

Rock Magnetic and Mineralogical Properties of Lateritic Soil Profiles Developed on Two Different Parent Rocks in Northern Kerala, South-Western India

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Abstract

The rock magnetic and mineralogical properties of two lateritic soil profiles developed on two different parent rocks (khondalite and granite) in northern Kerala, south-western India were investigated to better understand pedogenic processes under tropical climate. Field investigations reveal the presence of various horizons in the lateritic profiles, such as saprolite, mottled zone, pebble horizon and top soil. The particle size, rock magnetic, Vibrating Sample Magnetometer (VSM), Scanning Electron Microscopy (SEM)-Energy-Dispersive X-ray Spectrometer (EDS) and X-Ray Diffraction (XRD) analyses were performed on samples collected from different horizons of the two profiles. Magnetic susceptibility (χ_{fd}) values of the lateritic profiles vary from 9.97 to 1717.04 x 10⁻⁸ m³ kg⁻¹, with the granitic profile exhibiting overall higher values. The percentage frequency-dependent susceptibility ($\chi_{fd}\%$) ranges between 0 % and 13.9 %. The XRD data reveal the presence of kaolinite, gibbsite (except for top soil layer) and quartz along with magnetic minerals like magnetite, hematite and goethite. The upper horizons (top-soil and pebble horizon) exhibit high values for concentration dependent magnetic parameters like χ_{fd} and $\chi_{fd}\%$, whereas, the lower horizons (saprock, saprolite, pallid zone horizons) exhibit low values. The tropical soils in the region have undergone a higher degree of pedogenesis with increased magnetic mineral concentration compared to temperate soils. The magnetic enhancement in the topsoil may be due to the neoformation of ultra fine-grained SP magnetite/maghemite (with minor anti-ferro magnetic component), aided by sufficient Fe supply, alternate wetting and drying cycles, dehydration, oxidation and redox conditions.

Keywords: Lateritic Soils; Soil Magnetism; XRD; SEM; Magnetic Enhancement; Pedogenesis; Southern India.

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