



The annelid polychaete *Rotularia spirulaea* Lamarck, 1818 from the early Middle Eocene (middle-late Cuisian) of Çankırı Basin (Central Anatolia, Turkey)

Çankırı Havzası'nda (Orta Anadolu, Türkiye) erken Orta Eosen (orta-geç Küviziyen) annelid polychaete Rotularia spirulaea Lamarck, 1818

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ABSTRACT

The annelid of the genus *Rotularia* is a common element of Jurassic to Early Tertiary shallow-water marine faunas but few studies have been conducted on its palaeoecologic and stratigraphic significance. The polychaete *Rotularia spirulaea* Lamarck, 1818, from the middle-late Cuisian Yoncalı formation of the Çankırı Basin, Central Anatolia is here described and its mode of life and palaeobiogeographic distribution are discussed. This is the first polychaete annelids species *Rotularia spirulaea* Lamarck, 1818 discovered in Turkey, *Rotularia spirulaea* Lamarck is a stratigraphically and geographically widely distributed species.

Key Words: Annelid, Cuisian, Çankırı Basin, polychaete fossils.

ÖZ

Stratigrafik ve paleoekolojik açıdan üzerinde ender olarak durulan annelid cinsi Rotularia, Jura'dan Erken Tersiyer'e kadar sığ su denizel ortamlarda bulunur. Orta Anadolu'da Çankırı Havzası'ndaki Yoncalı formasyonunda orta-geç Küviziyen'de polychaete Rotularia spirulaea Lamarck, 1818, tanımlanmış, yaşam şekli ve paleobiyoğrafik yayılımları da tartışılmıştır. Paleocoğrafik olarak, geniş stratigrafik ve coğrafik yayılıma sahip olan Rotularia spirulaea Lamarck, 1818, polychaete annelid türü Türkiye'de ilk defa bulunmuştur.

Anahtar Kelimeler: Annelid, Küviziyen, Çankırı Havzası, polychaete fosiller.

INTRODUCTION

In central Anatolia, Turkey, the Çiçekdağ region of the Çankırı Basin (Figure 1) developed as a syn-col-lisional basin during the Tertiary. The sedimentary fill of the Çankırı Basin is mainly composed of three lithostratigraphic units which are the Bayat volcanics of the Early Eocene age and the Yoncalı and İncik formations of Late Eocene (Birgili et al., 1975; Tüysüz and Dellaloğlu, 1994; Erdoğan et al., 1996; Akgün et al., 2002; Figure 2). The annelid polychaete fossils from the Yoncalı formation are the main subject of this study. The most dominant element of the benthic community in the Eocene of the Çankırı Basin are nummulits, which are particularly well-represented in the early Middle Eocene (Figure 3). Moreover, the early Middle Eocene rocks exposed in the Çankırı Basin contain a rich macroinvertebrate fauna dominated by crabs, bivalves, gastropods, echinoids and polychaets.

GEOLOGICAL SETTING

In the investigated area, the sedimentary fill of the Çankırı Basin of the Early to Late Eocene age unconformably overlies the Late Cretaceous Çiçekdağ Belt (Akgün et al., 2002). Generally, there are three composite stratigraphic units in this region: 1) the Çiçekdağ Belt forming the basement, 2) the Çankırı basin-fill, and 3) the cover series (Erdoğan et al., 1996; Figure 2). The Çiçekdağ Belt is represented by the Yozgat magmatics and Çökellik volcanics of the Campanian to Paleogene ages. The mafic volcanic rocks, the Çökellik volcanics of the Çiçekdağ Belt, are cross-cut by the Yozgat granitoids. The basin fill of the Çankırı Basin is mainly composed of three lithostratigraphic units, being the Bayat volcanics of the Early Eocene age, and the Yoncalı and İncik formations of the Middle Eocene age. The cover series dominated by Miocene to Pleistocene red sandstone and conglomerate of the Bozkır and Değim formations, overlies the lithological units of the Çankırı Basin-fill (Akgün et al., 2002; Figure 2).

The Çankırı Basin-fill deposits are dominantly of a continental and shallow-marine character. The general composition of the Yoncalı formation is green shale and sandstone with a thickness of about 1500 m. The polychaete fossils, which are the main subject of this study, were collected from the central part of the Yoncalı formation (Figure 3). Beds containing the *Rotularia spiru-*

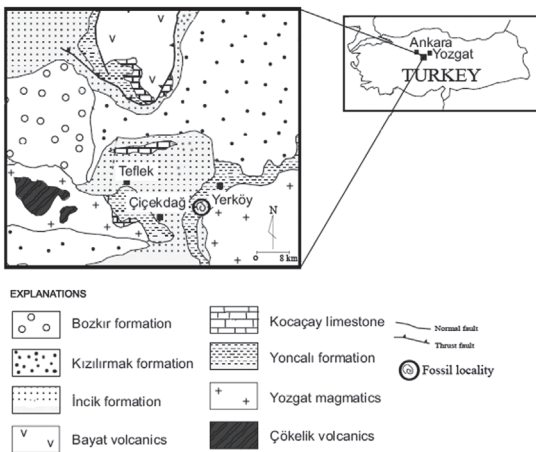


Figure 1. Location and regional geological map of the study area (after Akgün et al., 2002).

Şekil 1. Çalışma alanının yer bulduru ve bölgesel jeoloji haritası (Akgün vd., 2002'den).

laea Lamarck in the Kocaçay limestone crop out as discontinuous bodies in the region and attain 15 to 100 m in thickness. Specimens were collected from a single exposure in the Yoncalı formation, on the Kırşehir J32-b2, quadrangle, at latitude 34° 68'N, longitude 39° 25' E.

The İncik formation is composed of thick-bedded conglomerate with large-scale trough cross-stratification (Akgün et al., 2002). In the Çankırı Basin-fill basaltic andesite lava flows, volcanic breccia, and tuffs of the Bayat volcanics interfinger with both the Yoncalı and İncik formations, and form the third lithostratigraphic unit of the Çankırı Basin-fill (Birgili et al., 1975; Tüysüz and Dellaloğlu, 1994; Erdoğan et al., 1996; Akgün et al., 2002).

SYSTEMATIC PALEONTOLOGY

The descriptive terminology for the annelid characters of the *Rotularia* DeFrance, follows that of Chamberlin (1919) and Benini et al. (1988).

Phylum **Annelida** Lamarck, 1809

Class **Polychaeta** Grube, 1850

Family **Serpulidae** Burmeister, 1837

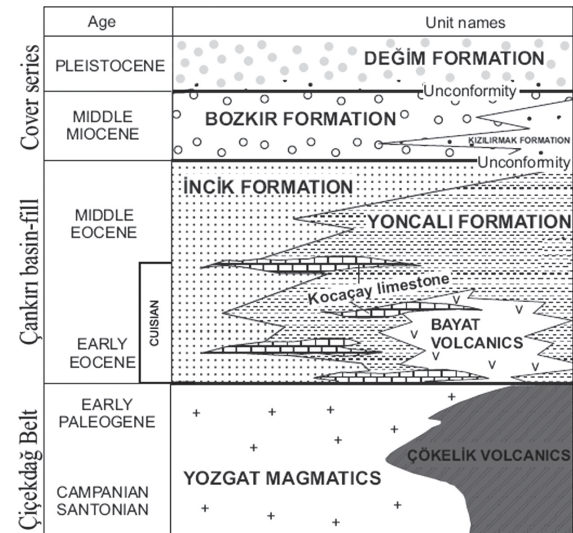


Figure 2. Generalized stratigraphic columnar section showing the rock units of the Çankırı Basin (after Erdoğan et al., 1996 and Akgün et al., 2002)

Şekil 2. Çankırı Havzası'nın kaya birimlerini gösteren stratigrafik dikme kesiti (Erdoğan vd., 1996 ve Akgün vd., 2002'den).

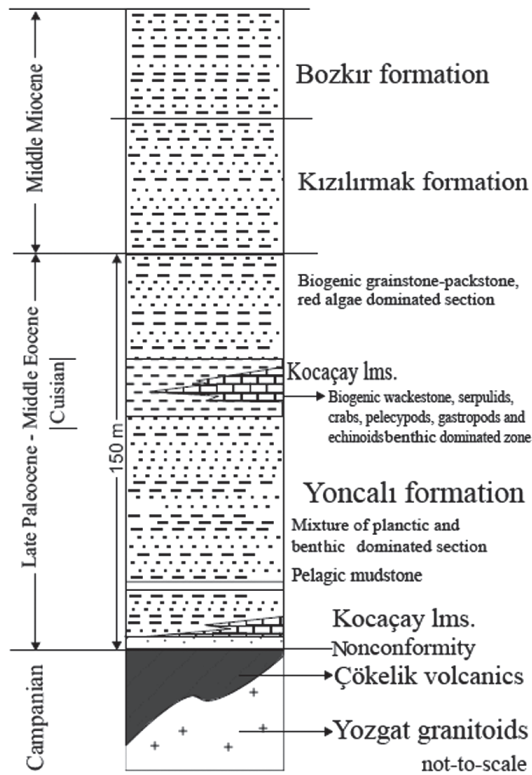


Figure 3. Partial stratigraphic columnar section of Yerköy region (after Akgün et al., 2002).

Şekil 3. Yerköy bölgesinin kısmi stratigrafik dikme kesiti (Akgün vd., 2002'den).

Subfamily **Spirorbinae** Chamberlin, 1919

Genus **Rotularia** DeFrance, 1827

Shell structure: The morphology of the shell was defined by Wrigley (1951), Schmidt (1955), and in more detail by Regenhardt (1961), Şuraru and Şuraru (1967) and Macellari (1984). As discussed by Wrigley (1951), the original composition of the tube is calcitic. Schmidt (1955) showed that the wall tube of *Rotularia* is composed of a thin inner structureless layer and a thick outer lamellar layer. Macellari (1984) noted that in most longitudinal sections the lamellae are arranged concentrically around the tube, but in many cases a complex pattern is observed, wherein the lamellae radiate is almost perpendicular to the tube wall.

Geologic range and distribution: *Rotularia* ranges from Late Liassic to Early Oligocene, and has a world-wide distribution (Şuraru and Şuraru, 1967).

***Rotularia spirulaea* Lamarck, 1818**

Plate 1, Figures 1-3.

1818 *Rotularia spirulaea* Lamarck, p. 366.

1826 *Serpula spirulaea* (Lamarck), Goldfuss, p. 241, pl. 71, fig. 8

1865 *Vermetus spirulaeus* (Bronn), Schauroth, p. 250, pl. 25, fig. 10.

1894 *Serpula spirulaea* (Lamarck), Koch, p. 295.

1899 *Rotularia spirulaea* Lamarck, Rovereto, p. 64.

1901 *Serpula (Rotularia) spirulaea* (Lamarck), Oppenheim, p. 227, pl. 18, fig. 15.

1904 *Serpula spirulaea* (Lamarck), Rovereto, p. 64.

1912 *Vermetus (Burtinella) spirulaea* (Lamarck), Cossmann, p. 141.

1924 *Serpula (Rotularia) spirulaea* (Lamarck), Zittel, p. 286, fig. 451h.

1951 *Rotularia spirulaea* Lamarck, Wrigley, p. 179, figs. 16-17, 32.

1952 *Serpula spirulaea* (Lamarck), Piveteau, p. 184, fig. 21.

1955 *Rotularia spirulaea* Lamarck, Schmidt, pp. 75-78, pl. 8, figs. 15-19.

1957 *Vermetus (Burtinella) spirulaea* (Lamarck), Meszaros, p. 126, pl. 25, fig. 2.

1964 *Burtinella spirulaea* (Lamarck), Karagiuleva, p. 143, pl. 41, fig. 11.

1967 *Rotularia spirulaea* Lamarck, Şuraru and Şuraru, pp. 111-112, pl. 10, figs. 1-9.

1988 *Rotularia spirulaea* Lamarck, Benini et al., pp. 421-423, fig. 2a.

1992 *Rotularia spirulaea* Lamarck, Benini et al., p. 96, figs. 4a-c.

Description: Conispirally and planispirally; coiling sinistral, rarely dextral. Periphery commonly with tricarinate keel. End of tube frequently projecting as a straight, tangential extension; aperture circular.

Discussion: The European specimens have the same dimensions and the same features as the ones from the fossil locality. From the Early-Late Eocene of England, *Rotularia bognorien-*

sis (Mantell) (Wrigley, 1951; figs. 1-3, 5, 10) is recorded from London Clay. These are different in that they are larger and not all of them develop a third spiral midway up the keel. *Rotularia clymenioides* (Guppy) (Müller, 1958; p. 397, fig. 469b), has been described from the Eocene Europe formations. This species is also smaller than the *Rotularia spirulaea* Lamarck and does not present a third spiral in the median part of the keel.

Dimensions: Diameter (D), 110; height (H), 50; D/H, 0,45. (measurements in tenths of mm).

PALEOECOLOGICAL AND PALEOBIOGEOGRAPHICAL IMPLICATIONS

Rotularia is generally found in strongly bioturbated sediments and there is a correlation between *Rotularia* abundance and the presence of abundant bioturbation. However, this bioturbation could have been produced by serpulids or other organisms also showing a preference for a high mud content in the sediment. The mode of life of *Rotularia* has no recent counterparts for comparison, and it is difficult to speculate on its specific environmental requirements. The serpulid

Rotularia is built rather regular, with planispiral or trochospiral tubes with an uncoiled adult portion. Juveniles of *Rotularia* were cemented to small substrates, and later in ontogeny grew into secondary, reclining epifaunal soft-bottom dwellers in medium-to high-energy environments. The uncoiled adult portion, together with the coiled portion of the tube, constituted a stabilizing structure increasing the effective area of contact with the substrate and was only exceptionally bent out of the coiling plane, a situation common in other sessile soft-bottom dwellers among polychaetes and gastropods (Macellari, 1984; Savazzi, 1995).

The polychaete fossils are associated with *Nummulites distans* Deshayes (A and B forms), *Aspilina laxispira* Dela Harpe (determined by Ercüment Sirel, Ankara University); the gastropod *Pleurotomaria* sp., the pelecypod *Spondylus* sp. (determined by İzzet Hoşgör, Ankara University), the crabs *Harpactocarcinus* sp. (determined by Carrie E. Schweitzer, Kent State University), and undetermined echinoids and serpulids (Figure 4). According to Serra-Kiel et al. (1998), these foraminiferal species indicate SB-11-12 zones (middle-late Cuisian). Based on this de-



Figure 4. Reconstruction of the early Middle Eocene shallow water community at the Çankırı Basin. The community is represented by polychaete (serpulids and species of serpulids *Rotularia spirulaea*), crabs, echinoids, spondylid pelecypods and gastropods (after Taylor and Wilson, 2003).

Şekil 4. Çankırı Havzası'nda erken Orta Eosen sığ su topluluklarının canlandırılması. Bu bölgede polychaete (serpulidler ve serpulid türü *Rotularia spirulaea*) ile birlikte, yengeçler, ekinitler, spondylid pelesipodlar ve gastropodların topluluğu oluşturması (Taylor ve Wilson, 2003'den).

termination, the Yoncalı formation is middle-late Cuisian in age. The uppermost part of Kocaçay limestone include only algae fossils.

The foraminiferal assemblage reveals the warm and shallow marine conditions during the middle-late Cuisian period. The sandstone and shale alternation points to cyclic high energy periods of transportation of coarse material from the coastal area. Towards the top of the sequence, the increments in the algae content suggest that warm, shallow and low energy conditions dominated in the region during middle-late Cuisian time interval.

Rotularia spirulaea is a stratigraphically and geographically widely distributed species. In Turkey, it exists in the early Middle Eocene (middle-late Cuisian) of the Çankırı Basin. It is also described from the Early to Late Eocene of Europe, for example southern France (Cossmann and Pissarro, 1911), England and Bulgaria (Karagiuleva, 1964), the Early-Middle Eocene of northern Italy (Rovereto, 1899, 1904), the Late Eocene of northwestern Transilvania (Meszaros, 1957; Şuraru and Şuraru, 1967), the Early Eocene of Ukraina and Croatia and the Early Oligocene of central Asia (Oppenheim, 1901).

CONCLUSIONS

Paleoecologically *Rotularia spirulaea* Lamarck is generally found in strongly bioturbated sediments and cemented to small substrates, reclining epifaunal soft-bottom dwellers in medium-to high-energy environments. Paleogeographically, *Rotularia spirulaea* Lamarck, is a stratigraphically and geographically widely distributed species. In Turkey, it exists in the early Middle Eocene (middle-late Cuisian) Yoncalı formation, in Kocaçay limestone in the Çankırı Basin.

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PLATE 1 / LEVHA 1

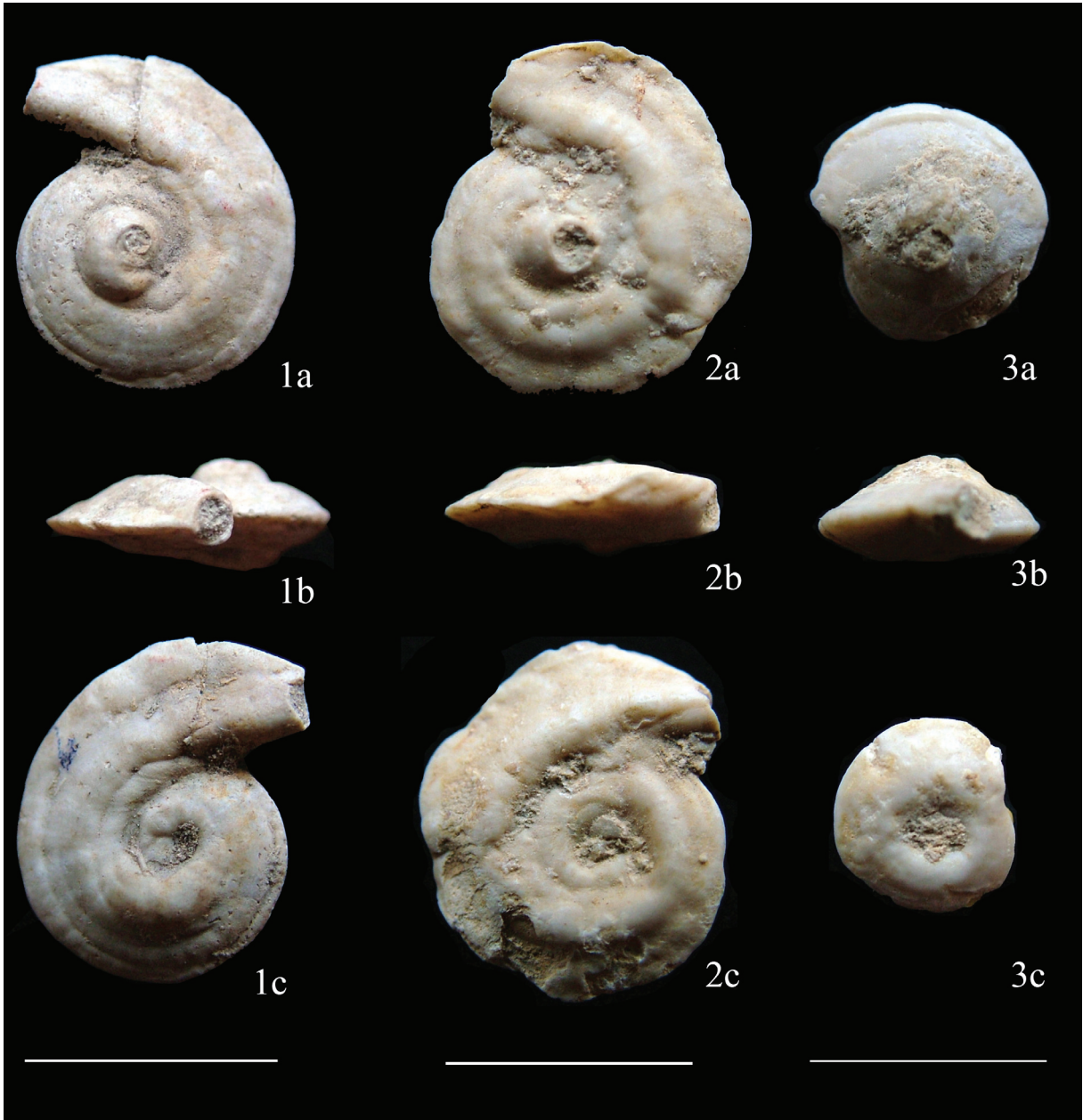


PLATE 1

Rotularia spirulaea Lamarck, 1818, 1a-c, dorsal, apertural and umbilical views, specimen YRA 060201. 2a-c, dorsal, apertural and umbilical views, specimen YRA 060202. 3a-c, dorsal, apertural and umbilical views, specimen YRA 060203 (Scale bars indicate 1 mm).

LEVHA 1

Rotularia spirulaea Lamarck, 1818, 1a-c, sırt, ön ve karından görünüş, örnek YRA 060201. 2a-c, sırt, ön ve karından görünüş, örnek YRA 060202. 3a-c, sırt, ön ve karından görünüş, örnek YRA 060203 (Ölçü çizgileri 1 mm'dir).

