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Turonian Radiolarians from Karnezeika, Argolis Peninsula, Peloponnesus (Greece)

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Key words: Mesozoic, Upper Cretaceous, Turonian, Radiolaria, Foraminifera, Tethys, Pelagonian Zone, Argolis Peninsula, Greece

ABSTRACT

Near Karnezeika a roughly 140 m thick Upper Cretaceous section consists of interbedded pelagic limestones, cherts and coarse polymict breccias including ophiolites and shallow water limestones. At the base, pink pelagic limestones rest on deeply altered and fractured Lower Jurassic Pantokrator Limestone. This first pelagic facies is dated as middle Turonian, based on planktonic Foraminifera. Over 100 m of coarse ophiolite-carbonate breccias, interpreted as a channel or canyon fill in a pelagic environment, document the erosion of the Late Jurassic nappe edifice along the Cretaceous Pelagonian margin. Above these breccias, we mesured 16 m of principally pink and red pelagic limestones and radiolarian cherts, in which we recovered well-preserved radiolarians discussed here. In this interval, the presence of planktonic Foraminifera allows to state a late Turonian to Coniacian age. More than 40 radiolarian species are described and figured in this work. The radiolarian chronostratigraphy established by 10 different authors in 11 publications was compared for this study and used to establish radiolarian ranges. This exercise shows major discrepancies between authors for the radiolarian ranges of the studied assemblage. Nevertheless, a Turonian age can be stated based on a synthesis of cited radiolarian ranges. This age is consistent with the age based on planktonic foraminifera. In combining the ages of both Radiolaria and planktonic Foraminifera, the studied samples can be restricted to the late Turonian. However, the discrepancies of published radiolarian ranges call for an urgent, major revision of the Late Cretaceous radiolarian biochronology. The integration of planktonic foraminifera with radiolarians may greatly enhance biochronologic resolution in sections where both groups occur.

Introduction

Relatively few studies exist of Upper Cretaceous Radiolaria from Greece, except for some occurences in the Pindos-Olonos zone (De Wever & Thiébault 1981; Thiébault et al. 1981; De Wever & Origlia-Devos 1982; Neumann 2003). In the Hellenides, ongoing tectonic activity is reflected in a small-scaled puzzle of shallow, detrital and pelagic facies in palaeogeographic realms such as the Pelagonian (Vrielynck 1981). Upper Cretaceous radiolarian occurrences are therefore restricted to times of high silica producticity in pelagic palaeoenvironments. One of the objectives of this study was to compare published radiolarian ranges given by different authors for the Upper Cretaceous and to try to establish an acceptable radiolarian age in spite of the differences in radiolarian ranges given by the various authors.

For this preliminary work we collected 17 samples in a total of 140 m of section for the study of planktonic Foraminifera and Radiolaria. 5 samples in a 2.6 m interval above coarse ophiolite-carbonate breccias yielded well-preserved radiolarians. From these samples 41 radiolarian species belonging to 18 genera are described and figured in this work. Overall, the assemblage resembles those described by O'Dogherty (1994) from the lower Turonian. The radiolarian biostratigraphy established by the following 11 publications (given with regions) was compared for this study: Dumitrica (1975, Romania), Foreman (1975, Pacific and 1977, Atlantic), O'Dogherty (1994, Italy and Spain), Pessagno (1976, California), Riedel & Sanfilippo (1974, Composite), Sanfilippo & Riedel (1985, Composite), Schaaf (1985, Composite), Taketani (1982, Japan), Thurow (1988, Atlantic), Vishnevskaya (2001, Russia).

The presence of abundant planktonic Foraminifera both at the base of the studied Cretaceous section and immediately above the radiolarian samples allow the comparison between the ages determined by radiolarian and foraminiferal biostratigraphy (Caron 1985).

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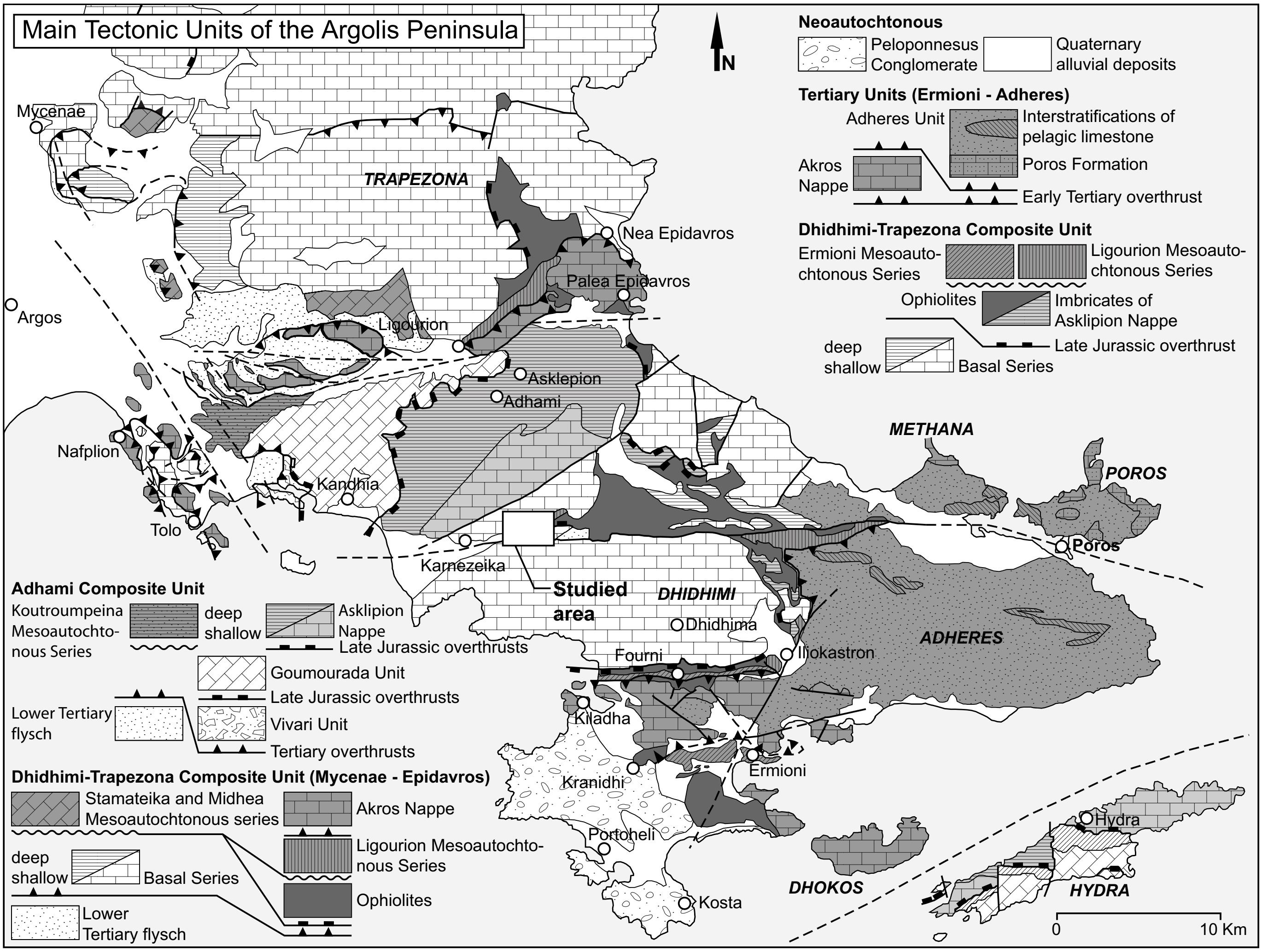

Fig. 1. Overview of the tectono-stratigraphy of the Argolis Peninsula. Based on: Baumgartner (1985), Vrielynck (1981), Clift (Poros Island) and several unpublished diploma thesis University of Lausanne (Bandini 2004; Giraud 2005; Glassey 2005).

Geological Setting

In the Argolis Peninsula, the Jurassic nappe edifice of the eastern Pelagonian margin is unconformably overlain by several different Cretaceous series (Vrielynck 1981). The studied section is located in the *Depression of Karnezeika-Stavropodhi*, a complex nappe syncline affected by neotectonic E-W trending subvertical faults (Fig. 1). The northern edge of this zone is built by Upper Triassic to Lower Jurassic *Pantokrator Limestone* (Fig. 2) belonging to the *Basal Series* of the *Dhidhimi-Trapezona Composite Unit* (Baumgartner 1985). These series became overthrust during the late Jurassic by nappes including ophiolites and then the area became deeply eroded during latest Jurassic and Early Cretaceous times.

Upper Cretaceous pelagic and coarse clastic sediments unconformably overlie the Pantokrator limestone of the basal series and contain disorganised boulder breccias of basalts and shallow water limestones that document the ongoing erosion of the Late Jurassic Pelagonian nappe edifice in a high-relief, deeper marine environment.

Stratigraphy and sedimentology

Near Karnezeika a roughly 140 m thick section consists of interbedded pelagic limestones, cherts and boulder breccias containing abundant ophiolite clasts along with boulders of the underlying Pantokrator Limestone (Fig. 3). At the base, pink pelagic limestones rest on deeply altered and fractured Pantokrator Limestone. Over 100 m of coarse ophiolite-carbonate breccias represent a channel or canyon fill in a pelagic environment. The following 16 m are principally pink and red pelagic limestones and radiolarian cherts, from which we recovered well-preserved radiolarians described here.

The studied section rests conformably on the breccias de-

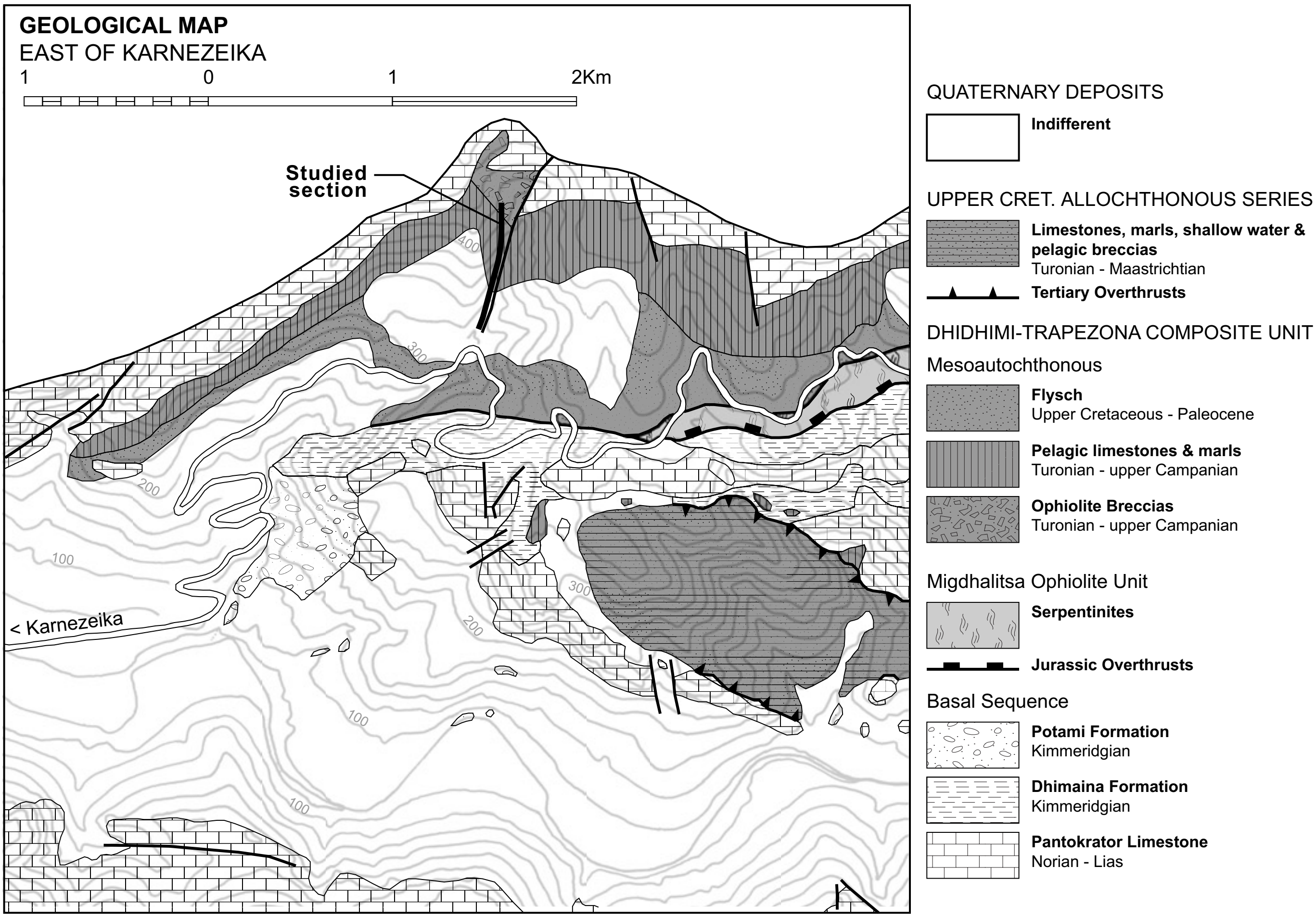

Fig. 2. Geological Map of the area east of Karnezeika (modified after Vernez 1990)

scribed above. It is a 16 m thick alternation of marls and red radiolarian cherts with detrital levels evolving progressively into a pelagic limestone rich in Globotruncanidae. Up section follow 10 m of disorganised boulder breccias with a limestone interbed, which are in turn unconformably covered by quaternary breccias.

Radiolarian biochronology

Today no standard radiolarian biochronology is available for the Late Cretaceous. However, several local and regional radiolarian zonations have been proposed in the past (see citations above).

In comparing the published range charts it becomes evident that the chronostratigraphic range of any given taxon proposed by different authors shows major discrepancies for the studied assemblage (Figs. 4a–b–c–d) from one pubication to the other. This may be due to uncertainties in the chronostratigraphic calibration of radiolarian occurrences. However, most radiolarian zonations of the Late Cretaceous are rather well calibrated by means of plaktonic foraminifera and nannofossils. We rather believe that the differences result from locally inclompete ranges of radiolarian taxa, either due to plaeobiogeographic or paleoecologic exclusions, or due to preservational (diagenetic) biases. The only way to use these radiolarian zonations is to maximise the range of each taxon by stacking the "spartial" ranges expressed in each publication. In principle, the best way of doing this is to create Unitary Associations (Guex 1977–1991: Baumgartner et al. 1980; Guex & Davaud 1982, 1984; Baumgartner 1984 and Savary & Guex 1991) in using the occurrence data of well-defined taxa only, detached from the chronostratigraphic calibrations (Baumgartner et al. 1995). In such a way, we can construct a range chart for the Late Cretaceous that reflects maximal ranges of each taxon with respect to the maximal ranges of all other taxa. This work is in progress, but not completed (Jackett et al. 2002 and Diserens et al. 2003). For this paper the comparison of ranges is based on the chronostratigraphic range of each taxon expessed by each author. We have simply stacked these chronostratigraphic ranges to obtain a minimum and a maximum age for the existence of each taxon. We are aware of the possible errors that may arise

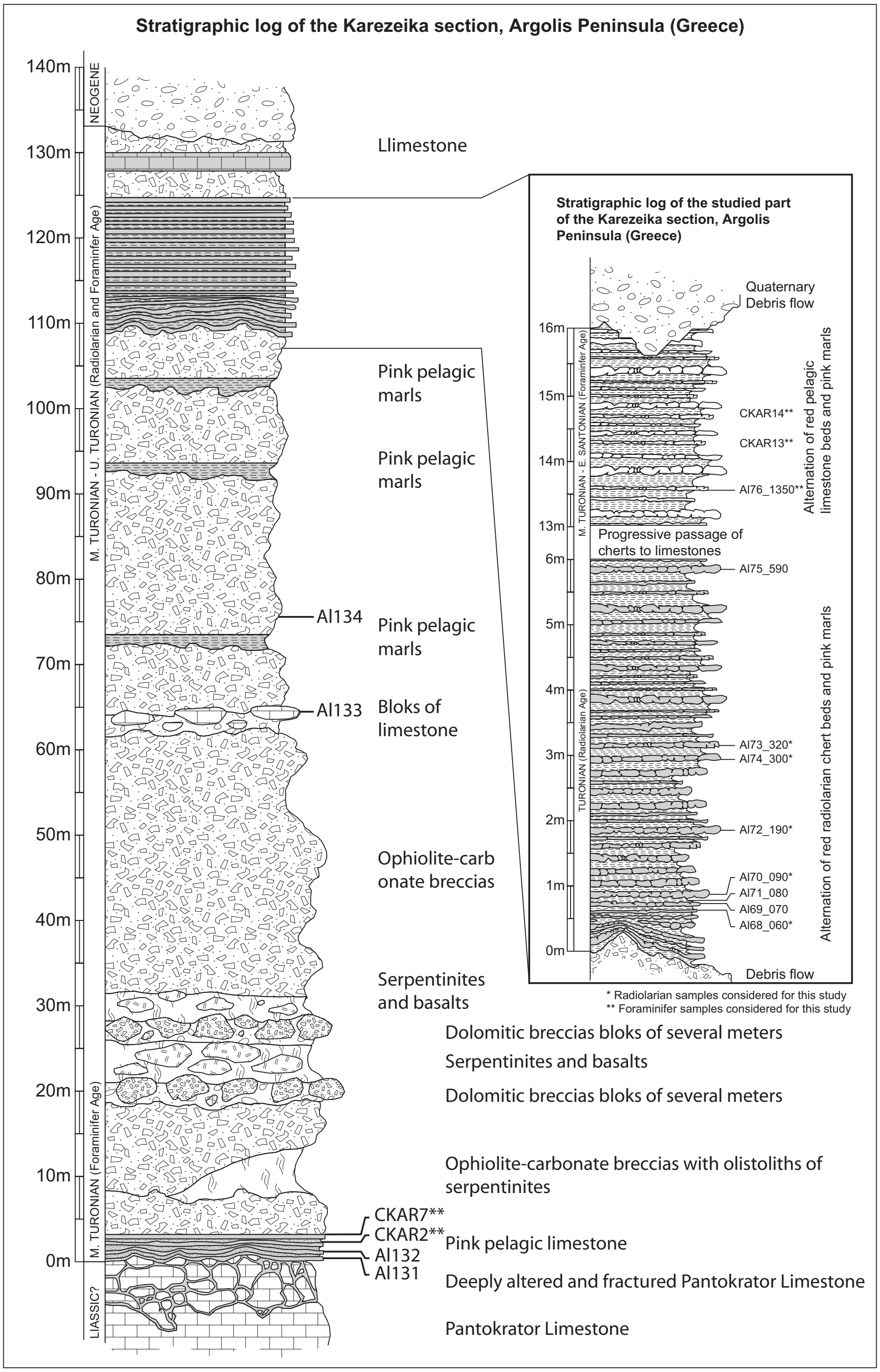

Fig. 3. Stratigraphic log of the Karnezeika section. The inset at right shows the pelagic interval studied for radiolarians and planktonic foraminifera with the samples.

using this procedure. We are, however, in good company, since this procedure was practiced in a series of papers on Mesozoic Radiolaria (e.g. De Wever et al. 1986).

Despite the major discrepancies between the ranges of each author, a Turonian age can be stated using the procedure described above. This age is mainly based on the presence of *Patellula ecliptica*, *Patellula heroica*, *Praeconocaryomma californiaensis* and *Afens liriodes* (have not been cited from earlier than early Turonian), found together with *Pseudoaulophacus putahensis* (has not been cited from later than late Turonian). Moreover, *Dictyomitra urakawensis, Stichomitra communis* and *Pseudodictyomitra pseudomacrocephala* have not been cited from later than Coniacian, *Crucella messinae* have not been cited from later than early Santonian (Fig. 5).

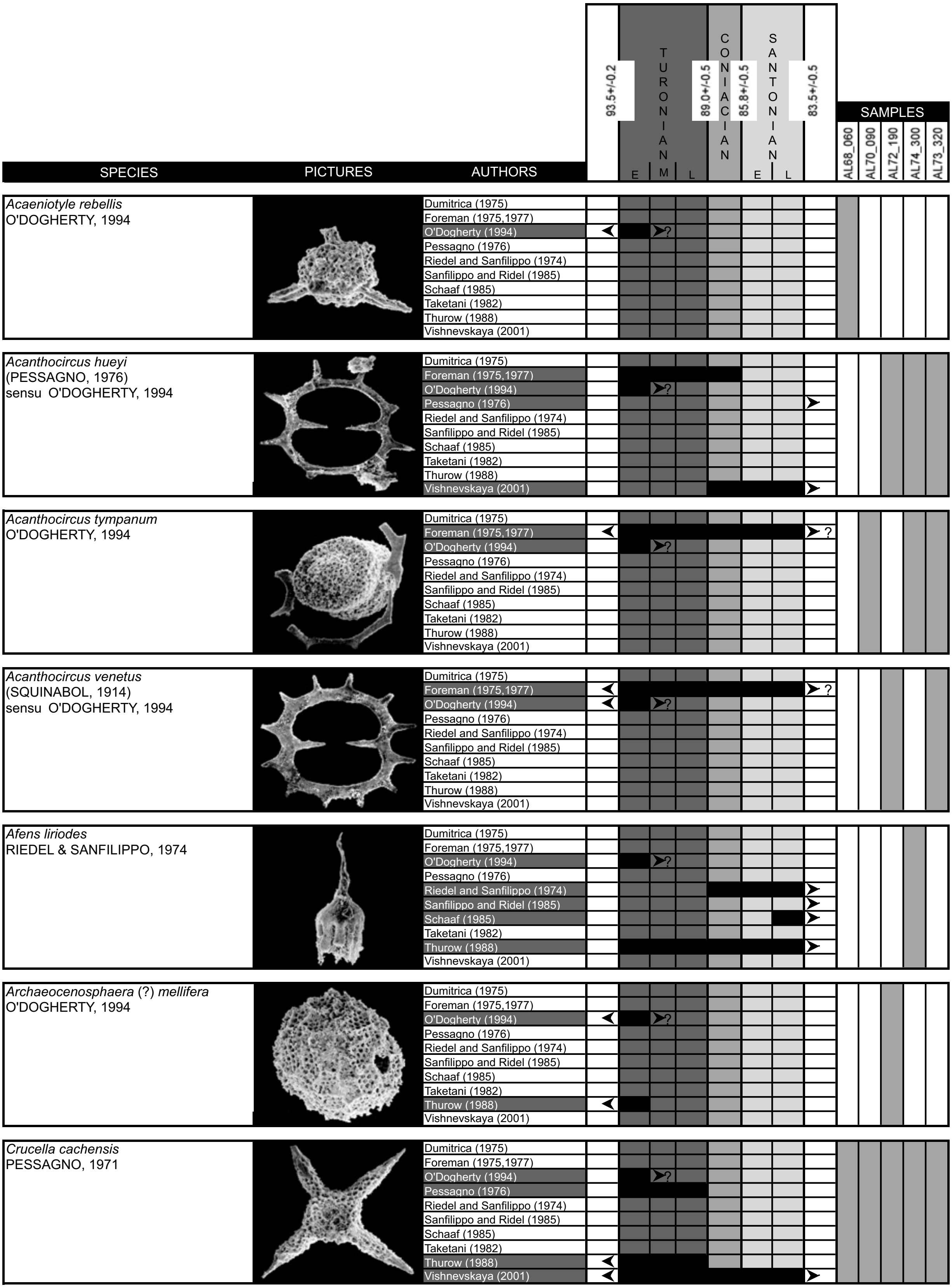

Fig. 4a. Selected Turonian-Santonian radiolarian ranges according to 10 authors as cited in the figures. Note the major discrepencies between authors.

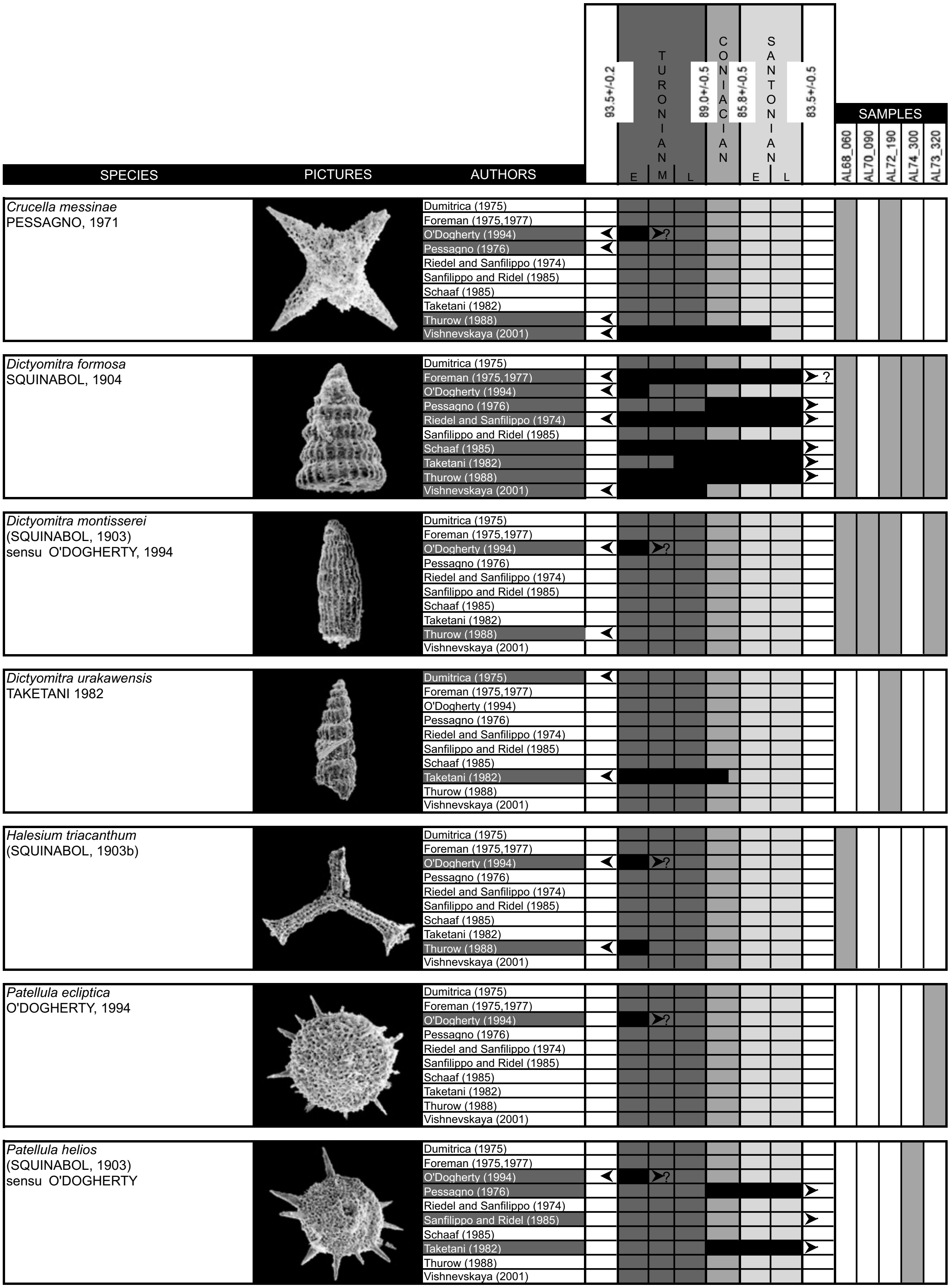

Fig. 4b. Selected Turonian-Santonian radiolarian ranges according to 10 authors as cited in the figures. Note the major discrepencies between authors.

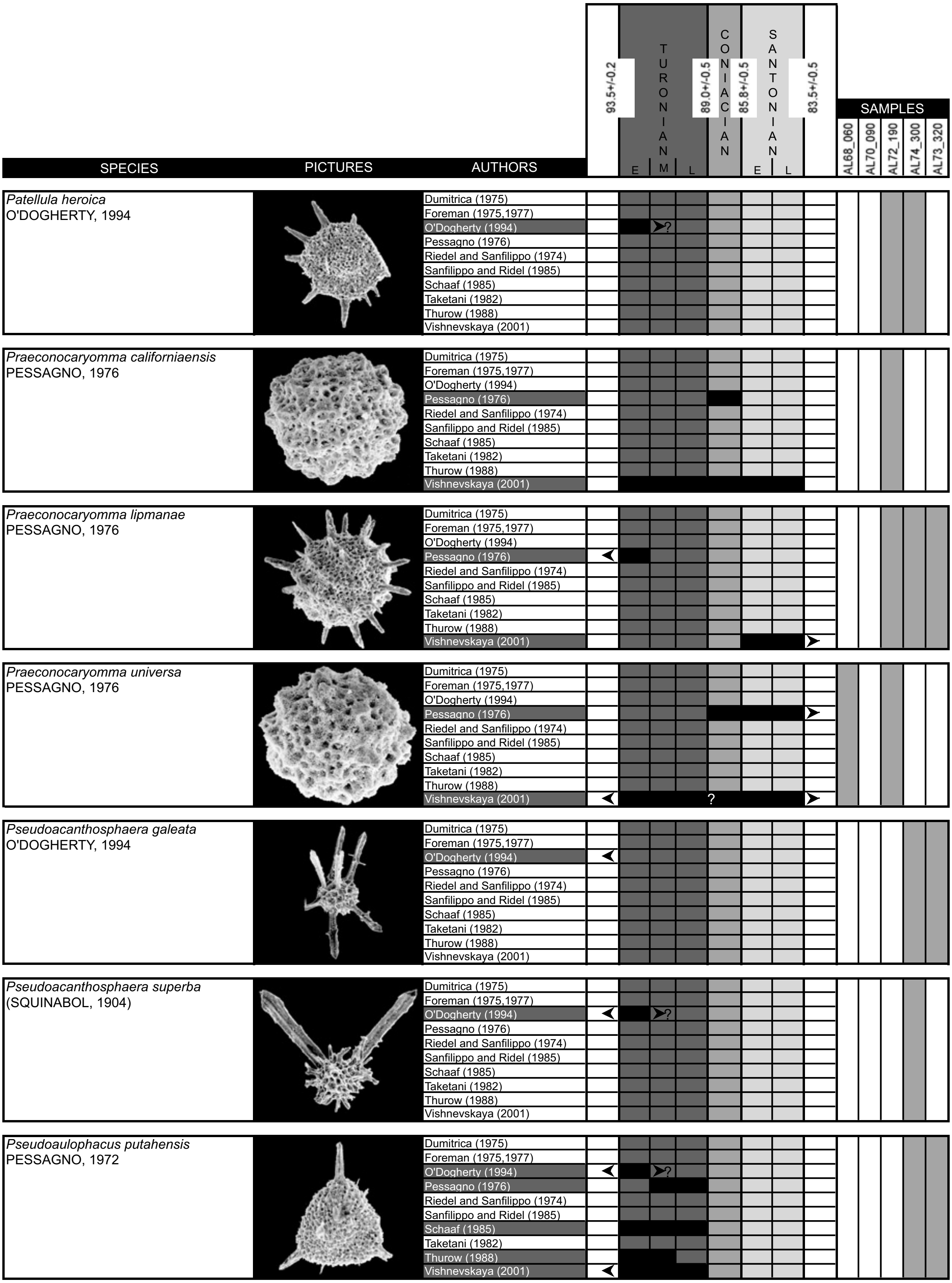

Fig. 4c. Selected Turonian-Santonian radiolarian ranges according to 10 authors as cited in the figures. Note the major discrepencies between authors.

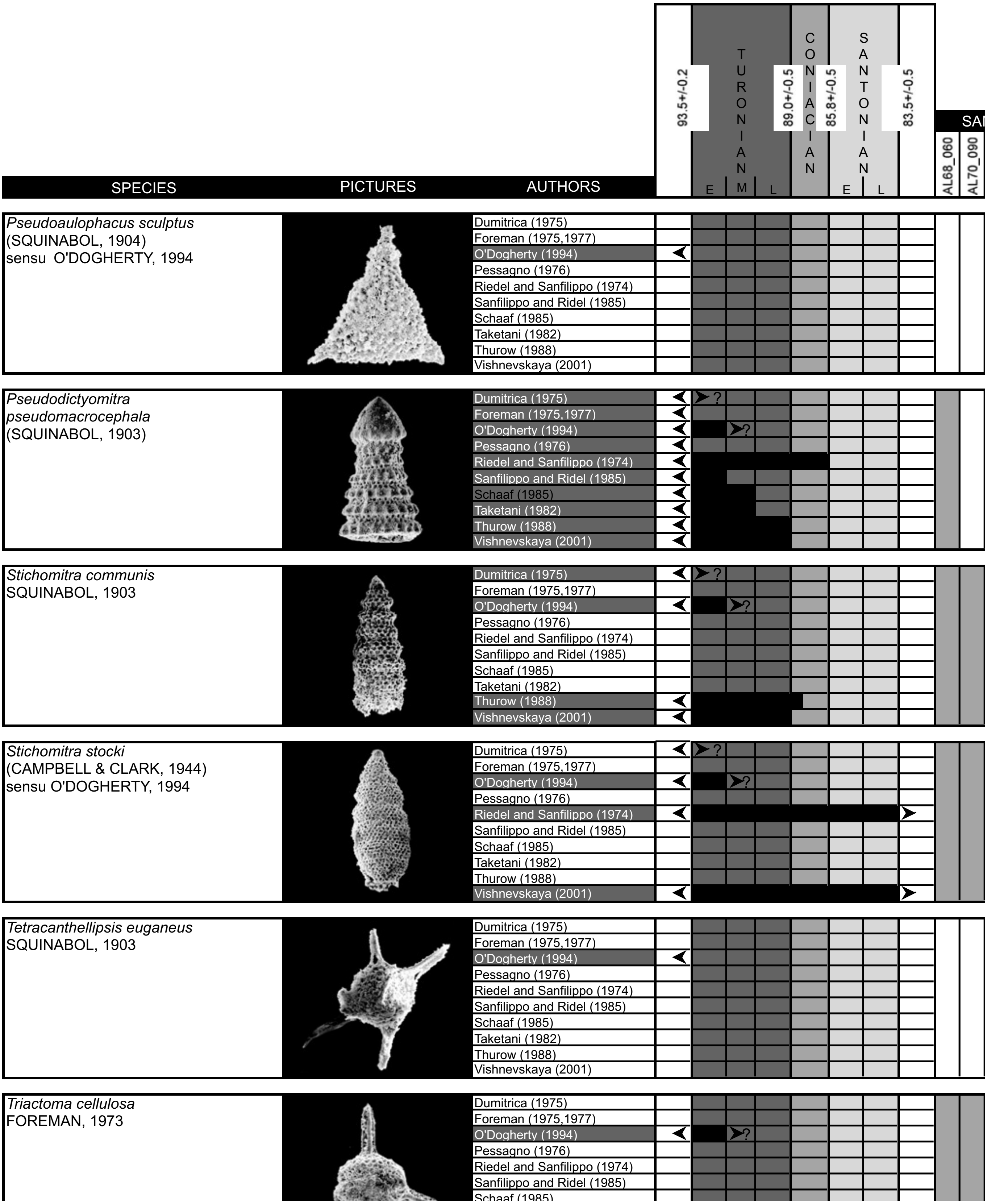

Fig. 4d. Selected Turonian-Santonian radiolarian ranges according to 10 authors as cited in the figures. Note the major discrepencies between authors.

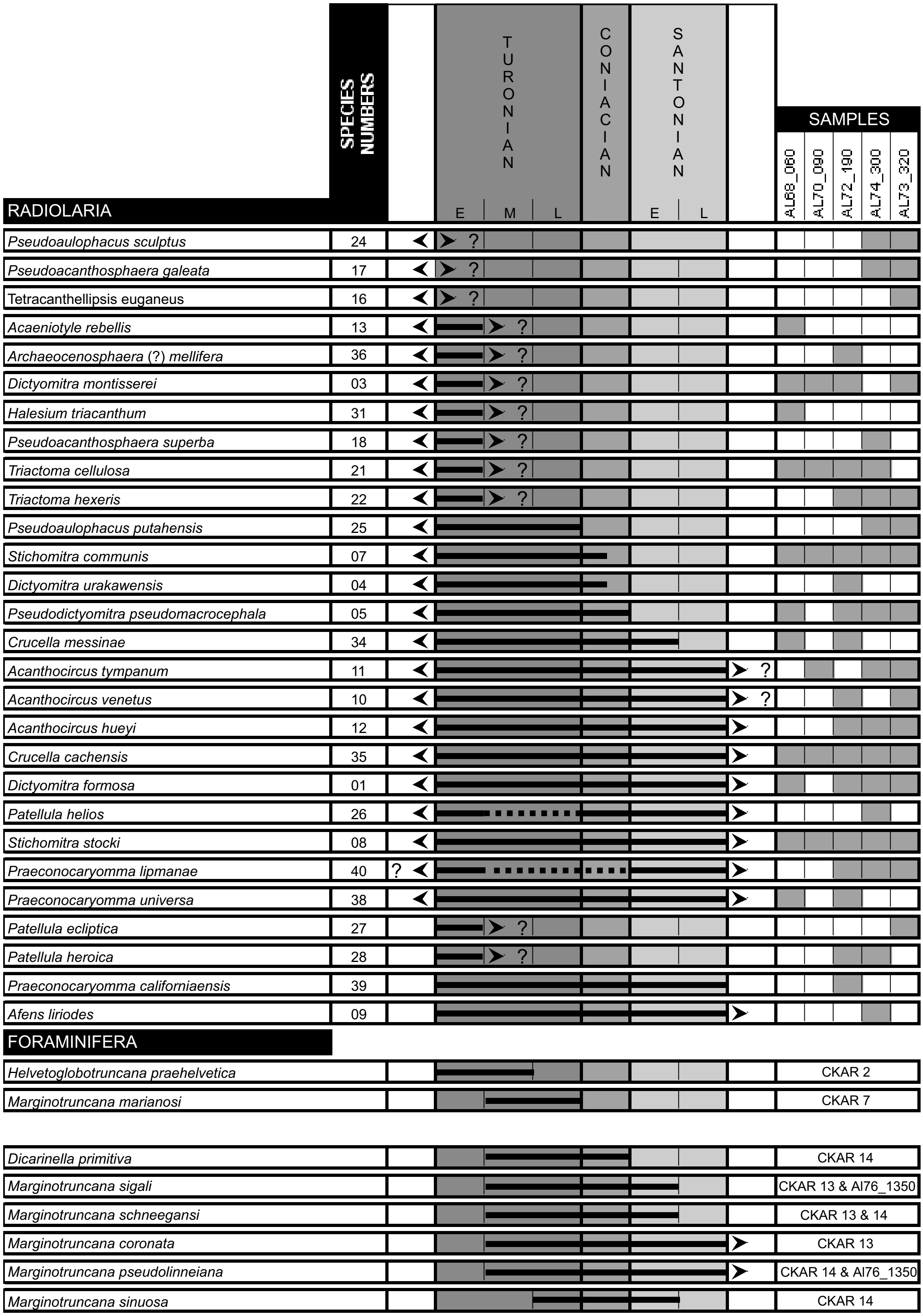

Fig. 5. Summary of Turonian to Santonian radiolarian and foraminfer ages obtained for the studied samples. The radiolarian ranges represent maximum ranges according to the 10 authors cited in figure 4.

Systematic Paleontology of Radiolaria

The suprageneric systematics presented here follow De Wever et al. (2001). The synonymies given include the original description of each taxon and additional synonymies from the following publications: Dumitrica (1975), Foreman (1975, 1977), O'Dogherty (1994), Pessagno (1976), Riedel & Sanfilippo (1974), Sanfilippo & Riedel (1985), Schaaf (1985), Taketani (1982), Thurow (1988), Vishnevskaya (2001). For further synonymies the reader is refered to these publications.

Class **ACTINOPODA**
Subclass **RADIOLARIA** MÜLLER 1858
Superorder **POLYCYSTINA** EHRENBERG 1838
Order **SPUMELLARIA** EHRENBERG 1875
Superfamily **ACTINOMMACEA (A)** HAECKEL 1862, *emend.* DE WEVER et al. 2001
Family **PARVIVACCIDAE** PESSAGNO & YANG *in* PESSAGNO et al. 1989
Subfamily **ACAENIOTYLINAE** YANG 1993

Genus **ACAENIOTYLE** FOREMAN 1973

Acaeniotyle rebellis O'DOGHERTY 1994
(Plate 1, Figs. 21–22)

1994 *Acaeniotyle rebellis* n. sp. O'DOGHERTY, p. 287–288, pl. 51, figs. 5–10.

Acaeniotyle* sp. *A
(Plate 1, Fig. 23)

Remarks. – Test with two primary spines well preserved and at the bottom right part of the shell a third spine. The angle between the three primary spines is 90 degrees (perhaps it had originally four primary spines?).

Acaeniotyle* sp. *B
(Plate 1, Fig. 24)

Remarks. – Specimen not very well preserved with only one spine. Test with tubercles.

Family **XIPHOSTYLIDAE** HAECKEL 1881

Genus **ARCHAEOCENOSPHAERA** PESSAGNO & YANG *in* PESSAGNO et al. 1989

Archaeocenosphaera* (?) *mellifera O'DOGHERTY 1994
(Plate 2, Fig. 18–19)

1988 *Hemicryptocapsa polyhedra* DUMITRICA. – THUROW,, p. 401, pl. 1, fig. 1.
1988 *Hemicryptocapsa* sp. cf. *H. polyhedra* DUMITRICA. – THUROW, p. 401, pl. 5, fig. 2.
1994 *Archaeocenosphaera*? *mellifera* n. sp. O'DOGHERTY, p. 375–376, pl. 74, figs. 1–5.

***Archaeocenosphaera* (?) sp.**
(Plate 2, Figs. 20–21)

Remarks. – Cortical shell very large, spherical with symmetrical meshwork. Cortical shell with very large polygonal pores. A medullary spongy cortical shell can be seen through the large pores of the first one. Very long spines occur at pore junctions. Spines with circular cross-section.

Genus **TRIACTOMA** RÜST 1885

Triactoma cellulosa FOREMAN 1973
(Plate 1, Figs. 30–31)

1973 *Triactoma cellulosa* new species FOREMAN, p. 259, pl. 2, figs 9–10; pl. 16, fig. 9.
1994 *Triactoma cellulosa* FOREMAN. – O'DOGHERTY, p. 300–301, pl. 54, figs 19–23.

Triactoma hexeris O'DOGHERTY 1994
(Plate 1, Figs. 32–33)

1994 *Triactoma hexeris* n. sp. O'DOGHERTY, p. 303, pl. 55, figs. 14–21.

Triactoma* sp. aff. *T. hexeris O'DOGHERTY 1994
(Plate 1, Fig. 34))

Remarks. – Test with cortical shell less rouded then previous species, but more hexagonal thiner. Pores are not clearly hexagonal.

Superfamily **ACTINOMMACEA (B)** HAECKEL 1862, *emend.* DE WEVER et al. 2001
Family **ACTINOMMIDAE** HAECKEL 1862

Genus **PSEUDOACANTHOSPHAERA** O'DOGHERTY 1994

Pseudoacanthosphaera galeata O'DOGHERTY 1994
(Plate 1, Fig. 26)

1994 *Pseudoacanthosphaera galeata* n. sp. O'DOGHERTY, p. 297, pl. 53, figs. 16–19.

Pseudoacanthosphaera superba (SQUINABOL 1904)
(Plate 1, Fig. 27)

1904 *Trisphaera superba* n. sp. SQUINABOL, p. 190, pl. 2, fig. 13.
1994 *Pseudoacanthosphaera superba* (SQUINABOL). – O'DOGHERTY, p. 298–299, pl. 54, figs. 5–10.

Pseudoacanthosphaera* sp. aff. *P. spinosissima (SQUINABOL 1904)
(Plate 1, Fig. 28)

Remarks. – Test with a small spinose cortical shell and two long three-bladed primary spines.

***Pseudoacanthosphaera* (?) sp.**
(Plate 1, Fig. 29)

Remarks. – Test with ellipsoidal cortical shell and three, maybe four primary spines (the fourth one is not visible). Primary spines three-bladed. Meshwork developing small secondary spines at pore vertices.

Genus **TETRACANTHELLIPSIS** SQUINABOL 1903

Tetracanthellipsis euganeus SQUINABOL 1903
(Plate 1, Fig. 25)

1903 *Tetracanthellipsis euganeus* n. sp. SQUINABOL, p. 117, pl. 8, fig. 9.
1994 *Tetracanthellipsis euganeus* SQUINABOL. – O'DOGHERTY, p. 295–296, pl. 53, figs. 8–10.

Superfamily **ACTINOMMACEA (C)** HAECKEL 1862, *emend.* DE WEVER et al. 2001
Family **CONOCARYOMMIDAE** LIPMAN 1969

Genus **PRAECONOCARYOMMA** PESSAGNO 1976

Praeconocaryomma universa PESSAGNO 1976
(Plate 2, Figs. 22–23)

1976 *Praeconocaryomma universa* n. sp. PESSAGNO, p. 42, pl. 6, fig. 14–16.
1982 *Praeconocaryomma universa* PESSAGNO. – TAKETANI, p. 47, pl. 1, figs. 3a–b, 4; pl. 9, fig. 4.
2001 *Praeconocaryomma universa* PESSAGNO. – VISHNEVSKAYA, p. 179, pl. 21, fig. 3; pl. 24, fig. 1; pl. 97, fig. 1; pl. 113, fig. 5; pl. 125, fig. 1–2; pl. 126, fig. 1.
2001 *Praeconocaryomma*? *universa* PESSAGNO. – VISHNEVSKAYA, p. 179, pl. 21, figs. 11.
2001 *Praeconocaryomma* ex gr. *universa* PESSAGNO. – VISHNEVSKAYA, p. 179, pl. 80, figs. 4; pl. 81, fig. 1.

Praeconocaryomma californiaensis PESSAGNO 1976
(Plate 2, Figs. 24–25)

1976 *Praeconocaryomma californiaensis* n. sp. PESSAGNO, p. 41, pl. 7, fig. 1–8.
1982 *Praeconocaryomma californiaensis* PESSAGNO – TAKETANI, p. 47, pl. 1, figs. 2a–c; pl. 9, figs. 1–2.

Praeconocaryomma lipmanae PESSAGNO 1976
(Plate 2, Figs. 26–27)

1976 *Praeconocaryomma lipmanae* n. sp. PESSAGNO, p. 41–42, pl. 4, fig. 12–13.
1982 *Praeconocaryomma lipmanae* PESSAGNO. – TAKETANI, p. 47, pl. 9, fig. 3.

***Praeconocaryomma* sp.**
(Plate 2, Figs. 28–29)

Remarks. – Elliptical cortical shell in outline with numerous equally spaced, cone-like mammae. Cortical shell with or without radial spines circular in cross-section projecting from center of each mamma. Cortical shell with pore frames of uniform size. Cortical shell with about ten elliptical pore frames on each mamma.

Superfamily **PYLONIACEA** HAECKEL 1881
Subsuperfamily **DACTYLIOSPHAERILAE** SQUINABOL 1904
Family **HAGIASTRIDAE** RIEDEL 1971

Genus **CRUCELLA** PESSAGNO 1971

Crucella messinae PESSAGNO 1971
(Plate 2, Figs. 14–15)

1971 *Crucella messinae* n. sp. PESSAGNO, p. 56, pl. 6, figs. 1–3.
1975 *Crucella* sp. FOREMAN, p. 612, pl. 1D, fig. 7; pl. 2D, fig. 9.
1976 *Crucella messinae* PESSAGNO. – PESSAGNO, p. 32, pl. 1, figs. 4.
non 1982 *Crucella messinae* PESSAGNO. – TAKETANI, p. 50, pl. 9, fig. 17.
1988 *Crucella messinae* PESSAGNO. – THUROW,, p. 399, pl. 5, fig. 22.
? 1988 *Crucella* sp. *B* THUROW,, p. 399, pl. 2, fig. 15.
1994 *Crucella messinae* PESSAGNO. – O'DOGHERTY, p. 368, pl. 70, figs. 21–24, pl. 71, figs. 1–6.
2001 *Crucella* cf. *messinae* PESSAGNO. – VISHNEVSKAYA, p. 158, pl. 114, fig. 10.

Crucella cachensis PESSAGNO 1971
(Plate 2, Figs. 16–17)

1971 *Crucella cachensis* n. sp. PESSAGNO, p. 53, pl. 9, figs. 1–3.
1976 *Crucella cachensis* PESSAGNO. – PESSAGNO, p. 31, pl. 3, figs. 14–15.
1982 *Crucella cachensis* PESSAGNO. – TAKETANI, p. 50, pl. 9, fig. 16.
1988 *Crucella cachensis* PESSAGNO. – THUROW,, p. 399, pl. 2, fig. 13.
1994 *Crucella cachensis* PESSAGNO. – O'DOGHERTY, p. 370, pl. 71, figs. 15–22.
2001 *Crucella cachensis* PESSAGNO. – VISHNEVSKAYA, p. 158, pl. 95, fig. 5; pl. 125, fig. 12; pl. 129, fig. 3.

Subsuperfamily **PATULIBRACCHIILAE** PESSAGNO 1971
Family **PATULIBRACCHIIDAE** PESSAGNO 1971

Genus **HALESIUM** PESSAGNO 1971

Halesium triacanthum (SQUINABOL 1903) **sensu** O'DOGHERTY, 1994
(Plate 2, Fig. 10)

1903 *Dictyastrum triacanthos* n. sp. SQUINABOL, p. 121, pl. 9, fig. 28.
? 1988 *Halesium quadratum* PESSAGNO. – THUROW,, p. 401, pl. 2, fig. 10.
1994 *Halesium triacanthum* (SQUINABOL). – O'DOGHERTY, p. 350–351, pl. 65, figs. 9–14.

***Halesium* sp.**
(Plate 2, Figs. 11–12)

Remarks. – Test with 3 relatively thick and small rays.

Genus **PESSAGNOBRACCHIA** KOZUR & MOSTLER 1978

***Pessagnobracchia* sp.**
(Plate 2, Fig. 13)

Remarks. – Spongy three-rayed test with irregular arrangement of pores on rays.

Family **PSEUDOAULOPHACIDAE** RIEDEL 1967
Subfamily **PSEUDOAULOPHACINAE** RIEDEL 1967

Genus **DACTILYODISCUS** SQUINABOL 1903

***Dactyliodiscus* sp.**
(Plate 2, Figs. 8–9)

Remarks. – Test is disc-shaped and circular in outline with a variable number of equatorial spines. Meshwork spongy with irregularly pore frames. Poorly defined central raised area. Upper and lower surfaces of the test with small tubercles.

Genus **PSEUDOAULOPHACUS** PESSAGNO 1963

Pseudoaulophacus sculptus (SQUINABOL 1904) **sensu** O'-DOGHERTY 1994
(Plate 1, Figs. 35–36)

1904 *Theodiscus sculptus* n. sp. SQUINABOL, p. 200, pl. 4, fig. 9.
1988 *Alievium superbum* « Cenomanian » form (SQUINABOL). – THUROW,, p. 397, pl. 5, fig. 11.
1988 *Alievium* sp. *A*. THUROW, p. 397, pl. 5, fig. 12.
1994 *Pseudoaulophacus sculptus* (SQUINABOL). – O'DOGHERTY, p. 319–320, pl. 59, figs. 1–4.

Pseudoaulophacus putahensis PESSAGNO 1972
(Plate 1, Figs. 37–38)

1972 *Pseudoaulophacus putahensis* n. sp. PESSAGNO, p. 301, pl. 27, fig. 1.
1976 *Pseudoaulophacus putahensis* PESSAGNO. – PESSAGNO, p. 28, pl. 3, fig. 13.
1988 *Pseudoaulophacus putahensis* PESSAGNO. – THUROW,, p. 404, pl. 2, fig. 4.
1994 *Pseudoaulophacus putahensis* PESSAGNO. – O'DOGHERTY, p. 320–321, pl. 59, figs. 5–13.
2001 *Pseudoaulophacus putahensis* PESSAGNO. – VISHNEVSKAYA, p. 181, pl. 130, fig. 7.

Superfamily **SPONGURACEA** HAECKEL 1862
Family **SPONGURIDAE** HAECKEL 1862

Genus **PATELLULA** KOZLOVA 1972

Patellula helios (SQUINABOL 1903) **sensu** O'DOGHERTY 1994
(Plate 2, Figs. 1–2)

1903 *Stylotrochus helios* n. sp. SQUINABOL, p. 124, pl. 10, figs. 23–23a.
1976 *Pseudoaulophacus lenticulatus* (WHITE). – PESSAGNO, p. 28, pl. 9, figs. 11–12.
1982 *Pseudoaulophacus lenticulatus* (WHITE). – TAKETANI, p. 51, pl. 10, fig. 11.
1985 *Pseudoaulophacus lenticulatus* (WHITE). – SANFILIPPO & RIEDEL, p. 596, text-figs. 6.4a–b.
1994 *Patellula helios* (SQUINABOL). – O'DOGHERTY, p. 327–328, pl. 60, figs. 19–24.

Patellula ecliptica O'DOGHERTY 1994
(Plate 2, Figs. 3–4)

1994 *Patellula ecliptica* n. sp. O'DOGHERTY, p. 329, pl. 61, figs. 1–5.

Patellula heroica O'DOGHERTY 1994
(Plate 2, Figs. 5–6)

1994 *Patellula heroica* n. sp. O'DOGHERTY, p. 330, pl. 61, figs. 6–11.

***Patellula* sp.**
(Plate 2, Fig. 7)

Remarks. – Test flattened ellipsoidal with fifteen spines radiating in the same equatorial plane.

Order **ENTACTINARIA** KOZUR & MOSTLER 1982
Family **SATURNALIDAE** DEFLANDRE 1953
Subfamily **SATURNALINAE** DEFLANDRE 1953

Genus **ACANTHOCIRCUS** SQUINABOL 1903

Acanthocircus venetus (SQUINABOL 1914) **sensu** O'DOGHERTY 1994
(Plate 1, Figs. 15–16)

1914 *Saturnalis venetus* n. f. SQUINABOL, p. 269, 299, pl. 20[1], fig. 2; pl. 24[5], fig. 1.
? 1975 *Spongosaturnalis horridus* (SQUINABOL). – FOREMAN, p. 610, pl. 4, fig. 3.
1975 *Spongosaturnalis hueyi* group (PESSAGNO). – FOREMAN, p. 611, pl. 1B, figs. 1–3; non pl. 1A, figs. 7–8 (=*A. tympanum*?).
1975 *Spongosaturnalis* (?) *preclarus* new species FOREMAN, p. 611, pl. 1A, figs. 4–5; pl. 4, fig. 8.
1994 *Acanthocircus venetus* (SQUINABOL). – O'DOGHERTY, p. 256, pl. 45, figs. 1–8.

Acanthocircus tympanum O'DOGHERTY 1994
(Plate 1, Figs. 17–18)

pars 1975 *Spongosaturnalis hueyi* group (PESSAGNO). – FOREMAN, p. 611, pl. 1A, figs. 7–8; non pl. 1B, figs. 1–3 (=*A. venetus*?)
1994 *Acanthocircus tympanum* n. sp. O'DOGHERTY, p. 259–260, pl. 45, figs. 17–24.

Acanthocircus hueyi (PESSAGNO 1976) **sensu** O'DOGHERTY 1994
(Plate 1, Figs. 19–20)

1975 *Spongosaturnalis hueyi* (PESSAGNO). – FOREMAN, p. 611, pl. 1A, fig. 6; pl. 4, fig. 10.
1976 *Spongosaturnalis hueyi* n. sp. PESSAGNO, p. 39, pl. 12, fig. 1.
1994 *Acanthocircus hueyi* (PESSAGNO). – O'DOGHERTY, p. 260–261, pl. 46, figs. 1–5.
2001 *Spongosaturnalis hueyi* (PESSAGNO). – VISHNEVSKAYA, p. 186, pl. 122, fig. 2.
2001 *Spongosaturnalis* ex. gr. *hueyi* (PESSAGNO). – VISHNEVSKAYA, p. 186, pl. 92, figs. 7–8, pl. 95, figs. 1–3.

Order **NASSELARIA** EHRENBERG 1875
Superfamily **ARCHAEDICTYOMITRACEA** PESSAGNO 1976

Family **ARCHAEDICTYOMITRIDAE** PESSAGNO 1976

Genus **DICTYOMITRA** ZITTEL 1876

Dictyomitra formosa SQUINABOL 1904
(Plate 1, Figs. 1–2)

1904 *Dictyomitra formosa* n. sp. SQUINABOL, p. 232, pl. 10, fig. 4.
1974 *Dictyomitra torquata* FOREMAN. – RIEDEL & SANFILIPPO, p. 778, pl. 5, figs. 1, 2 and 4.
1975 *Dictyomitra duodecimcostata* (SQUINABOL). – FOREMAN, p. 614, pl. 7, fig. 8; pl. 1G, fig. 5.
1976 *Dictyomitra formosa* SQUINABOL. – PESSAGNO, p. 51, pl. 8, figs. 10–12.
1982 *Dictyomitra formosa* SQUINABOL. – TAKETANI, p. 58, *pl.* 4, figs. 6a–b; pl. 11, fig. 13.
1985 *Dictyomitra formosa* SQUINABOL. – SCHAAF,, text-fig.11, p. 250.
1988 *Dictyomitra formosa* SQUINABOL. – THUROW,, p. 400, pl. 1, figs. 23 and 25.
1994 *Dictyomitra formosa* SQUINABOL. – O'DOGHERTY, p. 80, pl. 4, figs. 8–12.
2001 *Dictyomitra formosa* SQUINABOL. – VISHNEVSKAYA, p. 160, pl. 25, fig. 10.

Dictyomitra* sp. cf. *D. formosa SQUINABOL 1904
(Plate 1, Fig. 3)
(species number 2)
Dictyomitra montisserei (SQUINABOL 1903) **sensu** O'DOGHERTY 1994
(Plate 1, Figs. 4–5)

1903 *Stichophormis Montis Serei* n. sp. SQUINABOL, p. 137, pl. 8, fig. 38.
1975 *Dictyomitra* sp. *A*. FOREMAN, p. 615, pl. 1G, fig. 7; pl. 2G, figs. 18 and 20.
1982 *Archaedictyomitra* sp. *A*. TAKETANI, p. 58, pl. 4, figs. 5a–b.
? 1988 *Archaedictyomitra lacrimula* (FOREMAN). – THUROW,, p. 397, pl. 3, fig. 8.
1988 *Archaedictyomitra simplex* PESSAGNO. – THUROW,, p. 398, pl. 3, fig. 9.
1994 *Dictyomitra montisserei* (SQUINABOL 1903b). – O'DOGHERTY, p. 77, pl. 3, figs. 1–29.

Dictyomitra urakawensis (TAKETANI 1982)
(Plate 1, Fig. 6)

? 1975 *Dictyomitra* sp. – DUMITRICA,, text-fig.2; 8.
1982 *Dictyomitra urakawensis* n. sp. TAKETANI, p. 59, pl. 4, figs. 8a–b; pl. 11, fig. 16.

Superfamily **AMPHIPYNDACEA** RIEDEL 1967
Family **SPONGOCAPSULIDAE** PESSAGNO1977

Genus **TORCULUM** O'DOGHERTY 1995

Torculum coronatum (SQUINABOL1904)
(Plate 1, Fig. 9)

1904 *Theoconus coronatus* n. sp. SQUINABOL, p. 220, pl. 8, fig. 3.
1976 *Stichomitra* (?) *zamoraensis* n. sp. PESSAGNO, p. 54, pl. 3, figs. 7–9.
1982 *Spongocapsula* (?) *zamoraensis* (PESSAGNO). – TAKETANI, p. 62, pl. 5, figs. 6a–b; pl. 12, figs. 12–13.
1988 *Theoconus coronatus* Group SQUINABOL. – THUROW,, p. 407, pl. 4, figs. 2.
1988 *Theoconus* sp. *A* cf. *T. coronatus* SQUINABOL. – THUROW,, p. 407, pl. 4, figs. 3–4.
2001 *Spongocapsula* aff. *zamoraensis* (PESSAGNO). – VISHNEVSKAYA, p. 186, pl. 77, fig. 5; pl. 90, figs. 5–6.

Superfamily **EUCYRTIDIACEA** EHRENBERG 1847
Family **PSEUDODICTYOMITRIDAE** PESSAGNO 1977

Genus **PSEUDODICTYOMITRA** PESSAGNO 1977

Pseudodictyomitra pseudomacrocephala (SQUINABOL 1903)
(Plate 1, Figs. 7–8)

1903 *Dictyomitra pseudomacrocephala* n. sp. SQUINABOL, p. 139, pl. 10, fig. 2.
1974 *Dictyomitra macrocephala* SQUINABOL. – RIEDEL & SANFILIPPO, p. 778, pl. 4, figs. 10–11; pl. 14, fig. 11.
1975 *Dictyomitra pseudomacrocephala* SQUINABOL. – DUMITRICA,, text-fig.2, 19.
1975 *Dictyomitra pseudomacrocephala* SQUINABOL. – FOREMAN, p. 614, pl. 7, fig. 10.
1976 *Dictyomitra (?) pseudomacrocephala* SQUINABOL. – PESSAGNO, p. 53, pl. 3, figs. 2–3.
1982 *Pseudodictyomitra pseudomacrocephala* (SQUINABOL). – TAKETANI, p. 61, pl. 5, figs. 4a–b; pl. 12, figs. 7–8.
1985 *Pseudodictyomitra pseudomacrocephala* (SQUINABOL). – SANFILIPPO & RIEDEL, p. 608, text-figs. 10. 1a–b.
1985 *Pseudodictyomitra pseudomacrocephala* (SQUINABOL). – SCHAAF, text-fig.11, p. 250
1988 *Pseudodictyomitra pseudomacrocephala* (SQUINABOL). – THUROW,, p. 405, pl. 1, fig. 13; pl. 3, figs. 11–16.
1994 *Pseudodictyomitra pseudomacrocephala* (SQUINABOL). – O'DOGHERTY, p. 108–109, pl. 8, figs. 5–8.
2001 *Pseudodictyomitra pseudomacrocephala* (SQUINABOL). – VISHNEVSKAYA, p. 183–184, pl. 20, fig. 6; pl. 24, fig. 10; pl. 100, fig. 3; pl. 129, figs. 5, 9 and 10.

Family **EUCYRTIDIIAE** EHRENBERG 1847

Genus **STICHOMITRA** CAYEUX 1897

Stichomitra communis SQUINABOL 1903
(Plate 1, Figs. 10–11)

1903 *Stichomitra communis* n. sp. SQUINABOL, p. 141, pl. 8, fig. 40.
1975 *Stichomitra* sp. DUMITRICA,, text-fig.2, 21.
1975 *Stichomitra* spp. cf. *D. tekschaensis* ALIEV. – FOREMAN, p. 615, pl. 2H, fig1.
1982 *Stichomitra communis* SQUINABOL. – TAKETANI, p. 54, pl. 3, fig. 9; pl. 11, fig. 5.
1988 *Stichomitra communis* SQUINABOL. – THUROW,, p. 406, pl. 4, fig. 10.
1988 *Stichomitra* sp. cf. *S. communis* SQUINABOL. – THUROW,, p. 406, pl. 4, fig. 9.
1994 *Stichomitra communis* SQUINABOL. – O'DOGHERTY, p. 144–145, pl. 17, figs. 6–16.
2001 *Stichomitra communis* SQUINABOL. – VISHNEVSKAYA, p. 188, pl. 23, fig. 8; pl. 79, fig. 3; pl. 129, fig. 8.

Stichomitra stocki (CAMPBELL & CLARK 1944) **sensu** O'DOGHERTY 1994
(Plate 1, Figs. 12–13)

1944 *Stichocapsa* (?) *stocki* n. sp. CAMPBELL & CLARK, p. 44, pl. 8, figs. 31–33.

1974 *Amphipyndax stocki* (CAMPBELL & CLARK). – RIEDEL & SANFILIPPO, p. 775, pl. 15, fig. 11; pl. 11, figs. 1–3.
1975 *Amphipyndax stocki* (CAMPBELL & CLARK). – DUMITRICA, text-fig.2.23.
1982 *Amphipyndax stocki* (CAMPBELL & CLARK). – TAKETANI, p. 52, pl. 2, figs. 9a–b; pl. 10, figs. 13–14.
1982 *Amphipyndax* sp. TAKETANI, p. 52, pl. 10, fig. 16.
1988 *Stichomitra* (?) sp. *A*. THUROW,, p. 406, pl. 1, fig. 17.
1994 *Stichomitra stocki* (CAMPBELL & CLARK). O'DOGHERTY, p. 147–148 and 150, pl. 18, figs. 9–15.
2001 *Amphipyndax stocki* (CAMPBELL & CLARK). – VISHNEVSKAYA, p. 146, pl. 1, fig. 13; pl. 4, fig. 11–13; pl. 6, fig. 12; pl. 16, fig. 1; pl. 93, fig. 4–5; pl. 94, fig. 8 and 10; pl. 99, fig. 1–3 and 8; pl. 114, fig. 12.
2001 *Amphipyndax stocki* (CAMPBELL & CLARK) var. A VISHNEVSKAYA. – VISHNEVSKAYA, p. 146–147, pl. 16, fig. 2–6; pl. 26, fig. 6; pl. 100, fig. 4; pl. 123, fig. 16–21 and 23.
2001 *Amphipyndax stocki* (CAMPBELL & CLARK) var. B VISHNEVSKAYA. – VISHNEVSKAYA, p147, pl. 3, fig. 6; pl. 12, fig. 3 and 5; pl. 15, fig. 1–5.
2001 *Amphipyndax stocki* (CAMPBELL & CLARK) var. C VISHNEVSKAYA. – VISHNEVSKAYA, p. 147, pl. 3, fig. 2 and 4; pl. 14, fig. 1–3.V

NASSELLARIA INCERTAE SEDIS

Genus **AFENS** RIEDEL & SANFILIPPO 1974

Afens liriodes RIEDEL & SANFILIPPO 1974
(Plate 1, Fig. 14)

1974 *Afens liriodes* new genus and new species RIEDEL & SANFILIPPO, p. 775, pl. 11, fig. 11; pl. 13, figs. 14–16.
1985 *Afens liriodes* RIEDEL & SANFILIPPO. – SANFILIPPO & RIEDEL, p. 624, text-figs. 13.3a–c.
1985 *Afens liriodes* RIEDEL & SANFILIPPO. – SCHAAF, text-fig.11, p. 250.
1988 *Afens liriodes* RIEDEL & SANFILIPPO. – THUROW,, pl. 2,fig.1.
1994 *Afens liriodes* RIEDEL & SANFILIPPO. – O'DOGHERTY, p. 246, pl. 42, figs. 23–26.

Planktonic Foraminifera

In the following, we use the ranges proposed by Caron (1985). The first pelagic facies at the top of the Pantokrator Limestone is dated as middle Turonian by the presence of *Helvetoglobotruncana helvetica* (Pl. 3, Fig. 1, early Turonian – middle Turonian) and *Marginoglobotruncana marianosi* (Pl. 3, Fig. 2, middle Turonian – late Turonian).

In the pelagic limestone rich in Globotruncanidae at the top of the radiolarian cherts, the presence of *Dicarinella primitiva* (Pl. 3, Fig. 9, middle Turonian – Coniacian), *Marginotruncana sigali* (Pl. 3, Figs. 5 and 12, middle Turonian – early Santonian), *M. schneegansi* (Pl. 3, Figs. 3 and 7, middle Turonian – early Santonian), *M. coronata* (Pl. 3, Fig. 4, middle Turonian – early Campanian), *M. pseudolinneiana* (Pl. 3, Figs. 6, 10 and 11, middle Turonian – early Campanian) and *M. sinuosa* (Pl. 3, Fig. 8, late Turonian – early Santonian) allow to state a late Turonian to early Santonian age without further precision.

Discussion and Conclusions

The radiolarian chronostratigraphic ranges used for this paper are based on the comparison of taxon ranges established by 10 different authors (see list in introduction). By stacking chronostratigraphic ranges, we obtain a maximum range for the existence of each taxon. Despite possible inaccuracies of calibration, the radiolarian age given by this procedure is consistent with the age based on planktonic foraminifera (late Turonian to Coniacian). In combining the radiolarian and the planktonic foraminifer ages, the samples would be restricted to the late Turonian. However, the major discrepancies of published radiolarian ranges call for an urgent, major revision of the Late Cretaceous radiolarian biochronology, a project that is underway (Jackett et al. 2002 and Diserens et al. 2003). The integration of planktonic foraminifera with radiolarians may greatly enhance biochronologic resolution in sections where both groups occur.

This is the first time that Late Cretaceous radiolarians are described from the Argolis Peninsula.

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SPECIES LIST

Acaeniotyle rebellis O'DOGHERTY 1994 (Pl. 1, Figs. 1–2)
Acaeniotyle* sp. *A (Pl. 1, Fig. 3)
Acaeniotyle* sp. *B (Pl. 1, Fig. 4)
Acanthocircus hueyi (PESSAGNO 1976) **sensu** O'DOGHERTY 1994 (Pl. 2, Figs.18–19)
Acanthocircus tympanum O'DOGHERTY 1994 (Pl. 2, Figs. 16–17)
Acanthocircus venetus (SQUINABOL 1914) **sensu** O'DOGHERTY 1994 (Pl. 2, Figs. 14–15)
Afens liriodes RIEDEL & SANFILIPPO 1974 (Pl. 2, Fig. 33)
Archaeocenosphaera* (?) *mellifera O'DOGHERTY 1994 (Pl. 1, Figs. 5–6)
***Archaeocenosphaera* (?) sp.** (Pl. 1, Figs. 7–8)
Crucella cachensis PESSAGNO 1971 (Pl. 1, Figs. 29–30)
Crucella messinae PESSAGNO 1971 (Pl. 1, Figs. 27–28)
***Dactyliodiscus* sp.** (Pl. 2, Figs. 1–2)
Dictyomitra formosa SQUINABOL 1904 (Pl. 2, Figs. 20–21)
Dictyomitra montisserei (SQUINABOL 1903) **sensu** O'DOGHERTY 1994 (Pl. 2, Figs. 23–24)

Dictyomitra* sp. cf. *D. formosa SQUINABOL 1904 (Pl. 2, Fig. 22)
Dictyomitra urakawensis TAKETANI 1982 (Pl. 2, Fig. 25)
***Halesium* sp.** (Pl. 1, Figs. 32–33)
Halesium triacanthum (SQUINABOL 1903) **sensu** O'DOGHERTY 1994 (Pl. 1, Fig. 31)
Patellula ecliptica O'DOGHERTY 1994 (Pl. 2, Figs. 9–10)
Patellula helios (SQUINABOL 1903) **sensu** O'DOGHERTY 1994 (Pl. 2, Figs. 7–8)
Patellula heroica O'DOGHERTY 1994 (Pl. 2, Figs. 11–12)
***Patellula* sp.** (Pl. 2, Fig. 13)
***Pessagnobrachia* sp.** (Pl. 1, Fig. 34)
Praeconocaryomma californiaensis PESSAGNO 1976 (Pl. 1, Figs. 21–22)
Praeconocaryomma lipmanae PESSAGNO 1976 (Pl. 1, Figs. 23–24)
***Praeconocaryomma* sp.** (Pl. 1, Figs. 25–26)
Praeconocaryomma universa PESSAGNO 1976 (Pl. 1, Figs. 19–20)
***Pseudoacanthosphaera* (?) sp.** (Pl. 1, Fig.17)
Pseudoacanthosphaera galeata O'DOGHERTY 1994 (Pl. 1, Fig. 14)
Pseudoacanthosphaera* sp. aff. *P. spinosissima (SQUINABOL 1904) (Pl. 1, Fig. 16)
Pseudoacanthosphaera superba (SQUINABOL 1904) (Pl. 1, Fig. 15)
Pseudoaulophacus putahensis PESSAGNO 1972 (Pl. 2, Figs. 5–6)
Pseudoaulophacus sculptus (SQUINABOL 1904) **sensu** O'-DOGHERTY 1994 (Pl. 2, Figs. 3–4)
Pseudodictyomitra pseudomacrocephala (SQUINABOL 1903) (Pl. 2, Figs. 27–28)
Stichomitra communis SQUINABOL 1903 (Pl. 2, Figs. 29–30)
Stichomitra stocki (CAMPBELL & CLARK 1944) **sensu** O'-DOGHERTY 1994 (Pl. 2, Figs. 31–32)
Tetracanthellipsis euganeus SQUINABOL 1903 (Pl. 1, Fig. 18)
Torculum coronatum (SQUINABOL 1904) (Pl. 2, Fig. 26)
Triactoma cellulosa FOREMAN 1973 (Pl. 1, Figs. 9–10)
Triactoma hexeris O'DOGHERTY 1994 (Pl. 1, Figs. 11–12)
Triactoma* sp. aff. *T. hexeris O'DOGHERTY 1994 (Pl. 1, Fig. 13)

REFERENCES

BANDINI, A. 2004: Sédimentologie et tectonostratigraphie du sud de la péninsule de l'Argolide, Péloponèse (Grèce) & Upper Cretaceous radiolarians of Karnezeika, (Argolis Peninsula, Peloponesus (Greece). Unpublished diploma thesis, University of Lausanne.

BAUMGARTNER, P.O. 1984: Comparison of unitary associations and probabilistic ranking and scaling as applied to Mesozoic radiolarians. Computers and Geosciences, 10 (1), 167–183.

BAUMGARTNER, P.O. 1985: Jurassic sedimentary evolution and nappe emplacement in the Argolis peninsula (Peloponnesus, Greece). Denkschriften der Schweizerischen Naturforschenden Gesellschaft; 99, 111p. Birkhäuser, Basel, Boston, Stuttgart.

BAUMGARTNER, P.O., DE WEVER, P. & KOCHER, R. 1980: Correlation of Tethyan Late Jurassic-Early Cretaceous radiolarian events. Cahiers de Micropaléontologie, 2, 23–86.

BAUMGARTNER, P.O., GUEX, J. & DUMITRICA, P. 1995: Concepts of the systematic and biostratigraphic work. In: BAUMGARTNER, P.O et al. (Eds.): Middle Jurassic to Lower Cretaceous Radiolaria of Tethys: Occurrences, Systematics, Biochronology, 11–15. Mémoires de Géologie (Lausanne), 23. Institut de Géologie et de Paléontologie, Université de Lausanne.

CAMPBELL, A.S. & CLARK, B.L. 1944: Radiolaria from Upper Cretaceous of Middle California. Geological Society of America Special Paper, 57, 1–61.

CARON, M. 1985: Cretaceous planktic foraminifera. In: BOLLI, H.M., SAUDERS, J.B. & PERCH-NIELSEN, K. (Eds.): Plankton stratigraphy, 17–86. Cambridge University Press, Cambridge/ New York.

DE WEVER, P. & ORIGLIA-DEVOS, I. 1982: Datations nouvelles par les Radiolaires de la série des Radiolarites s. l. du Pinde-Olonos, (Grèce). C. R. Acad. Sc. Paris, 294, 399–404.

DE WEVER, P. & THIÉBAULT, F. 1981: Les Radiolaires d'âge jurassique supérieur à crétacé supérieur dans les radiolarites du Pinde-Olonos (Presqu'île de Koroni; Péloponnèse méridional, Grèce). Géobios, 14(5), 577–609.

DE WEVER, P., GEYSSANT, J.R., AZÉMA, J., DEVOS, I., DUÉE, G., MANIVIT, H. & VRIELYNCK, B. 1986: La coupe de Santa Anna (zone de Sciacca, Sicile): une synthèse biostratigraphique des apports des macro-, micro- et nannofosiles du Jurassique supérieur et Crétacé inférieur. Revue de Micropaléontologie, 29 (3), 141–186.

DE WEVER, P., DUMITRICA, P., CAULET, J.P., NIGRINI, C. & CARIDROIT, M. 2001: Radiolarians in the sedimentary record. 533 p, Gordon & Breach Science Publ..

DISERENS, M.-O., BAUMGARTNER, P.O. & DUMITRICA, P. 2003: Age determination of late Cretaceous radiolarites in orogenic environments: an example from accreted teeranes of southern Costa Rica. Interrad X 2003, Abstracts & Programme, University of Lausanne, Switzerland, 49–50.

DUMITRICA, P. 1975: Cenomanian Radiolaria at Podul Dimbovitei, Micropaleontological guide to the Mesozoic and Tertiary of the Romanian Carpathians. In: 14th European Micropaleontological Colloquium, Romania, 87–89. Institute of Geology and Geophysics, Bucarest.

FOREMAN, H.P. 1973: Radiolaria from DSDP Leg 20. In: HEEZEN, B.C. et al. (Eds.): Initial Reports of the Deep Sea Drilling Project, 20, 249–305. U.S. Government Printing Office, Washington, D.C.

FOREMAN, H.P. 1975: Radiolaria from the North Pacific, Deep Sea Drilling Project, Leg 32. In: LARSON, R.L. et al. (Eds.): Initial Reports of the Deep Sea Drilling Project, 32 (Hakodate, Japan to Honolulu, Hawaii, Aug.-Oct., 1973), 579–676. U.S. Government Printing Office, Washington, D.C.

FOREMAN, H.P. 1977: Mesozoic Radiolaria from the Atlantic Basin and its Borderlands. In: F.M. SWAIN (Ed.): Stratigraphic Micropaleontology of Atlantic Basin and Borderlands, 305–313. Elsevier Scientific Publishing Company, Amsterdam, Netherlands.

GIRAULT, F.E. 2005: Sédimentologie et tectonostratigraphie de Deprano et sa région (Argolide – Grèce). Unpublished diploma thesis, University of Lausanne.

GLASSEY, T. 2005: Etude sédimentologique et tectonique d'un secteur de la région de Midhéa, en Argolide septentrionale (Grèce). Unpublished diploma thesis, University of Lausanne.

GUEX, J. 1977: Une nouvelle méthode d'analyse biochronologique. Bulletin de la Société Vaudoise des Sciences Naturelles, 73, 170–216

GUEX, J. 1979: Terminologie et méthodes de la biostratigraphie moderne: commentaires critiques et propositions. Bulletin de la Société Vaudoise des Sciences Naturelles, 74, 170–216.

GUEX, J. 1980: Calcul, caractérisation et identification des associations unitaires en biochronologie. Bulletin de Société Vaudoise des Sciences Naturelles, 75, 111–126.

GUEX, J. 1981: Associations virtuelles et discontinuités dans la distribution des espèces fossiles: un exemple intéressant. Bulletin de la Société Vaudoise des Sciences Naturelles, 75, 179–197.

GUEX, J. 1984: Estimation numériques de la qualité de l'enregistrement fossile des espèces. Bulletin de la Société Vaudoise des Sciences Naturelles, 77, 79–89.

GUEX, J. 1987: Corrélations biochronologiques et associations unitaires. 244p., Presses Polytechniques Romandes, Lausanne.

GUEX, J. 1988: Utilisation des horizons maximaux résiduels en biochronologie. Bulletin de la Société Vaudoise des Sciences Naturelles, 79 (2), 135–142.

GUEX, J. 1991: Biochronological Correlations. Springer-Verlag, Berlin/Heidelberg/New York. 250 p.
GUEX, J. & DAVAUD, E. 1982: Recherche automatique des associations unitaires: option nouvelle et exemple d'application. Bulletin de la Société Vaudoise des Sciences Naturelles, 78 (2), 195–205.
GUEX, J. & DAVAUD, E. 1984: Unitary Associations Method: use of graph theory and computer algorithm. Computers & Geosciences, 10 (1), 69–96.
JACKETT, S.-J., DISERENS, M.-O & BAUMGARTNER, P.O. 2002: Late Cretaceous To Early Cenozoic Radiolarian Biochronology Of Low-Latitude Orogenic Regions. Problems And Solutions. Abstracts and Proceedings of the Norwegian Geological Society, 1, 63.
NEUMANN, P. 2003: Ablagerungsprozesse, Event- und Biostratigraphie kreidezeitlicher Tiefwassersediemente der Tethys in der Olonos-Pindos-Zone Westgriechenlands. Müncher Geowiss. Abh., 40, 1–156.
O'DOGHERTY, L. 1994: Biochronology and Paleontology of Mid-Cretaceous Radiolarians from Northern Apennines (Italy) and Betic Cordillera (Spain). Mémoires de Géologie (Lausanne), 21. 415p. Institut de Géologie et de Paléontologie, Université de Lausanne.
PESSAGNO, E.A. 1971: Jurassic and Cretaceous Hagiastridae from the Blake-Bahama Basin (Site 5A, JOIDES Leg 1) and the Great Valley Sequence, California Coast Ranges. Bulletins of American Paleontology, 60(264), 5–83.
PESSAGNO, E.A. 1976: Radiolarian zonation and stratigraphy of the Upper Cretaceous portion of the Great Valley Sequence, California Coast Ranges. Micropaleontology spec. Publ., 2, 1–95.
RIEDEL, W.R. & SANFILIPPO, A. 1974: Radiolaria from the southern Indian Ocean, DSDP Leg 26. In: DAVIES, T.A., et al. (Eds.): Initial Reports of the Deep Sea Drilling Project, 26 (Durban, South Africa to Fremantle, Australia; Sept.-Oct. 1972), 771–781. U.S. Government Printing Office, Washington, D.C.
SANFILIPPO, A. & RIEDEL, W.R. 1985: Cretaceous Radiolaria. In: BOLLI, H.M., SAUDERS, J.B. & PERCH-NIELSEN, K. (Eds.): Plankton stratigraphy, 631–712. Cambridge University Press, Cambridge/ New York.
SAVARY, J. & GUEX, J. 1991: BioGraph: un nouveau programme de construction des corrélations biochronologiques basées sur les associations unitaires. Bulletin de la Société Vaudoise des Sciences Naturelles, 80 (3), 317–340.
SCHAAF, A. 1985: Un nouveau canevas biochronologique du Crétacé inférieur et moyen: les biozones à radiolaires. Sci. géol. (Strasbourg) Bull., 38(3), 227–269.
SQUINABOL, S. 1903: Radiolarie fossile di Teolo (Euganei). Atti e memorie del'Academia di scienze, lettere ed arti. Padova, new series, 19, 127–130.
SQUINABOL, S. 1904: Radiolarie cretacee degli Euganei. Atti e memorie del'Academia di scienze, lettere ed arti. Padova, new series, 20, 171–244.
SQUINABOL, S. 1914: Contributo alla conoscenza dei Radiolarii fossili del Veneto. Appendice – Di un genera di Radiolari caratteristico del Secondario (Contribution to the knowledge of fossil Radiolaria. Appendix – On a genus of Radiolaria characteristic of the Mesozoic). Memorie dell'Istituto geologico della R. Universita di Padova, 2, 249–306.
TAKETANI, Y. 1982: Cretaceous radiolarian biostratigraphy of the Urakawa and Obira areas, Hokkaido. Sci. Rep. Tohoku Univ. Series 2: Geology = Tohoku Daigaku Rika Hokoku. Dai 2: Shu Chishitsugaku, 52(1–2), 1–76.
THIÉBAULT, F., DE WEVER, P., FLEURY, J.J. & BASSOULET, J.P. 1981: Précisions sur la série stratigraphique de la nappe du Pinde-Olonos de la presqu'île de Koroni (Péloponnèse méridional – Grèce): l'âge des Radiolarites – (Dogger – Crétacé supérieur). Ann. Soc. Géol. Nord, 100, 91–105.
THUROW, J. 1988: Cretaceous radiolarians of the North Atlantic Ocean; ODP Leg 103 (sites 638, 640, and 641) and DSDP legs 93 (Site 603) and 47B (Site 398). In: BOILLOT, G., WINTERER, E.L., (Eds.): Proceedings of the Ocean Drilling Program, Scientific results (Galicia margin; covering Leg 103 of the cruises of the drilling vessel JOIDES Resolution, Ponta Delgada, Azores, to Bremerhaven, Germany, 25 April 1985–19 June 1985), 103, 379–418. Texas A. & M. University, Ocean Drilling Program, College Station, TX, United States.
VERNEZ, G. 1990: Etude géologique et minéralogique de la Vallée de Paliominos entre Karnezeika et Stavropodhi. Unpublished diploma thesis, University of Lausanne.
VISHNEVSKAYA, V. S. 2001: Jurassic to Cretaceous radiolarian biostratigraphy of Russia. GEOS, Moscow, 376 p.
VRIELYNCK, B. 1981: Evolution paléogéographique et structurale de la presqu'île d'Argolide (Grèce). Revue de géologie dynamique et de géographie physique, 23(4), 277–288.

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Plate 1

SEM-illustrations of Upper Cretaceous radiolarians from Karnezeika, Argolis Peninsula (Greece)

Figures 1–2	***Acaeniotyle rebellis*** O'DOGHERTY 1994 Al68_06 (Figs. 1 and 2)
Figure 3	***Acaeniotyle* sp. *A*** Al74_300
Figure 4	***Acaeniotyle* sp. *B*** Al70_090
Figures 5–6	***Archaeocenosphaera* (?) *mellifera*** O'DOGHERTY 1994 Al72_190 (Figs. 5 and 6)
Figures 7–8	***Archaeocenosphaera* (?) sp.** Al73_320 (Figs. 7 and 8)
Figures 9–10	***Triactoma cellulosa*** FOREMAN 1973 Al74_300 (Figs. 9 and 10)
Figures 11–12	***Triactoma hexeris*** O'DOGHERTY 1994 Al73_320 (Figs. 11 and 12)
Figure 13	***Triactoma* sp. aff. *T. hexeris*** O'DOGHERTY 1994 Al72_190
Figure 14	***Pseudoacanthosphaera galeata*** O'DOGHERTY 1994 Al73_320
Figure 15	***Pseudoacanthosphaera superba*** (SQUINABOL 1904) Al74_300
Figure 16	***Pseudoacanthosphaera* sp. aff. *P. spinosissima*** (SQUINABOL 1904) Al73_320
Figure 17	***Pseudoacanthosphaera* (?) sp.** Al73_320
Figure 18	***Tetracanthellipsis euganeus*** SQUINABOL 1903 Al73_320
Figures 19–20	***Praeconocaryomma universa*** PESSAGNO 1976 Al72_190 (Figs. 19 and 20)
Figures 21–22	***Praeconocaryomma californiaensis*** PESSAGNO 1976 Al72_190 (Figs. 21 and 22)
Figures 23–24	***Praeconocaryomma lipmanae*** PESSAGNO 1976 Al74_300 (Figs. 23 and 24)
Figures 25–26	***Praeconocaryomma* sp.** Al74_300 (Fig.25 and 26)
Figures 27–28	***Crucella messinae*** PESSAGNO 1971 Al68_060 (Fig. 27), Al72_190 (Fig. 28)
Figures 29–30	***Crucella cachensis*** PESSAGNO 1971 Al74_300 (Fig. 29), Al73_320 (Fig. 30)
Figure 31	***Halesium triacanthum*** (SQUINABOL 1903) **sensu** O'DOGHERTY 1994 Al68_060
Figures 32–33	***Halesium* sp.** Al68_060 (Fig. 32), Al73_320 (Fig. 33)
Figures 34	***Pessagnobrachia* sp.** Al74_300

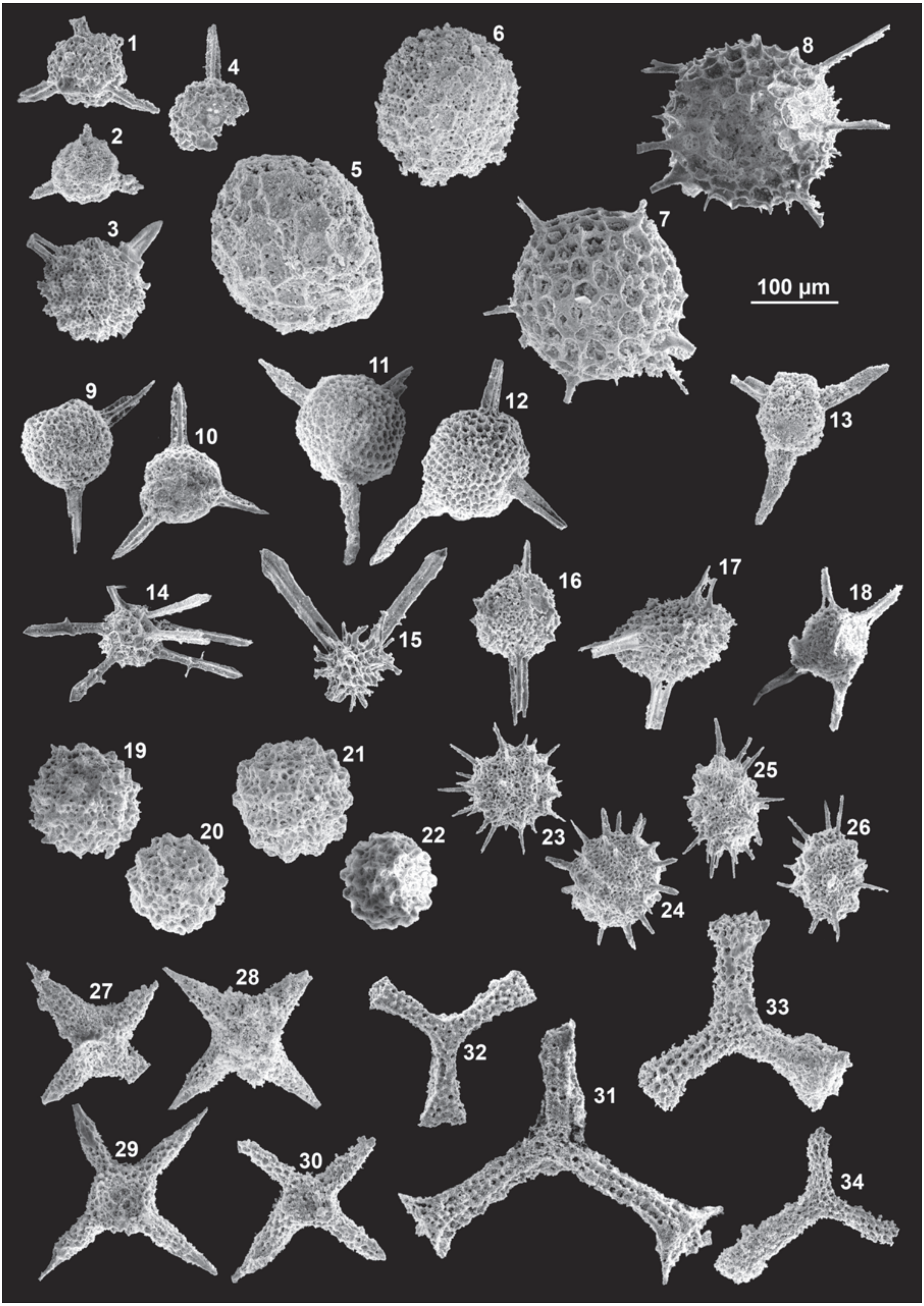
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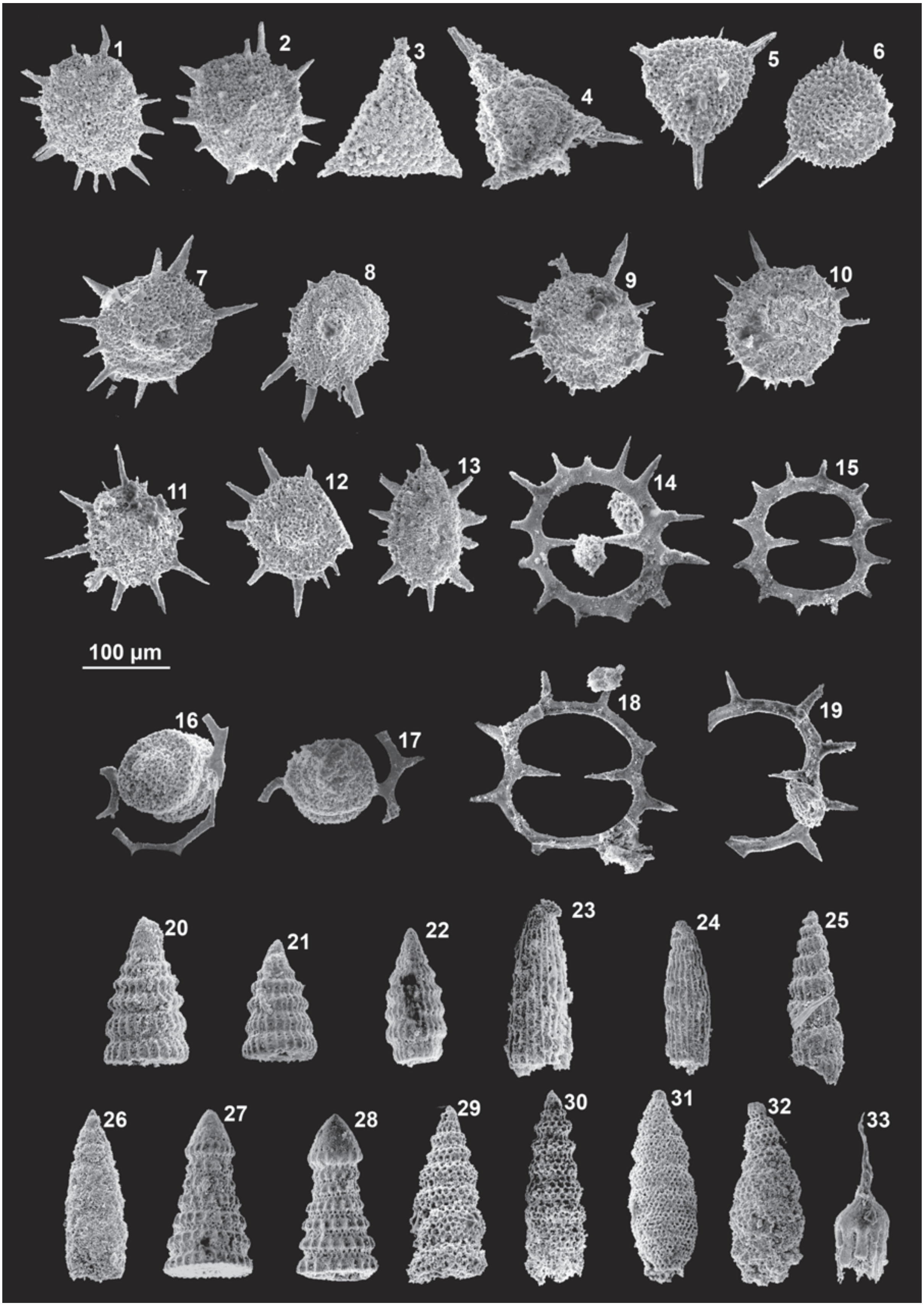
Plate 2

SEM-illustrations of Upper Cretaceous radiolarians from Karnezeika, Argolis Peninsula (Greece)

Figures 1–2 ***Dactyliodiscus* sp.** Al72_190 (Figs. 1 and 2)
Figures 3–4 ***Pseudoaulophacus sculptus*** (Squinabol 1904) **sensu** O'Dogherty 1994 Al72_190 (Figs. 3 and 4)
Figures 5–6 ***Pseudoaulophacus putahensis*** Pessagno 1972 Al73_320 (Figs. 5 and 6)
Figures 7–8 ***Patellula helios*** (Squinabol 1903) **sensu** O'Dogherty 1994 Al74_300 (Figs. 7 and 8)
Figures 9–10 ***Patellula ecliptica*** O'Dogherty 1994 Al73_320 (Figs. 9 and 10)
Figures 11–12 ***Patellula heroica*** O'Dogherty 1994 Al74_300 (Figs. 11 and 12)
Figure 13 ***Patellula* sp.** Al72_190
Figures 14–15 ***Acanthocircus venetus*** (Squinabol 1914) **sensu** O'Dogherty 1994 Al72_190 (Fig. 14), Al73_320 (Fig. 15)
Figures 16–17 ***Acanthocircus tympanum*** O'Dogherty 1994 Al74_300 (Fig. 16), Al73_320 (Fig. 17)
Figures 18–19 ***Acanthocircus hueyi*** (Pessagno 1976) **sensu** O'Dogherty 1994 Al74_300 (Fig. 18), Al73_320 (Fig. 19)
Figures 20–21 ***Dictyomitra formosa*** Squinabol 1904 Al72_190 (Fig. 20), Al73_320 (Fig. 21)
Figure 22 ***Dictyomitra* sp. cf. *D. formosa*** Squinabol 1904 Al72_190
Figures 23–24 ***Dictyomitra montisserei*** (Squinabol 1903) **sensu** O'Dogherty 1994 Al68_060 (Fig. 23), Al72_190 (Fig. 24)
Figure 25 ***Dictyomitra urakawensis*** Taketani 1982 Al72_190
Figure 26 ***Torculum coronatum*** (Squinabol 1904) Al72_190
Figures 27–28 ***Pseudodictyomitra pseudomacrocephala*** (Squinabol 1903) Al73_320 (Figs. 27 and 28)
Figures 29–30 ***Stichomitra communis*** Squinabol 1903 Al73_320 (Figs. 29 and 30)
Figures 31–32 ***Stichomitra stocki*** (Campbell & Clark 1944) **sensu** O'Dogherty 1994 Al68_060 (Fig. 31), Al73_320 (Fig. 32)
Figure 33 ***Afens liriodes*** Riedel & Sanfilippo 1974 Al74_300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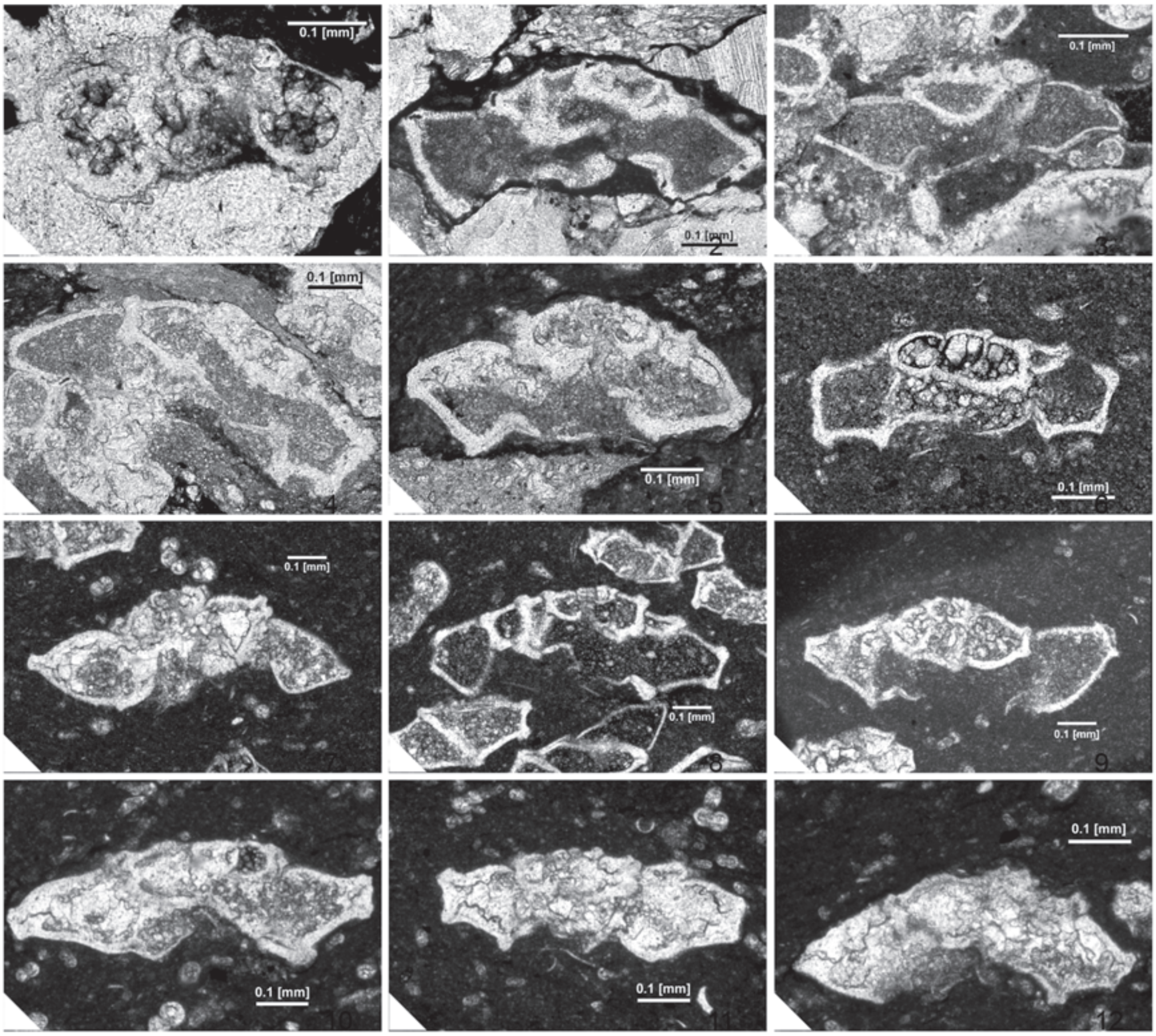

Plate 3

Optical microscope illustrations of Upper Cretaceous planktonic foraminfers from Karnezeika, Argolis Peninsula (Greece)

Figure 1 ***Helvetoglobotruncana helvetica*** (Bolli 1945) CKAR2
Figure 2 ***Marginotruncana marianosi*** (Douglas 1969) CKAR7
Figure 3 ***Marginotruncana schneegansi*** Sigal 1952 CKAR13
Figure 4 ***Marginotruncana coronata*** (Bolli 1945) CKAR13
Figure 5 ***Marginotruncana sigali*** (Reichel 1950) CKAR13
Figure 6 ***Marginotruncana pseudolinneiana*** Pessagno 1967 CKAR14
Figure 7 ***Marginotruncana schneegansi*** Sigal 1952 CKAR14
Figure 8 ***Marginotruncana sinuosa*** Porthault 1970 CKAR14
Figure 9 ***Dicarinella primitiva*** (Dalbiez 1955) CKAR14
Figure 10 ***Marginotruncana pseudolinneiana*** Pessagno 1967 Al76_1350
Figure 11 ***Marginotruncana pseudolinneiana*** Pessagno 1967 Al76_1350
Figure 12 ***Marginotruncana sigali*** (Reichel 1950) Al76_1350