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MECASTER MUTABILIS (LAMBERT, 1933) FROM THE MIDDLE CRETACEOUS NODULAR LIMESTONE (BAGH BEDS), GUJARAT, INDIA

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ABSTRACT

Mecaster mutabilis (Lambert, 1933) is being recorded and described from the Middle Cretaceous Nodular Limestone of Bilthana of the western region of the Bagh Beds. This occurrence suggests that the Nodular Limestone is the westerly extension of the marine Khadlu-Mongra Nodular Limestone and is deposited under subtidal, very shallow marine, low-energy environment. Taking into consideration the overall age of the Bagh sediments in the western region, the deposits correspond to Late Albian-Cenomanian-Turonian and Senonian (Campanian?) global transgressive event.

Keywords: Echinoids, Nodular Limestone, Cenomanian-Turonian, Bilthana, Gujarat, India

INTRODUCTION

The Bagh Formation of Central India represents one of the few good examples containing a diverse Late Cretaceous shallow-marine fauna. The sediments of the Bagh Formation comprise limestones and marls, deposited in shallow marine settings and are richly fossiliferous (Chiplonkar *et al.*, 1973; Dassarma and Sinha, 1975). These are unconformably overlain by terrestrial deposits of the Lameta Formation containing Maastrichtian dinosaurs (Ghosh *et al.*, 2003). The whole region was later covered by the Deccan basalt of latest Cretaceous-early Palaeogene age (Sahni *et al.*, 1996) and at present, only small windows exist onto these Cretaceous deposits.

From the stratigraphic view point, there are two sets of classifications which are generally followed. According to Guha (1976), the eastern Bagh beds consist of the Nimar Sandstone, Karondia Limestone (Nodular Limestone) and Chirakhan Limestone (marl and Coralline Limestone alterations), in ascending order. We retained the term Nodular Limestone since it is in use since Blanford (1869) and is more common. In the western region, we have the classification proposed by Dassarma and Sinha (1975) wherein Rajpipla limestone is considered younger to Coralline or Chirakhan Limestone. Subsequently, Biswas (1990) has used the term Navagam Limestone for the Rajpipla Limestone. We retained both the names for the convenience of the reader.

In the western part of the Narmada Basin along the Men River, the Nimar Sandstone and the Oyster Bed are well developed and they are very conspicuous, especially at Bilthana (21°57'42"N: 73°39'43"E) and Uchad (21°56'00"N : 73°41'45"E) sections (Fig. 1a). Most of the Nimar Sandstone appears to be fluvial, evident by absence of any body fossils. There are at least five bands of oysters with grey to violet, fine grained shale abounding in trace fossil *Levicyclus*. These oyster bands are at places overlain by the Nodular Limestone followed by a conglomeratic bed at the top. At Bilthana, the Nodular Limestone is unconformably overlain by conglomeratic sandstone. Though the Nodular Limestone is not richly fossiliferous, a few echinoid fossils are encountered in this horizon. Additional exposures at Khadlu (2 km West of Mongra) and Mongra (22°0'30"N: 74° 20'30"E) are much similar to the Bilthana-Uchad section.

This short communication reports the occurrence of *Mecaster mutabilis* (Lambert, 1933) (Smith 2010a) from the sediments of the Nodular Limestone of Bilthana (Fig. 1c) of the western region of the Bagh Beds. This region have been studied for its geology and palaeontology by many workers and notable among them are Blanford (1869), Bose (1884), Poddar (1964), Dassarma and Sinha (1975), Chiplonkar *et al.* (1977), Sastri *et al.* (1982), Acharyya and Lahiri (1991) and Srivastava (2004).

The shallow-water echinoid faunas are widely distributed and well documented from the sediments of Cenomanian age but their equivalents in the Turonian are largely unknown. The Bagh Formation contains important echinoid faunas, long thought to be of late Albian or Cenomanian in age but Smith (2010b) considered them to be of Late Turonian or younger in age. The important contributions made by the various workers on the echinoid taxa from the Bagh Formation (adapted from Smith, 2010b) are given in the Table 1.

The fossil echinoids of the present collection are very low in diversity. Though the specimens of fossil echinoids are complete (most of the specimens), their preservation is not good and all the forms are silicified, affecting the preservation of morphological characters for precise taxonomy. The poor preservation can be attributed to the exposure and very low rate of sedimentation. The echinoid specimens have been collected from the sediments of Middle Cretaceous age exposed in a dug pit (about 4.5 m wide X 3.6 m deep) at about 200 m east of Bilthana (21°57'42"N : 73°39'43"E), district Narmada, Gujarat, India (Fig. 1b).

The earliest report of the echinoids, in the Narmada Valley, is by Duncan (1865) who recorded *Cidaris cenomanensis* Cotteau from Oudipura and Chirakhan and *Echinobrissus similes* d'Orbigny from the Bagh Beds. Later, Bose (1884) also reported *Cidaris cenomanensis* Cotteau from the same locality. The various other genera reported from the Narmada Valley include *Cyphosoma*, *Diplopodia*, *Dorocidaris*, *Hemiaster*,

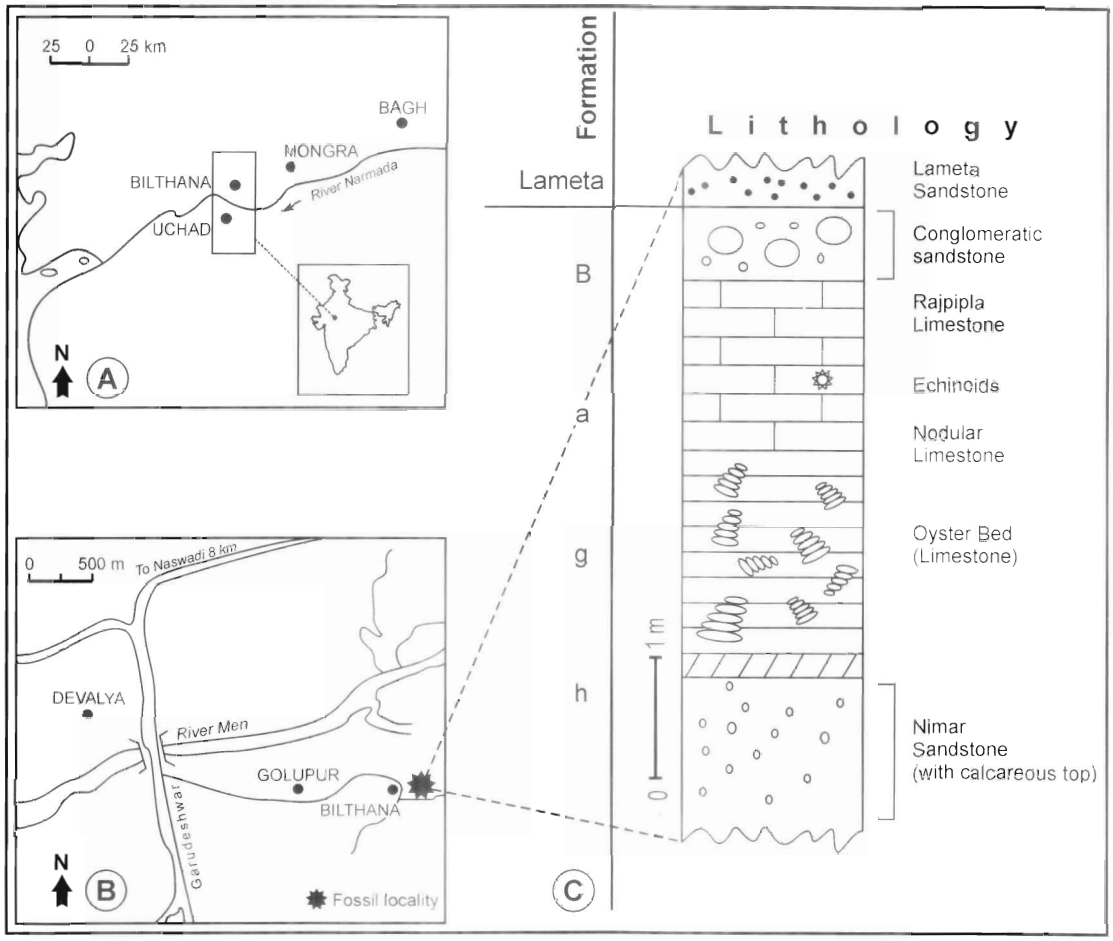


Fig. 1(A). Map of the western part of the Narmada Basin, district Narmada, Gujarat, India showing localities near Bilthana; (B). Map of the study area along the Men River showing fossil locality; (C) Lithological succession at the fossil locality, Bilthana.

Malwaster (a subgenus of *Hemiaster*), *Opiaster*, *Orthopsis*, *Neocleolites* and *Salenia* (Duncan, 1887a, 1887b; Fourtau, 1918; Chiplonkar, 1937, 1939, 1987). Chiplonkar and Badve (1972) reported *Polydiadema bosei* Chiplonkar and Badve, *Phymosoma mongraensis* Chiplonkar and Badve and *Hemiaster holoambitatus* Chiplonkar from the Nodular Limestone exposed near Mongra and Khadlu. Dassarma and Sinha (1975) have reported *Hemiaster holoambitatus* from the Nodular and Coralline Limestone of the east region and the Oyster Bed of western region. Recently, the first author had an opportunity to examine the type specimens of described echinoid taxa of the Narmada Valley at the Agharkar Research Institute, Pune. He has observed that the majority of the earlier taxa described need revisions and these should taxonomically be placed properly as per the ICZN (1999, 4th ed., Articles 11.9, 13.1)

SYSTEMATIC PALAEONTOLOGY

(Fischer, 1966; Kroh and Smith, 2010)

Order **Spatangoida** Claus,1876

Suborder **Hemiasterina** Fischer, 1966

Family **Hemiasteridae** Clark, 1917

Genus ***Mecaster*** Pomel,1883

Mecaster mutabilis (Lambert, 1933)

(Plate 1, figs. 1-9)

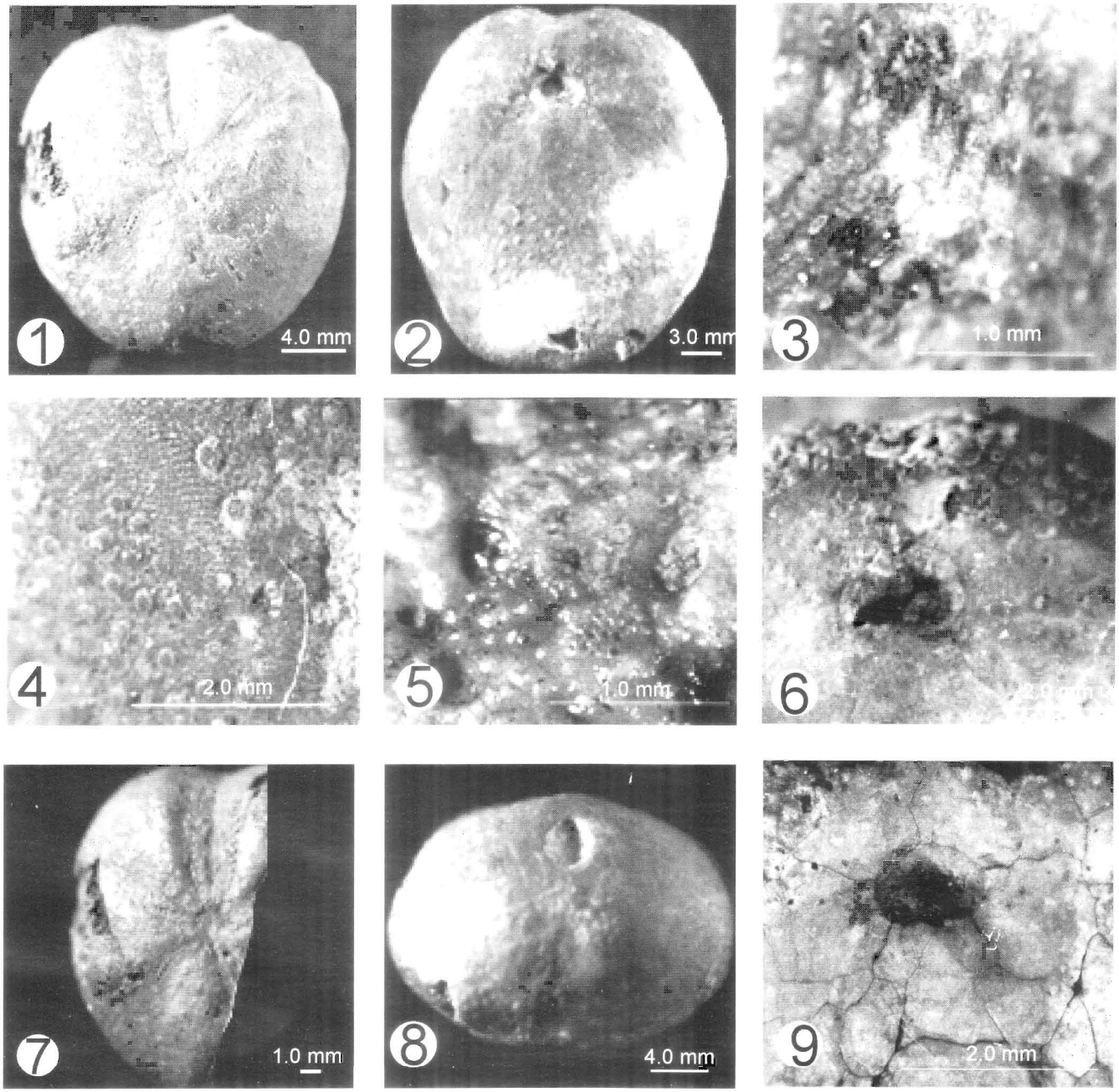
Material: 10 specimens (*MACSG 5176-5185), a few partly broken; preservation poor. (*Maharashtra Association for the Cultivation of Science-Geology)

Description: Test medium, globular with mild frontal sinus, keel mildly developed. The apical system is semiethmolytic, central with four genital pores. The petals are large, petaloid, sunken (III non-petaloid and open) and do not reach up to the ambitus; petals I & V are flexuous, shorter than the petals II & IV. Ambulacral plates simple. Periproct supramarginal and is transversally oval. Peristome excentic anteriorly, D-shaped; plastron protamphisternous. The peripetalous fasciole is well developed.

EXPLANATION OF PLATE I

1-9. ***Mecaster mutabilis*** (Lambert, 1933)
1. Aboral view.
2. Oral view.
3. Ambulacral plates.
4. Details of the peripetalous fasciloe.
5. Apical disc.
6. Peristome
7. Aboral view showing keel.
8. Posterior view.
9. Plating arrangement around peristome.

Plate I



tidal marine deposits (Hart, 1980) indicating strong marine influences and are found in the modern estuarine setups, especially where the normal marine conditions prevail. Thus, the reported assemblages in the study area appear to be near the mouth of the Cretaceous Bagh estuary, especially during Cenomanian-Turonian and Campanian periods.

The occurrence of foraminifera though indicates a marine environment, the depth is exceptionally very low (Rajshekhar and Atpalkar, 1995; Rajshekhar, 1997). It may be suggested that the shallow marine environment, set during the deposition of the Oyster Bed, continued till the deposition of the Rajpipla Limestone. At places, the Rajpipla/Navagam Limestone containing *Globotruncana*, becomes very deep (Biswas, 1990). The fossil assemblage from the Nodular Limestone suggests a very shallow marine, brackish to normal marine environment of deposition. The occurrence of planktic foraminifera at Bilthana (Rajshekhar and Atpalkar, 1997) may be attributed to the high seastand globally during Cenomanian-Turonian Period.

The Bagh Beds appear to be of Cenomanian–Turonian age, depending upon the presence of foraminifera (Rajshekhar, 1995 and present study). Earlier, Chiplonkar *et al.* (1977) studied the fauna of these beds (Echinoids, Bivalves, Ammonites, Gastropods, Broyozoa, Polychaets, Brachiopods) and suggested a Cenomanian age to the Bagh Beds. Later, Acharya and Lahiri (1991) suggested Late Albian to Coniacian age to these beds. Dassarma and Sinha (1975) recorded the echinoid fauna from the western Bagh Beds and suggested a Cenomanian to Senonian age to the Bagh Beds. However, Sastri *et al.* (1982) assigned Neocomian to Coniacian age to the Bagh Beds. Recently, Smith (2010b) presented an exhaustive account on the echinoid fauna of the Bagh Beds, especially from the Man River section in the eastern part of the Narmada Valley and observed that majority of the Bagh Formation is deposited during Turonian. However, in view of the above, Cenomanian-Turonian would be the most appropriate age for the Nodular Limestone of the Bilthana-Uchad section.

As mentioned earlier, the Navagam Limestone overlying the Nodular Limestone is extensively developed in this region. This limestone has yielded *Globotruncana* and indicates a Campainan age (Biswas, 1990). However, the Coralline Limestone is missing in the studied area. It may be concluded that the overall marine setting in the area started with the sedimentation of the Oyster Bed during Late Albian, followed by the deepening of the basin during Campanian and highest at the time of the deposition of the Navagam Limestone. Thus, the Bagh Formation, in the western region, may represent the Late Albian, Cenomanian-Turonian and Campanian global transgressive events.

REPOSITORY

The present collection of fossil echinoids MACSG5176-5185 (described, undescribed and photographed) have been deposited in the Museum, Agharkar Research Institute, G. G. Agarkar Road, Pune 411004, India.

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REFERENCES

Acharyya, S.K. and Lahiri, T.C. 1991. Cretaceous Palaeogeography of the Indian subcontinent; a review. *Cretaceous Research*, **12** : 3-26.

Biswas, S. K. 1990. Correlation of non-marine and estuarine Cretaceous of Western India (Presidential Address), p. 1-13. In: *Cretaceous Events, Stratigraphy and Correlation of the Indian marine strata* (Eds. Ashok Sahni and Asit Jolly), I.G.C.P. 216 of 245, Chandigarh.

Blanford, W. T. 1869. On the Geology of the Tapti and Lower Narbada Valleys and some adjoining districts. *Memoirs of the Geological Survey of India*, 6(2): 163-384.

Bose, P. N.1884. Geology of Lower Narbada valley between Nimawar and Kawant. *Memoirs of the Geological Survey of India*, **21**(1): 72p.

Chiplonkar, G. W. 1937. Echinoids from the Bagh Beds. *Proceedings of the Indian Academy of Science*, **6B** (1): 60-71.

Chiplonkar, G. W. 1939. Echinoids from the Bagh Beds. Pt. II. *Proceedings of the Indian Academy of Science*, **9B** (5): 236-246.

Chiplonkar, G. W. 1987. Three decades of invertebrate palaeontology and biostratigraphy of marine Cretaceous rocks of India. *Geological Survey of India, Special publication*, **11**(1): 305 – 339.

Chiplonkar, G. W. and Badve, R. M. 1972. Palaeontology of the Bagh Beds.II Echinoids. *Proceedings of the Indian Academy of Science*, **76B** (4): 133-152.

Chiplonkar, G.W., Ghare, M.A. and Badve, R.M. 1973. Bagh Beds, their fauna, age and affinities. *Biovigyanam*, **3**: 33-60.

Chiplonkar, G.W., Badve, R.M. and Ghare, M.A. 1977. On the stratigraphy of Bagh Beds of the Lower Narbada Valley. *Proceedings of IV[th] Colloquium Indian Micropaleontology and Stratigraphy*, O.N.G.C., I.P.E., Dehardun: 209-216.

Cotteau, G. H., Peron, P. A. and Gauthier, V. 1881. *Echinides fossils de l'Algerie*, Etage Turonien, **2**(*6*): 1-110, pl. 1-8. G. Masson, Paris.

Dassarma, D. G. and Sinha, N. K. 1975. Marine Creataceous formations of Narmada valley (Bagh Beds), Madhya Pradesh and Gujrat. *Memoirs of the Geological Survey of India, Palaeontologia Indica (N.S.)* **42**: 1-123, pl. 1-12.

Duncan, P. M. 1865. A description of Echinodermata from the strata on the southeastern coast of Arabia and at Bagh on t'e Nurbuda, in the collection Of Geological Society. *Quarterly Journal of the Geological Society of London*. **21**(1): 349 - 363.

Duncan, P. M. 1887 (a). Note on the echinoidea of the Cretaceous Series of the Lower Narbada Valley (with remarks upon their geological age). *Records of the Geological Survey of India*, **20**(2): 81 – 92.

Duncan, P. M. 1887 (b). On the echinoidea of the Cretaceous strata of the Lower Narbada region. *Quarterly Journal of the Geological Society of London*, **43**: 150 - 155.

Fischer, A. G. 1966. Spatangoids, p. U543-U628. In: *Treatise on Invertebrate Palaeontology* (Eds. Moore, R. C. *et al.*), pt U3 (2), (Echinodermata, Echinoidea). Geological Society of America Inc. and University of Kansas Press.

Fourtau, R. 1918. Les Echinides des 'Bagh Beds'. *Records of the Geological Survey of India*, **49**(1): 34 - 53.

Gangopadhyay, T.K. and Bardhan, S. 2000. Dimorphism and a new record of Barroisiceras de Grossouvre (Ammonoidea) from the Coniacian of Bagh, central India. *Canadian Journal of Earth Sciences*, **37**: 1377-1387.

Ghosh, P., Bhattacharya, S.K., Sahni, A., Kar, R.K., Mohabey, D.M. and Ambwani, K. 2003. Dinosaur coprolites from the Late Cretaceous (Maastrichtian) Lameta Formation of India: isotopic and other markers suggesting a C3 plant diet. *Cretaceous Research*, **24**: 743-750.

Guha, D.K. 1976. A lithostratigraphic classification of the Bagh (Group) Beds, Madhya Pradesh. *Proceedings VI[th] Indian Colloquium on*

Micropaleontology and Stratigraphy, Varanasi: 60-76.

ICZN (ed.) 1999. *International Code of Zoological Nomenclature, Fourth Edition*. International Trust for Zoological Nomenclature, London.

Jafar, S.A. 1982. Nannoplankton evidence of Turonian transgression along Narmada valley, India and Turonian-Coniacian boundary problem. *Journal of the Palaeontological Society of India*, **27**: 17-30.

Kennedy, W.J., Phansalkar, V.G. and Walaszczyk, I. 2003. *Prionocyclus germari* ([Reuss, 1845]), a Late Turonian marker fossil from the Bagh Beds of central India. *Cretaceous Research*, **24**: 433-438.

Kroh, A. and Smith, A.B. 2010. The phylogeny and classification of post-Palaeozoic echinoids. *Journal of Systematic Palaeontology*, **8**(2): 147-212.

Poddar, M.C. 1964. Mesozoics of western India-their geology and oil possibilities. *22nd International Geological Congress, New Delhi*, **1**:127-143

Rajshekhar C. 1995. Foraminfera from the Bagh Group, Narmada Basin, India. *Journal of the Geological Society of India* ,**46**: 413-428.

Rajshekhar, C. 1997. Significance of fossils from the Rajpipla Limestone, Cretaceous of Narmada basin, Gujarat. *Journal of the Geological Society of India*, **50** : 339-342, pl. 1.

Rajshekhar C. and Atpalkar, S. R. 1995. Foraminifera from Nodular Limestone, Bilthana, Gujarat: Statigraphic significance. *Journal of the Geological Society of India*, **45**: 585-593.

Sahni, A., Venkatachala, B.S., Kar, R.K., Rajanikanth, A., Prakash, T., Prasad, G.V.R. and Singh, R.Y. 1996. New palynological data from the Deccan Intertrapean beds: implications for the latest record of dinosaurs and synchronous initiation of volcanic activity in India. *Memoirs of the Geological Society of India*, **37**: 267-283.

Sastri, V.V., Raju, A.T.R., Shukla, S.N. and Venkatachala, B.S. 1982. Narbada Basin (Chapter) in IGCP No. 74/1/66. *"Evolution of geosynclinal and platform basins of India"* pp 36-49.

Smith, A. B. 2010a. The Echinoid Directory [Electronic Publication]. http://www.nhm.ac.uk/palaeontology/echinoid (Accessed 16th November, 2010).

Smith, A. B. 2010b. The Cretaceous Bagh Formation, India: a Gondwana window on to Turonian shallow water echinoid faunas. *Cretaceous Research*, **31**(4): 368-386.

Srivastava, D. K. 2004. Fossil Spatangoids (Echinodermata) of India – a Review. *Journal of the Palaeontological Society of India*, **49**: 125–149.

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