

Riverine particulate organic carbon from the western Southern Alps, New Zealand

R.G. HILTON¹, A. GALY² AND N. HOVIUS³

Department of Earth Sciences, University of Cambridge,
Downing Street, Cambridge, United Kingdom
(¹rgh31@esc.cam.ac.uk, ²albert00@esc.cam.ac.uk,
³nhovius@esc.cam.ac.uk)

The flux of particulate organic carbon (POC) from small mountainous rivers draining active orogens accounts for a large proportion of the global riverine POC flux [1]. Their importance in atmosphere-ocean carbon dynamics may be disproportionately large due to their high-sediment production, small storage potential and tendency to discharge sediment at extremely high concentrations [2]. It is therefore important to constrain the type and amount of carbon mobilised.

Suspended load, bedload and sediment samples from landslide debris fans were taken from catchments draining the rapidly eroding, densely vegetated western Southern Alps, New Zealand. The samples allow estimates of the POC yield and determination of the main sources of organic carbon (C_{org}) using C/N as a mixing proxy.

POC yield estimates range from $280\text{--}4600 \times 10^6 \text{ mol.yr}^{-1}$ – which are high globally and similar to previous estimates [1]. C_{org} decreases with increased suspended sediment concentration (SSC). At mean annual SSC C_{org} concentration $\sim 0.4\%$ and C/N ~ 13.5 , which is characteristic of the clay/silt fraction measured in landslide deposits. This may be the main POC source during mean flow and is related to breakdown and re-sorption of non-kerogen carbon onto mineral grains during soil processes (c.f. [3]). During higher flow events, when these rivers may transport the majority of their POC yields to the ocean, the source of carbon (and its C/N) may be significantly different.

References

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Geochemical evolution of Pleistocene glacial meltwaters within regional carbonate aquifer systems, Midcontinent, U.S.

J.C. MCINTOSH¹ AND L.M. WALTER²

¹Morton K. Blaustein Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD 21218, USA (jmcintosh@jhu.edu)

²Department of Geological Sciences, University of Michigan, Ann Arbor, MI 48109-1063, USA (lmwalter@umich.edu)

Pleistocene glacial meltwaters recharged regional aquifer systems along the margins of the Illinois, Michigan, and Appalachian basins, significantly suppressing freshwater-saline water mixing zones to great depths and reorganizing drinking water resources. Importantly, dilute water recharge into Silurian-Devonian carbonate aquifers migrated into overlying fractured, organic-rich shales and generated economic deposits of microbial gas. New elemental and isotope analyses of Sil.-Dev. groundwaters and overlying glacial drift, along the margins of the three basins, were integrated with previously published data on basinal fluids to investigate the impact of Pleistocene glaciation on regional-scale groundwater flow and geochemical evolution of glacial meltwaters within confined aquifers.

Groundwaters in the recharge areas of the glacial drift and carbonate aquifers are predominately Ca-Mg-HCO₃ waters with $\delta^{18}\text{O}$ and δD values within the range of modern precipitation (-11.0 to -4.5%), and have $\delta^{13}\text{C}$ values of DIC consistent with open system carbonate mineral dissolution ($\sim -12.5\%$). Groundwaters in confined aquifers, beneath lake-bed clays and Upper Dev. black shales, have relatively low $\delta^{18}\text{O}$ and δD values (-18 to -11%), within the estimated range of Pleistocene glacial meltwater (-25 to -11%), and have low activities of ^{14}C ($<8\text{pmc}$). Since the Late Pleistocene, these glacial meltwaters have been extensively altered by water-rock interactions, biogeochemical processes, and mixing with Na-Ca-Cl brines. Confined groundwaters have high $\delta^{13}\text{C}_{\text{DIC}}$ values (-10 to -2%), and elevated Sr/Ca and Mg/Ca ratios, indicating they evolved via incongruent dissolution of carbonate minerals and anhydrite under closed system conditions. The $^{87}\text{Sr}/^{86}\text{Sr}$ ratios and $\delta^{34}\text{S}_{\text{SO}_4}$ values are within the range of Sil.-Dev. carbonates and evaporites. Glacial meltwaters have been preserved at relatively shallow depths along the basin margins and have not been flushed out by more recent recharge, illustrating the importance of ice-induced hydraulic loading on deep circulation of meteoric waters, and the relatively long residence times of drinking water resources.