

## Experimental data and conditions

Supplementary Table 1. Measured volume fraction of porosity (vol%) in samples with 9 wt% dolomite.

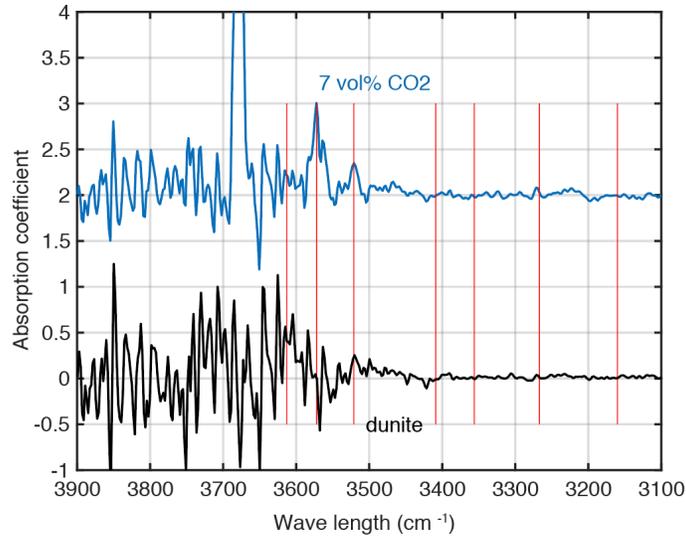
	Porosity
W2263	5.8 vol%
W2264	7.2 vol%
W2266	6.5 vol%
Mean fraction	7.0 vol%

Supplementary Table 2. Experimental data of sample with 7 vol% CO<sub>2</sub> (W2263, W2264, W2266) and 0 vol% CO<sub>2</sub> (W2271).

No.	Dolomite fraction	Measured porosity fraction	Displacement rate (mm/s)	Shear strain rate (/s)	Shear stress (MPa)	Strain	Thickness (mm)	Grain size (μm)		Pre-deformation hot (hour)
								Equivalent circular diameters	Line intercept	
W2263	9 wt%	5.8 vol%	7.5×10 <sup>-5</sup>	9.8×10 <sup>-5</sup>	76.3	1.2		4.5	4.8	18
			1.9×10 <sup>-5</sup>	2.7×10 <sup>-5</sup>	35.6	2.1				
			1.9×10 <sup>-4</sup>	3.1×10 <sup>-4</sup>	136.7	3.1				
			7.5×10 <sup>-5</sup>	1.3×10 <sup>-4</sup>	84.6	3.5	0.74			
W2264	9 wt%	7.2 vol%	7.5×10 <sup>-5</sup>	9.7×10 <sup>-5</sup>	100.2	1.1	0.88	5.8	7.1	17
W2266	9 wt%	6.5 vol%	7.5×10 <sup>-5</sup>	1.1×10 <sup>-4</sup>	100.7	2.3	0.77	7.3	9.5	17.5
W2261	9 wt%	7.0 vol%						5.9	9.9	18
W2271	0 wt%		7.5×10 <sup>-5</sup>	1.1×10 <sup>-4</sup>	172.0	1.9	1.13	6.6	7.1	17

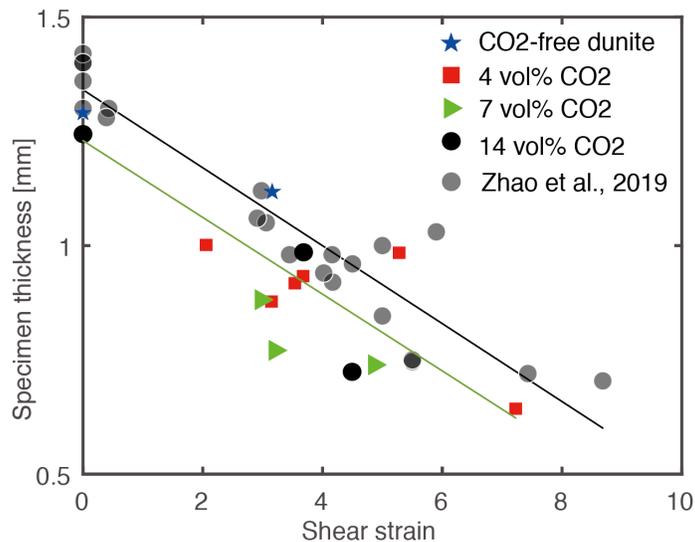
Supplementary Table 3. Mechanical data for an axial compression experiment (W2430) in the same sample assembly.

No.	Dolomite fraction	CO <sub>2</sub> fraction	Displacement rate (mm/s)	Strain rate (/s)	Stress (MPa)	Strain	Thickness (mm)	Grain size (μm)		Hot-pressed (hour)
								Equivalent circular diameters	Line intercept	
W2430	0 wt%		1.9×10 <sup>-4</sup>	2.2×10 <sup>-5</sup>	176.7	0.23		6.5	6.8	13.5
			5.9×10 <sup>-5</sup>	8.0×10 <sup>-6</sup>	77.0	0.31				
			7.5×10 <sup>-5</sup>	1.1×10 <sup>-5</sup>	83.6	0.36				
			7.4×10 <sup>-4</sup>	1.3×10 <sup>-4</sup>	242.0	0.41				
			1.9×10 <sup>-3</sup>	3.4×10 <sup>-4</sup>	323.0	0.5	5.5			



Supplementary Figure 1. FTIR spectra from hot-pressed polycrystalline samples. Data were from samples W2261 (blue curve), W2277 (black curve). The characteristic OH stretching bands in Ol (3613, 3572, 3521, 3409, 3356, 3267, 3160  $\text{cm}^{-1}$ ; Berry et al., 2005; Zhao et al., 2019) were presented by solid red lines.

Water contents in the polycrystalline aggregates were determined by FTIR spectroscopy. We obtained from the hot-pressed sample W2261, the two-layer sample that has 4 vol% at top and 7 vol% of  $\text{CO}_2$  at the bottom. The thickness of the sample wafer was 0.3 mm. To calculate hydroxyl concentration, we integrated spectra between 3650  $\text{cm}^{-1}$  and 3000  $\text{cm}^{-1}$ , which covered infrared hydroxyl stretching bands for Ol, CPx, and OPx (Berry et al., 2005; Demouchy et al., 2015; Ferriss et al., 2016; Zhao et al., 2019).



Supplementary Figure 2. The thickness of the specimens as a function of the shear strain. The result includes data from different  $\text{CO}_2$  contents (4 vol%, 7 vol%, 14 vol%) and  $\text{CO}_2$ -free dunite. Gray circles are data from Zhao et al. (2019). The green line is a least square fit to data from this work; the black line is a least square fit to the data from Zhao et al. (2019).