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DASYCLADALES (GREEN ALGAE) AND SOME BENTHIC FORAMINIFERA FROM THE UPPER CRETACEOUS ILAM FORMATION (LATE CONIACIAN–SATONIAN), SW IRAN (ONSHORE AND OFFSHORE)

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Keywords: Green algae; Foraminifera; Taxonomy; Biostratigraphy; Ilam Formation; Zagros Zone; Arabian Plate.

Abstract. New data (onshore, offshore) on the Upper Cretaceous Ilam Formation of southwestern Iran are provided concerning the common presence of dasycladalean green algae (families Triploporellaceae, Polyphysaceae) that have so far been treated mostly in open nomenclature. The assemblage consists of the five taxa *Salpingoporella ubaiydhi* Radoičić, 1979, *Dissocladella ondulata* (Raineri, 1922), *Trinocladus tripolitanus* Raineri, 1922, *Clypeina* cf. *dusanbrstinai* Radoičić, 1997, and gen. et sp. indet. The taxa typically prevail in wackestones-packstones but exhibit different distributional patterns. While *S. ubaiydhi* and *T. tripolitanus*, rarely associated with *D. ondulata*, form a characteristic assemblage in a distal infralittoral facies (more diverse assemblage; zone no. 31 of Wynd, 1965), *C.* cf. *dusanbrstinai* occurs in a proximal infralittoral facies associated with miliolids among also complex forms (rhapydioninids) (assemblage zone no. 30 of Wynd, 1965). It is concluded that the two assemblage zones refer to different palaeoenvironments, instead of different ages ('lower' and 'upper'). Based on benthic foraminifera, the main part of the Ilam Formation can be ascribed to the Santonian. For the lower part, a late Coniacian age is suggested implied indirectly by the comparably long vertical range of the rotaliid *Orbitokathina vonderschmitti* Hottinger, 1966 of the studied core. This would be in conformity with the K 150 Arabian Plate K 150 sequence boundary referring to a late Turonian?–early Coniacian hiatus. From a palaeobiogeographic perspective, *T. tripolitanus* is a cosmopolitan species, *S. ubaiydhi* is restricted to the area of the former Arabian Plate (subsurface Iraq, Saudi Arabia and Egypt), while *C. dusanbrstinai* has been recorded only from Serbia (type-locality). In addition to the algae, the stratigraphic discussion includes the occurrence of the benthic foraminifera *Reticulinella*? *kaeveri* Cherchi, Radoičić & Schroeder, 1989 and *Orbitoides mid-orientalis* (Eames & Smout, 1956) in the Ilam Formation.

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Introduction

Upper Cretaceous shallow-water carbonates have a comparably wide distribution along the northern and eastern margins of the Arabian Plate (Ziegler 2001; Barrier & Vrielynck 2008; Sharland et al. 2001; Bromhead et al. 2022). The micropalaeontological content of these carbonates is characterized by mixed assemblages of benthic foraminifera (small- and large-sized) and calcareous algae (dasycladalean and udoteacean green algae). Among these, the larger benthic foraminifera have attracted much more interest than the algae caused, among others, by often higher diversities of the former (Cox 1937; Henson 1948; Sampò 1969; Whittaker et al. 1998; Simmons et al. 2000; Schlagintweit et al. 2023; Simmons & Bidgood 2023). In the illustrations-plates provided in the literature, algae are clearly underrepresented and often just treated as 'algae' or in open nomenclature (e.g., genus level). In fact, just a few taxonomic works are available from Upper Cretaceous carbonates of various lithostratigraphic units of the Arabian Plate (Ellliott 1959, 1968; Radoičić 1979; Kuss & Conrad 1991; Kuss 1994; Okla 1992, 1995a, b; Rashidi & Schlagintweit 2019a, b).

From southwestern Iran (onshore and offshore Zagros Zone), shallow-water carbonates above the Cenomanian–Turonian Sarvak or Surgah formations are known as Ilam Formation (James and Wynd 1965; Omidvar et al. 2014; Mehrabi et al. 2014, 2023; Bagherpour et al. 2021). For this formation two 'biozones' or typical assemblages have been established by Wynd (1965): a lower '*Rotalia* sp. 22 - algae assemblage zone' (no. 30) and an upper '*Archaecyclus mid-orientalis - Pseudedomia* (*Fabularia*)' (no. 31) for which a Coniacian–Campanian age was indicated (= Santonian–Campanian in James & Wynd, 1965; Coniacian–Santonian in Sharland et al. 2001). The algae have neither been treated taxonomically nor been further classified (green algae? red algae?) or illustrated in these seminal works. In later papers, they were treated as debris of green algae or often in open nomenclature as *Salpingoporella* sp., or *Actinoporella* sp. (Bagherpour et al. 2021; Mehrabi et al. 2023) but not figured as such. About 20 years ago, a taxonomic study was prepared by Mark Alex-Sanders as '*Santonian calcareous algae from the subsurface Ilam Formation, southwestern Iran*' that has, for reasons unknown to us, most likely confidential reasons, never been published (scheduled for Journal of Micropaleontology; see 'Friends of Algae Newsletter' no. 12, 2003, paleopolis.rediris.es/FotAN/fotan-12.html#Alex). Our contribution therefore represents the first taxonomic work on the dasycladalean green algae of the Ilam Formation of southwestern Iran. It includes data from one offshore well and two onshore sections (Fig. 1A–B). The discussion of the stratigraphic relevance includes in addition the two benthic foraminifera *Reticulinella*? *kaeveri* Cherchi et al. and *Orbitoides mid-orientalis* (Eames & Smout).

Geological Setting

In the Late Cretaceous (Cenomanian–Santonian), the Persian Gulf formed part of the northeastern edge of the Arabian Plate positioned near the equator (Sharland et al. 2001; Stampfli and Borel 2002; Barrier & Vrielynck 2008; Barrier et al. 2018). Towards the end of the Cenomanian, a significant shift in tectonic setting occurred, with the transition from a passive to an active tectonic margin (e.g., Mehrabi et al. 2015a, b, c; Bromhead et al. 2022). This transformation was accompanied by the subduction of the Neo-Tethys oceanic plate beneath Central Iran (e.g., Alavi 2004; Moghadam et al. 2020; Moghadam & Stern 2021; Navidtalab et al. 2024).

In the Zagros Basin and the Persian Gulf, the interaction between porous and permeable reservoir units and various prolific source rocks played a pivotal role in the accumulation of substantial hydrocarbon reserves within the Cretaceous strata (e.g., Mehrabi et al. 2023). Additionally, the presence of numerous tectonic structures, including anticlines, salt domes, and diapirs, associated with effective cap rocks, created favorable conditions for the entrapment of hydrocarbons (Ghazban 2007; Mehrabi et al. 2015b, c, 2018). The oilfields related to salt formations in the eastern Persian Gulf exhibit distinctive characteristics, such as (a) dome-shaped structures, (b) independent closures, and (c) parallel faults within the structures (Kabirzadeh et al. 2020; Orang and Gharabeigli 2020).

At a large scale, the Cretaceous strata are subdivided into two tectonostratigraphic mega-sequences known as AP8 and AP9 (Sharland et al. 2001). The complete Albian to Turonian interval of the Arabian Plate falls within the AP8 mega-sequence, delimited by maximum flooding surfaces of K140–K90 (Shar-

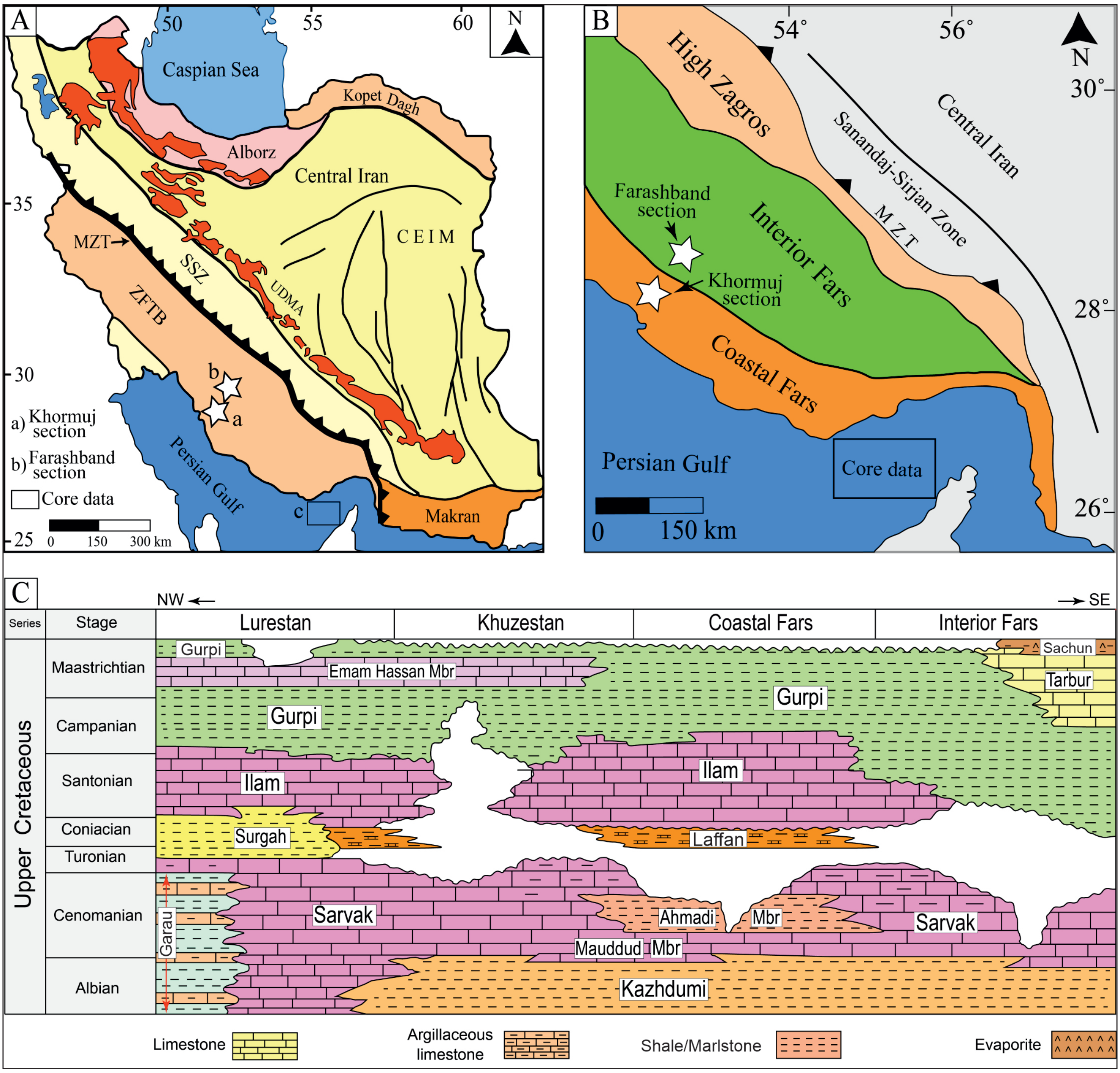


Fig. 1 - A) Simplified geological map of Iran (modified after Yazdi-Moghadam et al. 2023) showing the main tectonic subdivisions. B) Tectono-stratigraphic units of the Zagros belt with geological position of the studied surface- and subsurface sections. C) Lithostratigraphic units of the Zagros Fold–Thrust Belt (modified from James & Wynd 1965). Abbreviations: CEIM Central East Iran Microplate, UDMA Uromia Dokhtar Magmatic Arc, MZT Main Zagros Thrust, SSZ Sanandaj-Sirjan Zone, ZFTB Zagros Fold Thrust Belt.

land et al. 2001; Davies et al. 2002). The upper segment of the AP8 mega-sequence is encompassed by the Wasia Group (Ehrenberg et al. 2008; Alsharhan, 2014). Notably, the termination of this mega-sequence is marked by a significant mid-Turonian disconformity, representing the boundary between the Wasia and Aruma groups (Rahimpour-Bonab et al. 2013; Mehrabi et al. 2022a, b). This refers to the deposits enclosing the K 150 SB of the Arabian Plate (e.g., Sharland et al. 2001; Van Buchem et al. 2011; Bromhead et al. 2022; Schlagintweit et al. 2023). Along the paleo-platform margin, the Albian to Turonian interval is characterized by the presence of shallow-water carbonates (van Buchem et al. 1996, 2002; Mehrabi et al. 2020). Within the Persian Gulf, these sequences encompass the Mauddud, Khatiyah, and Mishrif formations, collectively referred to as the Sarvak Formation in Iran and representing the upper segment of the Wasia Group. In the Coniacian–Santonian interval, the sequences comprise the Laffan and Ilam (Halul) formations, which are attributed to the lower part of the Aruma Group (Fig. 1C).

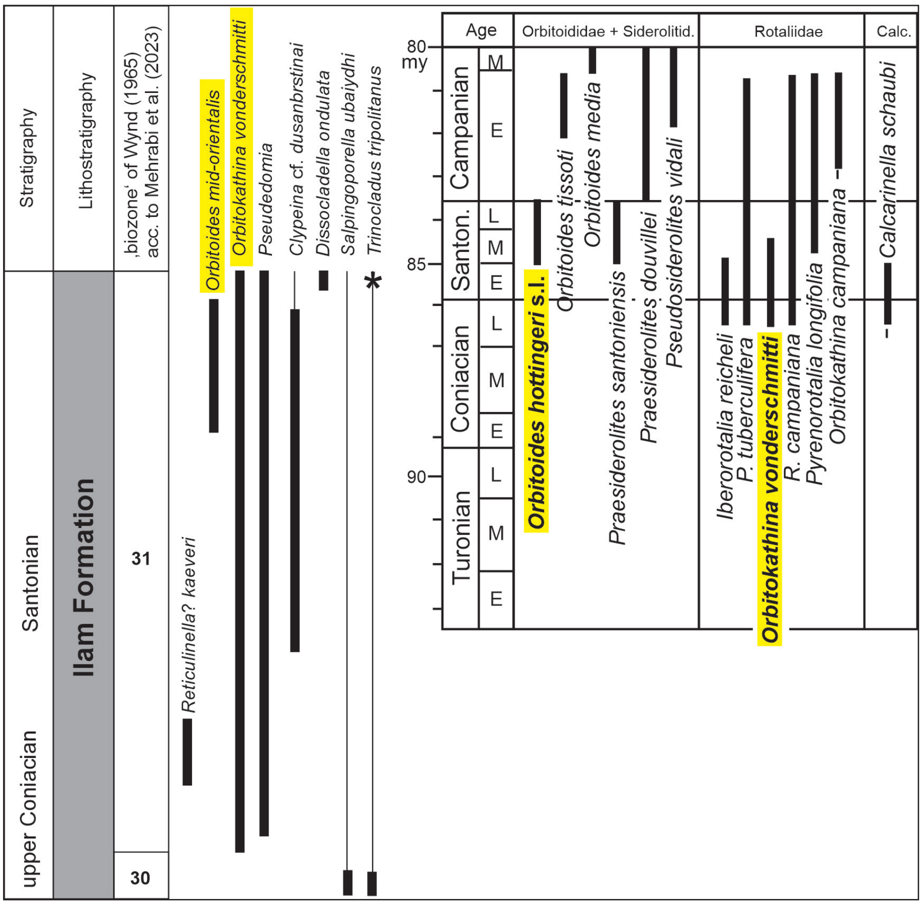


Fig. 2 - Left: Generalized log of the studied Persian Gulf core section (see Mehrabi et al. 2023) showing distribution of selected taxa of benthic foraminifera and dasycladalean algae. Right: Stratigraphic range chart (Turonian–Campanian interval) of selected rotaliid (and other) foraminifera (modified from Boix et al. 2009). The range of *Orbitoides hottingeri* and *Orbitokathina vonderschmitti* Hottinger are highlighted.

Offshore (core data)

The present study is based on the core data from a well drilled in a hydrocarbon field (S-Field) in the eastern part of the Persian Gulf. It belongs to the material and thin-sections studied by Mehrabi et al. (2023) but here with focus on the occurrence of dasycladalean algae. In the examined area, the Ilam Formation has a thickness of ~113 meters and is characterized by white to tan microcrystalline limestones, which are partly chalky, fossiliferous, and contain pyrite and cherts. Its lower boundary is identified at the top of the shale facies of the Laffan Formation (Fig. 1B, 2).

Khormuj section

The studied material refers to thin-sections of the Ilam Formation from the Khormuj section exposed in the northeast of Khormuj city, located in Coastal Fars where the Ilam Formation attains a thickness of about 130 m (Fig. 3). This locality with the coordinates N28°39'21" latitude and E51°24'14" and longitude has been studied by various researchers (Vincent et al. 2015; Schlagintweit et al. 2023; Xu et al. 2023; Hosseini et al. 2024).

Farashband section

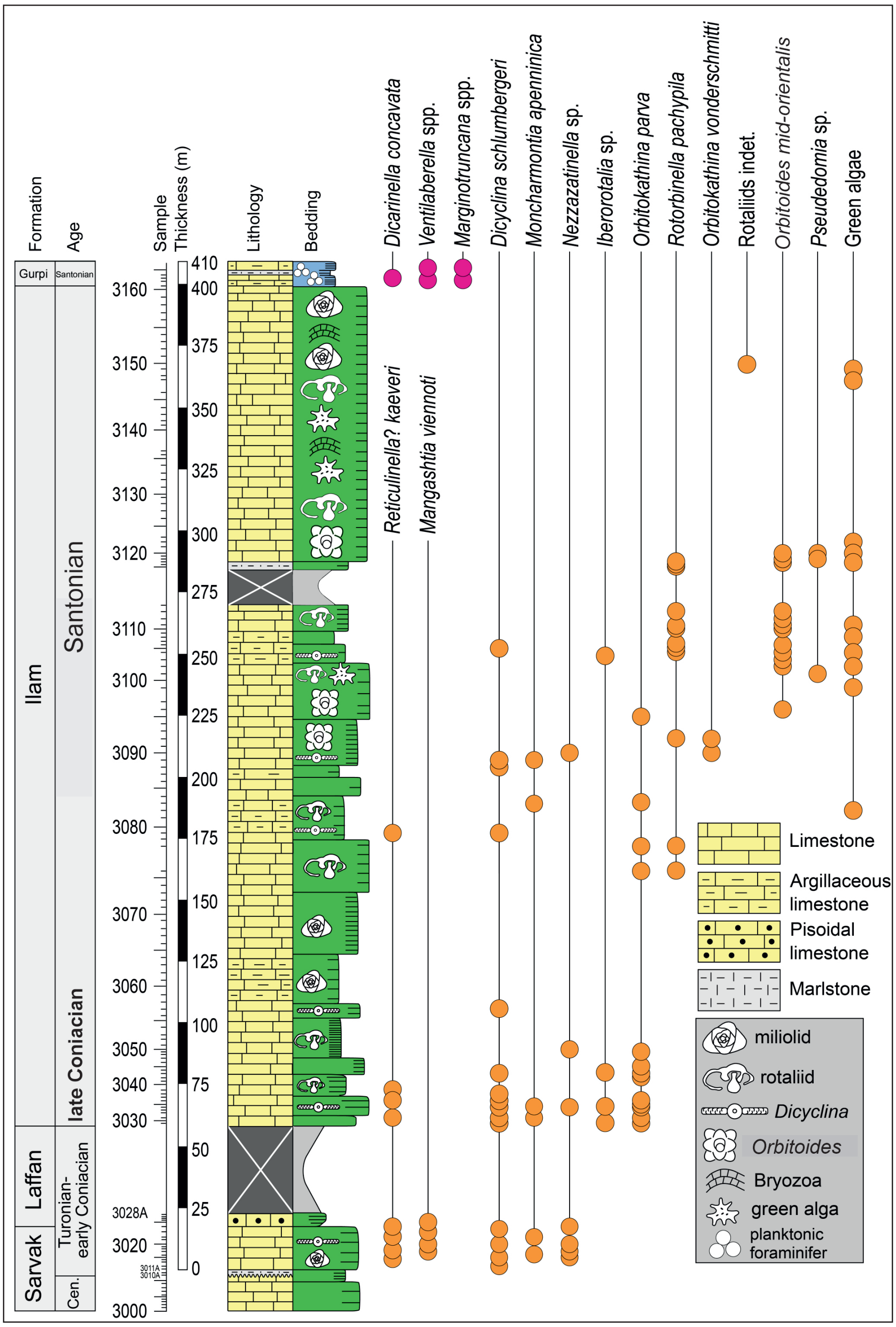
The outcrop of the Ilam Formation is situated about 92 km south of Shiraz close to the city of Farashband, Coastal Fars, named here as Farashband section. It is located along the road from Farashband to Firozabad. The Ilam Formation of this locality has been described by Hoseininezhad & Noroozpour (2018). The geographic coordinates for the section base are 28°48'13.09"N, 52°10'29.74"E. Here, just an overview sampling (sample prefix IFL) has been conducted, no log been prepared and no concrete age can be assigned. The material illustrated can be assigned to the assemblage zone 31 of Wynd (1965).

Material and methods

Core data

Altogether 249 thin-sections have been prepared from the carbonate rocks of the Ilam Formation and studied by Mehrabi et al. (2023). They are housed in the collection of the Exploration Directorate of the National Iranian Oil Company (NIOC). Due to

Fig. 3 - Log of the Khormuj section of late Cenomanian-Santonian (earliest Campanian?) age showing the distribution of selected benthic, planktonic foraminifera and green algae (undifferentiated).



confidentiality reasons no depths/sample numbers are indicated, instead the distribution of the taxa is referring to the lower and middle-upper part of the Ilam Formation, respectively assemblage zones no. 30 and 31 of Wynd (1965).

Khormuj Section

The studied thin-sections of the Khormuj section labeled DMS-, are stored in the slide collection of the National Iranian Oil Company Exploration Directorate, Tehran.

Farashband section

The studied thin-sections of the Farashband section labeled IFL- are stored in the collection of the Department of Geology, Yazd University (collection K. Rashidi).

Systematic Palaeontology

The suprageneric classification is adopted from Granier and Bucur in Granier et al. (2013). For

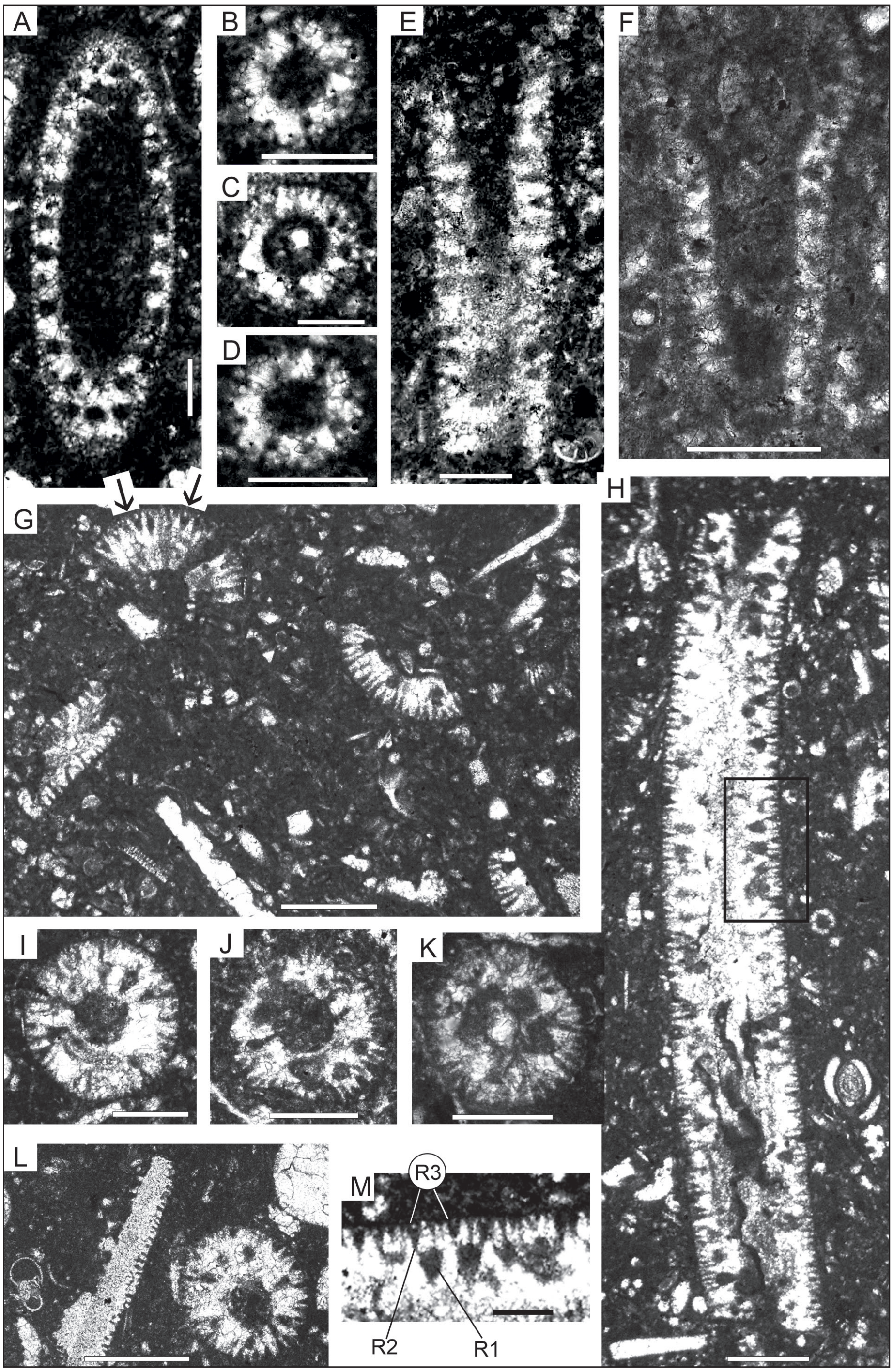


Fig. 4 - Dasycladales *Dissocladella ondulata* (Raineri) (A–F) and *Trinocladus tripolitanus* Raineri (G–M) from the Ilam Formation: Khormuj section (A–F), Farashband section (G–J, L–M), and Persian Gulf core data (K). A, L) Oblique sections. B–D, G (fragmentary), I–K) Tranverse sections. E–F, H) Longitudinal sections, showing club-shaped morphology in A and F. M) Detail from H (rectangle) showing three orders of laterals (R1 to R3; French ramifications). Scale bars 0.2 mm for A–F, M and 0.5 mm for G–L. Thin-sections of the Khormuj and Farashband sections DMS 3123 (A), DMS 3120 (B–D, F), DMS 3117 (E), IFL36-3 (G–H, L–M), IFL40-3 (I–J).

the biometric data, the standard abbreviations of Bassoullet et al. (1975) have been used as follows: D = outer thallus diameter, d = inner thallus diameter, h = vertical spacing of the verticils, l = length primary laterals, l' = length secondary laterals, l" = length tertiary laterals, p = diameter primary laterals, p' = diameter secondary laterals, p" = diameter tertiary laterals, w = number of laterals per verticil.

Order **Dasycladales** Pascher, 1931

Family Triploporellaceae (Pia, 1920)
Tribe Triploporelleae (Pia, 1920)
Genus *Trinocladus* Raineri, 1922

Trinocladus tripolitanus Raineri, 1922

Figs. 4G–M, 5A–B pars

1922 *Trinocladus tripolitanus* Raineri, p. 79, pl. 3, figs 15–16.
1936 *Trinocladus tripolitanus* - Pia, p. 5, fig. 3, pl. 2.
1987 *Trinocladus tripolitanus* - Reitner, pl. 33, fig. 4, pl. 44, fig. 2.
1994 *Trinocladus tripolitanus* - Kuss, p. 302, pl. 2, figs. 11–15.
2014 *Trinocladus tripolitanus* - Schlagintweit & Wilmsen, p. 19, figs. 3b–c (pars), 6m–u.

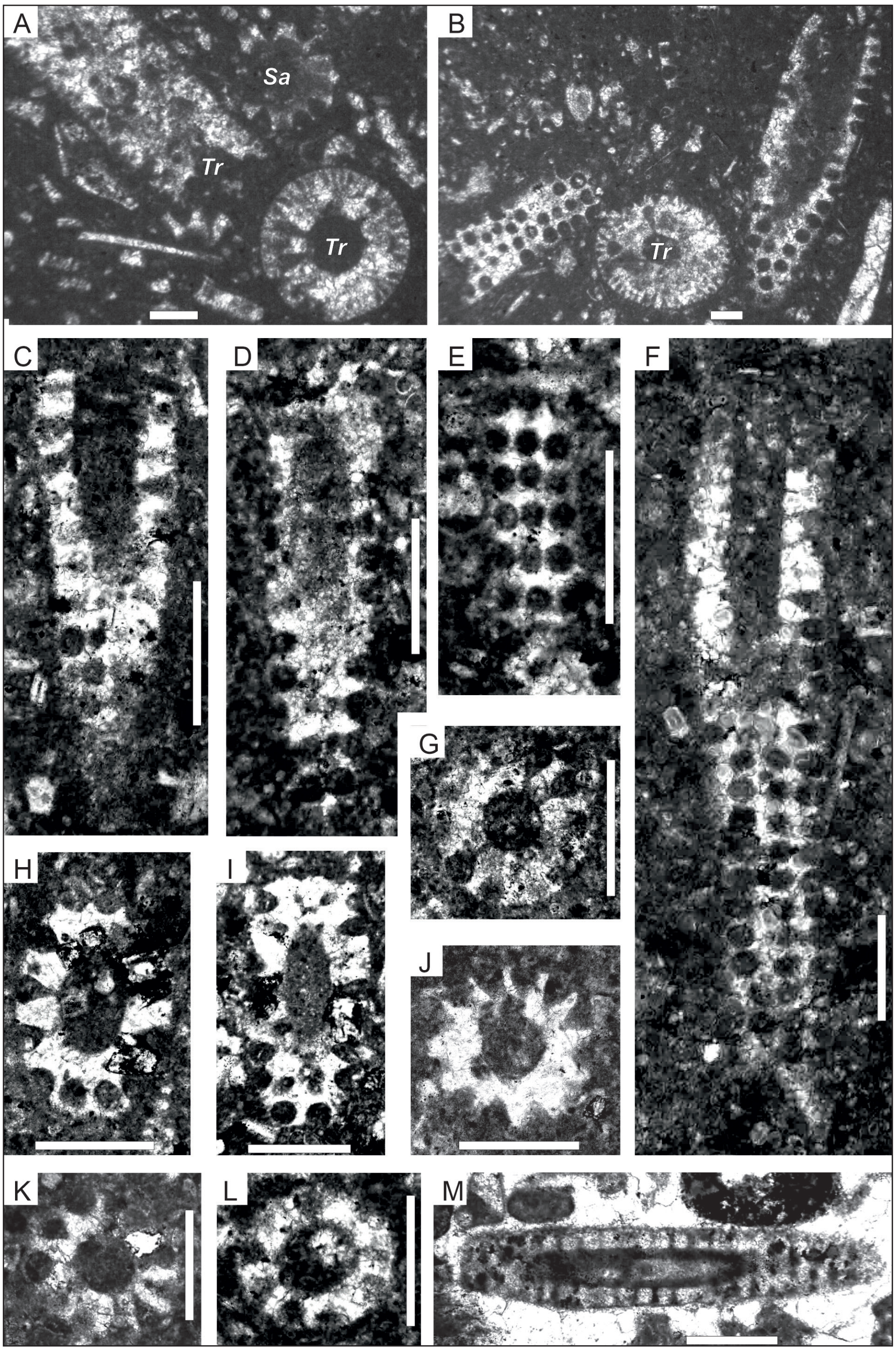


Fig. 5 - Dasycladales *Salpingoporella ubaiydhi* Radoičić (A–L, ?M) and *Trinocladus tripolitanus Raineri* (A–B) from the Ilam Formation: Persian Gulf core data (A–B) and Khormuj section, Interior Fars (C–M). A–B) Association of *S. ubaiydhi* (*Sa*) and *T. tripolitanus* (*Tr*). C–D) Longitudinal-oblique sections. E) Tangential section showing aligned verticils. F) Tangential (lower) and longitudinal (upper) sections showing aligned verticils. G, J–L) Transverse sections. H–I) Oblique sections. M) Longitudinal section of a bended thallus. Scale bars 0.3 mm. Thin-sections of the Khormuj section DMS 3104 (C, I), DMS 3108 (F), DMS 3111 (H, J), DMS 3116 (L), DMS 3117 (K), DMS 3117 (D–E, G), DMS 3094 (M).

2017 *Trinocladus tripolitanus* - Granier et al., p. 3, figs. 2–3.
2020 *Cymopolia tibetica* - Hughes et al., pl. 1, figs. 11–12.
?2021 Dasycladales algae - Mehrabi et al., fig. 12i.

Remarks. For species description see Raineri (1922), Pia (1936), Kuss (1994), Schlagintweit and Wilmsen (2014) and Granier et al. (2017). The general thallus morphology is usually considered as club-shaped, while specimens from the Farashband section are clearly elongate-cylindrical (Fig. 4H). Here, *T. tripolitanus* occurs in wackestones while the club-shaped morphology is reported from well-agitated facies in other areas (e.g., Schlagintweit & Wilmsen 2014; Granier et al. 2017) that might indicate a palaeoenvironmental influence. In general, dasycladalean classification, the thallus morphology is considered a generic characteristic (e.g., Bassoullet et al. 1975, 1978, 1979; Deloffre 1988; De Castro 1997). The dimensions of the Iranian specimens (e.g., outer diameter D) are larger than those from the Lybian type-locality (Pia 1936) and one locality in Brazil (Granier et al. 2017) where maximum D values of 0.68 mm and 0.89 mm were indicated. From another Brazilian locality, Granier et al. (2017) however described large specimens with diameters of up to 1.325 mm that corresponds to our maximum value of D.

According to Reitner (1987, fig. 110, and p. 210), *T. tripolitanus* is restricted to the reef flat areas, platform sands (shoals) and the open lagoon of the Albian-Cenomanian carbonate platforms of northern Spain. It ranges up to the Santonian–Campanian boundary (Barattolo 2002, tab. 2) witnessing a reduced biostratigraphic relevance. *T. tripolitanus* ocuurs in the basal as well as the topmost parts of the Ilam Formation (= assemblage zones no. 30 and 31 of Wynd 1965). In the former it may be associated with *Salpingoporella ubaiydhi* Radoičić (Fig. 5A–B).

Dimensions (in mm, except d/D and w)**.**

D: 0.70–1.37 mm
d: 0.19-0.36 mm
d/D: 0.14–0.37
p: 0.09–0.12 mm
p’: 0.04–0.06 mm
p”: ~0.02 mm
l: 0.17–0.23 mm
l’: 0.10–0.12 mm
l”: ~0.04 mm
h: ~0.16 mm
w: ~9
L: 5.15 mm (see Fig. 4H)

Tribus Dissocladelleae Elliott, 1977
Genus *Dissocladella* Pia, 1936

Dissocladella ondulata (Raineri, 1922) Pia, 1936

Fig. 4A–F

1922 *Neomeris cretacea* var. *ondulata* Raineri, p. 75, pl. 3, figs. 5–11.
1936 *Dissocladella undulata* (Raineri) - Pia, p. 18, figs. 12–16.
2005 *Dissocladella bonardii* n. sp. - Radoičić et al., p. 313, pl. 1, figs. 4–17 (with synonymy).
2010 *Dissocladella* sp. - Bucur et al., p. 32, pl. 2, fig. 4.
2013 *Neomeris* sp. - Rahimpour-Bonab et al.,fig. 8Y.
2014 *Dissocladella bonardii* - Schlagintweit & Wilmsen, p. 18, fig. 6a-i.
2017 *Dissocladella ondulata* - Granier et al., fig. 1B–F.

Remarks. This taxon is distinctly smaller then *T. tripolitanus*, usually exhibits a higher d/D ratio and has just two orders of laterals. Whereas in the former they are elongated-clubshaped (Fig. 4I), they are subspherical in *D. ondulata* (Fig. 4A). Both species co-occur in the North-African type-locality (Lybia) that has lead to some taxonomic dissent (Pia 1936; Radoičić et al. 2005; Granier et al. 2017: ‘The Lybian *Dissocladella* controversy’). *D. ondulata* has a Cenomanian–Santonian stratigraphic range (Barattolo 2002).

Dimensions (in mm, except d/D and w; *data of Pia 1936, **data of Radoičić et al. 2005).

D: 0.28–0.52 mm (*0.24–0.32 mm; **0.14–0.35 mm)
d: 0.10–0.29 mm (*0.08–0.10 mm; **0.05–0.13 mm)
d/D: 0.39–0.56 (*31–37; **0.24–0.44)
p: 0.024–0.037 mm
p’: 0.06–0.08 mm
l: 0.078–0.12 mm (**0.03–0.07 mm)
l’: ~0.05 mm (**0.03–0.07 mm)
h: ~0.08–0.11 mm (**0.037–0.049 mm)
w: ~8 (*8; **7)

Tribus Salpingoporelleae Bassoullet et al., 1979
Genus *Salpingoporella* Pia in Trauth, 1918

Salpingoporella ubaiydhi Radoičić, 1979

Fig. 5A–B pars, C–M

1968 *Dissocladella undulata* (Raineri) Pia - Elliott, pl. 11, figs. 4–6.
1979 *Salpingoporella ubaiydhi* Radoičić, p. 97, pl. 1, figs. 1–7, pl. 2, figs. 1–3.
1992 *Salpingoporella ubaiydhi* - Okla, pl. 3, figs. 2–6.
1995a *Salpingoporella ubaiydhi* - Okla, p. 481, figs. 3/7–9.
1995b *Dissocladella undulata* Raineri - Okla, pl. 2, fig. 1.
2020 *Cymopolia tibetica* - Hughes et al., pl. 1, fig. 13.
2023 Dasycladaceae - Mehrabi et al., figs. 12D–E, G–I (H and I together with *T. tripolitanus*)

Remarks. Radoičić (1997) described the species from subsurface strata of the Western Iraqi Desert in different strata ascribed to the Santonian, Campanian and early Maastrichtian. As the partly associated *Orbitoides gensacicus* (Leymerie, 1851) is an upper Maastrichtian species (Caus et al. 1996; Özcan et al. 2021), the range of *S. ubaiydhi* is here extended. Among the different *Salpingoporella* species (see Carras et al. 2006) it is distinct by having laterals arranged in linear lines along the thallus and by displaying laterals with rounded ends thereby not touching neighbouring laterals.

Dimensions. See Tab. 1.

Occurrences. Iraq (Elliott 1968, ‘Turonian’ Sadi Formation, Musaiyib no. 1 well; Radoičić 1979, type-locality, Western Iraqi Desert), Abu Dhabi? (Elliott 1968, not illustrated, ‘Turonian’ of Ras Radr well 1), Saudi Arabia (Okla 1992, Maastrichtian Aruma Formation), Iran (Coniacian–Santonian Ilam Formation; this work). The occurrence in the Sinai, Egypt by Imam (1996) included in the synonymy of Carras et al. (2006) refers to ‘micropaleontologi-

data - parameter	Radoičić (1979), Maastrichtian of Iraq	Okla (1992), Maastrichtian of Saudi Arabia	Late Coniacian-Santonian of Iran
L max	2.50 mm	~ 8.0 mm	8.1 mm
D	0.240-0.65 mm	0.5-1.15 mm	0.35-0.97
d	0.080-0.320 mm	0.28-0.48 mm	0.14-0.52
d/D	-	-	0.22-0.52
p	0.040-0.090 mm	0.09-0.14 mm	0.07-0.15
w	8-14	14-23	10-20
h	0.050-0.096 mm	0.05 mm	0.08-0.17

Tab. 1 - Dimensions of *Salpingoporella ubaiydhi* Radoičić from the Ilam Formation of SW Iran compared to the Iraqi type-locality and the Aruma Formation of Saudi-Arabia.

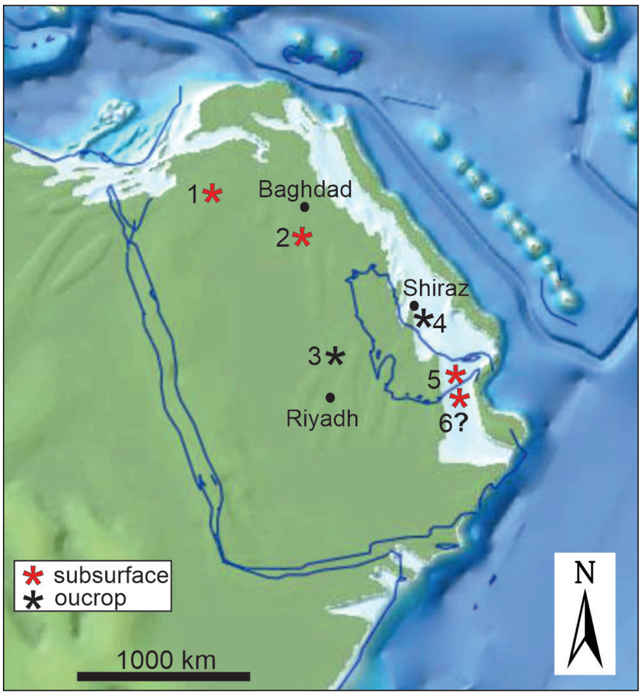


Fig. 6 - Palaeogeographic base map for the Santonian in the wider area of the Arabian plate showing distribution of *Salpingoporella ubaiydhi* Radoičić based on the synonymy list provided in the systematic part (map provided courtesy of Halliburton from the Neftex product suite).

cal fraud' where illustrations from Okla div. papers have been used (Granier et al. 2009 for details). These occurrences record a restriction (endemism) to the Arabian Plate (Fig. 6).

Family Polyphysaceae Kützing, 1843
Genus *Clypeina* (Michelin, 1845)

***Clypeina* cf. *dusanbrstinai* Radoičić, 1997**

Fig. 7A–F

1997 *Clypeina dusanbrstinai* Radoičić, p. 135, pl. 1, figs. 1–8, pl. 2, figs. 1–10, pl. 3, figs. 1–9.

Remarks. This species usually occurs as isolated verticil discs (e.g., Fig. 7A, D–F) or even individual branches dispersed in the micritic matrix accounting for some specific uncertainties (Fig. 7B, D). This might be the first record of the species since its description from Serbia by Radoičić (1997). The type strata have been assigned to the Santonian, but a Coniacian age might also be possible by the occurrence of *Accordiella conica* Farinacci, 1962 (see Frijia et al., 2015). In the Ilam Formation *C.* cf. *dusanbristinai* has been observed in the core data and the Khormuj section

? Family Polyphysaceae

Gen. et sp. indet.

Fig. 7G

Remarks. One oblique transverse sections of a comparably large dasycladale (D = ~4.0 mm, d = ~1.6 mm, w = ~20 to ~24) of unknown generic status (*Praturlonella*?, *Falsolikanella*?, *Milanovicella*?, *Clypeina*?). It shows similarities to equivalent sections of *Praturlonella jordanica* illustrated by Kuss and Conrad (1991, fig. 3.5–3.6) from the Cenomanian of Jordan. The distinctly larger size and the lack of further specimens (e.g. longitudinal sections) however account for the uncertain status of the find from Iran. The individual section has been detected in the upper part of the Ilam Formation (Santonian) from the core in the Persian Gulf and refers to the assemblage zone no. 31 of Wynd (1965).

Discussion on stratigraphy

Generally (with some exceptions), the larger benthic foraminifera experience a much better biostratigraphic resolution. Within the Zagros stratigraphic successions, an often-used local biozonation scheme is that of Wynd (1965), and James & Wynd (1965). This zonation corresponds to facies characteristic microfossil assemblages and does therefore not refer to a classical biozonation (Schlagintweit & Simmons 2022). Nonetheless, it has been proven useful in the correlation and recognising stratigraphic intervals. The 'biozones' are numbered consecutively from older to younger strata. Mostly

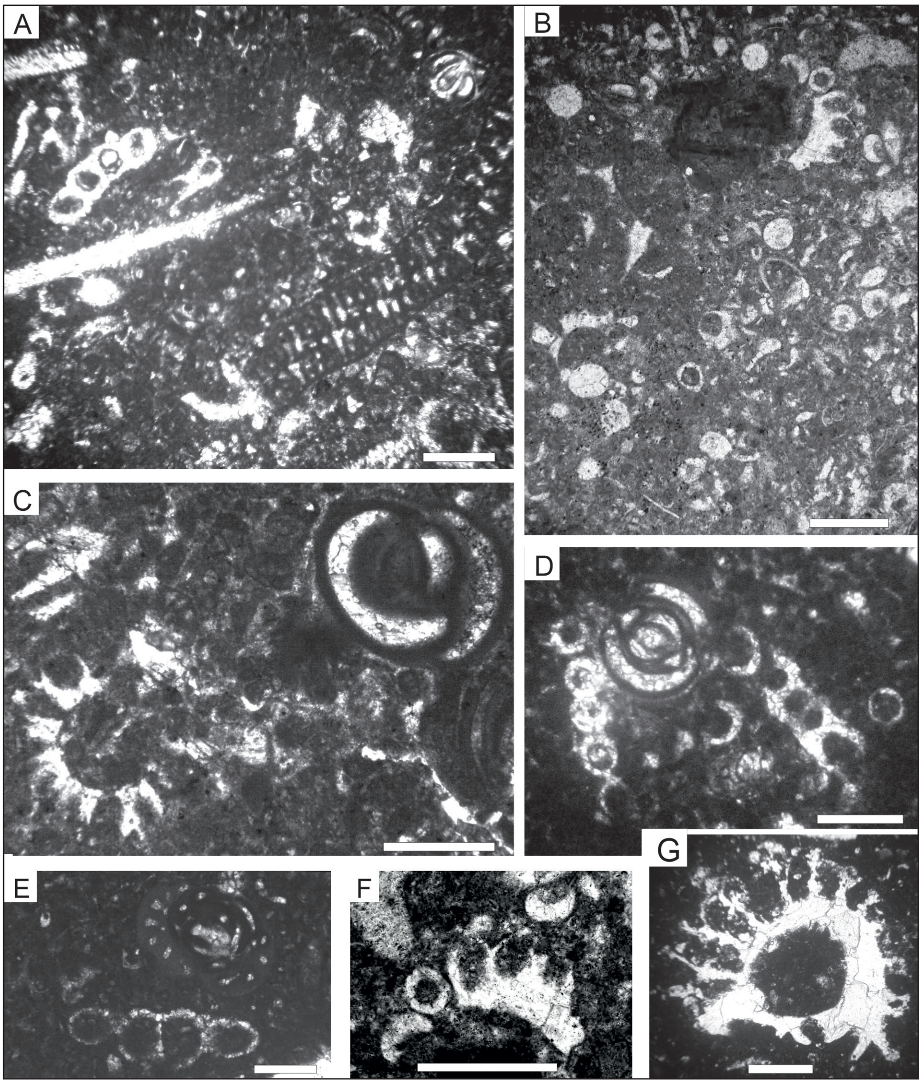


Fig. 7 - Dasycladales *Clypeina* cf. *dusanbrstinai* Radoičić (A–F) and Gen. et sp. indet. (G) from the Ilam Formation: Persian Gulf core data (A, C–E, G) and Khormuj section, Interior Fars (B, F). A–F) Bioclastic packstone with diverse sections of *C.* cf. *dusanbrstinai* associated with *Cuneolina-Dicyclina* (A), miliolids (C–D), and rhapydionidis (E). Typical preservation includes individual vertical discs (e.g., D) and/or isolated branches (including calcified envelope) dispersed in the sediment (B, F detail from B). G) Oblique section of a large-sized specimen. Scale bars 1.0 mm for G and 0.5 mm for all others. Thin-section of the Khormuj section DMS 3082 (B, F).

referring to larger benthic foraminifera, calcareous algae are sometimes included as typical constituents of the biofacies in certain stratigraphic interval such as the Ilam Formation. Since its description in the mid sixties, several new taxa of algae (here: Dasycladales) and benthic foraminifera have been established that have been recognized in the Cretaceous strata cropping out in the Iranian Zagros and partly been recognized also in other parts of the former Arabian Plate. Without any claim to completeness, the appendix lists most of them selectively referred here to the Aptian-Maastrichtian interval including the original literature reference. Besides new taxa, several forms included in the scheme of Wynd (1965) have meanwhile been revised (new combinations, synonymizations etc.). To avoid the future 'archaic usage' (Schlagintweit & Simmons 2022), they have been included in the Wynd scheme as summarized in table 2. As already mentioned, two 'biozones' have been established by Wynd (1965, p. 38) for the Ilam Formation: a lower '*Rotalia* sp. 22 - algae assemblage zone' (no. 30) '*normally succeeded by*' an upper '*Archaecyclus mid-orientalis - Pseudedomia* (*Fabularia*) zone (no. 31)'. It is worth mentioning that calcareous algae are present in both 'zones' and that the nominal reference just to the lower one (no. 30) is therefore misleading. A recent study has shown that certain morphotypes of "*Rotalia skourensis*" or *Rotalia* sp. in the Ilam Formation correspond to two new species, namely *Rotorbinella pachypila* Consorti, Bagherpour & Soleimani, 2024 and *Orbitokathina parva* Consorti, Bagherpour & Soleimani, 2024. With respect to the distribution of *O. mid-orientalis* in the upper part of the Ilam Formation, the name of the 'biozone' (no. 31 of Wynd 1965) is misleading in that in its major part, the eponymous taxon is not present (Figs. 2–3).

For the Ilam Formation a Coniacian–Campanian age was indicated (= Santonian–Campanian in James & Wynd 1965; Coniacian–Santonian in Shar-

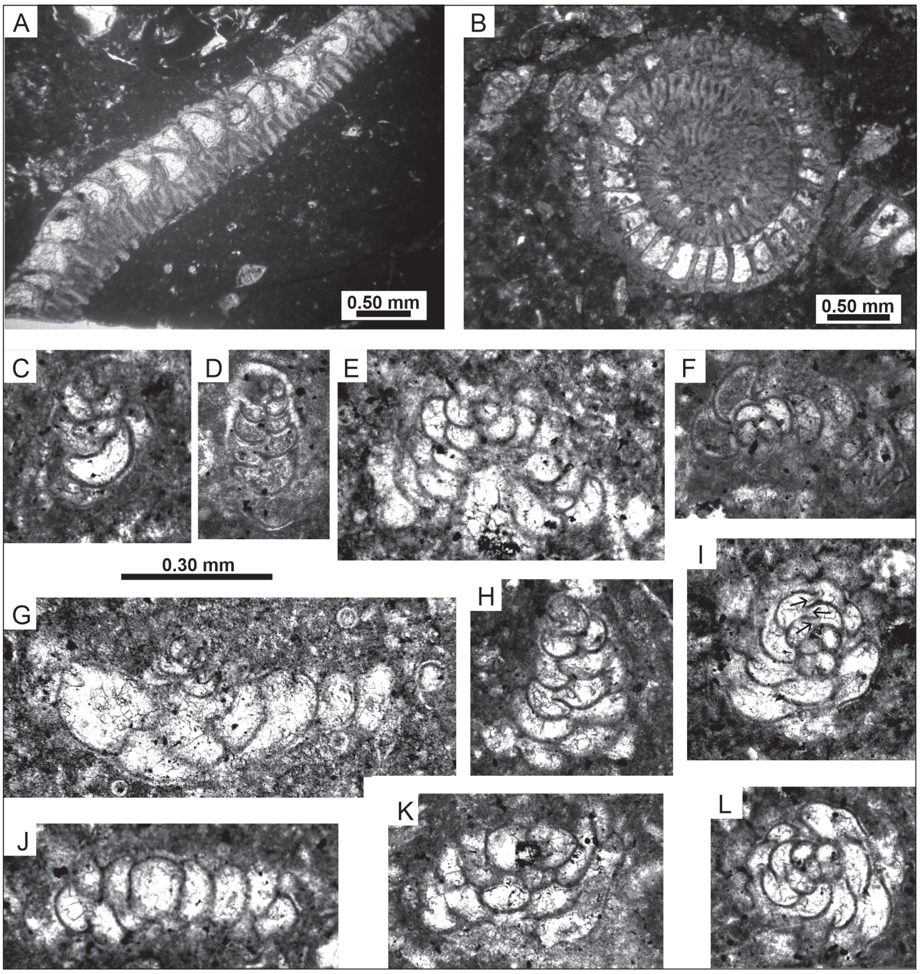


Fig. 8 - *Orbitokathina vonderschmitti* Hottinger (A–B) and *Orbitoides mid-orientalis* (Eames & Smout) (C–L) from the Ilam Formation: Persian Gulf core data (A–B) and Khormuj section, Interior Fars (C–L). (A) Slightly oblique axial section of microspheric specimen. (B) Slightly oblique equatorial section of a megalospheric specimen. (C–D, H) (Oblique) axial views of the initial spiral stage. (E, G, K) Oblique sections passing through initial coiled stage and adult stage with chambers in annular series. (F, H–I, L) Partly slightly oblique equatorial sections. Note interiomarginal foramina of the early coiled stage (arrows in I). (J) Oblique axial section. Thin-sections of the Khormuj section DMS 3101 (C), DMS 3102 (E, G), DMS 3103 (J), DMS 3112 (F, K–L), DMS 3113 (D, H).

land et al. 2001, Consorti et al. 2024; Santonian only in Alavi 2004; Piryaei et al. 2010). The investigated borehole (Mehrabi et al. 2023) was drilled through the complete Ilam Formation down to the Laffan Formation. The larger benthic foraminifer *Ortbitokathina vonderschmitti* occurs about 9 m from the base of the Ilam Formation up to its top, altogether over a vertical distance of ~106 m including both A- and B-forms (Figs. 2, 8A–B). In its Spanish type-area, *O. vonderschmitti* has a late Coniacian–middle Santonian range (Boix et al. 2009, fig. 2) (Fig. 2 right). Therefore, it appears reasonable to assume a late Coniacian age for the base of the Ilam Formation. On the other hand, we must also admit that this conclusion is only provisional lacking an accurate verification of correlation of the Spanish and Iranian biostratigraphic data. In addition, the Coniacian–Santonian boundary is difficult to assess in neritic carbonates based on larger benthic foraminifera.

In recent times, also the inclusion of upper Turonian strata for the Ilam Formation has been suggested based on the occurrence of the larger benthic foraminifer *Reticulinella*? *kaeveri* Cherchi et al. (Hosseini et al. 2024). This species has been found primarily in the basal parts of the Khormuj section and the core section, but occasionally also in the middle part. The further discussion focuses on the eponymous taxa of ‘biozone 31’, *Archaecyclus mid-orientalis* Eames & Smout and *R.*? *kaeveri*.

Orbitoides mid-orientalis (Eames & Smout, 1956)

This species was first described by Eames & Smout (1956, p. 505) as *Archaecyclus mid-orientalis* from ‘*limestones of Campanian age in the Kuwait Oil Company's Umm Gudair Well 1*’. This age assignment was due to its occurrence ‘*below beds of Maestrichtian age with* Omphalocyclus’. Eames & Smout (1956) noted structural affinities to *Orbitoides* Douvillé, and it has subsequently been accepted by several workers that it should be treated as a primitive species of this genus displaying a distinct trochospirally coiled early stage (Van Gorsel 1978; Albrich et al. 2014) (Fig. 8C–K). Whether or not this stage is strictly bi-

Wynd 1965	Comment	Formation/ Stratigraphy	Benthic foraminifera	Algae
Omphalocyclus-Loftusia assemblage zone (no. 37)	*Omphalocyclus*-orbitolinid-*Loftusia* assemblage zone	Tarbur Fm. (upper part), upper Maastrichtian	*Accordiella*? *tarburensis, Baktiariella naghanensis, Broeckina* cf. *dufrenoyi, Broeckinella arabica, Broeckinella hensoni, Dictyoconella complanata, Dictyoconus bakhtiari, Dicyclina schlumbergeri, Flabelloperforata tarburensis, Fleuryana adriatica, Gusicella minima, Gyroconulina columellifera, Idalina praecaenozoica, Laffiteina monodi, Loftusia* ssp., *Neobalkhania bignoti, Neodubrovnikella maastrichtiana, Omphalocyclus macroporus, Pachycolumella elongata, Palaeoelphidium multiscissurata, Persiacyclammina maastrichtiana, Persiella pseudolituus, Pseudochablaisia subglobosa, Pseudorbitolina schroederi, Pseudonummoloculina kalantarii, Reticulinella fleuryi, Spirolina*? *farsiana, Suraqalatia brasieri, Tarburina zagrosiana, Zagrosella rigaudii*	*Halimeda* sp., *Cymopolia eochoristospora, Salpingoporella pasmanica, Pseudocymopolia acuta, Pseudocymopolia anadyomenea, Uteria naghanensis, Zittelina*? *arumaensis*
Monolepidorbis-Orbitoides assemblage zone (no. 36)	Orbitoidids-siderolitids assemblage zone	Tarbur Fm. (lower part), upper Maastrichtian	*Siderolites calcitrapoides, Canalispina iapygia, Omphalocyclus macroporus, Suraqalatia brasieri*	*Suppiluliumaella tarburensis, Cymopolia eochoristospora*
Lopha limestone member (no. 35)	Primitive orbitoidids-*Neumannites* assemblage zone	Member within Gurpi Fm (upper part)., upper Campanian	*Orbitoides* gr. *hottingeri-sanctae-pelagiae, Sirtina granulata*	-
Archaecyclus mid-orientalis-Pseudedomia ('Fabularia') assemblage zone (no. 31)	*A. mid-orientalis* = *Planorbulinella* acc. to Rahaghi (1989) = *Acervulina cenomaniana* acc. to Brönnimann (1998) = *Orbitoides mid-orientalis* acc. to Van Gorsel (1978)	Ilam Fm., upper Coniacian?-Santonian	*Orbithokathina vonderschmitti, Rotorbinella pachypila, Orbitokathina parva, Orbitoides mid-orientalis, 'Pseudedomia', Dicyclina schlumbergeri, Nezzazatinella picardi, Moncharmontia apenninica, Periloculina drobnae,Reticulinella*? *kaeveri*	*Clypeina* cf. *dusanbrstinai*
Rotalia sp. 22-algae assemblage zone (no. 30)	Rotaliid-algae assemblage zone	Ilam Fm., upper Coniacian	*Dicyclina schlumbergeri, Rotorbinella pachypila, Orbitokathina parva*	*Salpingoporella ubaiydhi,Trinocladus tripolitanus*
Mangashtia-Reticulinella? assemblage zone (no. 29b)	see Schlagintweit et al. (2023)	Sarvak Fm. uppermost part; middle-upper Turonian	*Mangashtia viennoti* (common), *Reticulinella*? *kaeveri, Dicyclina schlumbergeri*, cuneolinids, *Nezzazata* ssp., *Nezzazatinella* sp., *Pseudonummoloculina* sp.	*Trinocladus tripolitanus*
Valvulammina-Dicyclina assemblage zone (no. 29a, most likely Turonian)	*Nezzazatinella-Dicyclina* assemblage zone	Sarvak Fm. upper part; Turonian	*Mangashtia viennoti* (rare), *Dicyclina schlumbergeri, Nezzazatinella* sp. (= cf. *aegyptiaca* sensu Chiocchini and Mancinelli, 1978), cuneolinids, *Nezzazata* ssp., *Moncharmontia apenninica, Rotorbinella mesogeensis,*	*Trinocladus tripolitanus* thaumatoporellaceans (incertae sedis)
Nezzazata-alveolinid assemblage zone (no. 25, Cenomanian-?Turonian)	*Nezzazata*-alveolinoids assemblage zone	Sarvak Fm. middle part; Late middle, p.p. upper Cenomanian	*Biconcava bentori, Biplanata peneropliformis, Chrysalidina gradata, Dicyclina sampoi, Ebrahimiella dercourtii, Heterocoskinolina* sp., *Iraqia ultima, Merlingina cretacea, Moncharmontia apenninica, Murgeina apula, Neodubrovnikella turonica, Neoiraqia insolita, Orbitolinella depressa, Orbitolinopsis cenomaniensis, Persiconus sarvaki, Planinummoloculina gnosi, Praealveolina tenuis, Pseudolituonella reicheli, Pseudotextulariella brevicamerata, Reticulinella reicheli, Pseudocyclammina sarvakensis, Simplalveolina simplex, Simplorabanitina simplex, Nezzazata* div. sp.	*Salpingoporella pasmanica* thaumatoporellaceans (incertae sedis)
Trocholina-Orbitolina assemblage zone (no. 21, Albian?-Cenomanian)	*Coscinoconus*-orbitolinid assemblage zone	Sarvak Fm., Mauddud Fm., upper Albian-lower Cenomanian	*Coscinoconus altispirus, C. arabica, Hensonipapillus lenticularis, Orbitolina sefini, O. concava, Mesorbitolina aperta, Neoiraqia insolita,*	*Permocalculus irenae*
Hemicyclammina-Orbitolina assemblage zone (no. 19, Albian-?Cenomanian)	*Hemicyclammina*-orbitolinid assemblage zone	Kazhdumi Formation, lower-middle, pp. upper Albian	*Hemicyclammina whitei, Mesorbitolina subconcava, M. texana, Palorbitolinoides hedini, Daxia cenomana* (upper part)	-
Conical *Orbitolina* assemblage zone (no.18)	Conical *orbitolinid* assemblage zone	Dariyan Fm. (upper part), Kazhdumi Fm. (lower part), upper Aptian-p.p. lower Albian	*Mesorbitolina* gr. *tibetica-texana*	-
Hensonella-Orbitolina-Choffatella assemblage zone (no. 16)	*Salpingoporella dinarica*-orbitolinid-*Choffatella* assemblage zone; *Hensonella cylindrica* = *Salpingoporella dinarica*	Dariyan Fm., upper Barremian-lower Aptian	*Choffatella decipiens, Montseciella*? *arabica, Nezzazata* sp., *Ovalveolina*? *primigenita, Palorbitolina lenticularis, Palorbitolinoides* cf. *pileus, Praechrysalidina infracretacea, Praeorbitolina cormyi-wienandsi*	*Salpingoporella dinarica*

Tab. 2 - Microfauna and microflora of upper Barremian–Maastrichtian shallow-water carbonates from southwestern Iran occurring in the assemblage zones of Wynd (1965) (see also the appendix).

serial in *O. mid-orientalis* needs further clarification in our opinion (e.g., Georgescu & Almogi-Labin 2008). In any case, O. *mid-orientalis* is here considered a valid species with a well-developed coiled stage and interio-marginal foramina differing from the other primitive species. *O. hottingeri* Van Hinte has a distinctly reduced early coil and orbitoidal foramina (= on both sides of the chamber) already in the third chamber (Caus et al. 1996; Albrich et al. 2014). Van Gorsel (1978, p. 37) envisaged a possible synonymy of *O. mid-orientalis* (Eames & Smout, 1956) with *O. hottigeri* Van Hinte, 1966.

These early primitive forms of *Orbitoides* originated in the late Santonian (e.g., Van Gorsel

1978; Caus et al. 1996) or even around the early–middle Santonian boundary (Boix et al. 2009; Fig. 7). In the Khormuj section, *O. mid-orientalis* occurs around 17 m above the last occurrence of *R.? kaeveri* (Fig. 3) and, as such, provides further evidence that the Turonian age for the Ilam Formation suggested by Hosseini et (2024) has to be rejected.

***Reticulinella? kaeveri* Cherchi, Radoičić & Schroeder, 1989**

Based on data deriving from Apenninic-Dinaridic-Hellenidic mountains chains, *R.? kaeveri* has been considered an intra-Turonian marker taxon (Cherchi et al. 1989; Frijia & Parente 2008; Frijia et al. 2015; Schlagintweit et al. 2023). Together with *Mangashtia viennoti* Henson, it has been recorded recently from the Sarvak Formation of the Khormuj section of southwestern Iran in time-equivalent strata between the two subaerial exposure surfaces (Schlagintweit et al. 2023) that were ascribed to the early Turonian and the late Turonian-early Coniacian respectively. The supposedly lower Coniacian paleosols associated with the upper exposure surface can be considered as time-equivalent to the Laffan Formation (Fig. 1B). Hosseini et al. (2024) recorded the occurrence of *R.? kaeveri* in the basal parts of the Ilam Formation from the Khormuj section that is confirmed by our restudy. Based on the published data from the peri-Mediterranean realm (see above), Hosseini et al. (2024, p. 21) concluded that the '*lower part of the Ilam Formation is upper middle to upper Turonian*' meaning a '*significant improvement in the chronostratigraphic calibration of sequence stratigraphy in the Cretaceous of the Zagros fold-and-thrust belt*'. The statement of Hosseini et al. (2024, p. 21) that 'Reticulinella? kaeveri *has a wider range than previously suggested*' was therefore not referring to chronostratigraphic range but a wider distribution than just the upper Sarvak Formation. The lack of *Mangashtia viennoti* Henson, 1948 the typical companion of *R.? kaeveri* in the upper Sarvak Formation, in the Ilam Formation including the Khormuj section and several others (unpublished data), is worth mentioning here. The record of *M. viennoti* in the Ilam Formation of the Persian Gulf core data (Mehrabi et al. 2023, fig. 11O) is in fact to be referred to another species (not belonging to the genus *Mangashtia* Henson, 1948) that will be described by one of us (F.S.) from the Upper Cretaceous of Tibet.

At first, one could think that the reticulinellids observed in the Ilam Formation in fact belong to *Reticulinella fleuryi* Cvetko, Gušić & Schroeder, 1997 et al., a species that is known from the middle Coniacian to late Maastrichtian (Schlagintweit & Sanders 2008; Schlagintweit et al. 2024) (Fig. 9L–U). A comparison with type-material from the Campanian of the island of Brač shows that *R.? kaeveri* has a strictly globular morphology, may attain larger dimensions and more solid (thicker) partitions. In *R. fleuryi*, the wall and internal structures are more delicate and the morphology is different. In fact, a tendency to uncoiling is observable along with an increase of height and width of the chambers during ontogeny resulting in peneropliform morphologies (Fig. 9M–N). These apparently larger sized specimens might be referable to microspheric specimens. But also, the undoubted megalospheric forms show a slight tendency to uncoil (Fig. 9L, 9Q). In addition, axial sections are slightly compressed (Fig. 9T; height diameter ratio < 1) and the radial partitions are more close-set. For further differences see Cvetko et al. (1997). The original descriptions of *R. kaeveri* (Turonian strata) and *R. fleuryi* (Campanian strata) indicate similar number of whorls (up to three) and equivalent dimensions (up to 0.47 mm and up to 0.46 mm). The specimens of *R.? kaeveri* from the Ilam Formation may show larger dimensions (up to 0.96 mm, Fig. 9E) and a greater number of whorls (up to five) that are here considered as just an infraspecific evolution. Accepting that the specimens observed in the basal Ilam Formation belong to *R.? kaeveri* we come to a conclusion different from Hosseini et al. (2024), namely the extension of the stratigraphic range into the Coniacian - early Santonian as deduced from the distribution of *Orbitoides mid-orientalis* as discussed previously. In summary, the cited intra-Turonian range of *R.? kaeveri* was based on limited data from the Mediterranean region. In the Iranian Zagros, it may well be that it has a longer range (i.e., into the Coniacian and/or Santonian), rather than being a biostratigraphic tool to assign a Turonian age. This is supported by other fossil occurrences in the Ilam Formation.

Conclusions

Micropalaeontological studies have been carried out on the poorly known assemblages of

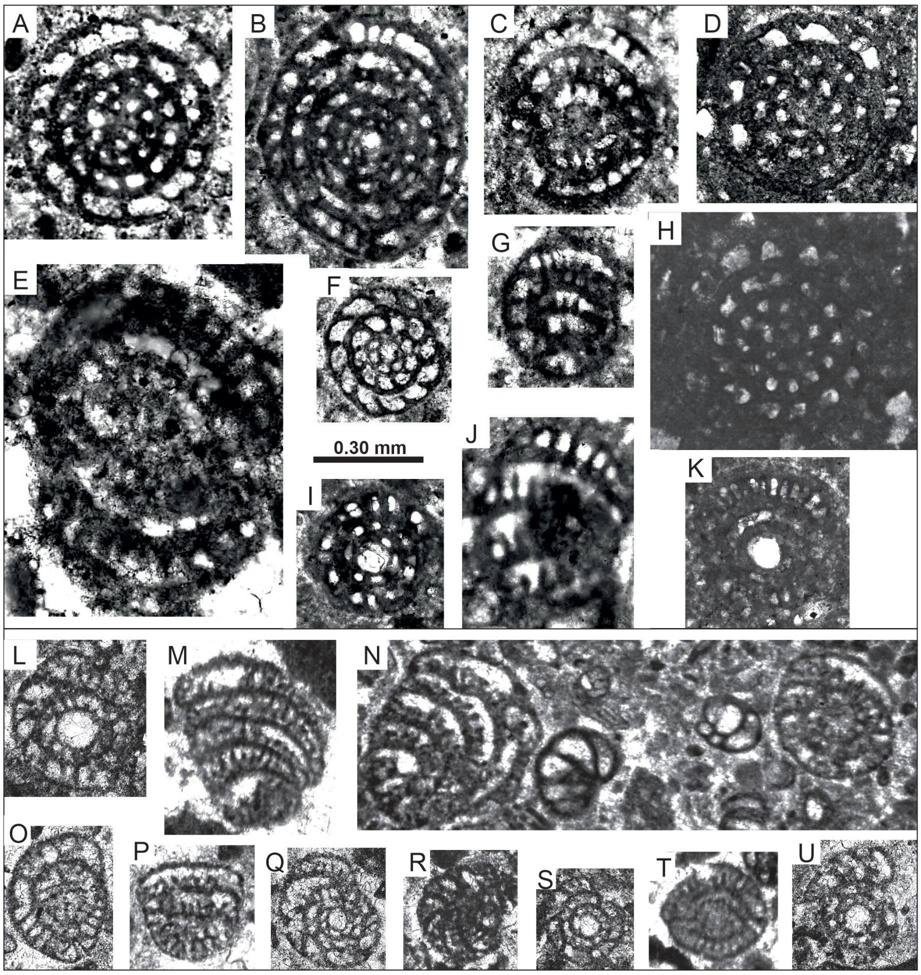


Fig. 9 - *Reticulinella*? *kaeveri* Cherchi et al. from the Ilam Formation of SW Iran (Khormuj section: A–G, I–K and Persian Gulf core data: H) and *Reticulinella fleuryi* Cvetko et al. from the Campanian type-locality and –area (L–U). (A, D, F, H–I, L, Q, S, U) (Sub)Equatorial sections. (B) Oblique equatorial section. (C, E, K, P, T) (Sub)Axial sections. (G, J, R) Oblique tangential sections. (O, M–N) Oblique sections. Note the large-sized specimens with uncoiling adult test part in M–N (possible microspheric specimens). Thin-sections of the Khormuj section DMS 3014 (J) DMS 3017 (A), DMS 3018 (B–C, F-G), DMS 3019 (E), DMS 3036 (D, I, K).

Dasycladalean green algae in the Upper Cretaceous Ilam Formation of southwestern Iran comprising subsurface and outcrop data. The microflora consists of just a few Late Cretaceous taxa that are not suited for precise biostratigraphic dating. The larger benthic foraminifera are much better suited for providing age informations. The recently proclaimed late Turonian age for the basal part of the Ilam Formation can be excluded; instead a late Coniacian age is here suggested. A marker taxon for fixing the Coniacian-Santonian boundary however appears not present. An update for the taxonomic inventory (dasycladales and larger benthic foraminifera) of the p.p. Lower and Upper Cretaceous formations cropping out in the Zagros zone and widely used in the zonation of Wynd (1965) is provided.

Appendix of taxa mentioned in the text in alphabetic order (see references)

Calcareous algae
Cymopolia eochoristosporica Elliott, 1968
Clypeina dusanbrstinai Radoičić, 1997
Disscocladella ondulata (Raineri, 1922)
Pseudocymopolia acuta Rashidi & Schlagintweit, 2019b
Pseudocymopolia anadyomenea (Elliott, 1959)
Permocalculus irenae Elliott, 1958
Salpingoporella dinarica Radoičić, 1959
Salpingoporella pasmanica Radoičić, 2002
Salpingoporella ubaiydhi Radoičić, 1979
Suppiluliumaella tarburensis Rashidi & Schlagintweit, 2018
Trinocladus tripolitanus Raineri, 1922
Uteria naghanensis Rashidi & Schlagintweit, 2019a
Zittelina arumaensis (Okla, 1995b)

Foraminifera
Accordiella? *tarburensis* Schlagintweit & Rashidi, 2016
Bakhtiariella naghanensis Schlagintweit & Rashidi, 2022
Biconcava bentori Hamaoui, 1965
Biplanata peneropliformis Hamaoui & Saint-Marc, 1970
Broeckina cf. *dufrenoyi* (d'Archiac & Haime in d'Archiac, 1854)
Broeckinella arabica Henson, 1948
Broeckinella hensoni Schlagintweit & Rashidi, 2020
Canalispina iapygia Robles-Salcedo et al., 2019
Choffatella decipiens Schlumberger, 1905
Coscinoconus altispirus (Henson, 1947)
C. arabicus (Henson, 1947)
Chrysalidina gradata d'Orbigny, 1839
Daxia cenomana Cuvillier & Szagall, 1949
Dictyoconella complanata Henson, 1948
Dictyoconus bakhtiari Schlagintweit et al., 2016a
Dicyclina sampoi Cherchi & Schroeder, 1990
Dicyclina schlumbergeri Munier-Chalmas, 1887

Ebrahimiella dercourti (Decrouez & Moullade, 1974)
Flabelloperforata tarburensis Schlagintweit & Rashidi, 2017a
Fleuryana adriatica De Castro et al., 1994
Gusicella minima (Henson, 1948)
Gyroconulina columellifera Schroeder & Darmoian, 1977
Hensonipapillus lenticularis (Henson, 1947)
Hemicyclammina whitei (Henson, 1948)
Idalina praecaenozoica Consorti et al., 2021
Iraqia ultima Yazdi-Moghadam & Schlagintweit, 2023
Laffiteina monodi Marie, 1945
Mangashtia viennoti Henson, 1948
Merlingina cretacea Hamaoui, 1965
Mesorbitolina aperta (Erman, 1854)
Mesorbitolina subconcava (Leymerie, 1878)
Mesorbitolina texana (Roemer, 1849)
Mesorbitolina gr. *tibetica* (Cotter, 1929)-*texana* (Roemer, 1849)
Moncharmontia apenninica (De Castro, 1966)
Montseciella? *arabica* (Henson, 1948)
Murgeina apula (Luperto Sinni, 1969)
Neobalkhania bignoti Cherchi et al., 1991
Neodubrovnikella turonica (Said & Kenawy, 1957)
Neodubrovnikella maastrichtiana Schlagintweit & Rashidi, 2018
Neoiraqia insolita (Decrouez & Moullade, 1974)
Nezzazatinella picardi (Henson, 1947)
Omphalocyclus macroporus (Lamarck, 1816)
Orbitoides mid-orientalis (Eames & Smout, 1956)
Orbitokathina parva Consorti et al., 2024
Orbithokathina vonderschmitti Hottinger, 1966
Orbitolina sefini Henson, 1948
O. concava (Lamarck, 1816)
Orbitolinella depressa Henson, 1948
Orbitolinopsis cenomaniensis Schlagintweit & Yazdi-Moghadam, 2020
Ovalveolina? *primigenita* Hosseinizadeh et al., 2020
Pachycolumella elongata Septfontaine et al., 2019
Palaeoelphidium multiscissuratum (Smout, 1955)
Palorbitolina lenticularis (Blumenbach, 1805)
Palorbitolinoides hedini Cherchi & Schroeder, 1980
Palorbitolinoides cf. *pileus* (Fossa-Mancini, 1928)
Periloculina drobnae Rahaghi, 1989
Persiacyclammina maastrichtiana Schlagintweit & Rashidi, 2017b
Persiconus sarvaki Yazdi-Moghadam & Schlagintweit, 2020
Persiella pseudolituus Schlagintweit & Rashidi, 2017a
Planinummoloculina gnosi Piuz & Vicedo, 2020
Praealveolina tenuis Reichel, 1933
Praechrysalidina infracretacea Luperto Sinni, 1979
Praeorbitolina cormyi-wienandsi Schroeder, 1964
Pseudochablaisia subglobosa Schlagintweit et al., 2019
Pseudocyclammina sarvakensis Schlagintweit & Yazdi-Moghadam, 2023
Pseudolituonella reicheli Marie, 1954
Pseudonummoloculina kalantarii Schlagintweit & Rashidi, 2016
Pseudorbitolina schroederi Luger, 2018
Pseudotextulariella brevicamerata Schlagintweit & Yazdi-Moghadam, 2023
Reticulinella? *kaeveri* Cherchi et al., 1989
Reticulinella fleuryi Cvetko et al., 1997
Reticulinella reicheli (Cuvillier et al., 1969)
Rotorbinella mesogeensis (Tronchetti, 1981)
Rotorbinella pachypila Consorti et al., 2024
Siderolites calcitrapoides Lamarck, 1801
Simplalveolina simplex (Reichel, 1936)
Simplorabanitina simplex Consorti et al., 2023
Sirtina granulata (Rahaghi, 1976)
Spirolina? *farsiana* Schlagintweit & Rashidi, 2016
Suraqalatia brasieri Görmüş et al., 2017
Tarburina zagrosiana Schlagintweit et al., 2016b
Zagrosella rigaudii Schlagintweit & Rashidi, 2017c.

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