Pressure dependence of the carbonation kinetics of CaO under H₂O saturation

R. Miletich[1]*, G. Gravogl[1,2], F. Birkelbach[3], D. Müller[2], C.L. Lengauer[1], P. Weinberger[2]

[1]Institut für Mineralogie und Kristallographie, Universität Wien, A-1090 Wien, Austria (*ronald.miletich-pawliczek@univie.ac.at, georg.gravogl@univie.ac.at, christian.lengauer@univie.ac.at)
[2]Institut für Angewandte Synthesechemie, TU Wien, A-1060 Wien, Austria (danny.mueller@tuwien.ac.at, peter.e163.weinberger@tuwien.ac.at
[3]Institut für Energietechnik und Thermodynamik, TU Wien, A-1060 Wien, Austria (felix.birkelbach@tuwien.ac.at)

Carbonation experiments of calcium oxide were performed in the low-temperature regime (ranging from 25°C to 100°C) at variable CO_2 gas pressures (from 10 to 50 bar) in a modified high-pressure reaction chamber adapted for in-situ XRD measurements. Conditions of water saturation on the sample powder was achieved by using a HPLC pump. The carbonation reaction was monitored by means of time-resolved XRD at a time resolution of 60 to 120 seconds using a 300K Pilatus detector on a Stoe Stadivari system. Conversion rates were extracted from quantitative phase analyses as obtained from Rietveld refinements.

CaO completely transforms within a few minutes by reaction with CO_2 and H_2O forming $Ca(OH)_2$ in a transient state and finally $CaCO_3$ A distinct P and T dependence can be observed and the non-parametric kinetic analysis confirmed the P,T dependence. Considering the two reactions steps $CaO{\rightarrow}Ca(OH)_2$ and $CaO/Ca(OH)_2{\rightarrow}CaCO_3$, a positive dependence on T and almost no P effect was observed for the hydration reaction, whereas a pronounced negative T-dependence together with a remarkably strong P-effect was found for the reaction part of the carbonation.