



Distinctive development in the fluvial cycle at cold-warm-cold transitions: a refinement of theory.

J. Vandenberghe

Vrije Universiteit, Institute of Earth Sciences, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands (jef.vandenberghe@falw.vu.nl)

It has been shown by geomorphological reconstructions and by model experiments that short phases of fluvial instability establish both at the transition from relatively warm to cold and from relatively cold to warm periods. Such instability typically starts with vertical erosion, successively followed by sedimentary refill of the erosive scar. These phases of instability are triggered by delays in the vegetation decay, respectively vegetation growth, and should induce a similar morphology.

However, in reality a couple of problems arose in this theory and will be exemplified. The first one is that the vertical incisions at cold-warm transitions are observed only rarely (except at the end of the last glacial), in contrast to the broadly recognized erosion phenomena at warm-cold transitions. Secondly, the morphological expression is generally different at both climatic transitions. Sharp, linear and rather deep but confined incisions at cold-warm transitions oppose widely extended but somewhat shallower incised valleys that are created at warm-cold transitions. These differences ask for a modification of the general theory of identical instability phases at both climatic transitions.

At the transition of relatively temperate environment to cold conditions rivers transformed gradually from a generally regular, one-channel course to a periodically high-energy, multi-channel type. This latter braided or anastomosing type is characterized by intense lateral movement rather than by deep vertical erosion. This fluvial activity results in a well-expressed morphology of wide, extensive valleys. On the contrary, the progressive change from a multi-channel river type under cold conditions to a mostly meandering type under more temperate conditions favors linearly incised valleys of limited lateral extent. Consequences are twofold: 1/ the spatial limitation of

the deeply incised valleys at the beginning of a warm period hinders their recognition; 2/ the laterally migrating valleys that establish at the cold-warm transitions remove most traces of the previous fluvial morphology, especially the incised valleys that developed at the previous cold-warm transition. It may be concluded that the different river styles that developed at both climatic transitions influence the characteristics of both instability phases and the resulting morphology.