Geophysical Research Abstracts
Vol. 12, EGU2010-5947, 2010
EGU General Assembly 2010

Bedrock gorges incising glacial hanging valleys (Western Alps, France): results from morphometric analysis, numerical modeling and 10Be cosmogenic dating

Pierre G. Valla (1), Peter A. van der Beek (1), Dimitri Lague (2), and Julien Carcaillet (1)

(1) Laboratoire de Géodynamique des Chaînes Alpines, Université Joseph Fourier, CNRS, Grenoble, France, (2) Géosciences Rennes, Université de Rennes 1, CNRS, Rennes, France

Bedrock gorges are frequent features in glacial or post-glacial landscapes and allow measurements of fluvial bedrock incision in mountainous relief. Using digital elevation models, aerial photographs, topographic maps and field reconnaissance in the Pelvoux-Ecrins Massif (French Western Alps), we have identified ∼30 tributary hanging valleys incised by gorges toward their confluence with the trunk streams. Longitudinal profiles of these tributaries are all convex and have abrupt knickpoints at the upper limit of oversteepened gorge reaches. From morphometric analyses, we find that mean channel gradients and widths, as well as knickpoint retreat rates, display a drainage-area dependence modulated by bedrock lithology. However, there appears to be no relation between horizontal retreat and vertical downwearing of knickpoints.

Numerical modeling has been performed to test the capacity of different fluvial incision models to predict the inferred evolution of the gorges. Results from simple end-member models suggest transport-limited behavior of the bedrock gorges. Using a more sophisticated model including dynamic width adjustment and sediment-dependent incision rates, we show that bedrock gorge evolution requires significant supply of sediment from the gorge sidewalls triggered by gorge deepening, combined with pronounced inhibition of bedrock incision by sediment transport and deposition.

We then use in-situ produced 10Be cosmogenic nuclides to date and quantify bedrock gorge incision into a single glacial hanging valley (Gorge du Diable). We have sampled gorge sidewalls and the active channel bed to derive both long-term and present-day incision rates. 10Be ages of sidewall profiles reveal rapid incision through the late Holocene (ca 5 ka), implying either delayed initiation of gorge incision after final ice retreat from internal Alpine valleys at ca 12 ka, or post-glacial surface reburial of the gorge. Both modeling results and cosmogenic dating suggest that fluvial incision rates >1 cm yr-1 into crystalline bedrock may be encountered in transient landscape features induced by glacial-interglacial transitions.