



Age and implications of the phosphatic Birmania Formation, Rajasthan, India

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ABSTRACT

The Birmania inlier in western Rajasthan, India, contains important phosphate deposits, the depositional age of which is poorly constrained. Here we provide the first direct age constraints for the phosphate-bearing Birmania Formation using a combination of paleontological and detrital zircon U–Pb data. The occurrence of the multicellular algal fossil *Wengania exquisita* in phosphatic chert of the Birmania Formation suggest that it was deposited during the Ediacaran. Detrital zircon age distributions contain prominent populations of 1.7–1.9 Ga grains, with subordinate younger grains that range from 650 to 980 Ma. The distribution broadly resembles those from Neoproterozoic strata from both cratonic and Himalayan India but, like zircon age distributions from the Marwar Group, lacks 1.0–1.2 Ga grains, which may suggest that both areas shared similar local sources. The lack of zircon grains younger than ~650 Ma is consistent with an Ediacaran depositional age because almost all Cambrian or younger strata from India have yielded Cambrian or latest Neoproterozoic age grains. These findings raise the possibility of a previously unrecognized late Neoproterozoic episode of phosphogenesis on the India craton. The presence of *Wengania exquisita* further supports strong palaeogeographic affinity between the India and South China during the Neoproterozoic and Cambrian.

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1. Introduction

India has an extensive and well-preserved suite of Proterozoic sedimentary rocks that have great potential for studies of the sedimentary and tectonic history of the continent. Realizing this potential requires resolving uncertainties in the depositional age and correlations among the various outcrop belts that constitute the “Purana Basins” (a name applied to all Proterozoic successions across the Indian subcontinent) (Wadia, 1975), and recent studies have made considerable progress in this regard (e.g. Malone et al., 2008; McKenzie et al., 2011a, 2013; Patranabis-Deb et al., 2007; Pradhan et al., 2012). Ore-grade phosphorite deposits have attracted special interest for their economic potential their relatively rarity in the stratigraphic record, and their value as

candidate marker horizons for inter-basinal stratigraphic correlation (e.g. Banerjee et al., 1986, 1997). However, uncertainty remains concerning the total number of phosphatic depositional events represented within the Indian stratigraphic succession. Improved resolution requires accurate dating of the depositional ages of individual phosphatic deposits. This paper provides such constraints for an important and enigmatic phosphate horizon, the Birmania Formation of the geographically isolated Birmania inlier of western Rajasthan.

2. History, location and geological setting

The Birmania inlier is located west of the extensive outcrops of Proterozoic rock preserved in the Aravalli–Delhi Belt and the Vindhyan Basin (Fig. 1). It consists of a poorly exposed sequence of sedimentary rocks exposed on the desert floor and as occasional low hills about 70 km south of Jaisalmer (Fig. 2A), and has been mapped as two outcrop belts separated by a tract of sand

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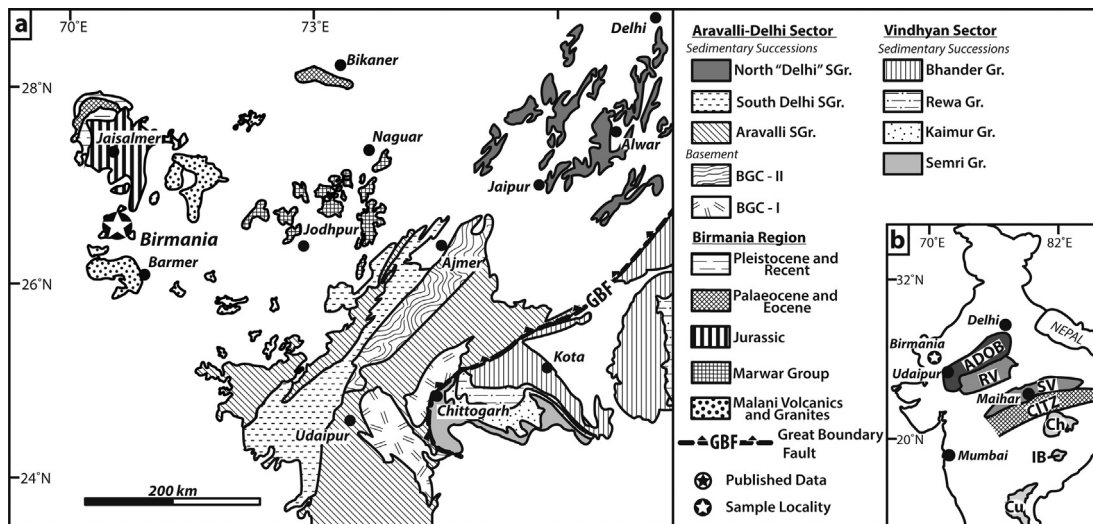


Fig. 1. Bedrock outcrops of much of the northern part of the Indian craton, showing the position of the Birmania inlier at the western extent of this area, figure modified from McKenzie et al. (2013). (a) Detail of the western Vindhyan basin, the Aravalli-Delhi Orogenic Belt, and outcrops in western Rajasthan. (b) Positions of major tectonic units and depositional basins: ADOB = Aravalli-Delhi Orogenic Belt, RV = Rajasthan Vindhyan, SV = Son Valley Vindhyan, CITZ = Central Indian Tectonic Zone, Ch = Chhattisgarh Basin, IB = Indravati Basin, Cu = Cuddapah Basin.

(Mathur and Chauhan, 1995; Srikantan et al., 1969). The inlier contains sedimentary rocks that are assigned to three formations: in ascending order the Rhanda, Birmania, and Lathi formations. The Lathi Formation comprises undeformed sandstone (Pareek, 1984) reported to contain fossilized wood and leaves (Mathur and Chauhan, 1995), and is known widely in western Rajasthan (Roy

and Jakhar, 2002). These early Jurassic (Roy and Jakhar, 2002) rocks rest unconformably on older strata. In the Birmania inlier the Lathi Formation is mapped as unconformable overlying the strongly folded Birmania Formation in the northern outcrop belt of the inlier known as the "Ladhu Singh ki Dhani" block (Mathur and Chauhan, 1995; Muktinath, 1969; Roy and Jakhar, 2002, fig. 8.31) (Fig. 1).

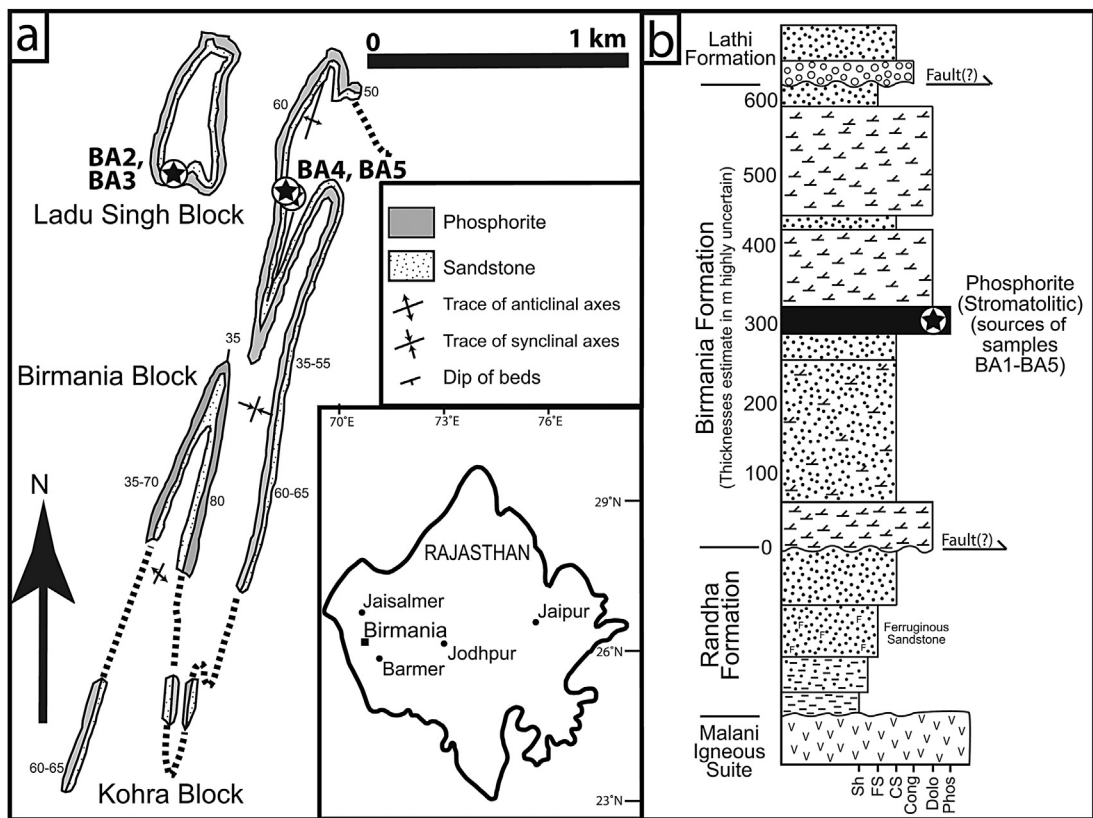


Fig. 2. (a) Outcrop of the phosphorite beds of the Birmania Formation in part of the Birmania inlier, showing different outcrop sectors previously designated as different "blocks", and positions of the detrital and productive fossil samples analyzed herein. Inset shows geographic location of Birmania within Rajasthan. Modified from Srikantan et al. (1969) and Husain and Banerjee (1986). (b) Stratigraphic log of the Birmania inlier succession modified from Mathur and Chauhan (1995) and Muktinath (1969), showing position of the phosphatic bed from which samples BA1–BA5 were collected. Published thickness estimates for the Birmania Formation vary from less than 200 m to over 2000 m. v indicates volcanics, sh indicates shale, fs indicates sandstone, cs indicates coarse sandstone, cong indicates conglomerate, dolo indicates dolostone.

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