Sources of organic carbon in the Rio Purus and Amazon River suspended matter and sediments: ^{13}C tracing

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Rivers represent the chief transport medium of carbon from the continents to the oceans. With respect to the total flux of dissolved and particulate carbon carried by rivers (~ 10^{15} gC/yr), the contribution of organic carbon is estimated to represent ~40%, with 16% being exported from the tropical rain forest environment as a whole and ~3.5 % by the Amazon River (Richey *et al.*, 1990), which is the largest river in the world, both in terms of discharge and drainage basin area. Approximately one half of the total organic carbon in the Amazon River is transported as particulate organic carbon (POC). Organic carbon from different sources contribute to the POC in the Amazon River. They can be characterized by their stable carbon isotopic composition: terrestrial organic matter produced by vascular C3 plants, either from upland or lowland sources, organic matter produced by vascular C4 plants and aquatic algae. Here we consider the POC sources and evolution in the Rio Purus system, which is typical of the "white waters", POC variations with depth in sections of the Amazon River and of major tributaries (Rios Negro, Madeira, Trombetas, Tapajos), and POC storage and remobilization in the river beds and banks.

Rio Purus sytem

The POC $\delta^{13}C$ values (−33 to −32‰) indicate a significant contribution of the algal source in the Rio Purus system, at least during the low-water season. This contribution is particularly important in a local tributary, which shows low suspended matter concentration and high organic carbon content (OC) (~6%). A study of the Rio Purus water column shows an increase of 60% in suspended matter concentrations and POC between surface and depth (respectively 0.2 and 16.5 m depth). There is no depth gradient in OC and only a weak ^{13}C depletion (0.5‰) with depth, suggesting that algal matter is produced in local varzea lakes and tributaries rather than in the Rio Purus channel. The fine-grained sediments stored on the Rio Purus banks and beds ($\delta^{13}C$ = −29 to −28.5‰) and coarser sediments stored in the river beds (−26‰) clearly differ by their isotopic composition from suspended matter during the low-water season. This indicates no storage of POC in the Rio Purus beds and banks during the low-water season. In the fine-grained sediments, the isotopic composition of organic carbon is consistent with a lowland forest-origin. In the coarse-grained sediments, it would indicate either an upland source, which seems unlikely in the Rio Purus system, or a minor contribution of C4 grasses. The $\delta^{13}C$-OC diagram clearly shows an increase in OC with increasing contribution of the algal component and decreasing contribution of the terrestrial component.

Amazon River and major tributaries

In the Amazon surface waters, the $\delta^{13}C$ values remain stable (−29.7 to −29.1‰), during the period of sampling, i.e. the falling stage of the low-water season. They are consistent either with (1) a dominant lowland forest-origin for the exported organic matter or (2) mixed sources including upland, lowland and algal-derived POC. There is only a weak increase of suspended matter and POC concentration (10−20%) and ^{13}C depletion (less than 0.5‰) with depth, which may be related to a minor algal contribution in the surface waters. The $\delta^{13}C$ of POC in the surface waters of the Rios Negro (−30.4‰) and Trombetas (−33.5‰) shows a significant contribution of algal matter. These two rivers are also characterized by low suspended matter content and high OC (>10%). The Rio Trombetas exhibits strong depth gradients (between 0.2 and 17 m depth) in suspended matter concentration, POC concentration and OC: the POC isotopic composition indicates dominant algal source in the surface waters and lowland terrestrial source at depth. Sediments from the Amazon river channel clearly differ by their

isotopic composition ($\delta^{13}C$ ~−27‰) from the suspended sediments ($\delta^{13}C$ = −29.7 to −29.1‰) during the period of our sampling (low-water). The ^{13}C values and the $\delta^{13}C$-OC diagram are consistent with the observation of Meade (1994) that suspended sediments are not stored but resuspended in the lower Amazon during falling stages. Sediments would be stored during the rising stages, as confirmed by their isotopic composition, which is close to the composition found for fine POC during the rising stages. During falling stages, they may be resuspended and contribute to the suspended sediments.

References

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