Palaeoproterozoic sedimentation pattern in the eastern part of the Singhbhum craton, India

Abstract

The rarity of remnants of crustal fragments documenting Archaean-Palaeoproterozoic transition is the major impediment to evaluate the relationship between the sedimentary rocks, their provenance, tectonic settings, paleoclimate, paleoweathering during sedimentation and the evolution of the atmosphere, hydrosphere, and continental crust through time. Unlike other cratonic blocks of India, the Singhbhum cratonic succession have a continuous depositional record from the Palaeoarchaean to Mesoproterozoic. The sedimentary facies characteristics and mode of stratigraphic sequence building of the Dhanjori, Chaibasa and Dhalbhum Formations are well known but sedimentary geochemistry, provenance and tectonic milieu of deposition of these Formations are hitherto unknown. This thesis presents sedimentological, petrological, geochemical data and particularly Sm-Nd isotopic data from the clastic sediments of Dhanjori and Chaibasa Formations for the first time. The Sm-Nd isotopic data for the Chaibasa clastics is unambiguous with respect to provenance. Average $\varepsilon_{\text{Nd}} (t = 2.2 \text{ Ga}) = -0.8 \pm 1.0$ and average Nd model age ($T_{DM}$) = 2.51 ± 0.08 Ga with average $^{147}\text{Sm}/^{144}\text{Nd}$ ratios = 0.1114 ± 0.0041 for metapelites and quartzites indicate an extremely homogeneous source signature consistent with a late Archaean “juvenile” crustal provenance, possibly a dominantly upper crustal provenance. The Sm-Nd isotopic data from the older Dhanjori Formation also indicate broadly similar provenance as comparable lithologies in the younger Chaibasa Formation. Sm-Nd data is entirely consistent with the previous sedimentological data and confirms a terrestrial, rift-dominated tectonic setting for the Dhanjori Formation (proximal sources, poorly mixed provenance) and a marginal marine to offshore setting for the more homogeneous Nd isotopic signature of the overlying Chaibasa Formation (distal sources, well mixed provenance). The Palaeoproterozoic supracrustal record of the Singhbhum Craton includes evidence for high continental freeboard conditions which is evident from the terrestrial Dhanjori Formation and development of Keonjihargarh palaeosol. In significant contrast to the Palaeoproterozoic successions around the world and Indian sub-continent, the Singhbhum Craton neither have any evidence of Palaeoproterozoic glaciation nor any occurrence of Banded Iron Formations. Therefore, known Late Archaean-early Palaeoproterozoic (2.6-2.2 Ga) events recorded in the Singhbhum Craton were largely craton specific.