

Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 17	Graz 2012
<i>IGCP 580, 4th Annual Meeting</i>		Graz, 24-30 th June 2012	

First report of magnetic susceptibility records of Tertiary sediments at Thiruvallam, Kerala, India

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Introduction

The Tertiary sedimentary Formations of Kerala extend as narrow, discontinuous bodies along the coast and unconformably overlie the Precambrian crystalline rocks. Both marine and nonmarine sediments are found in the basin. The sediments, ranging in age from Late Eocene to Mio-Pliocene (RAHA et al., 1983), form three divisions, such as the Warkalli Formation, Quilon Formation and Vaikom Formation. The Warkalli Formation, composed of alternate layers of sands and clays with intercalations of lignite beds, get to a thickness of nearly 80 m while the Quilon Formation which underlies the Warkallis and having a maximum thickness of 70 m and consisting of fossiliferous limestone, sands and clays (KING, 1882), as a whole, represents a period of reduced supply of terrigenous clastics owing to the planation of the provenance. The Vaikom Formation underlies the Quilon Formation and consists of gravel, coarse to very coarse sand with greyish clay and carbonaceous clay with thin seams of lignite and attains a maximum thickness of 100 m (RAGHAVARAO, 1976). Laterite is found as the cap rock above the Tertiary sediments.

Geological Background

The Warkalli Formation extends over 2000 km² and is also encountered in the nearshore regions at depths of over 6 fathoms during offshore drilling (PRABHAKAR RAO, 1968). Sticks and nodules of marcasite, impregnated in carbonaceous clays and in lignite towards the base of the Formation (PADMALAL et al., 1995), indicates reducing environment. Sands, varying in size from coarse to fine are angular and poorly sorted. The lithology and the spatial associations indicate that the Warkalli sediments are shallow water shoreline littoral and/or lacustrine to meandering river deposits (PRABHAKAR RAO, 1968). The faunal assemblages found in the clay beds and peat lenses represent a mixed ecological scenario stretching from low land-freshwater- to sandy beach environment with high organic input experiencing warm, humid climate with heavy rainfall (KUMARAN et al., 1995).

Three sets of geofractures with NW-SE to WNW-ESE, NNW-SSE to N-S and NE-SW trends have been recorded in between the Tertiary basin (VARADARAJAN & NAIR, 1978). The first set, parallel to the granulite trend, might have controlled the sedimentation. The second set is associated with the Western Ghat movement from Paleocene onwards while the third set with landward dips affects laterites and Recent sand bars at Varkala and Cochin. It is suggested that a reactivation rendered foundering of the sedimentary basin between the mainland and Laccadives. The Cenozoic tectonics of this region and surrounding areas played an important role in the deposition and distribution of the sediments within the basin. The rejuvenation of the source regions along with the tectonic uplifts of the Western Ghats and the adjoining areas resulted in varying conditions of sedimentation in a broad framework of basin margin deltaic environment.

The Tertiary sediments have already received much attention in terms of stratigraphical and palaeontological characters while the sedimentological and geochemical characters are studied only to a limited extent. The magnetic properties of the Tertiary sediments of Kerala coast are not dealt with hitherto. The present study aims to highlight the potential of magnetic susceptibility variation in interpreting the Tertiary sediments of the Kerala basin.

Thiruvallam section

A well developed section of Warkalli Formation (Fig. 1), capped by laterite and lateritic soil, is exposed at Thiruvallam, south Kerala. In a broad frame work, the section encompasses alternating layers of varying types of sand and clay with a lignite bed at the bottom. Sand layers vary in thickness from 20 cm to 2 m while clay layers vary from 2 m to 4 m. Minor ferruginous layers (10-20 cm) and a suspected layer of laterite are also found in the section.

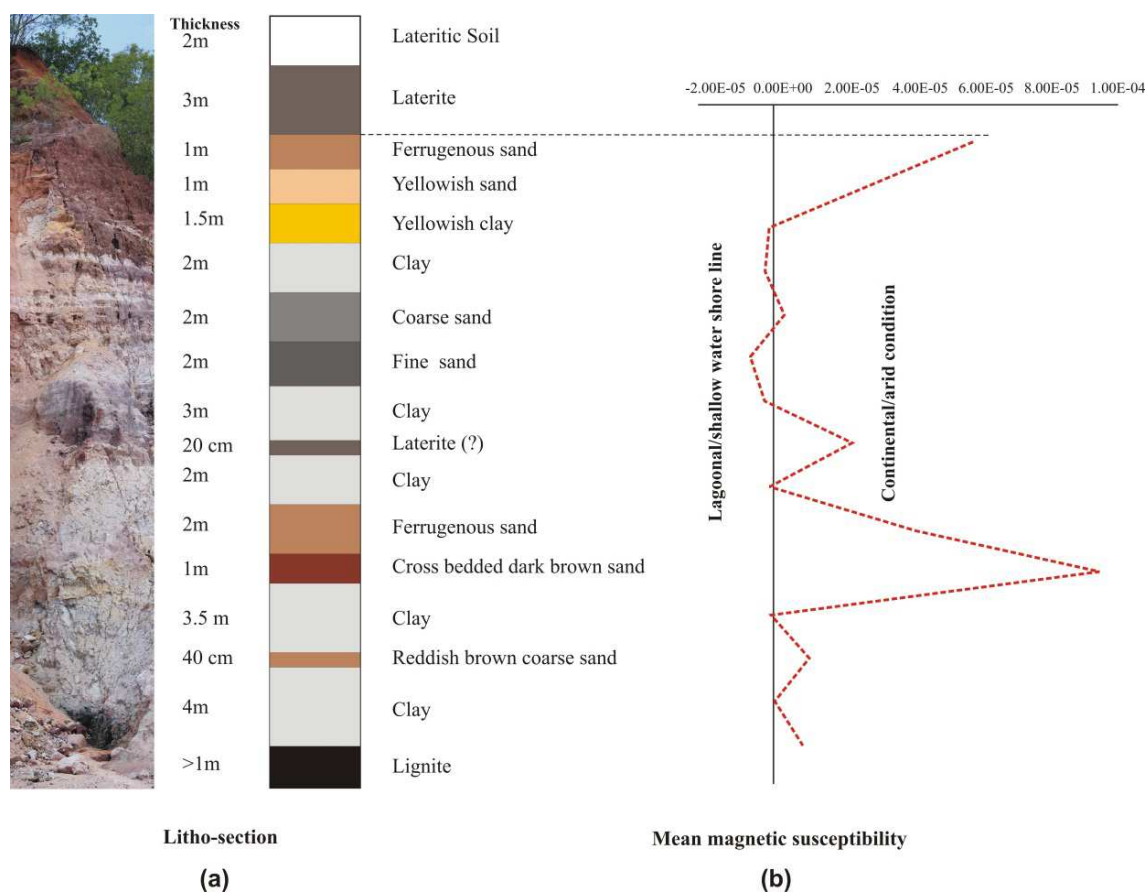


Fig. 1: (a) Lithosection at Thiruvallam cliff; (b) mean MS variation in the Thiruvallam section.

The mean magnetic susceptibility values (K_m) in the section range from $-8.51E-06$ to $9.94E-05$ and the P' values range from 1.016 to 3.668. The magnetic susceptibility in the different layers is mainly produced by the paramagnetic and diamagnetic minerals. Mean MS value shows maximum of $9.94E-05$ in the cross bedded dark brown sand, which is approximately of 1 m thickness. Ferruginous layers including the suspected laterite layer in the section is marked by progressive susceptibility while the clay layers show a sudden decrease in susceptibility. The ferruginous sediments indicate arid/oxidising condition with fluvial influx, while the clay layers might have deposited in a lagoonal-brackish-nearshore environment. Altogether the fluctuating MS values indicate a cyclic change from arid/oxidising to non-arid climatic extremes in the Tertiary period. Detailed analysis of the magnetic susceptibility from similar sections exposed at different parts of Kerala is being attempted for broad stratigraphic and environmental correlations.

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