Geophysical Research Abstracts
Vol. 15, EGU2013-12047, 2013
EGU General Assembly 2013

Strong feedbacks between hillslope sediment production and channel incision by saltation-abrasion

David Lundbek Egholm (1), Mads Faurschou Knudsen (1), and Mike Sandiford (2)

(1) Aarhus Universiy, Department of Geoscience, Aarhus, Denmark (david@geo.au.dk), (2) School of Earth Science, Melbourne University, Australia

While it is well understood that rivers erode mountain ranges by incising the bedrock and by transporting sediments away from the ranges, the basic physical mechanisms that drive long-term bedrock erosion and control the lifespan of mountain ranges remain uncertain.
A particularly challenging paradox is reconciling the dichotomy associated with the high incision rates observed in active mountain belts, and the long-term (108 years) preservation of significant topographic reliefs in inactive orogenic belts (e.g. von Blankenburg, 2005).

We have performed three-dimensional computational experiments with a landscape evolution model that couples bedrock landslides and sediment flux-dependent river erosion by saltation-abrasion (Sklar & Dietrich, 2004). The coupled model experiments show strong feedbacks between the channel erosion and the hillslope delivery of sediments. The feedbacks point to hillslope sediment production rate as the main control on channel erosion rates where saltation-abrasion dominates over other fluvial erosion processes.
Our models results thus highlight the importance of hillslope sediment production controlled by climate and tectonic activity for scaling erosion rates in fluvial systems. Because of variations in landslide frequency, the feedbacks make tectonic activity a primary driver of fluvial erosion and help clarifying the long-standing paradox associated with the persistence of significant relief in old orogenic belts, up to several hundred-million-years after tectonic activity has effectively ceased.

References

F. von Blankenburg. The control mechanisms of erosion and weathering at basin scale from cosmogenic nuclides in river sediment. Earth Planet. Sci. Lett. 237, 462-479 (2005).

L. S. Sklar, W. E. Dietrich. A mechanistic model for river incision into bedrock by saltating bed load. Water Resour. Res. 40, W06301 (2004).