Western Oregon as a low-sediment end member of particulate organic carbon export from temperate forested uplands

J.C. SMITH[1]*, A. GALY[1,2], N. HOVIUS[3] AND A. TYE[4]

[1]Department of Earth Sciences, University of Cambridge, Cambridge CB2 3EQ, United Kingdom (*correspondence: jcs74@cam.ac.uk)
[2](ajbg2@cam.ac.uk)
[3]German Research Centre for Geosciences GFZ, 14473 Potsdam, Germany (hovius@gfz-potsdam.de)
[4]British Geological Survey, Keyworth, Nottingham NG12 5GG, United Kingdom (atye@bgs.ac.uk)

The transfer of continental biomass to geological storage has the potential to sequester considerable amounts of carbon dioxide. Despite an initial focus on active mountain belts as prime locations for this erosion, temperate forested uplands might also have a significant role to play.

In some temperate catchments with high connectivity between hillslopes and actively incising channels, clastic yield is high, but soil is preferentially mobilised by overland flow beyond a moderate discharge threshold, resulting in the export of globally significant amounts of biomass [1]. However, these processes are not universal in temperate forested uplands. Using organic carbon and nitrogen elemental and isotopic ratios, we present results revealing contrasting particulate organic carbon dynamics in the headwaters of Western Oregon. Suspended sediment concentrations are typically very low, while organic carbon concentrations frequently reach 30%. A lack of active incision has led to the development of flat, thickly vegetated riparian zones which isolate hillslopes. Nevertheless, considerable amounts of soil and plant material are eroded from the channel and immediately adjacent areas during rain. Such settings export non-fossil organic carbon at rates of ~6 t km^{-2} yr^{-1}, around half the rate from the high-sediment temperate end member. Contrasts between the two systems suggest that ecosystem biology is the principal control on POC export style in temperate forested uplands.

Comparison of our results with studies made downstream of these headwaters at their entry to the Pacific Ocean [2, 3] offers new insights into the fate of biomass mobilised in Oregon's uplands and similar settings.

[1] Smith *et al*. (2013), *Earth Planet Sc Lett* **365**, 198-208. [2] Hatten, Goñi & Wheatcroft (2012), *Biogeochemistry* **107**, 3-66. [3] Goñi *et al*. (2013), *J Geophys Res-Biogeo* **118**, 1-23.

Helium equilibrium between pore water and quartz: A clever, but limited tool

S.D. SMITH[12]*, G.A. HARRINGTON[1], B.D. SMERDON[1] AND D.K. SOLOMON[2]

[1]CSIRO Water for a Healthy Country Flagship, Urrbrae, SA 5064, Australia
(*correspondence: stan.smith@csiro.au)
(glenn.harrington@csiro.au, brian.smerdon@csiro.au)
[2] Dept. of Geology and Geophysics, Univ. of Utah, Salt Lake City, UT 84112, USA (kip.solomon@utah.edu)

Pore water helium concentrations calculated from quartz helium concentrations [1] offer a unique tool to determine helium distribution in low permeability formations. Analyses have been carried out on shale and sandstone core samples from the San Juan Basin, USA and the Eromanga and Surat basins, Australia.

Comparing quartz-derived helium concentrations to direct pore water concentrations reveal up to an order of magnitude difference between the two. This uncertainty is unacceptable for modelling vertical helium transport to constrain estimates of fluid flux. However, in the San Juan Basin, $^3He/^4He$ ratios agree between methods. In the Eromanga Basin, modelling indicates >90% equilibrium is expected, however, when compared with direct pore water measurements [2], as low as 10% of equilibrium is observed. Regardless of present-day equilibrium, the method could be useful for paleohydrology studies, provided the timing of equilibrium can be constrained.

The method appears more promising in deeper (thus hotter) basins where the equilibrium time between pore water and quartz is reduced significantly. In shallow systems, the equilibrium time may greatly exceed the lifespan of shallow, quasi-steady state hydrological systems. Further testing of the method in additional basins may result in an adequate screening method to find where the method is applicable. The possibility exists that this method will not come to fruition as too much uncertainty remains and equilibrium is found in theory instead of in the samples.

[1] Lehmann, Waber, Tolstikhin, Kamensky, Gannibal, & Kalashnikov (2003) *Geophy Res Lett* **30**, 4. [2] Gardner, Harrington, & Smerdon (2012) *J. Hydrol* **468**, 63-75.

DOI:10.1180/minmag.2013.077.5.19