Early Eocene Caenogastropods (Mollusca, Gastropoda) from Haymana-Polatlı Basin, Central Anatolia (Turkey): taxonomy and palaeoecology

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ABSTRACT
This study describes 21 species of Caenogastropoda collected in the Macunköy section from the upper part of the Kırkkavak Formation (Haymana-Polatlı Basin, SW of Ankara). The known stratigraphical range of the studied species is consistent with an early Ypresian (early Eocene) age of the deposits, indicated by *Cerithium puigcercosensis* (Cossmann, 1897) n. comb. and *Tympanotonos turris* (Deshayes, 1833). This result supports previous biostratigraphic studies based on benthic foraminifers. Among the caenogastropods from the Macunköy section, two new species are described: *Bellatara ankaraensis* n. sp. and *Vicinocerithium seni* n. sp. Furthermore, *Cerithium puigcercosensis* n. comb. is described as a new combination. The gastropod assemblage of the Macunköy section indicates a mangrove-fringed, wet coastal ecosystem with euryhaline conditions, connected to coastal swamps and a delta system.

KEY WORDS
Mollusca,
Gastropoda,
Caenogastropoda,
euryhaline molluscs,
Early Ypresian,
central Anatolia,
tropical mangrove,
coastal ecosystem,
new species.

RÉSUMÉ
Caenogastropoda de l'Éocène inférieur du Bassin de Haymana-Polatlı, Anatolie centrale (Turquie) : taxonomie et palaéoecologie.
Cette étude décrit 21 espèces de Caenogastropoda recueillies dans la coupe de Macunköy qui constitue la partie supérieure de la Formation de Kırkkavak (bassin de Haymana-Polatlı, SW d'Ankara). La distribution stratigraphique connue des espèces étudiées correspond à l'Yprésien inférieur (Éocène inférieur), les formes indicatives étant en particulier *Cerithium puigcercosensis* (Cossmann, 1897) n. comb. et *Tympanotonos turris* (Deshayes, 1833). Ce résultat corrobore les études biostratigraphiques précédentes basées sur les foraminifères benthiques. La faune étudiée contient deux espèces nouvelles : *Bellatara ankaraensis* n. sp. et *Vicinocerithium seni* n. sp. En outre, *Cerithium puigcercosensis* n. comb. est décrit comme une nouvelle combinaison. L'assemblage de gastéropodes de la coupe de Macunköy indique un environnement de mangrove dans un écosystème côtier humide avec des conditions euryhalines en rapport avec les marais côtiers ou un système de delta.

MOTS CLÉS
Mollusca,
Gastropoda,
Caenogastropoda,
Mollusques euryhalins,
Yprésien inférieur,
Anatolie centrale,
mangrove tropicale,
écosystème côtier,
espèces nouvelles.

INTRODUCTION

In the geodynamic evolution of the Tethyan-Peritethyan realms, the late Paleocene-early Eocene interval is transitional between the Late Cretaceous major reorganization of plate boundaries, and the middle to late Eocene continent-continent collision (Meulenkamp & Sissingh 2003). In the early Paleogene, when large parts of both the northern and southern Peritethys platforms emerged, various marine corridors still connected the Atlantic and Tethyan/Indo-Pacific domains (Meulenkamp *et al.* 2000). Some marine connections became temporarily interrupted during the Early Ypresian due to plate tectonics, and enhanced by a major sea-level lowstand (see Miller *et al.* 2005), leading to the formation of endemic faunas in the different basins (Meulenkamp *et. al.* 2000). The ensuing episodes of sea-level rise in the early Eocene, the warmest temperatures of the Cenozoic (Zachos *et al.* 1993) and other environmental changes (large mass of carbon input into the ocean/atmosphere, negative carbon isotopic excursion [CIE], shoaling of carbon compensate depth [CCD], lowered PH of the ocean: Zachos *et al.* 2001, 2003, 2005) are correlated with important biotic turnovers (e.g., nannoplankton: Jiang & Wise 2006; Egger *et al.* 2009; benthic foraminifers: Kennett & Stott 1991; Hottinger *et al.* 1998; Orue-Extebarria *et al.* 2001; Rasser *et al.* 2005; Pujalte *et al.* 2009a; planktic foraminifers: Kelly *et al.* 1998; euryhaline molluscs: Dominici & Kowalke 2007; mammals: Gunnel 1998; Gingerich 2006) and a shift of planktic foraminifers toward high-latitudes (Molina *et al.* 1999). The distribution of gastropods with planktotrophic early ontogenetic development and the ability to disperse long distance, reveals connections between Tethyan and Proto-Mediterranean sub-provinces during the late Eocene (Popov 1993) and the Oligocene-early Miocene (Harzhauser *et al.* 2002).

Here we present the taxonomy of early Ypresian gastropods and an update of their stratigraphical ranges and palaeoecology. Taxonomic studies are the first step in documenting species richness during this greenhouse interval (Clyde 1999), when many marine and terrestrial groups experienced a rapid and steady diversification whose timing and dimensions we are only beginning to understand. The study area is located in central Anatolia, in the northwestern margin of the Haymana-Polatlı Basin which formed in a complex convergence-collision setting during the late Cretaceous-middle Eocene (Şengör & Yılmaz 1981; Görür *et al.* 1984; Koçyiğit 1991) (Fig. 1). The Paleocene-Eocene of this east-

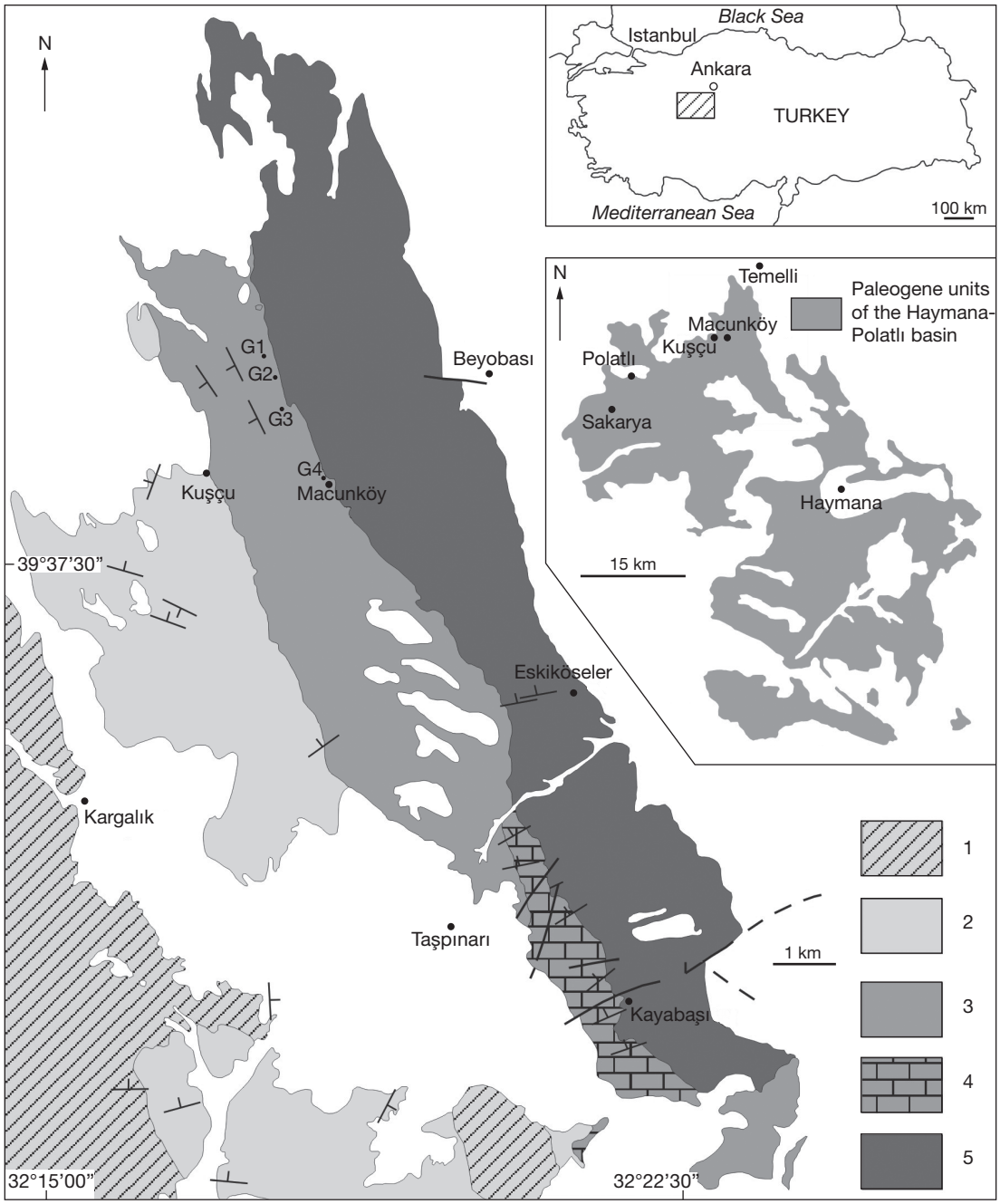

FIG. 1. — Geological map of the Paleocene-Eocene units exposed in the studied region and sample points of the Macunköy section (from Bilgin *et al.* 2009): **1**, Eskipolatlı Formation; **2**, Ilgınlıkdere Formation; **3**, Kırkkavak Formation; **4**, Kırkkavak Formation; Kayabaşı Member; **5**, Kartal Formation.

ern Tethys basin is rich in benthic foraminifers and molluscs (Stchepinsky 1941, 1946; Erünal 1942; Güngör 1975; Sirel 1998; Özcan *et al.* 2001; Okan & Hoşgör 2008).

CHRONOSTRATIGRAPHIC SETTING

The base of the Ypresian Stage is formally used as the reference level for the base of Eocene (Berggren & Aubry 1998; Aubry 2000; Gradstein *et al.* 2004). In biostratigraphy of Cenozoic shelf successions, shallow benthic biozones (SBZ) are widely adopted, SBZ3-4 corresponding to the early and late Thanetian, respectively, whereas the Ilerdian of Tethyan stratigraphy covering the former "boundary time span" is today regarded as contemporaneous with the early Ypresian (earliest Eocene, SBZ5-6: Luterbacher *et al.* 2004; Pujalte *et al.* 2009b) (Fig. 2).

The Paleogene deposits of the Kırkkavak Formation are represented by shallow water sediments, up to 640 m thick, transgressive over terrestrial units of the Kartal Formation (Ünalan *et al.* 1976). The Thanetian has been recognized from the distribution of larger benthic foraminifers (SBZ3-4), nannoplankton (NP8) and planktonic foraminifers (P8) (Sirel 1975, 1976a, b; Özcan *et al.* 2001), whereas the early Ypresian was based on correlation of SBZ5-6 with the uppermost part of the formation (Sirel 1975).

The type sections of the formation are located between Sakarya and Karahamzalı, S and SW of Polatlı (Kırkkavak, Karahamzalı, Sarıhalil, Sakarya, Kartal and Kayabaşı sections: Sirel 1975; Ünalan *et al.* 1976; Özcan *et al.* 2001; Bilgin *et al.* 2009). In this area, the lower and middle parts of the formation (up to 400 m thick) are formed by an alternation of sandstones, siltstones, conglomerates, sandy limestones, clayey limestones and marls. The carbonate dominant units, Kayabaşı Member (Bilgin *et al.* 2009), are assigned to the early and late Thanetian on the basis of characteristic benthic foraminifers (*Glomalveolina primaeva* Reichel & Renz, 1936*, Miscellanea yvettae* Leppig, 1988, *Ranikothalia bermudezi* (Palmer, 1934), *Nummulites heberti* (Munier-Chalmas *in* Hébert, 1882), *Vania anatolica* Sirel & Gündüz, 1985*; Discocyclina seunesi* Douvillé, 1929 and *Orbitoclypeus neumannae* (Toumarkine, 1967)) indicative of biozones SBZ 3-4 (Sirel 1975, 1976a, b, 1998; Özcan *et al.* 2001). The transgressive tendency culminates in the early Thanetian with the deposition of 100-150 m-thick basinal sediments (NP8 and P4 biozones of nannoplankton and planktonic foraminifer stratigraphy, respectively: Özcan *et al.* 2001).

In the northwest margin of the basin (Sakarya section), the upper units are up to 70 m thick and made of sandy limestones, sandstones and siltstones directly overlying the Kartal Formation. This part is correlated with the Early Ilerdian (Pujalte *et al.* 2009a, b), based on benthic foraminifers of SBZ5-6 (*Nummulites fraasi* de la Harpe, 1883*, Nummulites prelucasi* Douvillé, 1924, *Alveolina vredenburgi* Davies & Pinfold, 1937 [initially named *A. cucumiformis* Hottinger, 1998 by Hottinger *et al.* 1998], *Glomalveolina sublitis* (Hottinger, 1960), *Assilina pustulosa* Doncieux, 1926) (Sirel 1975; Ünalan *et al.* 1976).

The gastropods studied here were collected from the uppermost fine-grained siliciclastic units of the Kırkkavak Formation at Macunköy, in the northern margin of the basin, where transgressive deposits are represented by an alternation of conglomerates and mudstones. The contact with the underlying terrestrial sediments of the Kartal Formation is not visible (Fig. 3). However, a concordant relationship with the sandy limestone-limestone-sandstone facies of the middle-lower part of the Kırkkavak Formation in Macunköy area was reported by Bilgin *et al.* (2009). A few gastropod-dominated shell beds are present in the upper 5 m, within the siltstone-mudstone units separating the conglomerates. Four samples were collected within these shell beds (G1 = 40°59'40.4"N, 26°50'15.7"E; G2 = 40°59'40.4"N, 26°50'15.7"E; G3 = 40°59'40.4"N, 26°50'15.7"E, G4 = 40°59'40.4"N, 26°50'15.7"E).

SYSTEMATICS

The investigated fauna is composed of 21 taxa of gastropods (families Campanilidae, Ampullinidae Cossmann, 1918, Cerithiidae Fleming, 1822, Batillariidae Thiele, 1929 and Potamididae H. Adams & A. Adams, 1854). These constitute the totality of the

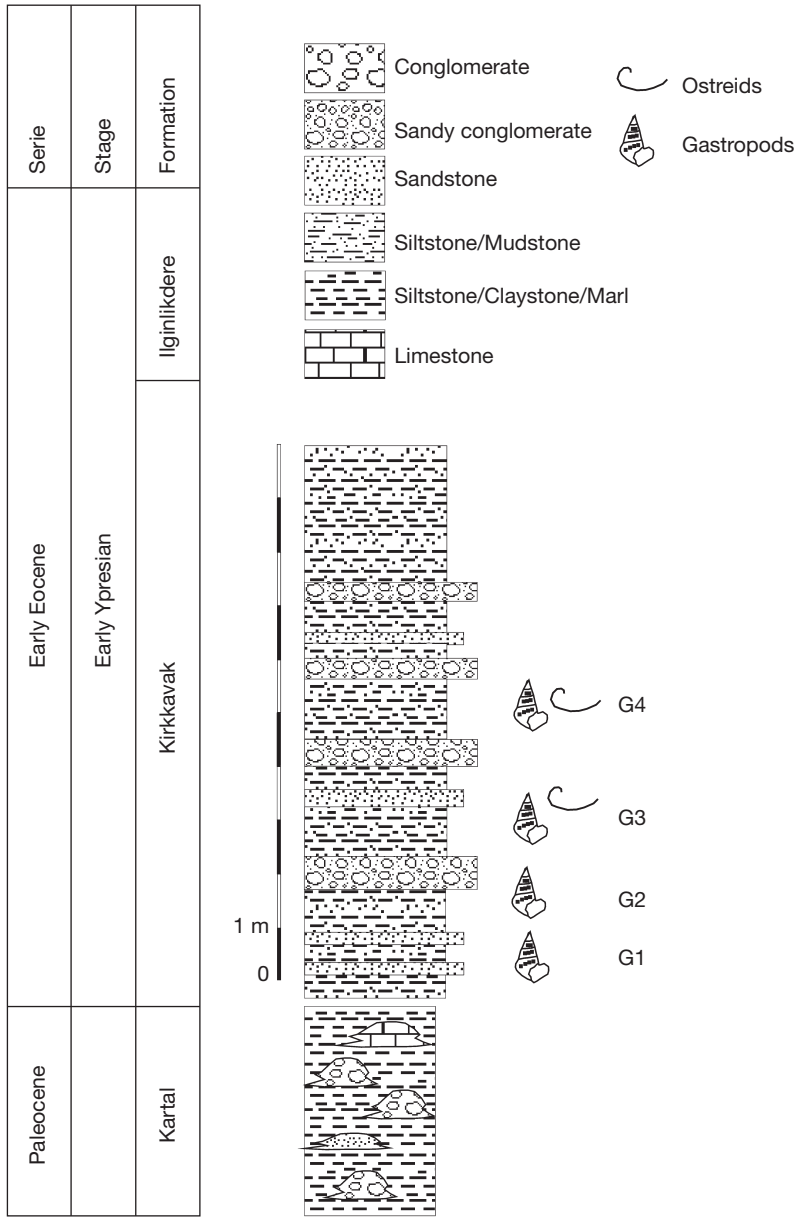

FIG. 2. — Correlation table between the time scales, stages and biozones for the Upper Paleocene-Lower Eocene chronostratigraphy (compiled from Berggren *et al.* 1985, 1995; Serra-Kiel *et al.* 1998; Berggren & Aubry 1998; Aubry 2000; Luterbacher *et al.* 2004; Pujalte *et al.* 2009a, b).

Macunköy molluscs recovered so far, with the exclusion of oysters (*Ostrea sakaryaensis* Stchépinsky, 1941: 145, pl. 1, figs 6-10). Biometric parameters are given in Figure 4, measurements in Appendix 1. Known stratigraphical and paleobiogeographical distributions of the described species are shown in Appendix 2.

Type material and all figured specimens are deposited in the Geological Research Department of General Directorate of Mineral Research and Exploration (MTA, collection of the first author) and at the Natural History Museum of Vienna, Austria (NHMV).

Class GASTROPODA Cuvier, 1797
Subclass ORTHOGASTROPODA
Ponder & Lindberg, 1995
Superorder CAENOGASTROPODA
Cox, 1960
Order ARCHITAENIOGLOSSA Haller, 1892
Superfamily AMPULLINOIDEA Cossmann, 1918

Family AMPULLINIDAE Cossmann, 1918

Ampullinidae represent large shallow-marine gastropods known since Jurassic times with the sole extant SE Asian survivor *Cernina fluctuata* (G. B. Sowerby, 1825) (Kase & Ishikawa 2003). Ampullospirinae Cox, 1930, Pseudamaurinae Kowalke & Bandel, 1996, Ampullininae Cossmann, 1918, and Globulariinae Wenz, 1941 represent subfamilies (see Ponder & Lindberg 1997). Their members of the ampullinids are defined on the basis of teleoconch and protoconch morphology, e.g., egg-shaped to conical shell, low to elevated spire, rounded to tabulate whorls, columellar sheet, small protoconch reflecting planktotrophic early ontogenic development), which differentiates them from convergent naticids (Kowalke 1998; Kase & Ishikawa 2003).

The mode of nutrition is recognized to be herbivorous (algal grazer) as described for extant *C. fluctuata* by Kase & Ishikawa (2003). Although we could only speculate on the feeding mode of the fossil species described here, the entire fauna lacks naticid boreholes. This could support the interpretation of a herbivorous mode also in case of the extinct species – moreover taking into account that drilling predation activities as characteristic feature of the naticids, are well known since the Mesozoic (Vermeij 1977) and remarkably increased especially during the Eocene (Kelley & Hansen 1996; Kase & Ishikawa 2003; see also Aronowsky & Leighton 2003).

The investigated specimens are morphologically similar to *Ampullina* Bowdich, 1822 and *Crommium* Cossmann, 1888, although their protoconchs and details of teleoconch sculpture and apertural characteristics are not preserved. Thus, we prefer to use open nomenclature on generic level in order to avoid further confusion.

Genus *Ampullina* Bowdich, 1822

TYPE SPECIES. — *Ampullaria depressa* Lamarck, 1804. Middle Eocene: Paris Basin.

The genus *Ampullina* was described from Jurassic (?Lias)-Miocene deposits from Europe, Africa, Middle East, Japan, India, New Zealand, Sunda Islands, North, Middle and South America (see e.g., Wenz 1938). *Ampullina* has a medium to large sized, thick, rather globose shell with relatively elevated spire, stepped whorls with spiral rows of fine pits. It is characterized by a half-moon-shaped aperture, small umbilicus limited by a sheet, thick columellar callus.

"***Ampullina***" cf. ***vapincana*** (d'Orbigny, 1850)
(Fig. 5A, B, N)

Natica vapincana d'Orbigny, 1850: 345, pl. 24, fig. 132. — Bayan 1873: 104, 105, pl. 15, figs 1, 2.

Natica (*Ampullina*) *vapincana* – Boussac 1911: 327, 328; pl. 20, figs 11, 13.

Ampullina vulcani var. *vapincana* – Mészarós 1957: 128, pl. 25, figs 7-7a.

Ampullina vulcani vapincana – Piccoli & Mocellin 1962: 19, pl. 1, fig. 11.

Globularia (*Globularia*) *vapincana* – Karagiuleva 1964: 176, pl. 48, fig. 2a, b; pl. 49, figs 1a, b, 5; pl. 50, fig. 4; pl. 51, fig. 6a, b.

Crommium vapincana – Pacaud 2007: 40.

Globularia vapincana – Okan & Hoşgör 2008: 5, pl. 1a-i.

MATERIAL EXAMINED. — Four specimens, MTA-Y.İ.-2007-02 to 05.

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: samples G1, G3).

PALAEOGEOGRAPHIC DISTRIBUTION. — Faudon, Hautes-Alpes (France): Priabonian (d'Orbigny 1850); Paris Ba-

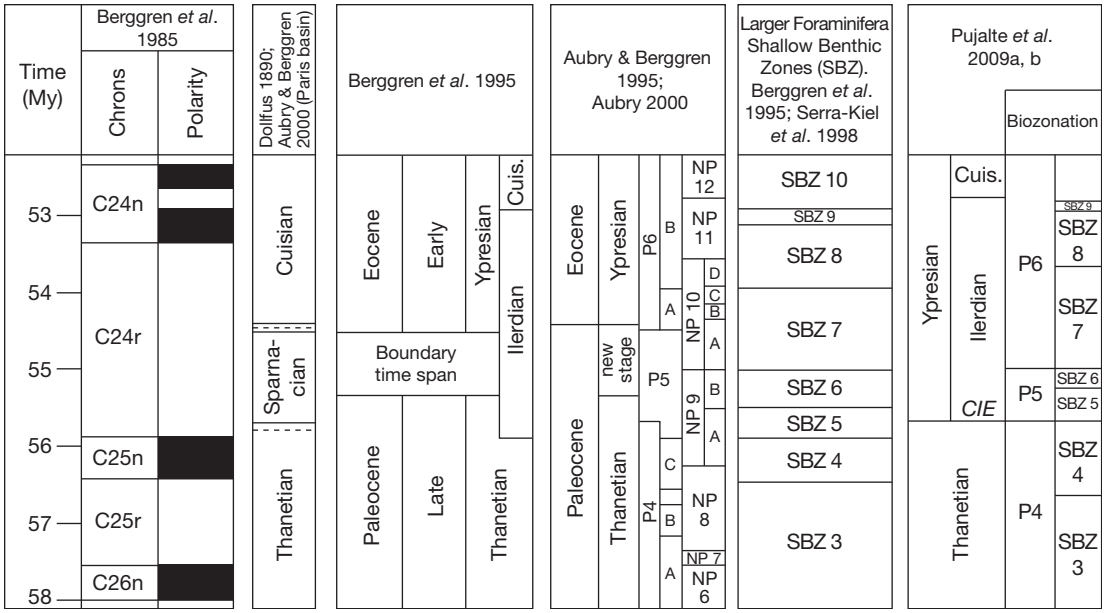

FIG. 3. — Macunköy section.

sin: Middle-Late Eocene; Alps (N Italy): Late Eocene; Pyrennes (S France): Late Eocene; Bulgaria: Late Eocene (Karagiuleva 1964); Macunköy (Polatlı, Central Turkey): Late Thanetian-Early Ilerdian (Okan & Hoşgör 2008: based on the former age interpretation of SBZ5-6 biozones given by Sirel 1975 and Serra-Kiel *et al.* 1998).

DESCRIPTION

Spire whorls are high, very convex and separated by deep sutures. Last whorl is very high, globular, slightly elongate in the base, measuring more than ¾ of the shell height. The teleoconch lacks a prominent umbilicus and shows an enrolled columellar lip. The rate of the width to the height (LT/HT) is approximately 0.75, apex angle is between 90-95 and LT (width)/D1 (diameter) of shell is 1.04-1.1 (Appendix 1).

REMARKS

The studied specimen resembles both "*Ampullina*" *vapincana* and "*Ampullina*" *vulcani* (Brongniart, 1823), the two being considered possible conspecific (Piccoli & Mocellin 1962; Brigantini 1985). Based on comparison with type material from the d'Orbigny and Brongniart collections of the Muséum national d'Histoire naturelle, Paris (MNHN, Département Histoire de la Terre) (B24241-4: Faudon, Hautes Alpes, France; B22105: Roncà, Italy), "*A.*" *vapincana* is considered distinct by its more convex and higher spire whorls. The specimen, as expressed by parameters shown in Appendix 1, is thus assigned to the d'Orbigny species.

"***Ampullina***" cf. ***vulcani*** (Brongniart, 1823) (Fig. 5C, D)

Ampullaria vulcani Brongniart, 1823: 57, pl. 2, fig. 16a, b.

Natica (*Ampullina*) *vulcaniformis* Oppenheim, 1896: 174, pl. 16, figs 4, 4a.

Globularia (*Globularia*) *vulcani* – Karagiuleva 1964: 175, 176; pl.49, fig. 4a-c.

Ampullina vulcani – Brigantini 1985: 411, 412; pl. 2, fig. 14. — Klepač 2003: 336, 337; pl. 64.

MATERIAL EXAMINED. — Four specimens, MTA-Y.İ.-2007-06 to 11.

LOCALITY AND HORIZON. — Grey siltstone-mudstone, Kırkkavak Formation (Macunköy: samples G1, G2, G3).

PALAEOGEOGRAPHIC DISTRIBUTION. — Paris Basin: Late Eocene; Bulgaria: Late Eocene (Karagiuleva 1964); N Africa: Middle-Late Eocene; Croatia (Island of Krk): Late Cuisian-Early Lutetian (Klepač 2003); Monte Postale (N Italy): Eocene (Oppenheim 1896).

DESCRIPTION

Spire whorls are slightly rounded, separated by deep suture lines. Last whorl is rounded and strongly convex. It takes up to more than ¾ of the shell height. The rate of LT/HT is between 0.82-0.85 and LT/D1 is 1.15-1.16 (Appendix 1).

REMARKS

By comparison of our material with the type material deposited in the collections of the MNHN, the specific features of the investigated specimens match those of "*Ampullina*" *vulcani*, differing from the morphology of "*A.*" cf. *vapincana* by a shorter last whorl, less globular shape and slightly convex, shorter spire whorls.

"***Ampullina***" cf. ***sireli*** (Okan & Hoşgör, 2008)
(Fig. 6N, O)

Globularia sireli Okan & Hoşgör, 2008: 10, pl. 2h-m.

MATERIAL EXAMINED. — Two specimens, MTA-Y.İ.-2007-1.

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: samples G3).

PALAEOGEOGRAPHIC DISTRIBUTION. — Macunköy (Polatlı, Central Turkey): Late Thanetian-Early Ilerdian (Okan & Hoşgör 2008: based on the former age interpretation of SBZ5-6 biozones given by Sirel 1975 and Serra-Kiel *et al.* 1998).

REDESCRIPTION

Shell is globular, wide, spire is rather short, spire whorls are slightly rounded, stepped, separated by deep suture lines. Last whorl with an angular shoulder is globular, strongly wide, ovate towards the base. Aperture is narrow and ovate. The rate of the width to the height (LT/HT) is approximately 0.92 and apex angle is between 105-110° (Appendix 1).

REMARKS

This species is similar to "*Globularia sireli*" which was described from the Macunköy section of the Kırkkavak Formation by Okan & Hoşgör (2008: 10, pl. 2h-m). They assigned their specimens to *Globularia* Swainson, 1840. However, the figured specimens differ from *Globularia* in having egg-shaped shells comprising elevated and stepped whorls, broad callus, large body whorl and half-moon-shaped ovate aperture and more likely fit in the genus *Ampullina*. The species is distinguished from "*Ampullina*" cf. *vulcani* and "*Ampullina*" cf. *vapincana* by a wider and more stepped last whorl.

Genus *Crommium* Cossmann, 1888

TYPE SPECIES. — *Natica willemeti* Deshayes, 1824. Middle Eocene: Paris Basin.

Crommium has moderately large to medium size, thick, globular shell. The most characteristic prominent features are the short, sharp, and concave spire, arched or somewhat flattened, stepped teleococh whorls separated by deep suture lines. The shell surface is smooth or ornamented very fine spiral lines and its last whorl very large, usually more or less flattened above, umbilicus slightly open or covered in part by the overthrow of the columellar edge and aperture narrow, ovate-elongated ovate

Crommium was described from Late Cretaceous-Miocene deposits from Europe, Iran, North and South America (Wenz 1938).

In previous studies *Crommium* was included in subfamily Globulariinae Wenz, 1941 of the family Naticidae Guilding, 1834 considering the general shape of the teleoconch (Cossmann 1888; Wenz 1938). Recently, the genus has been assigned to Ampullospiridae Cox, 1930 (=Ampullospirinae Marincovich, 1977), based on morphological similarities of the teloconch and protoconch features to the "living ampullospirid species" *Cernina fluctuata* (Kase & Ishikawa 2003). Following the latter we include this genus in Ampullinidae.

"***Crommium***" sp. 1
(Fig. 5L, M)

MATERIAL EXAMINED. — 13 specimens, MTA-Y.İ.-2007-12 to 15.

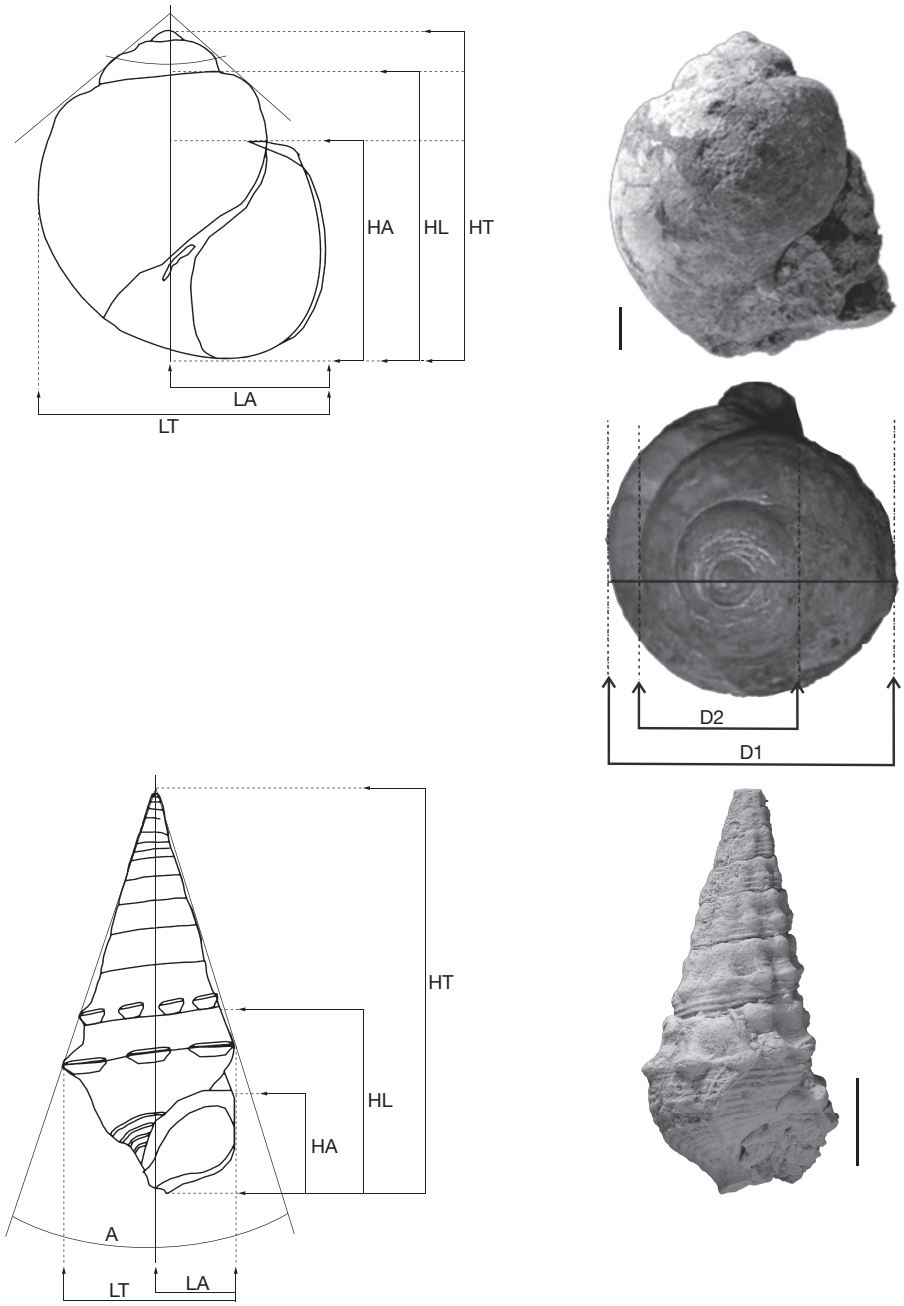

FIG. 4. — Biometric parameters of the caenogastropods used in this study (see Appendix 1 for measurements). Abbreviations: **A**, apex angle; **D1**, diameter of shell; **D2**, diameter of spire; **HA**, height of aperture; **HL**, height of body whorl; **HT**, height of the shell; **LA**, width of aperture; **LT**, width of shell. Scale bars: 1 cm.

LOCALITY AND HORIZON. — Grey siltstone-mudstone, Kırkkavak Formation (Macunköy: sample G3,4).

DESCRIPTION
High and stepped conical spire, spire whorls slightly convex, are flattened and become more pronounced in the abapical part. The body whorl is slightly convex, with an ovate shape and an angular shoulder, forming about ¾ of the shell height. Aperture elongated and slightly curved towards the base. Its apical angle is rather narrow between 83-86°, the range of LT/D1 is 1.14-1.32 (Appendix 1).

"***Crommium***" sp. 2
(Fig. 6P, R)

MATERIAL EXAMINED. — Two specimens, MTA-Y.İ.-2007-16 and 17.

LOCALITY AND HORIZON. — Grey siltstone-mudstone, Kırkkavak Formation (Macunköy: sample G4).

DESCRIPTION
High and slightly concave conical spire, with high and convex whorls. The last whorl is globular with a stepped outline, its upper surface somewhat flattened. The aperture is narrow and ovate. The apical angle is wider (between 105-107), HL/HT is shorter (0.80-0.82), LT/HT is 0.89-0.96 (Appendix 1).

REMARKS
"*Crommium*" sp. 2 differs from "*Crommium*" sp. 1 by concave stepped spiral whorls and a shorter body whorl.

Ampullinidae indet.
(Fig. 5E, F)

MATERIAL EXAMINED. — Two specimens, MTA-Y.İ.-2007-18.

TYPE LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: sample G1).

DESCRIPTION
Shell thick, medium sized, ovate globular, spire conical, high, spire whorls convex, stepped, separated by deep suture lines, body whorl ovate, narrow, forms about 70 % of total shell height. The umbilicus is covered by a thickened callus from the columellar part of the inner lip, the aperture is moderately narrow, ovate, quadrangular and elongated towards the base.

Order SORBEOCONCHA
Ponder & Lindberg, 1997
Superfamily CAMPANILOIDEA Douvillé, 1904
Family CAMPANILIDAE Douvillé, 1904

Genus *Campanile* Bayle *in* Fischer, 1884

TYPE SPECIES. — *Cerithium giganteum* Lamarck, 1804. Eocene (Lutetian): Paris Basin.

Campanile giganteum (Lamarck, 1804)
(Fig. 5G)

Cerithium giganteum Lamarck, 1804: 439. — Deshayes 1824: t. 2, 300-302, pl. 42, figs 1, 2. — Cossmann 1906: 71, 72, pl. 1, figs 1, 2.

Cerithium vicetinum Bayan, 1870: 30, pl. 2, figs 5-7.

Cerithium (*Campanile*) *giganteum* – Oppenheim 1896: 43, p. 183, pl. 12, fig. 5.

Campanile cf. *giganteum* – Boussac 1911: 283, pl. 17, figs 53, 54.

Campanile giganteum – Güngör 1975: 30, 31; pl. 1, fig. 1; pl. 5, fig. 1.

MATERIAL EXAMINED. — Six specimens, MTA-Y.İ.-2007-19 to 23.

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: sample G1).

PALAEOGEOGRAPHIC DISTRIBUTION. — Pyrenean Basin (Spain): Cretaceous-Early Eocene (Dominici & Kowalke 2007); Monte Postale (Italy): Eocene (Oppenheim 1896); Haymana-Polatlı Basin (Turkey): Lutetian (Middle Eocene) (Stchépinsky 1946; Güngör 1975); Crotia: Early Lutetian (Klepač 2003); Hampshire Basin (England): Eocene: Lutetian (Wrigley 1940).

DESCRIPTION
Shell is large-sized, massive, highly conical, whorls are flat, stepped, separated by thin suture lines, in-

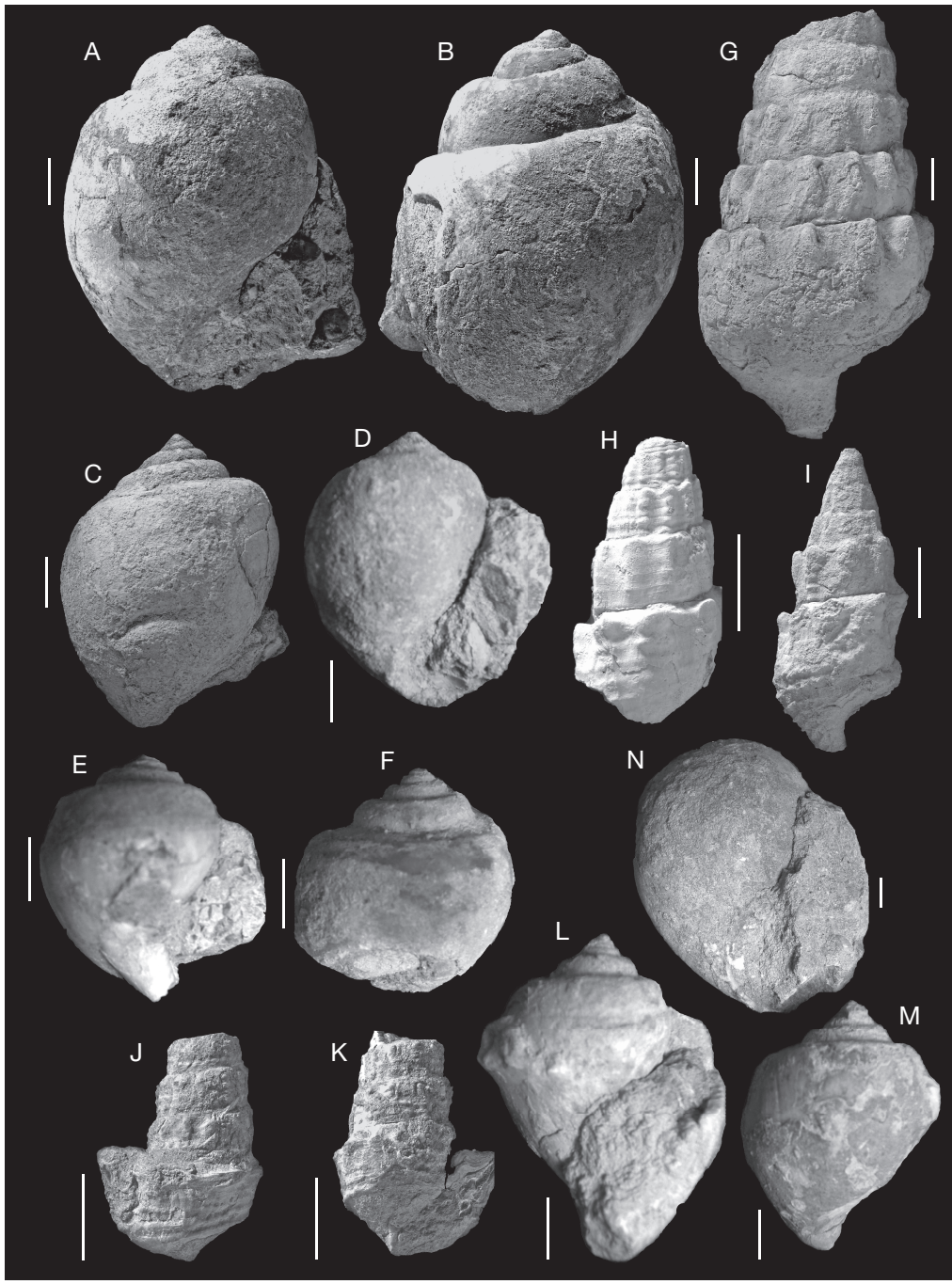

FIG. 5. — Caenogastropods (deposited in the repositories of the General Directorate of Mineral Research and Exploration, Ankara): **A**, **B**, **N**, "*Ampullina*" cf. *vapincana* (d'Orbigny, 1850); **C**, **D**, "*Ampullina*" cf. *vulcani* (Brongniart, 1823); **E**, **F**, "Ampullinid" indet.; **G**, *Campanile giganteum* (Lamarck, 1804); **H**-**K**, *Cerithium puigcercosensis* (Cossmann, 1897) n. comb.; **L**, **M**, "*Crommium"* sp. 1. Scale bars: 1 cm.

creasing in width and height from apex to aperture, there are 11 or 12 convex, slightly opisthocline axial ribs on each whorl of the early teleoconch, decreasing in numbers but increasing in width towards body whorl, body whorl is relatively small, rounded, quadrangular, with a short siphonal channel.

REMARKS.
Cerithium vicetinum Bayan, 1870 represents a synonym based on juvenile specimens of *C. giganteum* and a mistake due to ontogenetic changes in sculpture. *Campanile lachesis* (Bayan, 1870) has similar height and whorl shape to *C. giganteum* more slender shell with many whorls with strong adapical nodes, which may be elongated to short spines. *Campanile paronae* Boussac, 1911, from the late Eocene of France, differs in having flat spire whorls with disordered thick and rounded tubercules increasing in size towards the body whorl (Boussac 1911: 283, 284, pl. 17, figs 59, 63, 64 [Turin Basin]).

Superfamily CERITHIOIDEA Fleming, 1822
Family CERITHIIDAE Fleming, 1822
Subfamily CERITHIINAE Fleming, 1822

Genus *Cerithium* Bruguière, 1789

TYPE SPECIES. — *Cerithium nodulosum* Bruguière,1789. Extant: Indo-Pacific.

Cerithium puigcercosensis
(Cossmann, 1898) n. comb.
(Figs 5H-K; 6A)

Batillaria puigcercosensis Cossmann, 1898: 19, pl. 8, figs 1-4. — Cossmann 1906: 134.

MATERIAL EXAMINED. — 75 specimens, MTA-Y.İ.-2007-24 to 27. Three specimens in the NHMV (2008z0310/0013).

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: sample G2, G3, G4).

PALAEOGEOGRAPHIC DISTRIBUTION. — Pyrenees (Spain): Early Ypresian (Early Eocene) (Dominici & Kowalke 2007).

DESCRIPTION
Shell is narrow conical, turriculate, medium-sized. Spire consists of up to 6 stepped whorls separated by a deep suture. Each whorl is characterized by wide-spaced prominent axial ribs crossed by four spiral threads. The intersections bear marked nodes where the spiral cords intersect the axial ribs. The first row of nodes is the biggest and projecting one, whereas the subsequent series become smaller towards the adapical part of the whorl. Base ornamented by seven rounded spiral cords. The aperture is siphonostomate, with elongated oval shape and deeply-incised siphonal canal.

REMARKS
This species differs from *Batillaria* by lacking rounded whorls and only subordinated spiral sculpture, which is always strongly developed in *Cerithium* spp.

Cerithium cf. ***anguloseptum*** Rauff, 1885
(Fig. 6J)

Cerithium anguloseptum Rauff, 1885: 31, pl. 11, figs 17, 23, 24, 26, 29, 30. — Oppenheim 1896: 185-187; pl. 15, figs 5, 6.

MATERIAL EXAMINED. — One specimen hosted in the NHMV (2008z0310/0012).

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: sample G2).

PALAEOGEOGRAPHIC DISTRIBUTION. — Monte Postale (Italy): Ypresian (Oppenheim 1896).

DESCRIPTION
Medium-sized shell of up to nine whorls ornamented with a prominent, opisthocline, thick and rounded axial ribs crossed by 3-5 fine spiral threads. The intersections of axial ribs and spiral threads form tubercules growing up to the last whorl. Suture line is deep. The last whorl is inflated. The spiral threads are dominant at the base. Aperture is elongated oval.

REMARKS
The identity of the only specimen of *Cerithium anguloseptum* from the Eocene of Monte Postale is uncertain, due to its wider apical angle (40°; *Cerithium anguloseptum* has a 30° angle) and more inflated body

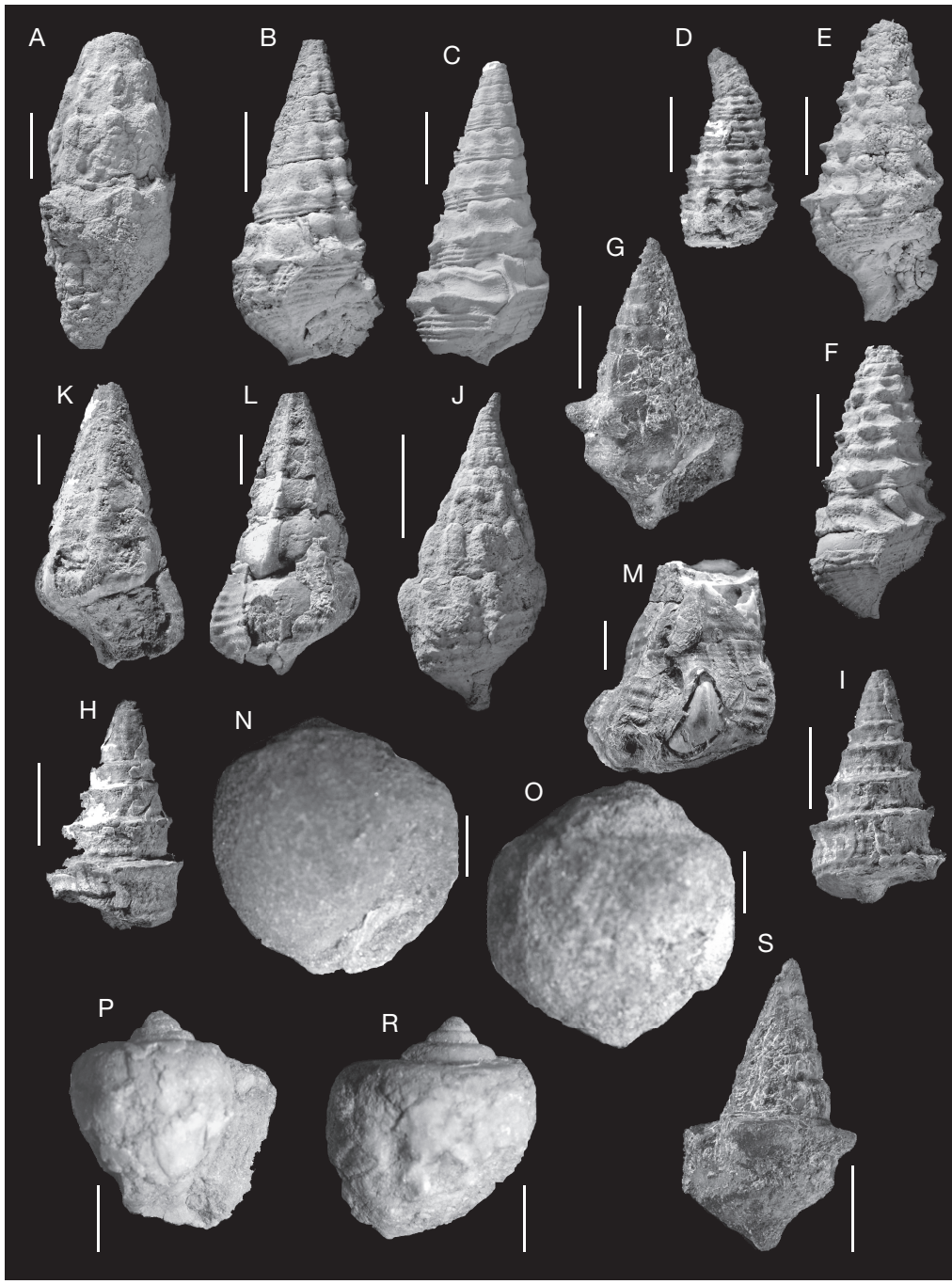

Fig. 6. — Caenogastropods (deposited in the repositories of the General Directorate of Mineral Research and Exploration, Ankara): **A**, *Cerithium puigcercosensis* (Cossmann, 1897) n. comb.; **B**-**F**, *Vicinocerithium* cf. *subacutum* (d'Orbigny, 1850); **G**, **S**, *Bellatara ankaraensis* n. sp., holotype; **H**, **I**, *Tympanotonos turris* (Deshayes, 1833); **J**, *Cerithium* cf. *anguloseptum* Rauff, 1884; **K**-**M**, *Gantechinobathra vulcani* (Brongniart, 1823); **P**-**R**, "*Crommium*" sp. 2. Scale bars: 1 cm.

whorl and thicker perpendicular axial ribs. *Cerithium* (*Thericium*) *depereti* Doncieux, 1908 from the early Eocene of the Corbières, France (Doncieux 1908: 116, pl. 7, fig. 1a-c; Plaziat 1970: 28, pl. 14, fig. 11) differs by its more plump shell having flat whorls with perpendicular, thicker and closer axial ribs. Our specimen has curved apical whorls, a variable feature of cerithioids which inhabit brackish environments (Plaziat 1977).

Cerithiidae indet.
(Fig. 7H)

MATERIAL EXAMINED. — One specimen hosted in the NHMV (2008z0310/0004).

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: sample G4).

DESCRIPTION
Large, teloconch with five spiral whorls (apex missing). Eight strong axial costae gradually becoming angular and more widely spaced in the middle of each whorl, as the spiral elements become more pronounced and the sutures more deeply impressed. The last whorl comprises slightly less than one half of the total height. The aperture is more angular than in the type specimen.

REMARKS
Unfortunately, we have no apex and complete apertural data. However, the large shell is very close to *Cerithium* in having strongly developed spiral sculpture and projecting tubercules. The specimen can also be compared to *Vicinocerithium* Wood, 1910 (type species is *Vicinocerithium bouei* (Deshayes, 1824), Europe, Eocene), which has a prominent spiral band, spinose tubercules and axial elements. *Benoistia* (type species *Cerithium muricoides* Lamarck, 1804, Middle Eocene [Lutetian], Paris Basin) is morphologically similar, but has a smaller shell with a higher apical angle (Cossmann 1906: 98, pl. 4. figs 24-27).

Genus *Bellatara* Strand, 1928

TYPE SPECIES. — *Bellardia janus* Mayer-Eymar, 1870 (= *Bellatara paleochroma* (Bayan, 1870)).

PALAEOGEOGRAPHIC DISTRIBUTION. — Italy (Monte Postale): Eocene (late Ypresian).

REMARKS
Species of the genus *Bellatara* are represented in the Eocene (Wenz 1938), the Oligocene of Europe (from Greece; Harzhauser 2004) and Indian Ocean Province (Baluchistan; Vredenburg 1925). It was included in the family Cerithiidae by Wenz (1938). However, there are some suspicions whether this genus belongs to this family or not (Harzhauser 2004). *Bellatara* has conical cerithioid shell sometimes with curved spire and almost flat whorls. The most characteristic prominent feature is the thick and projecting spines in the body whorl, a character held in common with members of the family Cerithiidae. Unfortunately, the protoconch morphology of *Bellatara* is still unknown. Thus, its relationship to cerithiids remains enigmatic.

Bellatara ankaraensis n. sp.
(Fig. 6G, S)

HOLOTYPE. — MTA-Y.İ.-2007-45.

PARATYPES. — MTA-Y.İ.-2007-46 and 47.

ETYMOLOGY. — After the name of Ankara, the capital city of Turkey, the nearest city to the locality.

OTHER MATERIAL EXAMINED. — 73 other non-type specimens (MTA-Y.İ.-2007-48 to 50).

TYPE LOCALITY AND HORIZON. — Grey siltstone-mudstone, Kırkkavak Formation (Macunköy: sample G1, G2, G3, G4).

DIAGNOSIS. — Medium-sized, up to 3.5 cm in height, turriculate shell of up to ten whorls; the spire is slender and conical; the spire whorls are flat, with two spiral rows of rounded nodes, the suture line is deep and grooved producing a stepped spire; the last whorl has 4 or 5 thick, rounded and projecting spines, increasing in thickness towards adapertural part of the whols, 5 or 6 thin and sharp spiral bands producing a slightly angulated outline of the base of the body whorl, aperture is oblique ovoidal with deeply incised and elongated anal siphonal canal, columellar lip folded, outer lip is sharp.

REMARKS
Bellatara ankaraensis n. sp. is closely related to *B. paleochroma* (Bayan, 1870) (= *Cerithium* (*Bellardia*)

Fig. 7. — Caenogastropods (deposited in the repositories of the Natural History Museum of Vienna and in the General Directorate of Mineral Research and Exploration, Ankara): **A**, *Tympanotonos* sp.; **B**, ?*Melanoides* sp.; **C**, *Terebralia* sp. 1; **D**, *Terebralia* sp. 2; **E**, *Vicinocerithium seni* n. sp. (paratype-Vienna museum); **F**, *Vicinocerithium seni* n. sp. (paratype-MTA, Ankara); **G**, *Vicinocerithium seni* n. sp. (holotype-MTA, Ankara); **H**, "*Cerithiid*" indet.; **I**, *Haustator granulosa* (Deshayes, 1824); **J**, *Haustator* sp.; **A**-**D**, **G**, **H**, NHMV; **E**, **F**, **I**, **J**, MTA. Scale bars: 1 cm.

paleochroma Bayan, 1870 = *Cerithium* (*Bellardia*) *janus* Mayer, 1870) from the Eocene of Italy, but differs in the less plump spire whorls with two row nodes ordered one below the other, causing an axial rib like appearance. Moreover, its aperture is more oblique with elongated siphonal canals. *Bellatara paleochroma* possesses a more slender, flat and slightly concave shell with 6-8 spines in the penultimate and last whorls (Oppenheim 1896: 182, pl. 15, figs 1-3). *Bellatara ankaraensis* n. sp. differs distinctly from Eocene *B. vellicatum* (Bellardi, 1852) and *B. verneulii* (Rouault, 1850) by its shorter spire and by the ornamentation. *Bellatara vellicatum* has a slender shell, ornamented with granules growing towards the last whorl. *Bellatara verneulii* bears axial sculpture. The Oligocene *B. lozoueti* Harzhauser, 2004 has an elongated body whorl and irregular, but continuous keel (Harzhauser 2004: 118, pl. 7, figs 5-7), whereas *B. narica* (Vredenburg, 1925) has a sculpture of axial ribs restricted to the last two whorls.

Family POTAMIDIDAE
H. Adams & A. Adams, 1854

Genus *Terebralia* Swainson, 1840

TYPE SPECIES. — *Terebralia palustris* (Linnaeus, 1767). Extant: Indo-Pacific.

Terebralia sp. 1
(Fig. 7C)

MATERIAL EXAMINED. — One specimen deposited in NHMV (2008z0310/0002), seven specimens in Ankara (MTA-Y.İ.-2007-51 and 52).

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: samples G2, G3).

DESCRIPTION
Medium in size, turreted-conical shell, teleoconch with more than six short flat whorls; body whorl one-third of total; sutures only slightly impressed; three spiral cords intersecting 15 or 16 axial costae and forming blunt, widely spaced tubercules. Base ornated with 5 or 6 spiral ribs, rounded body whorl; medium-sized anterior canal.

REMARKS
The oldest species of this genus known so far are *Terebralia subcorvina* (Oppenheim, 1894) from the Lutetian of Gánt (Kowalke 2001), *T. bonellii* (Deshayes, 1833) from the Paris Basin (Deshayes 1824) and the Hampshire Basin, England (Wrigley 1940). The present species is related to *T. bonellii*, but differs in having less impressed sutures and a conical shape, three spiral cords instead of four and larger tubercles. It differs from *T. subcorvina* by its much smaller size and by lacking the characteristic feature of decreasing sculpture in the course of the ontogeny.

Terebralia sp. 2
(Fig. 7D)

MATERIAL EXAMINED. — One specimen deposited in the NHMV (2008z0310/0005).

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: sample G3).

DESCRIPTION
Medium-sized, turreted-conical shell, teleoconch with more than six whorls, body whorl almost as long as the spiral whorl, impressed sutures. Weak spiral and axial sculpture, details unclear due to bad preservation. Oval and oblique aperture attached to body whorl, short and narrow anterior canal, inner lip smooth and twisted, thinner than the outer lip.

REMARKS
Terebralia bonellii is characterized by a wider and flared aperture separated from the body whorl and a larger anterior canal. *Terebralia* sp. 1 from Macunköy differs in having a less impressed suture and a pronounced ornamentation, although this last character is here determined with uncertainty due to bad preservation. Turkish *Terebralia* spp. allow to extend the record of the genus to the early Eocene, previous reports being doubtful (Reid *et al.* 2008).

Genus *Tympanotonos* Schumacher, 1817

TYPE SPECIES. — *Murex fuscatus* Linnaeus, 1758. Extant: W Africa.

The genus is based on the only living species *Tympanotonos fuscatus* (Linnaeus, 1758) from West African tropical shores. The type species is characterized by three spiral ribs strongly beaded by axial folds on each spiral whorl, with one riblet intercalated between the two anterior ribs, another riblet between anterior rib and suture, and the shoulder rib typically enlarged and sometimes spinose. Previous authors included several fossil species in the genus (e.g., Cossmann & Pissarro 1910, 1911), such as the middle Eocene *Tympanotonos calcaratus* (Brongniart, 1823) from the Western Tethys. The latter shows the variability of the living species, particularly regarding the number and type of spiral and axial elements, resulting in a granulate, tuberculate or spinose sculpture, sometimes changing within the same specimen (Plaziat 1970; Kowalke 2001). Bearing this variability in mind Kowalke (2001) included within *Tympanotonos* genera or subgenera such as *Eotympanotonos*, *Ptychopotamides* and *Potamidopsis*. Among Eocene potamidid genera, *Campanilopsis* Chavan, 1849 was considered a possible synonym of *Telescopium* Montfort, 1810. On the other hand, Reid *et al.* (2008) have lately assigned all Eocene "*Tympanotonos*", incuding *Eotympanotonos* and *Ptychopotamides*, to the genus typified by the Oligocene species *Potamides lamarkii* Brongniart, 1810. These authors attribute to *Potamides* the large variability of rib sculpture shown by Eocene species. Here the traditional solution reviewed by Kowalke (2001) is preferred, leaving *Potamides* for smaller-sized potamidids with rounded whorls that appeared in the Oligocene of the Tethys having a characteristic sculptural development of the protoconch and the early teleoconch, well distinguished from *Potamides*.

Tympanotonos turris (Deshayes, 1833)
(Fig. 6H, I)

Cerithium turris Deshayes, 1833: 335, pl. 35, figs 13, 14.

Potamides monsecanus – Cossmann 1896: 187, pl. 9, figs 18-20.

Potamides orengae – Cossmann 1896: 190, pl. 9, figs 15-17.

Tympanotonos turris – Cossmann & Pissarro 1910: t. 2, 29, fig. 151/6.

MATERIAL EXAMINED. — One specimen, MTA-Y.İ.-2007-53, from the early Ypresian of Kırkkavak Formation, Haymana-Polatlı Basin, Turkey.

LOCALITY AND HORIZON. — Grey siltstone-mudstone, Kırkkavak Formation (Macunköy: sample G2).

PALAEOGEOGRAPHIC DISTRIBUTION. — France: Early Ypresian (Early Eocene) (Cossmann & Pissarro 1911).

DESCRIPTION

The medium-sized shell has a conical spire consisting of eight slightly concave whorls with incised sutures. Up to five spiral ribs are recognized in each spiral whorl, six in the body whorl. The crossing of axial ribs with the posterior and more pronounced spiral rib forms sharp, close, elongated spines, resulting in a strong shoulder and a steep angular outline. The anterior ribs bear smaller and indistinct nodes. Whorls rapidly increase in width, resulting in a turriculated spire. The body whorl is short with a flat base sculptured by six widely-spaced spirals, the anterior ones being slightly more pronounced than the intermediate, crossed by oblique S-shaped growth lines. The aperture is siphonostomatous.

REMARKS

This species has a characteristic conoidal and turriculate shape, angular outline and pronounced shell ornamentation. The single specimen collected in Kırkkavak have a more prominent posterior spiral rib with respect to the holotype figured by Deshayes (1833). However, the species is highly variable, as recognized by Deshayes and proven by a comparison with material from the type area in the Sparnacian of the Paris Basin (see for example sample number J02518 within a sample from Pourcy, Marne, housed at the MNHN). On the other hand of the spectrum are morphotypes with a higher spire and distantly-spaced spines and tubercules, ribs being as few as three in the spiral, four in the body whorl. Deshayes (1833) under-

lines the similarities between "*Cerithium*" *turris* and *C. papalis* (Deshayes, 1833) another species he described from the Cuisian (late Ypresian) type locality. The latter can be distinguished on the basis of more numerous, finely sculptured spiral ribs and a less tuberculate posterior ramp.

Tympanotonos sp.
(Fig. 7A)

MATERIAL EXAMINED. — One specimen housed at the NHMV (2008z0310/0007).

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: sample G2).

DESCRIPTION
Medium-sized, turreted-conical shell, up to 27 mm high. Teloconch with more than seven slightly concave whorls with incised sutures. Four spiral ribs are visible. The adapical spiral is strongly developed, producing the shouldered outline of the shell. Early teleoconch whorls bear 12-16 axial ribs, which decrease in the course of the ontogeny to 10 on the body whorl. Nodes to short spines are formed in the points of intersection of the spiral and axial sculpture. Whorls moderately increase in width, resulting in an elongate turriculated outline of the shell; the aperture is narrow and quadrangular, siphonal channel slightly curved.

REMARKS
Tympanotonos sp. differs from *T. turris* by its more elongated shell, by bearing only four spirals and by the strongly developed axial sculpture.

Genus *Gantechinobathra* Kowalke, 2001

TYPE SPECIES. — *Terebra vulcani* Brongniart, 1823. European Eocene.

Gantechinobathra vulcani (Brongniart, 1823)
(Fig. 6K-M)

Terebra vulcani Brongniart, 1823: 67, pl. 3, fig. 11.

Cerithium vapincense – d'Orbigny 1850: t. 2, 367, fig. 588.

Cerithium (*Potamides*) *vulcani* – De Gregorio 1896: 72, pl. 8, fig. 31.

Cerithium vulcani – Boussac 1911: 305, 306.

MATERIAL EXAMINED. — Five specimens, MTA-Y.İ.-2007-54 to 58.

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: samples G2, G3).

PALAEOGEOGRAPHIC DISTRIBUTION. — Nigeria: Early Eocene; Romania, Hungary: Lutetian; Roncà (Italy): Bartonian.

DESCRIPTION
Shell is medium to large sized, wide-conical shaped with 30° apical angle bearing more than six flat whorls. The ornamentation of each whorl consist of prominent, thick, wide-spaced and slightly orthocline axial ribs lined up together. They attain their maximum strength in the posterior part of the whorls. Up to seven blunt axial ribs are accompanied by huge varices causing an angular outline of the shell and angular outline of the apertural margin. Axial ribs run by spiral cords which become thicker in the last whorl. Last whorl more convex and rounded in the posterior, but having angular corner in the anterior side. Aperture is narrow, diagonal, quadrangular-ovate, siphonal canal is short.

REMARKS
Our samples have been compared to the specimens of *Gantechinobathra vulcani* from Roncà, Italy (MNHN.F.B22659). On first appearance, the pyramidial shape and flat whorls are very similar to those of *Pyrazus pyramidatus* Deshayes, 1833 from the Cuisian of the Paris Basin (Cossmann & Pissarro 1910: t.2, pl. 29, fig. 151-2). However, it differs by its wider conical angle and clear difference between spire and last whorl width. *Cerithium fodicatum* Bellardi, 1852 from the Late Eocene (Auversian) of Turin Basin (Italy) displays similar strong axial ribbing. However, its apex angle is smaller, axial ribs are convex and not lined up one with the other whorls (Bellardi 1852: t. 4, 226, pl. 14, fig. 10; Boussac 1911: 289, pl. 17, figs 55, 56). On the other hand

our specimens also closely resemble those of the samples from Early Eocene units of Nigeria (MNHN.F.B44487).

Family BATILLARIIDAE Thiele, 1929

Genus *Vicinocerithium* Wood, 1910

TYPE SPECIES. — *Vicinocerithium bouei* (Deshayes, 1824). Europe, Eocene.

Vicinocerithium cf. ***subacutum*** (d'Orbigny, 1850) (Fig. 6B-F)

Cerithium subacutum d'Orbigny, 1850: 318, no. 385.

Batillaria subacuta – Erünal 1942: 128, figs 11, 12. — Stchépinsky 1946: 55, pl. 22, figs 19, 20.

Vicinocerithium subacutum – Pacaud 2007: 32.

MATERIAL EXAMINED. — 12 specimens (MTA-Y.İ.-2007-28 to 33).

LOCALITY AND HORIZON. — Grey siltstone-mudstone, Kırkkavak Formation (Macunköy: samples G1, G2).

PALAEOGEOGRAPHIC DISTRIBUTION. — Paris Basin (France); NW Turkey (Gündüzler/Kocaeli, Sünnet/Bolu): Late Ypresian (Stchépinsky 1946); Hampshire (England): Ypresian (Jeffery & Tracey 1997).

DESCRIPTION

Medium-sized, slender shells with more than seven flat whorls, incised, deep sutures. The sculpture of the whorls consists of spiral threads and projecting tubercules. Adapical part of each whorl comprises more than half part of the whorl and includes two granulate rows. Towards the last whorl, the length and width of the granules increase causing a slight angulation in the median line of the whorls as short spines between 9-10 in number. Abapical part of the whorls include only prominent up to four spiral threads. The granule rows of the whorls tied up with spiral threads being not dominant. The shell is decorated fine oblique, prosocline growth lines. Last whorl appears to be inflated. It's spines are strongly projecting. The posterior side of the base is characterized by at least 5 thick spiral threads. Aperture is typical cerithioid, oblique ovoidal siphonostome.

REMARKS

The specimens were compared to the very similar species *Batillaria subacuta* from Cuisian of Paris Basin and *Batillaria praesubacuta* Doncieux, 1908 from Sparnacian of Corbières Basin of France, as represented in the collections of the MNHN. The most distinctive features between these two species is that *Batillaria praesubacuta* has a more narrow and slender shell lacking the prominent spiral threads (Doncieux 1908). Compared to *Batillaria subacuta* (MNHN.F.J02530; Cuise, La Motte, Oise, France), our samples have a thicker shell and more spiral threads (up to four) in the spire whorls. Our smaller specimens display only small granules, whereas the adults have bigger spines in the last whorl. Moreover, some specimens have curved apex which is a known feature of brackish water environments (Plaziat 1977; Kowalke 2006a: south Mediterranean Quaternary). Compared to syntypes (syntypes of Doncieux hosted at the MNHN) of *Batillaria praesubacuta* (MNHN.F.R64133; Fabrezan, Aude, France), no spiral cords are observed on the slender shells of *Batillaria praesubacuta*. Only few specimens from the collections from the Corbières Basin (Collection Courtessole-Griffe; MNHN 1989-3) were characterized by a sculptural pattern of fine spiral threads. Another similar species is *Batillaria fauvergei* Doncieux, 1908 from Sparnacian of Corbières Basin (Collection Courtessole-Griffe, MNHN; ruinean de Perlinge, Caunettes-en-Val, France). But it differs from *V. subacuta* (d'Orbigny, 1850) by having one row of small rounded nodes.

The investigated specimens have sculptural pattern suggesting a relationship with *Batillaria subacuta*. Ornamentation is formed by spiral bands and sharp spinous tubercules. The species is provisionally placed in genus *Vicinocerithium* Wood, 1910 which was described as a subgenus of *Batillaria* by Wenz (1938). Given the distinct differences between *Batillaria* and *Vicinocerithium*, this species is proposed in a separate genus *Vicinocerithium* Wood, 1910 of the family

Batillariidae (Lozouet pers. corresp. 2005). Thus, usage of *Vicinocerithium* cf. *subacutum* (d'Orbigny, 1850) is appropriated.

Vicinocerithium seni n. sp.
(Fig. 7E-G)

HOLOTYPE. — MTA-Y.İ.-2007-34.

PARATYPES. — Seven paratypes in Ankara (MTA-Y.İ.-2007-35 to 41) and one paratype (NHMV 2008z0310/0001).

ETYMOLOGY. — In honour of Şevket Şen (CNRS, MNHN).

OTHER MATERIAL EXAMINED. — 118 specimens (MTA-Y.İ.-2007-42 to 44).

TYPE LOCALITY AND HORIZON. — Grey siltstone-mudstone, Kırkkavak Formation (Macunköy: samples G1, G2, G3).

DESCRIPTION
Angular whorls with 6-8 irregular, primary and secondary spiral riblets and 9-10 strong axial elements forming big, strong and smooth tubercules, connected by more pronounced spiral elements. Prominent axial elements are formed by the coalescence of thick tubercules in the adapical part of the whorls. This structure is oblique prosocline from the initial whorls towards the body whorl. The concave base is ornamented by spiral riblets similar to the riblets in the base of each spiral whorl. The anterior canal is elongated and the aperture is cerithioid with oblique ovoidal siphonostome.

REMARKS
The species differs from *Vicinocerithium* cf. *subacutum* and *Batillaria praesubacuta* by its prominent axial elements and prominent spiral threads (Doncieux 1908).

Family THIARIDAE Troschel, 1857

Genus *Melanoides* Olivier, 1804

TYPE SPECIES. — *Nerita tuberculata* Müller, 1774. Recent: subtropical-tropical Africa and Asia.

?***Melanoides*** sp. (Fig. 7B)

MATERIAL EXAMINED. — One specimen deposited in NHMV (2008z0310/0003).

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak Formation (Macunköy: sample G1).

DESCRIPTION
Slightly fusiform shell, last whorl little less than half of the total; turriculated spire composed of more than 7 whorls, suture impressed. In the early teloconch spiral cords intersect axial cords forming 3 series of circular nodes each with 14 or 15 nodes. The nodes tend to merge one into the other, forming in the body whorl 14 or 15 axially coalescent elements. Last whorl gently convex, base more than twice higher than the whorl, with 6 spiral cords more pronounced in the middle part. Narrow and oblique aperture.

REMARKS
Melanoides vidali (Cossmann, 1897) has similar size, shell shape and sculpture. However, it differs by the lack of a turriculated spire, the axial cords are always strongly developed than the spiral ones, and more sinuose in course with respect to *M. vidali*.

Superfamily TURRITELLOIDEA Lovén, 1847
Family TURRITELLIDAE Lovén, 1847

Genus *Haustator* Montfort, 1810

TYPE SPECIES. — *Turritella imbricataria* (Lamarck, 1804): Lutetian, Paris Basin.

Haustator granulosa (Deshayes, 1824)
(Fig. 7I)

Turritella granulosa Deshayes, 1824: 225, pl. 37, figs 1, 2. — Cossman 1888: 301, fasc. 3.

Turritella (*Haustator*) *granulosa* – Mészáros 1957: 124, pl. 27, figs 3, 3a.

MATERIAL EXAMINED. — One specimen hosted in Ankara (MTA-Y.İ.-2007-Polatlı-59).

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak formation (Macunköy: sample G2).

PALAEOGEOGRAPHIC DISTRIBUTION. — Paris Basin (France): Middle-Late Eocene (Cossmann 1888); Transylvania basin (Romania): Late Eocene (Mészáros 1957).

DESCRIPTION

Shell is small, narrow, turriculate. The whorls are almost flat, composed of fine, frequent spiral threads (up to ten). The spiral ribs consist of numerous small and very close nodes. The suture line is weak. The last whorl has an angular base with small and quadrangular aperture.

REMARKS

The species is the first report of *Haustator* from Early Ypresian deposits and the oldest (but see Allmon 1996 for a more prudent use of supraspecific names). *Haustator granulosa* differs from *Turritella velaini* Vasseur, 1881 (Loire basin, France; Early Eocene) (Cossmann 1899: t. 2, fasc. 1, 317, pl. 23, figs 1-3) by its more flat whorls and not having a prominent, sharp spiral rib close to the suture line. Another similar species, *Turritella* (*Haustator*) *custugensis* (Doncieux, 1908), has fine keel-like spiral threads.

Haustator sp.
(Fig. 7J)

MATERIAL EXAMINED. — One specimen hosted in Ankara (MTA-Y.İ.-2007-Polatlı-60).

LOCALITY AND HORIZON. — Grey siltstone, Kırkkavak formation (Macunköy: sample G2).

DESCRIPTION

Shell is medium sized, narrow-conic. The rather flat whorls bear eight to ten fine spiral ribs. Towards the abapical part, two ones are somewhat closer forming a rounded and thick spiral band. Last whorl is short with a flat base. Aperture is narrow.

REMARKS

Our specimen is very similar to syntype of "*Turritella*" *ataciana* d'Orbigny, 1850 (MNHN.F.R64189; Early Eocene of Le Jarrier, Alpes-Maritimes, France; d'Orbigny 1850: t. 2, p. 310, fig. 232) in that both species have rounded spiral bands in the abapical part of the whorls, consisting of fine spiral lines and becoming thicker towards the last whorl. However, our specimen differs from "*T.*" *ataciana* by its wider apex angle (16°) and shorter shell with a lower number of turricated whorls (see Appendix 1).

Haustator sp. also resembles the Oligocene species *Haustator perfasciata* Sacco, 1895 (*Haustator asperulus* var. *perfasicata* Sacco, 1895: t. 19, p. 17, pl. 1, fig. 63a, b) and *Haustator conofasciata* Sacco, 1895 (*Haustator conofasciatus* Sacco, 1895: t. 19, p. 18, pl. 1, fig. 67), which could be phylogenetically related. *Haustator perfasciata* is known from the Rupelian (former Tongriano) beds of Piedmonte basin (Northern Italy), whereas *H. conofasciata* is known from Oligocene (Northern Italy: Sacco 1895; Pakistan: Vredenburg 1928; Greece: Harzhauser 2004; SW Turkey: İslamoğlu 2008). *Haustator conofasciata* has thick, keel-like spiral threads seperated by a deep incline in the abapical part of the whorls. *Haustator perfasciata* has a narrower shell with flat whorls and rounded spiral ribs forming a strong spiral band close to suture.

DISCUSSION AND CONCLUSION

This study describes 21 species of Caenogastropoda collected in the Macunköy section from the upper part of the Kırkkavak Formation (Haymana-Polatlı Basin, SW of Ankara). Two species, *Cerithium puigcercosensis* n. comb. and *Tympanotonos turris*, indicate an early Ypresian age, which is in accordance with benthic foraminiferal assemblage SBZ5-6 found in correlative shallow marine sediments of the uppermost Kırkkavak Formation (Sirel 1975). Other Macunköy species, "*Ampullina*" cf. *vapincana*, "*Ampullina*" cf. *vulcani*, *Vicinocerithium* cf. *subacutum*, *Cerithium* cf. *anguloseptum*, *Gantechinobathra vulcani*, *Haustator granulosa* are known from late early Eocene (late Ypresian) or younger sediments (middle-Late Eocene) of the western Tethys (Paris and Corbières basins, France; Hampshire Basin, England; Roncà, Italy; Gánt, Western Hungary) (Appendix 2). Two species, *Terebralia* sp. 1 and sp. 2 allow to extend back the first appearance of the genus *Terebralia* with respect to previous data (Deshayes 1824; Kowalke 2001; Reid *et al.* 2008).

Ampullinids most probably represent algae grazers and usually appear in a separate palaeocommunity on subtidal hard grounds (e.g., Early Eocene of Southern Pyrenees: Dominici & Kowalke 2007; Middle Eocene of Gánt/W Hungary: Kowalke 2001). This paleocommunity type is well separated from mangrove/tidal flat ecosystems, but close to these and still exposed to varying salinities.

Batillariid, some cerithiid, potamidid and thiarid gastropods are euryhaline taxa (Kowalke 2001, 2003) among which the latter two families are particularly indicative of mangrove-fringed, wet coastal ecosystems with euryhaline conditions (Lozouet *et al.* 2001; Dominici & Kowalke 2007; Reid *et al.* 2008). Potamidid genera *Tympanotonos* and *Terebralia* today thrive in tropical mangrove habitats (Plaziat 1977; Kowalke 2001, 2006a, b; Reid *et al.* 2008). Another potamidid (*Gantechinobathra*) occurred in the Lutetian deposits of Gánt (Hungary) in coastal swamps with connection to the ocean (indicated by the presence of a marine larval stage; Kowalke 2001). Oligohaline to freshwater conditions tied to coastal swamp or delta system are indicated by the presence of *Melanoides* (Kowalke 2001). The overall abundance and high species richness is therefore consistent with the interpretation of an inter-tidal and shallow subtidal depositional environment, with brackish-water conditions. *Cerithium* cf. *anguloseptum* Rauf, 1885 and *Vicinocerithium* cf. *subacutum* (d'Orbigny, 1850) show curved apices also typically occuring in brackish waters (see Plaziat 1977; Kowalke 2001; Reid *et al.* 2008).

Turritellids, particularly the presence of *Haustator*, could indicate the proximity of the outer deltaic portion of larger river-systems, based on similar turritellid paleocommunities known in the Early Eocene mangrove-fringed coasts of the South Pyrenees (Dominici & Kowalke 2007) and the Lutetian mangroves of the Gánt ecosystem (Kowalke 2001).

This community type typically occurs in the tropical mangrove ecosystems wherever large rivers/delta systems interrupt the continuous mangrove and tidal flat systems, wherever strong particle/nutrient influx is supported by fluviatile systems at a salinity range of about 18-30 ppt. (a corresponding recent ecosystem in Cameroon, West Africa, was observed by TK). Similarly, the oysters frequently occur in outer mangroves (reduced salinity level) in the form of small patch-reefs on shells accumulations or similar small "hard-ground"-structures.

In conclusion, the composition of the euryhaline fauna, consistently with sedimentological data, indicate a wet coastal ecosystem with mangroves, probably connected to coastal swamps and a delta system.

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APPENDIX 1

Biometric data of the studied fauna. Specimen numbers correspond to type and non-type material. Abbreviations: **A**, apex angle; **D1**, diameter of shell; **D2**, diameter of spire; **HA**, height of aperture; **HL**, height of body whorl; **HT**, height of the shell; **LA**, width of aperture; **LT**, width of shell. For more détails on measurements, see Figure 4.

Taxon	Specimen number	Ranges										
		HT (mm)	HL (mm)	HA (mm)	LT (mm)	LA (mm)	D1 (mm)	D2 (mm)	A (°)	HL/HT	LT/HT	LT/D1
Globularia vulcani												
"*Ampullina*" cf. *vapincana*	4	36-85	32-74	24-57	28-64	15-64	25-61	15-32	90-92	0.86-0.87	0.75	1.04-1.1
"*Ampullina*" cf. *vulcani*	4	42-56	37-50	32-43	35-46	18-29	30-40	16-21	90-91	0.86-0.89	0.82-0.86	1.15-1.16
"*Ampullina*" cf. *sireli*	2	39-40	32-35	24-26	36-37	19-21	31-32	19-21	105-110	0.82-0.87	0.92	1.15-1.16
"?*Crommium*" sp. 1	16	41-49	36-42	31-39	32-37	16-20	28-31	15-17	83-86	0.85-0.87	0.80-0.84	1.14-1.32
"?*Crommium*" sp. 2	2	26-34	21-28	18-26	25-30	13-15	21-24	10.0-13	105-107	0.80-0.82	0.89-0.96	1.19-1.25
"Ampullinid" indet.	2	36	32	28	29	16	28	19	85	0.88	0.8	1.03
Campanile giganteum (Lamarck, 1804)	6		32-70	19-49	61-74	26-39	60-77	46-72	28-30			0.93-1.06
Cerithium puigcercosensis (Cossmann, 1887) n. comb.	78	35-52	16-28	12.0-15	16-21	9.0-12			32-34	0.53-0.62	0.4-0.5	
Cerithium cf. *anguloseptum* Rauff, 1884	1	27.5	10.2		13.44				31			
"Cerithiid" indet.	1	55.5	17.78		25.05				30			
Bellatara ankaraensis n. sp.	76	21-36	12.0-20	0.7-18	11.0-22	0.9-13			28-30	0.55-0.57	0.52-0.61	
Terebralia sp. 1	8	23-29	13-15	0.7-10	13-14	0.7-0.9			25-30	0.51-0.56	0.48-0.56	
Terebralia sp. 2	1	38	15.2		15.84				31			
Tympanotonos turris (Deshayes, 1833)	1	30	13	5	16	10	15	14	40	0.43	0.53	1.06
Tympanotonos sp.	1	34.7	12		16.9				31			
Gantechinobathra vulcani (Brongniart, 1823)	5	45-65	17-33	10.0-22	20-41	9.0-19	20-37	15-30	35-40	0.37-0.49	0.44-0.47	1.0-1.1
Vicinocerithium cf. *subacutum* (d'Orbigny, 1850)	12	35-51	22-28	14-15	16-19	9.0-12			32-34	0.53-0.62	0.36-0.45	
Vicinocerithium seni n. sp.	123	18-36	10.0-17	0.7-12	0.8-17	0.5-11			25-30	0.34-0.55	0.04-0.44	
?*Melanoides* sp.	1	32.8	12.5		12.14				27			
Haustator granulosa	1	22	4	2	7.5	4			11	0.18	0.34	
Haustator sp.	1		8	4	13	7			16			

APPENDIX 2

Stratigraphic and palaeogeographic distribution of the Early Ypresian taxa. Corresponding references: **France**, Lamarck 1804; Brongniart 1823, d'Orbigny 1850; Cossmann 1888, 1896, 1898, 1906; Cossmann & Pissarro 1910; Pacaud 2007; **southern France**, Doncieux 1908; Plaziat 1977; **northern France**, Deshayes 1824, 1833; d'Orbigny 1850; Bayan 1873; **southern England**, Jeffery & Tracey 1997; Wrigley 1940; **northern Spain**, Dominici & Kowalke 2007; **northern Italy**, Oppenheim 1896; **northern Bulgaria**, Karagiuleva 1964; **western Croatia** (Island of Krk), Klepač 2003; **central Romania**, Mészáros 1957; **northern Afrika**, Karagiuleva 1964; **western Afrika**, Heron-Allen & Earland 1922; **north-western Turkey**, Stchépinsky 1946; **central Turkey**, Erünal 1942; Stchépinsky 1941; Güngör 1975; **Haymana-Polatlı basin**, this study. Abbreviations: **HPb**, Haymana-Polatlı basin; **Bart.**, Bartonian; **Lut.**, Lutetian; **Pria.**, Priabonian; **Ypr.**, Ypresian; **E.**, Early; **L.**, Late.

	France		**England**	**Spain**	**Italy**	**Bulgaria**	**Croatia**	**Romania**	**Africa**		**Turkey**		
Taxa	S	N	S	N	N	N	W	C	N	W	NW	C	HPb
"*Ampullina*" cf. *vapincana*	Bart.-Pria.	Lut.-Pria.			Bart.-Pria.	Bart.-Pria.							
"*Ampullina*" cf. *vulcani*	Bart.-Pria.				Ypr.-Pria.	Bart.-Pria.	L. Ypr.-E. Lut.		M.-L. Eocene				
"*Ampullina*" cf. *sireli*													
"?*Crommium*" sp. 1													
"?*Crommium*" sp. 2													
Ampullinid indet.													
Campanile giganteum			Lutetian	Cret.-E. Eocene	Late Ypr.		Early Lut.					Lutetian	
Cerithium puigcercosensis n. comb.	Early Ypresian			Early Eocene									
Cerithium cf. *anguloseptum*					L. Ypr.								
"Cerithiid" indet.													
Bellatara ankaraensis n. sp.													
Terebralia sp.1													
Terebralia sp.2													
Tympanotonos turris		Early Ypr.											
Tympanotonos sp.													
Gantechinobathra vulcani					Ypresian			Lutetian		Ypresian			
Vicinocerithium cf. *subacutum*		Late Ypresian	Late Ypresian								Late Ypresian	former Paleocene	
Vicinocerithium seni n. sp.													
?*Melanoides* sp.													
Haustator granulosa		Middle-Late Eocene						Late Eocene					