STRATIGRAPHY OF BARMER BASIN, RAJASTHAN: IMPLICATIONS ON CRETACEOUS-TERTIARY BOUNDARY*

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EXTENDED ABSTRACT

Earth scientists have been in pursuit for long to find the truth about: (1) What killed dinosaurs at the end-Cretaceous? and (2) Had the mass extinction during the geological history been abrupt or is a gradual process? The objective of this paper is an attempt on the basis of data collected from the Barmer Basin, Rajasthan, to find a plausible answer to these two questions.

The palaeontological analysis done by Sepkoski (1992) reveals that the Earth has suffered five major mass extinctions during its history: during Late Ordovician, the Devonian, the Permian, the Triassic and the Cretaceous. It is generally believed that the species become extinct when their rate of adaptation is not able to compete with the environmental stress. The Earth has suffered many such episodes when its environment got highly deteriorated and became unsuitable for the then thriving species. The records of such events are often preserved in the sedimentary deposits of the Earth. The geological boundaries in the stratigraphical scale are therefore, manifestations of the physical, chemical and biological changes that Earth suffered during its long history. If we take into consideration a recent trend in the extinction of the species we find that there has been a rapid annihilation of many of the species in the past few hundred years. Thirty of the species became extinct in the 17^{th} century while forty species lost their existence in the 18^{th} century. In the 19^{th} century 100 species were wiped off from the globe and the same number of species vanished in the 20^{th} century. The culprit responsible for this catastrophe is often interpreted as 'Man'. This may partly be true as man's activities towards a developed world are resulting in a severe environmental stress leading to inability for many of the species to adapt to the recurring changes. Many of the scientists have shown their apprehension that this is a period of sixth major mass extinction. One of the prime reasons for this extinction is probably perturbation in the delicate balance of nitrogen (78%), oxygen (21%) and other gases (1%) in the atmosphere. All these changes are getting recorded in the Earth in the form of fossils, chemical anomalies and as distortion in the morphology of the Earth. If we imagine a scenario of the post 65 Ma era, it is possible that the intelligent being of the future era may find these changes incorporated in a thin sedimentary layer with no lateral continuity, and may fall into the trap of interpreting tens of thousand years as a very very small time period. It is to be noted that the enormity of dinosaurs must have caused extinction of many of the species of the Cretaceous Period. Though, final blow responsible for complete deterioration in the environment could be an impact that led to the death of dinosaurs.

The Barmer Basin is a narrow N-S trending graben. Its western margin is defined by a NNW-SSE trending fault exposed in the west of Barmer town where clastics of the Barmer Hill Formation are down faulted against Malani Rhyolite. Its southern extension is restricted by a NE-SW trending fault scarp exposed near Sarnu. A ridge exposing Fatehgarh Formation underlain by Lathi Formation shows its northern limit while its eastern margin is not observed. The sediments of the Barmer Basin are classified as pre-rift, syn-rift and post-rift that deposited on the Late Proterozoic Malani Igneous Suite (Sisodia and Singh, 2000). The pre-rift sediments are represented by: 1. Randha Formation (Siliceous facies). 2. Birmania Formation (Calcareous facies) and 3. Lathi Formation. The syn-rift sediments include Barmer Hill Formation and Fatehgarh Formation. The Fatehgarh Formation shows a mixed sand and mud tidal flat environment, it comprises besides other sediments a phosphorite bed with micro vertebrate fossils of Late Cretaceous age such as *Igdabatis* along with forms of *Semionodontid, Lapisosteum, Enchodontid* (Mathur et al. 2005). A thin unit called Siliceous Earth overlies Fatehgarh Formation. Siliceous Earth is basically a volcanic ash that represents a sequential time deposit accumulated over a short span of time close to the Cretaceous-Tertiary Boundary event (Sisodia et al. 2005). Most of the Barmer Basin has been filled up with post-rift sediments constituting the Mataji-ka-dungar Formation and

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Akli Formation. Mataji-ka-dungar Formation is a pro-deltaic, delta slope/delta mouth deposition. Akli Formation comprises bentonite and lignite representing low energy shallow basinal sedimentation. Lignites developed in protected lagoons within this setting. The palynological analysis of shales and lignites of Akli Formation yielded different palynomorphs of Middle to Late Palaeocene age such as *Dandotiaspora, Proxapertites, Spinizonocolpites* and *Matanomadhiasulcites* (Tripathi et al. 2003). The above described stratigraphy shows that the Barmer Basin epitomizes a record of continuous deposition from Late Jurassic to Early Eocene and hence, it can be testimony to the event at the terminal Cretaceous responsible for the extinction of dinosaurs.

A thin layer overlying phosphorite bed of the Fatehgarh Formation (Late Cretaceous in age) yielded unusual sediments that include: micro spherules consisting of opaque rim enclosing glassy interior; highly fractured quartz; quartz grains showing planar fractures; glassy balls; highly magnetic fine dust and micro breccia with flow texture and constituted of opaque iron glass, siliceous glass, spherules and highly fractured quartz fragments (Mathur et al. 2005). This type of sediments are mostly a product of impact origin.

It is to be noted that at the terminal Cretaceous, one large impact at Chicxulub responsible for the extinction of dinosaurs is well documented (Hildebrand et al. 1991). Its ejeta however, is not expected to reach India according to the fallout model of Alvarez (1996). One possibility therefore, for this material to be in the Barmer Basin is that it can be a post-impact storm surged material flooded onto the coastal zones of Indian Peninsula, which at the time of Chicxulub impact was placed totally isolated in the Indian Ocean. The discovery of iridium anomaly and impactites at Um Sohrygkew, Meghalaya (Bhandari et al. 1987) and at Anjar, Kutch (Bhandari et al. 1996) however does not strongly support this possibility and necessitates rethinking for a plausible but judicious answer to the K/T extinction. May be! We should look for another crater in the Indian Peninsula. Shiva Crater in offshore western India has already been proposed (Chatterjee and Rudra, 1996). At the same time it is also necessary to note that since Chicxulub did not trigger Deccan Volcanism (Bhandari et al. 1995) there is a leeway that this — another crater may be a candidate that triggered Deccan Volcanism; and both catastrophes together changed the history of life on the Earth!!

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