minerals

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Supplementary Materials

Describing Phosphorus Sorption Processes on Volcanic Soil in the Presence of Copper or Silver Engineered Nanoparticles

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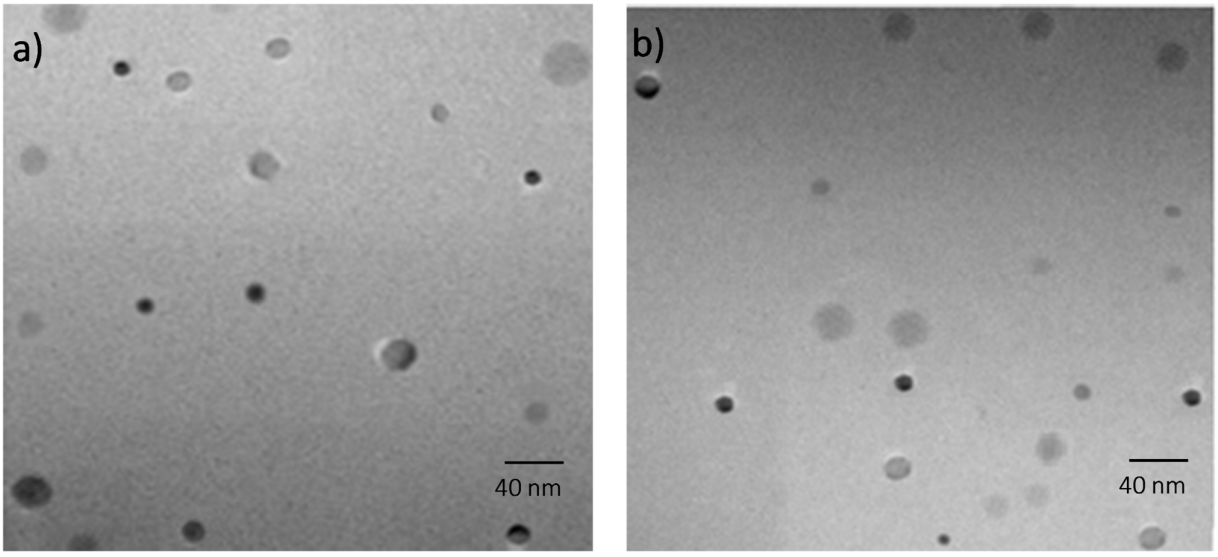

Figure S1. TEM images L-ascorbic acid-stabilized (**a**) Cu^0 and (**b**) Ag^0 ENPs.

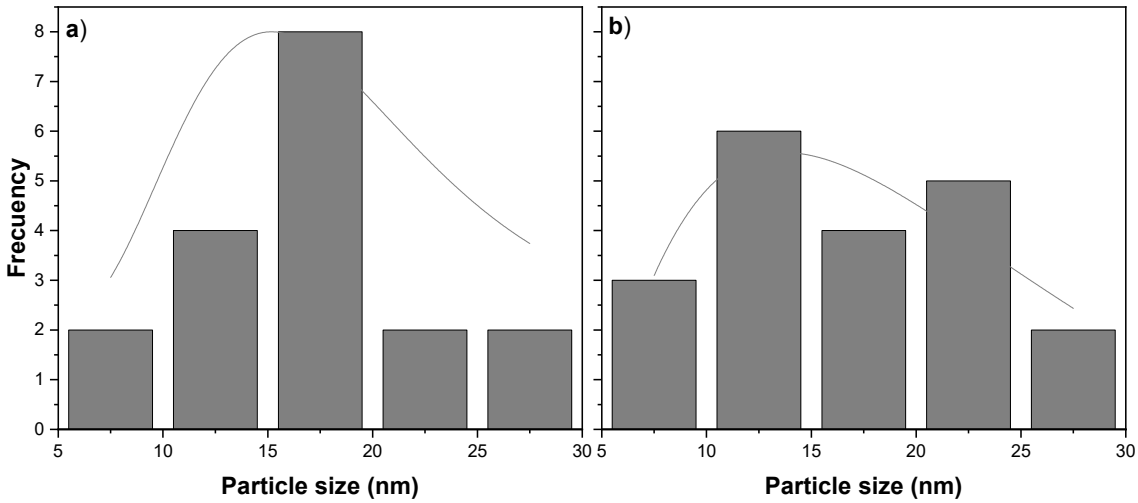

Figure S2. Histograms with the corresponding particle size distribution for L-ascorbic acid-stabilized (**a**) Cu^0 and (**b**) Ag^0 ENPs.

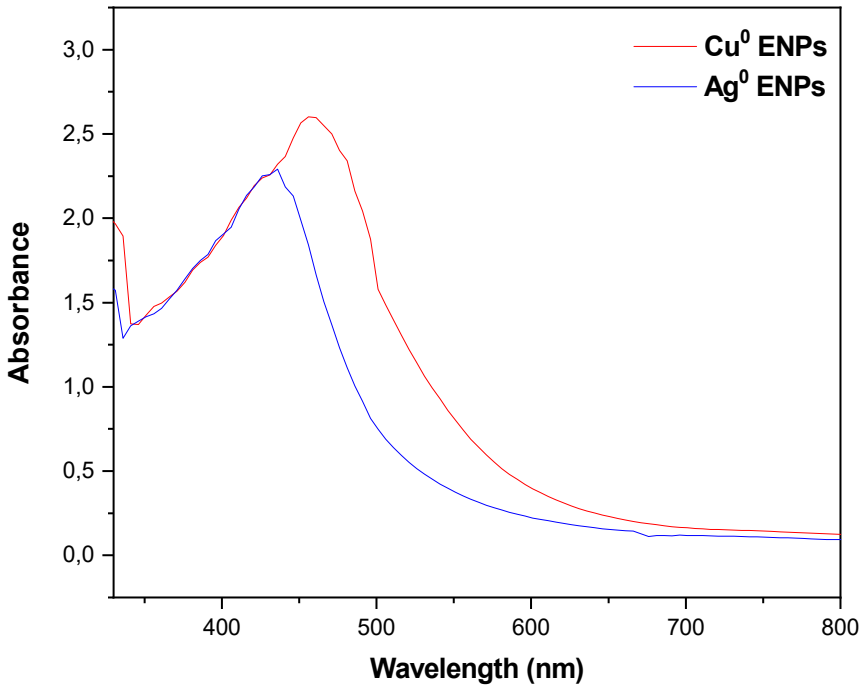

Figure S3. UV-Vis absorption spectra for L-ascorbic acid-stabilized Cu^0 and Ag^0 ENPs.

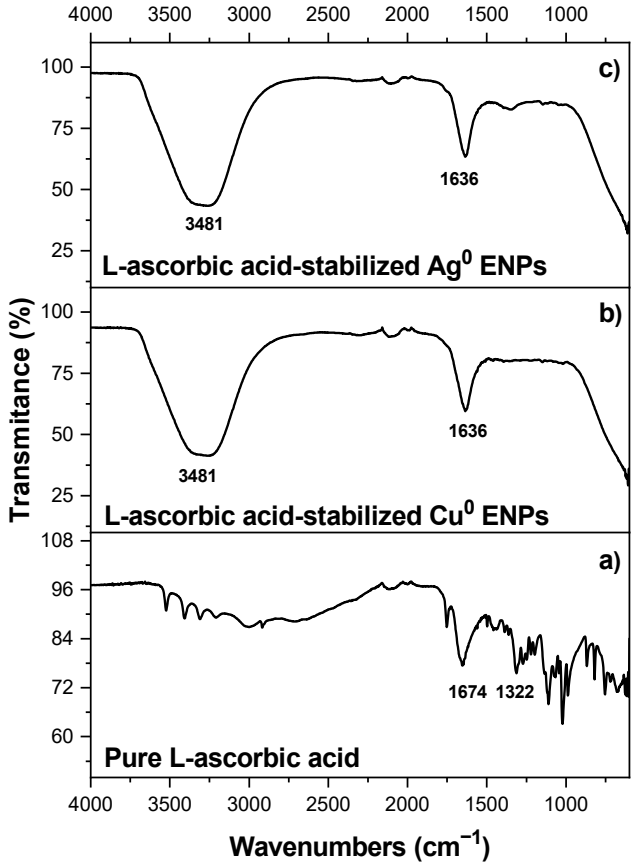

Figure S4. FT-IR spectra of (**a**) Pure L-ascorbic acid, (**b**) L-ascorbic acid-stabilized Cu^0 ENPs and (**c**) L-ascorbic acid-stabilized Ag^0 ENPs.

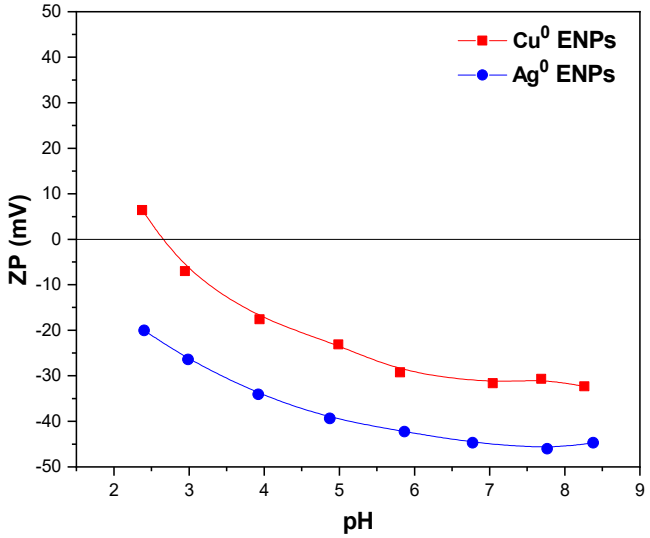

Figure S5. Zeta potential of L-ascorbic acid-stabilized Cu^0 and Ag^0 ENPs in 0.01 M KCl.

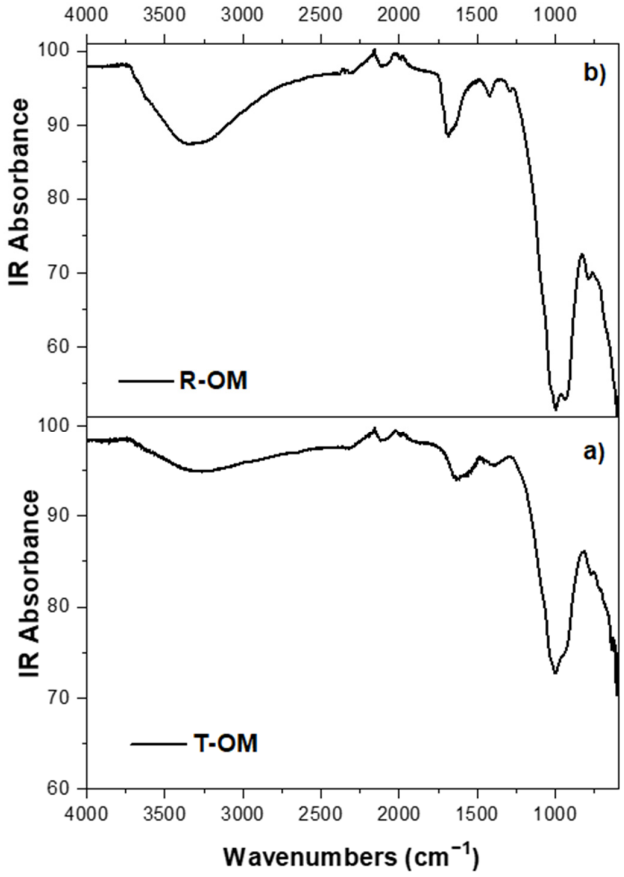

Figure S6. FT-IR spectrum for soil samples with (**a**) total organic matter (T-OM) and (**b**) partial removal of organic matter (R-OM).

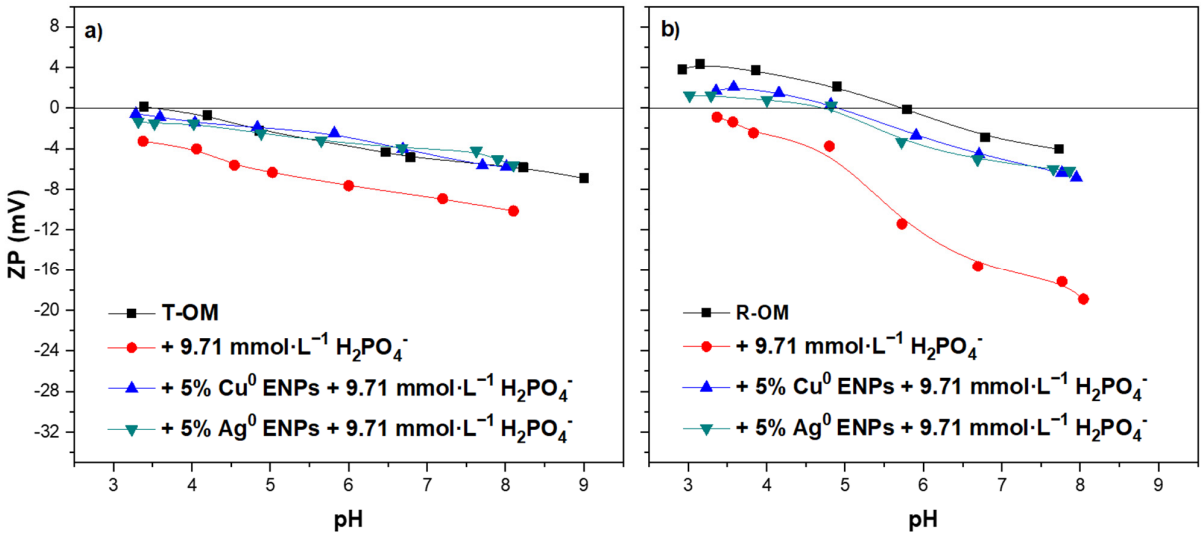

Figure S7. Zeta potential curves in the presence of 9.71 mmol·L^{-1} $H_2PO_4^-$ and 5% Cu^0 or 5% Ag^0 ENPs at constant ionic strength (0.01 M KCl) for soil with (**a**) total organic matter (R-OM) and (**b**) partial removal of organic matter (R-OM).

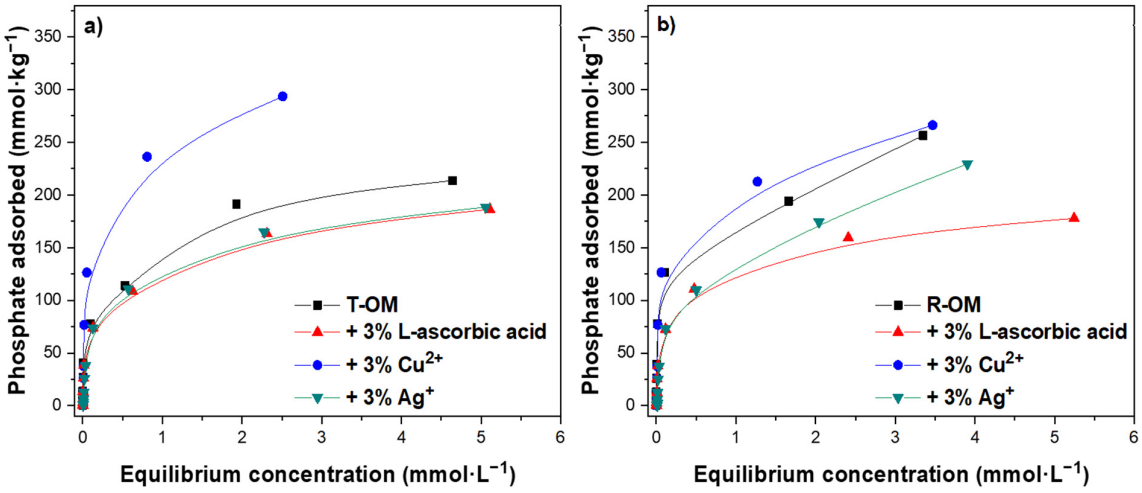

Figure S8. Adsorption isotherm curves of $H_2PO_4^-$ on (**a**) total organic matter (T-OM) and (**b**) partial removal of organic matter (R-OM) in the presence of 3% L-ascorbic acid and Cu^{2+} and Ag^+. Reaction conditions: Concentrations from 0.016 to 9.71 mmol·L^{-1} $H_2PO_4^-$ on 0.5 g soil in 0.01 M KCl at 20 ± 2 °C and pH 5.5.

Table S1. Pseudo-first-order parameters (± standard error) obtained from $H_2PO_4^-$ adsorption kinetics in the absence and presence of different doses of Cu^0 and Ag^0 ENPs at pH 5.5 ± 0.2 for soil with total organic matter (T-OM) and with partial removal of organic matter (R-OM).

		Pseudo-first-order			
	ENPs doses (%)	**$q_{e,cal}$ (mmol·kg^{-1})**	**k_1 (x 10^{-3} min^{-1})**	**r^2**	**χ^2**
T-OM	0	156.2 ± 6.7	198.7 ± 47.3	0.863	359
R-OM		165.6 ± 7.5	211.8 ± 53.7	0.848	451
			Cu^0		
T-OM	1	167.3 ± 8.0	193.2 ± 51.5	0.837	521
R-OM		195.8 ± 6.6	161.7 ± 29.5	0.920	341
T-OM	3	191.3 ± 9.8	218.0 ± 63.4	0.808	788
R-OM		215.0 ± 5.2	325.3 ± 50.0	0.945	231
T-OM	5	201.3 ± 10.5	163.3 ± 46.4	0.818	874
R-OM		225.7 ± 6.5	378.9 ± 73.9	0.920	371
			Ag^0		
T-OM	1	169.1 ± 11.4	151.6 ± 55.4	0.721	1018
R-OM		168.7 ± 8.7	131.8 ± 36.8	0.848	583
T-OM	3	190.9 ± 9.5	205.1 ± 56.9	0.820	725
R-OM		173.2 ± 9.5	137.1 ± 40.5	0.830	694
T-OM	5	204.5 ± 7.0	255.5 ± 51.2	0.905	403
R-OM		183.8 ± 9.5	201.9 ± 58.1	0.814	727