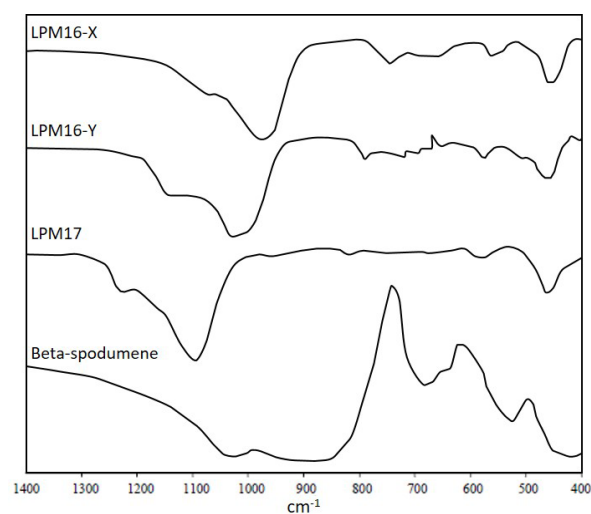


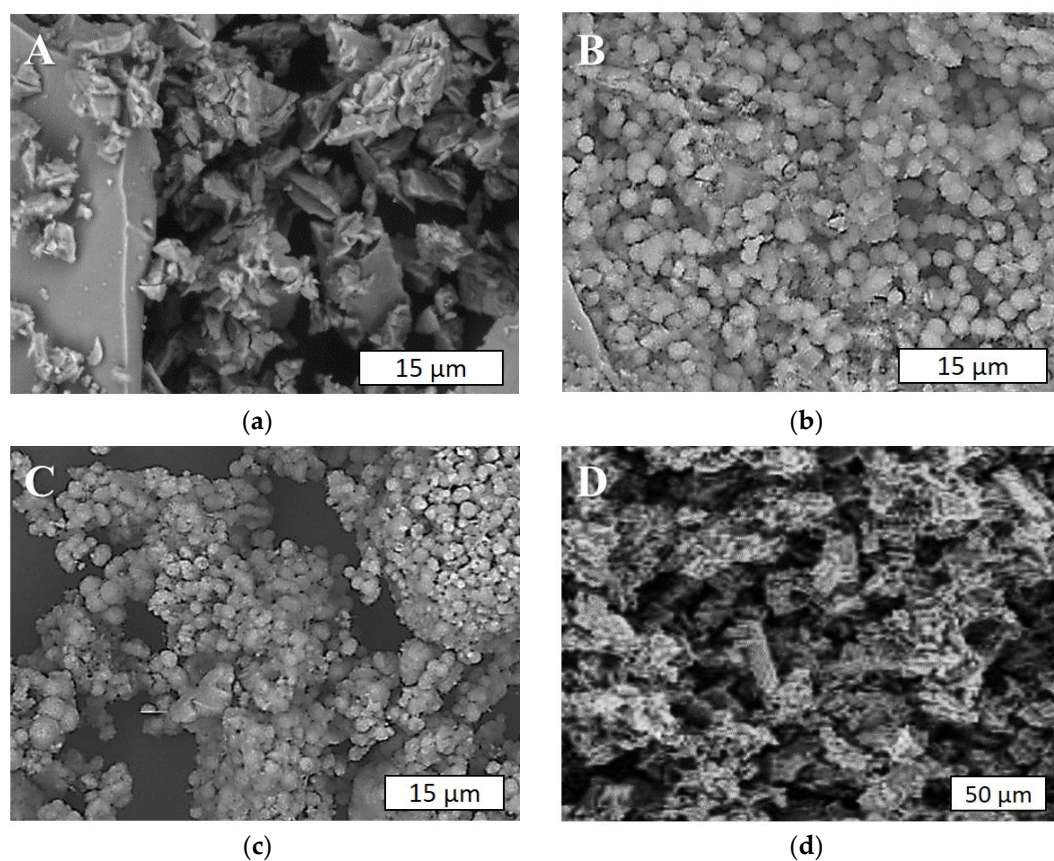
## Supplementary Materials



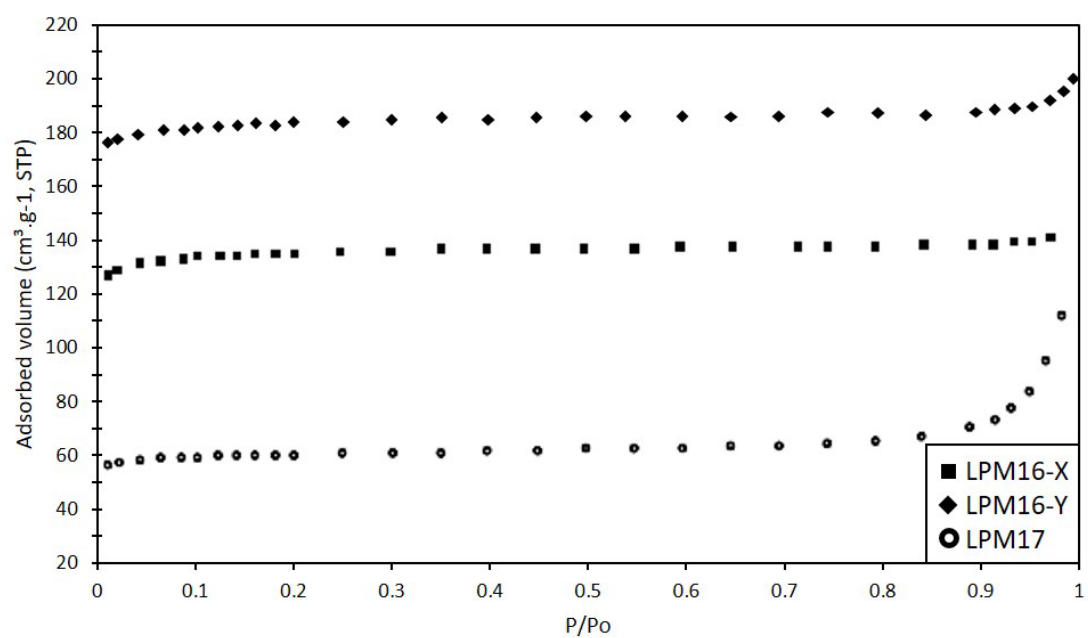
**Figure S1.** FT-IR spectra of zeolite by-products.

**Table S1.** Structural groups detailed via FT-IR spectroscopy.

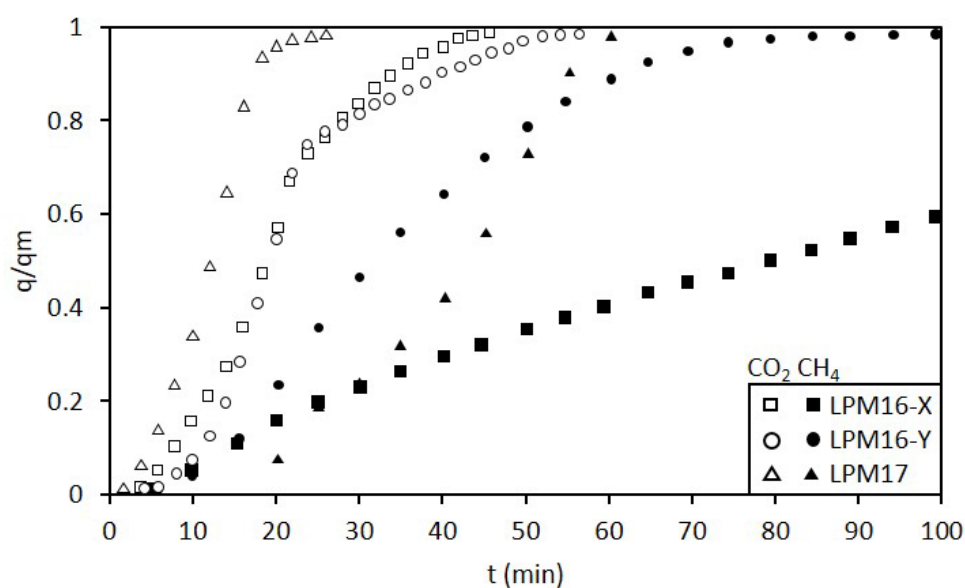
Wavenumber (cm <sup>-1</sup> )	Meaning
950–1250	T-O elongation involving movement associated with oxygen atoms, or as asymmetric elongation $\leftarrow \text{OT} \rightarrow \leftarrow \text{O}$ .
650–820	Symmetric stretching vibrations of bridge bonds – vs Si-O-Si and vs Si-O-Al.
562	Symmetric stretching vibrations of bridge bonds – vs Si-O-Si and bending vibrations – $\delta$ O-Si-O.
420–500	Bending vibrations – $\delta$ O-Si-O, occurring in “antiphase”, and $\delta$ O-Al-O.



**Figure S2.** SEM images: (a) beta-spodumene; (b) LPM16-X; (c) LPM16-Y; and (d) LPM17.



**Figure S3.** Experimental isotherms for cage- and channel-type zeolites.

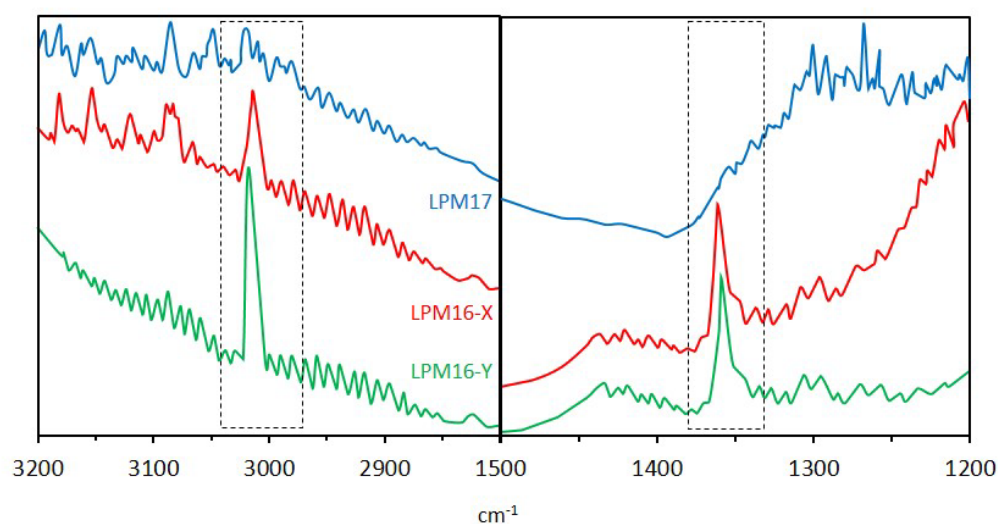


**Figure S4.** CH<sub>4</sub> and CO<sub>2</sub> fractional uptake curves of cage- and channel-type zeolites at 323 K and 1 bar.

**Table S2.** Initial adsorption rate, equilibrium time and adsorption capacity of CH<sub>4</sub> and CO<sub>2</sub> on cage- and channel-type zeolites.

By-product	IAR <sup>1</sup> (mol/sec) × 10 <sup>6</sup>		ET <sup>2</sup> (min)		AC <sup>3</sup> (mmol/g)	
	CH <sub>4</sub>	CO <sub>2</sub>	CH <sub>4</sub>	CO <sub>2</sub>	CH <sub>4</sub>	CO <sub>2</sub>
LPM16-X	1.4	2.8	250	67	10.9	3.1
LPM16-Y	3.5	3.0	65	58	9.4	3.3
LPM17	0.9	0.4	10	13	2.1	0.7

<sup>1</sup> Initial adsorption rate; <sup>2</sup> Equilibrium time; <sup>3</sup> Adsorption capacity.



**Figure S5.** FT-IR spectra of CH<sub>4</sub> adsorbed on cage- and channel-type zeolites at 293 K and 1 bar.