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Weathering and denudation history of the western continental margin of India constrained by combined Ar-Ar dating and paleomagnetism

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The western continental passive margin of Peninsular India is fringed by an escarpment, the Western Ghats escarpment (WGE), which separates a narrow coastal lowland plain drained to the west from a highland plateau drained to the east. Since Deccan Traps emplacement, the combined effects of chemical alteration and mechanical erosion led to the formation and dissection of lateritic landscapes whose relicts are preserved both sides of the WGE. Ar-Ar ages of K-rich manganese oxides (cryptomelane) sampled in the lateritic profile of each paleolandscape element have documented the weathering history and put constraints on the paleoclimatic and denudation history of Peninsular India [1,2]. The results have documented intense lateritic weathering during the Eocene (ca. 53-45 Ma) on either sides of the escarpment. Here, we present new independent constraints on the age of that weathering based on paleomagnetism of ferricretes included in thick lateritic weathering mantles of the coastal lowland plain. Our method is based on the paleomagnetic properties of Fe-oxy-hydroxides crystallized in situ in the lateritic weathering profile. The major magnetic minerals, hematite and goethite, have been analyzed by combining hysteresis and remanent magnetizations together with magnetic susceptibility measurements including thermomagnetic curves (KT curves). The main carrier of Natural Remanent Magnetization (NRM) at low temperature is a well-crystallized goethite of first generation characterized by sharp Neel temperature, Tn, at 85°C on KT curves; late goethite generations with distributed Tn below diurnal temperatures (< 65°C) are unable to keep stable NRM. At higher temperature, the component carried by primary and neoformed hematite mimics the primary goethite component. The derived paleopole fits the APWP of India at paleolatitude of 62.3° (with alpha95=5.2°) suggesting an age of ca. 52 Ma [3]. The reverse polarity systematically observed may be ascribed to Chron 23 [4] that refines the paleomagnetic age of the primary goethite to 51.9 – 52.2 Ma.
This new age is in agreement with previously obtained Ar-Ar ages in the same weathering mantle upslope the pediment occupying the lowland. These results imply together that the lateritic pediment formed at the foot of the WGE is old, and further attest for very limited denudation of the coastal lowland plain confirming the great stability of the escarpment since at least 50 Ma, despite the negative anomaly of the geoid observed at this latitude. These results have major implications for the Cenozoic topographic evolution of the western continental margin of India, which underwent negligible relief rejuvenation or positive epeirogeny over the last 50 Ma.

[1] Bonnet et al., 2016, Chemical Geology 446, 33-53.
[2] Beauvais et al., 2016, Geology 44, 299-292.
[3] Besse & Courtillot, 1991, J. Geophys. Research 96, 4029-4050
[4] Cande & Kent, 1995, Geomag. Paleomag. Mar. Geol. Geophys. 100, 6093-6095.