The experimental research on initiation mechanism of debris flow from glacial till

Yongbo Tie, Jintao Jiang, and Shuai Wang
Chengdu Center of China Geological Survey, Department of Geo-hazards research, China (229883592@qq.com)

The debris flow initiate by glacial till always dangers the local residents and facilities in alpine region in southwest China. The study of debris flow initiate from glacial till can help in understanding the mechanism of glacial till transfer to debris flow, in revealing the development of alpine mountainous topography. In this study, we designed analogue experiments that simulate the initiating process of glacial till eroded by the runoff. This research focuses on the relationship between the glacial till initiating and the critical value of flow velocity by performing analogue experiments with different flow velocity under a constant slope of landform.

A particle analysis of the modeled glacial till take from field allows understanding the structure of tested soil and standardizing the critical value of debris flow initiation. After the rush of flow with different velocity, the tested glacial till reaches a failure condition (i.e., the movement of certain particle, the undercutting of soil) which was assigned as the evidence for debris flow initiating. Results show that there are three types of erosion occurred during the experiment, the sheet erosion related to flood generation, the vertical erosion related to debris flow initiation, and lateral erosion related to the volume increasing of debris flow. Results show that the time duration of debris flow initiation are negative correlated with the velocity of flow. Because of the distribution of glacial till particle, the surface of the longitudinal profile showed corrugated form after the eroding of flow, this mainly depends on the infiltration zone where the water content of glacial till are saturated.

In the early period before the formation of debris flow, the main type of soil erosion was sheet erosion, the dual peak structure of glacial till made it easy to start up the soil with fine particles in the action of runoff scouring. Therefore, the sediment content in the flood could be improved, which provided a precondition for the formation of debris flow. In this process, the influence of runoff velocity was significant. According to the statistical results of the experiment, the faster the runoff velocity was, the faster the glacial till erosion rate was; and on the contrary, the slower the glacial till erosion rate was. We show that faster the flow velocity was, relatively shorter time the flood took to form, but relatively longer time the debris flow took to start. Finally, our results demonstrate the runoff scouring first leads to the removal of fine particles in glacial till, then the coarse grained soil was unstable due to the loss of foundation support and it initiated to form debris flows.