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NEW MORPHOTYPE OF RETICULATE *NUMMULITES* (FORAMINIFERIDA) FROM THE LOWER OLIGOCENE OF SOUTHWESTERN KUTCH, INDIA

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ABSTRACT

A new morphotype of the megalospheric form of the larger foraminifer *Nummulites* cf. *fichteli* Michelotti from the Lower Oligocene of southwestern Kutch, western India is documented here for the first time. This morphotype shows ontogenetic change of orientation of the coiling plane and is apparently endemic. Previous studies on the megalospheric form of this species had led to the documentation of lenticular, conical and saddle-shaped morphotypes. These multiple morphotypes reveal different adaptations to varied bottom conditions.

Keywords: Reticulate *Nummulites*, Lower Oligocene, Kutch, India

INTRODUCTION

The larger foraminiferal genus *Nummulites* Lamarck occurs abundantly in the Lower Oligocene rocks of Kutch, western India (Biswas, 1992; Sengupta, 2009). *Nummulites* species bearing reticulate pattern of septal filaments and commonly referred to as the reticulate *Nummulites*, include the pan-Tethyan *Nummulites fichteli* Michelotti and the endemic taxon here referred to as *Nummulites* cf. *fichteli* Michelotti; see Sengupta (2000) and Table 1. The megalospheric form of this endemic species is characterized by relatively small test diameter, conspicuously large protoconch size and multiple morphotypes (Sengupta, 2000 and 2002; Sengupta *et al*., 2011). A previously overlooked morphotype of *N*. cf. *fichteli* occurring in the Lower Oligocene rocks of southwestern Kutch (Fig. 1) is documented here for the first time. The Lower Oligocene sequence yielding the new morphotype had earlier ceded the other morphotypes of *N*. cf. *fichteli* mentioned above. The new morphotype is characterized by ontogenetic change of orientation of the coiling plane (Figs. 2 and 3), which is here interpreted to reflect space-constrained development of the spire rather than growth abnormality.

MATERIAL

Marine Oligocene rocks containing abundant reticulate *Nummulites* are well exposed in Kutch (Biswas, 1992). Thirty megalospheric tests of the new morphotype were isolated from the Lower Oligocene glauconitic marl collected from the Khari (23^0 28' N, 68^0 41' E) - Bermoti (28^0 28' N, 68^0 6' E) area of southwestern Kutch (Fig. 1). Lithostratigraphically, the sampled stratigraphic interval comprises the Basal Member of Maniyara Fort Formation (Biswas, 1992). In situ rock samples for the present study were systematically collected from the flanks of Rakhdi, Berwali and Golay rivers. Larger foraminifera were isolated from the rock samples by standard technique as described in Glaessner (1963). Rock samples were separately boiled in water mixed with sodium carbonate to obtain the matrix free bioclasts. Washing and drying of the bioclasts was followed by picking of the foraminifera under stereomicroscope.

All matrix free specimens of the new morphotype were externally examined under the stereomicroscope. Additionally, the exterior of 4 specimens was studied under the scanning electron microscope (SEM). The internal features were observed on the basis of 18 polished sections. Polished sections were prepared with the plane of section passing along the rib-like projection formed by the early part of the spire on one side of the test; see Fig. 2. This mode of section preparation takes into account the ontogenetic change of the spire orientation, as the half-cut test reveals early and latter parts of the same spire in near equatorial and near axial section respectively. All illustrated specimens of the present morphotype have been reposited in the Geology Department of Calcutta University under the reference number RN-KUTCH-4/14.

SYSTEMATIC PALAEONTOLOGY

Order **Foraminiferida** Eichwald, 1830
Family **Nummulitidae** de Blainville, 1825
Genus ***Nummulites*** Lamarck, 1801

Nummulites cf. *fichteli* Michelotti, 1841 *sensu* Sengupta, 2000

(Fig. 3, A-I; Table 1)

Nummulites cf. *fichteli* Sengupta, 2000, p. 673-677, pl. 1, figs. 1-14. – Sengupta, 2002, p. 223-224, fig. 1. – Renema, 2007, p. 206. – Sengupta *et al*., 2011, p. 263-268, pl. 1, figs. 1-8; table 1. – Sarkar and Syed, 2013, p. 124.

***Description*:** Small megalospheric tests (test diameter 2.11 to 3.44 mm) with smooth surface, short spire (up to 5 whorls) and reticulate pattern of septal filaments. Pore openings on the test surface show circular outline. Tests are asymmetric due to the presence of a rib-like projection on one side of the test formed by early part of the spire. Orientation of the plane of coiling changes in the early ontogenetic stage. Early portion of the spire comprising up to 2 whorls shows large circular protoconch (maximum internal diameter 0.49-0.52 mm), reniform deuteroconch (maximum internal dimension 0.45-0.47mm) and longer than high rectangular postembryonic chambers separated by short curved septa. Subsequent portion of the same spire shows higher than wide to wider than high triangular chambers, well-developed pillars and wide alar prolongation. The alar prolongation pinches out against the early part of the spire on one side of the test.

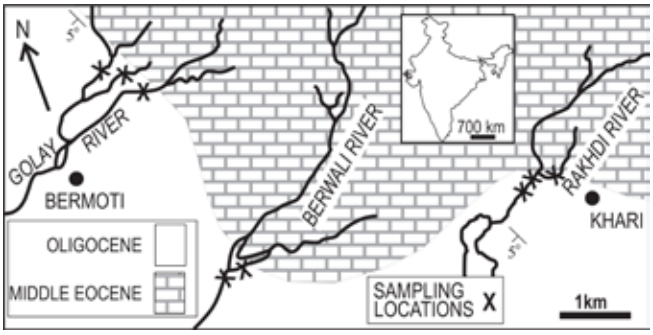

Fig. 1. a, Simplified geological map of the study area in SW Kutch showing sampling locations. Traverses were undertaken along Golay, Berwali and Rakhdi rivers. Inset: map of India showing the study area (+).

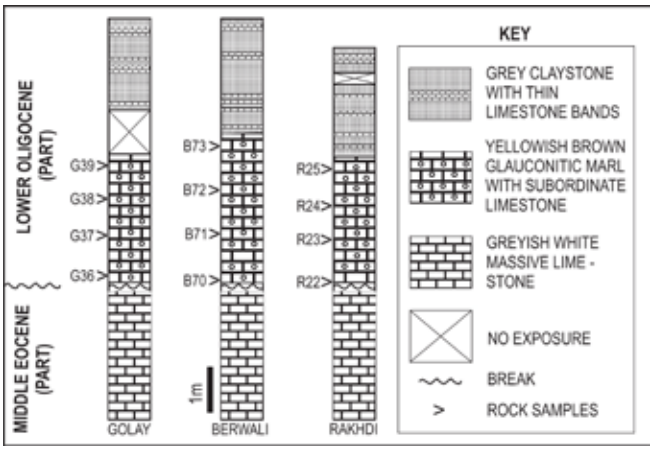

Fig. 1. b, Part of lithocolumns along the individual traverses showing stratigraphic position of the samples.

***Remarks*:** Various attempts to classify the megalospheric specimens of reticulate *Nummulites* of Kutch are summarized in Table 1. It is evident that the small protoconch bearing bilaterally symmetrical *N. fichteli* has been copiously documented but the large protoconch-bearing multiple morphotypes of *N.* cf. *fichteli* were either overlooked or arbitrarily clubbed with *N. fichteli*. Morphotypes of *N.* cf. *fichteli* documented in the earlier publications include the biconvex, the conical and the saddle-shaped tests (Sengupta, 2000 and 2002; Sengupta *et al*., 2011). The present morphotype with small test size, smooth surface, reticulate pattern of septal filaments, large protoconch, longer than high post-embryonic chambers, short-curved septa and short spire, is identified as the fourth morphotype of *N.* cf. *fichteli*. In this context it may be mentioned that Trevisani and Papazzoni (1996) reported morphological 'plasticity' in the reticulate taxon *N. fabianii*. Large protoconch bearing Oligocene reticulate *Nummulites* taxa are known to occur outside India, see Table 2. In larger foraminifera, protoconch size has been widely used as taxonomic discriminator (Schaub, 1981), but recent studies reveal the influence of environment over the protoconch dimension (Benedetti *et al*., 2010 and Benedetti and Pignatti, 2013). In the present case, protoconch size difference between the sympatrically occurring tests of *N. fichteli* and *N.* cf. *fichteli* may be considered to be taxonomically significant. Sengupta (2000) and Cotton and Renema (2014) noted that very little information is presently available on large protoconch bearing *Nummulites* taxa. Pending further investigation, the nomenclature of *N.* cf. *fichteli* has been kept open following the recommendations of Bengtson (1988).

DISCUSSION

In India, conspicuous modification of the spire in *Nummulites* has been reported from the Middle Eocene of Rajasthan and Gujarat. Singh (1957) documented unequal development of the spire about the cooling axis in the microspheric tests of *N. asymmetrica* Singh. This species appears to reflect space-constrained growth of the spire. Sengupta (2001) interpreted the strong undulation of the spire in the giant microspheric tests of *N. maculatus* Nuttall as a means to lengthen the spire while conserving the test size. Mukhopadhyay (2003) noted eccentric position of the spire in the subconical megalospheric tests of *N. boninensis* Hanzawa and opined that the asymmetric tests paired

Table 1. Schemes of classification of megalospheric tests of Oligocene reticulate *Nummulites*, Kutch.

Author	Taxa	Test diameter (mm)	Test shape and polar feature	Protoconch (mm)
Nuttall (1925)	*N. fichteli*	3.3-4.5	Biconvex with no apical mamelon	0.29-0.37
	N. clipeus	5.5 (av.)	Biconvex with apical mamelon	0.25-0.36
Mohan (1965)	*N. fichteli*	3.0-5.6	Biconvex; apical mamelon variably developed	0.25-0.37
Dasgupta (1970)	*N. fichteli*	2.5-6.0	Biconvex with feeble apical mamelon	0.45 (av.)
	N. clipeus	3.0-5.5	Biconvex with strong apical mamelon	0.35 (av.)
Roveda (1970)	*N. clipeus*	3.25-6.6	Biconvex; apical mamelon variably developed	0.30-0.38
Sengupta (2000, 2002)	*N. fichteli-clipeus* Group	3.3-5.5	Biconvex; apical mamelon variably developed	0.25-0.37
	N. cf. *fichteli*	3.0-4.6	Biconvex and conical morphotypes	0.6-0.8
Shukla (2008)	*N. fichteli* forma *fichteli*	4.25-6.0	Biconvex	0.4-0.75
	N. fichteli forma *clypeus*	2.1-6.25	Biconvex with strong apical mamelon	0.35-0.8
	N. fichteli forma *granulata*	2.15-5.75	Biconvex	0.4-0.6
Sengupta *et al*. (2011)	*N.* cf. *fichteli*	2.6-3.5	Saddle-shaped morphotype	0.45-0.51
This paper	*N.* cf. *fichteli*	2.11-3.44	Tests with ribbed appearance	0.49-0.52

up for plastogamic reproduction. Extreme modification of the spire among Indian *Nummulites* is, however, encountered in the megalospheric form of *N*. cf. *fichteli* as tests exhibit biconvex, conical and saddle-shaped tests (Sengupta, 2000 and 2002; Sengupta *et al*., 2011). The ontogenetic change of orientation of the plane of coiling in the new morphotype reveals additional modification of the spire in *N*. cf. *fichteli*. This morphological trait has been presently noted among 30 specimens of the new morphotype. This rules out the possibility of growth anomaly of the foraminifera on account of defective genotypes because identically defective genotypes are unlikely to occur over the space and time represented by the collected samples. The normal development of spiral laminae, pores, embryonic and post-embryonic chambers, septa, alar prolongation, pillars and the septal filaments in the examined specimens also rules out the possibility of abnormal growth of the foraminifera owing to defective genotype.

The plausible role of environmental stress in inducing growth anomaly in the new morphotype can be also ruled out because the associated biconvex megalospheric tests of *N*. cf. *fichteli* and the megalospheric tests of *N*. *fichteli* do not exhibit any morphological aberration due to environmental perturbation. The plane of coiling in these taxa remains straight. Further, the prevalence of stressed environment over the space and time represented by the collected samples cannot explain the occurrence of reticulate *Nummulites* in rock-forming abundance in the study area. Stouff *et al*. (1999) observed that high percentage (about 50%) of young *Ammonia* specimens thriving in the hypersaline condition exhibit abnormal developments of the coiling plane and the protoconch. In this connection, it may be noted that the specimens of *N*. cf. *fichteli* exhibit normal development of protoconch and amount to < 1% of the total megalospheric tests of the reticulate *Nummulites* isolated from the rocks. Evidences of physical damage or biological injury (viz. predation, see Syed *et al*., 2014) were not encountered in the tests of the new morphotype.

There is a superficial resemblance between the present morphotype and some extant specimens of *Amphisorus hemprichii* from the Gulf of Aqaba. The Aqaba specimens show simultaneous development of two planes of coiling in their late ontogenetic stage forming the 'double periphery' (terminology after Hottinger, 2009). Such individuals have been interpreted as teratological or deformed specimens (Reiss and Hottinger, 1984 and Hottinger *et al*., 1993). As pointed out by Sarkar and Syed (2013), the Kutch specimens are fundamentally different from the Aqaba specimens in that the former shows a one-time change of the coiling plane orientation in the early stage of the ontogeny, without having a 'double periphery' during the subsequent growth stages.

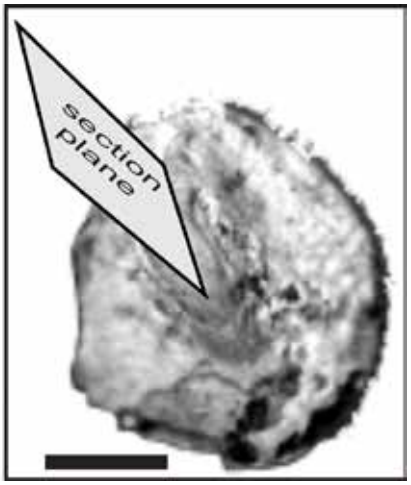

Fig. 2. Orientation of the plane of section relative to a specimen of the new morphotype of *N*. cf. *fichteli* Form A. Section is prepared along the rib-like projection present on one side of the test. Illustrated specimen is same as in Fig. 3D; scale bar 1 mm.

Earlier studies have indicated that the Lower Oligocene sediments of Kutch were deposited in low sedimentation regime in the study area (Sengupta, 2002 and Sengupta *et al*., 2011). This resulted in the accumulation of bioclasts on parts of the depositional surface (Kidwell, 1985). It has been inferred that the megalospheric specimens of *N*. cf. *fichteli* adapted differently to the varied substrates, demonstrating ecophenotypy (terminology after Haynes, 1992). The lenticular and conical morphotypes of *N*. cf. *fichteli* thrived on the marl and the shelly substrate respectively (Sengupta, 2002), while the saddle-shaped morphotype thrived within the confines of the bioclast interstitial spaces (Sengupta *et al*., 2011). In this context, it appears that the change of the coiling plane orientation in *N*. cf. *fichteli* facilitated unabated growth of the spire in constrained space. It is relevant to mention that Medioli and Scott (1978) and Boltovskoy *et al*. (1991) have elaborately discussed the adaptations of benthic foraminifera in response to diverse substrates.

In the Tethyan realm, reticulate *Nummulites* belonging to the *N*. *fabianii* lineage and bearing small protoconch have been well documented but those with large protoconch have been

Table 2. Protoconch size of some reticulate *Nummulites* recorded outside India. Taxa bearing large protoconch (>0.48 mm) are rarely documented.

Author	Taxon/lineage	Protoconch (mm)	Location	Age
Roveda (1970)	*N. hormoensis* Nuttall and Brighton	0.132-0.185	Hormo, Somaliland	Middle Eocene
	N. fichteli Michelotti	0.160-0.22	Turin Hill, Italy	?Oligocene
	N. garansiana Joly and Leymerie	0.260-0.320	Garans, France	?Oligocene
Papazzoni (1998)	*N.* "*ptukhiani*" – *fabianii* lineage	0.16- 0.32	Northern Italy, Spain, Romania	Middle-Upper Eocene
Özcan *et al*. (2009)	*N. bullatus –bormidiensis* lineage	0.065-0.450	Western Taurides, Turkey	Bartonian-Early Chattian
Roveda (1970)	*N. absurdus* (Doornink)	0.48, ?0.5	Tji Sukarama, Java, Indonesia	Lower Oligocene
Roveda (1970)	*N. fichteli* var. *dubia* Tellini	0.8	Liguria, Italy	Oligocene
Adams (1965)	*N. fichteli* s.l.	upto 0.8	Sarawak, Malaysia	Oligocene

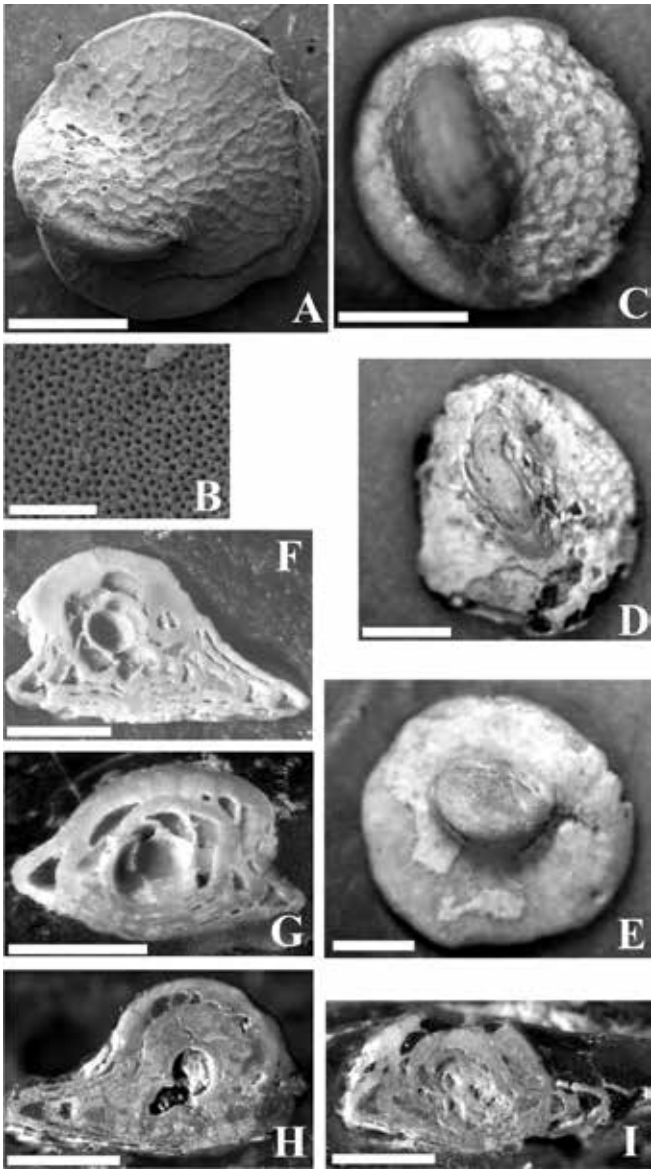

Fig. 3. A-I, New megalospheric morphotype of *Nummulites* cf. *fichteli* Michelotti, Lower Oligocene, SW Kutch, India. Stratigraphic position of specimens: **A-B,** B72; **C,** G36; **D,** G39; **E,** R24; **F,** G38; **G,** B73; **H,** B70; **I,** R23. **A-B,** SEM images; **C-I,** light microscope images; **A-E,** test exterior; **F-I,** internal features in half-cut vertical section passing along the early portion of the spire; **A** and **C-E,** appearance of test in polar view showing early part of the spire forming discoidal rib-like projection; **B,** spiral laminae showing normal development of outer end of pores; **F-I,** vertical section intersecting the early and later chambers along near equatorial and axial planes respectively. Bar scales 1 mm in A, C-I and 30 μ in B.

mostly neglected, see Table 2. In India, members of the *fabianii* lineage comprising *N. fabianii* (Samanta, 1968), *N. hormoensis* (Samanta *et al*., 1990) and *N. fichteli* Michelotti (Nuttall, 1925; references listed in Table 1) have been well documented. Studies carried out on *N.* cf. *fichteli* from Kutch can provide valuable insight in the study of lesser known comparable Oligocene reticulate *Nummulites* occurring outside India.

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REFERENCES

Adams, C.G. 1965. The foraminifera and stratigraphy of the Melinau Limestone, Sarawak and its importance in Tertiary correlation. *The Quarterly Journal of the Geological Society of London*, **121**(3): 283-338.

Benedetti, A., **Di Carlo, M. and Pignatti, J.** 2010. Embryo size in larger foraminiferal lineages: stratigraphy versus paleoecology in *Nephrolepidina praemarginata* (R. Douvillé, 1908) from the Majella Mt. (Central Appennines). *Journal of Mediterranean Earth Sciences*, **2**: 19-29.

Benedetti, A. and Pignatti, J. 2013. Conflicting evolutionary and biostratigraphical trends in *Nephrolepidina praemarginata* (Douvillé, 1908) (Foraminiferida). *Historical Biology*, **25**(3): 363-383.

Bengtson, P. 1988. Open nomenclature. *Palaeontology*, **31**(1): 223-227.

Biswas, S.K. 1992. Tertiary stratigraphy of Kutch. *Journal of the Palaeontological Society of India*, **37**(1): 1-29.

Boltovskoy, E., Scott, D.B. and Medioli, F.S. 1991. Morphological variations of benthic foraminiferal tests in response to changes in ecological parameters: a review. *Journal of Paleontology*, **65**(2): 175-185.

Cotton, L. and Renema, W. 2014. Global evolution of reticulate *Nummulites*. 10th North American Paleontological Convention - Abstract and Programme, *Paleontological Society Special Publications*, **13**: 117.

Dasgupta, A. 1970. Further studies on reticulate *Nummulites* (Foraminifera) from Oligocene beds of Cutch, India. *Journal Geological Mining and Metallurgical Society of India*, **42**(4): 159-172.

Glaessner, M.F. 1963. *Principles of micropalaeontology*. Hafner Publishing Co. New York.

Haynes, J.R. 1992. Supposed pronounced ecophenotypy in foraminifera. *Journal of Micropalaeontology*, **11**(1): 59-63.

Hottinger, L. 2009. The Paleocene and Earliest Eocene foraminiferal family Miscellaneidae: neither nummulitids nor rotaliids. *Carnets de Géologie (Brest)*, article 2009/06, PDF, 1-41.

Hottinger, L., Halicz, E. and Reiss, Z. 1993: Recent Foraminiferida from the Gulf of Aqaba, Red Sea. *Slovenska Akademija Znanosti in Umenosti (Ljubljana), classis IV*, **33**: 1-179.

Kidwell, S.M. 1985. Palaeobiological and sedimentological implications of fossil concentrations. *Nature*, **318**(6045): 457-460.

Medioli, F.S. and Scott, D.B. 1978. Emendation of the genus *Discanomalina* Asano and its implications on the taxonomy of some of the attached foraminiferal forms. *Micropaleontology*, **24**(3): 291-302.

Mohan, M. 1965. Variation in *Nummulites fichteli* Michelotti. *Bulletin of Geological Society of India*, **2**(4): 93-96.

Mukhopadhyay, S.K. 2003. Plastogamy and its early morphological indication in *Nummulites boninensis* Hanzawa from the Middle Eocene of Cambay Basin, India. *Revue de Paléobiologie*, **22**(1): 231-242.

Nuttall, W.L.F. 1925. Indian reticulate *Nummulites*. *Annals and Magazine of Natural History*, **15**(9): 661-669.

Özcan, E., Less, E., Baldi-Beke, M., Kollányik, K. and Acar, F. 2009. Oligo-Miocene foraminiferal record (Miogypsinidae, Lepidocyclinidae and Nummulitidae) from the Western Taurides (SW Turkey) : Biometry and implications for the regional geology. *Journal of Asian Earth Sciences*, **34**(6): 740-760.

Papazzoni, C.A. 1998. Biometric analyses of *Nummulites* "*ptukhiani*" Z.D. Kacharava, 1969 and *Nummulites fabianii* (Prever in Fabiani, 1905). *The Journal of Foraminiferal Research*, **28**(3): 161-176.

Reiss, Z. and Hottinger, L. 1984. *The Gulf of Aqaba*, Springer, New York.

Renema, W. 2007. Fauna Development of Larger Benthic Foraminifera in the Cenozoic of Southeast Asia, p. 179-215. In: *Biogeography, Time and Place: Distributions, Barriers and Islands* (Ed Renema, W.), Springer, Dordrecht.

Roveda, V. 1970. Revision of the *Nummulites* (Foraminiferida) of the *N. fabianii-fichteli* group. *Rivista Italiana di Paleontologia e Stratigrafia*, **76**(2): 235-324.

Samanta, B.K. 1968. *Nummulites* (foraminifera) from the Upper Eocene Kopili Formation of Assam, India. *Palaeontology*, **11**(5): 669-682.

Samanta, B.K., Bandopadhyay, K.P. and Lahiri, A. 1990. The occurrence of *Nummulites* Lamarck (Foraminiferida) in the Middle Eocene Harudi Formation and Fulra Limestone of Cutch, Gujarat, western India. *Bulletin Geological Mining and Metallurgical Society of India*, **55**: 1-66.

Sarkar, S. and Syed, R. 2013. Change of coiling plane orientation in Early Oligocene reticulate *Nummulites* from southwestern Kutch: Teratology or adaptation? *Abstract Volume XXIV Indian Colloquium Micropalaeontology and Stratigraphy*, p. 124.

Schaub, H. 1981. Nummulites et Assilines de la Tèthys paléogène. Taxinomie, phylogénese et biostratigraphie. *Schweizerische Paläontologische Abhandlungen,* **104**: 1-236.

Sengupta, S. 2000. Problems of classifying early Oligocene reticulate *Nummulites* (Foraminiferida) from southwestern Kutch, Gujarat. *Journal of the Geological Society of India*, **56**(6): 673-677.

Sengupta, S. 2001. Observations on the plane of coiling in *Nummulites maculatus* Nuttall Form B (:Foraminiferida). *Indian Journal of Geology*, **73**(3): 187-190.

Sengupta, S. 2002. A note on test shape of *Nummulites* cf. *fichteli* Michelloti Form A (:Foraminiferida) from the Early Oligocene deposit of southwestern Kutch, India. *Journal of the Geological Society of India*, **60**(2): 223-224.

Sengupta, S. 2009. Striate *Nummulites* (:Foraminiferida) from the Early Oligocene rocks of southwestern Kutch. *Journal of the Geological Society of India*, **74**(5): 597-600.

Sengupta, S., Sarkar, S. and Mukhopadhyay, S. 2011. Saddle-shaped reticulate *Nummulites* from Early Oligocene rocks of Khari area, SW Kutch, India. *Journal of Earth System Science*, **120**(2): 263-268.

Singh, S.N. 1957. Two aberrant types of Nummulitidae from the Eocene of Rajasthan India. *Journal of the Palaeontological Society of India*, **2**(1): 209-212.

Stouff, V., Geslin, E., Debenay, J.-P. and Lesourd, M. 1999. Origin of morphological abnormalities in *Ammonia* (Foraminifera): studies in laboratory and natural environments. *The Journal of Foraminiferal Research*, **29**(2): 152-170.

Shukla, S. 2008. Atlas of taxonomic and bio-chronostratigraphic studies on Paleogene larger benthic foraminifera from Indian sedimentary basins. *Paleontographica Indica*, no. **9**: 1-183.

Syed, R., Sarkar, S. and Sengupta, S. 2014. Predatory drilling in Tertiary larger foraminifera from India. *Current Science*, **106**(8): 1130-1133.

Trevisani, E. and Papazzoni, C.A. 1996. Paleoenvironmental control on the morphology of *Nummulites fabianii* (Prever) in the Late Priabonian parasequence of the Mortisa Sandstone (Venetian Alps, northern Italy). *Rivista Italiana di Paleontologia e Stratigrafia*, **102**(3): 363-366.

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