Geophysical Research Abstracts
Vol. 17, EGU2015-11077, 2015
EGU General Assembly 2015


# How long do U-shaped valleys last? The lifespan of glacial topography set by tectonics.

Günther Prasicek (a), Isaac Larsen (b), and David Montgomery (c)

(a) Deparment of Geoinformatics, University of Salzburg, Salzburg, Austria, (b) Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, USA, (c) Department of Earth and Space Sciences, University of Washington, Seattle, USA

More than 10 kyr after the last major glaciation the topography of mountain ranges world-wide remains dominated by characteristic glacial landforms such as U-shaped valleys, but the transition from a glacial to a fluvial landscape is poorly constrained and it remains unclear how long glacial morphology persists following deglaciation. The longevity of glacial topography influences glacial extent and erosion in subsequent glaciations and hence the cumulative impact of Pleistocene glacial cycles on the evolution of mountain ranges.

We tested whether tectonic forcing and erosional response control the timescale over which glacial topography persists into inter-glacial periods in the western Southern Alps of New Zealand and other mountain ranges worldwide, including the syntaxes of the Himalaya and Taiwan. We quantified the degree of glacial imprint by exploiting the conventional interpretation of V-shaped fluvial and U-shaped glacial valleys. Valley cross sections were automatically extracted from digital terrain models and power-laws were fitted to each cross section to quantify the shape of the valley flanks. A power-law exponent of 1 characterizes the straight valley flanks of a V-shaped cross section and greater exponents are indicative of progressively more U-shaped valleys.

Our results show that tectonic forcing is a first-order control on landscape evolution and on the persistence of glacial morphology worldwide. In Earth's most rapidly uplifting mountain ranges the lifespan of glacial topography is on the order of one interglacial period, preventing the development of a cumulative glacial signal. In contrast, in most alpine landscapes more than 100 kyr are required for the transformation from glacial back to fluvial topography and glacial landforms have not or have only partially been erased during the current interglacial. Thus we suggest, emphasizing the influence of glacially preconditioned topography on glacial extent and erosion, that tectonic forcing governs the impact of climate depressions on active orogens beyond controlling their vertical extent, by also altering the spatial and temporal pattern of erosion during subsequent glacial periods via a link between rock uplift and valley cross-sectional shape.