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Neoproterozoic–Early Cambrian isotopic variation and chemostratigraphy of the Lesser Himalaya, India, Eastern Gondwana

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Abstract

The Rodinia supercontinent had fragmented by 750 Ma and East Gondwana (India, Australia and Antarctica) separated from West Laurentia. Baltica, Africa and South America occupied other side of the Rodinia. Neoproterozoic rifting, breakup of Rodinia low latitude glaciation and global warming events have been recorded from the Lesser Himalaya of India. Chemostratigraphy of the Blaini–Krol–Tal succession indicates Precambrian–Cambrian transition lies in the Lower Tal Formation ($\delta^{13}C = -4‰$ PDB). The Krol belt in the Lesser Himalaya is characterized by positive $\delta^{13}C$ values (+1 to 6‰ PDB). The appearance of multicelluler Ediacaran life in the Upper Krol is consistent with hypothesis that increase in atmospheric oxygen played a major role in metazoan evolution and Cambrian diversification of life on Earth. The base of the Terminal Proterozoic System in the Lesser Himalaya is established in the Blaini Formation. The pink cap carbonate of the Blaini Formation shows negative $\delta^{13}C$ value (−3‰ PDB) and this Blainian glaciation is correlated with Marinoan glacial event other regions of the Eastern Gondwana and South China, parts of Siberia and North Africa. Neoproterozic–Early Cambrian chemostratigraphy in the Lesser Himalaya is consistent in the isotopic variation where there is carbon isotopic similarity between Neoproterozoic Bambui Group in Central Brazil, South America and the Krol Formation of the Lesser Himalaya, India. In the northeastern Lesser Himalaya, India the Neoproterozoic sedimentary succession shows well developed carbonate the Buxa Dolomite shows significantly positive C-isotope ratios ($\delta^{13}C = +3.7$ to +5.4‰ PDB). The O-isotopic data also shows remarkable consistency with the $\delta^{18}O$ values fluctuating within a narrow range between −8.9 and −7.2‰ VPDB. These isotopic results from the Eastern Lesser Himalaya correspond to the Terminal Proterozoic C-isotopic evolution, followed by oscillations during the Precambrian–Cambrian transition in the Lesser Himalaya in Eastern Gondwana.

Keywords: Neoproterozoic; Carbon and oxygen isotopes; Chemostratigraphy; Lesser Himalaya, Gondwana, India

1. Introduction

Himalayan mountain chain was formed as a result of collision of Indian Plate with Asian Plate. The fossil evidences of early evolution of life are well preserved in the Lesser Himalayan Proterozoic sedimentary basins

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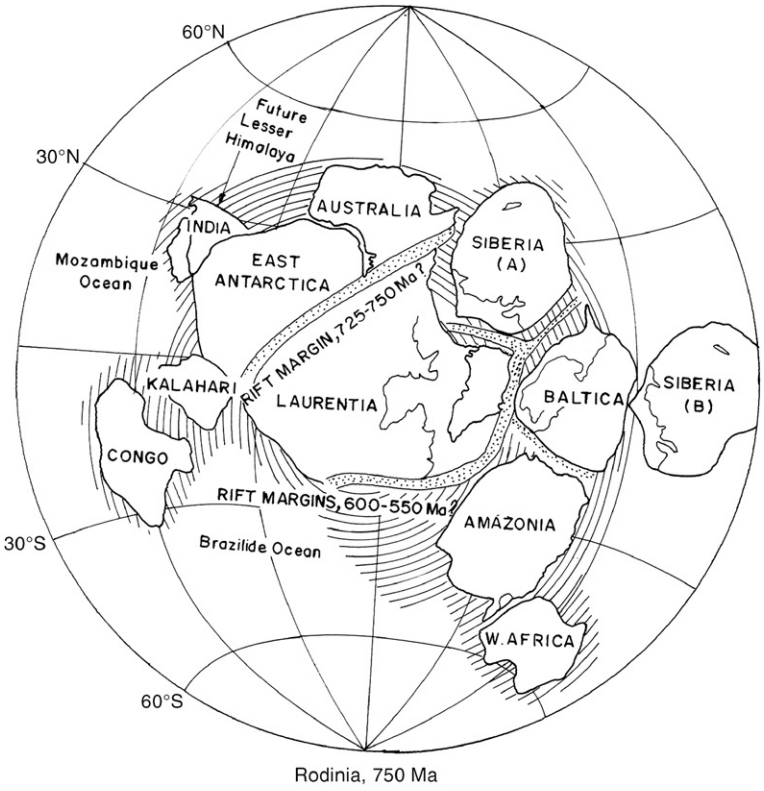

Fig. 1. Rodinia supercontinent (Cited after Powell et al., 1993; Yoshida and Arima, 2000).

from NW and NE region of India. The newly established Ediacaran Period (650–540 Ma) confirmably overlying the Cryogenian Period represents the evolution of the soft bodied animal on earth just after the Neoproterozoic glacial event. The record of Vendian/Ediacaran biota from the Lesser Himalaya (Krol belt in India), Doushantuo and Dengying Formations of China and other parts of Rodinia strongly supports that palaeogeographically these sedimentary basins were very close to each other. The Blaini diamictites in the NE Arunachal Himalaya and the Sinian diamictites of the Chinese region are correlated with the global Marinoan glaciation. During Terminal Neoproterozoic time (Tewari, 2001a,b,c, 2002a,b, 2003, 2004a,b). Major palaeobiological and carbon isotopic changes occurred in the Indian Lesser Himalaya and the Yangtze Platform of southern China leading to rapid evolution and diversification of multicellular life (Tewari, 2003, 2004a,b). Large acanthomorphic acritarchs, calcareous algae, Vendotaenids, sponges (micrometazoans) and Ediacaran soft bodied animals appeared in the Infra Krol–Krol Formation of India and Doushantuo Formation of Southern China. This major event was followed by Cambrian Explosion of life (animals with hard parts and small shelly fossils) found in the Lower Tal Formation of the Lesser Himalaya which corresponds to the Phosphatic Meischucunian Zone I of China. The carbon isotope chemostratigraphy of the Krol and Buxa Formations from the Lesser Himalaya and the Doushantuo Formation from the Yangtze Platform indicate very high positive carbon isotope values (Tewari, 2003; Shen and Schidlowski, 2000). Recently a detailed sedimentological study has been done in the Krol belt by Ganqing et al. (2002, 2003). This Ediacaran event is also global and has significance in early organic evolution of life on Earth (Narbonne, 1998).

A Late Neoproterozoic (Ediacaran, 0.6–0.54 Ma) supercontinent assembly was defined as Rodinia, however later it also included the older rocks that came together at 1.0 Ga (Veevers, 2004 and the references therein). The Rodinia supercontinent (Fig. 1) brokeup around 750 Ma and the East Gondwana (India, Australia and Antartica) separated from West Laurentia (Powell et al., 1993). The Baltika, Africa and South America occupied the other side of the Rodinia. However, the existence of Neoproterozoic super continent Rodinia is still hypothetical (Yoshida and Arima, 2000) and the recent geochronological and palaeomagnetic record of South America and Africa shows that these cratonic fragments may not have been part of Rodinia