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# CALLOVIAN RADIOLARIANS FROM THE LOWERMOST CALCARE SELCIFERO DI FONZASO AT PONTE SERRA (TRENTO PLATEAU, SOUTHERN ALPS, ITALY)

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*Abstract*. This paper deals with radiolarian biostratigraphy of the Calcare Selcifero di Fonzaso at the type-section of Ponte Serra (Southern Alps, Italy). The Ponte Serra section is located on the easternmost part of the Trento Plateau and represents an early-drowned sector that marks the transition to the Belluno Trough.

The Calcare Selcifero di Fonzaso consists of pelagic siliceous limestones of Middle to Late Jurassic age for a total thickness of about 70 m. A 24 metres thick package of resedimented limestone is interstratified. This research is focused on the lowermost part, 9 metres thick, that mainly consists of red and green siliceous micrites with interbedded clay beds and abundant chert lenses and nodules. The studied interval (belonging to Rosso Ammonitico Medio: RAM) lies between the lower member of the Rosso Ammonitico Veronese Formation below and the resedimented limestone above.

The recovered radiolarian assemblages indicate a Callovian age for the base of the Calcare Selcifero di Fonzaso. Correlation with other sections of the Trento Plateau reveals a significant diachronism in siliceous sedimentation that we relate to highly irregular sea-bottom paleotopography. The base of siliceous deposits can be even older (Bathonian) on the eastern margin of the Trento Plateau, but younger (Oxfordian) on its western margin. The Callovian succession of the Belluno Trough consists of radiolarian-bearing micrite alternating with oolitic limestone. The oolitic sands that filled in the Belluno Trough during the Middle Jurassic prograded over the eastern margin of the Trento Plateau in the early Oxfordian.

*Riassunto*. Questo articolo riguarda la biostratigrafia a radiolari del Calcare Selcifero di Fonzaso nella sezione tipo di Ponte Serra (Alpi Meridionali, Italia). La sezione di Ponte Serra è ubicata nel settore più orientale del Plateau di Trento, nella zona di transizione con il Solco Bellunese.

Il Calcare Selcifero di Fonzaso è costituito da circa 70 m di calcari pelagici silicei, riferibili al Giurassico medio-superiore, in cui sono intercalati 24 m di calcari risedimentati. Lo studio è focalizzato sulla porzione basale della sezione: i primi 9 m consistono principalmente di micriti silicee rosse e verdi con intercalati livelli di argilla e abbondanti lenti e noduli di selce. La parte di sezione analizzata (appartenente al Rosso Ammonitico Medio: RAM) è compresa tra il Rosso Ammonitico Inferiore sotto e i calcari risedimentati sopra.

Le associazioni a radiolari studiate indicano un'età calloviana per la base del Calcare Selcifero di Fonzaso. La correlazione con altre sezioni stratigrafiche del Plateau di Trento e del Solco Bellunese rivela un importante diacronismo nella sedimentazione silicea, probabilmente dovuto alla paleotopografia del fondale marino. La base dei sedimenti silicei può essere ancor più antica (Batoniano) sul margine orientale del Plateau di Trento, ma decisamente più recente (Oxfordiano) sul margine occidentale. La successione calloviana del Solco Bellunese consiste di calcari micritici ricchi di radiolari alternati a calcari oolitici. Le sabbie oolitiche che riempiono il Solco Bellunese durante il Giurassico medio progradano sul margine orientale del Plateau di Trento nell'Oxfordiano inferiore.

## Introduction

Very few authors have studied the Jurassic radiolarian assemblages of the Southern Alps. The first papers appeared in the '80s only and concerned some sections belonging to the Lombardian Basin where radiolarites are best developed (Baumgartner et al. 1980; Kocher 1981; Baumgartner 1984) and are still a subject of intense radiolarian research (Chiari et al. 2007). Other sections have been studied afterwards in the Trento Plateau (Baumgartner et al. 1995a; Kiessling 1996; Beccaro et al. 2002; Beccaro 2006a) and in the Belluno Trough (Vajont Dam and Val Ardo sections in Baumgartner et al. 1995a).

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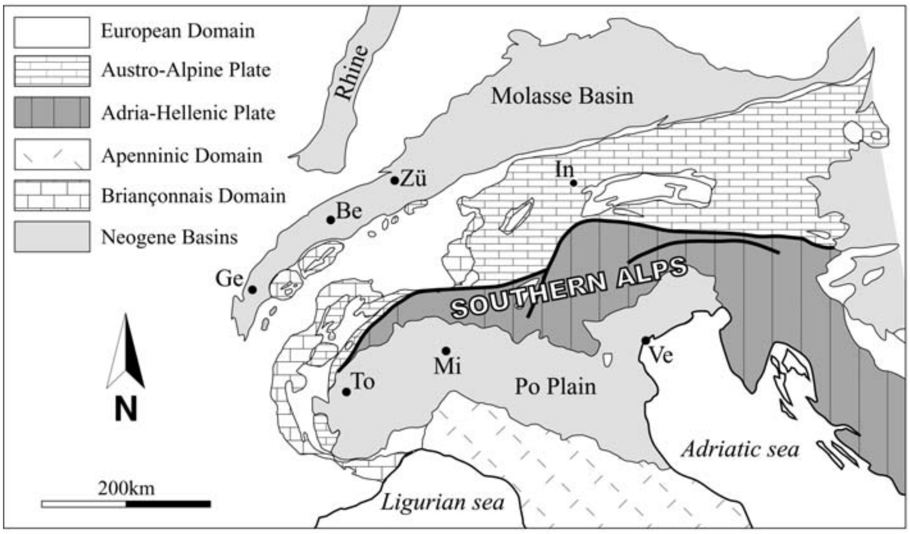


Fig. 1 - Main tectonic domains of the Alps, Apennines and Northern Dinarides (Stampfli et al. 1998).

The Ponte Serra section, located close to the village of Fonzaso, bears a particular importance being the type section of the Calcare Selcifero di Fonzaso Fm. (Bosellini & Dal Cin 1968). The Calcare Selcifero di Fonzaso (CSF) is about 70 m thick and represents a great part of the Middle-Upper Jurassic pelagic succession of the eastern margin of the Trento Plateau. The CSF occurs between two ammonite-bearing nodular limestones represented by the lower and the upper members of the Rosso Ammonitico Veronese Fm. (Martire et al. 2006; Martire 2007). Due to the absence of ammonites in the CSF Formation, its age is currently based on the ages of the bracketing Rosso Ammonitico Veronese lower and the upper members.

Numerous and moderately preserved radiolarians were recovered from the lower part of the CSF at the Ponte Serra section. The radiolarian assemblages are well diversified in most samples and mainly consist of long-ranging taxa similar to other Tethyan assemblages. The biostratigraphic units (Unitary Association Zones) used in the present biostratigraphical analysis were proposed by Baumgartner et al. (UAZ95; 1995b) and Beccaro (UAZ-SA; 2006a).

The CSF at Ponte Serra has been the object of some contributions concerning radiolarian data for the middle-upper part of the CSF (Baumgartner et al. 1995a; Kiessling 1996) and calcareous nannofossils (Cobianchi 2002). No radiolarian data are so far available for the lower part of CSF. The aim of this paper is: a) to describe the radiolarian associations; b) to establish a direct biochronostratigraphy of the lower part of the CSF at Ponte Serra; c) to compare such assemblages with nearby sections of the same formation already described (Baumgartner 1984; Baumgartner et al. 1995a; Diserens & Poget 2000; Beccaro et al. 2002; Beccaro 2006a).

## Geological setting of the Southern Alps

The Southern Alps are an important structural unit of the Alpine chain; they are composed of a Variscan basement and its Mesozoic-Cenozoic sedimentary cover (Fig. 1). The Southern Alps represent the southern continental margin of the Mesozoic western Tethys, which acquired an horst and graben structure during the Late Triassic and Early Jurassic rifting phases associated with the opening of the North Atlantic (e.g., Winterer & Bosellini 1981; Bertotti et al. 1993). The succession of highstanding blocks and troughs strictly controlled the sedimentary history of the different blocks. While the western sector of the margin (Piedmont and Lombardy) drowned during the early Liassic, two structural and paleogeographical highs (Trento Plateau and Friuli Platform separated by the Belluno Trough) survived in the eastern part of the margin (Fig. 2). The Trento Plateau remained a Bahamian-type platform from the Triassic to the Aalenian, and then drowned and a condensed sequence of ammonite-bearing, red nodular limestones (Rosso Ammonitico Veronese) was deposited (Sturani 1964; Clari 1975; Clari & Marelli 1983; Barbujani et al. 1986). During the late Bajocian and Bathonian time a deep-sea fan system originating from the productive Friuli Platform started to fill the Belluno Trough with oolitic sands (Vajont Fm.) (Bosellini et al. 1981). It displays a westward-thinning wedge geometry and locally onlaps the eastern margin of the Trento Plateau. At the end of the Tithonian, shallow water conditions persisted only on the Friuli Platform that faced a relatively deep-sea environment ranging from the Belluno Trough to the Lombardian Basin. White calcareous oozes blanketed the still existing, albeit reduced, topographical irregularities with a noteworthy facies homogeneity (Maiolica Fm.) (Winterer & Bosellini 1981).

In the context of the Trento Plateau, the studied area of the Feltrine Alps sector is characterized by an

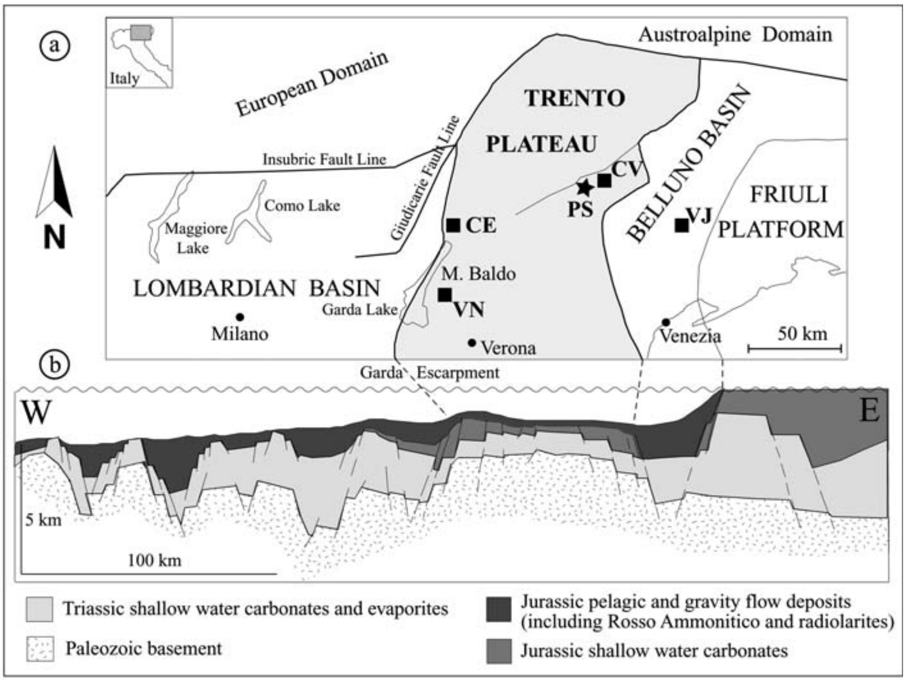


Fig. 2 - a: Present day distribution of the Mesozoic paleogeographical domains in the Southern Alps and geographical location of the stratigraphical sections: squares refer to previously studied sections (CE: Ceniga, CV: Coston delle Vette, VJ: Vajont Dam, VN: Cava Vianini) and the star refers to Ponte Serra (PS); b: schematic paleogeographical cross-section at the end of the Jurassic (modified after Bosellini et al. 1981).

earlier drowning (mid Early Jurassic) and a thicker sequence Middle to Upper Jurassic compared to the central and western part of the plateau (Dal Piaz 1907; Bosellini & Dal Cin 1968; Della Bruna & Martire 1985). Upper Bathonian-lower Kimmeridgian siliceous limestones about 100 m thick are, in fact, sandwiched between the lower and the upper member of the Rosso Ammonitico Veronese. These siliceous limestones were defined by Bosellini & Dal Cin (1968) as a distinct formation (Calcare Selcifero di Fonzaso - CSF) in the Feltre region as well as in the Belluno region where it overlies the Vajont Fm. The CSF is composed of radiolarian-rich siliceous wackestone and packstones interlayered with ooidal-peloidal beds. This siliceous unit can be correlated with a much thinner non-nodular siliceous interval that is locally found in the classical Rosso Ammonitico sequence in the western Venetian Alps of the same stratigraphical position (RAM: middle member of the Rosso Ammonitico Veronese) (Martire et al. 2006).

## Geographical location and lithostratigraphy of the Ponte Serra section

The studied section is located at Ponte Serra, about 3.5 km NW of the village of Fonzaso, a few kilometres east of Feltre (Belluno, Northern Italy) (Fig. 2). The section crops out at the confluence of the Senaiga and Cismon rivers, on the right side of the Cismon (46° 11′ 34″ N, 11° 45′ 53″ E, WGS84).

At Ponte Serra section the following lithostratigraphical units crop out:

1) *Oolitic grainstones* that were doubtfully referred to the Toarcian-Aalenian Oolite di S. Vigilio by Bosellini & Dal Cin (1968). Actually, they may be compared to the "calcari bianchi compatti oolitici" described on the Feltrine Alps by Dal Piaz (1907) who dated the top to the Domerian on the basis of the ammonite *Amaltheus margaritatus*. More recently, Masetti & Trevisani (1992) restudied these limestones on the Feltrine Alps and concluded that they are the uppermost unit of the Calcari Grigi Fm. in this area.

2) *Crinoidal limestones* that are comparable to the Membro Calcarenitico of Calcari Oolitici of Della Bruna & Martire (1985) that in the Feltrine Alps overlies the Domerian Calcari Oolitici and underlies the Rosso Ammonitico Inferiore (locally containing Aalenian ammonites at the very base). They may be paralleled to the Encrinite di Fanes defined by Masetti & Bottoni (1978) in the Dolomites.

3) *Rosso Ammonitico Inferiore (RAI)*, consisting of slightly nodular red limestones containing mineralised intraclasts and skeletal grains (Fig. 3a). No biostratigraphical data exist concerning this unit at Ponte Serra section except for nannofossils, that indicate a late Bathonian age for its top (Cobianchi 2002). In the Feltrine Alps the base ranges from early Aalenian to early Bajocian depending on the sections (Della Bruna & Martire 1985).

4) *Calcare Selcifero di Fonzaso (CSF)* that may be subdivided into three members: Listato member (LM), Middle member (MM), Scisti ad Aptici member (SAM) (Della Bruna & Martire 1985) (Fig. 3a). The lowermost 3 meters of the LM are represented by thin bedded whitish mudstones which alternate with peloidal grainstones. This bed package has been attributed to the Vajont Fm. by Cobianchi (2002), but is herein regarded as a part of the Calcare Selcifero di Fonzaso. Siliceous

limestones, interlayered with thin bedded ooidal-peloidal grainstones, follow for 6 meters. The Middle member is about 24 m thick and it is characterised by the occurrence of thicker and coarser white-grey peloidal and oolitic grainstones with marly interbeds; in the uppermost part of the MM the lithology changes to peloidal mudstones rich in brown cherts. Concentric ooids and pellets are the main components of the grainstones. The bioclastic content is very diverse and shows fragments of brachiopods, bryozoans, echinoderms, calcareous sponges and some foraminifera (miliolids and agglutinated forms). The Scisti ad Aptici member is 37 m thick and mainly consists of well-bedded white, grey and greenish mudstones and wackestones rich in cherts, although thin beds of oolitic grainstones are still present in the lowermost few meters. Chert is present both in nodules and in centimetre-thick bands, and marly interbeds occur. The bioclastic content shows abundant radiolaria, some foraminifera and a few echinoderm fragments. The lower part of CSF is the object of this paper and its more detailed description will be exposed below.

Cobianchi (2002) attributed a Callovian age to the lower part of the CSF on the basis of nannofossils, and a Kimmeridgian age at the top of the same sediments by the presence of *Saccocoma*. Radiolarians from the middle-upper part of the CSF at Ponte Serra were studied by Baumgartner et al. (1995a), who stated an Oxfordian-Tithonian age, and by Kiessling (1996), who established an Oxfordian-Kimmeridgian age.

5) *Rosso Ammonitico Superiore (RAS)* is represented by the typical red nodular limestones with scattered reddish chert nodules. Nannofossils indicate a late Kimmeridgian age for the base of this unit and an early Tithonian age for the middle part (Cobianchi 2002).

6) *Maiolica* (formerly named Biancone: Petti & Falorni 2007) consists of a monotonous succession of thin to medium bedded white mudstones and wackestones with wavy bedding planes; black chert nodules and bands are quite abundant. Several plurimetric slumped intervals occur. Maiolica Fm. ranges in age from upper Tithonian to lower Aptian.

### Description of the sampled section

For this research, a detailed description and sampling has been carried out from the top of the RAI to the first thick ooidal-peloidal grainstone bed for a total of 8.85 metres (Fig. 3b). Different lithozones may be distinguished on the ground of lithology and colour.

*Lithozone A* (280 cm) – thin to medium bedded alternances of whitish mudstones to wackestones with calcitized radiolarian moulds and fine-grained peloidal-bioclastic grainstones with faint parallel laminae. At the base, slight folding of beds points to slumping processes.

*Lithozone B* (45 cm) – cream-coloured thin-bedded cherty limestones mainly consisting of radiolarian wackestones. Cherts are in thin and elongated nodules and show a brownish colour and an internal lamination. They mainly occur in the upper half of the beds. At the top of the lithozone the colour fades to reddish.

*Lithozone C* (565 cm) – thin to medium bedded red cherty limestones consisting of radiolarian wackestones. Small nodules mainly represent red cherts but continuous thin chert layers also occur.

*Lithozone D* (40 cm) – lithologically similar to the underlying ones, these cherty limestones show alternating greenish and red colours.

*Lithozone E* (55 cm) – it consists of two whitish beds: the lower one being a graded ooidal-peloidal grainstone, and the upper one a partly silicified radiolarian-bearing wackestone. The section continues upwards with alternances of similar medium to thick beds.

### Methods

The siliceous limestone layers were sampled. The laboratory treatments followed the standard method (Dumitrica 1970; Pessagno & Newport 1972; De Wever 1982; De Wever et al. 2001). The first step is the processing with hydrochloric acid (HCl) whose concentrations varied between 3,6% and 10% for a period of 3-24 hours repeated several times. The second step is the processing with hydrofluoric acid (HF), whose concentrations varied between 1% and 8% for a period ranging from 4 to 96 hours repeated several times. The HF residues usually contained a more abundant and more diversified fauna than the HCl residues. The preservation quality of the radiolarians is expressed by means of the Preservation Index according to Kiessling (1996). This Preservation Index ranges from 1 (excellent) to 8 (extremely poor), and refers to recrystallization and corrosion but not to fragmentation.

The biostratigraphical analysis has been carried out by applying the radiolarian zonations of Baumgartner et al. (1995b) and Beccaro (2006a). The zonation UAZ95 of Baumgartner et al. (1995b) refers to a world correlation for the Middle Jurassic-Early Cretaceous Tethyan Realm and covers the Aalenian to early Aptian time through 22 Unitary Association Zones (UAZ 1 to UAZ 22). The zonation UAZ-SA of Beccaro (2006a) refers to the Unitary Association Zones defined for Sicily and the Southern Alps providing a more local zonation in comparison with Baumgartner et al. (1995b). The zonation of Beccaro (2006a) ranges from the early Bathonian to the late Kimmeridgian through 6 Unitary Association Zones (UAZ-SA A to UAZ-SA F) whose age was provided by calibration with ammonites occurring in the radiolarian-bearing successions, and in the under- and overlying sediments.

### Radiolarian dating of the CSF base at Ponte Serra

Overall 19 samples have been collected from a 6 m thick succession of the CSF at Ponte Serra section: the average radiolarian preservation is moderate and the radiolarian assemblages have been studied in eight samples (indicated in bold in Fig. 3b). The list of species and the Preservation Index for each sample are reported in Tab. 1.

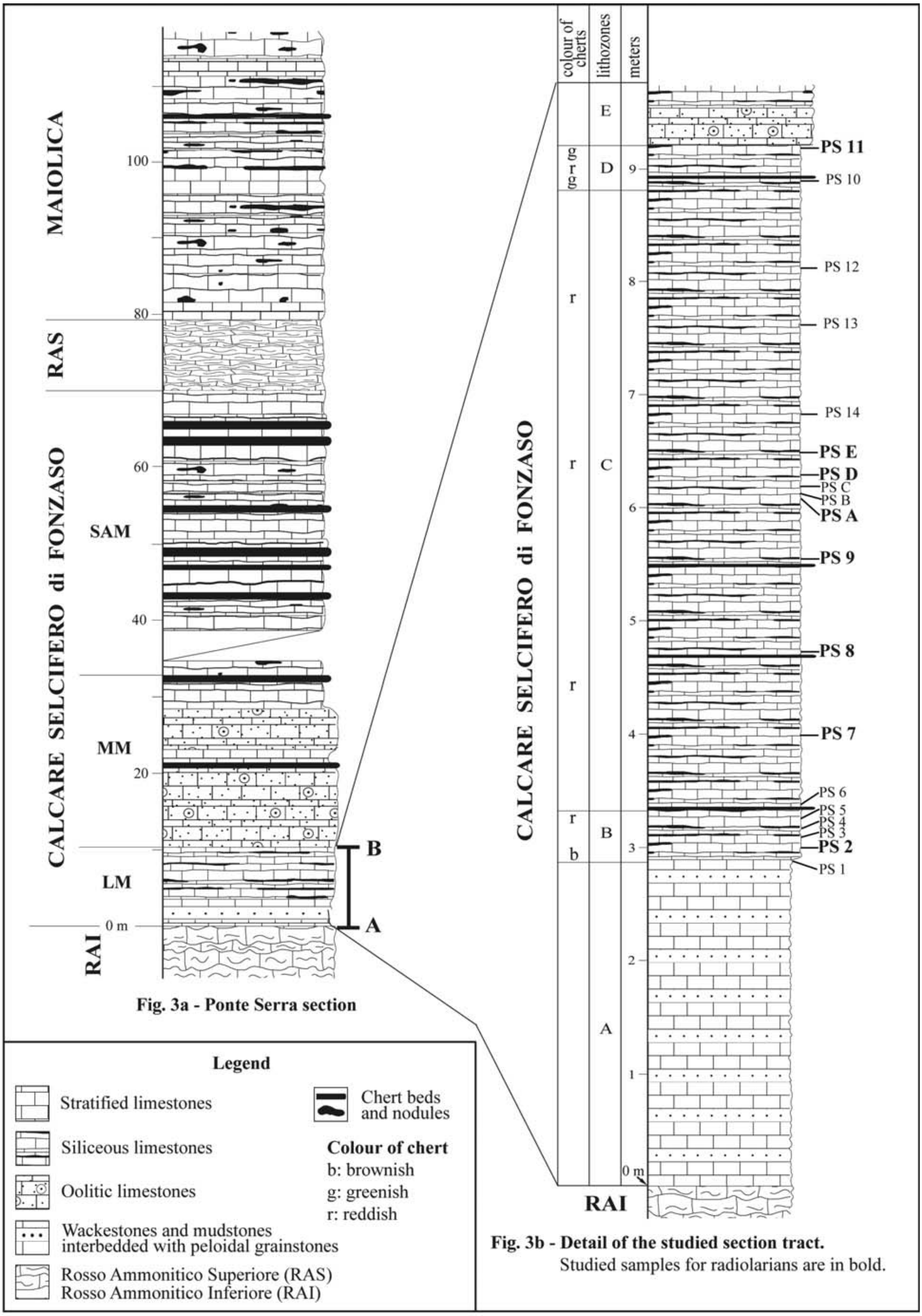


Fig. 3 - Litostratigraphical log of the Ponte Serra section. a: General overview on the whole section; b: detail of the studied tract of the Calcare Selcifero di Fonzaso (A-B segment of Fig. 3a). For description of lithozones A to E see text. LM: Listato member, MM: Middle member; SAM: Scisti ad Aptici member.

| Radiolarian assemblages at Ponte Serra (Trento Plateau, Southern Alps, Italy) | Plate Figure | Code | UAZ 95 | UAZ SA | PS 2 | PS 7 | PS 8 | PS 9 | PS A | PS D | PS E | PS 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Acaeniotylopsis variatus* s.l. (Ozvoldova) | 1 - 1, 2 | 4063 | 1-8 | A-B | ● | | | | ● | | | |
| *Alievium* sp. A sensu Conti & Marcucci 1991 | 2 - 2 | 4004 | 8-9 | | | | | ● | | | | |
| *Angulobracchia* sp. B sensu Baumgartner et al. 1995c | 1 - 3 | 4006 | 7-9 | | | | | ● | | | | |
| *Archaeospongoprunum imlayi* Pessagno | 1 - 4,5,6 | | | | ● | ● | ● | | ● | ● | | ● |
| *Bernoullius dicera* (Baumgartner) | 1 - 7, 8 | 3223 | 3-10 | A-F | | | | | ● | | | ● |
| *Bernoullius rectispinus* s.l. Kito, De Wever, Danelian & Cordey | 1 - 9, 10 | 4010 | 1-9 | | | ● | ● | | | | | |
| *Cinguloturris carpatica* Dumitrica | 2 - 17 | 3193 | 7-11 | D-F | | ● | ● | ● | ● | | | ● |
| *Dicerosaturnalis angustus* (Baumgartner) | 1 - 20 | 3082 | 6-10 | B-E | | | | | | ● | | |
| *Emiluvia hopsoni* Pessagno | 1 - 11 | 3225 | 6-15 | D-F | | ● | | | ● | | | |
| *Emiluvia orea* s.l. Baumgartner | 1 - 12 | 4069 | 4-11 | C-F | | | | ● | | | | ● |
| *Emiluvia premyogii* Baumgartner | 1- 13, 15 | 3210 | 3-10 | A-E | | | ● | ● | ● | | | |
| *Emiluvia salensis* Pessagno | 1 - 14 | 3215 | 4-13 | | | ● | | ● | | | | |
| *Eucyrtidiellum nodosum* Wakita | 2 - 18 | 3014 | 3-10 | B-E | | | ● | | ● | | | ● |
| *Eucyrtidiellum ptyctum* (Riedel & Sanfilippo) | 2 - 19/21 | 3017 | 5-11 | B-F | ● | ● | ● | ● | ● | | | ● |
| *Eucyrtidiellum unumaense* s.l. (Yao) | 2 - 22 | 3052 | 3-8 | A-C | | | | | | | | ● |
| *Gongylothorax* aff. *favosus* Dumitrica sensu Baumgartner et al. 1995c | 2 - 23 | 3279 | 7-8 | | | | | | | | | ● |
| *Guexella nudata* (Kocher) | 2 - 24 | 3061 | 5-8 | A-B | ● | | | | | | | |
| *Haliodictya* (?) *antiqua* s.l. (Rüst) | 1 - 16 | 3243 | 4-11 | | | | | | | ● | | |
| *Haliodictya* (?) *hojnosi* Riedel & Sanfilippo | 1 - 17 | 3254 | 3-10 | | | | ● | | ● | | | ● |
| *Helvetocapsa lemanensis* O'Dogherty, Gorican & Dumitrica | 2 - 25 | | | | | | ● | ● | | | | |
| *Hexasaturnalis minor* (Baumgartner) | 1 - 18 | | | B-F | ● | | | | | | | |
| *Hexasaturnalis nakasekoi* Dumitrica & Dumitrica-Jud | 1 - 19 | | | | ● | | | ● | | | | |
| *Homoeoparonaella elegans* (Pessagno) | 1 - 22 | 3104 | 4-10 | | | | | | ● | | | |
| *Hsuum speciosum* Hull | 3 - 23 | | | | | | ● | | | | | |
| *Lanubus cornutus* (Baumgartner) | 2- 7 | 3166 | 8-10 | D-E | | | | | | | ● | |
| *Levileugeo ordinarius* Yang & Wang | 1 - 21 | | | | | | ● | | | | | |
| *Loopus doliolum martae* Beccaro | 3 - 17 | LPMT | | C-E | | | | | | | | ● |
| *Mirifusus guadalupensis* Pessagno | 3 -1 | 3160 | 5-11 | | | | ● | ● | ● | | | |
| *Monotrabs goricanae* Beccaro | 1 - 24 | MTGC | | A-B | | | | ● | ● | | | |
| *Monotrabs plenoides* gr. Baumgartner | 1 - 23 | 3152 | 5-8 | | ● | ● | | | | | | |
| *Obesacapsula morroensis* Pessagno | 3 - 2 | 3266 | 5-21 | | | | | | ● | | | |
| *Orbiculiforma* sp. B sensu Widz 1991 | 1 - 25 | | | | | ● | | | | | | |
| *Palinandromeda podbielensis* (Ozvoldova) | 3 - 3, 4 | 3008 | 5-9 | | ● | ● | ● | | | | | |
| *Pantanellium riedeli* Pessagno | 1 - 30 | 3078 | 7-12 | B-F | | ● | | | | | | |
| *Parahsuum stanleyense* (Pessagno) | 3 - 24 | 2023 | 3-8 | | | | | | ● | | | |
| *Paronaella broennimanni* Pessagno | 1 - 28 | 3137 | 4-10 | | | | | ● | | | | |
| *Paronaella mulleri* Pessagno | 1 - 26 | 3139 | 6-10 | | | ● | ● | ● | ● | | | |
| *Paronaella pygmaea* Baumgartner | 1 - 27 | 3133 | 7-9 | E | | | | ● | | | | |
| *Podobursa andreai* Beccaro | 3 - 5 | PDAN | | B | | | ● | | | | | |
| *Podobursa polyacantha* (Fischli) | 3 - 6, 7 | 3174 | 5-8 | A-D | ● | | | | ● | | | |
| *Podobursa triacantha* (Fischli) gr. | 3 - 8 | PDTC | | B-F | ● | | | | | | ● | |
| *Podobursa vannae* Beccaro | 3 -10 | PDVN | | C-F | | ● | | | | | | |
| *Praewilliriedellum convexum* (Yao) | 2 - 26 | 3055 | 1-11 | B | ● | | | | | | | |
| *Praewilliriedellum robustum* (Matsuoka) | 2 - 27 | 3298 | 5-7 | B | ● | | | | | | | |
| *Pseudodictyomitrella tuscanica* (Chiari, Cortese & Marcucci) | 3 - 18 | | | | | | | ● | ● | | | |
| *Pseudoeucyrtis firma* Hull | 3 -19 | 3176 | 5-10 | A-B | | | ● | ● | ● | | | |
| *Pterotrabs arcuballista* Dumitrica, Baumgartner & Gorican | 2 - 1 | | | | | | | | | ● | | |
| *Ristola procera* (Pessagno) | 3 -16 | 3163 | 5-9 | | | | | | | | ● | |
| *Saitoum elegans* De Wever | 3 - 13 | 3022 | 8-21 | | | | | | ● | ● | | |
| *Saitoum levium* De Wever | 3 -11, 12 | 3024 | 4-9 | D-F | | ● | ● | | | | | ● |
| *Saitoum pagei* Pessagno | 3 -10 | 3020 | 4-11 | | | | ● | | | | | ● |
| *Sethocapsa* sp. cf. *S. trachyostraca* Foreman | 2 - 29,30 | 3063 | 7-22 | | ● | | ● | ● | ● | | | ● |
| *Striatojaponocapsa plicarum* s.l. (Yao) | 3 - 15 | 3051 | 3-8 | B | | | ● | | | | | |
| *Tethysetta dhimenaensis dhimenaensis* (Baumgartner) | 3 - 20 | 4072 | 3-11 | B | | | | ● | | | | |
| *Tethysetta dhimenaensis* ssp. A sensu Baumgartner et al. 1995c | 3- 21,22 | 4071 | 3-8 | A-B | | | ● | ● | ● | | | |
| *Tetradytrima corralitosensis* s.l. (Pessagno) | 2 - 3 | 3273 | 3-10 | | | | ● | | | | | |
| *Tetraditryma pseudoplena* Baumgartner | 2 - 4 | 3123 | 4-11 | | | | | ● | | | | |
| *Tetratrabs zealis* (Ozvoldova) | 2 - 5 | 3121 | 4-13 | B-E | ● | | | | ● | | | |
| *Theocapsomella himedaruma* (Aita) | 2 - 28 | 4038 | | | | | ● | | | | | |
| *Transhsuum brevicostatum* gr. (Ozvoldova) | 3 - 26 | 3181 | 3-11 | A-E | | ● | | ● | ● | ● | | |
| *Transhuum maxwelli* gr. (Pessagno) | 3 - 25 | 3180 | 3-10 | | | ● | ● | | ● | | | |
| *Triactoma blakei* (Pessagno) | 2 - 6 | 3095 | 4-11 | C-F | ● | ● | | | | | | |
| *Triactoma enzoi* Beccaro | 2 - 8 | TCEZ | | B-D | ● | | | | | | | |
| *Triactoma jonesi* (Pessagno) | 2 - 11 | 3096 | 2-13 | | | ● | | | ● | | | |
| *Triactoma mexicana* Pessagno & Yang | 2 - 10 | 3412 | 5-9 | | | | | | | | ● | |
| *Triactoma parablakei* Yang & Wang | 2 - 9 | 3413 | 4-7 | B | | | | | | | | ● |
| *Tritrabs casmaliaensis* (Pessagno) | 2 - 14 | 3117 | 4-10 | B-F | ● | ● | ● | | | | ● | ● |
| *Tritrabs ewingi* s.l. (Pessagno) | 2 - 13 | 3113 | 4-22 | B-F | | | | ● | | | | |
| *Tritrabs rhododactylus* Baumgartner | 2 - 15 | 3118 | 3-13 | E-F | | | | | | | ● | |
| *Williriedellum carpathicum* Dumitrica | 3 - 29 | 4055 | 7-11 | B-E | | | | ● | ● | ● | | ● |
| *Williriedellum* (?) *marcucciae* Cortese | 3 - 30 | 4060 | 4-8 | B-C | | | ● | | | | | |
| *Williriedellum yahazouense* (Aita) | 3 - 28 | | | | | | | ● | | | | |
| *Williriedellum yaoi* (Kozur) | 3 - 27 | | | | ● | | | | | | | |
| *Zhamoidellum ventricosum* Dumitrica | 3 - 31 | 3308 | 8-11 | C-F | | | ● | | | | | |
| **Age of the samples by UAZ-SA** (Beccaro 2006a)<br>A: early-mid Bath. - early Call B: early Call.-early Oxf. C: middle Oxf.<br>D: middle-late Oxf. E: late Oxf.-early Kimm. F: early-late Kimm. | | | | | **B** | | | | | | | |
| **Age of the samples by UAZ95** (Baumgartner et al. 1995b)<br>6: mid Bath. 7: late Bath.-early Call. 8: middle Call.-early Oxf.<br>9: middle-late Oxf. 10: late Oxf.-early Kimm. 11: late Kimm.-early Tith. | | | | | **7** | | | **7- 8** | | | | |
| **Preservation Index** (Kiessling 1996)<br>3: good 4: average 5: fair 6: poor 7: very poor | | | | | 5-6 | 4-5 | 3-4 | 4-5 | 3-4 | 5-6 | 6-7 | 4-5 |

Tab. 1 - Stratigraphical distribution of radiolarian taxa at Ponte Serra section (Trento Plateau, Southern Alps, Italy). The species carrying a numerical code are illustrated in Baumgartner et al. (1995c); the species carrying a lettered code are included in Beccaro (2006a). The ages of the samples are given by the Unitary Association Zones of Baumgartner et al. (UAZ95; 1995b) and by the Unitary Association Zones for Sicily and the Southern Alps (UAZ-SA) of Beccaro (2006a). The Preservation Index ranges from 3 (good) to 7 (very poor) (Kiessling 1996).

Each taxon is marked by a code in Tab. 1: the species carrying a numerical code are illustrated in the catalogue of Baumgartner et al. (1995c) and used for constructing the UAZ95 biozonation (Baumgartner et al. 1995b); the species carrying a lettered code were only used in the UAZ-SA biozonation (Beccaro 2006a); the species without any code were not used in these zonations. *Hexasaturnalis nakasekoi* Dumitrica & Dumitrica-Jud was included under *Hexasaturnalis suboblongus* s.l. (Yao) at the time of the UAZ95 (Baumgartner et al. 1995c). Recently, *H. suboblongus* s.l. (Yao) has been revised and split in three species: *H. suboblongus* (Yao), *H. minor* Baumgartner, and *H. nakasekoi* Dumitrica & Dumitrica-Jud (Dumitrica & Dumitrica-Jud 2005). Dumitrica & Dumitrica-Jud (2005) assert that *H. suboblongus* spans the Bajocian, while *H. minor* and *H. nakasekoi* range within the Bathonian-Kimmeridgian interval. Because of these taxonomical changes, *H. minor* Baumgartner and *H. nakasekoi* Dumitrica & Dumitrica-Jud have no range expressed by UAZ95.

All information about the ranges of the species and the ages of the samples are exposed in Tab. 1, and only some biostratigraphical considerations based on the most characteristic species are discussed below. Tab. 1 also contains the age assignments of individual zones (UAZ95 as well as UAZ-SA) and will therefore not be systematically referred to along the text. Because the succession is continuous (the superposition of samples is clear in the field), we discuss the age assignment of the studied interval as a whole and not as a set of independent samples.

In the zonation of Baumgartner et al. (1995b) *Praewilliriedellum robustum* (Matsuoka), occurring in the lowest sample (PS 2), makes its last appearance in the UAZ 7. Moreover, *Triactoma parablakei* Yang & Wang (LAD in UAZ 7) from the topmost sample together with *Cinguloturris carpatica* Dumitrica (FAD in UAZ 7) from the second sample (PS 7) would constrain the age of all following samples (PS 7 to PS 11) to the UAZ 7. On the other hand, some species first occurring in the UAZ 8 are also present in the studied interval: *Alievium* sp. A sensu Conti & Marcucci 1991, *Lanubus cornutus* (Baumgartner), *Saitoum elegans* De Wever, and *Zhamoidellum ventricosum* (Dumitrica). Such contradictory ranges are not unusual in radiolarian zonations and only mean that some co-occurrences have previously not been detected. For example, *Zhamoidellum ventricosum* has now been known from assemblages of UAZ 6-7 (e.g., Smuc & Gorican 2005; O'Dogherty et al. 2006) and is no more considered to have its FAD in UAZ 8. The other three species, among which *Lanubus cornutus* is the most characteristic, may either range down to the UAZ 7, or the range of *Triactoma parablakei* should be extended to the UAZ 8. We therefore assign the upper part of the section (samples PS 9 to PS 11) to UAZ 7 or UAZ 8. The lowest sample that might belong to UAZ 8 is PS 9, which contains *Alievium* sp. A. It should be emphasized that the studied interval contains no species with FAD in UAZ 9, but species that do not extend above the UAZ 8 are common. These are: *Acaeniotylopsis variatus* s.l. (Ožvoldova), *Eucyrtidiellum unumaense* s.l. (Yao), *Gongylothorax* aff. *favosus* Dumitrica sensu Baumgartner et al. 1995c, *Guexella nudata* (Kocher), *Monotrabs plenoides* gr. Baumgartner, *Parahsuum stanleyense* (Pessagno), *Podobursa poyacantha* (Fischli), *Striatojaponocapsa plicarum* s.l. (Yao), *Tethysetta dhimenaensis* ssp. A sensu Baumgartner et al. 1995c, and *Williriedellum* (?) *marcucciae* Cortese. The most important is the presence of *Eucyrtidiellum unumaense* s.l. (Yao) and *Gongylothorax* aff. *favosus* Dumitrica sensu Baumgartner et al. (1995c) in the topmost sample. We can thus firmly state that the top of the studied interval is not younger than UAZ 8.

In comparison with UAZ-SA of Beccaro (2006a), the base of the studied section (sample PS 2) is in good agreement with the zone B. Several species constraining the assignment to UAZ-SA B are present: *Acaeniotylopsis variatus* s.l. (Ožvoldova), *Eucyrtidiellum ptyctum* (Riedel & Sanfilippo), *Guexella nudata* (Kocher), *Podobursa triacantha* (Fischli) gr., *Praewilliriedellum convexum* (Yao), *P. robustum* (Matsuoka), *Tetratrabs zealis* (Ožvoldova), *Triactoma enzoi* Beccaro, and *Tritrabs casmaliaensis* (Pessagno). The only conflicting species in this sample is *Triactoma blakei* (Pessagno), which has a much longer range in the global zonation of Baumgartner et al. (1995b) and is thus not problematic. For the following samples PS 7 to PS 11 the correlation is much more difficult. Several species not extending above UAZ-SA B are present (e.g. *Acaeniotylopsis variatus* s.l. (Ožvoldova), *Monotrabs goricanae* Beccaro, *Pseuodeucyrtis firma* Hull, *Striatojaponocapsa plicarum* s.l. (Yao), and *Triactoma parablakei* Yang & Wang), but they are mixed with species making their first appearance in UAZ-SA C (e.g. *Emiluvia orea* s.l. Baumgartner, *Loopus doliolum martae* Beccaro, *Podobursa vannae* Beccaro, *Triactoma blakei* (Pessagno)), in UAZ-SA D (e.g. *Cinguloturris carpatica* Dumitrica, *Emiluvia hopsoni* Pessagno, *Lanubus cornutus* (Baumgartner), *Saitoum levium* De Wever), and even in UAZ-SA E (*Tritrabs rhododactylus* Baumgartner). These conflicting ranges are not surprising for several reasons: 1) the UAZ-SA zonation is local, the ranges are truncated by definition; 2) the UAZ-SA B was established on two sections only (Cava Vianini and Coston delle Vette), the assemblages of the UAZ-SA B are thus less complete than those of the UAZ-SA D to UAZ-SA F; 3) the subsequent UAZ-SA C also has a scarce record and has only been recognized in Sicily. The associations found in samples PS 7 to PS 11 at Ponte Serra were obviously not detected in the UAZ-SA zonation, which makes a reliable correlation impossible.

In Beccaro (2006a, p. 43) the UAZ-SA were compared to the UAZ95 of Baumgartner et al. (1995b). UAZ-SA B was included into UAZ 7 and this correlation is also confirmed in sample PS 2. Originally the UAZ 7 was attributed to late Bathonian-early Callovian, but in the Southern Alps the base of the correlative UAZ-SA B is younger than at least part of early Callovian, thanks to ammonites found in the Cava Vianini section (Beccaro 2006a). Local correlations in the Southern Alps strongly favour the assignment of the base of the Ponte Serra section to the Callovian. The overlying samples may range to the UAZ 8 (middle Callovian - early Oxfordian), an early Oxfordian age for the top of the studied interval can thus not be firmly excluded on the basis of radiolarians. However, the early Oxfordian is not likely, because calcareous nannofossils of Callovian age are associated throughout the studied interval at Ponte Serra (Cobianchi 2002).

## Correlation of Middle-Upper Jurassic siliceous deposits on the Trento Plateau and Belluno Basin

On the Trento Plateau (Southern Alps, Italy) four stratigraphical sections have been studied in particular detail for radiolarians: Ceniga (Baumgartner 1984; Baumgartner et al. 1995a; Beccaro 2006a, b), Coston delle Vette (Beccaro et al. 2002; Beccaro 2006a, b), Cava Vianini (Beccaro 2006a, b) and Ponte Serra (Baumgartner et al. 1995a; Kiessling 1996; this paper). Based on the radiolarian biostratigraphy exposed in Beccaro (2006a), the correlation among these sections reveals a significant diachronism for the lower boundary of the pelagic siliceous facies as well as important differences in sedimentation rates (Fig. 4, for location of sections see Fig. 2).

On the Trento Plateau the siliceous deposition began in the middle Bathonian (UAZ-SA A) at Coston delle Vette, in the Callovian (UAZ B) at Cava Vianini, and in the Oxfordian (UAZ-SA D) at Ceniga. In terms of radiolarian zones of Baumgartner et al. (1995b), the zonal assignment is as follows: the base of Coston delle Vette corresponds to UAZ 6, the base of Cava Vianini to UAZ 7 and the base of Ceniga to UAZ 8 (see correlation between both zonations in Beccaro 2006a, p. 43). These sections are located in different sectors of the Trento Plateau, and the diachronism suggests that an irregular bottom morphology, likely related to tectonic movements (Martire 1996), primarily controlled the onset of the siliceous deposition: the oldest onset took place at Coston delle Vette (located in a transitional area to the Belluno Trough), while the youngest onset was at Ceniga (located very close to the tectonically active Garda Escarpment).

The radiolarian assemblages of the CSF base at Ponte Serra section refer the first layers of siliceous limestone to the UAZ-SA B, which is younger than in the nearby Coston delle Vette section assigned to UAZ-SA A. The nannofossil data of Cobianchi (2002) refer the same sediments to lower-upper Callovian: this age well agrees with the radiolarian data exposed in the present paper. Comparing the Coston delle Vette and Ponte Serra sections, the different time-span of siliceous deposits is well expressed also in their thickness: the siliceous limestones between the RAI and the Middle Member of CSF at Coston delle Vette are 40 m thick, whereas at Ponte Serra they attain 9 m only.

In the Belluno Trough, characterized by a thick Middle Jurassic succession of oolitic gravity-flow deposits (Vajont Fm.), the transition to the overlying CSF is much more gradual than on the Trento Plateau. This transition consists of oolitic beds alternating with wackestone and packstone with radiolarians and pelagic bivalves. The base of the CSF is marked by the appearance of the first chert nodules and layers. Callovian age was determined with radiolarians of the UAZ 7 in the topmost part of the Vajont Fm. and in the first beds of the overlying CSF (Baumgartner et al. 1995a). This dating allows a good correlation with the base of the CSF at Ponte Serra.

Radiolarians from the middle-upper part of the CSF at Ponte Serra were studied by Baumgartner et al. (1995a) who stated a middle Oxfordian-early Tithonian age (UAZ 9-11), and by Kiessling (1996) who established an Oxfordian-Kimmeridgian age. These data coming from the sediments above the samples studied in this paper constrain the age of the Middle member to the early Oxfordian. The Middle member and the overlying siliceous limestone are directly correlatable with Coston delle Vette section, where a detailed radiolarian study of the entire CSF was previously carried out (Beccaro et al. 2002; Beccaro 2006a, b). Middle-late Oxfordian (UAZ 9-10) radiolarians were found above the Middle member and radiolarians not younger than early Oxfordian (UAZ 8) occur within this member (Beccaro et al. 2002). Deducing from the correlation between Ponte Serra and Coston delle Vette sections we also assume that the CSF/RAS boundary at Ponte Serra falls in the early Kimmeridgian.

## Conclusions

Radiolarian assemblages from the base of the Calcare Selcifero di Fonzaso (CSF) have been studied in the type locality of Ponte Serra, resulting of Callovian age. The samples coming from the upper tract of the studied section are most probably also referable to the Callovian.

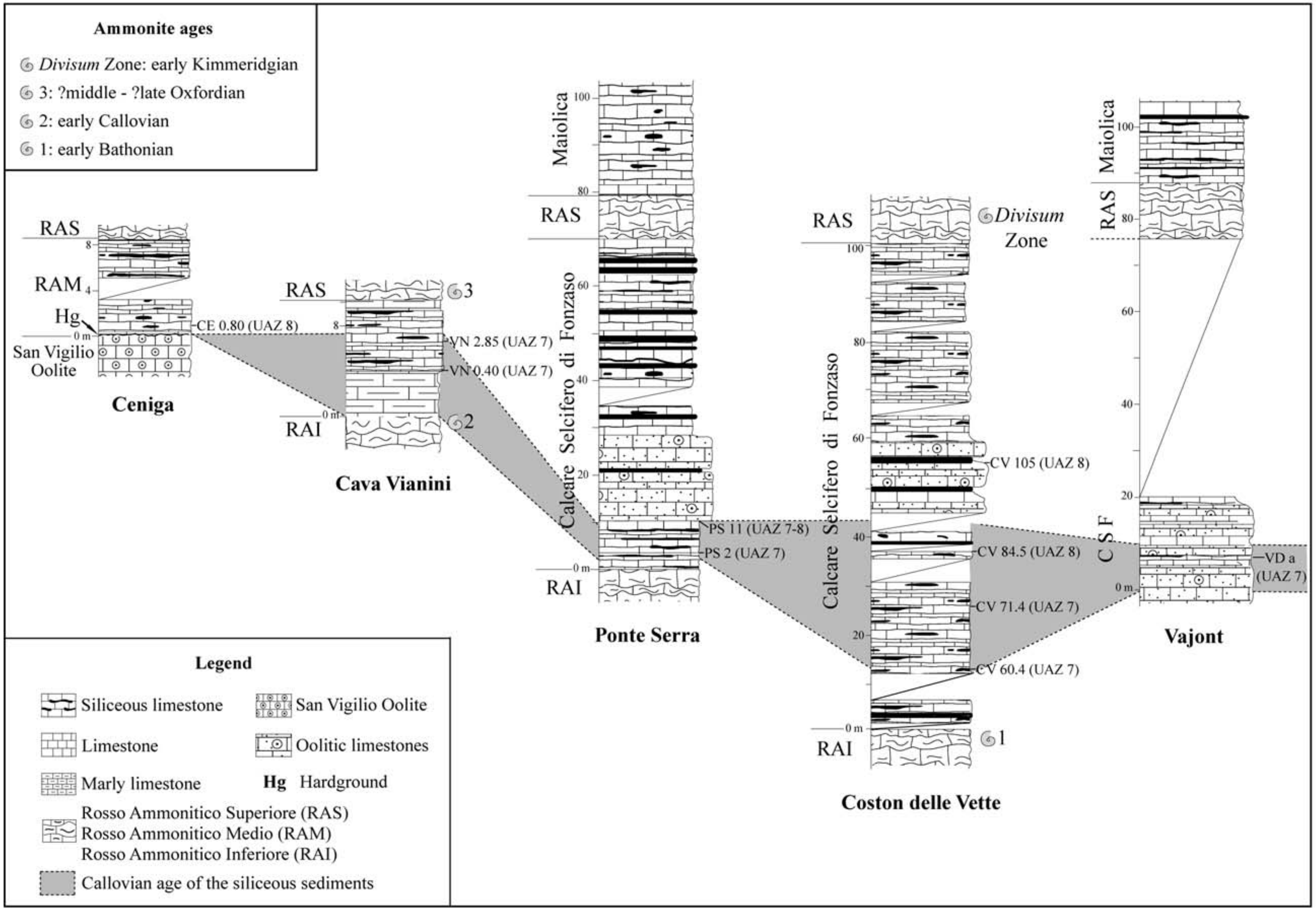


Fig. 4 - Radiolarian biostratigraphical correlation of the siliceous sediments in the Trento Plateau and Belluno Basin (Southern Alps, Italy). The investigated successions represent the intermediate pelagic siliceous member (RAM) of Rosso Ammonitico Fm. at Ceniga and Cava Vianini sections, and the Calcare Selcifero di Fonzaso (CSF) at Ponte Serra, Coston delle Vette and Vajont Dam sections. The hatched lines correlate those sediments that have been assigned to the Callovian based on radiolarian data. The correlation is based on data of Beccaro et al. (2002), Beccaro (2006a), and on the data of Baumgartner et al. (1995a) for the Vajont section. The correlated samples are indicated and their age is given according to the zonation of Baumgartner et al. (1995b). Ceniga and Cava Vianini sections are drawn in different scale than the other sections. The Vajont section is redrawn after Diserens & Poget (2000).

These data show that the onset of siliceous sedimentation at Ponte Serra is younger than in the nearby section of Coston delle Vette, where it occurs in the Bathonian. In spite of the close location of the two sections, and the substantially identical paleogeographical position, another important difference regards the presence of thick resedimented oolitic-peloidal beds that occur at 9 m from the base of the CSF at Ponte Serra and at more than 40 m at Coston delle Vette. The oolitic-peloidal beds are associated with radiolarian assemblages typical of UAZ 8 (middle Callovian-early Oxfordian) at Coston delle Vette and may be held as key beds that confirm that the marked thickness difference between the two sections is both due to diachronism of the base and to different sedimentation rates.

The highly diversified stratigraphy of middle-upper Jurassic cherty limestones is even more striking when these two sections, located on the eastern, early drowned, margin of the Trento Plateau, are compared with other sections (Cava Vianini and Ceniga) on its western margin. Here, the thickness is much reduced (less than 8 m) and the base may be as young as UAZ-SA D (Oxfordian). These results suggest a strong difference in the Middle-Late Jurassic sea floor paleotopography between the western and the eastern part of the Trento Plateau that importantly affected silica-rich sediment preservation.

PLATE 1

Scanning electron micrographs of Middle Jurassic radiolarians (Spumellaria) from the Calcare Selcifero di Fonzaso (Ponte Serra, Southern Alps, Italy). The sample number and the magnification of each specimen are given.

1 - *Acaeniotylopsis variatus* s.l. (Ožvoldova), PS 2, x150;
2 - *Acaeniotylopsis variatus* s.l. (Ožvoldova), PS A, x150;
3 - *Angulobracchia* sp. B sensu Baumgartner et al. 1995c, PS 9, x100;
4 - *Archaeospongoprunum imlayi* Pessagno, PS 11, x200;
5 - *Archaeospongoprunum imlayi* Pessagno, PS A, x200;
6 - *Archaeospongoprunum imlayi* Pessagno, PS 8, x200;
7 - *Bernoullius dicera* (Baumgartner), PS 11, x200;
8 - *Bernoullius dicera* (Baumgartner), PS A, x200;
9 - *Bernoullius rectispinus* s.l. Kito, De Wever, Danelian & Cordey, PS 7, x150;
10 - *Bernoullius rectispinus* s.l. Kito, De Wever, Danelian & Cordey, PS 8, x150;
11 - *Emiluvia hopsoni* Pessagno, PS 7, x150;
12 - *Emiluvia orea* s.l. Baumgartner, PS 9, x150;
13 - *Emiluvia premyogii* Baumgartner, PS A, x150;
14 - *Emiluvia salensis* Pessagno, PS 7, x150;
15 - *Emiluvia premyogii* Baumgartner, PS 8, x200;
16 - *Haliodictya* (?) *antiqua* (Rüst), PS D, x150;
17 - *Haliodictya* (?) *hojnosi* Riedel & Sanfilippo, PS 11, x200;
18 - *Hexasaturnalis minor* (Baumgartner), PS 2, x150;
19 - *Hexasaturnalis nakasekoi* Dumitrica & Dumitrica-Jud, PS 2, x150;
20 - *Dicerosaturnalis angustus* (Baumgartner), PS D, x150;
21 - *Levileugeo ordinarius* Yang & Wang, PS 8, x150;
22 - *Homoeoparonaella elegans* (Pessagno), PS A, x150;
23 - *Monotrabs plenoides* gr. Baumgartner, PS 2, x200;
24 - *Monotrabs goricanae* Beccaro, PS A, x150;
25 - *Orbiculiforma* sp. B sensu Widz 1991, PS 7, x200;
26 - *Paronaella mulleri* Pessagno, PS 9, x150;
27 - *Paronaella pygmaea* Baumgartner, PS 9, x150;
28 - *Paronaella broennimanni* Pessagno, PS 9, x150;
29 - *Paronaella* sp., PS 8, x200;
30 - *Pantanellium riedeli* Pessagno, PS 7, x250.

PLATE 2

Scanning electron micrographs of Middle Jurassic radiolarians (Spumellaria and Nassellaria) from the Calcare Selcifero di Fonzaso (Ponte Serra, Southern Alps, Italy). The sample number and the magnification of each specimen are given.

1 - *Pterotrabs arcuballista* Dumitrica, Baumgartner & Gorican, PS D, x150;
2 - *Alievium* (?) sp. A sensu Conti & Marcucci 1991, PS 9, x200;
3 - *Tetraditryma corralitosensis* s.l. Pessagno, PS 8, x150;
4 - *Tetraditryma pseudoplena* Baumgartner, PS 9, x150;
5 - *Tetratrabs zealis* (Ožvoldova), PS A, x100;
6 - *Triactoma blakei* (Pessagno), PS 2, x150;
7 - *Lanubus cornutus* (Baumgartner), PS E, x150;
8 - *Triactoma enzoi* Beccaro, PS 2, x150;
9 - *Triactoma parablakei* Yang & Wang, PS 11, x150;
10 - *Triactoma mexicana* Pessagno & Yang, PS E, x150;
11 - *Triactoma jonesi* (Pessagno), PS 7, x150;
12 - *Triactoma jonesi* (Pessagno), PS A, x150;
13 - *Tritrabs ewingi* s.l. (Pessagno), PS 9, x100;
14 - *Tritrabs casmaliaensis* (Pessagno), PS 7, x150;
15 - *Tritrabs rhododactylus* Baumgartner, PS E, x100;
16 - *Archaeodictyomitra* sp., PS 11, x200;
17 - *Cinguloturris carpatica* Dumitrica, PS 8, x250;
18 - *Eucyrtidiellum nodosum* Wakita, PS 8, x300;
19 - *Eucyrtidiellum ptyctum* (Riedel & Sanfilippo), PS 8, x300;
20 - *Eucyrtidiellum ptyctum* (Riedel & Sanfilippo), PS A, x300;
21 - *Eucyrtidiellum ptyctum* (Riedel & Sanfilippo), PS 11, x300;
22 - *Eucyrtidiellum unumaense* s.l. (Yao), PS 11, x300;
23 - *Gongylothorax* aff. *favosus* Dumitrica sensu Baumgartner et al. 1995c, PS 11, x300;
24 - *Guexella nudata* (Kocher), PS 2, x250;
25 - *Helvetocapsa lemanensis* O'Dogherty, Gorican & Dumitrica, PS 8, x300;
26 - *Praewilliriedellum convexum* (Yao), PS 2, x200;
27 - *Praewilliriedellum robustum* (Matsuoka), PS 2, x200;
28 - *Theocapsomella himedaruma* (Aita), PS 8, x300;
29 - *Sethocapsa* sp. cf. *S. trachyostraca* Foreman, PS 8, x250;
30 - *Sethocapsa* sp. cf. *S. trachyostraca* Foreman, PS 8, x200.

PLATE 3

Scanning electron micrographs of Middle Jurassic radiolarians (Nassellaria) from the Calcare Selcifero di Fonzaso (Ponte Serra, Southern Alps, Italy). The sample number and the magnification of each specimen are given.

1 - *Mirifusus guadalupensis* Pessagno, PS 8, x150;

2 - *Obesacapsula morroensis* Pessagno, PS A, x120;
3 - *Palinandromeda podbielensis* (Ožvoldova), PS 2, x150;
4 - *Palinandromeda podbielensis* (Ožvoldova), PS 8, x150;
5 - *Podobursa andreai* Beccaro, PS 8, x100;
6 - *Podobursa polyacantha* (Fischli), PS 2, x150;
7 - *Podobursa polyacantha* (Fischli), PS A, x200;
8 - *Podobursa triacantha* (Fischli) gr., PS E, x150;
9 - *Podobursa vannae* Beccaro, PS 7, x200;
10 - *Saitoum pagei* Pessagno, PS 11, x300;
11 - *Saitoum levium* De Wever, PS 8, x300;
12 - *Saitoum levium* De Wever, PS 8, x300;
13 - *Saitoum elegans* De Wever, PS D, x300;
14 - *Sethocapsa* sp., PS 8, x250;
15 - *Striatojaponocapsa plicarum* s.l. (Yao), PS 8, x300;
16 - *Ristola procera* (Pessagno), PS E, x150;
17 - *Loopus doliolum martae* Beccaro, PS 11, x300;
18 - *Pseudodictyomitrella tuscanica* (Chiari, Cortese & Marcucci), PS 9, x300;
19 - *Pseudoeucyrtis firma* Hull, PS 9, x150;
20 - *Tethysetta dhimenaensis dhimenaensis* (Baumgartner), PS 9, x250;
21 - *Tethysetta dhimenaensis* ssp. A sensu Baumgartner et al. 1995c, PS 8, x200;
22 - *Tethysetta dhimenaensis* ssp. A sensu Baumgartner et al. 1995c, PS A, x200;
23 - *Hsuum speciosum* Hull, PS 8, x200;
24 - *Parahsuum stanleyense* (Pessagno), PS A, x200;
25 - *Transhsuum maxwelli* gr. (Pessagno), PS 8, x200;
26 - *Transhsuum brevicostatum* gr. (Ožvoldova), PS D, x150;
27 - *Williridiellum yaoi* (Kozur), PS 2, x400
28 - *Williriedellum yahazouense* (Aita), PS 9, x300;
29 - *Williriedellum carpathicum* Dumitrica, PS A, x300;
30 - *Williriedellum* (?) *marcucciae* Cortese, PS 8, x300;
31 - *Zhamoidellum ventricosum* Dumitrica, PS 8, x200.

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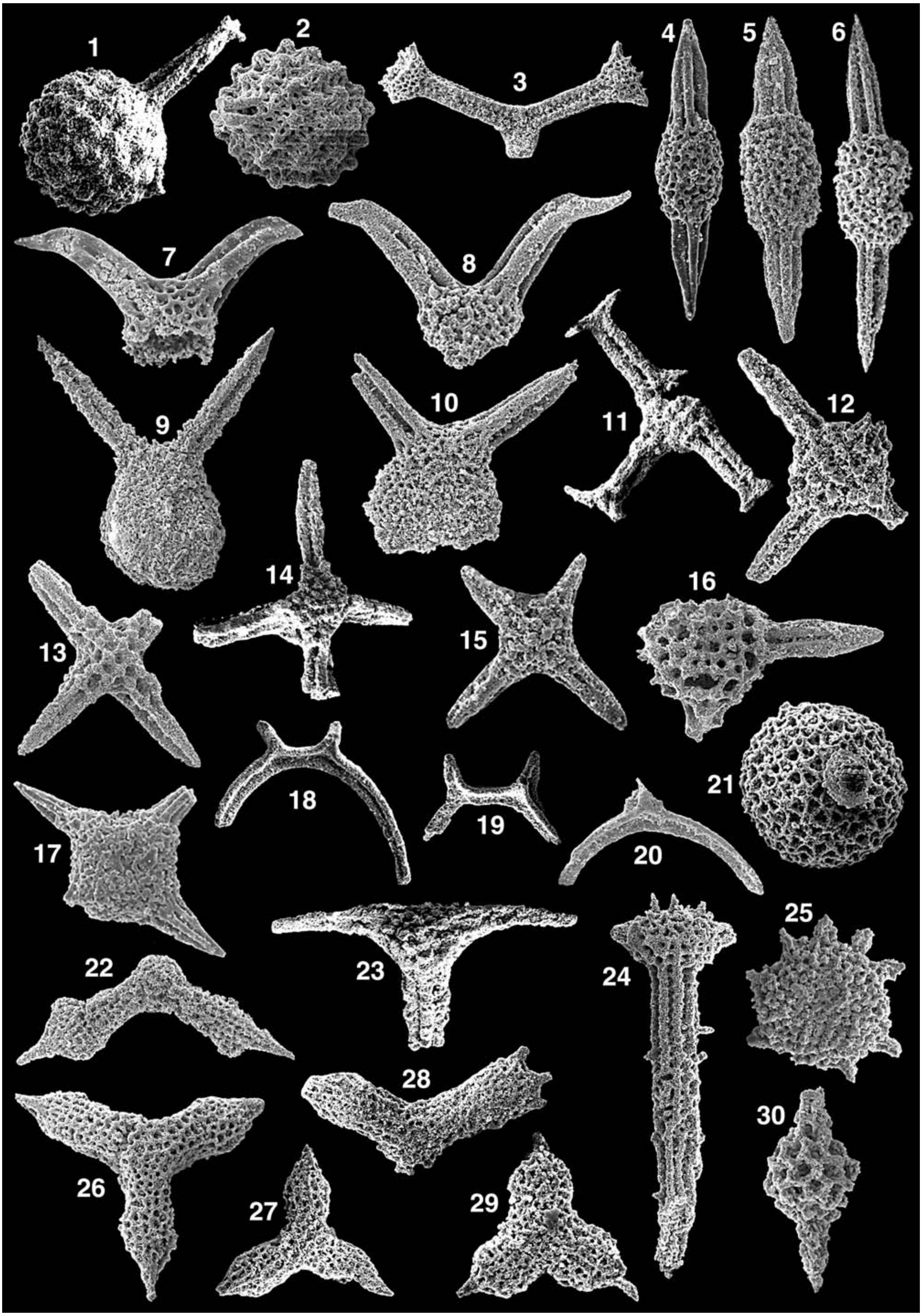
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PLATE 1

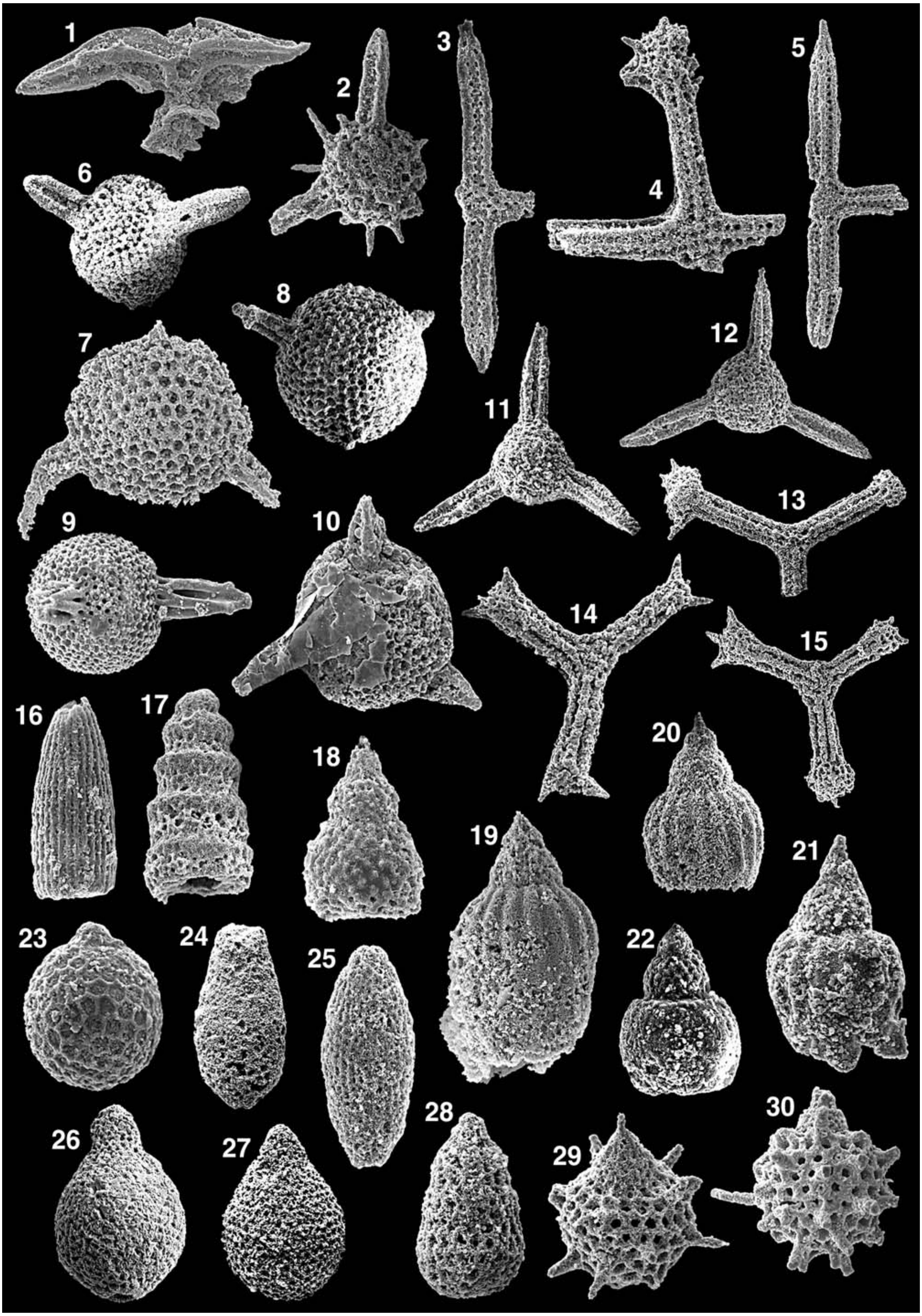
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PLATE 2

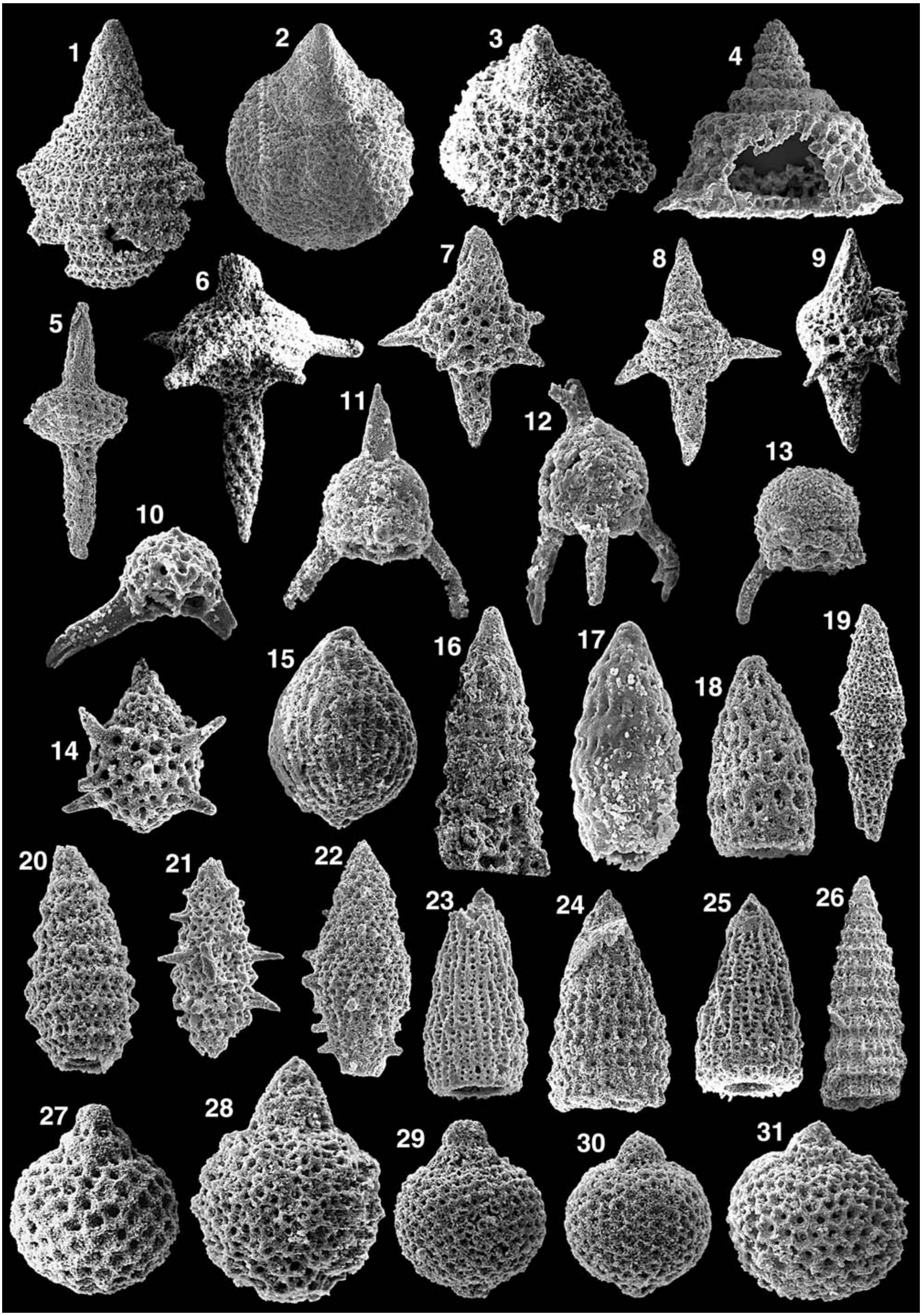
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PLATE 3

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