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Applicability of fingerprinting technique to various particle size sediment in a mountain catchment, Japan

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Most of recent fingerprinting studies using multivariate tracers have focused on fine sediment such as silt and clay size particles to address the sediment management in the “Source to Sink” sediment delivery system. In the steep terrain as Japan, coarser sediment particles can be transported from mountain to the sea even in a flood event, so that the quantitative evaluation of sediment sources for various particle size fraction is fundamental. The objective of this study was to apply the fingerprinting technique using natural radionuclide (NRN) tracers to wide particle size range of sediment. To achieve the objective, potential source materials and runoff sediment were collected in the Ashiaraidani catchment, headwater of Jintsu River, central Japan, and NRNs were analyzed by gamma-ray spectrometry for 5 particle size fractions, which were silt and clay (<0.075 mm), very fine to medium sand (<0.425 mm), coarse sand (<2 mm), very fine gravel (<4.75 mm) and fine gravel (<9 mm), respectively. The non-parametric Kruskal-Wallis H-test and discriminant function analysis were performed to seek the best combination of tracer properties and sediment source groups, and showed that the 5 NRNs were selected to discriminate 5 lithological source groups for each particle size fraction at more than 94% of correct classification. Particle size dependency of tracer property was found in all selected NRNs of each source group, and its tendency varied among NRNs and source groups, suggesting the difficulties in particle size correction for tracer properties in a simple manner. The contribution of each source groups to sediment were estimated in each size fraction, showing that the contributions of 3 source groups, which were dominated by granite, granodiorite and serpentinite, respectively, were found to be different significantly among the several particle size fractions. These results indicate that the fingerprinting technique using the NRNs can be useful for various particle size fractions, although the particle size correction for tracer properties is difficult.