

The effect of clay minerals on Li in a simulated martian groundwater environment

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On Earth, weathering removes highly soluble Li from minerals; this Li can then either be carried away by groundwater or incorporated into secondary products including clay minerals (Zawidzki 1976; Starkey 1982). This incorporation into clay minerals can occur as substitution into the mineral structure or via adsorption onto the surface (Horstmann 1957; Ashry, 1973; Nielsen 1976; Williams & Hervig, 2005; Ajouyed et al., 2011). This means that in terrestrial sediments Li is commonly elevated in the clay-size fraction (Starkey, 1982; Villumsen & Nielsen, 1976). Based on these observations on Earth, martian correlations in Li abundance, CIA, and clay mineral abundance observed by the Curiosity rover have been attributed to Li hosted in clay minerals, suggesting that Li can be used as a proxy for clay mineral abundance in some areas (Frydenvang et al., 2020; Bristow et al., 2021; Dehouck et al., 2022). To investigate this open question in the laboratory using Mars-relevant regolith and clay minerals, we conduct continuous flow packed-bed reactor experiments to test which clay minerals affect the Li concentration of Mars regolith simulant MGS-1 during a single aqueous event. We test 4 dioctahedral clay minerals (kaolinite, illite, nontronite, mixed layer illite/smectite) and 2 trioctahedral clay minerals (talc, saponite). We find that 5 of the 6 clay minerals (all but saponite) are capable of pulling Li from groundwater simulant into the solid sample at higher rates than the regolith simulant alone, with the talc having the strongest effect compared to the control. Whether this is via incorporation into the mineral structure or surface adsorption, this finding supports the observation that Li moves with clay mineral content in Gale crater and may be a suitable proxy for clay mineral content in rocks affected by aqueous diagenetic processes.