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Magnesium Isotopic Variations in an Early Cambrian Paleosol on the Great Unconformity: Implications for Intensive Silicate Weathering during the Precambrian-Cambrian Transition.

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Magnesium (Mg) isotopes can be substantially re-distributed and fractionated during silicate weathering processes, thus serving not only as an important tool to understand the global silicate and Mg-cycle during the continental weathering but also as a proxy to reconstruct paleo-weathering regimes. In this study, we examined the Mg isotopic composition of a saprolite profile under the Great Unconformity that was developed on an Archean crystalline granitic basement and later buried under the middle Cambrian Flathead sandstone. δ^{26}Mg of weathered saprolites exhibits a significant increase from the bedrock isotopic value, which ranges from -0.32 ± 0.09‰ to 0.93 ± 0.09‰: the heaviest isotopic composition reported for Mg in modern saprolites and soils developed on granitic basements. Extremely high δ^{26}Mg values indicate intensive chemical weathering during the transition from late Precambrian to early Cambrian on the Wyoming Craton. Mg isotopic fractionation during the development of the saprolite was likely controlled by the accumulation of clay minerals, rather than the dissolution of primary minerals. Such Mg isotopic behavior suggests that the weathering regime was transport-limited with a low erosion rate favoring secondary mineral precipitation. According to mineralogical and bulk geochemical analyses, clay mineral formation is dominantly illite and vermiculitized chlorite, while the dissolution of biotite to kaolinite and smectite is only focused in the less weathered saprock domain. Thorough studies on the Mg isotopic signature on the clay-sized portions of the saprolite are still required to better understand the Mg isotopic system of silicate weathering in deep time.