extended from 1 m to 10 m, with an average 6 m.

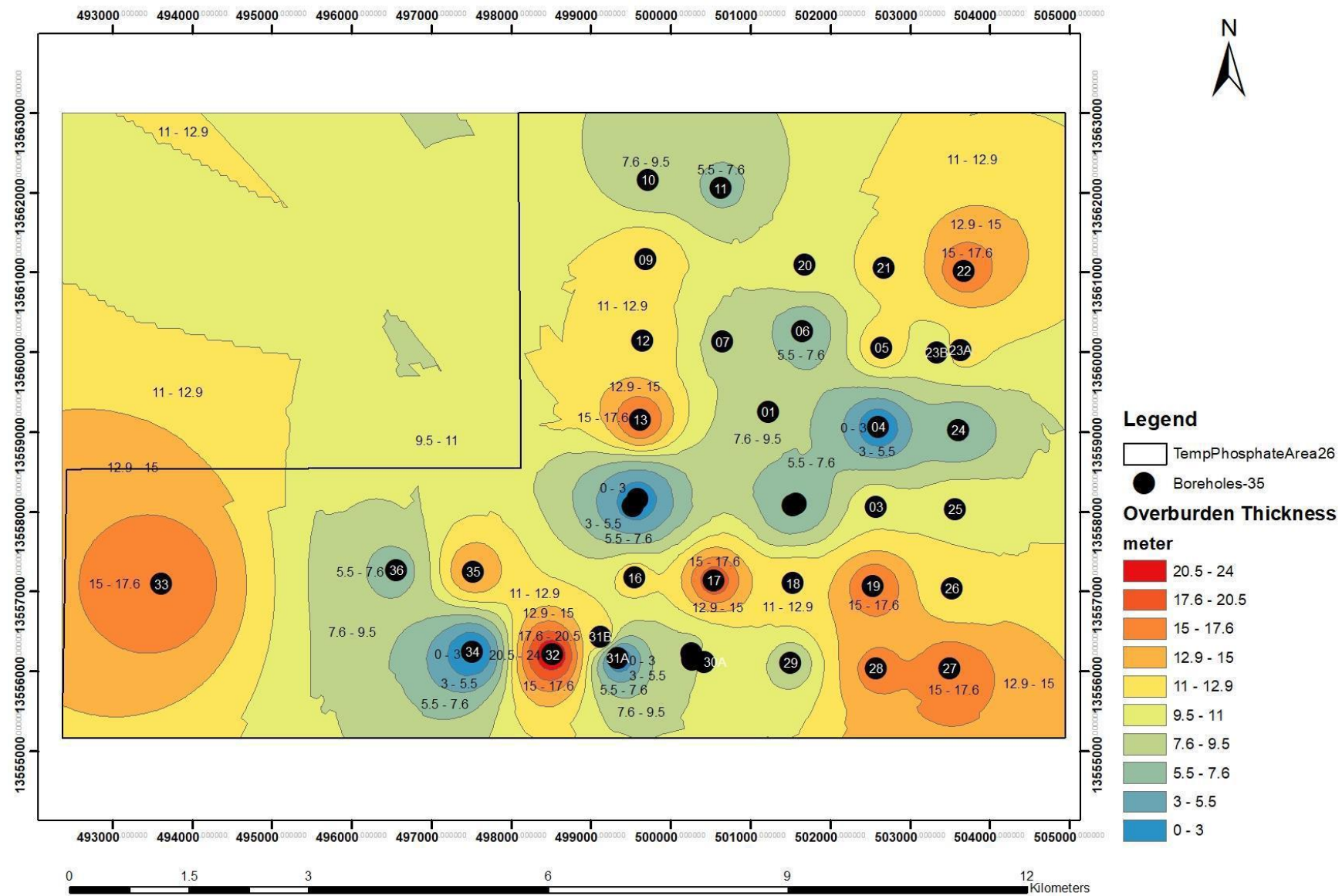
It exceeded 10 meters in some wells with an average content of P_2O_5 exceeds 18 % that marked medium grade according to the economical phosphate classification.

The thickness of high-quality phosphate, which contains concentrations of the quality of the ore with (P_2O_5 25% to 36%), thicknesses ranged from 4 to 8 meters.

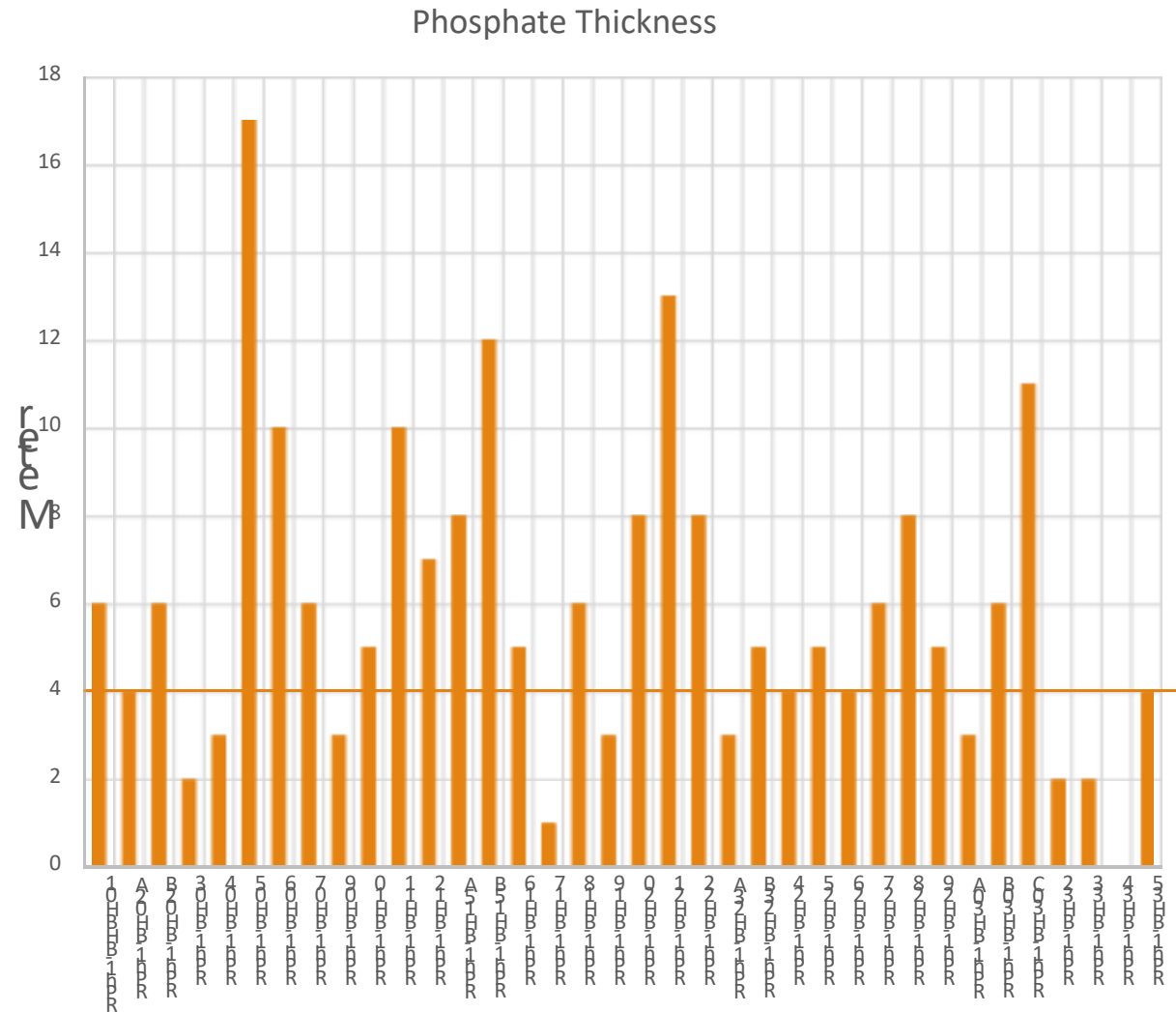
The sedimentary cover over the phosphate layer (overburden) did not exceed in average 10 meters, which ranges from zero to 18 meters in some wells.








BH. ID	Depth & Samples		OV	Phosphate Bed (m)		URC	P2O5			TCP		
	T.D	T.S		PH_all	PH+18		Max	Min	Average	Max	Min	Average
RPh1-BHBH01	35	19	9	6	6	20	34.2	0.8	24.6	74.7	39.5	53.6
RPh1-BH02A	16	16	6	4	4	6	24.7	1.5	21.5	54.0	41.5	46.9
RPh1-BH02B	21	18	5	7	6	9	31.2	20.1	23.7	68.2	43.9	51.8
RPh1-BH03	21	21	11	2	2	8	26.4	0.4	24.7	57.7	50.3	54.0
RPh1-BH04	30	30	0	4	3	26	24.3	18.9	20.7	53.1	41.3	45.3
RPh1-BH05	31	31	13	18	17	0	31.1	18.0	26.6	68.0	39.3	58.1
RPh1-BH06	15	15	5	10	10	0	33.8	0.2	27.4	73.9	44.6	59.8
RPh1-BH07	18	18	9	9	6	0	33.3	21.6	27.0	72.8	47.2	58.9
RPh1-BH09	19	19	13	4	3	2	24.3	0.4	20.0	53.1	43.3	47.3
RPh1-BH10	14	14	8	5	5	1	25.9	0.5	22.9	56.6	44.4	50.0
RPh1-BH11	24	24	7	12	10	5	33.3	20.5	26.6	72.8	44.8	58.0
RPh1-BH12	20	20	13	7	7	0	28.1	18.1	23.6	61.4	0.9	21.2
RPh1-BH13	21	21	18	5	5	-2	25.0	0.4	20.6	54.6	0.9	18.6
RPh1-BH15A	9	9	1	8	8	0	30.0	18.6	24.8	65.6	40.6	54.2
RPh1-BH15B	18	18	2	15	12	1	31.5	18.8	24.4	68.8	41.1	53.2
RPh1-BH16	18	18	12	6	5	0	33.8	22.7	29.5	73.9	49.6	64.5
RPh1-BH17	24	24	20	1	1	3	19.0	19.0	19.0	41.5	41.5	41.5
RPh1-BH18	24	24	13	9	6	2	31.2	20.9	25.0	68.2	45.7	54.7
RPh1-BH19	21	21	18	3	3	0	22.0	20.1	21.2	48.1	0.8	16.3
RPh1-BH20	22	22	11	11	8	0	36.0	20.1	30.5	78.7	43.9	66.7
RPh1-BH21	29	29	12	14	13	3	32.1	19.4	24.7	70.1	42.4	54.0
RPh1-BH22	25	25	17	8	8	0	32.4	18.1	24.5	70.8	39.5	53.4
RPh1-BH23A	18	18	12	3	3	3	27.4	20.4	23.1	44.6	59.9	50.5
RPh1-BH23B	27	27	10	6	5	11	27.0	18.3	21.5	59.0	40.0	47.7
RPh1-BH24	24	24	5	4	4	15	27.5	24.8	26.5	60.1	54.2	57.9
RPh1-BH25	24	24	11	6	5	7	32.2	19.6	26.4	70.4	38.7	54.9
RPh1-BH26	29	29	11	4	4	14	24.8	22.8	23.8	54.2	49.8	52.1
RPh1-BH27	24	24	17	6	6	1	25.5	18.8	21.5	55.7	41.1	47.0
RPh1-BH28	27	27	16	9	8	2	28.2	18.5	22.3	61.6	40.4	46.2
RPh1-BH29	29	29	8	6	5	15	29.7	19.0	25.6	64.9	41.5	55.8
RPh1-BH30A	15	15	12	3	3	0	29.1	25.1	26.9	63.6	54.8	58.5
RPh1-BH30B	13	13	7	6	6	0	30.3	19.3	25.5	66.2	42.2	55.7
RPh1-BH30C	25	25	9	12	11	4	27.9	19.2	24.1	61.0	42.0	52.7
RPh1-BH31A	17	17	0	0	0	17	11.8	0.4	2.5	25.8	0.8	5.6
RPh1-BH31B	21	21	13	8	8	0	34.6	31.4	32.9	68.6	75.6	72.0
RPh1-BH32	29	29	24	2	2	3	28.2	24.9	26.6	61.6	54.4	58.0
RPh1-BH33	28	28	17	2	2	9	32.8	24.8	28.8	71.7	54.2	62.9
RPh1-BH34	21	21				21	25.2	19.8	21.8	55.1	43.3	49.6
RPh1-BH35	30	30	15	12	4	3	21.9	20.5	21.0	47.9	44.8	45.0



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Quality of Phosphate

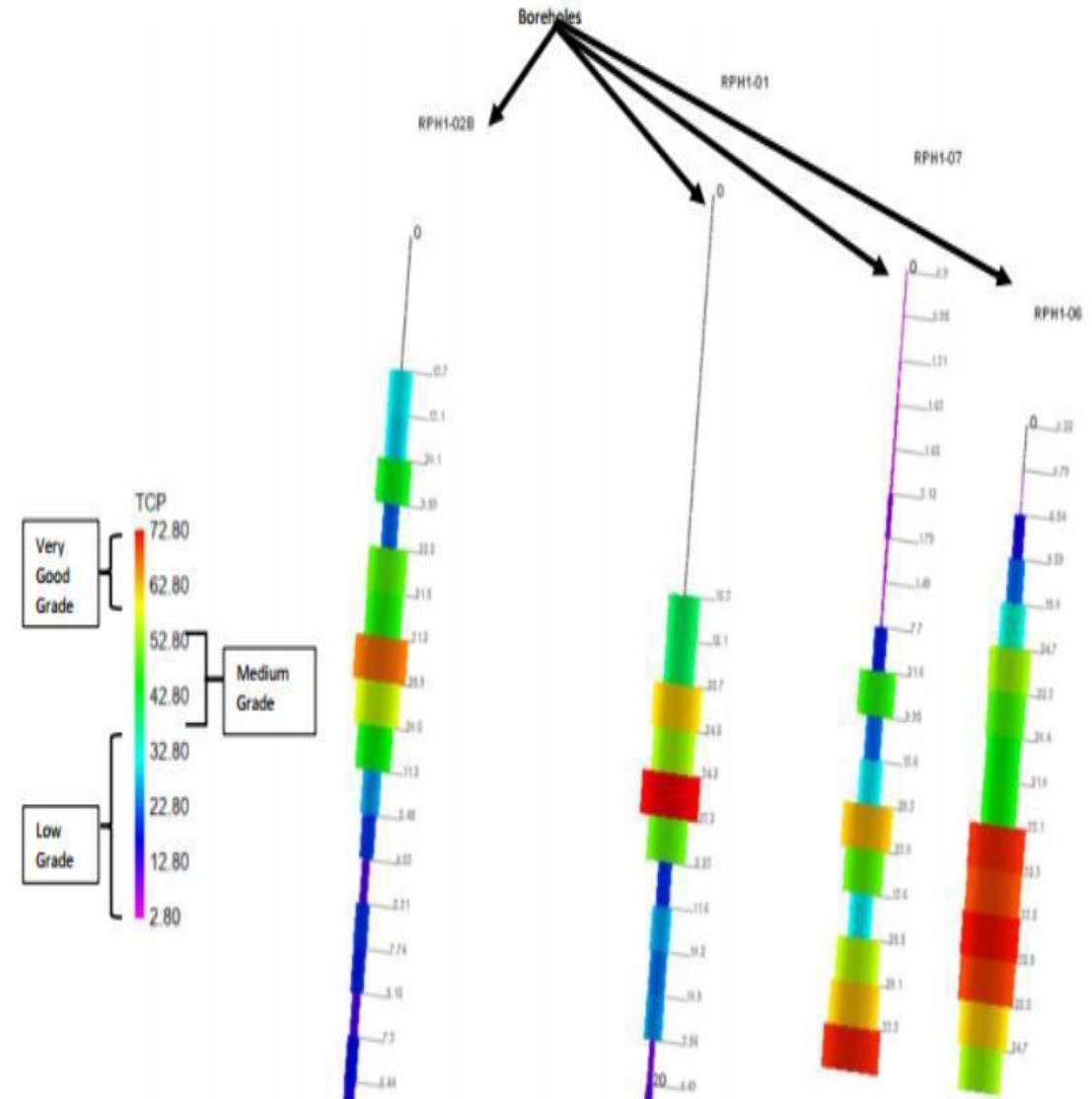
The quality of the phosphate layers was divided according to the concentration ratio of (P₂O₅)

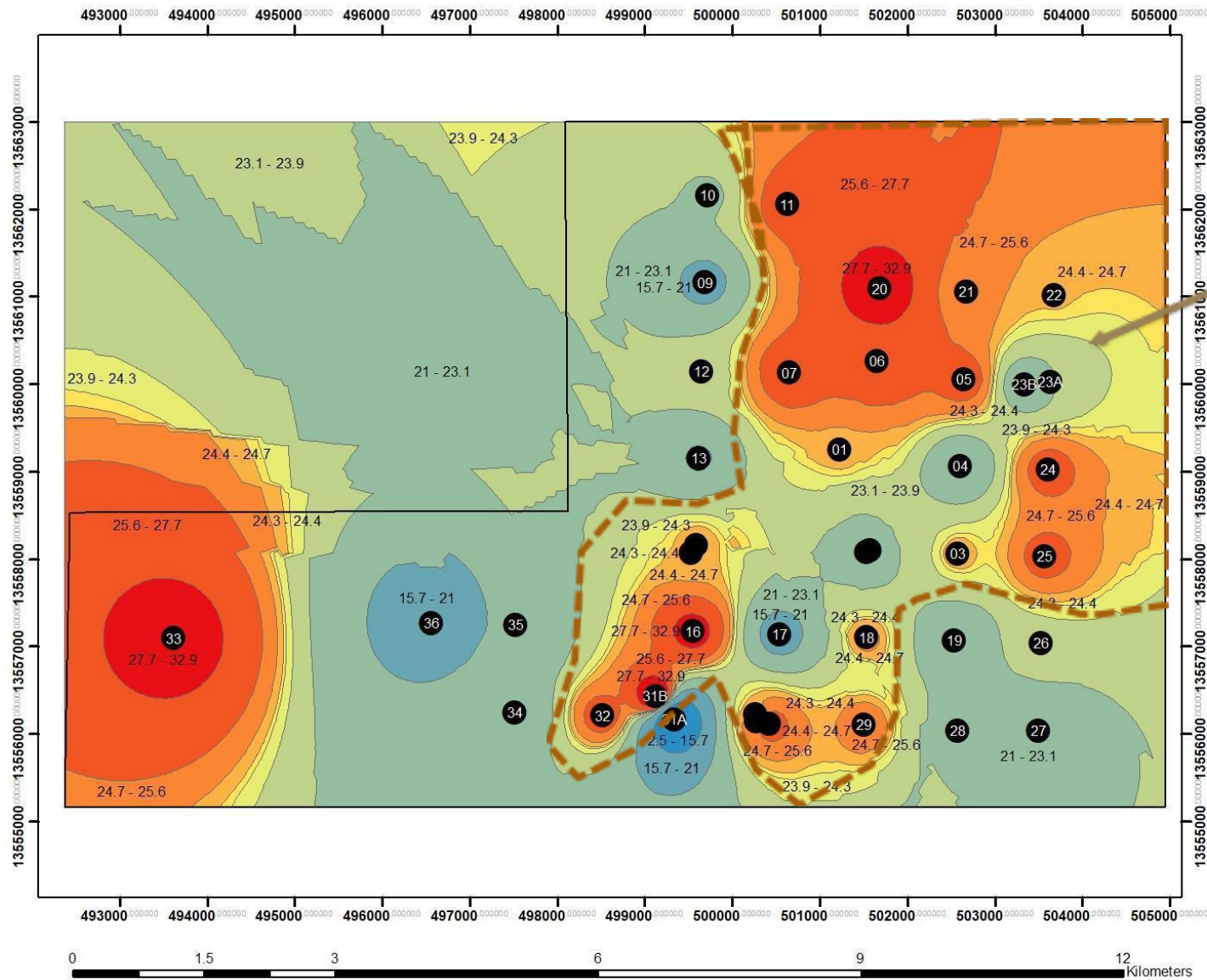
The ratios of the impurities to the ratios of phosphorous oxides

The results of more than 15 wells showing average content 25% of P₂O₅, which is marked as excellent quality according to TCP content with an average ratio 55% high grade.

More than 20 medium-quality wells of phosphates, ranged from 20 to 25% within the initial wells that were drilled.

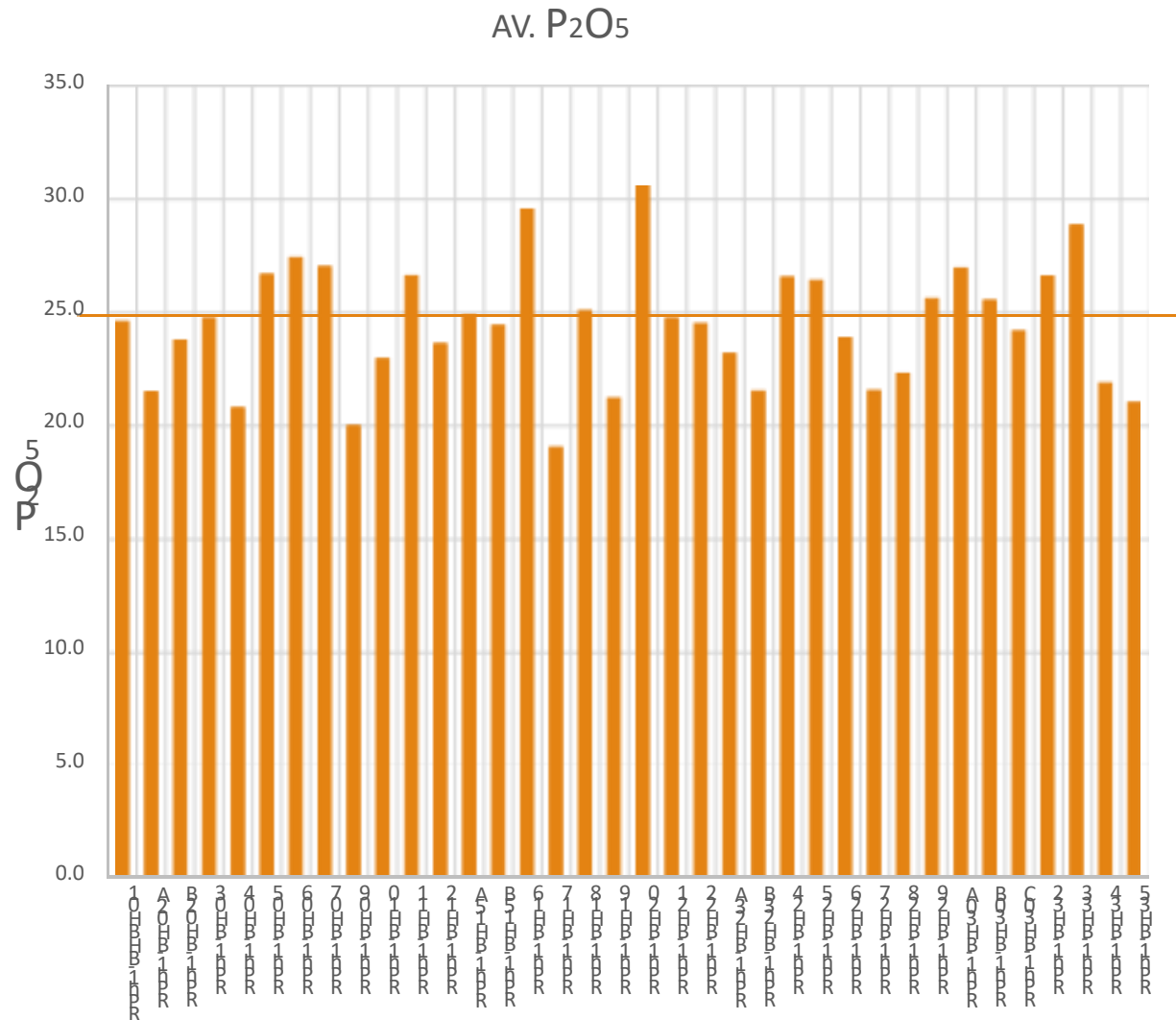
Note that the maximum value recorded exceeded 36%, which is equivalent to 80% of the TCP of phosphate grade.





Interest area with approximately of 30 km², the quality is indicated in ranging of 25 – 36 % with average thickness of 8 m

BH. ID	Depth & Samples		OV	Phosphate Bed (m)		P2O5			TCP		
	T.D	T.S		PH_all	PH+18	Max	Min	Average	Max	Min	Average
RPh1-BHBH01	35	19	9	6	6	34.2	0.8	24.6	74.7	39.5	53.6
RPh1-BH02A	16	16	6	4	4	24.7	1.5	21.5	54.0	41.5	46.9
RPh1-BH02B	21	18	5	7	6	31.2	20.1	23.7	68.2	43.9	51.8
RPh1-BH03	21	21	11	2	2	26.4	0.4	24.7	57.7	50.3	54.0
RPh1-BH04	30	30	0	4	3	24.3	18.9	20.7	53.1	41.3	45.3
RPh1-BH05	31	31	13	18	17	31.1	18.0	26.6	68.0	39.3	58.1
RPh1-BH06	15	15	5	10	10	33.8	0.2	27.4	73.9	44.6	59.8
RPh1-BH07	18	18	9	9	6	33.3	21.6	27.0	72.8	47.2	58.9
RPh1-BH09	19	19	13	4	3	24.3	0.4	20.0	53.1	43.3	47.3
RPh1-BH10	14	14	8	5	5	25.9	0.5	22.9	56.6	44.4	50.0
RPh1-BH11	24	24	7	12	10	33.3	20.5	26.6	72.8	44.8	58.0
RPh1-BH12	20	20	13	7	7	28.1	18.1	23.6	61.4	0.9	21.2
RPh1-BH13	21	21	18	5	5	25.0	0.4	20.6	54.6	0.9	18.6
RPh1-BH15A	9	9	1	8	8	30.0	18.6	24.8	65.6	40.6	54.2
RPh1-BH15B	18	18	2	15	12	31.5	18.8	24.4	68.8	41.1	53.2
RPh1-BH16	18	18	12	6	5	33.8	22.7	29.5	73.9	49.6	64.5
RPh1-BH17	24	24	20	1	1	19.0	19.0	19.0	41.5	41.5	41.5
RPh1-BH18	24	24	13	9	6	31.2	20.9	25.0	68.2	45.7	54.7
RPh1-BH19	21	21	18	3	3	22.0	20.1	21.2	48.1	0.8	16.3
RPh1-BH20	22	22	11	11	8	36.0	20.1	30.5	78.7	43.9	66.7
RPh1-BH21	29	29	12	14	13	32.1	19.4	24.7	70.1	42.4	54.0
RPh1-BH22	25	25	17	8	8	32.4	18.1	24.5	70.8	39.5	53.4
RPh1-BH23A	18	18	12	3	3	27.4	20.4	23.1	44.6	59.9	50.5
RPh1-BH23B	27	27	10	6	5	27.0	18.3	21.5	59.0	40.0	47.7
RPh1-BH24	24	24	5	4	4	27.5	24.8	26.5	60.1	54.2	57.9
RPh1-BH25	24	24	11	6	5	32.2	19.6	26.4	70.4	38.7	54.9
RPh1-BH26	29	29	11	4	4	24.8	22.8	23.8	54.2	49.8	52.1
RPh1-BH27	24	24	17	6	6	25.5	18.8	21.5	55.7	41.1	47.0
RPh1-BH28	27	27	16	9	8	28.2	18.5	22.3	61.6	40.4	46.2
RPh1-BH29	29	29	8	6	5	29.7	19.0	25.6	64.9	41.5	55.8
RPh1-BH30A	15	15	12	3	3	29.1	25.1	26.9	63.6	54.8	58.5
RPh1-BH30B	13	13	7	6	6	30.3	19.3	25.5	66.2	42.2	55.7
RPh1-BH30C	25	25	9	12	11	27.9	19.2	24.1	61.0	42.0	52.7
RPh1-BH31A	17	17	0	0	0	11.8	0.4	2.5	25.8	0.8	5.6
RPh1-BH31B	21	21	13	8	8	34.6	31.4	32.9	68.6	75.6	72.0
RPh1-BH32	29	29	24	2	2	28.2	24.9	26.6	61.6	54.4	58.0
RPh1-BH33	28	28	17	2	2	32.8	24.8	28.8	71.7	54.2	62.9
RPh1-BH34	21	21				25.2	19.8	21.8	55.1	43.3	49.6
RPh1-BH35	30	30	15	12	4	21.9	20.5	21.0	47.9	44.8	45.0



Traditional Concentrate Quality Guidelines for DH Phosphoric Acid Production and 18-46-0 DAP Manufacture

		<u>Acceptable Range</u>	<u>Jordanian Phosphate</u>
Phosphate	% P ₂ O ₅	28 to 36%	25-36 %
Calcium	weight ratio CaO/P ₂ O ₅	1.3 to 1.6	
Magnesium	%MgO	<0.6%	<0.2 %
Iron+Aluminum	%Fe ₂ O ₃ +Al ₂ O ₃	<3.0%	<0.78%
Aluminium	% Al ₂ O ₃	0.5 to 1.5%	<0.55%
MER	see next slide	0.03 to 0.1 ratio	
Silica – insoluble	% SiO ₂	>6%	
Silica – soluble	%SiO ₂	<0.8%	
Chlorine	low/med/high	300/500/1000 ppm	
Carbon Dioxide	CO ₂ +Organics	<4.5%	
Fluorine	%F	3 to 4%	3 – 4 %
Sodium	%Na ₂ O	<0.8%	>0.33%
Potassium	%K ₂ O	<0.8%	>0.09 %
Heavy Metals			


XRF Sample Sheet

Item	S.ID.	Fe ₂ O ₃ Wt.%	MnO Wt.%	TiO ₂ Wt.%	CaO Wt.%	K ₂ O Wt.%	SO ₃ Wt.%	P ₂ O ₅ Wt.%	SiO ₂ Wt.%	Al ₂ O ₃ Wt.%	MgO Wt.%	Na ₂ O Wt.%	F Wt.%	U Wt.%	L.O.I Wt.%
1	RPH1-BH31B-1	0.82	< 0.012	0.12	44.70	< 0.09	< 0.058	0.29	16.20	1.33	0.85	< 0.33	< 0.51	< 0.0125	35.67
2	RPH1-BH31B-2	0.35	< 0.012	0.058	49.80	< 0.09	< 0.058	0.34	9.57	0.62	0.62	< 0.33	< 0.51	< 0.0125	38.59
3	RPH1-BH31B-3	0.47	< 0.012	0.075	46.20	< 0.09	0.72	0.70	14.50	0.76	0.86	< 0.33	< 0.51	< 0.0125	35.71
4	RPH1-BH31B-4	< 0.23	< 0.012	< 0.029	51.30	< 0.09	< 0.058	0.62	9.42	< 0.55	< 0.21	< 0.33	< 0.51	< 0.0125	38.09
5	RPH1-BH31B-5	< 0.23	< 0.012	0.030	50.70	< 0.09	0.37	1.06	9.69	< 0.55	< 0.21	< 0.33	< 0.51	< 0.0125	37.34
6	RPH1-BH31B-6	< 0.23	< 0.012	0.029	51.40	< 0.09	0.19	1.15	8.43	< 0.55	< 0.21	< 0.33	< 0.51	< 0.0125	37.99
7	RPH1-BH31B-7	< 0.23	< 0.012	< 0.029	54.60	< 0.09	0.30	7.06	2.01	< 0.55	< 0.21	< 0.33	0.54	< 0.0125	35.06
8	RPH1-BH31B-8	< 0.23	< 0.012	< 0.029	53.40	< 0.09	0.12	4.07	4.42	< 0.55	< 0.21	< 0.33	< 0.51	< 0.0125	37.05
9	RPH1-BH31B-9	< 0.23	< 0.012	< 0.029	53.10	< 0.09	0.17	7.16	5.35	< 0.55	< 0.21	< 0.33	0.63	< 0.0125	33.22
10	RPH1-BH31B-10	< 0.23	< 0.012	< 0.029	49.50	< 0.09	0.19	8.20	11.40	< 0.55	< 0.21	< 0.33	0.47	< 0.0125	29.97
11	RPH1-BH31B-11	< 0.23	< 0.012	< 0.029	42.20	< 0.09	0.38	13.40	23.80	< 0.55	< 0.21	< 0.33	1.12	< 0.0125	18.62
12	RPH1-BH31B-12	< 0.23	< 0.012	< 0.029	44.60	< 0.09	0.40	13.90	19.90	< 0.55	< 0.21	< 0.33	1.12	< 0.0125	19.82
13	RPH1-BH31B-13	< 0.23	< 0.012	< 0.029	30.70	< 0.09	0.27	12.40	42.80	< 0.55	< 0.21	< 0.33	0.94	< 0.0125	12.69
14	RPH1-BH31B-14	< 0.23	< 0.012	< 0.029	52.40	< 0.09	1.25	32.90	2.03	< 0.55	< 0.21	< 0.33	3.55	< 0.0125	7.82
15	RPH1-BH31B-15	< 0.23	< 0.012	< 0.029	52.30	0.16	1.15	32.60	1.47	< 0.55	< 0.21	1.28	3.65	< 0.0125	7.24
16	RPH1-BH31B-16	< 0.23	< 0.012	< 0.029	52.50	< 0.09	1.07	33.40	2.46	< 0.55	< 0.21	< 0.33	3.62	< 0.0125	6.90
17	RPH1-BH31B-17	< 0.23	< 0.012	< 0.029	53.50	< 0.09	1.01	34.60	0.51	< 0.55	< 0.21	< 0.33	4.13	< 0.0125	6.23
18	RPH1-BH31B-18	< 0.23	< 0.012	< 0.029	53.20	< 0.09	0.99	34.10	1.02	< 0.55	< 0.21	< 0.33	4.08	< 0.0125	6.53
19	RPH1-BH31B-19	< 0.23	< 0.012	< 0.029	50.50	< 0.09	0.88	31.40	6.10	< 0.55	< 0.21	< 0.33	3.51	< 0.0125	7.46
20	RPH1-BH31B-20	< 0.23	< 0.012	< 0.029	51.10	< 0.09	1.07	32.40	4.62	< 0.55	< 0.21	< 0.33	3.82	< 0.0125	6.84
21	RPH1-BH31B-21	< 0.23	< 0.012	< 0.029	50.30	< 0.09	1.04	32.10	5.75	< 0.55	< 0.21	0.44	3.43	< 0.0125	6.72
Uncertainty (if required):		-	-	-	-	-	-	-	-	-	-	-	-	-	-

OV

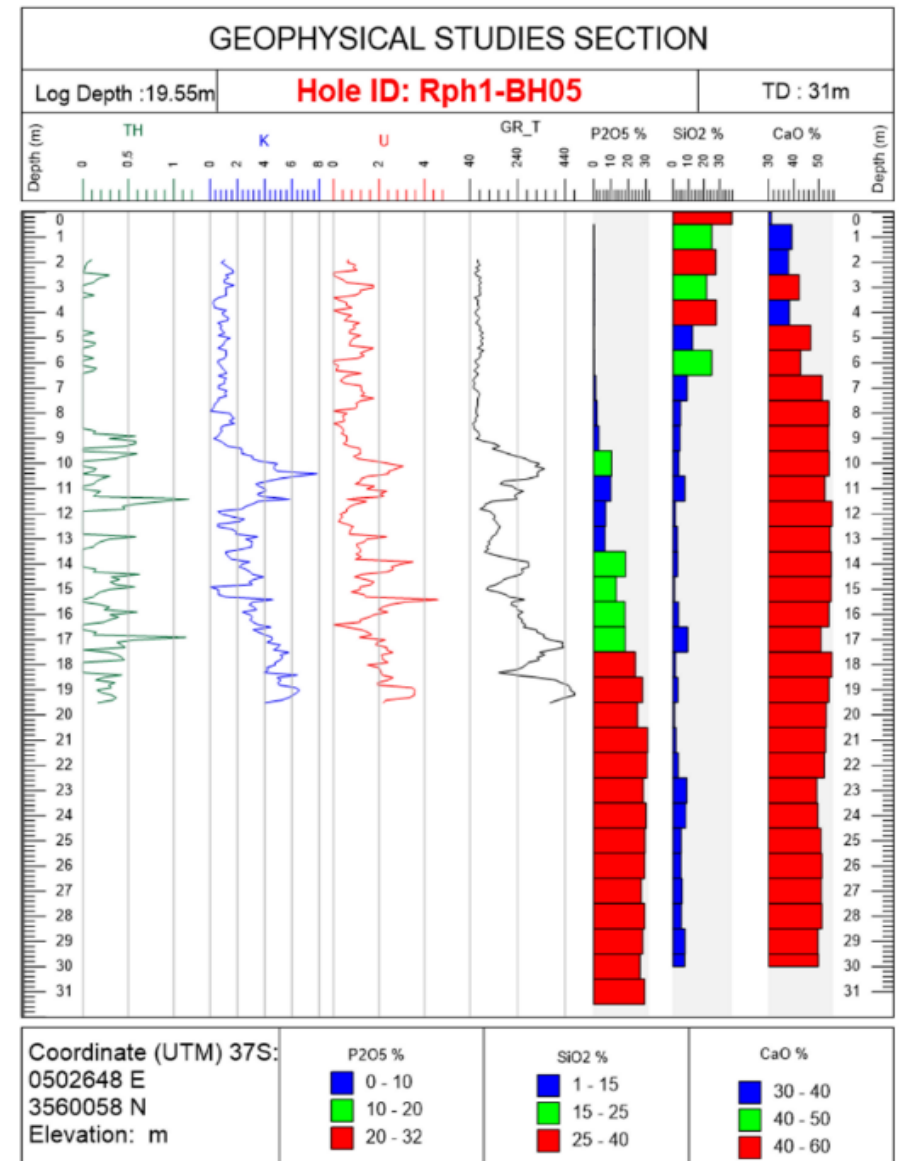
PH

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Logs

A geophysical logs was performed for the phosphate wells, where the results of the laboratory analysis of the ratio of P₂O₅ were compared with gamma radiation spectroscopy. .




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Geological resource

The initial resource was estimated at 650 million cubic meters of phosphate in the study area within an area of 70 km² of medium and high quality phosphate as estimated of a primary geological resource.

Al Risha phosphate prospecting project

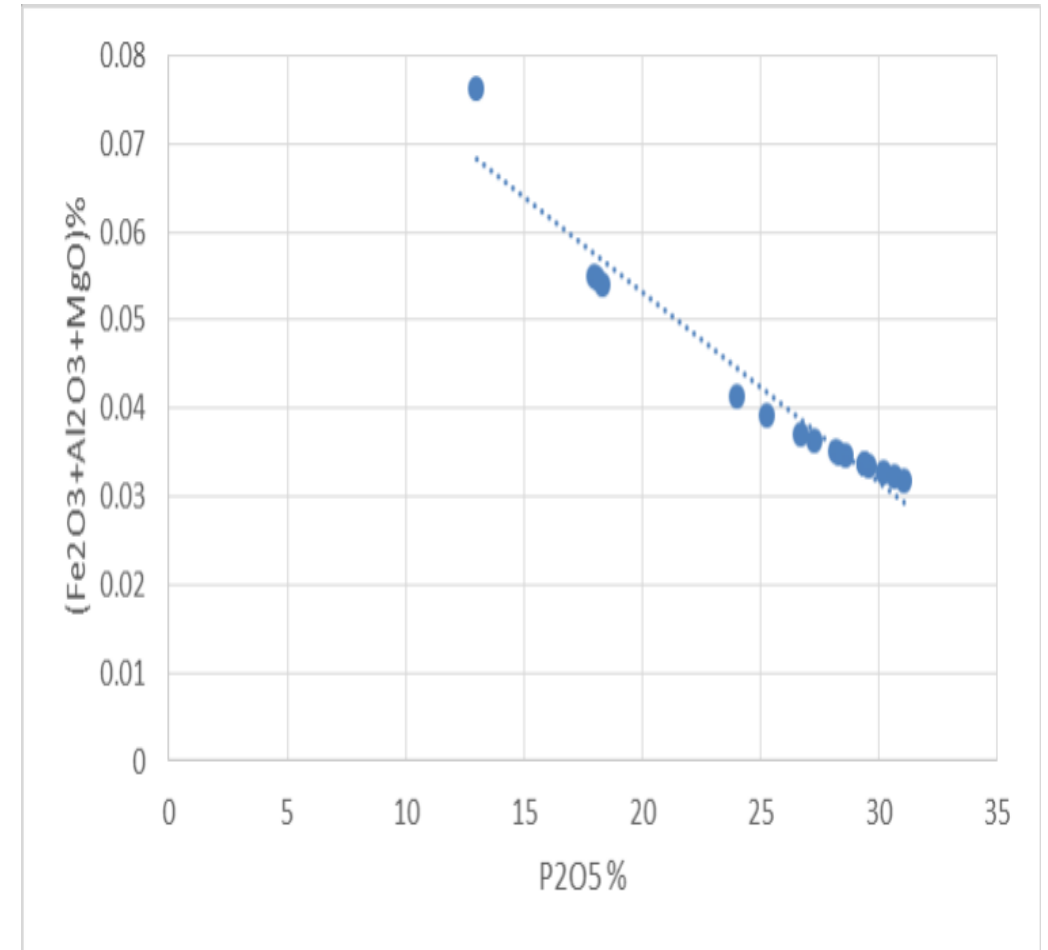
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Impurities

The rock phosphate in the Risha area is characterized by the low percentage of clay impurities, which were calculated through the ratios of total aluminum, iron and magnesium oxides to the ratios of phosphorous oxide.

$$\text{Impurities Oxides} = (\text{Fe}_2\text{O}_3 + \text{Al}_2\text{O}_3 + \text{MgO}) / \text{P}_2\text{O}_5$$

The results for the percentage of these impurities were very few, and sometimes reached less than 0.04%, which is a low percentage globally, which pushes this crude to be suitable for the manufacture of phosphorous acids and various manufacturing industries.



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Uranium in phosphate rock

The results showed that the percentages of uranium range from 56 to 117 parts per million, which are good results for uranium to form a by-product during the manufacturing industries, noting that countries such as China extract uranium from rock phosphate within concentrations that do not exceed 70 parts per million (70 g / metric ton of phosphate). Preliminary results indicate the presence of high concentrations of uranium, approximately one kilogram per 10 tons of phosphate ore. 14 out of 20 samples had a uranium concentration of more than 70 ppm

#	Code	U ppm
1	Rph1BH01-5	70.02
2	Rph1BH2B-7	60.05
3	Rph1BH11-15	90.48
4	Rph1BH11-16	93.31
5	Rph1BH15A-7	66.07
6	Rph1BH15B-10	117.61
7	Rph1BH16-16	113.43
8	Rph1BH16-17	94.92
9	Rph1BH16-18	79.62
10	Rph1BH18-18	55.22
11	Rph1BH20-16	72.48
12	Rph1BH20-18	99.71
13	Rph1BH21-21	73.93
14	Rph1BH22-22	81.19
15	Rph1BH24-6	56.09
16	Rph1BH24-8	70.66
17	Rph1BH26-15	74.22
18	Rph1BH27-18	36.48
19	Rph1BH29-13	62.58
20	Rph1BH29-14	82.12

Al Risha phosphate prospecting project

- **Introduction**
- **Location**
- **Thickness**
- **Phosphate Quality**
- **Boreholes Logs**
- **Geological Resource**
- **Impurities**
- **Uranium**
- **Summary**



Summary

- Total of 40 wells were drilled from 46 identified wells, the thickness of which ranged between 25 and 35 meters, with a total length of more than 1000 meters, more than 960 samples were collected and analyzed (cutting samples).
- The results of thickness analysis of phosphates of medium and high quality grade showed between 4 to 8 meters, with a maximum limit of more than 10 meters, with high concentrations of phosphate.
- A decrease in the associated clay impurities that did not exceed 0.1% in total, which is much less than the global minimum required for phosphate processing industries.
- The average sedimentary cover in the study area was within 10 meters in all the wells that were drilled While the grade concentration rates ranged from 25% to 36% for di phosphorous penta oxide P_2O_5
- The proportions of associated radioactive metals, according to the analysis of samples at the Atomic Energy Commission, ranged from 56 to 117 grams per ton of uranium, in addition to accompanying concentrations of thorium.
- The initial geological reserve is estimated at 650 million metric tons of phosphate ore within the area of 70 km² that has been completed so far.