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Quantifying petrogenic organic carbon weathering fluxes and associated CO_2 release using dissolved rhenium in rivers

MATHIEU DELLINGER[1], ROBERT HILTON[2], MATEJA OGRIC[3], KATE HORAN[4], KATHERINE E GRANT[5], GUILLAUME SOULET[6] AND A. JOSHUA WEST[7]

[1]CNRS - Université Savoie Mont Blanc
[2]University of Oxford
[3]Durham University
[4]The Royal Veterinary College
[5]Lawrence Livermore National Laboratory
[6]IFREMER
[7]University of Southern California

Presenting Author: mathieu.dellinger@univ-smb.fr

The oxidation of organic carbon contained within sedimentary rocks ("petrogenic" carbon, or OC_{petro}) is potentially a major emission of CO_2 to the atmosphere over long timescales (>10^5 yrs) but remains difficult to quantify. Dissolved Rhenium (Re) has emerged as a proxy that offers much promise to track and quantify OC_{petro} oxidation rates at watershed scale. In this presentation we synthesize a recent body of work that has sought to calibrate and apply this Re proxy in small to large river catchments around the world. We use river sediments and soil profiles to characterize the Re-OC_{petro} coupling loss during oxidative weathering, and we correct for non-OC_{petro} derived dissolved Re sources using mixing mass-balance based on elemental ratios. In mountain areas dominated by sedimentary rocks, the vast majority of dissolved Re is derived from OC_{petro} oxidation, validating the use of the Re-proxy to derive catchment-scale OC_{petro} oxidation fluxes in these settings.

Overall, we find that high erosion rates can significantly increase OC_{petro} oxidation rates. However, important secondary factors that include bedrock OC_{petro} content, temperature, and O_2-supply also appear to play a role. Hence, uplift and exhumation of sedimentary rocks in a mountain range can increase the rates of OC_{petro} oxidation and CO_2 release. However, because the overall OC_{petro} weathering intensity in mountains is generally low (< 50% OC_{petro} oxidized), we demonstrate that floodplains can further increase OC_{petro} oxidation and CO_2 release associated with mountain building, further tipping these landscapes towards being a source of CO_2. These new findings have important implications for improving our understanding of the source and processes controlling Re in rivers and allowing us to quantify long-term OC_{petro} cycling in large river basins.