学　位　論　文　内　容　の　要　旨

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学　位　論　文　題　名

Erosion in Bedrock and Alluvial Meanders through 2 Dimensional Numerical Models, Laboratory Experiments and Field Observations

(岩盤河床河岸河川および沖積地河川における河岸侵食と蛇行に関する研究)

Like alluvial rivers, Meandering is a phenomenon common in Bedrock Rivers also. A major number of studies conducted to understand meandering phenomena have concentrated their focus on alluvial meandering [Parker 1976, 2011 and Asahi 2013]. The characteristics of meandering in alluvial and bedrock channels are noticeably different from one another. To expand our understanding of landscape formation, it is vital that we understand bedrock channel characteristics as well as alluvial channel characteristics.

In the first part of this thesis, an attempt has been made to understand the process of erosion in Bedrock meanders. Several laboratory scale experiments were conducted to understand the process of erosion in bedrock channels. The focus was on erosion caused due to abrading bedload in a bend. This is the first time an experimental study is performed in Bedrock bend. . Multiple experiments were conducted to observe the changes occurring in a bedrock bend associated with changes in sediment flux. The experiments showed that vertical incision had a more complex relation with the sediment feed rate. A u-shaped channel roughly 1/1000 of the scale of Shimanto river was used to perform the experiments.

The relationship between sediment flux and vertical and lateral erosion in bedrock bend was stablished post multiple laboratory scale experiments and on-field observations. These relationships were numerically implemented and tested to produce desirable results. From this study, it was concluded that bank erosion is largely effected by sediment supply. It increases linearly with increase in sediment. It was also found that, bank erosion increases with increase in lateral bedslope, as effect of secondary flow decreases. Also, length and depth of bank erosion increased with increased sediment flux. We also observed the morphological differences in alluvial bend and bedrock bend. It was observed that bedrock bends largely erode in the center of the channel whereas alluvial bends are considered to largely erode in the outer bend of the channel.

Experiments were also conducted using a laboratory scale Sine Generated Curve channel to get a more explicit outlook regarding the effect of sediment on bedrock bends. It was observed that, erosion in bedrock banks is primarily caused by bedload. This study, combined with results of U-channel study, imply that sediment supply is a dominating factor causing erosion in bedrock banks.

Also, numerical model proposed by Inoue et al. (2015, Gravel bed river, 8) was established in this study. The model uses transverse bedload transfer rate in order to calculate bank erosion in bedrock channels. The model can successfully reproduce the laboratory scale experiments. Also, the model produced results in agreement with U-channel experiments, i.e. lateral erosion increases with increase

in sediment feed rate, also, increased sediment feed shifts the start point of erosion towards the upstream.

In the second part of this thesis numerical simulations were performed to prove that bedrock meanders require sufficient alluvial cover and sediment supply for its formation and migration. Also, a numerical scale comparison of skewness direction in alluvial meandering channel and bedrock meandering channels was performed. It was observed that, while alluvial channels are prone to Kinoshita type meandering, bedrock channels showed downstream skewness in the meandering bend. Also, effect of bed angle and initial wavelength on skewness of bedrock meanders was examined by performing multiple numerical simulations. It was found that, bedrock skewness was towards downstream irrespective of the bed angle. Initial wavelength affects the skewness; it is downstream when wavelength is smaller and upstream when wavelength increases.