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Erosion of particulate organic material from an Andean river and its delivery to the Amazon Basin

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Organic carbon and nutrients discharged by mountainous rivers can play an important role in biogeochemical cycles from regional to global scales. The eastern Andes host productive forests on steep, rapidly eroding slopes, a combination that is primed to deliver sediment, carbon and nutrients to the lowland Amazon River. We quantify clastic sediment and particulate organic carbon (POC) discharge for the Kosñipata River, Peru, an Andean tributary of the Madre de Dios River, using suspended sediment samples and discharge measurements over one year at two gauging stations. Calculations of sediment yield on the basis of this data suggest that the Madre de Dios basin may have erosion rates ∼10 times greater than the Amazon Basin average. The total POC yield over the sampling period was up to five times higher than the yield in the lowland Amazon Basin, with most POC (70-80%) exported between December and March in the wet season. We use radiocarbon, stable C isotopes and C/N ratios to distinguish between the erosion and discharge of POC from sedimentary rocks (petrogenic POC) and POC eroded from the modern terrestrial biosphere, from vegetation and soil (biospheric POC). We find that biospheric POC discharge was significantly enhanced during flood events, over that of clastic sediment and petrogenic POC.

The ultimate fate of the eroded POC may play a central role in the net carbon budget of Andean forest. In these forests, net productivity minus heterotrophic respiration is close to zero at the scale of forest plots, and the erosion of biospheric POC by this Andean river is sufficiently rapid that its fate downstream (sedimentary burial/preservation versus oxidation/degradation) may determine whether the mountain forest is a carbon sink or source to the atmosphere. In addition, the measured discharge of petrogenic POC suggests that fluxes from the Andes may be considerably higher than measured downstream in the Madeira River. If this petrogenic POC is oxidised rather than stored in the Amazon River floodplains, it could contribute an important release of CO_2 which is not considered in forest-plot scale measurements. Overall, our results suggest that the erosion of biospheric and petrogenic POC from the Andes and its discharge by rivers comprise an important part of the organic carbon budget of the Amazon River Basin, one that depends on the fate of material delivered to the lowlands.