THE RATIO OF GOETHITE VS. HEMATITE AS A PROXY FOR MOISTURE IN ANCIENT SOILS: A PILOT ROCK MAGNETIC STUDY OF NEOGENE PALEOSOLS IN PAKISTAN

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Studies of modern tropical soils have demonstrated that the relative abundance of pedogenic goethite and hematite is controlled by moisture availability. To evaluate the utility of a G/H ratio as a paleo-precipitation proxy, we conducted a rock-magnetic study of paleosol samples from a known paleo-environmental context. Goethite and hematite content of the studied samples has been estimated based on saturation IRM values of the corresponding magnetization components as identified by a statistical analysis of IRM acquisition curves. Independently, goethite contribution to the high coercivity fraction has been determined by the low-temperature cycling of the IRM. Both methods give identical estimates for the goethite content.

The Neogene Siwalik strata of Pakistan are composed of several thousand meters of stacked fluvial floodplain and channel deposits representing deposition by ancient river systems that drained the Himalaya Mountains and foothills. The Middle Miocene Chinji Formation, which is dominantly fine-grained, provides particularly good exposures of successive floodplain paleosols. G/H ratios of samples collected over 100's of meters along a lateral transect in a single Chinji Fm. paleosol show a good correlation (R^2 =0.88) with $\delta^{18}O$ of soil carbonate, indicating that the ratio can be effectively used as an indicator of moisture availability during pedogenesis. Based on lateral fluvial architecture and varying thickness of this paleosol, we can test the prediction that G/H ratios are lower on topographic highs compared with G/H ratios from topographic lows.

Siwalik paleosols affected by fire show a significant change in the high coercivity fraction. In contrast to unbaked samples, burned paleosols lack the goethite component, while the hematite component shows a ~ 350 mT increase in the mean coercivity value. Evidence for paleo-fires as well as the G/H ratios and their correlation with soil carbonate $\delta^{18}O$ provide new insights on varying environmental conditions that characterized the Miocene sub-Himalayan alluvial plains.

Paleosols, goethite, hematite

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