Relationship between bedrock strength and change in shape of bedrock channel due to base level lowing: Laboratory experiments

*Sota Iijima[1], Noritaka Endo[1]

1. Kanazawa university, Graduation school of natural science and technology

Developments of bedrock rivers are controlled by climate, uplift and bedrock strength, etc. Among these, it is suggested that bedrock strength may be an important parameter influencing the local aspect of river topography development, because some field studies reported that there often are knickzones in areas with high bedrock strength. However, the exact relationship is little understood, because topographic change takes a long time and many other parameters are widely different in fields. In this study, we conduct model experiments under simple setting where we simulate bedrock using homogenous mixtures of sand and kaolinite. We explore the dependence of developmental processes of channel shape on the bedrock strength.
Each run starts with an initial topography where a single straight channel is set in the center of the flume. The mixture consists of well-sorted sand (f=0.2mm) and kaolinite. By changing the ratio between sand and kaolinite, different rock strength can be realized. Water was flowed from the upstream end constantly using a discharge controller. The weir, a pile of blocks (1 cm in height), is installed at the downstream end. Base level drop is actualized by removing the block(s). At intervals of 20 minutes, one block is removed (i.e., 1 cm base level drop), which is repeated about 7 times during each run. The topography is measured three-dimensionally by photogrammetry. The experiment was finished when the channel profile remains almost unchanged for about 30 minutes or more after the last block was removed. We regarded the profile at the end of experiments as a final stable state.
Comparing the channel profiles at the end of experiment between runs, it was confirmed that final stable channel profiles is almost the same even if we change rock strength. This means that bedrock strength is not a factor that determines the final channel profile and has influence only while the river changes from the initial shape to the final shape.
During each run, the gradient of channel increases to the maximum value, and then declined to some constant value (stable state). The maximum value is higher with increase in rock strength, although final states are similar between different rock strengths. Sinuousity of channel tended to increase when the river has higher gradient than that in the stable state, although sinuousity at the final state also showed no difference between different bedrock strengths. This facts suggests the possibility that the strong meandering seen in the area of hard bedrock in nature is only a transitional phenomenon in the geographic timescale. Because it is considered that not only rock strength itself but also spatial variation in strength can affect the sinuousity, more experiment and discussion is necessary.

Keywords: river topography, bedrock strength, meandering

©2017. Japan Geoscience Union. All Right Reserved.