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Changes in particle size distribution of clayey material at a catastrophic landslide base

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In August 2009, a catastrophic rockslide avalanche was initiated by a cumulative rainfall of 1676.5 mm by Typhoon Morakot in the southern mountainous region of Taiwan. The landslide occurred on slopes extending from head scarp to the opposite riverside with a fall height of 830 m and generated the runout distance of 3.2 km long. The mobility of the landslide was high, indicating by its low apparent friction angle of 14 degrees and velocity of 70 to 120 km hr^{-1} in 95 s. The landslide claimed more than 400 people dead and missing when the village of Shiaolin was destroyed directly in the path of the landslide. We found clayey material in many locations at the base of the landslide deposits. Two samples S1 and S2 and one sample D1 of clayey material were respectively collected from the base of the remaining debris in the lower part of source area and the base of the deposits in the depositional area. Their mineralogy and particle size distribution were analyzed using an X-ray diffractometer (Rigaku Gaigerflex RAD IIB) and a laser diffraction particle size analyzer (Shimadzu, SALD-3100), respectively. The X-ray analysis indicates that the samples are the same material, in terms of texture and mineralogy, consisting of illite, chlorite, quartz, feldspar, and calcite. Besides, particle size analysis shows that samples S1 and S2 of the source area had two particle size modes at 15 μm and 50 – 100 μm, and sample D1 of the depositional area had one mode at 15 μm. This difference between the samples may reflect pulverization during movement of the material from the source area to the depositional area. The overall particle size distribution is narrower in sample D1, and the mean grain size (D_{50}) decreased from 11.03 μm in sample S2 to around 8.96 μm in sample D1. Sample S1 has larger amounts of finer fractions than do samples S2 and D1, and its distribution curve has a flattened top in comparison with the other two samples, which could be attributed to intense shearing between bedrock and debris. The results suggest that the clayey material at the landslide base and the increasing fine-grained content of the clayey material during shearing are assumed to have a significant impact on its long, rapid movement.

キーワード: rockslide avalanche, high mobility, clayey material, particle size distribution
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