of the estuary and occurrence during winter suggest its preference for relatively lower temperature and salinity in ambience.

Seagrass and algal biomass increase with rising salinity and light intensity from October to February[9,10]. The phytoplankton population too remains rich during the post-monsoon period due to the nutrient enrichment during monsoon and adequate light[16]. The present data reveal relatively more growth of algae, seagrass and phytoplankton population in the mangrove habitats from the mid reaches (station nos 7 and 8) of the estuary, where *E. bangtawaensis* aggregation was more predominant. These species commonly feed and are associated with green and red algae and seagrass beds[2,6,17]. Abundance of *E. grandifolia* has been reported during winter, associated with the richness of algal crop[6]. The richness of *E. bangtawaensis* population from station nos 7 and 8 could therefore be attributed to the existance of algae and seagrass beds. In the absence of algae the organism prefers feeding on bacteria, phytoplankton and cyanobacteria[2]. The dark green colour of *E. bangtawaensis* suggests its feeding preference for algae having rich chlorophyll *a* content[7].

In conclusion, *E. bangtawaensis* has been reported from India, contributing towards biodiversity. Ecological observations revealed its exclusive association to the mangrove swamp from the mid-reaches of the Mandovi estuary. Predominant occurrence in the mesohaline zone of the estuary indicates its preference for lower salinity. The present findings encourage further understanding regarding ecological adaptation and biotechnological potential of *E. bangtawaensis*.

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Was Bundelkhand–Aravalli nucleus part of Ur supercontinent?

Although the origin and evolution of the earliest crust is somewhat equivocal, the discovery of ~4.4 Ga detrital zircons from the Jack Hills of Narryer gneissic terrane, Yilgarn craton, western Australia[1], confirms the formation of continental crust during this time. It is generally perceived that the earliest crust formed at a number of isolated nuclei which grew and later coalesced to form protocontinents that later developed to form major continental masses. The major continental masses collided and joined together to form supercontinents.

Ur is the earliest known supercontinent which was formed at ~3.0 Ga ago[2]. It is believed that 3.0 Ga is the limit to which the studies relating to continents or supercontinents could be stretched. Conventionally, the age of a continent is deduced from the oldest rocks exposed in that continent. However, Rogers[2] argued that the age of the oldest rocks can only be taken as the age of the continent, provided the oldest rocks attained stability so that they could sustain a continent and other rocks could settle on it. It is most probable that many early formed rocks were reworked into the crust before attaining stability. These rocks can be considered transient crust and do not qualify for the age determination of the continent.

The first continental assembly called Ur, consisted of nuclei of cratonic blocks of present-day Africa, Australia, Antarctica and India. Nuclei of the Indian plate that are grouped together in the Ur assembly are the Western Dharwar craton, Eastern Dharwar craton, Bhandara–Bastar craton and Singhbhum craton[3] (Figure 1). The Bundelkhand–Aravalli nucleus is not taken into account in the Ur assembly, although it has all the qualifications to be grouped to the earliest continent assembly. Here I highlight the well-constrained geochronological data of the Bundelkhand–Aravalli nucleus to emphasize the age of the oldest rocks that stabilized and acted as a foundation for the other rocks to settle on them, and thus the age of the Bundelkhand–Aravalli protocontinent.

The Indian plate consists of a complex mosaic of Archaean nuclei of the Eastern Dharwar craton, Western Dharwar craton, Bhandara–Bastar craton, Singhbhum craton and the Bundelkhand–Aravalli craton. The boundaries or interfaces of the cratonic blocks constituting the Indian shield are demarcated by shear zones and/or major fault systems. However, there is no unequivocal or irrefutable evidence to indicate whether the Indian shield was formed by accretion of all the apparently discrete cratonic blocks or if some of the cratonic boundaries may represent intracratonic rifts. The Central Indian Tectonic Zone (CITZ) connects the southern peninsular India consisting of nuclei of Dharwar, Bastar and Singhbhum, with the northern peninsular India consisting of the Aravalli–Bundelkhand cratonic block. The CITZ which is an important continental-scale tectonic zone, contains the not yet unravelled record of a collision that brought together the northern Indian protocontinent (Bundelkhand–Aravalli) and the southern Indian continental mass consisting of Dharwar, Bastar and Singhbhum cratons[4]. Absence of robust geochronological data hampers our understanding of the process that brought these two terranes together and also the evolution of the CITZ[4]. Evolution histories of CITZ range from multi-phase development[5] from 2.5 Ga to 1.0 Ga to a younger event[6] of 1.0 Ga. The major structural trend of the southern continental block is N–S, whereas the northern continental block has a ENE–WSW structural trend along the CITZ.

The Bundelkhand–Aravalli protocontinent is divided into two cratonic blocks: the Aravalli cratonic block and the Bundelkhand cratonic block. The former consists of a heterogeneous assemblage of rocks dominantly composed of granitic gneisses and granitoids. The gneisses contain amphibolites and dismembered meta-sedimentary enclaves. The Bundelkhand cratonic block is dominantly a granite–gneiss complex, mainly consisting of highly deformed greenstone–gneiss assemblage with relicts of older supracrustals and a large number of granitoids intruding the preexisting greenstone–gneiss assemblage.

Available geochronological data reveal that the age of the oldest rock of the Aravalli craton is 3.3 Ga. Sm–Nd whole-rock isochron age of gneisses from Jhamarkotra of the Aravalli craton[7] was found to be 3307 ± 33 Ma. Another gneissic sample near Jhamarkotra also yielded an age of 3281 ± 3 Ma from ion microprobe zircon geochronological studies[8]. These are undoubtedly basement gneisses[9] which attained stability during 3.3 Ga and do not belong to the transient crust. These gneisses acted as a foundation on which metasedimentary rocks and amphibolites, which now occur as dismembered greenstone enclaves within the gneisses, were deposited. The amphibolites near Mavli occurring as enclaves within the gneisses have yielded a Sm–Nd isochron age[7] of 2828 ± 46 Ma. It then becomes clear that the gneisses formed at 3.3 Ga acted as a stable crust on which volcano-sedimentary rocks, now occurring as enclaves of greenstones within the gneisses, were deposited. Thus, the 3.3-Ga-old gneisses of the Aravalli craton should be considered as the oldest stable crust and thereby the age of the Aravalli continental mass.

Striking similarity in geochronological evolution has been observed in the case of the nearby Bundelkhand craton[10]. Ion microprobe $^{207}Pb/^{206}Pb$ zircon ages of the gneisses from Kuraicha of Bundelkhand craton indicate that the age of the oldest gneiss[10] is 3297 ± 8 Ma. These gneisses host a number of greenstone belts of volcano-sedimentary sequences. Thus like the Aravalli craton, these 3.3-Ga-old gneisses of the Bundelkhand craton also represent the oldest stable crust of the Bundelkhand region on which other rocks, including sedimentary rocks were deposited, and thus qualify for the age determination of the continental crust.

In addition to geochronological evolution, there are striking similarities in terms of geochemical evolution, lithotectonic make-up and structural evolution between the Bundelkhand and the Aravalli cratons. The oldest crustal components in both the cratons are 3.3 Ga gneisses having tonalite, trondhjemite composition with highly fractionated rare earth element patterns and depletion of heavy rare earth elements[10]. Regional metamorphism and deformation[10] in both the cratonic blocks took place at ~3.3 Ga and also in ~2.5 Ga.

Thus, it is observed that by 3.3 Ga, the gneisses of the Bundelkhand–Aravalli nucleus attained stability so that it could act as a stable crust to sustain the continent and provided a foundation for the other rocks, including sedimentary rocks

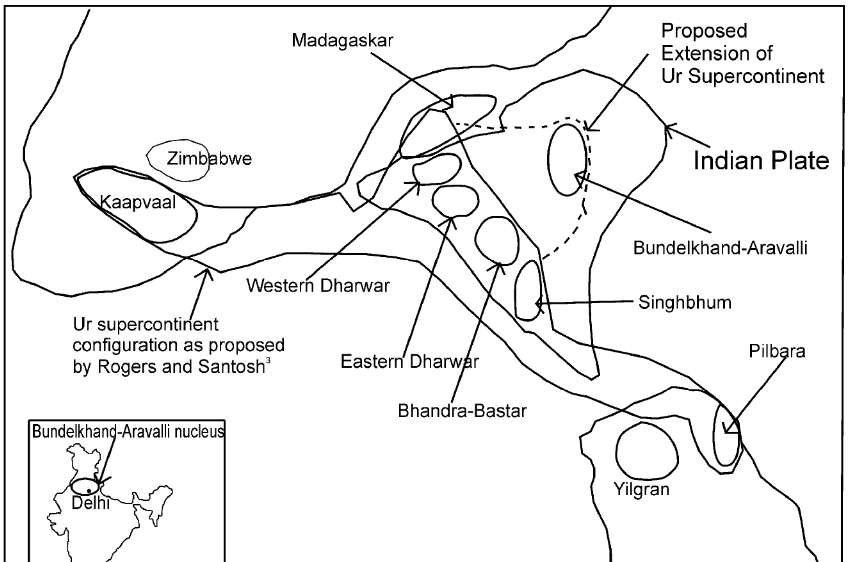

Figure 1. Ur supercontinent configuration[3].

to deposit on it. Thus the Bundelkhand–Aravalli nucleus should be considered as a constituent block in the Ur assembly along with the Eastern Dharwar, Western Dharwar, Bhandara–Bastar and Singhbhum cratons, and the Ur configuration should be redrawn (Figure 1).

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MEETINGS/SYMPOSIA/SEMINARS

National Seminar on Bauxite of Orissa and AP: Retrospect and Prospect

Date: 13–15 March 2009
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