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Assessing Mo isotope variations in siliciclastic sedimentary rocks deposited before the Great Oxidation Event

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Molybdenum isotopic compositions ($\delta^{98/95}$Mo) in terrigenous sedimentary rocks are emerging as a valuable tool for characterizing chemical weathering conditions. A previous study demonstrated that glacial diamictites deposited before the Great Oxidation Event (GOE) possess unfractionated $\delta^{98/95}$Mo values (+0.03 ± 0.18‰) whereas post-GOE glacial diamictites are enriched in isotopically light Mo (Greaney et al., 2020 *EPSL* **534**, 116083). The negative shift in $\delta^{98/95}$Mo has been interpreted to reflect the onset of oxidative weathering because isotopically light Mo is preferentially retained in Fe oxides during modern chemical weathering (e.g., Greaney et al., 2021 *Chem. Geol.* **566**, 120103). However, isotopic fractionation during anoxic weathering is poorly discussed because modern analogues for pre-GOE weathering are lacking.

To further understand $\delta^{98/95}$Mo variations among terrigenous sedimentary rocks, we focus on the chemical compositions of pre-GOE sandstones from the 2.45-Ga Matinenda Formation in the Huronian Supergroup, Canada. The Matinenda Formation formed in shallow braided channels and is known to contain detrital U-bearing minerals and pyrite (Fralick & Miall, 1989 *Sediment. Geol.* **63** 127-153). Detrital uraninite and pyrite were also observed in the samples analyzed. The $\delta^{98/95}$Mo of the analyzed samples range from -0.32 to 0.50‰ with an average value of +0.03 ± 0.39‰. The average value agrees well with that of the pre-GOE diamictites. However, the analyzed samples show more scattered values. Since the samples with low $\delta^{98/95}$Mo values show high total sulfur contents, the scatter likely reflects heterogeneity in the Mo isotopic composition of detrital pyrites. Hence, we suggest that anoxic weathering did not impart analytically resolvable Mo isotope fractionation to the sandstones of the Matinenda Formation.