

**WORKSHOP ON THE LOWER CRETACEOUS AMMONITE
WORKING GROUP, KILIAN GROUP – 8 September 2005.**

**The Deshayesitidae , STOYANOV 1949 (Ammonoidea)
from the historical stratotype
of Cassis-La Bédoule (SE France)**

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Abstract

One of the significant results from multidisciplinary investigations carried out during these last years in the Lower Aptian historical stratotype of the Cassis-La Bédoule region (South-Eastern France) (MOULLADE *et alii.*, 1998) was to propose an updated local Upper Barremian/Lower Aptian ammonite biozonation (ROPOLO *et alii.*, 1998) thought to be more consistent with the standard Mediterranean zonal subdivisions. Thus the lower and upper boundaries of the Lower Aptian (= Bedoulian substage of most French authors) as well as boundaries of four biozones (*Paradeshayesites tuarkyricus*, *P. weissii*, *Deshayesites deshayesi*, *Dufrenoyia furcata* Zones) and two sub-zones (*Roloboceras hambrovi* and *P. grandis* Subzones) were identified and formally defined in the stratotype. However, to support this zonal scheme, further descriptions and illustrations of the ammonites collected bed by bed in the various studied sections were still being needed. In this paper, we thus intend to more particularly present and stratigraphically locate the members of the most significant ammonite family found in the Lower Aptian of Cassis-La Bédoule, *i.e.* the *Deshayesitidae*. As for the zonation, taking into account the recent proposals of RAISOSSADAT (2002), HOEDEMAEKER, REBOULET *et al.* (2003), and VASICEK *et al.* (2004), we have replaced in a new zonal scheme the late index ammonite of the earliest Bedoulian Zone, *i.e.* *Paradeshayesites tuarkyricus* (BOGDANOVA 1983), by *Paradeshayesites oglanlensis* (BOGDANOVA 1983).

Key words: Aptian, ammonites, markers, biozonation, taxonomy, stratigraphy

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Introduction

In the South East France, the la Bédoule area, (cf. fig. 2) considered since many years as the historical Lower Aptian stratotype, was successively studied by MATHERON (1842, 1878-1880), REYNES (1861), HEBERT (1871), TOUCAS (1888), ROCH (1927), BLANC (1958), FLANDRIN (1965), FABRE-TAXY, MOULLADE and THOMEL (1965), MOULLADE, FABRE-TAXY and TRONCHETTI (1980), BUSNARDO (1984), CONTE (1984), ROPOLO, CECCA & GONNET (1998), ROPOLO, GONNET & CONTE (1998 – 1999), ROPOLO & GONNET (1999), CECCA, ROPOLO & GONNET (1998/1999), ROPOLO, CONTE, GONNET, MASSE, MOULLADE (1998).

HEBERT (1872) was the first author to give of those outcrops a lithological, and in a way, a "biostratigraphical" description, because based on levels characterized more or less by fossils. Initially subdivided in two zones by KILIAN & REBOUL (1915) and ROCH (1927), then considered as belonging to a single zone by FABRE-TAXY *et alii.* (1965), the Lower Aptian of la Bedoule was subdivided by BUSNARDO (1984) into seven ammonite zones, from bottom to top, the "*Prodeshayesites*", *Pseudocrioceras coquandi*, *Deshayesites consobrinus*, *Ancyloceras matheroni*, *Roloboceras hambrovi*, *Deshayesites grandis* and *Tropaeum bowerbanki* Zones. Because of the difficulties in using some of these zones away from the stratotype of La Bédoule (Cassis station quarry) such a division was not maintained at the different Workshops of the Lower Cretaceous Cephalopod Team of IGCP projects 262/362 (Digne 1990 - Mula 1992 - Piobbico 1994 - London 1997). The biostratigraphical zonation used in Transcaspian regions (Turkmenia), consisting of four zones: (from bottom to top the *D. tuarkyricus*, *D. weissii*, *D. deshayesi* and *Dufrenoyia dufrenoyi* Zones) was preferred.

Some reserves (BOGDANOVA & TOVBINA, 1994 – ERBA, 1996 - BOGDANOVA & MIKHAILOVA, 1999 - BARRAGAN-MANZO & MENDES-FRANCO, 2005) were directly or indirectly formulated, last years, against the Cassis-La Bédoule "formation" (MASSE, 1998a), which constitutes, according french authors, a historical and stratigraphical reference for the Lower Aptian (the so-called Bedoulian of TOUCAS, 1888). Those reserves were principally justified by the fact that, since to day, no complete revision of its ammonitic content was effected despite the corresponding recommendations of the Lyon Colloquium (1963) and that its stratigraphic scheme (BUSNARDO, 1984), was only of local use. "Parastratotypes" were proposed in Caucasian and Transcaspian regions (BOGDANOVA & PROZOROVSKY, 1998), to coordinate stratigraphical and palaeontological knowledge and to establish the base of a "standard" zonation for the Mediterranean Realm. It was necessary to actualize and redefine the Upper Barremian / Lower Aptian stratigraphy of South-Eastern France and new investigations were undertaken a first time by different research teams of Universities of Provence, Nice, Paris, Lyon, with the contribution of german and american colleagues, in many sections (Les Camerlots, Les Caniers, Highway A 52, Le Brigadan, Les Fourniers) of the La Bédoule locality surrounding the historical stratotype: COMTE Quarry section (= Cassis Station section).

New data concerning the la Bédoule area led us to propose a stratigraphic subdivision which conformed better to most of the recently proposed Mediterranean zones and permitted to partly correlate the standard zonation with that of the Boreal realm. (ROPOLO *et alii.* 1998c.). Those new data were:

the description of a rich Upper Barremian, *Pseudocrioceras* level, equivalent to the *Pseudocrioceras coquandi* Zone of BUSNARDO (1984) which allowed us to formally establish a *Pseudocrioceras waageni* Sub-Zone at the top of the *Martelites sarasini* Zone (ROPOLO *et al.* 1998 a, b, c / 1999; CECCA *et al.* 1998 / 1999 b). This Sub-Zone was later

transformed in *P. waagenoides* Zone (HOEDEMAEKER & RAWSON, Vienna, September 2000/Lyon July 2002) used for all the Tethyan realm.

the definition of the Bedoulian substage lower boundary, marked by the FAD of the genus *Deshayesites*, (DELANOY *et alii*, 1997 - MOULLADE *et alii*, 1998 a & b - ROPOLO *et alii*, 1998 /1999 - GONNET *et alii*, 1998 – ROPOLO & GONNET, 1999 - CECCA *et alii*, 1998 -1999)

- the drawing of the Bedoulian/Gargasian boundary at the top of the *D. furcata* Zone, (CONTE 1994, MOULLADE *et alii*, 1998 a & f, ROPOLO *et alii*, 1998c, ROPOLO & GONNET, 2003),

- the choice of *Deshayesitidae* (*Deshayesites tuarkyricus*, *D. weissii*, *D. deshayesi*, *Dufrenoyia furcata*) as zonal index species,

- the study of the ammonites collected during last five years and of their stratigraphic position, (ROPOLO *et alii*, 1998a, b, c., GONNET *et alii*, 1998 – ROPOLO and GONNET, 1999 - CECCA *et alii*, 1998 /1999 - ROPOLO, this paper)

- an analysis of the isotopes events (MOULLADE *et alii*, 1998a , KUHNT *et alii*, 1998 GALBRUN, 1998)

- and different important studies, concerning respectively Bedoulian lithology, (MOULLADE *et alii*, 1998), sedimentology, (MASSE, 1998a), belemnites, (COMBEMOREL 1998), gastropods and bivalves (MASSE, 1998b ALMERAS & MASSE, 1998), benthic and planctonic foraminifers (MOULLADE *et alii*, 1998e), nannofossils (BERGEN, 1998), ostracods (BABINOT, 1998), microflora and pollens. (MASURE *et alii*, 1998)

All those synthesised data allowed us to check the great homogeneity of the faunal successions in all the Tethyan Realm , and to confirm the stratigraphic importance of the locality of La Bedoule which is the only one in Europe to present a continuous succession dated by ammonites from the Upper Barremian (*Martelites sarasini* Zone) to the Gargasian. The dilated section of la Bedoule is composed effectively of 115 m high compacted sediments for a time interval corresponding to the Lower Aptian (= around 4 M years - MOULLADE *et alii*, 1998).

In this paper, we present and stratigraphically situate *Deshayesitidae* collected in the four zones of the Lower Aptian. (In following articles to be published, we shall describe and situate all other families of ammonites collected in the La Bédoule area as *Ancyloceratidae*, *Douvilleratidae*, and so on...). In agreement with the revision of *Deshayesitidae* by BOGDANOVA & MIKHAILOVA (1999, 2004) we used, for our stratigraphical scheme and for the taxa collected, generic terms proposed by Russian literature: the genera *Deshayesites*, *Paradeshayesites* and *Dufrenoyia*. Because individual beds can be correlated between all the studied sections, we have applied the official common bed numbering system used by MOULLADE *et alii*, 1998.

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Stratigraphy - Biozonation of the Upper Barremian / Lower Aptian (Bédoulian) in the stratotypical area of la Bédoule (SE France).

Beds	ZONES and Subzones	
170	<i>Dufrenoyia furcata</i>	
169		<i>Paradeshayesites grandis</i>
160		
148		<i>Roloboceras hambrovii</i>
134	<i>Deshayesites deshayesi</i>	
129	? <i>Yellow marls</i>	
128	<i>Paradeshayesites weissii</i>	
110		
109	<i>Paradeshayesites ogilensis</i>	
61	(ex Tuarkyriscus Zone)	<i>Barremian / Aptian boundary</i>
60	<i>Pseudocrioceras waagenoides</i>	
51		
	<i>Martelites sarasini</i>	
	?	<i>Leptoceratoides puzosianum</i>
40	<i>Imerites gi raudi</i>	

Figure 1: Upper Barremian /Lower Aptian (Bedoulian) biozonation in the stratotypical area of La Bédoule - SE France. In grey the uppermost Barremian. [The *P. waageni* Sub-Zone (Ropolo *et al.*1998) became *P. waagenoides* Zone – (Resolution of Vienna 2000 – Lyon July 2002)]. Beds numbering is given according to the official numbering in MOULLADE *et alii*, 1998.

Barremian/Aptian boundary: The problem of the Barremian / Aptian boundary in the Tethyan Realm was recently evoked and discussed by BOGDANOVA and MIKHAILOVA (2004). After having placed in synonymy the basal Aptian species *Deshayesites antiquus* BOGDANOVA, 1979, with the Barremian species *Turkmeniceras tumidum* BOGDANOVA, 1971, and considering the hypothetical presence often mentioned but never proved nor illustrated of the genus *Turkmeniceras* at La Bedoule, the Russian authors deducted the presence of a *Turkmeniceras* level in SE France. In fact, in spite of precedent assertions, (CONTE, oral communication) we never encountered this genus *s. str.* in the stratotypical area. In a first time we attributed erroneously to the species *Deshayesites antiquus* some shells which clearly resembled to one of the type-specimen illustrated by BOGDANOVA (1983, Pl. 2, fig. 6a, 6b). But in 1999, this same ammonite became *Deshayesites* aff. *antiquus* (BOGDANOVA 1999, p. 68-69, Plate 2, fig. f-g) and was occulted in the Russian following papers. We studied again more precisely our specimens and in our opinion, they have no affinities with the genus *Turkmeniceras*, because all the shells have narrower and less overlapping whorls. They have rather many similarities with the paratype of *Deshayesites lupповi* BOGDANOVA 1983, CNIGR Museum 25/9442 (fig. 9a,b, plate 2 in BOGDANOVA and MIKHAILOVA 2004). with 30 bifurcated ribs by half whorl, flanks flat or slightly convex. Intermediate ribs appear in the middle flanks. So, as we have found a continuous succession of beds without recognized stratigraphical gaps in the studied sections between the upper Barremian *waagenoides* Zone and the first appearance of *Deshayesites s. str.*, we conclude that at la Bédoule as in the Caucasus (Georgia) (KAKABADZE & KOTETISHVILI 1995), Czech Republic, (VASICEK *et al.* 2004) Bulgaria, Colombia, (HOEDEMAEKER, 2004, KAKABADZE 2004) etc. the previous Barremian *waagenoides* Zone (HOEDEMAEKER & RAWSON 2000) is still valid. The lower boundary of the Aptian in the Mediterranean area is usually drawn at the FO of the genus *Deshayesites s. str.* (bed 60 at La Bédoule: official numbering in MOULLADE *et alii*, 1998) This datum coincides with the disappearance of almost the whole of the heteromorph ammonites with Barremian characters.

Paradeshayesites oylanensis Zone : (cf. fig.1) Convincing arguments (RAISOSSADAT, 2002) have been put forward at 1st International Workshop of the IUGS Lower Cretaceous Ammonite Working Group, the “KILIAN Group” (Lyon, 11 July 2002) to use as index for the basal zone of the Aptian stage *Paradeshayesites oylanensis* BOGDANOVA 1983, rather than *Paradeshayesites turkmenicus* BOGDANOVA 1983. *Paradeshayesites oylanensis* has a wide geographical distribution, found in SE France, Spain, Romania, Iran and Transcasian regions, whereas *Paradeshayesites turkmenicus* was collected only in Turkmenia and Kopet Dag (Iran). So, in agreement with our colleagues, (HOEDEMAEKER, REBOULET *et alii* 2003, VASICEK *et al.* 2004, BARRAGAN-MANZO & MENDEZ-FRANCO 2005) we choosed to replace in our zonal scheme the preceding index ammonite by the species proposed by the Iranian author.

Paradeshayesites weissii Zone According to CASEY (Personal communication, March 2000), and to BOGDANOVA and MIKHAILOVA (2004, p. 194) the term “*weissii* Zone” should be considered as unacceptable. *Paradeshayesites weissii* is a *nomen dubium*. The examples figured by NEUMAYR & UHLIG and Von KOENEN are different and the types in any case are lost. Raymond CASEY, himself, has been unable to trace a single specimen in the German museums that could be used as neotype. Looking forward to the finding of a new acceptable index, we however conserve the term, for the time being.

Deshayesites deshayesi Zone We have drawn with doubt the base of the *deshayesi* Zone at the bed 129, where we collected the first example of the index ammonite. At this place, the beds are not in continuity; yellow marls are intercalated between the marly limestones of the bed 129 and the underlying calcareous beds of the *weissii* Zone. Because the lithologic change,

we considered that a gap could be possible between the two levels. In the middle (bed 48-160) and at the top (beds 160-169) of the *deshayesi* Zone, we have precized two horizons with respectively *Roloboceras hambrovii* and *P. grandis* as index-ammonites.

Lower Aptian (Bedoulian) / Middle Aptian (Gargasian) boundary:

The *furcata* zone boundaries at La Bédoule were drawn on following data:

- The first occurrence of *Dufrenoyia furcata* s. str. marks the *deshayesi/furcata* boundary.
- The FAD of pyritic *Aconeceras nesus* / *Epicheloniceras martini* assemblage shows the base of the Middle-Aptian. (Gargasian of french authors).
- According to MOULLADE *et al.* 2005, benthic foraminiferal assemblages (*Praedorothia praeoxicona*, *Lenticulina* cf. *nodosa*, *Astacolus crepidularis*, *Globorotalites bartensteini*) become extinct at the end of the Bedoulian, while two new planctonic forms *Praehedbergella luterbacheri* and *Globigerinelloides ferreolensis* appear slightly above the Bedoulian/Aptian boundary. This new data confort us in the choice of bed 178 to separate the Lower Aptian from the Middle Aptian.

Discussion:

The study of the *Deshayesitidae* in the La Bédoule area allows us to precise in great detail the evolution of Upper Barremian/Lower Aptian assemblages in the historical stratotype. We followed bed by bed, in a meticulous analysis the succession of populations and their evolutionary process in the different sections. We collected and situated again, stratigraphic markers usually accepted for the Tethyan Realm standard. Those new data of major importance for the definition of biostratons, confirm our previously proposed stratigraphic scheme (ROPOLO *et al.* 1998).

At the top of the Barremian stage (beds 45 – 60), the abundance of heteromorphic ammonites belonging to the *Pseudocrioceras* genus, characterizes the *waagenoides* Zone. We never detected in those levels, nor in the underlying or overlying beds any specimen of *Turkmeniceras* s. str. Inversely, it seems that no specimen of *Pseudocrioceras* was never collected in the *Turkmeniceras* levels of Turkmenia. According to DELANOY (oral communication, may/june 2005) the presence of this genus is proved at Angles, Barrême, Vergons in a level overlying the FAD of *Deshayesites*. (about 3 or 4 meters above the “faiseau épais”). A specimen of *Turkmeniceras* was found too, in a section of the Nice area, but in a condensed level. So, as the exact position of this genus remains unclear it seems impossible to establish in SE France for the time being, a *Turkmeniceras turkmenicum* Zone and we consider that the *Pseudocrioceras waagenoides* Zone is valid. to define the Barremian/Aptian boundary.

From bed 61 to bed 178, *Deshayesitidae* represent the leading family of the diverse fossil groups which characterize Lower Aptian deposits of La Bédoule. Four biozones are defined by the first appearance of following index species: *Paradeshayesites ogranlensis*, *Paradeshayesites weissii*, *Deshayesites deshayesi*, *Dufrenoyia furcata*. Evolution of the three genera: *Paradeshayesites*, *Deshayesites* and *Dufrenoyia* and their links with the other ammonite assemblages determine chronostratigraphic subdivisions more conform with the current Mediterranean standard scheme and allow correlations with other regions.

- **Beds 61-109: *Paradeshayesites ogranlensis* Zone:** Assemblage of this zone is represented successively by *Deshayesites bedouliensis* CECCA, ROPOLO & GONNET 1999, *Paradeshayesites ogranlensis* (BOGDANOVA, 1983), *Paradeshayesites planicostatus* (BOGDANOVA, 1991), *Paradeshayesites weissiformis* (BOGDANOVA, 1983), *D. luppovi* BOGDANOVA 1983, *D. aff. consobrinus* (d'ORBIGNY, 1841), *D. cf. luppovi* BOGDANOVA 1983, *Paradeshayesites* cf. *weissiformis* (BOGDANOVA, 1983),

Paradeshayesites aff. *weissiformis* (BOGDANOVA, 1983), *Paradeshayesites* aff. *planicostatus* (BOGDANOVA, 1991).

- **Beds 110 -128: *Paradeshayesites weissii* Zone:** In this interval we collected respectively: *Paradeshayesites weissii* (NEUMAYR & UHLIG 1883), *Paradeshayesites callidiscus* var. *rugosus* (CASEY 1961), *D. gr. spathi/normani* CASEY, 1964, *D. consobrinus* (d'ORBIGNY, 1841), *D. gr. spathi/normani* CASEY, 1961, *D. forbesi* CASEY, 1961, *Deshayesites bogdanovae* AVRAM 1999, *D. evolvens* LUPPOV 1952, *D. formosus* CASEY 1964, *D. euglyphus* CASEY 1964, *D. cf. planus*, CASEY, 1964, *D. dechyi* PAPP 1907, *D. cf. dechyi* PAPP 1907.

- **Beds 129 - 148: *Deshayesites deshayesi* Zone (pro parte):** *Deshayesites deshayesi* (LEYMERIE, 1841), *D. cf. dechyi* PAPP 1907, *D. rarecostatus* BOGDANOVA, KVANTALIANI & SHARIKADZE, 1979.

- **Beds 148 - 160 *Deshayesites deshayesi* Zone, *R. Hambrovi* Subzone :**

D. cf. gracilis CASEY, 1964 (and numerous *Roloboceras* gr. *hambrovi*, *transiens*, *Megatyloceras* gr. *coronatum*, *ricordeanum*).

- **Beds 161 - 170 *Deshayesites deshayesi* Zone, *Paradeshayesites grandis* Subzone :**

Paradeshayesites grandis (SPATH 1930), *Paradeshayesites* cf. *involutus* (SPATH 1930), *P. geniculatus* CASEY, 1964.

- **Beds 171- 178 *Dufrenoyia furcata* Zone :** *Dufrenoyia furcata* (SOWERBY, 1836) *D. fursovae* BOGDANOVA, 1991, *D. dufrenoyi* (d'ORBIGNY, 1840), *D. notha* CASEY, 1964 *D. praedufrenoyi* CASEY, 1964, *D. sinzowi* LUPPOV, 1949, *D. truncata* CASEY, *D. formosa* CASEY, 1964, *D. cf. dufrenoyi* (d'ORBIGNY, 1840), *D. mackesoni* CASEY, 1964.

Conclusion

Very instructive for stratigraphical researches in SE France, seems, at La Bédoule, the evolution of Lower Cretaceous ammonites. Evolute *Ancyloceratidae* characterize a constant level in the Tethyan Realm of Barremian age. Then, they become extinct with nearly all Barremian taxa and, at the Lower-Aptian, they are replaced in their predominance by *Deshayesitidae*, which in turn disappear at the top of *Furcata* Zone and their biotopes are occupied by new rich and diverse ammonite assemblages: Genus *Epicheloniceras* replaces *Cheloniceras* of the Early Aptian, and the appearance of *Colombiceratinae*, or *Parahoplitidae* confirms the Bedoulian/Gargasian transition

We tried, in this paper, to characterize Lower Aptian zones in the La Bedoule area and to revise their respective faunas. The results of our investigations show clearly that, contrary to the doubts expressed by russians authors, the historical stratotype may still represent a type area for the Mediterranean realm.

Numerous species of *Deshayesites*, originally described from Turkmenia or trans-Caspian regions were formally identified in the continuous successions of La Bédoule: *Paradeshayesites oglanlensis*, *Paradeshayesites planicostatus*, *Paradeshayesites weissiformis*, *D. luppovi*, *D. dechyi*, *D. bogdanovae*, *D. rarecostatus*, *Dufrenoyia sinzowi*, *D. fursovae*. It is now proved that other forms described from Boreal Realm, (they were initially collected in the *Forbesi*, *Deshayesi*, *Bowerbanki* Zones from SE England - CASEY, 1964) *Paradeshayesites callidiscus*, *D. gr. spathi/normani*, *D. formosus*, *Paradeshayesites grandis*,

P. geniculatus, *D. cf. gracilis*, *Paradeshayesites cf. involutus*, *Dufrenoyia notha*, *D. truncata*, *D. formosa*, *D. praedufrenoyi*, co-occured, at the Aptian stage, with typical mediterranean taxa and with species belonging to both domains.

Those data and the abundance of diverse fossil groups provide evidence of a new marine regime and lead us to think that at this period, the SE France area was probably an intense transmigration passage between faunas of the trans-Caspian area of Tethys and ammonites of the Boreal sea. Those faunal links, those changes, were probably the consequence of two major geological events near the end of Barremian times: a Tethyan sea level rise (ARNAUD-VANNEAU & ARNAUD 1990) and a transgression in the North Sea region. (RAWSON, 1994) both terminating the isolation of Boreal Realm.

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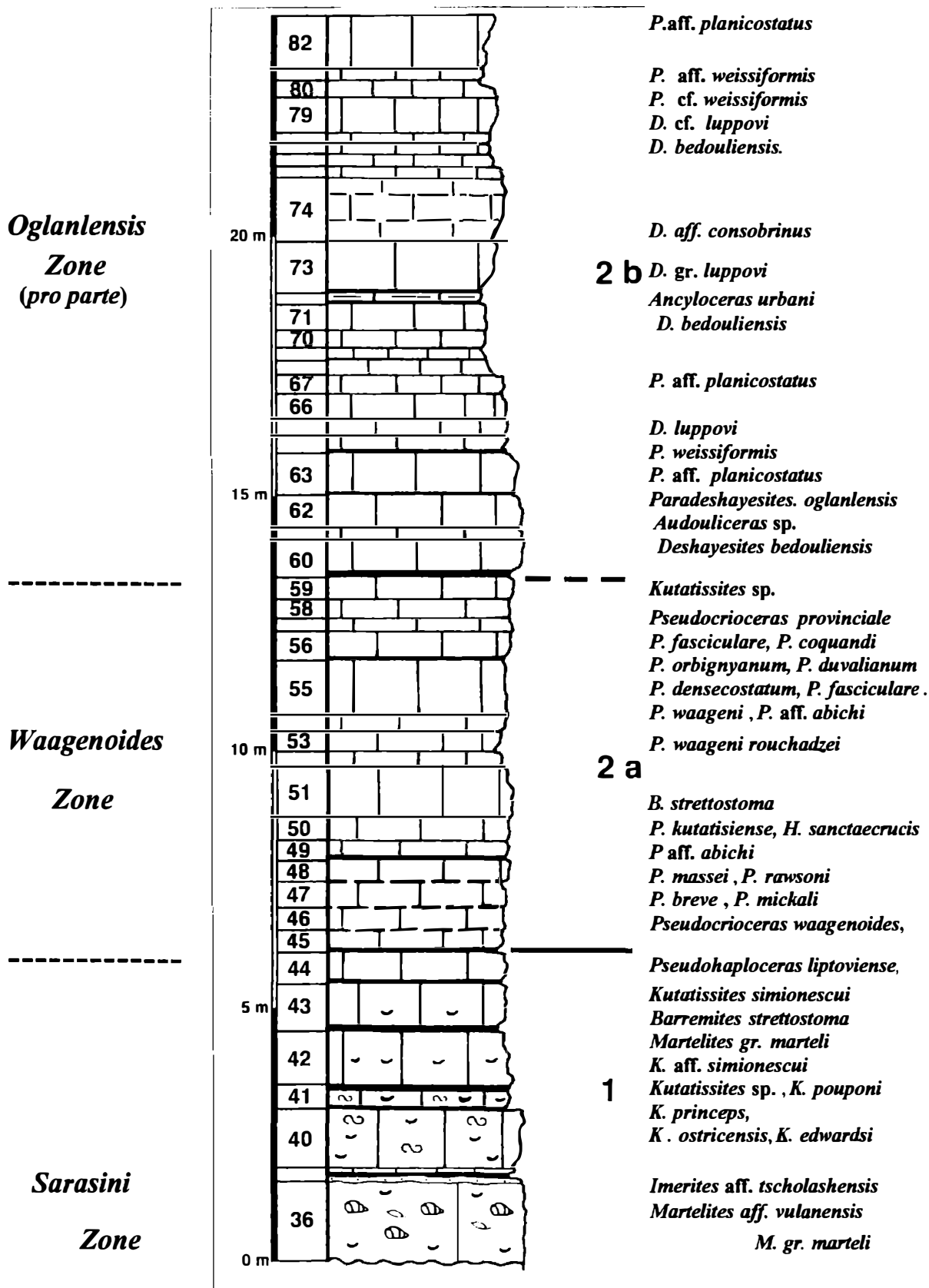


Figure 2

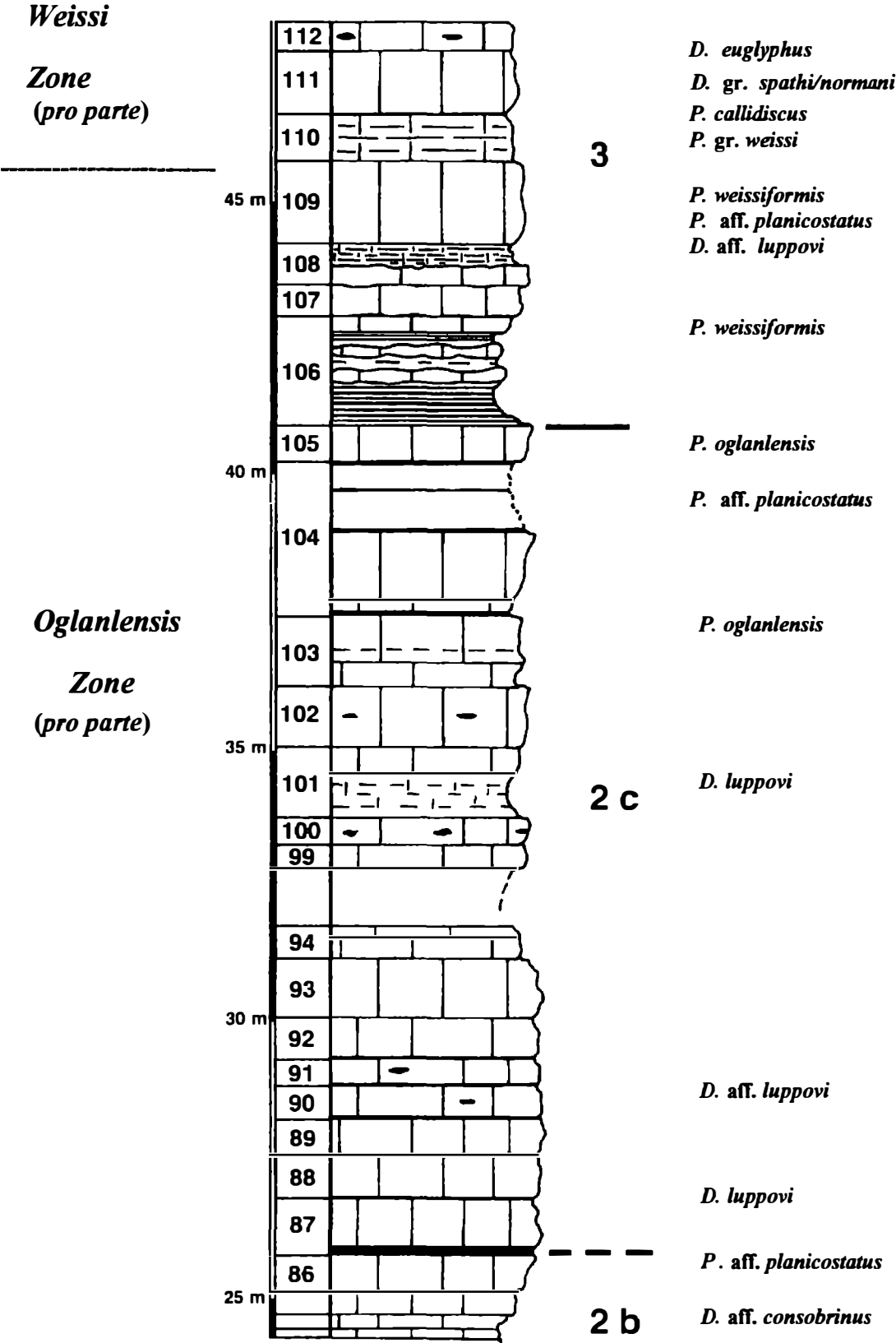


Figure 3.

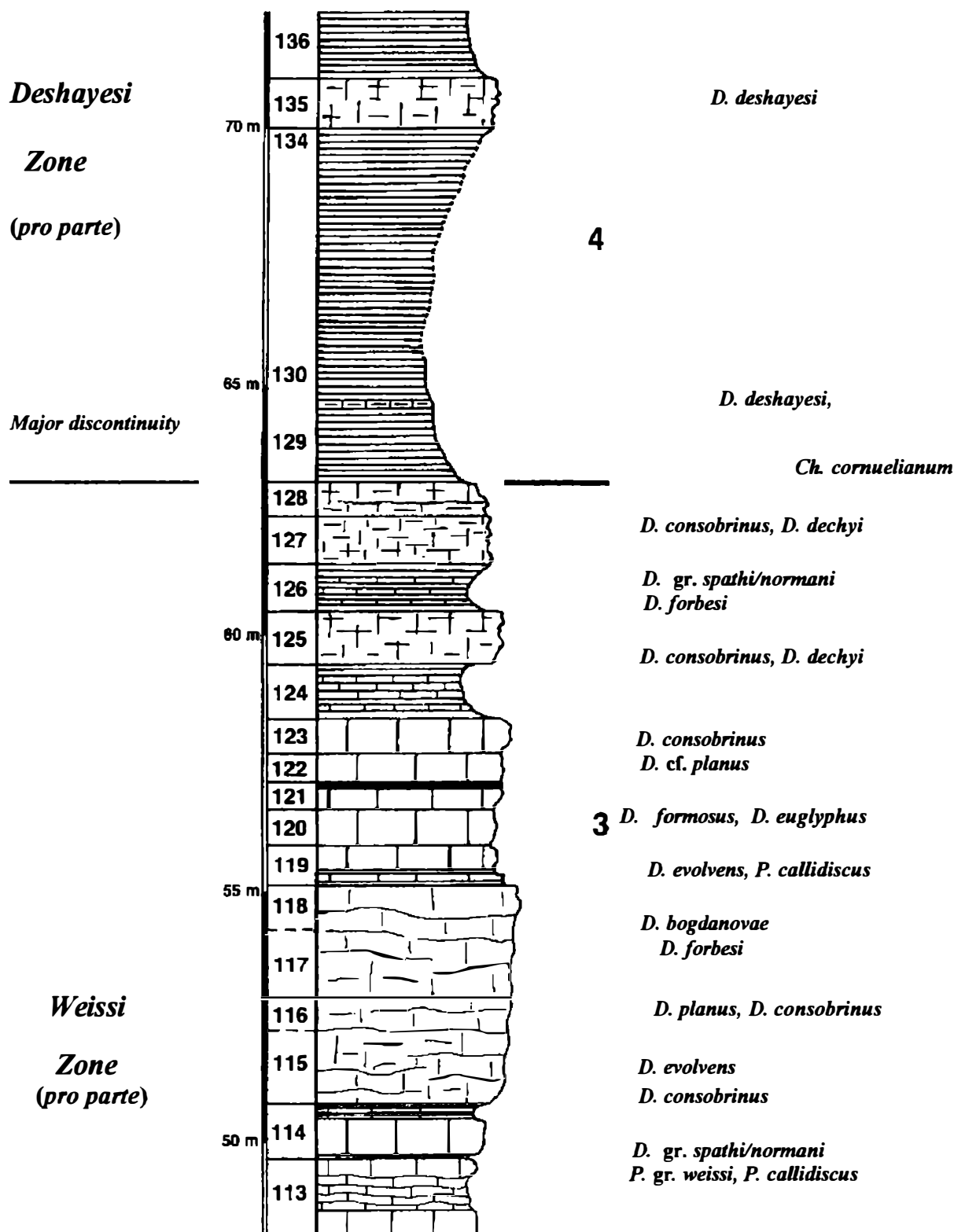


Figure 4.

ANNEX 4 : Distribution of *Deshayesitidae* in the stratotypical area of Cassis-La Bédoule

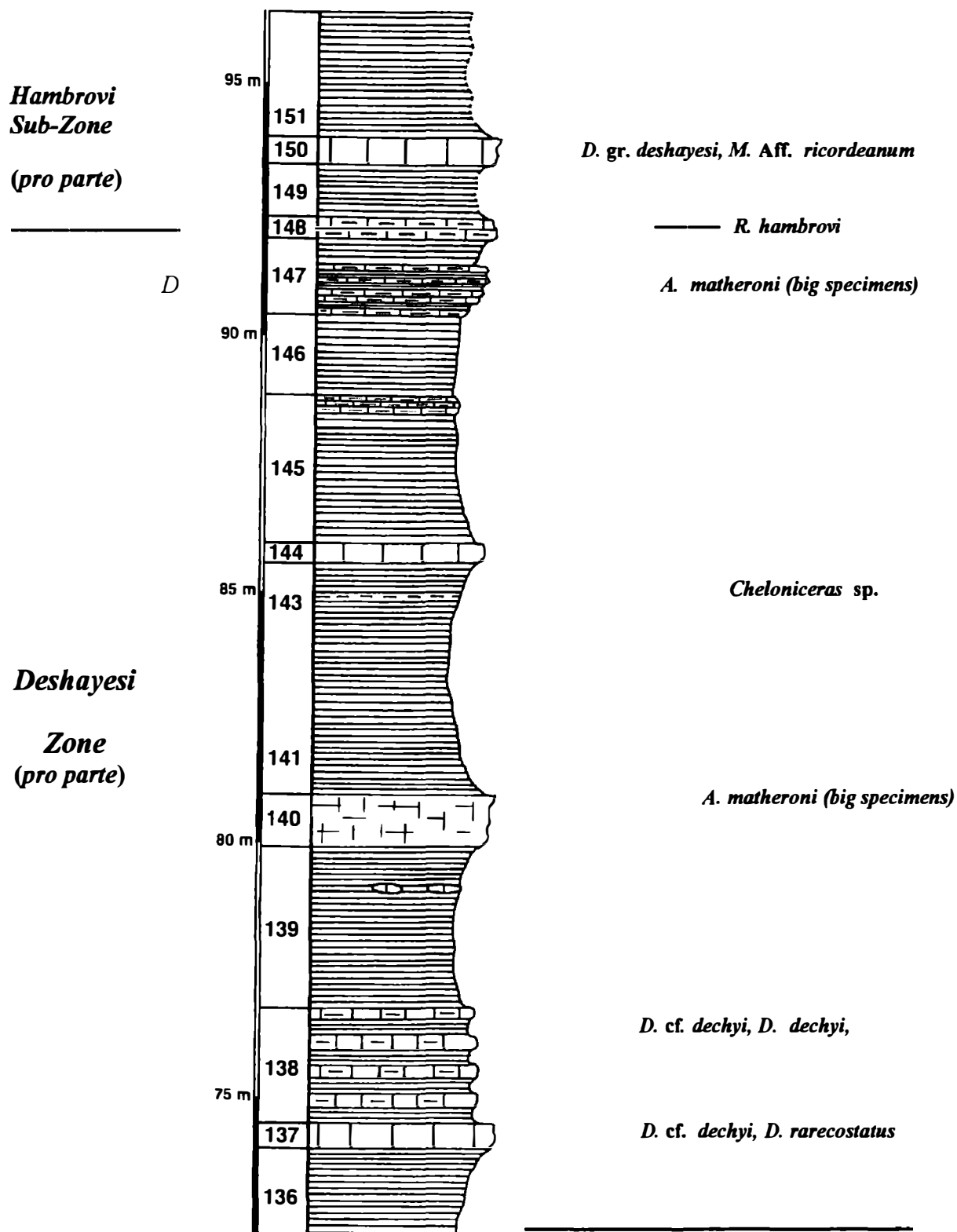


Figure 5.

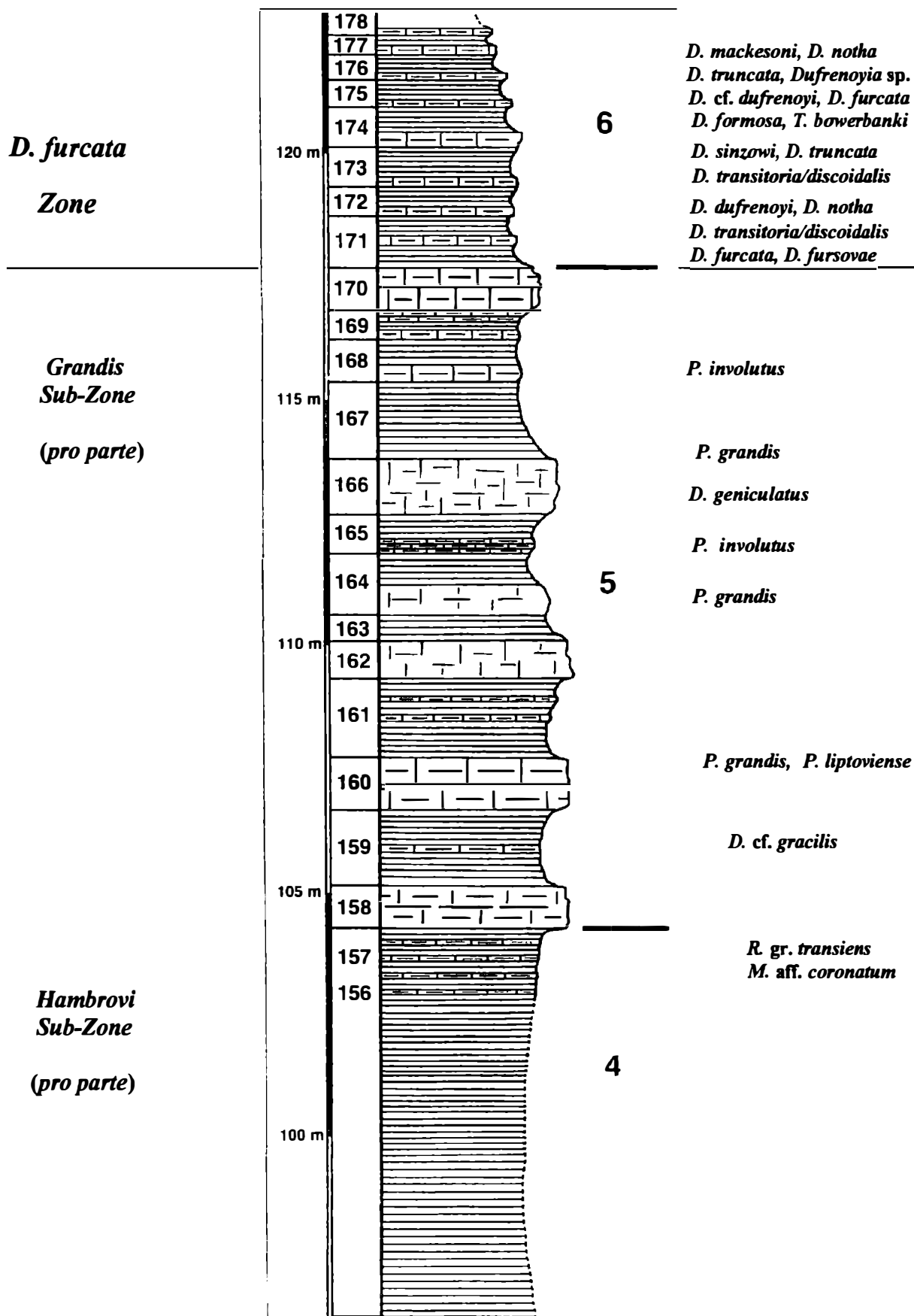


Figure 6.