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Variations in climate and exposed bedrock lithologies and implications for sediment discharge - a theoretical analysis calibrated with data from the Alps/North Alpine Foreland Basin system

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Paleofloristic data imply that paleoclimate changed in the Swiss Alps at the Oligocene/Miocene boundary from humid and hot conditions towards a climate with high temperature and low humidity. The aridisation is associated with a change in depositional pattern from alluvial fans to lakes and floodplains, suggesting decreasing sediment discharge. A further 25-40% decrease in sediment discharge occurred in the early Miocene when the orogenic core of the Alps became exposed to the surface.

A surface process model is used to explore potential controls on the pattern of sediment discharge and on the evolution of the Alpine drainage basin. The model is based on the presumption that the rates of fluvial incision into bedrock are proportional to shear-stress exerted by the flowing water. The model results imply that the paleoclimate change resulted in an instantaneous decrease in sediment discharge and a vertical topographic growth until steady state conditions between erosional and crustal mass flux are established. However, exposure of the crystalline core of the Alps in the early Miocene is likely to have resulted in the 25-40% decrease in sediment discharge and the reorganization of the drainage pattern from an orogen-normal to an orogen-parallel orientation of dispersion.