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TWO GENICULATE CORALLINE SPECIES FROM THE OFFSHORE SEQUENCE OF THE CHHASRA FORMATION (EARLY-MIDDLE MIOCENE) KACHCHH BASIN, WESTERN INDIA

MILIND P. KUNDAL

P.G. DEPARTMENT OF GEOLOGY, RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR–440001
E-MAIL.: milind.kundal@gmail.com

ABSTRACT

Two geniculate coralline algal species, *Arthrocardia indica* Kundal and Humane and *Jania indica* Kundal and Wanjarwadkar, earlier known from the older formations (Palaeocene and Eocene) of the Middle Andaman and the Kachchh Basin, are recorded from the early-middle Miocene Chhasra Formation of the Kachchh Basin (offshore sequence), western India. These species occur in association with three dasycladalean algal species, *Broeckella baratangensis* Badve and Kundal, *Neomeris arenularia* Morellet and *Pagodaporella wetzeli* Elliott. Based on this association, it is inferred that the studied core sequence of the Chhasra Formation in the offshore as deposited in the inner-shelf environment at 10-12m depth in low- energy conditions.

Keywords: Geniculate coralline algae, Miocene, Kachchh Basin, western India

INTRODUCTION

The early-middle Miocene Chhasra Formation consisting of alternations of fossiliferous limestone bands and oolitic gypseous claystone/silty clay bed is found both in the onshore and the offshore portions of the Kachchh Basin. This is known to have been deposited in the marginal marine to shallow inner-shelf environment (Biswas, 1992; Mishra, 2009). This formation is rich in calcareous algae as up to now 28 species have been known from the onshore portion (Kundal and Humane 2002, 2003, 2006a,b, 2007; Humane and Kundal 2005, 2010; Humane *et al.* 2006), and 18 species known from the offshore portion (Kundal, 2015; Kundal *et al.*, 2015a,b). The object of the present paper is to record two species of geniculate coralline algae from the Chhasra Formation of the Kachchh Basin (offshore part), earlier reported from the older geological sequences of India.

The Kachchh Basin, the westernmost pericratonic rift basin, is situated at the northern end of the western seaboard of India and this basin represents the earliest rift during the break up of Africa and India (Biswas, 1982) (Fig. 1). The Cenozoic offshore sequence of the Kachchh Basin is subdivided into eight formations, namely, Nakhtarana Formation (late Palaeocene), Jakhau Formation (early Eocene), Fulra Limestone Formation (late middle Eocene), Sir Formation (middle to late Eocene), Tuna Formation (early Oligocene), Narayan Sarovar Formation (early Miocene), Godhra Formation (early Miocene), Mitti Nadi Formation (early Miocene), Chhasra Formation (early middle Miocene) and Kandla Formation (middle Miocene to Recent) (Mishra, 2009).

MATERIAL AND METHODS

The samples from two, 2 m and 5 m, cores belonging to the Chhasra Formation were collected from the Regional Geosciences Laboratory, Oil and Natural Gas Corporation Ltd., Panvel, Navi Mumbai. Kundal (2014b) assigned an early-middle Miocene age to these cores based on the presence of two foraminiferal species, *Austrotrillina howchini* and *Pseudotaberina malabarica*. The samples from these cores have also yielded four bryozoan species, viz. ?*Margaretta* sp., *Vincularia* sp., *Steginoporella* sp and ?*Thalamoporella* sp. (Kundal, 2014c).

Arthrocardia indica Kundal and Humane was observed in sample C2 from GK-28-3 (22°30'N: 68°23'E) (depth 739 to 741m), while *Jania indica* Kundal and Wanjarwadkar was found in the sample C7 from GK-1-1 (22°50'N: 68°09'E) (Fig. 2) (depth 1009 to 1011m). Petrographically, the limestone of the well GK-28-3 is a foram- algal packstone and that of GK-1-1 is the foram algal grainstone.

SYSTEMATIC TAXONOMY

Division **Rhodophyta** Wittstein, 1901
Class **Florideophyceae** Cronquist, 1960
Subclass **Corallinophycidae** Le Gall and Saunders, 2007
Order **Corallinales** Silva and Johansen, 1986
Family **Corallinaceae** Lamouroux, 1812
Subfamily **Corallinoideae** Gray, 1821
Genus ***Arthrocardia*** Decaisne emend. Areschoug, 1852

Arthrocardia indica Kundal and Humane, 2002
(Pl. I, figs. 2, 3)

Arthrocardia indica Kundal and Humane: Kundal and Humane, 2002, p. 95. Kishore *et al.*, 2009, p. 192.

Material: Specimen Nos. PGTDG/MF/FCA/710 and 711.

Dimensions (in μm):

	Specimen Number 710	Specimen Number 711
Length of Segment	780	1245
Width of segment	300	208
Number of tiers	8	20
Thickness of Core region	300	67-83
Length of Core cell	90	16-8
Width of Core cell	20	8-16

Description: Intergenicula cylindrical. Cell rows of core region join regularly and more or less flattened. Cell fusions present. Conceptacle not preserved.

Remarks: The present specimens have similar length and width of core cell as that of *Arthrocardia indica* Kundal and Humane. Therefore, the present specimens are described as *Arthrocardia indica* Kundal and Humane.

Stratigraphical and Geographical distribution: Middle Eocene Fulra Limestone Formation, onshore portion of Kachchh Basin, Gujarat (Kundal and Humane, 2002) and middle to late Eocene Prang Formation, Jaintia Hills, Meghalaya (Kishore *et al.,* 2009).

Horizon and Locality: Chhasra Formation (early middle Miocene) of well GK-28-3 from the Kachchh Offshore Basin.

Genus Jania Lamouroux, 1812

Jania indica Kundal and Wanjarwadkar, 2000

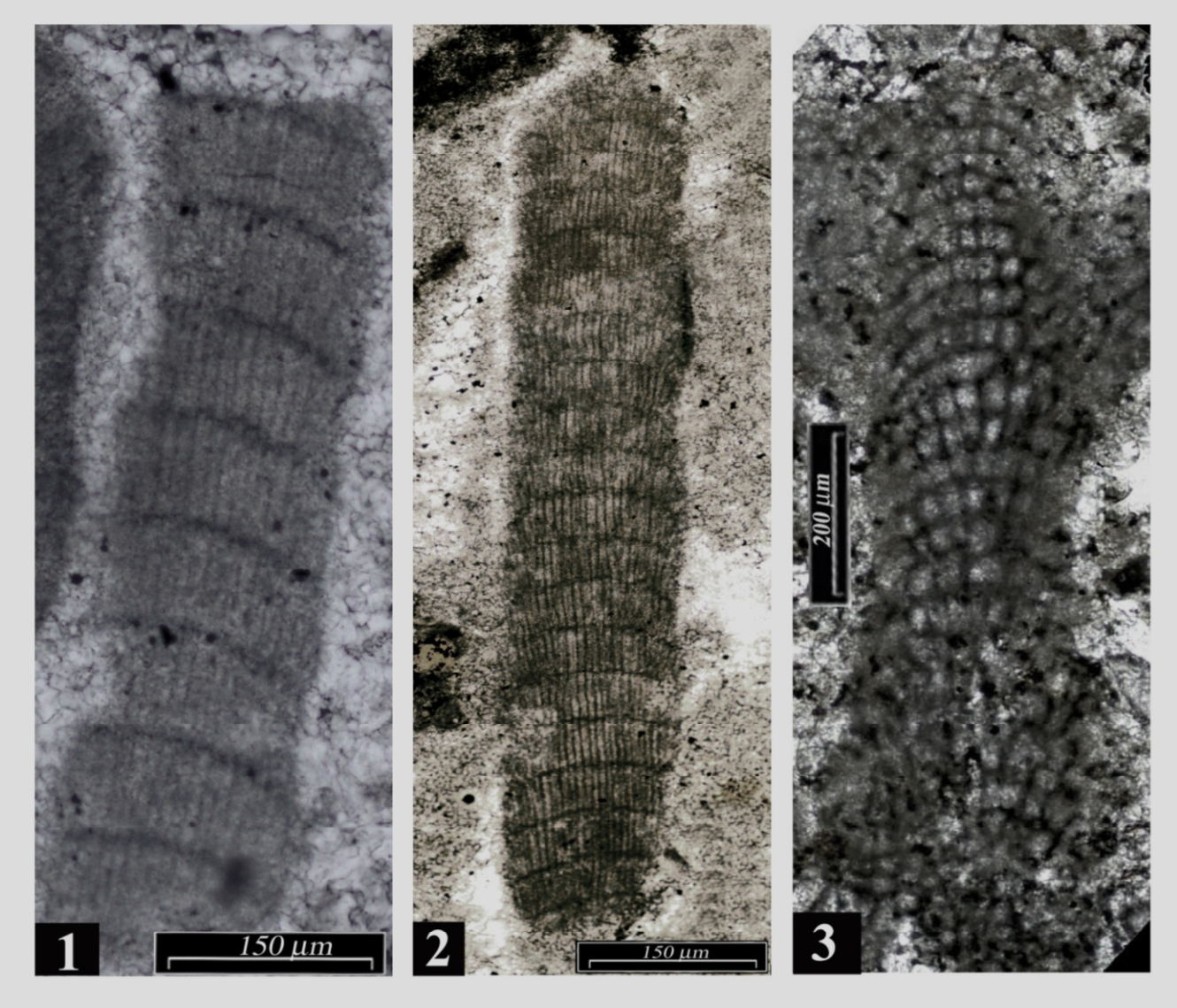
(Pl. I, fig. 3)

Jania indica Kundal and Wanjarwadkar: Kundal and Wanjarwadkar, 2000, p.231.

Material: Specimen Nos. PGTDG/MF/FCA/761.

Dimensions (in µm):

Length of Segment	1020
Width of segment	210-325
Thickness of Core region	130-245
Length of Core cell	21-35
Width of Core cell	14-24



EXPLANATION OF PLATE I

Fig. 1: *Arthrocardia indica* Kundal and Humane Sp. No. PGTDG/MF/FCA/710: Cylindrical intergeniculum in which rows of core region join regularly from early middle Miocene Chhasra Formation. (Well GK-28-3: Sample C2); 2. *Arthrocardia indica* Kundal and Humane Sp. No. PGTDG/MF/FCA/711: Cylindrical intergeniculum in which cell rows of core region join regularly from early middle Miocene Chhasra Formation. (Well GK-28-3:Sample C2); 3. *Jania indica* Kundal and Wanjarwadkar Sp. No. PGTDG/MF/FCA/761: Cylindrical branched intergeniculum with wedge shaped cell which join irregularly and cell fusions from early middle Miocene Chhasra Formation. (Well GK-1-1:Sample C7).

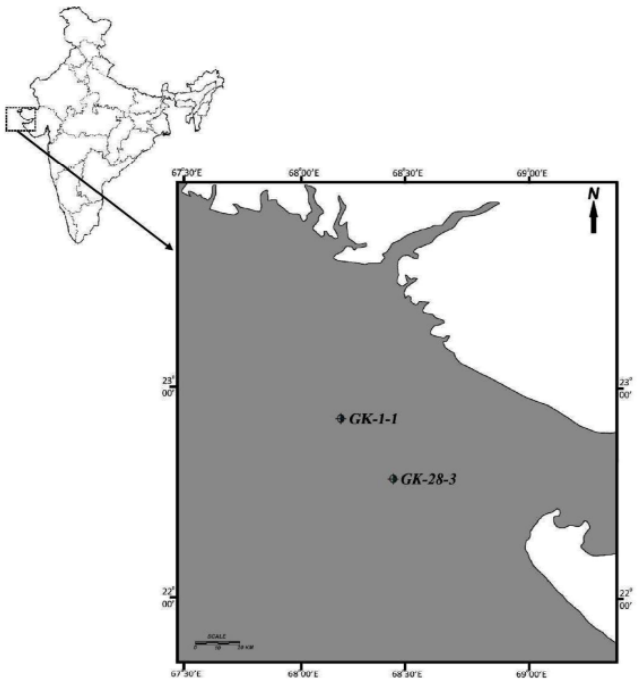


Fig. 1. Location map of the Kachchh Offshore Basin.

Description: Intergeniculum cylindrical and branched dichotomously. Core region consisting of wedge shaped cells which join irregularly. Peripheral region thin and poorly preserved. Conceptacle absent.

Remarks: The present specimen shows dichotomous branching, similar length and width of core cells as that of *Jania indica* Kundal and Wanjarwadkar. Hence, the present specimen is described under *Jania indica* Kundal and Wanjarwadkar.

Stratigraphical and Geographical distribution: Late Palaeocene of Middle Andaman, India (Kundal and Wanjarwadkar, 2000).

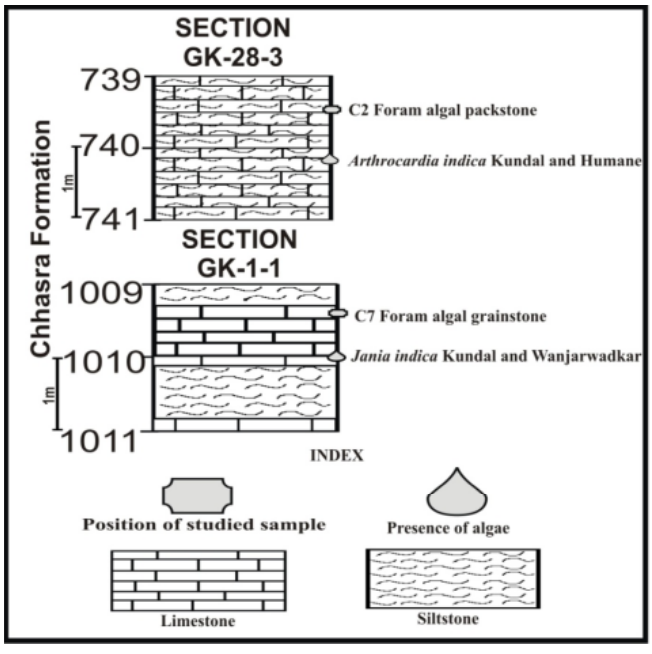


Fig. 2. Lithosection of Wells GK-28-3 and GK-1-1.

Horizon and Locality: Chhasra Formation (early middle Miocene) of well GK-1-1 from the Kachchh Offshore Basin.

CONCLUDING REMARKS

Two geniculate coralline algal species, *Arthrocardia indica* Kundal and Humane and *Jania indica* Kundal and Wanjarwadkar, are presently recorded from the two, 2 m and 2 m, cores of the Chhasra Formation in the offshore part of the Kachchh Basin, western India. The present report extends the geological range of these species to early-middle Miocene and their geographic range to the offshore part of the Kachchh Basin, western India. These species occur in association with three dasycladalean algal species, *Broeckella baratangensis* Badve and Kundal, *Neomeris arenularia* Morellet and *Pagodaporella wetzeli* Elliott recorded by Kundal *et al*. (2015b). The Chhasra Formation in the offshore part is inferred to have been deposited in the low-energy inner-shelf environment at 10-12m depths.

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