

Geochemistry of a Paleosol developed at Archean-Proterozoic boundary in central India

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The models for atmospheric evolution at Archean-Proterozoic boundary have two contrasting views regarding Fe content in paleosols developed during the period [1, 2]. The difficulties to understand evolution of the atmosphere at 2500-2200 Ma are due to uncertainties regarding pH, temperature and solution chemistry before 2200 Ma. We have carried out analysis of a paleosol horizon developed at ~2450 Ma in the Precambrian terrain of central India. Physical evidence of pedogenesis is marked by the development of soil peds, stress corrosion cracks and a nodular rock. Presence of siderite, ankerite, uraninite, alumino-silicate minerals, ilmenite, and magnetite in the soil profile is detected through XRD and SEM-EDX analysis. The chemical index of alteration of samples from an unweathered granite to the top of the soil profile shows variation from 50 to 71 %. The trend of weathering in A-CN-K plot matches with that of a granite with equal proportion of plagioclase and K-feldspar. The soil profile has an increasing value of Ti/Al ratio of 0.01 in the parent rock to 0.06 in the soil profile indicative of mobility of Al and an alkaline environment. The occurrence of nodules of silica, calcite, ankerite and organic matter, and the development of siderite and rhodochrosite constrain the pH value to the alkaline range of 7 to 8. High fluid-rock interaction is indicated by HREE depletion. A flat Ce and Eu anomalies, low Σ REE, and high (La/Yb)_{SN} value indicate a reducing environment during the formation of the paleosol, which is corroborated by a significant increase in the V/Cr ratio (0.25 in fresh rock and 2.8 in the paleosol). The paleosol samples show Fe enrichment, which can be explained by development of Fe²⁺-rich smectite from biotite under low P_{O_2} condition [3, 4]. The intensified magnetic signal in the soil profile can be explained by the development of fine-dispersed magnetite grains from the thermal decomposition of siderite. The geochemical data of the paleosol horizon has many unique features not reported from paleosols of same age.

[1] Gay & Grandstaff (1980) *Precamb Res* **12**, 349-373. [2] Rye & Holland (1998) *Am J Sci* **298**, 621-672. [3] Sujimori *et al* (2004) *Amer Min* **93**, 1080-1089. [4] Murakami *et al* (2004) *EPSL* **224**, 117-129.