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Assemblages and pathways of mineral magnetic and geochemical transformations in Laterites, Paleosols and Red boles from tropical Indian conditions

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We compare and review the tropical Indian weathering conditions by examining the parent to pedogenic assemblages and transformations of iron oxides, elemental geochemistry and clay mineral changes. The studies based on the occurrence of laterites from West coast, the Siwalik paleosols of Himalayan foreland and the red boles from Deccan traps in India by systematic sampling as well as synthesis of previous reports. The parent-saprolite-ferricrete transformations under lateritic conditions of the West Coast exhibit a complex and diffused vertical variability of iron oxides including magnetite-maghemite-hematite, goethite and limonite. The prolonged temporal development of these lateritic profiles are influenced by multiple imprints of pedogenic processes with complexity arising out of creation and filling of pore spaces during various stages of lateritization. The latest episode of such activity is detectable by SP fraction. It is inferred that the rapid lateritization during initial period is arrested and followed by several later episodes of lower intensities demanding an exhaustive regional approach both amongst lowland and upland laterites in the West Coast with detailed mineral magnetic, geochemical and isotopic efforts to derive generalized pathways.

The Siwaliks paleosols developed under high energy fluvial conditions are commonly top-truncated, laterally pinching out and pre-matured in nature. The oxisols and alfisols (s.l.) of the Mio-Pliocene Siwaliks are dominated by hematite and goethite which, in general, complement with relatively varying warm arid to warm humid conditions. However, the systematic study of Miocene to Plio-Pleistocene (11 Ma to 0.5 Ma) Siwalik paleosols substantiate that the post pedogenic burial and diagenetic changes also provoked transformation from pedogenic ferrimagnetic oxides (magnetite) to stable anti-ferromagnetic assemblages (hematite & goethite) with overburden. The burial compaction and diagenetic dissolution appears to have influenced the magnetic mineralogical assemblages more prominently in the Miocene Siwalik paleosols.

The 'red boles' are sandwiched between the lava flows of Deccan Trap and are affected by baking defying any ideal in-situ pedogenesis. They show a common pathway of iron oxide transformations i.e. parent titanomagnetite-magnetite to maghemite and finally to stable hematite. The other transformation pathways include precursor iron oxides (i.e. ferrihydrite and goethite) due to we athering of Fe-Mg minerals (i.e. olivine and pyroxene) and their transformation to maghemite and hematite. Both the pathways are influenced by heating from upper lava flow. The present study infers a large disparity amongst pedogenic maturities leading to episodic nature of processes in response to availability of moisture due to climate variability within tropical conditions as well as aggradational stability arresting/restarting the transformation pathways.