

Terebella lapilloides Münster, 1833 from the Upper Jurassic–Lower Cretaceous İnalıtı carbonates, northern Turkey: its taxonomic position and paleoenvironmental-paleoecological significance

Mustafa Yücel KAYA*, Demir ALTINER

Department of Geological Engineering, Middle East Technical University, Ankara, Turkey

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Abstract: The agglutinating annelid *Terebella lapilloides* Münster, 1833 is commonly encountered in reefal deposits from the Late Jurassic. This annelid is described and documented for the first time from the Upper Jurassic–Lower Cretaceous carbonates of the İnalıtı Formation in the Central Pontides, Turkey. The whole İnalıtı formation, 395 m in thickness, was studied near Bürnük village and 105 samples were collected along the section. The investigated thin sections reveal the shallow water and the reefal/fore-reefal character of the carbonates with coral-sponge frame-builders. The bioconstituents are accompanied by various microencrusters and microproblematica (such as *Lithocodium aggregatum*, *Bacinella*-type structures, *Koskinobullina socialis*, *Radiomura cautica*, *Perturbatacrusta leini*, *Thaumatoporella parvovesiculifera*, and encrusting sponges and bryozoans), boring bivalves, annelids (serpulids and terebellids), echinoids, rare benthic foraminifera, and abundant *Crescentiella morronensis*. Rare occurrences of calpionellids – particularly in the upper levels of the section – are also observed. The morphological analysis clearly indicates that the *Terebella lapilloides* population belongs to the agglutinated annelids, which are classified under the phylum Annelida, class Polychaeta, and order Terebellida. *Terebella lapilloides* is a typical marker of fore-reef to upper slope or toe of slope breccia facies and is generally found in low-energy settings with dysoxic conditions. In some levels of the studied section, *Terebella* and *Crescentiella* form an in situ association; however, *Terebella* never cooccurs with other microencrusters.

Key words: Annelid, polychaete, Upper Jurassic, Lower Cretaceous, İnalıtı Formation

1. Introduction

The basic types of Jurassic reefs can be grouped into 3 categories according to their paleogeographic setting and the composition of the biota as coral reefs, siliceous sponge reefs, and pure microbialite reefs (Leinfelder, 2001). There exists a great variety of transitional forms between these major categories (Leinfelder, 2001). Additionally, the occurrence of various types of bivalve reefs and red algal reefs from the Jurassic times was also reported (Leinfelder et al., 2002). Apart from the reef categories included in Leinfelder's classification, Schlagintweit and Gawlick (2008) described microencruster-cement boundstones as a separate reef type from the Northern Calcareous Alps of Austria. Displaying many similarities with these carbonate deposits of the Intra-Tethyan domain, coral-microbial-microencruster reefs were also documented from the southern Intra-Tethyan domain by Pleş et al. (2013). During the Late Jurassic, when one of the largest reefal expansions of the Phanerozoic occurred (Wood,

1999; Kiessling, 2002), mixed coral-sponge reefs were widespread on the isolated Intra-Tethys platform margins, whereas that mixing was rare on North Tethys/North Atlantic shelves due to the predomination of corals over sponges (Leinfelder, 2001).

Colonial scleractinian corals and siliceous sponges with a rigid skeleton were the prevailing reef building metazoans of the Jurassic with occasional contribution from coralline sponges (e.g., stromatoporoids) (Leinfelder et al., 1994). These framebuilders were accompanied by diverse encrusting, boring, and free-living benthic metazoans as well as free-growing or encrusting algae or algal-type organisms, which are generally problematic in systematic position (Leinfelder et al., 1993b, 1994). Among these organisms, some have great importance for the paleoenvironmental/paleoecological interpretations (e.g., for bathymetry, hydrodynamics, sedimentation rate, and oxygen content). The agglutinating annelid *Terebella lapilloides* Münster is one of those accompanying

* Correspondence: mykaya@metu.edu.tr

microencrusters and has been commonly encountered in reefal deposits from the Late Jurassic times. This agglutinating worm, in association with the other reefal biota, is detected in several samples of Upper Jurassic–Lower Cretaceous carbonates of the İnalıtı Formation in northern Turkey. This paper primarily aims to document the discovery of *Terebella lapilloides* in Turkey and provide its taxonomical analysis. In the following paragraphs, we emphasize its diagnostic significance for the paleoenvironmental/paleoecological interpretations by reviewing the published literature.

2. Geologic setting

The area studied in this paper, located close to the Kastamonu-Sinop road near Bürnük village, was chosen due to the accessibility to both the lower and the upper contact of the İnalıtı Formation (Figure 1). The carbonates of the İnalıtı Formation are bounded by the Bürnük Formation (mainly conglomerates, sandstones, and mudstones) at the bottom and by the Çağlayan Formation (gray to black shales, marl, and sandstone) at the top (Figures 2 and 3). Approximately 395 m was measured for the whole İnalıtı Formation and 105 samples were analyzed in thin sections. Thin section analyses revealed the shallow water and reefal/fore-reefal character of the carbonates with coral-sponge framebuilders accompanied by various encrusters (*Lithocodium aggregatum*, *Bacinella*-type structures, *Koskinobullina socialis*, *Radiomura cautica*, *Perturbatacrusta leini*, *Thaumatoporella parvovesiculifera*, encrusting sponges, and bryozoans), boring bivalves, annelids (serpulids and terebellids), echinoids, rare benthic foraminifera (*Protopeneroplis*, *Spirillina*, *Anchispirocyclina*, *Kastamonina*, *Mesoendothyra*, *Coscinophragma*, *Lenticulina*, *Troglotella*, *Pseudocyclammina*, *Textularia*, *Meandrospira*, *Bullopore*, *Ophthalmidium*, *Charentia*, *Nautiloculina*, *Mohlerina*), and abundant *Crescentiella morronensis*. In the upper levels of the section, rare occurrences of calpionellids also were noted.

Prior to the formal naming of the İnalıtı Formation by Ketin and Gümüş (1963), it was Lucius (1925) who recognized the İnalıtı carbonates for the first time as “massif limestones of Cumaakşanı Mountain” (“Cumaakşanı Dağı'nın masif kalkeri”). In the following years, the carbonates of the İnalıtı Formation were studied as Upper Jurassic–Lower Cretaceous “cover limestone series” (“örtü kalker serisi”) by Grancy (1938), Altınlı (1951a, 1951b), Fratschner (1952), and Wedding (1968, 1969); “reefal limestone” (“resif kalkeri”) or “Felsenkalke” by Blumenthal (1940); carbonates of the Zonguldak Formation by Tokay (1954, 1955) and Yergök et al. (1987); Massif limestone by Badgley (1959); Kestanedağı limestone by Akyol et

al. (1974); carbonates of Yukarıköy Formation by Yılmaz (1979); and Akkaya Limestone Formation by Gedik and Korkmaz (1984).

Ketin and Gümüş (1963) established the İnalıtı Formation near İnalıtı village located in the southwest of Sinop Province. They described the formation as reefal and shallow water carbonates containing algae, bryozoa, corals, gastropods, bivalves, some foraminifera (*Trocholina* sp., *Cyclammina* sp., *Choffotella* sp.), and calpionellids and assigned to the formation a Malm–Early Cretaceous age.

Similarly, following studies attributed a wide age range to the İnalıtı carbonates (Akyol et al., 1974; Saner et al., 1980; Saner et al., 1981; Yılmaz and Tüysüz, 1984). Later, 2 different depositional intervals [Oxfordian–Berriasian (? Valanginian) and Barremian–Albian] separated by an unconformity surface were suggested for the İnalıtı Formation in the Western Pontides (Derman, 1990; Akman, 1992). Recently the age of the İnalıtı Formation has been revised as Oxfordian to Valanginian in the Western Pontides by Tüysüz et al. (2004). There are no studies in the Central Pontides constituting our study area on the chronostratigraphic subdivision of the İnalıtı Formation at stage level. However, based on the foraminiferal associations present in our stratigraphic section, a Kimmeridgian to Berriasian age could be suggested for the overall succession of the İnalıtı Formation. All biostratigraphic data and the taxonomical problems related with the foraminiferal associations will be undertaken in a future publication.

3. Paleontological description

Phylum Annelida Lamarck, 1809

Class Polychaeta Grube, 1850

Order Terebellida, Rouse & Fauchald, 1997

Family Terebellidae Malmgren, 1867

Genus *Terebella* Linnaeus, 1767

Terebella lapilloides Münster, 1833

(Plate 1, Figures 1–16; Plate 2, Figures 1–8; Plate 3, Figure 1)

Selected synonymy [for further synonymy before 1993 see Schmid (1996)]

1993b *Terebella lapilloides* Münster; Leinfelder, Nose, Schmid and Werner, p. 206, pl. 41, figs. 1, 3

1995 *Terebella lapilloides* Münster; Hammes, p. 340

1995 Agglutinated worm tubes; Hammes, fig. 7

1996 *Terebella lapilloides* Münster; Schmid, p. 204, 205, fig. 74

1999 *Terebella*; Dupraz and Strasser, pl. 11, fig. 5

1999 *Terebella lapilloides* Münster; Dupraz, p. 33, text fig 4.4, pl. 8, fig. 4

1999 *Terebella lapilloides* Münster; Schlagintweit and Ebli, p. 382, pl. 1, fig. 5 - pl. 2, fig. 6 - pl. 12, figs. 6–11

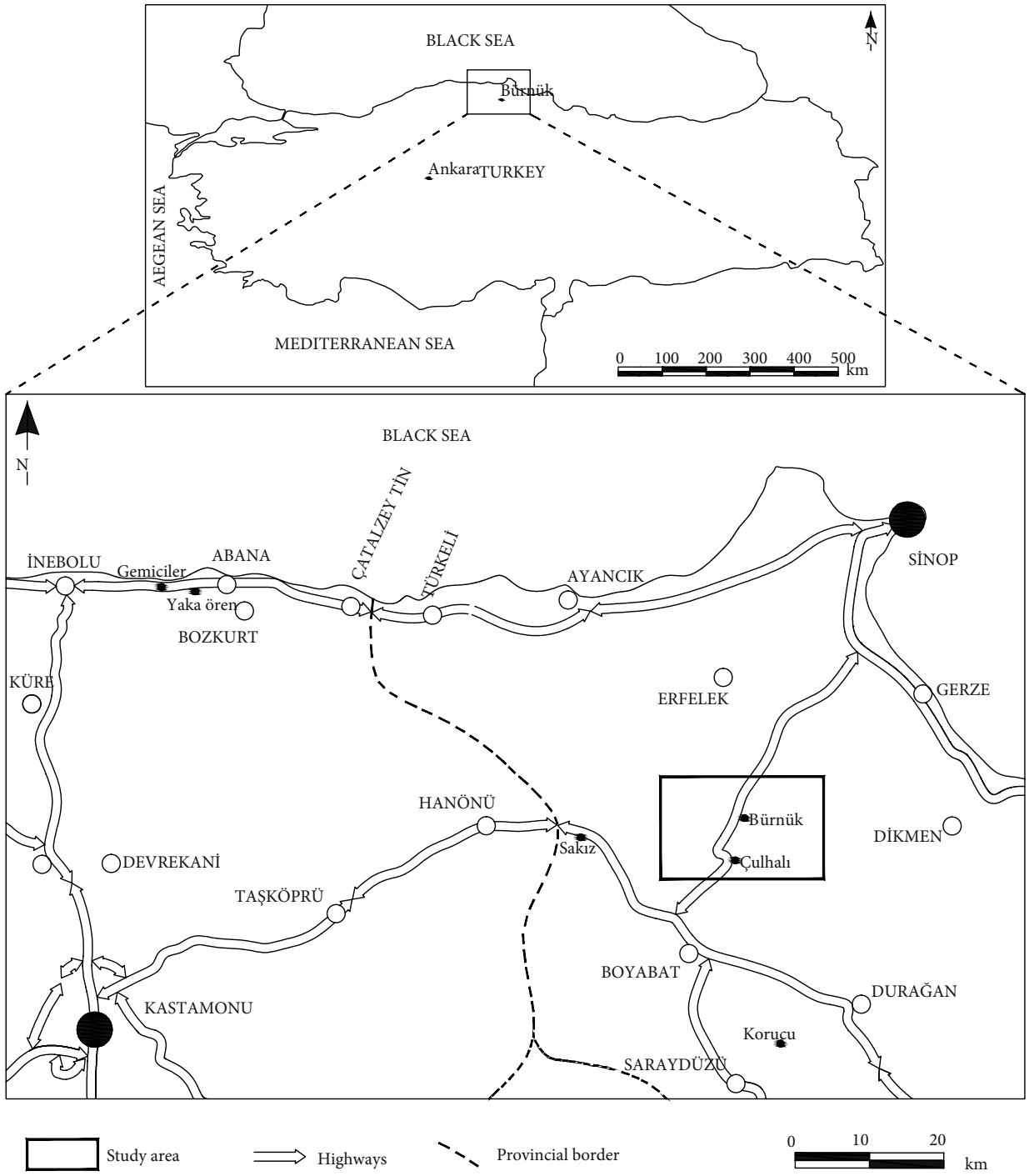


Figure 1. Location map of the study area.

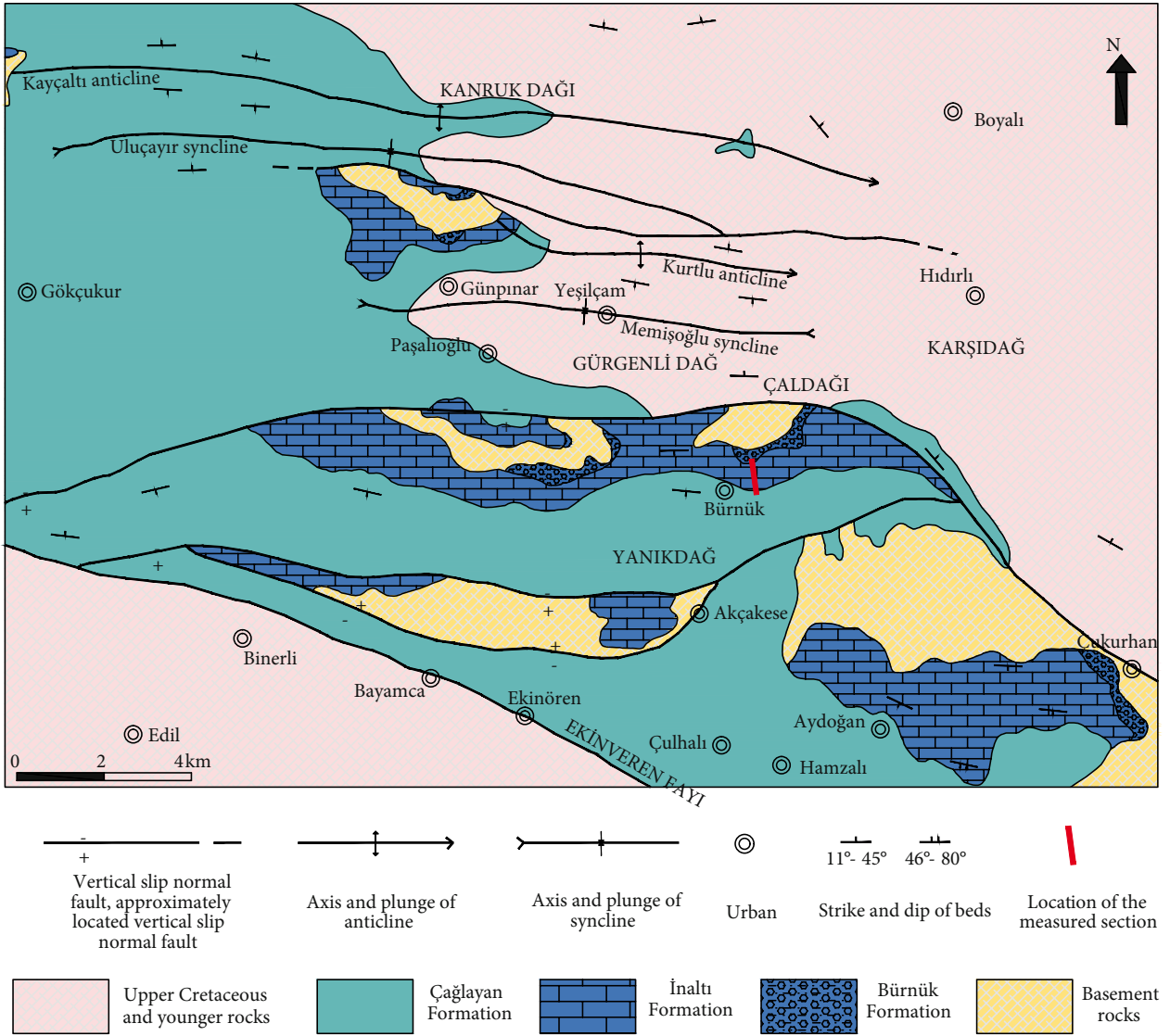


Figure 2. Geological map of the study area (modified from Uğuz and Sevin, 2008).

2001 *Terebella* sp.; Săsăran, Bucur, and Prica, pl. V, fig. 2
 2002 *Terebella*; Dupraz and Strasser, text fig. 14c
 ?2003 *Terebella lapilloides* Münster; Olóriz, Reloid, and Rodriguez-Tovar, p. 536, text fig. 11B
 2006 *Terebella lapilloides* Münster; Olóriz, Reloid, Rodriguez-Tovar, p. 121 (not figured)
 2006 *Terebella lapilloides* Münster; Helm and Schülke, p. 449 (not figured)
 2008 *Terebella lapilloides* Münster; Schlagintweit and Gawlick, text fig. 13a
 2010 *Terebella lapilloides* Münster; Bucur, Beleş, Săsăran, and Balica, p. 36 (not figured)
 Non 2010 *Terebella lapilloides* Münster; Olszewska, pl. 1, fig 10

2011 *Terebella lapilloides* Münster; Krajewski, Matyszkiewicz, Król, and Olszewska, text fig. 4B

2011 *Terebella lapilloides* Münster; Lazăr, Panaiotu, Grigore, Sandy, and Peckmann, p. 636, text figs. 10e, 10f

3.1. Description

Linking any specimen, fossil or recent, with a described taxon requires recognition of some unique features that link it to that taxon. Most of the polychaetes are supported by soft-body parts/segments that exist as important taxonomic characters. However, those characteristic structures are not seen in the fossil specimens. For instance, the details of chaetal structures, even the relatively large structures, such as the shape of parapodial lobes, are not easy to observe even in well-fossilized material (Fauchald

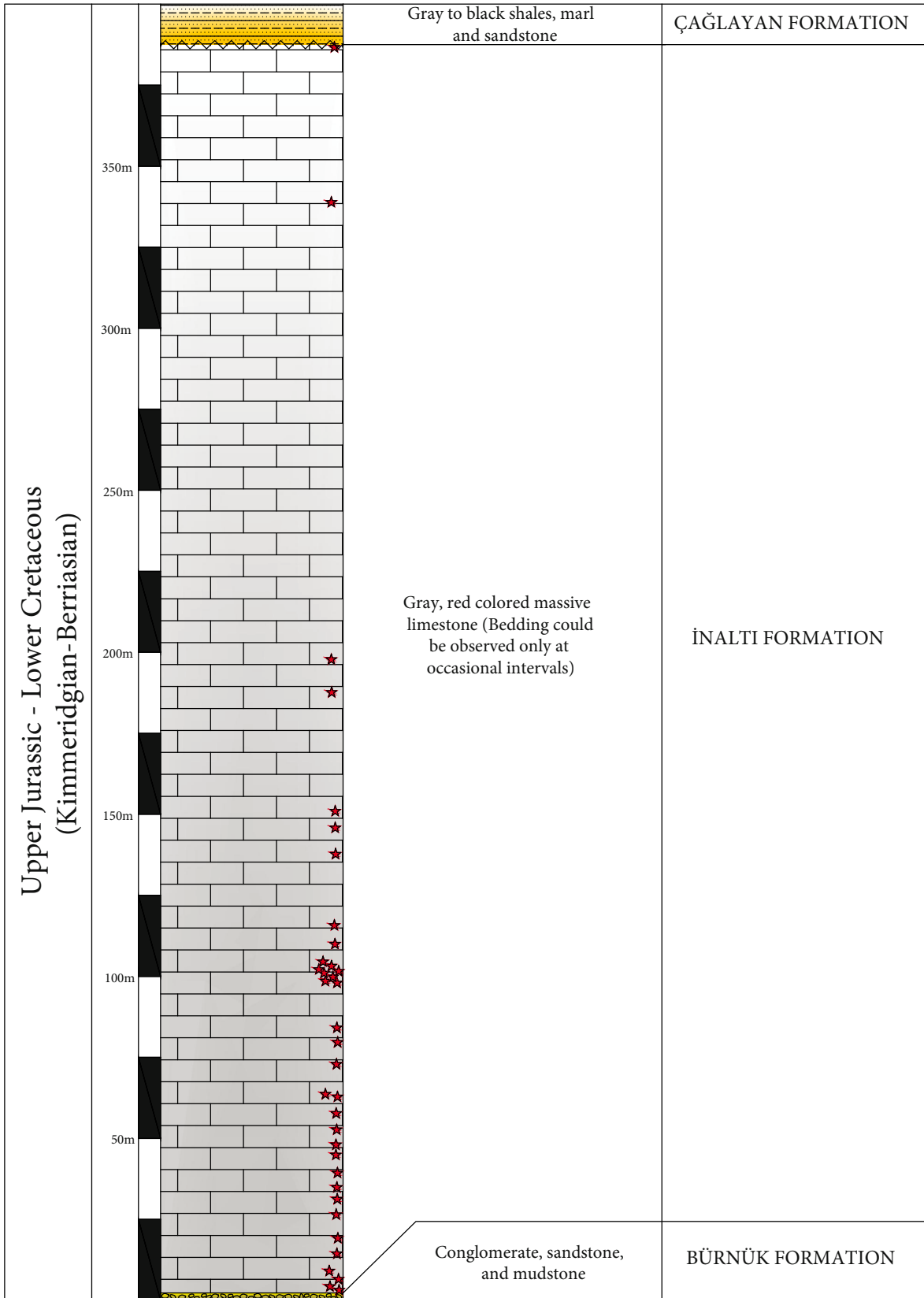


Figure 3. Simplified lithological column of the İnalti Formation. Stars show the levels with *Terebella*.

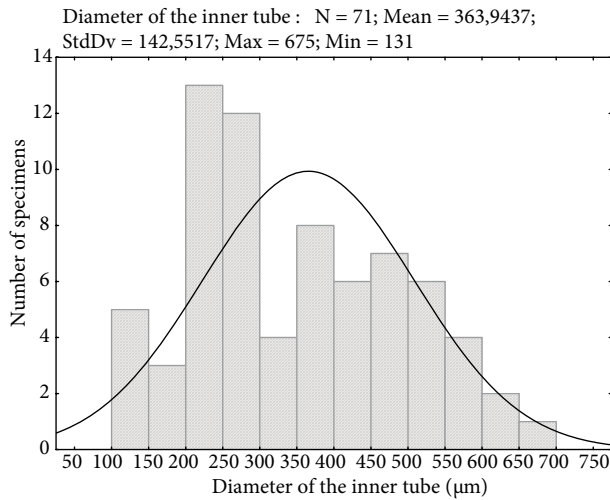


Figure 4. Histogram and normal curve of the frequency distribution of inner tube diameter.

and Rouse, 1997). Due to this unavailability in the fossil specimens, incorporation of the fossil taxa in polychaete systematic schemes is not easy (Fauchald and Rouse, 1997). Moreover, agglutinated annelid tubes are relatively scarce in the fossil record due to their vulnerability to destruction even though they have a long geologic range (Cambrian to Recent; Howell, 1962; Etnensohn, 1981). Nevertheless, some characteristics of the found fossil taxa such as wall composition (e.g., agglutinated or calcareous), coarseness of the agglutinated material, size of the inner/outer tube diameter, and thickness of the tube wall can be used as basic distinguishing features.

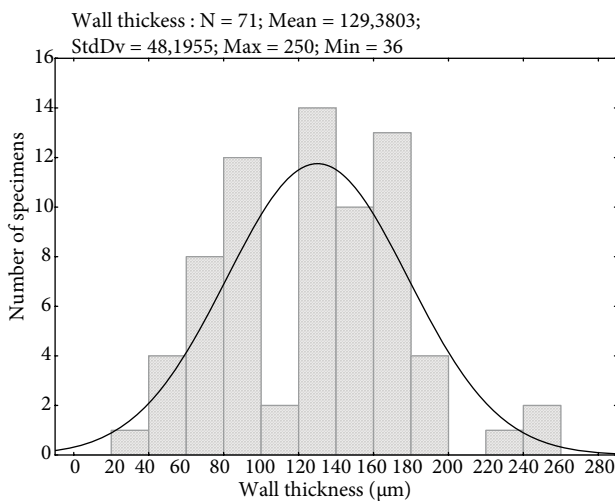


Figure 5. Histogram and normal curve of the frequency distribution of the wall thickness.

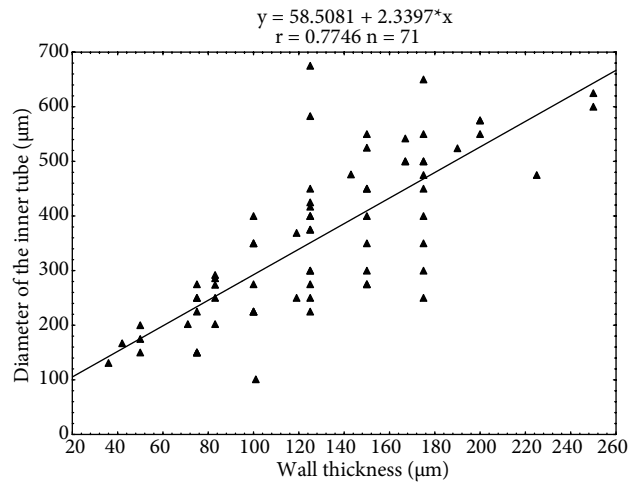


Figure 6. Scatter plot for the wall thickness and inner tube diameter.

Annelids consisting of an agglutinated tube are grouped under the generic name of *Terebella*. Being a species of the genus *Terebella*, *Terebella lapilloides* Münster is quite common in the late Jurassic reefal buildups. Examinations of the samples of İnalıtı carbonates reveal the frequent presence of this agglutinated annelid in the studied section (see Figure 3). In cross-section, the tube exhibits an agglutinated wall and the inner tube is filled with either blocky calcite or internal micritic sediments and peloids (Plate 1, Figures 1, 4, and 6). The wall of *Terebella lapilloides* consists mostly of fine-grained calcareous particles (Plate 1, Figures 1, 4, 6, and 7). Biometric measurements were utilized for the preparation of the frequency distribution histograms by STATISTICA version 8.0 (Figures 4 and 5). As can be seen from Figure 4, the inner tube diameters vary between 675 µm and 131 µm and the mean for the inner tube diameter is 364 µm. The distribution of the wall thickness is in the range of a maximum of 250 µm and minimum of 36 µm in thickness, and the mean is 71 µm (Figure 5). There is a general tendency for the forms having smaller inner tube diameters to have thinner walls and this positive correlation between the diameter of the inner tube and the wall thickness can be seen in Figure 6. The maximum length determined from the longitudinal sections is 1709 µm (1.7 mm).

3.2. Remarks

Previously *Terebella lapilloides* was related to different organisms. Schorr and Koch (1985) described it as a microproblematic organism, whereas Flügel and Steiger (1981) interpreted it as an agglutinated boring. Jansa et al. (1972), on the other hand, described it as allogromide foraminifera. Klieber (1985), with a different interpretation, identified it as the agglutinating worm *Terebella lapilloides* Münster. Like *Terebella*, some other very old taxa

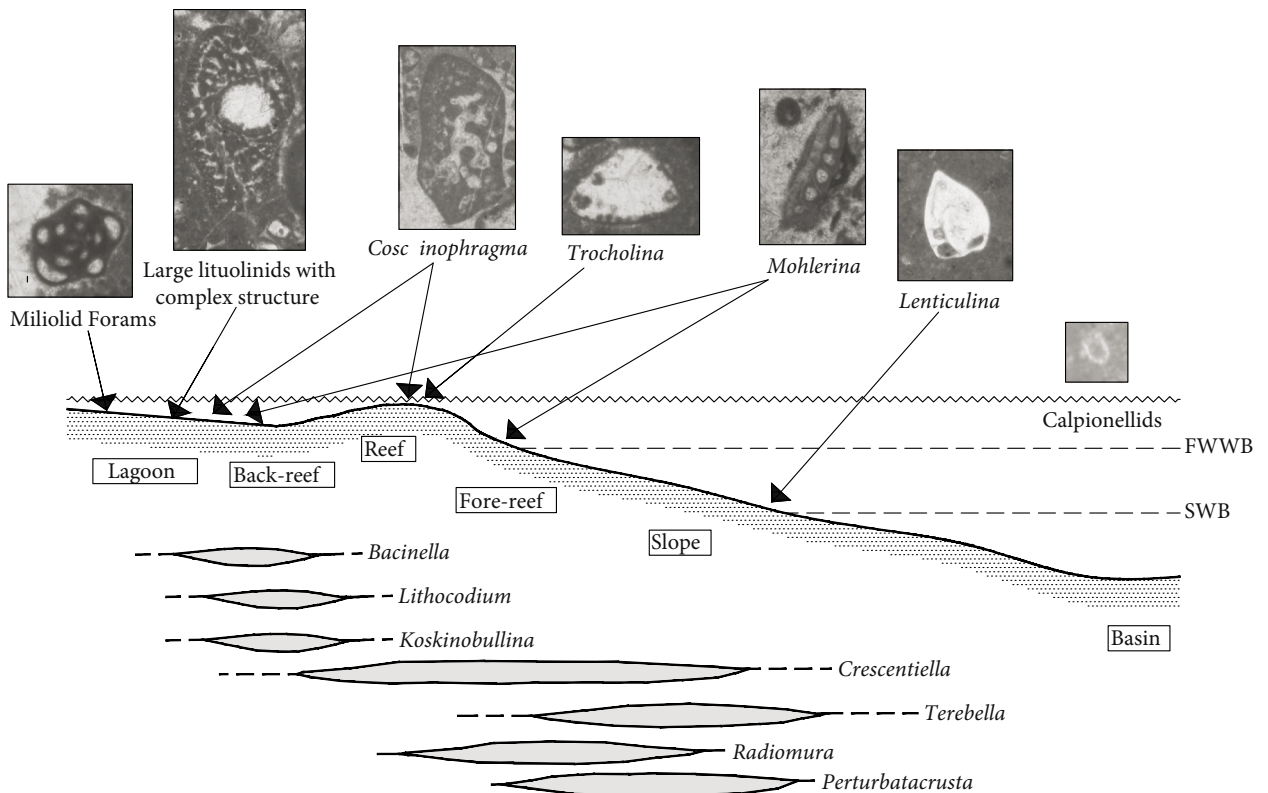


Figure 7. Facies distribution of some Upper Jurassic–Lower Cretaceous foraminifera, calpionellids, and microencrusts in the İnalti carbonate platform. FWWB: Fair weather wave base, SWB: Storm wave base (modified from Schlagintweit and Gawlick, 2006, 2011; Leinfelder et al., 1993b; Flügel, 2010).

(e.g., Precambrian *Platysolenites* and Early Cambrian *Volborthella*) are not only interpreted as agglutinated tubes of polychaete worms, but are also related to foraminifera due to their resemblance to agglutinated foraminifera (Vachard et al., 2010).

Hammes (1995) reported the preferential association of *T. lapilloides* with peloidal crust and sponge skeletons in the late Jurassic sponge mud-mounds. He observed that the inner tubes are filled with either blocky calcite cement, micritic internal sediment, and peloids or geopetal calcite and micritic internal sediment. Brachert (1986) distinguished 2 types of *Terebella lapilloides* Münster by their size and coarseness of the wall material used. The first tube type has a large, coarse agglutinated wall with 1 mm thickness, and its diameter is up to 6 mm. The second tube type has a small, very fine grained agglutinated wall, up to 0.1 mm thickness, with a diameter up to 1 mm. Helm and Schülke (2006) also determined the variations in tube diameter from 1 mm to around 3 mm. Schlagintweit and Ebli (1999), from their specimens of Berriasian age, identified 2 varieties of *Terebella lapilloides* Münster that differ in the dimensions of their outer and inner tube diameters. Olóriz et al. (2003) stated the occurrence of

larger forms of *Terebella lapilloides*, which can attain a diameter of 1 cm and a length of 12 cm (see the Table for comparisons with the specimens of this study).

Apart from the common usage of calcareous particles as agglutinated wall material, Dupraz (1999) also reported the preference of aluminosilicates to build *Terebella lapilloides* tubes.

3.3. Stratigraphic distribution

The known stratigraphic distribution of *T. lapilloides* is Late Triassic–Early Cretaceous (Berriasian). The stratigraphic distribution of our specimens ranges from Kimmeridgian to Berriasian.

Terebella? sp.

(Plate 1, Figures 17–19)

3.4. Description

These forms have been defined with a question mark because of the absence of longitudinal sections and the different nature of the agglutinated wall material. Circular transverse sections have larger sizes than a *T. lapilloides* population. Coarser particles such as foraminifera and peloids are observed as agglutinated wall materials (Plate 1, Figures 17 and 19). In some forms, the agglutinated wall material seems to be detached from the wall and scattered

Table. Comparison of the biometric measurements of *Terebella lapilloides* in the literature with the ones in this study.

	Brachert (1986)		Helm and Schülke (2006)	Schlagintweit and Ebli (1999)	Olóriz et al. (2003)	This study
Outer tube diameter	6 mm (max)	1 mm (max)	1–3 mm	0.6–0.76 mm	1 cm	1.125 mm (max)
Max. length	-	-	-	1.1 mm	12 cm	1.7 mm
Wall thickness	1 mm (max)	0.1 mm (max)	-	0.25–0.3	-	0.25 mm (max)

around the tube (Plate 1, Figure 18). The inner tube is filled with sparry calcite in all the observed forms (Plate 1, Figures 17–19). The largest inner tube diameter obtained is 925 μm . Despite their large tube diameter sizes, maximum observed wall thickness for *Terebella?* sp. is no more than 200 μm . These larger forms are most probably among the hitherto undefined species of *Terebella*.

3.5. Remarks

Similar large arenaceous forms in which the agglutinated particles include ooids, peloids, foraminifera, spicules, and quartz grains were also observed by Hermann (1996), Dupraz (1999), and Helm and Schülke (2006). Hermann (1996) defined them as “agglutinated polychaetid worm gen. et sp. indet.” whereas Dupraz (1999) and Helm and Schülke (2006), similar to our interpretation, considered these large arenaceous forms as undefined species of *Terebella*.

3.6. Stratigraphic distribution

Terebella? sp. has been encountered in the Kimmeridgian–Early Tithonian interval along the studied section.

4. Paleocological and paleoenvironmental significance of *Terebella* and associated fossils

Examinations of the İnalı carbonates reveal that *Terebella* may be found in the clasts of brecciated carbonates (Plate 2, Figure 3), as bioclasts in grainstone facies (Plate 2, Figure 4), as in situ forms in the peloidal-micrite dominated fabrics (Plate 2, Figure 5) or in the carbonates with coral boundstone texture (Plate 2, Figure 6). These observations lead us to interpret that *Terebella* appears in low-energy settings or in the perforations or cavities of coral boundstones in high-energy settings. Similar observations for the preferred appearance of *Terebella* in low-energy settings have also been noted in previous studies. Leinfelder et al. (1996) and Dupraz and Strasser (1999) reported that this annelid more often does not prefer to be in high-energy environments. However, its appearance in more energetic environments in cryptic cavities and perforations in coral-microbialite reefs was reported by Dupraz and Strasser (2002) and Dupraz (1999). Supporting their low-energy habitat preference,

Olóriz et al. (2006) observed the appearance of *Terebella lapilloides* in lithofacies with low-energy conditions. Existence of this annelid from a marine shelf under low to moderate currents was also observed by Huggett et al. (1986) and Krautter et al. (2001).

The *Terebella-Crescentiella* association of Leinfelder et al. (1993b) was described in a dense peloidal microbial fabric with very rare occurrence of other microencrusters. This association has a bathymetric significance implying its appearance in deep setting environments (Figure 6) (Leinfelder et al., 1993a, 1993b, 1996). It is the preferential occurrence of *Terebella lapilloides* in deeper settings that makes the *Crescentiella-Terebella* association bathymetrically significant (Leinfelder et al., 1993b), because *Crescentiella* may occur in both shallow- and deep-water environments (Leinfelder et al., 1993b).

In addition to the bathymetric significance, abundant occurrence of the *Crescentiella-Terebella* association in dysoxic conditions with the dominance of *Terebella* (Leinfelder et al., 1996) amplifies the importance of this community as an environmental indicator. As noted by Leinfelder et al. (1996), this community may also appear in well-oxygenated and oligotrophic deeper-water settings, but the prevalence of dysaerobic conditions is quite probable whenever the community is shifted towards a strong dominance of *Terebella* with the absence of accessory encrusters. Dupraz and Strasser (2002) mentioned the clear correlation between *Terebella lapilloides* and thrombolitic intervals, and they also added that *Terebella lapilloides* is generally the only microencruster found in thrombolitic intervals, which indicates its low-oxygen tolerance as proposed by Leinfelder et al. (1996).

As stated before, together with *Terebella lapilloides*, the investigated material contains some other forms indicating the reefal/fore-reefal character of the İnalı carbonates. Corals and sponges (Plate 2, Figure 6 and 7) occur as in situ framebuilders or as bioclasts. They are encrusted by various microencrusters and microproblematica including *Lithocodium aggregatum*, *Bacinella*-type structures, *Koskinobullina socialis*, *Radiomura cautica*, *Perturbatacrusta leini*, *Thaumatoporella parvovesiculifera*,

and some encrusting sponges and bryozoans (Plate 3, Figures 2–8). A common form other than the microencrusters and microproblematica is *Crescentiella morronensis*, which was recently interpreted as an association between cyanobacteria and nubecularid foraminifera by Senowbari-Daryan et al. (2008). They also considered the association between cyanobacteria and uncertain tubes or rarely other biogenic components for some specimens of *Crescentiella*. In our investigated material, *Crescentiella* and *Terebella* showed up together in the same facies (in situ) only in a few slides (Plate 2, Figure 8). In other cases, they occur in different breccia clasts or as bioclasts transported from reefal/peri-reefal settings. In such breccia levels indicating active reworking from the reefal/peri-reefal environments, other microencrusters are also seen in different clasts or as transported bioclasts (Plate 2, Figure 3). Rare foraminifera (Plate 2, Figure 2), echinoderm fragments (Plate 2, Figures 7 and 8), boring bivalves (Plate 2, Figure 7), gastropod shells (Plate 2, Figure 1), and other annelids (i.e. serpulids; see Plate 3, Figure 1) are the other organism groups associated with *Terebella*.

Figure 7 illustrates the Late Jurassic–Early Cretaceous distribution pattern of some microencrusters and foraminifera in distinct parts of the İnalıtı carbonate platform based on the available data in this study and the previous ideas and models proposed by Leinfelder et al. (1993b), Schlagintweit and Gawlick (2006, 2011), and Flügel (2010). According to this model, the *Terebella-Crescentiella* association, *Radiomura*, and *Perturbatacrusta* are confined to the deeper parts of the platform. As can be seen from the model, abundant occurrences of *Terebella* correspond to the part of the outer platform below the fair weather wave base supporting its common appearance in low-energy settings. Sporadic storms occurring above the storm wave base probably do not affect its distribution on the outer platform. Other microencrusters are distributed generally on the shallower parts of the platform. This model also provides the distribution pattern of the observed foraminifera in the İnalıtı carbonate platform. In the lagoonal-back-reef part of the platform miliolids,

larger complex benthic foraminifera, *Coscinophragma* and *Mohlerina*, can be observed. The reefal setting includes the trocholines and *Coscinophragma*, whereas *Mohlerina* displaying larger facies tolerance and *Lenticulina* can be present in the fore-reef to slope facies.

5. Conclusions

The occurrence of the agglutinated worm, *Terebella lapilloides*, has been reported and taxonomically described from the İnalıtı Formation and its paleoenvironmental-paleoecological importance has been emphasized in this study. The investigated İnalıtı platform carbonates show similar taxonomic composition with the other Upper Jurassic–Lower Cretaceous Tethyan examples from Europe (Leinfelder et al., 1993a, 1996; Schmid, 1996; Dupraz and Strasser, 1999; Schlagintweit and Ebli, 1999; Dupraz and Strasser, 2002; Schlagintweit and Gawlick, 2011). The discovery of *Terebella lapilloides* from the carbonates of the İnalıtı Formation has significant implications for possible further studies. It exhibits a specific spatial distribution on the outer carbonate platform representing the fore-reefal and slope environments. Its presence and absence in the samples of the measured section include clues about the change in the paleoenvironmental and paleoecological conditions. By analyzing the relative abundances of *Terebella lapilloides* and the other diagnostic microencrusters and microencruster associations, more evidence can be obtained about the changes in environmental conditions. The evolution of the reefal environment can then be well constrained by these analyses, similar to the study of Dupraz and Strasser (1999) on the coral bioherms of the Swiss Jura Mountains.

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Plate 1.

- Figure 1. *Terebella lapilloides* Münster. Transverse section MK-2, bar scale: 500 µm.
- Figure 2. *Terebella lapilloides* Münster. Oblique sections MK-3, bar scale: 500 µm.
- Figure 3. *Terebella lapilloides* Münster. Oblique sections MK-3, bar scale: 500 µm.
- Figure 4. *Terebella lapilloides* Münster. Oblique sections MK-3, bar scale: 500 µm.
- Figure 5. *Terebella lapilloides* Münster. Oblique sections MK-3, bar scale: 500 µm.
- Figure 6. *Terebella lapilloides* Münster. Transverse section MK-6, bar scale: 250 µm.
- Figure 7. *Terebella lapilloides* Münster. Oblique and transverse sections MK-3, bar scale: 500 µm.
- Figure 8. *Terebella lapilloides* Münster. Oblique and transverse sections MK-3, bar scale: 500 µm.
- Figure 9. *Terebella lapilloides* Münster. Oblique sections MK-12, bar scale: 500 µm.
- Figure 10. *Terebella lapilloides* Münster. Transverse section MK-10, bar scale: 250 µm.
- Figure 11. *Terebella lapilloides* Münster. Oblique sections MK-19, bar scale: 500 µm.
- Figure 12. *Terebella lapilloides* Münster. Part of a longitudinal section MK-4, bar scale: 500 µm.
- Figure 13. *Terebella lapilloides* Münster. Longitudinal section MK-9D, bar scale: 500 µm.
- Figure 14. *Terebella lapilloides* Münster. Part of a longitudinal section MK-14, bar scale: 500 µm.
- Figure 15. *Terebella lapilloides* Münster. Longitudinal sections MK-57, bar scale: 500 µm.
- Figure 16. *Terebella lapilloides* Münster. Part of a longitudinal sections MK-42, bar scale: 500 µm.
- Figure 17. *Terebella?* sp. Note agglutinated coarser particles, transverse section MK-8, bar scale: 500 µm.
- Figure 18. *Terebella?* sp. Note agglutinated coarser particles, transverse section MK-9B, bar scale: 500 µm.
- Figure 19. *Terebella?* sp. Note agglutinated coarser particles, transverse section MK-21, bar scale: 500 µm.

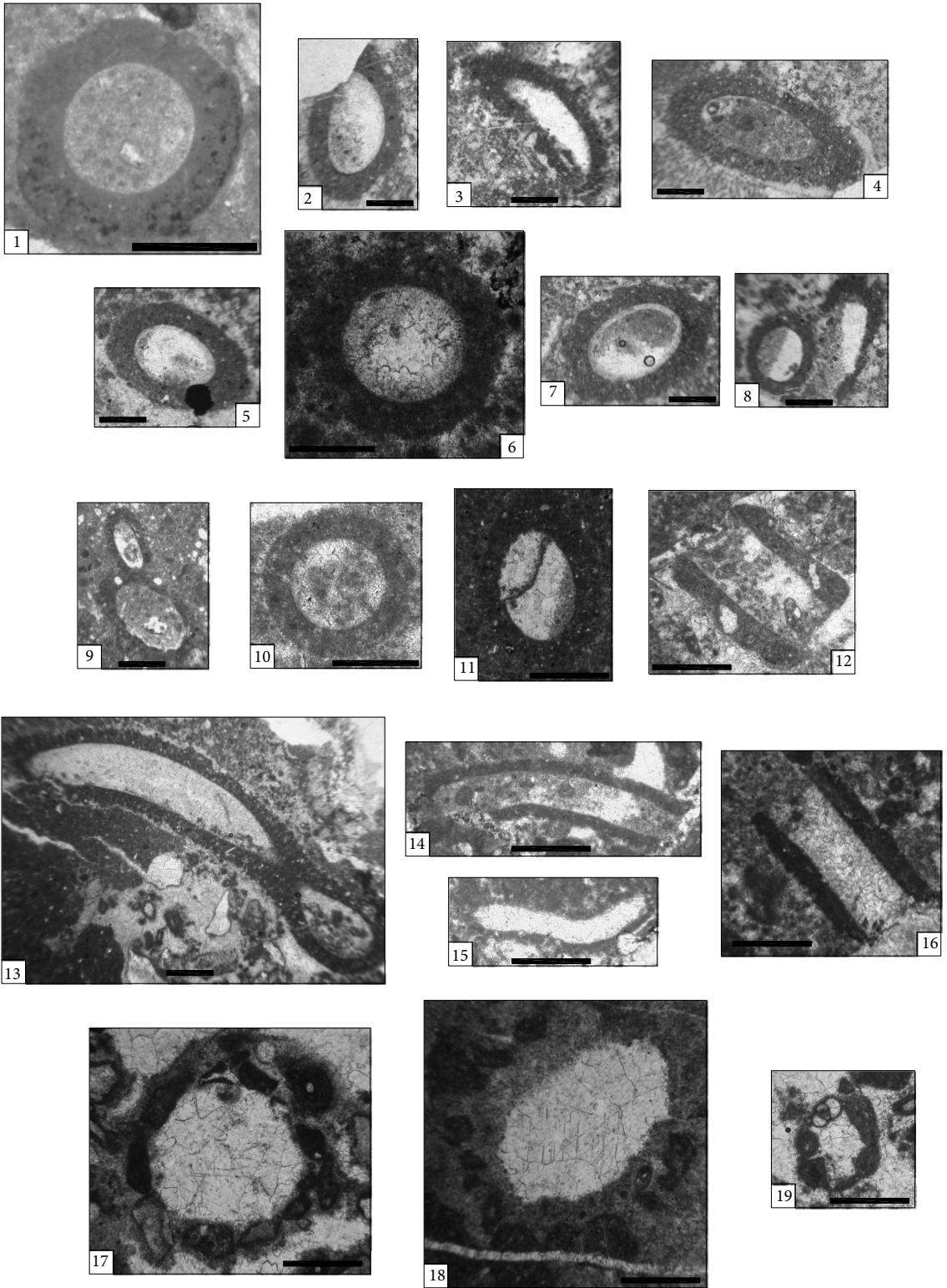


Plate 2.

Figure 1. *Terebella lapilloides* (T) in a micritic-peloidal facies with a recrystallized gastropod shell (G), MK-9C, bar scale: 500 µm.

Figure 2. *Terebella lapilloides* (T) in a micritic (wackestone) facies with foraminifera (F), MK-19, bar scale: 500 µm.

Figure 3. *Terebella lapilloides* (T) in a breccia clast, note *Perturbatacrusta leini* (P) in the other clast, MK-15, bar scale: 500 µm.

Figure 4. *Terebella lapilloides* (T) as a bioclast in a grainstone facies, MK-25, bar scale: 500 µm.

Figure 5. *Terebella lapilloides* (T) in a peloidal-micritic fabric, MK-9C, bar scale: 500 µm.

Figure 6. *Terebella lapilloides* (T) in a coral (Co) boundstone facies, MK-16, bar scale: 500 µm.

Figure 7. *Terebella lapilloides* (T) with sponge (Spo), echinoderm fragment (E), and a boring bivalve (BB), MK-2, bar scale: 500 µm.

Figure 8. *Terebella lapilloides* (T) with *Crescentiella* (C) and an echinoderm fragment (E), MK-10, bar scale: 500 µm.

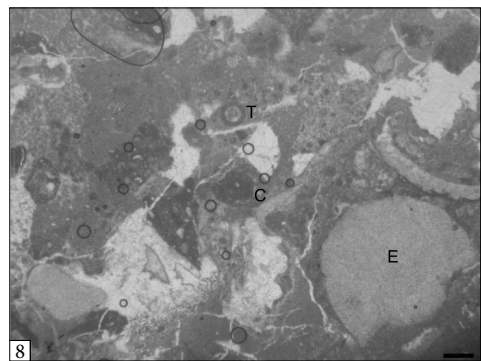
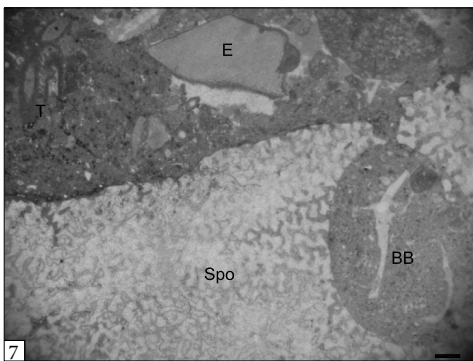
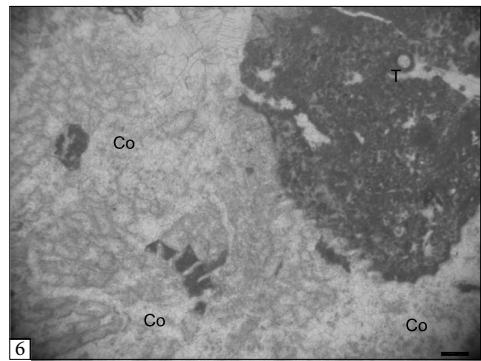
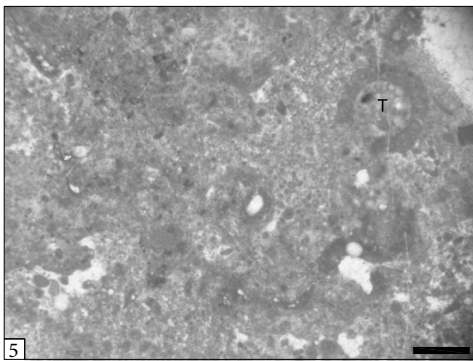
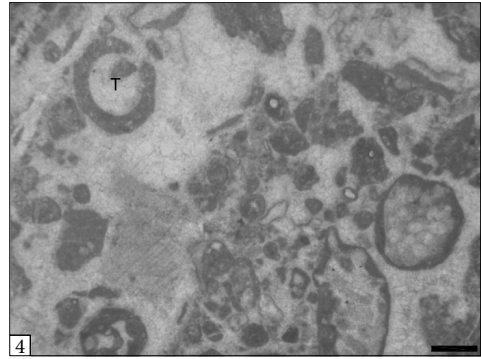
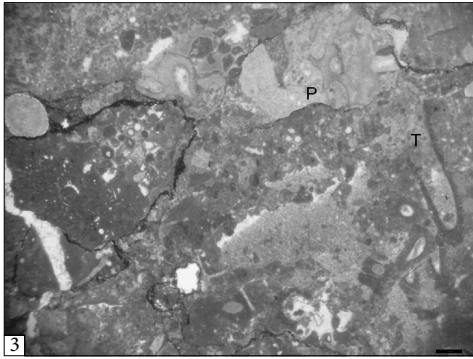
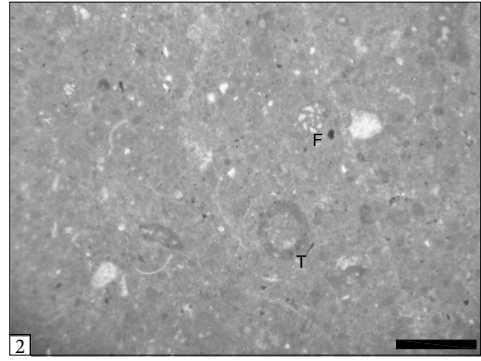
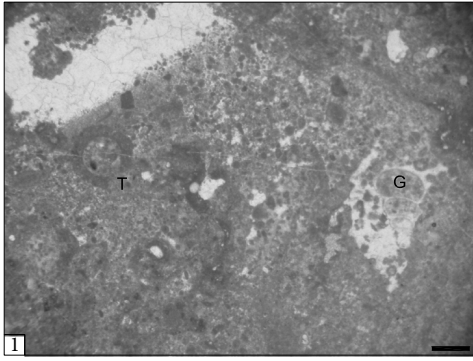


Plate 3.

Figure 1. *Terebella lapilloides* (T) with *Crescentiella* (C) and serpulids (s), MK-10, bar scale: 500 µm.

Figure 2. Encrusting sponge (Spo) and bryozoa (B), MK-54, bar scale: 500 µm.

Figure 3. *Lithocodium aggregatum*, MK-76, bar scale: 500 µm.

Figure 4. *Bacinella*-type structures, MK-92, bar scale: 500 µm.

Figure 5. *Koskinobullina socialis*, MK-2, bar scale: 500 µm.

Figure 6. *Radiomura cautica*, MK-6, bar scale: 500 µm.

Figure 7. *Perturbatacrusta leini*, MK-91, bar scale: 500 µm.

Figure 8. *Thaumatoporella parvovesiculifera*, MK-74, bar scale: 500 µm.

