

Retention of detonation nanodiamonds by soil: usage of tritium labeled nanoparticles and a key role for water-extractable Fe and Si[†]

Natalia A. Kulikova,^{*a,b} Maria G. Chernysheva,^c Gennady A. Badun,^c Olga I. Filippova,^a Vladimir A. Kholodov,^d Alexander B. Volikov^c and Andrey G. Popov^c

Table S1. Sites of sampling of the soils used in the study

Soil index	Soil name	Sampling site	
		Latitude	Longitude
Chernozem 1	Haplic Chernozem	51°37.046'N	36°15.629'E
Chernozem 2	Endocalcic Chernozem	51°01.862'N	40°43.565'E
Chernozem 3	Endocalcic Chernozem	51°01.850'N	40°43.514'E
Chernozem 4	Endocalcic Chernozem	51°01.879'N	40°43.708'E
Chernozem 5	Haplic Chernozem	51°07.344'N	40°22.089'E
Kastanozem 1	Haplic Kastanozem	49°06.658'N	44°07.307'E
Kastanozem 2	Haplic Kastanozem	49°05.445'N	44°08.855'E
Phaeozem 1	Haplic Phaeozem	53°58.439'N	37°09.596'E
Phaeozem 2	Haplic Phaeozem	53°57.707'N	37°10.077'E
Phaeozem 3	Luvic Chernic Phaeozem	53°28.881'N	38°58.276'E
Phaeozem 4	Luvic Chernic Phaeozem	53°29.835'N	38°58.931'E
Retisol 1	Epialbic Retisol	55°48.173'N	38°14.908'E
Retisol 2	Epialbic Retisol	56°02.058'N	37°09.286'E
Retisol 3	Epialbic Retisol	56°01.893'N	37°09.041'E
Solonetz	Humic Solonetz	49°06.652'N	44°07.248'E

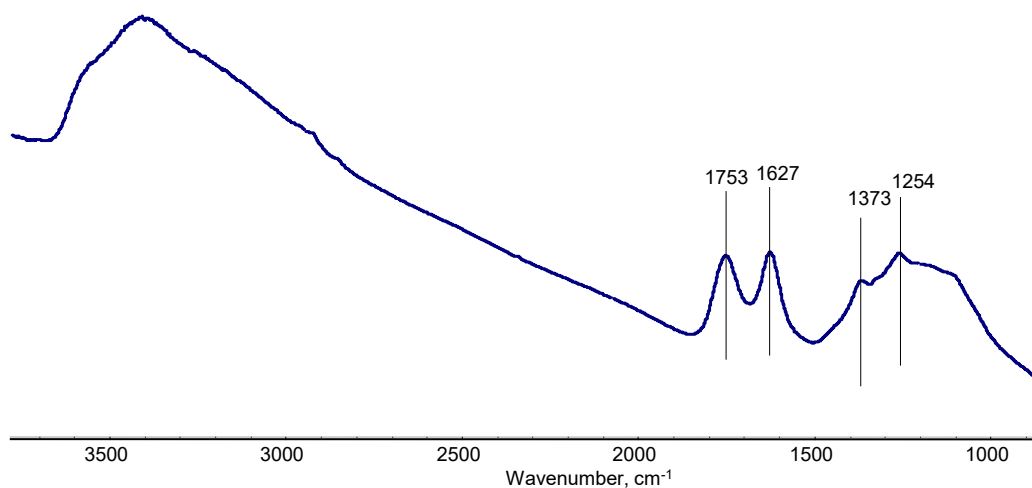


Figure S1. FTIR spectrum of NDs used in this work

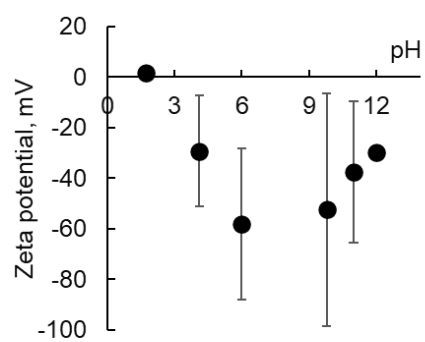


Figure S2. The dependence of zeta potential on pH for nanodiamond (RDDM-150). Error lines illustrate standard deviation of the distribution calculated by Malvern software

Table S2. Pearson correlation coefficients between some soil properties and their retention ability in relation to NDs

	Deposition	Retention	pH(CaCl ₂)	OC, %	N, %	Clay, %	Silt, %	Sand, %	σ	pH(H ₂ O)	WEOC	Al	Ca	Fe	K	Mg	Mn	Na	Si
Deposition	1																		
Retention	0.75	1																	
pH(CaCl ₂)	0.66	0.40	1																
OC, %	0.06	0.51	0.11	1															
N, %	0.19	0.39	0.27	0.75	1														
Clay, %	0.49	0.71	0.80	0.41	0.45	1													
Silt, %	-0.12	0.27	-0.04	0.68	0.52	0.31	1												
Sand, %	-0.02	-0.38	-0.18	-0.71	-0.58	-0.54	-0.97	1											
σ	0.56	0.50	0.35	0.37	0.47	0.20	0.25	-0.28	1										
pH(H ₂ O)	0.63	0.36	0.95	-0.10	0.09	0.72	-0.16	-0.05	0.20	1									
WEOC	-0.53	-0.07	-0.61	0.38	0.27	-0.39	0.43	-0.27	0.04	-0.61	1								
Al	-0.40	-0.61	0.16	-0.40	-0.11	0.09	-0.19	0.14	-0.19	0.19	-0.03	1							
Ca	0.65	0.58	0.49	0.41	0.46	0.34	0.24	-0.31	0.97	0.34	-0.12	-0.27	1						
Fe	-0.40	-0.61	0.18	-0.39	-0.10	0.11	-0.20	0.15	-0.19	0.20	-0.03	1.00	-0.27	1					
K	-0.21	-0.35	0.21	-0.09	0.20	0.04	-0.02	0.00	0.26	0.21	0.24	0.72	0.18	0.71	1				
Mg	-0.01	-0.15	0.46	0.01	0.32	0.30	0.03	-0.11	0.45	0.40	0.05	0.74	0.37	0.75	0.80	1			
Mn	-0.48	-0.32	-0.78	-0.25	-0.24	-0.63	0.15	0.04	-0.14	-0.67	0.69	0.13	-0.36	0.12	0.06	-0.06	1		
Na	-0.09	-0.36	0.14	-0.19	-0.12	0.06	-0.02	0.00	0.30	0.03	-0.16	0.63	0.21	0.64	0.39	0.64	0.12	1	
Si	-0.36	-0.53	0.06	-0.25	-0.16	0.08	0.01	-0.04	-0.08	0.05	0.10	0.72	-0.17	0.74	0.38	0.58	0.29	0.70	1

Deposition is a deposition during solid phase, mg kg⁻¹

Retention is a sum of aggregation and deposition, mg kg⁻¹

σ is a conductivity of water extract, mS cm⁻¹

WEOC is of water-extractable organic carbon, mg L⁻¹

Al, Ca, Fe, K, Mg, Mn, Na, Si are the concentrations in water extract, mg L⁻¹

Table S3 The ζ -potential and electrophoretic mobility of water extracted from the studied soils. $\pm$ represents one standard deviation (n = 3).

Soil index	ζ -potential, mV	Electrophoretic mobility, ($\mu\text{m}\times\text{cm}$) ($\text{V}\times\text{s}$) ⁻¹
Chernozem 1	-(12.1 $\pm$ 0.9)	-(0.947 $\pm$ 0.067)
Chernozem 2	-(12.6 $\pm$ 1.8)	-(0.989 $\pm$ 0.139)
Chernozem 3	-(11.8 $\pm$ 0.3)	-(0.920 $\pm$ 0.018)
Chernozem 4	-(11.8 $\pm$ 0.4)	-(0.925 $\pm$ 0.030)
Chernozem 5	-(13.8 $\pm$ 0.7)	-(1.086 $\pm$ 0.053)
Kastanozem 1	-(9.9 $\pm$ 1.9)	-(0.779 $\pm$ 0.145)
Kastanozem 2	-(10.5 $\pm$ 1.1)	-(0.826 $\pm$ 0.083)
Phaeozem 1	-(9.5 $\pm$ 0.6)	-(0.742 $\pm$ 0.049)
Phaeozem 2	-(12.3 $\pm$ 0.4)	-(0.964 $\pm$ 0.034)
Phaeozem 3	-(11.6 $\pm$ 0.8)	-(0.908 $\pm$ 0.065)
Phaeozem 4	-(13.8 $\pm$ 0.5)	-(1.085 $\pm$ 0.039)
Retisol 1	-(16.9 $\pm$ 0.7)	-(1.311 $\pm$ 0.067)
Retisol 2	-(10.6 $\pm$ 0.2)	-(0.832 $\pm$ 0.016)
Retisol 3	-(14.5 $\pm$ 0.9)	-(1.139 $\pm$ 0.069)
Solonetz	-(32.5 $\pm$ 1.1)	-(2.529 $\pm$ 0.118)