

Table S1 XRD peaks of raw silica (S) and acid-treated silica (AS)

S			AS			Phase
2θ (°)	d (Å)	Intensity (cps deg)	2θ (°)	d (Å)	Intensity (cps deg)	
6.396(4)	13.807(10)	126(11)	6.380(10)	13.84(2)	124(8)	Clinochlore
9.046(3)	9.768(3)	342(11)	9.025(8)	9.791(8)	550(15)	KMgAlSiOH
10.615(16)	8.328(13)	31(7)	10.655(8)	8.296(6)	40(9)	Albite
12.662(9)	6.985(5)	312(7)	12.647(7)	6.994(4)	430(11)	Clinochlore
13.983(4)	6.328(2)	35(7)	14.017(4)	6.3130(19)	76(10)	Albite
17.967(8)	4.933(2)	141(12)	17.939(14)	4.941(4)	229(11)	KMgAlSiOH
18.37(11)	4.83(3)	92(93)	-	-	-	KMgAlSiOH
18.962(10)	4.676(3)	104(15)	18.947(11)	4.680(3)	156(9)	Clinochlore
19.93(3)	4.450(7)	367(56)	19.95(4)	4.448(9)	309(19)	KMgAlSiOH
21.007(3)	4.2255(7)	589(10)	20.994(3)	4.2282(6)	725(15)	Albite
22.193(12)	4.002(2)	136(10)	22.151(5)	4.0098(9)	211(9)	Albite
23.227(14)	3.827(2)	160(12)	23.185(11)	3.8333(17)	50(9)	Calcite
23.668(9)	3.7561(15)	143(10)	23.679(11)	3.7544(18)	175(13)	Albite
24.38(4)	3.648(6)	160(25)	24.381(14)	3.648(2)	183(16)	Albite
25.313(12)	3.5156(17)	165(11)	25.26(2)	3.522(3)	534(27)	Clinochlore
25.57(8)	3.481(11)	242(34)	-	-	-	KMgAlSiOH
26.777(6)	3.3267(7)	3644(99)	26.7694(13)	3.32759(16)	5029(98)	Quartz
27.610(4)	3.2282(5)	231(35)	26.977(15)	3.3024(18)	769(86)	Albite
28.072(7)	3.1761(8)	913(80)	27.598(13)	3.2295(15)	566(29)	Albite
28.29(9)	3.152(10)	518(104)	28.055(7)	3.1779(8)	2044(41)	Albite
29.573(3)	3.0182(3)	1413(22)	29.97(3)	2.979(3)	549(57)	KMgAlSiOH
30.01(2)	2.975(2)	60(15)	30.634(5)	2.9160(5)	107(21)	Albite
30.379(17)	2.9399(16)	109(24)	-	-	-	Albite
30.588(14)	2.9203(13)	105(9)	-	-	-	Albite

31.082(9)	2.8750(8)	445(13)	-	-	-	Albite
31.385(9)	2.8480(8)	24(12)	31.336(15)	2.8523(13)	113(25)	Clinochlore
31.67(5)	2.823(5)	95(22)	31.721(14)	2.8185(12)	59(18)	Albite
32.18(4)	2.780(3)	45(17)	-	-	-	KMgAlSiOH
32.389(12)	2.7619(10)	8(6)	-	-	-	Albite
33.210(19)	2.6955(15)	26(8)	-	-	-	Albite
34.69(3)	2.584(2)	173(54)	-	-	-	KMgAlSiOH
35.09(3)	2.555(2)	606(60)	35.212(12)	2.5467(9)	607(29)	Albite
36.144(8)	2.4831(5)	271(14)	36.15(7)	2.482(4)	259(34)	Calcite
36.687(4)	2.4476(3)	445(13)	36.681(5)	2.4480(3)	466(17)	Quartz
37.836(13)	2.3759(8)	297(21)	37.75(3)	2.3809(17)	202(18)	Albite
39.595(5)	2.2743(3)	668(14)	39.593(4)	2.2744(2)	336(12)	Calcite
40.437(10)	2.2288(5)	186(11)	40.405(8)	2.2305(4)	184(10)	Quartz
41.28(6)	2.185(3)	89(17)	-	-	-	Albite
41.548(14)	2.1718(7)	21(12)	-	-	-	Albite
41.95(2)	2.1519(12)	109(9)	41.90(4)	2.1542(17)	70(13)	KMgAlSiOH
42.582(7)	2.1214(4)	428(13)	42.573(6)	2.1218(3)	509(13)	Quartz
43.346(13)	2.0858(6)	291(15)	-	-	-	Albite
45.944(7)	1.9737(3)	821(24)	45.908(7)	1.9752(3)	274(44)	Quartz
47.28(2)	1.9209(9)	139(19)	-	-	-	Calcite
47.664(12)	1.9064(4)	306(22)	-	-	-	Calcite
48.669(10)	1.8694(4)	381(13)	-	-	-	Quartz
50.274(4)	1.81339(14)	695(23)	50.247(3)	1.81429(10)	738(17)	Quartz
50.81(2)	1.7955(6)	95(24)	50.817(14)	1.7953(5)	217(25)	Albite
51.304(10)	1.7794(3)	90(10)	51.254(18)	1.7810(6)	42(7)	Albite
55.009(13)	1.6680(4)	228(13)	55.002(7)	1.66815(18)	326(20)	Quartz
55.449(14)	1.6558(4)	91(10)	55.454(7)	1.6556(2)	102(25)	Calcite

56.748(15)	1.6209(4)	36(12)	-	-	-	Calcite
57.602(6)	1.59890(16)	117(13)	-	-	-	Calcite
60.098(4)	1.53832(10)	491(12)	60.080(4)	1.53872(10)	739(14)	Albite
60.820(12)	1.5218(3)	117(18)	-	-	-	Calcite
61.78(6)	1.5003(12)	303(17)	61.80(2)	1.5000(5)	206(24)	Quartz
64.176(18)	1.4501(4)	126(11)	64.146(16)	1.4507(3)	165(14)	Calcite
64.831(19)	1.4370(4)	122(12)	-	-	-	Calcite
65.76(2)	1.4189(4)	66(33)	65.91(4)	1.4160(8)	108(17)	Albite
66.13(4)	1.4119(7)	40(39)	-	-	-	Quartz
67.885(6)	1.37956(11)	286(17)	67.858(5)	1.38005(9)	377(13)	Quartz
68.282(8)	1.37251(14)	522(23)	68.268(4)	1.37276(7)	351(40)	Quartz
69.59(6)	1.3499(11)	133(20)	69.59(3)	1.3498(6)	197(17)	Quartz
73.610(13)	1.28577(19)	270(18)	73.590(6)	1.28606(9)	157(12)	Quartz
75.768(7)	1.25442(9)	107(9)	75.785(12)	1.25418(16)	222(12)	Quartz
77.79(3)	1.2268(4)	55(11)	77.803(16)	1.2266(2)	84(12)	Quartz
80.028(9)	1.19802(11)	138(11)	79.994(10)	1.19844(13)	214(11)	Quartz
81.291(9)	1.18257(10)	116(12)	81.278(11)	1.18272(14)	154(15)	Quartz
81.617(10)	1.17867(12)	135(14)	81.619(8)	1.17864(9)	150(17)	Quartz
83.96(2)	1.1516(2)	145(13)	83.944(18)	1.1518(2)	98(9)	Calcite

Table S2 Parameters obtained when fitting the experimental data to the non-linear equations of isotherm models

Model	Sample	Parameter	Na ⁺	K ⁺	Cl ⁻
Langmuir	S	q _{max} , mg/g	4.55	7.07	2.31
		k _L , l/mg	-1.99*10 ⁵	-2.07*10 ⁶	-3.53*10 ⁴
		R ²	-3*10 ⁻⁸	-2.2*10 ⁻⁸	-6.3*10 ⁻⁸
	AS	q _{max} , mg/g	6.11	14.79	2.68
		k _L , l/mg	-1.57*10 ⁷	-1.27*10 ⁷	-4.15*10 ⁷
		R ²	-2.9*10 ⁻⁸	-4.2*10 ⁻⁸	-1*10 ⁻⁸
Freundlich	S	1/n	0.9625	0.6918	0.7243
		n	1.04	1.45	1.38
		k _f , mg/g	2.88*10 ⁻³	4.54*10 ⁻²	8.79*10 ⁻³
		R ²	0.9517	0.9691	0.8633
		q _{max} , mg/g	10.49	16.43	4.20
		ARE, %	24.24	84.02	89.23

	AS	1/n	0.7576	0.6111	0.7291
		n	1.32	1.11	1.37
		k_f , mg/g	$2.36 \cdot 10^{-2}$	$1.77 \cdot 10^{-2}$	$1.28 \cdot 10^{-2}$
		R ²	0.9814	0.9691	0.9478
		q _{max} , mg/g	16.07	31.64	5.96
		ARE, %	22.07	97.14	46.57
Temkin	S	A_t , l/g	$0.61 \cdot 10^{-2}$	$2.65 \cdot 10^{-2}$	$2.27 \cdot 10^{-3}$
		b_t , J/mol	1076.39	994.51	1521.85
		R ²	0.7664	0.7594	0.9572
		q _{max} , mg/g	7.86	12.19	3.96
	AS	A_t , l/g	$2.89 \cdot 10^{-2}$	$3.06 \cdot 10^{-2}$	$2.57 \cdot 10^{-2}$
		b_t , J/mol	1185.56	499.67	2593.69
		R ²	0.7216	0.7997	0.7187
		q _{max} , mg/g	10.67	24.81	4.55
Dubinin-Radushkevich	S	q_s , mg/g	12.44	14.27	3.78
		β , mol ² /kJ ²	0.8918	0.1512	0.1922
		R ²	0.8367	0.9790	0.9952
		E, J/mol	0.75	1.82	1.61
		q _{max} , mg/g	7.99	13.24	3.44
		ARE, %	53.11	40.99	18.31
	AS	q_s , mg/g	13.26	27.53	5.73
		β , mol ² /kJ ²	0.2587	0.0991	0.012
		R ²	0.9454	0.9727	0.9889
		E, J/mol	1.39	2.25	6.46
		q _{max} , mg/g	11.72	25.28	5.18
		ARE, %	49.19	37.27	40.93