

Geochemistry of weathering profiles in contrasting small mountainous rivers in the Pacific Northwest, USA: controls on the oxidation of petrogenic carbon

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There is an estimated $\sim 15 \times 10^6$ Pg C stored in the Earth's lithosphere as petrogenic organic carbon (OC_{petro}). During the weathering and erosion of sedimentary and metasedimentary rock, OC_{petro} is oxidized to release CO_2 – a process known as geologic respiration. The rate of geologic respiration is thought to be controlled by the supply of OC_{petro} available to react, which is influenced by the rate of physical erosion. The flux of georespiration is not well constrained globally, but it is thought to be similar in magnitude to the release of CO_2 from volcanic degassing. The trace element rhenium (Re) has been used as a tracer for the oxidation of OC_{petro} . Here we use an open system mass transfer approach to compare mobilization patterns between the Re and OC_{petro} during chemical weathering in deep weathering profiles, soils, and riverine bed material and suspended sediments in the Eel River of Northwestern California and in the Umpqua River of Southwestern Oregon. The Eel and Umpqua Rivers share many key characteristics in terms of size, discharge, climate, and vegetation, but they have a 10-fold difference in erosion rate and sediment yield due to their underlying lithologies and tectonic setting. We also compare the behavior of Re and OC_{petro} relative to other major and trace elements, including those derived from sulfide minerals, carbonate minerals, and silicate minerals. Soil profiles show that Re loss patterns are similar to those of OC_{petro} loss during weathering. We observe that the depth of the sulfide oxidation front is deeper than that of Re and OC_{petro} . The data from this study support the notion that in the solid phase, OC_{petro} and Re are associated with one another and are lost at similar rates during chemical weathering. By co-locating analyses of weathering profiles with data from watershed-scale riverine dissolved and particulate fluxes, this data allows for better understanding of the controls on OC_{petro} oxidation in actively eroding small mountainous river systems.