



## ***Demirina meridionalis* Özcan, 1994, Cenomanian larger benthic foraminifera from the Natih Formation of Oman: First record outside the type area and emendation of the genus**

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**ABSTRACT** - *Demirina meridionalis* Özcan, 1994 is the only known species of the larger benthic foraminifera genus *Demirina* Özcan, 1994. It was described as a nezzazatid (subfamily Coxitinae) from the Cenomanian of SE Turkey (Arabian Plate margin) based on limited and rather poorly preserved material. Several well-preserved specimens of *D. meridionalis* are found in the Cenomanian Natih Formation (members E to B) of Oman. A close architectural analysis of these fossil shells displays a short single rafter in the marginal chamber part, and beams generally aligned between subsequent chambers, which allows the transfer of *Demirina* to the order Loftusiida, and the family Spirocyclinidae. *Reissella ramonensis* Hamaoui, 1963, another little known loftusiid larger benthic foraminifera first described from the Cenomanian of Israel, as well as *Spirocyclus atlasica* Saint-Marc and Rahhali 1982 first reported from the Cenomanian of Morocco, are shown to differ from *Demirina* mainly by their test morphology and chamber shape. The Omani material represents the first record of *D. meridionalis* outside its type area in southeastern Turkey; a paleogeographic restriction to the former Arabian Plate is suggested, and a stratigraphic distribution ranging from the uppermost early to middle Cenomanian is proposed.

**Keywords:** Foraminifera; Loftusiida; Cenomanian; biostratigraphy; systematics.

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### **1. INTRODUCTION**

The Larger Benthic Foraminifera (LBF) are a group of very useful biostratigraphic taxa that are not only “large” but also require analysis of their internal structures to determine taxonomy and identity. They are particularly diversified during the Cenomanian, in the widespread equatorial tropical and sub-tropical shallow water carbonate platforms of the peri-Neotethys realm (e.g. Henson, 1948 a,b,c, Sampò, 1969, Moullade et al., 1985; Schroeder and Neumann, 1985; Consorti et al., 2015, 2022; Schlagintweit and Yazdi-Moghadam, 2023; Simmons and Bidgood, 2023; Simmons et al., 2025 a,b; Yazdi-Moghadam and Schlagintweit, 2021, 2023). Since the outstanding work of Schroeder and Neumann (1985), many new taxa have been described, sometimes based on imperfect or limited material. In recent years, the works of Bidgood and Simmons (2022), Bidgood et al. (2024), Simmons and Bidgood (2023), Simmons et al. (2025 a,b) summarized

the latest research on stratigraphic and palaeogeographical distribution of mid-Cretaceous LBF and provided practical guides to identification. They however evidenced that taxonomy often remained a “work in progress” and many taxa necessitated more in-deep studies.

*Demirina* (type-species *D. meridionalis* Özcan, 1994) was placed by Özcan (1994) in the Coxitinae Hamaoui and Saint-Marc, 1970 (characterized by the presence of subepidermic internal elements [e.g., beams] [Hamaoui and Saint-Marc, 1970, p. 321, “éléments structuraux internes supplémentaires sous-épidermique”]) and thought to be a possible early member of the internally subdivided Nezzazatidae Hamaoui and Saint-Marc, 1970, respectively the subfamily Coxitinae.

Since its description in 1994, *D. meridionalis* has only been found a second time in the type area of southeast Anatolia (Turkey). The type-locality is a Cenomanian-Turonian outcrop of the Karadut Formation in the Kahta-Adiyaman region (Özcan, 1994), and it has been reported

from Cenomanian samples of the Derdere Formation in the Derik field section (Özkan and Altiner, 2019). Geotectonically, these two localities in southeastern Turkey are part of the Arabian Plate. Here we report *D. meridionalis* for the first time outside Turkey, from the early-middle Cenomanian of Oman, and provide new data on the inner structure of the test, leading to a taxonomic revision of the genus and species.

## 2. GEOLOGICAL SETTING

During the mid-Cretaceous, the area today referred to the Sultanate of Oman was part of an extensive carbonate platform complex approximately 1000 km wide and 1200 m thick on the southern margin of Neotethys (Droste and Van Steenwinkel, 2004). The latest Aptian to mid-Turonian Wasia Group comprises the marls of the Nahr Umr Formation at the base, and carbonates of the Natih Formation at the top (Van Buchem et al., 2011). The upper Albian to Turonian Natih Fm. consists mainly of thick bedded, shallow water, mud supported bioclastic limestones with diversified larger foraminifera (e.g., Simmons and Hart, 1987; Piuz et al., 2014; Vicedo and Piuz, 2016; Piuz and Vicedo, 2020; Schlagintweit et al., 2025), and intraplatform basin organic rich calcareous shales with planktonic foraminifera (Bromhead et al., 2022). Deposition was interrupted several times by subaerial exposure with repeated emersions and incisions (Immenhauser et al., 2000; Droste and Van Steenwinkel, 2004; Grélaud et al., 2006, 2010; Homewood et al., 2008). Various hardgrounds mark disconformities across the Natih Fm.; some are easily recognizable in the field and are commonly used for correlation in the Adam Foothills (e.g. Van Buchem et al., 1996, 2002). Based on subsurface logs, petroleum geologists separated the Natih Fm. into seven informal lithostratigraphic members (Hughes Clarke, 1988; Scott, 1990; Forbes et al., 2010) labeled “A” to “G” from top to base. These members, together with various remarkable surfaces, are commonly used for regional correlations. The Natih Fm is locally well exposed in northern Oman (southern flank of Jabal Akhdar and Adam foothill) where it has been extensively studied. Detailed sedimentology was developed by Philip et al. (1995), Van Buchem et al. (1996, 2002), Homewood et al. (2008). Age calibration is based on ammonites (Kennedy and Simmons, 1991; Van Buchem et al., 1996, 2002, 2011; Meister and Piuz, 2013, 2015), benthic foraminifera (Simmons and Hart, 1987; Simmons et al., 2000, Forbes et al., 2010 - although much of the distinctive ones are endemic, e.g., Piuz et al., 2014; Vicedo and Piuz, 2016), planktonic foraminifera (Kennedy and Simmons, 1991); rudists (Philip et al., 1995), as well as chemostratigraphy (Wohlwend et al., 2016). Bromhead et al. (2022, figure 4 and p. 127-128) summarize the age and sequence stratigraphy for the different Natih members.

No ammonites were found in the Wadi Nakhr field section on the southern flank of Jabal Akhdar but Alveolinoid assemblages allow biostratigraphic

correlations. Alveolinoid assemblage I is uppermost early Cenomanian (Piuz et al., 2014; Bromhead et al., 2022); assemblages II and III are middle Cenomanian (Vicedo and Piuz, 2016; Bromhead et al., 2022).

*Demirina meridionalis* was found in samples from the Natih E to lower Natih B member, suggesting an early to middle Cenomanian age (Bromhead et al., 2022). It is found in wackestones, associated with several other LBF such as *Heterocoskinolina saintmarci* Luger, 2018, *Neoiraqia insolita* (Decrouez and Moullade, 1974), *Orbitolinella depressa* Henson, 1948, *Planinummoloculina gnosi* Piuz and Vicedo, 2020, *Decastroia miaidinensis* Vicedo and Piuz, 2016, *Reichelina magna* Vicedo and Piuz, 2016, *D. razini* Vicedo and Serra-Kiel, 2011, *D. oblonga* Vicedo and Piuz, 2016, *D. serrakieli* Vicedo and Piuz, 2016, *Simplexveolina* gr. *simplex* (Reichel, 1937); as well as *Chrysalidina gradata* (d'Orbigny, 1839), *Nezzazata* gr. *gyra* (Smout, 1956), *N. simplex* Omara, 1956, *Nezzazatinella* sp., *Biconcava bentori* Hamaoui, 1965, *Murgeina apula* (Luperto-Sinni, 1969), *Rotorbinella mesogeensis* (Tronchetti, 1981), *Cuneolina* spp., *Trocholina* spp., and various miliolids.

## 3. MATERIAL AND METHODS

The material presented in this study was collected during two field trips in Oman in 2009 and 2012. The Natih Formation is well exposed in the northern part of the country, particularly in the southern flank of Jabal Akhdar and in the Adam Foothills. Figure 1 gives the geographic location of the studied field sections located in Wadi Nakhr (southern side of Jabal Akhdar), and Jabal Madar, Jabal Madmar (two field sections), Jabal Khaydalah, Jabal Salakh (two field sections) and Jabal Qusaybah or Fitri (Adam foothills).

*Demirina meridionalis* was found in Wadi Nakhr, Jabal Nadah, Jabal Salakh, Jabal Khaydalah, Jabal Madmar,

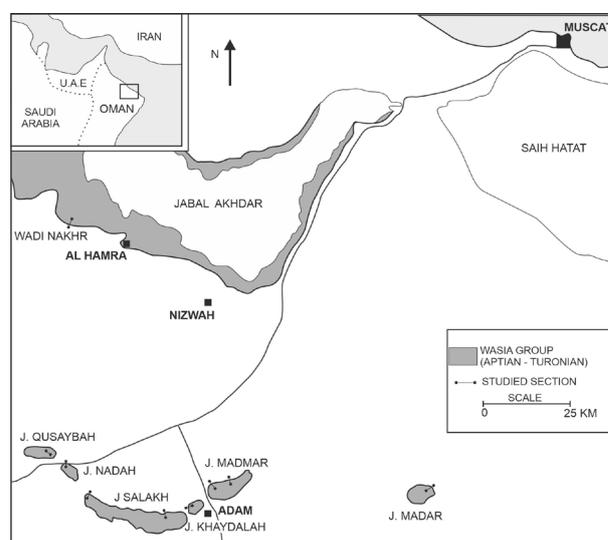


Fig. 1 - Geographical and geological setting of the studied localities.

and Jabal Madar in hard limestones, and studied in thin sections. They are rare in our material; found only in a dozen (out of 220) of rock samples. The 130 sections used to detail the shell architecture were photographed from about 50 thin sections with 1 to 4 test specimens per thin section. The material figured in this paper is housed in the micropaleontological collections of the Museum d'histoire naturelle de Genève. The vertical range of *D. meridionalis* is illustrated in figure 2, and the range of a selection of associated foraminifera in Wadi Nakhr field section are shown in figure 3.

#### 4. SYSTEMATIC PALAEOLOGY

Phylum Foraminifera Orbniguy, 1826

Class Globothalamana Pawłowski et al., 2013

Subclass Textulariana Mikhalevich, 1980

Order Loftusiida Kaminski and Mikhalevich in Kaminski, 2004

Suborder Loftusiina Kaminski and Mikhalevich in Kaminski, 2004

Superfamily Loftusioidea Brady, 1884

Family Spirocyclinidae Munier-Chalmas, 1887

Genus *Demirina* Özcan, 1994

*Remarks:* Originally (Özcan, 1994), *Demirina* was placed into the Nezzazatidae, respectively the subfamily Coxitinae Hamaoui and Saint-Marc, as followed by subsequent workers (Kaminski, 2000, 2014; Simmons and Bidgood, 2023; Simmons et al., 2025a). The planispiral test, the presence of a single rafter per chamber, beams generally aligned between subsequent chambers both forming a subepidermal network, and the lack of any septal plate looks incompatible with the features designated for the suborder Nezzazatina Kaminski, 2004 respectively the family Nezzazatidae Hamaoui and Saint-Marc, 1970 (e.g., Simmons et al., 2025a). Instead, the observed test features suggest transfer to the order Loftusiida Kaminski and Mikhalevich in Kaminski (2004), and the family Spirocyclinidae Munier-Chalmas, 1887.

*Emended diagnosis:* Test planispirally coiled, biumbilicate with a (sub)acute margin. Chambers low, rapidly increasing in length and width and slowly but continuously in height, partially subdivided by one short horizontal partition (rafter) and one (up to 2?) order of vertical partitions (beams), forming a coarse subepidermal network. The main vertical partitions are generally aligned between subsequent chambers; they may become discontinuous when a new partition is added as a result of chamber enlargement during ontogeny. Axial section of the adult stage of growth shows axially compressed (biumbilicate) shell and chambers of oval outline, often characteristic diamond shaped. Last chambers have tendency to uncoil. The apertural face of the uncoiled stage is flat. Foramina are single and interiomarginal, becoming cribrate in the very final (uncoiling?) chambers. Wall finely agglutinated and non-canalliculate.

*Demirina meridionalis* Özcan, 1994

(Figs. 4-6)

1994 *Demirina meridionalis* n. gen., n. sp. Özcan, p. 3, pl. I, figs. 1-10; pl. II, figs. 1-11

2000 *Demirina meridionalis* Özcan - Kaminski, p. 201, fig. 44 (illustration of original material)

2019 *Demirina meridionalis* - Özkan and Altiner, fig. 9(7)

2023 *Demirina meridionalis* - Simmons and Bidgood, p. 64. fig. 15 a-c (illustration of original material)

2025a *Demirina meridionalis* - Simmons et al., p. 18, fig. 8 (illustration of original material)

*Description:* Test composed of chambers planispirally arranged. The general outline is semi-involute, biumbilicate with acute chamber margins. In axial sections, the outline of the last chambers is diamond shaped. Proloculus small, subspherical with an inner diameter of 15 to 25 µm. Chambers numerous, low, in a rapidly enlarging coil; final stage peneropliform with tendency to uncoil. The first whorl comprises eight to nine chambers and the final whorls consist of 17 to 19 chambers. Septa and chambers distinctly arched. There is one short rafter per chamber that might be lacking or being much reduced in length within the first whorl. The rafters and the beams aligned from chamber to chamber, form a subepidermal mesh. They may occasionally be discontinuous, when a new partition is added as a result of chamber growth during ontogeny. In the final whorl secondary shorter vertical partitions (intercalary beams) occur. Foramina interiomarginal, become cribrate in the final possibly uncoiling chambers. Wall agglutinated, imperforate and noncanalliculate.

*Remarks:* Özcan (1994, Fig. 2) provided a schematic drawing of the test features of *Demirina* and their nomenclature. This original drawing was incorporated in Figure 6, with modifications reflecting the newly acquired observations and interpretations of the structural features. It differs from Özcan (1994) by (1) the additional presence of a single horizontal partition (rafter) in the chambers, (2) the general alignment of the beams.

The rafters of *Demirina* are clearly seen in equatorial sections, parallel to the septa and about 1/3 of their length (Fig. 5 G,J). It appears that the rafters are also dimly recognizable in the marginal partly eroded equatorial section of Özcan (1994, pl. 1, Fig. 1, below). Generally, the material illustrated by Özcan (1994) is not very well preserved. It appears that the rafters are not present in the first whorl or are just extremely short, most likely because there is not enough space to place them. Concerning the arrangement of the beams between subsequent chambers, Özcan (1994, p. 4) remarked that "some partitions are not continuous". Again, the poor preservation and the limited nature of the Turkish material did not allow any clear specification. Equatorial oblique to tangential sections of the Oman material shows the general alignment of the beams (Fig. 5 B,C,F). With the enlargement of

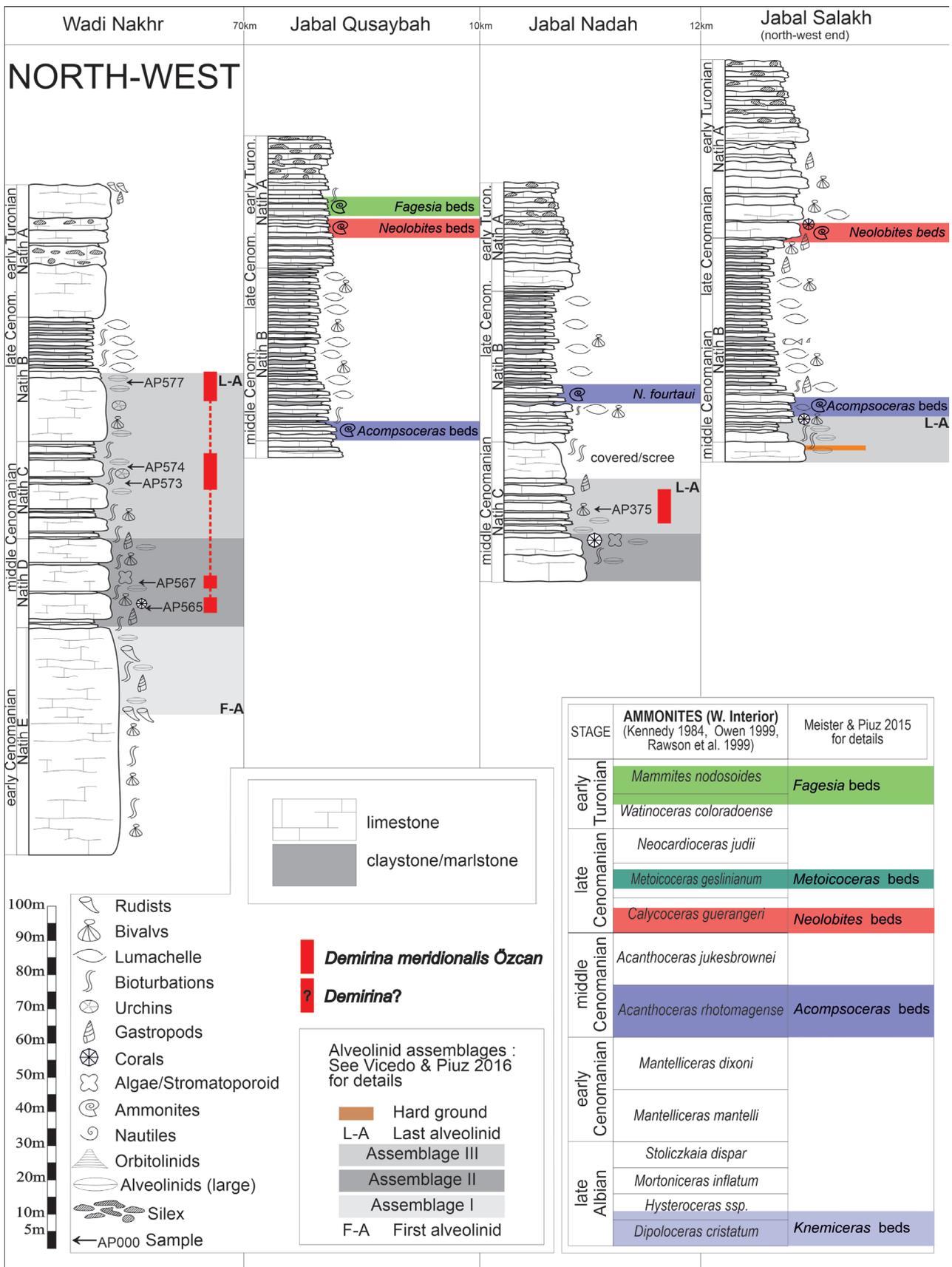


Fig. 2 - North-west. Field sections, localization of studied samples, and vertical range of *Demirina meridionalis* Özcan.

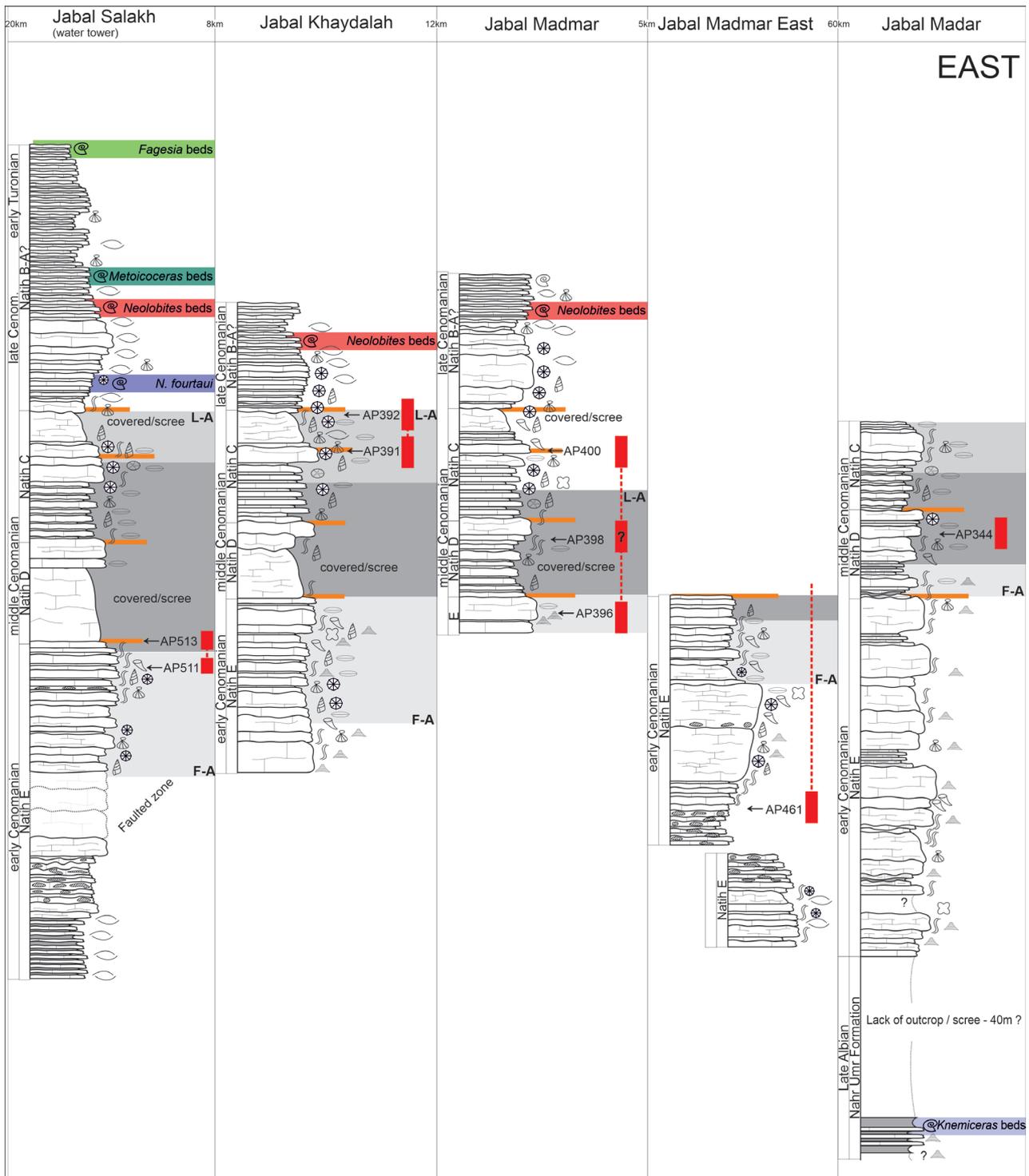


Fig. 2 - East. Field sections, localization of studied samples, and vertical range of *Demirina meridionalis* Özcan.

the chamber size during growth, additional beams are intercalated between the pre-existing ones that were aligned from one chamber to another; this constitutes a characteristic pattern of construction. (e.g., Cherchi and Schroeder, 1975, Fig. 3; Schlagintweit, 2020, Fig. 5) and results in some partitions being discontinuous.

The interiomarginal foramina of early whorls become

cribrate in the final (uncoiled?) chambers (Fig. 4K).

*Comparisons:* Özcan (1994) compared *Demirina* with the nezzazatids *Coxites* Smout, 1965 and *Rabanitina* Smout, 1965 as well as with *Barkerina* Frizzel and Schwartz, 1950. *Demirina* can also be compared with *Reissella* Hamaoui, (type-species *R. ramonensis*), another

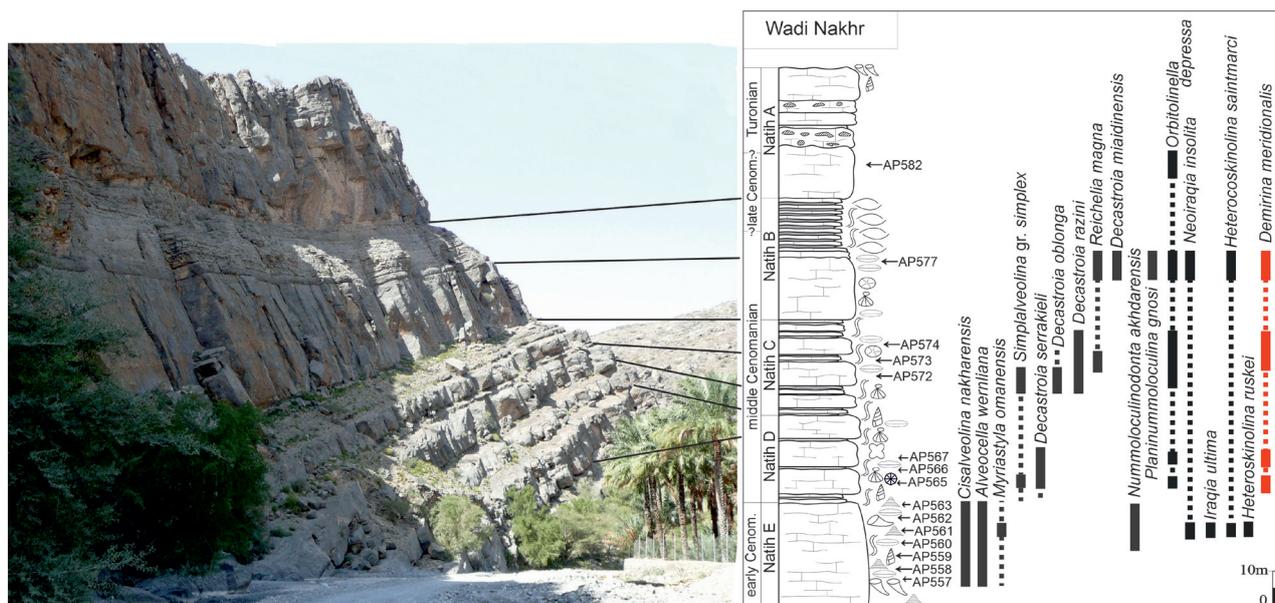


Fig. 3 - The Wadi Nakhr field section with vertical range of *D. meridionalis* Özcan and selected associated foraminifera.

spirocyclinid? taxon from the Cenomanian of Israel. This little-known taxon also exhibits a subepidermal network with beams aligned from chamber to chamber, but a different shell and chamber shape (Fig. 6.5). The chambers are typically broadly rounded, and the involute initial coiling shows rapid chamber enlargement with fewer (ca. 10) chambers in the last whorl (Hamaoui, 1963; Loeblich and Tappan, 1987; Simmons and Bidgood, 2023; Simmons et al., 2025b). It is worth mentioning that Simmons et al. (2025b) noted the uncertainty of the wall structure leaving open a possible soritoid nature with a porcelaneous wall. *Spirocyclina atlasica* Saint-Marc and Rahhali 1982 from the late Cenomanian of Morocco has much in common with *D. meridionalis* but is distinctly flattened (Fig. 6.6) with a test “which uncoils in a distinctly, almost dramatically, peneropliform style” (Simmons and Bidgood, 2023, p. 90), and possesses interseptal pillars and rows of foramina/apertures (Saint-Marc and Rahhali, 1982).

Some sections of the type material of *Carinoconus iraqiensis* Bernaus and Masse 2006 from the Cenomanian of Iraq seem surprisingly similar to sections of *Demirina meridionalis*. The general shape of some sections (e.g. Bernaus and Masse 2006, pl. 1 Fig. 1-3,6,7), the beams aligned from chamber to chamber, the presence of multiple foramen, rafters that appear (e.g. ibid pl. 1 Fig. 3, 10) despite what the authors mention in their description, is intriguing. Schlagintweit et al. (2025) note that sections of juvenile specimens, or sections cutting the initial spire obliquely of *Gusicella minima* (Henson, 1948), also display striking similarities to *Carinoconus iraqiensis*.

*Deuterospira pseudodaxia* Hamaoui, 1965 emend. Hamaoui, 1979 (Cenomanian of Negev, Israel), currently known from only one axial and one equatorial section (Hamaoui, 1965, 1966, 1979; Loeblich and Tappan, 1988;

Simmons and Bidgood, 2023; Simmons et al., 2025), resembles in many points to *D. meridionalis*. Its planispiral involute biumbilicate test, acute periphery, numerous low chambers, rapid expansion of the coil, interio-marginal foramina, and the outline of the chambers in axial section (see Hamaoui, 1979; Loeblich and Tappan, 1987, Simmons and Bidgood, 2023) are puzzling. But with only two sections available, with an initial coil infilled by agglutinated (or segregated) material and the absence of visible beams and rafters in both axial and equatorial sections, more research on topotypic material is necessary to go further with this poorly known taxon and its possible (senior) synonymy with *D. meridionalis*, as already suggested by Simmons and Bidgood (2023).

## 5. BIOSTRATIGRAPHY

In its type locality, a Cenomanian - Turonian outcrop of the Kahta-Adiyaman region (SE Turkey), *D. meridionalis* is known from the matrix of fine-grained calci-turbidite levels of the Karadut Formation, in association with *Biplanata peneropliformis*, *Nezzazata simplex*, *Charentia* cf. *cuvillieri*, *Praealveolina* gr. *cretacea*, *Orbitolina* sp. and *Rotalipora* sp. (Özcan, 1994). This suggests an age no younger than middle Cenomanian (Simmons and Bidgood, 2023).

In the Derdere Formation of the Derik field section, Özkan and Altiner (2019) suggest an undifferentiated Cenomanian age for the level with *D. meridionalis*. Simmons et al. (2020) however propose a different description of the Derdere Formation at Derik in terms of lithology, thickness, and age. They find important microfossils not recognized by Özkan and Altiner (2019) and use more recent taxonomic concepts. We refer the reader to Simmons et al. (2020) for details about the

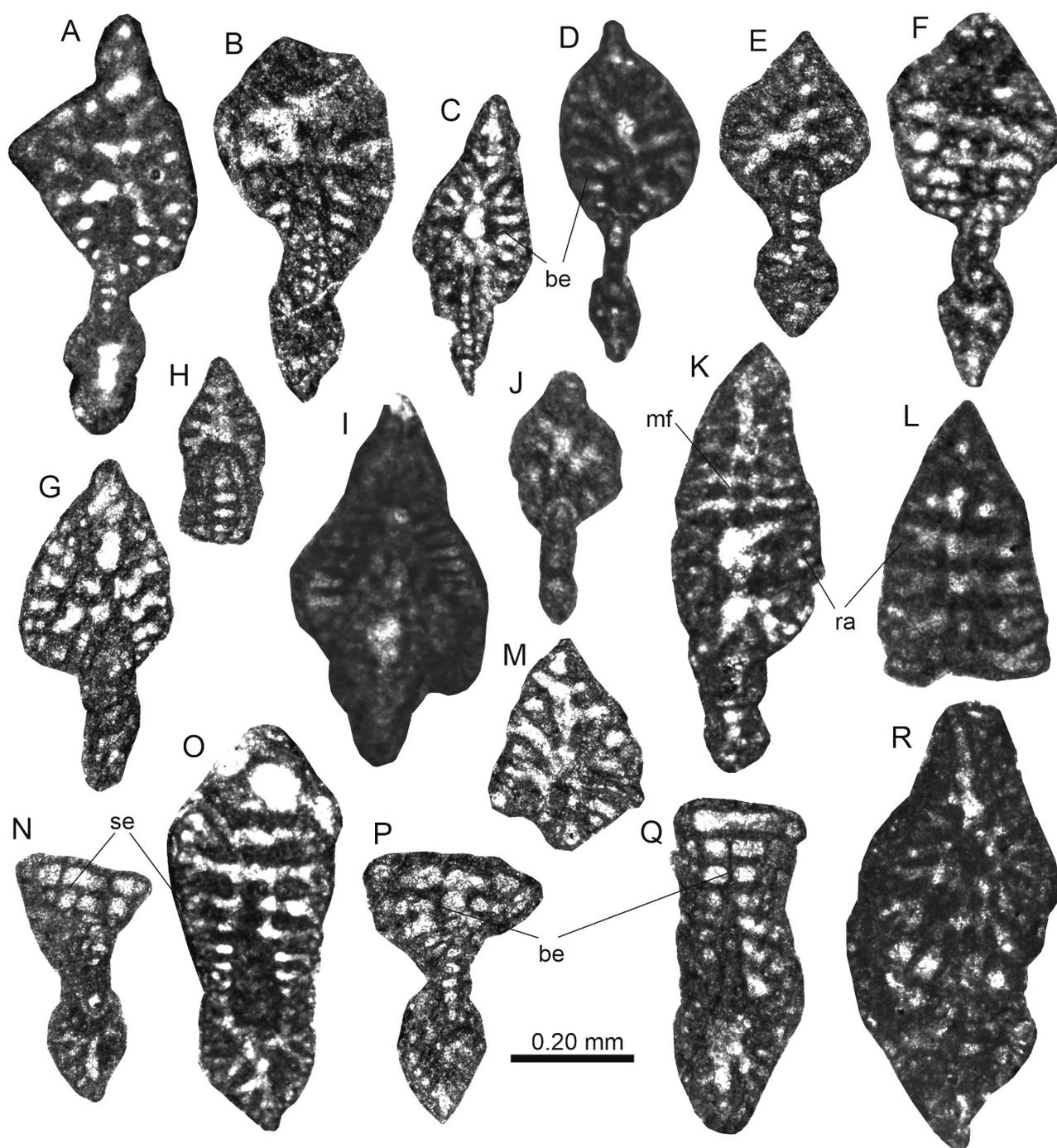


Fig. 4 - *Demirina meridionalis* Özcan from the Cenomanian Natih Formation of Oman. Subaxial sections A–C, E, G–H, J–K, N–P; Axial sections D, I; Fragmentary (subaxial) sections L–M; Oblique sections Q–R. Samples: A ap375; B ap577ag; C, H ap577ah; D ap577c; E, N, P ap577w; F ap577p; G ap577y; I ap392; J, M ap577; L ap573l; K, O ap574d; Q ap577s; R ap574d. Abbreviations: be = beam, ra = rafter, se = septum, mf = multiple foramen.

different taxa and their biostratigraphic value. It emerges that the interval showing a rich fauna of alveolinids and other benthonic foraminifera, where Özkan and Altiner (2019) found *Demirina meridionalis*, is now regarded as middle Cenomanian.

In Oman, *D. meridionalis* is recognized sporadically from the uppermost Natih E to the middle part of Natih B member (Fig. 2) in association with various short ranging

alveolinoids, orbitolinids and (pseudo)nummuloculinids (Fig. 3). This gives an uppermost early Cenomanian to middle Cenomanian (Bromhead et al., 2022 with references therein) range for *D. meridionalis* in Oman, which is in accordance with the two above-mentioned Turkish occurrences in the type area.

Although rare, *Demirina meridionalis* Özcan (1994) shows a rather short stratigraphic distribution; it can

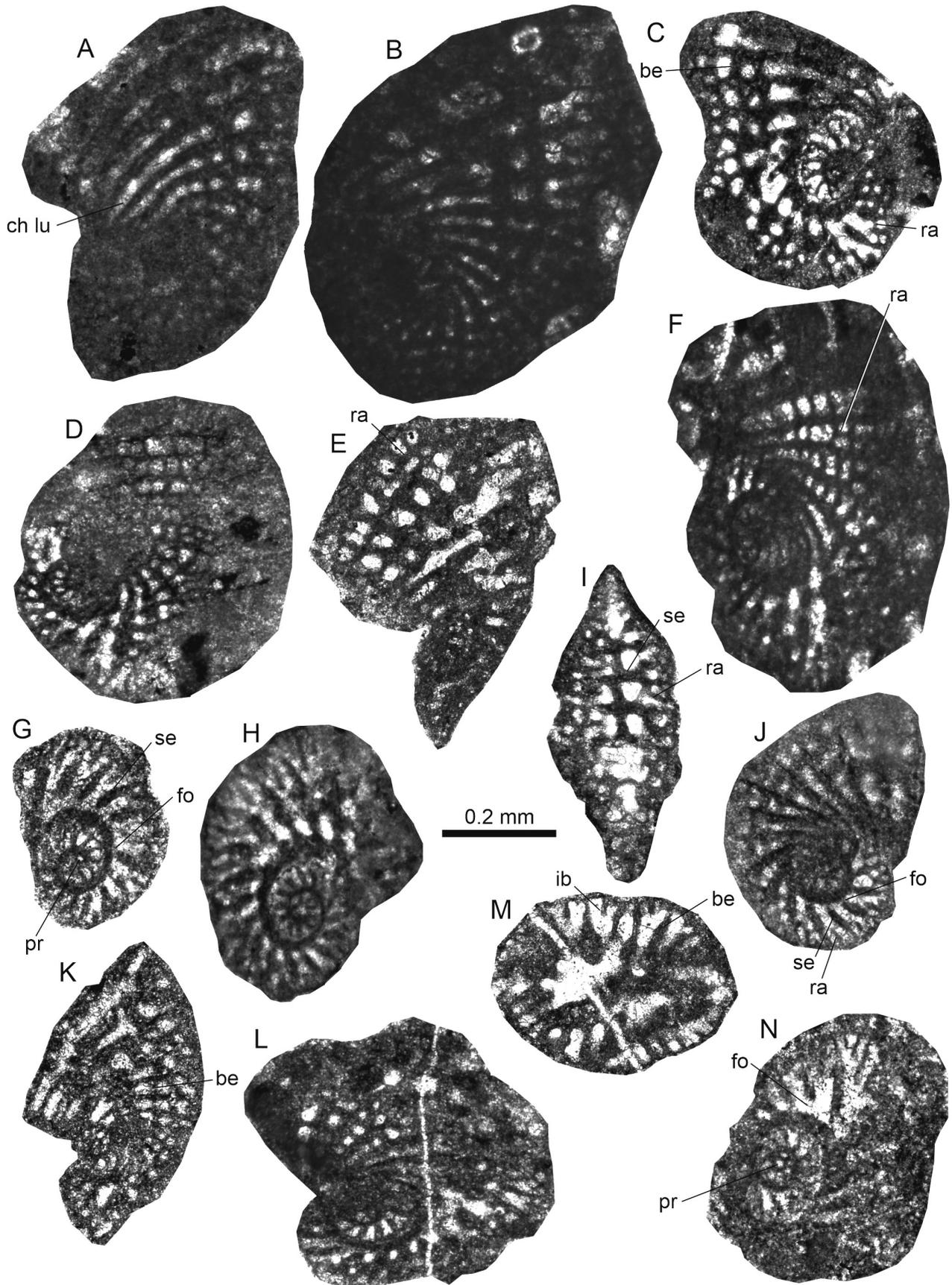


Fig. 5 - *Demirina meridionalis* Özcan from the Cenomanian Natih Formation of Oman. Equatorial-tangential sections A-D, F, L; Oblique section E; Equatorial sections, slightly oblique G-H, J, N. Transverse section of the adult test stage M. Samples: A ap573L; B ap574b; C ap577s; D ap577n; E, K ap577ab; F ap577d; G, N ap574b; H ap577j; I, L ap577ag; J ap577j; M ap577z. Abbreviations: be = beam, ch lu = chamber lumen, fo = foramen, ib = intercalary beam, pr = proloculus, ra = rafter, se = septum,

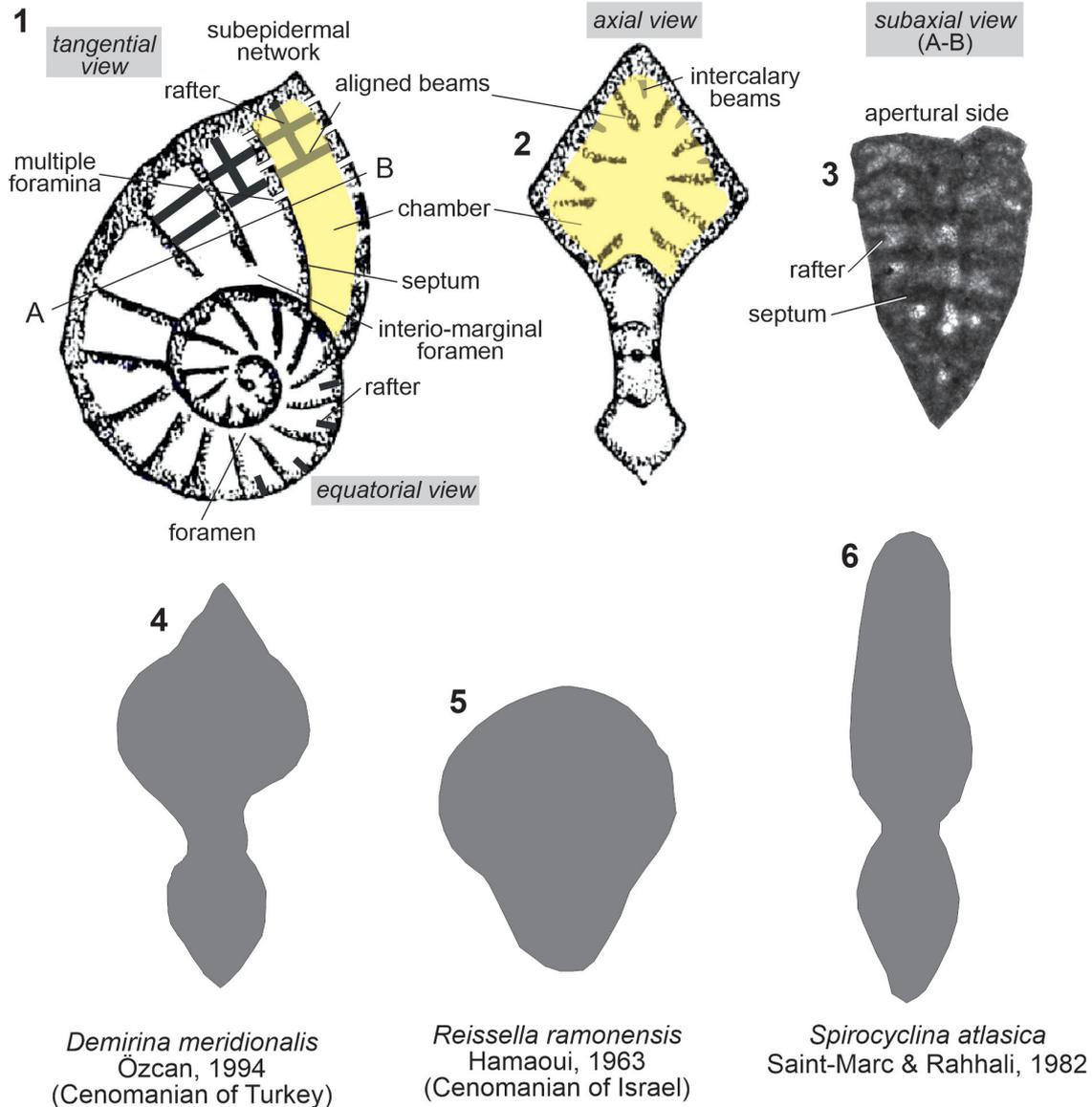


Fig. 6 - 1-3: Test reconstruction and terminology of *Demirina* Özcan in different sections (1 and 2 modified from Özcan, 1994, Fig. 2). 4-6 Test outline in axial section of *Demirina* (4) compared to the Cenomanian spirocyclinids *Reissella ramonensis* Hamaoui (5) and *Spirocyclus atlasicus* Saint-Marc & Rahhali (6).

then be a useful marker of the uppermost early to middle Cenomanian and thus may help to refine the middle/late Cenomanian boundary.

## 6. CONCLUSIONS

*Demirina meridionalis* Özcan was described in 1994 based on rather poorly preserved and limited material from the Cenomanian of southeastern Turkey. Since then, only one axial section was illustrated (Özcan and Altiner, 2019) from contemporaneous sediments collected 200 km from the type locality. Numerous sections of well preserved *Demirina meridionalis* are here illustrated from the Cenomanian Natih E to B members of Oman. They allow to improve the understanding of the internal structures of the test. The planispiral test, the presence

of a single rafter per chamber, beams generally aligned between subsequent chambers and interiomarginal aperture becoming cribrate in the last chambers allow the emendation of the genus, and the transfer of *Demirina* Özcan, 1994 from the Nezzazatina Kaminski, 2004 to the Loftusiida Kaminski and Mikhlevich in Kaminski, 2004, most likely to the family Spirocyclusidae Munier-Chalmas, 1887. Comparison with *Reissella ramonensis* Hamaoui, 1963 (Cenomanian spirocyclinid? of Israel) and *Spirocyclus atlasicus* Saint-Marc and Rahhali, 1982 (Cenomanian of Morocco), mainly based on the general shell and chamber shape, is discussed. *Deuterospira pseudodaxia* Hamaoui, 1965 emend. Hamaoui, 1979 (Cenomanian of Israel), is a possible (senior) synonym of *Demirina meridionalis* (already evidenced by Simmons and Bidgood, 2023) but more research is necessary to go

further with this very poorly known taxon. The limited localities from which *Demirina meridionalis* has been found so far suggests a restriction of this species to the Arabian Plate. Although rare, *D. meridionalis* can be a useful marker of uppermost early to middle Cenomanian.

#### Availability of data and material

All material is deposited in the micropaleontological collections of the Natural History Museum of the city of Geneva (Table 1).

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Tab. 1 - List of the material deposited in the Natural history Museum of Geneva (MHNG numbers).

| Field number | Locality     | Figure     | Depository         |
|--------------|--------------|------------|--------------------|
| ap375a       | Jabal Nadah  | 4a         | MHNG-GEPI-2025-017 |
| ap392a       | J. Khaydalah | 4i         | MHNG-GEPI-2025-018 |
| ap573l       | Wadi Nakhr   | 4l, 5a     | MHNG-GEPI-2025-019 |
| ap574b       | W. Nakhr     | 5b, 5g, 5n | MHNG-GEPI-2025-020 |
| ap574d       | W. Nakhr     | 4o, 4r, 4k | MHNG-GEPI-2025-021 |
| ap577        | W. Nakhr     | 4j, 4m, 5j | MHNG-GEPI-2025-011 |
| ap577ab      | W. Nakhr     | 5e, 5k     | MHNG-GEPI-2019-023 |
| ap577ag      | W. Nakhr     | 4b, 5i, 5l | MHNG-GEPI-2025-022 |
| ap577ah      | W. Nakhr     | 4c, 4h     | MHNG-GEPI-2019-026 |
| ap577c       | W. Nakhr     | 4d         | MHNG-GEPI-2016-031 |
| ap577d       | W. Nakhr     | 5f         | MHNG-GEPI-2016-032 |
| ap577j       | W. Nakhr     | 5h         | MHNG-GEPI-2016-037 |
| ap577n       | W. Nakhr     | 5d         | MHNG-GEPI-2019-031 |
| ap577p       | W. Nakhr     | 4f         | MHNG-GEPI-2025-023 |
| ap577s       | W. Nakhr     | 4q, 5c     | MHNG-GEPI-2025-024 |
| ap577w       | W. Nakhr     | 4e, 4n, 4p | MHNG-GEPI-2025-013 |
| ap577y       | W. Nakhr     | 4g         | MHNG-GEPI-2019-034 |
| ap577z       | W. Nakhr     | 5m         | MHNG-GEPI-2019-035 |

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