Geophysical Research Abstracts
Vol. 16, EGU2014-6959, 2014
EGU General Assembly 2014

How steep are the Alps?

Jörg Robl (1), Günther Prasicek (1), Kurt Stüwe (2), and Stefan Hergarten (3)

(1) Universität Salzburg, Geographie und Geologie, Salzburg, Austria , (2) Universität Graz, Institut für Erdwissenschaften, Graz, Austria,, (3) Universität Freiburg, Institut für Geo- und Umweltnaturwissenschaften, Freiburg, Germany

The topography of the European Alps reflects continental collision, crustal thickening and buoyancy driven surface uplift, overprinted by erosional processes. Topographic gradients generally steepen from the valley floors up to about 1500 m - 2000 m followed by an unexpected decrease in slope up to about 2900 m and a further increase to the highest summits of the range. Several studies have interpreted this pattern and the accompanied maximum in the hypsometric curve in terms of either the critical slope stability angle, the prematurity of the Alps caused by recent tectonic uplift, or the effect of the glacial "buzz saw" related to the Pleistocene glaciation cycles.

There is consensus that the lithological inventory represents a first order parameter for the steepness of fluvial channels and the angle of hillslopes in steady state and that the response time of a transient landscape is controlled by lithology. In this study we systematically explore the slope-elevation distributions for several hundred continuous domains of the major structural units of the Alps. For this, we apply a novel numerical code to determine the predominant cause for the observed peculiar topography. We compare adjacent alpine domains with contrasting lithology to explore lithological effects on the limiting slope stability angle. We analyze domains with different lithology in the non-glaciated parts of the orogen to highlight the state of maturity related to a recent uplift event. We evaluate the glacial effects on the landscape by the comparison of areas belonging to the same structural units but affected by a variable amount of glacial imprint.

The results show that lithology has a major impact on the morphometric characteristics of the European Alps. Adjacent but different structural units show a significant variability in their slope-elevation distributions although they have experienced the same uplift history and the same amount of glacial imprint. This suggests that the response time and process rates in transient landscapes are predominantly governed by the lithological inventory. Areas belonging to the same structural unit show similar characteristics in the slope-elevation distribution independent from their spatial position within the orogen (e.g. external massifs). These similarities are probably caused by the vertical position of the Pleistocene equilibrium line altitude - an observation well in line with the glacial "buzz saw" hypothesis.

However, several non-glaciated regions at the eastern and south-western border of the Alps show a slope-elevation relation similar to formerly glaciated domains. However, in contrast to the glaciated realm, the inflection point in the slope-elevation distribution is located at various elevation levels and is consistent with a reported recent pulse of uplift with spatial and/or temporal variations in uplift rate and initiation. Therefore, we interpret the slope-elevation distribution of the European Alps to be mainly caused by glacial erosion. The morphological record of a recent uplift event in the Alps has probably been overprinted by Pleistocene glaciations and may therefore only be detectable in non-glaciated regions of the peripheral parts of the Alps and in subsurface structures.