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A Theoretical Model for Determining Earthquake-related Erosion Rates by Using Cosmogenic ^{10}Be

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Coseismic landslides acts a crucial role in hillslope erosion and sediment dynamics for tectonically- active area. Accurately quantifying rates of landslide-related erosion and sediment transport has presented a major challenge in its own right.

Coseismic landslides could suddenly deliver substantial geomaterials to channel system, which may complicate the determination of catchment-scale erosion rate by using the commonly used cosmogenic 10Be method. However, this effect also may provide a possible opportunity to track the transport of landslide sediment. Here we propose a theoretical model, evaluating the detrital 10Be concentration post-earthquake in an end-mixing model to determining the erosion rates, by constructing the 10Be concentration for pre- earthquake period detrital sediments and coseismic landslide deposits. The eastern margin of the Tibetan Plateau, as a typical tectonic active area, attacked by 2008 catastrophic Mw 8.0 earthquake and numerous coseismic landslides. The geological settings and massive geo-datasets in here which provide an ideal condition for applying and validating our concept.

In this contribution we extracted topographic features covers the 2008 epicentral area using digital elevation data and sampled 23 catchments with various landslide distribution for detrital 10Be concentration determining by AMS. Our results reveal background fluvial erosion rate increases linearly with normalized channel steepness index, by constraint on sediment transport efficiency, the regional background fluvial erosion rates could be estimated throughout the spatial distribution of normalized channel steepness index. Additionally, we show that short-term erosion rate sharp increases across the epicentral area during earthquake, integrating the erosion rate analysis for pre- and post- earthquake period confirms the role of the coseismic landslides as necessary to balance the erosion rate for short- and long-term timescale.

This study provided new insights into the dynamic interactions between mountain topography with erosional processes in a landslide-dominated zone, with implications for understanding the contribution of the catastrophic landslides in the total mass removal from steep mountainous landscapes.

Key words: erosion rates; cosmogenic nuclides; coseismic landslides; channel topography; Tibetan plateau.