Denudation and weathering rates from meteoric $^{10}\text{Be}/^{9}\text{Be}$ ratios in the Amazon basin

H. Wittmann$^1$, F. V. Blanckenburg$^1$, N. Dannhaus$^1$, J. Bouchez$^{2,3}$, J. Gaillardet$^2$, J. L. Guyot$^3$, L. Maurice$^4$, H. Llacer-Roig$^5$, N. Filizola$^6$ and M. Christl$^7$

$^1$GFZ German Research Centre for Geosciences, Potsdam, Germany (*correspondence: wittmann@gfz-potsdam.de) $^2$IPG Paris, Université Paris Diderot, CNRS, Paris, France $^3$IRD, Casilla, Lima, Peru $^4$GEToulouse, CNRS-IRD-Université de Toulouse, France $^5$University of Brasilia, Brasilia, Brazil $^6$The Federal University of Amazonas, Manaus, Brazil $^7$Lab of Ion Beam Physics, ETH Zuerich, Switzerland

Quantification of river dissolved and particulate fluxes is essential for understanding the role of weathering and erosion in geochemical cycles. The Amazon River is a natural laboratory where novel methods to quantify riverine fluxes can be verified, because of the density of published data on present-day sediment and dissolved loads (e.g. [1-3]) and millenial-scale denudation rates from $in situ$ $^{10}\text{Be}$ [4]. Here we present extensive testing of a new method derived from the meteoric $^{10}\text{Be}$ over $^{9}\text{Be}$ (stable) ratio. This new proxy combines a known atmospheric flux tracer, meteoric $^{10}\text{Be}$, with $^{9}\text{Be}$ released from rocks by weathering. We show how long-term erosion (E), denudation (D), and weathering (W) rates can be determined from only sub gram-sized amounts of almost any fine-grained sediment, or from river water. Denudation rates from $^{10}\text{Be}/^{9}\text{Be}$ ratios measured in bedload, suspended sediment, and water samples from Amazon Rivers agree within a factor of ca. 2 with published $in situ$ $^{10}\text{Be}$ denudation rates. Erosion rates using $^{10}\text{Be}$ concentrations from depth-integrated suspended sediment (DSS) agree well with meteoric denudation rates, implying E $\approx$ D. A fraction of $^{9}\text{Be}$ released during weathering of rock to soil of roughly 40% is calculated from DSS samples. This number is invariant from the Andes across the lowlands to the amouth, indicating no weathering of Be-containing minerals in the Amazon floodplain. We anticipate that our promising results will lead to a broad application of this new proxy as former restrictive issues, such as retentivity and grain size, are now better understood and the bias on D from $^{10}\text{Be}/^{9}\text{Be}$ ratios is small.