

From the Lower Amazon to the Mekong: How floodplains modulate fluxes of carbon from land to the sea

JEFFREY E. RICHEY*, JOHN M. MELACK
AND KIMBERLEY N. IRVINE

(*correspondence: jrichey@uw.edu)

The large rivers of the tropics account for a significant fraction of the flux of carbon to the oceans and of fluvial and lacustrine CO₂ and CH₄ to the atmosphere. Through dynamic hydrologic, geomorphological, and biogeochemical processes, their floodplains and deltas provide a significant modulation to the materials transported by the river. In the process, the template set by these surface processes produces strong chemical disequilibria at the interface between water and sediments, impacting reactions down through the sediment column. But the magnitude, and even the specific dynamics, of these processes is poorly known. The last sampling stations on major rivers are typically above the delta and channel regions of tidally-impacted lower rivers, precisely to avoid dealing with the complexities. Which means that not only are time-series of the fluxes and controls from upriver not well-known, what happens in the lower river is even more poorly characterized. Here we examine recent results from the lower Amazon River and its floodplain, in comparison to the lower Mekong and the Tonle Sap Great Lake. About 20% of the Amazon basin is seasonally inundated, with extensive floodplains along several thousand kilometers of the main channel. These aquatic environments are sites of high evasion rates of methane and carbon dioxide, up to ten times the riverine flux to the ocean, and equivalent to sequestration by the forest. Considerable spatial and seasonal differences in carbon dioxide concentrations and evasion occur in the large shallow lakes common in the lower floodplains, with floodplain and geomorphological processes attenuating the chemical signal at the 'traditional' measuring station of Obidos. In contrast, floodplains of the Mekong are constrained to the lower reaches, with fluxes impacted by the Tonle Sap great lake. Higher pH than the Amazon results in greater export of respired carbon as bicarbonate relative to pCO₂. Implications for boundary conditions for deltaic sediment chemistry will be discussed.

High-temperature kinetic isotope fractionation in silicate systems: Laboratory and natural examples

F.M. RICHTER

Geophysical Sciences, The University of Chicago, Chicago, IL 60637, USA (richter@geosci.uchicago.edu)

The talk will focus on kinetic processes (see Table below) in silicate systems that result in easily measured stable isotope fractionations. The table below provides selected references that will provide the interested reader with a good introduction to the present state of affairs.

Process	Isotopic systems	laboratory examples	natural examples
Evaporation	Mg,Fe,Si, O	[1], [2], [3], [4]	CAIs [5] spherules [6]
Chemical diffusion	Li,Ca,Mg, K	[7],[8], [9]	Vinal Cove, Maine [10]
Grain-boundary diffusion	Li		Tin Mtn.[11] Pegmatite
Thermal diffusion	Mg,Ca, Fe, Si, O	[12],[13]	

In those cases where there is both laboratory and natural examples, I will focus on the commonality of what has been found. Recent developments in better understanding kinetic isotope fractionations by molecular dynamics simulations [8] and transition state theory [14] will also be discussed.

[1] Davis *et al.* (1990) *Nature* **347**, 655–658. [4] Dauphas *et al.* (2004) *Anal. Chem.* **76**, 5855–5863. [3] Richter *et al.* (2007) *GCA* **71**, 5544–5564. [4] Knight *et al.* (2009) *GCA* **73**, 6390–6401. [5] Clayton *et al.* (1988) *Phil. Trans. Roy. Soc. London A* **325**, 483–501. [6] Taylor *et al.* (2005) *GCA* **69**, 2647–2662. [7] Richter *et al.* (2003) *GCA* **67**, 3905–3923. [8] Bourq *et al.* (2010) *GCA* **74** 2249–2256. [9] Watkins *et al.* (2011) *GCA in press*. [10] Chopra (2010) *PhD dissertation*, Univ. Chicago. [11] Teng *et al.* (2006) *EPSL* **243**, 701–710. [12] Richter *et al.* (2009) *GCA* **73**, 4250–4263. [13] Huang *et al.* (2010) *Nature* **464**, 396–400. [14] Dominguez *et al.* (2011) *Nature in press*.