

Molluscan fauna from the Miocene sediments of Kachchh, Gujarat, India – Part 1. Oysters

V.D. Borkar, Kantimati G. Kulkarni and Satarupa Bhattacharjee

Agharkar Research Institute, Pune-411 004

Borkar, V.D., Kulkarni, K.G. & Bhattacharjee, S. 2004. Molluscan fauna from the Miocene sediments of Kachchh, Gujarat, India—Part 1. Oysters. *Geophytology* **34** (1&2): 1–7.

Four species of oysters collected from the Miocene sediments of the Abdassa Subdivision of Kachchh, Gujarat are briefly described. Present work also includes taxonomic revision of the other oyster species in the light of revised generic definitions. The species are now designated as *Hyotissa hyotis*, *Crassostrea gingensis*, *Ostrea (Ostrea) angulata*, *Ostrea (Ostrea) latimarginata*, *Crassostrea lingua* and *Crassostrea vestita*. All these species are known to occur in Gaj Series of Sind, Pakistan. One species viz., *Hyotissa hyotis* is also recorded from the Quilon Beds of Kerala, while *O. (O.) latimarginata* is common with the Miocene rocks of Kathiawar.

Key-words—Oysters, Miocene, Kachchh.

INTRODUCTION

THOUGH authentic geological mapping of Kachchh was undertaken by Wynne and Fedden in the late sixties of the nineteenth century and details of their findings appeared in the form of a Memoir (Wynne 1872), first documentation of geology of Kachchh was brought on record by Grant (1839). Fossils collected by him were studied by Sowerby (1839), who identified five oyster species. Four of them viz., *Ostrea angulata*, *Ostrea lingua*, *Ostrea tubifera* and *Gryphaea globosa* were reported as new species; whereas the fifth, *Ostrea flabellula*, was identified after Lamarck.

As regards fossils collected by Fedden and Wynne, from these Miocene sediments, which were then termed as ‘the Gaj Series of rocks’ of Kachchh, the molluscs were put at the disposal of Vredenburg (1924, 1928), while study of echinoids was assigned to Duncan and Sladen (1883). Vredenburg identified seven species of oysters, viz., *Ostrea angulata* Sowerby, *Ostrea lingua* Sowerby, *Ostrea vestita* Fuchs, *Ostrea gingensis* Schlotheim, *Ostrea imbricata* Lamarck (*Ostrea tubifera* Sowerby) and *Gryphaea brongniarti* Bronn (= *Gryphaea globosa* Sowerby) along with a new species viz., *Ostrea*

latimarginata Vredenburg (= *Ostrea flabellula* of Sowerby).

Subsequently, Biswas remapped the Kachchh district and his revised lithostratigraphic classification of the Tertiary rocks (Biswas 1992) has been followed in the present work.

Heterochronous homoeomorphy in different species of suborder Ostreina has led to a great deal of confusion as to their generic positions. Palaeontologists have been using generic names like *Ostrea*, *Gyphaea*, *Liostrea*, *Pycnodonte*, *Exogyra*, *Alectryonia*, etc. rather injudiciously. According to Stenzel (1971) many of the erroneous generic identifications of the oysters have defied analysis pertaining to evolution, phylogeny and classification, as problems were dealt with either by purely neontological or by purely palaeontological methods. Unraveling the tangle of generic definitions by resorting to interdisciplinary approach adopted by Stenzel (1971) has proved to be a handy tool for rectifying taxonomical identifications. The present work on oysters from the Miocene rocks of Kachchh, Gujarat includes their taxonomic revision in the light of work carried out by Stenzel.

SYSTEMATIC DESCRIPTION

Class – Bivalvia Linné 1758 (Buonanni 1681)

Subclass – Pteriomorphia Beurlen 1944

Order – Pterioida Newell 1965

Suborder – Ostreina Férussac 1822

Superfamily – Ostreacea Rafinesque 1815

Family – Gryphaeidae Vyalov 1936

Subfamily – Pycnodonteinae Stenzel 1959

Genus – *Hyotissa* Stenzel 1971

Type species – *Mytilus hyotis* Linné 1758

Hyotissa hyotis (Linné, 1758) Stenzel 1971

Pl. 1, Figs 1-5

1928 *Ostrea imbricata* Lamarck : Vredenburg, *Mem. geol. Surv. India*, vol. 50 (2), p. 426. 1962 *Ostrea hyotis* (Linné) : Dey, *Pal. Ind.*, New Series, vol. 36, p. 45.

Plesiotype – MACS G 4389.

Description – Small to medium in size. The valves are subequal, suborbicular and have similar ornamentation. The shell is more or less like a concavo-convex lens, the left valve being convex on exterior, while the right valve is concave on exterior. Curvature of the left valve is slightly more pronounced than that of the right valve, making it somewhat capacious. The ornamentation consists of strong, radial plicate ribs. They show irregular, dichotomous branching. Summits of the ribs are well rounded. Thereby, the commissure opposite to hinge gets plicated (Pl. 1, fig.5). The prominent growth squamae cross the ribs giving rise to hyote spines at irregular intervals. Chomata vermiculate and arborescent in nature, are restricted to the vicinity of hinge plate. Commissural shelves in both the valves are conspicuous.

Remarks – Examination of the GSI type specimen, an

isolated left valve of *Ostrea imbricata* (Vredenburg, 1928; Type No. 13490) shows that it is very closely similar to the specimens in our collection in all essential respects, especially the strong, plicate ribs showing irregular, dichotomous branching and development of strong hyote spines. Dey (1962) had rightly pointed out that *Ostrea imbricata* Lamarck is a junior synonym of *Ostrea hyotis* (Linné). This species is designated here as *Hyotissa hyotis* after Stenzel (1971) on the basis of squamose concentric ornamentation giving rise to hyote spines.

The species is distributed throughout the Indo-Pacific province in the present times. It is recorded from the Miocene of Pemba Island, Malagassy, Kenya, Java, Sumatra, Timor, etc. It also occurs in the Pliocene of Karikal, Philippine Islands and Tanga and Pleistocene of Java and Timor (Dey 1962)

Occurrence - Limestone intercalations in the Upper portion of Khari Nadi Formation at Aida; shell limestone intercalation in the Claystone Member of the Chhasra Formation west of Buta, south of Laiyari, north of Wadsar and around Chhasra; Kankawati river section between Khirsara and Vinjhan. Frequency of occurrence of this species is relatively higher towards the middle of the Claystone Member of the Chhasra Formation.

Family – Ostreidae Rafinesque 1815

Subfamily – Ostreinae Rafinesque 1815

Genus – *Crassostrea* Sacco 1897

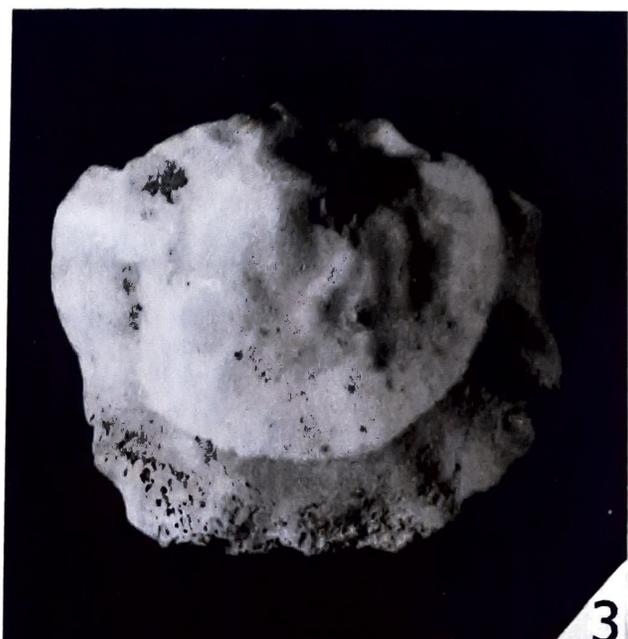
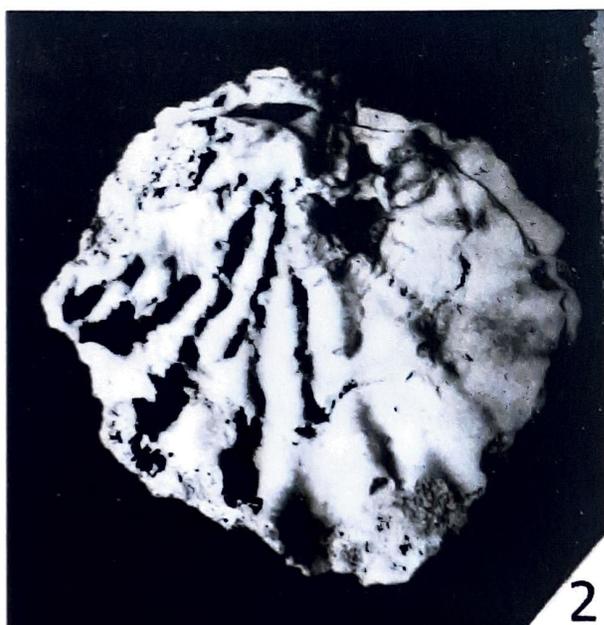
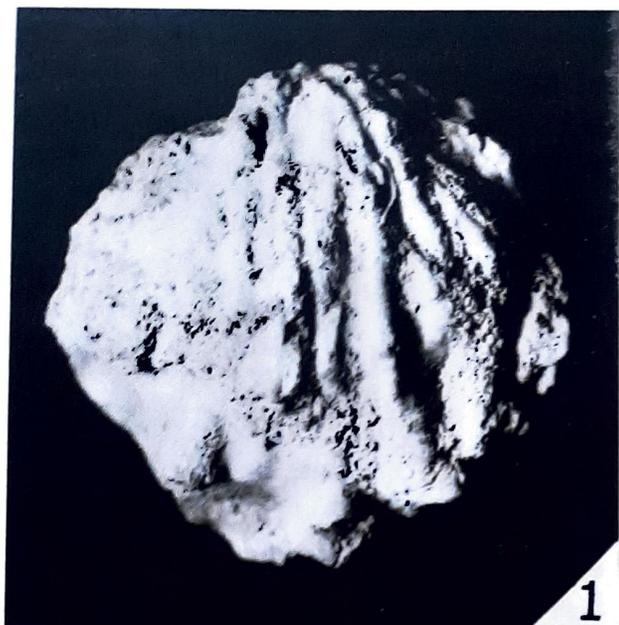
Crassostrea gingensis (Schlotheim, 1928) comb. nov.

Pl. 2, Figs 1-2

1928 *Ostrea gingensis* Schlotheim : Vredenburg, *Mem. geol. Surv. India*, vol. 50 (2), 427; Pl. 24, Fig. 1

PLATE 1

- 1-5. *Hyotissa hyotis* Linné (Stenzel). (Plesiotype No. MACS G 4389). 1. Left valve, external view (x 1.3). 2. Right valve, external view (x 1.3). 3. Left valve, Internal view (x 1.3). 4. Right valve, Internal view (x 1.3). 5. Commissural view opposite to hinge (x 1.5). Note the placations.



Synplesiotypes – MACS G 4390, MACS G 4391.

Description – The specimens in the present collection are damaged, incomplete left valves. However, a spatulate form can easily be made out. Presence of umbonal cavity is also discernible. Ornamentation consists of concentric growth folds.

Remarks – A comparison with Vredenburg's type specimen No. 13493, deposited in the Central Repository of the Geological Survey of India, Kolkata, enables specific identification on the basis of the general spatulate form, fairly deep nature of the left valve and growth folds on the exterior.

This species is identified as *Crassostrea* Sacco on the basis of presence of an umbonal cavity, preponderate posterior margin and rough surface with irregularly spaced growth squamae (Stenzel, 1971, p.U1128). Vredenburg (1928) had reported this species from the Miocene rocks of Sind and Kachchh.

Occurrence – Limestone intercalations in the Claystone Member of the Chhasra Formation near Chhasra village and west of Haripar.

Genus – *Ostres* Linné 1758

Subgenus - *Ostrea* Linné 1758

Type species – *Ostrea edulis* Linné 1758

Ostrea (Ostrea) angulata Sowerby 1840

Pl. 2, Figs 3-5

1928 *Ostrea angulata* Sowerby : Vredenburg, *Mem. geol. Surv. India*, vol. 50 (2), p. 422, pl. 24, fig. 3; pl. 24b, figs. 2,3.

Synplesiotypes – MACS G 4392, MACS G 4393

Description – Medium-sized oysters (height up to 8 cm, width up to 5 cm). Suborbicular outline, tending to be subtrigonal in some individuals. Radial

ornamentation consists of strong ribs, slightly narrower than the separating furrows. With the growth of shell, number of radiating ribs increases gradually due to repeated bifurcation. Concentric ornamentation consists of squamae, giving rise to scabrous surface. Commissural shelf of left valves well developed. Right valves are small, thin, more or less flat and devoid of radial ribs.

Remarks – The species is retained in the *Ostrea (Ostrea)* Linné (*s.s.*) as the margins are devoid of any plication and chomata are weak. This is one of the two most frequently occurring oyster species in the Miocene sediments of Kachchh. Vredenburg (1928) reported this species from the Miocene rocks of Sind and Kachchh.

Occurrence – The species occurs in almost all the limestone intercalations throughout the Miocene rock formations of Kachchh, at different localities including Jangadia, around Aida, west of Buta, west of Haripar, north of Wadsar, around Chhasra, near Khirsara and at Vinjhan.

Ostrea (Ostrea) latimarginata Vredenburg 1928

Pl. 2, Figs 6-8

1928 *Ostrea latimarginata* : Vredenburg, *Mem. geol. Surv. India*, 50 (2), p. 423, pl. 24, fig. 2; pl. 24a, fig. 1.

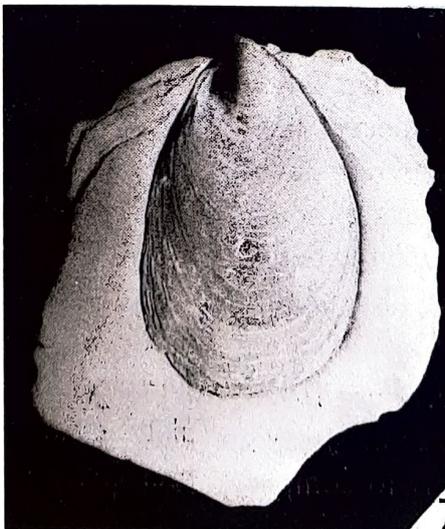
Synplesiotypes – MACS G 4394, MACS G 4395.

Description – Medium-sized oysters (height up to 10 cm, width up to 6 cm) with sub-orbicular left valve is more or less symmetrical and shows well-developed radial ornamentation consisting of strong ribs, much narrower than the intervening furrows. As shell grows, the ribs keep on bifurcating and number of radial ribs increases considerably to-

PLATE 2



- 1-2. *Crassostrea gingensis* (Schlotheim) comb. nov. 1. Left valve, external view x 1.3 (Synplesiotype No. MACS G 4390). 2. Left valve, internal view x 1.3 (Synplesiotype No. MACS G 4391).
- 3-5. *Ostrea (Ostrea) angulata* Sowerby. 3. Left valve, external view x 1.3 (Synplesiotype No. MACS G 4392). 4. Right valve, external view x 1 (Synplesiotype No. MACS G 4393). Note the commissural shelf of the left valve surrounding it. 5. Left valve, internal view x 1.3 (Synplesiotype No. MACS G 4393).
- 6-8. *Ostrea (Ostrea) latimarginata* Vredenburg. 6. Left valve, external view x 1.3 (Synplesiotype No. MACS G 4394). 7. Right valve, external view x 1.3 (Synplesiotype No. MACS G 4394). Note the commissural shelf of the left valve surrounding it. 8. Left valve, internal view x 1.3 (Synplesiotype No. Macs G 4395).



wards the ventral margin. Concentric growth lines are not very conspicuous. Commissural shelf of left valves well developed. Right valves are small, thin, almost flat and devoid of radial ribs.

Remarks - The species can be distinguished from *Ostrea (Ostrea) angulata* with which it is intimately associated in the field, since the left valve of former is more or less symmetrical. Also in *O. (O.) latimarginata* the ribs are not as strong as in *O. (O.) angulata*. Moreover, the concentric ornamentation in *O. (O.) angulata* giving a squamose appearance to the shell makes the distinction more vivid.

Like the previous species, this species is also retained in the subgenus *Ostrea (Ostrea)* since the margins are without any plication and chomata are weak. Vredenburg (1928) reported occurrence of this species from the Miocene rocks of Sind and Myanmar.

Occurrence - The species occurs in almost all the limestone intercalations throughout the Miocene rock formations of Kachchh, at different localities including Jangadia, around Aida, west of Buta, west of Haripar, north of Wadsar, around Chhasra, near Khirsara and at Vinjhan.

DISCUSSION

Among the oyster species known to occur in the Miocene sediments of Kachchh, three species viz., *O. vestita* Fuchs, *O. lingua* Sowerby and *Gryphaea brongniarti* Bronn (= *Ostrea globosa* of Sowerby) are not represented in the present collection.

Study of the type specimen of *Ostrea lingua* (G.S.I. type Specimen No. 13497) necessitated placing it under the genus *Crassostrea* Sacco (Stenzel, 1971, p. N 1127) on the basis of spatulate shape, presence of an umbonal cavity, development of growth squamae and absence of chomata.

As regards *Ostrea vestita*, Vredenburg (1928, p. 426) did not include illustration of this species, description given by him is too brief to compre-

hend its morphological characteristics. The type specimen of *O. vestita* (G.S.I. Type specimen No. 13497) was not available for study, however, Vredenburg found it closely related to *Ostrea lingua* Sowerby on the basis of comparable general characters. It, therefore, construes that *Ostrea vestita*, like *O. lingua*, belongs to the genus *Crassostrea*.

All the seven species occurring in the Miocene sedimentary rock formations of Kachchh, are known to occur in the Gaj Series of Sind, Pakistan. This fact speaks for the close affinity between the Miocene sediments of Sind and Kachchh. The Miocene sediments of Kathiawar share *Ostrea (Ostrea) latimarginata* with the Kachchh Miocene oyster assemblage. One more oyster species recorded from the Miocene sediments of Kathiawar is *Crassostra gajensis* (= *Ostrea gajensis* Vredenburg). Though this species is yet to be procured from the Miocene rocks of Kachchh, it is known to occur in the Gaj Series of Sind (Vredenburg 1928). *Hyotissa hyotis* is also reported from the Quilon Beds of Kerala. It may also be mentioned here that the marine Miocene strata of Sri Lanka have yielded one oyster species viz., *O. virleti* (Eames 1950). This species is so far not reported from the Miocene rocks of Kachchh, but is known to occur in the Gaj Series of Sind (Vredenburg 1928).

ACKNOWLEDGEMENT

The authors acknowledge the financial assistance provided by the Department of Science and Technology, Government of India, New Delhi, (Project Reg. No. ESS/23/VES/117/2000). The Director General, Geological Survey of India, very kindly gave his consent to examine the type specimens. Smt. Krishna Roychowdhury, Director, Central Palaeontological Laboratory, GSI, Kolkata provided unreserved help while we were working at Kolkata. Dr. V.S. Rao, Director, Agharkar Research Institute, Pune is gratefully acknowledged for his keen interest and encouragement.

REFERENCES

- Biswas, SK 1992. Tertiary stratigraphy of Kutch. *J. Palaeont. Soc. India* 37: 1-29.
- Dey, AK 1962. The Miocene mollusca from Quilon, Kerala (India). *Mem. geol. Surv. India, Palaeont. Ind.* 36: 129 p.
- Duncan, PM & Sladen, WP 1883. The fossil echinoidea of Kutch and Kathywar. *Palaeont. Ind.* 14 (1): 91p.
- Eames, FE 1936. *Ostrea (Crassostrea) gajensis* from the Baripada, Mayurbhanj State. *Rec. geol. Surv. India* 71 (2): 150-151.
- Eames, FE 1950. On the ages of certain Upper Tertiary beds of peninsular India and Ceylon. *Geol. Mag. London*, 87(4); 233-252.
- Grant, CW 1839. Memoirs to illustrate a geological map of Cutch. *Trans. geol. Soc. Lond.* 5 (2) : 289-329.
- Stenzel, HB 1971. *Treatise on Invertebrate Paleontology*, directed and edited by R.C. Moore, part N, v.3 Mollusca, Bivalvia: The Geological Society of America, Inc. and University of Kansas.
- Sowerby, J de C. 1840. Systematic description of organic remains from Kutch. *Trans. geol. Soc. Lond.* 5 (2): 327-329.
- Vredenburg, E 1924. Descriptions of mollusca from the Post-Eocene Tertiary formation of north western India: Gastropoda (In Part) and Lamellibranchiata. *Mem. geol. Surv. India* 50 (1): 1-351.
- Vredenburg, E. 1928. Descriptions of mollusca from the post-Eocene Tertiary formation of north western India: Gastropoda (In Part) and Lamellibranchiata. *Mem. geol. Surv. India* 50 (2): 351-506.
- Wynne, AB 1872. Memoir of the Geology of the Kutch to accompany the map compiled by A.B. Wynne and F. Fedden during the season 1867-68 and 1868-69. *Mem. geol. Surv. India* 9 (1): 1-293.