EGU22-9879
https://doi.org/10.5194/egusphere-egu22-9879
EGU General Assembly 2022

Effect of Clay Mineralogy on Hill Slope Weathering

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The shallow subsurface is prone to the dynamic influence of anthropogenic and environmental processes. To understand the influence, it is essential to quantify the rate of weathering across the depth profile. Chemical weathering rates for landscapes are difficult to quantify due to the non-uniqueness of the timescales over which weathering occurs. The rate of chemical weathering is generally observed to increase with physical erosion and weathering. Clay, a weathering product of rock mass, mainly contributes to this chemical weathering. Therefore, understanding the effect of clay mineralogy is significant in understanding this weathering environment. It is noticeable that intense rainfall in northeastern India mainly contributes to the weathering of the rock mass. Hence, the present study investigates the mechanism by examining the chemical weathering profile across the regolith depth. The primary objective of this study is to highlight that clay minerals have a significant role in the surface and subsurface weathering process across hillslope. Thus, for the analysis purpose, undisturbed soil samples were collected from the top 20 meters of the sediment column in a hillslope of northeastern India, inside IIT Guwahati campus, Assam at a regular 5-meter interval using the auger drilling technique. X-ray diffraction (XRD) was used to identify the clay mineralogy. Clay mineral was separated from the actual soil sample by following the USGS standard manual (extracting <2μm fraction) after treating with Hydrogen peroxide (H_2O_2) solution to remove organic matter. Organic matter was removed as it may cause background interference and prevent parallel orientation of clay minerals. It is observed that illite is the dominant clay mineral, followed by kaolinite and chlorite. Illite content decreases significantly with depth, while kaolinite and chlorite content increases slightly with depth. This variation may be attributed to climatic conditions, rainfall distribution across the year, resulting in deep infiltration. Mineral fluid interaction along with variation in climatic and environmental conditions subsequently causes clay mineral alteration. The accumulation of clay minerals and their alteration forms a zone of mechanical and chemical weakness, causing soil mass movement across hillslope. Thus, it can be concluded that mineralogical and geochemical analysis is essential for determining landscape sensitivity to erosion and weathering processes of hillslope areas.