Geophysical Research Abstracts
Vol. 17, EGU2015-12331, 2015
EGU General Assembly 2015

Geochemical composition of river loads in the Tropical Andes: first insights from the Ecuadorian Andes

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Processes governing the transport of total suspended material (TSM), total dissolved solids (TDS) and particulate organic carbon (POC) are currently not well known for Tropical Andean river systems. We analyzed the geochemical behavior and the budgets of the particulate and dissolved loads for several sub-catchments in the Paute River basin in the southern Ecuadorian Andes, and examined how anthropogenic activities influenced the dynamics of riverine suspended and dissolved loads.

We gathered a large dataset by regularly sampling 8 rivers for their TSM, POC, and TDS. Furthermore, we determined the major elements in the dissolved load and stable isotope composition (δ13C) of both the POC, and the dissolved inorganic carbon (DIC). The rivers that were sampled flow through a wide range of land uses including: 3 nature conservation areas (100 – 300 Km^2), an intensive grassland and arable zone (142 Km^2); downstream of two cities (1611 and 443 Km^2), and 2 degraded basins (286 and 2492 Km^2).

We described the geochemical characteristics of the river loads both qualitatively and quantitatively. Important differences in TSM, POC and TDS yields were found between rivers: the concentration of these loads increases according with human activities within the basins.

For all rivers, TSM, TDS and POC concentrations were dependent on discharge. Overall, a clear relation between TSM and POC (r^2=0.62) was observed in all tributaries. The C:N ratios and δ13CPOC suggest that the POC in most rivers is mainly derived from soil organic matter eroded from soils dominated by C3 vegetation (δ13CPOC < -22‰.

Low Ca:Si ratios (<1)and high δ13CDIC (-9 to -4) in the Yanuncay, Tomebamba1 and Machángara, rivers suggest that weathering of silica rocks is dominant in these catchments, and that the DIC is mainly derived from the soil or atmospheric CO_2. In contrast, the Ca:Si ratio was high for the Burgay and Jadán rivers (1-13), and the low δ13CDIC values (-9 to -15) suggest that carbonate rock weathering is dominant in these catchments.

Our data suggest that anthropogenic effects are the dominant control on variations in sediment and carbon export between the river catchments we studied, while differences in topography are of lesser importance. However, the effects of anthropogenic disturbances may confound with differences in lithology, as the disturbed catchments are underlain by relatively soft, carbonate-rich sedimentary rocks while the less disturbed catchments are underlain by the silicate-rich rocks.