
A newly discovered Neoproterozoic diamictite-cap carbonate couplet from the Western Himalaya

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Abstract

One of the central tenets of the snowball Earth hypothesis is the global recognition of the glacial diamictite-cap carbonate couplets in the Cryogenian sedimentary record. However, the scarcity of such peculiar stratigraphic elements in the Neoproterozoic successions of the Himalaya brings into question the severity and global extent of the snowball Earth event and likewise hampered glacio-stratigraphic correlation within the Himalaya and elsewhere. This study provides the first convincing evidence of the glacial diamictite-cap carbonate couplet from the Tanakki Member of the basal Kakul Formation, previously unknown from the Western Himalaya in North Pakistan. Detailed sedimentological analysis of the diamictite from the Tanakki Member reveals deposition in glacially-influenced proximal to distal subaqueous debris apron. The presence of glaciogenic clasts (striated, faceted and bullet-shaped) together with evidence of the ice-rafted dropstones in pervasive facies association provides credence to the glaciogenic affinity. The thin cap carbonate (herein referred to as Tanakki-cap dolomite; TCD) overlying the glacial diamictite record deposition in a deeper shelf (offshore) setting. The lithological, depositional and persistent negative C-isotope characteristics (ca. -3.2 to -5.8‰) combined with regional stratigraphic and available geochronological data allow us to interpret TCD as a ‘Marinoan’ cap carbonate and the underlying diamictite as an expansion of the terminal-Cryogenian (Marinoan) glaciation in the Western Himalaya. Moreover, the analyses of the tectonic and depositional history of the Tanakki Member coupled with the Neoproterozoic paleogeographic evolution of the northern margin of the Indian Plate argue against a previous interpretation of the culminating foreland basin orogeny and instead support deposition in an extensional fault-controlled rift basin. Finally, this study permits us to revise the Neoproterozoic stratigraphic framework of the Western Himalaya by describing the Cryogenian-Ediacaran boundary interval in the region that ultimately helps to overcome the previous glacio-stratigraphic discrepancies in the Neoproterozoic record of the Himalaya.

Keywords: Snowball Earth, glacial diamictite, cap carbonate, Neoproterozoic, Marinoan glaciation, Western Himalaya

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