ISOTOPIC SIGNATURES OF LIPID BIOMARKERS AS A TOOL FOR SEDIMENT PROVENANCE IN RIVER SYSTEMS WITH HIGH SUSPENDED LOAD

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River systems are the primary conduits for organic carbon transfer from vegetation-rich uplands to lowland basins and long-term marine sinks, and thus are responsible for significant fluxes among different reservoirs of the carbon cycle. Despite its importance, little is known about the behavior of organic carbon during transit (i.e. source, transport mechanism, preservation, degradation). Lipid biomarkers, primarily soil n-alkanes, which are refractory in nature and commonly preserved in the sedimentary record, are a key to tracing organic material through transport pathways in sedimentary systems. The n-alkane molecular and isotopic composition is influenced by a variety of ecological and environmental factors and thus can be used to trace their regional origin. For example, δD values of long-chain ($>C_{24}$) n-alkanes correlate with local δD values of mean annual precipitation (e.g. Sachse et al., 2012; Feakins et al., 2016). Building off this relationship, given we know the δD values of regional rainfall, the isotopic values of leaf wax biomarkers extracted from river suspended sediment have the potential to be used for organic sediment provenance.

We adopt this approach in the Rio Bermejo, an alluvial river system with a drainage basin area of ~120,000 km^2 on the eastern flank of the Andes in northern Argentina, which transports organic carbon from the range front to the subtropical lowlands. In the mountainous reaches of the river system, high weathering and erosion rates trigger large inputs of sediment and organic matter. Additionally, in the lowlands the river has a reach-averaged lateral migration rate of 20-30 m/yr (Sambrook Smith et al., 2016), driving rapid remobilization of floodplain sediments. This process is volumetrically most effective where the Rio Bermejo intersects the Andean forebulge. As a result of combined inputs, the downstream reach of the Rio Bermejo has an average suspended sediment concentration of 14 g/L in the wet season. In this study, we aim to trace biomarkers extracted from this suspended sediment back to their distinct sources in the catchment to learn where organic material is eroding and how lipid biomarkers are transported downstream. δD values for rain water received in the Rio Bermejo floodplain are distinct from values in its uplands, suggesting that organic material derived from these separate sources should also have distinct, identifiable δD values that reflect a source area.

We measured δD and $\delta^{13}C$ values of water samples and biomarkers extracted from river suspended sediment and floodplain soil samples collected at seven locations along a 700km reach of the Rio Bermejo. Stable isotopes of river water show a slight change to more negative $\delta^{18}O$ in the forebulge region, shifting to values of -6 to -8 from values of -5 to -6 upstream. *d*-excess is more positive in samples from the forebulge, increasing from a value of 6 upstream to values ranging from 16-20 in the forebulge. We interpret these changes to reflect increased inputs of groundwater and floodplain sediment from the uplifted forebulge. Biomarker isotopes will serve as a more powerful indication of the source of the organic material in the river. Biomarkers extracted from shallow suspended sediment show that the organic material transported by the river is composed primarily of long-chain *n*-alkanes, including C-29 and C-31 derived from higher terrestrial plants, but also significant concentrations of C-15 and C-18 alkanes, which may represent algae communities in the suspended sediment. There are higher concentrations of C-27 and C-31 n-alkanes in sediments collected from the forebulge, which could indicate increased contributions from a different higher terrestrial plant community established in this area. Stable isotope analysis will refine these preliminary interpretations.

References

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