0.03 to 0.80. High U/Th ratio of 0.80 for samples from Arath, indicates that U exploration may be feasible in this area.

Our studies carried out so far suggest that Karkeri–Bassi and Luni–Sukri tracts within the microclinite–pyroxenite–albitite zone may be a potential target for REE, Th and U exploration. This constitutes a new zone of REE mineralization, which is distinct from and parallel to the well-known albitite line of Rajasthan[9]. It assumes significance in suggesting that there may be other REE–Th–U mineralized zones in similar settings outside the albitite line in Rajasthan.

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Five-armed body fossil from the Ediacaran Jodhpur Sandstone, Marwar Supergroup, western Rajasthan, India: a possible precursor of phylum Echinodermata

The Jodhpur Sandstone is a prominent stratigraphic horizon of the Marwar Supergroup forming small hillocks in a desertic setting in western Rajasthan, which was earlier referred to as the Trans-Aravalli Vindhyans[1,2]. It is represented by fine to coarse-grained sandstone, pebbly sandstone, siltstone and shale, and attains a thickness of ca. 240 m. The rocks are unmetamorphosed and undeformed, and show well-preserved sedimentary structures, including cross-bedding, parallel bedding, wave and current ripple marks, and mud cracks. Argillaceous horizons occasionally show the presence of salt pseudomorph shales. These sandstones can be considered to be beach to coastal sand deposits formed in a moderate to high energy, shallow marine setting. The Jodhpur Sandstone has yielded well-preserved microbial mat structures, body fossils, microfossils and plant fossils[3–8].

The Marwar Supergroup has been subdivided into three groups; in stratigraphic order these are the Jodhpur Group, the Bilara Group and the Nagaur Group[2]. The Jodhpur Group has been further subdivided into the Pokaran Boulder Bed and the Jodhpur Sandstone (Table 1)[1]. The Jodhpur Sandstone includes both the Sonia Sandstone and the Girbhakar Sandstone[2]. The youngest of the Marwar Supergroup, the Nagaur Group, has yielded well-preserved trilobite trace fossils, *Cruziana* and *Rusophycus*[9,10] and on this basis a Lower Cambrian age has been assigned to the Nagaur Sandstone. The underlying Bilara Group, which represents basically a calcareous facies of the Marwar Supergroup, has been suggested to have the Precambrian/Cambrian boundary on the basis of carbon isotope data[11]. This implies that the Jodhpur Sandstone, which unconformably overlies the Malani Igneous Suite with radiometric age 779–681 Ma, should be younger than 681 Ma and

Table 1. Stratigraphic succession of the Marwar Supergroup (after Chauhan *et al.*[1] and Pareek[2])

Age	Supergroup	Group	Formation
Late Neoproterozoic to Early Cambrian	MARWAR SUPERGROUP	Nagaur Group (75–500 m)	Tunklian Sandstone Nagaur Sandstone
		Bilara Group (100–300 m)	Pondlo Dolomite Gotan Limestone Dhanapa Dolomite
		Jodhpur Group (125–240 m)	Jodhpur/Pokaran Sandstone Pokaran Boulder Bed
	~~ Unconformity ~~~~~~~~~~~~~~~~~~~~		
		Basement	Malani Rhyolite, Granite and Basalt

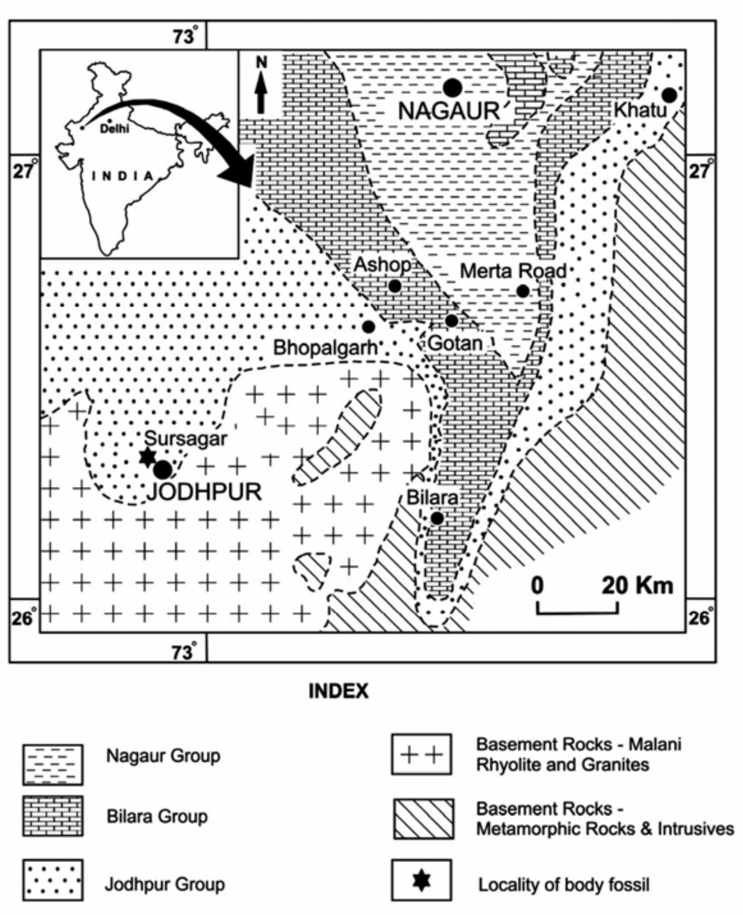

Figure 1. Geological and location map of the Jodhpur area, western Rajasthan (after Pareek[2]).

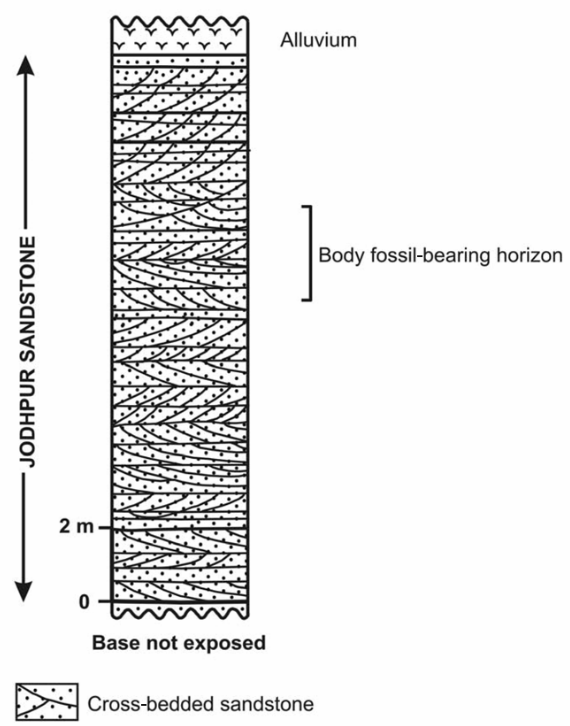

Figure 2. Litholog of the fossil-bearing horizon, Jodhpur Sandstone, Sursagar area.

older than the Cambrian[12]. Thus, the Jodhpur Sandstone can be referred to as Ediacaran with bracketed age between 630 and 542 Ma.

The body fossil has been found on the bedding surface of the light brown-coloured, fine-grained Jodhpur sandstone in a mine at Sursagar with GPS value 26°15.77′N and 73°0.14′E, which is about 7 km NW of Jodhpur city (Figures 1 and 2). The fossil-bearing sandstone is quartz arenite with mean grain size of 0.23 mm. The fossil is preserved as an epirelief and is characterized by the presence of five unequal, wavy arms emerging from a central circular disc of 1 cm in diameter (Figure 3). Arms are found radiating away from the disc. The angle between the different arms varies between 30° and 90°, and their length ranges from 12.5 to 22.5 cm, and mean length is 17 cm. The maximum width of the arms varies from 0.4 to 0.7 cm with mean as 0.56 cm. The margins of these arms are smooth and their tapering ends are pointed. However, no other surface feature could be observed.

The morphology of the structure under description cannot be produced by any inorganic process, including microbial mat-related sedimentary structures like *Aristophycus*[13] which is characterized by a regular, anastomosing, raised pattern of branching structures. It is not comparable with *Hiemalora stellaris* (Fedonkin)[14] also, as *Hiemalora* is characterized by the presence of appendages (rays) outwardly radiating from a disc generally of the order of disc diameter and rarely reaching double the diameter of the disc. The appendages are densely packed to moderately spaced, narrow rays. In the present specimen there are only five arms and the ratio of the dimensions of the arms and the disc is between 12.5 and 22.5 cm, whereas it is never more than 2 cm in *Hiemalora*. The morphology of the phylum Echinodermata shows five arms with a central disc and has been known from the Cambrian period. Living echinoderms are characterized by extensive water vascular structure and are pentamery. Fossil evidence shows that stereon evolved before pentamery, but both were acquired during the Lower Cambrian[15]. However, the tests of echinoderms are made up of calcium carbonate/aragonite and the present fossil shows no evidence of calcareous nature of the soft tissues. The present fossil can be simply considered to represent a pre-biomine-

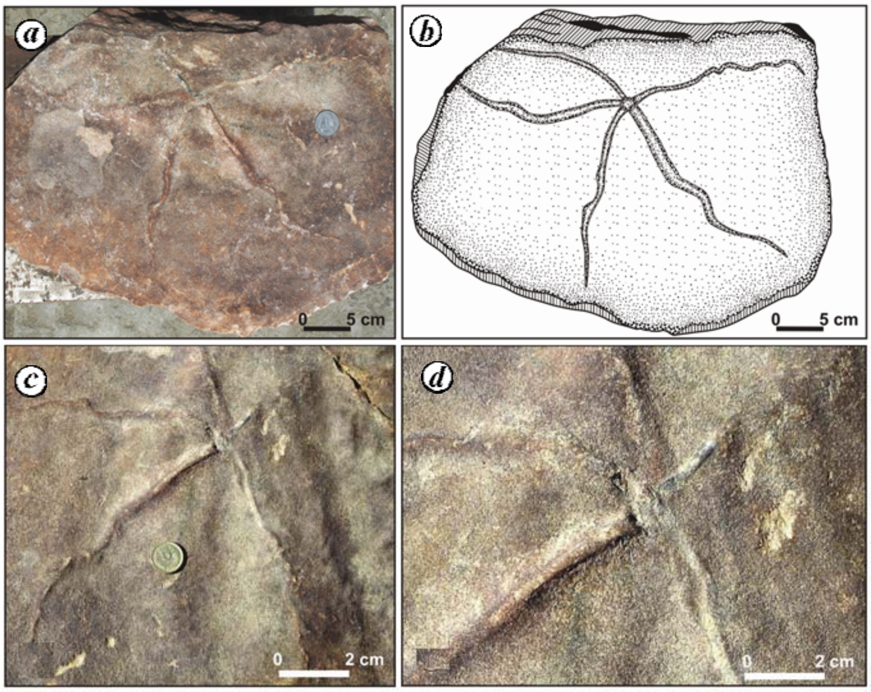

Figure 3. Five-armed body fossil on the bedding surface of the Jodhpur Sandstone. ***a***, ***c***, Five-armed body fossil. ***b***, Line diagram of the fossil seen in (***a***). ***d***, Enlarged view of (***c***) showing a disc-like structure at the centre of the body fossil.

ralization stage in the evolution of echinoiderms during the Ediacaran period.

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A simple technique to estimate linear body measurements of elephants

An objective assessment of body growth among elephants is important in optimizing their management. Elephants of both sexes never stop growing; the older they get, the taller and heavier they become[1]. Initially both sexes grow at the same rate, but once puberty is reached, male elephants begin to accelerate their growth (so called 'post-pubertal growth spurt'). As a result, adult males tend to be taller than adult females and may become twice as heavy. The importance of body measurements cannot be overstated for as Hanks[1] points out, it is possible that in habitats that are over-utilized, body growth rates may slow down before food becomes scarce, and this in turn could reduce the birth rate in the population. Any study of the dynamics of a population depends on an ability to assess the age of individual elephants[2]. To date, the most accurate method of ageing elephants is that of Laws[3], who utilized the elephant's molar replacement in the lower jaw to describe 30 age groups. The culling of hundreds of elephants in East Africa in order to protect their habitat enabled Laws[3] to refine the techniques of age determination. But in Asia where such culling is not an option practised in the management of elephants, there is a need to use non-invasive methods to estimate the age of elephants. Shoulder height and body length have been found to be reliable parameters to describe linear growth in elephants[3–5]. Estimates of shoulder height can be used as indices of the age of elephants in the wild.

There are several methods available for estimating shoulder height of elephants, and some are of limited reliability and too cumbersome for general field use. According to Tennent[6], one of the methods used by natives of Sri Lanka to measure Asian elephants (*Elephas maximus*) was by throwing a rope over them, the ends brought to the ground on each side, and taking half the length as the true height. Such a contour method is often misleading and exaggerates the height of elephants. A rod held perpendicular to the measuring pole and parallel to the ground, will rarely give more than