

Ferricretes of Sriperumbudur: Micromorphology and Geochemistry

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ABSTRACT

Earlier studies on the ferricrete of Sriperumbudur Formation were focused on their types of occurrences and mode of formation. However, in the present study, an attempt is made to understand the physico-chemical changes across seven saprolite-ferricrete profiles developed over sedimentary protolith after upliftment to decipher the paleoenvironmental conditions to which the Sriperumbudur Formation was exposed and to understand the processes of ferricretisation. For this purpose, the ferricrete exposures around Sriperumbudur were surveyed and mapped for their occurrences and types of ferricretes, collected samples were examined for various physio-chemical aspects. Geochemical and petrographic studies exhibit a relatively high percentage of iron content. The Fe_2O_3 content varies from 7.71% to 14.9% followed by the higher concentration of Al_2O_3 and SiO_2 as a result of deep weathering of the Sriperumbudur beds. Other major oxides such as CaO , MgO , Na_2O , K_2O , MnO and TiO_2 show lower concentrations. The bulk X-ray diffraction of the ferricrete samples shows the occurrence of tourmaline, muscovite and magnetite. SEM analysis of the ferricrete samples exhibits solution channels and pits in the matrix, on the limonite, quartz and magnetite revealing intense chemical weathering. Petrographic studies show the occurrence of quartz in a variety of shapes, sizes and sediment sorting, cemented by iron oxides in varying stages. It also reveals iron oxide mobilization due to the alteration of ferruginous sandstone forming a hard ferricrete crust. Iron oxide cementation is due to leaching and re-cementing from the parent sedimentary rock with subsequent re-deposition of the earlier material taking place in a near shore environment and in wetter conditions after the Sriperumbudur beds were exposed since the lower Cretaceous period.

INTRODUCTION

Ferricrete, laterite, plinthites, petroplinthites, oxisols, ferruginous laterites, red soils, are some of the names assigned to the ferruginous duricrusts (Ogura, 1987; Herbillon and Nahon, 1988). Other terms being used to describe ferruginous materials includes ortstein, ferruginous duricrust, lateritic duricrust, ironstone, indurated zones, ironstone gravels, and ironstone oolites. Iron depleted and iron mottled materials are referred as bleached and mottled zones respectively. Thus, the problems of terminology perennially beset studies on ferricretes (McFarlane and Sombroek, 1984), and these have still remained unresolved, there being no internationally accepted terms to describe ferricrete textures and structures despite promising attempts made by Pullan (1967) and Aleva (1982). In this study, iron cemented indurated crusts and horizons are referred to as 'ferricrete' since no detailed genetic connotations are available for the studied occurrences. A ferricrete (or hard plinthite) is a massive, horizon type hardpan enriched

and strongly cemented by sesquioxides, mainly iron oxides (MacVicar et al., 1977; Bourmann, 1993). Soft and hard ferricrete are diagnostic subsoil horizons defined in South Africa binomial soil classification system (Mac Vicar et al., 1977). The arid belt ferricrete of the world has provoked interest as to their mode of formation, development, stratigraphic correlation, as palaeoclimatic indicators and their age as iron enriched duricrusts are signatures of being formed in wetter conditions (Bourman et al., 1993). For example, in the Lake Eyre basin (Australia) the ferricretes and calcretes have survived from the penultimate interglacial fluvial episode (Bourman et al., 1993).

Ferricrete is a hard, erosion-resistant layer of material on the land surface that consists of near surface sediments that have been cemented by iron oxide into duricrusts (Achyuthan, 2004). Ferricretes contain sediments and other non-indigenous materials, which have been transported from outside the immediate area in which it occurs (Achyuthan, 2004). The iron oxide cements are derived from the oxidation of percolating solutions of iron salts and thus the word is derived from the combination of ferruginous oxides and concretions. Low-salinity groundwater emerges along the Sriperumbudur area (because of the marine intercalation). As the waters reach the oxygenated surface, the iron carried forms iron oxides. These oxides cement detritus quartz grains into concretions, termed 'ferricretes'. Ferricretes are products of chemical weathering and such surface formations occur due to intense chemical weathering and these were possible only during times of tectonic stability.

In the Indian context, the formation of duricrusts from peninsular India, was estimated after calculating the pole positions, from the pole site mean directions and a comparison with the Mesozoic-Tertiary apparent polar wander path (APWP) for India (Schmidt et al., 1983). The high-altitude laterites of the east coast and peninsular India seem to have undergone a complex history during the late Cretaceous and early Tertiary period. The low-altitude laterites are mid-to late Tertiary in age. The results of Indian laterite when compared with those of the Australian duricrusts, seem to be consistent with the relative timing of the northward drift of India and Australia (Schmidt et al., 1983).

The Sriperumbudur beds are Lower Cretaceous in age (Rajanikanth et al., 2010). The ferricrete beds are flat, hard, and red, reddish ochreous, dark brown in color enriched in iron and iron oxide content forming a ferricrete horizon or a duricrust at the surface that often vary in thickness (0.50 to 1 m in thickness). In this study, Sriperumbudur ferruginous sandstone deposits have been studied to understand the processes of ferricretisation.

STUDY AREA

Sriperumbudur is a town in the Kancheepuram district of Tamil Nadu, located 40 kilometres towards southwest of the city of Chennai. Seven locations around Vengad, Irumbedu, Chembarampakkam (Fig.1) and around Sriperumbudur were selected for sampling. All the

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