Supplementary Information

Enhanced H_2 Recovery by Coupling the Water-Gas Shift Reaction with in-situ Carbon Capture and Mineralization using Earth Abundant Ca- and Mg-Silicates and Hydroxides

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Table S1. Information of the Pt/Al_2O_3 catalyst

Catalyst	***Pt/Al_2O_3***
Surface area	163.131m^2/ g
Pore volume	0.303cc/g
Average pore diameter	6.282nm

Table S2.1. Selected saturated pressure from steam table

t[°C]	***T[K]***	***P_s[bar]***
200	473.15	15.5467
220	493.15	23.1929
250	523.15	39.7594
280	553.15	64.1646
300	573.15	85.8771

Table S2.2. Selected specific volume (m^3/kg) for superheated steam from the steam table

t [°C]	***5 bar***	***10bar***	***20bar***	***50bar***
200	0.425	0.206	/	/
220	0.445	0.217	0.102	/
250	0.474	0.233	0.110	/
280	0.503	0.248	0.120	0.042
300	0.523	0.258	0.125	0.045

Table S3. Residual formate concentrations in the aqueous phase determined by NMR

Sorbent Type	***Formate Concentration (ppm)***
Blank Experiment	1702.15
$Mg(OH)_2$	102.46
Mg_2SiO_4	147.99
$Ca(OH)_2$	196.74
$CaSiO_3$	131.97

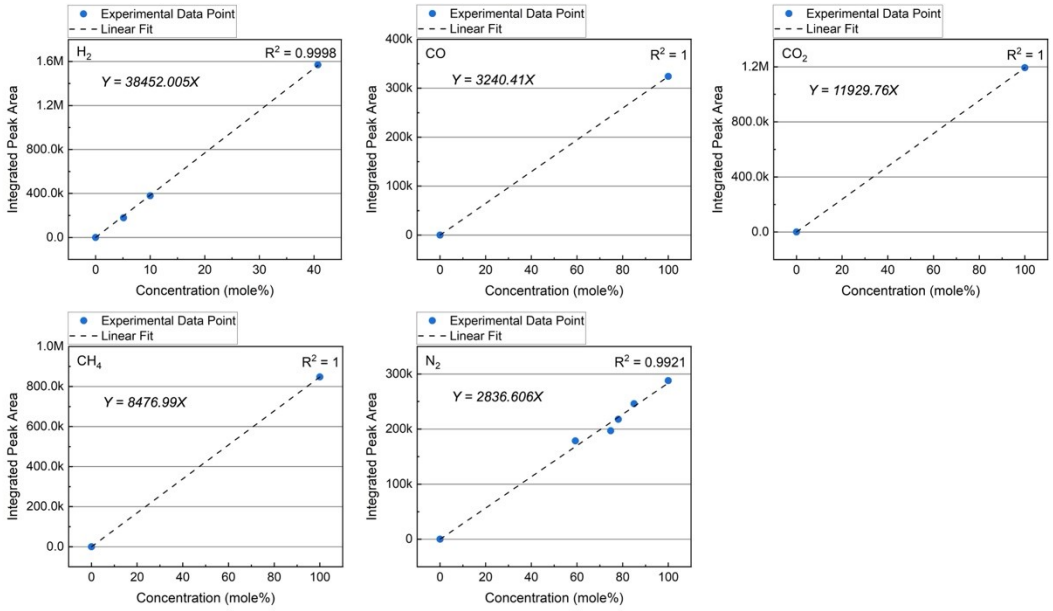

Figure S1. Gas chromatography (GC) calibration curves for different gas components.

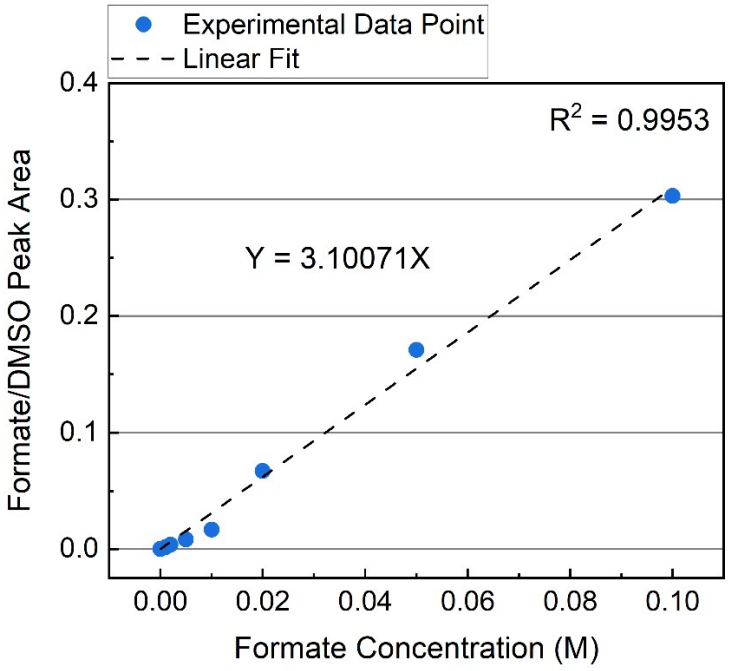

Figure S2. Formate concentration calibration line determined using liquid-NMR with DMSO internal standards.

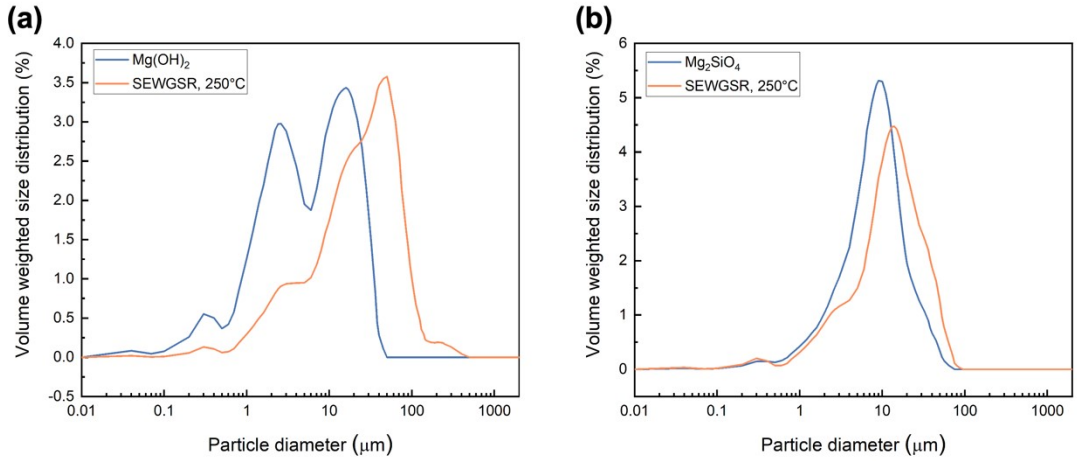

Figure S3. Particle size distribution of the unreacted and carbonated sorbents for (a) $Mg(OH)_2$; (b) Mg_2SiO_4;

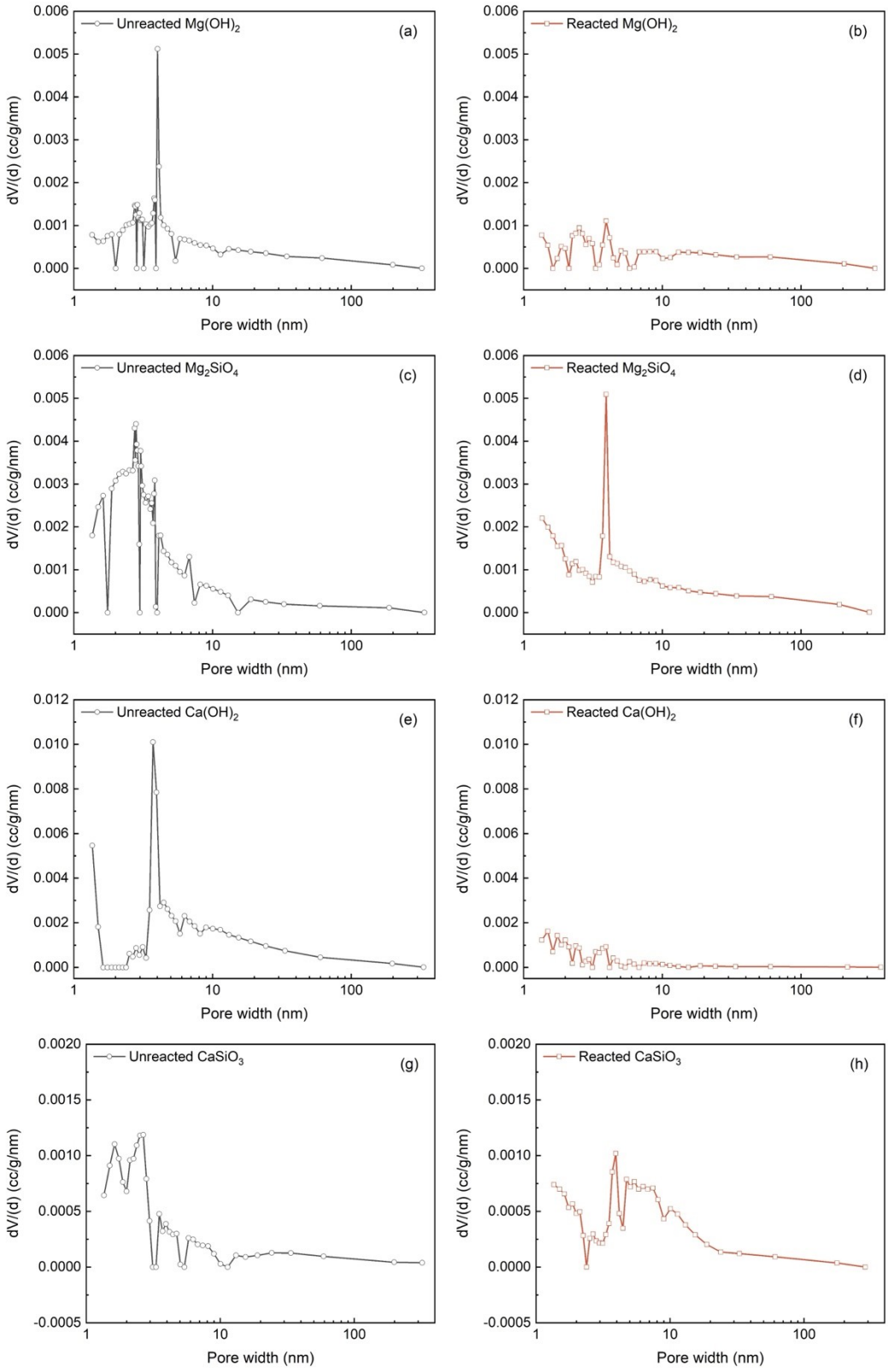

Figure S4. The pore size distribution of (a) unreacted $Mg(OH)_2$; (b) reacted $Mg(OH)_2$; (c) unreacted Mg_2SiO_4; (d) reacted Mg_2SiO_4; (e) unreacted $Ca(OH)_2$; (f) reacted $Ca(OH)_2$; (g) unreacted $CaSiO_3$; (h) reacted $CaSiO_3$ determined by the BJH model.

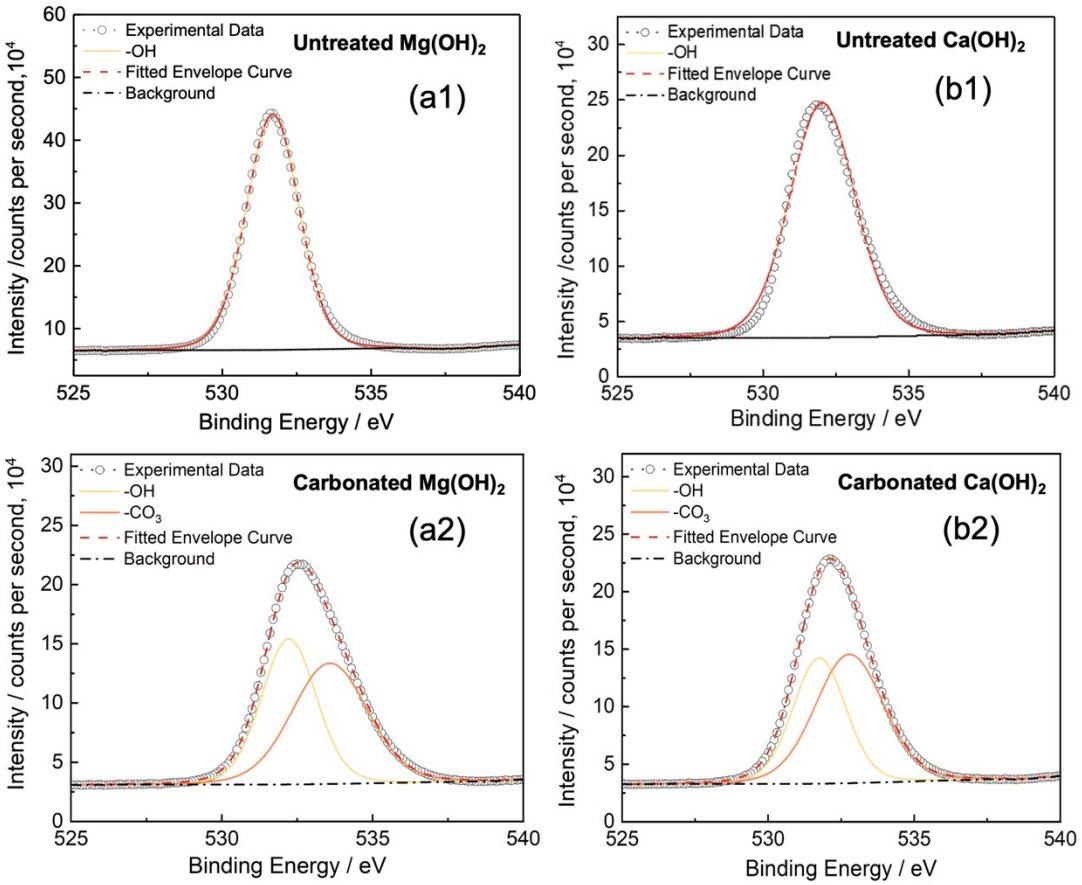

Figure S5. O1s XPS spectra of unreacted (a-1) $Mg(OH)_2$, (b-1) $Ca(OH)_2$) and carbonated (a-2) $Mg(OH)_2$; (b-2) $Ca(OH)_2$ sorbents respectively.

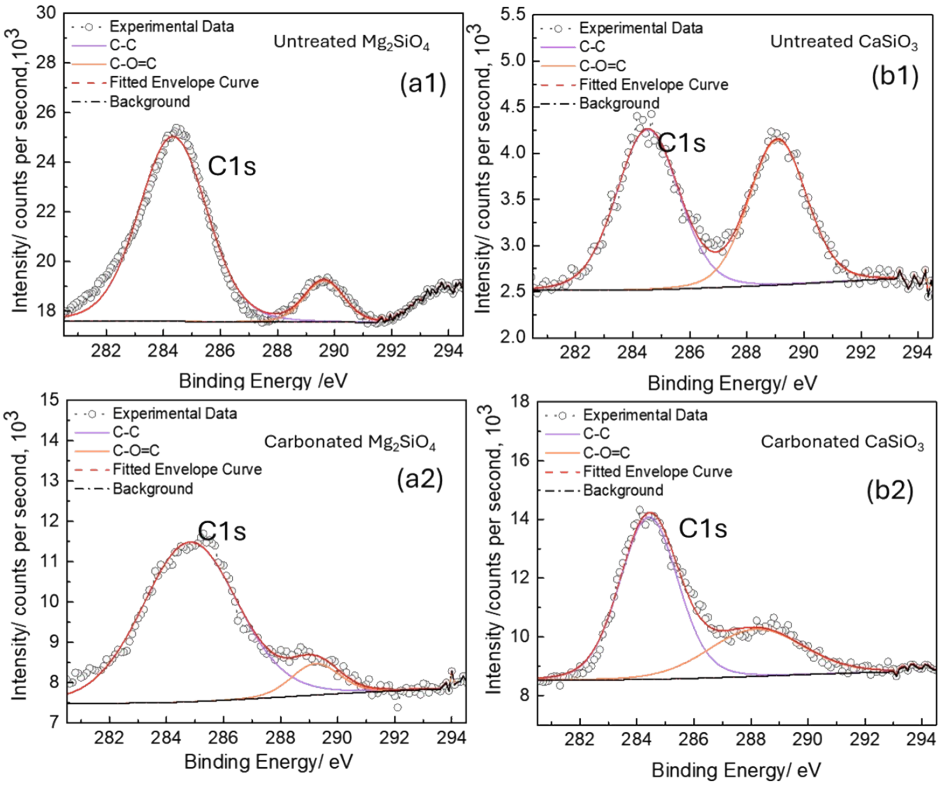

Figure S6. C1s XPS spectra of unreacted (a-1) Mg_2SiO_4, (b-1) $CaSiO_3$ and carbonated (a-2) Mg_2SiO_4; (b-2) $CaSiO_3$ sorbents respectively.

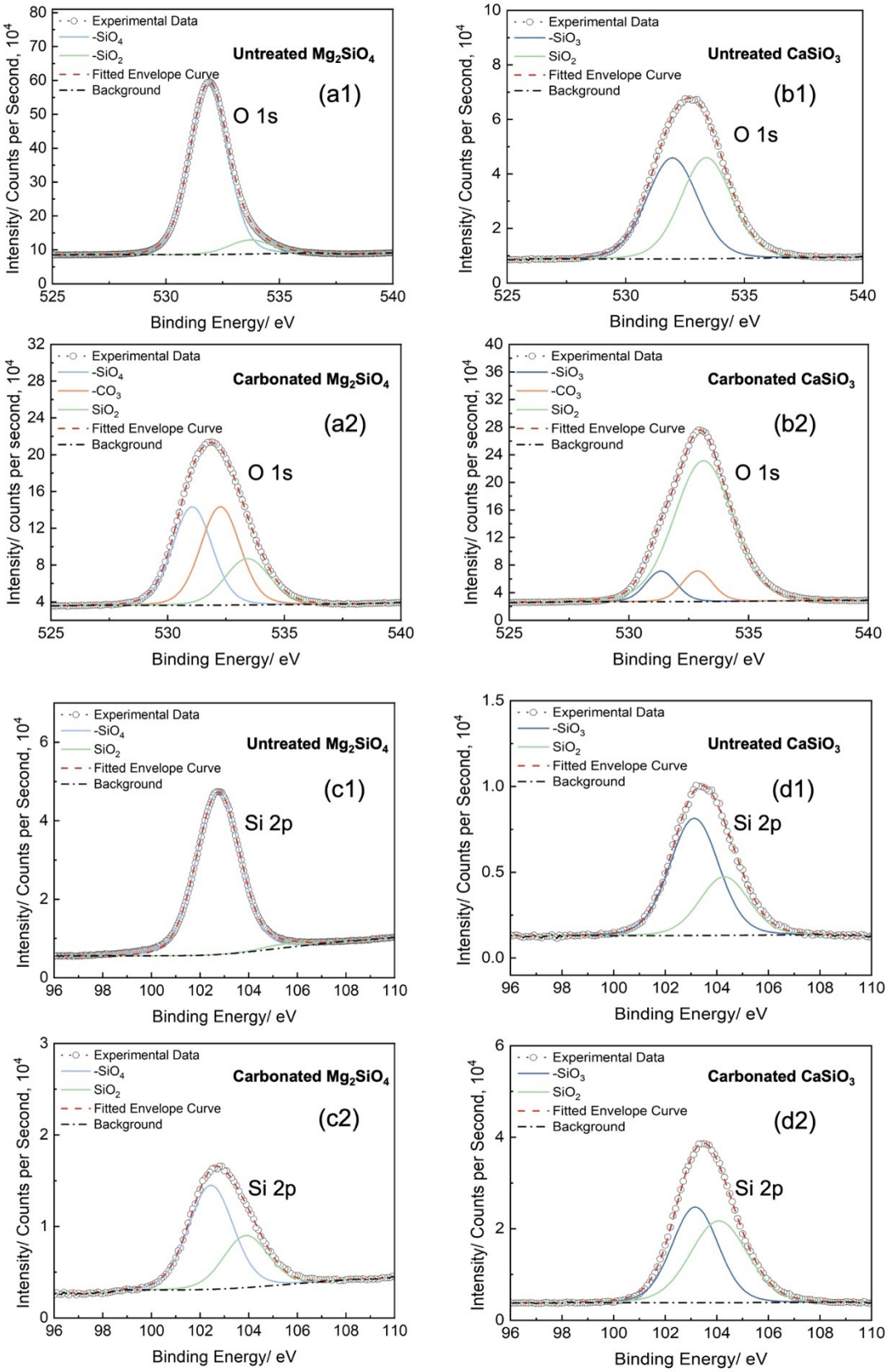

Figure S7. High resolution XPS spectra of ((a1-b2) O1s and (c1-d2) Si2p for unreacted and carbonated $CaSiO_3$, Mg_2SiO_4 sorbents, respectively

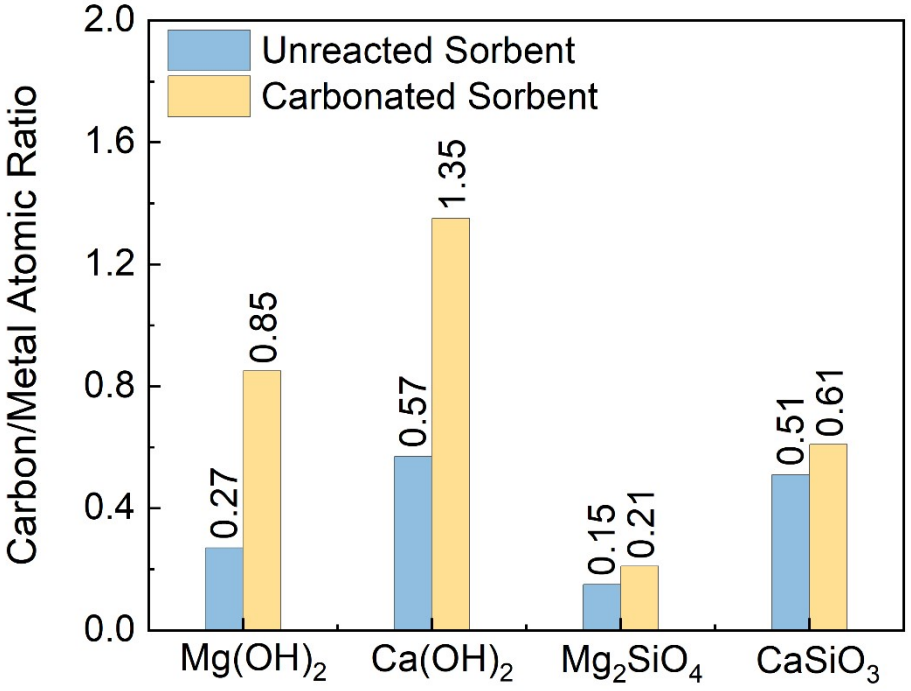

Figure S8. Carbon/Metal atomic ratios of the unreacted sorbents and corresponding carbonated products determined by XPS