Geophysical Research Abstracts, Vol. 8, 04294, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04294

Interactions of Erosion, Tectonics and Climate in the Taiwan Orogen

N. Hovius (1)

(1) Department of Earth Sciences, University of Cambridge, UK (nhovius@esc.cam.ac.uk, www.esc.cam.ac.uk/esp)

Rapid and well documented crustal deformation and erosion, and a wet and highly variable climate make Taiwan an outstanding place for the study of orogen dynamics and feedbacks between tectonic, atmospheric and surface processes. Recent work there has yielded insights into the mechanisms, patterns and rates of erosion across a range of scales from the channel reach to the mountain belt, and constraints on the manifestation, strength and characteristic scales of links between erosion and crustal deformation and climate. Key findings will be reviewed in this contribution.

In Taiwan, river incision is driven by frequent, moderate water discharges, but channel walls are eroded during large floods. This is due to changes in the distribution of bed shear stress with changing discharge. As a result, bedrock rivers with frequent large floods can move laterally faster than they incise downward, and may develop a high sinuosity. Along the western rim of the Pacific Ocean the sinuosity of bedrock rivers correlates with typhoon frequency. The Holocene climate of Taiwan has been wet and variable compared with the last cold stage. This has caused high rates of Holocene valley lowering compared with the long-term exhumation rate determined by fission track analysis. Ages of fluvially sculpted surfaces above the valley floor, measured using cosmogenic nuclides, indicate millennial valley lowering rates of $>$2cm y^{-1}. Other methods yield similar results and imply relatively low rates of fluvial incision during cold stages.

In the past decades, the Taiwan orogen has yielded $\sim$500 Mt of sediment per year. This is about 2% of the total sediment supply to the oceans from 0.02% of the land. The average rate of surface lowering in Taiwan is 3.5 mm y^{-1}, with a maximum of $>$60 mm y^{-1}. The pattern of erosion correlates with total seismic moment and discharge

variability, and reflects the stochastic nature of sediment production and routing on time scales shorter than the time constant of its forcing. In 1999, the M_w7.6 Chi-Chi earthquake triggered 20.000 landslides. In the epicentral area, landslide intensity scales with peak ground acceleration, and decays exponentially away from the epicentre. Subsequent rain storms have had a disproportionate effect on mass wasting in the Chi-Chi epicentral area due to coseismic weakening of the substrate. This has led to a factor-of-four increase in unit sediment concentration in rivers draining the area, and increased the magnitude and frequency of hyperpycnal sediment delivery to the ocean. Therefore earthquakes are recorded in the bundling of turbidites.

Hyperpycnal sediment delivery to the ocean promotes the sequestration of particulate organic carbon (POC) in marine basins. POC from living biomass and soil is mobilized in landslides and transferred by rivers. In the west flank of the Southern Alps, New Zealand, the CO_2 flux due to POC transfer is ten times greater than the CO_2 drawdown due to silicate weathering. Hyperpycnal discharge prevents the rapid recirculation of this material. In Taiwan, 30%-40% of all sediment discharge in the last decades has occurred at hyperpycnal concentrations. Sequestration of continental POC in marine turbidites may be the main mechanism of CO_2 drawdown in active mountain belts.