JAHRBUCH DER GEOLOGISCHEN BUNDESANSTALT
Jb. Geol. B.-A. | ISSN 0016-7800 | Band 154 | Heft 1–4 | S. 83–113 | Wien, Dezember 2014

Gastropods of an Ottnangian (Early Miocene) rocky shore in the North Alpine Foreland Basin (Allerding, Austria)

Mathias Harzhauser[1], Bernard M. Landau[2], Oleg Mandic[1], Andreas Kroh[1], Kaftan Kuttelwascher[1], Patrick Grunert[3], Simon Schneider[4] & Wolfgang Danninger[5]

1 Text-Figure, 4 Plates

Österreichische Karte 1:50.000
Blatt 29 Schärding

Gastropoda
Early Miocene
Ottnangian
Paratethys

Contents

Gastropoden einer Felsküste aus dem Ottnangium (frühes Miozän) des Nordalpinen Vorlandbeckens (Allerding, Österreich)

Zusammenfassung

Es wird die erste seichtmarine und Hartgrund-assoziierte Gastropoden-Vergesellschaftung aus dem Ottnangium (frühes Miozän) der zentralen Paratethys beschrieben. In vielen Fällen war aufgrund der schlechten und meist fragmentären Erhaltung als Steinkerne und Abdrücke keine genaue Bestimmung möglich. Trotzdem weist die 32 Arten umfassende Vergesellschaftung auf einen generell noch unbekannten Faunentyp hin, der durch hohe Endemismusraten gekennzeichnet ist. Rund 60 % der Arten waren noch unbeschrieben oder zumindest noch nicht aus der Paratethys bekannt.

Kurzlebige Aufschlüsse im Steinbruch der Schärdinger Granit Industrie AG bei Allerding (Oberösterreich) dokumentieren Granitblöcke der ehemaligen Küste der Böhmischen Masse, die gemeinsam mit Trochiden und Turbiniden durch verschiedene patelliforme Gastropoden-Arten unterschiedlichster Familien besiedelt wurden. Diese Hartgründe waren auch Lebensraum für Demospongien und Cnidarien, die durch die diversen Epitoniiden und die Häufigkeit von Siliquariiden indirekt nachweisbar sind. *Cellana*? *danningeri* Harzhauser & Landau nov. sp., *Bolma paratethyca* Harzhauser & Landau nov. sp. und *Claviscala norica* Harzhauser & Landau nov. sp. werden als neue Arten beschrieben. Zusätzlich werden neun Arten in offener Nomenklatur beschrieben, die zwar wahrscheinlich neue Arten repräsentieren, aber ungenügend erhalten sind.

1 Mathias Harzhauser, Oleg Mandic, Andreas Kroh, Kaftan Kuttelwascher: Naturhistorisches Museum Wien, Burgring 7, 1010 Vienna, Austria. mathias.harzhauser@nhm-wien.ac.at; oleg.mandic@nhm-wien.ac.at; andreas.kroh@nhm-wien.ac.at; kaftan.kuttelwascher@gmx.net
2 Bernard M. Landau: Naturalis Biodiversity Center, P.O. Box 9517, NL-2300 RA Leiden, The Netherlands; Departamento de Geologia e Centro de Geologia. Faculdade de Ciências. Universidade de Lisboa. Campo Grande, 1749–016 Lisbon, Portugal. bernielandau@sapo.pt
3 Patrick Grunert: Institute for Earth Sciences, University of Graz, NAWI Graz, Heinrichstraße 26, 8010 Graz, Austria. patrick.grunert@uni-graz.at
4 Simon Schneider: CASP, 181A Huntingdon Road, Cambridge CB3 0DH, UK. simon.schneider@casp.cam.ac.uk
5 Wolfgang Danninger: Hauptstraße 83, 4794 Kopfing. wolfgang.danninger@gmail.com

Abstract

We describe the first shallow marine and hard-ground associated gastropod assemblage from the Ottnangian (Early Miocene) of the Central Paratethys Sea. In many cases, the poor and usually fragmentary preservation as casts and moulds does not allow a definitive identification. Nevertheless, the small assemblage – comprising 32 species-level taxa – suggests a hitherto unknown faunal association with a high percentage of endemism. About 60 % of species are new to science or at least until now unknown from the Paratethys Sea.

Temporal outcrops at the Schärdinger Granit Industrie AG quarry at Allerding (Upper Austria) exposed the former coastal granite boulders of the Bohemian Massif, which were settled by several patelliform gastropod species of different families, along with the trochids and turbinids. These hardgrounds harboured also demosponges and cnidarians, which are indicated by the diversity of epitoniids and the frequency of siliquariids.

Cellana? *danningeri* Harzhauser & Landau nov. sp., *Bolma paratethyca* Harzhauser & Landau nov. sp. and *Claviscala norica* Harzhauser & Landau nov. sp. are described as new species. In addition, nine species are probably new but are described in open nomenclature due to the insufficient preservation.

Introduction

The Ottnangian is a Lower Miocene Paratethyan regional stage corresponding to the middle part of the Burdigalian stage with its stratotype defined at Ottnang/Schanze in Upper Austria (Rögl et al., 1973; Piller et al., 2007; Grunert et al., 2010). Within the Ottnangian stage two strongly contrasting phases can be recognised. The first phase reflects a fully marine shallow water environment, the second brackish or freshwater environments. At the beginning of the Ottnangian stage, a marine seaway across the North Alpine Foreland Basin (NAFB) connected the Central Paratethys with the western proto-Mediterranean Sea and communication with the North Sea existed via the Rhine Graben (Rögl, 1998). Within the NAFB, a tide-influenced shelf sea developed (Pippèrr, 2011; Grunert et al., 2012), reflected by the characteristic "schlier" deposits, comprising clayey silt and clay with silt and fine sand ripples. As a result of the uplift of the Alpine Foreland Basin, these marine connections ceased and the fluvial-lacustrine environments of the Upper Freshwater Molasse became established in the western NAFB (Berger, 1996). This is reflected by the evolution of a highly endemic mollusc fauna settling in the so-called *Rzehakia* lakes from southern Germany in the west to Moravia in the east (Harzhauser & Piller, 2007; Harzhauser & Mandic, 2008). This peculiar fauna most probably spread from the Eastern Paratethys into the Central and Western Paratethys (Steininger, 1973).

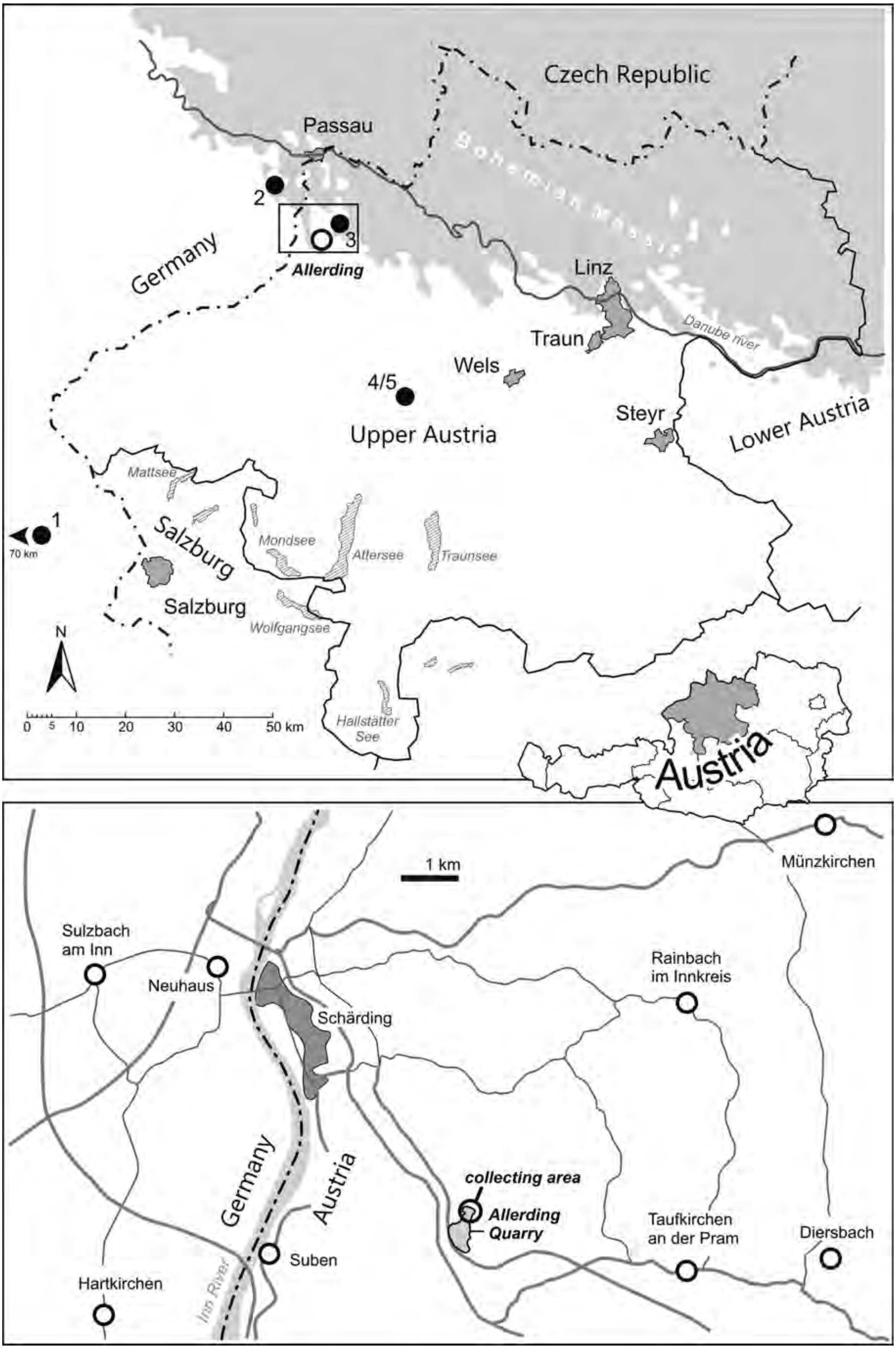
The low diversity endemic fauna of the late Ottnangian *Rzehakia* lakes is well documented by several papers on Bavarian, Austrian and Czech occurrences (Schlickum, 1963, 1964, 1966; Ctyroky, 1972; Steininger, 1973; Kowalke & Reichenbacher, 2005; Mandic & Ćorić, 2007). The molluscan fauna of the preceding marine phase, however, is still poorly known (e.g. Schneider & Mandic, 2013). The most recent synthesis of the Ottnangian marine molluscs was provided by Steininger (1973). Since then, the Hungarian localities treated in that monograph have been found to be of Karpatian age (late Burdigalian), younger than the middle Burdigalian age assumed by Steininger (1973) (see Mandic, 2003).

Therefore, our knowledge of Ottnangian molluscan faunas is based on very few occurrences in Bavaria (e.g. Kaltenbachgraben, Gernergraben, Gurlarn, Rott Valley) and Upper Austria (e.g. Ottnang/Schanze, Wolfsegg, Rainbach). As these occurrences mainly represent shelf settings, the associated molluscan faunas are predominated by infaunal bivalves and carnivorous gastropods. Gastropod faunas from coastal mudflats, rocky shores, sandy beaches and seagrass meadows are almost unknown, except for the Bavarian locality of Gurlarn (Frieling et al., 2009; Schneider et al., 2009), which however lacks aragonitic shells. Hence, the present description of the coastal assemblage from Allerding at Schärding in Upper Austria is an important step towards the reconstruction of early Ottnangian marine paleoenvironments and their faunas.

Geological Setting

The Allerding locality is situated in the quarry of the Schärdinger Granit Industrie AG close to Schärding in Upper Austria (Text-Fig. 1). In this quarry the Moldanubian Schärding Granite is exploited, which is part of the NW-SE trending southern margin of the Bohemian Massif that also formed the coast of the western Central Paratethys in the study area during most of the Early Miocene (Kuhlemann & Kempf, 2002). The granite is overlain by a few meters of Lower Miocene deposits of the Ottnangian stage (Krenmayr & Schnabel, 2006). Very little geological information is available from this section and no continuous profile was logged due to the temporary nature of the outcrops. The top of the Schärding Granite is strongly weathered, with deep cracks and a thick (1 to 2 m) layer of granite cobbles, in between which the overlying sediment is trapped. The surfaces of the boulders are partly covered by dark, biogenic crusts and settled by bryozoans and balanids. Immediately above the cobbles and boulders follow about 2 m of grey-brown clay, clayey silt and sand yielding marly concretions with abundant molluscs. This layer is rich in bioclastic debris of bryozoans, echinoderms, brachiopods and balanids. The upsection of these coarser-grained sediments are rapidly replaced by about 2 m of blue-grey pelitic "schlier" with the typical soft bottom molluscs as described by Hoernes (1875) and Sieber (1956) from Ottnang/Schanze (these species are not treated herein). The nature of the transition is not clear due to the poor outcrop.

Based on its sedimentology, the basal part of the Miocene succession seems to correspond to the up to 20 m-thick lower Ottnangian "Fossilreiche Grobsande" (fossil-rich coarse sand; Plesching Formation in Rupp et al., 2011), which was described by Walser (1990) from the north-eastern area of Schärding as a typical transgressive sediment. According to Ch. Rupp (pers. comm.), the microfauna of the overlying schlier might correspond either to the uppermost lower Ottnangian Ottnang Formation or to the middle Ottnangian Ried Formation. As we cannot add any new biostratigraphic data to fix the exact position of the



Text-Fig. 1.
Geographic position of the Allerding locality at the SW-margin of the Bohemian Massif (modified from Kroh, 2005). The lower map shows the outline of the Schärding Granit Industrie AG quarry in the SE of Schärding. The described material was mainly collected in the northern part of the quarry. Localities mentioned in the text: 1: Gernergraben & Kaltenbachgraben (Landkreis Miesbach), 2: Gurlarn, 3: Rainbach, 4: Ottnang/Schanze, and 5: Wolfsegg.

Allerding section, we prefer to attribute it to the Ottnang Formation referring to the geological map of Krenmayr & Schnabel (2006). For a detailed synthesis of the Ottnangian lithostratigraphy, sedimentology and depositional environments of Upper Austria see Rupp & van Husen (2007) and Rupp et al. (2011).

Material and Methods

In this paper the gastropod assemblage from Allerding is described; the bivalves will be treated in a subsequent paper. All specimens were collected over many years by Wolfgang Danninger and partly donated to the Natural History Museum Vienna (NHMW). Generally, the preservation of gastropods and other molluscs is very poor. Aside from few calcitic shells of epitoniids, all aragonitic shells are completely dissolved. Available information is limited to cavities with internal moulds preserved in sandy-marly concretions, which range from few cm to rarely 15–20 cm in diameter. After removing the steinkerns from the cavities, casts of the cavities were produced by infilling a two-component dental-silicone. Despite the huge number of concretions collected, only few imprints provide enough information for identification. This is partly due to fragmentation prior to fossilization and partly due to incomplete enclosure by the protecting concretions. Therefore, the gastropod assemblage is clearly taphonomically biased and represents probably only a small part of the total fauna.

All illustrated specimens are stored in the collections of the NHMW. The systematics follows Landau et al. (2013) and references therein.

Discussion

In total, 32 gastropod species are discussed. This is only a part of the total assemblage, as the remaining specimens are too poorly preserved to allow reliable identification and were excluded. Despite these limitations, the assemblage reflects a unique composition, distinct from any Paratethyan assemblage known. One third of the species are probably new to science (nine species), although the preservation does not allow us to describe them all formally as new species. Four further species represent well known Ottnangian endemics: *Calliostoma sturi* (Hoernes, 1875), *Nassarius pauli* (Hoernes, 1875), *Nassarius schultzi* Harzhauser & Kowalke, 2004, and *Sveltia suessi* (Hoernes, 1875). Another ten species are recorded for the first time from the Paratethys and the Ottnangian stage. Of these, most are known from the Early Miocene of the proto-Mediterranean Sea and/or the north-eastern Atlantic. This pattern supports the high level of endemism generally observed within Ottnangian molluscs as a whole and within certain families such as the Nassariidae, Cassidae and Cancellariidae in particular (Harzhauser & Kowalke, 2004; Harzhauser & Piller, 2007; Landau et al., 2009a; Harzhauser & Landau, 2012). This may be partly explained by repeated paleogeographic restrictions of the Paratethys from the proto-Mediterranean Sea promoting the evolution of regional faunas (Rögl, 1998).

The concretions were collected directly from the basal deposits overlying the granite that gets exploited. Many of the granite boulders have smooth surfaces due to coastal erosion and bear encrustations of barnacles and bryozoans. The basal sand is rapidly replaced by clayey silt and clay, reflecting sublittoral settings. Hence, there is little doubt, that the temporal outcrops at Allerding exposed a Miocene rocky shore and the associated foreshore, which then became submerged during the Ottnangian transgression. Although the taphonomic filter does not allow a serious quantitative calculation of faunal composition, it is obvious that trochid and turbinid species were abundant. Extant representatives of the two very abundant genera *Bolma* and *Homalopoma* are hardground dwellers often found from the intertidal zone down to the sublittoral (Bosch et al., 1995; Casellato & Stefanon, 2008; Campbell et al., 2004). Hard-ground habitats are also indicated by the abundant patelliform species of the genera *Emarginula, Fissurella, Cellana*? and *Siphonaria,* which occur from the rocky intertidal and supratidal down to deeper waters if hard substrates are present (Bosch et al., 1995; Zuschin et al., 2009). Epitoniids are also frequently found at Allerding and in many other Ottnangian localities (e.g. Gurlarn in Bavaria; Schneider et al., 2009) due to their more stable calcitic shells. Epitoniids are obligatorily associated with various anthozoans (Gittenberger & Hoeksema, 2013). Considering the lack of fossil Scleractinia at Allerding, it might be assumed that Actinaria were the preferred hosts for the epitoniids. A comparable scenario of a rocky shore settled by sea anemones and epitoniids was proposed by Mandic & Harzhauser (2003) for a Badenian section in the NAFB in Lower Austria. Another conspicuous element of the Allerding assemblage, which is usually rather rare in Miocene collections, is *Tenagodus*. This siliquariid gastropod is an obligatory sponge commensal, embedded inside demosponges (Bieler, 2004). The occurrence of sand burrowers such as *Ficus, Semicassis* and *Terebra* may either indicate the transition to the adjacent soft bottom habitats, fringing the rocky shore, or may represent beached specimens.

Systematics

Class: Gastropoda Cuvier, 1795
Subclass: Eogastropoda Ponder & Lindberg, 1996
Superfamily: Fissurelloidea Fleming, 1822
Family: Fissurellidae Fleming, 1822
Subfamily: Emarginulinae Children, 1834
Genus: ***Emarginula*** **Lamarck, 1801**

Type species: *Emarginula conica* Lamarck, 1801 [currently considered synonym of *Emarginula fissura* (Linnaeus, 1758)]; by monotypy. Recent, Eastern Atlantic.

Emarginula nov. sp. 1

(Pl. 1, Figs. 1a–1b)

Material: 1 natural cast and the corresponding silicone mould (NHMW 2014/0379/0001).

Dimensions: height: 3.5 mm, width: 4.3 mm.

Description: Medium-sized, patelliform, oval-elongated shell with strongly recurved apex and umbo placed in the posterior third of the shell; apex not overhanging posterior edge. Slit in anterior margin very short. Sculpture consisting of 22 strongly raised, wide-spaced axial ribs with a single secondary rib intercalated in some of the interspaces. Ribs crossed by slightly weaker, regularly spaced concentric lamellae, forming a reticulate pattern. Rounded tubercles are formed at the intersections.

Discussion: The Paratethyan Emarginulinae are still poorly known and many records are misidentified (see discussion in BAŁUK, 1975). *Emarginula clathrataeformis* EICHWALD, 1830, as described and illustrated by EICHWALD (1830, 1852, 1853), DUBOIS DE MONTPÉREUX (1831), FRIEDBERG (1938) and BAŁUK (2006), is characterised by a strongly recurved apex, which overhangs the posterior margin, wide-spaced and prominent primary ribs and prominent tubercles. Thus, it agrees well with the specimen from Allerding in size and sculpture, but differs in having the apex not reaching the posterior margin, in having less prominent concentric lamellae and in having a distinctly longer slit. Badenian specimens of *Emarginula subclathrata* D'ORBIGNY, 1852 differ from the Ottnangian shell in the higher number of axial ribs and the deeper slit. Three further species are documented from the Paratethyan Middle Miocene: *Emarginula chemnitzi* sensu BAŁUK (1975), which is clearly distinguished by its finer sculpture, *E. squamata* GRATELOUP, 1837, which has a depressed shell with a uniform reticulate sculpture with spiny nodes and *E. sotterii* MICHELOTTI, 1847, which is more elongate and has finer sculpture. As mentioned above, these comparisons are made using the specimens illustrated by BAŁUK (1975). Whether these Paratethyan shells illustrated are indeed conspecific with the species they were identified with from the French Atlantic Miocene, remains to be seen.

Distribution: Only known from the Ottnangian of the North Alpine Foreland Basin (Allerding).

Emarginula nov. sp. 2

(Pl. 1, Figs. 2a–2b)

Material: 1 natural cast and the corresponding silicone mould (NHMW 2014/0379/0002).

Dimensions: height: 5.2 mm, width: 9.2 mm.

Description: Medium-sized, oval-elongated and strongly convex patelliform shell with moderately recurved apex, which is placed in the posterior third of the shell; apex not overhanging posterior edge. Sculpture consisting of about 50 axial ribs, comprising primary and secondary ribs of nearly equal strength. Ribs crossed by weaker concentric lamellae, without forming tubercles or spines, resulting in a regular, finely reticulate pattern.

Discussion: The specimen is superficially reminiscent of *Emarginula subclathrata* D'ORBIGNY, 1852, which is documented from several Badenian localities of the Paratethys, but misidentified as *E. clathrataeformis* by HÖRNES (1856), CSEPREGHY-MEZNERICS (1954), STRAUSZ (1966) and ATANACKOVIĆ (1985). A comparison with the specimens from the Badenian of the Vienna Basin, described by HÖRNES (1856) shows that *E. subclathrata* differs in having more numerous lamellae and much deeper interspaces between the strongly raised lamellae, resulting in a deeply pitted surface.

Distribution: Only known from the Ottnangian of the North Alpine Foreland Basin (Allerding).

Subfamily: Fissurellinae FLEMING, 1822
Genus: *Fissurella* BRUGUIÈRE, 1789

Type species: *Patella nimbosa* LINNAEUS, 1758; by monotypy. Recent, Caribbean.

Fissurella costicillatissima SACCO, 1896

(Pl. 1, Figs. 3, 4, 5a–5b)

* 1896b *Fissurella costicillatissima* SACC. – SACCO, p. 11, pl. 1, figs. 46–47.

1984 *Fissurella costicillatissima* SACCO, 1897 – FERRERO-MORTARA et al., p. 277, pl. 51, figs. 5a–b.

? 1965 *Fissurella costicillatissima* SACCO – KONIOR & KRACH, p. 78, pl. 4, fig. 10.

Material: 3 natural casts and the corresponding silicone moulds (NHMW 2014/0379/0003, NHMW 2014/0379/0004, NHMW 2014/0379/0005).

Dimensions: height: 9 mm, max. diameter: 30 mm (pl. 1, fig. 3), height: 9 mm, max. diameter: 34 mm (pl. 1, fig. 4), height: 7.5 mm, max. diameter: 21 mm (pl. 1, figs. 5a–5b).

Description: Large-sized, patelliform, moderately elevated shell, with oval-elongated outline and nearly straight lateral margins. Simple, oval apical aperture placed $^2/_5$ behind the anterior margin, its rim being thickened by a narrow callus on the otherwise smooth shell interior. Sculpture consisting of numerous very fine, low axial ribs, crossed and interrupted by densely spaced concentric growth lines, becoming most prominent towards the margin, where the growth lamellae may predominate the sculpture.

Discussion: A very distinctive species, which is distinguished easily from all other Miocene Fissurellidae of the Proto-Mediterranean and Paratethys seas by its very fine sculpture.

Distribution: This species was known so far only from the Burdigalian of Italy (SACCO, 1896b). KONIOR & KRACH (1965) reported the species also from the Badenian of Poland, but their illustration does not allow a clear identification. A potential further record, mentioned by BETANCORT LOZANO (2012) from the Miocene of Lanzarote (Canary Islands) as *Fissurella* cf. *costicillatissima* SACCO 1896, needs verification.

Superfamily: Lottioidea GRAY, 1840
Family: Nacellidae THIELE, 1891
Genus: *Cellana* ADAMS, 1869

Type species: *Nacella cernica* ADAMS, 1869 [currently considered a synonym of *Cellana livescens* (REEVE, 1855)]; by monotypy. Recent, Indian Ocean.

Cellana? *danningeri* HARZHAUSER & LANDAU nov. sp.

(Pl. 1, Figs. 6a–6c)

Material: 1 specimen, holotype (NHMW 2014/0379/0006).

Dimensions: max. diameter: 50 mm, height of fragment: 11 mm.

Type locality, stratum typicum and age: Allerding in Upper Austria, Ottnang Formation, Ottnangian (Early Miocene).

Derivation of name: In honour of Wolfgang Danninger, collector of the fossils from Allerding.

Description: Large and solid, low patelliform shell with circular base and markedly thickened margins; apical part eroded. Sculpture consisting of c. 40 low and slightly irregularly spaced axial ribs of equal strength with wide interspaces. These ribs are best developed close to the margin, forming an undulating surface; no secondary ribs developed. Axial ribs crossed by blunt concentric growth lines, most prominent towards the rim-like margin. Shell interior smooth aside from concentric grooves close to margin.

Discussion: The shells of species in the genus *Cellana* are separated from those of the family Patellidae based primarily on shell microstructure (Lindberg, 1998). Unfortunately, the material available does not allow investigation of the shell microstructure. However, it is characterised by its large size, extremely solid shell, circular outline and rim-like margin. None of the patelliform species described from the European Miocene so far displays this combination of features. The only somewhat reminiscent species is "*Patella*" *subcentralis* Sacco, 1896, from the Burdigalian of Italy, which differs in its broader and close-set axial ribs (see Sacco, 1896b). Due to the fragmentary preservation the generic placement is tentative. The circular outline and the radial sculpture, which is most strongly developed close to the margins, fit well within the Nacellidae genus *Cellana*, which was so far unknown from the Tethyan region. A relation to *Siphonaria* can be excluded based on the absence of the characteristic muscle scar and siphonal groove. If our taxonomic placement is correct, this is an interesting record, as it would represent an element now restricted to the Indo-West Pacific region. The genus did not manage to extend its range further westwards during the Burdigalian, as it is not present in any of the extensive Lower Miocene assemblages from the Proto-Mediterranean or eastern Atlantic frontage. Any biogeographic interpretation, however, is hampered by the lack of any fossil record of this genus.

Distribution: Only known from the Ottnangian of the North Alpine Foreland Basin (Allerding).

Superfamily: Trochoidea Rafinesque, 1815
Family: Trochidae Rafinesque, 1815
Subfamily: Trochinae Rafinesque, 1815
Genus: *Jujubinus* Monterosato, 1884

Type species: *Trochus matoni* Payraudeau, 1826 [currently considered a synonym of *Jujubinus exasperatus* (Pennant, 1777)]; subsequent designation by Pilsbry (1889). Recent, Mediterranean Sea.

Jujubinus nov. sp.

(Pl. 1, Figs. 7–9)

Material: 3 natural casts and the corresponding silicone moulds (NHMW 2014/0379/0007, NHMW 2014/0379/0008, NHMW 2014/0379/0009).

Dimensions: height: 14 mm, width: 9 mm (pl. 1, fig. 7); height: 14 mm, width: 9 mm (pl. 1, fig. 8), height: 15 mm, width: c. 11 mm (pl. 1, fig. 9, specimen is compressed).

Description: Slender conical to slightly cyrtoconoid shell with 7 imbricate, straight-sided to weakly convex teleoconch whorls, slightly overhanging suture abapically; apical angle about 40°; protoconch unknown. First three spire whorls bear 7–8 finely-beaded spiral cords of variable strength, adsutural cord most strongly beaded, beads weaken on fourth and fifth whorls, replaced by 7–8 broad, smooth spiral cords separated by narrow grooves. Cords weaken on late teleoconch whorls, which appear almost smooth, aside from the prosocline growth lines. Base and aperture not preserved.

Discussion: *Jujubinus* nov. sp. differs from the co-occurring *Calliostoma tauromiliare* (Sacco, 1896) in its narrower spire angle and the characteristic change of sculpture during ontogeny (see Sacco, 1896b). The Middle Miocene Paratethyan *Jujubinus turricula* (Eichwald, 1853) and *J. hoernesiana* Sacco, 1896 develop a comparable sculpture on the early teleoconch but maintain the sculpture throughout ontogeny and are distinctly smaller (see Sacco, 1896b, Bałuk, 1975, and Landau et al., 2013).

Distribution: No comparable species has been described so far from the Miocene of the Paratethys.

Family: Calliostomatidae Thiele, 1924
Subfamily: Calliostomatinae Thiele, 1924
Genus: *Calliostoma* Swainson, 1840

Type species: *Trochus zizyphinus* Linnaeus, 1758; by monotypy. Pliocene-Recent, Europe.

Calliostoma tauromiliare (Sacco, 1896)

(Pl. 1, Figs. 10–12)

* 1896b [*Calliostoma*] *A.*[*mpullotrochus*] *subexcavatus*? var. *tauromiliaris* Sacc. – Sacco, p. 43, pl. 4, fig. 39.

1949 *Calliostoma tauromiliare* Sacco – Glibert, p. 33, pl. 2, figs. 8a–h.

Material: 5 natural casts and the corresponding silicone moulds (NHMW 2014/0379/0010, NHMW 2014/0379/0011, NHMW 2014/0379/0012).

Dimensions: height: 13.5 mm, width: 11.5 mm (pl. 1, fig. 12), height: 6.5 mm, width: c. 6 mm (pl. 1, fig. 10), height: 5.2 mm, width: 5.8 mm (pl. 1, fig. 11).

Description: Elevated conical spire with an apical angle of c. 60°. Early teleoconch whorls are straight-sided with linear sutures; the last whorls become slightly imbricated with weak adsutural concavity. Early teleoconch whorls develop 6–7 spiral cords of rather regular beads; later secondary cords with smaller beads are intercalated raising the number of spiral cords to 8 on the last two whorls the beads grade into densely spaced, slightly elongate-prosocline beads. Two more prominent cords form the angulated periphery. Base only weakly convex, covered by more than 20 smooth spiral cords.

Discussion: The shells from Allerding agree well with those from the Middle Miocene of the Loire Basin, described by

Glibert (1949). The much younger Pliocene shells from Spain, described by Landau et al. (2003) as *C. tauromiliare*, differ in their lower number of spiral cords (on the whorls and on the base), the wider interspaces and do not have two prominent cords at the periphery. A morphologically quite similar species occurs during the Badenian in the Paratethys Sea. It is traditionally referred to as *Calliostoma trigonum* (Eichwald, 1830) [= *Trochus miliaris* of Hörnes, 1856 and *Jujubinus exasperatus* of Bałuk, 2006] and differs from *C. tauromiliare* in its coarser sculpture, lower number of spiral cords and wider apical angle (see Strausz, 1966; Atanacković, 1985; Bałuk, 2006). Whether this species is really conspecific with the coeloconoid and carinate shells described and figured by Eichwald (1830) from the Middle Miocene of Ukraine needs verification.

Distribution: The species appears in the Burdigalian of the Proto-Mediterranean Sea (Italy, Sacco, 1894) and occurs also in the Middle Miocene of the north-eastern Atlantic (Loire Basin, Glibert, 1949). It was unknown so far from the Paratethys Sea.

Calliostoma sturi (Hoernes, 1875)

(Pl. 1, Fig. 13)

* 1875 *Trochus sturi* nov. sp. – Hoernes, p. 361, pl. 10, fig. 10.

1956 *Calliostoma sturi* (R. Hörn.) – Sieber, 316.

1973 *Calliostoma* (*Calliostoma*) *sturi* (R. Hoernes 1875) – Steininger, p. 384, pl. 1, figs. 4–5.

Material: 1 natural cast and the corresponding silicone mould (NHMW 2014/0379/013).

Dimensions: width: 19 mm.

Discussion: Only a single fragmentary specimen of this low conical, slightly cyrtoconoid species is available. The bulgy and very prominent prosocline growth lines on the last whorl fully agree with those seen in the syntypes and support the identification.

Distribution: Only known from the Ottnangian of Upper Austria (Ottnang, Allerding) and Bavaria (Gernergraben, Kaltenbachgraben) (Steininger, 1973).

Superfamily: Turbinoidea Rafinesque, 1815
Family: Turbinidae Rafinesque, 1815
Genus: *Bolma* Risso, 1826

Type species: *Turbo rugosus* Linnaeus, 1767; by monotypy. Pliocene to Recent, Europe, Mediterranean Sea.

Bolma paratethyca Harzhauser & Landau nov. sp.

(Pl. 2, Figs. 1–7, 8a–8b)

Material: Holotype: pl. 2, fig. 1, NHMW 2014/0379/0017.; paratype: pl. 2, fig. 6, NHMW 2014/0379/0022; additional material: 5 natural casts and the corresponding silicone moulds (NHMW 2014/0379/0018, NHMW 2014/0379/0019, NHMW 2014/0379/0020, NHMW 2014/0379/0021, NHMW 2014/0379/0023) and numerous fragments of internal casts. 1 natural cast of an operculum, which is tentatively assigned to this species (NHMW 2014/0379/0024).

Dimensions: largest specimen: height: 38 mm, width: 39 mm (paratype).

Type locality, stratum typicum and age: Allerding in Upper Austria, Ottnang Formation, Ottnangian (Early Miocene).

Derivation of name: Referring to the Paratethys Sea.

Description: Medium-sized, robust, turbiniform shell. Teleoconch of about six whorls with distinct change in morphology during ontogeny. Early teleoconch pagodiform, with broadly channelled suture, strong peripheral carina bearing small, sometimes spiny nodes. Sutural ramp broad, flat-sided on first two teleoconch whorls, strongly convex on third whorl, which bears a finely beaded subsutural cord. Later whorls lack carina, weakly angulated in the lower third. On last whorl peripheral angulation disappears, resulting in a regularly rounded whorl. Sculpture of adult whorls consists of 5–8 spiral rows of beads and nodes of variable strength, separated by interspaces of variable width. Axial sculpture absent. Last whorl rapidly expanding. Aperture and base only fragmentarily preserved; however, aperture moderately prosocline; outer lip attached below periphery; spiral sculpture of nodes continues on base. No information on basal callus available.

Discussion: This species is amongst the most frequent fossils at Allerding. The change in sculpture seen with ontogeny is striking in this species, and more dramatic than in any of its fossil or Recent congeners (see Beu & Ponder, 1979). The sculpture of the adult whorls is highly reminiscent of the Pliocene *Bolma castrocarensis* (Foresti, 1876), as described by Landau et al. (2003) from Estepona in Spain, but the conspicuous pagodiform early teleoconch of the Austrian species allows a clear separation. Along with the different early teleoconch, the absence of any axial swellings on the last whorl allows also a separation from the Early and Middle Miocene *Bolma meynardi* (Michelotti, 1847) (see Bałuk, 1975; Landau et al., 2013). *Bolma mehelyi* (Boettger, 1896) is smaller and differs in its conical spire and carinate last whorl (see Bałuk, 1975, 2006). The early teleoconch of the Atlantic Miocene *Bolma belgica* (Glibert, 1952) has a comparable carina but later whorls develop a flat and steep sutural ramp and the suture is less incised (see Glibert, 1952 and Janssen, 1984).

Distribution: Only known so far from the Ottnangian of the North Alpine Foreland Basin in Upper Austria.

Family: Colloniidae Cossmann, 1917
Genus: *Homalopoma* Carpenter, 1864

Type species: *Turbo sanguineus* Linnaeus, 1758, by original designation. Recent, Mediterranean Sea.

Homalopoma nodulus (Eichwald, 1830) nov. comb.

(Pl. 1, Figs. 14–16)

* 1830 *Turbo nodulus* m. – Eichwald, p. 220.

1830 *Monodonta Mamilla* Nobis – Andrzejowski, 100, pl. 5, figs. 2a–b.

1837 *Monodonta mamilla* Andrz. – Pusch, p. 105, pl. 10, fig. 2.

1852 *Turbo nodulus* – Eichwald, p. 3, pl. 9, fig. 31 (Atlas).

1853 *Turb.*[*o*] *nodulus* m – Eichwald, p. 241.

1856 *Monodonta mamilla* ANDRZ. – HÖRNES, p. 438, pl. 44, fig. 8.

1896b [*Leptothyra*] *Cantrainea mamilla* (ANDRZ.) – SACCO, p. 7, pl. 1, fig 11.

1918 *Cantrainea mamilla* (ANDRZEJOWSKI) – COSSMANN, p. 133, pl. 4, figs. 17–18.

1928 *Leptothyra mamilla* ANDRZ. – FRIEDBERG, p. 472, pl. 29, fig. 7.

1960 *Homalopoma* (*Cantrainea*) *mamilla* (ANDRZEJOWSKI 1830) – KOJUMDGIEVA & STRACHIMIROV, p. 90, pl. 29, figs. 10a–b.

1966 *Monodonta mammilla* ANDRZEJOVSKI, 1830 – STRAUSZ, p. 38, fig. 22.

2003 *Homalopoma mamilla* (ANDRZEJOWSKI 1830) – LANDAU et al., p. 27, pl. 6, fig. 3.

Material: 5 natural casts and the corresponding silicone moulds (NHMW 2014/0379/0014, NHMW 2014/0379/0015, NHMW 2014/0379/0016).

Dimensions: height: 9.5 mm, width: 12 mm (pl. 1, fig. 14), height: 9 mm, width: 10 mm (pl. 1, fig. 16).

Description: Small robust turbiniform shells displaying considerable variability concerning spire height due to the variable position of the suture, which may shift from the mid-line of the preceding whorl down distinctly below the periphery. Shell surface appears nearly smooth but bears close-set flattened spiral cords, which are most prominent in the adapical part of the whorls. A well developed narrow spiral cord accompanies the linear suture. Base imperforate. Aperture not preserved in the specimens from Allerding.

Discussion: The oldest available name for this species is *Turbo nodulus* provided by EICHWALD (1830), which has priority over *Monodonta mamilla* ANDRZEJOWSKI, 1830 [see LANDAU et al. (2013: p. 28) for a discussion on the priority of names established by EICHWALD (1830) versus those introduced by ANDRZEJOWSKI (1830)]. We are not aware of any other author who had used *Turbo nodulus* earlier; the combination *Turbo nodulus* listed in ANTON (1839: p. 58) and PFEIFFER (1840: p. 48), clearly postdates EICHWALD's paper. Article 23.2 of the code of the International Commission for Zoological Nomenclature (ICZN) pleads for nomenclatural stability and perpetuation of long-accepted names and accordingly we would be inclined to declare *Turbo nodulus* a *nomen oblitum*. Indeed, to our knowledge, the name *Turbo nodulus* EICHWALD, 1830 has not been used as a valid name after 1899, which meets the requirements of ICZN Article 23.9.1.1. ("the senior homonym has not been used as a valid name after 1899"). In addition, ICZN Article 23.9.1.2. states that "the junior homonym has been used as its presumed valid name in at least 25 works, published by at least 10 authors in the immediately preceding 50 years and encompassing a span of not less than 10 years." This requirement cannot be fulfilled for *Monodonta mamilla* ANDRZEJOWSKI, 1830. Therefore, the name *Turbo nodulus* does not meet the requirements under ICZN rules to be declared a *nomen oblitum* and must replace the better established name *Monodonta mamilla* ANDRZEJOWSKI, 1830. We treat this species herein as *Homalopoma nodulus* (EICHWALD, 1830).

Distribution: This is the first Early Miocene record of the species from the Paratethys Sea, where it is wide-spread during the Badenian (Austria, Czech Republic, Bulgaria, Romania, Ukraine). In the Proto-Mediterranean Sea it appears during the Burdigalian (SACCO, 1896b). According to LANDAU et al. (2003) it persists in the Mediterranean Sea from the Late Miocene up to the Pleistocene.

Subclass: Caenogastropoda COX, 1960
Superfamily: Cerithioidea FLEMING, 1822
Family: Siliquariidae ANTON, 1839
Genus: *Tenagodus* GUETTARD, 1770

Type species: *Serpularia anguina* LINNAEUS, 1758, subsequent designation by SACCO, 1896a. Recent, Indian Ocean.

Tenagodus obtusus (SCHUMACHER, 1817)

(Pl. 2, Figs. 9–10)

* 1817 *Anguinaria obtusa* SCHUMACHER, p. 262.

1896a *T.*[*enagodus*] *anguinus* var. *miovermiculata* SACC. – SACCO, p. 19, pl. 2, fig. 18.

2004 *Tenagodus* (*Tenagodus*) *obtusus* (SCHUMACHER, 1817) – LANDAU et al., p. 14, pl. 2, fig. 7.

2013 *Tenagodus* (*Tenagodus*) *obtusus* (SCHUMACHER, 1817) – LANDAU et al., p. 58, pl. 5, fig. 8 (cum syn.).

Material: 3 natural casts with corresponding silicone moulds (NHMW 2014/0379/0025, NHMW 2014/0379/0026) and numerous fragments of adult whorls.

Dimensions: height: 13 mm (incomplete specimen), width: 4.5 mm.

Description: A slender spire and a very irregular coiling even of early spire whorls characterise the specimens from Allerding. In shape and size, they agree with other Early Miocene shells described by SACCO (1896a) from several localities in the Torino Hills as variety *miovermiculata*. The size of the fragments of the nearly straight last whorls, however, suggests that fully grown specimens did attain the large size of the Middle Miocene and Pliocene specimens of *T. obtusus* illustrated by SCHULTZ (1998) and LANDAU et al. (2004, 2013). The usually more regular coiling and rather obtuse spire of these specimens seem to be of little systematic value given the variability of these features in extant *T. obtusus* shells.

Distribution: This species appears during the Early Miocene (Burdigalian) of the Proto-Mediterranean and Paratethys seas (SACCO, 1896a; this paper). During the latest Early/early Middle Miocene and the Early Pliocene, it reaches up to the North Sea (LANDAU et al., 2004; MARQUET, 1997) and is wide-spread from the northeastern Atlantic to the Proto-Mediterranean and the Paratethys seas in the Middle Miocene (LANDAU et al., 2013). It persists in the Mediterranean and northeastern Atlantic throughout the Late Miocene and Pliocene and is still present in the Mediterranean Sea and along West Africa (see LANDAU et al., 2013 for details).

Superfamily: Calyptraeoidea LAMARCK, 1809
Family: Calyptraeidae LAMARCK, 1809
Genus: *Calyptraea* LAMARCK, 1809

Type species: *Patella chinensis* LINNAEUS, 1758; by monotypy. Recent, European.

***Calyptraea chinensis* (LINNAEUS, 1758)**

(Pl. 2, Figs. 11a–11b)

* 1758 *Patella chinensis* LINNAEUS, p. 1257.
2004 *Calyptraea chinensis* (LINNAEUS, 1758) – LANDAU et al., p. 70, pl. 15, fig. 3 (cum syn.).
2011 *Calyptraea chinensis* (LINNAEUS, 1758) – LANDAU et al., p. 14, pl. 4, fig. 9 (cum syn.).
2013 *Calyptraea chinensis* (LINNAEUS, 1758) – LANDAU et al., p. 95, pl. 9, fig. 7, pl. 61, fig. 6 (cum syn.).

Material: 1 natural cast with corresponding silicone mould (NHMW 2014/0379/0027).

Dimensions: height: 8 mm, diameter: 21 mm.

Description: The sub-circular specimen has a pointed protoconch and a strongly convex first teleoconch whorl, which is smooth aside from dense growth lines. The second teleoconch whorl is slightly less convex – therefore well separated from the first one in profile – and bears roughly spirally arranged rows of short tubular spines, which are abapically open.

Discussion: The high and strongly ornamented shell is reminiscent of *C. chinensis taurostriatella* (SACCO, 1896) from the Early Miocene of Italy and France (SACCO, 1896a; COSSMANN & PEYROT, 1919) and the early Middle Miocene of the Paratethys (SCHULTZ, 1998). Comparable morphologies, however, are also present in Pliocene (e.g. Asti NHMW collection) to Recent populations of *C. chinensis*, and therefore, we follow LANDAU et al. (2004, 2011, 2013) and refrain from separating the Miocene shells as distinct species. Moreover, the poor preservation of the Ottnangian specimen does not allow a more detailed assessment.

Distribution: A wide-spread species in European seas since the Early Miocene. In the Paratethys Sea, it is ubiquitous during the Middle Miocene but is also documented from Early Miocene (Eggenburgian: STEININGER, 1971; Karpatian: HARZHAUSER, 2002). For a very detailed list of occurrences and references, see LANDAU et al. (2013).

Superfamily: Cypraeoidea RAFINESQUE, 1815
Family: Cypraeidae RAFINESQUE, 1815
Genus: *Zonarina* SACCO, 1894

Type species: *Cypraea pinguis longovulina* SACCO, 1894 (= *Cypraea pinguis* GRATELOUP, 1845), by original designation. Miocene, France and Italy.

***Zonarina* sp.**

(Pl. 2, Figs. 12a–12b)

Material: 1 natural cast with corresponding silicone mould (NHMW 2014/0379/0028).

Dimensions: height (of aperture): c. 37 mm.

Discussion: Only a single fragment of the outer lip is preserved, which does not allow definitive identification. However, it reflects a medium-sized shell with about 18 stout labral teeth extending over half the width of the swollen lip. The labral callus is well-developed and delimited from the dorsum. This fragment is similar to the shell illustrated by FEHSE (2001) as *Zonarina* (*Zonarina*) *dertamygdaloides dertamygdaloides* (SACCO, 1894), which according to the author is a senior synonym of *Z. austriaca* SCHILDER, 1927. However, the specimen illustrated by SACCO (1894) has far denser and smaller labral teeth than the Paratethyan shell. The Ottnangian fragment is also similar to the shell illustrated by BAŁUK (1995) as *Zonarina* cf. *exglobosa* (SACCO, 1894), but the teeth in the Polish specimen illustrated are restricted to the edge of the inner lip.

Superfamily: Tonnoidea SUTER, 1913 (1825)
Family: Cassidae LATREILLE, 1825
Genus: *Semicassis* MÖRCH, 1852

Type species: *Cassia japonica* REEVE, 1848, subsequent designation by HARRIS (1897). Miocene-Recent, Indo-West Pacific.

***Semicassis grateloupi* (DESHAYES, 1853)**

(Pl. 2, Figs. 13, 14a–14b)

* 1853 *Cassis grateloupi* DESH. – DESHAYES, p. 69, pl. 116, fig. 2.
1958 *Phalium* (*Semicassis*) *grateloupi* (DESHAYES 1850) – HÖLZL, p. 217, pl. 20, figs. 1–2a
2001 *Semicassis grateloupi* (DESHAYES, 1853) – LOZOUET et al., p. 45 (cum syn.).

Material: 2 natural casts with corresponding silicone moulds (NHMW 2014/0379/0029, NHMW 2014/0379/0030) and several natural internal casts, which might represent this species.

Dimensions: height (of aperture): c. 40 mm, width: 34 mm (pl. 2, fig. 13), height (last whorl): c. 30 mm, diameter: 23 mm (pl. 2, figs. 14a–14b).

Discussion: One of the specimens shows a sculpture of dense spiral cords with sharp edges; only a single, weaker secondary cord appears along the periphery. This sculpture agrees well with specimens of *S. grateloupi* as described by COSSMANN & PEYROT (1924) and with Early Miocene specimens from France in the NHMW collection. As pointed out by LANDAU et al. (2009a), *S. neumayri* (HOERNES, 1875) from coeval deposits of Ottnang/Schanze is based on subadult and deformed shells. Therefore, the sculpture and apertural features of fully grown specimens are unknown. Nevertheless, *S. neumayri* seems to be reliably distinguished from the shells from Allerding by its shorter and more globular last whorl and the presence of secondary threads between the primary spiral cords. The slightly older *Semicassis subsulcosa* (HOERNES & AUINGER, 1884), from the Eggenburgian of the Paratethys, differs in its prominent, broad and rounded spiral cords.

Distribution: *Semicassis grateloupi* is described from the Aquitanian and Burdigalian of the Aquitaine Basin (COSSMANN & PEYROT, 1924). In the Paratethys it is a rare species, known so far only from the latest Eggenburgian or Ottnangian of Bavaria (Hölzl, 1958) and from the Ottnangian of Austria.

Superfamily: Ficoidea Meek, 1864
Family: Ficidae Meek, 1864
Genus: *Ficus* Röding, 1798

Type species: *Ficus variegata* Röding, 1798; subsequent designation by Dall (1906). Recent, Indo-West Pacific.

***Ficus condita* (Brongniart, 1823)**

(Pl. 2, Fig. 15)

* 1823 *P.*[*yrula*] *condita* A. Br. – Brongniart, p. 75, pl. 6, fig. 4 (not Pliocene species).

1875 *Pyrula condita* Brong. – Hoernes, p. 352.

2013 *Ficus condita* (Brongniart, 1823) – Landau et al., p. 132, pl. 19, fig. 13, pl. 62, fig. 10 (cum syn.).

Material: 1 natural cast with remnants of the shell (NHMW 2014/0379/0031) and numerous poorly preserved casts, which most probably represent this species.

Dimensions: height: 92 mm, width: 52 mm.

Discussion: The illustrated specimen has a very prominent primary sculpture and is unusually large for this species. It would fit better within the size range of *Ficus cingulata* (Bronn in Hörnes, 1853), which is also recorded from the Ottnangian of Upper Austria (Mathias Harzhauser own data). Nevertheless, the sculpture, which is partly preserved as calcitic pseudomorphosis, excludes this identification. A comparably large specimen with strongly raised primary sculpture was described by Cossmann & Peyrot (1923) from the Early Miocene of the Aquitaine Basin as *Ficus condita ventricosa* (Grateloup, 1845). A coeval specimen from the Turin Hills with identical sculpture was described by Sacco (1890) as *F. condita anteficoides*. Our material does not allow a decision, if these morphs represent a distinct species and therefore, we follow Lozouet et al. (2001) and Landau et al. (2013) in treating these taxa as synonyms of *Ficus condita*.

Distribution: *Ficus condita* is a ubiquitous species in European seas from the Late Oligocene to the Middle Miocene and persists in the Proto-Mediterranean Sea up to the Late Miocene. For a detailed list of occurrences, see Landau et al. (2013). Hoernes (1875) already mentioned occurrences from the Ottnangian of Upper Austria.

Superfamily: Epitonioidea Berry, 1910 (1812)
Family: Epitoniidae Berry, 1910 (1812)
Genus: *Epitonium* Röding, 1798

Type species: *Turbo scalaris* Linnaeus, 1758; subsequent designation by Suter (1913). Recent, Pacific.

***Epitonium* nov. sp.**

(Pl. 3, Fig. 5)

Material: 1 natural cast with corresponding silicone mould (NHMW 2014/0379/0036).

Dimensions: height: 13 mm (incomplete specimen), width: 4.5 mm.

Description: A small, slender shell with strongly inflated and regularly rounded teleoconch whorls, which increase only slowly in width; sutures deeply incised. Axial sculpture not continuous, consisting of densely spaced and slightly prosocline lamellae. No spiral sculpture developed. Aperture unknown.

Discussion: The fragmentary preservation does not allow specific identification. Nevertheless, the specimen differs from all somewhat similar *Epitonium* species from the Early Miocene of France and Italy, described by Cossmann & Peyrot (1922) and Sacco (1891), in its slender outline and the bulbous whorls. Only *Subuliscala lagusensis* de Boury in Cossmann, 1912, from the Burdigalian of Saucats (France), is very similar concerning shape and sculpture but is much smaller (4 mm in height).

Distribution: Only known from the Ottnangian of Allerding.

Genus: *Cirsotrema* Mörch, 1852

Type species: *Scalaria varicosa* Lamarck, 1822; by monotypy. Recent, Indo-West Pacific.

***Cirsotrema crassicostanomala* Sacco, 1891**

(Pl. 3, Figs. 1a–1b)

* 1891 *C.*[*irsotrema*] *Duciei* var. *crassicostanomala* Sacc. – Sacco, p. 49, pl. 2, fig. 21.

1984 [*Cirsotrema duciei*] var. *crassicostanomala* Sacco, 1891 – Ferrero-Mortara et al., p. 47, pl. 5, fig. 15.

Material: 1 specimen (NHMW 2014/0379/0032).

Dimensions: height: 33 mm (incomplete specimen), width: 13.5 mm.

Description: Moderately-sized conical-turriculate shell, lacking the early spire whorls. Five weakly convex teleoconch whorls preserved, nearly coalescing in profile; an incised suture only visible on earliest preserved whorl, obscured by axial sculpture on later whorls. Sculpture consisting of very broad and raised, prosocline, strap-like axial ribs, which are broader than their deep interspaces. On early teleoconch whorls, axial ribs narrow and override five sharp, raised spiral cords, which weaken adapically. At abapical suture, ribs broaden further and almost fuse to form a broad subsutural collar, below which there is a weakly concave subsutural depression to the whorl profile, below this the whorl is slightly swollen and convex in profile. Basal disc present. Aperture subcircular; peristome continuous but narrowed at the parietal wall.

Discussion: The largely obscured sutures and the axial ribs extending up to the preceding whorl are unique features of this species. The Italian holotype, which is the only known specimen, differs in its broader shell. In view of the lack of information concerning the intraspecific variability of this species and the very characteristic sculpture, we provisionally consider them to be conspecific. Sacco (1891) introduced this species as variation of "*Cirsotrema Duciei*" described by Wright (1855) from the Miocene of Malta.

The Maltese species, however, differs very distinctly in its deeply incised sutures and is not closely related.

This species is superficially reminiscent of *Cirsotrema crassicostatum* (Deshayes, 1853) but differs substantially in the almost smooth varices and axial ribs, and in the absence of deep sutures. *Cirsotrema crassicostatum subseguenzai* Sacco, 1891 from the Late Miocene of Sant'Agata Fossili also has strongly reduced sculpture on the axial ribs but has deep sutures and more numerous spiral cords. Moreover, the axial ribs are irregular in width and distance.

Distribution: The origin of the shell described by Sacco (1891) is unclear. The collection label indicated the Late Miocene locality Tortona but Sacco (1891) doubted this provenance and suggested that the specimen is derived from a "*facies elveziana*", which would be roughly coeval with the herein described occurrence. Aside from this occurrence in the Miocene of the Proto-Mediterranean Sea, *C. crassicostanomala* is now documented also from the Ottnangian of the Paratethys Sea.

Genus: *Scalina* Conrad, 1865

Type species: *Scalina staminea* Conrad, 1865; subsequent designation by Palmer (1937). Eocene, USA.

***Scalina subreticulata* (d'Orbigny, 1852)**

(Pl. 3, Figs. 2, 3, 4a–4b)

1847 *Scalaria reticulata* mihi – Michelotti, p. 161, pl. 6, fig. 13 (non *Scalaria reticulata* Sowerby, 1829, nec Philippi, 1843).

* 1852 [*Scalaria*] *subreticulata* d'Orb. – d'Orbigny, p. 31, nr. 413.

1856 *Scalaria amoena* Phil. – Hörnes, p. 479, pl. 46, figs. 11a–b (non *Scalaria amoena* Philippi, 1843).

1875 *Scalaria amoena* Phil. – Hoernes, p. 362, pl. 10, figs. 8–9 (non *Scalaria amoena* Philippi, 1843).

1891 *A.*[*crilla*] *amoena* var. *subreticulata* (d'Orb.) – Sacco, p. 61, pl. 2, fig. 51.

? 1913 *S.*[*cala*] (*Acrilla*) *phoenix* de Boury nov sp. – de Boury, p. 315, pl. 11, fig. 15.

? 1922 *Acrilla phoenix* de Boury – Cossmann & Peyrot, p. 157, pl. 4, figs. 91–92.

1952 *Scala (Acrilla) amoena* f. *subreticulata* d'Orbigny, 1852 – Glibert, p. 44, pl. 7, fig. 1.

1956 *Scala* (*Acrilla*) *amoena hörnesi* Pant. – Sieber, p. 316

1969 *Scala* (*Acrilla*) *amoena subreticulata* d'Orb. – Csepreghy-Meznerics, p. 74, pl. 1, fig. 30.

1973 *Amaea* (*Acrilla*) *amoena hoernesii* Pant. – Steininger, p. 407, pl. 4, fig. 9 (non *Scalaria* (*Cirsotrema*) *Hörnesi* Pantanelli, 1886).

1975 *Acrilla* (*Acrilla*) *subreticulata* (d'Orbigny, 1852) – Bałuk, p. 175, pl. 21, figs. 5–7.

1984 *Amaea* (*Scalina*) *subreticulata* (d'Orbigny, 1852) – Janssen, p. 165, pl. 7, fig. 11, pl. 50, fig. 12.

2006 *Acrilla subreticulata* (d'Orbigny, 1852) – Bałuk p. 203, pl. 10, fig. 6.

2007 *Amaea* (*Acrilla*) *hoernesii* Pantanelli – Rupp & van Husen, p. 84 (non *Scalaria* (*Cirsotrema*) *hörnesi* Pantanelli, 1886).

Material: 3 specimens (NHMW 2014/0379/0033, NHMW 2014/0379/0034, NHMW 2014/0379/0035).

Dimensions: height: 20 mm (incomplete specimen), width: 9 mm (pl. 3, fig. 3), height: 34 mm (incomplete specimen), width: 12.5 mm (pl. 3, fig. 4), width: 14 mm (pl. 3, figs. 5a–5b).

Description: A very large and moderately slender turriculate species, which attains a height of up to 53 mm (based on specimens from Ottnang/Schanze in the GBA and NHM collections). Protoconch of Austrian specimens unknown; > 11 teleoconch whorls evenly rounded with deeply incised sutures; only the last whorls may develop a faint shoulder. Sculpture comprising five to six prominent, regularly spaced spiral cords with flat backs. Weakly prosocline to sinuous axial ribs of regular strength and disposition override the spiral cords, resulting in a cancellate sculpture. Secondary spiral threads of irregular strength appear in the interspaces. A broad, band-like varix may be developed on the last whorl; the basal cord is slightly more prominent forming a weak angulation towards the less convex base, which bears only axial ribs and weaker secondary spiral threads. The sculpture is quite variable ranging from specimens with strictly cancellate sculpture to specimens in which the spiral cords are slightly more prominent than the axial ribs. Similarly, the strength and contribution of the secondary spiral threads is variably. Aperture poorly preserved; columellar lip thickened; no palatal lip developed; funiculus very weak.

Discussion: This large species, which is very frequent in the Ottnangian of Upper Austria, was confused by Hoernes (1875) with the Late Oligocene *Scalina amoena* (Philippi, 1843) from the North Sea Basin, which differs in its smaller size. Already Pantanelli (1886) recognised that the Miocene shells were not conspecific with *Scalina amoena* and discussed the specimens illustrated by Hoernes (1875) from Ottnang in his description of *Scalaria* (*Cirsotrema*) *hörnesi* from Pantano of Reggio Emilia in Italy (Langhian in age; see Borghi, 2012). He tentatively suggested that both records were conspecific but emphasised, that this conclusion was based solely on the illustration in Hoernes (1875) and not on comparison of specimens. Therefore, the name *Scalina hoernesi* (Pantanelli, 1886) refers to the species occurring in the Middle Miocene (Langhian) of Italy and cannot be used for the Ottnangian species, as done by Sieber (1956) and Steininger (1973).

Several species with comparable sculpture and shape appear during the Early Miocene in the North Sea Basin, the Aquitaine Basin and the Piedmont Basin: *Scalina subreticulata* (d'Orbigny, 1852), *S. subcancellata* (d'Orbigny, 1852), *S. phoenix* (de Boury, 1913) and *S. taurocancellata* (Sacco, 1891). The separation of these species is mainly based on minor differences in sculpture and size and their status needs revision. Based on the variability of the sculpture, observed in Middle Miocene specimens from Poland, Bałuk (1975) doubted whether the separation of most of these species was justified.

Distribution: *Scalina subreticulata* is based on a specimen from the Langhian of Albugnano, which was first described by Michelotti (1847) and later re-illustrated by Sacco (1891). It is probably also present in the Early Miocene of the Aquitaine Basin (e.g. as *S. phoenix* and *S. miobronni* sensu Cossmann, 1912 and is documented from the Burdigalian and

Langhian of the North Sea Basin. In the Paratethys it is only known from the Ottnangian of Upper Austria and the Badenian (Middle Miocene) of Poland (Bałuk, 2006), Austria (Hörnes, 1856), Romania (Boettger, 1906) and Hungary (Csepreghy-Meznerics, 1969).

Genus: *Claviscala* de Boury, 1909

Type species: *Scalaria richardi* Dautzenberg & de Boury, 1897; by original designation. Recent, North Atlantic.

***Claviscala norica* Harzhauser & Landau nov. sp.**

(Pl. 4, Figs. 14–16)

Material: Holotype: pl. 4, fig. 14, NHMW 2014/0379/0058; paratype: pl. 4, fig. 15, NHMW 2014/0379/0059; additional material: 1 natural cast and the corresponding silicone mould (NHMW 2014/0379/0060).

Dimensions: largest specimen: diameter: 6 mm, height: > 33 mm.

Type locality, stratum typicum and age: Allerding in Upper Austria, Ottnang Formation, Ottnangian (Early Miocene).

Derivation of name: Referring to Noricum, a province of the Roman Empire, including also the territory of the present-day Upper Austria.

Description: Large-sized and slender shell comprising at least 12 teleoconch whorls; protoconch unknown. The weak convexity of the whorls is emphasised by the prominent, regularly spaced, prosocline to weakly opisthocyrt axial ribs, which are separated by slightly narrower interspaces. The ribs fade out towards the sutures; a distinct spiral cord appears along the lower suture, whilst only an indistinct spiral swelling adjoins the upper suture. The suture is narrow but deeply incised between these two elements. No spiral threads are developed. Aperture unknown.

Discussion: This species is characterised by its conspicuous lower adsutural spiral cord and the slightly convex whorls. These features allow a clear separation from all Miocene proto-Mediterranean-Paratethyan epitoniids. The Oligocene North Sea species *Opaliopsis* sp.1 of Schnetler & Beyer (1990) and the Miocene *Opaliopsis turbonillaeformis* (Janssen, 1967), from the Reinbekian of Dingden, are both slightly reminiscent of the Ottnangian species but have deeper sutures and lack the adsutural cord. The extant North Atlantic and Mediterranean *Claviscala richardi* Dautzenberg & de Boury, 1897 is very similar but differs from the Ottnangian shell in its slightly broader and larger shell (see Bouchet & Warén, 1986).

Distribution: Only known from the Ottnangian of Allerding.

Order: Neogastropoda Wenz, 1938
Superfamily: Buccinoidea Rafinesque, 1815
Family: Nassariidae Iredale, 1916 (1835)
Genus: *Nassarius* Duméril, 1805

Type species: *Buccinum arcularia* Linnaeus, 1758; by monotypy. Recent, Indian Ocean.

Note: The endemic nature of nassariids has been highlighted in recent papers dealing with the family in the European Neogene assemblages (i.e. Gürs, 2002; Harzhauser & Kowalke, 2004; Landau et al., 2009b, 2013). Although this Ottnangian assemblage is not speciose, two of the three nassariids from Allerding are endemic to the Ottnangian Paratethys, and the third is known only from the Lower and Middle Miocene Paratethys.

***Nassarius schultzi* Harzhauser & Kowalke, 2004**

(Pl. 3, Figs. 6a–6b)

1875 *Buccinum subquadrangulare* Micht. – Hoernes, p. 349, pl. 11, figs. 8–10 (non *Buccinum subquadrangulare* Michelotti, 1847).

1965 *Hinia* (*Uzita*) *subquadrangularis* (Michelotti, 1847) – Hölzl, p. 270, pl. 4, fig. 6 (non *Buccinum subquadrangulare* Michelotti, 1847).

1973 *Hinia* (*Uzita*) *subquadrangularis* (Michelotti 1847) – Steininger, p. 425, pl. 7, figs. 1–2 (non *Buccinum subquadrangulare* Michelotti, 1847).

1998 *Hinia* (*Uzita*) *subquadrangularis* (Michelotti) – Schultz, p. 66, pl. 26, fig. 17 (non *Buccinum subquadrangulare* Michelotti, 1847).

* 2004 *Nassarius schultzi* nov. sp. – Harzhauser & Kowalke, p. 10, text-figs. 4/a–c, 6/a–b.

Material: 1 shell (NHMW 2014/0379/0037) and 1 natural cast with corresponding silicone mould; several small fragments seem to represent this species as well.

Dimensions: height: 14 mm, diameter: 7.5 mm; height: 16.5 mm, diameter: 8.5 mm.

Discussion: Harzhauser & Kowalke (2004) gave a detailed description of this species, which was previously confused with the Proto-Mediterranean *Nassarius subquadrangularis* (Michelotti, 1847). It was known so far only from the “schlier”-facies of Ottnang but is quite common in the coastal deposits of Allerding. Already the few type specimens suggested some variability of spire height; one of the newly recorded shells from Allerding has an even higher spire, suggesting some considerable intraspecific variability.

Distribution: The species is endemic to the Central Paratethys Sea during the Ottnangian. It is only known so far from the North Alpine Foreland Basin where it is documented from Ottnang/Schanze and Allerding in Austria and from the Kaltenbach-Gernergraben area in Bavaria (Hölzl, 1965; Harzhauser & Kowalke, 2004).

***Nassarius striatulus* (Eichwald, 1829)**

(Pl. 3, Figs. 7a–7b, 8)

* 1829 *Buccinum striatulum* Eichwald – Eichwald, p. 297, pl. 5, fig. 7.

2004 *Nassarius striatulus* (Eichwald 1829) – Harzhauser & Kowalke, p. 19, pl. 1, figs. 8–14 (cum syn.).

Material: 2 natural casts with corresponding silicone moulds (NHMW 2014/0379/0038, NHMW 2014/0379/0039).

Dimensions: diameter of last whorl: 8.5 mm.

Discussion: This species and its complex taxonomic history were discussed in detail by Harzhauser & Kowalke (2004). The shells from Allerding are rather stout and bear distinct axial ribs on the spire, which are replaced by slightly beaded spiral cords on the last whorl. Therefore, this Ottnangian morphotype ranges between the elongate and smooth "*N. hoernesii*"-morphotype and the stout and strongly sculptured "*N. costulatus*"-morphotype.

Distribution: This is the first record of this species from the Early Miocene. During the Middle Miocene it is ubiquitous in the Paratethys Sea and might also be documented from the Langhian of the Turin Hills (Harzhauser & Kowalke, 2004).

Nassarius pauli (Hoernes, 1875)

(Pl. 3, Fig. 9)

* 1875 *Buccinum Pauli* nov. sp. – Hoernes, p. 348, pl. 11, figs. 5–7.

1882 *Buccinum* (*f. Niotha*) *Pauli* R. Hoern. – Hoernes & Auinger, p. 126, pl. 13, fig. 22.

1965 *Hinia* (*Uzita*) *pauli* (R. Hoernes) – Hölzl, p. 270, pl. 4, fig. 7.

1973 *Hinia* (*Uzita*) *pauli* (R. Hoernes 1875) – Steininger, p. 425, pl. 6, figs. 12–13.

2004 *Nassarius pauli* (Hoernes 1875) – Harzhauser & Kowalke, p. 12, pl. 1, fig. 8.

Material: 1 natural cast (with silicone mould) (NHMW 2014/0379/0040).

Dimensions: height: 9 mm, diameter: 5.5 mm.

Discussion: This species was described in detail by Harzhauser & Kowalke (2004); it can be distinguished from the co-occurring *Nassarius schultzi* by its smaller size, the stout shape and its gradate spire.

Distribution: In the Central Paratethys Sea *Nassarius pauli* is restricted to the Ottnangian of the North Alpine Foreland Basin. It is documented from Ottnang/Schanze and Allerding in Austria and from the Kaltenbach-Gernergraben area in Bavaria (Hölzl, 1965; Harzhauser & Kowalke, 2004). The occurrence in the Langhian of the Proto-Mediterranean Sea, described by Sacco (1904: p. 69, pl. 16, fig. 33), would be surprising in respect to the stratigraphic gap and will need verification.

Family: Buccinidae Rafinesque, 1815

Buccinidae indet.

(Pl. 3, Fig. 10)

Material: 1 natural cast with corresponding silicone mould (NHMW 2014/0379/0041).

Dimensions: height: > 60 mm, diameter: 31 mm.

Discussion: A single fragment is available showing a large fusiform shell with high conical spire, inflated last whorl and shallow subsutural concavity. Sculpture consisting of numerous densely spaced, low spiral cords with flat backs. We are not aware of any other Miocene buccinid of the Paratethys, which might be conspecific with this species. "*Neptunea" hoernesi* (Bellardi, 1873), from the Middle Miocene of the Paratethys, has a distinctly coarser spiral sculpture and lacks a sutural cord. "*N.*" *costulatus* (Bellardi, 1873), from the Early Miocene of Italy, develops a similar spiral sculpture but has a higher last whorl and weak axial folds on the spire whorls. Thus, although the poor preservation does not allow a reliable identification, we consider this species unknown so far from the Paratethys.

Distribution: Only known from the Ottnangian of Allerding.

Genus: *Scalaspira* Conrad, 1862

Type species: *Fusus strumosa* Conrad, 1832; by monotypy. Miocene, Maryland.

Scalaspira? nov. sp.

(Pl. 3, Figs. 11–12)

Material: 2 natural casts with corresponding silicone moulds (NHMW 2014/0379/0042, NHMW 2014/0379/0043).

Dimensions: largest specimen (without spire): height: > 42 mm, diameter: 24 mm.

Description: No completely preserved specimen is available; based on the fragments, the teleoconch seems to consist of about 6 to 7 whorls, which gradually increase in convexity. Penultimate whorl strongly convex with incised sutures; one specimen displays irregular axial folds. Last whorl inflated with shallow adsutural concavity, delimiting a more prominent sutural cord; rest of whorl covered with about 30 densely spaced spiral cords with slightly granulose surface, separated by narrow interspaces. Base rapidly contracting into a moderately long and slightly deflected siphonal canal. The few, irregularly spaced, weak, fold-like axial ribs of the last whorl become most prominent along the neck. Pear shaped aperture with thin outer lip; inner lip very narrow and thin.

Discussion: The spiral sculpture is reminiscent of *Scalaspira loczyi* (Noszky, 1936) from the Oligocene of Hungary, which differs only in its more slender shell and the broad axial swellings (see Báldi, 1973). Tembrock (1968) revised this mainly boreal and rather polymorphic genus. All species described by her differ from the Ottnangian species either in their conical spire, coarser spiral sculpture and/or more slender-fusiform outline. As emphasised by Tembrock (1968), the characteristic feature of all *Scalaspira* species is the reticulate or cancellate sculpture of the late protoconch and early teleoconch. This feature is not preserved in our material and therefore the generic placement remains questionable. Nevertheless, the presence of the genus in the Ottnangian Paratethys was already documented by *Scalaspira haueri* (Hoernes, 1875), which differs in its much broader and wider-spaced spiral cords.

The sculpture of the last whorl is also similar to species of the North Sea genus *Liomesus* Stimpson, 1865, especially to *Liomesus ventrosus* (Beyrich, 1856) from the Miocene of the North Sea (see Rasmussen, 1956; Schnetler, 2005) and *L. escheri* (Mayer, 1858) from the Miocene of the Loire Basin (see Glibert, 1952), which develop a comparable sculpture and a strongly convex last whorl but differ clearly in their lower spires and the less incised sutures. Both lack the *Neptunea*-like axial folds seen in the Ottnangian species. The Pliocene type species *Liomesus dalei* (Sowerby, 1825), differs clearly in its weak sculpture and moderate convexity of the whorls.

The "northern flair" implied by the placement in *Scalaspira* is contrasted by a "southern" scenario as this species might also be related to a group of Early and Middle Miocene proto-Mediterranean and Paratethyan species, which are traditionally placed in *Chrysodomus* SWAINSON, 1840 (= *Neptunea* RÖDING, 1798) since the first thorough description by BELLARDI (1873). These species are "*Neptunea" cingulifera* (BELLARDI, 1873), "*N." hoernesii* (BELLARDI, 1873), "*N." glomoides* (BELLARDI & MICHELOTTI, 1840) and "*N." costulatus* (BELLARDI, 1873). For some of these species, the generic placement in *Neptunea* was also proposed by ROBBA (1968), SNYDER (2003) and ZUNINO & PAVIA (2009). In our opinion, these species do not belong to *Neptunea* based on their slender fusiform shape, the comparatively narrow aperture and the short and wide siphonal canal. The above mentioned Proto-Mediterranean species all differ from the species from Allerding either in their smaller size and/or the much coarser sculpture. Only "*N." costulatus* has a comparable sculpture but is distinctly more slender. In addition, the Austrian species differs from these species in its strongly concave neck and the concavity of the outer lip marking the transition into the siphonal canal. These features are indeed reminiscent of *Neptunea* species, such as *Neptunea striata* (SOWERBY, 1813) from the Pliocene of Belgium. Similarly, the fold-like growth lines on the last whorl appear also in *Neptunea*. However, there is no reliable fossil record for *Neptunea* before the Pliocene, when it is represented in the North Sea by at least two or three species (e.g. MARQUET, 1998; VERVOENEN et al., 2014). Therefore, we refrain from placing this species in *Neptunea*.

Distribution: Only known from the Ottnangian of Allerding.

Genus: *Metula* H. ADAMS & A. ADAMS, 1853

Type species: *Buccinum clathratum* ADAMS & REEVE, 1850; by subsequent designation (KOBELT, 1876). Recent, Panamic western America.

Metula nov. sp.

(Pl. 3, Fig. 13)

Material: 1 natural casts with corresponding silicone mould (NHMW 2014/0379/0044).

Dimensions: height: > 26 mm, diameter: 10 mm.

Description: A single fragmentary specimen is available; protoconch comprising at least 3 high, smooth and moderately convex whorls; a delicate adsutural spiral cord appears on the last protoconch whorl. Beginning of teleoconch marked by the onset of a dense pattern of axial ribs and spiral cords producing delicate beads at the intersections. The cancellate sculpture is followed by only weak spiral sculpture within the third spire whorl and especially on the base and the short canal.

Discussion: The species seems to be closely related to *Metula submitraeformis* (D'ORBIGNY, 1852), which was widespread during the Early and Middle Miocene in the European seas (LANDAU et al., 2013). It agrees in its multispiral protoconch and in the sculpture of the early teleoconch but differs from the Ottnangian shell in its more convex spire whorls and the slowly contracting base. At same size, the spire whorls are much lower in the Ottnangian shell and especially the penultimate whorl of *M. submitraeformis* appears higher due to the low position of the aperture. *Metula reticulata* (BELLARDI & MICHELOTTI, 1840) from the Early Miocene of Turin, Italy differs in having a reticulate sculpture developed on all teleoconch whorls. *Metula recta* (SACCO, 1904), also from the Miocene of the Turin area, has strongly convex whorls.

Distribution: Only known from the Ottnangian of Allerding.

Family: Fasciolariidae GRAY, 1853
Subfamily: Fusininae SWAINSON, 1840
Genus: *Fusinus* RAFINESQUE, 1815

Type species: *Murex colus* LINNAEUS, 1758; by monotypy. Recent, Indo-West Pacific.

Fusinus nov. sp.

(Pl. 4, Figs. 1–3)

Material: 3 natural casts of spire fragments and the corresponding silicone moulds (NHMW 2014/0379/0045, NHMW 2014/0379/0046, NHMW 2014/0379/0047).

Dimensions: diameter of largest fragment: 21 mm.

Description: Early spire whorls regularly convex, bearing narrow, strongly raised and slightly prosocline axial ribs, crossed by 5–6 sharp, prominent spiral cords. Secondary spiral threads intercalated between primary cords on third and fourth teleoconch whorls. Spirals slightly swollen at intersections with axial ribs. Later whorls become angulated at shoulder, with steep sutural ramp bearing weak spiral threads. Axial ribs prominent, rounded, about half the width of their interspaces, weakening abapically, bearing horizontally-elongated tubercles at the sculptural intersections. Last whorl convex, bearing about ten primary spiral cords, with secondary and tertiary spiral threads intercalated in the interspaces. Columellar lip narrow and thin; rest of aperture and siphonal canal not preserved.

Discussion: This species is quite distinctive, and there is a strong change in sculpture and whorl profile with ontogeny. The fragments could be mistaken for strongly sculptured specimens of *Fusinus hoessii* (HOERNES & AUINGER, 1880) from the Badenian of the Paratethys. Nevertheless, the Ottnangian species shows a much stronger differentiation of the spiral sculpture into primary and secondary cords and the axial ribs on the early spire whorls are much narrower, more raised and slightly prosocline. We have not found any known species to which to attribute these Ottnangian fragments, but in the absence of better preserved material, we refrain from formally describing it.

Distribution: Probably only known from the Ottnangian of Allerding.

Superfamily: Muricoidea RAFINESQUE, 1815
Family: Muricidae RAFINESQUE, 1815
Genus: *Chicoreus* DE MONTFORT, 1810
Subgenus: *Triplex* PERRY, 1810

Type species: *Murex foliatus* PERRY, 1810 [= *C.* (*T.*) *palmarosae* (LAMARCK, 1822)]; by monotypy. Recent, Indo-West Pacific.

Chicoreus (*Triplex*) *aquitanicus* (GRATELOUP, 1833)

(Pl. 4, Figs. 4a–4b)

* 1833 *Murex aquitanicus* GRAT. – GRATELOUP, p. 94.

1845 *Murex Aquitanicus* GRAT. – GRATELOUP, pl. 31, figs. 12a–b.

1973 *Chicoreus* (*Chicoreus*) cf. *aquitaniensis* (GRATELOUP, 1833) – STEININGER, p. 418.

2011 *Chicoreus* (*Triplex*) *aquitanicus* (GRATELOUP, 1833) – MERLE et al., p. 350, pl. 53, figs. 1–7.

2013 *Chicoreus* (*Triplex*) *aquitanicus* (GRATELOUP, 1833) – LANDAU et al., 147, pl. 21, fig. 11 (cum syn.).

Material: 1 natural cast and a silicone mould (NHMW 2014/0379/0048) and numerous natural internal casts.

Dimensions: height: 116 mm, diameter: 66 mm.

Discussion: The specimen from Allerding does not differ at all from other shells of this species, which was intensively discussed by MERLE et al. (2011) and LANDAU et al. (2013).

Distribution: *Chicoreus* (*Triplex*) *aquitanicus* appears during the Burdigalian in the northeastern Atlantic (Aquitaine Basin, France, COSSMANN & PEYROT, 1924) and the Proto-Mediterranean Sea (Colli Torinesi, Italy (BELLARDI, 1873; SACCO, 1904). In the Central Paratethys Sea it appears during the Ottnangian, when it is recorded from Kaltenbachgraben in Germany (STEININGER, 1973) and Allerding in Upper Austria. During the Middle Miocene climatic Optimum around the Early-Middle Miocene boundary it reaches as far north as the North Sea Basin (Netherlands, JANSSEN, 1984). During the Middle Miocene it is wide-spread from the Loire Basin (France; GLIBERT, 1952) via the Aquitaine Basin (France, COSSMANN & PEYROT, 1924) to the Central Paratethys Sea and the Proto-Mediterranean Sea (see LANDAU et al., 2013 for details). The latest occurrence is recorded from the Tortonian of the Po Basin in Italy (MICHELOTTI, 1847). The poorly preserved casts from the Eggenburgian of Belpberg (Switzerland), described by PFISTER & WEGMÜLLER (2007: p. 157 pl. 3, figs. 3–12) as *Chicoreus* sp. aff. *sedgwicki* (MICHELOTTI, 1847), might at least partly also represent *C. aquitanicus*.

Family: Mitridae SWAINSON, 1829
Genus: *Episcomitra* MONTEROSATO, 1917

Type species: *Mitra zonata* MARRYAT, 1818; by monotypy. Recent, Mediterranean Sea.

Episcomitra sp.

(Pl. 4, Figs. 5a–5b, 6)

Material: 2 natural casts with corresponding silicone moulds (NHMW 2014/0379/0049, NHMW 2014/0379/0050) and numerous fragments, which seem to represent this species.

Dimensions: height: > 55 mm, diameter: 21 mm.

Discussion: The fragments suggest a large, moderately fusiform and smooth species with incised sutures and 5 prominent columellar folds of which the interspace between the uppermost two folds is slightly wider than the other interspaces. The overall shape and the reduced set of conchological features available agree well with early Middle Miocene Paratethyan shells of *Episcomitra fusiformis* (BROCCHI, 1814) in the NHMW collection. This species, however, is unknown so far from Lower Miocene deposits (see LANDAU et al., 2013). The north-eastern Atlantic Early Miocene *Episcomitra dufresnei* (DE BASTEROT, 1825) has a lower spire and a broader base. The Paratethyan Middle Miocene *Episcomitra brusinae* (HOERNES & AUINGER, 1880) differs in its more slender spire.

Superfamily: Cancellarioidea FORBES & HANLEY, 1851
Family: Cancellariidae FORBES & HANLEY, 1851
Genus: *Sveltia* JOUSSEAUME, 1887

Type species: *Voluta varricosa* BROCCHI, 1814; by original designation. Pliocene, Italy.

Sveltia suessi (HOERNES, 1875)

(Pl. 4, Figs. 7a–7b)

* 1875 *Cancellaria Suessi* nov. sp. – HOERNES, p. 355, pl. 11, figs. 22–23.

1890 *Cancellaria* (c. *Narona*) *Suessi* R. HOERN. – HOERNES & AUINGER, p. 279, pl. 35, figs. 8–9.

1973 *Narona* (*Sveltia*) *suessi* (R. HOERNES, 1875) – STEININGER, p. 435, pl. 8, figs. 1–2.

2012 *Sveltia suessi* (HOERNES, 1875) – HARZHAUSER & LANDAU, p. 52, figs. 10C1–C3, 10D1–D3 (cum syn.).

Material: 1 natural cast with corresponding silicone mould (NHMW 2014/0379/0051).

Dimensions: height: 35 mm, diameter: 21 mm.

Discussion: This species was discussed in detail by HARZHAUSER & LANDAU (2012). The new finding reveals a broad band of delicate lirae in the outer lip (about 15), which is not seen in the type specimens, due to the sediment infill. Compared to the type specimens, the axial ribs appear rather sharp and the characteristic nodes seem to be weaker. Both features, however, are preservational effects.

Distribution: Only known from the Ottnangian (Middle Burdigalian) of the Central Paratethys Sea. It is recorded only from the North Alpine Foreland Basin, where it was found at Ottnang/Schanze and Allerding in Austria and at Gernergraben and Kaltenbachgraben in Bavaria (HÖLZL, 1973; HARZHAUSER & LANDAU, 2012).

Superfamily: Conoidea FLEMING, 1822
Family: Turridae H. ADAMS & A. ADAMS, 1853
Genus: *Gemmula* WEINKAUFF, 1875

Type species: *Pleurotoma gemmata* REEVE, 1843 (= *G. hindsiana* BERRY, 1958); subsequent designation by COSSMANN (1896). Recent, tropical West America.

Gemmula coronata (MÜNSTER in GOLDFUSS, 1841)

(Pl. 4, Figs. 8–10)

* 1841 *Pleurotoma coronata* MÜNSTER – MÜNSTER in GOLDFUSS, p. 21, pl. 171, fig. 8.

1875 *Pleurotoma rotata* Brocch. – Hoernes, p. 356 [non *Murex rotatus* Brocchi, 1814].

1856 *Pleurotoma coronata* Münster – Hörnes, p. 683, pl. 52, fig. 9.

1973 *Gemmula* (*Gemmula*) *coronata* (Münster, 1844) – Steininger, p. 441, pl. 8, fig. 10.

2013 *Gemmula coronata* (Münster in Goldfuss, 1841) – Landau et al., p. 294, pl. 51, fig. 4 (cum syn.).

Material: 5 natural casts with corresponding silicone moulds (NHMW 2014/0379/0052, NHMW 2014/0379/0053, NHMW 2014/0379/0054).

Dimensions: largest specimen without siphonal canal: height: 24 mm, width: 14 mm (pl. 4, fig. 9).

Discussion: This species was discussed in detail by Landau et al. (2013). The herein described specimens agree fully with those from the Badenian of the Vienna Basin. The keel and its beads are covered by very weak spiral threads being thus reminiscent of the Middle Miocene Paratethyan *Gemmula trifasciata* (Hörnes, 1854). Unlike *G. coronata*, typical specimens of *G. trifasciata* bear three distinct spiral cords on the keel.

Distribution: This species is known from the Ottnangian of Bavaria (Steininger, 1973) and Upper Austria (Allerding). In addition, Hoernes (1875) erroneously reported the species as *Pleurotoma rotata* from Ottnang. It becomes ubiquitous in the Paratethys during the Badenian (Middle Miocene; see Landau et al., 2013 for details) when it is also recorded from the northeastern Atlantic (Langhian, Loire Basin) and the Proto-Mediterranean Sea (Serravallian, Karaman Basin, Turkey (Landau et al., 2013). Its last occurrences are recorded from the Late Miocene of the Proto-Mediterranean Sea (Tortonian, Po Basin, Italy; Sacco, 1904).

Family: Borsoniidae Bellardi, 1875
Genus: *Bathytoma* Harris & Burrows, 1891

Type species: *Murex cataphractus* Brocchi, 1814; by original designation. Neogene, Europe.

Bathytoma nov. sp.

(Pl. 4, Fig. 11)

Material: 1 fragmentary natural cast with corresponding silicone mould (NHMW 2014/0379/0055).

Dimensions: diameter: c. 22 mm, height: c. 23 mm.

Description: A single spire fragment is available showing a high conical shell with an apical angle of c. 60°. The whorls are strongly angulate with sharp keel, bearing numerous tiny beads. The upper two thirds of the whorls form a flat sutural ramp with a narrow concavity below the suture; below the keel the whorls are straight-sided and form a delicate, granulated adsutural spiral thread; entire shell surface covered by numerous very delicate spiral threads; no growth lines visible.

Discussion: Although the fragmentary preservation does not allow a clear identification, we are not aware of any comparable species from the Proto-Mediterranean-Paratethyan Miocene. *Bathytoma trochlearis* (Hörnes, 1854), from the Middle Miocene of the Paratethys, is superficially similar but has a smooth, sharp keel and lacks the adsutural spiral thread. The wide-spread *Bathytoma cataphracta* (Brocchi, 1814) has much coarser nodes on the keel and a granular sculpture (see Bałuk, 2003; Landau et al., 2013). The fragment is reminiscent of the gradate spire of *Conilithes antidiluvianus* sensu Brocchi, 1814 (see Janssen et al., 2014 for discussion on the status of this taxon) but differs clearly in its sharp and delicately beaded keel.

Distribution: Only known from the Ottnangian of Allerding.

Family: Conidae Fleming, 1822
Genus: *Conilithes* Swainson, 1840

Type species: *Conus antidiluvianus* Bruguière, 1792; by monotypy. Miocene–Pliocene, Europe.

Conilithes cf. *dujardini* (Deshayes, 1845)

(Pl. 4, Fig. 12)

cf. * 1845 *Conus Dujardini* Desh. – Deshayes, p. 158.

cf. 1973 *Conus* (*Conolithus*) *dujardini* Deshayes, 1845 – Steininger, p. 446, pl. 9, fig. 6.

cf. 2013 *Conilithes dujardini* (Deshayes, 1845) – Landau et al., p. 252, pl. 41, figs. 1–3, pl. 41, fig. 18, pl. 42, fig. 12, pl. 82, fig. 5 (cum syn.).

Material: 1 natural cast with corresponding silicone mould (NHMW 2014/0379/0056).

Dimensions: height: 21 mm, width: 9 mm.

Discussion: A slightly deformed specimen with characteristic gradate spire is available. The slightly bulgy keel of the specimen seems to be a preservational feature. See Landau et al. (2013) for an extensive discussion on the taxonomic history of this wide-spread species.

Distribution: This species appears during the Early Miocene in the Paratethys, the Proto-Mediterranean Sea and the North Sea and is ubiquitous in all European seas during the Middle Miocene. The last occurrence is documented from the Tortonian of the Proto-Mediterranean Sea (see Landau et al., 2013 for detailed references). Steininger (1973) described it from Ottnangian deposits of Bavaria and Upper Austria.

Subclass: Heterobranchia Gray, 1840
Superfamily: Siphonarioidea Gray, 1827
Family: Siphonariidae Gray, 1827
Genus: *Siphonaria* Sowerby, 1823

Type species: *Siphonaria sipho* G.B. Sowerby I, 1823; by monotypy. Recent, Indian Ocean.

Siphonaria cf. *vasconiensis* Michelin, 1831

(Pl. 4, Figs. 13a–13b)

cf. * 1831 *Siphonaria vasconiensis* Michelin, p. 32, pl. 1, figs. 1–2.

cf. 2001 *Siphonaria vasconiensis* Michelin, 1831 – Lozouet et al., p. 84, pl. 37, figs. 9a–b (cum syn.).

Material: 1 fragmentary specimen (NHMW 2014/0379/0057).

Dimensions: diameter restored: c. 25 mm, height: c. 10 mm.

Description: Very solid patelliform shell, probably with near circular outline and slightly thickened margins. Spire moderately elevated with weakly coeloconoid profile; apical tip destroyed. Surface smooth aside from very indistinct growth lines. Shell interior smooth with marked concentric muscle scar; siphonal groove not preserved.

Discussion: The identification of the fragment is very tentative. *Siphonaria vasconiensis* MICHELIN has a similar size and agrees in the solid shell and slightly thickened margin. Typical specimens have a radial sculpture, which may be reduced only in the apical area. Some specimens from the Aquitaine Basin, however, are nearly smooth (e.g. PEYROT, 1938, pl. 12, fig 24; www.fossilshells.nl/taxon_siphonarioidea.html and have a comparable outline to the shell from Allerding (PEYROT, 1932, pl. 12, fig. 30). Thus, it remains unclear if the herein described specimen is conspecific with the French species or represents a separate species.

Lepetella pileata (MICHELOTTI, 1847), from the Burdigalian of Italy, is also reminiscent of the Austrian shell and agrees especially in its smooth shell surface but differs in its thin shell, elongate base and the high conical shape. Only few other patelliform gastropods of comparable size with smooth and robust shells are known from the European Miocene. *Tectura taurinensis* SACCO, 1896 and *Tectura tauroconica* SACCO, 1896, both from the Burdigalian of Italy (SACCO, 1896b), are smaller, less solid and elongate.

Distribution: Aquitanian to Langhian of the Aquitaine Basin (PEYROT, 1932; LOZOUET et al., 2001).

Conclusions

Despite the very poor preservation, it is possible to identify 32 gastropod species from the Ottnangian coastal deposits of Allerding. The assemblage is unique for Paratethyan settings with regard to composition and paleoecology. More than 60 % of the species are recorded for the first time from the Paratethys Sea or represent undescribed species. Hence, the assemblage confirms the previously stated high degree of endemism in the Central Paratethys Sea during the Ottnangian even during the marine phase prior to the *late Ottnangian Extinction Event* (HARZHAUSER & PILLER, 2007).

Most taxa suggest the presence of hard-grounds and support a rocky shore setting, which is also indicated by the geological situation. Indirectly, the presence of demosponges and cnidarians such as Actinaria is documented by epitoniids and siliquariids. Such paleoenvironments are rarely reported from the Ottnangian, which is characterised by wide-spread tidal-influenced shelf deposits with soft bottoms. Moreover, the poor overlap with older (Eggenburgian) and younger (Karpatian) faunas of the Paratethys emphasizes the discreetness of the Ottnangian faunas, which still lacks convincing explanation.

Acknowledgements

We thank CHRISTIAN RUPP and REINHARD ROETZEL (Geological Survey of Austria, Vienna) for their help with literature on regional geology and IRENE ZORN (Geological Survey of Austria, Vienna) for providing access to the collections. STEFANO DOMINICI (Università degli Studi di Firenze, Museo di Storia Naturale) helped with the stratigraphy of Italian localities. Thanks to ARIE W. JANSSEN and FRANK WESSELINGH (Naturalis Biodiversity Center, Leiden, Netherlands) for discussions and literature. Many thanks to FRANZ BERGER (Kopfing, Austria), who generously donated the specimens illustrated on plate 3, figure 1, and plate 4, figure 13.

References

ADAMS, H. (1869): Descriptions of a new genus and fourteen new species of marine shells. – Proceedings of the Zoological Society of London, **1869**, 272–275, London.

ADAMS, A. & REEVE, L. (1850): The zoology of the voyage of H.M.S. Samarang; under the command of Sir Edward Belcher during the years 1843–1846, 3: Mollusca. – 87 pp., London (Reeve, Bentham & Reeve).

ADAMS, H. & ADAMS, A. (1853–1858): The genera of Recent Mollusca, arranged according to their organisation. – Vol. 1, i–x, 484 pp.; vol. 2, 661 pp.; vol. 3, pls. 1–138 [dates (Vol. 2, p. 661): Vol. 1: 1–256, 1853; 257–484, 1854; vol. 2: pp. 1–92, 1854; 93–284, 1855; 285–412, 1856; 413–540, 1857; 541–661, 1858], London (J. van Voorst).

ANDRZEJOWSKI, A. (1830): Notice sur quelques coquilles fossiles de Volhynie, Podolie etc. – Bulletin de la Société Impériale des Naturalistes de Moscou, **2**, 90–104, Moscou.

ANTON, H.E. (1839): Verzeichniss der Conchylien welche sich in der Sammlung von Hermann Eduard Anton befinden. – XVI + 110 pp., Halle.

ATANACKOVIĆ, M.A. (1985): Mekušci Morskog Miocena Bosne. – Geologija Bosne i Hercegovine, **1**, 1–305, Sarajevo.

BÁLDI, T. (1973): Mollusc fauna of the Hungarian Upper Oligocene (Egerian). – 511 pp., Akadémiai Kiadó, Budapest.

BAŁUK, W. (1975): Lower Tortonian Gastropods from Korytnica, Poland, 1. – Palaeontologia Polonica, **32**, 1–186, Warszawa.

BAŁUK, W. (1995): Middle Miocene (Badenian) gastropods from Korytnica, Poland, 2. – Acta Geologica Polonica, **45**, 1–255, Warszawa.

BAŁUK, W. (2003): Middle Miocene (Badenian) gastropods from Korytnica, Poland, 4. Turridae. – Acta Geologica Polonica, **53**, 29–78, Warszawa.

BAŁUK, W. (2006): Middle Miocene (Badenian) gastropods from Korytnica, Poland, 5. Addenda et corrigenda ad Prosobranchia. – Acta Geologica Polonica, **56**, 177–220, Warszawa.

Basterot, B. de (1825): Mémoire géologique sur les environs de Bordeaux. Première partie, comprenant les observations générales sur les mollusques fossiles, et la description particulière de ceux qu'on rencontre dans ce bassin. – 100 pp., Paris (J. Tastu).

Bellardi, L. (1873): I Molluschi dei terreni terziari del Piemonte e della Liguria. Parte 1: Cephalopoda, Pteropoda, Heteropoda, Gasteropoda (Muricidae e Tritronidae). – Memorie della Reale Accademia delle Scienze di Torino, Series 2, **27**, 33–294 [reprint, C. Clausen, Torino, 1–264], Torino.

Bellardi, L. & Michelotti, G. (1840): Saggio orittografico sulla classe dei gasteropodi fossili dei terreni terziari del Piemonte. – Memorie della Reale Accademia delle Scienze di Torino, Series 2, **3**, 93–172 [reprint, Tipografia Reale, Torino, 80 pp., 8 pls.], Torino.

Berger, J.-P. (1996): Cartes paléogéographiques-palinspastiques du bassin molassique suisse (Oligocène inférieur – Miocène moyen). – Neues Jahrbuch für Geologie und Paläontologie, **202**, 1–44, Stuttgart.

Berry, S.S. (1910): Report on a collection of shells from Peru, with a summary of littoral marine Mollusca of the Peruvian zoological province. By William Healey Dall, 1909. – Proceedings of the United States National Museum, **37**, 147–294, Washington D.C.

Berry, S.S. (1958): Notices of new Eastern Pacific Mollusca. II. – Leaflets in Malacology, **1**, 83–90, Redlands.

Betancort Lozano, J.F. (2012): Fósiles marinos del Neógeno de Canarias (Colección de la ULPGC): dos neotipos, catálogo y nuevas aportaciones (Sistemática, Paleoecología y Paleoclimatología). – Univ. de Las Palmas de Gran Canaria, Tesis Ph.D. 413 pp., Gran Canaria.

Beu, A.G. & Ponder, W.F. (1979): A revision of the species of *Bolma* Risso, 1826 (Gastropoda: Turbinidae). – Records of the Australian Museum, **32**, 1–68, Sydney.

Beyrich, H.C. (1853–1857): Die Conchylien des norddeutschen Tertiärgebirges. – Berlin (Hertz), pp. 1–82, pls. 1–5, 1853; pp. 83–176, pls. 6–15, 1854; pp. 177–296, pls. 16–25, 1856; pp. 297–336, pls. 26–20, 1857 [also published almost simultaneously in Zeitschrift der Deutschen Geologischen Gesellschaft, **5**, 273–358, 1853; **6**, 406–500, 726–781, 1854; **8**, 21–88, 1855; **8**, 553–588, 1856].

Bieler, R. (2004): Sanitation with sponge and plunger: western Atlantic slit-wormsnails (Mollusca: Caenogastropoda: Siliquariidae). – Zoological Journal of the Linnean Society, **140**, 307–333, Oxford.

Boettger, O. (1896): Zur Kenntnis der Fauna der mittelmiocänen Schichten von Kostej im Banat. – Verhandlungen und Mitteilungen des Siebenbürgischen Vereins der Naturwissenschaften zu Hermannstadt, **46**, 49–66, Hermannstadt.

Boettger, O. (1906–1907): Zur Kenntnis der Fauna der mittelmiocänen Schichten von Kostej im Krassó-Szörényer Komitat. (Gasteropoden und Anneliden.) III. – Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für Naturwissenschaften zu Hermannstadt, **54**/**55**, 1–99 (1906), 101–244 (1907), Hermannstadt.

Borghi, E. (2012): Il genere *Spatangus* (Echinoidea) nel Langhiano dell'Appennino reggiano. – Notiziario Della Società Reggiana di Scienze Naturali, **11**, 43–61, Reggiana.

Bosch, D.T., Dance, S.P., Moolenbeek, R.G. & Oliver, P.G. (1995): Seashells of eastern Arabia. – 296 pp., Dubai (Motivate Publishing).

Bouchet, P. & Warén, A. (1986): Revision of the northeast Atlantic bathyal and abyssal Aclididae, Eulimidae, Epitoniidae. – Bollettino Malacologico, Suppl. **2**, 297–57, Napoli.

Boury, E. de (1890): Révision des Scalidae miocènes et pliocènes de l'Italie. – Bollettino della Società Malacologica Italiana, **14**, 161–326, Pisa.

Boury, E. de (1909): Catalogue des sous-genres de Scalidae. – Journal of Conchyliologie, **57**, 255–258, Paris.

Boury, E. de (1913): Description de Scalidae nouveaux ou peu connus. – Journal de Conchyliologie, **60**, 269–322, Paris.

Brocchi, G. (1814): Conchiologia fossile subapennina, con osservazioni geologiche sugli Apennini e sul suolo adiacente. – Stamperia Reale, **1**, 1–240, **2**, 241–712, Milano.

Brongniart, A. (1823): Mémoire sur les terrains de sédiment supérieurs calcaréo-trappéens du Vicentin, et sur quelques terrains d'Italie, de France, d'Allemagne, etc., qui peuvent se rapporter à la même époque. – iv + 86 pp., Paris (F.G. Levrault).

Bruguière, J.G. (1789–1792): Encyclopédie Méthodique ou par Ordre de Matières. Histoire Naturelle des Vers. – Vol. 1, 758 pp. Part 1, xviii + 344 pp. (1789); part 2, 345–757 (1792), Paris (Panckoucke).

Campbell, K.A., Grant-Mackie, J.A., Buckeridge, J.S., Hudson, N., Alfaro, A.C., Hoverd, J., Morgan, S., Horne, N. & Banfield, A. (2004): Paleoecology of an early Miocene, rapidly submerging rocky shore, Motuketekete Island, Hauraki Gulf, New Zealand. – New Zealand Journal of Geology and Geophysics, **47**, 731–748, Wellington.

Carpenter, P.P. (1864): Supplementary report on the present state of our knowledge with regard to the Mollusca of the west coast of North America. – Reports of the British Association for the Advancement of Science, **33** (1863), 517–686.

Casellato, S. & Stefanon, A. (2008): Coralligenous habitat in the northern Adriatic Sea: an overview. – Marine Ecology, **29**, 321–341, Chichester.

Children, J.G. (1834): [Mollusca]. – Synopsis of the contents of the British Museum, ed. **28**, 88–118, London.

Conrad, T.A. (1832): Fossil shells of the Tertiary formations of North America, illustrated by figures drawn on stone, from nature. – 20 pp., Philadelphia.

Conrad, T.A. (1862): Catalogue of the Miocene shells of the Atlantic slope. – Proceedings of the Academy of Natural Sciences of Philadelphia, **8**, 559–583, Philadelphia.

Conrad, T.A. (1865): Descriptions of new Eocene shells of the United States. – American Journal of Conchology, **1**, 142–149.

Cossmann, M. (1895–1925): Essais de Paléoconchologie comparée 1–13. – Cossmann, Paris; **1**: 159 pp. (1895); **2**: 180 pp. (1896); **3**: 201 pp. (1899); **4**: 292 pp. (1901); **5**: 215 pp. (1903); **6**: 151 pp. (1904); **7**: 261 pp. (1906); **8**: 248 pp. (1909); **9**: 215 pp. (1912); **10**: 292 pp. (1915); **11**: 388 pp. (1918), **12**: 349 pp. (1921); **13**: 345 pp. (1925).

Cossmann, M. & Peyrot, A. (1909–1924): Conchologie néogénique de l'Aquitaine. – Actes de la Societé Linéenne de Bordeaux, **63**, 72–293, 1909; **64**, 235–400, 1910; **64**, 401–445, 1911; **65**, 51–98, 1911; **65**, 99–333, 1912; **66**, 169–232, 1912; **66**, 233–324, 1913; **68**, 5–210, 1914; **68**, 361–435, 1915; **69**, 157–365, 1917; **70**, 5–180, 1918; **70**, 181–491, 1919; **73**, 5–321, 1922; **74**, 257–342, 1923; **75**, 71–144, 193–318, 1924, Bordeaux.

Cox, L.R. (1960): Gastropoda – General characteristics of Gastropoda. – In: Moore, R.C.: Treatise on Invertebrate Paleontology, Part I, Mollusca 1, 84–169, Geological Society of America/University of Kansas Press.

Csepreghy-Meznerics, I. (1954): A Keletcserháti Helvéti és Tortónai fauna. – Annales Instituti Geologici Publici Hungarici, **41**, 1–185, Budapest.

Csepreghy-Meznerics, I. (1969): La faune tortonienne-inferieure des gisements tufiques de la Montagne de Bükk: Gastropodes I. – Egri Múzeum Évkönyve, **7**, 17–33, Eger.

Ctyroky, P. (1972): Die Molluskenfauna der Rzehakia-(Oncophora) Schichten Mährens. – Annalen des Naturhistorischen Museums in Wien, **76**, 41–141, Wien.

Cuvier, G. (1795): Second mémoire sur l'organisation et les rapports des animaux à sang blanc, dans lequel on traite de la structure des mollusques et de leur division en ordre, lu à la société d'Histoire Naturelle de Paris, le 11 prairial an troisième. – Magazin Encyclopédique, ou Journal des Sciences, des Lettres et des Arts, **2**, 433–449, Paris.

Dall, W.H. (1906): Early history of the generic name *Fusus*. – Journal of Conchology, **11**, 289–297, London.

Dautzenberg, P. & de Boury, E. (1897): Diagnoses d'espèces nouvelles appartenant aux genres *Scalaria* et *Mathildia*. – Bulletin de la Société Zoologique de France, **22**, 31–33, Paris.

Deshayes, G.-P. in Deshayes, G.-P. & Milne-Edwards, H. (1845): Histoire naturelle des animaux sans vertèbres, Présentant les Caractères Généraux et Particuliers de ces Animaux, leur Distribution, leurs Classes, leurs Familles, leurs Genres, et la Citation des Principales Espèces qui s'y Rapportent; Précedée d'une Introduction Offrant la Détermination des Caractères Essentiels de l'Animal, sa Distinction du Végétal et des Autres Corps Naturels; Enfin, l'Exposition des Principes Fundamentaux de la Zoologie. – Deuxième Édition, **11**, 665 pp., Paris (J.-B. Baillière).

Deshayes, G.-P. (1853) [in 1839–1853]: Traité élémentaire de conchyliologie avec les applications de cette science à la géologie. – Tome troisième, 80 pp., Planches et Explication des planches, Paris.

DuBois de Montperreux, F. (1831): Conchyliologie fossile et aperçu géognostique des formations du plateau Wolhyni-Podolien. – 76 pp., Berlin (Schropp and Companie).

Duméril, A.M.C. (1805): Zoologie analytique, ou méthode naturelle de classification des animaux, rendue plus facile à l'aide de tableaux synoptiques. – xxxii + 344 pp., Paris (Allais).

Eichwald, E. (1829): Zoologia specialis, quam expositis animalibus tum vivis, tum fossilibus potissimum Rossiae in universum et Poloniae in specie, in usum lectionum publicarum in Universitate Caesarea Vilnensi. – Josephi Zawadski, **1**, 314 pp., Vilnius.

Eichwald, E. (1830): Naturhistorische Skizze von Lithauen, Volhynien und Podolien in Geognostisch-Mineralogischer, Botanischer und Zoologischer Hinsicht. – 256 pp., 3 pls., Vilnius (Eichwald).

Eichwald, E. (1852): Lethaea Rossica ou Paléontologie de la Russie. Explication des planches du troisième volume. – 4 pp., 14 pls., Stuttgart (Schweizerbart).

Eichwald, E. (1853): Lethaea Rossica ou Paléontologie de la Russie. Troisième volume. Dernière période. – 533 pp., Stuttgart (Schweizerbart).

Fehse, D. (2001): Katalog der fossilen Cypraeoidea (Mollusca: Gastropoda) in der Sammlung Franz Alfred Schilder, 3. Die unterfamilie Erroneinae Schilder, 1925. – Club Conchylia Informationen, **33**, 3–42, Wien.

Ferrero Mortara, E.L., Montefameglio, L., Novelli, M., Opesso, G., Pavia, G. & Tampieri, R. (1984): Catalogo dei tipi e degli esemplari figurati della collezione Bellardi e Sacco II. – Museo Regionale di Scienze Naturali, Cataloghi, **7**, 484 pp, Torino.

Fleming, J. (1822): The philosophy of zoology, a general view of the structure, functions and classification of animals, vol. 2. – 618 pp., Edinburgh (Constable & Co.).

Forbes, E. & Hanley, S. (1848–1853): A history of British Mollusca and their shells. – 4 vols., London (van Voorst). [Published in parts; for dates of parts see Fisher & Tomlin, 1935, Journal of Conchology, **20**/5, 150–151.]

Foresti, L. (1876): Cenni geologici e paleontologici sul Pliocene antico di Castrocaro. – Memorie della Accademia delle Scienze dell'Instuto di Bologna, serie 3, **6**, 1–56, Bologna.

Friedberg, W. (1911–1928): Mieczaki Miocenskie ziem Polskich (Mollusca Miocaenica Poloniae), Czesc I. Slimaki i Lódkonogi (Pars I. Gastropoda et Scaphopoda). – Museum Imienia Dzieduszyckich (Musaeum Dzieduszyckianum), 631 pp., 38 pls., Lwów i Poznan.

Friedberg, W. (1938): Katalog mego zbioru mięczaków mioceńskich Polski – Katalog meiner Sammlung der Miozänmollusken polens). – Mémoires de l'Academie polonaise des Sciences et des Lettres, Classe des Sciences mathématiques et naturelles, B. Sciences naturelles, **12**, 1–164, Cracovie.

Frieling, D., Pippèrr, M., Schneider, S. & Reichenbacher, B. (2009): The rocky northern coast of the Molasse Basin at Gurlarn near Passau (Lower Miocene, Ottnangian). – Facies, **55**, 47–62, Berlin–Heidelberg.

Gittenberger, A. & Hoeksema, B.W. (2013): Habitat preferences of coral-associated wentletrap snails (Gastropoda: Epitoniidae). – Contributions to Zoology, **82**, 1–25, Amsterdam.

Glibert, M. (1949): Gastropodes du Miocène moyen du Bassin de la Loire, 1. – Memoires de l'Institut Royal des Sciences Naturelles de Belgique, **2**/30, 1–240, Bruxelles.

Glibert, M. (1952): Gastropodes du Miocène moyen du Bassin de la Loire, deuxième partie. – Memoires de l'Institut Royal des Sciences Naturelles de Belgique, **2**/46, 241–450, Bruxelles.

Goldfuss, A. (1841): Petrefacta Germaniae, tam ea quae in museo universitatis regio Borussicae Fridericiae Wilhelmiae Rhenanae servantur quam alia quaecunque in Museis Hoeninghusiano Muensterniano aliisque extant inconibus et descriptionibus illustrata. Abbildungen und Beschreibungen der Petrefacten Deutschlands und der angrenzenden Länder, unter Mitwirkung des Herrn Grafen Georg zu Münster, 3. – 20 pp., Düsseldorf (Arnz).

Grateloup, J.P.S. de (1833): Tableau des coquilles fossiles qu'on rencontre dans les terrains calcaire tertiaires (faluns) des environs de Dax, dans le Département des Landes. – Actes de la Société Linnéenne de Bordeaux, **6**, 159–164, Bordeaux.

Grateloup, J.P.S. de (1837): Notice sur la famille des bulléens dont on trouve les dépouilles fossiles dans les terrains marins supérieurs du Bassin de l'Adour, aux environs de Dax (Landes), précédée de considérations générales sur cette famille et du tableau des genres et des espèces connus, soit à l'état vivant soit à l'état fossile. – Actes de la Société Linnéenne de Bordeaux, **8**, 247–299, Bordeaux.

Grateloup, J.P.S. de (1845–1847): Conchyliologie fossile des terrains tertiaires du Bassin de l'Adour (environs de Dax), 1. Univalves. Atlas. Bordeaux (Th. Lafargue), pls. 1–45; xx + 12 pp., pls. 46–48; all plates published 1845, except plates 2, 4, 11 (1847).

Gray, J.E. (1827): Plate Mollusca. – In: Smedley, E. & Rose, H.J. (Eds.): Encyclopaedia Metropolitana, **7**, Plates to Zoology, London.

Gray, J.E. (1840): Shells of molluscous animal. – Synopsis of the contents of the British Museum, ed. **42**, 105–152, London.

Gray, J.E. (1853): On the division of ctenobranchous gasteropodous Mollusca into larger groups and families. – Annals and Magazine of Natural History, ser. 2, **11**, 124–132, London.

Grunert, P., Soliman, A., Ćorić, S., Scholger, R., Harzhauser, M. & Piller, W.E. (2010): Stratigraphic re-evaluation of the stratotype for the regional Ottnangian stage (Central Paratethys, middle Burdigalian). – Newsletter on Stratigraphy, **44**, 1–16, Stuttgart.

Grunert, P., Soliman, A., Ćorić, S., Roetzel, R., Harzhauser, M. & Piller, W.E. (2012): Facies development along the tide-influenced shelf of the Burdigalian Seaway: An example from the Ottnangian stratotype (Early Miocene, middle Burdigalian). – Marine Micropaleontology, **84–85**, 14–36, Amsterdam.

Guettard, J.E. (1770): Mémoires sur différentes parties des sciences et arts. Tome second. – 85 + 72 + 530 pp., Paris (L. Prault).

Gürs, K. (2002): Miocene nassariid zonation. A new tool in North Sea Basin Neogene biostratigraphy. Northern European Cenozoic Stratigraphy. – Proceedings of the 8th Biannual Meeting RCNNS/RCNPS, 91–106, Flintbek.

Harris, G.F. (1897): Catalogue of the Tertiary Mollusca in the department of geology, British Museum (Natural History), 1. The Australasian Tertiary Mollusca. London. – 407 pp., British Museum (Natural History), London.

Harris, G.F. & Burrows, H.W. (1891): The Eocene and Oligocene beds of the Paris Basin. – Geological Association of London, 8 + 129 pp., London.

Harzhauser, M. (2002): Marine und brachyhaline Gastropoden aus dem Karpatium des Korneuburger Beckens und der Kreuzstettener Bucht (Österreich, Untermiozän). – Beiträge zur Paläontologie, **27**, 61–159, Wien.

Harzhauser, M. & Kowalke, T. (2004): Survey of the Nassariid Gastropods in the Neogene Paratethys. – Archiv für Molluskenkunde, **133**, 1–63, Frankfurt am Main.

Harzhauser, M. & Landau, B. (2012): A revision of the Neogene cancellariid Gastropods of the Paratethys Sea. – Zootaxa, **3472**, 1–72, Auckland, NZ.

Harzhauser, M. & Mandic, O. (2008): Neogene lake systems of Central and South-Eastern Europe: Faunal diversity, gradients and interrelations. – Palaeogeography, Palaeoclimatology, Palaeoecology, **260**, 417–434, Amsterdam.

Harzhauser, M. & Piller, W.E. (2007): Benchmark data of a changing sea. – Palaeogeography, Palaeobiogeography and Events in the Central Paratethys during the Miocene. – Palaeogeography, Palaeoclimatology, Palaeoecology, **253**, 8–31, Amsterdam.

Hoernes, R. (1875): Die Fauna des Schliers von Ottnang. – Jahrbuch der k.k. Geologischen Reichsanstalt, **25**, 333–400, Wien.

Hoernes R. & Auinger, M. (1879–1891): Die Gastropoden der Meeresablagerungen der ersten und zweiten Miocänen Mediterran-Stufe in der Oesterreichisch-Ungarischen Monarchie. – Abhandlungen der k.k. Geologischen Reichsanstalt, **8**, 1–382, 50 pls. [in 8 parts], Wien.

Hölzl, O. (1958): Die Mollusken-Fauna des oberbayerischen Burdigals. – Geologica Bavarica, **38**, 1–348, pl. 1–22, München.

Hölzl, O. (1965): Die Molluskenfauna aus dem Grenzbereich Burdigal-Helvet im Kaltenbach-Gernergraben, Landkreis Miesbach/Oberbayern (vorläufige Mitteilung). – Geologica Bavarica, **50**, 258–289, München.

Hölzl, O. (1973): Faziostratotypus: Kaltenbachgraben. – In: Papp, A., Rögl, F. & Seneš, J. (Eds.): Chronostratigraphie und Neostratotypen. Miozän der zentralen Paratethys. Band III. M2 Ottnangien. Die Innviertler, Salgótarjáner, Bántapusztaer Schichtengruppe und die Rzehakia Formation, 155–196, Bratislava (Verlag der Slowakischen Akademie der Wissenschaften).

Hörnes, M. (1851–1870): Die fossilen Mollusken des Tertiär-Beckens von Wien. – Abhandlungen der k.k. Geologischen Reichsanstalt, **3**, 1–42, pl. I–V (1851), 43–208, pl. VI–XX (1852), 209–296, pl. XXI–XXXII (1853), 297–384, pl. XXXIII–XL (1854), 383–460, pl. XLI–XLV (1855), 461–736, pl. XLVI–LII (1856); **4**, 1–479, pl. I–LXXXV (1870), Wien.

Iredale, T. (1916): On two editions of Duméril's Zoologie Analytique. – Proceedings of the Malacological Society of London, **12**, 79–84, London.

Janssen, A.W. (1967): Beiträge zur Kenntnis des Miocäns von Dingden und seiner Molluskenfauna. – Geologica et Palaeontologica, **1**, 115–173, Marburg.

Janssen, A.W. (1984): Mollusken uit het Mioceen van Winterswijk-Miste. Een inventarisatie, met beschrijvingen en afbeeldingen van alle aangetroffen soorten. – 451 pp., Koninklijke Nederlandse Natuurhistorische Vereniging, Nederlandse Geologische Vereniging & Rijkmuseum van Geologie en Mineralogie, Leiden.

Janssen, A.W., Janssen, R., Tracey, S., Vaessen, L.M.B. & van der Voort, J. (2014): History of a marine, Cainozoic gastropod taxon, *Conus antidiluvianus* Bruguière, 1792 and its nomenclatural implications. – Cainozoic Research, **14**, 73–90, Leiden.

Jousseaume, F.P. (1887): La famille des Cancellariidae (Mollusques gastéropodes). – Le Naturaliste, **9**, 155–157, 192–194, 213–214, 221–223, Paris.

Kobelt, W. (1876-1878): Illustrirtes Conchylienbuch. Erster Band. – 16 + 144 pp., Nürnberg (Bauer & Raspe).

Kojumdgieva, E.M. & Strachimirov, B. (1960): Les fossiles de Bulgarie. VII. Tortonien. – 317 pp., 59 pls., Académie des Sciences de Bulgarie, Sofia.

Konior, K. & Krach, W. (1965): Zlepieñce dêbowieckie i fauna mioceñska z wiercenia B4. – Acta Geologica Polonica, **15**, 39–80, Warszawa.

Kowalke, T. & Reichenbacher, B. (2005): Early Miocene (Ottnangian) Mollusca of the Western Paratethys – ontogenetic strategies and palaeoenvironments. – Geobios, **38**, 609–635, Amsterdam.

Krenmayr, H.G. & Schnabel, W. (2006): Geologische Karte von Oberösterreich 1:200.000. – Geol. B.-A., Wien.

Kroh, A. (2005): Catalogus Fossilium Austriae. Band 2. Echinoidea neogenica. – 210 pp., Österreichische Akademie der Wissenschaften, Wien.

Kuhlemann, J. & Kempf, O. (2002): Post-Eocene evolution of the North Alpine Foreland Basin and its response to Alpine tectonics. – Sedimentary Geology, **152**, 45–78, Amsterdam.

Lamarck, J.B.P.A. de M. de (1801): Système des Animaux sans Vertèbres, ou Tableau Général des Classes, des Orders et des Genres de ces Animaux; Présentant leurs Caractères Essentiels et leur Distribution, d'Après la Considération, et Suivant l'Arrangement Établi dans les Galeries du Muséum d'Hist. Naturelle, Parmi leurs Dépouilles Conservées; Précéde du Discours d'Ouverture du Cours de Zoologie, donné dans le Muséum National d'Histoire Naturelle l'an de la République. – viii + 432 pp., Paris.

Lamarck, J.B.P.A. de M. de (1809): Philosophie zoologique. Volume 1. – xxv + 428 pp., Paris.

Lamarck, J.B.P.A. de M. de (1822): Histoire naturelle des animaux sans vertèbres, présentant les charactères généraux et particuliers... – Tome **7**, 711 pp., Chez l'auteur, au Jardin du Roi, Paris.

Landau, B., Marquet, R. & Grigis, M. (2003): The Early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 1. Vetigastropoda. – Palaeontos, **3**, 1–87, Antwerp.

Landau, B., Beu, A. & Marquet, R. (2004): The Early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 5. Tonnoidea, Ficoidea. – Palaeontos, **5**, 35–102, Antwerp.

Landau, B., Harzhauser, M. & Beu, A.G. (2009a): A revision of the Tonnoidea (Caenogastropoda, Gastropoda) from the Miocene Paratethys and their palaeobiogeographic implications. – Jahrbuch der Geologischen Bundesanstalt, **149**, 61–109, Wien.

Landau, B., Marques da Silva, C. & Gili, C. (2009b): The Early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 8. Nassariidae. – Palaeontos **17**, 1–101, Antwerp.

Landau, B., Marques da Silva, C. & Mayoral, E. (2011): The Lower Pliocene gastropods of the Huelva Sands Formation, Guadalquivir Basin, Southwestern Spain. – Palaeofocus, **4**, 1–90, Mortsel.

Landau, B., Harzhauser, M., İslamoğlu, Y. & Marques da Silva, C. (2013): Systematics and palaeobiogeography of the gastropods of the middle Miocene (Serravallian) Karaman Basin of Turkey. – Cainozoic Research, **11–13**, 3–576, Leiden.

Latreille, P.A. (1825): Familles naturelles du règne animal, exposées succinctement et dans un ordre analytique avec l'indication de leurs genres. – 570 pp., Paris (J.B. Baillière).

Lindberg, D. (1998): Order Patellogastropoda. – In: Beesley, P.L., Ross, G.J.B. & Wells, A. (Eds.): Mollusca: The Southern Synthesis. – Fauna of Australia, **5**(B), 639–652, Melbourne.

Linnaeus, C. (1758): Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis, 1. Editio decima, reformata. – 824 pp., Laurentii Salvii, Holmiae.

Linnaeus, C. (1767): Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis, 1(1–2). Editio duodecima, reformata. – 1–532 (1), 533–1327, 1–37 (2), Laurentii Salvii, Holmiae.

Lozouet, P., Lesport, J.F. & Renard, P. (2001): Révision des Gastropoda (Mollusca) du Stratotype de l'Aquitanien (Miocène inf.): site de Saucats "Lariey", Gironde, France. – Cossmanniana, Hors série, **3**, 1–189, Paris.

Mandic, O. (2003): Bivalves of the Karpatian in the Central Paratethys. – In: Brzobohaty, R., Cicha, I., Kováč, M. & Rögl, F. (Eds.): The Karpatian – A Lower Miocene Stage of the Central Paratethys, 217–227, Masaryk University Brno, Brno.

Mandic, O. & Ćorić, S. (2007): Eine neue Molluskenfauna aus dem oberen Ottnangium von Rassing (NÖ) – taxonomische, biostratigrafische, paläoökologische und paläobiogeografische Auswertung. – Jahrbuch der geologischen Bundesanstalt, **147**, 387–397, Wien.

Mandic, O. & Harzhauser, M. (2003): Molluscs from the Badenian (Middle Miocene) of the Gaindorf Formation (Alpine Molasse Basin, NE Austria) – Taxonomy, Paleoecology and Biostratigraphy. – Annalen des Naturhistorischen Museums in Wien, **104A**, 85–127, Wien.

Marquet, R. (1997): Pliocene gastropod faunas from Kallo (Oost-Vlaanderen, Belgium), 2. Caenogastropoda: Potamididae to Tornidae. – Contributions to Tertiary and Quaternary Geology, **34**, 9–29, Oegstgeest.

Marquet, R. (1998): De Pliocene gastropodenfauna van Kallo (Oost-Vlaanderen, België). – 246 pp., Belgische Vereniging voor Paleontologie v.z.w., Antwerpen.

Marryat, F. (1818): Descriptions of two new shells. – Transactions of the Linnean Society of London, **12**, 336–339, London.

Mayer, K. (1858): Description de coquilles fossiles des étages supérieurs des terrains tertiaires (suite). – Journal de Conchyliologie, **7**, 73–89, Paris.

Meek, F.B. (1864): Checklist of the invertebrate fossils of North America. Miocene. – Smithsonian Miscellaneous Collections, **7**/183, ii + 32 pp, Washington D.C.

Merle, D., Garrigues, B. & Pointier, J.P. (2011): Fossil and Recent Muricidae of the World. Part Muricinae. – 648 pp., Hackenheim (ConchBooks).

Michelin, H. (1831): Siphonaire. *Siphonaria* Sowerby, S. de Gascogne. *S. vasconiensis* Michelin. – Magasin de Zoologie, **1**, 32.

Michelotti, G. (1847): Description des fossiles des terrains miocènes de l'Italie septentrionale. Ouvrage publié par la société Hollandaise des Sciences, et accompagné d'un atlas de 17 planches. – 408 pp., Leiden (A. Arns & Compie). [reprinted from: Naturkundige Verhandlingen van de Bataafsche Hollandsche Maatsechappye der Wetenschappen te Harlem, Ser. 2, **3**/2, 1–408].

Monterosato, T. di (1884): Nomenclatura generica e specifica di alcune conchiglie mediterranee. – 152 pp., Palermo.

Monterosato, T. di (1917): Molluschi delle coste cirenaiche raccolti dall'Ing. Camillo Crema. – Memorie Reale Comitato Talassografico Italiano, **107**, 1–14, Venezia.

Montfort, D. de (1810): Conchyliologie systématique, ou classification méthodique des coquilles; offrant leurs figures, leur arrangement générique, leurs descriptions caractéristiques, leurs noms; ainsi que leur synonymie en plusieurs langues. Ouvrage destiné à faciliter l'étude dew coquilles, ainsi que leur disposition dans les cabinets d'histoire naturelle. Coquilles univalves, non cloissonnées. Coquilles univalves, non cloisonnées. – 676 pp., Paris (F. Schoell).

Mörch, O.A.L. (1852): Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea Comes de Yoldi, regis daniae cubiculariorum princeps, ordinis dannebrogici in prima classe & ordinis Caroli Tertii Eques, 1. Cephalophora. – iv + 170 pp., Hafniae (Ludovici Kleini).

Noszky, J. (1936): Az egri felsö Cattien molluszkafaunája. – Annales Musei Nationalis Hungarici, Pars Mineralogica, Geologica, et Palaeontologica, **30**, 53–115, Budapest.

Orbigny, A. d' (1852): Prodrome de paléontologie stratigraphique universelle des animaux mollusques et rayonnés, faisant suite au cours élémentaire de paléontologie et de géologie stratigraphique. Troisième volume. – V. Masson, Paris, pp. 1–196, 1–189.

Palmer, K.V.W. (1937): The Clabornian Scaphopoda, Gastropoda and dibranchiate Cephalopoda of the southern United States. – Bulletin of American Paleontology, **7**, 548 pp., Ithaca.

Pantanelli, D. (1886): Specie nuove di molluschi del Miocene medio. – Bollettino della Società Malacologica Italiana, **12**, 123–134, Pisa.

Payraudeau, B.C. (1826): Catalogue descriptif et méthodique des Annelides et des Mollusques de l'île de Corse. –218 pp., Paris.

Pennant, T. (1777): The British Zoology. Vol. 4 Crustacea, Mollusca, Testacea. – xviii + 156 pp., London (Benjamin White).

Perry, G. (1810): Arcana; or the museum of natural history: Containing the most recent discovered objects. Embellished with colored plates, and corresponding descriptions; with extracts related to animals, and remarks of celebrated travellers; combining a general survey of nature. – James Stratford, London, [348 pp.], 84 pls. unnumbered [issued in 21 monthly parts each of 4 pls, 1 Jan. 1810-1 Sept. 1811; plates bear individual dates].

Peyrot, A. (1938): Les mollusques testacés univalves des dépots Helvétiens du Bassin Ligérien – Catalogue critique, descriptif et illustré. – Actes de la Société Linnéenne de Bordeaux, **89**, 5–361, Bordeaux.

Pfeiffer, L. (1840): Kritisches Register zu Martini und Chemnitz's systematischem Konchylien-Kabinet. – VIII + 112 pp., Cassel (Theodor Fischer).

Pfister, T. & Wegmüller, U. (2007): Gastropoden aus den Belpberg-Schichten (Obere Meeresmolasse, mittleres Burdigalium) bei Bern, Schweiz. 1. Teil: Fissurelloidea bis Naticoidea. – Archiv für Molluskenkunde, **136**, 79–149, Frankfurt am Main.

Philippi, R.A. (1843): Beiträge zur Kenntniss der Tertiärversteinerungen des Nordwestlichen Deutschlands. – iii + 85 pp., Cassel (Theodor Fischer).

Piller, W.E., Harzhauser, M. & Mandic, O. (2007): Miocene Central Paratethys stratigraphy – current status and future directions. – Stratigraphy, **4**, 151–168, New York.

Pilsbry, H.A. (1889): Manual of conchology, structural and systematic, with illustrations of the species, 11. Trochidae, Stomatiidae, Pleurotomariidae, Haliotidae. – 519 pp., Philadelphia (G.W. Tryon).

Pippèrr, M. (2011): Characterisation of Ottnangian (middle Burdigalian) palaeoenvironments in the North Alpine Foreland Basin using benthic foraminifera – A review of the Upper Marine Molasse of southern Germany. – Marine Micropaleontology, **79**, 80–99, Amsterdam.

Ponder, W.F. & Lindberg, D.R. (1996): Gastropod phylogeny. Challenges of the 90's. – In: Taylor, J.D. (Ed.): Origins and evolutionary radiation of the Mollusca, 135–154, Oxford.

Pusch, G.G. (1836–1837): Polens Paläontologie, oder Abbildung und Beschreibung der vorzüglichsten und der noch unbeschriebenen Petrefakten aus den Gebirgsformationen in Polen, Volhynien und den Karpathen. –viii + 218 pp., 16 pls [pp. 1–80, pls. 1–10, 1836; pp. 81–218, pls. 11–16, 1837], Stuttgart.

Rafinesque, C.S. (1815): Analyse de la nature ou tableau de l'univers et des corps organisés. Le nature es mon guide, et Linnéus mon maître. – 224 pp., Palermo (privately published).

Rasmussen, L.B. (1956): The marine Upper Miocene of South Jutland and its molluscan fauna. – Danmarks Geologiske Undersøgelse, **2**/81, 1–166, København.

Reeve, L.A. (1843–1846): Monograph of the Genus *Pleurotoma*. – Conchologia Iconica, or Illustrations of the Shells of Molluscous Animals, Vol. **1**, 40 pls. + index and errata. [Published in parts; 1843: pls. 1–18, published January-December, 1843; 1844: pl. 19, published January, 1844; 1845: pls. 20–33, published October-December, 1845; 1846: pls. 34–40, index and errata, published January-April, 1846.], London (Reeve Brothers).

Reeve, L.A. (1848): Monograph of the genus *Cassis*. – Conchologia Iconica, Reeve, L.A., **5**, 12 pls., London.

Reeve, L.A. (1855): Monograph of the genus *Patella*. – Conchologia Iconica, Reeve, L.A., **8,** 25–42, London.

Risso, A. (1826): Histoire naturelle des principales productions de l'Europe méridionale et principalement de celles des environs de Nice et des Alpes-Maritimes, 4. Mollusques. – vii + 439 pp., Paris (Levrault).

Robba, E. (1968): Molluschi del Tortoniano-tipo (Piemonte). – Rivista Italiana di Paleontologia e Stratigrafia, **74**, 457–646, Milano.

Röding, P.F. (1798): Museum Boltenianum, sive catalogus cimeliorum e tribus regnis naturae... pars secunda. – 199 pp., Hamburg (Johan. Christi Trappii). [facsimile reprint, Sherborn & Sykes, 1906].

Rögl, F. (1998): Palaeogeographic considerations for Mediterranean and Paratethys Seaways (Oligocene to Miocene). – Annalen des Naturhistorischen Museums Wien, **99**, 279–310, Wien.

Rögl, F., Schultz, O. & Hölzl, O. (1973): Holostratotypus und Faziostratotypen der Innviertler Schichtengruppe. – In: Papp, A., Rögl, F. & Seneš, J. (Eds.): Chronostratigraphie und Neostratotypen. Miozän der zentralen Paratethys. Band III. M2 Ottnangien. Die Innviertler, Salgótarjáner, Bántapusztaer Schichtengruppe und die Rzehakia Formation, 140–196, Verlag der Slowakischen Akademie der Wissenschaften, Bratislava.

Rupp, C. & van Husen, D. (2007): Zur Geologie des Kartenblattes Ried im Innkreis. – In: Egger, H. & Rupp, C. (Eds.): Beiträge zur Geologie Oberösterreichs. – Arbeitstagung Geologische Bundesanstalt 2007, 73–111, Wien.

Rupp, C., Linner, M. & Mandl, G.W. (2011): Geologische Karte von Oberösterreich 1:200.000. Erläuterungen. – 255 pp., Geologische Bundesanstalt, Wien.

Sacco, F. (1890): I molluschi dei terreni terziari del Piemonte e della Liguria, 8. Galeodoliidae, Doliidae, Ficulidae e Naticidae. – Memorie della Reale Accademia delle Scienze di Torino, **2**/41, 225–338, Torino (reprint, C. Clausen, Torino, 114 pp., 2 pls).

Sacco, F. (1891): I molluschi dei terreni terziarii del Piemonte e della Liguria, 9. Naticidae (fine), Scalariidae ed Aclidae. – Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Universita di Torino, **6,** 103 pp. (May 29 1891), Torino.

Sacco, F. (1894): I molluschi dei terreni terziarii del Piemonte e della Liguria. Parte 15: Fam. Cypraeidae Gray 1824. – Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Universita di Torino, **9**/171, 65–67 (April 27 1894), Torino.

Sacco, F. (1896a): I molluschi dei terreni terziarii del Piemonte e della Liguria. Parte 20; (Caecidae, Vermetidae, Phoridae, Calyptraeidae, Capulidae, Hipponycidae e Neritidae). – Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Universita di Torino, **11**/267, 82–84 (published consecutively with Parts 19, 21, 22) (December 14 1896), Torino.

Sacco, F. (1896b): I molluschi dei terreni terziarii del Piemonte e della Liguria. Parte 22: Gasteropoda (fine) (Pleurotomariidae, Scissurellidae, Haliotidae, Fissurellidae, Tecturidae, Patellidae, Oocorythidae, Cyclophoridae, Cyclostomidae, Aciculidae, Truncatellidae, Actaeonidae, Tornatinidae, Scaphandridae, Bullidae, Cyclichnidae, Philenidae, Umbrellidae). – Pulmonata (Testacellidae, Limacidae, Vitrinidae, Helicidae, Pupidae, Stenogyridae, Succineidae, Auriculidae, Limnaeidae, Physidae; Siphonariidae). Amphineura (Chitonidae). – Scaphopoda (Dentaliidae). – Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Universita di Torino, **11**/267, 89–98 (published consecutively with Parts 19–21) (December 14, 1896), Torino.

Sacco, F. (1904): I Molluschi dei terreni terziari del Piemonte e della Liguria. Parte 30. Aggiunte e correzioni (con 1400 figure). Considerazioni generali. Indice generale dell'opera. – 203 + xxxvi pp., 31 pls., Torino (C. Clausen).

Schilder, F.A. (1927): Revision der Cypraeacea (Mollusca, Gastropoda). – Archiv für Naturgeschichte, **91** (A/10), 1–171 (dated 1925), Berlin.

Schlickum, W.R. (1963): Die Molluskenfauna der Süßbrackwassermolasse von Ober- und Unterkirchberg. – Archiv für Molluskenkunde, **92**, 1–10, Frankfurt am Main.

Schlickum, W.R. (1964): Die Molluskenfauna der Süssbrackwassermolasse Niederbayerns. – Archiv für Molluskenkunde, **93**, 1–68, Frankfurt am Main.

Schlickum, W.R. (1966): Die Molluskenfauna der Kirchberger Schichten des Jungholzes bei Leipheim/Donau.– Archiv für Molluskenkunde, **95**, 321–335, Frankfurt am Main.

Schneider, S. & Mandic, O. (2013): Middle Ottnangian (late Burdigalian) mollusks from the Rott Valley (SE Germany): the ultimate marine fauna of the Western Paratethys. – Paläontologische Zeitschrift, DOI 10.1007/s12542-013-0209-x, Frankfurt am Main.

Schneider, S., Berning, B., Bitner, M.A., Carriol, R-P., Jäger, M., Kriwet, J., Kroh, A. & Werner, W. (2009): A parautochthonous shallow marine fauna from the Late Burdigalian (early Ottnangian) of Gurlarn (Lower Bavaria, SE Germany): Macrofaunal inventory and paleoecology. – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, **254**, 63–103, Stuttgart.

Schnetler, K.I. (2005): The mollusca from the stratotype of the Gram Formation (late Miocene, Denmark). – Palaeontos, **7**, 62–189, Antwerp.

Schnetler, K.I. & Beyer, C. (1990): A late Oligocene (Chattian B) molluscan fauna from the coastal cliff at Mogenstrup, north of Skive, Jutland, Denmark. – Contributions to Tertiary and Quaternary Geology, **27**, 39–81, Oegstgeest.

Schultz, O. (1998): Tertiärfossilien Österreichs, Wirbellose, niedere Wirbeltiere und marine Säugetiere; schöne, interessante, häufige und wichtige Makrofossilien aus den Beständen des Naturhistorischen Museums Wien und Privatsammlungen; eine Bilddokumentation. – 159 pp., Korb (Goldschneck-Verlag).

Schumacher, C.F. (1817): Essai d'un nouveau système des habitations des vers testacés. – 287 pp., Copenhagen (Schultz).

Sieber, R. (1956): Die faunengeschichtliche Stellung der Makrofossilien von Ottnang bei Wolfsegg. – Jahrbuch des oberösterreichischen Musealvereins, **101**, 309–318, Linz.

Snyder, M.A. (2003): Catalogue of the marine gastropod family Fasciolariidae. – Academy of Natural Sciences of Philadelphia, special publication, **21**, 1–431, Philadelphia.

Sowerby, G.B. (1822–1834): The Genera of Recent and Fossil Shells, for the Use of Students in Conchology and Geology: Plates of Genera; also Corresponding Letter-press, Descriptive of the Characters by which Each Genus is Distinguished. Particularly the Land, Fresh Water & Marine Nature of Each Genus, as well as the Strata in which Fossil Species Occur. – Vol. 1 (Text), G.B. Sowerby, London, 274 pp. Vol. 2 (Atlas), 264 pls.

Sowerby, J. (1812–1845) [continued by J. de C. Sowerby]: The mineral conchology of Great Britain; or coloured figures and descriptions of those remains of testaceous animals or shells, which have been preserved at various times and depths in the earth. – 1–7, London (Sowerby). (for authorship, collation and dates of parts see Bulletin of Zoological Nomenclature, **44** (1987), 64–67).

Steininger, F. (1971): Die Mollusken der Eggenburger Schichtengruppe. – In: Steininger, F. & Seneš, J. (1971): Chronostratigraphie und Neostratotypen. Miozän der zentralen Paratethys. Band II. M1 Eggenburgien. Die Eggenburger Schichtengruppe und ihr Stratotypus, 356–591, Verlag der Slowakischen Akademie der Wissenschaften, Bratislava.

Steininger, F. (1973): Die Molluskenfaunen des Ottnangien. – In: Papp, A., Rögl, F. & Seneš, J. (Eds.): Chronostratigraphie und Neostratotypen. Miozän der zentralen Paratethys. Band III. M2 Ottnangien. Die Innviertler, Salgótarjáner, Bántapusztaer Schichtengruppe und die Rzehakia Formation, 380–615, Verlag der Slowakischen Akademie der Wissenschaften, Bratislava.

Stimpson, W. (1865): Review of the northern Buccinums, and remarks on some other northern marine mollusk, part 1. – The Canadian Naturalist, New Series, **2**, 364–389, Toronto.

Strausz, L. (1966): Die Miozän-Mediterranen Gastropoden Ungarns. – Akadémiai Kiadó, 692 pp., 79 pls., Budapest.

Suter, H. (1913): Manual of the New Zealand Mollusca, with an atlas of quarto plates [1915]. – xxiii + 1120 pp., Wellington (Government Printer).

Swainson, W. (1829–1833): Zoological Illustrations, or original figures and descriptions of new rare or interesting animals. – Series 2, **3**/29, 132–136 pls., London (Baldwin & Cradock).

Swainson, W. (1840): A treatise on malacology or shells and shellfish. – viii + 419 pp., London (Longman).

Tembrock, M.L. (1968): Taxionomisch-stratigraphische Studie zur *Scalaspira*-Gruppe (Gastropoda, Tertiär). – Paläontologische Abhandlungen, Abt. A., Paläozoologie, **3**/2, 193–366, Berlin.

Thiele, J. (1891): Das Gebiss der Schnecken, zur Begründung einer natürlichen Classification. – Nicolai, Berlin, **2**/7, 249–334, Berlin (Nicolai).

Thiele, J. (1924): Revision des Systems der Trochacea. – Mitteilungen aus dem Zoologischen Museum in Berlin, **11**, 49–72, Berlin.

Vervoenen, M., van Nieulande, F., Fraussen, K., Wesselingh, F.P. & Pouwer, R. (2014): Pliocene to Quaternary sinistral *Neptunea* species (Mollusca, Gastropoda, Buccinidae) from the NE Atlantic. – Cainozoic Research, **14**, 17–34, Leiden.

Walser, W. (1990): Bericht 1989 über geologische Aufnahmen im Tertiär des Gebietes um Münzkirchen auf den Blättern 12 Passau, 13 Engelhartszell, 29 Schärding und 30 Neumarkt. – Jahrbuch der Geologischen Bundesanstalt, **133**/3, 419–421, Wien.

Weinkauff, H.C. (1875): Ueber eine kritische Gruppe des Genus *Pleurotoma* Lam. sensu stricto. – Jahrbücher der Deutschen Malakozoologischen Gesellschaft, **2**, 283–292, Frankfurt am Main.

Wenz, W. (1938–1944): Gastropoda. Prosobranchia. – In: Schindewolf, O.H. (Ed.): Handbuch der Paläozoologie, **6**, 1201–1505, Berlin (Gebrüder Borntraeger).

Wright, T. (1855): On fossil echinoderms from the island of Malta: with notes on the stratigraphical distribution of the fossil organisms in the Maltese beds. – Annals and Magazine of Natural History, **15**, 101–127, London.

Zunino, M. & Pavia, G. (2009): Lower to Middle Miocene mollusc assemblages from the Torino hills (NW Italy): synthesis of new data and chronostratigraphical arrangement. – Rivista Italiana di Paleontologia e Stratigrafia, **115**, 349–370, Milano.

Zuschin, M., Janssen, R. & Baal, Ch. (2009): Gastropods and their habitats from the northern Red Sea (Egypt: Safaga) part 1: Patellogastropoda, Vetigastropoda and Cycloneritimorpha. – Annalen des Naturhistorischen Museums Wien, **111A**, 74–158, Wien.

Received: 7. October 2014, Accepted: 10. November 2014

Plate 1

Figs. 1a–1b *Emarginula* nov. sp. 1; silicone mould; NHMW 2014/0379/0001.

Figs. 2a–2b *Emarginula* nov. sp. 2; silicone mould; NHMW 2014/0379/0002.

Fig. 3 *Fissurella costicillatissima* Sacco, 1896; natural cast; NHMW 2014/0379/0003.

Fig. 4 *Fissurella costicillatissima* Sacco, 1896; silicone mould; NHMW 2014/0379/0004.

Figs. 5a–5b *Fissurella costicillatissima* Sacco, 1896; silicone mould; NHMW 2014/0379/0005.

Figs. 6a–6c *Cellana*? *danningeri* Harzhauser & Landau nov. sp.; holotype; NHMW 2014/0379/0006.

Fig. 7 *Jujubinus* nov. sp; silicone mould; NHMW 2014/0379/0007.

Fig. 8 *Jujubinus* nov. sp; silicone mould; NHMW 2014/0379/0008.

Fig. 9 *Jujubinus* nov. sp; silicone mould; NHMW 2014/0379/0009.

Fig. 10 *Calliostoma tauromiliare* (Sacco, 1896); silicone mould; NHMW 2014/0379/0010.

Fig. 11 *Calliostoma tauromiliare* (Sacco, 1896); silicone mould; NHMW 2014/0379/0011.

Fig. 12 *Calliostoma tauromiliare* (Sacco, 1896); silicone mould; NHMW 2014/0379/0012.

Fig. 13 *Calliostoma sturi* (Hoernes, 1875); silicone mould; NHMW 2014/0379/0013.

Fig. 14 *Homalopoma nodulus* (Eichwald, 1830); silicone mould; NHMW 2014/0379/0014.

Fig. 15 *Homalopoma nodulus* (Eichwald, 1830); silicone mould; NHMW 2014/0379/0015.

Fig. 16 *Homalopoma nodulus* (Eichwald, 1830); silicone mould; NHMW 2014/0379/0016.

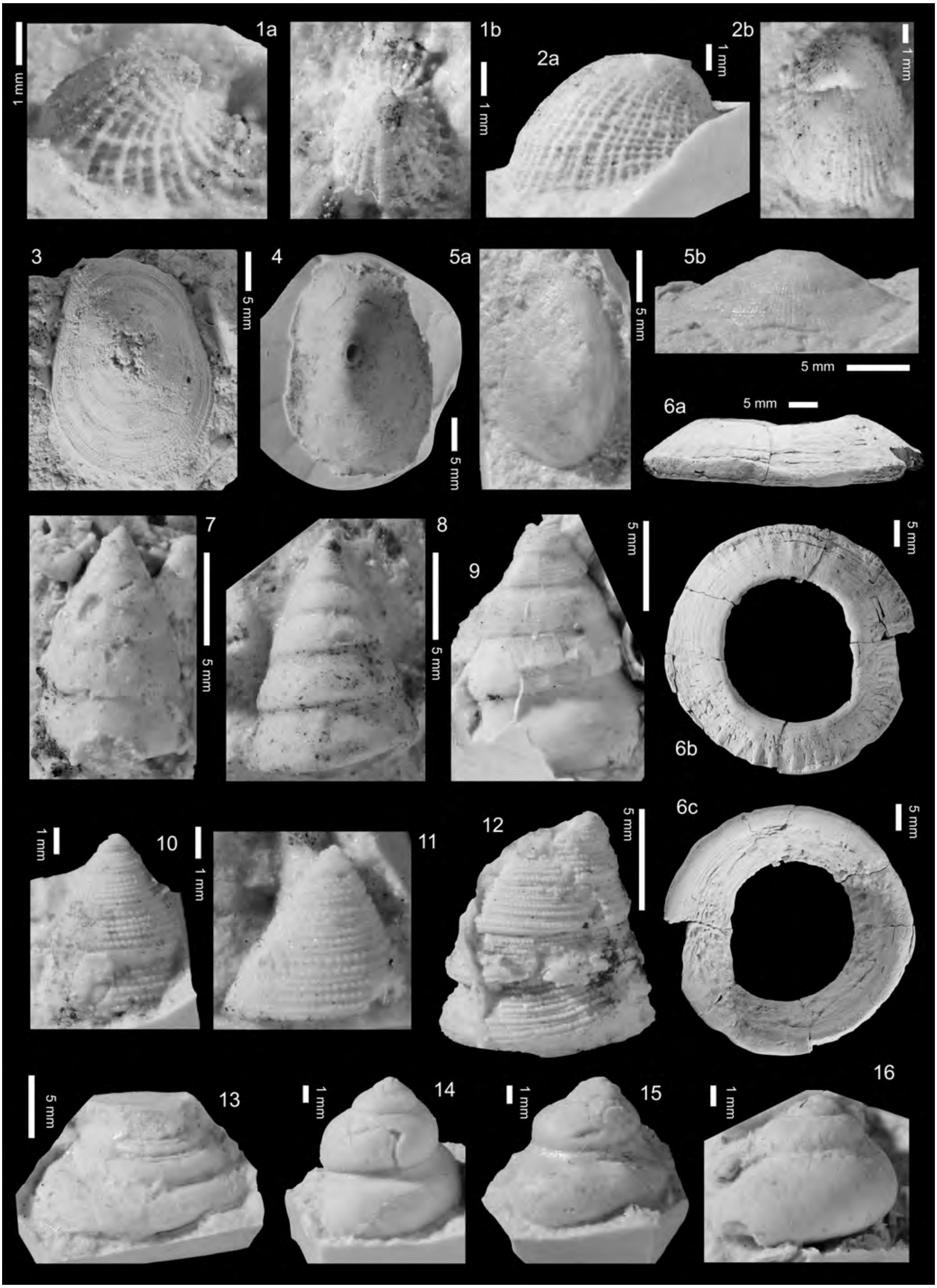

1a
1 mm
1b
1 mm
2a
1 mm
2b
1 mm
3
5 mm
4
5 mm
5a
5 mm
5b
5 mm
6a
5 mm
7
5 mm
8
5 mm
9
5 mm
5 mm
6b
10
1 mm
1 mm
11
12
5 mm
6c
5 mm
5 mm
13
1 mm
14
1 mm
15
1 mm
16

Plate 2

Fig. 1	*Bolma paratethyca* HARZHAUSER & LANDAU nov. sp.; silicone mould of holotype; NHMW 2014/0379/0017.
Fig. 2	*Bolma paratethyca* HARZHAUSER & LANDAU nov. sp.; silicone mould; NHMW 2014/0379/0018.
Fig. 3	*Bolma paratethyca* HARZHAUSER & LANDAU nov. sp.; silicone mould; NHMW 2014/0379/0019.
Fig. 4	*Bolma paratethyca* HARZHAUSER & LANDAU nov. sp.; silicone mould; NHMW 2014/0379/0020.
Fig. 5	*Bolma paratethyca* HARZHAUSER & LANDAU nov. sp.; silicone mould; NHMW 2014/0379/0021.
Fig. 6	*Bolma paratethyca* HARZHAUSER & LANDAU nov. sp.; paratype; NHMW 2014/0379/0022.
Fig. 7	*Bolma paratethyca* HARZHAUSER & LANDAU nov. sp.; silicone mould; NHMW 2014/0379/0023.
Figs. 8a–8b	*Bolma paratethyca* HARZHAUSER & LANDAU nov. sp.; silicone mould of operculum; NHMW 2014/0379/0024.
Fig. 9	*Tenagodus obtusus* (SCHUMACHER, 1817); silicone mould; NHMW 2014/0379/0025.
Fig. 10	*Tenagodus obtusus* (SCHUMACHER, 1817); silicone mould; NHMW 2014/0379/0026.
Figs. 11a–11b	*Calyptraea chinensis* (LINNAEUS, 1758); silicone mould; NHMW 2014/0379/0027.
Figs. 12a–12b	*Zonarina* sp.; silicone mould; NHMW 2014/0379/0028.
Fig. 13	*Semicassis grateloupi* (DESHAYES, 1853); silicone mould; NHMW 2014/0379/0029.
Figs. 14a–14b	*Semicassis grateloupi* (DESHAYES, 1853); silicone mould; NHMW 2014/0379/0030.
Fig. 15	*Ficus condita* (BRONGNIART, 1823); NHMW 2014/0379/0031.

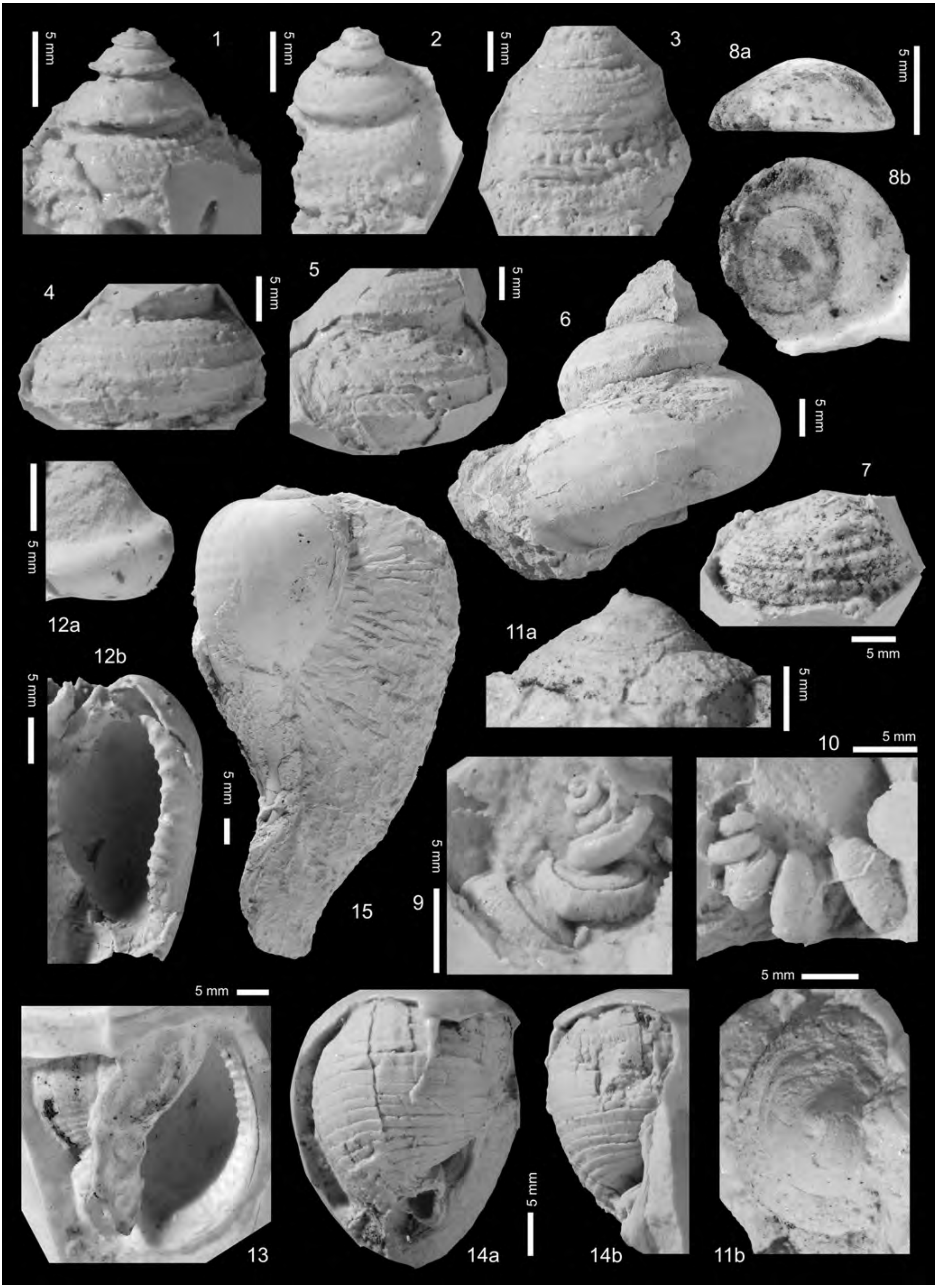

1
5 mm
2
5 mm
3
5 mm
8a
5 mm
8b
4
5 mm
5
5 mm
6
5 mm
7
5 mm
12a
5 mm
11a
5 mm
12b
5 mm
5 mm
15
10
5 mm
9
5 mm
5 mm
5 mm
13
14a
5 mm
14b
11b

Plate 3

Figs. 1a–1b *Cirsotrema crassicostanomala* SACCO, 1891; NHMW 2014/0379/0032.

Fig. 2 *Scalina subreticulata* (D'ORBIGNY, 1852); NHMW 2014/0379/0033.

Fig. 3 *Scalina subreticulata* (D'ORBIGNY, 1852); NHMW 2014/0379/0034.

Figs. 4a–4b *Scalina subreticulata* (D'ORBIGNY, 1852); NHMW 2014/0379/0035.

Fig. 5 *Epitonium* nov. sp.; silicone mould; NHMW 2014/0379/0036.

Figs. 6a–6b *Nassarius schultzi* HARZHAUSER & KOWALKE, 2004; NHMW 2014/0379/0037.

Figs. 7a–7b *Nassarius striatulus* (EICHWALD, 1829); silicone mould; NHMW 2014/0379/0038.

Fig. 8 *Nassarius striatulus* (EICHWALD, 1829); silicone mould; NHMW 2014/0379/0039.

Fig. 9 *Nassarius pauli* (HOERNES, 1875); silicone mould; NHMW 2014/0379/0040.

Fig. 10 Buccinidae indet.; silicone mould; NHMW 2014/0379/0041.

Fig. 11 *Scalaspira*? nov. sp.; silicone mould; NHMW 2014/0379/0042.

Fig. 12 *Scalaspira*? nov. sp.; silicone mould; NHMW 2014/0379/0043.

Fig. 13 *Metula* nov. sp.; silicone mould; NHMW 2014/0379/0044.

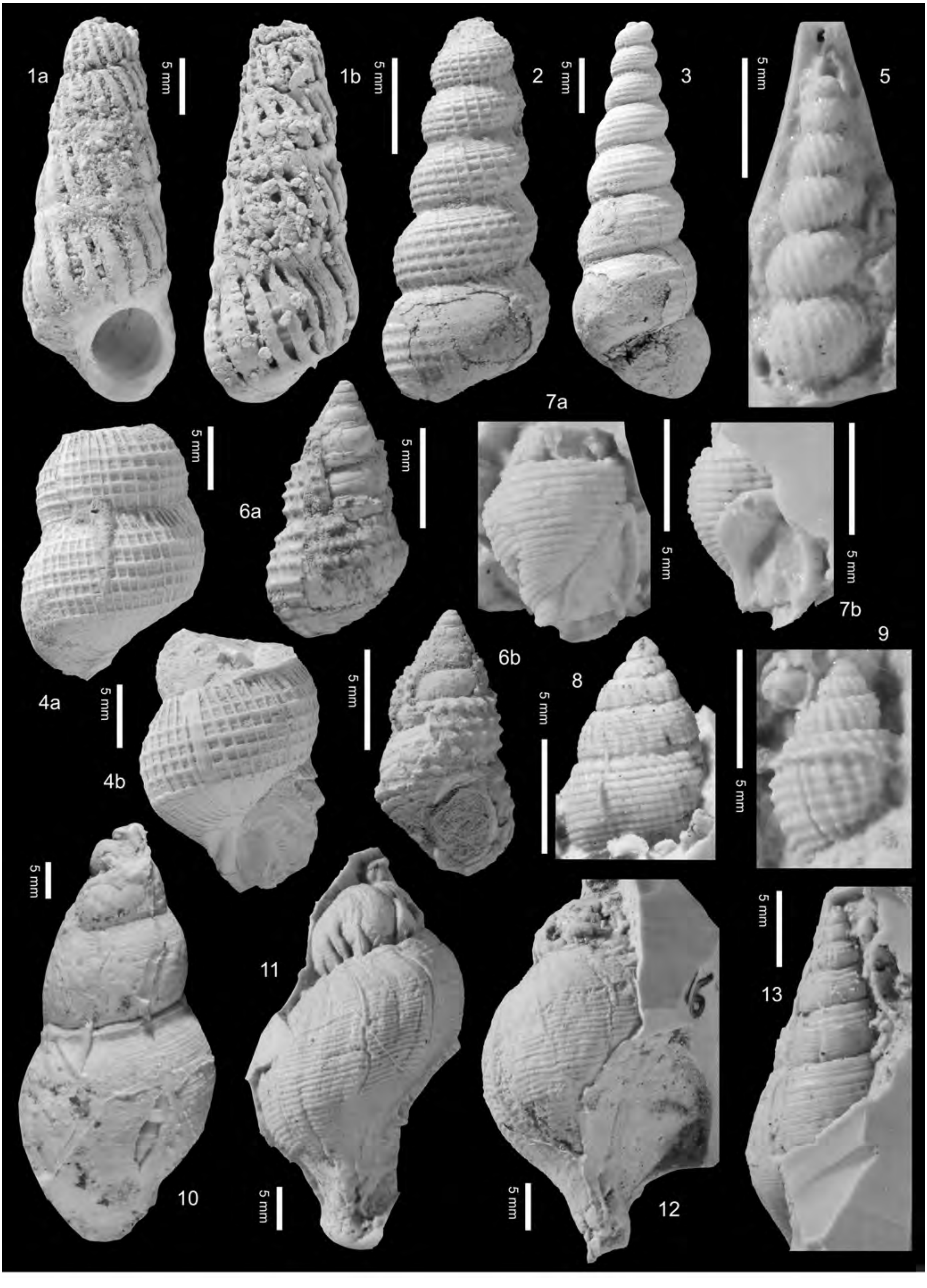

1a
5 mm
1b
5 mm
2
5 mm
3
5 mm
5
7a
5 mm
6a
5 mm
5 mm
5 mm
7b
9
4a
5 mm
6b
5 mm
8
5 mm
5 mm
4b
5 mm
11
13
5 mm
10
5 mm
5 mm
12

Plate 4

Fig. 1 *Fusinus* nov. sp.; silicone mould; NHMW 2014/0379/0045.

Fig. 2 *Fusinus* nov. sp.; silicone mould; NHMW 2014/0379/0046.

Fig. 3 *Fusinus* nov. sp.; silicone mould; NHMW 2014/0379/0047.

Figs. 4a–4b *Chicoreus* (*Triplex*) *aquitanicus* (Grateloup, 1833); silicone mould; NHMW 2014/0379/0048.

Figs. 5a–5b *Episcomitra* sp.; natural cast and corresponding silicone mould; NHMW 2014/0379/0049.

Fig. 6 *Episcomitra* sp.; silicone mould; NHMW 2014/0379/0050.

Figs. 7a–7b *Sveltia suessi* (Hoernes, 1875); silicone mould; NHMW 2014/0379/0051.

Fig. 8 *Gemmula coronata* (Münster in Goldfuss, 1841); silicone mould; NHMW 2014/0379/0052.

Fig. 9 *Gemmula coronata* (Münster in Goldfuss, 1841); silicone mould; NHMW 2014/0379/0053.

Fig. 10 *Gemmula coronata* (Münster in Goldfuss, 1841); silicone mould; NHMW 2014/0379/0054.

Fig. 11 *Bathytoma* nov. sp.; silicone mould; NHMW 2014/0379/0055.

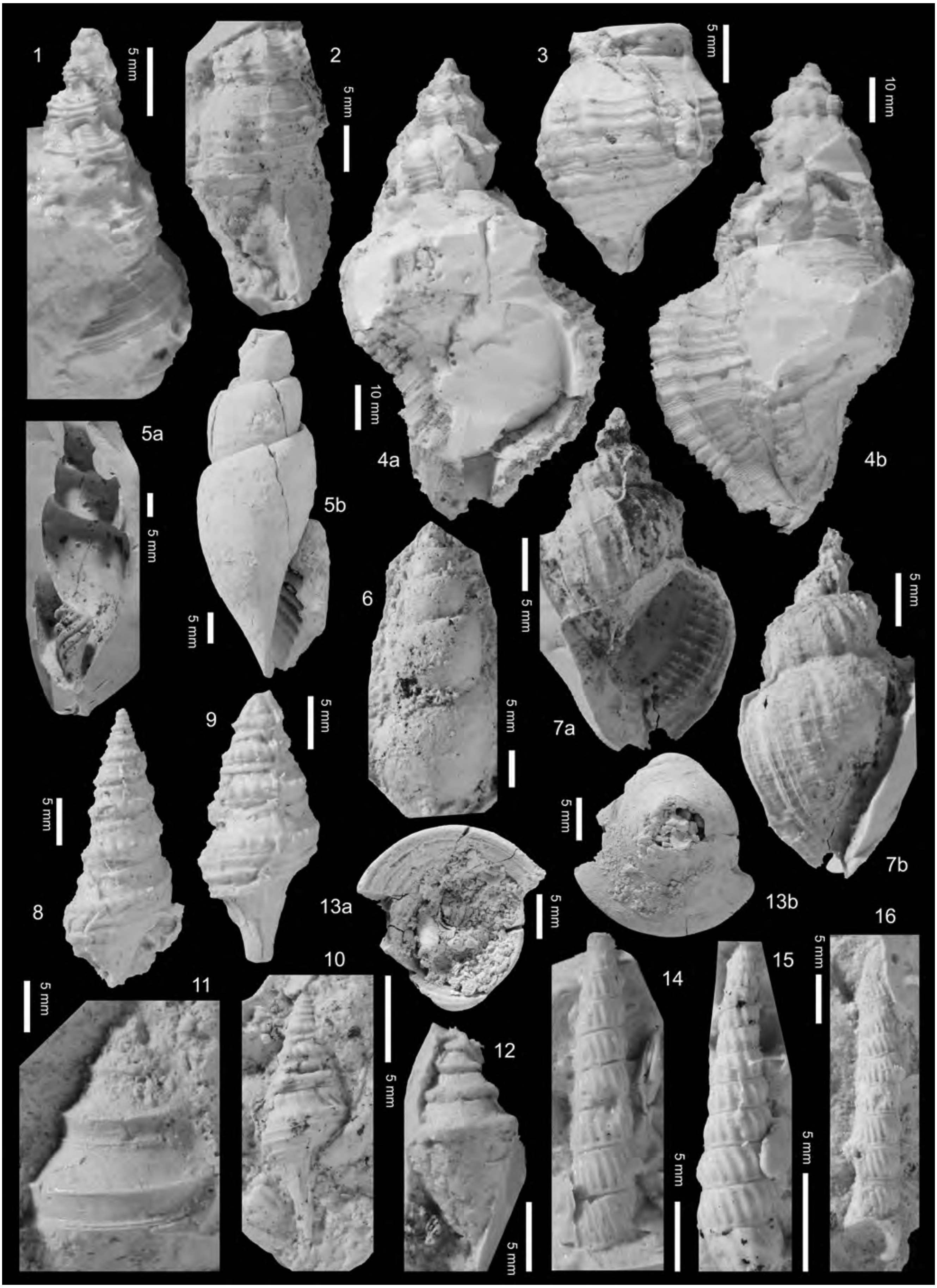
Fig. 12 *Conilithes* cf. *dujardini* (Deshayes, 1845); silicone mould; NHMW 2014/0379/0056.

Figs. 13a–13b *Siphonaria* cf. *vasconiensis* Michelin, 1831; NHMW 2014/0379/0057.

Fig. 14 *Claviscala norica* Harzhauser & Landau nov. sp.; silicone mould of holotype; NHMW 2014/0379/0058.

Fig. 15 *Claviscala norica* Harzhauser & Landau nov. sp.; silicone mould of paratype; NHMW 2014/0379/0059.

Fig. 16 *Claviscala norica* Harzhauser & Landau nov. sp.; silicone mould; NHMW 2014/0379/0060.


1
5 mm
2
5 mm
3
5 mm
10 mm
4a
4b
10 mm
5a
5 mm
5b
5 mm
6
5 mm
5 mm
7a
7b
5 mm
8
5 mm
9
5 mm
13a
5 mm
13b
5 mm
10
5 mm
11
5 mm
12
5 mm
14
5 mm
15
5 mm
16
5 mm