Geophysical Research Abstracts
Vol. 21, EGU2019-6993, 2019
EGU General Assembly 2019
© Author(s) 2019. CC Attribution 4.0 license.

Unraveling the kinematics of the active Northern Apennines orogen by combining GPS geodesy, geomorphologic observations and 10Be measurements

Erica Erlanger (1), Yanyan Wang (1), Sean Gallen (2), Vincenzo Picotti (1), and Sean Willett (1)

(1) ETH Zurich, Geology, Earth Sciences, Zurich, Switzerland (erica.erlanger@erdw.ethz.ch), (2) Department of Geosciences, Colorado State University, Fort Collins, Colorado

The Northern Apennines are an active orogen driven by subduction and slab rollback of the Adriatic plate. The orogen is characterized by asymmetric topography, with a steeper, narrower Tyrrhenian side (retrowedge) and a broader, gentler Adriatic side (prowedge). Topographic metrics such as ksn and chi analysis illustrate higher channel steepness on the Tyrrhenian side and lower channel steepness on the Adriatic side. We determined catchment-averaged erosion rates from cosmogenic 10Be for major basins on the Tyrrhenian and Adriatic sides between Genoa and Florence, and demonstrate that modern erosion rates are higher on the Adriatic side by a factor of 2-6 compared to the Tyrrhenian side. Furthermore, erosion rates derived from thermochron ages suggest a long-lived pattern of slower erosion rates on the Tyrrhenian side ($\sim$0.3 mm/yr) and higher rates on the Adriatic side ($\sim$1 mm/yr) since 3-5 Ma. This presents a contradiction in which the steeper topography is eroding slower than the gentler topography. We can reconcile this paradox with a kinematic model of the Northern Apennines in which deformation is driven by subduction and slab retreat. The key to this model is the recognition that the 10Be concentration measures the flux of material from the orogenic wedge and is a function of both vertical and horizontal components of rock velocity. Assuming topography is at steady state, we can re-interpret 10Be concentrations as a measure of the total rock flux from the mountain belt, including the non-vertical component. We include geodetic data to constrain both horizontal and vertical rock velocities and can obtain a common solution for geodetic data, cosmogenic erosion rate data and geomorphic observations. The model proposes a constant horizontal rock velocity of 2-5 mm/yr to the SW relative to the wedge surface, with average vertical rock uplift rates of $\sim$0.5 to 1 mm/yr in the prowedge and no uplift or a slight subsidence of the retrowedge. In combination with horizontal GPS measurements, we estimate a rate of slab retreat (5-9 mm/yr), consistent with independent, long-term estimates ($\sim$6-10 mm/yr) for a similar latitude in the Northern Apennines.