



# Gastropod, cephalopod, and tentaculitid fauna from the Takche Formation (Ordovician-Silurian), Tidong Valley, Kinnaur Himalaya

Ranveer Singh Negi<sup>a</sup>, Olev Vinn<sup>b</sup>, Birendra P Singh<sup>c</sup>, O. N. Bhargava<sup>c</sup> and Mare Isakar<sup>d</sup>

<sup>a</sup>Birbal Sahni Institute of Palaeosciences, 53-University Road, Lucknow, UP, India; <sup>b</sup>Department of Geology, Institute of Ecology and Earth Sciences, University of Tartu, Tartu, Estonia; <sup>c</sup>Department of Geology, Panjab University, Chandigarh, India; <sup>d</sup>Natural History Museum, University of Tartu, Tartu, Estonia

## ABSTRACT

We describe a small collection of Late Ordovician gastropods *Holopea?* sp. *Hormotoma* sp. *Poleumita?* sp. *Gyronema rupestre*; cephalopod *Discoceras* sp. unidentified Nautiloids, and rare *Tentaculites* sp. from the Takche Formation (Ordovician-Silurian) exposed in the Tidong Valley (Kinnaur) of the Tethyan Himalaya. This is the first report of mollusc fossils from the Ordovician-Silurian successions of the Tidong Valley, Kinnaur. The reported Late Ordovician gastropods are also known from Baltica, suggesting a probable oceanic link between these remote regions. *Tentaculites* from the Takche Formation does not resemble any Baltic or North American tentaculitoids and show greater resemblance to the tentaculitoids from the other Gondwanan regions.

## ARTICLE HISTORY

Received 17 May 2024  
Accepted 21 October 2024

## KEYWORDS

Takche formation;  
gastropods; cephalopods;  
*Tentaculites*; Ordovician-Silurian

## Introduction

In the Tethyan Himalaya, the Takche Formation (Ordovician-Silurian) is extensively studied in the Spiti Valley and is known for its carbonate build-ups and diverse marine life including acritarchs, bryozoans, brachiopods, cephalopods, chitinozoans, conodonts, trilobites, rugose and tabulate corals, and sponges (Reed 1912; Srikantia et al. 1976, 1980; Srikantia 1977, 1981; Goel and Nair 1977, 1982; Mehrotra et al. 1982; Bhargava et al. 1984; Bhargava and Bassi 1986, 1998; Kumar and Kashkari 1987; Kato et al. 1987; Bhargava 1997, 2008; Maithy et al. 1998, 1999; Talent and Bhargava 2003; Suttner 2003, 2007; Suttner and Ernst 2007; Schallreuter et al. 2008; Myrow et al. 2019, 2023; Chaubey et al. 2019, 2023; Husain et al. 2020; Wang et al. 2021; Vinn et al. 2023). The present work provides a taxonomic description of a low-diverse assemblage of gastropods, cephalopods, and tentaculites from the Takche Formation in the Tidong Valley, Kinnaur region. We also discuss the biostratigraphic, paleoenvironmental, paleobiogeographic implications, and regional correlation of the faunal contents. The equivalent sequences of the Takche Formation are the Rishkabal Formation in Kashmir (Reed 1912; Boucot and Gauri 1968; Srikantia and Bhargava 1983; Bhargava 2015), Shiala-Yong-Variegated formations in Kumaun-Garhwal (Salter and Blandford 1865; Shah and Sinha 1974; Khanna et al. 1985; Sinha et al. 1998; Swami et al. 2019), Manchap Formation in Kinnaur (Bassi et al. 1983; Bhargava and Bassi 1986, 1998; Bhargava et al. 1991); Chitlang-Chandragiri formations in Nepal (Bordet et al. 1959; Bhargava 2008; Acharya and Paudyal 2019); and Wachi La Formation in Bhutan (Chaturvedi et al. 1983a, 1983b; Bhargava 1995; Tangri and Pande 1995; Hughes et al. 2011; Myrow et al. 2023). Based on high-resolution chemostratigraphic studies in Takche Formation of the Spiti Valley, Baltoscandic PAROVEJA isotope excursion was identified (Myrow et al. 2019). It could potentially align with the latest Katian (Ordovician) global warming Boda Event (Suttner et al. 2007; Myrow et al. 2019) and two pre-Hirnantian glaciations global cooling events (see Myrow et al. 2019, 2023) i.e. the HICE and KaH excursions.

The Kinnaur region, located east of the Spiti Valley (Figure 1a), geologically remained a scantily explored area (Negi et al. 2023). The Takche Formation is somewhat loosely defined in Kinnaur (Bassi et al. 1983; Bhargava and Bassi 1986, 1998; Bhargava et al. 1991); initially, it was designated as the Manchap Formation (Bassi et al. 1983). Subsequently, Bhargava and Bassi (1998), based on gross lithostratigraphic and faunal similarities in the Palaeozoic to Mesozoic sequences of Kinnaur and Spiti, adopted 'Takche' (type section) over 'Manchap'. Despite better preservation in Kinnaur, the term Takche was preferred as Manchap is located in a rugged terrain requiring six days of trekking; however, Manchap was retained as a junior synonym of Takche (Srikantia and Bhargava 2018, 2020).

## Geological Setting and Lithostratigraphy

The Kinnaur region is situated in the easternmost section of Himachal Pradesh and constitutes a part of the Tethyan Himalaya (TH). It is framed between the Indo-Tsangpo Suture Zone (ITSZ) in the north and Tibetan Detachment System (STDS) in the south (Negi et al. 2023) (Figure 1a). The TH holds fossiliferous marine successions spanning from the Precambrian to the Eocene period, stretching from Arunachal Pradesh in the east to Kashmir-Zaskar in the west (Bhargava and Singh 2020; Singh and Bhargava 2020).

In Kinnaur, the Palaeozoic rocks are prominent in the Baspa, Tidong, Gymthiang, and Hojis valleys (Negi et al. 2023). However, the Ordovician-Silurian successions are only exposed in the Tidong, Gymthiang, and Hojis valleys. In the Tidong Valley, the basal Tethyan succession comprises the Haimanta (?Precambrian-Cambrian) and Sanugba (Ordovician-Silurian) groups, non-conformably rest above the Vaikrita's crystalline rocks (Bassi et al. 1983; Bhargava and Bassi 1998). The Haimanta Group in Kinnaur is represented by the Kunzam La Formation (Negi et al. 2023), while the Sanugba Group includes the Thango and Takche formations (Bhargava et al. 1991; Bhargava and Bassi 1998). The terms Thango