# Probing silicates to assess reactivity at the surface-solution interface: An NMR study of feldspars

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A method developed to quantify hydroxyl (OH) sites on kaolinite is applied here for the first time to feldspar grains from soils in a glacial chronosequence. Illuminating the interplay between accumulation of surface OH sites and time primary silicate minerals have spent in the weathering environment could be a step towards mechanistically understanding the reasons mineral dissolution rates are observed to decrease with time. In this study, we have sampled soil from discrete deposits—with ages ranging 10ka to 200ka—along glacial chronosequences in the Sierra Nevada and Colorado Rocky Mountains. Feldspar grains were picked from these soils and treated with (3,3,3 trifluoropropyl) dimethylchlorosilane (TFS). This molecule selectively binds to $Q^3$ OH sites on silica and alumina tetrahedra—sites wherein one tetrahedral anion forms a hydroxyl at the surface during dissolution and the other three remain coordinated with the crystal. NMR spectroscopty is a sensitive, non-destructive analytical method, and we used it here to quantify $^{19}F$ in TFS on our treated feldspar samples. OH concentrations were inferred from these data, and normalized to BET specific surface area. Treated samples were also dissolved and run through an MP-OES for elemental analysis, to determine whether or not time-dependent mineralogical evolution was at play.

Preliminary results from NMR experiements show a positive correlation between $Q^3$ OH site count and exposure age of the deposit. Elemental analysis by MP-OES confirms that mineralogical differences among samples were not significant enough to overshadow the trend. This study confirms that the NMR procedure used for kaolinite by Sanders et al.[1] is sensitive enough to quantify significantly lower concentrations of OH sites, as found on feldspar surfaces. It is our hope that continued investigation using the NMR method will shed light on the molecular-scale processes that drive interface-limited systems.

[1] Sanders, Washton & Mueller (2010), *Journal of Phys. Chem.* **114**, 5491-5498