

EXPERIMENTALLY CONSTRAINING RATES OF SEPIOLITE GROWTH AT AMBIENT CONDITIONS

MARIA L. ARIZALETA*¹, MICHAEL NIGHTINGALE¹,
BENJAMIN M. TUTOLO¹

¹ University of Calgary, 2500 University Dr. NW Calgary,
AB, T2N 1N4, Canada | maria.arizaleta@ucalgary.ca

The magnesium silicate mineral sepiolite is an important component of sediments deposited in a variety of environments worldwide, including alkaline lakes, basaltic geothermal systems, and diatomaceous marine sediments. Because of its widespread occurrence and unique geochemical behaviour, it is important to quantify sepiolite growth and produce improved quantitative geochemical models of these environments where it occurs. Although some estimates of solubility and growth rates for amorphous Mg-silicates have been published^[1], the growth rate of sepiolite as a function of important parameters such as pH, Mg, and Si concentrations remains almost entirely unconstrained. Thus, we have performed a series of sepiolite-seeded batch and flow-through experiments at room temperature with varying pH and concentrations of Mg and SiO₂(aq). Two chemically pure varieties of sepiolite were used in the experiments; their stoichiometric ratios of Mg to Si were found to be 0.57 and 0.52, respectively, slightly lower than that of ideal sepiolite. Growth rates were measured by monitoring the rate of depletion of Mg and Si from the solution during interaction with these sepiolite seeds. Within error, our experiments achieve stoichiometric sepiolite growth over a range of Mg and Si concentrations in solution. Typical growth rates are on the order of 10⁻¹² mol/m²/s, in agreement with previously measured rates^[2]. The data also demonstrate that the rate of sepiolite growth increases with increasing pH and Mg and Si concentrations. However, at very high pH (≥10.5), brucite precipitates rather than sepiolite, even at relatively low Mg concentrations. The sepiolite growth rate law developed in this study will inform geochemical models of sepiolite formation, which, in turn, will be used to interpret the evolution of modern sepiolite-forming systems as well as the paleoenvironments of sepiolite-bearing sediments.

References:

- ^[1] Tosca N, Masterson A. (2014) Chemical controls on incipient Mg-silicate crystallization at 25°C: Implications for early and late diagenesis. *Clay Miner.* 49(2): 165–194.
- ^[2] Brady, P. V. 1992. Surface complexation and mineral growth: Sepiolite. *Water-Rock Interaction*, Kharaka & Maest (eds) p: 85-88.