Rivista Italiana di Paleontologia e Stratigrafia	volume 118	no. 2	4 pls.	pp. 247-260	July 2012

CHAMBERED HEXACTINELLID SPONGES FROM UPPER TRIASSIC (NORIAN-RHAETIAN?) REEFS OF NAYBAND FORMATION IN CENTRAL IRAN

B. SENOWBARI-DARYAN [1] & F. AMIRHASSANKHANI [2]

Received: November 14, 2011; accepted: February 13, 2012

Key words: Sponge, Hexactinellida, Reef, Triassic, Norian, Nayband Formation, Iran.

Abstract. This paper describes several chambered hexactinellid sponges, including *Casearia iranica* n. sp., *C. vezvanensis* n. sp., C. *delijanensis* n. sp., *Esfahanella magna* gen. n. n. sp., and *E. parva* gen. n. n. sp. from reefs of the Upper Triassic (Norian-Rhaetian) Nayband Formation exposed south of the town of Delijan in central Iran. The relative abundance of chambered and non-chambered hexactinellid sponges at this locality – as compared to hypercalcified representatives – highlight the importance of this group of sponges in reef and reefal limestones in central and east Tethys (China, Caucasia, Iran).

Riassunto. In questo articolo vengono descritte diverse spugne hexactinellidi tra cui *Casearia iranica* n. sp., *C. vezvanensis* n. sp., C. *delijanensis* n. sp., *Esfahanella magna* gen. n. n. sp., e *E. parva* gen. n. n. sp. Provenienti dai reef del Triassico Superiore (Norico-Retico) della Formazione Nayband, che affiora a sud della città di Delijan in Iran centrale. La relativa abbondanza di spugne hexactinellidi sia camerate che non camerate in questa località, se confrontata con le spugne ipercalcificate, mette in evidenza l'importanza di questo gruppo di spugne nei reef e nei calcari recifali nella Tetide centrale ed orientale (Cina, Caucaso, Iran).

Introduction

Chambered sponges, known as "Sphinctozoida" (Steinmann, 1882) or "Thalamida" (Laubenfels, 1955) are highly polyphyletic. The chambered construction is developed by all groups of sponges, including Hexactinellida, Calcispongida, Heteractinida, Demospongida as well as Archaeocyathida (Reitner 1990; Senowbari-Daryan 1991; Senowbari-Daryan & Garcio-Bellido 2002; Finks & Rigby 2004). The majority of chambered fossil sponges are hypercalcified (Senowbari-Daryan 1990) and most fossil specimens, as well as the recent hypercalcified genus – *Vacelatia* (Vacelet 1977) – belong to the Demospongea (Vacelet 2002; Wörheide 2008). Representatives of chambered hexactinellid sponges and other aforementioned groups are rare, with only a few genera known.

Earlier work has identified chambered hexactinellid sponges, *Spongia articulata* Schmidel, 1780 (= *Casearia* Quenstedt, 1858), from Jurassic deposits (for detailed synonymy see Müller 1974). Triassic representatives of chambered haxactinellid sponges were described much later, with the first reported occurrence of chambered hexactinellid sponge *Casearia* from the Triassic of Germany (Freyberg 1928). As mentioned by Pisera (1997) the segmentation of this sponge can not be seen and therefore its attribution to the genus *Casearia* is doubtful (compare Mehl 1992).

Generally hexactinellid sponges are not abundant in Triassic reefs, shallow water environments, or other sedimentary deposits (Rauf 1937). Wu & Xiao (1989) and Wu (1989, 1990) have described some chambered hexactinellid sponges from the Late Triassic (Carnian) reefs of northwest Sichuan, China (compare also Wendt et al. 1989; Rigby et al. 1998). Boiko (1990) reported several chambered hexactinellid sponges from Norian-Rhaetian and Jurassic reefs of the Caucasia. Chambered hexactinellid sponges from Upper Triassic reefs of the northwest Tethyan realm (alpine-mediterranean region) were not known, however, we have recently found the first chambered hexactinellid sponge belonging to the genus *Casearia*, described as *C. alpina* by Senowbari-Daryan & Zankl (2010) in Dachsteinkalk reefs (Norian)

1 Geozentrum Nordbayern, Department of Paleontology, University Erlangen-Nürnberg, Loewenichstr. 28, D-91054 Erlangen, Germany. E-mail: basendar@pal.uni-erlangen.de

2 Department of Geology, Science of Research branch, Islamic Azad University, Tehran, Iran. E-mail: amirhasankhani@gmail.com

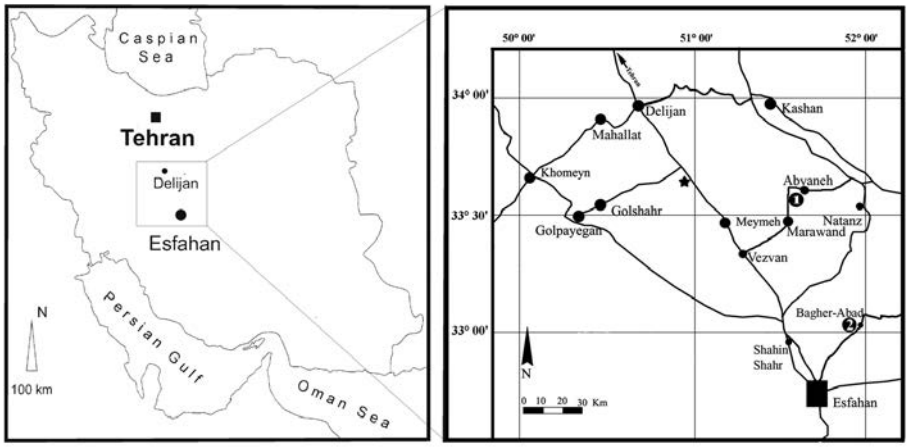

Fig. 1 - Geographic position of the locality, location of the sponges described in this paper is marked with an asterisk. GPS coordinates N 33° 38' 6.47"; E 50° 57' 47.42". The other nearest localities of Nayband Formation (1= near the towns Marawand and 2= Bagher-Abad) are also shown.

Fig. 2 - Panorama of three conical reef structures form which the sponges in this paper are described is shown with a white arrow.

of Hohe Göll (see Zankl 1969). Un-chambered and uncertain chambered hexactinellid sponges (*Casearia*) are reported by Keupp et al. (1989) from the Upper Triassic (Carnian) reef boulders of Cassian Formation of Dolomites, northern Italy. The first complete hexactinellid sponge species *Tremadictyon* cf. *roemeri* from the Middle Triassic (Anisian) of the alpine region was described by Tichy (1975).

The sponge association in the Upper Triassic reefs south of the town of Delijan, central Iran (Figs 1, 2) reveals the abundance of chambered and un-chambered hexactinellid sponges in central and eastern Tethys (Sichuan, Caucasia, Iran). Hexactinellid sponges, both chambered and un-chambered types, are found in different localities of the Upper Triassic Nayband Formation (Norian-Rhaetian) in Iran (compare Senowbari-Daryan & Hamedani 1999; Senowbari-Daryan 2005a). Of note is the relatively abundance of hexactinellid sponges in reefs, exposed south of the town of Delijan (Figs 1, 2) (Senowbari-Daryan 2005a, 2005b). In these reefs the species diversity of un-chambered haxactinellid sponges is (possibly) higher than chambered representatives. A large un-chambered hexactinellid species with a diameter of 17 cm and a height of approximately 30 cm was described as *Naybandospongia gigantia* in a separate paper by Rigby, Senowbari-Daryan & Hamedani (2005).

The separation of un-chambered from chambered hexactinellid sponges is complex. Some representatives of un-chambered hexactinellids build very low crescent-like cavities between the elongated rays of hexactine spicules. The preceding hexactine lattice is supported by the elongation of one ray of hexactine spicule (Fig. 3). Representatives of this group are excluded from chambered types and calcified as un-chambered types. Such species without a spongocoel are attributed to the genera *Dracospongia* by Rigby et al. (1998) and those with spongocoel to *Radiopelica* by Wu (1990) and also by Rigby et al. (1998).

Representatives of the chambered hexactinellid sponges exhibit distinct outer and inner segmentation. Two types of chambered hexactinellis were found. The first type is characterized by chamber walls (exo-, inter and endowalls) build by hexactine lattice. The chamber roofs are not supported to the preceding or younger chamber roofs by elongation of one ray of hexactine spicule (Pl. 1, figs 1, 3-4; Pl. 2, figs 1, 4; Pl. 3, figs 4, 6). In other words, the chamber interiors are whole and do not contain any spicules as internal skeleton or skeletal filling. One ray of hexactines may extend into the chamber interior, but never reaches the chamber roofs of the preceding chambers (Pl. 3, fig. 6; Fig. 4). The skeletal construction of this type corresponds the hypercalcified chambered sponge with ring-chambers without internal filling skeleton, like *Amblysiphonella*. The second type of chambered hexactinellis is characterized by chamber walls built by a hexactinellid lattice with irregularly arranged hexactine needles secreted within the chamber interiors that support the chamber roofs of younger chambers against the preceding chambers

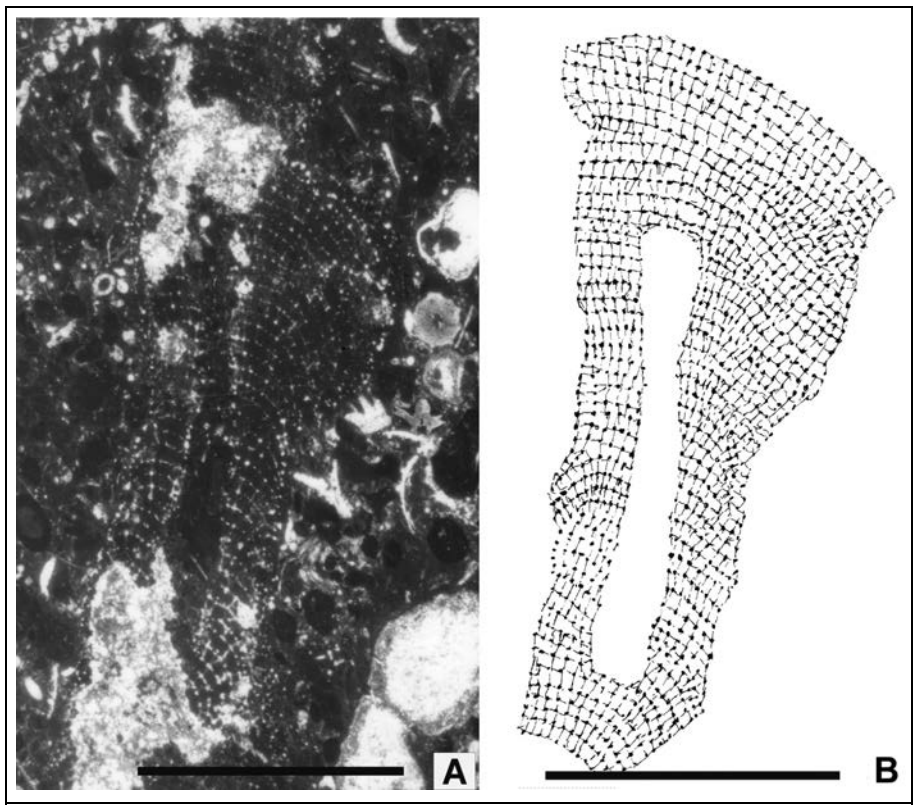

Fig. 3 - A) Longitudinal section of a non-chambered hexactinelid sponge, which is built by a hexactine lattice. The cavities between the horizontally layers are not interpreted as chambers. B) The same sponge shows the arrangement of the hexactine needles. Scale = 5 mm.

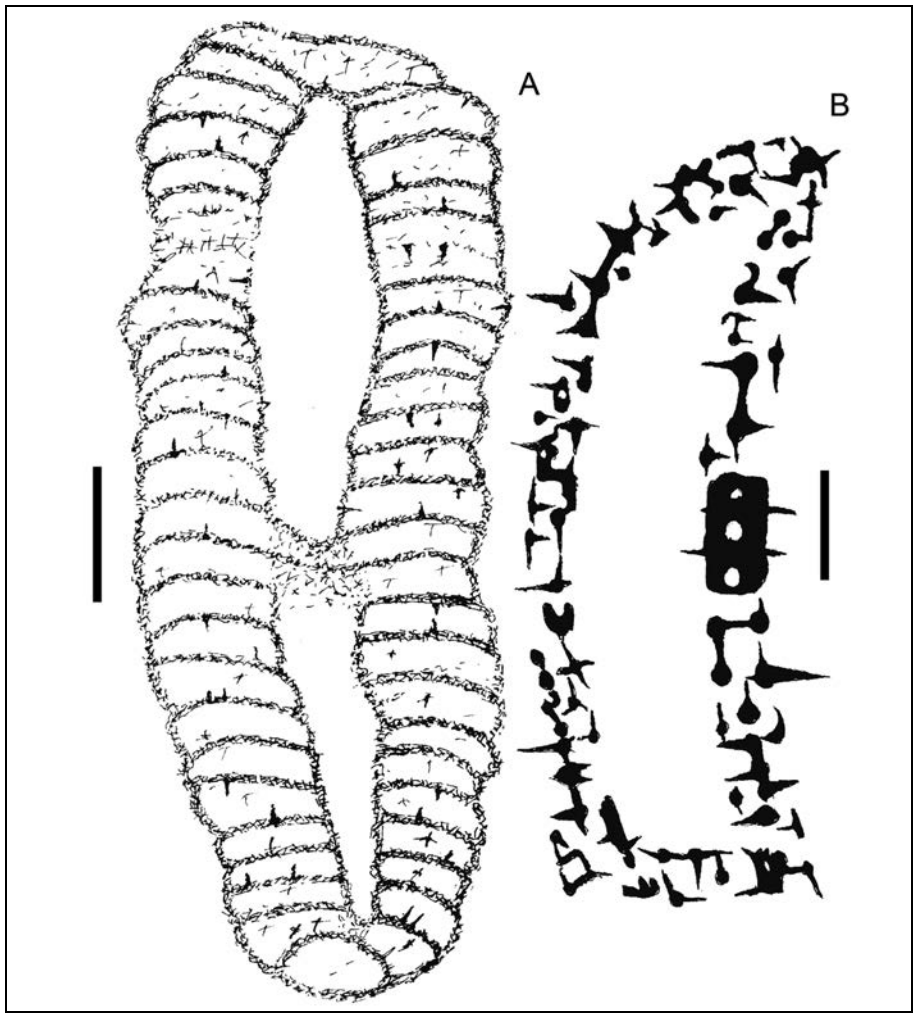

Fig. 4 - A) *Casearia vezvanensis* n. sp. Holotype (drawn from Pl. 2 fig. 4) showing the hollow chambers, chamber walls with a prolongated ray of hexactines. Scale bar = 10 mm; B) Magnification of a chamber wall exhibiting the arrangement of hexactines. Scale bar = 1 mm

Fig. 5 - *Esfahanella parva* gen. n. n. sp. (Holotype). Drawn from Pl. 2, fig. 3 showing the ring-like chambers with thin chamber walls. The interior of the chambers, especially the old chambers contain filling skeleton composed of irregularly arranged hexactine needles.

(Pl. 1, fig. 5; Pl. 2, fig. 3; Fig. 5). This type corresponds the other hypercalcified chambered sponges with an internal filling skeleton, such as the genus *Stylothalamia* with pillar-like filling skeleton or *Solenolmia* with reticulate filling skeleton. As shown in Fig. 5, generally the old chambers contain richer filling skeleton than the young chambers.

Locality

The locality is situated on the right side of the highway from Tehran to Esfahan (geological map of Golpaygan, Nr. E7, 1:250.000, completed by Thiele et al. 1968). Approximately 50 km south of the town of Delijan (from Delijan to the town of Vezvan) several Upper Triassic (Norian-Rhaetian?) reefs of conical geometry are exposed on the right side of the highway. All reef structures overlie bedded sandy limestones of the Nayband Formation and have a variety of different reef building organisms (including different types of corals, hypercalcified and hexactinellid sponges). The relative abundance of chambered and non-chambered hexactinellids sponges at this site (called Delijan reefs by Senowbari-Daryan 2005a) differs from other reef structures of the Nayband Formation in central and northeast Iran. The occurrence of the globular hydrozoan *Heterastridium conglobatum* and *H. lobatum* is also mentionable. *H. lobatum*, which is almost absent in the next nearest area of Nayband Formation (e. g. near the town Marawand or Bagher-Abad, see Fig. 1), occurs in relative abundance at this locality.

Because of the fragility of the hexactine skeleton, many sponge specimens were broken and whole skeletons were not preserved (Pl. 3, figs 6, 8). The occurrence of extremely abundant hexactine needles within the micritic matrix are evidence of the destroyed skeletons (Pl. 4, figs 5, 6). The matrix of the hexactinellid sponge bearing carbonates is micritic and the skeletal spaces in the well-preserved specimens are filled with micrite. This observation suggests a relatively deeper water (deeper than the storm base) depositional environment, although some scleractinian corals occur.

Representatives of chambered hexactinellid sponges from the aforementioned locality are described

in the following sections. The description of non-chambered hexactinellid sponges will follow in a further publication.

Repository: The studied material (thin sections) is housed in the "Bayerische Staatssammlung für Paläontologie und Geologie" (Bavarian State Collection for Palaeontology and Geology), Richard Wagner Str. 10, 80333 München (Munich), Germany under the numbers BSPG 2011 XLIV 1- 9.

Systematic Palaeontology

Class **Hexactinellida** Schmidt, 1870

Order **Innaecoeliida** Boiko, 1990

Family Craticulariidae Rauff, 1893

Synonymy: Caseariidae Schramen, 1937; Innaecoeliidae Boiko, 1990; Monilispongiidae Wu, 1990; Dracolychniidae Wu 1990 (compare Reid 2004: 486).

Genus *Casearia* Quenstedt, 1858

Type species: *Spongia articulata* Schmidel, 1780

Synonymy: *Innaecoelia* Boiko, 1990; *Monilispongia* Wu, 1990.

Remarks. The systematic position of the genus *Casearia* is controversial. Laubenfels (1955: err. *Caesaria*) attributed *Casearia* to the family Pleurostomatidae. This systematic was followed by some other workers, e. g. by Müller (1974). Mehl (1992), Pisera (1997: 55) and Krautter (2002) considered *Casearia* as Hexactinosa "incertae sedis". Rigby et al. (1998) placed *Casearia*, with question-mark, in the family Craticulariidae Rauff. This systematic is followed by Reid (2004).

Following the emended diagnosis by Pisera (1997: 38) the family Craticulariidae is characterized by "Dictyonal framework euretoid showing primary canalization in the form of diplorhysis with epi- and aporhyses in quadrunx arrangement. Dermal skeleton if observed developed as pentactines with distal ray absent, often fused with the proximal one to the choanosomal skeleton and forming tangential veil". In extinct forms of the family Craticulariidae the chambered construction is lacking.

Mehl (1992) synonymied *Innaecoelia* Boiko (1990) with *Casearia* and Rigby et al. (1998) synonymied *Monilispongia* Wu (1990) with *Caesarea*, too. As discussed before, the chambered construction is a polyphyletic feature and occurs in all sponge groups, including the hexactinellids. We propose to classify (at present time) the representative of segmented hexactinellid sponge to the order Innaecoeliida Boiko (1990) until clearness about the identity of internal skeleton pattern exists (see also Senowbari-Daryan & Garcia-Bellido 2002). Here this classification is followed.

Casearia iranica n. sp.

Pl. 1, figs 1-4; Pl. 3, fig. 2-3, 7

2002 *Casearia* sp.- Senowbari-Daryan & Garcia-Bellido, p. 1516, fig. 5/C, 5E.

2011 *Caesaria* sp.- Senowbari-Daryan et al., p. 276, pl. 1, fig. I.

Derivatio nominis: Named from the occurrence of the species in Iran.

Holotype: Plate 1, fig. 1 (magnifications in Pl. 4, figs 2-3, 7) (BSPG 2011 XLIV-1).

Paratypes: Pl. 1, figs 3, 6.

Locus typicus: Reefs, located approximately 50 km south of the town of Delijan, at the right side of the highway Delijan-Esfahan (Figs 1, 2).

Stratum typicum: Nayband Formation, Upper Triassic (probably Norian, Rhaetian?)

Material: Three specimens (inventory: BSPG 2011 XLIV-1, BSPG 2011 XLIV-2 BSPG 2011 XLIV-X).

Diagnosis: Chambered cylindrical-conical hexactinellid sponge with ring-chambers and well recognizable outer segmentation. Wide Spongocoel is of retrosiphonate type. Chamber walls even perforated and are formed by haxactine lattic. Chamber interiors are without additional skeleton.

Description. Three specimens of this sponge were found in Delijan Reefs. Two specimens are cut in oblique longitudinal direction, the third one in axial longitudinal section. The first one (holotype, Pl. 1, fig. 1) is composed of eight ring-shaped chambers arranged around a wide spongocoel of retrosiphonate type. The holotype reaches a diameter of 34 mm, spongocoel of 15 mm and heights of the chambers up to 9 mm. In the second one (Pl. 1, fig. 3) only six chambers are cut. The third one has a conical (?) shape reaching a height of 70 mm with a diameter of 40 mm at the top, only 20 mm at the base. The width of the chambers is relatively constant reaching an average diameter of 10 mm in all three specimens. The diameter of the retrosiphonate spongocoel is at least 17 mm in the holotype (15 mm or 12 mm in one paratype, almost half of the whole sponge diameter). The exo-, inter- and endowalls have the same thickness. The walls are composed of a lattice of hexactine needles and perforated by evenly sized pores (Pl. 3, figs 2-3). The diameter of the pores of the endowall (spongocoel wall) is larger than the exo- and interwalls. The hexactinellid spicules reach a diameter of approximately 20 µm and the regular spaces between the spicules have a diameter of 40 µm. The maximum length of individual rays of hexactines in the wall is about 100 µm, the prolonged rays into the chamber interior reach a length of up to 600 µm. The outer surface of the chamber roofs (interwalls) is usually smooth but from the internal surface of the roofs or from the exowalls

one hexactine ray my elongated into the chamber interior. The interior of the chambers is filled by micrite and some tubes are coated with microbial crusts. The biometrical data of all three specimens of *Casearia iranica* n. sp. are listed in Tab. 1.

Comparison. See after the description of the other species of the genus.

Occurrence. In addition of the specimens from Delijan-Reefs (see Fig. 2) Senowbari-Daryan et al. (2011: plate 1/I) described a specimen of chambered hexactinellid sponge from the reefs of the Nayband Formation near Yazd (central Iran) as *Casearia* sp. The dimensions and other characteristics of this species correspond to *C. iranica*. Therefore, Yazd is the second locality where this sponge occurs.

Casearia vezvanensis n. sp.

Pl. 2, fig. 4; Pl. 3, fig. 4; Fig. 4

Synonymy: 1999 *Casearia articulata* (Schmidel, 1780) – Senowbari-Daryan & Hamedani, p. 94, pl. 7, fig. 1-4.

Derivatio nominis: Named from the nearest town of Vezvan (south of the locality, see Fig. 1).

Holotype: Pl. 2, fig. 4; Pl. 3, fig. 4; Fig. 4A. (BSPG 2011 XLIV-4).

Paratypes: Specimens described by Senowbari-Daryan & Hamedani (1999, Pl. 7, figs 1, 2).

Locus typicus: Reefs, located approximately 50 km south of the town of Delijan, at the right side of the highway Delijan-Esfahan (Figs 1-2).

Stratum typicum: Reefs within the Nayband Formation, Upper Triassic (most probably Norian).

Material: One well preserved specimen and some fragments.

Diagnosis: A cylindrical species of the genus *Casearia* with low chambers and relatively coarse and loose packed hexactinellids forming the chamber walls.

Description. This cylindrical species is composed of numerous chambers reaching a length of up to 65 mm (60 mm, this and all data in parenthesis are according to Senowbari-Daryan & Hamedani 1999) and diameter of 25 mm (20-23 mm). A spongocoel of retrosiphonate type with a diameter of 8 mm (10 mm) passes internally through the whole sponge. The poorly preserved outer annulation corresponds to the internal segmentation. Heights of the chambers are relatively constant, varying between 2 mm and 3 mm (3 mm). Chamber walls are equal in thickness, measuring between 0.3 mm and 0.4 mm (0.3-0.4 mm) and are formed by both coarse and loosely packed hexactine lattices. Usually a long ray (up to 1 mm) of hexactines is extended into the chamber interior, but never into the spongocoel (Fig. 4A-B). The chamber walls as well as the wall of the spongocoel are pierced by small pores, measuring about 0.2-0.4 mm (0.2-0.4 mm). The biometrical data of the sponge are listed in Tab. 1.

Comparison. See after the description of the next species.

Casearia delijanensis n. sp.

Pl. 2, fig. 1, 2; Pl. 3, fig. 1

Derivatio nominis: Named after the town of Delijan, about 50 km north of the locality.

Holotype: Plate 2, Fig. 1-2 (BSPG 2011 XLIV-5).

Locus typicus: Reefs, located approximately 50 km south of the town of Delijan, at the right side of the highway Delijan-Esfahan (Figs 1, 2).

Stratum typicum: Reefs within the Nayband Formation, Upper Triassic (most probably Norian).

Material: One specimen only.

Diagnosis: Cylindrical species of the genus *Casearia* with thin chamber walls with compact appearance composed of smaller hexactine. A very short ray of hexactins may extend into the chamber interior. The spongocoel wall contains larger openings than in the chamber walls.

Description. The only specimen in collection is partly well preserved exhibiting the sponge features in detail. The cylindrical sponge reaches a height of at least 45 mm with a diameter of 25 mm. An axial spongocoel of retrosiphonate type with a diameter of 10 mm passes internally through the whole sponge. The height of ring-shape chambers varies between 4 mm and 6 mm. Conditioned by small hexactines amalgamated to lattices the thin chamber walls of 0.2 mm appear compact (Pl. 2, fig. 2; Pl. 3, fig. 1). Rarely a very short ray of hexactine may extend into the chamber interiors. The chamber walls are pierced by pores of 0.2-0.3 mm in diameter (Pl. 3, fig. 1). The openings of 0.4-0.7 mm on the relatively thick spongocoel wall, however, are lager than the pores of the chamber walls (Pl. 2, fig. 2). The biometrical data of the sponge are listed in Tab. 1.

Comparison. The biometrical data of the three described species, charactering the species determination are listed in Tab. 1. Such it appears that *C. iranica* with a sponge diameter of 30-40 mm and other large biometrical data is clearly differentiated from two other species. The sponge diameters and some other biometrical data of C. *valiabadensis* and *C. delijanensis* are almost identical. These species are differentiated by chamber heights, different perforation pattern of exo- and endowall in one case and interwall in another case, by the thickness of the chamber walls, and finally the loose packed hexactines in *C. valiabadensis* differs this species from *C. delijanensis*. In addition the extended ray into the chamber interiors in *C. valiabadensis* is abundant and much longer than in *C. delijanensis*. The differences between the three new species from Iran and other known species of Triassic are listed in Tab. 1.

Genus *Esfahanella* gen. n.

Type species: *Esfahanella magna* n. sp.

Derivatio nominis: Named from Esfahan (central Iran), the next large city to the type locality.

Diagnosis: Cylindrical chambered hexactinellid sponge with ring-like chambers. Well developed internal segmentation which is indistinctly recognizable from the exterior. Spongocoel of retrosiphonate type. Chamber walls are formed by hexactine lattice. Chamber interiors contain filling skeleton composed of hexactine spicules supporting the chamber roofs.

Comparison. *Esfahanella* gen. n. differs from *Casearia* by having skeletal elements as filling skeleton within the chamber interiors, like *Caucasocoelia* Boiko (1990) or *Dracholychnos* Wu & Xiao (1989). *Esfahanella* gen. n. differs from the asiphonat *Caucasocoelia* for a spongocoel extending through the whole sponge. *Esfahanella* gen. n. is differentiated from the funnel-shaped to broadly obconical *Dracholychnos* by the cylindrical shape of the sponge. *Esfahanella* gen. n. is similar to *Pseudoverticillites* Boiko (1990), but differs from it by having the internal filling skeleton composed of hexactines.

Further species. *E. parva* gen. n. n. sp.

Esfahanella magna gen. n. n. sp.

Pl. 1, fig. 5

Derivatio nominis: *Magnus* (lat. = large, big). Named for the large diameter of the species compared with *Esfahanella parva* n. sp.

Holotype: Pl. 1, fig. 5 (BSPG 2011 XLIV-6).

Locus typicus: Delijan-Reefs (see Fig. 2).

Stratum typicum: Reefs of the Nayband-Formation (probably Norian, Rhaetian?).

Material: One specimen only.

Diagnosis: Large species with relatively flatted crescent-shaped ring-chambers arranged around a very wide retrosiphonate spongocoel that passes through the whole sponge. Because the chamber height decreases at the periphery of the sponge, the chambered construction is either not identifiable or weakly recognizable from the exterior. The chamber walls are composed of a hexactine lattice. Chamber interiors contain loose or amalgamated hexactine needles.

Description. This singular specimen is cut in oblique longitudinal section and exhibits all characteristics of the sponge. This cylindrical sponge has a diameter of 63 mm and composed of numerous flatted ring-chambers arranged around a wide retrosiphonate spongocoel having a diameter of 40 mm.

The outer segmentation of the sponge is weakly developed and hardly recognizable. The chamber width varies between 10 mm and 15 mm. The height of the chambers varies between 3 mm and 4 mm. The chamber walls have a thickness of 0.8 mm and are built by hexagonal needles amalgamated into a hexactine lattice. The chamber interiors also contain loose and amalgamated hexactine needles.

Species/Thin section	L	ODS	DS	CH	CW	DPI	DPE	WT
Casearia iranica	40	30	12	7-8	10	0.2-0.25	0.6-0.8	0.3-0.5
Casearia iranica	70	40	17	5-8	10-11	0.2-0.3	0.6-0.8	0.15-0.5
Casearia iranica	45	33	15	6-8.5	9-10	0.15-0.25	0.6.0.8	0.4-0.6
Casearia vezvanensis	65	20-25	8-10	2-3	5-6	0.2-0.4	0.2-0.4	0.3-0.4
Casearia delijanensis	45	25	10	4-6	6	0.2-0.3	0.4-0.7	0.2

Tab. 1 - Skeletal dimensions of the three described species of the genus *Caesarea.* L) length of the sponge, ODS) outer diameter of the sponge, DS) diameter of the spongocoel, CH) chamber height, CW) chamber width, DPI) diameter of the pores in exo- and interwalls, DPE) diameter of the pore in the endowal (wand of spongocoel), WT) thickness of the walls. All measurements are in mm.

Esfahanella parva gen. n. n. sp.

Pl. 2, fig. 3; Pl. 4, fig. 1; Pl. 4, fig. 1; Fig. 5

Derivatio nominis: *Parvus* (lat. = small). Named for the small diameter of the species compared with the type species *E. magna* gen. n. n. sp.

Holotype: Pl. 2, fig. 3 (BSPG 2011 XLIV-7).

Paratype: Pl. 4, fig. 1 (BSPG 2011 XLIV-8).

Locus typicus and stratum typicum: As preceding species.

Material: Two specimens (BSPG 2011 XLIV-7 and BSPG 2011 XLIV-8).

Diagnosis: Internally and externally well segmented, a small species of the genus *Esfahanella*. Chamber interiors, especially the old chambers contain loose filling skeleton composed of hexactine needles. Chamber walls have numerous pores.

Description. The holotype (Pl. 2, fig. 3, compare Fig. 5) is an almost incomplete specimen, reaching a length of 23 mm with a diameter of 15 mm in its youngest part. The base and top of the sponge are broken away. An axial spongocoel of 3 mm passes internaly through the sponge. It is composed of 6 chambers with chamber heights of 3-4 mm. Chamber interiors, especially the old chambers contain loose filling skeletons composed of hexactine needles (Fig. 5). Chamber walls are 0.3 mm thick and pierced with numerous small pores.

The second specimen is also an incomplete specimen with a diameter of 13 mm (spongocoel 3 mm) and cut in oblique cross section exhibiting two chambers, spongocoel and the filling skeleton within the chamber interiors (Pl. 4, fig. 1), corresponds to the holotype.

Comparison. *Esfahanella parva* gen. n. n. sp. differs from the type species *Esfahanella magna* gen. n. n. sp. by the dimensions of the sponge, chamber height, chamber shape, narrow spongocoel, and by large hexactine needles. The indistinct outer segmentation of *E. magna* gen. n. n. sp. is well developed in *E. parva* gen. n. n. sp.

Esfahanella cf. **E. magna** n. sp.

Pl. 4, figs 2-4

Material: One specimen only (BSPG 2011 XLIV-9).

Description. This V-shaped sponge reaches a height of 110 mm. The diameter of sponges on its youngest part is 70 mm, where the spongocoel has a diameter of 40 mm. The sponge wall is about 5-6 mm thick. Due to recrystallization, the chambered construction of this sponge is recognisable only on the youngest part of the sponge (Pl. 4, figs 3, 4). Also the base of the skeleton and the sponge wall in part indicate the chambered nature of this sponge (Pl. 4, fig. 2: arrows). The interior of the young chambers contains sparse filling skeleton: therefore its attribution to the genus *Esfahanella.* This species differs from *Esfahanella magna* gen. n. n. sp. by the V-shaped skeleton and lower chambers.

PLATE 1

Fig. 1 - *Casearia iranica* n. sp. Holotype. Marginal axial section exhibiting the ring-shape chambers arranged around a wide axial spongocoel. The thin chamber walls were formed by hexactine lattice. Chamber interiors are whole without any spicular skeleton. Arrow indicates the magnification in Fig. 2. (BSPG 2011 XLIV 1).

Fig. 2 - Magnification from Fig. 1 (arrow) shows the spongocoel wall built by hexactine lattice.

Fig. 3 - *Casearia iranica* n. sp. Similar section to the holotype illustrated in Fig. 1. (BSPG 2011 XLIV 2).

Fig. 4 - *Casearia iranica* n. sp. Oblique longitudinal section exhibiting numerous ring-shape chambers around the spongocoel of retrosiphonate type. (BSPG 2011 XLIV X).

Fig. 5 - *Esfahanella magna* gen. n. n. sp. Holotype. Oblique longitudinal section through the broken specimen exhibiting low, crescent-like chambers. Chamber interiors contain filling skeleton of hexactine needles. (BSPG 2011 XLIV-6).

Scale in figs 1, 3-5 = 10 mm, in fig. 2 = 1 mm.

PLATE 2

Fig. 1 - *Casearia delijanensis* n. sp. Holotype. Longitudinal section showing the well preserved skeletal elements on the right side of the photograph. The chamber walls appear as thin lines. The small white arrow shows the spongocoel wall with large openings enlarged in fig. 2. (BSPG 2011 XLIV-5).

Fig. 2 - Enlargement from fig. 1 (arrow) showing the thick spongocoel wall with large openings and a part of the thin chamber wall with a small opening.

Fig. 3 - *Esfahanella parva* gen. n. n. sp. Holotype. Oblique longitudinal section showing the ring-like chambers arranged around the axial spongocoel. Chamber interiors, especially the old chambers are filled with skeletal filling composed of hexactine needles.

Fig. 4 - *Casearia vezvanensis* n. sp. Holotype. Longitudinal section exhibiting numerous low and crescent-like chambers with thin chamber walls (compare Fig. 3A). For magnification of the chamber walls and hexactine spicules see Pl. 3, fig. 4 and Fig. 3B) (BSPG 2011 XLIV-4).

Scale in figs 1, 4 = 10 mm, in fig. 2 = 1 mm, in fig. 3 = 5 mm.

PLATE 3

Fig. 1 - Magnification of the chamber walls of the *Casearia delijanensis* n. sp. holotype (illustrated in Pl. 2, fig. 1) highlighting the perforation pattern.

Fig. 2 - The holotype of *Casearia iranica* n. sp. (illustrated in Pl. 1, fig. 1) shows the equally perforated chamber exowall with smooth outer surface.

Fig. 3 - *Casearia iranica* n. sp. (Holotype, illustrated in Pl. 1, fig. 1). The grainy appearing spongocoel wall shows a large opening approximately 1 mm in diameter.

Fig. 4 - Magnification from Pl. 2, fig. 4 (holotype of *Caesarea valiabadensis* n. sp.) showing two chamber walls with hexactine needles. A short ray of hexactines are extended into the chamber interior.

Fig. 5 - *Esfahanella parva* gen. n. n. sp. The magnification from the holotype illustrated in Pl. 2, fig. 2 shows a chamber with chamber walls and sparse filling skeleton within the chamber interior.

Fig. 6 - Magnification from fig. 8 shows the chamber walls composed of hexactine and some elongated ray of hexactine needles into the chamber interiors.

Fig. 7 - The spongocoel wall of *Cesearia iranica* n. sp. (illustrated in Pl. 1, fig. 1) shows the grainy appearing wall composed of small hexactgine lattice pierced by large openings.

Fig. 8 - Incomplete chambered hexactine sponge gen et sp. indet showing the chamber walls. For magnification see fig. 6.

Scale bars= 1 mm.

PLATE 4

Fig. 1 - *Esfahanella parva* gen. n. n. sp. Oblique section through two or three chambers exhibiting the chamber walls and the filling skeleton within the chamber interiors (BSPG 2011 XLIV-8).

Fig. 2 - *Esfahanella* cf. *E. magna* n. sp. Oblique longitudinal section through the V-shaped sponge. The large arrows indicate the chamber walls, appearing as lines and the small arrows indicate the partly magnification of the sponge wall in figs 3 and 4 (BSPG 2011 XLIV-9).

Fig. 3 - Magnification of the youngest part of the sponge from fig. 2 exhibiting the chamber walls and the spare filling skeleton within the chamber interiors.

Fig. 4 - As fig. 3 from the opposite end of the sponge wall in fig. 2.

Fig. 5 - Numerous decayed spicules within the micritic matrix are very abundant in investigated material.

Fig. 6 - As fig. 5. Some hexactines are well recognizable.

Scale in figs 1-2 = 10 mm, in figs 3-4 = 5 mm, in figs. 5-6 = 1 mm.

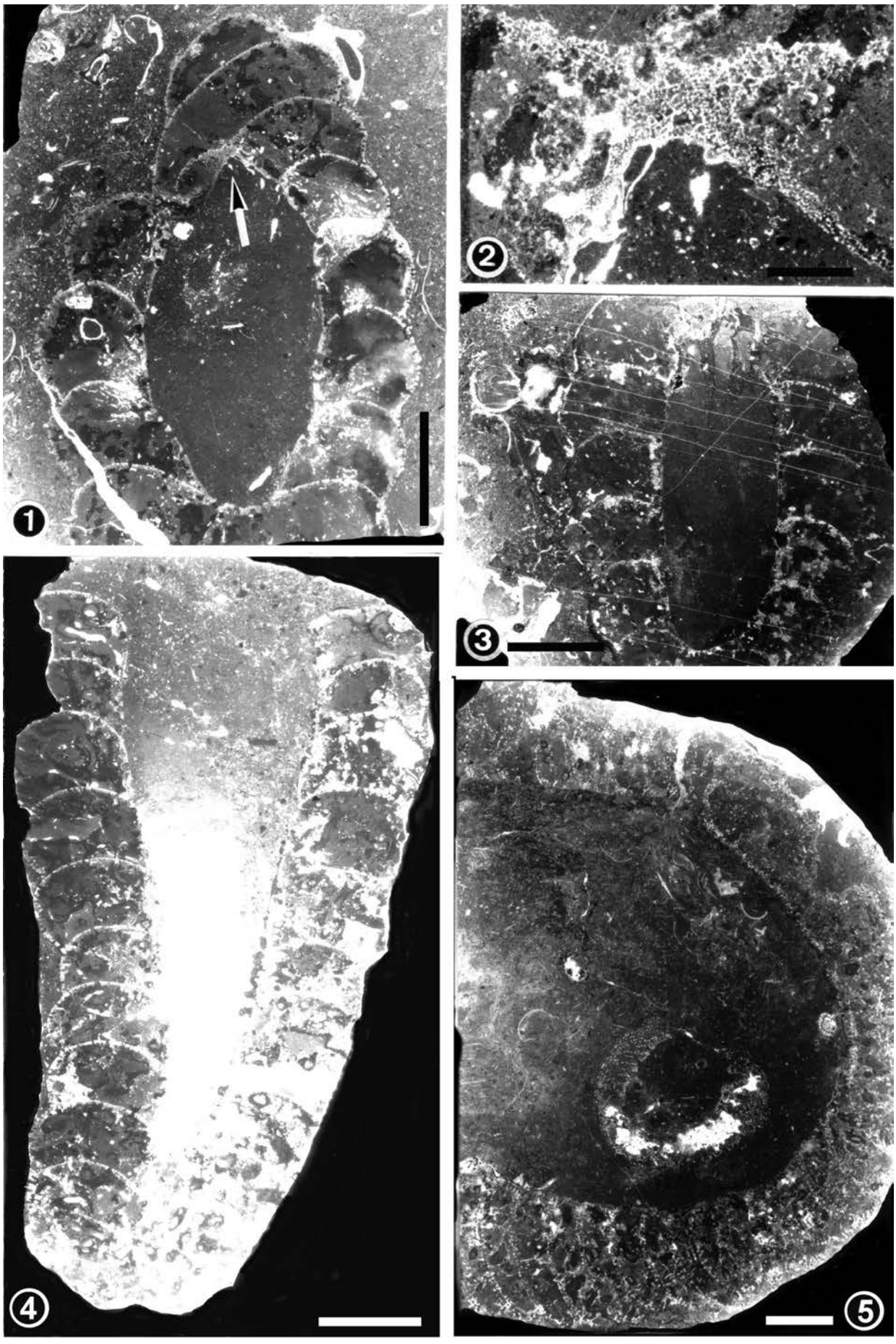

PLATE 1

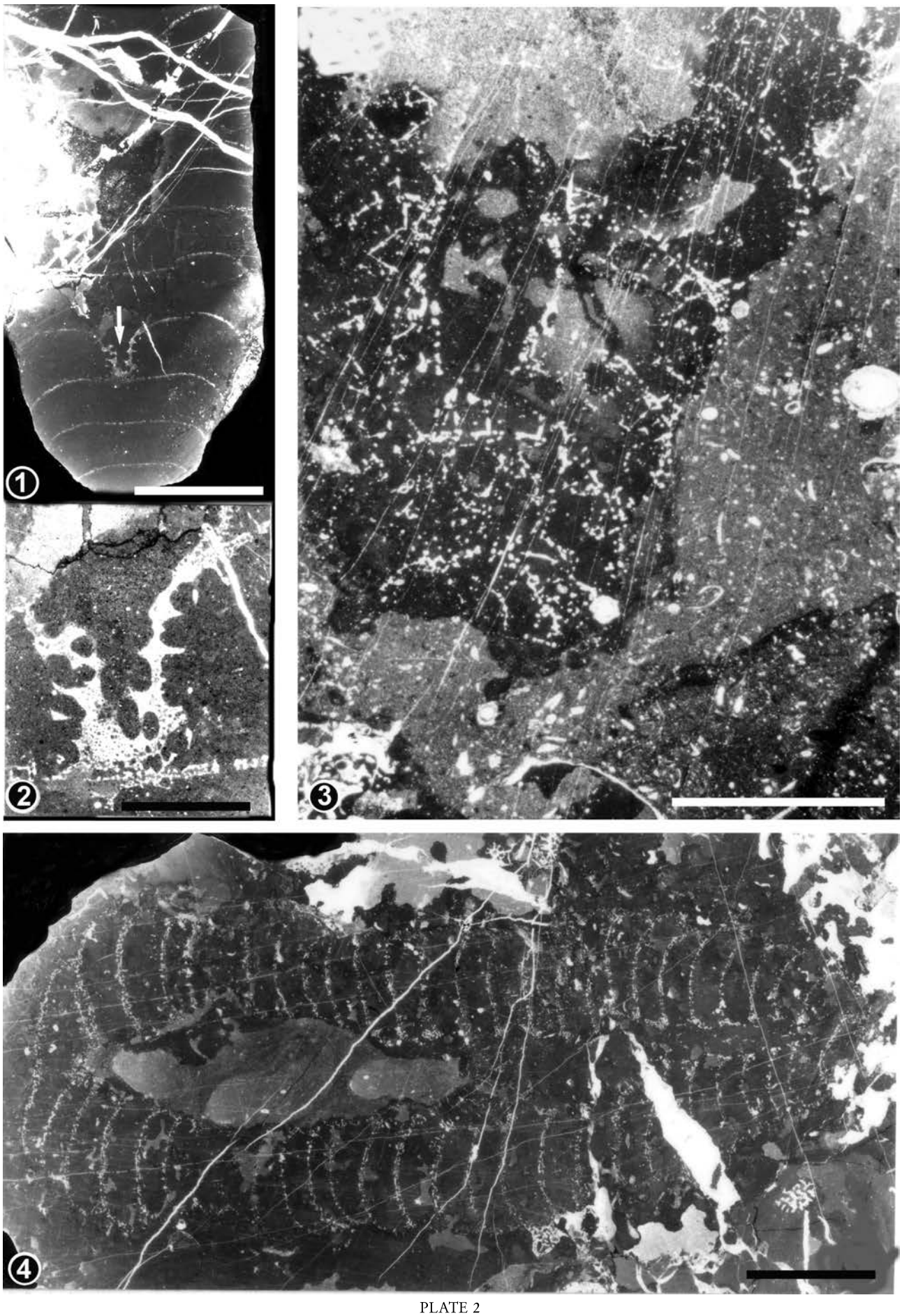

PLATE 2

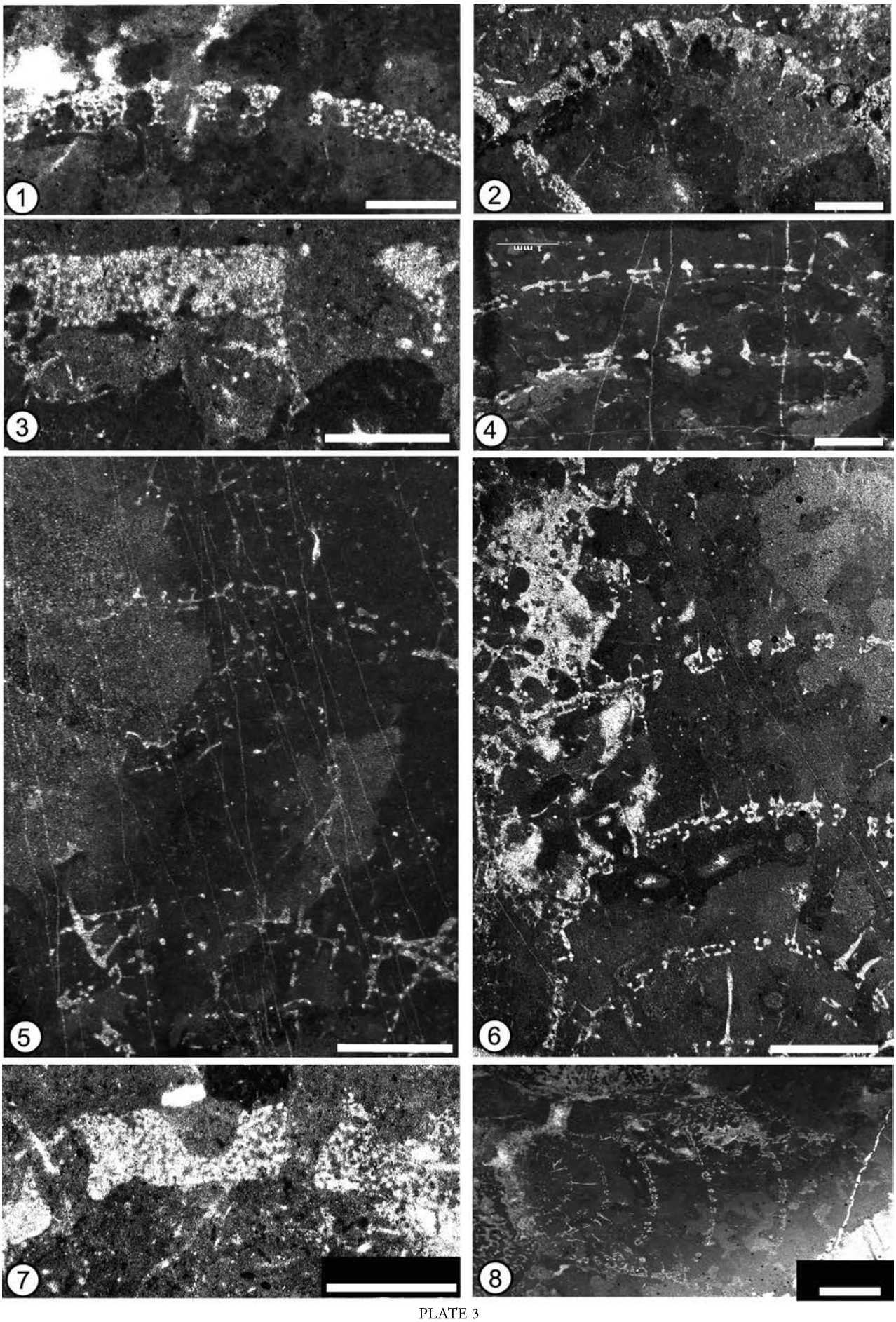

PLATE 3

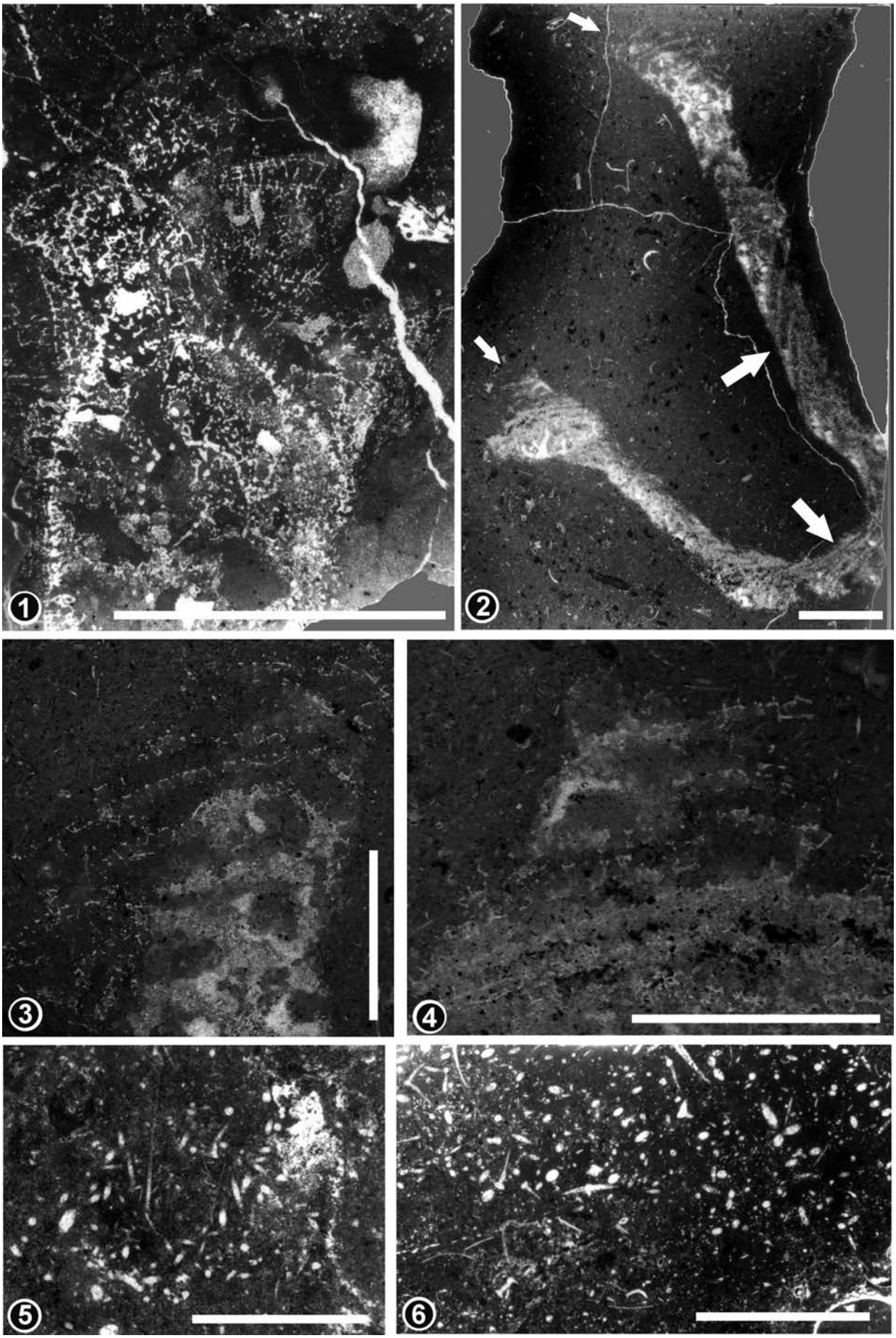

PLATE 4

Acknowledgements. The investigations were carried out by the financial support of the "Fonds der Universität Erlangen-Nürnberg" to B. Senowbari-Daryan. Rowan Martindale (Los Angeles) is gratefully acknowledged for the English correction of the manuscript.

REFERENCES

Boiko E. V. (1990) - Variability of skeletal structure in segmented sponges. in: Fossil Problematica of USSR, Akademy of Science USSR, Institute of Geology and Geophysics, Siberian Department, 783: 119-129 (in Russian).

Finks R. & Rigby J. K. (2004) - Porifera. In: Kaesler R. L. (Ed.) - Treatise on Invertebrate Paleontology, Part E, vol. 3: Paleozoic Hexactinellid Sponges: 319-583, Lawrence, Kansas.

Fryberg B. (1928) - *Casearia* sp., ein Schwamm aus dem Muschelkalk von Sonderhausen. *Beitr. Geol. Thüringen*, 1: 24-27.

Keupp H., Reitner J. & Salomon D. (1989) - Kieselschwämme (Hexactinellida und "Lithistida" aus den Cipit-Kalken der Cassianer Schichten (Karn, Südtirol). *Berliner geowiss. Abh*., A, 106: 221-241.

Krautter M. (2002) - Fossil Hexactinellida: An overview. In: Hooper J. N. A. & Van Soest R. W. M. (Eds): Systema Porifera, Vol. 2: 1511-1538, Plenum press, New York.

Laubenfels M. W. De (1955) - Porifera. Treatise on Invertebrate Paleontology, Part E, 122 pp., Lawrence, Kansas.

Mehl D. (1992) - Die Entwicklung der Hexactinellida seit dem Mesozoikum. Palökologie, Phylogenie und Evolutionsökologie. *Berliner geowiss. Abh*., E, 2: 1-164.

Müller W. (1974) - Beobachtungen an der hexactinelliden Juraspongie *Casearia articulata* (Schmidel). *Stuttgarter Beitr. zur Naturkunde*, Ser. B (Geologie und Paläontologie), 12: 1-19.

Pisera A. (1997) - Upper Jurassic siliceous sponges from the Swabian Alb: Taxonomy and Paleoecology. *Palaeontol. Polonica*, 57: 1-216.

Quenstedt F. A. (1958) - Der Jura. 842 S., Tübingen.

Rauff H. (1893) - Palaeospongiologie, erster oder allgemeiner Theil und zweiter Theil, erste Hälfte. *Palaeontographica* 40: 1-232.

Rauff H. (1937) - Beitrag über die Spongien. In: Assmann P. (Ed.) - Revision der Fauna der Wirbellosen der oberschlesischen Trias. *Abh. Preuß. Geol. L.-A*., N. S., 170: 7-14.

Reid R. E. H. (2004) - Mesozoic and Cenozoic Hexactinellid Sponges: Lyssacinosa and Hexactinosa. In: Kaesler R. L. (Ed.) - Treatise on Invertebrate Paleontology, Part E, vol. 3: 449-556, Lawrence, Kansas.

Reitner J. (1990) - The polyphyletic origin of the "Sphinctozoans". In: Rützler K. (Ed.) - New perspectives in sponge biology: 33-42, Washington (Smithonian Inst. Press).

Rigby J. K., Senowbari-Daryan B. & Hamedani A. (2005) - First reported occurrence of wewokellid sponges (Calcarea, Heteractinida) from the Permian of central Iran. *Facies*, 51: 516-521.

Rigby J. K., Wu X. & Fan J. (1998) - Triassic Haxactinellid Sponges from Patch Reefs in North-Central Sichuan, People's Republic of China. *Brigham Young Univ., Geol. Studies*, 43: 119-165.

Schmidt O. (1870) - Grundzüge einer Spongien-Fauna des atlantischen Gebirges. 88 pp., Jena.

Schmidel C. C. (1780) - Vorstellung einiger merkwürdiger Versteinerungen. 70 pp. (v. Bishoff), Nürnberg.

Schrammen A. (1937) - Die Kieselspongien des Oberen Jura von Süddeutschland, B, Besonderer teil. *Palaeontographica* 85: 1-114.

Senowbari-Daryan B. (1990) - Die systematische Stellung der thalamiden Schwämme und ihre Bedeutung in der Erdgeschichte. *Münchner Geowiss. Abh*., A, 21: 1-326.

Senowbari-Daryan B. (1991) - "Sphinctozoa": An Overview. In: Reitner J. & Keupp H. (Eds) - Fossil and Recent Sponges: 224-241, Berlin, Springer- Verlag.

Senowbari-Daryan B. (2005a) - Hypercalcified sphinctozoan sponges from Upper Triassic (Norian-Rhaetian) reefs of Nayband Formation (Central and Northeast Iran). *Jb. Geol. B.-A., Wien*, 145(2): 171-277.

Senowbari-Daryan B. (2005b) - Neue inozoide Schwämme aus den obertriassischen (Nor-Rhät) Riffen der Nayband-Formation (Zentraliran). *Senckenbergiana lethaea*, 85(2): 261-299.

Senowbari-Daryan B. & Garcia-Bellido D. C. (2002) - Sphinctozoa or chambered sponges (Polyphyletic). In: Hooper J. N. A. & Van Soest R. W. M. (Eds) - Systema Porifera, Vol. 2: 1511-1538, Plenum Press, New York.

Senowbari-Daryan B. & Hamedani A. (1999) - Thalamid sponges from the Upper Triassic (Norian-Rhaetian) Nayband Formation near Wali Abad, SE Abadeh, Central Iran. *Riv. It. Paleont. Stratigr*., 105(1): 79-100.

Senowbari-Daryan B., Rashidi K. & Bettollah H. (2011) - Hepercalcified sponges from a small reef within the Norian-Rhaetian Nayband Formation near Yazd, central Iran. *Riv. It. Paleont. Stratigr*., 117(2): 269-281.

Senowbari-Daryan B. & Zankl H. (2010) - First Chambered Hexactinellid Sponge from the Upper Triassic Dachstein Reef Limestone (Hoher Göll, Northern Calcareous Alps). *Jb. Geol. B.-A. Wien*, 150(3+4): 389-392.

Thiele O., Alavi M., Assefi R., Hushmand-Zadeh A. Seyed-Emami K. & Zahedi M. (19&(9. Explanatory test of the Golpaygan Quadrangle Map 1:250.000, Sheet Golpaygan, No. E7. Geol. Surv. of Iran, Tehran.

Tichy G. (1975) - Der erste körperlich erhaltene Kieselschwamm (*Tremadictyon* cf. *roemeri*) aus der Trias (Anis) der Alpen. *Verh. Geol. B.-A.*, Jg. 1975 (2-3): 67-73.

Steinmann G. (1882) - Pharetronen-Studien. N. *Jb. Miner. Geol. Palaeont., II*: 139-191, Stuttgart.

Vacelet J. (1977) - Une nouvelle relique du Secondaire un representant actuel des Esponges fossils Sphinctozoaires. *CR Acad. Sci. Paris*, 285: 509-511.

Vacelet J. (2002) - Recent "Sphinctozoa", Order Verticillitidae Steinmann, 1882. In: Hooper J. N. A. & Van Soest R. W. M. (Eds) - System Porifera vol. 2. Guide to the Supraspecific Classification of Sponges and Spongiomorphids (Porifera): 1097-1098, Plenum, New York.

Wendt J., Wu X. & Reinhardt J. W. (1989) - Deep-water hexactinellid sponge mounds from the Upper Triassic of northern Sichuan (China). *Paleogeogr., Paleoclim., Paleoecol.*, 76: 17-29.

Wörheide G. (2008) - A hypercalcified sponge with soft relatives: *Vaceletia* is a keratose demosponge. *Mol. Phylogenet. Evol.*, 47: 433-438.

Wu X. (1989) - Late Triassic Carnian strata in western Sichuan Basin and a new sponge family. *Acta Palaeont. Sin.*, 28(6): 766-771 (in Chinese with English Summary).

Wu X. (1990) - Late Triassic Lychniscosa fauna in northwestern Sichuan. *Acta Palaeont. Sin.*, 29(3): 349-363.

Wu X. & Xiao R. (1989) - Discovery of Late Triassic sponge fauna in north-western. *J. Kumming Instit. Technol.*, 14(1): 12-21.

Zankl H. (1969) - Die Hohe Göll- Aufbau und Lebensbild eines Dachsteinkalk-Riffes in der Obertrias der nördlichen Kalkalpen. *Abh. Senckenberg. Naturf. Ges.*, 519: 1-123.

Zittel K. A. (1878) - Studien über fossile Spongien. Dritte Abteilung, Monactinellidae, Tetractinellidae und Calcispongiae. *Abh. königlich-bayer. Acad. Wiss., math.-phys. Kl.*, 2: 91-138.