1 **Supplementary Information for:**

A universal uptake mechanism for cobalt(II) on soil constituents: Ferrihydrite, kaolinite, humic acid, and organo-mineral composites.

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2 **Consists of 7 pages, 4 figures and 1 table.**

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1. Sensitivity Analysis of the Co-Ferrihydrite, -Kaolinite, and Humic Acid Surface Complexation Models

A sensitivity analysis was performed to evaluate the sensitivity of the end-member models to the input parameters. For each model, the input parameters (C_{stern}, electrolyte binding constants, surface site densities, and surface area) were systematically varied while monitoring the log *K* values for the Co adsorption complexes. The analyses are based on the protocols of Moon and Peacock (2013). The C_{stern} was varied by ±50%, the log *K* electrolyte binding constants between -1.5 and 0.5, and the surface site densities and the surface areas were varied by a factor of ±3. Log K values for each surface site and their uncertainty are presented in table 4 in the main text.

Supplementary Tables

Table S1: Co K-edge EXAFS fitting parameters for high signal: noise ferrihydrite samples, where N is the Occupancy, r is the interatomic distance, σ^2 is the Debye–Waller Factor and reduced χ^2 and *R* are the goodness of fit parameters. Uncertainties in the last digit shown in parentheses. MS = multiple scattering pathways within the CoO_6 octahedral and Co-O-Co linkages. MS pathways are italicised and do not contribute to the structural fit.

Experiment Description	Pathway	N	r (Å)	σ^2 ($Å^2$)	χ^2; *R*
A: Fh_5wt%Co_0.1_pH8	Co-O	6(2)	2.05(1)	0.013(8)	851; 0.011
δe0 = -2(1)	Co-Fe	1.2(3)	2.98(2)	0.006(3)	
S^2_0 = 0.92	Co-Co	1.6(4)	3.14(1)	0.006(2)	
	CoO_6 MS	*12(3)*	*4.10(2)*	*0.026(16)*	
	Co-O-Co MS	*6(2)*	*3.65(2)*	*0.009(5)*	
B: Fh_2wt%Co_0.1_pH 6.5	Co-O	6(2)	2.04(1)	0.006(1)	299; 0.086
δe0 = -4(2)	Co-Co	1.7(4)	3.09(4)	0.010(5)	
S^2_0 = 0.92	*CoO_6 MS*	*12(3)*	*4.08(1)*	*0.013(1)*	
	Co-O-Co MS	*6(2)*	*3.62(3)*	*0.008(3)*	
C: Fh_1wt%Co_0.1_pH7	Co-O	6(2)	2.04(2)	0.009(1)	66; 0.065
δe0 = -2(2)	Co-Co	1.8(4)	3.09(3)	0.008(4)	
S^2_0 = 0.92					
D: Fh_0.5wt%Co_0.1_pH8	Co-O	6(2)	2.04(1)	0.004(1)	532; 0.058
δe0 = -4(2)	Co-Co	1.6(4)	3.08(2)	0.006(3)	
S^2_0 = 0.92					

Supplementary Figures

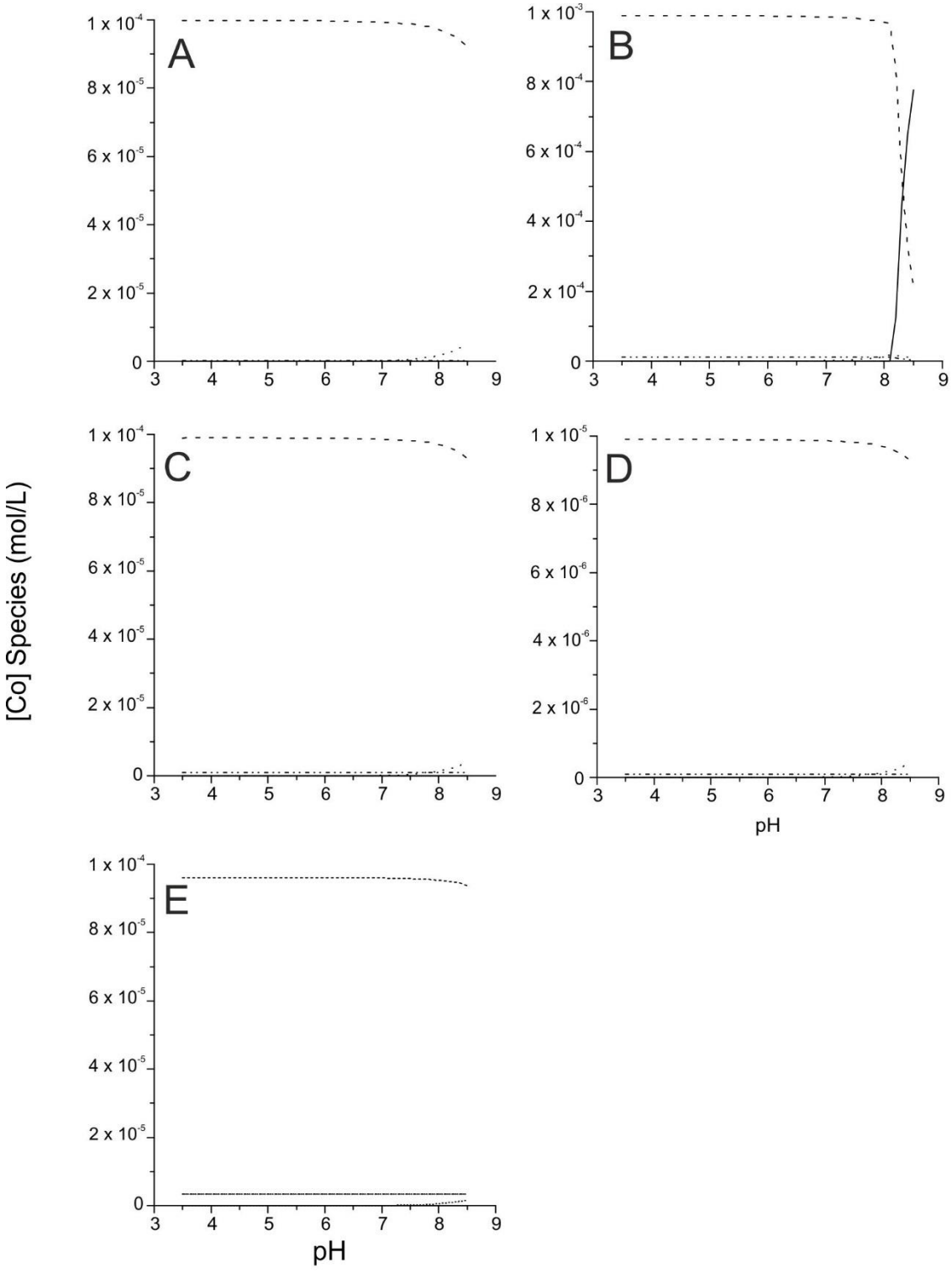

Figure S1: Co speciation plots for each of the ionic strength and Co concentrations used in the sorption experiments (solid lines, $Co(OH)_2$, dashes, Co^{+2}, dots, $CoOH^+$, and dash-dot-dot, $CoNO_3^+$). Panels A, C, and E show 10^{-4} mol L^{-1} Co at 10^{-3}, 10^{-2}, and 10^{-1} mol L^{-1} $NaNO_3$, respectively. Panels B and C show 10^{-3} and 10^{-5} mol L^{-1} Co at 10^{-2} mol L^{-1} $NaNO_3$.

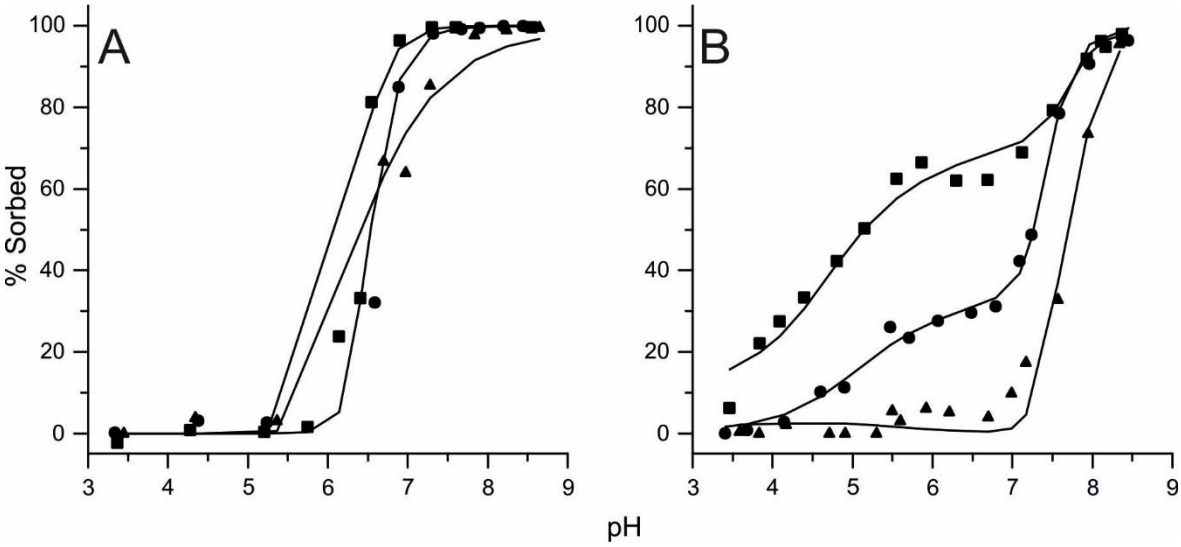

Figure S2: Co sorption to ferrihydrite (A) and kaolinite (B) as a function of pH and Co concentration. For ferrihydrite, squares show 0.058 wt% Co, circles show 0.58 wt% Co, and triangles show 5.8 wt% Co systems. For kaolinite, squares show 0.0058 wt% Co, circles show 0.058 wt% Co, and triangles show 0.58 wt% Co. Solid lines represent the EQLFOR fits. The solid:solution ratio was 1 g L^{-1} for ferrihydrite experiments, and 10 g L^{-1} for kaolinite.

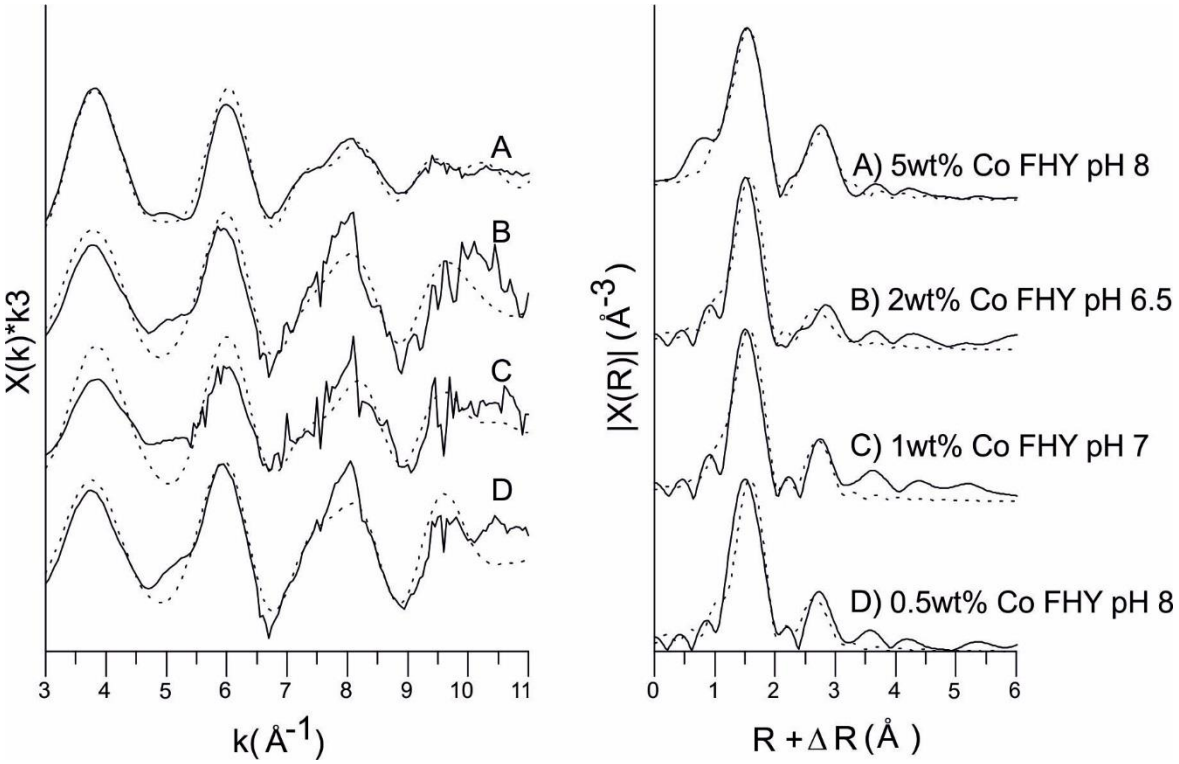

Figure S3: EXAFS spectra and resulting Fourier Transform for samples with low signal:noise and high self-absorption. Sample names are presented as: adsorbent_wt % Co_ionic strength (in mol L^{-1})_sample pH. The solid line represents the data and dotted line is the best fit. All samples were fit to a similar model to that of the 2 wt% Co FHY pH 8 sample in figure 4.

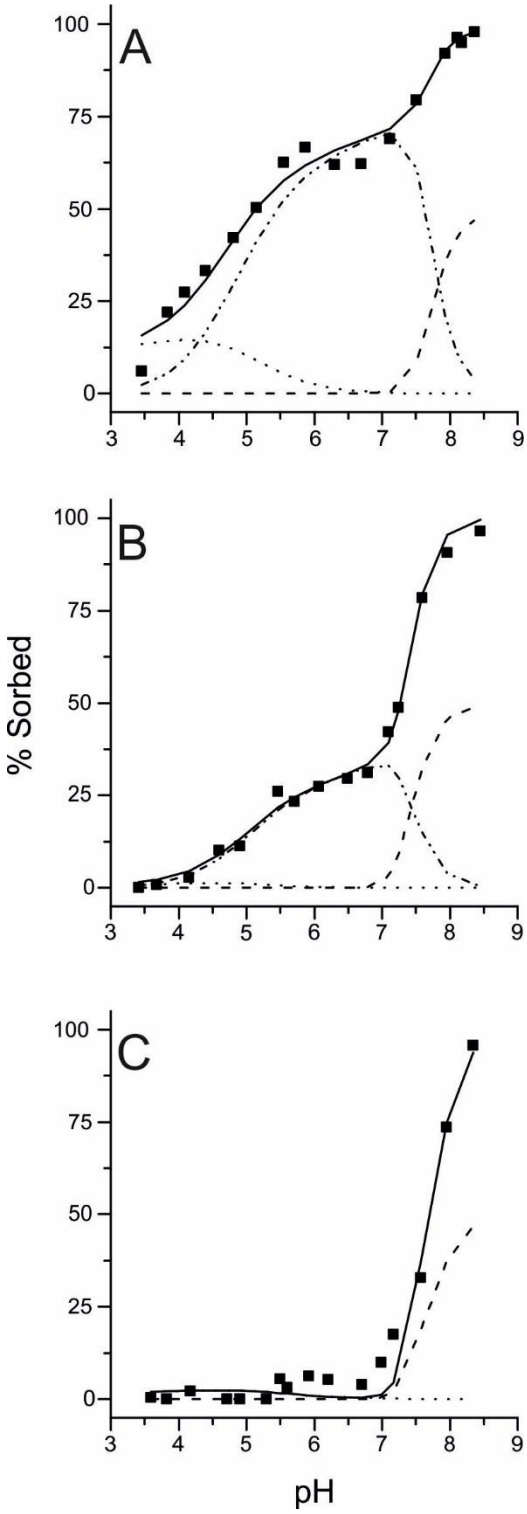

Figure S4: EQLFOR model predictions for Co sorption to kaolinite surface sites. Panel A shows predicted sorption at 0.0058 wt% Co, panel B at 0.058 wt% Co, and panel C at 0.58 wt% Co. Solid lines represent total amount of Co predicted to be sorbed, dashed lines show sorption to ≡AlOH sites, dotted lines show sorption to ≡XH sites, and dash-dot-dot lines show sorption to $\equiv X^-$ sites.