

## Barremian ammonoids from Serre de Bleyton (Drôme, SE France)

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(With 4 figures)

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### Abstract

Barremian ammonoids were collected at the Serre de Bleyton locality in the Department Drôme, SE France. The cephalopod fauna from the “*coulées boueuses*”, correlated with other macrofossil groups (belemnitoids, brachiopods, crinoids, echinoids etc.) and microfossil data (foraminifera) from the turbiditic unit, indicates Barremian age. The deposition of the allodapic limestones and marls in this interval occurred during positionally unstable conditions which led to the formation of turbiditic layers.

The ammonoid fauna comprises 8 different genera, each apparently represented by a single species. The assemblage at the Serre de Bleyton section is dominated by ammonoids of the *Melchiorites*-type. Ammonitina are the most frequent component (*Melchiorites* 52%; *Holcodiscus* 8%), followed by the Phylloceratina (*Phyllopachyceras* 3% and *Hypophylloceras* 2%), the Lytoceratina (*Protetragonites* 15%), and the Ancyloceratina (*Anahamulina* 10%, *Karsteniceras* 8% and *Macroscaphites* 2%). The ammonoid fauna consists solely of Mediterranean elements.

**Keywords:** Cephalopoda, Ammonoidea, Barremian, Serre de Bleyton, SE France.

### Zusammenfassung

Ammoniten aus dem Barremium wurden an der Lokalität Serre de Bleyton im Distrikt Drôme, Südost-Frankreich, aufgesammelt. Die Cephalopoden Fauna der „*coulées boueuses*“ zeigt, in Verbindung mit anderen Makrofossilgruppen (Belemniten, Brachiopoden, Crinoiden, Seeigel etc.) und dem Mikrofossilbefund der turbiditischen Einheit, Barremium an. Die Ablagerung der allodapischen Kalke und Mergel dieses Abschnitts fand während instabiler Ablagerungsbedingungen statt, was zur Bildung solcher turbiditischen Lagen führte. Die Ammoniten-Fauna zeigt 8 unterschiedliche Gattungen, von welchen jede durch nur eine Art vertreten ist. Das Vorkommen des Serre de Bleyton wird durch Ammoniten vom Typ *Melchiorites*-dominiert. Die Ammonitina

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stellen das häufigste Faunenelement dar (*Melchiorites* 52%; *Holcodiscus* 8%), gefolgt von der Gruppe der Phylloceratina (*Phyllopachyceras* 3% and *Hypophylloceras* 2%), den Lytoceratina (*Protetragonites* 15%) und den Ancyloceratina (*Anahamulina* 10%, *Karsteniceras* 8% und *Macroscaphites* 2%). Die Ammoniten Fauna setzt sich ausschließlich aus mediterranen Elementen zusammen.

**Schlüsselwörter:** Cephalopoda, Ammonoidea, Barremium, Serre de Bleyton, Südost-Frankreich.

## Introduction

Lower Cretaceous pelagic sediments are well known to form a major element of the tectonic units of Southern France (COTILLON et al. 1984; PASQUINI et al. 2004; ARNAUD 2005; ADATTE et al. 2005). In the area around the Serre de Bleyton ridge the Barremian cephalopod-bearing deposits are recorded as siliciclastic and turbiditic beds, the “*coulées boueuses*”. These beds are channel like seafloor fans ending in the Vocontian Trough (ADATTE et al. 2005; ARNAUD 2005). The latter author described this turbiditic phenomenon from the east of the nearby Col de Perty.

Biostratigraphic data on the “*coulées boueuses*” in the pelagic Vocontian Trough (SE-France) are remarkably scarce. This reflects the rare occurrence of an identifiable ammonoid macrofossil fauna. The discussed lithological (turbiditic fan sediments) and biostratigraphic data (Barremian), however, are extraordinarily important for reconstructing Lower Cretaceous geodynamics of the Vocontian Trough (= Vocontian Basin). The turbiditic beds mark the siliciclastic input into the basin, reflecting the formation of an basinal seafloor fan. The newly discovered outcrop at Serre de Bleyton (Fig. 1) in the heart of SE-France comprises a new faunal assemblage of the Barremian in the well documented Vocontian Trough. That section revealed, for the first time, the critical interval in an environment comprising extraordinarily rich accumulations of ammonoids, belemnoids, brachiopods, crinoids, echinoids and foraminifera.

## Geographical setting

The outcrop is situated in the Vocontian Basin which is part of the district Drôme. The Vocontian Basin extends on the Drôme and several other departments. The exact position is about 20 km north-east of Nyons and 2 km south-east of Arnayon (Fig. 1). The outcrops are located along a forest road. The surrounding area is called Serre de Bleyton and so is the locality itself Serre de Bleyton.

The light grey turbiditic succession, comprising the ammonoid-bearing beds, is located on the southern side of the Serre de Bleyton ridge (approx. 980 m asl.). The ammonoid-occurrence is exposed on the left side (northern) of the forest road. The locality is splitted into 3 distinguishable small outcrops (e.g. loc. 1, 2 and 3) which are located within ap-

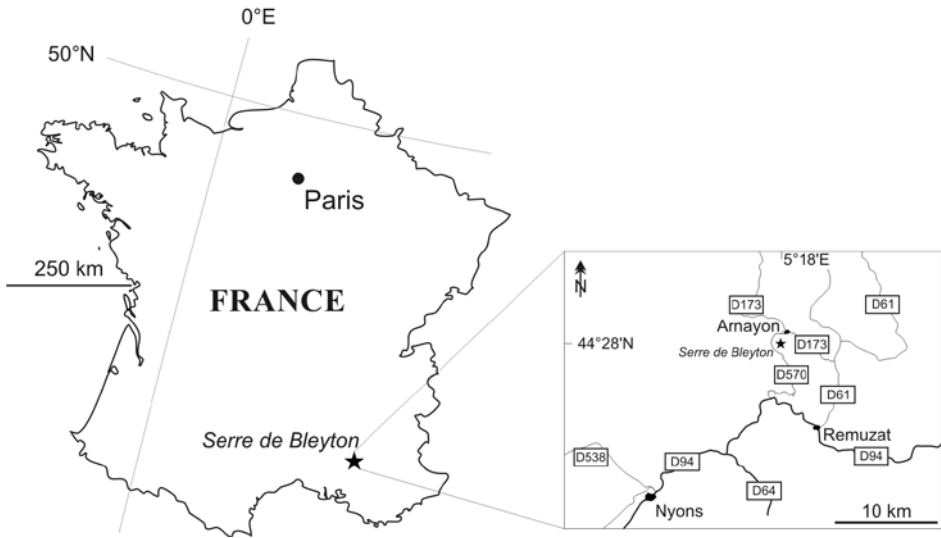


Fig. 1. Locality map of France with the position of the Serre de Bleyton locality Department Drôme, SE-France (left). Detailed map of the roads around Serre de Bleyton with outcrop position of the Barremian ammonoid-bearing beds indicated by an asterisk (right).



Fig. 2. Exposure of the investigated section with the position of the outcrop at the Serre de Bleyton section (Drôme). Note the positions of loc. 1 and loc. 2 at the forest road south of the Serre de Bleyton locality.

prox. 200 m (Fig. 2). The exact position of the ammonoid-occurrences as determined by GPS (global positioning system): Locality 1 is N 44°28'55'' and E 5°18'00'' (Fig. 1), locality 2. N 44°28'54'' and E 5°17'58'' and locality 3 with N 44°28'58'' and E 5°18'02''.

### **Material, preservation and methods**

During the course of this study, 60 ammonoid specimens (NHMW 2009z0108/0001 to 0036) were examined. Additionally, fossil groups as brachiopods, crinoids, echinoids, foraminifera, and rhyncholites were collected. Ammonoids are preserved as steinkerns, mostly pyritic, and are well preserved. No shell is present. In most specimens only the innermost, juvenile part (approx. 2-5 mm in diameter), is preserved. The latter fact is important to note due to the fact that many ammonoid groups develop their characteristic features after the juvenile growth stage during later ontogenetical phases (e.g. ribbing, constrictions etc.). The material was collected by G. MOOSLEITNER who took bulk samples. The samples were washed and treated with Rewoquat® for cleaning. The preservation influences the precise determination of most ammonoids herein. Therefore only genera could be determined precisely.

### **Lithology, fauna and biostratigraphy**

*Lithology.* The Serre de Bleyton section apparently consists of turbiditic sediments (ARNAUD 2005), as herein called allodapic limestones. These are bioclastic grainstones with its incorporated ammonoid specimens. The components gravitatively derive from the outer platform to hemipelagic areas surrounding the Vocontian Trough. The beds comprise reworked and autochthonous components.

*Depositional and tectonic setting.* The studied section in SE-France from Serre de Bleyton includes a pelagic to hemipelagic succession of the Vocontian Trough, representing a well known part of the Vocontian Basin system, the Lower Cretaceous palaeogeographic position of which was shown by SCOTSE (2001) and STAMPFLI & MOSAR (1999). The unique feature at the latter locality is pointed by the beds investigated are turbiditic deposits (fan systems; ADATTE et al. 2005; ARNAUD 2005), derived from different sedimentation areas, as the platform and the hemipelagic edge of the Vocontian Trough. The original depositional area of the sediments was located west of the Vocontian Trough. The Provence Platform was situated to the south of the Vocontian Basin. To the west of the basin was the carbonate platform covering the Central Massif (ARNAUD 2005). The Barremian ammonoid material described herein derives from turbiditic beds of the Serre de Bleyton (Commune d'Arnayon, Drôme).

*Fauna.* The invertebrate fauna consists of ammonoids and belemnoids (JANSSEN 2010), rhyncholites (RIEGRAF & MOOSLEITNER 2010), brachiopods, corals (LÖSER 2010), echi-

noids, and crinoids (JÄGER 2010) that fits well into characteristic Mediterranean upper Lower Barremian to Upper Barremian faunas.

*Biostratigraphy.* According to ammonoids and the additional macrofossil faunas (see JANSSEN 2010, RIEGRAF & MOOSLEITNER 2010, LÖSER 2010, JÄGER 2010), the association indicates that the cephalopod-bearing beds of the Serre de Bleyton section belong into the timespan from the late Early Barremian up to the Late Barremian age (see REBOULET et al. 2009).

For the Barremian the biostratigraphically indicative ammonoids are: *Protetragonites* cf. *crebrisulcatus* (UHLIG), *Melchiorites* sp., *Holcodiscus* ex. gr. *perezianus* (D'ORBIGNY), *Holcodiscus* cf. *caillaudianus* (D'ORBIGNY), *Karsteniceras* sp., *Anahamulina* sp., and *Macroscaphites* sp.

Due to the turbiditic formation of the beds and the fact that zonal index ammonoids are missing, no more precise stratigraphic estimations can be made by ammonoid data. The typical ammonoid association, in correlation with other macrofossil data, allows an evaluation only on substage level.

If the holcodiscids of Serre de Bleyton are compared to other Barremian occurrences (COMPANY et al. 2008 for Morocco; FÖZY & JANSSEN 2009 for Hungary). *Holcodiscus perezianus* occurs in the Lower Barremian *Kotetishvilia compressissima* Zone (REBOULET et al. 2009), at which holcodiscids show their main diversification. It was shown by HOEDEMAEKER & LEEREVELD (1995) from Caravaca in Spain (Rio Argos) that *H. perezianus* appears in the late Early Barremian, *M. moutonianum* Zone (upper part of the former *H. caillaudianus* Zone after HOEDEMAEKER & LEEREVELD 1995). The *H. caillaudianus* Zone has been replaced by the lower *K. compressissima* and upper *M. moutonianum* Zones (REBOULET et al. 2009; see also COMPANY et al. 1995). After COMPANY et al. (1995) *H. perezianus* appears in Caravaca already in the *Kotetishvilia nicklesi* and *Nicklesia pulchella* Zones. COMPANY et al. (1995) reported the presence of *Holcodiscus* aff. *perezianus* (but not true *H. perezianus*) in the *Nicklesi* and *Pulchella* Zones. These forms were described later as *Holcodiscus thomeli* (COMPANY, FÖZY, SANDOVAL & TAVERA, 2006). True *H. perezianus* are restricted to the *Compressissima* Zone, whereas *H. caillaudianus* occurs in the middle/upper part of this zone, as stated by VERMEULEN (2002), COMPANY et al. (2008) and FÖZY & JANSSEN (2009).

## Palaeontology

*Conventions.* The material examined is stored in the palaeontological collection of the Natural History Museum (NHMW), Vienna, Austria (Burgring 7, 1010, Vienna). All specimens illustrated in Fig. 3 and 4 were coated with ammonium chloride before photographing. Ammonoid systematics follow WRIGHT et al. 1996 and KLEIN (2005, 2007, 2009). *Karsteniceras* was compared to specimens figured by VAŠIČEK & WIEDMANN (1994). Localities 1-3 are abbreviated loc. 1-3.

## Ammonoids

*Protetragonites* cf. *crebrisculcatus* (UHLIG) (Figs 3I-L), *Phyllopachyceras* sp. (Figs 3A-B), *Hypophylloceras* sp. (Fig. 3C), *Melchiorites* sp. (Figs 4A-N), *Holcodiscus* ex. gr. *perezianus* (D'ORBIGNY) (Fig. 3F), *Holcodiscus* cf. *caillaudianus* (D'ORBIGNY) (Fig. 3H), *Holcodiscus* sp. (Figs 3D-E and G), *Karsteniceras* sp. (Figs 4O-R), *Anahamulina* sp. (Figs 4S-W), and *Macroscaphites* sp. (Fig. 4X),

The ammonite fauna (loc. 1, 2 and 3; n=60) comprises 8 different genera. The occurrence at the Serre de Bleyton section is dominated by ammonites of the puzosiid-type (*Melchiorites*). Ammonitina are the most frequent component (*Melchiorites* 52%; *Holcodiscus* 8%), followed by the Phylloceratina (*Phyllopachyceras* 3% and *Hypophylloceras* 2%), the Lytoceratina (*Protetragonites* 15%), and the Ancyloceratina (*Anahamulina* 10%, *Karsteniceras* 8% and *Macroscaphites* 2%). The ammonoid fauna consists solely of Mediterranean elements.

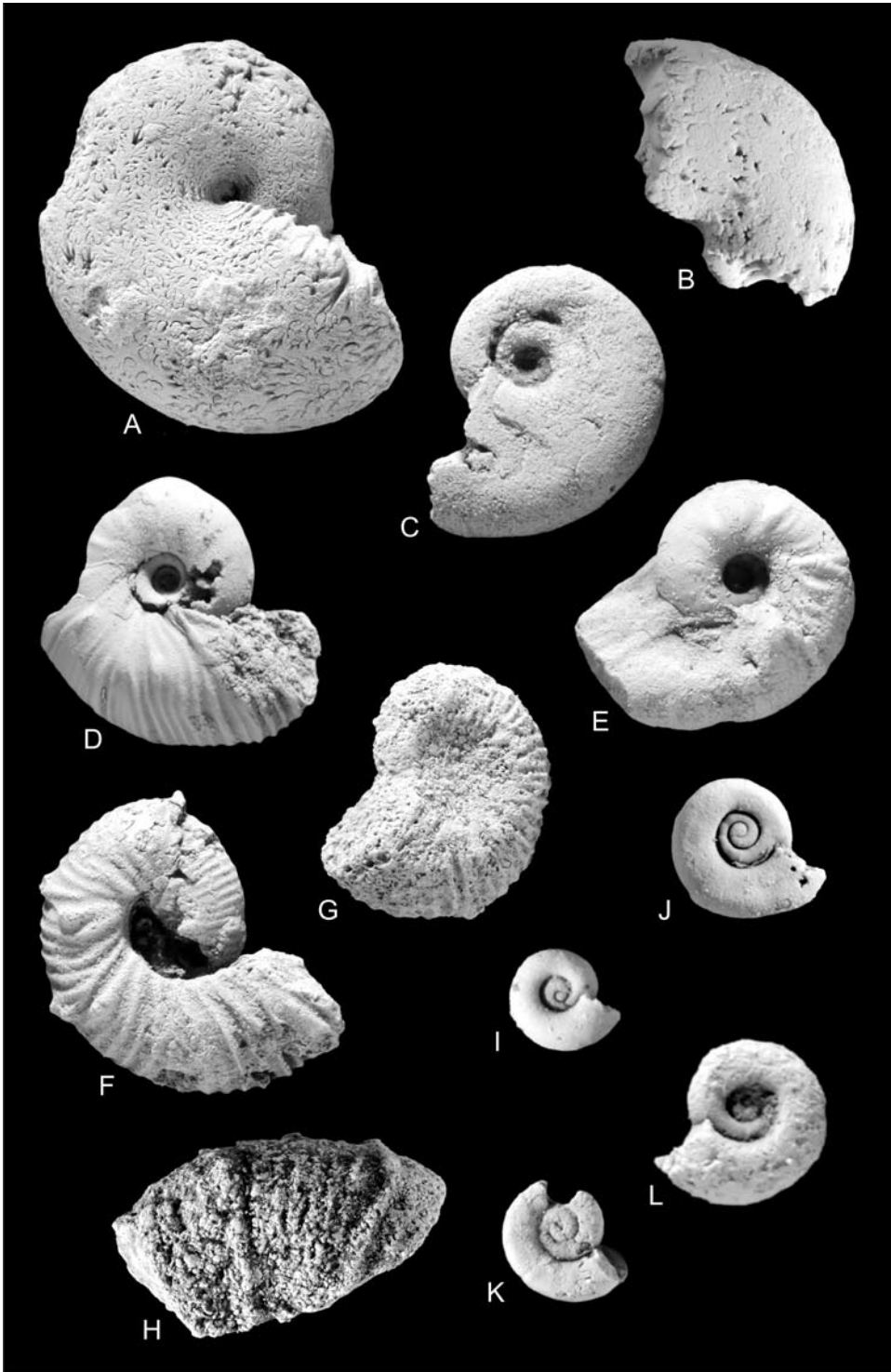
*Melchiorites* is the dominant element in all localities by 67% in locality 1 (followed by *Anahamulina*, *Holcodiscus* and *Protetragonites*, together 11%), in locality 2 with 49% (followed by *Anahamulina* and *Protetragonites*; both 17%) and in locality 3 with 70% (followed by *Anahamulina* and *Phyllopachyceras*; 11% and 7%).

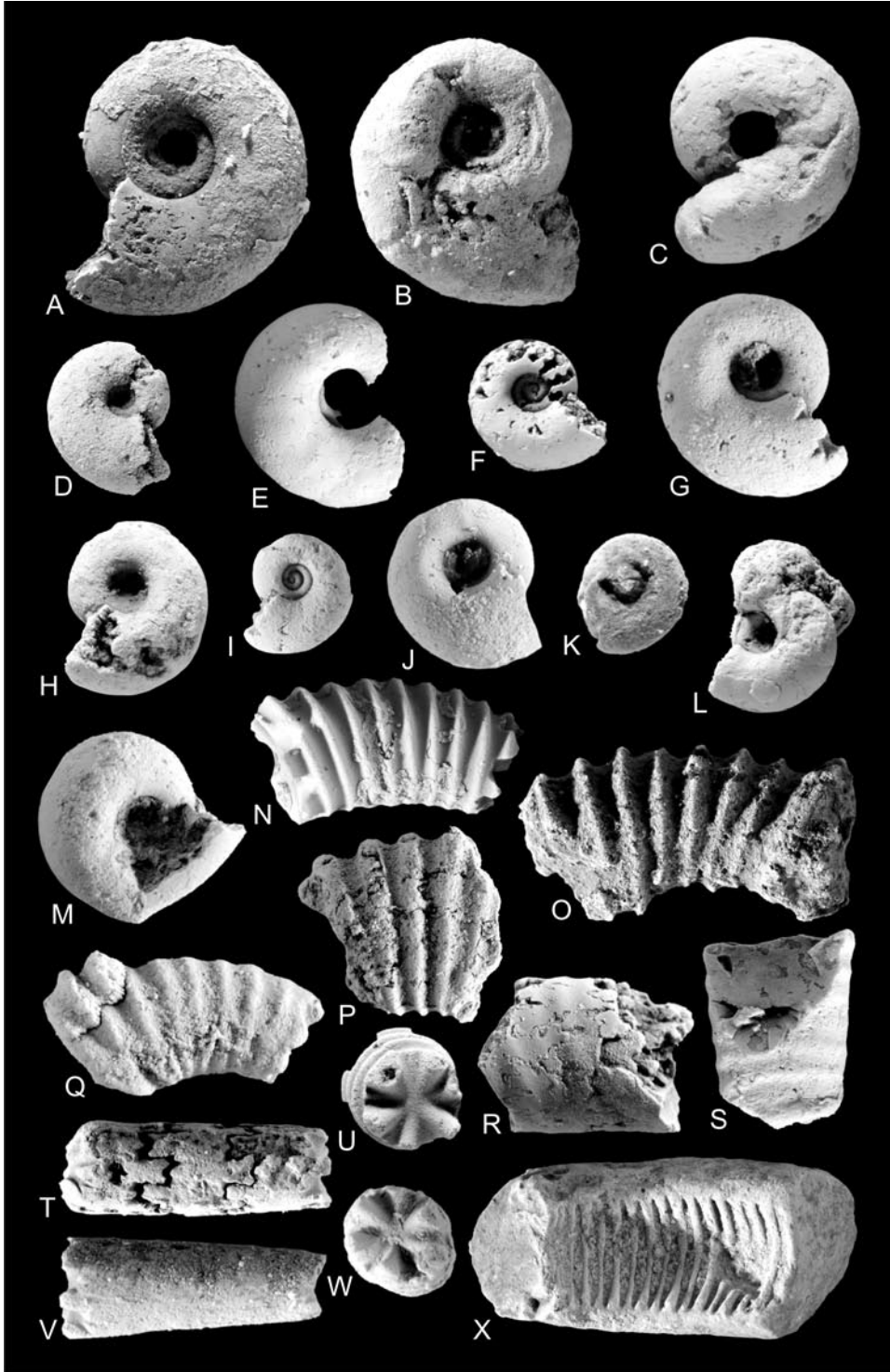
## Discussion

*Interpretation of the section.* The biostratigraphic analysis (macro and microfossils; see also KROH et al. 2010; RIEGRAF & MOOSLEITNER 2010; JANSSEN 2010; all this volume) indicate that the turbiditic section, is of Barremian age.

The ammonoid assemblage from Serre de Blayton shows a typical Barremian (Lower to Upper Barremian) composition. Additional investigations on the different fossil groups as belemnites (JANSSEN 2010), rhyncholites (RIEGRAF & MOOSLEITNER 2010), corals (LÖSER 2010), bryozoans (TAYLOR 2010), asteroids (VILLIER 2010), and crinoids (JÄGER 2010) fit into the picture of an Barremian fauna. As stated above, the species of *Holcodiscus* (e.g. *H. ex. gr. perezianus* and *H. cf. caillaudianus*) rather point to an Early Barremian age. The Thethyan fauna from Serre de Bleyton is comparable to other Barremian sections from the Mediterranean as known from Austria (LUKENEDER 2003, 2004, 2005), France (ADATTE et al. 2005; COTILLON et al. 1984; 1992, 1994, 1997, 2003; DELANOY 1992; DE-

Fig. 3. Ammonoids from Serre de Bleyton. A-B: *Phyllopachyceras* sp. (A: loc. 3, x2, 2009z0108/0001; B: loc. 3, x8, 2009z0108/0002); C: *Hypophylloceras* sp. (loc. 3, x8, 2009z0108/0003); D-E: *Holcodiscus* sp. (D: loc. 3, x8, 2009z0108/0004; E: loc. 3, x8, 2009z0108/0005); F: *Holcodiscus* ex. gr. *perezianus* (D'ORBIGNY) (loc. 3, x3, 2009z0108/0006); G: *Holcodiscus* sp. (loc. 1, x3, 2009z0108/0007); H: *Holcodiscus* cf. *caillaudianus* (D'ORBIGNY) (loc. 2, x3, 2009z0108/0008); I-L: *Protetragonites* cf. *crebrisculcatus* (UHLIG) (I: loc. 3, x10, 2009z0108/0009; J: loc. 3, x10, 2009z0108/0010; K: loc. 1, x10, 2009z0108/0011; L: loc. 3, x10, 2009z0108/0012). ►





LANOY & JOLY 1995; DELANOY et al. 2008; THOMEL et al. 1990; VERMEULEN 1999, 2000, 2002, 2003, 2005, 2007; VERMEULEN & BULOT 2007; VERMEULEN & LAZARIN 2007; VERMEULEN et al. 2007), Hungary (FÖZY & JANSSEN 2009), Italy (LUKENEDER & ASPMAIR 2006), Czech Republic (UHLIG 1883; VAŠIČEK 1972, 2008; VAŠIČEK et al. 1994, 2004), Rumania (AVRAM 1994), Slovakia (VAŠIČEK 2006), Spain (COMPANY et al. 1994; COMPANY et al. 1995; HOEDEMAEKER & LEEREVELD 1995), or even Morocco (COMPANY et al. 2008) and Algeria (VERMEULEN & LAHONDÈRE 2008) (incomplete excerpt of papers on Barremian faunas). Barremian holcodiscid and desmoceratid dominated successions are typical in the Barremian times in the Tethyan Realm.

The cephalopod data presented allow a more precise biostratigraphic reconstruction of the studied turbiditic beds. Accordingly, the described specimens were deposited in habitats of the platform edge to basin (Vocontian Trough) and probably mirror a mixed fauna, derived from different sedimentational areas.

## Conclusions

The presented results are based on new ammonoid findings from the Department Drôme (SE-France) at Serre de Bleyton. The macrofauna, as already stated, is represented by ammonoids, belemnoids, brachiopods, corals, crinoids, echinoids and rhyncholites. The whole section, separatable into three localities (loc. 1-3), yielded 60 ammonoid individuals. The sparse and selective occurrence of the ammonoids within the section at Serre de Bleyton and the lithologic character (siliciclastic) of the sediments makes the sampling difficult. In most cases only the innermost whorls (up to 5 mm), or juvenile parts of the ammonoids are preserved which makes determination difficult.

The stratigraphic investigation of the ammonoid fauna revealed that the Serre de Bleyton section comprises Barremian sediments. A more precise age model is not possible with this ammonoid material. The ammonoid fauna contains solely representatives of the Mediterranean Province.

The new ammonoid assemblage from the Serre de Bleyton locality in SE-France shows once more the importance of correlating different macrofossil groups with the accompa-

- ◀ Fig. 4. Ammonoids from Serre de Bleyton. A-M: *Melchiorites* sp. (A: loc. 2, x8, 2009z0108/0013; B: loc. 1, x5, 2009z0108/0014; C: loc. 2, x8, 2009z0108/0015; D: loc. 3, x8, 2009z0108/0016; E: loc. 3, x8, 2009z0108/0017; F: loc. 1, x5, 2009z0108/0018; G: loc. 3, x8, 2009z0108/0019; H: loc. 3, x8, 2009z0108/0020; I: loc. 3, x8, 2009z0108/0021; J: loc. 3, x8, 2009z0108/0022; K: loc. 3, x8, 2009z0108/0023; L: loc. 2, x8, 2009z0108/0024; M: loc. 3, x8, 2009z0108/0025); N-Q: *Karsteniceras* sp. (N: loc. 3, x8, 2009z0108/0026; O: loc. 3, x8, 2009z0108/0027; P: loc. 2, x8, 2009z0108/0028; Q: loc. 2, x8, 2009z0108/0029); R-W: *Anahamulina* sp. (R: loc. 2, x8, 2009z0108/0030; S: loc. 2, x8, 2009z0108/0031; T: loc. 2, x8, 2009z0108/0032; U: loc. 3, x8, 2009z0108/0033; V: loc. 2, x8, 2009z0108/0034; W: loc. 2, x8, 2009z0108/0035; X: *Macroscaphites* sp. (loc. 3, x1.5, 2009z0108/0036).

nying microfossil fauna. Restricting the stratigraphic evaluation of the Serre de Bleyton outcrop to the ammonoid assemblage would have indicated a time span and age of middle to late Early Barremian.

Sediment deposition at Serre de Bleyton took place during conditions of relatively stable water masses and during relatively high (turbiditic) sedimentation rates within a fan system but unstable sedimentological conditions (allodapic limestones and turbidites). An uncertain amount of the ammonoid specimens were apparently redeposited from shallower shelf regions into a deeper shelf environment.

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