

ECOLOGICAL REGIMEN AND DISTRIBUTION OF *VIRGULINELLA* SPP. IN THE INSHORE SEDIMENTS OF WESTERN INDIA

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ABSTRACT

Nigam, R. and Setty, M. G. A. P., 1982. Ecological regimen and distribution of *Virgulinema* spp. in the inshore sediments of western India. *Palaeogeogr., Palaeoclimatol., Palaeoecol.*, 38: 57–61.

Virgulinema Cushman, 1932 was distinguished as a subgenus from *Virgulina* d'Orbigny, 1826 (non *Virgulina* Bory, 1823 = *Fursenkoina*) on the basis of the development of numerous small arched sutural openings alternating with bridges formed by basal chamber walls. In the region of the Dabhol–Mangalore sector of western India, *V. gunteri* and *V. pertusa* are encountered predominantly at 10–60 m in clayey-silts, with moderate occurrence in silty-clay substrates. They thin out north and south of this region to disappear completely south of Cochin. A few transparent specimens containing minute spherules of pyrites also have pores in the test wall, whereas some others are mottled or opaque and thick-walled, while the majority are transparent, thin-walled and exceedingly fragile. *Virgulinema* abundance correlates very closely with *Bulimina exilis* in both living and dead populations. Nature of the substrate, depth range, temperature and percentage of organic carbon content in the sediment are considered to be the main factors critical to the growth and development of *Virgulinema*. This is the first report of *V. pertusa* in Indian waters.

INTRODUCTION

As part of an oceanographic survey under the project "Distribution, ecology and significance of foraminiferal fauna on the Continental margin of west coast of India", several surficial sediment and core samples have been collected on board RV *Gaveshani* and also by a few smaller boats since 1977.

More than 200 species of foraminifera were identified from these sediments. *Virgulinema* was represented by three species, *V. pertusa*, *V. gunteri* and *V. sp.*

Virgulinema is reported from the Miocene of Germany, The Netherlands, Italy, Algeria and Egypt; and Miocene and Pliocene of Belgium, California and Indonesia (Loeblich and Tappan, 1964). It is also described from the Miocene of Maryland, Florida, Louisiana and southwestern United States (Todd and Bronnimann, 1957).

Transparent and exceedingly fragile species of *Virgulinea* are reported from the Recent offshore surface sediments of Peru, Gulf of Paria (Todd and Bronnimann, 1957), and Cariaco Gulf, South America (Bermudez and Seiglie, 1963), Baie de Levrie, West Africa by Lutze (quoted in Siebold, 1975). However, no detailed report on the distribution and ecology of *Virgulinea* is available.

INDIAN OCCURRENCE

Setty and Nigam (1980) reported excentricity in the size and shape of the last three chambers and also a case of twinning in *Virgulinea* recovered from the shelf sediments (24–37 m depth) of Ratnagiri, Western India. A very small percentage of living specimens were also reported from this area. Tests of living specimens were fresh, transparent and fragile (at the time of collection). Some dead tests found have infillings of (1) very fine, powdery, greenish gray clayey material with metallic lustre (glauconite); (2) small rounded grains of pyrite, or (3) stains of brown or reddish-brown iron oxide (big patches somewhat localised or distributed irregularly). Specimens with the filling have a muddy appearance, and reflection of metallic lustre from inside the transparent test wall, gives a pearly/opaline/schillerization effect in transmitted light.

The presence of spherules of pyrite gives the impression of pores in the test wall.

A few specimens with opaque, milky white and thick walls also occur with the thin-walled, transparent and fragile forms.

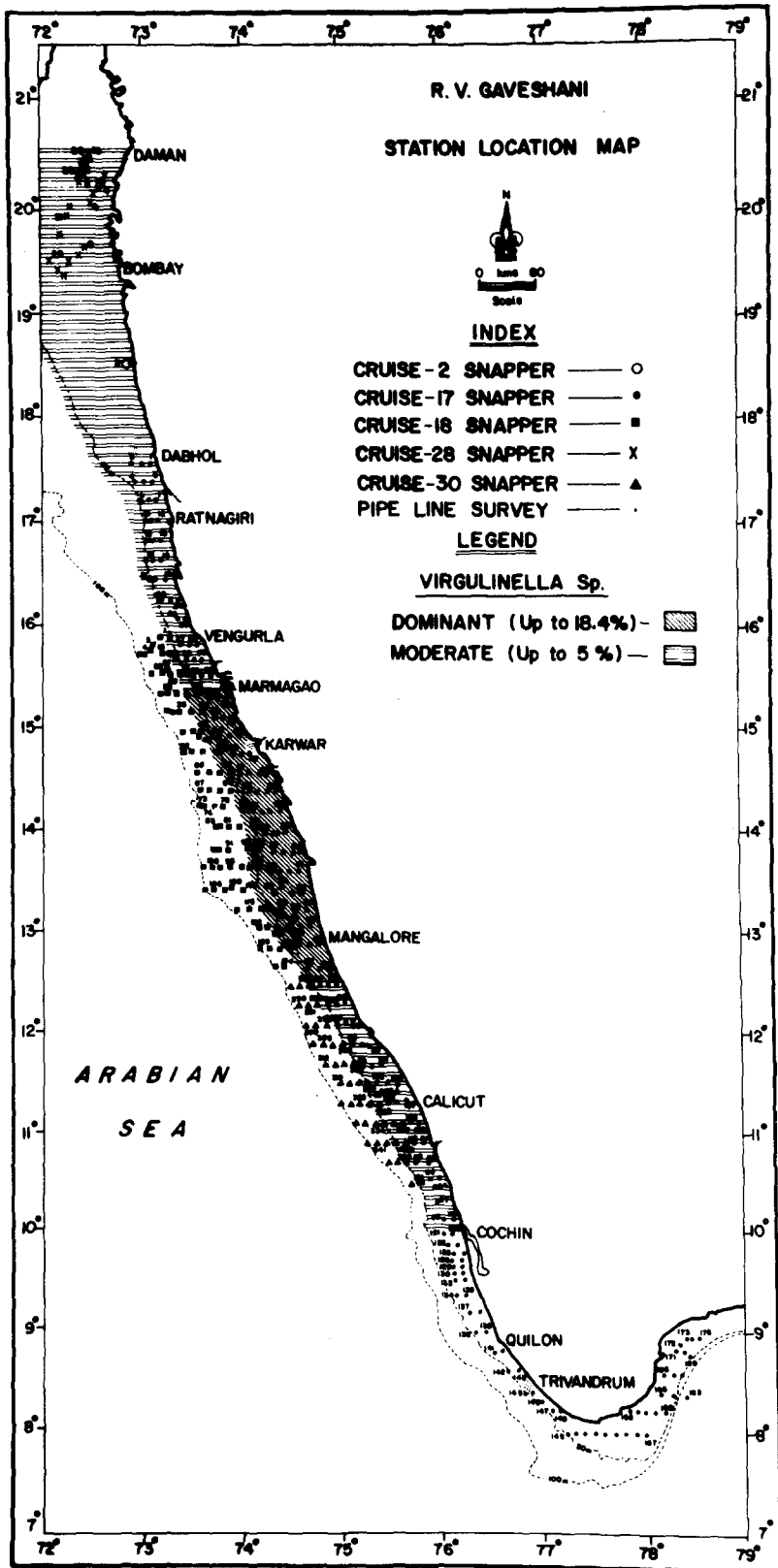
Further investigations on the shelf sediments of the entire western Indian continental shelf revealed their general pattern of distribution. In surface sediment samples collected from 372 stations from the shelf off Daman in the north of Kanyakumari in the south, from a depth range of 2.5 to 100 m (Fig.1), *Virgulinea* was restricted to a depth range of 10–60 m. Its maximum occurrence (18.4%) was in clayey-silts (Sta. no. 37 at a depth of 38 m off Marmagoa) while a moderate occurrence of 5% was found in silty-clay substrates. Very fine grained sands rarely contained a few specimens.

Geographically, the predominant distribution of *Virgulinea* is in the near-shore of the central west coast, in the Dabhol–Mangalore sector. It thins out north and south of this region and disappears completely to the south of Cochin. The east coast shelf is completely devoid of this species.

DISCUSSION

Among others, *Virgulinea pertusa* appears to be one of the most prolific and dominating species in the central west coastal shelf. *V. gunteri* is

Fig. 1. General pattern of distribution of *Virgulinea* spp. in the surface sediments of western Indian continental shelf — from Daman in the north of Cochin in the south.



described from Cochin (Siebold, 1975) and Lutze (in Siebold, 1975) reported it from west Africa. Zobell (1973) reported the occurrence of *Virgulinea* sp. from one station at 43 m depth off Marmagoa. On comparison with the illustration (Zobell, 1973, pl.II, 8–9), the present authors believe that it is a *V. pertusa*.

V. pertusa is present in 25–35.5 m deep clayey-silts with an organic carbon content of 1.104% off the Bombay–Daman area. Its density in the total foraminiferal fauna is very low (0.05%) but sporadic, and it is not found at all stations. However, its percentage increases further south, (Dabhol–Vengurla sector) to 5%. *V. gunteri* is also present (0.09%) along with *V. pertusa* in the 22–37 m depth range in sediments with organic carbon contents of 2.94%. Further south, in the region of Vengurla–Marmagoa to Mangalore, *V. pertusa* increases to 15% with *V. gunteri* rising to 3.4% at 38 m depth (sta. no. 37) where organic carbon content is 3.22%. *V. pertusa* (6.1%) is encountered along the Karwar coast with *V. gunteri* (1.33%) at a 10.6–11.8 m depth range with organic carbon contents of 3.58% (sta. nos. 22 and 24). *V. pertusa* decreases, however, drastically to 5% (at sta. nos. 98 at 47 m depth) in the Mangalore–Cochin sector. *V. gunteri* (which is usually low in number when compared to *V. pertusa*) is further reduced to 0.09% (at sta. 118 at 37 m depth). Beyond Cochin to the south, neither *V. pertusa* nor *V. gunteri* are noticed where the substrate tends to be mostly sandy and the organic carbon content becomes very low.

V. pertusa is found living in the shelf of the Ratnagiri sector and is prolific in the Dabhol–Mangalore region. The organic carbon content (1.104 to 3.58%) in the sediment and the bottom temperature (sediment–water interface) of 27.9 to 30.5°C seem to be conducive for the growth of *Virgulinea* in the Dabhol–Mangalore sector where it is dominant. However, if the organic carbon content increases beyond 4%, it disappears.

The transparent, clean and empty, thin walled test of *Virgulinea* (in spite of its morphological variability) gives a sort of cracked reflection from its surface instead of a homogenous, hyaline or glassy lustred surface. This may be due to accretion of tiny crystalline calcite grains and the interspaces between them as the organism secretes CaCO_3 from the sea water.

A few transparent specimens which contain minute spherules of pyrite show pores in the test walls. These pores are large and are sparsely distributed in the chamber walls irrespective of the nature of the filling. Todd (personal communication) is of the opinion that they may have been formed by predatory action, rather than being specific or generic variations characteristic of the species. It is also possible that the “pores” are (a) only reflections of the infilled pyrite grains (could be mistaken for pores) through the transparent wall, and are as numerous as the spherules which are sticking all along the walls. On breaking and spilling of the contents, (b) the test wall should appear clean and very clear (without the pores); but, this is not the case. The broken walls do exhibit such pores. Further investigation is necessary as there is no earlier mention of types of *Virgulinea* with pores in the literature.

Mineral spherules are occasionally observed inside the chamber walls of various kinds of foraminifera that have been lying empty on the sea floor over a period of time (Todd, personal communication).

Virgulinea coexists with *Bulimina exilis* but strangely it also disappears if *B. exilis* decreases and disappears; but if *B. exilis* becomes very low (rare), *Virgulinea* will be totally absent and if *B. exilis* is high it is also present. These two taxa may have a similar habitat preference.

It is concluded that nature of the substrate, depth range, temperature and percentage of organic carbon content in the sediment are the main factors critical to the growth and development of *Virgulinea*. The close association with *B. exilis* is a further index to the presence or absence of *Virgulinea*.

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