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***Morphoceras* Douvillé, 1880 and *Ebrayiceras* Buckman, 1920 from the Dalichai Formation (Lower Bathonian) North and Northeast of Damghan (Northeast Alborz), Iran**

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Abstract

Several species of the genera *Morphoceras* Douvillé, 1880 and *Ebrayiceras* Buckman, 1920 are described from the Dalichai Formation of eastern Alborz Mountains (northeast Iran), including one new species, *M. kelarizis*. The fauna comes from a few meters of red nodular limestones and marls in “Ammonitico Rosso” facies. It represents a typical Northwest-Tethyan fauna, closely related to Central Europe (Subboreal / Submediterranean provinces).

Key words: Morphoceratidae, new species, NE Iran.

Zusammenfassung

Mehrere Exemplare der Gattungen *Morphoceras* Douvillé, 1880 und *Ebrayiceras* Buckman, 1920 werden aus der Dalichai Formation im östliche Alborz Gebirge (Nordost Iran) beschrieben, darunter eine neue Art, *M. kelarizis*. Die Fauna stammt aus einigen Metern eines roten nodularen Kalksteins und Mergeln in “Ammonitico Rosso” Fazies; sie ist eine typische Nordwest-Tethys Fauna mit engen Beziehungen zu Zentraleuropa (subboreale / submediterrane Provinzen).

Schlüsselwörter: Morphoceratidae, neue Art, NE Iran

1. Introduction

The Dalichai Formation (Late Bajocian – Oxfordian) is a sequence of greyish limestones and marls widely distributed along the Alborz Mountains (North Iran, Fig. 1). Locally it contains a relatively rich ammonite fauna, which is often concentrated in a few condensed beds. The ammonites from the upper part of the Dalichai Formation in the eastern Alborz and Binalud mountains (Fig. 1) have recently been studied by Majidifard (2003), Seyed-Emami & Schairer (2010, 2011a, b), and Seyed-Emami et al. (2013). The Morphoceratidae described in this paper come from three sections located north and northeast of Damghan (Fig. 1), Kelariz, Talu and Parikhan. The sections at Parikhan and Talu have been studied by Shafeizad (2001) and Befahr (2009) within the framework of MSci. theses. Syntheses of both theses were published by Shafeizad & Seyed-Emami (2005) and Befahr et al. (2012). Later, in 2012/2013, A. Raoufian re-measured and re-sampled the two former sections and studied the Kelariz section for the first time. The studied ammonites all come from a few

red-coloured and condensed beds in “Ammonitico Rosso” facies (Fig. 2).

Although Morphoceratidae are not rare elements in the ammonite fauna of the Dalichai Formation, larger and complete specimens of *Morphoceras* with preserved body chamber are not often found. From sections in Talu and Kelariz several relatively complete specimens have been discovered, including a new species. This study is significant since it contributes to a more complete understanding of the biodiversity of Jurassic Morphoceratidae in Iran and their possible relationships with taxa described from elsewhere.

2. Geological setting and specimen repository

2.1 Geological setting

The sections belong to the Dalichai Formation (Upper Bajocian – Lower Oxfordian) and are located

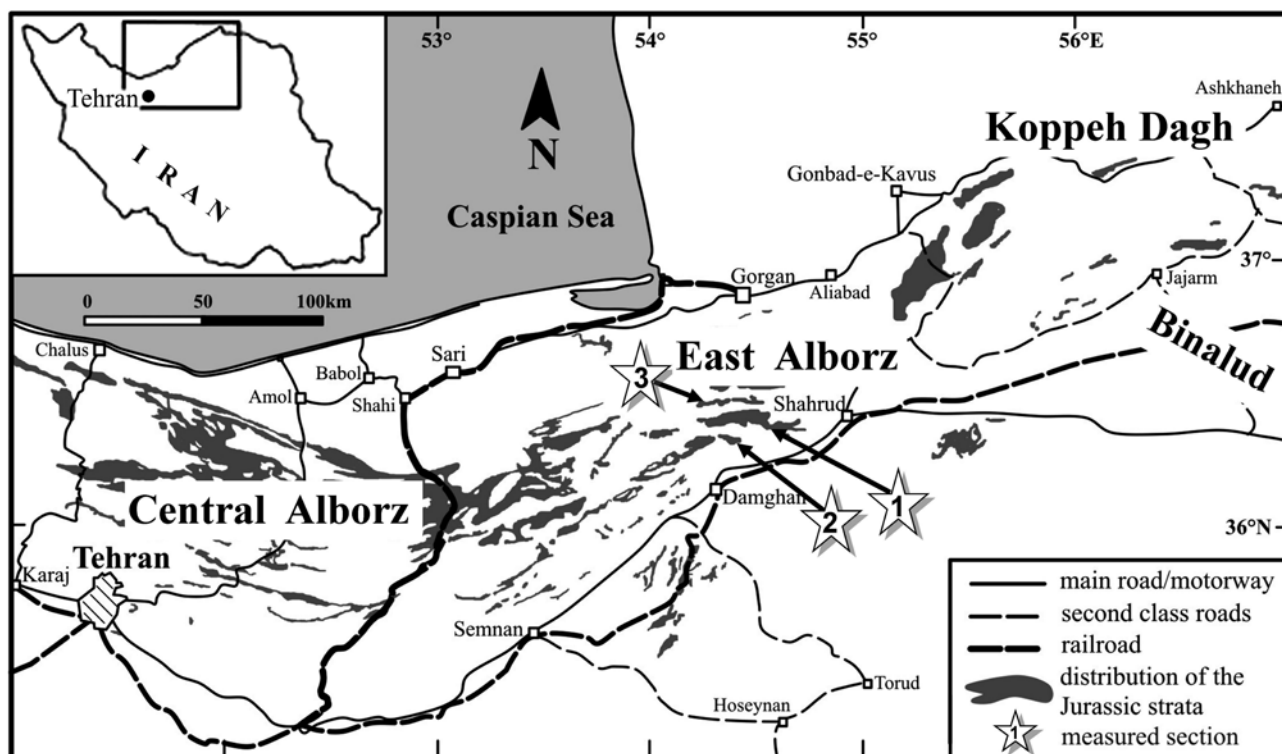


Figure 1: Geographic map of central and east Alborz Mountains with location of the sections; 1 = Parikhan, 2 = Talu, 3 = Kelariz.

north and northeast of Damghan, in eastern Alborz (Fig. 1). The Parikhan section is located c. 48 km northeast of Damghan (11 km west of the town of Shahrud) with coordinates (E 54° 49' 21", N 36° 23' 31"), the Talu section c. 19 km north of Damghan (E 54° 26' 04", N 36° 19' 06"), and the Kelariz section 25 km north of Damghan (E 54° 17' 11", N 36° 22' 21") (Fig. 1). According to A. Raoufian, the thicknesses of the sections are: 255 m (Parikhan), 170 m (Talu), and 152 m (Kelariz), respectively. All three sections are roughly subdivided into four members. The *Morphoceratidae* described in this study come from condensed red-coloured beds within the third member, at Talu and Kelariz from the second red-coloured bed, and at Parikhan from the first red-coloured bed (Fig. 2).

Member 1: In all three sections the Dalichai Formation begins with several meters of brownish, sandy to fine-conglomeratic limestones with intercalations of marls, which disconformably overly the Shemshak Formation (Upper Triassic – Lower Bajocian). At Parikhan and Talu, this member is c. 15 m thick; at Kelariz it has a larger thickness (55 m) and mainly consists of calcareous sandstones and marls.

Member 2: Parikhan (45 m), Talu (60 m), Kelariz (13 m): grey-green, argillaceous and very soft marls, with intercalations of marly limestones in the upper part.

Member 3: Parikhan (155 m), Talu (70 m), Kelariz (13 m): alternation of greyish marly limestones and marls. Within the third member at Talu and at Kelariz, there are three distinct levels (at Parikhan only two) of few meters of condensed, pink, nodular lime-

stones and marls in “Ammonitico Rosso” facies. The red-coloured beds are the most prominent feature of the Dalichai Formation along the eastern Alborz and Binalud mountains (Seyed-Emami et al. 2013):

“Ammonitico Rosso” I: at Talu (c. 95 m above the base; 1.5 m thick); at Kelariz (c. 68 m above the base; 0.7 m thick). Both sections contain Late Bajocian ammonites (*Oxycerites*, *Parkinsonia*, perisphinctids, etc.). At Parikhan (c. 65 m above the base, 7 m thick) it corresponds to the second red-coloured bed at Talu and Kelariz, containing Early Bathonian ammonites, among others the *morphoceratids* of this study.

“Ammonitico Rosso” II: at Talu (c. 120 m above the base; 2 m thick) and at Kelariz (c. 80 m above the base; 1.2 m thick); both sections contain Early Bathonian ammonites (*Oxycerites*, *Parkinsonia*, *Morphoceratidae* of present study). At Parikhan (4 m thick) the second red-coloured bed corresponds to the third red-coloured bed at Talu and Kelariz and yields Middle Callovian ammonites.

“Ammonitico Rosso” III: at Talu (c. 140 m above the base; 4 m thick) and at Kelariz (c. 90 m above the base; c. 2 m thick) with *Hecticoceratinae*, *Reineckeiidae*, *Perisphinctidae*, etc. (Middle Callovian).

Member 4: Parikhan (33 m), Talu (27 m), Kelariz (12 m): light-grey limestones, occasionally with marly intercalations, and becoming cherty in the upper part. It contains Late Callovian to Early Oxfordian ammonites.

The contact to the overlying Lar Formation is gradational and is established commonly by the vanishing of marly intercalations and onset of cherty limestones.

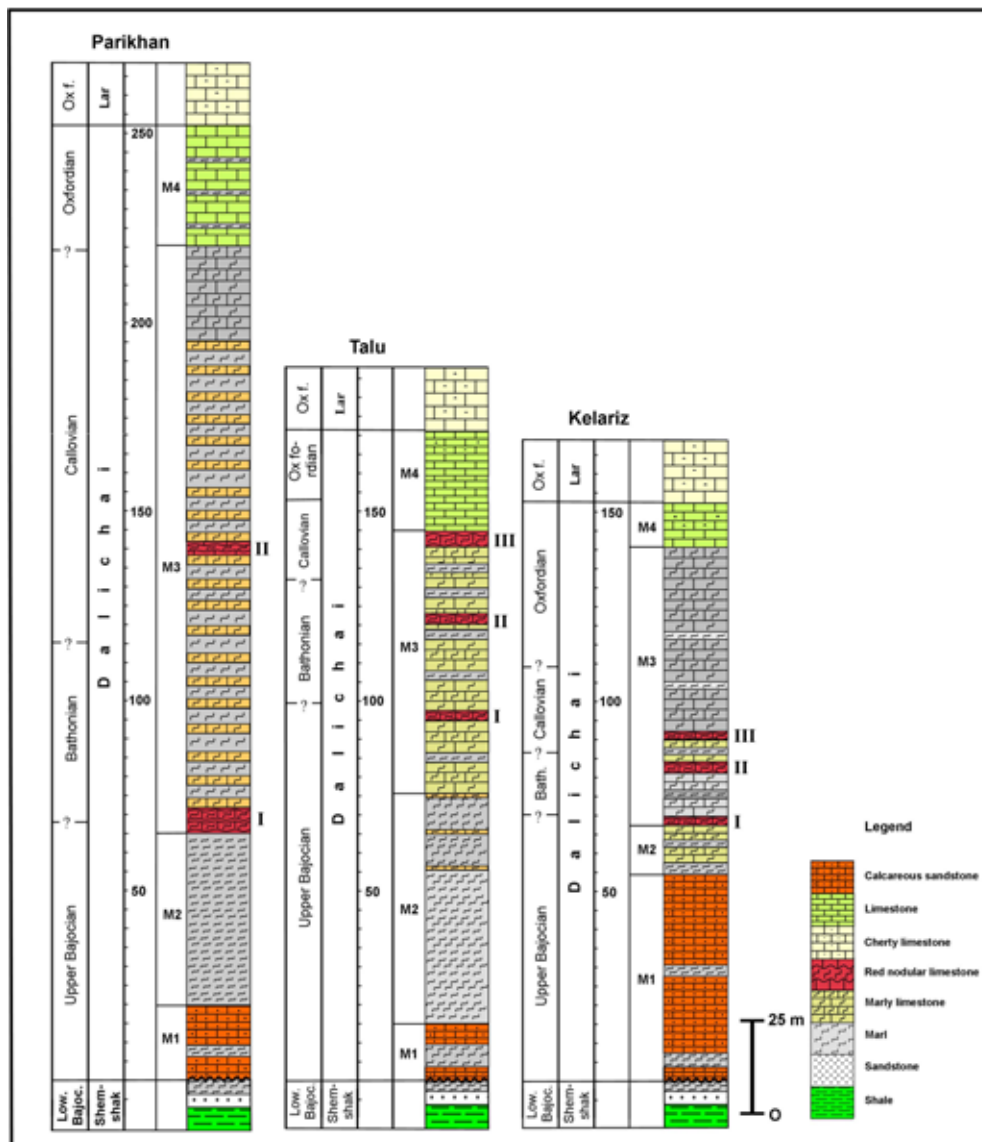


Figure 2: Stratigraphic logs of the studied sections. I, II, III: red condensed beds.

2.2 Specimen repository

The ammonites described in this paper are deposited in the collections of the Bayerische Staatssammlung für Paläontologie und Geologie (BSPG) in Munich, Germany, under acquisition numbers SNSB-BSPG 2013 XXIV 1–12.

In addition to the specimens detailed in this paper a number of small nuclei of *Morphoceratidae* were found that cannot be identified down to species level and therefore have not been considered.

3. Systematics

Remark: Because of conventional reasons and as commonly dealt in the literature, we handle the taxa of the dimorphic pair *Morphoceras* [M] / *Ebrayiceras* [m] separately.

Family *Morphoceratidae* Hyatt, 1900

Genus *Morphoceras* Douvillé, 1880

Morphoceras multiforme Arkell, 1951
Pl. 1, Figs 5, 6

- 1846 *Ammonites polymorphus*, d'Orb. – d'Orbigny, p. 379, pl. 124, figs. 1–4 [LT].
- 1951 *Morphoceras multiforme* nom. nov. – Arkell, p. 17.
- 1955 *Morphoceras multiforme* Arkell. – Arkell, p. 132, text-fig. 47 [LT], 50, pl. 16, figs 1, 2.
- 1970 *Morphoceras multiforme* Arkell, 1951. – Mangold, p. 59, pl. 4, figs 1–11, text-fig. 32.
- 1970 *Morphoceras multiforme* Arkell. – Hahn, p. 33, text-fig. 7, pl. 5, figs 1–5.
- v 2005 *Morphoceras thalmani* (Mangold). – Shafeizad & Seyed-Emami, fig. 11.2.
- 2010 *Morphoceras multiforme* Arkell 1951[M]. – Zaton, p. 161, pl. 12I, 13A–B; text-fig. 14.

Material: 1 specimen from Parikhan. There are several incomplete specimens from Parikhan and Kelariz that have not been considered.

Description: The body chamber comprises about $\frac{3}{4}$ of the last whorl and shows a slight egression just behind the peristome, of which a small part is preserved. The ribbing is well developed on the phragmocone, but becomes fainter on the body chamber. There are four constrictions discernible on the internal mould.

Discussion: Although the illustrated specimen with a diameter of 78 mm is unusually large, there is no doubt about its affiliation to *M. multiforme*.

Occurrence: This species has been described previously from the Lower Bathonian of North and Central Iran (Seyed-Emami et al. 1985, 1989, 1991; Majidifard 2003; Shams & Seyed-Emami, 2010).

Morphoceras macrescens (Buckman, 1923)
Pl. 1, Figs 7, 10–12

- v * 1923 *Patemorphoceras macrescens* nov. – Buckman, pl. 376 [HT].
v 1955 *Morphoceras macrescens* S. Buckman. – Arkell, p. 133, pl. 16, fig. 4 [HT]; pl. 17, fig. 3.
1970 *Morphoceras macrescens macrescens* (S. Buckman). – Mangold, p. 69, pl. 5, figs 11–13, pl. 6, figs 1–7, text-fig. 34.
1970 *Morphoceras macrescens* (S. Buckman). – Hahn, p. 35, pl. 5, figs 10–15, text-fig. 7c.
2010 *Morphoceras macrescens* (S. Buckman 1923) [M]. – Zatoń, p. 162, pl. 12H, 13C; text-fig. 14.

Material: 2 specimens from Talu, 2 specimens from Kelariz.

Description: The larger specimen from Talu (Pl. 1, Figs 10, 11) is a complete phragmocone (diameter: 50 mm), on which the trace line of the body chamber is still recognizable. It shows a well-developed egression and comprises nearly an entire whorl. The smaller specimen (diameter: 27 mm) from the same locality (Pl. 1, Fig. 12) exhibits 7 constrictions, which is unusual high for this taxon. Another large specimen from Kelariz (Pl. 1, Fig. 7) with a diameter of c. 90 mm is completely preserved with the peristome. The relatively smooth body chamber occupies little more than $\frac{3}{4}$ of the last whorl.

Occurrence: *M. macrescens* is already known from Central and North Iran (Seyed-Emami et al. 1985, 1989, 1991; Majidifard, 2003).

Morphoceras aff. *patescens* (Buckman, 1922)
Pl. 1, Figs 15, 16

aff. 1922 *Patemorphoceras patescens* nov. – Buckman, pl. 351.

Material: 1 specimen from Talu.

Description: The poorly preserved internal mould comprises the phragmocone and parts of the body chamber which covers little more than $\frac{3}{4}$ of the last whorl. The beginning of the body chamber is indicated by an egression. The whorl section is broad and subquadratic. The ribbing is relatively fine and dense.

Discussion: In comparison with *M. patescens* the present specimen lacks the rather coarse and flexuous ribbing. Seyed-Emami et al. (1991) described an inner whorl of *M. patescens* from Central Iran.

Morphoceras egrediens Wetzel, 1937
Pl. 1, Figs 1, 2

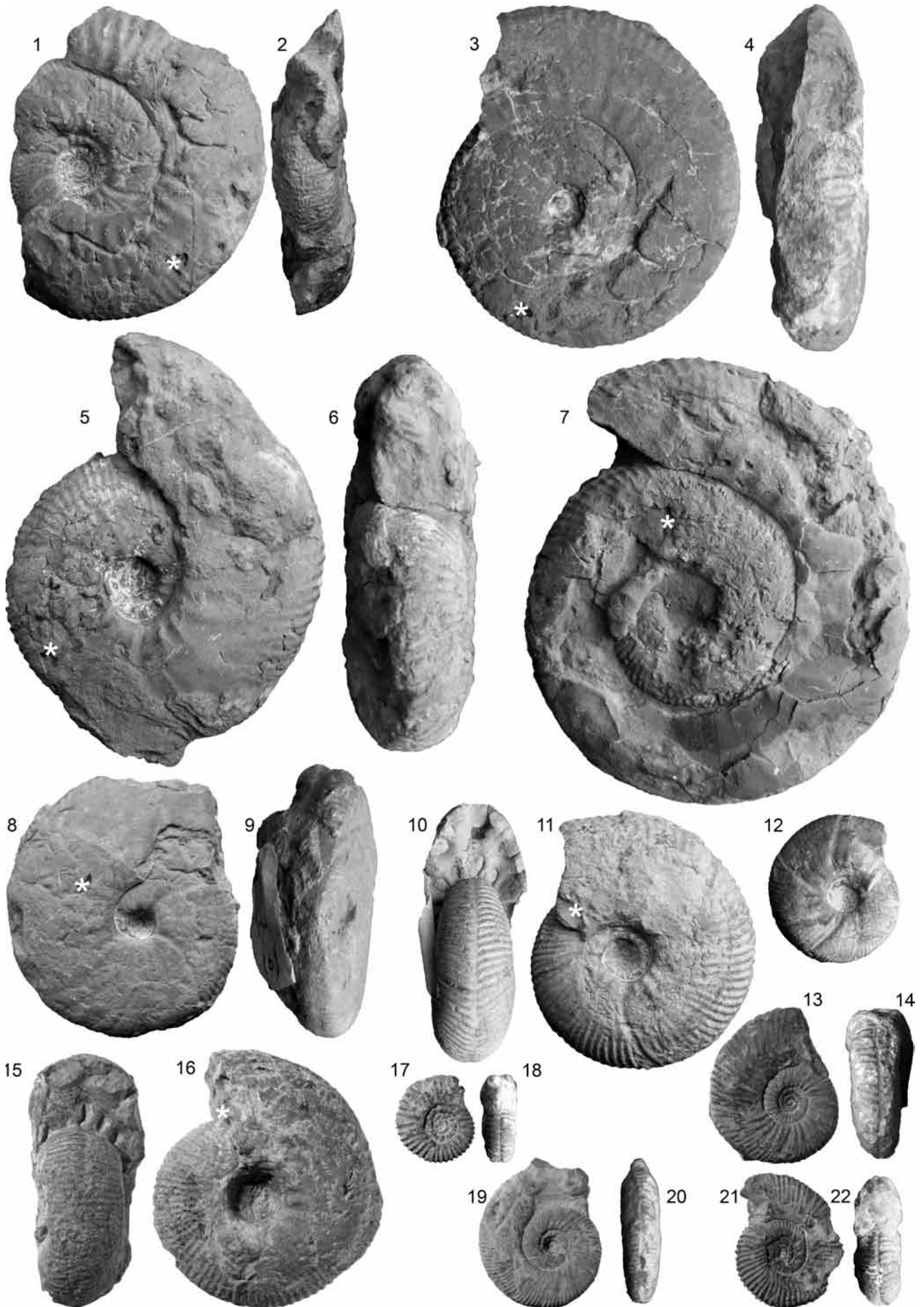
- * 1887 *Ammonites parkinsoni inflatus* – Quenstedt, p. 621, pl. 74, fig. 1 [LT].
1937 *Morphoceras inflatum* Qu. sp. 1849 var. *egrediens* n. var. – Wetzel, p. 132.
1970 *Morphoceras egrediens* Wetzel, 1937. – Mangold, p. 66, pl. 5, figs 3, 6, 7, 10.
non 2003 *Morphoceras* cf. *egrediens* (Wetzel). – Majidifard, pl. 7, Fig. 2.

Material: 1 specimen from Kelariz.

Description: The specimen (Pl. 1, Figs 1, 2) is an incomplete internal mould, of which only one flank is preserved. The phragmocone is extremely evolute. Approximately half of a whorl of the body chamber is preserved, which strongly egresses just posterior to the end of the phragmocone. On the body chamber the ribbing is rather coarse and well developed.

Discussion: We follow the interpretation of this species by Mangold (1970: pl. 5, figs 3, 6, 7, 10). Our specimens differ from the lectotype by less distinct constrictions, a little more open umbilicus and a lesser whorl height on the body chamber. The lectotype (Quenstedt 1886/87: pl. 74, fig. 1) shows also a distinct egression, still recognizable by the imprint line of the lost body chamber. In spite of its more closed umbilicus we place another specimen from

Plate 1: (1, 2) *Morphoceras egrediens* Wetzel; Kelariz; “Ammonitico Rosso” II; SNSB-BSPG 2013 XXIV 1. (3, 4) *Morphoceras* cf. *egrediens* Wetzel; Kelariz; “Ammonitico Rosso” II; SNSB-BSPG 2013 XXIV 2. (5, 6) *Morphoceras multiforme* Arkell; Parikhan; “Ammonitico Rosso” I; SNSB-BSPG 2013 XXIV 3. (7, 10–12) *Morphoceras macrescens* (Buckman), “Ammonitico Rosso” II. (7) Kelariz; SNSB-BSPG 2013 XXIV 4; (10, 11) Talu, SNSB-BSPG 2013 XXIV 5; (12) Talu, SNSB-BSPG 2013 XXIV 6. (8, 9) *Morphoceras kelarizis* n. sp.; Kelariz; “Ammonitico Rosso” II; SNSB-BSPG 2013 XXIV 7. (13, 14, 21, 22) *Ebrayiceras sulcatum* (Zieten); (13, 14) Parikhan, “Ammonitico Rosso” I; SNSB-BSPG 2013 XXIV 8; (21, 22) Talu, “Ammonitico Rosso” II; BSGP 2013 XXIV 9. (15, 16) *Morphoceras* aff. *patescens* (Buckman); Talu; “Ammonitico Rosso” II; SNSB-BSPG 2013 XXIV 10. (17, 18) *Ebrayiceras problematicum* (Gemmellaro); Talu; “Ammonitico Rosso” II; SNSB-BSPG 2013 XXIV 11. (19, 20) *Ebrayiceras filicosta* Wetzel; Talu; “Ammonitico Rosso” II; SNSB-BSPG 2013 XXIV 12. (1–22) Dalichai Formation, Member 3, Lower Bathonian, Zigzag Zone, Convergens or Macrescens Subzone. All specimens: x1. The end of the phragmolone is marked by an asterisk.



Kelariz (Pl. 1, Figs 3, 4) close to this taxon (as *M. cf. egrediens*). There is also some resemblance to *M. thalmanni* Mangold, but it differs from the holotype of *M. thalmanni* (Mangold 1970: pl. 3, figs 11, 12) by its narrower umbilicus and a lower whorl height of the body chamber.

Occurrence: This is the first record of *M. egrediens* for Iran. The specimen described by Majidifard (2003: p. 113, pl. 7, fig. 2) as *Morphoceras egrediens* Wetzel (in figure caption as *Morphoceras cf. egrediens*) lacks the characteristic features of the taxon and is misidentified.

Morphoceras kelarizis n. sp.

Pl. 1, Figs 8, 9

v 2008 *Morphoceras* nov. spec. – Fischer, p. 182, fig. 3.

v 2008 *Morphoceras* nov. sp. – Müller, p. 47, upper image.

Holotypus: specimen K 2 – 106 (SNSB-BSPG 2012 XXXIV 7).

Stratum typicum: Dalichai Formation.

Locus typicus: Kelariz, north of Damghan, north-east Alborz Range, NE Iran.

Derivatio nominis: After the locality Kelariz (north of Damghan).

Material: Only holotype.

Diagnosis: Medium-sized *Morphoceras* with tight umbilicus, a high and narrow whorl cross section with an abrupt and strong egression of the body chamber.

Description: The holotype is a fairly well preserved internal mould. About ¼ of the last whorl belongs to the body chamber, which begins at a diameter of ca 50 mm. The onset of the body chamber is marked by a distinct egression, indicated by the imprint line of the lost body chamber. The flanks are nearly parallel. The whorl cross section is narrow and high both on the phragmocone and on the body chamber. The ribbing is weak, partly caused by its preservation as an internal mould. On the venter the ribs are interrupted. On the phragmocone faint constrictions occur.

Differential diagnosis: *M. dimorphitiformis* Sandoval and ?*Morphoceras ellipticum* Sandoval differ in a nearly closed umbilicus, more evolute whorls and a lower whorl height of the body chamber. In addition, *M. ellipticum* is smaller than *M. kelarizis* n. sp. From *M. subpatescens* Besnosov the new taxon is distinguished especially by its much narrower whorls in all ontogenetic stages. Except the tighter umbilicus, *M. kelarizis* differs from the closest related *M. kostelecense* Rakús in having much narrower whorls on the phragmocone. *M. multiforme* Arkell exhibits

much broader whorls and the egression occurs distinctly anterior to the beginning of the body chamber. For these significant differences the new taxon can hardly be mistaken by any other nominal species of *Morphoceras*.

Discussion: As the genus *Morphoceras* derives from *Dimorphinites* of the Late Bajocian Parkinsoni Zone (Mangold 1997; Dietze & Bernt 2009), there is no wonder that specimens from the Early Bathonian Convergens Subzone still show a rather tight umbilicus (Köstler & Schairer 1996; Dietze & Dietl 2006; Fischer 2008; Pavia et al. 2008; Fernández-López et al. 2009).

Genus *Ebrayiceras* Douvillé, 1880

Ebrayiceras sulcatum (Zieten, 1830)

Pl. 1, Figs 13, 14, 21, 22

- * 1830 *Ammonites sulcatus* Hehl. – Zieten, p. 6, pl. 5, fig. 3 [HT].
- 1970 *Ebrayiceras sulcatum* (Zieten, 1830). – Mangold, p. 89, pl. 7, text-figs 1–6.
- 1970 *Ebrayiceras sulcatum* (v. Zieten). – Hahn, p. 42, pl. 6, figs 1–6 [reproduction of HT].

Material: 1 specimen from Parikhan, 1 specimen from Talu.

Description: The specimen from Talu (Pl. 1, Figs 21, 22) is a phragmocone with a fragmentary portion of the body chamber. The other one from Parikhan (Pl. 1, Figs 13, 14) is almost complete except of the aperture.

Occurrence: *M. sulcatum* has been already described from various sites in North and Central Iran (Seyed-Emami et al. 1985, 1989, 1991; Majidifard 2003).

Ebrayiceras problematicum (Gemmellaro, 1877)

Pl. 1, Figs 17, 18

- * 1877 *Perisphinctes problematicus*, Gemm. – Gemmellaro, p. 71, pl. 4, fig. 1 [LT].
- 1970 *Ebrayiceras cf. problematicum* (Gemmellaro). – Hahn, p. 46, pl. 6, figs 7, 8.
- 2002 *Ebrayiceras problematicum* (Gemmellaro, 1877). – Pavia, p. 252, fig. 173 [reillustration of LT].

Material: 1 specimen from Talu.

Description: A phragmocone with broad whorls and a coarse ribbing. Apart from the less prosiradial ribs on the ventral side, it is very close to the lectotype.

Ebrayiceras filicosta Wetzel, 1937

Pl. 1, Figs 19, 20

- * 1937 *Ebrayiceras filicosta* n. sp. – Wetzel, p. 133, pl. 14, fig. 7 [HT].

1970 *Ebrayiceras filicosta* Wetzel, 1937. – Mangold, p. 95, pl. 7, figs 7, 8.

Material: 2 specimens from Talu.

Description: The illustrated specimen from Talu (Pl. 1, Figs 19–22) exhibits a very narrow whorl section and remarkably fine and dense ribbing.

Occurrence: *E. filicosta* has already been recorded from North and Central Iran (Seyed-Emami et al. 1985, 1991).

4. Summary and conclusions

The morphoceratids described above come from the Dalichai Formation (Upper Bajocian – Oxfordian) north and northeast of Damghan. The Dalichai Formation is an alternation of marls and limestones, which are widely distributed along the Alborz Range (North Iran) from west to the east and its eastern continuation, the Binalud Mountains (Fig. 1). This formation contains a relatively rich ammonite fauna, which often is concentrated in a few condensed beds. Nearly all fossils considered in this paper come from the second red bed within Member 3 of the Dalichai Formation at Talu and Kelariz sections and belong to the Lower Bathonian (Zigzag Zone, Convergens or Macrescens subzones). Morphoceratidae are excellent tools for stratigraphic correlation in the Lower Bathonian of different faunal provinces in Central and southern Europe, North Africa, Caucasus, North and Central Iran; more recently this ammonite family was also reported from South America (Riccardi & Westermann 1999; Fernández-López & Chong Diaz 2011). This family is well-known from Iran and has also been recorded from southwest Alborz (Seyed-Emami et al. 1985), central Alborz (Arkell 1956), southeast Alborz (Seyed-Emami et al. 1989; Majidifard 2003), and eastern Central Iran (Seyed-Emami et al. 1991).

A remarkable feature of the Dalichai Formation, especially in the eastern Alborz area, is the occurrence of several red nodular limestone beds and marls in “Ammonitico Rosso” facies. These represent condensation horizons, indicated by reduction of the thickness, presence of hardened surfaces, nodules, iron coatings and concentration of fossils. Additionally, because of syndimentary dissolution, all ammonites are only on one side preserved. This lithology is widespread and well-known from the Alpine-Mediterranean Jurassic (e.g., Elmi 1981; Farinacci et al. 1981a,b; Böhm et al. 1999; Rais et al. 2007; Jenkyns 1974, 2009; Kandemir & Yilmaz 2009; Baraboshkin et al. 2010).

The deeper sedimentary environment of the Dalichai Formation along the Alborz Range is indicated by structural features as slumping, trace fossils and in most cases by a great number or dominance of Phylloceratidae. The composition of ammonite fami-

lies at Talu, based on c. 1500 specimens, is as follows: Phylloceratidae (19,9%), Lytoceratidae (3,8%), Oppeliidae (9,6%), Stephanoceratidae (3,1%), Macrocephalitidae (5,7%), Parkinsoniidae (0,8%), Morphoceratidae (6,4%), Reineckeidae (18,3%), Perisphinctidae (30,6%), Aspidoceratidae (0,8%) (Behfar 2009; Behfar et al. 2012).

Palaeobiogeographically the ammonite fauna of the Dalichai Formation is typically northwest-Tethyan, with relations to Subboreal / Submediterranean provinces.

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