

RETENTION OF PHOSPHATE BY PEAT SAMPLES

ARMI KAILA

University of Helsinki, Department of Agricultural Chemistry

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Since **Way** in 1850 (ref. 15) demonstrated that soils are able to retain soluble phosphate, the problem of the sorption of phosphate by soils and soil constituents has been dealt by a great number of scientific papers. Generally, these works confirm the early results. They give, however, a somewhat confusing picture regarding the reactions involved.

Most of the studies have been made on mineral soils. Among the few works concerning peat soils the papers by **DOUGHTY** (1, 2) and **KASAKOW** (6) may be mentioned. These authors conclude that precipitation and physical adsorption are both functioning in the removal of phosphate from solution by peat samples. **DOUGHTY** states that in the material studied the formation of iron, aluminum and calcium phosphates will account for the fixation of phosphorus under field conditions. According to **KASAKOW**, the maximum retention of phosphate by peat occurs at about pH 2—3; owing to the higher content of iron, aluminum and calcium in the fen peat, the fixation of phosphate by this group is higher than that by the bog peats. **McCOOL** (9) noted that the capacity of peat and muck soils to take up phosphorus increased with the mineral content and the degree of decomposition. **VERHOEVEN** (14) maintains that the retention of phosphate by irreversibly shrinking peat soils primarily depends on the mobile iron content of the soils. **LARSEN** (8) found a positive correlation between the sesquioxide content of organic soils and their phosphate fixing capacity.

Obviously, the retention of phosphate by peat soils may be connected with several factors. In the present paper an attempt is made to study the capacity of Finnish virgin peat soils to retain phosphate and the factors on which this capacity depends.

There is no generally accepted way to determine the phosphate-sorption capacity of a soil. It is a quantity which varies with the ratio of soil to phosphate solution and with the phosphorus concentration of the solution. Other ions present also exert their effect, likewise the acidity, temperature, and time of connection.

Therefore, one is compelled to choose a more or less conventional method which gives values that, at least, are correlated with the phosphate fixing capacity of the soil. RUSSEL and PRESCOTT (13) already found that the relationship between the amount of phosphate sorbed and the corresponding equilibrium concentration of phosphate in experiments generally comply with the Freundlich adsorption isotherm. Recently OLSEN and WATANABE (10) and RENNIE and MCKERCHER (12) have emphasized the applicability of the Langmuir isotherm to the estimation of phosphate retention by soils.

In this study the coefficient k in the Freundlich adsorption equation $y = k \times c^n$ was taken to characterize the retention of phosphate by the peat samples (y = the amount of P adsorbed, mg/kg of soil, c = the equilibrium concentration of phosphorus in the solution mg/l, n = a constant). According to RUSSELL and PRESCOTT (13) k «represents the tenacity with which the soil keeps its phosphate or the reluctance with which the soil parts with its phosphate under the conditions of the experiment». The factors the effect of which on the value of k was studied in the present work were the degree of humification and the acidity of the peat, the sampling depth, the amount of extractable calcium, and the amounts of iron and aluminum soluble in diluted hydrochloric acid.

Material and methods

The material of the present study consisted of 134 peat samples collected from different layers of virgin peat lands.

The samples were air-dried and ground in a Wiley mill. The methods used for the determination of the degree of decomposition (H), the weight of volume, pH, and the content of extractable calcium are described in previous papers (4, 5).

The «exchangeable» phosphorus was extracted by an alkali solution 0.1 N with respect to potassium hydroxide and potassium carbonate. The ratio of soil to solution was 1 : 100, and the shaking time was 2 + 4 hours in two consecutive days. The inorganic phosphorus in the solution was determined after the precipitation of the organic matter by sulphuric acid.

The coefficient k in the Freundlich adsorption equation was calculated on the basis of data for removal of phosphorus by 5 grams of peat from 100 ml of KH_2PO_4 -solution containing phosphorus 15.5 mg/l and 155.0 mg/l, respectively. The suspensions were heated on a boiling water-bath for two hours in two consecutive days. The values of «exchangeable» phosphorus were used in the calculations to represent the native sorbed phosphate.

Iron and aluminum were extracted from 2 g-samples with 100 ml of 0.1 N HCl by shaking for one hour. The iron dissolved was determined by the method of KUNIN (7). The aluminum content of the extract was estimated by the Aluminon method in which the disturbing effect of iron was eliminated by hydroxylamine hydrochloride.

Table I. Analyses of peat samples.

Sample	Depth dm	H	pH	Volume weight	Exchangeable P ppm	k	Extractable Ca ppm	0.1 N HCl-soluble	
								Fe ppm	Al ppm
<i>Sphagnum</i> peat									
22									
65	0—2	1	3.7	0.05	68	0	1800	110	120
K 31	0—2	1	4.2	0.08	58	0	4100	170	170
K 32	4—6	1	4.4	0.08	28	0	4700	280	270
K 21	0—2	1	4.3	0.09	71	0	6200	50	180
K 34	0—2	1	4.2	0.09	72	112	3400	2840	3250
A 4	3—5	1	4.7	0.10	15	0	2800	110	180
K 37	0—2	1	4.5	0.11	96	0	4900	490	470
K 6	1—2	1	4.5	0.11	144	8	7000	1220	1700
A 27	0—2	1	4.5	0.12	31	209	2000	210	3600
36	0—2	1	4.0	0.12	70	36	2000	610	2300
A 37	0—2	1	4.4	0.28	53	40	3200	2000	1250
A 31	0—2	1	3.9	0.29	64	0	2100	410	1050
66	2—5	1	3.6	0.09	34	0	—	280	230
K 22	2—4	2	5.0	0.14	72	0	10600	140	100
K 7	2—3	2	4.6	0.17	154	126	6800	1440	2730
A 5	5—7	3	4.9	0.23	19	0	3500	170	440
A 1	2—3	3	3.7	0.29	35	0	3200	300	970
A 32	3—5	3	4.0	0.34	35	3	1500	140	1150
A 6	12—14	4	4.7	0.21	19	0	7100	140	440
105	2—4	4	4.4	0.20	27	0	5800	80	110
A 2	3—4	5	3.8	0.49	40	0	3600	440	850
A 3	7—10	7	4.4	0.38	36	137	5600	2160	3130
<i>Carex-Sphagnum</i> peat									
19									
69	0—3	2	4.2	0.09	135	0	2300	610	930
K 38	2—4	2	4.6	0.23	95	0	4300	610	560
107	1—3	3	4.4	0.16	83	51	2000	560	1820
28	4—6	3	4.2	0.23	27	9	2100	2110	950
37	0—3	3	4.7	0.33	44	22	2800	220	1910
A 52	1—3	3	3.8	0.33	54	0	1530	860	550
K 39	4—6	4	4.6	0.25	53	0	3500	380	1100
A 28	5—7	4	4.3	0.30	19	123	1600	250	3270
70	3—5	4	4.4	0.25	103	22	1730	460	2230
34	0—3	4	4.5	0.34	60	399	1300	2720	3650
35	0—3	4	4.5	0.38	75	318	2600	2670	2550
K 8	3—4	5	4.6	0.39	96	299	3900	1060	4500
K 33	6—8	5	4.5	0.25	62	0	4400	550	690
29	15—20	5	5.1	0.33	18	123	4400	5670	2450
A 29	8—10	5	4.1	0.35	27	50	1800	260	2150
106	2—4	6	4.7	0.26	82	36	5600	210	1340
71	7—10	6	4.3	0.36	54	139	1180	260	3350
K 42	2—4	7	3.9	0.39	71	66	3000	260	2140
A 46	4—6	7	4.1	0.49	52	78	2200	280	2100

Sample	Depth dm	H	pH	Volume weight	Exchange- able P ppm	k	Extract- able Ca ppm	0.1 N HCl-soluble	
								Fe ppm	Al ppm
<i>Sphagnum-Carex peat</i>									
K 28	0—2	1	4.5	0.20	115	26	4500	2080	1300
A 19	1—3	2	5.0	0.25	46	13	6000	830	740
A 12	3—5	2	4.8	0.25	44	16	4600	1500	1250
A 23	1—3	2	4.7	0.38	99	63	4400	2170	1250
59	0—2	3	3.6	0.23	98	106	1600	1220	1800
K 12	0—1	3	4.4	0.27	101	240	5100	1000	2650
B 14	1—3	3	4.3	0.30	31	5	4800	1890	900
A 53	1—3	3	4.2	0.42	31	43	1100	220	1800
A 47	2—4	3	4.6	0.23	62	519	2400	6120	3900
A 11	0—2	3	4.9	0.26	46	18	2400	830	820
A 16	6—8	3	4.5	0.30	28	57	1800	120	2200
A 35	0—4	3	5.5	0.31	40	0	13200	40	80
K 18	0—2	3	5.5	0.27	67	74	3300	1000	1600
B 6	1—3	4	4.3	0.21	74	303	2160	3780	2200
K 24	6—8	4	5.1	0.35	25	0	6600	750	330
A 49	1—3	4	4.3	0.34	95	30	2700	2840	1700
89	0—2	4	4.5	0.22	155	0	—	2280	1050
33	0—3	4	4.7	0.30	100	0	2700	1330	680
A 20	4—6	4	4.2	0.30	31	0	2900	390	560
B 2	1—3	4	4.1	0.33	26	145	1840	430	3100
A 15	2—4	4	4.3	0.34	52	19	2100	1000	1540
B 7	4—6	4	4.3	0.33	69	272	2360	4170	2650
B 8	8—12	5	4.4	0.30	71	329	2500	4950	3450
A 33	8—10	5	4.1	0.30	25	20	1300	100	1910
60	3—9	5	3.5	0.32	53	7	1700	1000	850
K 35	4—6	5	4.9	0.34	99	170	3400	1250	2830
K 23	4—6	5	5.0	0.32	42	0	7900	420	210
B 3	4—6	6	4.0	0.36	22	250	790	680	4300
K 59	0—5	6	5.3	0.45	30	83	3000	780	1980
61	10—13	7	4.5	0.40	52	268	1900	3490	3550
76	60—62	9	4.8	0.71	60	71	4400	1120	2300
<i>Carex-peat</i>									
K 29	5—7	2	4.6	0.20	94	91	3700	2060	1500
B 10	1—3	3	4.3	0.20	26	68	1570	1780	1800
24	1—3	3	5.0	0.22	33	30	6470	260	1270
A 40	0—2	3	4.7	0.30	39	30	3550	2610	1000
A 41	3—5	3	4.8	0.25	18	13	2400	2330	900
A 8	0—3	3	4.7	0.32	36	126	3970	6340	2350
A 38	3—5	3	4.5	0.29	35	29	2100	950	1150
A 24	5—6	3	5.0	0.34	30	25	3700	2110	1300
A 43	2—5	3	4.5	0.24	43	66	3000	1260	3300
45	0—2	4	4.7	0.28	46	163	5000	1330	2600
38	0—2	4	4.9	0.36	152	38	6800	2840	1050
K 13	1—3	4	4.9	0.28	65	138	3900	610	2220
K 14	5—7	4	5.1	0.26	53	87	3400	780	2010
K 25	1—3	4	4.6	0.21	65	159	3400	940	2380
K 26	5—7	4	4.2	0.20	58	176	3500	1220	3180

Sample	Depth dm	H	pH	Volume weight	Exchange- able P ppm	k	Extract- able Ca ppm	0.1 N Cl- soluble	
								Fe ppm	Al ppm
103	2-4	4	4.8	0.28	130	276	3200	2670	1950
109	1-3	4	4.6	0.24	104	120	1300	2110	850
111	1-3	4	4.7	0.26	61	112	2400	1550	2550
K 27	11-14	4	4.4	0.23	59	367	2900	1670	5400
A 44	6-8	4	4.3	0.27	21	468	3300	1670	4950
110	2-4	5	4.6	0.24	45	142	2800	1660	2700
B 15	4-6	5	4.3	0.34	11	3	4600	1820	750
K 36	4-6	5	4.9	0.34	72	426	3700	3000	5400
A 17	8-10	5	4.1	0.31	27	39	2000	180	2500
K 30	2-5	5	4.8	0.38	70	343	3600	3670	3300
K 41	2-6	5	4.2	0.28	59	37	3900	1280	1150
23	2-4	6	5.0	0.34	141	484	9800	1330	4850
26	2-4	6	6.1	0.34	58	20	18900	280	230
K 20	6-8	6	5.4	0.30	52	83	3800	760	2550
104	2-4	6	4.6	0.29	85	135	2300	2860	1750
A 25	8-9	6	5.1	0.37	30	240	4100	2280	3400
B 4	8-12	7	4.3	0.33	26	309	850	830	5050
B 16	8-12	7	4.2	0.35	11	12	5000	2270	1100
B 12	8-12	7	4.4	0.37	15	63	2400	2210	1970
B 11	4-6	7	4.1	0.50	23	99	1570	2480	2000
A 21	8-10	7	5.8	0.37	20	20	9000	110	1550
K 19	3-5	7	5.4	0.46	59	81	3400	840	1680
A 50	3-5	7	4.6	0.31	39	83	2100	1940	1900
31	3-6	8	4.9	0.39	28	105	13400	800	2400
30	0-3	8	4.6	0.54	44	98	13200	1030	2050
A 9	0-3	8	4.6	0.58	62	292	—	6340	2450
A 45	12-14	8	4.9	0.52	213	716	2900	3390	5250
32	0-5	8	4.7	0.69	40	623	7700	1310	6150
<i>Bryales-Carex peat</i>									
K 9	0-2	1	4.9	0.16	87	48	5200	1330	1800
K 1	0-2	1	5.5	0.14	32	0	10500	110	360
K 10	2-3	2	5.2	0.24	44	85	3700	560	1650
74	0-3	2	6.2	0.20	45	0	13300	110	70
39	0-2	2	4.7	0.23	34	0	4300	830	540
139	0-2	2	3.9	0.48	205	0	4400	1400	1450
K 2	3-5	3	5.2	0.28	26	58	8600	120	2420
97	0-2	3	3.9	0.26	70	0	23500	720	920
73	0-2	3	8.0	0.44	33	219	23500	330	1540
75	0-2	4	5.4	0.24	70	23	10200	2050	1100
125	4-7	4	4.9	0.30	24	19	7300	2330	800
134	4-10	6	5.7	0.43	51	552	11500	720	4950
142	2-4	5	4.8	0.53	44	0	11700	330	120
140	2-4	6	5.1	0.58	56	138	14700	2560	1400
K 11	5-7	7	5.0	0.37	42	116	4000	610	2380
K 3	7-9	7	5.3	0.34	26	68	6800	450	2550
<i>Eutrophic Sphagnum-Carex peat</i>									
91	0-2	2	5.8	0.18	108	0	—	0	60
40	0-3	3	5.6	0.25	54	0	14000	190	70
63	3-7	5	4.7	0.32	42	0	9550	330	480

Results

The analytical results of the peat samples are reported in Table 1. There are 22 samples of *Sphagnum* peat (Sp), 19 samples of *Carex-Sphagnum* peat (CSp), 31 samples of *Sphagnum-Carex* peat (SCp), 43 samples of *Carex* peat, 16 samples of *Bryales-Carex* peat (BCp), and 3 samples of eutrophic *Sphagnum-Carex* peat (EuSCp). On account of the low number of samples in some of the peat groups, the samples of Sp and CSp are treated as one group, and so are also the samples of Cp, BCp and EuSCp.

In order to get a general survey of the material the mean values for the analytical data of each group are calculated. They are recorded in Table 2 which also contains the corresponding standard deviations.

Owing to one sample (number 76) taken from the depth of 60—62 dm, the average sampling depth is somewhat higher in the SCp-group than in the other ones. Without sample 76, the mean sampling depth in this group is 3.8 dm. Both the average degree of decomposition, H, and the weight of volume appear to be lower in the group of Sp and CSp than in the other groups. Also the members of the former group tend to be more acid and contain less samples with a high content of extractable calcium than the other ones do.

Table 2. Mean values of the analytical results in different peat groups

Peat group Number of samples	Sp and CSp 41		SCp 31		Cp and BCp 62	
	mean	s	mean	s	mean	s
Sampling depth, dm	3.9	3.4	5.6	11.1	4.2	3.0
H	3.1	1.9	4.0	1.6	4.6	1.9
Weight of volume	0.24	0.12	0.32	0.09	0.32	0.11
pH	4.3	1.8	4.5	1.8	4.9	0.6
Extractable Ca, ppm	3550	2000	3470	2500	6200	5500
»Exchangeable» P, ppm	60	34	61	33	56	41
k	59	304	101	130	135	165
Acid-soluble Fe, ppm	880	1200	1620	1490	1520	1820
» Al, ppm	1540	1210	1900	1160	2090	2220

The data for the »exchangeable» phosphorus are low in all the samples which, of course, is connected with the low content of inorganic phosphorus in Finnish uncultivated peat soils. In a previous work the author (4) found that the average content of inorganic phosphorus in the different peat groups varied from 120 to 180 ppm.

The variation in the values of the coefficient k seems to be very large. There are numerous samples, particularly in the Sp and BCp groups, which apparently do not retain phosphate under the conditions of the experiment. On the other hand,

there are samples which have values of k higher than 300. For the sake of comparison it may be mentioned that for a clayed and cultivated peat soil which is known to have a high capacity to fix phosphate (according to the method by PIPER (11) its phosphate exchange capacity is about 13000 ppm of P) the k value obtained by the present method was about 300. The highest k -values of the present material are 623 and 716 for the Cp-samples 32 and A 45, respectively. The average k -values for the different groups are, however, markedly lower: 59, 101, and 135 for the Sp and CSp, SCp, and Cp and BCp, respectively. Owing to the large variation, no significant difference exists between the peat groups.

The amounts of iron and aluminum extracted by diluted hydrochloric acid also vary in the present material quite markedly. The lowest iron content is 40 ppm and the highest one 6340 ppm. The corresponding limits for the aluminum content are 70 ppm and 5250 ppm, respectively. The average contents of soluble iron and aluminum tend to be lower in the Sp and CSp group than in the other groups, although the differences are not significant. It is of interest to notice that a large part of the samples contains more acid soluble aluminum than acid soluble iron.

In order to study the association between the phosphate retention and the different other factors in these samples, the total correlation coefficients between the values of k and the sampling depth, the degree of decomposition, the weight of volume, pH, the content of extractable calcium, and the contents of soluble iron and aluminum, respectively, were calculated. The following total correlation coefficients were obtained between k and

	depth	H	w./v.	pH	Ca	Fe	Al
Sp and CSp	-0.01	0.24	0.33*	0.07	-0.19	0.49***	0.81***
SCp	0.15	0.16	-0.10	-0.17	-0.25	0.75***	0.84***
Cp and BCp	0.35**	0.39**	0.39**	0.01	0.06	0.30**	0.88***
All samples	0.108	0.324***	0.319***	0.018	-0.098	0.465***	0.855***

The phosphate retention capacity of these peat samples, as characterized by the coefficient k , appears to be most closely connected with the content of acid-soluble aluminum. Also the association with the acid-soluble iron is quite marked, but the extractable calcium or the acidity apparently do not play any important role in the phosphate retention under the conditions of the experiment. There may be some connection with the degree of humification, represented by the H-values and the weights of volume, but the sampling depth is probably only of a minor importance.

The association of the k values with the amounts of soluble aluminum and iron, and the degree of decomposition (H) was further studied by calculating the partial correlation coefficients in which the effect of each variable was isolated from the effects of the other variables. The elimination of the effect of the soluble iron or the degree of decomposition does not to any noteworthy degree change the correlation between k and soluble aluminum: the respective partial correlation coefficients are

$$r_{kAl;Fe} = 0.838^{***} \text{ and } r_{kAl;H} = 0.837^{***}$$

The elimination of the effect of soluble aluminum from the correlation between k and soluble iron decreases the degree of reliability of the association, but the elimination of the effect of the degree of decomposition has less influence. The partial correlation coefficients are

$$r_{kFe;Al} = 0.362^{***} \text{ and } r_{kFe;H} = 0.442^{***}$$

The elimination of the effect of soluble aluminum reduces the correlation between k and the degree of decomposition to a nothingness whereas the elimination of the effect of soluble iron causes a far less decrease:

$$r_{kH;Al} = -0.036 \text{ and } r_{kH;Fe} = 0.285^{**}$$

The partial correlation coefficients between k and soluble aluminum, or soluble iron, or the degree of decomposition are after the elimination of the effect of the two other variables are the following:

$$r_{kAl;FeH} = 0.823^{***}$$

$$r_{kFe;AlH} = 0.364^{***}$$

$$r_{kH;AlFe} = -0.051$$

Similar results are obtained, if instead of the degree of decomposition the weight of volume is used to indicate the degree of humification.

The multiple correlation coefficient is $r_{k(AlFeH)} = 0.876^{***}$ which proves that the linear regression technique employed is fairly well suited for this material.

The regression equation for estimating k (y) for any particular values of soluble aluminum (x_1), soluble iron (x_2), and H (x_3) is thus

$$y = 0.085^{***} x_1 + 0.022^{***} x_2 - 1.68 x_3 - 75.2$$

and the standard deviation of any estimate will be 69.0.

Owing to the fact that the elimination of the effect of the soluble aluminum content results in the disappearance of the association between k and the degree of decomposition, k may be fairly reliably estimated on the basis of the contents of soluble aluminum and iron, only. This regression equation is

$$y = 0.083^{***} x_1 + 0.021^{***} x_2 - 79.6$$

and the standard deviation of any estimate will be 68.7. The multiple correlation coefficient is $r_{k(AlFe)} = 0.875^{***}$.

Discussion

As far as the coefficient k of the present work actually represents the sorption of phosphorus by the peat samples, the results obtained contain some interesting facts. Under the conditions of the experiment the retention of phosphorus varied quite markedly, even within the same kind of peat, and no significant differences

could be detected between the peat groups, although the Sphagnum peats tended to retain phosphorus to a lower degree than did the fen peats. This sorption was most closely connected with acid-soluble aluminum whereas acid-soluble iron appeared to play a minor role.

The present literature shows an essentially universal agreement that phosphate fixation in acid soils is primarily due to iron and aluminum, but there is very little information as to their mutual importance. Recently WILLIAMS et al. (16) found that in mineral soils aluminum extracted by different acid solutions gave highly significant correlations with the phosphate sorption, and in no case did the addition of a term for iron significantly improve the estimate of sorption given by aluminum alone. Although in these peat samples the degree of association of acid-soluble iron with the phosphate sorption was markedly lower than that of acid-soluble aluminum, also the effect of iron had to be counted.

There is, of course, no reason to suppose that just the amounts soluble in diluted hydrochloric acid would be equal to the active fractions of aluminum and iron in peat soils. WILLIAMS et al. (16) maintain that aluminum extracted by the Tamm acid-oxalate method is the best single criterion of phosphate sorption in the mineral soils studied. Attention must also be paid to the fact that the peat samples were air-dried and ground which may exert some effect on the retention of phosphate and on the solubility of aluminum and iron.

The results of the present study do not explain the mechanism of the phosphate retention by the peat samples. The Freundlich adsorption isotherm was used, but it does not imply an adsorption process. According to FISHER (3) the equation also applies to many reactions that are not adsorption. It must be emphasized that the values of k by no means are equal to the phosphate sorption capacity, they only are supposed to be correlated with this quantity the determination of which is difficult, or practically impossible if absolute figures are demanded.

S u m m a r y

The factors on which the retention of phosphorus by peat depends were studied on the basis of a material of 134 virgin peat samples. The coefficient k in the Freundlich adsorption isotherm $y = k c^n$ was used as an indicator of the phosphate sorption. The association of k with the sampling depth, the degree of decomposition, weight of volume, pH, extractable calcium, and the iron and aluminum dissolved by 0.1 N hydrochloric acid was treated.

The acid-soluble aluminum gave with k a highly significant correlation which did not decrease when the effects of acid-soluble iron and the degree of humification were eliminated. The correlation between k and the acid-soluble iron was also highly significant although less close than the former association, and it was to some extent lowered by the elimination of the effect of aluminum. The fairly low, although statistically significant correlation between k and the degree of humification as expressed by the degree of decomposition or by the volume

weight disappeared when the effect of aluminum was isolated. In the present material the sampling depth, pH and the content of extractable calcium did not give any significant correlation with k.

As far as these results are valid under natural conditions, aluminum appears to play a more important role in the phosphorus sorption of peat soils than iron does.

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SELOSTUS:

TURVENÄYTTTEIDEN FOSFORIN PIDÄTYKSESTÄ

ARMI KAILA

Yliopiston maanviljelyskemian laitos, Helsinki

Tutkimuksessa on yritetty selvittää turpeiden fosforin pidätyskykyyn vaikuttavia tekijöitä. Aineistona oli 134 luonnontilaisilta soilta kerättyä näytettä, jotka edustivat eri turvelajeja.

Fosforin pidätyskykyyn indikaattorina käytettiin Freundlichin adsorptioyhtälön, $y = kc^x$, kerrointa k. Tutkittiin k:n riippuvuutta maatumisasteesta, näytteenottoisyvyydestä, tilavuuspainosta, pH:sta, uuttuvasta kalsiumista sekä 0.1 n suolahappoon liukenevasta raudasta ja alumiiniumista.

Todettiin, että aluminiumin ja k:n välillä vallitsi erittäin voimakas korrelaatio, joka ei heikentynyt, kun raudan tai maatumisasteen vaikutus eliminoitiin. Myös k:n ja raudan välinen korrelaatio oli verraten voimakas, joskin huomattavasti matalampi kuin edellinen. Aluminiumin vaikutuksen eliminointi heikensi jonkin verran k:n ja raudan välistä riippuvuutta ja hävitti kokonaan heikohkon korrelaation k:n ja maatumisasteen väliltä. Näytteenottosyvyys, pH ja kalsiumin pitoisuus eivät tämän aineiston perusteella vaikuta turpeen fosforin pidätyskykyyn.

Mikäli näitä ilmakeivisiä näytteitä käyttäen saatuja tuloksia voidaan soveltaa luonnon olosuhteisiin, näyttää aluminium yhdisteinen olevan myös turvemaissa tärkeämpi fosforin pidättäjä kuin rauta.