Rock restrictions on topographical features of rivers: model experiment

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Landforms of mountainous areas is developed by both downcutting and lateral erosion of rivers. For example, ingrown meanders develop when the lateral erosion is predominant, while entrenched meanders form when the downcutting is dominant. It is a generally accepted understanding that the relative superiority or inferiority between the downcutting and lateral erosion is determined by the uplift rate of the land, rock strength difference, riverbed gradient, deflection of flow in a channel, but the systematic discussion remains insufficient. In this study, we conducted flume experiments to investigate the relationship between bedrock strength and sinuosity, and the relationship between time series pattern of uplift and meandering development. We prepared a single channel that cut a uniform substrate in a two-dimensional flume. The substrates were made of the mixture of fine sand and clay, and we examined two types of substrate, hard and soft ones, which can be formed by changing the ratio of sand and clay (the mixure including more clay is harder). Uplift of the experimental land was realized by lowering a weir set at the downstream end of the channel, i.e. the base-level lowering.

Knickpoints were observed more frequently in the case of hard substrate, which is consistent with previous study (Grimaud, 2016). Sinuosity of the channel tended to be higher for the hard substrate than the soft substrate, which is seemingly opposite the conventional understanding, but can be attributed to sustainability of the channel shape due to erosion resistance of the hard substrate. In all the experiments, the sinuosity tended to be higher after the uplift ceased rather than during the period of uplift.

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