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LATE TRIASSIC (LATE NORIAN-RHAETIAN) RADIOLARIANS FROM THE ANTALYA NAPPES, CENTRAL TAURIDES, SOUTHERN TURKEY

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Riassunto. La sezione di Hocaköy, misurata nella Falda di Alakirçay (falda mediana delle falde di Antalya) contiene una ricca fauna a radiolari, che si estende dal Norico superiore (Triassico superiore) al Cenomaniano medio-superiore (Cretaceo). Nella parte inferiore della sezione, la Formazione Gökdere (Norico superiore-Retico) è caratterizzata da calcari grigi con selce alla base e da alternanze di selci rosse e di calcari grigi nella parte superiore. Nelle selci rosse sono presenti Radiolari con uno stato di conservazione da buono a moderato. La soprastante Hocaköy Radiolarite è rappresentata in prevalenza da alternanze di selci e argilliti, con alcuni interstrati calcarei.

I Radiolari della Formazione Gökdere possono venir correlati con il Mino Terrane del Giappone e la fauna della Queen Charlotte Islands, British Columbia, Canada. Nella Formazione Gökdere possono venir riconosciute quattro suddivisioni zonali del Giappone centrale e precisamente la "*Praemesosaturnalis multidentatus* Lowest Occurrence Zone (TR8A)" (Norico superiore), "*Praemesosaturnalis pseudokahleri* Lowest Occurrence Zone (TR8B)" (Norico superiore), ? "Skirt F lowest Occurrence Zone (TR8C)" (Norico superiore-Retico) e in parte la "*Haeckelicyrtium breviora* Taxon Range Zone (TR8D)" (Retico). Possono anche venire riconosciute due zone della fauna delle Queen Charlotte Islands, e precisamente la "Zona a *Betraccium deweveri*" (Norico superiore) e la "Zona a *Proparvicingula moniliformis*" (Retico inferiore). I Radiolari della parte sommitale della Formazione Gökdere indicano che la " Zona a *Globolaxtorum tozeri*" definita nelle Queen Charlotte Islands e corrispondente al Retico superiore, non è presente nella sezione studiata.

Abstract. The Hocaköy section measured from the Alakirçay Nappe (middle nappe) of the Antalya Nappes contain rich radiolarian fauna ranging from late Norian (Late Triassic) to middle-late Cenomanian (mid Cretaceous).

At the basal part of the section, the Late Triassic (late Norian-Rhaetian) Gökdere Formation is characterized by gray to beige cherty limestone at the base and pinkish red chert- gray to beige limestone alternation at the top, with moderately to well-preserved radiolarians in the red chert beds. The overlying Jurassic - Middle Cretaceous Hocaköy Radiolarite is mainly represented by chert-mudstone alternations with some limestone interlayers.

Radiolarians of the Gökdere Formation can be well correlated with that of the fauna from the Mino Terrane, central Japan and the fauna from the Queen Charlotte Islands, British Columbia, Canada. Four radiolarian zones from central Japan are recognized in the fauna obtained from Gökdere Formation such as "*Praemesosaturnalis multidentatus* Lowest Occurrence Zone (TR8A)" (late Norian), "*Praemesosaturnalis pseudokahleri* Lowest Occurrence Zone (TR8B)" (late Norian), ? "Skirt F lowest Occurrence Zone (TR8C)" (late Norian-Rhaetian) and partly "*Haeckelicyrtium breviora* Taxon Range Zone (TR8D)" (Rhaetian). In comparison with the Queen Charlotte fauna, the two zones "*Betraccium deweveri* Zone" (late Norian) and "*Proparvicingula moniliformis* Zone" (early Rhaetian) are also encountered in the Gökdere Formation. Radiolarians of the uppermost part of the Gökdere Formation indicate that "*Globolaxtorum tozeri* Zone" defined in Queen Charlotte Islands corresponding to the late Rhaetian, is not present in the section.

Five new taxa, *Capnuchosphaera okayi, Bistarkum rhaeticum, Praemesosaturnalis heilongjiangensis aksekiensis, P. nobleae, Veghicyclia sanfilippoae* were determined within the late Norian-Rhaetian radiolarian fauna of the Gökdere Formation in Hocaköy section.

Introduction

Over the past 30 years, radiolarian biostratigraphy of the Late Triassic has been clarified by many investigations. In particular, Norian-Rhaetian radiolarians have been investigated by Kozur & Mostler (1972, 1981, 1990), De Wever et al. (1979), De Wever (1982), Pessagno et al. (1979), Pessagno & Blome (1980), Blome (1983, 1984), Carter (1990, 1991, 1993), Nakaseko & Nishimura (1979), Yao (1982), Yoshida (1986), Yeh (1989, 1990, 1992), Sugiyama (1997), Yeh & Cheng (1996), Bragin (1991), Bragin & Krylov (1996, 1999), Bragin & Tekin (1996) and Tekin (1999).

Previously, very few researches focused on the Late Triassic radiolarian fauna of the Taurus Mountains. Early Norian radiolarians of the Antalya Nappes from the Isparta cay area, (western Taurides) has been reported by De Wever et al. (1979) and De Wever (1982). Subsequently, late Middle to Late Triassic radiolarian systematics and biostratigraphy of the Taurus Mountains and Ankara region was documented by Tekin (1999).

The aim of the present study is to evaluate the

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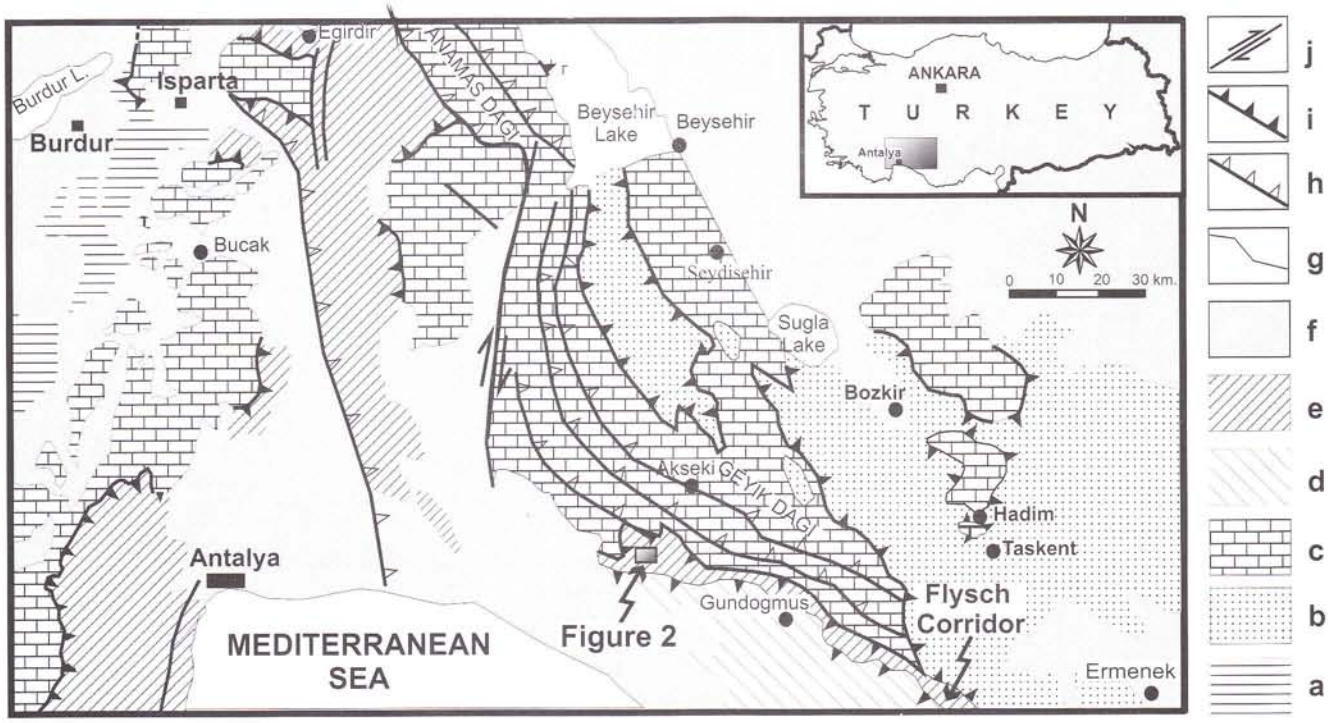


Fig. 1 - Simplified geological map showing the distribution of autochthonous and allochthonous units in the area between western and central Taurides. a. Lycian Nappes, b. Beysehir-Hoyran-Hadim Nappes, c. Beydaglari and Anamas-Akseki Autochthonous sequences, d. Alanya Nappe, e. Antalya Nappes, f. Post-Eocene cover rocks, g. Stratigraphic contact, h. Thrust fault , i. Overthrust fault, j. Strike-slip fault.

radiolarian assemblage of the late Norian-Rhaetian part of the Hocaköy section and correlate this fauna with the previously studied material from Turkey, as well as the other Tethys and circum-Pacific faunas. Radiolarian biostratigraphy of middle Hettangian- early late Sinemurian interval from the same section will be the subject of another publication (Tekin, 2002).

Geology

The Taurides, as one of the major tectonic units of Turkey, are situated along the southern part of Turkey. It includes allochthonous and autochthonous units. The allochthonous units were considered as "nappes" by Brunn et al. (1971), whereas Özgül (1976, 1984) adopted the term "tectonostratigraphic units".

The Antalya Nappes as a part of the Taurides include many radiolaria-bearing pelagic Mesozoic successions (Fig. 1). Lefevre (1967) first described and named it as single nappe (Antalya Nappe) in the Antalya region. Brunn et al. (1971) first attempted to subdivide it into three slices such as the "Çataltepe Unit " (lower nappe), the "Alakirçay Unit" (middle nappe), and the "Tahtalidag Unit" (upper nappe). At the final step, Antalya Nappes were subdivided into four different units: the "Çataltepe Nappe", the "Alakirçay Nappe", the "Tahtalidag Nappe" and the "Tekirova Ophiolitic Nappe" by Senel et al. (1992). Within these units, the Alakirçay Nappe (middle nappe) includes Middle Triassic to Late Cretaceous pelagic sediments with basic volcanic rocks as a distinctive feature (Senel et al. 1992, 1996). This nappe is widely exposed in the "Flysch Corridor" of Blumenthal (1951) as the "middle tectonic unit" of Antalya Nappes. Hocaköy section is one of the best and continuous section from this nappe (Figs. 1 & 2). Many scientists from Blumenthal (1951) to Senel et al. (1992) mainly concentrated on the stratigraphy and tectonic style of this part of the Antalya Nappes.

Lithostratigraphy and general characteristics of the Hocaköy section.

The Hocaköy section was measured at the westernmost part of the "Flysch Corridor" (Fig. 1). It is situated in the Alanya O27a2 quadrangle (Start Point: 3.78.625N, 40.86.875E; End Point: 3.78.875N, 40.87.250E), approximately 2 km northwest of the Hocaköy village (Figs. 1 and 2). Although, the Antalya Nappes are exposed in highly tectonized slices in the "Flysch Corridor", Hocaköy section represents a continuous sequence from Late Triassic to Middle Cretaceous with a 204 m of total thickness.

Two main units, the Gökdere Formation and the Hocaköy Radiolarite, could be recognized at the Hocaköy section (Fig. 3A). The basal part of the section is represented by the Gökdere Formation. Although this unit was named by Senel et al. (1992) as "Halobia bearing limestone Member of the Çandir Formation" in the

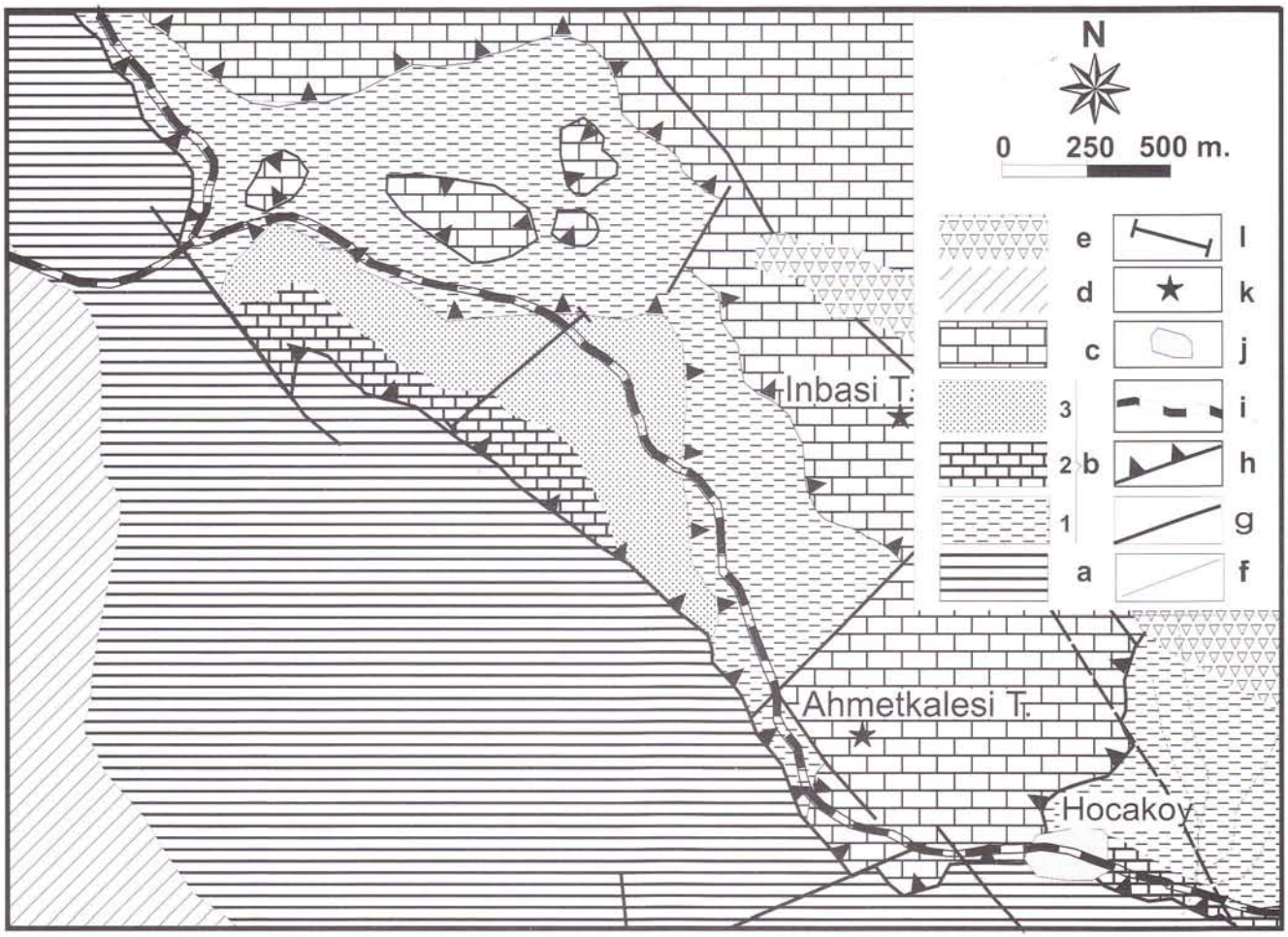


Fig. 2 - Geological map of the study area. a-c: Antalya Nappes; a. Undifferentiated Cataltepe Nappe, b. Alakircay Nappe: 1. Çandir Fm. (Triassic clastics), 2.Gökdere Formation (Late Triassic cherty limestone). 3. Hocaköy Radiolarite (Jurassic-Cretaceous mainly alternation of chert and mudstone with early Liassic Radiolaria bearing cherty limestone shale alternations at the base), c. Undifferentiated Tahtalidag Nappe, d. Miocene cover rocks, e. Quaternary deposits, f. Stratigraphic contact, g. Fault, h. Thrust fault, i. Main roads, j. Village, k. Main peaks, l. Location of the Hocakoy section (simplified after Esentürk 1991 and Senel 1991).

study area, its equivalent was defined as Gökdere Formation by Kalafatcioglu (1974) at the west of the Antalya Gulf. In this study, the term "Gökdere Formation" is adopted for the general correlation within this nappe system. The total thickness of the Gökdere Formation in the study area is 41 m (Fig. 3B). Gökdere Formation is emplaced tectonically over the Çataltepe Nappe (lower nappe). This formation is characterized by thin to medium bedded greenish gray to beige limestones with black to gray chert nodules at the base. No radiolarians were obtained from this part of section, only some undetermined remains of conodonts were found.

The upper part of the Gökdere Formation includes gray to beige, thin bedded limestone and pinkish red chert alternation. The pinkish red chert beds contains moderately to well-preserved abundant late Norian-Rhaetian radiolarians. As the main topic of this study, detailed systematics and biostratigraphy of these radiolarians is presented in the following chapters.

The Jurassic-Cretaceous Hocaköy Radiolarite overlying the Gökdere Formation was first described by Monod (1977). Although, Monod (1977) defined this unit as the possible cover of the Güzelsu unit (Çataltepe Nappe), according to Senel et al. (1992), it belongs to tectonically overlying Alakirçay Nappe and should be defined as a separate unit. To the west of the Antalya Gulf, Ballik Formation of Robertson & Woodcock (1981) could be considered as a equivalent of this unit (Tekin 1999).

The Hocaköy Radiolarite mainly consists of chert and mudstone alternation with some limestone interlayers with a total thickness of 163 m. At the base of the Hocaköy Radiolarite, mudstone/silicified mudstone with chert and limestone layers were encountered. No radiolarians were obtained from these part. First middle Hettangian radiolarians (*Gorgansium alpinum* Kozur & Mostler, *Pantanellium browni* Pessagno & Blome, *Praehexasaturnalis kirchsteinensis* Kozur & Mostler, *P. tetraradiatus* Kozur & Mostler, *Droltus carinaspinosus* Kozur & Mostler, *Charlottea weedensis* Whalen & Carter, *Canoptum merum* Pessagno & Whalen, *Protokatroma aquila*

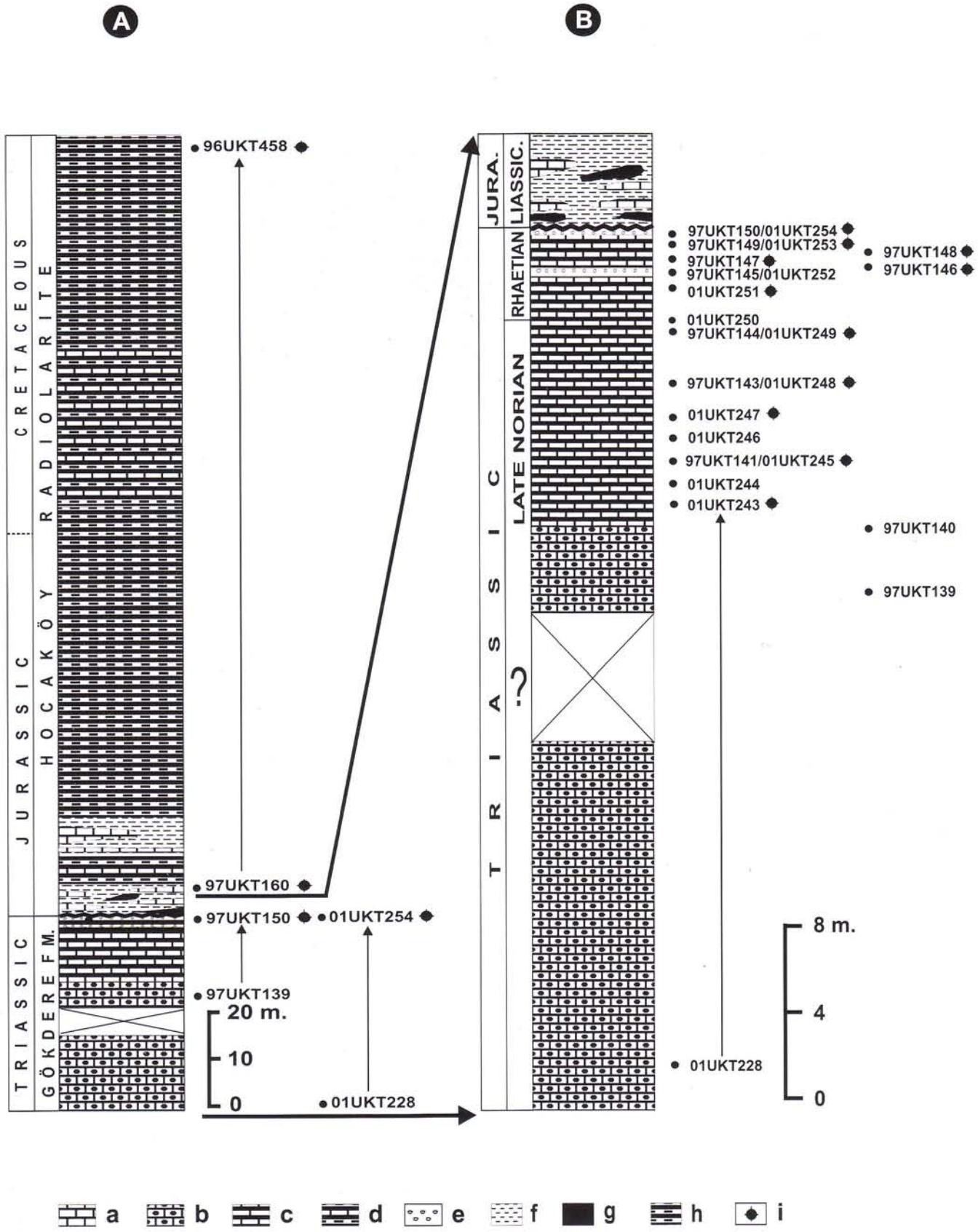


Fig. 3A - The Hocaköy columnar section and sampling levels. B. Enlargement of the Late Triassic part of the Hocaköy Measured Section. a. Limestone, b. Cherty limestone, c. Alternation of limestone and chert, d. Alternation of chert, limestone and mudstone, e. Micro-conglomerate, f. Mudstone, silicified mudstone, g. Chert, h. Alternation of chert and mudstone, i. Radiolaria bearing samples.

Whalen & Carter, *Bipedis hannai* Whalen & Carter etc. indicating basal part of *Pantanellium browni* Zone of Carter et al. (1998)) appear in the limestone interlayer (sample 97UKT160) within a silicified mudstone (Tekin in press, Fig. 3A). Towards the upper part, the successions become younger without gap with respect to radiolarian faunas. The youngest age of the Hocaköy Radiolarite in the section (sample 96UKT458) is middle Cenomanian - upper Cenomanian (according to zonal scheme of O'Dogherty 1994) with respect to following fauna: *Pseudodictyomitra pseudomacrocephala* (Squinabol), *Pseudodictyomitra tiara* (Holmes), *Novixitus mclaughlini* Pessagno, *Stichomitra communis* Squinabol and *Thanarla* spp. (Fig. 3A). Uppermost part of the section is tectonically separated from the Çandir Formation of Alakirçay Nappe (Fig. 2).

Materials, methods and repository

Thirty samples were collected both from the cherty limestone and chert-limestone alternation of the Gökdere Formation in the Hocaköy section. No radiolarians were obtained from limestone samples. Some chert beds (11 samples) yielded moderately to well-preserved late Norian-Rhaetian radiolarians.

The chert samples from the study area were processed by using techniques suggested by Pessagno & Newport (1972) and Dumitrica (1970), using diluted (5-10%) hydrofluoric acid. The already extracted radiolarians have been picked up and studied in light microscope Nikon SMZ-2B. The SEM microscope Zeiss DSM 940A in Innsbruck University, Austria has been utilized for more precise determinations and photographic works.

All holotypes and paratypes with collection numbers, MTA1534 - MTA1543, are stored at the Natural History Museum in General Directorate of Mineral Research and Exploration, Ankara.

Systematic paleontology

In this part, following abbreviations are used for the measurements; HT: Holotype, Min.: Minimum, Max.: Maximum, Av.: Average, Exc.: Excluding, Incl.: Including.

Subclass Radiolaria Müller, 1858

Order Polycystina Ehrenberg, 1838 emend. Riedel, 1967b

Suborder Spumellaria Ehrenberg, 1838

Superfamily Liosphearaecea Haeckel, 1881 emend. Pessagno & Blome, 1984

Subsuperfamily Liospherilae Haeckel, 1881

Family Capnuchosphaeridae De Wever, 1979 emend. Pessagno, 1979 emend. Blome, 1983

Subfamily Capnuchosphaerinae De Wever, 1982

Genus *Capnuchosphaera* De Wever, 1979 emend. Pessagno, 1979 emend. Blome, 1983

Type Species. *Capnuchosphaera triassica* De Wever, 1979.

Capnuchosphaera okayi n. sp.

Pl. 1, figs. 1, 2

Etymology. This species is dedicated to Prof. Dr. Aral Okay, Istanbul Technical University, Istanbul in honur of his contribution to the knowledge of Turkish geology.

Holotype. The specimen on Pl. 1, Fig. 1. Sample 97UKT141.

Type locality. Gökdere Formation, Hocaköy section, Antalya Nappes, southern Turkey (See locality description).

Description. Cortical shell subsphaerical in outline with double-layered wall structure. Tumidaspinae subcircular, short to moderately long and slightly expanding distally. Spinal tumors, as long as spinal tunnels display slight sinistral torsion. Tumidapores large, elongated. Spinal shafts short, circular in axial section. Length of tumidispinae always shorter than diameter of cortical shell.

Remarks. *Capnuchosphaera okayi* n. sp. differs from *Capnuchosphaera neosagaris* Sugiyama by having more spherical cortical shell and shorter and wider tumidispinae with slightly torsioned spinal tumors instead of strongly twisted tumors. It can be differentiated also from *C. puncta* De Wever (in De Wever, Sanfilippo, Riedel & Gruber 1979, p. 83, pl. 3, figs. 7-9) longer spinal tunnels and slightly torsioned spinal tumors instead of strongly twisted tumors.

Measurements (μm). (Based on 4 specimens)

	HT	Min.	Max.	Av.
Diameter of the cortical shell	150	135	150	146
Length of tumidaspinae	93	93	110	100
Width of tumida-spinae (proximally)	43	43	50	48

Range. Late Triassic; late Norian.

Occurrence. Antalya Nappes, southern Turkey.

Capnuchosphaera sp. cf. **C. okayi** n. sp.

Pl. 1, fig. 3

Remarks. Although this form is similar to *Capnuchosphaera okayi* n. sp., its bad preservation does not permit a more precise identification.

Range. Late Triassic; late Norian.

Occurrence. Antalya Nappes, southern Turkey.

Capnuchosphaera neosagaris Sugiyama, 1997

Pl. 1, fig. 4

1997 *Capnuchosphaera neosagaris* Sugiyama, pp. 148-149, figs. 40-5-7b.

Range. Late Triassic; late Norian.

Occurrences. Japan; Antalya Nappes, southern Turkey.

Family Ferresidae Carter, 1993

Genus *Ferresium* Blome, 1984 emend. Carter, 1993

Type Species: *Ferresium laseekense* Blome, 1984.

Ferresium laseekense Blome, 1984

Pl. 1, fig. 5

1984 *Ferresium laseekense* Blome, p. 43, pl. 7, figs. 10, 11, 14, 15, 22; pl. 8, figs. 1, 5, 8, 12, 14; pl. 17, fig. 2
? 1993 *Ferresium* sp. aff. *F. laseekense* Blome- Carter, p. 69, pl. 8, fig. 1

Range. Late Triassic; late Norian - ?Rhaetian.

Occurrences. Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Ferresium philippinense Yeh & Cheng, 1996

Pl. 1, figs. 6, 7

1986 *Ferresium* sp. A Yoshida, pl. 14, fig. 9
1996 *Ferresium triquetrum* Carter- Bragin & Tekin, pl. 2, figs. 4, 5
1996 *Ferresium philippinense* Yeh & Cheng, p. 7, pl. 4, figs. 1, 3, 5, 9, 10
1999 *Ferresium philippinense* Tekin, p. 13, figs. 12-13.

Range. Late Triassic; late Norian - Rhaetian.

Occurrences. Central Japan; Busuanga Island, Philippines; Eryaman, Ankara and Antalya Nappes, Turkey.

Ferresium sp. A

Pl. 1, fig. 8

1984 *Ferresium* sp. A Blome, p. 45, pl. 9, figs. 1, 5, 6, 10.

Short definition. Test as genus. Cortical shell spherical, top and bottom of the surfaces convex, inflated. Primary spines symmetrically arranged, three-carinate, strongly sinistrally twisted with deep grooves and thick ridges.

Remarks. It differs from *F. hecatense* Blome (1984, p. 43, pl. 7, figs. 9, 16, 17, 21) by having a more inflated test and highly twisted primary spines.

Range. Late Triassic; late Norian.

Occurrences. ?Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Genus *Risella* Carter, 1993

Type Species. *Risella tledoensis* Carter, 1993.

Risella sp. aff. **R. conclusum** (Carter, 1993)

Pl. 1, fig. 9

aff. 1993 *Ferresium conclusum* Carter, pp. 68-69, pl. 9, figs. 1-5
aff. 1999 *Risella conclusum* (Carter)- Carter & Guex, p. 191, pl. 1, figs. 1-3

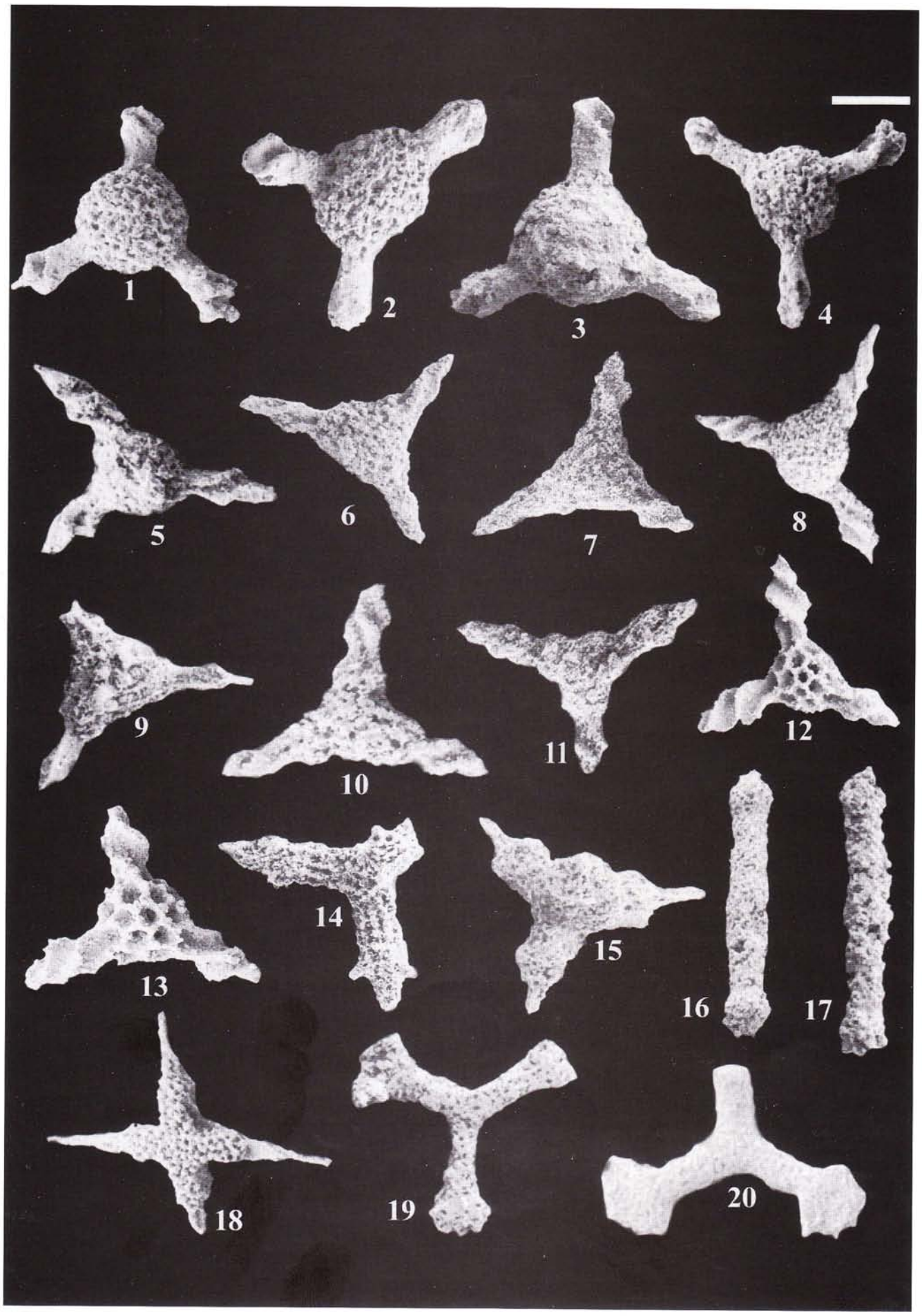
Remarks. It differs from *Risella conclusum* (Carter) by having wider primary spines with very wide grooves.

Range. Late Triassic; Rhaetian.

PLATE 1

Scanning electron micrographs of Late Triassic Spumellaria (Radiolaria) from the Gökdere Formation in Hocaköy section. Scale = number of microns for each figure.

Figs. 1, 2 - *Capnuchosphaera okayi* n. sp. 1. Holotype. Sample no. 97UKT141, late Norian, scale bar= 110μm.,2. Paratype. Sample no. 01UKT245, late Norian, scale bar= 110μm.
Fig. 3 - *Capnuchosphaera* sp. cf. *C. okayi* n. sp. Sample no. 97UKT141, late Norian, scale bar= 90μm.
Fig. 4 - *Capnuchosphaera neosagaris* Sugiyama. Sample no. 01UKT243, late Norian, scale bar= 110μm.
Fig. 5 - *Ferresium laseekense* Blome. Sample no. 01UKT249, late Norian. scale bar= 90μm.
Figs. 6, 7 - *Ferresium philippinense* Yeh & Cheng. Fig. 6 is from sample 97UKT148, Rhaetian, scale bar= 90μm. Fig. 7 is from sample 01UKT253, Rhaetian, scale bar= 90μm.
Fig. 8 - *Ferresium* sp. A. Sample no. 01UKT248, late Norian, scale bar= 110μm.
Fig. 9 - *Risella* sp. aff. *R. conclusum* (Carter). Sample no. 97UKT150, Rhaetian, scale bar= 120μm.
Fig. 10 - *Risella stalkungiensis* Carter. Sample no. 97UKT146, Rhaetian, scale bar= 90μm.
Fig. 11 - *Risella tledoensis* Carter. Sample no. 01UKT253, Rhaetian, scale bar= 100μm.
Figs. 12, 13 - *Betraccium deweveri* Pessagno & Blome. Both specimens are from sample 01UKT248, late Norian, scale bar for both specimens= 100μm.
Fig. 14 - *Paratriassoastrum* sp. A. Sample no. 97UKT148, Rhaetian, scale bar= 90μm.
Fig. 15 - *Paratriassoastrum* sp. B. Sample no. 97UKT148, Rhaetian, scale bar= 120μm.
Figs. 16, 17 - *Bistarkum rhaeticum* n. sp. 16. Holotype. Sample no. 01UKT253, Rhaetian, scale bar= 140μm. 17. Paratype. Sample 01UKT253, Rhaetian, scale bar= 120μm.
Fig. 18 - *Crucella* sp. A. Sample no. 97UKT147, Rhaetian, scale bar= 130μm.
Fig. 19 - *Paronaella pacofiensis* Carter. Sample no. 01UKT251, Rhaetian, scale bar= 160μm.
Fig. 20 - *Paronaella* sp. A. Sample no. 97UKT148, Rhaetian, scale bar= 140μm.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Occurrence. Antalya Nappes, southern Turkey.

Risella stalkungiensis Carter, 1993

Pl. 1, fig. 10

1992 *Paronaella* sp. B Yeh, p. 62, pl. 2, fig. 12.
1993 *Risella stalkungiensis* Carter, p. 74, pl. 9, fig. 8.
1999 *Risella stalkungiensis* Tekin, p. 102, pl. 14, figs. 1-2.
1999 *Risella stalkungiensis* Carter & Guex, p. 191, pl. 1, fig. 1.

Range. Late Triassic; Rhaetian.

Occurrences. Uson Island, Philippines; Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Risella tledoensis Carter, 1993

Pl. 1, fig. 11

1990 Gen. nov. C sp. 1 Carter, pl. 2, fig. 1.
1991 *Hagiastrum* ? sp. Bragin, pl. 7, fig. 2.
1993 *Risella tledoensis* Carter, pp. 75-76, pl. 9, figs. 10, 11, 13.
1996 *Risella tledoensis* - Yeh & Cheng, p. 8, pl. 4, figs. 2, 6.
1997 *Risella tledoensis* - Sugiyama, p. 186, fig. 50-16.
1999 *Risella tledoensis* - Tekin, p. 102, pl. 14, figs. 13-14.
1999 *Risella tledoensis* - Carter & Guex, p. 191-192, pl. 1, figs. 7-9.

Range. Late Triassic; Rhaetian.

Occurrences. Kunga and Queen Charlotte Islands, British Columbia; Sikhote-Alyn, Fareast Russia; Busuanga Island, Philippines; Central Japan; Antalya Nappes, southern Turkey.

Family Pantanelliidae Pessagno, 1977 emend. Pessagno & Blome, 1980

Subfamily Pantanellinae Pessagno, 1977

Genus *Betraccium* Pessagno, 1979

Type species. *Betraccium smithi* Pessagno, 1979

Betraccium deweveri Pessagno & Blome, 1980

Pl. 1, figs. 12, 13

1980 *Betraccium deweveri* Pessagno & Blome, pp. 230-231, pl. 1, figs. 1, 2, 5-8, 13, 14.
1984 *Betraccium deweveri* - Blome, pp. 37-38, pl. 5, figs. 6, 7, 13, 20.
1986 *Betraccium deweveri* - Yoshida, pl. 13, figs. 6-9.
1986 *Betraccium deweveri* - Bragin, pl. 1, fig. 5.
1986 *Betraccium deweveri* - Sato, Murata & Yoshida, fig. 16, no. 16.
1987 *Betraccium deweveri* - Blome, Moore, Simes & Watters, pl. 1, fig. 11.
1988 *Betraccium deweveri* - Spörli & Aita, pl. 1, fig. 4.
1989 *Betraccium deweveri* - Cheng, p. 145, pl. 11, figs. 8, 9, 16 non pl. 8, fig. 8.
1991 *Betraccium deweveri* - Bragin, p. 84 , pl. 7, figs. 13, 14.
1992 *Betraccium deweveri* - Yeh, p. 59, pl. 1, figs. 9, 13, 14.
1993 *Betraccium deweveri* - Carter, p. 58, pl. 6, fig. 1.
1996 *Betraccium deweveri* - Bragin & Tekin, pl. 1, fig. 6.
1996 *Betraccium deweveri* - Yeh & Cheng, p. 6, pl. 2, fig. 3.
1997 *Betraccium deweveri* - Sugiyama, p. 175, fig. 50-22.
1999 *Betraccium deweveri* - Tekin, pp. 97-98, pl. 12, figs. 11-12.

Range. Late Triassic; late Norian.

Occurrences. Queen Charlotte Islands, British Columbia; Central Japan; Kawakawa Bay, New Zealand; Uson and Busuanga Islands, Philippines; Sikhote-Alyn, Fareast Russia; Eryaman, Ankara and Antalya Nappes, Turkey.

Family Paratriassoastridae Kozur & Mostler, 1981

Genus *Paratriassoastrum* Kozur & Mostler, 1981

Type Species. *Paratriassoastrum austriacum* Kozur & Mostler, 1981.

Paratriassoastrum sp. A

Pl. 1, fig. 14

Short definition. Test as with genus, large and tetrahedral. Central shell small, subspherical. Rays long, slightly expanding to the distal part, two lateral branches appeared at the tip of rays. Main tips thick, contracting distally.

Remarks. It differs from *Paratriassoastrum omegaense* Carter (1993, p. 78, pl. 11, figs. 4, 7, 8, 14, 19) in having two lateral branches at the distal part.

Range. Late Triassic; Rhaetian.

Occurrence. Antalya Nappes, southern Turkey.

Paratriassoastrum sp. B

Pl. 1, fig. 15

Short definition. Test as with genus, tetrahedral. Central shell subspherical, medium in size. Rays short to medium in length, wide and expanding distally and become bulbous. Tips of the arms three-carinate, long slightly tapering distally, pointed.

Remarks. It differs from *Paratriassoastrum* sp. B sensu Carter (1993, p. 79, pl. 11, figs. 15, 18) by having bigger size of test and more bulbous rays.

Range. Late Triassic; Rhaetian.

Occurrence. Antalya Nappes, southern Turkey.

Family Patulibrachiidae Pessagno, 1971 emend. Baumgartner, 1980

Subfamily Patulibrachiinae Pessagno, 1971 emend. Baumgartner, 1980

Genus *Bistarkum* Yeh, 1987

Type Species. *Bistarkum rigidum* Yeh, 1987.

Bistarkum rhaeticum n. sp.

Pl. 1, figs. 16, 17

Etymology. This is named for its occurrence in Rhaetian.
Holotype. The specimen on Pl. 1, Fig. 16. Sample 01UKT253.
Type locality. Gökdere Formation, Hocaköy section, Antalya Nappes, southern Turkey (See locality description).

Description. Test, cylindrical, long with two nearly equal-sized spongy rays. Rays approximately uniform in size till distal part. Rays ended with bulbous, subspherical part. No auxiliary spines observed at tips.

Remarks. *Bistarkum rhaeticum* n. sp. differs from the *B.* ? *cylindratum* Carter (1993, pp. 79-80, pl. 10, figs. 1, 18) in having more slender test, bulbous ray tips and absence of fringe-like structure in ray tips. It could be differentiated from Jurassic species *B. rigidum* Yeh (1987, pp. 43-44, pl. 1, fig. 5; pl. 21, fig. 5; pl. 22, figs. 1, 3, 7, 11) by having spherical, bulbous tips instead of large ellipsoidal tips.

Measurements (μm). (Based on 4 specimens)

	HT	Min.	Max.	Av.
Total length of test	482	433	482	45
Width of rays	71	57	82	70
Width of the tips	89	71	100	87

Range. Late Triassic; Rhaetian.
Occurrence. Antalya Nappes, southern Turkey.

Genus *Crucella* Pessagno, 1971

Type Species. *Crucella messinae* Pessagno, 1971.

Crucella sp. A

Pl. 1, fig. 18

1993 *Crucella* sp. B Carter, p. 85, pl. 10, figs. 10-11.

Short definition. Test large, cruciform with long rays. Rays equal in length, thick approximately uniform in width. Outer layers of meshwork and of central area and rays composed of tetragonal to trigonal pore frames with large nodes at pore frame vertices. Rays ended with very long three-carinate spines, tapering distally, pointed.

Remarks. It differs from *C. flowerpotensis* Carter (1993, p. 84, pl. 10, figs. 13, 14) by having rays with approximate uniform width instead of laterally expanded rays, larger nodes at pore frame vertices and longer spines at tips.

Range. Late Triassic; Rhaetian.
Occurrences. Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Genus *Paronaella* Pessagno, 1971 emend.
Baumgartner, 1980

Type species. *Paronaella solanoensis* Pessagno, 1971.

Paronaella pacofiensis Carter, 1993

Pl. 1, fig. 19

1992 *Sontonella* sp. A Yeh, p. 62, pl. 2, fig. 8.
1993 *Paronaella pacofiensis* Carter, pp. 81-82, pl. 10, fig. 5.
1997 *Paronaella pacofiensis* - Sugiyama, p. 184, fig. 50-15.
1999 *Paronaella pacofiensis* - Tekin, p. 90, pl. 10, fig. 2.

Range. Late Triassic; Rhaetian.
Occurrences. Uson Island, Philippines; Queen Charlotte Islands, British Columbia; Central Japan; Antalya Nappes, southern Turkey.

Paronaella sp. A

Pl. 1, fig. 20; Pl. 2, fig. 1

1999 *Paronaella* sp. A Tekin, pp. 90-91, pl. 10, fig. 6.

Short definition: Test large with thin rays. Rays long and wide. Ray tips flattened and elliptical with a rare auxiliary spines.

Remarks: *Paronaella* sp. A differs from the other *Paronaella* in having flattened ray tips with short spines.

Range. Late Triassic; Rhaetian.
Occurrence. Antalya Nappes, southern Turkey.

Paronaella sp. B

Pl. 2, fig. 2

Short definition. Test with small central area. Rays equal in length, short and thick gently expanded distally. Meshwork of central area and rays composed of small mostly triangular pore frames with rounded nodes at vertices of bars. Ray ends without tips.

Remarks. It differs from *P.* ? *beatricia* Carter (1993, p. 80, pl. 10, figs. 7, 8, 15, 16) by possessing shorter and wider rays.

Range. Late Triassic; Rhaetian.
Occurrence. Antalya Nappes, southern Turkey.

Superfamily Saturnaliceae Deflandre, 1953
Family Parasaturnalidae Kozur & Mostler, 1972 emend.
Kozur & Mostler, 1983
Subfamily Parasaturnalinae Kozur & Mostler, 1972

Genus *Praemesosaturnalis* Kozur & Mostler, 1981

Type Species. *Spongosaturnalis bifidus* Kozur & Mostler, 1972.

Praemesosaturnalis heilongjiangensis
Yang & Mizutani, 1991
Praemesosaturnalis heilongjiangensis heilongjiangensis

Yang & Mizutani, 1991

Pl. 2, fig. 3

1982 *Palaeosaturnalis bifidus* (Kozur & Mostler)- Yao, pl. 3, fig. 17.
1986 *Acanthocircus* sp. Yoshida, pl. 16, fig. 12.
1991 *Praemesosaturnalis heilongjiangensis* Yang & Mizutani, pp. 67-68, pl. 1, figs. 3, 4, 6, 10, 12, 13.
1997 *Praemesosaturnalis heilongjiangensis* - Sugiyama, p. 185, fig. 51-16.

Range. Late Triassic; late Norian.

Occurrences. Japan; Northeast China; Antalya Nappes, southern Turkey.

Praemesosaturnalis heilongjiangensis aksekiensis

n. subsp.

Pl. 2, figs. 4, 5, 6

Etymology. This subspecies is named for its type locality situated at the vicinity of Akseki Town.

Holotype. The specimen on Pl. 2, Fig. 4. Sample 01UKT248.

Type locality. Gökdere Formation, Hocaköy section, Antalya Nappes, southern Turkey (See locality description).

Description. Peripheral ring circular to subcircular in outline, broad. Ten to twelve peripheral spines short, mainly bluntly ended rarely pointed ended with shallow and wide grooves flanked by two thin ridges. Both two polar rays and four auxiliary rays long, circular to subcircular in cross-section.

Remarks. *Praemesosaturnalis heilongjiangensis aksekiensis* n. subsp. differs from *P. heilongjiangensis heilongjiangensis* Yang & Mizutani by having much shorter and wider peripheral spines.

Measurements (μm). (Based on 3 specimens)

	HT	Min.	Max.	Av.
Max. diameter of the inner cavity	189	189	203	197
Width of ring	58	32	58	44
Max. length of peripheral spines	71	43	75	63

Range. Late Triassic; late Norian.

Occurrence. Antalya Nappes, southern Turkey.

Praemesosaturnalis huxleyensis (Carter, 1993) n. comb.

Pl. 2, fig. 7

1993 *Kozurastrum huxleyense* Carter, pp. 53-54, pl. 4, figs. 4, 5, 6.
1996 *Pseudoheliodiscus huxleyensis* (Carter)- Yeh & Cheng, p. 9, pl. 3, figs. 1, 2, 4, 5.

Remarks. *Kozurastrum* De Wever, 1984 is the junior synonym of the *Praemesosaturnalis* Kozur & Mostler, 1981.

Range. Late Triassic; Rhaetian.

Occurrences. Queen Charlotte Islands, British Columbia; Busuanga Island, Philippines; Antalya Nappes, southern Turkey.

Praemesosaturnalis multidentatus

(Kozur & Mostler, 1972) Group

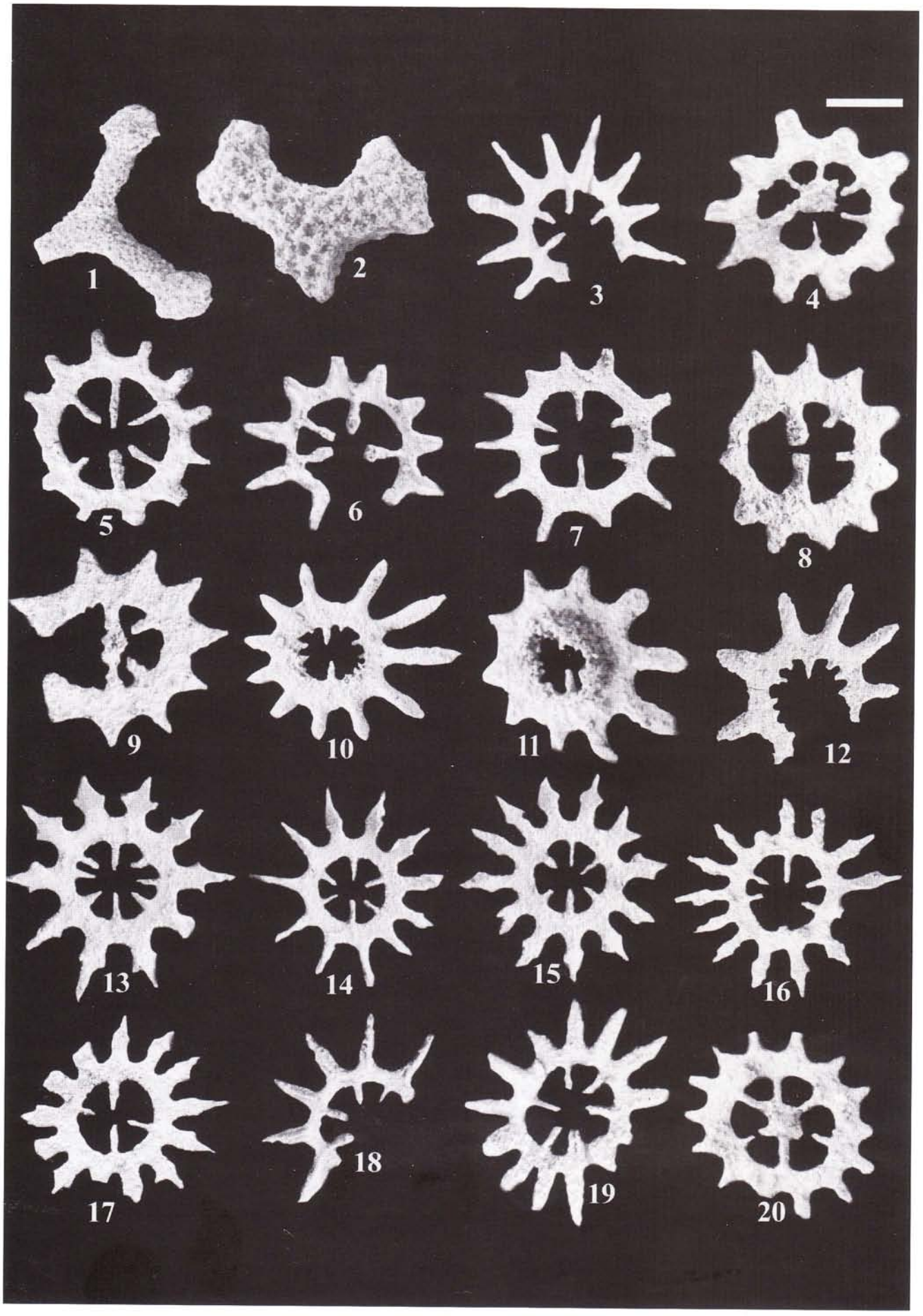
Pl. 2, figs. 8, 9

1972 *Spongosaturnalis multidentatus* Kozur & Mostler, p. 38, pl. 1, fig. 20.
1981 *Praemesosaturnalis multidentatus* (Kozur & Mostler)- Kozur & Mostler, p. 58.
1982 *Palaeosaturnalis* sp. G Kishida & Sugano, pl. 3, figs. 17-19.
1982 *Palaeosaturnalis* sp. H Kishida & Sugano, p.3, figs. 20-21.
1986 *Acanthocircus* sp. Yoshida, 1986, pl. 16, figs. 1-5.
pars 1990 *Pseudoheliodiscus* sp. aff. *P. multidentatus* (Kozur & Mostler)- Yeh, p. 18, pl. 15, figs. 7, 9, 10, 11 non fig. 13 (=*Praemesosaturnalis nobleae* n. sp.).
1990 *Pseudoheliodiscus* sp. cf. *P. multidentatus* - Yeh, p. 18, pl. 15, fig. 12.
1991? *Kozurastrum multidentatus* - Bragin, p. 93, pl. 7, fig. 9.
1996 *Praemesosaturnalis* sp. aff. *P. multidentatus*- Bragin & Krylov, pl. 1, fig. 10, pl. 2, fig. 10.
pars 1997 *Praemesosaturnalis multidentatus* (Kozur & Mostler) Group-

PLATE 2

Scanning electron micrographs of Late Triassic Spumellaria (Radiolaria) from the Gökdere Formation in Hocaköy section. Scale = number of microns for each figure.

Fig. 1 - *Paronaella* sp. A. Sample no. 97UKT147, Rhaetian, scale bar= 160μm.
Fig. 2 - *Paronaella* sp. B. Sample no. 97UKT147, Rhaetian, scale bar= 80μm.
Fig. 3 - *Praemesosaturnalis heilongjiangensis heilongjiangensis* Yang & Mizutani. Sample no. 01UKT248, late Norian, scale bar= 230μm.
Figs. 4, 5, 6 - *Praemesosaturnalis heilongjiangensis aksekiensis* n. subsp. 4. Holotype. Sample no. 01UKT248, late Norian, scale bar= 140μm. 5, 6 Paratypes. Fig. 5 is from sample 97UKT141, late Norian, scale bar= 140μm. Fig. 6 is from sample 01UKT247, late Norian, scale bar= 140μm.
Fig. 7 - *Praemesosaturnalis huxleyensis* (Carter). Sample no. 01UKT251, Rhaetian, scale bar= 140μm.
Figs. 8, 9 - *Praemesosaturnalis multidentatus* (Kozur & Mostler) Group. Both specimens are from sample 01UKT243, late Norian, scale bar for both specimens= 90μm.
Figs. 10, 11, 12 - *Praemesosaturnalis nobleae* n. sp. 10. Holotype. Sample no. 01UKT243, late Norian, scale bar= 150μm. 11-12. Paratypes. Both specimens are from sample 01UKT243, late Norian, scale bar= 110μm. and 150μm. respectively.
Figs. 13, 14, 15, 16, 17 - *Praemesosaturnalis pseudokahleri* Sugiyama. All specimens are from sample 01UKT248, late Norian, scale bar = 180, 210, 200, 180 and 180μm. respectively.
Figs. 18, 19 - *Praemesosaturnalis rugosus yehae* Tekin. Both specimens are from sample 01UKT248, late Norian, scale bar= 210 and 190μm. respectively.
Fig. 20 - *Praemesosaturnalis sandspitensis* (Blome). Sample no. 97UKT150, Rhaetian, scale bar= 160μm.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Sugiyama, p. 185, figs. 51-1 non fig. 28-2 (=*Praemesosaturnalis nobleae* n. sp.).

? 1999 *Praemesosaturnalis* sp. cf. *P. multidentatus* - Bragin & Krylov, p. 556, fig. 9F.

Range. Late Triassic; middle Norian - late Norian.

Occurrences. Pötschen, Austria; Japan; Sikhote-Alyn, Fareast Russia; Busuanga Island, Philippines; Cyprus; Antalya Nappes, southern Turkey.

Praemesosaturnalis nobleae n. sp.

Pl. 2, figs. 10, 11, 12

pars 1990 *Pseudoheliodiscus* sp. aff. *P. multidentatus* (Kozur & Mostler)- Yeh, p. 18, pl. 12, fig. 13 non pl. 15, figs. 7, 9, 10-11.

pars 1997 *Praemesosaturnalis multidentatus* (Kozur & Mostler) Group-Sugiyama, p. 185, fig. 28-2 non fig. 51-1.

Etymology. This species is dedicated to Dr. Paula J. Noble, University of Nevada, USA, in honor of her great contribution to the knowledge of Paleozoic radiolarian biostratigraphy.

Holotype. The specimen on Pl. 2, Fig. 10. Sample 01UKT243.

Type locality. Gökdere Formation, Hocaköy section, Antalya Nappes, southern Turkey (See locality description).

Description. Peripheral ring subspherical to subellipsoidal, broad. Ten to twelve peripheral spines in different length. While at one side of the test, peripheral spines short and wide triangular, peripheral spines at the other side of test longer than the former, elongated, expanding till medial part then contracting, pointed ended. Two polar rays longer than the auxiliary rays. Nine to ten auxiliary rays short, pointed, circular in cross-section.

Remarks. It differs from *Praemesosaturnalis latifolia* (Kozur & Mostler 1972, p. 37, pl. 1, figs. 18-19) by having more peripheral spines (10-12 instead of 8-10) and irregular length of these spines. It can be differentiated also from *Praemesosaturnalis multidentatus* (Kozur & Mostler) by having medially expanding peripheral spines instead of continuously contracting peripheral spines.

Measurements (μm). (Based on 6 specimens)

	HT	Min.	Max.	Av.
Max. diameter of the inner cavity	135	122	135	130
Width of ring	43	36	50	42
Max. length of peripheral spines	145	94	145	119

Range. Late Triassic; late Norian.

Occurrences. Busuanga Island, Philippines; Japan; Antalya Nappes, southern Turkey.

Praemesosaturnalis pseudokahleri Sugiyama, 1997 emend. herein.

Pl. 2, figs. 13, 14, 15, 16, 17

pars 1996 *Kozurastrum* spp. Bragin & Tekin, pl. 2, fig. 6, non fig. 7 (=*Praemesosaturnalis rugosus yehae* Tekin) and fig. 8.

1997 *Praemesosaturnalis pseudokahleri* Sugiyama, p. 67, figs. 28-3, 45-8, 9.

1999 *Praemesosaturnalis pseudokahleri* - Tekin, p. 113, pl. 18, fig. 6.

Emended Description. Ring moderately wide to wide, circular to subcircular in outline. Ten to fourteen peripheral spines, displaying slight to strong sinistral torsion, become wider distally and three branches appear. Auxiliary rays vary from four to six. Auxiliary rays mainly shorter than two polar rays, sometimes as long as polar rays.

Range. Late Triassic; late Norian.

Occurrences. Central Japan; Antalya Nappes, southern Turkey.

Praemesosaturnalis rugosus (Yeh, 1990)

Praemesosaturnalis rugosus yehae Tekin, 1999

Pl. 2, figs. 18, 19

1982 *Palaeosaturnalis* sp. D Kishida & Sugano, pl. 3, fig. 11.

1982 *Palaeosaturnalis* sp. E Kishida & Sugano, pl. 3, figs. 12, 13.

1982 *Palaeosaturnalis* sp. J Kishida & Sugano, pl. 4, figs. 1, 2, 4, non 3.

non 1990 *Pseudoheliodiscus rugosus* Yeh, p. 19, pl. 12, figs. 10, 14; pl. 13, fig. 12 (=*Pr. rugosus rugosus* (YEH 1990).

1996 *Pseudoheliodiscus rugosus* - Yeh & Cheng, p. 9, pl. 3, figs. 8, 9, 10.

pars 1996 *Kozurastrum* spp. Bragin & Tekin, pl. 2, fig. 7, non pl. 2, fig. 6 (=*Praemesosaturnalis pseudokahleri pseudokahleri* Sugiyama) and fig. 8.

1997 *Praemesosaturnalis* sp. A Sugiyama, p. 167, fig. 45-10.

1999 *Praemesosaturnalis rugosus yehae* Tekin, pp. 113-114, pl. 18, figs. 7-8.

Range. Late Triassic; late Norian.

Occurrences. Central Japan; Busuanga Island, Philippines; Eryaman, Ankara and Antalya Nappes, Turkey.

Praemesosaturnalis sandspitensis (Blome, 1984)

Pl. 2, fig. 20

1982 *Palaeosaturnalis* aff. *quinquespinosa* (Kozur & Mostler)- Yao, pl. 3, fig. 18.

1984 *Pseudoheliodiscus sandspitensis* Blome, p. 27, pl. 3, figs. 6, 7.

1986 *Pseudoheliodiscus sandspitensis* - Yoshida, pl. 15, fig. 10.

1989 *Pseudoheliodiscus sandspitensis* - Blome, Reed & Tailleur, pl. 33.2, fig. 21.

1989 *Pseudoheliodiscus sandspitensis* - Cheng, p. 146, pl. 9, fig. 10.

1993 *Kozurastrum sandspitense* (Blome)- Carter, p. 54, pl. 4, fig. 2.

1993 *Kozurastrum* sp. aff. *K. sandspitense* (Blome)- Carter, p. 54, pl. 4, fig. 3.

1997 *Praemesosaturnalis sandspitense* - Sugiyama, p. 185, fig. 51-11.

1999 *Praemesosaturnalis sandspitense* Tekin, p. 114, pl. 18, fig. 9.

Range. Late Triassic; late Norian - Rhaetian.

Occurrences. Central Japan; Kunga and Queen Charlotte Islands, British Columbia; Uson Island, Philippines; Antalya Nappes, southern Turkey.

Praemesosaturnalis sp. A

Pl. 3, figs. 1, 2

Short definition. Peripheral ring circular in outline with wide medial groove on surfaces, flanked by a narrow ridge. Typically twelve to fourteen peripheral spines short to moderately long, flat to subcircular, triangular to elongated triangular, pointed without grooves and ridges. Two polar rays long, four auxiliary rays regularly arranged, long and circular in cross-section.

Remarks. It is differentiated from *P. heilongjiangensis heilongjiangensis* Yang & Mizutani by having ring with groove flanked by ridges instead of smooth ones. In addition to this, the former has narrower and shorter peripheral spines without central groove flanked by thin ridges.

Range. Late Triassic; late Norian.

Occurrence. Antalya Nappes, southern Turkey.

Genus *Saturnosphaera* Tichomirova, 1975 emend. Kozur & Mostler, 1983

Type Species. *Saturnosphaera gracilis* Tichomirova, 1975

Saturnosphaera sp. A

Pl. 3, fig. 3

Short definition. Ring, circular to subcircular, broad. Seventeen long to moderately long peripheral spines slightly expanding medially then decreasing in width, blunted ended. Eight long, circular rays present in the inner part of the ring.

Remarks. It differs from *Saturnosphaera gracilis* Tichomirova in having broad and more peripheral spines (17 instead of 13).

Range. Late Triassic; late Norian.

Occurrence. Antalya Nappes, southern Turkey.

Family Pseudoacanthocircidae Kozur & Mostler, 1990

Genus *Pseudoacanthocircus* Kozur & Mostler, 1990

Type Species. *Pseudoacanthocircus mediospinosus* Kozur & Mostler, 1990.

Pseudoacanthocircus sugiyamai Tekin, 1999

Pl. 3, fig. 4

1997 *Pseudoacanthocircus* sp. C Sugiyama, p. 168, fig. 45-14.
1999 *Pseudoacanthocircus sugiyamai* Tekin, p. 116, pl. 19, figs. 10-12.

Range. Late Triassic; late Norian - Early Jurassic; Sinemurian.

Occurrences. Japan; Antalya Nappes, southern Turkey.

Family Veghicycliidae Kozur & Mostler, 1972

Genus *Veghicyclia* Kozur & Mostler, 1972

Type Species. *Veghicyclia pulchra* Kozur & Mostler, 1972.

Veghicyclia sanfilippoae n. sp.

Pl. 3, figs. 5, 6

Etymology. This species is dedicated to Dr. Annika Sanfilippo, Scripps Institution of Oceanography, University of California at San Diego, USA, in honor of her great contribution to the Cretaceous and Tertiary radiolarian biostratigraphy.

Holotype. The specimen on Pl. 3, Fig. 5. Sample 01UKT251.

Type Locality. Gökdere Formation, Hocaköy section, Antalya Nappes, southern Turkey (See locality description).

Description. Cortical shell, large, spongy and flat discoidal in outline. Equatorial disc circular to subcircular with two rows of pores. Pores on equatorial disc medium to big, in different size subcircular to subelliptical in outline. Outer pores mainly bigger than the previous ones. Fifteen to sixteen symmetrically arranged outer peripheral spines short to medium in length, flat, triangular to elongated triangular, pointed.

Remarks. *Veghicyclia sanfilippoae* n. sp. can be differentiated from *V. pulchra* Kozur & Mostler (1972, pp. 11-12, pl. 4, figs. 14, 17) by having flat discoidal instead of discoidal cortical shell and bigger pores on equatorial disc. It also differs from *Veghicyclia* sp. A in this study by having a smaller cortical shell, smaller and more circular, irregular pores on equatorial disc and more peripheral spines (15-16 instead of 12-13).

Measurements (μm). (Based on the 3 specimens)

	HT	Min.	Max.	Av.
Diameter of the cortical shell	136	136	147	142
Width of the equatorial disc	53	38	53	47
Max. length of the peripheral spines	44	44	53	50

Range. Late Triassic; Rhaetian.

Occurrence. Antalya Nappes, southern Turkey.

Veghicyclia sp. A

Pl. 3, figs. 7, 8

Short definition. Cortical shell, large, flat discoidal and spongy. Equatorial disc circular to subcircular with two rows of pores. Pores on equatorial disc big in size, elliptical to subelliptical, in outline. Twelve to thirteen symmetrically arranged outer peripheral spines short to long, in different size, flat to circular in outline.

Remarks. It was compared to *Veghicyclia sanfilippoae* n. sp. under latter species.

Range. Late Triassic; Rhaetian.

Occurrence. Antalya Nappes, southern Turkey.

Superfamily Trematodiscacea Haeckel, 1862 emend. Kozur & Mostler, 1979

Family Relindellidae Kozur & Mostler, 1980

Genus *Pentaspongodiscus* Kozur & Mostler, 1979

Type Species. *Pentaspongodiscus tortilis* Kozur & Mostler, 1979.

Pentaspongodiscus ? dihexacanthus

Carter, 1993 Group

Pl. 3, figs. 9, 10

1993 *Pentaspongodiscus ? dihexacanthus* Carter, pp. 87-88, pl. 13, figs. 1, 2, 3.
? 1997 *Pentaspongodiscus ? dihexacanthus* - Sugiyama, p. 184, fig. 51-9.
1999 *Pentaspongodiscus ? dihexacanthus* Carter Group- Tekin, pl. 22, fig. 2-4.

Range. Late Triassic; Rhaetian - ? Early Jurassic; ? Sinemurian.

Occurrences. Queen Charlotte Islands, British Columbia; ?Japan; Antalya Nappes, southern Turkey.

Superfamily Centrocubacea Hollande & Enjumet, 1960

Family Centrocubidae Hollande & Enjumet, 1960 emend. Dumitrica, 1982

? **Centrocubidae** incertae sedis

Pl. 3, fig. 11

Short definition. Test large with latticed, cube-shaped cortical shell. Eight, short and tetra-carinate spines present in each corner.

Remarks. Inner structure of the form is not clear, because of this it is tentatively assigned to Centrocubidae.

Range. Late Triassic; late Norian.

Occurrence. Antalya Nappes, southern Turkey.

Spumellaria genus and species indetermined

Spumellaria gen. and sp. indet. A

Pl. 3, fig. 12

1993 Spumellaria gen. and sp. indet. B- Carter, p. 92, pl. 13, figs. 6, 8, 11.
1999 Spumellaria gen. and sp. indet. A- Tekin, p. 124, pl. 23, fig. 7.

Range. Late Triassic; Rhaetian.

Occurrences. Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Spumellaria gen. and sp. indet. B

Pl. 3, figs. 13, 14

1993 Spumellaria gen. and sp. indet. D- Carter, p. 92, pl. 13, figs. 12, 13.
1999 Spumellaria gen. and sp. indet. B- Tekin, p. 124, pl. 23, figs. 8-11.

Range. Late Triassic; early Norian - Rhaetian.

Occurrences. Queen Charlotte Islands, British Columbia; Eryaman, Ankara and Antalya Nappes, southern Turkey.

Suborder Entactinaria Kozur & Mostler, 1982

Superfamily Hexastylacea Haeckel, 1882 emend. Petrushevskaya, 1979

Family Eptingiidae Dumitrica, 1978

Genus *Eptingium* Dumitrica, 1978

Type Species. *Eptingium manfredi* Dumitrica, 1978.

Eptingium ? sp. A

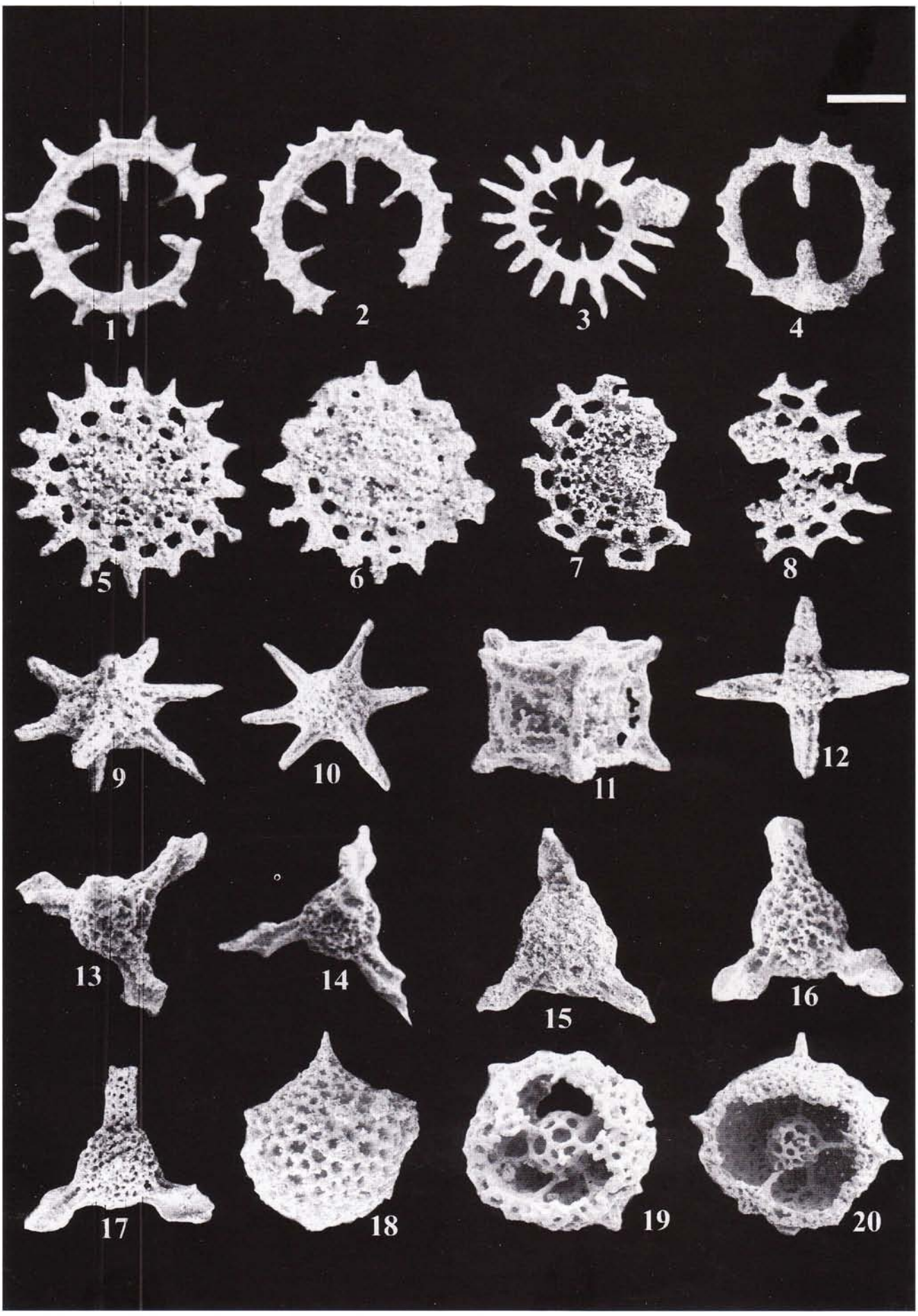
Pl. 3, fig. 15

Short definition. Cephalis large, subspherical, compressed in direction perpendicular to plane of radial horns. Three horns mainly unequal, sometimes apical horn (A) a little bit longer than two lateral horns (L) and have angle with these two L much bigger than angle

PLATE 3

Scanning electron micrographs of Late Triassic Spumellaria and Entactinaria (Radiolaria) from the Gökdere Formation in Hocaköy section. Scale = number of microns for each figure.

Figs. 1, 2 - *Praemesosaturnalis* sp. A. Both specimens are from sample no. 01UKT248, late Norian, scale bar= 120 and 100μm. respectively.
Fig. 3 - *Saturnosphaera* sp. A. Sample no. 01UKT248, late Norian, scale bar= 250μm.
Fig. 4 - *Pseudoacanthocircus sugiyamai* Tekin. Sample no. 01UKT253, Rhaetian, scale bar= 120μm.
Figs. 5, 6 - *Veghicyclia sanfilippoae* n. sp. 5. Holotype. Sample no. 01UKT251, Rhaetian, scale bar= 100μm. 6. Paraype. Sample no. 01UKT251, Rhaetian, scale bar= 100μm.
Figs. 7, 8 - *Veghicyclia* sp. A. Both specimens are from sample 01UKT253, Rhaetian, scale bar= 130 and 120μm. respectively.
Figs. 9, 10 - *Pentaspongodiscus ? dihexacanthus* Carter. Both specimens are from sample 01UKT251, Rhaetian, scale bar= 110 and 140μm. respectively.
Fig. 11 - ?Centrocubidae incertae sedis. Sample no. 01UKT248, late Norian, scale bar= 90μm.
Fig. 12 - Spumellaria gen. and sp. indet. A. Sample no. 97UKT147, Rhaetian, scale bar= 90μm.
Figs. 13, 14 - Spumellaria gen. and sp. indet. B. Fig. 13 is from sample 01UKT243, late Norian, scale bar= 90μm. Fig. 14 is from sample 01UKT245, late Norian, scale bar= 100μm.
Fig. 15 - *Eptingium* ? sp. A. Sample no. 97UKT141, late Norian, scale bar= 80μm.
Figs. 16, 17 - *Pylostephanidium ankaraense* Bragin & Tekin. Both specimens are from sample 01UKT248, late Norian, scale bar= 110 and 130μm. respectively.
Fig. 18 - *Pentactinocarpus sevaticus* Kozur & Mostler. Sample no. 01UKT248, late Norian, scale bar= 150μm.
Figs. 19, 20 - *Braginella rudis* (Bragin). Fig. 19 is from sample 97UKT143, late Norian, scale bar= 130μm. Fig. 20 is from sample 01UKT243, late Norian, scale bar= 130μm.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between these two L. Horns three-carinate with very wide grooves and very thin ridges. Horns proximally wide then tapering distally with loose sinistrial torsion.

Remarks. This form is tentatively assigned to *Eptingium* because of the lack of knowledge about internal spicule system. It can be differentiated from *Eptingium ? amoenum* Carter (1993, p. 93, pl. 14, figs. 1, 8, 12, 16) in having less globular cephalis and loosely sinistrial twisted horns instead of strongly dextral twisted horns.

Range. Late Triassic; late Norian.

Occurrence. Antalya Nappes, southern Turkey.

Genus *Pylostephanidium* Dumitrica, 1978

Type Species. *Pylostephanidium clavator* Dumitrica, 1978

Pylostephanidium ankaraense Bragin & Tekin, 1996

Pl. 3, figs. 16, 17

1996 *Pylostephanidium ankaraense* Bragin & Tekin, pp. 117, 119, pl. 1, figs. 1-5.
1999 *Pylostephanidium ankaraense* Tekin, p. 126, pl. 24, figs. 9-11.

Range. Late Triassic; late Norian.

Occurrences. Eryaman, Ankara and Antalya Nappes, Turkey.

Superfamily Palaeoscenidiacea Riedel, 1967 emend. Kozur & Mostler, 1982

Family Pentactinocarpidae Dumitrica,1978 emend. Kozur & Mostler, 1981

Genus *Pentactinocarpus* Dumitrica, 1978

Type species. *Pentactinocarpus fusiformis* Dumitrica, 1978.

Pentactinocarpus sevaticus Kozur & Mostler, 1981

Pl. 3, fig. 18

1981 *Pentactinocarpus sevaticus* Kozur & Mostler, pp. 21-22, pl. 52, fig. 3, pl. 53, fig, 5, pl. 55, fig. 1.
1993 *Pentactinocarpus* sp. cf. *P. sevaticus* - Carter, p. 40, pl. 1, figs. 11, 15; pl. 21, figs. 15, 17.
1996 *Pentactinocarpus* sp. cf. *P. sevaticus* - Bragin & Tekin, pl. 3, fig. 1.
1996 *Pentactinocarpus sevaticus* - Bragin & Krylov, pl. 1, fig. 7.
? 1997 *Pentactinocarpus sevaticus* - Sugiyama, p. 184, fig. 50-7.
1999 *Pentactinocarpus sevaticus* - Tekin, p. 134, pl. 27, figs. 7-8

Range. Late Triassic; ? middle Norian - late Norian - Rhaetian.

Occurrences. Pötschen, Austria; Queen Charlotte Islands, British Columbia; Central Japan; Eryaman, Ankara and Antalya Nappes, Turkey.

Entactinaria Incertae Sedis

Genus *Braginella* Sugiyama, 1997

Type Species. *Pentactinosphaera rudis* Bragin, 1986.

Braginella rudis (Bragin, 1986)

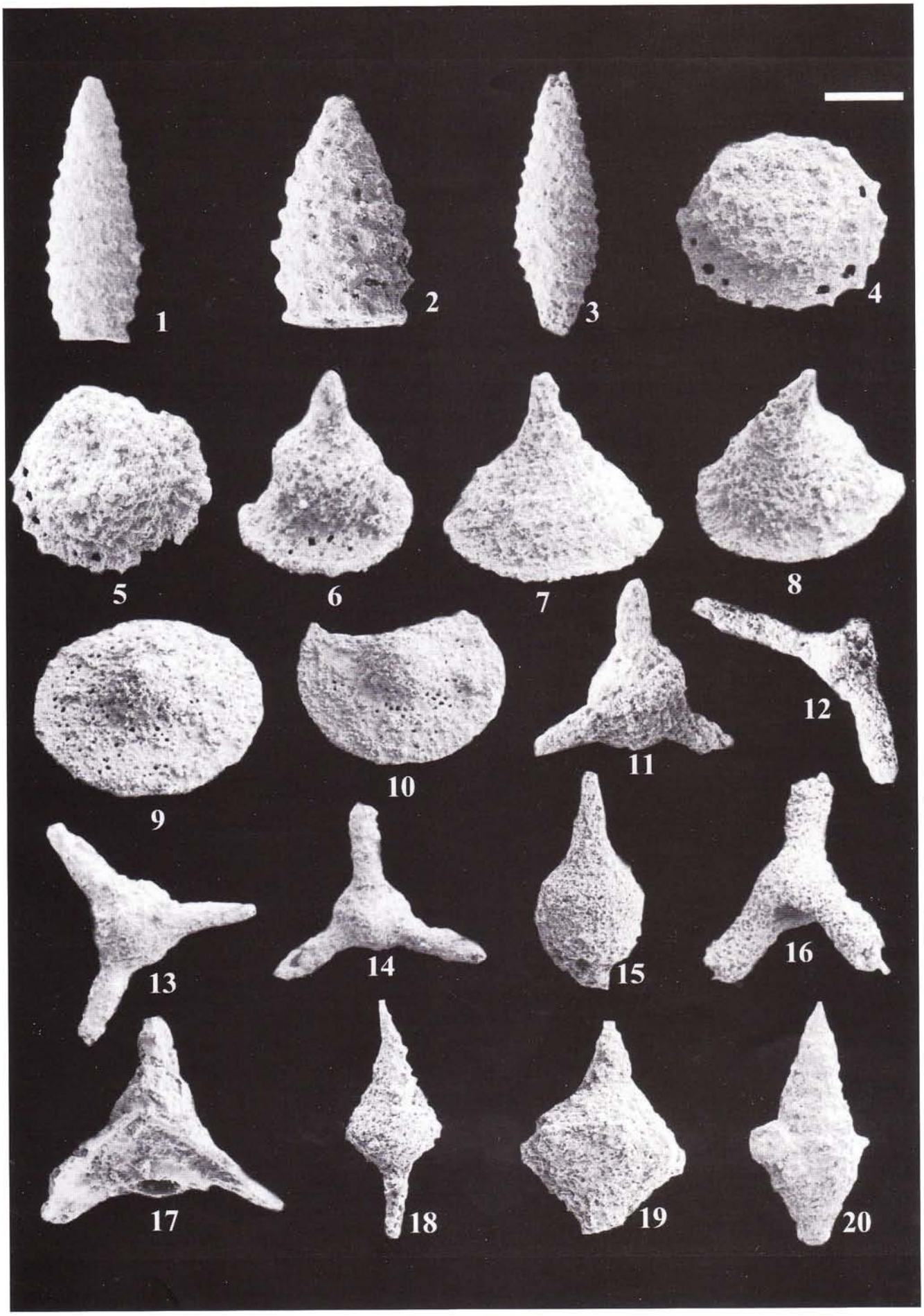
Pl. 3, figs. 19, 20

1986 *Pentactinosphaera rudis* Bragin, p. 69, pl. 1, figs. 14.
1989 Spumellaria gen. and sp. Indet. B Cheng, p. 147, pl. 10, figs. 9-10, 13-14.
1991 *Pentactinosphaera rudis* - Bragin, p. 82, pl. 8, figs. 1-5.
1996 *Pentactinosphaera rudis* - Bragin & Tekin, pl. 3, figs. 2-4, 6.

PLATE 4

Scanning electron micrographs of Late Triassic Nassellaria (Radiolaria) from Gökdere Formation in Hocaköy section. Scale = number of microns for each figure.

Fig. 1 - *Canoptum* sp. aff. C. *dixoni* Pessagno & Whalen. Sample no. 97UKT147, Rhaetian, scale bar= 90μm.
Fig. 2 - *Canoptum rhaeticum* Kozur & Mostler. Sample no. 97UKT147, Rhaetian, scale bar= 50μm.
Fig. 3 - *Canoptum* sp. A. Sample no. 97UKT147, Rhaetian, scale bar= 110μm.
Figs. 4, 5 - *Deflandrecyrtium breviora* (Sugiyama). Fig. 4 is from sample 97UKT150, Rhaetian, scale bar= 120μm. Fig. 5 is from sample no. 97UKT146, Rhaetian, scale bar= 120μm.
Fig. 6 - *Deflandrecyrtium ithacanthum* (Sugiyama). Sample 01UKT251, Rhaetian, scale bar= 110μm.
Figs. 7, 8 - *Deflandrecyrtium* sp. A. Both specimens are from sample 01UKT253, Rhaetian, scale bar= 90 and 100μm.
Figs. 9, 10 - *Haeckelicyrtium* sp. A. Fig. 9 is from sample 01UKT248, late Norian, scale bar= 150μm. Fig. 10 is from sample 01UKT247, late Norian, scale bar= 160μm.
Fig. 11 - *Livarella densiporata* Kozur & Mostler. Sample no. 97UKT147, Rhaetian, scale bar= 70μm.
Fig. 12 - *Livarella magna* Tekin. Sample no. 01UKT249, late Norian, scale bar= 120μm.
Figs. 13, 14 - *Livarella valida* Yoshida. Fig. 13 is from sample 01UKT248, late Norian, scale bar= 120μm. Fig. 14 is from sample 01UKT249, late Norian, scale bar= 100μm.
Fig. 15 - *Syringocapsa rhaetica* Kozur & Mostler. Sample no. 97UKT146, Rhaetian, scale bar= 140μm.
Fig. 16 - *Ayrtonius elizabethae* Sugiyama. Sample no. 01UKT248, late Norian, scale bar= 120μm.
Fig. 17 - *Bipedis acrostylus* Bragin. Sample no. 97UKT150, Rhaetian, scale bar= 150μm.
Fig. 18 - *Globolaxtorum* sp. cf. *G. cristatum* Carter. Sample no. 97UKT147, Rhaetian, scale bar= 110μm.
Fig. 19 - *Globolaxtorum* sp. A. Sample no. 97UKT147, Rhaetian, scale bar= 110μm.
Fig. 20 - *Laxtorum capitaneum* Carter. Sample no. 97UKT147, Rhaetian, scale bar= 100μm.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1997 *Braginella rudis* (Bragin)- Sugiyama, p. 146, figs. 39-19, 40-2-3b.
1999 *Braginella rudis* - Tekin, p. 134, pl. 27, figs. 11-12.

Range. Late Triassic; late Norian - Rhaetian.

Occurrences. Sakhalin, Fareast Russia; Busuanga Islands, Philippines; Eryaman, Ankara and Antalya Nappes, Turkey; Central Japan.

Suborder Nassellaria Ehrenberg, 1875

Family Canoptidae Pessagno, 1979

Genus *Canoptum* Pessagno, 1979

Type Species. *Canoptum poissoni* Pessagno, 1979.

Canoptum sp. aff. **C. dixoni** Pessagno & Whalen, 1982

Pl. 4, fig. 1

aff. 1982 *Canoptum dixoni* Pessagno & Whalen, p. 124, pl. 2, figs. 1, 2, 8, 9, 14; pl. 12, fig. 2.
1993 *Canoptum* sp. aff. *C. dixoni* Pessagno & Whalen- Carter, p. 104, pl. 18, figs. 4-7.

Range. Late Triassic; Rhaetian.

Occurrences. Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Canoptum rhaeticum Kozur & Mostler, 1981

Pl. 4, fig. 2

1981 *Canoptum rhaeticum* Kozur & Mostler, pp. 103-104, pl. 20, figs. 1-4.
1982 *Canoptum triassicum* Yao, p. 60, pl. 3, figs. 3-4.
1982 *Canoptum triassicum* - Yao, Matsuoka & Nakatani, pl. 2, fig. 1.
1986 *Canoptum triassicum* - Bragin, pl. 3, fig. 5.
1990 *Canoptum rhaeticum* - Kozur & Mostler, pp. 219-220.
1991 *Canoptum triassicum* - Bragin, p. 102, pl. 7, figs. 1, 5.
?1993 *Canoptum* sp. cf. *C. triassicum* - Carter, p. 105, pl. 18, figs. 11, 12, 13.
1996 *Canoptum triassicum* - Yeh & Cheng, p. 11, pl. 3, fig. 5 .
1997 *Canoptum rhaeticum* - Sugiyama, p. 175, fig. 50-5.
1999 *Canoptum rhaeticum* - Tekin, p. 138, pl. 29, fig. 1.

Range. Late Triassic; late Norian - Rhaetian.

Occurrences. Zlambachgraben, Austria; Central Japan; Sakhalin, Fareast Russia; ?Queen Charlotte Islands, British Columbia; Busuanga Island, Philippines; Eryaman, Ankara and Antalya Nappes, Turkey.

Canoptum sp. A

Pl. 4, fig. 3

?1993 *Canoptum* sp. A Carter, p. 105, pl. 18, figs. 8, 9.

Short definition. Test slender with twelve post-abdominal segments. Test mainly covered by microgranular silica and become wider at medial part. Short remnant of tube could be seen at distal end.

Remarks. It differs from *L. capitaneum* Carter by having more segments and lacking medial spines.

Range. Late Triassic; Rhaetian.

Occurrences. ?Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Family Deflandrecyrtiidae Kozur & Mostler, 1979

Genus *Deflandrecyrtium* Kozur & Mostler, 1979

Type Species. *Deflandrecyrtium popofskyi* Kozur & Mostler, 1979.

Deflandrecyrtium breviora (Sugiyama, 1997)

Pl. 4, figs. 4, 5

1982 *Squinabolella* (?) sp. C Yao, pl. 3, fig. 8.
1982 *Squinabolella* (?) sp. C - Yao, Matsuoka & Nakatani, pl. 2, fig. 3.
1990 *Squinabolella* (?) sp. C - Hori, p. 581, fig. 8-2.
? 1993 *Squinabolella* sp. D Carter, p. 103, pl. 17, fig. 8.
1997 *Haeckelicyrtium breviora* Sugiyama, p.155, figs. 42-5-8.
1999 *Deflandrecyrtium breviora* (Sugiyama)- Tekin, p. 140, pl. 30, figs. 1-2.

Range. Late Triassic; Rhaetian.

Occurrences. Central Japan; Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Deflandrecyrtium ithacanthum (Sugiyama, 1997)

Pl. 4, fig. 6

1986 *Dreyericyrtium* (?) sp. Yoshida, pl. 8, figs. 5, 6.
? 1990 *Deflandrecyrtium* sp. A Hori, p. 581, fig. 8-1.
1997 *Dreyericyrtium ithacanthum* Sugiyama, pp.151, 153, figs. 40-8-10.
1999 *Deflandrecyrtium ithacanthum* (Sugiyama)- Tekin, p. 141, pl. 30, figs. 7-8.

Range. Late Triassic; late Norian - Rhaetian.

Occurrences. Central Japan; Antalya Nappes, southern Turkey.

Deflandrecyrtium sp. A

Pl. 4, figs. 7, 8

Short definition. Test as with genus. Cephalis conical to subconical with rare pores. Apical horn robust, straight to slightly inclined to main axis, three-carinate with deep grooves and thick ridges. Collar stricture distinct marked by relatively deep depression. Thorax much broader, bonnet like with scattered pores. Short abdomen flaring to short disc-shaped abdominal skirt. Lumbar stricture indistinct. Abdominal skirt smooth, short without pores.

Remarks. It differs from *Deflandrecyrtium ithacanthum* (Sugiyama) by having more robust apical horn, wider thorax and abdomen and shorter poreless abdominal skirt.

Range. Late Triassic; Rhaetian.

Occurrence. Antalya Nappes, southern Turkey.

Genus *Haeckelicyrtium* Kozur & Mostler, 1979 emend. Carter, 1993

Type Species. *Haeckelicyrtium austriacum* Kozur & Mostler, 1979.

Haeckelicyrtium sp. A

Pl. 4, figs. 9, 10

Short definition. Cephalis without apical horn. Thorax very short bonnet shaped with very small, circular pores. Short abdomen flaring to very wide abdominal skirt. Abdominal skirt subcircular to subelliptical in outline with many, small, circular to subcircular scattered pores except the distal end of abdominal skirt. Distal part of the abdominal skirt, band like, smooth without pores.

Remarks. *Haeckelicyrtium* sp. A could be differentiated from the other *Haeckelicyrtium* by having very short proximal part (cephalis, thorax and abdomen) and very wide, flat abdominal skirt with very small scattered pores.

Range. Late Triassic; late Norian.

Occurrence. Antalya Nappes, southern Turkey.

Family Livarellidae Kozur & Mostler, 1981

Genus *Livarella* Kozur & Mostler, 1981

Type Species. *Livarella densiporata* Kozur & Mostler, 1981.

Livarella densiporata Kozur & Mostler, 1981

Pl. 4, fig. 11

1981 *Livarella densiporata* Kozur & Mostler, pp. 114-115, pl. 9, fig. 1.
1986 *Livarella densiporata* - Yoshida, pl. 2, figs. 1, 2.
1990 *Livarella densiporata* - Carter, pl. 1, fig. 3.
1992 *Livarella densiporata* - Yeh, p. 67, pl. 3, figs. 8, 11; pl. 4, figs. 8, 11, 12, 15.
1993 *Livarella densiporata* - Carter, p. 116, pl. 21, figs. 1, 5, 10, 13, 16.
non 1996 *Livarella densiporata* - Yeh & Cheng, p. 13, pl. 6, figs. 7, 10, 11.
1997 *Livarella densiporata* - Sugiyama, p. 183, fig. 50-20.
1999 *Livarella densiporata* - Tekin, p. 148, pl. 33, figs. 1-2.

Range. Late Triassic; late Norian - Rhaetian.

Occurrences. Zlambacher, Austria; Central Japan; Uson Island, Philippines; Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Livarella magna Tekin, 1999

Pl. 4, fig. 12

1999 *Livarella magna* Tekin, p. 148, pl. 33, figs. 3-6.

Range. Late Triassic; latest Norian - Rhaetian.

Occurrence. Antalya Nappes, southern Turkey.

Livarella valida Yoshida, 1986 Group

Pl. 4, figs. 13, 14

1986 *Livarella validus* Yoshida, p. 14, pl. 3, figs. 1-3.
1986 *Livarella gifuensis* Yoshida, p. 15, pl. 2, figs. 6-10.
1987 *Livarella validus* - Kojima & Mizutani, fig. 3, no. 18.a. b.
1991 *Livarella gifuensis* - Bragin, p. 96, pl.7, fig. 4.
1992 *Livarella gifuensis* - Yeh, p. 67, pl. 4, figs. 5, 6, 9, 10, 13, 14.
1992 *Livarella validus* - Mizutani & Kojima, pl. 1, figs. 3.a. b.
1993 *Livarella validus* - Carter, p. 117, pl. 21, figs. 2, 3, 4, 6, 7, 14.
1993 *Livarella* sp. aff. *L. gifuensis* - Carter, p.116, pl. 21, figs. 8, 9.
1996 *Livarella gifuensis* - Yeh & Cheng, p. 13, pl. 6, figs. 3, 4, 8, 12, 15.
1997 *Livarella valida* Yoshida Group- Sugiyama, p. 183, fig. 50-18 non 19.
1999 *Livarella valida* - Tekin, p. 149, pl. 33, fig. 7.

Range. Late Triassic; late Norian - Rhaetian.

Occurrences. Central Japan; Oman; Northeast China; Queen Charlotte Islands, British Columbia; Antalya Nappes, southern Turkey.

Family Syringocapsidae Foreman, 1973 emend. Pessagno, 1977

Genus *Syringocapsa* Neviani, 1900

Type Species. *Theosyringium robustum* Vinassa, 1901.

Syringocapsa rhaetica Kozur & Mostler, 1981

Pl. 4, fig. 15

1981 *Syringocapsa rhaetica* Kozur & Mostler, p. 87, pl. 9, fig. 2.
1999 *Syringocapsa rhaetica* - Tekin, p. 167, pl. 40, fig. 6.

Range. Late Triassic; Rhaetian.

Occurrences. Zlambachgraben, Austria; Antalya Nappes, southern Turkey.

Nassellaria Incertae Sedis

Genus *Ayrtonius* Sugiyama, 1997

Type Species. *Ayrtonius elizabethae* Sugiyama, 1997.

Ayrtonius elizabethae Sugiyama, 1997

Pl. 4, fig. 16

1997 *Ayrtonius elizabethae* Sugiyama, pp. 144-145, figs. 39-7-9.

Range. Late Triassic; late Norian.

Occurrences. Central Japan; Antalya Nappes, southern Turkey.

Genus *Bipedis* De Wever, 1982

Type Species. *Bipedis calvabovis* De Wever, 1982.

Bipedis acrostylus Bragin, 1991

Pl. 4, fig. 17

Age	LATE NORIAN					RHAETIAN					
Blome (1984) & Carter (1993)'s radiolarian zones				*Betraccium deweveri*		*? Proparvicingula moniliformis* Z.					
Sugiyama (1997)'s radiolarian zones	TR8A			TR8B - TR8C		TR8D					
Samples / Taxa	01UKT243	97UKT141-01UKT245	01UKT247	97UKT143-01UKT248	97UKT144-01UKT249	01UKT251	97UKT146	97UKT147	97UKT148	97UKT149-01UKT253	97UKT150-01UKT254
Capnuchosphaera neosagaris Sugiyama	+										
Praemesosaturnalis nobleae n. sp.	+	+									
P. multidentatus (Kozur & Mostler)	+	?	+	+							
Ayrtonius elizabethae Sugiyama	+	+	?	+							
Praemesosaturnalis rugosus yehae Tekin	+	?	+	+	+						
Spumellaria gen. and sp. indet. B	+	+	+	+	+	+	?	+	+	+	
Braginella rudis (Bragin)	+	+	+	+	+	?	+	?	+	+	
Livarella densiporata Kozur & Mostler	+	?	+	+	+	+	?	+	?	+	
Capnuchosphaera okayi n. sp.		+									
Capnuchosphaera sp. cf. *C. okayi* n. sp.		+									
Eptingium ? sp. A		+									
P. heilongjiangensis aksekiensis n. subsp.		+	+	+							
Livarella valida Yoshida		+	?	+	+	?	?	+			
Bipedis acrostylus Bragin		+	+	+	?	+	?	+	?	?	+
Praemesosaturnalis sp. A			+	+							
Haeckelicyrtium sp. A			+	+							
Betraccium deweveri Pessagno & Blome			+	+	+						
Deflandrecyrtium ithacanthum (Sugiyama)			+	+	?	+	?	+			
Ferresium philippinense Yeh & Cheng			+	+	?	+	?	+	+	+	
P. heilongjiangensis heilongjiangensis Y. & M.				+							
Saturnosphaera sp. A				+							
? Centrocubidae incertae sedis				+							
Ferresium laseekense Blome				+	+						
Ferresium sp. A				+	+						
Praemesosaturnalis pseudokahleri Sugiyama				+	+						
Pylostephanidium ankaraense Bragin & Tekin				+	+						
Pentactinocarpus sevaticus Kozur & Mostler				+	?	?	+				
Canoptum rhaeticum Kozur & Mostler				+	?	?	+	+	+	+	
Praemesosaturnalis sandspitensis (Blome)				+	+	+	?	+	?	?	+
Livarella magna Tekin					+	+	?	+			
Veghicyclia sanfilippoae n. sp.						+					
Paronaella pacofiensis Carter						+	?	+			
Spumellaria gen. and sp. indet. A						+	?	+			
Praemesosaturnalis huxleyensis (Carter)						+	?	+	+		
Pentaspongodiscus ? *dihexacanthus* Carter						+	?	+	+	+	+
Syringocapsa rhaetica Kozur & Mostler							+				
Risella stalkungiensis Carter							+	+	?	+	
Deflandrecyrtium breviora (Sugiyama)							+	+	?	+	+
Crucella sp. A								+			
Paronaella sp. B								+			
Globolaxtorum sp. cf. *G. cristatum* Carter								+			
Globolaxtorum sp. A								+			
Canoptum sp. A								+			
Paronaella sp. A								+	+		
Bistarkum rhaeticum n. sp.								+	?	+	
Veghicyclia sp. A								+	+	+	
Laxtorum capitaneum Carter								+	?	+	
Canoptum sp. aff. *C. dixoni* P. & W.								+	?	?	+
Risella tledoensis Carter								+	+	+	+
Paratriassoastrum sp. A									+		
Paratriassoastrum sp. B									+		
Pseudoacanthocircus sugiyamai Tekin										+	
Deflandrecyrtium sp. A										+	
Risella sp. aff. *R. conclusum* (Carter)											+

Fig. 4 - Occurence of Late Triassic radiolarians in the Hocaköy section.

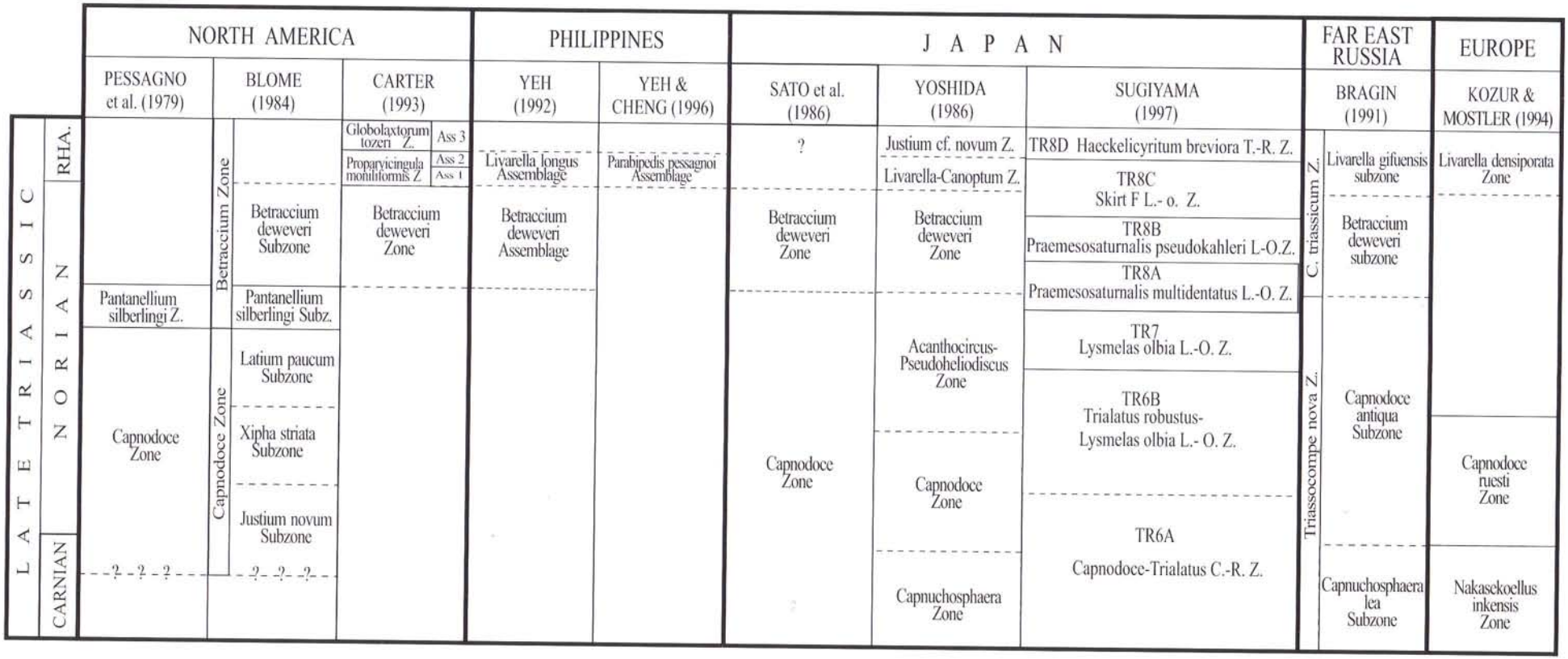

Fig. 5 - Correlation of Late Triassic radiolarian zones and assemblages for different regions.

1982 Nassellaria gen. and sp. Indet. sp. A Yao, pl. 3, fig. 14.
1982 Nassellaria gen. and sp. Indet. sp. A Yao, Matsuóka & Nakatani, pl. 2, fig. 6.
1986 Nassellaria B Yoshida, pl. 9, figs. 12, 13.
1989 Undescribed Nassellarian- Blome, Reed & Tailleur, pl. 33.2, fig. 2.
1990 *Triassobipedis* ? sp. 1 Carter, pl.1, fig. 12.
1991 *Bipedis acrostylus* Bragin, p. 107, pl. 7, fig. 8.
1992 Nassellaria Indet. gen. A sp. A Yeh, p. 69, pl. 5, fig. 7.
1992 Nassellaria Indet. gen. B sp. A Yeh, p. 70, pl. 6, figs. 1-3.
1993 *Bipedis acrostylus* Bragin- Carter, pp. 109-110, pl. 20, figs. 10, 11, 12.
1996 *Bipedis acrostylus* - Bragin & Tekin, pl. 1, fig. 8.
1996 *Parabipedis pessagnoi* Yeh & Cheng, p. 16, pl. 7, figs. 1-15.
1997 *Bipedis acrostylus* - Sugiyama, p. 175, fig. 50-17.
1999 *Bipedis acrostylus* - Tekin, pp. 176-177, pl. 43, figs. 9-11.

Range. Late Triassic; late Norian - Rhaetian.

Occurrences. Central Japan; Alaska, USA; Sikhote-Alyn, Fareast Russia; Queen Charlotte Islands, British Columbia; Uson and Busuanga Islands, Philippines; Eryaman, Ankara and Antalya Nappes, Turkey.

Genus *Globolaxtorum* Carter, 1993

Type Species. *Globolaxtorum tozeri* Carter, 1993.

Globolaxtorum sp. cf. **G. cristatum** Carter, 1993

Pl. 4, fig. 18

cf. 1993 *Globolaxtorum cristatum* Carter, pp. 110-111, pl. 19, figs. 11, 12, 13, 17.
cf. 1999 *Globolaxtorum cristatum* - Carter & Guex, p. 192, pl. 2, figs. 10-13.

Remarks. This form resembles to *Globolaxtorum cristatum* Carter in general shape and characteristics but poor preservation prevents an accurate identification.

Range. Late Triassic; Rhaetian.

Occurrence. Antalya Nappes, southern Turkey.

Globolaxtorum sp. A

Pl. 4, fig. 19

1999 *Globolaxtorum* sp. C Tekin, p. 179, pl. 44, fig. 5.

Short definition. Test spindle-shaped with short apical part. Medial part of the test abruptly expanding with short, wide seven (four of them visible at one side of the test) medial spines. Then width of the segments decreasing in width. Small, slightly tapering tube present at distal end.

Remarks. It differs from the other *Globolaxtorum* by having strong spindle shape.

Range. Late Triassic; Rhaetian.

Occurrence. Antalya Nappes, southern Turkey.

Genus *Laxtorum* Blome, 1984 emend. Carter, 1993

Type Species. *Laxtorum hindei* Blome, 1984.

Laxtorum capitaneum Carter, 1993

Pl. 4, fig. 20

?1992 *Pleesus* sp. A Yeh, p. 68, pl. 5, fig. 14.
1993 *Laxtorum capitaneum* Carter, pp. 112-113, pl. 19, figs. 6, 7, 8.
?1997 *Laxtorum* sp. cf. *L. capitaneum* Carter - Sugiyama, pp. 181-182, fig, 50-2.
1999 *Laxtorum capitaneum* - Tekin, p. 179, pl. 44, fig. 6.
1999 *Laxtorum capitaneum* - Carter & Guex, p. 192, pl. 2, figs. 5-8.

Range. Late Triassic; Rhaetian.

Occurrences. ?Uson Island, Philippines; Queen Charlotte Islands, British Columbia; ? Central Japan; Antalya Nappes, southern Turkey.

Dating and Comparison of the Late Triassic radiolarians

In the basal part of the Hocaköy section (limestone with chert nodules), no radiolarians were obtained, only some undetermined remains of conodonts were found. The first radiolaria bearing sample (01UKT243) is very close to the basal part of red chert and beige limestone alternations (Fig. 3B). The following radiolarians were found in this sample; *Capnuchosphaera neosagaris* Sugiyama, *Praemesosaturnalis nobleae* n. sp, *P. multidentatus* (Kozur & Mostler) Group, *P. rugosus yehae* Tekin, *Braginella rudis* (Bragin), *Ayrtonius elizabethae* Sugiyama and *Livarella densiporata* Kozur & Mostler (Fig. 4). This assemblage clearly indicates *Praemesosaturnalis multidentatus* Lowest Occurrence Zone (TR8A) of Sugiyama (1997) corresponding to the late Norian (Fig. 5).

Betraccium deweveri Pessagno & Blome first appears in sample 01UKT247 which is the index form of the late Norian (Fig. 4). *Betraccium deweveri* Subzone of Betraccium Zone was first proposed by Blome (1984), subsequently many scientists (Carter 1993, Yeh 1992, Sato et al. 1986, Yoshida 1986, Bragin 1991, Fig. 5) have accepted and adopted this zone for the upper part of late Norian. According to Sugiyama (1997), *B. deweveri* appears slightly after *Capnuchosphaera neosagaris* Sugiyama and *P. multidentatus* (Kozur & Mostler) Group, before the appearance of *Praemesosaturnalis pseudokahleri* Sugiyama. A similar distribution was observed in late Norian part of the Hocaköy section (Fig. 4).

P. pseudokahleri Sugiyama and other taxa such as abundant *Pylostephanidium ankaraense* Bragin & Tekin, first appear within the sample 97UKT143-01UKT248 (Fig. 4). This fauna could define the basal part of *Praemesosaturnalis pseudokahleri* Lowest Occurrence Zone (TR8B) suggested by Sugiyama (1997) to be late

Norian (Fig. 5).

Drastic changes in radiolarian fauna was observed in sample 01UKT251 (Fig. 4). Many forms which were first defined in the Queen Charlotte Islands by Carter (1993) were encountered in this sample as *Paronaella pacofiensis* Carter, *Praemesosaturnalis huxleyensis* (Carter), *Pentaspongodiscus ? dihexacanthus* Carter. The age of this assemblage could be estimated as basal to middle Rhaetian (UAZ 6-18 corresponding to assemblages 2a-2c of *Proparvicingula moniliformis* Zone). Microconglomerate level between sample 01UKT251 and 97UKT146 indicate a small gap in this part of the section (Fig. 3B, 4).

In the studied section, the first appearance of *Risella stalkungiensis* Carter and *Deflandrecyrtium breviora* (Sugiyama) were detected in sample 97UKT 146 (Fig. 4). This part of the section could be correlated to the basal part of *Haeckelicyrtium breviora* Taxon Range Zone (TR8D) of Sugiyama (1997) in Rhaetian (Fig. 5). According to Carter (1993), *Risella stalkungiensis* Carter first appears in uppermost part (UAZ 15) of Assemblage 2b in *Proparvicingula moniliformis* Zone corresponding to early Rhaetian (Fig. 5).

Many radiolarian taxa such as *Pentaspongodiscus ? dihexacanthus* Carter, *Risella stalkungiensis* Carter and *Risella tledoensis* Carter are present at the uppermost part of the section (sample 97UKT150-01UKT254). According to Carter (1993), these taxa disappear at the basal part of *Globolaxtorum tozeri* Zone (middle to upper part of Rhaetian). These data together with the presence of microconglomerate at the uppermost part of Gökdere limestone reveal that the upper part of the Rhaetian corresponding to the *Globolaxtorum tozeri* Zone of Carter (1993) is not present at the section.

Conclusions.

The Antalya Nappes including abundant radiolaria-bearing pelagic Mesozoic successions are widely exposed at the southern part of the Taurides, southern Turkey. In this study, the radiolarian assemblage of Late Triassic age (late Norian- Rhaetian) from the basal part of Hocaköy section measured from the Alakirçay Nappe (middle nappe) of the Antalya Nappes is presented.

Two different formations with distinctive characteristics can be observed in the section. At the basal part, Late Triassic (late Norian-Rhaetian) Gökdere Formation is composed of gray to beige cherty limestone and red chert- gray to beige limestone alternation. Although no radiolarians were obtained from the lowermost cherty limestone beds, the overlying red chert beds yielded moderately to well -preserved radiolarians. The Hocaköy Radiolarite above the Gökdere Formation is mainly characterized by chert - mudstone alternations with some limestone interbeds. Radiolarians obtained from the Hocaköy Radiolarite indicate middle Hettangian to middle - late Cenomanian age.

The radiolarian fauna of the Gökdere Formation resembles the fauna from Queen Charlotte Islands studied by Blome (1984) and Carter (1993) and the fauna from Mino Terrane, central Japan studied by Sugiyama (1997). In ascending order, four radiolarian zones proposed by Sugiyama (1997) have been recognized in this fauna such as "*Praemesosaturnalis multidentatus* Lowest Occurrence Zone (TR8A)" (late Norian), "*Praemesosaturnalis pseudokahleri* Lowest Occurrence Zone (TR8B)" (late Norian), "? Skirt F lowest Occurrence Zone (TR8C)" (late Norian-Rhaetian) and partly "*Haeckelicyrtium breviora* Taxon Range Zone (TR8D)" (Rhaetian). In comparison with that of the Queen Charlotte fauna, two zones could be defined in Gökdere Formation as "*Betraccium deweveri* Zone" (late Norian) suggested by Blome (1984) and Carter (1993) and "*Proparvicingula moniliformis* Zone" (early Rhaetian) suggested by Carter (1993). Radiolarians of the uppermost part of Gökdere Formation indicate that "*Globolaxtorum tozeri* Zone" of Carter (1993) corresponding to the late Rhaetian is not present in the section.

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