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Effects of lithology on bedrock channel occurrence: an examination from the Seogang River in South Korea

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Bedrock river is rock-bound, its bed and banks are composed mainly of in-place bedrock. Bedrock channel reaches, commonly short and intermittent, often occur where transport capacity exceeds bedload sediment flux. Despite the abundant research on the typical patterns of alluvial channel reaches, the distribution of bedrock channels has not been well studied. Rock type may affect the occurrence of bedrock channels because the strength, joint density, and erosion process of bedrock vary depending on the rock type. Previous studies have viewed the bedrock channel occurrence in the aspect of the excessive sediment transport capacity, but the influence of lithology has not been considered in the literature. To understand the influence of lithology on bedrock channel occurrence in a drainage basin-scale, we investigated the distribution of bedrock channels in relation to varying lithology and unit stream power along the Seogang River in South Korea. We used satellite images with high resolution for the identification of bedrock channel reaches and then verified them through field surveys. Geological maps and 1 arc-second SRTM DEMs were used to analyze lithological effects and calculate unit stream power. As a result of the analysis, we identified 94 bedrock channels in the studied river, varying depending on lithologies. The frequency of bedrock channels in granitic gneiss areas (0.73/km) is much higher than those in the other rock type areas (granite areas, 0.57/km; limestone areas, 0.16/km). In the more frequent granitic gneiss areas, the bedrock channels are steepened (average channel slope: 0.0074 m/m) and narrow (average channel width: 65 m) and mainly reside within steepened and narrow (average valley width: 123 m) rock-bound valleys so that their occurrence is mainly associated with high unit stream power. In contrast, the bedrock channels over the other lithologies are wider (89 m) and lower-gradient (0.0056 m/m) and occur along flat and broad valleys (391 m). Consequently, the bedrock channels in the studied river were divided into two types: confined and unconfined bedrock channels. The confined bedrock channels are within the steepened and narrow valleys composed of resistant granitic gneiss and show the evidence for recent bedrock incision processes. However, the unconfined bedrock channels are mainly within the broad and flat valleys of weak saprolites and limestone with high joint density have lower unit stream power and don't show any marker for bedrock incision. In conclusion, high-relief landscape mainly composed of more resistant rocks generates steep and narrow valleys, which leads to the formation of

continuous and actively incising bedrock channels. However, low-relief landscape underlain by non-resistant rocks shows wider and lower-gradient channels, with intermittent bedrock channels due to locally more resistant rock bodies.