

Constraining the role of poorly crystalline Mg-phylosilicates in carbonate precipitation in lacustrine environments

MARIA L. ARIZALETA, PHD, NINA ZEYEN, MAIJA RAUDSEPP AND SIOBHAN A. WILSON

University of Alberta

Presenting Author: arizalet@ualberta.ca

Authigenic, Al-poor, hydrated, Mg-rich phyllosilicates (e.g., stevensite, sepiolite, kerolite) are important components of modern sediments, such as alkaline lakes and siliceous marine environments^[1]. Mg-phylosilicates (stevensite, talc) are sometimes preserved in the geologic record as part of ancient evaporite deposits from lakes or seawater, and they are associated with carbonate minerals, such as calcite, aragonite, dolomite, and magnesite. Replacement of Mg-phylosilicates by carbonate minerals has been inferred from observations of lacustrine sediments and microbialites. Hence, it has been hypothesized that poorly crystalline Mg-phylosilicates can serve as a precursor for Ca-Mg-carbonate precipitation in alkaline lakes^[2]. However, the precise geochemical conditions in which this transformation may occur, and the mineral phases involved, remain relatively unknown. Despite numerous studies done on Mg-silicate precipitation rates and behaviour^[1], there is still a significant gap in knowledge on the kinetic barriers present in natural environments given the observation that many natural waters are supersaturated with respect to Mg-phylosilicates, but they do not precipitate.

Here, we present the results of a series of bench-top batch experiments designed to study the reaction between poorly crystalline stevensite, a Mg-rich, Al-poor smectite, and alkaline waters. Variables tested in these experiments (aqueous Mg/Si concentrations, alkalinity, pH, aqueous Ca, presence or absence of microbes) show how the geochemistry of the solution controls the final mineral products. Synthetic stevensite, associated carbonate minerals and microbes were analyzed using scanning electron microscopy (SEM), powder X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR). Given that the conditions required for the co-existence and transformation of the involved mineral phases are poorly understood, the parameters tested in these experiments in a laboratory and field setting as well as in modelling, will allow for better quantitative geochemical models of these environments and their potential for carbon sequestration.

References

[1] Tosca, N. J. 2015. Geochemical pathways to Mg-clay formation. In: *Magnesian Clays: Characterization, Origins and Applications* (Eds M. Pozo and E. Galan). *AIPEA Special Publications*, 2, 283–329.

[2] Zeyen, N., et al. 2021. Integrative analysis of the mineralogical and chemical composition of modern microbialites from ten Mexican lakes: What do we learn about their