Arab J Geosci (2017) 10: 365
DOI 10.1007/s12517-017-3145-3

ORIGINAL PAPER

Suraqalatia brasieri n.gen., n.sp. (larger foraminifera) from the Maastrichtian of Sulaimani area in northern Iraq

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Received: 6 January 2017 / Accepted: 4 August 2017 / Published online: 18 August 2017

Abstract *Suraqalatia brasieri* n.gen., n.sp. from the family Dicyclinidae Loeblich and Tappan 1964 occurs on the Maastrichtian carbonate platform of northern Iraq. The new genus is recognizable by its large very compressed conical test, up to 55–70 mm in diameter, to 0.3–1.6 mm in thickness, planspiral cooling having very small proloculus in the initial part and later circular chambers including numerous chamberlets with an agglutinated wall. *Suraqalatia brasieri* n.gen., n.sp. is associated with textulariids, miliolids and rotaliids as *Loftusia elongata* Cox, *L. morgani* Douvillé, *Orbitoides medius* d'Archiac, *O. megaloformis* Papp & Kupper, *O. gruenbachensis* Papp, *O. apiculatus* Schlumberger, *Omphalocyclus macroporus* (Lamarck), *Siderolites calcitrapoides* Lamarck, *Sirtina orbitoidiformis* Brönnimann & Wirz. The associated macrofauna comprises large and rich giant rudists (*Preradiolites* sp.), other bivalves (*Gryphaea* sp. and *Glycymeris* sp.), gastropods (*Acteonella* sp.), echinoderms and corals. The fauna indicates shallow marine carbonate platform conditions within the Maastrichtian green house. It is also worth mentioning that the new genus has only been recorded from the Maastrichtian age.

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Keywords *Suraqalatia brasieri* n.gen., n.sp. · Maastrichtian · Foraminifera · Dicyclinidae · North Iraq

Introduction

The new *Suraqalatia brasieri* n.gen., n.sp. described herein comes from Suraqalat Village, located about 20 km NW of Sulaimani city in the Kurdistan Region, northern Iraq (Fig. 1). *Suraqalatia,* the foraminiferal new genus from the upper Cretaceous deposits of the northern Iraq, has a typical agglutinated endoskeleton wall structure. The new genus differs from other agglutinated benthic foraminifera species of cyclolinid, orbitopsellid, cyclamminid, discyclinid, spirocyclinid and orbitolinid in having a larger test size, larger ratio of thickness to diameter, a compressed conical, annular to undulated annular test, an initial part and arrangements of chamber-chamberlets. Particularly, the embryonic structures of orbitolinids and spirocyclinids are very different from the new genus's apparatus part. Equatorial chamberlets' views of the cyclolinid, orbitopsellid and cyclamminid forms are also dissimilar. Two genera namely *Broeckinella* Henson, 1948 and *Dicyclina* Munier-Chalmas 1887, seem to be the closest genera to the new genus. It is known that *Broeckinella arabica* Henson, 1948 was based on only a single holotype specimen (Cherchi and Schroeder 1978). Cherchi and Schroeder (1978) state that the figures of the holotype presented by Henson (1948) are too indistinct and give no clear information about the structure of the embryon, form and arrangement of the first chambers, or the form of the chambers of the adult stage. They give a new

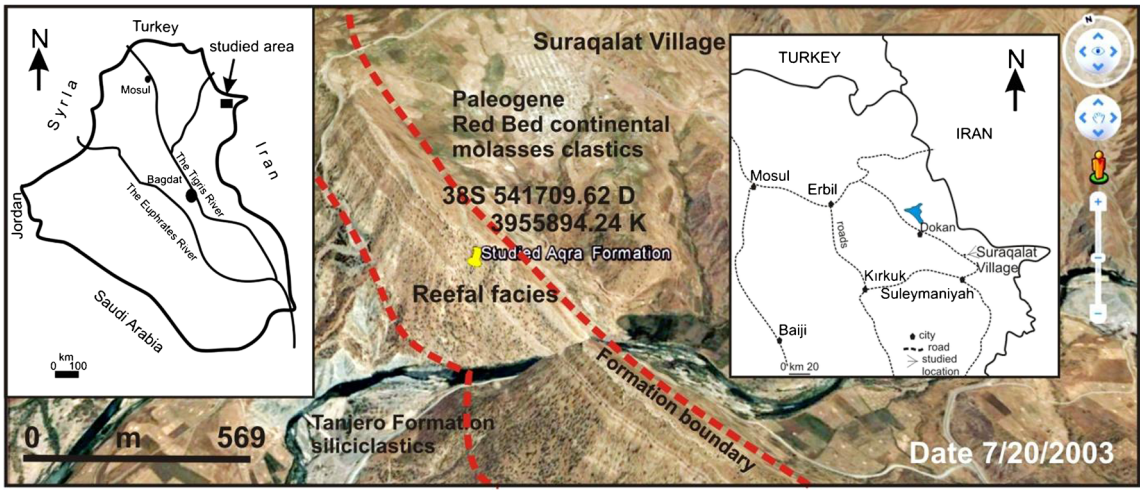

Fig. 1 Locality map of the investigation area and the Google Earth view (https://www.google.com/earth/)

description of the type specimen having a reniform shape in outline, and a planspiral initial part. In the classification of foraminifera based on Loeblich and Tappan (1987), the Discyclinidae family only includes one genus namely *Dicyclina* Munier-Chalmas 1887. It has a discoid test, numerous small chamberlets, and epidermal parts. So it is thought that the new genus may belong to the family Dicyclinidae Loeblich and Tappan, 1964. More recently, similar genera, such as *Broeckinella* and *Dicyclina* have been reported from the late Maastrichtian shallow water carbonates of the Tarbur Formation in the Zagros area, SW Iran (Schlagintweit and Rashidi 2016). Based on its similarities with *Dicyclina*, the new genus is placed in the Dicyclinidae family.

The studied new genus is seen in the upper Cretaceous sequence–Aqra Formation which is related to the upper part of the tectonic mega sequence of the Arabian plate (TMSAP 9) (Sharland et al. 2001; Aqrawi et al. 2010; Lawa et al. 2013) (Fig. 1). The formation was defined as a member within the upper parts of the Tanjero Formation (Lawa et al. 1998; Sharbazheri 2008). It mainly includes carbonates and fine silty, sandy carbonates. At the study site, the Maastrichtian Aqra Formation overlies conformably siliciclastics of the Tanjero Formation. The Paleocene–Eocene Red Bed Series is seen unconformably on the Maastrichtian carbonates (Fig. 2). The deposits of the Aqra Formation are rich in larger benthic foraminiferal assemblage including *Loftusia* Brady 1870, *Orbitoides* d'Orbigny, 1848 (in Lyell 1848), *Lepidorbitoides* Silvestri 1907, *Omphalocyclus* Bronn, 1853 (in Bronn and Roemer 1853), textulariid and nodosariid. It also comprises a predominance of giant *Hippurites*, gastropods, echinoids and other bivalves. The Aqra Formation generally includes rudistic biostromal occurrences (Al-Omari and Sadek 1975; Lawa 1983; Lawa et al. 1986; Al-Omari et al. 1989; Lawa et al. 1998; Özer et al. 2013).

Material and methods

Samples were collected from the sandy limestones and limestones of the Aqra Formation. Hard rock thin-section samples and individual thin sections of *Suraqalatia brasieri* n.gen., n.sp. from the Aqra Formation were studied. More than 55 rock samples, and 124 thin sections (mostly oriented in equatorial or longitudinal directions) were prepared. The length and diameter of more than 50 individuals of *Suraqalatia brasieri* n.gen., n.sp. were measured. Microphotographs of thin sections were taken in the Geology Department of the Ankara University. The material is housed in the collections of the Geological Engineering Department of Ankara University in Turkey.

Systematic taxonomy

The classification scheme followed here is that of the foraminiferal species data base (Hayward 2013). Related genera comparison is mainly based on the classification of and information from Henson (1948), Lawa (1983), Lawa et al. (1986), Loeblich and Tappan (1987), Al-Omari et al. (1989), Mohammed (1996) and Boudagher-Fadel (2008).

Phylum FORAMINIFERA (d'Orbigny 1826)

Class GLOBOTHALAMEA Pawlowski, Holzmann, Tyszka 2013

Subclass TEXTULARIIA Mikhalevich 1980

Order LOFTUSIIDA Kaminski, Mikhalevich 2000 (in Kaminski 2004)

Suborder ATAXOPHRAGMIINA Fursenko 1958

Superfamily ATAXOPHRAGMIOIDEA Schwager 1877

Family DICYCLINIDAE Loeblich & Tappan 1964

Suraqalatia n.gen.

Figs. 3 (1)–(12), 4 (1)–(13) and 5 (1)–(8)

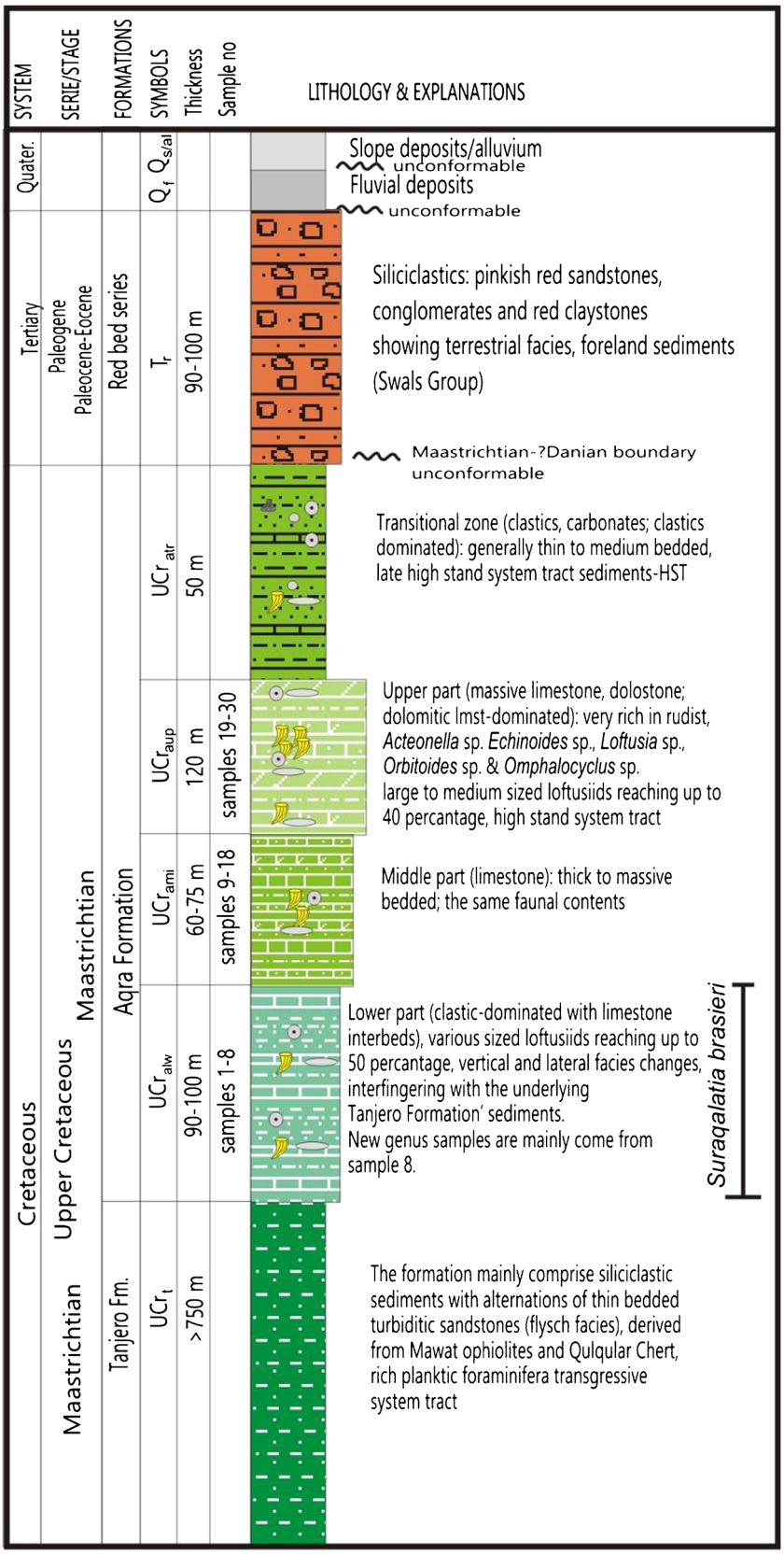

Fig. 2 Simplified generalised stratigraphical column of the area showing the geological units (modified from Lawa et al. 1998)

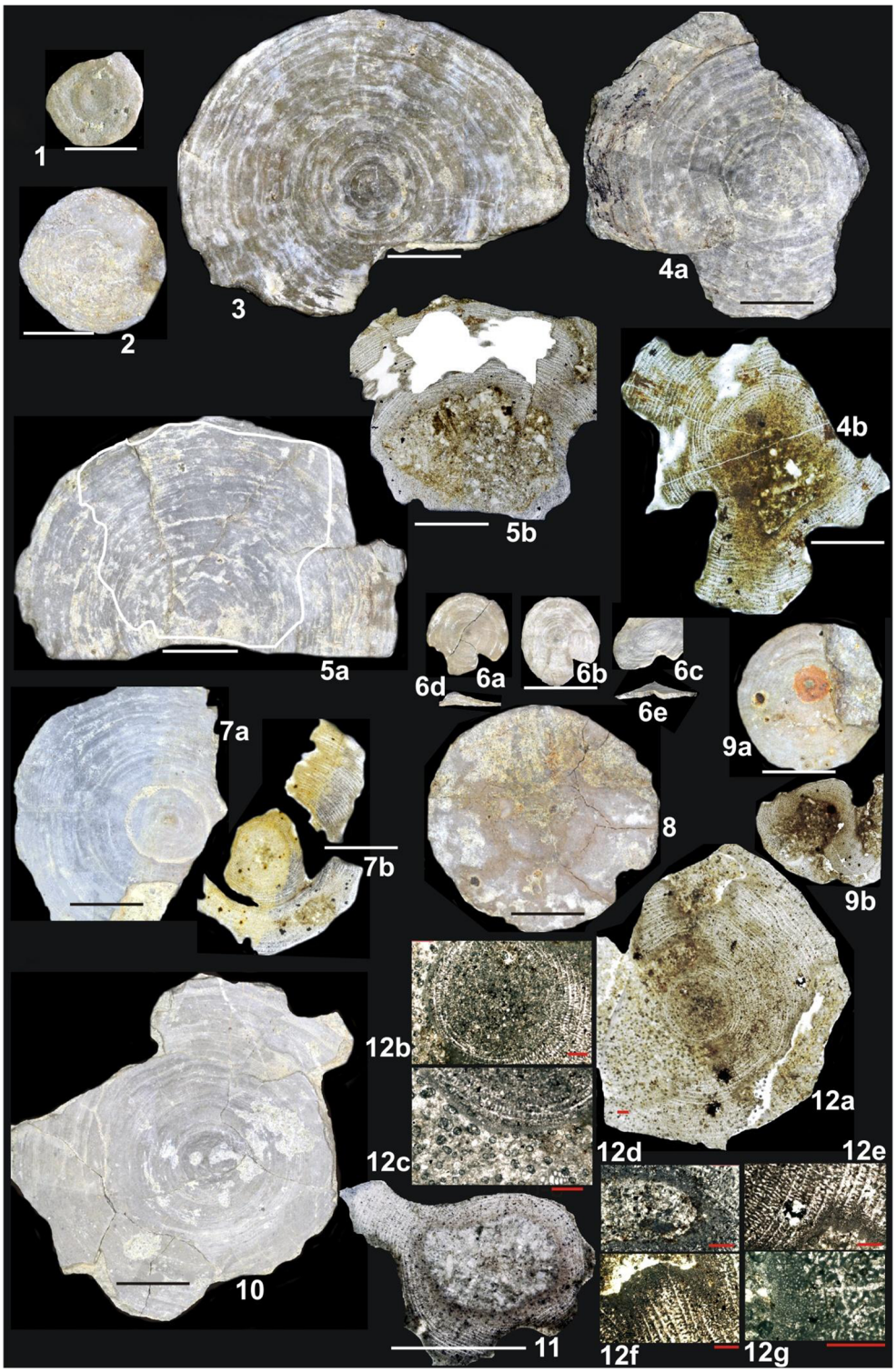

Fig. 3 *Suraqalatia brasieri* n.gen., n.sp.. All figures are from sample 8. **1** External view, specimen 2. **2** External view, specimen 6. **3** External view, specimen 3. **4a** External view. **4b** Equatorial section, specimen 11. **5a** External view. **5b** Equatorial section, specimen 8. White line in 5a shows the external boundary of the specimen thin section in 5b. **6a**–c External views. **6d–e** Side views, specimen 16. **7a** External view. **7b** Equatorial section. specimen 15. **8**. External view, specimen 17. **9a** External view. **9b** Equatorial section, specimen 6. **10** External view, specimen 10. **11** Equatorial section, specimen 9a. **12a** equatorial section. **12b**–**c** Initial part. **12d**–**g** Closer views of equatorial chamberlets, specimen 2 (scale bars in figures 1–11 show 1 cm, scale bars in figure 12a–g indicate 0.5 mm)

Type species *Suraqalatia brasieri* n.gen., n.sp.

Origin of the genus name It derives from *Suraqalat* Village in northern Iraq.

Type locality Suraqalat.

Type level Maastrichtian.

Description External characters: Test free, large, discoid, annular, undulated annular, a low cone to flat test with a very small pointed apex on the convex side, flat to sinusoidal base on the concave base, symmetrical. Figure 6 is a schematic

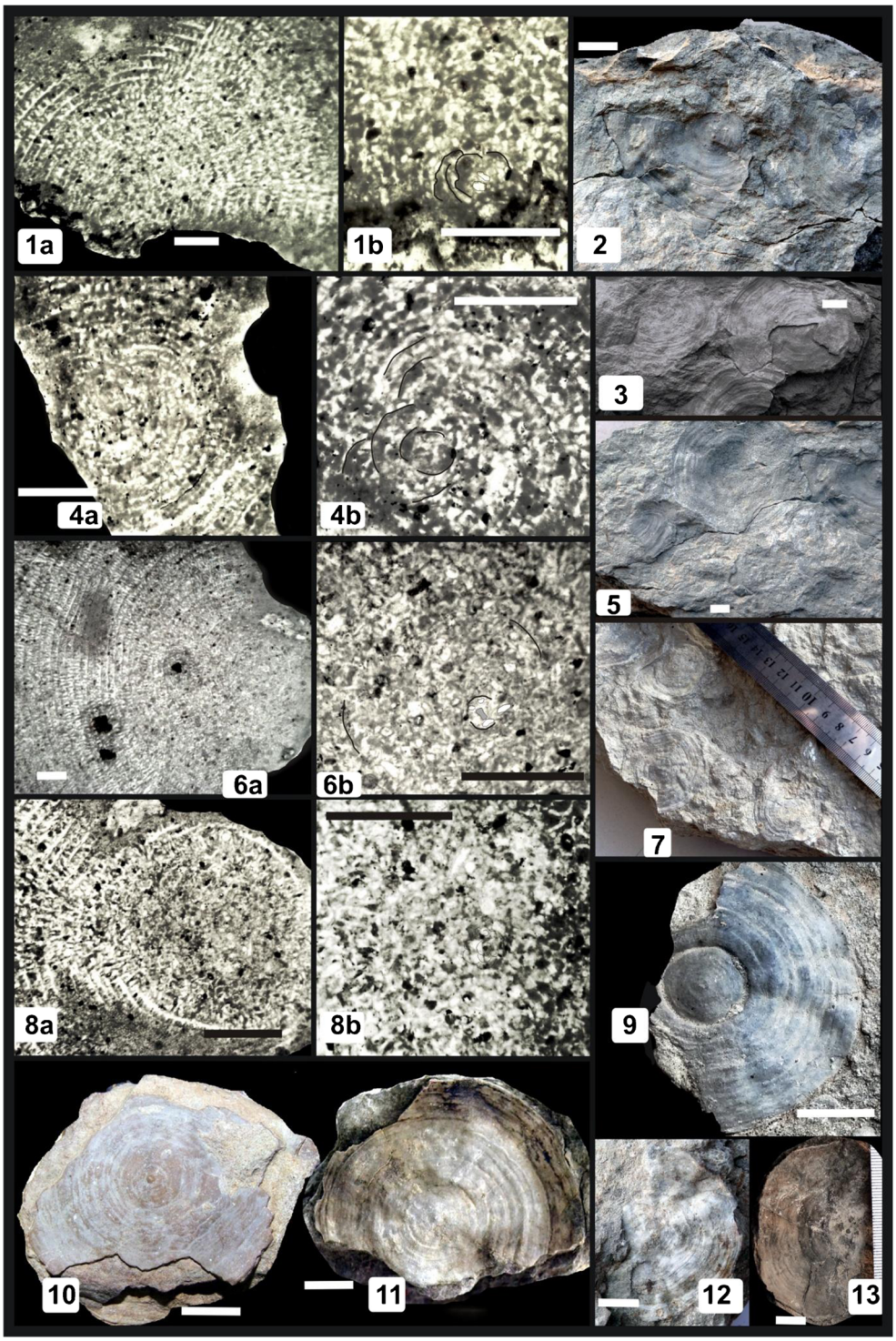

Fig. 4 *Suraqalatia brasieri* n.gen., n.sp.. All figures are from sample 8. **1a** Equatorial section. **1b** Closer view of the initial part, specimen K1. **2** Individuals within clayey sandy limestones, sample 8a. **3** Individuals within clayey sandy limestones, sample 8b. **4a** Equatorial section. **4b** Closer view of the initial part, specimen K2. **5** Individuals within clayey sandy limestones, sample 8c. **6a** Equatorial section. **6b** Closer view of the initial part, specimen K3. **7** Individuals within clayey sandy limestones, sample 8d. **8a** Equatorial section. **8b** Closer view of the initial part, specimen K5. **9**–**13** Closer views of external views, sample 8e–i (scale bar 1 cm)

drawing that illustrates a three- dimensional views of the new genus' external and internal characteristics. Figure 7 shows a comparison with similar genera. The edge is sub rounded to rounded. Surface ornamentation includes numerous septa traces, circular in shape. Septa traces are depressed and more or less equal in width. The number of chambers varies between 40 and 60 from the initial part to the end of the test. Test diameter ranges from 5 to 70 mm. The thickness of the test varies between 0.3 and 1.3 mm. The mean diameter of 25 examined specimens is 35 mm and the mean value for thickness is 1 mm (Fig. 8). Bituminous relicts and ironized borings, up to 5 mm, are also seen on the test surface. The imperforate test appears grey in colour under reflected light.

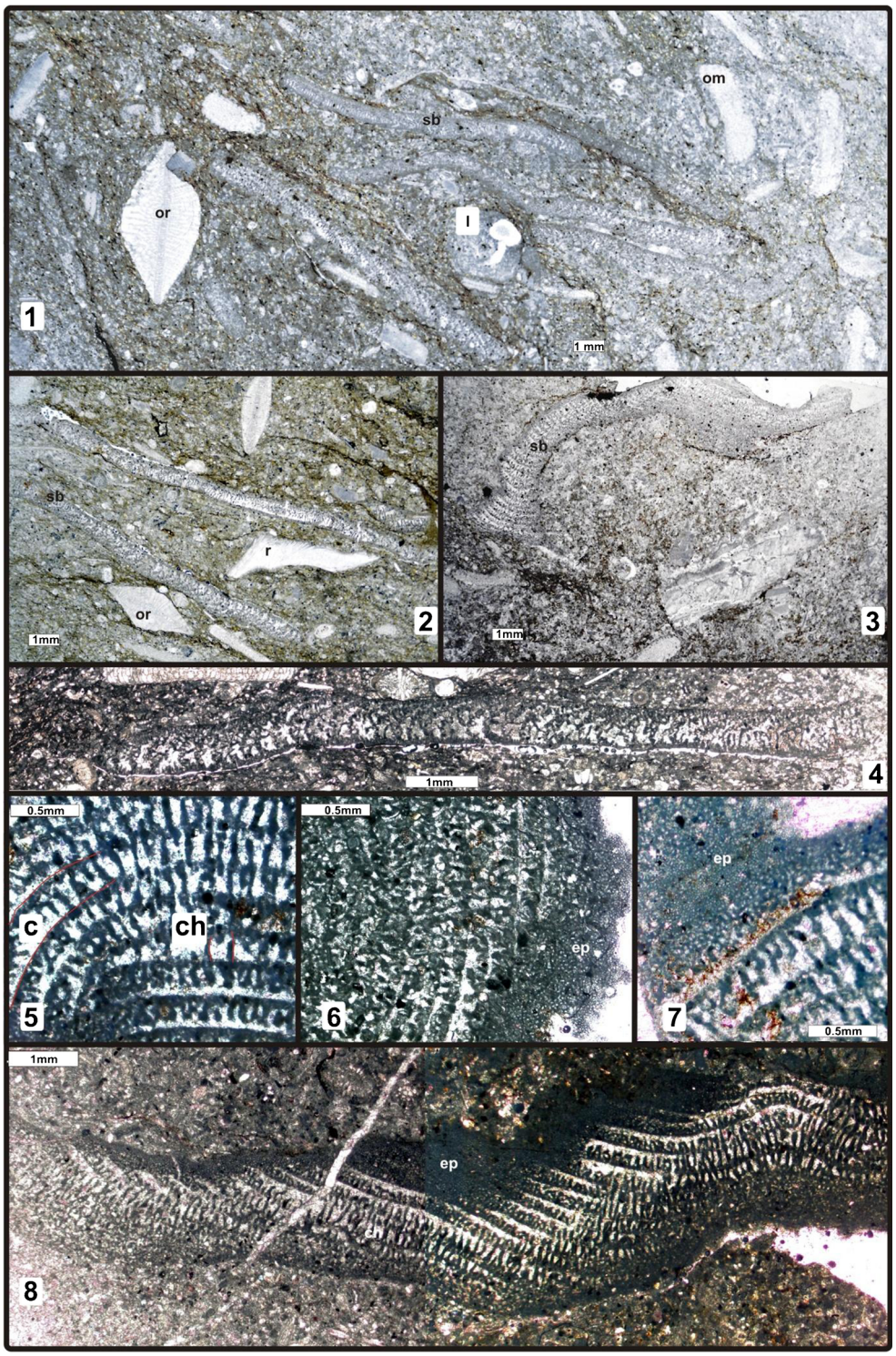

Fig. 5 **1**–**3** Thin sections including *Suraqalatia brasieri* n.gen., n.sp. (sb), or *Orbitoides* sp., l. *Loftusia* sp., om *Omphalocyclus macroporus*, r rudist shell, sample 8. **4** Axial section, sample 8. **5**–**7** Closer views of equatorial chamber (c) and chamberlets (ch), ep. epidermal wall, specimen numbers. 5 S11A(6). 6 S11A(2). 7 S11A(6). **8** Oblique section, specimen S11A(4)

Internal characters: Only microspheric forms were found. The proloculus is so tiny that no clear initial part was seen in more than 50 examined specimens including equatorial, axial sections and free specimens. The tiny proloculus was only discerned in a few specimens as it is usually confused with agglutinated silty and sandy materials. Later, circular whorls begin. In axial and tangential sections, numerous septa are seen as perpendicular, or curved perpendicular towards the epidermal parts. In equatorial sections, the interior of

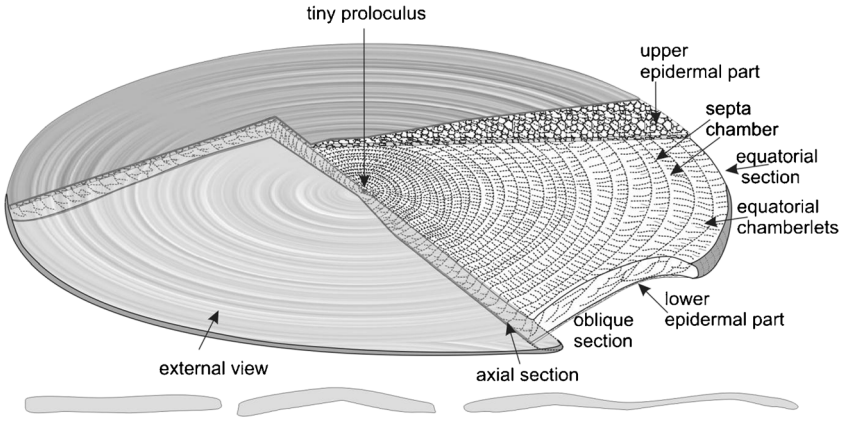

Fig. 6 A diagrammatic reconstruction of *Suraqalatia brasieri* n.gen., n.sp. (**a**) and its test modifications (**b**)

the chambers is divided by numerous partitions. The number of septa varies from 30 to 60, all with similar widths of 0.1 to 0.2 mm. Almost every septum includes numerous rectangular shaped chamberlets. Regular growth is seen. Crossing chamberlets are common within undulated annular tests. Apertures are numerous and lie in the epidermal parts at the edges of the test. Test is agglutinated, labyrinthic and includes chert, limestone grains, small intraclasts and fragments of textulariid and miliolid foraminifera. The dark line part of the septa (chamber line) is alveolar. Tiny clasts derived from the substrate are also seen within the chamberlets and endoskeleton part of the wall.

Similarities and differences When the new genus is compared with other larger agglutinated benthic foraminifera, some genera of cyclolinid, orbitopsellid, cyclamminid, spirocyclinid and orbitolinid appear simi-

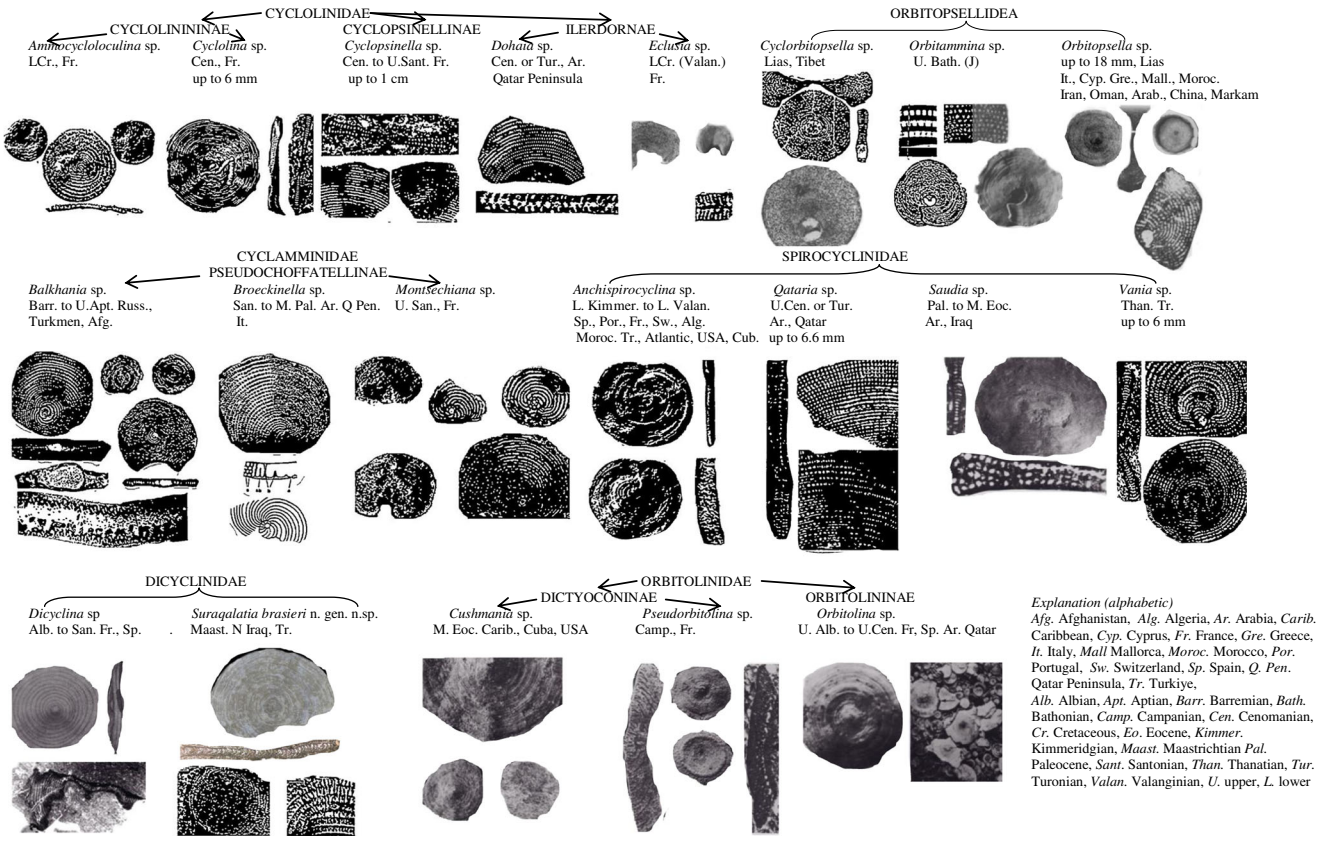

Fig. 7 Comparison of *Suraqalatia* n.gen. with other larger benthic agglutinant walled genera (all figures except new genus are from Loeblich and Tappan 1987)

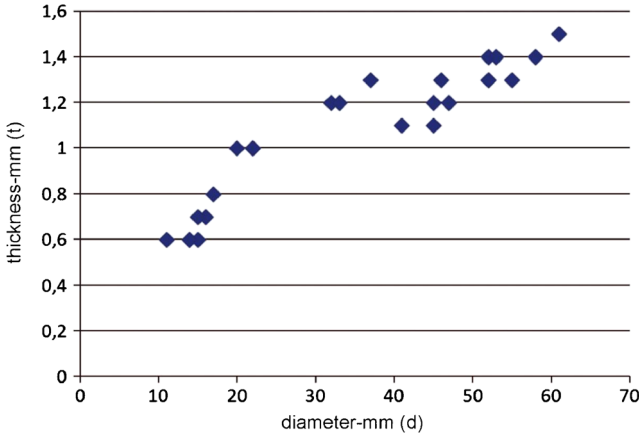

Fig. 8 A scatter diagram including diameter (d) and thickness (t) measurements of the test for the *Suraqalatia* n.gen. (25 individuals)

lar externally. Among agglutinated benthic foraminifera species, conical tests include various genera such as *Lituonella, Coskinolina, Dictyoconus, Orbitolinopsis, Iraqia, Kilianina* and *Orbitolina* while compressed-conical tests comprise the genera of *Lituonelloides, Coskinolinopsis, Dictyoconella* (Henson 1948) (Fig. 7). While a large proloculus is seen in the initial parts of orbitopsellid and orbitolinids, dicyclinid forms include a tiny proloculus. *Qataria dukhani* Henson, 1948 and *Montsechiana* (Aubert et al. 1963) are accepted as hauriniid forms whose test structure is very different (Boudagher-Fadel 2008). The flabelliform and spiral initial parts of cyclolinid, cyclamminid and spirocyclinid are also not the same as the new genus. Polygonal sub epidermal patterns should be ascribed to the Spirocyclinidae family instead of Cyclamminidae (Schlagintweit and Rashidi 2016). The size of *Broeckinella arabica* Henson, 1948 varies between 2.4 and 3.1 mm (Cherchi and Schroeder 1978; Schlagintweit and Rashidi 2016). It is also found that its initial part is planspiral, flabelliform and its shape is reniform in outline. According to Loeblich and Tappan (1987), the Dicyclinidae family comprises only one genus called *Dicyclina*. Its age ranges from Albian to Santonian. It is thought that age, size and number of chambers and chamberlets, initial view of the new genus is very different from similar genera (Fig.7). Internal structures of the genus *Qataria* looks like similiar structures with the new genus. However, *Qataria* has so different internal structures with its regular chamberlets' arrangement. *Dicyclina* Munier-Chalmas 1887 seems to be the closest to the new genus due to its small proloculus, internal chamberlets characteristics, external test view and agglutinated labyrinthic wall structure. Due to the closest view and internal architecture, we restrain the new genus *Suraqalatia* in the Dicyclinidae family.

Stratigraphic and regional distribution The type locality is near the Suraqalat Village in northern Iraq and corresponds to the lower part of the Aqra Formation. The maximum thickness of the sediments is about 100 m. Limestones and silty and sandy limestones include new genus occurrences. Faunal assemblages together with the new genus indicate Maastrichtian age. *Loftusia elongata* Cox, *L. morgani* Douvillé, *Orbitoides medius* d'Archiac, *O. megaloformis* Papp & Kupper, *Orbitoides gruenbachensis* Papp, *O. apiculatus* Schlumberger, *Omphalocyclus macroporus* (Lamarck), *Siderolites calcitrapoides* Lamarck, *Sirtina orbitoidiformis* Brönnimann &Wirz, *Lepidorbitoides* sp., textulariid and nodosariid forms are seen in the same levels (Fig. 9 (2–22). This accompanying fauna indicates a shallow inner shelf environment with a low energy index. *Dicyclina* cf. *schlumbergeri* and other Maastrichtian larger benthic foraminifera were recorded in the upper part of the Tarbur Formation by Schlagintweit and Rashidi (2016). Khosrow Tehrani and Afghah (2004) reported *Dicyclina* from the *Loftusia-Dicyclina* assemblage zone of the Amiran Formation in SW Iran, Zagros Zone. The similar occurrences are also seen in the SE Turkey. So, the paleogeograpy of the new genus may extend to southeastern Turkey.

Suraqalatia brasieri n. gen. n. sp.

Figs. 3 (1–12), 4 (1–13) and 5 (1–8)

Origin of species name In memory and honour of Martin Brasier who was my PhD supervisor during my stay in the UK from 1987 to 1990.

Holotype External view, Fig. 3 (3)

Paratype External view, Fig. 3 (4)

Depository Holotype and paratypes are kept in the Geological Engineering Department of Ankara University.

Type locality Suraqalat.

Type level Maastrichtian.

Description The new species is described as a form of the genus *Suraqalatia* n. gen. As a monospecific genus, the above description of the genus including external and internal features, applies to the species. Discoid annular, compressed conical large tests, a globular tiny proloculus on a few specimens, microspheric occurrences and a labyrinthic wall with epidermal parts and alveolar agglutinated tests are characteristics of the new species.

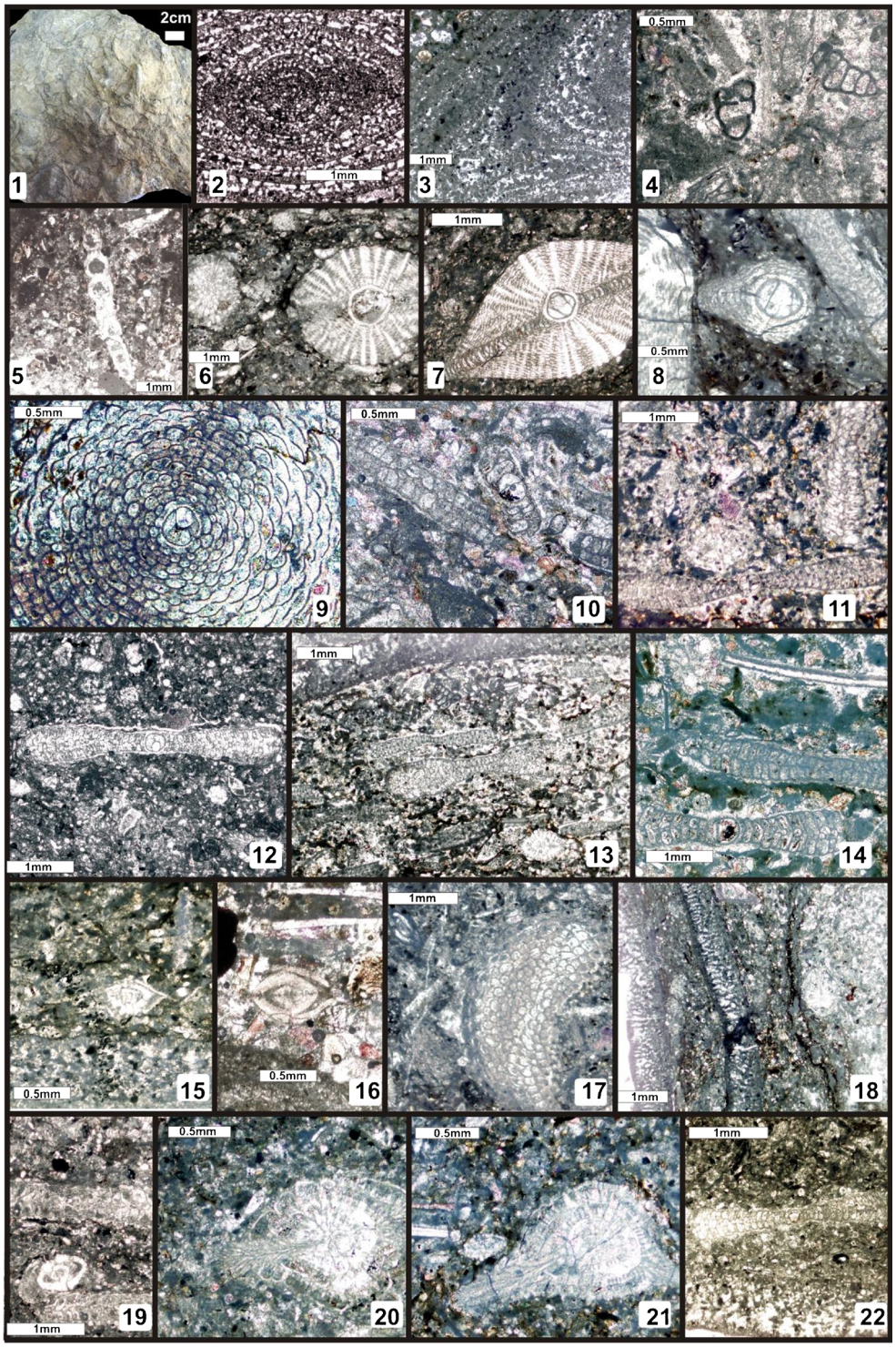

Fig. 9 **1** *Suraqalatia brasieri* n.gen., n.sp. and *Loftusia* sp. within limestone, sample 8. **2–22** Associated benthic foraminifer's fauna. **2–3b** *Loftusia* cf. *elongata* Cox. **4** Textulariid forms. **5** Nodosariid form. **6–8** *Orbitoides gruenbachensis* Papp, axial sections. **9** *Omphalocyclus macroporus* (Lamarck), equatorial section. **10** *Omphalocyclus macroporus* (Lamarck), axial and tangential sections. **11–14** *Omphalocyclus macroporus* (Lamarck), axial and tangential sections. **15** *Sirtina orbitoidiformis* Brönnimann & Wirz. **16** *Sulcoperculina* sp. **17** *Omphalocyclus* sp. **18** *Suraqalatia brasieri* n.gen., n.sp., axial sections, **19** *Sulcoperculina* sp. **20–21**. *Siderolites calcitrapoides* Lamarck. **22**. *Omphalocyclus macroporus* (Lamarck) and *Suraqalatia brasieri* n.gen., n.sp., axial sections; thin section numbers. 2. S22A(4), 3. S22A(4), 4. S22A(5), 5. S22A(6), 6. MG1, 7. MG1, 8. S22A(1), 9. S22A(6), 10. S22A(4), 11. S22A(6), 12. Y2, 13. S11(1), 14. S22(4), 15. S10(3), 16. S22A(5), 17. S11A(4), 18. S10(2), 19. MG1, 20. MG1, 21. S10(6), 22. S11A

Conclusion

In contrast to most other agglutinants larger benthics, *Suraqalatia brasieri* n.gen., n.sp. has a discoid to compressed discoid larger test including numerous rectangular chamberlets with labyrinthic wall structure. Although there have been many studies on orbitolinids (e.g. Cherchi and Schroeder 1999; Schroeder et al. 2010; Shirazi and Abedi 2013), dicyclinid forms have not been well documented in Iraq. The relatives closest to *Suraqalatia* may be *Dicyclina* due to its internal characteristics. But it differs from *Dicyclina* in being larger sizes, with many numerous rectangular chamberlets and epidermal parts. Test sizes reach up to 70 mm, and the

thickness up to 1.5 mm. The new genus occurrences come from upper Maastrichtian deposits.

In conclusion, the data obtained relate to larger benthic agglutinated foraminifera of the Maastrichtian from the northern Iraq and allow us to describe this new genus and species identified as *Suraqalatia brasieri* n.gen., n.sp.

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