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# Cosmogenic nuclide-derived sediment budget of the Amazon basin

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Sediment gauging suggests that the annual sediment mass discharged into the main Amazon basin from the Andes and the cratonic shields is not in steady state with the mass discharged to the Atlantic Ocean. Here we use sediment production rates from cosmogenic 10Be in sediment to compare these with transport rates from river load gauging.

About 1 million km2 or 95% of the total Andean area draining to the Amazon provide sediment to the central Amazon river with an averaged 10Be nuclide concentration of 5.0 +- 0.5x1e4 at/g(Qz). Average nuclide concentrations for Brazilian shield headwaters amount to 15.3 +- 1.2x1e4 at/g(Qz), and to 38.6 +- 2.4x1e4 at/g(Qz) for the Guyana shield headwaters, respectively. For the Andes, nuclide concentrations translate to an integrated Andean denudation rate of 0.35 $\pm$ 0.05 mm/yr. Sediment from the headwaters of the Brazilian and Guyana shields translate into very low denudation rates (0.02 and 0.01 mm/yr, respectively), as is expected for tectonically stable tropical highlands.

These headwater 10Be nuclide concentrations and derived denudation rates can now be compared with those derived from central Amazon stream sediment including the main Amazon, which was sampled over Ĩ000 km from Manaus to Óbidos. Cosmogenic nuclide concentration analyses of several grain sizes (from 125 up to 800 $\mu$m) show large variations; we found that coarse-grained material records the nuclide signal of the cratonic shield areas, whereas the Andean signal is best represented by the fine sand fraction, which is preserved virtually unaltered over 1000s of km of sediment transport. In all central Amazon trunk stream samples and tributaries, the fine grain size fraction (125-250 $\mu$m) contains 10Be at 6.5 +- 1.2x1e4 at/g(Qz), which is similar to that of the Andean source areas. The integrated denudation rate from this fraction is 0.23 +- 0.04 mm/yr for the entire Amazon basin at Óbidos, which compares well with the mean Andean denudation rate of 0.35 +- 0.05 mm/yr. Coarse grain sizes (>500 $\mu$m) record the very low denudation rate of the cratonic shields. Given these low rates, the shields discharge only small amounts of sediment into the Amazon trunk stream. Multiplied with the area of the providing hinterland, we can use these erosion rates to calculate sediment mass budgets. The flux of sediment expected from cosmogenic nuclide-based denudation rates amounts to 540 Mt/yr at Óbidos. This flux compares to the total load of 1100 Mt/yr at Óbidos[1,2,3] as estimated from sediment gauging. This disparity is unexpected, as today at least 40% of the sediment discharged from the Andes is stored in floodplains[4]; a process not detected with cosmogenic 10Be. The longer denudation integration time scale of 8 kyr for cosmogenic nuclides possibly includes a period of drier climate than the wet conditions during the late Holocene, where a wetter modern climate possibly favors more rapid erosion in the Andes and more efficient sediment transport in the large rivers.

1 Gaillardet et al. (1997), Chemical Geology (142), 141-173.
2 Dunne et al. (1998), GSA Bulletin (110), 450-467.
3 Guyot et al. (2005), IAHS Publications (291), 1-8.
4 Guyot et al. (1996), IAHS Publications (236), 55-63.