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Sponges from a section of the Upper Triassic Nayband Formation, northeast of Esfahan, central Iran

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(With 13 plates and 10 figures)

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Abstract

Hypercalcified sponges, including "Sphinctozoans" and "Inozoans" are described in details from the biocostructions in an Upper Triassic (most probably Rhaetian in age) section of the Nayband Formation, exposed in the northeast area of Esfahan, central Iran. Some chaetetid and spongiomorphid sponges are indentified and described informally. Hexactinellid sponges are extremely rare and are represented by only two connected lattices and in some thin sections by isolated loose spicules. The reefs and reefal limestones in the lower part of the section are dominated by hypercalcified sponges; the upper part of the section is characterized by the dominance of the red algae (Solenoporaceans). Horizontally growing sheets of spongiomorphids are very abundant in some carbonate beds.

Hypercalcified sponges occur with at least 25 genera and almost 38 species including 14 sphinctozoan genera and 23 species (three of them as new and two of them as gen. et sp. indet), six inozoan genera with 8 species (one as uncertain genus and species), five chaetetid species and at least two species of spongiomorphids. Two representatives of hexactinellids occur in the investigated section of the Nayband Formation. The following species are described as new: "Sphinctozoa": *Amblysiphonella bisiphonata*, *A. torabii*, and *Parauvanella spinosa*. Inozoa: *Peronidella pilleri.*

Keywords: Sponges, Sphinctozoa, Inozoa, Spongiomorphida, Chaetetida, Systematic, Nayband Formation, Triassic, Iran

Zusammenfassung

Coralline Schwämme, einschließlich die "Sphinctozoen" und "Inozoen", der obertriassischen (höchstwahrscheinlich rhätischen Alter) Biokonstruktionen der Nayband-Formation nordöstlich der Stadt Esfahan (Zentraliran) werden systematisch beschrieben. Einige Chaetetiden und

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Spongiomorphiden können nur als gen. et sp. indet bestimmt werden. Hexactinelliden Schwämme sind extrem selten und nur durch zwei zusammenhängende Skelettgitter und einige lose Skleren vertreten. Die Riffe und riffoide Karbonate im Liegenden des untersuchten Profils werden durch die Dominanz der corallinen Schwämme, die hangenden Teile des Profils jedoch durch das Vorherrschen der Rotalgen (Solenoporaceen) charakterisiert. Horizontal wachsende, plattige Spongiomorphiden sind in einigen Karbonatbänken des Profils gesteinsbildend.

Coralline Schwämme treten im untersuchten Material mit mindestens 25 Gattungen und etwa 38 Arten auf. Es sind 14 Gattungen und 23 Arten den Sphinctozoen (drei von ihnen als neue Arten und zwei als Gen. et sp. indet), sechs Gattungen und acht Arten den Inozoen (eine als unsichere Gattung und Art), fünf Arten den Chaetetiden und schließlich zwei Arten den Spongiomorphiden zuzuordnen. Hexactinelliden Schwämme sind mit zwei Arten vertreten. Folgende Arten werden neu beschrieben: „Sphinctozoa“: *Amblysiphonella bisiphonata*, *A. torabii* und *Parauvanella spinosa*; „Inozoa“: *Peronidella pilleri*

Schlüsselwörter: Schwämme, Sphinctozoa, Inozoa, Spongiomorphida, Chaetetida, Systematik, Nayband-Formation, Trias, Iran

Introduction

The Upper Triassic (Norian-Rhaetian) siliciclastic-carbonatic deposits of the Nayband Formation is one of the most widespread geological units that crop out at numerous localities in central and northeast Iran (Seyed-Emami 2003). The type locality of the Nayband Formation lies on the southern flank of the Kuh-e Nayband, about 220 km south of the town Tabas in northeast Iran (geological map J8 of Naybandan: Kluyver et al. 1983). Here the Nayband Formation reaches a thickness of about 3.000 m. Several horizons of coral- or sponge-dominated bioconstructions, usually of biostromal, but also of biohermal type are embedded within the Nayband Formation. A rich invertebrate fauna and flora were found within the carbonatic and non-carbonatic deposits of the formation. The sponge fauna of Nayband Formation was described from different localities by Senowbari-Daryan et al. (1997), Senowbari-Daryan & Hamedani (1999), and Senowbari-Daryan (2005a, 2005b), herein further references are listed. A general work about the Nayband Formation is carried out by Seyed-Emami (2003) and the description of facies patterns and depositional environment is given by Fürsich et al. (2005).

Studied section

The studied section of the Nayband Formation is about 130 m thick and located south of the small town of Bagherabad, northeast of the city of Esfahan, central Iran (N: 32° 56´ 35.4´´, E: 51° 56´ 04.7´´; Fig. 1). The carbonate succession in this section differs from all other known sections of the Nayband Formation by the dominance of several meter thick algal constructions developed in the upper part of the section. A detailed description of the section is given by Senowbari-Daryan et al. (2008), where the solenoporaceans

including the new taxa *Solenopora rectangulata* and *Parachaetetes dizluensis* were described. The description of the foraminiferal fauna and foraminiferal association was carried out by Senowbari-Daryan et al. (2010). Hypercalcified sponges are the most abundant reef building organisms – at least in the lower part of the section – and are described in this paper. The investigated materials are stored in the department of Palaeontology, University of Erlangen-Nürnberg (Senowbari-Daryan: Iran, Triassic, Algae section).

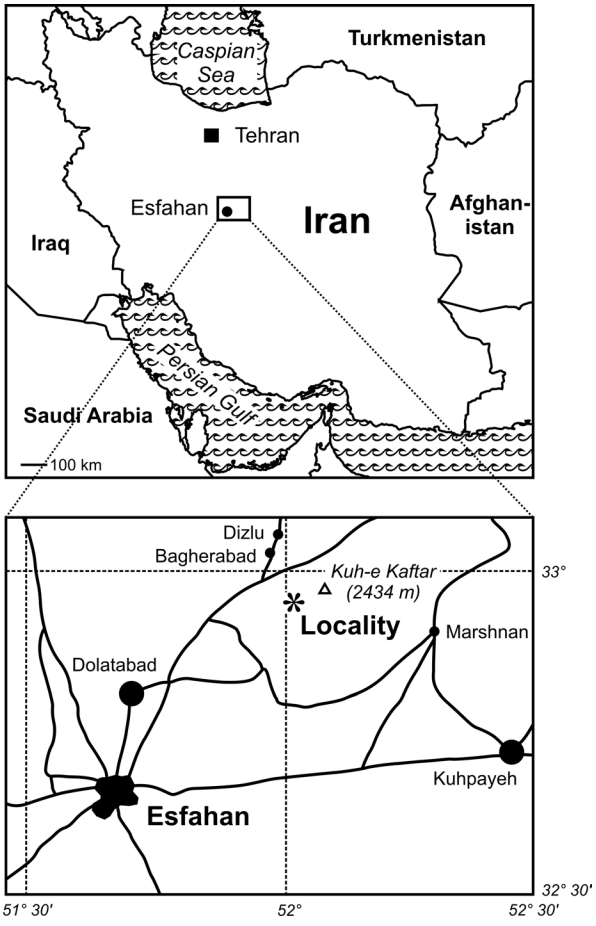

Fig. 1. Geographic position of the investigated section of Nayband Formation located south of the town Bagherabad, northeast of Esfahan (N. 32° 56´ 35.4´´, E. 51° 56´ 04.7´´).

Systematic palaeontology

In general the systematic classification proposed by Finks & Rigby (2004) is used for description of the sponge fauna. For detailed description of the sponge fauna from the Nayband Formation of other localities in central Iran see Senowbari-Daryan et al. (1997), Senowbari-Daryan & Hamedani (1999), and Senowbari-Daryan (2005a for "Sphinctozoans"; 2005b for "Inozoans").

The studied material is deposited at the Geozentrum Nordbayern, Department of Palaeontology, University of Erlangen-Nürnberg (Inventary Senowbari-Daryan: Iran, Triassic, Algae sections).

Class Demospongea Sollas, 1875

Order Agelasida Verrill, 1907

Family Sebargasiidae de Laubenfels, 1955

Subfamily Sebargasiinae Senowbari-Daryan, 1990

Genus *Amblysiphonella* Steinmann, 1882

Type species: *Amblysiphonella barroisi* Steinmann, 1882.

Further species: See Senowbari-Daryan (1990); Senowbari-Daryan & Garcia-Bellido (2002).

***Amblysiphonella bisiphonata* nov. spec.**
(Pl. 1, Figs A-B)

Derivatio nominis: Named for the presence of two spongocoels.

Holotype: Pl. 1, Figs A-B (both sections are made from the same sponge, thin sections 1/0/1 and 1/0/2).

Locus typicus: Section of Nayband Formation, located south of the small town of Bagherabad (N: 32°56´35.4, E: 51°56´ 04.7´´, see Fig. 1).

Stratum typicum: Upper Triassic Nayband Formation (most probably Rhaetian).

Diagnosis: Small species of the genus *Amblysiphonella* with two spongocoels. Spongocoel walls are pierced by large and rimmed openings. Chamber roofs (interwalls) are much thicker than the exowalls and endowalls (spongocoel walls). Chamber interiors are without filling skeleton and vesiculae.

Material: One specimen, of which two thin sections (no. 1/0/1 and 1/0/2) were made.

Description: The only one specimen of this sponge reaches a height of 21 mm with a diameter of 7 mm. It is composed of 6 barrel-shaped chambers with heights of 3.5–4.5 mm. Chamber exowalls are 0.4–0.8 mm thick and are pierced by pores of 0.1 mm in diameter. Thickness of endowalls is variable, varying between 0.2 mm and 1 mm. They are pierced by large openings of 0.3–0.6 mm in diameter. Some of them are rimmed. Chamber interwalls are doubled reaching thicknesses of up to 2 mm. Two spongocoels of retrosiphonate type pass through the whole sponge. The diameter of the spongocoels is about 1.4 mm. Chamber interiors are without filling skeleton and vesiculae.

Comparison: *Amblysiphonella* is a long-lasting genus, known from Cambrian or Ordovician (with a gap in the Silurian to Devonian) up to the Triassic (Pickett & Jell 1983; Rigby & Potter 1986). About 60 species of the genus are known. All species of *Amblysiphonella* (known up to 1990) with their biometrical data are listed by Senowbari-Daryan (1990) and those described later are listed by Senowbri-Daryan & Hamedani (1999). According to the sponge diameter (7 mm) of Triassic species only *A. carntiaca* Dullo (in Dullo & Lein, 1980) is comparable with *A. bisiphonata* nov. spec., but all other characteristics of the sponge are different. Senowbari-Daryan & Hamedani (1999) have described an *Amblysiphonella*-species from the Nayband Formation near Wali-Abad

(south of Abadeh, central Iran) as *A*. cf. *tubifera*, but this species seems to have several spongocoels and is much larger than the new species.

From the Nayband Formation Senowbari-Daryan (2005a) described four other species of *Amblysiphonella* (three of them informally). All these species are larger than *A. bisiphonata* and a comparison is urgent. The biometrical data of *A. bisiphonata* is similar to *A. najafiani* Senowbari-Daryan (2005a), but *A. bisiphonata* differs from this species by having of two spongocoels.

A small species of *Amblysiphonella* with two spongocoels was described as *A. parva* from the late Triassic (probably Norian-Rhaetian) of Trang Province, Southern Thailand by Senowbari-Daryan & Ridd (2008). The Iranian species with two spongocoels differs from the species from Thailand by large dimensions of the sponge (diameter of *A. bisiphonata* 7 mm, *A. parva* 2–2.5 mm), by a secondarily secreted skeleton around the chamber wall in *A. parva*, and by the doubled chamber interwalls in *A. bisiphonata* nov. spec.

***Amblysiphonella torabii* nov. spec.**

(Pl. 1, Fig. H; Pl. 9, Fig. A)

Derivatio nominis: This species is dedicated to Hossein Torabi (University of Esfahan), who discovered this section of the Nayband Formation.

Holotype: Specimen illustrated in Pl. 1, Fig. H/1 (Thin section K28).

Paratypes: Specimens illustrated in Pl. 1, Fig. H/2 and Pl. 9, Fig. A.

Locus typicus: The section of Nayband Formation south of the small town of Bagherabad (N: 32°56´35.4, E: 51°56´ 04.7´´, see Fig. 1).

Stratum typicum: Upper Triassic Nayband Formation (most probably Rhaetian).

Diagnosis: Smallest species of *Amblysiphonella* with spherical chambers. Interwalls doubled. Chamber interiors are without filling skeleton and vesiculae.

Material: 3 specimens in thin sections K28 and K115.

Description: All three specimens of this sponge are cut in oblique sections and therefore the height of the sponge is not known.

The holotype (Pl. 1, Fig. H/1) exhibits three chambers with a diameter of 1.9 mm. Heights of the chambers are about 0.8 mm. Chamber exowalls are about 0.16 mm thick and strongly recrystallized, but some well preserved parts exhibit the perforated chamber walls with pore diameter of 0.02 mm. Interwalls are doubled reaching a thickness of 0.3 mm. Endowalls are moderately thinner (0.06 mm) and pierced by large openings of about 0.16 mm.

The biometric data of one paratype (Pl. 1, Fig. H/2) are more or less identical with those of the holotype. This specimen seems to be branched.

The third specimen (Pl. 9, Fig. A) is, with a diameter of 4 mm, moderately larger than the holotype or other paratype, but other characteristics correspond to the other two specimens.

Comparison: *A. torabii* nov. spec. differs from all other known species of *Amblysiphonella* by the small diameter of the sponge. From the preceding species *A. bisiphonata* nov. spec. it differs by the small size and by the presence of the single spongocoel.

The dimension of *A. torabii* nov. spec. is almost identical with *A. parva*, a small species described from the late Triassic of Southern Thailand by Senowbari-Daryan & Ridd (2008); it differs from this species, however, by the presence of only one spongocoel (*A. parva* has two spongocoels) and by the lack of a secondary skeleton occurring in *A. parva*.

Amblysiphonella **spec. 1**
(Pl. 4, Fig. B)

Material: Two specimens, which are growing together (thin section K18).

Description: Two specimens of this species – recognizable by the chamber orientation – are grown together. Both specimens are cut at the edge of the thin section and do not exhibit the whole characteristics of the sponge.

The sponge is composed of ring-shaped chambers of 23 mm in diameter corresponding to the sponge´s diameter. Chamber height varies between 8 mm and 12 mm. Chamber walls are partly perforated (pore diameter 0.3–0.4 mm) with a thickness of 0.4–0.7 mm and partly imperforated with a thickness of 1–2 mm. In both specimens the axial spongocoel is cut marginally and its true dimension in unknown. Chamber interiors are without vesiculae.

Remarks: See *Amblysiphonella* spec. 3 for discussion.

Amblysiphonella **spec. 2**
(Pl. 4, Fig. C)

Material: Three incomplete specimens in investigated thin sections (illustrated specimen in thin section 7).

Description: Two of three specimens of this sponge are cut marginally and do not show all characteristics of the sponge. The specimen illustrated in Pl. 4, Fig. C reaches a length of 20 mm with a diameter (in the middle part) of 5.5 mm. A spongocoel of 1 mm in diameter is cut in the middle part of the sponge. There are numerous ring-like to irregular chambers arranged around the spongocoel. Chamber walls are thin (0.2 mm) and pierced by regularly distributed pores of 0.15–0.2 mm in diameter. Most probably this

sponge is a new species, but due to the rarity of the material, which is insufficient to fully characterize the species.

***Amblysiponella* spec. 3**
(Pl. 4, Fig. D)

Material: Two incomplete specimens (illustrated specimen in thin section K39).

Description: The length of this *Amblysiphonella* species with a diameter of 15 mm is unknown. The ring-shaped chambers are arranged around an axial spongocoel of almost 6 mm in diameter. Chamber heights amount to approximately 5 mm. Exowalls (0.8 mm thick) are moderately thinner than the interwalls (1.2 mm thick). Endowalls is thinner than exo- and interwalls. Exowalls and endowalls (wall of spongocoel) are pierced by pores of about 0.2 mm in diameter. Some pores of exowall are branched to the outside. Interwalls exhibit only few pores. Chamber interiors are without vesiculae and secondary skeleton.

Remarks: The three informally described species of *Amblysiphonella* spec. 1–3 differ from the two species described above by the dimensions of the chambers and spongocoel as well as by the perforation pattern of the chamber walls.

Family Colospongiidae Senowbari-Daryan, 1990

Subfamily Corymbospongiinae Senowbari-Daryan, 1990

Genus *Parauvanella* Senowbari-Daryan & Di Stefano, 1988

Type species: *Parauvanella paronai* Senowbari-Daryan & Di Stefano, 1988.

Further species: *Parauvanella bimuralis* (= *Colospongia bimuralis* Senowbari-Daryan 1978); *P. minima* Senowbari-Daryan 1990; *P. ferdowsensis* Senowbar-Daryan 2005a; and *P. delijanensis* Senowbari-Daryan 2005a.

***Parauvanella spinosa* nov. spec.**
(Pl. 1, Fig. J; Pl. 9, Fig. G/1; Pl. 10, Fig. F/1)

Derivatio nominis: Spinosus (lat. =) spiny, prickly. Named for the spine-like elements in the internal side of the chamber walls.

Holotype: Specimen illustrated in Pl. 9, Fig. G/1 (thin section K28).

Paratypes: Specimens in Pl. 1, Fig. J; Pl. 10, Fig. F/1.

Locus typicus: The section of the Nayband Formation, south of the small town of Bagherabad (N: 32°56′35.4, E: 51°56′ 04.7′′, see Fig. 1).

Stratum typicum: Upper Triassic Nayband Formation (most probably Rhaetian).

Diagnosis: Sponge composed of hemispherical chambers with thin and perforated chamber walls. Chamber walls bear spine-like elements internally. Chamber interiors are without any secondary skeleton.

Material: At least four specimens (illustrated specimens in thin section 12, K28, K37).

Description: The aggregates of this sponge are composed of several hemispherical chambers arranged in clusters, one above and beside others. Chamber walls are thin, but in one paratype (Pl. 10, Fig. F) they are partly thickened. The most characteristic feature of sponge is the spine-like elements extending from the chamber roofs over a short distance into the chamber interiors. These elements do not reach the chamber roofs of the preceding chambers. Chamber walls are pierced by pores of approximately 0.4 mm in diameter. Chamber walls between two adjacent chambers are doubled. Chamber interiors are without any secondary filling skeleton. The holotype, illustrated in Pl. 9, Fig. G/1 is composed of several hemispherical chambers of varying size reaching a dimension of 7 x 6 mm.

Comparison: Two species of *Parauvanella* were described by Senowbari-Daryan (2005a) from the Nayband Formation of Iran: *P. ferdowsensis* and *P. delijanensis*. The new species differs from these Iranian species and from the other species mentioned above by the perforation pattern of the chamber walls and particularly by the spine-like elements extending from the chamber roofs into the chamber interiors.

Subfamily Kashanelliinae Senowbari-Daryan, 2005a

Genus *Kashanella* Senowbari-Daryan, 2005a

Type species: *Kashanella irregularis* Senowbari-Daryan, 2005a.

***Kashanella irregularis* Senowbari-Daryan, 2005a**
(Pl. 2, Figs K-L; Pl. 4, Figs E, H-I)

2005a *Kashanella irregularis* nov. sp. – Senowbari-Daryan, p. 181–182; Pl. 5, Fig. 4; Pl. 19, Fig. 6; Pl. 20, Fig. 7; Pl. 21, Figs 6–7.
2009 *Kashanella irregularis* Senowbari-Daryan. – Senowbari-Daryan, p. 115; Pl. 2, Figs H-I; Pl. 3, Figs A/2, H-I; Pl. 15, Fig. E.

Material: Numerous specimens (illustrated specimens in thin sections K2, K6, K12, K14, K39).

Description: This irregularly growing sponge is composed of several irregular chambers (Pl. 4, Fig. H). Chambered construction is not always recogziable from the outside of the sponge (Pl. 2, Figs K-L). The most characteristic of the sponge is the labyrinthic canals system of the chamber walls, giving the walls a “spongy” appearance. A detailed description of the species is given by Senowbari-Daryan (2005a).

Occurrence and stratigraphic range: *Kashanella irregularis* is known from the Norian-Rhaetian reefs of the Nayband Formation, Iran, from the stratigraphic time equivalent reefs of the Gosaukamm in Austria (Senowbari-Daryan 2009), and from the Norian reefs of Taurus Mountains in southern Turkey (Senowbari-Daryan & Link, in press).

Family Annaecoeliidae Senowbari-Daryan, 1978

Genus *Annaecoelia* Senowbari-Daryan, 1978

Type species: *Annaecoelia maxima* Senowbari-Daryan, 1978

Further species: *A. interiecta* Senowbari-Daryan & Schäfer 1979; *A. mirabilis* Senowbari-Daryan & Schäfer 1979; *A. parva* Senowbari-Daryan 2005a.

Annaecoelia mirabilis Senowbari-Daryan & Schäfer, 1979

(Pl. 2, Fig. J?, Pl. 4, Fig. J)

1979 *Annaecoelia mirabilis* n. sp. – Senowbari-Daryan & Schäfer, p. 27; Pl. 2, Figs 1, 3; Pl. 3, Figs 2–3; Pl. 5, Fig. 5; Pl. 7, Figs 3, 5.

Material: One (two?) specimen (illustrated specimens in thin sections 7, K46).

Description: The small specimen of this sponge reaches a diameter of about 2.5 mm and is grown on another sponge (Pl. 4, Fig. J). The chambers are crescent-shaped and extended upward to form several spongocoels of prosiphonate type. Chamber walls are poorly preserved and therefore the fine pores are recognizable in part. Chamber interiors are without any filling skeleton and vesiculae.

According to the thin and extremely finely perforated chamber walls the specimen illustrated in Pl. 2, Fig. J is surely an *Annaecoelia*, but the small openings within the chamber walls are characteristic of *Annaecoelia interiecta* Senowbari-Daryan & Schäfer (1979). We are not sure about the identity of this sponge as *A. mirabilis*.

Remarks: The dimension of the Iranian specimen is much smaller than the dimensions of the type material (diameter 6–10 mm), described by Senowbari-Daryan & Schäfer (1979) from the Upper Rhaetian reefs of the Northern Calcareous Alps, Austria. The shape of the chambers and the formation of the spongocoels are identical in the type specimens.

From the reefs, embedded within the Nayband Formation in Iran two possibly species of the genus *Annaecoelia* (*A.*? *interiecta* and *A.*? *parva*) were described by Senowbari-Daryan (2005a). This species is the third one of the genus occurring in Norian-Rhaetian reefs in Iran.

Occurrence and stratigraphical range: *A. mirabilis* is known from the Rhaetian of the type locality in Austria (Senowbari-Daryan & Schäfer, 1979). The age of the Iranian specimens is most probably Rhaetian, too.

Annaecoelia parva Senowbari-Daryan, 2005a
(Pl. 2, Fig. D: arrow; Pl. 4, Fig. L)

2005a *Annaecoelia*? *parva* nov. sp. – Senowbari-Daryan, p. 84; Pl. 29, Figs 4, 6.

Material: One specimen only (thin section K/1/1).

Description: The small specimen of this sponge reaches a length of 5 mm with a diameter of only 2 mm. It is composed of spherical chambers, which are arranged glomerately around the axial spongocoel of at least 0.3 mm in diameter. The diameter of the chambers is about 1.0–1.6 mm. Chamber walls are only 0.04 mm thick and pierced by extremely fine pores of less than 0.01 mm.

Remarks: The very thin chamber walls and their extremely fine perforation, recognized in the investigated material, justifies the attribution of this sponge to *Annaecoelia* without questionmark as done by Senowbari-Daryan (2005a).

Occurrence and stratigraphical range: *A. parva* is known exclusively from the Norian-Rhaetian reefs embedded within the Nayband Formation in Iran.

Family Polytholosiidae Seilacher, 1962

Subfamily Polytholosiinae Senowbari-Daryan, 1990

Genus *Nevadathalamia* Senowbari-Daryan, 1990

Type species: *Polytholosia cylindrica* Seilacher, 1962.

Further species: *Nevadathalamia variabilis* Senowbari-Daryan 2005a; *N. ramosa* (Senowbari-Daryan & Reid 1987); and *N. waliabadensis* Senowbari-Daryan & Hamedani 1999.

Nevadathalamia variabilis Senowbari-Daryan, 2005a
(Pl. 4, Fig. A)

2005a *Nevadathalamia variabilis* nov. sp. – Senowbari-Daryan, p. 185; Pl. 10, Figs 1–6, 7?; Pl. 11, Figs 1–6; Pl. 28, Figs 12–14.

Material: One specimen (thin section K120).

Description: The only specimen of this sponge is cut in longitudinal section showing all characteristics of the sponge. Reaching a length of 60 mm with a diameter of 13 mm, it is composed of several ring-shaped chambers. Chamber height varies between 3 mm and 8 mm. Chamber walls are 1–2 mm thick and pierced by pores of 0.4 mm, which are partly branched to the outside of the chambers. Chamber interiors are filled with a tubular filling skeleton.

Occurrence and stratigraphic range: *N. variabilis* it known from several Norian-Rhaetian reef localities of the Nayband Formation in central and northeast Iran (Senowbari-Daryan 2005a). It is a rare sponge in the investigated section.

Nevadathalamia sp.

(Pl. 2, Fig. C)

Material: One (or tow?) specimen(s) (illustrated specimen in thin section K117).

Description: The only one (or two?) specimen(s) of this sponge is cut at the edge of the thin section. It is not clearly recognizable if it is a branched specimen or if two specimens are grown together. This sponge differs from the preceding one by the thin chamber walls and by the minor tubular filling skeleton within the chamber interiors.

Family Solenolmiidae Engeser, 1986

Genus *Welteria* Vinassa de Regny, 1915

Type species: *Welteria repleta* Vinassa de Regny, 1915.

Further species: *W. fluegeli* Senowbari-Daryan 1990; *W. rhaetica* Senowbari-Daryan 1990; *W.*? *hawasinensis* Weidlich & Seonwbari-Daryan 1996; and *W. hamedanii* Senowbari-Daryan 2005a.

Welteria hamedanii Senowbari-Daryan, 2005a

(Pl. 4, Fig. C: arrow; Pl. 10, Figs A, H)

2005a *Welteria hamedanii* nov. sp. – Senowbari-Daryan, p. 191–192; Pl. 13, Fig. 2C; Pl. 20, Figs 1–2, 4–5, 6?.

Material: At least three incomplete specimens (illustrated specimens in thin sections 4, 7, K28).

Description: Three incomplete sections of this sponge are available in the investigated thin sections. The most characteristic feature of this sponge is the labyrinthic canal system of the chamber walls. The ring-shaped chambers are arranged around the axial spongocoel of retrosiphonate type (Pl. 4, Fig. C: arrow). Chamber interiors contain a coarse and loose filling skeleton. A detailed description of the species is given in Senowbari-Daryan (2005a).

Occurrence and stratigraphic range: *Welteria hamedanii* is known only from the Norian-Rhaetian reefs embedded within the Nayband Formation of central and northeast Iran (Senowbari-Daryan 2005a).

Genus *Paradeningeria* Senowbari-Daryan & Schäfer, 1979

Type species: *Paradeningeria alpina* Senowbari-Daryan & Schäfer, 1979.

Further species: *Paradeningeria gruberensis* Senowbari-Daryan & Schäfer, 1979; *P. martaensis* Belyaeva (in Boiko et al., 1991); *P. weyli* Senowbari-Daryan & Schäfer, 1979; *P. minor* Senowbari-Daryan, 2005a.

Paradeningeria alpina Senowbari-Daryan & Schäfer, 1979
(Pl. 2, Figs D, G-H; Pl. 4, Fig. K; Pl. 9, Fig. G/2)

1979 *Paradeningeria alpina* n. g., n. sp. – Senowbari-Daryan & Schäfer, p. 22–24; Pl. 2, Figs 2, 4–5, 7; Pl. 4, Fig. 6; Pl. 5, Fig. 6.

Material: Several specimens (illustrated specimens in thin sections K1/1, K1/2, K14, K28, K106).

Description: Specimens of this sponge are composed of several globular to barral-shaped chambers with thick chamber walls. Chamber interiors communicate with the spongocoel by large openings. It commonly occurs in the Norian-Rhaetian reefs embedded within the Nayband Formation and was reported first by Senowbari-Daryan (2005a).

Occurrence and stratigraphic range: *P. alpina* in a cosmopolitan sponge and is known from several Norian-Rhaetian reefs in the Tethyan realm (see Senowbari-Daryan 2005a).

Genus *Deningeria* Wilckens, 1937

Type species: *Deningeria camerata* Wilckens, 1937.

Further species: See Senowbari-Daryan (2005a: 192).

Deningeria tabasensis Senowbari-Daryan, 2005a
(Pl. 9, Figs C, F)

2005a *Deningeria tabasensis* nov. sp. – Senowbari-Daryan, p. 192; Pl. 18, Figs 1, 4; Pl. 20, Fig. 3).

Material: At least three specimens (illeustrated specimens in thin section K28).

Description: Specimens of this sponge are composed of numerous funnel-shaped or square chambers arranged moniliforme one above another. Diameters of the sponge and of the chambers are about 4–5 mm. The chambers are usually wider than high. The chamber interiors contain a reticulate filling skeleton. The fibers of the filling skeleton are oriented mostly parallel to the sponge axis. The chamber roofs are usually thinner than the exowalls.

Fig. 2. Sections through two specimens of *Deningeria* cf. *D. tenuireticulata* SENOWBARI-DARYAN, ZÜHLKE, BECHSTÄDT & FLÜGEL, 1993. Chamber interiors are filled with a loose reticulate skeleton. Chamber walls are coarsely perforated (drawn from Pl. 8, Fig. D).

Occurrence and stratigraphic range: *D. tabasensis* was originally described from the Norian-Rhaetian reef complex embedded within the Nayband Formation near the town of Ali-Abad (northeast Iran). The Bagherabad section is the second locality, from where the herein described sponge derives from.

***Deningeria* cf. *D. tenuireticulata* SENOWBARI-DARYAN, ZÜHLKE, BECHSTÄDT & FLÜGEL, 1993**
(Fig. 2; Pl. 8, Fig. D)

1993 *Deningeria tenuireticulata* n. sp. – SENOWBARI-DARYAN, ZÜHLKE, BECHSTÄDT & FLÜGEL, p. 214; Pl. Fig. 43/7; Pl. 44, Figs 1–2, 7–8; Pl. 48, Figs 1–2.

Material: At least 2 specimens (illustrated specimen in thin section K105).

Description: The specimens of this sponge are composed of several chambers, arranged moniliforme one above another. The chambers are spherical to subspherical reaching diameters of about 4 mm. The chamber walls are approximately 0.1–0.3 mm thick and pierced by large openings. The chamber interiors contain a fine and loose reticulate filling skeleton (see Fig. 2).

Remarks: The asiphonate construction of this sponge and the reticulate filling skeleton within the chamber interiors allowed for the attribution of this sponge to *Deningeria*. The fine and loose character of the filling skeleton and the character of the chamber walls are similar to the sponge described as *Deningeria tenuireticulata* by SENOWBARI-DARYAN et al. (1993) from the Anisian reef boulders of the Dolomites, Italy. We are not sure about the identity of these sponges.

Genus *Panormida* Senowbari-Daryan, 1980

Type species: *Panormida priscae* Senowbari-Daryan, 1980.

Further species: *Panormida gautretae* Senowbari-Daryan 1990; *P. bisiphonata* Senowbari-Daryan 2009; *P. multisiphonata* Senowbari-Daryan 2009; and *P. unisiphonata* Senowbari-Daryan 2009.

Panormida bisiphonata Senowbari-Daryan, 2009
(Pl. 4, Figs F-G)

2009 *Panormida bisiphonata* nov. sp. – Senowbari-Daryan, p. 118–119; Pl. 5, Figs A-B, D, J; Pl. 6, Fig. G/1.

Material: Several specimens in thin section 3.

Description: Specimens of this sponge are composed of several triangular or barrel-shaped chambers arranged one above another. The largest specimen reaches a height of 32 mm and is composed of 9 chambers. Chamber heights usually amount to 5 mm, chamber diameters 4–5 mm, depending on the sponge diameter. The outer surface appears uneven, caused by the perforation of a labyrinthic canal system. Two (in some specimens three) spongocoels of 0.4–0.8 mm pass through the whole sponge.

Occurrence and stratigraphic range: *P. bisiphonata* was originally described from the Norian reef limestone of the Gosaukamm, Austria by Senowbari-Daryan (2009). This sponge was not found in other reef localities embedded within the Nayband Formation (Senowbari-Daryan 2005a) and is described here for the first time from Iran.

Genus *Senowbaridaryana* Engeser & Neumann, 1986

Type species: *Verticillites triassicus* Kovács, 1978.

Further species: *Senowbaridaryana conica* (Senowbari-Daryan & Schäfer, 1986); *S. gruberensis* (Senowbari-Daryan, 1978); *S. caucasica* (Moiseev, 1944); *S. hydriotica* Senowbari-Daryan, 1990; *S. raretrabeculata* (Boiko in Boiko et al., 1991); *S. rectangulata* Senowbari-Daryan. 2005a.

Senowbaridaryana raretrabeculata (Boiko) in Boiko et al., 1991
(Pl. 2, Figs A-B)

1991 *Polycystocoelia raretrabeculata* sp. nov. – Boiko (in Boiko et al.), p. 155; Pl. 46, Figs 1–2.
2005a *Senowbaridaryana raretrabeculata* (Boiko). – Senowbari-Daryan, p. 189–190; Pl. 14, Figs 1–4, 6.

Material: One specimen only (thin sections K1/1, K1/2).

Description: From the only specimen of this sponge two longitudinal sections were made. The sponge is composed of numerous crescent-shaped chambers with thin and

Fig. 3. *Tabasia minima* SENOWBARI-DARYAN, 2005a. The longitudinal section clearly shows the outer segmentation. Due to the numerous vertical tubes the internal chambered construction is not recognizable (drawn from Pl. 2, Fig. M).

perforated chamber walls. The internally chambered construction of the sponge is not recognizable from the outside, because the young chambers partly or totally overlap the old ones, responsible for the disappearance of the outer segmentation. The chamber interior contains a reticulate filling skeleton. An axial spongocoel passes vertically through the entire sponge. The sponge illustrated in Pl. 2, Fig. 1–2 is colonized by a bivalve, which interrupted the normally growth of the sponge. Afterwards the sponge branched by producing several tubes, visible at the left side of the photograph. The growth of the sponge ended by colonization of another sponge on the top (Pl. 2, Fig. B).

Occurrence: *S. raretrabeculata* is known from the Norian-Rhaetian reefs of Caucasia (BOIKO in BOIKO et al., 1991), and was found in several reef localities in Iran (see SENOWBARI-DARYAN 2005a). It is a rare sponge in the investigated section of the Nayband section.

Family Tabasiidae SENOWBARI-DARYAN, 2005a

Genus *Tabasia* SENOWBARI-DARYAN, 2005a

Type species: *Tabasia maxima* SENOWBARI-DARYAN, 2005a.

Further species: *Tabasia media* SENOWBARI-DARYAN, 2005a; *T. minima* SENOWBARI-DARYAN, 2005a; *T. gregaria* SENOWBARI-DARYAN, 2005a; and *T.*? *conica* SENOWBARI-DARYAN, 2005a.

Tabasia minima SENOWBARI-DARYAN, 2005a

(Fig. 3; Pl. 2, Fig. M; Pl. 12, Figs A–C)

2005a *Tabasia minima* nov. sp. – SENOWBARI-DARYAN, p. 197; Pl. 28, Figs 1–3, 4?, 5–9.

Material: Several isolated specimens in body preservation and at least one specimen in thin section K120b.

Description: In the only section the sponge specimen reaches a height of 17 mm and a diameter of 5 mm. The chambered construction of the sponge is well recognizable

Fig. 4. *Tabasia media* Senowbari-Daryan, 2005a. Longitudinal section through three chambers with indistinct vertically running tubes and reticulate filling skeleton within the chambers. The walls of old chambers are thickened (drawn from Pl. 9, Fig. D).

from the outside; this feature, however, is indistinct because of the numerous vertically running tubes. Chamber heights are smaller than chamber widths.

Several isolated specimens (Pl. 12, Figs A-C) exhibiting the outer view of this sponge. Like in the original material, the chambers are arranged oblique in some specimens (Pl. 12, Fig. B). For detailed description of the species see Senowbari-Daryan (2005a).

Occurrence and stratigraphic range: *Tabasia minima* is a common Norian-Rhaetian sponge in the bioconstructions within the Nayband Formation, particularly in the type locality near the town of Ali-Abad in the Shotori Mountains (see Senowbari-Daryan 2005a). It is also common in the investigated section. Several isolated specimens were available.

Tabasia media Senowbari-Daryan, 2005a

(Fig. 4; Pl. 9, Fig. D)

2005a *Tabasia media* nov. sp. – Senowbari-Daryan, p. 197; Pl. 23, Figs 1, 6; Pl. 24, Figs 1–2, 5–6; Pl. 26, Figs 1–5; Pl. 27, Figs 1–7; Pl. 30, Figs 6–7.

Material: Only one specimen in thin section K117.

Description: Specimens of this species reach a maximum diameter of 15 mm. A small specimen with a diameter of 5 mm is illustrated in Pl. 9, Fig. D and shows the vertically running tubes and the loose filling skeletal elements. Similar to *T. minima*, the chambers of this species are relatively high. A detailed description of the species is given by Senowbari-Daryan (2005a).

Occurrence and stratigraphic range: This species has the same areal distribution and age as the preceding species.

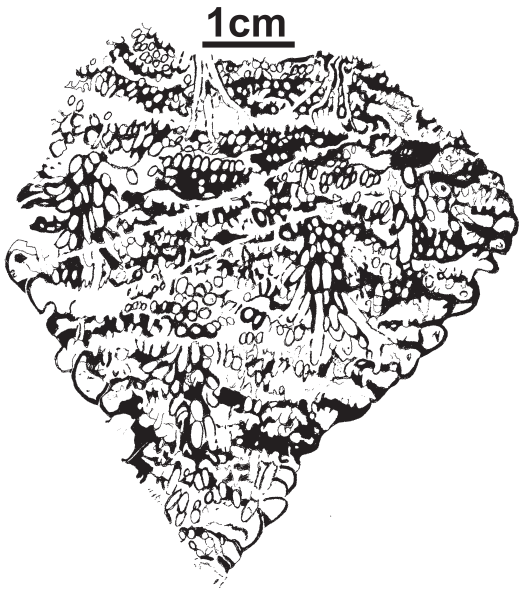

Fig. 5. *Tabasia maxima* SENOWBARI-DARYAN, 2005a. Longitudinal section through the holotype showing the indistinct internal segmentation, several tube bundles, and numerous individual tubes running vertically through the sponge (modified from SENOWBARI-DARYAN, 2005a: Fig. 16).

Tabasia maxima SENOWBARI-DARYAN, 2005a
(Fig. 5; Pl. 12, Figs D-H)

2005a *Tabasia maxima* nov. sp. – SENOWBARI-DARYAN, p. 196–197; Pl. 24, Fig. 4; Pl. 25, Fig. 5; Pl. 28, Figs 10–11; Text-fig. 16.

Material: Several isolated specimens in body preservation.

Description: Morphologically, this conical sponge is recognizable by numerous horizontal lines on the outer surface, corresponding partly to the indistinct internally chambered construction. The top of the sponge is characterized by several individual tips, which have coalesced laterally. Each tip is characterized by several circular openings that represent the exit of vertical tubes running through the sponges (Pl. 12, Fig. F). Fig. 5 shows the internal construction of the sponge. A detailed description of the sponge is given by SENOWBARI-DARYAN (2005a).

Genus *Musandamia* SENOWBARI-DARYAN & BERNECKER, 2010

Type species: *Musandamia omanica* SENOWBARI-DARYAN & BERNECKER, 2010

Further species: *Musandamia gosaukammensis* (= *Enoploecoelia*? *gosaukammensis* SENOWBARI-DARYAN, 1994)

Musandamia gosaukammensis (SENOWBARI-DARYAN, 1994)
(Pl. 1, Figs B: arrow, D, E-G)

1994 *Enoploecoelia*? *gosaukammensis* n. sp. – SENOWBARI-DARYAN, p. 670; Pl. 1, Figs 1–5.

Diagnosis: See SENOWBARI-DARYAN (1994: p. 670).

Material: Several specimens in thin sections 1/0/2, 1/1, K1/2, K117.

Fig. 6. *Naybandella prosiphonata* Senowbari-Daryan, 2005a. Sections through several specimens exhibiting the irregulary to glomerate arrangement of the chambers around the spongocoel. The large sieve-plates are covered with a thin and finely perforated dermal layer indicated with arrows (drawn from Pl. 3, Fig. A).

Description: This small thalamid sponge is composed of several ring-shaped and spherical chambers arranged around an axial spongocoel of ambisiphonate type. The diameter of the sponge in the Iranian material is almost constant around 1.8 mm. The diameter of the chambers corresponds with the diameter of the sponge; the chamber height varies between 0.6 mm and 1.0 mm. The spongocoel reaches diameters of 0.4–0.8 mm and is pierced by large openings of up to 0.3 mm in diameter. The chamber walls are 0.08–0.1 mm thick and pierced by small pores of 0.02 mm in diameter. The chamber roofs are thicker than the chamber exowalls. Typical of the species is the honeycomb-like outer surface appearing as grooves between spine-like elements in thin section. The distance between the "spines" amounts to about 0.2 mm.

Remarks: The size and the biometrical elements of the sponge in Iranian material are within the scope of the original material from the Norian reef limestones of the Gosaukamm (Austria), described by Senowbari-Daryan (1994). Originally this species was attributed with question-mark to the genus *Enoplocoelia*. The genus *Enoploecoelia*, however, is defined as aporate, whereas the character of the chamber walls (porate or aporate) was not recognizable in the original material. The specimens from Iran exhibit the porate nature of chamber walls. In this paper it is attributed to the new genus *Musandamia*, established by Senowbari-Daryan & Bernecker (2010) from the Upper Triassic (Norian) of Oman.

Family Thaumastocoeliidae Ott, 1967

Subfamily Enoplocoeliinae Senowbari-Daryan, 1990

Genus *Naybandella* Senowbari-Daryan, 2005a

Type species: *Naybandella prosiphonata* Senowbari-Daryan, 2005a.

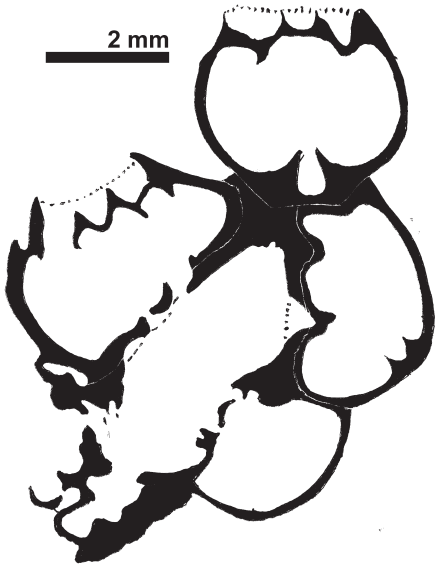

Fig. 7. *Naybandella prosiphonata* Senowbari-Daryan, 2005a. Oblique section through a specimen showing four chambers arranged around the spongocoel. The sieve-plates are covered with a thin and finely perforated dermal layer (drawn from Pl. 3, Fig. B).

Naybandella prosiphonata Senowbari-Daryan, 2005a

(Figs 6–7; Pl. 1, Figs C, I; Pl. 2, Fig. E; Pl. 3, Figs A-F)

2005a *Naybandella prosiphonata* nov. sp. – Senowbari-Daryan, p. 201; Pl. 9 Fig. 6; Pl. 22, Figs 1–6; Pl. 23, Fig. 4B; Text-fig. 22–23.

Material: Numerous specimens in thin sections 1/2, K14, K143.

Description: This sponge is very common, particularly in the lower part of the investigated section of the Nayband Formation. Numerous well preserved specimens exhibit more information about the sponge and allow for a detailed re-description. Some transversal sections (Pl. 2, Fig. E; Pl. 3, Fig. F) clearly exhibit the glomerate arrangement of the chambers around an axial spongocoel. The chamber arrangement was described as catenulate in the original description. In longitudinal sections, however, the chamber arrangement is not always recognizable (Pl. 1, Fig. C; Pl. 3, Figs A-C, E). Furthermore, the exo- and endowalls of the sponge are pierced by openings, which are combined to groups (sieve-like) forming a major, large opening or the sieve plate. The diameter of the individual openings ranges from 0.3 mm up to 1 mm, while the diameter of the sieve plates reaches up to 4 mm. The number of openings in a sieve plate recognized in the sections amounts to 4 (Pl. 3, Fig. D). The sieve plates are covered by a thin and finely perforated cortex (Pl. 3, Figs B, C: white arrows, Text-Figs. 6–7). Because of the poor preservation, the thin cortex was not clearly observed in the original description. A spongocoel of prosiphonate type passes through the entire of the sponge. The chamber interiors lack any secondary skeleton and vesiculae.

Occurrence and stratigraphic range: *N. prosiphonata* is known only from the Norian-Rhaetian reefs embedded within the Nayband Formation in Iran.

Order Hadromerida Topsent, 1898

Familiy Alpinothalamiidae Senowbari-Daryan, 1990

Remarks: Finks & Rigby (2004: 725) combined several sphinctozoan families including the Alpinothalamiidae Senowbari-Daryan (1990), Pisothalamiidae Senowbari-

Daryan & Rigby (1988) and part of the Annaecoeliidae Senowbari-Daryan (1978) to the Celyphiidae de Laubenfels (1955). In their emended diagnosis of the Celyphiidae they also combined different genera of a magnesium calcitic and aragonitic skeletal mineralogy, of different microstructure and of different spicules, if the latter were found in some genera. The genus *Uvanella* Ott e. g. has magnesium calcitic mineralogy and a microgranular microstructure, while *Celyphia* possesses an aragonitic skeleton with a lamellar microstructure (Senowbari-Daryan 1989, 1990, 1991; Reitner 1992: Pl. 11, Figs 1–4, non Pl. 10). Monaxone spicules as found in *Celyphia* were never recognized in *Alpinothalamia*, the type genus of Alpinothalamiidae. These differences, especially the different skeletal mineralogy, justify the separation of these sponge families and genera. Alpinothalamiidae was proposed for sponge genera with magnesium calcitic skeleton by Senowbari-Daryan (1990).

Genus *Uvanella* Ott, 1967

Type species: *Uvanella irregularis* Ott, 1967.

Further species: See Senowbari-Daryan & Garcia-Bellido (2002).

***Uvanella norica* (Senowbari-Daryan & Schäfer, 1978)**
(Pl. 2, Fig. E: arrows; Pl. 8, Fig. B)

1978 *Follicatena irregularis* n. sp. – Senowbari-Daryan & Schäfer, p. 315; Figs 1–10.
1990 *Uvanella norica* (= *Follicatena irregularis* Senowbari-Daryan & Schäfer). – Senowbari-Daryan, p. 142; Pl. 31, Fig. 1. [cum syn.]
2009 *Uvanella norica* (Senowbari-Daryan & Schäfer). – Senowbari-Daryan, p. 121–122; Pl. 7, Figs A-C; Pl. 8, Fig. E; Pl. 13, Fig. A/1. [cum syn.]

Material: Several specimens (illustrated specimens in in thin section 1/2).

Description: The irregular aggregates of this sponge are composed of irregular chambers of various sizes. The chamber walls appear dark micritic in transmitted light and are pierced by large openings. Abundant vesiculae occur within the chamber interiors. This sponge is a secondary reef builder growing on and between the reef builders and stabilizing the reef framework.

Occurrence and stratigraphic range: *U. norica* is known from numerous Norian-Rhaetian reef localities, especially in the northwestern Tethys. This sponge is not very common in bioconstructions embedded within the Nayband Formation in Iran.

"Sphinctozoa" gen. et sp. indet 1
(Fig. 8; Pl. 1, Fig. K)

Material: One specimen in thin section 7.

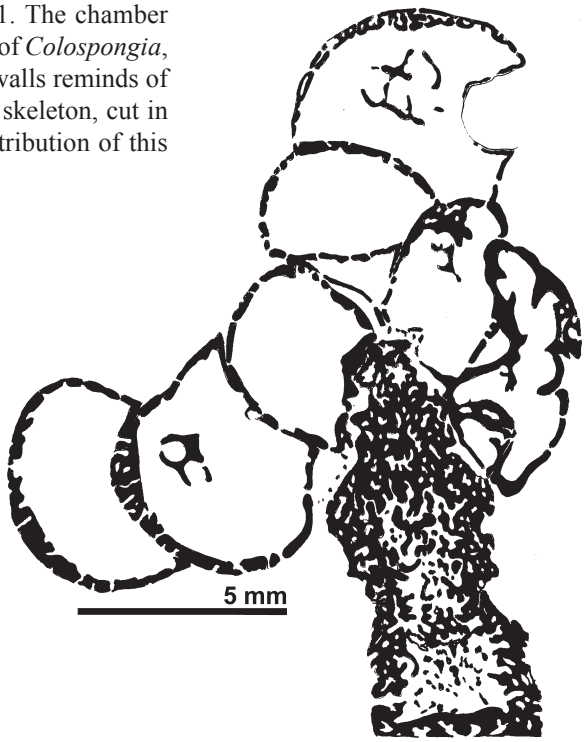

Fig. 8. "Sphinctozoa" gen. et sp. indet 1. The chamber shapes of this sponge are similar to those of *Colospongia*, but the labyrinthic canals system of the walls reminds of *Kashanella*. The possibly tubular filling skeleton, cut in two chambers, does not allow for the attribution of this sponge to the mentioned genera.

Description:
This *Colospongia*-like sponge has grown on other sponges and is composed of at least 6 spherical chambers. The diameter of the largest chamber is about 6 mm. The chamber walls are 0.2–0.7 mm thick and pierced by unevenly distributed single pores or even labyrinthic pore system. The walls between two chambers are partly doubled. In three chambers the tube-like filling skeleton is visible. Fig. 8 shows the perforation pattern of the chamber walls and the tube-like skeletal elements within two chambers.

Remarks: The chamber shapes of this sponge are similar to those of *Colospongia*, but the labyrinthic canal system of the walls resembles that of *Kashanella*. The possibly tubular filling skeleton recognized within some chambers does not allow the attribution of this specimen to one of the both mentioned genera or to only other known sponge genera.

"Sphinctozoa" gen. et sp. indet 2
(Pl. 2, Fig. F; Pl. 11, Fig. D).

Material: Two specimens in thin section 3.

Description: The chambers of this sponge show varying thicknesses of the walls. The exowalls may be thickened and "spongy" in appearance. The most characteristic feature of this sponge is the presence of star-like elements secreted in the interwalls and within the chamber interiors.

Order Inozoida Rigby & Senowbari-Daryan, 1996

Family Auriculospongiidae Termier & Teremier (in Termier et al.), 1977

Subfamily Auriculospongiinae Rigby & Senowbari-Daryan, 1996

Genus *Molengraaffia* Vinassa de Regny, 1915

Type species: *Molengraaffia regularis* Vinassa de Regny, 1915.

Molengraaffia regularis Vinassa de Regny, 1915
(Pl. 8, Fig. A/1)

1915 *Molengraaffia regularis* n. g. n. f. – Vinassa de Regny, p. 80; p. 64 (2), Figs 1–3.
2009 *Molengraaffia regularis* Vinassa de Regny. – Senowbari-Daryan, p. 122; Pl. 10, Figs B-D. [cum syn.]

Material: Two specimens (illustrated specimen is thin section K29.

Description: The size of this conical to sheet-like sponge is variable. The sponge is without distinct inhalant and exhalant canals. The circulating water passes through the space of the fiber skeleton. In longitudinal sections the fiber skeleton shows a linear arrangement with indistinct concentric lines (Pl. 8, Fig. A/1), while in cross sections, the skeleton has a reticulate appearance.

Occurrence and stratigraphic range: *M. regularis* is known from the Norian-Rhaetian of Karakorum and Bakony (Vinassa de Regny 1915, 1932), Caucasia (Moissev, 1944), Iran (Senowbari-Daryan 2005b; this paper), Northern Calcareous Alps, Austria (e.g. Gosaukamm reef, Senowbari-Daryan 2009), and from Greece (unpublished material of BSD).

Genus *Anguispongia* Senowbari-Daryan, 2005b

Type species: *Anguispongia parva* Senowbari-Daryan, 2005b.

Further species: *Anguispongia magna* Senowbari-Daryan 2005b; and *A. alpina* Senowbari-Daryan 2009.

Anguispongia parva Senowbari-Daryan, 2005b
(Pl. 6, Figs H-I/1)

2005b *Anguispongia parva* nov. sp. – Senowbari-Daryan, p. 266–267; Pl. 2, Figs 1–6; Pl. 3, figs.1–3; Text-fig. 6.

Material: Two species (illustrated specimen in thin section K105.

Description: The sheet-like sponge lacks any additional inhalant and exhalant canals. Circulating water passes through the space of the fiber skeleton. The thickness of the sheets measures up to 10 mm. Depending on the section, the fiber skeleton appears reticulate (Pl. 6, Fig. I/1) or shows a linear arrangement (Pl. 6, Fig. H). A detailed description of the species is given by Senowbari-Daryan (2005b).

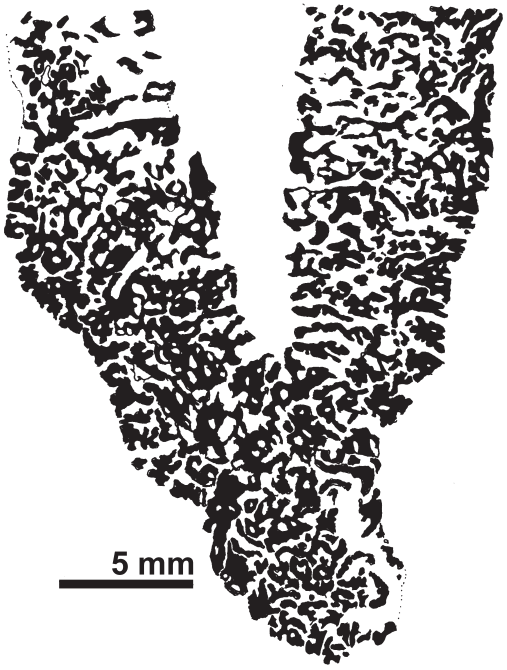

Fig. 9. *Permocorynella* cf. *P. maxima* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997. The longitudinal section shows the reticulate fiber skeleton of the wall and a few inhalant and exhalant canals within the wall (drawn from Pl. 6, Fig. C).

Occurrence and stratigraphic range: *A. parva* is known exclusively from the Norian-Rhaetian reefs embedded within the Nayband Formation in Iran.

Family Preperonidellidae Finks & Rigby, 2004

Subfamily Permocorynellinae Rigby & Senowbari-Daryan, 1996

Genus *Permocorynella* Rigby & Senowbari-Daryan, 1996

Type species: *Corynella ovoidalis* Parona, 1933.

***Permocorynella maxima* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997**
(Pl. 5, Figs A-C, E)

1982 *Corynella* sp. – Wurm, p. 217; Pl. 35, Fig. 1.
1997 *Permocorynella maxima* Senowbari-Daryan, Seyed-Emami & Aghanabati. – p. 302; Pl. 3, Figs 1–8; Pl. 6, Fig. 5; Pl. 7, Figs 1–3, 6; Text-fig. 7.
2009 *Permocorynella maxima* Senowbari-Daryan, Seyed-Emami & Aghanabati. – Senowbari-Daryan, p. 125; Pl. 9, Fig. E; Pl. 12, Figs D-E; Pl. 17, Fig. A/1.

Material: Several specimens (illustrated specimens in thin sections 15, K10, K16).

Description: Specimens of this dichotomously branched, cylindrical to conical sponge reach diameters between 15 mm and 30 mm (in the original description diameters of sponge were given with up to 60 mm, most of them 30–40 mm). The sponge is

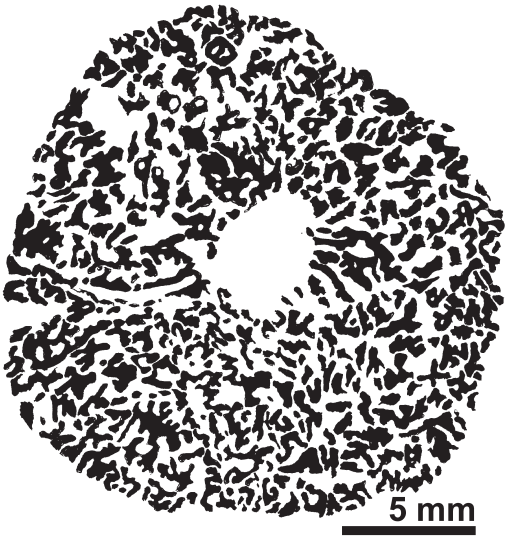

Fig. 10. *Permocorynella* cf. *P. maxima* Senowbari-Daryan et al., 1997. Cross section of the same specimen as Fig. 9. The section shows only one exhalant canal (drawn from Pl. 6, Fig. D).

characterized by a thick wall, which is pierced by two types of canals: inhalant canals running from the sponge surface into the sponge wall and exhalant canals reaching from the sponge wall into the spongocoel. The diameter of inhalant and exhalant canals varies between 0.4 mm and 0.6 mm. Both canal types exhibit a distinct wall, pierced by small pores of about 0.1 mm in diameter. Canals maybe branched to the periphery of the sponge (Pl. 5, Fig. E). The sponge wall between the inhalant and exhalant canals is filled by the reticulate fiber skeleton. A spongocoel of different diameter (depending from the sponge diameter) passes through the entire sponge.

Occurrence and stratigraphic range: *Permocorynella maxima* is known from the Upper Triassic (Norian-Rhaetian) reefs within the Nayband Formation in Iran (Senowbari-Daryan et al. 1997) and from the Gosaukamm reef in Austria (Wurm, 1982: described as *Corynella* sp., Senowbari-Daryan 2009).

Permocorynella cf. ***P. maxima*** **Senowbari-Daryan, Seyed-Emami & Aghanabai, 1997**

(Figs 9–10; Pl. 6, Figs C-E; Pl. 9, Fig. B)

Material: Three specimens in thin sections 108, 108/l, 108/q, K11.

Description: The lengths of this conical sponge is distinctly shorter than that of *Permocorynella maxima*, but its diameter (15 mm and less) is in scope of some small specimens of *P. maxima*. The inhalant and exhalant canals are not well developed in this species, and the fiber skeleton of the sponge wall is some what different from *P. maxima*. Both species can not be identified with certainly.

Subfamily Heptatubispongiidae Rigby & Senowbari-Daryan, 1996

Genus *Marawandia* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997

Type species: *Marawandia iranica* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997.

Marawandia iranica Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997.
(Pl. 6, Figs F-G, I/2)

1997 *Marawandia iranica* Senowbari-Daryan, Seyed-Emami & Aghanabati, p. 314; Pl. 5, Figs 1–7; Pl. 6, Figs 1–4, 7; Pl. 7, Figs 5–7.

Material: Several specimens (illustrated specimens in thin sections 105, 117).

Description: *Marawandia iranica* is a cylindrical and branching inozoan sponge characterized by several (up to 10) exhalant canals which pass through the entire sponge. The canals are internally distributed (usually not symmetrically) within the whole sponge. The canals are pierced by openings leading to the spaces between the reticulate skeletal fibers. The diameter of the canals varies between 0.3 mm and 0.8 mm. A detailed description of the species is given by Senowbari-Daryan et al. (1997).

Occurrence and stratigraphical range: *M. iranica* is known from several localities of the Norian-Rhaetian reefs within the Nayband Formation in central and northeast Iran (see Senowbari-Daryan et al., 1997).

Family Sestrostomellidae de Laubenfels, 1955

Genus *Sestrotomella* Zittel, 1878

Type species: *Sestrostomella robusta* Zittel, 1878.

Sestrostomella robusta Zittel, 1878
(Pl. 7, Fig. D)

1878 *Sestrostomella robusta*. – Zittel, p. 41.
1997 ?*Sestrostomella robusta* Zittel. – Senowbari-Daryan, Seyed Emami & Aghanabati, p. 310; Pl. 4, Figs 1–7; Pl. 6, Fig. 6; Pl. 8, Fig. 6. [cum syn.]
2009 *Sestrostomella robusta* Zittel. – Senowbari-Daryan, p. 126; Pl. 9, Fig. B.

Material: Two specimens (illustrated specimen in thin section K26).

Description: Two specimens of this sponge are illustrated in Pl. 7, Fig. D. One of them is cut in cross section, being 8 mm in diameter, while the other one which has grown on this specimen is cut in oblique section.

The single or branched and cylindrical specimens of this sponge are characterized by a bundle of axial tubes serving as spongocoel. The diameter of a tube bundle is about ½ of the sponge diameter, and the individual tubes measure about 0.4 mm in diameter. Inhalant and exhalant canals are well developed, but they are not cut in cross section in one illustrated specimen. Some of them, however, are cut in the second specimen. The sponge wall between the inhalant and exhalant canals is composed of a reticulate fiber skeleton. Spicules were not observed in the investigated material, but according to Reitner (1992)

Sestrostomella possesses diactine spicules, indicating the relationship of *Sestrostomella* to the haplosclerid sponge family Oceanapiidae.

Remarks: For discussion of the systematic position of *Sestrostomella* and differences between *Sestrostomella* and similar inozoid sponges in the Triassic see Senowbari-Daryan et al. (1997).

Occurrence and stratigraphic range: The genus *Sestrostomella* is reported from Middle and Upper Triassic (Ladinian-Norian) and from Jurassic-Cretaceous deposits. *S. robusta* is known from Upper Ladinian to Norian deposits of the northern and southern Alps, Carpathians, and Iran (see Riedel & Senowbari-Daryan 1991; Senowbari-Daryan et al. 1997).

Genus *Peronidella* Hinde, 1893
(= *Peronella* Zittel, 1978)

Type species: *Spongia pistilliformis* Lamouroux, 1821.

***Peronidella norica* (Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997)**
(Pl. 5, Fig. D)

1997 *Radiofibra norica* n. sp. – Senowbari-Daryan, Seyed-Emami & Aghanabati, p. 299; Pl. 1, Figs 1–7; Pl. 2, Figs 1–6.
2009 *Peronidella norica* (Senowbari-Daryan, Seyed-Emami & Aghanabati). – Senowbari-Daryan, p. 124; Pl. 11, Figs A, C-D, G-H. [cum syn.]

Material: Two specimens in thin section K12.

Description: Both illustrated specimens of *Peronidella norica* in Pl. 5, Fig. D reach diameters of about 30 mm. The thick sponge wall is composed of a reticulate fiber skeleton with a radial orientation in cross section or water-jet-like in longitudinal to oblique sections. An axial spongocoel of about 5 mm in both specimens is some what smaller than in material collected e. g. from the Gosaukamm in Austria (Senowbari-Daryan 2009), but it is identical with the original material from Iran (Senowbari-Daryan et al. 1997).

Remarks: The dimensions of *Peronidella norica* are similar or almost identical with dimensions of some specimens of *Permocorynella maxima*, occurring together in Norian-Rhaetian reefs. *P. norica* (Pl. 5, Fig. D) differs from *P. maxima* (see Pl. 5, Fig. A-C, E) by the lack of inhalant and exhalant canals in the sponge wall.

Occurrence and stratigraphical range: *Peronidella norica* is known from the Norian-Rhaetian reefs embedded within the Nayband Formation (Senowbari-Daryan et al. 1997; this paper) and from the time equivalent Gosaukamm reef in Austria (Senowbari-Daryan 2009).

Peronidella pilleri nov. spec.
(Pl. 6, Figs A-B; Pl. 11, Figs A-C)

Derivatio nominis: The name of this species is dedicated to Prof. Dr. W. Piller (Graz) for his contribution to the palaeontological science.

Holotype: As holotype the specimen illustrated in Pl. 11, Fig. A is designated (thin section 3).

Paratypes: All specimens illustrated in Pl. 6, Figs A-B, Pl. 11, Figs B-C.

Locus typicus: Section of Nayband Formation, located south of the small town of Bagherabad (N: 32°56´35.4, E: 51°56´ 04.7´´, see Fig. 1).

Stratum typicum: Upper Triassic Nayband Formation (most probably Rhaetian).

Diagnosis: Single and small specimen of the genus *Peronidella* with coarse fiber skeleton. Without inhalant and exhalant canals. A large opening may occur between the sponge wall and the spongocoel.

Material: Several specimens in thin section 3.

Description: The single specimens of this sponge reach diameters between 3 mm and 5 mm. The thick sponge wall is composed of a coarse reticulate fiber skeleton without inhalant and exhalant canals. Circulating water passes through the open spaces of the fiber skeleton. Thickness of the fiber skeleton is about 0.1–0.16 mm. An axial spongocoel of about 0.6–1.1 mm passes through the sponge. The spongocoel reaches a diameter of about 1.8 mm, in the largest specimen with a diameter of 5.5 mm (illustrated in Pl. 11, Fig. C).

The holotype (Pl. 11, Fig. 1) is cut in longitudinal section reaching a length of 6.5 mm and a diameter of 3 mm. An axial spongocoel of 0.6 mm is cut marginally.

Remarks: All Triassic species of *Peronidella* are listed in Senowbari-Daryan (2003; see also Senowbari-Daryan 2009). Two species of *Peronidella* are known from the Norian-Rhaetian reefs within the Nayband Formation: *P. norica* (see above) and *P. iranica* Senowbari-Daryan (2003). According to the sponge diameter both species are larger than *P. pilleri* nov. spec. In addition *P. iranica* is, in contrast to *P. pilleri*, a multibranched species. A further difference between *P. iranica* and *P. pilleri* is the distinct wall of the spongocoel in *P. iranica*.

The diameter of *P. pilleri* is similar to that of *P. subcaespitosa* (Münster, 1841; described as *Scyphia subcaespitosa* from the Carnian of Cassian Formation, Italy), but *P. subcaspitosa* is also a multibranched sponge. Furthermore, the fiber skeleton of *P. subccaespitosa* is finer than that of *P. pilleri*.

***Peronidella*? sp.**
(Pl. 8, Fig. A/2)

Material: One specimen only (thin section K29).

Description: This cylindrical sponge of 12 mm in diameter is composed of fine reticulate skeletal fibers. The sponge shows several circular openings (spongocoels?) of 1.5 mm in diameter. The interpretations of these openings as spongocoels or borings are uncertain. The thin walls around the openings, however, support their canal interpretation and thus the possible attribution of this sponge to the genus *Peronidella*.

Class Demospongea? Sollas, 1875

Order Spongiomorphida Alloiteau, 1952

Family Spongiomorphidae Frech, 1890

Remarks: Frech (1890: p. 68) established the family Spongiomorphidae with following original diagnosis: "Das Skelett der massigen Stöcke besteht aus kräftigen Trabekeln (Primärdornen) mit wohl entwickelten Horizontalleisten (Pseudosynapthikeln Pratz), welche sich mit einander verbinden und zuweilen besser ausgebildet sind als die verticalen Elemente. Jeder Trabekel besteht aus einem feinen Primärdorn, der von strahlig angeordnetem Stereoplasma umgeben wird. Eigentliche als Längsscheidewände entwickelte Septen fehlen; zuweilen sind sechs Primärdornen in Form eines Sternes mit einem siebenten Dorn als Columella angeordnet, ohne das jedoch diese Kelche irgendwelche Abgrenzung gegen das Coenoenchyn erkennen liessen, zuweilen fehlt jede Spur von radiärer Anordnung. Die Entwicklung der Dissepimentblasen steht in umgekehrtem Verhältnis zu der der Horizontalleisten. Bei *Spongiomorpha* und *Stromatomorpha* sind die Blasen wohl entwickelt, bei *Heptastylis*, wo die Leisten förmliche Horizontalschicthen darstellen, fehlen die ersteren."

The following genera were attributed to the Spongiomorphidae by Frech (1890): *Spongiomorpha* – with two subgenera *Heptastylopsis* and *Heptastylis* – and *Stromatomorpha*. The spongiomorphids were attributed to corals by Frech and by some later authors (e. g. Yabe & Sugiyama 1931), hydrozoans (Flügel 1969, 1975; Boiko 1972; 1979) or sponges (e. g. *Stromatomorpha*; see Senowbari-Daryan & Stanley 2009). Recently some Jurassic Spongiomorphids (e. g. *Spongiomorpha crassa* LeMaitre 1935, *Heptastylopsis asiatica* LeMaitre 1935, *Spongiomorpha globosa* Flügel & Hötzl 1966) were classified as corals (family Microsolenidae) by Roniewicz (in press).

In Norian-Rhaetian reefs, especially in bioconstructions within the Nayband Formation in Iran two morphological types of "spongiomorphids" occur:

a) Dendroid and multibranched stems of more than 1 meter in height and diameter. Individual branches of such dendroid spongiomorphids reach diameters of up to 50 mm. Such spongiomorphids were not found in the investigated section of the Nayband

Formation. They are however, extremelly abundant (Pl. 13, Fig. C) in the "salt spring" locality of Kristan-Tollmann et al. (1980), located south of Bagherabad (N: 33° 04´ 22´´, E: 52° 01´4´´).

b) Sheet-like laminated spongiomorphids are locally very abundant in the Nayband Formation, north of the Kuh-e Naybandan (near the town of Ali-Abad: see Senowbari-Daryan 2005a) and also in the investigated section. Such fossils were described as *Lamellata* by Flügel & Sy (1959) from the Upper Rhaetian reefs of Northern Calcareous Alps or as *Spongiomorpha* sp. by Senowbari-Daryan & Maurer (2008) from the Norian Musandam Peninsula of United Arab Eimirates and Oman. Laminated spongiomorphids of the bioconstructions within the Nayband Formation in Iran seem to be different from *Lamellata* Flügel & Sy. Here we document two field photographs of morphologically laminated and dendroid spongiomorphids (in Pl. 13, Figs B-C) and some thin section photographs in Pl. 7, Figs A-C and Pl. 11, Figs E. Skeletal elements of the specimen illustrated in Pl. 7, Figs B-C is similar to the inozoan sponge which is above described as *Molengraaffia regularis* Vinassa de Regny (see Pl. 8, Fig. A/1). Similar or identical thin section photographs were illustrated as *Spongiomorpha ampluramosa* by Boiko (1972: p. 163, Pl. 3, same photographs are also illustrated by Boiko 1979: Pl. 5).

As shown by Senowbari-Daryan & Stanley (2009) *Stromatomorpha* Frech is definitely a demospongid sponge. Most probably all other genera described by Frech (1890) represent also demospongid sponges. Detailed investigations of Upper Triassic spongiomorphids, based on well preserved material, are urgently needed.

Class Demospongea Sollas, 1875

Order Chaetetida Okulitch, 1936

Family Chaetetidae Milne-Edwards & Haime, 1850

Remarks: Chaetetids are an abundant fossil group of sponges, characterized by a rigid skeleton composed of tubes. The skeletal mineralogy of most specimens is aragonite, while some of them are calcite. Numerous taxa were described from Paleozoic and Mesozoic deposits. Fossil chaetetids are very abundant in the Carboniferous and Permian time interval. From the Triassic about 10 genera (about 30 species) are described, including *Aculeachaetetes* Boiko (1979), *Antalyopsis* Cuif (1983), *Artrochaetetes* Cuif & Fischer (1974), *Bauneia* Peterhans (1927), *Blastochaetetes* Dietrich (1919), *Chaetetes* Fischer de Waldheim (1829), *Levcenipora* Giattini (1902), *Pamirochaetetes* Boiko 1979, *Pseudoseptifer* Fischer (1970), and *Ptychochaetetes* Koechlin (1947). Descussion about the Triassic chaetetids is given by Senowbari-Daryan & Maurer (2008). Living chaetetids are represented only by few genera, such as *Acanthochaetetes* or *Merlia*.

The classification of chaetetids is based on the presence of spicules, type and arrangement of spicules (if present), mineralogy and microstructure of the rigid skeleton, and on the biometrical data of the internal structures (Fischer 1970; West 1989, 1994; Wood 1991). Because of the common recrystallization, the skeletal mineralogy and microstructure are

not useful for classification of the chaetetids in the investigated limestones. Here they are described informally as gen. et sp. indet 1–5.

Chaetetid sponge gen. et sp. indet 1
(Pl. 7, Figs E-F; Pl. 10, Figs B, E)

Material: Several specimens (illustrated specimens in thin sections K35, K117).

Description: The cylindrical and rod-like specimens of this species reach lengths of up to 50 mm with diameters of 5–6 mm. Characteristic feature of this species are the tubes running parallel to the axis of the rods in the axial region, whereas at the periphery they are oriented nearly vertically to the axis of the rod. The tubes are polygonal to irregular in cross section. The diameter of the tubes amounts to about 0.2 mm, while the thickness of the tube walls is about 0.06–0.12 mm. In one specimen a budding, oriented perpendicular to the main stem occurs. The top of most specimens is colonized by solenoporacean red algae. For biometrical data of the species see Table 1.

Chaetetid sponge gen. et sp. indet 2
(Pl. 8, Fig. C)

Material: Several specimens (illustrated specimens in thin section K15).

Description: clyindrical to rod-like specimens of this species reach diameters of about 10 mm. The stems are composed of numerous tubes running divergently (water-jet-like) from the axis to the periphery. At the periphery the tubes are oriented obliquely to the axis. In cross section the tubes are circular with a diameter of 0.2–0.3 mm. The tube walls are 0.04–0.12 mm thick. The specimens clearly show that new tubes develop by splitting of the tube walls. For biometrical data see Table 1.

Chaetetid sponge gen. et sp. indet 3
(Pl. 9, Fig. E)

Material: At least one specimen in thin section K32.

Description: The spherical specimen of this species reaches a diameter of more than 30 mm. The tubes are circular and distinctly larger, measuring up to 0.5 mm in diameter. The tube walls are 0.04–0.3 thick. For biometrical data see Table 1.

Chaetetid sponge gen. et sp. indet 4
(Plate 10, Figs D?, G)

Material: At least 2 specimens in thin sections 1/2, K14.

Table 1. Biometrical data of chaetetid sponges found in thin sections of the investigated limestones. DS) Diameter of the stems, DT) Diameter of the tubes, ST) Shape of the tubes in cross section, TTW) Thickness of the tube walls, T) Tabulae-like elements within the tubes. All measurements are in mm, +) present, -) absent.

Chaetetid	Shape	DS	DT	ST	TTW	T
Gen. et sp. indet 1	Cylindrical	5-6	0.2	polyg.-irreg.	0.06-0.12	-
Gen. et sp. indet 2	cylindrical	10	0.2-0.3	Circular	0.04-0.12	-
Gen. et sp. indet 3	Sphaerical	30	0.5	Circular	0.03-0.3	?
Gen. et sp. indet 4	cylindrical	10	0.2-0.4	circular-oval	0.1	+
Gen. et sp. indet 5	cylindircal	2.5	0.2	circular-oval	0.05-0.1	-

Description: Specimens of this cylindrical species show diameters of up to 10 mm. The tubes measure 0.2–0.4 mm in diameter and are arranged water-jet-like, diverging from the center to the periphery of the stems. The tubes are circular to oval in cross section. Tabulae-like elements occur within the tubes. For biometrical data see Table 1.

Chaetetid sponge gen. et sp. indet 5
(Plate 10, Fig. C)

Material: At least three species (illustrated specimen in thin section 1/1).

Description: The specimens of this cylindrical species are dichotomously branched. Individual branches reach diameters of 2.5 mm. The branches are composed of tubes running almost parallel to the axis of the branches. The tubes are about 0.2 mm in diameter and circular to oval in cross sections. For biometrical data see Table 1.

Hexactinellids

In contrast to the occurrence of hexactinellid sponges in Carnian reefs in eastern Tethys (WU 1989a, 1989b; WU & XIAO 1989; RIGBY et al. 1998), this group of sponges are not known from the Norian-Rhaetian reefs in the northwestern Tethys (Alps and adjacent areas), but occur rarely in the time-equivalent reefs in the central and northern Tethys. They are described from Caucasia by BOIKO (1990) and from Iran by SENOWBARI-DARYAN & HAMEDANI (1999).

In the investigated limestones only two specimen of undetermined hexactinellid sponges with more or less complete lattice were found (Pl. 8, Fig. E). Isolated spicules, however, occurs in some thin sections.

Discussion

Hypercalcified sponges including "Sphinctozoans", "Inozoans", some "Chaetetids" and "Spongiomorphids" are described from a section in the upper part (most probably Rhaetian) of the Nayband Formation, exposed south of the small town Bagherabad, north-

east of Esfahan. The majority of the sponge fauna corresponds to those taxa known from other localities of the Nayband Formation. *Iranothalamia incrustans* (Boiko), an abundant chambered sponge occurring in almost all other localities of Nayband Formation, was not found in investigated material of this section. *Nevadathalamis variabilis* Senowbari-Daryan, another abundant chambered sponge in Nayband Formation is very rare in the investigated section. In addition, some other chambered sponges occurring in the reefs of Nayband Formation were not found in the investigated section.

Among the Inozoans the abundant species *Grossotubenella variabilis* which commonly occurs in the reefs of Nayband Formation in Iran and in Norian reef Gosaukamm (Senowbari-Daryan 2009) as well as some others (compare Senowbari-Daryan 2005b) are missing in the material of the investigated section.

The absence of the mentioned sphinctozoan and inozoans sponges may indicate that the taxa missing in investigated section are limited to the Norian part of the Nayband Formation and do not occur in Rhaetian part.

In general, the sponge taxa in the investigated thin section are smaller than in other localities of the Nayband Formation. This section of the Nayband Formation differs from other sections in central and northeast Iran by the common occurrence of solenopracean red algae (Senowbari-Daryan et al. 2008) as reef builders in the upper part of the section and the foraminiferal association in the investigated section (Senowbari-Daryan & Rashidi 2010).

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References

Alloiteau, J. (1952): Classe des Hydrozooaires. – In: Piveteau, J. (ed.). – Traité de Paléontologie, **1**: 377–398.

Boiko, E.V. (1972): Pozdentriasovye spongiomorfidy (Hydrozoa) yugovostochnogo pamira. – Paleontology Zhurnal, **1972**/2: 20–25.

—— (1979): Pozdnetriqasovie Hydrozoa Jugo-Vostocuogo Pamira. – 113 p., Dushanbe (Donit).

—— (1990): Miogoobrazie skeletiij structur u camjeriij gubok. Iscopaemie problematiki SSSR (On the diversity of skeletal structure of Porifera Camerata. Problematic fossils of SSSR). – Academie Nauk SSSR. Siberische Abteilung, Institute Geology Geophysic Trudy, **783**/60: 119–129.

——, Belyaeva, G.V. & Zhuravleva, I.T. (1991): Phanerozoic sphinctozoans from the Territory of the USSR. – pp. 1–233, Nauka Acadey Scinces USSR, Siberian Department, Institute of Geology and Geophyscs, Academy Sciences Tajikistan, USSR, Institut Tajikistan. [Russian]

Cuif, J.P. (1983): Chaetetida à microstructure sphérolitique dans le Trias supérieur de Turquie. – Comptes Rendus, Academie Sciences Paris, **296**/11: 1469–1472.

—— & Fischer, J.C. (1974): Étude systématique sur les Chaetetida du Trias de Turquie. – Annales de Paléontologie des Invertébrés, **60**/1: 1–14.

Dietrich, W.O. (1919): Über sogenannte Tabulaten des Jura und der Kreide, insbesondere die Gattung Acantharia Qu. – Zentralblatt für Mineralogie, Geologie und Paläontologie 1919, p. 208–218.

Dullo, W.-C. & Lein, R. (1980): Das Karn von Launsdorf in Kärnten: Die Schwammfauna der Leckkogelschichten. – Verhandlungen der geologischen Bundesanstalt Wien, **1980**/2: 25–61.

Engeser, T. (1986): Nomenklatorische Notiz zur Gattung *Dictyocoelia* Ott, 1967 („Sphinctozoa", Porifera). – Neues Jahrbuch für Geologie und Paläontologie, Monatshefte, **1986**/10: 587–590.

—— & Neumann, H.H. (1986): Ein neuer verticillitider Sphinctozoe (Demospongiae, Porifera) aus dem Campan der Krappfeld-Gosau (Kärnten, Österreich). – Mitteilungen des geologisch-paläontologischen Instituts, Universität Hamburg, **61**: 149–159.

Finks, R.M. & Rigby, J.K. (2004): Hypercalcified sponges. – In: Kaesler, R.L. (ed.): Treatise on Invertebrate Paleontology, Part E, Porifera (revised), vol. 3: 585–764, Geological Society of America and University of Kansas, Boulder, Kansas.

Fischer, J.C. (1970): Révision et essai de classification des Chaetetida (Cnidaria) post-paléozoiques. – Annales de Paléontologie **56**/2: 151–230.

Fischer de Waldheim, G. (1829): In: d´Eichwald, C.: Zoologia specialis quam expositis animalibus tum vivo, tum fossilibus potissimum Rossiae in unversum et Poloniae in specie, in usum lectionum. – Vols. 1–2, Vilane.

Flügel, E. (1969): Catalogus Fossilium Astriae. – Österreichischen Akademie der Wissenschaften, Heft IVb, Hydrozoa. – 74 p. (Springer).

—— (1975): Fossile Hydrozoen – Kenntnisstand und Probleme. – Paläontologische Zeitschrift, **49**/4: 369–406.

—— & Hötzl, H. (1966): Hydrozoen aus Ober-Jura der Hesperischen Ketten (Ost-Spanien). – Neues Jahrbuch der Geologie und Paläontologie, Abhandlungen, **124**/2: 103–117.

—— & Sy, E. (1959): Die Hydrozoen der Trias. – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, **109**/1: 1–108.

Frech, F. (1890): Die Korallen der Trias. I. Die Korallen der juvavishen Triasprovinz. – Palaeontographica, **37**: 1–116.

Fürsich, F.T., Hautmann, M., Senowbari-Daryan, B. & Seyed-Emami, K. (2005): The Upper Triassic Nayband and Darkuh formations of east-central Iran: Strtigraphy, facies pattern and biota of extensional basins on an accreted terrane. – Beringeria, **35**: 53–133.

Giattini, G.B. (1902): Fossili del Loveen nel Mentenegro. – Rivista Italiana di Paleontologia e Stratigrafia, **8**: 62–66.

Hinde. G.J. (1893): A monograph of the British fossil sponges, Part 3, Sponges of Jurassic strata. – Palaeontographical Society, Monograph **189** (254), London.

Koechlin, E. (1947): Chaetetiden aus dem Malm des Berner Jura. – Schweizerische Paläontologische Abhandlungen, **65**: 1–16.

Kovács, S. (1978): New sphinctozoan sponges from the North Hungarian. – Neues Jahrbuch für Geologie und Paläontologie, Monatshefte, **1978**/11: 685–697.

Kristan-Tollmann, E., Tollmann, A. & Hamedani, A. (1980): Beiträge zur Kenntnis der Trias von Persien. II. Zur Rhätfauna von Bagerabad bei Isfahan (Korallen, Ostracoden). – Mitteilungen der österreichischen geologischen Gesellschaft, **70**: 119–186.

Kluyver, H.H., Tirrul, R., Chance, P.N., Johns, G.W. & Meixner, H.M. (1983): Explanatory text of the Naybandan Quadrangle Map 1:250.000. – Geological Survey of Iran. Geological Quadrangel J8, 143 p., 1 map, Tehran.

Lamouroux, J.V.F. (1821): Expositon méthodique des genres de l´ordre des polypiers, des Zoophytes d´Ellis et Solander. Chez Mem. – 115 p., Paris (Veuve Agasse).

Laubenfels, M.W. de (1955): Porifera. – In: Moore, R.C. (ed.): Treatise on Invertebrate Paleontology, Part E, Archaeocyatha and Porifera. – pp. 21–112, Boulder, KS (Geological Society of America and University of Kansas).

Le Maitre, D. (1935): Description des Spongiomorphides et des Algues du Lias Marocain. – Notes et Mémoires du Service des Mines du Maroc, **34**: 18–58.

Milne-Edwards, H.M. & Haime, J. (1850): Monograph of British fossil Corals, Introduction. – Palaeontographical Society, **3**/2: 1–85.

Moiseev, A.D. (1944): Vodorosli, gubki, gidroidnye polipy i korally verkhnege triasa Kavkazskogo khrebtra (Algae, sponges, aqueous polyps and corals of the Upper Triassic of the Cacasia). – Uchenye Zapiski Leningradskogo Gosaudarst-vennogo Universita, Setiya Geologo-Pochvenno-Geografichykaya, **11**/70: 15–28.

Münster, G.F. zu (1841): Beiträge zur Geognosie und Petrefakten-Kunde des südöstlichen Tirols, vorzüglich der Schichten von St. Cassian. – 152 p., Bayreuth.

Okulitch, V.J. (1936) : On the genera *Heliolites*, *Tetradium* and *Chaetetes*. – American Journal of Scieces, **32**: 361–379.

Ott, E. (1967): Segmentierte Kalkschwämme (Sphinctozoa) aus der alpinen Mitteltrias und ihre Bedeutung als Riffbildner im Wettersteinkalk. – Bayerische Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse, Abhandlungen, Neue Folge, **131**: 1–96.

Parona, C.F. (1933): Le spugne della fauna permiana de Palazzo Adriano (Bacino del Sosio). – Memorie della Societá Geologica Italiana, **1**: 1–58.

Peterhans, E. (1927): Sur la présence d´un Bryozoaire trépostome dans le Malm de la nappe des "Préalpes médianes". – Eclogae Geologie Helvetiae, **20**/3: 380–393.

Pickett, J.W. & Jell, P.A. (1983): Middle Cambrian Sphinctozoa (Porifera) from New South Wales. – Memoir Association of Australasian Palaeontologists, **1**: 85–92.

Reitner, J. (1992): „Coralline Spongien". Der Versuch einer phylogenetisch-taxonomischen Analyse. – Berliner geowissenschaftliche Abhandlungen, Reihe E, **1**: 1–352.

Riedel, P. & Senowbari-Daryan, B. (1991): Pharetronids in Triassic Reefs. – In: Reitner, J. & Keupp, H. (eds): Fossil and Recent Sponges. – pp. 465–476 (Springer).

Rigby, J.K. & Potter, A.W. (1986): Ordovician sphinctozoan sponges from the eastern Klamath Mountains, northern California. – Journal of Paleontology, Supplement **60**/4: 1–47.

—— & Senowbari-Daryan, B. (1996): Upper Permian inozoid, demospongid, and hexactinellid sponges from Djebel Tebaga, Tunisia. – University of Kansas, Paleontological Contribution, new series, **7**: 1–130

——, Wu, X. & Fan, J. (1998): Triassic Hexactinellid Sponge from Patch Reefs in North-Central Sichuan, People´s Republic of China. – Brigham Young University, Geology Studies, **43**:119–165.

Roniewicz, E. (in press): Early Norian corals from the Northern Calcareous Alps, Austria and the intra-Norian faunal turnover. – Acta Palaeontologica Polonica (in press).

Seilacher, A. (1962): Die Sphinctozoa, eine Gruppe fossiler Kalkschwämme. – Akademie der Wissenschaften und Literatur in Maiz, Abhandlungen der mathematisch-naturwissenschaftlichen Klasse, **1961**/10: 720–790.

Senowbari-Daryan, B. (1978): Neue Sphinctozoen (segmentierte Kalkschwämme) aus den „oberrhätischen" Riffkalken der nördlichen Kalkalpen (Hintersee/Salzburg). – Senckenbergiana lethaea, **59**/4-6: 205–227.

—— (1980): Neue Kalkschwämme (Sphinctozoen) aus obertriadischen Riffkalken von Sizilien. – Mitteilungen der Gesellschaft für Geologie und Bergbaustudenten Österreich, **26**: 179–203.

—— (1989): Spiculae in segmentierten Schwämmen. – Berliner geowissenschaftliche Abhandlungen, A, **106**: 473–515.

—— (1990): Die systematische Stellung der thalamiden Schwämme und ihre Bedeutung in der Erdgeschichte. – Münchner Geowissenschaftliche Abhandlungen, Reihe A (Geologie und Paläontologie), **21**: 1–325.

—— (1991): "Sphinctozoa": An overview. – In: Reitner, J. & Keupp, H. (eds.): Fossil and Recent Sponges. – pp. 224–241 (Springer).

—— (1994): *Enoplocoelia*? *gosaukammensis*, ein neuer thalamider Schwamm aus den obertriadischen Riffkalken des Gosaukammes (Nördliche Kalkalpen, Österreich). – Jahrbuch der geologischen Bundesanstalt Wien, **137**/4: 669–674.

—— (2003): Peronidellen (Schwämme) der Trias und Beschreibung von *Peronidella iranica* n. sp. aus der Obertrias (Nor-Rhät) des Iran und von Österreich. – Jahrbuch der geologischen Bundesanstalt Wien, **143**/1: 63–72.

—— (2005a): Hypercalcified Sphinctozoen Sponges from Upper Triassic (Norian-Rhaetian) Reefs of the Nayband Formation (Central and Northeast Iran). – Jahrbuch der geologischen Bundesanstalt Wien, **145**/2: 171–177.

—— (2005b): Neue inozoide Schwämme aus obertriassischen (Nor-Rhät) Reefs of the Nayband Formation (Central and Northeast Iran). – Senckenbergiana Lethaea, **85**/2: 261–299.

—— (2009): Coralline Schwämme aus dem norisch-rhätischen Dachstein-Riff des Gosaukammes (Nördliche Kalkalpen, Österreich). – Jahrbuch der geologischen Bundesanstalt Wien, **149**/1: 111–166.

—— & Bernecker, M. (2010): *Amblysiphonella aghaensis* nov. sp. and *Musandamia omanica* nov. gen., nov. sp. (Porifera) from the Upper Triassic of Oman. – Zitteliana (A), **50**: 3–7.

—— & Di Stefano, P. (1988): Microfacies and sphinctozoen assemblage of some Lower Permian breccias from the Lercara Formation (Sicily). – Rivista Italiana di Paleontologia e Stratigrafia, **94**: 3–34.

—— & Garcia-Bellido, D.C. (2002): "Sphinctozoa": Chambered Sponges (Polyphyletic). – In: Hooper, J.N.A. & Van Soest, R.W.M. (eds): System Porifera. A Guide to the Classification of Sponges. – pp. 1511–1533 (Kluwer Academic/Plenum Publishers).

—— & Hamedani, A. (1999): Thalamid sponges from the Upper Triassic (Norian-Rhaetian) Nayband Formation near Wali Abad, SE Abadeh, Central Iran. – Rivista Italiana Paleontologia e Stratigrafia, **105**/1: 79–100.

—— & Link, M. (in press): Hypercalcified segmented sponges ("Sphinctozoans") from the Upper Triassic (Norian) reef boulders of Taurus Mountains (South Turkey). – Facies, in press.

—— & Maurer, F. (2008): Upper Triassic (Norian) hypercalcified sponges from the Musandam Peninsula (United Arab Emirates and Oman). – Facies, **54**: 433–460.

——, Rashidi, K. & Torabi, H. (2010): Foraminifera and their associations of a Rhaetian? section of the Nayband Formation in Central Iran, Northeast of Esfahan. – Facies, **56**: 567–596.

—— & Reid, R. P. (1987): Upper Triassic sponges (Sphinctozoa) from southern Yukon, Stikinia terrane. – Canadian Journal Earth Siences, **24**: 882–902.

—— & Ridd, M.F. (2008): Two new Triassic sphinctozoan sponge species from near Kantang, Trang Province, Southern Thailand. – Paläontologische Zeitschrift, **82**/3: 254–261.

—— & Rigby, J.K. (1988): Upper Permian Segmented Sponges from Djebel Tebaga, Tunisia. – Facies, **19**: 171–250.

—— & Schäfer, P. (1978): *Follicatena irregularis* n. sp., ein segmentierter Kalkschwamm aus den Oberrhät-Riffkalken der alpinen Trias. – Neues Jahrbuch für Geologie und Paläontologie, Monatshefte, **1978**/5: 314–320.

—— & Schäfer, P. (1979): Neue Kalkschwämme und ein Problematikum (*Radiomura cautica* n. g., n. sp.) aus Oberrhät-Riffen südlich von Salzburg (Nördliche Kalkalpen). – Mitteilungen der österreichischen geologischen Gesellschaft, **70**(1977): 17–42.

—— & Schäfer, P. (1986): Sphinctozoen (Kalkschwämme) aus den norischen Riffen von Sizilien. – Facies, **14**: 235–284.

——, Seyed-Emami, K. & Aghanabati, A. (1997): Some Inozoid sponges from Upper Triassic (Norian-Rhaetian) Nayband Formation of Central Iran. – Rivista Italiana Paleontologia e Stratigrafia, **103**/3: 293–322.

—— & Stanley, G. D., Jr. (2009): Taxonomic affinities and paleogeography of *Stromatomorpha californica* Smith, a distinctive Upper Triassic reef-adapted Demosponge. – Journal of Paleontology, **83**/5: 783–793.

——, Torabi, H. & Rashidi, K. (2008): New Solenoporaceans from Upper Triassic (?Norian-Rhaetian) reef limesstones in central Iran. – Geologia Croatica, **61**/2–3: 135–157.

——, Zühlke, R. Bechstädt, T. & Flügel, E. (1993): Anisian (Middle Triassic) Buildups of the Northern Dolomites (Italy): The Recovery of Reef Communities after the Permian/Triassic Crisis. – Facies, **28**: 181–256.

Seyed-Emami, K. (2003): Triassic in Iran. – Facies, **48**: 91–106.

Sollas, W.J. (1875): Sponges. In: Encyclopedia Britanica. 9th edition. London, p. 451

Steinmann G. (1882): Pharetronen-Studien. – Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, **2**: 139–191.

Termier, H., Termier, G. & Vachard, D. (1977): Monographie paléontologique des affleurements permiens du Djebel Tebaga (Sud Tunesien). – Palaeontographica, Abteilung A, **156**/1–3: 1–109.

Topsent, E. (1898): Introduction à l´étude monographique des Monaxonides de France, Classification des Hadromerina. – Archives de Zoologie Expérimentale et Générale, **4**/3: 91–113.

Verrill, A.E. (1907): Porifera of the Bermuda Islands. – Transaction of the Academy of Arts and Sciences, New Haven, Connecticut, **12**: 330–344.

Vinassa de Regny, P. (1915): Triadische Algen, Spongien, Anthozoen und Bryozoen aus Timor. – Paläontologie Timor, **4**/8: 73–118.

—— (1932): Hydrozoen und Korallen aus der oberen Trias des Karakorum. – Wissenschaftliche Ergebnisse der Dr. Trinklerischen Zentralasien-Expedition, **2**: 192–196.

Weidlich, O. & Senowbari-Daryan, B. (1996): Late Permian sphinctozoans from reefal Blocks of the Ba´id area, Oman. – Journal of Paleontology, **70**/1: 27–46.

West, R.R. (1989): Carboniferous species of *Chaetetes* in North America. – Geological Society of America, Abstracts Program, **21**: 43.

West, R.R. (1994): Species in coralline demosponges: Chaetetida. – Courier Forschungsinstitut Senckenberg, **172**: 399–409.

Wilckens, O. (1937): Korallen und Kalkschwämme aus dem obertriadischen Pharetronenkalk von Seran (Molukken). – Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, Beilage-Band **77B**: 171–211.

Wood, R. (1991): Non-Spicular Biomineralization in Calcified Demosponges. – In: Reitner, J. & Keupp, H. (eds): Fossil and Recent Sponges. – pp. 322–340 (Springer).

Wu, X. (1989a). Late Triassic Carnian strata in western Sichuan Basin and a new sponge family. – Acta Palaeontologica Sinica, **28**/6: 766–772. [in Chinese with English abstract]

—— (1989b): Late Triassic Lychniscosa fauna in northwestern Sichuan. – Acta Palaeontologica Sinica, **29**/3: 349–363.

—— & Xiao, R. (1989): Discovery of Late Triassic sponge fauna in northwestern Sichuan. – Journal Kunming Institut Technology **14**/1: 12–21.

Wurm, D. (1982): Mikrofazies, Paläontologie und Paläoökologie der Dachsteinriffkalke (Nor) des Gosaukammes (Österreich). – Facies, **6**: 203–296.

Yabe, H. & Sugiyama, T. (1931): On some spongiomorphoid coral from Sanpozan, Province of Tosa, Japan. – Contribution from the Institute of Geology and Palaeontology, Tohoku Imperial University, Sendai, **10**/1–2: 5–9.

Zittel, K.A. (1878): Studien über fossile Spongien. Dritte Abteilung, Monactinellidae, Tetractinellidae und Calcispongiae. – Abhandlungen der königlich-bayerischen Akademie der Wissenschaften, mathematisch-physikalische Klasse, **2**: 91–138.

Plate 1

Fig. A. *Amblysiphonella bisiphonata* nov. spec. Holotype. Longitudinal section through several ring-like and rectangular (barrel-like) chambers arranged around two axial spongocoels. The spongocoels are connected with the chamber interiors by the large and rimmed openings. The chamber roofs are much thicker than the exo- and endo-walls. Chamber interiors are whole. Thin section 1/0/1.

Fig. B. *Amblysiphonella bisiphonata* nov. spec. The section parallel to Fig. A (holotype) shows similar characteristics of the sponge. The white arrow on the left shows the small thalamid sponge *Musandamia gosaukammensis* (for close up see Fig. D). Thin section 1/0/2.

Fig. C. *Naybandella prosiphonata* Senowbari-Daryan, 2005a. The longitudinal section shows the chamber of different shape which are arranged glomerate around the thick-walled spongocoel. Thin section 1/2.

Fig. D. *Musandamia gosaukammensis* (Senowbari-Daryan, 1994). Close up from Fig. B (see arrow) showing three ring-like chambers, the ambisiphonate type of the spongocoel, and the uneven surface of the sponge. Thin section 1/0/2.

Fig. E. *Musandamia gosaukammensis* (Senowbari-Daryan, 1994). Axial section through a specimen showing the ambisiphonate type of the spongocoel and the uneven surface of the sponge. The "upper" part of the sponge is colonized by a chaetetid sponge. Thin section 1/1.

Fig. F. *Musandamia gosaukammensis* (Senowbari-Daryan, 1994). Section through three chambers showing almost identical characteristics as the specimen in Fig. D. Thin section K117.

Fig. G. *Musandamia gosaukammensis* (Senowbari-Daryan, 1994). Section through two chambers. Thin section K1/2.

Fig. H. *Amblysiphonella torabii* nov. spec. Oblique sections through two specimens. 1) Holotype. Thin section K28.

Fig. I. *Naybandella prosiphonata* Senowbari-Daryan, 2005a. Transversal section through a specimen showing the glomerate arrangement of the chambers around the spongocoel with a thickened wall. Thin section 1/2.

Fig. J. *Parauvanella spinosa* nov. sp. Section through several hemispherical chambers with glomerate arrangement. Thin section 12.

Fig. K. "Sphinctozoa" gen. et sp. indet 1. The perforation of chamber walls are similar to the genus *Kashanella*, Chamber shapes similar to *Colospongia*, but the possibly internal filling structure within the chamber interiors do not allow to attribute this sponge either to *Colospongia* nor to *Kashanella*. Thin section 7.

Scale in A-C, I-K 5 mm, in D-H 1 mm.

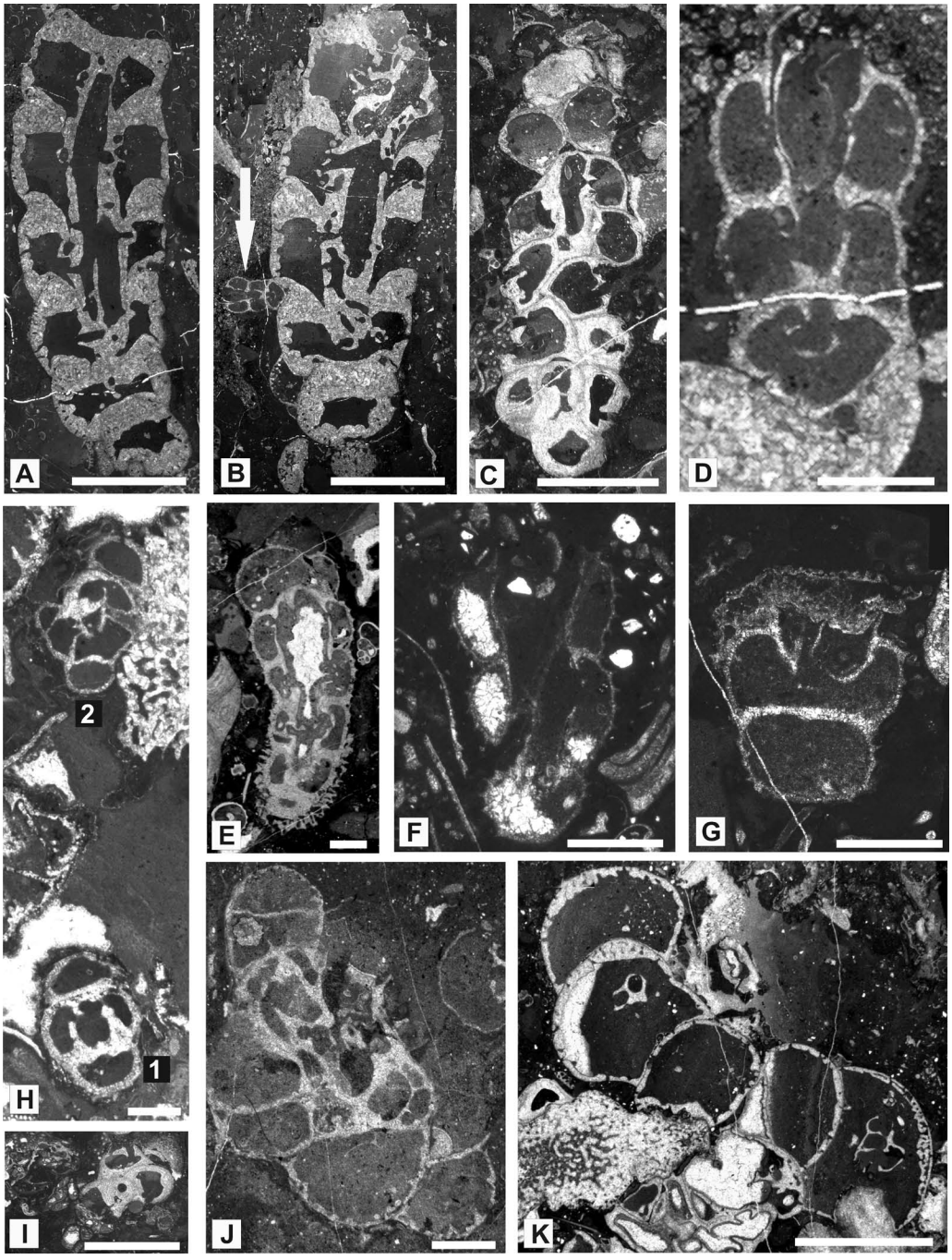
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Plate 2

Figs A-B. *Senowbaridaryana raretrabeculata* (Boiko, 1991). A: Longitudinal section. The normally growth of the sponge is interrupted by the colonization of a bivalve. The sponge branches by producing of several osculi at the left side of the photograph. Thin section K1/1. B: Section parallel to Fig. A exhibits similar characteristics as Fig. A. The sponge growth ended due to the colonization of another sponge at the top. Thin section K1/2.

Fig. C. *Nevadathalamia* sp. Section through several chambers with thin and equally perforated chamber walls. Some tubular filling skeleton is secreted within the chamber interiors. Thin section K117

Fig. D. *Paradeningeria alpina* Senowbari-Daryan & Schäfer, 1979 and *Annaecoelia parva* Senowbari-Daryan, 2005a (arrow). For magnification see Pl. 4, Fig. L. Thin section K1/1.

Fig. E. *Naybandella prosiphonata* Senowbari-Daryan, 2005a and *Uvanella norica* (Senowbari-Daryan & Schäfer, 1978: arrows). For magnification see Pl. 8, Fig. B. Thin section 1/2.

Fig. F. "Sphinctozoa" gen. et sp. indet 2. The sponge is characterized by very thin chamber walls and star-like elements within the chamber interwalls. Thin section 3.

Fig. G. *Paradeningeria alpina* Senowbari-Daryan & Schäfer, 1979. Section through three chambers. Thin section K1/2.

Fig. H. *Paradeningeria alpina* Senowbari-Daryan & Schäfer, 1979. Thin section K1/1.

Fig. I. Sphinctozoan sponge gen. et sp. indet. Thin section K106.

Fig. J. *Annaecoelia mirabilis*? Senowbari-Daryan & Schäfer, 1979 growing on another sponge. Thin section K46.

Figs K-L. *Kashanella irregularis* Senowbari-Daryan, 2005a. K: Section through an internally subdivided specimen. The labyrinthic canal system of the sponge walls is well recognizable. Thin section K2. L: Similar section as Fig. K. Thin section K39.

Fig. M. *Tabasia minima* Senowbari-Daryan, 2005a. Longitudinal section through a specimen with well defined outer segmentation. Numerous vertically running tubes pass through the chamber roofs (compare Fig. 3). Thin section K120b.

Scale in all Figs. 5 mm.

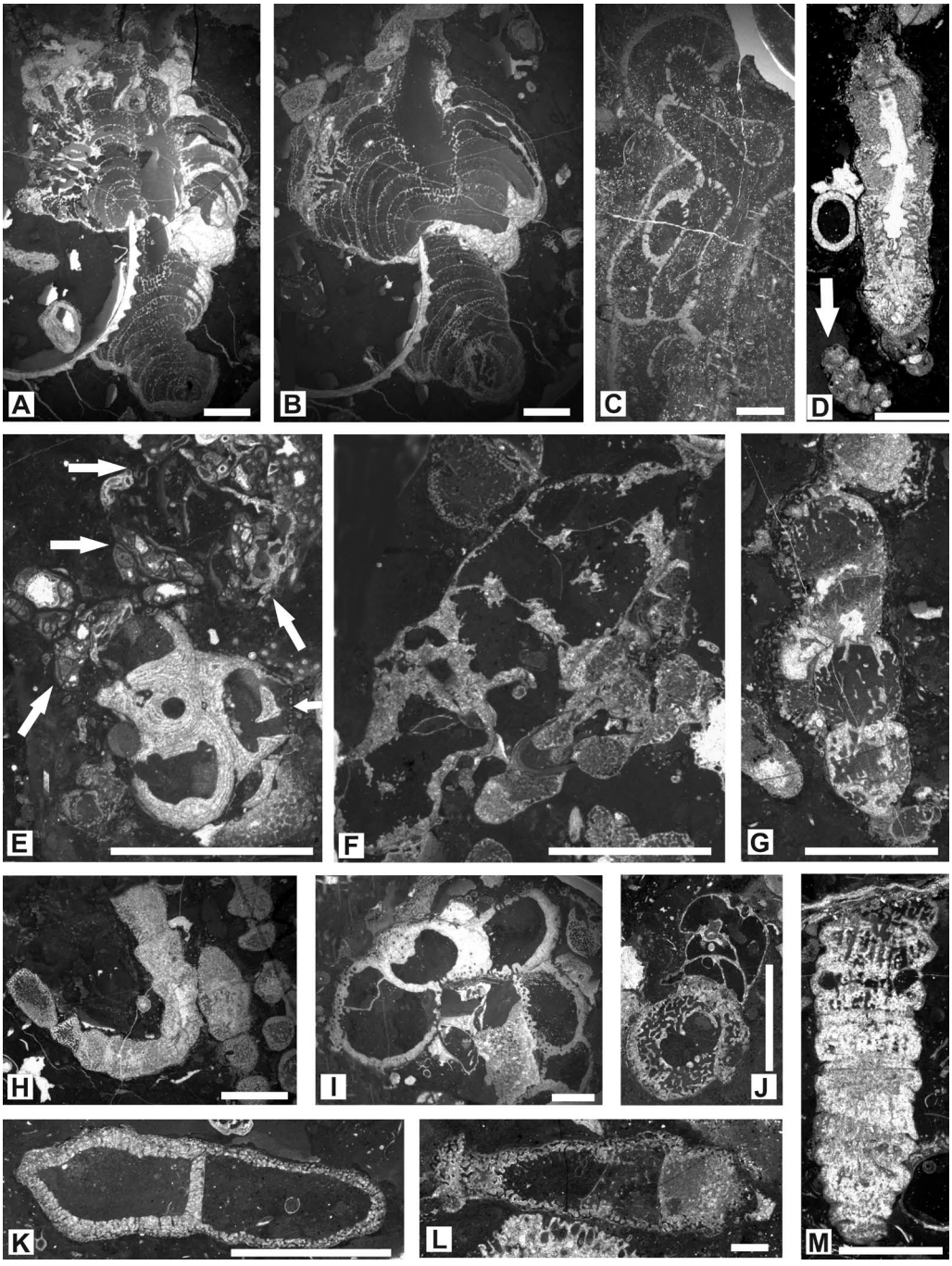
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Plate 3

***Naybandella prosiphonata* Senowbari-Daryan, 2005a**

Fig. A. Sections through several specimens. For magnification of white retangle see Fig. C. Thin section K14.

Fig. B. Section through four chambers arranged around the spongocoel. Arrows indicate the thin and finely perforated dermal layer above the sive plates (compare Fig. 7). Thin section K143.

Fig. C. Close-up of Fig. A (rectangle) showing a specimen in longitudinal section. The spherical chambers are arranged around the spongocoel and communicate with it through the large openings. Thin section K14.

Fig. D. Section similar as B. Arrows indicate the thin and finely perforated dermal layer abve the sieve-plates. Thin section K14.

Fig. E. Section through three specimens showing the spherical chambers with numerous sieve-plates. Axial canal is cut in two specimens. Thin section K14.

Fig. F. Cross section. Four chambers are arranged around the spongocoel. Thin section 1/2.

Scale in A 10 mm, in all others 5 mm.

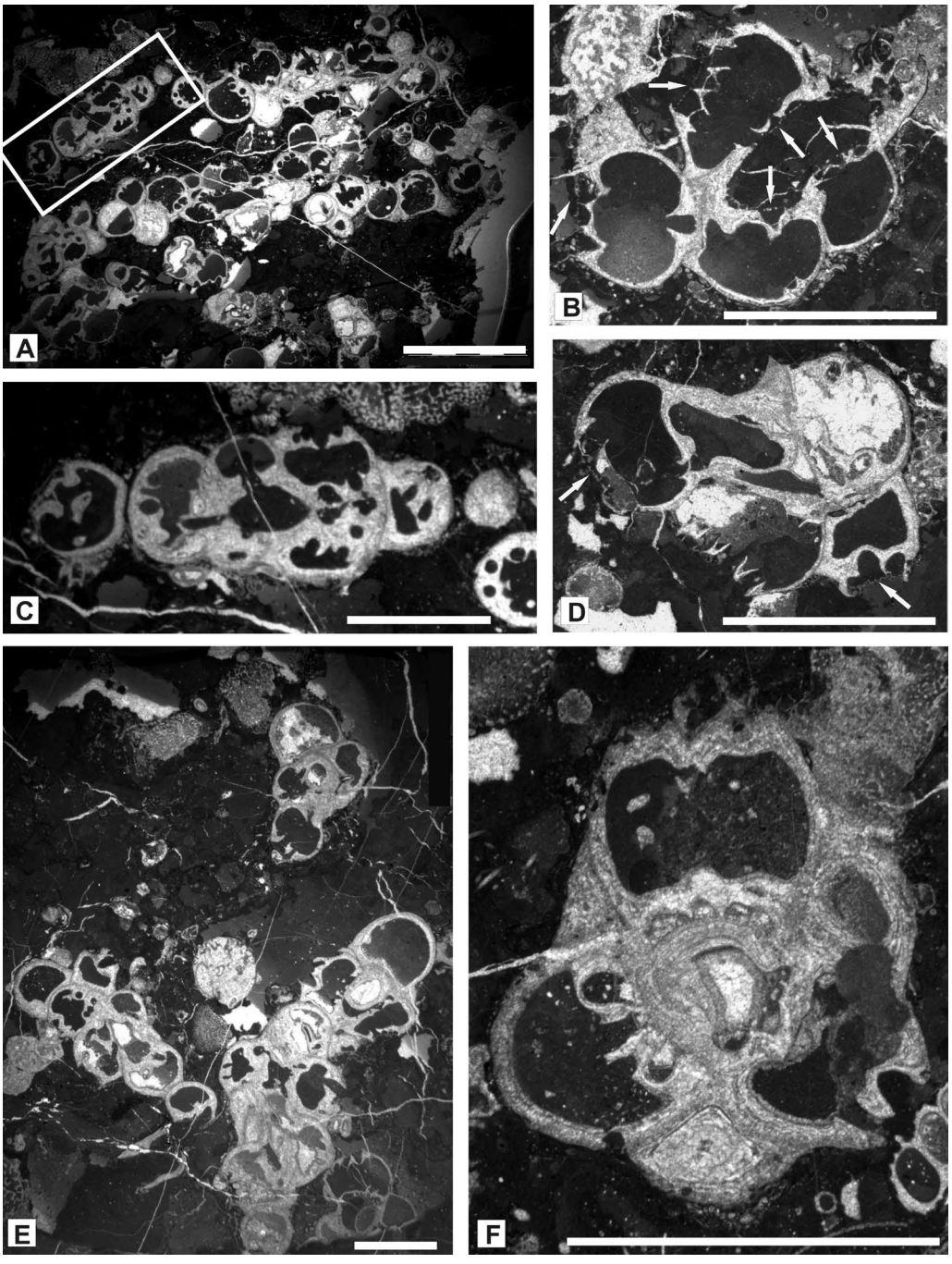
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Plate 4

Fig. A. *Nevadathalamia variabilis* Senowbari-Daryan, 2005a. The longitudinal section shows the perforated chamber walls and the tubular filling skeleton within the chamber interiors. The spongocoel is cut in the lower part of the sponge. Thin section K120

Fig. B. *Amblysiphonella* sp. 1. Two specimens were amalgamated. The chamber walls are partly fine perforated. Thin section K18.

Fig. C. *Amblysiphonella* sp. sp. 2. The sponge shows irregular chambers with well perforated chamber walls. Arrow indicates a specimen of *Welteria hamaedanii* Senowbari-Daryan, which is cut marginally showing three chambers. Thin section 7.

Fig. D. *Amblysiphonella* sp. 3. Section through three ring-shaped chambers, which are arranged obliquely to the sponge axis. Thin section K39.

Fig. E. *Kashanella irregularis* Senowbari-Daryan, 2005a. Section through a specimen with indistinct outer segmentation, but a well subdivided or chambered internal structure. Thin section K6.

Figs F-G. F: *Panormida bisiphonata* Senowbari-Daryan, 2009. Oblique sections through several specimens. G: Longitudinal, oblique and cross sections through several specimens. The two or more canals are well recognizable in cross sections. Both Figs. in thin section 3.

Fig. H. *Kashanella irregularis* Senowbari-Daryan, 2005a. Section through several chambers of an irregulary growing specimen. Thin section K12.

Fig. I. *Kashanella irregularis* Senowbari-Daryan, 2005a. Thin section K14.

Fig. J. *Annaecoelia mirabilis* Senowbari-Daryan & Schäfer, 1979. The section through a small specimen exhibits several spongocoels of prosiphonate type. Spongocoels are developed by the extinction of the chamber walls. Thin section 7.

Fig. K. *Paradeningeria alpina* Senowbari-Daryan & Schäfer, 1979. Longitudinal section. Thin section K14.

Fig. L. *Annaecoelia parva* Senowbari-Daryan, 2005a. Oblique section. Several spherical chambers are arranged glomerately around the axial spongocoel (magnification from Pl. 2, Fig. D). Thin section K1/1.

Scale in A-D 10 mm, in E-I and K 5 mm, in J and L 3 mm.

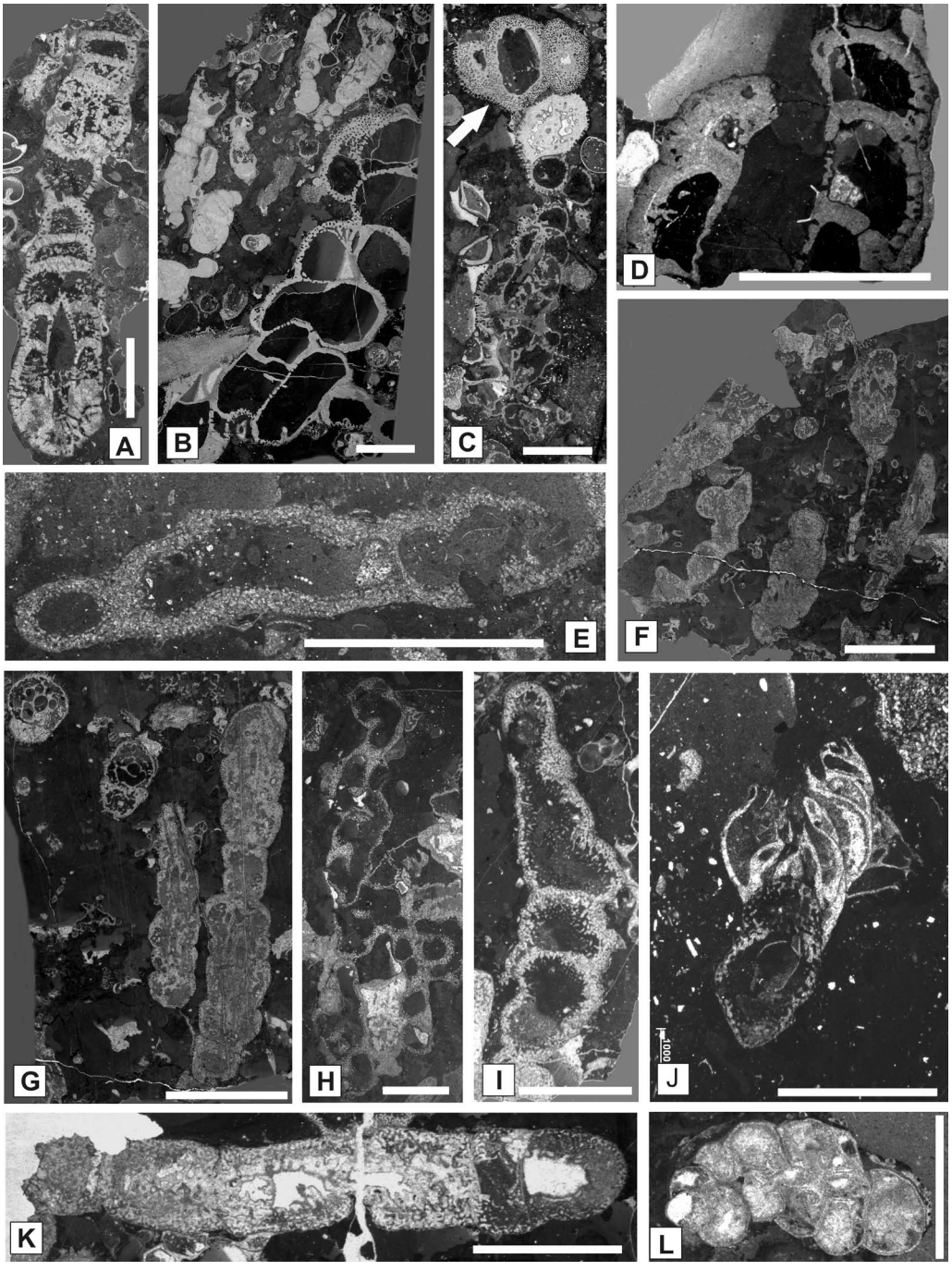
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Plate 5

***Permocorynella maxima* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997**

Fig. A. Cross sections through three specimens. The inhalant and exhalant canals are well recognizable, particularly in a specimen in the middle part of the photograph. Thin section 15.

Fig. B. Longitudinal sections through several amalgameted specimens. Thin section K10.

Fig. C. This longitudinal section through a specimen shows the inhalant and exhalant canals as well as the reticulate fiber skeleton of the sponge wall. Thin section K16.

Fig. E. The cross section through a specimen shows the inhalant and exhalant canals which partly branch towards the outside of the sponge wall. Thin section K19.

***Peronidella norica* (Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997)**

Fig. D. Cross and oblique sections through two specimens. Both specimens show the indistinct radialy orientation or the fiber skeleton. Thin section K12.

Scale in all Figs. 10 mm.

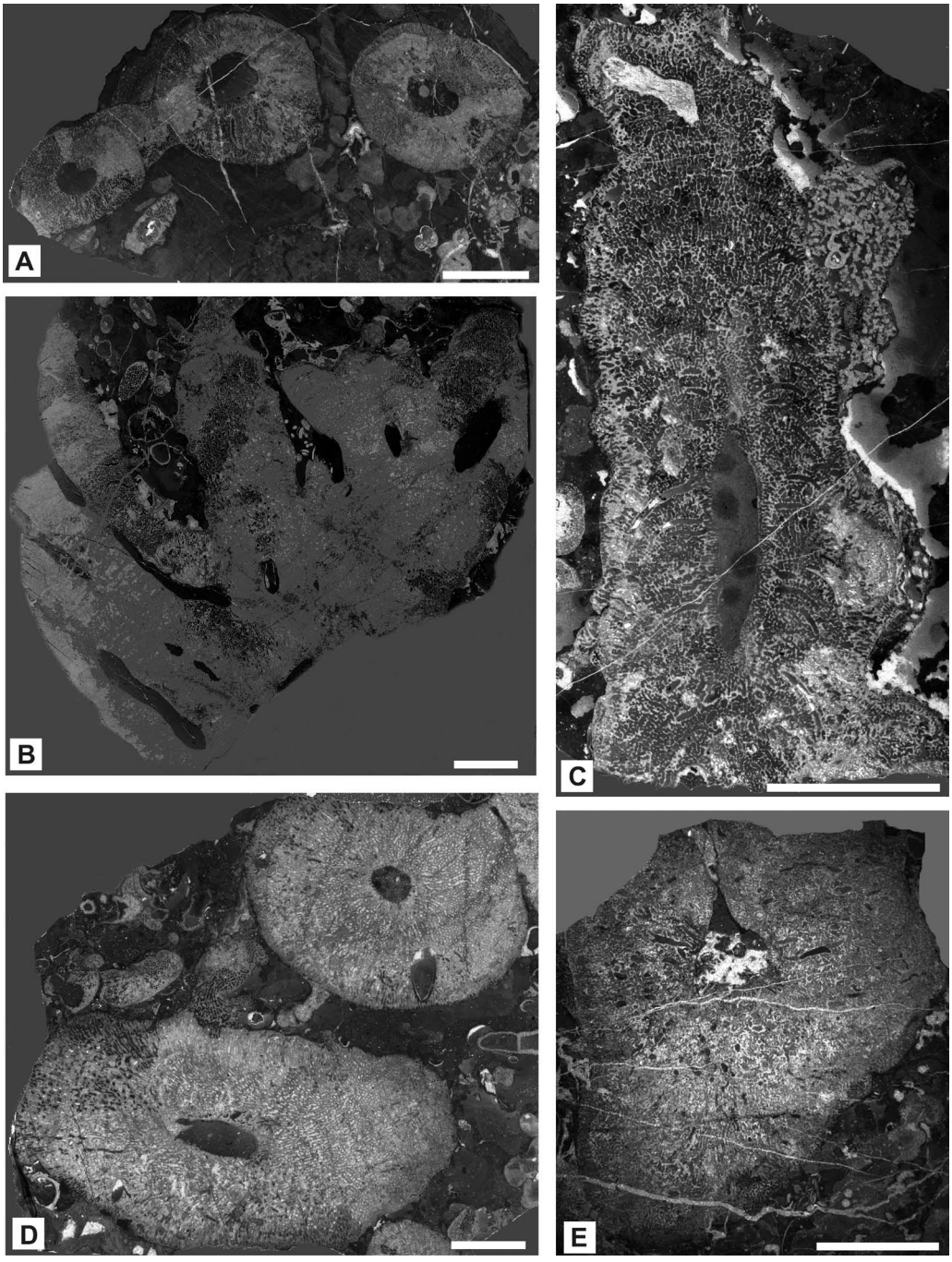
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Plate 6

Figs A-B. *Peronidella pilleri* nov. spec. A: Cross section showing the coarse reticulate fiber skeleton of the sponge wall. 3. B: Similar as Fig. A. Thin section 3.

Figs C-E. *Permocorynella* cf. *P. maxima* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997. C: Longitudinal section. The exhalant and inhalant canals are not well developed. Thin section 108/l. D: Cross section from the same specimen illustrated in Fig. C. Thin section 108/q. E: Longitudinal section showing the thick wall and the inhalant and some exhalant canals piercing the wall. Thin section 108.

Fig. F. *Marawandia iranica* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997. A) Oblique section showing several canals distributed within the sponge. Thin section 117.

Fig. G. *Marawandia iranica* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997. Similar as Fig. F. Thin section 117.

Fig. H. *Anguispongia parva* Senowbari-Daryan, 2005b. The oblique section of the sheet exhibits the different appearance of both sides of the sponge. Thin section K105.

Fig. I. 1: *Anguispongia parva* Senowbari-Daryan, 2005b. The section shows the reticulate appearance as in the upper part of the species in Fig. H. 2: *Marawandia iranica* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997. Oblique longitudinal section exhibiting the spongocoels distributed in the sponge. 3) Chaetetid sponge. Thin section K105.

Scale in A-B and F-G 2 mm, in C-E and H-I 10 mm.

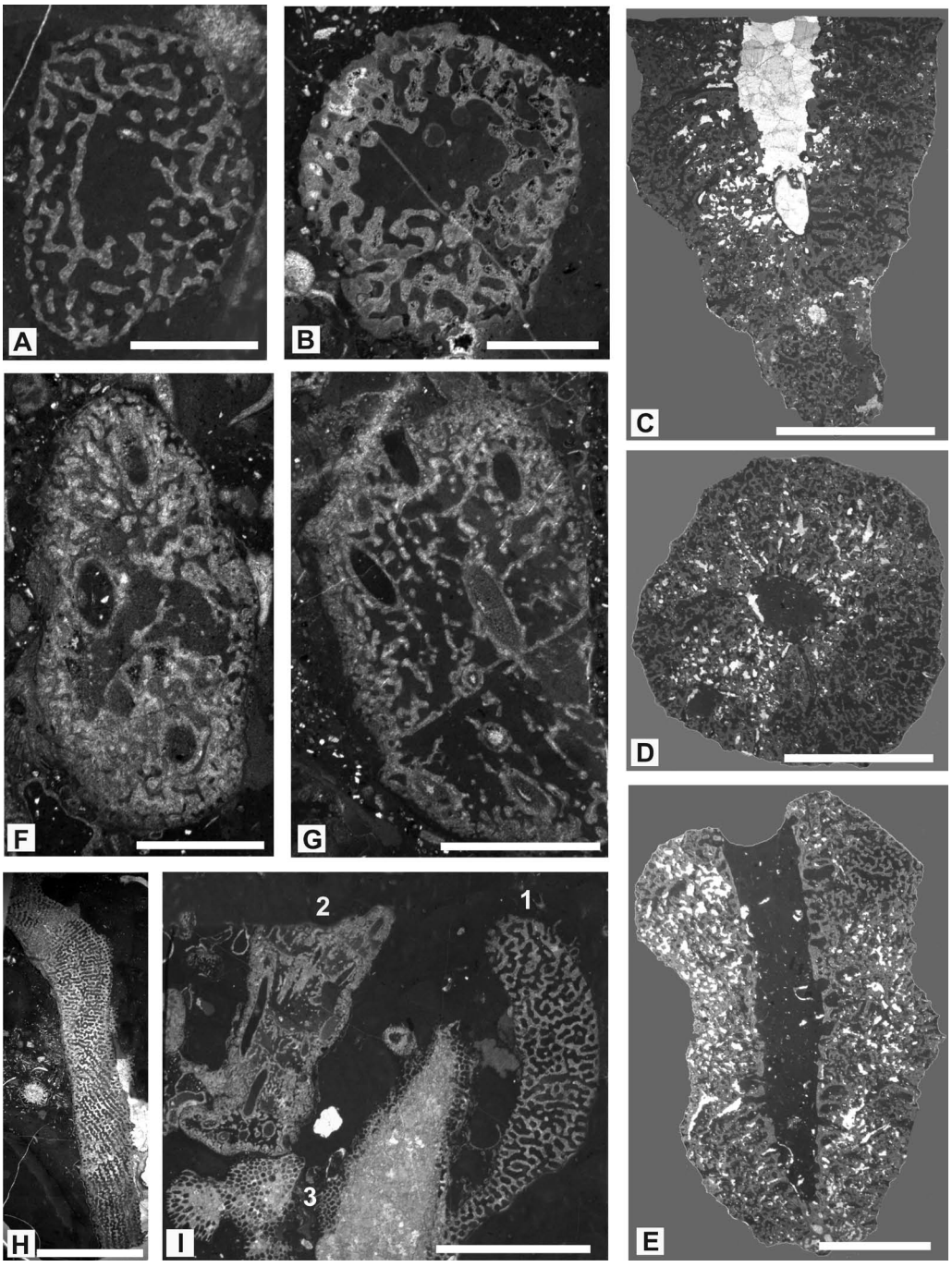
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Plate 7

Fig. A. Horizontally growing sheet-like spongiomorphids serving as colonization substratum for the growth of other organisms. Thin section 16/2

Fig. B. The longitudinal section (section perpendicular to the image plane) of sheet-like spongiomorphids shows the linear arrangement of the fiber skeleton similar to that in *Molengraaffia regularis* Vinasse de Regny, 1915 (compare Pl. 8, Fig. A/1). K26.

Fig. C. Section of a similar specimen showing the skeletal structure in cross section (upper part) and in oblique to longitudinal section (lower part) of the photograph. Thin section 2.

Fig. D. *Sestrostomella robusta* Zittel, 1878. Cross section through a specimen serving as substratum for another specimen which is cut in oblique section. Both specimens are characterized by a bundle of axial tubes. Thin section K26.

Fig. E. Chaetetid sponge gen. et sp. indet 1. Longitudinal section of a specimen clearly showing the vertically oriented tubes at the periphery of the rods. Thin section K35.

Fig. F. Chaetetid sponge gen. et sp. indet 1. Sections through four specimens. Two specimens clearly show the tubes running parallel to the rod axis in the axial region or perpendicular to the axis at the periphery respectively. Thin section K35.

Scale in A-C 10 mm, in D-F 5 mm.

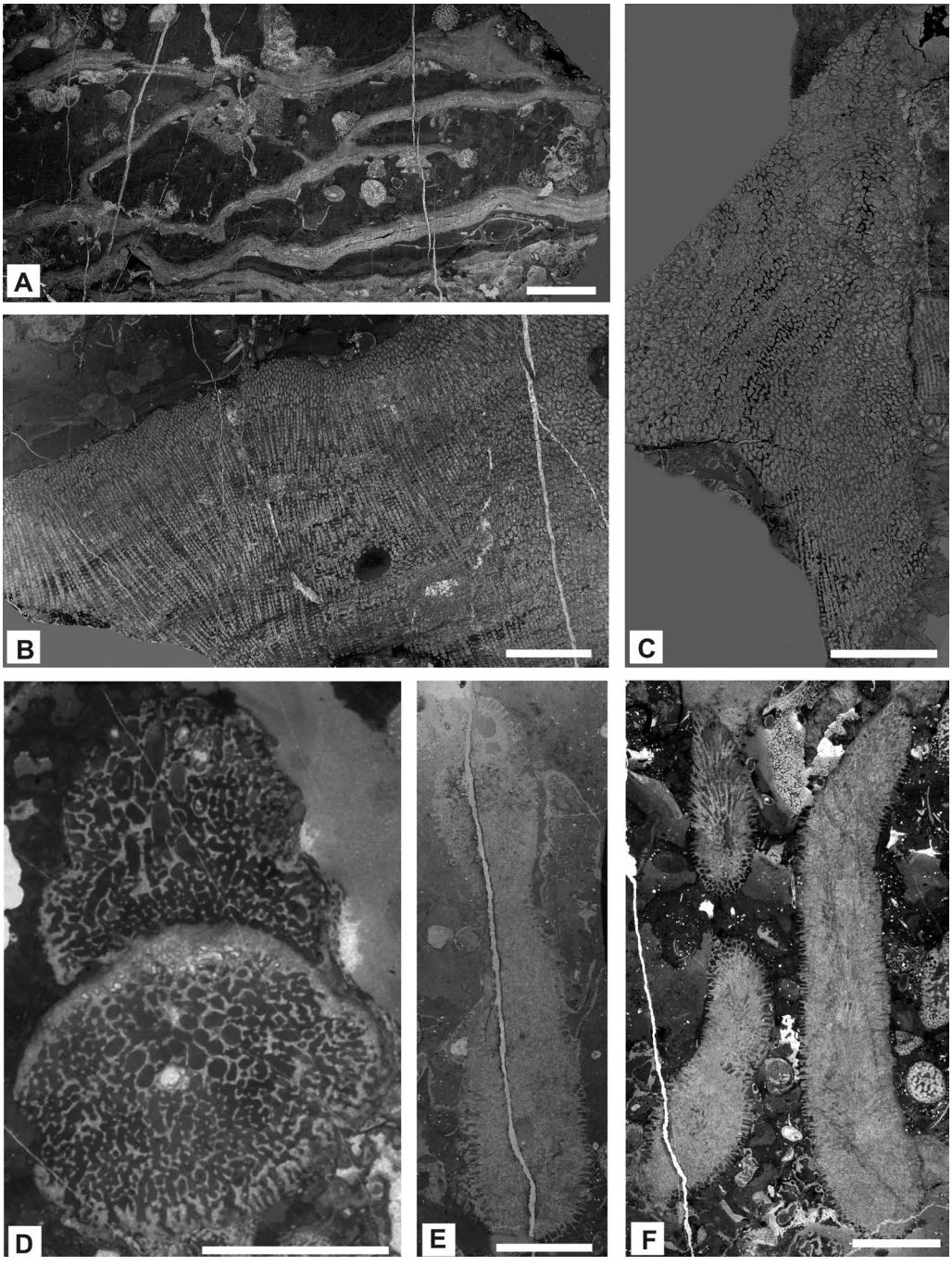
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Plate 8

Fig. A. 1: *Molengraaffia regularis* Vinassa de Regny, 1915. 2: *Peronidella*? sp. The sponge exhibits several small openings; their interpretation as spongocoel or borings is uncertain. Thin section K29.

Fig. B. *Uvanella norica* (Senowbari-Daryan & Schäfer, 1978). Section through numerous irregular chambers. The circular to ovate structures in the lower right corner represent sections of numerous serpulid worm tubes. Thin section 1/2.

Fig. C. Chaetited gen. et sp. indet 2. Sections through numerous specimens. Some specimens are bored. Thin section K15.

Fig. D. *Deningeria* cf. *D. tenuireticulata* Senowbari-Daryan, Zühlke, Bechstädt & Flügel, 1993. Sections through two specimens exhibiting the moniliforme arrangement of the chambers and the finely reticulate filling skeleton within the chamber interiors (compare Fig. 2). Thin section K105.

Fig. E. Hexactinellid sponge gen. et sp. indet. The hexactinellid spicules of this species are preserved in form of a lattice. Thin section 15.

Scale in Figs. A, C and E 10 mm, in Figs. B and D 5 mm.

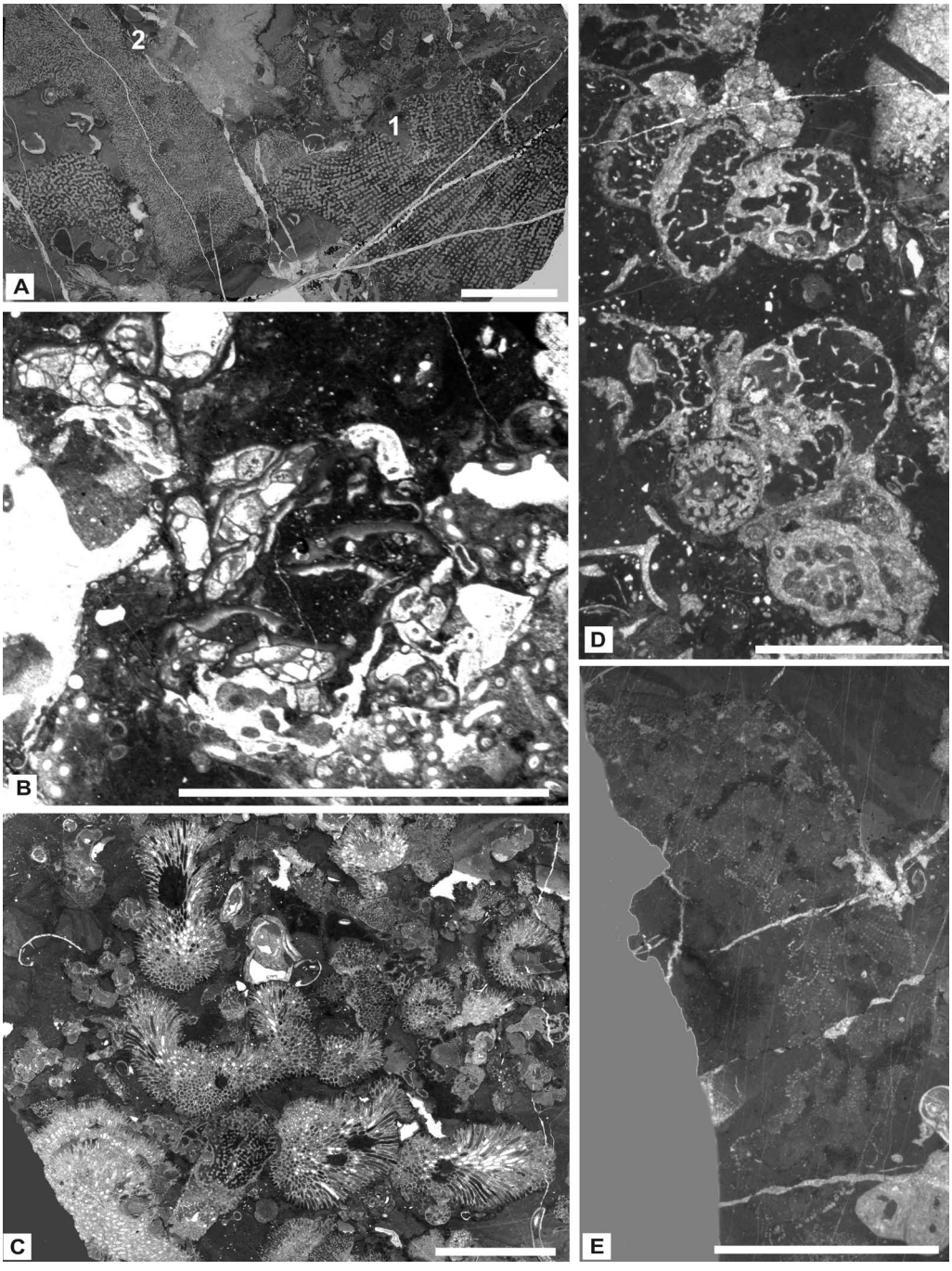
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Plate 9

Fig. A. *Amblysiphonella torabii* nov. spec. The oblique section shows the ring-shaped chambers and the spongocoel. Thin section K115.

Fig. B. *Permocorynella* cf. P. *maxima* Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997. Oblique section. Thin section K11.

Fig. C. *Deningeria tabasensis* Senowbari-Daryan, 2005a. Longitudinal section through several chambers. Chamber roofs are distinctly thinner than the chamber exowalls. Thin section K28.

Fig. D. *Tabasia media* Senowbari-Daryan, 2005a. Marginally longitudinal section through three chambers. The vertically running tubes are clearly recognizable. Thin section K117.

Fig. E. Chaetetid sponge gen. et sp. indet 3. Thin section K32.

Fig. F. *Deningeria tabasensis* Senowbari-Daryan, 2005a. Section through numerous chambers of a curved specimen showing the rectangular chambers with thin chamber roofs. Thin section K28.

Fig. G. 1: *Parauvanella spinosa* nov. sp. Holotype. The sponge has grown on two serpulid worm tubes and shows thin chamber walls with spine-like elements extending from the chamber roofs into the chamber interior. 2: *Paradeningeria alpina* Senowbari-Daryan & Schäfer, 1979. Marginal section through four chambers. Thin section K28.

Scale in all Figs. 5 mm.

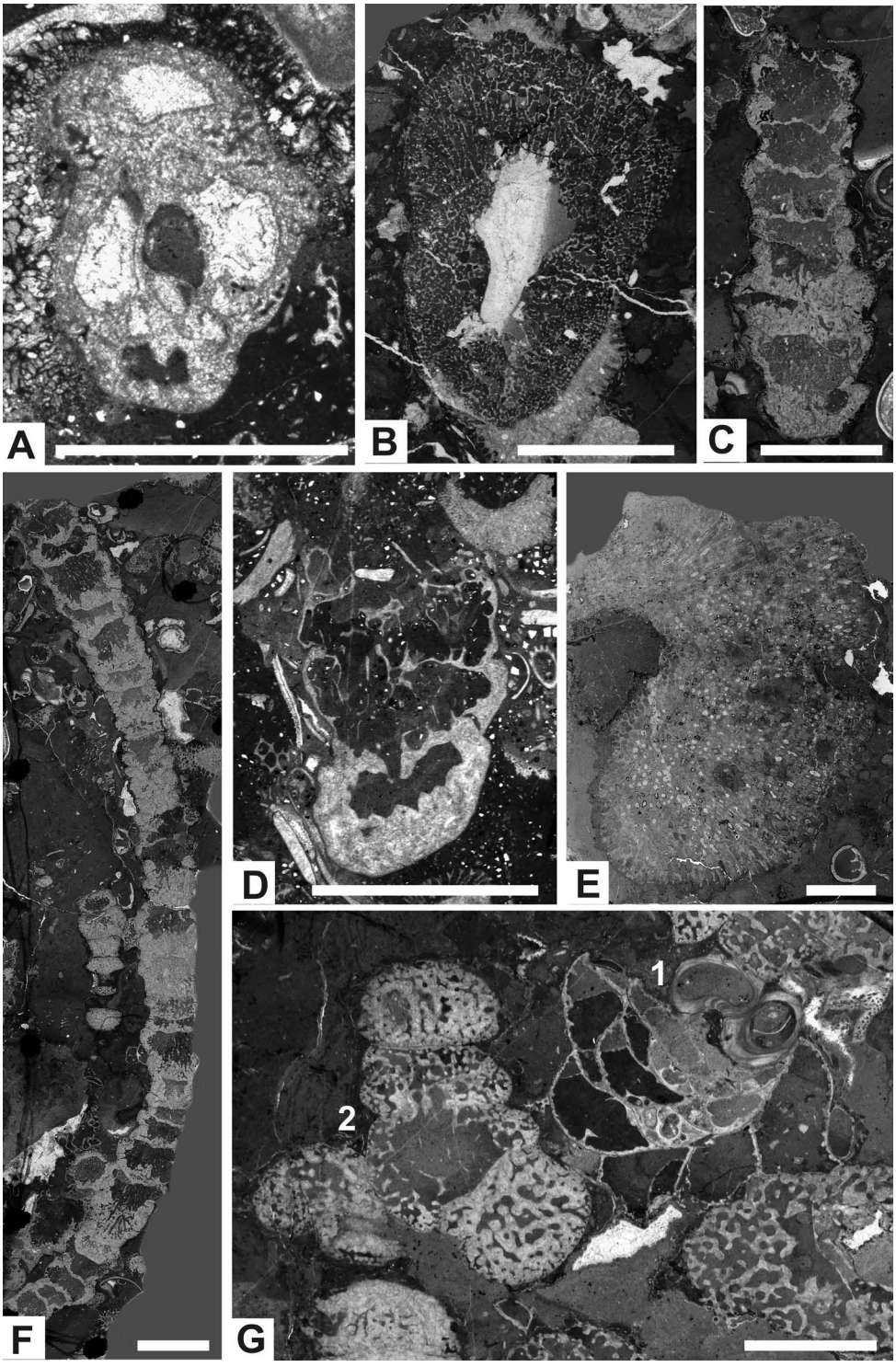

A
B
C
D
E
F
G
1
2

Plate 10

Fig. A. *Welteria hamedani* Senowbari-Daryan, 2005a. Marginal section through three chambers. Thin section 4.

Fig. B. Chaetetid sponge gen. et sp. indet 1. Thin section K117.

Fig. C. Chaetetid sponge gen. et sp. indet 5. The dichotomously branched specimen is composed of tubes running almost parallel to the axis of branches. Thin section 1/1

Fig. D. Chaetetid sponge gen. et sp. indet 4? Thin section 1/2.

Fig. E. Chaetetid sponge gen. et sp. indet 1. The arrow indicates a specimen of *Musandamia gosaukammensis* (Senowbari-Daryan, 1994). The magnification of this sponge is illustrated in Pl. 1, Fig. F. Thin section K117.

Fig. F. *Parauvanella spinosa* nov. spec. marked with number 1. Arrow indicates a specimen of the brachiopod *Gosaukammerella eomesozoica* (Flügel, 1972). Thin section K46.

Fig. G. Chaetetid sponge gen. et sp. indet 4. The chaetetid sponge is grown on a specimen of the sphinctozoan sponge *Naybandella prosiphonata* Senowbari-Daryan, 2005a. Thin section K14.

Fig. H. View of a thin section with different sponges and serpulid worm tubes in between. The incomplete two chambers with a labyrinthic pore system of the chamber walls at the base of photograph represent a specimen of *Welteria hamedanii* Senowbari-Daryan, 2005a. Thin section K28.

Scale in A, C-G 5 mm, in B 3 mm, in H 10 mm.

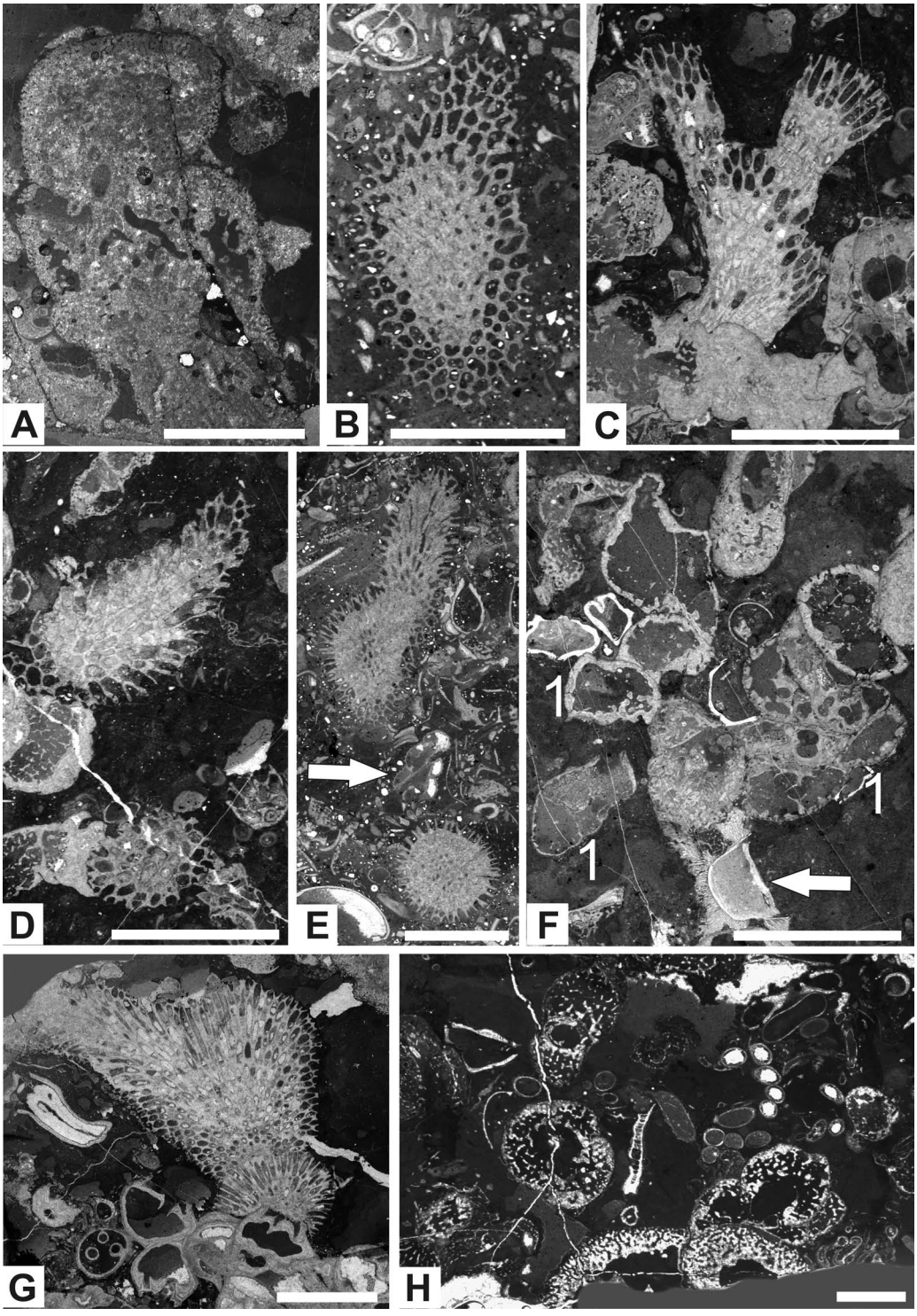

A
B
C
D
E
F
1
1
1
G
H

Plate 11

Figs A-C. *Peronidella pilleri* nov. sp. A: Holotype. The longitudinal section shows the coarse reticulate fiber skeleton of the sponge wall. Thin section 3. B: Similar section as Fig. A. Thin section 3. C: Two specimens. The specimen marked with 1 is the largest specimen with a diameter of about 5 mm. The small specimen (2) is about 3 mm in diameter. Thin section 3.

Fig. D. "Sphinctozoa" gen. et sp. indet 2. The sponge is characterized by thin interwalls and star-like elements within the interwall and chamber interwalls. Thin section 3.

Fig. E. Numerous fragments of a laminated spongiomorphid. Thin section K20.

Fig. F. Sperpulid worm tubes are relatively abundant in investigated limestones. Thin section K37.

Fig. G. *Solenopora rectangulata* Senowbari-Daryan, Torabi & Rashidi, 2008. Solenoporaceen occur in the upper portion of the section, building a solenoporacean-dominated reef structure. Thin section 16.

Scale in all Figs. 2 mm.

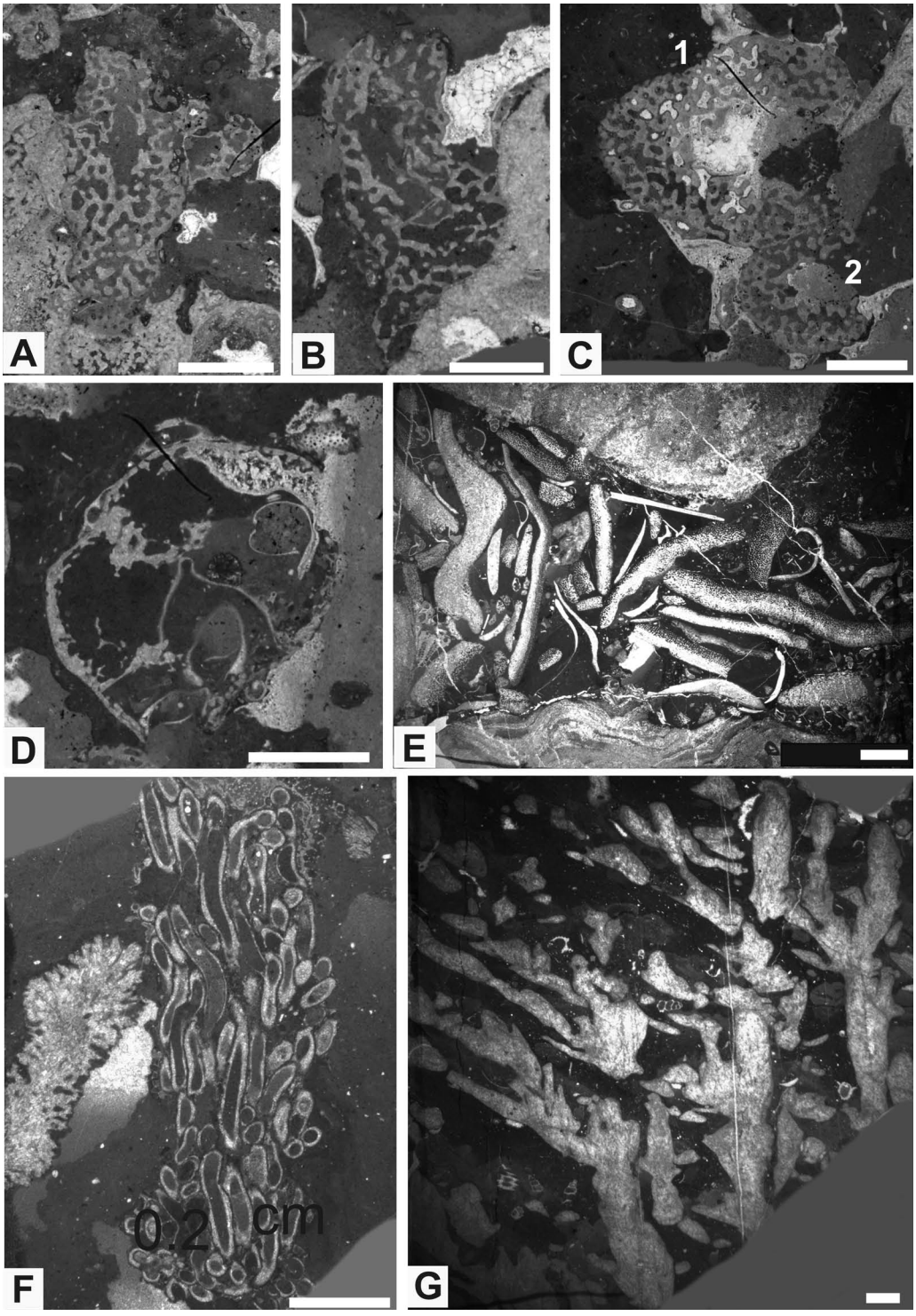

A
B
C
1
2
D
E
F
0.2 cm
G

Plate 12

***Tabasia minima* Senowbari-Daryan, 2005a**

Fig. A. View of an isolated specimen showing several flattened chambers.

Fig. B. This specimen shows the chamber with oblique arrangement.

Fig. C. Similar to A.

***Tabasia maxima* Senowbari-Daryan, 2005a**

Fig. D. View of the outer surface of an isolated specimen which is characterized by numerous horizontally lines corresponding to the internal segmentation.

Fig. E. Top of the specimen illustrated in Fig. D, indicating two groups of internal vertically running tubes.

Fig. F. Top of the specimen illustrated in Fig. G showing several groups of pores which correspond to the internal running tubes.

Fig. G. View of the outer surface of an isolated specimen showing numerous horizontal lines corresponding to the internal segmentation.

Fig. H. Lateral view of an isolated specimen like in Fig. D.

Scale in A-C 5 mm, in D-G 10 mm.

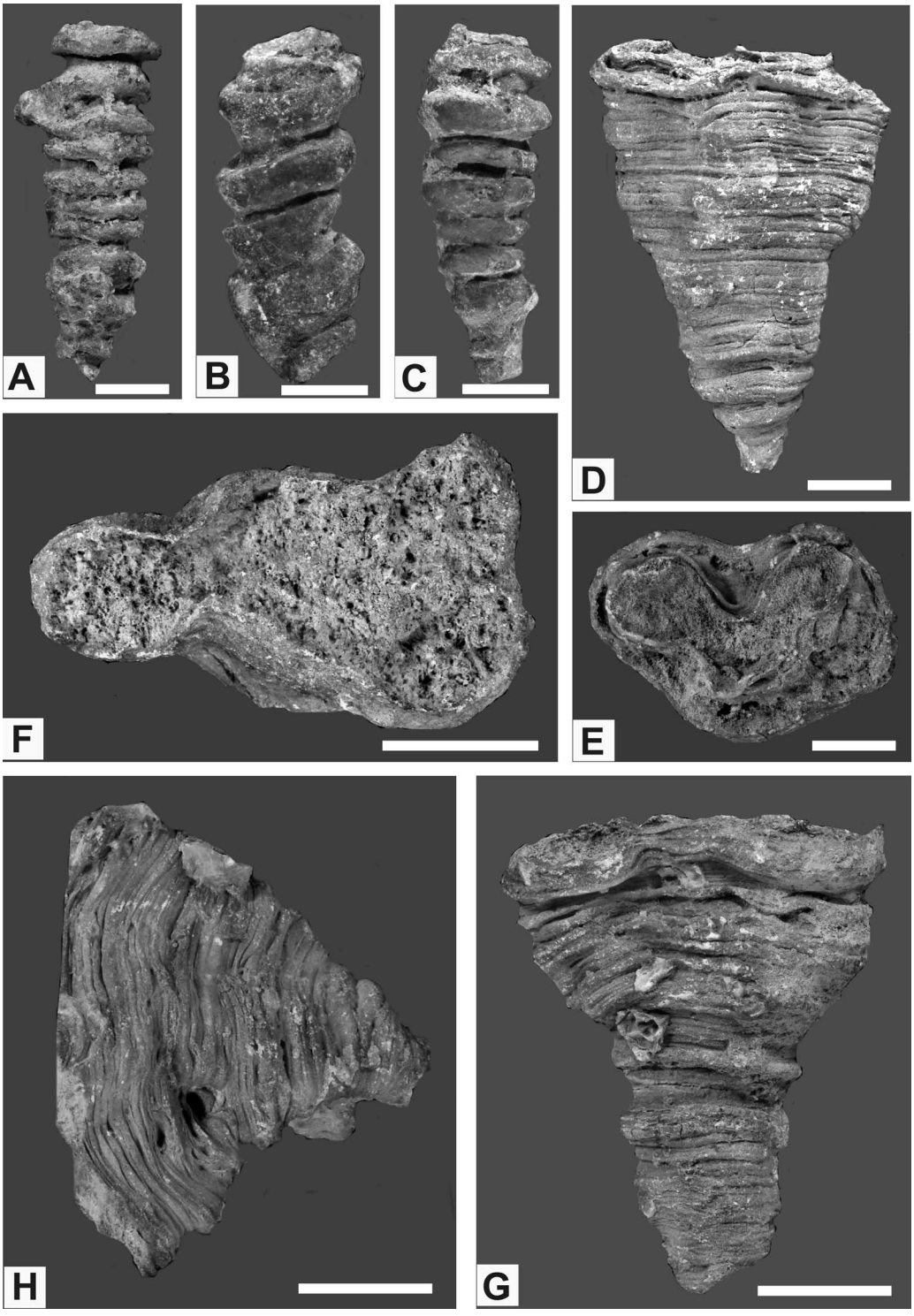
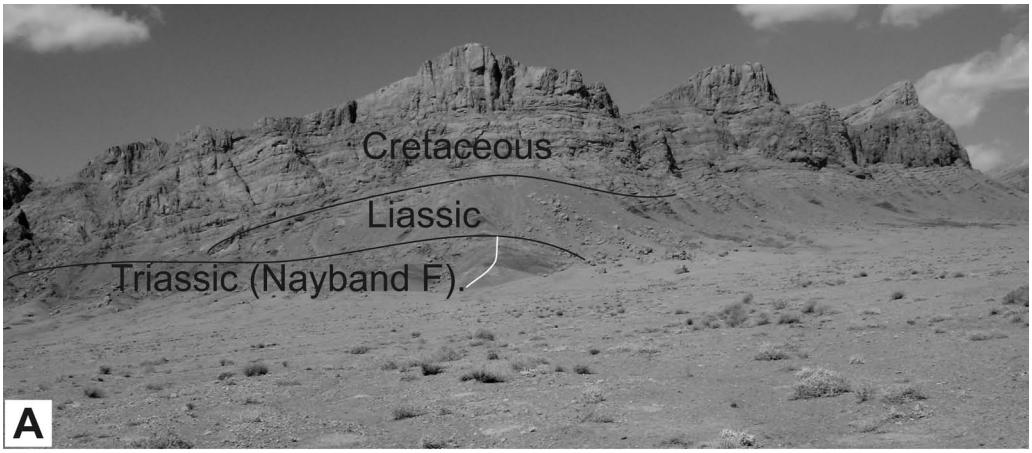

A
B
C
D
F
E
H
G

Plate 13

Fig. A. Overview of the locality in the field. The upper part of the escarpment is formed by *Orbitolina*-bearing limestone of Cretaceous (Barremian) age. The white line shows the position of the studied section.

Fig. B. Outcrup of a carbonate bed with abundant sheets of horizontally growing laminated spongiomorphids.

Fig. C. Outcrup of a large "colony" (diameter about 1.5 meter!) of the cylindrical and dendroid *Spongiomorpha* (*S. ramosa*? Frech). The locality is about 20 m fair from the "salt spring" (N. 33° 04´10´´; E. 52° 01´ 40´´, locality of Kristan-Tollmann et al., 1980). Here and in southern area of this locality spongiomorphs of dendroid types are very abundant.


Cretaceous
Liassic
Triassic (Nayband F).
A


B


C