Supplementary file

Failure patterns in layered gas-storage systems

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Table S1. Calculation details of excess pore fluid pressure and the failure patterns.

Cap layer particle size (mm)	Capillary barrier (Pa)	Effective stress (Pa)	Injection rate (mm^3/s)	Excess pore pressure (Pa)	Flow rate (mm^3/s)	Permeability (Darcy)	Phenomena
1.18 to 2.36	274.68	400.00	25.00	3.15	14.71	225.12	Capillary invasion
			50.00	8.07	37.68		Capillary invasion
			100.00	13.05	60.97		Capillary invasion
			200.00	26.09	121.86		Capillary invasion
			400.00	52.31	244.34		Capillary invasion
			800.00	95.86	447.78		Capillary invasion
			1,600.00	166.45	777.53		Capillary invasion
			3,688.00	491.03	2,293.71		Fracture opening
0.60 to 1.18	549.36	400.00	25.00	7.13	12.77	86.36	Integral uplifting
			50.00	11.16	19.99		Integral uplifting
			100.00	18.80	33.69		Integral uplifting
			200.00	97.16	174.10		Integral uplifting
			400.00	209.82	375.99		Integral uplifting
			800.00	368.76	660.81		Integral uplifting
			1,600.00	427.28	765.68		Fracture opening
0.30 to 0.60	1,098.72	400.00	25.00	17.17	16.32	45.80	Integral uplifting
			50.00	44.18	41.99		Integral uplifting
			100.00	93.01	88.39		Integral uplifting
			200.00	187.20	177.91		Integral uplifting
			400.00	333.36	316.81		Integral uplifting
			800.00	456.67	434.00		Fracture opening
			1,600.00	530.07	503.75		Fracture opening
0.15 to 0.30	2,197.44	400.00	25.00	55.52	18.10	15.71	Integral uplifting
			50.00	76.17	24.83		Integral uplifting
			100.00	232.10	75.66		Integral uplifting
			200.00	423.61	138.09		Fracture opening
			400.00	932.96	304.13		Fracture opening
			800.00	1,526.52	497.62		Fracture opening
			1,600.00	1,755.52	572.27		Heaving
0.075 to 0.15	4,394.88	400.00	25.00	269.23	18.10	3.24	Integral uplifting
			50.00	354.60	23.84		Integral uplifting
			100.00	1218.06	81.89		Fracture opening
			200.00	2647.03	177.96		Heaving
			400.00	4,200.36	282.39		Violent liquefaction
			800.00	4,666.67	313.74		Violent liquefaction
			1,600.00	7,232.63	486.25		Violent liquefaction

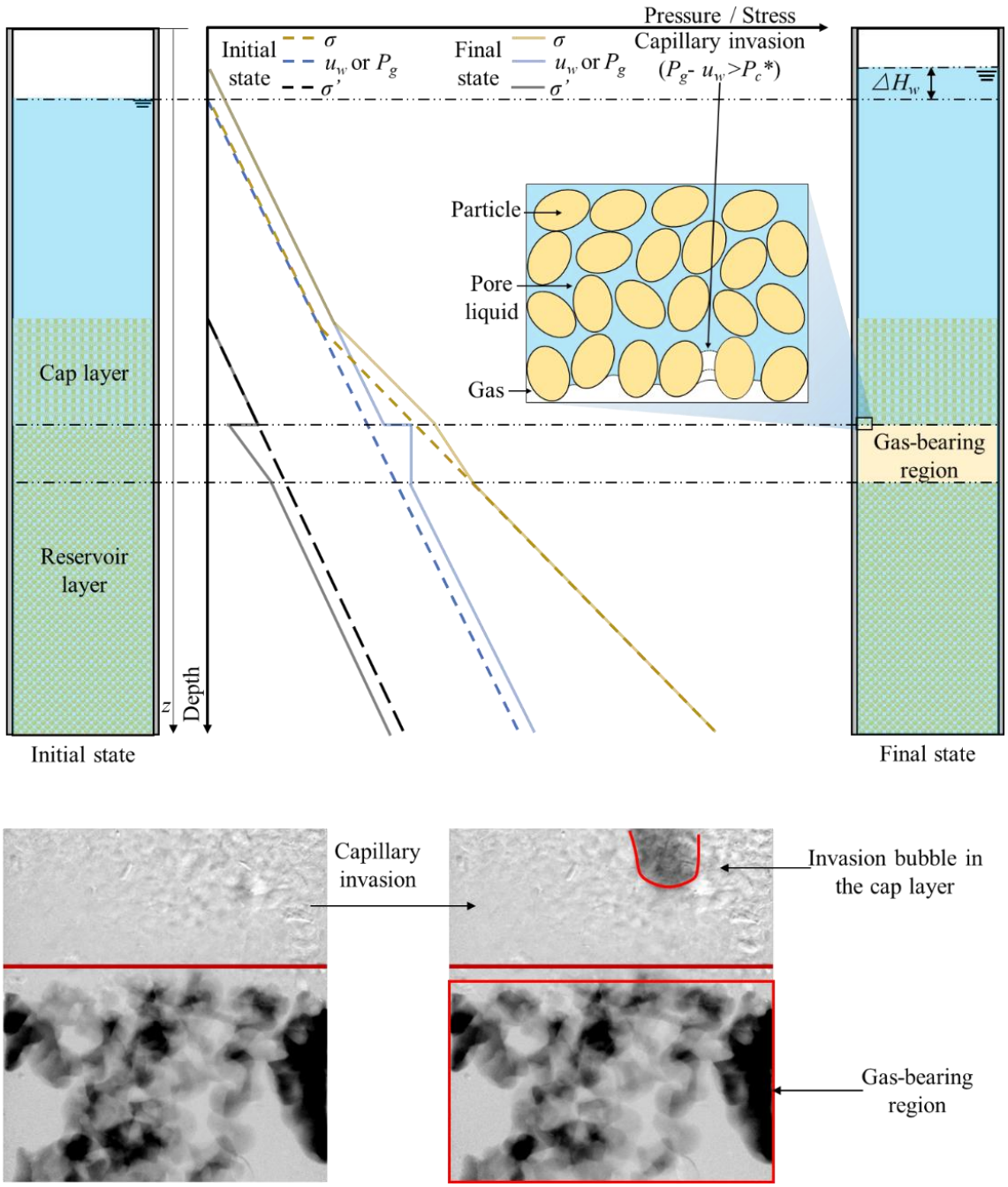

Fig. S1. Effective stress σ' varies at different depths during the capillary invasion, along with corresponding CT images. In these images, the black areas represent gas.