ABSTRACT: The results of a carbon isotope study from a hitherto unexplored marine sediments from the Birmania basin, Northwestern India are reported, which documents significant isotope variation across the Precambrian-Cambrian boundary (Pc/C). An attempt has been made to identify carbon isotope chronostratigraphic marker for the Precambrian-Cambrian boundary in the sedimentary succession. The transition is marked by a negative excursion during phosphoritic activity at the base of the Birmania succession which is followed by a positive excursion close to the boundary and a swing back to less positive values in the Early Cambrian. The characteristics of the paleoenvironment during the transition interval is also discussed.

INTRODUCTION

The paleogeographic reconstruction of the end phase of Neoproterozoic assumes a significance due to the fact that the interactions between the biosphere and the atmosphere, hydrosphere and geosphere during this period of time strongly influenced the evolution of life and initiated a remarkable phase of organic evolution well documented in the rocks of this age (Banerjee and Majumdar 1999). Time related changes in these carbon reservoirs and processes during the end Proterozoic have played an important role in the evolution of the environment and of life (Des Marais 1997). Brasier (1992) discussed at length various factors that pushed shallow marine ecosystem of the late Neoproterozoic-Cambrian towards P-limitation and suggested that nitrate fixation, density stratification and massive removal of P in the sediments were responsible for the formation of phosphatic deposits within this time interval. East Gondwana assembly of continents provide fine examples of stratigraphic successions in which the ideas related to oceanic stratification, phosphate deposition, enhanced organic production and carbon isotope fluctuations can be verified and correlated from continent to continent (Banerjee and Majumdar 1999).

The Birmania basin is an oval shaped isolated remnant of the Marwar basin (Neoproterozoic-Early Palaeozoic) located in the heart of the Thar desert of western Rajasthan, India. It is underlain by Malani Igneous Suite of rocks which range in age...
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The sedimentary rocks of Birmania basin are broadly grouped into two formations viz: lower Randha Formation which comprises mainly siliciclastic facies and upper Birmania Formation which consists of repetitive sequences of siliciclastic, carbonate and phosphorite facies (Fig. 1). The stratigraphic position of this succession is delineated on the basis of regional correlation with rocks of the Salt Range in Pakistan. Logical comparison of phosphorite beds of the Krol belt in the lesser Himalaya, Hazara in the salt range (Banerjee 1986) and Birmania in western Rajasthan (Hussain and Banerjee 1979) helps in identifying this closely connected continental mass as representing the end phase of the Neoproterozoic and the dawn of a new era.

The Birmania Formation comprises a mixed assemblage of siliciclastic, carbonate and phosphorite facies. This package of mixed assemblage has been divided into three distinct lithofacies associations i.e., the lower siliciclastic dominated, middle phosphorite dominated and upper carbonate dominated lithofacies association (Fig. 1). The lower lithofacies association comprises grey coloured microsparitic dolostones at the base which grades upwards into deep brown ferruginous sandstone, finally culminating into quartz arenite. These siliciclastic rocks show wavy to lenticular bedding and small-scale cross-bedding. The middle lithofacies association starts with stromatolitic phosphorite horizon. The stromatolites are domical to pseudocolumnar structures of 2.0 to 8 cm in height. They are composed of 2 to 3 mm thick, moderate to steeply convex laminae of carbonate and phosphate. The stromatolitic phosphorite is followed by laminated to bedded phosphorite, which is composed of alternate laminations of carbonate and phosphate minerals. The upper lithofacies association starts with thickly bedded, dark grey microsparitic dolostones. It is followed by massive micritic dolostones which appear light grey in colour. The calcrete dolostone overlying micritic dolostone is a greyish brown massive hard rock. It shows gradational contact with the underlying micritic dolostones. The top of lithofacies association is represented by creamy white quartz arenite. This sequence of the Birmania Formation is unconformably overlain by conglomerate and sandstone of Lathi Formation of Jurassic age.

The siliciclastic rocks of Birmania basin comprises 80 to 95 percent clean washed medium to coarse detrital quartz of unimodal nature (Mathur and Chauhan 1995). Heavy minerals present are tourmaline, zircon, sphene, garnet and magnetite. The phosphorite facies consisting of stromatolitic and bedded phosphorite is mainly composed of microcrystalline fluorapatite, calcite/dolomite and terrigeneous quartz. The stromatolitic phosphorite comprises columnar to pseudocolumnar structures in which each stromatolitic column is composed of alternate laminations of phosphate and carbonate minerals often studded with detrital quartz grains. The intercolumnar spaces of the stromatolites are filled with quartz and phosphorite clasts which are in turn cemented by phosphate or carbonate minerals. The bedded phosphorite is composed of three types of laminations.

The microsparitic dolostone is composed of equant grains of dolomite/calcite showing xenotopic fabric with a few lenses of sparite. The micritic dolostones appears as structureless homogeneous dolomicroite mud at the bottom. It grades upward into a complex microsparitic mass consisting of clots of dolomicroite of 1.6 to 2.4 mm diameter. Calcrete dolostone represents three distinct textural patterns. Firstly, angular to subangular silt sized quartz coated by micrite. Secondly, spherical to ooidal carbonate bodies 0.64 to 2.3 mm in size, outlined by microsparite and micrite. Thirdly, bigger elongated, irregular carbonate bodies of 0.61 to 2.6 mm diameter. They also possess outer rim of micrite and internally composed of radial fibrous sparite.

The carbonate rocks of Birmania basin contain 28.77 to 33.70% CaO, 15.43 to 21.53% MgO with corresponding 1.3 to 2.05 CaO/MgO ratio (Mathur and Chauhan 1995). The carbonate rocks of Birmania basin may be defined as mainly calcitic dolostones (cf. Pettijohn 1969). \( P_2O_5 \) content of phosphorite of the area is as high as 29.37% (Mathur and Chauhan 1995). The CaO indicate positive correlation while SiO2 and MgO show negative correlation with \( P_2O_5 \) contents.