## Climate proxies from the Siwalik Group in the eastern Himalaya: an oxygen and hydrogen isotope record from authigenic clays

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Lines of evidence are growing for spatial and temporal correlations between rates of precipitation, surface erosion, and deformation along active orogens; however, field evidence for couplings and feedbacks between erosional, climatic, and tectonic processes are still lacking. The coupled Himalayan orogen and Indian Summer Monsoon (ISM) is an ideal system to study these relationships. The Siwalik Group, at the toe of the Himalaya, was formed during the Miocene as the erosional products of the uplifting Himalaya that resulted from the collision of India and Eurasia ~55 Ma. The ISM was established by approximately 12 Ma, as a moist air package moving northward from the Bay of Bengal up to the orographic barrier, formed by the Himalayan foothills, where it rises and cools causing precipitation. The ISM is perturbed in the eastern Himalaya where the Shillong Plateau, an ~1600 m high orographic barrier, is located directly south of Bhutan, along the northward pathway of the monsoonal circulation, causing high amounts of precipitation along its southern slope and creating a rain shadow to the north.

The uplift of the Shillong Plateau occurred at the Miocene-Pliocene transition, 6-7 Ma after the ISM had been established and has potentially induced a drastic reduction in rainfall along the Bhutan Himalaya front. Meanwhile, low-temperature thermochronological data suggest that the cooling rates (i.e., erosion rates) slowed in Bhutan at the Miocene-Pliocene transition suggesting a temporal correlation between erosion and rainfall distribution.

Because the Siwalik sediments cover the period of interest for the uplift of the Shillong Plateau, these sediments may carry information on the changes in precipitation patterns and the concomitant changes in erosion in the hinterland. This study focused on extracting the climate proxies from the Siwalik sediments to assess the regional climatic changes potentially induced by the uplift of the Shillong Plateau.

A river section in southeastern Bhutan offers ~2200 m of continuous stratigraphic outcrop of the Siwalik Group. In this study, measurements of oxygen and hydrogen isotopes in authigenic clays were used to estimate the precipitation within the Himalayan foreland basin at the time of the Shillong Plateau's uplift. Processes of evaporation, condensation, and rain-out of water from air masses passing over mountain belts will systematically affect the isotope composition of the precipitation and therefore of hydrous minerals formed by weathering. Preliminary results indicate the clays to be authigenic because they are made up of kaolinite and smectite rather than detrital mica. The isotopic variations show cyclic events throughout the Siwalik Group, with sparse cyclic patterns in the upper Siwalik Group. These results are the first continental paleoclimatic record for the eastern Himalaya. Accurate dating of the sediments (magnetostratigraphy, detrital thermochronology) will allow comparison of isotopic data with the established marine record and provide a final interpretation.



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