



PALAEOECOLOGICAL SIGNIFICANCE OF TURRITELLINE DOMINATED GASTROPOD ASSEMBLAGE FROM THE INFRATRAPPEAN BEDS OF THE RAJAHMUNDRY AREA, ANDHRA PRADESH

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ABSTRACT

A molluscan fauna dominated principally by the large *Turritellina* (referred to as *Turritella* Lamarck, 1799) gastropods occurs in thick Infratrappean beds of Doddukuru along with *Volutomorpha* (Gabb, 1877) and bivalves such as *Venericardia* (Lamarck, 1801), *Cardium* (Linnaeus, 1758), *Glycymeris* (Da Costa, 1778) and *Tellina* (Linne, 1758). They are found in the Soma quarry near Gowripatnam and also in the Tadapudi canal section where blocks of sandy limestone (Infratrappean beds) dredged from the bottom of a canal, contain abundant *Turritellines*. High density of *Turritellines* indicates shallow shelf environment with well-oxygenated conditions below wave base. This is the first report of such an assemblage from the Infratrappean beds of east coast of India; their palaeogeographic and palaeoecological significance is also discussed.

Keywords: Palaeoecology, *Turritella*, Infratrappean, Rajahmundry, Andhra Pradesh

INTRODUCTION

The Infratrappean limestone bed of Doddukuru contains abundant, well-preserved turritelline gastropod. Among the various biotic groups, turritellines constitute the major component of this unit, providing useful information about palaeoenvironment and palaeogeography of the study area. *Turritellina* gastropods belong to the family *Turritellidae*, subfamily *Turritellinae*; Marwick, 1957 and are common components of many Cretaceous to Recent benthic marine assemblages worldwide. They are frequently the dominant or even the sole macrofossil constituent of such assemblages termed the “*Turritellina-dominated assemblages*” (TDAs; Allmon, 1988; Allmon and Knight, 1993). They are defined as macrofaunal assemblages in which turritelline gastropods: 1) comprise either at least 20% of the total actual or estimated biomass or at least 20% of the macroscopic individuals in the assemblage and 2) are at least twice as abundant as any other macroscopic species in the assemblage (Allmon and Harris, 2008). TDAs have been widely reported from siliciclastic and carbonate sediments of the U.S. Gulf and Atlantic Coastal Plains. turritelline dominated limestones sometimes referred to as “*Turritella Limestone* or *Turritella Bed*” appear to be limited to the Cretaceous and Palaeogene successions (Allmon and Knight, 1993).

Molluscan fauna dominated principally by the large turritelline gastropods occurs along with *Volutomorpha* sp. and bivalves such as *Venericardia*, *Cardium*, *Glycymeris* and *Tellina* sp. (Pl. I, fig. f; Pl. II, figs. a-f) which are the next commonly occurring forms in the thick Infratrappean beds of Doddukuru crowded with individuals found in the Soma quarry near Gowripatnam (Lat. 17°02'20" N; Long. 81°38'20" E) and also in the Tadapudi canal quarry section (Lat. 17°01'25" N; Long. 81°33'52" E). The blocks of the sandy limestone (Infratrappean beds) dredged from the bottom of the canal section contain abundant well-preserved turritellines. They are the sole macrofossil taxon and can make up as much as 98% of the visible individuals (Pl. I, fig. f). This is the first

report of such an assemblage from the Infratrappean beds of east coast of India.

GEOLOGICAL SETTING

The present study of the turritelline-dominated gastropod assemblage was carried out from the Infratrappean beds of the Soma quarry near the Gowripatnam and the Tadapudi canal quarry section of the Rajahmundry area, which is situated in the west Godavari district of Andhra Pradesh (Fig. 1). The Infratrappean beds occur as the scattered patches below the Deccan traps and dip southeast at 4°–6°. It is clearly seen on the west bank as well as east bank of Godavari River and has been traced for a distance of 10 km with <1 km width. It is cream to light-colored, fine to coarse-grained friable limestone. There is approximately 50 m of trap overburden on the infratrappeans. The junction between the infratrappean and the overlying trap is clearly seen (Pl. I, fig. a). Overlying the flows are the intertrappean beds varying in thickness from 0.61 to 9.14 m (Pl. I, fig. a). There is again approximately 30 to 46 m of trap overburden on the intertrappean (Bhalla, 1967). Overlying the flows are the Mio-Pliocene fluvial sediments in the western margin of the basin known as the Rajahmundry Sandstone, which consists of sandstones and clays. The maximum thickness of the Rajahmundry sandstone is estimated to be about 300 m (Prasad and Pundir, 1999).

PALAEOECOLOGY

The *Turritellina* species usually live in waters considerably less than 30 m deep, are most abundant in relatively shallow cool water and have frequently been used as palaeoenvironmental indicators (Allmon and Knight, 1993). The palaeoenvironmental distribution of turritelline-dominated assemblages in the entire history of the group shows that they have occurred in siliciclastic and only in the warm water carbonate environments particularly in the Cretaceous and Palaeogene periods. Although they are ecologically somewhat heterogeneous, the Recent turritellines are most abundant in cooler waters, commonly associated with upwelling areas and

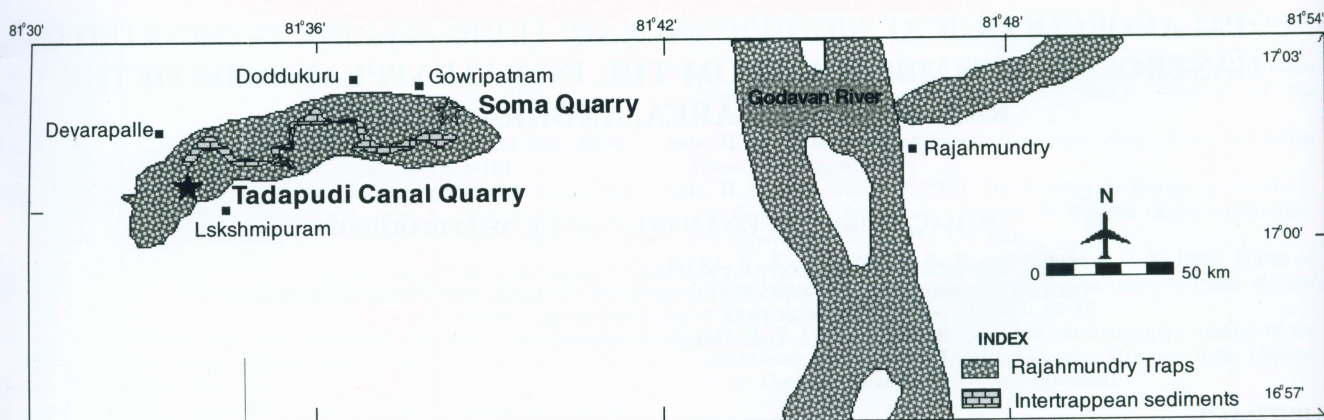


Fig. 1. Surface Exposures of the Rajahmundry Traps and Intertrappean sediments with locations of section studied (Modified after Knight et al., 2003).

are rare in warm water carbonate environments (Allmon, 1988). Whether this has been the case throughout their history, however, is not clear (Allmon, 1992). Some Palaeogene forms live in true carbonate environments and warmer water conditions (Wilson, 1975) and this pattern of occurrence of *Turritella* may indicate that at least some species of the group were more thermophilic in the Palaeogene than are most species today. The presence of turritelline-dominated assemblages in the carbonate environment of Cretaceous age reflects the actual environmental preference of the group during that time and it seems that the thermal tolerance of the group has changed over its history, from more thermophilic earlier to less so later (Allmon, 1992). Cretaceous oceans were almost certainly warmer than Cenozoic oceans and upwelling was probably less common during much of the Cenozoic. High turritelline density in the Cretaceous may therefore have resulted from somewhat different set of environmental conditions from those of today (i.e. cool temperature and high nutrients). The ecological data on *Turritella* suggests that it is essentially a marine genus (Gardner, 1957) and is generally found at shallow depths characterized by well-oxygenated conditions, high nutrients, nearshore, warm sandy bottoms (Plummer, 1933). *Venericardia*, *Cardium*, *Glycymeris* and *Tellina* species are marine bivalves occurring in association with *Turritella* in shallow approximately normal marine waters.

DISCUSSION

The present investigation has revealed the presence of abundant turritelline-dominated gastropod assemblage reported for the first time from the Infratrappean beds of the Doddukuru area. The palaeobiogeographical distribution of the turritelline species recorded from the Doddukuru Infratrappean indicates that all these species occur extensively

in the Cretaceous–Palaeocene sediments of the different parts of the world (Allmon, 1993; Allmon and Harris, 2008; Ward and Waller, 1988).

The family *Turritellidae* comprises one of the dominant groups of gastropods in the Tertiary deposits of the Atlantic and Gulf coastal plain. Unlike some of the dominant molluscan groups of the Eocene, the turritellines had already become well-established members of the coastal faunas before the close of the Cretaceous. turritelline gastropod-dominated assemblages are reported from the mid-Cretaceous (Albian–Cenomanian) of Texas and Oklahoma (Hobday and Mortan, 1984; Scott, 1974). Forms closely related to or identical with that taxon have been found in the Upper Palaeocene deposits in South Carolina (Allmon, 1993) at Wilsons Landing on the Santee River and North Carolina (Allmon and Harris, 2008). *Turritella mortoni* also occurs in Alabama where it ranges from the Nanafalia Formation (Palaeocene) to the Bell Landing Marl Member of the Tusahoma Formation (Upper Palaeocene). *Turritella humerosa*, another common taxon in the Paspotansa (late Palaeocene) is found in the Nanafalia and Tusahoma Formations (Ward and Waller, 1988). Several molluscs present are also found in the Upper Palaeocene beds from Maryland to Alabama (Ward and Waller, 1988). They show close resemblance with our material. The bivalves such as *Venericardia*, *Glycymeris* and *Cardium* sp. are known from the Eocene (Griffin, 1951) and *Volutomorpha* sp. are known from the Ripley Formation, Cretaceous (Harbison, 1945) and also the Lower Maastrichtian sediments of the Mexicala Formation of southern Mexico (Perrilliat et al., 2000). They have also been recorded from the Infratrappean beds of the Rajahmundry area. The present turritelline-dominated gastropod assemblage can be correlated with the Cretaceous–Palaeocene sediments of U.S. Gulf and Atlantic Coastal Plains on the basis of similarity.

EXPLANATION OF PLATE I

Field photographs of Infratrappean beds of Rajahmundry area, Andhra Pradesh.

- Contact between Infratrappean bed and the overlying trap rock of Gowripatnam quarry section.
- Turritella* bed (MFS) in the Infratrappean beds of Gowripatnam quarry section.
- Infratrappean beds and the Trap rock in Tadapudi canal quarry section.
- Turritella* bed (MFS) and overlying trap in the Tadapudi canal quarry section.
- Turritella* bed in the Infratrappean beds of the Tadapudi canal quarry section.
- Turritella*-dominated gastropod assemblages.



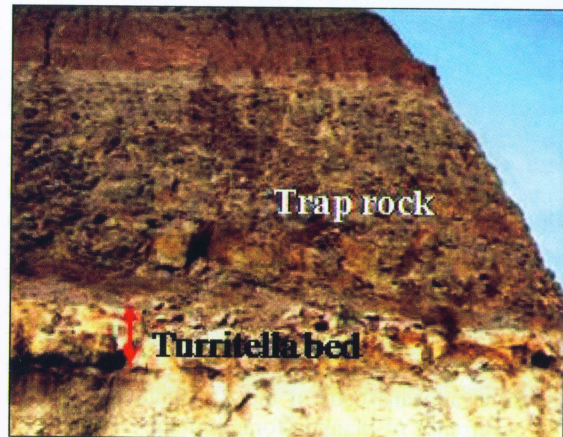
a



b



c



d



e



f

Based on abundant occurrence of *Turritella* sp., it is concluded that it is essentially a marine genus generally found in shallow depth with well-oxygenated conditions, high nutrients and warm-water nearshore sandy bottom environment. Marine incursion (Bastia, 2007) occurred in the Cretaceous which was followed by Deccan volcanism. During the Late Maastrichtian prior to the deposition of the lower Rajahmundry trap in the Krishna-Godavari Basin, sea level receded by about 50 km (Raju *et al.*, 1994). These sea level changes largely reflect local uplift and subsidence associated with Deccan volcanism (Saunders *et al.*, 2007; Jay and Widdowson, 2008; Keller *et al.*, 2008). The exposed sedimentary sequences are marine successions of Late Maastrichtian to early Danian in age (Keller *et al.*, 2008). Abundance of megafossil assemblage and their frequency and preservation in the upper fossiliferous limestone unit indicate a gradual upward increase in bathymetry. The abundant megafauna suggests their full-life mortality in a tranquil environment, generally observed during standstill conditions occurring in maximum flooding event. The acme of *Turritella* in this sequence represents an ideal Maximum Flooding Surface (MFS). This surface constructs the maximum landward extent of marine flooding. The MFS is clearly exhibited in the Gowripatnam quarry section (Pl. I, fig. b) and in the Tadapudi canal quarry section (Pl. I, figs. c-e) of Doddukuru Infratrappeans. Good age control can be obtained for the Intertrappean beds from the planktic foraminiferal assemblages (Keller, *et al.*, 2008). Based on the occurrence of planktic foraminifera, the sediment below the lowermost lava flows indicate deposition sometime during the latest Maastrichtian (Jaiprakash *et al.*, 1993). Reworked Late Maastrichtian species occur in the Intertrappean beds also and suggest that the reworked species were probably derived from the erosion of the Late Maastrichtian limestone (Infratrappean beds) that were deposited before the arrival of the lower trap lava flows (Keller *et al.*, 2008). Late Maastrichtian age has been assigned to the Doddukuru Infratrappeans beds of the Rajahmundry area on the basis of occurrence of planktic foraminifera.

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EXPLANATION OF PLATE II

Field photographs of Infratrappean beds of Rajahmundry area, Andhra Pradesh.

- Venericardia* sp., occurs with *Turritella* sp., in the Infratrappeans of Tadapudi canal quarry.
- Cardium* sp., seen in association with *Turritella* sp., in the Infratrappean beds of Gowripatnam quarry.
- Volutomorpha* sp., occurs along with *Turritella* sp., in the Infratrappean beds of Tadapudi canal quarry.

- ?Pseudoaluc* sp., occurs in association with *Turritella* sp., in the Infratrappean beds.
- Volutomorpha* sp., occurs along with *Turritella* sp., in the Infratrappean beds of Tadapudi canal quarry.
- Glycymeris* sp., occurs along with *Turritella* sp., in the Infratrappean beds of Gowripatnam quarry.



a



b



c



d



e



f

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