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The Ge/Si ratio and Si isotopic fractionation in the Baxter Hollow paleosol may indicate minimal clay mineral formation in the Paleoproterozoic

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Paleosols provide an opportunity to study the preserved remnants of ancient weathering processes. Of novel interest are paleosols that formed during periods that coincided with the early evolution of complex life. Here we report on the stable isotopic composition and elemental Ge/Si ratios of a Late Paleoproterozoic and early Mesoproterozoic paleosol in the stable craton of North America.

The Baxter Hollow granite, a lobe of the 1.75 Ga Montello batholith, was exposed and weathered for an unknown duration with the overlying Baraboo Interval Quartzite deposited at 1.7 Ga preserving the sharp erosional contact. The unconformably overlying conglomeratic mudstone and siltstones grade upwards into a mature quartz arenite and phyllite. Today this interval is buried and only accessible via drill core 613 archived at the Wisconsin Geological and Natural History Survey Repository at Mount Horeb, WI

The saprolite and regolith, as defined and described by Medaris et al., (2017) in this profile were sampled and the Si isotopic composition and Ge/Si ratios measured. Chemical alteration, expressed as CIA ranged from 55 in the protolith to 83 in the saprolite, indicating significant alteration. The Ge/Si ratio of 1.45 ± 0.2 remains fairly constant from the protolith to the upper saprolite, with decreasing ratios observed in the highest saprolite and regolith samples. The silicon isotopic composition also remains fairly constant, with silicon isotope values nearly identical to the protolith of $\delta 30Si = -0.25‰$.

The minimal fractionation observed in Si isotopes and Ge/Si ratios during the weathering of the Baxter Hollow granite remains in contrast to the previously reported intensive sub-aerial chemical weathering in the region during the late Paleoproterozoic. The increase in CIA values and the destruction of primary minerals and accompanying minimal Si isotope fractionation may be attributable to limited clay mineral production.