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Re-evaluation of erosion rate in the uppermost reach of Yangtze River based on topographic classification using GIS

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Erosion and deposition in a river system in a tectonically active area plays a role in forming topographic features that keep balance with tectonic activity, and affect atmospheric circulation. Erosion also controls the rate of chemical weathering through interaction with physical weathering by increasing the surface area of rock. Supply of sediments due to erosion also accelerates the burial of organic matters in basins. These processes also affect climate through the changes in atmospheric composition. Therefore, it is important to know how erosion rate changes with changes in relief, uplift rate, bedrock geology, temperature, and precipitation in order to understand tectonics-climate linkage through landform evolution and global geochemical cycles. To discuss this issue, The Tibetan Plateau and surrounding river drainage basins are ideal because of their highly active tectonics.

Measurement of cosmogenic ^{10}Be concentration in quartz grains in river sediments is useful to estimate spatial distribution of relatively long-term erosion rate because river sediment samples are easily obtainable and quartz is common in these sediments. Indeed, there are several studies estimating erosion rates in the Tibetan Plateau and the Jinshajiang River, the uppermost reach of the Yangtze River in south China.

Two common assumptions of this method are 1) erosion rate is uniform within a drainage basin, and 2) eroded sediments do not stay long within a river system but discharge out of the system within a short period. However, such assumptions are not necessarily correct considering topographic variations in a basin and occasional occurrence of depositional landforms that may trap sediments for a long period. We call such landforms 'trapping features'. Previous studies in the Jinshajiang basin using ^{10}Be basically ignored the trapping features although they often occur in the basin. We extracted such features using DEMs(digital elevation models) and GIS and evaluated their depositional effect on erosion rate, re-estimated the sediment flux through the drainage basin, and examined the relationship of erosion rate with local landforms and geology.

Along the lower reaches of the Jinshajiang River, pull-apart-basins and their buried landforms (we call such landforms 'reclaimed features') often occurs, whereas there are many small lakes along the uppermost reaches on the Tibetan Plateau. We regarded the reclaimed features and lakes as trapping features. We surveyed some local reclaimed features in the field and described their forms. Then, we used DEMs and ArcGIS to extract the reclaimed features and their source areas. Similarly, we identified the lakes and their source areas. We regarded the rest of the river basin as 'sediment supply area'. Then we re-calculated average erosion rates in the sediment supply areas using 10Be data from previous studies and compared the result with pervious calculations that did not take into account of the effect of trapping features.

The effect of trapping features reduced the estimated sediment flux in the Jinshajiang River basin to about 70% of the previous estimation. We plan to estimate the effect of the trapping features in the drainage area corresponding to each ^{10}Be sample, and discuss the distribution of re-estimated erosion rates in relation to topography, bedrock, geology, and climate.

Keywords: erosion rate, cosmogenic nuclides, GIS, Yangtze River, Tibetan Plateau