Universal Journal of Environmental Research and Technology
 eISSN 2249 0256
Available Online at: www.environmentaljournal.org
Volume 2, Issue 1: 36-40

**Open Access** **Research Article**

# Environmental Significance of Coral-Algal Reef Section Exposed in Well Near Mithapur, Saurashtra, India

**Shyam N. Mude, P. A. Dalvi-Naik and Rajkumar Wagh**

Department of Geology, Fergusson College, Shivaji Nagar, Pune-411 004

**Corresponding author: shyammude25@yahoo.co.in**

## Abstract:

**The Pleistocene-Holocene sediments are well exposed along Dwarka-Okha section of Saurashtra, Gujarat, Western India. The sediments are represented by bio-clastic limestones, coral reef limestones and conglomerates. These sediments constitute the Chaya Formation which further includes the Okha shell Limestone Member and the Armada Reef Member. The sediments of the Okha shell limestone Member are represented by bioclastic limestones, off-white limestones and conglomerates while the sediments of the Armada Reef Member are represented by coral-reef limestones. The coral-algal reef section of the Armada Reef Member exposed in a well section at global co-ordinates N $22^{0}$ $20^{l}$ 46 $^{ll}$ and E $69^{0}$ $01^{l}$ $05^{ll}$ is examined in the present study. This section of 10 feet is divided into nine units from A to I based on rock type and coral- algal assemblage. The sequence consists of alternate coral framestone and algal framestone (Rhodoliths) from unit-A to unit-H and at top rudstone (unit-I). The observations made from unit A to Unit H suggests fluctuating sea level while unit-I represents very shallow environment and evidence of Rhodophycean macro-algal bloom. This algal bloom is probable cause for the collapse of this coral-algal reef system along with marine transgression.**

**Keywords:** Rhodophycean macro-algal bloom, Armada Reef Member, Western India

## 1.0 Introduction:

The Pericratonic-shelf Saurashtra basin along the northwestern coast of India consists of the Neogene-Quaternary sediments which are very well exposed along coastal tract. Mathur *et al*., (1988) have classified these sediments into four formations namely, the Gaj Formation, the Dwarka Formation, the Miliolite Formation and the Chaya Formation (Tab.1). The Miliolite Formation is subdivided into two namely, the Dhobaliya Talav Member and the Adatiana Member. Pandey *et al.*, (2007) studied the Neogene-Quaternary sediments of Saurashtra and they have studied sediments of the Chaya Formation from different localities for stratigraphic distribution and depositional environment. They introduced a new member in the Chaya Formation and thus Chaya Formation consists of three members; the Okha Shell Limestone Member, the Aramda Reef Member and the Porbandar Calarenite Member. Mathur and Pandey (2002) divided the present sequence into 4 units (Unit-I to Unit-IV) and named as coral framestone , Algal framestone, Coral bafflestone with algal debris and Rudstone consisting of algal debris only, in ascending order of deposition. Kundal and Dharashivkar (2005) documented and classified rhodoliths of this section from units II, III and IV following divisions of the sequence made by Mathur and Pandey (2002). The present section is analyzed to study the presence of coralline algae and symbiotic relationship between corals and coralline algae. Thus, in the present study, the section has been divided into nine units and the top unit (unit-I) exhibits evidences of paleo-macro algal bloom. By analyzing these corals and coralline algae, the authors have commented of sea level fluctuations and probable causes for collapse of this reef-system.

## 2.0 Geological Setting:

The Dwarka-Okha area is studied in detail by Jain (1990) whereas Jain and Agarwal (1992) gave three fold classification of the Dwarka Formation. Bhatt (2000) put forward the lithostratigraphy of the Neogene-Quaternary deposits of the Dwarka-Okha area (Table-1). He classified the Chaya Formation into two members, the Dwarka Formation into three members and the Gaj Formation into two members. The Ashapura Limestone Member of the Gaj Formation consists of grey clays, variegated clays,

marls with some gypsum bands while Ranjitpur Limestone Member consists of yellow and brown fossiliferous limestone. The Positra Limestone Member of the Dwarka Formation possesses bioclastic and coralline limestone with few dolomatic bands; the Shankhodhar Sand-Clay Member is represented by sandy clays and sandstones, while the Kalyanpur Limestone Member contains recrystallised fossiliferous limestone and sandy limestone. The Okha Shell Limestone Member of the Chaya Formation is represented by off white coloured bioclastic limestone and conglomerate and the Aramda Reef Member contains coral reef limestone.

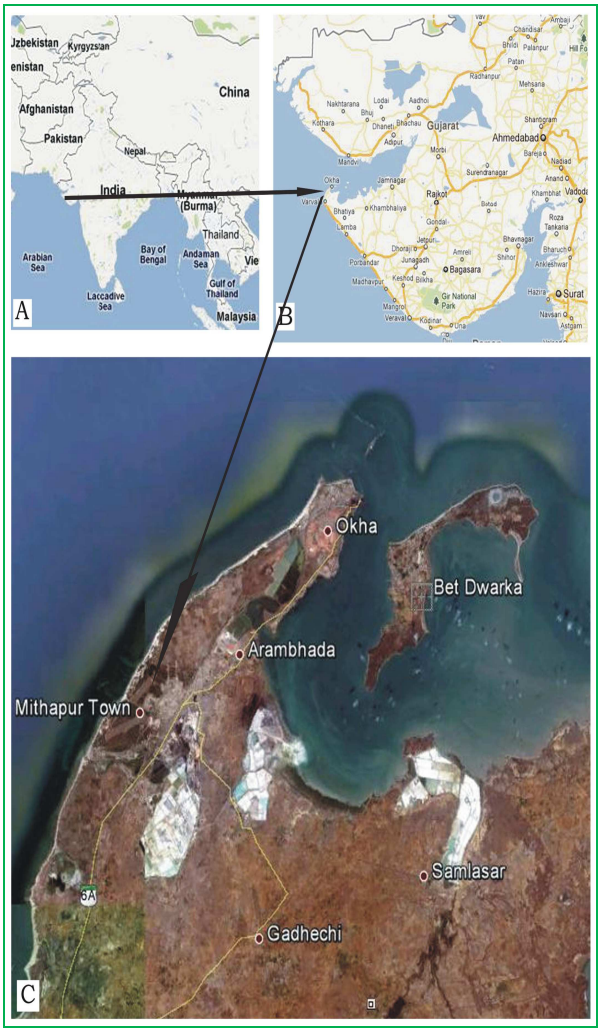



**Fig.1:** A) Location map of India (Source- Google Map), B) Location Map of Gujarat (Source- Google Map) and C) Location map of study area (Source - Google Earth)

**Fig. 2: Photograph showing Algal Framestone (Rhodoliths) and Rudstone**

**Fig. 3: Photograph showing Coral Framestone**

**Table 1: Lithostratigraphy of Neogene-Quaternary deposits of Saurashtra (Bhatt, 2000, Pandey et al., 2007)**

| Stratigraphic Unit | Lithology | Age |
|---|---|---|
| **Holocene Deposits** | Beach and dune sands Tidal clays, alluvium (Unconformity | Holocene) |
| **Chaya Formation** | | |
| Porbandar Calc-Arenite Membe | Calc-rudite, Calc-arenites | Late Pleistocene to Holocene |
| Aramda Reef Membe | Coral reef limestone | Late Pleistocene to Holocene |
| Okha Shell Limestone | Off white coloured bioclastic limestone & conglomerate (Unconformity) | Middle to Late Pleistocene |
| **Dwarka Formation** | | |
| Kalyapur Limestone Member (30m) | Recrystallised fossilifer- ous limestone and sandy Limestone | Lower Pliocene |
| Shankhodhar Sand- Clay Member (60m) | Sandy clays an sandstones | Upper Miocene |
| Positra Limestone Member (25m) | Bioclastic and coralline limestone with few dolo- mitic bands (Disconformity) | Middle Miocene |
| **Gaj Formation** | | |
| Ranjitpur Limestone Member (5m) | Yellow and brown fossiliferous limestone | Lower to Middle Miocene |
| **Deccan Trap** | Basalt and other derivatives covered at places by laterite and bauxite | Upper Cretaceous to Eocene |

## 3.0 Observations:

The present well section of the Armada Reef Member is examined to study the variation in coralline algae. Another motto of studying this sequence is to check the pattern of sea level fluctuation during the deposition of these sediments. On the basis of megascopic study and approximate percentage of corals and algae, this sequence is divided into nine units. Unit-A is represented by algal framestone (Rhodoliths), Unit-B is represented by coral framestone with minor rhodoliths, Unit-C is represented by coral framestone, Unit-D is represented by algal framestone (Rhodoliths), Unit-E is coral framestone with minor rhodoliths, Unit-F is represented by algal framestone (Rhodoliths), Unit G is coral-algal framestone, Unit-H is algal framestone with minor corals and unit I is represented by rudstone (mainly algal debris).

## 4.0 Results and Discussion:

Coralline algae are dominant component of carbonate sediments during the Cenozoic Era. Nongeniculate and geniculate corallines, the two groups of corallinaceans are widely distributed, occurred in tropical and non-tropical countries with diversified environmental conditions, making them highly noteworthy for paleo-ecological restoration. Coralline algae have also a potential as paleo-environmental and paleo-bathymetrical indicators, which are deduced by comparison of fossil algal assemblage with environmental and geographical distribution of modern algal associations.

Coralline algae occur usually from low tide level down to depth of 25 to 30m (Johnson, 1961). Littler et al., (1986) mentioned that the overall range of calcareous algae is from 0 to 270m. Adey (1979) has given the bathymetry of coralline algae. Water

turbulence controls the morphology of coralline algae and the coralline algae growing in high-energy conditions have thick crust and radial branching and coralline algae growing in moderate energy conditions have delicate framework with some branching and concentric crust (Bosence, 1991). The Neogene-Quaternary sediments of Saurashtra consists of well preserved and diversified coralline algae (Kundal and Mude, 2009a, 2009b, 2010; Mude and Kundal, 2010, 2011, 2012).

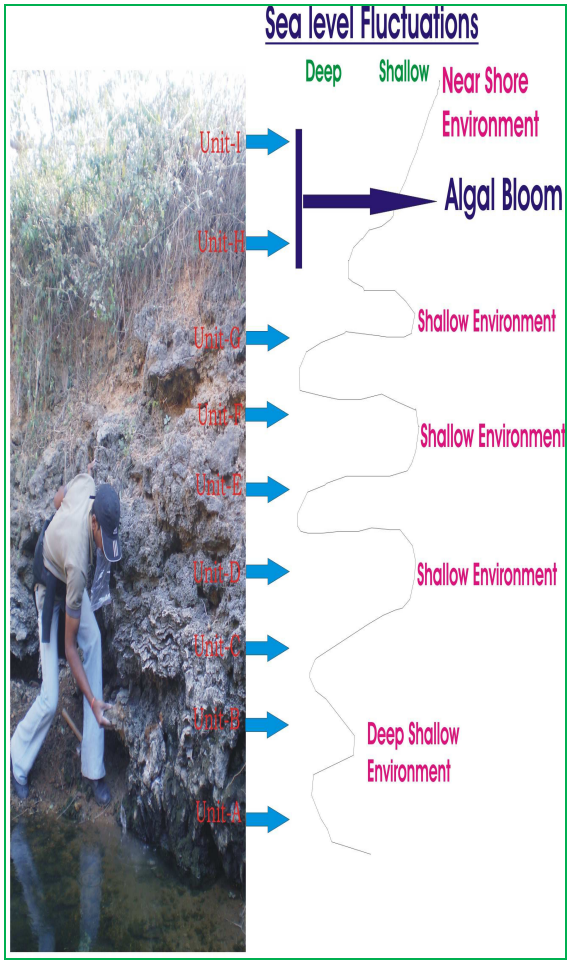
The present section of the Armada Reef Member of the Chaya Formation exposed at global co-ordinates N $22^{0}$ $20^{I}$ 46 $^{II}$ and E $69^{0}$ $01^{I}$ $05^{II}$ in a well near Mithapur village is divided into nine units from Unit-A to Unit-I in ascending order of deposition, based on megascopic study and approximate percentage of corals and algae. This sequence is significant as there are alternate presences of algal framestone (Rhodoliths). Earlier this section was divided into four units from Unit-I to Unit-IV in ascending order of deposition (Mathur and Pandey, 2002). Kundal and Dharashivkar (2005), on the basis of rhodoliths and other algal assemblages pointed out high energy conditions with turbulence for deposition of Units II and IV and low to moderate energy conditions during the deposition of Unit III of the Aramda Reef Member. In the present study, we observed that overall decrease in the percentage of corals from Unit-A to Unit-I and the percentage of coralline algae increases from Unit-A to Unit-I though Unit-A, D, F & H are algal framestones and Unit- I is rudstone. Unit-A, D, F & H are deposited in shallow water marine environment which are dominated by the presence of shallow water marine coralline algae and Unit-I was deposited in near-shore marine environment. During the nine depositional events, there was five times shallow water level and four times deep water level. Unit-I mainly composed of algal debris which clearly marks evidence of paleo-algal bloom, may be due to marine regression and addition of nutrients along with sediments at the last phase of deposition of this coral-algal reef system. This paleo-algal bloom is probable cause for the collapse of this coral-algal reef system.

## 5.0 Conclusions:

**1.** The present section is divisible into nine units based on the percentage of corals and coralline algae and they are classified as Unit-A, Unit-B, Unit-C, Unit-D, Unit-E, Unit-F, Unit-G, Unit-H and Unit-I in ascending order of the deposition.

**2.** The alternate presence of the coralline algae (rhodoliths) clearly demarked the evidences of sea level fluctuations.

**3.** During the deposition of Unit-I, there would be marine regression and more supply of nutrients which causes paleo-macro algal bloom and collapse of this coral algal reef system.




**Well Section of Armada Reef Member**

## 6.0 Acknowledgement:

The authors (SNM & PDN) are greatly thankful to the Principal, Fergusson College, Pune-4, for providing financial assistance under CPE-Research Activities to carry this work.

## References:


1) Adey, W. H. (1979): Crustose coralline algae as microenvironmental indicator for the Tertiary. *In* : Gray, J, Boucot A. J. (Eds), Historical biogeography. Oregon State Univ. Press, pp. 459-464.
2) Bhatt, N. (2000): Lithostratigraphy of Neogene-Quaternary deposits of Dwarka-Okha area, Gujarat. *Jour. Geol. Soc. India*, 55: 139-148.
3) Bosence, D. W. J. (1991): Coralline algae: Mineralisation, Taxonomy and Paleoecology; pp. 99-113. *In* Ridings, R. (ed), Calcareous Algae and Stromatolites, Springer- Verlag, New York, pp. 571.
4) Jain, R. L. (1990). Tertiary rocks of Gujarat. *Rec. Geol. Surv. India*, 123 (7) : 36-38.
5) Jain, R. L. and Agarwal, R. K**.** (1992): Tertiary rocks of Gujarat. *Rec. Geol. Surv. India*, 124(7) : 26-29.
6) Johnson, J. H. (1961):Fossil algae from Eniwetok, Funafuti and Kita-Daito-Jima, Geol. Surv. *Professional Papers* 260-2: 905-948.
7) Kundal P., and Mude, S. N. (2010): *Amphiroa*, A Geniculate Coralline Alga From Neogene-Quaternary Sediments of Porbandar Area, Gujarat, *Jour. Palae. Soc. India*, 55 (1):37-44.
8) Kundal, P. and Mude, S. N. (2009): Geniculate coralline algae from Neogene- Quaternary sediments in and around Porbandar, southwest coast of India. *Jour. Geol. Soc. India,* 74(2): 267-274.
9) Kundal, P. and Mude, S. N. (2009): Nongeniculate Coralline algae from the Lower Miocene to Late Holocene sequence of Porbandar area, Saurashtra, Western India. *Jour. Palaeo. Soc. India*. 54(1):73-80.
10) Littler, M. M., Littler, D. S., Blair, S. M. and Norris, J. N. (1986): Deep-water Communities from an uncharted seamount of San Salvador Island, Bahamas: distribution, abundance and primary productivity. *Deep-sea Research*, 33: 881-892.
11) Mathur, U. B. and Pandey, D. K.(2002) : Radiocarbon dates of corals, gastropods and foraminifers from Saurashtra peninsula, Gujarat and their implications for sea level studies. *J. Geol. Soc. India*, 60: 303–308.
12) Mude, S. N. and Kundal, P. (2012) : Additional Coralline algae from the Lower Miocene to Late Holocene Sediments of the Porbandar Group, Gujarat, *Jour. Geol. Soc. India*. 79: 69-76.
13) Mude, S. N**.** and Kundal, P. (2011): *Subterraniphyllum thomasii* Elliott*,* Fossil Calcareous Alga the evolutionary link between geniculate and nongeniculate coralline algae: A Hypothesis, *Open Journal of Geology*, *USA*, 1(3): 51-55.
14) Mude, S. N. and Kundal, P. (2010): A note on rare structure of fossil coralline algae from the southwest coast of India. *Jour. Geol. Soc. India*, 75 : 380-382.
15) Pandey, D. K., Bahadur, T. and Mathur U. B. (2007): Stratigraphic distribution and depositional environment of the Chaya Formation along the Northwestern coast of Saurashtra peninsula, Western India, *Jour. Geol. Soc. India* 69: 1215-1230.