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Quantitative data on the genus *Loftusia* from the Zagros Mts., northern Iraq

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ABSTRACT:

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The Maastrichtian sediments of northern Iraq are rich in larger benthic foraminifera. Among them, the genus *Loftusia* is well-known one because of its significant palaeogeographic distribution across the Mediterranean and Middle East. In this study, observations of abnormal test shapes, species recognition criteria and endoskeleton characteristics of *Loftusia* are discussed, based on the new material from north-eastern Iraq. The following species of *Loftusia* are described: *Loftusia elongata* Cox, *L. persica* Brady, *Loftusia morgani* Douvillé, *L. anatolica* Meriç, *L. matsumarui* Meriç and Görmüs, *L. minor* B Cox, *L. ketini* B Meriç and *L. kahtaensis* Meriç, *Loftusia minor* A Cox, *L. oktayi* Meriç and *L. baykali* Meriç. The predominant species are *Loftusia elongata*, *L. morgani* and *L. baykali.* Skewed abnormal individuals and epidermal parts of the endoskeleton structure are also interesting aspects to note**.** Quantitative data obtained for *Loftusia* allow us to better understand and interpret species identification criteria, abnormal occurrences and the endoskeleton structure.

Key words: *Loftusia*; Northern Iraq; Maastrichtian; Quantitative data.

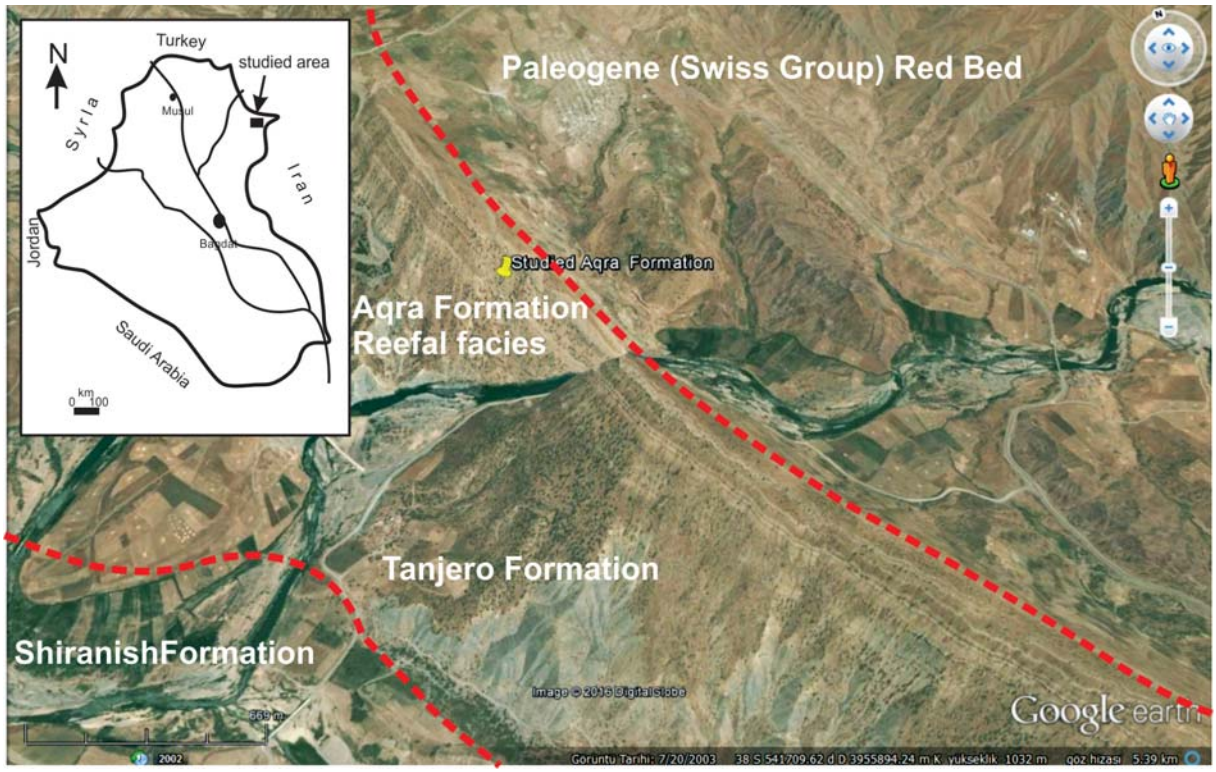
INTRODUCTION

Due to its high stratigraphical potential and importance in palaeoenvironmental and palaeobiogeographic interpretations, the genus *Loftusia* is one of the critical palaeontological tools in attempts to reveal the latest Cretaceous (Maastrichtian) history of the entire Tethyan Realm. Consequently, palaeontologists, stratigraphers, petroleum geologists and field geologists are interested in a proper understanding of its taxonomy and phylogeny, which may bring its better application in biostratigraphic and environmental interpretations.

The species-level taxonomy of the genus is still unclear. At least three main aspects of *Loftusia* taxonomy, which require further studies, may be listed: (1) quantitative population analysis of possibly large samples; (2) endoskeleton structure and skewed tests; and (3) the taxonomic meaning of microspheric (B) and megalospheric forms (A).

The present paper is based on new material of *Loftusia*, collected in the Zagros Mts., of northern and north-eastern Iraq. This material allows the following issues of *Loftusia* taxonomy to be discussed: (1) evaluation of quantitative data and of parameters used in the species-level taxonomy of *Loftusia*; (2) epidermal views and re-crystallization effects in test characteristics; and (3) intra-specific morphological variability.

Reviews of *Loftusia* were published recently by Meriç and Görmüs (2001) and BouDagher-Fadel



Text-fig. 1. Location of the study area (Google Earth view; www.googleearth.com**)**

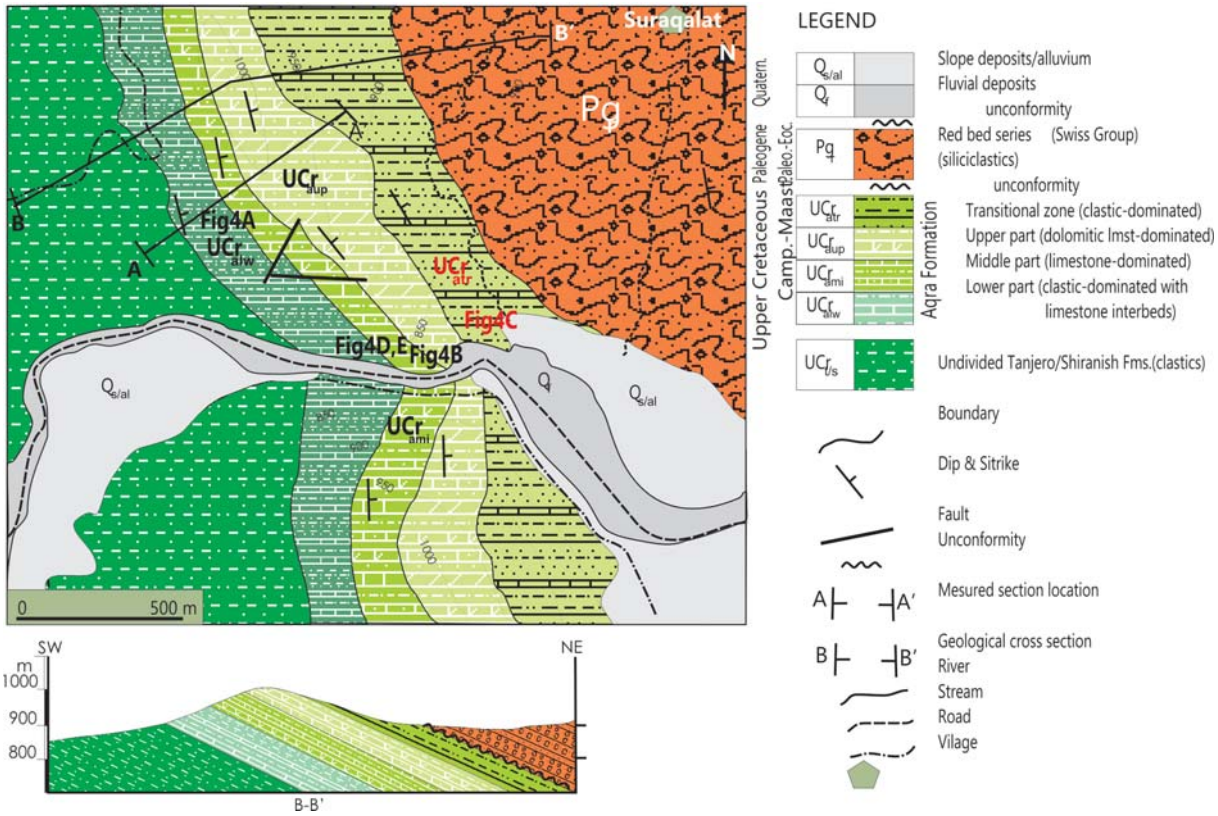
(2008). The genus was also reported from Greece (Zambetakis-Lekkas and Kemeridou 2004, 2006), the United Arab Emirates and Sultanate of Oman border region and the western side of the Northern Oman Mountains (Abdelghany 2003, 2006), and Iran (BouDagher-Fadel and Price 2009; Maghfouri-Moghadam *et al.* 2009; Pirbaluti *et al.* 2013). The palaeogeography and selected morphological aspects of the genus were discussed by Meriç *et al.* (2001) and Goldbeck and Langer (2009). From northern Iraq, the genus was first described by Al-Omari and Sadek (1976), who reported two species, *L. elongata* and *L. persica*. Several other species, from Geli sheikh Abdula Aziz (the type section of the Aqra Formation), were reported subsequently, by Lawa (1983), Al-Ameri and Lawa (1986) and Al-Omari *et al.* (1989).

LOCATIONS, MATERIALS AND METHODS

The *Loftusia* material studied herein comes from the Maastrichtian of the Zagros Mts near the village of Maukaba, about 20 km northwest of the town of Sulaimani and 1 km south of the Khaiwata Bridge, in the Kurdistan Region of northern Iraq (see Text-figs 1, 2). The samples were collected from the mudstone-sandstone units of the Tanjero Formation and from the carbonates of the Aqra Formation (Text-fig. 3). The material consists of 30 samples rich in larger benthic foraminifers. More than two hundred thin sections of *Loftusia* were prepared, with both equatorial and axial sections. The length and diameter of 450 individuals of *Loftusia* were measured, and used subsequently in the quantitative examination of the material. Microphotographs of thin sections were taken at Ankara University. The material is housed in the collections of the Geological Departments of Sulaimani University in Iraq and Ankara University in Turkey.

LITHOSTRATIGRAPHY OF *LOFTUSIA*-BEARING SEDIMENTS

The study area is considered to be a part of the Imbricated Zone of the western Zagros-fold thrust belt (Lawa *et al.* 2013). In ascending order, the geological succession in the area is composed of (Text-fig. 3): (1) Shiranish Formation (Campanian);



Text-fig. 2. Geological map and cross-section of the studied area near the village of Suraqalat

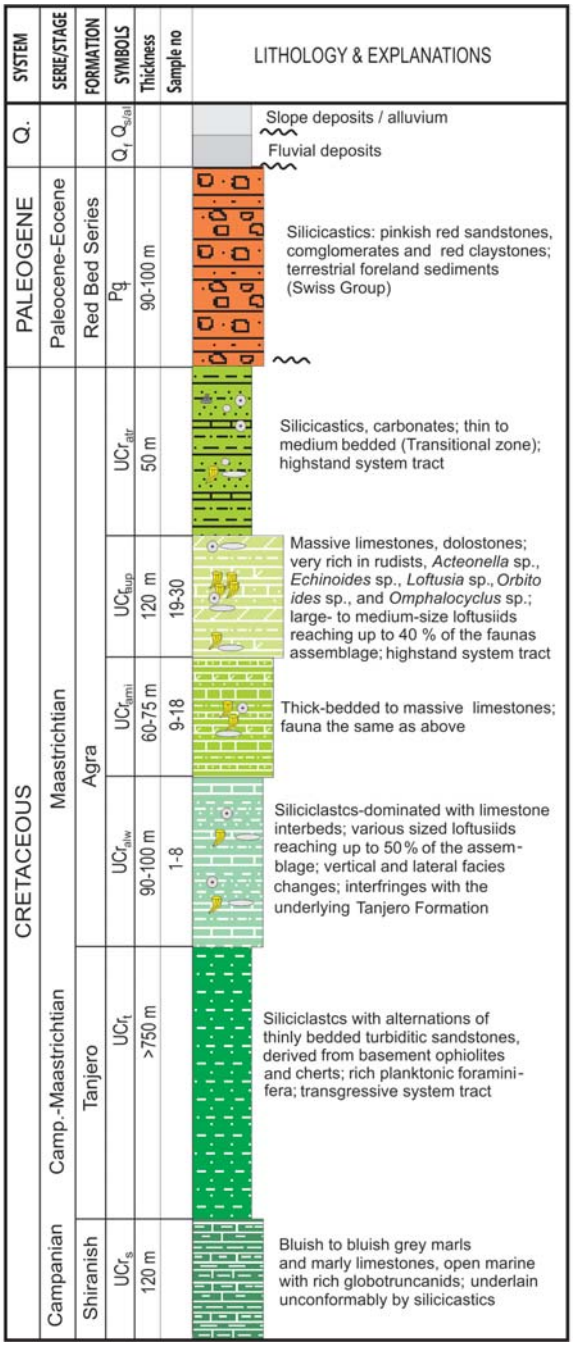
(2) Tanjero (Campanian–Maastrichtian) and Aqra formations (Maastrichtian); and of (3) Swais Group (Red-Bed Series, Paleogene) (Text-figs 2, 3). The majority of the *Loftusia* material comes from the Aqra Formation, composed mostly of carbonates (Text-fig. 4). Based on geological maps by Lawa *et al.* (2001), the Aqra Formation is subdivided into lower, middle and upper units (see Text-fig. 2). The Aqra Formation is well exposed around the village of Suraqalat (Text-figs 2, 4F, 4G). The carbonates are characterized by predominance of giant *Hippurites*, gastropods, echinoids and other bivalves, indicating reefal facies. The formation is a lateral equivalent of the siliciclastic Tanjero Formation (Lawa *et al.* 1998). The thickness of the formation is about 330 m. Ozer *et al.* (2013) recorded rudists indicative of its middle to late Maastrichtian age. They also mention *Loftusia* sp. *Orbitoides medius* and *Omphalocyclus macroporus*. Lawa *et al.* (1986, 1998) recorded more than 27 large foraminiferal species from the Maukaba section including mainly *Orbitoides*, *Lepidorbitoides*, *Omphalocyclus* and *Loftusia*. Rich *Loftusia* assemblages are seen in carbonates and clayey carbonates (Text-fig. 4E).

QUANTITATIVE DATA

Loftusia is a fusiform to ovoid-shaped larger benthic foraminifer having either rounded or pointed ends. It comprises a series of chambers with a labyrinthic wall. The taxonomic description is based on a series of external and internal parameters (Text-fig. 5).

External parameters: They include: length (l), diameter (d), and length-to-diameter (l/d) ratio.

Length (l): Cox (1937) and Al Omari and Sadek (1976) recorded the largest *Loftusia* individuals in Iran and northern Iraq. In our samples, the largest specimen (*Loftusia elongata*), is 66 mm in length. The smallest length is around 4 mm (Table 1). The mean values for each sample range from 6.2 to 58 mm (Text-fig. 9). In samples 1–3, large-sized *Loftusia* (LSL), such as *L. elongata* and *L. persica*, are the dominant species. From the lower part of the type section of the Aqra Formation, Lawa *et al.* (1986) recorded 110 mm long *L. elongata* in association with *Loftusia persica* and *Lepidorbitoides socialis* var *pustulusa*. From the middle part of the succession, medium-sized *Loftusia* (MSL) were recorded,



Text-fig. 3. Geological log of the succession in the area studied (modified from Lawa *et al.* 1998)

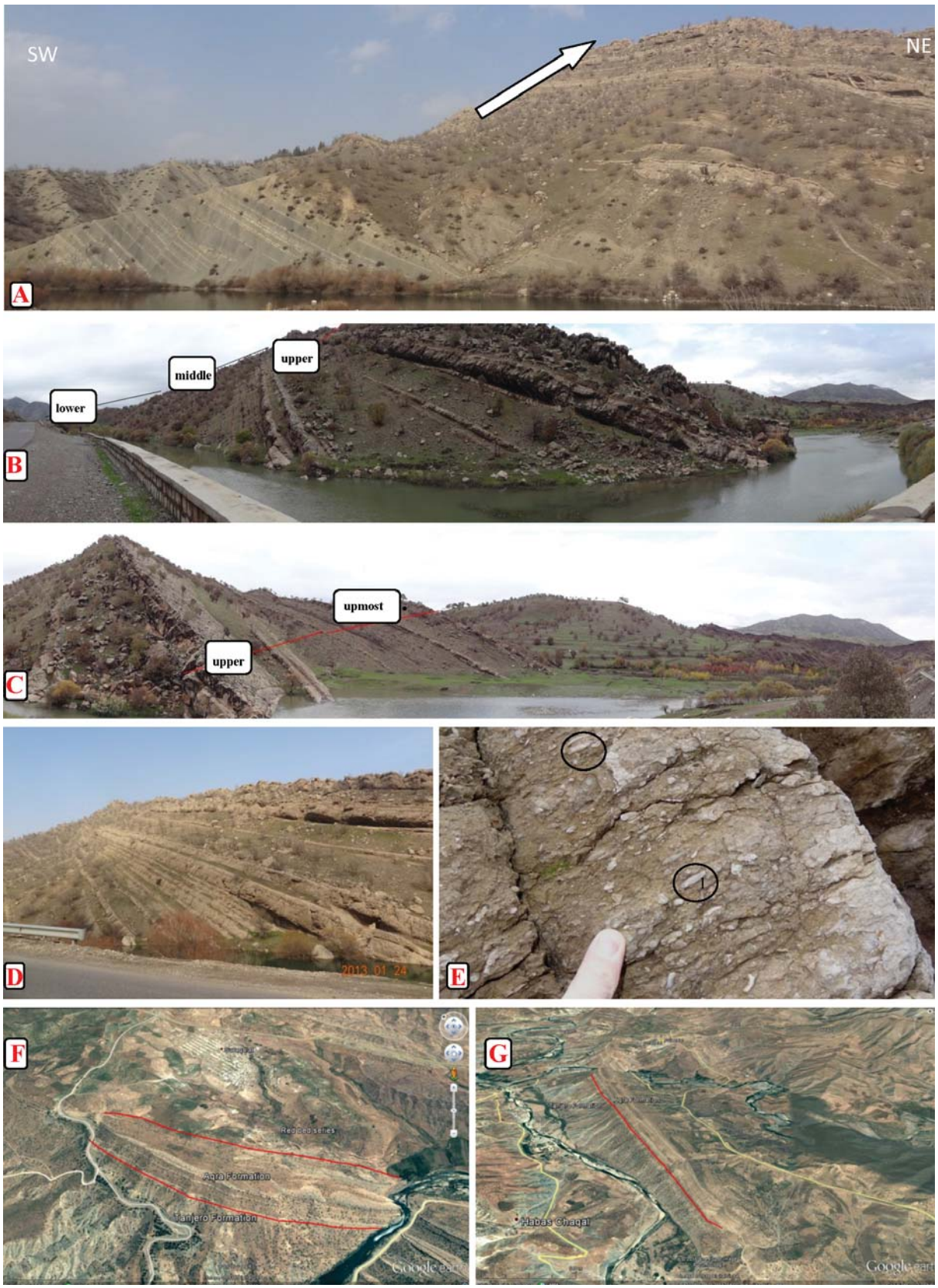
and these are: *Loftusia anatolica*, *L. kahtaensis*, *L. ketini* B, *L. matsumarui, L. minor* B and *L. morgani*. Meanwhile large-sized *Loftusia* (LSL) *L. elongata* in sample 12, small-sized *Loftusia* (SSL) *L. baykali, L. minor* A and *L. ketini* in sample 11 are dominant species in the middle part (Table 1). According to Meriç and Görmüş (2001), the largest test size reaches up to 118 mm for *Loftusia elongata* while the minimum size is around 1.5–2 mm for *Loftusia minor* A, *L. harrisoni* and *L. oktayi*. Diameter, length and ratio of length to diameter are the parameters for definitions of *Loftusia* species (Cox 1937; Meriç and Görmüş 2001). The limits are given as 7 and 40 mm. However, the size values of *L. elongata* and *L. persica* in our samples show that these limits may be changed to 7 and 35 mm. Endoskeleton structures; septal geometry and d/l ratio are similar for these samples. As seen in Text-fig. 6, many species of medium-sized *Loftusia* are described as individuals with length between 7 and 35 mm. Therefore, medium-sized *Loftusia* are dominant. Only a few samples include large-sized forms (Table 1). Due to the predominance of medium-sized *Loftusia*, it is assumed that quite favourable conditions were dominant for *Loftusia* in that part of the Tethyan realm.

Test diameter (d): Some *Loftusia* are abnormally skewed individuals (Text-fig. 5; Pl. 5). To get reliable results for their diameter, the following formula was used: d = (d1 + d2)/2. The maximum diameter (19 mm) was measured for *L. persica* and the minimum (1 mm) for *L. baykali, L. oktayi* and *L. minor* A (Table 1). *Loftusia morgani* and *L. anatolica* have more skewed abnormal forms. The mean diameter values range between 2.7 and 15.5 mm. Based on diameter, *Loftusia* may be subdivided into three size-groups: large-sized (d < 11 mm), medium-sized (3.5 > d > 11), and small-sized (d > 3.5 mm).

Test shape (diameter-to-length ratio (d/l)): To describe the shape, the fractional values used in previous studies (Cox 1937; Meriç 1967; Al Omari and Sadek 1976) are replaced by decimal values (between 0 and 1). The frequency distribution of the d/l ratio in each sample is between 0.16 and 0.71. Based on this ratio individual forms are referred to as fusiform or ovoid. At d/l < 0.18, the individuals are more fusiform or platy-fusiform, whereas at d/l ranging between 0.18 and 0.33 they are fusiform (Meriç and Görmüs 2001). At d/l > 0.33 the individuals are fusiform to ovoid The d/l value = 0.28 is proposed herein as lower boundary value of large-sized *Loftusia persica* and *L. elongata*.

Polar features: Large *Loftusia persica* and smaller *L. oktayi* have rounded poles. Others show acute and subrounded polar characteristics.

Text-fig. 4. Aqra Formation in the studied area: A-C – lower, middle and upper parts of the formation; D – well-bedded middle part; E. *Loftusia*-bearing limestone, circular indicates *Loftusia* individuals (l); F-G – conformable relation between the Tanjero and Aqra Formations in the northern and southern regions of the investigation area in Google Earth views →


SW
NE
A
lower
middle
upper
B
upmost
upper
C
2013_01_24
D
E
F
Aqra Formation
Tanjero Formation
G
Habas Chaqal

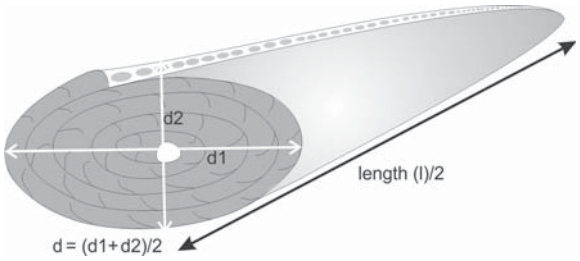
Sample No	Individuals Numbers	Length (mm) min-max (mean)	Diameter (d) min-max (mean)	d/l min-max (mean)	Number of whorls (nw) min-max (mean)	Dominance
1–2	11	59–66 (43)	12–19 (15.5)	0.19–0.3 (0.26)	15–21 (19)	LSL
3	7	33–45 (38)	9.5–14.5 (11)	0.29–0.35 (0.32)	9–18 (14)	LSL
4	42	4.5–20 (16)	3.5–8 (4.5)	0.22–0.5 (0.28)	6–10 (8.2)	MSL
5	48	5–31 (18)	1.3–8 (4.5)	0.16–0.32 (0.23)	8–13 (9.5)	MSL
6	96	5–28 (16)	3–6 (4.6)	0.21–0.69 (0.32)	–	MSL
7	8	18–24 (21)	5.4–7 (6.2)	0.25–0.39 (0.3)	9–10 (9.5)	MSL
8	70	4.2–28 (16)	3–6 (4.7)	0.21–0.71 (0.29)	4–7 (4.8)	MSL
9	13	10–17 (12.4)	2.7–4.7 (3.8)	0.2–0.45 (0.33)	5–7 (5.8)	MSL
10	13	12–17 (14.8)	4–6.3 (4.9)	0.25–0.39 (0.33)	5–10 (7.5)	MSL
11	16	4–7.4 (6.2)	2–3.5 (2.7)	0.33–0.55 (0.45)	3–5 (3.7)	SSL
12	8	52–61 (58)	10.5–13.1 (12.3)	0.18–0.24 (0.21)		LSL
13	60	15.5–27 (21)	4.25–6.3 (5.4)	0.19–0.32 (0.26)		MSL
14	35	8–19 (13)	1.85–5 (3.8)	0.23–0.38 (0.29)		MSL

Table 1. Minimum, maximum and mean values of external and internal parameters of *Loftusia* individuals in each sample from northern Iraq. LSL – large-sized, MSL – medium-sized, SSL – small-sized

Internal parameters: These include: protoconch, wall structure, and coiling.

Protoconch: This is in the center of the *Loftusia* test. The megalospheric forms of *Loftusia anatolica, L. baykali, L. ketini, L. matsumarui, L. minor and L. oktayi* have a globular protoconch. The diameter of the proloculus ranges from 0.9 to 1.1 mm. The microspheric forms of *L. elongata*, *L. kahtaensis*, *L. ketini*, *L. minor*, *L. persica* include a very tiny nucleoconch. This is unclear due to the complex endoskeleton initial part with very tiny clasts. Meriç and Görmüs (2001) indicated that some *Loftusia* species only have A or B forms. We have seen megalospheric and microspheric forms in the same sample and have identified the *Loftusia* species based on the previous literature data. It means that some species may be integrated but this needs more statistical data and observations from other localities of the world.

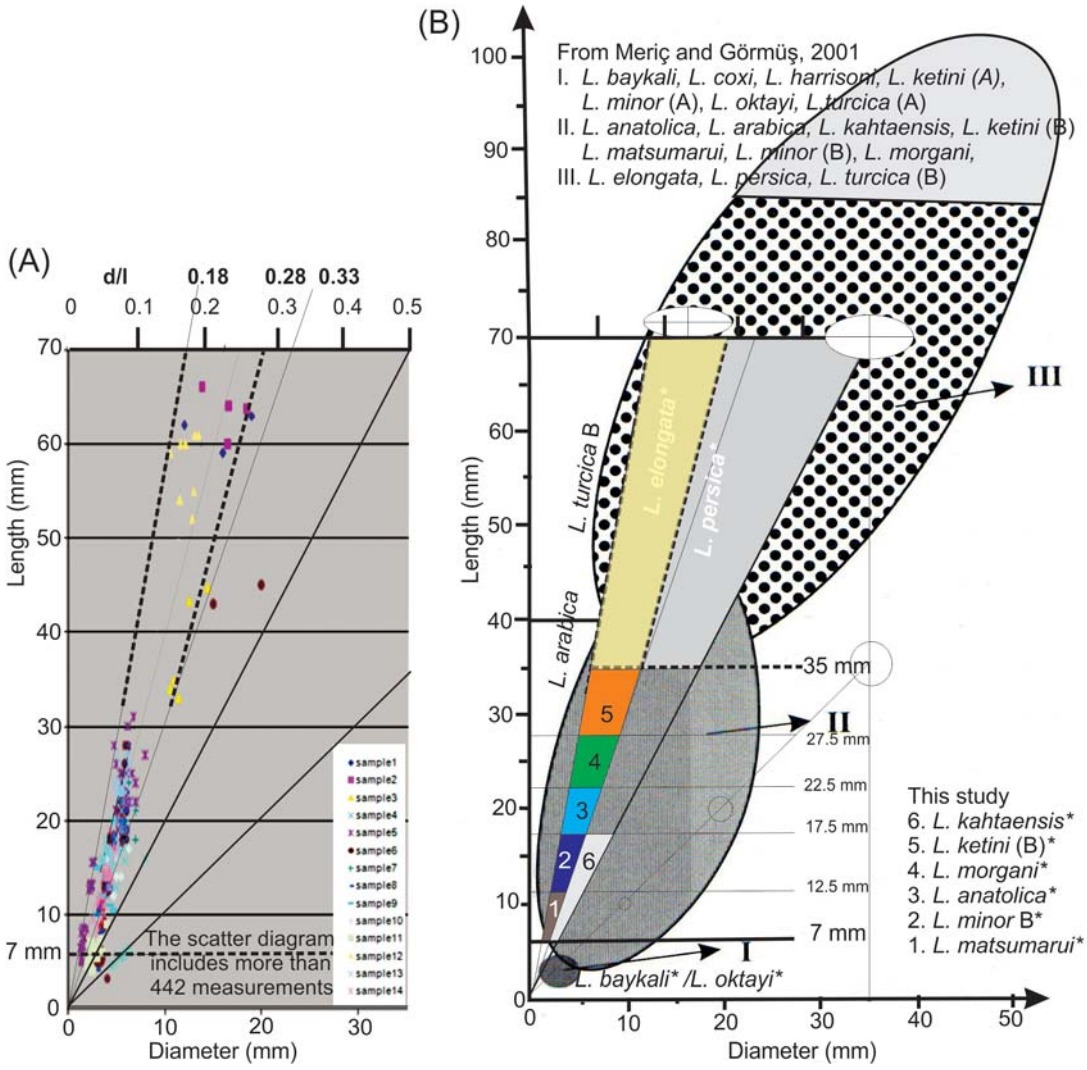
Wall structure and septa: Three types of endoskeleton wall structures are recognized: (1) arenaceous with many clasts; (2) simple, clear labyrinthic, and (3) re-crystallized inner epidermal part (Pl. 6). The *Loftusia* wall consists of a thin outer calcareous layer and a thick inner labyrinthic agglutinated layer. Particularly the inner labyrinthic layer includes silty- to sand-sized grains incorporated from the host environment including microforaminiferal tests. Many tests also contain oxide grains produced during diagenetic filling of the tests. These grains were inaccurately called "red spherules" by Brady (1869, 1884; and BouDagher-Fadel and Price 2009).



Text-fig. 5. Schematic block diagram of the skewed abnormal *Loftusia* individual showing diameter differences

The identification of *Loftusia* species is mostly based on three main features: (1) complexity of test (including many small arenaceous clasts) (Pl. 6.1, 6.2); (2) portion structure (Pl. 6.3–6.9); and (3) morphology of the primary and secondary septa. Some individuals of *Loftusia ketini* and *L. kahtaensis* contain many small extra arenaceous clasts, including opaque sediment clasts, quartz minerals and others. A labyrinthic endoskeleton wall might also contain microorganism tests, such as small foraminifers. Micro-borings are rarely observed. It is assumed that smaller foraminifera used the tests of *Loftusia* as a host place after its death. This is known as a hermit type life. Modification of the endoskeleton (Pl. 6.6–6.9) might be due to re-crystallization and/or dolomitization of the inner epidermal part.

Coiling: The number of whorls *vs* diameter in tight- and loosely-coiled individuals can also be used as an important parameter for classification. Usually, large-sized forms include more whorls; few of them have loose coiling. Tight coiling mostly dominates in medium-sized forms. Test shape (d/l) was also plotted versus the number of whorls (Text-fig. 8). The figure shows different areas as A, B, C, D, E and F. Each area contains different *Loftusia* spe-



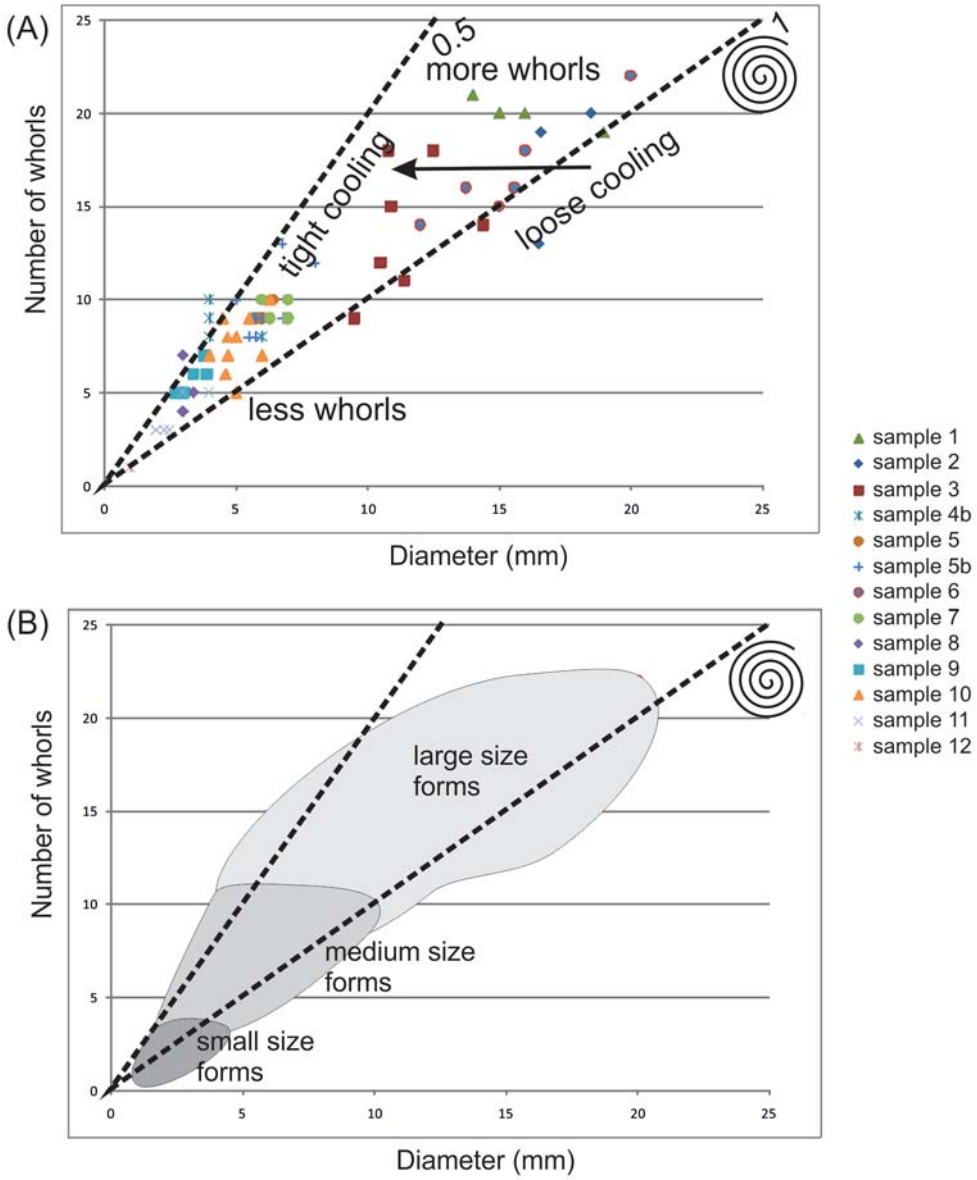
Text-fig. 6. Based on external parameters (length, diameter and diameter:size ratio) of the *Loftusia* species from northern Iraq: A. Scatter diagram of external measurements of samples with at least ten individuals; B. Evaluation diagram of data by Meriç and Görmüş (2001); stars mark the species identified herein

cies. So, some values for the number of whorls (nw) may also be suggested as follows: Large-sized forms nw 11, medium-sized forms 3.5 > nw > 11, small sized forms nw ≥ 3.5.

DISCUSSION AND CRITERIA FOR SPECIES DESCRIPTIONS

Loftusia belongs to the superfamily Loftusiacea, Brady and is characterized by its agglutinated wall and labyrinthic structures (see also Meriç and Görmüs 2001; BouDagher-Fadel 2008 for more details). Is *Loftusia* a Lazarus species? BouDagher-Fadel and Price (2009) indicate that only the endoskeleton of *Loftusia persica* (Brady) contains *Turborotalia pomeroli* (Toumarkine and Bolli), which is a very distinctive middle-to-late Eocene planktonic foraminifera. Therefore, they suggest a Lazarus occurrence along with other alternatives, such as burrowing activity and an identical form in the Eocene, such as the Elvis species (Erwin and Droser 1993). However, we believe that *Loftusia* is an extinct form from the Maastrichtian.

The distinguishing of species in paleontological material is always controversial. Typological or populational approaches have been mainly used in definitions of foraminifer's species. Species of *Loftusia* were

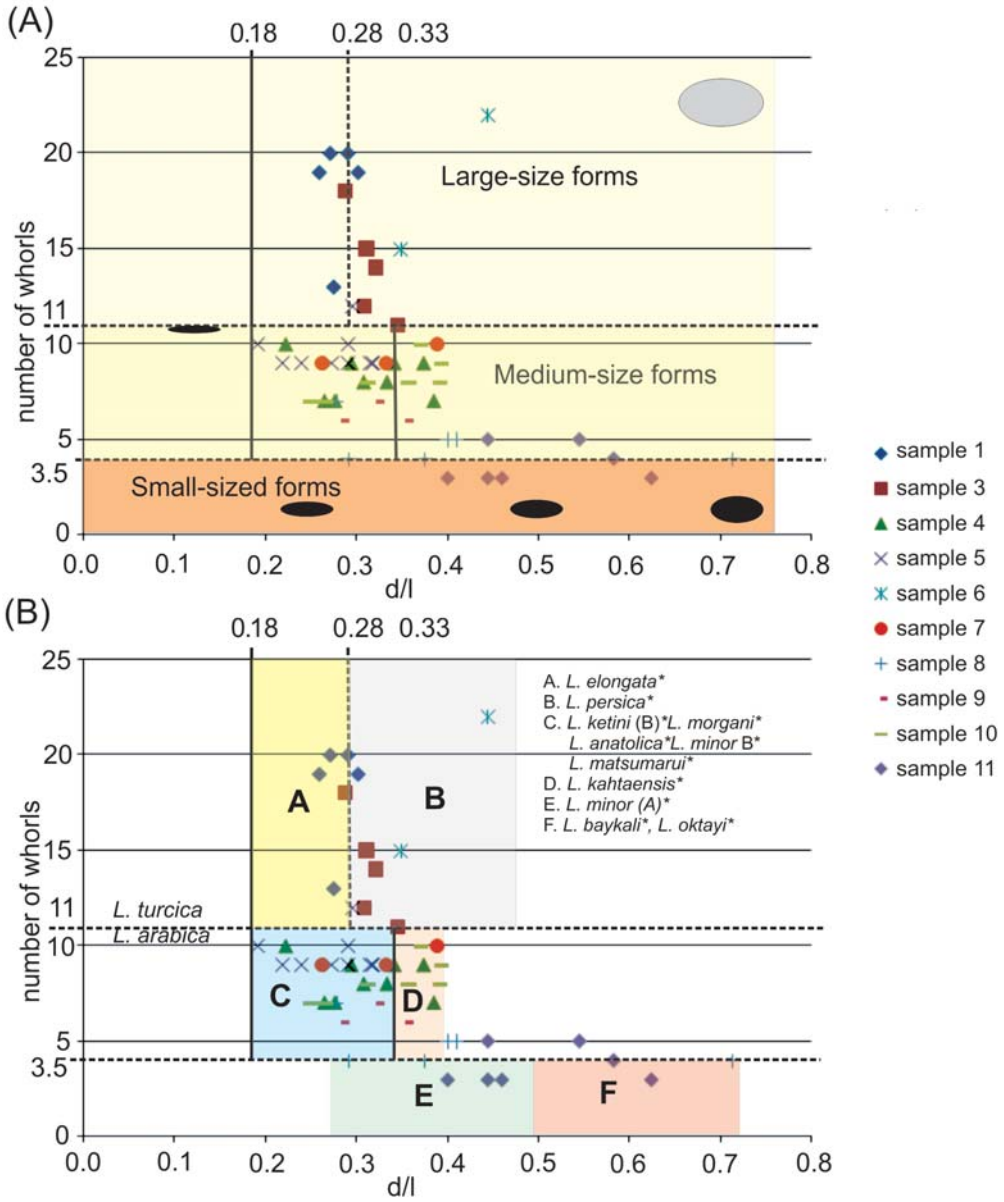


Text-fig. 7. A – Type of coiling, as shown by the diameter-to-number of whorls relationship observed in particular samples. B – Groupings of large-, medium- and small-sized *Loftusia*

also defined on morphological criteria (i.e. Cox 1937; Henson 1948; Meriç 1967). To identify the species of *Loftusia*, the following are significant subjects to notify: (1) integrating or amendments of the *Loftusia* species, (2) wall structure details, and (3) grouping of species based mainly on size (l), shape (d/l), wall structure, polar features and number of whorls.

L. morgani, *L. anatolica* and *L. matsumarui* have more or less the same characteristics. They are seen in the same sample. The only differences are their initial parts and sizes. We believe that *Loftusia morgani* may include A and B forms. *L. anatolica* and *L. matsumarui* could be a synonym for *L. morgani*. Small A forms might be its juvenile forms. Larger A ones might be adult forms. *L. harrisoni* or other small-sized *Loftusia* forms may also be accepted as A forms of *Loftusia elongata* or *L. persica*.

The endoskeleton wall structure includes various types. These include arenaceous with many clasts, a bright-labyrinthic wall with less clasts and a wall with an epidermal part including re-crystallization. A complex arenaceous endoskeleton is clear in the tests of *Loftusia tursica*, *L. morgani*, *L. anatolica*, *L. ketini*, *L. kahtaensis*, *L. oktayi*, *L. baykali*. A bright-labyrin-

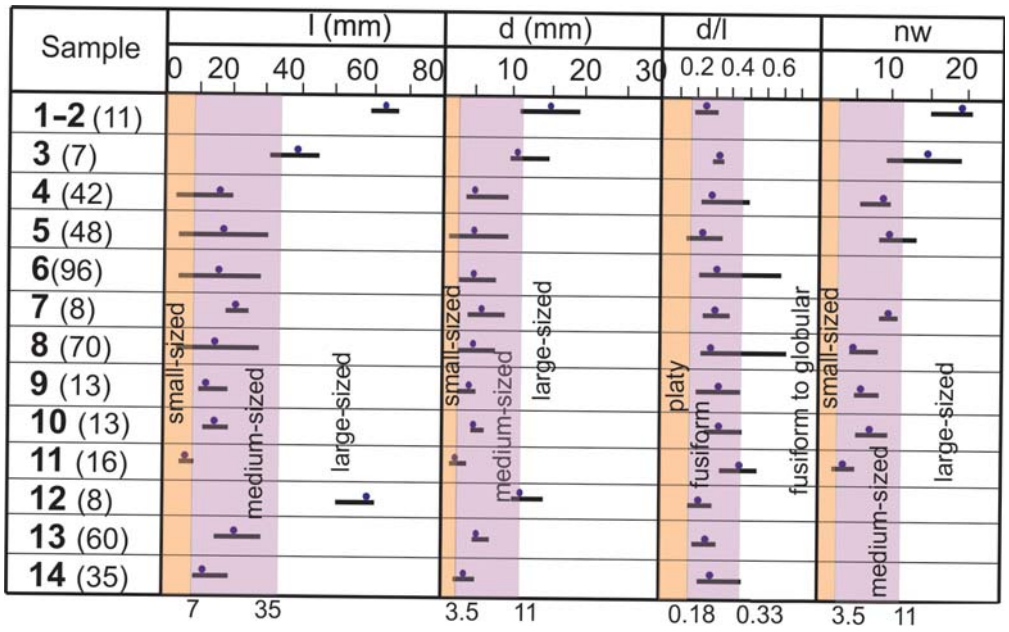


Text-fig. 8. Large-, medium- and small-sized *Loftusia* species as demonstrated by shape-to-number of whorls relationship. A. Scatter diagram for each sample; B. Large-, medium- and small-sized species-definition areas.

thic wall and clear septal endoskeleton are seen in the tests of *L. persica*, *L. elongata*, *L. minor*, *L. harrisoni*. A wall with an epidermal part including re-crystallization was observed in medium sized *Loftusia* species.

The grouping and scattering of external and internal parameters based on the previous literature and the quantitative data may bring out useful information on identification of the *Loftusia* species. In this study, we use statistical data from northern Iraq and offer the following limit values for *Loftusia* species found in Iraq.

Large-sized forms: In the studied material, they range in size between 35 and 66 mm and are represented by *Loftusia elongata* and *L. persica*. The main distinguishing parameter is their d/l ratio and their internal endoskeleton characteristics. *Loftusia elongata* is more fusiform than *L. persica* with d/l ratio by the latter being > 0.28. In the studied material *Loftusia elongata* is more abundant and larger than *L. persica* (Plate 1, 4). *Loftusia tursica* B has a platy-fusiform test in shape. It has only been reported in Turkey (Meriç and Avşar 1992).



Text-fig. 9. External and internal parameters in large-, medium- and small-sized *Loftusia* species

Medium-sized forms: These range in size between 7 and 35 mm (Table 2). Skewed forms, from the studied material are referred to *L. morgani* or *L. anatolica* (Pls 2, 3). This group also includes *Loftusia arabica* (microspheric forms), *L. coxi* (with oblique septa) and *L. occidentalis* (microspheric forms). These forms have only been reported from central Arabia (El-Asa'ad 1989), Qatar (Henson 1948) and Yugoslavia (Milavanovich 1935, 1938). Forms with d/l ratio > 0.33, are referred to *Loftusia kahtaensis*, characterized by a complex test endoskeleton.

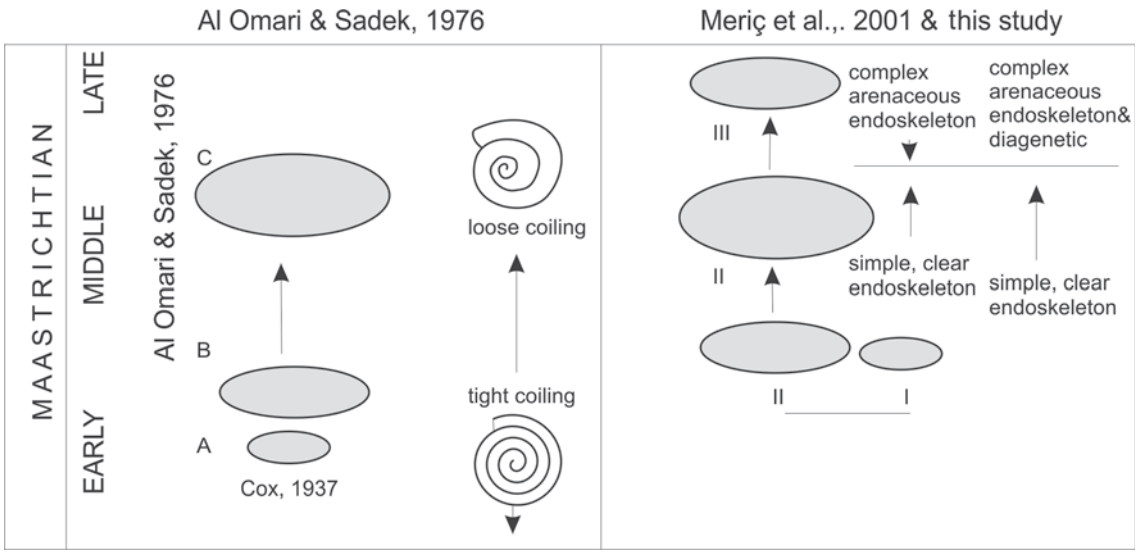
Small-sized forms: Their sizes are less than 7 mm. The megalospheric individuals of *Loftusia ketini*, *L. minor*, *L. baykali* and *L. oktayi* were identified. *Loftusia ketini* includes a more arenaceous wall structure whereas *Loftusia minor* includes secondary septa and different endoskeleton. The other small-sized forms. *baykali* and *L. oktayi* are smaller than *L. minor.* d/l values are different for each species (Text-fig. 8).

CONCLUSIONS

Based on the diagnostic characteristics of *Loftusia* species, including skewed abnormal specimens and various endoskeleton structures from the middle to upper Maastrichtian of Kurdistan (northern Iraq), a new classification of the genus is proposed. Taking into consideration the internal and external quantitative values of *Loftusia* individuals, large-sized *Loftusia elongata* and *L. persica*, medium-sized *Loftusia morgani*, *L. anatolica*, *L. matsumarui*, *L. minor* B, *L. ketini* B and *L. kahtaensis* and small-sized *Loftusia minor* A, *L. ketini* A, *L. oktayi* and *L. baykali* were identified from carbonates of the Aqra Formation in northern Iraq. *Loftusia elongata*, *L. morgani* and *L. baykali* are the predominant species. We propose a new diagram and values for definitions of the *Loftusia* species. If appearances and occurrences of the *Loftusia* species, and literature data, are taken into consideration, *L. arabica*, *L: harrisoni* and *L.*

Length (l) limits (mm)	Length mean value (mm)	A/B form	Species	Diameter (d) limits (mm)	Diameter mean value (mm)
7–12.5	10	A	*L. matsumarui*	<3	2.5
12.6–17.5	15	B	*L. minor B*	3.1–4	3.5
17.6–22.5	20	A	*L. anatolica*	4.1–5	4.5
22.6–27.5	25	B	*L. morgani*	5.1–6	5.5
27.5–33	30	B	*L. ketini B*	6.1–7	6.5

Table 2. Suggested limits for medium-sized *Loftusia* based on quantitative data from northern Iraq and from Meriç and Görmüş (2001, table 3)



Text-fig. 10. *Loftusia* species over time. A represents *L. harrisoni* and *L. minor* from Iran (Cox 1937); B and C reflect medium to large sizes from northern Iraq (Al Omari and Sadek, 1976). I – *L. harrisoni*, II – *L. persica* and *L. elongata*, III – *L. morgani* and *L. anatolica* from Turkey (Meriç and Görmüş, 2001); I – small sized forms, II – medium- to large-sized forms, III – Medium-sized forms from northern Iraq (this study)

minor are seen at the bottom of the *Loftusia*-bearing succession (Cox 1937; El-Asa'ad 1989). This could be early Maastrichtian in age. During the middle Maastrichtian, we have seen *L. persica*, *L. elongata*, *L. baykali* in the middle part of the Maastrichtian succession. *L. morgani* and *L. anatolica* are seen dominantly at the end of Maastrichtian (Text-fig. 10). Population abundances of the associated fauna such as *Omphalocyclus macraporus* and *Orbitoides apiculatus* indicate the middle–late Maastrichtian. In conclusion, the *Loftusia* data obtained from the Kurdistan region of northern Iraq enable us to understand and interpret the species' criteria with descriptions of new forms including skewed abnormal occurrences and various types of endoskeleton structures (Pls 5, 6) with new quantitative values.

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PLATES 1–6

PLATE 1

Loftusia external views

1-2 – *Loftusia elongate* Cox, 1937; **3** – *Loftusia morgani* Douvillé, 1904; **4** – Abnormal forms; **5** – Mixed *Loftusia* individuals; **6** – *Loftusia persica* Brady, 1869, including silicified and burrowed initial part, equatorial section, specimen no. 12.3; **7** – *Loftusia* cf. *L. morgani*, equatorial section, specimen no. 5.1. **8** – *Loftusia anatolica* Meric, 1979, axial section, specimen no. 12.2. **9** – Closer view of nucleoconch, *Loftusia anatolica*, specimen no. 12.1. **10**, **12** – *L.* cf. *morgani,* axial sections showing normal and abnormal initial parts, specimen nos 5.4, 5.5; **11**, **13** – *Loftusia anatolica*, axial sections including nucleoconch views, specimen nos 5.3, 7.1.


1
1 cm
2
1 cm
3
1 cm
4
1 cm
5
1 cm
6
0.5 cm
7
1 mm
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1 mm
9
1 mm
10
1 mm
11
1 mm
12
1 mm
13
1 mm

PLATE 2

Small- and medium-sized loftusiids

1-2, **5** – *L. baykali*, axial sections, specimen nos 8.3, 8.8, 8.10; **3-4**, **6-7**, **9** – *L. oktayi* Meric, 1979, axial sections, specimen nos 8.5-7, 8.19, equatorial section, specimen no. 8.11; **8**, **10** – *L. ketini* A Meric, 1979, axial sections, specimen nos 6.1, 8.2; **11**, **12** – *L.* cf. *minor* A Cox, 1937, axial sections, specimen nos 8.13, 8.15; **13**, **14** – *L.*cf. *matsumarui* Meriç and Görmüs, 2001, axial sections, specimen nos 9.13, 8.16; **15**, **16** – *Loftusia* sp. loose and tight coolings in equatorial sections without nucleoconch, specimen nos 8.26, 8.25; **17** – *Loftusia* sp. axial section including abnormal nucleoconch part, specimen no. 5.5; **18** – *L.* cf. *morgani*, axial section, specimen no. 5.4.

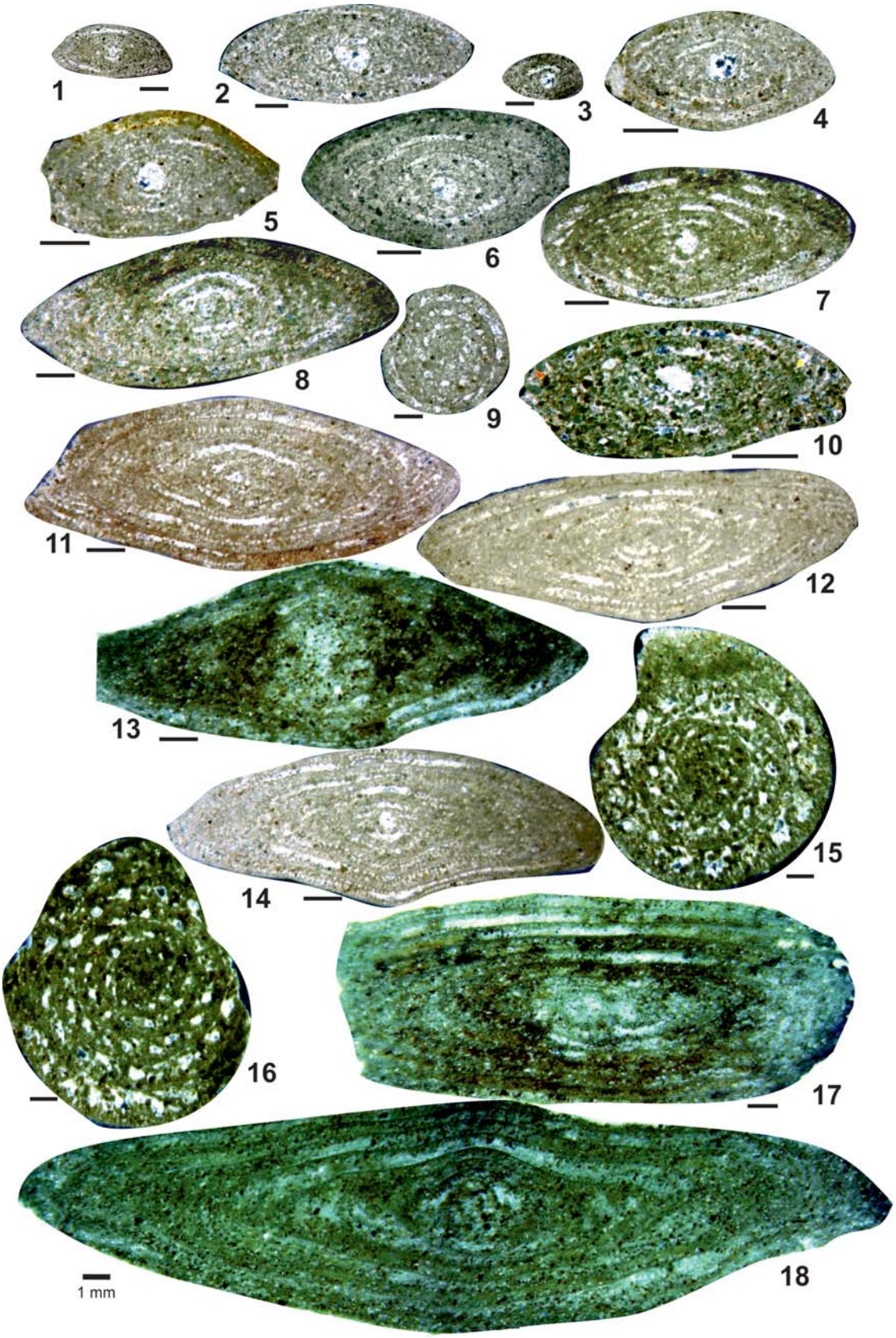
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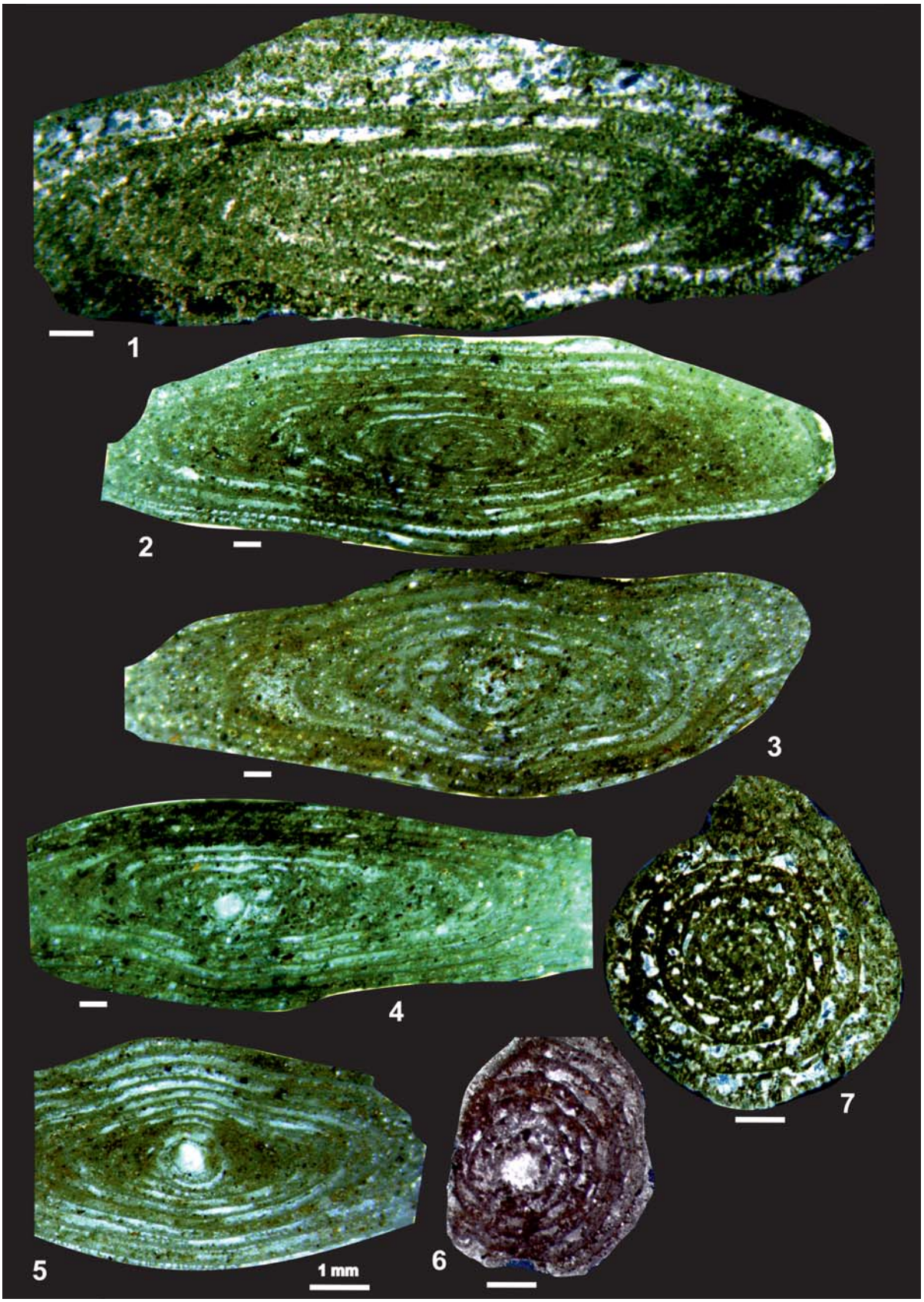
PLATE 3

Medium-sized loftusiids

1 – *Loftusia kahtaensis* Meric, 1979, axial section, specimen no. 8.24, **2**, **8** – *Loftusia morgana* Douvillé, 1904, axial and equatorial sections, specimen nos 7.2, 8.27, **3-7** – *L. anatolica* Meric, 1979 axial sections, specimen nos 5.2, 5.3, 7.1, equatorial section, 4B7.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7
1 mm

PLATE 4

Large-sized loftusiids

1-4 – *Loftusia elongata* Cox, 1937, axial sections, specimen nos 1.3, 1.3b2, 1.3b1, 2,4. **5** – *Loftusia persica* Brady, 1869, axial section, specimen no. 6.1. **6-8** – *Loftusia elongata* Cox, 1937, equatorial sections, specimen nos 1.5, 1.4, 1.5 closer view, 7 includes microboring traces filled by clasts and mud. **9** – *Loftusia elongata* Cox, 1937, axial section, specimen no. 1.2.

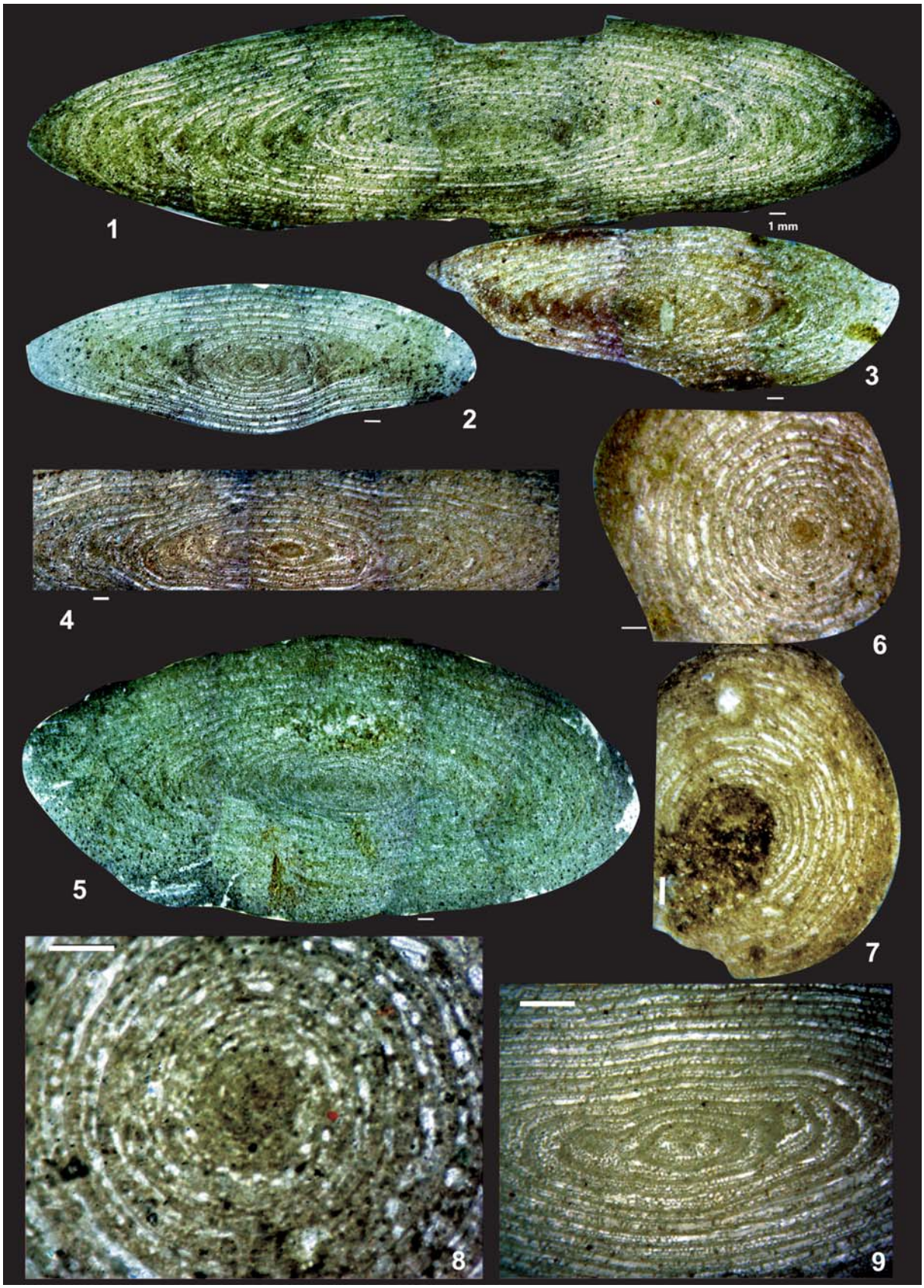
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PLATE 5

Abnormal *Loftusia*

All figures are related to equatorial sections to show d1 and d2 diameters

1-2, **7** – *L.* cf. *anatolica* Meric, 1979*,* specimen nos 6.1, 6.2, 6.4. **3-6**, **8-9** – *Loftusia morgana* Douvillé, 1904, specimen nos 5b11, 5b9, 5b7, 6.3, 6.5.

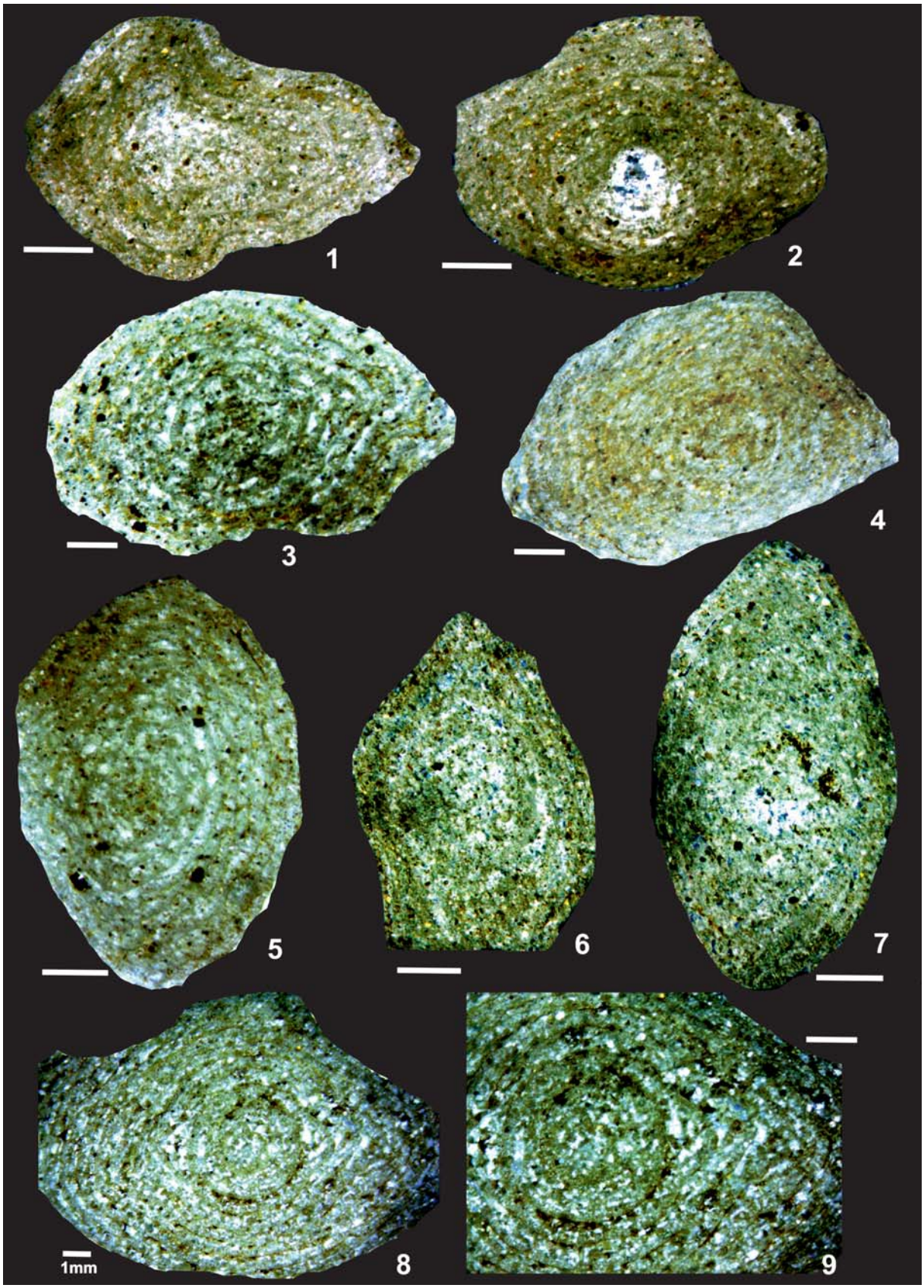
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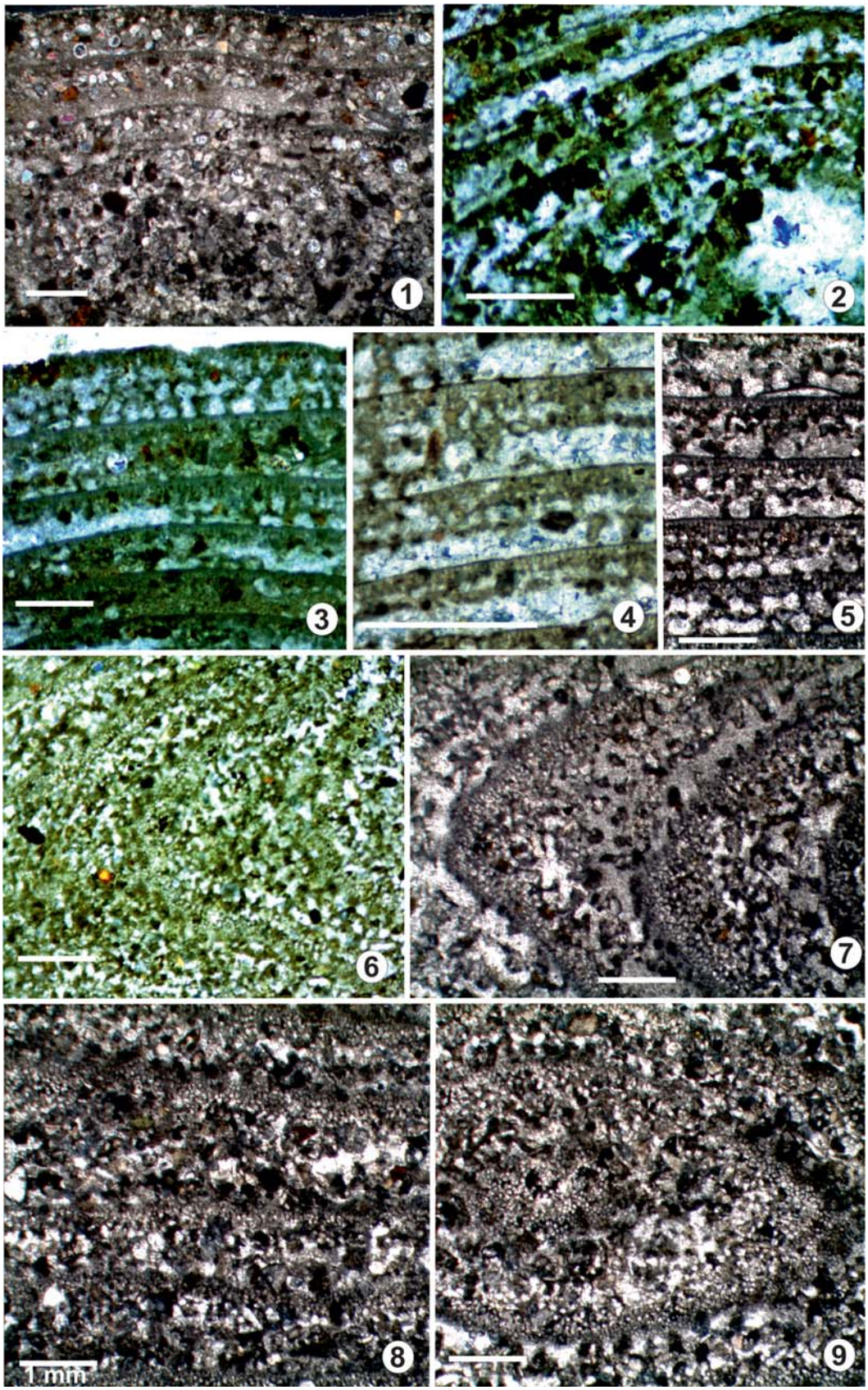
PLATE 6

Three types of endoskeleton structure views of *Loftusia*

1-2 – Agglutinated walls with opaque and various clasts, *Loftusia ketini* Meric, 1979, specimen nos 4.3, 10.4, **3-5** – Labyrinthic walls including fewer clasts and micro-organisms within the chambers, *Loftusia elongata* Cox, 1937, specimen nos 7.1B, 1.1, 1.2, **6-9** – Re-crystallized epidermal wall, specimen nos 3.1, 1.2, 3.B2.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