SURAQALATIA BRASIERI GÖRMUŞ, LAWA & NUAIMY, 2017 (LARGER BENTHIC FORAMINIFERA; SURAQALATIIDAE N. FAM.) FROM THE LATE MAASTRICHTIAN OF THE TARBUR FORMATION (ZAGROS FOLD-THRUST-BELT) AND REMARKS ON *DICYCLINA* MUNIER-CHALMAS, 1887

Felix Schlagintweit[1*] & Koorosh Rashidi[2]

Received: 24 June 2018 / Accepted: 16 July 2018 / Published online: 25 July 2018

Abstract The larger benthic foraminifera *Suraqalatia brasieri* Görmuş, Lawa & Nuaimy (type-locality: Maastrichtian Aqra Formation of Iraq) is reported for the first time from the upper Maastrichtian Tarbur Formation of the Zagros Fold-Thrust-Belt, SW Iran. It has originally been assigned to the Dicyclinidae Loeblich & Tappan. The complex exoskeleton and the test morphology (flat, low conical with annular-concentric chambers forming the main part) however exclude its belonging to this family (discoidal, cyclical chambers biserially added, complex megalospheric embryo). Herein we describe a new family, the Suraqalatiidae. *Suraqalatia brasieri* might represent a Maastrichtian endemic taxon restricted to the Arabian Plate. Two species belonging to the genus *Dicyclina* Munier-Chalmas (*D. sampoi* Cherchi & Schroeder and *D. schlumbergeri* Munier-Chalmas) are present in the Upper Cretaceous of Iran.

Keywords: *Benthic foraminifera, Zagros Zone, Biostratigraphy, Palaeobiogeography*

INTRODUCTION

The Upper Cretaceous Tarbur Formation, named after the village of Tarbur (Fars Province), and cropping out in the SW Zagros basin, represents a predominantly carbonate lithostratigraphic unit that contains rich microfauna and microflora associated with rudists (James and Wynd, 1965). It extends from the northwest to the southeast of the Zagros basin along the western edge of the imbricated Zagros zone, between the main Zagros fault and the Shabazan fault to the east (Alavi, 2004). Towards the southwest the Tarbur Formation interfingers with the Gurpi Formation, which usually underlies the former.

The Tarbur Formation is extraordinarily rich in larger benthic foraminifera (LBF), among orbitoidids, siderolitids, soritids, orbitolinids and others (Vaziri-Moghadam et al., 2005; Afghah, 2009; Maghfouri-Moghaddam et al., 2009; Rajabi et al., 2011; Abyat et al., 2012, 2015; Afghah and Farhoudi, 2012; Pirbaluti and Abyat, 2013; Pirbaluti et al., 2013; Afghah and Yaghmour, 2014; Schlagintweit et al., 2016a, b). Among them are some taxa that are palaeogeographically restricted to the Maastrichtian of the Arabian Plate (Schlagintweit and Rashidi, 2018). In the present paper the LBF *Suraqalatia brasieri* Görmuş, Lawa & Nuaimy, 2017 (type-locality: Maastrichtian Aqra Formation of Iraq) is reported for the first time from the upper Maastrichtian of the Tarbur Formation. Its original assignment to the Dicyclinidae is critically assessed along with remarks on the occurrence of *Dicyclina* in the Upper Cretaceous of Iran.

STUDIED SECTIONS

The studied samples are from two sections of the Tarbur Formation:

a) Mandegan section

The study area, located in the High Zagros Belt, is situated north of Mount Dena, about 65 km south of the town of Semirom (Fig. 1).

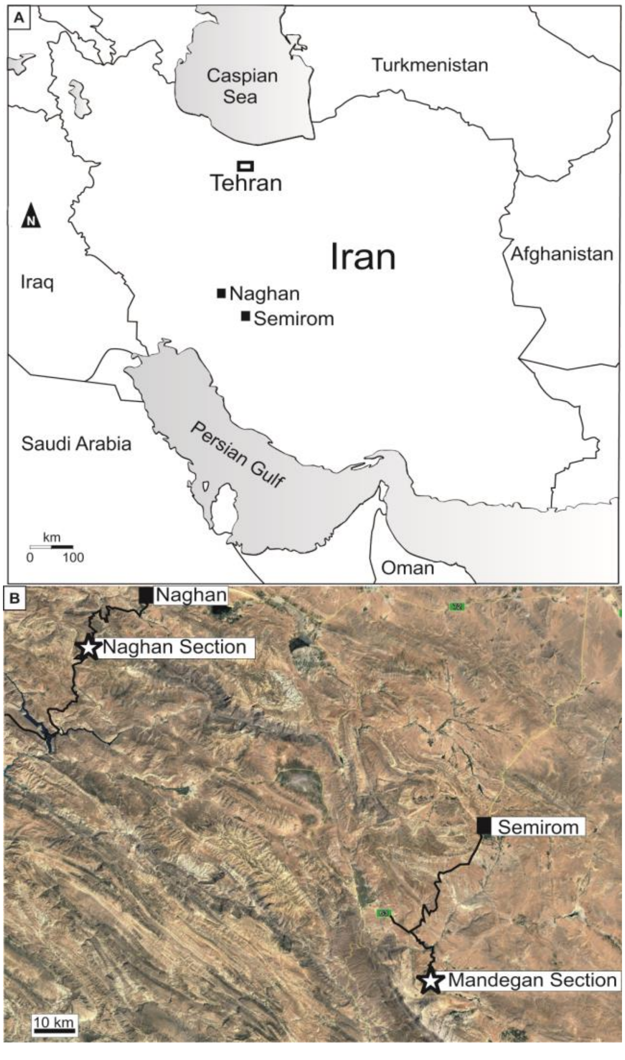

Fig. 1 Location map of the Naghan and Mandegan sections (B: from google maps).

[1]Lerchenauerstr. 167, 80935 Munich, Germany, *Corresponding author: felix.schlagintweit@gmx.de
[2] Department of Geology, Payame Noor University, Po Box 19395-3697 Tehran, Iran, kooroshrashidi@pnu.ac.ir

The section of the Tarbur Formation is exposed about 10 km south of the village of Mandegan. Here the Tarbur Formation with a thickness of ~272 m overlies conformably the Gurpi Formation. The top of the section is unconformably overlain by conglomerates of the Pliocene Bakhtiari Formation (see Bahrami, 2009, for details). Based on the lithostratigraphy, the section has been subdivided into three units (from base to top): unit 1 is dominated by thick-bedded limestones, unit 2 mostly contains medium-bedded limestones with intercalated marly limestone layers, and unit 3 consists of marly limestones. *Suraqalatia brasieri* Görmuş, Lawa & Nuaimy appears in the lower part of unit 1, persisting until the boundary with unit 2. Unlike several other taxa, it does not reach the topmost parts of the Tarbur Formation (Fig. 2). The Greenwich coordinates of the section base are N 31º, 25', 8.13" and E 51º, 24', 34.58".

b) Naghan section

The studied area in the folded Zagros belt is located approximately 50 km south-west of Naghan town near Gandomkar village and is here named the Naghan section (Fig. 1). At this locality, the Tarbur Formation unconformably rests on the Gurpi Formation and is overlain by the Paleocene Sachun Formation. Lithologically, the Gurpi Formation consists of dark shales, grey calcareous shales with planktonic foraminifera. The Sachun Formation consists of gypsum, red shales, anhydrite and some layer of carbonates.

The thickness of the Tarbur Formation at the Naghan section is about ~ 274 m. It is composed of medium to thick–bedded grey limestone, shales and marls and can be subdivided into five units

- unit 1 (99 m), red to yellow shales.
- unit 2 (61 m), medium- to thick-bedded grey limestones with *Loftusia* and rudist debris (calcarenites to calcirudites).
- unit 3 (33 m), intercalation of grey shales and cream to grey, medium- to thick-bedded limestones (calcilutites and calcarenites).
- unit 4 (38 m), thick-bedded to massive, grey to cream-coloured limestones containing broken rudist shells and tests of *Loftusia* (calcarenites, calcilutites to calcirudites).
- unit 5 (~ 41.6 m), shales interbedded with medium- to thick-bedded yellow limestones containing *Loftusia* fragments.

Suraqalatia brasieri Görmuş, Lawa & Nuaimy appears in unit 4 reaching the middle part of unit 5 (see Schlagintweit et al., 2016a, fig. 4). The Greenwich coordinates of the section base are N 31°47' 52" and E 50° 32' 53 ".

SYSTEMATICS

The high-rank classification follows Pawlowski et al. (2013). For the low-rank classification see Kaminski (2014). For a glossary of terms, see Hottinger (2006).

Phylum Foraminifera d´Orbigny, 1826
Class Globothalamea Pawlowski et al., 2013
Order Loftusiida Kaminski & Mikhalevich, 2004
Suborder Loftusiina Kaminski & Mikhalevich, 2004
Superfamily Loftusoidea Brady, 1884
Family Suraqalatiidae Schlagintweit & Rashidi n. fam.

Diagnosis: Test low-conical to almost flat with a reduced probably low trochospiral stage followed by an uncoiled main part with annular chambers. Marginal part of chambers with exoskeleton consisting of series of fine beams and rafters, covered externally by a thin epiderm. The exoskeleton forms a dense polygonal subepidermal network becoming coarser towards the chamber interior. The inner part of the chambers is undivided (no endoskeleton). Test wall agglutinating. Foramina multiple.

Remarks. Discussing the suprageneric position, the genus *Suraqalatia* was placed in the family Dicyclinidae Munier-Chalmas by Görmüş et al. (2017). The authors (p. 365) also state that "dicyclinid forms include a tiny proloculus" contrasting other forms such as *Orbitopsella* or *Orbitolina*. This statement is incorrect and does not take into account the results of Cherchi & Schroeder (1990a, b) as will be shown later in the text (see chapter on *Dicyclina*). Loeblich and Tappan (1987) and Kaminski (2014) separated two families, the Cuneolinidae Saidova (genera with conical, compressed or not, to flabelliform tests: *Cuneolina*, *Palaeolituonella*, *Pseudotextulariella*, *Vercorsella*) and the Dicyclinidae Loeblich & Tappan (genus with cyclic chambers: *Dicyclina*). According to the emendation of Arriaga et al. (2016, p. 19), the Cuneolinidae Saidova are considered a synonym of Dicyclinidae, "because the differences in test shape of the adult forms are not considered a criterion sufficient to erect two separate families. The family is characterized by biserial arrangement of the chambers, reticular subepidermal network, and absence of an endoskeleton". The chamber arrangement in *Suraqalatia* is not biserial as in the Dicyclinidae and instead is cyclical-concentric, thereby excluding its belonging to the Dicyclinidae. Note that for genera that share the same type of exoskeleton covered by the epiderm (forming a polygonal subepidermal network), differences in the chamber arrangement are considered a suprageneric criterion: "planispiral to uncoiled, peneropliform or cyclical (Spirocyclinidae); biserial (Dicyclinidae); low trochospiral (Dictyopsellidae)" (Albrich et al., 2015, p. 265). Representatives of the Spirocyclinidae with cyclic (ring-shaped) chambers have a discoidal flattened test; in the Suraqalatiidae test is low-conical with annular (ring-shaped) chambers. The early growth stage of the Spirocyclinidae displays planispirally arranged chambers. Concerning the exoskeleton, the comparably long (primary) beams protruding widely into the chamber lumen of *Suraqalatia* are worth mentioning. For the moment being the Suraqalatiidae only include the name-giving genus *Suraqalatia* Görmüş, Lawa & Al Nuaimy, 2017. The inadequate knowledge on the initial part of *Suraqalatia* respectively the megalospheric embryo, and the distributional pattern of the multiple foramina hinders a further specification in the family diagnosis for the time being.

Genus *Suraqalatia* Görmüş, Lawa & Al Nuaimy, 2017
Suraqalatia brasieri Görmüş, Lawa & Al Nuaimy, 2017
(Figs. 3–5)

2008 *Pseudorbitolina* cf. *marthae* Douvillé – Al-Kubaysi, figs. 2–12 (Maastrichtian Aqra Formation of Iraq).
2016 *Pseudorbitolina marthae* Douvillé – Al-Kubaysi and Abid, figs. 6-1 to 6-3 (Maastrichtian Aqra Formation of Iraq).

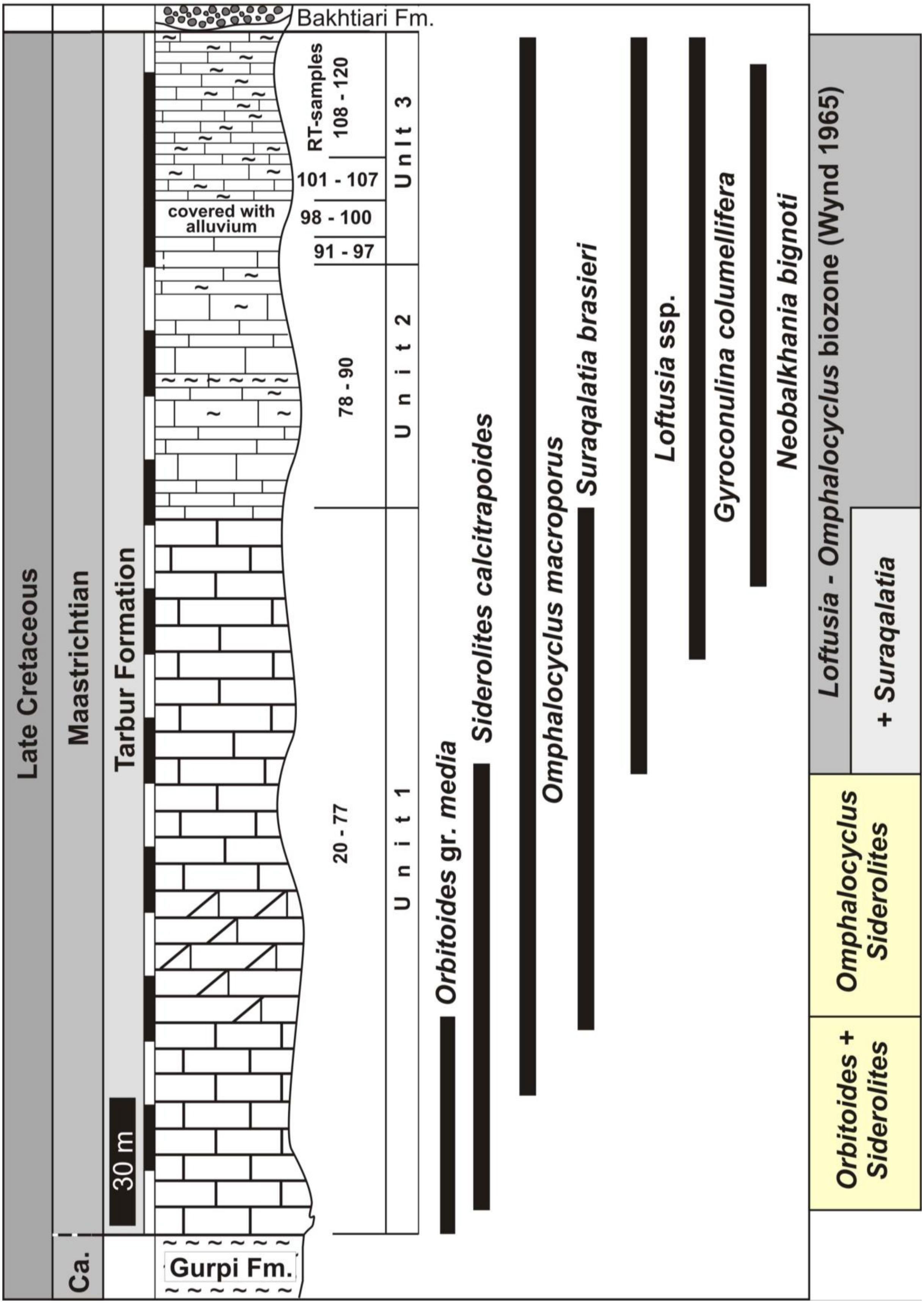

Fig. 2 Distribution (total vertical range) of *Suraqalatia brasieri* Görmüş, Lawa & Al Nuaimy and some other larger benthic foraminifera in the Tarbur Formation of the Mandegan section.

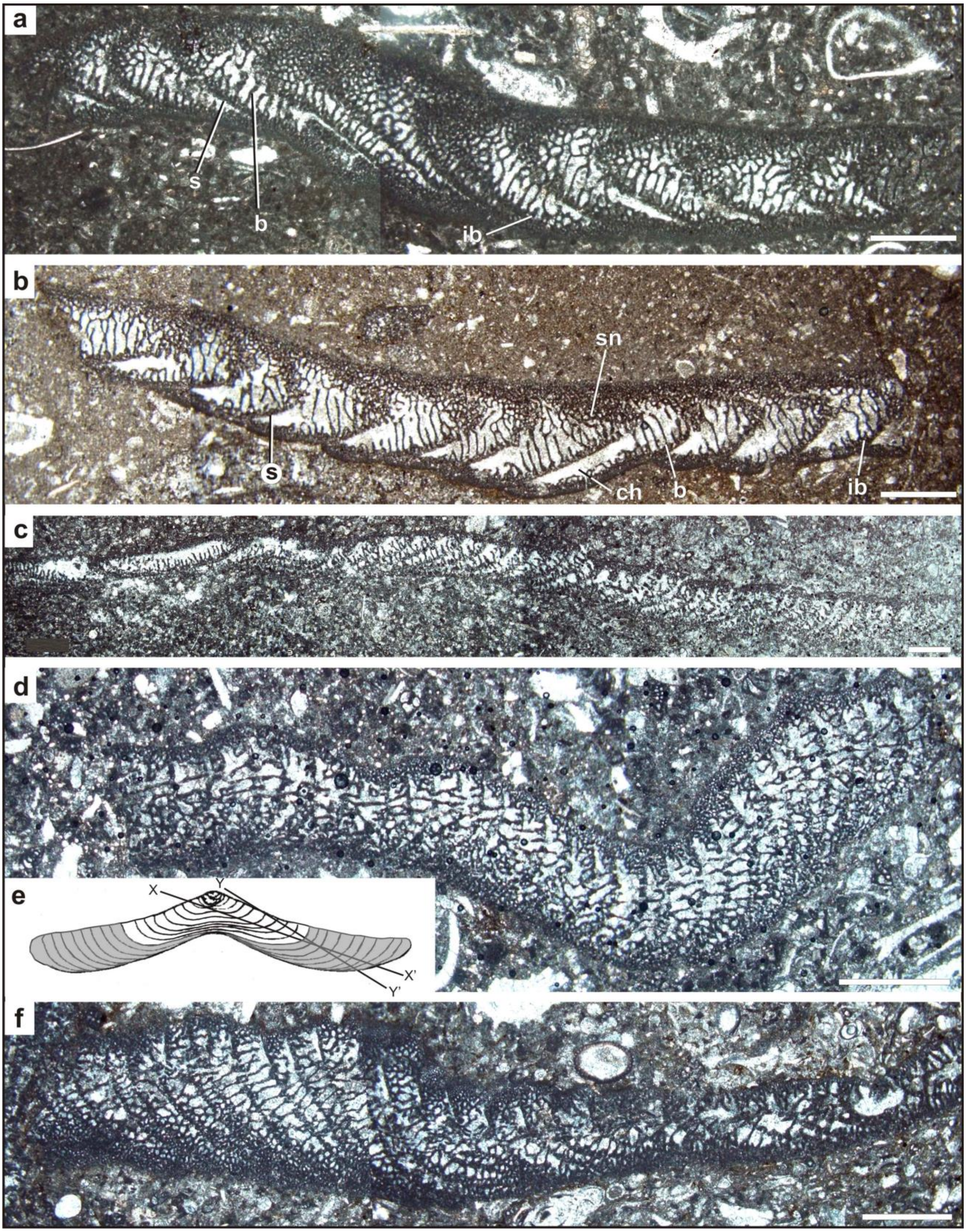

Fig. 3 *Suraqalatia brasieri* Görmüş, Lawa & Al Nuaimy, upper Maastrichtian Tarbur Formation of Mandegan **(a, c)** and Naghan sections **(b, d, f)**; oblique, partly tangential sections. **e** development of annular chambers (in grey) in some orbitolinids (modified from Douglass, 1960, fig. 21) and two sections (X–X' and Y–Y') comparable to those illustrated in a–d, and f. Abbreviations: b = beam, ch = chamber, ib = intercalary beam, s = septum, sn = subepidermal network. Thin-sections: Rt 63 (**a**), 2NG 183 (**b**), Rt 36 (**c**), 2NG 146 (**d**), 2NG 169 (**f**).

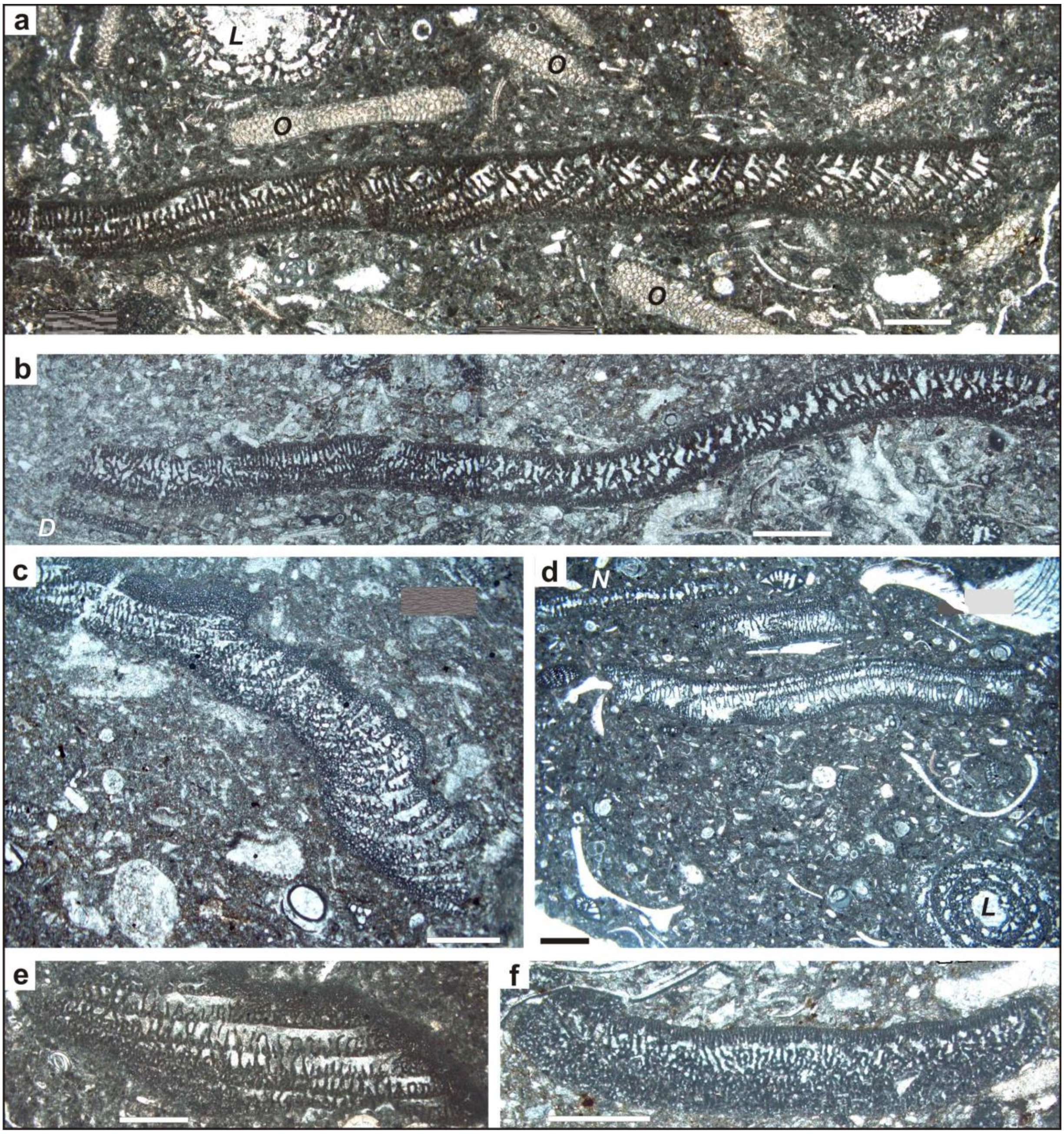

Fig. 4 *Suraqalatia brasieri* Görmüş, Lawa & Al Nuaimy, upper Maastrichtian Tarbur Formation of Mandegan **(a, e)** and Naghan sections **(b–d, f)**; oblique, partly tangential sections. Abbreviations: *D* = *Dicyclina*, *L* = *Loftusia*, *N* = *Neobalkhania*, *O* = *Omphalocyclus*. Scale bars = 1 mm. Thin-sections: Rt 63 (**a**), 2NG 183 (**b**), Rt 36 (**c**), 2NG 146 (**d**), 2NG 169 (**f**).

2016a *Loftusia* sp. – Schlagintweit et al., fig. 12b (Maastrichtian Tarbur Formation of Iran).
*2017 *Suraqalatia brasieri* n.gen., n. sp. – Görmüş et al., p. 2, figs. 3–5 (Maastrichtian Aqra Formation of Iraq).

Remarks. The specimens from the Tarbur Formation shown here only comprise tangential and oblique sections, whereas the original description of the Iraqi material was based on both thin-sections and isolated specimens. Therefore we refrain from a detailed description of the Iranian sections instead commenting the one given by Görmüş et al. (2017) thereby referring to their figures in the following. The specimens from the weathered rock surface (e.g. Figs. 3/7a, 4/9 to 4/11) viewed from above and from the side (Fig. 3/6e) as well as the equatorial section shown in Fig. 4b of Görmüş et al. (2017) display its test morphology. Accordingly, *Suraqalatia brasieri* displays a low conical, mostly conico-concave test, sometimes irregularly bent, displaying annular (ring-shaped) chambers. Sometimes the tests also display a bending upwards of the final chambers. Note that such "reflexed convex forms" are recorded from some orbitolinids (e.g., Douglass, 1960, figs. 17, 21). The maximum test diameter of the Iraqian specimens was indicated as up to 7 cm and up to 60 chambers. The sections from Iran not affecting complete tests attain a size of up to 2.2 cm (~ half size of an incomplete specimen amounting for a total of ~4.4 cm). Whether or not the mentioned test irregularities reflect any kind of dimorphism is unknown but appears unlikely as no two typical morphologies, e.g., differing by their apical angles, occur. The initial part is poorly documented. No megalospheric embryo has been illustrated by Görmüş et al. (2017). The isolated specimens display a pustular apex (Fig. 4/10). The annular chambers making up the main test part are subdivided marginally by beams (primary and intercalary) and rafters forming a polygonal subepidermal network. The latter becomes coarser towards the chamber interior. Externally it is covered by a thin epiderm (about 15 µm in thickness) (Fig. 5 this work).

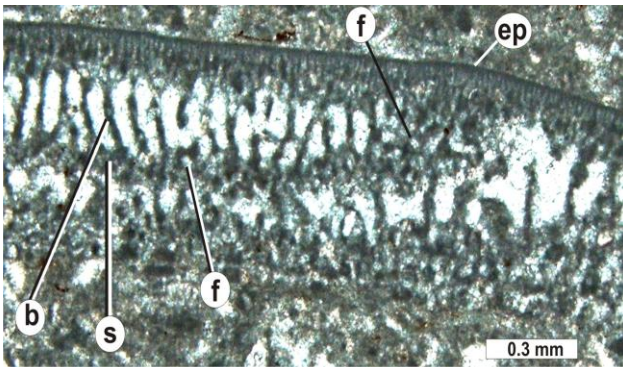

Fig. 5 *Suraqalatia brasieri* Görmüş, Lawa & Al Nuaimy, upper Maastrichtian Tarbur Formation of Mandegan section. Detailed view showing wall structure and exoskeleton (subepideremal network). Abbreviations: b = beam, ep = epiderm, f = foramen, s = septum. Thin-section Rt 63.

In some sections of Görmüş et al. (2017, figs. 4/1a, 5/8) it appears that the main partitions are aligned in successive chambers. The interior part of the chambers does not show any structural elements (endoskeleton) (e.g., transverse section of Görmüş et al., 2017, fig. 3/4b, 3/12a, or Fig. 3b this work). Concerning the foramina, the information in the original description is not concrete, stating "apertures are numerous and lie in the epidermal parts at the edges of the test" (op. cit., p. 365). Some tiny foramina have been observed alternating with the beams (Fig. 5). Summarizing, there is still a lack of knowledge concerning the initial part, and the foramina that are multiple but of unknown distributional pattern.

Microfacies. In the Tarbur Formation *Suraqalatia brasieri* was observed in wackestones/floatstones displaying variable amount of fine siliciclastic input. Besides rudist debris it is associated with other larger benthic foraminifera, common with *Loftusia* sp., *Omphalocyclus macroporus* (Lamarck), and *Dicyclina schlumbergeri* Munier-Chalmas, more rarely with *Neobalkhania bignoti* Cherchi, Radoičić & Schroeder, *Persiella pseudolituus* Schlagintweit & Rashidi and *Dictyoconus bakhtiar*. Schlagintweit, Rashidi & Babadipour. Besides some thalli of *Salpingoporella pasmanica* Radoičić, the paucity of calcareous algae is worth mentioning in the samples containing *S. brasieri*.

Occurrences and stratigraphy. Iraq: lower part of the Aqra Formation, Maastrichtian (Görmüş et al., 2017). Iran: upper Maastrichtian Tarbur Formation (see Schlagintweit et al., 2016b). Görmüş et al. (2017, p. 365) noted the co-occurrence of *Dicyclina* and *Loftusia* with *Suraqalatia*. Due to the sole occurrence of the latter two taxa in the Maastrichtian of southeastern Turkey the authors state that the latter might extend in its distribution towards this area. If so this would imply the occurrence within the whole distributional area of *Loftusia* (see Fleury et al., 1990). As *S. brasieri* represents a taxon that can hardly be overlooked and that has not been illustrated elsewhere in the literature such an assumption remains just speculative and by no means proven. Last but not least, it should be mentioned that within the Tarbur Formation, *S. brasieri* has been observed in the two northern sections (Naghan and Mandegan sections) but not in the southern locality (?deeper environment) that we studied (Fasa section, see Schlagintweit et al., 2016b). Therefore it might be restricted to the middle and upper region of the Tarbur Formation within the Zagros Zone.

REMARKS ON *DICYCLINA* MUNIER-CHALMAS, 1887, FROM THE UPPER CRETACEOUS OF IRAN

The genus *Dicyclina* Munier-Chalmas (Albian? Cenomanian-Maastrichtian) is represented by three species: the type-species *D. schlumbergeri* Munier-Chalmas, 1887 (Coniacian-Santonian of S-France), *D. simplex* Cherchi & Schroeder, 1990a (Middle Cenomanian of France), and *D. sampoi* Cherchi & Schroeder, 1990b (Cenomanian of Iran). These differ in the complexity of the embryo as an essential criterion, the chamber shape in axial sections, and the wall structure. Concerning the latter aspect, the European taxa (*D. schlumbergeri* and *D. simplex*) possess an agglutinated-keriothecal wall, lacking in the Middle East *D. sampoi*. As has been pointed out by Cherchi & Schroeder (1990b, p. 210), however, this might be due to a disappearance by diagenetic processes. The differences of the three species are mainly due to the size, position and complexity of their megalospheric embryonic apparatuses (Cherchi & Schroeder 1990a, b, for details). For the two species occurring in the Upper Cretaceous of Iran, *D. sampoi* (Cenomanian of Sarvak Fm.; Fig. 6) and *D. schlumbergeri* (Maastrichtian Tarbur Fm.; Fig. 7), the difference mainly refers to the complexity of the embryonic apparatus. *D. sampoi* exhibits an irregularly ellipsoidal embryo with a complex supra- and subembryonic zone composed of main and intercalary partitions. The diameter of the embryonic apparatus of the specimen (slightly oblique axial section) shown in Figure 6 is 1.5 mm (Cherchi & Schroeder, 1990b: up to 0.86 mm). The connection between the embryonic and post-embryonic chambers has not been evidenced in the original description. It is represented by pores (foramina) with a diameter of ~0.045 mm situated between the supra- and subembryonic zones. The protoconch has a diameter of ~1.2 mm and a height of ~0.55 mm. *Dicyclina sampoi* was described by Cherchi & Schroeder (1990b) from the middle-upper Cenomanian Sarvak Formation of the Zagros Range. From this formation it was erroneously reported in recent years as *Dicyclina schlumbergeri* Munier-Chalmas (Afghah & Fadaei, 2014; Omvidar et al., 2014;

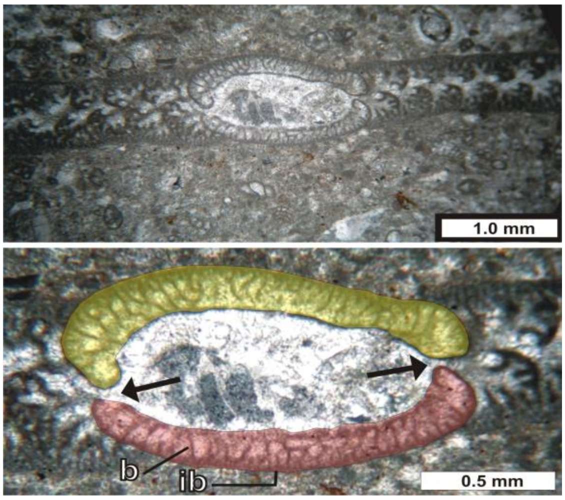

Fig. 6 *Dicyclina sampoi* Cherchi & Schroeder, from the Cenomanian of the Sarvak Formation, Zagros Zone, SW Iran, slightly oblique axial section (from Omidvar et al., 2014, fig. 3.10 as *Dicyclina schlumbergeri*). Megalospheric specimen showing embryonic apparatus and bilateral symmetric pores (foramina) enabling the communication with the first cyclic post-embryonic chamber. These are located between the supra- (upper; in yellow) and subembryonic zones (below; in red) (arrows). Both zones are subdivided by primary (b = beams) and secondary partitions (ib = intercalary beams).

Toulabi & Roozbahani, 2015; Rikhtegarzadeh et al., 2016). *Dicyclina schlumbergeri* illustrated by Afghah et al. (2014, fig. 11F) from the Early-Middle Cenomanian of the Sarvak Formation belongs to *Cuneolina* sp.

The protoconch of *D. schlumbergeri* as depicted in equatorial section has a diameter of ~0.9 mm. It displays an irregular ellipsoidal to kidney-shaped outline (Fig. 7a-b). There are only main partitions projecting into the embryonic chamber. The total diameter of the embryonic apparatus is 0.5 to 0.8 mm (Cherchi & Schroeder, 1990a: 0.65–0.95 mm). *Dicyclina schlumbergeri* is rather common in the Tarbur Formation and present throughout a comparably wide vertical range in the studied sections. The microfacies corresponds to wackestones and floatstones with larger benthic foraminifera, dasycladalean algae, and rudists. *Dicyclina schlumbergeri* was also reported from the Coniacian-Campanian Ilam Formation (e.g., James and Wynd, 1965; Omidvar et al., 2014). It is worth mentioning that from the Lower Cretaceous Taft Formation of Central Iran a "*Glomospira urgoniana*-*Dicyclina schlumbergeri* biozone" was established by Babazadeh & Dehej (2015). The illustrated specimens on Figure 6i-k in fact belong to *Balkhania balkhanica* Mamontova, as do those shown in Figure 6q-r as *Pseudochoffatella cuvillieri*. The specimen illustrated as *D. schlumbergeri* by Sari et al. (2009, pl. 3, fig. 8) from a reworked Upper Cretaceous succession from Turkey belongs to *D. simplex* Cherchi & Schroeder due to the structure and size of its embryo. With this respect the range of *D. schlumbergeri* as Middle Cenomanian to Coniacian (Sari et al., 2009, fig. 17) remains unproven. In fact, the available data much more suggest that *Dicyclina schlumbergeri* represents a taxon with a Coniacian to Maastrichtian stratigraphic range (e.g., Gendrot, 1968; Cherchi & Schroeder, 1990a, b; Velić 2007, Boix et al., 2011; this work).

ACKNOWLEDGMENTS

Many thanks to Mahboobeh Omidvar (Isfahan) for providing the image of *Dicyclina sampoi* and the permission for its reproduction. Helpful comments provided by the two reviewers Lorenzo Consorti (Naples), and Michael Kaminski (Dharan) are kindly acknowledged.

REFERENCES

Abyat, A., Afghah, M., Feghhi, A., 2012. Stratigraphy and foraminiferal biozonation of Upper Cretaceous sediments in southwest Sepid Dasht, Lurestan, Iran. Australian Journal of Basic and Applied Sciences, 6 (13): 18-26.

Abyat, A., Afghah, M., Feghhi, A., 2015. Biostratigraphy and lithostratigraphy of Tarbur Formation (Upper Cretaceous) in southwest of Khorram Abad (southwest Iran). Carbonates and Evaporites, 30 (1): 109-118.

Afghah, M., 2009. New investigations of the Tarbur Formation lithostratigraphy in the review of type section and its correlation with Kuh-e Tir section. Journal of Sciences Islamic Azad University, 19 (73): 183-196.

Afghah, M., Fadaei, H.R., 2014. Biostratigraphy of Cenomanian succession in Zagros area (south west of Iran). Geosciences Journal, 19 (2): 257-271.

Afghah, M., Farhoudi, G., 2012. Boundary between Upper Cretaceous and Lower Paleocene in the Zagros Mountain Ranges of southwestern Iran. Acta Geologica Sinica, 86 (2): 325-338.

Afghah, M., Yaghmour, S., 2014. Biostratigraphy study of Tarbur Formation (Upper Cretaceous) in Tang-E Kushk and east of Sarvestan (SW of Iran). Journal of Earth Science, 25 (2): 263-274.

Afghah, M., Yousefzadeh, A., Shirdel, S., 2014. Biostratigraphic revision of Middle Cretaceous succession in South Zagros Basin (SW of Iran). Journal of Earth Science & Climatic Change, 5 (8): 216.

Alavi, M., 2004. Regional stratigraphy of the Zagros foldthrust belt of Iran and its proforeland evolution. American Journal of Science, 304: 1-20.

Albrich, S., Boix, C., Caus, E., 2015. Selected agglutinated larger foraminifera from the Font de les Bagasses unit (Lower Campanian, southern Pyrenees). Carnets de Géologie 15 (18): 245-267.

Al-Kubaysi, K.N., 2008. Biostratigraphy of Aqra, Tanjero and Shiranish Formations in Chwarta, Area, Sulaimaniyah governorate, NE Iraq. Geology and Mine of Iraq, 4 (2): 1-23.

Al-Kubaysi, K.N., Abid, A.A., 2016. A new record of foraminifera species (*Pseudorbitolina marthae* Douville) indicating the late Maastrichtian stage within the Aqra formation in Chwarta area, Sulaimaniyah governorate, ne Iraq. Journal of Zankoy Sulaimani, Special Issue, GeoKurdistan, II: 203-212.

Arriaga, M.E., Frijia, G., Parente, M., Caus, E., 2016. Benthic foraminifera in the aftermath of the Cenomanian-Turonian boundary extinction event in the carbonate platform facies of the Southern Apennines (Italy). Journal of Foraminiferal Research, 46 (1): 9-24.

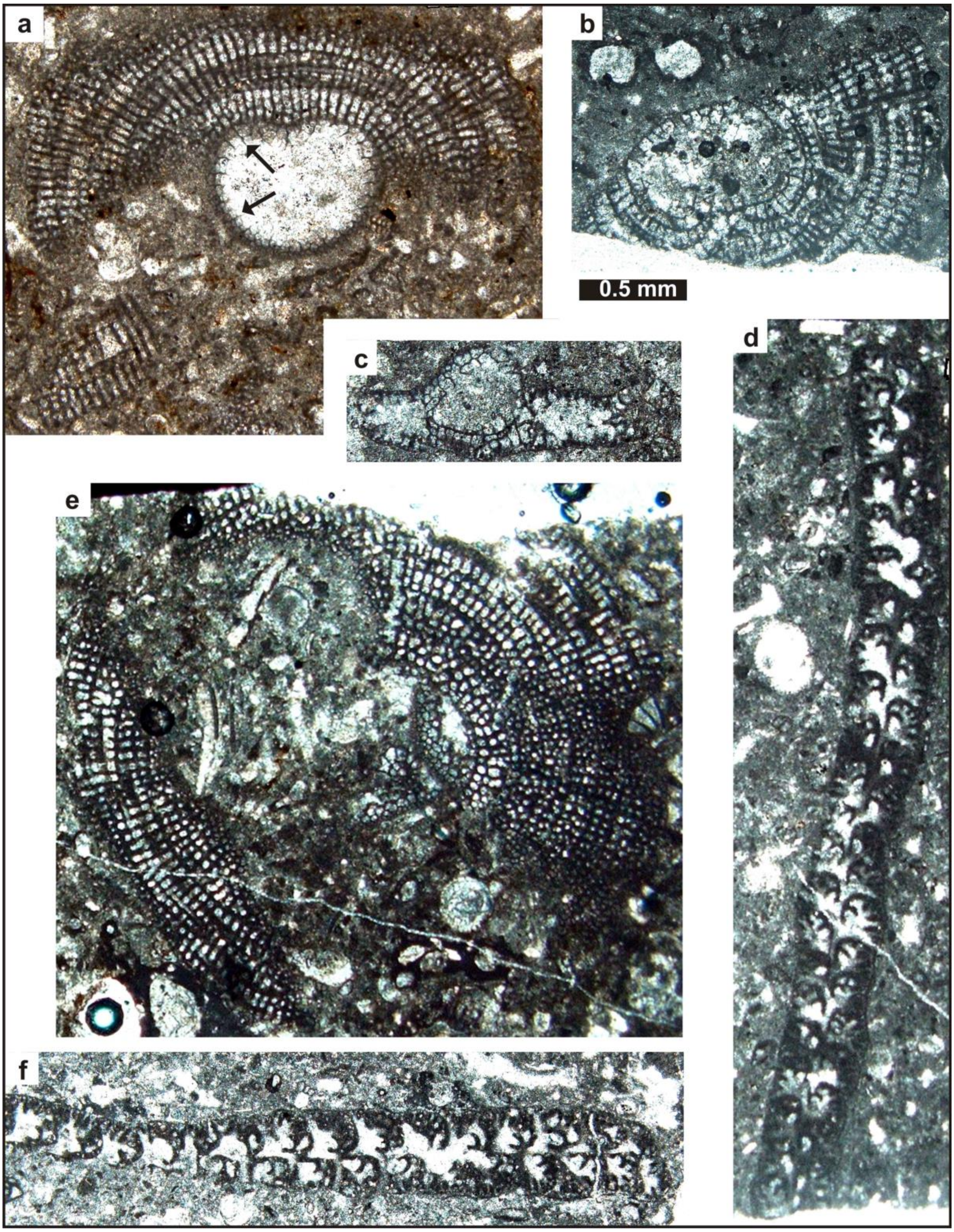

Fig. 7 *Dicyclina schlumbergeri* Munier-Chalmas, Late Maastrichtian Tarbur Formation of the Naghan section. **a–b** Oblique equatorial sections showing embryonic chamber, kidney-shaped in outline. Note the presence of primary partitions only (arrows). **c** Oblique section of a juvenile specimen. **d, f** Partial, slightly oblique axial sections. **e** Fragmentary equatorial section. Scale bars = 1 mm. Thin-sections: 2NG 191 (**a**), NG 83 (**b**), NG 13-1 (**c**), NG 34 (**d**), NG 49 (**e**), 2NG 34 big (**f**).

Babazadeh, S.A., Dehej, T.E., 2015. Stratigraphical study of the Taft Formation in the Bohruk area from Yazd Block, Central Iran. Journal of Earth Science, 26 (5): 729-739.

Bahrami, M., 2009. Sedimentology and paleogeography of the Bakhtyari conglomeratic formation at Ghalat and Garu-Charmakan Mountains, NW of Shiraz, Iran. Journal of Geology, Geophysics and Geosystems, 3 (1): 1-10.

Boix, C., Frijia, G., Vicedo, V., Bernaus, J.M., Di Lucia, M., Parente, M., Caus, E., 2011. Larger foraminifera distribution and strontium isotope stratigraphy of the La Cova limestones (Coniacian–Santonian, "Serra del

Montsec", Pyrenees, NE Spain). Cretaceous Research, 32: 806-822.

Cherchi, A., Schroeder, R., 1990a. Révision de *Dicyclina schlumbergeri* Munier-Chalmas, grand Foraminifère du Crétacé mésogéen. Comptes rendus de l' Academie des Sciences, ser. I, 310: 329-334.

Cherchi, A., Schroeder, R., 1990b. *Dicyclina sampoi* n. sp., a larger foraminifer from the Cenomanian of Zagros Range (SW Iran). Paläontologische Zeitschrift, 64 (3/4): 203- 211.

Douglass, R.C., 1960. The foraminiferal genus *Orbitolina* in North America. Geological Survey Professional Papers, 333: 1-52.

Fleury, J.-J., Mavrikas, G., Baudin, F., 1990. Paléobiogéographie du genre *Loftusia*, foraminifère du Crétacé terminal de la Téthys. Bulletin de la Société Géologique de France, (8), 6 (3): 487-495.

Gendrot, C., 1968. Stratigraphie et micropaléontologie du Sénonien de la région des Martigues près Marseille (Bouches-du-Rhône). Eclogae Geologicae Helvetiae 61 (2): 657-694.

Görmüş, M., Lawa, F.A.A., Al Nuaimy, Q.A.M., 2017. *Suraqalatia brasieri* n.gen., n.sp. (larger foraminifera) from the Maastrichtian of Sulaimani area in northern Iraq. Arabian Journal of Geosciences, 10: 365.

Hottinger, L., 2006. Illustrated glossary of terms used in foraminiferal research. Carnets de Géologie / Notebooks on Geology - Memoir 2006/02, pp. 126.

James, G.A., Wynd, J.G., 1965. Stratigraphic Nomenclature of Iranian Oil Consortium Agreement Area. AAPG Bulletin, 49 (12): 2218-2232.

Kaminski, M.A., 2014. The year 2010 classification of the agglutinated Foraminifera. Micropaleontology, 60 (1): 89-108.

Loeblich, A.R., Jr., Tappan, H., 1987. Foraminiferal genera and their classification, Van Nostrand Reinhold, New York, 2 vol., 970 p., 847 pls.

Maghfouri-Moghaddam, I., Zarei-Sahamieh, R., Ahmadi-Khalaji, A., Tahmasbi, Z., 2009. Microbiostratigraphy of the Tarbur Formation, Zagros Basin, Iran. Journal of Applied Sciences, 9 (9): 1781-1785.

Munier-Chalmas, E., 1887. Sur les Foraminifères ayant un réseau de mailles polygonales. Bulletin de la Société Géologique de France, ser. 4, 2: 349-353.

Omidvar, M., Mehrabi, M., Sajjadi, F., Bahramizadeh-Sajjadi, H., Rahimpour-Bonab, H., Ashrafzadeh, A., 2014. Revision of the foraminiferal biozonation scheme in Upper Cretaceous carbonates of the Dezful Embayment, Zagros, Iran: Integrated palaeontological, sedimentological and geochemical investigation. Revue de Micropaléontologie, 57 (3): 97-116.

Pawlowski, J., Holzmann, M., Tyszka, J., 2013. New supraordinal classification of Foraminifera: Molecules meet morphology: Marine Micropaleontology, 100: 1-10.

Pirbaluti, B.A., Abyat, A., 2013. Microbiostratigraphy and lithostratigraphy of the Tarbur Formation in southeast of Shahr-e-kord, Iran. Advances in Environmental Biology, 7 (11): 3481-3486.

Pirbaluti, B.A., Ataabadi, M.M., Djafarian, M.A., Khosrow Tehrani, K., Afghah, M., Davoudi Farad, Z., 2013. Biostratigraphy and regional aspects of the Tarbur Formation (Maastrichtian) in Central Zagros, Southwest Iran. Rivista Italiana di Paleontologia e Stratigrafia, 119 (2): 215-227.

Rajabi, P., Safizadeh, M., Nowroozpour, H., 2011. Microbiostratigraphy and microfacies of Tarbour Formation in Makhmal-kuh (north east of Khorram Abbad-Iran). Journal of Basic and Applied Scientific Research, 1 (10): 1724-1731.

Rikhtegarzadeh, M., Vaziri, S.H., Alaeli, M., Bakhttiar, H.A., Jahani, D., (2016). Microbiostratigraphy, microfacies and depositional environment of the Sarvak Formation in Bi Bi Hakimeh oil field (well no. 29). International Journal of Geography and Geology, 5 (10): 194-208.

Sari, B., Tasli, K., Özer, S., 2009. Benthonic foraminiferal biostratigarphy of the Upper Cretaceous (Middle Cenomanian–Coniacian) sequences of the Bey Dağlari Carbonate Platform, Western Taurides, Turkey. Turkish Journal of Earth Sciences, 18: 393-425.

Schlagintweit, F., Rashidi, K., 2018. *Persiella pseudolituus* n. gen., n. sp., and *Flabelloperforata tarburensis* n. gen., n. sp., two new larger benthic foraminifera from the Upper Maastrichtian of Iran. Acta Palaeontologica Romaniae, 13 (2): 3-19.

Schlagintweit, F., Rashidi, K. & Babadipour, M., 2016a. Orbitolinid foraminifera from the Late Maastrichtian of the Tarbur Formation (Zagros Zone, SW Iran). Acta Palaeontologica Romaniae, 12 (2): 29-46.

Schlagintweit, F., Rashidi, K., Barani, F., 2016b. First record of *Gyroconulina columellifera* Schroeder & Darmoian, 1977 (larger benthic foraminifera) from the Maastrichtian Tarbur Formation of SW Iran (Zagros Fold-Thrust-Belt). Geopersia, 6 (2): 169-185.

Toulabi, L., Roozbahani, P.R., 2015. Stratigraphy and foraminiferal biozonation of Upper Cretaceous deposits in south-west of Iran (Khorramabad-Kuhdasht). Buletin Teknologi Tanaman, 12: 92-95.

Vaziri-Moghadam, H., Safari, A., Taheri, A., 2005. Microfacies, palaeoenvironment and sequence stratigraphy of the Tarbur Formation in the Kherameh area, SW Iran. Carbonates and Evaporites, 20 (2): 131-137.

Velić, I., 2007. Stratigraphy and palaeobiogeography of Mesozoic benthic foraminifera of the Karst Dinarides (SE Europe). Geologia Croatica, 60: 1-113.

Wynd, J.G., 1965. Biofacies of the Iranian Oil Consortium Agreement Area. IOOC Report No. 1082, 89 p.