Carbon export by erosion of biomass from a mountain belt: Controls on rates of transfer

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Erosion of particulate organic carbon (POC) from the continents and its delivery to the ocean by rivers is an important global carbon transfer. POC yields are highest in mountain river catchments which contribute a significant part of this flux. To understand how surface processes drive CO_2 sequestration, it is key to better constrain how POC is eroded from the terrestrial biosphere (POC_{mod}) in mountain landscapes. This necessitates river sampling over a large range of hydrological conditions and recognition that fossil POC from sedimentary rock is important in these settings[1]. Here we focus on 11 major catchments of the Central Range, Taiwan, where physical erosion is high and frequent tropical cyclones provide a large range of flow conditions. We sampled river suspended load at hydrometric gauging stations one to three times a month over two years. The fraction of non-fossil POC of the suspended load was quantified using a mixing model constrained by the stable carbon isotopes and nitrogen to organic carbon ratio (whose precision and accuracy was independently assessed using ^{14}C[1]). A general positive relationship was observed between suspended sediment and POC_{mod} yields across the mountain belt. However, four catchments with similar sediment yields over the gauged period ($20\pm2\times10^3$ t km^{-2} yr^{-1}, mean ± σ) had POC_{mod} yields which varied by a factor of ~4 (15±8 tC km^{-2} yr^{-1}, mean ± σ). We can explain the general trend and variability by modelling erosion processes in mountain landscapes: bedrock landslides supply the bulk of clastic sediment and some POC_{mod}; further POC_{mod} is supplied by shallow landsliding and overland flow. Erosion of POC_{mod} is strongly controlled by climate in these catchments.

[1] Hilton *et al.* (2010) *Geochim. Cosmochim. Acta,* **74**: 3164-3181, doi:10.1016/j.gca.2010.03.004

Experimental constraints on molybdenum isotope fractionation between metal and silicate liquids

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So far planetary core formation conditions have been mainly constrained by element partitioning, particularly by experimental determination of distribution coefficients between metal and silicate liquids. However, driven by analytical developments fractionation of non-traditional stable isotopes has become a new tool for studies of core formation. Experimental determinations of metal-silicate liquid equilibrium Si and Fe isotope fractionation factors reveal significant effects for Si, but not for Fe [1,2].

As a siderophile and refractory element, Mo can provide additional information about conditions of core-mantle differentiation. As oxidised Mo should occur in a 4+ valence state in equilibrium with metal [3], its bond stiffness may be more similar to that of Si than to that of Fe.

To evaluate the possibility of equilibrium mass-dependent Mo isotope fractionation during metal-silicate segregation, we have designed piston cylinder experiments with a basaltic silicate composition and an iron based metal with ~8 wt% Mo. Metal and silicate phases are completely segregated by use of a centrifuging piston cylinder at ETH Zurich, such preventing analyses of mixed metal and silicate signatures. Molybdenum isotope compositions were measured using a Nu1700 MC-ICP-MS at ETH Zurich. To ensure an accurate correction of analytical mass fractionation a ^{100}Mo-^{97}Mo double spike was admixed before chemical Mo purification.

Preliminary results suggest that the equilibrium $^{98}Mo/^{95}Mo$ isotope fractionation factor between metal and silicate liquids may be -0.17±0.15‰ (2σ uncertainty) at 1350°C and 1 GPa. More analyses on reproduced experiments will have to show if this small fractionation can be confirmed, making Mo isotopes a potential tool for constraining the conditions of core formation in asteroids and terrestrial planets.

[1] Shahar *et al.* (2009) *EPSL* **288**, 228-234. [2] Poitrasson *et al.* (2009) *EPSL* **278**, 376-385. [3] Farges *et al.* (2006) *Can. Min.* **44**, 731-753.