Geophysical Research Abstracts, Vol. 8, 03668, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03668

Detection of Large Late Quaternary Rock-slope Failures in the Himalayas: Implications for Extreme Events in Mountain Relief Destruction

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We review the occurrence of large catastrophic rockslide deposits of volumes >1 km^3, which have occurred in crystalline lithology (gneisses, migmatites, granites) of the Himalayas during the Late Quaternary. We find that intrusive bodies of leucogranites at elevations of 5000–5500 m a.s.l. are among the most susceptible rock types to large-scale failure in the High Himalayan Crystalline (HHC) Sequence close to the South Tibetan Detachment System (STDS).

These large rockslides and rock avalanches attained km-scale dimensions and have contributed to catastrophic lowering of high mountain peaks, rapid infilling and obliteration of valley floors with debris, blocking of major rivers, and imposing significant changes to catchment sediment budgets by forcing local sediment storage.

We present selected geo(morpho)logical field and laboratory evidence from a number of sites (i.e. Kalopani in the Dhaulagiri Himal, Latamrang in the Annapurna Himal, Tsergo Ri in the Langtang Himal, and Dzongri in the Kangchenjunga Himal) where extremely rapid slide and flow movement of large rock masses was primarily detected by field exposures of extreme rock fragmentation covered by angular boulder carapaces, internal shear stratigraphy, and local occurrence of microbreccias and frictionite.

We argue that such sedimentologic evidence, together with geomorphologic field interpretation and quantitative terrain analysis, are indispensable for mapping such large rock-slope failures in the High Himalayas. This is because high erosion rates locally

have rendered large rockslide deposits almost undetectable on remote sensing or digital shaded relief images, i.e. data sources that are commonly used for identifying and mapping large landslides.

Consequently, we infer that remote sensing-based studies may underestimate to an unquantifiable degree the number of preserved deposits from these extreme slope-failure events, which contribute to destroying some of the highest relief on Earth.