Ammonites from Bathonian and Callovian (Middle Jurassic) North of Damghan, Eastern Alborz, North Iran

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Abstract

The following Middle Jurassic ammonite families (subfamilies) are described from the Dalichai Formation north of Damghan (eastern Alborz), some of them for the first time: Phylloceratidae, Lytoceratidae, Oppeliidae (Hecticoceratinae), Stephanoceratidae (Cadomitinae), Tulitidae and Reineckeiidae. The fauna is typically Northwest-Tethyan and closely related to Central Europe (Subboreal – Submediterranean Provinces).

Key words: Ammonites, Dalichai Formation, Middle Jurassic, Alborz, Iran

Schrödernfassung

Aus der Dalichai Formation nördlich von Damghan (Ostalborz) werden einige mitteljurassische Ammoniten, teils zum ersten Mal, beschrieben. Folgende Familien und Unterfamilien sind vertreten: Phylloceratidae, Lytoceratidae, Oppeliidae (Hecticoceratinae), Stephanoceratidae (Cadomitinae), Tulitidae und Reineckeiidae. Die Fauna ist typisch für die Nordwest-Tethys und zeigt enge Beziehungen zu Zentraleuropa (Subboreale und Submediterrane Faunenprovinzen).

Schlüsselwörter: Ammoniten, Dalichai Formation, Mittlerer Jura, Alborz, Iran

Introduction

The present study is a continuation of a larger research project on the ammonite fauna of the Dalichai and Lar formations in eastern Alborz and Binalud Range. The ammonites of the Dalichai Formation were studied largely by Seyed-Emami et al. (1985, 1989, 1995), Schairer et al. (1991) and in recent years by Majidifard (2003), Seyed-Emami & Schairer (2010, 2011a, b), Seyed-Emami et al. (2013), Raoufian (2014), Raoufian et al. (2011, 2014), Dietze et al. (2014), Parent et al. (2014) and Seyed-Emami et al. (2015). The studied ammonites come - except of one specimen - from the Parikhan section west of Shahrud (Seyed-Emami et al. 2013, fig. 3B) and are exclusively from the Dalichai Formation at Talu, north of Damghan (Fig. 1). At Talu as elsewhere in the Alborz Range, the Dalichai Formation is a sequence of greyish limestones and marlstones, overlying disconformably the Shemshak Group (Norian–Early Bajocian; Fürsich et al. 2009). It is followed gradually by the light and cliff building carbonates of the Lar Formation (Upper Jurassic). The outcrop at Talu was studied by Behfar (2009) and Behfar et al. (2012) in the frame of a MSc. thesis. For the present study, a new section nearby was chosen and collections were made by A. Raoufian (2015). The greater part of the Morphoceratidae from Talu and Kelariz (Fig. 1) were previously studied by Dietze et al. (2014) and the Macrocephalitidae by Seyed-Emami et al. (2015).

2. Geological setting and specimen repository

2.1 Geological setting

The section Talu is located ca 19 km north of Damghan, E 54° 26’ 04”, N 36° 19’ 06” (see geological map of Damghan 1: 100,000 prepared by Alavi-Naini & Salehi Rad 1975).

The ammonites described in this study come from the upper part of the Dalichai Formation at Talu and are of Callovian age, except of a few specimens which have a Bathonian age. The new measured section at Talu (Fig. 2) has a thickness of 152 m and can be subdivided roughly into four members (from base to top):
**Member 1:** 15.5 m of brownish, sandy to fine-conglomeratic limestone with intercalation of marlstone.

**Member 2:** 60 m of greyish-green, argillaceous and very soft marlstone, with intercalation of marly limestone in the upper part. This unit contains few fragments of sponges, pelecypods, gastropods, crinoid ossicles and belemnites.

**Member 3:** 70 m of an alternation of greyish marly limestone and marlstone, with varying content of ammonites. Within this member, there are three distinct succeeding stratigraphic levels, consisting of few meters of condensed, reddish, nodular limestone and marls in “Ammonitico Rosso” facies:

- **Red Bed I:** begins ca 95 m above the base of the section and is 1.5 m thick. It contains Late Bajocian ammonites (*Oxycerites, Parkinsonia, Perisphinctidae* etc.).
- **Red Bed II:** begins ca 120 m above the base and is 2 m thick. It contains Early Bathonian ammonites (*Oxycerites, Cadomites, Parkinsonia, Morphoceratidae* and *Perisphinctidae*).
- **Red Bed III:** begins ca 140 m above the base and is ca 4 m thick. It contains Callovian ammonites (*Hecticoceratinae, Reineckelidae, Perisphinctidae*, etc.). About 2 meters below this bed, there is a bed with fairly rich Macrocephalitinae.

The red beds are the most prominent features within the Dalichai Formation along the eastern Alborz and Binalud Mountains (Seyed-Emami et al. 2013). They represent condensation horizons of red nodular limestone and marls with iron coating and hardened surfaces. This lithology is widespread in the Alpine-Mediterranean Jurassic.

**Member 4:** 27 m, alternation of light-grey limestone and marlstone with intercalation of cherty limestones in the upper part. It contains Upper Callovian to Lower Oxfordian ammonites.

### 2.2 Specimen repository

The ammonites studied herein are deposited in the collections of the “Bayerische Staatssammlung für Paläontologie und Geologie” in Munich, Germany under the numbers SNSB-BSPG 2013 XX1V 40–62.

### 2.3 Measured parameters and abbreviations

As far as possible, the following parameters are given: diameter (D) in mm; umbilical width (U), whorl height (H), whorl width (W) (all in % of diameter); number of primary ribs (PR) on a whorl, (SR) number of secondary ribs on a whorl; [m] = microconch, [M] = macroconch. All figures are in natural size, if not otherwise indicated.

### 3. Systematics

**Family Phylloceratidae** Zittel, 1884  
**Subfamily Phylloceratinae** Zittel, 1884  

**Genus Adabofoloceras** Joly, 1977

*Adabofoloceras aff. adabofolense* (Collignon, 1958)  
Pl. 1, Fig. 1a, b
The greatest whorl width is near to the mid-flank, from where the flank falls towards venter and umbilicus. The umbilicus is closed and funnel-shaped. The ribs are nearly rectiradiate and begin faintly within the inner flank. Towards the venter the ribs become distinctly coarser and bifurcate usually around the mid-flank, occasionally with intercalatory ribs. Suture line is not visible.

Discussion: Our specimen can be well compared to the holotype of Collignon (1958, pl. 12, figs 63, 63a–b) being reproduced by Joly (1977: p. 119, pl. 1, fig. 1, pl. 38, figs a–b), from the Lower Callovian of Madagascar.
Textfigure 3: Field aspects of the Dalichai Formation north of Talu. (a) Position of the Dalichai Formation between Shemshak and Lar formations. (b) Sharp contact between Shemshak and Dalichai formations with paleosoil (Mid-Cimmerian Event). (c) Position of the first, second and third Red Beds within the Dalichai Formation. (d) Aspect of Red Bed III at Talu. (e) Reineckeia in situ within the Red Bed III.

Occurrence: From Red Bed III.

Family Lytoceratidae Neumayr, 1875
Subfamily Lytoceratinae Neumayr, 1875

Lytoceras sp.
Pl. 1, Fig. 2a, b

Material: One fully septated internal mould from Talu: SNSB-BSPG 2013 XXIV 41.

Dimensions: D U H W
BSPG 2013XXIV 41 99 41 37 32

Description: The rather strongly eroded phragmocone has a diameter of nearly 100 mm. It is a serpentine and evolve Lytoceratidae with circular to high oval, slightly higher than wide whorl section. Because of the strong erosion the ribbing is not well recognizable. So far visible, very faint radial and distant ribs can be recognized.

Age: Late Early to Middle Callovian (Red Bed III).

Family Oppeliidae Bonarelli, 1894
Subfamily Hecticoceratinae Spath, 1925

Genus Hecticoceras Bonarelli, 1894

Hecticoceras gr. metomphalum Bonarelli, 1894
Pl. 1, Figs 3a, b, 4a, b, 5, 6a, b;
Pl. 2, Figs 1a, b, 2a, b

1894 Hecticoceras (Lunuloceras) metomphalum n. f. – Bonarelli, p. 90.

1956 Hecticoceras (Rossiensiceras) metomphalum Bonarelli – Zeiss, p. 54, pl. 2, fig. 4 (with synonymy).

2000 Hecticoceras (Rossiensiceras) metomphalum Bonarelli – Schairer et al., p. 55, fig. 14.


2003 Hecticoceras (Putaliceras) metomphalum (Bonarelli) – Majidifard, pl. 4, figs 1, 4.

2009 Hecticoceras (Lunuloceras) gr. metomphalum (Bonarelli, 1894) – Schlögl et al., p. 66, figs 5.9–11, 6.4–5.

2011b Hecticoceras (Rossiensiceras) aff. metomphalum (Bonarelli, 1894) – Seyed-Emami & Schairer, p. 376, fig. 3A.

2013 Hecticoceras (Rossiensiceras) gr. metomphalum (Bonarelli, 1894) – Seyed-Emami et al., p. 50, fig. 5f.

2014 Hecticoceras metomphalum Bonarelli, 1893 – Parent et al., pl. 2, figs 2–3.


Dimensions: D U H W
BSPG 2013 XXIV 43 43 36 40 -
BSPG 2013 XXIV 46 48 40 38 -

Discussion: The systematics of Hecticoceratinae is still a persistant problem and they are subdivided into many unnecessary and probably synonymous taxa. Particularly the metomphalum-group shows apparently a large intraspecific variability, as emphasized already by Schlögl et al. (2009: 66), Seyed-Emami & Schairer (2011b: 4) and Dietl (2013).

Morphotype 1. Rather involute and compressed forms with semi-coarse ornamentation: SNSB-BSPG 2013 XXIV 42, 48 (Pl. 1, Fig. 3a, b; Pl. 2, Figs 2 a, b):

In specimen SNSB-BSPG 2013 XXIV48 (Pl. 2, Fig. 2 a, b) only one side is preserved. It is a partially eroded internal mould with a diameter over 65 mm. The body chamber begins at D = 53 mm. It is relatively involute with high-oval, slightly shouldered whorl cross-section and a sharp, low and narrow keel. The nearly smooth inner flank falls gently towards the rather sharp umbilical margin and is slightly concave. The umbilical wall is low and vertical. Ribbing is up to a diameter of 40 mm relatively fine, but later it becomes coarser. On the last half whorl of the phragmocone there are about 7–8 flat and blunt peri-umbilical tubercles, giving way to 3 to 4 blunt and concave outer ribs. On the body chamber the tubercles almost cease and the inner flank becomes smooth. On the outer flank there are still faint and distant ribs. Specimen SNSB-BSPG 2013 XXIV 42 is a large phragmocone with a diameter of nearly 80 mm. These forms can be attributed to the group of Hecticoceras metomphalum metomphalum.

Morphotype 2. Rather evolute and depressed forms with coarse ornamentation: SNSB-BSPG 2013 XXIV 43, 44, 45, 46 (Pl. 1, Figs 4a, b, 5, 6a, b; Pl. 2, Fig. 1a, b, b). These forms can be best compared with the group of Hecticoceras metomphalum multi-costatum Tsytovich, 1911.

SNSB-BSPG 2013 XXIV43 (Pl. 1, Fig. 4a, b) is a phragmocone with only one-side preserved. It is fairly evolute with a low keel and a smooth inner flank gently falling towards the low umbilicus. The umbil-
Discussion: The different morphotypes of the group of *Hecticoceras metomphalum* are relatively frequent in the Dalichai Formation. Because of the condensation, it cannot be determined whether these are only morphotypes of a single species or different taxa of different age.

Age: Zeiss (1956: 45) recorded *H. metomphalum* from the Anceps to the Lamberti zone, Schlögl et al. (2009: 66) from the Middle Callovian (Coronatum Zone) and Dietl (2013) from the Middle Callovian (upper Jason Zone). Our specimens come from the Red Bed III at Talu. Considering the stratigraphic position of Macrocephalitidae from the same section (Seyed-Emami et al., 2015, p. 6, table 1), which occur ca 2 meters below the Red Bed III, the age of the herein described Hecticoceratinae is most probably late Early Callovian (Gracilis Chron) to early Middle Callovian (Anceps Chron).

*Hecticoceras* aff. *paulowi* (de Tsytovitch, 1911)

Material: One eroded internal mould from Talu: SNSB-BSPG 2013 XXIV 49.

**Description:**

The strongly eroded specimen is a partially eroded phragmocone with only one side preserved. It is relatively involute with high-oval whorl section and a sharp, low and narrow keel. The nearly smooth inner flank falls gently towards the umbilical margin. The umbilical wall is low and steep. The ribbing is up to a diameter of ca 35 mm relatively fine and seemingly limited to the outer flank, but later it becomes slightly coarser. The inner part of the flank is up to a diameter of 35 mm almost smooth, but later indistinct, distant and thickened inner ribs appear.

Discussion: Concerning the rather smooth inner flank and the relatively narrow umbilicus the present specimen can be best compared with *H. paulowi*. "*Orbignyceras paulowi*" from the Upper Callovian of Herznach (Switzerland) as reported by Jeannet (1951, pl. 9, fig. 12) is very similar. It also can be compared with involute and smoothly ribbed morphotypes of the *H. metomphalum* group.

Age: Zeiss (1956: 45) and Fortwengler et al. (2012: 120) reported *H. paulowi* from the Upper Callovian (Lamberti Zone). Schlögl et al. (2009) reported it from the Middle Callovian (Coronatum Zone). The present specimen comes from the Red Bed III indicating a late Early to Middle Callovian age.

*Hecticoceras (Lunuloceras)* sp.

**Material:** An eroded half of a phragmocone from Talu: SNSB-BSPG 2013 XXIV 47.

**Description:**

The half-preserved phragmocone has a diameter of nearly 50 mm. It is a discoidal, moderately evolute, carinate and slightly shouldered *Hecticoceras* with high-oval cross section. The umbilical margin is sharp, the umbilical wall vertical. The flank is slightly convex and falls from the tubercles slightly towards the umbilicus and the venter. The ribbing is rather fine and consists of short and prorsiradiate inner ribs which end shortly above the umbilicus at small and rounded tubercles. On a half-whorl, at a diameter of ca 50 mm, there are 12 to 13 tubercles. Two concave outer ribs radiate almost regularly from the tubercles. On the shoulder the ribs bend forward and end at the keel.

Discussion: The present form cannot be attributed to any known Hecticoceratinae yet. So far the best comparable taxon is *Hecticoceras pseudopunctatum* (Lahnusen, 1883) in Jeannet (1951, p. 43, pl. 9, fig. 11) and Zeiss (1956, p. 40, fig. 4, 9).

**Occurrence:** Red Bed III.

*Hecticoceras* sp. nov.? [M]

**Material:** A one-side preserved internal mould from Talu: SNSB-BSPG 2013 XXIV 50.

**Description:** The strongly eroded specimen has a diameter of more than 80 mm. Apart from a small portion of the body chamber the greater part of the last whorl belongs to the phragmocone. A slight
egression at a diameter of ca 80 mm indicates the beginning of the body chamber. It is a discoidal, carinate and involute *Hecticoceras* with high-oval, slightly shouldered whorl section and a low keel. The umbilical margin is rather sharp, with a vertical umbilical wall. The flank is slightly convex and falls from the mid-flank gently towards the umbilicus and the venter. The ribbing is falcoid. Probably due to erosion, the ribbing on the inner flank is somewhat obscure, but still some flat, broad and widely spaced ribs can be recognized. At about the mid-flank, the ribs give way to two or three slightly concave outer ribs, occasionally with an intercalate rib. Towards the venter the ribs become stronger and broader and somewhat scale-like. On the shoulder the ribs bend forward and reach up to the faint keel.

Discussion: The present specimen is characterized by its large size. Among the known taxa of *Hecticoceras* our specimen can be best compared to *H. paulowi* (1951, p. 45) the taxon can reach a size of up to 90 mm. Another partially similar taxon is (1951, pl. 10, figs 1–3). After Jeannet (1951, p. 45) the specimen illustrated in Mangold & Rioult (1997, pl. 2, fig. 8a–c) from the Binalud Mountains, northeast Iran. Most probably it represents a new species.

Age: Late Early to Middle Callovian (Red Bed III).  
Family Stephanoceratidae Neumayr, 1875  
Subfamily Cadomitinae Westermann, 1956

Genus *Cadomites* (Cadomites) Munier-Chalmas, 1892

*Cadomites bremeri* Tsereteli, 1968  
Pl. 3, Fig. 2a–c

1968 *Cadomites bremeri* Tsereteli s. nov. – Tsereteli, p. 80, pl. 12, figs 1 (holotype), 2–4.  
1974 *Cadomites* (Cadomites) *bremeri* Tsereteli, 1968 – Kopik, p. 22, pl. 3, fig. 3, pl. 4, figs 1a–c, pl. 5, figs 1a–c, pl. 6, figs 1a–b, pl. 7, figs 1a–b.  
1997 *Cadomites* (Cadomites) *bremeri* Tser. – Mangold & Rioult, p. 59, pl. 16, fig. 1.  
2007 *Cadomites* bremeri* Tsereteli – Dietze et al., p. 114, fig. 8c.  

Material: Two incomplete and one-side preserved internal moulds from Talu: SNSB-BSPG 2013 XXIV 52, 53.

Dimensions:  
BSPG 2013 XXIV 52 56 36 36 ca 57

Description: Specimen pl. 2, fig. 8a, b is a fully septated, rather evolute phragmocone with cadicone to broad trapezoid whorl cross-section. The flank falls steeply towards the umbilicus and merges gradually into the vertical umbilical wall. The ornamentation consists of relatively coarse, slightly prorsiradiate and concave inner ribs, which end ventrolaterally into semi-coarse tubercles. From the tubercles radiate 3–4 fine and slightly convex ventral ribs. At a diameter of 56 mm there are 30 tubercles per whorl.

Discussion: Because of their lesser rib density the two specimens stand between *C. bremeri* and *C. op-pitzi/altispinosus*. In Europe, we know little about Ca-
Domites in the Retrocostatum Zone. Only Kopik described a few microconchs and his C. stegeus (p. 17, pl. II, figs 2a, b, 3) seems to be the same species as the Iranian specimen. Imlay (1953) described many species of Cadomites as „Gowericeras“ from Canada of which C. costidensum is very close to the two specimens illustrated here; they also come from a similar stratigraphic level (lower part of Upper Bathonian).

Cadomites rectelobatus (Hauer) is much more inflated and has much wider whorls. Cadomites cf. stegeus (Buckman) in Pavia et al. (2008, pl.1, figs 6–7) is less broad and has coarser and less dense ribbing. In comparison with the very similar taxon Cadomites daubenyi (Gemmellaro, 1877) in Galác et al. (2008, p. 58, pl. 2, fig. 8, pl. 4, fig. 3) and Pavia & Cresta (2002, p. 236, figs 161 a–d) our specimens are distinguished by a wider umbilicus and coarser ribbing. For further differences towards other similar species see Kopik (1974: 19).

Age: The type of C. costidensum comes from the Western Interior (USA). After Callomon (1984) this horizon corresponds to the Cranocoephaloide Zone in the Boreal Realm, which represents the upper part of the Bremeri Zone in Europe. Our specimens were collected loosely from the scree above the Red Bed II and below Red Bed III.

Family Tulitidae Buckman, 1921

Genus Bullatimorphites Buckman, 1921

Bullatimorphites (?Kheraiceras) sp. [M]

Pl. 3, Fig. 1a, b

cf. 1983 Bullatimorphites (Bullatimorphites) costatus (Arkell) – Sandoval, p. 556, pl. 69, figs 1, 2, pl. 71, fig. 2.
cf. 1988 Bullatimorphites (Bullatimorphites) cf. costatus (Arkell) – Westermann & Callomon 1988, p. 81, pl. 17, fig. 5a, b.
1991 Bullatimorphites aff. ymir (Oppel) – Seyed-Emami et al., p. 72, pl. 3, fig. 1–4
2006 Bullatimorphites (Bullatimorphites) perispinctoides Arkell – Topčišchiwilli et al., pl. 33, fig. 1, pl. 34, fig. 1 (= Bullatimorphites suevicus Tsereteli, 1968)

Material: One incomplete and strongly eroded specimen from Talu: SNSB-BSPG 2013 XXIV 54.

Description: An incomplete specimen with a diameter of ca 103 mm. It comprises parts of the body chamber, indicated by a distinct eggression and simultaneous contraction of the whorl at about D = ca 80 mm. The phragmocone is fairly involute and depressed. The ribbing is little coarse on the phragmocone. Towards the body chamber it becomes coarser and ribs are more distant.

Discussion: In the upper part of the Bremeri Zone (fortecostatum horizon) there occur species that stand between the bullatimorphus-costatus group and B. hannoveranus. But they have a narrower umbilicus (as B. costatus), the ribbing is somewhat coarser and they are slightly smaller (110–140 mm). Typical specimens have already been illustrated under different names (see synonym list). On the Internet there is a manuscript name: “B. sandovali”, for Bullatimorphites novo sp. 1 Sandoval, 1983. A similar, but older taxon is B. latecentratus (Quenstedt), designated and figured by Hahn (1971, p. 97, pl. 6, fig. 3a, b) and figured by Arkell (1954, P. 109, fig. 35) and Schlegelmilch (1985, p. 134, pl. 52, fig. 2). Another similar taxon is B. hermi Seyed-Emami et al. (1998, p. 123, pl. 2, fig. 1, textfig. 3) which is very close to B. hannoveranus (Roemer).

Age: Bremeri Zone, upper part. The Iranian specimen is collected loosely from the scree above Red Bed II at Talu and may be little younger.

Bullatimorphites (Bomburites) microstoma

Orbigny, 1846 [m]
Pl. 2, Fig. 5a, b

1939 Sphaeroceras microstoma d’Orb. – Kuhn, p. 472, pl. 6, fig. 3.
1954 Ammonites microstoma D’Orbigny sp. – Arkell, p. 108, fig. 35 (refiguration of the lectotype).
1971 Bullatimorphites (Bomburites) microstoma (d’Orbigny) – Hahn, p. 108, pl. 7, figs 5, 6; pl. 9, fig. 8.
1972 Bullatimorphites microstoma (d’Orbigny) – Mönnig, p. 71, pl. 10, fig. 1.
1994 Bullatimorphites bullatus forme microconque microstoma (d’Orbigny, 1846) – Thierry et al., p. 132, pl. 56, figs 2a–c (refiguration of the holotype), 3a, b.
1995 Bullatimorphites (Bomburites) microstoma (d’Orbigny, 1846) – Männig, p. 71, pl. 10, fig. 1.
2003 Bullatimorphite (Bomburites) cf. microstoma (d’Orbigny) – Majidifard, p. 98, pl. 4, fig. 12.
2009 Bullatimorphites aff. (Bomburites) suevicus (Roemer) – Behfar et al., pl. 1, fig. 6.
2012 Bullatimorphites (Bomburites) aff. microstoma (Orbigny, 1846) – Behfar et al., pl. 1, fig. 6.
2016 Kheraiceras (Bomburites) microstoma (d’Orbigny) – Sandoval, p. 241, fig. 9c.

Material: One slightly distorted specimen, with a part of the body chamber from Talu: SNSB-BSPG 2013 XXIV 55.

Description: The slightly deformed specimen has a diameter of ca 38 mm. About half of the last whorl belongs to the body chamber, which is indicated by a clear eggression and simultaneous contraction of the whorl and a distinct crinkle. The crinkle at the beginning of the body chamber may be strengthened by distortion. The phragmocone is ellipticcone, involute, and moderately inflated. The ribbing is on the
phragmocone fine, dense and slightly prorsiradiate, single or irregularly bifurcating above the umbilicus and higher up. On the body chamber the ribbing becomes slightly coarser and more widely spaced; the inner ribs are short, slightly thickened and bifurcate often irregularly on the flank.

Discussion: Arkell (1954: p. 108) could not observe any lappet on d’Orbigny’s specimens and considered them rather to be small Bullatimorphites. But Thierry et al. (1994: p. 133) mentioned a short lappet, which can be seen on the figured specimen (pl. 56, fig. 2) and stated that the specimens were found together with B. bullatus and can be considered as microconch forms of the latter.

The present specimen, though a little smaller, can be well compared to B. microstoma in Thierry et al. (1994: pl. 56, fig. 2a, b), Kuhn (1939, pl. 6, fig. 3) and Hahn (1971, pl. 7, fig. 6). The very similar specimen Bullatimorphites (Bomurites) suevicus (Roemer) from the upper Bathonian (Hahn 1971, p. 106, pl. 8, figs 5, 6, 8, 10; Dietl 1994, p. 19, pl. 2, fig. 1) is more depressed and has a greater size.

Age: Bullatimorphus (Bomurites) microstoma is usually reported from the lower Callovian (Hahn 1971, p. 108; Kuhn 1939, p. 472; Thierry et al. 1994, p. 133) and Sandoval (2016, p. 242). The present specimen comes from the beds with Macrocephalites, ca 2 m below the Red Bed III, which corresponds also to Lower Callovian (Bullatus Zone) see Seyed-Emami et al. (2015, p. 19).

Bullatimorphites (Bomurites) aff. suevicus
(Roemer, 1911) [m]
Pl. 2, Figs 6a, b, 7a, b
aff. 1971 Bullatimorphites (Bomurites) suevicus (J. Roemer) – Hahn, p. 106, pl. 8, figs 5, 6, 8, 10.
aff. 1985 Bullatimorphites (Bomurites) suevicus (Roemer, 1911) – Schlegelmilch, p. 135, pl. 52, fig. 7.
2005 Bullatimorphites (Kheraceras) bullatus (Orbigny) – Shafeizad & Seyed-Emami, pl. 1, fig. 18.
aff. 2015 Bullatimorphites (Bomurites) suevicus (Roemer, 1911) – Martin & Mangold, p. 55, pl. 22, figs 1–9 (with synonymy).

Material: One nearly complete internal mould from Parikhan (west Shahrud, col. Shafeizad): SNSB-BSPG 2013 XXIV 60. Another similar taxon is Bullatimorphites weigelti Kuhn (1939, pl. 7, fig. 3), refigured by Schlegelmilch (1985, pl. 52, fig. 3).

Family Reineckeidae Hyatt, 1900

Remarks on Reineckeidae from Talu: In Talu, Reineckeidae are most abundant next to the Perisphinctidae as is usual within the Dalichai Formation in North Iran. Of more than hundred specimens, only few examples are considered here, because of nomenclatural problems regarding this ammonite family.

Genus Reineckeia Bayle, 1878

Reineckeia (Reineckeia) gr. stuebeli
(Steinmann, 1881) (M)
Pl. 4, Figs 4a, b, 5a, b
1984 Reineckeia (Reineckeia) stuebeli Steinmann, 1881
– Cariou, p. 264, pl. 40, figs 1–4a–c, 5, pl. 41, figs 2a–b, 3, 6a–b; textfigs 131–132, 146–149, 152, 159–160 (with synonymy).

Material: Two on one side preserved phragmoco-
ones from Talu: SNSB-BSPG 2013 XXIV 58, 59.

Dimensions: \[\begin{array}{cccc}
D & U & H & W \\
BSPG 2013 XXIV 58 & 65 & 47 & 31 & 38 \\
BSPG 2013 XXIV 59 & 65 & 52 & 29 & -
\end{array}\]

Description: Specimen SNSB-BSPG 2013 XXIV 58 is a fragment of a larger, fully septated and very
evolute Reineckeidae. In the inner whorls the whorl
section is broad trapezoid-oval, but becomes later
ovate and slightly higher than wide. The umbilicus is
wide and shallowed with rounded umbilical margin and
steep umbilical wall. The ribbing consists of short,
distant, nearly radiate and fairly coarse primary ribs,
which start at the seam and end shortly above the
umbilicus into fairly strong and sharp (spinose) tu-
bercles. There are 11 tubercles on a half whorl at a
diameter of 65 mm. Mostly four slightly prorsiradi-
ate secondary ribs radiate from the tubercles with
occasionally intercalated ribs. The ribs end vertically
at a distinct ventral furrow. At a diameter of 65 mm
there are two deep, prorsiradiate constrictions per
half whorl.

Discussion: Regarding the wide umbilicus and the
pattern of ribbing our specimens can be fairly well
compared to the macroconch forms of R. suebeli
(Steinmann, 1881) as reported by Cariou (1984, p.
264.), especially the specimens illustrated on plate
40. A rather similar taxon is Rehmannia (Loczyeras)
reiissi (Steinmann) in Cariou & Krishna (1988, p. 156,
pl. 1, fig. 1) from the Anceps Zone of Cutch, India.

Age: After Cariou (1984: p. 278) and Cariou (1994:
p. 150) R. suebeli is a frequent taxon in the lower
Middle Callovian (Anceps Zone) of Europe, being
also known from the South Tethyan Realm (North
Africa, India (Cutch) and Madagaskar). At Talu, the
specimens come from Red Bed III.

Reineckeia (Reineckeia) ex gr. anceps
(Reinecke, 1818)

Pl. 4, Fig. 1a, b

1984 Reineckeia (Reineckeia) anceps anceps (Reinecke) –
Cariou, p. 220, pl. 33, figs 4, 5a–b; pl. 34, figs 1, 2,
5a–b; pl. 35, figs 1, 4, 5a–b; textfigs 123, 126, 137,
155, 156 (with synonymy).

1988 Reineckeia (Reineckeia) anceps (Reinecke 1818) –
Cariou & Krishna, p. 160, pl. 2, figs 2a–b; pl. 3, figs
1a–b (with synonymy).

2002 Reineckeia (Reineckeia) anceps (Reinecke, 1818) –
Seyed-Emami et al., p. 185, figs 2–2–4.

Material: One phragmococone from Talu: SNSB-
BSPG 2013 XXIV 60.

Dimensions: \[\begin{array}{cccc}
D & U & H & W \\
BSPG 2013 XXIV 60 & 75 & 41 & 37 & -
\end{array}\]

Description: A fully septated, fairly evolute and
rather depressed Reineckeia with a diameter of 76
mm. The whorl section is, at the end of the last pre-
erved whorl, rounded to oval and nearly as high
as wide. The ribbing on the inner whorl consists of
short, radiate, distant and coarse primaries, begin-
ning at the seam. These end alternately into coarse,
conical and spinose tubercles. Towards the last pre-
erved whorl, the tubercles weaken. On the last por-
tion of the whorl the ribbing consists of coarse and
distant primaries, which often trifurcate above the
mid-flank. Only one constriction can be recognized
on the last whorl.

Discussion: The holotype of R. anceps (Reinecke
1818, p. 82, pl. 7, fig. 61) is lost and so far no neo-
type is established. Therefore, there is a lot of confu-
sion regarding this taxon. Considering the numerous
topotypes the taxon has to be re-studied. After E.
Mönning (pers. com. 2016) “the holotype comes from
a little creek E of Uetzing in Franconia and probably
from the upper Jason Zone (Dietl & Mönning, in press).
Similar species are also known from the upper Jason
Zone of Swabia (Dietl 2013)”. Our specimen can be
well compared to depressed morphotypes of the R.
anceps group as reported by Cariou (1984), espe-
cially to R. anceps elmii Bourquin, 1968 in Cariou (pl.
37, fig. 2a, b). Concerning the broad whorl section
and the coarse ribbing it shows also similarity with
Reineckeia (R.) nodosa (Till, 1907).

Age: After Dietl (2013) Reineckeia anceps occurs
in the upper part of the Jason Zone, which corre-
sponds to the Upper Anceps Zone (Tyranniformis
Subzone) in the Submediterranean Province. Our
specimen comes from Red Bed III at Talu.

Reineckeia sp. 
Pl. 4, Fig. 2a, b

Material: One phragmococone from Talu: SNSB-
BSPG 2013 XXIV 61.

Dimensions: \[\begin{array}{cccc}
D & U & H & W \\
BSPG 2013 XXIV 61 & 60 & 38 & 38 & 38
\end{array}\]

Description: Fairly evolute and slightly depressed
Reineckeia with a rounded to oval whorl section. The
ribbing consists of slightly proverse and distant pri-
maries which end within the inner third of the flank
into conical (spinose?) tubercles. Three or four rather
fine, dense and partly polygrate secondaries bundle
from the tubercles. Two or three intercalated ribs oc-
cur irregularly. There are three prorsiradiate and rat-
her deep constrictions on the last whorl.

Age: early Middle Callovian, Red Bed III.

Genus Alborzites Schairer,
Seyed-Emami & Zeiss, 1991
The Dalichai Formation (Late Bajocian–Oxfordian) is a sequence of greyish limestone and marlstone, being widely distributed along the Alborz Range and its eastern continuation Binalud Mountains. It contains locally a rather rich ammonite fauna, being often concentrated in few condensed beds. The studied ammonites come mostly from the upper part of the Dalichai Formation at Talu, north of Damghan. At Talu the ammonites are mostly accumulated within three few meter thick beds of condensed, red, nodular limestones and marls (Red Beds I–III). The red nodular limestone beds are the most prominent features within the Dalichai Formation along the eastern Alborz and Binalud Mountains (Seyed-Emami et al. 2013). Representing condensation horizons being deposited on pelagic swells of a swell-trough system (Sandoval 2016, p. 245). This facies is widespread in the Alpine-Mediterranean Jurassic (e.g. Elmi 1981; Farinacci et al. 1981a, b; Martire 1988, 1989; Böhm et al. 1999; Rais et al. 2007; Jenkyns 1974, 2009; Baraboshkin et al. 2010; Sandoval 2016).

Within the red beds the ammonites are preserved mostly as one-sided internal moulds with iron impregnation and crusts without shell. This indicates strong dissolution, presence of oceanic currents and probably deeper-water environments. The deeper environmental deposition of the Dalichai Formation is also indicated by sedimentary structures such as slumpings, trace fossils, the great number of Phylloceratidae and the relatively great numbers of Lytoceratidae (Behfar et al. 2012).

At Talu, the bulk of the ammonite fauna consists of Perispininctidae (ca 30%), Phylloceratidae (ca 20%) and Reinekeidae (ca 18%) as is usual for the Dalichai Formation (Seyed-Emami et al. 2013). The relative high number of Lytoceratinae (ca 4%) and Macrocephalitidae (ca 6.5%) is especially remarkable, as they are rather rare elements within the Dalichai Formation. On the other hand, the nearly complete absence of Reinekeidae and Macrocephalitidae in the section near Kelariz nearby Talu is remarkable (Seyed-Emami et al., 2015), although both sections are separated by a few kilometres only. Usually Reinekeidae are amongst the most frequent ammonite taxa within the Dalichai Formation.

Paleobiogeographically the ammonite fauna of the Dalichai Formation is typically north-west Tethyan, with relations to the subboreal/submediterranean provinces (Seyed-Emami et al. 2013; Dietze et al. 2014).

4. Discussion

The Dalichai Formation (Late Bajocian–Oxfordian) is a sequence of greyish limestone and marlstone, being widely distributed along the Alborz Range and its eastern continuation Binalud Mountains. It contains locally a rather rich ammonite fauna, being often concentrated in few condensed beds. The studied ammonites come mostly from the upper part of the Dalichai Formation at Talu, north of Damghan. At Talu the ammonites are mostly accumulated within three few meter thick beds of condensed, red, nodular limestones and marls (Red Beds I–III). The red nodular limestone beds are the most prominent features within the Dalichai Formation along the eastern Alborz and Binalud Mountains (Seyed-Emami et al. 2013), representing condensation horizons being deposited on pelagic swells of a swell-trough system (Sandoval 2016, p. 245). This facies is widespread in the Alpine-Mediterranean Jurassic (e.g. Elmi 1981; Farinacci et al. 1981a, b; Martire 1988, 1989; Böhm et al. 1999; Rais et al. 2007; Jenkyns 1974, 2009; Baraboshkin et al. 2010; Sandoval 2016).

Within the red beds the ammonites are preserved mostly as one-sided internal moulds with iron impregnation and crusts without shell. This indicates strong dissolution, presence of oceanic currents and probably deeper-water environments. The deeper environmental deposition of the Dalichai Formation is also indicated by sedimentary structures such as slumpings, trace fossils, the great number of Phylloceratidae and the relatively great numbers of Lytoceratidae (Behfar et al. 2012).

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Paleobiogeographically the ammonite fauna of the Dalichai Formation is typically north-west Tethyan, with relations to the subboreal/submediterranean provinces (Seyed-Emami et al. 2013; Dietze et al. 2014).

5. Age of the Red Bed III

Red Bed III lies about two meters above the beds with Macrocephalitinae which belong to the Bullatus and Prahequense zones of the Lower Callovian (Seyed-Emami et al. 2015). Consequently, regarding the stratigraphic position and the faunal composition, the age of the Red Bed III is late Early to Middle Callovian (Gracilis to Coronatum chrones). At Talu the first Macrocephalitinae appear in the Bullatus Zone, in which the Reineckeidae are still absent. The first Reineckeidae appear in the Gracilis Zone. It is remarkable that in southeast Spain the first Macrocephalitidae also appear in the Gracilis Zone, in which the Reineckeidae are still absent and the first Reineckeidae appear in the Gracilis Zone (Sandoval, 2016, p. 240).

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6. References


