Geophysical Research Abstracts
Vol. 12, EGU2010-10207, 2010
EGU General Assembly 2010
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Geologic control of knickpoints in eastern part of Korea

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A knickpoint (KP) is a steepened reach in the fluvial longitudinal profile, often coinciding with the sharply defined descents of waterfalls or cascades that separate graded reaches. Despite the overall simplicity of this concept, there is confusion in definitions of a KP due to differences in the scales of research. For basin-scale research, KPs are generally steepened reaches sometimes described as 'knickzones'(e.g., Zaprowski et al., 2001; Wolkowinski and Granger, 2004), whereas at the reach scale, KPs coincide with waterfalls and bedrock steps, regardless of their spatial dimensions. Here, the term is used in former, basin-scale sense.
Bedrock KPs may originate from relative base-level fall (e.g., sea-level fall [Mosley, 1984; Yodis and Kesel, 1993] and/or surface uplift [Seeber and Gornitz, 1983; Humphrey and Konrad, 2000], lithological and structural controls (Pohn, 1983; Miller, 1991; Alexandrowicz, 1994), and changes in tributary inputs and discharge and sediment supply (Penck, 1925; von Engeln, 1940; Hasbargen and Paola, 2000). Recent work has also proposed that bedrock river KPs can initiated with base-level fall and migrate headward follow the tributaries (Crosby and Whipple, 2006).
The origins of KPs can be different by the geomorphic setting of the drainage basin area. Especially the role of lithologic boundaries and faulting can be regarded as primary cause of KP formation. To find the role of lithologic control of KP distribution in Korea, longitudinal profiles of 12 streams, higher than 4th order in Horton-Strahler system, are analyzed. Longitudinal profiles are extracted from 1:25,000 Map Series (Korea National Geographic Institute) and the lithologic boundaries and fault lines are drawn based on the information from KIGAM's 1:50,000 Geological map series. Most of KPs are found near of lithologic boundaries or fault lines, however there are some KPs found upstream of large tributary input.
However, physical strength of each lithologies have not been studied in the field. So we visited some KPs and measured the rock strength using concrete test hammer (Schmidt hammer), where bedrock is exposed to the surfaces. Compressive strength(kg per sq. cm) of the rocks are measured and channel gradient changes are plotted against the strength changes. To find the role of sedimentary input, drainage basin sizes of tributary are compared.

The study area also experienced tectonic uplift last 47Ma. Overall uplift rate of the study area is about 40m/Ma but three different period of different uplift rate were recognized. 47∼37Ma, uplift was very slow (20m/Ma) and accelerated to 170m/Ma from 37∼35Ma and decreased to 40m/Ma ever since. This change in uplift rate can affects the formation and headward retreat of KP along the channel. Using physically based abrasion model, effect of uplift rate change to longitudinal profile is investigated.