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RECORD OF *MEGAPNEUSTES* GAUTHIER (BRISSID ECHINOID) FROM THE KHUIALA FORMATION, JAISALMER DISTRICT, RAJASTHAN, INDIA

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ABSTRACT

The spatangoid genus *Megapneustes* Gauthier, 1899 is recorded, for the first time, from the Khuiala Formation (early Eocene) exposed at Gharollia Hill, near Pariwar village, Jaisalmer district, Rajasthan, India. The specimens are placed in a new species characterised by its large, heart-shaped test with moderate frontal sinus; dome-shaped aboral surface; flat oral surface; anteriorly eccentric ethmolytic, monobasal apical system; anteriorly eccentric, kidney-shaped, labiate peristome; long, subpetaloid petals; inframarginal periproct at the posterior truncation and perforate, crenulated tubercles.

Keywords: *Megapneustes*, Khuiala Formation, Jaisalmer, Rajasthan, India

INTRODUCTION

The spatangoid genus *Megapneustes* Gauthier, 1899 is known so far from the Eocene sediments of Africa and Egypt (Fischer, 1966; Smith, 2007). Now, it is being recorded from the basal sediments of the Khuiala Formation (early Eocene) exposed almost in the middle part of the Gharollia Hill section, situated about 2 km northwest of village Pariwar (27^0 15' N : 70^0 45' E), Jaisalmer district, Rajasthan, India (Fig. 1) and described as *Megapneustes jaisalmerensis* n. sp. Earlier, two echinoid genera, *Recrosalenia* [*R. jaisalmerensis* from the Jurassic sediments (Sahni, 1955; Sahni and Bhatnagar, 1958)] and *Echinocyamus* [*E. jaisalmerensis* from the middle Eocene sediments (Srivastava and Mathur, 1996)] were recorded from Rajasthan, India. However, nummulitids (*Assilina* sp.) (Pl. I, fig. 4) have been found associated with these echinoids.

GEOLOGY OF THE AREA

The Jaisalmer Basin, a part of West Rajasthan Shelf, is located to the west of Aravalli ranges and represents the eastern shelf of the Indus Basin. The Delhi - Lahore Ridge and basement ridges bound this shelf in north and south respectively. The fossiliferous, isolated outcrops of the Mesozoic and the Cenozoic formations are interspread in the southeastern part of the Jaisalmer Basin within the desert sands (Singh, 2006).

The Tertiary sequences in the Jaisalmer basin are represented by the Sanu, Khuiala, Bandha and Shumar formations in ascending order (Das Gupta, 1974; Pareek, 1984; Singh, 1996, 2003; Sinha Roy *et al.*, 1998; Bhandari, 1999). The generalized Tertiary stratigraphy of the Jaisalmer Basin (surface and subsurface) is given in Table 1.

The Khuiala Formation, named after the village Khuiala, conformably lies over the Sanu Sandstone (Sanu Formation) and comprises orthoquartzite, clay and limestone. The sequence (Fig. 2) commences with orthoquartzite comprising medium to coarse grained sandstone which in turn is overlain by thin bands of greenish or yellowish–brownish gypseous clay with foraminiferal limestone, chalk and marly limestone containing fossils of bivalves and echinoids and algal limestone towards the top. The Khuiala Limestone covers a major part of the area towards the north, west, southwest and south and is covered by the brown sands. Swaminath *et al.* (1959) have observed that the Eocene sediments in the Jaisalmer area, Rajasthan, measuring about 45.9 m (153 feet) between Khuiala and Ramgarh, overlap the underlying Abur Formation to the west and Jurassic Formation in the north of the region. The rock consists mainly of compact, greyish-white, dense siliceous limestone containing many foraminifera, the Fuller's Earth and minor bands of clay. Abundant fossils in which corals, echinoids, lamellibranchs, gastropods and Nummulites are predominant, characterize the sequence. These deposits are infraneritic and were deposited under stable to unstable shelf conditions.

Table 1: Tertiary stratigraphy of the Jaisalmer Basin.

Age	Formation	Member (surface)	Member (subsurface)
Pleistocene to Sub Recent	Shumar		
Middle Eocene	Bandah	Bakhri Tibba	Bakhri Tibba
		Batrewala Limestone	Batrewala Limestone
Early Eocene	Khuiala	Khinsar	Upper Khinsar
			Sirhera
			Lower Khinsar
		Tetakkar Limestone	Tetakkar Limestone
Palaeocene	Sanu		Kharatar
		Mohammaed Dhani	Mohammaed Dhani
Cretaceous	Abur/Pariwar		

The age of the Khuiala echinoid-bearing horizon (calcareous sandy marl) is constrained by the presence of index larger foraminifer *Assilina lacunata* Cizancourt which indicates an early Eocene (Ypresian) age (Singh, 1996, 2003 and 2007). The ostracode, bivalve and other biotic elements previously described from the Khuiala Formation are also consistent with this age assignment (Khosla, 1972; Das

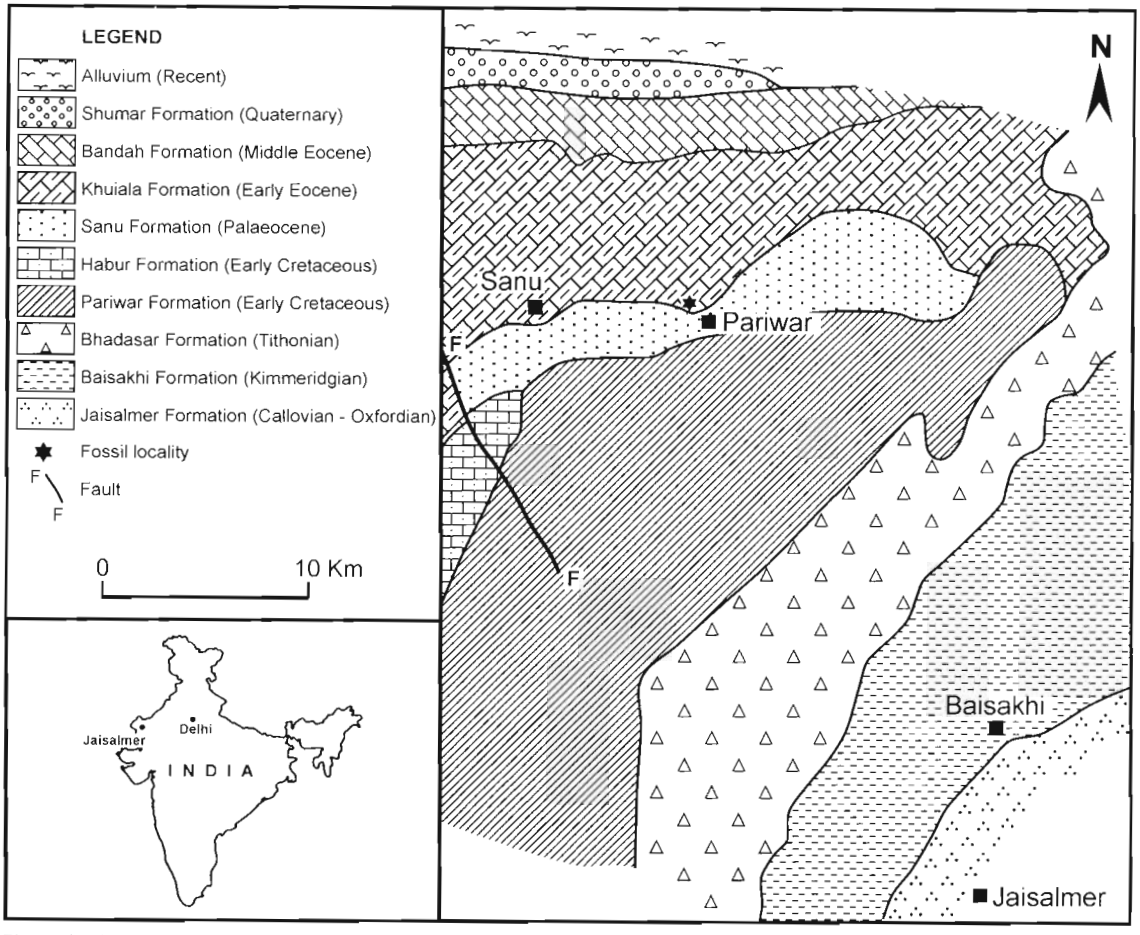


Fig. 1: Geological map of the part of Jaisalmer district, Rajasthan, India showing fossil locality (modified after Das Gupta, 1975).

Gupta, 1974; Pareek, 1984; Ghose, 1987; Bhandari, 1995; Singh, 1996, 1997, 2003).

SYSTEMATIC PALAEONTOLOGY

Class **Echinoidea** Leske, 1778

Order **Spatangoida** Claus, 1876

Suborder **Micrasterina** Fischer, 1966

Family **Brissidae** Gray, 1855

Genus ***Megapneustes*** Gauthier, 1899

(Type species: *M. grandis* Gauthier, 1899; p. 681 by original designation)

Diagnosis: Test medium to large, oval to heart shaped with moderate frontal sinus; aboral surface dome shaped; oral surface flat; apical system tetrabasal to monobasal, ethmolytic; peristome labiate, kidney shaped; ambulacral petals long, subpetaloid, petal III indistinct and non petaloid; ambulacral plates simple (occluded plates absent); periproct inframarginal at the posterior truncation; tubercles perforate, crenulate and a very thin peripetalous fasciole present; not indented in lateral interambulacra (mostly lost through poor preservation). The significance of the fascioles in spatangoid echinoids has recently been dealt within detail by Smith and Stockley (2005).

Remarks: *Megapneustes* Gauthier, 1899 (Fischer, 1966; Smith, 2007) is close to the genus *Fourtaunia* Lambert, 1902 but it differs in lacking subanal fasciole.

Age: early Eocene.

Megapneustes jaisalmerensis n. sp.

(Pl. I, figs. 1–3, 5–8)

Material: Nine specimens (few are partly broken). Holotype: GU/R/KE/2023; Paratypes: GU/R/KE/2024 to GU/R/KE/2026 and GU/R/KE/F - 2027 to GU/R/KE/F - 2031.

EXPLANATION OF PLATE I

(Scale bars = 10 mm otherwise as stated)

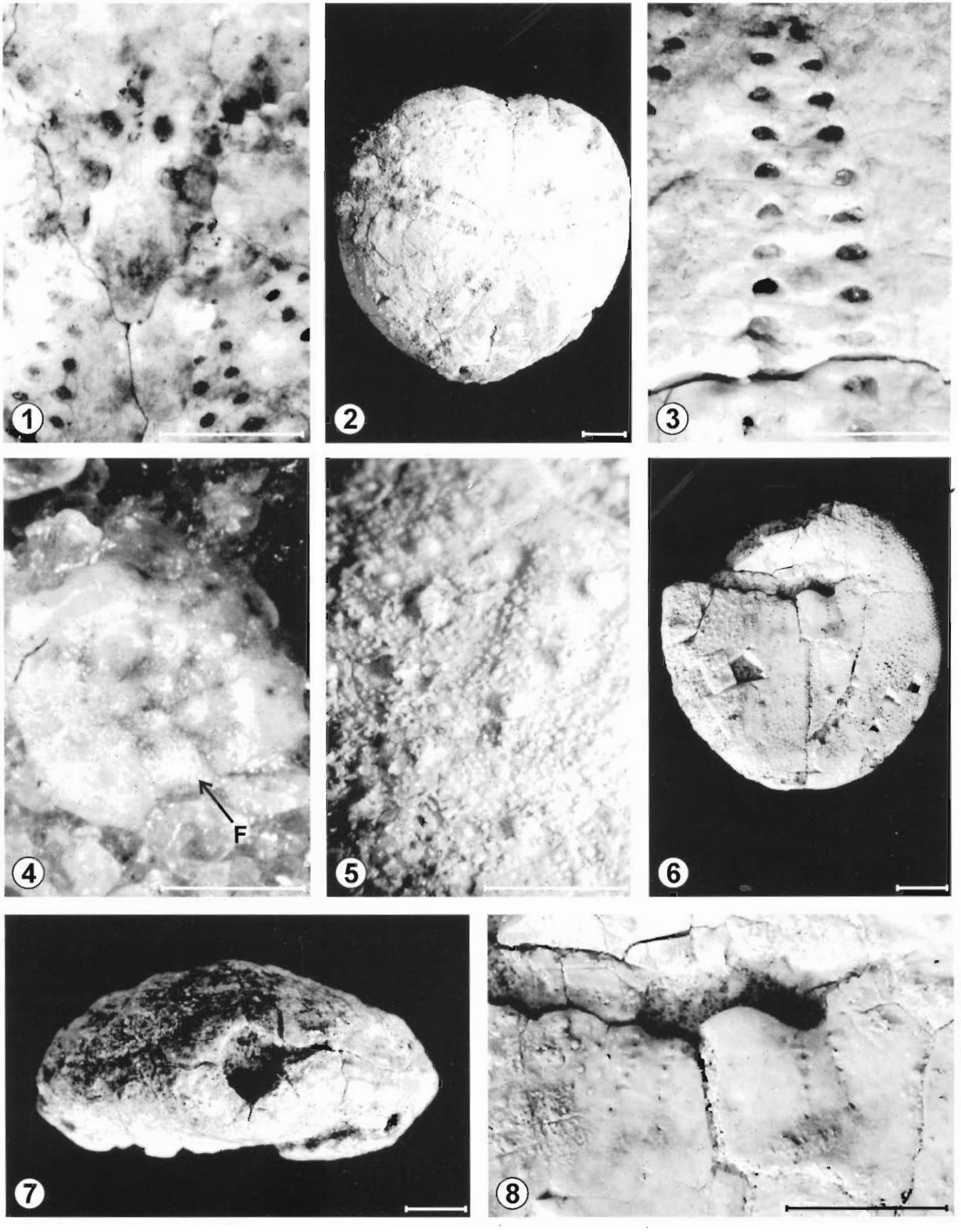
1-3, 5. ***Megapneustes jaisalmerensis*** n. sp. GU/R/KE/I/2023 (Holotype).
1. Apical disc (bar = 5 mm).
2. Aboral view.
3. Ambulacral petal – I near the apical disc showing simple ambulacral plates (bar = 5 mm).

4. **Nummulitids (*Assilina* sp.)** (F) associated with Paratype no. GU/R/KE/I/2025 (bar = 5 mm).

5. Perforate tubercles on aboral surface near ambitus (bar = 5 mm).

6,8. ***Megapneustes jaisalmerensis*** n. sp. GU/R/KE/I/2024 (Paratype).
6. Oral view showing peristome.
8. Peristome enlarged.

7. ***Megapneustes jaisalmerensis*** n. sp. GU/R/KE/I/2025 (Paratype). Posterior view showing periproct.



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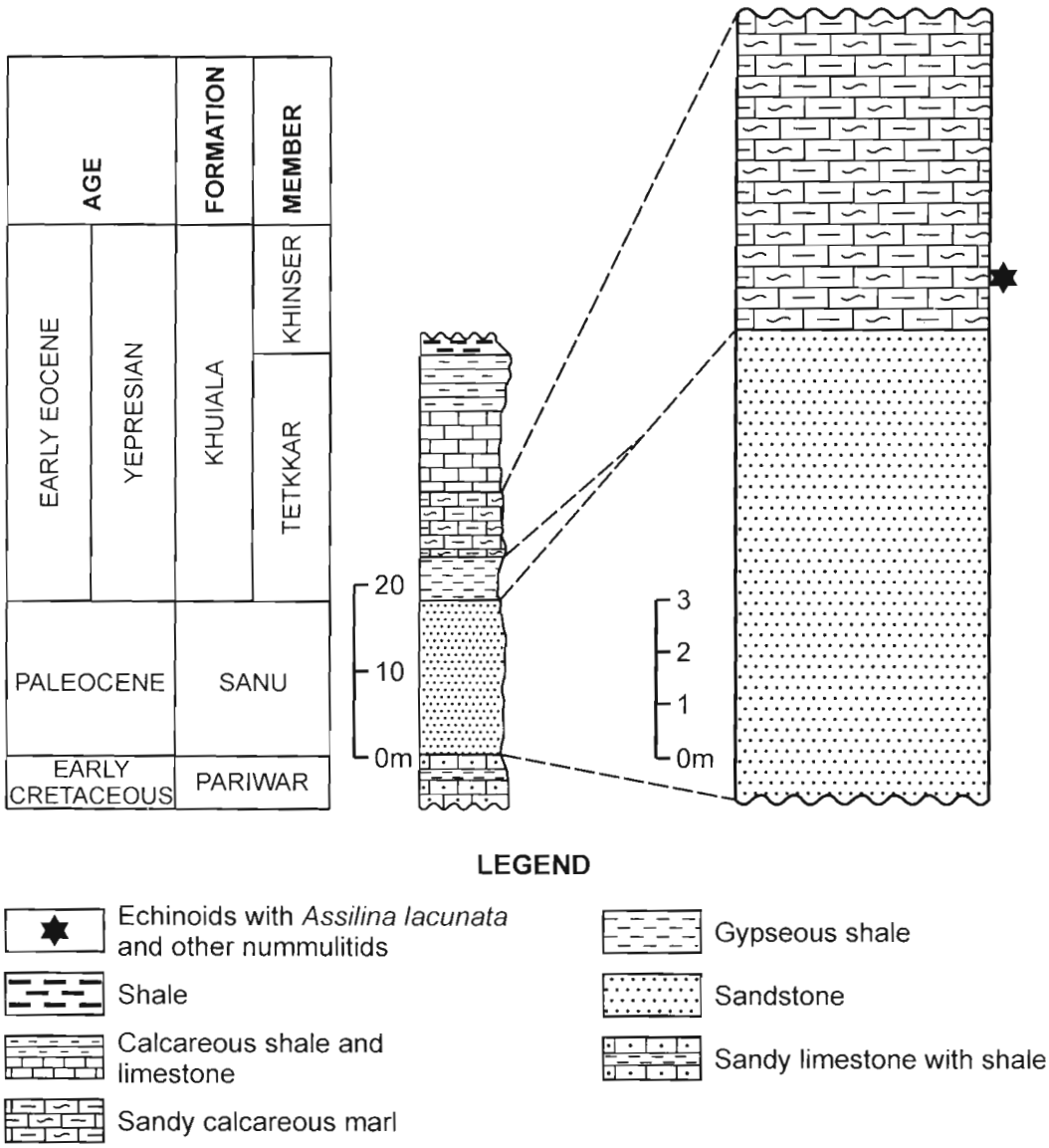

Fig. 2. Lithocolumn of the studied section.

Derivation of name: The species has been named after the district Jaisalmer, Rajasthan, India.

Diagnosis: Test large, heart shaped with moderate frontal sinus; aboral surface dome shaped; oral surface flat; anteriorly eccentric ethmolytic, monobasal apical system; anteriorly eccentric kidney shaped labiate peristome; long, subpetaloid petals, ambulacral plates simple (occluded plates absent); inframarginal periproct at the posterior truncation; perforate, crenulated tubercles and fascioles not preserved due to the poor preservation of the specimens.

Description: Test large, heart shaped with moderate frontal sinus, truncated posteriorly; longer than broad and its maximum width lying opposite to petals II &IV; the marginal contour triangular; highest point of the test is at the centre; the aboral surface dome shaped; oral surface flat; margin tumid and well rounded. Apical system small, monobasal, ethmolytic and excentric anteriorly; the two anterior circular genital pores are closer than the two posterior ones. The ambulacral petals long reaching almost up to the ambitus, slightly depressed and subpetaloid; petal III indistinct, petal I & V longest, broadest; poriferous zones narrow, each consisting of a small, inner circular pore, a slightly larger circular to elliptical outer pore and these porepairs do not conjugate. The ambulacral plates simple (occluded plates absent). The interporiferous zones slightly broader than the poriferous zones. The peristome anteriorly eccentric, kidney shaped and labiate; periproct inframarginal at the posterior truncation and longitudinally oval in shape. Tubercles small, abundant, perforate and crenulated, comparatively larger and dense on the oral surface than the aboral surface.

Measurement (in mm): Specimen No. GU/R/KE/2023 (Holotype)

Length of the test	:	56.8
Breadth of the test	:	56.2
Height of the test	:	20.9

Ratio between Length, breadht and height: 1.0 : 0.98 : 0.36

Petal	Length	Breadth
III	---------	---------
II& IV	25.5	06.3
I&V	28.9	06.3

Distance between the apical system and the anterior ambitus	:	28.4
Distance between the apical system and the posterior ambitus	:	36.5
Maximum diameter of peristome	:	10.6 (specimen No. GU/R/KE/2024)
Minimum diameter of peristome	:	03.9 (specimen No. GU/R/KE/2024)
Maximum diameter of periproct	:	07.3 (specimen No. GU/R/KE/2025)
Minimum diameter of periproct	:	05.6 (specimen No. GU/R/KE/2025)
Distance between the peristome and the anterior ambitus	:	17.8 (specimen No. GU/R/KE/2026)
Distance between the peristome the posterior ambitus	:	38.8 (specimen No. and GU/R/KE/2026)

Remarks: The species described as new is close to the *M. grandis* Gauthier, 1899 described from the Eocene sediments of Egypt (Gauthier, 1899) but it differs from the latter in having heart-shaped test, monobasal apical system, long, subpetaloid, ambulacral petals which reach almost up to the ambitus, whereas the Egyptian species has an oval test with tetrabasal apical system and straight ambularal petals which do not reach up to the ambitus.

Locality: Near Parivar village, Jaisalmer district, Rajasthan.

Horizon: Khuiala Formation, early Eocene.

Repository: All fossil echinoid specimens of the present collection (described, undescribed and photographed) with Type Nos. GU/R/KE/I/2023 to GU/R/KE/2026 and GU/R/KE/F - 2027 to GU/R/KE/F – 2031 (GU/R/KE - Garhwal University/ Rana/Khuiala Echinoid) have been deposited in the Laboratory of Vertebrate Palaeontology, Department of Geology, HNB Garhwal University, Srinagar (Garhwal), Uttaranchal, India.

DISCUSSIONS AND CONCLUSIONS

Until now the genus *Megapneustes* Gauthier, 1899 has only been recorded from the Eocene sediments of Africa and Egypt (Fischer, 1966; Smith, 2007). India, Africa and Egypt were near the equator (tropical) sharing similar ecological conditions during the Palaeocene (60 Ma) and Eocene (50 Ma) times; a prominent marine link was possibly available for the dispersal of the faunal elements between these regions. The occurrence of this genus in the early Eocene sediments (Khuiala Formation) in India may be explained as a result of its evolution from one of the members of the Toxasteridae and later its migration to Africa and Egypt during the Eocene. Its phylogenetic relationship with other spatangoid taxa has been discussed by Stockley *et al.* (2005) who have recently studied the evolution of the spatangoids in detail.

Swaminath *et al.* (1959) have observed that the Eocene sediments in the Jaisalmer area, Rajasthan consist mainly of compact, greyish-white, dense siliceous limestone containing many foraminifera, the Fuller's Earth and minor bands of clay. Abundant fossils in which corals, echinoids, lamellibranchs, gastropods and *Nummulites* are predominant characterize the sequence. The *Nummulites* is suggestive of an Eocene age for the sequence of the Khuiala Formation. The Eocene sediments overlap the underlying Abur Formation to the west and Jurassic Formation in the north of the region. The full thickness of the Eocene is nowhere exposed, but a thickness of 153 feet was measured between Khuiala and Ramgarh. The Eocene deposits are infraneritic and they were deposited under stable to unstable shelf conditions.

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