Isotopic analysis of Permo-Carboniferous Talchir sediments from East-Central India: signature of glacial melt-water lakes

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Abstract

Presence of calcareous nodules in the upper part of the Talchir sedimentary sequence (Permo-Carboniferous) in Gondwana sediments of east-central India offers a chance to delineate the environment of deposition and the regional palaeo-climate. Carbon and oxygen isotopic compositions of the carbonate cement in these early diagenetic nodules indicate that this phase of Talchir sedimentation took place in lakes formed by glacial melt-water. The estimated mean δ18O of the meteoric water is about −22.5 ‰, close to the expected composition at the 70°S palaeo-latitude of this area. Majority of the nodules have highly depleted carbon isotope ratios indicating significant contribution from biogenic carbon dioxide. Since the lower part of the Talchir Formation is characterized by glacier derived materials (conglomerates and diamictites), the presence of biotic signature in the upper part indicates a climatic change from the cold glacier regime to a warm period.

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1. Introduction

The Late Carboniferous and Early Permian period was an exceptional phase in the earth’s history when the precursors of the modern continents were assembled in the form of two big landmasses (Gondwana and Laurasia) which were connected to form a supercontinent (Pangaea) such that the major part of the land area was in the southern hemisphere (Scotese, 1997). Since the Earth’s climate is dependent on land and ocean distribution, the global air circulation and climate were radically different from the present. For example, Fawcett et al. (1994) developed a climate model which predicts that during the Late Permian a large summer thermal cell over the southern hemisphere landmass brought monsoonal rains to India and east Africa and strong mid-latitude storms prevailed in winter. Similar predictions were made by Robinson (1973) and Kutzbach and Gallimore (1989). Sedimentary features of contemporary basins are the only evidence available to test some of these predictions. For example, hummocky cross-stratification in sedimentary beds can be an indicator of strong winter storms (Bhattacharya et al., 1989; Duke, 1985). Similarly, a cool humid climate may be reflected in a preponderance of coal beds (Fawcett et al., 1994).