Informes del Insitituto de Fisiografía y Geología

Volumen 1
(2014)

Reports of the Instituto de Fisiografía y Geología

Volume 1
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Rosario, Septiembre 2014

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Publicado en web: 14/09/2014

La fauna de amonites del intervalo Bayociano-Kimmeridgiano (Jurásico Medio-Superior) de la Formación Dalichai en el sudeste de la Cordillera Binalud, Irán.

Resumen: La Cordillera Binalud en el al noroeste de Irán es considerada la extensión oriental de la Cordillera Alborz. La sucesión jurásica y la fauna de amonites de tres secciones seleccionadas (Dahaneh-Heydari, Bojnow and Baghi) de la Formación Dalichai fueron muestreadas capa por capa con fines sedimentológicos y paleontológicos. La fauna de amonites es abundante y representa el intervalo Bayociano Superior-Oxfordiano Superior en la sección Baghi, pero solamente Oxfordiano Superior-Kimmeridgiano Inferior en las secciones Dahaneh-Heydari y Bojnow.

Palabras clave: Cordillera Binalud, Formación Dalichai, Bayociano-Kimmeridgiano, Baghi, Dahaneh-Heydari,. Bojnow.

The Bajocian-Kimmeridgian ammonite fauna of the Dalichai Formation in the SE Binalud Mountains, Iran.

Abstract: The Binalud Mountains in NE Iran are considered the eastern extension of the Alborz Ranges. The Jurassic successions and ammonite fauna of three selected sections (Dahaneh-Heydari, Bojnow and Baghi) have been studied by means of a detailed survey consisting of sedimentological and palaeontological bed-by-bed sampling of the Dalichai Formation. The ammonite fauna is abundant and ranges in age from the Upper Bajocian to the Upper Oxfordian in the Baghi section, but only Upper Oxfordian to Lower Kimmeridgian in the Dahaneh-Heydari and Bojnow sections.

Key-words: Binalud Mountains, Dalichai Formation, Bajocian-Kimmeridgian, Baghi, Dahaneh-Heydari,. Bojnow.

INTRODUCTION

The Binalud Mountains in northeast Iran, about 400 km length, are the eastern extension of the Alborz Ranges, ranging from the city of Jajarm in North Khorasan to Mashhad. They are often considered lithologically intermediate between Alborz Mountains to the west and Koppeh Dagh Mountains in the north (Fig. 1).

The deposits of the Jurassic System in north and northeast Iran (Alborz, Binalud and Koppeh Dagh Mountains) are usually classified by a three-fold subdivision: Shemshak, Dalichai and Lar formations in the Alborz Mountains and respectively Kashafrud, Chaman Bid and Mozduran formations in the Koppeh Dagh Mountains (Seyed-Emami & Schairer 2010, Seyed-Emami et al 2011; see Fig. 2). For the Binalud Mountains, both nomenclatures have been applied in the literature. Herein, we adopt the subdivision of the Alborz Mountains.

The Jurassic successions and ammonite faunas of the eastern Alborz and Binalud Mountains have been studied by Seyed-Emami et al. (1994, 1998, 2011a, b, 2013), Schairer et al. (1991, 1999), Majidifard (2003, 2008), Taheri et al. (2006, 2009), Wilmsen et al. (2009), Raoufian et al. (2011, 2014), Aghaei et al. (2012), and also unpublished M.Sc. thesis (Mahdifar 2000, Raoufian 2008).

The abundance of ammonites is one of the most important features of the Dalichai Fm in the Binalud Mountains. Studies of the Jurassic ammonite faunas of the Alborz and Binalud Mountains by Seyed-Emami et al. (2008, 2013), Raoufian et al. (2008, 2011, 2014) show close similarities with those of the Submediterranean Province, especially the Northeast Paleo-Tethys Ocean. These faunal similarities reflect good communication between these regions and other parts of the Paleo-Tethys during the Jurassic.

GEOLOGICAL SETTING

The Iranian Plate, composed of the central-east Iranian microcontinent, the Alborz Mountains and northwestern Iran, detached from the northwestern margin of Gondwana during the Early Permian (Stampfli & Borel 2002) and collided with Eurasia (Turan Plate) producing the Cimmerian Mountains chain (Sengör 1990). In Iran, this suture is believed to lie between the Alborz, Koppeh Dagh and Binalud Mountains (Alavi 1992, Alavi *et al.* 1997, Zanchi *et al*. 2006, Ramezani Oomali *et al*. 2008) as shown in Fig. 3. The timing of this orogenic event is still under debate (e.g. Seyed-Emami 2003, Golonka 2004) but probably occurred during the Late Triassic (Fürsich *et al*. 2009a). While drifting northwards during the Triassic, the Iran plate was covered by extensive carbonate platforms (Shotori and Elika formations). After this collision and forming the Cimmerian Mountains, the existing carbonate system was replaced by a southward facing, Norian to Aalenian, terrestrial-facies foreland basin in central Iran (the Shemshak Group; Davoudzadeh and Schmidt 1983, Wilmsen *et al*. 2009a, b). After the Bajocian Mid-Cimmerian tectonic movements, the silisiclastic regime was replaced by a carbonate system (Dalichai Fm) that covered large parts of the Iranian Plate until the end of the Jurassic (Fürsich et al. 2009a).

The growing deposition of carbonates was also facilitated by southward migration of the Iranian plate, which had occupied a

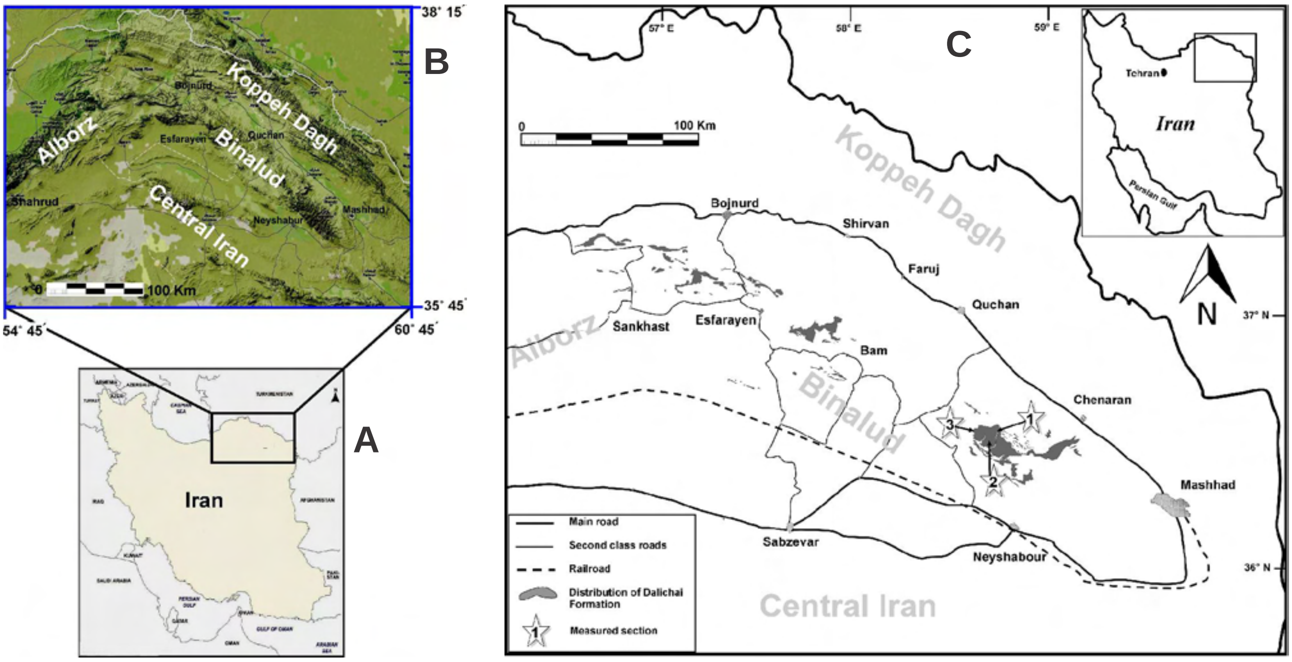
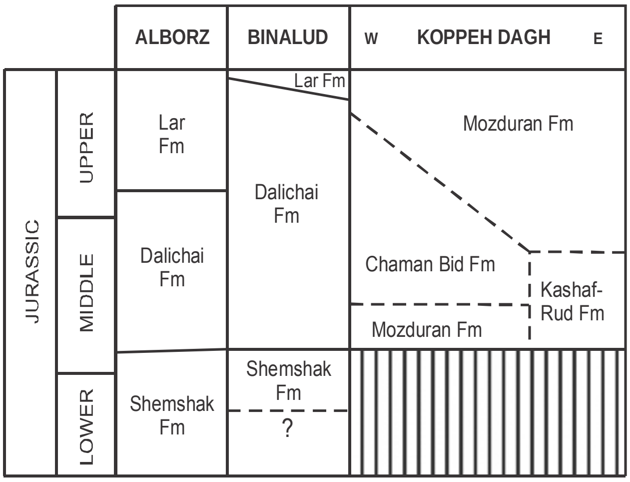


Figure 1. **A**: Location of the study area. **B**: Aerial view of the study area with indication of the main ranges. **C**: Detailed map of the study area with indication of the location of the studied sections of the Binalud Range: Baghi (1), Bojnow (2) and Dahaneh-Heydari (3).



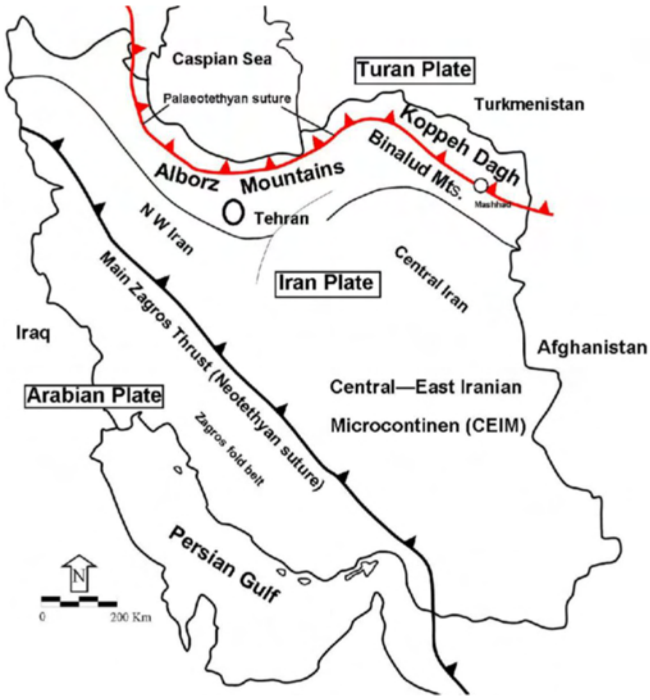


Figure 2. Jurassic lithostratigraphy of the Alborz Mountains, the Binalud Mountains and the Koppeh-Dagh basin. Based on Seyed-Emami et al (2011) and the present report.

Figure 3. Structural and geographic framework of Iran and emplacement of the Binalud Mountains. The suture between Iran and Turan plates indicated by the red line. Modified from Wilmsen et. al. (2009b).

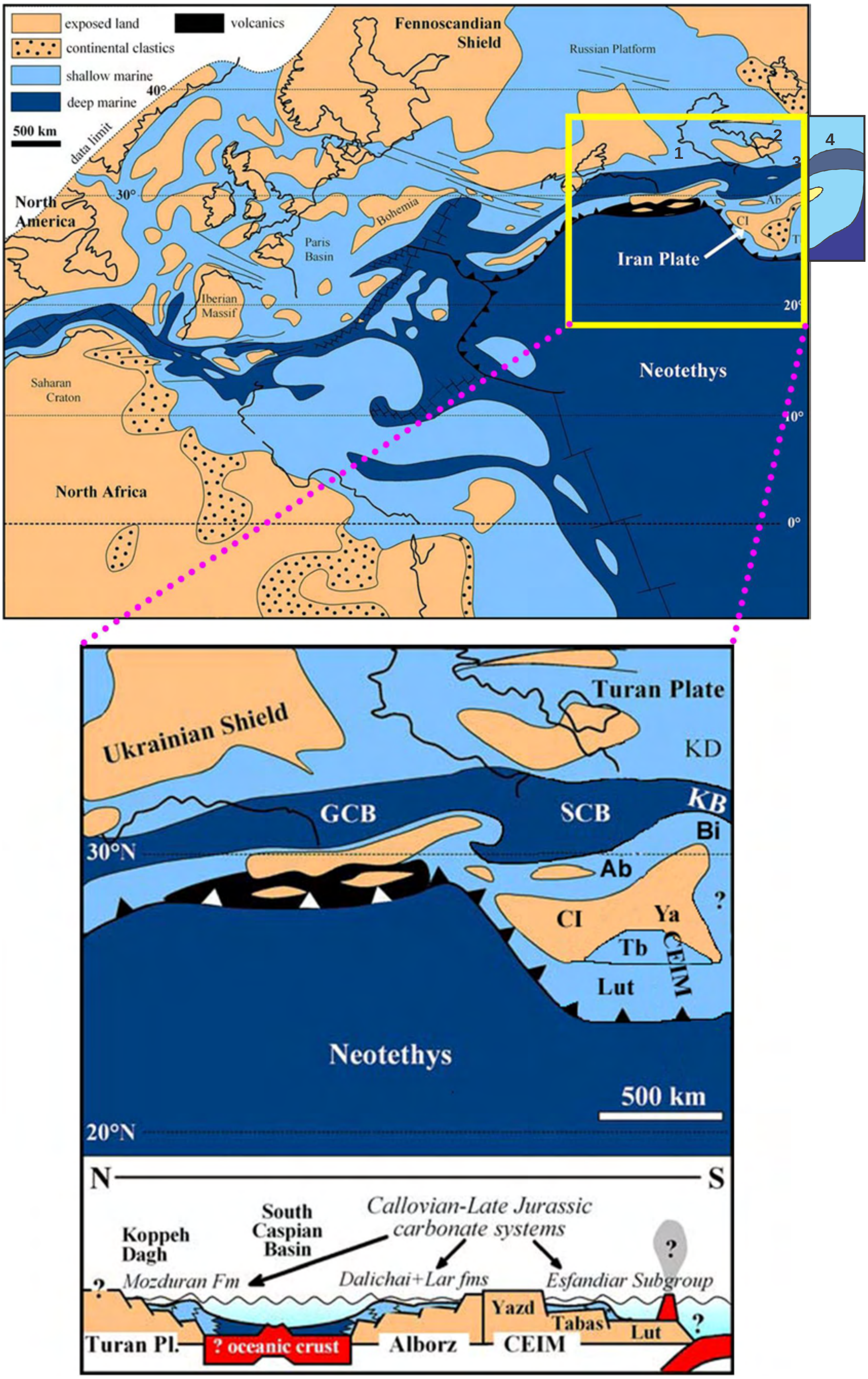


Figure 4. Palaeogeographic and tectonic setting of the Callovian-Late Jurassic carbonate systems of northern Iran .Tb: Tabas Block, Ya: Yazd Block, Ab: Alborz Mountains, Bi: Binalud Mountains, CI: Central Iran, GCB: Greater Caucasus Basin, KB: Kashafrud Basin, KD: Kopet Dagh, SCB: South Caspian Basin. Lut: Lut Block, CEIM: Central-East Iranian Microcontinent. Modified from Thierry (2000) and Wilmsen et al. (2009 a, b). Additional localities in the Russian platform for comparison are: North Caucasus (1), Great Balkhan and Tuarkyr (2), Kopet-DAgh (3), and Hissar Ridge (4) after Besnosov & Mitta (1993, 1998, 2000).

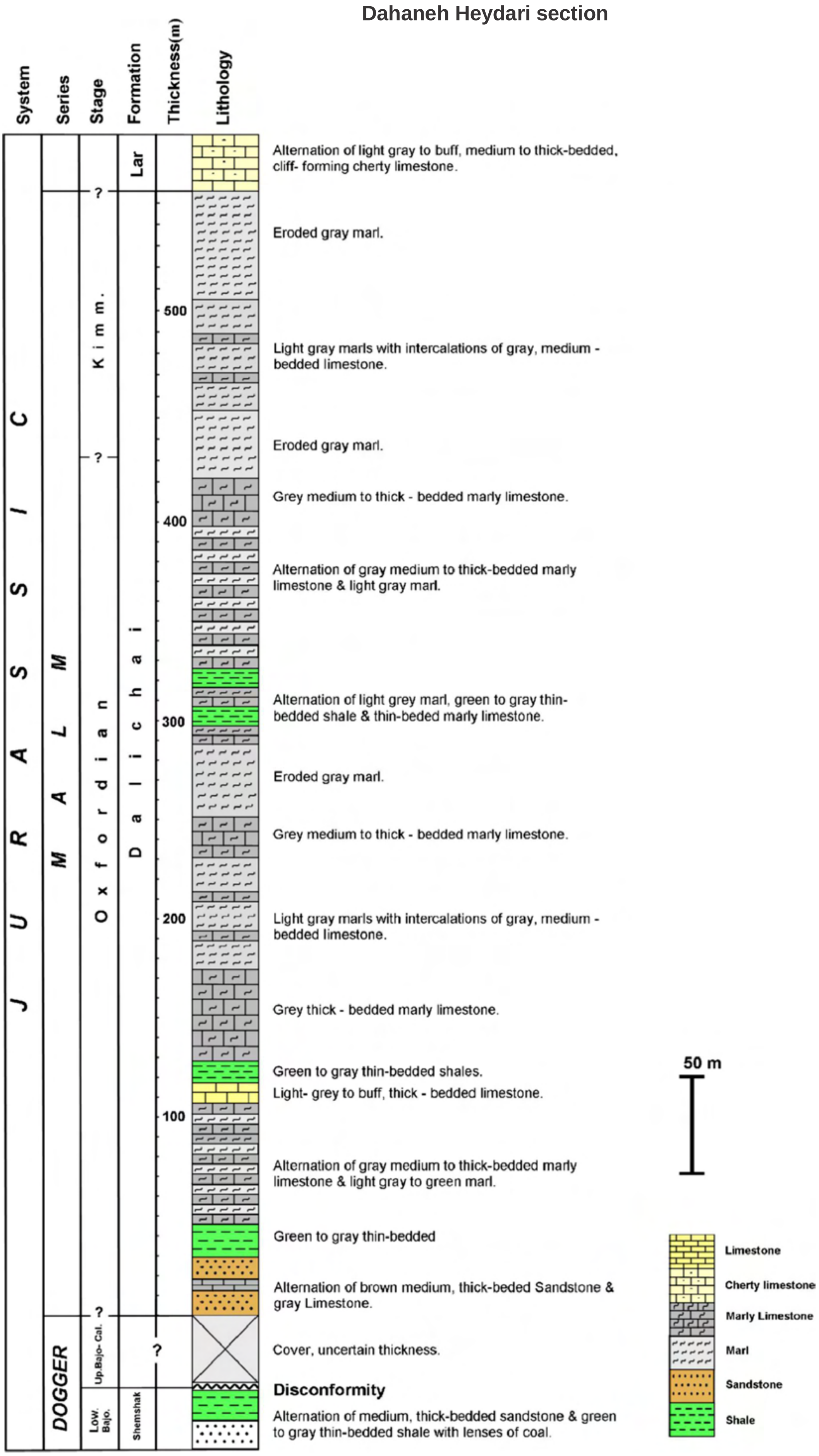


Figure 5. Log of the Dahaneh Heydari section.

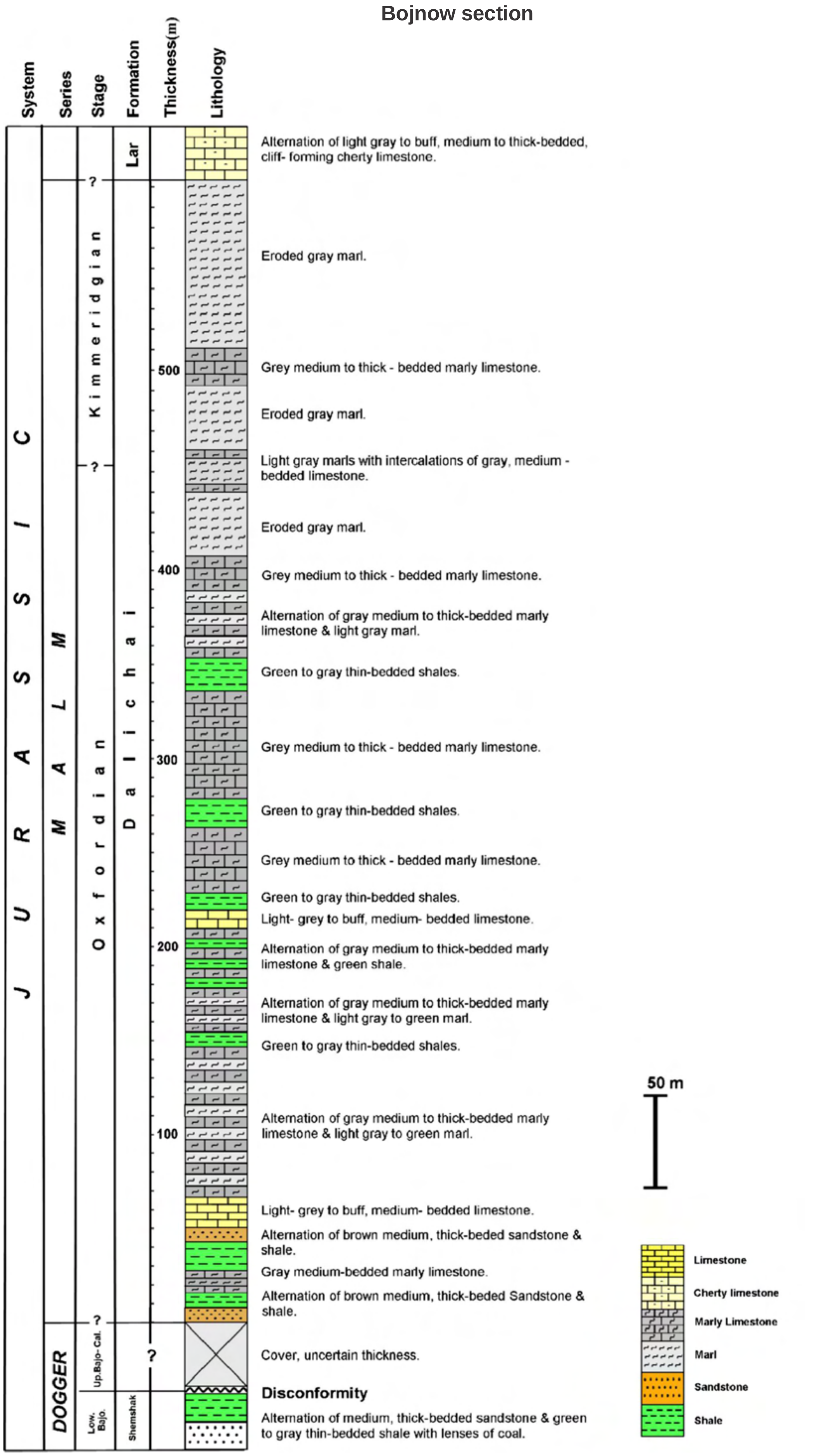


Figure 6. Log of the Bojnow section.

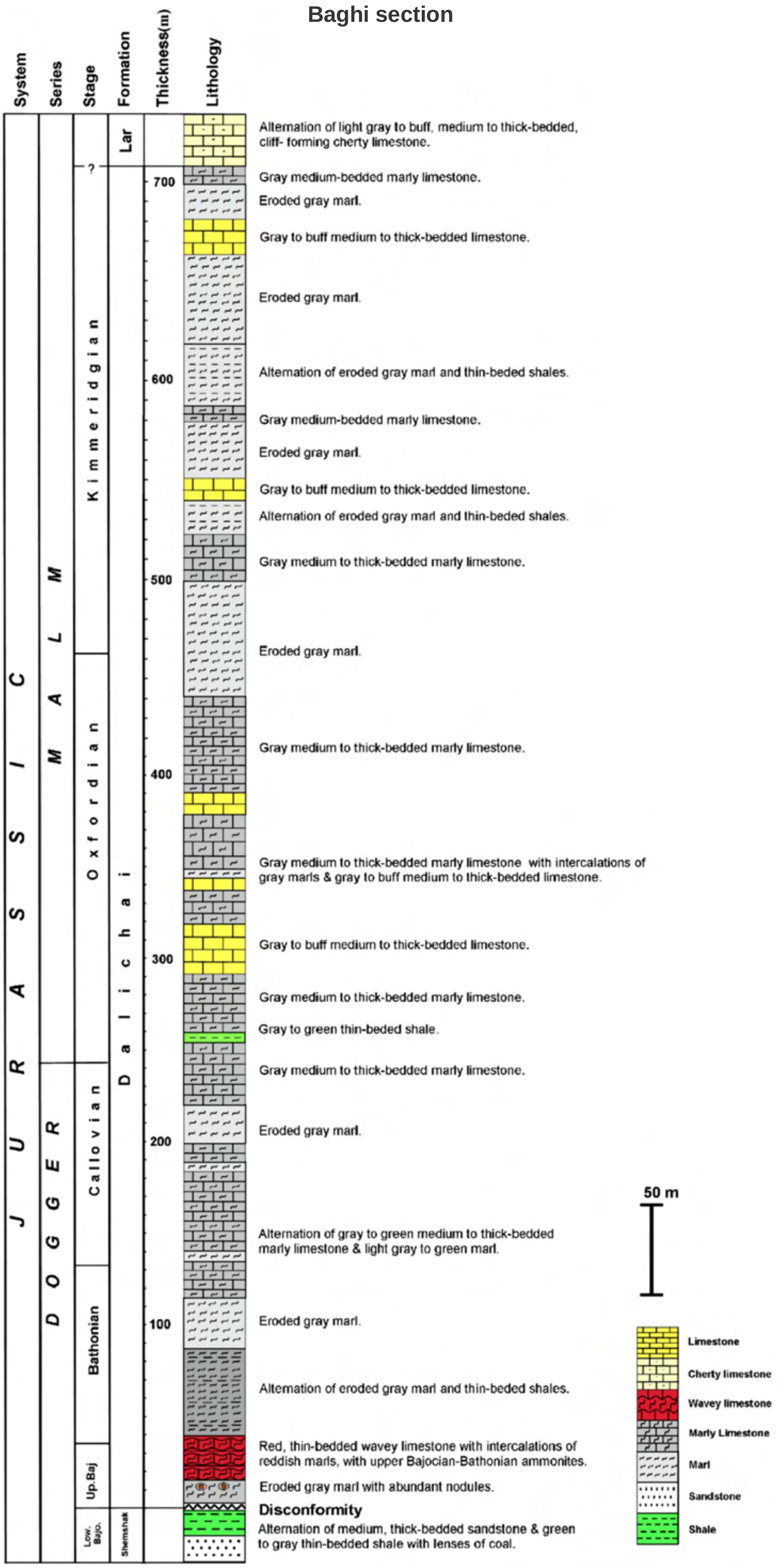


Figure 7. Log of the Baghi section.

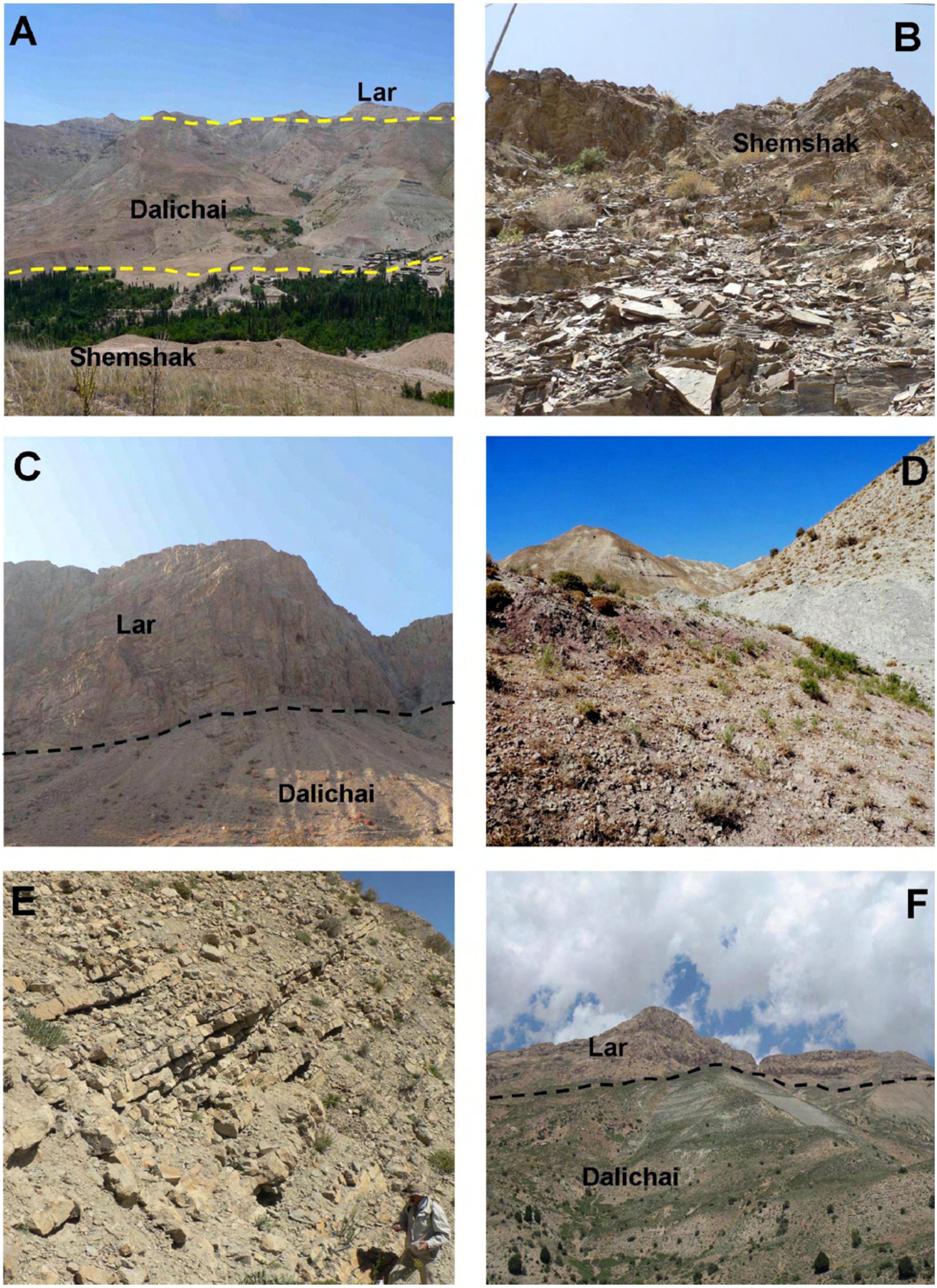


Figure 8. Field aspects of the Dalichai Formation in the east of the Binalud range zone. **A**: Position of Dalichai Formation between Shemshak (below) and Lar (above) formations in the Baghi section. **B**: Alternation of sandstones and dark shales (Shemshak Formation) below the Dalichai (Baghi section). **C**: Buff limstones of the Lar Formation above of the Dalichai Formation in Dahaneh Heydari. **D**: Red condensed bed at Baghi section. **E**: Bluish-grey marls with intercalated limestone beds (Baghi section). **F**: Marls of the upper part of the Dalichai Formation in the Bojnow section.

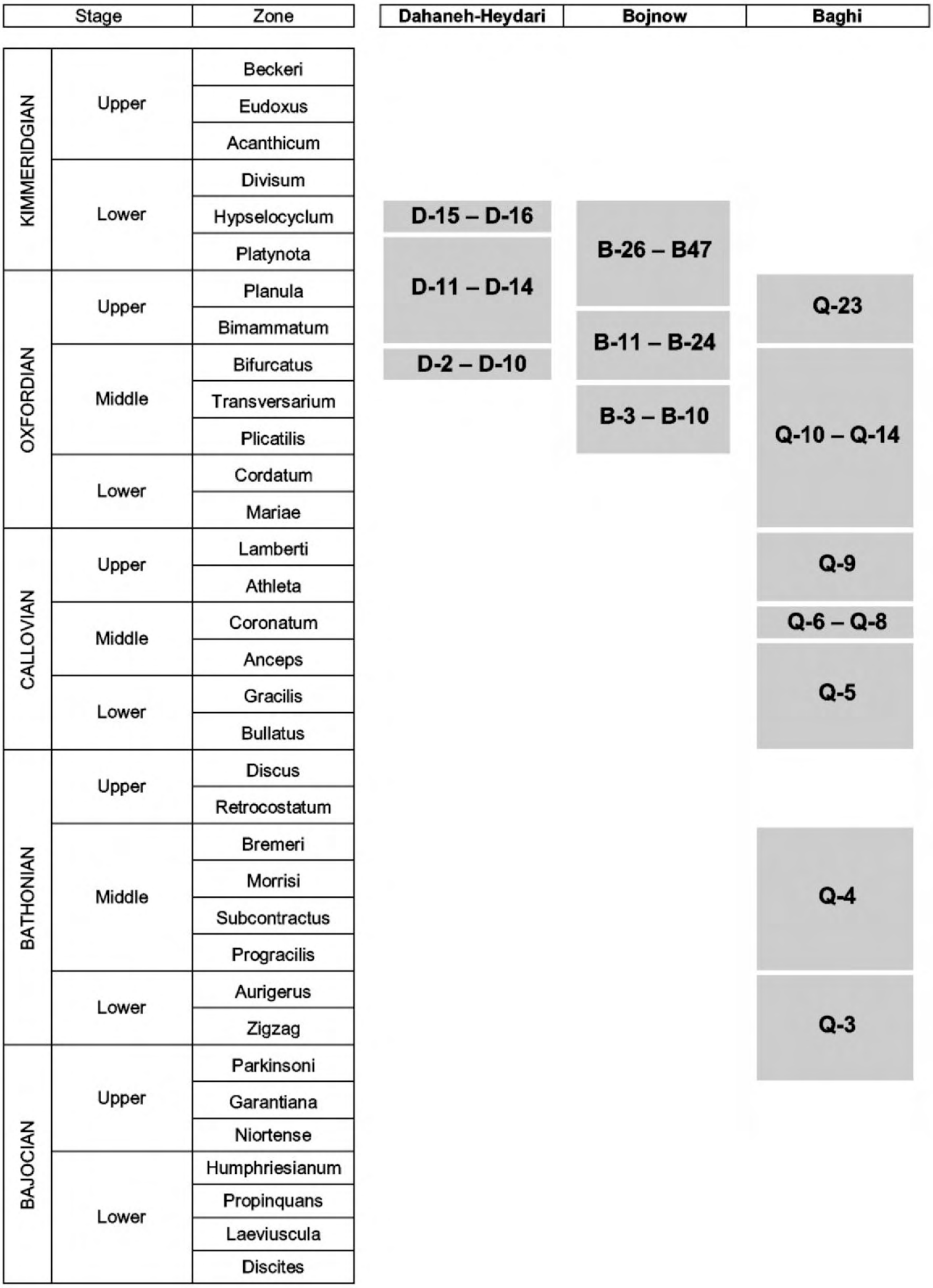


Figure 9. Time-correlation chart of the studied sections based on biostratigraphy of the succession of ammonite assemblages. Stratigraphic levels indicated in Figs 3-5. Primary Standard Chronostratigraphic zonation based on Cariou & Hantzpergue (1997).

fairly high latitudinal position of approximately 44°N during the Early Jurassic (Dercourt et al. 2000), to a lower latitude of about 20-30°N during the Middle Callovian (Thierry 2000, Seyed-Emami *et al*. 2008, Wilmsen et al. 2010), see Fig. 4. Thus, architecture, facies and thickness of widespread Late Jurassic deposits in northern Iran reflect continued tectonic instability within a low-latitude back-arc setting on continental crust (Aghaei *et al*. 2012).

Lithostratigraphy

The Middle-Late Jurassic Dalichai Fm has great thickness in the Binalud Mountains. The present study is based on three sections: (1) Dahaneh-Heydari (thickness 544 m, see Fig. 5) north of the village Dahaneh Heydari in Dahaneh Heydari wildlife refuge, about 65 km NW of Neyshabour (Fig. 1; 36°35'52″N, 58°36'35″E), (2) Bojnow (thickness 592 m, see Fig. 6) north of the village Bojnow, about 55 km NW of Neyshabour (Fig. 1; 36°32'38″N, 58°40'07″E), and (3) Baghi (thickness 706 m; see Fig. 7), about 60 km NW of Neyshabour (Fig. 1), north of the village Baghi (36°35'37"N, 58°42'1"E).

In the studied sections the Dalichai Fm consists largely of an alternation of marls, marly limestones and limestones and follows, after a discontinuity, on the dark, siliciclastic and coal bearing Shemshak Fm (Fig. 8B) and is overlain gradationally by the light and cliff-forming carbonates of the Lar Formation (fig. 8C).

The Baghi section is the most complete. There, the Dalichai Fm ranges the interval Upper Bajocian-Upper Oxfordian. The Dahaneh Heydari and Bojnow sections are less complete, with lower parts of the Dalichai Fm not exposed, by which the exposures show Oxfordian rocks upwards. In the Baghi section the lower part of the Dalichai Fm consists of several meters of grayish green and very soft marls. Abundant nodules with fragmentary ammonites occur in these marls. Over the marls there are few meters of red nodular limestones and marls (Fig. 8D) in "Ammonitico Rosso facies" yielding an abundant ammonite fauna Late Bajocian to Bathonian in age. This red bed is one of the most conspicuous features of the Dalichai Fm in the Binalud and eastern Alborz Mountains (Seyed–Emami et al., 2013). It represents condensed horizons with red nodular limestones and marls, and occurs in different stratigraphic levels embodying different time spans (Late Bajocian, Bathonian, Callovian). This lithology is also 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). These are followed by several meters of bluish-grey marls with intercalated limestone beds (fig. 8E). The upper part of the Dalichai Fm consists largely of an alternation of grayish limestones and marls (Fig. 8F).

SYSTEMATIC PALAEONTOLOGY

The material described is housed at the Ferdowsi University of Mashhad, Mashhad, Iran. Bodychamber is abbreviated with Bc and phragmocone with Ph; macroconch (female): [M], microconch (male): [m]; HT: holotype, LT: lectotype. Measurements are indicated as follows: diameter (D), diameter at the last adult septum (D_{ls}), final adult diameter at peristome (D_p), umbilical width (U), whorl width (W), whorl height (H_1), and whorl ventral (or apertural) height (H_2), all given in millimetres [mm]; approximated or estimated values marked with (^{e}); length of body chamber (L_{Bc}) in degrees [°]. Number of primary (P) and ventral (V) ribs and periumbilical (T_U), lateral (T_L) and ventro-lateral (T_V) tubercles per half whorl. The terms involute and evolute are mainly used to refer the degree of whorls overlapping as could be measured by H_2/H_1; the relative umbilical width (U/D) does not clearly reflect the degree of involution in some ammonite-morphotypes.

The specimens all throughout the plates are figured in different scales; the real sizes and dimensions of each specimen are given in the Appendix "Plates captures" after the plates.

Order Ammonitida Fischer, 1882
Suborder Lytoceratina Hyatt, 1889
Superfamily Lytoceratoidea Neumayr, 1875
Family Lytoceratidae Neumayr, 1875
Subfamily Nannolytoceratinae Spath, 1927
Genus *Nannolytoceras* Buckman, 1905
Type species: *Ammonites pygmaeus* D'Orbigny, 1846 by OD

***Nannolytoceras pygmaeum* (d'Orbigny, 1846)**
Pl. 1: 1

Material: One specimen from Baghi.
Description: Phragmocone, many-whorled, very evolute with rounded whorl section. Smooth with well spaced, slightly sigmoidal, deep and wide constrictions.
Remarks and comparison: Very similar to the specimen figured by Arkell (1957: fig. 228: 2) and to that by Sturani (1966: pl. 3: 8) as *Nannolytoceras* sp. from the Middle Bathonian, Progracilis Zone of Bas Auran, SE France.
Occurrence: Baghi section, level Q-4, few meters above the Q-3 which yields *Morphoceras multiforme* indicating the Zigzag Z. of the Lower Bathonian. The present specimen could be somewhat younger but most likely still Bathonian.

Suborder Ammonitina Fischer, 1882
Superfamily Haploceratoidea Zittel, 1884
Family Lissoceratidae Douvillé, 1885
Genus *Lissoceras* Bayle, 1879
Type species: *Ammonites psilodiscus* Schloenbach, 1865

***Lissoceras ferrifex* (Zittel, 1868)**
Pl. 1: 3

Material: One specimen from Baghi.
Description: Specimen wholly septated. Smooth, compressed evolute platycone with wide umbilicus and suboval, higher than wide whorl section with narrowly rounded venter; the flanks are curved; the umbilical shoulder is sharp on the inner whorls and rounded in the outermost one.
Remarks and comparison: The present specimen is identical to that figured by Dietze & Dietl (2006: Pl. 1: 3) from the Upper Bajocian Parkinsoni Z.

The specimens assigned to different species of *Lissoceras* seem to show a pattern of covariation defined by specimens with inflate and rounded shells towards compressed specimens with narrower venter and acute umbilical shoulder. However, it is not possible to establish synonymies under this criterium for the genus is always scarce and has a very long stratigraphi range from the Bajocian up to at least the Tithonian, and usually assigned to different genera as the succession *Lissoceras-Lissoceratoides-Pseudolissoceras*.
Occurrence: Baghi section, level Q-3, Zigzag Z., Lower Bathonian.

***Lissoceras erato* (d'Orbigny, 1840)**
Pl. 1: 4

Material: One specimen from Dahaneh Heydari.
Description: Smooth, compressed and moderately evolute platyconic shell. Whorl section suboval, higher than wide with rounded venter and flattish flanks; sharp umbilical shoulder and steep umbilical wall. The last part of the last whorl belongs to

the bodychamber which is clearly uncoiled indicating the adult stage.
Remarks and comparison: The lectotype (Fischer et al. 1994: pl. 74: 2) as well other specimens in the literature (e.g., Branger et al. 1995: pl. 10: 4) of the Middle Oxfordian Transversarium Z., are similar but show a rounded umbilical shoulder.
Occurrence: Dahaneh Heydari section, level D-7.

Family Oppeliidae Douvillé, 1890
Subfamily Oppeliinae Douvillé, 1890
Genus *Oecotraustes* Waagen, 1869
Type species: *Oecotraustes genicularis* Waagen, 1869; SD Munier-Chalmas, 1892 (ICZN Opinion 324).

***Oecotraustes genicularis* Waagen, 1869**
Pl. 2: 6

Material: One specimen, well preserved, from Baghi.
Description: Phragmocone, moderately involute platycone. Whorl section suboval with inclined flanks and rounded venter. Ribbing confined to the uppermost part of the flank, consisting of densely spaced, rursiradiate ribs which reach the venter and die out against a feeble keel.
Remarks and comparison: The present specimen perfectly matchs the type specimen figured by Arkell et al. (1957: fig. 320, 2) from the Bajocian. Very similar to *Oecotraustes maubeugei* Stephanov, 1966 as figured by Dietl (1981: pl. 1: 1) from the Aspidoides-Oolith, Upper Bathonian, Zollernalb.
Occurrence: Baghi section, level Q-3, Lower Bathonian, Zigzag Z.

Genus *Oxycerites* Rollier, 1909
Type species: *Ammonites aspisoides* Oppel, 1862

***Oxycerites* cf. *aspisoides* (Oppel, 1857)**
Pl. 1: 6

Material: A poorly preserved phragmocone specimen from Baghi.
Remarks and comparison: Compressed and very involute oxycone; smooth with a rather undifferentiated mid-ventral keel.
Although the present specimen is poorly preserved there are some parts of the last whorl which show it is smooth. In *O. aspisoides* and related species the phragmocone at sizes comparable to that of our specimen is commonly smooth or very weakly ribbed (*e.g.* Dietl 1982, Elmi & Mangold 1966).
Occurrence: Baghi section, level Q3, Zigzag Z., Lower Bathonian.

***Oxycerites* sp. A**
Pl. 2: 1

Material: A single specimen from Baghi.
Description: Compressed oxycone with small umblicus. Whorl section compressed lanceolate. The lower half of the flank with weak prosocline ribs interrupted by a well marked, mid-flank spiral groove. Above groove the primaries become strongly concave and bi- or trifurcate. Secondary ribs fade-off abruptly by the formation of a strong ventral keel.
Occurrence: Baghi section, level Q5, Lower Callovian.

Subfamily Hecticoceratinae Spath, 1925
Genus *Hecticoceras* Bonarelli, 1893
Type species: *Nautilus hecticus* Reinecke, 1818 by OD.

***Hecticoceras metomphalum* Bonarelli, 1893**
Pl. 2: 2-3

Material: two specimens from Baghi.
Description and remarks: Phragmocones (D = 26 and 45 mm). Evolute platycones widely umbilicate. Whorl section suboval higher than wide with moderately rounded venter, flattish flanks and subvertical umbilical wall. The lower part of the flanks is smooth. Below the middle of the flanks there is a row of prosocline bullae from which develop one or three concave ribs; these ribs with some intercalatory form a regular ribbing on the upper flank, extended on the venter and fading out against a poorly differentiated mid-ventral keel.
Similar specimens have been described by Seyed-Emami et al. (2012: fig. 5f) from Kuhe-Tapal and Majidifard (2003: pl. 4: 1, 4) from the Golbini-Jorbat and Tooy-Takhehbashgheh sections (E Iran). From the Fraizi section Seyed-Emami & Schairer (2011: fig. 3A) recorded the species associated with *Collotia* sp. suggesting the interval upper Gracilis-Athleta zones (Cariou 1984: fig. 232). The associated specimen of *Collotia* sp. is only a fragment (Seyed-Emami & Schairer 2011: fig. 3G) but shows a portion of phragmocone which is characteristic of the representatives of the Gracilis-Anceps zones, at this size with a short primary which arises and trifurcate on the lower flank, e.g. *C. oxyptycha* (Neumayr) or *C. gigantea* (Bourquin) figured by Cariou (1984: pls. 44-50).
Occurrence: Baghi section, level Q5. This species is said to range from the Anceps to the Lamberti zones (Zeiss 1956).

***Hecticoceras lunuloides* (Kilian, 1887)**
Pl. 2: 5

Material: one specimen from Baghi.
Description: Moderately involute oxycone. Whorl section suboval, compressed higher than wide with flat flanks and single-keeled venter. Lower half of flanks smooth or with very weak primary ribs. From mid-flank develop strong ribs which swell on the uppermost flank and fade out just before contact with the keel.
Remarks: The specimen figured by Quenstedt (1849: pl. 8: 3) is the holotype. Species name *compressum* is preoccupied by which may be replaced by next younger synonym, which should be *Harpoceras lunuloides* Kilian, 1887. At present this taxon may be called *Lunuloceras lunuloides* (Kilian, 1887). No complete specimens have ever been illustrated, because the specimens are nuclei from claystones. Most likely this taxon comes form the Middle Callovian, Jason Zone (G. Schweigert, pers. comm. 19/02/2014). The present specimen can be attributed in morphologic terms although the biological significance and thus the age is not possible to be asserted.
Occurrence: Baghi section level Q-9, probably lower Upper Callovian.

Genus *Paroxycerites* Breistrofer, 1947
Type species: *Ammonites subdiscus* d'Orbigny, 1842.

***Paroxycerites*? sp. A**
Pl. 2: 4

Material: A single specimen from Baghi.
Description: A juvenil phragmocone (D = 63 mm), involute, oxyconic, very narrowly umbilicate. Whorl section lanceolate, much higher than wide, flanks high and gently curved, converging into a very narrow venter with a well marked keel. Ribbing composed by weak falcoid primary ribs bi- or trifurcate on the upper half of the flank. Secondary ribs end slightly swollen besides the keel.
Remarks: The specimen is almost identical but more involute than that figured by Majidifard (2003: pl. 2: 13) as *Eochetoceras* sp. from the Golbini-Jorbat section and assigned to the lower Oxfordian.

Occurrence: Baghi section, level Q-9. The genus is poorly known by sparsed records in the Upper Bathonian (Enay et al. 1994) and the lower Upper Callovian (Parent 2006).

Genus *Ochetoceras* Haug, 1885

Type species: *Ammonites canaliculatus* von Buch, 1832 by SD Munier-Chalmas, 1892.

***Ochetoceras* cf. *canaliculatum* (Buch, 1832)**

Pl. 3: 1

Material: One specimen from Baghi section.
Description: Inflate oxcycone with moderately narrow umbilicus. Whorl section subtriangular with high, genly convex flanks which converge on a narrow venter. The lower half of flanks are covered by feeble prosocline primary ribs which, on the upper half of the flank divide indistinctly in two or three rursiradiate secondaries producing a flacoid ribbing.
Remarks: The specimen is a macroconch, adult considering the uncoiling observed in the beginning of the bodychamber and the fading of the sculpture. It is almost identical to the specimen figured by Jeannet (1951: pl. 20: 3) from the lower Plicatilis Z. of Herznach, Switzerland.
Occurrence: Baghi section level Q-10, upper Cordatum to lower Plicatilis Z.

***Ochetoceras* cf. *basseae* Fradin, 1947**

Pl. 3: 2

Material: A single specimen from Baghi.
Description: Inflate oxycone with moderately narrow umbilicus. Whorl section subtriangular with high, genly convex flanks which converge on a narrow, keeled venter. Sculpture definitely falcoid consisting of densely arranged prosocline primary ribs which, on a mid-flank groove bifurcate on generally two rursiradiate secondaries. About half whorl of bodychamber is preserved. It is smooth and more inflate, slightly uncoiled.
Remarks: The specimen is an adult macroconch, similar with the holotype (Fradin 1947: pl. 13: 1) but with finer and more closely spaced primaries. The sculpture strongly suggests the present specimen belongs to an intermediate form between *O*. cf. *canaliculatum* (above) and *O. basseae*. The species occurs typically in the Bifurcatus Z. (Cariou 1966: 50).
Occurrence: Baghi section level Q-11, likely Plicatilis to Transversarium zones.

Taramelliceratinae Spath, 1928

Genus *Taramelliceras* Del Campana, 1904

Type species: *Ammonites trachynotus* Oppel, 1863, SD Arkell (1957)

***Taramelliceras* cf. *broilii* (Wegele, 1929)**

Pl. 3: 3, 5

Material: Two phragmocones from Bojnow.
Description: Compressed and involute, high whorled with narrow venter, although crushed. Ribbing falcate. Primary ribs born on the umbilical shoulder projected forward and curved barckwards becoming somewhat weaker and forming a ventro-lateral tubercle. On the point of inflection, on the lower half of the flank, some primaries bifurcate irregularly and one or two intercalatory ribs run parallel to the secondaries. Lateral ribbing on the upper half of the flank is rather evenly spaced and reach the ventro-lateral shoulder intercalated within the tubercles.
Remarks: The shell-shape and the sculpture compare closely with the specimen from the Hauffianum Subz. of Mühlheim/Donau (Germany) figured by Schweigert & Callomon (1997: pl. 3: 9). Both specimens are comparable with the specimen figured by Dabbaghi-Sadr et al. (2011: pl. 2: 3) from NW Neyshabour (W Binalud Range).
Occurrence: Bojnow section levels B-10 (Late Oxfordian, probably Bimammatum Z.) and B-47 (?Planula Z.).

Subfamily Streblitinae Spath, 1925

***Genus Streblites* Hyatt, 1900**

Type species: *Ammonites tenuilobatus* Oppel, 1862 by OD

***Streblites* cf. *kobyi* (Choffat, 1893)**

Pl. 3: 4

Material and remarks: Compressed, involute oxyconic and feebly ribbed specimen from Bojnow section level B-20. Primaries are falcoid with the inflection at mid-flank and a delicate radial bulla on the uppermost flank or ventro-lateral shoulder. From the mid-flank occur five to six fine, indistinct secondaries and intercalatories which reach the narrow venter.

The specimen is comparable to the lectotype of *S. kobyi* (Choffat, 1893: pl. 16: 3), although our specimen is more widely umbilicate. It is also similar to the specimen of the Bimammatum Z. of Germany figured by Schweigert & Callomon (1997: pl. 3: 2) but our specimen has more marked primaries.

Superfamily Perisphinctoidea Steinmann, 1890

Family Reineckeiidae Hyatt, 1900

Subfamily Reineckeiinae Hyatt, 1900

Genus *Reineckeia* Bayle, 1878

Type species: *Nautilus anceps* Reinecke, 1818 by OD.

***Reineckeia anceps* (Reinecke, 1818)**

Pl. 4: 4-5

Material: Two specimens from Baghi.
Remarks: The material is typical of the species (see Cariou 1984).
Occurrence: Baghi section level Q-6, Middle Callovian, probably Anceps Zone.

Genus *Alborzites* Schairer, Seyed-Emami & Zeiss, 1991

Type species: *Alborzites semnanensis* Schairer, Seyed-Emami & Zeiss, 1991; by OD.

Diagnosis: *Alborzites* is distinguished from other reineckeiids by the occurrence of polygyrate ribs and by secondaries which are markedly prorsiradiate (proverse) towards the venter (Schairer et al. 1991: 57); later expanded on the basis of more abundant material by Seyed-Emami et al. (2012: 55).

***Alborzites binaludensis* Seyed-Emami, 2012**

Pls. 5: 3-4, 6: 3, 8: 4, 20: 3

Material: Several more or less well preserved specimens from Baghi.
Occurrence: Baghi section, levels Q6-Q10, Coronatum to Athleta zones. The species is abundant in the upper Middle Callovian of the Binalud Range. The holotype comes from the Baghi section as also the bulk of our material.

***Alborzites*? *besnosovi* (Mitta, 2000)**

Pl. 10: 3

*	2000	*Loczyceras besnosovi* sp. nov. – Mitta: 72, pl. 27: 1 (HT), 2-4
	2003	cf. *Reineckeia* sp. – Majidifard: 122, pl. 9: 6, pl. 10: 1
?	2003	cf. *Reineckeia* sp. – Majidifard: 122, pl. 10: 2

Material: a single specimen from Baghi section.

Description: Stout, involute with strong, irregular ribbing on the bodychamber.
Remarks: The type material from the Great Balkan (Mitta 2000: fig. 1; see Fig. 7) comes from beds attributed to the Coronatum Zone of the Middle Callovian. The present specimen from the Baghi section (level Q14) seems to be Oxfordian, although could be late Callovian. The specimens figured by Majidifard (2003) come from the Golbini-Jorbat section and have been attributed to the Lower Callovian. Our specimens closely resemble the holotype, whereas the Lower Callovian specimens from the Golbini-Jorbat section differ by the presence of tubercles in some specimens. In this sense the record of *Alborzites*? *besnosovi* would cover the Callovian and Oxfordian, and likely, accounting the small differences and different stratigraphic position, the Golbini-Jorbat material could belong to a different chronospecies.
Occurrence: Baghi section, level Q-14.

Family Morphoceratidae Hyatt, 1900
Genus *Morphoceras* H. Douvillé, 1880
Type species: *Ammonites polymorphus* d'Orbigny, 1846
(non Quenstedt, 1845 = *Morphoceras multiforme* Arkell, 1951)
(Synonym: *Ebrayiceras* Buckman, 1920; Type species: *Ebrayiceras ocellatum* Buckman, 1920)

***Morphoceras multiforme* Arkell, 1951**
Pls. 3: 7, 4: 1

Material: Two phragmocones from Baghi
Description: Globular, very depressed and moderately involute. Whorl section very depressed with low flanks and widely rounded convex venter. Umbilical wall steep and high. Ribbing dense and stronly constricted. Two or three primaries, joined on the umbilical shoulder, run the flanks directed forwardly, some bi- or trifurcate. On the inner whorls (D < 30 mm) the ventral ribbing cross the venter unchanged and evenly spaced; on outer whorls (D > 40 mm) the secondary ribs are interrupted in the venter by a smooth band.
Remarks: The material from Baghi is more globular and depressed than typical material (cf. Mangold 1970), but the distinctive sculpture leaves no doubts about the identification. The specimens figured by Westermann (1958: pl. 31: 1-2) from NW Deutschland are morphologically indistinguishable but at the half of the size of our specimens. It could be interepreted that the local populations of the species developed in the form of a globular morphotype, just as ecophenotypic, intraspecific variation. Nevertheless, there must be considered the microconch described below which very likely is the dimorphic pair of the present macroconchs. This microconch has some distinctive differences respect to typical specimens from western Tethys. It shoud be very interesting to collect new and abundant material for a full characterization of the species.
Occurrence: Baghi section level Q-3 (condensed bed), lower Bathonian.

Genus *Ebrayiceras* Buckman, 1920
Type species: *Ebrayiceras ocellatum* Buckman, 1920 by OD

***Ebrayiceras* aff. *rursum* (Buckman, 1921)**
Pl. 4: 3

Material: A single, well preserved almost complete adult [m] from Baghi.
Description: Max preserved D = 24 mm preserving about half whorl of bodychamber. Very evolute and slender with subrectangular whorls, slightly higher than wide. Inner whorls with strong ribs, from a tubercle placed on the umbilical shoulder born three primary ribs which reach, undivided, the ventro-lateral shoulder. The ribs end on a stout ventral tubercle which merge three ribs aside a smooth mid-ventral band. On the bodychamber the two rows of tubercles vanish and the ribs reach the venter up to the smooth ventral band.
Remarks: The present specimen differs significantly from the species *E. rursum* in having ventral tubercles in the phragmocone. Closely comparable specimens have been figured by Mangold (1970: pl. 7: 22-25).
Occurrence: Baghi section level Q-3, lower Bathonian.

Family Perisphinctidae Steinmann, 1890

There is a group of perisphinctids, mainly from the Indo-Malgach domain, which needs to be grouped in a new subfamily including, at least, a well defined branch of the Perisphinctidae:

Sivajiceras Spath, 1928 [Upper Bathonian-Lower Callovian (Callomon 1993)]
Cutchisphinctes Spath, 1931 [Lower Callovian]
Obtusicostites Buckman, 1921
Hubertoceras Spath, 1930
Kinkeliniceras Buckman, 1921 [Upper Callovian].

These genera include the so-called *Proplanulites*-like ammonites, ranging from the Lower Callovian up to at least the Upper Callovian. Krishna & Ojha (1996: 151) proposed the name "Kinkeliniceratinae" as a new subfamily which could seem to include the mentioned genera. Unfortunately, it is an invalid taxon for it was defined with neither explicit indication of the type genus, nor description and scope of the taxon (ICZN Art. 16).

***Genus Kinkeliniceras* Buckman, 1921**
Type species: *Proplanulites kinkelini* Dacqué, 1910; by OD.

***Kinkeliniceras*? sp. A**
Pl. 7: 4

Material: A single well preserved phragmocone with half whorl of bodychamber from Baghi.
Description: Moderately involute and compressed. Whorls suboval, higher than wide. Ribbing strong and acute; primaries born on the umbilical shoulder and bifurcate on the upper third of the flanks. Secondaries remain strong and acute; there is about one intercalatory between each pair of secondary ribs. Ventral ribbing cross the venter unchanged and evenly spaced.
Remarks: The specimen is very similar to the specimens of *Kinkelini kinkelini* (Dacqué 1910: pls. 5: 1, 6: 1-4) but this species shows the primary ribs more strongly differentiated from the finer secondaries. The type specimens of *K. kinkelini* from West Africa are probably Late Callovian in age considering that they would come from the same type locality and horizon of *Peltoceras ngerengerianum* Dacqué, 1910. The first representatives of the genus *Peltoceras* in Europe occur invariably in the lower Upper Callovian Athleta Z. *P. ngerengerianum* is morphologically identical to, and seems to be conespecific with, *Peltoceras marysae* Bonnot et al., 2005 from the lower Athleta Zone of Maine-et-Loire, W France.
Occurrence: Baghi section level Q-7, Middle-?Upper Callovian.

Subfamily Leptosphinctinae Arkell, 1950
Genus *Cleitosphinctes* Arkell, 1953
Type species: *Leptosphinctes cleitus* Buckman, 1920

***Cleitosphinctes* cf. *cleitus* Buckman, 1920**
Pl. 4: 2

Material: A small phragmocone from Baghi.
Description: Very evolute and widely umbilicate serpenticone. Whorl section suboval slightly wider than high. Ribbing dense,

prosocline and very regular. Primary ribs born on the umbilical wall, densely spaced bifurcate on the uppermost part of the flanks producing weak secondaries which cross the venter with a trend to fade out.
Remarks: A small phragmocone is not enough for a definite classification at the species level but barely to the genus level. As a reference the present specimen can be compared with the specimens of *C. cleitus* from the Upper Bajocian of Germany figured by Dietl (1980: pl. 10: 8-9).
Occurrence: Baghi section level Q-3, Upper Bajocian-Lower Bathonian.

Subfamily Pseudoperisphinctinae Schindewolf, 1925
Genus *Grossouvria* Siemiradzki, 1898
Type species: *Perisphinctes subtilis* Neumayr, 1870; SD Buckman 1920
[= *Ammonites sulciferus* Oppel, 1857 obj.; *Perisphinctes artisulcus* Teyssiere, 1889 obj.]

***Grossouvria* sp. A**
Pl. 8: 3

Material: an almost complete adult ?macroconch from Baghi section.
Description: Evolute and widely umbilicate. Ribbing irregular, mainly composed of strong primaries bifurcated on the uppermost part of the flanks; more or less prosocline in the inner whorls passing to subradial in the bodychamber. About one constriction per whorl associated with a parabolic rib.
Occurrence: Baghi section level Q-3, Lower Bathonian.

Genus *Choffatia* Siemiradzki, 1898
Type species: *Perisphinctes cobra* Waagen, 1875 by SD Buckman (1920)

***Choffatia* cf. *recuperoi* (Gemmellaro, 1872)**
Pl. 8: 1, 5

Material: two complete adult [M].
Occurrence: Baghi section levels Q-7 and Q-5.

***Choffatia waageni* [m]**
Pl. 20: 7

Material: a complete adult microconch from Ghoroneh section.
Remarks: This well preserved specimen is shown for comparative purposes.

Genus *Indosphinctes* Spath, 1930
Type species: *Ammonites calvus* Sowerby, 1840

***Indosphinctes calvus* (Sowerby, 1840)**
Pl. 8: 2

Material: a single, well preserved adult [m] from Baghi section.
Description: Platyconic, involute, narrowly umbilicate. Primary ribbing strong, short, beginning on the umbilical wall, polyfurcated on the lower half of the flanks producing sheaves of finer secondaries which become weak or interrupte on the mid-venter. The bodychamber is uncoiled along the last portion. Peristome smooth with a pair of lappets.
Occurrence: Bacqi section, level Q-5, Middle Callovian.

Subfamily Perisphinctinae Steinmann, 1890
Genus *Alligaticeras* Buckman, 1923
Type species: *Ammonites alligatus* Leckenby, 1859

***Alligaticeras alligatum* (Leckenby, 1859)**
Pl. 9: 3

Material: a single poorly preserved specimen (phragmocone) from Baghi section.
Description: moderately narrowly umbilicate, compressed serpenticone, finely and densely ribbed with primary ribs bi- or triufurcate on the ventro-lateral shoulder.
Occurrence: Bacqi section, level Q-6, Upper Callovian.

Genus *Prososphinctes* Schindewolf, 1925
Type species: *Perisphinctes mazuricus* Bukowski, 1887

***Prososphinctes mazuricus* (Bukowski, 1887)**
Pl. 9: 1-2

Material: two specimens (phragmocones) from Baghi section.
Occurrence: Bacqi section, levels Q-9-10, Lower Oxfordian.

Genus *Perisphinctes* Waagen, 1869
Type species: *Ammonites variocostatus* Buckland, 1836; SD Arkell 1951

***Perisphinctes* cf. *panthieri* Enay, 1966**
Pls. 10: 4-5, 11: 1

Material: two specimens (phragmocones) from Bojnow section.
Description: Moderately involute with narrow umbilicus, subrectangular to suboval whorl section. Densely ribbed with primaries narrowly splitted in two secondaries projected forwards.
Remarks: The specimen from level B-4 (Pl. 10: 4) preserves remains of the umbilical seam showing it was clearly uncoiled, suggesting it is an incomplete [m]. This specimen closely matchs with the microconch figured by Enay (1966: pl. 31: 6), a topotype of *Perisphinctes elisabethae* De Riaz, 1898.
Occurrence: Bojnow section, levels B-3-5, upper Middle Oxfordian.

***Perisphinctes* cf. *alatus* Enay, 1966**
Pl. 12: 1, 3, 5

Material: Thress specimens, apparently phragmocones from Bojnow section.
Description: Evolute and compressed platycones. Finely and densely ribbed by prosocline primary ribs which bifurcate on the upper part of the flanks. As far as can be observed the ventral ribbing cross the venter unchanged and evenly spaced.
Remarks: The specimens are very similar to the inner whorls of *P. alatus* from the Transversarium Z. or lower Bifurcatus Z of Submediterranean domains. However, these specimens could be incomplete microconchs or inner whorls of macroconchs since there are no signs of uncoiling for deciding about their developmental stage.
Occurrence: Bojnow section levels B-22 and B-24, upper Middle Oxfordian.

***Perisphinctes* cf. *variocostatus* (Buckland, 1836)**
Pls. 12: 2, 4, 6; 13: 1, 3, 6

Material: Several specimens from the Dahaneh Heydari and Bojnow sections.
Description: Moderately involute, rounded to suboval in whorl section. Ribbing dense, composed by normal, slightly flexuous primary ribs which mostly bifurcate on the upper part of the flanks in two slightly finer secondaries, which cross the venter unchanged and evenly spaced. Some specimens show constrictions in the inner whorls (D < 40 mm). All the specimens are septated till the end, with no clear signs of uncoiling, preventing identification of the sex dimorph to which they belong.

Occurrence: Dahaneh Heydari section levels D-3-4, 10 and Bojnow section level B-20, upper Middle to Upper Oxfordian, probably within the interval Bifurcatus-lower Bimammatum zones.

***Perisphinctes* sp. A**
Pls. 11: 2, 13: 4

Material: Two specimens from Bojnow section.
Description: Small, evolute serpenticones with suboval whorl section. Ribbing regularly bifurcated with polyschizotomics preceding constrictions. In the best preserved specimen the aperture bears long, spatulated lateral lappets.
Remarks: These specimens are adult microconchs which could be included in the morpho-subgenus Dichotomosphinctes. This morphogenus ranges the Lower and Middle Oxfordian in the Tethyan successions.
Occurrence and distribution: Bojnow section level B-4-5(?), Middle Oxfordian.

Genus *Subdiscosphinctes* Malinowska, 1972
Type species: *Perisphinctes kreutzi* Siemiradzki, 1891; OD

***Subdiscosphinctes* sp. A**
Pl. 14: 3

Remarks: Schairer et al. (2003) have figured several specimens to which the present one can be closely compared.
Occurrence: D-12

***Subdiscosphinctes* sp. B**
Pl. 16: 5

Material: 1 adult phragmocone
Occurrence: Bojnow section level B-26.

Genus *Pseudorthosphinctes* Enay, 1966
Type species: *Pseudorphosphinctes alternans* Enay, 1966; by OD

***Pseudorthosphinctes* cf. *alternans* Enay, 1966**
Pls. 15: 2, 17: 2

Material: 2 phragmocones from Dahaneh-Heydari.
Description: Incomplete phragmocone. Evolute, rounded in whorl section. Inner whorls with dense ribbing of bifurcate primaries and strong constrictions. Outer whorl with strong primary ribs, subradial, bi- and mainly trifurcate on the upper third of the flank.
Occurrence: Dahaneh Heydani section level D-11. The genus *Pseudorthosphinctes* occurs in the Bimammatum Zone of Europe (Enay 1966).

Subfamily Idoceratinae Spath, 1924
Genus *Subnebrodites* Spath, 1925

***Subnebrodites* cf. *laxevolutum* (Fontannes, 1879)**
Pl. 9: 5

Material: 1 rather complete and well preserved specimen from Bojnow.
Description: Compressed, evolute platycone with acute venter. Inner whorls finely and densely ribbed. Outer whorl with irregular ribbing, composed by widely spaced, wiry primary ribs which mostly bifurcate on the upper part of the flank. Ventral ribbing cross the venter unchanged.

Occurrence: Bojnow section level B-26. Planula-Platynota zones.

Family Ataxioceratidae Buckman, 1921
Subfamily Ataxioceratinae Buckman, 1921
Genus *Lithacosphinctes* Olóriz, 1978
Type species: *Ammonites lictor evolutus* Quenstedt, 1888 (renamed *Lithacosphinctes siemiradzkii* Zeiss; see Kiessling & Zeiss 1992) by OD.

***Lithacosphinctes* cf. *freybergi* (Geyer, 1961)**
Pls. 11: 3-4, 14: 2, 15: 1

Description: Adult phragmocones with the beginning of the bodychamber; probably macroconchs. Compressed platycones, moderately involute, finely and densely ribbed all throughout the ontogeny. Primary ribs bifurcate on the upper third of the flank. There are some undivided primaries and constrictions irregularly distributed.
Remarks.- The inner whorls are very similar to those of *L.* cf. *freybergi* described above, by which it is possible they are the dimorphs of a single species. In the lower Upper Oxfordian *Lithacosphinctes* can be considered the macroconch of *Ardescia* (Parent et al. 2006), on the other hand Hantzpergue (1989) considers both as independent, sexually dimorphic genera in the Platynota-Hypselocyclum zones. The specimens are also very similar to the large macroconch of *Lithacosphinctes evolutus* (Quenstedt) figured by Koerner (1963: pl. 22: 2).
Occurrence.- Bojnow section levels B-11, 13 and Dahaneh-Heydari section level D-12, Upper Oxfordian.

***Lithacosphincts* cf. *gidoni* (Atrops, 1982)**
Pl. 16: 3

Remarks: A fragmentary specimen (Dahaneh-Heydari section level D6) with features resembling *L. gidoni*, a species characteristic of the Planula Z. (Atrops 1982).

***Lithacosphinctes*? sp. B**
Pl. 16: 2, 4

Material: 2 phragmacones from Dahaneh-Heydari and Bojnow.
Occurrence: Bojnow section level B-21 and Dahaneh-Heydari section level D-14. Bimammatum-Planula zones.

***Lithacosphinctes*? sp. A**
Pl. 15: 3-4

Material: 2 specimens form Dahaneh-Heydari.
Description: Phragmocone with part of bodychamber. Moderately involute and stout serpenticone with rounded subrectangular whorl section. Inner whorls densely ribbed by slightly prosocline primaries. Outher whorl (partially bodychamber) more strongly ribbed by primaries which born on the umbilical sean and run the flanks radially and bi- or trifurcate on the uppermost part of the flanks. Ventral ribbing well marked, uninterrupted, evely spaced.
Occurrence: Dahaneh Heydari section level D-14.

Genus *Ardescia* Atrops, 1982
Type species: *Ataxioceras desmoides* Wegele, 1929; OD

***Ardescia* cf. *inconditus* (Fontannes, 1876)**
Pl. 17: 1, 3-4

Material: 3 microconchs with incomplete bodychamber.
Occurrence: Dahaneh-Heydari level D-15, Lower Kimmeridgian, Hypselocyclum Z.

Genus *Ataxioceras* Fontannes, 1879
Type species: *Perisphinctes hypselocyclus* Fontannes, 1879.

***Ataxioceras lothari* (Oppel, 1863)**
Pl. 14: 1

Material: A well preserved but crushed specimen from Dahaneh Heydari section.
Description: The specimen available is moderately well preserved, a phragmocone with beginning of the bodychamber, probably adult because of the incipient uncoiling.
Remarks: The specimen matchs satisfactorily with the type specimen figured by Oppel (1863: pl. 67: 6) and the specimens of Atrops (1982: pls. 7: 3, 8: 7-8).
Occurrence and distribution: Dahaneh Heydari section level D-16. The species has been recorded from the Hypselocyclum Z. in Europe (Atrops 1982).

***Ataxioceras* cf. *hyppolytense* Atrops, 1982**
Pls. 16: 1, 17: 5

Material: Several specimens moderately well preserved from Bojnow and Dahaneh Heydari sections.
Occurrence and distribution: Bojnow section level B-41 and Dahaneh Heydari section levels D-14. The species is abundant in the lower Hyselocyclum Zone in the Tethys (Atrops 1982: 197).

***Ataxioceras*? sp. A**
Pl. 10: 1

Material: a fragmentary macroconch bodychamber from Dahaneh section
Occurrence: Dahaneh section level D13, ?Lower Kimmeridgian.

Subfamily Lithacoceratinae Zeiss, 1968
Genus *Lithacoceras* Hyatt, 1900
Type species: *Ammonites ulmensis* Oppel, 1858; by OD

***Lithacoceras*? sp. A**
Pl. 10: 2

Material: 2 adult phragmocones from Bojnow section.
Occurrence: Bojnow section level B-45, Lower Kimmeridgian.

Family Aspidoceratidae Zittel, 1895
Subfamily Aspidoceratinae Zittel, 1895
Genus *Euaspidoceras* Spath, 1930
Type species: *Ammonites perarmatus* Sowerby, 1822; OD.

***Euaspidoceras douvillei* Collot, 1917**
Pl. 19: 4

Material: A well preserved macroconch with bodychamber from Baghi.
Description: At D = 5-10 mm the whorls are rounded in whorl section with feeble sculpture composed of widely spaced primary ribs with a ventro-lateral tubercle. At D > 10-15 mm the shell becomes platyconic, moderately involute with subrectangular, higher than wide whorl section with narrow gently rounded venter. Sculpture composed of primary ribs with umbilical and ventro-lateral small tuberlces which persist up to the max preserved diameter of 79 mm. The bodychamber seems to begin at D = 55 mm.
Remarks: E. douvillei is a species characteristic of the Lower Oxfordian Mariae to Cordatum zones (Bonnot & Gygi 1998).
Occurrence: Baghi section level Q-12, uppermost Callovian to Lower Oxfordian.

***Euaspidoceras raynaudi* Bonnot, 1996**
Pl. 19: 1

Material: An adult, almost coplete macroconch from Baghi.
Description: Relatively large (max D = 135 mm at bodychamber), evolute, rather compressed with subrectangular whorl section slightly wider than high. From inner whorls (about D = 15-20 mm) bituberculate with umbilical and ventro-lateral tubercles connected by a weak primary rib.
Remarks: The specimen matchs the material originally figured by Bonnot (1996) from the Athleta Zone of Maine-et-Loire, France.
Occurrence: Baghi section level Q-11 assigned to the Upper Callovian, probably Athleta Zone.

Genus *Clambites* Rollier, 1922
Type species: *Ammonites clambus* Oppel, 1863 by SD Roman (1938)

***Clambites* sp. A**
Pl. 19: 2

Material: A well preserved phragmocone from Dahaneh-Heydari.
Description: Compressed and evolute, platyconic. Whorl section subrectangular higher than wide with flat flanks and rounded venter. Inner whorls feeble ribbed with widely spaced primary ribs with umbilical and ventro-lateral spiny tubercles. In the outer whorl the rows of tubercles are more narrowly spaced and connected by irregularly developed ribs.
Remarks: Clambites is well developed in the Bimammatum Z. Nevertheless, there are some early representatives of the genus in the Bifurcatus Z. (discussion in Parent 2006).
Occurrence: Dahaneh Heydari section level D-2. Upper Middle Oxfordian

Subfamily Peltoceratinae Spath, 1924
Genus *Metapeltoceras* Spath, 1931
Type species: *Ammonites armiger* Sowerby, 1840

***Metapeltoceras* cf. *armiger* (Sowerby, 1840)**
Pl. 19: 3

Material: 1 phragmocone from Baghi.
Occurrence: Baghi section level Q-6. Upper Middle Callovian.

Genus *Peltoceras* Waagen, 1871
Type species: *Ammonites athleta* Phillips, 1829; SD Schindewolf (1925)

***Peltoceras athleta* (Phillips, 1829)**
Pl. 18: 3

Material: a well preserved macroconch from Baghi.
Description: Evolute and depressed macroconch with max preserved D = 81 mm. Widely umbilicated with subrectangular, wider than high whorl section which becomes wider during growth; venter wide and rounded. Inner whorls with acute primary ribs on the flanks. From about D = 25 mm the ribs fade out and develop ventro-lateral tubercles first, then lamellar to rounded umbilicals, both of which reinforce during growth. In the last whorl preserved the ventro-lateral tubercles are connected by a weak and wide ventral rib.
Remarks: The specimen is very similar to the neotype (Arkell et al. 1957: fig. 442, 7) from the Upper Callovian Athleta Zone of England.
Occurrence: Baghi section level Q-9, Late Callovian, probably Athleta Zone.

Superfamily Stephanoceratoidea Neumayr, 1875
Family Sphaeroceratidae Buckman, 1920
Subfamily Macrocephalitinae Salfeld, 1921
Genus *Macrocephalites* Zittel, 1884
Type species: *Ammonites macrocephalus* Schlotheim, 1813; SD by Lemoine (1910: 15).

***Macrocephalites* cf. *tumidus* (Reinecke, 1818)**
Pl. 3: 6

Material: A poorly preserved phrgmocone from Baghi.
Description: Medium sized (max preserved D = 76 mm), involute. The whorl section is very depressed (W/D = 0.72, W/H_1 = 1.7), widely u-shaped with low flanks and gently rounded umbilical shoulder and broad venter. Densely ribbed by acute primaries which born on the umbilical wall and bifurcate on the upper half of the flank in indistinct secondaries that cross the venter unchanged and evenly spaced.
Occurrence: Baghi section level Q-5.

BIOSTRATIGRAPHY AND TIME CORRELATION

The stratigraphic position of each species was estimated individually by comparison with the best known Tethyan occurrences of the most similar ammonites in literature. Time-correlation of the stratigraphic levels was estimated considering the respective assemblages as a whole as also between the three studied sections. Results are summarized in Fig. 9.

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Plate captions

Plate 1:
Figs.1a-c: Part 1 Baqhi (Q4-6), Late Bajocian-Bathonian (condensed red bed).

Figs.2a-b: Part 1 Baqhi (Q3-26), Late Bajocian-Bathonian (condensed red bed).

Figs.3a-b: Part 1 Baqhi (Q3-23), Late Bajocian-Bathonian (condensed bed).

Figs.4a-c: Part 2 Dahaneh Heydari (D7-2), Late Oxfordian.

Figs.5a-c: Part 2 Baqhi (Q7-14), Early-Middle Callovian.

Figs.6a-c: Part 1 Baqhi (Q3-35), Late Bajocian-Bathonian (condensed red bed).

Plate 2:
Figs.1a-c: Part 2 Baqhi (Q5-21), Callovian.

Figs.2a-c: Part 2 Baqhi (Q5-15), Middle Callovian (Anceps Zone).

Figs.3a-c: Part 2 Baqhi (Q5-18), Middle Calovian (Anceps Zone)

Figs.4a-c: Part 2 Baqhi (Q9-11), Late Callovian (Athleta Zone).

Figs.5a-c: Part 2 Baqhi (Q9-5), Late Callovian.

Figs.6a-c: Part 1 Baqhi (Q3-69), Late Bajocian-Bathonian (condensed red bed).

Plate 3:
Figs.1a-b: Part 3 Baqhi (Q10-1), Early Oxfordian.

Figs.2a-c: Part 3 Baqhi (Q11-6), Early Oxfordian.

Figs.3a-b: Part 1 Bojnow (B10-3), Late Oxfordian.

Figs.4a-b: Part 2 Bojnow (B20-1), Late Oxfordian.

Figs.5a-b: Part 3 Bojnow (B47-1), Late Oxfordian- Kimmeridgian?

Figs.6a-b: Part 2 Baghi (Q5-26), Early Callovian.

Figs.7a-c: Part 1 Baqhi (Q3-38), Bathonian (Zigzag Zone)(condensed red bed).

Plate 4:
Figs.1a-c: Part 1 Baqhi (Q3-43), Bathonian (Zigzag Zone) (condensed red bed).

Figs.2a-b: Part 1 Baqhi (Q3-53), Late Bajocian-Bathonian (condensed red bed).

Figs.3a-c: Part 1 Baqhi (Q3-57), Late Bajocian-Bathonian (condensed red bed).

Figs.4a-b: Part 2 Baqhi (Q6-3), Middle Callovian (Anceps Zone)

Figs.5a-b: Part 2 Baqhi (Q6-7), Middle Callovian (Anceps Zone).

Plate 5:
Figs.1a-c: Part 2 Baqhi (Q6-11), Middle Callovian (Anceps Zone).

Figs.2a-c: Part 2 Baqhi (Q7-18), Middle Callovian.

Figs.3a-b: Part 2 Baqhi (Q9-8), Late Callovian.

Figs.4a-c: Part 3 Baqhi (Q10-9), Late Callovian- Oxfordian.

Figs.5a-b: Part 2 Baqhi (Q6-8), Middle Callovian (Anceps Zone).

Figs.6a-c: Part 2 Baqhi (Q7-21), Middle Callovian (Anceps Zone).

Plate 6:
Figs.1a-b: Part 2 Baqhi (Q8-9), Middle Callovian.

Figs.2a-c: Part 2 Baqhi (Q8-11), Middle Callovian.

Figs.3a-c: *Alborzites binaludensis,* Part 2 Baqhi (BSPG 2011 XXVII 56), Middle Callovian (Coronatum zone).

Figs.4a-b: Part 2 Baqhi (Q9-18), Late Callovian.

Plate 7:
Figs.1a-c: Part 2 Baqhi (Q9-21), Late Callovian.

Figs.2a-c: Part 1 Baqhi (Q3-64), Late Bajocian-Bathonian (condensed red bed).

Figs.3a-c: Part 1 Baqhi (Q3-73), Late Bajocian-Bathonian (condensed red bed).

Figs.4a-c: Part 2 Baqhi (Q7-24), Middel Callovian.

Plate 8:
Figs.1a-b: Part 2 Baqhi (Q7-23), Middel Callovian.

Figs.2a-b: Part 2 Baghi (Q5-24), Early- Middle Callovian.

Figs.3a-c: Part 1 Baqhi (Q3-75), Late Bajocian-Bathonian (condensed red bed).

Figs.4a-b: Part 2 Baqhi (Q6-24), Middel Callovian.

Figs.5a-c: Part 2 Baqhi (Q5-25), Early- Middle Callovian.

Plate 9:
Figs.1a-c: Part 2 Baqhi (Q9-24), Late Callovian-Early Oxfordian.

Figs.2a-c: Part 3 Baqhi (Q10-16), Late Callovian-Early Oxfordian.

Figs.3a-c: Part 2 Baqhi (Q6-26), Middel Callovian.

Figs.4a-b: Part 2 Baqhi (D6-1), Late Oxfordian.

Figs.5a-b: Part 2 Dahaneh Heydari (D6-2), Late Oxfordian.

Plate 10:
Figs.1: Part 3 Dahaneh Heydari (D13-1), Early-Late Kimmeridgian.

Figs.2: Part 3 Bojnow (B45-2), Early Kimmeridgian.

Figs.3a-b: Part 3 Baqhi (Q14-10), Late Oxfordian (Bifurcatus Zone).

Figs.4a-c: Part 1 Bojnow (B4-4), Late Oxfordian (Transversarium Zone).

Figs.5a-c: Part 1 Bojnow(B5-2), Late Oxfordian (Transversarium Zone).

Plate 11:
Figs.1a-c: Part 1 Bojnow (B3-5), Late Oxfordian (Transversarium Zone).

Figs.2a-b: Part 1 Bojnow (B3-6), Late Oxfordian.

Figs.3a-c: Part 1 Bojnow (B11-6), Late Oxfordian.

Figs.4a-c: Part 1 Bojnow (B13-2), Late Oxfordian.

Plate 12:

Figs.1a-c: Part 2 Bojnow (B24-1), Late Oxfordian.

Figs. 2a-c: Part 2 Dahaneh Heydari (D3-4), Late Oxfordian (Bifurcatus zone).

Figs.3a-b: Part 2 Bojnow (B24-2), Late Oxfordian (Bifurcatus zone).

Figs.4a-c: Part 3 Dahaneh Heydari (D10-3), Late Oxfordian.

Figs.5a-c: Part 2 Bojnow (B22-6), Late Oxfordian.

Figs.6a-b: Part 3 Dahaneh Heydari (D10-4), Late Oxfordian.

Plate 13:

Figs.1a-c: Part 2 Bojnow (B20-3), Late Oxfordian (Bifurcatus zone).

Figs.2a-c: Part 2 Bojnow (B21-3), Late Oxfordian (Bifurcatus zone).

Figs.3a-c: Part 2 Dahaneh Heydari (D4-6), Late Oxfordian.

Figs.4a-b: Part 1 Bojnow (B4-7), Early-Late Oxfordian.

Figs.5a-c: Part 1 Bojnow (B10-5), Late Oxfordian.

Figs.6a-c: Part 1 Bojnow (B12-6), Late Oxfordian.

Plate 14:

Figs.1a-c: Part 3 Dahaneh Heydari (D16-1), Early Kimmeridgian.

Figs.2a-c: Part 3 Dahaneh Heydari(D14-2), Early Kimmeridgian.

Figs.3a-c: Part 3 Dahaneh Heydari (D12-1), Early Kimmeridgian.

Plate 15:

Figs.1a-b: Part 3 Dahaneh Heydari (D11-1), Early Kimmeridgian.

Figs.2a-c: Part 3 Dahaneh Heydari (D11-2), Late Oxfordian-Early Kimmeridgian.

Figs.3a-b: Part 3 Dahaneh Heydari (D14-3), Late Oxfordian-Early Kimmeridgian.

Figs.4a-c: Part 4 Baqhi (Q23-5), Late Oxfordian-Early Kimmeridgian.

Figs.5a-c: Part 3 Bojnow (B26-3), Early Kimmeridgian.

Plate 16:
Figs.1a-c: Part 3 Dahaneh Heydari (D14-4), Late oxfordian-Early Kimmeridgian.

Figs.2a-c: Part 2 Bojnow (B21-2), Late Oxfordian.
Figs.3a-b: Part 2 Dahaneh Heydari (D6-6), Late Oxfordian.

Figs.4a-b: Part 3 Dahaneh Heydari (D14-1), Early-Late Kimmeridgian.

Figs.5a-b: Part 3 Bojnow(B6-2), Early-Late Kimmeridgian.

Plate 17:
Figs.1a-b: Part 3 Dahaneh Heydari (D15-2), Early Kimmeridgian.

Figs.2a-c: Part 3 Dahaneh Heydari (D16-3), Late Oxfordian-Early Kimmeridgian

Figs.3a-c: Part 3 Dahaneh Heydari (D15-3), Early Kimmeridgian.

Figs.4: Part 3 Dahaneh Heydari (D15-5), Early Kimmeridgian.

Figs.5a-b: Part 3 Bojnow (B41-1), Early Kimmeridgian.

Plate 18:
Figs.1: Part 3 Dahaneh Heydari (D15-1), Early-Late Kimmeridgian

Figs.2: Part 3 Dahaneh Heydari (D14-5), Early-Late Kimmeridgian.

Figs.3a-c: Part 2 Baghi (Q9-14), Late Callovian.

Figs.4a-c: Part 3 Baqhi (Q11-16), Late Callovian-Early Oxfordian.

Plate 19:
Figs.1a-c: Part 3 Baqhi (Q11-17), Late Callovian- Oxfordian.

Figs.2a-c: Part 2 Dahaneh Heydari (D2-3), Early-Late Oxfordian.

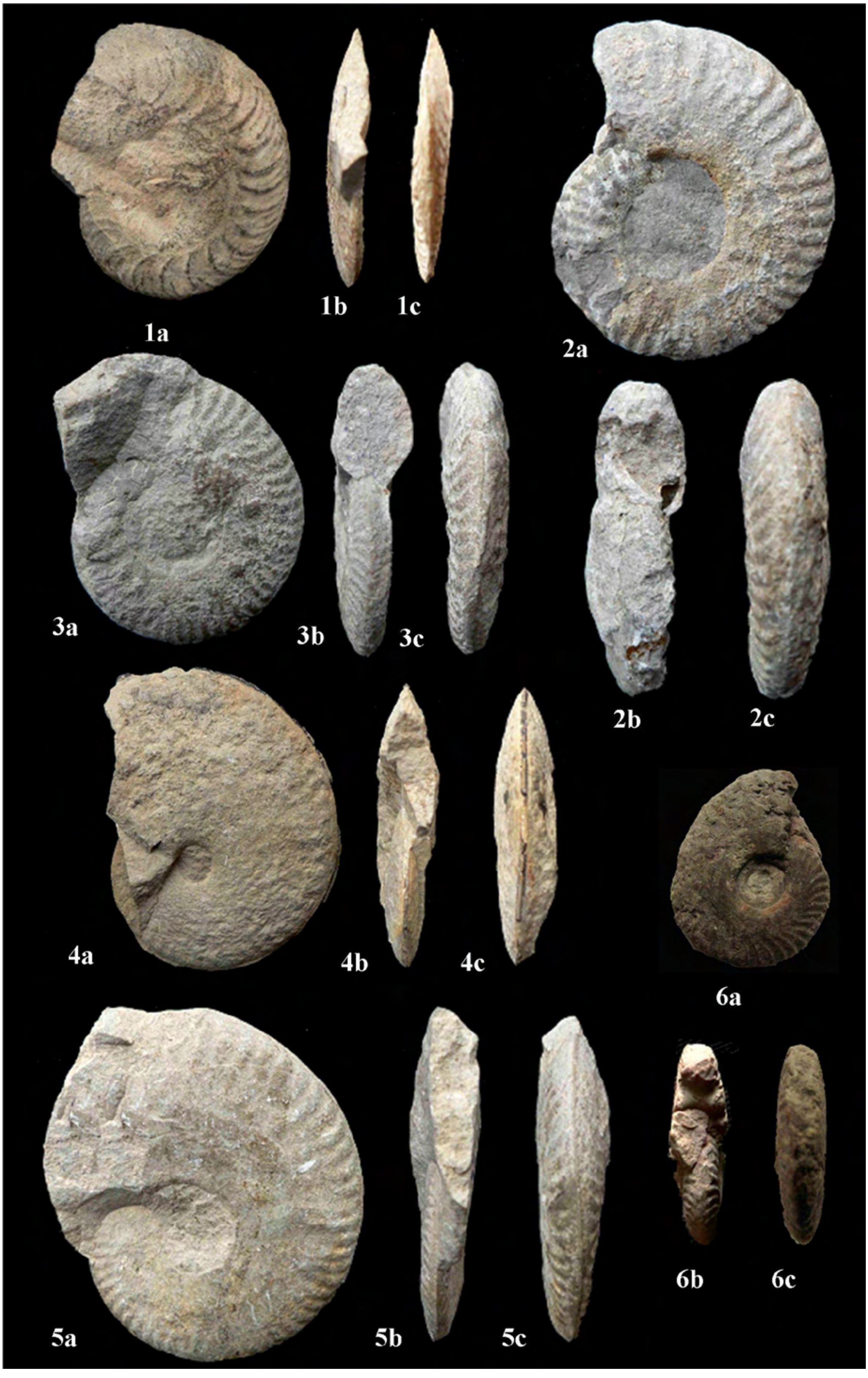
Figs.3a-c: Part 2 Baghi (Q6-13), Middel Callovian.

Figs.4a-c: Part 2 Baqhi (Q12-5), Late Callovian-Oxfordian

Plate 20:
All of the samples belong to the Callovian beds of Ghoroneh section.

Plate 1

Plate 2



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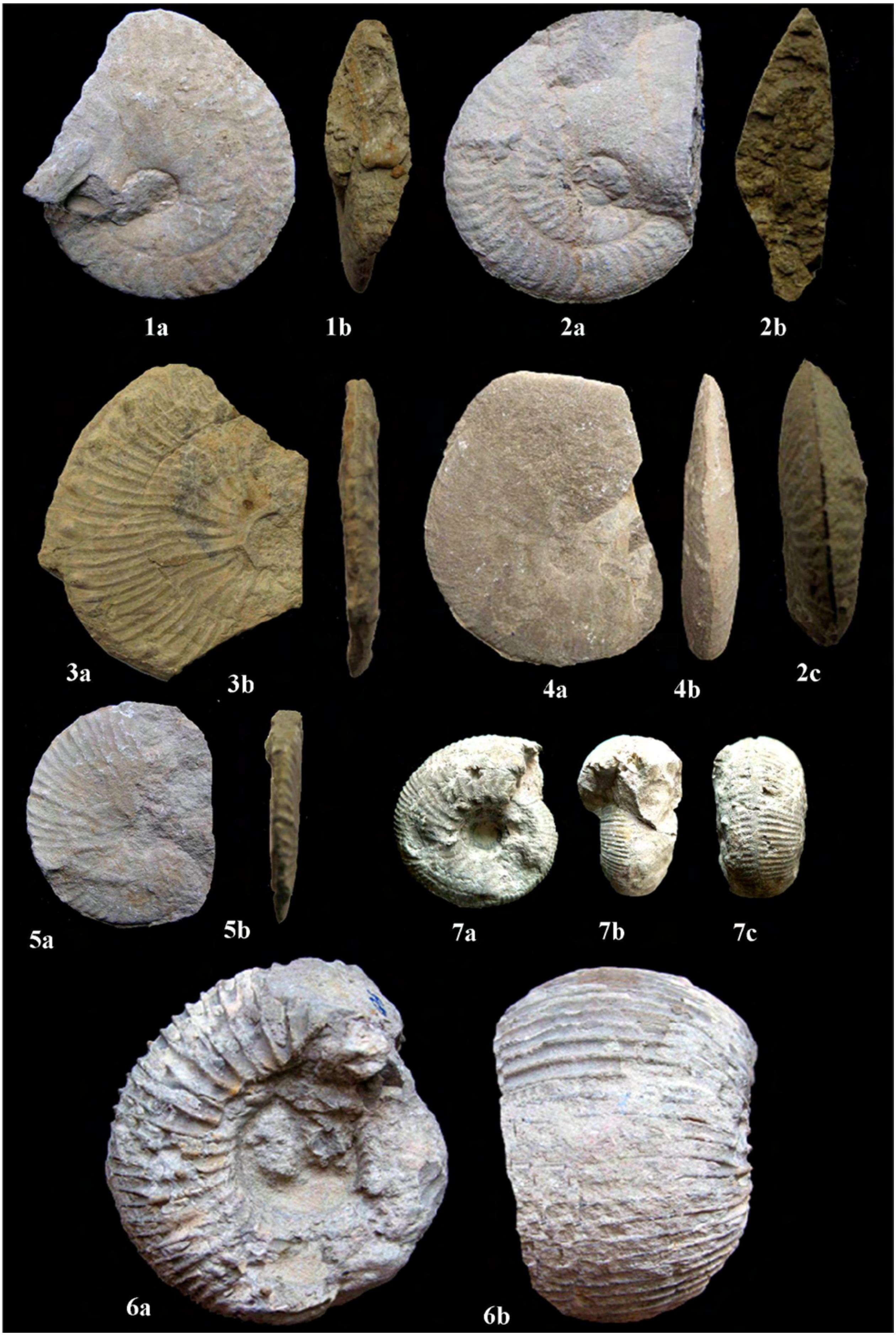

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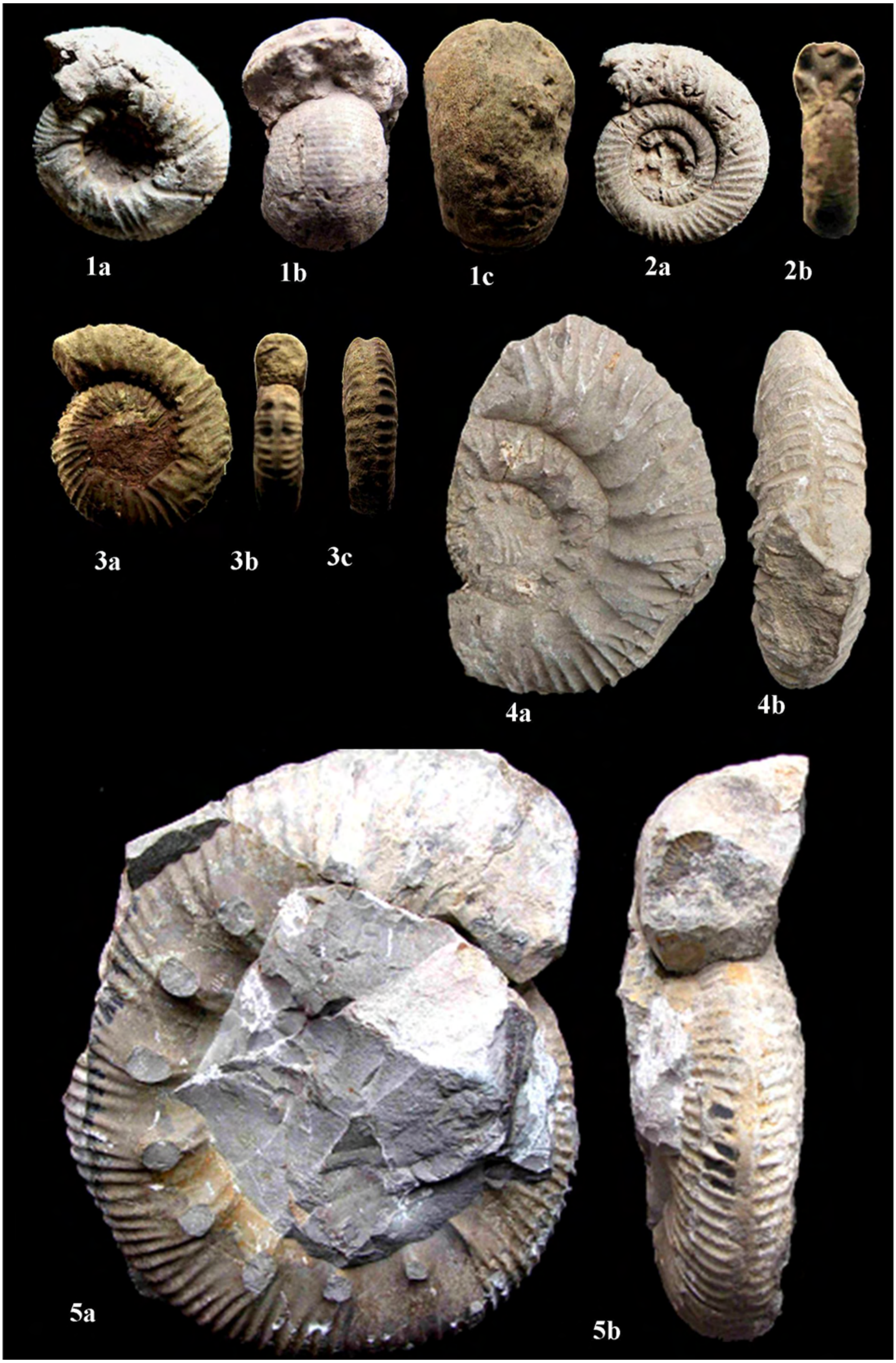

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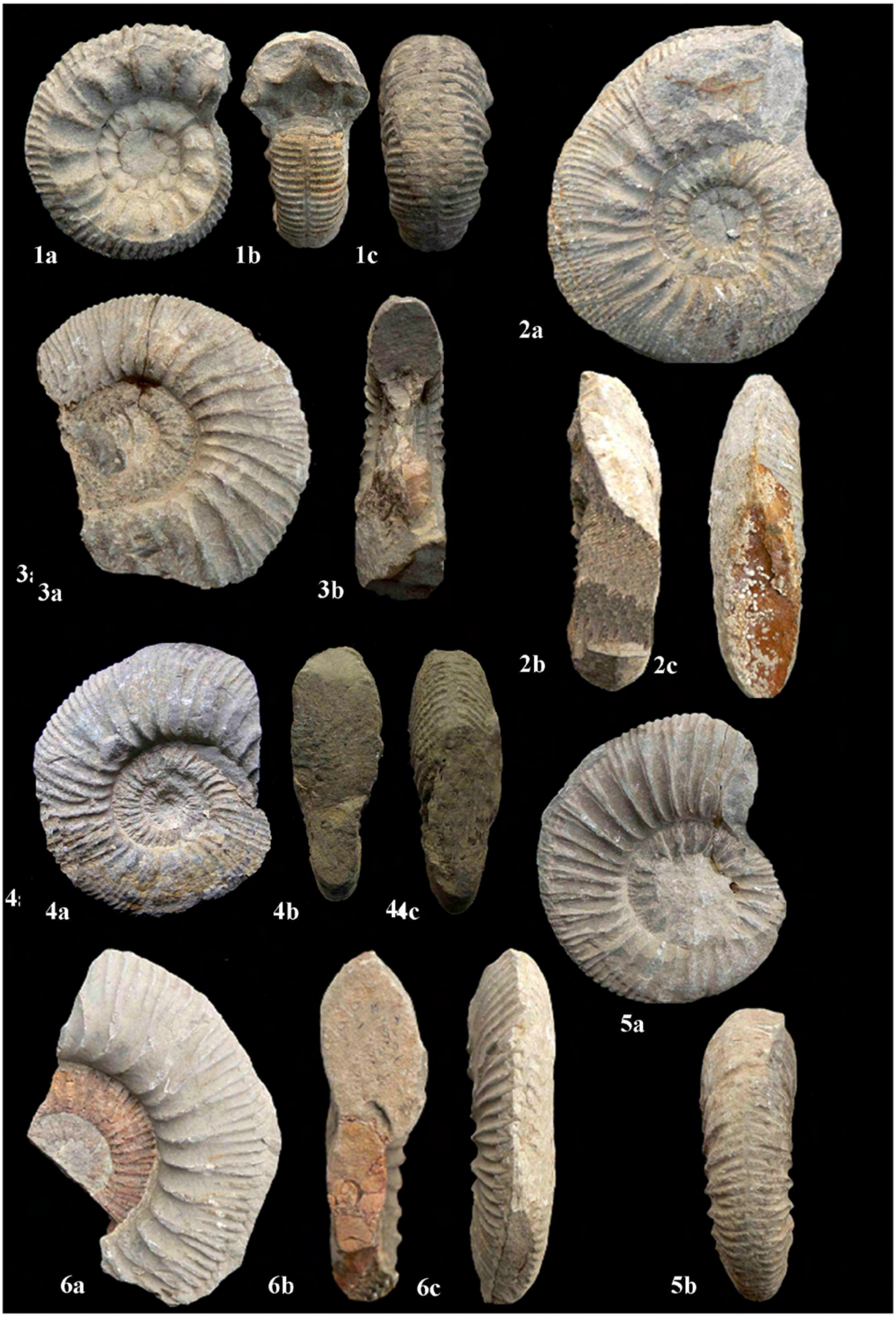

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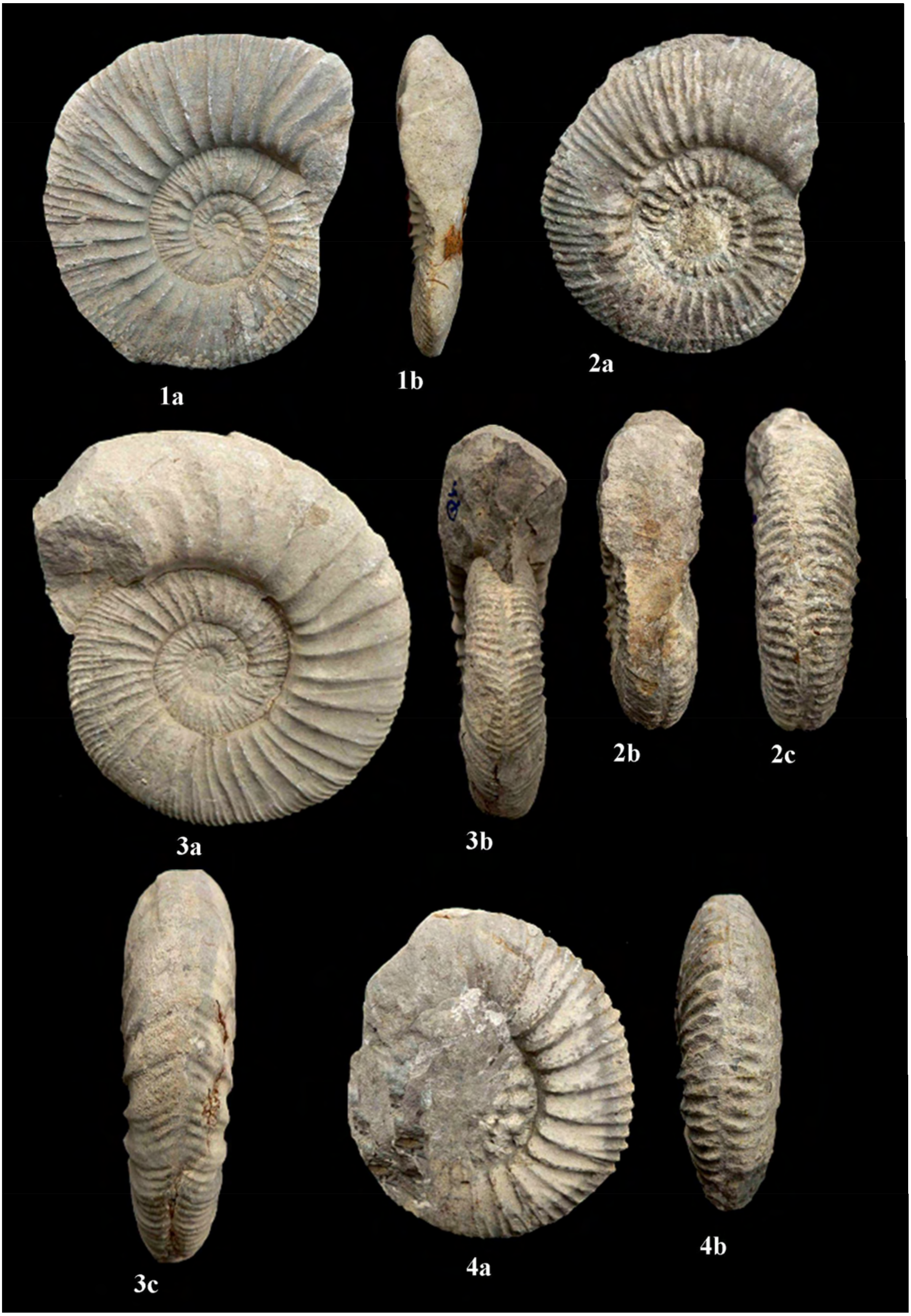
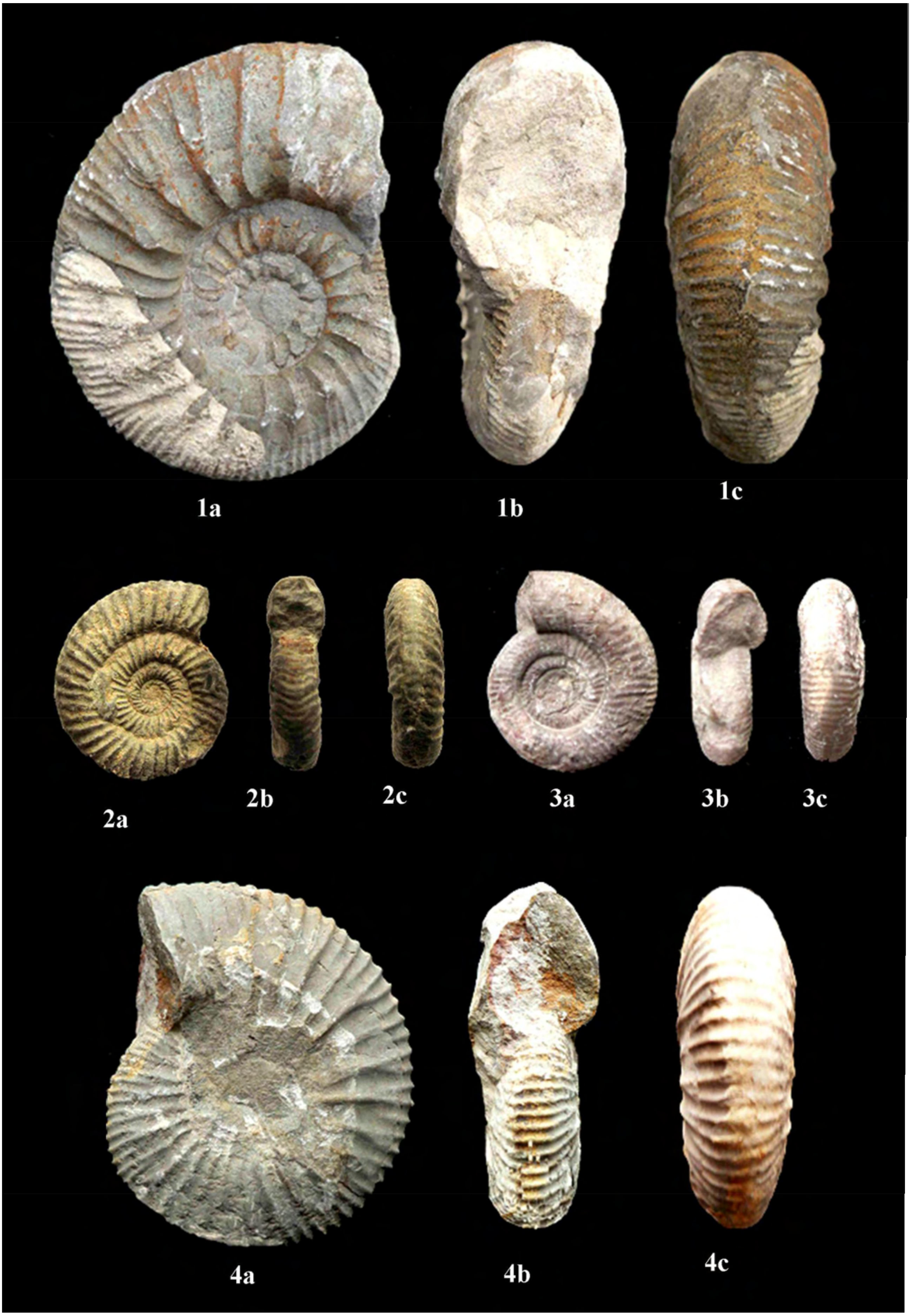


Plate 7



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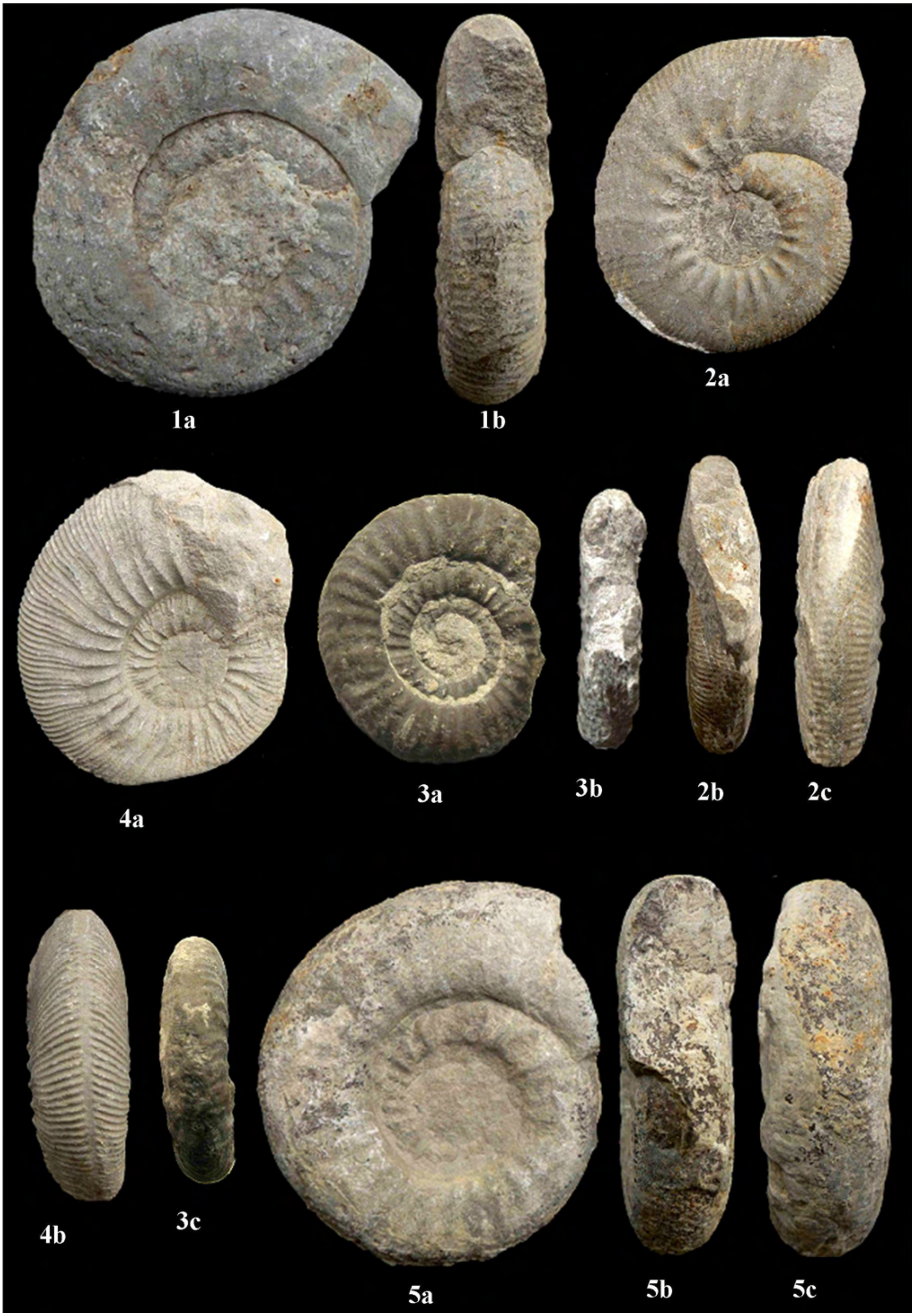

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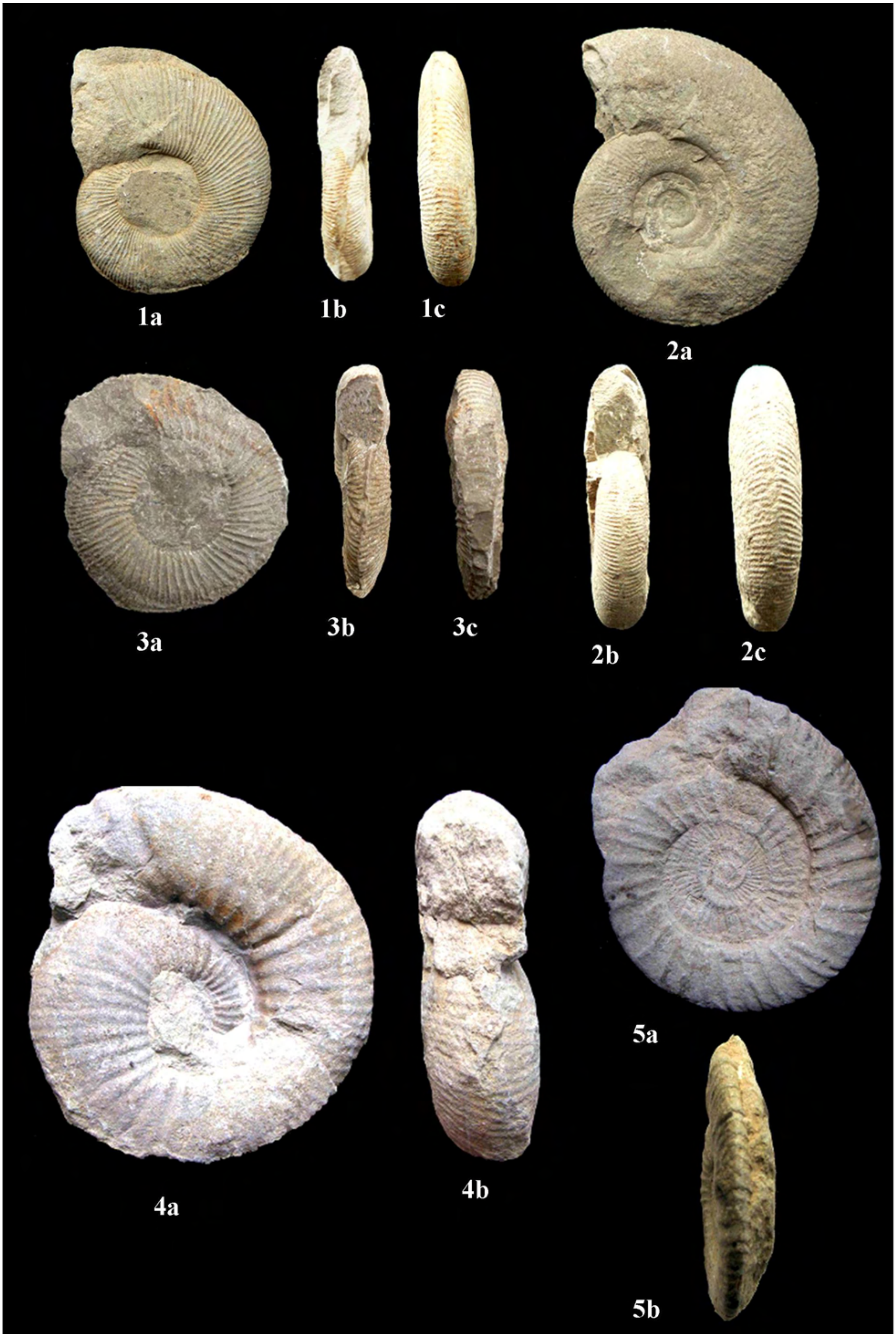

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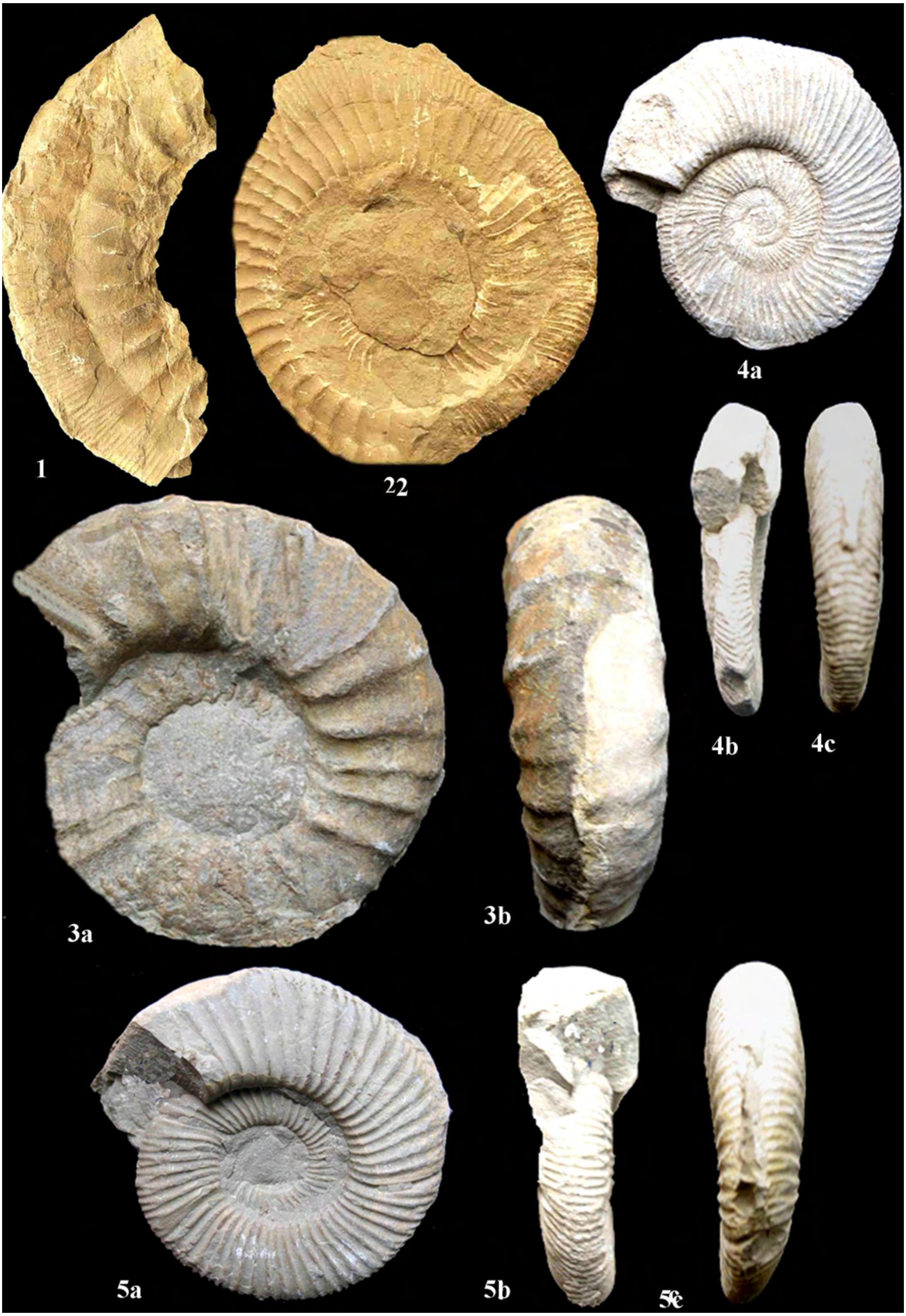

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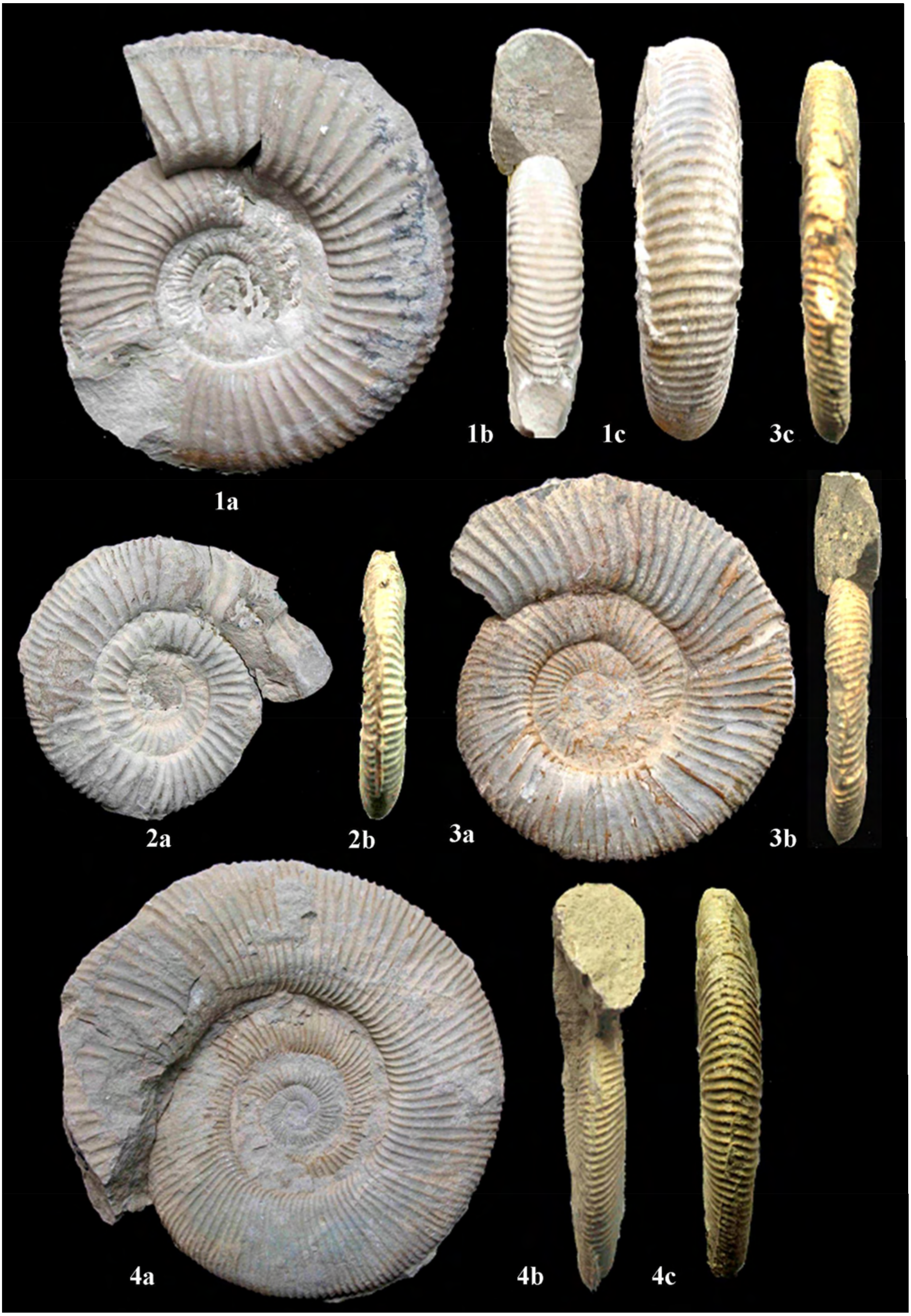
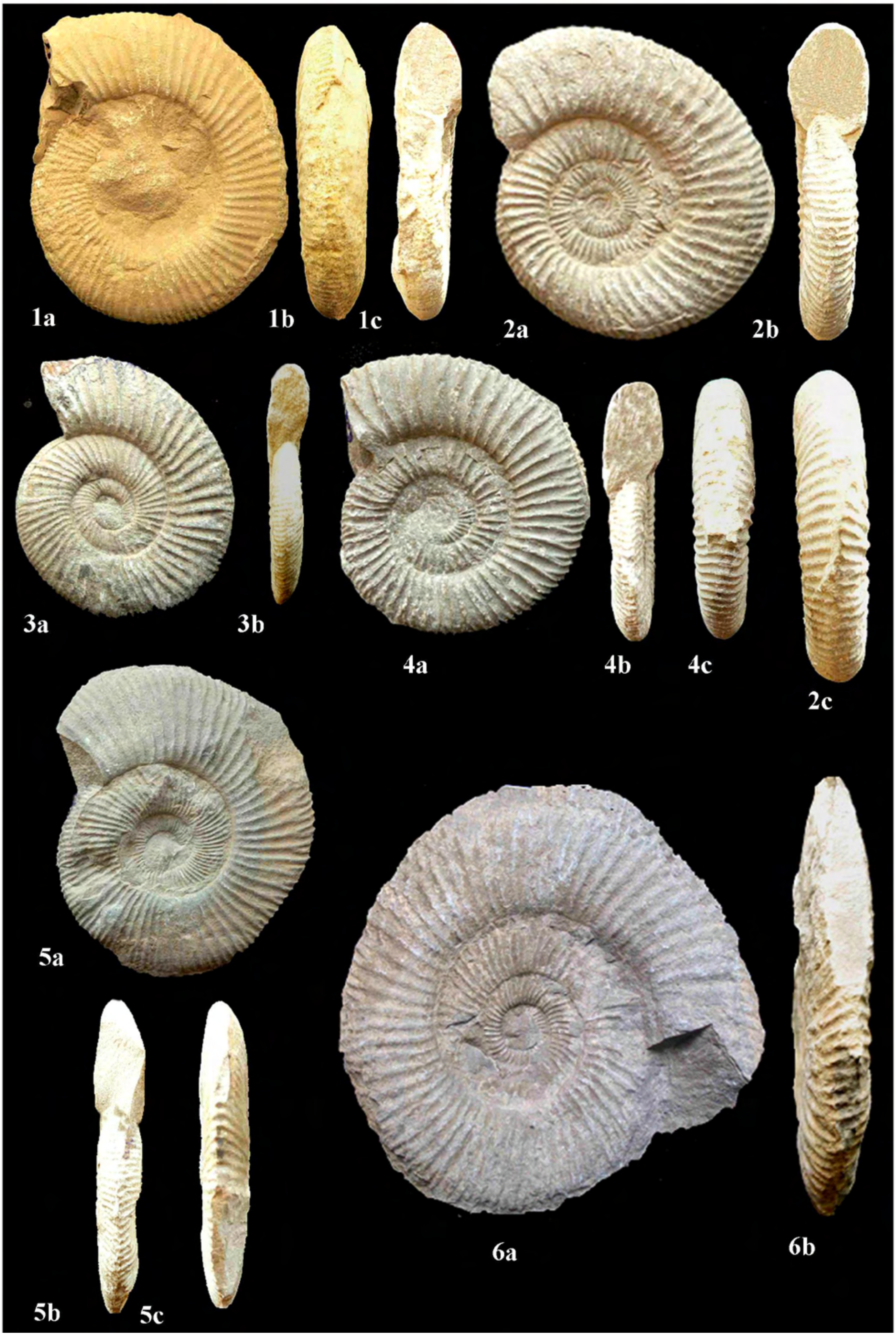


Plate 12



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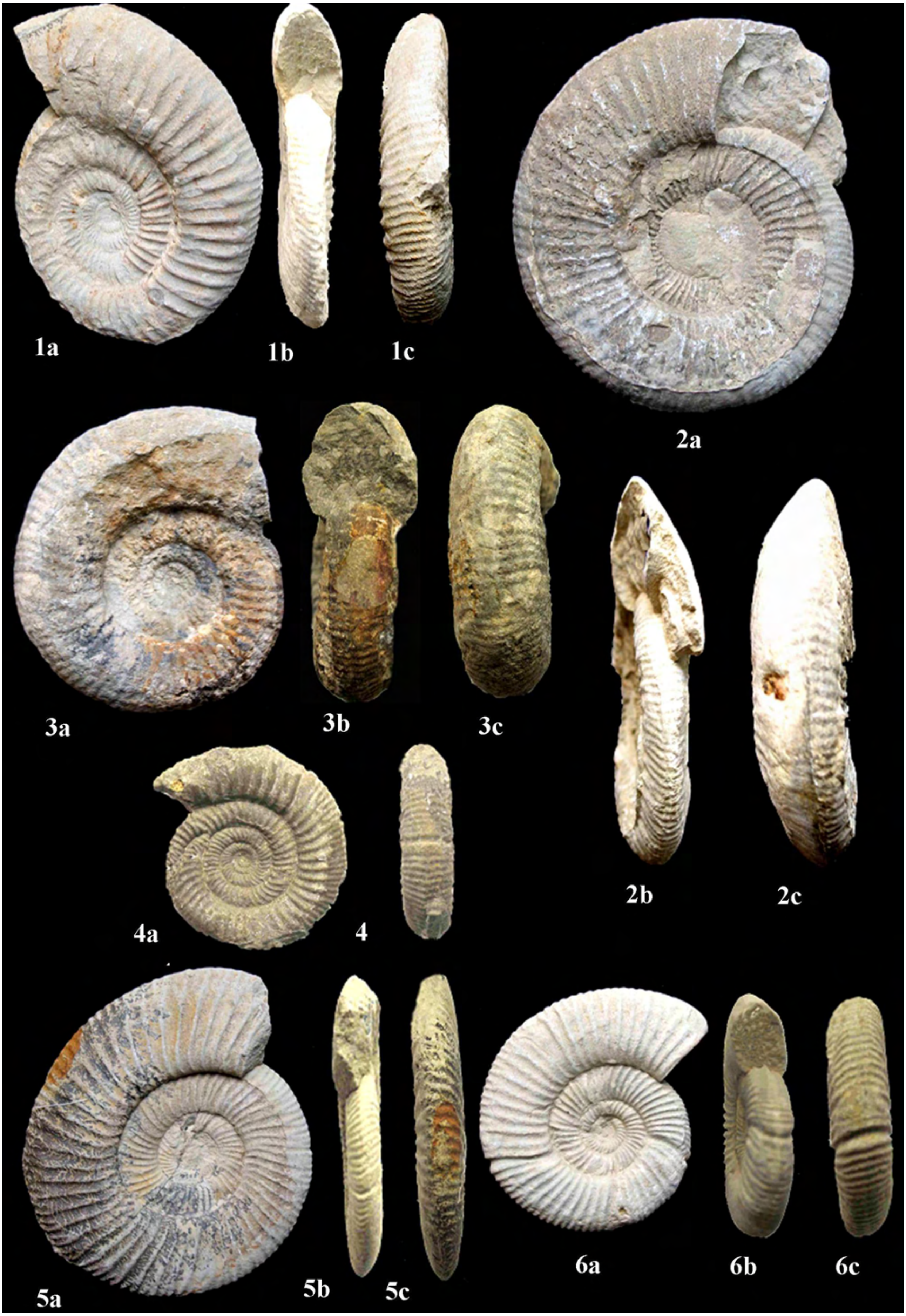

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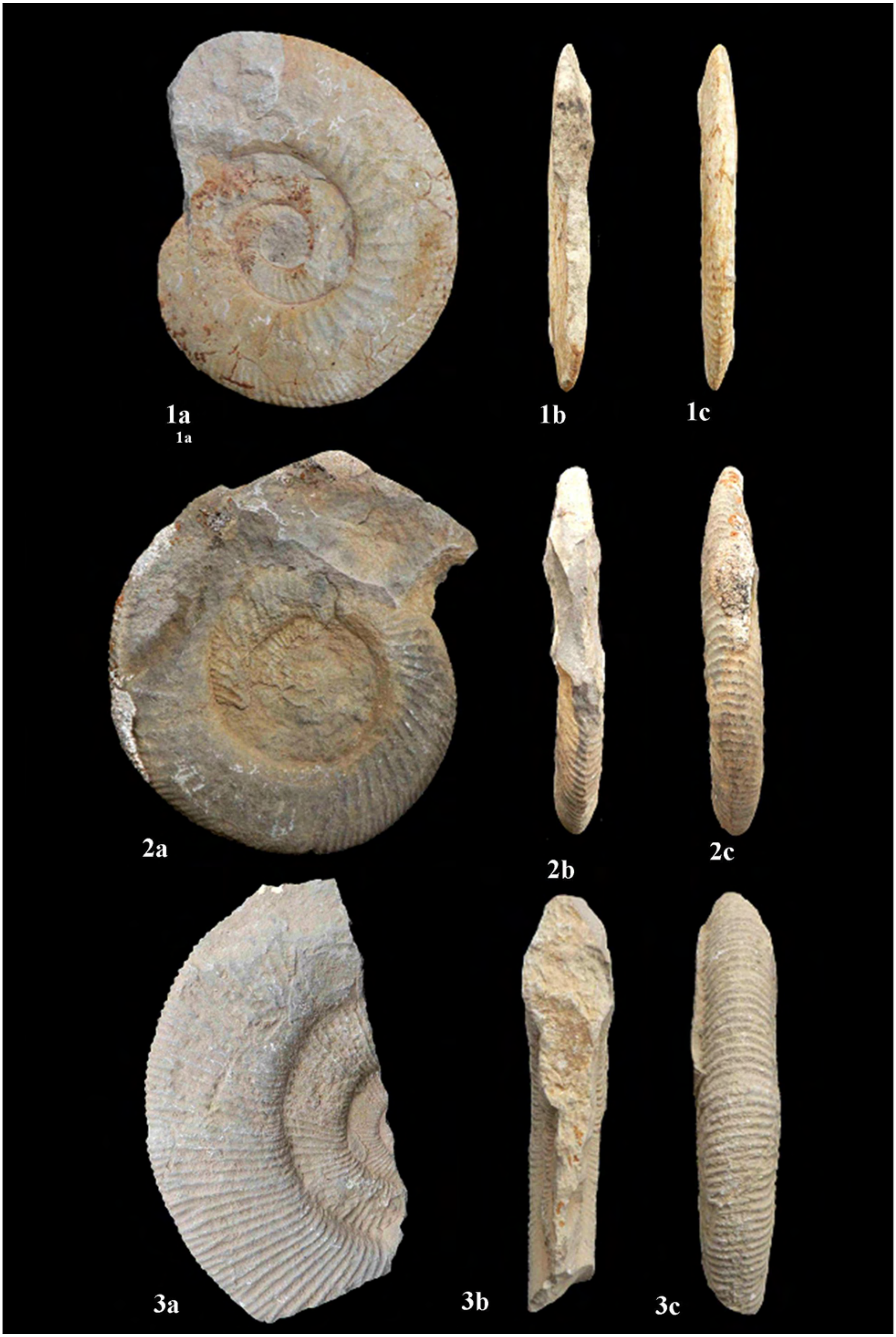

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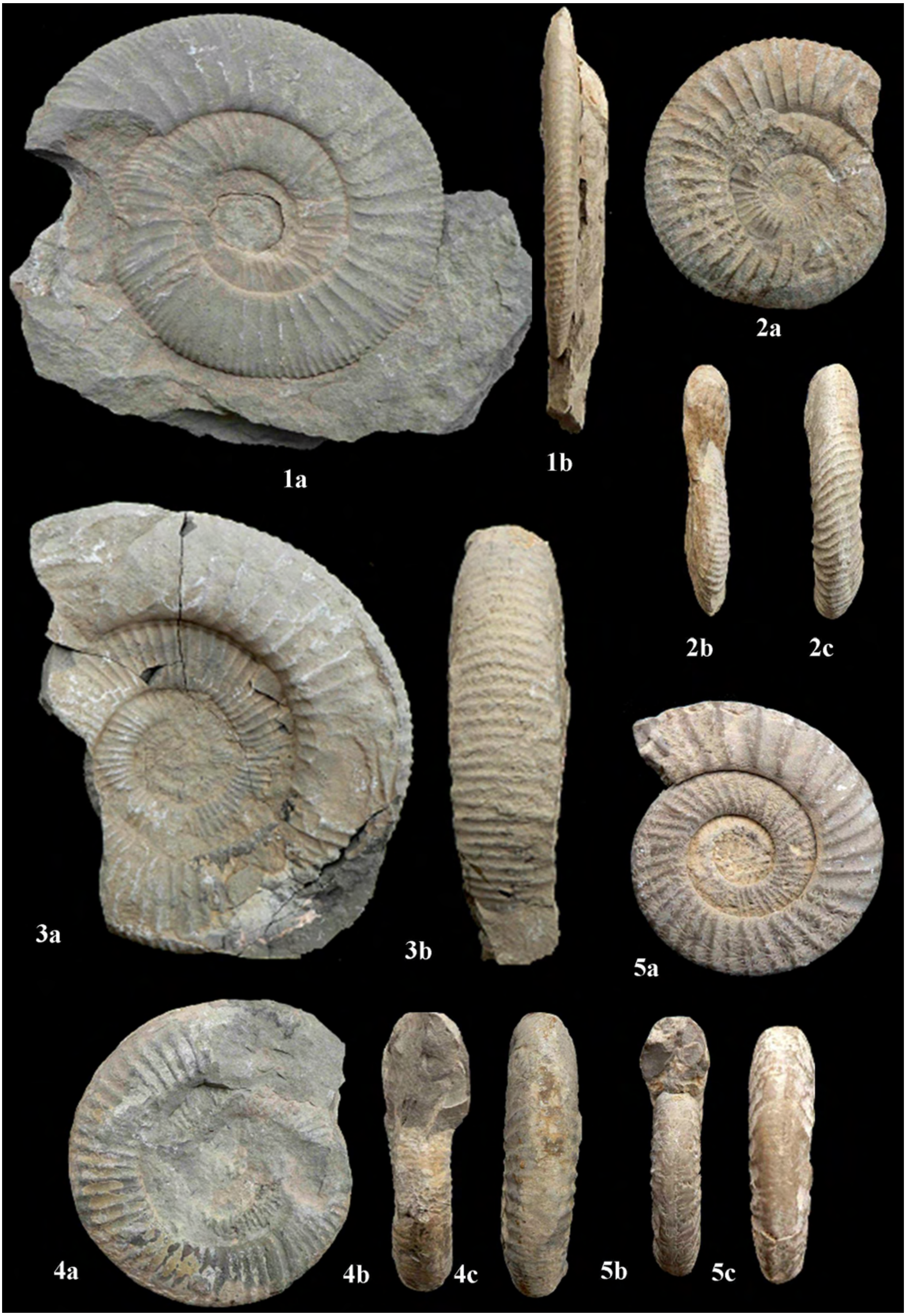


Plate 16

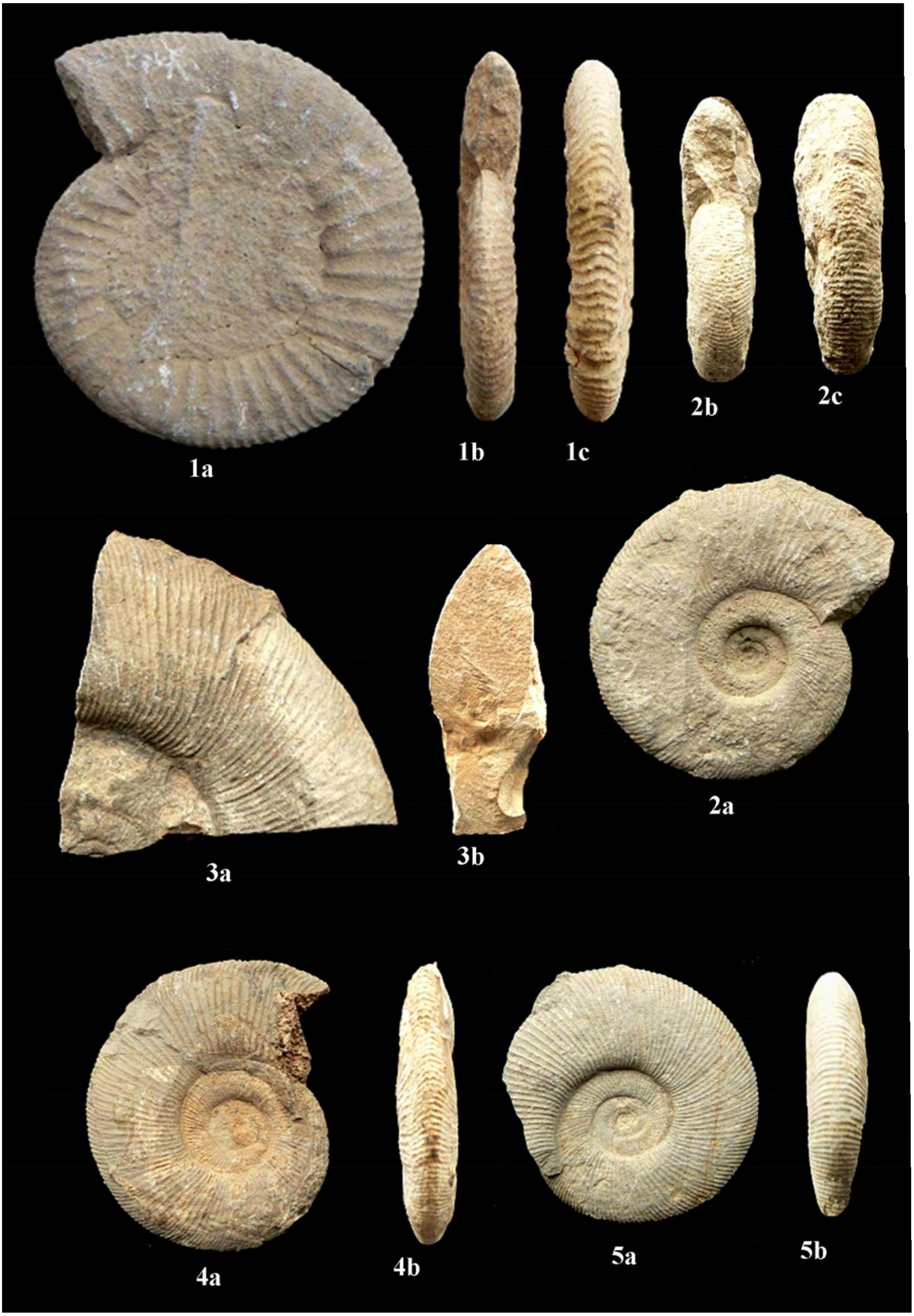


Plate 17

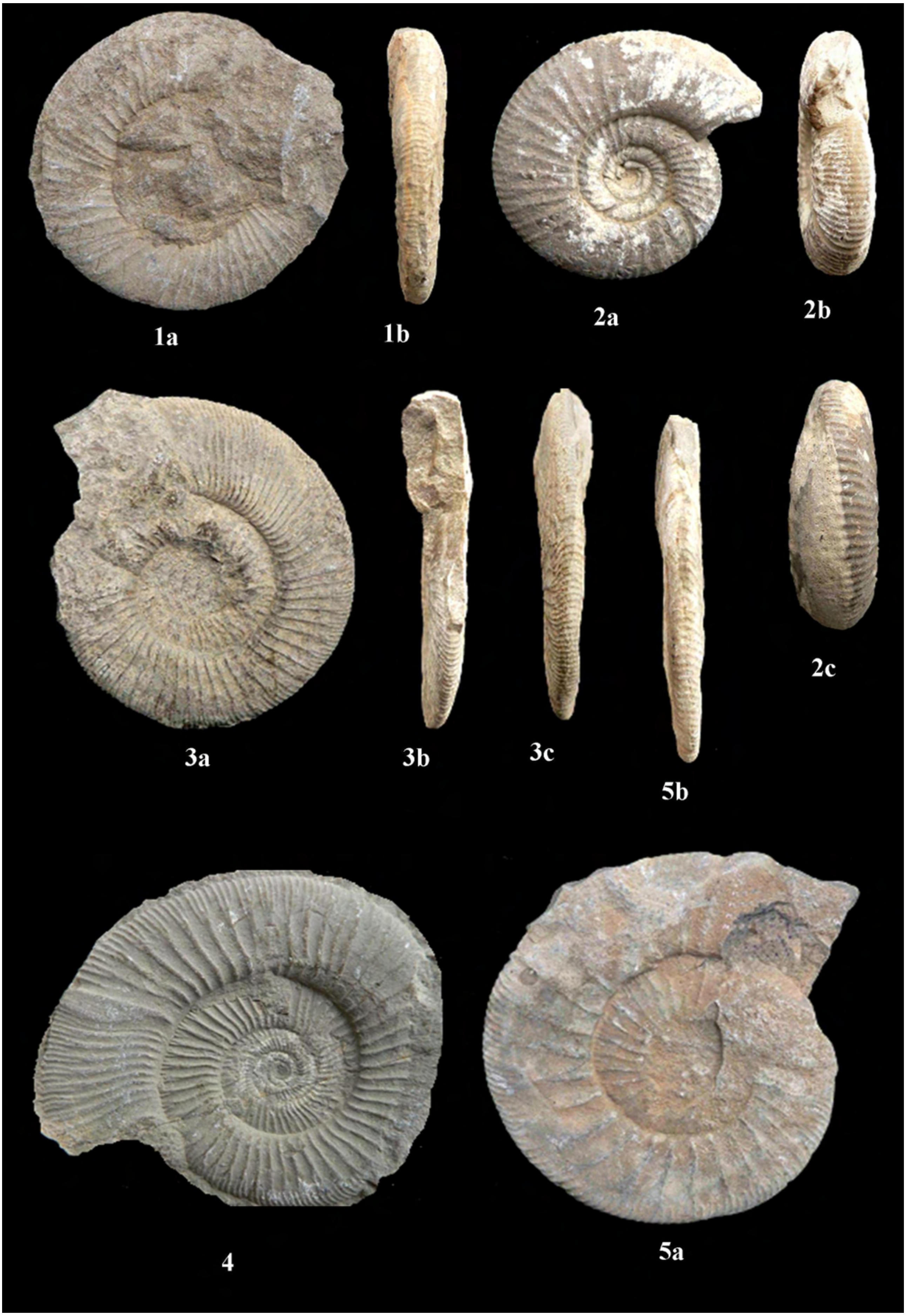


Plate 18

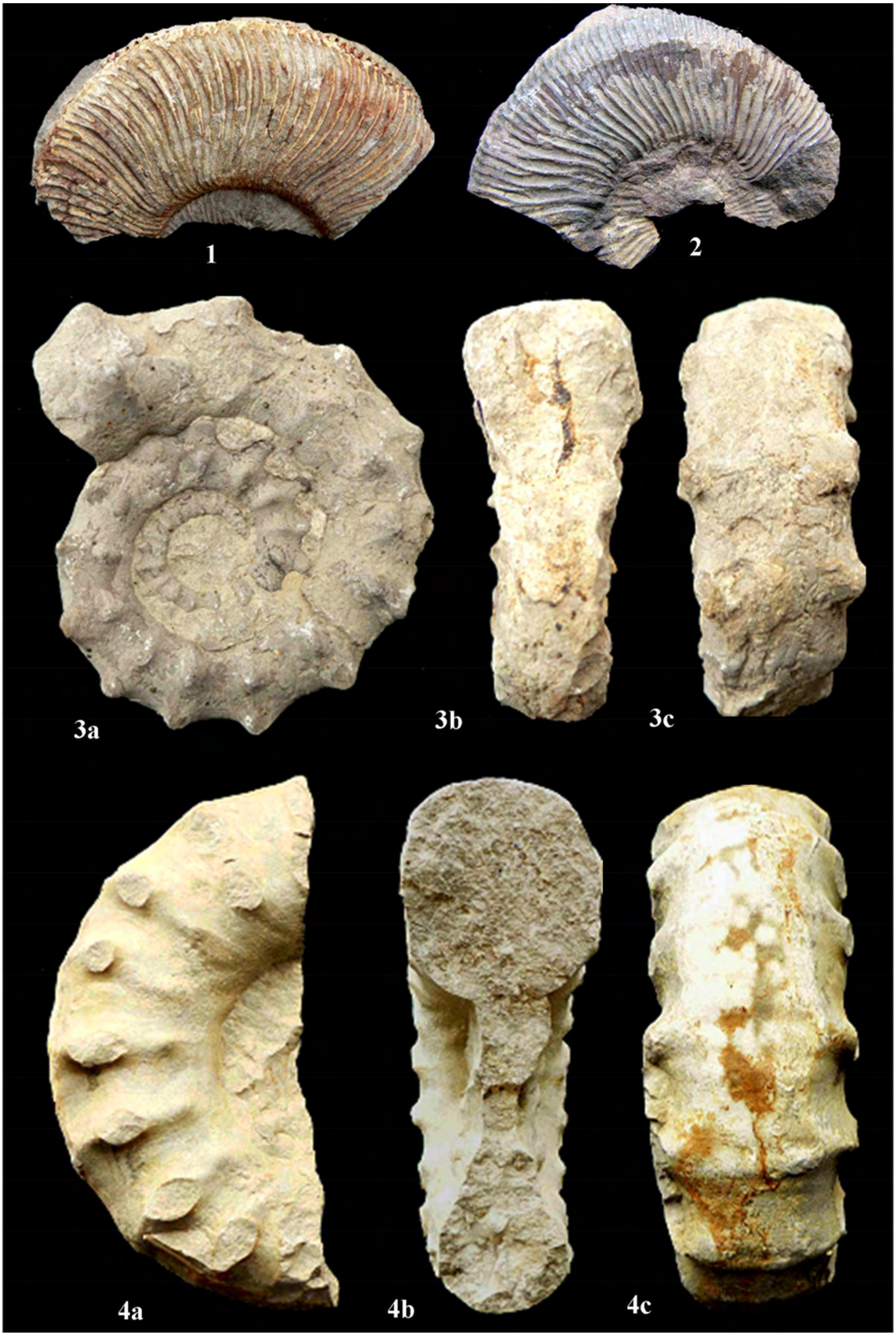


Plate 19

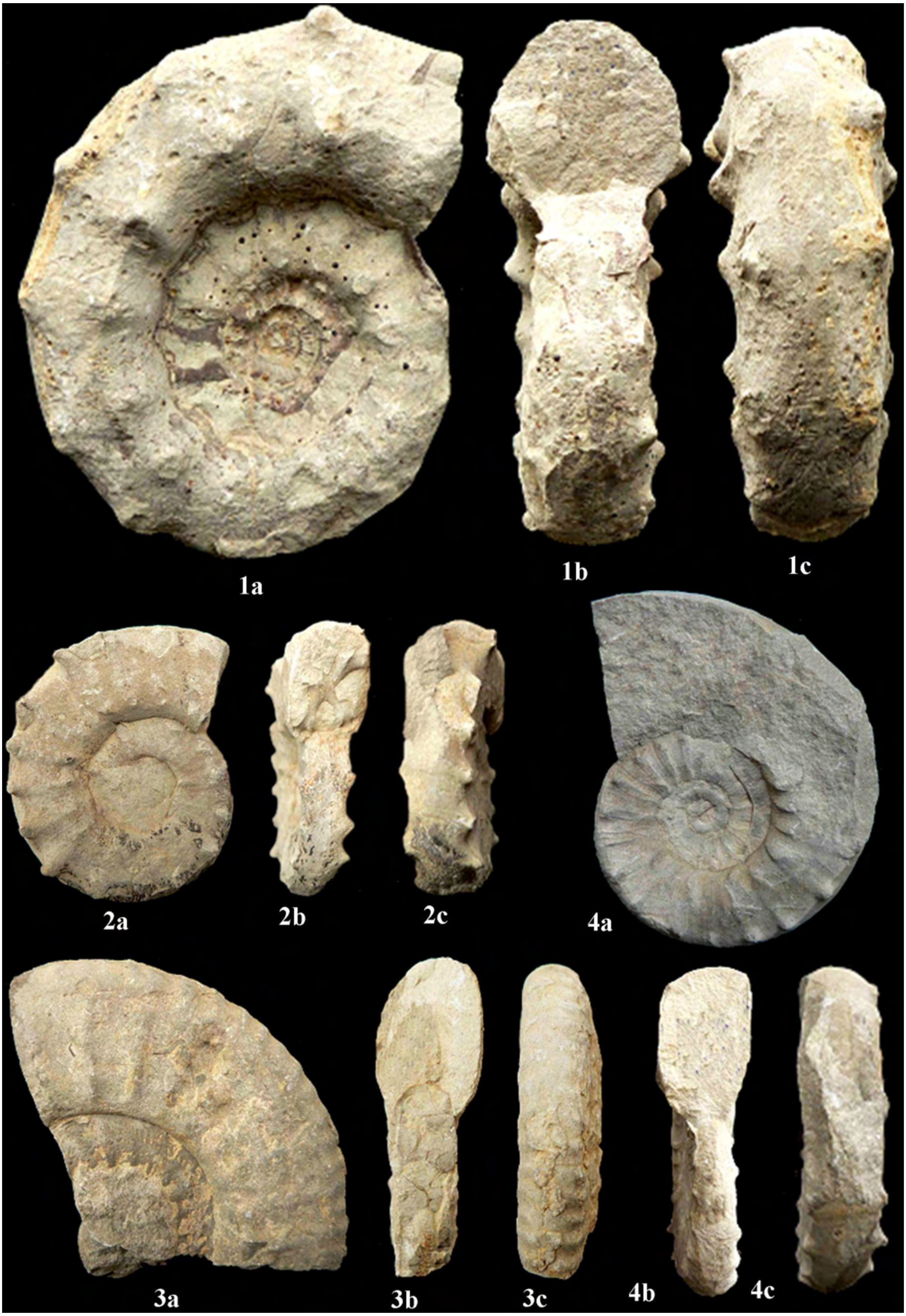
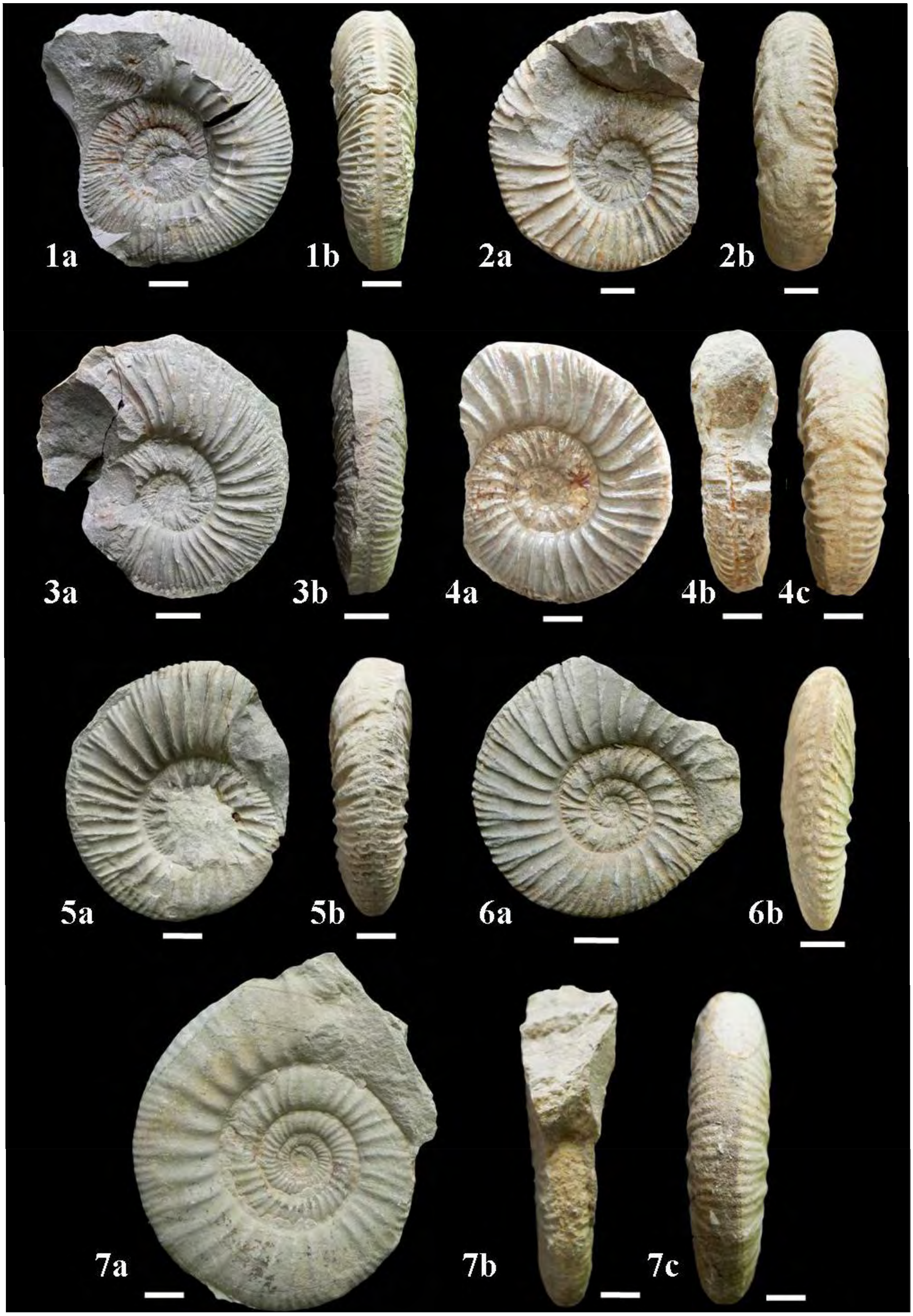


Plate 20



Abbreviations:

SN: sample number in our collection.

As far as the preservation of the specimens allows the following parameters are given:

D: diameter (mm)

Ud: umbilical width (mm)

Wh: whorl height (mm)

Wt: whorl thickness (mm)

U: $\frac{Ud}{D}$ (%)

H: $\frac{wh}{D}$ (%)

W: $\frac{wt}{D}$ (%)

Q: $\frac{H}{W}$

P/2: number of primary ribs on a half whorl.

S/2: number of secondary ribs on a half whorl.

N/2: number of tubercles/half whorl.

Plate 1:

Figs.1a-c: Part 1 Baqhi (Q4-6), Late Bajocian-Bathonian (condensed red bed).

	SN	D(mm)	Ud(mm)	H (%)	W (%)	Q	U (%)
1	Q4-6	41	18	36.5	36.5	1	43.9

Figs.2a-b: Part 1 Baqhi (Q3-26), Late Bajocian-Bathonian (condensed red bed).

	SN	D(mm)	Wh(mm)	Wt(mm)	H (%)	W (%)	Q
1	Q3–26	26	14	10	53	38	1.39

Figs.3a-b: Part 1 Baqhi (Q3-23), Late Bajocian-Bathonian (condensed bed).

	SN	D(mm)	Ud(mm)	H(%)	W (%)	Q	U (%)
1	Q3-23	34	8	44	26.4	1.66	23

Figs.4a-c: Part 2 Dahaneh Heydari (D7-2), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)
1	D7-2	53	12	49	20	1.37	22

Figs.5a-c: Part 1 Baqhi (Q7-14), Early-Middle Callovian.

	SN	D(mm)	H (%)	W (%)	Q
1	Q7-14	70	52	22	2.36

Figs.6a-c: Part 1 Baqhi (Q3-35), Late Bajocian-Bathonian (condensed red bed).

	SN	D(mm)	H (%)	W (%)	Q
1	Q3-35	27	59	22	2.68

Plate 2:

Figs.1a-c: Part 2 Baqhi (Q5-21), Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2
1	Q5-21	66	22	45	21	1.76	33	17

Figs.2a-c: Part 2 Baqhi (Q5-15), Middle Callovian (Anceps Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	N/2
1	Q5-15	26	16	47	27	1.74	29	24	8

Figs.3a-c: Part 2 Baqhi (Q5-18), Middle Calovian (Anceps Zone)

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	N/2
1	Q5-18	45	16	38	20	1.8	35	26	7

Figs.4a-c: Part 2 Baqhi (Q9-11), Late Callovian (Athleta Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)
1	Q9-11	63	7	57	20	2.85	11

Figs.5a-c: Part 2 Baqhi (Q9-5), Late Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2
1	Q9-5	45	10	51	20	2.55	22	20

Figs.6a-c: Part 1 Baqhi (Q3-69), Late Bajocian-Bathonian (condensed red bed).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)
1	Q3-69	31	7	45	23	1.95	23

Plate 3:

Figs.1a-b: Part 3 Baqhi (Q10-1), Early Oxfordian.

	SN	D(mm)	H(%)	W(%)	Q	P/2
1	Q10-1	50	50	20	2.5	23

Figs.2a-c: Part 3 Baqhi (Q11-6), Early Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2
1	Q11-6	75	11	56	23	2.47	15	25

Figs.3a-b: Part 1 Bojnow (B10-3), Late Oxfordian.

	SN	D(mm)	H(%)	W(%)	Q	P/2	N/2
1	B10-3	-	-	-	-	13	-

Figs.4a-b: Part 2 Bojnow (B20-1), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)
1	B20-1	80	15	46	16	2.87	18

Figs.5a-b: Part 3 Bojnow (B47-1), Late Oxfordian- Kimmeridgian?

	SN	D(mm)	H(%)	W(%)	Q	P/2	S/2
1	B47-1	59	49	15	3.26	12	25

Figs.6a-b: Part 2 Baghi (Q5-26), Early Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q5-26	76	23	43	72	0.5	30	17	32

Figs.7a-c: Part 1 Baqhi (Q3-38), Bathonian (Zigzag Zone)(condensed red bed).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q3-38	40	6	50	50	1	15	14	40

Plate 4:

Figs.1a-c: Part 1 Baqhi (Q3-43), Bathonian (Zigzag Zone) (condensed red bed).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q3-43	25	6	48	68	0.7	24	-	33

Figs.2a-b: Part 1 Baqhi (Q3-53), Late Bajocian-Bathonian (condensed red bed).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q3-53	22	10	27	31	0.87	45	27	52

Figs.3a-c: Part 1 Baqhi (Q3-57), Late Bajocian-Bathonian (condensed red bed).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q3-57	24	11	29	29	1	46	25	52

Figs.4a-b: Part 2 Baqhi (Q6-3), Middle Callovian (Anceps Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
1	Q6-3	78	37	32	35	0.91	47	10	21	10

Figs.5a-b: Part 2 Baqhi (Q6-7), Middle Callovian (Anceps Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
3	Q6-7	150	78	42	31	1.35	52	10	36	9

Plate 5:

Figs.1a-c: Part 2 Baqhi (Q6-11), Middle Callovian (Anceps Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
1	Q6-11	38	15	40	50	0.8	39	10	27	7

Figs.2a-c: Part 2 Baqhi (Q7-18), Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q7-18	81	29	40	27	1.48	36	15	46

Figs.3a-b: Part 2 Baqhi (Q9-8), Late Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q9-8	76	28	39	33	1.18	37	14	36

Figs.4a-c: Part 3Baqhi (Q10-9), Late Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q10-9	60	22	38	28	1.36	37	14	30

Figs.5a-b: Part 2 Baqhi (Q6-8), Middle Callovian (Anceps Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q6-8	70	30	38	31	1.22	43	16	31

Figs.6a-c: Part 2 Baqhi (Q7-21), Middle Callovian (Anceps Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q7-21	105	48	33	20	1.6	46	15	27

Plate 6:

Figs.1a-b: Part 2 Baqhi (Q8-9), Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q8-9	83	35	35	25	1.4	42	16	32

Figs.2a-c: Part 2 Baqhi (Q8-11), Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q8-11	76	32	34	33	1.03	42	18	38

Figs.3a-c: *Alborzites binaludensis,* Part 2 Baqhi (BSPG 2011 XXVII 56), Middle Callovian (Coronatum zone).

Figs.4a-b: Part 2 Baqhi (Q9-18), Late Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q9-18	68	26	39	28	1.39	38	12	23

Plate 7:

Figs.1a-c: Part 2 Baqhi (Q9-21), Late Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q9-21	78	29	41	36	1.13	37	12	36

Figs.2a-c: Part 1 Baqhi (Q3-64), Late Bajocian-Bathonian (condensed red bed).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q3-64	30	15	33	27	1.22	50	21	-

Figs.3a-c: Part 1 Baqhi (Q3-73), Late Bajocian-Bathonian (condensed red bed).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q3- 73	29	14	31	27	1.14	48	28	-

Figs.4a-c: Part 2 Baqhi (Q7-24), Middel Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q7- 24	87	21	42	34	1.2	24	13	24

Plate 8:

Figs.1a-b: Part 2 Baqhi (Q7-23), Middel Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)
1	Q7-23	92	40	40	29	1.37	43

Figs.2a-b: Part 2 Baghi (Q5-24), Early- Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
3	Q5-24	75	25	37	27	1.37	27	?	?

Figs.3a-c: Part 1 Baqhi (Q3-75), Late Bajocian-Bathonian (condensed red bed).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q3- 75	35	18	42	28	1.5	51	19	33

Figs.4a-b: Part 2 Baqhi (Q6-24), Middel Callovian,

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q6-24	63	23	41	33	1.24	36	16	43

Figs.5a-c: Part 2 Baqhi (Q5-25), Early- Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	N/2	S/2
1	Q5-25	83	36	33	31	1.06	43	15	25

Plate 9:

Figs.1a-c: Part 2 Baqhi (Q9-24), Late Callovian-Early Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q9-24	64	21	42	21	2	32	38	70

Figs.2a-c: Part 3 Baqhi (Q10-16), Late Callovian-Early Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q10-16	54	14	42	31	1.3	25	36	68

Figs.3a-c: Part 2 Baqhi (Q6-26), Middel Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q6-26	49	22	30	26	1.15	45	28	50

Figs.4a-b: Part 2 Baqhi (D6-1), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D6-1	120	44	36	28	1.3	36	16	30

Figs.5a-b: Part 2 Dahaneh Heydari (D6-2), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D6-2	57	28	28	15	1.87	49	18	31

Plate 10:

Figs.1: Part 3 Dahaneh Heydari (D13-1), Early-Late Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D13-1	230	-	32	11	2.9	-	-	-

Figs.2: Part 3 Bojnow (B45-2), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B45-2	155	81	34	9	3.7	52	29	82

Figs.3a-b: Part 3 Baqhi (Q14-10), Late Oxfordian (Bifurcatus Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q14-10	120	50	36	33	1.09	41	10	14

Figs.4a-c: Part 1 Bojnow (B4-4), Late Oxfordian (Transversarium Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B4-4	53	21	35	20	1.75	39	35	66

Figs.5a-c: Part 1 Bojnow (B5-2), Late Oxfordian (Transversarium Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B5-2	57	23	36	31	1.1	40	24	46

Plate 11:

Figs.1a-c: Part 1 Bojnow (B3-5), Late Oxfordian (Transversarium Zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B3-5	92	37	35	23	1.5	40	27	50

Figs.2a-b: Part 1 Bojnow (B3-6), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B3-6	65	33	30	13	2.3	50	22	44

Figs.3a-c: Part 1 Bojnow (B11-6), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B11-6	74	36	32	31	1	48	32	56

Figs.4a-c: Part 1 Bojnow (B13-2), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B13-2	84	36	36	16	2.25	42	40	76

Plate 12:

Figs.1a-c: Part 2 Bojnow (B24-1), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
2	B24 – 1	72	33	30	19	1.5	45	23	42

Figs. 2a-c: Part 2 Dahaneh Heydari (D30-4), Late Oxfordian (Bifurcatus zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D30-4	75	34	34	21	1.6	45	21	42

Figs.3a-b: Part 2 Bojnow (B24-2), Late Oxfordian (Bifurcatus zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B24-2	55	23	29	14	2	41	23	42

Figs.4a-c: Part 3 Dahaneh Heydari (D10-3), Late Oxfordian (Bifurcatus zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D10-3	70	33	32	20	1.6	47	23	46

Figs.5a-c: Part 2 Bojnow (B22-6), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B22-6	77	30	38	14	2.7	38	27	54

Figs.6a-b: Part 3 Dahaneh Heydari (D10-4), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D10-4	115	43	33	13	2.5	37	30	57

Plate 13:

Figs.1a-c: Part 2 Bojnow (B20-3), Late Oxfordian (Bifurcatus zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B20-3	78	34	39	19	2	43	19	38

Figs.2a-c: Part 2 Bojnow (B21-3), Late Oxfordian (Bifurcatus zone).

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B21-3	85	35	34	22	34	1.5	21	40

Figs.3a-c: Part 2 Dahaneh Heydari (D4-6), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D4-6	45	22	35	37	0.9	48	224	44

Figs.4a-b: Part 1 Bojnow (B4-7), Early-Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B4-7	31	16	29	25	1.16	51	20	36

Figs.5a-c: Part 1 Bojnow (B10-5), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B10-5	60	19	31	11	2.8	50	25	47

Figs.6a-c: Part 1 Bojnow (B12-6), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B12-6	51	22	31	23	1.3	43	22	40

Plate 14:

Figs.1a-c: Part 3 Dahaneh Heydari (D16-1), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D16-1	110	42	24	10	2.4	38	21	48

Figs.2a-c: Part 3 Dahaneh Heydari(D14-2), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D14-2	130	57	31	13	2.38	44	31	73

Figs.3a-c: Part 3 Dahaneh Heydari (D12-1), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D10 -1	-	72	-	-	-	-	48	84

Plate 15:

Figs.1a-b: Part 3 Dahaneh Heydari (D11-1), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D11-1	104	49	29	10	2.9	47	19	43

Figs.2a-c: Part 3 Dahaneh Heydari (D11-2), Late Oxfordian-Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D11-2	47	23	28	19	1.47	49	20	45

Figs.3a-b: Part 3 Dahaneh Heydari (D14-3), Late Oxfordian-Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D14-3	125	63	26	23	1.13	50	23	52

Figs.4a-c: Part 4 Baqhi (Q23-5), Late Oxfordian-Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	Q23-5	145	78	32	23	1.39	54	27	61

Figs.5a-c: Part 3 Bojnow (B26-3), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B26-3	67	30	27	20	1.34	44	19	45

Plate 16:

Figs.1a-c: Part 3 Dahaneh Heydari (D14-4), Late oxfordian-Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D14-4	76	40	29	16	1.84	53	19	47

Figs.2a-c: Part 2 Bojnow (B21-2), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
4	B21-2	85	32	41	21	1.95	37	44	85

Figs.3a-b: Part 2 Dahaneh Heydari (D16-6), Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
2	D16-6	-	-	-	-	-	-	-	-

Figs.4a-b: Part 3 Dahaneh Heydari (D14-1), Early-Late Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D14-1	84	31	40	19	2.1	36	48	72

Figs.5a-b: Part 3 Bojnow (B26-2), Early-Late Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B26-2	43	14	41	18	2.2	32	44	85

Plate 17:

Figs.1a-b: Part 3 Dahaneh Heydari (D15-2), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D15-2	93	38	34	16	2.15	40	27	72

Figs.2a-c: Part 3 Dahaneh Heydari (D16-3), Late Oxfordian-Early Kimmeridgian

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D16-3	50	21	34	26	1.3	42	22	54

Figs.3a-c: Part 3 Dahaneh Heydari (D15-3), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D15-3	64	27	33	12	2.62	42	36	102

Figs.4: Part 3 Dahaneh Heydari (D15-5), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D15-5	57	27	30	12	2.5	47	31	68

Figs.5a-b: Part 3 Bojnow (B41-1), Early Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	B41-1	97	45	32	12	2.66	46	13	42

Plate 18:

Figs.1: Part 3 Dahaneh Heydari (D15-1), Early-Late Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D15-1	-	27	-	-	-	-	51	96

Figs.2: Part 3 Dahaneh Heydari (D14-5), Early-Late Kimmeridgian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2
1	D14-5	55	-	34	12	2.28	-	34	56

Figs.3a-c: Part 2 Baghi (Q9-14), Late Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	N/2
1	Q9-14	81	41	34	40	0.85	50	7

Figs.4a-c: Part 3 Baqhi (Q11-16), Late Callovian-Early Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	N/2
1	Q11-16	150	61	37	37	1	40	8

Plate 19:

Figs.1a-c: Part 3 Baqhi (Q11-17), Late Callovian-Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	N/2
1	Q11-17	135	67	32	37	0.86	49	7

Figs.2a-c: Part 2 Dahaneh Heydari (D2-3), Early-Late Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	N/2
1	D2-3	66	27	34	28	1.2	40	8

Figs. 3a-c: Part 2 Baghi (Q6-13), Middel Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	N/2
1	Q6-13	-	37	-	-	-	-	14	-

Figs. 4a-c: Part 2 Baqhi (Q12-5), Late Callovian-Oxfordian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	N/2
1	Q12-5	79	30	37	27	1.3	37	10

Plate 20:

Figs. 1a-b: Part 3 (GH 7-1), Early-Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
1	GH 7-1	85	35	35	23	1.52	41	14	43	9

Figs. 2a-b: Part 3 (GH 6-3), Early-Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
1	GH 6-3	73	33	41	32	1.2	45	14	35	-

Figs. 3a-b: Part 4 (GH 8-5), Middle-Late Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
1	GH 8-5	74	26	38	21	1.8	35	16	48	-

Figs. 4a-c: Part 3 (GH 7-3), Early-Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
1	GH 7-3	87	33	32	40	0.8	38	14	29	-

Figs. 5a-b: Part 3 (GH 6-7), Early-Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
1	GH 6-7	65	30	41	26	1.57	46	15	40	-

Figs. 6a-b: Part 3 (GH 6-8), Early-Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
1	GH 6-8	60	25	33 ?	20 ?	1.65 ?	41	14	37	-

Figs. 7a-c: Part 3 (GH 6-10), Early-Middle Callovian.

	SN	D(mm)	Ud(mm)	H(%)	W(%)	Q	U(%)	P/2	S/2	N/2
1	GH 6-10	110	60	31	30	1.03	54	18	45	-