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Drainage system evolution associated with segment linkage within active thrust zones: the northern Tokachi fault zone, eastern Hokkaido, northern Japan

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We investigated geomorphology, chronology and active tectonics of the northern Tokachi fault zone (Ikeda et al, 2002) since middle Pleistocene in eastern Hokkaido to define evolution of drainage system patterns associated with active thrust fault activity, mainly based on field mapping of fluvial terraces, drainage and stream patterns by use of 1:25,000 topographical maps and detailed stereopair interpretation. Eastern Hokkaido is located at arc-arc junction, where forearc sliver of the Kuril arc has collided with the northeast Japan arc due to oblique subduction of the Pacific Plate since late Miocene (Kimura, 1986). The Tokachi fault zone is an active intraplate, north-trending, west-verging thrust zone that extends for about 100 km and likely has consumed a part of strains accumulated by the arc-arc collision. This major active thrust forms a distinct topographic and geologic boundary between the Tokachi Plain and the Osarushinai Hills to the east, and deforms fluvial terraces deposits. Middle to late Pleistocene fluvial terraces widespread over the hangingwall and footwall of the thrust zone possibly record temporal and spatial changes of channel stream networks, fault activity, and their interaction. Distribution of well preserved higher terraces formed during the middle Pleistocene indicates that SE-trending transverse paleostreams at the age of older middle Pleistocene Kamiasahigaoka (KA) terrace drastically shifted its course to flow on the footwall syncline west of the fault zone at the age of younger Kita-Oribe (KI) terrace (i.e., paleo-Otofuke River) and that older, antecedent NW-trending channel streams had lost most of their upper drainage basins. This drastic deflection of major stream channels during the middle Pleistocene occurred at the segment boundary between two en-echelon, NNE-trending thrusts comprising the Tokachi fault zone. We hypothesized that the transverse paleostream have interrupted and deflected due to two en-echelon thrust fault segments linkage. In contrast to these deflected paleostream channels, a transverse stream channel incised into the adjacent, northernmost thrust segment appears to maintain its course since middle Pleistocene. Uniform size of upstream catchment area, stream slope and lithology of hillslopes and thus erodability of strata along the thrust zone indicate that rates of rock uplift along the northernmost thrust segment have been slower than those along the southern segments. The drainage evolution in the area also shows that some of the paleostreams once beheaded in the age of KI terrace have again rejuvenated during the late Quaternary, leading to the remarkable dissection of landforms and reorganization of fluvial systems across the fault zone. This might reflect (1) enhanced erosion by climatic change and (2) decay of the activity of the Tokachi fault zone after middle Pleistocene. We conclude, therefore, that the drainage evolution in the northern Tokachi fault zone provides a good example of temporal and spatial evolution of channel stream networks strongly affected by segment linkage, along-strike variation of slip rates within active thrust zones and its activity.

References

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