

Pliocene-Pleistocene Upper Siwalik Biota of the Outer Northwest Himalaya, Jammu and Kashmir, India: Palaeobiodiversity, Palaeoecology and Palaeoenvironment

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Abstract

Siwalik sediments of the Himalaya are famous worldwide for their rich biotic preservation comprising vertebrates, invertebrates, microfossils, and plant fossils. From time to time, various authors have been recovered, and described, fossil specimens from various Pliocene-Pleistocene fossiliferous sites of the Outer Northwest Himalaya, Jammu and Kashmir, India. The current work aims to present up-to-date Pliocene-Pleistocene fossil records from the Pliocene-Pleistocene Siwalik deposits. Based on this fossil record, a clear picture of palaeobiodiversity, palaeoecology, and palaeoenvironment of these deposits was reconstructed during the present study. Further, fossil record indicates that artiodactyls and charophytes were the highly diversified groups among the fauna and flora of these deposits. The fauna and flora suggest that two distinct palaeo-communities existed during the Pliocene-Pleistocene time *viz.* one terrestrial and another aquatic in the Outer Northwest Himalaya of Jammu and Kashmir.

Keywords: Pliocene-Pleistocene, Palaeobiodiversity, Palaeoecology, Palaeoenvironment, Jammu Province, India

Introduction

The Siwalik Group of rocks is the southernmost part of the Himalayan foreland basin and home of fossilised vertebrates, invertebrates, micro-vertebrates, microfossils, ichnofossils and plant fossils (Kundal, 2022). It is divided into three subgroups: the Lower Siwalik Subgroup, which comprises argillaceous sediments; the Middle Siwalik Subgroup, made up of arenaceous sediments; and the Upper Siwalik Subgroup, which consists of rudaecous sediments. A comparative study indicates that the Upper Siwalik Subgroup has more biotic diversity than Lower and Middle Siwalik Subgroups. The Upper Siwalik Subgroup is divided into three formations *viz.* Tatrot Formation, Pinjor Formation and Boulder Conglomerate Formation. Among these three formations, Pinjor Formation contains a rich assemblage of fossil specimens (proboscideans, reptiles, artiodactyls, carnivores, perissodactyls, rodents, lizards, frogs, fishes, ostracodes, charophytes, gastropods, bivalves, plant impressions and trace fossils). The Siwalik Group of rocks is well exposed in Jammu region and lying between the Line of Actual Control (LAC) (border between Pakistan and Jammu & Kashmir) in the west and the Ravi River (boundary between Jammu and Kashmir and Punjab) in the east. The Upper Siwalik Subgroup

of Jammu contains a rich assemblage of fossil specimens, which have been collected and described by various authors from time to time. The vertebrate specimens collected and described by various researchers over time (Wadia, 1925; De Terra and Teilhard, 1936; Verma *et al.*, 2002; Suneja and Kumar, 1979; Suneja and Sanjeev, 1983; Ganjoo, 1985; Ganjoo, 1992; Gupta and Verma, 1988; Rage *et al.*, 2001; Gupta and Prasad, 2001; Prasad *et al.*, 2005; Kundal and Kundal, 2011; Kundal and Prasad, 2011; Kundal, 2018; Kundal *et al.*, 2017, 2019, 2022). Additionally, invertebrate fossils have been studied (Kundal, 2013), along with microfossils (Suneja *et al.*, 1980; Bhatia *et al.*, 2001; Bhandari and Kundal, 2008; Kundal, 2015, Kundal, 2022; Kundal *et al.*, 2023), ichnofossils (Kundal *et al.*, 2022) and plant fossils including algae (Kundal, 2022).

Geology and Stratigraphy Setting

The Outer Northwest Himalaya is bounded between two tectonic units *viz.* Main Boundary Thrust (MBT) and Himalayan Frontal Fault (HFF). The MBT separates the Lesser Himalaya from the Outer Himalaya in the north and HFF separating the Indo-Gangetic Plains from the Outer Himalaya in the south. The Outer Himalaya is divided into three subgroups and seven formations (Pilgrim, 1934) *viz.* Lower Siwalik Subgroup, Middle Siwalik Subgroup and Upper Siwalik Subgroup. Argillaceous rock units dominate Lower Siwalik Subgroup (Kamlial Formation and Chinji Formation), arenaceous rock units dominate the Middle Siwalik