Reaction kinetics of Mg-carbonates

Report by U-N Berninger

Mineral scale formation is a common and costly phenomenon in many processes handling with aqueous solutions. Carbonate precipitation e.g. is responsible for lost efficiency in heat exchangers and boilers. The retrograde solubility of carbonates is the driving force to produce these scaling minerals. Besides this thermodynamic driving force kinetic factors as cation dehydration are influencing carbonate precipitation. With respect to this, especially magnesium plays a crucial role in the carbonate system. While influencing precipitation rates of calcite and partly being decisive for the final CaCO₃ polymorph formation, the formation of anhydrous Mg-carbonates seems to be inhibited.

To constrain the influence of magnesium in the carbonate system a better understanding of the reaction kinetics of Mg-carbonates is needed. Main Mg-carbonates encountered in natural environments are e.g. dolomite, magnesite and hydromagnesite. Closed-system reactors were used to investigate reaction kinetics of hydromagnesite as a function of temperature and pH at far to near equilibrium conditions in NaHCO₃/Na₂CO₃ bearing aqueous solutions. Fig. 1 shows the temporal evolution of aqueous Mg concentration at 22.5 °C before and after injection of 2 mL of a MgCl₂– enriched solution.



Fig. 1: Temporal evolution of aqueous Mg contration (squares) and the kinetic fit (yellow line) at 22.5 °C.