Geophysical Research Abstracts
Vol. 15, EGU2013-11355, 2013
EGU General Assembly 2013

Quantifying bedload modifications during fluvial transport and their influence on detrital provenance analysis: a combined experimental, field and numerical study in the central Southern Alps of New Zealand

Lukas Flükiger (1), Frédéric Herman (2), Olivier Beyssac (3), Simon Cox (4), and Jerome Lavé (5)

(1) ETH, Geology, Zurich, Switzerland , (2) Institute of Earth Sciences, University of Lausanne, Switzerland, (3) Institut de Minéralogie et de Physique des Milieux Condensés, CNRS-Université Pierre et Marie Curie, France, (4) Geological and Nuclear Sciences, Dunedin, New Zealand, (5) Centre de Recherches Pétrographiques et Géochimiques (CRPG), CNRS-Université de Lorraine, France

Quantifying catchment scale erosion is key to understanding landscape evolution. To that end, detrital provenance studies, in which sediments are collected at the outlet of a catchment, have become increasingly popular in geomorphology. Here we perform a provenance analysis on detrital sands to infer spatial patterns of erosion at the catchment-scale using Raman spectroscopy on carbonaceous material, which provides an estimate of the peak temperature (RSCM-T) experienced during metamorphism of rocks. We focus on the Whataroa River in the Southern Alps of New Zealand and exploit the well-constrained metamorphic gradient that runs parallel to drainage direction. The relative ease of making measurements enables us to acquire a large amount of data within the eroding catchment.

While the distribution of RSCM-T in detrital sands primarily reflects spatial distribution of erosion rates, it can also be influenced by various factors such as initial sand content of sediment supplied to the river network, sand production by pebbly bedload abrasion during fluvial transport and organic carbon content in exposed bedrock. In order to account for these effects when unraveling spatial distribution of erosion rates from the observed RSCM-T, we first measured abrasion properties through flume experiments and total organic carbon (TOC) content in the bedrock within the catchment, and then introduced these parameters into a mass-conservative model that includes pebble abrasion during transport along the fluvial network. The flume experiment reveals that internally 'weak' lithologies, such as micaschist, produce significantly more fine particles (silt to coarse sand) than more durable lithologies, such as sandstone. This result is important because it reveals the potential biases might be arisen when conducting provenance analyses on sand. Finally, contrary to the long-term patterns of uplift and exhumation, present day erosion rates are highest ten kilometres from the Alpine Fault, where the greatest amounts of contemporary uplift are measured by continuous GPS survey. This result has implications for our understanding of the coupling between tectonics, climate and erosion in the tectonically active areas such as the Southern Alps of New Zealand.