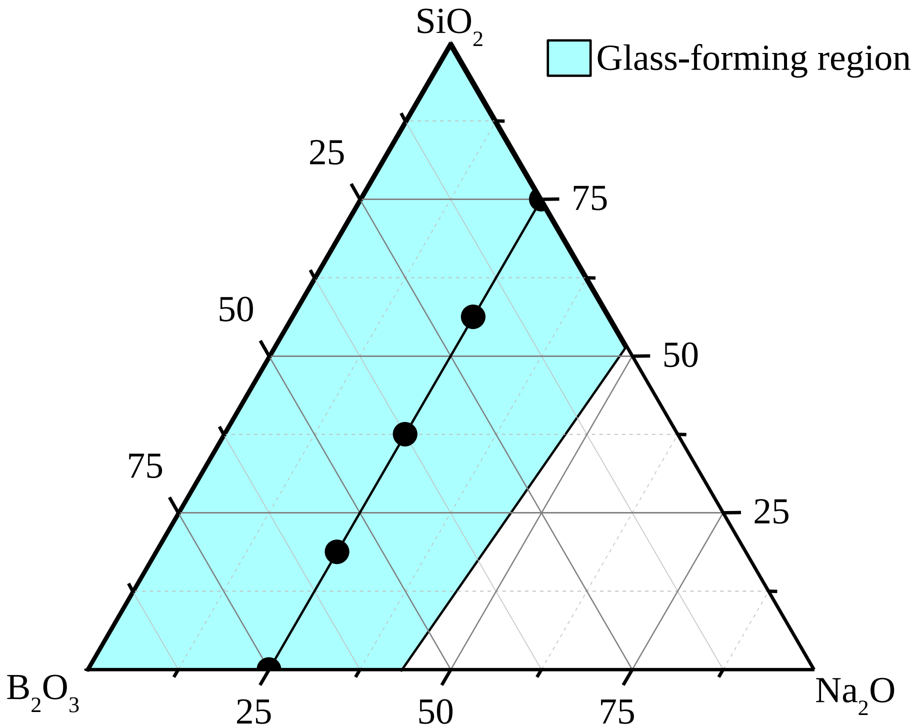
Chapter 2. Supplementary Information



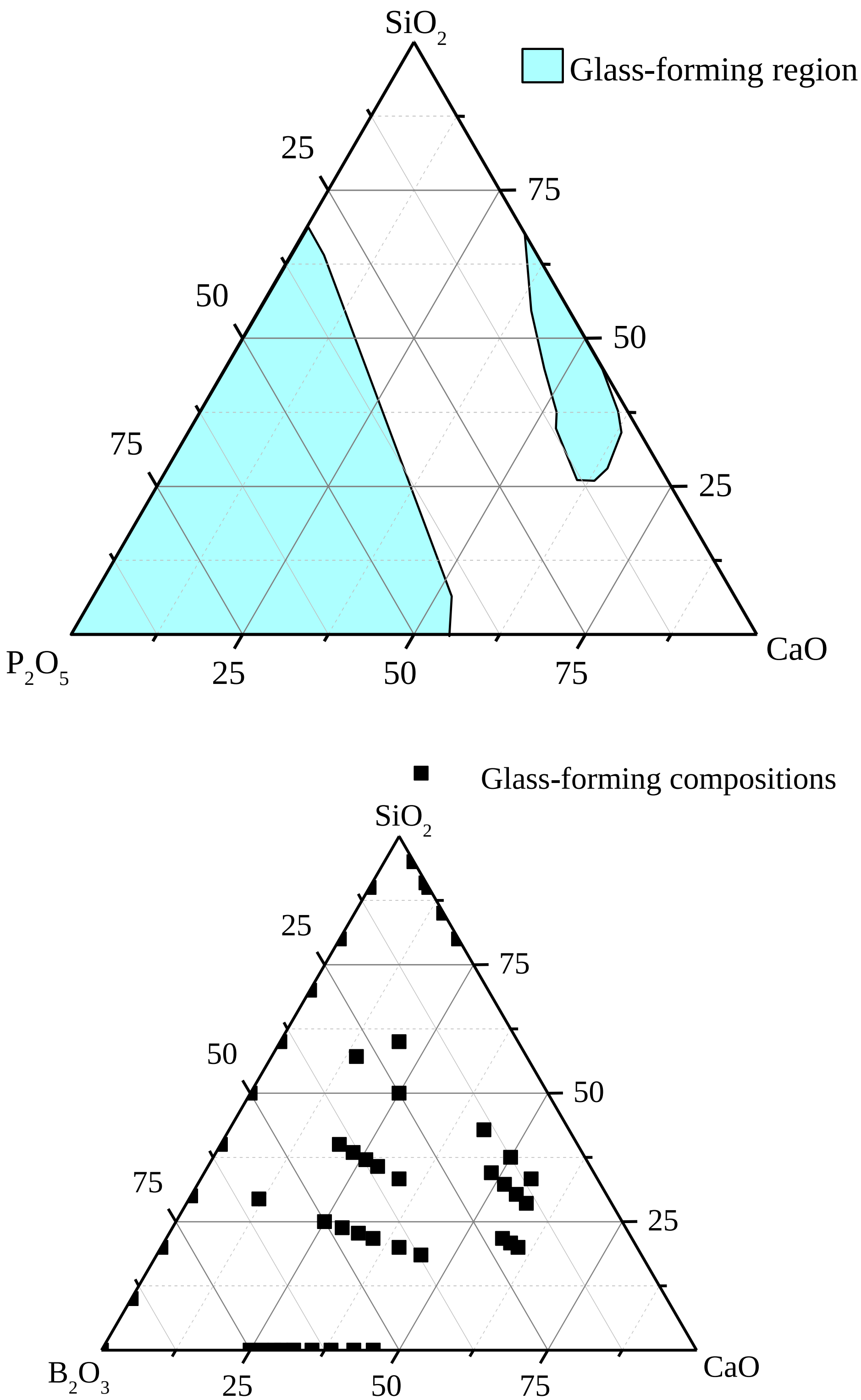


Figure S1. Glass-forming region and compositions of our study vs. glass-forming behavior in systems common to bioactive glass applications.

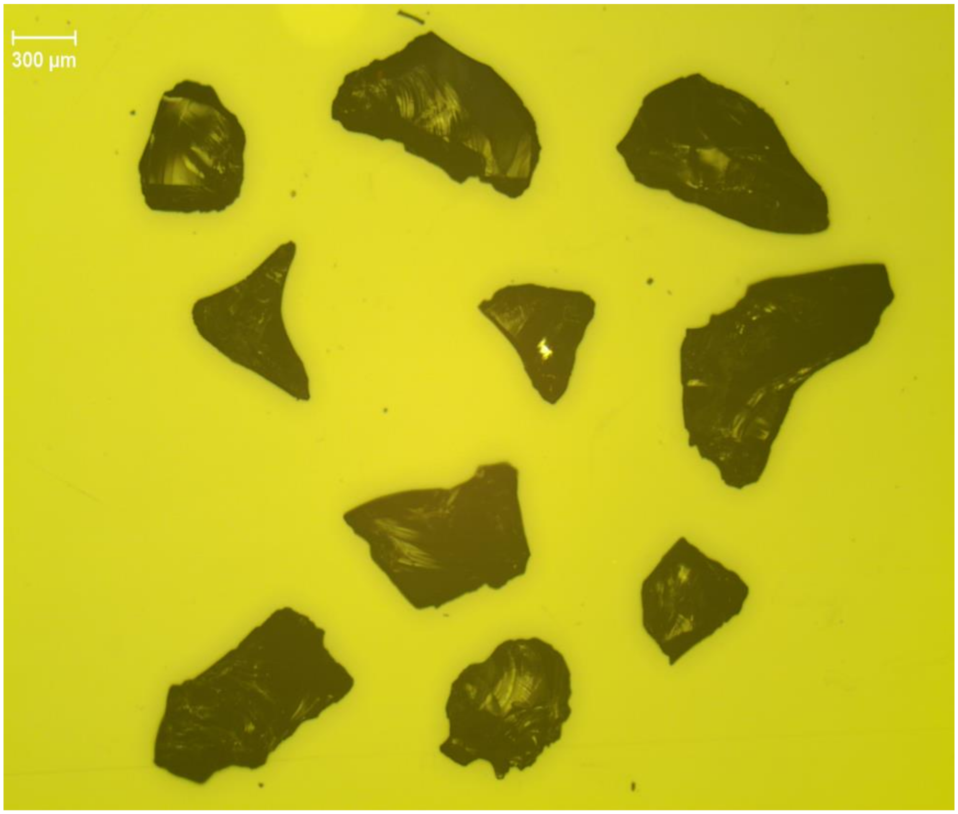
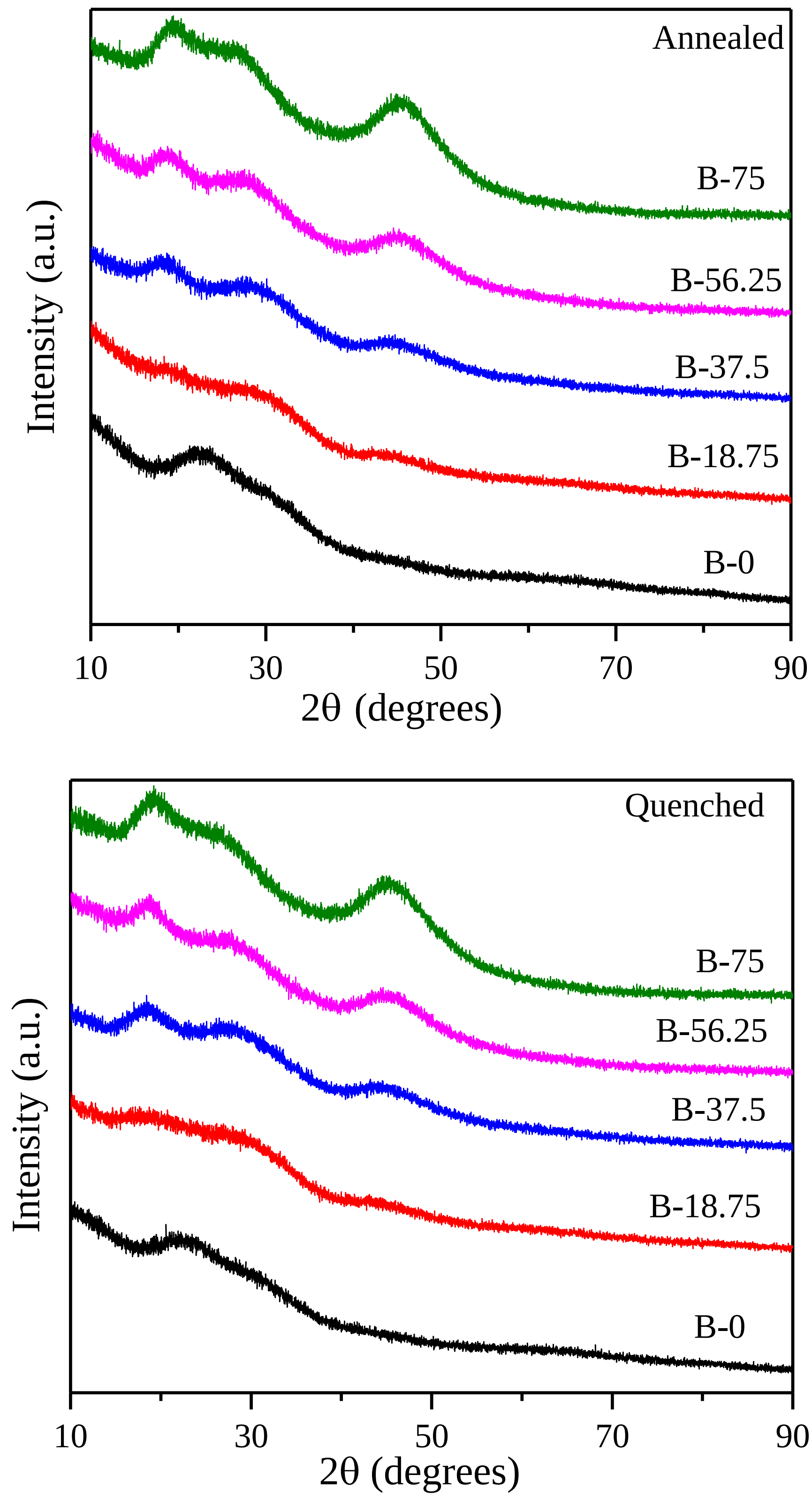


Figure S2. Optical image of crushed glass particles (300-425 µm diameter) which were used to calculate average surface area.



Annealed
B-75
B-56.25
B-37.5
B-18.75
B-0
Intensity (a.u.)
10
30
50
70
90
2θ (degrees)
Quenched
B-75
B-56.25
B-37.5
B-18.75
B-0
Intensity (a.u.)
10
30
50
70
90
2θ (degrees)

Figure S3. X-ray diffraction patterns which confirm the amorphous nature of glasses in this study.

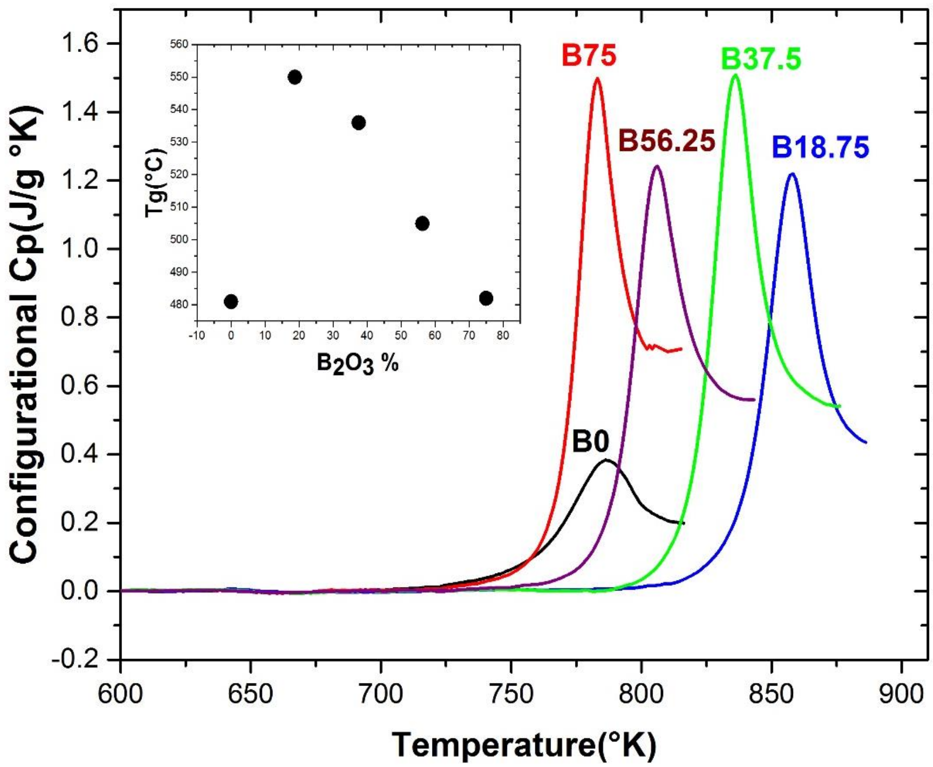


Figure S4. Configurational heat capacity of glasses with experimental B_2O_3 (mol%) content as a function of temperature in the vicinity of glass transition range. T_g values estimated from the onset of the Cp curves depict the significant increase of the T_g with the introduction of B_2O_3 followed by the systematic decrease of the T_g values with increasing B_2O_3 content.

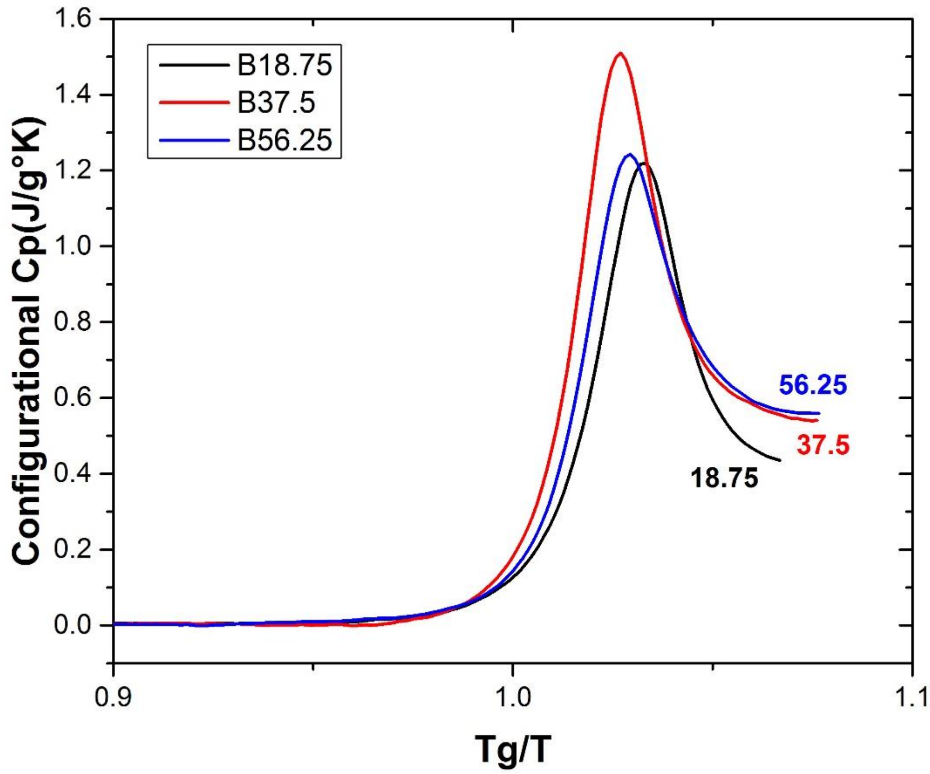


Figure S5. Normalized configurational heat capacities of B-18.75, B-37.5, and B-56.25 glasses.

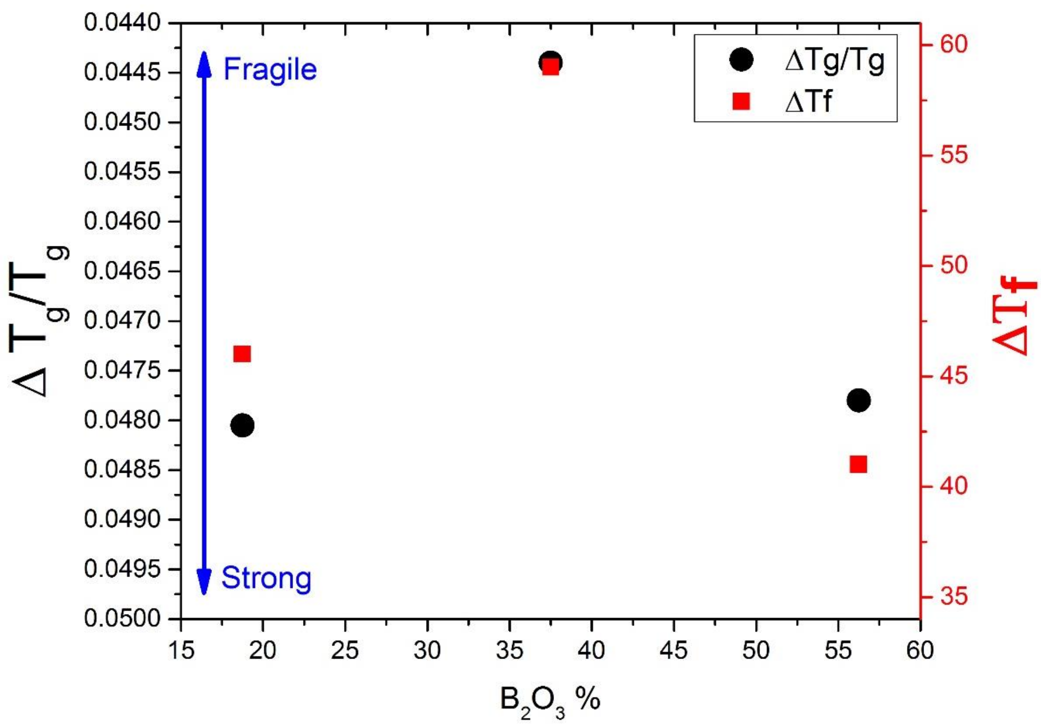
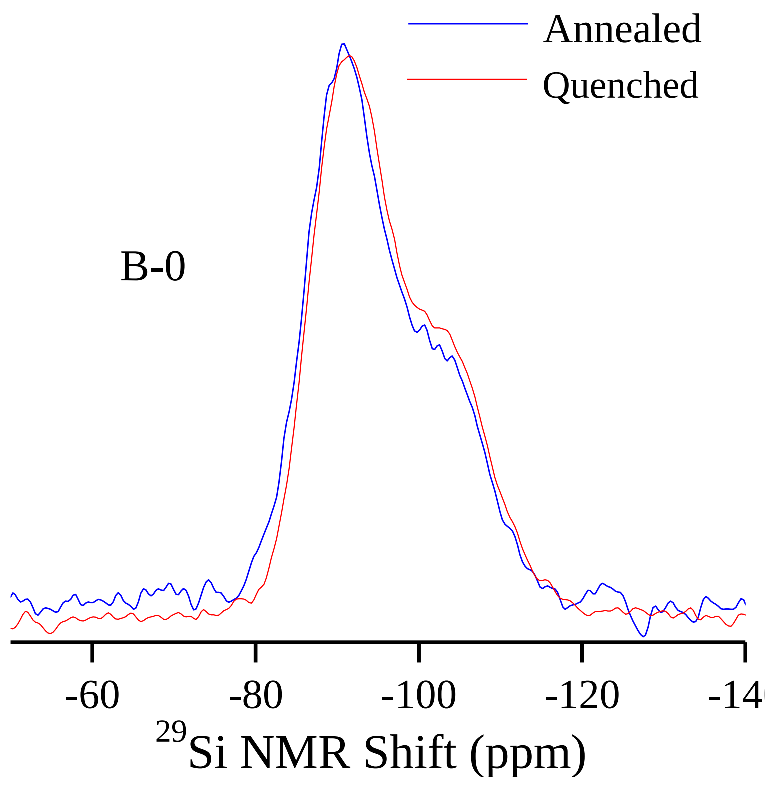


Figure S6. Thermodynamic fragility ($\Delta T_g/T_g$) shown as black dots vs. fictive temperature difference (ΔT_f) shown as red squares for B-18.75, B-37.5, and B-56.25 glasses.


Annealed
Quenched
B-0
-60
-80
-100
-120
-14
^{29}Si NMR Shift (ppm)

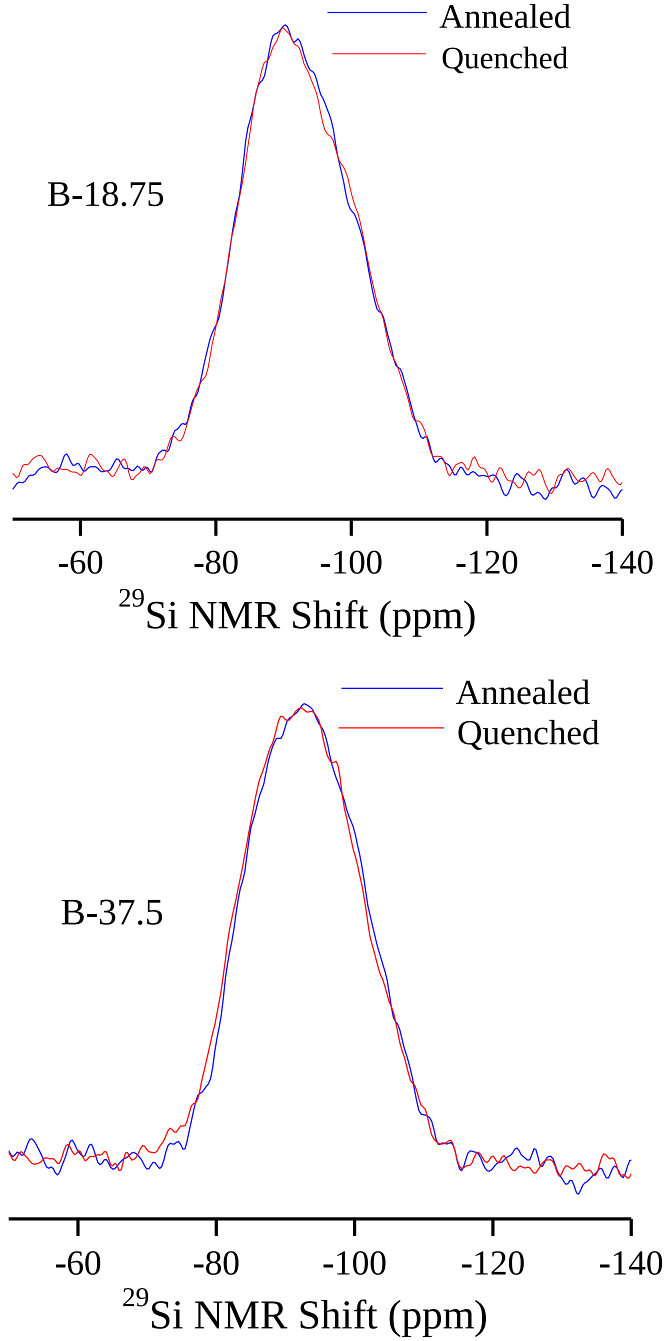


Figure S7. ^{29}Si MAS NMR spectra of quenched and annealed glasses.

Table S1. Average concentration (g/L), averaged normalized loss (g/m^2), and pH as a function of time (h) for annealed glass samples. The reported errors are calculated 1σ standard deviation for duplicate samples.

B-0A		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	9.94±0.06	0.000	0.000	0.000	±0.000	0.012	±0.000	--	--	0.16	±0.23	12.33	±0.37
6	10.24±0.03	0.000	0.000	0.046	±0.005	0.080	±0.001	--	--	26.58	±2.78	80.72	±0.53
12	10.74±0.03	0.001	0.001	0.057	±0.005	0.132	±0.001	--	--	33.18	±3.12	133.47	±0.72
24	10.71±0.03	0.000	0.000	0.120	±0.042	0.158	±0.001	--	--	69.94	±24.42	160.02	±0.86
72	10.63±0.04	0.001	0.000	0.138	±0.003	0.188	±0.010	--	--	80.66	±1.51	190.40	±9.79
168	10.86±0.08	0.000	0.000	0.168	±0.044	0.188	±0.022	--	--	98.16	±25.55	190.98	±22.57
336	10.74±0.06	0.000	0.000	0.175	±0.027	0.186	±0.017	--	--	101.91	±15.84	188.98	±17.59
B-18.75A		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	7.34±0.02	0.0000	±0.0000	0.0036	0.0002	0.0000	±0.0000	0.000	±0.00	2.840	±0.16	0.000	±0.00
6	8.64±0.12	0.0055	±0.0013	0.0272	0.0060	0.0156	±0.0024	17.146	±3.97	21.382	±4.73	16.792	±2.57
12	9.46±0.01	0.0123	±0.0012	0.0553	0.0049	0.0383	±0.0027	38.641	±3.88	43.468	±3.88	41.392	±2.95
24	9.43±0.02	0.0237	±0.0005	0.0909	0.0027	0.0539	±0.0004	74.164	±1.53	71.416	±2.14	58.174	±0.41
72	9.43±0.01	0.0360	±0.0013	0.1340	0.0037	0.0759	±0.0027	112.617	±4.21	105.259	±2.91	81.996	±2.89
168	9.77±0.01	0.0931	±0.0014	0.2901	0.0222	0.2071	±0.0030	291.551	±4.30	227.843	±17.44	223.645	±3.21
336	9.63±0.01	0.0730	±0.0015	0.2112	0.0088	0.1721	±0.0021	228.633	±4.59	165.875	±6.89	185.795	±2.21
B-37.5A		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	9.08±0.02	0.0301	±0.0012	0.0128	±0.0049	0.0388	±0.0022	45.38	±1.80	17.36	±6.58	40.82	±2.31
6	9.28±0.01	0.1358	±0.0008	0.0545	±0.0069	0.1479	±0.0102	204.58	±1.17	73.64	±9.33	155.64	±10.72
12	9.28±0.01	0.1754	±0.0048	0.0928	±0.0037	0.2155	±0.0047	264.32	±7.27	125.41	±5.03	226.78	±4.91
24	9.27±0.01	0.1786	±0.0070	0.1054	±0.0111	0.1929	±0.0066	269.21	±10.57	142.43	±14.95	203.02	±6.99
72	9.29±0.01	0.1822	±0.0014	0.1506	±0.0100	0.2217	±0.0052	274.50	±2.11	203.55	±13.52	233.31	±5.51
168	9.30±0.00	0.1859	±0.0053	0.1597	±0.0033	0.1999	±0.0080	280.09	±7.93	215.90	±4.49	210.38	±8.47
336	9.30±0.01	0.1915	±0.0060	0.1886	±0.0064	0.2039	±0.0092	288.52	±9.06	254.93	±8.68	214.53	±9.73
B-56.25A		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	9.04±0.00	0.152	±0.013	0.051	±0.016	0.079	±0.012	162.98	±13.66	139.16	±42.88	87.23	±13.09
6	9.06±0.00	0.266	±0.000	0.070	±0.000	0.184	±0.002	285.41	±0.30	193.09	±0.12	203.00	±2.06
12	9.06±0.01	0.248	±0.163	0.061	±0.022	0.133	±0.067	266.35	±174.74	166.70	±61.30	147.32	±73.64
24	9.03±0.00	0.210	±0.001	0.066	±0.002	0.121	±0.008	225.11	±0.91	181.70	±5.77	133.71	±9.04
72	9.04±0.01	0.214	±0.006	0.082	±0.002	0.128	±0.008	229.83	±6.68	224.97	±5.64	141.68	±8.76
168	9.05±0.02	0.214	±0.001	0.084	±0.006	0.121	±0.010	229.35	±0.83	230.35	±15.65	133.42	±11.29
336	9.04±0.01	0.226	±0.013	0.086	±0.003	0.126	±0.011	242.81	±13.50	237.56	±7.35	138.72	±11.60
B-75A		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	8.89±0.02	0.2304	±0.0007	--	--	0.0999	±0.0005	192.87	±0.59	--	--	116.75	±0.64
6	8.90±0.00	0.2479	±0.0018	--	--	0.1058	±0.0008	207.52	±1.54	--	--	123.65	±0.96
12	8.90±0.00	0.2276	±0.0002	--	--	0.0945	±0.0005	190.49	±0.18	--	--	110.41	±0.63
24	8.90±0.00	0.2314	±0.0151	--	--	0.0984	±0.0103	193.67	±12.61	--	--	115.03	±12.02

Table S2. Average concentration (g/L), averaged normalized loss (g/m^2), and pH as a function of time (h) for quenched glass samples. The reported errors are calculated 1σ standard deviation for duplicate samples.

B-0Q		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	10.13±0.07	–	–	0.000	±0.000	0.008	±0.004	–	–	0.00	±0.00	8.21	±3.62
6	10.46±0.07	–	–	0.056	±0.017	0.101	±0.003	–	–	32.67	±9.77	100.05	±2.99
12	10.65±0.08	–	–	0.126	±0.020	0.149	±0.004	–	–	74.05	±11.49	147.52	±4.40
24	10.81±0.08	–	–	0.172	±0.022	0.199	±0.038	–	–	101.16	±13.19	196.09	±37.06
72	10.67±0.09	–	–	0.189	±0.041	0.202	±0.001	–	–	111.15	±24.29	199.59	±1.12
168	10.71±0.08	–	–	0.197	±0.015	0.182	±0.001	–	–	116.11	±8.95	179.20	±1.26
336	10.61±0.06	–	–	0.183	±0.002	0.195	±0.000	–	–	107.94	±0.96	192.65	±0.43
B-18.75Q		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	7.59±0.05	0.002	±0.0007	0.0052	±0.0011	0.0000	±0.0000	4.99	±2.17	4.33	±0.92	0.00	±0.00
6	9.10±0.07	0.012	±0.0016	0.0359	±0.0070	0.0338	±0.0049	35.37	±4.73	29.65	±5.82	34.56	±5.00
12	9.60±0.02	0.027	±0.0030	0.0769	±0.0084	0.0723	±0.0058	80.78	±8.88	63.43	±6.92	73.79	±5.92
24	9.66±0.04	0.056	±0.0008	0.1524	±0.0162	0.1223	±0.0041	165.37	±2.28	125.70	±13.36	124.89	±4.19
72	9.51±0.07	0.094	±0.0055	0.2568	±0.0297	0.2407	±0.0098	277.56	±16.34	211.87	±24.50	245.80	±9.96
168	9.73±0.07	0.089	±0.0022	0.2669	±0.0307	0.2322	±0.0079	263.73	±6.66	220.20	±25.32	237.12	±8.09
336	9.60±0.05	0.090	±0.0000	0.2874	±0.0000	0.2272	±0.0000	265.47	±0.00	237.12	±0.00	232.01	±0.00
B-37.5Q		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	9.12±0.01	0.034	±0.005	0.011	±0.003	0.044	±0.004	52.67	±7.06	14.54	±3.55	46.44	±4.67
6	9.28±0.01	0.157	±0.017	0.075	±0.009	0.167	±0.015	240.40	±25.84	99.14	±12.45	178.04	±16.19
12	9.28±0.00	0.182	±0.001	0.068	±0.015	0.189	±0.002	278.68	±2.23	90.03	±19.44	200.53	±1.88
24	9.25±0.00	0.177	±0.012	0.109	±0.013	0.192	±0.001	270.61	±19.05	142.82	±17.34	204.01	±0.84
72	9.25±0.00	0.157	±0.006	0.151	±0.009	0.168	±0.046	239.85	±9.92	198.17	±12.15	179.01	±48.50
168	9.27±0.00	0.152	±0.008	0.143	±0.005	0.135	±0.015	232.72	±12.17	188.01	±6.90	143.16	±16.14
336	9.26±0.01	0.162	±0.009	0.150	±0.012	0.129	±0.009	247.19	±13.38	196.80	±15.80	137.31	±9.52
B-56.25Q		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	9.05±0.02	0.184	±0.007	0.051	±0.003	0.097	±0.001	198.12	±7.70	131.91	±7.85	109.03	±0.71
6	9.08±0.01	0.209	±0.009	0.052	±0.001	0.109	±0.008	225.19	±10.15	136.79	±2.67	122.82	±8.84
12	9.07±0.01	0.209	±0.010	0.047	±0.018	0.111	±0.009	225.25	±10.98	122.18	±46.64	124.76	±9.86
24	9.02±0.01	0.205	±0.012	0.063	±0.003	0.103	±0.008	220.88	±12.89	164.54	±7.89	116.56	±9.07
72	9.03±0.03	0.198	±0.015	0.072	±0.005	0.103	±0.012	213.22	±16.10	187.16	±13.14	116.19	±13.90
168	9.05±0.02	0.216	±0.001	0.076	±0.000	0.122	±0.001	232.69	±0.76	198.38	±0.66	138.21	±1.66
336	9.05±0.00	0.216	±0.000	0.083	±0.000	0.117	±0.000	232.64	±0.53	215.94	±0.65	132.48	±0.16
B-75Q		Concentration, g/L						Normalized Loss, g/m^2					
Time (h)	pH	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error
1	8.90±0.00	0.230	±0.005	–	–	0.095	±0.000	193.78	±3.82	–	–	107.60	±0.40
6	8.90±0.00	0.313	±0.003	–	–	0.138	±0.002	264.28	±2.87	–	–	156.88	±2.35
12	8.90±0.00	0.322	±0.019	–	–	0.135	±0.004	271.93	±16.42	–	–	153.02	±4.98
24	8.91±0.00	0.124	±0.002	–	–	0.054	±0.009	104.72	±1.50	–	–	61.32	±10.60

Chapter 3. Supplementary Information

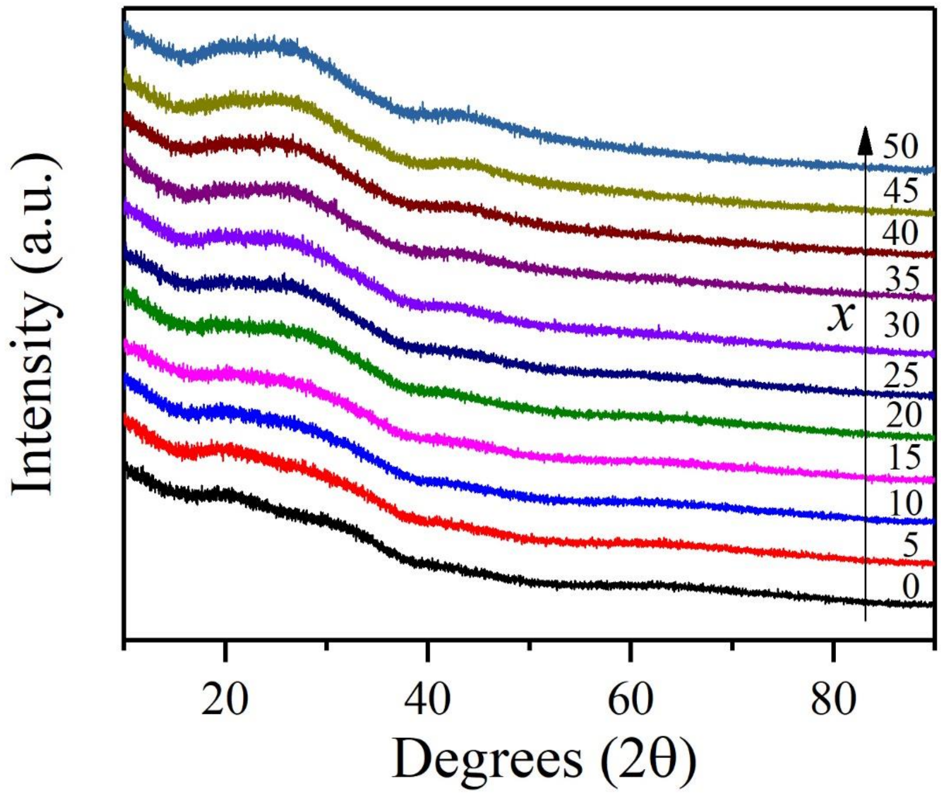


Figure S1. X-ray diffraction verification of the amorphous nature of the as-melted glass compositions.

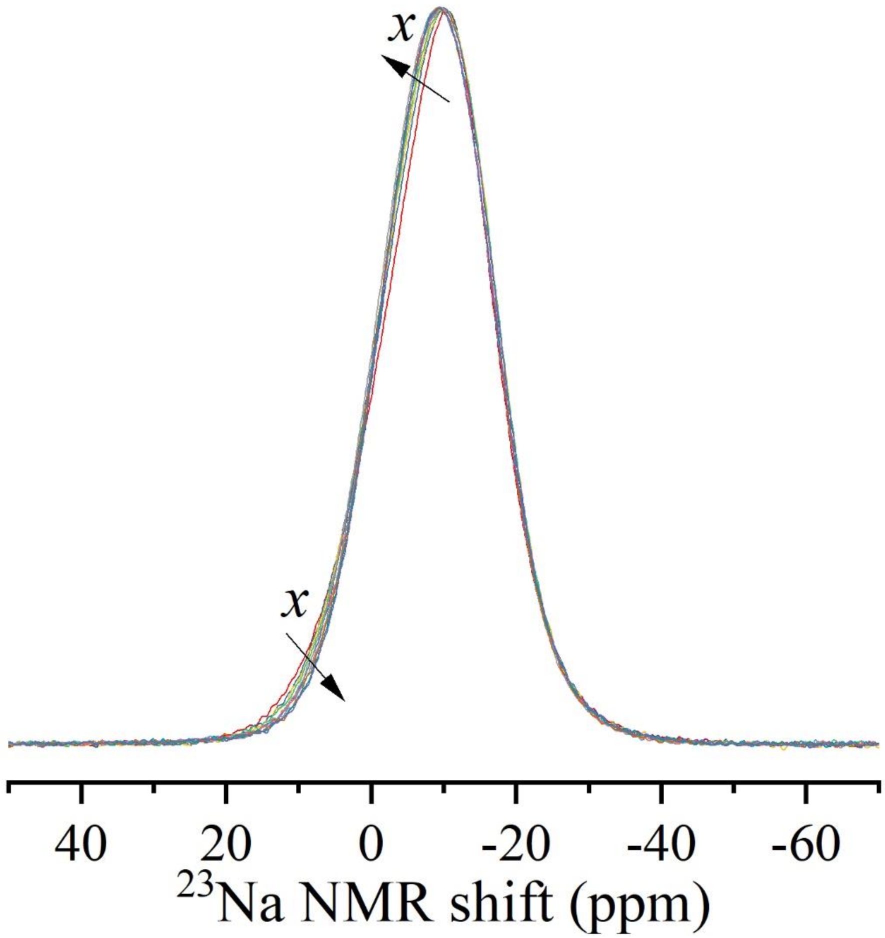
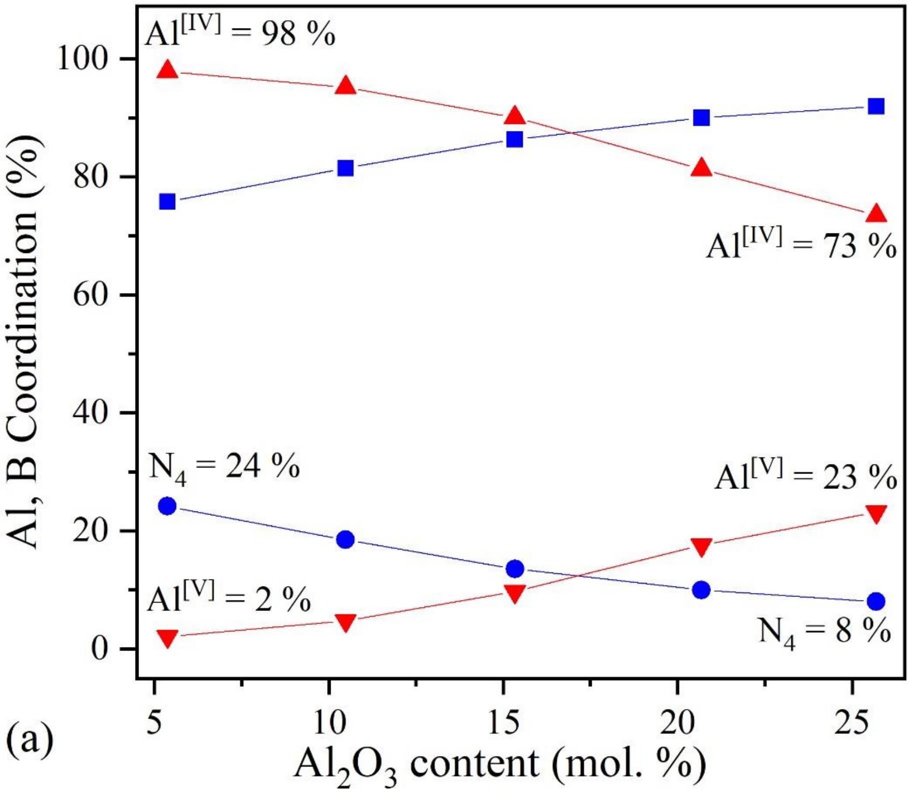


Figure S2. ^{23}Na MAS NMR spectra of the as-synthesized glasses.



Al$^{[IV]}$ = 98 %
Al$^{[IV]}$ = 73 %
N$_4$ = 24 %
Al$^{[V]}$ = 23 %
Al$^{[V]}$ = 2 %
N$_4$ = 8 %
Al, B Coordination (%)
0
20
40
60
80
100
5
10
15
20
25
Al$_2$O$_3$ content (mol. %)

(a)

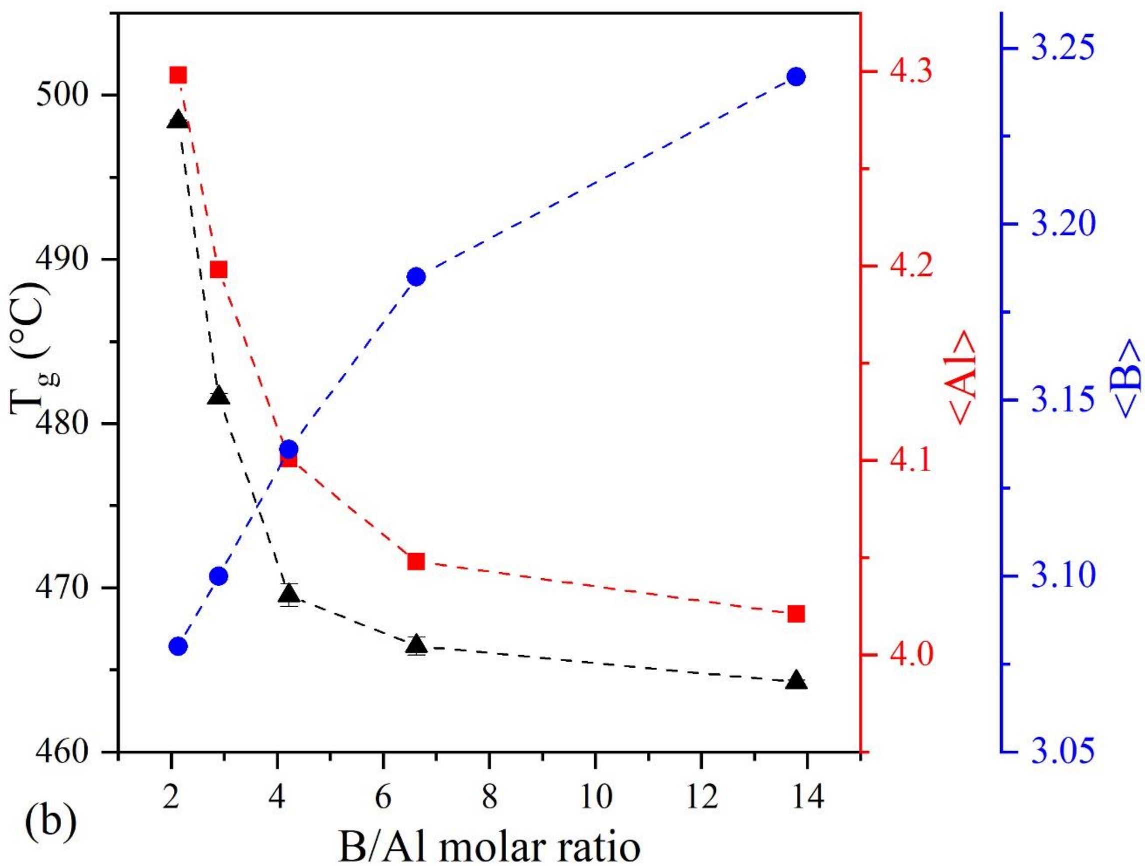


Figure S3. (a) Al and B coordination changes (%) in the previously studied 20 Na_2O–*x* Al_2O_3–(80-*x*) B_2O_3 glass system as a function of Al_2O_3 content (mol. %). (b) T_g and average Al and B coordination across the same sodium aluminoborate series as a function of B/Al molar ratio. T_g is displayed on the left axis and average B and Al coordination are both shown on the right axes.

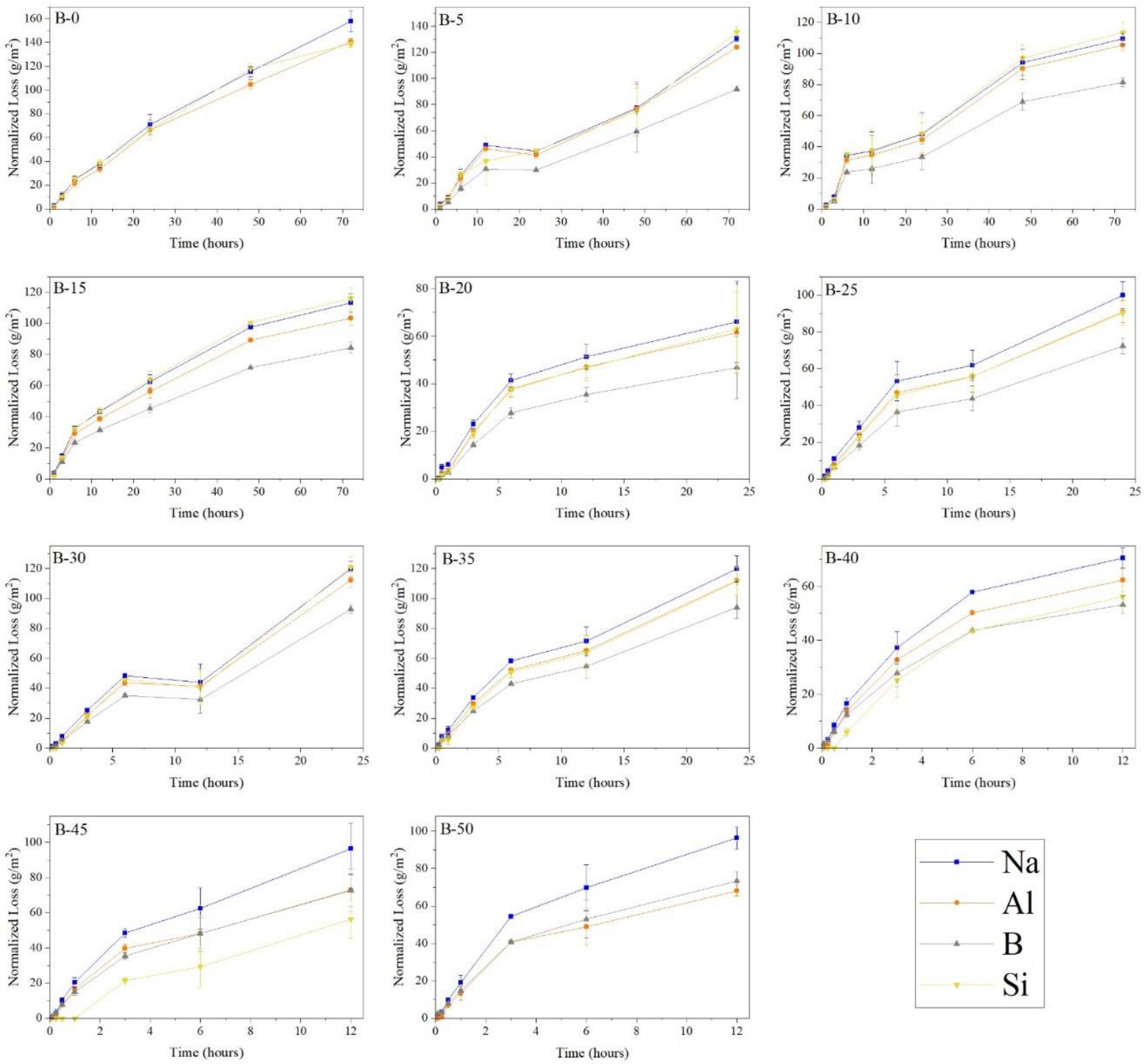


Figure S4. Plots of normalized loss (g/m^2) of each element present in the glass as a function of time (hours) for all studied glasses.

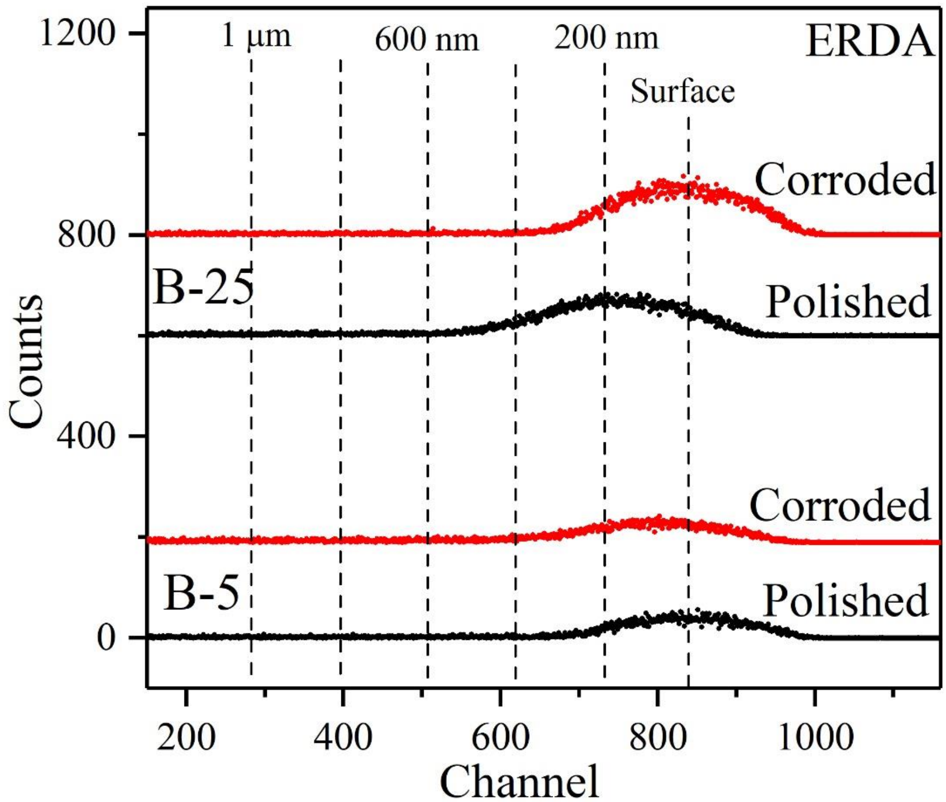
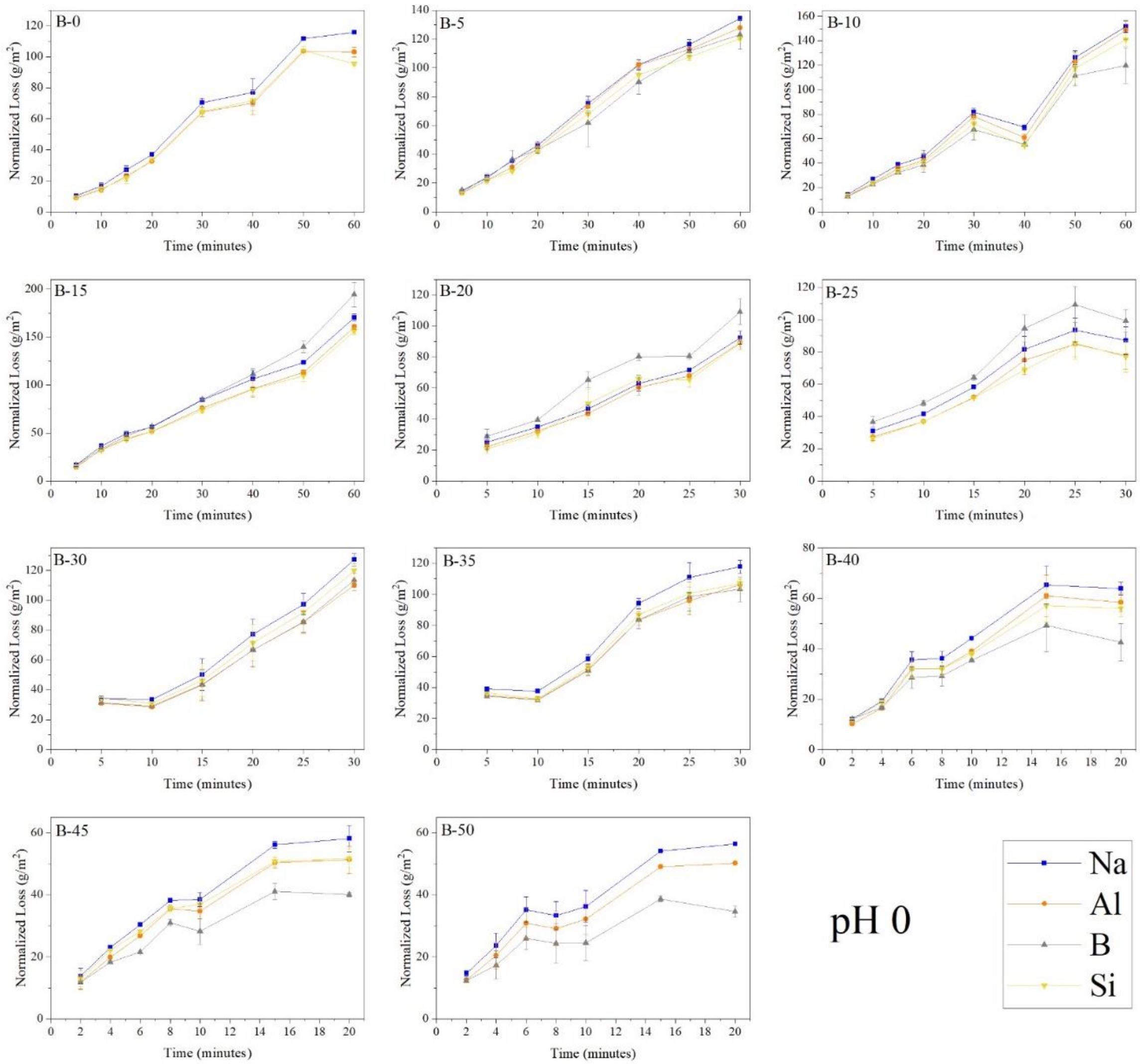


Figure S5. ERDA spectra of polished and corroded B-5 and B-25 glass coupons. The corroded samples were immersed in pH 2 solution for 3 days and 1 day, respectively.


B-0
B-5
B-10
B-15
B-20
B-25
B-30
B-35
B-40
B-45
B-50
Normalized Loss (g/m^2)
Time (minutes)
Na
Al
B
Si
pH 0

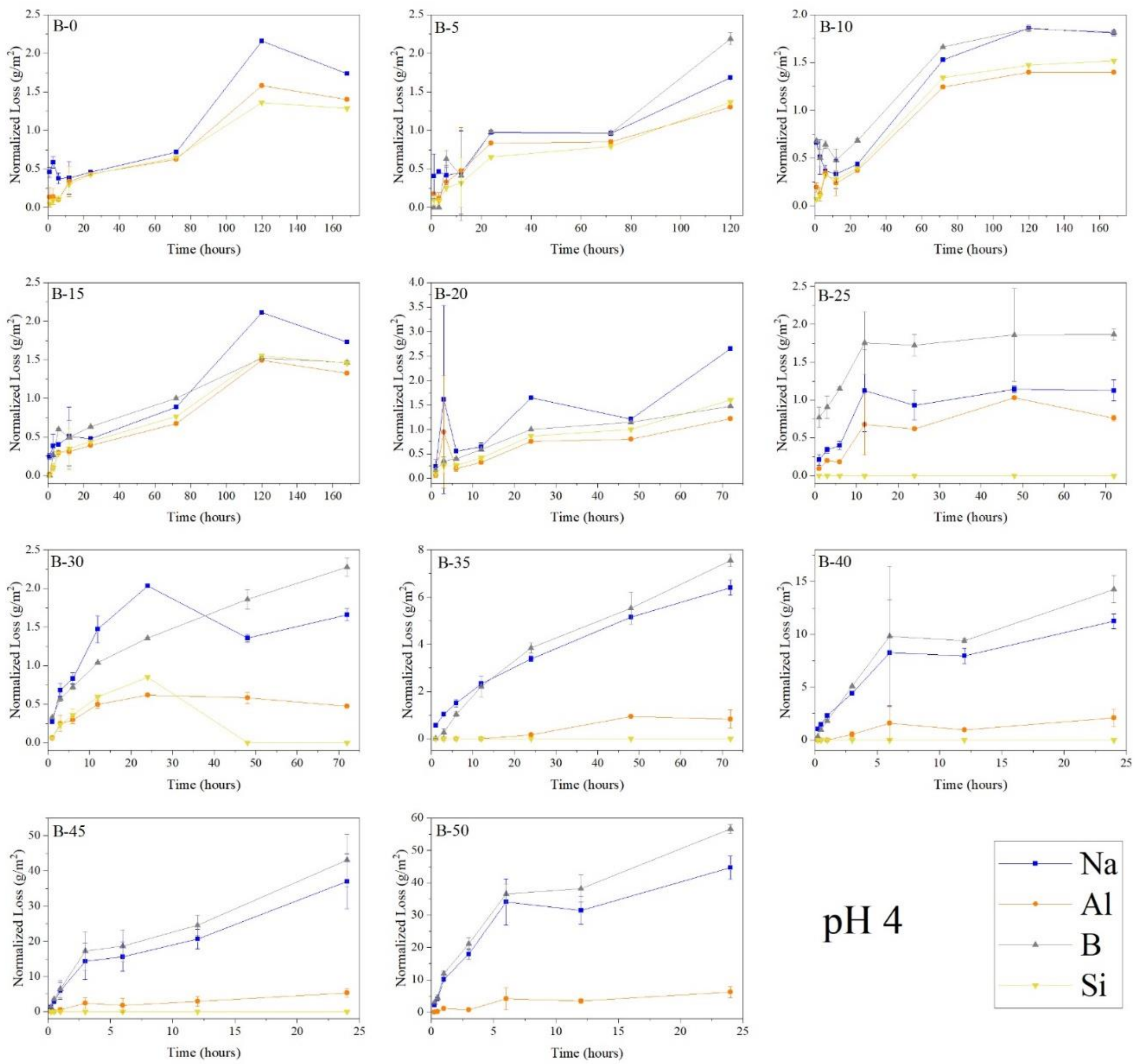


Figure S6. Plots of normalized loss (g/m^2) as a function of time (min / h) of the all glasses in pH 0 and 4 solutions, respectively, for each element present in the glass.

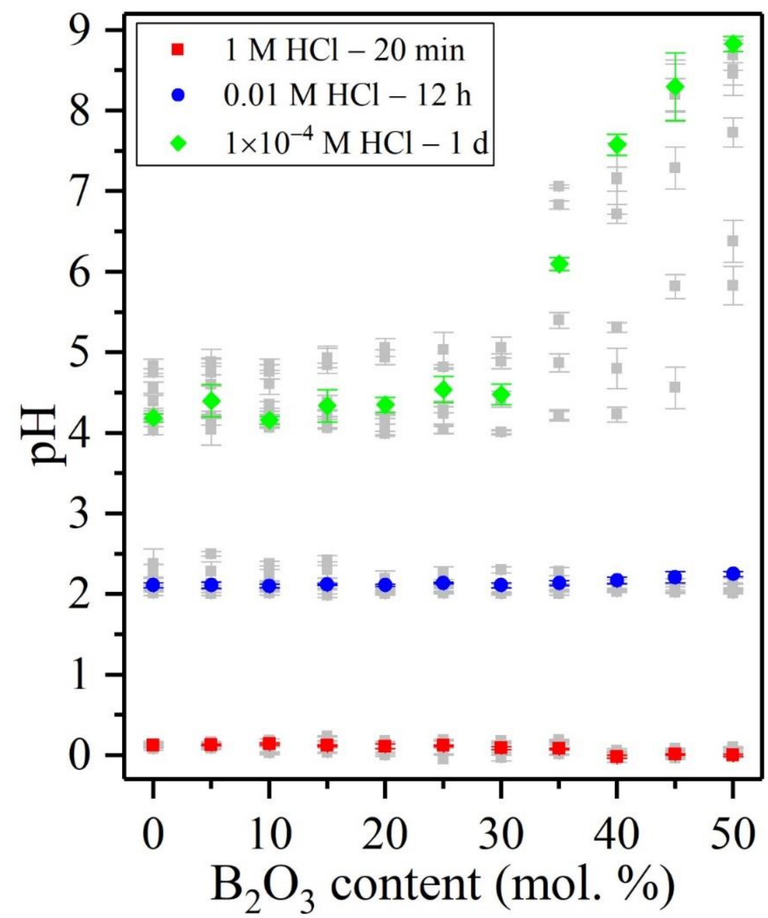
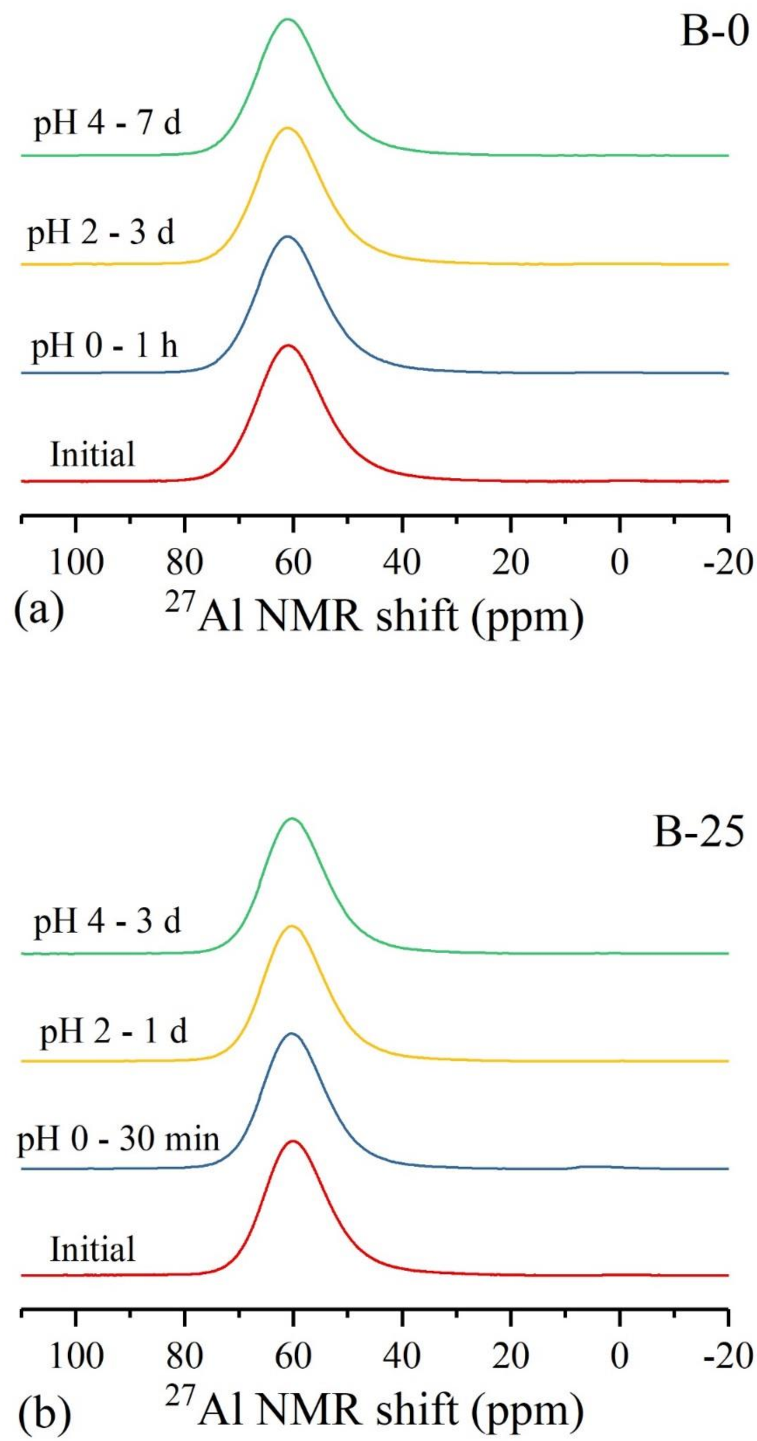


Figure S7. Solution pH as a function of glass B_2O_3 content (mol. %) in 1 M HCl (pH 0), 0.01 M HCl (pH 2), and 0.0001 M HCl (pH 4) starting solutions after 20 minutes, 12 hours, and 1 day of dissolution experiments, respectively. The data points displayed in gray represent the pH data spread along the course of corrosion experiments for each composition and solution environment.


B-0
pH 4 - 7 d
pH 2 - 3 d
pH 0 - 1 h
Initial
100
80
60
40
20
0
-20
(a)
^{27}Al NMR shift (ppm)
B-25
pH 4 - 3 d
pH 2 - 1 d
pH 0 - 30 min
Initial
100
80
60
40
20
0
-20
(b)
^{27}Al NMR shift (ppm)

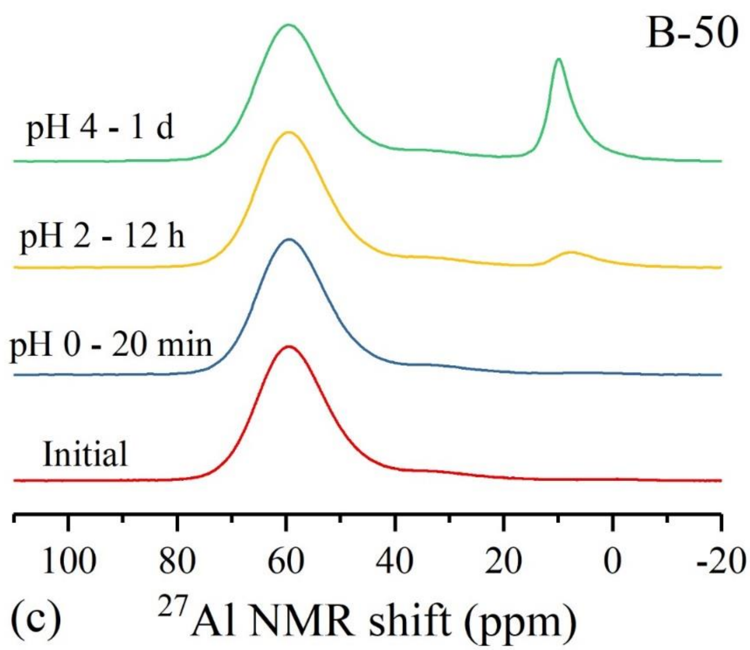


Figure S8. ^{27}Al MAS NMR spectra of (a) B-0, (b) B-25, and (c) B-50 grains recovered from dissolution experiments at pH 0, 2, and 4.

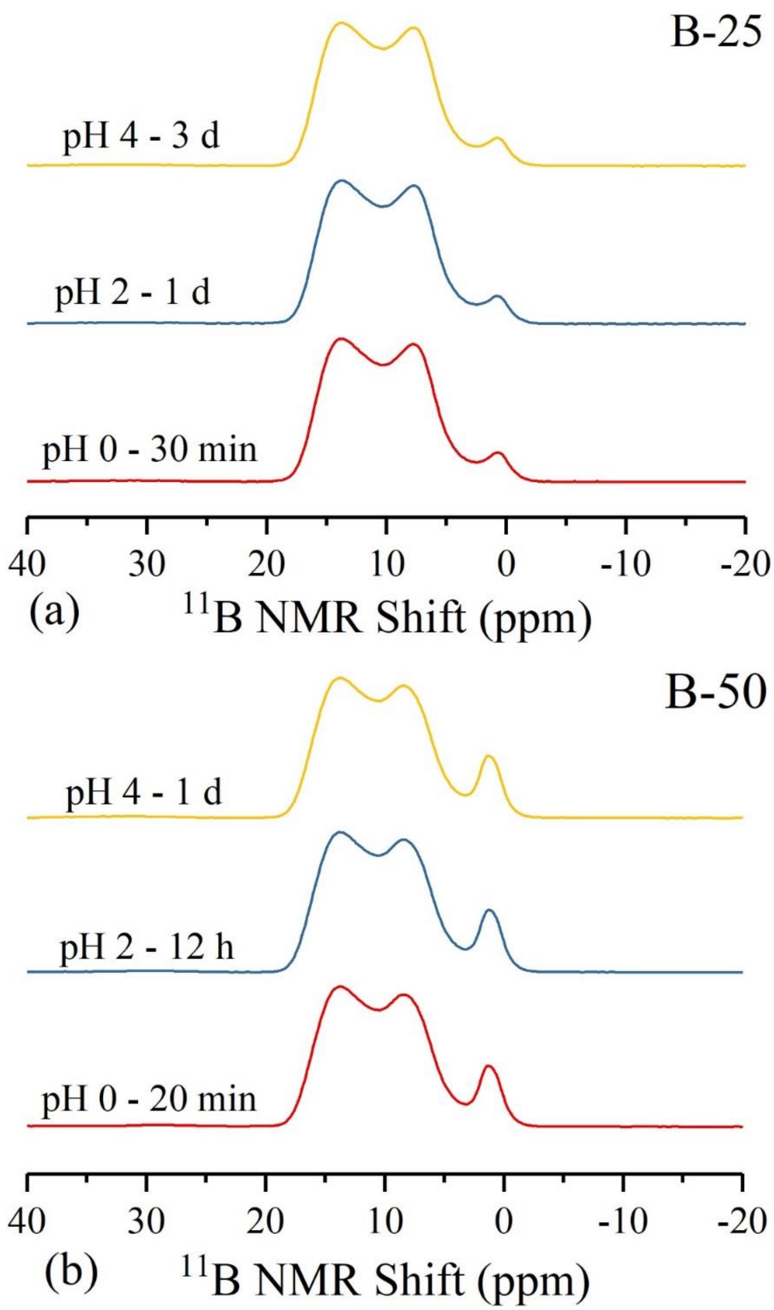


Figure S9. ^{11}B MAS NMR spectra of (a) B-25 and (b) B-50 grains recovered from dissolution experiments at pH 0, 2, and 4.

Table S1. Fitting parameters of ^{23}Na MAS NMR spectra.

Sample ID	^{23}Na MAS NMR	
	δ_{iso} (ppm)	C_q (MHz)
B-0	*	*
B-5	*	*
B-10	-7.0	1.7
B-15	-6.6	1.8
B-20	-6.3	1.8
B-25	-5.9	1.9
B-30	-5.8	2.0
B-35	-5.7	2.0
B-40	-5.6	2.0
B-45	-5.5	2.1
B-50	-5.5	2.1

* Note: Samples were unable to be fit using the CZSimple model in DMFit

Table S2. Average concentration (ppm), averaged normalized loss (g/m^2), and pH as a function of time (h) for all glasses in pH 2 solutions. The reported errors are calculated 1σ standard deviation for duplicate samples.

B-0		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	2.01±0.03	1.0	±0.1	0.6	±0.2	--	--	1.0	±0.2	2.4	±0.2	1.2	±0.4	--	--	2.1	±0.5
3	2.07±0.00	4.6	±1.1	4.4	±1.2	--	--	5.1	±1.5	11.5	±2.7	9.0	±2.4	--	--	10.6	±3.0
6	2.04±0.01	10.0	±1.1	10.5	±1.5	--	--	12.1	±1.6	24.7	±2.8	21.5	±3.0	--	--	25.0	±3.3
12	2.11±0.03	15.3	±1.3	16.4	±1.3	--	--	18.5	±1.3	37.9	±3.3	33.5	±2.7	--	--	38.3	±2.8
24	2.16±0.05	28.6	±3.5	32.6	±4.1	--	--	31.9	±3.9	70.9	±8.7	66.6	±8.3	--	--	66.3	±8.1
48	2.29±0.08	46.7	±1.8	51.2	±1.9	--	--	56.7	±2.4	115.6	±4.6	104.7	±3.9	--	--	117.6	±5.1
72	2.38±0.18	63.7	±3.6	68.9	±1.2	--	--	67.0	±1.6	157.7	±8.9	140.7	±2.5	--	--	139.1	±3.3
B-5		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	2.00±0.02	1.5	±0.7	1.0	±0.7	<0.2	--	1.3	±0.6	3.6	±1.7	2.2	±1.5	--	--	3.0	±1.3
3	2.07±0.01	3.6	±0.4	3.7	±0.6	0.2	±0.0	3.7	±0.6	8.9	±1	7.8	±1.3	5.0	±0.2	8.5	±1.4
6	2.06±0.01	10.5	±1.8	11.4	±2.0	0.6	±0.1	11.6	±2.3	26.0	±4.5	23.8	±4.2	15.9	±2.2	26.7	±5.4
12	2.11±0.04	19.8	±0.2	21.9	±0.1	1.2	±0.1	15.9	±7.8	49.0	±0.5	45.9	±0.1	30.7	±1.5	36.7	±17.9
24	2.13±0.02	17.9	±0.7	19.7	±1.1	1.1	±0.0	19.4	±0.6	44.4	±1.8	41.2	±2.4	29.7	±0.5	44.8	±1.3
48	2.28±0.12	31.3	±7.3	36.6	±9.8	2.3	±0.6	32.4	±7.7	77.5	±18.2	76.7	±20.6	59.4	±16	74.7	±17.7
72	2.50±0.03	52.7	±0.8	59.2	±0.5	3.5	±0.0	58.9	±1.8	130.5	±2.0	123.9	±1.0	92.0	±0.8	135.8	±4.1
B-10		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	2.01±0.02	1.0	±0.4	0.6	±0.4	<0.2	--	0.6	±0.4	2.6	±0.9	1.3	±0.9	--	--	1.6	±0.9
3	2.05±0.01	3.0	±0.7	2.8	±0.6	0.3	±0.1	2.4	±0.4	7.5	±1.8	5.8	±1.3	4.9	±1.0	6.2	±1.0
6	2.06±0.01	13.5	±0.3	15.3	±0.2	1.6	±0.0	13.7	±0.0	34.2	±0.8	31.5	±0.3	23.6	±0.3	35.2	±0.0
12	2.10±0.02	14.6	±5.0	16.8	±6.1	1.8	±0.6	14.6	±5.2	37.1	±12.7	34.7	±12.7	25.9	±9.1	37.7	±13.4
24	2.12±0.03	19.1	±5.5	21.6	±5.5	2.3	±0.6	18.8	±4.8	48.3	±13.8	44.4	±11.3	33.5	±8.4	48.4	±12.4
48	2.24±0.07	37.2	±3.2	43.8	±3.5	4.7	±0.4	37.7	±3.2	94.2	±8.2	90.3	±7.1	69.1	±5.7	97.1	±8.2
72	2.38±0.03	43.3	±1.5	51.2	±1.8	5.5	±0.2	44.1	±2.7	109.6	±3.7	105.4	±3.7	81.5	±3.1	113.5	±6.9
B-15		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	1.98±0.02	1.4	±0.2	1.1	±0.0	0.4	±0.0	0.8	±0.0	3.6	±0.4	2.2	±0.0	3.6	±0.3	2.3	±0.1
3	2.06±0.00	5.7	±0.1	6.2	±0.2	1.1	±0.0	4.7	±0.1	14.8	±0.4	12.6	±0.3	11.0	±0.3	14.0	±0.4
6	2.06±0.01	12.6	±0.4	14.3	±0.2	2.4	±0.0	10.8	±0.2	32.5	±1.1	29.1	±0.3	23.2	±0.0	32.3	±0.7
12	2.12±0.01	16.7	±0.6	19.1	±0.7	3.3	±0.1	14.7	±0.5	43.3	±1.5	38.8	±1.4	31.4	±0.8	43.9	±1.6
24	2.14±0.01	24.2	±1.7	27.7	±2.1	4.7	±0.3	21.4	±1.8	62.6	±4.3	56.4	±4.3	45.2	±2.9	63.9	±5.5
48	2.30±0.10	37.8	±0.2	43.9	±0.1	7.4	±0.0	33.6	±0.0	97.7	±0.5	89.2	±0.3	71.5	±0.3	100.3	±0.1
72	2.42±0.06	43.8	±2.3	50.9	±2.5	8.7	±0.4	38.8	±2.4	113.3	±6.1	103.5	±5.2	84.4	±3.7	115.9	±7.2

B-20		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.25	2.03±0.01	<0.5	--	<0.2	--	<0.2	--	<0.2	--	--	--	--	--	--	--	--	--
0.5	2.01±0.02	1.8	±0.6	1.2	±0.7	0.3	±0.1	0.5	±0.5	4.6	±1.5	2.5	±1.4	1.8	±0.9	1.7	±1.6
1	2.00±0.01	2.4	±0.3	1.7	±0.4	0.4	±0.1	0.9	±0.4	6.0	±0.8	3.5	±0.7	2.5	±0.6	3.1	±1.2
3	2.03±0.02	9.0	±0.8	9.4	±0.8	2.0	±0.1	5.4	±0.5	22.9	±2.0	19.6	±1.6	14.2	±1.1	18.9	±1.9
6	2.05±0.02	16.2	±1.1	18.1	±1.4	3.9	±0.3	10.8	±1.1	41.4	±2.8	37.6	±2.9	27.7	±2.2	38.2	±3.8
12	2.11±0.01	20.1	±2.0	22.6	±2.2	5.0	±0.4	13.3	±1.6	51.3	±5.1	47.0	±4.6	35.4	±3.1	46.7	±5.5
24	2.19±0.1	25.9	±6.7	29.5	±8.1	6.6	±1.8	17.9	±5.2	66.0	±17.1	61.5	±16.9	46.8	±13	63.1	±18.5

B-25		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.25	2.03±0.01	0.6	±0.2	<0.2	--	<0.2	--	<0.2	--	1.5	±0.5	--	--	--	--	--	--
0.5	2.02±0.01	1.7	±0.3	1.0	±0.3	0.4	±0.1	<0.2	--	4.3	±0.7	2.0	±0.7	2.3	±0.5	--	--
1	2.01±0.01	4.2	±0.0	3.7	±0.0	1.1	±0.0	1.5	±0.1	10.9	±0.1	7.7	±0.0	6.4	±0.2	6.3	±0.2
3	2.11±0.02	10.9	±1.4	11.4	±1.6	3.3	±0.5	5.4	±0.9	27.8	±3.7	23.9	±3.4	18.4	±2.6	22.9	±3.7
6	2.09±0.02	20.8	±4.2	22.3	±4.7	6.5	±1.4	10.6	±2.1	53.2	±10.8	46.8	±9.9	36.4	±7.7	45.4	±8.9
12	2.14±0.01	24.2	±3.2	26.5	±4.0	7.8	±1.2	13.0	±1.9	61.9	±8.1	55.7	±8.5	43.8	±6.8	55.6	±8.1
24	2.26±0.08	39.0	±2.9	43.3	±2.8	12.9	±0.7	21.2	±1.6	99.9	±7.4	91.0	±6	72.3	±4.2	90.4	±6.9

B-30		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.25	2.05±0.02	0.5	±0.4	<0.2	--	<0.2	--	<0.2	--	1.2	±0.9	--	--	--	--	--	--
0.5	2.01±0.01	1.2	±0.4	0.5	±0.5	0.4	±0.2	<0.2	--	3.1	±1.2	1.1	±1.1	1.7	±0.8	--	--
1	2.00±0.01	3.0	±0.1	2.5	±0.1	1.0	±0.0	0.7	±0.0	7.7	±0.2	5.2	±0.1	4.8	±0.1	3.4	±0.1
3	2.10±0.03	9.7	±0.5	10.4	±0.5	3.7	±0.1	4.1	±0.3	25.2	±1.2	21.9	±1.2	17.7	±0.6	21.3	±1.3
6	2.10±0.02	18.7	±0.5	20.6	±0.6	7.3	±0.2	9.0	±0.1	48.5	±1.2	43.5	±1.3	35.1	±1.2	46.0	±0.4
12	2.11±0.03	16.9	±4.6	19.6	±5.6	6.8	±1.9	7.8	±2.2	44.0	±12.0	41.4	±11.8	32.5	±9.3	40.2	±11.6
24	2.30±0.04	46.1	±2.0	53.2	±2.5	19.4	±0.6	23.5	±1.4	119.8	±5.2	112.4	±5.3	92.9	±2.9	120.9	±7.2

B-35		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.25	2.05±0.01	0.8	±0.2	<0.2	--	0.5	±0.2	<0.2	--	2.0	±0.6	--	--	2.2	±1.0	--	--
0.5	2.01±0.02	3.0	±0.4	2.6	±0.4	1.4	±0.1	0.7	±0.8	7.8	±1.0	5.5	±0.9	5.9	±0.5	4.8	±5.5
1	2.00±0.00	4.6	±1.1	4.2	±1.4	2.1	±0.6	0.8	±0.5	12.0	±2.9	9.0	±3.1	8.5	±2.3	5.5	±3.1
3	2.11±0.02	12.9	±0.2	13.9	±0.2	6.1	±0.1	4.1	±0.1	33.8	±0.5	29.9	±0.5	24.8	±0.6	27.5	±0.5
6	2.11±0.01	22.3	±0.4	24.1	±0.7	10.6	±0.1	7.5	±0.5	58.2	±1.0	51.9	±1.6	43.1	±0.6	50.7	±3.5
12	2.14±0.03	27.3	±3.7	30.3	±4.5	13.4	±1.9	9.4	±1.8	71.4	±9.7	65.2	±9.7	54.6	±7.8	63.6	±12.0
24	2.28±0.05	45.9	±3.3	52.1	±4.5	23.0	±1.8	16.4	±1.4	119.9	±8.7	111.9	±9.6	94.0	±7.3	111.2	±9.8

B-40		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.08	2.03±0.01	<0.5	--	<0.2	--	0.5	±0.1	<0.2	--	--	--	--	--	1.8	±0.5	--	--
0.25	2.03±0.01	1.2	±0.0	0.5	±0.1	0.8	±0.0	<0.2	--	3.1	±0.0	1.2	±0.2	3.0	±0.0	--	--
0.5	2.06±0.01	3.2	±0.4	2.7	±0.3	1.7	±0.1	<0.2	--	8.4	±1.1	5.9	±0.6	6.2	±0.3	--	--
1	2.04±0.01	6.3	±0.7	6.3	±0.7	3.5	±0.3	0.6	±0.1	16.6	±1.9	13.6	±1.5	12.4	±1.2	6.0	±1.4
3	2.13±0.01	14.2	±2.3	15.0	±2.7	7.8	±1.4	2.5	±0.6	37.2	±6.0	32.7	±5.8	27.9	±4.9	25.2	±6.4
6	2.16±0.02	22.2	±0.1	23.1	±0.1	12.2	±0.1	4.4	±0.0	57.9	±0.2	50.3	±0.2	43.7	±0.3	43.6	±0.0
12	2.17±0.04	27.0	±1.4	28.7	±2.0	14.9	±0.9	5.6	±0.4	70.5	±3.7	62.4	±4.3	53.2	±3.3	56.1	±3.9
B-45		**Concentration, ppm**								**Normalized Loss, g/m^2**							
Time (h)	**pH**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
0.08	2.02±0.01	<0.5	--	<0.2	--	0.4	±0.1	<0.2	--	--	--	--	--	1.3	±0.2	--	--
0.25	2.04±0.00	1.0	±0.4	0.3	±0.4	1.1	±0.6	<0.2	--	2.6	±1.1	0.6	±0.9	3.4	±1.9	--	--
0.5	2.06±0.00	3.9	±0.5	3.4	±0.5	2.5	±0.3	<0.2	--	10.3	±1.2	7.5	±1.1	7.8	±0.8	--	--
1	2.07±0.02	7.7	±1.1	7.6	±1.2	4.8	±0.6	<0.2	--	20.3	±2.8	16.7	±2.6	15.1	±1.8	--	--
3	2.13±0.01	18.3	±1.0	18.0	±1.1	11.3	±0.6	1.0	±0.1	48.5	±2.6	39.8	±2.3	35.4	±1.8	21.3	±2.0
6	2.16±0.03	23.6	±4.4	21.9	±4.7	15.5	±2.8	1.4	±0.6	62.6	±11.7	48.4	±10.5	48.4	±8.8	29.4	±11.6
12	2.21±0.07	36.4	±5.4	33.1	±5.4	23.3	±2.9	2.7	±0.5	96.5	±14.3	73.1	±12.0	72.8	±9.0	56.5	±10.7
B-50		**Concentration, ppm**								**Normalized Loss, g/m^2**							
Time (h)	**pH**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
0.08	2.01±0.01	0.8	±0.2	<0.2	--	0.9	±0.0	--	--	2.0	±0.5	--	--	2.7	±0.0	--	--
0.25	2.04±0.00	1.2	±0.2	0.3	±0.1	1.1	±0.1	--	--	3.2	±0.4	0.6	±0.3	3.2	±0.3	--	--
0.5	2.05±0.01	3.8	±0.2	3.2	±0.2	2.8	±0.1	--	--	9.9	±0.4	7.0	±0.4	8.0	±0.3	--	--
1	2.07±0.01	7.3	±1.4	6.1	±1.6	5.2	±0.9	--	--	19.2	±3.8	13.4	±3.6	14.8	±2.5	--	--
3	2.13±0.01	20.7	±0.1	18.5	±0.1	14.3	±0.1	--	--	54.4	±0.2	40.7	±0.3	40.7	±0.2	--	--
6	2.17±0.03	26.6	±4.7	22.2	±4.3	18.6	±3.6	--	--	69.8	±12.2	49.0	±9.6	53.1	±10.1	--	--
12	2.25±0.03	36.7	±2.2	30.9	±1.3	25.8	±1.8	--	--	96.4	±5.8	68.1	±2.8	73.5	±5.0	--	--

Table S3. Average concentration (ppm), averaged normalized loss (g/m^2), and pH as a function of time (h) for all glasses in pH 0 solutions. The reported errors are calculated 1σ standard deviation for duplicate samples.

B-0		**Concentration, ppm**								**Normalized Loss, g/m^2**							
Time (h)	**pH**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
0.08	0.13±0.01	12.7	±0.5	12.9	±0.9	--	--	13.7	±1.1	10.5	±0.4	8.8	±0.6	--	--	9.5	±0.8
0.17	0.14±0.01	20.4	±2.2	21.0	±3.0	--	--	21.8	±3.1	16.8	±1.8	14.3	±2.1	--	--	15.1	±2.2
0.25	0.11±0.01	32.7	±3.2	33.9	±5.3	--	--	31.7	±5.2	27.0	±2.7	23.1	±3.6	--	--	21.9	±3.6
0.33	0.1±0.00	44.7	±1.3	47.9	±1.4	--	--	48.6	±0.9	36.9	±1.1	32.6	±1.0	--	--	33.7	±0.6
0.5	0.13±0.03	85.2	±3.8	94.4	±4.3	--	--	93.6	±4.1	70.3	±3.1	64.3	±2.9	--	--	64.8	±2.9
0.67	0.10±0.01	93.4	±10.5	103.2	±11.1	--	--	104.0	±9.2	77.1	±8.6	70.2	±7.6	--	--	71.9	±6.4
0.83	0.14±0.03	135.3	±0.8	152.4	±0.9	--	--	150.2	±4.3	111.7	±0.7	103.8	±0.6	--	--	103.9	±3.0
1	0.08±0.02	140.4	±0.2	151.3	±4.6	--	--	138.1	±1.6	115.9	±0.2	103.0	±3.1	--	--	95.5	±1.1
B-5		**Concentration, ppm**								**Normalized Loss, g/m^2**							
Time (h)	**pH**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
0.08	0.15±0.01	17.3	±0.1	18.7	±0.2	1.8	±0.0	17.7	±0.2	14.3	±0.1	13.0	±0.1	15.3	±0.4	13.6	±0.2
0.17	0.16±0.01	29.4	±2.5	31.6	±3.6	2.7	±0.3	28.8	±2.6	24.3	±2.1	22.0	±2.5	23.3	±2.2	22.2	±2.0
0.25	0.08±0.01	43.0	±0.5	44.3	±0.3	4.2	±0.8	36.8	±0.2	35.5	±0.4	30.9	±0.2	36.3	±6.6	28.3	±0.2
0.33	0.13±0.01	56.1	±2.8	63.3	±4.7	5.0	±0.3	55.1	±3.0	46.3	±2.3	44.2	±3.3	43.3	±2.7	42.3	±2.3
0.5	0.12±0.01	91.2	±5.9	104.6	±6.8	7.1	±1.9	88.8	±6.6	75.2	±4.9	73.0	±4.7	61.7	±16.3	68.2	±5.0
0.67	0.10±0.00	124.0	±4.3	146.1	±3.0	10.4	±1.0	123.8	±0.1	102.3	±3.5	101.9	±2.1	90.2	±8.4	95.1	±0.1
0.83	0.13±0.01	140.8	±4.3	161.6	±3.2	12.9	±0.4	140.0	±3.1	116.2	±3.5	112.7	±2.2	111.6	±3.1	107.6	±2.4
1	0.08±0.01	162.7	±1.8	183.4	±1.6	14.2	±1.2	156.8	±1.8	134.2	±1.5	127.9	±1.1	123.0	±10.3	120.4	±1.4
B-10		**Concentration, ppm**								**Normalized Loss, g/m^2**							
Time (h)	**pH**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
0.08	0.15±0.01	17.0	±1.6	18.3	±1.9	2.6	±0.2	15.9	±1.2	14.4	±1.3	12.6	±1.3	12.8	±1.0	13.6	±1.1
0.17	0.18±0.02	31.6	±0.9	34.8	±2.4	4.6	±0.3	27.8	±1.7	26.7	±0.8	23.9	±1.6	22.6	±1.4	23.9	±1.5
0.25	0.03±0.02	45.5	±2.7	51.6	±3.5	6.6	±0.2	38.8	±2.1	38.4	±2.3	35.4	±2.4	32.3	±1.2	33.3	±1.8
0.33	0.14±0.01	53.7	±6.1	61.2	±8.7	7.8	±1.2	47.3	±6.9	45.3	±5.1	42.0	±5.9	38.4	±5.7	40.5	±5.9
0.5	0.14±0.01	96.9	±3.3	113.5	±4.6	13.7	±1.7	84.1	±9.2	81.8	±2.8	77.9	±3.2	67.2	±8.4	72.1	±7.9
0.67	0.12±0.01	81.9	±2.4	88.7	±4.0	11.2	±0.1	63.0	±4.7	69.1	±2.0	60.9	±2.7	55.1	±0.3	54.0	±4.0
0.83	0.11±0.01	149.6	±6.7	178.7	±11.3	22.7	±1.6	137.2	±14.6	126.3	±5.6	122.6	±7.8	111.3	±8.0	117.7	±12.6
1	0.03±0.01	179.8	±5.6	216.5	±11.1	24.4	±3.0	164.5	±6.6	151.8	±4.7	148.6	±7.6	119.9	±14.7	141.0	±5.6

B-15		Concentration, ppm								Normalized Loss, g/m²							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.08	0.24±0.01	19.2	±1.6	20.9	±2.1	5.0	±0.4	15.2	±1.1	16.6	±1.4	14.2	±1.4	16.1	±1.3	15.1	±1.1
0.17	0.18±0.01	42.2	±3.1	48.2	±3.6	10.4	±1.1	32.2	±1.8	36.4	±2.7	32.6	±2.5	33.5	±3.4	32.0	±1.8
0.25	0.03±0.01	57.0	±2.4	65.4	±2.8	14.5	±1.4	43.7	±2.1	49.2	±2.1	44.3	±1.9	46.9	±4.6	43.5	±2.1
0.33	0.12±0.01	65.4	±1.4	76.0	±0.6	17.7	±0.3	52.1	±0.0	56.4	±1.2	51.5	±0.4	57.0	±1.0	51.8	±0.0
0.5	0.11±0.03	97.9	±0.7	112.0	±1.5	26.3	±0.1	74.2	±2.9	84.4	±0.6	75.9	±1.0	84.6	±0.4	73.8	±2.9
0.67	0.12±0.02	123.2	±10.2	141.8	±12.7	34.5	±1.8	95.9	±6.5	106.2	±8.8	96.1	±8.6	111.2	±5.9	95.4	±6.5
0.83	0.11±0.01	143.3	±1.8	167.1	±3.3	43.4	±1.8	110.0	±5.4	123.6	±1.5	113.2	±2.3	140.0	±5.9	109.5	±5.4
1	0.03±0.00	197.4	±4.5	237.0	±3.9	60.3	±4.0	157.0	±3.5	170.2	±3.9	160.6	±2.7	194.4	±12.9	156.2	±3.4

B-20		Concentration, ppm								Normalized Loss, g/m²							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.08	0.00±0.00	29.3	±5.6	31.8	±6.1	12.3	±1.9	17.6	±2.3	24.9	±4.8	22.0	±4.2	28.9	±4.6	20.6	±2.7
0.17	0.00±0.01	41.1	±1.1	46.4	±1.6	16.8	±0.2	26.0	±2.1	34.9	±0.9	32.2	±1.1	39.6	±0.5	30.5	±2.5
0.25	0.06±0.02	54.5	±2.8	62.9	±2.3	27.7	±2.2	42.4	±8.3	46.3	±2.4	43.6	±1.6	65.2	±5.1	49.8	±9.8
0.33	0.11±0.03	74.2	±5.9	86.8	±7.0	34.0	±1.0	56.1	±2.3	63.0	±5.0	60.2	±4.8	80.2	±2.3	65.8	±2.7
0.42	0.18±0.00	84.4	±0.5	97.6	±0.4	34.1	±0.9	55.7	±4.0	71.7	±0.5	67.7	±0.3	80.4	±2.0	65.3	±4.7
0.5	0.16±0.01	108.9	±5.0	128.6	±6.2	46.3	±3.5	75.9	±2.3	92.5	±4.3	89.2	±4.3	109.2	±8.2	89.0	±2.7

B-25		Concentration, ppm								Normalized Loss, g/m²							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.08	-0.05±0.00	36.2	±1.8	39.0	±3.0	19.6	±1.7	18.5	±1.3	30.9	±1.6	27.3	±2.1	36.6	±3.2	26.3	±1.8
0.17	0.01±0.01	48.5	±0.1	52.7	±0.7	25.8	±0.9	25.9	±0.5	41.5	±0.1	36.9	±0.5	48.3	±1.7	36.8	±0.7
0.25	0.10±0.01	68.3	±1.3	74.2	±0.6	34.2	±0.9	36.2	±0.3	58.3	±1.1	52.0	±0.4	64.0	±1.7	51.6	±0.5
0.33	0.12±0.01	95.6	±9.3	106.9	±12.6	50.6	±4.5	48.3	±1.1	81.7	±7.9	74.9	±8.8	94.6	±8.5	68.8	±1.6
0.42	0.19±0.01	109.5	±8.7	121.3	±11.3	58.5	±6.0	60.1	±7.2	93.6	±7.5	84.9	±7.9	109.5	±11.3	85.6	±10.2
0.5	0.19±0.01	101.9	±10.3	110.8	±12.3	53.0	±3.8	54.2	±6.8	87.0	±8.8	77.6	±8.6	99.2	±7.1	77.2	±9.6

B-30		Concentration, ppm								Normalized Loss, g/m²							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.08	-0.03±0.04	39.6	±0.2	44.1	±1	19.6	±0.1	19.9	±0.3	34.3	±0.2	31.1	±0.7	31.3	±0.1	34.2	±0.6
0.17	0.02±0.02	38.6	±0.4	40.7	±0.7	18.2	±0.2	18.1	±0.3	33.5	±0.4	28.7	±0.5	29.1	±0.4	31.0	±0.5
0.25	0.12±0.02	57.9	±12.1	61.3	±15.1	27.2	±6.1	27.0	±6.3	50.2	±10.5	43.2	±10.6	43.4	±9.7	46.4	±10.9
0.33	0.09±0.02	89.0	±11.9	94.5	±15.6	41.7	±7.4	41.7	±7.1	77.1	±10.3	66.6	±11	66.7	±11.8	71.5	±12.2
0.42	0.17±0.01	112.4	±8.2	121.1	±10.6	53.5	±4.4	53.5	±4.7	97.4	±7.1	85.3	±7.5	85.6	±7	91.8	±8.1
0.5	0.18±0.00	146.8	±4.7	156.6	±5.1	70.9	±3	69.8	±2.7	127.2	±4	110.3	±3.6	113.3	±4.7	119.8	±4.6

B-35		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.08	0.01±0.01	45.0	±1.6	48.3	±2	25.4	±1	16.1	±0.2	39.1	±1.4	34.6	±1.4	34.5	±1.3	36.4	±0.5
0.17	0.04±0.02	43.3	±1.5	45.3	±2.2	23.3	±0.6	14.5	±0.7	37.7	±1.3	32.5	±1.6	31.7	±0.8	32.8	±1.7
0.25	0.14±0.01	67.0	±3.3	71.7	±4.9	37.3	±1.7	23.6	±1.6	58.4	±2.9	51.4	±3.5	50.8	±2.4	53.2	±3.7
0.33	0.08±0.01	108.1	±3.7	116.5	±4.7	61.4	±4	38.5	±2	94.1	±3.3	83.4	±3.4	83.5	±5.4	87.1	±4.5
0.42	0.17±0.01	127.4	±11.1	134.1	±12.5	72.5	±6.8	44.5	±4.2	110.9	±9.7	96.0	±9	98.6	±9.2	100.6	±9.6
0.5	0.19±0.01	135.4	±4.8	148.6	±4.5	76.0	±5.8	47.4	±1.7	117.9	±4.2	106.4	±3.3	103.4	±7.9	107.1	±3.8

B-40		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.03	0.04±0.02	14.0	±0.5	14.1	±0.5	10.1	±0.7	3.5	±0.2	12.2	±0.4	10.2	±0.4	12.1	±0.8	11.7	±0.6
0.07	0.04±0.02	22.1	±0.6	22.7	±1.1	14.0	±0.6	5.7	±0.3	19.3	±0.5	16.4	±0.8	16.7	±0.7	18.9	±1.0
0.1	-0.01±0.01	40.9	±3.6	44.3	±4.3	24.0	±3.6	9.7	±1.1	35.7	±3.1	32.1	±3.1	28.6	±4.3	32.3	±3.8
0.13	0.02±0.01	41.4	±3.3	44.4	±3.2	24.5	±3.4	9.7	±0.8	36.1	±2.9	32.2	±2.3	29.2	±4.1	32.0	±2.6
0.17	-0.05±0.04	50.6	±0.3	53.7	±1.1	29.7	±0.5	11.4	±0.3	44.1	±0.3	38.9	±0.8	35.4	±0.6	37.9	±0.9
0.25	0.06±0.02	75.0	±8.7	84.3	±11.3	41.4	±8.9	17.3	±2.0	65.3	±7.6	61.0	±8.2	49.4	±10.6	57.2	±6.6
0.33	-0.02±0.02	73.4	±2.8	80.5	±4.9	35.7	±6.2	16.9	±1.0	63.9	±2.5	58.3	±3.6	42.6	±7.4	56.1	±3.3

B-45		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.03	0.06±0.01	15.7	±2.7	16.2	±3.2	11.3	±2.0	1.9	±0.4	13.8	±2.4	11.9	±2.4	11.8	±2.1	12.9	±2.6
0.07	0.04±0.02	26.1	±0.3	27.1	±0.2	17.5	±0.5	3.2	±0.0	23.0	±0.3	19.9	±0.1	18.3	±0.5	22.1	±0.2
0.1	-0.01±0.01	34.5	±0.3	36.5	±0.3	20.8	±0.0	4.1	±0.0	30.4	±0.3	26.9	±0.2	21.6	±0	28.2	±0.2
0.13	0.02±0.01	43.3	±0.8	48.3	±1.4	29.8	±1.0	5.2	±0.2	38.2	±0.7	35.6	±1.1	31.0	±1.1	35.7	±1.2
0.17	-0.04±0.01	43.6	±2.6	47.2	±3.0	27.1	±4.0	5.4	±0.3	38.5	±2.3	34.7	±2.2	28.2	±4.2	37.0	±1.8
0.25	0.08±0.01	63.7	±1.3	68.4	±2.3	39.5	±2.4	7.4	±0.2	56.2	±1.1	50.3	±1.7	41.1	±2.5	50.8	±1.6
0.33	0.01±0.01	65.9	±4.8	69.7	±5.9	38.5	±0.6	7.6	±0.4	58.1	±4.3	51.3	±4.4	40.1	±0.6	51.8	±3

B-50		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
0.03	0.10±0.01	16.8	±1.1	17.0	±1.2	13.0	±0.4	--	--	14.7	±0.9	12.5	±0.8	12.4	±0.4	--	--
0.07	0.07±0.01	27.1	±4.6	27.7	±6.0	18.3	±4.7	--	--	23.7	±4.0	20.4	±4.4	17.4	±4.5	--	--
0.1	0.00±0.01	40.2	±4.7	42.1	±6.4	27.3	±3.8	--	--	35.2	±4.1	30.9	±4.7	25.9	±3.6	--	--
0.13	0.02±0.01	38.0	±5.1	39.7	±7.6	25.7	±6.6	--	--	33.3	±4.5	29.2	±5.6	24.4	±6.3	--	--
0.17	-0.02±0.01	41.4	±5.9	43.8	±6.8	25.8	±6.0	--	--	36.3	±5.1	32.2	±5.0	24.5	±5.7	--	--
0.25	0.10±0.01	61.8	±0.0	66.7	±0.3	40.8	±0.9	--	--	54.1	±0.0	49.1	±0.2	38.7	±0.8	--	--
0.33	0.00±0.01	64.5	±0.7	68.3	±0.1	36.5	±1.9	--	--	56.5	±0.6	50.2	±0.0	34.6	±1.8	--	--

Table S4. Average concentration (ppm), averaged normalized loss (g/m^2), and pH as a function of time (h) for all glasses in pH 4 solutions. The reported errors are calculated 1σ standard deviation for duplicate samples.

B-0		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	4.03±0.05	0.18	±0.03	0.06	±0.06	--	--	0.02	±0.02	0.46	±0.07	0.13	±0.13	--	--	0.05	±0.03
3	4.23±0.05	0.24	±0.03	0.07	±0.05	--	--	0.05	±0.03	0.59	±0.07	0.14	±0.10	--	--	0.09	±0.05
6	4.15±0.01	0.15	±0.03	0.05	±0.01	--	--	0.05	±0.02	0.38	±0.07	0.10	±0.01	--	--	0.11	±0.04
12	4.39±0.08	0.16	±0.09	0.17	±0.10	--	--	0.15	±0.07	0.39	±0.21	0.34	±0.20	--	--	0.30	±0.15
24	4.19±0.05	0.18	±0.00	0.21	±0.01	--	--	0.21	±0.01	0.46	±0.01	0.44	±0.02	--	--	0.43	±0.01
72	4.56±0.07	0.29	±0.00	0.31	±0.00	--	--	0.31	±0.00	0.72	±0.00	0.62	±0.00	--	--	0.65	±0.01
120	4.83±0.09	0.87	±0.01	0.77	±0.01	--	--	0.65	±0.01	2.16	±0.01	1.58	±0.01	--	--	1.36	±0.01
168	4.75±0.05	0.70	±0.00	0.69	±0.01	--	--	0.62	±0.00	1.74	±0.00	1.40	±0.02	--	--	1.29	±0.00
B-5		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	4.04±0.19	0.16	±0.12	0.08	±0.00	0.00	±0.00	0.04	±0.03	0.41	±0.29	0.17	±0.00	0.00	±0.00	0.10	±0.07
3	4.19±0.01	0.19	±0.00	0.06	±0.04	0.00	±0.00	0.04	±0.02	0.47	±0.00	0.12	±0.08	0.00	±0.00	0.08	±0.04
6	4.16±0.06	0.17	±0.05	0.16	±0.00	0.02	±0.00	0.11	±0.02	0.42	±0.13	0.33	±0.01	0.63	±0.11	0.25	±0.05
12	4.6±0.33	0.18	±0.22	0.23	±0.27	0.02	±0.02	0.14	±0.14	0.45	±0.54	0.48	±0.56	0.41	±0.59	0.32	±0.32
24	4.40±0.20	0.39	±0.01	0.40	±0.01	0.04	±0.00	0.29	±0.00	0.97	±0.02	0.83	±0.02	0.98	±0.01	0.66	±0.00
72	4.75±0.17	0.39	±0.01	0.41	±0.01	0.04	±0.00	0.34	±0.01	0.96	±0.03	0.85	±0.02	0.97	±0.01	0.79	±0.01
120	4.88±0.16	0.68	±0.00	0.62	±0.01	0.08	±0.00	0.59	±0.01	1.68	±0.01	1.30	±0.01	2.19	±0.08	1.37	±0.02
168	4.85±0.02	2.08	±0.01	2.36	±0.02	1.26	±0.02	0.75	±0.01	5.15	±0.01	4.94	±0.05	32.85	±0.40	1.73	±0.03
B-10		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	4.07±0.01	0.26	±0.01	0.09	±0.02	0.05	±0.00	0.03	±0.00	0.66	±0.02	0.19	±0.05	0.68	±0.00	0.07	±0.00
3	4.25±0.02	0.20	±0.07	0.06	±0.04	0.03	±0.01	0.04	±0.01	0.51	±0.18	0.12	±0.07	0.50	±0.09	0.11	±0.03
6	4.14±0.03	0.14	±0.02	0.17	±0.02	0.04	±0.00	0.12	±0.01	0.36	±0.06	0.34	±0.05	0.64	±0.04	0.32	±0.01
12	4.35±0.04	0.13	±0.06	0.11	±0.06	0.03	±0.01	0.11	±0.04	0.33	±0.15	0.24	±0.13	0.48	±0.12	0.28	±0.1
24	4.16±0.05	0.17	±0.00	0.18	±0.00	0.05	±0.00	0.15	±0.00	0.44	±0.01	0.37	±0.00	0.68	±0.02	0.40	±0.01
72	4.61±0.13	0.60	±0.01	0.60	±0.00	0.11	±0.00	0.52	±0.00	1.53	±0.02	1.24	±0.01	1.66	±0.01	1.34	±0.01
120	4.85±0.07	0.73	±0.00	0.68	±0.00	0.13	±0.00	0.57	±0.00	1.86	±0.00	1.40	±0.01	1.86	±0.03	1.47	±0.00
168	4.76±0.09	0.71	±0.01	0.68	±0.01	0.12	±0.00	0.59	±0.00	1.81	±0.03	1.39	±0.01	1.82	±0.00	1.52	±0.01

B-15		Concentration, ppm								Normalized Loss, g/m²							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	4.06±0.01	0.10	±0.02	0.01	±0.01	0.00	±0.00	0.00	±0.00	0.25	±0.04	0.01	±0.01	0.00	±0.00	0.01	±0.01
3	4.24±0.04	0.15	±0.06	0.05	±0.01	0.03	±0.00	0.03	±0.02	0.39	±0.15	0.10	±0.03	0.27	±0.04	0.10	±0.05
6	4.19±0.02	0.16	±0.01	0.15	±0.01	0.06	±0.00	0.10	±0.00	0.40	±0.02	0.30	±0.02	0.60	±0.02	0.29	±0.01
12	4.38±0.09	0.19	±0.15	0.15	±0.11	0.05	±0.02	0.12	±0.09	0.50	±0.38	0.31	±0.23	0.49	±0.22	0.35	±0.26
24	4.34±0.20	0.18	±0.00	0.19	±0.00	0.07	±0.00	0.15	±0.00	0.47	±0.00	0.39	±0.00	0.63	±0.01	0.44	±0.01
72	4.91±0.17	0.34	±0.00	0.33	±0.00	0.10	±0.00	0.26	±0.00	0.89	±0.01	0.67	±0.01	1.00	±0.01	0.76	±0.01
120	4.93±0.12	0.82	±0.00	0.74	±0.01	0.16	±0.00	0.52	±0.00	2.11	±0.01	1.50	±0.03	1.52	±0.02	1.55	±0.00
168	4.84±0.03	0.67	±0.00	0.65	±0.01	0.15	±0.00	0.49	±0.01	1.73	±0.01	1.33	±0.02	1.47	±0.02	1.46	±0.04

B-20		Concentration, ppm								Normalized Loss, g/m²							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	3.99±0.03	0.10	±0.06	0.03	±0.02	0.02	±0.00	0.03	±0.02	0.25	±0.14	0.06	±0.05	0.17	±0.01	0.09	±0.06
3	4.10±0.12	0.63	±0.75	0.45	±0.55	0.05	±0.01	0.08	±0.05	1.61	±1.92	0.95	±1.14	0.36	±0.09	0.27	±0.16
6	4.17±0.06	0.22	±0.01	0.09	±0.03	0.06	±0.00	0.07	±0.02	0.55	±0.04	0.20	±0.06	0.40	±0.02	0.26	±0.06
12	4.21±0.03	0.25	±0.03	0.16	±0.02	0.08	±0.00	0.12	±0.01	0.64	±0.08	0.33	±0.04	0.59	±0.01	0.42	±0.04
24	4.35±0.09	0.65	±0.01	0.36	±0.00	0.14	±0.00	0.25	±0.00	1.65	±0.01	0.75	±0.00	1.00	±0.01	0.86	±0.00
48	5.06±0.11	0.47	±0.00	0.39	±0.00	0.16	±0.00	0.28	±0.00	1.21	±0.01	0.80	±0.00	1.15	±0.02	1.00	±0.00
72	4.94±0.09	1.04	±0.00	0.59	±0.01	0.21	±0.00	0.46	±0.00	2.65	±0.01	1.22	±0.02	1.48	±0.01	1.60	±0.02

B-25		Concentration, ppm								Normalized Loss, g/m²							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	4.05±0.06	0.08	±0.03	0.04	±0.01	0.14	±0.02	0.00	±0.00	0.21	±0.07	0.09	±0.02	0.77	±0.14	0.00	±0.00
3	4.05±0.05	0.13	±0.02	0.09	±0.01	0.16	±0.03	0.00	±0.00	0.34	±0.04	0.20	±0.01	0.91	±0.15	0.00	±0.00
6	4.24±0.16	0.16	±0.02	0.09	±0.01	0.20	±0.00	0.00	±0.00	0.40	±0.05	0.18	±0.01	1.15	±0.02	0.00	±0.00
12	4.29±0.04	0.44	±0.21	0.32	±0.19	0.31	±0.07	0.00	±0.00	1.12	±0.54	0.67	±0.40	1.75	±0.42	0.00	±0.00
24	4.54±0.16	0.36	±0.08	0.29	±0.00	0.31	±0.03	0.00	±0.00	0.93	±0.20	0.62	±0.01	1.72	±0.14	0.00	±0.00
48	5.03±0.22	0.45	±0.02	0.49	±0.00	0.33	±0.11	0.00	±0.00	1.14	±0.04	1.03	±0.01	1.86	±0.61	0.00	±0.00
72	4.82±0.03	0.44	±0.05	0.36	±0.02	0.33	±0.01	0.00	±0.00	1.13	±0.14	0.76	±0.04	1.86	±0.08	0.00	±0.00

B-30		Concentration, ppm								Normalized Loss, g/m²							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	4.01±0.03	0.10	±0.00	0.03	±0.01	0.07	±0.00	0.01	±0.00	0.27	±0.00	0.06	±0.02	0.33	±0.00	0.06	±0.02
3	4.01±0.02	0.26	±0.03	0.12	±0.05	0.12	±0.01	0.05	±0.01	0.68	±0.09	0.25	±0.11	0.57	±0.03	0.24	±0.05
6	4.42±0.10	0.32	±0.03	0.14	±0.02	0.15	±0.01	0.07	±0.02	0.83	±0.07	0.29	±0.05	0.72	±0.03	0.36	±0.08
12	4.42±0.10	0.57	±0.07	0.23	±0.02	0.22	±0.00	0.12	±0.00	1.47	±0.18	0.50	±0.05	1.04	±0.01	0.59	±0.01
24	4.48±0.13	0.78	±0.01	0.29	±0.01	0.28	±0.00	0.16	±0.00	2.03	±0.02	0.62	±0.01	1.36	±0.01	0.85	±0.01
48	5.06±0.13	0.78	±0.02	0.25	±0.03	1.25	±0.03	0.00	±0.00	1.36	±0.05	0.58	±0.07	1.86	±0.13	0.00	±0.00
72	4.89±0.09	0.89	±0.03	0.20	±0.01	1.34	±0.02	0.00	±0.00	1.66	±0.08	0.47	±0.01	2.27	±0.12	0.00	±0.00

B-35		Concentration, ppm								Normalized Loss, g/m^2							
Time (h)	pH	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error	Na	Na-error	Al	Al-error	B	B-error	Si	Si-error
1	4.22±0.07	0.22	±0.02	0.00	±0.00	0.00	±0.00	0.00	±0.00	0.57	±0.04	0.00	±0.00	0.01	±0.01	0.00	±0.00
3	4.22±0.05	0.39	±0.00	0.00	±0.00	0.06	±0.04	0.00	±0.00	1.03	±0.01	0.00	±0.00	0.26	±0.18	0.00	±0.00
6	4.87±0.11	0.57	±0.06	0.00	±0.00	0.25	±0.02	0.00	±0.00	1.50	±0.16	0.00	±0.00	1.03	±0.1	0.00	±0.00
12	5.40±0.10	0.89	±0.04	0.00	±0.00	0.54	±0.1	0.00	±0.00	2.32	±0.1	0.00	±0.00	2.21	±0.43	0.00	±0.00
24	6.10±0.08	1.30	±0.05	0.08	±0.01	0.94	±0.05	0.00	±0.00	3.39	±0.13	0.17	±0.01	3.84	±0.22	0.00	±0.00
48	6.83±0.05	1.97	±0.03	0.44	±0.02	1.36	±0.16	0.00	±0.00	5.15	±0.07	0.95	±0.04	5.53	±0.67	0.00	±0.00
72	7.06±0.02	2.45	±0.12	0.39	±0.18	1.85	±0.07	0.00	±0.00	6.40	±0.32	0.83	±0.39	7.55	±0.27	0.00	±0.00
B-40		**Concentration, ppm**								**Normalized Loss, g/m^2**							
Time (h)	**pH**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
0.25	4.23±0.09	0.39	±0.04	0.00	±0.00	0.09	±0.01	0.00	±0.00	1.03	±0.10	0.00	±0.00	0.32	±0.02	0.00	±0.00
0.5	4.80±0.25	0.56	±0.05	0.00	±0.00	0.27	±0.04	0.00	±0.00	1.46	±0.12	0.00	±0.00	0.97	±0.15	0.00	±0.00
1	5.31±0.06	0.87	±0.03	0.00	±0.00	0.51	±0.04	0.00	±0.00	2.29	±0.07	0.00	±0.00	1.81	±0.13	0.00	±0.00
3	6.72±0.12	1.70	±0.03	0.24	±0.11	1.42	±0.01	0.00	±0.00	4.43	±0.09	0.53	±0.25	5.08	±0.05	0.00	±0.00
6	7.16±0.44	3.16	±1.92	0.73	±0.72	2.74	±1.85	0.00	±0.00	8.27	±5.01	1.59	±1.56	9.82	±6.63	0.00	±0.00
12	7.15±0.15	3.05	±0.27	0.43	±0.01	2.62	±0.06	0.00	±0.00	7.96	±0.70	0.94	±0.03	9.39	±0.22	0.00	±0.00
24	7.58±0.13	4.30	±0.27	0.96	±0.37	3.99	±0.36	0.00	±0.00	11.24	±0.70	2.08	±0.80	14.27	±1.28	0.00	±0.00
B-45		**Concentration, ppm**								**Normalized Loss, g/m^2**							
Time (h)	**pH**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
0.25	4.56±0.26	0.47	±0.08	0.00	±0.00	0.42	±0.06	0.00	±0.00	1.25	±0.20	0.00	±0.00	1.31	±0.19	0.00	±0.00
0.5	5.82±0.15	1.05	±0.07	0.00	±0.00	1.14	±0.08	0.00	±0.00	2.77	±0.19	0.00	±0.00	3.56	±0.25	0.00	±0.00
1	7.29±0.26	2.25	±0.90	0.21	±0.28	2.08	±0.81	0.00	±0.00	5.95	±2.37	0.46	±0.62	6.49	±2.54	0.00	±0.00
3	8.25±0.38	5.41	±1.95	1.09	±0.69	5.50	±1.75	0.00	±0.00	14.31	±5.15	2.41	±1.53	17.18	±5.47	0.00	±0.00
6	8.20±0.20	5.90	±1.56	0.78	±0.92	5.97	±1.44	0.00	±0.00	15.63	±4.13	1.73	±2.03	18.63	±4.49	0.00	±0.00
12	8.28±0.30	7.79	±1.06	1.32	±0.64	7.85	±0.90	0.00	±0.00	20.63	±2.81	2.91	±1.41	24.51	±2.80	0.00	±0.00
24	8.30±0.42	13.98	±2.95	2.39	±0.57	13.77	±2.39	0.00	±0.00	37.00	±7.81	5.27	±1.26	43.01	±7.45	0.00	±0.00
B-50		**Concentration, ppm**								**Normalized Loss, g/m^2**							
Time (h)	**pH**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
0.25	5.83±0.24	0.84	±0.13	0.00	±0.00	1.04	±0.20	--	--	2.22	±0.33	0.00	±0.00	2.96	±0.57	--	--
0.5	6.38±0.26	1.51	±0.21	0.05	±0.08	1.54	±0.32	--	--	3.97	±0.54	0.12	±0.17	4.40	±0.90	--	--
1	7.73±0.18	3.84	±0.14	0.54	±0.08	4.15	±0.33	--	--	10.08	±0.36	1.19	±0.17	11.81	±0.93	--	--
3	8.46±0.14	6.85	±0.62	0.34	±0.06	7.43	±0.67	--	--	17.99	±1.62	0.75	±0.14	21.16	±1.91	--	--
6	8.69±0.19	12.98	±2.72	1.90	±1.57	12.85	±1.07	--	--	34.09	±7.16	4.20	±3.47	36.59	±3.05	--	--
12	8.51±0.32	11.95	±1.63	1.56	±0.3	13.44	±1.48	--	--	31.39	±4.28	3.45	±0.65	38.26	±4.21	--	--
24	8.83±0.09	17.01	±1.38	2.80	±0.77	19.88	±0.48	--	--	44.68	±3.63	6.17	±1.69	56.61	±1.36	--	--

Table S5. Normalized loss rates of Na, Al, B, and Si for the studied glass in pH 0, 2, and 4 solutions. These rates were determined by linearly fitting normalized loss vs. time plots.

		Normalized Loss Rates (g-glass/[m^2h])							
pH 0	**B/Si Ratio**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
B-0	0	125	±2	114	±3	--	--	109	±3
B-5	0.22	136	±2	134	±2	123	±8	125	±2
B-10	0.5	143	±4	141	±7	116	±11	132	±7
B-15	0.86	154	±4	145	±3	181	±10	139.5	±4
B-20	1.33	159	±11	157	±11	185	±16	158.6	±9
B-25	2	199	±21	184	±22	231	±30	180.5	±25
B-30	3	234	±11	202	±11	207	±12	217.9	±13
B-35	4.67	255	±16	231	±15	229	±22	235.0	±16
B-40	8	353	±47	329	±47	249	±66	308.0	±58
B-45	18	242	±23	234	±23	183	±21	222.8	±26
B-50	∞	308	±63	276	±72	204	±55	--	--
pH 2	**B/Si Ratio**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
B-0	0	3.2	±0.3	2.9	±0.3	--	--	3.3	±0.3
B-5	0.22	4.2	±0.1	4.1	±0.1	2.8	±0.2	3.2	±1.7
B-10	0.5	6.5	±0.3	6.3	±0.2	4.4	±0.2	7.0	±0.2
B-15	0.86	5.8	±0.3	5.4	±0.07	3.93	±0.06	6.0	±0.1
B-20	1.33	7.1	±0.5	6.6	±0.5	4.9	±0.4	6.8	±0.6
B-25	2	8.9	±1.8	8.1	±1.7	6.2	±1.3	8.0	±1.5
B-30	3	8.3	±0.2	7.7	±0.2	6.1	±0.2	8.45	±0.07
B-35	4.67	9.6	±0.2	8.9	±0.3	7.0	±0.2	8.8	±0.7
B-40	8	12.3	±2.2	11.2	±2.1	8.9	±1.8	9.9	±2.8
B-45	18	16.4	±0.9	13.7	±0.9	11.6	±0.7	*	*
B-50	∞	18.2	±0.1	14.1	±0.1	13.26	±0.07	--	--
pH 4	**B/Si Ratio**	**Na**	**Na-error**	**Al**	**Al-error**	**B**	**B-error**	**Si**	**Si-error**
B-0	0	*	*	0.015	±0.004	--	--	0.017	±0.002
B-5	0.22	0.024	±0.008	0.031	±0.005	0.037	±0.003	0.025	±0.003
B-10	0.5	0.015	±0.001	0.015	±0.001	0.016	±0.001	0.017	±0.000
B-15	0.86	0.008	±0.001	0.008	±0.001	0.011	±0.001	0.009	±0.001
B-20	1.33	*	*	*	*	0.034	±0.002	0.031	±0.003
B-25	2	0.08	±0.05	0.05	±0.04	0.09	±0.04	*	*
B-30	3	0.10	±0.02	0.036	±0.006	0.061	±0.001	0.046	±0.002
B-35	4.67	0.119	±0.006	0.027	±0.001	0.17	±0.01	*	*
B-40	8	1.2	±0.8	0.3	±0.4	1.6	±1.1	*	*
B-45	18	4.7	±2.0	1.0	±0.7	5.6	±2.1	*	*
B-50	∞	5.4	±1.2	0.7	±0.6	5.7	±0.5	--	--

*Dissolution rate was not able to be extracted due to non-linear behavior in the forward rate regime and/or concentrations near the ICP-OES detection limits

Supplementary section: chemical dissolution behavior in pH = 0 and 4 environments

Liquid analysis of effluent solutions

Tables S3-S4 present the pH, elemental concentrations, and normalized mass loss (NL) evolution of the glasses in this study as a function of time for pH = 0 and 4 solutions, respectively, while Figure S6 displays the plotted NL vs. time curves for all glass composition. The data points displayed represent an average elemental concentration from experiments performed in duplicate (where the liquid aliquot from each experiment was measured three times by ICP-OES/ICP-MS). Duration of experiments was varied in an attempt to capture the early release behavior depending on (i) the acidity of solution and (ii) the relative durability of each composition. The release of Na^+ cations and Al species in the acidic solutions which readily occurs due to ion-exchange or hydrolysis[1] has varying effects upon solution pH: Na^+ tends to increase the alkalinity of solution while alumina species (which exist as Al^{3+} or $Al(OH)_3$ in acidic environments) exhibit amphoteric behavior, depending on the acidity of solution and relative concentrations of Al species.[2, 3] Meanwhile, the release of B—a species which is also released at elevated rates—has an opposite effect on the pH as its extraction is tantamount to additions of boric acid to solution. The spread of pH values with time according to solution environment and batched B_2O_3 content can be seen in Figure 2, while the pH values are listed in Tables S3-S4. We see in these results that the elemental release from the glass minimally impacts pH readings in the pH 0 solutions (which hover near 0-0.2 and do not show any systematic trends with time). In contrast, pH = 4 experiments show a steady rise in pH over time, with ultimate values trending between 4.7-8.8. Some glass compositions show a steadying of pH after longer times in certain solution environments. The spread of pH data shown in Figure S7 helps to additionally demonstrate the impact that glass composition has upon pH evolution, while also depicting the changes in solution buffering capacity from one aqueous environment to the next. Specific durations in Figure S7 have been highlighted in different colors (20 min, 12 h, and 1 d for pH 0, 2, and 4 solutions, respectively) to provide comparisons in pH evolution and buffering capacities between different glass compositions and solution environments. We see that the solution pH after 20 min and 12 h in pH 0 and 2 experiments, respectively, changes less than ±0.2 for all glass compositions, due to the high buffering capacity of these solutions. Meanwhile, pH 4 experiments show much more drastic changes when compared over the same sampling timeframe. In these experiments (at pH = 4), it is seen that, for compositions up to x = 30, pH shows rather insignificant changes of up to +0.5 after 12 h of dissolution, whereas beyond x = 30, pH increases substantially by 2-5 units in the first 12 h due to the confluence of (i) limited buffering capacity of the pH 4 solution, and (ii) more rapid dissolution rates of glasses with higher boron content at the expense of silica. In order to further explain pH evolution and gain further understanding of the mechanisms by which these glasses corrode, we will next discuss the kinetics of glass corrosion as determined from individual elemental release rates from the glass at early timeframes of release (forward-rate regime).

As can be seen in Table S3, each composition submerged in pH 0 media shows a general rise in normalized loss with time. Such highly acidic environments tend to promote tremendous ion exchange/hydrolysis of the glass network relative to solutions near neutral pH, with normalized loss values in pH 0 experiments reaching upwards of 150 g/m^2 within the first hour of experiments. This tendency for rapid attack of the network is especially prominent in glasses with significant Al_2O_3 content, as Al-O bonds tend to rapid hydrolysis in acids relative to neutral pH conditions.[4] Glasses between $x = 0 – 20$ mol.% show a linear trend with time throughout the duration of experiments, while samples with $x \geq 25$ mol.% start to show behavior marked by (i) an initial linear increase, followed by (ii) a concave downward behavior indicative of decreases in elemental release rates towards a slower residual rate. The reduction in apparent release rate in static experiments can result from several possible mechanisms or reasons, including formation of a protective gel/precipitate layer near the surface of the glass; significant reduction in glass surface area over the course of experiments; or solution feedback effects that manifest as elements approach saturation in the surrounding aqueous environment (we will explore this in more depth in the next two sections).[4, 5]

All the samples with $x \leq 35$ mol.% show close agreement in normalized loss values throughout the duration of experiments, indicating congruent release of Na, Al, B, and Si from the glass. This congruent-release behavior in acidic media is similar to what has been observed previously in the glass corresponding to the stoichiometric composition of the nepheline crystal ($NaAlSiO_4$), aluminosilicate endpoint (B-0), and is attributable to the low overall connectivity of the remaining silicate sub-network after relatively rapid extraction of Na and Al (and B) from the glass.[6] Slight deviations from congruent release in these glasses are seen in the highly B_2O_3-rich compositions ($x \geq 40$), which show up to 25-40 % lower NL values for B in comparison to Na, Al, and Si (where present in the glass) in 15 and 20 min experiments, while congruent release was evident within the first 10 minutes of experiments (within estimated experimental uncertainty). It has been seen in previous studies that glasses submerged in acidic media tend to release cations (i.e. Na^+, Al^{3+}) and B (as H_3BO_3) at a preferentially high rate until Si units either form a gel layer, or are freed from the network to be released congruently in the limit of low connectivity.[4, 7, 8] In our studies at pH 0, the NL data suggest that these glasses largely undergo congruent release—with the only slight exceptions being in latter time experiments in the significantly-less-studied B_2O_3-rich regime wherein the glass network is primarily borate-based. Congruent release in the majority of data presented for pH 0 can be explained by the fact that nepheline-based ($NaAlSiO_4$) glasses extensively contain Al-O-Si linkages, and which can readily release Si units once Al-O bonds are hydrolyzed.[6] As B_2O_3 replaces SiO_2 in the network, Al-O-B and Si-O-B linkages form alongside Al-O-Si, which tend to hydrolyze even quicker. Rapid proton attack of the non-silicate portion of the glassy network therefore causes swift release of all glassy components in these mixed-species networks (with low Si-O-Si connectivity), leading to congruent release patterns in the ensemble.

In order to further compare release kinetics at pH 0 for these glasses, we deduce forward dissolution rates on the basis of each element by performing linear regression on normalized loss vs. time plots in the early, linear portions of the release curves. The slope of the line provides an estimate of the forward dissolution rate; these fits should only be considered estimates due to the somewhat subjective nature of determining the linear portion of the NL curve, as well as observing non-zero intercepts at $t = 0$ (with fits not being constrained to pass through (0,0)). Experimental error in fitting a single dissolution rate to NL data has been highlighted extensively in the literature.[9, 10] Rates and uncertainties as a function of pH, and B_2O_3 content can be found in Table S5. In order to assess standard uncertainty in linear regression, the standard deviation of each NL data point was considered, and the relative impact of fitting a slope to uncertain data was summed to determine the overall fitted-slope uncertainty, similar to the method discussed in Kragten.[11]

For SiO_2-rich compositions ($x < 25$), regressions were performed over the first 30 min – 1 h of experiments, while in B_2O_3-rich compositions ($x \geq 25$) regressions were performed over the first 6 – 25 min. We see that glasses introduced into pH 0 environment show a very high release rate varying between ~100-350 g m^{-2} h^{-1}. There is a general rise in release rate throughout the composition series, as marked by a 2-3 times increase between $x = 0$ and $x = 40$-50 due to replacement of SiO_2 in the network by B_2O_3. Dissolution rates remain similar among $x > 30$ glasses in which B_2O_3 is the majority glass network former. The increase in dissolution rate with B/Si ratio from the nepheline endpoint is expected due to the replacement of Si-O-Al bonds with Si-O-B, B-O-Al, and B-O-B bonds, each of which are more easily hydrolyzed.[12] Slight differences in mean inter-elemental release rates at pH 0 are determined insignificant based upon the assessed fitting uncertainty. Surface analysis results from corroded specimens, summarized in later sections, will clarify whether congruent release is validated by compositional and structural changes taking place at the glass-solution interface.

Table S4 presents the normalized loss data against time for glasses submerged in pH 4 solution. Each glass tends to show a monotonic linear increase in the first 3-12 hours of dissolution followed by a reduction in rate at longer exposure times. We see that normalized loss values in pH 4 experiments are significantly lower than were seen in either pH 0 or 2 experiments, as is expected due to much lower proton concentrations in solution available to hydrolyze the glass network. We also see that the majority of compositions show less than 5 g/m^2 of release over the maximum timeframe of the experiments, with only the $x = 35$-50 compositions exceeding these release values (up to near 50 g/m^2 in B-50). Glasses with $x \leq 25$ tend to show congruent release for all elements in pH 4 surroundings. Interestingly, all B_2O_3-rich glasses ($x \geq 30$) tend to show more incongruent release at pH 4, as Na and B tend to show overlapping NL values, while Al values are much lower. It is important to note that most glasses with $x = 25$ and $x \geq 35$ displayed Si release below the ICP-OES detection limits, so we suspect that Si NL values are lower than Al in these compositions and do not follow Na and B release patterns. Incongruent behavior seen in B_2O_3-rich glasses is likely attributed to the significant change in pH from initial conditions, due to much lower solubility of Al and Si in environments between pH 6 and 8.5 as compared to Na and B. In contrast, the pH of solutions in experiments from glasses with $x \leq 30$ maintained an acidic pH of 4-4.5 over the same time period, which tends to promote congruent release from these glasses.

Forward dissolution rates for glasses submerged in pH 4 solutions were quantified within the first 3-72 hours of corrosion experiments, similar to the procedure applied to pH 0 solution data. The variation in time window used for fitting of forward release rates can be explained by a relatively large dependence of durability upon glass composition—i.e., the B_2O_3-rich glasses showed a much more rapid release for the linear portion of the kinetic curves describing the forward rate regime (3-6 hours) as compared to SiO_2-rich compositions (24-72 hours). Normalized loss rates, shown in Table S5, decreased by as much as 1-2 orders of magnitude compared to pH 2 experiments and varied over a wide range (between ~0.01 – 6 g m^{-2} h^{-1}). Such large differences in rate across the series is likely driven by the significant evolution of solution pH over the course of the experiments in samples which contain a majority B_2O_3 as a network former. In terms of congruency at pH 4, glasses with $x < 25$ showed similar rates of normalized release between all elements, while glasses with $x \geq 25$ showed a 40-90 % lower Al NL rate as compared to Na and B (all outside the expected uncertainties in dissolution experiments). This effect was amplified with increasing B_2O_3 content, where, again, Si rate was not able to be determined with ICP-OES. Significant incongruence of Al release has also been seen in water dissolution experiments of sodium aluminoborate glasses,[13] wherein it was observed that a rise in pH towards neutral-to-basic environments from an initially acidic pH significantly decreases Al solubility. As pH 4 environments tend to attack the glass network more slowly than pH 0 or 2 due to lower proton concentration, it follows that we similarly observe congruent release in low B_2O_3-content glasses, where solution pH stayed close to 4 over the course of the experiment. In glasses which did not maintain a stable pH near 4, congruency behavior varied greatly from what we saw in the same compositions in more strongly acidic media.

Bulk structural characterization of leached grains

Grains recovered from dissolution experiments were analyzed via XRD and MAS NMR to obtain insight into the evolution of bulk structural characteristics. XRD analysis determined all grains recovered (independent of pH or composition) to be amorphous due to their lack of sharp crystal peaks, ruling out the formation of highly ordered secondary phases during corrosion. In order to unearth the nature of bulk structural changes taking place, ^{27}Al and ^{11}B MAS NMR were performed on selected samples (as displayed in Figures S8 and S9). We chose to investigate grains from the maximum time duration in experiments with pH 0, 2, and 4 solutions, focusing on glass compositions B-0, B-25, and B-50—the goal being to interrogate extremes of potential structural changes taking place as glasses across the composition series corrode at varying acidic pH. Figure S8a-c displays the ^{27}Al spectra of pre- and post-corroded glasses. In Figure S8a-b, we see that B-0 and B-25 glasses show identical spectra before versus after corrosion, regardless of solution pH.

The position of the peak corresponds to Al in a tetrahedral environment, and consistency of the spectra indicate that the local environment around Al is not detectably altered with these glasses under these conditions. Figure S8c, on the other hand, shows that B-50 develops a noteworthy peak near 5 ppm in pH 2 and 4 environments after 12 h and 1 d of dissolution, respectively. We associate the emergence of this peak with the development of hydrated AlO_6 secondary phases near the glass-solution interface.[8, 13, 14] While an AlO_6 peak is not seen following pH 0 experiments, the this peak emerges at pH 2 and rises in intensity and sharpens between pH 2 and 4. The significant AlO_6 peak seen at pH 4 displays a significant amount of highly-ordered octahedral Al which was not discernable in XRD, which is indicative of a significant decrease in alumina solubility as pH rises towards neutral environments.[13] Although both SiO_2-poor and SiO_2-rich glasses both show significant elemental release at pH 2, we presumably only see AlO_6 formation in B-50 due to more significant borate network dissolution in this glass near the surface coupled with an apparent change in corrosion mechanism as composition approaches the aluminoborate endpoint; similar behavior has, however, been seen in SiO_2-rich glasses exposed to acid solutions, as seen in Tsomaia et al.[8] and Criscenti et al.,[14] however these changes would likely only show evidence upon longer acid immersion. It is interestingly also seen in pH 2 experiments of B_2O_3-rich glasses that despite Al releasing from the glass at similar rates to other elements, its relatively lower solubility triggers Al to again form solid species on the surface of the glass, which we will revisit in the next section. On the other hand, in pH 4 experiments, B-50 and other B_2O_3-rich glasses exhibit slower release of Al in comparison to Na and B due to an even lower solubility for Al in this environment, promoting rapid structural conversion near the glass surface. However, despite an initial pH of 4 in these experiments, the weak buffering capacity of this solution causes drastic increases in pH, as latter experiments of borate rich glasses better represent near neutral conditions (as depicted in Figure 3). Aluminoborate glasses under these conditions have been previously shown to exhibit similar behavior, where low levels of alumina are released into neutral environments and octahedral Al crystal phases form.[13]

In Figure S9a-b, we see the ^{11}B MAS NMR spectra of B-25 and B-50 glasses after corrosion in each environment. When comparing these spectra to the pre-corroded glasses (Figure 3.1a), although BO_3 peaks show different shapes which are a function of different experimental magnetic fields, calculated N_4 fractions for pre- and post-corroded samples are almost identical (± 0.5 %; within ± 1 % error limits typically associated with fitting MAS NMR spectra) signifying that no significant structural changes occur in the borate network as these glasses corrode. Although Al showed conversion from tetrahedral to octahedral coordination as alumina is taken up by the surface in pH 2 and 4 solutions for B_2O_3-rich glasses, borate species released into solution presumably stay in solution due to their extremely high solubility, regardless of glass composition or initial solution environment (pH 0 to 4). Thus, acidic environments attacking the borate glass network will hydrolyze bonds with no preferential affinity for hydrolysis of BO_3 or BO_4 units, despite differences in typical bond energies.[12]

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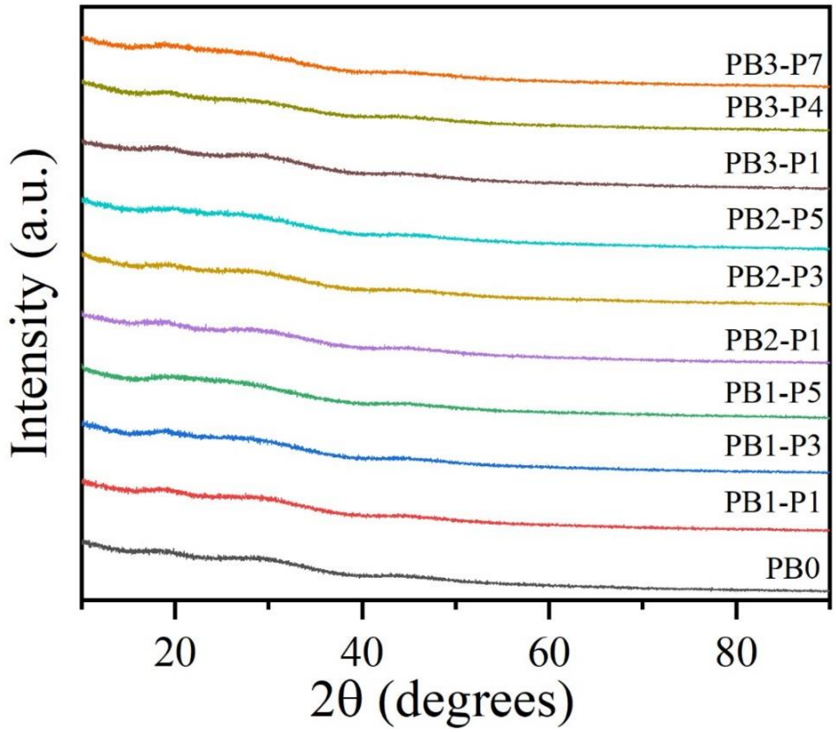
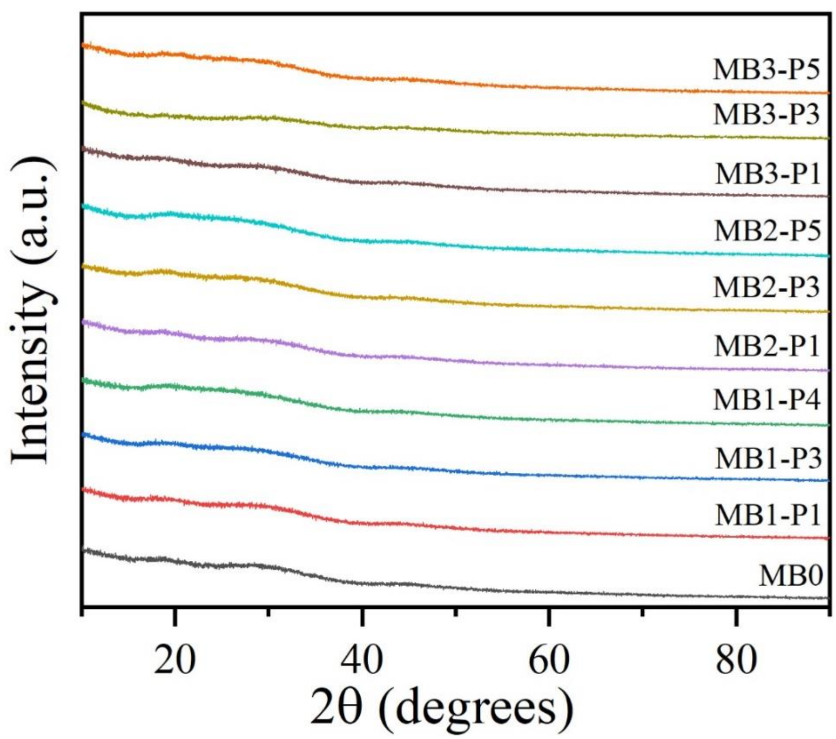
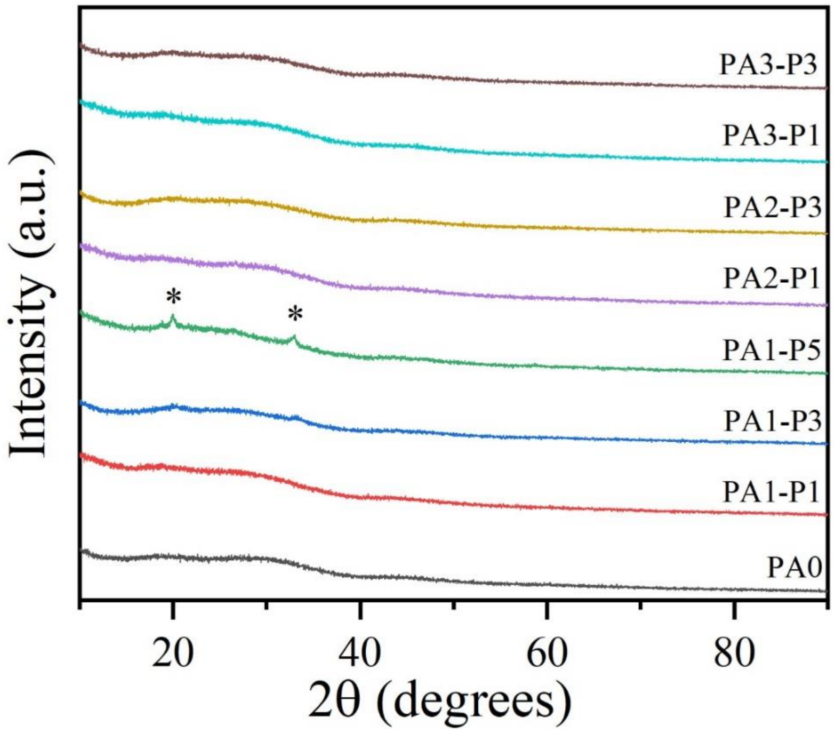
Chapter 4. Supplementary Infromation

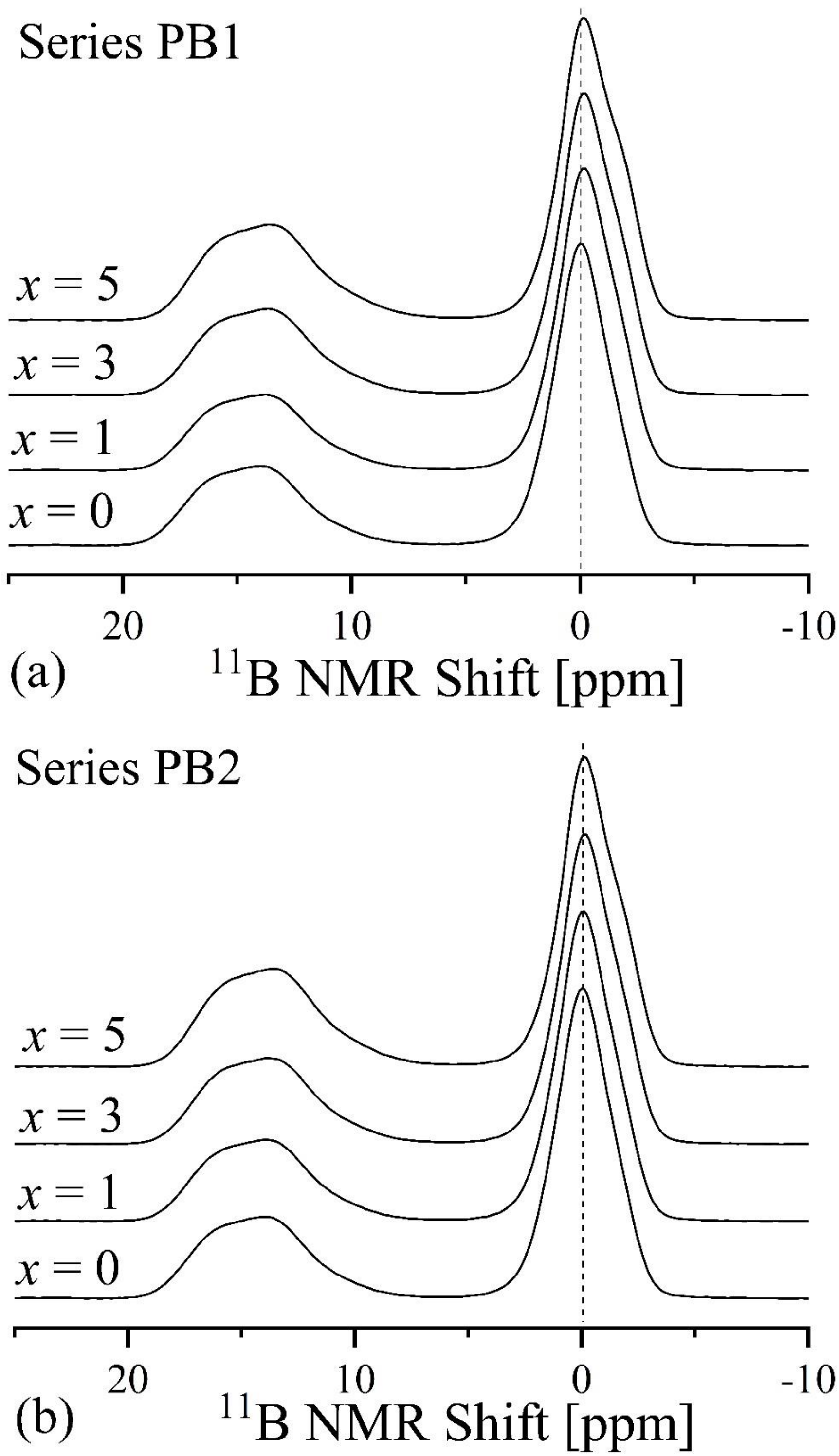






* XRD peaks associated with tetrasodium diphosphate crystals

Figure S1. X-ray diffraction spectra of PB, MB, and PA glass compositions, respectively. All samples shown, with the exception of PA1-P5, were used in this study due to their amorphous / visually non-phase-separated nature. PA1-P5 displays an example of a glass which developed crystalline phases upon quenching, as was seen in all x = 5 PA glasses.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x = 1
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0
-10
(a)
11B NMR Shift [ppm]
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x = 1
x = 0
20
10
0
-10
(b)
11B NMR Shift [ppm]

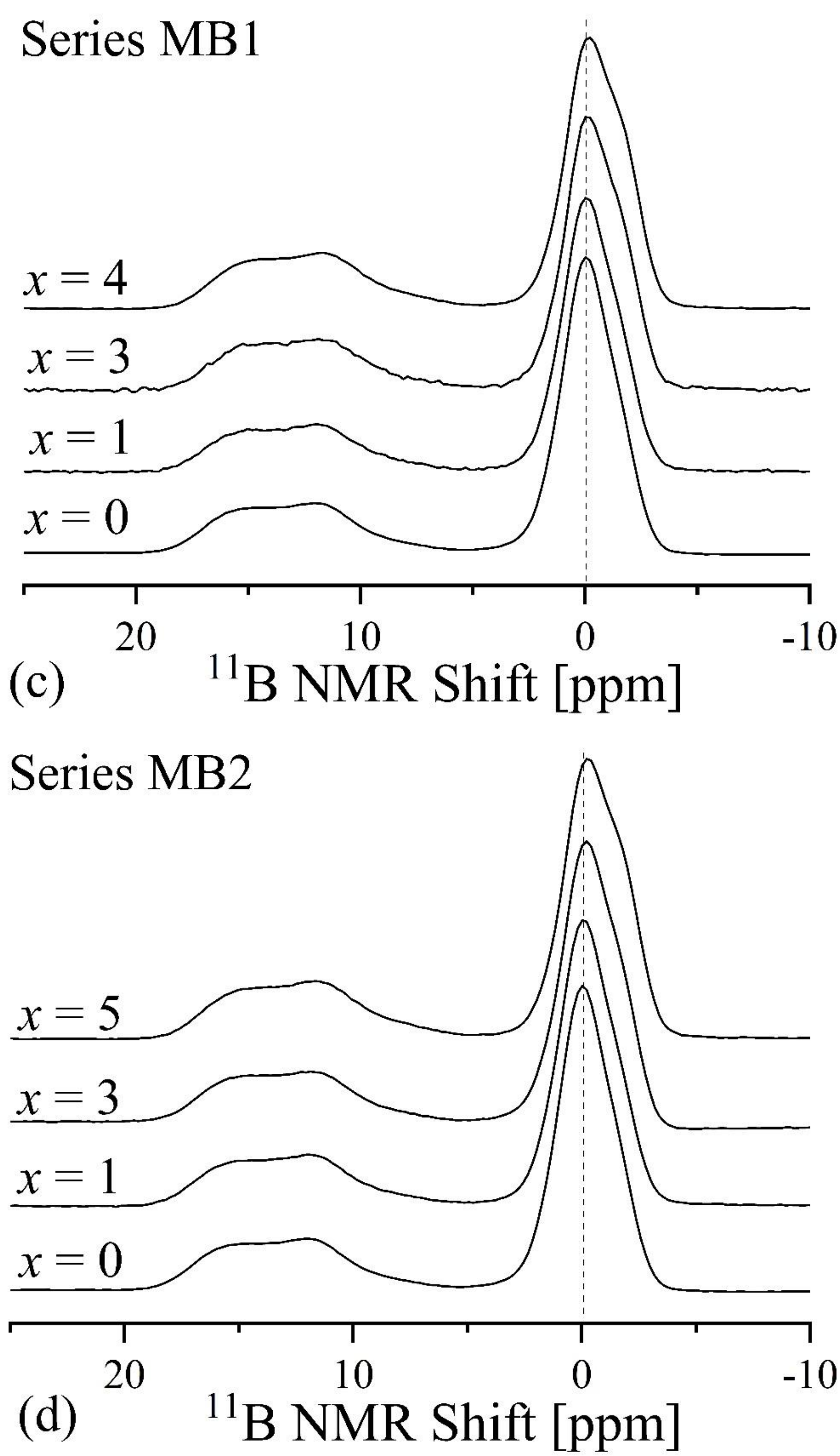
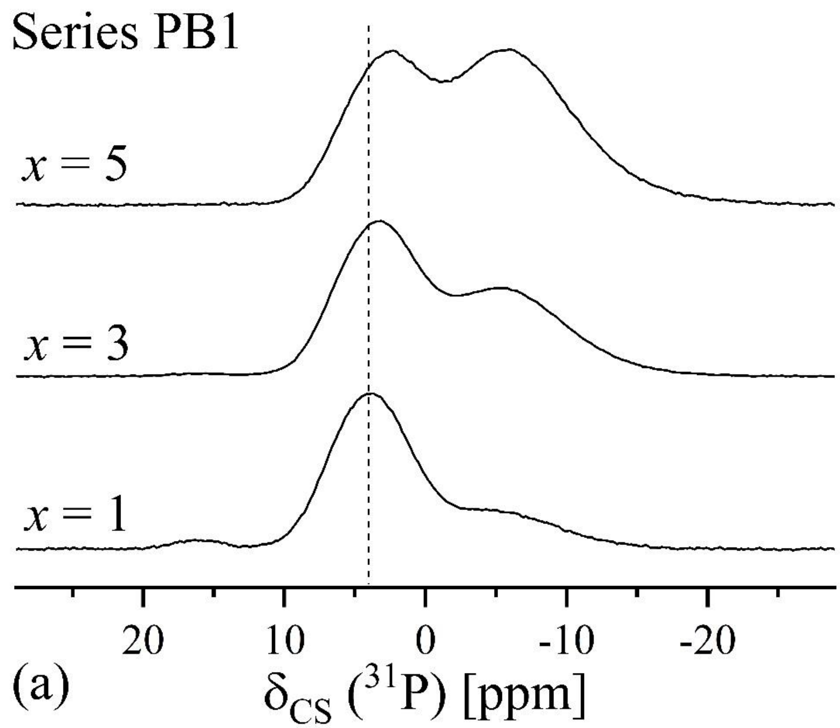


Figure S2. ^{11}B MAS NMR spectra of all Series “1” and “2” glasses in the perboric and metaboric regimes, in addition to Series “1” and “3” in the peralkaline regime.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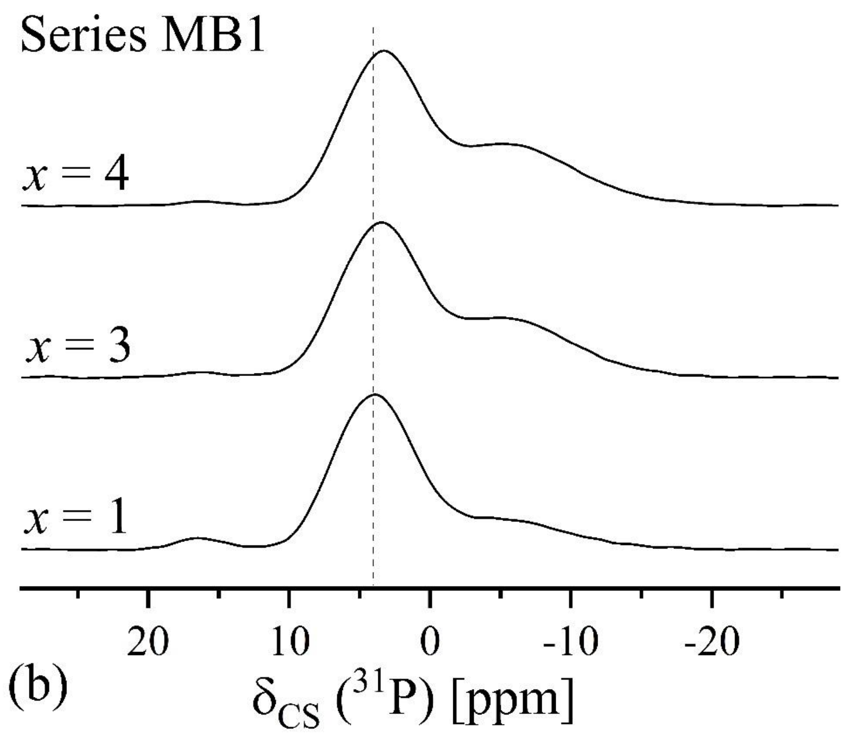
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(b)
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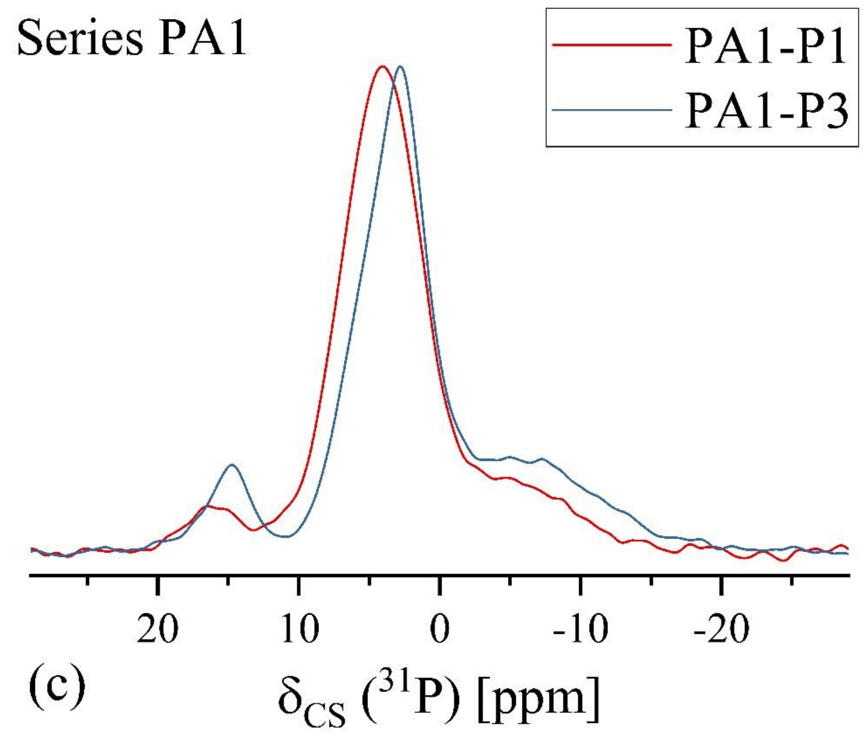
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PA1-P3
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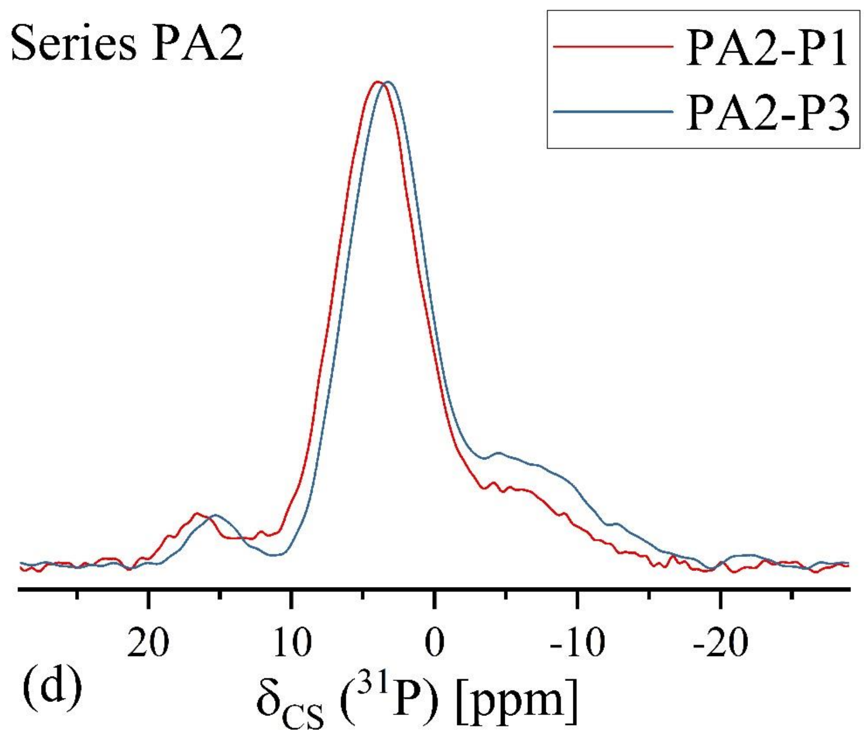
-10
-20
(c)
δ_{CS} (^{31}P) [ppm]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PA2-P3
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10
0
-10
-20
(d)
δ_{CS} (^{31}P) [ppm]

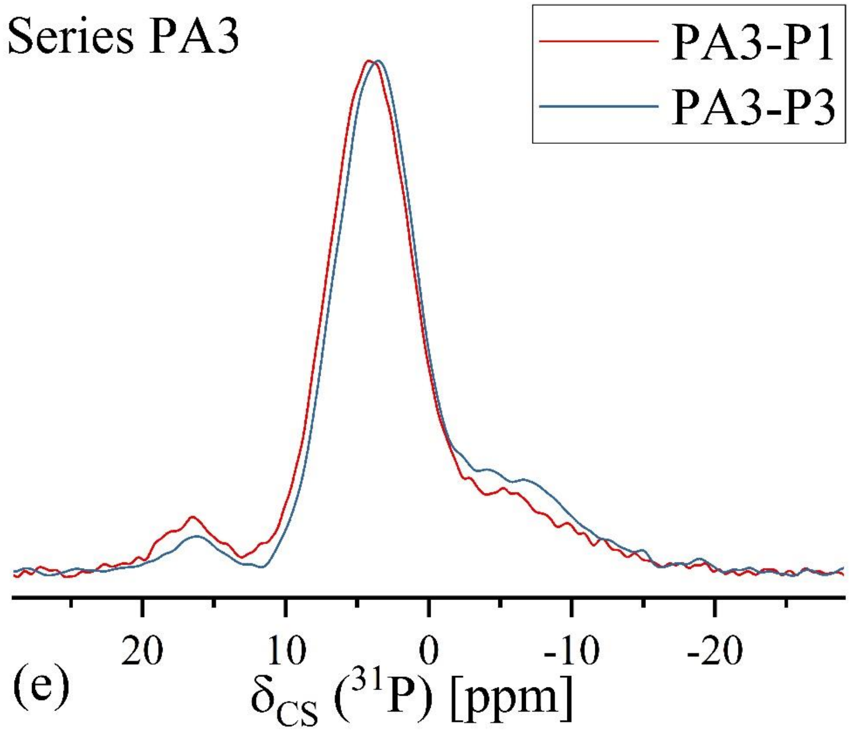


Figure S3. ^{31}P MAS NMR spectra of Series “1” PB and MB samples and all PA samples.

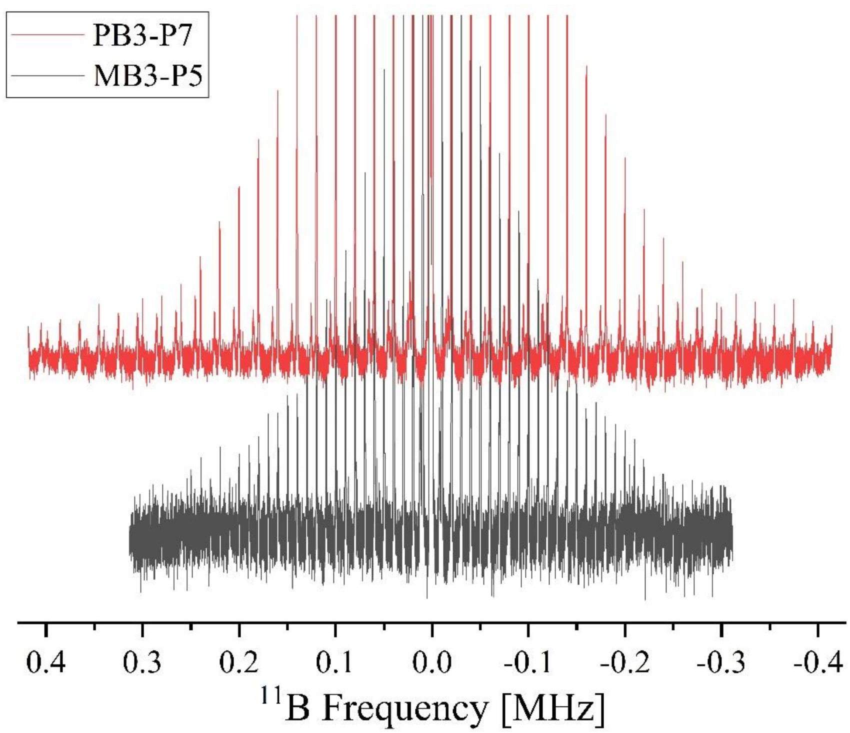
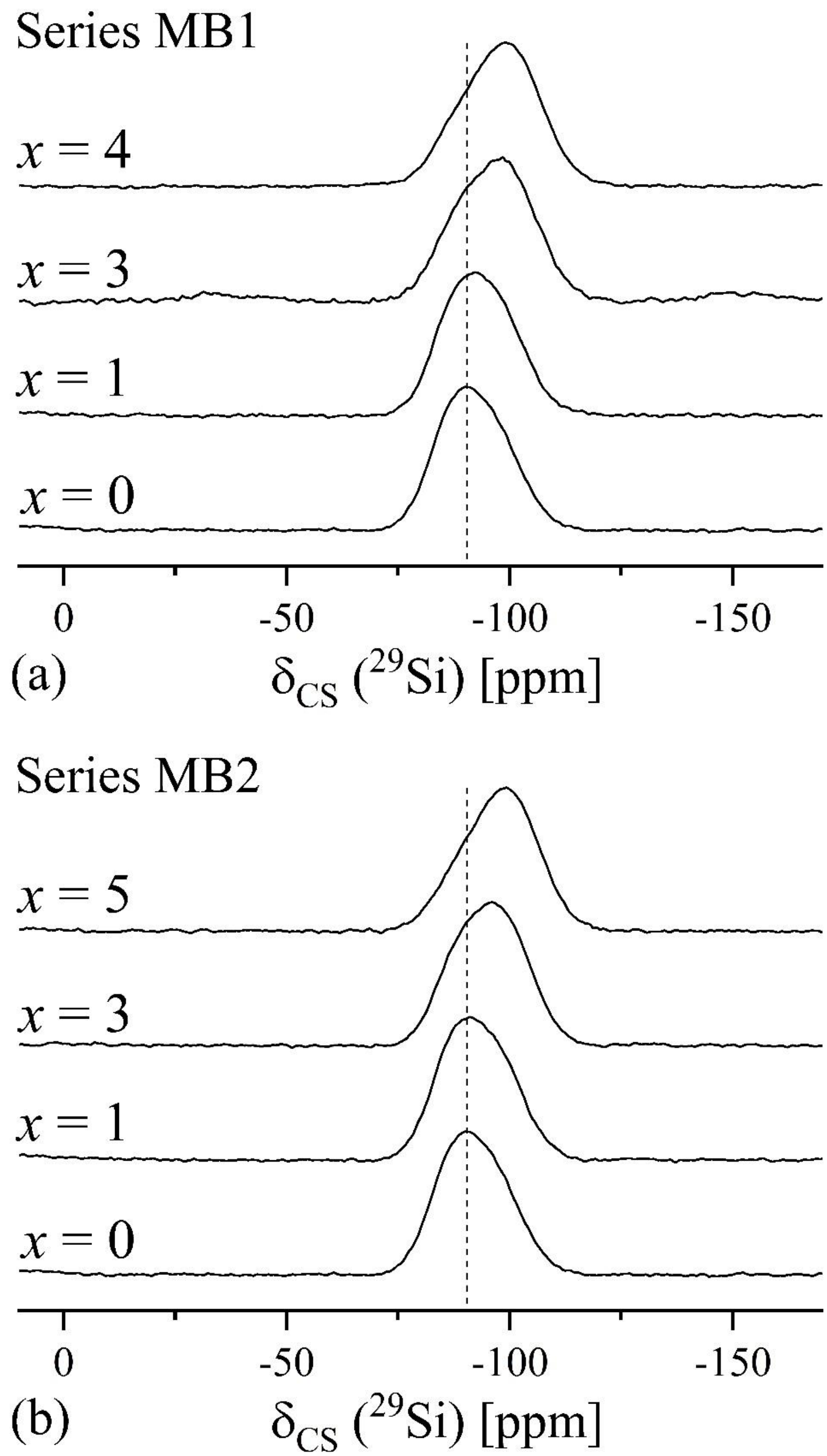


Figure S4. Overall spectral range of ^{11}B MAS NMR spectra of PB3-P7 and MB3-P5 samples, which was used to estimate ^{11}B quadrupolar coupling constants, based on the spinning sideband pattern of the satellite transition.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x = 1
x = 0
0
-50
-100
-150
(a)
δCS (29Si) [ppm]
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-100
-150
(b)
δCS (29Si) [ppm]

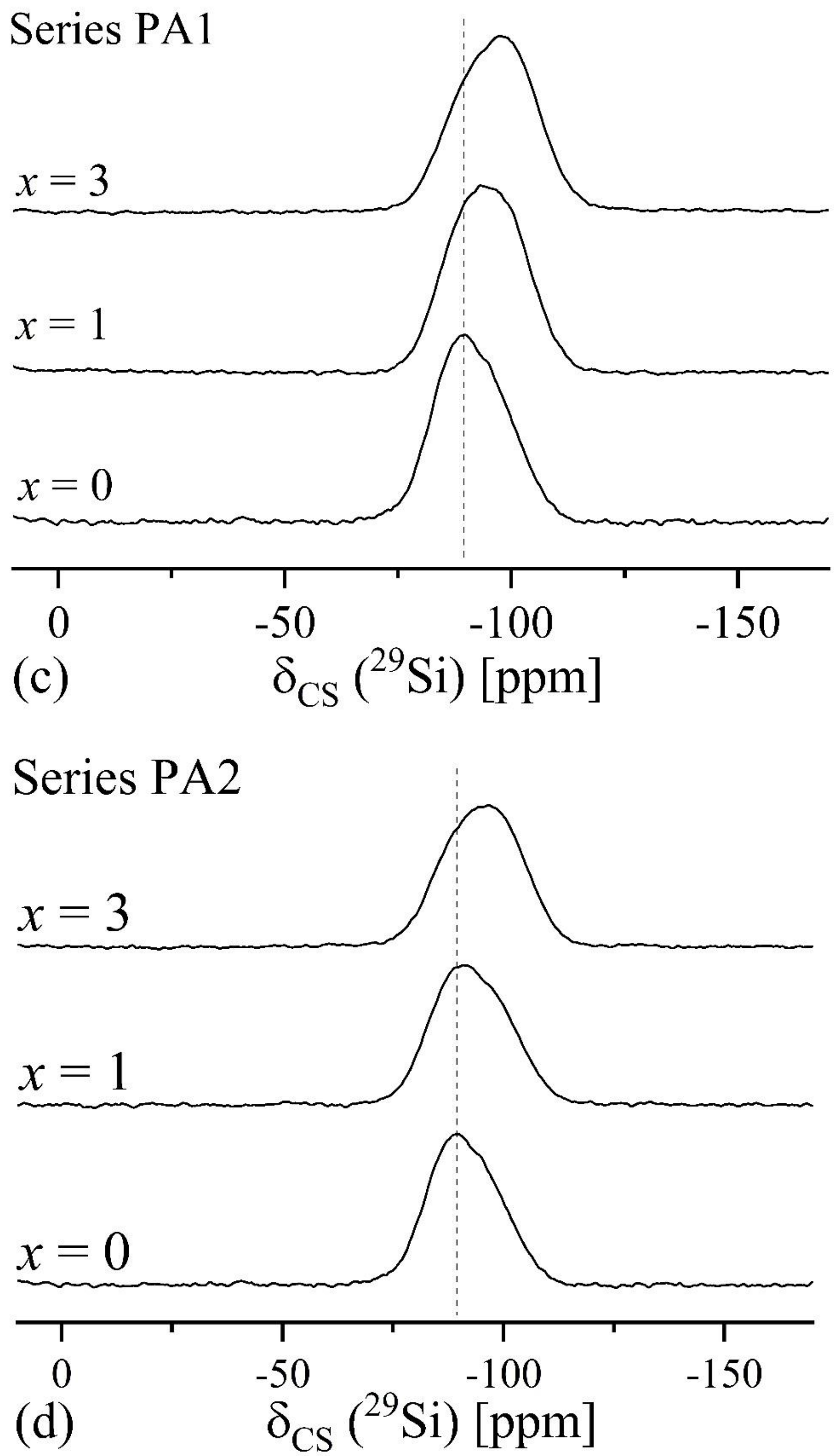

Figure S5. ^{29}Si MAS NMR spectra of Series "1" and "2" samples.

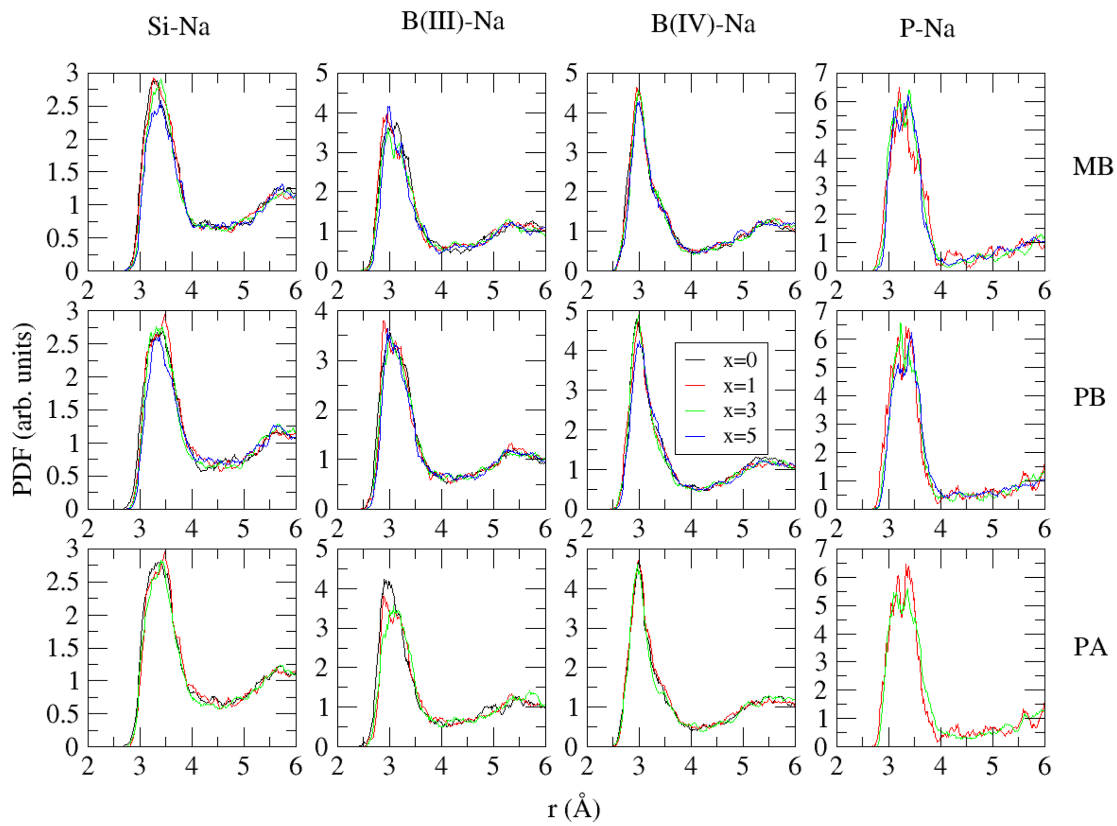

Figure S6. T-Na (T=Si, B(III), B(IV), P) pair distribution functions of the glasses investigated. *x* is the content of P_2O_5 in the glass.

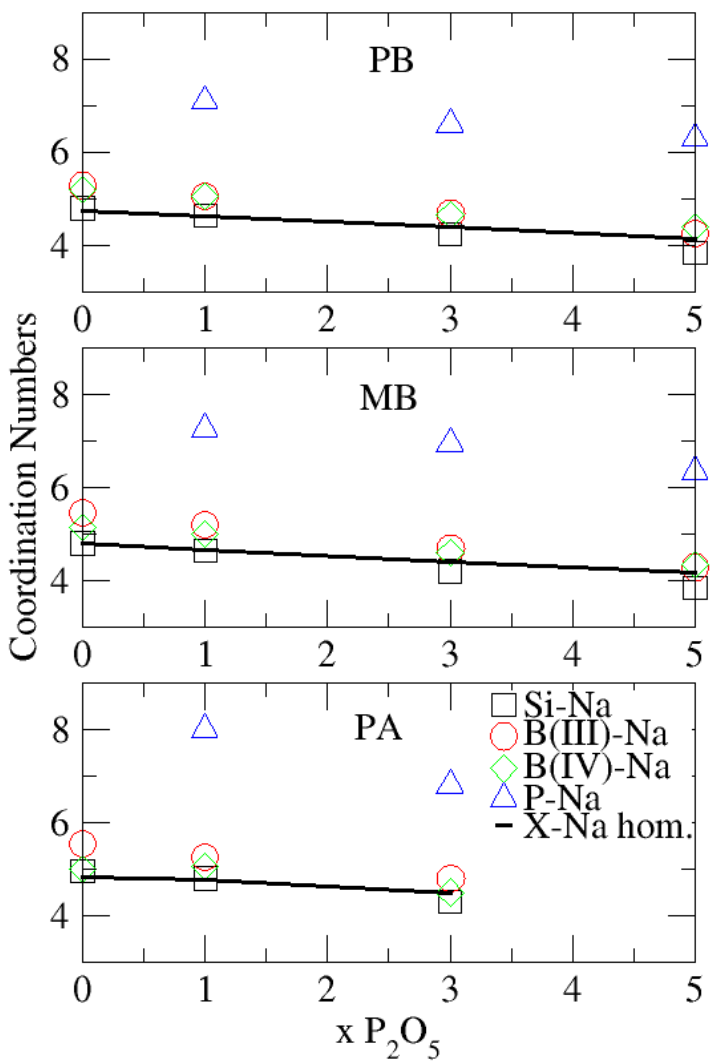

Figure S7. T-Na coordination numbers (computed using a cutoff = 4.5 Å) as a function of P_2O_5 content. The black line represents the coordination numbers for models in which sodium is homogeneously distributed.

Table S1. Number of atoms in the simulation cells of the investigated glasses.

Glass	B	Si	P	O	Na	# atoms
PB0	600	450	-	2050	500	3600
PB2-P1	590	440	20	2060	490	3600
PB2-P3	580	430	60	2120	480	3670
PB2-P5	570	420	100	2180	470	3740
MB0	500	500	-	2000	500	3500
MB2-P1	490	500	20	2030	490	3530
MB2-P3	480	490	60	2090	480	3600
MB2-P5	470	480	100	2150	470	3670
PA0	400	550	-	1950	500	3400
PA2-P1	390	540	20	1910	490	3350
PA2-P3	380	530	60	2020	480	3470
55 Na_2O – 45 P_2O_5	-	-	72	224	88	384
40 Na_2O – 18 B2O3 – 42 P_2O_5	27	-	63	228	60	378

Table S2. Shell model interatomic potential parameters used in this work.

	Buckingham			*Ref.*
Pairs	**A (eV)**	**ρ (Å)**	**C (eV Å^6)**	
O_s-O_s	22764.30	0.1490	27.88	[1]
Si-O_s	1283.91	0.32052	10.661580	[1]
Na-O_s	56465.345	0.193931	0.000000	[2]
B-O_s	511.0	0.3310	0.0	this work
P-O_s	1120.09	0.33477	0.0	[3]
	Three-body potential			
	k_b (eV rad^{-2})	**θ_0 (deg)**	**ρ (Å)**	***Ref.***
O-Si-O	100.0	109.47	1.0	[3]
O-P-O	50.0	109.47	1.0	[3]
	Core-shell potential			
	k_s (eV Å^{-2})	**Y(e)**	**m_{shell} (uma)**	
O_c-O_s	74.92	-2.8482	3.0	

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[3] A. Tilocca, A.N. Cormack, N.H. De Leeuw, The structure of bioactive silicate glasses: New insight from molecular dynamics simulations, Chem. Mater. 19 (2007) 95–103. doi:10.1021/cm061631g.

Chapter 5. Supplementary Information

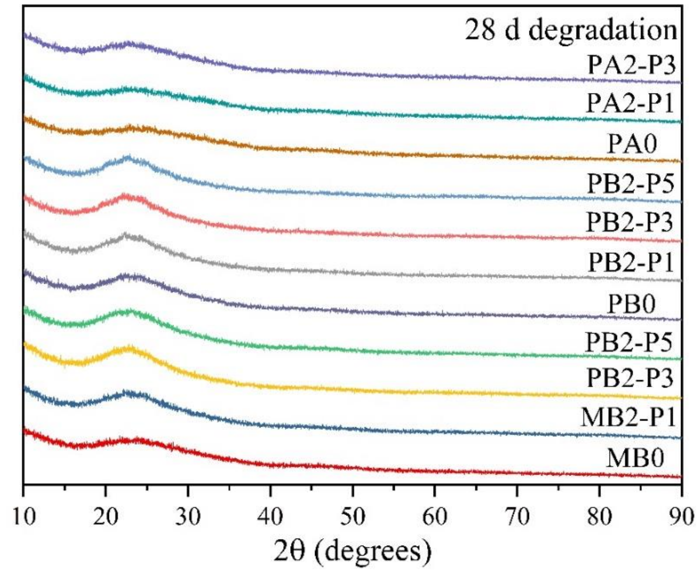

Figure S1. XRD patterns of glass powders recovered from 28 d degradation experiments.

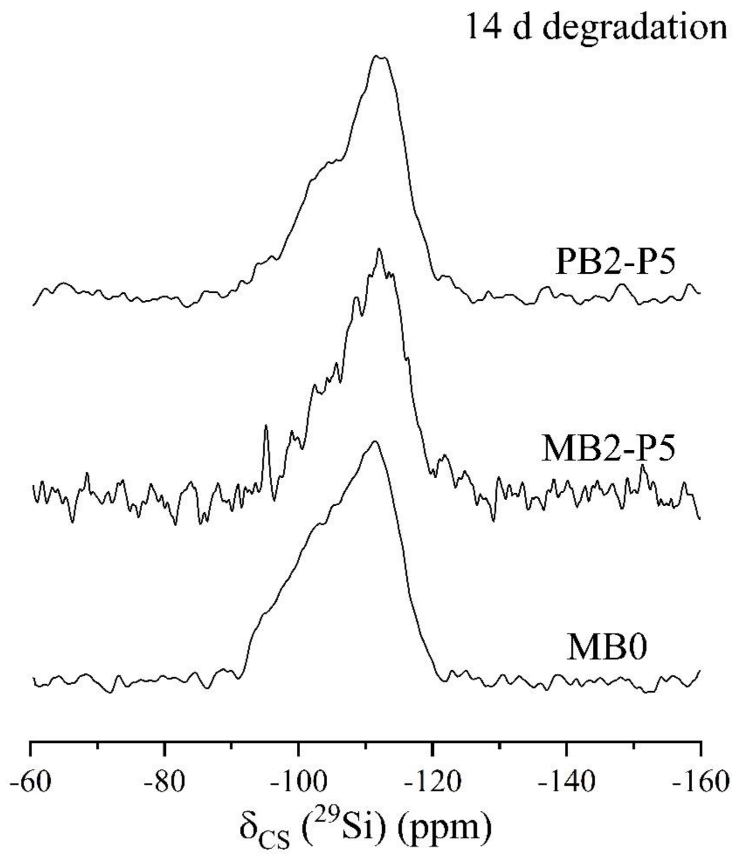

Figure S2. ^{29}Si MAS NMR patterns of glass powders recovered from 14 d degradation experiments.

Chapter 6. Supplementary Info

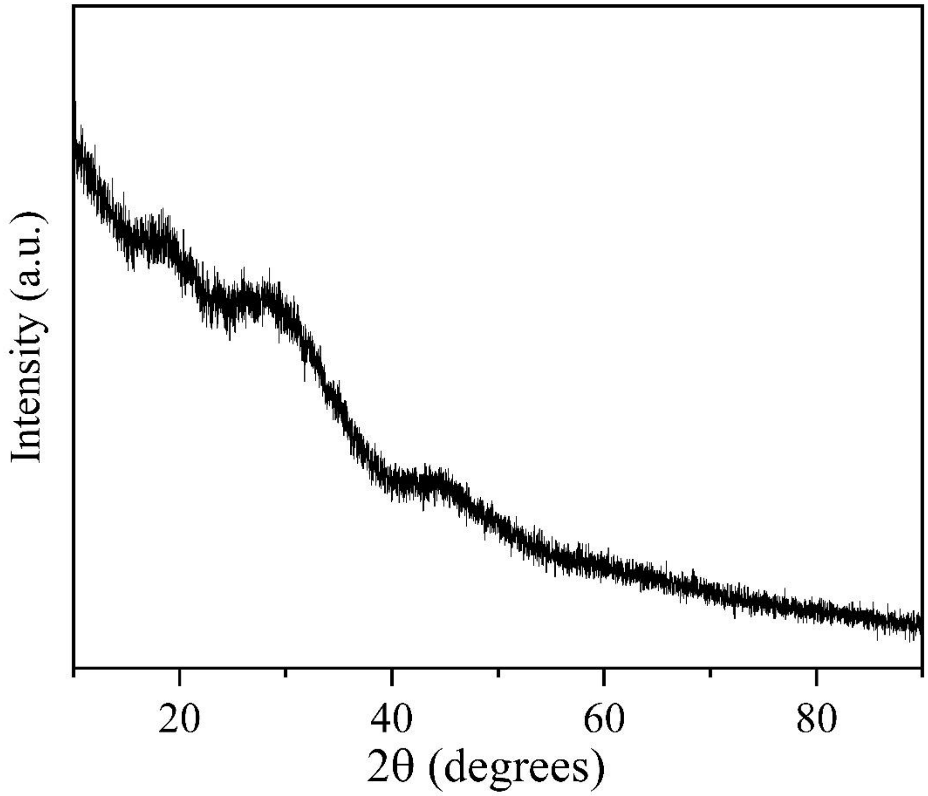

Figure S1. X-ray diffraction verification of the amorphous nature of the as-synthesized glass composition.

Table S1. Average concentration (ppm), averaged normalized loss (g/m^2), and pH as a function of time (h) for all glasses in varied Tris-based solutions. The reported errors are calculated 1σ standard deviation for duplicate samples.

0.1 M Tris-HCl (pH 7)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	6.97±0.01	3.1	±0.8	2.0	±0.4	0.3	±0.2	6.9	±1.9	7.0	±1.7	0.5	±0.4
1	7.02±0.01	14.2	±1.6	6.8	±0.7	2.8	±0.3	31.1	±3.5	29.1	±3.3	5.0	±0.6
3	7.07±0.02	57.4	±0.0	26.7	±0.3	17.5	±0.4	125.8	±0.0	121.9	±1.3	31.3	±0.7
6	7.08±0.03	80.5	±2.2	35.9	±1.1	28.7	±0.5	176.3	±4.8	164.7	±5.1	51.5	±0.9
9	7.12±0.02	78.3	±6.3	35.2	±2.9	24.8	±5.9	171.5	±13.7	161.7	±13.3	44.5	±10.5
12	7.15±0.01	106.6	±8.1	48.5	±3.3	46.7	±6.4	233.4	±17.7	223.4	±15.6	83.8	±11.4
24	7.17±0.01	115.0	±0.2	53.0	±0.2	65.2	±0.1	251.9	±0.4	244.6	±0.9	116.8	±0.2
0.1 M Tris-HNO_3 (pH 7)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	7.03±0.01	4.4	±0.8	3.0	±0.0	0.7	±0.3	9.7	±1.8	13.8	±0.0	1.2	±0.6
1	7.03±0.01	16.8	±0.5	7.9	±0.1	3.1	±0.1	36.8	±1.0	36.6	±0.3	5.6	±0.1
3	7.06±0.01	52.3	±5.8	24.9	±2.9	13.7	±3.1	114.6	±12.7	116.0	±13.5	24.5	±5.6
6	7.16±0.00	78.5	±7.1	36.4	±3.1	24.9	±3.2	171.9	±15.5	169.8	±14.3	44.6	±5.8
9	7.16±0.02	97.2	±2.1	45.8	±1.2	39.0	±0.3	212.9	±4.6	213.3	±5.7	70.0	±0.6
12	7.19±0.00	101.5	±13.6	47.8	±6.4	40.5	±7.0	222.4	±29.9	222.8	±29.7	72.7	±12.6
24	7.16±0.00	113.3	±8.1	53.8	±3.8	49.1	±3.7	248.1	±17.8	250.8	±17.7	88.0	±6.6
0.01 M Tris-HCl (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	7.99±0.01	2.3	±0.4	3.1	±0.3	<0.2	--	5.0	±0.9	4.4	±1.2	--	--
1	8.02±0.01	9.5	±1.8	6.0	±0.7	2.5	±0.8	20.8	±3.9	18.1	±3.1	4.4	±1.4
3	8.16±0.01	36.0	±0.2	16.9	±0.2	17.3	±0.0	78.8	±0.5	69.0	±0.9	31.0	±0.0
6	8.28±0.01	57.4	±0.5	26.5	±0.1	27.8	±1.4	125.8	±1.1	113.6	±0.5	49.9	±2.4
9	8.43±0.02	73.4	±8.0	33.5	±3.7	40.6	±5.7	160.8	±17.5	146.4	±17.2	72.8	±10.3
12	8.34±0.04	64.2	±2.1	29.9	±0.8	29.3	±2.1	140.5	±4.6	129.4	±3.8	52.6	±3.8
24	8.55±0.01	106.0	±2.8	48.4	±1.2	62.4	±0.4	232.2	±6.2	215.5	±5.8	111.8	±0.7
0.01 M Tris-HNO_3 (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	8.00±0.01	2.7	±0.7	3.1	±0.3	<0.2	--	5.8	±1.5	5.4	±1.4	--	--
1	8.04±0.01	7.1	±0.9	4.8	±0.4	1.4	±0.5	15.5	±2.0	13.8	±2.1	2.6	±0.9
3	8.21±0.02	29.1	±2.7	13.9	±1.1	13.3	±1.6	63.7	±5.9	56.0	±5.3	23.8	±2.9
6	8.35±0.05	45.9	±5.3	22.6	±4.3	17.1	±0.4	100.5	±11.7	96.7	±19.8	30.6	±0.7
9	8.44±0.03	75.4	±2.0	33.7	±1.1	43.0	±3.1	165.0	±4.3	148.1	±5.1	77.1	±5.5
12	8.53±0.02	93.2	±3.7	42.0	±1.5	56.4	±1.7	204.1	±8.0	186.8	±6.9	101.1	±3.1
24	8.49±0.02	114.0	±0.3	51.4	±0.1	74.7	±2.5	249.6	±0.6	230.4	±0.7	133.9	±4.4

0.05 M Tris-HCl (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	8.13±0.02	4.1	±1.0	4.0	±0.5	0.3	±0.4	9.0	±2.2	7.0	±2.2	0.5	±0.7
1	8.09±0.00	9.6	±0.0	6.2	±0.1	2.2	±0.4	21.0	±0.1	17.4	±0.7	4.0	±0.8
3	8.11±0.01	36.0	±0.6	17.4	±0.2	12.4	±0.8	78.9	±1.3	69.5	±1.0	22.3	±1.4
6	8.16±0.03	54.0	±11.7	25.4	±4.7	21.3	±8.4	118.2	±25.7	106.7	±21.7	38.2	±15.0
9	8.18±0.01	80.4	±2.0	37.1	±2.2	40.7	±3.6	176.2	±4.4	161.0	±10.1	72.9	±6.5
12	8.16±0.01	76.5	±15.2	35.3	±7.1	35.5	±20.1	167.5	±33.4	153.1	±33.0	63.6	±36.1
24	8.16±0.03	102.5	±3.2	47.1	±1.1	57.0	±2.5	224.5	±6.9	207.8	±4.9	102.1	±4.5
0.05 M Tris-HNO_3 (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	8.12±0.03	9.8	±0.3	5.9	±0.1	0.9	±0.0	21.5	±0.6	18.7	±0.5	1.7	±0.0
1	8.01±0.00	17.3	±0.6	9.4	±1.0	3.4	±0.0	37.8	±1.3	35.1	±4.5	6.1	±0.1
3	8.10±0.04	37.9	±1.3	17.9	±0.6	10.8	±1.0	83.1	±2.9	74.4	±2.8	19.4	±1.8
6	8.09±0.02	58.6	±0.8	26.8	±0.9	19.8	±1.2	128.3	±1.8	115.8	±4.1	35.5	±2.1
9	8.10±0.02	68.0	±0.5	30.5	±0.4	24.0	±0.8	149.0	±1.0	133.2	±1.7	43.1	±1.4
12	8.04±0.01	73.4	±0.7	32.9	±0.3	24.3	±0.4	160.8	±1.4	144.3	±1.5	43.5	±0.7
24	8.10±0.03	93.1	±2.4	42.1	±1.2	42.3	±5.5	204.0	±5.3	187.4	±5.5	75.8	±9.9
0.1 M Tris-HCl (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	8.08±0.01	<0.5	--	0.6	±0.0	1.4	±0.0	--	--	2.8	±0.0	1.3	±0.1
1	8.05±0.01	8.8	±0.5	4.5	±0.1	4.3	±0.1	19.2	±1.0	21.1	±0.5	6.4	±0.2
3	8.08±0.01	30.0	±0.4	14.2	±0.2	12.7	±0.0	65.7	±0.8	66.2	±0.9	21.5	±0.0
6	8.03±0.01	57.0	±2.9	27.8	±2.7	28.8	±4.7	124.8	±6.5	129.7	±12.7	50.4	±8.4
9	8.05±0.01	52.4	±3.4	24.6	±1.3	23.6	±1.5	114.8	±7.3	114.6	±6.1	41.0	±2.7
12	8.08±0.01	73.5	±0.1	35.0	±0.1	38.7	±3.6	160.9	±0.3	163.0	±0.3	68.1	±6.4
24	8.04±0.00	90.9	±1.8	43.2	±0.5	55.4	±3.2	199.1	±3.9	201.3	±2.2	98.0	±5.8
0.1 M Tris-HNO_3 (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	8.07±0.01	1.5	±0.6	1.2	±0.2	1.7	±0.2	3.3	±1.3	5.6	±0.8	1.8	±0.3
1	8.06±0.00	4.3	±1.1	2.7	±0.5	2.7	±0.5	9.5	±2.3	12.8	±2.1	3.5	±0.8
3	8.07±0.01	29.3	±1.2	14.2	±0.4	12.4	±0.9	64.3	±2.5	66.1	±2.1	20.9	±1.5
6	8.07±0.01	37.7	±4.1	18.7	±2.7	13.3	±2.5	82.6	±8.9	87.1	±12.8	22.5	±4.4
9	7.98±0.01	60.2	±1.0	28.4	±0.4	26.5	±0.7	131.8	±2.2	132.3	±1.7	46.1	±1.3
12	8.00±0.00	81.7	±0.7	39.3	±0.4	45.7	±0.2	178.8	±1.5	182.9	±1.9	80.6	±0.3
24	7.99±0.01	93.8	±0.1	44.9	±0.0	54.2	±2.2	205.4	±0.1	209.3	±0.1	95.9	±3.9

0.3 M Tris-HCl (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	8.09±0.01	6.8	±0.0	4.8	±0.0	0.9	±0.3	14.8	±0.1	13.6	±0.1	1.6	±0.5
1	8.08±0.01	11.2	±0.5	6.5	±0.2	3.5	±0.2	24.3	±1.2	21.1	±0.9	6.2	±0.3
3	8.05±0.00	26.9	±1.1	14.6	±0.5	10.6	±0.7	58.7	±2.3	59.2	±2.5	19.1	±1.2
6	8.06±0.01	42.2	±3.3	22.7	±1.4	20.9	±1.8	92.4	±7.3	96.9	±6.6	37.4	±3.1
9	8.06±0.01	48.2	±1.0	25.4	±0.5	23.6	±2.0	105.5	±2.1	109.6	±2.5	42.3	±3.5
12	8.05±0.01	54.3	±0.9	28.5	±0.7	28.1	±3.3	118.8	±1.9	123.8	±3.1	50.3	±5.9
24	8.06±0.01	69.3	±1.6	36.4	±1.5	44.0	±4.5	151.6	±3.4	160.4	±7.2	78.9	±8.1
0.3 M Tris-HNO_3 (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	8.04±0.01	6.2	±1.1	3.5	±0.5	0.9	±0.4	13.7	±2.3	15.4	±2.2	1.6	±0.7
1	8.03±0.01	9.6	±0.9	5.2	±0.4	2.5	±0.4	21.0	±1.9	23.3	±2.0	4.5	±0.7
3	7.99±0.01	27.0	±0.2	14.0	±0.1	10.5	±0.2	59.2	±0.4	64.3	±0.4	18.8	±0.4
6	8.00±0.01	40.9	±3.9	21.2	±1.8	17.5	±2.9	89.5	±8.5	98.1	±8.2	31.3	±5.1
9	8.00±0.00	48.5	±3.1	24.9	±1.9	21.2	±4.3	106.2	±6.9	115.1	±9.0	38.1	±7.7
12	8.00±0.00	53.9	±5.0	27.8	±2.7	26.1	±3.9	118.1	±11.0	128.7	±12.5	46.8	±6.9
24	7.99±0.00	68.6	±0.2	35.4	±0.1	39.5	±0.6	150.3	±0.4	164.2	±0.3	70.8	±1.1
0.5 M Tris-HCl (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	8.07±0.02	5.3	±0.7	2.8	±0.4	0.8	±0.5	11.5	±1.8	12.8	±1.8	1.4	±0.9
1	8.07±0.01	6.9	±0.5	3.6	±0.2	1.4	±0.3	14.7	±1.0	16.7	±1.0	2.5	±0.5
3	8.02±0.00	21.2	±0.4	11.2	±0.2	8.4	±0.5	46.1	±0.9	52.1	±1.0	15.0	±0.9
6	8.03±0.00	35.2	±0.2	18.2	±0.1	16.9	±0.5	76.6	±0.3	84.7	±0.3	30.4	±0.9
9	8.04±0.02	39.1	±0.0	20.6	±0.1	18.5	±0.7	85.1	±0.1	95.7	±0.6	33.2	±1.3
12	8.03±0.01	42.0	±0.8	21.9	±0.6	20.0	±2.5	91.6	±1.7	102.1	±2.9	35.9	±4.4
24	8.02±0.01	56.5	±0.7	29.6	±0.4	30.4	±1.5	123.3	±1.5	137.8	±1.7	54.5	±2.7
0.5 M Tris-HNO_3 (pH 8)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.5	8.06±0.01	4.3	±0.0	2.1	±0.0	<0.2	--	9.4	±0.0	9.8	±0.0	--	--
1	8.05±0.00	8.4	±0.1	4.4	±0.1	2.1	±0.0	18.5	±0.3	20.3	±0.4	3.8	±0.0
3	8.01±0.01	21.2	±0.5	11.1	±0.2	7.7	±0.6	46.5	±1.0	51.9	±0.9	13.8	±1.1
6	8.01±0.01	36.4	±2.0	19.0	±1.0	17.4	±1.7	79.7	±4.3	88.6	±4.5	31.1	±3.1
9	8.03±0.01	38.3	±0.2	20.5	±0.0	16.8	±0.9	83.9	±0.4	95.3	±0.0	30.1	±1.5
12	8.01±0.01	39.0	±0.3	20.6	±0.1	16.0	±0.4	85.3	±0.7	95.8	±0.4	28.7	±0.7
24	8.01±0.02	56.9	±3.1	30.0	±1.7	32.5	±4.2	124.7	±6.8	139.8	±8.0	58.3	±7.5

0.1 M Tris-HCl (pH 9)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.25	8.99±0.01	<0.5	--	<0.2	--	<0.2	--	--	--	--	--	--	--
0.5	8.99±0.01	<0.5	--	<0.2	--	<0.2	--	--	--	--	--	--	--
1	9.02±0.02	2.3	±0.4	0.4	±0.2	1.2	±0.2	5.1	±1.0	1.8	±1.0	2.1	±0.4
3	9.02±0.03	25.9	±0.7	12.7	±0.4	11.2	±0.3	56.6	±1.5	58.9	±1.7	20.1	±0.5
6	9.05±0.03	63.1	±6.2	31.3	±3.1	42.3	±8.1	138.3	±13.7	145.6	±14.4	75.9	±14.4
9	9.03±0.01	68.0	±0.5	33.7	±0.3	45.8	±1.4	149.0	±1.2	156.9	±1.4	82.0	±2.6
12	9.04±0.00	91.0	±7.4	45.8	±4.3	60.0	±13.7	199.3	±16.1	213.4	±20.2	107.5	±24.6
0.1 M Tris-HNO_3 (pH 9)		Concentration, ppm						Normalized Loss, g/m^2					
Time (h)	pH	Na	Na-error	B	B-error	Si	Si-error	Na	Na-error	B	B-error	Si	Si-error
0.25	8.95±0.01	0.7	±0.3	<0.2	--	<0.2	--	1.6	±0.7	--	--	--	--
0.5	8.95±0.01	3.8	±0.3	0.9	±0.2	1.4	±0.1	8.3	±0.6	4.4	±1.1	2.5	±0.3
1	8.93±0.01	5.5	±0.0	2.0	±0.0	2.7	±0.1	12.2	±0.1	9.2	±0.1	4.8	±0.1
3	8.98±0.01	34.3	±4.9	16.4	±3.0	19.0	±5.2	75.0	±10.8	76.3	±13.9	34.1	±9.3
6	8.98±0.00	66.5	±2.7	32.7	±1.5	47.6	±2.8	145.5	±5.9	152.5	±6.9	85.4	±5.1
9	9.00±0.01	75.3	±4.0	37.4	±2.7	48.4	±7.6	165.0	±8.7	174.1	±12.8	86.8	±13.7
12	9.01±0.01	95.1	±3.2	48.0	±1.5	57.5	±1.7	208.2	±6.9	223.7	±7.2	103.2	±3.1