Supplementary Material

A cylindrical, custom-designed, constant volume pressure vessel with internal dimensions of 60 mm (diameter) and 116 mm (length) was used to conduct the laboratory experimentation (Figure S1A). The pressure vessel was constructed from 316-stainless steel and thus maintained a constant volume throughout the test duration, mimicking the unyielding host-rock wall of the KBS3 disposal concept [SKB (1983), Harrington and Tamayo-Mas (2016), Harrington *et al. (2017)*]. The pressure vessel was oriented horizontally and instrumented with 5 load cells (3 radial and 2 axial) to measure the stress distribution in the sample and 12 radial pore pressure transducers (Figure S1B). Tungsten carbide pushrods running from the internal face of the vessel to the outer rim translated the stress from the clay sample to the load cells. The load cells were contained in a stainless steel housing on the outside of the vessel. As a result of the indirect nature of the pushrod and load cell measurements, the quoted pressures can be considered accurate to ±80 kPa. The pore pressure transducers were configured in three planar arrays of 4 sensors, each separated at 90 degrees around the bore of the vessel. They were also sited behind porous plugs that prevented the sample from extruding out into the recess created for the instrumentation. Two sintered metal filters recessed into the two end closures of the vessel supplied the test fluid evenly to each end of the sample. At the left-hand end of the vessel, the clay was located directly on the pushrod connected to the sensor and there was water available to the clay, supplied evenly through the sintered metal filter recessed into the end-closure. A matching sintered filter recessed into the end-closure at the opposite end of the vessel (right-hand end) allowed the pore pressure to be applied to the void space.

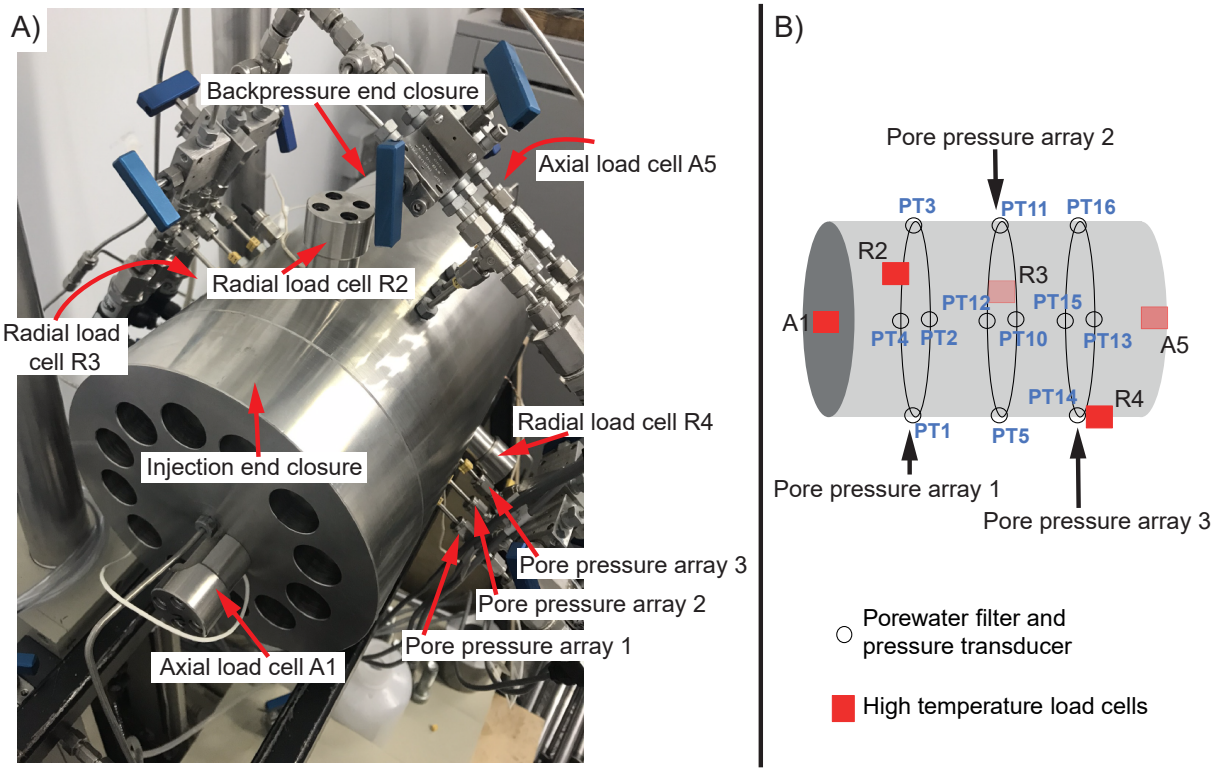

Figure S1: Experimental apparatus with (**A**) cylindrical, custom-designed pressure vessel, and (**B**) the location of the instruments with respect to the inner surface of the test vessel.

		Analysis No.	**Weight % Element** [Total Fe determined as Fe^{3+}; O calculated from element-oxide stoichiometry; concentrations normalised to 100%]												
			Na	Mg	Al	Si	P	S	K	Ca	Ti	Mn	Fe	O	Total
Slice 1 piece AA	(Gel)	1	1.14	2.95	9.89	31.05	0.00	0.20	0.92	1.05	0.33	0.00	3.39	49.09	100.00
		2	1.03	2.88	9.86	30.92	0.00	0.26	0.91	1.14	0.35	0.00	3.60	49.06	100.00
		3	1.10	2.86	10.07	31.06	0.00	0.20	0.92	1.06	0.30	0.00	3.29	49.14	100.00
		4	0.65	2.44	9.24	30.25	0.00	0.24	1.16	1.37	0.39	0.00	5.84	48.42	100.00
		5	0.62	2.52	9.40	30.62	0.21	0.11	1.13	1.45	0.36	0.00	4.88	48.70	100.00
		6	0.96	2.82	9.95	31.16	0.00	0.14	0.99	0.98	0.30	0.08	3.55	49.08	100.00
		7	0.95	2.89	9.83	30.86	0.00	0.29	1.13	1.21	0.33	0.06	3.44	49.00	100.00
		8	0.70	2.86	9.98	31.20	0.00	0.34	0.94	1.21	0.24	0.00	3.26	49.28	100.00
		9	0.91	2.79	9.68	31.13	0.00	0.32	0.98	1.28	0.35	0.00	3.44	49.12	100.00
		10	0.98	2.85	9.68	31.44	0.00	0.14	0.87	1.05	0.37	0.00	3.45	49.18	100.00
		11	0.93	2.92	9.81	31.22	0.00	0.23	0.97	1.25	0.28	0.02	3.22	49.15	100.00
		12	0.99	2.85	9.72	30.82	0.00	0.31	1.01	1.19	0.48	0.08	3.55	49.00	100.00
		13	0.84	2.71	9.57	29.99	0.00	1.09	0.89	1.93	0.17	0.00	3.74	49.07	100.00
		14	0.97	2.86	9.77	30.72	0.00	0.52	0.87	1.29	0.40	0.00	3.47	49.13	100.00
		15	0.95	2.72	9.62	31.15	0.00	0.11	0.92	1.20	0.46	0.00	3.91	48.98	100.00
		16	0.74	2.63	9.51	31.25	0.00	0.17	1.15	1.02	0.35	0.00	4.20	48.99	100.00
		17	1.08	2.60	9.75	31.31	0.00	0.17	0.86	1.33	0.30	0.00	3.48	49.10	100.00
		18	0.89	2.79	9.62	31.10	0.00	0.24	1.09	1.04	0.35	0.00	3.86	49.02	100.00
		19	1.09	3.24	9.49	30.89	0.00	0.12	1.01	1.22	0.32	0.10	3.67	48.84	100.00
		20	0.86	2.92	9.64	31.44	0.00	0.30	0.92	0.93	0.22	0.09	3.41	49.26	100.00
		21	0.63	2.32	9.01	31.29	0.00	0.26	1.59	1.20	0.37	0.00	4.52	48.80	100.00
		22	0.51	2.33	8.71	30.55	0.00	0.54	1.55	1.55	0.70	0.00	4.97	48.60	100.00
		23	0.45	2.05	8.46	30.25	0.00	0.81	1.76	2.07	0.59	0.00	5.10	48.47	100.00
		24	0.61	2.62	9.29	30.83	0.00	0.37	1.45	1.46	0.37	0.00	4.19	48.81	100.00
		25	0.98	2.45	9.61	30.82	0.16	0.40	2.01	1.45	0.25	0.00	3.00	48.87	100.00
Gel	substrate	26	0.61	1.87	7.30	33.86	0.00	0.55	1.89	1.33	0.30	0.00	2.69	49.61	100.00
		27	0.80	2.43	9.63	31.31	0.00	0.22	1.18	1.17	0.23	0.00	3.99	49.03	100.00
		28	0.87	2.63	9.36	30.96	0.00	0.27	1.34	1.23	0.50	0.00	4.00	48.85	100.00
		29	1.02	2.61	9.33	30.63	0.44	0.14	1.20	1.79	0.33	0.00	3.69	48.82	100.00
Slice 2 piece BB	(Bentonite matrix)	30	0.61	3.02	9.17	32.52	0.00	0.00	0.67	0.98	0.20	0.00	3.33	49.50	100.00
		31	0.57	2.67	9.05	33.05	0.00	0.00	0.97	0.80	0.15	0.00	3.11	49.62	100.00
		32	0.44	1.23	6.49	37.68	0.00	0.00	0.31	0.69	0.00	0.00	2.20	50.95	99.99
		33	0.40	1.59	9.22	33.41	0.00	0.00	0.60	1.01	0.09	0.13	3.82	49.72	100.00
		34	0.25	0.98	4.25	39.43	0.00	0.00	0.53	0.82	0.08	0.00	2.60	51.05	100.00
		35	0.44	1.23	4.95	38.41	0.00	0.00	0.46	0.70	0.16	0.00	2.83	50.82	100.00
		36	0.28	0.57	2.46	42.92	0.00	0.00	0.18	0.35	0.00	0.00	1.02	52.20	100.00
		37	0.37	1.65	7.65	34.25	0.00	0.00	0.92	0.87	0.22	0.00	4.43	49.63	100.00
		38	0.65	1.54	7.11	34.34	0.00	0.00	0.53	0.91	0.00	0.00	5.44	49.49	100.01
		39	0.49	1.48	6.94	37.57	0.00	0.00	0.26	0.64	0.00	0.00	1.53	51.09	100.00
		40	0.57	1.58	6.52	31.97	0.00	0.00	0.94	1.22	0.31	0.00	8.80	48.11	100.00

Table S1: EDXA analyses of bentonite gel and bentonite substrate (weight % element).

		Analysis	Molar % Ions											
		No.	Na^{+}	Mg^{2+}	Al^{3+}	Si^{4+}	P^{5+}	S^{4+}	K^{+}	Ca^{2+}	Ti^{4+}	Mn^{2+}	Fe^{3+}	O^{2-}	Total
Slice 1 piece AA	(Gel)	1	1.02	2.51	7.58	22.87	0.00	0.13	0.49	0.54	0.14	0.00	1.26	63.46	100.00
		2	0.93	2.46	7.57	22.80	0.00	0.17	0.48	0.59	0.15	0.00	1.34	63.52	100.00
		3	0.99	2.43	7.72	22.86	0.00	0.13	0.48	0.55	0.13	0.00	1.22	63.49	100.00
		4	0.59	2.11	7.20	22.63	0.00	0.15	0.62	0.72	0.17	0.00	2.20	63.60	100.00
		5	0.56	2.17	7.28	22.79	0.14	0.07	0.61	0.75	0.16	0.00	1.83	63.64	100.00
		6	0.86	2.40	7.64	22.97	0.00	0.09	0.52	0.51	0.13	0.03	1.32	63.53	100.00
		7	0.86	2.46	7.55	22.78	0.00	0.19	0.60	0.63	0.14	0.02	1.28	63.49	100.00
		8	0.63	2.44	7.64	22.96	0.00	0.22	0.50	0.63	0.10	0.00	1.21	63.68	100.00
		9	0.82	2.37	7.43	22.96	0.00	0.20	0.52	0.66	0.15	0.00	1.28	63.60	100.00
		10	0.88	2.42	7.42	23.16	0.00	0.09	0.46	0.54	0.16	0.00	1.28	63.59	100.00
		11	0.84	2.48	7.52	22.99	0.00	0.15	0.51	0.64	0.12	0.01	1.19	63.54	100.00
		12	0.90	2.43	7.48	22.76	0.00	0.20	0.53	0.61	0.21	0.03	1.32	63.53	100.00
		13	0.76	2.31	7.37	22.19	0.00	0.71	0.48	1.00	0.07	0.00	1.39	63.72	100.00
		14	0.87	2.43	7.50	22.66	0.00	0.33	0.46	0.67	0.17	0.00	1.29	63.61	100.00
		15	0.85	2.32	7.40	23.03	0.00	0.07	0.49	0.62	0.20	0.00	1.45	63.56	100.00
		16	0.67	2.25	7.33	23.13	0.00	0.11	0.61	0.53	0.15	0.00	1.56	63.66	100.00
		17	0.97	2.22	7.48	23.09	0.00	0.11	0.46	0.69	0.13	0.00	1.29	63.56	100.00
		18	0.80	2.38	7.40	22.98	0.00	0.15	0.58	0.54	0.15	0.00	1.44	63.58	100.00
		19	0.99	2.77	7.30	22.82	0.00	0.08	0.54	0.63	0.14	0.04	1.36	63.34	100.00
		20	0.78	2.48	7.38	23.14	0.00	0.20	0.49	0.48	0.10	0.03	1.26	63.66	100.00
		21	0.57	1.99	6.97	23.27	0.00	0.17	0.85	0.63	0.16	0.00	1.69	63.70	100.00
		22	0.47	2.01	6.77	22.83	0.00	0.36	0.83	0.81	0.31	0.00	1.87	63.76	100.00
		23	0.41	1.78	6.60	22.67	0.00	0.53	0.95	1.09	0.26	0.00	1.92	63.79	100.00
		24	0.56	2.25	7.18	22.90	0.00	0.24	0.77	0.76	0.16	0.00	1.56	63.62	100.00
		25	0.89	2.10	7.43	22.92	0.11	0.26	1.08	0.75	0.11	0.00	1.12	63.23	100.00
Gel	substrate	26	0.55	1.59	5.60	24.94	0.00	0.36	1.00	0.69	0.13	0.00	1.00	64.16	100.00
		27	0.72	2.08	7.41	23.16	0.00	0.15	0.63	0.60	0.10	0.00	1.49	63.66	100.00
		28	0.79	2.25	7.22	22.94	0.00	0.18	0.71	0.64	0.22	0.00	1.49	63.56	100.00
		29	0.92	2.23	7.20	22.69	0.30	0.09	0.64	0.93	0.14	0.00	1.37	63.48	100.00
Slice 2 piece BB	(Bentonite matrix)	30	0.55	2.56	7.01	23.89	0.00	0.00	0.35	0.51	0.09	0.00	1.23	63.82	100.00
		31	0.52	2.27	6.91	24.25	0.00	0.00	0.51	0.41	0.07	0.00	1.15	63.92	100.00
		32	0.39	1.04	4.91	27.37	0.00	0.00	0.16	0.35	0.00	0.00	0.80	64.98	100.00
		33	0.36	1.35	7.07	24.60	0.00	0.00	0.32	0.52	0.04	0.05	1.41	64.27	99.99
		34	0.22	0.82	3.23	28.73	0.00	0.00	0.28	0.42	0.04	0.00	0.95	65.31	100.00
		35	0.39	1.03	3.76	28.02	0.00	0.00	0.24	0.36	0.07	0.00	1.04	65.09	100.00
		36	0.25	0.47	1.84	30.89	0.00	0.00	0.09	0.18	0.00	0.00	0.37	65.91	100.00
		37	0.33	1.41	5.89	25.31	0.00	0.00	0.49	0.45	0.10	0.00	1.65	64.38	100.00
		38	0.59	1.32	5.48	25.45	0.00	0.00	0.28	0.47	0.00	0.00	2.03	64.38	100.00
		39	0.43	1.24	5.22	27.19	0.00	0.00	0.13	0.33	0.00	0.00	0.56	64.90	100.00
		40	0.53	1.38	5.14	24.24	0.00	0.00	0.51	0.65	0.14	0.00	3.35	64.05	100.00

Table S2: EDXA analyses of bentonite gel and bentonite substrate (molar % ions).

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