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Smithian (Early Triassic) ammonoid faunas from Exotic Blocks from Timor: taxonomy and biochronology

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Abstract

Two extensive collections retrieved from Exotic Blocks from West Timor have yielded several astonishingly well-preserved and highly diversified Smithian (Early Triassic) ammonoid faunas (*Kashmirites* fauna, *Owenites* fauna, *Anasibirites* fauna). A population approach on this material, with an emphasis on ontogeny and covariation of morphological characters, led to the unprecedented assessment of intraspecific variation for many species. Based on this, their synonymy is thoroughly discussed whenever possible. One new genus (*Roopnarinites*) and five new species (*Paraspidites bicarinatus*, *Flemingites lidakensis*, *Subflemingites bihatiense*, *Baidites obesus* and *Churkites warei*) are described. These results have a direct impact on the resolution and accuracy of biochronological correlations, as well as on the accuracy of diversity counts at the species level, which is important for potential future broad-scale diversity analyses. This material also provides highly valuable data for comprehensive biogeographical and phylogenetic studies hopefully to come. Finally, these new Timor data strengthen the singularly uniform biogeographical distribution of the Smithian ammonoid faunas within the Tethys.

Keywords: Ammonoids; Early Triassic; Smithian; Timor

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1 Introduction

Ammonoid cephalopods were among the organisms most affected by the Permian-Triassic boundary mass extinction (about 251.96 Ma, BARESEL et al. 2017). However, it is now well established that ammonoids recovered very fast in the aftermath of this crisis (BRAYARD et al. 2009a; ZAKHAROV & ABNAVI 2013; ZAKHAROV & POPOV 2014; BRAYARD & BUCHER 2015).

In this context, the Smithian is a critical time interval within the Early Triassic: the main rediversification of ammonoids occurred in the early and middle Smithian, then immediately followed by the most severe intra-Triassic crisis for the nekton, in the late Smithian (BRAYARD et al. 2006; BRAYARD et al. 2009a; BRÜHWILER et al. 2010a; WARE et al. 2015; Text-fig. 1).

Oceanic basins documenting this major, global Smithian diversification-extinction cycle recently received much attention from the earth science community (e.g., western USA, BRAYARD et al. 2009b; JENKS et al. 2010; BRAYARD et al. 2013; JATTIOT et al. 2017; South China, BRAYARD & BUCHER 2008; South Primorye, ZAKHAROV et al. 2002; SHIGETA & ZAKHAROV 2009; SHIGETA et al. 2009; ZAKHAROV et al. 2013; SHIGETA & KUMAGAE 2015; South Tibet, BRÜHWILER et al. 2010b; Oman, BRÜHWILER et al. 2012a; Salt Range, BRÜHWILER et al. 2012b; Spiti, BRÜHWILER et al. 2012c; Vietnam, SHIGETA & NGUYEN 2014).

Timor Island is also long known for providing abundant Smithian ammonoids with a state of preservation often considered as unmatched in the rest of the world for this time interval.

However, there are to our knowledge very few studies on Smithian ammonoids from Timor in the literature. After the substantial pioneering work of WELTER (1922), only SPATH (1934) and KUMMEL (1968a) examined Smithian ammonoids from Timor, and none of these three works studied a much extensive material using a statistical population approach.

Our work is based on two collections (Snyder and Veit collections, Paläontologisches Institut der Universität Zürich) that include very abundant (about 1400 measured specimens), diverse and exceptionally well-preserved Smithian ammonoids from Timor, allowing us to perform remarkably accurate taxonomic work. A part of this material has been recently studied by JATTIOT et al. (2015) in a revision of the late Smithian *Anasibirites* genus. Noteworthy, most of the early and middle Smithian specimens from the two collections were already fully prepared and isolated, and therefore lack stratigraphical superposition. However, on the one hand the exceptional preservation of the material led to the unprecedented assessment of intraspecific variation for many species, and to the description of unconspicuous and previously unknown features in previously described species. On the other hand, several new taxa have been found, which is important for future broad-scale diversity analyses. Finally, this material provides highly valuable data for potential biogeographical and phylogenetic studies.

2 Geological setting

During Early Triassic times, Timor was located in the eastern part of Pangea (c. –15° latitude and 125° longitude) and off the northern Australian margin, in the transition zone between the Tethyan and Panthalassic realms. The present-day Timor Island is situated in the southeastern part of the Indonesian archipelago, 1500 km east of Java and 400 km northwest of northern Australia. The studied material was retrieved in West Timor, mainly in Lidak, Bihati (Baun) and Noe Tobe localities (Text-fig. 2).

In Timor, Early Triassic ammonoids mostly come from the prolifically fossiliferous lithologies termed the 'Cephalopod Limestone Facies' (WANNER 1911; WANNER 1913), which occurs as exotic blocks up to a few meters thick, embedded in the Cenozoic Bobonaro Formation (CHARLTON et al. 2009). These cephalopod limestones usually form highly condensed sequences but the ages represented by the different ammonoid faunas indicate that the three main subdivisions of the Smithian are present (early, middle and late Smithian). Reddish-pinkish micritic pelagic limestones (Hallstatt facies) represent the early and middle Smithian, whereas the late Smithian is characterized by a singular white lumachelle facies thoroughly described in JATTIOT et al. (2015). Early Smithian ammonoids are often coated in black ferromanganiferous minerals.

Regarding biostratigraphy, WELTER (1922) described three subdivisions in his pioneer work, namely the *Meekoceras* limestone (early Smithian), the *Owenites* limestone (middle Smithian) and the *Anasibirites* limestone (late Smithian). We here consider WELTER's (1922) *Meekoceras* limestone subdivision as inaccurate since no actual *Meekoceras* were identified in our early Smithian material that instead yielded numerous specimens of *Kashmirites*. Hence, we define three subdivisions: the *Kashmirites* fauna (early Smithian), the *Owenites* fauna (middle Smithian) and the *Anasibirites* fauna (late Smithian).

Comparing our new Smithian ammonoid faunas from Timor with faunal successions from well-expanded sections from South China (BRAYARD & BUCHER 2008), South Tibet (BRÜHWILER et al. 2010b), Pakistan (BRÜHWILER et al. 2012b) and Spiti (BRÜHWILER et al. 2012c), mixing of faunas due to condensation was evidenced in the early and middle Smithian material. Indeed, regarding the middle Smithian, the species *Nyalamites angustecostatus* (WELTER, 1922), *Pseudoceltites multiplicatus* (WAAGEN, 1895) and *Truempyceras compressum* BRÜHWILER et al., 2012c, used as bed markers in Tethys localities (Text-fig. 3), were found undeniably associated.

Noteworthy, the genus *Brayardites* was not directly found in association with *Owenites* in our material. However, the species *Brayardites compressus* BRÜHWILER et al., 2010b, *Owenites simplex* WELTER, 1922 and *Pseudaspenites layeriformis* (WELTER, 1922) were identified each on different pieces of the same block (NR10), all parts of this block sharing the exact same sedimentological facies. This suggests that the middle Smithian *Brayardites compressus* beds recognized below the *Owenites* beds in the Tethys (the Salt Range, South Tibet and Spiti) is not individualized in Timor. Thorough field investigations are thus crucial to further enhance the Smithian biostratigraphy of Timor.

3 Systematic palaeontology

Systematic descriptions follow the classification established by TOZER (1981; 1994) and then further refined by BRAYARD & BUCHER (2008), BRÜHWILER et al. (2012a; 2012b; 2012c). The quantitative morphological range of each species is illustrated by plots provided at least three measureable specimens were available. Each set of measurements includes the classical geometric parameters of the ammonoid conch such as the shell diameter (D) and corresponding whorl height (H), whorl width (W) and umbilical diameter (U). To assess their variability within each species, these parameters are plotted as a ratio of the size-related parameter D (H/D, W/D and U/D) in order to remove the influence of growth.

Abbreviations: non: material not forming part of the current species; p: pars; v.: video or vidimus; ?: questionable. Repository of specimens is abbreviated PIMUZ (Paläontologisches Institut und Museum der Universität Zürich, Switzerland).

Subclass Ammonoidea ZITTEL, 1884

Order Ceratitida HYATT, 1884

Superfamily Xenodiscaceae FRECH, 1902

Family Kashmiritidae SPATH, 1934

Genus *Kashmirites* DIENER, 1913

Type species: *Celtites armatus* WAAGEN, 1895

Kashmirites armatus (WAAGEN, 1895)

(Plate 1, Figs D–T)

1895 *Celtites armatus* WAAGEN, p. 75, pl. 7, figs 1, 7.
1922 *Xenodiscus lidacensis* WELTER, p. 108, pl. 5, figs 5–7, 18; pl. 6, figs 1, 2.
1922 *Xenodiscus lidacensis involutior* WELTER, p. 109, pl. 5, figs 3, 4, 11–13.
v 2012b *Kashmirites armatus* – BRÜHWILER & BUCHER, p. 24, fig. 19A–M.

Occurrence: *Kashmirites* fauna.

Measurements: See Text-fig. 4. Estimated maximal size: ~ 7 cm.

Description: Very evolute, serpenticonic shell with slightly flattened flanks and depressed whorls. Venter broad and subtabulate with slightly rounded but marked shoulders. Umbilicus wide with a nearly vertical wall and rounded shoulders. Ornamentation consists of distinct ribs showing great variability in spacing and shape, and becoming finer and denser at maturity. Ribs usually stop at ventral shoulders, but occasionally cross the venter as faint ridges. Suture line ceratitic with slightly phylloid saddles.

Discussion: This species mainly differs from *K. nivalis* (DIENER, 1897) and *K. kapila* (DIENER, 1897) by its more depressed whorls.

Kashmirites baidi BRÜHWILER & BUCHER, 2012a

(Plate 1, Figs A–C)

v 2012a *Kashmirites baidi* BRÜHWILER & BUCHER, p. 16, pl. 1, fig. 2.
v 2012b *Kashmirites baidi* – BRÜHWILER & BUCHER, p. 25, fig. 19N–Z.

Occurrence: *Kashmirites* fauna. One single specimen.

Measurements: See Text-fig. 5. Estimated maximal size: ~ 4 cm.

Description: Very evolute, serpenticonic shell with slightly convex flanks and depressed whorls. Venter broad and subtabulate with slightly rounded but marked shoulders. Umbilicus wide, with a nearly vertical wall and rounded shoulders. Ornamentation very distinctive, consisting of simple or paired, radial ribs, becoming denser at maturity. Ribs cross the venter as broad folds at juvenile stages, and as weak ribs at maturity. Suture line not available in our material.

Discussion: Other species of *Kashmirites* differ from this species by an ornamentation exclusively consisting of simple ribs. The ornamentation of *K. baidi* is also much stronger on innermost whorls.

Kashmirites cf. *guangxiense* BRAYARD & BUCHER, 2008

(Plate 1, Figs U–Z)

v 2008 *Kashmirites guangxiense* BRAYARD & BUCHER, p. 16, pl. 1, figs 1–10.

Occurrence: *Kashmirites* fauna.

Measurements: See Text-fig. 6. Estimated maximal size: ~ 8.5 cm.

Description: Very evolute, serpenticonic shell with slightly convex flanks and depressed whorls. Venter broad and slightly arched with rounded shoulders. Umbilicus with moderately high wall, inclined on outer

whorl but nearly vertical on inner whorls. Rounded umbilical shoulders. Ornamentation consists of very broad, swollen (bullate) folds at juvenile stages, then gradually passing to rursiradiate fold-like ribs and finally to fine and dense rursiradiate ribs at maturity. Ornamentation crosses the venter. Delicate strigation visible on the inner whorls of the adult specimen. Suture line not available in our material.

Discussion: This taxon shares with *K. guangxiense* BRAYARD & BUCHER, 2008 an ornamentation consisting of bullate folds at juvenile stages. However, our large specimen is much larger than the type specimens of *K. guangxiense*, thus preventing a definitive species assignment. Alternatively, the two specimens might represent extreme variants of *K. nivalis*. The type species is distinguished by its sharper and denser ornamentation.

Kashmirites nivalis (DIENER, 1897)

(Plate 2, Figs A–U)

	1897	*Danubites nivalis* DIENER, p. 51, pl. 15, figs 17–19.
	1909	*Xenodiscus nivalis* – KRAFFT & DIENER, p. 102, pl. 24, figs 1–3, 5; pl. 25, fig. 5.
	1922	*Xenodiscus nivalis* – WELTER, p. 107, pl. 5, figs 19, 20.
	1922	*Xenodiscus molengraaffi* WELTER, p. 108, pl. 4, figs 10–13.
	1934	*Anakashmirites nivalis* – SPATH, p. 237, pl. 12, fig. 4a–e.
v	2012b	*Kashmirites* cf. *nivalis* – BRÜHWILER & BUCHER, p. 25, fig. 19AA–AH.
v	2012c	*Kashmirites nivalis* – BRÜHWILER et al., p. 130, fig. 13I–R.

Occurrence: *Kashmirites* fauna.

Measurements: See Text-fig. 7. Estimated maximal size: ~ 7 cm.

Description: Very evolute, serpenticonic shell with convex flanks and slightly compressed whorls. Venter arched with rounded shoulders. Umbilicus wide, with low, inclined umbilical wall and rounded shoulders. Ornamentation consists of distant folds-like ribs that may cross the venter on the outer whorl of a few specimens. Ribs become finer and denser at maturity. Suture line ceratitic with relatively deep lobes; first lateral saddle very slightly phylloid.

Discussion: This species differs from *K. armatus* by its more compressed whorls and blunt, thicker ribs. *Kashmirites kapila* exhibits a sharper and denser ribbing.

Genus *Preflorianites* SPATH, 1930

Type species: *Danubites strongi* HYATT & SMITH, 1905

Preflorianites radians CHAO, 1959

(Plate 2, Fig. V)

	1922	*Xenodiscus bittneri* – WELTER, p. 106, pl. 4, figs 8, 9.
	1959	*Preflorianites radians* CHAO, p. 196, pl. 3, figs 6–8.
?	1968	*Preflorianites* cf. *radians* – ZAKHAROV, p. 137, pl. 27, figs 5, 6.
v	2008	*Pseudoceltites*? *angustecostatus* – BRAYARD & BUCHER, p. 18, pl. 3, figs 1–7.
v	2012a	*Preflorianites radians* – BRÜHWILER & BUCHER, p. 15, pl. 1, figs 8, 9; pl. 2, figs1–7.
v	2012c	*Preflorianites* cf. *radians* – BRÜHWILER et al., p. 132, fig. 13A–E.
	2014	*Preflorianites radians* – SHIGETA & NGUYEN, p. 66, figs 46, 47.
	2018	*Preflorianites* cf. *radians* – JENKS & BRAYARD, p. 15, figs 11, 12.

Occurrence: *Owenites* fauna. One single specimen.

Measurements: not available.

Description: Evolute shell with a compressed whorl section. Venter rounded with rounded shoulders forming elliptical whorl section. Large, shallow umbilicus with a steeply inclined wall and rounded shoulders. Ornamentation consists of regularly spaced, strong, slightly rursiradiate ribs fading out towards ventral shoulders. Suture line not available in our material.

Discussion: The reader is referred to BRAYARD et al. (2013), JATTIOT et al. (2017) and JENKS & BRAYARD (2018).

Genus *Pseudoceltites* HYATT, 1900

Type species: *Celtites multiplicatus* WAAGEN, 1895

Pseudoceltites multiplicatus (WAAGEN, 1895)

(Plate 3, Figs A–AB, Plate 4, Figs A–O)

	1895	*Celtites multiplicatus* WAAGEN, p. 78, pl. 7, fig. 2a–c.
	1895	*Celtites dimorphus* WAAGEN, p. 80, pl. 7, fig. 5a–c.
	1922	*Kashmirites* cf. *subarmatus* – WELTER, p. 121, pl. 10, figs 6–8.

1922 *Kashmirites subrobustus* WELTER, p. 121, pl. 9, figs 13–15.
Kashhmirites robustus WELTER, p. 122, pl. 9, figs 7–8.
1922 *Kashmirites evolutus* WELTER, p. 124, pl. 10, figs 1–5.
1922 *Kashmirites acutangulatus* WELTER, p. 125, pl. 9, figs 9–12.
1976 *Pseudoceltites multiplicatus* – WANG & HE, p. 289, pl. 6, figs 7–11.
? 1976 *Eukashmirites* cf. *blaschkei* – WANG & HE, p. 290, pl. 6, fig. 12.
? 1976 *Eukashmirites* cf. *subarmatus* – WANG & HE, p. 291, pl. 6, figs 13, 14.
v 2010b *Pseudoceltites multiplicatus* – BRÜHWILER et al., p. 409, fig. 5 (1–7).
v 2012b *Pseudoceltites multiplicatus* – BRÜHWILER & BUCHER, p. 27, fig. 21A–AC.
v 2012c *Pseudoceltites multiplicatus* – BRÜHWILER et al., p. 128, fig. 11A–Z.
v 2012c ?*Pseudoceltites* sp. indet. – BRÜHWILER et al., p. 130, fig. 11AA–AE.

Occurrence: *Owenites* fauna. In association with *Nyalamites angustecostatus* (see Plate 3, Fig. W).

Measurements: See Text-fig. 8. Estimated maximal size: ~ 7 cm.

Description: Moderately evolute to evolute shell, with a subquadratic to subrectangular whorl section. Flanks flat, converging very weakly. Venter broad and subtabulate, slightly arched with narrowly rounded shoulders. Umbilicus with a high vertical wall and marked, abruptly rounded shoulders. Great intraspecific variation in ornamentation, varying among specimens as well as on the same specimen from strong, distant radial ribs to fine, more closely spaced and slightly sinuous ribs. Remarkably, one specimen (Plate 3, Figs T–V) tends to develop umbilical tubercles. Ribs usually fade out on ventral shoulders, but occasionally cross the venter as faint ridges or folds; and tend to become finer and denser on flanks at mature stages. Suture line not available in our material.

Discussion: This species shows a very high morphological and ornamental variation. For instance, most of the specimens exhibit a subquadratic whorl section, but compressed variants with a subrectangular and narrower venter do exist, such as the holotype and some specimens from Timor (Plate 4, Figs A–O). '*Kashmirites*' *acutangulatus* erected by WELTER (1922) also corresponds to these compressed variants of *P. multiplicatus*. Furthermore, our abundant and well-preserved material clearly shows that the three species *K. subrobustus*, *K. robustus* and *K. evolutus* erected by WELTER (1922) belong to the genus *Pseudoceltites* and merely represent variants of a single species: *P. multiplicatus*. Likewise, specimens described as *K.* cf. *subarmatus* by WELTER (1922) fall within the intraspecific variation of *P. multiplicatus*.

Pseudoceltites densistriatus (WELTER, 1922)

(Plate 4, Figs P–AJ)

1922 *Kashmirites densistriatus* WELTER, p. 123, pl. 10, figs 9–16.

Occurrence: *Owenites* fauna.

Measurements: See Text-fig. 9. Estimated maximal size: ~ 4.5 cm.

Description: Moderately evolute to evolute shell, with a subquadratic to subrectangular whorl section. Flanks flat, converging very weakly. Venter broad and subtabulate, slightly arched with narrowly rounded shoulders. Umbilicus with a high vertical wall and marked, abruptly rounded shoulders. Ornamentation consists of very fine and very dense ribs that often cross the venter as faint ridges. Suture line not available in our material.

Discussion: *Pseudoceltites densistriatus* differs from the type species, especially on inner whorls, by its very dense and very fine ribbing. This type of ornamentation might fall within the intraspecific variation of *P. multiplicatus*. However, this hypothesis must remain uncorroborated in the absence of stratigraphical control and intermediate morphologies.

Genus *Nyalamites* BRÜHWILER, BUCHER & GOUDEMAND, 2010b

Type species: *Xenodiscus angustecostatus* WELTER, 1922

Nyalamites angustecostatus (WELTER, 1922)

(Plate 5, Figs A–AE)

? 1895 *Celtites acuteplicatus* WAAGEN, 1895, p. 82, pl. 7a, figs 5–7.
1922 *Xenodiscus angustecostatus* WELTER, p. 110, pl. 4, figs 14–17.
1922 *Xenodiscus oyensi* WELTER, p.111, pl. 5, figs 1, 2, 17.
1968 *Anakashmirites angustecostatus* – KUMMEL & ERBEN, p. 128, pl. 19, figs 1–8.
1973 *Anakashmirites angustecostatus* – COLLIGNON, p. 144, pl. 5, figs 7–8.
1973 *Anakashmirites oyensi* – COLLIGNON, p. 146, pl. 5, figs 9, 10.
1976 *Pseudoceltites angustecostatus* – WANG & HE, p. 289, pl. 6, figs 3–6.

1978 *Eukashmirites angustecostatus* – GUEX, pl. 7, figs 4, 9.
v 2010b *Nyalamites angustecostatus* – BRÜHWILER et al. p. 411, fig. 7 (3–5).
v 2012a *Nyalamites angustecostatus* – BRÜHWILER & BUCHER, p. 14, pl. 1, figs 3–6.
v 2012b *Nyalamites angustecostatus* – BRÜHWILER & BUCHER, p. 29, fig. 2lAG–BB.
v 2012c *Nyalamites angustecostatus* – BRÜHWILER et al., p. 132, fig. 13S–AA.

Occurrence: Owenites fauna. In association with Pseudoceltites multiplicatus and Truempyceras pluriformis.

Measurements: See Text-fig. 10. Estimated maximal size: ~ 5.5 cm.

Description: Very evolute shell with slightly convex, sub-parallel flanks. Venter subtabulate with narrowly rounded shoulders to slightly arched with rounded shoulders on largest specimens. Umbilicus shallow and wide with inclined wall and rounded shoulders. Ornamentation consists of regularly spaced, strong, sharp, radial ribs that fade out on ventral shoulders. This species exhibits some variation in ribbing density. Suture line not available in our material.

Discussion: This species marks the late middle Smithian in South Tibet, Pakistan and Spiti (*Nyalamites angustecostatus* beds, BRÜHWILER et al., 2010b, 2012b, c; Fig. 3). It also occurs in the *Owenites koeneni* fauna of Oman (BRÜHWILER et al., 2012a).

Genus *Hanielites* WELTER, 1922

Type species: *Hanielites elegans* WELTER, 1922

Hanielites elegans WELTER, 1922

(Plate 5, Figs AF–AK)

1922 *Hanielites elegans* WELTER, p. 145, pl. 14, figs 7–11.
1934 *Hanielites elegans* – SPATH, p. 243, fig. 82a–e.
? 1959 *Hanielites evolutus* CHAO, p. 280, pl. 37, figs 8–12.
? 1959 *Hanielites elegans* var. *involutus* CHAO, p. 281, pl. 37, figs 4–6.
? 1959 *Hanielites rotulus* CHAO, p. 281, pl. 37, figs 12–15.
? 1959 *Owenites kwangsiensis* CHAO, p. 250, pl. 22, figs 1, 2, 5, 6.
? v 2008 *Hanielites elegans* BRAYARD & BUCHER, p. 19, pl. 4, figs 1–5.
? v 2012c *Hanielites elegans* BRÜHWILER et al., p. 132, fig. 14J–L.

Occurrence: *Owenites* fauna.

Measurements: See Text-fig. 11. Estimated maximal size: ~ 2.5 cm.

Description: Small, moderately involute shell with flat, parallel flanks. Venter subangular, with a low but distinct keel bearing a spiral strigation. Umbilicus moderately shallow with low, vertical wall and slightly rounded shoulders. Ornamentation is variocostate, consisting of distinct ribs becoming stronger at lower flank and stopping at ventral shoulders. Suture line not available in our material.

Discussion: Our larger specimen is identical to the holotype from Timor (WELTER 1922). Conversely, the morphology of specimens from China and Spiti (BRAYARD & BUCHER 2008; BRÜHWILER et al. 2012c) is somewhat distant from that of the holotype. Indeed, they are significantly more evolute, they do not show a well-expressed keel, and their ribs are thinner and more closely spaced.

Due to the scarcity of the material from Timor, whether these specimens from China and Spiti represent another species or variants of *H. elegans* cannot be determined.

Hanielites gracilus BRAYARD & BUCHER, 2008

(Plate 5, Figs AL–AV)

v 2008 *Hanielites gracilus* BRAYARD & BUCHER, p. 20, pl. 4, figs 6–8.

Occurrence: *Owenites* fauna.

Measurements: See Text-fig. 12. Estimated maximal size: ~ 3.5 cm.

Description: Small, moderately involute, compressed shell with flat, parallel flanks. Angular venter bearing a distinct keel and with rounded ventral shoulders. Umbilicus moderately shallow with low, vertical wall and slightly rounded shoulders. Ornamentation consists of thin prorsiradiate plications, projecting forward onto venter and terminating at the keel. Suture line not available in our material.

Discussion: This species mainly differs from the type species by its more compressed whorls and weaker, denser ornamentation.

Kashmiritidae gen. et sp. indet.

(Plate 15, Figs I–K)

Occurrence: *Kashmirites* fauna.

Measurements: See Table 1. Estimated maximal size: ~ 10 cm.

Description: Relatively large, very slightly compressed shell with flat, parallel flanks forming a subrectangular whorl section. Venter broadly arched with indistinct Umbilicus wide and moderately shallow. Umbilical wall steep on inner whorls, becoming more inclined on outer whorl; umbilical shoulders marked but rounded. Ornamentation of the flanks consists of distant, fold-like ribs becoming denser and finer on second half of the outer whorl. Vague strigation visible on inner whorls. Suture line not available in our material.
Discussion: Coiling invites comparison with kashmiritids, especially with *Kashmirites guangxiense* BRAYARD & BUCHER (2008). However, typical representatives of the family Kashmiritidae differ by their more evolute, serpenticonic coiling and lower whorls forming a subquadratic whorl section.

Superfamily Meekocerataceae WAAGEN, 1895
Family Proptychitidae WAAGEN, 1895

Genus *Roopnarinites* n. gen.

Type species: *Roopnarinites* n. gen. *paucesculptatum* (WELTER, 1922)
Etymology: Named after Peter Roopnarine.
Included species: Type species only.
Diagnosis: Thick, somewhat globose Proptychitidae with broad, rounded venter and suture with four slightly phylloid saddles.
Discussion: This genus is only tentatively assigned to the family Proptychitidae based on its suture line vaguely resembling that of *Pseudaspidites*, i.e., with phylloid saddles, strongly indented lobes, and second and third saddles markedly curved towards the umbilicus.

Roopnarinites n. gen. *paucesculptatum* (WELTER, 1922)

(Plate 6, Figs A–V)

1922 *Meekoceras paucesculptatum* WELTER, p. 128, pl. 11, figs 16, 17; text-fig. 12.
Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 13. Estimated maximal size: ~ 3 cm.
Description: Involute, slightly compressed shell with convex flanks. Whorl thickness and coiling somewhat variable. Venter rounded with rounded shoulders. Umbilicus with nearly perpendicular wall and rounded shoulders. On well-preserved shell, very feeble radial folds visible on the flanks. Suture line with four slightly phylloid saddles, strongly indented lobes, and second and third saddles markedly curved towards the umbilicus.
Discussion: The Oman specimen described as *Pseudaspidites* sp. indet. by BRÜHWILER & BUCHER (2012a) is morphologically identical to one of our specimens (Plate 6, Figs G–I) but differs by its suture line with three saddles only, very close to that of typical *Pseudaspidites*. The American species *Paranannites aspenensis* HYATT & SMITH, 1905 is very similar in shape but strongly differs by its simple suture line, with two broad lateral saddles.

Genus *Tulongites* BRÜHWILER, BUCHER & GOUDEMAND, 2010b

Type species: *Tulongites xiaoqiaoi* BRÜHWILER et al., 2010b

?*Tulongites* sp. indet.

(Plate 6, Figs AA–AG)

Occurrence: *Owenites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 3 cm.
Description: Involute, platyconic shell with slightly convex flanks. Venter rounded with rounded shoulders. Umbilicus small with vertical wall and abruptly rounded shoulders. Ornamentation not preserved on our specimens. Suture line poorly preserved, with slightly phylloid first lateral saddle.
Discussion: The scarcity and the imperfect preservation of our material hinder a more precise assignment. However, those specimens seem morphologically rather similar to *Tulongites xiaoqiaoi* BRÜHWILER et al., 2010b, although they differ by having a slightly different suture line with broader saddles.

Proptychitidae gen. et sp. indet.

(Plate 6, Figs W–Z)

? v 2012b Proptychitidae gen. et sp. indet. A BRÜHWILER & BUCHER, p. 53, fig. 37C–H.
Occurrence: *Owenites* fauna. One single specimen.
Measurements: See Table 1. Estimated maximal size: ~ 2.5 cm.

Description: Involute, platyconic shell with slightly convex flanks. Venter slightly rounded with rounded shoulders. Umbilicus with moderately high, perpendicular wall and narrowly rounded shoulders. Surface smooth. Simple suture line, but incomplete and very poorly preserved.
Discussion: This taxon is somewhat similar to *Pseudaspidites*, but differs by its simpler suture line. Specimens described as Proptychitidae gen. et sp. indet. A by BRÜHWILER & BUCHER (2012b) may represent the same taxon.

Genus *Paraspidites* SPATH, 1934

Type species: *Aspidites superbus* mut. *praecursor* FRECH, 1905
Discussion: As suggested by TOZER (1981), BRÜHWILER & BUCHER (2012b) included this genus in the family Proptychitidae. Although supported by the suture line and the shape of the umbilicus, this assignment remains questionable as *Paraspidites* differs from other members of that family by its acutely keeled or bicarinate venter.

Paraspidites bicarinatus n. sp.

(Plate 6, Figs AH–AT)

Etymology: Named for its bicarinate venter.
Holotype: Specimen PIMUZ 37001 (Plate 6, Figs AN–AP).
Occurrence: *Kashmirites* fauna.
Measurements: See Text-fig. 14. Estimated maximal size: ~ 6 cm.
Diagnosis: Relatively evolute *Paraspidites* with thick whorls, a high umbilical wall and a distinctive very narrow bicarinate venter.
Description: Moderately involute, compressed shell with distinctive very narrow bicarinate venter. Maximum whorl width at umbilical margin. Umbilicus with high wall (overhanging on inner whorls of holotype; Plate 6, Fig. AN) and angular shoulders. Surface smooth except for extremely delicate strigation and weak folds. Suture line similar to that of *Paraspidites obesus* BRÜHWILER & BUCHER, 2012b, i.e., with first lateral saddle long, narrow and slightly phylloid, second saddle broad and slightly asymmetrical, and auxiliary series with a well-individualized, small fourth saddle.
Discussion: This species is very similar to *Paraspidites obesus* that only differs by its acutely keeled venter.

Family Galfettitidae BRÜHWILER & BUCHER, 2012a

Genus *Galfettites* BRAYARD & BUCHER, 2008

Type species: *Galfettites simplicitatis* BRAYARD & BUCHER, 2008

Galfettites simplicitatis BRAYARD & BUCHER, 2008

(Plate 7, Figs A–I)

v 2008 *Galfettites simplicitatis* BRAYARD & BUCHER, p. 48, pl. 21, figs 1, 2.
v 2012a *Galfettites simplicitatis* – BRÜHWILER & BUCHER, p. 26, pl. 15, figs 1–4; pl. 16, fig. 1.
Occurrence: *Owenites* fauna. One specimen in association with *Nyalamites angustecostatus*.
Measurements: See Text-fig. 15**.** Estimated maximal size: ~ 13.5 cm.
Description: Evolute, very compressed shell with a very narrow tabulate venter and angular ventral shoulders. Flat, parallel flanks for about two thirds of flank, then gradually converging towards venter. Umbilicus shallow and wide with low, steeply inclined wall and rounded shoulders. Surface smooth except for dense, delicate folds. Suture line not available on our material.
Discussion: *Galfettites omani* BRÜHWILER & BUCHER, 2012a is very similar to *G. simplicitatis* but differs by its shallower umbilicus and its distant folds on outer whorl. "*Meekoceras*" *wanneri* and "*Meekoceras*" *hanieli* erected by WELTER (1922) from the "*Meekoceras*-Kalke" of Timor are very similar in shape to representatives of the genus *Galfettites*. However, suture line of "*Meekoceras*" *wanneri* is unknown and suture line of "*Meekoceras*" *hanieli* appears much simpler. Furthermore, the "*Meekoceras*-Kalke" is assumed to be of early Smithian age, since it is placed stratigraphically below the "*Owenites*-Kalke" according to WELTER (1922: 92). Therefore, these two species may rather belong to the family Flemingitidae (*Rohillites*?).

Galfettites omani BRÜHWILER & BUCHER, 2012a

(Plate 7, Figs J–M)

v 2012a *Galfettites omani* BRÜHWILER & BUCHER, p. 27, pl. 14, figs 6–8.

v 2012c *Galfettites omani* – BRÜHWILER et al., p. 137, fig. 17A–AD.
Occurrence: *Anasibirites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 8 cm.
Description: Moderately evolute and very compressed shell with a very narrow tabulate venter and angular ventral shoulders. Flat, parallel flanks for about two thirds of flank, then gradually converging towards venter. Umbilicus wide and very shallow with very low wall and rounded shoulders. Surface smooth except for vague, distant, radial folds on outer whorl. Suture line incomplete, but typical of the genus, i.e., with second lateral saddle with a distinctly trigonal tip and third saddle slightly curved towards the umbilicus.
Discussion: All previous specimens described as *G. omani* are older (middle Smithian; see BRÜHWILER et al. 2012a, c). Nevertheless, our specimens display all diagnostic features of this species and no paleontological condensation was evidenced in the *Anasibirites* blocks (see JATTIOT et al. 2015). Therefore, we here report the youngest occurrence of the genus *Galfettites*, from the late Smithian of Timor.

Genus *Paranorites* WAAGEN, 1895
Type species: *Paranorites ambiensis* WAAGEN, 1895

Paranorites cf. *ambiensis* WAAGEN, 1895

(Plate 7, Figs N–V)

1895 *Paranorites ambiensis* WAAGEN, p. 158, pl. 22, fig. la–d.
p 1895 *Koninckites volutus* WAAGEN, p. 268, pl. 28, fig. 1 only.
v 2012b *Paranorites ambiensis* – BRÜHWILER & BUCHER, p. 64, figs 42A, 46A–I, 47A–J, 48A–F.
Occurrence: *Kashmirites* fauna.
Measurements: See Text-fig. 16. Estimated maximal size: ~ 3.5 cm.
Description: Moderately involute, compressed shell with slightly convex, convergent flanks. Sligthly egressive coiling. Venter tabulate with angular shoulders. Umbilicus with high, vertical wall and marked, slightly rounded shoulders. Ornamentation consists of distant, vague folds fading out towards venter. Spiral lines visible near venter only. Suture line not available in our material.
Discussion: In the absence of suture line, the assignment of our specimens to *Paranorites ambiensis* is tentative only.

Genus *Vercherites* BRÜHWILER, WARE, BUCHER, KRYSTYN & GOUDEMAND, 2010c
Type species: *Koninckites vercherei* WAAGEN, 1895

Vercherites cf. *vercherei* (WAAGEN, 1895)

(Plate 7, Figs W–AB)

1895 *Koninckites vercherei* WAAGEN, p. 268, pl. 30, fig. la–c.
v 2012b *Vercherites vercherei* – BRÜHWILER & BUCHER, p. 64, figs 40A–M, 41A–N, 42I–L.
Occurrence: *Kashmirites* fauna.
Measurements: See Text-fig. 17. Estimated maximal size: ~ 4 cm.
Description: Moderately involute, compressed shell with subparallel flanks. Slightly egressive coiling. Venter tabulate with angular shoulders. Specimen PIMUZ 37011 (Pl. 7, Figs W–Y) is probably pathological as it shows a tabulate venter that becomes narrowly rounded on the outer whorl. Umbilicus with high, vertical wall and marked, slightly rounded shoulders. Ornamentation consists of dense, very weak folds and biconcave growth lines. Suture line not available in our material.
Discussion: Given the absence of suture line, the assignment of our specimens to *V. vercherei* is tentative only. *Vercherites* cf. *vercherei* mainly differs from *P.* cf. *ambiensis* by its earlier umbilical egression and flatter flanks.

Genus *Urdyceras* BRAYARD & BUCHER, 2008
Type species: *Urdyceras insolitus* BRAYARD & BUCHER, 2008

Urdyceras tulongensis BRÜHWILER, BUCHER & GOUDEMAND, 2010b

(Plate 7, Figs AC–AQ)

v 2010b *Urdyceras tulongensis* BRÜHWILER et al., p. 416, fig. 10 (5–11).
v 2012c *Urdyceras tulongensis* – BRÜHWILER et al., p. 139, fig. 17AH–BF.
Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 18. Estimated maximal size: ~ 4 cm.

Description: Compressed and moderately involute to moderately evolute shell. Flanks convex and convergent. Venter tabulate with very angular shoulders. Umbilicus with steeply inclined wall and marked, slightly rounded shoulders. Ornamentation on flanks consists of low radial, slightly sinuous folds. Suture line not available in our material.

Discussion: According to BRÜHWILER et al. (2010b), the slightly older type species *Urdyceras insolitus* BRAYARD & BUCHER, 2008 from the *Flemingites rursiradiatus* beds (late early Smithian) of South China differs by its thicker whorls and broader venter. However, based upon examination of the type material of the two species, we assert that *U. insolitus* does not exhibit a broader venter than *U. tulongensis*. Furthermore, several specimens assigned to *U. tulongensis* from Timor (this work, Plate 7, Figs AL–AN) and Spiti (BRÜHWILER et al. 2012c: figs 17AU–AW) have relatively thick whorls, making greater thickness as a diagnostic character of *U. insolitus* very doubtful. It is therefore not excluded that *U. tulongensis* is a synonym of *U. insolitus*, but more material from China is needed to verify this hypothesis.

Genus *Safraites* BRÜHWILER & BUCHER, 2012a

Type species: *Safraites simplex* BRÜHWILER & BUCHER, 2012a

Safraites simplex BRÜHWILER & BUCHER, 2012a

(Plate 7, Figs AR–AU)

v 2012a *Safraites simplex* BRÜHWILER & BUCHER, p. 29, pl. 8, figs 5–10.

Occurrence: *Owenites* fauna.

Measurements: See Text-fig. 19. Estimated maximal size: ~ 2.5 cm.

Description: Small, involute and compressed shell with subparallel flanks. Venter tabulate with angular shoulders. Umbilicus with very low, vertical wall and angular shoulders. Surface smooth. Suture line not available in our material.

Discussion: This species was originally described from the *Nammalites pilatoides* fauna of Oman (BRÜHWILER et al. 2012a).

Family Flemingitidae HYATT, 1900

Genus *Flemingites* WAAGEN, 1895

Type species: *Ceratites flemingianus* DE KONINCK 1863

Flemingites flemingianus (DE KONINCK, 1863)

(Plate 8, Figs A–C)

1863 *Ceratites flemingianus* DE KONINCK, p. 10, pl. 7, fig. 1.
1895 *Flemingites flemingianus* – WAAGEN, p. 199, pl. 12, fig. 1, pl. 13, fig. 1, pl. 14, fig. 1.
1895 *Flemingites compressus* WAAGEN, p. 202, pl. 15, fig. 1, pl. 16, fig. 1a–c.
1895 *Flemingites trilobatus* WAAGEN, p. 193, pl. 16, fig. 2a–b.
1922 *Flemingites griesbachiformis* WELTER, p. 113, pl. 8. figs 1, 2.
1933 *Flemingites compressus* – COLLIGNON, p. 170, pl. 3, fig. 1, la.
1933 *Flemingites flemingi madagascariensis* COLLIGNON, p. 173, pl. 5, fig. 1.
1933 *Flemingites griesbachi* – COLLIGNON, p. 176, pl. 4, fig. 3, 3a; pl. 5, fig. 4; pl. 6, figs 1, 2.
v 2012b *Flemingites flemingianus* BRÜHWILER & BUCHER, p. 66, figs 50A–K, 51A–G.

Occurrence: *Kashmirites* fauna. One single specimen.

Measurements: See Text-fig. 20. Estimated maximal size: ~ 28 cm.

Description: Very large shell with oval whorl section and egressive coiling. Inner whorls moderately evolute, outer whorls evolute. Venter rounded with indistinct shoulders. Umbilicus wide with rounded wall. Shell ornamented with coarse strigation and radial to slightly rursiradiate fold-like ribs. Ribs barely conspicuous on inner whorls, strongest at the beginning of the outer whorl and becoming finer and closely spaced on the last half of the outer whorl. Suture line not available in our material.

Discussion: This species is very similar to *Flemingites pulcher* WELTER, 1922 that mainly differ by its tabulate venter with abruptly rounded shoulders. Indeed, as stated by WAAGEN (1895) in his *F. flemingianus* description, 'on the whole the transverse section of the whorls is oval, well rounded everywhere'. We also assume a smaller size at maturity for *F. pulcher*.

Flemingites cf. *planatus* BRÜHWILER & BUCHER, 2012b

(Plate 8, Figs D–F)

2012b *Flemingites planatus* BRÜHWILER & BUCHER, p. 75, fig. 62A–K.

Occurrence: *Kashmirites* fauna. One single specimen.
Measurements: See Text-fig. 21. Estimated maximal size: ~ 8.5 cm.
Description: Evolute shell with flat, subparallel flanks and maximum whorl width near mid-flank. Outer third of flanks convergent. Venter subtabulate with abruptly rounded shoulders. Umbilicus wide and shallow with low, nearly vertical wall amd rounded shoulders. Surface smooth except for very fine radial folds. Suture line not available in our material.
Discussion: In comparison with the holotype of *Flemingites planatus*, our specimen exhibits slightly lower whorls and lacks the strigation on outer flanks and venter, but is otherwise very similar.

Flemingites pulcher WELTER, 1922

(Plate 9, Figs A–G)

1922 *Flemingites pulcher* WELTER, p. 114, pl. 8, figs 3, 4; pl. 9, figs 1, 2.
Occurrence: *Kashmirites* fauna.
Measurements: See Text-fig. 22. Estimated maximal size: ~ 13.5 cm.
Description: Moderately evolute, compressed shell with convex flanks and maximum whorl width slightly above mid-flank. Venter tabulate with abruptly rounded shoulders. Umbilicus moderately deep with rounded wall. Shell ornamented with radial fold-type ribs on innermost whorls gradually passing to wide, low folds, as well as with strigation becoming gradually more conspicuous with growth. Suture line ceratitic with long. slightly phylloid saddles and strongly indented lobes.
Discussion: The Salt Range species *Flemingites hofmanni* BRÜHWILER et al., 2012b also exhibits a tabulate venter but differs by its lower, more compressed whorls and its suture line with much broader saddles.

Flemingites lidakensis n. sp.

(Plate 10, Figs Q–V)

Etymology: Named after Lidak locality in Timor.
Holotype: Specimen PIMUZ 37040 (Plate 10, Figs T–V).
Occurrence: *Kashmirites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 7 cm.
Diagnosis: Serpenticone and very thick *Flemingites* with very low whorls.
Description: Evolute, serpenticonic, depressed shell with convex flanks and maximum whorl width slightly above mid-flank. Broadly rounded venter with indistinct shoulders. Umbilicus with high, nearly vertical wall and rounded shoulders. Surface smooth except for low constrictions and delicate strigation fading out at umbilical shoulders. Suture line not available in our material.
Discussion: This species significantly differs from other *Flemingites* species by its more evolute coiling and by its depressed whorls. Singularly, *F. lidakensis* n. sp. is similar in thickness and coiling to specimens from China assigned to *F. flemingianus* (BRAYARD & BUCHER, 2008) that may actually represent variants of *F. rursiradiatus* according to BRÜHWILER & BUCHER (2012b). However, these specimens display a conspicuous ribbing and a much stronger strigation.

Genus *Euflemingites* SPATH, 1934
Type species: Flemingites guyerdetiformis WELTER 1922

Euflemingites guyerdetiformis (WELTER, 1922)

(Plate 9, Figs H–M)

1922 *Flemingites guyerdetiformis* WELTER, p. 117, pl. 6, figs 10–12.
1934 *Euflemingites guyerdetiformis* SPATH, p. 115, fig. 29.
Occurrence: *Kashmirites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 5.5 cm.
Description: Moderately involute, somewhat compressed shell with convex flanks and maximum whorl width near umbilical shoulders. Venter subtabulate with abruptly rounded shoulders. Umbilicus with moderately high, nearly vertical wall and rounded shoulders. Shell ornamented with a strigation fading out on upper flank. Suture line ceratitic with long, slightly phylloid saddles and strongly indented lobes.
Discussion: Contrary to SPATH's (1934) statement, the venter of *Euflemingites guyerdetiformis* is not arched but subtabulate. *Euflemingites cirratus* (WHITE, 1880) is mainly distinguished by its flat, parallel flanks and its much coarser strigation. *Flemingites pulcher* is similar in shape but differs by its more compressed whorls and the presence of radial ornamentation.

Genus *Rohillites* WATERHOUSE, 1996

Type species: *Flemingites rohilla* DIENER, 1897

Rohillites rohilla (DIENER, 1897)

(Plate 10, Figs A–P)

		1897	*Flemingites rohilla* DIENER, p. 93, pl. 18, figs 2–4; pl. 23, fig. 1.
?		1922	*Flemingites* cf. *muthensis* – WELTER, p. 113, pl. 6, figs 8, 9.
?	v	2008	*Rohillites* sp. indet. – BRAYARD & BUCHER, p. 47, pl. 19, fig. 7.
v		2012a	*Rohillites omanensis* BRÜHWILER & BUCHER, p. 23, pl. 13, figs 4–8.

Occurrence: *Kashmirites* fauna.

Measurements: See Text-fig. 23. Estimated maximal size: ~ 8 cm.

Description: Moderately evolute, compressed shell. Flanks parallel, although becoming markedly convergent on lower flanks. Venter tabulate with subangular to angular shoulders. Umbilicus with low wall and rounded umbilical shoulders. Ornamentation consists of vague radial folds and strigation usually restricted to lower flanks. Suture line ceratitic, with relatively strongly indented lobes, slightly phylloid saddles and asymmetrical third saddle.

Discussion: According to BRÜHWILER & BUCHER (2012a), this species differs from *Rohillites omanensis* BRÜHWILER & BUCHER, 2012a by being more evolute and by its narrower venter. However, our material from Timor allows us to assess the intraspecific variation of *R. rohilla* and shows that its venter width is variable (compare Plate 10, Figs A–C with Plate 10, Figs G–I), as well as its coiling (involute variant Plate 10, Fig. N). Thus, we here consider *R. omanensis* as a synonym of *R. rohilla*. The specimen from China described as *Rohillites* sp. indet. (BRAYARD & BUCHER, 2008) might also belong to this species, but its poor preservation hinders a definitive assignment. Noteworthy, when shell is preserved in our material, the demarcation between the flat upper flanks and the markedly convergent lower flanks is very distinct, as the shell is thicker on this area. When specimens are preserved as internal molds, this demarcation is much less conspicuous.

R. pakistanensis BRÜHWILER & BUCHER, 2012b, *R. bruehwileri* BRAYARD & BUCHER, 2008 and *R. sobolevi* BRAYARD & BUCHER, 2008 are mainly distinguished from *R. rohilla* by their stronger ornamentation, especially on outer whorls.

The specimen from Timor described as *Flemingites* cf. *muthensis* in WELTER (1922) is very similar to our material, although it appears to display stronger folds.

Genus *Pseudoflemingites* SPATH, 1930

Type species: *Pseudoflemingites timorensis* SPATH, 1930 (= *Ophiceras nopscanum* WELTER, 1922, p. 104, pl. 4, figs 4, 5 only)

Pseudoflemingites timorensis SPATH, 1930

(Plate 9, Figs N–V)

p		1922	*Ophiceras nopcsanum* WELTER, p. 104, pl. 4, figs 4, 5 only.
		1930	*Pseudoflemingites timorensis* SPATH, p. 90.
		1934	*Pseudoflemingites timorensis* – SPATH, p. 116, fig. 30.
non	v	2012b	*Pseudoflemingites* cf. *timorensis* – BRÜHWILER & BUCHER, p. 78, fig. 61A–J.

Occurrence: *Kashmirites* fauna.

Measurements: See Text-fig. 24. Estimated maximal size: ~ 7 cm.

Description: Evolute, serpenticonic shell with convex flanks. Venter rounded with rounded ventral shoulders. Umbilicus wide and moderately shallow with nearly vertical wall and rounded shoulders. Ornamentation consists of extremely delicate strigation visible on a few specimens only, rursiradiate fold-like ribs, and ventro-lateral pairs of barely conspicuous and seldomly present nodes. Inner whorls nearly smooth. Suture line not available in our material.

Discussion: At comparable size, specimens from Pakistan described as *Pseudoflemingites* cf. *timorensis* (BRÜHWILER & BUCHER, 2012b) are more involute and have slightly more compressed whorls. They also do not display rursiradiate ribs or pairs of ventro-lateral nodes.

Flemingites rursiradiatus CHAO, 1959 is very similar in shape, but is distinguished by its very distinct strigation, its stronger ornamentation, and by the absence of ventro-lateral nodes.

Genus *Subflemingites* SPATH, 1934

Type species: *Aspidites meridianus involutus* WELTER, 1922

Subflemingites involutus (WELTER, 1922)

(Plate 11, Figs A–J)

1922 *Aspidites meridianus* WELTER, p. 132, pl. 12, figs 1–3.
1922 *Aspidites meridianus involutus* WELTER, p. 133, pl. 12, figs 4, 5.
1934 *Subflemingites involutus* – SPATH, p. 118, fig. 32.
non v 2012a *Subflemingites involutus* – BRÜHWILER & BUCHER (= *Anaxenaspis orientale*), p. 23, pl. 13, figs 1–3.

Occurrence: *Kashmirites* fauna.

Measurements: See Text-fig. 25. Estimated maximal size: ~ 7.5 cm.

Description: Moderately involute, conpressed shell with slightly convex flanks and elliptical whorl section. Venter rounded with indistinct shoulders. Umbilicus with steeply inclined, low wall and abruptly rounded shoulders. Ornamentation consists of regular radial folds fading towards venter and more marked at mid-flank. Suture line too poorly preserved to be illustrated.

Discussion: Type specimens of *Subflemingites involutus* come from the early Smithian of Timor ("*Ophiceras crassecostatum*-Kalke"; WELTER 1922). Specimens from Oman described as *S. involutus* (BRÜHWILER & BUCHER, 2012a) are younger (middle Smithian, *Nammalites pilatoides* fauna) and do no not exhibit conspicuous folds. They are here reassigned to *Anaxenaspis orientale* (DIENER, 1895).

Subflemingites bihatiense n. sp.

(Plate 11, Figs K–M)

? v 2010b ?*Leyeceras* sp. indet. BRÜHWILER et al., p. 411, fig. 7 (8).
? v 2012a *Leyeceras* cf. *rothi* BRÜHWILER & BUCHER, p. 18, pl. 5, figs 1–5; pl. 6, figs 1–3.

Etymology: Named after Bihati locality in Timor.

Holotype: Specimen PIMUZ 37046 (Plate 11, Fig. M).

Occurrence: *Owenites* fauna. In association with *Nyalamites angustecostatus*.

Measurements: See Table 1. Estimated maximal size: ~ 6 cm.

Diagnosis: Involute *Subflemingites* with weak, distant radial folds.

Description: Involute, conpressed shell with convex flanks and elliptical whorl section. Venter narrowly rounded, with indistinct shoulders. Umbilicus with steeply inclined, low wall and abruptly rounded shoulders. Ornamentation consists of weak radial folds fading towards venter and more marked at mid-flank. Extremely delicate strigation present at the beginning of the last whorl of the holotype. Suture line not available in our material.

Discussion: This species differs from the type species by its more involute coiling, its slightly higher whorl section and its more distant, weaker folds. Furthermore, the occurrence of *S. bihatiense* n. sp. is younger (middle Smithian). The species *Leyeceras rothi* BRAYARD & BUCHER, 2008 strongly differs from *Subflemingites bihatiense* n. sp. by its subtabulate venter, its thicker whorls and by the presence of radial lirae on flanks. Specimens described as *Leyeceras* cf. *rothi* by BRÜHWILER & BUCHER (2012a) do not exhibit a subtabulate venter or lirae and are instead very similar to *Subflemingites bihatiense* n. sp. They very likely belong to this latter, but in the absence of suture line for Timor specimens, this hypothesis must remain uncorroborated.

?*Subflemingites* sp. indet.

(Plate 11, Figs N–Q)

Occurrence: *Owenites* fauna. One single specimen.

Measurements: See Table 1. Estimated maximal size: ~ 5 cm.

Description: Involute shell with convex flanks. Venter rounded with indistinct shoulders. Funnel-like umbilicus, i.e., flanks gradually sloping until umbilical suture with no umbilical wall. Ornamentation consists of thick, very weak radial folds that cross the venter. Suture line very poorly preserved, with a wide first lateral lobe and a narrow second lateral lobe.

Discussion: The overall morphology and ornamentation consisting of folds only invites comparison with *Subflemingites bihatiense* n. sp. of the same age. However, it mainly differs by its more involute coiling and thicker whorls. The scarcity of the material and the lack of suture line information for our *Subflemingites* specimens preclude a generic assignment.

Genus *Anaxenaspis* KIPARISOVA, 1956

Type species: *Xenaspis orientale* DIENER, 1895

Discussion: In shape, this genus is nearly identical to the American genus *Anaflemingites* KUMMEL & STEELE (1962). However, *Anaflemingites* differs from *Anaxenaspis* by the presence of a strigation on the flanks. The type species *Anaflemingites silberlingi* KUMMEL & STEELE (1962) is also distinguished from *Anaxenaspis* by a suture line with an extremely broad first lateral lobe and relatively narrow saddles, with the first lateral saddle being especially narrow.

Anaxenaspis orientale DIENER, 1895

(Plate 12, Figs A–P)

		1895	*Xenaspis orientale* DIENER, 1895, p. 42, pl. 3, fig. 3.
		1922	*Flemingites lidacensis* WELTER, p. 115, pl. 7, figs 1–4.
		1922	*Flemingites densistriatus* WELTER, p. 116, pl. 6, figs 5–7.
?		1959	*Flemingites* cf. *lidacensis* – KUMMEL.
?		1968	*Flemingites* cf. *lidacensis* – KUMMEL & ERBEN, p. 115, pl. 24, fig. 2.
?		1973	*Flemingites lidacensis* – COLLIGNON, p. 9, pl. 2, figs 1–3.
		1978	*Xenoceltites nammalensis* GUEX, p. 112, pl. 6, figs 1, 2.
?	v	2008	?*Anaxenaspis* sp. indet. – BRAYARD & BUCHER, p. 49, pl. 23, fig. l.
v		2008	*Anaflemingites hochulii* BRAYARD & BUCHER, p. 51, pl. 24, figs 3–6.
v		2012a	*Anaxenaspis* cf. *lidacensis* – BRÜHWILER & BUCHER, p. 22, plate 13, figs 9–11; plate 14, figs 1–3.
v		2012a	*Subflemingites involutus* – BRÜHWILER & BUCHER, p. 23, pl. 13, figs 1–3.
v		2012b	*Anaxenaspis nammalensis* – BRÜHWILER & BUCHER, p. 78, fig. 64A–V.
v		2012c	?*Anaxenaspis* sp. indet. – BRÜHWILER et al., p. 145, figs 22A–M, 23A–C.

Occurrence: *Owenites* fauna.

Measurements: See Text-fig. 26. Estimated maximal size: ~ 17 cm.

Description: Large, compressed and evolute shell with elliptical whorl section and convex flanks. Venter narrowly rounded with indistinct or abruptly rounded shoulders. Umbilicus with steeply inclined wall and rounded shoulders. Ornamentation highly variable, from nearly smooth shell with faint folds only, to conspicuous radial fold-like ribs varying in strength and fading out towards venter. When present, ribbing gradually weakens at later stages. Slightly biconcave growth lines discernible on a few specimens. Suture line with strongly indented lobes and elongated, sometimes slightly phylloid saddles; but highly variable.

Discussion: BRÜHWILER & BUCHER (2012a) assigned the Timor species "*Flemingites*" *lidacensis* (WELTER, 1922) to *Anaxenaspis* 'because it shows no significant differences with the type species *Anaxenaspis orientale*, except for its delicate strigation'. In our extensive material of *Anaxenaspis* (~40 specimens), a thorough investigation of the astonishingly preserved shells led to the conclusion that there is no strigation whatsoever on the flanks. Extremely delicate spiral wrinkles are nevertheless sporadically visible on rare specimens. We assume that these wrinkles create the false impression of a strigation on WELTER'S (1922) illustrations of the type specimens of *A. lidacensis* and *A. densistriatus*. Therefore, we here consider *A. orientale* and *A. lidacensis* as conspecific. Given the large intraspecific variation of *A. orientale* as evidenced in our material (Plate 12, Figs A–P), we also synonymize *A. densistriatus* with *A. orientale*.

According to BRÜHWILER & BUCHER (2012b), the type species only differs from *Anaxenaspis nammalensis* (GUEX, 1978) from the Salt Range by its smoother inner whorls. However, our Timor material shows that the range of intraspecific variation of *A. orientale* includes specimens that can also display ornamented inner whorls as seen in *A. nammalensis*. This latter is therefore synonymized with *A. orientale*. Finally, a reinvestigation of the suture line of *Anaflemingites hochulii* BRAYARD & BUCHER, 2008 type specimen revealed that it actually displays a broader second lateral saddle than what illustrated in BRAYARD & BUCHER (2008). This revised feature and the absence of strigation are contradictory with what is seen in *Anaflemingites*. Therefore, this species is here transferred to *A. orientale* as it does not show any difference with our weakly ornamented variants.

Noteworthy, the vast range of intraspecific variation of *A. orientale* combined with the absence of stratigraphical control made assignments of some specimens to either *A. orientale*, *A. compressus* or *Hochuliites retrocostatus* BRÜHWILER et al., 2012c (see below) very difficult and tentative only.

Anaxenaspis compressus (BRÜHWILER et al., 2010b)

(Plate 13, Figs H–N)

v	2010b	?*Subflemingites compressus* BRÜHWILER et al., p. 413, fig. 8 (1–6).
v	2012c	?*Subflemingites compressus* – BRÜHWILER et al., p. 145, fig. 23D–J.

Occurrence: *Owenites* fauna. One specimen in association with *Pseudoceltites multiplicatus*.

Measurements: See Text-fig. 27. Estimated maximal size: ~ 7.5 cm.

Description: Moderately evolute, compressed shell with slightly convex flanks and elliptical whorl section. Venter narrowly rounded with indistinct shoulders. Umbilicus with inclined wall and rounded shoulders. Ornamentation consists of vague folds. Very delicate strigation discernible on venter of one specimen (Plate 13, Fig. J). Suture line with strongly indented lobes and elongated, slightly phylloid saddles.

Discussion: *Anaxenaspis compressus* from South Tibet was originally tentatively assigned to the genus *Subflemingites* SPATH, 1934. However, this latter clearly differs by its umbilicus with steeply inclined, low wall and abruptly rounded shoulders. We here assign this species to the genus *Anaxenaspis* and, as a general rule, it differs from the type species by being more involute and more compressed. Some rare variants of *A. orientale* are as involute, but they are more strongly ornamented and thicker.

Hochuliites retrocostatus BRÜHWILER et al., 2012c differs from *A. compressus* by its simpler suture line, whose saddles are broad and nonphylloid; and by its much more conspicuous ornamentation.

Genus *Baidites* BRÜHWILER & BUCHER, 2012a

Type species: *Baidites hermanni* BRÜHWILER & BUCHER, 2012a

Baidites tenue (WELTER, 1922)

(Plate 14, Figs A–J)

		1922	*Ophiceras tenue* WELTER, p. 104, pl. 3, figs 1, 2.
?	p	1922	*Ophiceras nopcsanum* WELTER, p. 104, pl. 4, figs 1–3 only.
non	p	1922	*Ophiceras nopcsanum* WELTER, p. 104, pl. 4, figs 4, 5 only (= *Pseudoflemingites timorensis*).
?		1922	*Xenodiscus rotula* – WELTER, p. 106, pl. 6, figs 3, 4.

Occurrence: *Kashmirites* fauna.

Measurements: See Text-fig. 28. Estimated maximal size: ~ 8.5 cm.

Description: Evolute, compressed shell. Relatively narrow, subtabulate to tabulate venter with abruptly rounded shoulders. Whorl shape constant throughout ontogeny, with slightly converging flanks from umbilical margin area towards venter. Umbilicus wide and relatively shallow. Umbilical wall steep on inner whorls, becoming more inclined on outer whorl; umbilical shoulder marked but rounded. Ornamentation of the flanks usually consists of low, distant radial folds. Suture line ceratitic with rather narrow, deep lobes.

Discussion: One specimen (V-346, Plate 14, Figs G–I) displays an unusually strong ornamentation consisting of dense, conspicuous folds but is otherwise morphologically identical to other specimens assigned to *Baidites tenue*. *Baidites tenue* and the type species share a narrow venter and compressed whorls. However, *B. hermanni* is distinguished by a singular ontogenetic change in whorl section, with flat flanks on inner whorls and outer whorls showing a demarcation between the inner two thirds and the outer third (see BRÜHWILER et al. 2012a, pl. 11, fig. 3). Furthermore, in comparison with *B. tenue*, the type species appears more evolute and exhibits a conspicuous ornamentation on outer whorls consisting of blunt ribs.

Baidites crassecostatum (WELTER, 1922)

(Plate 14, Figs K–Z)

	1922	*Ophiceras crassecostatum* WELTER, p. 103, pl. 2, figs 11–14; pl. 3, fig. 3.
?	1922	*Xenodiscus rotula* – WELTER, p. 106, pl. 5, figs 8–10.

Occurrence: *Kashmirites* fauna.

Measurements: See Text-fig. 29. Estimated maximal size: ~ 13.5 cm.

Description: Large, evolute, somewhat compressed to depressed shell. Venter relatively broad and subtabulate to lowly arched on robust specimens, with abruptly rounded shoulders. Maximum whorl width at umbilical margin. Flanks distinctively converving towards venter from the umbilical margin. Umbilicus wide and moderately shallow. Umbilical wall steep with marked umbilical shoulders on inner whorls becoming rapidly more inclined with rounded umbical shoulders on outer whorl. Ornamentation of the flanks consists of blunt fold-like ribs that do not cross the venter. Ornamentation stronger on robust, more evolute variants. This type of covariation is well known as Buckman's first law of covariation (WESTERMANN 1966, HAMMER & BUCHER 2005). Strength and spacing of ribs somewhat variable. Ribs gradually passing to closely spaced low folds on outer whorl eventually fading out at

maturity. Growth lines replacing the ribs discernible at maturity. No strigation visible on our specimens. Suture line not available in our material.

Discussion: Two specimens (Plate 14, Figs K–P) are interpreted as more evolute and robust variants. Their greater whorl thickness results in the presence of a broadly arched venter instead of the usual subtabulate venter.

Baidites tenue mainly differs from *B. crassecostatum* by its narrower venter and more compressed whorl section. Alternatively, *B. tenue* could correspond to extreme compressed variants of *B. crassecostatum*. However, in the absence of stratigraphical control and of intermediate forms, it is safer to retain the two existing species.

The spiral strigation described by WELTER (1922) on one of the two type specimens was not observed on our specimens, despite an exceptional state of preservation of the shell.

Baidites obesus n. sp.

(Plate 15, Figs A–H)

? 1922 *Ophiceras* cf. *gibbosum* – WELTER, p. 105, pl. 3, figs 8, 9; pl. 4, fig. 6, 7.

Etymology: The species name refers to its involute coiling.

Holotype: Specimen PIMUZ 37071 (Plate 15, Figs F–H).

Occurrence: *Kashmirites* fauna.

Measurements: See Text-fig. 30. Estimated maximal size: ~ 10 cm.

Diagnosis: Involute *Baidites* with thick whorls.

Description: Relatively large, somewhat compressed shell. Venter subtabulate with marked but rounded shoulders. Maximum whorl width at umbilical margin. Flanks converging towards venter from the umbilical margin. Umbilicus deep and moderately wide. Umbilical wall steep on inner whorls, becoming more inclined on outer whorl; umbilical shoulders marked but rounded. Ornamentation of the flanks consists of low, broad folds gradually fading throughout ontogeny. Suggestion of strigation only locally visible. Slightly biconcave growth lines discernible at maturity. Suture line ceratitic with rather narrow, deep lobes, similar to that of *B. tenue*.

Discussion: This species clearly differs from *Baidites crassecostatum* and *B. tenue* by its higher whorls, more involute coiling and ornamentation characterized by low, broad folds.

Family Dieneroceratidae KUMMEL, 1952

Genus *Dieneroceras* SPATH, 1934

Type species: *Ophiceras dieneri* HYATT & SMITH, 1905

Dieneroceras dieneri (HYATT & SMITH, 1905)

(Plate 16, Figs A–R)

	1905	*Ophiceras dieneri* HYATT & SMITH, p. 118, pl. 8, figs 16–29.
?	1905	*Xenaspsis marcoui* HYATT & SMITH, p. 116, pl. 7, figs 26–33.
	1932	*Ophiceras dieneri* – SMITH, p. 48, pl. 8, figs 16–29.
?	1932	*Xenodiscus* (*Xenaspsis*) *marcoui* – SMITH, p. 47, pl. 7, figs 26–33.
	1955	*Ophiceras iwaiense* SAKAGAMI, p. 135, pl. 1, figs 1–9.
	1955	*Ophiceras* sp. – SAKAGAMI, p. 136, pl. 1, figs 10–11.
?	1959	*Kariceltites indicus* JEANNET, p. XXX, pl. 7, figs 10–12; pl. 8, fig. 15.
	1960	*Dieneroceras iwaiense* – KUMMEL & SAKAGAMI, p. 4, pl. 1, figs 3–5; pl. 2, figs 7–9.
?	1961	*Dieneroceras dieneri* – KIPARISOVA, p. 47, pl. 9, fig. 2.
?	1961	*Dieneroceras chaoi* KIPARISOVA, p. 48, pl. 9, figs 3–6.
?	1961	*Dieneroceras caucasicum* POPOV, p. 41, pl. 6, fig. 1.
?	1965	*Dieneroceras* cf. *dieneri* – KUENZI, p. 369, pl. 53, figs 13–18, text-figs 3, 4.
	1968	*Dieneroceras dieneri* – NAKAZAWA & BANDO, p. 93, pl. 4, figs 1–6.
	1968	*Dieneroceras* aff. *chaoi* – NAKAZAWA & BANDO, p. 95, pl. 4, figs 7, 8; pl. 5, fig. 1.
?	1973	*Dieneroceras knechti* – COLLIGNON, p. 131, pl. 1, figs 2, 3.
?	1973	*Dieneroceras chaoi* – COLLIGNON, p. 132, pl. 1, figs 6–8.
?	1995	*Dieneroceras caucasicum* – SHEVYREV, p. 25, pl. 1, figs 3–5.
?	1995	*Dieneroceras magnum* SHEVYREV, p. 26, pl. 1, fig. 6.
	2010	*Wyomingites arnoldi* – STEPHEN et al, fig. 5c, d.
v	2012	*Dieneroceras* cf. *dieneri* – BRÜHWILER & BUCHER, p. 20, pl. 8, figs 1–4; pl. 9, figs 1–7; pl. 10, figs 1–3.
v	2013	*Dieneroceras dieneri* – BRAYARD et al., p. 173, fig. 36a–s.
v	2017	*Dieneroceras dieneri* – JATTIOT et al., p. 19, pl. 5, figs A–S.
	2018	*Dieneroceras dieneri* – JENKS & BRAYARD, p. 38, fig. 32.

Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 31. Estimated maximal size: ~ 3.5 cm.
Description: Serpenticonic, laterally compressed shell with a subtabulate to tabulate venter and a large umbilicus. Broadly convex flanks with maximum thickness near umbilicus, impartling a slightly ovoid whorl section. Inner whorls slightly more rounded than outer whorls. Umbilical wall steeply inclined with rounded shoulders, forming a shallow umbilicus. Surface smooth except for faintly sinuous growth lines and barely conspicuous folds on some juvenile specimens. Spiral strigation described by HYATT & SMITH (1905) from type specimen not observed on our exceptionally well-preserved material. Suture line not available in our material.
Discussion: The reader is referred to BRAYARD et al. (2013) and JENKS & BRAYARD (2018) for further details.

Dieneroceras knechti (HYATT & SMITH, 1905)

(Plate 16, Figs S–V)

1905 *Lecanites knechti* HYATT & SMITH, p. 138, pl. 9, figs 11–16.
1915 *Proavites knechti* – DIENER, p. 228.
1932 *Lecanites* (*Paralecanites*) *knechti* – SMITH, p. 41, 42, pl. 9, figs 11–16; p. 28, figs 1–7.
1934 "*Lecanites*" *knechti* – SPATH, p. 88, 93, 123, 134.
1962 *Dieneroceras knechti* – KUMMEL & STEELE, p. 662, pl. 99, figs 14, 15.
v 2017 *Dieneroceras knechti* – JATTIOT et al., p. 21, pl. 5, figs T–AA.
2018 *Dieneroceras knechti* – JENKS & BRAYARD, p. 41, fig. 36.
Occurrence: *Owenites* fauna.
Measurements: see Table 1. Estimated maximal size: ~ 5 cm.
Description: Serpenticonic, laterally compressed shell with rounded venter and broad umbilicus. Broadly convex flanks with maximum thickness near umbilicus, imparting a slightly ovoid whorl section. Inner whorls slightly more rounded than outer whorls. Umbilical wall steeply inclined with rounded shoulders forming a shallow umbilicus. Surface smooth except for faintly sinuous growth lines and delicate strigation on one specimen (Plate 16, Fig. S). Injury visible on same specimen as a scar on the outer whorl. Suture line not available in our material.
Discussion: *Dieneroceras knechti* is distinguished from *D. dieneri* by its rounded venter.

Dieneroceras cf. *tientungense* CHAO, 1959

(Plate 16, Figs W–AI)

1959 *Dieneroceras tientungense* CHAO, p. 192, pl. 2, figs 5–6, 8–10, 29.
1959 *Dieneroceras*? *vermiforme* CHAO, p. 192, pl. 2, figs 14–16, 28.
1959 *Dieneroceras ovale* CHAO, p. 192, pl. 2, figs 11–13.
v 2008 *Dieneroceras tientungense* – BRAYARD & BUCHER, p. 40, pl. 15, figs 5–12.
v 2012c *Dieneroceras* cf. *tientungense* – BRÜHWILER et al., p. 139, fig. 17BG–BV.
Occurrence: *Kashmirites* fauna.
Measurements: See Text-fig. 32. Estimated maximal size: ~ 6.5 cm.
Description: Serpenticonic, evolute to very evolute shell with slightly convex flanks. Venter subtabulate to gently rounded with rounded shoulders. Umbilicus wide and shallow with rounded umbilical wall. Ornamentation consists of weak folds and minor contrictions. Suture line simple, typical of family, with narrow, relatively deep lobes; indentation of lobes poorly preserved.
Discussion: Most of our largest specimens (> 20 mm) are more involute and show slightly higher whorls than typical representatives of *Dieneroceras tientungense*, making the taxonomical assignment uncertain. However, *D. tientungense* exhibits significant variation in whorl section (BRAYARD & BUCHER 2008), and these specimens from Timor may fall within the range of its intraspecific variation.

Family Paranannitidae SPATH, 1930

Genus *Owenites* HYATT & SMITH, 1905

Type species: *Owenites koeneni* HYATT & SMITH, 1905

Owenites koeneni HYATT & SMITH, 1905

(Plate 17, Figs AB–AW)

1905 *Owenites koeneni* HYATT & SMITH, p. 83, pl. 10, figs 1–22.
1915 *Owenites koeneni* – DIENER, p. 214.
1932 *Owenites koeneni* – SMITH, p. 100, pl. 10, figs 1–22.

1932 *Owenites egrediens* – SMITH, p. 100, pl. 52, figs 6–8.
1932 *Owenites zitteli* SMITH, p. 101, pl. 52, figs 1–5.
1934 *Owenites koeneni* – SPATH, p. 185, fig. 57.
1947 *Owenites* aff. *egrediens* – KIPARISOVA, p. 139, pl. 32, figs 1–3.
1955 *Kingites shimizui* SAKAGAMI, p. 138, pl. 2, figs 2a–c.
1957 *Owenites koeneni* – KUMMEL in ARKELL et al., p. L138, figs 171-8a–b.
1959 *Owenites costatus* CHAO, p. 249, pl. 22, figs 10–18, 22, 23, text-fig. 26c.
1959 *Owenites pakungensis* CHAO, p. 248, pl. 21, figs 6–8.
1959 *Owenites pakungensis* var. *compressus* CHAO, p. 248, pl. 21, figs 4, 5.
1959 *Pseudowenites oxynotus* CHAO, p. 252, pl. 23, figs 1–16, text-figs 27a–d.
1959 *Owenites shimizui* – KUMMEL, p. 430.
1959 *Owenites* cf. *koeneni* – KUMMEL, p. 441, figs 2–4.
1960 *Owenites shimizui* – KUMMEL & SAKAGAMI, p. 6, pl. 2, figs 5, 6.
1962 *Owenites koeneni* – KUMMEL & STEELE, p. 674, pl. 101, figs 3–7.
1962 *Owenites koeneni* – POPOV, p. 44, pl. 6, fig. 6.
1965 *Owenites koeneni* – KUENZI, p. 374, pl. 53, figs 1–6, text-figs 3d, 6.
1966 *Owenites koeneni* – HADA, p. 112, pl. 4, figs 2–4.
1968 *Owenites koeneni* – KUMMEL & ERBEN, p. 121, figs 12; pl. 19, figs 10–15.
1968 *Owenites carinatus* SHEVYREV, p. 189, pl. 16, fig. 1.
1968 *Owenites koeneni* – ZAKHAROV, p. 94, pl. 18, figs 1–3.
1973 *Owenites koeneni* – COLLIGNON, p. 139, pl. 4, figs 2, 3.
1979 *Owenites koeneni* – NICHOLS & SILBERLING, pl. 1, figs 17, 18.
1981 *Owenites koeneni* – BANDO, p. 158, pl. 17, fig. 7.
1984 *Owenites carinatus* – VU KHUC, p. 81, pl. 6, figs 1–4, text-fig. H16.
1984 *Pseudowenites oxynotus* – VU KHUC, p. 82, pl. 7, figs 3, 4.
1990 *Owenites koeneni* – SHEVYREV, p. 118, pl. 1, fig. 5.
1995 *Owenites koeneni* – SHEVYREV, p. 51, pl. 5, figs 1–3.
? 2004 *Owenites pakungensis* – TONG et al., p. 199, pl. 2, figs 9–10, text-fig. 7.
v 2008 Owenites koeneni – BRAYARD & BUCHER, p. 67, pl. 36, figs 9–10, text-fig. 7.
v 2010b *Owenites koeneni* – BRÜHWILER et al., p. 426, fig. 15(9).
v 2012a *Owenites koeneni* – BRÜHWILER & BUCHER, p. 43, pl. 25, figs 1–6.
v 2012c *Owenites koeneni* – BRÜHWILER et al., p. 155, fig. 35AH–AJ.
v 2013 *Owenites koeneni* – BRAYARD et al., p. 204, fig. 74.
2014 *Owenites koeneni* – SHIGETA & NGUYEN, p. 126, figs 89–96
v 2017 *Owenites koeneni* – JATTIOT et al., p. 38, pl. 17, figs K–AD.
2018 *Owenites koeneni* – JENKS & BRAYARD, p. 96, figs 92, 93A–C'.

Occurrence: *Owenites* fauna.

Measurements: See Text-fig. 33. Estimated maximal size: ~ 7 cm.

Description: Fairly small, compressed, involute shell characterized by an inflated lenticular whorl section with maximum width at umbilical shoulder. Venter subangular to angular that may resemble a keel on some specimens. Umbilicus characterized by large variation in width, from occluded to fairly narrow with low, gently inclined wall and broadly rounded shoulders. Most of the largest shells exhibit some degree of egressive coiling of the ultimate whorl.

Surface smooth except for dense, prorsiradiate growth lines that project forward high on flank and also tend to form barely perceptible folds bordered by minute constrictions in rare instances. Suture line ceratitic with several divided umbilical saddles.

Discussion: As shown by JENKS & BRAYARD (2018), this species exhibits an extremely wide range of intraspecific variation in umbilicus width, especially in its mature form. However, among specimens superior to 3 cm in diameter illustrated in JENKS & BRAYARD (2018), none shows an occluded umbilicus. On the contrary, some of our largest Timor specimens (diameter between 3 and 4.5 cm) clearly exhibit an occluded umbilicus. These specimens might demonstrate an even wider intraspecific variability of umbilicus shape in *O. koeneni*. Alternatively, they might be representatives of a new species with an occluded umbilicus at all growth stages. More Timor material is needed to decipher this taxonomic conundrum.

Owenites egrediens WELTER, 1922

(Plate 18, Figs A–AD)

1922 *Owenites egrediens* WELTER, p. 151, pl. 14, figs 22–26.
1934 *Owenites egrediens* – SPATH, p. 186, figs 56, 57d–f.

Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 34. Estimated maximal size: ~ 5.5 cm.
Description: Involute shell with an inflated, lenticular whorl section, very convergent flanks and egressive coiling. Subangular to angular venter that may resemble a keel on some specimens. Maximum thickness on the umbilical margin. Funnel-shaped umbilicus with marked umbilical shoulders and a high, inclined wall. Surface smooth except for growth lines and very weak folds in rare instances. Injury visible on specimen PIMUZ 37106 (Plate 18, Figs D, E) as deep scar all along the outer whorl, resulting in the disappearance of the angular venter ('ornamental compensation'; see GUEX 1968). Suture line not available in our material.
Discussion: *Owenites egrediens* WELTER, 1922 is mainly distinguished from the type species by its diagnostic funnel-shaped umbilicus with marked umbilical shoulders, its very converging flanks and its greater thickness at mature stages (D > 40 mm). Although hardly distinguishable, juvenile stages of *O. egrediens* differ from those of *O. koeneni* by their slightly greater thickness.

Owenites simplex WELTER, 1922

(Plate 19, Figs A–AM)

	1922	*Owenites simplex* WELTER, p. 153, pl. 15, figs 1–8.
	1934	*Parowenites simplex* – SPATH, p. 187, fig. 58.
	1959	*Owenites kwangsiensis* CHAO, p. 250, pl. 22: 1–6, text-fig. 26b.
	1959	*Owenites plicatus* CHAO, p. 251, pl. 22: 19–21, 24–25, text-fig. 26e.
	1968a	*Owenites simplex* – KUMMEL, p. 2, pl. 1, figs 1–9.
	1968	*Owenites simplex* – KUMMEL & ERBEN, p. 122, fig. 12k, n, o.
v	2008	*Owenites simplex* – BRAYARD & BUCHER, p. 69, pl. 35, figs 20–22; text-fig. 59.
v	2010b	*Owenites simplex* – BRÜHWILER et al., p. 427, pl. 35, fig. 15 (10–12).
v	2012a	*Owenites simplex* – BRÜHWILER & BUCHER, p. 46, pl. 24, figs 10–14.
non v	2012c	*Owenites* cf. *simplex* – BRÜHWILER et al., p. 158, figs 35Y–AC.

Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 35. Estimated maximal size: ~ 4 cm.
Description: Moderately involute and somewhat compressed shell with subparallel flanks. Subangular to angular venter that may resemble a keel on some specimens. Moderately deep umbilicus with a low, inclined wall and rounded shoulders. Ornamentation consists of conspicuous, prorsiradiate, sigmoidal fold-like ribs becoming denser and weaker at maturity. Suture line not available in our material.
Discussion: *Owenites simplex* is distinguished from other *Owenites* species by its more evolute coiling at all ontogenetic stages and by its lower whorls. *Owenites koeneni* and *O. egrediens* also do not show a conspicuous ribbing. Specimen PIMUZ 37124 (Plate 19, Figs W–Z) and specimens from China (BRAYARD & BUCHER 2008) are weakly ornamented variants.

Owenites sp. indet.

(Plate 17, Figs A–AA)

Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 36. Estimated maximal size: ~ 2.5 cm.
Description: Small, very involute and inflated shell. Venter subangular to narrowly rounded. Flanks convex from the occluded umbilicus. Maximum thickness near the umbilicus. Surface smooth, except for growth lines when and very weak constrictions.
Discussion: These small-sized specimens of *Owenites* are hardly assignable to any species. All could be juveniles of *O. koeneni*, although thickest specimens might as well be juveniles of *O. egrediens*. If we admit some variability, the whole group also morphologically corresponds to the species *O. carpenteri* SMITH, 1932, abundantly mentioned in the Tethys (South China, BRAYARD & BUCHER 2008; South Tibet, BRÜHWILER et al. 2010b; Oman, BRÜHWILER et al. 2012a; and Spiti, BRÜHWILER et al. 2012c), by having a rounded venter and an occluded umbilicus. However, the validity of this species is highly questionable, as most of specimens figured under that name fall well within the intraspecific variation of *O. koeneni* (see JENKS & BRAYARD 2018, for a thorough discussion on *O. carpenteri* legitimacy).

Steckites brevus WELTER, 1922

(Plate 20, Figs A–AU)

2012c	*Steckites brevus* BRÜHWILER et al., p. 161, figs 35AV–BC.
2018	*Steckites* cf. *brevus* – JENKS & BRAYARD, p. 100, fig. 93G'–M'.

Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 37. Estimated maximal size: ~ 3.5 cm.
Description: Involute, slightly compressed shell with subparallel flanks. Venter subangular with indistinct shoulders. Umbilicus with inclined wall and rounded shoulders. Surface smooth except for prorsiradiate, sinuous and weal plications that cross the venter. Suture line ceratitic, with three lateral saddles and a very short auxiliary series.
Discussion: This taxon is very similar to *Owenites*, but this latter displays a suture line with several well-individualized auxiliary saddles (BRÜHWILER et al. 2012c) and a more angular venter. *Steckites brevus* also differs from *O. egrediens* and *O. koeneni* by its different whorl section (subparallel flanks). *Owenites simplex* shares a somewhat similar whorl section, but it is much more evolute and it bears a much stronger ornamentation.

Genus *Omanites* BRÜHWILER et al. 2012a

Type species: *Omanites musjahensis* BRÜHWILER et al. 2012a

?*Omanites* sp. indet.

(Plate 16, Figs AJ–AK)

Occurrence: *Owenites* fauna. One single specimen.
Measurements: See Table 1. Estimated maximal size: ~ 2.5 cm.
Description: Small, depressed and evolute shell. Venter rounded without shoulders. Umbilicus deep, with high, vertical wall and rounded shoulders. Surface smooth. Suture line not available in our material.
Discussion: This specimen is somewhat similar to *Omanites musjahensis* BRÜHWILER et al., 2012a that differs by being more involute at comparable size.

Family Melagathiceratidae WAAGEN, 1895

Genus *Juvenites* SMITH, 1927

Type species: *Juvenites kraffti* SMITH, 1927

Juvenites spathi (FREBOLD, 1930)

(Plate 21, Figs A–AB)

	?	1922	*Nannites* cf. *heberti* – WELTER, p. 100, pl. 2, figs 8–10.
	?	1922	*Nannites* cf. *hindostanus* – WELTER, p. 102, pl. 2, figs 5–7.
		1930	*Prosphingites spathi* FREBOLD, p. 20, pl. 4, figs 2, 3, 3a.
		1934	*Prosphingites spathi* – SPATH, p. 195, pl. 13, figs 1, 2.
p	?	1959	*Prosphingites kwangsianus* CHAO, p. 296, pl. 28, figs 17, 18.
p	?	1959	*Prosphingites sinensis* CHAO, p. 297, pl. 27, figs 14–17, text-fig. 40a.
?		1961	*Prosphingites spathi* – TOZER, p. 58, pl. 13, figs 1, 2.
?		1962	‘‘*Prosphingites*’’ *slossi* KUMMEL & STEELE, p. 683, pl. 101, figs 8–17.
?		1982	*Prosphingites spathi* – KORCHINSKAYA, pl. 5, fig. 2.
?		1994	*Paranannites spathi* – TOZER, p. 77, pl. 36, figs 1, 2.
v		2008	*Paranannites spathi* – BRAYARD & BUCHER, p. 63, pl. 35, figs 10–19.
v		2010b	*Paranannites spathi* – BRÜHWILER et al., p. 426, fig. 16(1, 2).
v		2012a	*Juvenites spathi* – BRÜHWILER & BUCHER, p. 38, pl. 22, figs 12–17.
v		2012c	*Paranannites* sp. indet. BRÜHWILER et al., p. 155, figs 35A–X.
v		2012c	*Juvenites* cf. *spathi* – BRÜHWILER et al., p. 161, figs 37A–O.
v	?	2013	*Juvenites* aff. *spathi* – BRAYARD et al., p. 166, fig. 27a–c.
		2014	*Paranannites sinensis* – SHIGETA & NGUYEN, p. 120, figs 85–87.
v		2017	*Juvenites spathi* – JATTIOT et al., p. 17, pl. 3, figs AF–AW.
		2018	*Juvenites spathi* – JENKS & BRAYARD, p. 107, figs 98, 99.

Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 38. Estimated maximal size: ~ 5.5 cm.
Description: Globose and moderately evolute shell. Venter arched, or triangular in rare instances only (Plate 21, Figs A–C). Flanks gradually converging towards the venter from bluntly angular umbilical shoulder. Umbilicus deep with high, perpendicular wall (crateriform umbilicus). Ornamentation consists of prorsiradiate constrictions, becoming denser at maturity. Suture line not available in our material. Specimen PIMUZ 37150 (Plate 21, Figs M, N) is a complete, mature individual.
Discussion: Our material reveals that large-size specimens do not necessarily display a triangular whorl section, contrary to as commonly stated (e.g., BRAYARD et al. 2013). Consequently, the marked crateriform umbilicus with bluntly angular umbilical shoulders is the most diagnostic trait of *Juvenites*

spathi (see discussion in JENKS & BRAYARD 2018). Specimens assigned to *Paranannites* sp. indet in BRÜHWILER et al. (2012c) are only slightly more compressed and involute than typical representatives of *J. spathi* and therefore very likely fall within the intraspecific variation of this species.

Juvenites septentrionalis SMITH, 1932

(Plate 22, Figs A–Q)

1932 *Juvenites septentrionalis* SMITH, p. 110, pl. 31, figs 31–40.
1932 *Juvenites sanctorum* SMITH, p. 110, pl. 31, figs 22–30.
1978 *Juvenites* sp. indet. GUEX, pl. 5, fig. 3.
v 2008 *Juvenites procurvus* BRAYARD & BUCHER, p. 32, pl. 22, figs 6–12.
v 2008 *Juvenites* cf. *kraffti* BRAYARD & BUCHER, p. 32, pl. 9, figs 20–23.
v 2012a *Juvenites procurvus* – BRÜHWILER & BUCHER, p. 41, pl. 22, figs 10–11.
v 2012b *Juvenites* cf. *kraffti* – BRÜHWILER & BUCHER, p. 105, fig. 89BB–BF.
v 2012c *Juvenites procurvus* – BRÜHWILER et al., p. 163, fig. 37AK–AP.
2018 *Juvenites septentrionalis* – JENKS & BRAYARD, p. 103, figs 95, 96A–H.

Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 39. Estimated maximal size: ~ 3.5 cm.
Description: Small, moderately evolute shell with an arched venter and flanks convergent from umbilical shoulders to rounded venter (without distinct ventral shoulders). Moderately deep umbilicus with relatively high, steeply inclined wall and somewhat abruptly rounded shoulders. Ornamentation consists of strong, slightly forward projected constrictions crossing the venter with equal intensity. Density and intensity of constrictions highly variable among specimens. Suture line not available in our material.
Discussion: Our Timor specimens tend to confirm that *Juvenites thermarum* is more involute and more depressed than *J. septentrionalis* (Text-fig. 39), as stated by BRAYARD et al. (2013: 165). Furthermore, *J. septentrionalis* specimens as gathered in our synonymy list usually differ from published specimens of *J. thermarum* by their stronger and/or more closely spaced constrictions. Nevertheless, it is not excluded that *J. thermarum* and *J. septentrionalis* might alternatively represent a single species with a large intraspecific variation (see detailed discussion in JENKS & BRAYARD 2018).

Family Inyoitidae SPATH, 1934

Genus *Subinyoites* SPATH, 1930

Type species: *Inyoites kashmiricus* DIENER, 1913

Subinyoites cf. *punjabiensis* BRÜHWILER & BUCHER, 2012b

(Plate 22, Figs U–X)

2012b *Subinyoites punjabiensis* BRÜHWILER & BUCHER, p. 107, fig. 93S–AA.
Occurrence: *Owenites* fauna. One single specimen.
Measurements: See Table 1. Estimated maximal size: ~ 4.5 cm.
Description: Moderately involute shell with an elliptical whorl section. Egressive coiling. Venter narrowly rounded with indistinct shoulders. Umbilicus relatively deep, with inclined wall and rounded shoulders. Surface smooth except for slightly biconcave growth lines and faint folds. Suture line ceratitic with relatively narrow lateral lobe and second lateral saddle slighty tapered. Indentations of lobes poorly preserved.
Discussion: In shape, this specimen is identical to the holotype of *S. punjabiensis*. However, this species was first described from a younger stratigraphic unit (late Smithian, *Wasatchites distractus* beds, BRÜHWILER et al., 2012b). Furthermore, the suture line of our Timor specimen has a slightly narrower lateral lobe (Plate 22, Fig. U). Therefore, the species assignment must remain uncertain.

Genus *Subvishnuites* SPATH, 1930

Type species: *Vishnuites* spec. WELTER, 1922 (= *Subvishnuites welteri* sp. nov. SPATH, 1930)

Subvishnuites welteri SPATH, 1930

(Plate 22, Figs Y–AS)

1922 *Vishnuites* spec. – WELTER, p. 137, pl. 13, figs 3–5.
1930 *Subvishnuites welteri* SPATH, p. 30, p. 90.
1934 *Subvishnuites welteri* – SPATH, p. 1l7, fig. 31.
1959 *Subvishnuites welteri* – KUMMEL, p. 443, fig. 7.
v 2012a *Subvishnuites welteri* – BRÜHWILER & BUCHER, p. 36, pl. 21, figs 9–13.

v 2017 *Subvishnuites welteri* – JATTIOT et al., p. 25, pl. 8, figs O–T.
Occurrence: *Owenites* fauna. In association with *Nyalamites angustecostatus*.
Measurements: See Text-fig. 40. Estimated maximal size: ~ 6.5 cm.
Description: Compressed, evolute shell. Convex flanks, subparallel on the inner half and strongly convergent towards the venter on the outer half. Whorl shape highly variable at juvenile stages. Venter narrowly rounded or almost acute, except for individuals with depressed juvenile stages that instead bear a rounded venter (Plate 22, Figs AK–AM and see cross-section of holotype in WELTER 1922, pl. 13, fig. 4). Umbilicus wide and moderately deep with relatively high and steeply inclined wall, and rounded shoulders. Ornamentation consisting of closely and regularly spaced, weak folds. Suture line too poorly preserved to be illustrated.
Discussion: *Inyoites stokesi* KUMMEL & STEELE, 1962 differs from *S. welteri* by its keel, more compressed shell and conspicuous ribbing.

Subvishnuites cf. *posterus* BRÜHWILER et al., 2012c

(Plate 22, Figs AT, AU)

v 2012a *Subvishnuites* sp. indet. – BRÜHWILER & BUCHER, p. 36, pl. 21, fig. 14.
v 2012c *Subvishnuites posterus* BRÜHWILER et al., p. 163, fig. 37AQ–BK.
Occurrence: *Anasibirites* fauna. One single specimen.
Measurements: See Text-fig. 41. Estimated maximal size: ~ 5.5 cm.
Description: Moderately evolute, compressed shell. Flanks subparallel on the upper half and strongly converging on the lower half. Venter narrowly rounded. Umbilicus wide and shallow with rounded umbilical wall. Ornamentation not preserved. Suture line not available in our material.
Discussion: This specimen is morphologically very similar to typical representatives of *Subvishnuites posterus*. However, its poor preservation precludes a definitive specific assignment.

Genus *Hochuliites* BRÜHWILER et al., 2012c
Type species: *Hochuliites retrocostatus* BRÜHWILER et al., 2012c

Hochuliites retrocostatus BRÜHWILER et al., 2012c

(Plate 13, Figs A–G)

v 2012c *Hochuliites retrocostatus* BRÜHWILER et al., p. 107, fig. 39Q–AA.
Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 42. Estimated maximal size: ~ 10 cm.
Description: Evolute, compressed shell with an elliptical whorl section. Venter narrowly rounded with indistinct shoulders. Umbilicus with steeply inclined wall and rounded shoulders. Ornamentation consists of rursiradiate folds on upper flanks that fade out below mid-flank. Growth lines biconcave. Suture line ceratitic with relatively narrow lateral lobe and low, broad saddles.
Discussion: *Hochuliites retrocostatus* differs from *Anaxenaspis orientale* by its more compressed whorl section, its denser ornamentation, especially on innermost whorls, and its simpler suture line, whose saddles are low and broad.

Family Arctoceratidae ARTHABER, 1911

Genus *Truempyceras* BRÜHWILER & BUCHER, 2012b
Type species: Anasibirites pluriformis GUEX, 1978
Discussion: According to BRÜHWILER & BUCHER (2012b, p. 89), '*Truempyceras* differs from *Brayardites* by its less convergent flanks, its more tabulate venter with more pronounced shoulders and its ornamentation, which tends to develop a ventro-lateral tuberculation'. However, Timor material shows that some specimens of *Brayardites* also exhibit a ventro-lateral tuberculation (Plate 24, Figs A, B, R–T).

Truempyceras pluriformis (GUEX, 1978)

(Plate 23, Figs A–Z)

? 1895 *Ceratites normalis* WAAGEN, p. 38, pl. 6, fig. 2.
? 1911 *Pronorites osmanicus* ARTHABER, p. 205, pl. 17, fig. 10.
1922 *Pronorites* spec. ind. ex aff. arbani v. Arth. – WELTER, p. 95, pl. 1, fig. 9.
p 1978 *Anasibirites pluriformis* GUEX, p. 107, pl. 3, figs 7–9; pl. 4, figs 1–2, 4, 7–8 only; pl. 5, figs 6–7.
1985 *Anasibirites* sp. PAKISTANI-JAPANESE RESEARCH GROUP, pl. 14, fig. 1a–b.
v 2010b *'Anasibirites'pluriformis* – BRÜHWILER et al., p. 423, fig. 5(8).
2012b *Truempyceras pluriformis* – BRÜHWILER & BUCHER, p. 89, figs 72P–U, 73A–N.

? v 2012b ?*Pseudoceltites* cf. *normalis* – BRÜHWILER & BUCHER, p. 27, fig. 21AD–AF.
Occurrence: *Owenites* fauna. Often in association with *Nyalamites angustecostatus*.
Measurements: See Text-fig. 43. Estimated maximal size: ~ 7.5 cm.
Description: Moderately involute shell with flat, slightly convergent flanks. Distinct egressive coiling. Venter subtabulate to slightly arched with narrow, rounded shoulders. Umbilicus with a high, vertical wall (somewhat overhanging on some specimens) and abruptly rounded shoulders. Ornamentation of variable strength, conforming to the Buckman's first law of covariation (WESTERMANN 1966), and consisting of radial, slightly biconcave ribs that form a tuberculation on ventral shoulders. Strongest ribs may cross the venter. Robust variants also exhibit elongated umbilical tubercles. Suture line ceratitic with relatively deep lobes and tapered saddles.
Discussion: *Truempyceras compressum* BRÜHWILER et al., 2012c is distinguished by a more compressed whorl section, a narrower venter with angular shoulders, and a weaker ornamentation. '*Ceratites normalis*' (WAAGEN 1895) and the single fragmentary specimen assigned to ?*Pseudoceltites normalis* in BRÜHWILER & BUCHER (2012b) might correspond to the most compressed and most involute variants of *T. pluriformis* showing a weaker ornamentation with slightly denser row of marginal tubercles, as illustrated by some of our specimens (e.g., Pl. 23, Figs J–L, P–R). According to BRÜHWILER & BUCHER (2012b), the holotype of '*Ceratites*' *normalis* is supposedly much older (lower Smithian), whereas ?*Pseudoceltites* cf. *normalis* is of the same age than our material.

Truempyceras compressum BRÜHWILER et al., 2012c

(Plate 23, Figs AD–AT)

? 1922 *Pronorites arbanus* v. Arth. – WELTER, p. 94, pl. 1, fig. 10–14.
2012c *Truempyceras compressum* BRÜHWILER et al., p. 148, fig. 29A–AA.
Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 44. Estimated maximal size: ~ 11 cm.
Description: Moderately involute to moderately evolute, compressed shell with flat, slightly convergent flanks. Distinct egressive coiling. Venter subtabulate with angular to slightly rounded shoulders. Umbilicus with a high, vertical wall (somewhat overhanging on some specimens) and abruptly rounded shoulders. Ornamentation consists of weak, slightly biconcave ribs or almost inexistent on involute juvenile specimens. Strongest ribs may cross the venter. Suture line ceratitic with relatively deep lobes.
Discussion: The reader is referred to *T. pluriformis* discussion.

Truempyceras cf. *compressum* BRÜHWILER et al., 2012c

(Plate 23, Figs AA–AC)

2012c *Truempyceras compressum* BRÜHWILER et al., p. 148, fig. 29A–AA.
Occurrence: *Owenites* fauna. One single specimen.
Measurements: See Table 1. Estimated maximal size: ~ 5.5 cm.
Description: Moderately involute, compressed shell with flat, slightly convergent flanks. Distinct egressive coiling. Venter tabulate with angular shoulders. Umbilicus with a high, vertical wall and abruptly rounded shoulders. Ornamentation only consists of very weak folds. Suture line not available.
Discussion: This specimen differs from typical representatives of *Truempyceras compressum* by its narrower, tabulate venter with angular shoulders and by the near absence of ornamentation.

Genus *Brayardites* BRÜHWILER et al., 2010b
Type species: *Brayardites crassus* BRÜHWILER et al., 2010b
Discussion: When erecting the genus *Brayardites*, BRÜHWILER et al. (2010b) did not include specimens described as *Meekoceras malayicum* by WELTER (1922). Yet, this species definitely belongs to this genus. The genus *Brayardites* shows a remarkably vast morphological and ornamental variability, making species taxonomy very difficult to establish. For this reason, and in the absence of any stratigraphical control, we opted for a typological approach and here retain all existing species.

Brayardites compressus BRÜHWILER et al., 2010b

(Plate 24, Figs A–T)

v 2010b *Brayardites compressus* BRÜHWILER et al., p. 419, fig. 13 (1–6).
v 2012b *Brayardites compressus* – BRÜHWILER & BUCHER, p. 82, figs 70A–AC, ?AD–AF.
v 2012c *Brayardites compressus* – BRÜHWILER et al., p. 145, figs 25A–O, 26A.
Occurrence: *Owenites* fauna. One specimen in association with *Nammalites* cf. *pilatoides*.

Measurements: See Text-fig. 45. Estimated maximal size: ~ 10 cm.
Description: Moderately evolute, compressed shell with flat, converging flanks. Maximum whorl width near umbilical shoulder. Venter subtabulate with rounded shoulders. Umbilicus with very high, vertical wall (overhanging in rare instances) and rounded shoulders. Ornamentation consists of prorsiradiate, biconcave fold-like ribs that develop strong tubercles near umbilicus and fade out towards mid-flank. Thick folds may cross the venter, and rare specimens (Plate 24, Figs A, B, R–T) bear tubercles on ventral shoulders, reminiscent of those present in *Truempyceras*. Growth lines biconcave. Suture line ceratitic with relatively deep lobes.
Discussion: Upon comparison between type specimens of *Brayardites malayicum* (WELTER, 1922) and *B. compressus*, this latter differs by its strong, distant umbilical tubercles and its conspicuous ornamentation on inner whorls. *B. malayicum* also shows a more rounded venter. Noteworthy, some of our *B. compressus* specimens are somewhat morphologically intermediate between the two species as they bear less conspicuous tubercles (e.g., Pl. 24, figs C–E, L–N). Wether or not these two species represent end-member variants of a single, highly variable species cannot be determined in the absence of any stratigraphical control.

Brayardites malayicum (WELTER, 1922)

(Plate 25, Figs A–S)

1922 *Meekoceras malayicum* WELTER, p. 127, pl. 11, figs 6–9.
v p ? 2012c *Brayardites compressus* – BRÜHWILER et al., p. 145, fig. 26A only.
Occurrence: *Owenites* fauna. One specimen in association with *Hanielites gracilus*.
Measurements: See Text-fig. 46. Estimated maximal size: ~ 10 cm.
Description: Moderately evolute, compressed shell with flat, converging flanks. Maximum whorl width near umbilical shoulder. Subtabulate to rounded venter, with rounded shoulders. Umbilicus with very high, vertical wall (overhanging in rare instances) and rounded shoulders. Ornamentation consists of dense prorsiradiate biconcave fold-like ribs becoming stronger near umbilical shoulders but without forming true tubercles. Suture line not available in our material.
Discussion: The reader is referred to *Brayardites compressus* discussion. Specimen illustrated as *B. compressus* in BRÜHWILER et al. (2012c, fig. 26A) might actually be a representative of *B. malayicum*.

Brayardites cf. *malayicum* (WELTER, 1922)

(Plate 25, Figs T–AA)

1922 *Meekoceras malayicum* – WELTER, p. 127, pl. 11, figs 6–9.
v p ? 2012c *Brayardites compressus* – BRÜHWILER et al., p. 145, fig. 26A only.
Occurrence: *Owenites* fauna. One specimen in association with *Hanielites gracilus*.
Measurements: see See Text-fig. 46. Estimated maximal size: ~ 8.5 cm.
Description: Moderately evolute shell with thick whorls and converging flanks. Maximum whorl width near umbilical shoulder. Venter broadly arched with rounded shoulders, and rounded shoulders. Umbilicus with very high, vertical wall (overhanging in rare instances) and rounded shoulders. Ornamentation consists of prorsiradiate ribs becoming stronger near umbilical shoulders, then resembling elongated tubercles. Ribs fade out towards mid-flank. Suture line not available in our material.
Discussion: These specimens differ from *Brayardites malayicum* by their wider and arched venter, their stronger ribbing, and their thicker whorls. They might represent robust end-member variants of *B. malayicum*. They are also very similar to the type species *B. crassus* that only differs by its more depressed whorls and by being more evolute. *Brayardites* cf. *malayicum* is somewhat morphologically intermediate between *B. malayicum* and *B. crassus*.

Genus *Nammalites* BRÜHWILER, BUCHER & GOUDEMAND, 2010b
Type species: Kazakhstanites pilatoides GUEX, 1978

?*Nammalites* cf. *pilatoides* (GUEX, 1978)

(Plate 26, Figs A–I)

1909 *Meekoceras* sp. ind. aff. *pilato* – KRAFFT & DIENER, p. 42, pl. 28, fig. 2a–c.
1968b *Subvishnuites* cf. *enveris* – KUMMEL, p. 491, pl. 1, figs 8–9.
1968b *Wasatchites* sp. indet. – KUMMEL, p. 500, pl. 3, figs 10–11.
1968 *Eoptychites* sp. indet. – KUMMEL & ERBEN, p. 120, pl. 22, figs 10–11.
1978 *Kazakhstanites pilatoides* GUEX, p. 109, pl. 6, figs 5, 6, 16.

? 1978 *Kazakhstanites pilatoides* GUEX, p. 109, pl. 8, fig. 6.
p 1978 *Anasibirites pluriformis* GUEX, pl. 4, fig. 3 only.
v 2010b *Nammalites pilatoides* – BRÜHWILER et al. p. 416, fig. 15(6–8).
v 2012a *Nammalites pilatoides* – BRÜHWILER & BUCHER, p. 31, pl. 18, figs 1–7.
v 2012b *Nammalites pilatoides* – BRÜHWILER & BUCHER, p. 85, fig. 72A–O.
v 2012c *Nammalites pilatoides* – BRÜHWILER et al., p. 146, figs 26B–Y, 27A–D.
Occurrence: *Owenites* fauna. One specimen in association with *Brayardites compressus*.
Measurements: See Text-fig. 47. Estimated maximal size: ~ 4.5 cm.
Description: Moderately involute shell with convex, convergent flanks. Maximum whorl width at umbilical border. Venter broadly rounded to subtabulate with rounded shoulders. Umbilicus with high, vertical wall and abruptly rounded shoulders. Ornamentation consists of distant, rursiradiate ribs that tend to develop elongated bullae near the umbilicus and then fade out towards the venter. Suture line ceratitic with deep lobes.
Discussion: According to BRÜHWILER et al. (2010b), the slightly older genus *Brayardites* differs essentially by its prorsiradiate ribbing and stronger tubercles. However, given the absence of stratigraphical control and the high intraspecific variability observed in *Brayardites* (see below), our specimens are only tentatively assigned to *Nammalites pilatoides* based on their rursiradiate ribbing.

Genus *Churkites* OKUNEVA, 1990
Type species: *Churkites egregius* ZHARNIKOVA & OKUNEVA in OKUNEVA, 1990

Churkites warei n. sp.

(Plate 26, Figs J–O)

Etymology: Named after David Ware (Berlin).
Holotype: Specimen PIMUZ 37213 (Plate 26, Figs M–O).
Occurrence: *Owenites* fauna. In association with *Nyalamites angustecostatus*.
Measurements: See Table 1. Estimated maximal size: ~ 7.5 cm.
Diagnosis: *Churkites* with a conspicuous ribbing on inner whorls, gradually passing to vague umbilical tubercles throughout ontogeny.
Description: Moderately evolute with compressed and relatively high whorls. Egressive coiling at maturity. Narrowly rounded venter at juvenile stages, becoming acute at maturity. Gently convex flanks forming slightly ovoid whorl. Umbilical wall high and perpendicular with abruptly rounded shoulders. Ornamentation consists of marked fold-like ribs on inner whorls. Mature stages bear weak umbilical tubercles slightly extending on the flanks. Suture line not available in our material.
Discussion: This species is distinguished from *Churkites noblei* JENKS, 2007 mainly by its conspicuous ribbing on inner whorls (see JENKS 2007; JENKS et al. 2010; BRAYARD et al. 2013; JATTIOT et al. 2017; JENKS & BRAYARD 2018). The close affinities of *Churkites* species between opposite sides of Panthalassa underline the potential long-distance faunal exchange that occurred during the Early Triassic (BRAYARD et al. 2009b; SHIGETA & KUMAGAE 2015).

Family Prionitidae HYATT, 1900
Genus *Prionites* WAAGEN, 1895
Type species: *Prionites tuberculatus* WAAGEN, 1895

Prionites tuberculatus WAAGEN, 1895

(Plate 27, Figs A–R)

1895 *Prionites tuberculatus* WAAGEN, p. 58, pl. 5, fig. 2a–c.
1895 *Prionites undatus* WAAGEN, p. 59, pl. 5, fig. la–b.
1895 *Prionites lingnatus* WAAGEN, p. 61, pl. 6, fig. 3–5.
1922 *Prionites laevis* WELTER, p. 134, pl. 12, figs 8–10.
1922 *Prionites armatus* WELTER, p. 135, pl. 12, figs 11–13.
1922 *Prionites elegans* WELTER, p. 136, pl. 12, figs 14–16.
v 2012b *Prionites tuberculatus* – BRÜHWILER & BUCHER, p. 91, figs 75A–V, 76A–E.
Occurrence: *Owenites* fauna. Commonly in association with *Nyalamites angustecostatus*.
Measurements: See Text-fig. 48. Estimated maximal size: ~ 9 cm.
Description: Involute shell with egressive coiling at maturity. Maximum whorl width at upper third of flank. Venter tabulate with angular shoulders on inner whorls, subtabulate with rounded shoulders on outer whorls. Umbilicus deep and funnel-shaped with inclined wall and rounded shoulders. Inner whorls smooth or with strong tubercles on very depressed specimens (e.g., Plate 27, Figs J–L); outer whorls with

distant bullae on inner flanks that develop into strong, broad tubercles. Growth lines biconcave. Suture line not available in our material.

Discussion: Although all juvenile specimens figured by BRÜHWILER et al. (2012b) have compressed whorls, suggesting that it is the typical juvenile morphology, specimen PIMUZ 37217 (Pl. 27. Figs J–L) shows that adult features (tubercules and great thickness, conforming to the Buckman's first law of covariation; WESTERMANN 1966) can occur earlier in ontogeny.

Prionites involutus BRÜHWILER et al., 2010b

(Plate 27, Figs S–Y)

v 2010b *Prionites involutus* BRÜHWILER et al., p. 419, fig. 14 (1–6).

Occurrence: *Owenites* fauna. In association with *Nyalamites angustecostatus*.

Measurements: See Text-fig. 49. Estimated maximal size: ~ 7 cm.

Description: Involute, compressed shell with slightly convex flanks. Egressive coiling at maturity. Maximum whorl width below mid-flank. Venter tabulate with angular shoulders, but subtabulate with abruptly rounded shoulders at maturity. Umbilicus narrow, deep and funnel-shaped with inclined wall and rounded shoulders. Surface smooth except for biconcave growth lines. Delicate spiral strigation on the venter of one specimen (Plate 27, Fig. U). Suture line ceratitic with broad saddles.

Discussion: *Prionites involutus* differs from *P. tuberculatus* by retaining a compressed whorl section and involute coiling throughout ontogeny.

Prionites nammalensis BRÜHWILER & BUCHER, 2012b

(Plate 27, Figs Z–AB)

v 2012b *Prionites nammalensis* BRÜHWILER & BUCHER, p. 93, fig. 76F–X.

Occurrence: *Owenites* fauna. One single specimen, in association with *Nyalamites angustecostatus*.

Measurements: See Text-fig. 50. Estimated maximal size: ~ 7 cm.

Description: Moderately involute, compressed shell with egressive coiling at maturity and convex, convergent flanks. Maximum whorl width at upper third of flank. Venter tabulate with angular shoulders, but subtabulate with abruptly rounded shoulders at maturity. Umbilicus funnel-shaped with inclined wall and rounded shoulders. Surface smooth except for biconcave growth lines. The low, prorsiradiate, distant wavy folds on lower flanks described by BRÜHWILER et al. (2012b) are not visible on our specimen. Suture line not available in our material.

Discussion: This species differs from *Prionites tuberculatus* by its narrower venter and its more compressed outer whorls. Furthermore, according to BRÜHWILER et al. (2012b), its suture line has deeper lobes. It is more evolute than *P. involutus*.

Genus *Stephanites* WAAGEN, 1895

Type species: *Stephanites superbus* WAAGEN, 1895

Stephanites superbus WAAGEN, 1895

(Plate 27, Figs AC–AD)

1895 *Stephanites suberbus* WAAGEN, p. 101, pl. 2, fig. 2.
1895 *Stephanites corona* WAAGEN, p. 102, pl. 3, fig. l.
1905 *Stephanites corona* – FRECH, pl. 28, fig. 1.
v 2010b *Stephanites superbus* – BRÜHWILER et al., p. 423, fig. 14 (7–12).
v 2012b *Stephanites superbus* – BRÜHWILER & BUCHER, p. 94, fig. 81 A–H.
v 2012c *Stephanites superbus* – BRÜHWILER et al., p. 152, fig. 31 P–S.

Occurrence: *Owenites* fauna. One single specimen, in association with *Nyalamites angustecostatus*.

Measurements: See Text-fig. 51. Estimated maximal size: ~ 4.5 cm.

Description: Moderately involute shell with convex, convergent flanks. Maximum whorl width slightly below mid-flank. Venter broadly rounded with rounded shoulders. Umbilicus very deep with well-rounded, inclined wall without distinct shoulders. Ornamentation consists of strong, distant tubercles on flanks, coinciding with maximum whorl width. Tubercles are elongated dorso-ventrally. Suture line not available in our material.

Discussion: The reader is referred to BRÜHWILER et al. (2012b).

Genus *Wasatchites* MATHEWS, 1929

Type species: *Wasatchites perrini* MATHEWS, 1929

Wasatchites distractus (WAAGEN, 1895)

(Plate 28, Figs A–H)

	1895	*Acrochordiceras distractum* WAAGEN, p. 94, pl. 3, fig. 4.
	1895	*Acrochordiceras coronatum* WAAGEN, p. 96, pl. 3, fig. 5.
	1895	*Acrochordiceras* cf. *damesi* – WAAGEN, p. 97, pl. 4, fig. 5.
	1895	*Acrochordiceras* compressum – WAAGEN, p. 98, pl. 4, fig. 4.
p	1909	*Sibirites* sp. indet. – KRAFFT & DIENER, p. 138, pl. 28, fig. 4 only.
?	1978	*Stephanites corona* – GUEX, pl. 5, fig. 2.
v	2010b	*Wasatchites distractus* – BRÜHWILER et al., p. 423, fig. 15(1).
v	2012b	*Wasatchites distractus* – BRÜHWILER & BUCHER, p. 97, figs 81 M–U, 82 A–X.
v	2012c	*Wasatchites distractus* – BRÜHWILER et al., p. 152, fig. 32 A–Z.
?	2018	*Wasatchites* cf. *distractus* – JENKS & BRAYARD, p. 89, fig. 84.

Occurrence: *Anasibirites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 6 cm.
Description: Moderately involute, somewhat compressed shell with convex flanks forming a trapezoidal whorl section. Venter ranging from tabulate on some inner whorls to subtabulate or slightly arched on mature whorls. Ventral shoulders abruptly rounded. Umbilicus moderately deep with a typical oblique wall and rounded shoulders. Ornamentation very conspicuous, consisting of projected ribs varying in strength and width. Ribs typically alternating between strong and weak and may arise from lateral tubercles. Intraspecific variation high, largely depending upon size at which transition between non-tuberculate to tuberculate stages occurs. Suture line not available in our material.
Discussion: *Wasatchites distractus* essentially differs from the type species by the more lateral position of its tubercles on the flank and its more radial and conspicuous ribs whose strength decreases at maturity. The reader is referred to BRAYARD et al. (2013) for a thorough discussion of the genus *Wasatchites*.

Genus Anasibirites MOJSISOVICS, 1896

Type species: *Sibirites kingianus* WAAGEN, 1895
See JATTIOT et al. (2015) for thoroughly illustrated specimens from Timor and extensive descriptions and discussions of *Anasibirites* species.

?*Anasibirites* sp. indet. A

(Plate 28, Figs I–N)

Occurrence: *Anasibirites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 6.5 cm.
Description: Moderately involute, somewhat compressed shell with convex flanks. Venter subtabulate to rounded with rounded shoulders. Umbilicus moderately deep with a typical oblique wall and rounded shoulders. Ornamentation consists of strong ribs rapidly fading out throughout ontogeny. Last half of outer whorl smooth, except for biconcave growth lines. Suture line not available in our material.
Discussion: This taxon differs from typical representative of *Anasibirites* by its stronger, more spaced ornamentation and from *Wasatchites distractus* by the absence of tuberculation and an ornamentation rapidly disappearing throughout ontogeny. It may be considered as an 'intermediate' form between *Wasatchites* and *Anasibirites*.

?*Anasibirites* sp. indet. B

(Plate 28, Fig. O)

Occurrence: *Anasibirites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 5.5 cm.
Description: Moderately involute, compressed shell with convex flanks. Singularly marked egressive coiling of the outer whorl. Venter subtabulate with slightly rounded shoulders. Umbilical shoulders broadly rounded forming a deep umbilicus with inclined wall. Ornamentation very singular, consisting of low folds crossing the venter becoming stronger and more distant throughout the outer whorl but finally disappearing at the visible end of the whorl.
Discussion: This specimen is characterized by an unusual, inconstant ornamentation and a marked egressive coiling.

Genus *Arctoprionites* (FREBOLD, 1930)

Type species: *Goniodiscus nodosus* FREBOLD, 1930

Arctoprionites resseri (MATHEWS, 1929)

(Plate 28, Figs P–U)

		1929	*Kashmirites resseri* – MATHEWS, p. 38, pl. 8, figs 4–7.
		1932	*Kashmirites resseri* – SMITH, p. 67, pl. 81, figs 9, 10.
		1961	*Arctoprionites* sp. indet – TOZER, pl. 20, fig. 1.
		1962	*Arctoprionites* sp. indet. – KUMMEL & STEELE, p. 699, pl. 101, fig. 2.
		1994	*Arctoprionites williamsi* – TOZER, p. 83, pl. 34, figs 1–4.
v		2013	*Arctoprionites resseri* – BRAYARD et al., p. 198, fig. 67.
v		2017	*Arctoprionites resseri* – JATTIOT et al., p. 34, pl. 12, figs N–X.
		2018	*Arctoprionites resseri* – JENKS & BRAYARD, p. 92, figs 86, 87.

Occurrence: *Anasibirites* fauna.

Measurements: See Text-fig. 52. Estimated maximal size: ~ 8 cm.

Description: Involute, compressed shell with slightly egressive coiling. Flanks slightly convex and whorl section trapezoidal. Depression near ventral shoulders visible on immature whorls. Venter tabulate with angular shoulders. Venter becoming flat with abruptly rounded shoulders on mature whorls. Umbilical shoulders broadly rounded, with a deep umbilicus and inclined wall. Ornamentation consisting of conspicuous, slightly projected, angular folds or elongated bullae near umbilical margin that fade away near mid-flank. Suture line not available in our material.

Discussion: See BRAYARD et al. (2013) for a comprehensive discussion of the taxon *Arctoprionites resseri*. The genus *Hemiprionites* mainly differs by the absence of conspicuous folds or bullae on the upper half of the flanks. To our knowledge, *Arctoprionites* was previously only known from Utah, Nevada and British Columbia. Thus, this is the first evidence of *Arctoprionites* from the opposite side of the Panthalassa and it underlines the potential long-distance faunal exchanges that occurred during the Early Triassic.

Genus *Hemiprionites* SPATH, 1929

Type species: *Goniodiscus typus* WAAGEN, 1895

Hemiprionites typus (WAAGEN, 1895)

(Plate 29, Figs A–AN)

		1895	*Goniodiscus typus* WAAGEN, p. 128, pl. 9, figs 7–10.
		1929	*Goniodiscus typus* – MATHEWS, p. 31, pl. 5, figs 12–21.
		1929	*Goniodiscus americanus* MATHEWS, p. 32, pl. 5, figs 22–27.
		1929	*Goniodiscus shumardi* MATHEWS, p. 33, pl. 6, figs 11–14.
		1929	*Goniodiscus utahensis* MATHEWS, p. 33, pl. 6, figs 29–31.
		1929	*Goniodiscus ornatus* MATHEWS, p. 34, pl. 6, figs 6–10.
		1929	*Goniodiscus slocomi* MATHEWS, p. 34, pl. 6, figs 15–17.
		1929	*Goniodiscus butleri* MATHEWS, p. 35, pl. 6, figs 18–21.
		1932	*Anasibirites typus* – SMITH, p. 76, pl. 80, figs 6–8.
		1932	*Anasibirites utahensis* – SMITH, p. 77, pl. 80, figs 9, 10.
		1932	*Anasibirites ornatus* – SMITH, p. 75, pl. 80, figs 11, 12.
		1934	*Hemiprionites typus* – SPATH, p. 331, figs 114a–c.
v	p	2008	*Hemiprionites* cf. *butleri* – BRAYARD & BUCHER, p. 58, pl. 29, figs 1, 4, 7 only.
v		2012b	*Hemiprionites typus* – BRÜHWILER & BUCHER, p. 103, figs 89A–AH.
v		2013	*Hemiprionites* cf. *typus* – BRAYARD et al., p. 197, fig. 66.
v		2017	*Hemiprionites typus* – JATTIOT et al., p. 31, pl. 12, figs A–M; pl. 13, figs A–X.
		2018	*Hemiprionites typus* – JENKS & BRAYARD, p. 81, figs 77, 78, 79A–P.

Occurrence: *Anasibirites* fauna.

Measurements: See Text-fig. 53. Estimated maximal size: ~ 10 cm.

Description: Involute, compressed shell with deeply embracing whorls and slightly egressive coiling. Flanks convex and convergent with or without an *Ambites*-like depression (minute depression on outer edge of flank) immediately below ventral shoulders. Depression near ventral shoulders sometimes only present in early ontogeny, then fading away on outer whorl. Maximum whorl width near mid-flank. Venter tabulate to weakly sulcate in rare instances. Ventral area ornamented with spiral lines on well-preserved specimens. Ventral shoulders angular, or less abrupt on specimens without depression. Umbilical shoulders broadly rounded forming a deep umbilicus with inclined wall. Ornamentation usually consisting of very vague radial folds occasionally crossing the venter. Flexuous growth lines parallel to folds. Suture line ceratitic with rather deep lateral lobes and broad and rounded saddles.

Discussion: The reader is referred to JATTIOT et al. (2017).

Hemiprionites walcotti (MATHEWS, 1929)

(Plate 29, Figs AO–BG)

p		1922	*Anasibirites multiformis* WELTER, p. 138, pl. 17, figs 4–7, 11–14 only.
		1929	*Goniodiscus walcotti* MATHEWS, p. 32, pl. 6, figs 1–5.
		1934	*Hemiprionites timorensis* SPATH, p. 331.
v	p	2008	*Hemiprionites* cf. *butleri* – BRAYARD & BUCHER, p. 58, pl. 29, figs 2, 3, 6 only.
v		2008	*Hemiprionites klugi* BRAYARD & BUCHER, p. 59, pl. 30, figs 1–4.
v	p	2012a	*Hemiprionites* cf. *butleri* – BRÜHWILER & BUCHER, p. 33, pl. 19, fig. 10 only.
v	p	2012b	*Anasibirites angulosus* – BRÜHWILER & BUCHER, p. 103, figs 87H–J, N–P only.
v		2012b	*Hemiprionites klugi* – BRÜHWILER & BUCHER, p. 103, figs 87Q–AB.
v		2017	*Hemiprionites walcotti* – JATTIOT et al., p. 34, pl. 14, figs A–Y.
		2018	*Hemiprionites walcotti* – JENKS & BRAYARD, p. 81, fig. 79Q–V.

Occurrence: *Anasibirites* fauna.
Measurements: See Text-fig. 54. Estimated maximal size: ~ 6.5 cm.
Description: Coiling involute throughout juvenile stages, becoming slightly egressive at maturity. Compressed shell with tabulate venter (as a general rule thinner than *H. typus*), angular or abruptly rounded ventral shoulders and convex flanks with maximum curvature at mid-flank. Ventral area ornamented with spiral lines on well-preserved specimens. *Umbilicus* deep with steeply inclined wall, very narrow at juvenile stages and becoming slightly more open at mature stages. Umbilical shoulders broadly rounded. Very vague radial folds occasionally crossing the venter occurring in a few variants. Flexuous growth lines parallel to folds when present. Suture line ceratitic, with tapered first and second lateral saddles.
Discussion: The reader is referred to JATTIOT et al. (2017). *Hemiprionites walcotti* differs from *H. typus* by its more involute coiling, its greater whorl height and its narrower venter.

Superfamily Sageceratacea HYATT, 1884
Family Hedenstroemiidae WAAGEN, 1895
Genus *Hedenstroemia* WAAGEN, 1895
Type species: *Ceratites hedenstroemi* KEYSERLING, 1845

Hedenstroemia evoluta (SPATH, 1934)

(Plate 30, Figs A–O)

		1905	*Hedenstroemia mojsisovicsi* – FRECH, pl. 27, fig. 4.
?		1922	*Hedenstroemia waageni* WELTER, p. 96, pl. 1, fig. 3, text-figs 5, 6.
		1934	*Anahedenstroemia evoluta* SPATH, p. 219, pl. 6, fig. 6.
		2012b	*Hedenstroemia evoluta* – BRÜHWILER & BUCHER, p. 109, fig. 94A–Q.

Occurrence: *Kashmirites* fauna.
Measurements: See Text-fig. 55. Estimated maximal size: ~ 9 cm.
Description: Very involute shell with strong egressive coiling on outer whorl and convergent flanks. Venter narrow and tabulate with angular shoulders. Umbilicus small and deep with vertical wall and abruptly rounded shoulders. Surface smooth except for falcoid growth lines associated with very vague folds on lower half of flanks. Suture line ceratitic and complex with one adventitious lobe and a long, well-individualized auxiliary series.
Discussion: According to SPATH (1934), this species differs from *Hedenstroemia waageni* WELTER, 1922 from Timor by being more evolute. However, this is probably only due to the size difference between the two type specimens that may actually be conspecific. *H. kossmati* HYATT & SMITH, 1905 does not show an egressive coiling.

Genus *Mesohedenstroemia* CHAO, 1959
Type species: *Mesohedenstroemia kwangsiana* CHAO, 1959

Mesohedenstroemia kwangsiana CHAO, 1959

(Plate 30, Figs P–X)

?		1895	*Parakymatites discoides* WAAGEN, p. 214, pl. 36, fig. 3.
		1959	*Mesohedenstroemia kwangsiana* CHAO, p. 266, pl. 34, figs 1–18.
		1959	*Mesohedenstroemia inflata* CHAO, p. 267, pl. 35, figs 4–8.
v		2008	*Mesohedenstroemia kwangsiana* – BRAYARD & BUCHER, p. 75, pl. 41, figs 1–8.

2018 *Mesohedenstroemia kwangsiana* – JENKS & BRAYARD, p. 114, fig. 106A–L.

Occurrence: *Kashmirites* fauna.

Measurements: See Table 1. Estimated maximal size: ~ 5.5 cm.

Description: Very involute, compressed shell with subparallel flanks. Venter relatively broad and tabulate with angular shoulders. Umbilicus narrow, deep, with perpendicular wall and abruptly rounded shoulders. Surface smooth except for growth lines, curving slightly forward near venter, when shell is well preserved. Suture line not available in our material.

Discussion: This species differs from *Hedenstroemia evoluta* (SPATH, 1934) by its wider venter and its simple suture line without adventious elements (BRAYARD & BUCHER 2008). For a thorough discussion, the reader is referred to BRAYARD & BUCHER (2008).

Genus *Pseudosageceras* DIENER, 1895

Type species: *Pseudosageceras* sp. indet. DIENER, 1895

Pseudosageceras multilobatum NOETLING, 1905

(Plate 31, Figs A–W)

1905 *Pseudosageceras multilobatum* NOETLING, pl. 25, fig. 1, pl. 26, fig. 3.
1905 *Pseudosageceras intermontanum* HYATT & SMITH, p. 99, pl. 4, figs 1–3; pl. 5, figs 1–6; pl. 63, figs 1, 2.
1909 *Pseudosageceras multilobatum* – KRAFFT & DIENER, p. 145, pl. 21, fig. 5.
1911 *Pseudosageceras drinense* ARTHABER, p. 201, pl. 17, figs 6, 7.
1913 *Pseudosageceras multilobatum* – WANNER, p. 181, pl. 7, fig. 4.
1922 *Pseudosageceras multilobatum* – WELTER, p. 94, fig. 3.
1929 *Pseudosageceras intermontanum* – MATHEWS, p. 3, pl. 1, figs 18–22.
1932 *Pseudosageceras multilobatum* – SMITH, p. 87–89, pl. 4, figs 1–3; pl. 5, figs 1–6; pl. 25, figs 7–16; pl. 60, fig. 32; pl. 63, figs 1–6.
1934 *Pseudosageceras multilobatum* – COLLIGNON, p. 56–58, pl. 11, fig. 2.
1934 *Pseudosageceras multilobatum* – SPATH, p. 54, fig. 6a.
1947 *Pseudosageceras multilobatum* – KIPARISOVA, p. 127, pl. 25, figs 3, 4.
1947 *Pseudosageceras multilobatum* var. *giganteum* – KIPARISOVA, p. 127, pl. 26, figs 2–5.
1948 *Pseudosageceras* cf. *clavisellatum* – RENZ & RENZ, p. 90, pl. 16, fig. 3.
1948 *Pseudosageceras drinense* – RENZ & RENZ, p. 92, pl. 16, fig. 6.
1948 *Pseudosageceras intermontanum* – RENZ & RENZ, p. 90, pl. 16, figs 4, 7.
1959 *Pseudosageceras multilobatum* – CHAO, p. 183, pl. 1, figs 9, 12.
1959 *Pseudosageceras tsotengense* CHAO, p. 184, pl. 1, figs 7, 8, text-fig. 5b.
1959 *Pseudosageceras curvatum* CHAO, p. 185, pl. 1, figs 13, 14, text-fig. 5a.
? 1959 *Pseudosageceras multilobatum* var. nov. – JEANNET, p. 30, pl. 6, fig. 1.
1961 *Pseudosageceras schamarense* – KIPARISOVA, p. 31, pl. 7, fig. 3.
1961 *Pseudosageceras multilobatum* var. *gigantea* – POPOV, p. 13, pl. 2, figs 1, 2.
? 1966 *Pseudosageceras multilobatum* – HADA, p. 112, pl. 4, fig. 6.
? 1968 *Pseudosageceras multilobatum* – KUMMEL & ERBEN, p. 112, pl. 19, fig. 9.
1968 *Pseudosageceras multilobatum* – SHEVYREV, p. 791, pl. 1, figs 1, 2.
? 1973 *Pseudosageceras multilobatum* – COLLIGNON, p. 5, pl. 1, fig. 1.
1978 *Pseudosageceras multilobatum* – WEITSCHAT & LEHMANN, p. 95, pl. 10, figs 2ab.
1984 *Pseudosageceras multilobatum* – VU KHUC, p. 26, pl. 1, fig. 1.
1994 *Pseudosageceras multilobatum* – TOZER, p. 83, pl. 18, figs 1a, b; p. 384, fig. 17.
v 2008 *Pseudosageceras multilobatum* – BRAYARD & BUCHER, p. 70, pl. 37, figs 1–5.
2010 *Pseudosageceras multilobatum* – STEPHEN et al., figs 6c, d, h.
v 2010b *Pseudosageceras multilobatum* – BRÜHWILER et al., p. 429, fig. 16(14).
v 2012a *Pseudosageceras multilobatum* – BRÜHWILER & BUCHER, p. 47, pl. 26, fig. 4.
v 2012b *Pseudosageceras multilobatum* – BRÜHWILER & BUCHER, p. 109, figs 95A–N.
v 2013 *Pseudosageceras multilobatum* – BRAYARD et al., p. 208, fig. 77.
2014 *Pseudosageceras multilobatum* – SHIGETA & NGUYEN, p. 137, figs 98, 99.
v 2017 *Pseudosageceras multilobatum* – JATTIOT et al., p. 41, pl. 19, figs A–I.
2018 *Pseudosageceras multilobatum* – JENKS & BRAYARD, p. 111, fig. 102A–M.

Occurrence: *Kashmirites* and *Owenites* faunas.

Measurements: See Text-fig. 56. Estimated maximal size: ~ 14 cm.

Description: Extremely involute, compressed oxyconic shell with an occluded umbilicus. As a general rule, venter extremely narrow and bicarinate. Specimens PIMUZ 37272 and PIMUZ 37273 (Pl. 31, Figs K–R) are variants with a relatively wide venter. On the contrary, specimens PIMUZ 37274 and PIMUZ 37275 (Pl. 31, Figs S–W) are variants with an acute venter, no longer bicarinate. Flanks weakly convex,

convergent from umbilicus to venter. Surface smooth without ornamentation. Suture line ceratitic, complex and composed of many adventitious elements with characteristic trifid lateral lobe. Other lobes are bifid.

Discussion: Many specimens previously illustrated as *Pseudosageceras multilobatum* seem to show an acute, non-bicarinate venter (e. g., HYATT & SMITH 1905: pl. 5, fig. 1, 2; TOZER 1994: pl. 18, fig. 1a–b; BRAYARD et al. 2013: fig. 77a–b; JATTIOT et al. 2017: pl. 19, Figs A–C; JENKS & BRAYARD 2018: fig. 102) and two of our Timor specimens (Pl. 31, Figs S–W) unequivocally confirm this unusual feature. Interestingly, TOZER (1994) also notices this feature, as he writes that one of his specimen "has a narrowly tabulate venter at the beginning of the outer whorl, where part of the test is preserved. On the greater part, which apparently nowhere preserves the full thickness of the test, the venter is narrowly rounded". However, our Timor specimens exhibiting a non-bicarinate venter bear a very well-preserved test. This could imply that TOZER's (1994) observation is not due to preservation but instead indicates an actual change in venter shape throughout ontogeny of the same specimen. This is corroborated by SPATH (1934) who describes the species *P. drinense* ARTHABER, 1911 (now commonly considered as a synonym of *P. multilobatum*) with a venter "at first narrowly tabulate, later acute (in some examples?)". Thus, *P. multilobatum* is proved to show a great intraspecific variation in venter shape, from more or less narrow bicarinate venter to acute venter (see also JENKS & BRAYARD 2018).

Genus *Episageceras* NOETLING, 1904

Type species: *Sageceras wynnei* WAAGEN, 1887

Episageceras cf. *intermedium* WELTER, 1922

(Plate 31, Figs X–AA)

1922 *Episageceras intermedium* WELTER, p. 93, pl. 1, figs 1, 2.

Occurrence: *Kashmirites* fauna.

Measurements: See Table 1. Estimated maximal size: ~ 2.5 cm.

Description: Very involute, very compressed shell with a narrow tabulate venter and very angular ventral shoulders resembling keels. Subparallel flanks. Umbilicus very narrow, with moderately high, perpendicular wall and abruptly rounded shoulders. Surface smooth, except for barely conspicuous growth lines. Suture line typical of the genus, composed of many adventitious elements with bifid lobes; lateral saddles slightly phylloid; complex ventral saddle.

Discussion: Our single specimen is morphologically similar to the holotype of *Episageceras intermedium* WELTER, 1922, but the very small size of our specimen precludes a definitive assignment.

Episageceras sp. indet.

(Plate 31, Figs AB–AF)

Occurrence: *Owenites* fauna.

Measurements: See Table 1. Estimated maximal size: ~ 2 cm.

Description: Very involute, compressed shell with flat, parallel flanks. Venter subtabulate with very angular shoulders. Surface smooth. Suture line typical of the genus, composed of many adventitious elements with bifid lobes; lateral saddles slightly phylloid. Ventral saddle characteristic of the genus not preserved.

Discussion: The scarcity and the small size of the material preclude an assignment at the species level. This taxon mainly differs from the older taxon *Episageceras* cf. *intermedium* by its subtabulate venter.

Family Aspenitidae SPATH, 1934

Genus *Aspenites* HYATT & SMITH, 1905

Type species: *Aspenites acutus* HYATT & SMITH, 1905

Aspenites acutus HYATT & SMITH, 1905

(Plate 32, Figs AE–AH)

1905 *Aspenites acutus* HYATT & SMITH, 1905, p. 96, pl. 2, figs 9–13; pl. 3, figs 1–5.
? 1909 *Hedenstroemia acuta* KRAFFT & DIENER, p. 157, pl. 9, fig. 2.
1922 *Aspenites acutus* – WELTER, p. 98, fig. 7.
1922 *Aspenites laevis* WELTER, p. 99, pl. 1, figs 4, 5.
1932 *Aspenites acutus* – SMITH, p. 86, pl. 2, figs 9–13, pl. 3, figs 1–5, pl. 30, figs 1–26, pl. 60, figs 4–6.
1932 *Aspenites laevis* – SMITH, p. 86, pl. 28, figs 28–33.

1932 *Aspenites obtusus* SMITH, p. 86, pl. 31, figs 8–10.
1934 *Aspenites acutus* – SPATH, p. 229, fig. 76.
? 1934 *Parahedenstroemia acuta* – SPATH, p. 221, fig. 70.
1957 *Aspenites acutus* – KUMMEL, p. L142, fig. 173a–c.
1959 *Aspenites acutus* – CHAO, p. 269, pl. 35, figs 12–18, 23, text-fig. 34a.
1959 *Aspenites laevis* – CHAO, p. 270, pl. 35, figs 9–11, text-fig. 34b.
1962 *Aspenites acutus* – KUMMEL & STEELE, p. 692, pl. 99, figs 16–17.
1962 *Hemiaspenites obtusus* – KUMMEL & STEELE, p. 666, pl. 99, fig. 18.
1962 *Pseudosageceras multilobatum* – KUMMEL & STEELE, p. 701, pl. 102, figs 1, 2.
1979 *Aspenites* cf. *acutus* – NICHOLS & SILBERLING, pl. 1, figs 10–11.
1979 *Aspenites acutus* – NICHOLS & SILBERLING, pl. 1, figs 12–14.
v 2008 *Aspenites acutus* – BRAYARD & BUCHER, p. 77, pl. 42, figs 1–9.
2010 *Aspenites acutus* – STEPHEN et al., fig. 4f.
v 2010b *Aspenites acutus* – BRÜHWILER et al., p. 429, fig. 16(12, 13).
v 2012a *Aspenites acutus* – BRÜHWILER & BUCHER, p. 48, pl. 26, figs 1, 2.
v 2012c *Aspenites acutus* – BRÜHWILER et al., p. 164, figs 41A–M.
v 2013 *Aspenites acutus* – BRAYARD et al., p. 212, fig. 81.
v 2017 *Aspenites acutus* – JATTIOT et al., p. 44, pl. 18, figs A–H.
2018 *Aspenites acutus* – JENKS & BRAYARD, p. 118, figs 109, 115A–D.

Occurrence: *Owenites* fauna. One single specimen.

Measurements: See Text-fig. 57. Estimated maximal size: ~ 7.5 cm.

Description: Extremely involute, very compressed oxyconic shell with an occluded umbilicus. Maximum curvature at mid-flank. Venter with a characteristic acute keel. Flanks slightly convex. Umbilical region slightly depressed. Surface nearly smooth except for fine radial folds and falcoid growth lines. Suture line not available in our material.

Discussion: *Aspenites weitschati* JENKS & BRAYARD, 2018 is distinguished mainly by its more compressed shell and much larger adult size. *A. acutus* mainly differs from other aspenitid taxa (e.g., *Pseudaspenites layeriformis*) by its slightly depressed umbilical region and its occluded umbilicus. However, *P. layeriformis* and *P. acutus* are almost indistinguishable at a diameter of less than 20 mm since *P. layeriformis* exhibits a nearly occluded umbilicus at that size.

Genus *Pseudaspenites* SPATH, 1934

Type species: *Aspenites layeriformis* WELTER, 1922

Pseudaspenites layeriformis (WELTER, 1922)

(Plate 32, Figs A–AD)

1922 *Aspenites layeriformis* WELTER, p. 97, pl. 1, figs 6–8.
1934 *Pseudaspenites layeriformis* – SPATH, p. 230, fig. 77.
1959 *Inyoites striatus* CHAO, p. 197, pl. 2, figs 22–26.
1959 *Inyoites obliqueplicatus* CHAO, p. 198, pl. 2, figs 7, 17–21, 27.
non v 2008 *Pseudaspenites layeriformis* – BRAYARD & BUCHER, p. 79, pl. 43, figs 1–6.
2012a *Pseudaspenites layeriformis* – BRÜHWILER & BUCHER, p. 48, pl. 26, fig. 3a–b.
2012c *Pseudaspenites* cf. *layeriformis* – BRÜHWILER et al., p. 169, fig. 41N–Y.

Occurrence: *Owenites* fauna.

Measurements: See Text-fig. 58. Estimated maximal size: ~ 8.5 cm.

Description: Very involute, very compressed oxyconic shell similar to *Aspenites*, but with an egressive coiling. Flanks slightly convex, strongly converging on the lowermost part. Venter acutely keeled, although less compressed variants (e.g., Plate 32, Figs L– M) do not bear a keel but an acute venter only. Umbilicus shallow and narrow with rounded shoulders and inclined umbilical wall. Surface nearly smooth except for falcoid growth lines and fine falcoid folds. Suture line ceratitic with an adventitious lobe and a well-individualized auxiliary series.

Discussion: Small-sized specimens from South China described as *Pseudaspenites layeriformis* by BRAYARD & BUCHER (2008) are significantly more evolute than our juvenile specimens (exhibiting a nearly occluded umbilicus at the same size), some of them bear a crenulated keel that is not observed in any of our exceptionally well-preserved specimens, and they are older (early Smithian, *Flemingites rursiradiatus* beds). Therefore, we hypothesize that these specimens from South China do not belong to *P. layeriformis* and are instead representatives of *P. evolutus* BRAYARD & BUCHER, 2008.

Family Ussuridae SPATH, 1930

Genus *Ussuria* DIENER, 1895

Type species: *Ussuria schamarae* DIENER, 1895

Ussuria schamarae DIENER, 1895

(Plate 33, Figs A–C)

1895 *Ussuria schamarae* DIENER, p. 26, pl. 3, fig. 4.
1895 *Ussuria iwanowi* DIENER, p. 27, pl. 3, fig. 5.
? 1922 *Ussuria* nov. sp. ind. ex. aff. *iwanowi* – WELTER, p. 100, pl. 3, fig. 10.

Occurrence: *Owenites* fauna.
Measurements: See Text-fig. 59. Estimated maximal size: ~ 7 cm.
Description: Compressed, very involute, deeply embracing shell with whorls increasing rapidly in height. Venter narrowly rounded. Flanks convex and convergent. Maximum thickness slightly above mid-flanks. Umbilicus narrow and deep, with broadly rounded umbilical shoulders. Delicate strigation visible on venter. Suture line not available in our material.
Discussion: DIENER (1895) erected two species of *Ussuria*: *U. schamarae* and *U. iwanowi*. We here consider that *U. iwanowi* actually represents a later ontogenetic stage of the type species. According to BRAYARD & BUCHER (2008), *U. kwangsiana* CHAO, 1959 from China is more laterally compressed.

?*Parussuria* sp. indet.

(Plate 33, Figs D–G)

Occurrence: *Owenites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 2.5 cm.
Description: Extremely involute, compressed oxycone with a rounded venter. Flanks slightly convex. Occluded umbilicus. Surface smooth except for delicate lirae. Suture line typical of ussuriids with highly frilled lobes and saddles.
Discussion: The small size of the specimen hinders any assignment at the species level and the assignment to *Parussuria*, based on the shape of the suture lines, is tentative only.

Order Phylloceratida ZITTEL, 1884
Superfamily Ussuritaceae HYATT, 1900
Family Palaeophyllitidae POPOV, in LUPPOV & DRUSHCHITS, 1958
Genus *Goudemandites* BRÜHWILER & BUCHER, 2012a

Type species: *Goudemandites sinensis* BRÜHWILER & BUCHER, 2012a

Goudemandites cf. *sinensis* BRÜHWILER & BUCHER, 2012a

(Plate 33, Fig. K)

v 2008 ?Palaeophyllitidae gen. indet. – BRAYARD & BUCHER, p. 85, pl. 7, fig. 7.
v 2012a *Goudemandites sinensis* BRÜHWILER & BUCHER, p. 50, pl. 26, fig. 5.

Occurrence: *Owenites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 4.5 cm.
Description: Moderately evolute, somewhat compressed shell with convex, convergent flanks. Venter rounded with indistinct shoulders. Umbilicus moderately deep with vertical wall and rounded shoulders. Ornamentation very poorly preserved on our specimens, but usually consists of biconcave plications and lirae that do not cross the venter (BRÜHWILER & BUCHER 2012a). Suture line not available in our material.
Discussion: The absence of suture line prevents a firm assignment to the type species.

Palaeophyllitidae gen. et sp. indet.

(Plate 33, Figs H–J)

Occurrence: Smithian.
Measurements: See Table 1. Estimated maximal size: ~ 7 cm.
Description: Evolute, somewhat depressed shell with convergent flanks from umbilical shoulders. Ventre broadly rounded, becoming narrowly rounded at maturity. Maximum thickness at umbilical shoulders. Umbilicus wide and shallow, with broadly rounded umbilical shoulders. Surface smooth except for dense radial lirae and barely discernible constrictions on inner whorls.
Discussion: This specimen might be a large representative of the species '*Prenkites*' *sundaicus* WELTER, 1922 from the "Meekoceras-Kalke" of Timor that is assumed to be of early Smithian age, since it is located stratigraphically below the "*Owenites*-Kalke" according to WELTER (1922). However, there is no

age control for our specimen, making any assignment impossible. We tentatively assign this taxon to the Palaeophyllitidae family based on its serpenticonic coiling and its dense, radial lirae.

Family Incertae sedis
Genus gen. et sp. indet.

(Plate 22, Figs R–T)

Occurrence: *Owenites* fauna.
Measurements: See Table 1. Estimated maximal size: ~ 1.5 cm.
Description: Small, moderately evolute shell with an arched venter and flanks convergent from umbilical shoulders to rounded venter (without distinct ventral shoulders). Moderately deep umbilicus with relatively high, steeply inclined wall and somewhat abruptly rounded shoulders. Ornamentation consists of barely conspicuous constrictions crossing the venter with equal intensity. Suture line not available in our material.
Discussion: This specimen is roughly morphologically similar to typical representatives of *J. septentrionalis* but is distinguished by its barely conspicuous constrictions.

Subclass Nautiloidea AGASSIZ, 1847
Order Nautiloida AGASSIZ, 1847
Family Tainoceratidae HYATT, 1884
Genus gen. indet.

(Plate 33, Figs L–N)

Occurrence: *Kashmirites* fauna.
Description: Moderately involute shell with a marked egressive coiling at maturity and a subquadratic whorl section. Biconcave aperture. Flanks flat and slightly convergent. Venter very broad and subtabulate with rounded shoulders. Umbilicus with high, vertical wall and abruptly rounded shoulders. Ornamented with rursiradiate ribs fading out on last half of the outer whorl and bearing umbilical and ventral nodes; as well as biconcave growth lines. Suture line not available in our material.

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Scale bars are 10 mm unless otherwise indicated.

Plate 1

Figs A–C. *Kashmirites baidi* BRÜHWILER & BUCHER, 2012a. PIMUZ 36927. *Kashmirites* fauna, early Smithian.
Figs D–F. *Kashmirites armatus* (WAAGEN, 1895). PIMUZ 36928. *Kashmirites* fauna, early Smithian.
Figs G–I. *Kashmirites armatus* (WAAGEN, 1895). PIMUZ 36929. *Kashmirites* fauna, early Smithian.
Figs J–L. *Kashmirites armatus* (WAAGEN, 1895). PIMUZ 36930. *Kashmirites* fauna, early Smithian.
Figs M–O. *Kashmirites armatus* (WAAGEN, 1895). PIMUZ 36931. *Kashmirites* fauna, early Smithian.
Figs P–Q. *Kashmirites armatus* (WAAGEN, 1895). PIMUZ 36932. *Kashmirites* fauna, early Smithian.
Figs R–S. *Kashmirites armatus* (WAAGEN, 1895). PIMUZ 36933. *Kashmirites* fauna, early Smithian.
Fig. T. *Kashmirites armatus* (WAAGEN, 1895). Suture line of PIMUZ 36934 with scale bar representing 5 mm, at H = 6.4 mm. *Kashmirites* fauna, early Smithian.
Figs U–W. *Kashmirites* cf. *guangxiense* BRAYARD & BUCHER, 2008. PIMUZ 36935. *Kashmirites* fauna, early Smithian.
Figs X–Z. *Kashmirites* cf. *guangxiense* BRAYARD & BUCHER, 2008. PIMUZ 36936, ×0.75. *Kashmirites* fauna, early Smithian.

Plate 2

Fig. A. *Kashmirites nivalis* (DIENER, 1897). Suture line of PIMUZ 36937 with scale bar representing 5 mm, at H = 10 mm. *Kashmirites* fauna, early Smithian.

Figs B–D. *Kashmirites nivalis* (DIENER, 1897). PIMUZ 36938, ×0.75. *Kashmirites* fauna, early Smithian.

Figs E–F. *Kashmirites nivalis* (DIENER, 1897). PIMUZ 36939, ×0.75. *Kashmirites* fauna, early Smithian.

Figs G–I. *Kashmirites nivalis* (DIENER, 1897). PIMUZ 36940, ×0.75. *Kashmirites* fauna, early S mithian.

Figs J–L. *Kashmirites nivalis* (DIENER, 1897). PIMUZ 36941, ×0.75. *Kashmirites* fauna, early Smithian.

Figs M–O. *Kashmirites nivalis* (DIENER, 1897). PIMUZ 36942, ×0.75. *Kashmirites* fauna, early Smithian.

Figs P–R. *Kashmirites nivalis* (DIENER, 1897). PIMUZ 36943, ×0.75. *Kashmirites* fauna, early Smithian.

Figs S–U *Kashmirites nivalis* (DIENER, 1897). PIMUZ 36944, ×0.75. *Kashmirites* fauna, early Smithian.

Fig. V. *Preflorianites radians* CHAO, 1959. PIMUZ 36945. *Owenites* fauna, early Smithian.

Plate 3

Figs A–C. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36946, ×0.75. *Owenites* fauna, middle Smithian.
Figs D–F. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36947, ×0.75. *Owenites* fauna, middle Smithian.
Figs G–I. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36948, ×0.75. *Owenites* fauna, middle Smithian.
Figs J–L. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36949, ×0.75. *Owenites* fauna, middle Smithian.
Figs M–O. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36950, ×0.75. *Owenites* fauna, middle Smithian.
Fig. P. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36951, ×0.75. *Owenites* fauna, middle Smithian.
Figs Q–S. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36952, ×0.75. *Owenites* fauna, middle Smithian.
Figs T–V. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36953, ×0.75. *Owenites* fauna, middle Smithian.
Fig. W. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36954, ×0.75. *Owenites* fauna, middle Smithian.
Figs X–Z. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36955, ×0.75. *Owenites* fauna, middle Smithian.
Fig. AA. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36956, ×0.75. *Owenites* fauna, middle Smithian.
Fig. AB. *Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36957, ×0.75. *Owenites* fauna, middle Smithian.

Plate 4

Figs A–C.	*Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36958, ×0.75. *Owenites* fauna, middle Smithian.
Figs D–F.	*Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36959, ×0.75. *Owenites* fauna, middle Smithian.
Figs G–I.	*Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36960, ×0.75. *Owenites* fauna, middle Smithian.
Figs J–L.	*Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36961, ×0.75. *Owenites* fauna, middle Smithian.
Figs M–O	*Pseudoceltites multiplicatus* (WAAGEN, 1895). PIMUZ 36962, ×0.75. *Owenites* fauna, middle Smithian.
Figs P–R.	*Pseudoceltites densistriatus* (WELTER, 1922). PIMUZ 36963, ×0.75. *Owenites* fauna, middle Smithian.
Figs S–V.	*Pseudoceltites densistriatus* (WELTER, 1922). PIMUZ 36964, ×0.75. *Owenites* fauna, middle Smithian.
Figs W–Y.	*Pseudoceltites densistriatus* (WELTER, 1922). PIMUZ 36965, ×0.75. *Owenites* fauna, middle Smithian.
Figs Z–AB.	*Pseudoceltites densistriatus* (WELTER, 1922). PIMUZ 36966, ×0.75. *Owenites* fauna, middle Smithian.
Figs AC–AE.	*Pseudoceltites densistriatus* (WELTER, 1922). PIMUZ 36967, ×0.75. *Owenites* fauna, middle Smithian.
Figs AF–AH.	*Pseudoceltites densistriatus* (WELTER, 1922). PIMUZ 36968, ×0.75. *Owenites* fauna, middle Smithian.
Figs AI–AJ.	*Pseudoceltites densistriatus* (WELTER, 1922). PIMUZ 36969, ×0.75. *Owenites* fauna, middle Smithian.

Plate 5

Figs A–C.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36970. *Owenites* fauna, middle Smithian.
Figs D–E.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36971. *Owenites* fauna, middle Smithian.
Fig. F.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36972, X0.75. *Owenites* fauna, middle Smithian.
Figs G–I.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36973. *Owenites* fauna, middle Smithian.
Figs J–L.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36974. *Owenites* fauna, middle Smithian.
Figs M–O.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36975. *Owenites* fauna, middle Smithian.
Figs P–R.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36976. *Owenites* fauna, middle Smithian.
Figs S–T.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36977. *Owenites* fauna, middle Smithian.
Figs U–W.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36978. *Owenites* fauna, middle Smithian.
Figs X–Y.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36979. *Owenites* fauna, middle Smithian.
Figs Z–AB.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36980. *Owenites* fauna, middle Smithian.
Figs AC–AE.	*Nyalamites angustecostatus* (WELTER, 1922). PIMUZ 36981. *Owenites* fauna, middle Smithian.
Figs AF–AH.	*Hanielites elegans* WELTER, 1922. PIMUZ 36982. *Owenites* fauna, middle Smithian.
Figs AI–AK.	*Hanielites elegans* WELTER, 1922. PIMUZ 36983. *Owenites* fauna, middle Smithian.
Figs AL–AN.	*Hanielites gracilus* BRAYARD & BUCHER, 2008. PIMUZ 36984. *Owenites* fauna, middle Smithian.
Figs AO–AQ.	*Hanielites gracilus* BRAYARD & BUCHER, 2008. PIMUZ 36985. *Owenites* fauna, middle Smithian.
Fig. AR.	*Hanielites gracilus* BRAYARD & BUCHER, 2008. PIMUZ 36986. *Owenites* fauna, middle Smithian.
Figs AS–AT.	*Hanielites gracilus* BRAYARD & BUCHER, 2008. PIMUZ 36987. *Owenites* fauna, middle Smithian.
Figs AU–AV.	*Hanielites gracilus* BRAYARD & BUCHER, 2008. PIMUZ 36988. *Owenites* fauna, middle Smithian.

Plate 6

Figs A–C. *Roopnarinites* n. gen. *paucesculptatum* (WELTER, 1922). PIMUZ 36989. *Owenites* fauna, middle Smithian.

Figs D–F. *Roopnarinites* n. gen. *paucesculptatum* (WELTER, 1922). PIMUZ 36990. *Owenites* fauna, middle Smithian.

Figs G–I. *Roopnarinites* n. gen. *paucesculptatum* (WELTER, 1922). PIMUZ 36991. *Owenites* fauna, middle Smithian.

Figs J–L. *Roopnarinites* n. gen. *paucesculptatum* (WELTER, 1922). PIMUZ 36992. *Owenites* fauna, middle Smithian.

Figs M–O. *Roopnarinites* n. gen. *paucesculptatum* (WELTER, 1922). PIMUZ 36993. *Owenites* fauna, middle Smithian.

Figs P–R. *Roopnarinites* n. gen. *paucesculptatum* (WELTER, 1922). PIMUZ 36994. *Owenites* fauna, middle Smithian.

Figs S–U. *Roopnarinites* n. gen. *paucesculptatum* (WELTER, 1922). PIMUZ 36995. *Owenites* fauna, middle Smithian.

Fig. V. *Roopnarinites* n. gen. *paucesculptatum* (WELTER, 1922). Suture line of PIMUZ 36991 with scale bar representing 5 mm, at H = 11.7 mm. *Owenites* fauna, middle Smithian.

Figs W–Y. Proptychitidae gen. et sp. indet. PIMUZ 36996. *Owenites* fauna, middle Smithian.

Fig. Z. Proptychitidae gen. et sp. indet. Suture line of PIMUZ 36996 with scale bar representing 5 mm. *Owenites* fauna, middle Smithian.

Figs AA–AC. ?*Tulongites* sp. indet. PIMUZ 36997. *Owenites* fauna, middle Smithian.

Figs AD–AF ?*Tulongites* sp. indet. PIMUZ 36998. *Owenites* fauna, middle Smithian.

Fig. AG. ?*Tulongites* sp. indet. Suture line of PIMUZ 36997 with scale bar representing 5 mm, at H = 8 mm. *Owenites* fauna, middle Smithian.

Figs AH–AI. *Paraspidites bicarinatus* n. sp. PIMUZ 36999, ×0.75. *Kashmirites* fauna, early Smithian.

Figs AJ–AL. *Paraspidites bicarinatus* n. sp., paratype. PIMUZ 37000, ×0.75. *Kashmirites* fauna, early Smithian.

Fig. AM. *Paraspidites bicarinatus* n. sp. Suture line of PIMUZ 37000 with scale bar representing 5 mm, at H = 13.3 mm. *Kashmirites* fauna, early Smithian.

Figs AN–AP. *Paraspidites bicarinatus* n. sp., holotype. PIMUZ 37001, ×0.75. *Kashmirites* fauna, early Smithian.

Figs AQ–AR. *Paraspidites bicarinatus* n. sp. PIMUZ 37002, ×0.75. *Kashmirites* fauna, early Smithian.

Figs AS–AT. *Paraspidites bicarinatus* n. sp. PIMUZ 37003, ×0.75. *Kashmirites* fauna, early Smithian.

Plate 7

Figs A–C. *Galfettites simplicitatis* BRAYARD & BUCHER, 2008. PIMUZ 37004. *Owenites* fauna, middle Smithian.

Figs D–G. *Galfettites simplicitatis* BRAYARD & BUCHER, 2008. PIMUZ 37005. *Owenites* fauna, middle Smithian.

Figs H–I. *Galfettites simplicitatis* BRAYARD & BUCHER, 2008, X0.5. PIMUZ 37006. *Owenites* fauna, middle Smithian.

Figs J–L. *Galfettites omani* BRÜHWILER & BUCHER, 2012a. PIMUZ 37007, ×0.75. *Anasibirites* fauna, late Smithian.

Fig. M. *Galfettites omani* BRÜHWILER & BUCHER, 2012a. Suture line of PIMUZ 37007 with scale bar representing 5 mm, at H = 32.7 mm. *Anasibirites* fauna, late Smithian.

Figs N–P. *Paranorites* cf. *ambiensis* WAAGEN, 1895. PIMUZ 37008, ×0.75. *Kashmirites* fauna, early Smithian.

Figs Q–S. *Paranorites* cf. *ambiensis* WAAGEN, 1895. PIMUZ 37010, ×0.5. *Kashmirites* fauna, early Smithian.

Figs T–V. *Paranorites* cf. *ambiensis* WAAGEN, 1895. PIMUZ 37009, ×2. *Kashmirites* fauna, early S mithian.

Figs W–Y. *Vercherites* cf. *vercherei* (WAAGEN, 1895). PIMUZ 37011, ×0.75. *Kashmirites* fauna, early Smithian.

Figs Z–AB. *Vercherites* cf. *vercherei* (WAAGEN, 1895). PIMUZ 37012, ×0.75. *Kashmirites* fauna, early Smithian.

Figs AC–AE. *Urdyceras tulongensis* BRÜHWILER, BUCHER & GOUDEMAND, 2010b. PIMUZ 37013. *Owenites* fauna, middle Smithian.

Figs AF–AH. *Urdyceras tulongensis* BRÜHWILER, BUCHER & GOUDEMAND, 2010b. PIMUZ 37014. *Owenites* fauna, middle Smithian.

Figs AI–AK. *Urdyceras tulongensis* BRÜHWILER, BUCHER & GOUDEMAND, 2010b. PIMUZ 37015. *Owenites* fauna, middle Smithian.

Figs AL–AN. *Urdyceras tulongensis* BRÜHWILER, BUCHER & GOUDEMAND, 2010b. PIMUZ 37016. *Owenites* fauna, middle Smithian.

Figs AO–AQ. *Urdyceras tulongensis* BRÜHWILER, BUCHER & GOUDEMAND, 2010b. PIMUZ 37017. *Owenites* fauna, middle Smithian.

Figs AR–AU. *Safraites simplex* BRÜHWILER & BUCHER, 2012a. PIMUZ 37018. *Owenites* fauna, middle Smithian.

Plate 8

Figs A–C. *Flemingites flemingianus* (DE KONINCK, 1863). PIMUZ 37020, ×0.375. *Kashmirites* fauna, early Smithian.
Figs D–F. *Flemingites* cf. *planatus* BRÜHWILER & BUCHER, 2012b. PIMUZ 37021. *Kashmirites* fauna, early Smithian.

Plate 9

Figs A–C. *Flemingites pulcher* WELTER, 1922. PIMUZ 37022, ×0.4. *Kashmirites* fauna, early Smithian.

Figs D–F. *Flemingites pulcher* WELTER, 1922. PIMUZ 37023, ×0.4. *Kashmirites* fauna, early Smithian.

Fig. G. *Flemingites pulcher* WELTER, 1922. Suture line of PIMUZ 37024 with scale bar representing 5 mm, at H = 31.4 mm. *Kashmirites* fauna, early Smithian.

Figs H–I. *Euflemingites guyerdetiformis* (WELTER, 1922). PIMUZ 37025, ×0.75. *Kashmirites* fauna, early Smithian.

Figs J–L. *Euflemingites guyerdetiformis* (WELTER, 1922). PIMUZ 37026, ×0.75. *Kashmirites* fauna, early Smithian.

Fig. M. *Euflemingites guyerdetiformis* (WELTER, 1922). Suture line of PIMUZ 37027 with scale bar representing 5 mm, at H = 13.3 mm. *Kashmirites* fauna, early Smithian.

Figs N–O. *Pseudoflemingites timorensis* SPATH, 1930. PIMUZ 37028. *Kashmirites* fauna, early Smithian.

Figs P–Q. *Pseudoflemingites timorensis* SPATH, 1930. PIMUZ 37029. *Kashmirites* fauna, early Smithian.

Fig. R. *Pseudoflemingites timorensis* SPATH, 1930. PIMUZ 37030. *Kashmirites* fauna, early Smithian.

Figs S–U. *Pseudoflemingites timorensis* SPATH, 1930. PIMUZ 37031, ×0.75. *Kashmirites* fauna, early Smithian.

Fig. V. *Pseudoflemingites timorensis* SPATH, 1930. PIMUZ 37032. *Kashmirites* fauna, early Smithian.

Plate 10

Figs A–C. *Rohillites rohilla* DIENER, 1897. PIMUZ 37033. *Kashmirites* fauna, early Smithian.
Figs D–F. *Rohillites rohilla* DIENER, 1897. PIMUZ 37034. *Kashmirites* fauna, early Smithian.
Figs G–I. *Rohillites rohilla* DIENER, 1897. PIMUZ 37035. *Kashmirites* fauna, early Smithian.
Figs J–L. *Rohillites rohilla* DIENER, 1897. PIMUZ 37036, ×2. *Kashmirites* fauna, early Smithian.
Fig. M. *Rohillites rohilla* DIENER, 1897. Suture line of PIMUZ 37035 with scale bar representing 5 mm, at H = 15.6 mm. *Kashmirites* fauna, early Smithian.
Fig. N. *Rohillites rohilla* DIENER, 1897. PIMUZ 37037. *Kashmirites* fauna, early Smithian.
Figs O–P. *Rohillites rohilla* DIENER, 1897. PIMUZ 37038. *Kashmirites* fauna, early Smithian.
Figs Q–S. *Flemingites lidakensis* n. sp., paratype. PIMUZ 37039, ×0.75. *Kashmirites* fauna, early Smithian.
Figs T–V. *Flemingites lidakensis* n. sp., holotype. PIMUZ 37040, ×0.75. *Kashmirites* fauna, early Smithian.

Plate 11

Figs A–C. *Subflemingites involutus* (WELTER, 1922). PIMUZ 37041. *Kashmirites* fauna, early Smithian.
Fig. D. *Subflemingites involutus* (WELTER, 1922). PIMUZ 37042. *Kashmirites* fauna, early Smithian.
Figs E–G. *Subflemingites involutus* (WELTER, 1922). PIMUZ 37043. *Kashmirites* fauna, early Smithian.
Figs H–J. *Subflemingites involutus* (WELTER, 1922). PIMUZ 37044. *Kashmirites* fauna, early Smithian.
Figs K–L. *Subflemingites bihatiense* n. sp., paratype. PIMUZ 37045. *Owenites* fauna, middle Smithian.
Fig. M. *Subflemingites bihatiense* n. sp., holotype. PIMUZ 37046. *Owenites* fauna, middle Smithian.
Figs N–P. ?*Subflemingites* sp. indet. PIMUZ 37047. *Owenites* fauna, middle Smithian.
Fig. Q. ?*Subflemingites* sp. indet. Suture line of PIMUZ 37047 with scale bar representing 5 mm, at H = 21.7 mm. *Owenites* fauna, middle Smithian.

Plate 12

Figs A–C. *Anaxenaspis orientale* DIENER, 1895. PIMUZ 37048, ×0.5. *Owenites* fauna, middle Smithian.

Fig. D. *Anaxenaspis orientale* DIENER, 1895. PIMUZ 37049, ×0.5. *Owenites* fauna, middle Smithian.

Fig. E. *Anaxenaspis orientale* DIENER, 1895. PIMUZ 37050. *Owenites* fauna, middle Smithian.

Fig. F. *Anaxenaspis orientale* DIENER, 1895. PIMUZ 37051, ×0.5. *Owenites* fauna, middle Smithian.

Fig. G. *Anaxenaspis orientale* DIENER, 1895. Suture line of PIMUZ 37052 with scale bar representing 5 mm, at H = 23.1 mm. *Owenites* fauna, middle Smithian.

Figs H–J. *Anaxenaspis orientale* DIENER, 1895. PIMUZ 37052, ×0.5. *Owenites* fauna, middle Smithian.

Fig. K. *Anaxenaspis orientale* DIENER, 1895. PIMUZ 37053, ×0.5. *Owenites* fauna, middle Smithian.

Figs L–N. *Anaxenaspis orientale* DIENER, 1895. PIMUZ 37054, ×0.5. *Owenites* fauna, middle Smithian.

Fig. O. *Anaxenaspis orientale* DIENER, 1895. Suture line of PIMUZ 37048 with scale bar representing 5 mm, at H = 28.7 mm. *Owenites* fauna, middle Smithian.

Fig. P. *Anaxenaspis orientale* DIENER, 1895. Suture line of PIMUZ 37055 with scale bar representing 5 mm. *Owenites* fauna, middle Smithian.

Plate 13

Figs A–C. *Hochuliites retrocostatus* BRÜHWILER et al., 2012c. PIMUZ 37056, ×0.75. *Owenites* fauna, middle Smithian.

Figs D–F. *Hochuliites retrocostatus* BRÜHWILER et al., 2012c. PIMUZ 37057, ×0.75. *Owenites* fauna, middle Smithian.

Fig. G. *Hochuliites retrocostatus* BRÜHWILER et al., 2012c. Suture line of PIMUZ 37056 with scale bar representing 5 mm, at H = 24.3 mm. *Owenites* fauna, middle Smithian.

Figs H–J. *Anaxenaspis compressus* (BRÜHWILER et al., 2010b). PIMUZ 37058. *Owenites* fauna, middle Smithian.

Fig. K. *Anaxenaspis compressus* (BRÜHWILER et al., 2010b). Suture line of PIMUZ 37059 with scale bar representing 5 mm, at H = 20.8 mm. *Owenites* fauna, middle Smithian.

Figs L–N. *Anaxenaspis compressus* (BRÜHWILER et al., 2010b). PIMUZ 37059. *Owenites* fauna, middle Smithian.

Plate 14

Figs A–C. *Baidites tenue* (WELTER, 1922). PIMUZ 37060, ×0.5. *Kashmirites* fauna, early Smithian.
Figs D–F. *Baidites tenue* (WELTER, 1922). PIMUZ 37061, ×0.5. *Kashmirites* fauna, early Smithian.
Figs G–I. *Baidites tenue* (WELTER, 1922). PIMUZ 37062, ×0.5. *Kashmirites* fauna, early Smithian.
Fig. J. *Baidites tenue* (WELTER, 1922). Suture line of PIMUZ 37061 with scale bar representing 5 mm, at H = 11.8 mm. *Kashmirites* fauna, early Smithian.
Figs K–M. *Baidites crassecostatum* (WELTER, 1922). PIMUZ 37063, ×0.5. *Kashmirites* fauna, early Smithian.
Figs N–P. *Baidites crassecostatum* (WELTER, 1922). PIMUZ 37064, ×0.5. *Kashmirites* fauna, early Smithian.
Figs Q–S. *Baidites crassecostatum* (WELTER, 1922). PIMUZ 37065, ×0.5. *Kashmirites* fauna, early Smithian.
Figs T–V. *Baidites crassecostatum* (WELTER, 1922). PIMUZ 37066, ×0.5. *Kashmirites* fauna, early Smithian.
Fig. W. *Baidites crassecostatum* (WELTER, 1922). PIMUZ 37067, ×0.5. *Kashmirites* fauna, early Smithian.
Figs X–Z. *Baidites crassecostatum* (WELTER, 1922). PIMUZ 37068, ×0.5. *Kashmirites* fauna, early Smithian.

Plate 15

Fig. A. *Baidites obesus* n. sp. Suture line of PIMUZ 37069 with scale bar representing 5 mm, at H = 25.5 mm. *Kashmirites* fauna, early Smithian.

Figs B–D. *Baidites obesus* n. sp., paratype. PIMUZ 37069, ×0.6. *Kashmirites* fauna, early Smithian.

Fig. E. *Baidites obesus* n. sp. PIMUZ 37070, ×0.6. *Kashmirites* fauna, early Smithian.

Figs F–H. *Baidites obesus* n. sp., holotype. PIMUZ 37071, ×0.6. *Kashmirites* fauna, early Smithian.

Figs I–K. Genus gen. indet. A. PIMUZ 37072, ×0.6. *Kashmirites* fauna, early Smithian.

Plate 16

Figs A–D. *Dieneroceras dieneri* (HYATT & SMITH, 1905). PIMUZ 37073. *Owenites* fauna, middle Smithian.
Figs E–H. *Dieneroceras dieneri* (HYATT & SMITH, 1905). PIMUZ 37074. *Owenites* fauna, middle Smithian.
Figs I–K. *Dieneroceras dieneri* (HYATT & SMITH, 1905). PIMUZ 37075. *Owenites* fauna, middle Smithian.
Figs L–N. *Dieneroceras dieneri* (HYATT & SMITH, 1905). PIMUZ 37076. *Owenites* fauna, middle Smithian.
Figs O–R. *Dieneroceras dieneri* (HYATT & SMITH, 1905). PIMUZ 37077. *Owenites* fauna, middle Smithian.
Fig. S. *Dieneroceras knechti* (HYATT & SMITH, 1905). PIMUZ 37078. *Owenites* fauna, middle Smithian.
Figs T–V. *Dieneroceras knechti* (HYATT & SMITH, 1905). PIMUZ 37079. *Owenites* fauna, middle Smithian.
Fig. W. *Dieneroceras* cf. *tientungense* CHAO, 1959. PIMUZ 37080. *Kashmirites* fauna, early Smithian.
Figs X–Y. *Dieneroceras* cf. *tientungense* CHAO, 1959. PIMUZ 37081. *Kashmirites* fauna, early Smithian.
Fig. Z. *Dieneroceras* cf. *tientungense* CHAO, 1959. PIMUZ 37082. *Kashmirites* fauna, early Smithian.
Figs AA–AC. *Dieneroceras* cf. *tientungense* CHAO, 1959. PIMUZ 37083. *Kashmirites* fauna, early Smithian.
Figs AD–AF. *Dieneroceras* cf. *tientungense* CHAO, 1959. PIMUZ 37084. *Kashmirites* fauna, early Smithian.
Figs AG–AH. *Dieneroceras* cf. *tientungense* CHAO, 1959. PIMUZ 37085. *Kashmirites* fauna, early Smithian.
Fig. AI. *Dieneroceras* cf. *tientungense* CHAO, 1959. Suture line of PIMUZ 37085 with scale bar representing 5 mm, at H = 5.2 mm. *Kashmirites* fauna, early Smithian.
Figs AJ–AK. ?*Omanites* sp. indet. PIMUZ 37086. *Owenites* fauna, middle Smithian.

Plate 17

Figs A–C. *Owenites* sp. indet. PIMUZ 37087. *Owenites* fauna, middle Smithian.
Figs D–F. *Owenites* sp. indet. PIMUZ 37088. *Owenites* fauna, middle Smithian.
Figs G–I. *Owenites* sp. indet. PIMUZ 37089. *Owenites* fauna, middle Smithian.
Figs J–L. *Owenites* sp. indet. PIMUZ 37090. *Owenites* fauna, middle Smithian.
Figs M–O. *Owenites* sp. indet. PIMUZ 37091. *Owenites* fauna, middle Smithian.
Figs P–R. *Owenites* sp. indet. PIMUZ 37092. *Owenites* fauna, middle Smithian.
Figs S–U. *Owenites* sp. indet. PIMUZ 37093. *Owenites* fauna, middle Smithian.
Figs V–X. *Owenites* sp. indet. PIMUZ 37094. *Owenites* fauna, middle Smithian.
Figs Y–AA. *Owenites* sp. indet. PIMUZ 37095. *Owenites* fauna, middle Smithian.
Figs AB–AD. *Owenites koeneni* HYATT & SMITH, 1905. PIMUZ 37096. *Owenites* fauna, middle Smithian.
Figs AE–AG. *Owenites koeneni* HYATT & SMITH, 1905. PIMUZ 37098. *Owenites* fauna, middle Smithian.
Fig. AH. *Owenites koeneni* HYATT & SMITH, 1905. Suture line of PIMUZ 37097 with scale bar representing 5 mm, at H = 12 mm. *Owenites* fauna, middle Smithian.
Figs AI–AJ. *Owenites koeneni* HYATT & SMITH, 1905. PIMUZ 37099. *Owenites* fauna, middle Smithian.
Figs AK–AM. *Owenites koeneni* HYATT & SMITH, 1905. PIMUZ 37100. *Owenites* fauna, middle Smithian.
Figs AN–AP. *Owenites koeneni* HYATT & SMITH, 1905. PIMUZ 37101. *Owenites* fauna, middle Smithian.
Fig. AQ. *Owenites koeneni* HYATT & SMITH, 1905. PIMUZ 37102. *Owenites* fauna, middle Smithian.
Figs AR–AT. *Owenites koeneni* HYATT & SMITH, 1905. PIMUZ 37103. *Owenites* fauna, middle Smithian.
Figs AU–AW. *Owenites koeneni* HYATT & SMITH, 1905. PIMUZ 37104. *Owenites* fauna, middle Smithian.

Plate 18

Figs A–C. *Owenites egrediens* WELTER, 1922. PIMUZ 37105. *Owenites* fauna, middle Smithian.
Figs D–E. *Owenites egrediens* WELTER, 1922. PIMUZ 37106. *Owenites* fauna, middle Smithian.
Figs F–H. *Owenites egrediens* WELTER, 1922. PIMUZ 37107. *Owenites* fauna, middle Smithian.
Figs I–K. *Owenites egrediens* WELTER, 1922. PIMUZ 37108. *Owenites* fauna, middle Smithian.
Figs L–N. *Owenites egrediens* WELTER, 1922. PIMUZ 37109. *Owenites* fauna, middle Smithian.
Figs O–R. *Owenites egrediens* WELTER, 1922. PIMUZ 37110. *Owenites* fauna, middle Smithian.
Figs S–U. *Owenites egrediens* WELTER, 1922. PIMUZ 37111. *Owenites* fauna, middle Smithian.
Figs V–X. *Owenites egrediens* WELTER, 1922. PIMUZ 37112. *Owenites* fauna, middle Smithian.
Figs Y–AA. *Owenites egrediens* WELTER, 1922. PIMUZ 37113. *Owenites* fauna, middle Smithian.
Figs AB–AD. *Owenites egrediens* WELTER, 1922. PIMUZ 37114. *Owenites* fauna, middle Smithian.

Plate 19

Figs A–D. *Owenites simplex* WELTER, 1922. PIMUZ 37116. *Owenites* fauna, middle Smithian.
Figs E–G. *Owenites simplex* WELTER, 1922. PIMUZ 37117. *Owenites* fauna, middle Smithian.
Figs H–J. *Owenites simplex* WELTER, 1922. PIMUZ 37118. *Owenites* fauna, middle Smithian.
Figs K–L. *Owenites simplex* WELTER, 1922. PIMUZ 37119. *Owenites* fauna, middle Smithian.
Figs M–O. *Owenites simplex* WELTER, 1922. PIMUZ 37120. *Owenites* fauna, middle Smithian.
Fig. P. *Owenites simplex* WELTER, 1922. PIMUZ 37121. *Owenites* fauna, middle Smithian.
Figs Q–S. *Owenites simplex* WELTER, 1922. PIMUZ 37122. *Owenites* fauna, middle Smithian.
Figs T–V. *Owenites simplex* WELTER, 1922. PIMUZ 37123. *Owenites* fauna, middle Smithian.
Figs W–Z. *Owenites simplex* WELTER, 1922. PIMUZ 37124. *Owenites* fauna, middle Smithian.
Figs AA–AC. *Owenites simplex* WELTER, 1922. PIMUZ 37125. *Owenites* fauna, middle Smithian.
Figs AD–AF. *Owenites simplex* WELTER, 1922. PIMUZ 37126. *Owenites* fauna, middle Smithian.
Figs AG–AJ. *Owenites simplex* WELTER, 1922. PIMUZ 37127. *Owenites* fauna, middle Smithian.
Figs AK–AM. *Owenites simplex* WELTER, 1922. PIMUZ 37128. *Owenites* fauna, middle Smithian.

Plate 20

Figs A–C. *Steckites brevus* WELTER, 1922. PIMUZ 37129. *Owenites* fauna, middle Smithian.
Figs D–F. *Steckites brevus* WELTER, 1922. PIMUZ 37130. *Owenites* fauna, middle Smithian.
Figs G–I. *Steckites brevus* WELTER, 1922. PIMUZ 37131. *Owenites* fauna, middle Smithian.
Figs J–K. *Steckites brevus* WELTER, 1922. PIMUZ 37132. *Owenites* fauna, middle Smithian.
Fig. L. *Steckites brevus* WELTER, 1922. PIMUZ 37133. *Owenites* fauna, middle Smithian.
Fig. M. *Steckites brevus* WELTER, 1922. PIMUZ 37134. *Owenites* fauna, middle Smithian.
Figs N–Q. *Steckites brevus* WELTER, 1922. PIMUZ 37135. *Owenites* fauna, middle Smithian.
Figs R–S. *Steckites brevus* WELTER, 1922. PIMUZ 37136. *Owenites* fauna, middle Smithian.
Figs T–V. *Steckites brevus* WELTER, 1922. PIMUZ 37137. *Owenites* fauna, middle Smithian.
Figs W–Y. *Steckites brevus* WELTER, 1922. PIMUZ 37138. *Owenites* fauna, middle Smithian.
Figs Z–AA. *Steckites brevus* WELTER, 1922. PIMUZ 37139. *Owenites* fauna, middle Smithian.
Figs AB–AD. *Steckites brevus* WELTER, 1922. PIMUZ 37140. *Owenites* fauna, middle Smithian.
Figs AE–AG. *Steckites brevus* WELTER, 1922. PIMUZ 37141. *Owenites* fauna, middle Smithian.
Figs AH–AJ. *Steckites brevus* WELTER, 1922. PIMUZ 37145. *Owenites* fauna, middle Smithian.
Figs AK–AN. *Steckites brevus* WELTER, 1922. PIMUZ 37142. *Owenites* fauna, middle Smithian.
Figs AO–AQ. *Steckites brevus* WELTER, 1922. PIMUZ 37143. *Owenites* fauna, middle Smithian.
Figs AR–AT. *Steckites brevus* WELTER, 1922. PIMUZ 37144. *Owenites* fauna, middle Smithian.
Fig. AU. *Steckites brevus* WELTER, 1922. Suture line of PIMUZ 37138 with scale bar representing 5 mm, at H = 8.3 mm. *Owenites* fauna, middle Smithian.

Plate 21

Figs A–C. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37146. *Owenites* fauna, middle Smithian.
Figs D–F. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37147. *Owenites* fauna, middle Smithian.
Figs G–I. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37148. *Owenites* fauna, middle Smithian.
Figs J–L. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37149. *Owenites* fauna, middle Smithian.
Figs M–N. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37150. *Owenites* fauna, middle Smithian.
Figs O–Q. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37151, ×0.75. *Owenites* fauna, middle Smithian.
Figs R–T. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37152, ×0.75. *Owenites* fauna, middle Smithian.
Figs U–W. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37153. *Owenites* fauna, middle Smithian.
Figs X–Z. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37154. *Owenites* fauna, middle Smithian.
Figs AA–AB. *Juvenites spathi* (FREBOLD, 1930). PIMUZ 37155. *Owenites* fauna, middle Smithian.

Plate 22

Figs A–D. *Juvenites septentrionalis* SMITH, 1932. PIMUZ 37156. *Owenites* fauna, middle Smithian.
Figs E–G. *Juvenites septentrionalis* SMITH, 1932. PIMUZ 37157. *Owenites* fauna, middle Smithian.
Figs H–K. *Juvenites septentrionalis* SMITH, 1932. PIMUZ 37158. *Owenites* fauna, middle Smithian.
Figs L–N. *Juvenites septentrionalis* SMITH, 1932. PIMUZ 37159. *Owenites* fauna, middle Smithian.
Figs O–Q. *Juvenites septentrionalis* SMITH, 1932. PIMUZ 37160. *Owenites* fauna, middle Smithian.
Figs R–T. *Juvenites* cf. *septentrionalis* SMITH, 1932. PIMUZ 37161. *Owenites* fauna, middle Smithian.
Fig. U. *Subinyoites* cf. *punjabiensis* BRÜHWILER & BUCHER, 2012b. Suture line of PIMUZ 37162 with scale bar representing 5 mm, at H = 19 mm. *Owenites* fauna, middle Smithian.
Figs V–X. *Subinyoites* cf. *punjabiensis* BRÜHWILER & BUCHER, 2012b. PIMUZ 37162. *Owenites* fauna, middle Smithian.
Figs Y–AA. *Subvishnuites welteri* SPATH, 1930. PIMUZ 37163. *Owenites* fauna, middle Smithian.
Figs AB–AD. *Subvishnuites welteri* SPATH, 1930. PIMUZ 37164. *Owenites* fauna, middle Smithian.
Figs AE–AG. *Subvishnuites welteri* SPATH, 1930. PIMUZ 37165, ×0.75. *Owenites* fauna, middle Smithian.
Figs AH–AJ. *Subvishnuites welteri* SPATH, 1930. PIMUZ 37166. *Owenites* fauna, middle Smithian.
Figs AK–AM. *Subvishnuites welteri* SPATH, 1930. PIMUZ 37167. *Owenites* fauna, middle Smithian.
Figs AN–AP. *Subvishnuites welteri* SPATH, 1930. PIMUZ 37168. *Owenites* fauna, middle Smithian.
Figs AQ–AS. *Subvishnuites welteri* SPATH, 1930. PIMUZ 37169, ×0.75. *Owenites* fauna, middle Smithian.
Figs AT–AU. *Subvishnuites* cf. *posterus* BRÜHWILER et al., 2012c. PIMUZ 37170. *Anasibirites* fauna, late Smithian.

Plate 23

Figs A–C. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37171, ×0.5. *Owenites* fauna, middle Smithian.

Figs D–F. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37172, ×0.5. *Owenites* fauna, middle Smithian.

Figs G–H. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37173, ×0.5. *Owenites* fauna, middle Smithian.

Fig. I. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37174, ×0.5. *Owenites* fauna, middle Smithian.

Figs J–L. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37175, ×0.5. *Owenites* fauna, middle Smithian.

Figs M–O. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37176, ×0.5. *Owenites* fauna, middle Smithian.

Figs P–R. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37177, ×0.5. *Owenites* fauna, middle Smithian.

Figs S–U. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37178, ×0.5. *Owenites* fauna, middle Smithian.

Fig. V. *Truempyceras pluriformis* (GUEX, 1978). Suture line of PIMUZ 37179 with scale bar representing 5 mm, at H = 15.2 mm. *Owenites* fauna, middle Smithian.

Figs W–Y. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37179, ×0.5. *Owenites* fauna, middle Smithian.

Fig. Z. *Truempyceras pluriformis* (GUEX, 1978). PIMUZ 37180, ×0.5. *Owenites* fauna, middle Smithian.

Figs AA–AC. *Truempyceras* cf. *compressum* BRÜHWILER et al., 2012c. PIMUZ 37181, ×0.5. *Owenites* fauna, middle Smithian.

Figs AD–AF. *Truempyceras compressum* BRÜHWILER et al., 2012c. PIMUZ 37182, ×0.5. *Owenites* fauna, middle Smithian.

Figs AG–AJ. *Truempyceras compressum* BRÜHWILER et al., 2012c. PIMUZ 37183, ×0.5. *Owenites* fauna, middle Smithian.

Figs AK–AM. *Truempyceras compressum* BRÜHWILER et al., 2012c. PIMUZ 37184, ×0.5. *Owenites* fauna, middle Smithian.

Fig. AN. *Truempyceras compressum* BRÜHWILER et al., 2012c. PIMUZ 37186, ×0.5. *Owenites* fauna, middle Smithian.

Fig. AO. *Truempyceras compressum* BRÜHWILER et al., 2012c. Suture line of PIMUZ 37187 with scale bar representing 5 mm, at H = 14.8 mm. *Owenites* fauna, middle Smithian.

Figs AP–AR. *Truempyceras compressum* BRÜHWILER et al., 2012c. PIMUZ 37188, ×0.5. *Owenites* fauna, middle Smithian.

Fig. AS. *Truempyceras compressum* BRÜHWILER et al., 2012c. PIMUZ 37189, ×0.5. *Owenites* fauna, middle Smithian.

Fig. AT. *Truempyceras compressum* BRÜHWILER et al., 2012c. PIMUZ 37190, ×0.5. *Owenites* fauna, middle Smithian.

Plate 24

Figs A–B. *Brayardites compressus* BRÜHWILER et al., 2010b. PIMUZ 37191, ×0.5. *Owenites* fauna, middle Smithian.

Figs C–E. *Brayardites compressus* BRÜHWILER et al., 2010b. PIMUZ 37192, ×0.5. *Owenites* fauna, middle Smithian.

Figs F–H. *Brayardites compressus* BRÜHWILER et al., 2010b. PIMUZ 37193, ×0.5. *Owenites* fauna, middle Smithian.

Figs I–K. *Brayardites compressus* BRÜHWILER et al., 2010b. PIMUZ 37194, ×0.5. *Owenites* fauna, middle Smithian.

Figs L–N. *Brayardites compressus* BRÜHWILER et al., 2010b. PIMUZ 37195, ×0.5. *Owenites* fauna, middle Smithian.

Figs O–P. *Brayardites compressus* BRÜHWILER et al., 2010b. PIMUZ 37196, ×0.5. *Owenites* fauna, middle Smithian.

Fig. Q. *Brayardites compressus* BRÜHWILER et al., 2010b. Suture line of PIMUZ 37197 with scale bar representing 5 mm, at H = 29.9 mm. *Owenites* fauna, middle Smithian.

Figs R–T. *Brayardites compressus* BRÜHWILER et al., 2010b. PIMUZ 37198, ×0.5. *Owenites* fauna, middle Smithian.

Plate 25

Figs A–C. *Brayardites malayicum* (WELTER, 1922). PIMUZ 37199, ×0.5. *Owenites* fauna, middle Smithian.
Figs D–F. *Brayardites malayicum* (WELTER, 1922). PIMUZ 37200, ×0.5. *Owenites* fauna, middle Smithian.
Figs G–H. *Brayardites malayicum* (WELTER, 1922). PIMUZ 37201, ×0.5. *Owenites* fauna, middle Smithian.
Figs I–K. *Brayardites malayicum* (WELTER, 1922). PIMUZ 37202, ×0.5. *Owenites* fauna, middle Smithian.
Figs L–M. *Brayardites malayicum* (WELTER, 1922). PIMUZ 37203, ×0.5. *Owenites* fauna, middle Smithian.
Figs N–P. *Brayardites malayicum* (WELTER, 1922). PIMUZ 37204, ×0.5. *Owenites* fauna, middle Smithian.
Figs Q–S. *Brayardites malayicum* (WELTER, 1922). PIMUZ 37205, ×0.5. *Owenites* fauna, middle Smithian.
Figs T–V. *Brayardites* cf. *malayicum* (WELTER, 1922). PIMUZ 37206, ×0.5. *Owenites* fauna, middle Smithian.
Figs W–Y. *Brayardites* cf. *malayicum* (WELTER, 1922). PIMUZ 37207, ×0.5. *Owenites* fauna, middle Smithian.
Figs Z–AA. *Brayardites* cf. *malayicum* (WELTER, 1922). PIMUZ 37208, ×0.5. *Owenites* fauna, middle Smithian.

Plate 26

Figs A–C. ? *Nammalites* cf. *pilatoides* (GUEX, 1978). PIMUZ 37209, X1.5. *Owenites* fauna, middle Smithian.

Figs D–F. ? *Nammalites* cf. *pilatoides* (GUEX, 1978). PIMUZ 37210, X1.5. *Owenites* fauna, middle Smithian.

Fig. G. ? *Nammalites* cf. *pilatoides* (GUEX, 1978). Suture line of PIMUZ 37209 with scale bar representing 5 mm, at H = 8 mm. *Owenites* fauna, middle Smithian.

Figs H–I. ? *Nammalites* cf. *pilatoides* (GUEX, 1978). PIMUZ 37211. *Owenites* fauna, middle Smithian.

Figs J–L. *Churkites warei* n. sp., paratype. PIMUZ 37212. *Owenites* fauna, middle Smithian.

Figs M–O. *Churkites warei* n. sp., holotype. PIMUZ 37213. *Owenites* fauna, middle Smithian.

Plate 27

Figs A–C. *Prionites tuberculatus* WAAGEN, 1895. PIMUZ 37214, ×0.5. *Owenites* fauna, middle Smithian.

Figs D–F. *Prionites tuberculatus* WAAGEN, 1895. PIMUZ 37215, ×0.5. *Owenites* fauna, middle Smithian.

Figs G–I. *Prionites tuberculatus* WAAGEN, 1895. PIMUZ 37216, ×0.5. *Owenites* fauna, middle Smithian.

Figs J–L. *Prionites tuberculatus* WAAGEN, 1895. PIMUZ 37217, ×0.5. *Owenites* fauna, middle Smithian.

Figs M–O. *Prionites tuberculatus* WAAGEN, 1895. PIMUZ 37218, ×0.5. *Owenites* fauna, middle Smithian.

Figs P–R. *Prionites tuberculatus* WAAGEN, 1895. PIMUZ 37219, ×0.5. *Owenites* fauna, middle Smithian.

Figs S–U. *Prionites involutus* BRÜHWILER et al., 2010b. PIMUZ 37220, ×0.5. *Owenites* fauna, middle Smithian.

Figs V–X. *Prionites involutus* BRÜHWILER et al., 2010b. PIMUZ 37221, ×0.5. *Owenites* fauna, middle Smithian.

Fig. Y. *Prionites involutus* BRÜHWILER et al., 2010b. Suture line of PIMUZ 37221 with scale bar representing 5 mm, at H = 24.5 mm. *Owenites* fauna, middle Smithian.

Figs Z–AB. *Prionites nammalensis* BRÜHWILER & BUCHER, 2012b. PIMUZ 37222, ×0.5. *Owenites* fauna, middle Smithian.

Figs AC–AD. *Stephanites superbus* WAAGEN, 1895. PIMUZ 37223. *Owenites* fauna, middle Smithian.

Plate 28

Figs A–C. *Wasatchites distractus* (WAAGEN, 1895). PIMUZ 37224. *Anasibirites* fauna, late Smithian.
Figs D–F. *Wasatchites distractus* (WAAGEN, 1895). PIMUZ 37225. *Anasibirites* fauna, late Smithian.
Figs G–H. *Wasatchites distractus* (WAAGEN, 1895). PIMUZ 37226. *Anasibirites* fauna, late Smithian.
Figs I–K. ?*Anasibirites* sp. indet. PIMUZ 37227, ×0.75. *Anasibirites* fauna, late Smithian.
Figs L–N. ?*Anasibirites* sp. indet. PIMUZ 37228. *Anasibirites* fauna, late Smithian.
Fig. O. Prionitidae gen. indet. PIMUZ 37229. *Anasibirites* fauna, late Smithian.
Fig. P. *Arctoprionites resseri* (MATHEWS, 1929). PIMUZ 37230, ×0.75. *Anasibirites* fauna, late Smithian.
Fig. Q. *Arctoprionites resseri* (MATHEWS, 1929). PIMUZ 37231, ×0.75. *Anasibirites* fauna, late Smithian.
Figs R–S. *Arctoprionites resseri* (MATHEWS, 1929). PIMUZ 37232. *Anasibirites* fauna, late Smithian.
Figs T–U. *Arctoprionites resseri* (MATHEWS, 1929). PIMUZ 37233, ×0.75. *Anasibirites* fauna, late Smithian.

Plate 29

Figs A–B. *Hemiprionites typus* (WAAGEN, 1895) with depression near venter. PIMUZ 37234, ×0.75. *Anasibirites* fauna, late Smithian.

Figs C–D. *Hemiprionites typus* (WAAGEN, 1895) with depression near venter. PIMUZ 37235, ×0.75. *Anasibirites* fauna, late Smithian.

Figs E–F. *Hemiprionites typus* (WAAGEN, 1895) with depression near venter. PIMUZ 37236, ×0.75. *Anasibirites* fauna, late Smithian.

Figs G–I. *Hemiprionites typus* (WAAGEN, 1895) with depression near venter. PIMUZ 37237, ×0.75. *Anasibirites* fauna, late Smithian.

Figs J–L. *Hemiprionites typus* (WAAGEN, 1895) with depression near venter. PIMUZ 37238, ×0.75. *Anasibirites* fauna, late Smithian.

Fig. M. *Hemiprionites typus* (WAAGEN, 1895) with depression near venter. PIMUZ 37239, ×0.75. *Anasibirites* fauna, late Smithian.

Figs N–O. *Hemiprionites typus* (WAAGEN, 1895) with depression near venter. PIMUZ 37240, ×0.75. *Anasibirites* fauna, late Smithian.

Figs P–R. *Hemiprionites typus* (WAAGEN, 1895) with depression near venter. PIMUZ 37241, ×0.75. *Anasibirites* fauna, late Smithian.

Figs S–T. *Hemiprionites typus* (WAAGEN, 1895) with depression near venter. PIMUZ 37242, ×0.75. *Anasibirites* fauna, late Smithian.

Figs U–W. *Hemiprionites typus* (WAAGEN, 1895) without depression near venter. PIMUZ 37243, ×0.75. *Anasibirites* fauna, late Smithian.

Figs X–Z. *Hemiprionites typus* (WAAGEN, 1895) without depression near venter. PIMUZ 37244, ×0.75. *Anasibirites* fauna, late Smithian.

Fig. AA. *Hemiprionites typus* (WAAGEN, 1895) without depression near venter. PIMUZ 37245, ×0.75. *Anasibirites* fauna, late Smithian.

Figs AB–AD. *Hemiprionites typus* (WAAGEN, 1895) without depression near venter. PIMUZ 37246, ×0.75. *Anasibirites* fauna, late Smithian.

Figs AE–AG. *Hemiprionites typus* (WAAGEN, 1895) without depression near venter. PIMUZ 37247, ×0.75. *Anasibirites* fauna, late Smithian.

Fig. AH. *Hemiprionites typus* (WAAGEN, 1895) without depression near venter. PIMUZ 37248, ×0.75. *Anasibirites* fauna, late Smithian.

Figs AI–AK. *Hemiprionites typus* (WAAGEN, 1895) without depression near venter. PIMUZ 37249, ×0.75. *Anasibirites* fauna, late Smithian.

Fig. AL. *Hemiprionites typus* (WAAGEN, 1895) without depression near venter. Suture line of PIMUZ 37249 with scale bar representing 5 mm, at H = 11 mm. *Anasibirites* fauna, late Smithian.

Figs AM–AN. *Hemiprionites typus* (WAAGEN, 1895) without depression near venter. PIMUZ 37250, ×0.75. *Anasibirites* fauna, late Smithian.

Figs AO–AQ. *Hemiprionites walcotti* (MATHEWS, 1929). PIMUZ 37251, ×0.75. *Anasibirites* fauna, late Smithian.

Figs AR–AS. *Hemiprionites walcotti* (MATHEWS, 1929). PIMUZ 37252, ×0.75. *Anasibirites* fauna, late Smithian.

Figs AT–U. *Hemiprionites walcotti* (MATHEWS, 1929). PIMUZ 37253, ×0.75. *Anasibirites* fauna, late Smithian.

Figs AV–AX. *Hemiprionites walcotti* (MATHEWS, 1929). PIMUZ 37254, ×0.75. *Anasibirites* fauna, late Smithian.

Figs AY–AZ. *Hemiprionites walcotti* (MATHEWS, 1929). PIMUZ 37255, ×0.75. *Anasibirites* fauna, late Smithian.

Fig. BA. *Hemiprionites walcotti* (MATHEWS, 1929). Suture line of PIMUZ 37252 with scale bar representing 5 mm, at H = 12.4 mm. *Anasibirites* fauna, late Smithian.

Figs BB–BD. *Hemiprionites walcotti* (MATHEWS, 1929). PIMUZ 37257, ×0.75. *Anasibirites* fauna, late Smithian.

Figs BE–BG. *Hemiprionites walcotti* (MATHEWS, 1929). PIMUZ 37258, ×0.75. *Anasibirites* fauna, late Smithian.

Plate 30

Figs A–C. *Hedenstroemia evoluta* (SPATH, 1934). PIMUZ 37256, ×0.5. *Kashmirites* fauna, early Smithian.
Fig. D. *Hedenstroemia evoluta* (SPATH, 1934). PIMUZ 37259, ×0.5. *Kashmirites* fauna, early Smithian.
Figs E–G. *Hedenstroemia evoluta* (SPATH, 1934). PIMUZ 37260, ×0.5. *Kashmirites* fauna, early Smithian.
Figs H–J. *Hedenstroemia evoluta* (SPATH, 1934). PIMUZ 37261, ×0.5. *Kashmirites* fauna, early Smithian.
Figs K–L. *Hedenstroemia evoluta* (SPATH, 1934). PIMUZ 37262, ×0.5. *Kashmirites* fauna, early Smithian.
Fig. M. *Hedenstroemia evoluta* (SPATH, 1934). Suture line of PIMUZ 37263 with scale bar representing 5 mm, at H = 26.7 mm. *Kashmirites* fauna, early Smithian.
Fig. N. *Hedenstroemia evoluta* (SPATH, 1934). Suture line of PIMUZ 37264 with scale bar representing 5 mm, at H = 30.6 mm. *Kashmirites* fauna, early Smithian.
Fig. O. *Hedenstroemia evoluta* (SPATH, 1934). Suture line of PIMUZ 37265 with scale bar representing 5 mm, at H = 39 mm. *Kashmirites* fauna, early Smithian.
Figs P–R. *Mesohedenstroemia kwangsiana* CHAO, 1959. PIMUZ 37266, ×2. *Kashmirites* fauna, early Smithian.
Figs S–U. *Mesohedenstroemia kwangsiana* CHAO, 1959. PIMUZ 37267, ×2. *Kashmirites* fauna, early Smithian.
Figs V–X. *Mesohedenstroemia kwangsiana* CHAO, 1959. PIMUZ 37268. *Kashmirites* fauna, early Smithian.

Plate 31

Figs A–B. *Pseudosageceras multilobatum* NOETLING, 1905. PIMUZ 37269, ×0.5. *Owenites* fauna, middle Smithian.

Figs C–F. *Pseudosageceras multilobatum* NOETLING, 1905. PIMUZ 37270, ×0.5. *Owenites* fauna, middle Smithian.

Fig. G. *Pseudosageceras multilobatum* NOETLING, 1905. Suture line of PIMUZ 37270 with scale bar representing 5 mm, at H = 59.1 mm. *Owenites* fauna, middle Smithian.

Figs H–I. *Pseudosageceras multilobatum* NOETLING, 1905. PIMUZ 37271. *Owenites* fauna, middle Smithian.

Fig. J. *Pseudosageceras multilobatum* NOETLING, 1905. Suture line of PIMUZ 37272 with scale bar representing 5 mm, at H = 16.6 mm. *Owenites* fauna, middle Smithian.

Figs K–M. *Pseudosageceras multilobatum* NOETLING, 1905. PIMUZ 37272. *Owenites* fauna, middle Smithian.

Fig. N. *Pseudosageceras multilobatum* NOETLING, 1905. Suture line of PIMUZ 37273 with scale bar representing 5 mm, at H = 34.9 mm. *Owenites* fauna, middle Smithian.

Figs O–R. *Pseudosageceras multilobatum* NOETLING, 1905. PIMUZ 37273. *Owenites* fauna, middle Smithian.

Figs S–T. *Pseudosageceras multilobatum* NOETLING, 1905. PIMUZ 37274, ×0.4. *Kashmirites* fauna, early Smithian.

Fig. U. *Pseudosageceras multilobatum* NOETLING, 1905. Suture line of PIMUZ 37275 with scale bar representing 5 mm, at H = 59.9 mm. *Owenites* fauna, middle Smithian.

Figs V–W. *Pseudosageceras multilobatum* NOETLING, 1905. PIMUZ 37275, ×0.5. *Owenites* fauna, middle Smithian.

Fig. X. *Episageceras* cf. *intermedium* WELTER, 1922. Suture line of PIMUZ 37276 with scale bar representing 5 mm, at H = 12.5 mm. *Kashmirites* fauna, early Smithian.

Figs Y–AA. *Episageceras* cf. *intermedium* WELTER, 1922. PIMUZ 37276. *Kashmirites* fauna, early Smithian.

Figs AB–AC. *Episageceras* sp. indet. PIMUZ 37277. *Owenites* fauna, middle Smithian.

Figs AD–AE. *Episageceras* sp. indet. PIMUZ 37278. *Owenites* fauna, middle Smithian.

Fig. AF. *Episageceras* sp. indet. Suture line of PIMUZ 37278 with scale bar representing 5 mm, at H = 7 mm. *Owenites* fauna, middle Smithian.

Plate 32

Figs A–C. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37279, ×0.75. *Owenites* fauna, middle Smithian.
Figs D–F. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37280, ×0.75. *Owenites* fauna, middle Smithian.
Figs G–H. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37281, ×0.75. *Owenites* fauna, middle Smithian.
Figs I–K. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37282, ×0.75. *Owenites* fauna, middle Smithian.
Figs L–M. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37283, ×0.75. *Owenites* fauna, middle Smithian.
Figs N–O. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37284, ×0.75. *Owenites* fauna, middle Smithian.
Figs P–R. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37285, ×0.75. *Owenites* fauna, middle Smithian.
Figs S–U. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37286, ×0.75. *Owenites* fauna, middle Smithian.
Figs V–X. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37287, ×0.75. *Owenites* fauna, middle Smithian.
Fig. Y. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37288, ×0.75. *Owenites* fauna, middle Smithian.
Figs Z–AA. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37289, ×0.75. *Owenites* fauna, middle Smithian.
Fig. AB. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37290, ×0.75. *Owenites* fauna, middle Smithian.
Fig. AC. *Pseudaspenites layeriformis* (WELTER, 1922). PIMUZ 37291, ×0.75. *Owenites* fauna, middle Smithian.
Fig. AD. *Pseudaspenites layeriformis* (WELTER, 1922). Suture line of PIMUZ 37279 with scale bar representing 5 mm, at H = 13.3 mm. *Owenites* fauna, middle Smithian.
Figs AE–AH. *Aspenites acutus* HYATT & SMITH, 1905. PIMUZ 37292, ×0.75. *Owenites* fauna, middle Smithian.

Plate 33

Figs A–C. *Ussuria schamarae* DIENER, 1895. PIMUZ 37293, ×0.75. *Owenites* fauna, middle Smithian.

Figs D–F. ? *Parussuria* sp. indet. PIMUZ 37294. *Owenites* fauna, middle Smithian.

Fig. G. ? *Parussuria* sp. indet. Suture line of PIMUZ 37294 with scale bar representing 5 mm, at H = 11.5 mm. *Owenites* fauna, middle Smithian.

Figs H–J. Genus gen. indet. B. PIMUZ 37295. Smithian?

Fig. K. *Goudemandites* cf. *sinensis* BRÜHWILER & BUCHER, 2012a. PIMUZ 37296. *Owenites* fauna, middle Smithian.

Figs L–N. Genus gen. indet. C. PIMUZ 37297. *Kashmirites* fauna, early Smithian.

Text-fig. 1. Chronostratigraphic subdivisions of the Early Triassic calibrated with published radiometric ages (OVTCHAROVA et al. 2006; GALFETTI et al. 2007; OVTCHAROVA et al. 2015; BARESEL et al. 2017). δC^{13}_{carb} curves and anoxic/euxinic events from GALFETTI et al. 2007. A: *Anasibirites*, X: *Xenoceltites*, ea.: early, mi.: middle, l.: late. Simplified ammonoid diversity curve is inferred from data from BRAYARD et al. (2006; 2009a), BRÜHWILER et al. (2010a), WARE et al. (2015) and JATTIOT et al. (2016).

Text-fig. 2. Map of Timor showing the location of Lidak, Noe Tobe and Bihati localities in West Timor (black stars). Modified after CHARLTON et al. (2009).

Text-fig. 3. Timor ammonoid zonation and correlation with other Smithian successions. Spa. Spathian, Dien. Dienerian. Modified after BRAYARD et al. (2013).

Text-fig. 4. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Kashmirites armatus* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 8]; grey symbols indicate specimens from Pakistan, data from BRÜHWILER et al. 2012b [n = 3]).

Text-fig. 5. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Kashmirites baidi* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 1]; grey symbols indicate specimens from Oman and Pakistan, data from BRÜHWILER et al. 2012a; BRÜHWILER et al. b [n = 6]).

Text-fig. 6. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Kashmirites* cf. *guangxiense* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 2]; grey symbols indicate specimens from China, data from BRAYARD & BUCHER, 2008 [n = 9]).

Text-fig. 7. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Kashmirites nivalis* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 15]; grey symbols indicate specimens from Spiti, data from BRÜHWILER et al. 2012c [n = 2]).

Text-fig. 8. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Pseudoceltites multiplicatus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 17]; grey symbols indicate specimens from Spiti, Pakistan and Tibet, data from BRÜHWILER et al. 2010b; BRÜHWILER et al. 2012b; BRÜHWILER et al. 2012c [n = 44]).

Text-fig. 9. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Pseudoceltites densistriatus* from Timor, *Owenites* fauna (n = 7).

Text-fig. 10. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Nyalamites angustecostatus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 25]; grey symbols indicate specimens from Spiti, Oman, Pakistan and Tibet, data from BRÜHWILER et al. 2010b; BRÜHWILER et al. 2012a; BRÜHWILER et al. 2012b; BRÜHWILER et al. 2012c [n = 22]).

Text-fig. 11. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Hanielites elegans* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 2]; grey symbols indicate specimens from Spiti and China, data from BRAYARD & BUCHER 2008 ; BRÜHWILER et al. 2012c [n = 10]).

Text-fig. 12. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Hanielites gracilus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 6]; grey symbols indicate specimens from China, data from BRAYARD & BUCHER 2008 [n = 1]).

Text-fig. 13. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Roopnarinites* n. gen. *paucesculptatum*. All specimens from Timor (open symbols indicate specimens from this work, *Owenites* fauna [n = 8], grey symbols indicate holotype, from WELTER 1922).

Text-fig. 14. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Paraspidites bicarinatus* n. sp. *Kashmirites* fauna [n = 5].

Text-fig. 15. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Galfettites simplicitatis* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 3]; grey symbols indicate specimens from China and Oman, data from BRAYARD & BUCHER 2008 and BRÜHWILER et al. 2012a [n = 15]).

Text-fig. 16. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Paranorites* cf. *ambiensis* (open symbols indicate specimens from Timor, Kashmirites fauna [n = 2], grey symbols indicate specimens from Pakistan; data from BRÜHWILER et al. 2012b [n = 9]).

Text-fig. 17. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Vercherites* cf. *vercherei* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 2], grey symbols indicate specimens from Pakistan; data from BRÜHWILER et al. 2012b [n = 10]).

Text-fig. 18. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Urdyceras tulongensis* from Timor (open symbols, *Owenites* fauna [n = 4]) and from Spiti (grey symbols, data from BRÜHWILER et al. 2012c [n = 8]); and for the holotype of *Urdyceras insolitus* (dark symbols, data from BRÜHWILER et al. 2010b).

Text-fig. 19. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Safraites simplex* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 1]; grey symbols indicate specimens from Oman, data from BRÜHWILER et al. 2012a [n = 16]).

Text-fig. 20. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Flemingites flemingianus* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 1]; grey symbols indicate specimens from Pakistan; data from BRÜHWILER et al. 2012b [n = 5]).

Text-fig. 21. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Flemingites* cf. *planatus* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 1]) and for *Flemingites planatus* from Pakistan (grey symbols, with holotype in dark symbols, data from BRÜHWILER et al. 2012b [n = 3]).

Text-fig. 22. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Flemingites pulcher*. All specimens from Timor (open symbols indicate specimens from this work, *Kashmirites* fauna [n = 4]; grey symbols indicate holotype, from WELTER 1922).

Text-fig. 23. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Rohillites rohilla* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 8]; dark symbols indicate holotype from Spiti, data from DIENER 1897) and for *Rohillites omanensis* (grey symbols, data from BRÜHWILER et al. 2012a [n = 6]).

Text-fig. 24. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Pseudoflemingites timorensis* from Timor (open symbols, *Kashmirites* fauna [n = 6]) and for *Pseudoflemingites* cf. *timorensis* from Pakistan (grey symbols, data from BRÜHWILER et al. 2012b [n = 3]).

Text-fig. 25. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Subflemingites involutus*. All specimens from Timor (open symbols indicate specimens from this work, *Kashmirites* fauna [n = 4]; grey symbols indicate holotype, from WELTER 1922).

Text-fig. 26. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Anaxenaspis orientale*. All specimens from Timor (open symbols, *Owenites* fauna [n = 21]).

Text-fig. 27. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Anaxenaspis compressus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 5]; grey symbols indicate specimens from Tibet, data from BRÜHWILER et al. 2010b [n = 6]).

Text-fig. 28. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Baidites tenue* from Timor (open symbols, *Kashmirites* fauna [n = 4]) and for *Baidites hermanni* from Oman (grey symbols, with holotype in dark symbols, data from BRÜHWILER et al. 2012a [n = 7]).

Text-fig. 29. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Baidites crassecostatum*. All specimens from Timor (open symbols indicate specimens from this work, *Kashmirites* fauna [n = 6]; grey symbols indicate paratype and dark symbols indicate holotype, from WELTER 1922).

Text-fig. 30. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Baidites obesus* n. sp. from Timor (open symbols, *Kashmirites* fauna [n = 2]) and for *Baidites crassecostatum* from Timor (grey symbols, this work, *Kashmirites* fauna [n = 6]; dark symbols indicate holotype, from WELTER 1922).

Text-fig. 31. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Dieneroceras dieneri* from Timor (open symbols, *Owenites* fauna [n = 5]) and for *Dieneroceras* cf. *dieneri* from Oman (grey symbols, data from BRÜHWILER et al. 2012a [n = 25]).

Text-fig. 32. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Dieneroceras* cf. *tientungense* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 7]; grey symbols indicate specimens from China, data from BRAYARD & BUCHER 2008 [n = 58]).

Text-fig. 33. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Owenites koeneni* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 11]; grey symbols indicate specimens from Oman, data from BRÜHWILER et al. 2012a [n = 15]).

Text-fig. 34. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Owenites egrediens*. All specimens from Timor (open symbols, *Owenites* fauna [n = 11]).

Text-fig. 35. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Owenites simplex* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 13]; grey symbols indicate specimens from Oman, data from BRÜHWILER et al. 2012a [n = 5]).

Text-fig. 36. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Owenites* sp. indet. All specimens from Timor (open symbols, *Owenites* fauna [n = 23]).

Text-fig. 37. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Steckites brevus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 21]; grey symbols indicate specimens from Spiti, data from BRÜHWILER et al. 2012c [n = 2]).

Text-fig. 38. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Juvenites spathi* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 14]; grey symbols indicate specimens from China and Oman, data from BRAYARD & BUCHER 2008; BRÜHWILER et al. 2012a [n = 82]).

Text-fig. 39. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Juvenites septentrionalis* from Timor (open symbols, *Owenites* fauna [n = 4]) and for *Juvenites thermarum* from Oman, Utah and Nevada (grey symbols, data from BRÜHWILER et al. 2012a; BRAYARD et al. 2013; JATTIOT et al. 2017 [n = 39]).

Text-fig. 40. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Subvishnuites welteri* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 10]; grey symbols indicate specimens from China and Oman, data from BRAYARD & BUCHER 2008; BRÜHWILER et al. 2012a [n = 12]).

Text-fig. 41. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Subvishnuites* cf. *posterus* from Timor (open symbols, *Anasibirites* fauna [n = 1]) and for *Subvishnuites posterus* from Spiti (grey symbols, data from BRÜHWILER et al. 2012c [n = 8]).

Text-fig. 42. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Hochuliites retrocostatus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 3]; grey symbols indicate specimens from Pakistan, with holotype in dark symbols, data from BRÜHWILER et al. 2012b [n = 2]).

Text-fig. 43. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Truempyceras pluriformis* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 17]; grey symbols indicate specimens from Pakistan, data from BRÜHWILER et al. 2012b [n = 5]).

Text-fig. 44. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Truempyceras compressum* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 14]; grey symbols indicate specimens from Spiti, data from BRÜHWILER et al. 2012c [n = 8]).

Text-fig. 45. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Brayardites compressus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 10]; grey symbols indicate specimens from Tibet, data from BRÜHWILER et al. 2010b [n = 17]).

Text-fig. 46. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Brayardites malayicum* from Timor (open symbols, *Owenites* fauna [n = 13]; black symbols indicate holotype, from WELTER 1922) and for *Brayardites* cf. *malayicum* from Timor (grey symbols, *Owenites* fauna [n = 5]).

Text-fig. 47. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for ?*Nammalites* cf. *pilatoides* from Timor (open symbols, *Owenites* fauna [n = 3]) and for *Nammalites pilatoides* from Spiti (grey symbols, data from BRÜHWILER et al. 2012c [n = 23]).

Text-fig. 48. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Prionites tuberculatus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 7]; grey symbols indicate specimens from Pakistan, data from BRÜHWILER et al. 2012b [n = 12]).

Text-fig. 49. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Prionites involutus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 2]; grey symbols indicate specimens from Tibet, data from BRÜHWILER et al. 2010b [n = 4]).

Text-fig. 50. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Prionites nammalensis* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 1]; grey symbols indicate specimens from Pakistan, data from BRÜHWILER et al. 2012b [n = 6]).

Text-fig. 51. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Stephanites superbus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 1]; grey symbols indicate specimens from Pakistan, data from BRÜHWILER et al. 2012b [n = 2]).

Text-fig. 52. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Arctoprionites resseri* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 4]; grey symbols indicate specimens from Nevada, data from JATTIOT et al. 2017 [n = 7]).

Text-fig. 53. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Hemiprionites typus*. All specimens from Timor (open symbols indicate specimens without depression, *Anasibirites* fauna [n = 65]; grey symbols indicate specimens with depression, *Anasibirites* fauna [n = 121]).

Text-fig. 54. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Hemiprionites walcotti* (open symbols indicate specimens from Timor, *Anasibirites* fauna [n = 11]; grey symbols indicate specimens from Nevada, data from JATTIOT et al. 2017 [n = 26]).

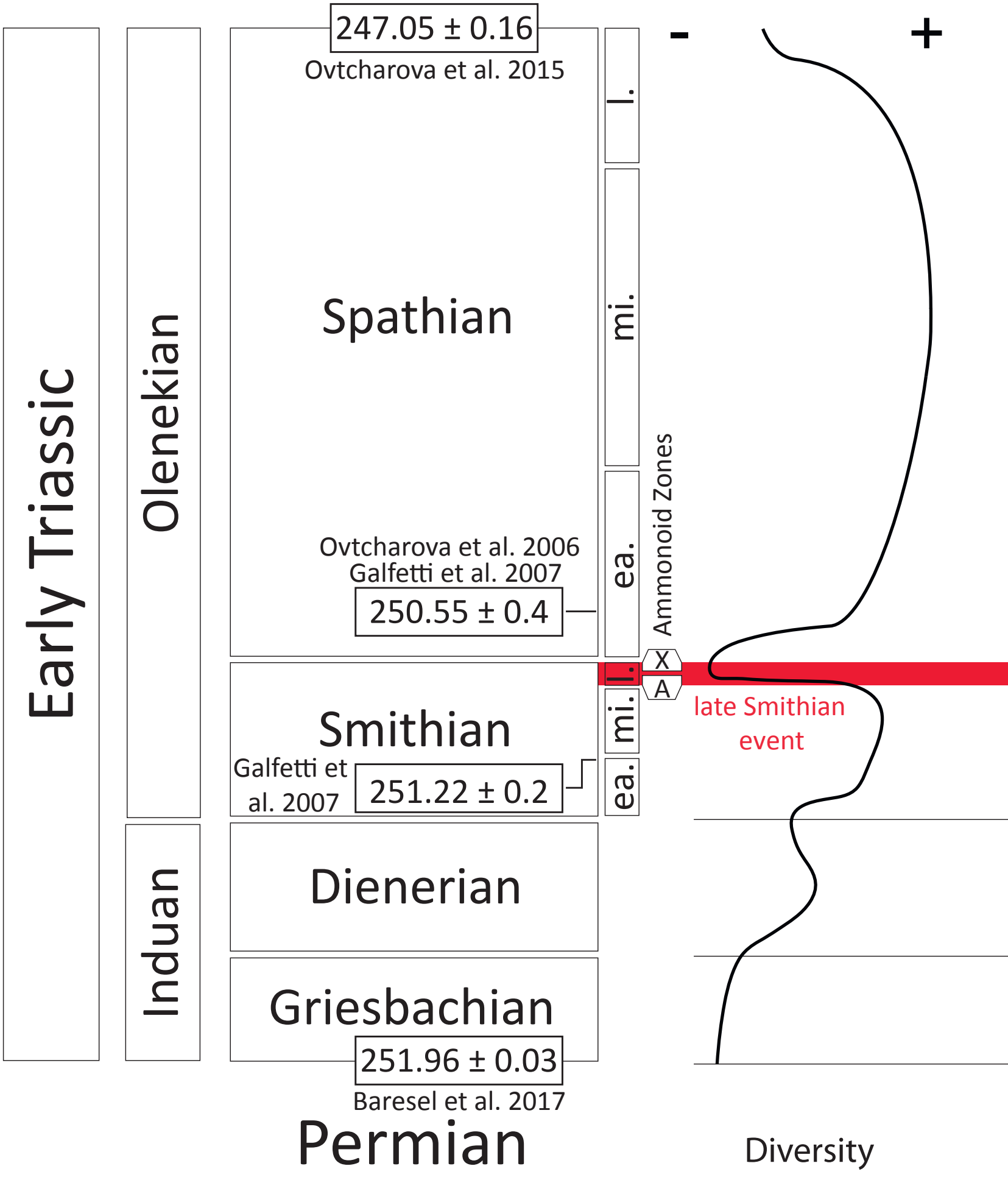
Text-fig. 55. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Hedenstroemia evoluta* (open symbols indicate specimens from Timor, *Kashmirites* fauna [n = 13]; grey symbols indicate specimens from Pakistan, data from BRÜHWILER et al. 2012b [n = 3]).

Text-fig. 56. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Pseudosageceras multilobatum*. All specimens from Timor, *Kashmirites* and *Owenites* faunas (open symbols indicate specimens with an acute venter, [n = 2]; grey symbols indicate specimens with a bicarinate venter, [n = 6]).

Text-fig. 57. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Aspenites acutus* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 1]; grey symbols indicate specimens from Oman and Spiti, data from BRÜHWILER et al. 2012a; BRÜHWILER et al. 2012c [n = 7]).

Text-fig. 58. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Pseudaspenites layeriformis* (open symbols indicate specimens from Timor, this work, *Owenites* fauna [n = 21], dark symbols indicate the holotype from Timor, data from WELTER 1922; grey symbols indicate specimens from China and Spiti, data from BRAYARD & BUCHER 2008; BRÜHWILER et al. 2012c [n = 15]).

Text-fig. 59. Scatter diagrams of H, W and U, and H/D, W/D, and U/D for *Ussuria schamarae* (open symbols indicate specimens from Timor, *Owenites* fauna [n = 1], dark symbols indicate the holotype from Russia, data from DIENER 1895) and for the holotype of *Ussuria iwanowi* from Russia (grey symbols, data from DIENER 1895).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Ovtcharova et al. 2015
Early Triassic
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Induan
Spathian
Smithian
Dienerian
Griesbachian
Ovtcharova et al. 2006
Galfetti et al. 2007
250.55 ± 0.4
Galfetti et al. 2007
251.22 ± 0.2
251.96 ± 0.03
Baresel et al. 2017
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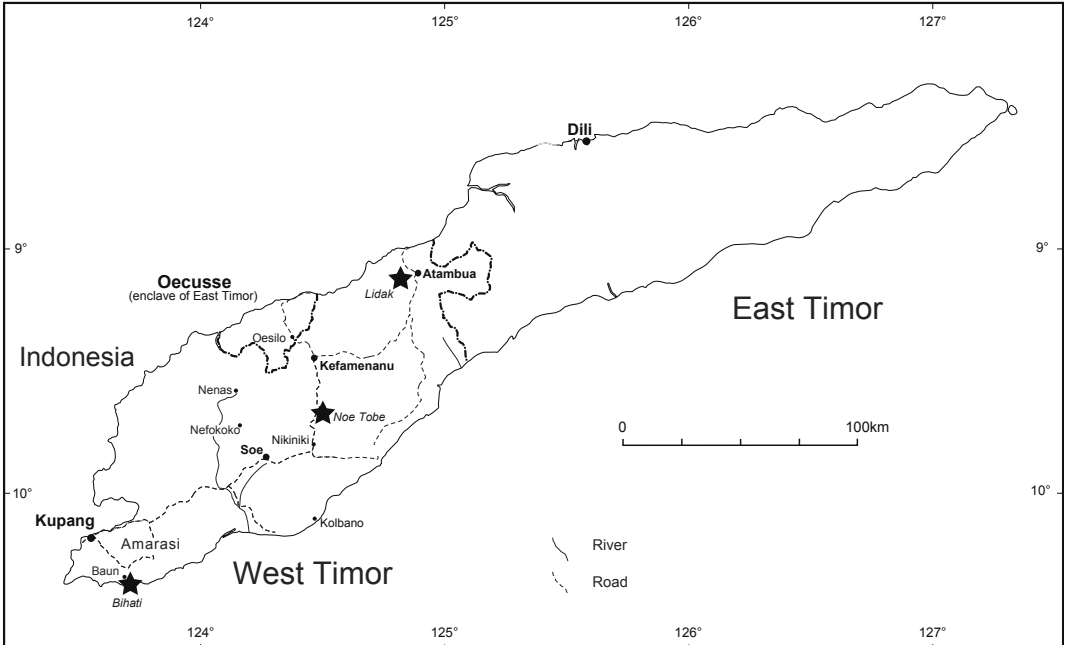
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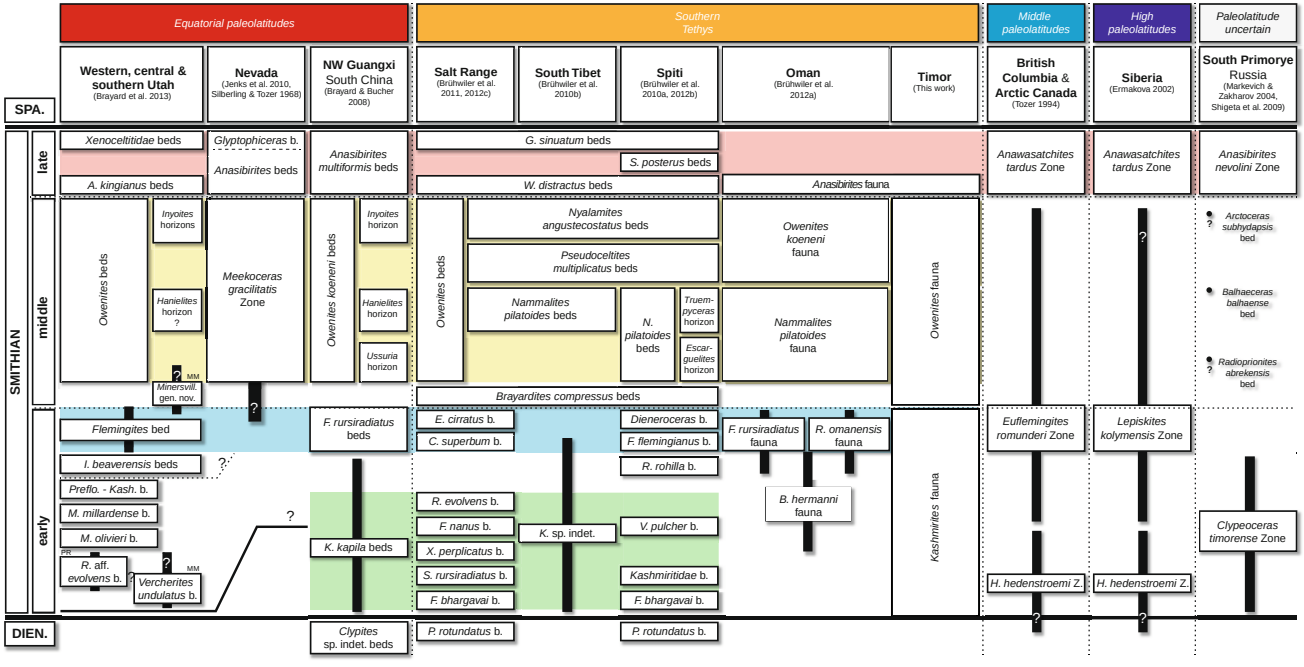
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Southern Tethys
Middle paleolatitudes
High paleolatitudes
Paleolatitude uncertain
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Nevada (Jenks et al. 2010, Silberling & Tozer 1968)
NW Guangxi South China (Brayard & Bucher 2008)
Salt Range (Brühwiler et al. 2011, 2012c)
South Tibet (Brühwiler et al. 2010b)
Spiti (Brühwiler et al. 2010a, 2012b)
Oman (Brühwiler et al. 2012a)
Timor (This work)
British Columbia & Arctic Canada (Tozer 1994)
Siberia (Ermakova 2002)
South Primorye Russia (Markevich & Zakharov 2004, Shigeta et al. 2009)
SPA.
SMITHIAN
late
middle
early
DIEN.
Xenoceltitidae beds
A. kingianus beds
Glyptophiceras b.
Anasibirites beds
Anasibirites multiformis beds
G. sinuatum beds
S. posterus beds
W. distractus beds
Anasibirites fauna
Anawasatchites tardus Zone
Anawasatchites tardus Zone
Anasibirites nevolini Zone
Owenites beds
Inyoites horizons
Hanielites horizon ?
Minersvill. gen. nov.
Meekoceras gracilitatis Zone
Owenites koeneni beds
Inyoites horizon
Hanielites horizon
Ussuria horizon
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Nyalamites angustecostatus beds
Pseudoceltites multiplicatus beds
Nammalites pilatoides beds
N. pilatoides beds
Truem-pyceras horizon
Escar-guelites horizon
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Nammalites pilatoides fauna
Owenites fauna
Arctoceras subhydapsis bed
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Radioprionites abrekensis bed
Brayardites compressus beds
Flemingites bed
I. beaverensis beds
Preflo. - Kash. b.
M. millardense b.
M. olivieri b.
R. aff. evolvens b.
Vercherites undulatus b.
F. rursiradiatus beds
K. kapila beds
Clypites sp. indet. beds
E. cirratus b.
C. superbum b.
R. evolvens b.
F. nanus b.
X. perplicatus b.
S. rursiradiatus b.
F. bhargavai b.
P. rotundatus b.
K. sp. indet.
Dienerocerasb.
F. flemingianus b.
R. rohilla b.
V. pulcher b.
Kashmiritidae b.
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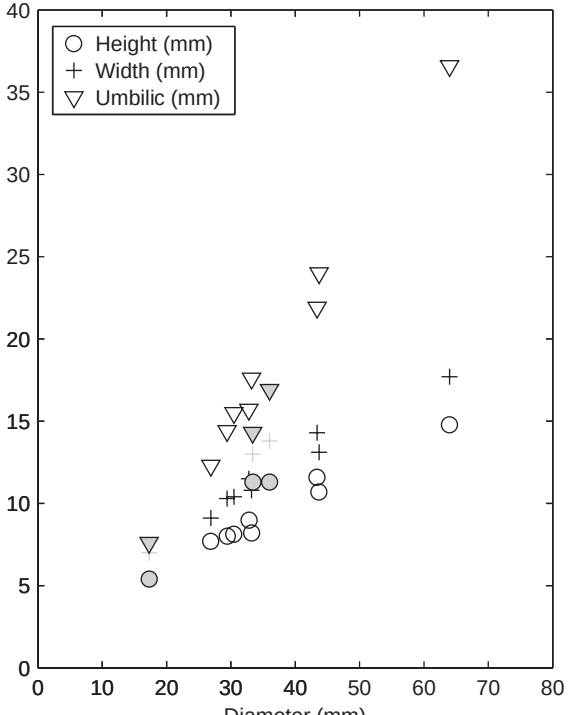
H. hedenstroemi Z.
H. hedenstroemi Z.
Clypeoceras timorense Zone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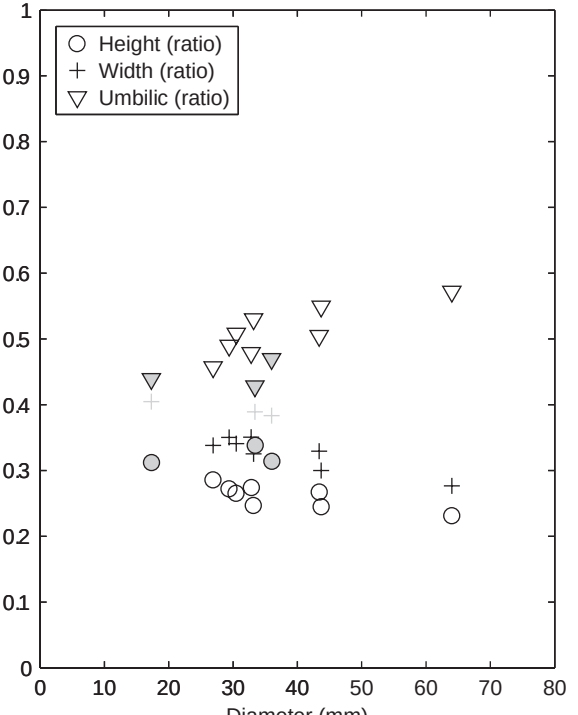
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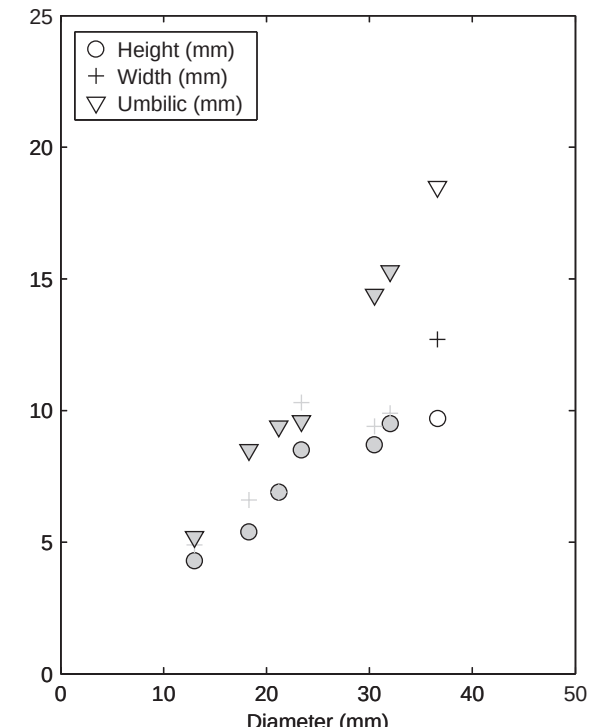
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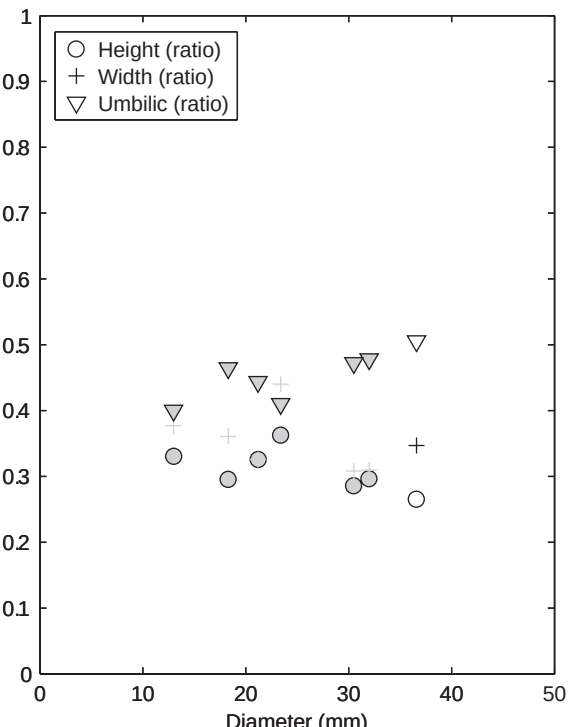
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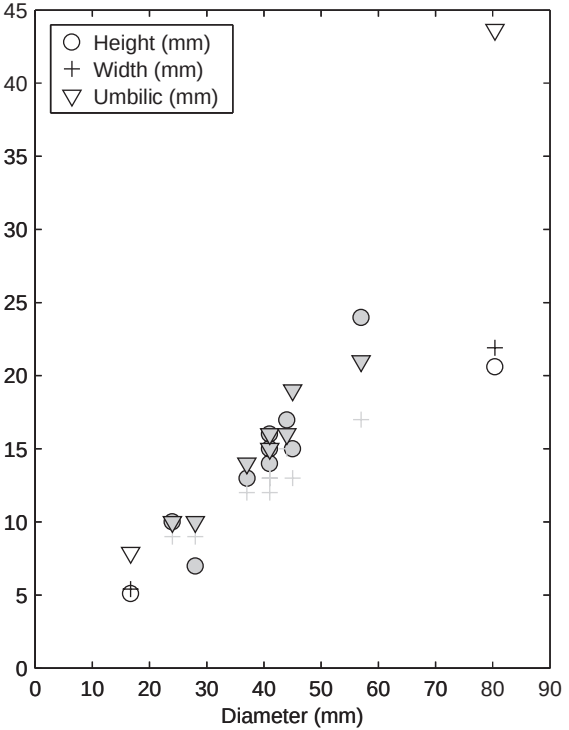
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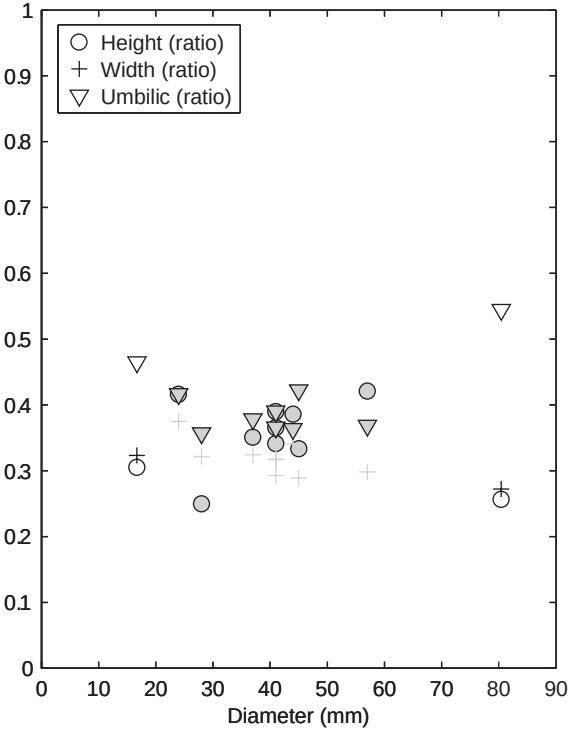
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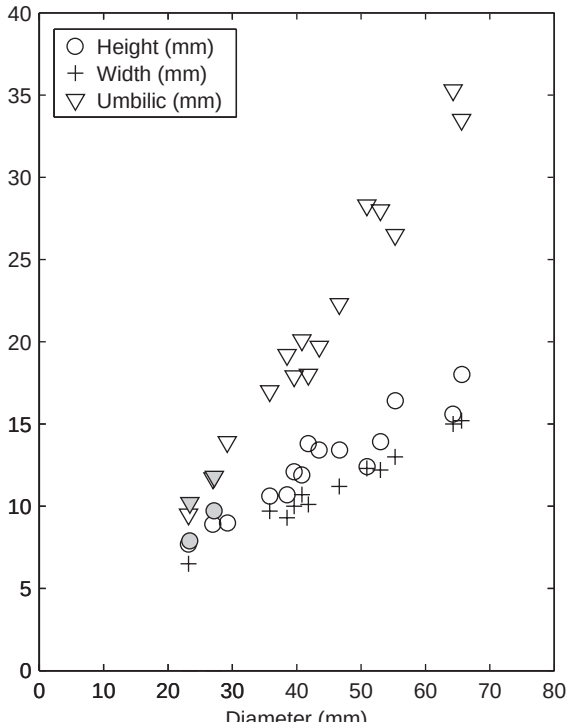
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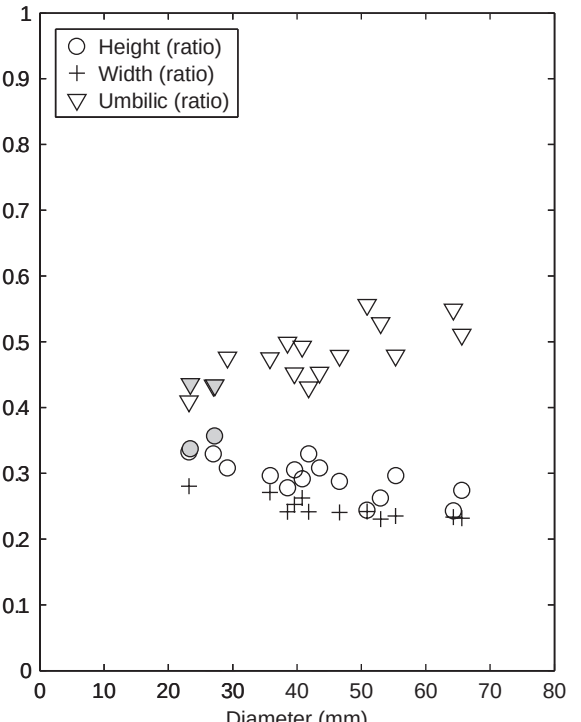
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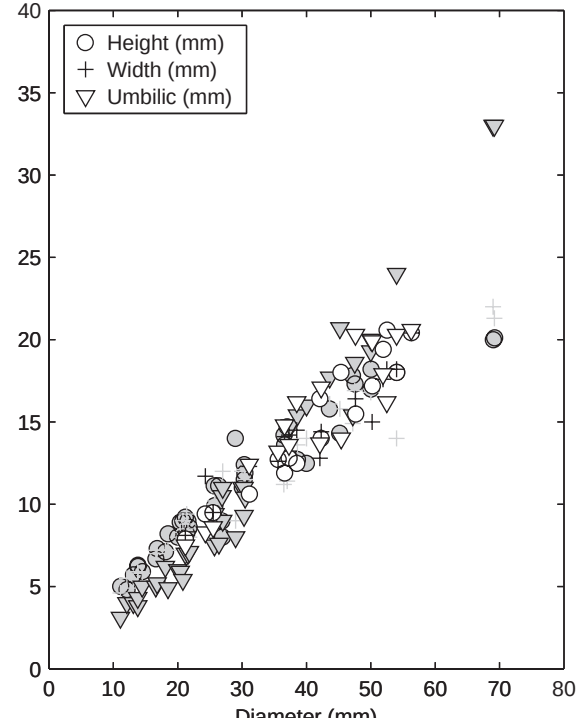
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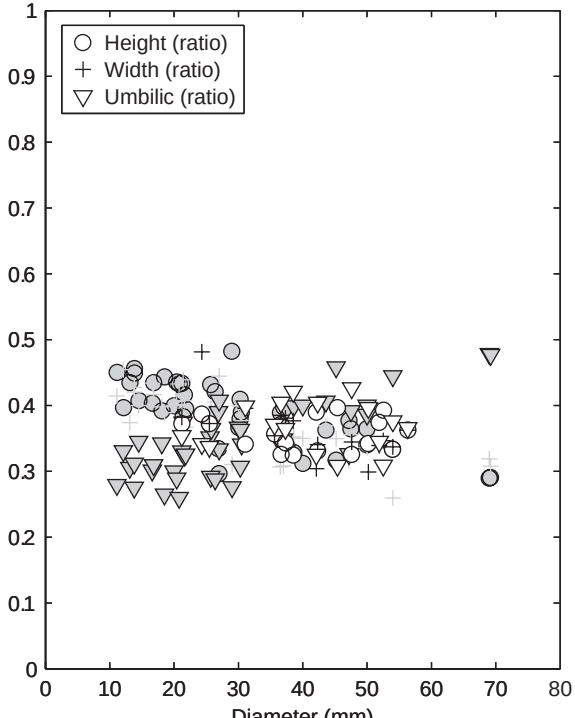
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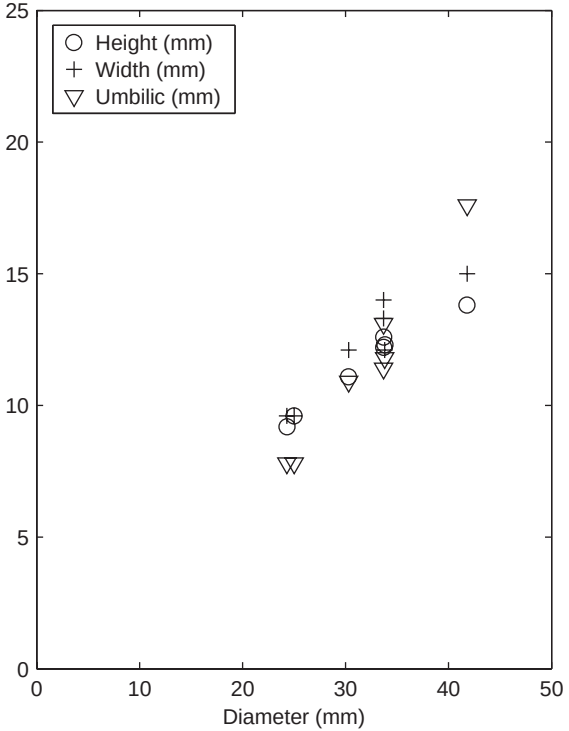
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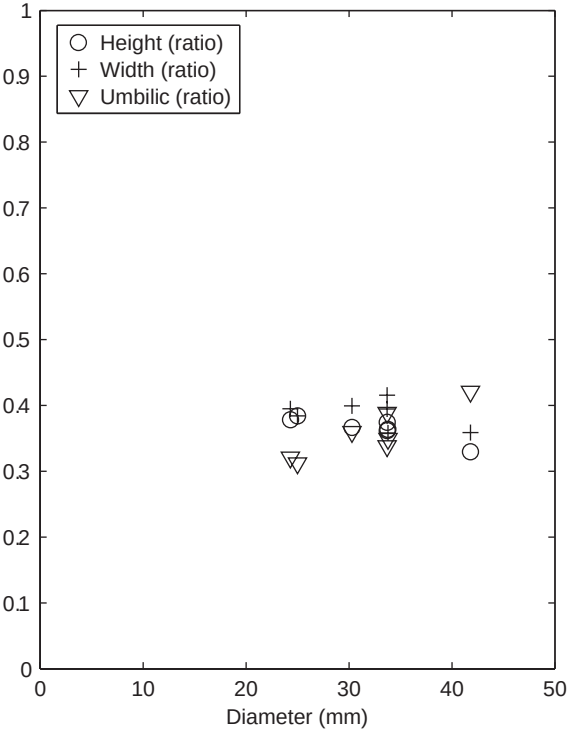
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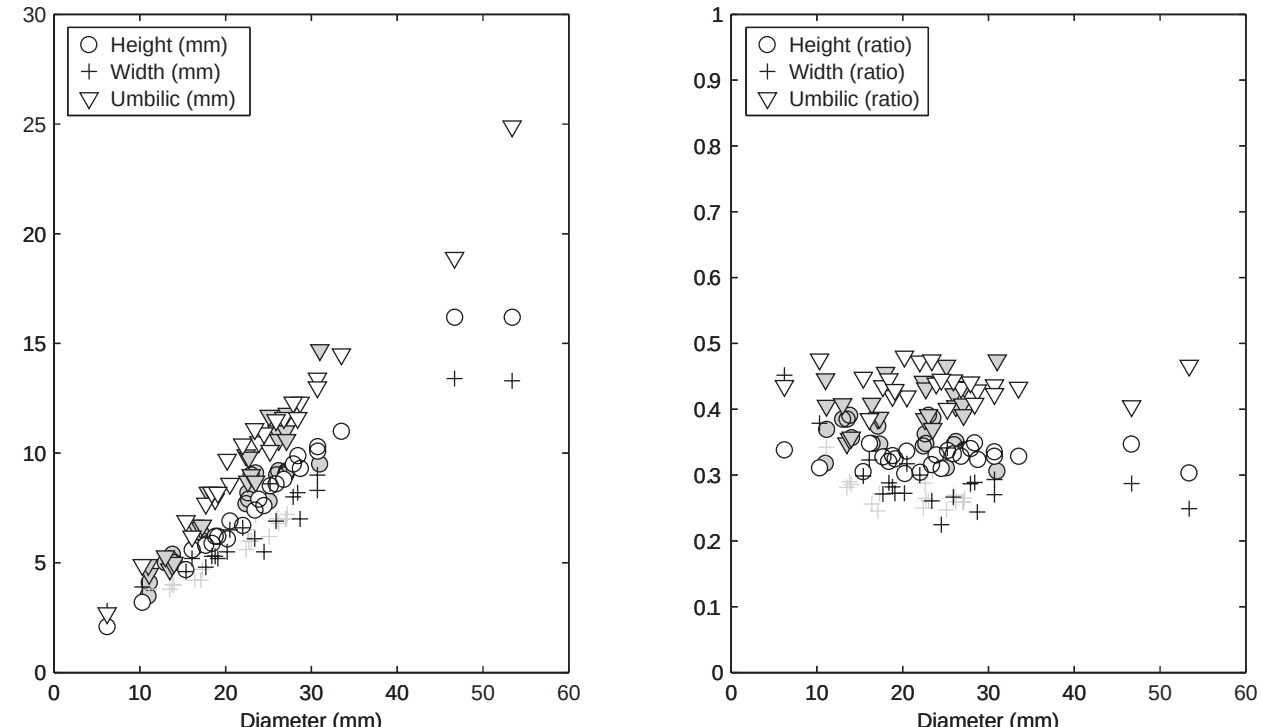
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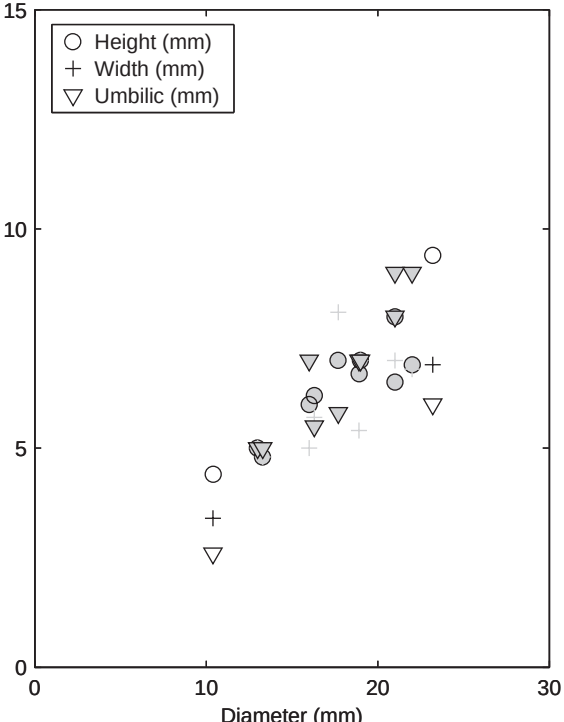
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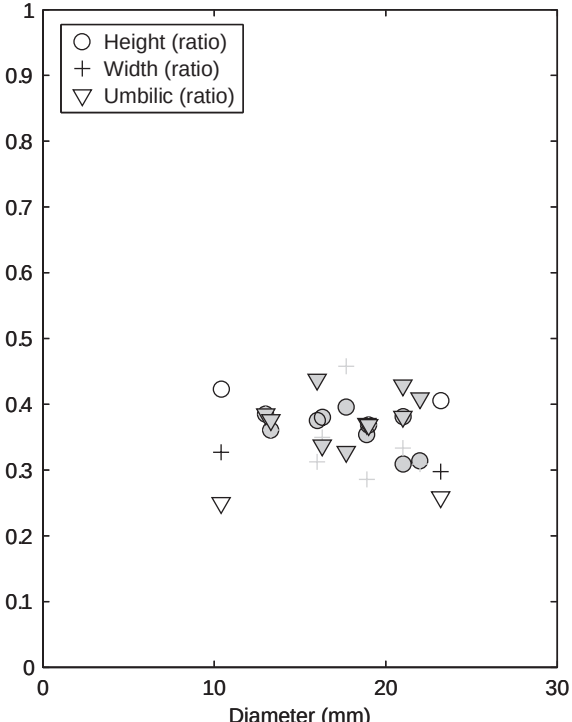
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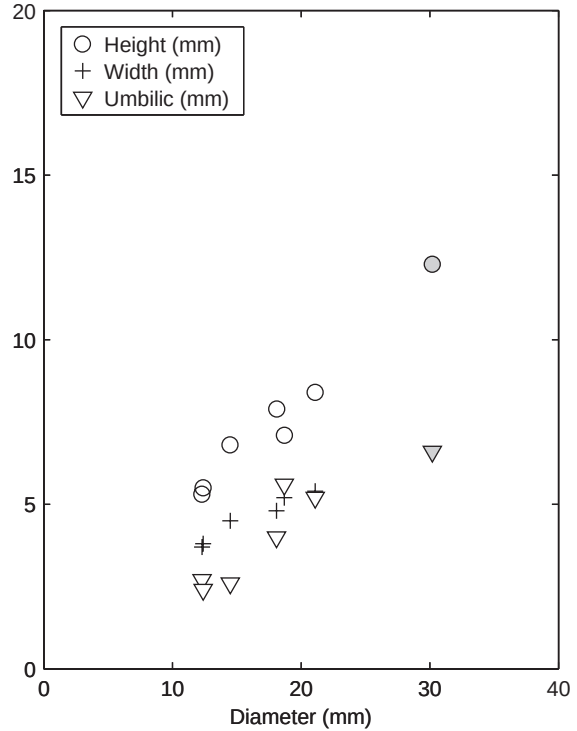
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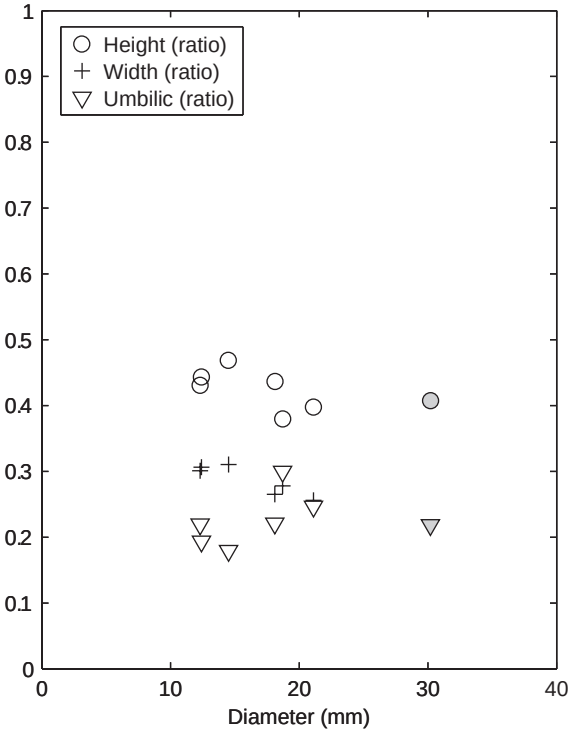
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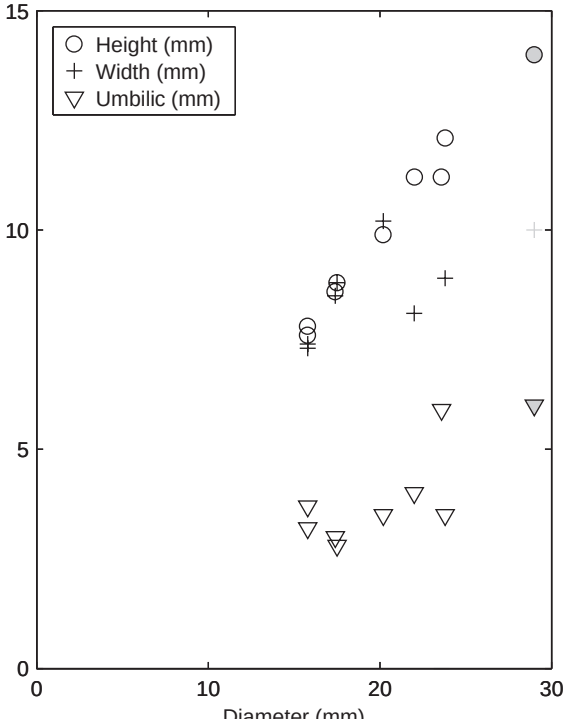
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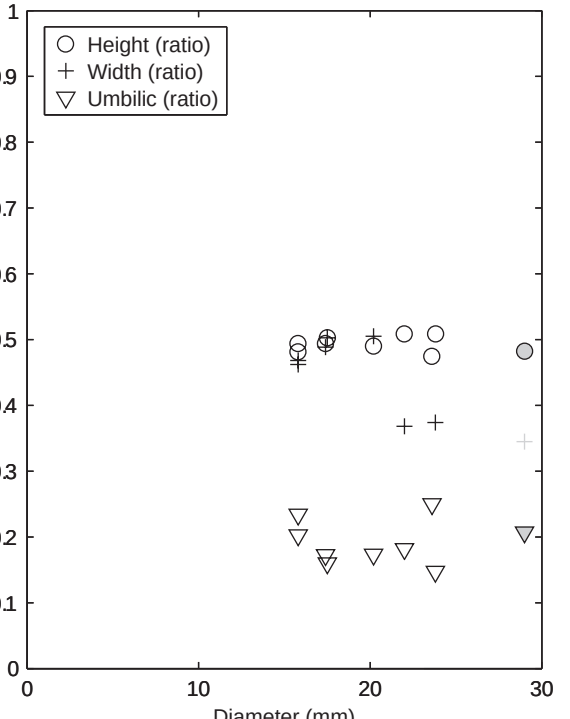
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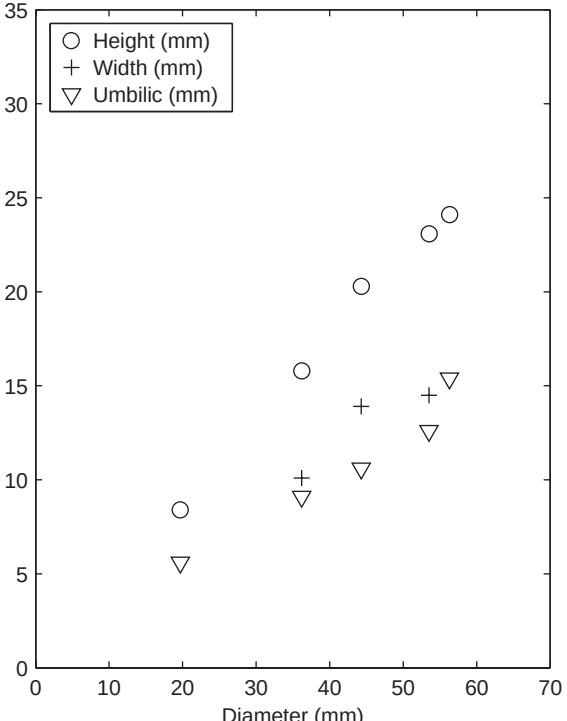
Diameter (mm)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Width (mm)
Umbilic (mm)
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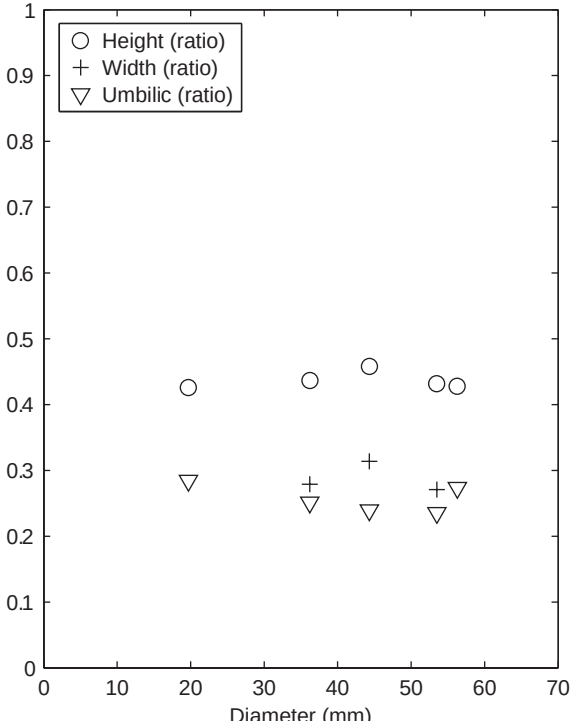
60
70
Diameter (mm)


Height (ratio)
Width (ratio)
Umbilic (ratio)
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0.8
0.7
0.6
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0
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20
30
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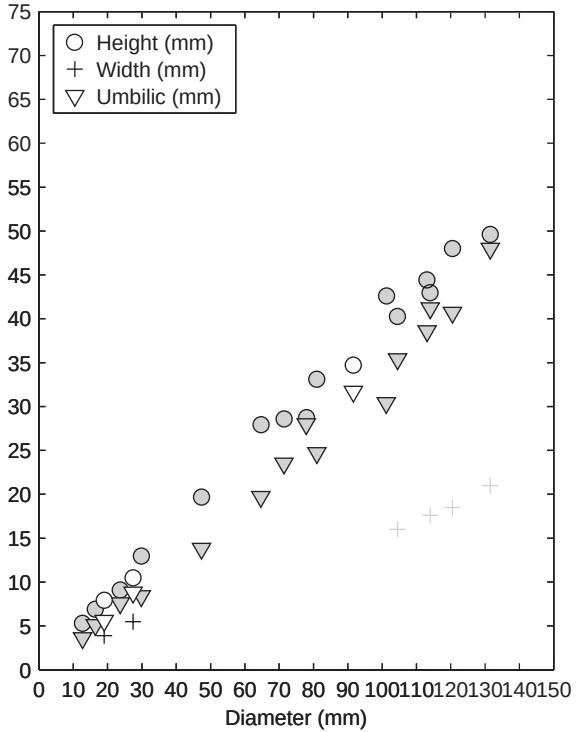
50
60
70
Diameter (mm)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Width (mm)
Umbilic (mm)
Diameter (mm)
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70
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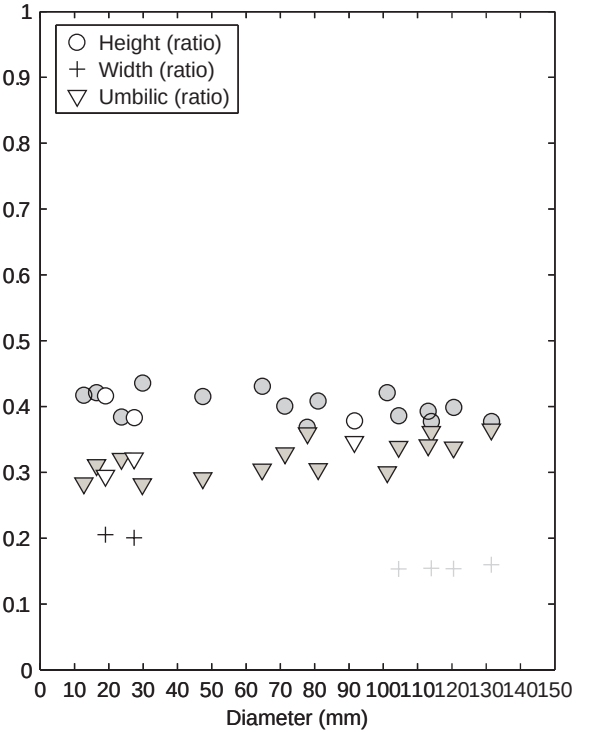
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Width (ratio)
Umbilic (ratio)
Diameter (mm)
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0.7
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0.9
1
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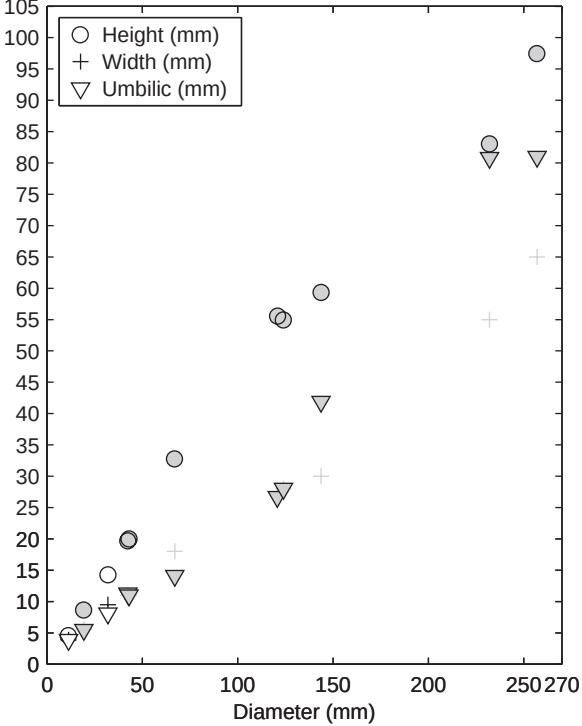
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Width (mm)
Umbilic (mm)
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100
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200
250
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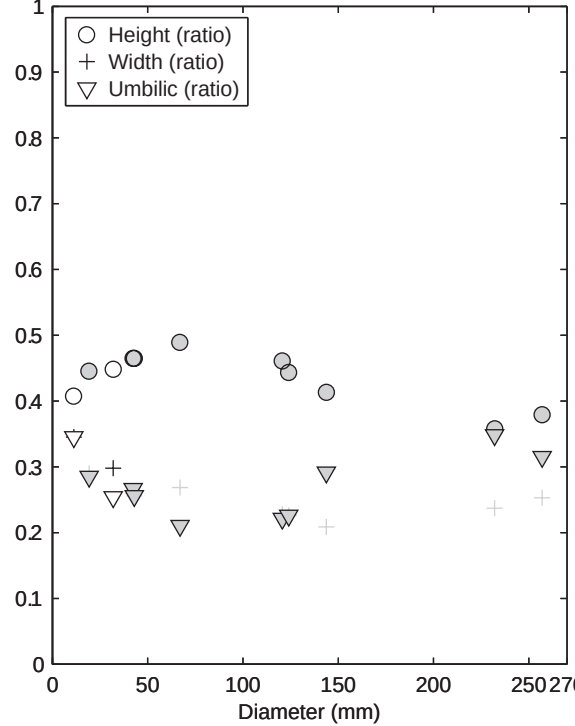
Diameter (mm)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Width (ratio)
Umbilic (ratio)
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0.1
0
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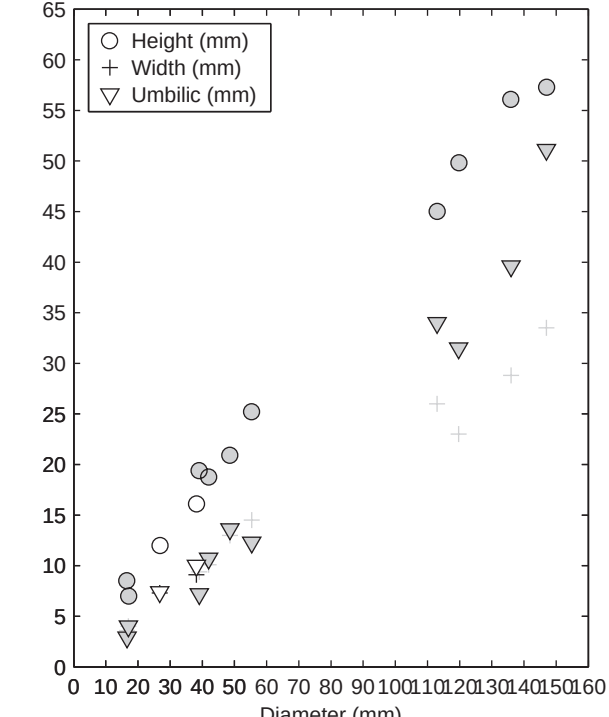
50
100
150
200
250
270
Diameter (mm)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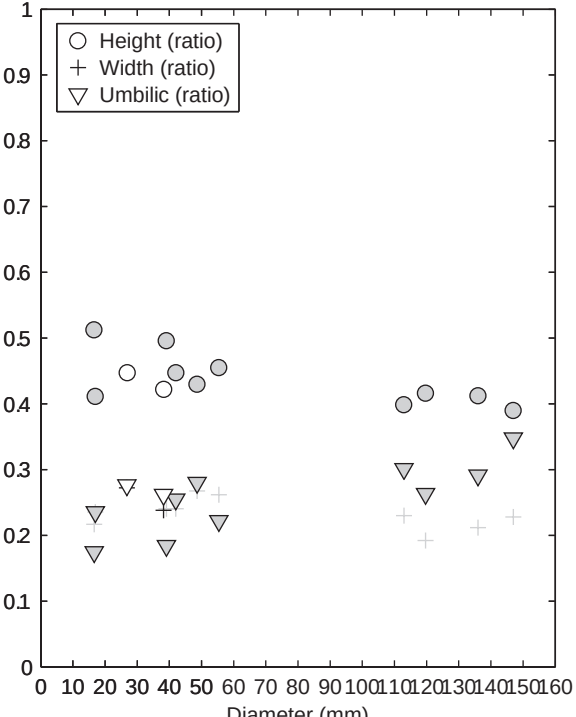
Umbilic (mm)
Diameter (mm)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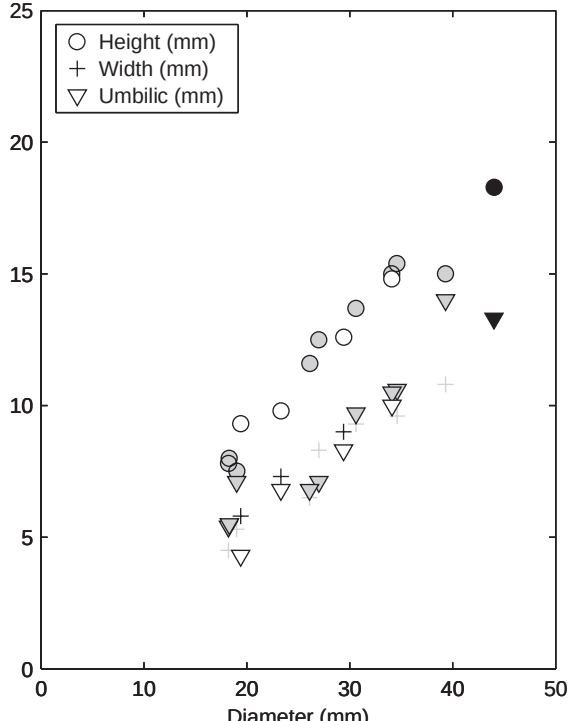
Diameter (mm)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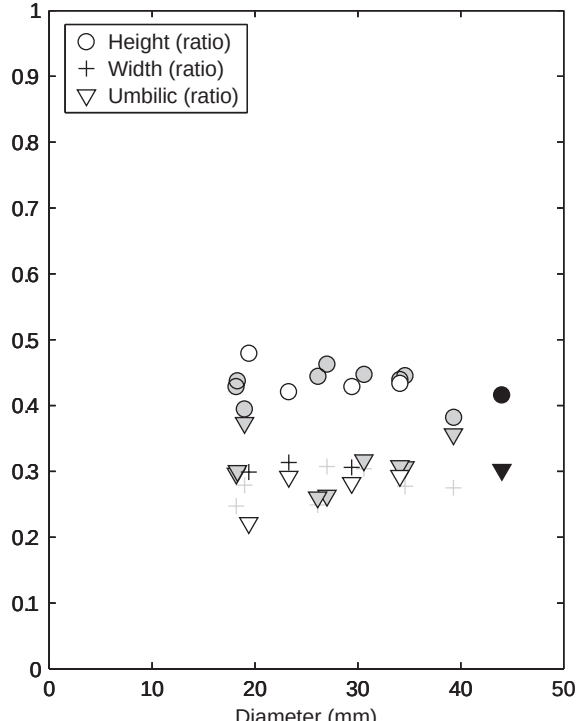
Diameter (mm)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Width (ratio)
Umbilic (ratio)
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0.6
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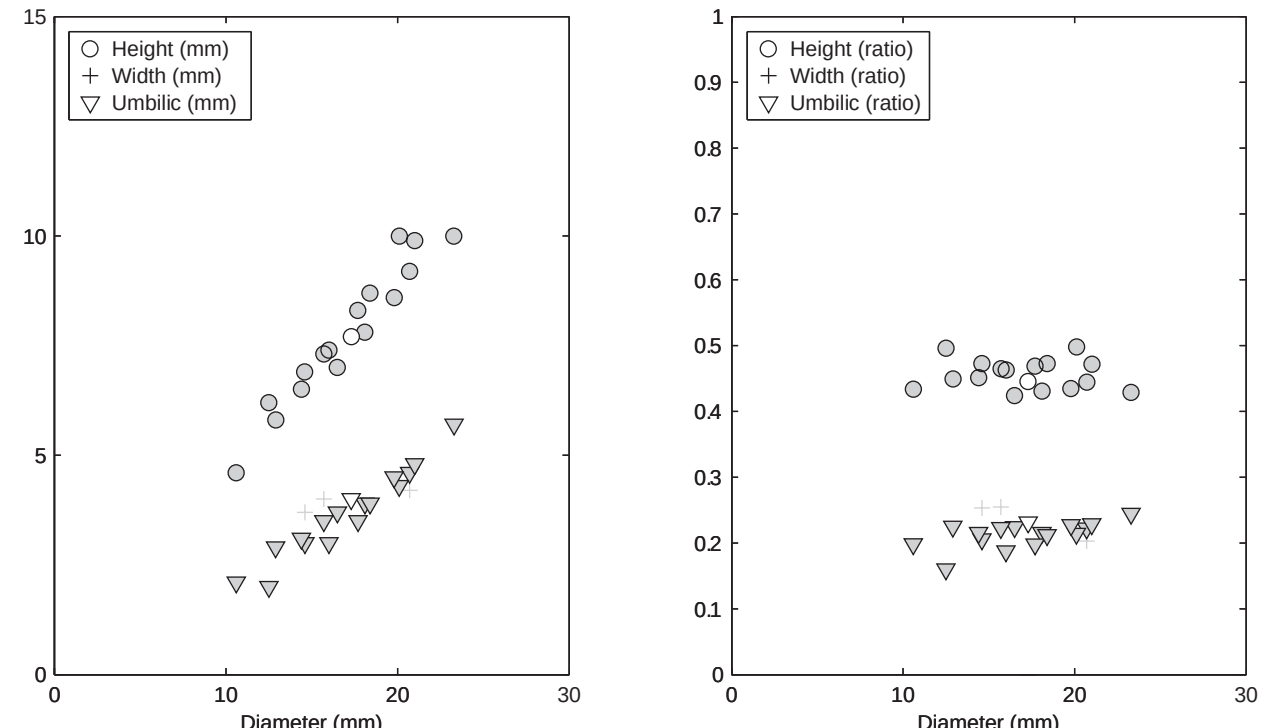
1
0
10
20
30
40
50
Diameter (mm)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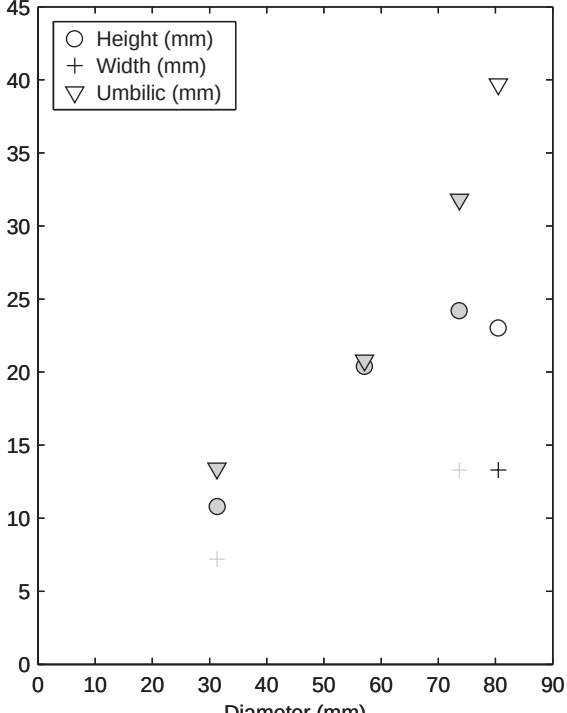
Width (mm)
Umbilic (mm)
Diameter (mm)
Height (ratio)
Width (ratio)
Umbilic (ratio)
Diameter (mm)


Height (mm)
Width (mm)
Umbilic (mm)
Diameter (mm)
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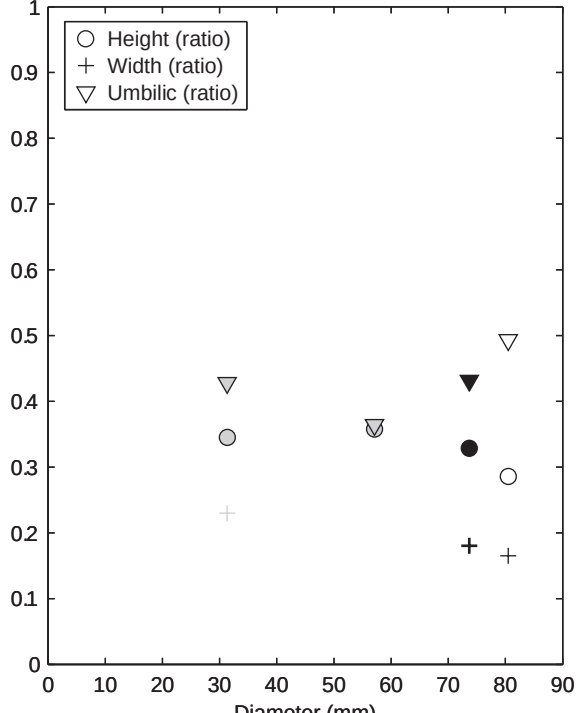
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Width (ratio)
Umbilic (ratio)
Diameter (mm)
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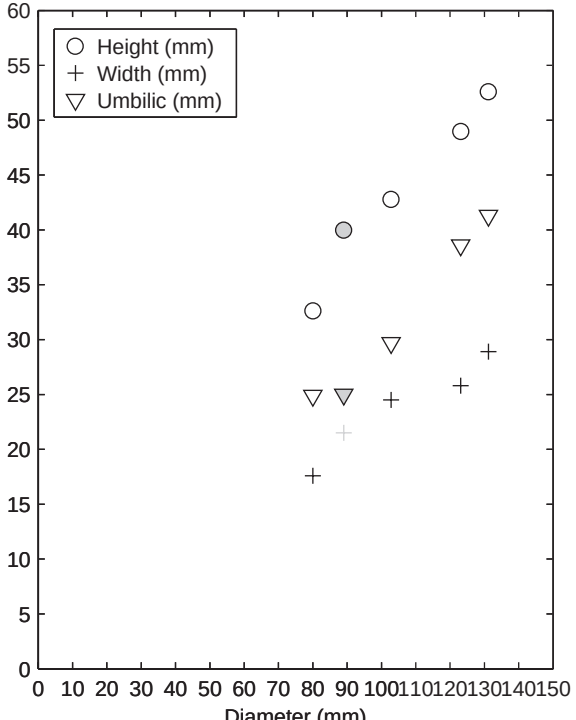
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Width (mm)
Umbilic (mm)
Diameter (mm)
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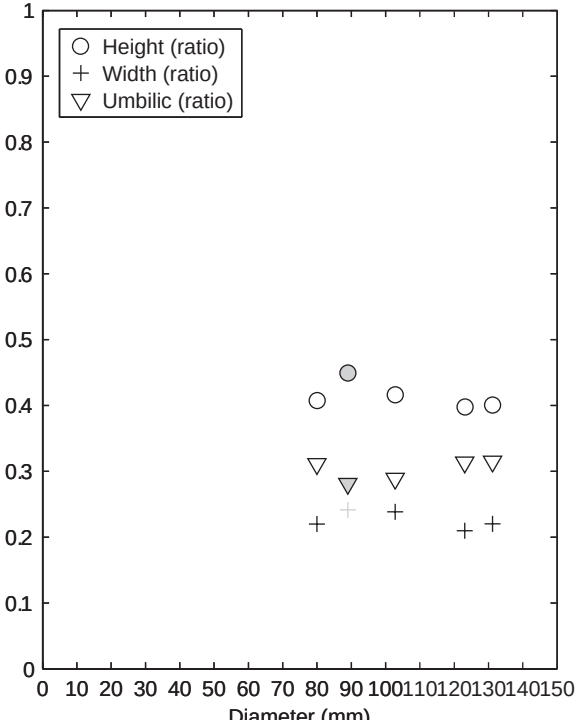
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0.9
1
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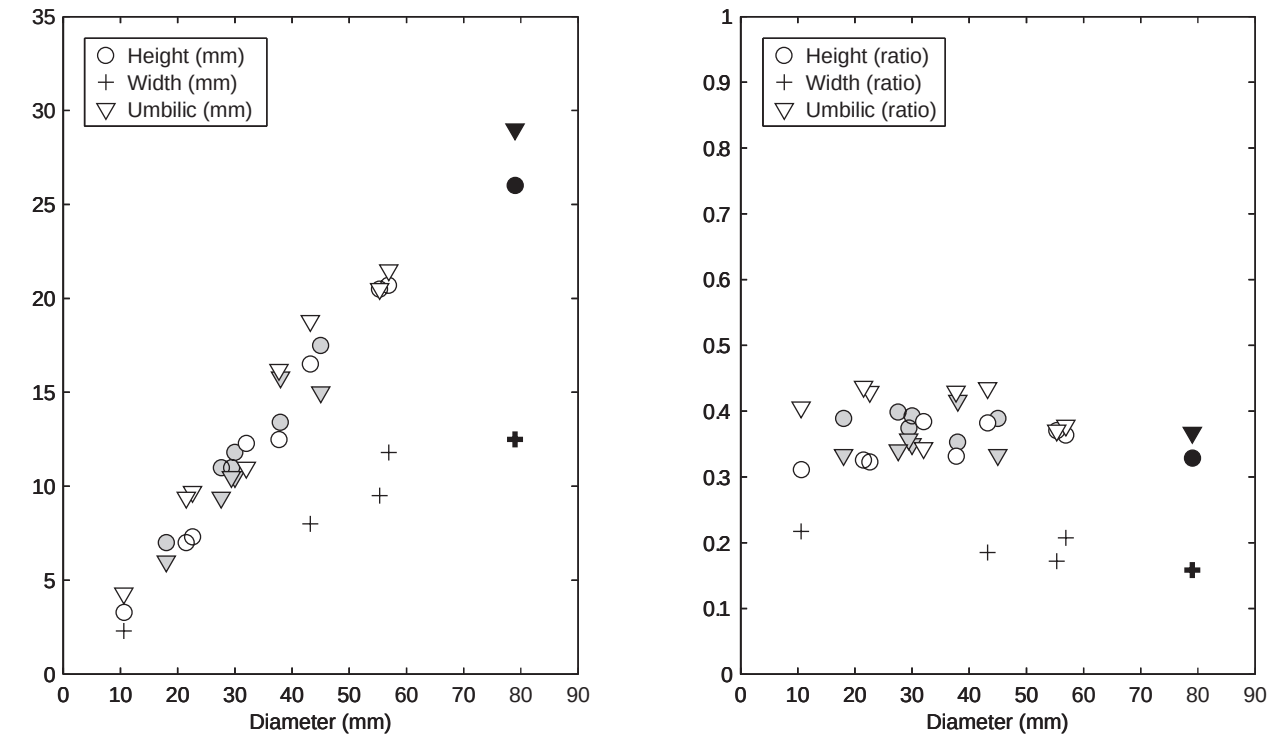
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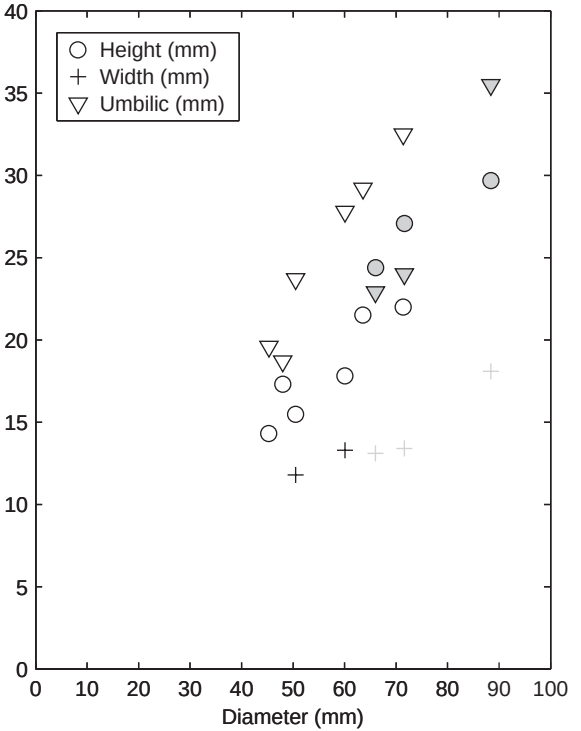
Diameter (mm)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Width (mm)
Umbilic (mm)
Diameter (mm)
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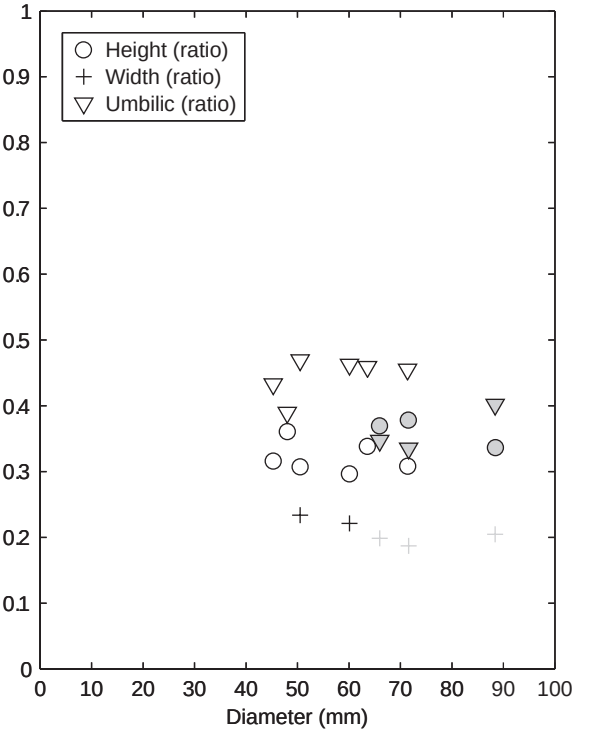
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Width (ratio)
Umbilic (ratio)
Diameter (mm)
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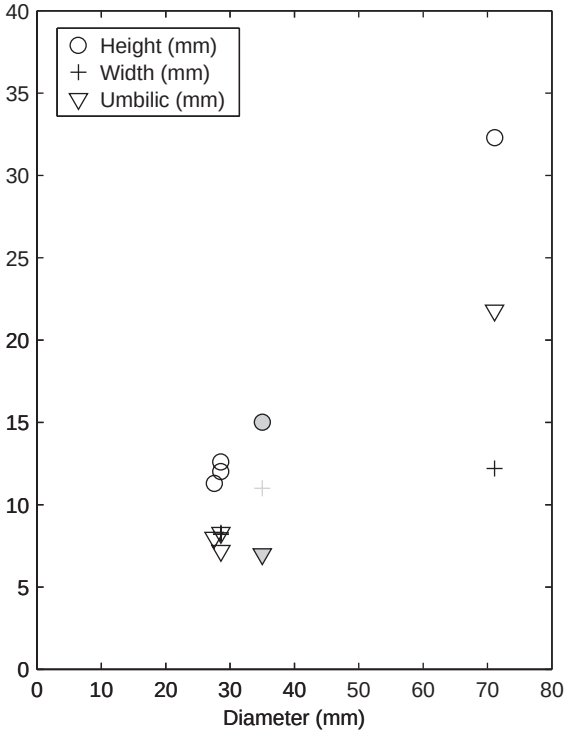
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Width (mm)
Umbilic (mm)
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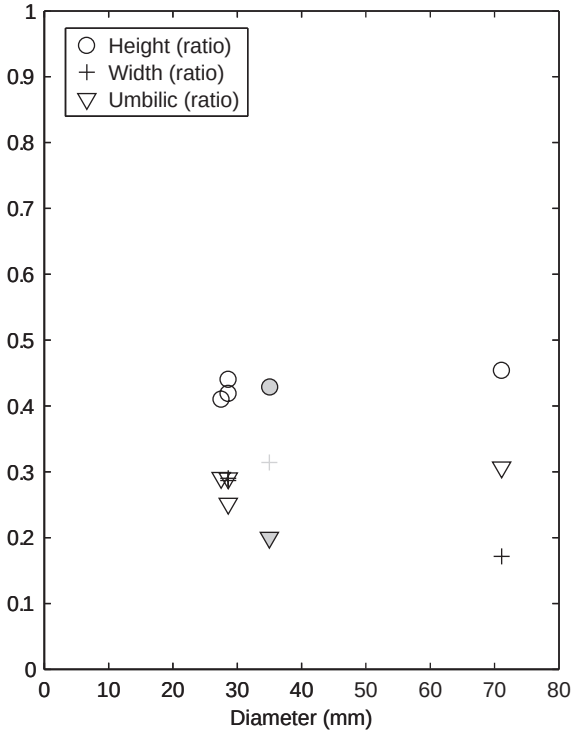
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Width (ratio)
Umbilic (ratio)
Diameter (mm)
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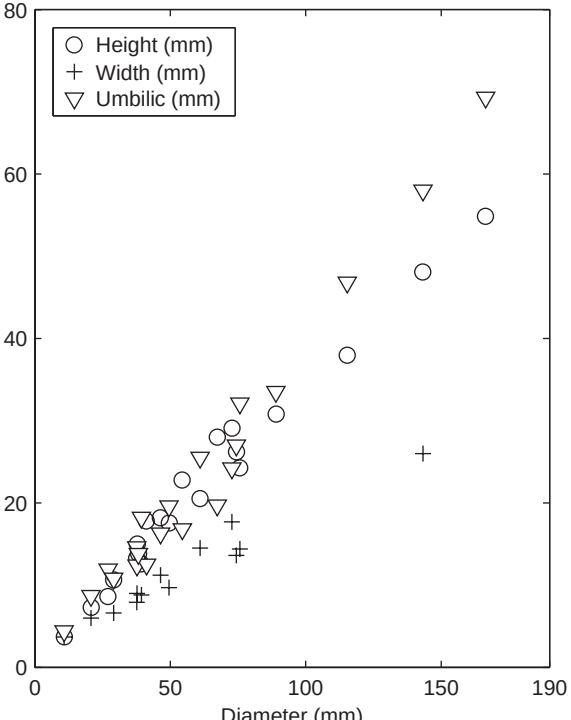
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Umbilic (mm)
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100
150
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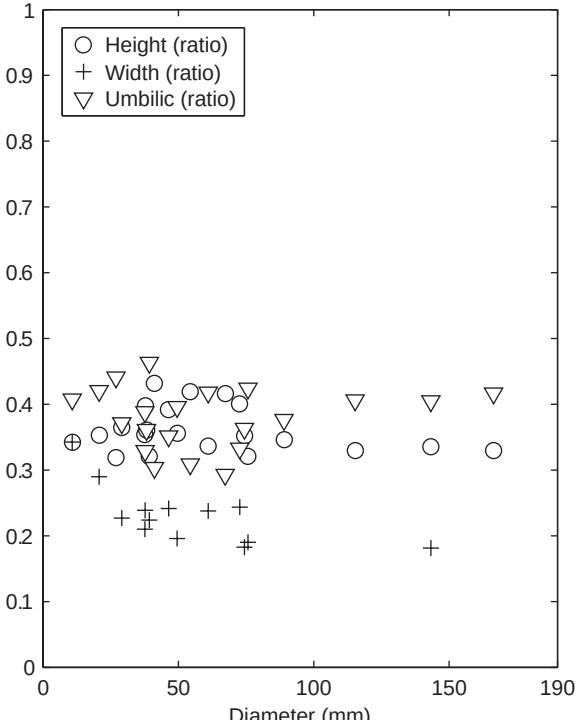
Diameter (mm)


Height (ratio)
Width (ratio)
Umbilic (ratio)
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0
0
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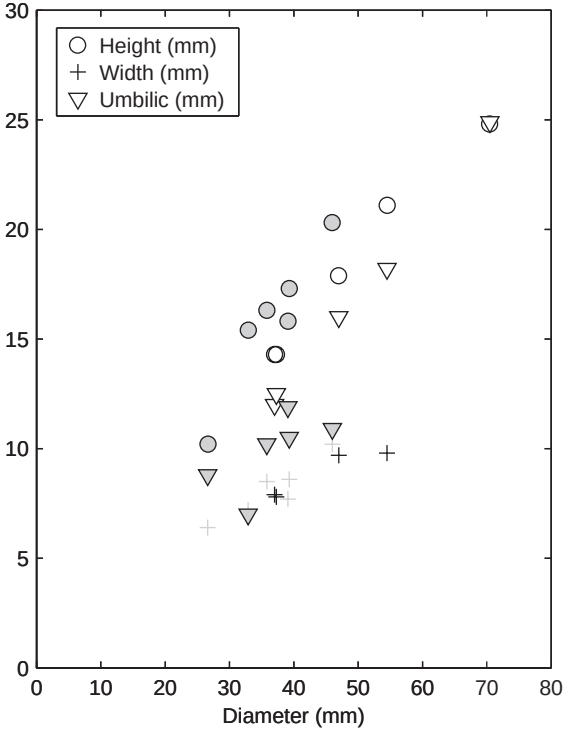
100
150
190
Diameter (mm)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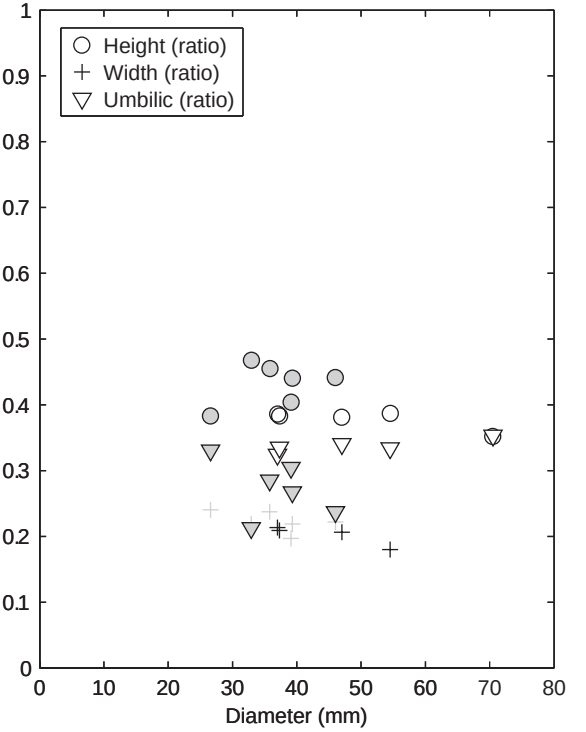
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Umbilic (ratio)
Diameter (mm)
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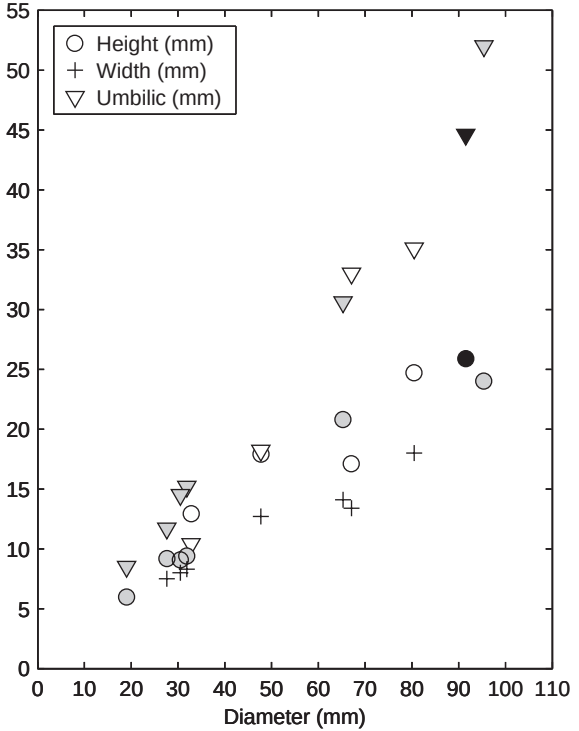
Height (mm)
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Diameter (mm)
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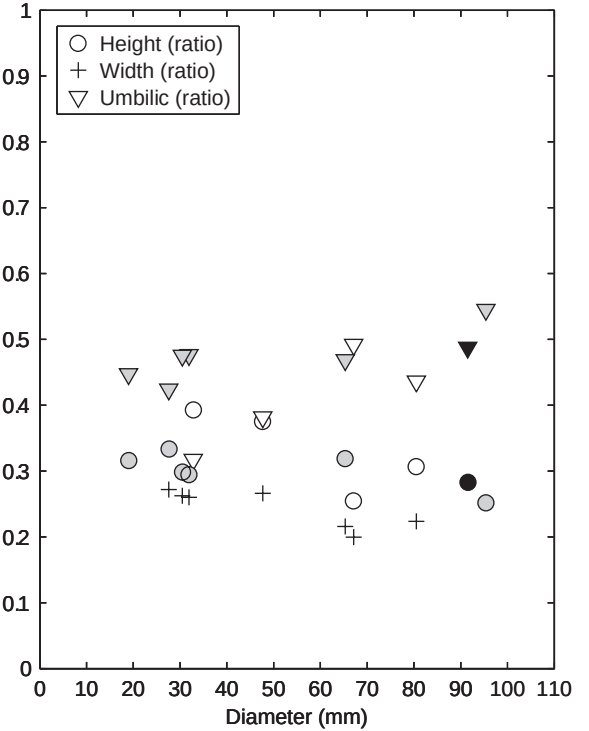
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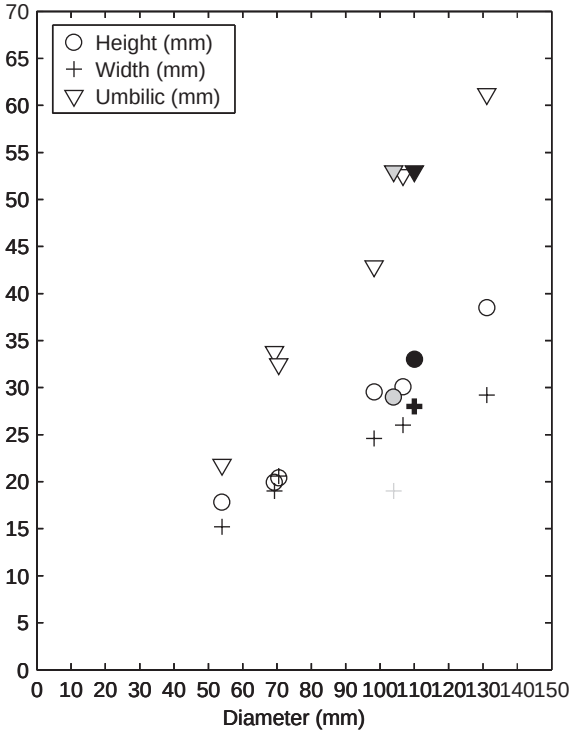
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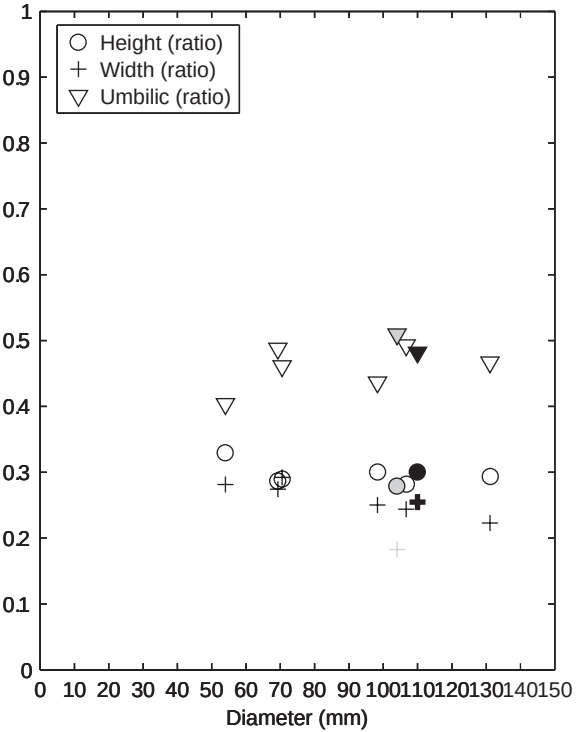
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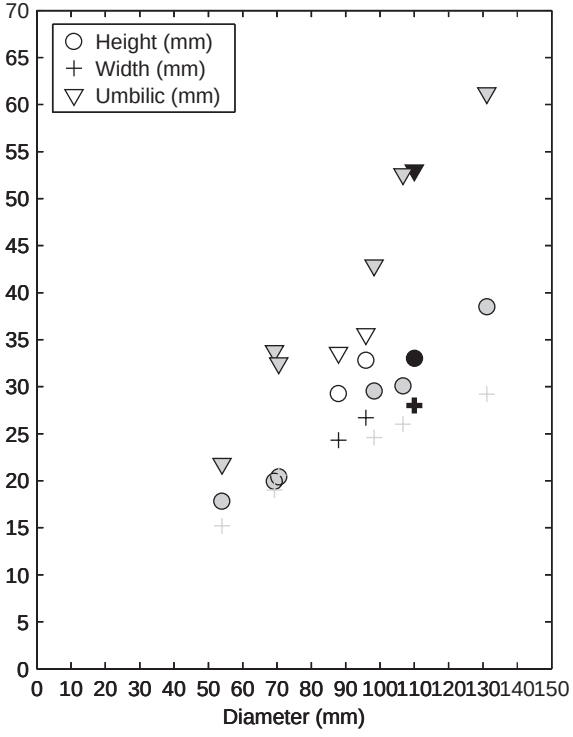
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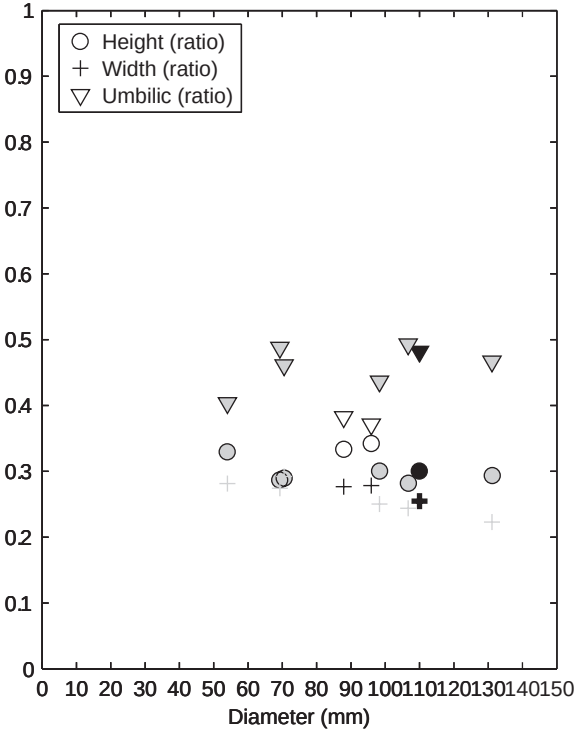
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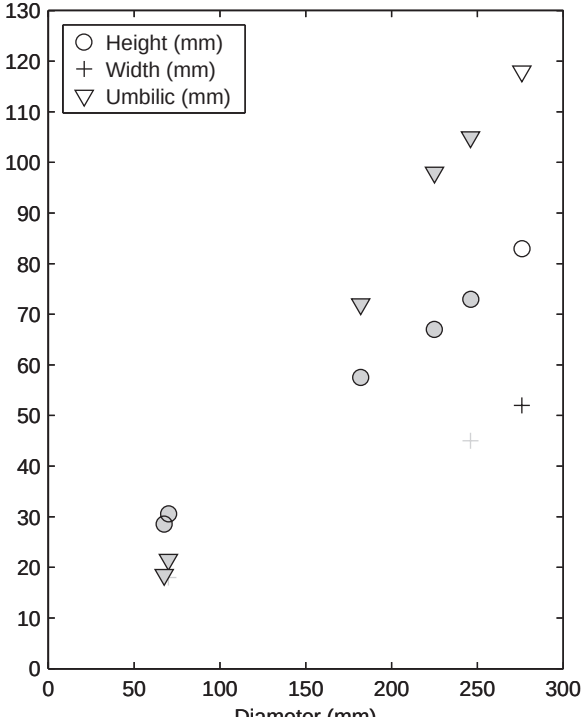
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Diameter (mm)
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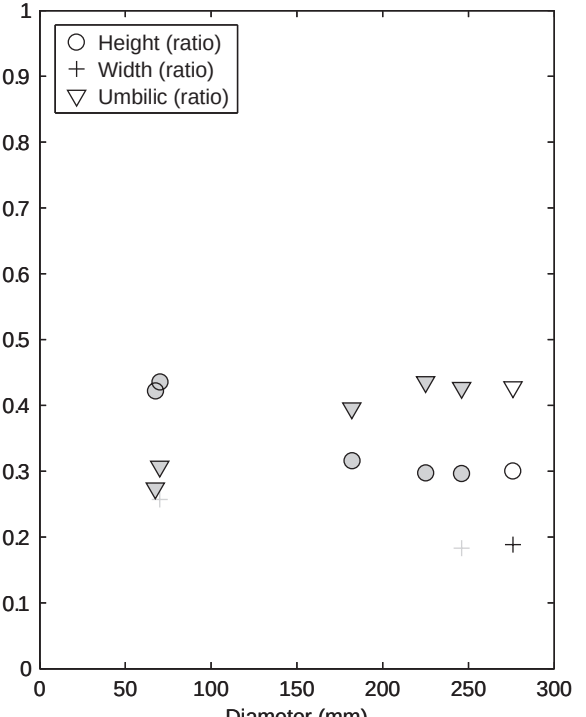
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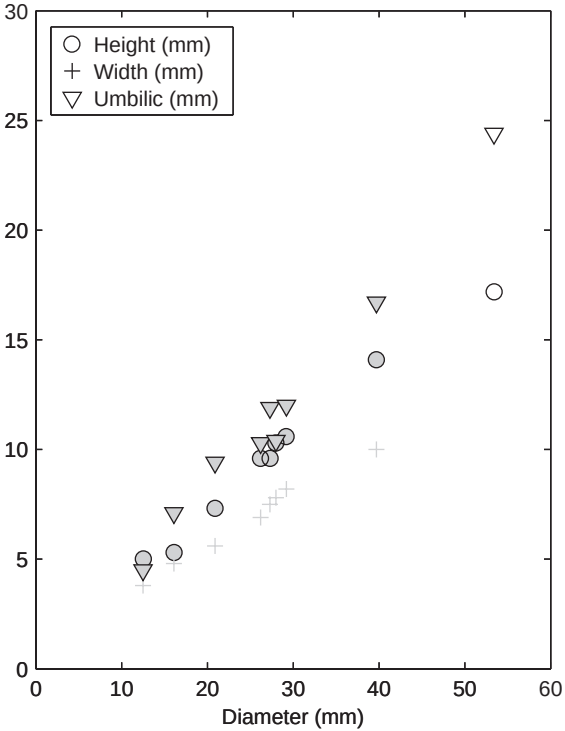
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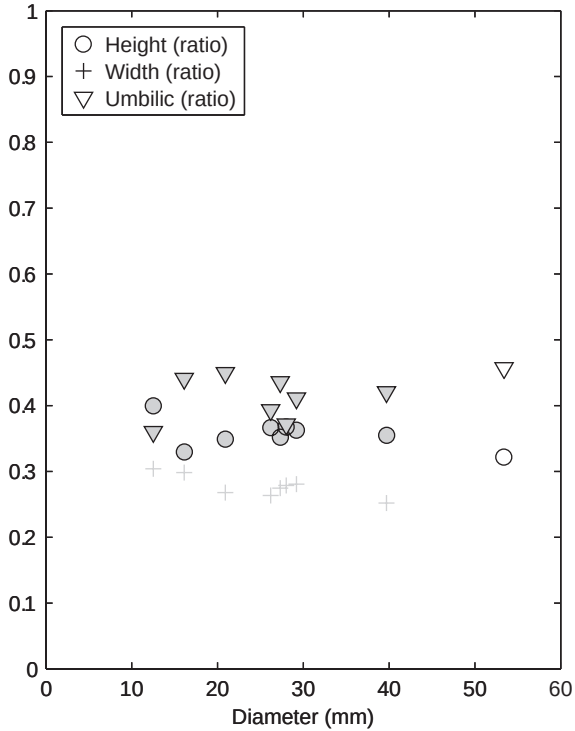
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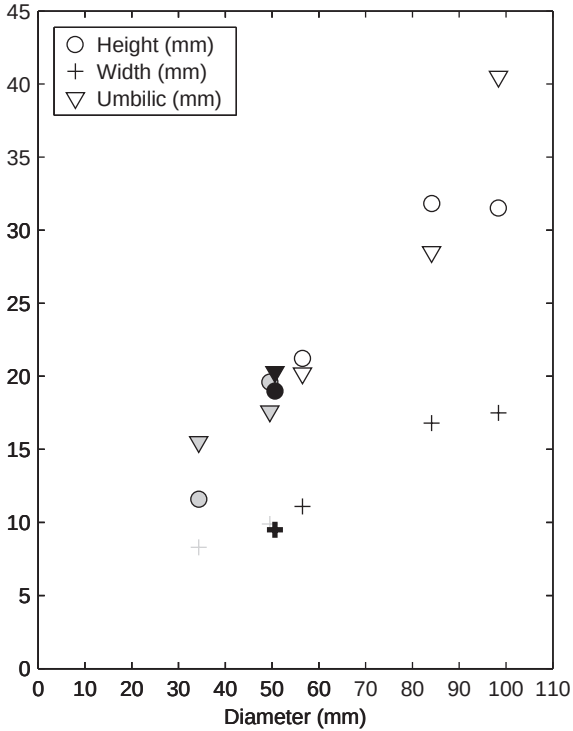
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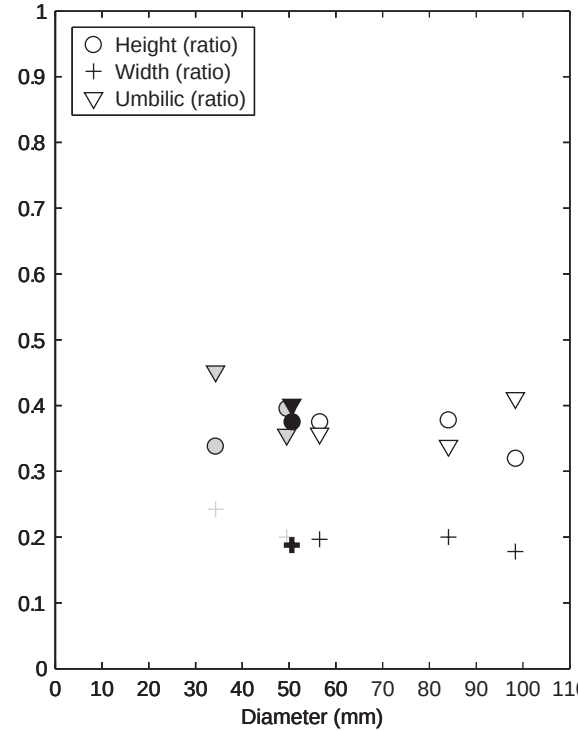
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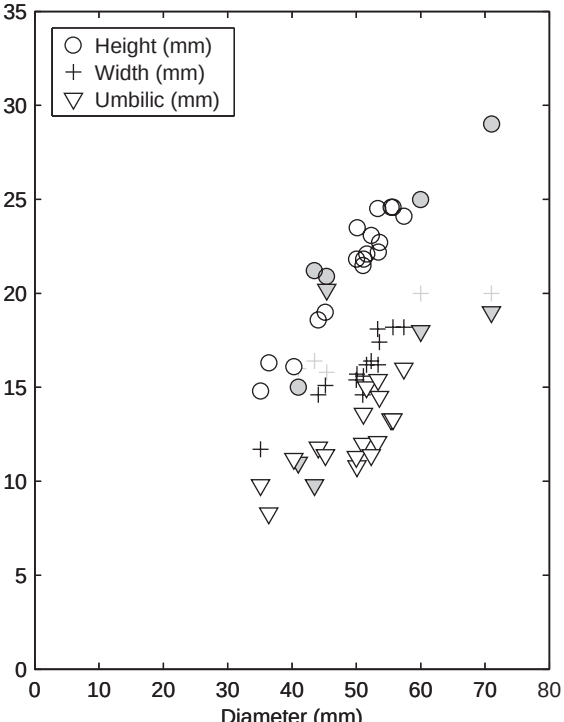
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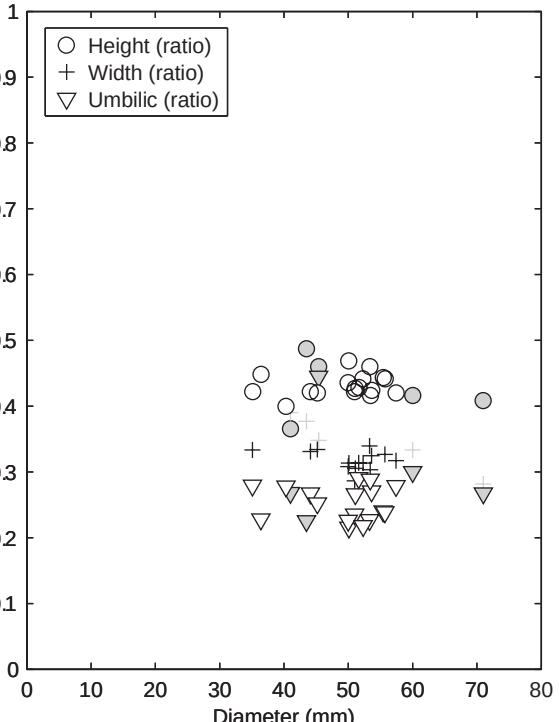
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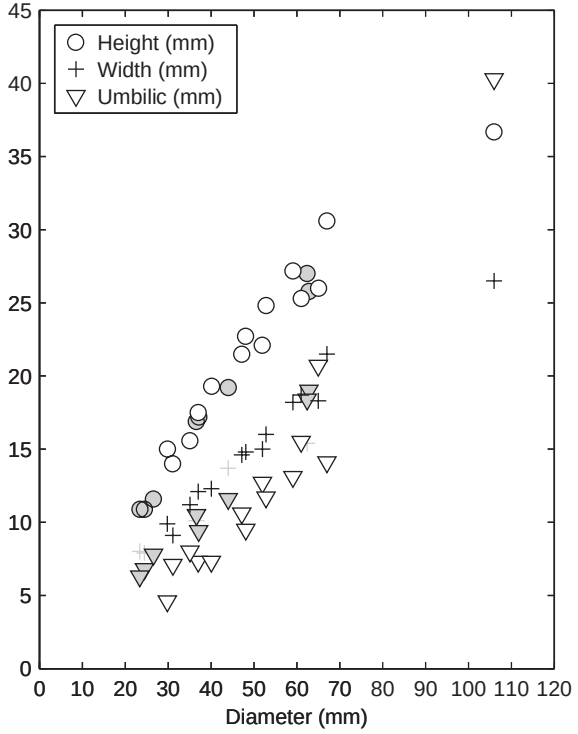
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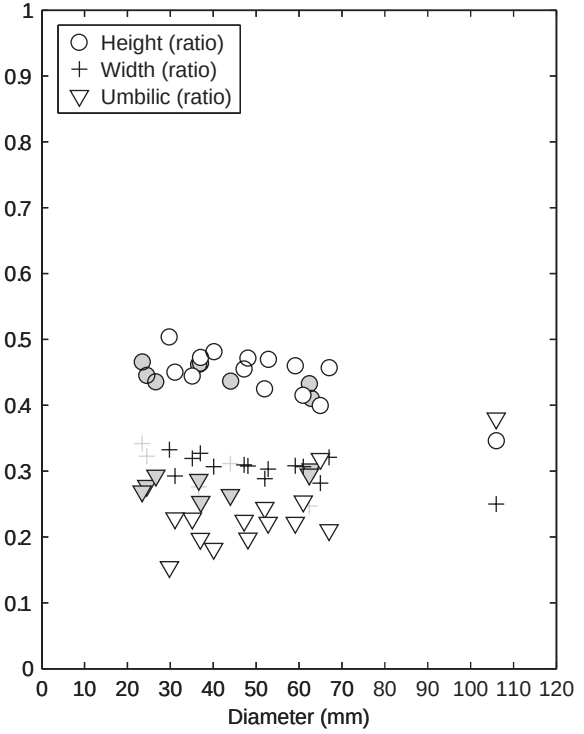
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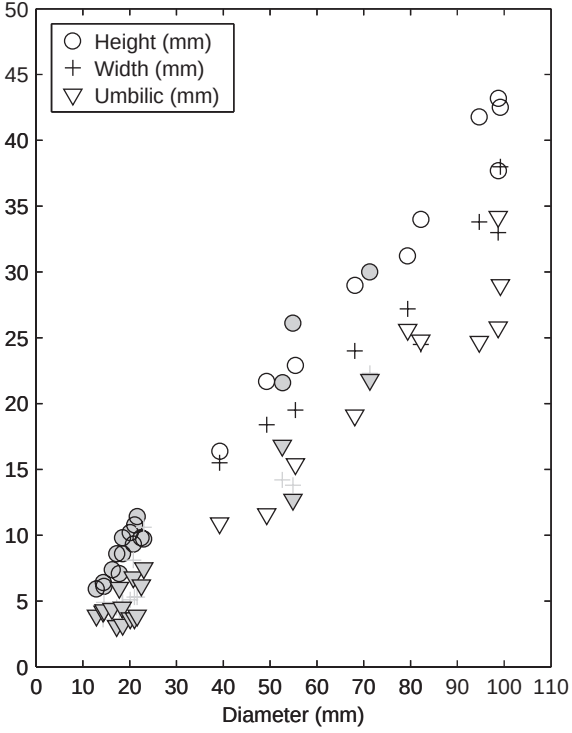
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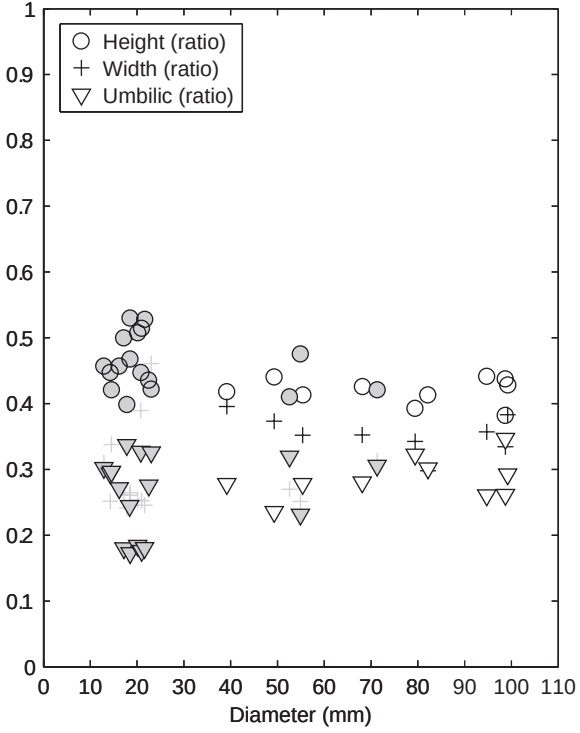
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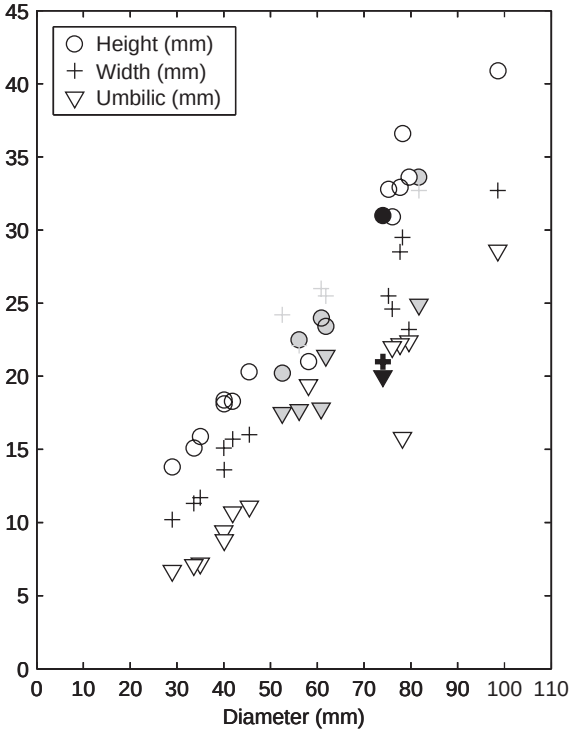
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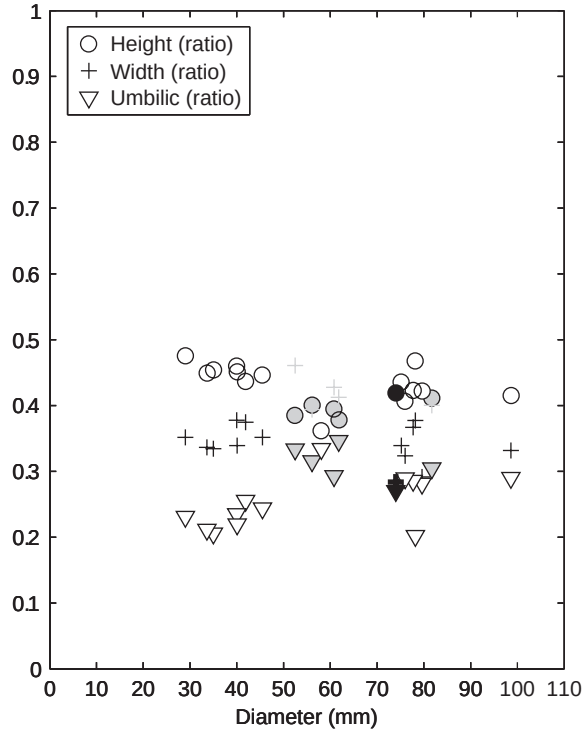
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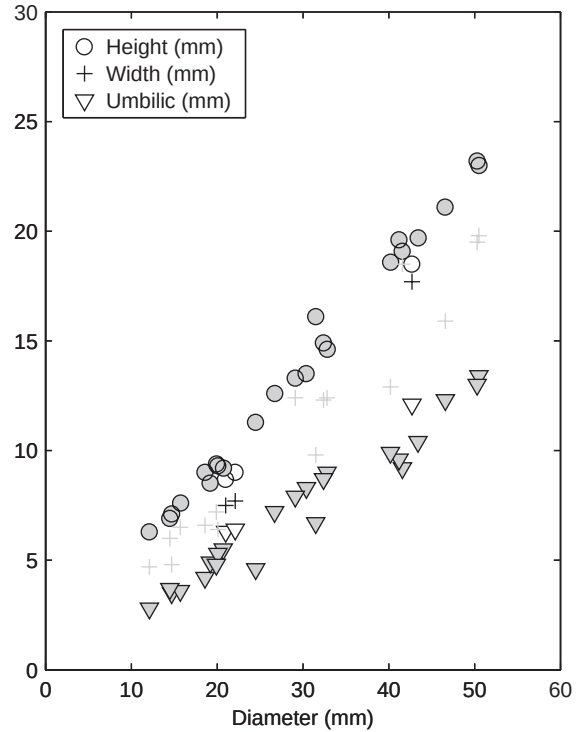
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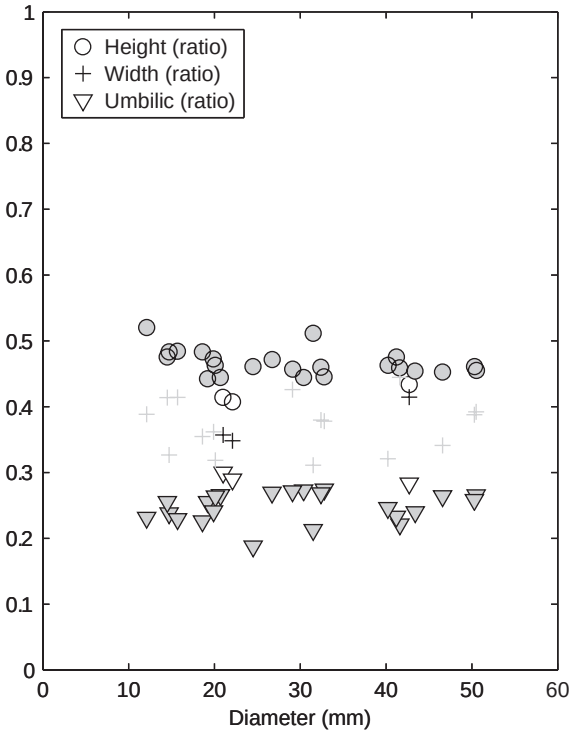
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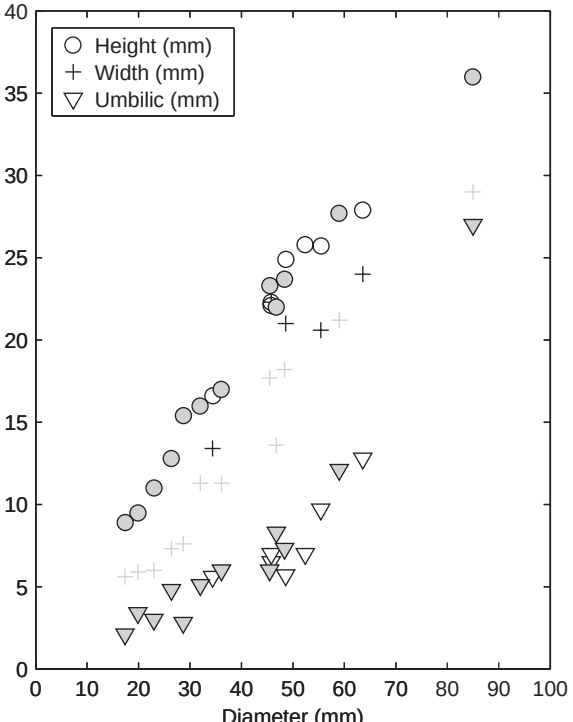
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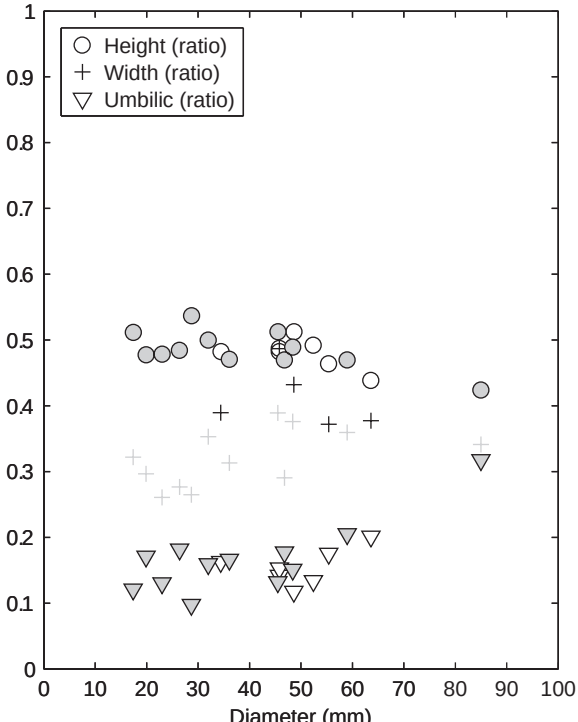
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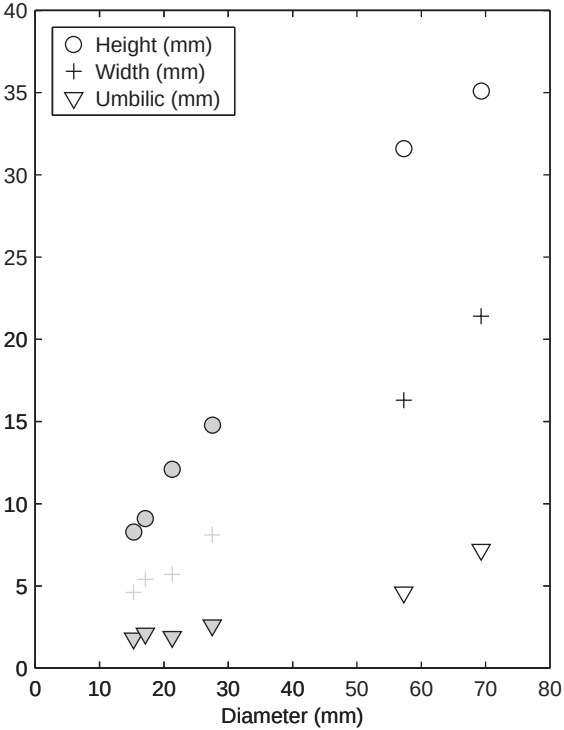
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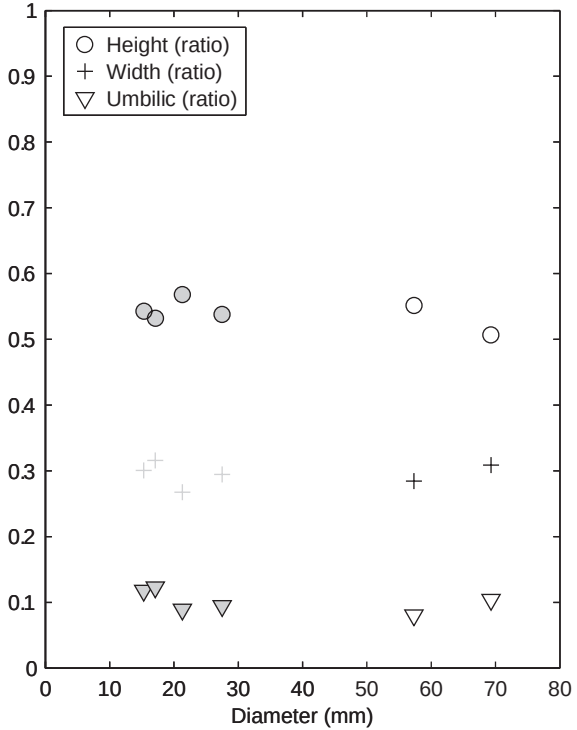
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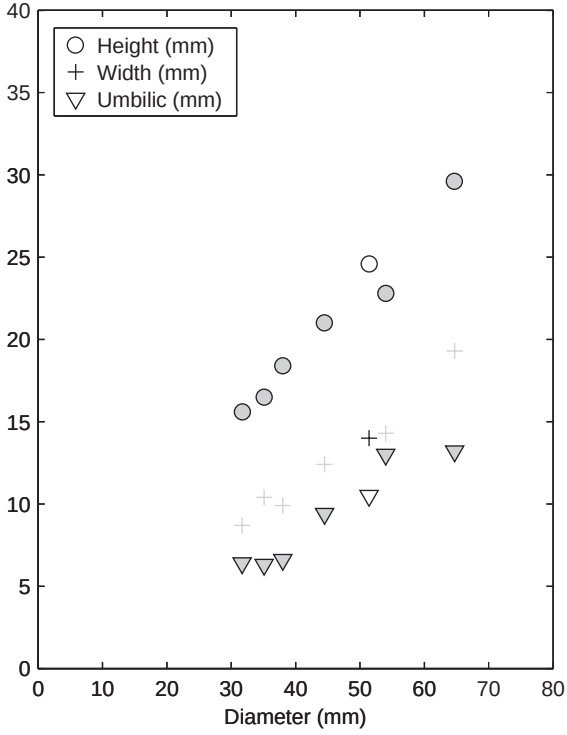
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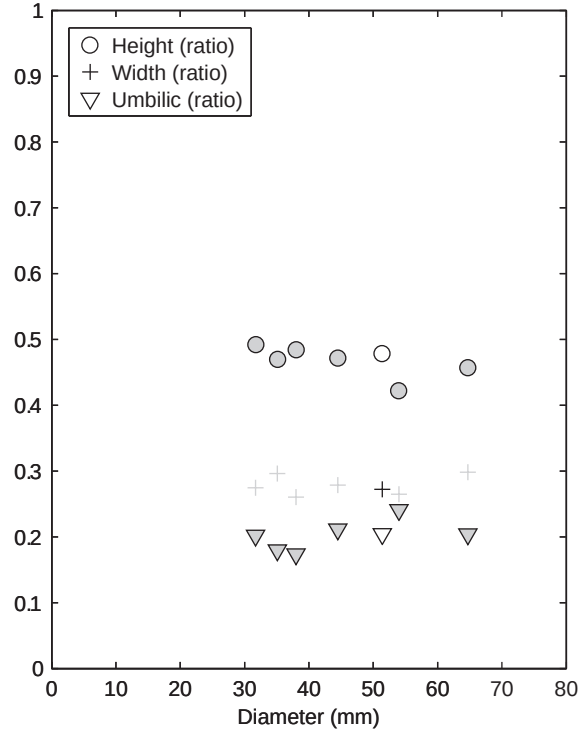
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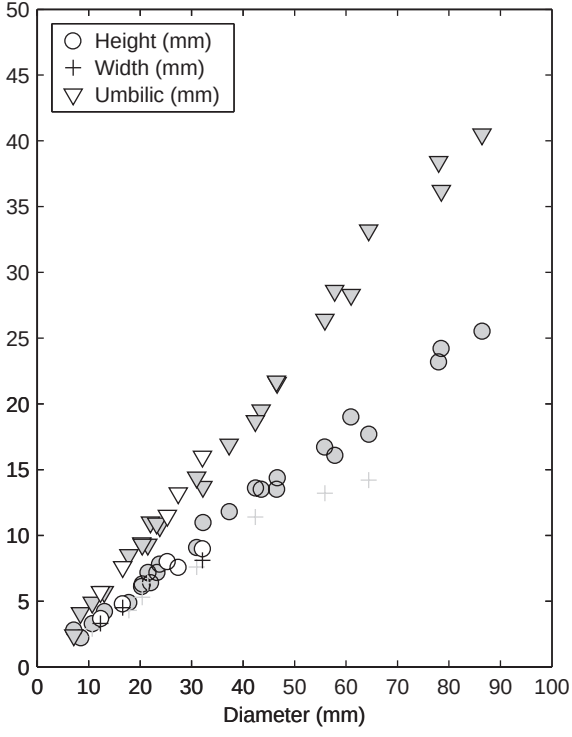
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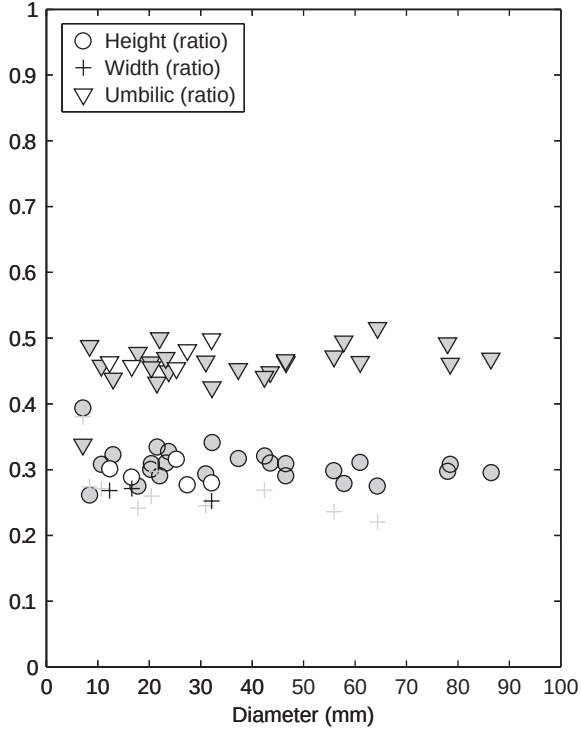
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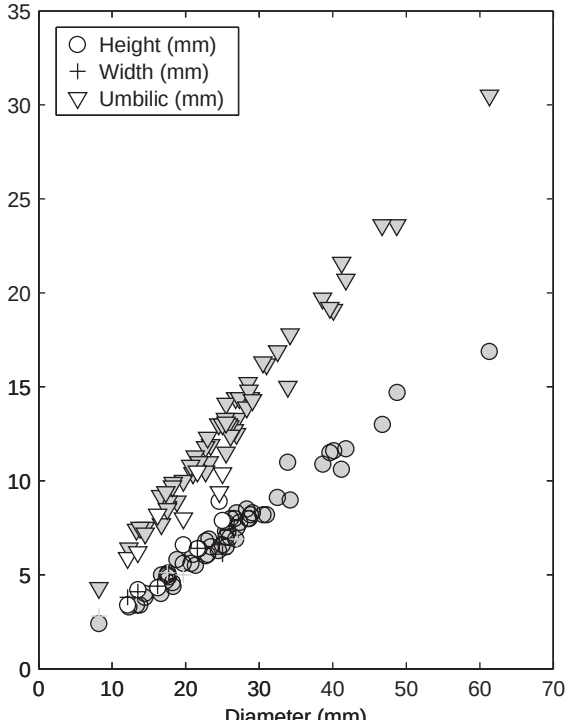
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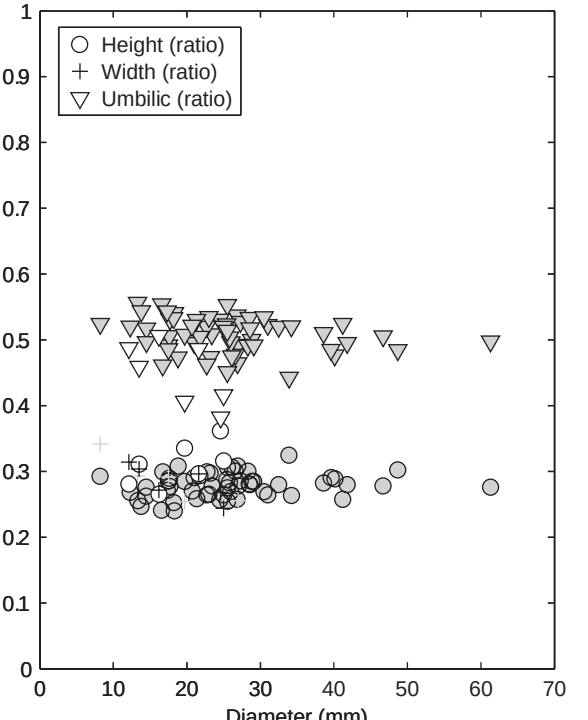
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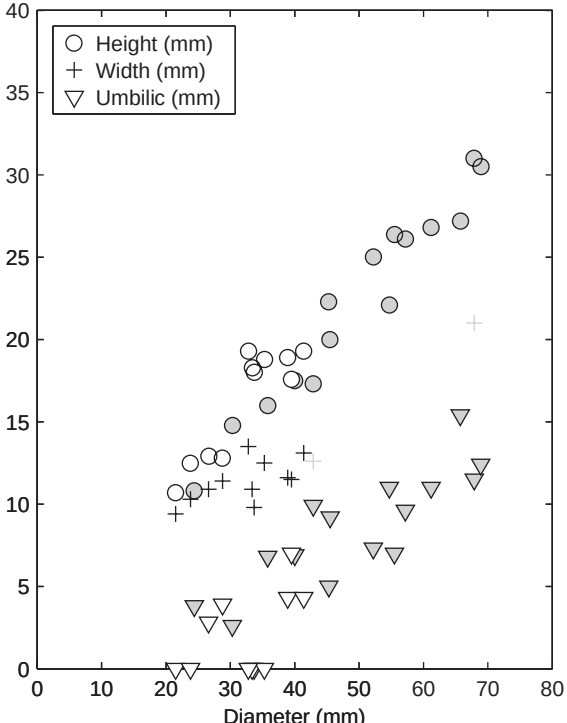
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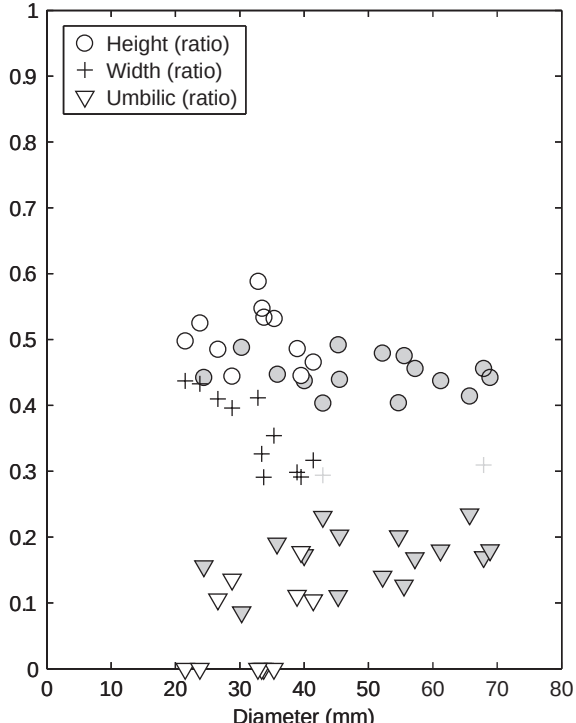
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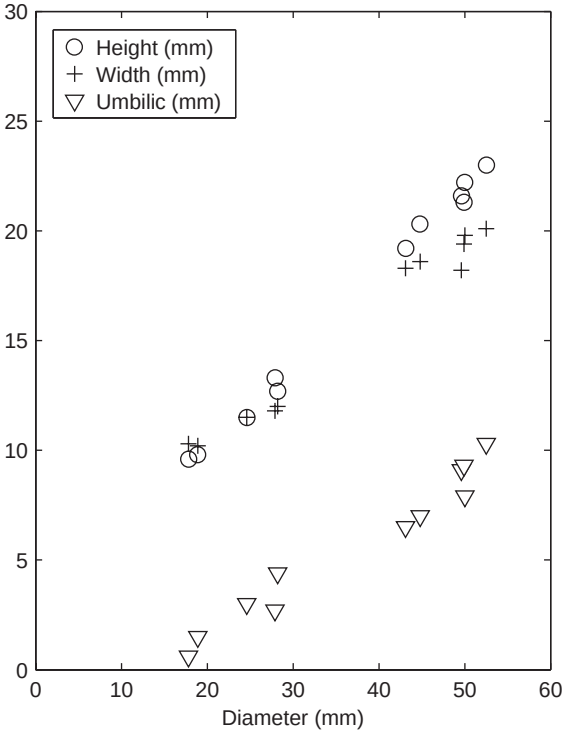
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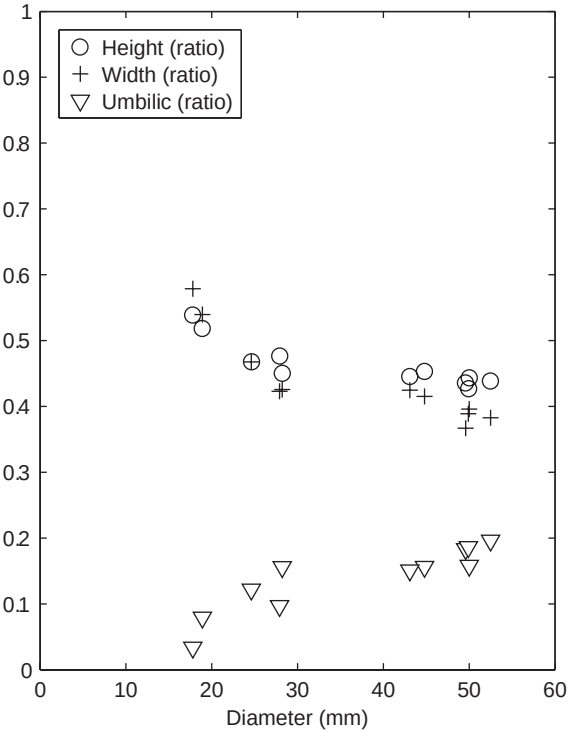
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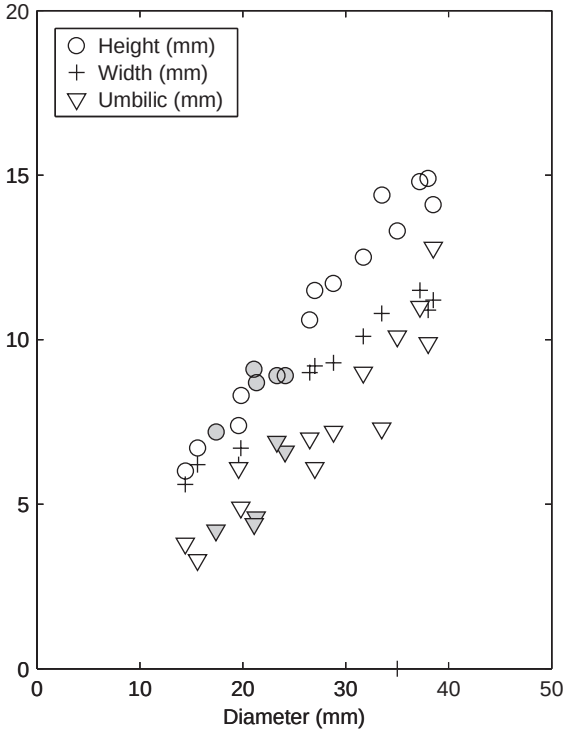
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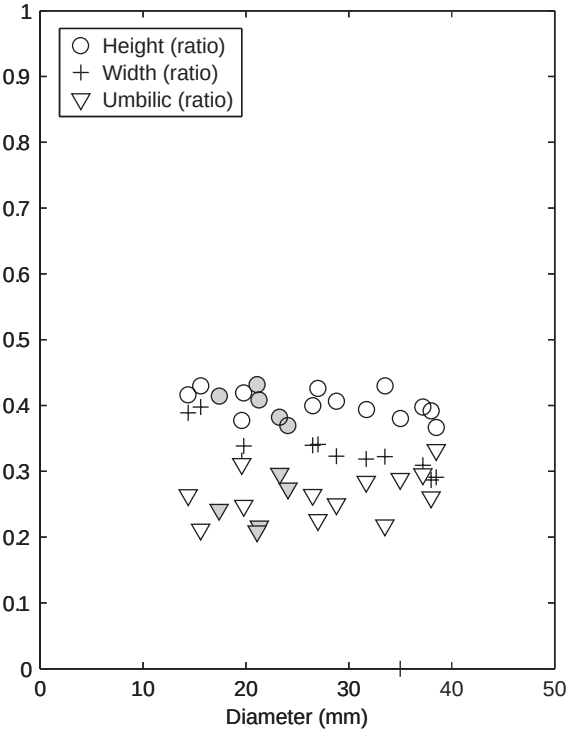
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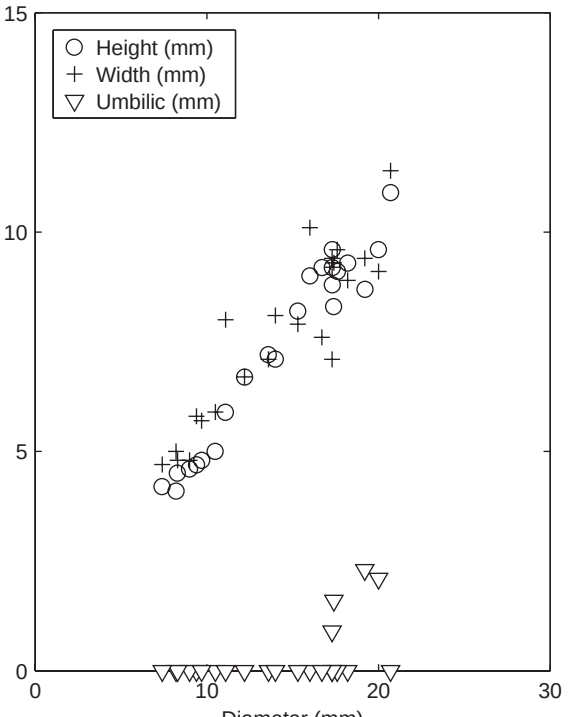
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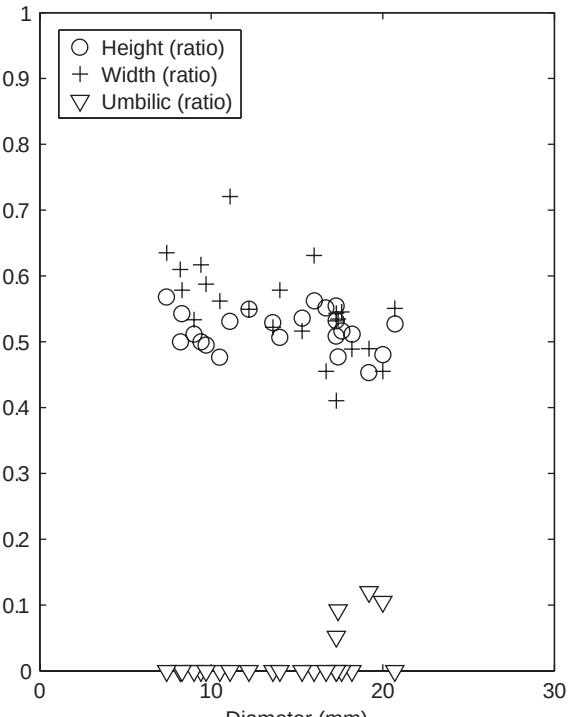
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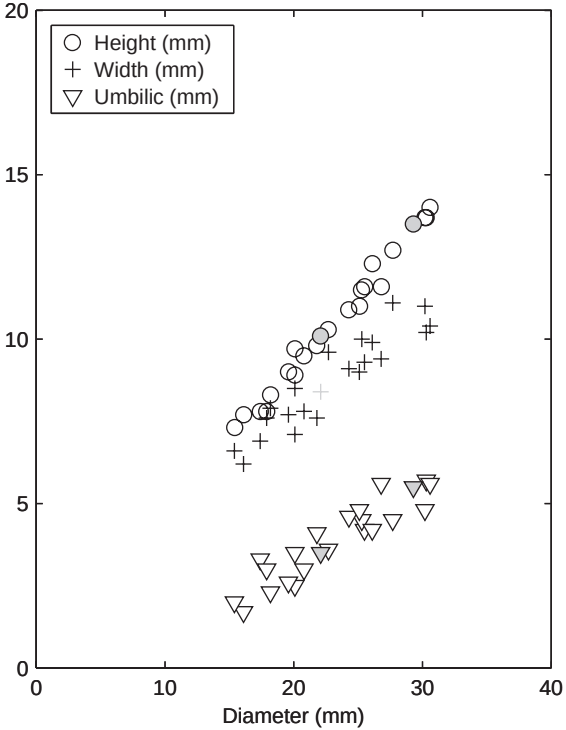
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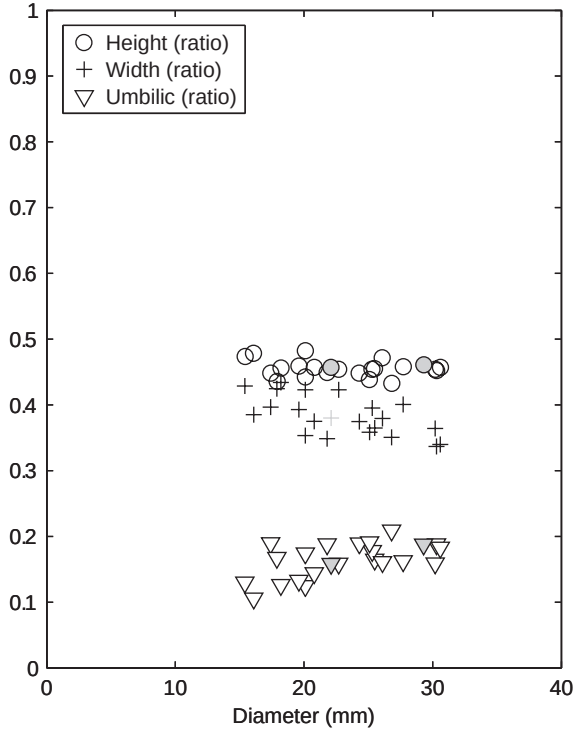
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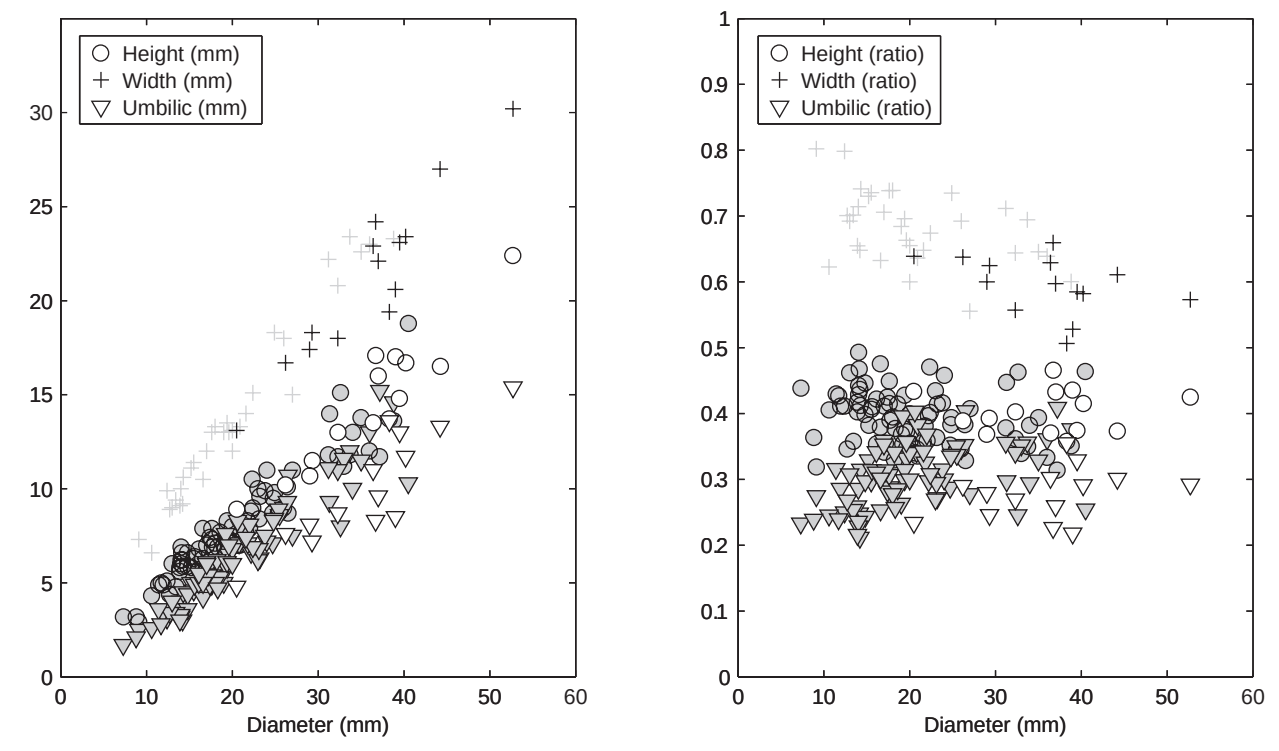
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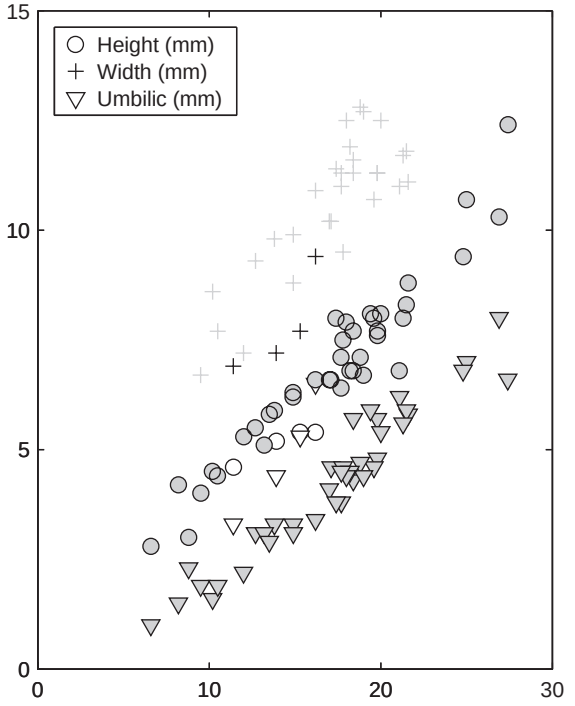
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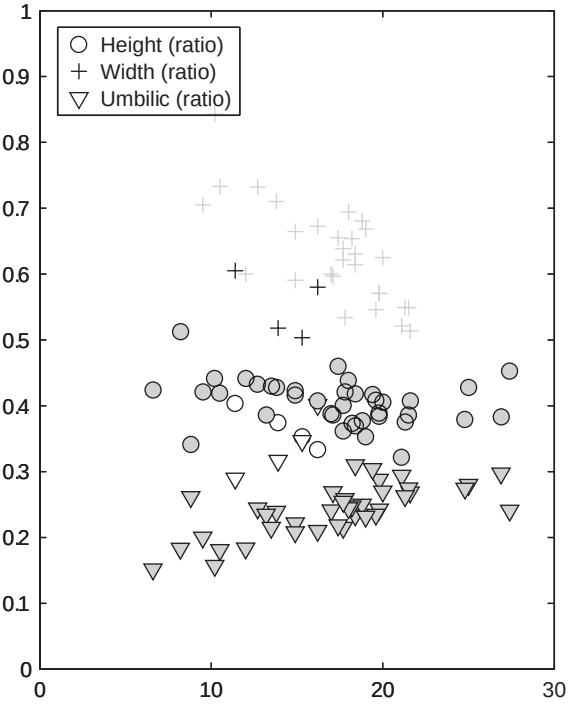
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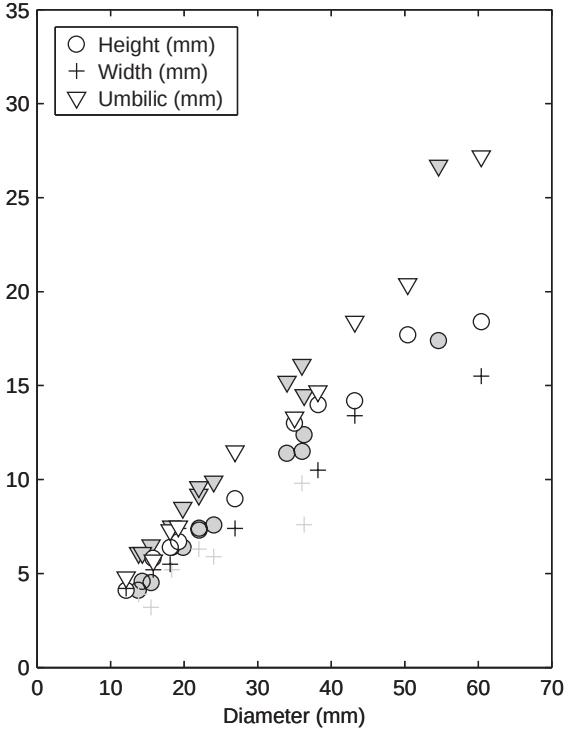
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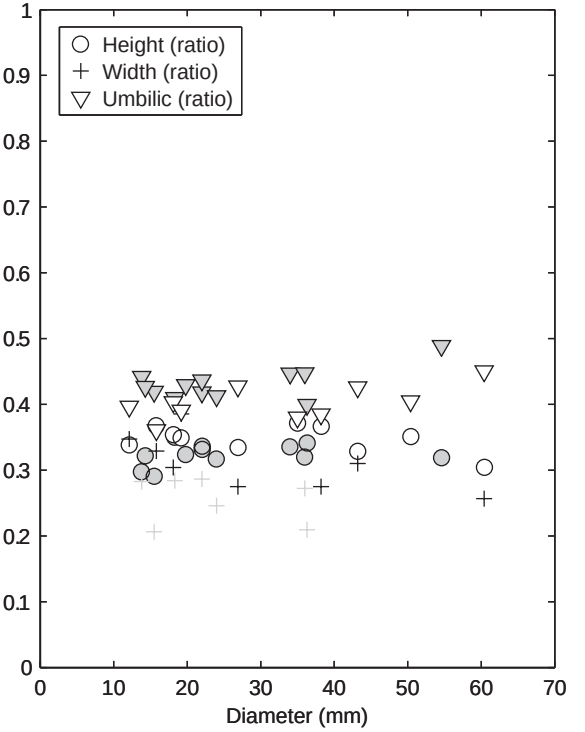
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Diameter (mm)
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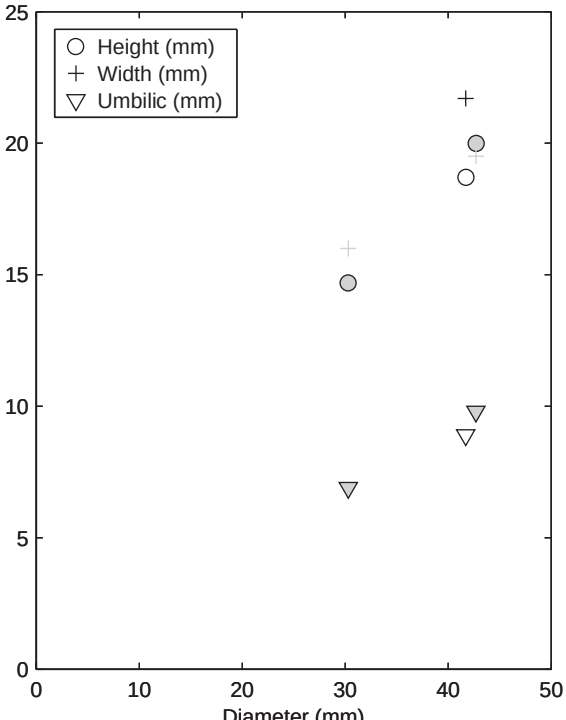
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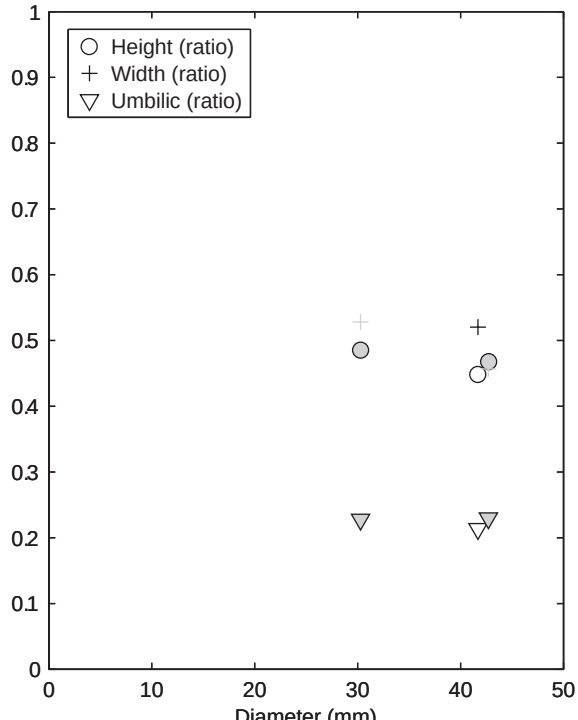
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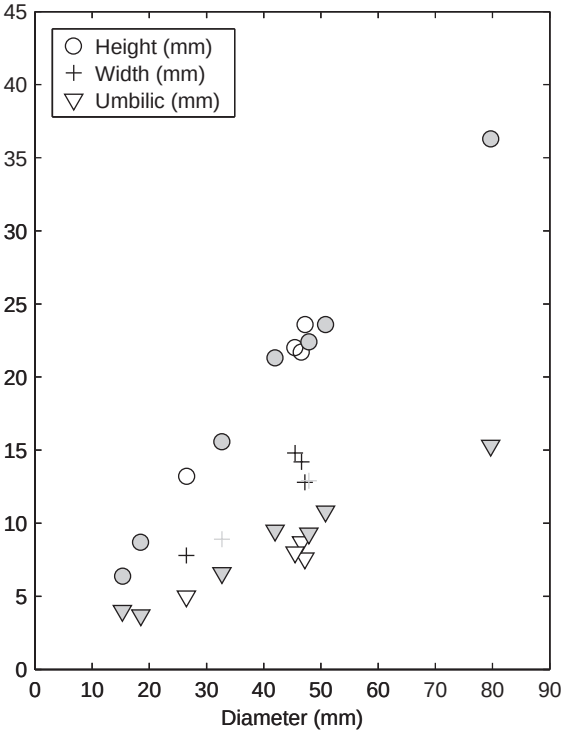
Diameter (mm)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Umbilic (mm)
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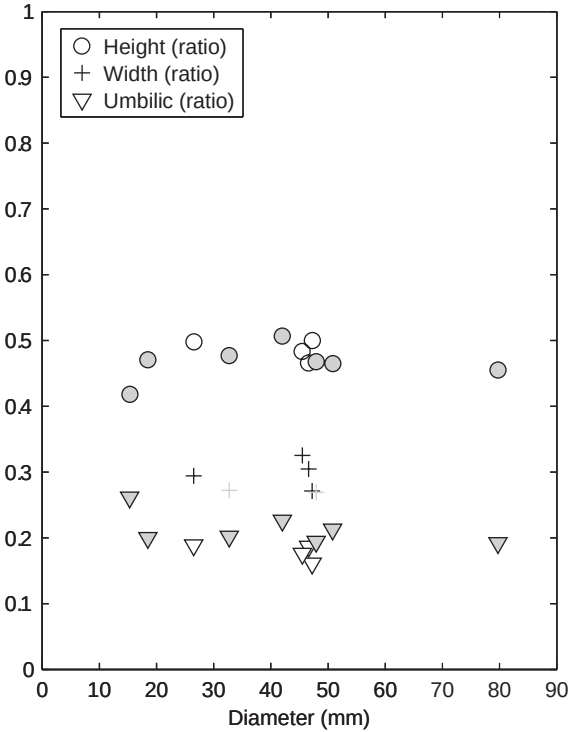
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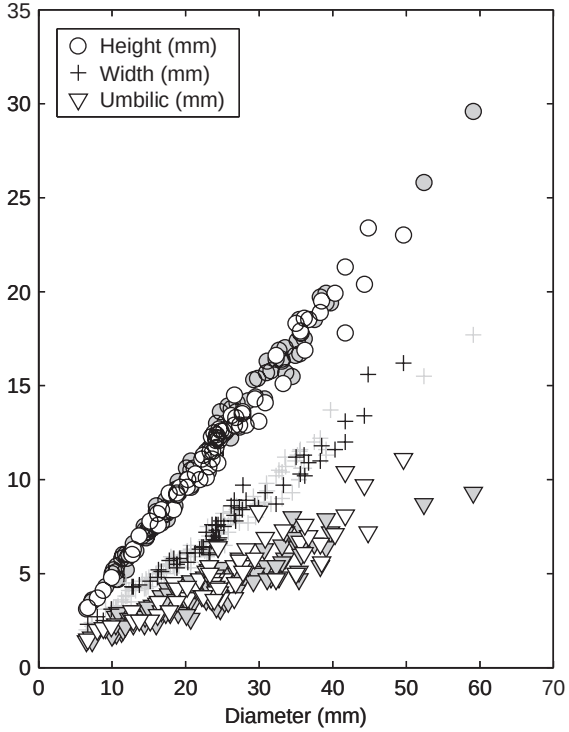
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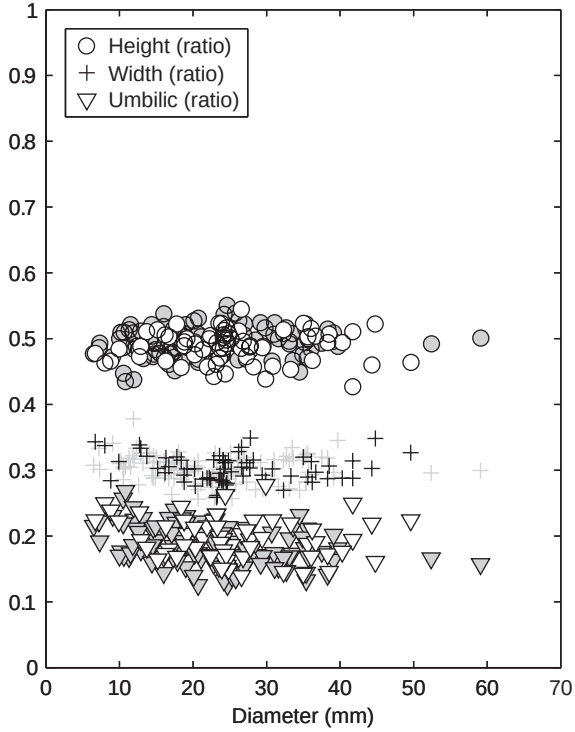
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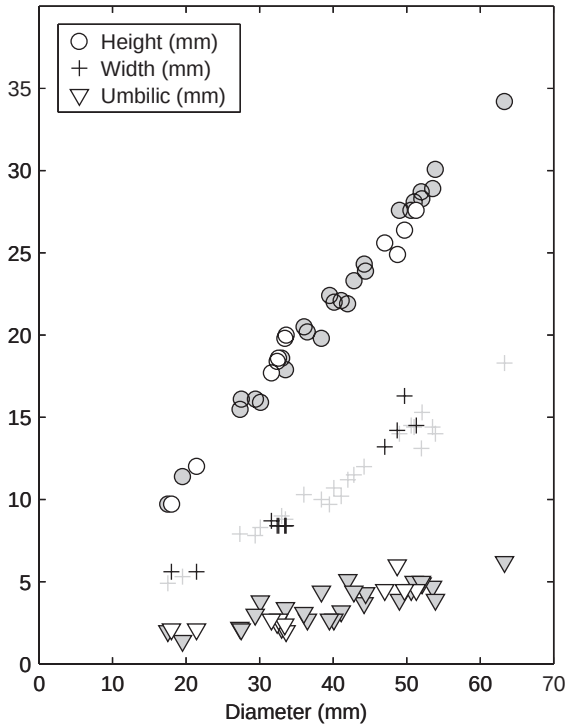
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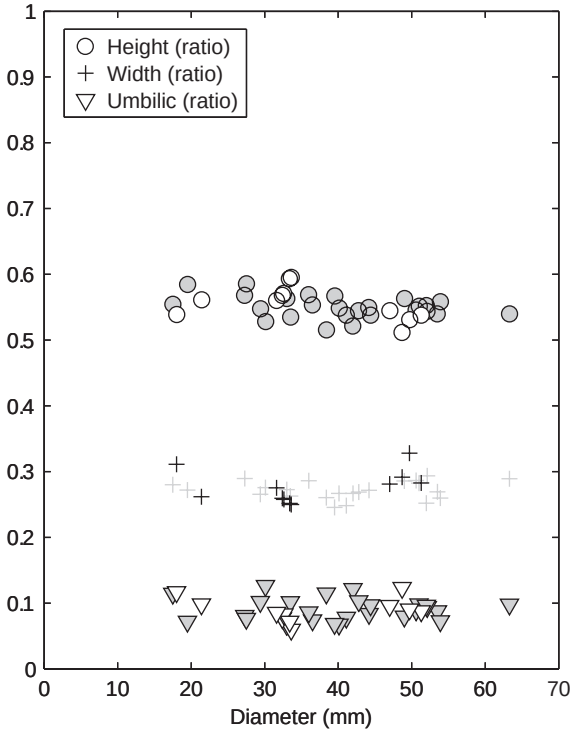
Diameter (mm)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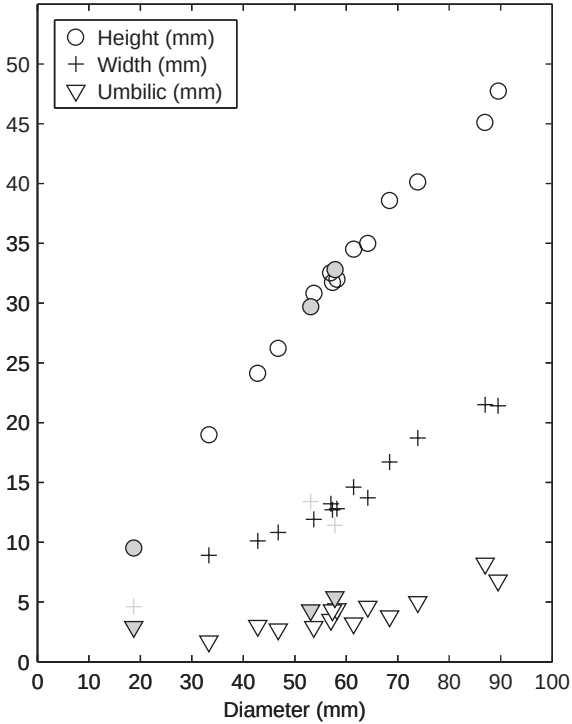
Diameter (mm)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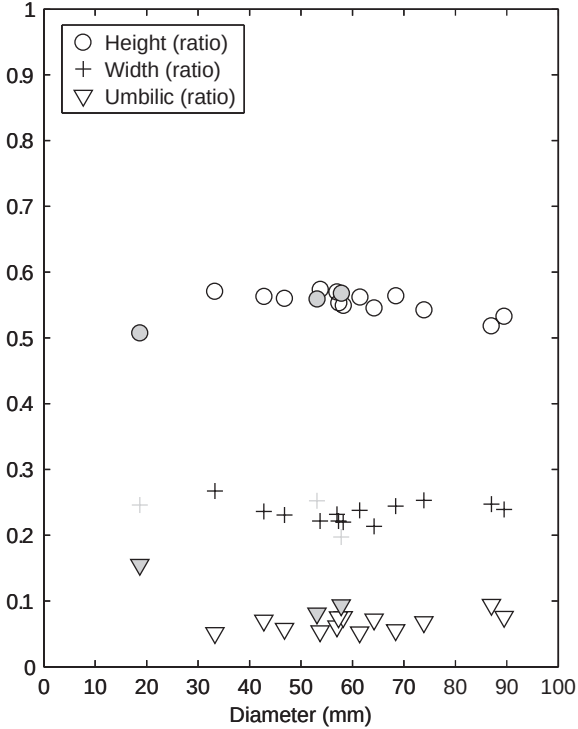
Diameter (mm)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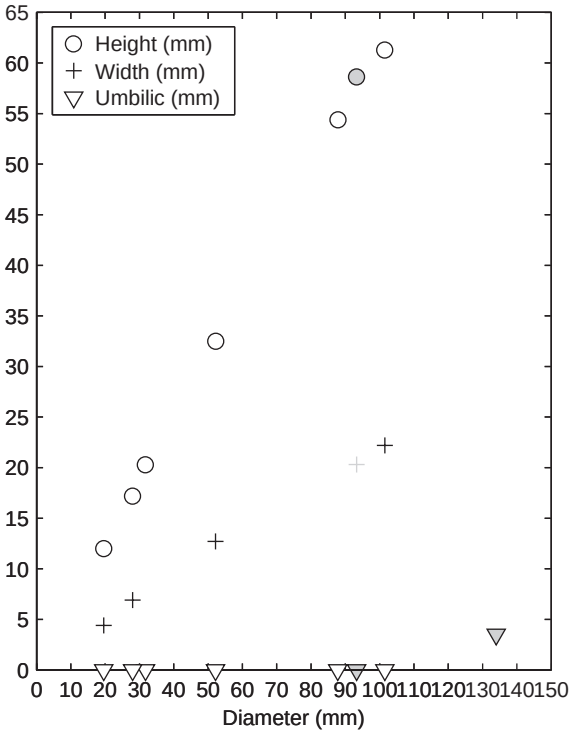
Diameter (mm)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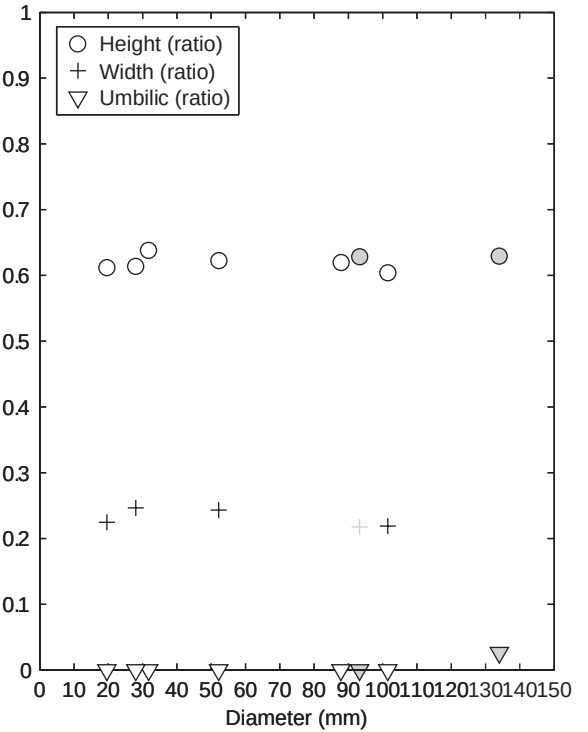
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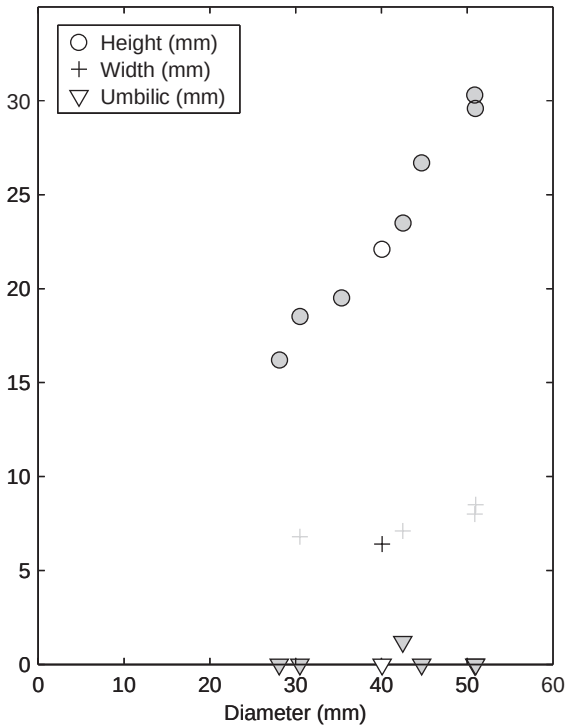
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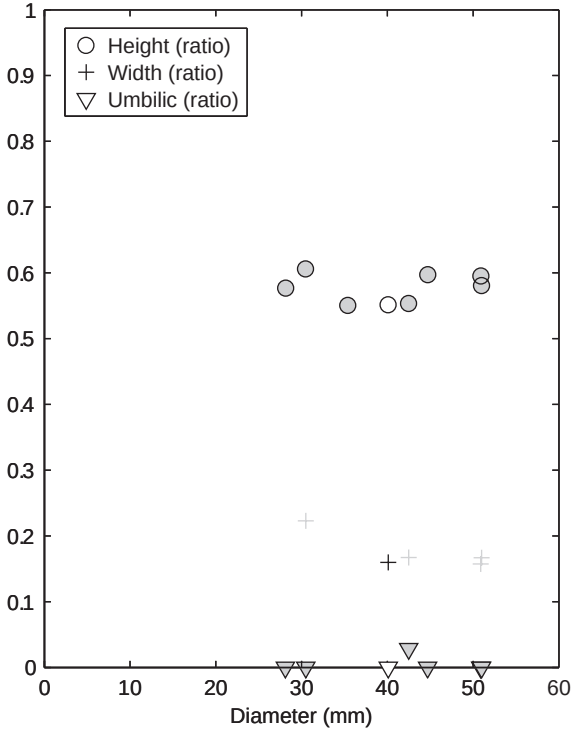
Diameter (mm)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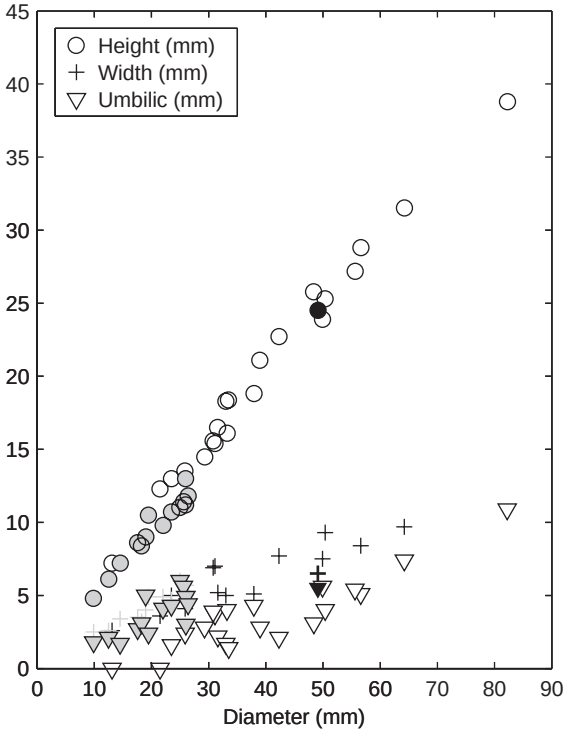
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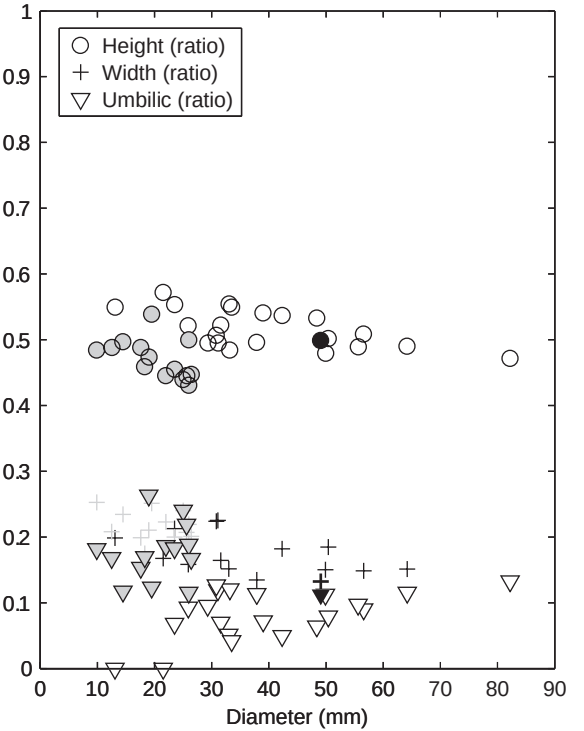
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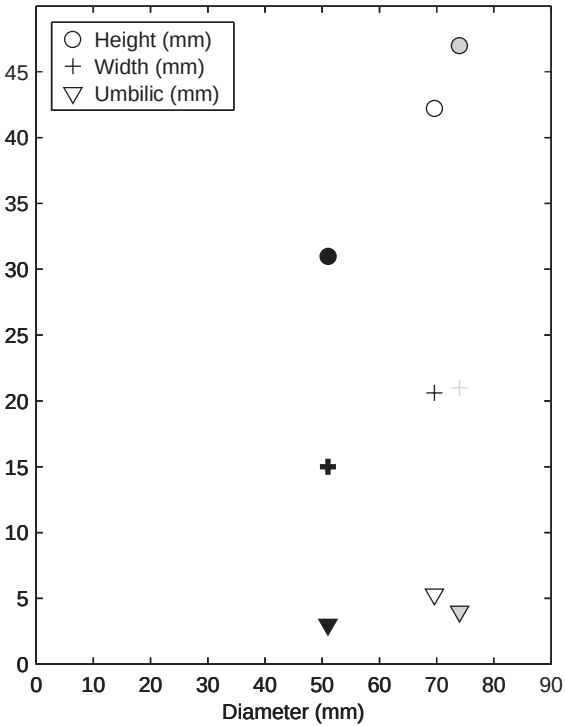
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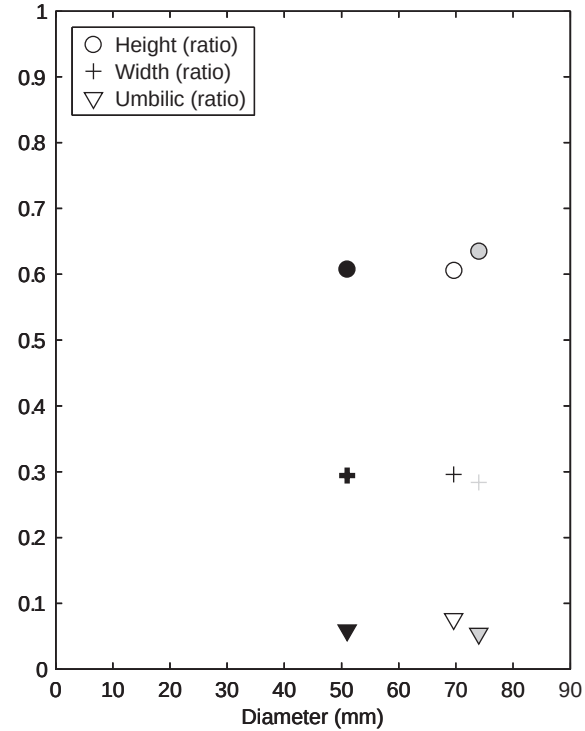
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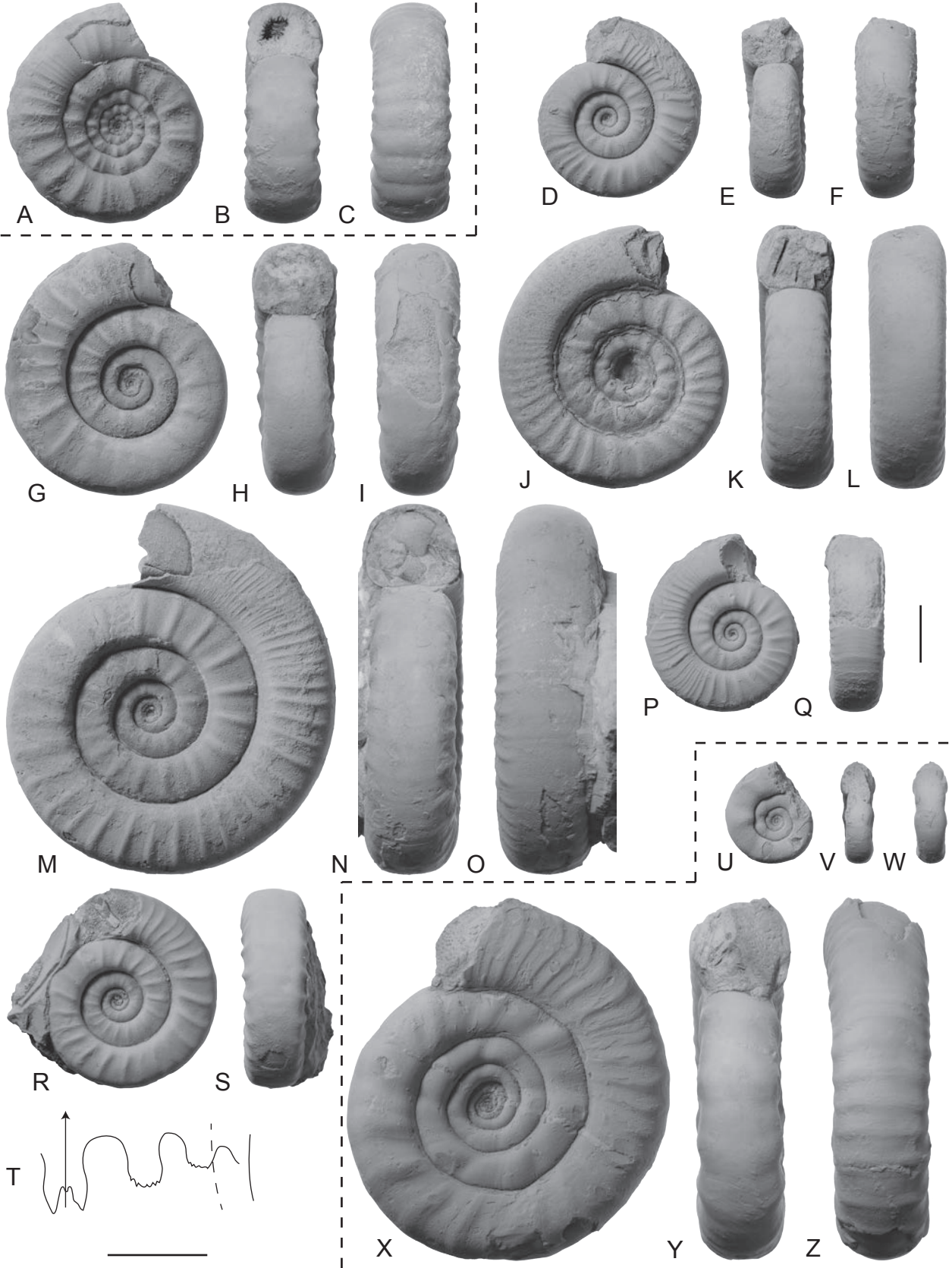
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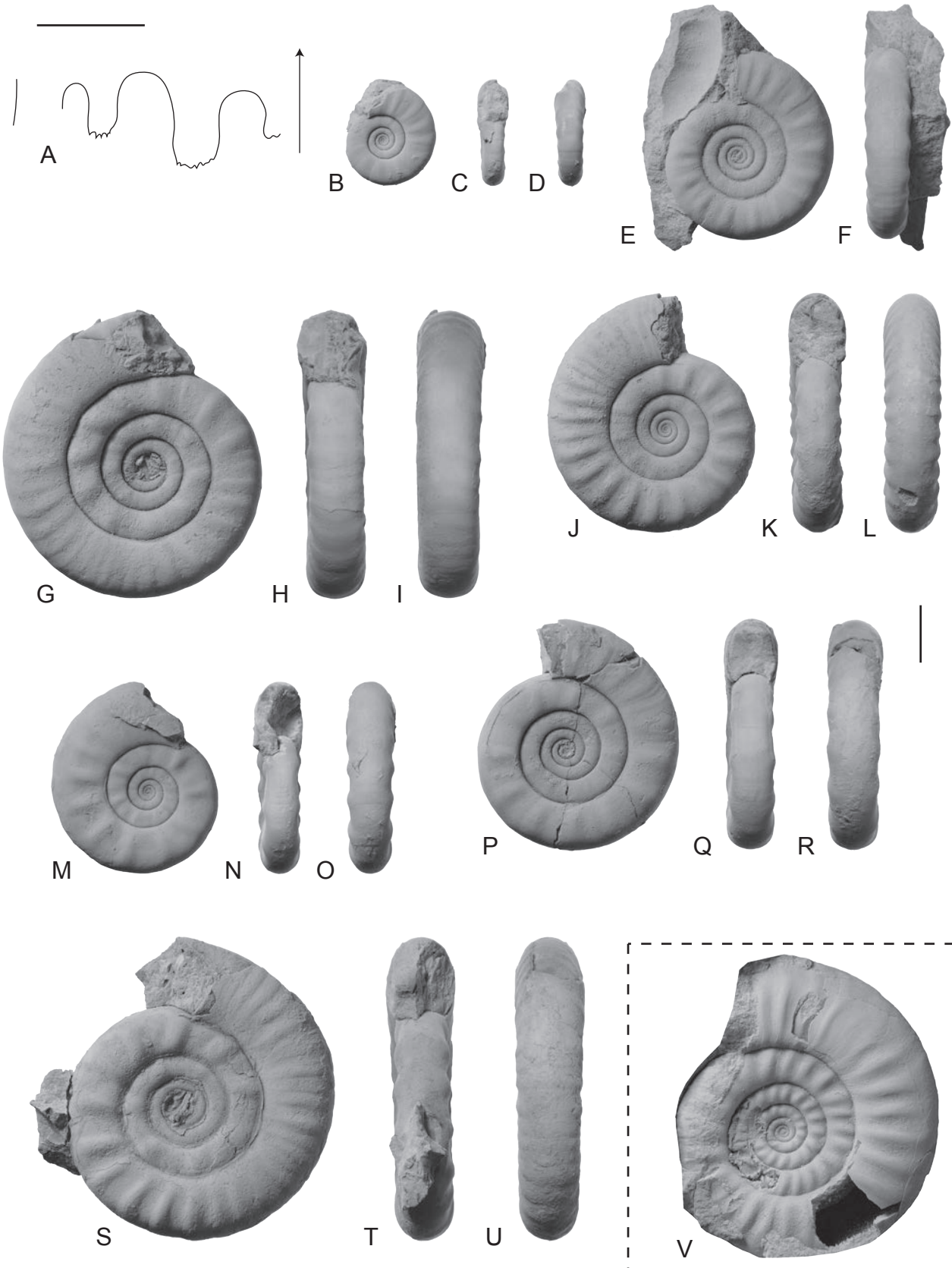
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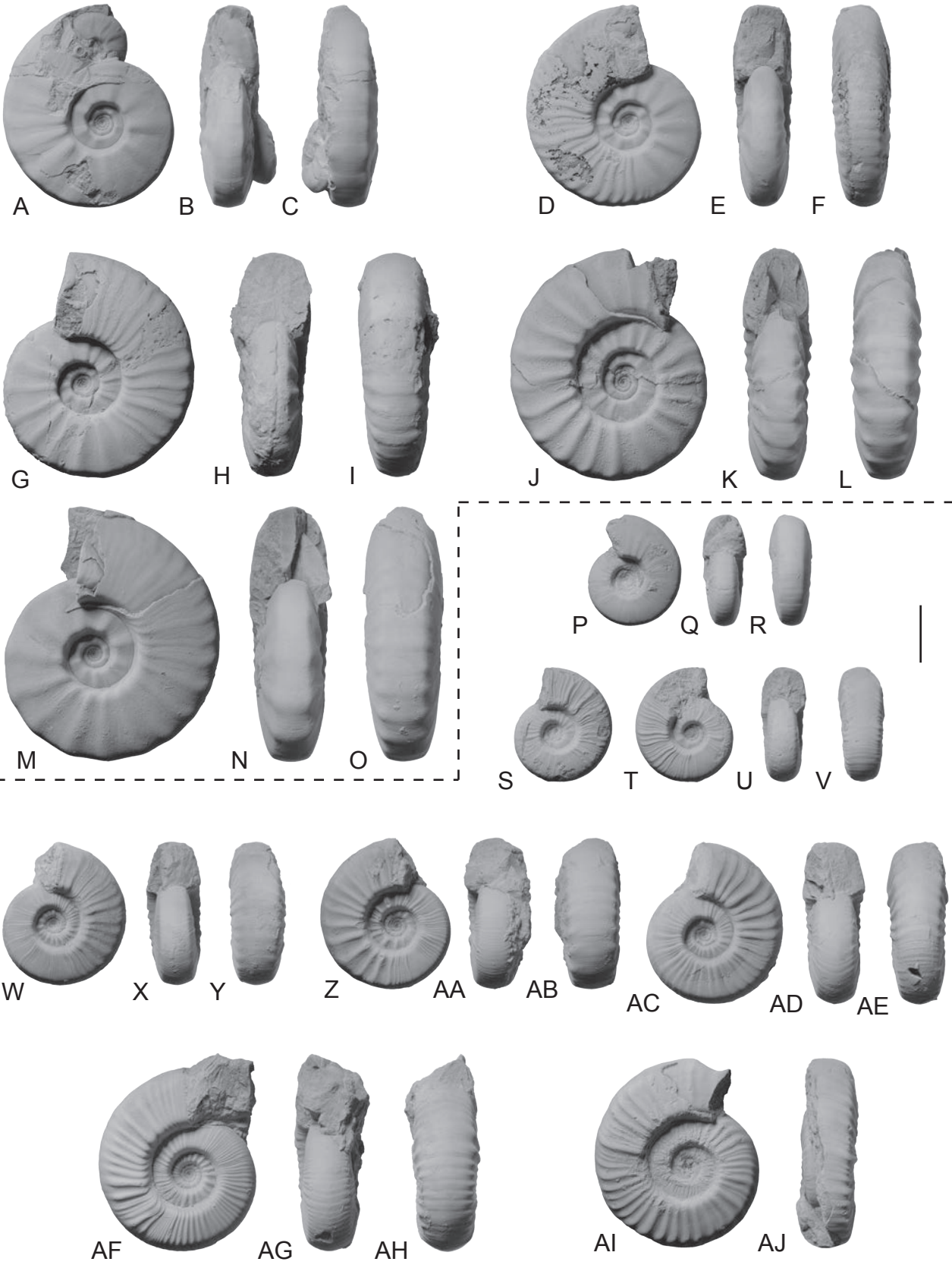
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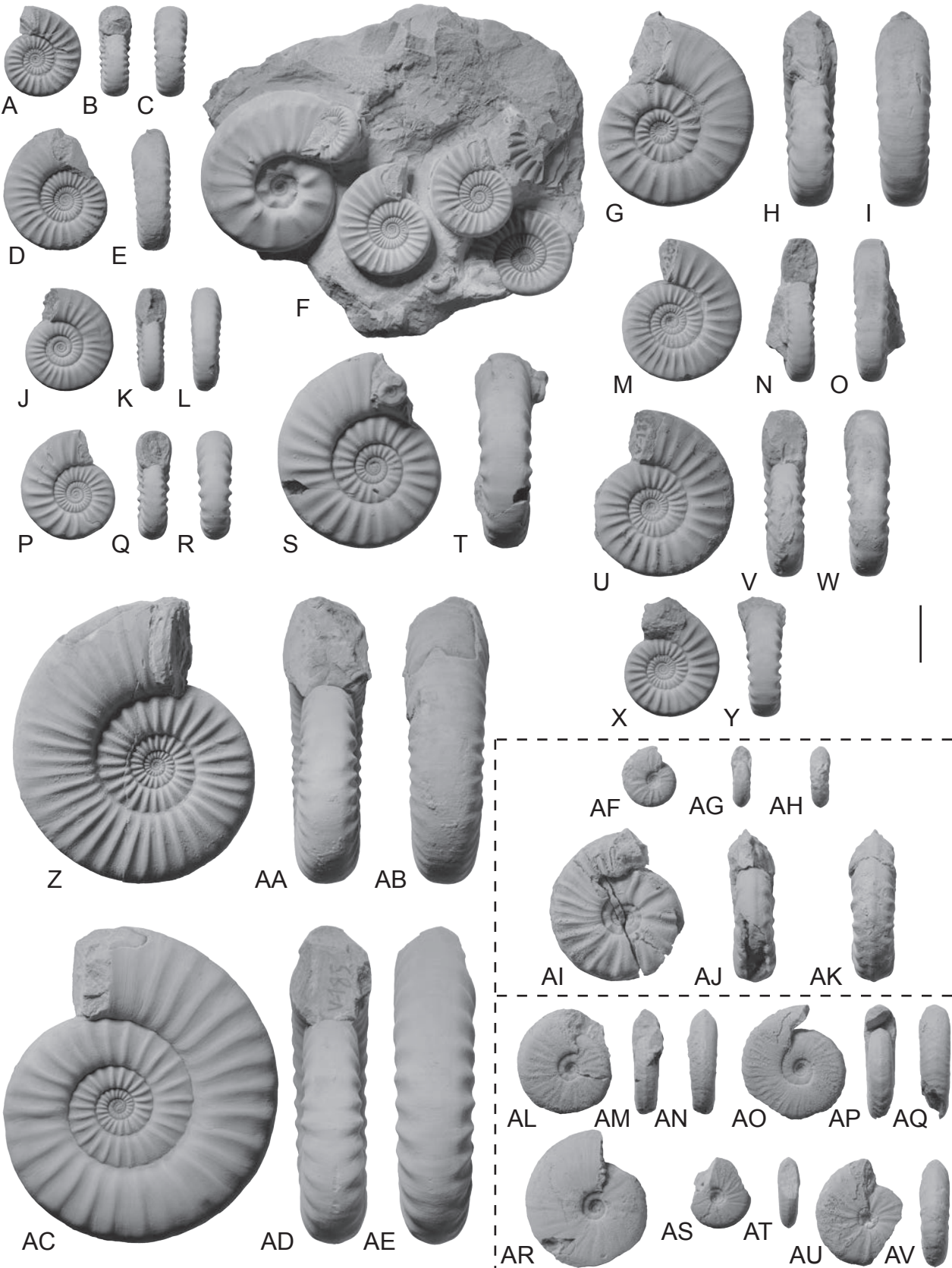
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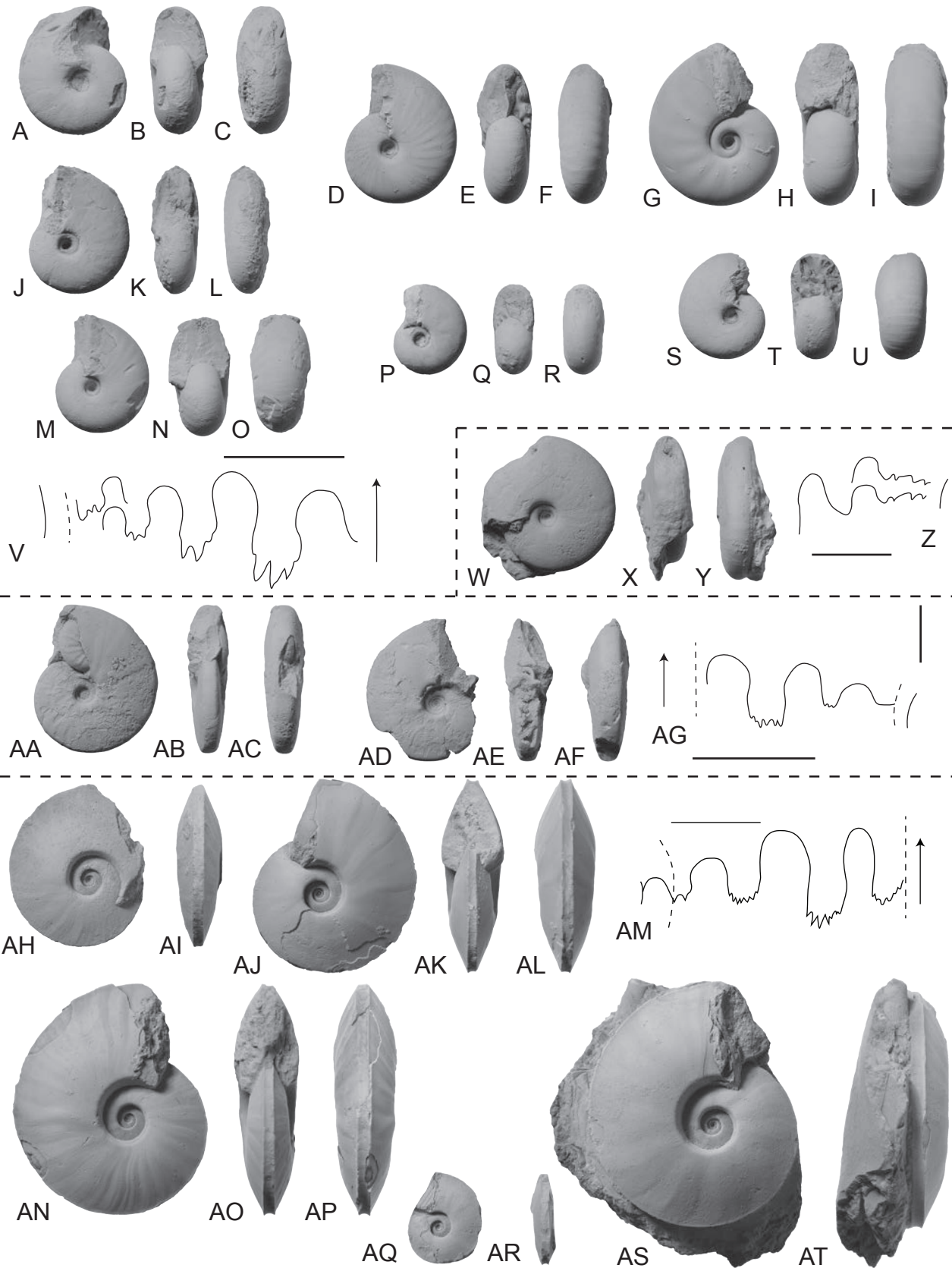
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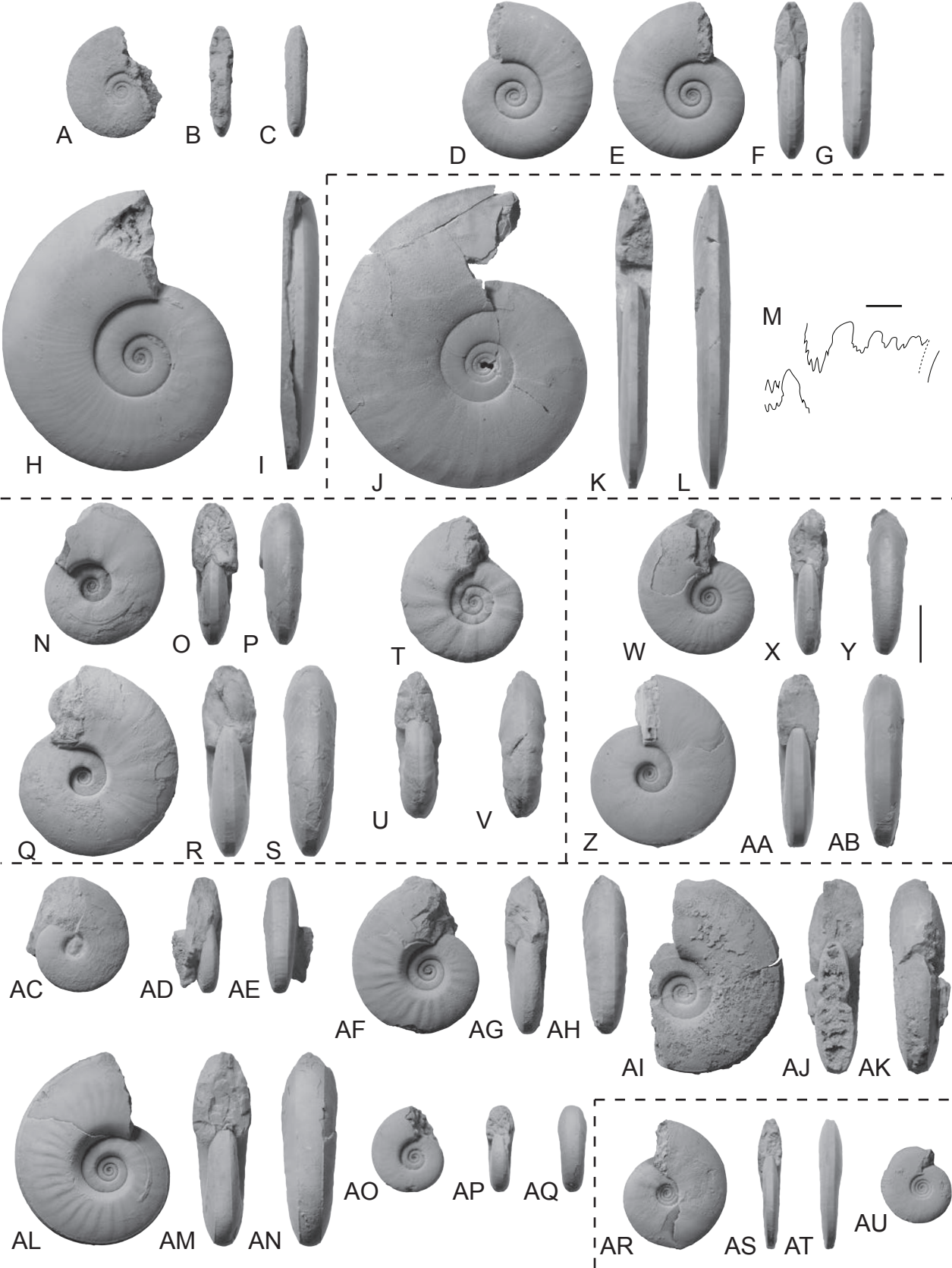
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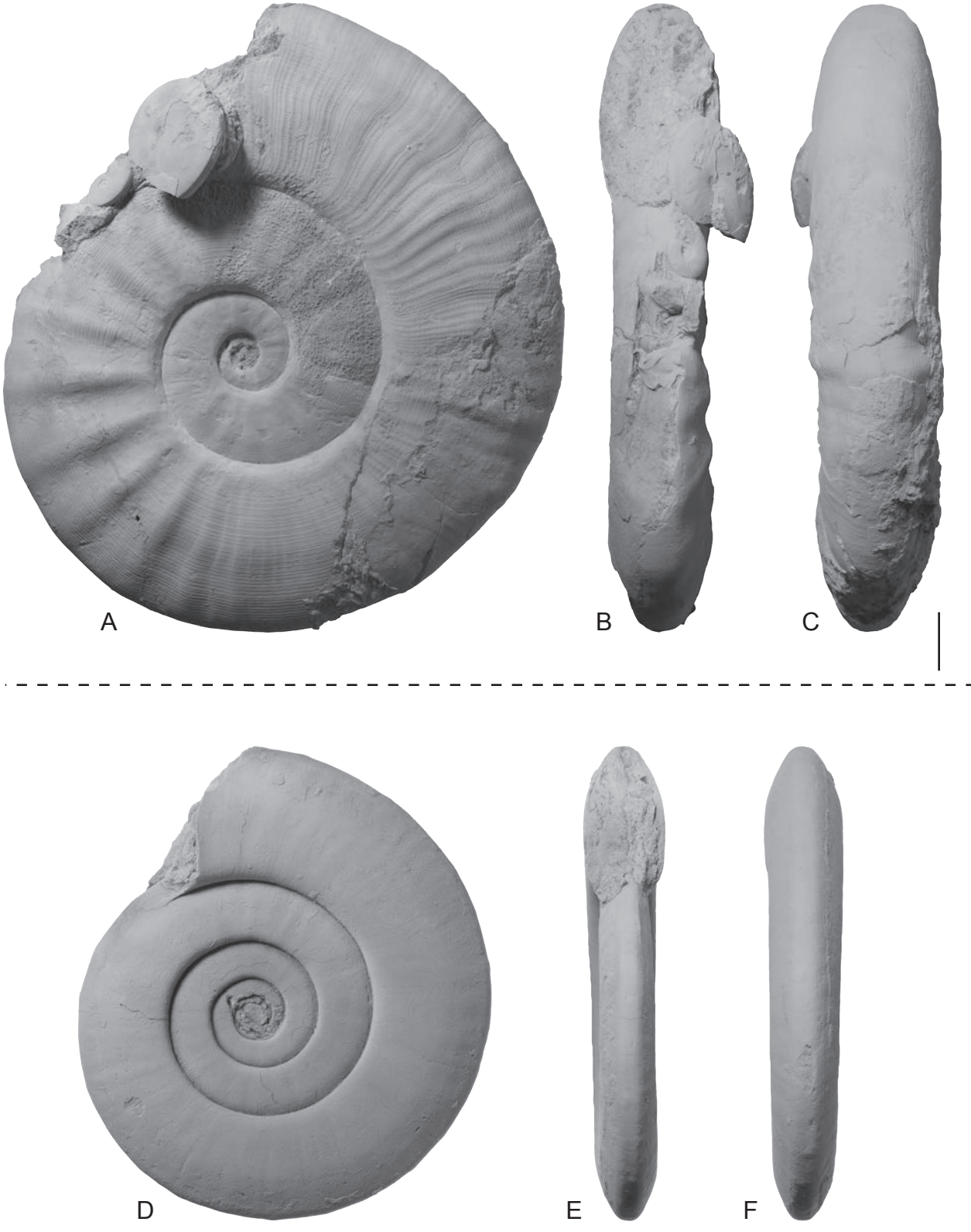
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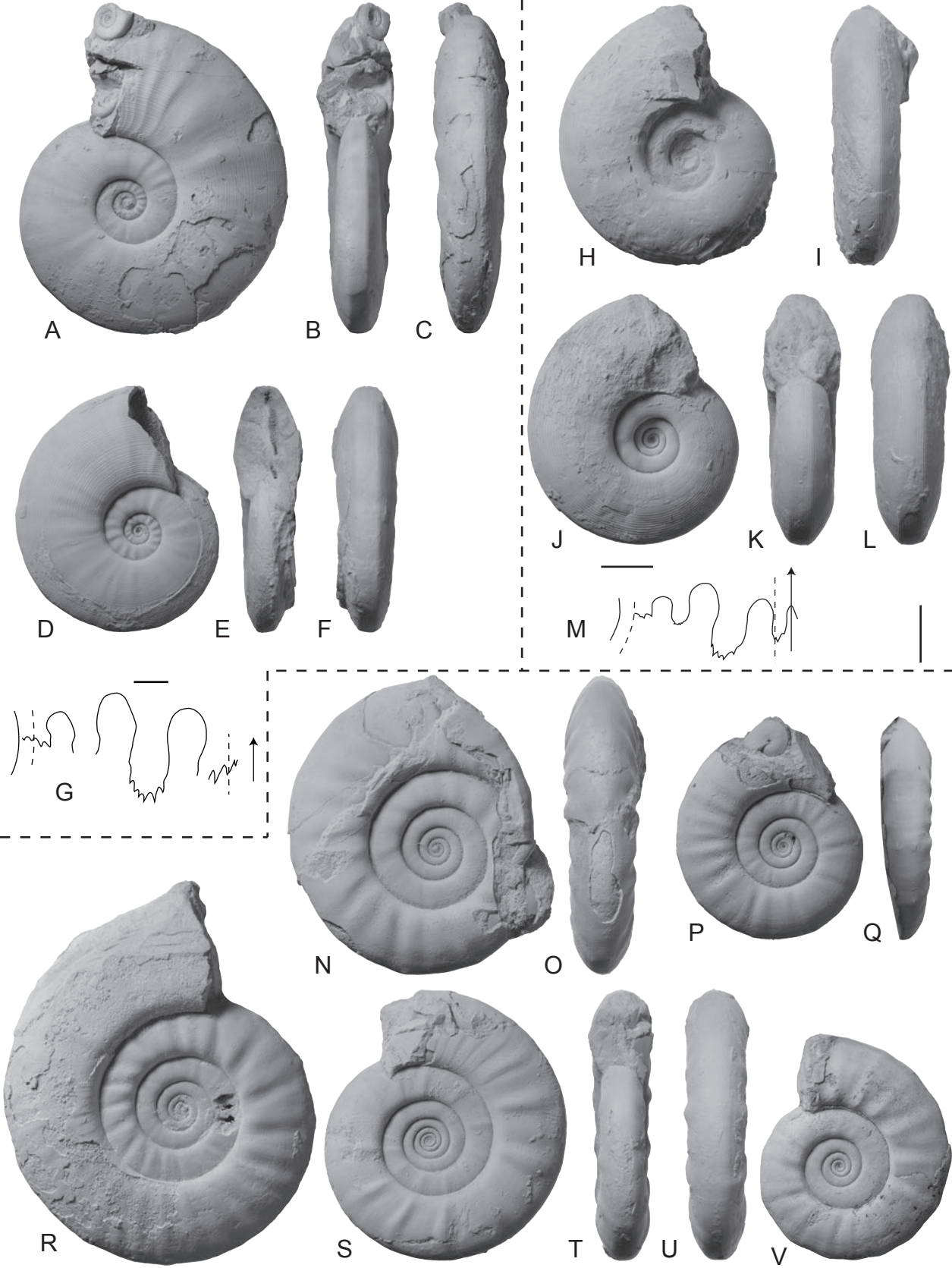
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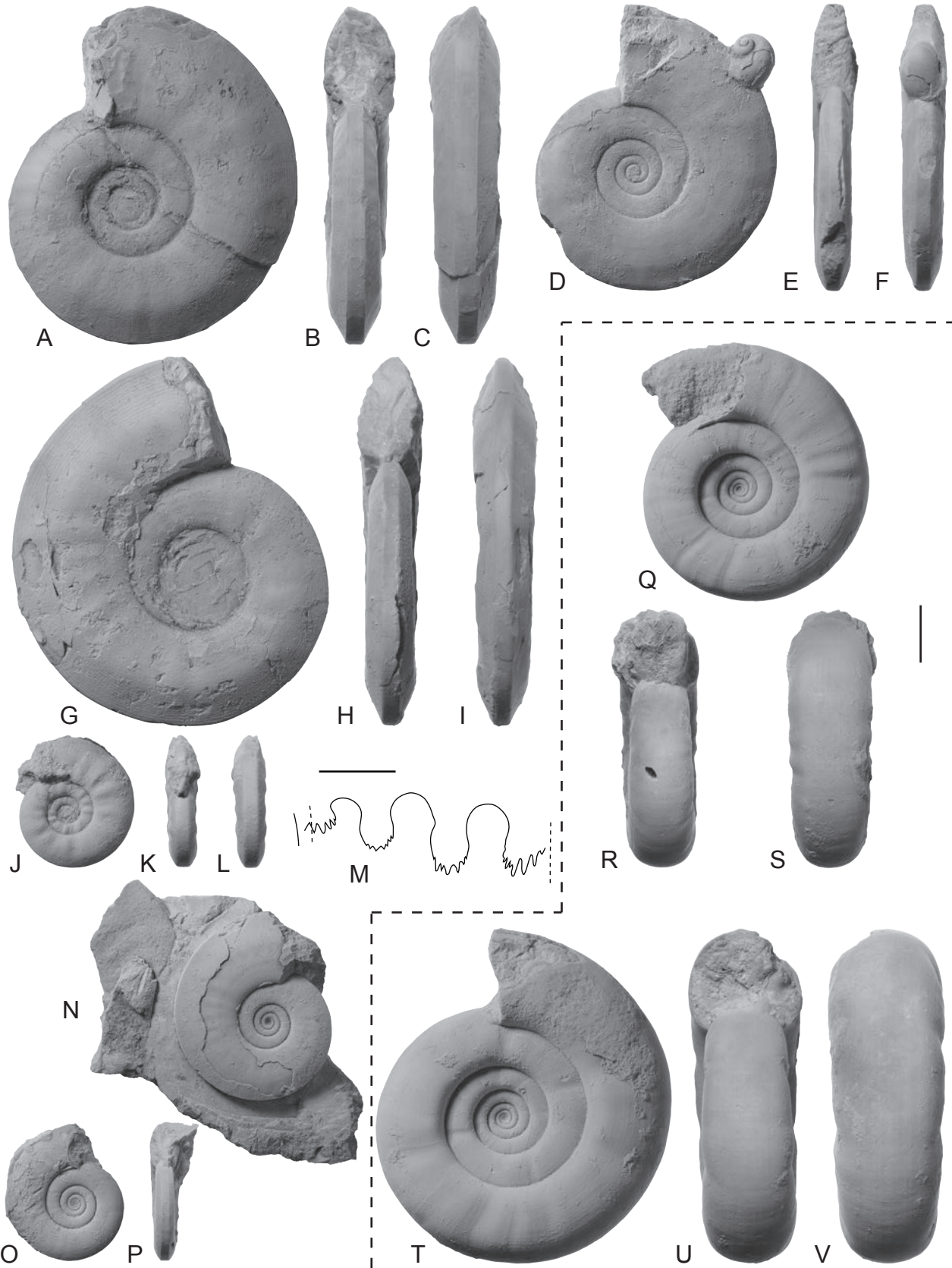
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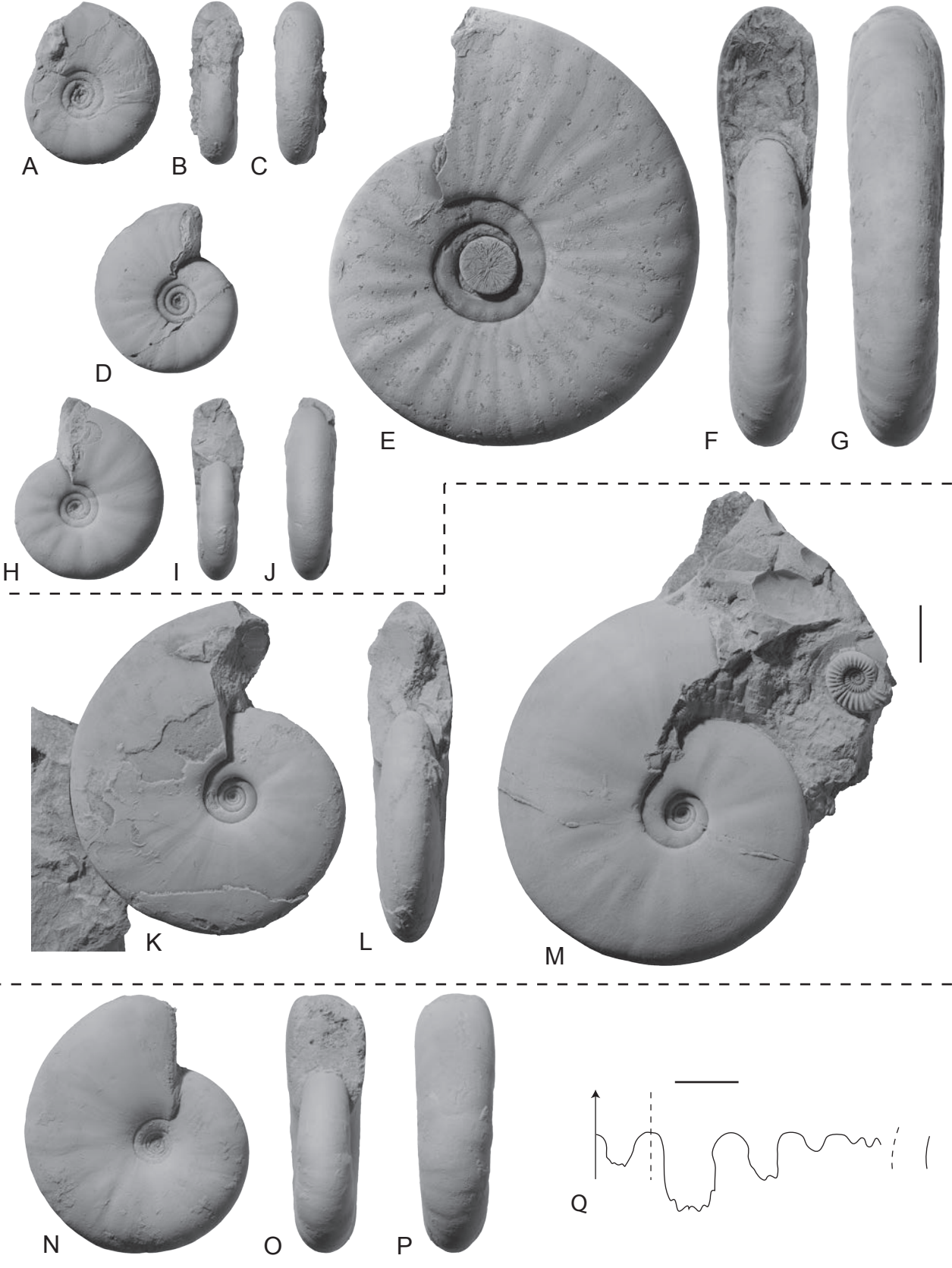
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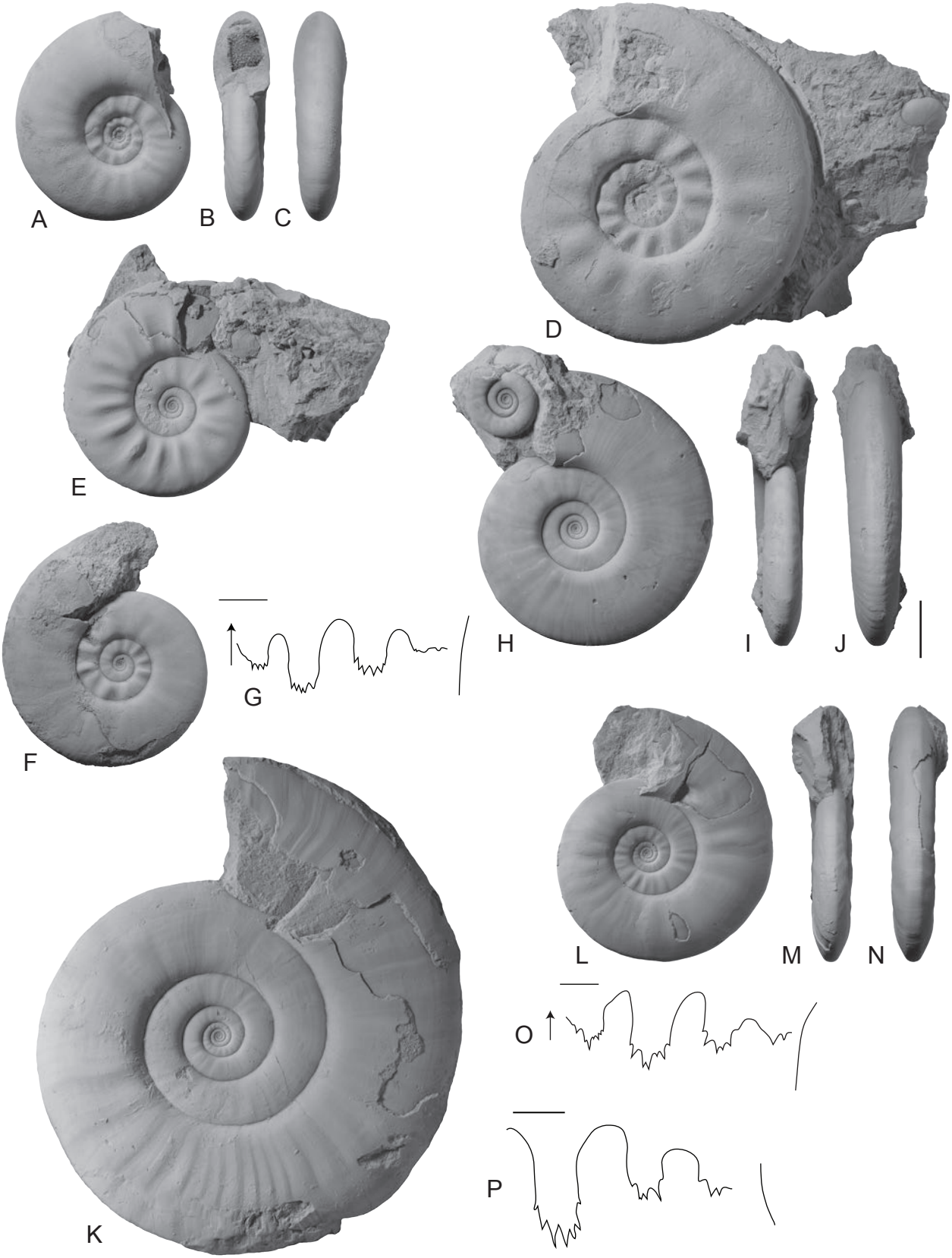
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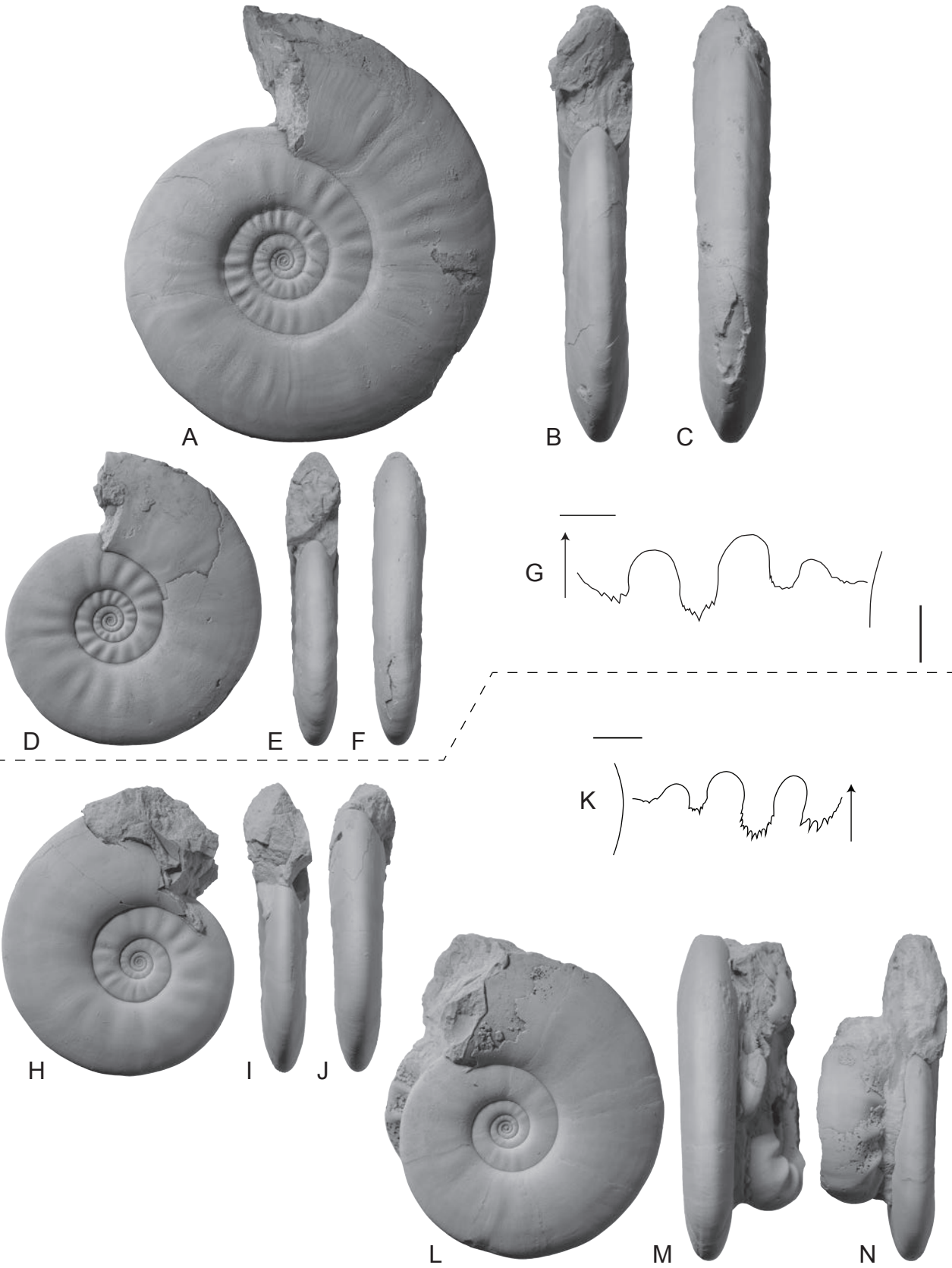
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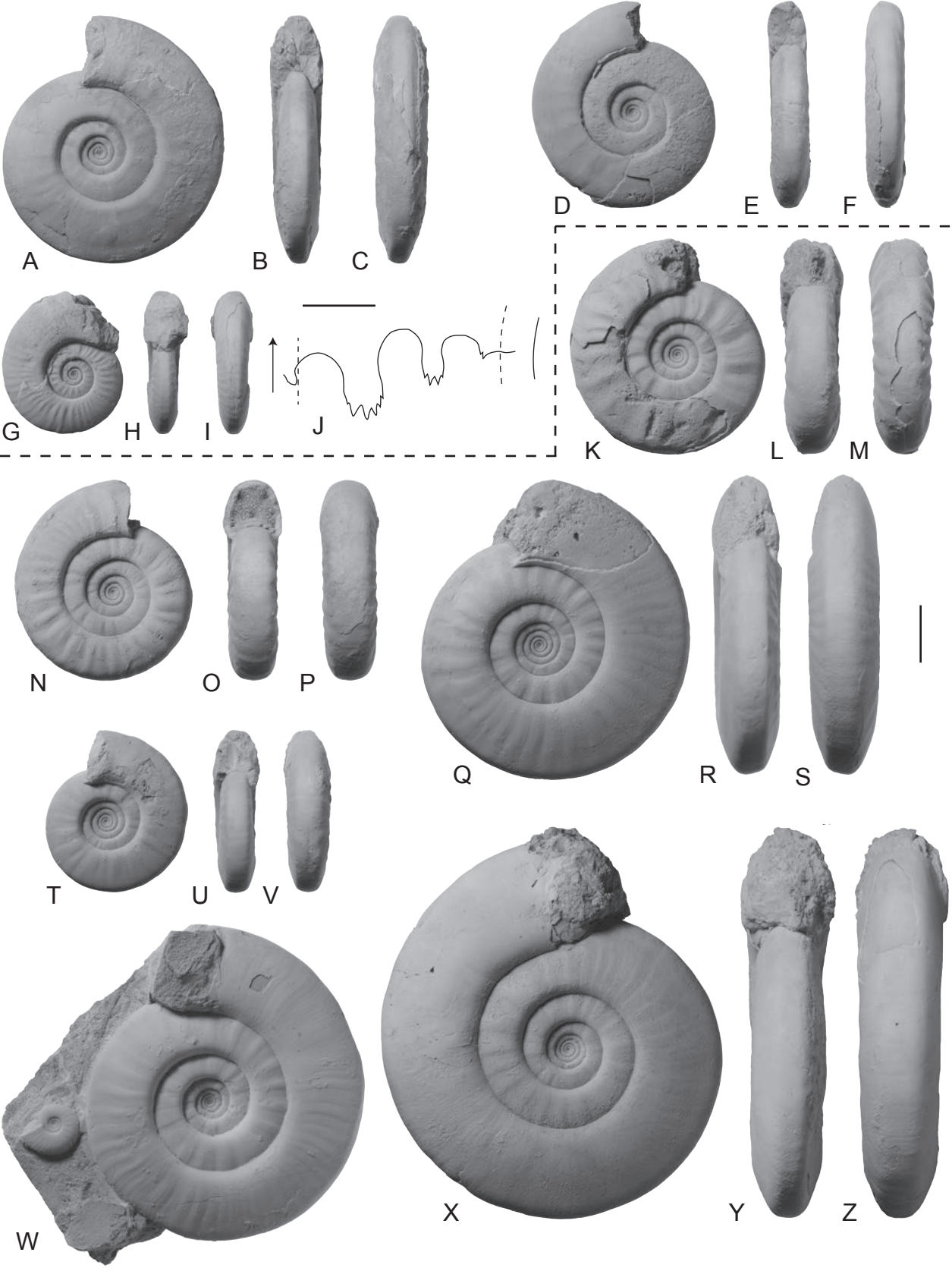
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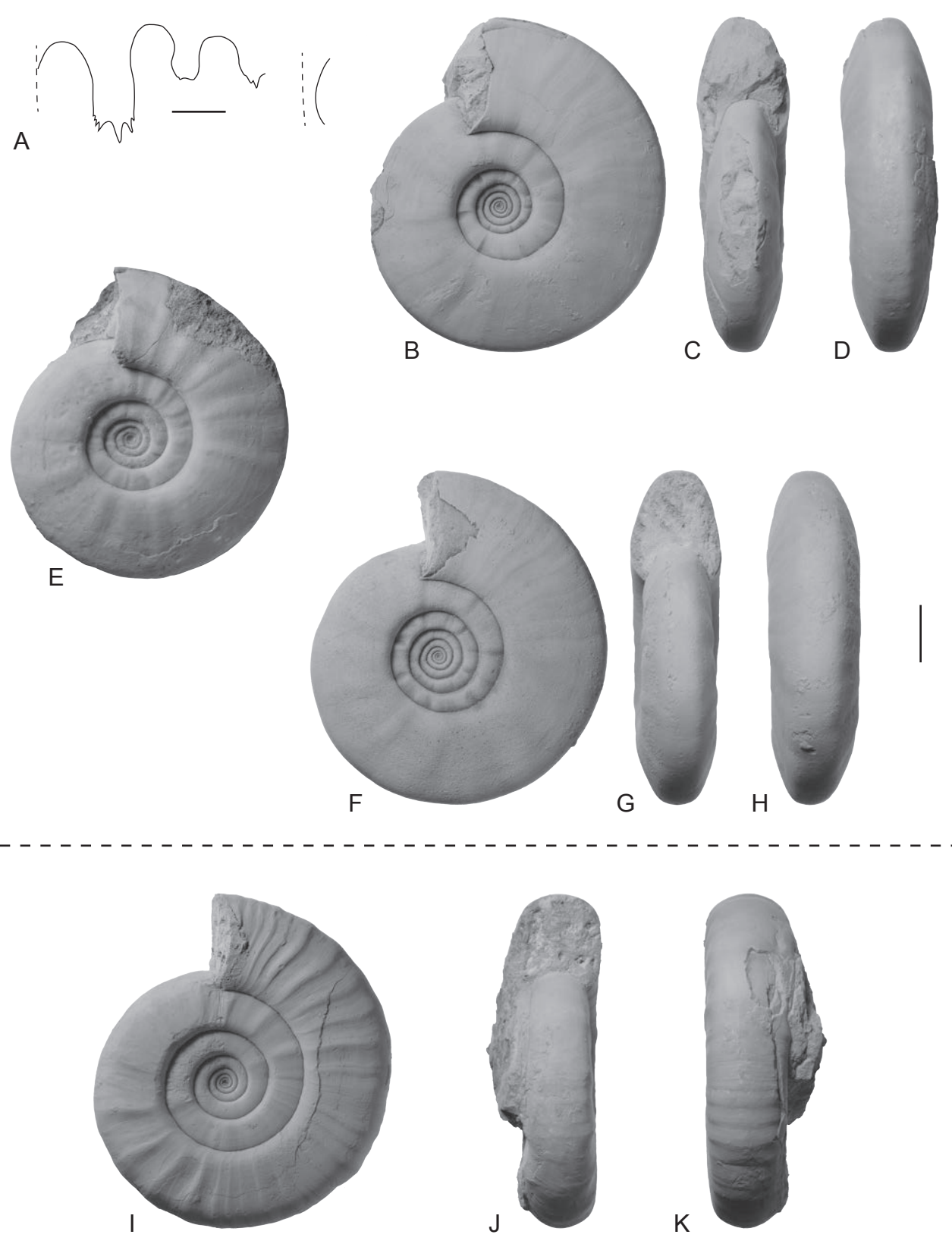
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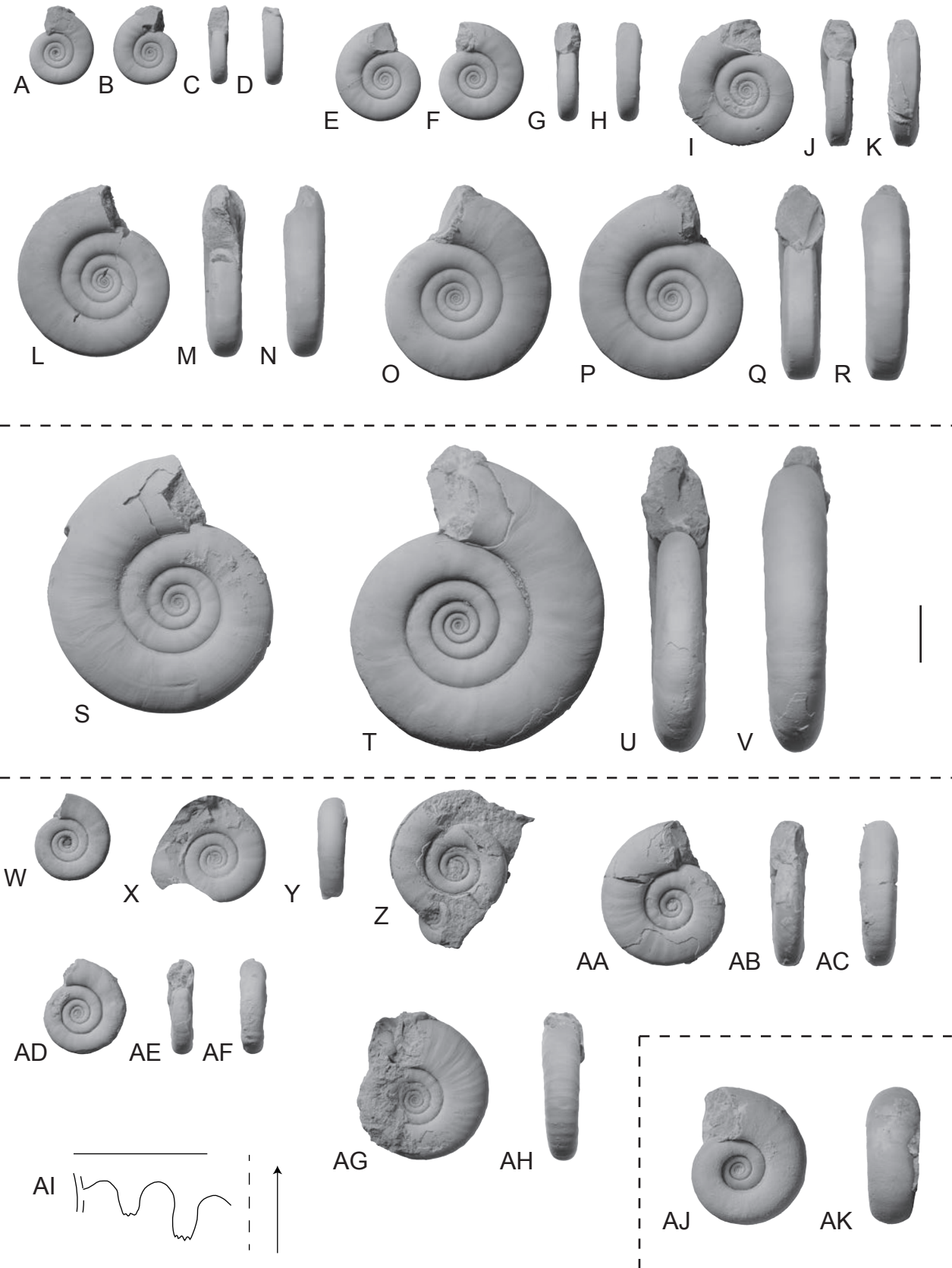
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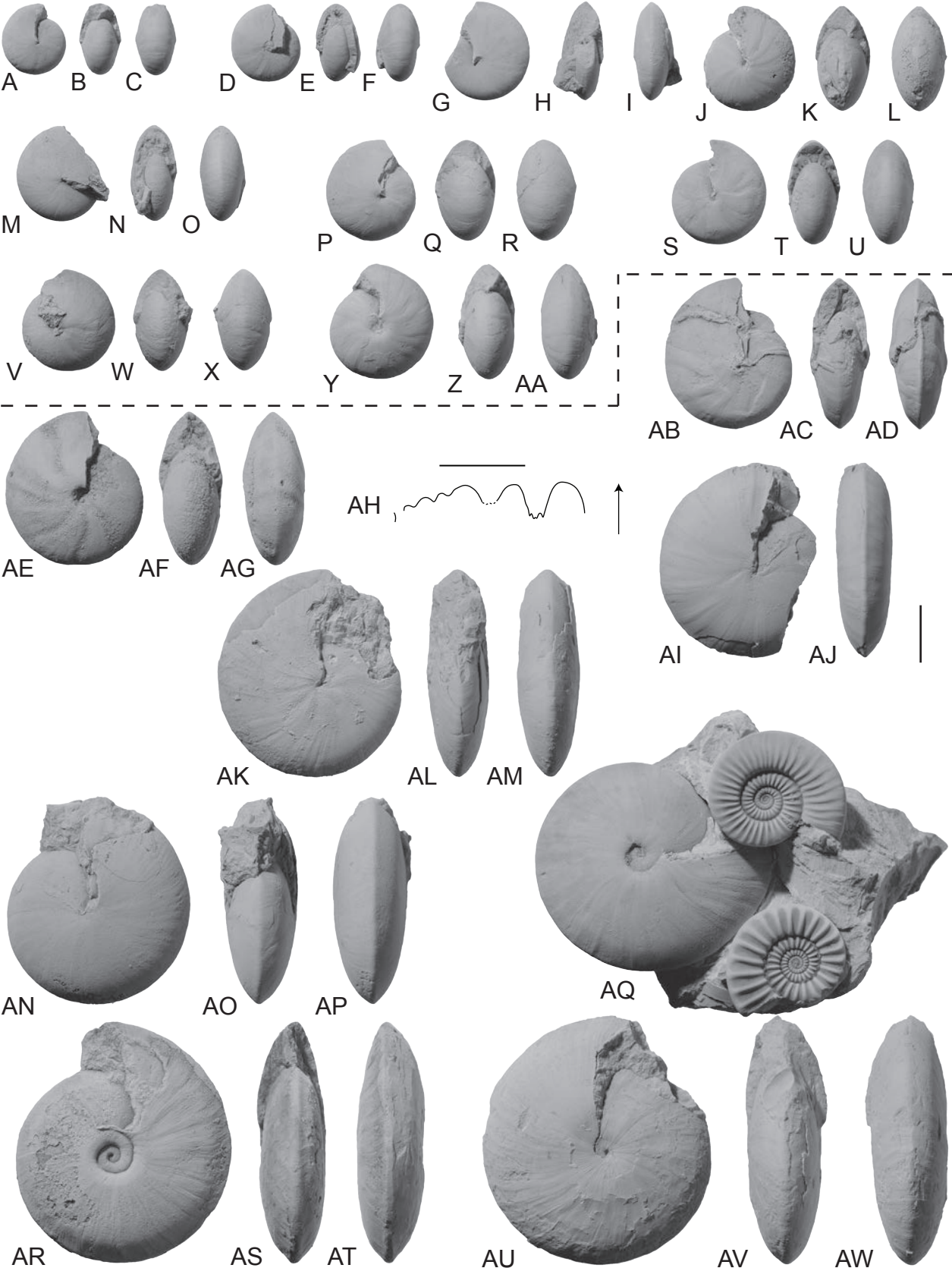
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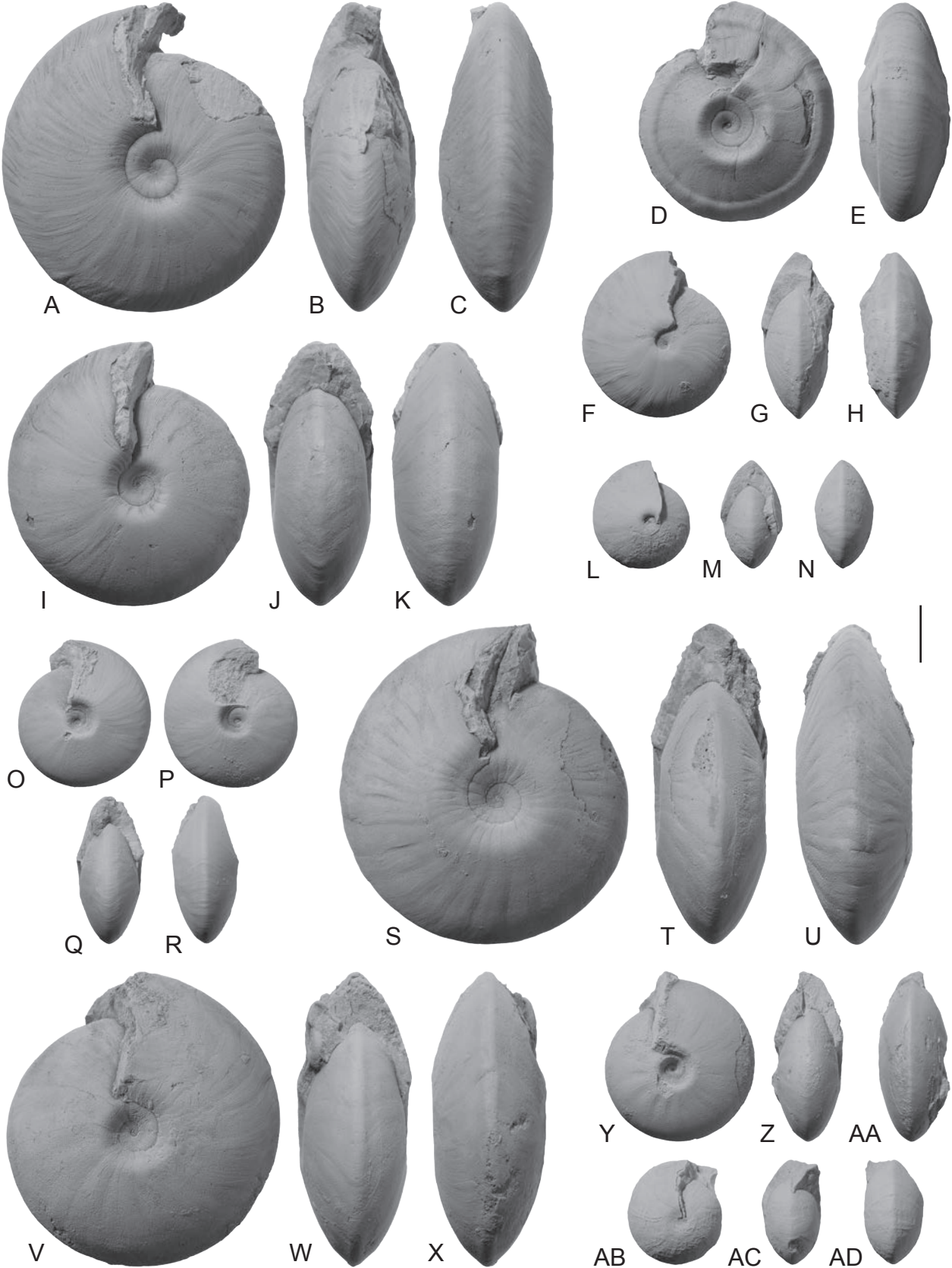
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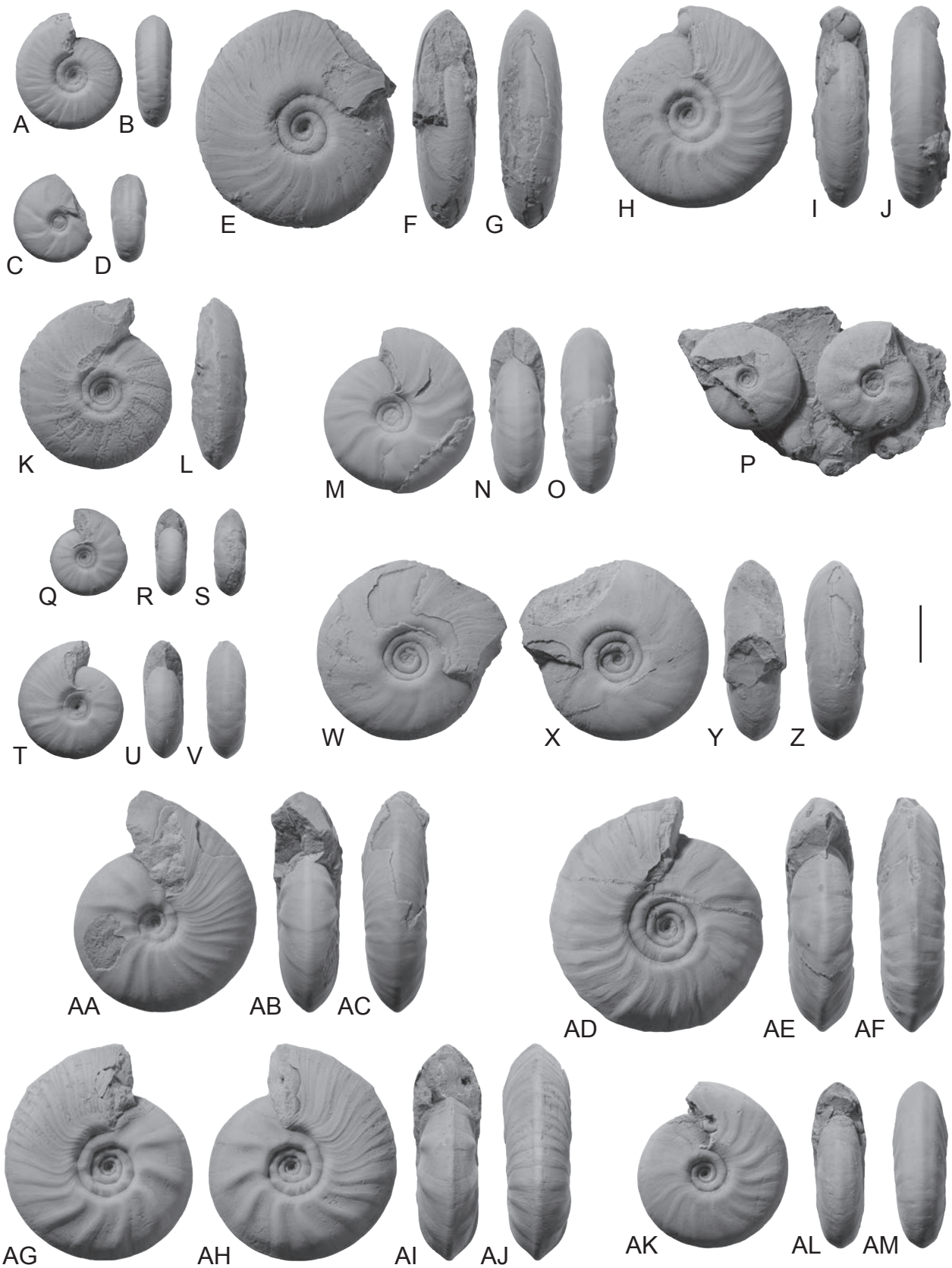
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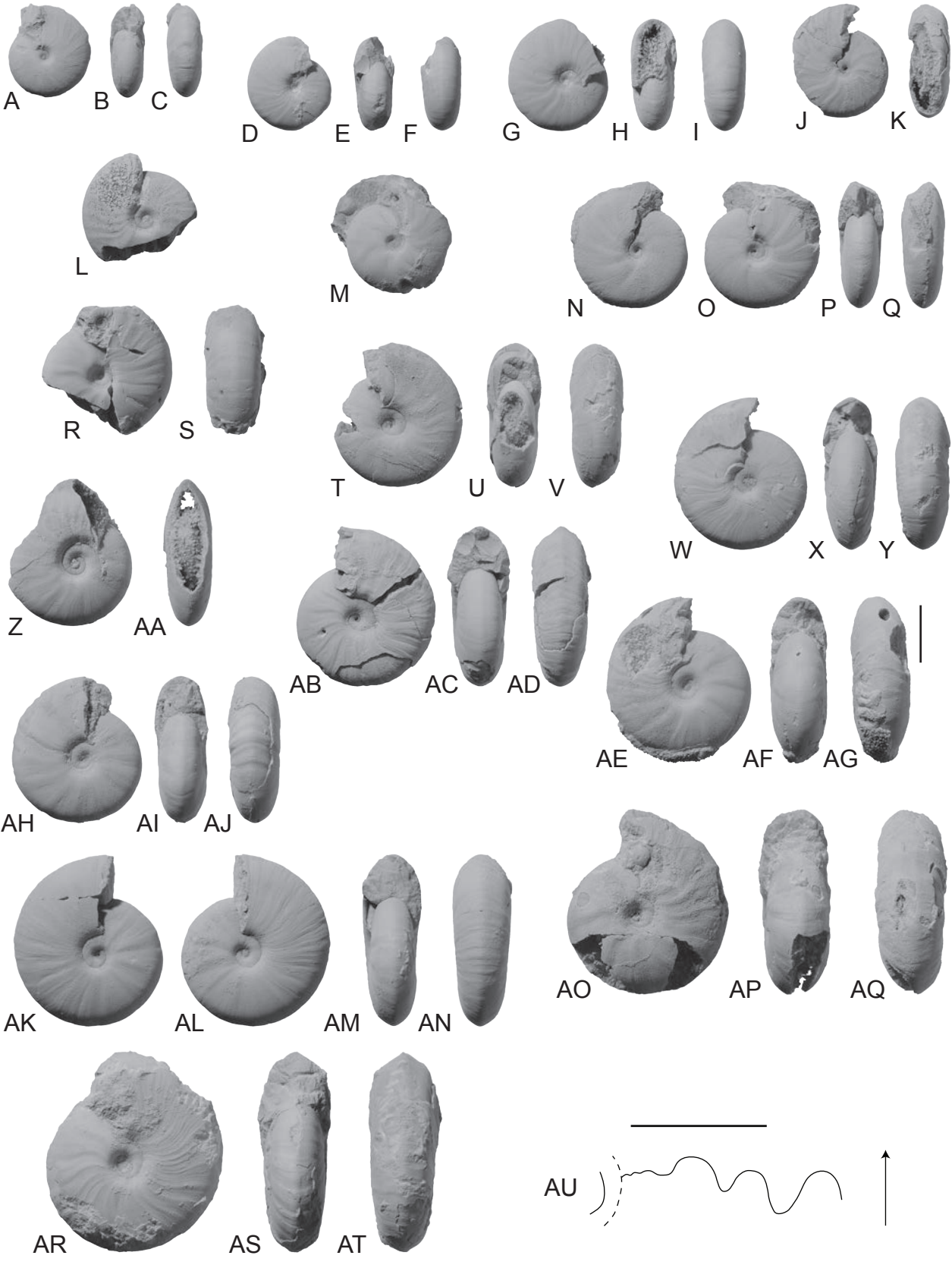
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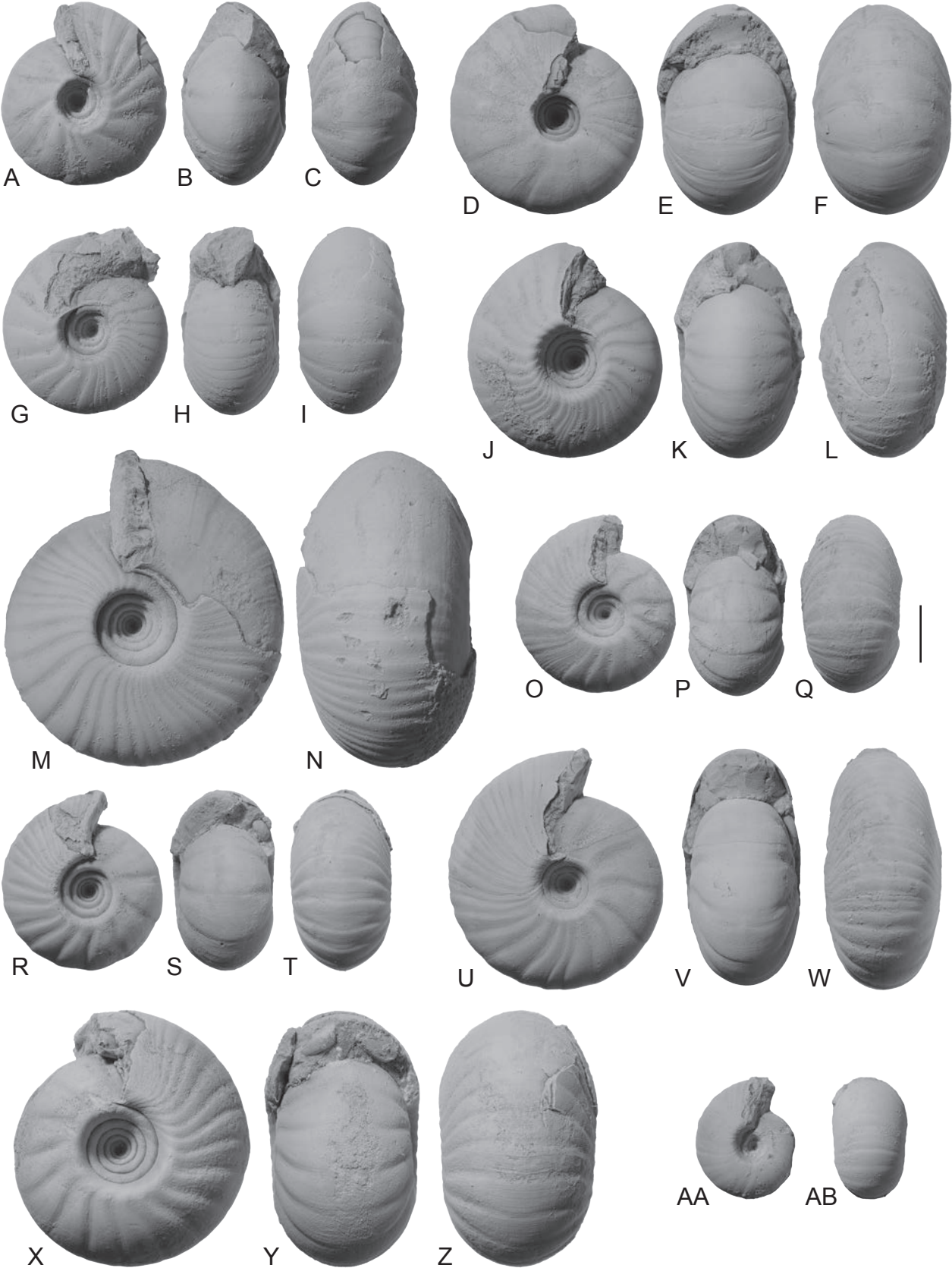
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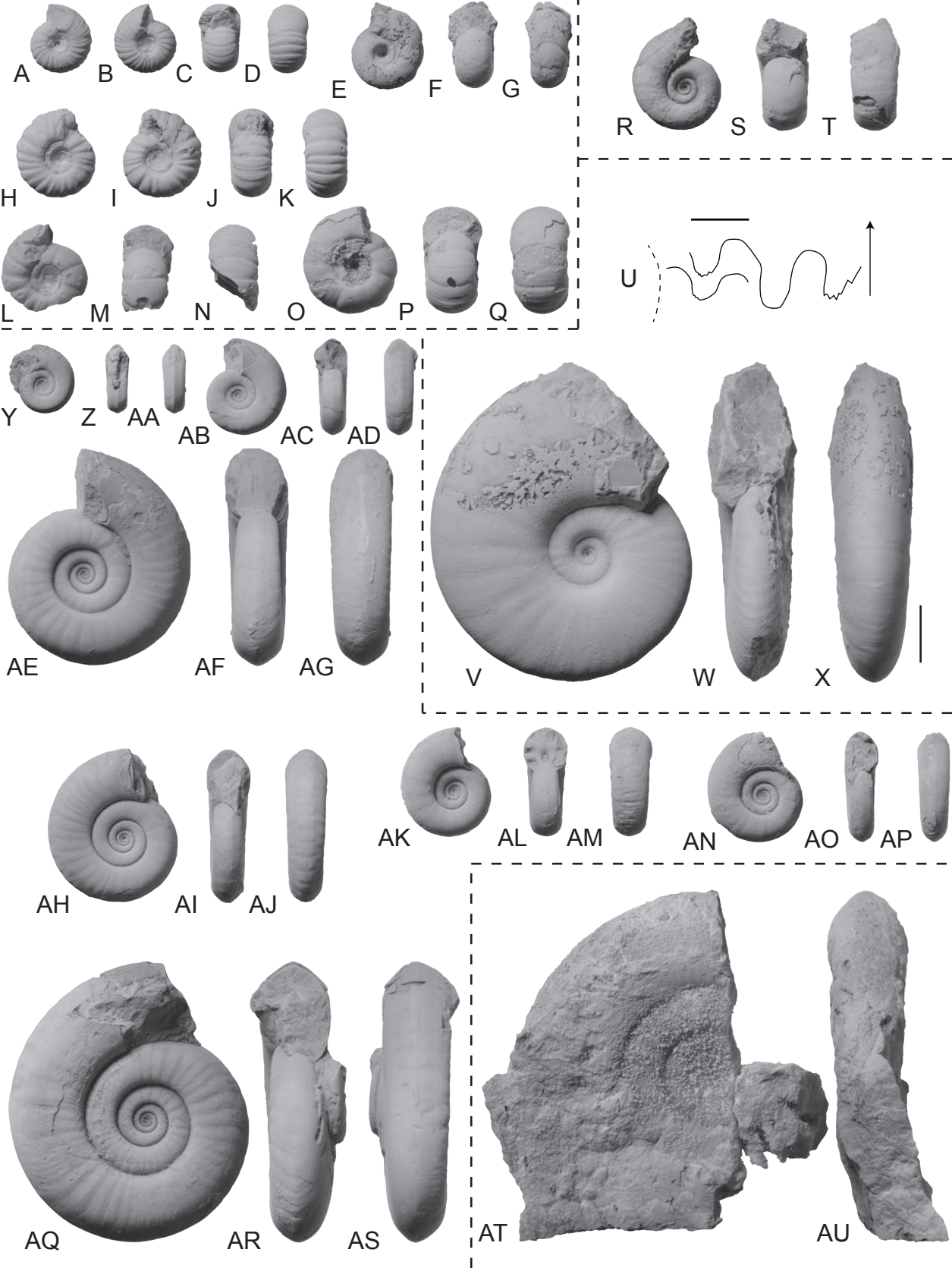
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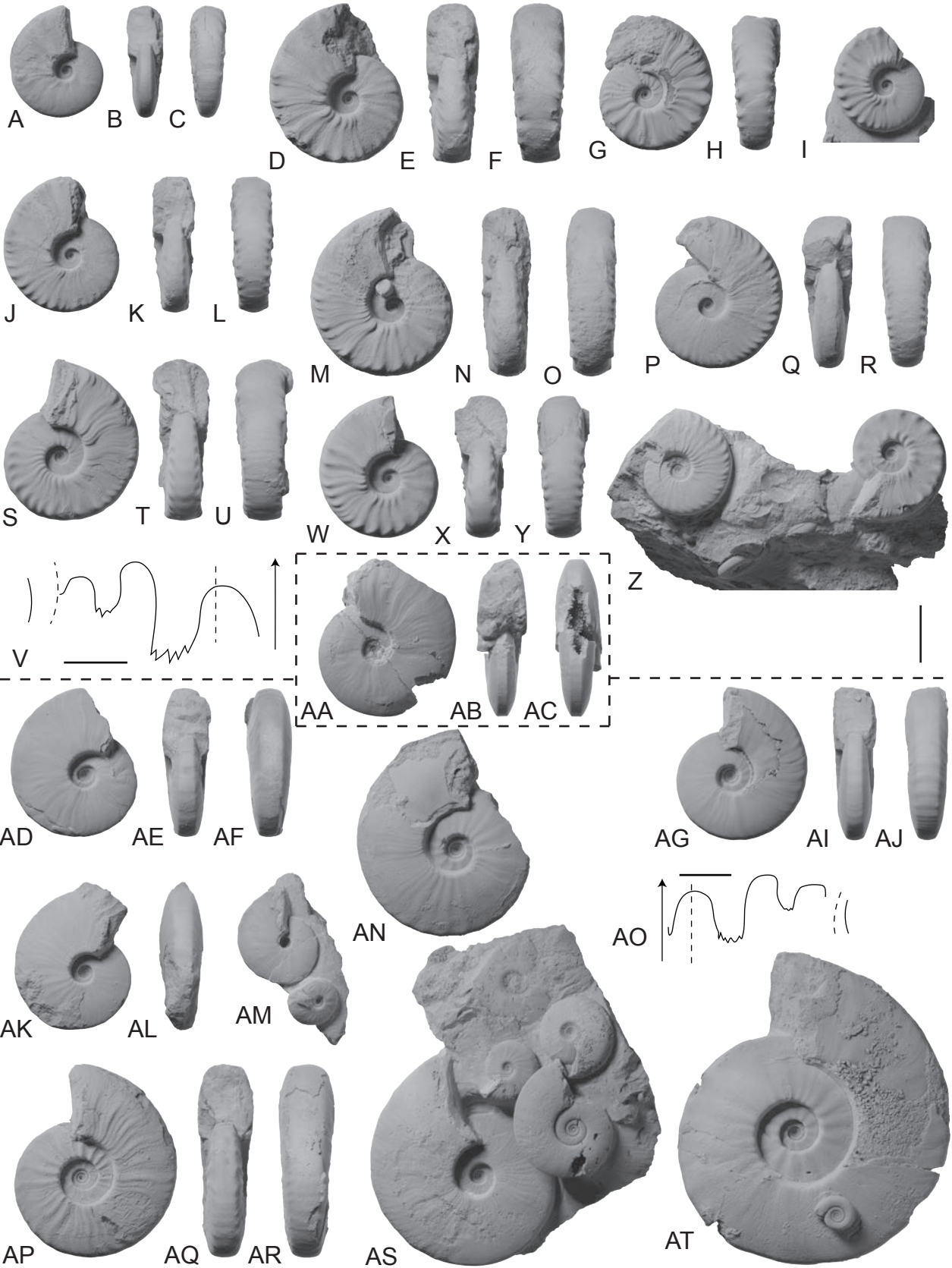
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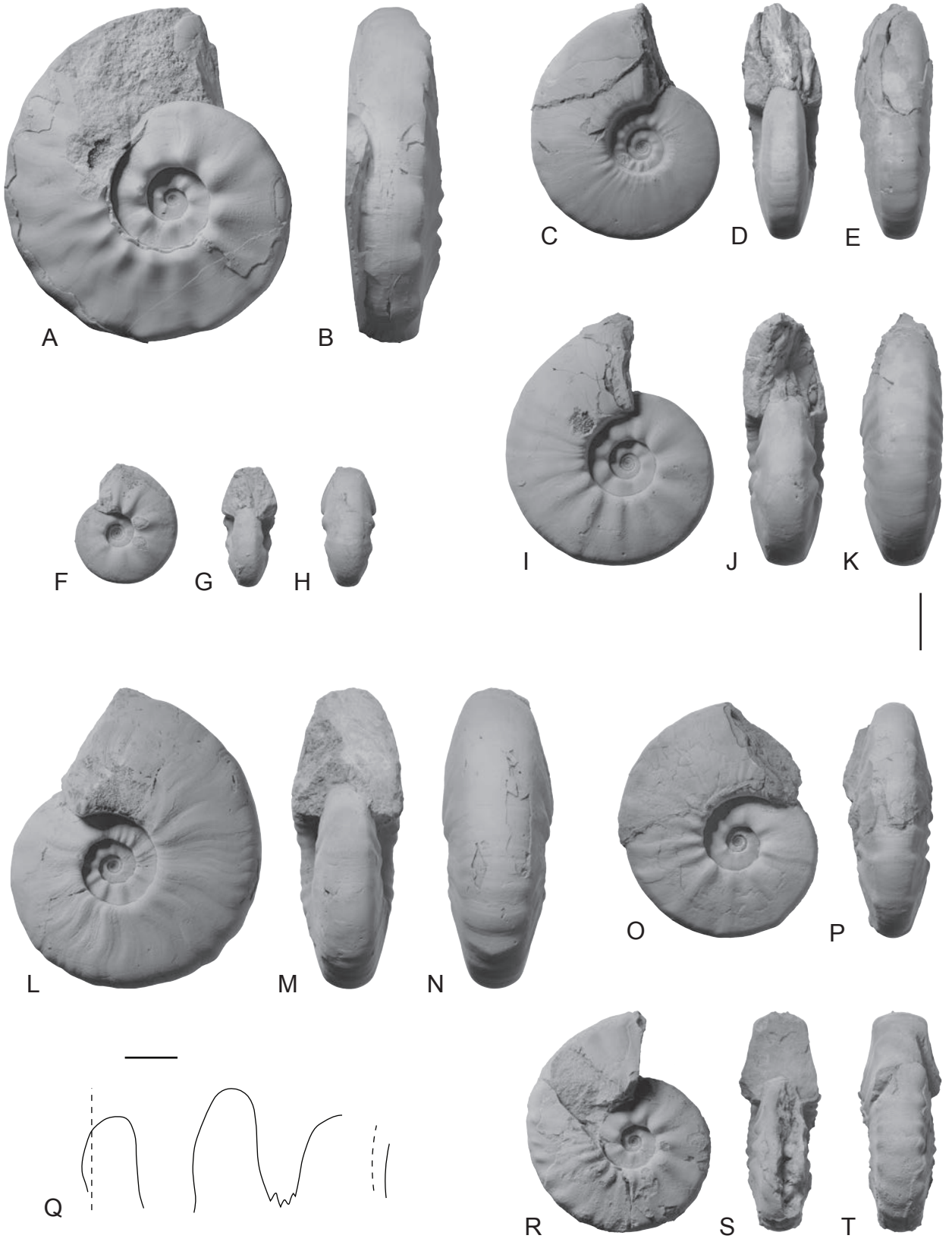
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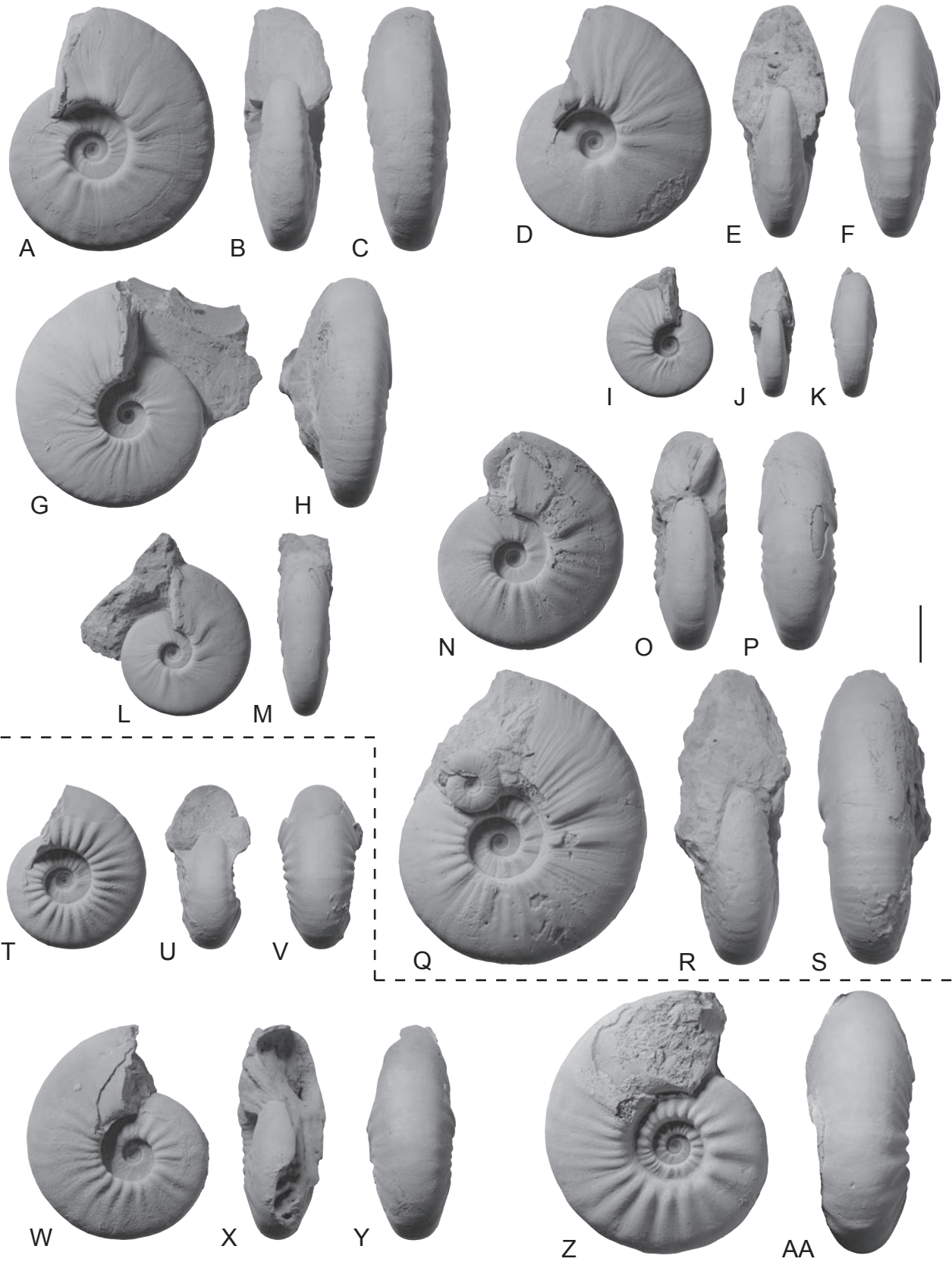
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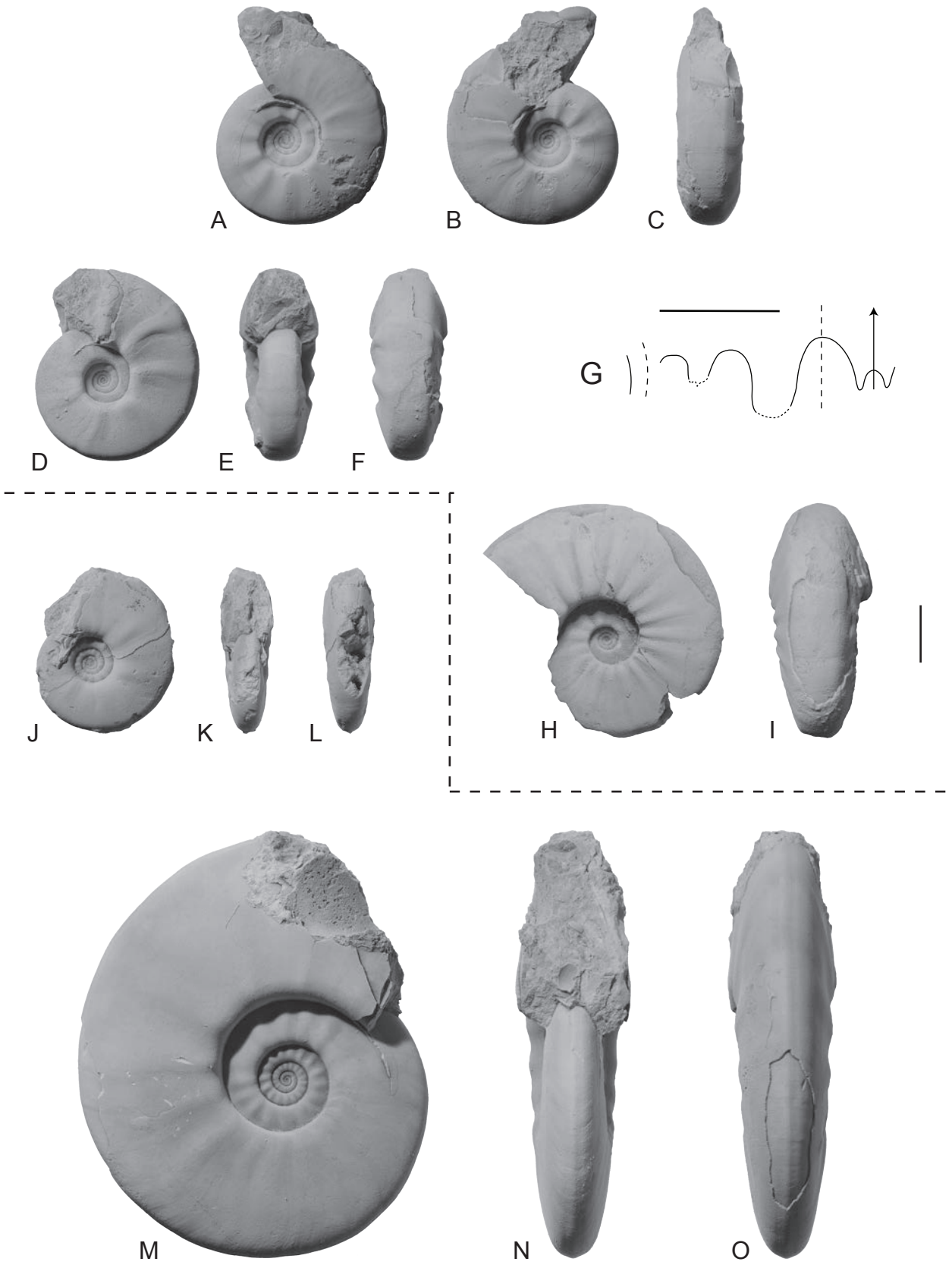
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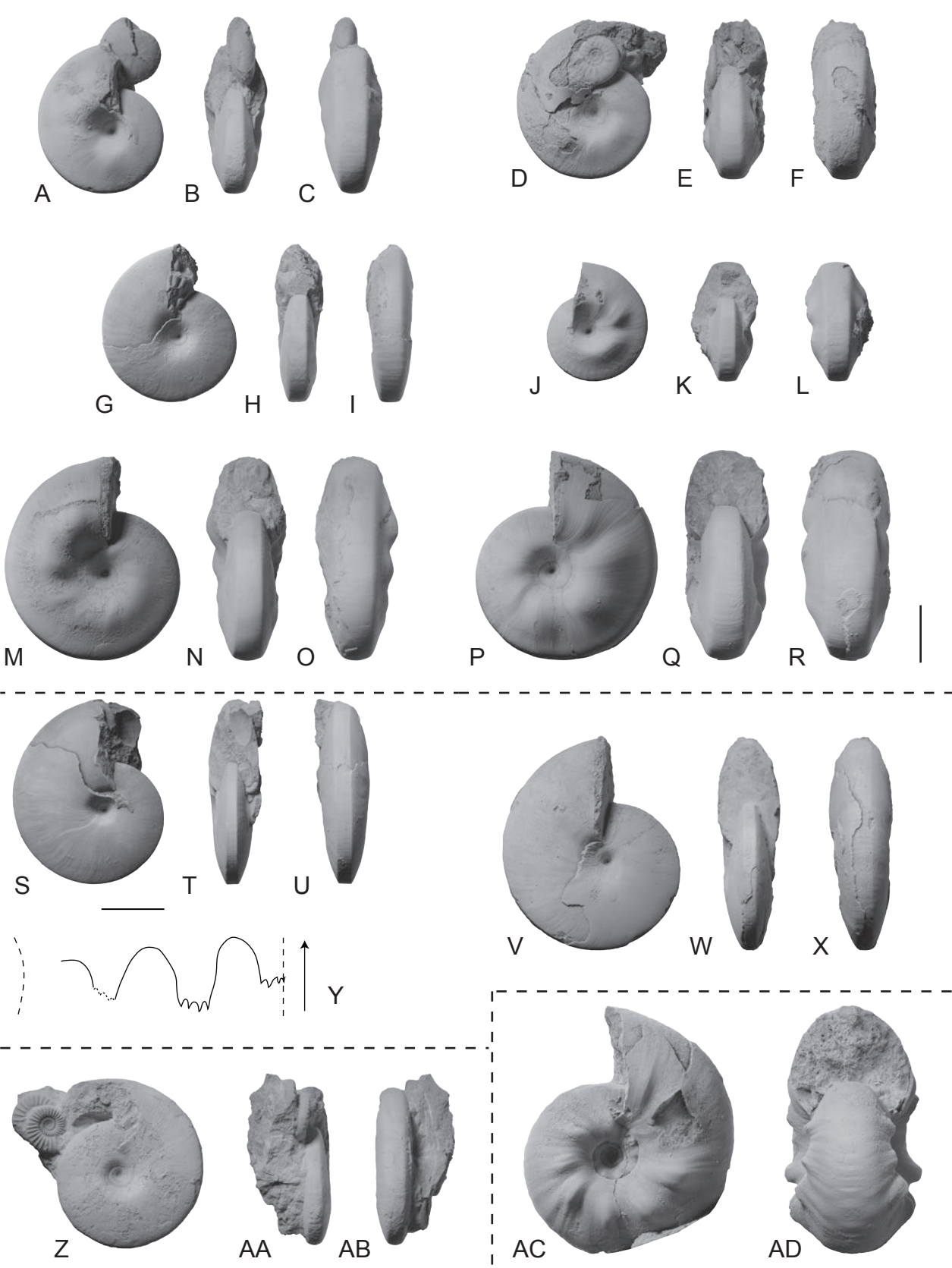
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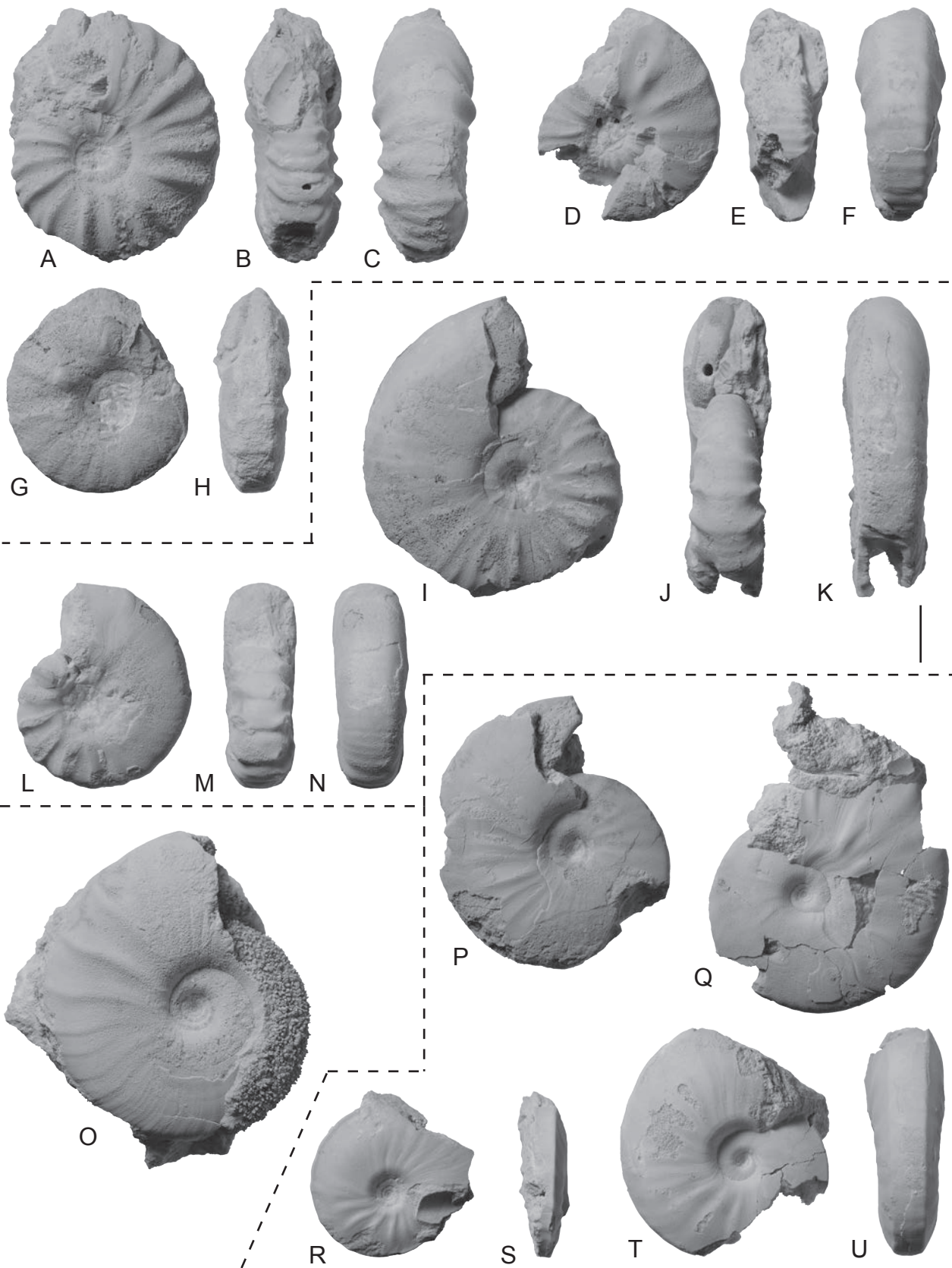
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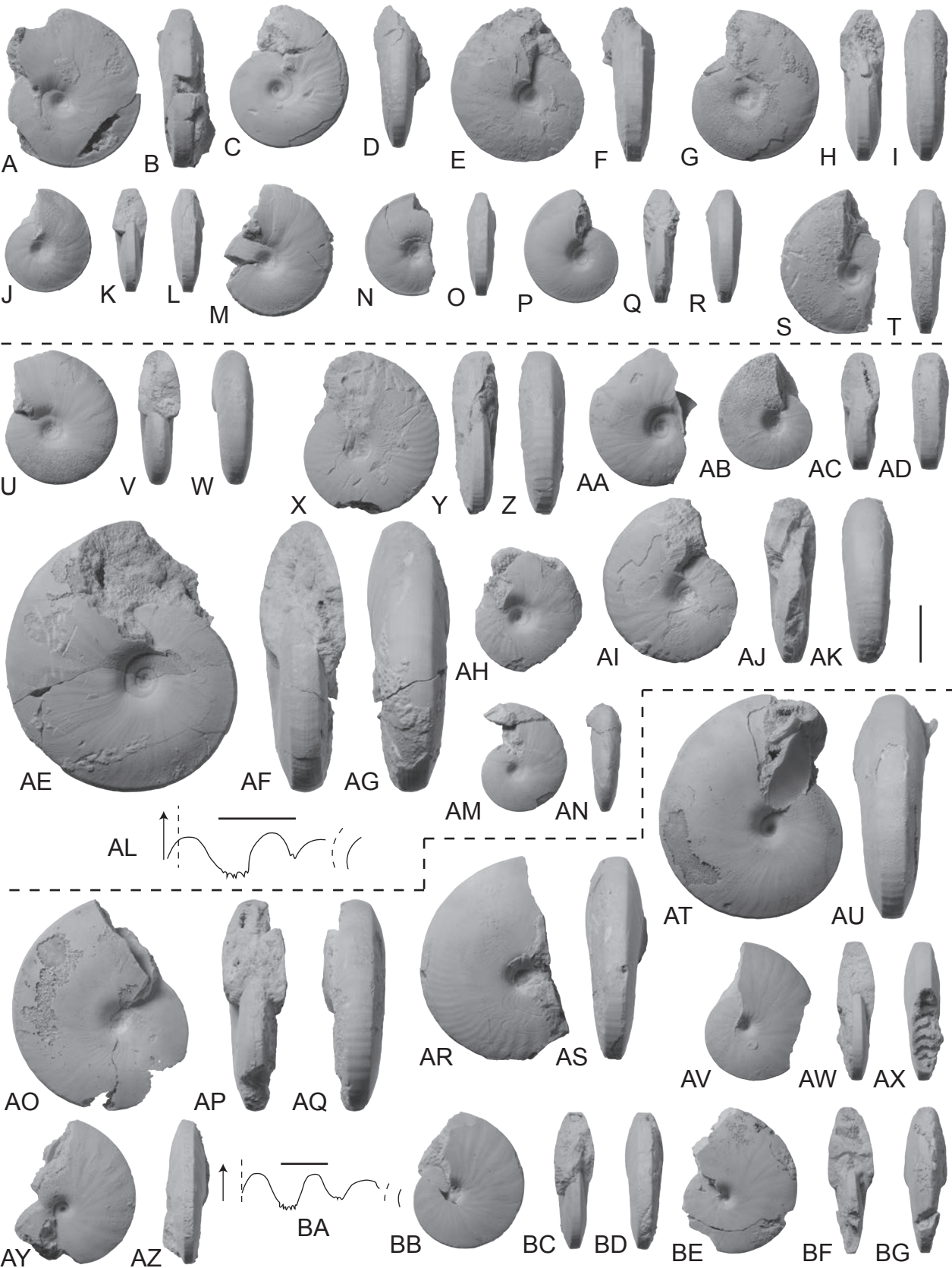
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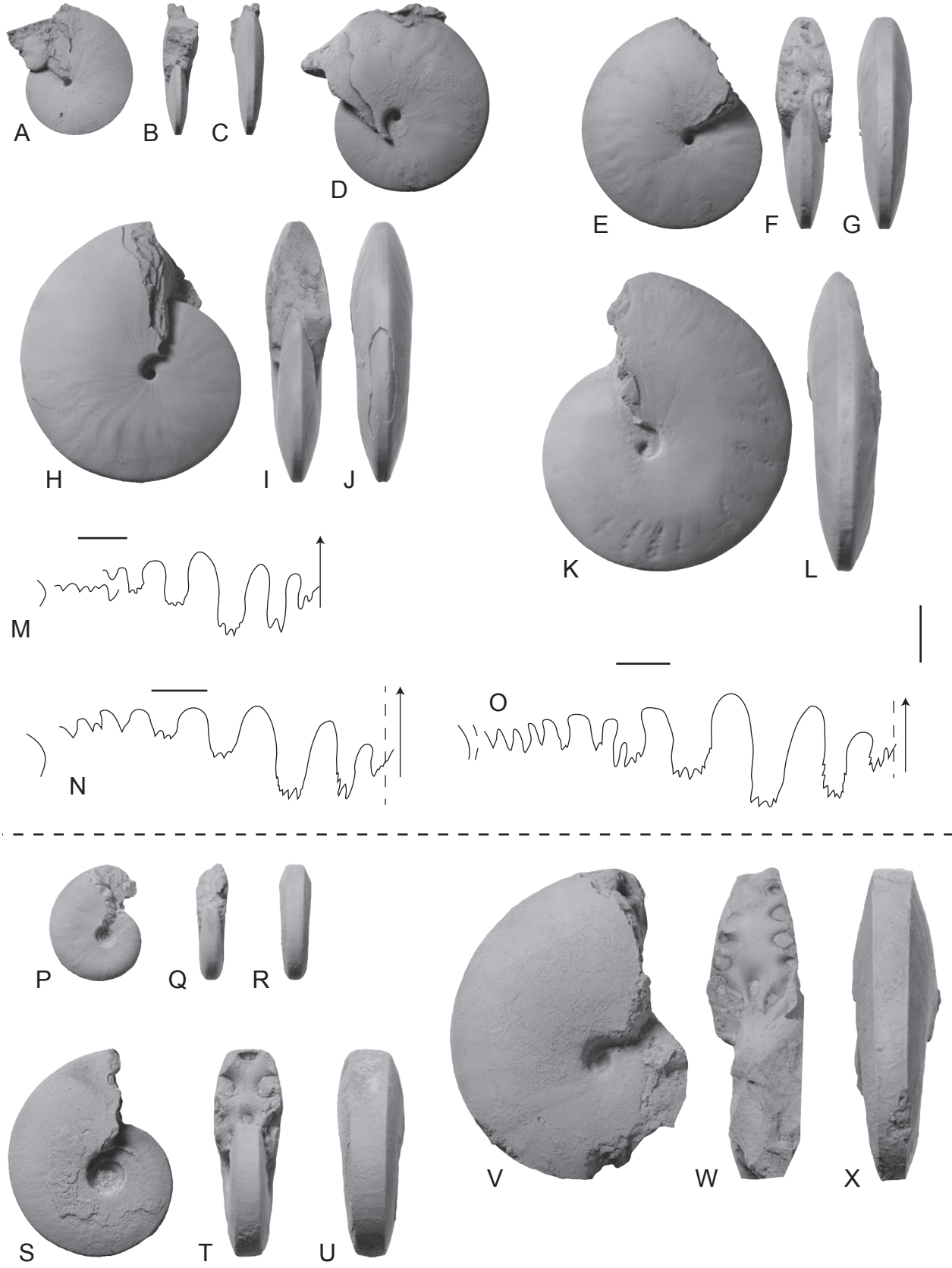
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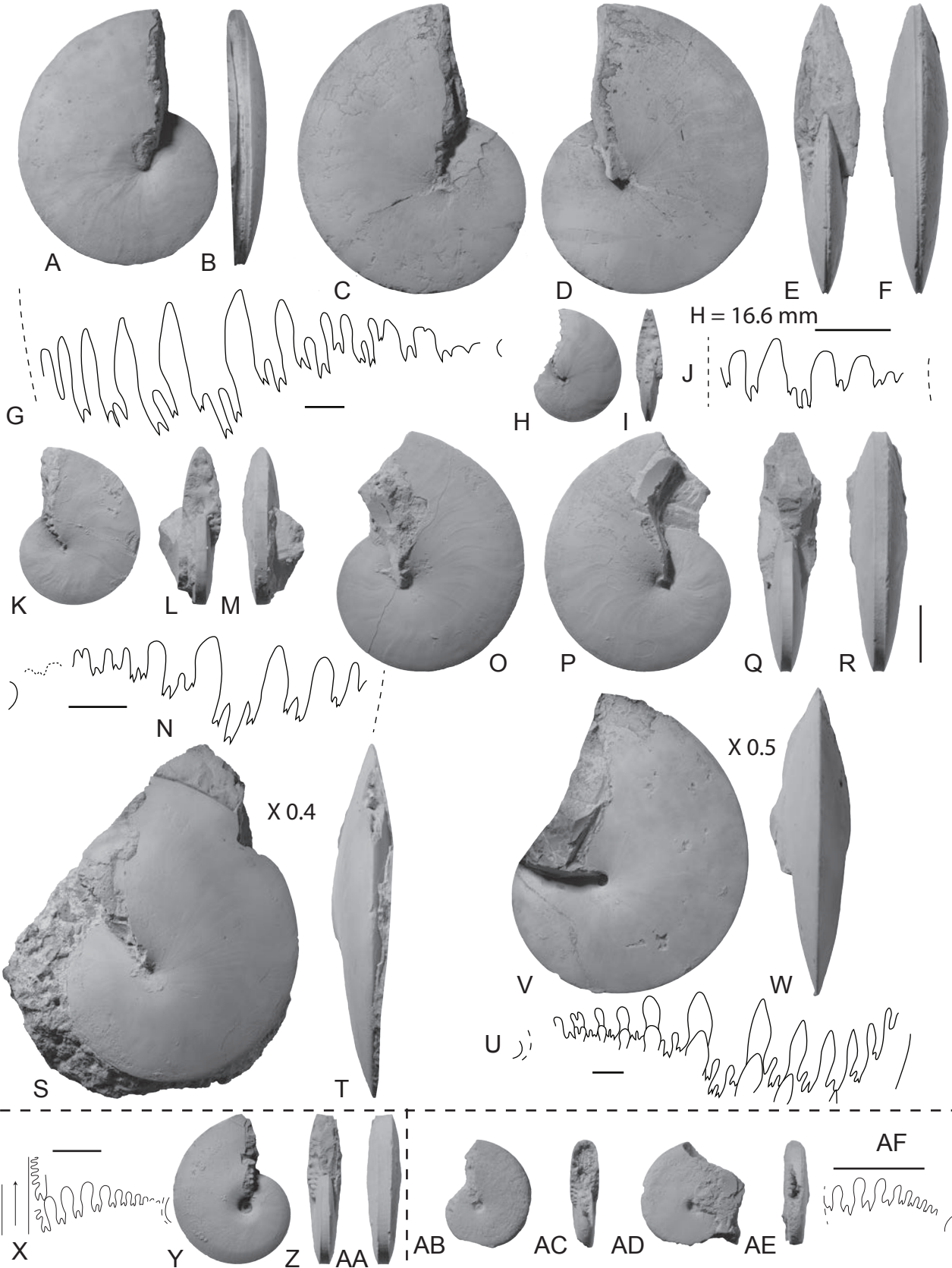
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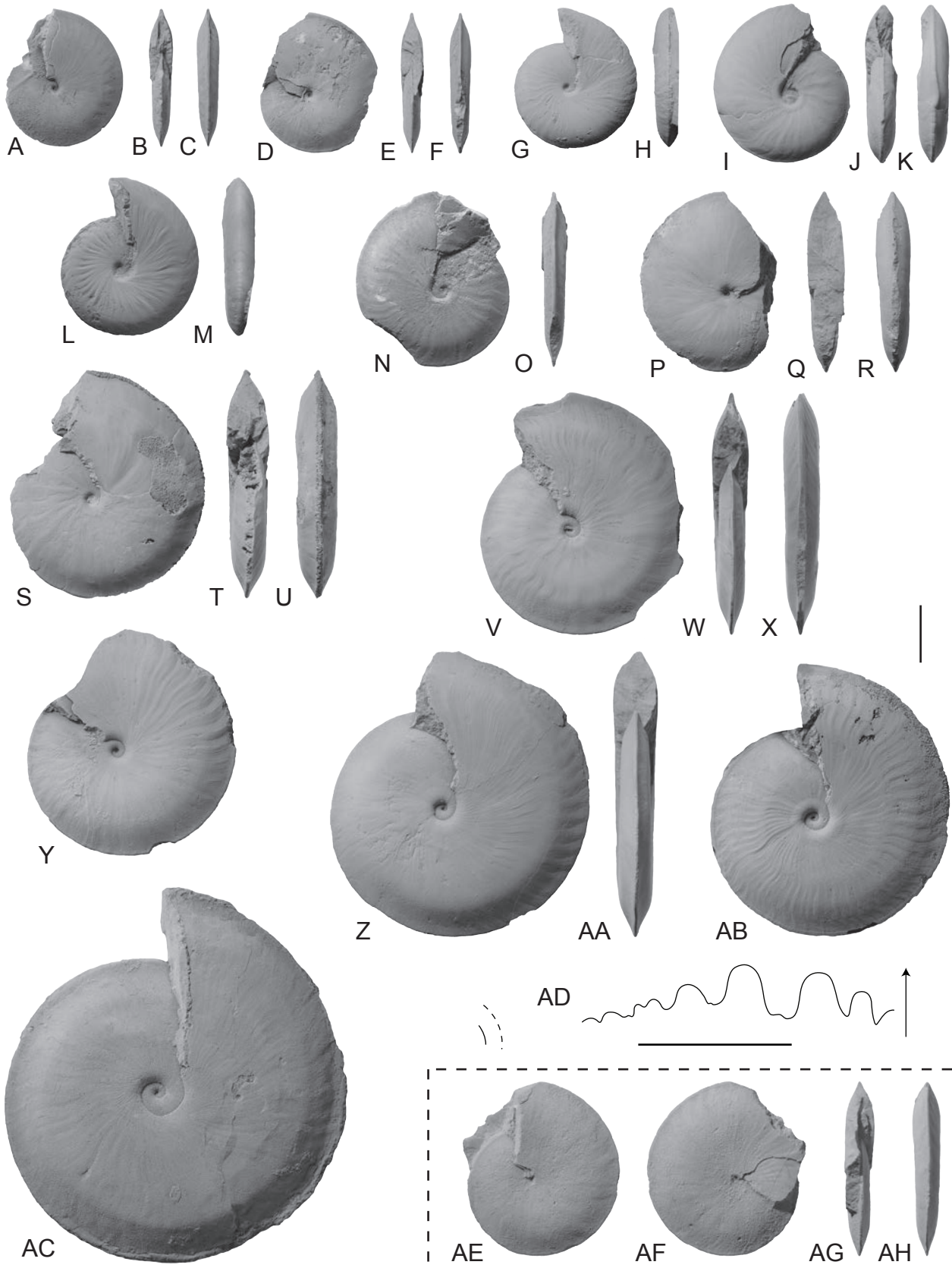
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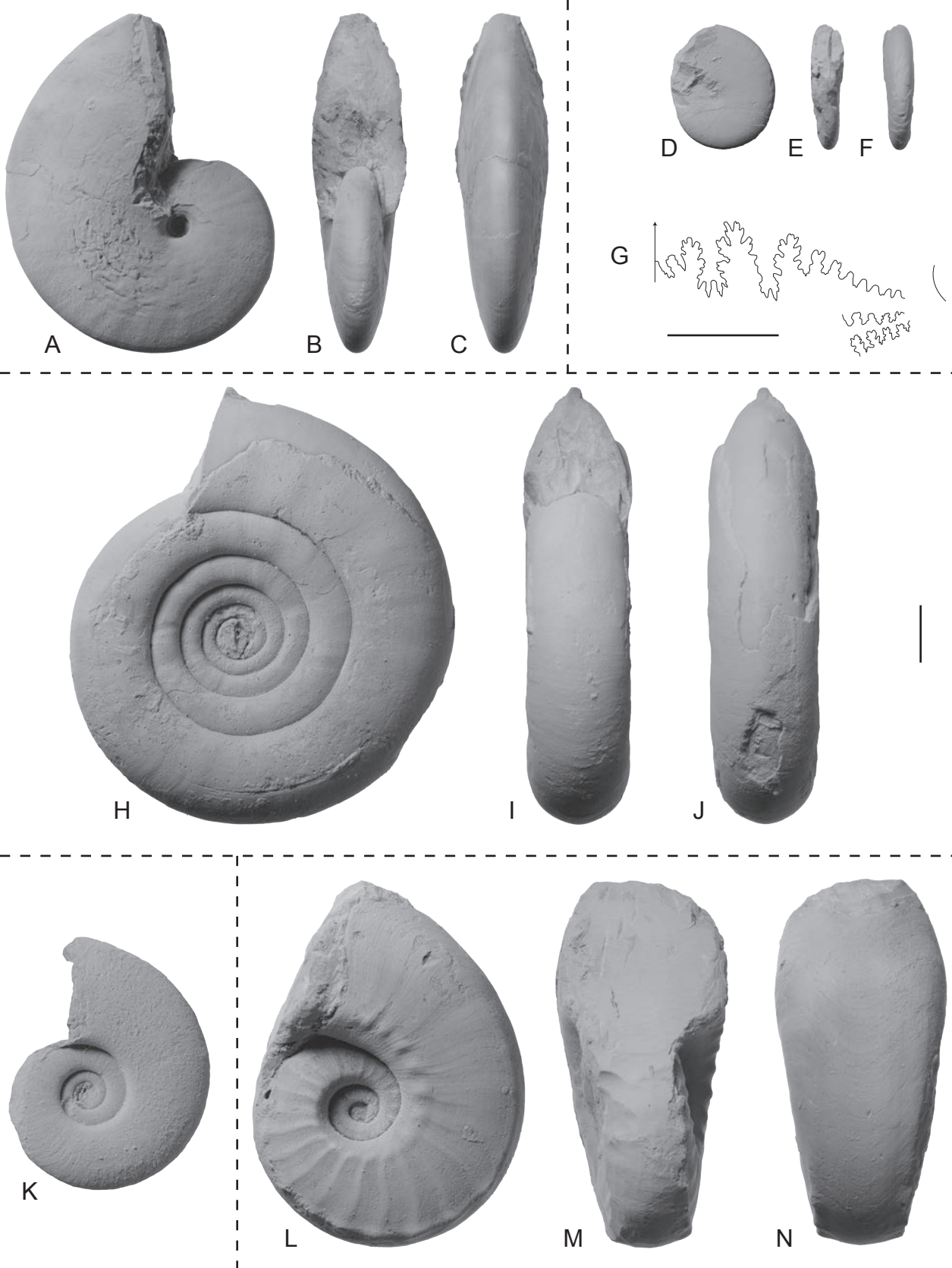
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