Deciphering the offshore biogeochemical record of Holocene erosion in the Waipaoa watershed, New Zealand

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Continental margin sediments preserve a record of long-term changes in erosion in adjacent watersheds, and organic matter is one of the most useful components for decoding that record. ^{14}C in particular serves as an invaluable tool for resolving the relative contributions of sediment from shallow and deeper levels in the regolith, and therefore for reconstructing changes in the roles of various geomorphic processes over time. Here we report on a study of the sedimentary record preserved on the continental shelf offshore from the Waipaoa River, NZ. ^{14}C and δ^{13}Canalyses of bulk sediments as well as clay-sized, wood, and charcoal isolates provide evidence for a mid-Holocene episode of elevated bedrock OC input that is consistent with evidence for earthflow activity in the watershed and a stormy period in the region. Deforestation of the watershed by Polynesian settlers ca. 700 years ago is recorded by evidence for biomass burning as well as elevated levels of shallow landsliding and soil erosion. Finally, the development of deeply incised gullies following deforestation of the headwaters by European settlers is reflected by large contributions of bedrock OC to the riverine particulate carbon load during the past century. Our approach in the Waipaoa system offers promise for using biogeochemical stratigraphic records to reconstruct the influence of tectonics, climate, and human activities on geomorphic processes in watersheds around the world.

Arsenic mobilization in a high Andean watershed impacted by legacy mining

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Northern Chile is known by its water scarcity and rich mining activity. A complex mixture of contaminants from natural and anthropogenic sources limits the development of agricultural and industrial activities in the Lluta river watershed. A legacy sulfur mine site in the Altiplano is a key source of acid mine drainage on the upper section of the watershed. Tailings show high concentrations of arsenic (2-8 g/kg) (Fig 1) and sulfur (3-13 g/kg), with pH<1. The XRD analyses of tailings reveal a high proportion of elemental sulfur. Although this is a semi-arid environment (310 mm/year of precipitation), storms concentrate during the Bolivian winter. The RUSLE method estimates that ~14% of storms are erosive; thus sediments with acid formation potential are mobilized during the wet season. Downstream, mixing with neutral waters at varying proportions induce the occasional formation of Fe and Al oxides that become an arsenic repository. Fine colloids are mobilized by base flows, whereas coarse arsenic rich Fe-coated sediments are stored on the sediments. The sustainable development of water infrastructure (reservoir, irrigation works) needs to consider the interactions between hydrological, hydrodynamic and chemical processes.

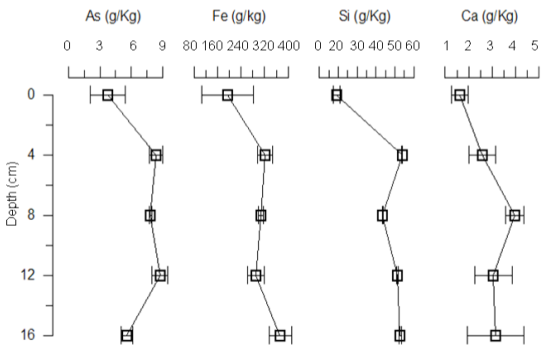

Figure 1: Geochemical analysis of tailings profile (As content and elemental associations [Fe, Si, Ca]). *Representative profile*.

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