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RESEARCH ARTICLE

Magnetostratigraphy and Sedimentology of Deccan Intertrappean Succession from Sagar, Central India: Insights into Palaeo-environment and End-Cretaceous Palaeogeography

Sarvendra Pratap Singh[1,4], Arvind Kumar Singh[1,2,!], Mohammad Arif[1,2,*], Vandana Prasad[1,2], Mamilla Venkateshwarlu[3] and Amiya Shankar Naik[4]

[1]Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow - 226 007, India
[2]Academy of Scientific & Innovative Research, CSIR-HRDC Campus, Ghaziabad - 201 002, India
[3]CSIR-National Geophysical Research Institute, Hyderabad - 500 007, India
[4]Department of Geology, Banaras Hindu University, Varanasi - 221 005, India
E-mail: *arif@bsip.res.in*; mdarifkrl@gmail.com*;arvindsingh@bsip.res.in[!]*

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ABSTRACT

The study of Deccan volcano-sedimentary successions is significant for understanding the palaeomagnetic correlation, eruption history and palaeoenvironmental conditions of the Central India during the Cretaceous-Paleogene (K-Pg) transition. In this study, we applied an integrated magnetostratigraphic and sedimentological approach to the Deccan Intertrappean Succession exposed at the Mothi Hill (Malwa Subprovince), Sagar, to provide palaeomagnetic age constraints for the lava flows, depositional environment and end-Cretaceous palaeogeography. Palaeomagnetic data suggest that the lower and upper Trap lava flows associated with the Mothi Intertrappean deposits are not coeval, and they correspond to C29r and C29n magnetochrons, respectively, which points to the age duration of 66.3–65.1 Ma (late Maastrichtian-early Danian). The palaeomagnetic data also marks the presence of upper magnetic polarity transition (C29r/C29n) in the eastern part of the Malwa Subprovince, which indicates the occurrence of C30n-C29r-C29n magnetostratigraphic sequence for the Subprovince. The Malwa, eastern Mandla and Western Ghats Subprovinces can be palaeomagnetically correlated and are partly synchronous with each other.

The Mothi Intertrappean deposition occurred in a low energy shallow water lacustrine setup with swampy to brackish depositional condition similar to shallow coastal lake type environment. The occurrence of such coastal type depositional environment at Sagar in the central part of India, points to the influence of temporary marine incursion and existence of marine pathway up to Central India, possibly through the western corridor of Narmada-Tapti rift zone during the late Maastrichtian-early Danian period. Moderate to intense chertification within the argillaceous limestone suggests post-depositional diagenetic modification and secondary silica generation due to interaction with silica enriched meteoric water diagenesis.

Keywords: Deccan traps; intertrappean deposits; palaeo-magnetism; sedimentology; depositional environment

INTRODUCTION

The timing of Deccan volcanism coincides with an important transitional phase in the Earth's history that witnessed an acute climatic changes resulting in disappearance of biota, known as the end-Cretaceous mass extinction (Keller, 2012). It led to disappearance of 75% or more living species including dinosaurs (Longrich et al., 2012), and a sizable number of remaining groups underwent remarkable adaptive radiation (Feduccia, 1995; Friedman, 2010).

The northward migration of the Indian plate over Réunion hotspot and subsequent outpouring of basaltic lavas resulted in the formation of the Deccan Volcanic Province (DVP), one of the largest continental flood basalt province in the world where the duration of eruption of this volcanic province spans across the Cretaceous-Paleogene (K-Pg) boundary (Duncan and Pyle, 1988; Widdowson et al., 2000; Ganerød et al., 2011). The sedimentary sequences, deposited during pauses or quiescent periods of volcanic activity, were trapped in this lava flows–structurally known as Deccan Intertrappean sediments (Chatterjee et al., 2013). The Intertrappean sediments associated with these lava flows are generally deposited in terrestrial/freshwater to lacustrine environments and contain diverse biota (both flora and fauna) of Maastrichtian-Danian age (Khosla and Sahni, 2003; Khosla et al., 2004; Fantasia et al., 2016; Verma and Khosla, 2019). However, several discoveries of fossils from the Intertrappean deposits of Malwa and Main Central Deccan Subprovinces (Fig.1a) also provide evidence for short term marine influence during the K-Pg transition (e.g. Bonde et al., 2004; Keller et al., 2008, 2009a). These palaeontological observations have played an important role in inferring the extent and nature of terrestrial and marine environmental changes during the K-Pg transition in the Indian subcontinent. However, information on the physical sedimentology and facies analysis of the trapped sediments are limited in literature, and such studies could be beneficial for inferring the changes in the marine and terrestrial environment during the critical transitionary period in the Earth's history, caused by the Deccan volcanism.

Due to limits of analytical errors associated with the radiometric dating (K-Ar, Ar-Ar) techniques, a precise information on the time of

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