Temporal and spatial changes of sediment supply processes from tributaries since the last glacial period in the upper valleys of the Tama and Ara rivers, central Japan

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To understand the sediment routing systems in the long-term, it is important to reveal the temporal and spatial changes of sediment supply processes from tributaries to the trunk river in upper reaches. Although Shimazu (1990; 1991) discuss the relationship between the longitudinal changes of the gravel size on the trunk riverbed and the tributary slope based on the slope 8% (the slope which debris flow deposition occurs), few studies discuss the temporal changes of the sediment supply processes of tributaries. Fill terrace formed in the last glacial period are developed in the upper reaches of the rivers in the Hokkaido, northeastern and central Japan. In the upper valley of the Tama and Ara rivers, most fill terraces are toe-cut terraces formed by tributaries (e.g. Takahashi and Sugai, 2018). The slope of their tread (Sg) indicates the tributary slope in the last glacial period. This study compares Sg and the present tributary slope (Sp) and discusses the temporal and spatial changes of the tributary slope and the sediment supply process from tributaries based on the slope 8%.

Sg is greater than Sp at the same tributary. This indicates that the tributary channels have been steepened because of the incision of the trunk river in the postglacial. Based on 8%, the tributaries can be classified as the three types (Type-A, B and C). Type-A tributaries (Sg and Sp > 8%) have been able to supply the sediment the debris flow to trunk river since the last glacial period. Type-B tributaries (Sg is less than 8%, Sp > 8%) supply the sediment by debris flow in the post glacial and by traction in the postglacial. Type-C tributaries (Sg and Sp are less than 8%) have supplied the sediment the traction to trunk river since the last glacial period. Based on the tributary Types above, the upper valleys of the Tama and Ara rivers were classified as three segment types (Seg. A, B and C). Seg. A is the segment that Type-A tributaries frequently join and appears in the upper part of the Tama and Ara river valleys. Seg. B is the segment that Type-B tributaries frequently join and appears in the lower part of the Tama River valley, and the upper part of the Chichibu Basin and the gorge of the Ara River valley. Seg. C is the segment that Type-C tributaries frequently join and appears in the lower part of the Chichibu Basin and gorge of the Ara River valley.

Seg. A appears the upper part of Tama and Ara river valleys, the sorting of the trunk river was dominated in their downstream in the last glacial period. The reason why Seg. C appears in the lower part of the Chichibu Basin is that the tributaries from the hills composed of the Neogene sedimentary rocks join. In contrast steep tributaries join in the gorge mainly because metamorphic rocks partly appear along the gorge of the Ara River and because the valley width are narrow by rock control. Sp and Sg are positively correlated with the relief ratio (Rr) of the tributary catchment. Sp, Sg and Rr decrease toward downstream (the east) in the Tama River valley. In the Ara River valley, these values decrease downstream from the headwaters to the Chichibu Basin, and increase in the gorge. The tendency for Sp, Sg and Rr to decrease downstream reflects the lowering of mountain ridges toward the east. It is suggested that the changes of tributary slope and the sediment supply process from tributaries are affected by the distribution of lithology and mountain relief along with the elevation changes of the trunk riverbed.

Keywords: fluvial terrace, debris flow, mountain river, sediment routing system

