

# Natural Zeolites for the Sorption of Ammonium: Breakthrough Curve Evaluation and Modeling

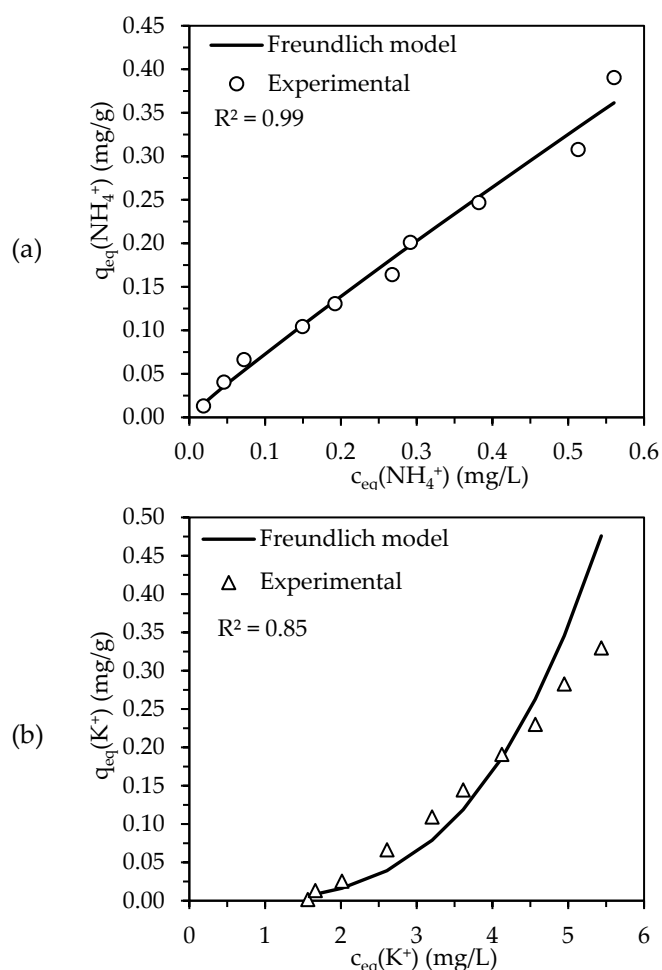
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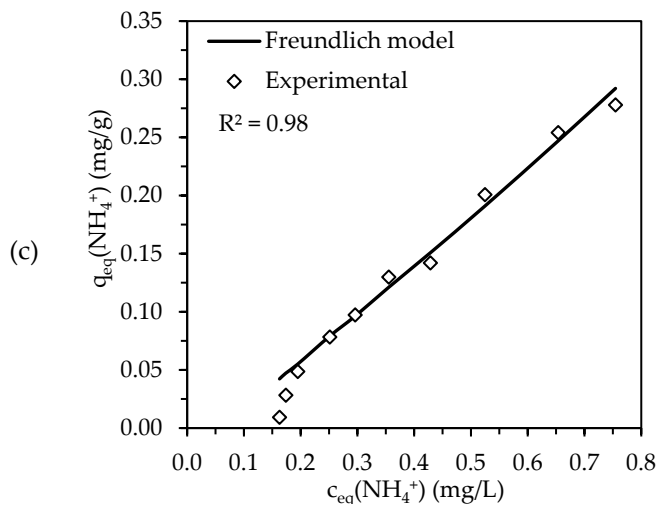
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## Supporting Information

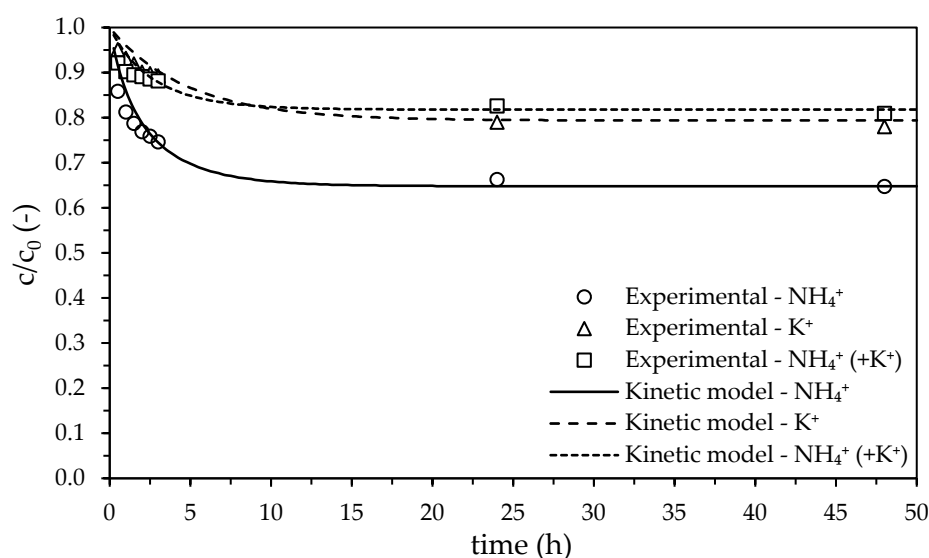
### S1 Isothermal Data





**Figure S1.** Experimental and Freundlich model isotherms (matrix: ultrapure water;  $t_{eq}$ : 21 d;  $pH_0$ : 5.5–6.2; **(a)**:  $c_0(NH_4^+) = 0.06$ –2.22 mmol/L; **(b)**:  $c_0(K^+) = 0.03$ –1.02 mmol/L; **(c)**  $c_0(NH_4^+) = 0.06$ –2.22 mmol/L,  $c_0(K^+) = 0.7$  mmol/L;  $w/v = 100$  g<sub>z</sub>/L,  $T = 22$  °C; grain size: 0.5–0.8 mm;  $n = 2$ ).

## S2 Kinetic Data



**Figure S2.** Experimental and modeled kinetic data (matrix: ultrapure water;  $t_{eq}$ : 48 h;  $pH_0$ : 5.5–6.2; ( $c_0(NH_4^+) = 0.7$  mmol/L,  $c_0(K^+) = 0.7$  mmol/L,  $c_0(NH_4^+, K^+) = 0.7$  mmol/L;  $w/v = 0.7$  g/L,  $T = 22$  °C; grain size: 0.5–0.8 mm;  $n = 2$ ).

## S3 Thomas Model Evaluation in Ultrapure Water

**Table S1.** Determined Thomas model constants (matrix: ultrapure water).

Water matrix	Thomas model constants			
	$k_{Th}$ (L/h*mg)	$a$ (mg/g)	$b$	$R^2$
0.7 mmol/L $NH_4^+$	$1.44 \pm 9.73$	$2.24 \pm 15$	$0.12 \pm 0.83$	0.98
0.7 mmol/L $K^+$	$0.015 \pm 0.62$	$92.76 \pm 3723$	$6.42 \pm 258$	0.95
0.7 mmol/L $NH_4^+/K^+$	$0.25 \pm 1.76$	$13.04 \pm 92$	$1.56 \pm 11$	0.99

## S4 Influence of Natural Water Matrices

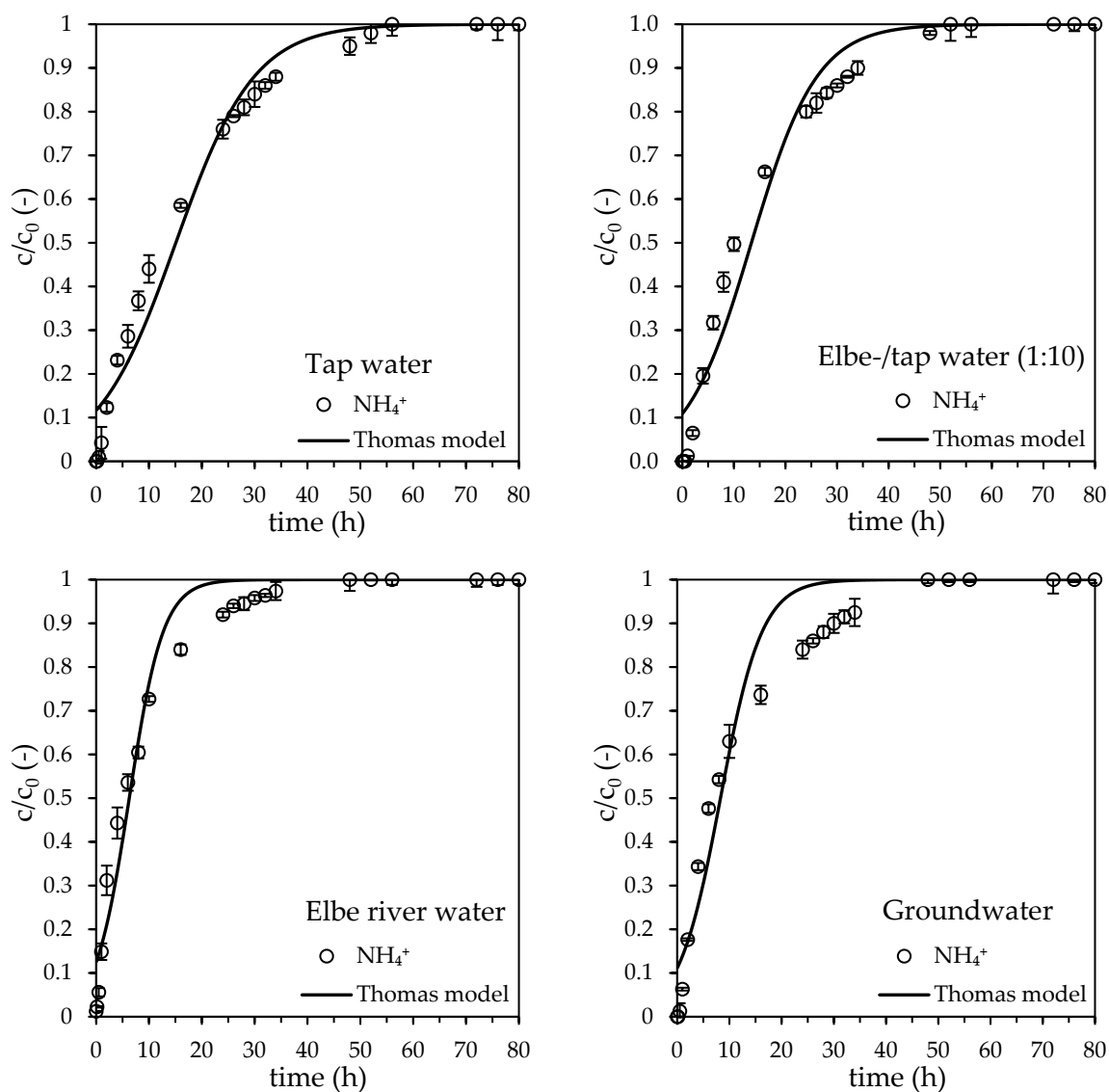
**Table S2.** General information to the investigated natural water matrices.

Water matrices	EC <sup>x</sup> ( $\mu S/cm$ )	Sample description	
Groundwater	$560 \pm 2.8$	Date of sampling:	14.10.2022
		Sampling Location:	Sampling in 70 m distance to the Elbe river (50°57'56.6"N 13°55'25.5"E)
		Characteristics:	pH: 7.6; T = 14 °C
		Autoclaved:	25 min at 121 °C
Elbe water	$462 \pm 1.7$	Date of sampling:	09.09.2022
		Sampling Location:	Elbe river in Dresden near the bank (51°04'19.0"N 13°43'21.1"E)
		Characteristics:	pH: 7.8; T = 17 °C
		Autoclaved:	25 min at 121 °C

<sup>x</sup> electrical conductivity

**Table S3.** Determined Thomas model constants (matrix: natural water).

Water matrix	Thomas model constants			
	$k_{Th}$ (L/h*mg)	a (mg/g)	b	$R^2$
Tap water	$0.04 \pm 0.81$	$48.57 \pm 946$	$3.22 \pm 63.02$	0.97
Elbe-/tap water (1:10)	$0.15 \pm 3.19$	$13.86 \pm 293$	$1.03 \pm 22.03$	0.96
Groundwater	$0.33 \pm 10.48$	$6.14 \pm 191$	$0.74 \pm 23.19$	0.94
Elbe river water	$0.58 \pm 16.62$	$3.35 \pm 96$	$0.53 \pm 15.41$	0.96

**Figure S3:** Experimental  $NH_4^+$  breakthrough curves and modeling using the Thomas model.