Mediterranean Neocomian belemnites, part 4: belemnites of the Barremian stratotype section

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Abstract: This paper deals with the distribution of belemnites in the latest Hauterivian to early Bedoulian of the Angles Barremian Stratotype Section (ABSS). The distribution of the belemnites in the ABSS is not uniform, mainly due to the inaccessibility of certain beds. To cover this, and to compare the distribution with more proximal settings, we investigated a section to the north of Le Bourguet. The latest Hauterivian sediments mainly yield *Hibolithes* ex gr. *subfusiformis* besides some *Duvalia* ex gr. *dilatata*. The earliest Barremian sediments deliver a richer association that yields the last *Hibolithes* spp. The first typical Barremian belemnites occur just one bed above the Hauterivian-Barremian boundary based on ammonites. This belemnite association (BaBA1) consists of *Duvalia* ex gr. *silesiacagagrica*, *Duvalia pontica* and several species of *Hibolithes*. At the boundary between the *Nicklesia pulchella* and the *Kotetishvilia compressissima* zones the diversity increases and the first classical Barremian belemnites occur. These were formerly attributed to *Mesohibolites* (BaBA2). These species are herein attributed to a new genus *Shvetsovia*. Together with the duvaliids from BaBA1 they were first described from Abkhasia by SHVETSOV (1913). The latest Early Barremian (BaBA3) and the earliest Late Barremian (BaBA4) show well diversified belemnite associations, with many classical species, dominated by few genera closely resembling the true *Mesohibolites*. Eventually, these belemnite associations are compared to more proximal sections within the Vocontian Basin, and areas outside the Vocontian Basin (chiefly Hungary and Georgia). Some differences in the frequency and abundance of several species in these different palaeogeographical settings are believed to indicate differences in natural habitat. *Duvalia* ex gr. *grasiana* appears to be more abundant in more distal sections, while juvenile Mesohibolitidae, *Conohibolites* and *Curtohibolites* appear to be more abundant in the more proximal environments. Finally, a biozonation is presented and defined based on the distribution of the belemnites in the ABSS. This biozonation appears applicable in the more proximal sections, although some biozones are diachronous. The first *Mesohibolites* occur in the Upper Barremian *Imerites giraudi* Zone. In the Barremian-Bedoulian boundary sediments, as defined in the ABSS, *Neohibolites* first occurs, but the latter is only dominant in the marly sediments above the "calcareous Bedoulian". In the Late Barremian-early Bedoulian seven main belemnite associations can be distinguished, *viz.* BaBA5, BaBA6, BaBA7, BdBA1, BdBA2, BdBA3 and BdBA4. The following new species and genera are described: *Hibolithes keleptrishvilii* sp. nov. (latest Hauterivian), *Duvalia vermeuleni* sp. nov. (Early Barremian), *Curtohibolites* (?) *bourguetensis* sp. nov. (Early Barremian), and *Shvetsovia* gen. nov. (late Early-early Late Barremian). Besides, the Late Barremian yields the new species *Mesohibolites anglesensis*. Moreover, eleven species are described in open-nomenclature.

Key Words: Angles; Hauterivian; Barremian stratotype; Bedoulian; Aptian; Belemnites; Bourguet; stratigraphy.

Citation : JANSSEN N.M.M., CLÉMENT A. & BONT W. (2012).- Mediterranean Neocomian belemnites, part 4: belemnites of the Barremian stratotype section.- Carnets de Géologie [Notebooks on Geology], Brest, Memoir 2012/02 (**CG2012_M02**), p. 201-274.

Résumé : ***Bélemnites néocomiennes des régions méditerranéennes, 4ème partie: bélemnites de la coupe stratotypique du Barrémien.***- Cette étude aborde la distribution des bélemnites de l'Hauterivien terminal au Bédoulien inférieur de la Coupe Stratotypique du Barrémien d'Angles (ABSS). La distribution des bélemnites sur l'ABSS n'est pas uniforme, principalement due à l'inaccessibilité de certains bancs. Pour y remédier et pouvoir comparer leur distribution avec celle qui est observée en des domaines moins profonds, nous avons étudié d'autres localités comme les environs du Bourguet. Les sédiments de l'Hauterivien terminal ont fourni principalement *Hibolithes* ex gr. *subfusiformis* et quelques *Duvalia* ex gr. *dilatata*. Les sédiments du Barrémien basal ont livré une association plus riche comportant les dernières *Hibolithes* spp. Les premières bélemnites barrémiennes apparaissent juste un banc au dessus de la limite Hauterivien-Barrémien fondée sur les ammonites. Cette association de

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Manuscript online since December 10, 2012
[Editor: Michel MOULLADE; copy editor: Christian C. EMIG; language editor: John STARMER]

bélemnites (BaBA1) se compose de *Duvalia* ex gr. *silesiaca-gagrica*, *Duvalia pontica* et de plusieurs espèces d'*Hibolithes*. À la limite des zones à *Nicklesia pulchella* et *Kotetishvilia compressissima*, la diversité augmente et apparaissent alors les bélemnites "classiques" du Barrémien. Anciennement attribuées au genre *Mesohibolites* (BaBA2), ces espèces sont à présent rattachées au nouveau genre *Shvetsovia*. En association avec les duvaliidés de BaBA1 elles ont été initialement décrites dans l'Abkhazie par SHVETSOV (1913). Le Barrémien inférieur somminal (BaBA3) et la partie basale du Barrémien supérieur (BaBA4) montrent des associations de bélemnites diversifiées, avec de nombreuses espèces classiques. En particulier les niveaux du Barrémien inférieur terminal et du Barrémien supérieur basal montrent une association riche et diversifiée, dominée par quelques genres ressemblant étroitement aux vrais *Mesohibolites*. Ces associations de bélemnites sont ensuite comparées à celles de plusieurs coupes plus proximales dans le Bassin vocontien et à des zones situées en dehors du Bassin vocontien (principalement la Hongrie et la Géorgie). Certaines différences dans la fréquence et l'abondance de plusieurs espèces dans ces diverses coupes sont censées refléter des différences dans leur habitat naturel. *Duvalia* ex gr. *grasiana* semble être plus abondante dans les coupes les plus distales, tandis que les jeunes Mesohibolitidae, *Conohibolites* et *Curtohibolites* semblent être plus abondants dans les environnements plus proximaux. Les premiers *Mesohibolites* ont été récoltés dans le Barrémien supérieur (zone à *Imerites giraudi*) et les derniers dans le partie sommitale du "calcaire Bédoulien". Les premiers *Neohibolites* ont été récoltés dans la "zone non caractérisée" (Barrémien-Bédoulien) de l'ABSS, mais ce genre est plus fréquent dans les dépôts du "Bédoulien marneux". Les dépôts du Barrémien supérieur-Bédoulien inférieur se composent de sept associations de bélemnites, *viz.* BaBA5, BaBA6, BaBA7, BdBA1, BdBA2, BdBA3 et BdBA4. Pour conclure, une biozonation est présentée, définie par la distribution des bélemnites dans l'ABSS. Cette biozonation semble applicable dans les coupes les plus proximales, bien que certaines biozones puissent être diachrones. Les nouvelles espèces et les nouveaux genres suivants sont décrits: *Hibolithes keleptrishvilii* sp. nov. (Hauterivien terminal), *Duvalia vermeuleni* sp. nov. (Barrémien inférieur), *Curtohibolites* (?) *bourguetensis* sp. nov. (Barrémien inférieur), *Shvetsovia* gen. nov. (Barrémien) et *Mesohibolites anglesensis* sp. nov. (Barrémien supérieur). Enfin onze taxons ont été laissés en nomenclature ouverte.

Mots-Clefs : Angles ; Hauterivien ; Barrémien stratotype ; Bédoulien ; Aptien ; bélemnites ; Bourguet ; stratigraphie.

1. Introduction

We present information about the distribution of belemnites in the Angles Barremian Stratotype section (ABSS). This section is exposed along the road to the hamlet of Angles, Alpes-de-Haute-Provence (Fig. 1), and encompasses latest Hauterivian to early Bedoulian sediments. The section starts with beds that are exposed to the right of a small road. Depending on the conditions the first two beds are often covered by loose sediments (Pl. 18, fig. A). To the left of this road, few beds are visible, but these are generally not well exposed.

The exposures along the road to Angles are selected as a stratotype section for the Barremian (BUSNARDO, 1965, p. 103; FLANDRIN 1967). Former biostratigraphic studies, chiefly ammonites (VERMEULEN, 1980a, 1996, 1998a, 1998b, 2002, 2005; DELANOY, 1995, 1998; BERT *et al.*, 2008), give us the opportunity to present our data in a well-established stratigraphic framework. We will deal with the latest Hauterivian to Bedoulian belemnites from the section. Furthermore, supplementary information regarding the distribution of these belemnites was obtained by comparing with other sections. Additional stratigraphical information came from the so-called "coupe complémentaire (ou coupe C)" (BUSNARDO, 1965, p. 105, fig. 2). The latter section will be named by its acronym COM throughout the text, as it is often referred to as the Combe Lambert section (DELANOY, 1995, 1998; BODIN *et al.*, 2009). Actually this area is known as "Les Hermas" on the cadastral maps. Additional information about the palaeogeographical distribution of the Early Barremian belemnites came from a more proximal section near Le Bourguet, Var (Fig. 1; to the south of Castellane), and in between these sections, section DLX (Fig. 1; to the west of the hamlet of Demandolx).

Except for the unpublished work of CLÉMENT (2000), papers that relate to the distribution of belemnites in the Barremian of the western Mediterranean Tethys are absent. However, some papers deal with single finds or faunal lists (KILIAN, 1896, 1913; CONTE, 1989; COMBÉMOREL, 2000). Guided by the fact that we collected over 700 belemnites from the ABSS, and are able to put them into a suitable stratigraphic framework, this work contributes towards a better understanding of the stratigraphic distribution of the Barremian and the early Bedoulian belemnites. Moreover, as we are able to compare this distribution pattern with other regions, a first attempt at a proper biostratigraphic zonation based on belemnites seems possible.

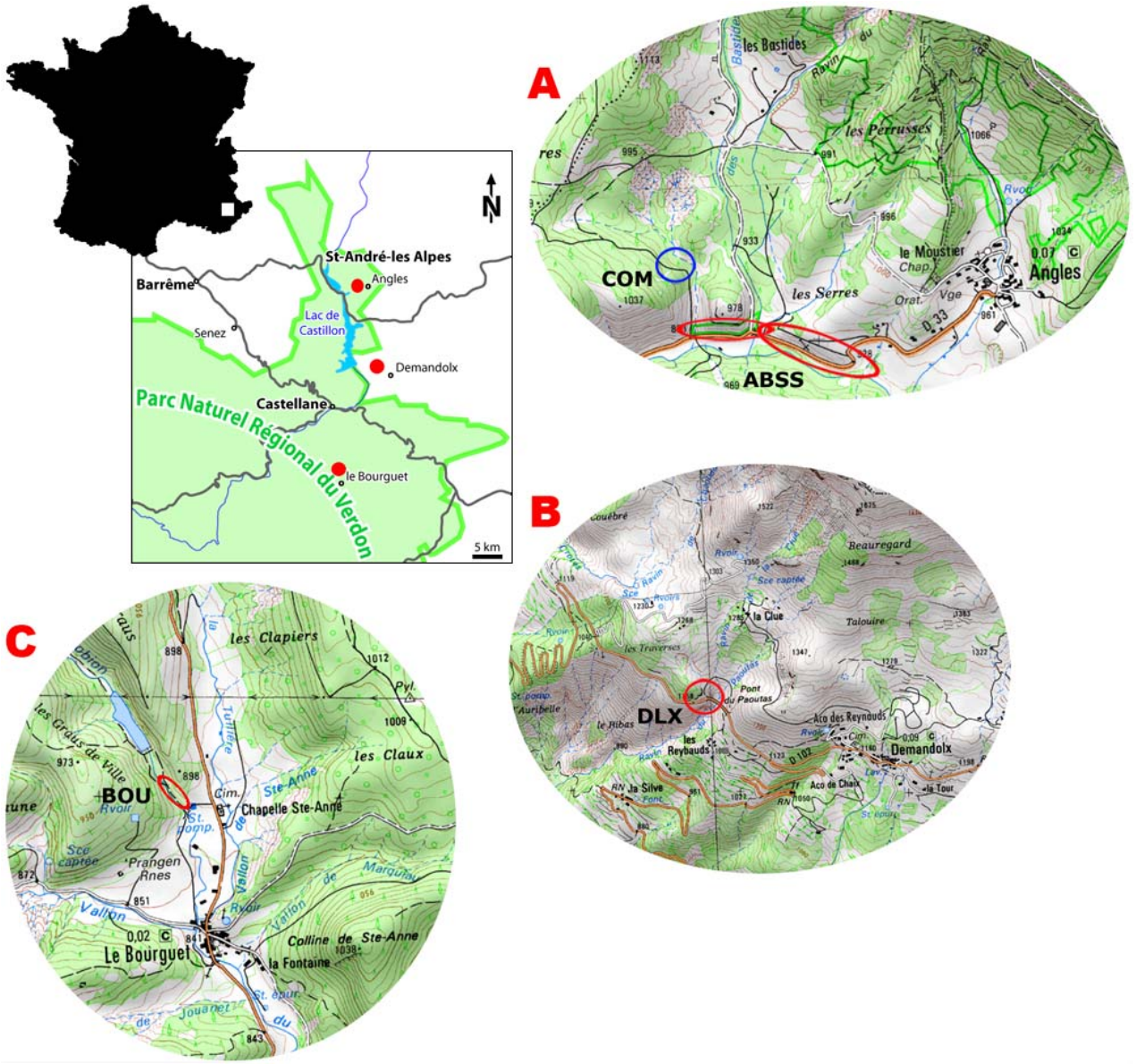

Figure 1: Geographical position of the sections investigated in the surroundings of Castellane. **A)** The Barremian Stratotype section, ABSS, is indicated by red ovals (Coordinates: 06°32'32.6"E - 43°56'28.8"N to 06°33'02"E - 43°56'24.8"N) and the section COM indicated by a blue circle (Coordinates: 06°32'33"E - 43°56'39"N). The Barremian-Bedoulian boundary is positioned roughly just ahead of the bend in the road. **B)** Section DLX (circled) to the west of the hamlet of Demandolx (Coordinates: 06°33'59"E - 43°52'24"N). **C)** The section BOU to the west of chapelle Ste-Anne, north of Le Bourguet, Var (Coordinates: 06°31'02"E - 43°47'20"N).

2. Lithology and stratigraphy

In the exposures along the road to the hamlet of Angles calcareous sedimentary rocks prevail, though certain intervals show dark coloured marls, sometimes with thin, undulating, very marly calcareous intercalations. Due to tectonically induced pressure, parts of the marly beds are diminished, as evidenced by tectonically disturbed and partially dissolved belemnites. Owing to minor faults, and some slopes consisting of fallen-down rock waste, minor parts of the Angles section were and still are less well exposed (see BUSNARDO, 1965, p. 110-111; VERMEULEN, 1980a; BUSNARDO & VERMEULEN, 1986). Especially the beds of latest Hauterivian age are momentarily affected by rock waste. However, the lithological development of the missing parts in the section herein depicted can be seen in VERMEULEN (2005, p. 31 and 38). The latest Hauterivian to earliest Barremian part of the section (Fig. 2) is characterized by more or less regular alternating calcareous and marly beds. At the moment the Late Hauterivian ammonite zonation is still debatable and several different proposals exist. For example, compare the papers of HOEDEMAEKER (1995), VERMEULEN (2002, 2004, 2005), and COMPANY *et al.* (2003).

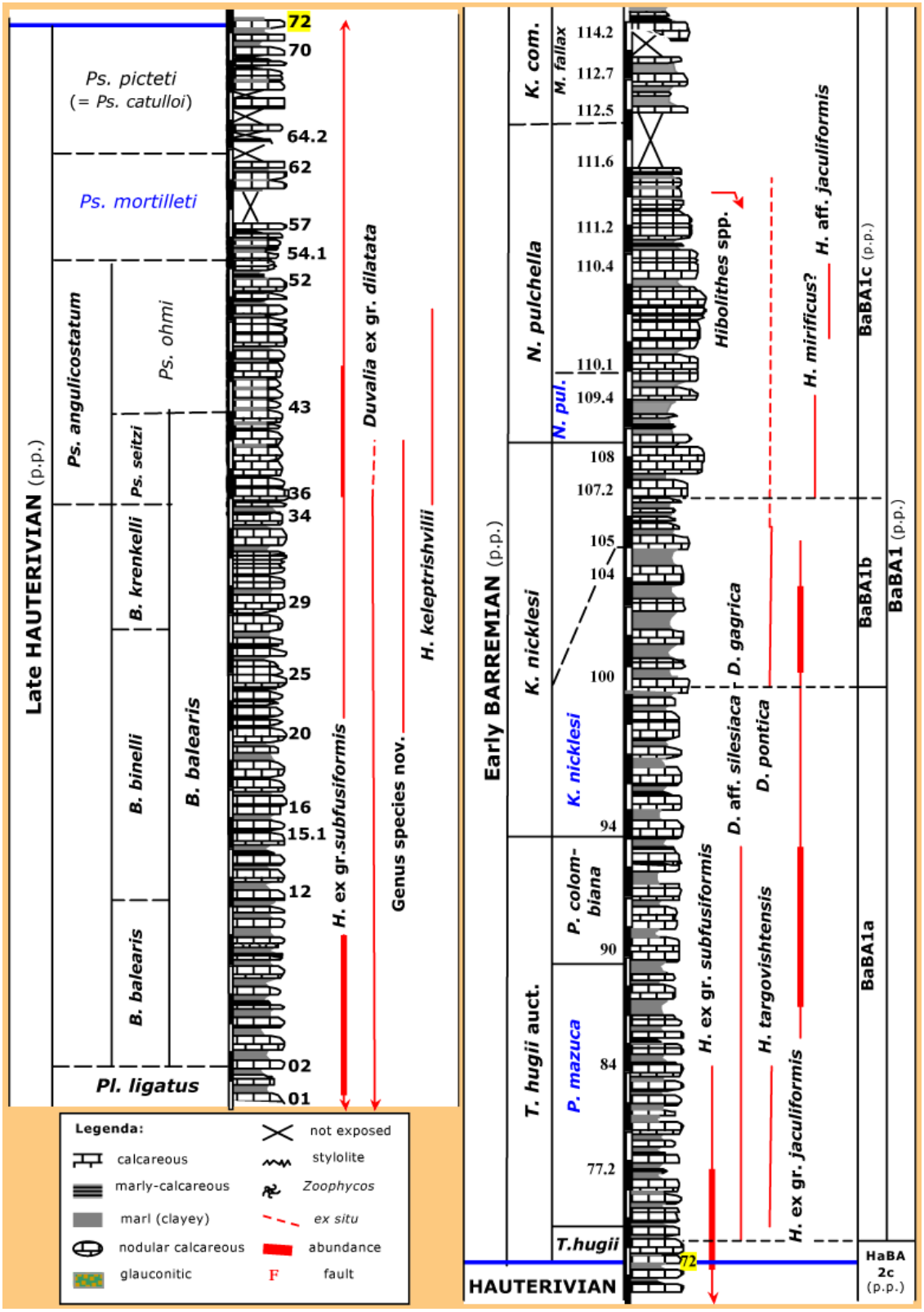

Figure 2: The stratigraphical distribution of belemnites in the latest Hauterivian to earliest Barremian (ANG001 to ANG114.3). See VERMEULEN (2005, p. 31 and 38) for non-exposed parts. Scale bar graduations = 1 m. Ammonite zones or subzones in blue are not (yet) accepted in REBOULET *et al.* (2011). Abbreviations: *B.* = *Balearites*, *D.* = *Duvalia*, *H.* = *Hibolithes*, *N. pul.* = *Nicklesia pulchella*, *K.* = *Kotetishvilia*, *K. com.* = *Kotetishvilia compressissima*, *M.* = *Metahoplites*, *P.* = *Psilotissotia*, p.p. = *pro parte*, *Pl.* = *Plesiospitidiscus*, *Ps.* = *Pseudothurmannia*, and *T.* = *Taveraidiscus*.

The Early Barremian *Nicklesia pulchella* and *Kotetishvilia compressissima* zones (Fig. 2; Pl. 18, fig. B) mainly yield rather thick calcareous beds, but sometimes more marly levels occur. Currently, the base of the Barremian is set at ANG072, while the base of the Upper Barremian is documented by the first occurrence of *Heinzia sayni* HYATT (ANG147.2; Pl. 19, fig. A; cf. VERMEULEN, 2002, p. 45) (Fig. 3). Conditionally, based on lithological grounds, this boundary was placed at ANG137 (BUSNARDO, 1965, p. 110-111), because the interval between the beds ANG137 to ANG152 was relatively devoid of ammonites. Still some parts of the studied interval, notably the Barremian-Bedoulian boundary interval, are relative devoid of characteristic ammonites. Also, belemnites appear to be distributed unevenly. Especially, the earliest Barremian, up to and including the base of the *K. compressissima* Zone yielded few belemnites only. In the late Early Barremian (*Coronites darsi* Zone) thick calcareous beds occur, alternated with relatively thick marly beds. In these marly sets, thin irregular marly to calcareous beds sometimes occur. The latter, especially the thinnest beds, often become visible as whitish, weathered layers with a peculiar powder-like appearance. From the top of the *C. darsi* Zone on, the lithology is dominated by calcareous beds, often separated by very small marly levels that are sometimes barely visible, while a thicker marl level only exists very sporadically. Herein, the *Holcodiscus uhligi* Zone *sensu* VERMEULEN (2002) marks the top of the Lower Barremian (Pl. 19, fig. A). It is not untill the *Imerites giraudi* Zone that marly sediments become again more pronounced but calcareous sediments remain the dominant lithology (Fig. 3). It should be noted that the name-bearing ammonite of the *I. giraudi* Zone was challenged by LEPINAY & VERMEULEN (2009, p. 96) and VERMEULEN & LEPINAY (2010a, p. 19, 22) in favour of *Imerites cristatus* (ORBIGNY). However, eventually they concluded, guided by the acceptation these species being distinct, that only a small adjustment of the base of the name-bearing ammonite zone would be necessary (VERMEULEN & LEPINAY, 2010b, p. 107).

Along the road to Angles, the upper part of the section, *i.e.*, the "calcareous Bedoulian" is disturbed by a minor fault (between the beds ANG216 and ANG223; Pl. 4, fig. A) while the topmost part is covered by vegetation. Contrary, these beds are quite well exposed in the section COM (BUSNARDO, 1965, p. 105; DELANOY, 1995, Pl. 10; 1998, p. 218). The last bed of the "calcareous Bedoulian" is thought to be a hardground (BUSNARDO, 1965, p. 108; FLANDRIN, 1967), but that could not be confirmed in the field

As stated before, it is in the *I. giraudi* Zone that marly sediments become more pronounced. However, part of the apparent absence of readily visible marly levels might have been caused by tectonic pressure. Especially, the marly beds between ANG165.1 and ANG169.2 show signs of shearing. In the early Late Barremian a compressional fault system in the top of the *He. sayni* Zone is accompanied by some stylolites. It causes some fluctuations in the thickness of individual beds. This system is well visible along the road around the indication of hectometer 6 (Pls. 22-23). However, the absence of more marly levels might better be explained by a certain amount of condensation or bypassing. Some beds, notably the top of bed ANG169.1, show abundant corroded belemnites that could suggest some amount of condensation. Also, in the *Gerhardtia sartousiana* Zone (top of ANG161.2; Fig. 3) and in the marls of Bedoulian age (on top of COM137; Fig. 4), levels with pitted and worn belemnites occur. Moreover, the beds ANG161.2 top, ANG161.3/4-162 (Pl. 20-23), ANG171.2-172, and the top of bed ANG179.2 delivered some sponges (? *Elasmostoma*) attached to ammonites. Besides, the beds ANG161.2 (top part), ANG162 (VERMEULEN, 2002, p. 47), ANG165.1, ANG165.2, ANG167, and ANG170.1 (*G. sartousiana* Zone to the base of the *I. giraudi* Zone) do show traces of glauconite, confined to the surface of ammonite-remains. However, WISSLER *et al.* (2002) most probably overrated the amount of time which is presented by these, most probably local, condensations (see also BODIN *et al.*, 2009, p. 1257-1259).

Fig. 4 depicts the Late Barremian-early Bedoulian of the ABSS. The ammonite zonation is adopted and modified after DELANOY (1995, 1998) and VERMEULEN (2005). These modifications are based on bed-by-bed correlations with various sections in the neighbourhood. The data are extracted from the work of DELANOY (1995, 1998), *viz.* the sections of Descouère (DES), Grande-Terre (GT), Méouilles (MEO), and Moriez (MOR). Especially, the *Hemihoplites feraudianus* Subzone appears to be ill represented in the ABSS (Fig. 3), but see VERMEULEN *et al.*, 2009. Herein, ammonites occur (*i.e., Spinocrioceras*) that are known from the lower *Parancyloceras bidentatum* Zone of Germany (KEMPER, 1973; DELANOY & FÉRAUD, 1995; LEPINAY & VERMEULEN, 2009). The *H. feraudianus* Subzone marks the transition from the overall calcareous latest Early to early Late Barremian, to the late Late Barremian with more marked marly beds.

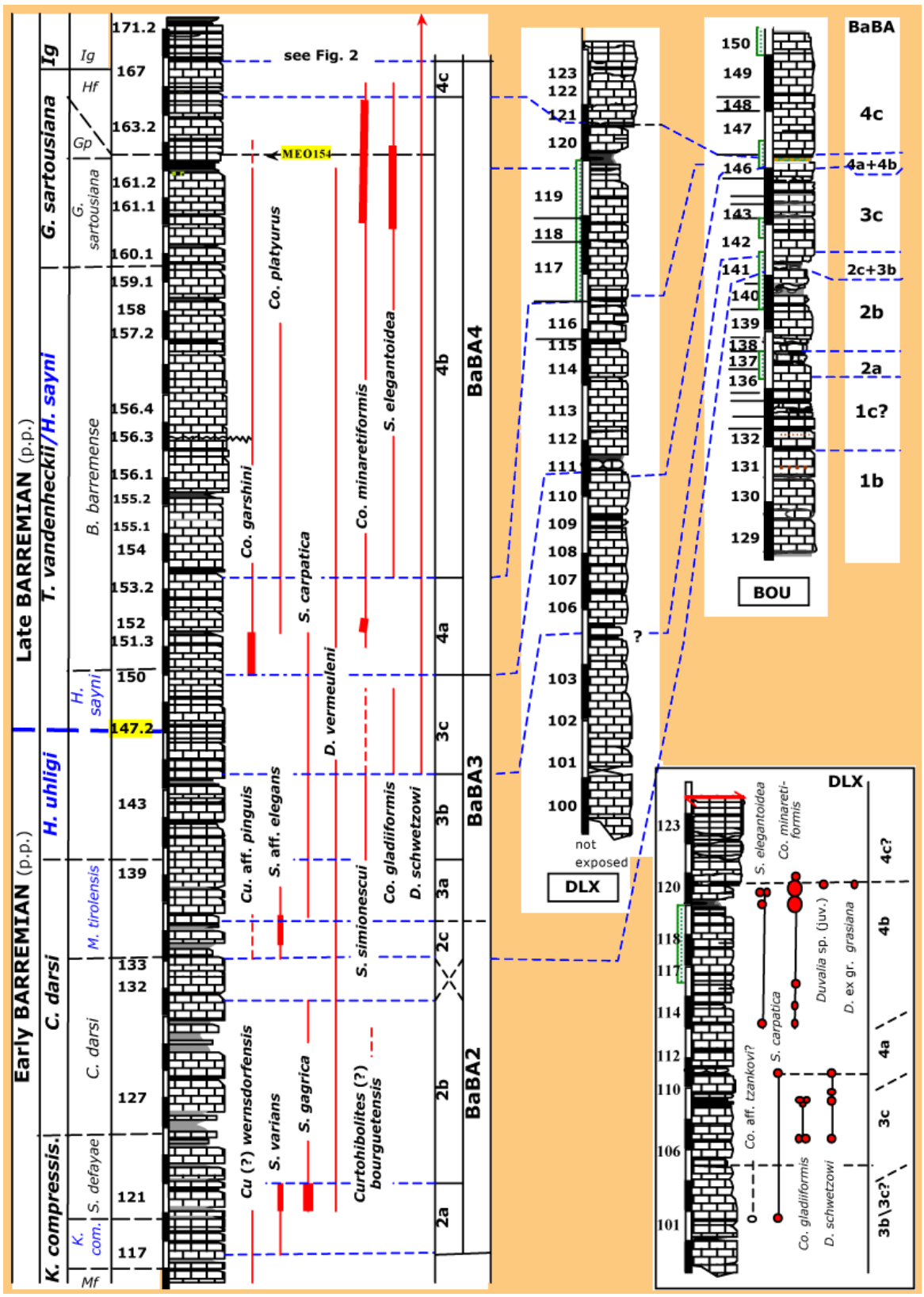

Figure 3: The late Early to early Late Barremian (ANG115 to ANG171.3) in the ABSS. From left to right are indicated: (sub-) stages, ammonite zones, ammonite subzones, bed-numbers, lithology (for legend explanation see Fig. 2), the FO and LO of the belemnite species, and the belemnite associations. Scale bar graduations = 1 m [note difference in seize between distal (ABSS) and proximal sections (DLX, BOU - see Fig. 5 for details)]. Ammonite zones and/or subzones in blue are not (yet) accepted in the latest publication of the KWG (REBOULET *et al.*, 2011). Abbreviations: *Co.* = *Conohibolites*, *K. com.* = *Kotetishvilia compressissima*, *Cu.* = *Curtohibolites*, *D.* = *Duvalia*, *Gp* = *Gerhardtia provincialis*, *Hf* = *Hemihoplites feraudianus*, *Ig* = *Imerites giraudi*, MEO = Méouilles, *K. com.* and *K. compressis.* = *Kotetishvilia compressissima*, *Mf* = *Metahoplites fallauxi*, and *S.* = *Shvetsovia*.

In the upper part of the Barremian of the ABSS, the top of the *Martelites sarasini* Subzone, age-indicative ammonites are rare or absent. However, the close Descouère section (DELANOY, 1998, p. 242: beds DES184 and DES186) yielded few correlative ammonites, notably *Pseudocrioceras* and some *Kutatisites*. This interval correlates to the beds ANG189 to ANG191. Particularly, in the area of the Bedoulian stratotype, a comparable ammonite association (CECCA *et al.*, 2000; ROPOLO *et al.*, 2000, 2006), is known from the top of the former *M. sarasini* Zone (now a Subzone; cf. REBOULET *et al.*, 2011). Its upper limit reaches just above the "ROCH Horizon" (*sensu* MOULLADE *et al.*, 2000). In the Bedoulian type-area near Marseille, DELANOY *et al.* (1997) placed the Barremian-Bedoulian boundary at the first occurrence of *Deshayesites* (see CECCA *et al.*, 2000). In the ABSS the first ammonite that characterizes the Bedoulian is apparently found in bed ANG200 [cf. KAKABADZE & KOTETISHVILI, 1995, p. 107 – *Prodeshayesites* ? sp. ind. (= deshayesitidae)]. The thick beds below this level and in the Combe Lambert section have not yielded any significant ammonites to date. This interval is known as the "non-characteristic interval", and ever since BUSNARDO (1965) the base of this level (bed ANG197) is used as the boundary between the Barremian and Bedoulian (Pl. 4, fig. B).

OOSTING *et al.* (2006) concluded that only few species of dinoflagellates appeared isochronous between the ABSS (Tethyan Realm) and the Austral Realm. Among those species *Pseudoceratium retusum* var. *securigerum* first occur in bed ANG199 of the ABSS. Also, the Boreal-Atlantic *Prodeshayesites fissicostatus* Zone yields this species. This suggests it as a good indicator of strata of early Bedoulian age. Recently, GUIOMAR & VERMEULEN (2010, p. 30) placed the Barremian-Bedoulian boundary even lower, *i.e.*, at bed ANG192 without further explanation.

The index ammonite for the early Bedoulian, *Paradeshayesites oglanlensis* (BOGDANOVA), is not known from the ABSS. It apparently does occur in the nearby Méouilles section in bed MEO199 [see DELANOY, 1998 (= DELANOY, 1995, Pl. 2, fig. 1a, 1b), p. 231, Pl. 6, fig. 3a, 3b (erroneously indicated from bed MEO208)]. However, according to BOGDANOVA & MIKHAILOVA (2004, p. 214) this species is more similar to *Paradeshayesites weissiformis*. Nevertheless, this still would indicate the same age. The bed MEO199 correlates with the middle part of bed ANG202 (Fig. 4). In bed ANG210, *Deshayesites* ex gr. *spathi-normanni* occurs: it is an ammonite characteristic for the *Deshayesites forbesi* Zone (former *Deshayesites weissi* Zone) (DELANOY, 1998, p. 221). It appears that in general, index or indicative ammonite species for the Barremian-Bedoulian boundary and the early Bedoulian interval are absent in the ABSS. This is believed to be the result of palaeogeographical bias, of shallow versus deeper taxa (DELANOY, 1995; ROPOLO *et al.*, 2006, p. 3-4).

3. Distribution of belemnites in the ABSS

Roughly, the Early to early Late Barremian can be divided into four main belemnite associations, *i.e.*, BaBA1, BaBA2, and BaBA3 and BaBA4 (the latter two are partially BaBA2 and BaBA3 *sensu* JANSSEN & FŐZY, 2005). The calcareous Late Barremian to Bedoulian can be divided into six main belemnite associations: BaBA5, BaBA6, BaBA7, BdBA1, BdBA2, and BdBA3 (Figs. 2 - 3 - 4).

The latest Hauterivian did not deliver abundant belemnites but the general picture is comparable to other areas in and outside the Vocontian Basin. Based on ammonites, the Hauterivian-Barremian boundary is fixed at ANG072 in the ABSS (VERMEULEN, 2002). So far, the first genuine Barremian belemnites occur in the marly level above ANG073. This earliest Barremian belemnite association (BaBA1) yields species first described from Gagra (or Gagry) in Abkhazia by SHVETSOV (1913) and to some extent recorded from the ABSS by CLÉMENT (2000, "faune à *Duvalia*"). The earliest Barremian, up to and including part of the *N. pulchella* Zone, yields belemnites that are closely related to Hauterivian taxa. The typical Hauterivian *H.* ex gr. *subfusiformis* last occurs in the *Taveraidiscus hugii* Zone, together with *H. targovishtensis*. It is succeeded by *H.* ex gr. *jaculiformis*. The last occurrence of this species is recorded in the *Kotetishvilia nicklesi* Zone. However, closely related species occur in the *N. pulchella* Zone. The latter interval yields ? *Hibolithes mirificus* STOYANOVA-VERGILOVA, 1965, and strongly flattened fusiform species, either related to *H. mirificus*, the *jaculiformis*-group or to *Shvetsovia* (a new genus, see palaeontological part). Also, in Hungary this interval yielded peculiar, yet rather indefinite, taxa like *Curtohibolites bakalovi* (STOYANOVA-VERGILOVA, 1965) and *H. mirificus*. These taxa appear to represent a transitional fauna between the earliest Barremian BaBA1 and BaBA2.

Subsequently, there is a belemnite association (BaBA2) that is also characterized by belemnites first described from Gagra. Most characteristic is the *S. varians-gagrica* group, accompanied by a new species related to *Duvalia grasiana* (DUVAL-JOUVE, 1841) and *Curtohibolites* (?) *wernsdorfensis* STOYANOVA-VERGILOVA, 1963. The first elements of BaBA2 occur in ANG115. The beds of the *K. compressissima* Acme Subzone yield a relative abundant fauna of belemnites dominated by the *S. gagrica-varians* group. The first genuine *Curtohibolites* STOYANOVA-VERGILOVA, 1963, occurs in the upper part of the *C. darsi* Zone (BaBA2).

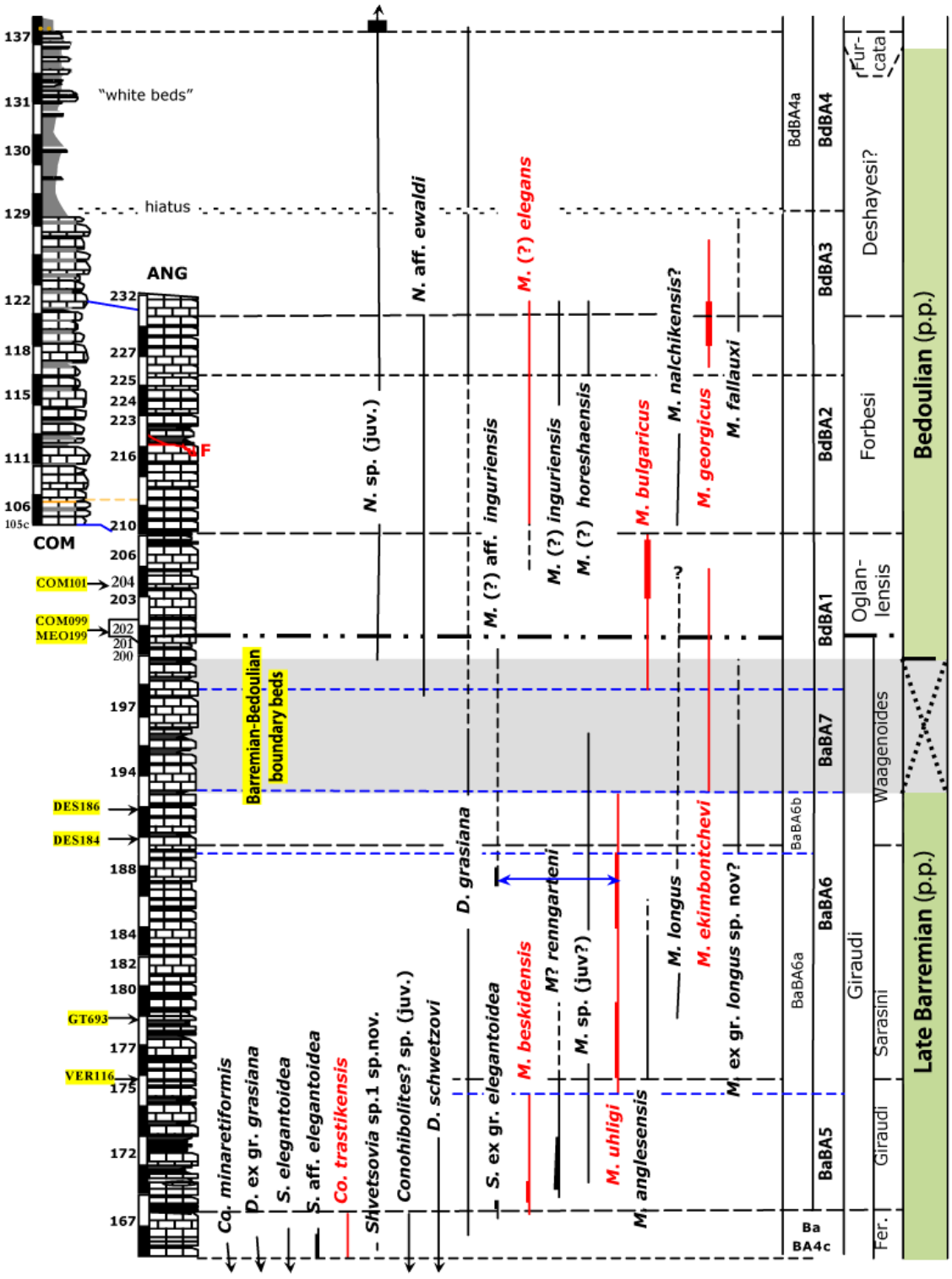

Figure 4: Distribution of belemnites in the latest Late Barremian to early Bedoulian. See Fig. 2 for legend explanation. Abbreviations: *Co.* = *Conohibolites*, *D.* = *Duvalia*, F = fault, Fer. = *Hemihoplites feraudianus*, *M.* = *Mesohibolites*, *N.* = *Neohibolites*, *S.* = *Shvetsovia*, ANG = Angles, COM = Combe Lambert, DES = Descoure, GT = Grande Terre, MEO = Méouilles, and VER = Vergons-1 (cf. DELANOY, 1995, 1998). Scale bar graduations = 1 m.

This association is followed by BaBA3 and BaBA4, or "mid" Barremian association *sensu* JANSSEN & FŐZY (2004, 2005). Species of the *Conohibolites gladiiformis* - *Shvetsovia carpatica* complex characterize BaBA3. Also, *Shvetsovia simionescui* and common *D.* ex gr. *grasiana* occur in this interval. BaBA4 is packed with a group of belemnites preceding the true *Mesohibolites*, of which *Conohibolites* ex gr. *minaretiformis* (SHVETSOV, 1913) and *Shvetsovia elegantoidea* (STOYANOVA-VERGILOVA, 1965) are the most common in the ABSS. These belemnites appear to be especially abundant in the upper part of the *Toxancyloceras vandenheckii* Zone (*Barrancyloceras barremense* Subzone; Pl. 21,

fig. B) and disappear in the *H. feraudianus* Subzone. Also, the last *Conohibolites* [*Co. trastikensis* (STOYANOVA-VERGILOVA, 1965)] disappears in the *H. feraudianus* Subzone. *S. elegantoidea* is succeeded by *Shvetsovia* ex gr. *elegantoidea* (STOYANOVA-VERGILOVA, 1965). The latter disappears in the lower part of the *I. giraudi* Zone (ANG168-169.1).

The first *Mesohibolites* [*Mesohibolites beskidensis* (UHLIG, 1883)] occurs in the *I. giraudi* Zone. Species that show intermediate characteristics between *Shvetsovia* and *Mesohibolites* also appear here. This species is herein refered to as *Mesohibolites* (?) *renngarteni* KRYMGOL'TS, 1939. It is quite abundant in the *I. giraudi* Subzone and disappears in the lower part of the *M. sarasini* Subzone. In the lower and topmost part of the *M. sarasinii* Subzone *Mesohibolites uhligi* (SHVETSOV, 1913) becomes abundant, as does a new species of belemnite, *viz.* "*Mesohibolites minaret* RASPAIL" *sensu* KELEPTRISHVILI *in* TOPCHISHVILI *et al.*, 2002 (= *Mesohibolites anglesensis* sp. nov., see palaeontological part). In the marly calcareous bed ANG171.1 a small belemnite that is very similar to *Neohibolites* first occurs. This belemnite is either a juvenile specimen of *Mesohibolites*, related to *Neohibolites*, or related to the Georgian "*Hibolites*" ex gr. *bsibiensis* RUKHADZE, 1938. The latest Barremian is characterized by robust belemnites related to *Mesohibolites bulgaricus* (STOYANOVA-VERGILOVA, 1965) and *Mesohibolites ekimbontchevi* STOYANOVA-VERGILOVA, 1965. *Duvalia grasiana* occurs throughout the *I. giraudi* Zone. However, this species appears to be absent, or very rare, in the Barremian-Bedoulian boundary beds. It is again relative common in the uppermost part of the "calcareous Bedoulian".

Mesohibolites bulgaricus STOYANOVA-VERGILOVA, 1965, is also characteristic for the lowermost beds of the Bedoulian, where it occurs in abundance. In addition, *Mesohibolites georgicus* NAZARISHVILI, 1973, *Mesohibolites fallauxi* (UHLIG, 1883), *Mesohibolites* (?) *elegans* (SHVETSOV, 1913), *Mesohibolites* (?) ex gr. *horeshaensis-inguriensis* (RUKHADZE, 1938), *Neohibolites* aff. *ewaldi* (STROMBECK, 1861), and *Neohibolites* occur in these sediments. Like in Romania (BARRAGÁN & MELINTE, 2006, p. 533), *Neohibolites* appears earlier as compared to the Bedoulian deshayesitidae. However, it is nearly impossible to separate between juvenile *Mesohibolites* and *Neohibolites*, at least for part of the material (see palaeontological part).

4. Comparison to more proximal and more distal facies

Stratigraphical data from the Barremian interval concerning the distribution of ammonites are mainly based on the relative distal basin section of Angles and the platform deposits in the Bedoulian type-area (la Bédoule-Cassis). To the north and northwest of Angles, and to the north of the Montagne de Lure, more inward basin facies are developed in typical subpelagic marl-limestone deposits (FERRY, 1989, p. 32-35). Therein, frequent and abundant disturbances in the sedimentary development occur. As a result, the latest Hauterivian, the Barremian and the Bedoulian sedimentation is rather complex in the Vocontian Basin. These large and small-scaled gravity-driven deposits (FERRY & FLANDRIN, 1979; FERRY, 1989; FRIÈS & PARIZE, 2003) result in areas with chaotic lithology, and other areas with sedimentary gaps on various scales.

CLÉMENT (2000, p. 5-6) depicted a section near Montclus (cf. Palluel section and other sections figured by FERRY, 1989, p. 38-41), that show these synsedimentary gliding phenomena ("coulée boueuse") clearly. In the Montclus section, the base of the Barremian is characterized by the "Gagra-fauna", situated above a chaotic marly interval with glauconite, which yields reworked calcareous blocks, some with ammonites, pointing to the Hauterivian-Barremian boundary sediments. Abundant brachiopods, echinoids and belemnites occur in the marly sedimentary rocks. Among these, species characteristic for the "mid" Barremian occur (*Curtohibolites*, *Conohibolites* JANSSEN & FŐZY, 2005, and *Shvetsovia* gen. nov.). This level is succeeded by a calcareous succession with the ammonites *Camereiceras limentinus* (THIEULOY) and *Ezeiceras heberti* VERMEULEN (det. J. VERMEULEN), followed by an interval where characteristic latest Barremian to early Bedoulian *Mesohibolites* occur.

Despite being rare in the ABSS, the genus *Curtohibolites* is rather common in the more proximal palaeogeographical settings, with condensed and glauconitic calcareous and marly beds. *Curtohibolites* is also known from distal deposits near Montclus, Gard (CLÉMENT, 2000), and Serre de Bleyton, Drôme (JANSSEN, 2010). However, there gravity-flows are frequent (FERRY & FLANDRIN, 1979; FERRY, 2005; KROH *et al.*, 2010). Therefore, we assume these belemnites most probably to be transported into the deeper parts of the Vocontian Basin.

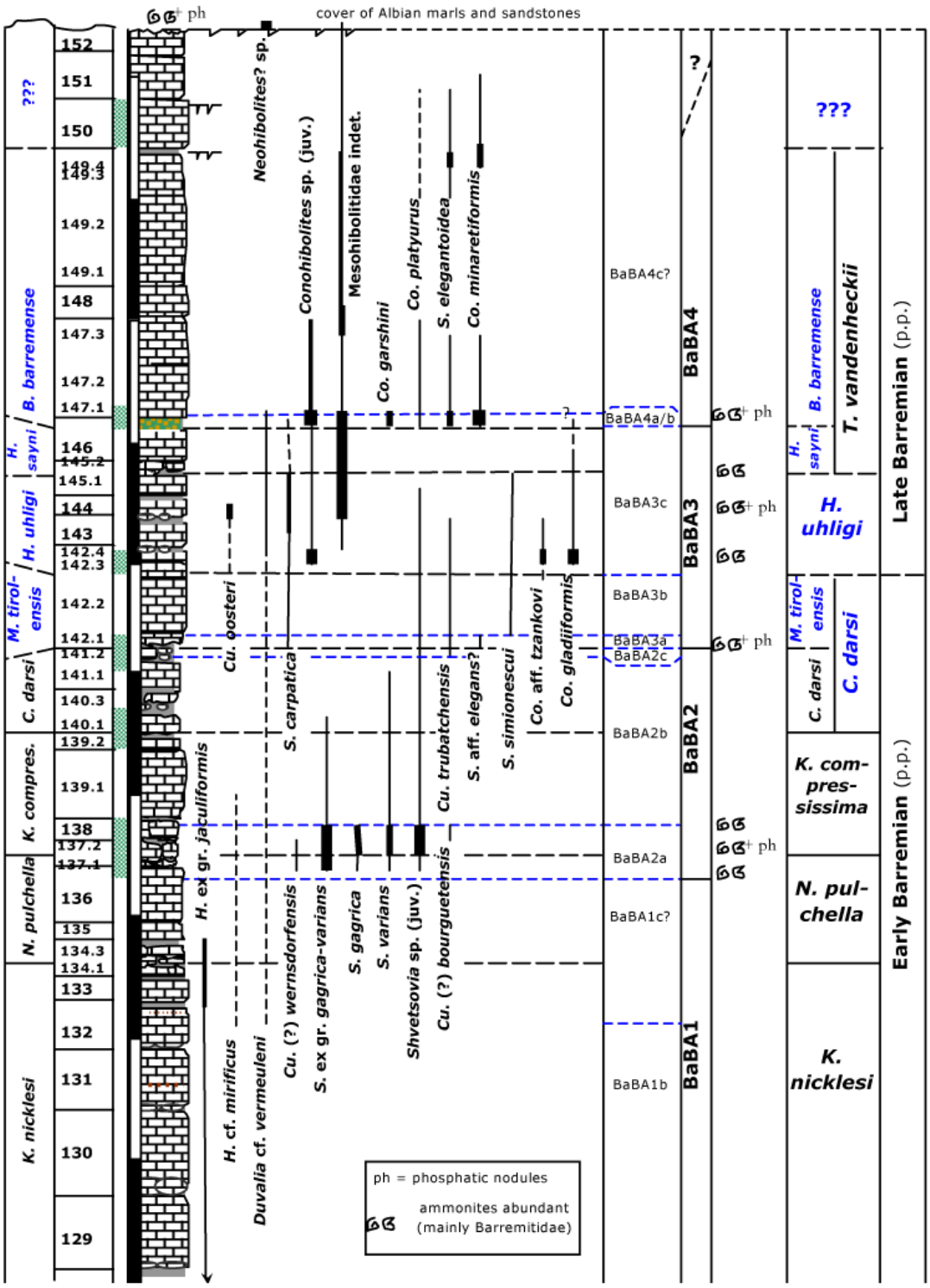

Figure 5: Distribution of belemnites in the section (BOU) to the west of chapelle Ste-Anne (N of Le Bourguet). Ammonite zonation in black, after VERMEULEN (1980b, 2002, and pers. com.). Ammonite zones in blue, based on the mutual distribution of belemnite species in the ABSS. Scale bar for sections graduations = 1 m. Abbreviations: *D.* = *Duvalia*, *Co.* = *Conohibolites*, *Cu.* = *Curtohibolites*, *H.* = *Hibolithes*, *S.* = *Shvetsovia.* See Fig. 2 for legend explanation.

To the south of Angles, more proximal facies are developed with lesser depositional. Sediments are developed in typical condensed, glauconitic facies. In these successions belemnites may occur abundantly. We investigated some outcrops to the north of Le Bourguet. Here, latest Hauterivian to earliest Late Barremian rocks are well-exposed below an Albian cover of marls and calcareous nodular sandstones. Especially the glauconitic latest Early Barremian sediments often yield abundant belemnites (Fig. 5). We aimed to get information about the distribution of belemnites in the interval which we could not sample well in the ABSS, the boundary between the *N. pul-*

chella and the *K. compressissima* zones, and to compare the general distribution of belemnites between the two areas (Fig. 3).

The section BOU is exposed to the west of the chapelle Sainte-Anne (Fig. 1; 06°31'02"E - 43°47'20"N). Along the eastern side of a water-reservoir, typical thick bedded Hauterivian sediments that are exposed yielded few *H.* ex gr. *subfusiformis*. Some glauconitic beds are intercalated. Eventually, bed thicknesses diminish and more and more beds with glauconite occur. In general, these beds are often delimited by intensively bioturbated horizons (*Thalassinoides*-burrows). As a result, these levels are irregular and with nodular calcareous remains are abundant. Consequently, the transition to the thin intercalating marl beds is often obscured. Near the top of the section a pronounced glauconitic marly level exists with abundant belemnites. Fossils appear to be reworked in part and phosphatic ammonite remains occur. This bed is captured by a glauconitic calcareous bed with abundant belemnites, and followed by few calcareous beds with glauconitic spots. Eventually, these beds are truncated by Albian marls and sandstones, separated by a reworked level with phosphatic ammonites and rolled belemnites. In some beds rather deep burrows filled with glauconitic sediment, can be noted. Brachiopods, corals, but especially cephalopods are abundant in these deposits. This will partially be the result of condensation but as some species and genera are more respectively less abundant in these more proximal facies as compared to the ABSS, part of it will reflect natural habitat. In these more proximal facies, juvenile species and belemnites related to the *S. gagrica-varians* group are especially abundant.

In the "*Holcodiscus*-beds" of an exposure (approx. 05°46'44"E - 44°07'16"N) NW to the classical section at Combe-Petite (Montagne de Lure; BUSNARDO & FOURY, 1966, p. 416-417), with platform margin deposits, a comparable picture can be observed (abundance of the *S. gagrica-varians* group). In contrast, in the ABSS this group is clearly less abundant. On the other hand, *D.* ex gr. *grasiana* is much more abundant in the deeper facies of the ABSS, but the latter species is very rare in the more proximal facies.

As noted before, due to the near absence of belemnites hitherto in the *N. pulchella* Zone and in the lower part of the *K. compressissima* Zone the exact position of the change in the belemnite faunal association is difficult to fix in the ABSS. To better delimit this change, we collected belemnites in palaeogeographically more proximal sections (BOU) and in another to the ENE of Clos (or Clot) de Barral (CBL; 06°38'07.4"E - 43°45'28.8"N). In the latter, *Cu.* (?) *wernsdorfensis* associated with *H. mirificus* occurs in the nodular bed CBL134d (corresponding to bed BOU137.1). This represents the transition between the *N. pulchella* Zone and the *K. compressissima* Zone. In BOU the glauconitic top part of the calcareous bed BOU136 yields the first *Cu.* (?) *wernsdorfensis* associated with the first specimens of the *S. gagrica-varians* group. The marly bed CBL134d-135 (= BOU137.1-2) yielded the first specimens of the *S. gagrica-varians* group, above beds with abundant *N. pulchella*, and occurring up to CBL140 (= BOU140.1). The latter bed yields, among others, the ammonite *Subtorcapella defayae*. While the beds in between yielded a rich association of ammonites that includes, among others: *Kotetishvilia compressissima*, *Nicklesia didayana*, *Holcodiscus caillaudianus* and *Heinzia communis* (cf. VERMEULEN, 1980a, 1980b, 1998b, 2002, p. 50).

To the south of the ABSS, at Demandolx (DLX: 06°33'59"E - 43°52'24"N), in an abandoned quarry, the boundary beds between the Early and Late Barremian are exposed (Fig. 3). The top part of the section is disturbed by faults and heavily disturbed, and is succeeded by Early Bedoulian marls. This section is of interest because of the more proximal position with respect to the ABSS. The relative few belemnites that could be recovered show belemnite associations intermediate between the ABSS and the more proximal facies (BOU, CBL). This is indicated by the occurrence of *Co. tzankovi*, relative frequent occurrence of *D. schwetzowi*, and also *Co. gladiiformis* is relative common. There and by, the beds DLX116c to DLX119 contained traces of glauconite. However, most abundant appears to be *Co. minaretiformis*. Apparently, this species was common in all the investigated palaeogeographical settings.

5. Comparison to other areas (outside the Vocontian Basin)

The latest Hauterivian did not deliver abundant belemnites but the general picture is comparable to other areas in and outside the Vocontian Basin. A rather species poor association dominated by *H.* ex gr. *subfusiformis* (RASPAIL, 1829), *D.* ex gr. *dilatata* (BLAINVILLE, 1827) and some poorly known, undescribed species. *D.* ex gr. *dilatata* is so far not known from any sediments younger than the latest Hauterivian (*e.g.* Río Argos, Spain; JANSSEN, 1997, p. 7). However, more illustrative from a stratigraphical point of view, is the absence of *H. subfusiformis*, and the genera *Pseudobelus* and *Pseudoduvalia* (HaBA2c *sensu* JANSSEN, 2009, p. 16). It should be noted that the ranges of *H.* ex gr. *subfusiformis* and *H. subfusiformis* s.s. are mixed up in the scheme presented therein.

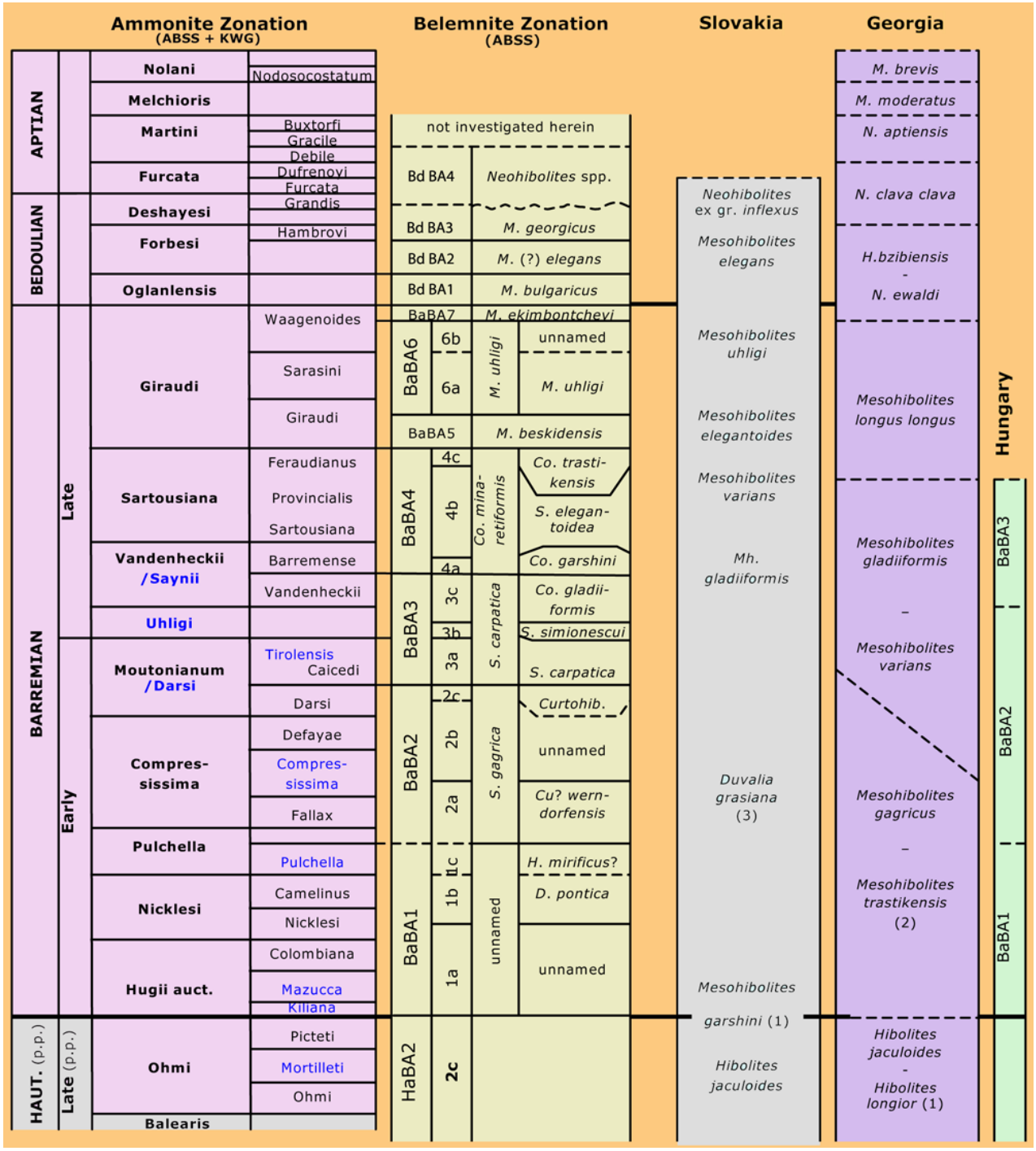

Figure 6: Comparing belemnite zonations and correlations of ABSS and BOU, with Hungary (JANSSEN & FŐZY, 2005), Georgia (KELEPTRISHVILI, 1998) and Slovakia (VAŠÍČEK *et al.*, 1994). Abbreviations: *Co.* = *Conohibolithes*, *Cu.* = *Curtohibolites*, *D.* = *Duvalia*, *H.* = *Hibolithes*, p.p. = pro parte, and *S.* = *Shvetsovia*. (1) = *Hibolithes keleptrishvilii* sp. nov., (2) = *Curtohibolites* (?) *wernsdorfensis*, (3) = *Duvalia vermeuleni* sp. nov.

The earliest Barremian belemnite fauna described by SHVETSOV (1913) and herein referred to as the "Gagra-fauna" occurs throughout the Mediterranean Tethys. Most characteristic species (*D. pontica* and *D. gagrica-silesiaca* group) occur in the southeast of Spain, both in deep water deposits of the Río Argos, as well in more proximal facies of the Tornajo Mountain (pers. obs.). While the smaller species *D.* aff. *silesiaca* appears to be more frequent in the deeper deposits, *D. pontica* is especially abundant in the more proximal facies. In general, these duvaliids are accompanied by *H.* ex gr. *jaculiformis*, apart from other rarer species. This association is also known from Azerbaijan (ALI-ZADE, 1972), Bulgaria (STOYANOVA-VERGILOVA, 1964, 1965, 1979), Crimea (GORN, 1966, 1974), Georgia (SHVETSOV, 1913; TOPCHISHVILI *et al.*, 2002), Hungaria (JANSSEN & FŐZY, 2004, 2005), and the Western Carpathians (VAŠÍČEK *et al.*, 1994). Also, the association dominated by species of the *S. gagrica-varians* group occurs

throughout the same regions. JANSSEN & FŐZY (2005, p. 66) showed the boundary between BaBA1 and BaBA2 to roughly coincide with the younger part of the *K. compressissima* Zone in Hungary (Fig. 6). This could best be concluded from their section B (FŐZY & JANSSEN, 2009), herein *D.* ex gr. *grasiana* (= *Duvalia vermeuleni* sp. nov., see systematic description) that first occurs in bed 124 together with abundant *Holcodiscus fallax* (COQUAND). Moreover, because *Hibolithes* ? sp. is at least partially conspecific with *Shvetsovia gagrica*, this boundary would even be lower in that section. Note that the *D. grasiana* figured by VAŠÍČEK *et al.* (1994) is in our opinion *D. vermeuleni* sp. nov., the oldest *Mesohibolites garshini* figured is most probably *H. keleptrishvilii* sp. nov., and *Mesohibolites varians* is *S. carpatica*. In the belemnite zonal scheme of Georgia (KELEPTRISHVILI, 1998, p. 443), the *Mesohibolites trastikensis* appears to be our *Cu.* (?) *wernsdorfensis*. Thereandby, the *M. gargicus - M. trastikensis* zone yields *Duvalia pontica* and *D. gagrica* (Fig. 6).

Stratigraphical data regarding belemnites of the "mid" Barremian are less well-known in detail in the Caucasus but *Shvetsovia-Conohibolites* associations do occur in Georgia: KRYMGOL'TS, 1939; NAZARISHVILI, 1973; TOPCHISHVILI *et al.*, 2002; KVANTALIANI & SAKHELASHVILI, 2005; KVANTALIANI & KELEPTRISHVILI, 2005 (Abkhazia), TOPCHISHVILI *et al.*, 2002 (Megreliya), KVANTALIANI & NAZARISHVILI, 1975; TOPCHISHVILI *et al.*, 2002 (Kutaisi), and KAKABADZE, 2005 (South-Ossetia).

JANSSEN & FŐZY (2005) described a well-diversified earliest to "mid" Barremian belemnite association from the Gerecse Mountains (Hungary). These belemnites were collected together with abundant ammonites, adding biostratigraphic details to these belemnite associations, which represent a mix of *Curtohibolites*, *Conohibolites*, and *Shvetsovia* species. Despite that belemnite taxa from the *Curtohibolites - Shvetsovia* and *Conohibolites* associations are briefly mentioned from Bulgaria (STOYANOVA-VERGILOVA, 1963, 1965, 1970a), Czech Republic (VAŠÍČEK, 1978a: Outer Western Carpathians), Georgia, Hungary, and Slovakia (VAŠÍČEK *et al.*, 1994: Central Western Carpathians), faunal elements from the belemnite association characterized by the true *Mesohibolites* are most commonly known throughout the Mediterranean Tethys (KRYMGOL'TS, 1939; ERISTAVI, 1952; STOYANOVA-VERGILOVA, 1965, 1970a; NAZARISHVILI, 1968, 1973; ALI-ZADE, 1972; GUSTOMESOV, 1973; KELEPTRISHVILI, 1990; VAŠÍČEK *et al.*, 1994; TOPCHISHVILI *et al.*, 2002; KVANTALIANI & KELEPTRISHVILI, 2005). Late Barremian to Bedoulian belemnites are well known from the Caucasus. Unfortunately, publications with detailed stratigraphical information on belemnites are scarce. In general, papers dealing with ammonite stratigraphy also deal with other groups of fossils, including belemnites: KOTETISHVILI, 1970; KAKABADZE, 1971, 2000; KVANTALIANI & NAZARISHVILI, 1975; ADAMIYA *et al.*, 1988; KAKABADZE & KOTETISHVILI, 2003.

6. Systematic descriptions

During the times we collected, named and described the specimens mentioned herein it became apparent that several nominal species were not defined accurately enough from a stratigraphical point of view. As a result several "Lazarus species" occurred in our material. For instance, some of the species described by UHLIG (1883b) originate from the upper part of the Hradiště-Schichten. This formation is of Barremian to Bedoulian age (cf. VAŠÍČEK, 1978b, p. 118). Subsequent researchers attributed Late Barremian to Bedoulian ages to these species, without much further detail. From our investigations it appears that, morphologically similar species occur in restricted and stratigraphically well-separated intervals. As we can virtually rule out the influence of facies in the ABSS, the inaccurate origin of the type material results in ambivalent time-slice. Hence, we sometimes use the affiliation "aff.".

Throughout the text, the following abbreviations are used: "+" = invalid: a *nomen dubium* (nom. dub.), *nomen nudum* (nom. nud.), or *nomen nullum* (nom. null.) (= secondary typing error), "pt" = *partim*, LT = lectotype, HT = holotype, MT = by monotypy, and OD = original designation.

Materials will be stored in the collection of NCB-Naturalis (Leiden, The Netherlands). The inventory numbers are: RGM361471-361499, RGM361511-361598, RGM361800-361999, RGM543000-543034, RGM582933-583148, RGM583421-583835 (ABSS: ANG, and Combe Lambert: COM), RGM583149-583420 (chapelle Ste-Anne, north of Le Bourguet: BOU), RGM583836-583840 (Méouilles: MEO), and RGM583841-583877 (Demandolx: DLX).

We have arranged this chapter in several sections in relation to the stratigraphical distribution of the belemnite associations because we think it is practical and improves clarity.

Latest Hauterivian belemnite associations HaBA2c:

Family Mesohibolitidae Nerodenko, 1983

Genus *Hibolithes* Denys de Montfort, 1808

Hibolithes keleptrishvilii sp. nov.

Pl. 1, figs. 22-23

? 1994 *Mesohibolites garshini* Stoyanova-Vergilova; Vašíček *et al.*, p. 82-83, Pl. 26, figs. 3-4.
2002 *Hibolites longior* Schwetzoff; Topchishvili *et al.*, p. 64-65, Pl. VI, figs. 1-2, 3-4 (not the synonymy).
? 2004 *Hibolithes jaculiformis brevicostatus* [sic!] Shvetsov; Janssen & Főzy, p. 32 (bed 208 only).
pt 2009 *Hibolithes jaculiformis* Shvetsov; Janssen, p. 16.

Derivation of name: Named after the belemnitologist Shalva Keleptrishvili (Tbilisi, Georgia).

Holotype: RGM 361817.

Stratum: Beds ANG042-043 to ANG050-051.

Material: Five specimens, all from ABSS. The holotype is the most complete one.

Description: The rostrum is characterized by a dorso-ventrally flattened apical part and a lateral compressed alveolar area. The rostrum is more or less spindle-shaped in ventral view with the widest part situated in the apical region. The alveolar groove is relative long, well-developed, approximately reaching halfway the rostrum. The alveolus reaches about 1/3 of the length of the rostrum. In lateral view the rostrum is more or less parallel, tapering towards a centrally placed apex in the apical part.

Remarks: The rostrum figured by Vašíček *et al.* (1994) is probably a gerontic specimen. The specimens from Hungary are believed to originate from the *Plesiospitidiscus ligatus* Zone, but no ammonites were found that would rule out a stratigraphically younger level.

Phylogeny: From a morphological point of view it is probably descendant from *H. subfusiformis* s.s.

Stratigraphic occurrence: Latest Hauterivian (*Pseudothurmannia ohmi* Zone). The specimens from Georgia are from the *Pseudothurmannia angulicostata* Zone. The latter is (partially) equivalent to the *P. ohmi* Zone.

Belemnite association: HaBA2c (FO and LO).

Geographical occurrence: France (Vocontian Basin), Georgia (Kutaisi-area), Hungaria (probably) and Slovakia (probably).

Hibolithes ex gr. *subfusiformis* (Raspail, 1829)

Pl. 1, figs. 1-2, 3-4 (juv.)

Material: Several tens of nearly complete to partially preserved specimens.

Stratum: Beds ANG001-001a to ANG084-085.

Phylogeny: Most probably descendant from *Hibolithes* related to the *H. longior*-group.

Stratigraphic occurrence: Earliest Hauterivian (*Acanthodiscus radiatus* Zone) to earliest Barremian (*T. hugii* Zone).

Belemnite association: HaBA2c (common) to BaBA1a (LO).

Geographical occurrence: Circum Mediterranean Tethys.

Family Duvaliidae Pavlow, 1914

Genus *Duvalia* Bayle, 1878

Duvalia ex gr. *dilatata* (Blainville, 1827)

Pl. 2, figs. 3-4

Material: Seven specimens.

Stratum: Beds ANG007-008 to ANG015.1 and one loose incomplete specimen from the beds ANG036-040 (all *Balearites balearis* Zone).

Specimens included: *D. dilatata dilatata* (Blainville, 1827) and *D. dilatata binervioides* Stoyanova-Vergilova, 1965.

Specimens excluded: *D. maioriana* Stoyanova-Vergilova, 1965 (originally binomial *dilatata majoriana*) and *D. variegata* (Raspail, 1829). The first occurs in the Early/Late Hauterivian boundary beds while the latter occurs in the latest Valanginian and earliest Hauterivian and precedes *D.* ex gr. *dilatata* subsp.

Remarks: The two subspecies might represent a dimorphic pair.

Phylogeny: Most probably descendant from *D. variegata* - "*vaunagensis*" group.

Stratigraphic occurrence: Hauterivian (*Crioceratites loryi* Zone to *Pseudothurmannia picteti* Zone).

Belemnite association: HaBA2c (LO).

Geographical occurrence: Circum Mediterranean Tethys.

Family, Genus, Species unknown

Pl. 1, figs. 24-25, 26-27

Material: Six specimens.

Stratum: Beds ANG020-021 to ANG041-042.

Description: A small, spindle-like, laterally compressed (duvaloid?) specimen with conspicuous pseudobeloid morphology, with feeble ventro-lateral incisions.

Remarks: The alveolar area is not preserved, but the general appearance is like a juvenile *Hibolithes*. However, the latter taxa are always round to subrounded in cross-section. Due to the well-marked, but rather shallow, ventro-lateral incisions, it can not be attributed to any known genus. *Pseudobelus*-type of taxa are always characterized by (deep) mid-lateral incisions. These incisions relate to the so-called double-lines, and might indicate strengthening of the mantle muscle attachment. However, *Pseudobelus* is believed to be extinct by this time (cf. JANSSEN, 2009, Fig. 15).

Phylogeny: These rather small species might relate to dilatatoid *Duvalia* or to *Pseudobelus*.

Stratigraphic occurrence: Latest Hauterivian (*Balearites balearis* Zone).

Belemnite association: HaBA2c (FO and LO).

Geographical occurrence: Vocontian Basin (France).

Earliest Barremian belemnite associations BaBA1:

Most characteristic are the belemnites that relate to *H. jaculiformis* and to *D.* aff. *silesiacagagrica*.

Family Mesohibolitidae NERODENKO, 1983

Genus *Hibolithes* DENYS de MONTFORT, 1808

Hibolithes ex gr. *jaculiformis* SHVETSOV, 1913

Pl. 1, figs. 5-6, 7-8, 9, 10-11, 12-13, 14-15, 16-17

1913 *Hibolites jaculiformis* var. *brevisulcatus* SHVETSOV, p. 52-53, 68, Pl. III, fig. 4a-c, 4h-i.
1913 *Hibolites jaculiformis* n. sp. SHVETSOV, p. 52-53, 68, Pl. II, figs. 5-6; Pl. III, figs. 4e-g, 4k-l, 11-12.
1913 *Hibolites jaculiformis* var. *inflata* SHVETSOV, p. 52-53, 68, Pl. III, figs. 4d, 4j, 13-14.
? 1994 *Hibolites jaculoides depressirostris* SWINNERTON; VAŠÍČEK *et al.*, Pl. 25, figs. 1-2.
1994 *Hibolites longior* SCHWETZOFF; VAŠÍČEK *et al.*, Pl. 25, figs. 7-8.
? 2002 *Vaunagites pistilliformis* (BLAINVILLE); TOPCHISHVILI *et al.*, Pl. V, fig. 6.
pt 2004 *Hibolithes* gr. *jaculiformis* SHVETSOV; JANSSEN & FŐZY, Pl. III, fig. 6, non figs. 24-25.
+ 2004 *Hibolithes jaculiformis brevicostatus* [sic!] SHVETSOV; JANSSEN & FŐZY, p. 32.
2004 *Hibolithes* gr. *subfusiformis* (RASPAIL); JANSSEN & FŐZY, Pl. III, fig. 10.
? 2005 *Hibolithes targovishtensis* STOYANOVA-VERGILOVA; JANSSEN & FŐZY, p. 68, Pl. III, figs. 7-12; Pl. V, figs. 12-13.
2005 ? *Hibolithes jaculiformis* SHVETSOV; JANSSEN & FŐZY, p. 65, Pl. III, figs. 3-4.
? 2005 *Hibolithes* ? sp. JANSSEN & FŐZY, Pl. III, figs. 18-19.

Material: Twenty-eight (ABSS) and fifteen (BOU) rostra in various stages of preservation.

Stratum: Beds ANG087 to ANG105.

Remarks: No type indicated by SHVETSOV (1913).

Phylogeny: Most probably descendant from *H.* ex gr. *subfusiformis*.

Stratigraphic occurrence: Earliest Barremian (*T. hugii* Zone to *K. nicklesi* Zone).

Belemnite association: BaBA1a (FO) and BaBA1b (LO).

Geographical occurrence: Circum Mediterranean Tethys.

Hibolithes aff. *jaculiformis* SHVETSOV, 1913

Pl. 1, figs. 20-21

Material: One complete and four partially preserved rostra.

Stratum: Beds ANG110.2 to ANG110.4.

Description: The depicted specimen shows a medium sized, rather robust, dorso-ventrally well compressed rostrum. Herein, it differs from the generally more slender *H.* ex gr. *Jaculiformis*, and the larger less compressed *H. jaculiformis brevisulcatus*.

Stratigraphic occurrence: Earliest Barremian (upper part of *N. pulchella* Zone).

Belemnite association: BaBA1c (FO and LO).

Geographical occurrence: France (Vocontian Basin).

? *Hibolithes mirificus* STOYANOVA-VERGILOVA, 1965

* 1965 *Hibolites mirificus* sp. nov. STOYANOVA-VERGILOVA, p. 151-152, Pl. I, figs. 1a-c [HT], 2-4.
pt 2005 *Hibolithes mirificus* STOYANOVA-VERGILOVA; JANSSEN & FŐZY, p. 65, 67-68, Pl. III, figs. 5-6; Pl. V, fig. 14 (cum synonymy).

Material: Seven largely incomplete, hence

the question-mark, specimens of different ontogeny.

Stratum: Beds ANG107.1-2 to ANG109.3-4.

Description: Parts of well-rounded to compressed guards, which occasionally show the (typical) pointed to mucronate apex preserved.

Remarks: The specimens mentioned by JANSSEN & FŐZY (2005) from the beds 12, 399 and 410 do most probably not belong to the nominal species.

Stratigraphic occurrence: Earliest Barremian (*N. pulchella* Subzone).

Belemnite association: BaBA1c (FO and LO).

Geographical occurrence: Bulgaria, France, Hungary, and Slovakia.

Hibolithes targovishtensis STOYANOVA-VERGILOVA, 1979

Pl. 1, figs. 18-19

pt 1913 *Hibolithes jaculiformis* var. *inflata* SHVETSOV, Pl. III, fig. 6.
* 1979 *Hibolites targovishtensis* sp. nov. STOYANOVA-VERGILOVA, p. 37-39, Pl. I, figs. 1 [HT by OD], 2-7.
\+ 1979 *Hibolites targovichtensis* sp. nov. STOYANOVA-VERGILOVA, p. 37 (*lapsus calami*).
? 2005 *Hibolithes targovishtensis* STOYANOVA-VERGILOVA; JANSSEN & FŐZY, p. 68, Pl. III, figs. 7-12; Pl. V, figs. 12-13.

Material: Eleven specimens.

Stratum: Beds ANG074-075 to ANG084-085.

Description: A small to medium sized, slightly dorso-ventrally compressed hibolitoid rostrum, with a well-developed alveolar groove and a short alveolus.

Remarks: Certain resemblance to immature *H.* ex gr. *jaculiformis* exists. In the ABSS in many, but not all of the specimens *Acrothoracia*-burrows occur.

Phylogeny: Most probably descendant from *H.* ex gr. *subfusiformis*.

Stratigraphic occurrence: Earliest Barremian (*T. hugii* Zone).

Belemnite association: BaBA1a (FO and LO).

Geographical occurrence: Bulgaria, France, Georgia (Abkhasia), and possibly Ukraine (Crimea).

Family Duvaliidae PAVLOW, 1914

Genus *Duvalia* BAYLE, 1878

Duvalia ex gr. *gagrica-silesiaca*

Material: Fifteen specimens (ABSS) and see below for separate species descriptions.

Stratum: Beds ANG073 to ANG093-094.

Description: The species are well characterized by a bend, generally well visible, in the ventral part of the rostrum solidum. However, two different types of bending occur. In *D. gagrica* this bend is not accompanied by a strong constriction of the alveolar area, in contrast to *D.* aff. *silesiaca*, herein, it is like in *D. dilatata binervioides*. Moreover, it is smaller, more leaf-like in outer morphology (like in *D. dilatata binervioides*). *Duvalia gagrica* is more robust like *D. dilatata dilatata*, with a more elongated rostrum solidum. The alveolar opening shows a peculiar almost cross-like shape. Herein, in contrast to *D. pontica*, the lateral expulsions are shifted towards the dorsal side, while in *D. pontica* these are more or less situated in the middle part of the lateral side. However, as can be observed on the material depicted by SHVETSOV (1913), in more mature specimens these expulsions become comparable.

Remarks: It is well possible that *D. gagrica* and *D.* aff. *silesiaca* are ontogenetical stages, or a dimorphic pair. Therefore, we have not introduced a new name yet for *D.* aff. *silesiaca*.

Phylogeny: Most probably descendant from *D.* ex gr. *dilatata*. It is succeeded by *D. pontica*, which is characterized by a more expanded alveolar part and a straight, laterally well flattened rostrum solidum with more or less parallel dorsal and ventral sides.

Stratigraphic occurrence: Earliest Barremian (*T. hugii* Zone).

Belemnite association: BaBA1a (FO and LO).

Geographical occurrence: Circum Mediterranean Tethys.

Duvalia gagrica SHVETSOV, 1913

Pl. 2, figs. 7-8 (?), 15-16 (?), 17-18, 27-28

* 1913 *Duvalia gagrica* SHVETSOV, p. 47, 67, Pl. II, fig. 4 [HT by MT].
2004 *Duvalia gagrica* SHVETSOV; JANSSEN & FŐZY, p. 45, Pl. II, figs. 2-5; Pl. III, fig. 29 (cum synonymy).

Material: Five specimens.

Stratum: Beds ANG083 to ANG093-094.

Stratigraphic occurrence: Earliest Barremian (*T. hugii* Zone).

Belemnite association: BaBA1a (FO and LO).

Geographical occurrence: Circum Mediterranean Tethys.

Duvalia aff. *silesiaca* Uhlig, 1902

Pl. 2, figs. 9-10, 13-14, 19-20, 21-22, 23-24, 25-26

1902 *Belemnites* (*Duvalia*) *dilatatus* Blainville forma *silesiaca* Uhlig, p. 64, Pl. I, figs. 5 [LT], 6.
pt 1994 *Duvalia binervia* (Raspail); Vašíček *et al.*, Pl. 28, figs. 8-9; Pl. 30, figs. 7-9.
2004 *Duvalia silesiaca* Uhlig; Janssen & Főzy, p. 46, Pl. III, fig. 26 (cum synonymy).

Material: Ten specimens (ABSS), and two specimens from CBL.

Stratum: Beds ANG073-074 to ANG092-093.

Remarks: Lectotype indicated by Vašíček (1978a). Specimens are virtually indistinguishable from *Duvalia binervia* (Raspail, 1829), except for the taxa that accompany this species. *D. binervia* occurs in post earliest Late Valanginian sediments and up to and including the earliest Hauterivian. As the age of the type stratum of *Duvalia silesiaca* is unclear (probably from Hauterivian), we prefer to use the affiliation "aff." for the species herein indicated.

Phylogeny: Most probably descendant from *D.* ex gr. *dilatata*.

Stratigraphic occurrence: Earliest Barremian (*T. hugii* Zone).

Belemnite association: BaBA1a (FO and LO).

Geographical occurrence: Circum Mediterranean Tethys.

Duvalia pontica Shvetsov, 1913

Pl. 2, figs. 1-2, 5-6, 11-12; Pl. 5, figs. 15-16

* 1913 *Duvalia pontica* n. sp. Shvetsov, p. 46-47, 67, Pl. II, fig. 7 [HT by MT].
1965 ? *Polygonalia pontica* (Schwetzoff); Ali-Zade, p. 142.
1997 *Duvalia* sp. B; Janssen, p. 25-26, Pl. 4, figs. 3, 6.
2002 *Pseudoduvalia pontica* (Schwetzoff); Topchishvili *et al.*, p. 165, Pl. XXIV, fig. 1 (cum synonymy).

Material: Seven specimens (ABSS) and one from CBL.

Stratum: Beds ANG100-101 to ANG103-104 and loose specimens from the beds ANG104 to 106, and the beds around ANG110.

Description: A robust, elongated, dilatatoid specimen, with a clear long groove and more or less parallel sides. In the alveolar area the outline of the rostrum is rhomboidal. Immature specimens are smaller but otherwise comparable to mature ones.

Phylogeny: Descendant from *D.* ex gr. *silesiaca-gagrica*.

Stratigraphic occurrence: Earliest Barremian (*K. nicklesi* to *N. pulchella* Zone).

Belemnite association: BaBA1b (FO) and BaBA1c (LO).

Geographical occurrence: Circum (Mediterranean) Tethyan.

Late Early Barremian belemnite associations BaBA2:

Most characteristic are the species that relate to the new genus herein established, and the species of the genus *Curtohibolites*.

Family Mesohibolitidae Nerodenko, 1983

Genus *Shvetsovia* gen. nov.

= pars *Mesohibolites* auct. Pl.

= "*Mesohibolites*" sensu Janssen & Főzy, 2004

= "*Mesohibolites*" sensu Janssen & Főzy, 2005

Derivation of name: Named after the Russian geologist Mikhail Sergeevich Shvetsov (Михаил Сергеевич Швецов).

Genotype: *Hibolites gagricus* Shvetsov, 1913.

Differential diagnosis: Elongated to very elongated fusiform (spindle-like) species, both from lateral as from dorsal or ventral view, with moderate to strong dorso-ventral flattening (subrounded to strong ellipsoidal cross-sections), except for the most apical part which has a more or less round cross-section. The length of the alveolar groove is variable, but generally it is short to very short while the alveolus is shallow to very shallow. Immature *Conohibolites* show a comparable morphology but can be separated by their dorso-ventrally compressed heart-shaped cross-sections. In *Conohibolites* the dorsal or ventral view is conical to cylindro-conical, but the lateral view is always conical with the apex clearly shifted towards the ventral side. The alveolar slit is more or less comparable to the text-fig. 2c depicted by Stoyanova-Vergilova (1970a, p. 9). However, contrary to the slight curving depicted, it appears to be running almost straight from the apical line towards the ventral side, to the point where the alveolar groove ends abruptly. Very juvenile to very immature rostra show round cross-sections (Pl. 4, fig. 22) but in *Conohibolites* these are ventro-dorsally compressed and more elongated (Pl. 6, figs. 13-14; Pl. 9, figs. 29-30).

Remarks: Immature specimens of *Conohibo-*

lites gladiiformis do show a more or less comparable elongated fusiform morphology, as do some *Co. minaretiformis*. In contrast to fusiform shaped *Hibolithes*, the spindle-shape in *Shvetsovia* is in some species, the result of broadening ("shoulder-like" developments) of the area in which the apical part is defined as part of the rostrum solidum. If present, it appears to result in a much more angular shaped rostrum as compared to the smoothly curved fusiform morphology. In the genus *Hibolithes* the alveolar area appears to be much more constricted as compared to *Shvetsovia*, giving the latter a more robust appearance. Moreover, in *Hibolithes*, the constriction between the rostrum solidum and the rostrum cavum often results in the exfoliation of the alveolar area, unlike in *Shvetsovia*.

Phylogeny: Most probably descendant from *H.* ex gr. *jaculiformis*.

Stratigraphic occurrence: Early Barremian (*K. compressissima* Zone) to early Late Barremian (*I. giraudi* Subzone).

Belemnite association: BaBA2a (FO) and lowermost part of BaBA5 (LO).

Geographical occurrence: Circum Mediterranean Tethys.

Shvetsovia gagrica (Shvetsov, 1913)

Pl. 3, figs. 7-8 (ex gr.), 9-10, 13-14 (ex gr.), 19-20, 21-22, 25-26

1913 *Hibolites gagricus* n. sp. Shvetsov, p. 57-58, 69, Pl. IV, fig. 1a-c.
2002 *Mesohibolites gagricus* (Schwetzoff); Topchishvili *et al.*, p. 76-77, Pl. VIII, fig. 1 (cum synonymy).
? 2005 *Hibolithes* ? sp.; Janssen & Főzy, p. 68, Pl. III, figs. 18-19.
non 2005 "*Mesohibolites*" ? *gagricus* (Shvetsov); Janssen & Főzy, p. 79 (= *Co.* ex gr. *minaretiformis*).

Material: Twenty specimens (ABSS) and twenty-one specimens (BOU).

Stratum: Beds ANG120-121 to ANG131-132.

Description: A slender elongated, more or less fusiform guard with a relatively long alveolar groove and a relatively short alveolus. The alveolar opening is rounded to laterally compressed, while the rostrum solidum shows rounded to dorso-ventrally compressed cross-sections. More mature specimens show the development of "shoulders" (see remarks of the genus description) and the elongation of the apical area.

Remarks: A lectotype has been chosen from among the specimens that were not figured from Shvetsov's collection by Stoyanova-Vergilova (1970a, p. 30-31). Subsequently Ali-Zade (1972) and Topchishvili *et al.* (2002) invalidly indicated the most mature figured specimen to be the holotype.

Stratigraphic occurrence: *S. defayae* Subzone to *C. darsi* Subzone (ABSS), apparently being most abundant in the *S. defayae* Subzone. In BOU it is found in the topmost part of the *N. pulchella* Zone up to *C. darsi* Subzone. In BOU it is most abundant in the lower part of the *K. compressissima* Zone. Incomplete and certain phylogenetic stages in the development can be difficult to separate from *varians* (Pl. 3, figs. 7-8, 13-14).

Belemnite association: BaBA2a (FO and common) and BabA2b (LO).

Geographical occurrence: Azerbaijan, Bulgaria, France, Georgia, Hungaria, and Russia (Kabardino-Balkariya ASR).

Shvetsovia varians (Shvetsov, 1913)

Pl. 3, figs. 11-12, 15-16, 17-18, 23-24, 27-28, 29-30

pt 1913 *Hibolites varians* n. sp. Shvetsov, p. 56-57, 69, Pl. IV, fig. 3a-d, 3e-f.
? pt 2002 *Mesohibolites varians* (Schwetzoff); Topchishvili *et al.*, p. 80-81, Pl. IX, figs. 1, 3 (?).
2005 *Conohibolites* ? *varians* (Shvetsov); Janssen & Főzy, p. 80-81, Pl. IV, figs. 16-17; Pl. V, figs. 2-3 (cum synonymy).

Material: Thirteen specimens (ABSS) and thirteen specimens (BOU).

Stratum: Beds ANG117-118 to ANG122-123.

Description: A smaller, much more spindle-like species (*sensu stricto*) as compared to *S. gagrica*. Mature (? or *sensu lato*) morphs show the development of an extremely long apical area comparable to the development in the conically shaped *Co. gladiiformis*.

Remarks: Based on stratigraphical data Janssen & Főzy (2005) provisionally regarded only the *sensu stricto* morph as the nominal one. Based on the belemnites we collected from the ABSS and BOU, Shvetsov's original interpretation appears correct, but mature incomplete specimens are difficult to separate, hence they were regarded as species of the *S. gagrica-varians* group. Topchishvili *et al.* (2002) designated a lectotype (Shvetsov, 1913: Pl. IV, fig. 3e-f), as no type was originally indicated.

Stratigraphic occurrence: *K. compressissima* Zone (ABSS and BOU).

Belemnite association: BaBA2a (FO and common) and BabA2b (LO).

Geographical occurrence: Azerbaijan, France (Vocontian Basin), Georgia, Hungary (Gerecse

Mts.), Ukraine (Crimea).

Shvetsovia aff. *elegans* (Shvetsov, 1913)

Pl. 4, figs. 1-2, 3-4, 5-6, 7-8, 16-17, 23-24 (?), 27, 32-33; Pl. 8, figs. 1-2 (?)

pt 1841 *Belemnites platyurus* Duval-Jouve, Pl. XI, fig. 3.
non 1913 *Hibolites elegans* n. sp. Shvetsov, p. 60-61, 70, Pl. V, figs. 3a-b, 3c-f, 8c.
2005 ? "*Mesohibolites*" ? aff. *elegans* (Shvetsov) sp. nov.; Janssen & Főzy, p. 78, Pl. IV, figs. 20-25; Pl. V, figs. 10-11 (pars cum synonymy).

Material: Twelve specimens (ABSS) and three specimens from BOU.

Stratum: Beds ANG133-134 to ANG138-139 and BOU141.2 to BOU142.1.

Description: A more or less subfusiform hibolitoid rostrum, however with a more or less feeble to very distinct (Pl. 4, figs. 7-8) flattening of the ventral side of the rostrum solidum, except for the apical part. The latter has a much more rounded outline. The length of the alveolar groove is variable extending relatively far beyond the initiation of the alveolus. Lateral lines are often well visible.

Remarks: Apparently, the length of the alveolar groove is variable, both in immature as well as in more mature specimens (Pl. 4, figs. 5-6, 16-17). Also, the outline of the cross-sections in the rostrum solidum varies from specimens with well flattened ventral areas, to more rounded outlines. The nominal species was originally described from "Aptian" sediments of Abkhasia by Shvetsov (1913), hence the affiliation "aff.".

Stratigraphic occurrence: In the *C. darsi* Subzone (top part) to *Macroscaphites tirolensis* Subzone.

Belemnite association: BaBA2c (FO) and BaBA3a (LO).

Geographical occurrence: France (Vocontian Basin), Georgia (?), Hungary (Gerecse Mts.) and Slovakia (?).

Shvetsovia simionescui (Stoyanova-Vergilova, 1970)

Pl. 4, figs. 15, 25-26; Pl. 8, figs. 3-4 (?)

pt 1898 *Belemnites jaculum* Phillips; Simionescu, p. 52 (108)-53 (109), Pl. I, fig. 5.
1952 *Mesohibolites minaret* (Raspail); Roger, p. 715, text-fig. 38.
* 1970a *Hibolites simionescui* sp. nov. Stoyanova-Vergilova, p. 21-22, 68, Pl. VI, fig. 4 [HT by MT].
pt 1970a *Mesohibolites minaret* (Raspail); Stoyanova-Vergilova, Pl. VIII, figs. 5-6.

Material: Twelve (ABSS) and seven (BOU) specimens.

Stratum: Beds ANG140 to ANG149.3-4.

Description: A rather striking species with a well compressed (ventro-dorsally) rostrum. It has a deep alveolus, a well developed alveolar groove that fades away in the apical part, giving way to a characteristic flattened area. In lateral view the rostrum tapers down towards the apex, while in ventral view, the rostrum is subcylindrical to cylindro-conical. The typical broadening ("shoulder-like" development) is well visible.

Remarks: Certain resemblance to (very) mature *S. gagrica* exists. However, the latter is generally of larger size with a much more extended apical area.

Stratigraphic occurrence: *Ho. uhligi* Zone to lower part of *To. vandenheckii* Zone (*He. sayni* Subzone).

Belemnite association: BaBA3b (FO) and BaBA3c (LO).

Geographical occurrence: Bulgaria, France (Vocontian Basin), and Romania.

Genus *Curtohibolites* Stoyanova-Vergilova, 1963

Within the original concept of *Curtohibolites*, five specimens were distinguished. Of these, two show a conical to subcylindrical outer morphology, while the other three are much more subcylindrical to pistilliform, thus with a more constricted alveolar part. The latter species include the genotype (*Curtohibolites trubatchensis* Stoyanova-Vergilova, 1963). The conical morphs include *Curtohibolites rasgradensis* Stoyanova-Vergilova, 1963, *Cu. wernsdorfensis* Stoyanova-Vergilova, 1963, and a new species described herein. This group of species seems to have a different stratigraphical level, they occur in older sediments, as compared to the more subcylindrical group of species, and are placed, with some reservation, in the nominal genus.

Curtohibolites (?) *bourguetensis* sp. nov.

Pl. 4, figs. 18-19, 28-29

Derivation of name: Named after the geographical locality it is found in the vicinity of.

Holotype: RGM 583366.

Type stratum: BOU137.2-138 (*K. compressissima* Zone).

Material: One immature specimen from the

ABSS and one mature specimen from BOU (holotype).

Stratum: The specimen from the ABSS originates from the beds ANG129-131. The mature specimen originates from the marly interval with calcareous nodules between BOU137.2 and bed BOU138.

Description: A robust specimen with a short rostrum solidum. It is ventro-dorsally well compressed with an alveolus which reaches halfway the preserved part of the rostrum. The apex is shifted to the ventral side. Also, the immature specimen is well-compressed but shows a relative long alveolar groove, combined with a deep alveolus.

Remarks: Differs from *Cu.* (?) *wernsdorfensis* by the absence of two plains of symmetry. Moreover, it is much more dorso-ventrally compressed, and shows a less elongated apical area.

Stratigraphic occurrence: Topmost part of the *K. compressissima* Zone and lower part of the *C. darsi* Zone.

Belemnite association: BaBA2a (FO) and BaBA2c (LO).

Geographical occurrence: France (Vocontian Basin).

Curtohibolites aff. *pinguis* (Shvetsov, 1913)

2005 *Curtohibolites* aff. *pinguis* (Shvetsov); Janssen & Főzy, p. 79, Pl. IV, figs. 30-31; Pl. V, figs. 20-21.
2010 *Curtohibolites* aff. *pinguis* (Shvetsov); Janssen, p. 663, 665, text-fig. 2.16-17.

Material: One specimen (ABSS).

Stratum: A loose specimen from the marly beds between ANG135 to ANG137.

Description: Specimen is comparable to *Cu. oosteri* but for the development of the alveolar part of the rostrum. It shows a more or less sub-trapezoidal with the widest part being situated at the dorsal side.

Remarks: See *Cu. oosteri*.

Stratigraphic occurrence: *M. tirolensis* Subzone.

Belemnite association: BaBA2c (FO and LO).

Geographical occurrence: France (Vocontian Basin), and Hungary (Gerecse Mts.).

Curtohibolites (?) *wernsdorfensis* Stoyanova-Vergilova, 1963

Pl. 3, figs. 1-2, 3-4, 5-6

1883 *Belemnites* aff. *extinctorius* [sic!] (Raspail); Uhlig, p. 175, Pl. I, fig. 12.
* 1963 *Curtohibolites wernsdorfensis* sp. nov. Stoyanova-Vergilova, p. 216-217, Pl. II, fig. 7 [HT by MT] (cum synonymy).
1970a *Curtohibolites wernsdorfensis* Stoyanova-Vergilova; Stoyanova-Vergilova, p. 24, Pl. VII, figs. 6 (= Stoyanova-Vergilova, 1963), 7.
\+ 1975 *Mesohibolites garschini* [sic!] Stoyanova-Vergilova; Kvantaliani & Nazarishvili, p. 140-141, Pl. I, fig. 2.
pt 2002 *Mesohibolites garshini* Stoyanova-Vergilova; Topchishvili *et al.*, Pl. IX, fig. 4 (= Kvantaliani & Nazarishvili, 1975).
2005 ? *Conohibolites* (?) aff. *platyurus* (Duval-Jouve) sp. nov.; Janssen & Főzy, p. 75, Pl. V, figs. 8-9.
non 2010 *Curtohibolites* (?) *wernsdorfensis* Stoyanova-Vergilova; Janssen, p. 665, text-fig. 2.7-8 (=*Co. tzankovi*).

Material: Five specimens (ABSS) and two from BOU.

Stratum: Beds ANG115 to ANG120-121.

Description: A species with a striking cylindro-conical morphology with round to rounded or subrounded to dorso-ventrally compressed cross-sections. The alveolus reaches about halfway the rostrum, while the clear alveolar groove reaches just beyond the extension of the alveolus.

Remarks: Specimen strongly resembles *Conohibolites* (but they are not cylindro-conical in both lateral as in dorsal or ventral view) or very large *Curtohibolites*. However, both genera appear in younger strata only, probably indicating this to be the ancestor to either one of these taxa. As the *S. gagrica-varians* group is most probably the ancestor of *Co. gladiiformis*, attribution to the generally smaller *Curtohibolites* appears to be most probable. Also, its outer-morphology suggests a close resemblance to the latter genus, which is sub-cylindrical to cylindro-conical. Characteristic appears to be the double plain of symmetry, both from lateral as from dorso-ventral view the rostrum appears to be near symmetrical.

Phylogeny: Doubtful, but probably descendant from *H. mirificus*, which from a morphological point of view appears to be most comparable.

Stratigraphic occurrence: In the upper part of the *K. compressissima* Zone (ABSS). In the upper part of the *N. pulchella* Zone and the *K. compressissima* Zone of BOU and CBL.

Belemnite association: Topmost part of BaBA1c (FO) and BaBA2a (LO).

Geographical occurrence: Bulgaria, Czech Republic (Veřovice (= Wernsdorf), Moravia), France (Vocontian Basin), and Hungary (Gerecse Mts.).

Family Duvaliidae PAVLOW, 1914

Genus *Duvalia* BAYLE, 1878

Duvalia vermeuleni sp. nov.

Pl. 5, figs. 1-2, 3-4, 7-8

pt 1841 *Belemnites grasianus* DUVAL-JOUVE, p. 63.
1989 *Duvalia grasiana* (DUVAL-JOUVE); MICHALÍK & VAŠÍČEK, Pl. 2, fig. 4.
1994 *Duvalia grasiana* (DUVAL-JOUVE); VAŠÍČEK *et al*, Pl. 30, figs. 3-4 (= MICHALÍK & VAŠÍČEK, 1989), 5-6.
2005 *Duvalia* sp. nov. (immature?); JANSSEN & FŐZY, Pl. III, figs. 1-2.
2005 *Duvalia grasiana* (DUVAL-JOUVE); JANSSEN & FŐZY, Pl. III, figs. 38-39; Pl. V, figs. 18-19, 25-26.
2010 *Duvalia* ex gr. *grasiana* (DUVAL-JOUVE); JANSSEN, p. 667-668, Text-fig. 2.20-21.

Derivation of name: Named after Jean VERMEULEN (Barrême, France), specialist in Barremian ammonites, who donated the holotype.

Material: Twenty-four specimens (ABSS) and four, in part *ex situ*, specimens (BOU).

Holotype: RGM 361561 (a gerontic specimen from ANG120; Pl. 5, figs. 1-2).

Paratype: RGM 583021 (ANG120-121).

Type stratum: Bed ANG120, *S. defayae* Subzone, *K. compressissima* Zone.

Differential diagnosis: Dilatatoid rostrum with a relative long alveolar groove and more or less lozenge-shaped cross-sections. Essentially it differs from typical *D. grasiana* by the shorter length of the alveolar groove (however, atypically long in the holotype), the less deep alveolus, and the more lozenge-shaped cross-sections. In typical *D. grasiana* these are always ellipsoidal. Also, *D. grasiana* differs by its "fatter" appearance, *i.e.*, more latatoid as compared to the more slender, dilatatoid *D. vermeuleni*. Also, the apical area is more flattened in *D. vermeuleni* as compared to typical *grasiana*. It differs from *D. pontica* due to its parallel lateral sides, without the long pronounced expanded alveolar area. *Duvalia grasiana* shows a much longer alveolar groove, always reaching the apex, and it is much more latatoid, *i.e.*, less laterally compressed. In mature *D. grasiana* the apical area appears to be slightly different as compared to the stratigraphically older species. In general, it is characterized by a more laterally flattened ventral part (as if it were squeezed), as compared to the dorsal side of the apical area.

Description: The dorsal and ventral sides are more or less parallel but for the most apical part. The apex is displaced to the dorsal side. As a result the dorsal side is less curved in the apical part, compared to the ventral side. The deep alveolus reaches about half-way the rostrum. The dorsal alveolar groove generally ends near the apical area. It should be noted that the holotype shows an atypical long alveolar groove. In the paratype (Pl. 7, figs. 3-4) the more typical length of the alveolar groove is shown.

Ontogeny: The ontogenetical development is essentially simple. All stages are comparable but for their size.

Variations: As in most duvaliids, mature specimens develop dorsal bulges, giving way to a more irregular outline. Some specimens are partially more latatoid, *i.e.*, they show a thicker, more robust rostrum in the alveolar part, with clearer lozenge-shaped cross-sections, but with more flattened lateral sides in the apical area [see *Duvalia schwetzowi* (KELEPTRISHVILI, 1999)]. In the *G. sartousiana* Zone the more rounded latatoid cross-sections appear (Pl. 5, figs. 7-8), however initially with a shorter groove as compared to typical *D. grasiana* (Pl. 5, figs. 6, 9-10, 11-12). The latter undoubtedly occurs in the *I. giraudi* Zone and in younger sediments, but specimens with squeezed ventral apical areas first occur in the *H. feraudianus* Subzone (ANG166.2-ANG167).

Remarks: The sometimes feeble differences (splitting?) that are noted between specimens of *D.* ex gr. *grasiana* are based on stratigraphical observations. From this stratigraphical point of view, within the investigated material from the ABSS the range of variation within all the early specimens does not exceed the observed range which exists in the later species. However, as we compare the variation of *D. grasiana* from Germany as depicted by STOLLEY (1911, Pl. VII and VIII) it seems that the population is morphologically comparable to specimens from older stratigraphical layers and even to *D. silesiaca*-like morphs (STOLLEY, 1911, Pl. VIII, fig. 11, a teratological specimen according to the author).

Phylogeny: Most probably descendant from *D. pontica*.

Stratigraphic occurrence: Beds ANG120 to ANG161.2-3 (*S. defayae* Subzone to *G. sartousiana* Subzone).

Belemnite association: BaBA2a (FO) and BaBA4b (LO).

Geographical distribution: France (Vocontian Basin), Hungary (Gerecse Mts.), and Slovakia.

Duvalia schwetzowi (KELEPTRISHVILI, 1999)

Pl. 7, figs. 5a-c, 13-14, 17-18

? 1883 *Duvalia Grasi* [sic!] DUVAL; UHLIG, Pl. I, fig. 6.
1913 *Duvalia Grasi* [sic!] DUVAL var. B; SHVETSOV,

p. 48, 67, Pl. II, fig. 8e-g.
pt 1957 *Duvalia Grasi* [sic!] DUVAL var. *schwetzovi* var. nov. ERISTAVI, p. 53-54 (pars cum synonymy).
non 1957 *Duvalia Grasi* [sic!] DUVAL var. *schwetzovi* var. nov. ERISTAVI, Pl. II, figs. 8-9.
* 1999 *Pseudoduvalia schwetzowi* sp. nov. KELEPTRISHVILI, p. 23-24, Pl. 2, fig. 8 [HT by OD].
2005 *Duvalia grasiana* (DUVAL-JOUVE); JANSSEN & FŐZY, p. 65 (section E, beds: 300/10, 300/2).

Material: Six specimens (ABSS) and four specimens from DLX.

Stratum: Beds ANG142.3-4 to ANG172.3, and beds DLX106-107 to DLX110-111.

Differential diagnosis: Dilatatoid rostrum with a relative short alveolar groove. It shows a typical quadrangular shaped outline of the alveolar region.

Description: The dorsal and ventral sides are more or less parallel but for the apical part. The apex is displaced to the dorsal side. As a result the dorsal side is less curved in the apical part, compared to the ventral side. The alveolar groove is relative short and more or less restricted to the alveolar area, the depth of the alveolar groove is comparable to the length of the alveolar groove. The alveolar opening is characterized by a typical quadrangular shaped outline. The widest parts are more or less centrally placed.

Remarks: A certain resemblance to *D. pontica* can be observed. However, it differs from *D. pontica* due to the absence of the typical bend that characterizes the rostrum solidum of the latter species. *D. grasiana* shows a much longer alveolar groove. It is much more latatoid, *i.e.*, less laterally compressed, in the rostrum solidum. The new specimen of KELEPTRISHVILI (1999) is well comparable. However, it originates from the early Bedoulian *Deshayesites deshayesi* Zone.

Stratigraphic occurrence: From the *Ho. uhligi* Zone to *I. giraudi* Zone. In Georgia it occurs in the early Bedoulian *D. deshayesi* Zone.

Belemnite association: BaBA3b (FO) and BaBA5b (LO).

Geographical distribution: France (Vocontian Basin), Georgia (Abkhasia), Hungary and probably Slovakia.

Latest Early Barremian belemnite associations BaBA3:

This association is characterized by the abundance of *Shvetsovia* and the first occurrence of *Conohibolites*, the last occurrence of *Curtohibolites* while *Hibolithes* is absent.

Family Mesohibolitidae NERODENKO, 1983

Genus *Conohibolites* JANSSEN & FŐZY, 2005

Conohibolites gladiiformis (UHLIG, 1883)

Pl. 4, figs. 9-10, 11-12;
Pl. 8, figs. 13-14, 15-16,
19-20, 25-26, 30-31

* 1883 *Belemnites gladiiformis* n. sp. UHLIG, p. 176, Pl. I, fig. 2 [HT by MT].
non 1978a *Mesohibolites* cf. *gladiiformis* (UHLIG); VAŠÍČEK, p. 14-16, Pl. II, fig. 5 (= *M. beskidensis*).
? 2002 *Mesohibolites garshini* STOYANOVA-VERGILOVA; TOPCHISHVILI *et al.*, Pl. VIII, fig. 6.
? 2005 *Conohibolites garshini* (STOYANOVA-VERGILOVA); JANSSEN & FŐZY, Pl. III, figs. 36-37 (imm.).
? 2005 *Conohibolites gladiiformis* (UHLIG); JANSSEN & FŐZY, Pl. IV, figs. 5-6.
pt 2005 *Conohibolites gladiiformis* (UHLIG); JANSSEN & FŐZY, p. 74, Pl. IV, figs. 7-11; Pl. V, fig. 22 (cum synonymy).
2010 *Conohibolites* cf. *gladiiformis* (UHLIG); JANSSEN, p. 662-663, Text-fig. 2.24.
2010 *Conohibolites* ex gr. *gladiiformis* (UHLIG); JANSSEN, p. 663, Text-fig. 2.9-10.
2010 *Conohibolites* sp. A; JANSSEN, p. 663, Text-fig. 2.22-23 (cum synonymy).

Material: Nine (ABSS), five (DLX), and thirty-three (BOU) specimens.

Stratum: Beds ANG144 to ANG149.4, and BOU142.3 to 146.1.

Description: Elongated ventro-dorsally compressed rostrum. It tapers down from the alveolar opening towards the apex. Both from lateral view as from a ventral view it is conical to cylindro-conical. Mature to gerontic specimens (*Conohibolites* sp. A *sensu* JANSSEN, 2010, text-fig. 2.22-23) appear very robust while immature specimens are clearly much more slender (hence they are comparable to *S. carpatica*) and elongated. The alveolar opening is more or less rounded in immature specimens and ventro-dorsally compressed in mature to gerontic specimens. Juvenile to immature specimens are well flattened and spindle-like in ventral view.

Remarks: The species is relative rare in the ABSS. However, it is common in the proximal facies of BOU. Especially, mature to gerontic specimens occur quite frequently in these more proximal deposits.

Stratigraphic occurrence: *H. uhligi* Zone to *To. vandenheckii* Zone (*He. sayni* Subzone or lower part of *B. barremense* Subzone).

Belemnite association: BaBA3c (FO and LO).

Geographical occurrence: Bulgaria, Czech Republic, France (Vocontian Basin), Georgia, Hungary (Gerecse Mts.), and Slovakia.

Conohibolites ex gr. *gladiiformis* (Uhlig, 1883)

2005 *Conohibolites* gr. *gladiiiformis* (Uhlig) ? n. sp.; Janssen & Főzy, p. 74-75, Pl. IV, figs. 14-15; Pl. V, figs. 23-24.

Material: One very incomplete specimen from the ABSS.

Stratum: Bed ANG142.2-143.1 (possibly *ex situ*).

Description: A very compressed and elongated specimen with a very long alveolar groove and a short alveolus.

Remarks: Due to the extreme ventro-dorsal compression of the rostrum solidum and the long alveolar groove, small parts can easily be identified, except for the apical most parts. The partially preserved specimen from the ABSS appears to be even more flattened as compared to the specimen from Hungary.

Stratigraphic occurrence: *Ho. uhligi* Zone.

Belemnite association: BaBA3b (single occurrence).

Geographical occurrence: France (Vocontian Basin) and Hungary (Gerecse Mts.).

Conohibolites tzankovi (Stoyanova-Vergilova, 1965)

Pl. 7, figs. 13-14, 27-30; Pl. 8, figs. 36-38; Pl. 11, figs. 17-18a

1898 *Belemnites minaret* Raspail; Simionescu, Pl. I, fig. 3.
* 1965 *Mesohibolites tzankovi* n. sp. Stoyanova-Vergilova, p. 158-159, Pl. I, fig. 7 [HT by OD]; Pl. IV, fig. 8; Pl. VII, figs. 2-4.
? 1970a *Mesohibolites platyurus* (Duval-Jouve); Stoyanova-Vergilova, Pl. XVIII, fig. 5; Pl. XIX, fig. 4.
1970a *Mesohibolites tzankovi* Stoyanova-Vergilova; Stoyanova-Vergilova, p. 37-38, Pl. X, figs. 1-4; Pl. XXXII, fig. 14.
2010 *Curtohibolites* (?) *wernsdorfensis* Stoyanova-Vergilova; Janssen, p. 665, Text-fig. 2.7-8.

Material: Six specimens (BOU), and one from DLX.

Stratum: BOU142.3-BOU144.

Description: A typical conical to cylindro-conical rostrum with a deep alveolus and consequently a relative short rostrum solidum with a more or less pointed to elongate apex. Cross-sections are typically heart-shaped, but are more subrounded to heart-shaped in the alveolar part. In lateral view, the dorsal side tapers much more rapidly to the apical area, as compared to the ventral side. The latter is more or less straight, except for the apical most part in which a feeble incurvation towards the apex can be observed. The apex is elongated. From ventral view, the apical area is more or less minaret-like shaped. Overall, the rostrum is dorso-ventrally compressed.

Remarks: In *Co. platyurus* the rostrum solidum is larger giving it a more elongated appearance and the alveolar opening is well-rounded to feebly dorso-ventrally flattened. In the nominal species the extension of the apical area appears to be much larger as compared to the specimens described herein. Also the rostrum solidum appears to be larger in the specimens herein described.

Phylogeny: Most probably descendant from *Co. gladiiformis*.

Stratigraphic occurrence: Latest Early Barremian to earliest Late Barremian (*M. tirolensis* Subzone (?) - *Ho. uhligi* Zone).

Belemnite association: BaBA3c (FO and LO).

Geographical occurrence: Bulgaria, France (Vocontian Basin; apparently absent from the more distal facies in the ABSS), and Romania.

Genus *Curtohibolites* Stoyanova-Vergilova, 1963

Curtohibolites oosteri Stoyanova-Vergilova, 1963

Pl. 4, figs. 20-21, 30-31

1857 *Belemnites Orbignyanus* Duval-Jouve; Ooster, Pl. I, figs. 9-10, 11, 12-15.
* 1963 *Curtohibolites oosteri* sp. nov. Stoyanova-Vergilova, p. 215-216, Pl. I, figs. 2 [HT]-3 (pars cum synonymy).
1964 *Curtohibolites oosteri* Stoyanova-Vergilova; Stoyanova-Vergilova, p. 138, 139, 146.
pt 1963 *Curtohibolites orignyanus* (Duval-Jouve); Stoyanova-Vergilova, p. 214-215, Pl. I, fig. 1 (not the synonymy).
? 1997 *Conobelus orbignyanus* (Duval-Jouve); Krymgol'ts, p. 149, Pl. 59, fig. 7.

Material: Seven specimens (BOU).

Stratum: From the beds BOU142.4 (top part) to BOU144.

Description: A small sized, clavate to pistilliform specimen, with a more or less mucronate apex, a relative long alveolar groove and a shallow alveolus. The rostrum solidum is slightly compressed, ventro-dorsally. The alveolar cross-section in one specimen is comparable to the one shown by Stoyanova-Vergilova (1963, Pl. I, fig. 2d), that is more or less sub-trapezoidal.

Remarks: Herein, the widest part is situated in the ventral area, in contrast to *Cu.* aff. *Pin-*

guis in which it is situated to the dorsal side. At the moment it is not known whether or not this difference is part of the variety of *Cu. oosteri*.

Stratigraphic occurrence: From the *M. tirolensis* Subzone.

Belemnite association: BaBA3c (FO and LO).

Geographical occurrence: Bulgaria, France (Vocontian Basin), Suisse, and possibly Ukraine (Crimea).

Genus *Shvetsovia* gen. nov.
(for description see above)

Shvetsovia carpatica (Uhlig, 1883)

Pl. 4, figs. 13-14; Pl. 8, figs. 5-6 (?)

* 1883 *Belemnites carpaticus* n. sp. Uhlig, p. 177, Pl. I, fig. 1 [HT by MT].
2005 *Hibolithes*? *carpaticus* (Uhlig); Janssen & Főzy, p. 68-69, Pl. III, figs. 20-27; Pl. V, figs. 15, 17 (cum synonymy).

Material: Eleven specimens (ABSS), two (DLX), and fifteen specimens from BOU.

Stratum: Beds ANG136.1-2 to ANG151.3-152.

Description: Very elongated, ventro-dorsally compressed rostrum, except for the alveolar part. The alveolus is shallow, with a short alveolar groove. Sometimes cross-sections in the apical part are more rounded. The alveolar area is more or less laterally compressed. In ventro-dorsal view, immature specimens are more or less spindle-shaped.

Remarks: Rather typical taxon with a very elongated rostrum. Differentiation between incomplete specimens of *S. carpatica* and *Co. gladiiformis* is sometimes difficult, but for their mature to gerontic stages.

Stratigraphic occurrence: In the upper part of the *C. darsi* Zone (*M. tirolensis* Subzone) to *To. vandenheckii* Zone (*B. barremense* Subzone).

Belemnite association: BaBA3a (FO) to BaBA4a (LO).

Geographical occurrence: Czech Republic, France (Vocontian Basin), Georgia, and Hungary (Gerecse Mts.).

Earliest Late Barremian belemnite associations BaBA4:

This association is characterized by the abundance of *Conohibolites* and *Shvetsovia*, while *Curtohibolites* and *Hibolithes* are absent, and *Mesohibolites* is not yet developed.

Family Mesohibolitidae Nerodenko, 1983

Genus *Conohibolites* Janssen & Főzy, 2005

Conohibolites garshini (Stoyanova-Vergilova, 1965)

Pl. 7, figs. 9-10, 11-12, 17-18, 19-20;
Pl. 8, figs. 17-18

\+ 1964 *Mesohibolites garschini* sp. nov. Stoyanova-Vergilova, p. 139, 145 (nom. nud.).
* 1965 *Mesohibolites garshini* sp. nov. Stoyanova-Vergilova, p. 157, Pl. III, fig. 4 [HT by OD]-6.
1970a *Mesohibolites garshini* Stoyanova-Vergilova; Stoyanova-Vergilova, p. 36-37, Pl. XVI, figs. 5-7 (= Stoyanova-Vergilova, 1965); Pl. XXXII, fig. 15.
non 1975 *Mesohibolites garschini* [sic!] Stoyanova-Vergilova; Kvantaliani & Nazarishvili, Pl. I, fig. 2 (= *Cu.* (?) *wernsdorfensis*).
non 1994 *Mesohibolites garshini* Stoyanova-Vergilova; Vašíček *et al*, Pl. 26, figs. 3-4 (= Michalík & Vašíček, 1989: Pl. 2, fig. 3), 5 (= *Co.* ex gr. *minaretiformis*).
non 2005 *Conohibolites garshini* (Stoyanova-Vergilova); Janssen & Főzy, Pl. III, figs. 36-37.
pt 2005 *Conohibolites garshini* (Stoyanova-Vergilova); Janssen & Főzy, p. 72, Pl. IV, figs. 3-4.
pt 2005 "*Mesohibolites*" sp. A (aff. *minaretiformis* Shvetsov); Janssen & Főzy, Pl. IV, figs. 26-27.

Material: Fifteen specimens (ABSS) and seven (BOU).

Stratum: Beds ANG150 to ANG163.1b.

Description: Cylindro- to subcylindro-conical specimen with a relative robust appearance. The ventral side is more or less flattened, with a well developed alveolar groove reaching more or less halfway to the rostrum. The alveolus occupies approximately 1/3 of the length of the rostrum. The apical area is rather short with a ventrally shifted apex. In lateral view, the rostrum typically tapers down to the apex in its dorsal side, but the ventral side is more or less straight, except for its apical-most part. Due to the flattened ventral area, however with a well-developed alveolar groove, the outline of the cross-sections in the alveolar part and the rostrum solidum, except for the apical most part, a more or less lozenge-shaped.

Remarks: The ventro-lateral tapering aspect is clearly not as pronounced as in *Co. platyurus* and *Co. tzankovi*, while the apical end is clearly less extended.

Stratigraphic occurrence: Top part of the *He. sayni* Zone to the *Gerhardtia provincialis* Subzone.

Belemnite association: BaBA4a (FO and common) and BaBA4b (LO).

Geographical occurrence: Bulgaria, France, Georgia, and Hungary.

Conohibolites ex gr. *minaretiformis* (Shvetsov, 1913)

The specimens that belong to this group of belemnites are quite variable. From a morphological point of view they are close to several species that occurred previously or occur simultaneously, *viz. Conohibolites garshini*, *Co. gladiiformis*, *Co. platyurus*, and *Shvetsovia carpatica*. Also, they bear some resemblance to certain kinds of true *Mesohibolites* exists (*e.g. Mesohibolites beskidensis*). In particular, individual incomplete specimens can often not be distinguished with certainty. Several of these closely resembling species show their last occurrence approximately at the beginning of the initiation of this group of belemnites, or disappear short after the rise of this group. For the moment it is not clear whether or not a new genus should be introduced. Therefore they are for the moment included within the genus *Conohibolites*, which they most resemble morphologically.

Conohibolites minaretiformis (Shvetsov, 1913)

Pl. 6, figs, 1-2, 3-4, 5-6, 7-8, 9-10, 11-12, 17-18, 19-20, 21-22, 25-26, 27-28;
Pl. 7, figs. 1-2, 3-4, 5-6;
Pl. 8, figs. 21-22, 11-12, 28-29, 32-33, 34-35;
Pl. 9, figs. 5-6, 13-14, 15-16, 26-27

pt 1883 *Belemnites minaret* Raspail; Uhlig, Pl. I, fig. 9, non fig. 8 (= *S. elegantoidea*).
1898 *Belemnites beskidensis* Uhlig; Simionescu, p. 107 (51)-108 (52), Pl. I, fig. 4.
? 1898 *Belemnites* sp. Simionescu, Pl. I, fig. 7.
1913 *Hibolites minaretiformis* n. sp. Shvetsov, p. 54-55, 68-69, Pl. IV, fig. 5a-d, e-f [LT].
non 1915 *Belemnites* (*Aulacobelus*) *minaretiformis* Schwetzoff; Kilian & Reboul, p. 255, 269 (= *Adiakritobelus* sp.).
1919 *Mesohibolites minaretiformis* Schwetzoff; Stolley, p. 45.
1970 *Mesohibolites beskidensis* Uhlig; Kotetishvili, p. 105-106, Pl. XX, fig. 4.
1970a *Mesohibolites minaretiformis* (Schwetzoff); Stoyanova-Vergilova, p. 26-27, Pl. X, figs. 5-7.
? 1995 *Mesohibolites beskidensis* Uhlig; Kakabadze & Kotetishvili, p. 106 (probably from the *To. vandenheckii* Zone).
2002 *Mesohibolites minareticus* Krimholz; Topchishvili *et al.*, Pl. XI, fig. 4.
pt 2005 "*Mesohibolites*" sp. A (aff. *minaretiformis* Shvetsov); Janssen & Főzy, p. 78, Pl. IV, figs. 28-29.
pt 2005 "*Mesohibolites*" ? *gagricus* (Shvetsov); Janssen & Főzy, p. 79.

Material: About seventy specimens (ABSS) and about twenty specimens from BOU. Besides several dozens of incomplete specimens (BOU) that might partially belong to *S. elegantoidea*.

Stratum: ANG151.2 to ANG166.1.

Description: An elongated, dorso-ventrally compressed, rostrum with a pointed apex and a shallow alveolar cavity. Two clear ontogenetical stages can be observed. In juvenile to immature specimen, the whole rostrum is dorso-ventrally flattened. In ventral view the rostrum is elongated spindle-like, with a very pointed apical part, a short alveolar groove and a shallow alveolar cavity. In immature specimen the first hint of a feeble ventro-lateral ridge occurs in the alveolar part that is not always well-visible, but well-defined by touch. This ridge disappears in gerontic specimens. Mature to gerontic specimens have a cylindro-conical outline. In lateral view, this outline is askew. The ventral side is more or less straight in the alveolar part and part of the rostrum solidum. However, the apical part is characterized by a curvation towards the central to slightly ventral shifted apex. This curvation is slightly stronger in the dorsal side, and increases in gerontic specimens. However, the outlines of the rostrum cavum and part of the rostrum solidum remain more or less parallel for about half of the total length of the rostrum, like in *Co. garshini*. However, the latter has a much more robust appearance as compared to *Co. minaretiformis*. Moreover, *Co. garshini* has a minaret-like apical part, while the stout morph of *Co.* ex gr. *minaretiformis* has a blunt apex. The alveolar groove is well-defined and in mature specimens it runs onto the rostrum solidum and disappears gradually. The alveolar cavity is short, approximately one-fifth to one-sixth of the total length of the rostrum. In mature to gerontic specimens the alveolar opening can be rounded to faintly laterally compressed, while in less mature specimens the alveolar opening is more or less dorso-ventrally flattened.

In *Conohibolites* the alveolar slit has a more or less a straight appearance, with a sudden curvation near the apical line, comparable to the *Mesohibolites*-type depicted by Stoyanova-Vergilova (1970a, text-fig. 2c). *Shvetsovia* shows an alveolar slit which is different. Its appearance is more or less comparable to something in between the text-fig. 2b (*Hibolithes*) and 2f (*Duvalia*; without the "dentation") as depicted by Stoyanova-Vergilova (1970a). However, it is not clear if the morphology of the alveolar slit is of generic taxonomical significance.

Remarks: Stoyanova-Vergilova (1970a) selected a rather blunt, more robust morph as the LT. In our material this morph (Pl. 6, figs. 1-2, 3-4) is rare and restricted to the lower beds of the occurrence of *Co.* ex gr. *Minaretiformis*. The specimen described as *M. beskidensis* (Uhlig) by Kotetishvili (1970), appears to originate from the *G. sartousiana* Zone and not from beds with *Pulchellia* and *Heinzia* (cf.

VERMEULEN, 2002, p. 182).

Stratigraphic occurrence: *B. barremense* Subzone to *H. feraudianus* Subzone.

Belemnite association: BaBA4a (FO, common in topmost part) and BaBA4c (LO).

Geographical occurrence: Bulgaria, Czech Republic, France (Vocontian Basin), Georgia, and Hungaria.

Conohibolites platyurus (DUVAL-JOUVE, 1841)

Pl. 7, figs. 7-8, 15-16, 21-22 (?), 23-24

pt 1841 *Belemnites platyurus* DUVAL-JOUVE, p. 73-74, Pl. XI, fig. 1, 4 [LT].
non 1841 *Belemnites platyurus* DUVAL-JOUVE, Pl. XI, fig. 2 (= juvenile Mesohibolitidae), non fig. 3 (= *S.* aff. *elegans*).
? 1952 *Belemnites* (*Hibolites*?) *escragnollensis* n. sp. DELATTRE, p. 150-154, text-figs. 60-63, Pl. V, fig. 69.
pt 1970a *Mesohibolites platyurus* (DUVAL-JOUVE); STOYANOVA-VERGILOVA, p. 27-28, Pl. XIX, figs. 5-7; Pl. XXXII, fig. 13.
? 2002 *Mesohibolites platyurus* (DUVAL-JOUVE); TOPCHISHVILI *et al.*, p. 79-80, Pl. VIII, fig. 5.
2005 *Conohibolites escragnollensis* (DELATTRE); JANSSEN & FŐZY, p. 70, 72, Pl. IV, figs. 1-2; Pl. V, figs. 6-7 (cum synonymy).

Material: Eight specimens (ABSS) and five specimens (BOU).

Stratum: ANG151.3 to ANG157.2.

Description: A rather robust, typical conical to cylindro-conical rostrum with a deep alveolus and a rather short rostrum solidum with a very elongated apex. Cross-sections are typically heart-shaped, but change to well rounded outlines in the alveolar part.

Remarks: In *Co. tzankovi* the rostrum solidum is smaller and the apical tapering is more abrupt as compared to the nominal species. DUVAL-JOUVE (1841) indicated in his description that fig. 1 is typical. However, STOYANOVA-VERGILOVA (1970a) indicated fig. 4 to be the LT and subsequently TOPCHISHVILI *et al.* (2002) indicated fig. 1 to be the LT.

A certain resemblance to large (mature to gerontic) *Co. gladiiformis* or *Co. garshini* exists. However, the latter species show dorso-ventrally flattened outlines in the alveolar part of their rostrum. Moreover, the apical area is much more extended and dorso-ventrally flattened in *Co. gladiiformis* but much less in *Co. garshini*. The latter shows a minaret-like apical part, more or less comparable to *S. simionescui*, and has a much larger rostrum solidum.

Phylogeny: Probably descendant from *Co. garshini*.

Stratigraphic occurrence: Earliest Late Barremian *B. barremense* Subzone.

Belemnite association: BaBA4a (FO) and BaBA4b (LO).

Geographical occurrence: Bulgaria, France (Vocontian Basin), Georgia (?) and Hungaria.

Conohibolites cf. *trastikensis* (STOYANOVA-VERGILOVA, 1965)

Pl. 9, figs. 17-18, 19-20

\+ 1964 *Mesohibolites trastikensis* sp. nov. STOYANOVA-VERGILOVA, p. 139, 146 (nom. nud.).
\+ 1964 *Mesohibolites trastickensis* sp. nov. STOYANOVA-VERGILOVA, p. 144 (nom. nud.).
* 1965 *Mesohibolites trastikensis* sp. nov. STOYANOVA-VERGILOVA, p. 157-158, Pl. III, figs. 1 [HT by OD], 2, 3.
\+ 1965 *Mesohibolites trastickensis* sp. nov. STOYANOVA-VERGILOVA, p. 168 (*lapsis calami*).
non 1975 *Mesohibolites trastikensis* STOYANOVA-VERGILOVA; KVANTALIANI & NAZARISHVILI, pp. 138-140, Pl. I, fig. 1.
non 2002 *Mesohibolites trastikensis* STOYANOVA-VERGILOVA; TOPCHISHVILI *et al.*, p. 77-78, Pl. VIII, figs. 2, 3 (= KVANTALIANI & NAZARISHVILI, 1975).

Material: Eight incomplete to badly preserved (partially dissolved) specimens.

Stratum: ANG165.2 to ANG167.

Description: A robust, typical conical to cylindro-conical, tapering rostrum with a near minaret-like apex. Cross-sections are subrounded, slightly dorso-ventrally depressed. The alveolus reaches about a third to halfway the total length of the rostrum, as does the alveolar groove.

Remarks: In *Co. tzankovi* the rostrum solidum is smaller and the apex tapers much more as compared to the nominal species. In *Co. platyurus* the rostrum has a well-rounded outline in the alveolar opening, and the apical area typically tapers into an extended, elongated pointed apex.

Phylogeny: Probably descendant from *Co. garshini*.

Stratigraphic occurrence: *H. feraudianus* Subzone.

Belemnite association: BaBA4c (FO and LO).

Geographical occurrence: Bulgaria and France (Vocontian Basin).

Conohibolites sp. (teratological?)

Pl. 7, figs. 25-26

Material: One specimen.

Stratum: ANG166.2 to ANG167.

Description: A relative short conical belemnite, which differs from all other Mesohibolitidae mentioned herein by a well-defined laterally compression of the rostrum solidum. The alveolar groove is very short and the alveolus is likewise shallow.

Remarks: As this kind of outer-morphology is unknown from any Mesohibolitidae, except for teratological specimens, it is believed to be a misshapen specimen too.

Stratigraphic occurrence: *H. feraudianus* Subzone.

Belemnite association: BaBA4c (single occurrence).

Geographical occurrence: France (Vocontian Basin).

Genus *Shvetsovia* gen. nov.

(for description see above)

Shvetsovia elegantoidea (Stoyanova-Vergilova, 1965)

Pl. 6, figs. 15-16, 23-24;
Pl. 8, figs. 7-8, 9-10, 23-24, 26-27;
Pl. 9, figs. 7-8, 11-12, 21-22, 25-26;
Pl. 16, figs. 1-2, 3-4, 5-6

pt 1883 *Belemnites minaret* Raspail; Uhlig, Pl. I, fig. 8, non fig. 9 (= *Co. minaretiformis*).
\+ 1964 *Mesohibolites elegantoides* sp. nov. Stoyanova-Vergilova, p. 139, 144, 146 (nom. nud.).
* 1965 *Mesohibolites elegantoides* sp. nov. Stoyanova-Vergilova, p. 155-156, Pl. IV, figs. 1 [HT by OD], 3-4.
1970 *Mesohibolites elegans* Schwetzoff; Kotetishvili, p. 106, Pl. XX, fig. 2.
? 1973 *Hibolites jaculum* Phillips; Nazarishvili, Pl. I, figs. 12-13.
? 1994 *Mesohibolites elegantoides* Stoyanova-Vergilova; Vašíček *et al*, p. 82, Pl. 27, figs. 3-4.
non 2002 *Mesohibolites elegantoides* Stoyanova-Vergilova; Topchishvili *et al.*, p. 100-101, Pl. XIII, figs. 4-5.

Material: Forty specimens (ABSS) and over fifty from BOU.

Stratum: ANG153.2 to ANG166.2-167.

Description: Both in ventral as well in lateral view the rostra have a more or less fusiform outline. Mature to gerontic specimens do show a less well pronounced fusiform outline in lateral view. The maximal outline of the cross-sections is situated towards the apical part. The alveolar part shows a well-rounded outline. The alveolus is rather short, about one-fifth of the total length of the rostrum. The alveolar groove reaches onto the rostrum solidum, occupying about one-third of the total length of the rostrum. At the transition from the rostrum cavum towards the rostrum solidum, the outline of the rostrum changes to ventro-dorsally flattened cross-sections. This flattening is maintained throughout the larger part of the rostrum solidum, except for the apical most part. The apex is pointed and orientated slightly to the ventral side. This relates to the more pronounced incurvation of the dorsal side as compared to the ventral side in lateral view.

Remarks: Some fragmentary specimens from the marly bed between ANG157.1-2 and in younger strata can not be grouped with certainty within the nominal species. These could equally well belong to immature specimens of *Co.* ex gr. *minaretiformis*. They differ from *M.* (?) *renngarteni* Krymgol'ts, 1939, by a clearly more ventro-dorsally compressed rostrum. *M.* (?) *renngarteni* is even more spindle-like, has a longer alveolar groove, and a rounded to slightly laterally compressed alveolar part of the rostrum. Moreover, the apex is almost mucronate.

Stratigraphic occurrence: In the upper part of the *B. barremense* Subzone and disappears in the *H. feraudianus* Subzone. The material from Bulgaria originates from the Barremian, except for some material from the Bedoulian of Opaka. The latter most probably relates to *M.* (?) *elegans* (Shvetsov, 1913).

Belemnite association: BaBA4b (FO) and BaBA4c (LO).

Geographical occurrence: Bulgaria, Czech Republic (?), France (Vocontian Basin), Georgia, and Slovakia (?).

Shvetsovia aff. *elegantoidea* (Stoyanova-Vergilova, 1965)

Pl. 9, figs. 3-4

Material: Eleven specimens, varying from near complete to partially preserved specimens.

Stratum: Beds ANG165.1 to ANG166.2-167.

Remarks: Comparable to *S. elegantoidea* but with a clearly less-well developed alveolar groove, a more robust appearance and a more ventro-dorsally compressed rostrum solidum. Also, the alveolar part is dorso-ventrally compressed.

Stratigraphic occurrence: In the "middle" to lower upper part of the *H. feraudianus* Subzone.

Belemnite association: BaBA4c (FO and LO).

Geographical occurrence: France (Vocontian Basin).

Shvetsovia ex gr. *elegantoidea* (Stoyanova-Vergilova, 1965)

Pl. 9, figs. 31-32, 33-34

Material: Three specimens, one immature is complete while the other two are more mature but incomplete.

Stratum: Beds ANG167-168 to ANG168-169.1.

Remarks: Well-flattened, rather robust, spindle-shaped rostrum with a fairly long alveolar groove relative to the depth of the alveolus. The latter is very shallow and also ventro-dorsally compressed. The apical part is pointed.

Stratigraphic occurrence: The upper part of the *H. feraudianus* Subzone to the lowermost part of the *I. giraudi* Zone.

Belemnite association: BaBA4c (FO in topmost part) and BaBA5a (LO and common in lowermost part).

Geographical occurrence: France (Vocontian Basin).

Shvetsovia sp. 1 nov. ?

Pl. 9, figs. 1-2

? + 2003 *Hibolites irregularis* Rouchadze: Kakabadze & Kotetishvili, p. 40 (*nom. null.*).

Material: Three specimens, of which is only one almost completely preserved.

Stratum: Beds ANG165.2-166.1 to ANG166.1.

Remarks: Elongated spindle-like rostrum, with a relative long alveolar groove in relation to the depth of the alveolus. The latter is very shallow and laterally compressed. The rostrum becomes more rounded to slightly ventro-dorsally compressed towards the rostrum solidum. The apical part is pointed and elongated. The general morphology is reminiscent of *S. carpatica*. However, the latter is restricted to the boundary beds between the Early and Late Barremian. Moreover, it is much more spindle-like, with a much better expressed "point-of-widest-section", *i.e.*, the rostrum solidum is almost straight.

Stratigraphic occurrence: In the "middle" part of the *H. feraudianus* Subzone.

Belemnite association: BaBA4c (FO and LO).

Geographical occurrence: France (Vocontian Basin) and Georgia (?).

Family Duvaliidae Pavlow, 1914

Genus *Duvalia* Bayle, 1878

Duvalia grasiana (Duval-Jouve, 1841)

Pl. 5, figs. 6, 9-10, 11-12, 19-20

1841 *Belemnites Grasianus* Duval-Jouve, p. 63 (pars), Pl. 7, figs. 1, 2, 3, 4-5 (?).
1842 *Belemnites pseudo-dilatatus* Nob. Raspail, p. 45 (*nomen oblitum*; nom. dub.).
non 1994 *Duvalia grasiana* (Duval-Jouve); Vašíček *et al.*, Pl. 30, figs. 3-4, 5-6 (= *D. vermeuleni* sp. nov.).
2002 *Duvalia grasiana* (Duval-Jouve); Topchishvili *et al.*, p. 158-160, Pl. XXII, figs. 4-6 (pars cum synonymy).
non 2005 *Duvalia grasiana* (Duval-Jouve); Janssen & Főzy, Pl. III, figs. 38-39; Pl. V, figs. 18-19, 25-26 (= *D. vermeuleni* sp. nov.).
2008 *Duvalia grasiana* (Duval-Jouve); Abu-Zied, p. 607, 615, 617, 619, Text-fig. 3K-L.

Material: Twenty-five specimens.

Stratum: Beds ANG166.2-167 to COM137 (top part of bed).

Description: Latatoid rostrum with a long alveolar groove and a deep alveolus. The cross-sections are ellipsoidal and laterally flattened. The dorsal and ventral sides are more or less parallel but for the apical part. The apex is placed to the dorsal side. As a result the dorsal side is less curved in the apical part, compared to the ventral side. The dorsal alveolar groove generally ends near the apical area. The deep alveolus reaches about half-way the rostrum.

Remarks: In the *G. sartousiana* Zone specimens intermediate between *D. vermeuleni* and *D. grasiana* occur. An immature specimen (see Pl. 5, figs. 19-20) is very reminiscent of *D. silesiaca*.

Phylogeny: Descendant from *Duvalia vermeuleni* sp. nov.

Belemnite association: BaBA4c (FO) to BdBA4 (LO).

Stratigraphical distribution: They first occur in the *H. feraudianus* Subzone, but are most common in the *I. giraudi* and *M. sarsini* subzones of the *I. giraudi* Zone. The apparent absence, or at least relative rarity, of this species in the Barremian-Bedoulian boundary beds is striking. The last specimens occur in the condensed (?) bed on top of COM137 (Aptian; *Dufrenoya furcata* Zone or *Epicheloniceras debile* Subzone).

Geographical distribution: Circum Mediterranean Tethys, Mexico, eastern Africa, and in the Boreal-Atlantic Provence (northern Germany).

Late Barremian to early Bedoulian ("calcareous Bedoulian") belemnite associations BaBA5 to BdBA3:

These associations are characterized by the occurrence of *Mesohibolites* (FO in BaBA5), the absence of *Conohibolites*, while *Shvetsovia* last occurs in the lowermost part of BaBA5. The FO of *Neohibolites* is in BdBA1. Especially in BaBA7, the diversity among the belemnites is rather low.

Family Mesohibolitidae Nerodenko, 1983

Genus *Mesohibolites* Stolley, 1919 emend. Janssen & Főzy, 2005 nomen conservandum

Type species: *Hibolites uhligi* Shvetsov, 1913 (see Janssen & Főzy, 2005, p. 59, 63).

Remarks: The genus is characterized by mature specimens with cylindro-conical outlines, both in lateral as well as in ventral view. In these species the immature specimens show a spindle-like outline in ventral view. However, there are some exceptions, *viz.* the specimens around *Mesohibolites renngarteni* Krymgol'ts, 1939, *Mesohibolites elegans* (Shvetsov, 1913), and the Georgian belemnites related to "*Hibolithes*" ex gr. *horeshaensis-inguriensis* Rukhadze, 1938. Therefore, these specimens are attributed with some doubt to the nominal genus. Especially, the latter two probably belong to *Neohibolites*, or to a new genus. They can almost certainly not belong to *Hibolithes* Denys de Montfort, 1808. The latter genus was already extinct in the Tethyan Realm and only endemic, dwarfed specimens (*Hibolithes minutus* Swinnerton, 1935) survived in the Atlantic-Boreal Province, up to the Barremian-Bedoulian boundary beds (also see juvenile *Mesohibolites*).

Generally, *Mesohibolites* differs from *Shvetsovia* by the absence of spindle-like lateral views in mature specimens (but see above for exceptions). In general, *Conohibolites* is shorter with a less elongated apical area. Moreover, the latter shows much more ventro-dorsally compressed cross-sections, generally throughout its rostrum. The development of the apical area appears to be somewhat different. In general, in *Conohibolites* it is characterized by a sudden kink in the outline of the rostrum solidum, giving way to the apical area. In *Mesohibolites* the apical area appears to be developed in a much more gradual way, in relation to the rostrum solidum. The alveolus is displaced to the dorsal side in *Mesohibolites*, while being centrally placed in *Shvetsovia* and *Conohibolites*. Juvenile specimens of *Shvetsovia* are rather comparable in morphology, but tend to be more clavate-like, while juvenile *Conohibolites* tend to be more elongated and even more dorso-ventrally flattened.

The occurrence of small, probably juvenile specimens - at least herein interpreted as being such - with the first occurrence of the genus *Mesohibolites* is interesting. Probably these specimens point to a relation between the genera *Mesohibolites* and *Neohibolites*, the latter being related to the stratigraphically older genus by neoteny.

Range: Late Barremian - early Bedoulian (*I. giraudi* Zone to *D. deshayesi* Zone).

Phylogeny: Most probably descendant from *Co.* ex gr. *minaretiformis*.

Belemnite association: BaBA5 (FO) and BdBA3 (LO).

Occurrence: Circum Mediterranean Tethys.

Mesohibolites anglesensis sp. nov.

Pl. 10, figs. 11-12, 15-16;
Pl. 13, figs. 27-28

? +1968 *Mesohibolites warians* [sic!] Schwetzoff; Nazarishvili, p. 635.
? 1975 *Mesohibolites minaret* (Raspail); Kvantaliani & Nazarishvili, p. 136.
? 1994 *Mesohibolites* ex gr. *minaret* (Raspail); Vašíček *et al.*, p. 83, Pl. 26, figs. 6-7 (gerontic?).
pt 2002 *Mesohibolites minaret* (Raspail); Topchishvili *et al.*, Pl. XI, fig. 6 (not the synonymy).

Derivation of name: Named after the hamlet of Angles.

Material: Thirteen specimens.

Holotype: RGM 583631 (ANG179.3; Pl. 10, figs. 11-12).

Paratype: RGM 583617 (ANG178.2-179; Pl. 10, figs. 15-16).

Type stratum: *Martelites sarasini* Subzone.

Stratum: Beds ANG175.2-176.1 to ANG186-187.

Description: A medium sized, tapering down to the apex, belemnite. In both ventral as well as in lateral view it is almost conical. The rostrum is dorso-ventrally compressed, except for its apical-most part. This part shows round cross-sections. The alveolar groove reaches approximately half-way the rostrum, while the alveolar cavity is slightly less deep. The apex is very pointed. The alveolar side is almost straight, with only a slight curvation to the apex. As a consequence, the apex is shifted towards the ventral side.

Remarks: Immature specimens of *M. beski-*

densis are cylindro-conical and more slender. Also *M. longus* is cylindro-conical but much more slender, while *M. georgicus* is more robust, *i.e.*, with a less elongated apical area.

Phylogeny: Probably descendant from *Co.* ex gr. *minaretiformis*.

Stratigraphic occurrence: Topmost part of the *I. giraudi* Subzone to *M. sarasini* Subzone.

Belemnite association: BaBA6a (FO and LO).

Geographical occurrence: Georgia (Abkhazia), France (Vocontian Basin), and Slovakia (?).

Mesohibolites beskidensis (Uhlig, 1883)

Pl. 10, figs. 1-2, 3-4, 5-6, 7-8, 9-10, 13-14, 17-18, 19-20

+ 1883a *Belemnites Beskidensis* n. sp. Uhlig, p. 87 (nom. nud.).
1883b *Belemnites Beskidensis* n. sp. Uhlig, p. 177-178, Pl. I, fig. 3 [LT].
non 1898 *Belemnites beskidensis* Uhlig; Simionescu, p. 107 (51)-108 (52), Pl. I, fig. 4 (= *Co. minaretiformis*).
non 1939 *Mesohibolites beskidensis* Uhlig; Krymgol'ts, p. 16-17, Pl. III, figs. 2-4 (= *M. georgicus*).
non 1952 *Mesohibolites beskidensis* Uhlig; Khechinashvili, p. 77, Pl. IV, figs. 2-3 (=? *Co. minaretiformis*).
non 1960 *Mesohibolites beskidensis* Uhlig; Kabanov, p. 359, Pl. II, fig. 6 (= *M. georgicus*).
? pt 1970a *Mesohibolites beskidensis* (Uhlig); Stoyanova-Vergilova, p. 28-29, Pl. XII, fig. 8 (from Golyamo Novo, Targovishko - Barremian), non figs. 5-7 (from Opaka - Bedoulian).
non 1973 *Mesohibolites beskidensis* Uhlig; Gustomesov, p. 151, Pl. XLVIII, fig. 2a-c (= *M. ekimbontchevi*).
non 1973 *Mesohibolites beskidensis* (Uhlig); Nazarishvili, p. 33-34, Pl. 3, figs. 4-6; Pl. 10, figs. 1-2.
non 1976 *Mesohibolites* sp. ex gr. *M. beskidensis* (Uhlig); Patrulius & Avram, p. 140 (6), 146 (12) (= *Adiakritobelus*).
1978a *Mesohibolites* cf. *gladiiformis* (Uhlig); Vašíček, p. 14-16, Pl. II, fig. 5.
1978a *Mesohibolites beskidensis* (Uhlig); Vašíček, p. 19, Pl. II, fig. 2 (= Uhlig, 1883b: Pl. I, fig. 3).
non 2002 *Mesohibolites beskidensis* (Uhlig); Topchishvili *et al.*, p. 96-97, Pl. XII, figs. 4-5 (= *M. georgicus*).

Material: Twenty-six specimens.

Stratum: Beds ANG168 (in top of bed) to ANG174.2-175.1.

Description: Rather large elongated rostrum with cylindro-conical outlines, both in ventral as well as in lateral view. However, the ventral outline is more spindle-like in more mature specimens. The alveolar groove is long, approximately up to the point in which the rostrum has its maximum outline, and the alveolar cavity occupies approximately 1/3 of the total length of the rostrum. The rostrum cavum is laterally compressed, being more pronounced in the more mature specimens. The rostrum solidum is dorso-ventrally compressed, except for its apical most part. The latter has round cross-sections. The apex is pointed and displaced slightly to the ventral side.

Remarks: LT (Uhlig, 1883b, Pl. I, fig. 3) selected by Stoyanova-Vergilova (1970a). The other figured specimen (fig. 7) was attributed to *Mh. uhligi* by Shvetsov (1913), which was subsequently followed by other researchers.

Phylogeny: Most probably descendant from *Co.* ex gr. *minaretiformis*.

Stratigraphic occurrence: Restricted to the *I. giraudi* Subzone (BaBA5), and being most abundant in the *I. giraudi*-Horizon. The specimen described by Uhlig originates from the upper part of the Hradiště-Schichten. This formation is of Barremian to Bedoulian age (cf. Vašíček, 1978b, p. 118).

Belemnite association: BaBA5 (FO, common, and LO).

Geographical occurrence: Bulgaria, Czech Republic, France (Vocontian Basin). It appears to be restricted to the western part of the Mediterranean Tethys.

Mesohibolites bulgaricus Stoyanova-Vergilova, 1965

Pl. 13, figs. 3-4 (?), 5-6, 11-12, 13-14, 23-24

* 1965 *Mesohibolites longus bulgaricus* n. sp. Stoyanova-Vergilova, p. 160-161, Pl. V, figs. 1 [HT by OD]-2; Pl. VII, fig. 1.
pt 1973 *Mesohibolites uhligi* Schwetzow; Gustomesov, p. 151, Pl. XLIX, figs. 9-10.
non 1994 *Mesohibolites longus bulgaricus* Stoyanova-Vergilova; Vašíček *et al.*, p. 83, Pl. 27, figs. 1-2 [= *M. longus* (Shvetsov)].
2002 *Mesohibolites longus bulgaricus* Stoyanova-Vergilova; Topchishvili *et al.*, p. 91-92, Pl. XI, fig. 2 (cum synonymy).

Material: Twenty-nine specimens.

Stratum: ANG198 to ANG209.

Description: Elongated to moderately robust cylindro-conical rostrum, with weak dorso-ventrally compressed rostrum solidum and rounded rostrum cavum. Maximum outline, but almost not spindle-like, near end of alveolar groove. The alveolus occupies approximately half the length of the alveolar groove. It is clearly less compressed as *M. uhligi* and more robust as compared to *M. longus*.

Remarks: As the specimen appears through-

out the Mediterranean Tethys there seems to be no reason to distinguish between geographical species or subspecies. In our material, a quite slender elongated specimen occurs that is much like *M. longus* (Pl. 13, figs. 3-4).

Phylogeny: Probably descendant of *M. ekimbontchevi*.

Stratigraphic occurrence: Barremian-Bedoulian boundary sediments to early Bedoulian (*Pa. oglanlensis* Zone).

Belemnite association: BdBA1 (FO, common and LO).

Geographical occurrence: Bulgaria, France (Vocontian Basin), Georgia, and Ukraine (Crimea).

Mesohibolites ekimbontchevi Stoyanova-Vergilova, 1965

Pl. 13, figs. 21-22;
Pl. 15, figs. 1-2, 3-4, 13-14

+ 1964 *Mesohibolites ekimbontchevi* sp. nov. Stoyanova-Vergilova, p. 140, 146 (nom. nud.).
* 1965 *Mesohibolites ekimbontchevi* sp. nov. Stoyanova-Vergilova, p. 159-160, Pl. VI, figs. 1 [HT by OD]-2; Pl. VII, fig. 5.
1970a *Mesohibolites ekimbontchevi* Stoyanova-Vergilova; Stoyanova-Vergilova, p. 38-39, Pl. XX, figs. 1-5.
1973 *Mesohibolites beskidensis* Uhlig; Gustomesov, p. 151, Pl. XLVIII, fig. 2a-c.
? 1973 *Mesohibolites ekimbontchevi* Stoyanova-Vergilova; Nazarishvili, p. 42-43, Pl. 4, figs. 12-14; Pl. 11, figs. 5-6.
non 1989 *Mesohibolites ekimbontchevi* Stoyanova-Vergilova; Conte, p. 28, text-fig. d (teratological; =? *M. uhligi*).
1998 *Neohibolites ekimbontchevi* Stoyanova-Vergilova; Avram & Melinte, Pl. I, fig. 8.
2002 *Mesohibolites ekimbontchevi* Stoyanova-Vergilova; Topchishvili *et al.*., p. 98-99, Pl. XIII, fig. 1.

Material: Eleven specimens.

Stratum: ANG194 to ANG205 (*i.e.*, the Barremian-Bedoulian boundary beds).

Description: A rather robust cylindro-conical (lateral view) to slightly spindle-shaped (ventral view), dorso-ventrally compressed rostrum. The pointed apex is centrally placed. The alveolar groove is well-pronounced, while the alveolar cavity is rather shallow.

Remarks: In all the mature to gerontic specimens (Pl. 15, figs. 1-2, 13-14) the alveolar part of the rostrum is not preserved. The other specimen is probably a teratological one (Pl. 15, figs. 3-4). Overall, the specimens are much like mature to gerontic *M. uhligi* (Pl. 14, figs. 1-2) but are characterized by a longer apical part of the rostrum. Also, the dorso-ventral compression is less, as compared to *M. uhligi.*

Phylogeny: Probably descendant from *M. uhligi*.

Stratigraphic occurrence: Latest Barremian (topmost *Pseudocrioceras waagenoides* Subzone).

Belemnite association: BdBA1 (FO and LO).

Geographical occurrence: Bulgaria, France (Vocontian Basin), Georgia, Romania, and Ukraine (Crimea).

Mesohibolites fallauxi (Uhlig, 1883)

Pl. 16, figs. 11-12, 15-16, 25-26

+ 1883a *Belemnites Fallauxi* n. sp. Uhlig, p. 187 (nom. nud.).
1883b *Belemnites Fallauxi* n. sp. Uhlig, p. 177 (53), Pl. I, figs. 4 [LT], 13 (teratological), 14 (?).
? pt 1970a *Mesohibolites minaret* (Raspail); Stoyanova-Vergilova, Pl. VIII, figs. 1-4, non figs. 5-6.
? 1970a *Mesohibolites* ex gr. *minaret* (Raspail); Stoyanova-Vergilova, Pl. IX, figs. 1-6.
1973 *Mesohibolites fallauxi* Uhlig; Gustomesov, p. 152, Pl. XLVIII, figs. 8-9.
2002 *Mesohibolites fallauxi* (Uhlig); Topchishvili *et al.*, p. 95-96, Pl. XII, fig. 1 (cum synonymy).

Material: Four specimens.

Stratum: ANG225-226 (= ANG116-117) to ANG231, and one loose specimen from the topmost part of the calcareous section to the east, off the road to Angles. The latter beds correspond to COM122-129 (= ANG231-238).

Description: The specimen is quite robust and characterized by a dorso-ventrally well-flattened rostrum solidum, and a dorso-ventrally depressed rostrum cavum. The alveolar groove is well-visible, broad and relatively long, approximately reaching half-way the rostrum. The alveolus is rather deep. The maximum outline is more or less in the middle part of the rostrum, but mature specimens tend to become almost cylindro-conical. However, the general outline is more spindle-like than cylindro-conical.

Remarks: LT (Uhlig, 1883b: Pl. I, fig. 4) selected by Stoyanova-Vergilova, 1970a. The specimens herein named *S.* ex gr. *elegantoidea* are morphologically comparable but show a very shallow alveolus, a less pronounced alveolar groove, and a less robust rostrum solidum.

Phylogeny: Probably descendant from *M. georgicus*.

Stratigraphic occurrence: Top part of *D. forbesi* Zone to lower part of *D. deshayesi*? Zone.

Belemnite association: BdBA3 (FO and LO).

Geographical occurrence: Bulgaria, Czech

Republic, France (Vocontian Basin), Georgia, Russia (Kabardino-Balkaria ASR), and Ukraine (Crimea).

Mesohibolites georgicus (Nazarishvili, 1973)

Pl. 16, figs. 17-18a, 19-20, 23-24; Pl. 17, figs. 1-2, 3-4, 5-6, 7-8, 9-10, 11-12

? 1952 *Mesohibolites semicanaliculatus* (Blainville); Khechinashvili, Pl. VIII, figs. 1-2; Pl. IX, figs. 1-2.
? 1960 *Mesohibolites uhligi* Schwetzoff; Kabanov, p. 359, Pl. II, fig. 4.
pt 1973 *Mesohibolites uhligi* Schwetzow; Gustomesov, p. 151, Pl. XLVIII, fig. 1a-c.
1973 *Mesohibolites uhligi georgicus* Nazarishvili, p. 32-33, Pl. 3, figs. 1-3; Pl. 9, figs. 13-14 (cum synonymy).
2002 *Mesohibolites uhligi georgicus* Nazarishvili; Topchishvili *et al.*, p. 85-86, Pl. IX, fig. 6; Pl. X, fig. 1; Pl. XIV, fig. 6 (pars cum synonymy).

Material: Thirty-two specimens.

Stratum: Beds ANG225-226 to COM127 (= ANG236).

Description: Rather robust, cylindro-conical, slightly dorso-ventrally depressed specimen with a pointed to blunt apex. The latter is more or less centrally placed, or shifted slightly to the ventral side. Also, the alveolar area is slightly dorso-ventrally depressed. The alveolar groove is rather pronounced, occupying approximately 1/3 of the length of the rostrum, or less. In general, the depth of the alveolus is comparable to the length of the alveolar groove.

Remarks: The specimen shown by Nazarishvili (1973) is indicated to be the HT by Topchishvili *et al* (2002). However, this is not the original designation, nor the only specimen available. In fact a LT has to be indicated, as originally no type was indicated. As the specimen appears throughout the Mediterranean Tethys there seems to be no reason to distinguish between geographical species or subspecies.

Phylogeny: Probably descendant from the specimens herein named *M. nalchikensis*?

Stratigraphic occurrence: In the ABSS restricted to the *D. forbesi* and *D. deshayesi* zones.

Belemnite association: BdBA3 (FO, common, and LO).

Geographical occurrence: Bulgaria, Georgia, France (Vocontian Basin), Russia (Kabardino-Balkaria ASR), Slovakia, and Ukraine (Crimea).

Mesohibolites longus (Shvetsov, 1913)

Pl. 13, figs. 1-2, 9-10, 19-20

1913 *Hibolites longus* n. sp. Shvetsov, pp. 59-60, 70, Pl. V, figs. 1a-b [LT], 1c-f, 8b.
1931 *Hibolites longus* (Schwetzoff); Rukhadze, p. 127-128, Pl. I, figs. 2-3.
1994 *Mesohibolites longus bulgaricus* Stoyanova-Vergilova; Vašíček *et al.*, p. 83, Pl. 27, figs. 1-2.
2000 *Mesohibolites* sp.; Combémorel, p. 177-178, Text-fig. 1a-b.
2002 *Mesohibolites longus longus* (Schwetzoff); Topchishvili *et al.*, p. 90-91, Pl. X, fig. 5; Pl. XI, fig. 1 (cum synonymy).

Material: Ten specimens.

Stratum: ANG178.2-179.1 to ANG181-182.

Description: Cylindro-conical, elongated rostrum with a relative long alveolar groove, but a relative short alveolar cavity. In ventral view specimens often show a spindle-like outline. Overall, the rostrum has rounded to slightly dorso-ventrally compressed cross-sections, except for its alveolar part. Herein, often a feeble lateral compression occurs. The apical part is elongated (stretched) and shows a pointed apex.

Remarks: Lectotype chosen by Ali-Zade (1972). The specimen appears throughout the Mediterranean Tethys thus there seems to be no reason to distinguish between geographical species or subspecies. The specimens of Combémorel (2000) originated from the beds 45 and 48, *i.e.*, the boundary beds of the *M. sarasini* and the *Pc. waagenoides* subzones. It is quite well comparable to the specimen figured by us as *M.* ex gr. *longus* (Pl. 14, figs. 3-4) but appears to be much less dorso-ventrally compressed.

Phylogeny: Probably descendant from *M. anglesensis*.

Stratigraphic occurrence: *M. sarasini* Subzone (Upper Barremian).

Belemnite association: BaBA6a (FO and LO).

Geographical occurrence: Azerbaijan, Bulgaria, France (Vocontian Basin), Georgia, and Slovakia.

Mesohibolites ex gr. *longus* (Shvetsov, 1913)

Pl. 13, figs. 15-16; Pl. 14, figs. 3-4

pt 1913 *Hibolites longus* n. sp. Shvetsov, Pl. V, fig. 1e-f.

Material: Five specimens.

Stratum: ANG189 to ANG196.2-197.

Description: Cylindro-conical specimens with an elongated rostrum. Mature and immature specimens are characterized by a very strong flattening (dorso-ventral compression) of the rostrum. The apex is shifted to the ventral side.

The alveolar groove is quite long and fades away approximately halfway the rostrum. The alveolus is quite shallow, approximately 1/5 of the length of the rostrum.

Remarks: Much more dorso-ventrally compressed rostrum as compared to *M. longus*, and a stronger elongation as compared to *M. uhligi*. Much more elongated as compared to *M. bulgaricus*. It is probably a new species.

Phylogeny: Probably descendant from *M. longus*.

Stratigraphic occurrence: *Pc. waagenoides* Subzone (latest Barremian).

Belemnite association: BaBA6b (FO) and BaBA7 (LO).

Geographical occurrence: France (Vocontian Basin) and Georgia (Abkhasia).

Mesohibolites nalchikensis? KRYMGOL'TS, 1939

Pl. 15, figs. 5-6

\+ 1937 *Mesohibolites* cf. n*alcikensis* sp. nov. (KRIMHOLZ); KUZNETSOV, p. 40 (nom. nud.).
* 1939 *Mesohibolites nalčikensis* sp. nov. KRYMGOL'TS, p. 18-19, Pl. IV, fig. 3 [HT by OD], 4.
2002 *Mesohibolites nalchikensis* KRIMHOLZ; TOPCHISHVILI *et al.*, p. 86-87, Pl. X, fig. 3 (cum synonymy).

Material: Five specimens and one loose specimen.

Stratum: ANG210 to ANG218-219 (= 222-223).

Description: Relative small, cylindro-conical (lateral view) to conical (ventral view) specimens with slightly, laterally depressed rostrum cavum. The alveolar groove is relative long, while the alveolar cavity is rather shallow. In both mature (not figured) and immature specimens, the guard tapers down to the apex. The rostrum solidum is dorso-ventrally depressed well on to the apical area.

Remarks: The specimens are attributed with doubt to the nominal species. Except for one mature specimen all others are probably immature. They are best comparable to KRYMGOL'TS (1939: Pl. IV, fig. 4).

Phylogeny: Probably descendant from *M. bulgaricus*.

Stratigraphic occurrence: early Aptian, the *D. forbesi* Zone.

Belemnite association: BdBA2 (FO and LO).

Geographical occurrence: France (?, Vocontian Basin), Georgia, and Russia (Kabardino-Balkaria ASR).

Mesohibolites (?) *renngarteni* KRYMGOL'TS, 1939

Pl. 11, figs. 1-2, 3-4, 5-6, 11-12, 13-14, 15-16

*1939 *Mesohibolites renngarteni* sp. nov. KRYMGOL'TS, p. 18, Pl. IV, figs. 1, 2 [HT by OD].
\+ 1952 *Mesohibolites rengarteni* KRIMHOLZ; KHECHINASHVILI, p. 78, Pl. VI, figs. 1-2.
non 1960 *Mesohibolites renngarteni* KRIMHOLZ; KABANOV, p. 359, Pl. II, fig. 5 (= *M. renngarteni caucasicus* NAZARISHVILI).
1970 *Hibolites subfusiformis inflata* SCHWETZOFF; KOTETISHVILI, p. 105, Pl. XX, fig. 1 (from the *I. giraudi* Zone).
? pt 1970a *Hibolites krimholzi* sp. nov. STOYANOVA-VERGILOVA, p. 18-19, 67-68, Pl. I, figs. 1 (?), 3, non Pl. I, fig. 2.
non 1972 *Mesohibolites renngarteni* KRIMHOLZ; ALI-ZADE, p. 148-149, text-fig. 50, Pl. VII, fig. 3 (=*M. renngarteni caucasicus* NAZARISHVILI).
non 1973 *Neohibolites renngarteni* KRIMHOLZ; STEVENS, Pl. I, figs. G-I (= *M.* (?) *elegans*).
2000 "*Hibolithes*" nov. sp. 1 CLÉMENT, Pl. 3, fig. 2a-b (from the *I. giraudi* Zone).
non 2000 "*Mesohibolites*" *renngarteni renngarteni* KRIMHOLZ; CLÉMENT, Pl. 3, fig. 1a-b (= *M.* (?) *elegans*).
2002 *Mesohibolites renngarteni renngarteni* KRIMHOLZ; TOPCHISHVILI *et al.*, p. 87-88, Pl. X, fig. 2 (cum synonymy).

Material: Twenty-one specimens.

Stratum: Beds ANG169.1-2 to ANG176.1-2 (and a loose specimen from ANG176.2-179).

Description: This species shows a spindle-like development, both from ventral as well from lateral view. However, the spindle-like development is best seen in ventro-dorsal view. The alveolar groove is well-developed, running towards the point of maximal width of the rostrum solidum, but generally not reaching this point. The alveolus is rather short, reaching approximately halfway the length of the alveolar groove. The alveolar part is rounded or shows a slight lateral compression. However, the rostrum solidum is slightly dorso-ventrally flattened and culminates in a centrally placed pointed, almost mucronate apex. This dorso-ventral flattening is not as pronounced as in *S. elegantoidea*.

Remarks: Differs from more or less comparable species like *S. elegantoidea* by a less ventro-dorsally compressed rostrum. According to KRYMGOL'TS (1939) typical *M. renngarteni* appear to have a rostrum-solidum with well-rounded cross-sections. In our material these specimens occur too. As the specimen appears throughout the Mediterranean Tethys there seems to be no reason to distinguish between geographical species or subspecies.

Phylogeny: Unknown, either descendant from *S.* ex gr. *elegantoidea* or *M. beskidensis*.

Stratigraphic occurrence: The Late Barremian *I. giraudi* Zone and the base of the *M. sarasini* Zone.

Belemnite association: BaBA5 (FO and common) and probably BaBA6a (LO).

Geographical occurrence: Bulgaria, France (Vocontian Basin), Georgia, and Russia (Kabardino-Balkaria ASR).

Mesohibolites uhligi (SHVETSOV, 1913)

Pl. 11, figs. 7-8, 9-10, 19-20;
Pl. 13, figs. 17-18;
Pl. 14, figs. 1-2, 3-4, 5-6, 9-10, 11-12, 13-14, 15-16; Pl. 15, figs. 11-12

? 1883b *Belemnites beskidensis* n. sp. UHLIG, Pl. I, fig. 7.
1913 *Hibolites Uhligi* n. sp. SHVETSOV, p. 55-56, 69, Pl. IV, fig. 6a-c, d-e [LT], f-n; Pl. V, fig. 8a.
non 1970 *Mesohibolites uhligi* SCHWETZOFF; KOTETISHVILI, p. 105, Pl. XX, fig. 3 (= *M. georgicus*).
non 1973 *Mesohibolites uhligi* SCHWETZOW; GUSTOMESOV, p. 151, Pl. XLVIII, fig. 1a-c (= *M. georgicus*).
non 1973 *Mesohibolites uhligi* SCHWETZOW; GUSTOMESOV, p. 151, Pl. XLIX, figs. 9-10 (= *M. bulgaricus*).
1973 *Mesohibolites uhligi* (SCHWETZOFF); STEVENS, Pl. I, figs. P-R.
? 1994 *Mesohibolites uhligi* (SCHWETZOFF); VAŠÍČEK *et al.*, p. 83, Pl. 26, figs. 8-9.
2002 *Mesohibolites uhligi uhligi* (SCHWETZOFF); TOPCHISHVILI *et al.*, p. 83-84, Pl. IX, fig. 5; Pl. XIV, figs. 4, 7 (pars cum synonymy).

Material: Forty specimens.

Stratum: Beds ANG174.2-175.1 to ANG193-194.

Description: Rather robust, spindle-shaped rostrum, both in lateral as well as in ventral view. In general, the alveolar opening is round but sometimes very slightly laterally compressed. The rostrum solidum is clearly dorso-ventrally compressed. The alveolar groove is well-visible and fades away approximately half-way the rostrum. The maximal outline of the rostrum is situated slightly below this point, but is situated approximately half-way along the rostrum. The alveolus occupies approximately half the length of the groove, or less, *i.e.*, being relative shallow. The apex is pointed and centrally placed, and sometimes near mucronate.

Remarks: As the specimen appears throughout the Mediterranean Tethys there seems to be no reason to distinguish between geographical species or subspecies. LT (SHVETSOV, 1913: Pl. IV, fig. 6d-e) selected by TOPCHISHVILI *et al.* (2002). In the upper part of its range, specimens occur that show a much more laterally compressed alveolar part of the rostrum (Pl. 14, 17-18; Pl. 15, figs. 7-8, 19-20). They appear intermediate between *M. uhligi* and *M.* (?) aff. *inguriensis*. These specimens appear to be comparable to CONTE (1989, text-fig. e – *Mesohibolites schaoriensis* KHETSCHINASCHVILI).

Phylogeny: Probably descendant from *M. beskidensis*.

Stratigraphic occurrence: The *M. sarasini* Subzone to *Pc. waagenoides* Subzone.

Belemnite association: BaBA6 (FO, common, and LO).

Geographical occurrence: Azerbaijan, Bulgaria, Czech Republic (?), Georgia, France (Vocontian Basin), and Slovakia.

? *Mesohibolites* sp. (juvenile)

Pl. 12, figs. 1-2, 3-4, 5-6, 7-8, 9-10, 11-12, 13-14, 15-16, 17, 18-19, 20-21, 22-23, 26-27, 36-37

Material: Forty specimens.

Stratum: Beds ANG171.1 to ANG196.1-2.

Description: Small (< 3 cm), generally clavate, *Neohibolites*-like belemnites with often a well-visible, but short alveolar groove. However, also specimens in which no alveolar groove can be seen occur. Often, lateral lines are clearly visible. In general, the apical part is more or less obtuse. The cross-sections are generally rounded, sometimes almost square-like and sometimes slightly dorso-ventrally depressed. Especially in the smallest specimens the cross-sections are near circular. Generally, the widest cross-sections are situated near the apical area. In the alveolar area, the specimens are either slightly laterally compressed or round to near round. Especially in the very small specimens (elongated morphs) there is almost no point in which a "widest cross-section" can be differentiated.

Remarks: These small belemnites do belong to the Mesohibolitidae. The only genus that occurs in the Tethys in sediments of this age is *Mesohibolites*. However, from a morphological point of view, these specimens do either relate to *Neohibolites* or to *Hibolithes*. There are several species in literature that can be compared to the above mentioned specimens, not only regarding the morphology but also their stratigraphical occurrences. In the Boreal-Atlantic Province occurs the small *Hibolithes minutus* SWINNERTON, 1935. However, this species relates to *Hibolithes jaculoides* SWINNERTON, 1937 (IMMEL & MUTTERLOSE, 1980). It is regarded as endemic to the Barremian of east England and northwest Germany, disappearing

in the Barremian-Bedoulian boundary beds, and, at least in Germany, never occurs together with *Neohibolites ewaldi* (MUTTERLOSE & WIEDENROTH, 2009, p. 284), but see MITCHELL & UNDERWOOD (1999, p. 283, 284).

From the Barremian-Bedoulian of the eastern Mediterranean Tethys, RUKHADZE (1938) described the new species of belemnites "*Hibolites bsibiensis, - horeshaensis,* and *– inguriensis*", and included some small specimens depicted by SHVETSOV (1913, Pl. V, fig. 6). The other specimen (SHVETSOV, 1913, Pl. V, fig. 7) was later included in the synonymy of the new species "*Hibolites lashensis*" by KELEPTRISHVILI (1999). Previously however, ERISTAVI (1957, p. 49) included this specimen in his newly species "*Neohibolites patara*". Already SHVETSOV (1913, p. 71) included these belemnites in his "jeunes rostres des Bedoulien" [*sic*]. NAZARISHVILI (1973, p. 106 and chart between p. 86-87) and KVANTALIANI & NAZARISHVILI (1975, p. 133) refer to some of these specimens from latest Barremian sediments (the *I. giraudi* Zone). However, overall, these species are mentioned from the Bedoulian (TOPCHISHVILI *et al.*, 2002, p. 71-75).

Stratigraphic occurrence: In the *I. giraudi* Zone (Latest Barremian).

Belemnite association: BaBA5 (FO) and BaBA7 (LO).

Geographical occurrence: France (Vocontian Basin), Georgia, and Russia (Kabardino-Balkaria ASR).

Mesohibolites (?) *elegans* (SHVETSOV, 1913)

Pl. 15, figs. 9-10, 15-16, 17-18

1913 *Hibolites elegans* n. sp. SHVETSOV, p. 60-61, 70, Pl. V, figs. 3a-b [LT], 3c-f, 4g-h, 8c.
non 1939 *Mesohibolites elegans* SCHWETZOFF; KRYMGOL'TS, p. 20, Pl. IV, figs. 7-8 (= *S. elegantoidea*).
non 1949 *Mesohibolites elegans* (SCHWETZOFF); KRYMGOL'TS, p. 261, Pl. LXXXI, figs. 5-6 (= *S. elegantoidea*).
non 1949 *Mesohibolites elegans* (SCHWETZOFF); KRYMGOL'TS, Pl. LXXXI, fig. 7 (= KRYMGOL'TS, 1939: Pl. IV, fig. 8).
1960 *Mesohibolites elegans* SCHWETZOFF; KABANOV, p. 360, Pl. II, fig. 2.
non 1970 *Mesohibolites elegans* SCHWETZOFF; KOTETISHVILI, p. 106, Pl. XX, fig. 2 (from the *I. giraudi* Zone = *M.* (?) *renngarteni*).
1970a *Mesohibolites elegans* (SCHWETZOFF); STOYANOVA-VERGILOVA, p. 33-34, Pl. XI, figs. 1-7; Pl. XXXII, fig. 6.
? 1970a *Neohibolites* sp. STOYANOVA-VERGILOVA, Pl. XXI, fig. 6.
1972 *Mesohibolites elegans* (SCHWETZOFF); ALI-ZADE, p. 145-146, Pl. V, figs. 3-4.
1973 *Mesohibolites elegans* SCHWETZOW; GUSTOMESOV, p. 152, Pl. XLIX, fig. 2.
non 1973 *Mesohibolites elegans* (SCHWETZOFF); NAZARISHVILI, pp. 44-45, Pl. 5, figs. 4-5; Pl. 10, figs. 7-8 (= *S. elegantoidea*).
? 1989 *Mesohibolites* (*hibolites*) *elegans* SCHWETZOFF; CONTE, p. 28, text-fig. f.
1994 *Mesohibolites elegans* (SCHWETZOFF); VAŠÍČEK *et al.*, p. 81-82, Pl. 27, figs. 7-8.
2002 *Mesohibolites elegans* (SCHWETZOFF); TOPCHISHVILI *et al.*, p. 99-100, Pl. XIII, figs. 2-3 (pars cum synonymy).
2008 *Mesohibolites elegans* (SCHWETZOFF); ABU-ZIED, p. 607, 615, 616, 617, 619, text-fig. 3I-J.

Material: Nine specimens, and (?) three specimens.

Stratum: ANG210 to ANG231-232, and (?) from ANG206 to ANG209.

Description: The specimens are spindle-shaped in both ventral as well as in lateral view, but more pronounced in ventral view. The maximum cross-section is shifted towards the apex and cross-sections are well to slightly dorso-ventrally compressed in the apical part while being laterally compressed in the alveolar part. Between the initiation of the alveolus and the point in which the thickest outline is reached, cross-sections change from laterally compressed to almost round to dorso-ventrally compressed. This area is rather wide in this species. The groove reaches approximately halfway the rostrum. It fades away before the point of maximum thickness. The alveolus is very shallow, being approximately 1/3 of the length of the alveolar groove. The apex is placed centrally and very pointed.

Remarks: LT (SHVETSOV, 1913: Pl. V, fig. 3a-b) selected by ALI-ZADE, 1972. In the beds ANG206 to ANG209 specimens occur that do not show any sign of an alveolar groove but are otherwise comparable. They occur in slightly older beds as compared to the nominal species. Moreover, some specimens are difficult to separate from *M.* (?) ex gr. *horeshaensis-inguriensis*.

Phylogeny: Probably descendant of the specimens herein called *M.* (?) aff. *inguriensis*.

Stratigraphic occurrence: Bedoulian *D. forbesi* Zone to base of *D. deshayesi*? Zone.

Belemnite association: BdBA2 (FO) and BdBA3 (LO).

Geographical occurrence: Bulgaria, France (Vocontian Basin), Georgia, Russia (Kabardino-Balkaria ASR), Slovakia, Ukraine (Crimea), and northern Africa (Egypte).

Mesohibolites (?) *horeshaensis* (RUKHADZE, 1938)

Pl. 16, figs. 13-14

1938 *Hibolites horeshaensis* n. sp. RUKHADZE, p. 154, 171, 187, Pl. II, fig. 4.
1952 *Hibolites horeshaensis* ROUCHADZEI;

KHECHINASHVILI, p. 110-111, Pl. X, figs. 1-3.
+ 1952 *Hibolites horeshiensis* ROUCHADZE; KHECHINASHVILI, p. 118.
1995 *Parahibolites horeshaensis* (ROUCHADZE); RIEGRAF, p. 97.
2002 *Hibolites horeshaensis* ROUCHADZE; TOPCHISHVILI *et al.*, p. 73-74, Pl. VII, fig. 3.

Material: Six specimens.

Stratum: ANG225-226 to ANG231-232.

Description: Spindle-like, both from ventral as well as from lateral view, relative slim specimens with a long alveolar groove and a very shallow alveolus. The alveolar area is laterally compressed, while the apical most part is dorso-ventrally depressed. In between, the outlines of the cross-sections change, as in *M.* (?) *elegans*, from laterally compressed to dorso-ventrally compressed. The apex is centrally placed and rather pointed.

Remarks: The specimen figured by RUKHADZE (1938) shows a hibolitoid-like morph, but our material is much more comparable to the specimens figured by KHECHINASHVILI (1952). There was no type-specimen chosen from the material originally studied by RUKHADZE (1938), so a lectotype has to be chosen from his material.

Phylogeny: Probably relates to *M.* (?) *elegans*.

Stratigraphic occurrence: Bedoulian *D. forbesi* Zone to base of *D. deshayesi*? Zone.

Belemnite association: BdBA2 (FO) and BdBA3 (LO).

Geographical occurrence: France (Vocontian Basin) and Georgia.

Mesohibolites (?) *inguriensis* (RUKHADZE, 1938)

Pl. 16, figs. 7-8, 9-10, 21-22

1938 *Hibolites inguriensis* n. sp. RUKHADZE, p. 154, 171, Pl. II, fig. 3.
+ 1938 *Hibolites ingouriensis* n. sp. RUKHADZE, p. 186-187.
1973 *Hibolites inguriensis* ROUCHADZE; NAZARISHVILI, p. 25-26, Pl. 2, figs. 3-4.
1995 *Neohibolites inguriensis* (ROUCHADZE); RIEGRAF, p. 94.
2002 *Hibolites inguriensis* ROUCHADZE; TOPCHISHVILI *et al.*, p. 71-72, Pl. VII, fig. 6.

Material: Five specimens.

Stratum: ANG223-224 to ANG231-232.

Description: Rather elongated, almost cylindrical specimen in lateral view. In ventral view the specimen is cylindro-conical to slightly spindle-like. The alveolar part is laterally compressed, while the apical part is dorso-ventrally compressed. In between the rostrum changes from laterally compressed, to almost round and to dorso-ventrally compressed. The apex is pointed and centrally placed. The alveolar groove is long and reaches just below the point in which the specimen has its maximum thickness. The alveolus is rather shallow, reaching approximately halfway the extension of the groove, or less.

Remarks: It is well possible that *M.* (?) *horeshaensis* represents immature stages of *M.* (?) *inguriensis*. There was no type-specimen chosen from the material originally studied by RUKHADZE (1938), so a lectotype has to be chosen from his material.

Phylogeny: Probably relates to *M.* (?) *elegans*.

Stratigraphic occurrence: Bedoulian *D. forbesi* Zone to base of *D. deshayesi* ? Zone.

Belemnite association: BdBA2 (FO) and BdBA3 (LO).

Geographical occurrence: Bulgaria, France (Vocontian Basin), and Georgia.

Mesohibolites (?) aff. *inguriensis* (RUKHADZE, 1938)

Pl. 13, figs. 7-8; Pl. 14, figs. 5-6, 7-8

+ 1970a *Neohibolites ingouriensis* (ROUCHADZE); STOYANOVA-VERGILOVA, p. 42-43, Pl. XXI, fig. 3.
2000 *Neohibolites* aff. *clansayensis* STOYANOVA-VERGILOVA; CLÉMENT, Pl. 4, fig. 7 (herein Pl. 13, figs. 7-8).

Material: Five specimens.

Stratum: ANG187.1 to ANG188 (four specimens), and ANG200.

Description: The specimens are like *M. uhligi* regarding their ventral outline, but in lateral view they show a cylindro-conical to almost cylindrical outline comparable to *M.* (?) *inguriensis*. They appear to be more robust as compared to the nominal species.

Remarks: In the upper part of the range of *M. uhligi*, specimens occur that show a much more laterally compressed alveolar part of the rostrum [Pl. 14, 17-18; Pl. 15, figs. 7-8, 19-20; cf. *Mesohibolites schaoriensis* KHETSCHINASCHVILI *sensu* CONTE (1989, text-fig. e)]. They appear intermediate between *M. uhligi* and *M.* (?) aff. *inguriensis* (indicated by a blue two-headed arrow in Fig. 4). Also see remarks with *M. uhligi*.

Phylogeny: Probably descendant from *M. uhligi*.

Stratigraphic occurrence: Latest Barremian *Pc. waagenoides* Subzone.

Belemnite association: BaBA6a (topmost part, FO and common) and BdBA1 (LO).

Geographical occurrence: France (Vocontian Basin), and Georgia (?).

Genus *Mucrohibolites* Nazarishvili, 1969

Type species: *Mesohibolites schaoriensis* Khechinashvili, 1952.

Remarks: So far, the genus *Mucrohibolites* is known only from the Caucasus, *i.e.*, Georgia and probably Azerbaijan. Apparently, it ranges from the Barremian to the Aptian, being especially abundant in the Aptian. Part of this material seems to be very similar to *Neohibolites semicanaliculatus* Auct. (non Blainville, 1827) and *Mesohibolites notus* Mishunina, 1935. This genus is hardly mentioned outside Georgia. It was originally defined by Nazarishvili (1969, p. 179) with the monotypic species as genotype.

Genus *Neohibolites* Stolley, 1911

Type species: *Belemnites semicanaliculatus* Ewald, 1850 (non Blainville, 1827) (= *Belemnites Ewaldi* Strombeck, 1861). Over the years, this genus was reason for much dispute because of some apparent inconsistencies regarding its type species (cf. Stolley, 1911, 1919; Ali-Zade, 1964; Gorn, 1968; Stoyanova-Vergilova, 1970b) and its status is actually pending validation by the ICZN (Riegraf *et al.*, 1998, p. 160). It was originally established on material from the Boreal-Atlantic Province.

Range: Latest Barremian (see remarks) – Earliest Middle Cenomanian (Combémorel *et al.*, 1981).

Remarks: The first ammonite indicative for the Bedoulian was found in the bed ANG200. The first *Neohibolites* occurs in slightly older levels (ANG197-198). As a result, in the ABSS, this genus occurs in the latest Barremian *Pc. Waagenoides* Subzone already. There and by small neohibolitoid species occur already well in the lower part of the Late Barremian *I. giraudi* Zone (see: juvenile ? *Mesohibolites*).

Neohibolites aff. *ewaldi* (Strombeck, 1861)

Pl. 12, figs. 24-25, 28-29, 30-31, 32-33, 34-35

non 1861 *Belemnites Ewaldi* Strombeck, p. 34-38.
? + 1981 *Mesohibolites eichwaldi* [sic!] Sront.; Kakabadze, p. 139 (Late Barremian).
1998 *Neohibolites* aff. *ewaldi* (Strombeck); Avram & Melinte, p. 1119, 1122, Pl. I, fig. 7.
2002 *Neohibolites ewaldi* (Strombeck); Topchishvili *et al.*, p. 111-112, Pl. XVI, figs. 3-4.

Material: Twenty specimens.

Stratum: ANG197-198 to ANG231-232.

Description: Small, dorso-ventrally compressed specimens with a short alveolar groove. Both in ventral as well as in lateral view, the specimens are spindle-like.

Remarks: The specimens are reminiscent of juvenile *Neohibolites*, and are well-comparable to the specimens figured by Avram & Melinte (1998) and Topchishvili *et al.* (2002). Additionally, these sediments yielded forty-two juvenile specimens without alveolar groove preserved. These are well-comparable to *N. patara* Eristavi, 1957. These occur in BdBA1 to BdBA4.

Stratigraphic occurrence: FO is in the uppermost part of the *Pc. waagenoides* Subzone (Barremian-Bedoulian boundary beds).

Belemnite association: BdBA1 (FO) to BdBA3.

Geographical occurrence: France (Vocontian Basin), Georgia, Romania, and Russia (Kabardino-Balkaria ASR).

7. Belemnite zonation for the latest Hauterivian to earliest Late Barremian

Belemnite zonation in the ABSS

Based on the data presented above, and given the fact that we deal with belemnite-associations from the ABSS which we can compare to areas outside the Vocontian Basin, it seems justified to define certain biozones based on the (partial) range of selected belemnite species. Fig. 7 depicts the relationship between the biozones we define herein and the ammonite zones in the ABSS. For each zone and subzone the faunal elements will be given. The latest Hauterivian is not zoned herein. The sediments contain belemnites that belong to HaBA2c. This interval yields the last occurrence (LO) of *D.* ex gr. *dilatata*, abundant *H.* ex gr. *subfusiformis* and is further characterized by the absence of *Pseudoduvalia* and *Pseudobelus*. We propose the following biozonation, based on the distribution of belemnites in the ABSS:

Zone unnamed" [BaBA1]

Definition - The base of this biozone is defined by the first occurrence (FO) of *Duvalia* aff. *silesiaca* (ANG073-074), and the top is defined by the FO of taxa of the *Shvetsovia gagrica-varians* group (ANG117). Three subzones are defined herein.

- Subzone unnamed [BaBA1a]
  Definition - The base is defined by the FO of *D.* aff. *silesiaca* (ANG073-074), the top is defined by the FO of *D. pontica*.
  Characteristic species - *D.* aff. *silesiaca*, *D. gagrica*, *H. targovishtensis*, the FO of

H. ex gr. *jaculiformis*, and the last *H.* ex gr. *subfusiformis*.

- Subzone of *Duvalia pontica* [BaBA1b]
  Definition - The base is defined by the FO of the index species (ANG100), the top is defined by the FO of *H. mirificus*?
  Characteristic species - The index species and common *H.* ex gr. *jaculiformis*.

- Subzone of *Hibolithes mirificus*? [BaBA1c]
  Definition - The base is defined by the FO of the index species (ANG107.2), however attribution to the nominal species is doubtful.
  Characteristic species - Next to the index species, several specimens related (but most probably not conspecific) to *H.* ex gr. *jaculiformis* and the first *Curtohibolites* (?) occur in (the upper part of) this biozone. Also, the last *Hibolithes* occur in this subzone.

ZONE OF *SHVETSOVIA GAGRICA*" [BABA2]

Definition - The base of this zone is defined by the FO of the *S. gagrica-varians* group (ANG117). The top is defined by the FO of *S. carpatica* (ANG136.1-2). Three subzones are defined herein.

- Subzone of *Curtohibolites* (?) *wernsdorfensis* [BaBA2a]
  Definition - The base of this subzone is defined by the FO of the index species (ANG117). The top is defined by the absence of the index species in combination with the occurrences, but not abundant, of the *S. gagrica-varians* group.
  Characteristic species - FO and abundant occurrence of *S.* ex gr. *gagrica-varians*, FO and LO of *Cu.* (?) *wernsdorfensis*, FO of *Cu.* (?) *bourguetensis* sp. nov., and FO of *D. vermeuleni* sp. nov.

- Subzone unnamed [BaBA2b]
  Definition - The subzone is defined by the LO of *Cu.* (?) *bourguetensis* in combination with single occurrences of the *S. gagrica-varians* group. The top is defined by the FO of *Curtohibolites* (ANG133-134).

- Subzone of *Curtohibolites* spp. [BaBA2c]
  Definition - The base of this subzone is defined by the FO of *Curtohibolites* (ANG133-134). The top is defined by the FO of *S. carpatica* (ANG136.1-2).
  Characteristic species - Next to the index species, the subzone yields the last *S.* ex gr. *gagrica-varians* and the FO of *S.* aff. *elegans*.

ZONE OF *SHVETSOVIA CARPATICA*" [BABA3]

Definition - The base of this zone is defined by the FO of the index species (ANG136.1-2). The top is defined by the FO of *Co. garshini* (ANG150). This zone is divided into three subzones.

- Subzone of *Shvetsovia carpatica* [BaBA3a]
  Definition - The base of this zone is defined by the FO *S. carpatica* (ANG136.1-2). The top is defined by the FO of *S. simionescui* (ANG140).
  Characteristic species - Next to the index species, *Curtohibolites* spp. (LO), *Co. gladiiformis* (FO), *S.* aff. *elegans* (LO), and the index species (common and LO).

- Subzone of *Shvetsovia simionescui* [BaBA3b]
  Definition - The base of this zone is defined by the FO of *S. simionescui* (ANG140). The top is defined by the FO of *Co. gladiiformis* (ANG144).
  Characteristic species - The index species, *Co. gladiiformis* (FO and probably also the LO), *Co.* ex gr. *gladiiformis*, and *D. schwetzowi* (FO).

- Subzone of *Conohibolites gladiiformis* [BaBA3c]
  Definition - The base of this zone is defined by the FO of *Co. gladiiformis* (ANG144). The top is defined by the FO of *Co. garshini* (ANG150).
  Characteristic species - The index species (FO and probably also the LO), *S. simionescui* (LO), and common *D. vermeuleni*.

ZONE OF *CONOHIBOLITES MINARETIFORMIS*" [BABA4]

Definition - The base of this zone is defined by the FO of *Co. garshini* (ANG150). The top is defined by the FO of *Mesohibolites*. This zone is divided into three subzones.

- Subzone of *Conohibolites garshini* [BaBA4a]
  Definition - The base of this subzone is defined by the FO of the index species (ANG150). The top is defined by the FO of *S. elegantoidea* (ANG153.2).
  Characteristic species - *Co.* ex gr. *minaretiformis* (abundant), *Co. garshini*, *Co. platyurus* (FO), and *S. carpatica* (LO).

- Subzone of *Shvetsovia elegantoidea* [BaBA4b]
  Definition - The base of this subzone is defined by the FO of the index species (ANG153.2 top). The top is defined by the FO of *Co. trastikensis* (ANG165.1).
  Characteristic species - Besides the

index species (common), *Co. platyurus* (LO), *Co. garshini* (LO), *Co.* ex gr. *minaretiformis* (common), and *D. vermeuleni* (LO).

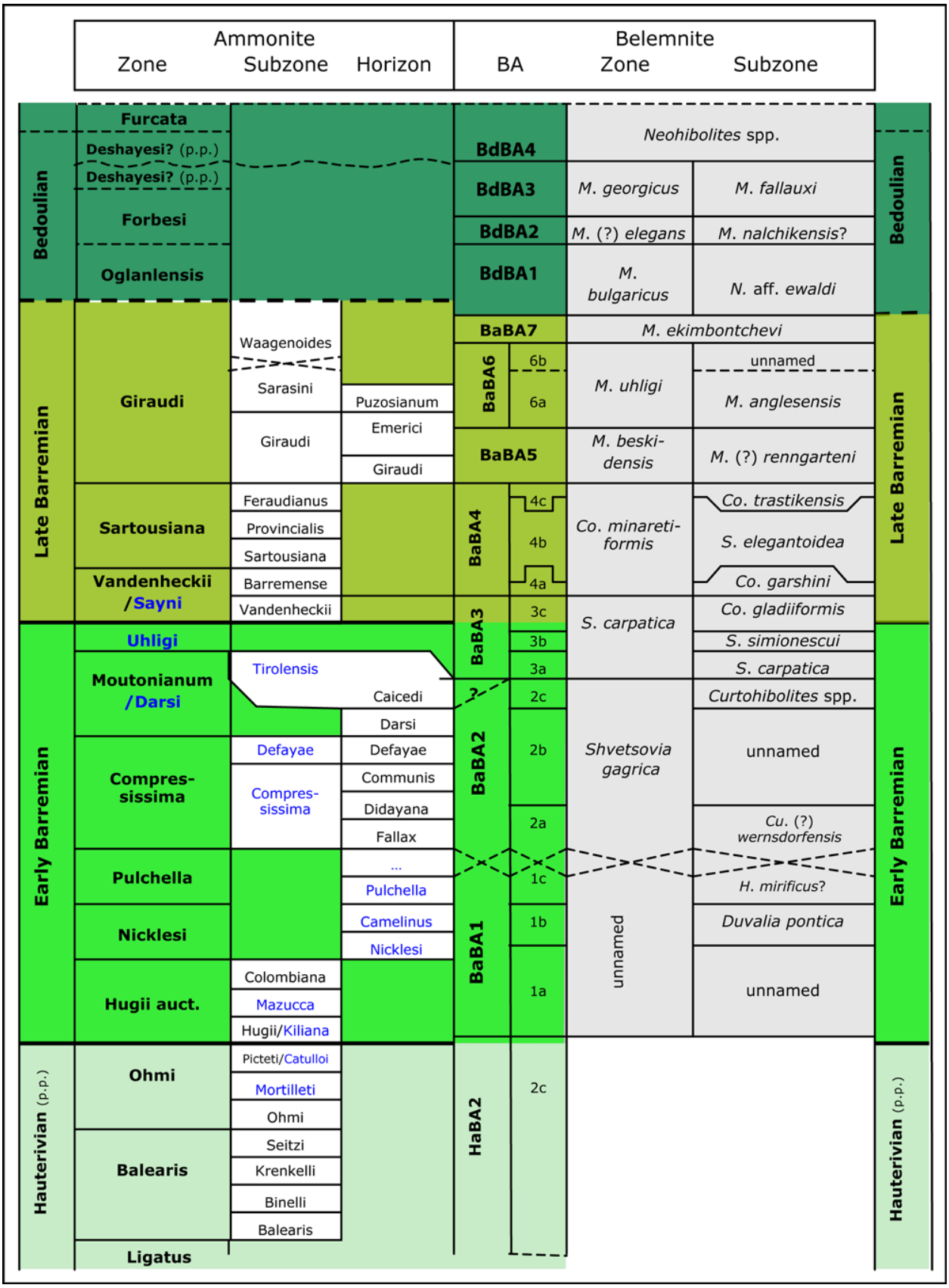

Figure 7: Distribution of the Barremian belemnites associations (BaBA) in the ABSS. Ammonite zonation based on REBOULET *et al.* (2011) and additional data from VERMEULEN (1996, 1998a, 1998b, 2002) and MOULLADE *et al.* (2011). Ammonite zones in blue are not (yet) recognized by REBOULET *et al.* (2011).

- Subzone of *Conohibolites trastikensis* [BaBA4c]
  Definition - The base of this zone is defined by the FO of *Co. trastikensis* (ANG165.1). The top is defined by the FO of the true *Mesohibolites* (ANG168).
  Characteristic species - Besides the index species (FO and LO), *Co.* ex gr. *minaretiformis* (LO), *S. elegantoidea* (LO), *S.* ex gr. *elegantoidea* (FO), *D. grasiana* (FO) and in the top part *Conohibolites* becomes extinct.

ZONE OF *MESOHIBOLITES BESKIDENSIS*" [BABA5]

Definition - The base of this zone is defined by the FO of *M. beskidensis* (ANG168). The top is defined by the FO of *M. uhligi* (ANG174.2-175.1).
Characteristic species - Besides the index species (FO and very common in the lower part), *S.* ex gr. *elegantoidea* (LO), *M.* ? *renngarteni* (FO and common), *D. grasiana* (common), and *D. schwetzowi* (rare). *Conohibolites* and *Shvetsovia* become extinct in the lowermost part.

ZONE OF *MESOHIBOLITES UHLIGI*" [BABA6]

Definition - The base of this subzone is defined by the FO of the index species (ANG174.2-175.1). The top is defined by the FO of *M.* ex gr. *longus* (ANG189).

- Subzone of *Mesohibolites anglesensis* [BaBA6a]
  Definition - The base of this subzone is defined by the FO of *M. uhligi*.
  Characteristic species - Besides the index species (FO and common), *M. anglesensis* (FO), *M. longus*, *M*? *renngarteni* (LO), *M.* ? aff. *ingouriensis* (FO), and *D. grasiana*.

- Subzone unnamed [BaBA6b]
  Definition - The base of this subzone is defined by the FO of *M.* ex gr. *longus* (ANG189). The top is defined by the FO of *M. ekimbontchevi* (ANG194).
  Characteristic species - The index species (FO), *M. uhligi* (LO), and *D. grasiana*.

ZONE OF *MESOHIBOLITES EKIMBONTCHEVI*" [BABA7]

Definition - The base of this zone is defined by the FO of the index species (ANG194). The top is defined by the FO of *M. bulgaricus* (ANG198).
Characteristic species - Besides the index species (FO), *M.* ex gr. *longus* sp. nov., *D. grasiana* (very rare), and *Neohibolites* (FO in the uppermost part).

ZONE OF *MESOHIBOLITES BULGARICUS*" [BDBA1]

Definition - The base of this zone is defined by the FO of *M. bulgaricus* (ANG198). The top is defined by the FO of *M.* (?) *elegans* (ANG210). *D. grasiana* is apparently absent.
Characteristic species - Besides the index species (FO), *M. ekimbontchevi* (LO), and regularly *Neohibolites*. In the top most part yields *M.* (?) *elegans*? (a species without an alveolar groove).

ZONE OF *MESOHIBOLITES* (?) *ELEGANS*" [BDBA2]

Definition - The base of this zone is defined by the FO of *M.* (?) *elegans* (ANG210). The top is defined by the FO of *M. georgicus* (ANG226). Apparently, the sediments yielded no *D. grasiana*.
Characteristic species - Besides the index species (FO), *M. nalchikensis* ? (rare), *M.* (?) *inguriensis* (FO in the uppermost part), and *Neohibolites*.

ZONE OF *MESOHIBOLITES GEORGICUS*" [BDBA3]

Definition - The base of this zone is defined by the FO of *M. georgicus* (ANG226). The top is defined by the absence of *Mesohibolites* - not found so far *in situ* in the beds ANG236 to 238 (= COM 127-129), these beds are most probably followed by a hiatus of yet unknown scale between the so-called "Bédoulien calcaire" and "Bédoulien marneux".
Characteristic species - Besides the index species (FO, LO and common), *M. fallauxi* (FO and LO), *M.* (?) *elegans* (LO), *M.* (?) *inguriensis* (LO), *M.* (?) *horeshaensis* (FO and LO), few *D. grasiana*, and *Neohibolites*. Actually, *M.* (?) *horeshaensis* was first recorded in the marly bed below ANG226.

ZONE OF *NEOHIBOLITES* SPP." [BDBA4]

Definition - The base of this zone is defined by the absence of *Mesohibolites* (beds above ANG236 to 238; = COM 127-129). The top is not defined herein.
Characteristic species - *Neohibolites* (common to abundant) and *D. grasiana* (LO; in the reworked, with pitted belemnites, or condensed level on top of COM137).

Belemnite zonation in BOU

In general the belemnite associations in BOU can be compared to the ABSS. However, the associations differ from several points of view. While *Duvalia* is largely absent from the more proximal areas, juvenile and/or immature specimens of Mesohibolitidae, several *Curtohibolites* and certain species of *Conohibolites* (*gladiiformis*, *tzankovi*) are much more common as compared to the ABSS. Partially due to the condensed nature of many of the beds distinguished in BOU. However, this also seems to reflect natural habitats. The belemnite associations show the condensed nature of BOU very well. BaBA2c and BaBA3a appear to be restricted to few condensed beds, while BaBA4a appears to be restricted to one glauconitic bed.

The base of BaBA1 was not investigated in BOU. However, the index species does occur in a comparable proximal section at Clos de Barral

(the glauconitic marly level CBL119-120 and CBL120; cf. VERMEULEN, 1980a, 1980b), so does *D. pontica* (CBL122 or CBL123), and *H.* ex gr. *jaculiformis* (CBL123 or 125). In BOU the latter species occurs in the beds BOU124 (not depicted) to BOU134.3-135. *H. mirificus* was not found *in situ* so far in BOU but loose specimens were found. In the top part of CBL134 this species was found together with *Cu.* (?) *wernsdorfensis*. The latter species is found in BOU136 and in BOU137.2. So, all the index species for the three subzones (BaBA1a-c) can be found in these proximal facies.

The FO of the *S. gagrica-varians* group (BaBA2) is in the glauconitic top of BOU136.1. The *S. gagrica-varians* group is especially abundant in the beds BOU137.1 to BOU138 (*N. pulchella* Zone to base *K. compressissima* Zone; BaBA2b). So far, BOU141.1 yields the last specimens of this group. These specimens, recorded as *S. varians* s.l. are difficult to separate from *Co. gladiiformis*, which they are probably ancestral to. Above this bed, probably in the top part of the *C. darsi* Subzone, the first *Curtohibolites* occur. In a glauconitic nodular level between BOU141.2 and BOU 142.1 few *S.* aff. *elegans* occur. There and by this level yields the first *S. carpatica*. The latter belemnites point to the presence of BaBA3. The bed BOU142.1 yielded the first *S. simionescui* (BaBA3b). In the glauconitic bed BOU142.3 *Co. gladiiformis* is abundant, among the specimens large (mature to gerontic) morphs previously indicated as *Conohibolites* sp. A (JANSSEN & FŐZY, 2005; JANSSEN, 2010) occur. In these glauconitic beds, and up to the bed 145.1, *Co. gladiiformis*, *S. simionescui* and *Cu. oosteri* are most common. In the glauconitic bed BOU146.3-147.1 belemnites are abundant. Also, phosphatic, green coloured (glauconitic) small *Barremites* and rolled belemnites occur (Fig. 5). This striking level is preceded by a thin white weathered layer (ash-layer?), just above the calcareous bed BOU146.

In the glauconitic bed, typical earliest Late Barremian belemnites occur, among which *Co. minaretiformis* is most abundant. There and by, few *Duvalia* and *Co. platyurus* occur. However, most abundant are *Co. garshini* and *S. elegantoidea* in this condensed bed. Except for *Co. garshini*, the other species can also be found in the few remaining beds before the section is truncated by Albian marls and calcareous sandstones. At the base of these sediments a level with rolled and broken belemnites occurs. These belemnites probably belong to *Neohibolites*.

8. Conclusions

It can be concluded that the belemnite associations from the distal facies (ABSS and DLX) match with those from the more proximal facies (BOU and CBL). The most striking differences exist in the near absence of *Duvalia* in the more proximal sections. More proximal facies show a higher abundance of certain species of *Conohibolites*, *Curtohibolites*, and juvenile to immature Mesohibolitidae. Especially, *Co. gladiiformis* appears to be much more abundant in the more proximal facies. Parts of these differences will be due to the condensed nature of the more proximal sections but it is believed that part reflect natural habitat and natural differences in abundance.

The zonation proposed herein is applicable beyond the Vocontian Basin. In parts of Bulgaria, Czech Republic, Georgia, Hungary, Slovakia, and southern Russia comparable species occur but in general, stratigraphical details are lacking. Although gaps occur in the ranges of some belemnite species and genera, we can in all probability make the following phylogenetical conclusions. In general, these conclusions are based on more or less comparable morphology of the rostrum.

- The new genus *Shvetsovia* relates to *H.* ex gr. *jaculiformis*. The *S. gagrica-varians* group which includes the genotype of *Shvetsovia* eventually gave way to *Co. gladiiformis*. Both genera are characterized by elongated and more robust specimens. However, juvenile to immature specimens of *Conohibolites* appear much more flattened and elongated as compared to *Shvetsovia*. On the other hand, immature specimens and incomplete more mature specimens might virtually be undistinguishable. It is unclear at the moment, but *Co. gladiiformis* was probably the ancestor to the short more robust morphs like *Co. tzankovi*. Eventually in the earliest Late Barremian it developed into *Co.* ex gr. *minaretiformis*. This group of belemnites shows again the typical elongated and short, more robust morphs, but appears slightly more divers. This group, in its widest sense, includes *Co. garshini*, *Co. platyurus* and the most variable *Co. minaretiformis.*

- *Shvetsovia carpatica* that most probably relates to the *S. gagrica-varians* group too, includes in our view also rather variable morphologies. These variations range between extremely elongated specimens to much shorter, more or less spindle-shaped specimens. Like *Co. gladiiformis* the last specimens of *S. carpatica* seem to disappear with the appearance of the *minaretiformis*-group at the base of the *B. barremense* Subzone. If we accept the idea that some of the differences that exist in the outer-morphology of the rostrum of a

belemnite reflect (subtle) adaptations to differences in natural habitat, it seems that the *minaretiformis*-group occupied more or less the same niches as many previous species did. So, eventually several variations or subspecies could be created.

- In the *B. barremense* Subzone *S. elegantoidea* and *Co.* ex gr. *minaretiformis* occur in great abundance. They appear, from a morphological and from a stratigraphical point of view, to be the ancestor to the belemnites included provisionally within the *Mesohibolites*. As a result the genus *Mesohibolites* would be polyphyletic. However, the latter issue needs further investigation.

- The robust morphs of *Curtohibolites*-like species, which occur in older sediments as compared to the smaller typical *Curtohibolites*, are probably descended from *H. mirificus*. Also, within the genus *Shvetsovia* a comparable morph exists, *i.e., S.* aff. *elegans*. The latter is quite common in the distal facies but nearly absent in the more proximal facies. Apart from the fact that the sediments in common appear to be condensed in the more proximal facies, it is well possible that the species represents an adaptation to fill in the niche that appears to be left open by the near absence of *Curtohibolites* in the more distal facies.

- The belemnites that relate to *Neohibolites* are probably descended by neoteny from *Mesohibolites*, or from the more spindle-like specimens herein questionably attributed to *Mesohibolites*. Some of the smaller, clavate-like morphs relate either to *Mesohibolites* or to *Mesohibolites* (?). Alternatively, they could, maybe in part, be separate species, comparable to the Georgian Late Barremian - Bedoulian "*Hibolithes*", *i.e.*, *H. bsibiensis* or *H. lashensis*.

- In Fig. 7 the relation between the ammonite zonation and the belemnite associations is figured. The ammonite zonation for the ABSS was refined by Jean VERMEULEN. Eventually, VERMEULEN (1980a, 1980b, 1998a, 2002) developed a zonation based on distal (ABSS) and proximal (CBL) sections, and several more sections in between. Though several horizons could be distinguished in both facies, others were typically restricted to the more proximal facies. The *Heinzia caicedi* Horizon, a stratigraphical unit based on abundant occurrence of its nominal species, could not be distinguished in the ABSS. In Hungary this species occurs (FŐZY & JANSSEN, 2009, p. 83) together with and just after the occurrence of *S.* aff. *elegans*. In the ABSS the latter species is restricted to the uppermost part of the *C. darsi* Subzone and the *M. tirolensis* Subzone. Combining the above data would suggest that the *H. caicedi* Horizon and the *M. tirolensis* Subzone at least in part overlap.

- Based on belemnites the Hauterivian - Barremian boundary is, except for one bed, comparable as defined by ammonites (Fig. 2). Based on belemnites (base of BaBA4; Fig. 3), the boundary between the Early and Late Barremian is slightly younger as compared to the boundary defined by VERMEULEN (2002). The Barremian – Bedoulian boundary would either be indicated by the FO of *N.* aff. *ewaldi* in ANG197-198, the FO of the *M. ekimbontchevi* at the base of ANG194, or the FO of *M. bulgaricus* in ANG198 (Fig. 4). For the moment we prefer to use the FO of *M. bulgaricus* that is almost identical to the FO of *N.* aff. *ewaldi*. However, at the moment we have no certainty about the relationship between the *Neohibolites* as herein described and the species from the Boreal-Atlantic Province. The "marly Bedoulian" that yields abundant *Neohibolites* and *Mucrohibolites* will be dealt with in a subsequent paper.

Acknowledgements

Our thanks go to Myette GUIOMAR (Réserve naturelle géologique de Haute-Provence, Digne-les-Bains, France) for permission to sample belemnites, Shalva KELEPTRISHVILI (Tbilisi, Georgia) for discussions and information regarding certain belemnites, Jaap KLEIN (Vinkeveen, The Netherlands) for supporting and encouraging this work, Jean VERMEULEN (Barrême, France) for donation of some specimens and for the good company in and out of the field. We would like to express our cordial thanks to Martin KOŠŤÁK (Prague, Czech Republic) and Zdenek VAŠÍČEK (Ostrava, Czech Republic) for their conscientious review. We would like to thank John STARMER (Gainesville, U.S.A.) for linguistic corrections and improvements.

Editorial note

ZooBank Reference:
urn:lsid:zoobank.org:pub:3AB8B960-941E-4A4B-B03C-B15AF1D7D6A4

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Plates

Plates 1-17 (belemnites) & 18-24 (section)

All specimens (x1) unless otherwise indicated. In all specimens the alveolar view is shown (left picture), while in the lateral view the ventral side is to the left unless otherwise indicated (VR - ventral side to the right; VL - ventral side to the left).

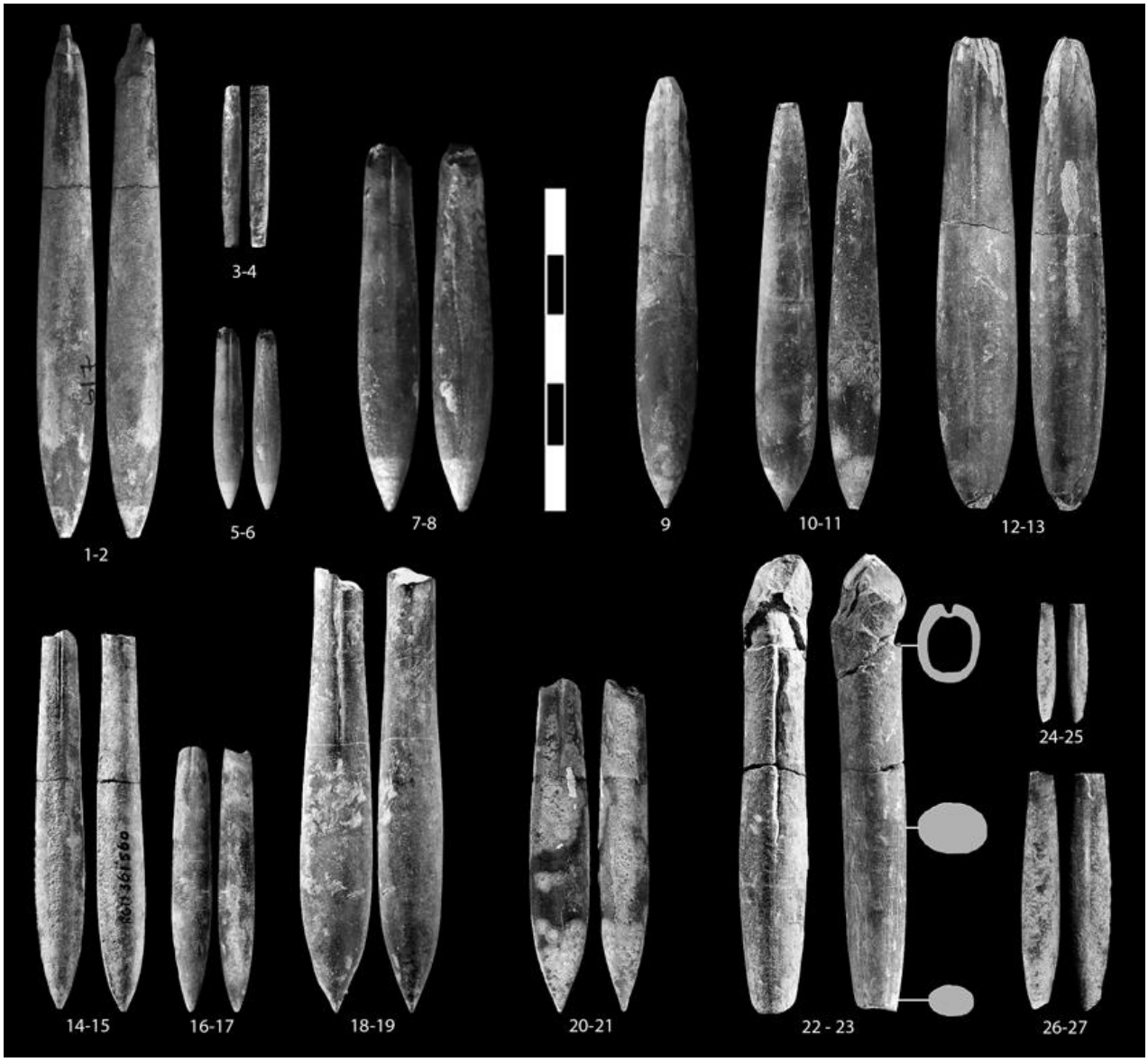


Plate 1. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Hibolithes* ex gr. *subfusiformis* (RASPAIL, 1829), ANG006-007, *B. balearis* Zone, RGM 361567
figs. 3-4. *Hibolithes* ex gr. *subfusiformis* (RASPAIL, 1829) (juv.) ANG034-035, *B. balearis* Zone, RGM 582971
figs. 5-6. *Hibolithes* ex gr. *jaculiformis* SHVETSOV, 1913 (juv.), ANG102-103, *K. nicklesi* Zone, RGM 583003
figs. 7-8. *ibid.* (x2)
fig. 9. *Hibolithes* ex gr. *jaculiformis* SHVETSOV, 1913, ANG102-104, *K. nicklesi* Zone, RGM 361556
figs. 10-11. *Hibolithes* ex gr. *jaculiformis* SHVETSOV, 1913, ANG102-103, *K. nicklesi* Zone, RGM 583006
figs. 12-13. *Hibolithes* ex gr. *jaculiformis* SHVETSOV, 1913, ANG088-089, *Pt. mazuca* Subzone, RGM 592995
figs. 14-15. *Hibolithes* ex gr. *jaculiformis* SHVETSOV, 1913 (imm.), ANG087-088, *Pt. mazuca* Subzone, RGM 361560 (VR)
figs. 16-17. *Hibolithes* ex gr. *jaculiformis* SHVETSOV, 1913 (imm.), ANG100-102, *K. nicklesi* Zone, RGM 361820a
figs. 18-19. *Hibolithes targovishtensis* STOYANOVA-VERGILOVA, 1979, ANG084-085, *Pt. mazuca* Subzone, RGM 582994
figs. 20-21. *Hibolithes* aff. *jaculiformis* SHVETSOV, 1913, ANG110.2-3, *N. pulchella* Zone, RGM 361840
figs. 22-23. *Hibolithes keleptrishvilii* sp. nov. [HT], ANG045 *P. ohmi* Zone, RGM 361817
figs. 24-25. Genus species nov., ANG021-022, *B. balearis* Zone, RGM 582963 (ventral side not known)
figs. 26-27. *Ibid.* (x2) (ventral side not known)

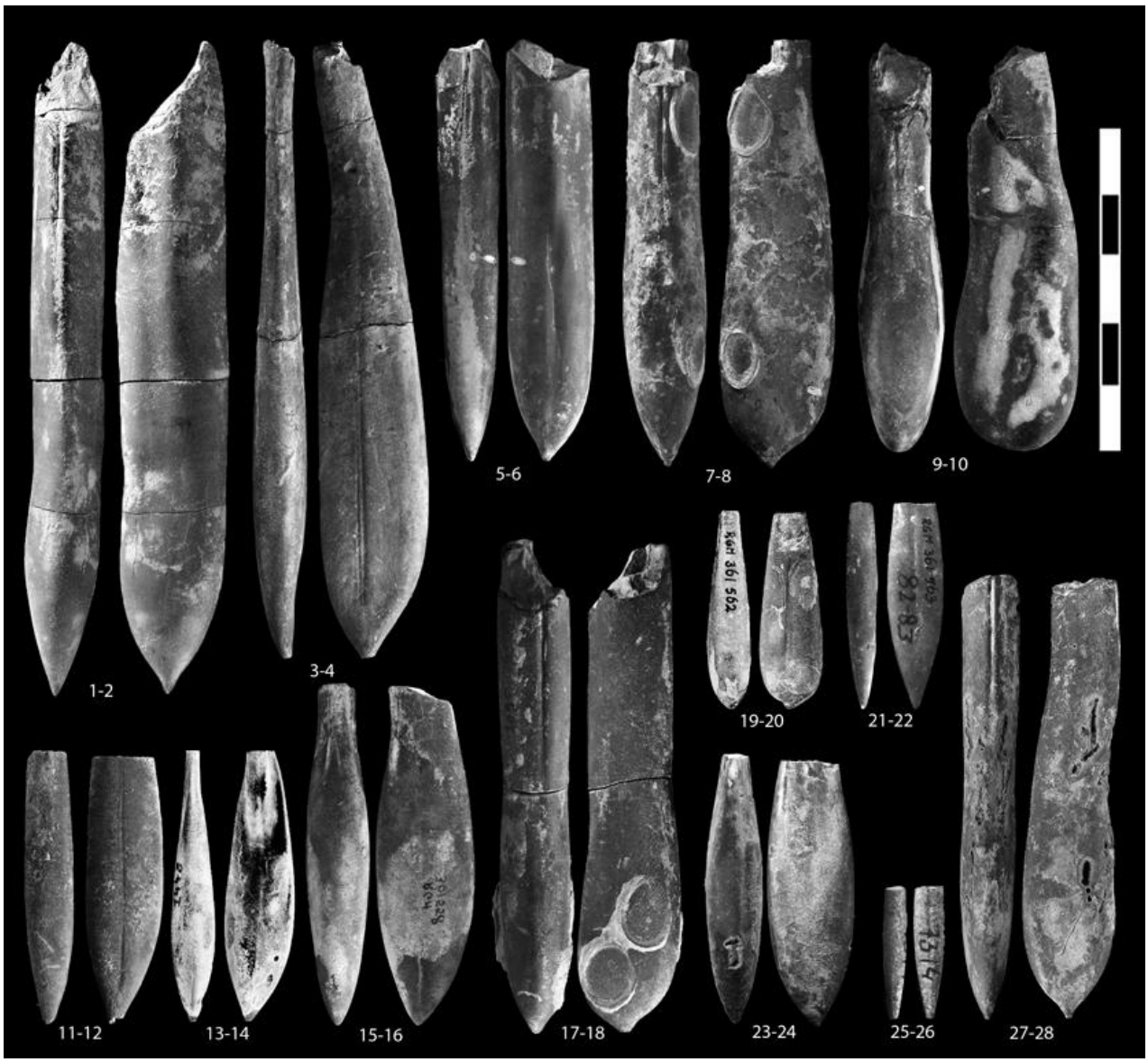


Plate 2. In all specimens ventral side is to the right, unless otherwise indicated.
figs. 1-2. *Duvalia pontica* SHVETSOV, 1913, ANG102-103, *K. nicklesi* Zone, RGM 583004
figs. 3-4. *Duvalia dilatata binervioides* STOYANOVA-VERGILOVA, 1965, ANG014, *B. balearis* Zone, RGM 582995
figs. 5-6. *Duvalia pontica* SHVETSOV, 1913 (ger.), ANG100-101, *K. nicklesi* Zone, RGM 583002
figs. 7-8. *Duvalia gagrica* ? SHVETSOV, 1913, ANG083-084, *Pt. mazuca* Subzone, RGM 582997
figs. 9-10. *Duvalia silesiaca* UHLIG, 1902 (mat?), ANG081-082, *Pt. mazuca* Subzone, RGM 583019
figs. 11-12. *Duvalia pontica* SHVETSOV, 1913 (imm.), ANG103-104, *K. nicklesi* Zone, RGM 361834
figs. 13-14. *Duvalia silesiaca* UHLIG, 1902, ANG084-085, *Pt. mazuca* Subzone, RGM 582990
figs. 15-16. *Duvalia gagrica* ? SHVETSOV, 1913, ANG085-086, *Pt. mazuca* Subzone, RGM 361558
figs. 17-18. *Duvalia gagrica* SHVETSOV, 1913, ANG083-084, *Pt. mazuca* Subzone, RGM 582998
figs. 19-20. *Duvalia silesiaca* UHLIG, 1902 (imm.), ANG084-085, *Pt. mazuca* Subzone, RGM 361562 (VL)
figs. 21-22. *Duvalia silesiaca* UHLIG, 1902 (imm.), ANG082-083, *Pt. mazuca* Subzone, RGM 361563 (VL)
figs. 23-24. *Duvalia silesiaca* UHLIG, 1902, ANG092-093, *Psilotissotia colombiana* Subzone, RGM 582997
figs. 25-26. *Duvalia silesiaca* UHLIG, 1902 (juv.), ANG073-074, *T. hugii* auct. Subzone, RGM 361565 (VL)
figs. 27-28. *Duvalia gagrica* SHVETSOV, 1913, ANG093-094, *Pt. colombiana* Subzone, RGM 582998 (VL)

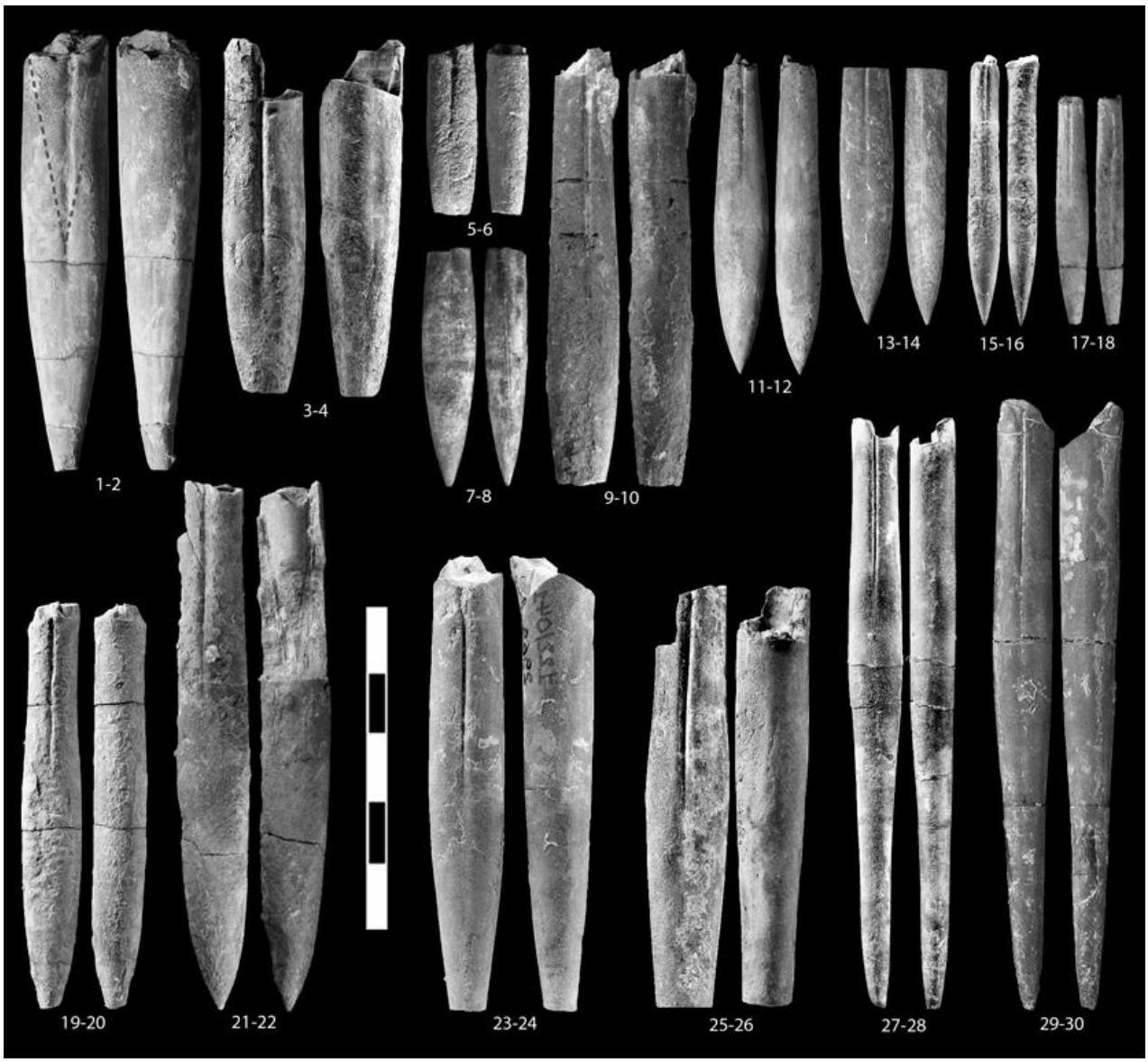


Plate 3. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Curtohibolites* (?) *wernsdorfensis* (STOYANOVA-VERGILOVA, 1963), ANG117, *S. defayae* Subzone, RGM 583023 (VR)
figs. 3-4. *Curtohibolites* (?) *wernsdorfensis* (STOYANOVA-VERGILOVA, 1963), ANG120-121, *S. defayae* Subzone, RGM 361856 (VR)
figs. 5-6. *Curtohibolites* (?) *wernsdorfensis* ? (STOYANOVA-VERGILOVA, 1963) (imm.), ANG120-121, *S. defayae* Subzone, RGM 361855 (VR)
figs. 7-8. *Shvetsovia* ex gr. *gagrica-varians* (SHVETSOV, 1913) (imm.), ANG120-121, *S. defayae* Subzone, RGM 583020
figs. 9-10. *Shvetsovia gagrica* (SHVETSOV, 1913), BOU137.2-138, *K. compressissima* Zone, RGM 583367 (VR)
figs. 11-12. *Shvetsovia varians* (SHVETSOV, 1913), ANG120-121, *S. defayae* Subzone, RGM 361854
figs. 13-14. *Shvetsovia* ex gr. *gagrica-varians* (SHVETSOV, 1913) (imm.), ANG121-122, *S. defayae* Subzone, RGM 361859
figs. 15-16. *Shvetsovia varians* (SHVETSOV, 1913), ANG122, *S. defayae* Subzone, RGM 583031 (VR)
figs. 17-18. *Shvetsovia varians* (SHVETSOV, 1913) (juv.), BOU138-139, *K. compressissima* Zone, RGM 583353 (VR)
figs. 19-20. *Shvetsovia gagrica* (SHVETSOV, 1913), ANG122, *S. defayae* Subzone, RGM 361860 (VR)
figs. 21-22. *Shvetsovia gagrica* (SHVETSOV, 1913), BOU137.2, *K. compressissima* Zone, RGM 583369 (VR)
figs. 23-24. *Shvetsovia varians* (SHVETSOV, 1913), ANG122, *S. defayae* Subzone, RGM 583032 (VR)
figs. 25-26. *Shvetsovia gagrica* (SHVETSOV, 1913), ANG121-123, *S. defayae* Subzone, RGM 361861 (VR)
figs. 27-28. *Shvetsovia varians* (SHVETSOV, 1913), ANG121-122, *S. defayae* Subzone, RGM 583034 (VR)
figs. 29-30. *Shvetsovia varians* (SHVETSOV, 1913), ANG122, *S. defayae* Subzone, RGM 583033 (VR)

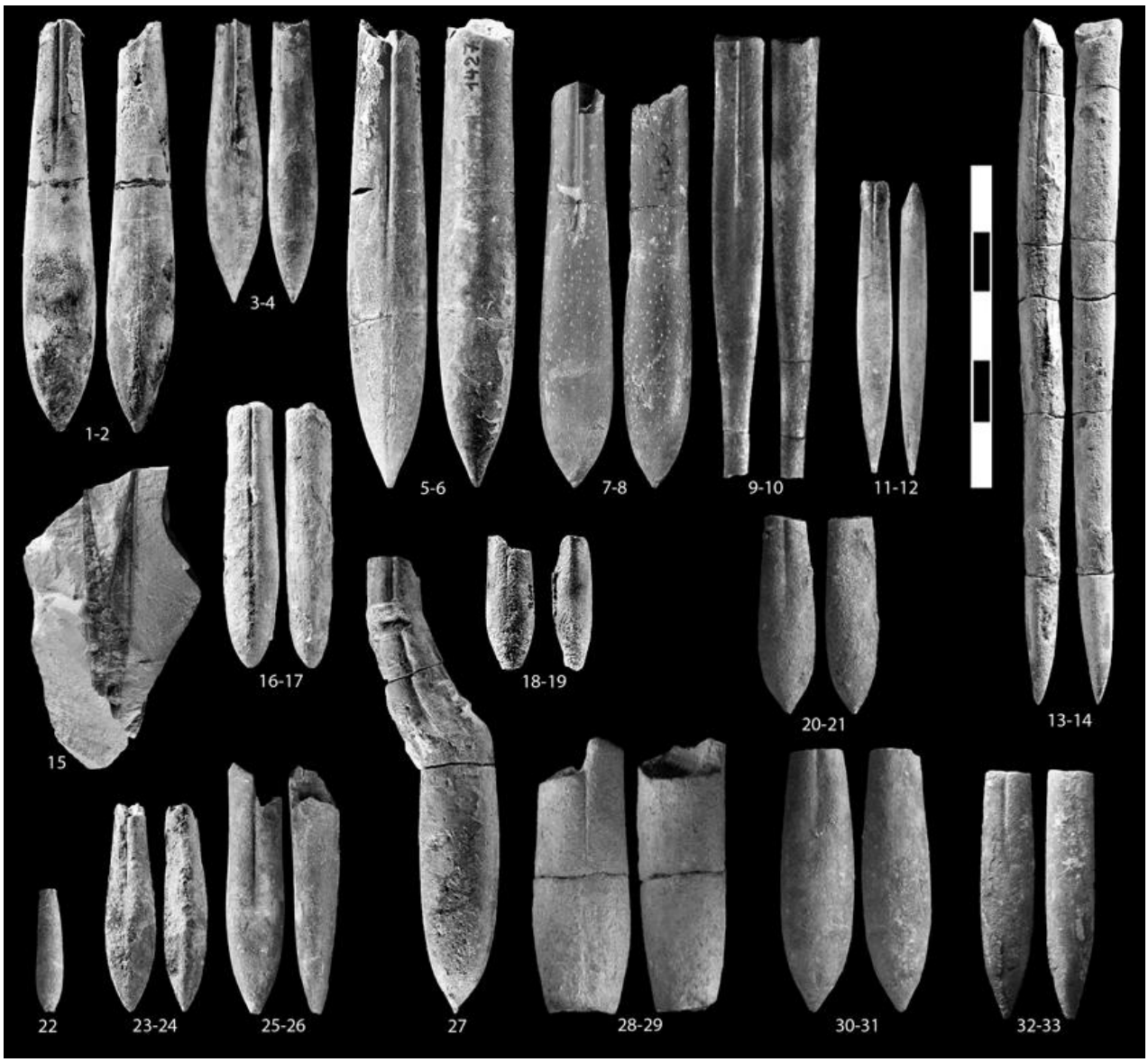


Plate 4. In all specimens ventral side is to the left.
figs. 1-2. *Shvetsovia* aff. *elegans* (SHVETSOV, 1913), ANG133-134, *C. darsi* Zone, RGM 583046 (VR)
figs. 3-4. *Shvetsovia* aff. *elegans* (SHVETSOV, 1913) (imm.), ANG134-135, *M. tirolensis* Subzone, RGM 583048 (VR)
figs. 5-6. *Shvetsovia* aff. *elegans* (SHVETSOV, 1913), ANG135-136.1, *M. tirolensis* Subzone, RGM 583051
figs. 7-8. *Shvetsovia* aff. *elegans* (SHVETSOV, 1913), ANG136.2-137, *M. tirolensis* Subzone, RGM 583052 (VR)
figs. 9-10. *Shvetsovia gladiiformis* (UHLIG, 1883) (imm./mat.), ANG144-145, *Ho. uhligi* Zone, RGM 361878
figs. 11-12. *Shvetsovia gladiiformis* (UHLIG, 1883) (juv./imm.), ANG143.5-144, *Ho. uhligi* Zone, RGM 361878 (VR)
figs. 13-14. *Shvetsovia carpatica* (UHLIG, 1883), ANG138-139.1, *S. defayae* Subzone, RGM 361872 (VR)
fig. 15. *Shvetsovia simionescui* (STOYANOVA-VERGILOVA, 1970) internal view, ANG141.1, *Ho. uhligi* Zone, RGM 361872 (VR)
figs. 16-17. *Shvetsovia* aff. *elegans* (SHVETSOV, 1913) (imm.), ANG138-139, *M. tirolensis* Subzone, RGM 361873
figs. 18-19. *Curtohibolites* (?) *bourguetensis* sp. nov. (juv./imm.), ANG129-131, *C. darsi* Zone, RGM 361499 (VR)
figs. 20-21. *Curtohibolites oosteri* STOYANOVA-VERGILOVA, 1963 (imm.), BOU144 base, *M. tirolensis* Subzone, RGM 583290
figs. 22. *Shvetsovia* sp. (juv.) BOU144-145.1, *M. tirolensis* Subzone, RGM 583281
figs. 23-24. *Shvetsovia* aff. *elegans*? (SHVETSOV, 1913) (imm.), ANG136.2-137, *M. tirolensis* Subzone, RGM 361871 (VR)
figs. 25-26. *Shvetsovia simionescui* (STOYANOVA-VERGILOVA, 1970) (imm.), ANG144-145, *Ho. uhligi* Zone, RGM 361881
fig. 27. *Shvetsovia* aff. *elegans* (SHVETSOV, 1913), ANG135-136.1, *M. tirolensis* Subzone, RGM 361867
figs. 28-29. *Curtohibolites* (?) *bourguetensis* sp. nov. [HT], BOU137.2-138, *K. compressissima* Zone, RGM 583366 (VR)
figs. 30-31. *Curtohibolites oosteri* STOYANOVA-VERGILOVA, 1963, BOU144 base, *M. tirolensis* Subzone, RGM 583289 (VR)
figs. 32-33. *Shvetsovia* aff. *elegans* (SHVETSOV, 1913) imm., BOU141.1-142.1, *C. darsi* Zone, RGM 583337

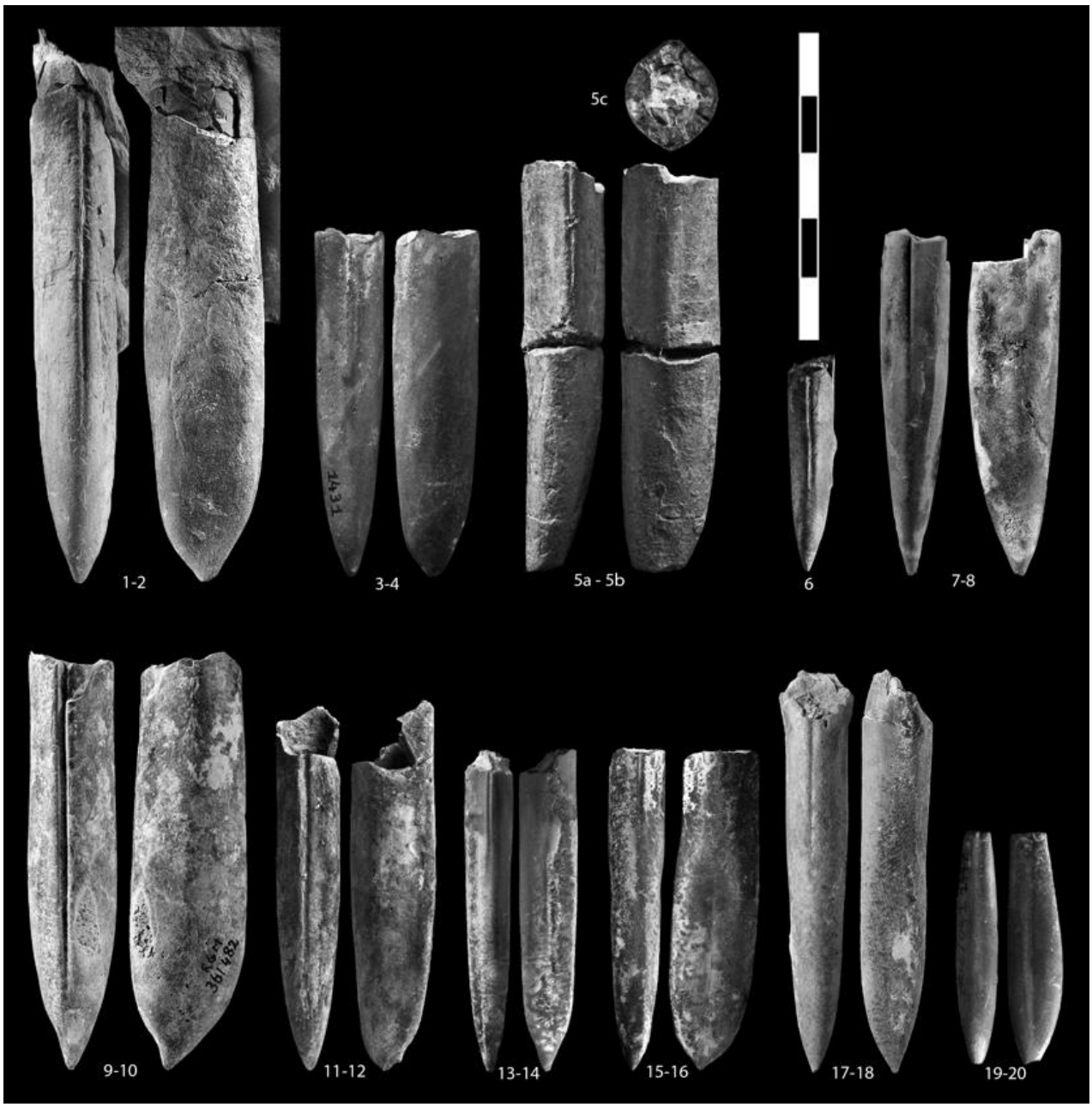


Plate 5. In all specimens ventral side is to the right, unless otherwise indicated.
figs. 1-2. *Duvalia vermeuleni* sp. nov. (HT), ANG120, *S. defayae* Subzone, RGM 361561
figs. 3-4. *Duvalia vermeuleni* sp. nov. (immature), ANG120-121, *S. defayae* Subzone, RGM 583021
figs. 5a-c. *Duvalia schwetzowi* KELEPTRISHVILI, 1999 (mature), ANG143.3-4, *Ho. uhligi* Zone, RGM 583062
fig. 6. *Duvalia grasiana* (DUVAL-JOUVE, 1841) (immature), ANG171.3-172.1, *I. giraudi* Zone, RGM 361481
figs. 7-8. *Duvalia vermeuleni* sp. nov., ANG161.2-3, *G. sartousiana* Zone, RGM 583126 (VL)
figs. 9-10. *Duvalia grasiana* (DUVAL-JOUVE, 1841), ANG169.2-170.1, *I. giraudi* Zone, RGM 361481
figs. 11-12. *Duvalia grasiana* (DUVAL-JOUVE, 1841), ANG226-227, *D. forbesi* Zone, RGM 583756
figs. 13-14. *Duvalia schwetzowi* KELEPTRISHVILI, 1999, ANG151.3-152, *B. barremense* Subzone, RGM 583085
figs. 15-16. *Duvalia pontica* SHVETSOV, 1913 (immature), ANG104-106, *K. nicklesi* Zone, RGM 361554
figs. 17-18. *Duvalia schwetzowi* KELEPTRISHVILI, 1999, DLX111-112; *B. barremense* Subzone, RGM 583855 (VL)
figs. 19-20. *Duvalia grasiana* (DUVAL-JOUVE, 1841) (juv./imm.), ANG171.1, *I. giraudi* Zone, RGM 583557

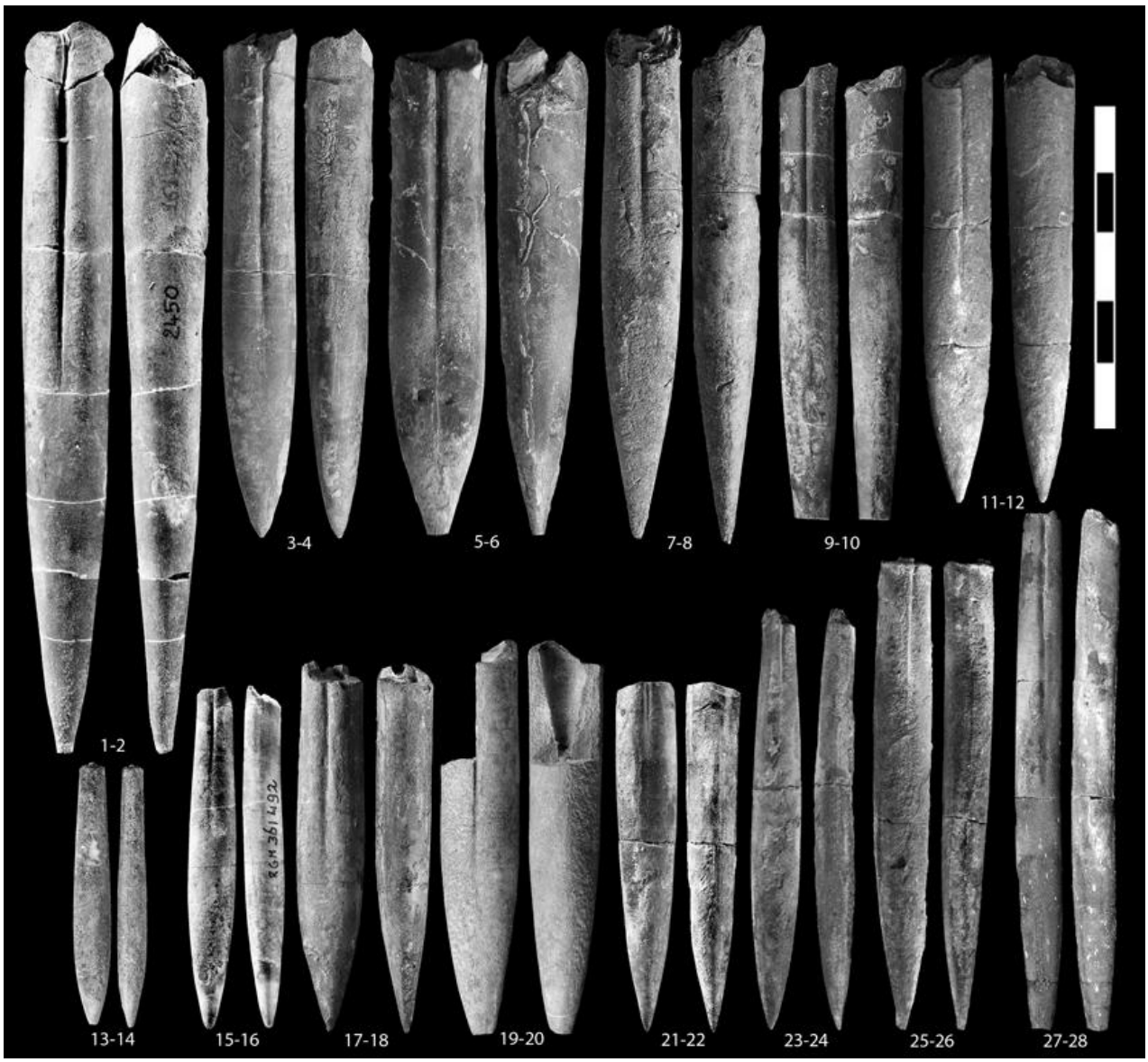
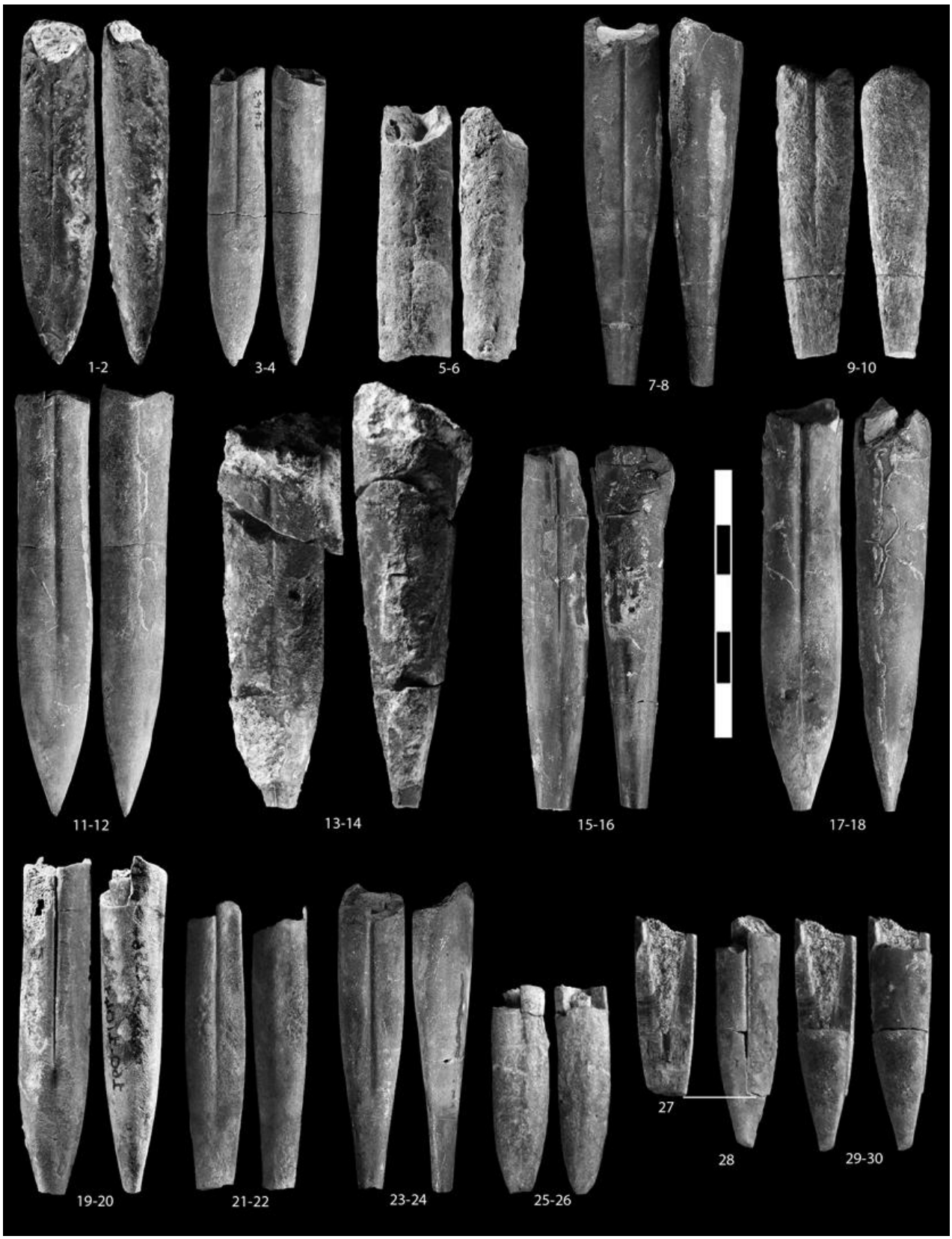


Plate 6. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG161.2-3, *B. barremense* Subzone, RGM 583136
figs. 3-4. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3-152, *B. barremense* Subzone, RGM 583092
figs. 5-6. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3-152, *B. barremense* Subzone, RGM 583095 (VR)
figs. 7-8. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3-152, *B. barremense* Subzone, RGM 583090
figs. 9-10. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3-152, *B. barremense* Subzone, RGM 583082 (VR)
figs. 11-12. *Conohibolites minaretiformis* (SHVETSOV, 1913), BOU146.3-147.1, *B. barremense* Subzone, RGM 583219 (VR)
figs. 13-14. *Conohibolites* sp. juv., ANG151.3-152, *B. barremense* Subzone, RGM 361913
figs. 15-16. *Shvetsovia elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG157.1-2, *B. barremense* Subzone, RGM 361492
figs. 17-18. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3-152, *B. barremense* Subzone, RGM 361907 (VR)
figs. 19-20. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG152-153.1, *B. barremense* Subzone, RGM 361917 (VR)
figs. 21-22. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3-152, *B. barremense* Subzone, RGM 361566
figs. 23-24. *Shvetsovia elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG153.2-154, *B. barremense* Subzone, RGM 361919
figs. 25-26. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG156.2-3, *B. barremense* Subzone, RGM 583106 (VR)
figs. 27-28. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3-152, *B. barremense* Subzone, RGM 583089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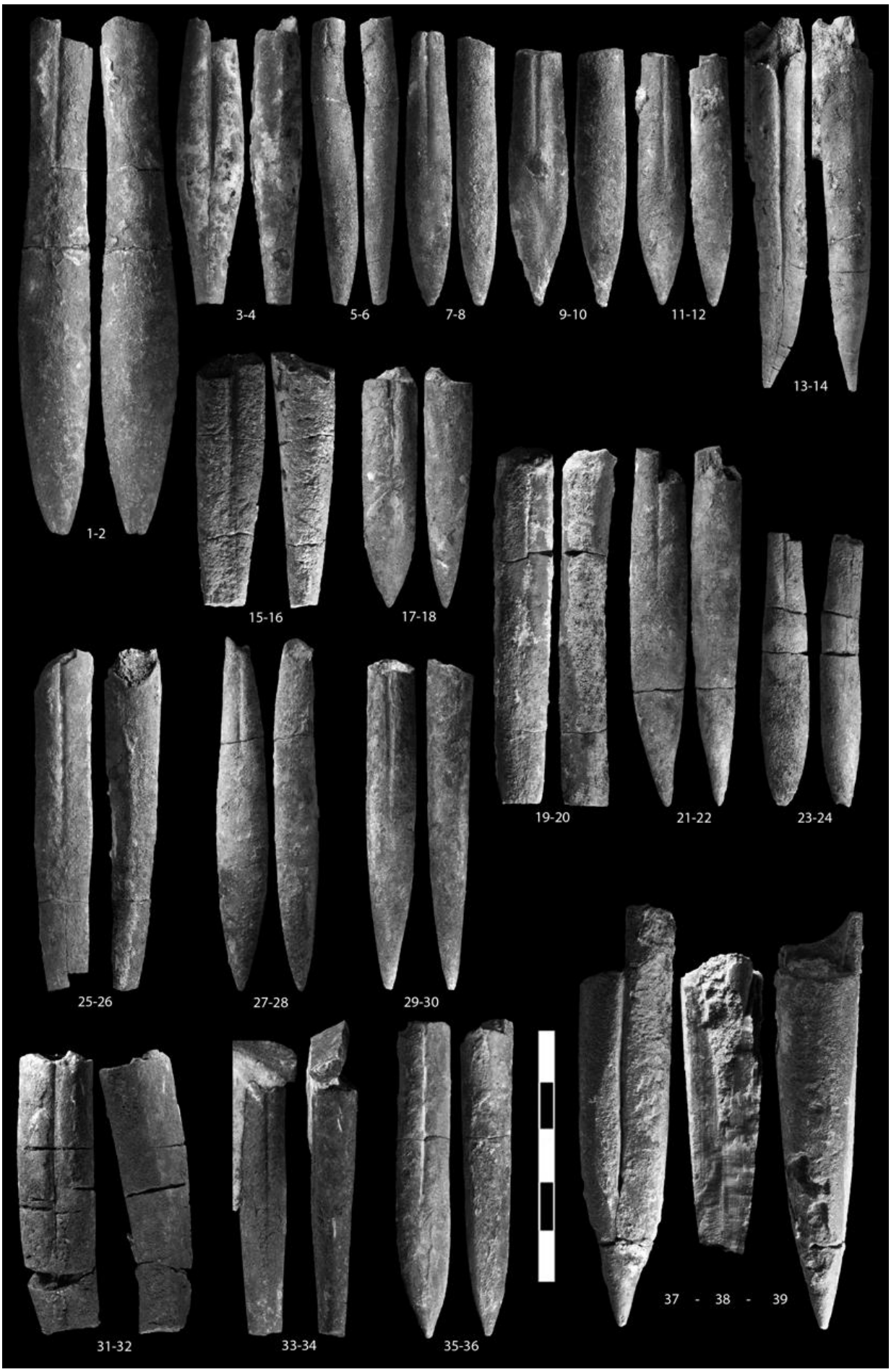
◀ **Plate 7.** In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3, *B. barremense* Subzone RGM 583081 (VR)
figs. 3-4. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3-152, *B. barremense* Subzone, RGM 583091 (VR)
figs. 5-6. *Conohibolites* cf. *minaretiformis* (SHVETSOV, 1913) corroded, ANG161.2 top, *G. sartousiana* Zone, RGM 361962a (VR)
figs. 7-8. *Conohibolites platyurus* (DUVAL-JOUVE, 1841), ANG152-153.1, *B. barremense* Subzone, RGM 583099 (VR)
figs. 9-10. *Conohibolites garshini* (STOYANOVA-VERGILOVA, 1965), BOU146.3-147.1, *B. barremense* Subzone, RGM 583197
figs. 11-12. *Conohibolites garshini* (STOYANOVA-VERGILOVA, 1965), ANG151.3-152, *B. barremense* Subzone, RGM 583094 (VR)
figs. 13-14. *Conohibolites tzankovi* (STOYANOVA-VERGILOVA, 1965), BOU144 base, *Ho. uhligi* Zone, RGM 583294
figs. 15-16. *Conohibolites platyurus* (DUVAL-JOUVE, 1841), ANG151.3-152, *B. barremense* Subzone, RGM 583096
figs. 17-18. *Conohibolites garshini* (STOYANOVA-VERGILOVA, 1965), ANG151.3-152, *B. barremense* Subzone, RGM 583093 (VR)
figs. 19-20. *Conohibolites garshini* (STOYANOVA-VERGILOVA, 1965), ANG160.1-2, *B. barremense* Subzone, RGM 583111 (VR)
figs. 21-22. *Conohibolites platyurus* (DUVAL-JOUVE, 1841) (imm.), BOU146.3-147.1, *B. barremense* Subzone, RGM 583198 (VR)
figs. 23-24. *Conohibolites platyurus* (DUVAL-JOUVE, 1841), ANG151.3-152, *B. barremense* Subzone, RGM 583097
figs. 25-26. *Conohibolites* sp. (teratological?), ANG166.2-167, *H. feraudianus* Subzone, RGM 583512 (VR)
figs. 27-30. *Conohibolites tzankovi* (STOYANOVA-VERGILOVA, 1965) (imm.), BOU142.3, *H. uhligi* Zone, RGM 583315 (VR)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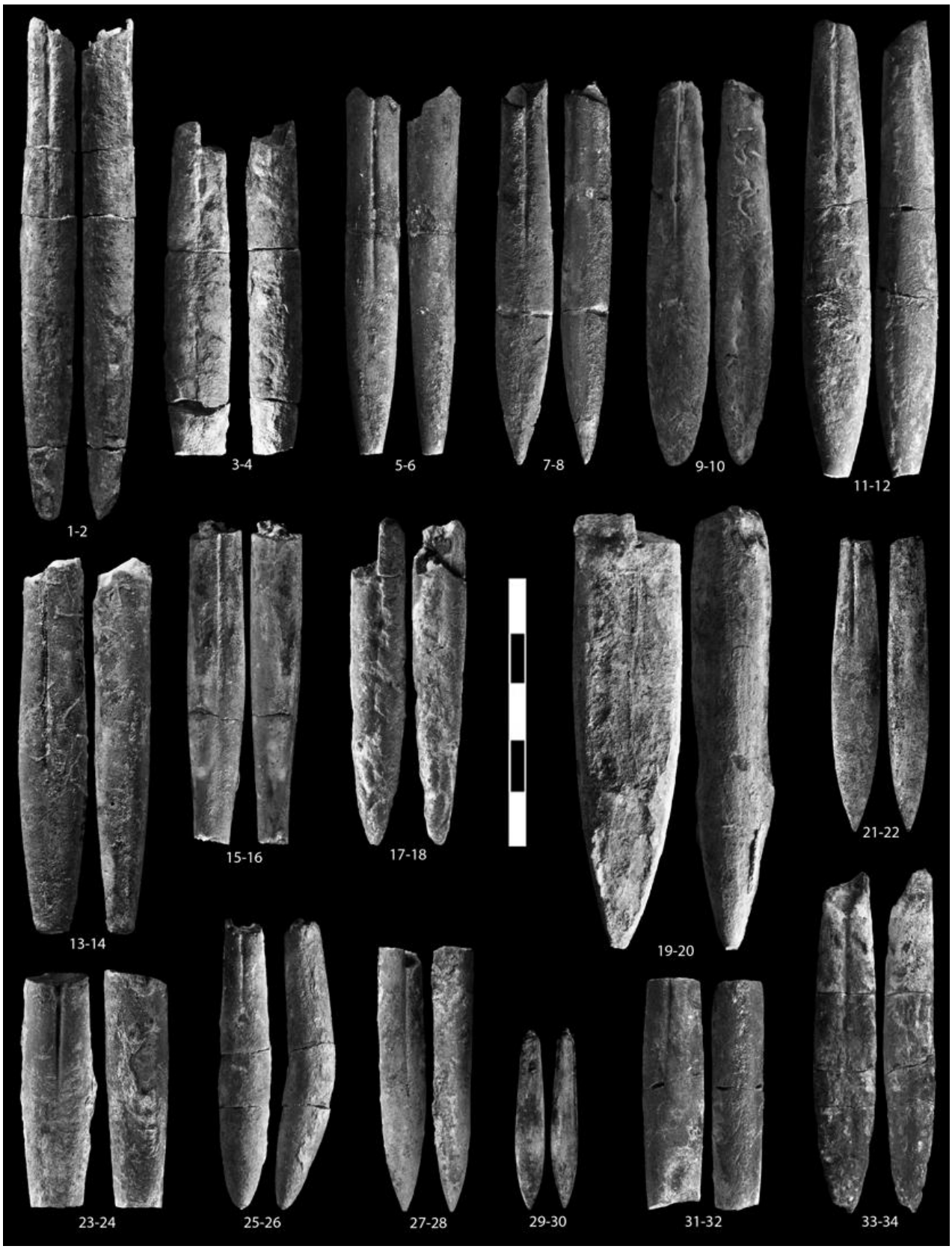
◀ **Plate 8.** In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Shvetsovia* aff. *elegans* ? (SHVETSOV, 1913) (gerontic?), BOU141 or BOU142, *M. tirolensis*? Subzone, RGM 583304 (*ex situ*) (VR)
figs. 3-4. *Shvetsovia simionescui* ? (STOYANOVA-VERGILOVA, 1970), BOU141 or BOU142, *M. tirolensis*? Subzone, RGM 583335 (*ex situ*) (VR)
figs. 5-6. *Shvetsovia carpatica* ? (UHLIG, 1883), BOU146.3-147.1, *B. barremense* Subzone, RGM 583195 (VR)
figs. 7-8. *Shvetsovia elegantoidea* (SHVETSOV, 1913), BOU 146.3-147.1, *B. barremense* Subzone, RGM 583254
figs. 9-10. *Shvetsovia* sp. [? *S. elegantoidea* (SHVETSOV, 1913)], BOU146.3-147.1, *B. barremense* Subzone, RGM 583202 (VR)
figs. 11-12. *Conohibolites minaretiformis* (SHVETSOV, 1913), BOU146.3-147.1, *B. barremense* Subzone, RGM 583229 (VR)
figs. 13-14. *Conohibolites gladiiformis* (UHLIG, 1883), BOU142.3, *M. tirolensis* Subzone, RGM 583322 (VR)
figs. 15-16. *Conohibolites* cf. *gladiiformis* (UHLIG, 1883) imm., BOU142 or BOU143, *M. tirolensis* Subzone, RGM 583308 (*ex situ*) (VR)
figs. 17-18. *Conohibolites garshini* (STOYANOVA-VERGILOVA, 1965), BOU146.3-147.1, *B. barremense* Subzone, RGM 583232 (VR)
figs. 19-20. *Conohibolites* cf. *gladiiformis* (UHLIG, 1883), BOU142 or BOU143, *M. tirolensis* Subzone, RGM 583310 (*ex situ*)
figs. 21-22. *Conohibolites minaretiformis* (SHVETSOV, 1913), BOU146.3-147.1, *B. barremense* Subzone, RGM 583223
figs. 23-24. *Shvetsovia elegantoidea* (STOYANOVA-VERGILOVA, 1965), BOU146.3-147.1, *B. barremense* Subzone, RGM 583203
figs. 25-26. *Conohibolites gladiiformis* (UHLIG, 1883), BOU144 or BOU145.1, *Ho. uhligi* Zone, RGM 583279 (*ex situ*) (VR)
figs. 27-28. *Shvetsovia elegantoidea* (STOYANOVA-VERGILOVA, 1965), BOU146.3-147.1, *B. barremense* Subzone, RGM 583205
figs. 29-30. *Conohibolites minaretiformis* (SHVETSOV, 1913), BOU146.3-147.1, *B. barremense* Subzone, RGM 583249 (VR)
figs. 31-32. *Conohibolites gladiiformis* (UHLIG, 1883), BOU145.1-2, *Ho. uhligi* Zone, RGM 583262 (VR)
figs. 33-34. *Conohibolites minaretiformis* (SHVETSOV, 1913), BOU148 base, *B. barremense* Subzone, RGM 583173 (VR)
figs. 35-36. *Conohibolites minaretiformis* (SHVETSOV, 1913), BOU146.3-147.1, *B. barremense* Subzone, RGM 583216 (VR)
figs. 37-39. *Conohibolites tzankovi* (STOYANOVA-VERGILOVA, 1965), BOU142 or BOU143, *M. tirolensis* Subzone, RGM 583305 (*ex situ*) (figs. 39 - VR)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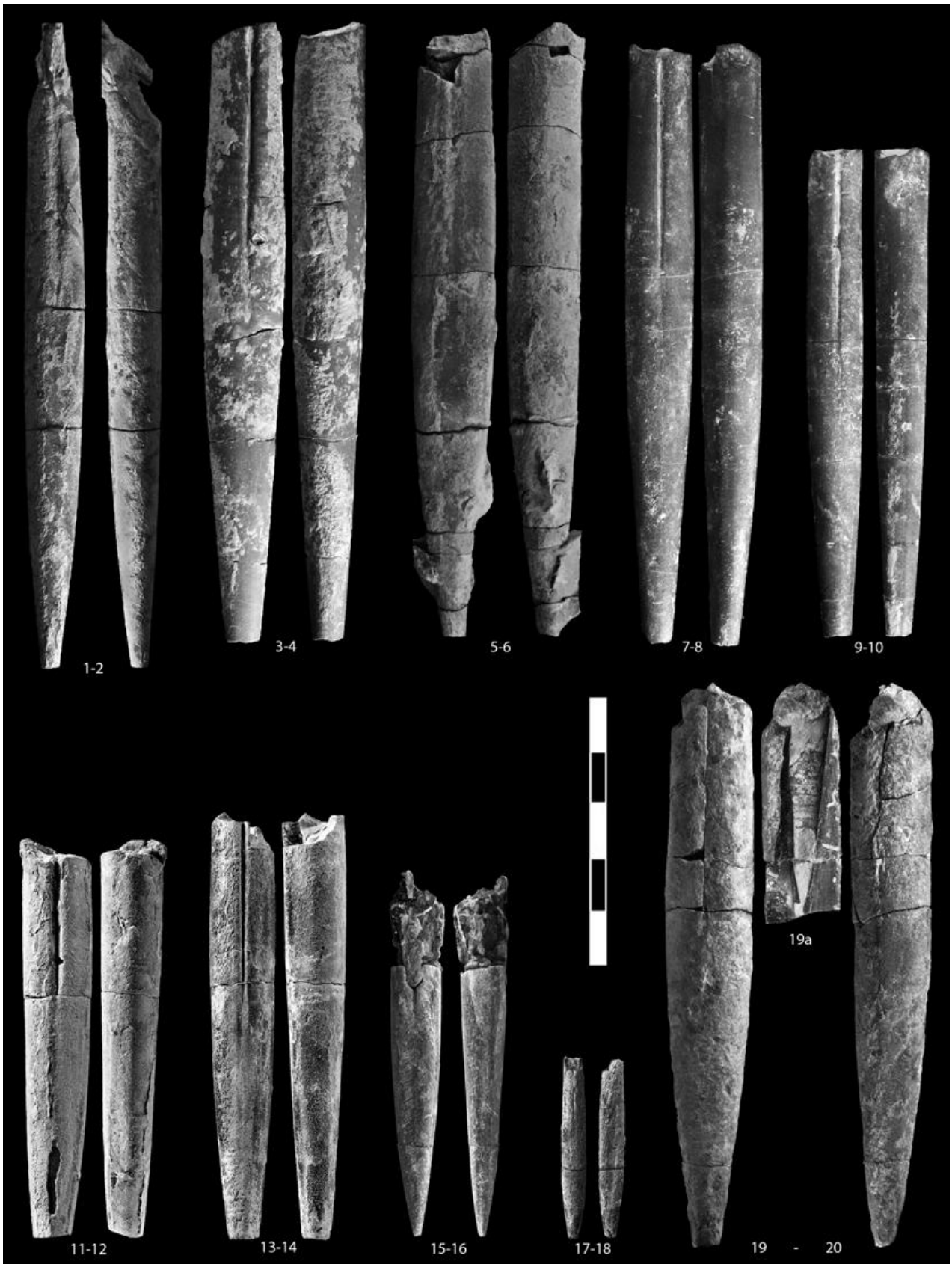
◀ **Plate 9.** In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Shvetsovia* sp. 1 nov.?, ANG165.2-166.1, *H. feraudianus* Subzone, RGM 583488 (VR)
figs. 3-4. *S.* aff. *elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG165.2 top, *H. feraudianus* Subzone, RGM 583478 (VR)
figs. 5-6. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG161.3-4, *G. sartousiana* Subzone, RGM 361984 (VR)
figs. 7-8. *S. elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG156.5-6, *B. barremense* Subzone, RGM 361921 (VR)
figs. 9-10. *S. elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG166.2-167, *H. feraudianus* Subzone, RGM 583511 (x0.7)
figs. 11-12. *S. elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG165.2-166.1, *H. feraudianus* Subzone, RGM 583503 (VR)
figs. 13-14. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG151.3-152, *B. barremense* Subzone, RGM 583087 (VR)
figs. 15-16. *Conohibolites minaretiformis* (SHVETSOV, 1913), ANG160.3-161, *M. sartousiana* Subzone, RGM 361947a (VR)
figs. 17-18. *Co. trastikensis* (STOYANOVA-VERGILOVA, 1965) (imm.), ANG165.2-166, *H. feraudianus* Subzone, RGM 583486 (VR)
figs. 19-20. *Co. trastikensis* (STOYANOVA-VERGILOVA, 1965) corroded, ANG165.2-166, *H. feraudianus* Subzone, RGM 583498 (VR)
figs. 21-22. *S. elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG161.2-3, *M. sartousiana* Subzone, RGM 583132 (VR)
figs. 23-24. *Co. garshini* (STOYANOVA-VERGILOVA, 1965), ANG161.3-162, *M. sartousiana* Subzone, RGM 583147 (VR)
figs. 25-26. *S. elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG164.3-165, *H. feraudianus* Subzone, RGM 583457
figs. 27-28. *Conohibolites minaretiformis* (SHVETSOV, 1913), BOU146.3-147.1, *B. barremense* Subzone, RGM 583230 (VR)
figs. 29-30. *Conohibolites* sp. (juv.), ANG164.3-165, *H. feraudianus* Subzone, RGM 583466 (VR)
figs. 31-32. *S.* ex gr. *elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG167-168, *H. feraudianus* Subzone, RGM 583522 (VR) (x0.7)
figs. 33-34. *S.* ex gr. *elegantoidea* (STOYANOVA-VERGILOVA, 1965) (imm.), ANG168-169.1, *H. feraudianus* Subzone, RGM 583533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◀ **Plate 10.** In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Mesohibolites beskidensis* (UHLIG, 1883), ANG171.1, *I. giraudi* Subzone, RGM 583559 (VR)
figs. 3-4. *Mesohibolites beskidensis* (UHLIG, 1883), ANG170.1, *I. giraudi* Subzone, RGM 583548 (VR)
figs. 5-6. *Mesohibolites beskidensis* (UHLIG, 1883), ANG170.2, *I. giraudi* Subzone, RGM 583556
figs. 7-8. *Mesohibolites beskidensis* (UHLIG, 1883), ANG170.1, *I. giraudi* Subzone, RGM 583549 (VR)
figs. 9-10. *Mesohibolites beskidensis* (UHLIG, 1883), ANG170.1, *I. giraudi* Subzone, RGM 583550 (VR)
figs. 11-12. *Mesohibolites anglesensis* sp. nov. holotype, ANG178.2-179, *M. sarasini* Subzone, RGM 583617 (VR)
figs. 13-14. *Mesohibolites beskidensis* (UHLIG, 1883), ANG169.2-170.1, *I. giraudi* Horizon, RGM 583539
figs. 15-16. *Mesohibolites anglesensis* sp. nov. paratype, ANG179.3 top, *M. sarasini* Subzone, RGM 583631
figs. 17-18. *Mesohibolites beskidensis* (UHLIG, 1883), ANG169.2-170.1, *I. giraudi* Horizon, RGM 583541
figs. 19-20. *Mesohibolites beskidensis* (UHLIG, 1883), ANG168-169.1, *I. giraudi* Horizon, RGM 583531 (VR)
fig. 19a. *ibid.* (alveolar part) (VR)

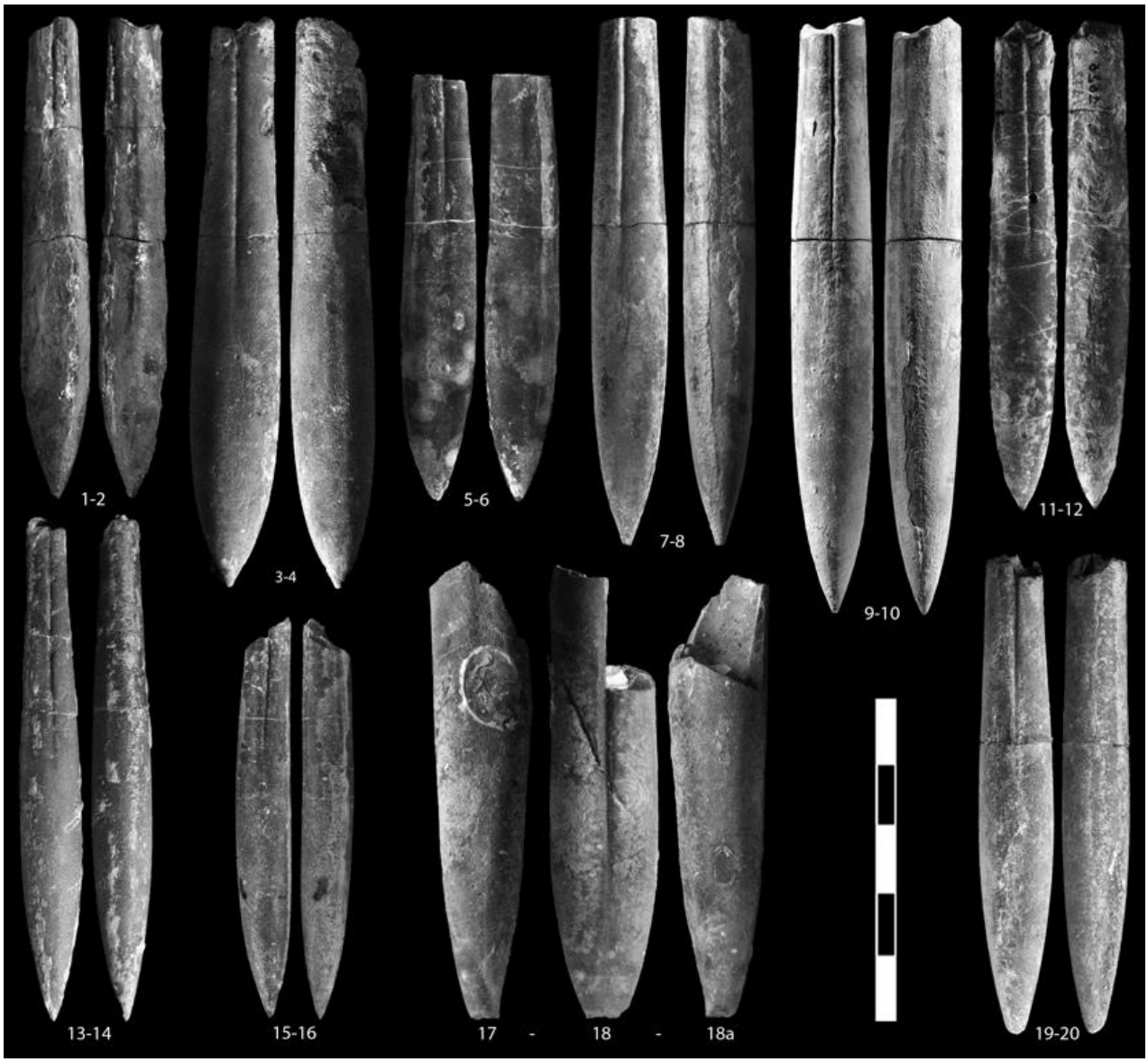


Plate 11. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Mesohibolites renngarteni* KRYMGOL'TS, 1939, ANG169.1-2, *I. giraudi* -Horizon, RGM 583536
figs. 3-4. *Mesohibolites renngarteni* KRYMGOL'TS, 1939, ANG169.2-170.1, *I. giraudi* -Horizon, RGM 583543
figs. 5-6. *Mesohibolites renngarteni* KRYMGOL'TS, 1939, ANG169.2-170.1, *I. giraudi* -Horizon, RGM 583544 (VR)
figs. 7-8. *Mesohibolites uhligi* (SHVETSOV, 1913), ANG177.1, *M. sarasini* Subzone, RGM 583605
figs. 9-10. *Mesohibolites uhligi* (SHVETSOV, 1913), ANG177.1, *M. sarasini* Subzone, RGM 583606
figs. 11-12. *Mesohibolites renngarteni* KRYMGOL'TS, 1939, ANG172.3, *I. giraudi* Subzone, RGM 583571 (VR)
figs. 13-14. *Mesohibolites renngarteni* ? KRYMGOL'TS, 1939, ANG176.1, *I. giraudi* Subzone, RGM 583594
figs. 15-16. *Mesohibolites renngarteni* KRYMGOL'TS, 1939 (immature), ANG172.3, *I. giraudi* Subzone, RGM 583572
figs. 17-18a. *Conohibolites tzankovi* (STOYANOVA-VERGILOVA, 1965), DLX101-102; *C. darsi/M. uhligi* Zone, RGM 583541 (fig. 18a - VR)
figs. 19-20. *Mesohibolites uhligi* (SHVETSOV, 1913), ANG179.1-2, *M. sarasini* Subzone, RGM 583623

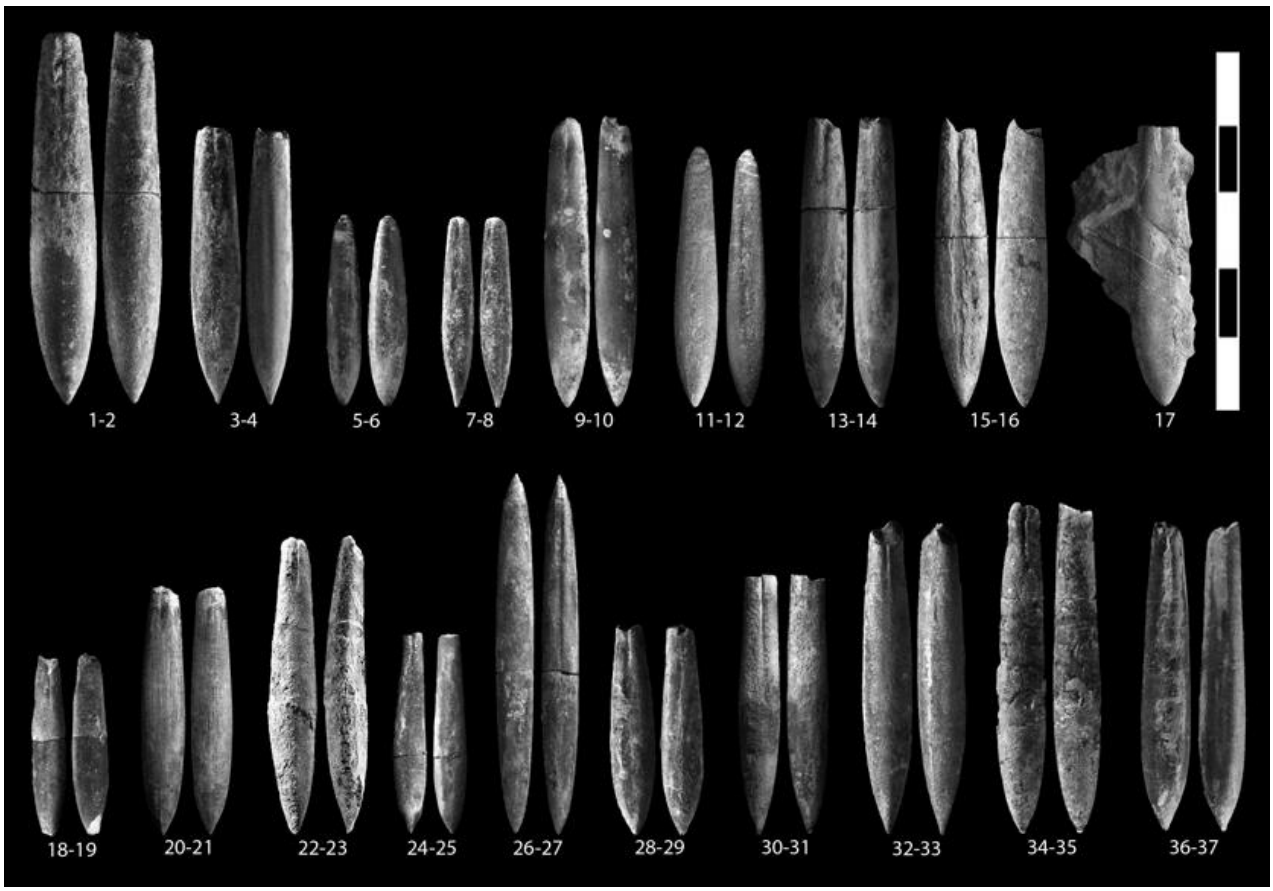


Plate 12. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Mesohibolites* ? sp. juvenile, ANG172.1 top, *I. giraudi* Subzone, RGM 583565
figs. 3-4. *Mesohibolites* ? sp. juvenile, ANG173-174.1 top, *I. giraudi* Subzone, RGM 583578
figs. 5-6. *Mesohibolites* ? sp. juvenile, ANG171.1 top, *I. giraudi* Subzone, RGM 583558
figs. 7-8. *Mesohibolites* ? sp. juvenile, ANG172.3-172, *I. giraudi* Subzone, RGM 583573
figs. 9-10. *Mesohibolites* ? sp. juvenile, ANG (167)-174, *I. giraudi* Subzone, RGM 583581
figs. 11-12. *Mesohibolites* ? sp. juvenile, ANG175.2-176, *I. giraudi* Subzone, RGM 583589 (VR)
figs. 13-14. *Mesohibolites* ? sp. juvenile, ANG178.2-179.1, *M. sarasini* Subzone, RGM 583620 (VR)
figs. 15-16. *Mesohibolites* ? sp. juvenile, ANG179.2-3, *M. sarasini* Subzone, RGM 583629
figs. 17. *Mesohibolites* ? sp. juvenile, ANG180 base, *M. sarasini* Subzone, RGM 583636
figs. 18-19. *Mesohibolites* ? sp. juvenile, COM094-095 (= ANG196.1-197), *Pc. waagenoides* Subzone, RGM 583803
figs. 20-21. *Mesohibolites* ? sp. juvenile, COM077-078 (= ANG181-182), *M. sarasini* Subzone, RGM 583790 (VR)
figs. 22-23. *Mesohibolites* ? sp. juvenile, ANG184-185, *Pc. waagenoides* Subzone, RGM 583647
figs. 24-25. *Neohibolites* aff. *ewaldi* (STROMBECK, 1861), ANG210 base, *D. forbesi* Zone, RGM 583744
figs. 26-27. *Mesohibolites* ? sp. juvenile, ANG200-201, *Pc. waagenoides* Subzone, RGM 583694
figs. 28-29. *Neohibolites* aff. *ewaldi* (STROMBECK, 1861), ANG197-198, *Pc. waagenoides* Subzone, RGM 583685
figs. 30-31. *Neohibolites* aff. *ewaldi* (STROMBECK, 1861), ANG197-198, *Pc. waagenoides* Subzone, RGM 583683
figs. 32-33. *Neohibolites* aff. *ewaldi* (STROMBECK, 1861), COM102-103 (= ANG205-206), *Pa. oglanlensis* Zone, RGM 583807 (VR)
figs. 34-35. *Neohibolites* aff. *ewaldi* (STROMBECK, 1861), ANG228-229, *D. forbesi* Zone, RGM 543017
figs. 36-37. *Mesohibolites* ? sp. juvenile, ANG172.3-173, *I. giraudi* Subzone, RGM 583574

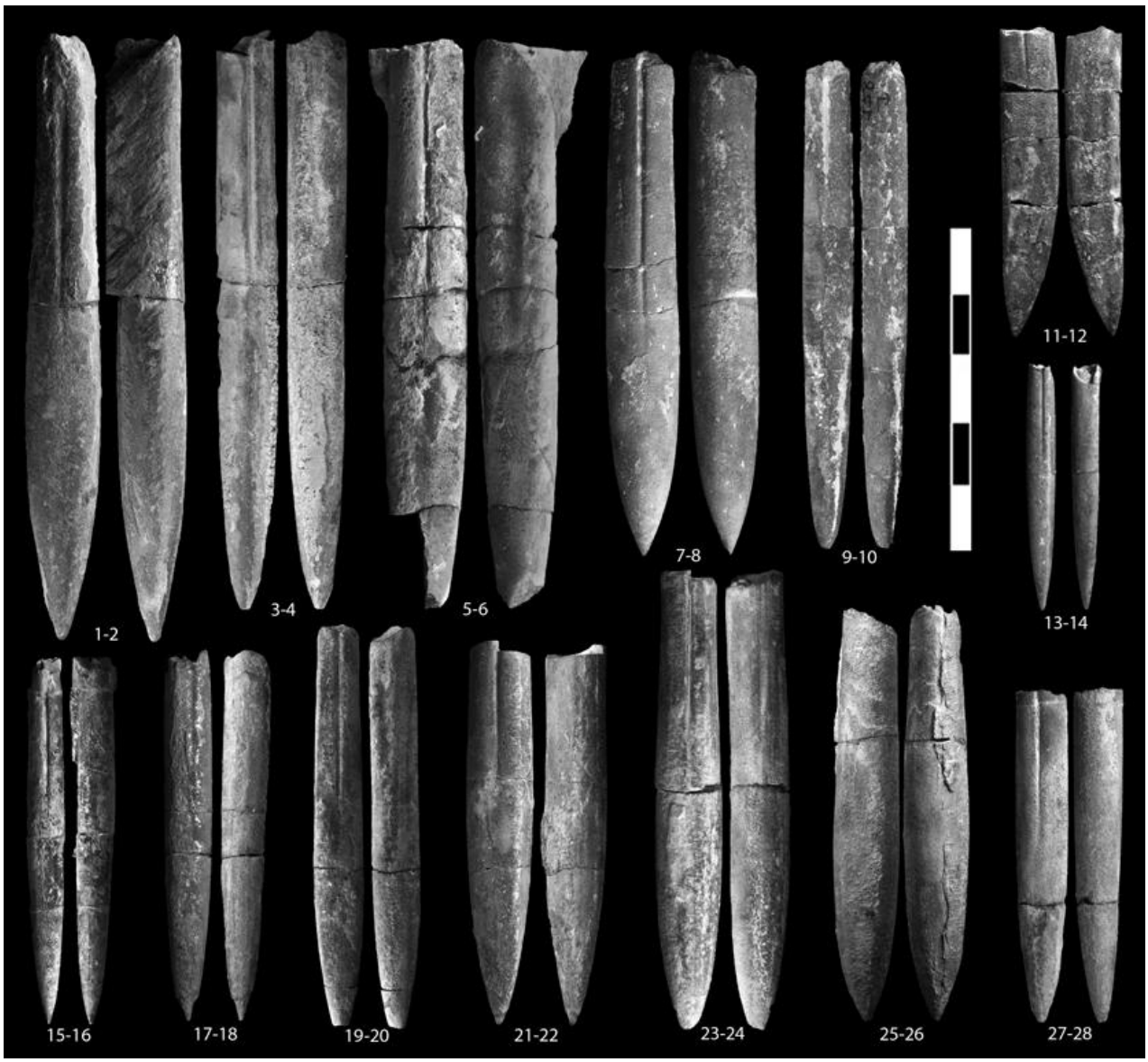


Plate 13. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Mesohibolites longus* (SHVETSOV, 1913), ANG179.3, *M. sarasini* Subzone, RGM 583630 (VR)
figs. 3-4. *Mesohibolites bulgaricus* ? STOYANOVA-VERGILOVA, 1965, ANG205-206, *Pa. oglanlensis* Zone, RGM 583730
figs. 5-6. *Mesohibolites bulgaricus* STOYANOVA-VERGILOVA, 1965, ANG202 top, *Pa. oglanlensis* Zone, RGM 583701
figs. 7-8. *Mesohibolites* (?) aff. *inguriensis* (RUKHADZE, 1938), ANG200, *Pc. waagenoides* Subzone, RGM 361473
figs. 9-10. *Mesohibolites longus* (SHVETSOV, 1913) (imm.), ANG178.2-179.1, *M. sarasini* Subzone, RGM 583616 (VR)
figs. 11-12. *Mesohibolites bulgaricus* STOYANOVA-VERGILOVA, 1965, ANG207-208, *Pa. oglanlensis* Zone, RGM 583737 (VR)
figs. 13-14. *Mesohibolites bulgaricus* STOYANOVA-VERGILOVA, 1965 (juv.), ANG200-201, *P. waagenoides* Subzone, RGM 583692
figs. 15-16. *Mesohibolites* ex gr. *longus* (SHVETSOV, 1913) (imm.), ANG196.1-2, *Pc. waagenoides* Subzone, RGM 583678 (VR)
figs. 17-18. *Mesohibolites longus* (SHVETSOV, 1913) (imm.), ANG175.2-176.1, *I. giraudi* Subzone, RGM 583586
figs. 19-20. *Mesohibolites longus* (SHVETSOV, 1913), ANG179.1-2, *M. sarasini* Subzone, RGM 583622 (VR)
figs. 21-22. *Mesohibolites ekimbontchevi* STOYANOVA-VERGILOVA, 1965, ANG198-199, *Pc. waagenoides* Subzone, RGM 583688 (VR)
figs. 23-24. *Mesohibolites bulgaricus* STOYANOVA-VERGILOVA, 1965, ANG205 top, *Pa. oglanlensis* Zone, RGM 583715 (VR)
figs. 25-26. *Mesohibolites* (?) *elegans* ? (SHVETSOV, 1913), COM103-104 (= ANG206-207), *Pa. oglanlensis* Zone, RGM 583809 (VR)
figs. 27-28. *Mesohibolites anglesensis* sp. nov. (imm.), ANG178.1-2, *M. sarasini* Subzone, RGM 583611 (VR)

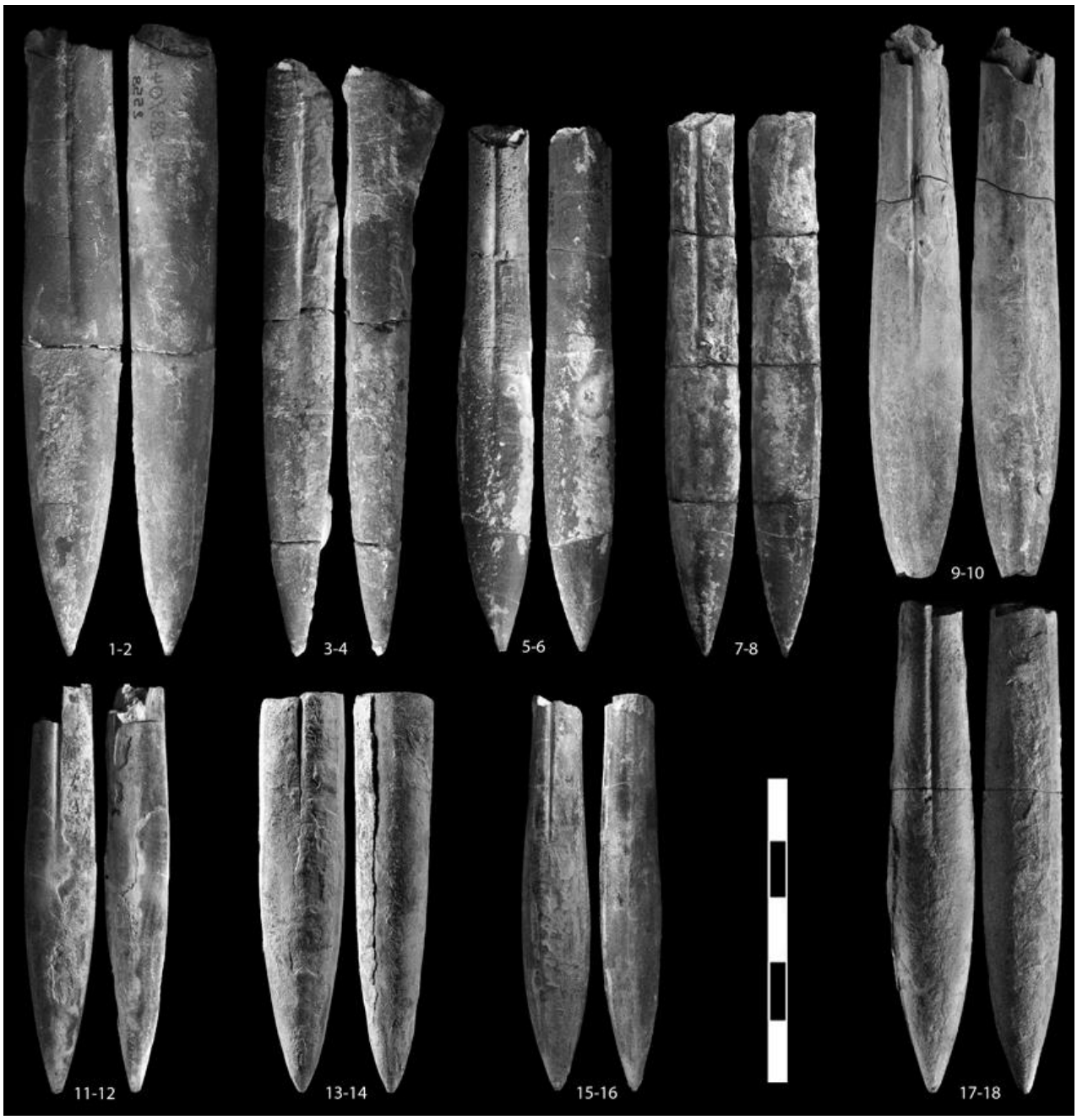


Plate 14. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Mesohibolites uhligi* (SHVETSOV, 1913), ANG183, *M. sarasini* Subzone, RGM 583643 (VR)
figs. 3-4. *Mesohibolites* ex gr. *longus* (SHVETSOV, 1913), ANG189 top, *Pc. waagenoides* Subzone, RGM 583667
figs. 5-6. *Mesohibolites* (?) aff. *inguriensis* (RUKHADZE, 1938), ANG187.1, *Pc. waagenoides* Subzone, RGM 583651 (VR)
figs. 7-8. *Mesohibolites* (?) aff. *inguriensis* (RUKHADZE, 1938), ANG188 base, *Pc. waagenoides* Subzone, RGM 583661
figs. 9-10. *Mesohibolites uhligi* (SHVETSOV, 1913), ANG187.2-188, *Pc. waagenoides* Subzone, RGM 583659
figs. 11-12. *Mesohibolites uhligi* (SHVETSOV, 1913), ANG174.2-175, *I. giraudi* Subzone, RGM 361478 (VR)
figs. 13-14. *Mesohibolites uhligi* (SHVETSOV, 1913), ANG187.1-2, *Pc. waagenoides* Subzone, RGM 583652
figs. 15-16. *Mesohibolites uhligi* (SHVETSOV, 1913), COM082-083 (= ANG187.2-188), *Pc. waagenoides* Subzone, RGM 583797 (VR)
figs. 17-18. *Mesohibolites uhligi*? (SHVETSOV, 1913) or *M.* (?) aff. *inguriensis* (RUKHADZE, 1938), ANG187.2 top, *Pc. waagenoides* Subzone, RGM 583656

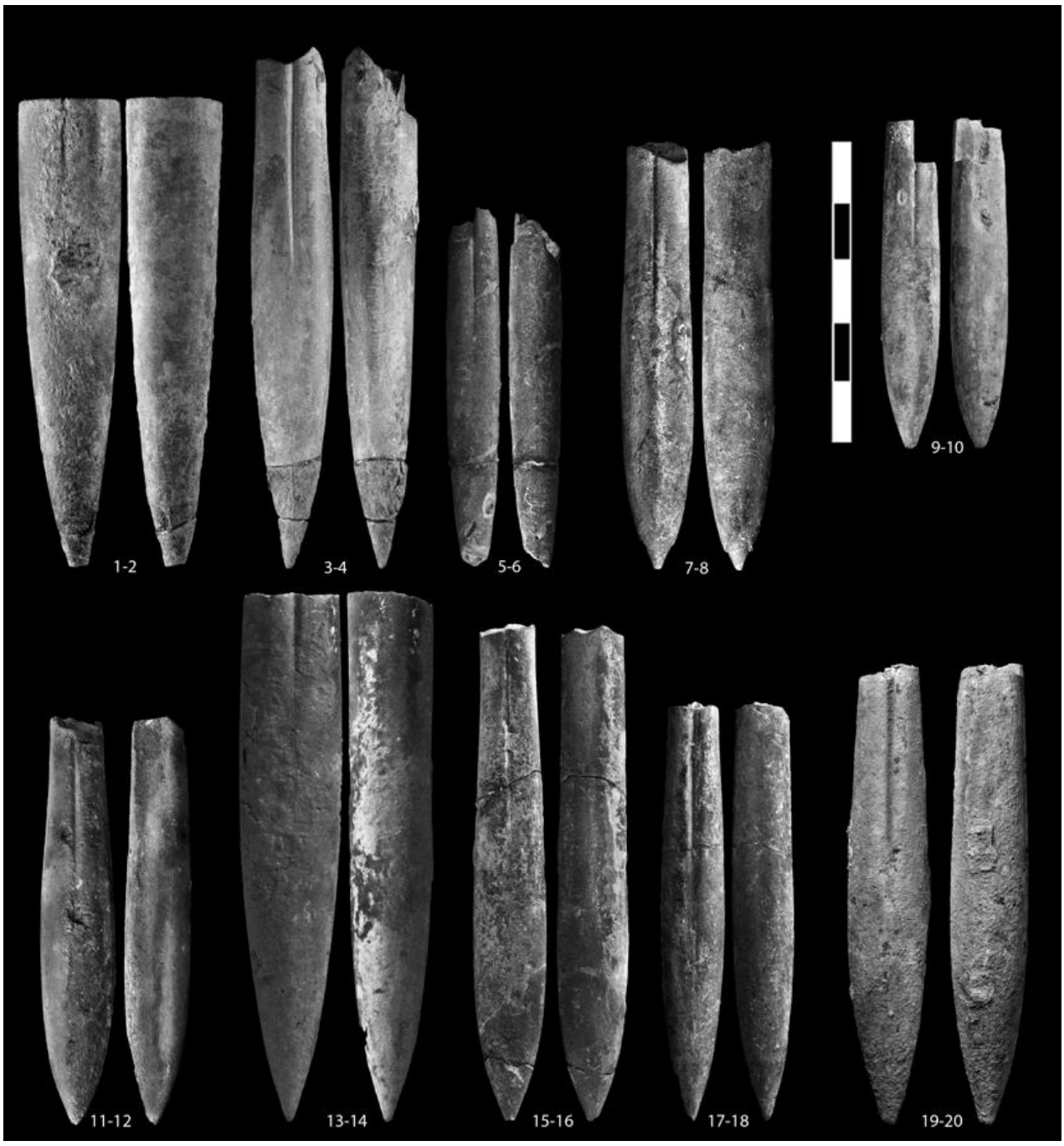


Plate 15. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Mesohibolites ekimbontchevi* STOYANOVA-VERGILOVA, 1965, ANG197 base, *Pc. waagenoides* Subzone, RGM 583681
figs. 3-4. *Mesohibolites ekimbontchevi* STOYANOVA-VERGILOVA, 1965, ANG201-202, *Pc. waagenoides* Subzone, RGM 583699
figs. 5-6. *Mesohibolites nalchikensis* ? KRYMGOL'TS, 1939, ANG210, *D. forbesi* Zone, RGM 583745
figs. 7-8. *Mesohibolites uhligi* ? (SHVETSOV, 1913) or *M.* (?) aff. *inguriensis* (RUKHADZE, 1938), Méouilles, ?*M. sarasini* Subzone, RGM 583839 (VR)
figs. 9-10. *Mesohibolites elegans* (SHVETSOV, 1913), ANG230-231, *D. forbesi* Zone, RGM 583775
figs. 11-12. *Mesohibolites uhligi* (SHVETSOV, 1913), Méouilles, ?*M. sarasini* Subzone, RGM 583837 (VR)
figs. 13-14. *Mesohibolites ekimbontchevi* STOYANOVA-VERGILOVA, 1965, ANG200-202, *Pc. waagenoides* Subzone, RGM 583697 (VR)
figs. 15-16. *Mesohibolites elegans* (SHVETSOV, 1913), ANG215 top, *D. forbesi* Zone, RGM 583749
figs. 17-18. *Mesohibolites elegans* (SHVETSOV, 1913), ANG225-226, *D. forbesi* Zone, RGM 543022
figs. 19-20. *M. uhligi* ? (SHVETSOV, 1913) or *M.* (?) aff. *inguriensis* (RUKHADZE, 1938), Méouilles, ?*M. sarasini* Subzone, RGM 583838 (VR)

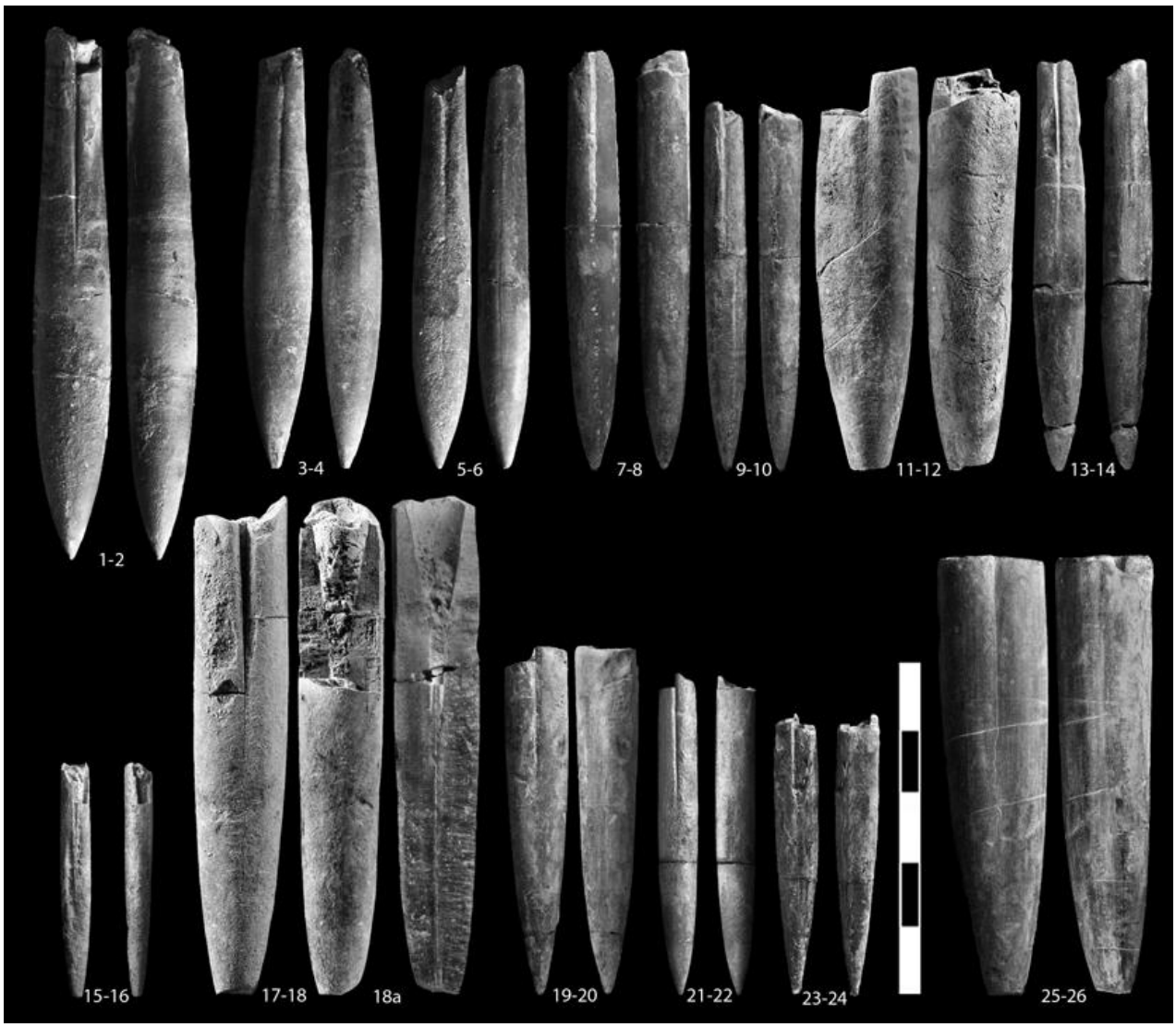


Plate 16. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Shvetsovia elegantoidea* (STOYANOVA-VERGILOVA, 1965), ANG161.2-3, *G. sartousiana* Zone, RGM 583135a (VR)
figs. 3-4. *Shvetsovia elegantoidea* (STOYANOVA-VERGILOVA, 1965) (imm.), ANG161.2-3, *G. sartousiana* Zone, RGM 583135b (VR)
figs. 5-6. *Shvetsovia elegantoidea* (STOYANOVA-VERGILOVA, 1965) (imm.), ANG161.2-3, *G. sartousiana* Zone, RGM 583135c (VR)
figs. 7-8. *Mesohibolites* (?) *inguriensis* (RUKHADZE, 1938), ANG231-232, *D. deshayesi* ? Zone, RGM 543003 (VR)
figs. 9-10. *Mesohibolites* (?) *inguriensis* (RUKHADZE, 1938), ANG223-224, *D. forbesi* Zone, RGM 583752
figs. 11-12. *Mesohibolites fallauxi* (UHLIG, 1883), ANG (231)-238, *D. deshayesi* Zone, RGM 583789 (*ex situ*)
figs. 13-14. *Mesohibolites* (?) *horeshaensis* (RUKHADZE, 1938), COM121-122 (= ANG230-231), *D. forbesi* Zone, RGM 583829 (VR)
figs. 15-16. *Mesohibolites fallauxi* (UHLIG, 1883) (juvenile), COM121-122 (= ANG230-231), *D. forbesi* Zone, RGM 583833 (VR)
figs. 17-18. *Mesohibolites georgicus* NAZARISHVILI, 1973, ANG225-226, *D. forbesi* Zone, RGM 543021 (VR)
fig. 18a. *ibid.* internal view.
figs. 19-20. *Mesohibolites georgicus* NAZARISHVILI, 1973, ANG231-232, *D. deshayesi*? Zone, RGM 583780 (VR)
figs. 21-22. *Mesohibolites* (?) *inguriensis* (RUKHADZE, 1938) (imm.), COM121-122 (= ANG230-231), *D. forbesi* Zone, RGM 583832
figs. 23-24. *Mesohibolites georgicus* NAZARISHVILI, 1973 (imm.), ANG225-226, *D. forbesi* Zone, RGM 583754
figs. 25-26. *Mesohibolites fallauxi* (UHLIG, 1883), ANG229-230, *D. forbesi* Zone, RGM 583767

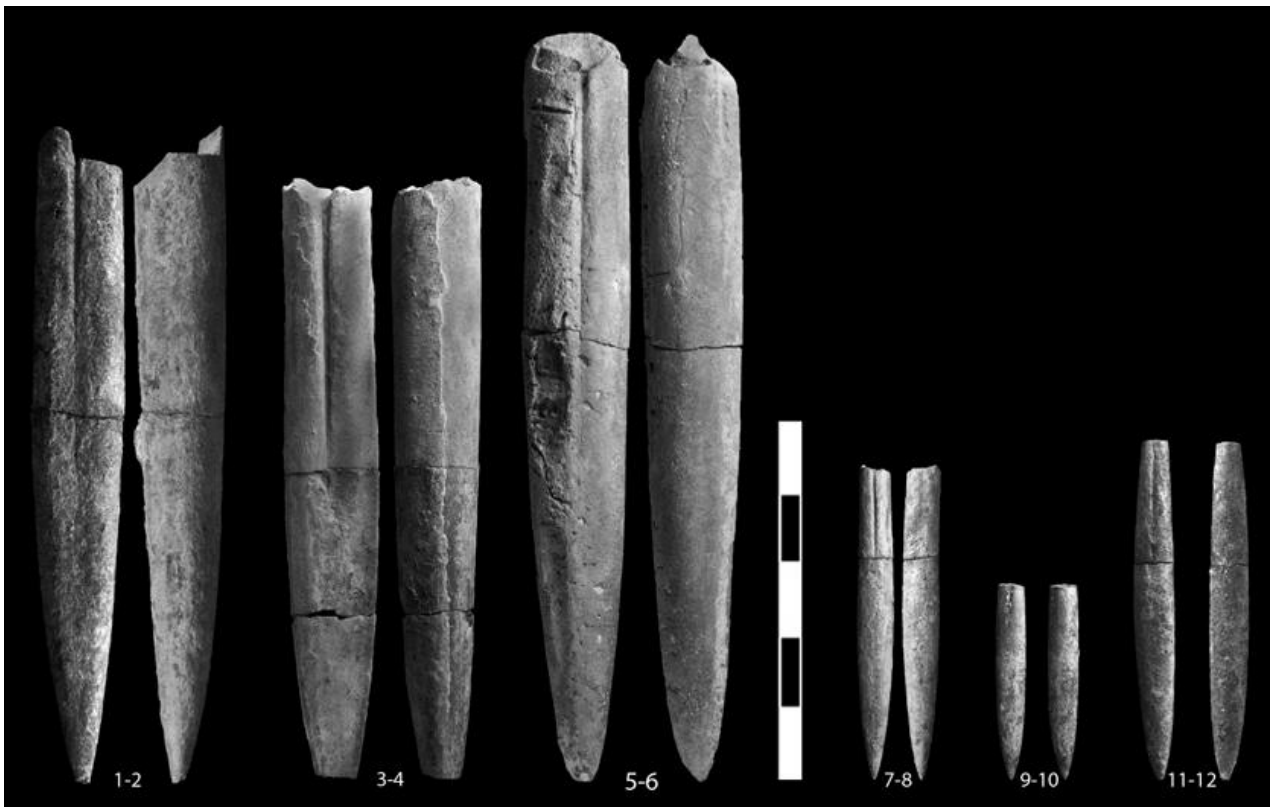
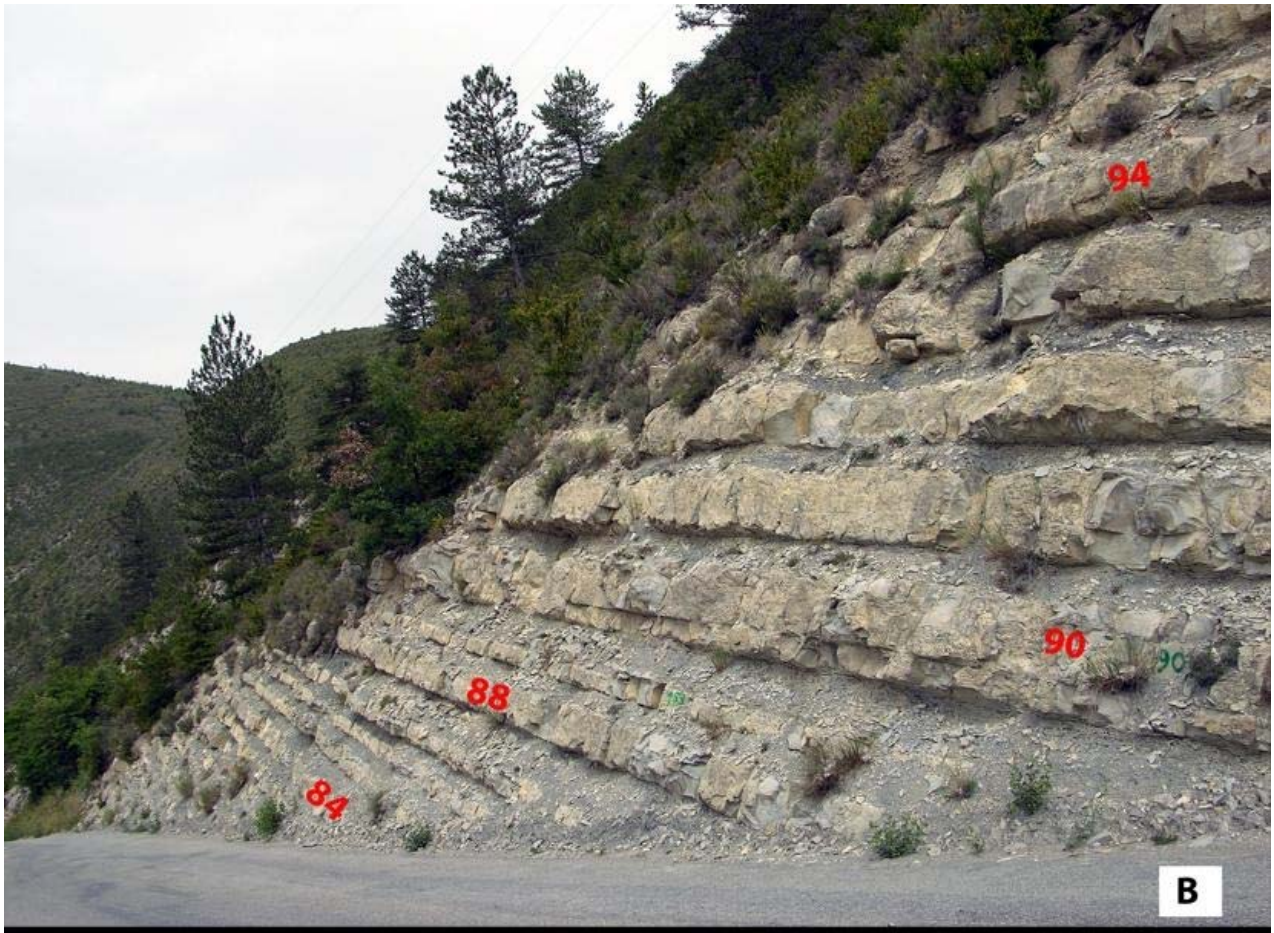


Plate 17. In all specimens ventral side is to the left, unless otherwise indicated.
figs. 1-2. *Mesohibolites georgicus* NAZARISHVILI, 1973, ANG228-229, *D. forbesi* Zone, RGM 583760 (VR)
figs. 3-4. *Mesohibolites georgicus* NAZARISHVILI, 1973, COM120-121 (= ANG229-230), *D. forbesi* Zone, RGM 583826
figs. 5-6. *Mesohibolites georgicus* NAZARISHVILI, 1973, ANG231- (232), *D. deshayesi*? Zone, RGM 543004
figs. 7-8. *Mesohibolites georgicus* NAZARISHVILI, 1973 (imm.), ANG228-229, *D. forbesi* Zone, RGM 583759
figs. 9-10. *Mesohibolites georgicus* NAZARISHVILI, 1973 (juv.), ANG231- (232), *D. deshayesi*? Zone, RGM 543005
figs. 11-12. *Mesohibolites georgicus* NAZARISHVILI, 1973 (imm.), ANG228-229, *D. forbesi* Zone, RGM 583761 (VR)


94
90
90
88
84
B


13
07
03
1
A

◀ **Plate 18:**
fig. A. The first beds of the section (ANG001 to ANG 015), *Pl. ligatus* and *B. balearis* zones. Bed-numbers are indicated in red.
fig. B. The first beds of the Barremian are exposed in the lower left part of the picture. The rather thick beds of the *Pt. colombiana* (ANG090 to ANG093) and the *K. nicklesi* (from ANG094 on) are as well. View approximately to the west, along the road of the hamlet of Angles. Bed-numbers are indicated in red.

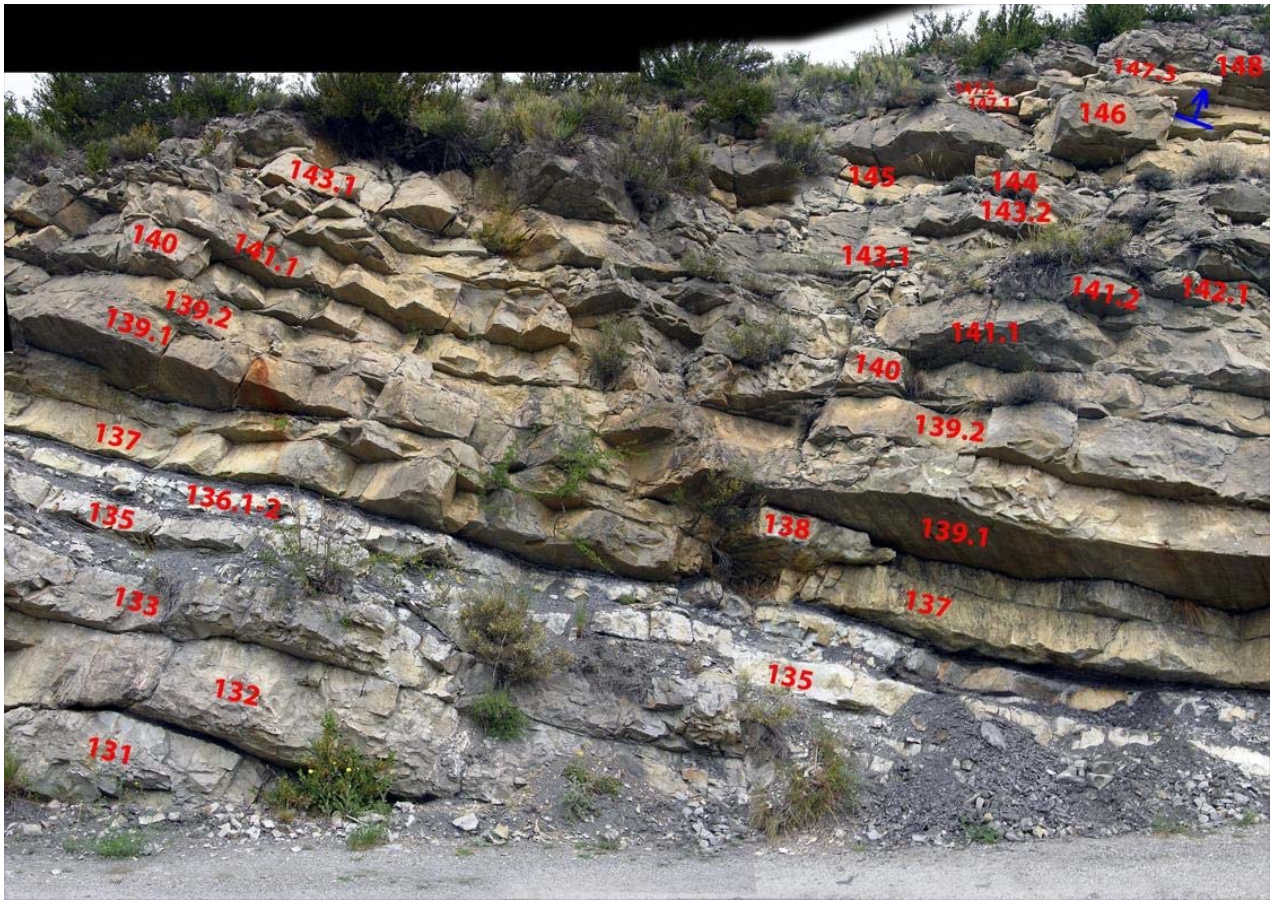


Plate 19:
The transition from the marly-calcareous to the calcareous dominated beds in the latest Early Barremian. The boundary between the Early and Late Barremian is indicated by the blue arrow in bed ANG147.2. Bed-numbers are indicated in red.

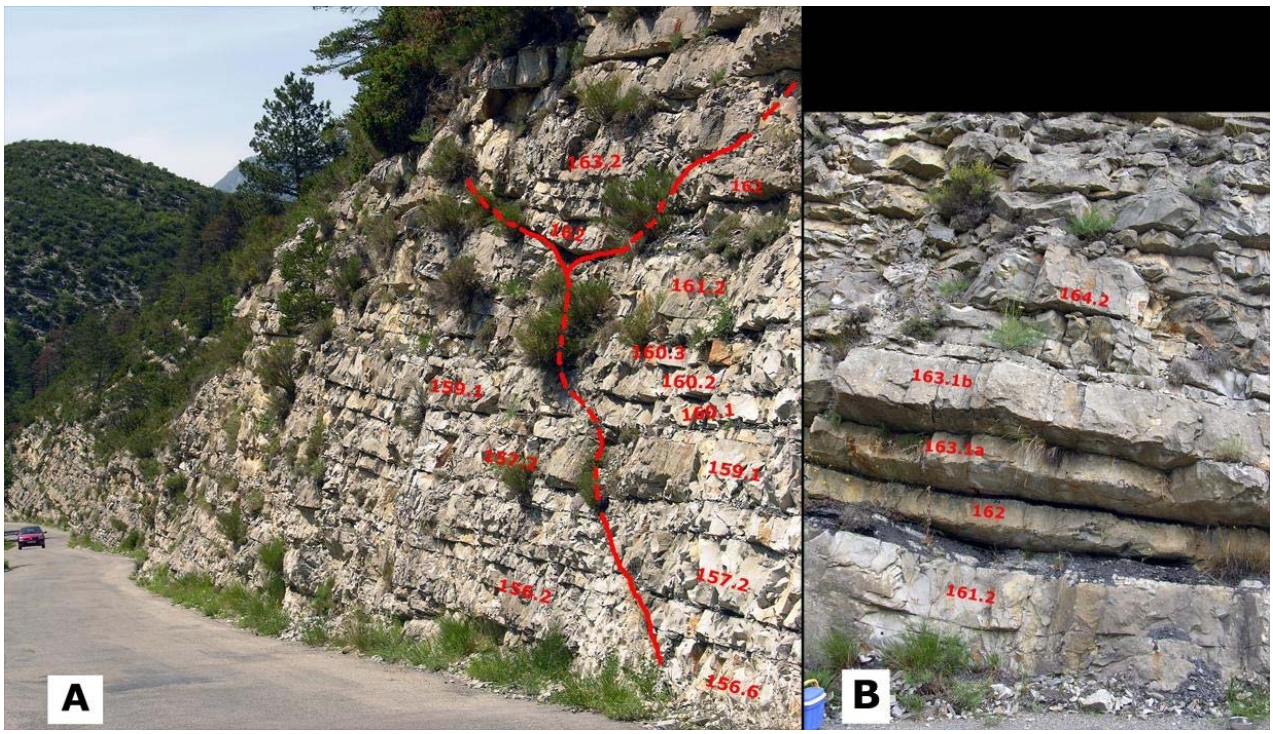


Plate 20:
fig. A. Small-scaled fault system in the *B. barremense* - *G. sartousiana* subzones. The view is approximately to the west, along the road of the hamlet of Angles. Bed-numbers are indicated in red.
fig. B. View of the marly beds with two thin marly-calcareous beds (ANG161.3 and ANG161.4) on top of ANG161.2 (*G. sartousiana* Subzone). Typical development of marly intervals in the calcareous dominated earliest Barremian sediments. Bed-numbers are indicated in red.

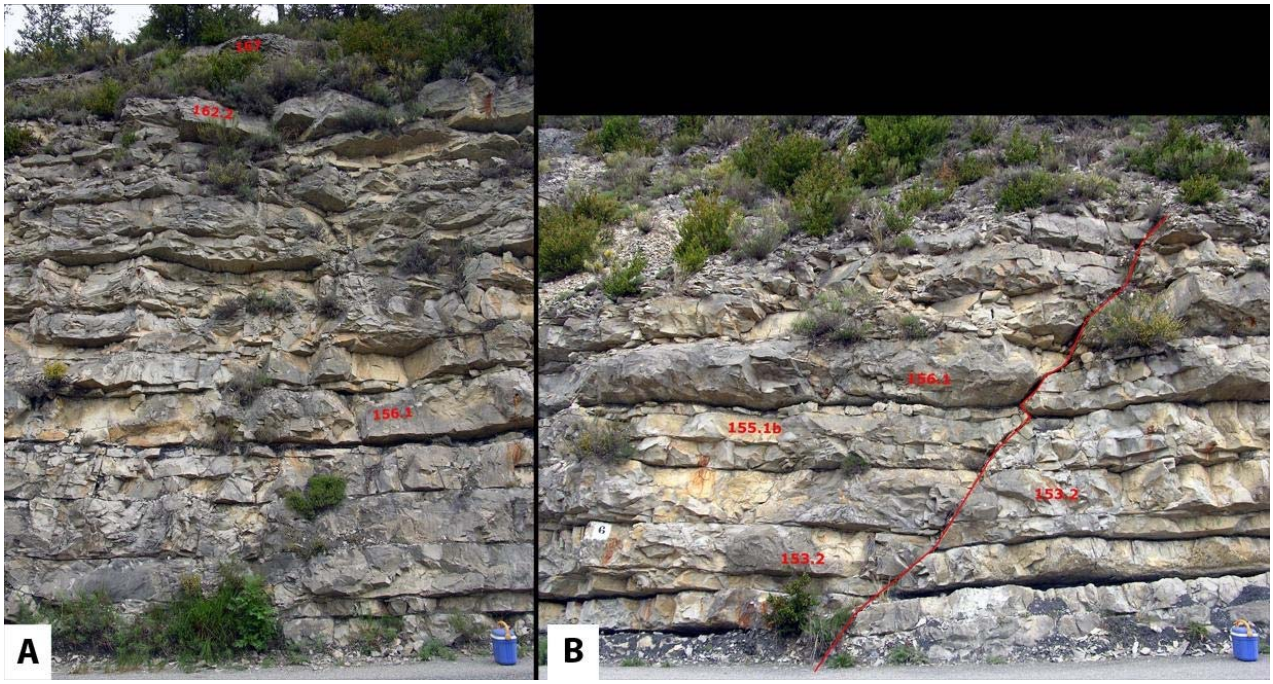


Plate 21:
fig. A. Typical development of the calcareous earliest Barremian *B. barremense* Subzone. Bed-numbers are indicated in red.
fig. B. Base of the *B. barremense* Subzone with relative thick marly bed (ANG151.3-152) at the base of the section. Bed-numbers are indicated in red.

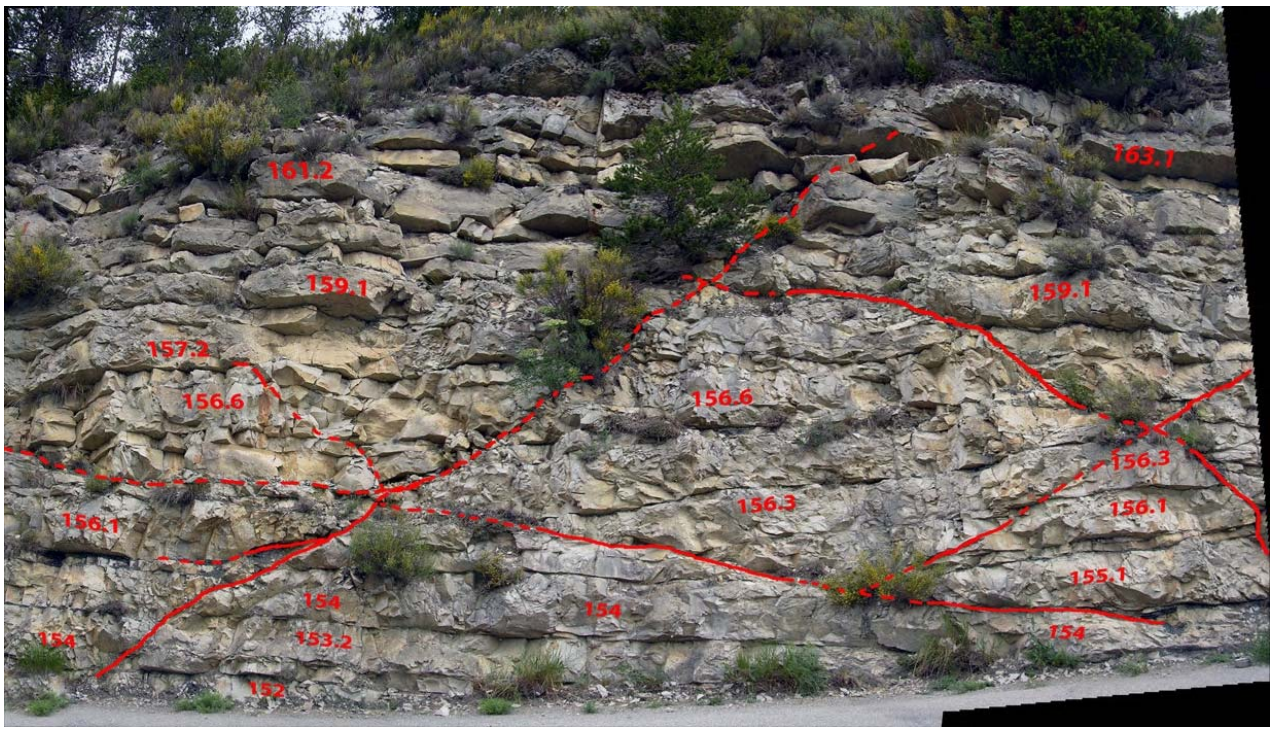


Plate 22:
Typical development compressional fault pattern in the *B. barremense* Subzone. Bed-numbers are indicated in red.

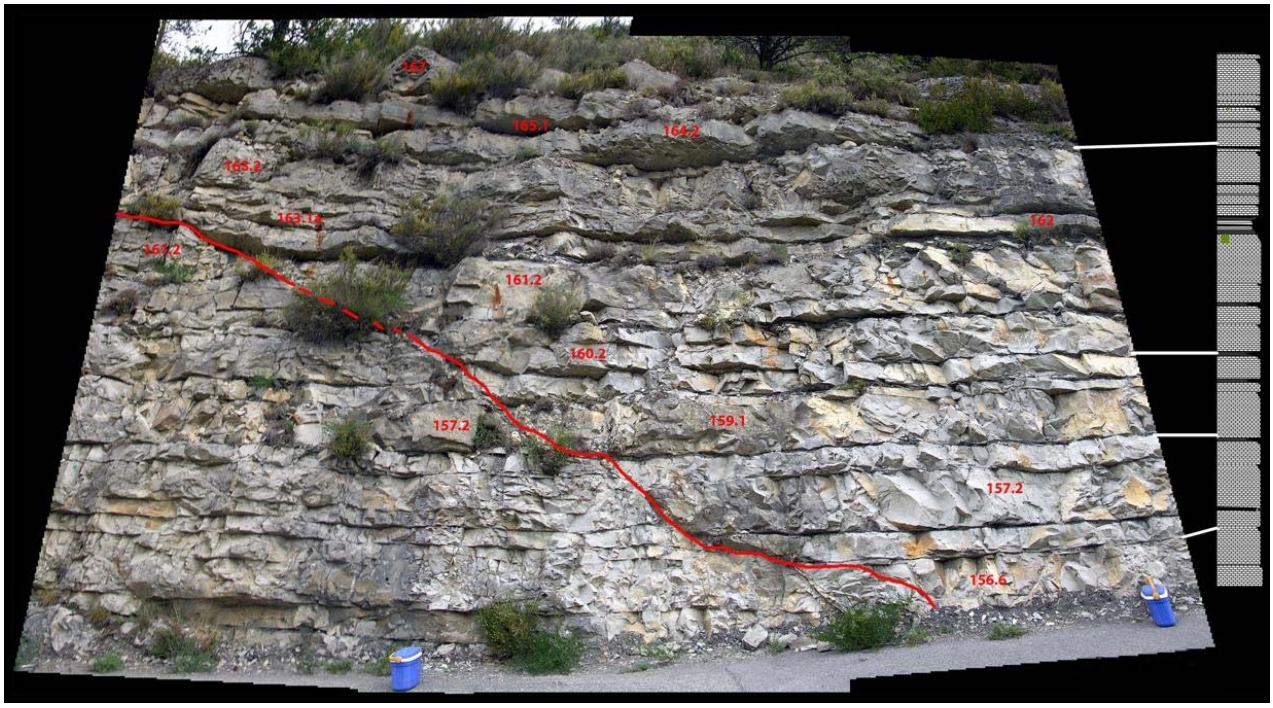


Plate 23:
The *B. barremense* Subzone with regular alternations of thin and thick beds of calcareous rock, intercalated with either very thin marly layers and some more pronounced marly beds. Stratigraphical column to the right. Bed-numbers are indicated in red.

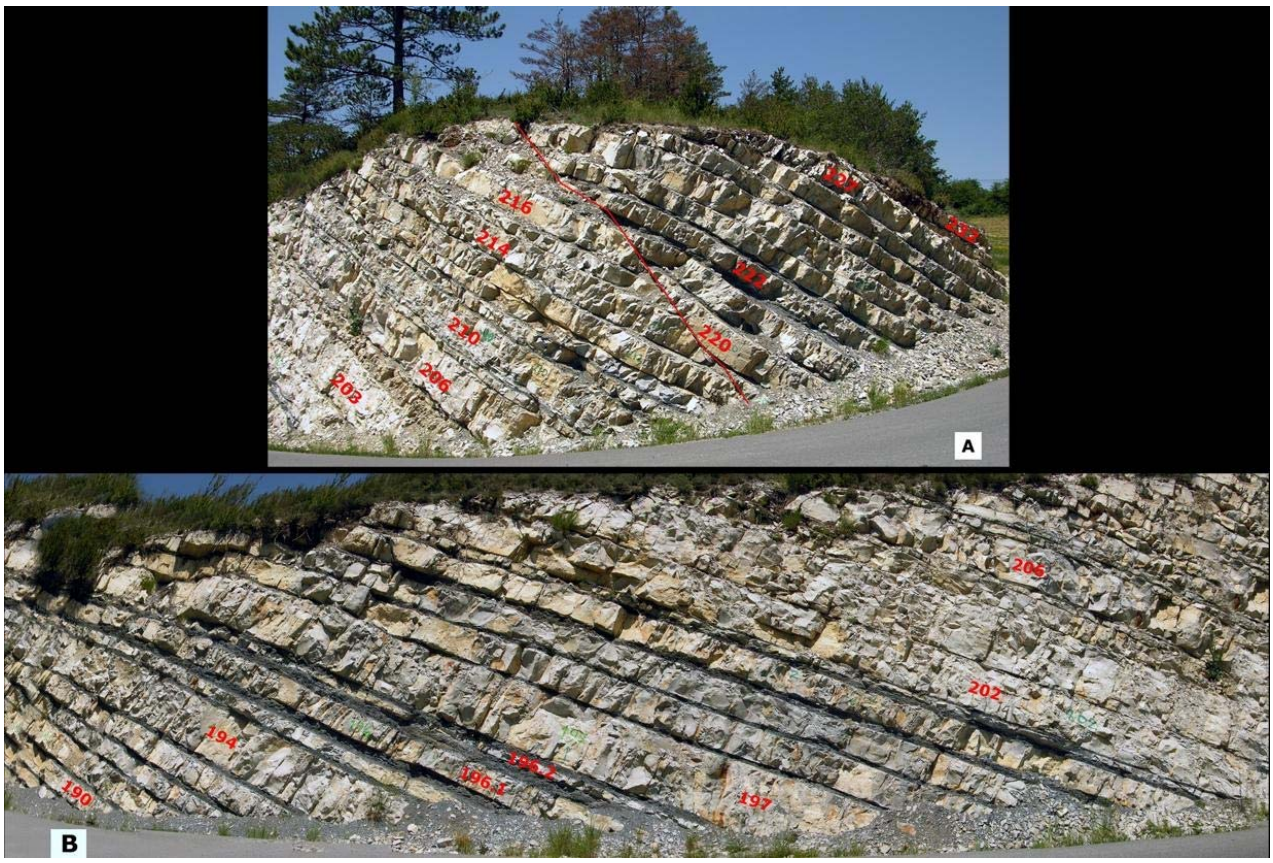


Plate 24: fig. A. The upper part of the section with a small fault, note bed ANG216 = ANG220. Bed-numbers are indicated in red. **fig. B.** The boundary beds between the Barremian and Bedoulian. The boundary is placed in the middle part of ANG202 (based on the occurrence of the ammonite *Pa. oglanlensis* in a nearby section). Bed-numbers are indicated in red.