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Understanding the phase associations and weathering behavior of rhenium to assess the use of Re as a tracer of georespiration

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On geologic timescales, oxidative weathering of sedimentary rocks influences Earth's climate. The flux of CO_2 released via oxidation of petrogenic carbon (OC_{petro}) – a process known as georespiration – is not well constrained globally, but it is thought to be similar in magnitude to the release of CO_2 from volcanic degassing. Recent research highlights the potential for the redox sensitive trace metal rhenium (Re) to serve as a tracer for this process; however, questions remain whether Re release during oxidative weathering is associated with OC_{petro} oxidation, sulfide oxidation, or primary mineral dissolution. Here we use an open system mass transfer approach to compare mobilization patterns between Re, OC_{petro}, and other major and trace elements (including those derived from sulfide minerals, carbonate minerals, and silicate minerals) in weathering profiles from two small mountainous river systems (Eel and Umpqua Rivers in the Pacific Northwest, USA). We also conducted a 6-step sequential extraction protocol modified from Dellinger et al. (2021) on eight bedrock samples and two standard reference materials (BCR-2 and SDO-1) to investigate the Re content of solid phases in a bulk sample. Soil and borehole profiles show that Re loss patterns are similar to OC_{petro} and primary minerals, while there is an obvious deep sulfide oxidation front that does not coincide with the loss of Re. Ongoing analyses of the supernatants and solid residues of the sequential extractions will evaluate the phase associations of Re relative to free ions, exchangeable ions, carbonates, sulfides, OC_{petro}, and silicates. Comparing the weathering behavior of Re in the solid phase in soils and boreholes, in tandem to sequential extractions to target the phase association of Re, allows for better understanding on the efficacy of Re to trace the process of geologic respiration.

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