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Middle Miocene pedological record of monsoonal climate from NW Himalaya (Jammu & Kashmir State), India

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Abstract

The Lower Siwalik Subgroup represented by the Dodenal (Kamlial Formation) and Ramnagar Members (Chinji Formation) is well exposed at Ramnagar, District Udhampur, Jammu & Kashmir State. The Ramnagar Member consists of an alternating sequence of silt and mudstone formed under crevasse-splay and flood-plain environments of deposition. Argillisol and gleysol soils are developed on the Ramnagar Member deposits. Argillisols formed under well-drained conditions at high levels, whereas gleysols formed under poorly drained conditions at low levels of the palaeo-landscape. Geochemical and micromorphological studies of the Ramnagar Member palaeosols suggest formation under wet and humid climatic conditions. Early uplift of the Tibetan Plateau/Himalaya resulted in a contemporaneous change in precipitation and monsoonal climate conditions within the Indian region beginning in Middle Miocene.

Keywords: Lower Siwalik Subgroup; Middle Miocene; Ramnagar Member; Palaeosols; Monsoonal climate; Jammu

1. Introduction

The Siwalik Group stretches between the Potwar Plateau (Pakistan) to the northwest and Arunachal Pradesh (India) to the northeast in South Asia. The Group runs through the states of Jammu & Kashmir, Punjab, Himachal Pradesh of India and Nepal. It is divided into the Lower, Middle and Upper Siwalik Subgroups that range in age from Miocene to Pleistocene (Johnson et al., 1985; Ranga Rao et al., 1988). The type sections of the Lower Siwalik Subgroup (Kamlial and Chinji Formations) are in Pakistan, but representative sections are also exposed in India, including Jammu (Jammu & Kashmir State). The Lower Siwalik Subgroup of the Jammu Siwaliks in Ramnagar is divided into the Dodenal and Ramnagar Members of the Mansar Formation (Table 1), corresponding to the Kamlial and Chinji Formations, respectively.

A rich collection of vertebrate fauna has been reported from the Ramnagar area (Nanda and Sehgal, 1993) of Udhampur District, Jammu & Kashmir State (Fig. 1). The vertebrate faunal assemblage from the Ramnagar area is characterized by *Dissopsalis* sp., *Vishnufelis* sp., *Deinotherium pentapotamiae*, *Conohyus chinjiensis*, *Dicoryphochoerus haydeni*, *Anthracotherium punjabiense*, *Dorcabune anthracotherioides*, *D. hyaemoschoides*, *Giraffa priscilla*, etc. (Vasishat et al., 1978; Gaur and Chopra, 1983; Nanda and Sehgal, 1993). The stratigraphic range of the various taxa collected from Ramnagar indicates the presence of fauna belonging to the Chinji Formation. Using as a reference only of the appropriate stratotype data from the Potwar Plateau, Pakistan, the age of the Chinji Formation ranges between 13.1 and 10.1 Ma (Johnson et al., 1982) representing the Middle Miocene. This time period is particularly interesting as it is characterized by the presence of several carbon and oxygen isotope excursions (Miller et al., 1991), numerous inferred global sea level changes (Haq et al., 1987), an increase in salinity (Floegel et al., 2000) and evolution of modern oceans (Ahmad et al., 2005).

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Table 1
Lithostratigraphic succession of the Siwalik Group in Ramnagar area, Udhampur district, J & K State (Gupta, 2000)

Group	Subgroup	Formation	Member	Lithology	Equivalents
Siwalik	Upper Siwalik	Uttarbaini	Marikhui	Buff coloured conglomerate with thin impersistent bands of sandstones and clays	Pinjor Formation
			Labli	Grey sandstones, occasionally pebbly with thin interbeds of red, grey and buff clays, laterally grading into grey conglomerates containing thin impersistent bands of grey sandstones and red clays	Tatort/Saketi Formation
	Middle Siwalik	Mohargarh		Grey to grayish white, medium grained sandstones, with thin partings of ash grey to carbonaceous clays	Dhok Pathan Formation
		Dewal		Grey to dull grey, massive, thickly bedded sandstones with subordinate clays	Nagri Formation
	Lower Siwalik	Mansar	Ramnagar	Brown, light and orange, red clays, claystones and siltstones, with fine to medium grained, grey, grayish, green and brown sandstones	Nahan Group/Nurpur beds/ Chinji Formation
			Dodenal	Multistoried ridge forming, hard, fine grained, greenish grey and purple sandstones, purple, reddish brown clays, claystones and siltstones	Kamlial Formation
Murree				Fine to medium grained, buff, grey and purple sandstones, with interbeds of buff, orange red, purple and brown shales, claystones, siltstones and marlite. Conglomerate bands restricted to upper horizons	Kasauli Formation; Dagshai Formation

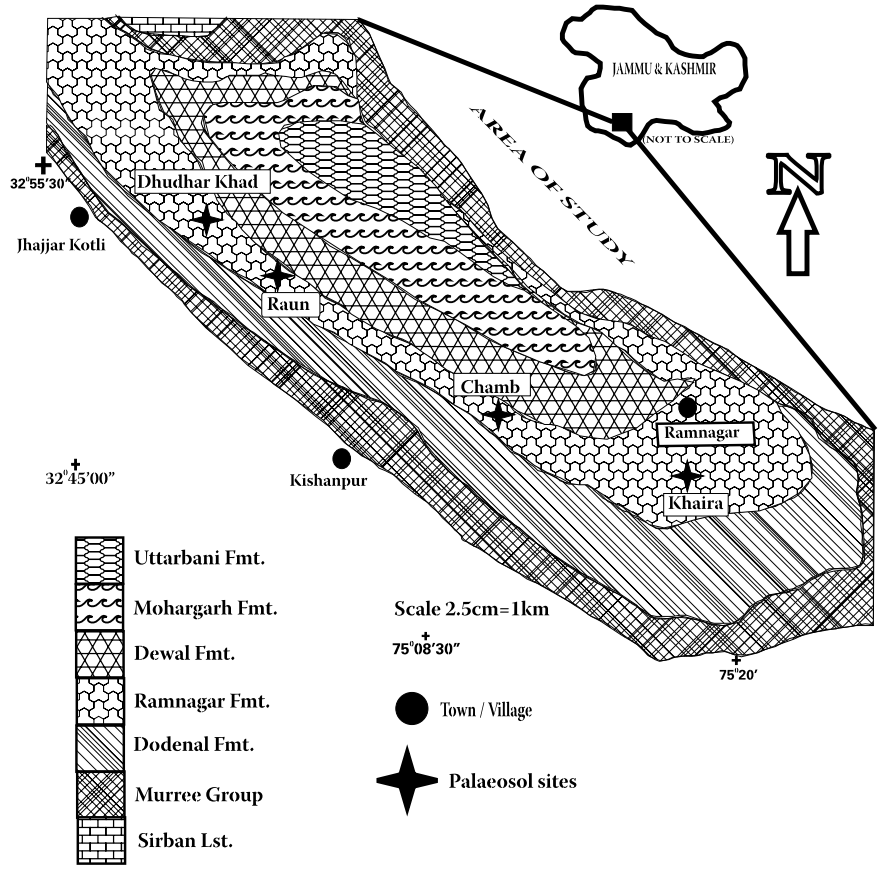

Fig. 1. Geological map of Udhampur dun showing the location of Middle Miocene soil sections.

2. Physical characteristics of palaeosols

The dominate lithology of the Lower Siwalik Subgroup exposed at Ramnagar is siltstone and mudstone produced by suspension settling of sediments (Fastovsky, 1987) in ponded or low energy conditions. Finely bedded lamination constitutes the dominant type of stratification and iron staining is common along the planes. The siltstones are interbedded with mudstones that generally exhibit gray, green and brown colours of low chromas. A few macroscopic features such as roots/burrows, oriented perpendicular (Fig. 2) to bedding planes, are well preserved in mudstones.