



**Preliminary investigations of an Aptian GSSP candidate
at the historical Bedoulian locality
near Cassis (Bouches-du-Rhône)
and a complementary section
at the stratotype Barremian locality
at Angles (Alpes-de-Haute-Provence)**

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Abstract: This report presents preliminary investigations of a new candidate for the Aptian Global boundary Stratotype Section and Point (GSSP) at Cassis (Bouches-du-Rhône, France), within the historical Bedoulian stratotype area, and a complementary section at Angles (Alpes-de-Haute-Provence, France). Fieldwork in 2025 identified a promising continuous section (13022-BGD) in the Vallat des Brayes–Brigadan area of Cassis, exposing the lower Aptian La Bédoule Formation. Preliminary observations of *Pseudocrioceras* and *Deshayesites* indicate that the Barremian/Aptian boundary likely occurs within a narrow interval. Despite partial coverage, the section is accessible, correlatable, and located on protected municipal land, making it a strong GSSP candidate. Complementary research at Angles confirms comparable faunal successions in a pelagic context, notably at the Combe-Lambert section, now fully exposed and protected within the National Geological Nature Reserve. Together, these sites provide an integrated framework for defining the base of the Aptian Stage.

Keywords:

- Aptian;
- Bedoulian;
- GSSP proposal;
- stratigraphy;
- Angles;
- Cassis;
- Roquefort-La Bédoule

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Résumé : Travaux préliminaires sur un site candidat au GSSP de l'Aptien dans la localité historique bédoulienne près de Cassis (Bouches-du-Rhône) et section complémentaire dans la localité stratotypique barrémienne d'Angles (Alpes-de-Haute-Provence). - Ce rapport présente les résultats préliminaires d'investigations menées sur un nouveau site candidat pour le Point Stratotypique Mondial (GSSP) de la base de l'Aptien à Cassis (Bouches-du-Rhône, France), au sein de la zone stratotypique historique du Bédoulien, ainsi qu'une section complémentaire à Angles (Alpes-de-Haute-Provence, France). Les travaux de terrain effectués en 2025 ont permis d'identifier une coupe continue prometteuse (13022-BGD) dans le secteur du Vallat des Brayes-Brigadan à Cassis, correspondant à la Formation de La Bédoule (Aptien inférieur). Les premières observations de *Pseudocrioceras* et *Deshayesites* suggèrent que la limite Barrémien/Aptien se situe dans un intervalle restreint. Bien que partiellement masquée, la coupe est accessible, corrélable et située sur un terrain communal protégé, en faisant un solide candidat au GSSP. Des recherches complémentaires à Angles confirment des successions fauniques comparables en contexte pélagique, notamment à la coupe de Combe-Lambert, désormais entièrement dégagée et protégée au sein de la Réserve Naturelle Nationale Géologique de Haute-Provence. Ensemble, ces sites offrent un cadre intégré pour la définition de la base de l'étage Aptien.

Mots-clefs :

- Aptien ;
- Bédoulien ;
- proposition de GSSP ;
- stratigraphie ;
- Angles ;
- Cassis ;
- Roquefort-La Bédoule

1. Introduction

The La Bédoule area, in southeastern France (Fig. 1) was chosen by TOUCAS (1888) as the type locality of the Bedoulian stage. Numerous studies have been devoted to this locality, which reached their peak with the publication of a multidisciplinary volume in the journal *Géologie Méditerranéenne* in 1998 (MOULLADE *et al.*, ed., 1998), with no less than 23 dedicated articles. The themes addressed were as much on the lithological, as on the biostratigraphic, paleontological, or geochemical aspects. More recent works (see below chapter 3) show the interest, still as great, for the Aptian of this area as a reference locality for the Aptian Global boundary Stratotype Section and Point (GSSP).

Due to intense urbanization in the territories of the municipalities of Cassis and Roquefort-La Bédoule, access to various sites of interest has become either impossible or restricted. For instance, the site of the former VILLENEUVE quarry is now occupied by the Moteurs BAUDOUIN factory. The stratigraphic succession has been largely filled in, and only part of the former main mining face remains. The former eastern mining face is partly leveled and occupied by a car park. The former COMTE quarry is currently the location of an EHPAD (nursing home). The Marcouline quarry, where the upper part of the lower Aptian series outcropped, is completely filled in; only the large marl outcrop of the northern mining face remains. Finally, only the Vallon de COMTE (here Vallat des Brayes) remains and allows observations, under

the Brigadan allotment, which has extensively extended towards the south since the end of the 20th century (MOULLADE *et al.*, 1998).

On June 16th, 2025, on the invitation of Bruno GRANIER, we conducted a reconnaissance survey on a large parcel of land, labelled AN0103 (Fig. 2). On August 13th, 2025, some more investigations were made.

One aim of this paper is to evaluate the feasibility and suitability of proposing this site as a candidate for the Aptian GSSP (near the Brigadan allotment: BGD in Fig. 1), in light of the recent restrictions affecting the neighboring historical quarries.

At the same time, it was interesting to search for a complete section around the Barremian/Aptian boundary in the well-known sector of the Barremian stratotype of Angles, in a pelagic and therefore complementary paleogeographic context. Investigations therefore took place at the Angles road and in its immediate surroundings (ANG in Fig. 1).

It is noteworthy that both sites, in addition to satisfying the established scientific criteria (see HEDBERG *et al.*, 1976; COWIE *et al.*, 1986; SALVADOR, ed., 1994; REMANE *et al.*, 1996; GRANIER, 2025), also fulfill all supplementary requirements and recommendations of the International Commission on Stratigraphy (ICS), including those related to historic stability, uniqueness, accessibility, and protection - criteria that are not fully met by some other Aptian GSSP candidate sections.

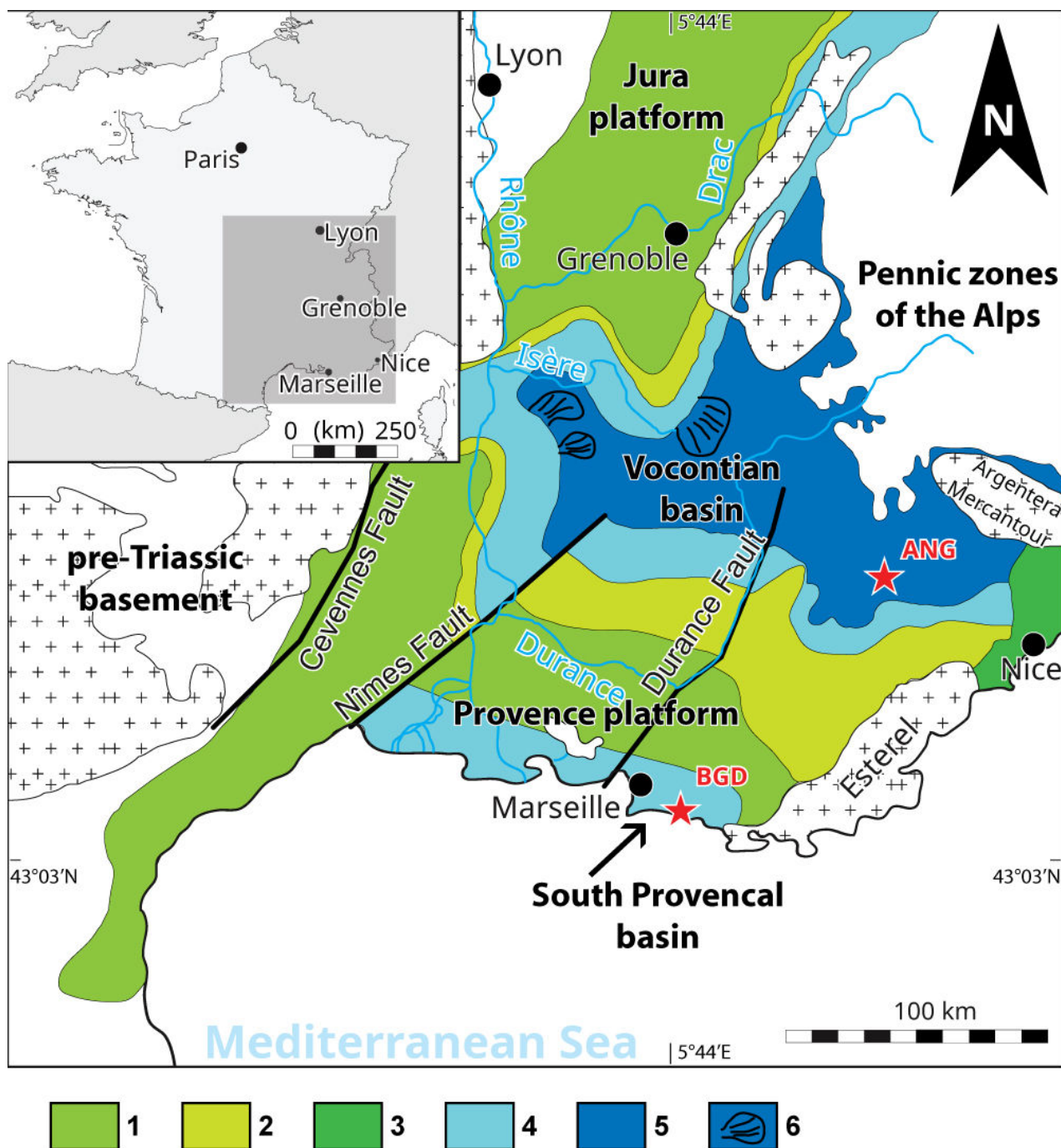


Figure 1: Map of the sections studied in the context of the Vocontian Basin, the Provence Platform and the South Provençal Basin; BGD=le Brigadan section near Cassis-La Bédoule; ANG=the Angles Barremian stratotype section. Caption: 1) inner shelf bioclastic facies; 2) outer shelf facies; 3) outer shelf, glauconitic (condensed facies); 4) hemipelagic facies (slope); 5) pelagic facies (basin); 6) gravity flow deposits.

2. Geological context

The lower Aptian outcrops around Cassis-Roquefort-La Bédoule belong to the Carpiagne anticline, of which they constitute the southern flank. They are in normal contact with the underlying Urganian Formation, which constitutes the synclinal core, but are intersected by numerous small faults throughout the sector. In the historic 'Vallon COMTE' (in lit. - here Vallat des Brayes according to the local toponymy), the lower Aptian layers are oriented towards the SE with a slight dip

(10°). The studied area is framed by two of these faults, overall oriented E-W and perpendicular to the orientation of the strata. The northern fault exhibits strike-slip displacement relative to the Urganian Formation.

On the 1:50,000 geological map of Aubagne-Marseille (GUEU *et al.*, 1969), this area includes both the Urganian Formation (n4U, 'Barrémien à faciès Urganien', an internal platform facies) and its hemipelagic uppermost Barremian-lower Aptian cover, the Bédoule Formation (n5) consisting of limestones, argillaceous limestones and marls.

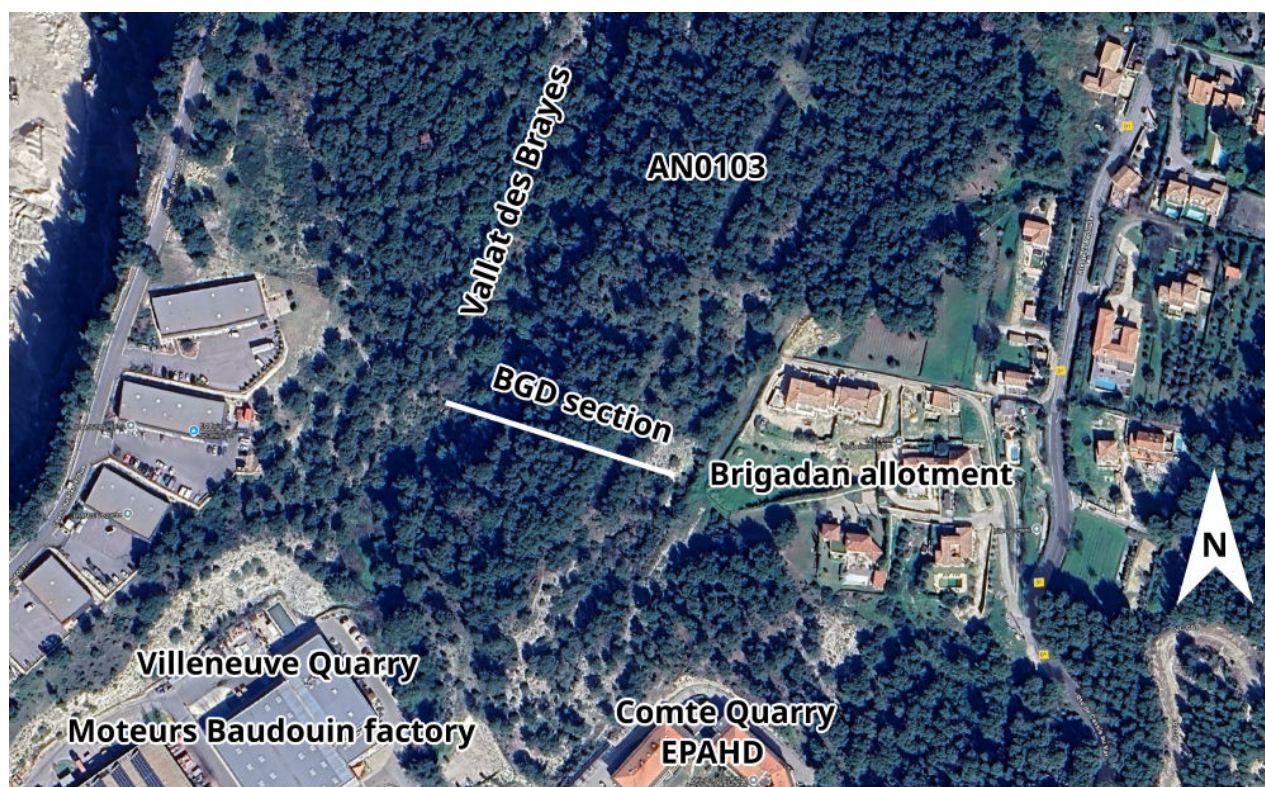


Figure 2: Closeup of the locality of the Brigadan section (here BGD), in the vicinity of the Villeneuve and COMTE quarries. The Valla des Brayes is the local toponymy for the Vallon COMTE (*in lit.*).

Paleogeographically (Fig. 1), this area corresponds to the South Provençal Basin, bordered to the south by the South Provençal Urgonian platform (which outcrops near Toulon), and to the north by the North Provençal Urgonian platform (Monts de Vaucluse - Ventoux). This basin is separated from the Vocontian Basin, to the north-east, by the Verdon sill. The Vocontian Basin is a large subsident intracratonic area characterized by pelagic sedimentation deposited during the Mesozoic Era at the extreme northwestern Tethys (Alpine Ocean).

From a paleoecological point of view, in the Cassis-Roquefort-La Bédoule area, the Urgonian Formation is overlain by a more siliciclastic calcareous series of topmost Barremian and basal Aptian. The faunas show an opening of the environment (cephalopods, mainly ammonites, absent from the Urgonian Formation), but remain predominantly neritic, with benthic forms being common (mollusca). This opening is confirmed from the *Deshayesites forbesi* Zone, manifested in the field by a very marked change in lithology to the deposition of marls.

Since the 1998 volume, the works of LORENZEN *et al.* (2013), and MOULLADE *et al.* (2015), have provided new elements on the carbon and oxygen cycles of this area, based on a borehole, mainly carried out as part of research on Oceanic Anoxic Event 1a (OAE1a). Borehole LB1 was drilled in the Fourniers area, at a place called 'Le Camping' and was correlated bed-by-bed with the reference section of the Cassis Station (see MOULLADE *et al.*, 1998). It is, however, interesting to note the richness of the bioturbation, and the presence of

glauconite, pyrite, micas, quartz and sponges (spicules) over the entire borehole, as well as the progressive aspect of the transitions between more calcareous and more marly beds, which sometimes mimic our own difficulties in the field in clearly delimiting certain bed limits (point 4). It is also necessary to note the apparent continuity of sedimentation over the entire borehole, with a minimum of diagenetic disturbances.

STEIN *et al.* (2012) also conducted a geochemical study where they analysed the entire Cassis-Roquefort-La Bédoule section for the stable carbon isotope composition of organic carbon, as well as for its phosphorus (P), redox-sensitive trace elements (RSTE), and clay-mineral contents in order to explore changes in palaeoenvironmental conditions leading to OAE 1a. The evolution of kaolinite rate reveals the environment shifts from proximal (Barremian) to hemipelagic (lower Aptian). Based on the work of STEIN *et al.* (2012), the section of Cassis-Roquefort-La Bédoule is of particular interest for several reasons: (1) it documents the drowning of Urgonian-type platform during the uppermost Barremian; (2) several laminated and organic-rich layers of uppermost Barremian age occur immediately on the top of the drowning unconformity (MASSE & MACHHOUR, 1998); and (3) the sedimentary interval containing the negative $\delta^{13}\text{C}$ excursion is expanded, compared to that of other sections.





As for the sections of the Vocontian Basin (area of the Barremian stratotype of Angles), they present a relatively homogeneous and continuous rhythmic sedimentation of alternating limestone beds and marl interbeds between the terminal Barremian and the basal Aptian, before the deposition of all the marlstone-dominated series. Useful comparisons can be made between the two areas.

3. The state of the art in finding a suitable and accessible section today

In the search for a suitable place to define an Aptian GSSP, it is necessary to find a section where topmost Barremian and beds displaying the onset of the *Deshayesites* genus, which is considered the basic marker of the Aptian stage (RAWSON, 1983; see CECCA *et al.*, 1999, and literature), are present.

Authors from the 1990s agreed to recognize 3 distinct faunal intervals above the Urgonian at Cassis-Roquefort-La Bédoule: (1) a Heteroceratidae-bearing interval at the base (with *Martelites* and *Micrancyloceras breve*), (2) a *Pseudocrioceras*-bearing interval, and then (3) a more developed *Deshayesites*-bearing interval marking the beginning of the Aptian. However, the authors did not agree on the distribution of the genus *Pseudocrioceras*. According to BUSNARDO (1984), the distribution of this genus postdates the FAD of the *Deshayesitidae* ('*Prodeshayesites*'). For DELANOY *et al.* (1997), *Pseudocrioceras* appears before *Deshayesites*, but would disappear when the latter genus is already well expressed in the faunas. Finally, ROPOLO *et al.* (1998) and GONNET *et al.* (1998), maintained that *Pseudocrioceras* disappears before the appearance of *Deshayesitidae* without their distributions overlapping. Following DELANOY *et al.* (1997), it appears that due to significant morphological convergence, citations of '*Prodeshayesites*' in the literature must be actually *Martelites*, while more recent work (see ROPOLO *et al.*, 2006) settled the question by showing that *Pseudocrioceras* is always older than *Deshayesites* and that their distributions do not overlap.

It is established that the historical stratotype of the Bedoulian is located at the Cassis railway station (MASSE *et al.*, 1998), and that the stratotype zone extends into the surrounding area of Roquefort-La Bédoule and Cassis. The immediate surroundings of Roquefort-La Bédoule no longer present any outcrops exposing the Barremian/Aptian boundary, with the exception of the highway section, which is difficult to access. CONTE (1994) located the Bedoulian stratotype in the former COMTE Quarry, while ROPOLO *et al.* (1998) located it in the former Villeneuve quarry, these two old quarries being almost adjacent. For GONNET *et al.* (1998), the stratotype is located at the Cassis railway station. In reality, the area studied in the past by ROCH (1927) and referred to as 'historical', corresponds to a fairly large sector including the old COMTE and VILLENEUVE quarries, and the Vallat des Brayes (MOULLADE *et al.*, 1980, 1998):

this is the whole area that corresponds to the so-called 'Gare de Cassis' outcrops reported by 20th century authors. FABRE-TAXY (1963) described this area in detail and created a cross-section of all the formations she recognized there. Simultaneously, HUMBERT (1963) emphasized the variations in facies between the outcrops. The site of the Cassis cemetery, where the Heteroceratidae level was reported, is now very urbanized and no longer allows any observations.

The Vallat des Brayes (3 sections between the railway station and the Sardons) subsequently appeared to have the most stable and complete lithological succession (HUMBERT, 1963, Fig. 2) and would correspond to a zone with extremely localized subsidence compared to the other sections of this area (BLANC, 1960). As previous authors did, we can clearly recognize the separation into two distinct lithologies (limestone at the base, marlier at the top), the Barremian-Aptian limit being confined to the lower and more calcareous zone. It appears that the section known as the historical Bedoulian stratotype corresponds to a composite section between all these outcrops (MOULLADE *et al.*, 1998). This observation is shared by STEIN *et al.* (2012), who also reported the difficulty of accessing certain parts of the synthetic section due to vegetation, and the difficulties of correlations between the sections. A detailed history of studies in this sector is given by FLANDRIN (1965) in the 1963 Lower Cretaceous conference, then again by MOULLADE *et al.* (1998).

Concerning the designation of a GSSP, CECCA *et al.* (1999) had proposed that the Bedoulian stratotype area be considered as a reference for the Barremian/Aptian boundary, but without designating a type section. Only the Brigadan section was described in their work (right side of the Vallat des Brayes, already cited by CECCA *et al.*, 1998, then again by ROPOLO *et al.*, 1999), with the stage boundary precisely positioned between beds 81 and 82 (appearance of the first *Deshayesites* in bed 82). It would therefore be legitimate to consider this section as a potential GSSP candidate. This outcrop was found by us, although it was poorly located by these authors (e.g., CECCA *et al.*, 1999, Fig. 2, point 1), in an area where only the Urgonian outcrops. It is now completely covered by forest and can no longer be studied. This section clearly corresponded to a few beds that were difficult to delineate and measure due to their shallow dip (CECCA *et al.*, 1999, p. 268). This difficulty, as well as the different numbering of the beds from that used on the composite stratotype section, make correlations difficult. It appears that this site cannot therefore be validly considered for designation as a GSSP. More recently, a Bedoulian GSSP (as an independent stage) was proposed by MOULLADE *et al.* (2011), in the Villeneuve quarry at the base of bed 60 of the stratotype terminology. Its access and study are now made very complicated by the presence of the Moteurs BAUDOUIN Company, and this choice can no longer be retained today.



Other sections have been described on the right side of the Vallat des Brayes. DELANOY *et al.* (1997, Fig. 2) described a log named 'les Sardons section': in this section, the authors placed the Barremian/Aptian boundary between beds 80 and 81 (appearance of the first *Deshayesites* in bed 81). Here again, the numbering is not that of the stratotype terminology, and the lithology does not resemble the sections figured by the other authors. This section was redescribed by GONNET *et al.* (1998), then ROPOLLO *et al.* (1999) under the name 'les Caniers section', but the lithology and the distribution of the faunas are again not the same. MOULLADE *et al.* (1998, p. 19 and Fig. 3), in their article describing the lithology of the sections in the Cassis-La Bédoule sector, proposed a reference horizon of black shales supposed to represent the Barremian/Aptian boundary in the Cassis-La Bédoule area: the ROCH Horizon. In the synthetic stratotype log (*op.cit.*, Fig. 3), this horizon is located between beds 59 and 60. In the same work, the authors discussed the section 'les Sardons (les Caniers)' (*op.cit.*, p. 27, Fig. 10): the ROCH Horizon is expressly reported and identified there; it is also located between beds 59 and 60. However, the lithology/numbering of this section differs clearly from those named 'les Sardons' and/or 'les Caniers' figured by DELANOY *et al.* (1997, Fig. 2) then ROPOLLO *et al.* (1998, Fig. 1). MOULLADE *et al.* (1998) positioned the ROCH Horizon in the 'les Caniers' section of ROPOLLO *et al.* (1998, Fig. 1) '1.5 m above bed 81', which would make it correspond to a marl level located between beds 86 and 87, high above the Barremian/Aptian boundary recognized by these authors. Later, FRAU and DELANOY (2022, Fig. 3) re-described the 'les Sardons section' of DELANOY *et al.* (1997, Fig. 2) by naming it 'les Sardons (= les Caniers)'. These authors cited and included numerous fossils from sites sometimes named 'les Sardons/les Caniers', sometimes 'les Caniers/les Sardons', which adds to the confusion surrounding these localities. The location of these sections, given by the authors, corresponds to an area where the Urgonian outcrops and the site has not yet been found by us; new research will be conducted in this sector over a wider area to identify this locality.

We have to wait for the work of ROPOLLO *et al.* (2006, Figs. 7-8), to see the faunas of the different sections replaced in relation to the synthetic stratotype log of MOULLADE *et al.* (1998) with the corresponding bed numbers. It is however important to point out that most of the ammonites collected and reported in works during 1990-2010 (all authors combined) do not come from the sections used to produce the synthetic stratotype log, but from sections outcropping in poor condi-

tions, that are provisional (depending on construction works), or sampled in conditions which do not correspond to current scientific standards (approximate collections by amateurs). One may wonder how the correlations proposed at the bed level were carried out, given that the log-surveys of the addenda sections (Caniers/Sardon, Brigadan, Fournier, Camerlots) are dissimilar from the synthetic reference log, and that the precise location at the bed level of the specimens collected sometimes appears to be unreliable. This is the case, for example, of the specimen shown by ROPOLLO *et al.* (1999, Pl. 5, fig. 1), and identified as *Pseudocrioceras orbignyanum*, reported in bed 80 of the Camerlots section (*sic*). This specimen actually comes from the old Marcouline quarry, in much more recent levels, as indicated by R. GONNET to one of us (DB, oral communication of the 07/03/2012), to whom this specimen belonged, and who told us the conditions of collection of this specimen (and others) by Francis GONDRA. This specimen must be reassigned to *Ammonitoceras* (morphology *Epancyloceras*, see BERSAC & BERT, 2022). To our knowledge, the specimens from private collections studied by the authors of the 1990's-2000's have for the most part not been deposited in public institutions, and are largely no longer accessible to the scientific community.

More recently, FRAU and DELANOY (2022) proposed the revision of several ammonite species around the Barremian/Aptian boundary of the Cassis-La Bédoule area. Their stratigraphic distribution is given, essentially from samples taken by R. BUSNARDO in the 1980's and since deposited at the University of Lyon 1. They described again the synthetic stratotype section based on the work of STEIN *et al.* (2012) and in turn proposed correlations between the different sections of the literature (Cassis station, Brigadan, Caniers, Sardons) also noting the difficulties due to imprecise logs and faunal distributions that could be problematic (*e.g.*, 'idealised' in ROPOLLO *et al.*, 2006). MORENO-BEDMAR *et al.* (2009, 2010) also recognized those discrepancies concerning taxonomy and sample control, which pose some problems to correlate the age of the OAE1a event between the Iberian Chain and the Cassis-La Bédoule areas.

To summarize, in the literature there is currently no section of the Barremian/lower Aptian limestone series that is not either synthetic or partial, and sampled with the standards that one would expect in the context of the study of a GSSP. New field research is therefore necessary, on the one hand to find a non-composite section that is as complete as possible around the Barremian/Aptian boundary, and that can be easily sampled (ideally not on a quarry face) to allow precise location of future samples.



Figure 3: The current aspect of the cliff of the section BGD (see Fig. 2); the level set back at the base of the cliff corresponds to the TOUCAS Level; bed numbering according to Figure 4.

4. The Vallat des Brayes site

Urgonian strata, which form a structural surface on the western slope of the valley ('rive droite'), are also visible at its deepest part. The area of interest in the Vallat des Brayes is the 'Limestone Member' of the lower Aptian. The Barremian/Aptian boundary is located in the La Bé-doule Formation, which starts several meters above the last rudist levels of the Urgonian Formation (bed 36 of the type section in MOULLADE *et al.*, 1998).

Along the eastern flank of the valley - for example, at GPS coordinates $43^{\circ}14'28.4''\text{N}$, $5^{\circ}33'35.8''\text{E}$ - a succession of supra-Urgonian beds can be observed, standing out more or less clearly in the topography. Several extensive old excavations are visible, in several levels. The sequence continues upward with thinly bedded limestones, which form a structural surface within the forest (at GPS coordinates $43^{\circ}14'23.7''\text{N}$, $5^{\circ}33'35.4''\text{E}$). Above this level, just below the first houses of the Brigadan residential area, a few more additional beds are exposed.

At GPS coordinates $43^{\circ}14'22.7''\text{N}$, $5^{\circ}33'31.1''\text{E}$, we logged a section of supra-Urgonian beds forming a small cliff (Fig. 3). This section, here designated 13022-BGD, shows traces of old, now illegible numbering on several beds. The beds follow each other easily in the upper part of the section. In the lower part, the outcrop includes some zones of poor visibility, which could be cleaned later. In particular below the old excavation residues mask the lowest layers. It will be necessary either to remove the debris or to clear the hidden layers on the side. The bottom of the talweg at this point is also completely vegetated and we cannot see the limit with the Urgonian. On the other hand, a little further north, we see that the Urgonian is probably uplifted and exposed by a north/south fault which cuts across the valley because it forms a step of approximately 3 m height.

The first levels here are still Urgonian with bivalves and rudists; the section continues above the Urgonian for more than several meters in height.

Throughout the section, fossils are rare on the ground, but it was possible to observe *Pseudocrioceras* sp. (not in situ) in the lower part, followed closely above by *Deshayesites* sp. The bed numbers in the log (Fig. 4) are provisional and will need to be revised once the obscured areas have been cleaned.

We can compare our provisional survey-log (Fig. 4) with the synthetic reference section. At this point, there remain differences in interpretation due to the particular lithology of the naturally eroded beds, and for which it is sometimes difficult to correctly place the limit compared to the reference log, which was taken largely on quarry working faces where the beds and interbeds do not have the same appearance as at the outcrop. The main marl level, which forms the most visual clue in the middle of the slope (our level 229-230; Fig. 3) corresponds to the TOUCAS Horizon (bed 106 of the reference section; not visible in the FABRE-TAXY log-section of 1963, between meters 30-35). The upper part can easily be correlated to bed 128, which represents the structural surface in the forest in section 13022-BGD (top of our bed 247. It is at meter 42 on the FABRE-TAXY log-section). The lower part, at the marker formed by the TOUCAS Horizon, is also largely correlatable up to our bed 225 (=104). Further down, the presence of covered sections does not allow us for the moment to be more precise. In particular, we are currently unable to precisely locate the Barremian/Aptian boundary due to an insufficient number of surface-collected ammonites, but it could likely lie within the interval spanning beds 205-207. The marl level at 204-204 could possibly correspond to the ROCH Horizon. Future work is required to remove these uncertainties.

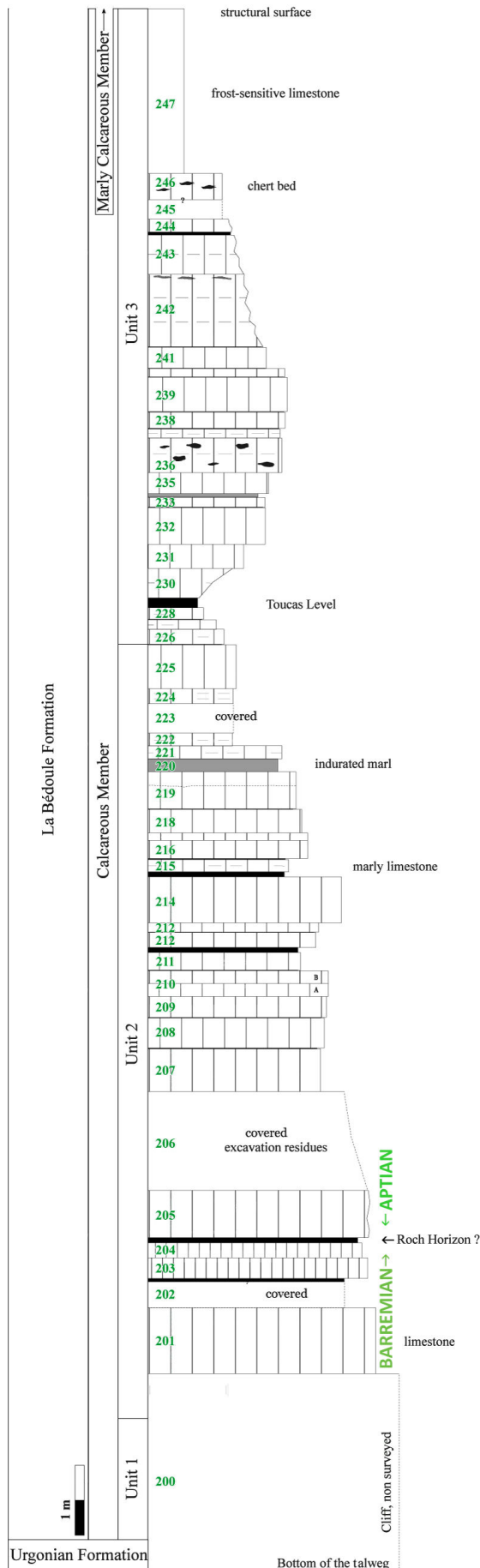


Figure 4: The log-section BGD. Bed numbers are provisional, pending new log-survey with cover removed.

From these initial observations, it appears that this section is probably one of the last that can be studied (*i.e.*, contiguous, and capable of being surveyed and sampled) in the sector of the historical Bedoulian stratotype. Although it is partly covered by debris in its lower part, future field campaigns should be able to make a complete log of the limestone member of the Bédoule Formation that contains the Barremian/ Aptian boundary, in order to propose a GSSP. It has the advantage of being on a parcel of communal land, which, in collaboration with the Town Hall of Cassis, should facilitate its long-term preservation, both against urbanization and illegal excavations conducted by amateurs.

5. The Angles area

At Cassis-La Bédoule, the genus *Deshayesites* immediately and abundantly follows, to the precise bed, the genus *Pseudocrioceras*, which marks a very clear and distinct boundary between the Barremian and Aptian stages. This succession, however, appears to be very abrupt and should be confirmed by observations in a pelagic area with sedimentation known to be regular and continuous. The area of the Barremian stratotype of Angles (ANG in Fig. 1) is now well known and was chosen because of the numerous studies that have already taken place there.

According to the literature concerning the biostratigraphy of the Barremian/Aptian boundary of the southern Vocontian area, we note that:

1. the genus *Pseudocrioceras* is reputed to be absent, or too rare for correlations to be made with the Cassis area (notable exception in DELANOY, 1997, p. 242, in the Descouère section), and other regions of the world where this genus is present (Colombia, Caucasus, *etc.*);
2. according to the work of DELANOY (1997), the ammonites become considerably rarer upwards the upper part of the Sarasini Zone (see also JANSSEN *et al.*, 2012, p. 207);
3. according to CECCA *et al.* (1998), the ammonite succession would be less complete stratigraphically than at Cassis-Roquefort-La Bédoule (*op.cit.*, p. 280; CECCA *et al.*, 1999, p. 280-284). This observation, not explained by those authors, is most likely related to the presence of a fault in the basal Aptian along the reference section of the Angles road, between beds 216 and 220 (JANSSEN *et al.*, 2012, p. 205).

Further to the first point, a work in progress (BERT *et al.*, in preparation) shows that the genus *Pseudocrioceras*, with the first occurrence of the genus *Kutatissites*, is indeed present in the area of the Barremian stratotype of Angles, in a well-defined stratigraphic unit between the *Martelites* and *Deshayesites* levels. This suggests very precise correlations between the historical Bedoulian and Barremian stratotypes are possible.

The second point must also be qualified. Even if they are not always abundant, our field research always shows the presence of ammonites.



This becomes even more obvious, as it is now possible to identify *Deshayesites* species on the basis of small specimens, provided that their ventral zone in the internal whorls is preserved (BERSAC & BERT, 2012, 2015, 2025).

Finally, although the Barremian stratotype section along the Angles' road shows a clearly visible lithological succession, it is difficult to sample. The presence of a fault may have discouraged some authors from studying it in greater depth (JANSSEN *et al.*, 2012, Pl. 24, fig. A). In the surrounding area, only a few sections have been described by DELANOY (1997) with the certain presence of the Barremian/Aptian boundary. These are at Méouilles, le Vignon, and possibly Grande-Terre. The Combe-Lambert section was described in 1965 by BUSNARDO as a complementary section to the roadside stratotype. It presents the whole lower Aptian limestone, but the boundary with the Barremian is not known (DELANOY, 1997, Fig. 129) due to cover. This section was recently revisited and exposed, which allowed observations upwards the base of the Giraudi Zone. The section, protected by the National Geological Nature Reserve of Haute-Provence, is currently under study and could be proposed as a complementary section to the GSSP of the Aptian.

6. Conclusions

The 'coupe du Brigadan' described by CECCA *et al.* (1998: Fig. 1) and ROPOLLO *et al.* (1998: Fig. 4), located 500 m north of the Villeneuve quarry, is only 6 meters thick and begins at a fault. In contrast, our Brigadan section (13022-BGD), situated just 100 m north of the Villeneuve quarry, is more developed and has a greater measured thickness, making it a strong candidate for the Aptian GSSP.

Parcel AN0103 is owned by the municipality of Cassis (Bouches-du-Rhône). According to the PLUI (Local Intercommunal Urban Plan), it is predominantly classified as zone A1 (agricultural zone), with a portion designated as zone Ns (natural zone). Numerous traces of excavation are visible across the site, some of which are fairly extensive. While most appear to be old - likely related to earlier geological work - others are clearly more recent. Several of these excavations affect multiple stratigraphic levels. A procedure to protect and preserve the entire site, in accordance with the requirements of the ICS (International Commission on Stratigraphy; COWIE *et al.*, 1986; REMANE *et al.*, 1996; GRANIER, 2025), is currently underway.

The Combe-Lambert section, in the immediate vicinity of the Barremian stratotype of the Angles road (Alpes-de-Haute-Provence), now presents a large part of the upper Barremian and the whole lower Aptian limestone. This follows recent fieldwork, which removed cover that obscured its base. Study of this section is in progress, and its location in a protected area (National Geological Nature Reserve of Haute-Provence) should allow it to be considered as an auxiliary candidate to the Aptian GSSP.

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