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Geomorphometric constraints on the development of the Wutach capture

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The Wutach capture is one of the most prominent river captures in central Europe. Subsidence of the Upper Rhine Graben and subsequent incision of tributaries to the Hochrhein led to the piracy of the Danube-Wutach draining the Feldberg region of the Black Forest at ~18 ka. The sudden lowering of the base level led to headward incision of the Wutach and the formation of numerous fluvial knickpoints along the trunk river and its tributaries. These knickpoints represent excellent markers that enable testing several hypotheses including the role of bedrock erodibility, the impact of deglaciation, and mechanisms that control the diversion of the Wutach. Here we present a geomorphometric approach predicated on the stream-power incision model to test these hypotheses. We show that the spatial distribution of knickpoints upstream of the capture is consistent with predictions by the stream-power model. Including proxy information about deglaciation change the parameters of the model, but only slightly increase the fit between modelled and observed knickpoint locations. By comparing estimates of the erodibility derived from knickpoints to those derived from catchment-wide denudation rates in nearby catchments, we observe differences of the order of two magnitudes. The difference in these estimates may be explained by several processes including channel-bed armouring by sediment. We conclude that stream power parameters derived from the spatial distribution of knickpoints in the Wutach catchment are representative of exceptional (short-term) erosional conditions right after the capture event, rather than of landscape evolution on longer-term geological timescales.