



Were the hydraulic parameters of Precambrian rivers different?



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ABSTRACT

Palaeohydraulic estimates have been made using time-tested standard empirical formula involving channel dimensions, especially channel depth, in four Indian Proterozoic fluvial formations. These are the Mesoproterozoic Ramdurg, younger Mesoproterozoic Muchkundi and Neoproterozoic Cave Temple Arenite in Karnataka, and Upper Rewa Sandstone in central India. The basic data came from direct measurement of decompacted thicknesses of completely preserved channel-fills or bedforms, and more commonly of cross-sets. The result, in combination with data derived by others in a similar way from a few other Precambrian fluvial formations helps to provide a new insight into the palaeohydraulics of Precambrian rivers.

River gradients appear to have been steeper during the Precambrian; the possibly continuous range of variation in river gradients from alluvial fans to the plains, as a whole shifted to higher values during the Precambrian epoch. The likely reason is a greater possibility of sediment bypassing on vegetation-free land. Concomitant downstream increase in discharge was enhanced in Precambrian rivers due to lack of withdrawal of groundwater through biogenic activity. Precambrian rivers were commonly ephemeral, but downstream the ephemerality index was reduced and some rivers might have been perennial where they debouched into standing bodies of water. The Precambrian river deposits studied generally had smaller width and depth with respect to Phanerozoic and modern rivers, possibly due to unstable substratum causing surface run-off tended to be impelled along multiple independent minor channels.

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1. Introduction

The hydraulics of Precambrian rivers are seldom addressed (Eriksson et al., 2006). The question, whether Precambrian rivers had hydraulic parameters comparable to those of modern and Phanerozoic rivers is, nonetheless, a loaded one. Since sedimentation framework underwent significant changes in post-Cambrian times, some significant differences in river-hydraulics should be expected. To resolve this potential issue hydraulic parameters have been estimated for four Proterozoic fluvial formations in India. The purpose of the paper is three-fold, namely, augmenting data on Precambrian river palaeohydraulics, making a comparison with Phanerozoic and modern equivalents, and establishing plausible explanations for any observed difference.

Out of the four formations studied, two, namely, the fluvial formations in the basal part of the Ramdurg Formation, including the Salgundi Conglomerate and the basal part of the Saundatti Quartzite members, in Karnataka (Fig. 1; Bose et al., 2008), and the Upper Rewa Sandstone member of the Rewa Formation in central India (Fig. 1; Bose and Chakraborty, 1994; Mukhopadhyay, 2012) have

been studied extensively and used as the basis for the conclusions made. The other two fluvial intervals studied, namely the basal part of the Muchkundi Quartzite and the Cave Temple Arenite members (Fig. 1; Jana, 2009), in Karnataka, provide limited data that are used to test the conclusions. All the studied formations are predominantly sandy and have some common characters: (1) mosaic of channel-form sandstone bodies stacked one above another; (2) separated from each other by, more or less, planar master erosion surfaces; (3) distinctly fining upward deposition-altrends; (4) almost ubiquitous trough cross-strata; (5) general immature texture, in terms of grain sorting and roundness (Fig. 2), as well as (6) regionally unidirectional palaeocurrent patterns (Fig. 1). The palaeohydraulic parameters derived from these formations are compared with the few published records of Precambrian river palaeohydraulics (Van der Nuet and Eriksson, 1999; Eriksson et al., 2006, 2008; Köykkä, 2011a,b; Sarkar et al., 2012).

2. Geological background

The chosen fluvial intervals belong to the Indian Proterozoics characterized by mild deformation and metamorphism and Holand (1907) coined a general term 'Purana basins' for their reposi-

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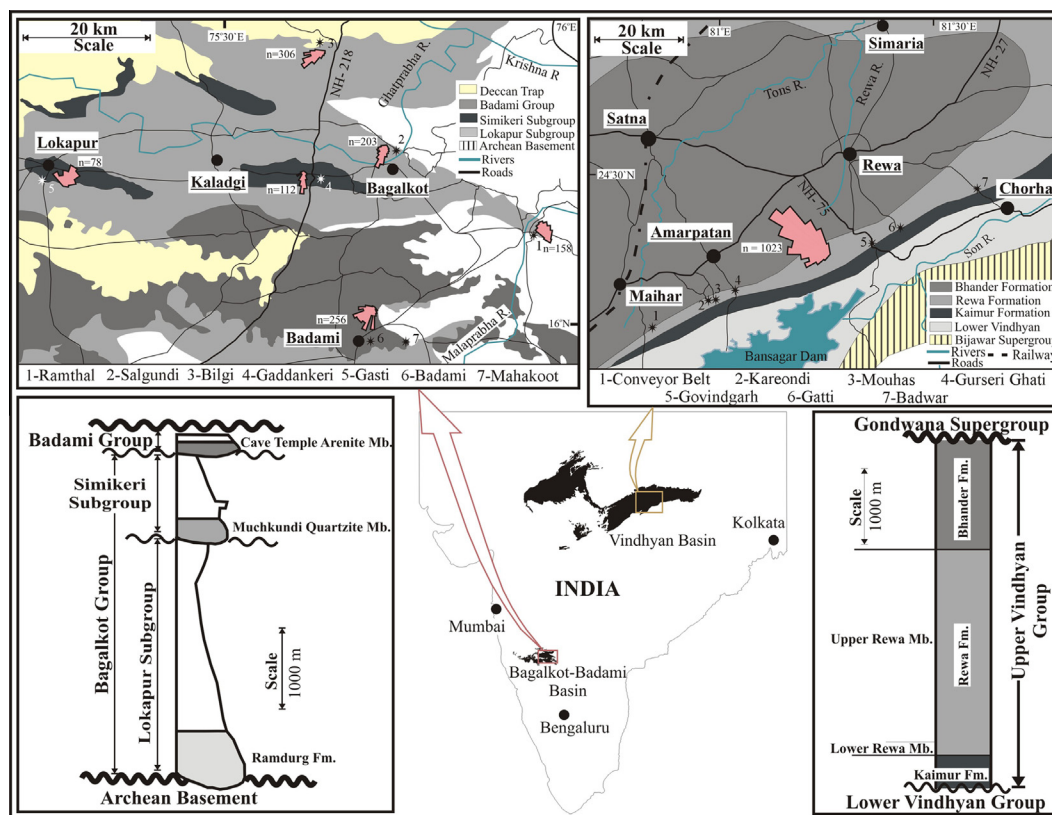


Fig. 1. Study locations in India. Distribution of exposures of the Lokapur Subgroup, Simikeri Subgroup and the Badami Group in South India and of the Rewa Formation in Central India. Numbers refer to further details of locations (above). Stratigraphic context of the studied fluvial intervals of Ramdurg Formation, Muchkundi Quartzite, Cave temple Arenite in S. India and Upper Rewa Sandstone in central India (below). Palaeocurrent roses for the studied formations have been added in the location in map above.

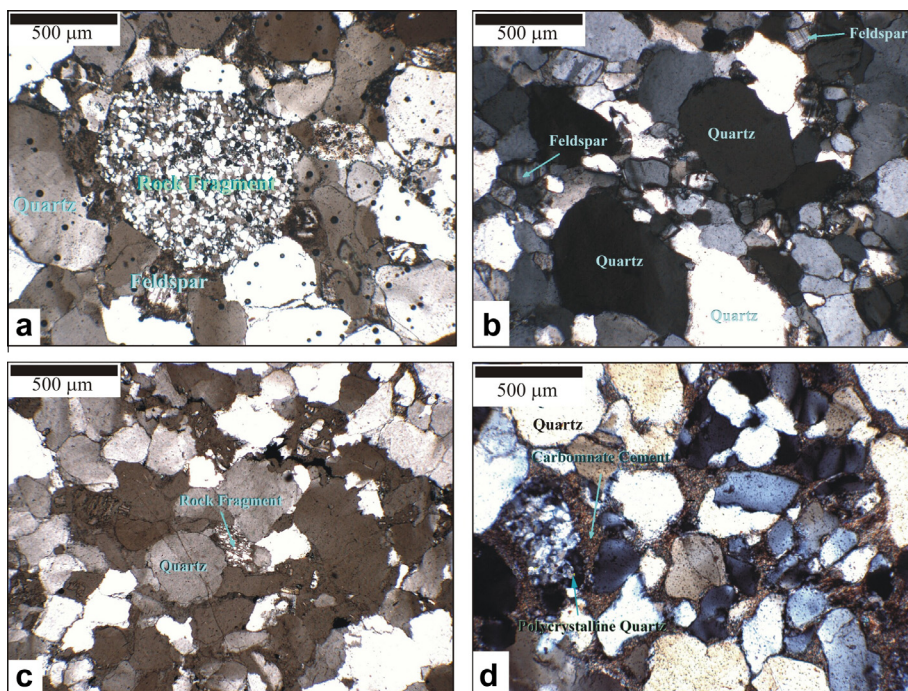


Fig. 2. Microphotographs of sandstone units, showing general textural immaturity (Sublitharenite of Ramdurg Fm, in PPL, a; Subarkose of Muchkundi Quartzite M, in CPL, b; Quartz arenite of Cave Temple Arenite M, in PPL, c; Sublitharenite of Rewa Fm, in CPL, d).

stories. Two of them are from the Mesoproterozoic Bagalkot Basin and one from the partially overlapping Neoproterozoic Badami Basin in the south-western part of India. The other one is from the

Vindhyan Basin of central India, more specifically from its Neoproterozoic fill, the Upper Vindhyan (Fig. 1). The oldest one overlying an unconformity is at the base of the Lokapur Subgroup and the

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