

Andrea Billarent-Cedillo, Cédric Goudswaard, Helen King, Oliver Plümper (2022) Characterization of aqueous silica species and in-situ dissolution-precipitation monitoring using Raman and FTIR spectroscopy. AGU, Fall Meeting 2022, Chicago, IL., 12-16 December.

In the permeable upper crust, dissolution and precipitation reactions between silicate minerals and the silica species in aqueous fluids affect the porosity and permeability of the rocks, sealing existing fluid pathways or producing new ones. Understanding the evolution of these pathways is highly significant in the improvement of resource exploitation and the sequestration of contaminants and greenhouse gases. Silica reactivity is important in diverse geological, biogeochemical, and material science studies. Yet, there is no experimental research on the spatial and temporal tracing of dissolution-precipitation reactions in silica-rich fluid systems. Previous studies have used ^{18}O -doped water to identify the chemical reaction mechanisms and trace the transportation of material during these reactions. This method has been effectively used in the oxyanion systems PO_4^{3-} and CO_3^{2-} using vibrational spectroscopy¹. Silica in aqueous fluids is more complex than the PO_4^{3-} and CO_3^{2-} oxyanions, as it can be present in multiple forms such as silicic acid, monomers, and polymers and may form particles such as colloids and even gels whose structure evolves with time. The stability and presence of different silica species and phases can be sensitive to the physicochemical conditions of the fluid. Therefore, in this work, we have built a comprehensive overview of silica behavior related to temperature (22-100 °C), pH (7-13), and ionic strength (varying Na-, K-, Ca-, and Mg chloride salts) that would be applicable to geothermal systems. Silica in these systems was analyzed in-situ with Raman and attenuated total reflectance Fourier transform infrared (ATR-FTIR) spectroscopy. Using vibrational spectroscopy also enabled us to observe changes in the water structure under different conditions, which may affect the exchange rate of ^{18}O from doped water into silica. This information was then combined to test if ^{18}O -exchange from doped water coupled with vibrational spectroscopy can be used as a reaction tracer for the silica system.

1. King & Geisler *Minerals* 8, 1–15 (2018).