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ORIGINAL ARTICLE

Geochemical signatures of Cambrian clastic sediments from Tidong Valley (Kinnaur), Tethyan Himalaya: Tracing continental island arc magmatism along the northern margin of the Indian plate

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Abstract The Cambrian basin of the Tethyan Himalaya lies along the northern margin of the Indian Plate. For the first time to our knowledge, the clastic sediments of the Kunzam La Formation (Cambrian Series 2–Stage 4) in the Tidong Valley, Kinnaur, have been subjected to a geochemical investigation. Analysis of rare earth elements and trace elements, supported by sandstone petrography and modal analysis, indicates a mixed provenance—primarily felsic (UCC composition) with some basic (HFSE-depleted) input—suggesting derivation from continental crustal melts in an active marginal continental island arc setting, linked to recycled orogens. The Cambrian basin was subsequently obliterated by the Late Cambrian-Early Ordovician Kurgiakh Orogeny, accompanied by extensive acidic magmatism and metamorphism. Elemental ratios of Ce/Ce*, Eu/Eu*, Ni/Co, U/Th, Y/Ho, Sr/Ba, and Sr/Cu, suggesting the formation, were deposited in a shallow marine environment with fluvial influence under highly oxidizing palaeo-redox conditions, low palaeo-salinity, and a warm, humid climate. The present geochemical data complement previous sedimentological studies of the formation in the Tidong Valley and enable a comparative assessment with geochemical data from the Spiti region.

Keywords Tethyan Himalaya · Cambrian · Kinnaur · Kunzam La · REE · Trace element

1 Introduction

The Himalayas, from north to south, are divided into (1) the Tethyan Himalaya (TH), including Late Neoproterozoic to Eocene sequences, interstratified with Permian and Cretaceous volcanic rocks and obducted ophiolite klippen and associated exotic blocks, (2) the Greater Himalaya (GH), comprising granitoids and metamorphic rocks, (3) the Lesser Himalaya (LH), containing sediments ranging from the Palaeoproterozoic to Eocene, and (4) Sub-Himalaya (SH), made up of Cenozoic sediments (Bhargava and Bassi 1998 and references therein). These regions are separated by the Indus-Tsangpo Suture Zone (ITSZ), South Tibetan Detachment System (STDS), Main Central Thrust (MCT), and Main Boundary Thrust (MBT), respectively (Fig. 1a).

The Tethyan basin, located on the northern margin of the Indian plate, constitutes part of the eastern Gondwana (Hughes 2016; Myrow et al. 2010; Singh et al. 2023). Recent contributions to the palaeontology, biostratigraphy, sedimentology, geochronology, and tectonics have attracted global attention to the Cambrian of the Himalayas (Hughes

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