Fluvial breaking and abrasion mechanisms acting upon gravel-sand grains utilizing the difference of grain lithology

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Downstream fining of fluvial clastic sediments has been generally attributed to two processes: hydraulic sorting and pristine grain production, controlled by breaking and abrasion mechanisms. We investigate the role and presence of these mechanisms focusing on downstream lithological compositional and roundness changes on both sand and gravel fractions. Roundness is strongly responsive to both breaking and abrasion acting upon detritus (e.g. Krumbein 1941). Although sands may be produced from coarser grains, they were not investigated alongside gravels in previous downstream fining studies. We studied two tributaries originated from the Ashio Mountains constituted by the Ashio Belt, a Jurassic sedimentary rocks accretionary complex, in the watershed of Tone River. Breaking and abrasion mechanisms acting upon detritus was revealed by both field survey (cobbles-coarser pebbles) and laboratory analysis (finer pebble and granule-coarse sand grains), utilizing grains of contrasting durability (hard chert and fragile shale). For the evaluation of grain roundness, nine sets of standard roundness images classified by Krumbein (1941) was adopted as standard.
The downstream increase in chert/shale ratio of cobble-pebble and downstream rounding of shale pebble-sand grains occurred, in spite of a low chert detrital supply. The results suggested that pristine sand grains were produced from gravels and sands by breaking mechanism, which leads to grain size reduction and higher angularity, and by abrasion mechanism, which gives rise to grain rounding while keeping nearly unchanged size and produces angular pristine produced finer particles, during transport, considering with the existence of changes in chert grains roundness. Additionally, the contrasting trend of downstream roundness changes between the two rivers is recognized, which might have been caused by the different gradients among the researched section of the rivers. Therefore, it is possible to reveal the relationship between the river gradient and breaking and abrasion mechanisms in this study.

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Reference
Krumbein, K. C. 1941. Jour. Sed. Pet. 11: 64-72.

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