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Sponges from the Upper Triassic (Norian–Rhaetian) Nayband Formation, Northeast Iran

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1 Text-Figure, 7 Plates

Nayband Formation
Stromatomorpha
Cheilosporites
Plagaspongia
Iranofungia
Lamellata
Sponge
Triassic
Iran

Contents

Schwämme aus der obertriassischen (Norium–Rhätium) Nayband-Formation, NE Iran

Zusammenfassung

Die corallinen Schwämme, einschließlich der polyphyletischen Gruppe der so genannten Spongiomorphiden, die früher den Hydrozoen zugeordnet waren, stellen Schwämme dar, die in den obertriassischen, besonders in den norisch-rhätischen Riffen im Iran ziemlich häufig auftreten. In dieser Arbeit werden zwei Taxa – *Plagaspongia lutensis* nov. gen., nov. sp. und *Iranofungia multiosculata* nov. gen., nov. sp. – aus der norisch-rhätischen Nayband-Formation im nordöstlichen Iran beschrieben. Das erste Taxon wird den Spongiomorphiden, das zweite den inozoiden Schwämmen zugeordnet. Zusätzlich werden *Stromatomorpha californica* SMITH (ein „lithistider" Schwamm der Ordnung Orchocladina), ein der *St. Californica* ähnlicher Organismus, und *Cheilosporites tirolensis* WÄHNER beschrieben. Alle Arten werden zum ersten Mal aus der obertriassischen Nayband-Formation des Iran beschrieben.

Abstract

Hypercalcified sponges including the polyphyletic group of so called Spongiomorphids, which were formerly classified as hydrozoans, commonly occur in Upper Triassic, especially Norian–Rhaetian reefs in Iran. In this paper two new sponge taxa – *Plagaspongia lutensis* nov. gen., nov. sp. and *Iranofungia multiosculata* nov. gen., nov. sp. – are described from the Norian–Rhaetian Nayband Formation of northeast Iran. The former is assigned to the Spongiomorphids, the latter to the inozoan sponges. In addition *Stromatomorpha californica* SMITH – a "lithistid" sponge (order Orchocladina), an organism similar to *Stromatomorpha californica* – and *Cheilosporites tirolensis* WÄHNER are described. All species are reported for the first time from the Upper Triassic Nayband Formation of Iran.

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Introduction

FLÜGEL & SY (1959) gave some detailed descriptions of the Triassic Hydrozoans, including the spongiomorphids. Representatives of Upper Jurassic spongiomorphid-like organisms were previously discussed by LEINFELDER et al. (2005). Spongiomorphids of the Triassic and partly Lower Liassic are briefly discussed in this paper.

FRECH (1890: 68) for the first time described the family of Spongiomorphidae as Hexacorals and assigned the genera *Spongiomorpha* FRECH (1890) – with the two Subgenera *Heptastylopsis* and *Heptastylis* FRECH (1890) – and *Stromatomorpha* FRECH (1890) to the family Spongiomorphidae. The Spongiomorphids were placed to the Hydrozoans by KÜHN (1936). ALLOITEAU (1952) established the order Spongiomorphida and classed the family Spongiomorphidae with this order. According to TURNSEK (1968), the Spongiomorphids are an independent group of Cnidarians.

Based on new research the spongiomorphids represent a polyphyletic group of sponges. While the genus *Stromatomorpha* is definitely a demosponge (SENOWBARI-DARYAN & STANLEY, 2009), the systematic position of the other genera is still uncertain.

At first only those genera were assigned to the family Spongiomorphidae, which were established by FRECH (1890). VINASSA DE REGNY (1907) added the genus *Balatonia* to this family. LE MAITRE (1937: 12) added the subgenus *Cylicopsis* to the genus *Stromatomorpha* FRECH. LE MAITRE (1935: 27), HILL & WELLS (1956), FLÜGEL & SY (1959), and FLÜGEL (1969: 62) raised the subgenus state of *Heptastylis* to genus level. The genus *Lamellata*, described by FLÜGEL & SY (1959) should also be included in the family Spongiomorphidae FRECH.

Localities

The two sponges described in this paper derive from the southern area of the type section of the Nayband Formation, located at the southern flank of the Kuh-e Nayband (Text-Fig. 1). *Plagaspongia lutensis* nov. gen., nov. sp. derives from the Norian Bidestan member and was collected about 2 km west of Dig-e Rostam, a motorway service area about 10 km south of the town Naybandan. There is access with vehicle to this remote area. *Plagaspongia* was found in a biostromal carbonate bed reaching a thickness of 1.5–2 m (Pl. 1, Fig. A, arrow). This thick bed is completely full of such sponge specimens.

The location of *Iranofungia multiosculata* is approximately 10 km southwest of Dig-e Rostam. This site is accessible only by foot or motorcycle or on horseback. This sponge most probably derives from the Norian?–Rhaetian Howz-e Khan member of the Nayband Formation. *Iranofungia* was found in a small reef of about 2 m thickness with approximately 18 m lateral extension. It is associated with corals, sponges and other reef organisms.

The species *Stromatomorpha californica* SMITH and cf. *St. californica* derive from the third location, about 40 km south of Dig-e Rostam on the left side (200 m off the road) of the main road from Naybandan to Kerman (see Text-Fig. 1). The investigated material (7 rock-pieces, 11 thin sections) is deposited in the "Staatssammlung für Paläontologie und historische Geologie in München, Inventar-Nr.: 2010 XII – 2010 XII 18").

Systematic Paleontology

?Class Demospongea SOLLAS, 1875
Order Spongiomorphida ALLOITEAU, 1952
Family Spongiomorphidae FRECH, 1890

Remarks: The systematic position of spongiomorphids is uncertain (FRECH, 1890: 68). The following genera were attributed to the Spongiomorphidae by FRECH: *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* LE MAITRE 1935, *Heptastylopsis asiatica* LE MAITRE 1935, *Spongiomorpha globosa* FLÜGEL & HÖTZL 1966) were classified as corals (family Microsolenidae) by RONIEWICZ (2011).

As shown by SENOWBARI-DARYAN & STANLEY (2009) *Stromatomorpha* FRECH is definitely a demospongid sponge. Most probably all other Triassic genera described by FRECH (1890) and other authors represent demospongid sponges as well. Detailed investigations of Upper Triassic spongiomorphids, based on well preserved material, are urgently needed.

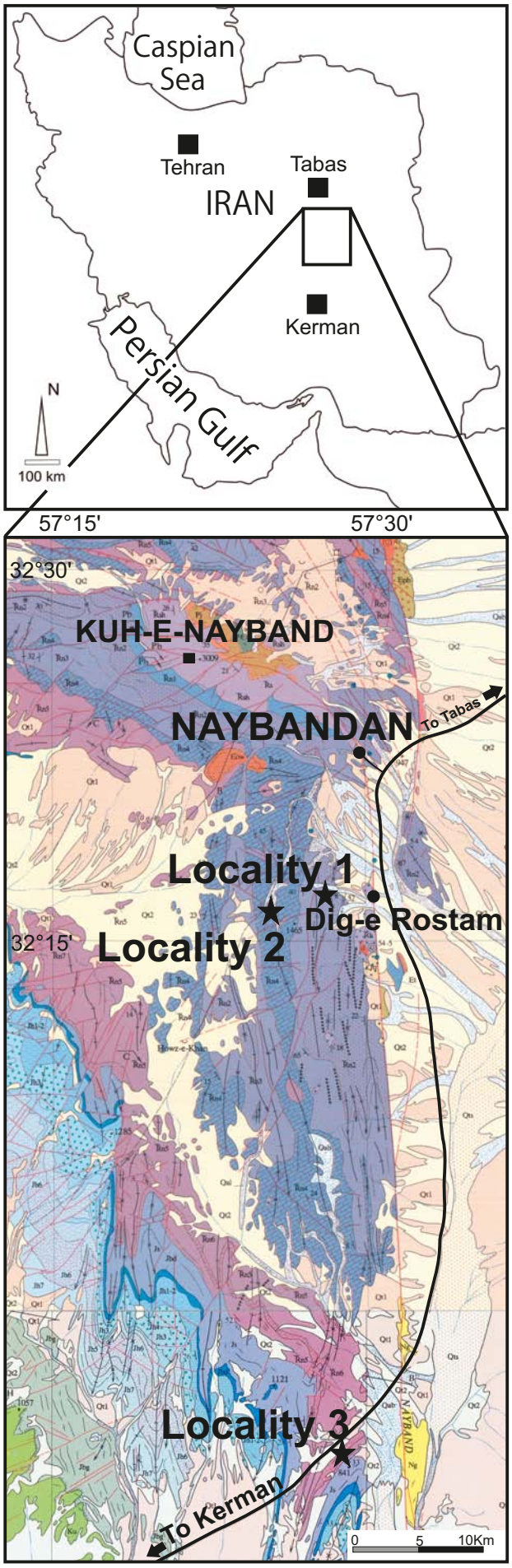
Genus *Plagaspongia* nov. gen.

Derivatio nominis: Named after plaga (Lat. = net) and sponge.

Diagnosis: Irregularly growing and multi-branched spongiomorphid sponge. The branches are mostly oriented perpendicular to each other, producing a coarse net-like structure. Individual branches are cylindrical or oval in cross section, while in longitudinal section they appear two-layered. Skeletal fibers in the axial region are oriented parallel and divergent (water-jet-like). On the periphery they are running vertically to the axis of branches.

Type species: *Plagaspongia lutensis* nov. sp.

Discussion: An assignment of this sponge to the group of inozoans or spongiomorphids is possible. Inozoan sponges similar to *Plagaspongia* are not known, neither from the Paleozoic nor from Mesozoic deposits. The different arrangement of skeletal fibers in the axial and peripheral regions of *Plagaspongia* is usual in specimens of spongiomorphid sponges. *Spongiomorpha stylifera* FRECH (1890) clearly shows this different orientation of skeletal elements in axial and peripheral areas. BOIKO (1970; see also BOIKO, 1979) described several species of genera *Pamiropora* or *Parastromatopora* from the Norian of the Pamir Mountains, which in cylindrical specimens clearly exhibit different arrangements of the skeletal fibers in the axial and peripheral regions. Spongiomorphids with such a distinct axial and peripheral differentiation of skeletal elements also commonly occur in the Norian–Rhaetian Nayband Formation, particularly in reefs north of Esfahan (unpublished material). Due to this characteristic feature, *Plagaspongia* is classified as a new genus to the Spongiomorphidae FRECH (1890).



***Plagaspongia lutensis* nov. sp.**

(Pl. 1, Fig. B; Pl. 2, Fig. A–B; Pl. 3, Fig. A–H)

Derivatio nominis: Named after the Lut desert, eastern area of the locality.

Holotype: Specimen illustrated in Pl. 1, Fig. B. All photographs indicated with NB1 in Pl. 3 are taken from the thin section made from the reverse side of the sample containing the holotype.

Paratypes: Pl. 2, Fig. A–B; Pl. 3, Fig. D–E, H.

Locus typicus: Nayband Formation near Dig-e Rostam (a motorway service area with a hot water spring), south of the town of Naybandan, about 225 km south of Tabas (see Text-Fig. 1, locality 1).

Stratum typicum: Bidestan member (Norian) of the Nayband Formation, Upper Triassic.

Diagnosis: Since only one species exists, the diagnosis of the species corresponds to that of the genus.

Material: Four rock samples full of the sponge. From each sample a large thin section (10x15 cm) was made.

Description: A thick carbonate bed within the Bidestan member (Norian) of the Nayband Formation contains so many specimens of this sponge that it is impossible to recognize or distinguish the individual "colonies". Our samples are about 15x15 cm large and full of this sponge (Pl. 1, Fig. B; Pl. 2, Fig. A–B).

The net-like and multi-branched sponge is composed of numerous branches. The "main" branches are usually thicker than the "lateral" or "second" branches, which are usually arranged perpendicular to the "main" branches producing the net-like framework (Pl. 1, Fig. B; Pl. 2, Fig. A–B; Pl. 3, Fig. E). Individual branches are circular to oval in cross section. In longitudinal sections the "main" branches are straight, exhibiting a two-layered structure. The axial area is composed of up- and outward diverging (water-jet-like) skeletal fibers, while at the periphery the skeletal fibers are arranged vertically to the axis of branches, producing the layers (Pl. 3, Fig. A–B, E). The laterally arranged secondary branches are also two-layered (Pl. 3, Fig. D–F, H). The "upper" layer is composed of coarse skeletal fibers of 0.1 mm thickness, which are arranged vertically to the axis of branches. The width of the interspaces between the fibers is also about 0.1 mm. This layer is usually well preserved, because the interfiber spaces are filled with micritic sediment. On the other hand the skeletal fibers of the "lower" layer are poorly preserved, since the interspaces of skeletal fibers lack any micritic infilling. The arrangement of the skeletal fibers might be different in the two layers. The inhalant or exhalant canals as well as the spongocoels or similar tubes are missing completely, while borings within the branches occur. Spicules are not known.

Occurrence: *Plagaspongia lutensis* nov. gen., nov. sp. was found in the Bidestan member (Norian) of the Nayband Formation at the type locality only (Text-Fig. 1). The carbonate bed indicated with an arrow in Pl. 1, Fig. 1 is completely composed of this sponge.

Text-Fig. 1.
Geological map of the area, south of the village Naybandan showing the sampling locations of the sponges described in this paper.
Locality 1: Type section of *Plagaspongia lutensis* nov. gen., nov. sp and *Cheilosporites tirolensis* WÄHNER.
Locality 2: Location of *Iranofungia multiosculata* nov. gen., nov. sp.
Locality 3: Location of Stromatomorpha (Modified from KLUYVER et al., 1983).

Class Demospongea Sollas, 1875
Order Agelasida Verrill, 1907
Family Virgolidae? Termier & Termier (in Termier et al.), 1977

(nom. corr. by Finks & Rigby, 2004: 596)

Synonymy: See Finks & Rigby (2004: 596).

Genus *Iranofungia* nov. gen.

Derivatio nominis: From Iran and fungi (Lat. = mushroom). Named after the mushroom-like shape of the sponge.

Diagnosis: Mushroom-shaped sponge with several spongocoels running vertically. The spongocoels are arranged over the top of the sponge. Each spongocoel is composed of clusters of tubes producing a circular or polygonal pattern. Vertical sections exhibit layers of vertically and horizontally arranged skeletal fibers.

Type species: *Iranofungia multiosculata* nov. sp.

Iranofungia multiosculata nov. sp.
(Pl. 4, Fig. A–C; Pl. 5, Fig. A–G)

Derivatio nominis: Multi (lat. = many) and osculum (lat. = small mouth), due to the abundance of osculi on the sponge top extending as spongocoels into the sponge interior.

Holotype: Plate 4, Fig. A–C; Pl. 5, Fig. A–C (all photographs are from the holotype).

Paratypes: Pl. 5, Fig. D–G.

Locus typicus: See locality 2 in Text-Fig. 1.

Stratum typicum: Most probably the Howz-e Khan member (Rhaetian) of the Nayband Formation.

Diagnosis: Mushroom-shaped sponge with numerous spongocoels ending in circular to polygonal clusters of osculi on the sponge top, which appear like coral corallites. In the axial region of the osculum-circle a pillar-like element occurs, resembling the columella of corals. Additionally, small circular to polygonal pores cover the top surface between the osculi. The sponge base is covered by a wrinkled dermal layer without openings. The internal structure is composed of skeletal elements arranged in layers.

Material: Four specimens in body preservation.

Description: The mushroom-shaped specimens of this sponge reach 80–100 mm in diameter on the top and up to 20–50 mm height. All specimens are wider than high. The base of the sponge is covered by a wavy wrinkled dermal layer without any pores or openings. The dermal layer reaches up to the top (Pl. 4, Fig. B). The top of the sponge is not smooth as it exhibits numerous circular to polygonal osculi in a moderately depressed area of about 7–8 mm in diameter (Pl. 4, Fig. 1; Pl. 5, Fig. 1). The space between the depressed areas (osculi) is moderately elevated. The circular depressed areas and the spaces between them are covered by numerous small pores of 0.3–0.5 mm in diameter (Pl. 4, Fig. A, C; Pl. 5, Fig. A). In cross section the pores of the depressed area are radially arranged showing the same dimensions like the pores in the area between them (Pl. 5, Fig. B). The polished slab of the longitudinal section from the peripheral part of the holotype shows horizontally arranged skeletal elements with a pillar-like structure between these elements (Pl. 5, Fig. C). The base of the holotype is laterally broken, possibly revealing a budding of the specimen.

The paratype specimen illustrated in Pl. 5, Fig. D–G is well preserved. It was investigated in longitudinal and cross section on polished slab and thin section. The polished slab illustrated in Pl. 5, Fig. F shows several circular osculi composed of numerous radially arranged openings. Each osculum is bounded by a dark line. Spaces between the osculi are occupied by honey-comb-like skeletal fibers as shown in thin section illustrated in Pl. 5, Fig. G. The longitudinal section of the paratype distinctly exhibits the layered skeletal elements with converging tubes ending on the circular osculi at the sponge top (Pl. 4, Fig. D–E).

Occurrence: *Iranofungia multiosculata* nov. gen., nov. sp. was found solely in the type locality (see Text-Fig. 1, locality 2).

Class Demospongea Sollas, 1885
Subclass “Lithistida” Schmidt, 1870
Order Orchocladina Rauff, 1895
Family Anthaspidellidae Miller, 1889

Genus *Stromatomorpha* Frech, 1890
(emend. Senowbari-Daryan & Stanley, 2009)

Type species: *Stromatomorpha stylifera* Frech 1890.

Stromatomorpha californica Smith, 1927
(Pl. 6, Fig. A–E)

* 1927 *Stromatomorpha californica* n. sp. – Smith, p. 134, Pl. 118, Fig. 4; Pl. 119, Fig. 1; Pl. 120.

2009 *Stromatomorpha californica* Smith. – Senowbari-Daryan & Stanley, p. 788, Fig. 2–4, 7–9, 9.1–9.4, 10.1–10.4 (cum synonymy).

Material: Five specimens.

Description: Sheet-like skeletons of the Iranian specimens of *Stromatomorpha californica* reach 100 mm in height and 60 mm in width with thicknesses of usually less than 20 mm, but up to 30 mm. Under the microscope the regularly arranged horizontal-concentrical layers (“trabeculae”) and vertically oriented elements (“pillars”) of *St. californica* giving the stocks a net-like structure (Pl. 6, Fig. B–D), are clearly recognizable. Heights of concentrical layers measure between 0.4–0.6 mm, while the distance of vertical elements is 0.3–0.4 mm (Pl. 6, Fig. E). These measurements are moderately smaller than the data from North American specimens that are given by Senowbari-Daryan & Stanley (2009). Horizontal layers are strictly aligned, but vertical pillars are not arranged on lines. Due to re-crystallisation, the dendroclone spicules, described from the North American material by Senowbari-Daryan & Stanley (2009), are not recognizable in our material. Spicules are not known either from the material of the Alps, described as *St. rhaetica* by Kühn (1942) and by later authors (for synonymy see Senowbari-Daryan & Stanley, 2009).

Remarks: Specimens of *Stromatomorpha californica* Smith from North America described by Senowbari-Daryan & Stanley (2009) and from the Alps described by Kühn (1942) and by other authors (ref. see Senowbari-Daryan & Stanley, 2009) are massive and hemispherical, while the specimens from Iran represent sheet-like forms.

The finely layered specimens of *Stromatomorpha californica* may be confused with *Lamellata wähneri* FLÜGEL & SY (1959) in the field and in hand samples. The vertical elements in the skeleton of *St. californica*, which are well recognizable under the microscope distinctly differentiate this species from *L. wähneri* devoid of vertical elements. The space between the laterally running layers in *L. wähneri* is filled by a "spongy"-like fiber skeleton, not by pillars as in *St. californica.*

Occurrence: The geographic occurrence and stratigraphic range of *Stromatomorpha rhaetica* is given by SENOWBARI-DARYAN & STANLEY (2009). The species is described for the first time from the Norian–Rhaetian of the Nayband Formation in Iran. It was found only in locality 3 indicated in Text-Fig. 1.

cf. Stromatomorpha californica SMITH, 1927

(Pl. 7, Fig. A–E)

Material: Four specimens.

Description: Specimens of this species are poorly preserved. Their outer morphology resembles that of *St. californica* SMITH, being composed of wavy layers with the same thickness. The layers of this species are 0.2–0.4 mm thick, moderately smaller than in *St. californica* of about 0.4–0.6 mm thickness. There are, however, some differences, recognizable when using a hand lens. The net-like structure of *St. californica* is rather reticulate in this species. The distance of vertical elements (pillars) – if recognizable – is about 0.1–0.2 mm, in *St. californica* 0.3–0.4 mm.

Thin sections were made from three specimens. Internally all specimens exhibit the same structure of a rather reticulate fiber skeleton. The horizontal layers are more or less well recognizable, but the pillars are not distinctly developed. The specimens are associated with *St. californica*, described above.

Comparison: Similarities with *St. californica* and differences were mentioned under the description of the species. The fossil resembles *Lamellata wähneri* described by FLÜGEL & SY (1959) from the Upper Triassic of the Alps. Another fossil, with an internally comparable structure is *St. tenuiramosa* described by BOIKO (1979) from the Norian of the Pamir Mountains. The growth pattern of the species from the Pamir Mountains is, however, very different compared with the Iranian species. We are not sure if this organism is identical with *Stromatomorpha californica* SMITH, *St. tenuiramosa* BOIKO or *Lamellata wähneri* FLÜGEL & SY.

Occurrence: Both, *Stromatomorpha californica* SMITH and cf. *St. californica* were found in locality 3, indicated in Text-Fig. 1.

?Class Demospongea SOLLAS, 1875
?Order Agelasida VERRILL, 1907
Suborder Porata SEILACHER, 1962
Family Cheilosporitidae FISHER, 1962

Genus *Cheilosporites* WÄHNER, 1903

Type species: *Cheilosporites tirolensis* WÄHNER, 1903.

Cheilosporites tirolensis WÄHNER, 1903

(Pl. 7, Fig. F)

* 1903 *Cheilosporites tirolensis* nov. sp. – WÄHNER, p. 138, Fig. 2.

1980 *Cheilosporites tirolensis* WÄHNER. – SENOWBARI-DARYAN, p. 230, Pl. 24, Fig. 1–4 (cum synonymy).

1981 *Cheilosporites tirolensis* WÄHNER. – FLÜGEL, Fig. 11/A.

1981 *Cheilosporites tirolensis* WÄHNER. – PILLER, Fig. 8/a.

1982 *Cheilosporites tirolensis* WÄHNER. – WURM, Pl. 35, Fig. 2.

1986 *Cheilosporites tirolensis* WÄHNER. – SENOWBARI-DARYAN & SCHÄFER, p. 230; Pl. 48, Fig. 7.

1989 *Cheilosporites tirolensis* WÄHNER. – STANTON & FLÜGEL, Pl. 24, Fig. 14; Pl. 29, Fig. 7a; Pl. 37, Fig. 2; Pl. 45, Fig. 6.

1991 *Cheilosporites tirolensis* WÄHNER. – BOIKO (in BOIKO et al., 1991), p. 136, Pl. 32, Fig. 1–3.

1996 *Cheilosporites tirolensis* WÄHNER. – SENOWBARI-DARYAN et al., Pl. 19, Fig. 5; Pl. 20, Fig. 1–2, 4.

2004 *Cheilosporites tirolensis* WÄHNER. – FINKS & RIGBY, p. 710, Fig. 711.

Material: Three specimens in one thin section only.

Description: The multi-chambered specimens of this fossil reach lengths of about 5 mm and diameters of 1.8 mm. The maximum known diameter of the species amounts to 7 mm (SENOWBARI-DARYAN, 1980). An axial canal of 0.4 mm is developed. A detailed description of the species is given out by FISCHER (1962) and SENOWBARI-DARYAN (1980).

Remarks: The systematic position of *Cheilosporites tirolensis* is uncertain. It was attributed to corallinacean algae (WÄHNER, 1903), calcareous sponges (PIA, 1939), foraminifers (FISCHER, 1962), a problematic organism (HÄNTZSCHEL, 1975), and a sphinctozoan sponge (SENOWBARI-DARYAN, 1980). For detailed discussion of the systematic position of *Ch. tirolensis* see SENOWBARI-DARYAN (1980).

Occurrence and stratigraphic age: *Cheilosporites tirolensis* WÄHNER is an index fossil of Norian–Rhaetian age. It is known from several localities in the Alps, Sicily, Greece, and the Pamir Mountains (compare synonymy list). The fossil is described here for the first time from the Rhaetian of the Nayband Formation in Iran.

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Plate 1

Fig. A: View of the Norian–Rhaetian Nayband Formation near Dig-e Rostam, south of the town of Naybandan with the thick carbonate bed (arrow) containing extremely abundant *Plagaspongia lutensis* nov. gen., nov. sp.

Fig. B: *Plagaspongia lutensis* nov. gen., nov. sp.
View of the holotype showing several “main” stems and numerous “lateral” branches on the naturally weathered rock surface. The arrow indicates the possible growth direction.

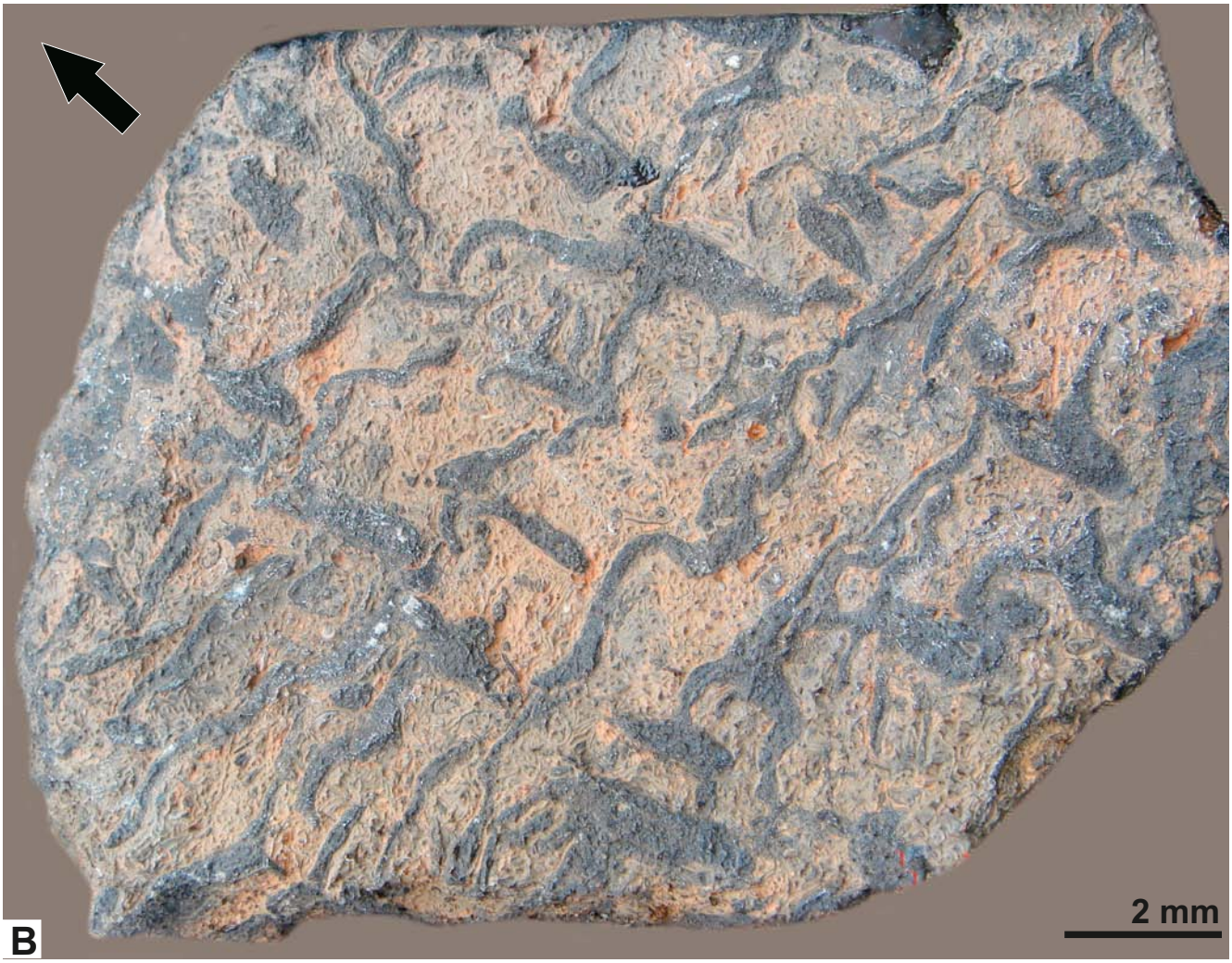


Plate 2

Fig. A–B: *Plagaspongia lutensis* nov. gen., nov. sp. from the Nayband Formation near Dig-e Rostam, south of the town of Naybandan. Scale in mm.

Fig. A: View of numerous “main” and “lateral” branches on a naturally weathered rock surface. The vertical “main” stems are arranged parallel to each other, indicating the possible growth direction.

Fig. B: Similar “colony” as Fig. A on the naturally weathered rock surface.

Plate 3

Fig. A–H: *Plagaspongia lutensis* nov. gen., nov. sp. from the Norian–Rhaetian Nayband Formation near Dig-e Rostam, south of the town of Naybandan.
All thin section photographs indicated as NB1 are from the backside of the holotype, illustrated in Pl. 1, Fig. B.

Scale in C, D and G is 1 mm, in all others 5 mm.

Fig. A: Section through some branches showing the upward and outward (left in photograph) diverging skeletal fibers in the axial area of the "main" stem.
Skeletal elements of the peripheral area appear darker.
Thin section NB1.

Fig. B: Similar section as Fig. A distinctly showing the up- and outward diverging skeletal elements in the axial area and vertically arranged skeletal elements on the periphery of the branch.
Thin secion NB1.

Fig. C: Colonisation of a sponge branch by a solenoporacean (S) which itself is overgrown by the sponge. Thin secion NB1.

Fig. D: The close-up view of Fig. E (rectangle) shows a two-layered lateral branch.
In the upper layer the skeletal fibers are arranged vertically to the axis of the branch, in the lower part they are reticulate without any orientation of the skeletal fibers.
Thin section NB2.

Fig. E: Section through the "main" stem and two "lateral" branches.
In the axial area of the "main" stem the skeletal fibers are arranged up- and outward (water-jet-like), while on the periphery (darker area) they are arranged vertically to the axis of the stem. Both lateral branches show two layers, recognizable by the orientation of the skeletal fibers (for magnification see Fig. D).
Thin section NB2.

Fig. F: Section through several branches clearly showing the two-layered skeletal fibers.
Thin section NB1.

Fig. G: A saw-like ripped bivalve shell (bottom in photograph) serves as substrate for the sponge.
Thin section NB1.

Fig. H: Section through a curved branch showing the two-layered skeletal fibers recognizable by different contrast in photograph.
Thin section NB3.

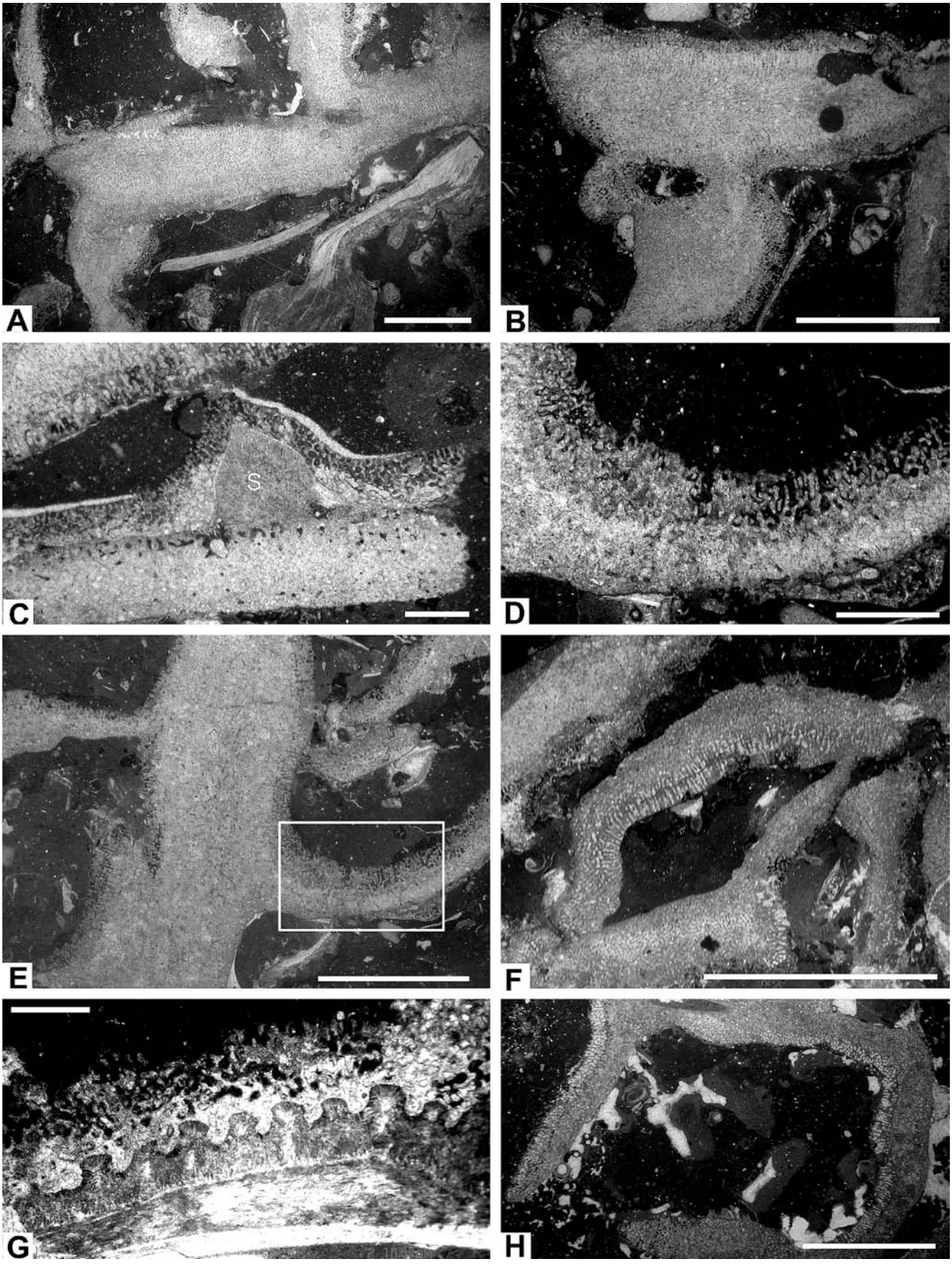


Plate 4

Fig. A–C: *Iranofungia multiosculata* nov. gen., nov. sp., most probably from the Howz-e Khan member (Rhaetian) of the Nayband Formation near Dig-e Rostam.
Scale in Fig. A–B in mm, in C 5 mm.

Fig. A: Holotype.
View of the sponge top showing numerous depressed areas appearing like corals. The top surface is covered by numerous evenly distributed circular to polygonal pores (for magnification see Fig. C).

Fig. B: Holotype.
The side view shows the wavy wrinkled dermal layer and the acute base of the sponge.

Fig. C: The close-up view of the holotype (see rectangle in Fig. A) shows a depressed circle with numerous pores on the sponge top.

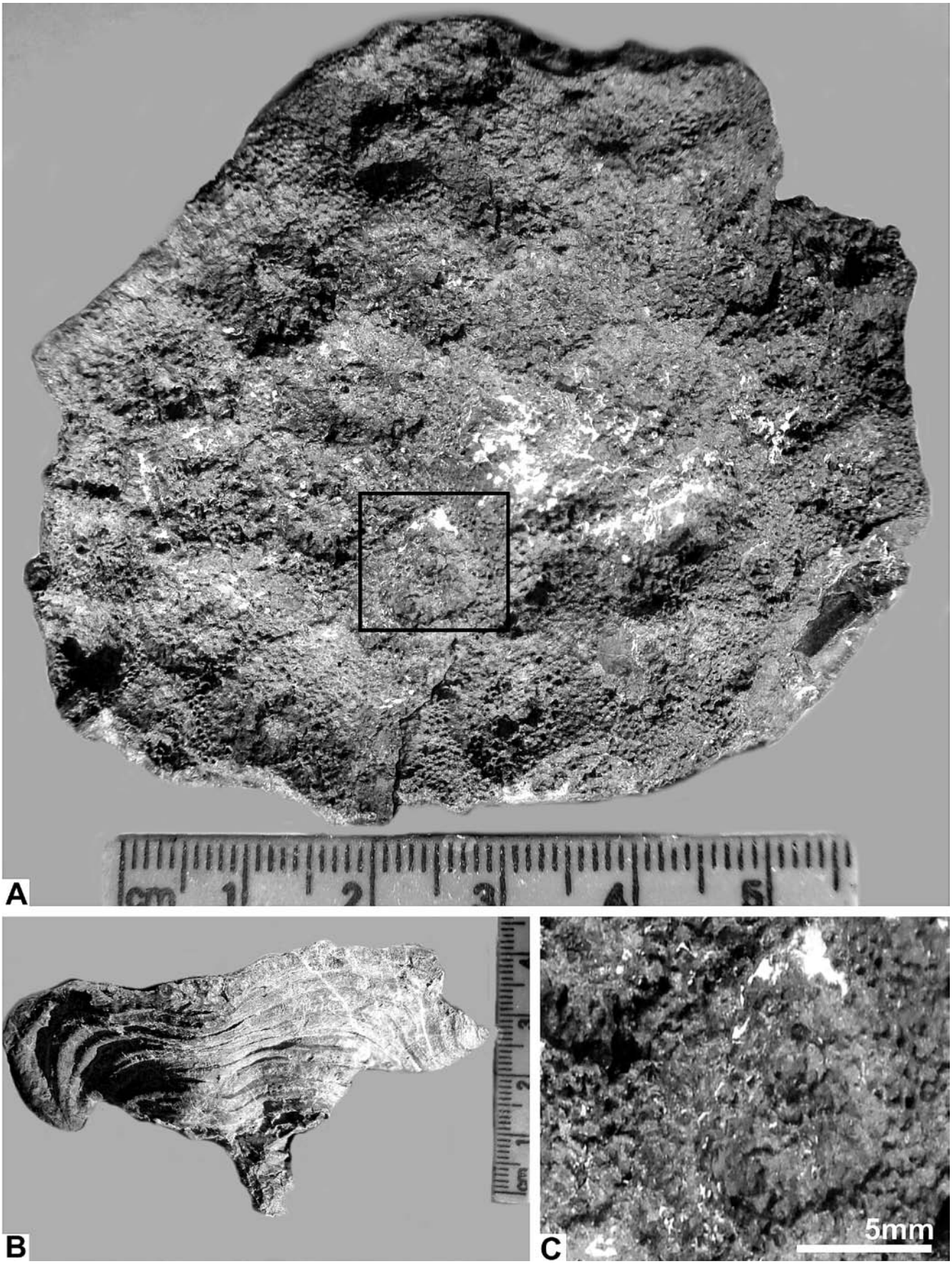


Plate 5

Fig. A–G: *Iranofungia multiosculata* nov. gen., nov. sp., most probably from the Howz-e Khan member (Rhaetian) of the Nayband Formation near Dig-e Rostam. Fig. A–C: From the holotype illustrated in Pl. 4, Fig. A–B.
Scale in all Figs. 10 mm.

Fig. A: Magnification of Fig. A in Pl. 4 (holotype) showing numerous circular depressed areas (osculi) and their interspaces. The sponge surface is covered with numerous circular to polygonal pores.

Fig. B: Holotype.
The polished slab oriented parallel to the top shows three depressed areas with radially arranged pores at the periphery.

Fig. C: Section perpendicular to the top of the holotype showing horizontally oriented skeletal elements with pillar-like vertical elements in between.

Fig. D: The longitudinal section from the paratype, illustrated in Fig. F exhibits several layers of horizontally arranged skeletal fibers (for magnification see Fig. E).

Fig. E: Magnification of Fig. D clearly showing the skeletal layers and the fiber skeleton.
The upper part (arrow) exhibits several converging tubes ending in the osculum on the sponge top.

Fig. F: Section (polished slab) parallel to the sponge top showing several circular osculi and numerous pores in between.
The dark appearing centers of the osculi correspond to the columella-like elevated area (compare Fig. A).

Fig. G: Thin section photograph parallel to Fig. F showing some osculi with fiber skeletal elements in between.

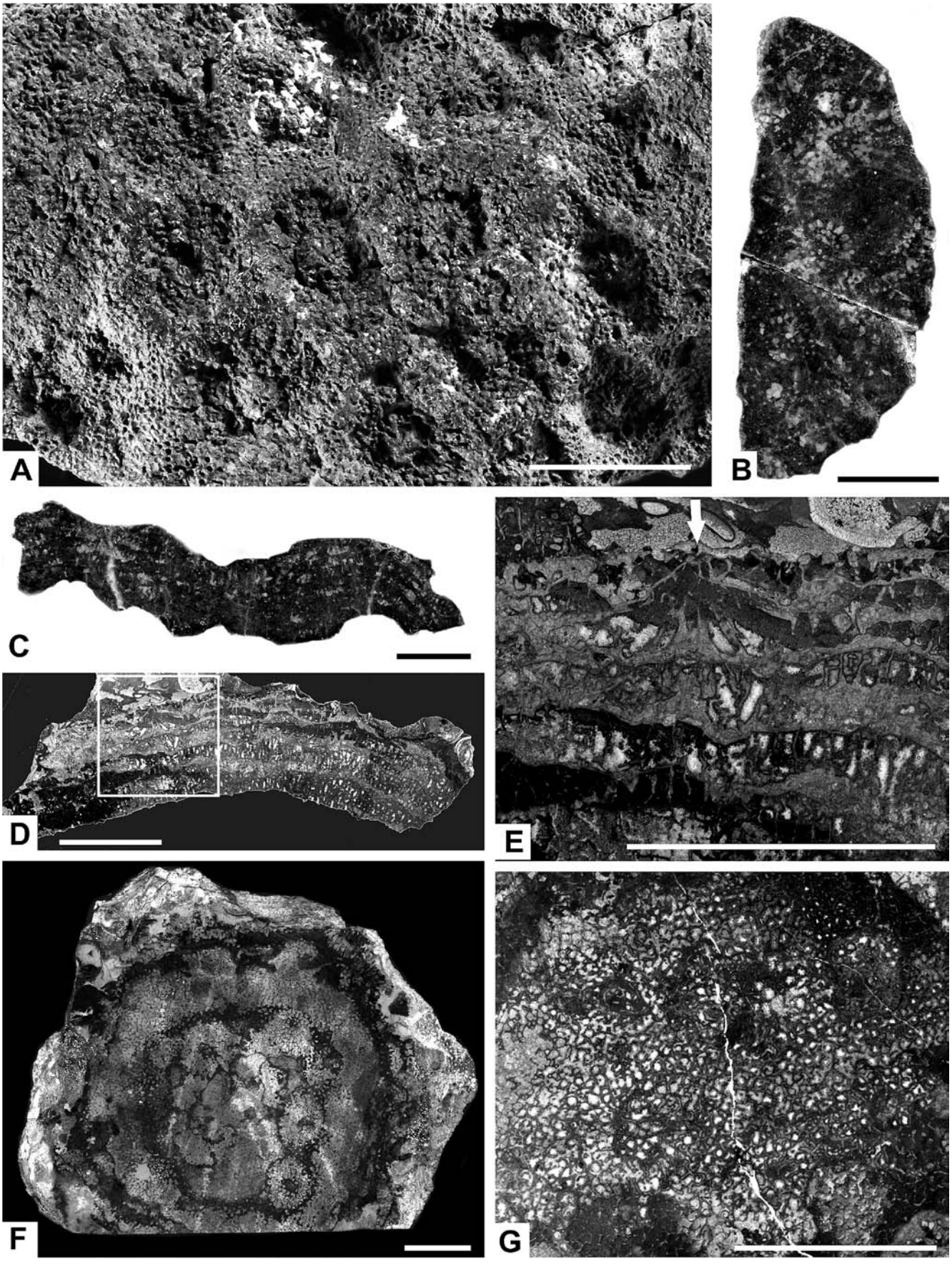


Plate 6

Fig. A–E: *Stromatomorpha californica* SMITH, most probably from the Howz-e Khan member (Rhaetian) of the Nayband Formation near Dig-e Rostam.
Scale in A, C and E 20 mm, in B and D 2 mm.

Fig. A: Longitudinal section parallel to the sheet of the specimen illustrated in Fig. E, showing the wavy horizontal layers, while vertical layers are not recognizable (for magnification see Fig. B).

Fig. B: The magnification of Fig. A (rectangle) clearly shows the horizontal layers and the vertically running pillars.
The dendroclone spicules are not preserved because of re-crystallisation.
The sponge grows on another sponge (right in photograph).

Fig. C: Section perpendicular to the sheet of the specimen illustrated in Fig. E (left side on photograph).
Note the horizontal and vertical layers appearing as producing a lattice (for magnification see Fig. D).

Fig. D: The close-up of Fig. C shows the horizontal layers (running vertically in the photograph) and the pillars (horizontally running elements in photograph).

Fig. E: View of the surface of a naturally weathered sheet-like specimen showing the wavy layers.
For internal structure of the specimen see Figs. A–D.

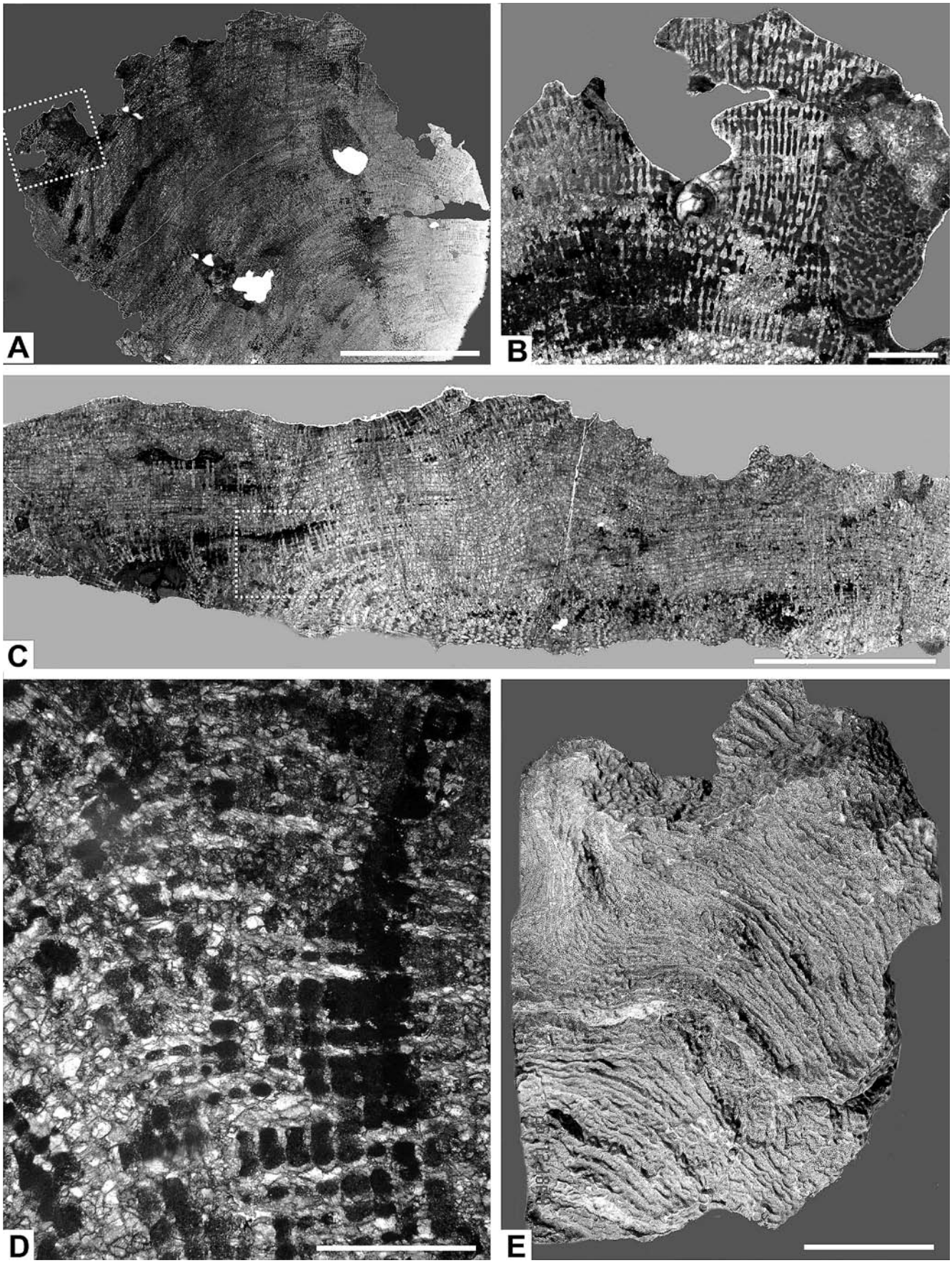


Plate 7

Fig. A–D: cf. *Stromatomorpha californica* SMITH, most probably from the Howz-e Khan (Rhaetian) member of the Nayband Formation near Dig-e Rostam.
Scale in A and D 10 mm, in B, C and D 2 mm.

Fig. A: View of the surface of a naturally weathered sheet-like specimen showing the finely laminated horizontal layers.
The specimen was cut later along the white line (see photograph) and thin sections were made (see Fig. D).

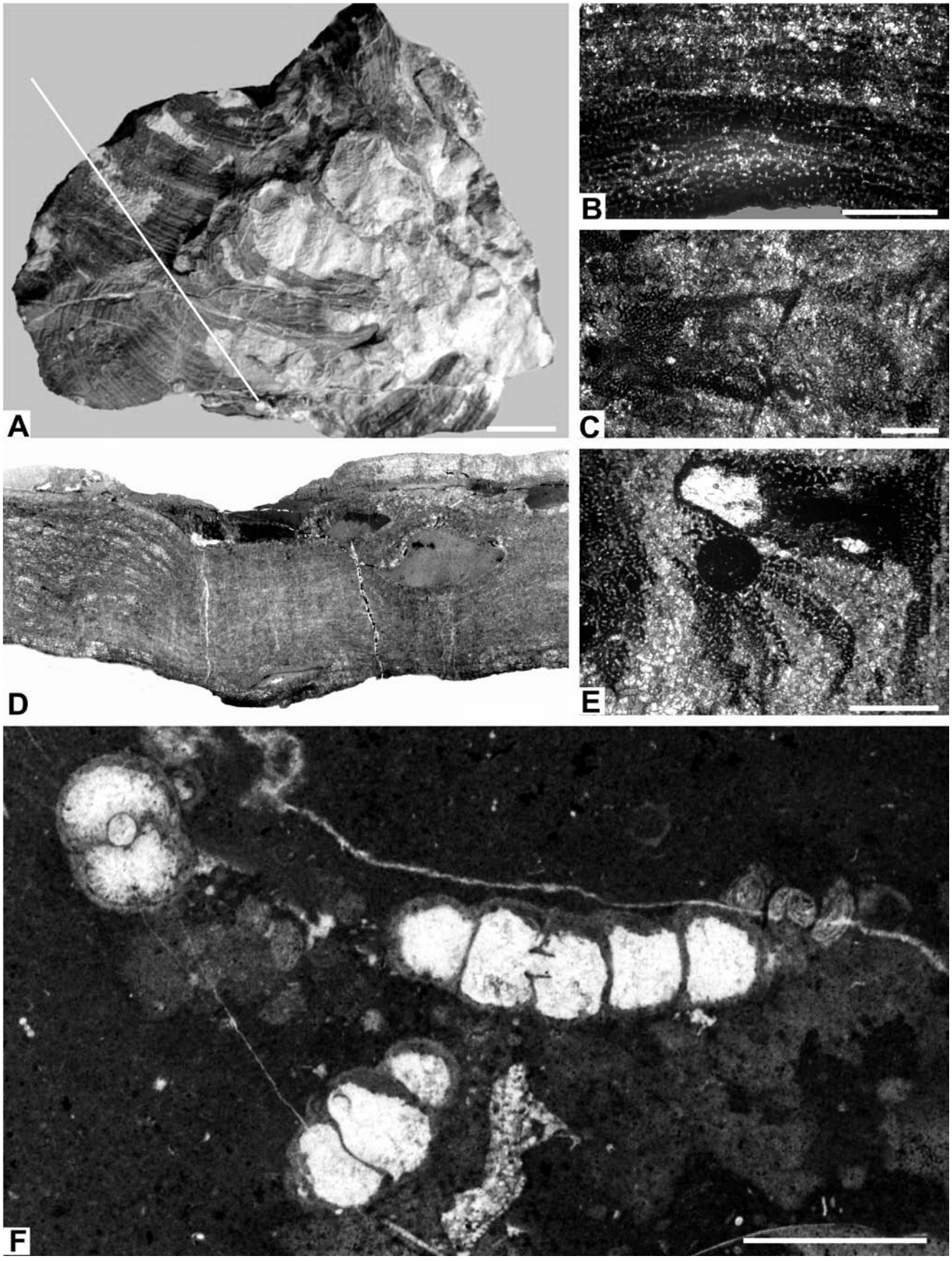
Fig. B: Magnification of a thin section oriented perpendicular to the sheet of a relatively well preserved specimen showing the skeletal elements.

Fig. C: Magnification of a thin section oriented parallel to the sheet of a relatively well preserved specimen showing the reticulate skeletal elements.

Fig. D: Section along the line in Fig. A, oriented perpendicular to the sheet showing the horizontal layers.
Vertical elements are indistinct.

Fig. E: Magnification of a thin section oriented parallel to the sheet of the same specimen as in Fig. C.
Note the reticulate skeletal fibers. The dark circle in the center represents a boring.

Fig. F: *Cheilosporites tirolensis* WÄHNER.
Differently oriented sections through three specimens. Two specimens show the axial siphon.



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