Geophysical Research Abstracts
Vol. 16, EGU2014-6429, 2014
EGU General Assembly 2014

Coupling of physical erosion and chemical weathering after phases of intense human activity

Jerome Schoonejans (1), Veerle Vanacker (1), Sophie Opfergelt (2), Yolanda Ameijeiras-Mariño (2), and Peter W. Kubik (3)

(1) Earth and Life Institute, George Lemaître Center for Earth and Climate Research, Université catholique Louvain, Place Louis Pasteur 3, 1348 Louvain-la-Neuve, (2) Earth and Life Institute, Environmental Sciences, Université catholique Louvain, Croix du Sud 2 bte L7.05.10, 1348 Louvain-la-Neuve, (3) Ion Beam Physics, ETH Zurich, Switzerland

Anthropogenic disturbance of natural vegetation profoundly alters the lateral and vertical fluxes of soil nutrients and particles at the land surface. Human-induced acceleration of soil erosion can thereby result in an imbalance between physical erosion, soil production and chemical weathering. The (de-)coupling between physical erosion and chemical weathering in ecosystems with strong anthropogenic disturbances is not yet fully understood, as earlier studies mostly focused on natural ecosystems.

In this study, we explore the chemical weathering intensity for four study sites located in the Internal Zone of the Spanish Betic Cordillera. Most of the sites belong to the Nevado-Filabres complex, but are characterized by different rates of long-term exhumation, 10Be catchment-wide denudation and hill slope morphology. Denudation rates are generally low, but show large variation between the three sites (from 23 to 246 mm kyr^{-1}). The magnitude of denudation rates is consistent with longer-term uplift rates derived from marine deposits, fission-track measurements and vertical fault slip rates.

Two to three soil profiles were sampled per study site at exposed ridge tops. All soils overly fractured mica schist, and are very thin (< 60cm). In each soil profile, we sampled 5 depth slices, rock fragments and the (weathered) bedrock. In total, 38 soil and 20 rock samples were analyzed for their chemical composition. The chemical weathering intensity is constrained by the Chemical Depletion Fraction that is based on a chemical mass balance approach using Zr as an immobile element. Chemical weathering accounts for 5 to 35% of the total mass lost due to denudation. We observe systematically higher chemical weathering intensities (CDFs) in sites with lower denudation rates (and vice versa), suggesting that weathering is supply-limited.

Our measurements of soil elemental losses from 10 soil profiles suggest that the observed variation in chemical weathering is strongly associated with long-term 10Be derived denudation rates, and tectonic uplift rates. Our data do not provide direct evidence of an imbalance between soil production and chemical weathering, despite more than 2000 years of intense human activity.