

*Revised lithostratigraphy of the Upper Cretaceous
(Santonian) carbonate platform succession on the
northern flank of Sant Corneli, southern Central
Pyrenees*

*Revisión de las unidades litoestratigráficas de la plataforma
carbonatada del Cretácico Superior (Santoniense) en el flanco
norte de Sant Corneli, Pirineos centro-meridionales*

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ABSTRACT

We describe a revised formal lithostratigraphy for the Sant Corneli Formation (Upper Cretaceous, Santonian) on the northern flank of the Sant Corneli Anticline, ENE of Tremp, southern Central Pyrenees. The formation comprises a carbonate platform succession, which overlies the platform deposits of the Montagut limestones, and is overlain by the basinal Herba-savina clays and marls. Five members are recognized in the formation, three of which are included in a newly defined type section in the western part of the outcrop. This section (196 m) exposes a lower and an upper tongue of the Aramunt Vell Member, separated by an eastward-thickening wedge consisting of the Sant Pere de Vilanoveta Member (new name) and overlying l'Aubagueta Member (new name). The Aramunt Vell Member comprises numerous coarsening-up cycles, each a few metres thick, of nodular silty marls and yellow-brown weathering, miliolid-rich bioclastic calcarenites. Its two tongues unite westwards to encompass the entire thickness of the formation. The Sant Pere de Vilanoveta Member contains coarsening-up cycles of coral-rich marls and marly limestones, rudist

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lithosomes and bioclastic floatstones and grainstones. The l'Aubagueta Member contains marly limestones and silty clays. Eastwards, two further members represent slope deposits that originally adjoined the platform, though now separated from it by a NW-SE trending normal fault. The Llau de Castellet Member (new name) comprises orange-brown marls and marly limestones laterally equivalent to the lower Aramunt Vell tongue. The overlying Llau de Joncarlat Member (new name) consists of white marls and marly limestones, laterally equivalent to the remaining platform units. Former names incompatible with this revised scheme, hence rejected herein, are the Carreu Formation and el Grau and Prats de Carreu members.

Keywords: carbonate platform, Cretaceous, Pyrenees, Santonian, Sant Corneli Formation, Spain.

RESUMEN

En este trabajo se presenta una revisión formal de la litoestratigrafía de la Formación Sant Corneli (Santoniense) en el flanco norte del anticlinal de Sant Corneli, al ENE de Tremp, en los Pirineos centro-meridionales. Esta formación comprende una sucesión de plataforma carbonatada que yace sobre los depósitos de plataforma de las calizas de Montagut y está cubierta por las arcillas y margas de Herba-savina. Se han reconocido cinco miembros, tres de los cuales se han incluido en una nueva serie tipo, que se localiza en la parte occidental del área de estudio. Esta serie, de 196 m de potencia, comprende la parte inferior y superior del Miembro Aramunt Vell, separadas por una cuña que se abre hacia el Este, y que está constituida por dos miembros: el Miembro Sant Pere de Vilanoveta (nombre nuevo) y el Miembro l'Aubagueta (nombre nuevo), suprayacente al anterior. El Miembro Aramunt Vell comprende numerosos ciclos granocrecientes, de pocos metros de potencia, de margas arenosas y calcarenitas bioclásticas ocreas, ricas en miliólidos. Las dos partes de este miembro se unen hacia el Oeste para abarcar toda la potencia de la formación. El Miembro Sant Pere de Vilanoveta está constituido por ciclos granocrecientes de margas ricas en corales y calizas margosas, litosomas de rudistas y grainstones y floatstones bioclásticos. El Miembro l'Aubagueta comprende calizas margosas y arcillas arenosas. Hacia el Este, aparecen dos nuevos miembros, que representan depósitos de pendiente originalmente contiguos a la plataforma. Sin embargo, en la actualidad aparecen separados de ésta por una falla normal de dirección NW-SE. El Miembro Llau de Castellet (nombre nuevo) comprende margas pardas y calizas margosas lateralmente equivalentes a la parte inferior del Miembro de Aramunt Vell. El Miembro Llau de Joncarlat (nombre nuevo), suprayacente al anterior, está formado por margas blancas y calizas margosas, lateralmente equivalentes al resto de las unidades de la plataforma. Proponemos que las unidades 'Formación Carreu' y miembros 'el Grau' y 'Prats de Carreu' sean dejadas de utilizar.

Palabras clave: plataforma carbonatada, Cretácico, Pirineos, Santoniense, Formación Sant Corneli, España

INTRODUCTION

Extensive outcrops of a Santonian carbonate platform succession on the northern flank of the Sant Corneli Anticline, near Tremp in the southern Central Pyrenees (Fig. 1), have allowed us to undertake detailed studies of the constituent lithosomes during the last few years (Gili *et al.*, 1995a, b, 1996; Gili and Skelton, 2000; Skelton *et al.*, 1995, 1997). Our objectives in those earlier works mainly concerned sedimentological and palaeoecological analysis of the rudist and coral lithosomes and their situation in the platform succession. Our current investigations seek to understand the dynamic development of this well-exposed platform in a broader geological context. To this end, an up-to-date formal revision of the existing lithostratigraphical scheme (Gallemí *et al.*, 1982), had become necessary following correction of an original miscorrelation of units across the NW-SE trending Montagut Fault in the eastern part of the study area (Fig. 2; see Gili *et al.*, 1994). Informal revisions were presented by Gili *et al.* (1995a) and Vicens *et al.* (1998), the latter also documenting biostratigraphical evidence for the entirely Santonian age of the Sant Corneli Formation. These revisions were briefly formalized by Gili *et al.* (2001), who designated a type section for the formation (which was previously lacking) and defined its constituent members, again by reference to the type section together with a supplementary type section to the East. The purpose of the present paper is to discuss this revised lithostratigraphy and its rationale in more detail. We do not intend at this stage to present a palaeoenvironmental interpretation or sequential analysis, as these are objectives of our continuing work in the area, and will be discussed in future pub-

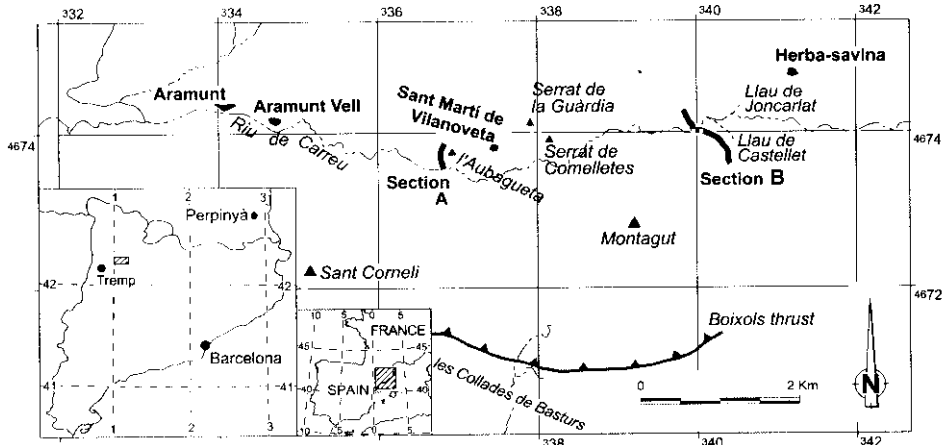


FIG. 1.- Location map.

Fig. 1.- Localización geográfica del área de estudio.

lications. Where possible, we have conserved older names, in the interests of nomenclatural stability. However, some could not be retained in the light of the revisions, and some newly named and defined members have also been proposed.

GEOLOGICAL SETTING

The Serra de Sant Corneli is the western periclinal termination of a southward verging thrust propagation anticline, related to the Boixols Thrust (Figs. 1; see also Deramond *et al.*, 1993 and Berástegui *et al.*, 1993). The platform succession described in this paper is extensively exposed along the gorge of the Riu Carreu, which flows westwards along the northern side of Sant Corneli, from a little way to the South of Vilanoveta (in full, Sant Martí de Vilanoveta) to Aramunt Vell – both villages now abandoned (Fig. 2). Further exposures occur to the South on the broad northern dipslope of Sant Corneli itself, while laterally equivalent slope deposits crop out further east, beyond the Montagut Fault, in the upstream section of the Riu Carreu, which passes along the northern side of the Serra de Montagut (Figs. 1, 2).

The succession is also considered to be broadly co-eval with similar deposits in the Collades de Basturs, on the southern side of Sant Corneli (Rosell, 1967; Gili *et al.*, 1994). Detailed correlation between the two successions has not, as yet, been proposed, but is an objective of our future work in the area.

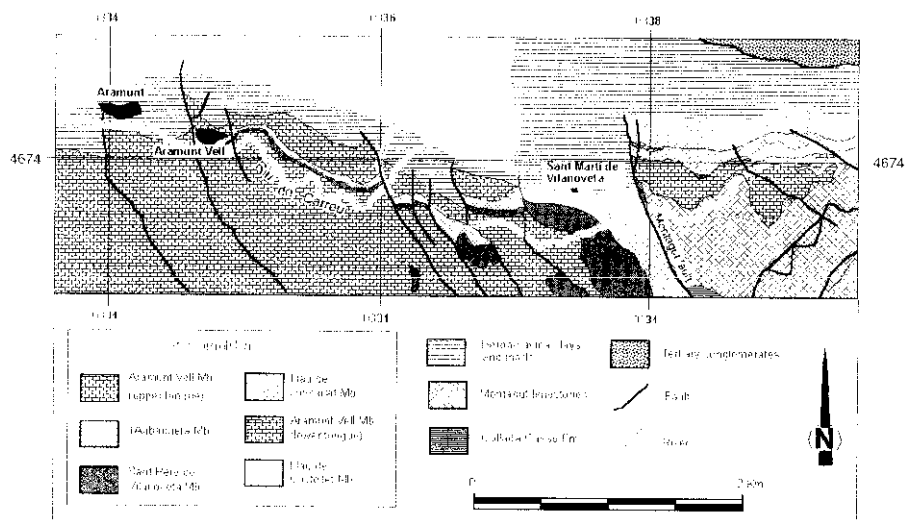


FIG. 2.- Geological map of the study area.
FIG. 2.- Mapa geológico del área de estudio.

LITHOSTRATIGRAPHY

Grid references (UTM) and names for locations are taken from the topographical map of Catalunya at 1:5000 scale, mapa topogràfic nacional (MTN) no. 252, sheets 5-7 (Aramunt; 1995) and 6-7 (Sant Martí de Vilanoveta; 1994) (Institut Cartogràfic de Catalunya).

SANT CORNELI FORMATION (SANTONIAN)

Authors. Gallemí *et al.* (1982, p. 939-940).

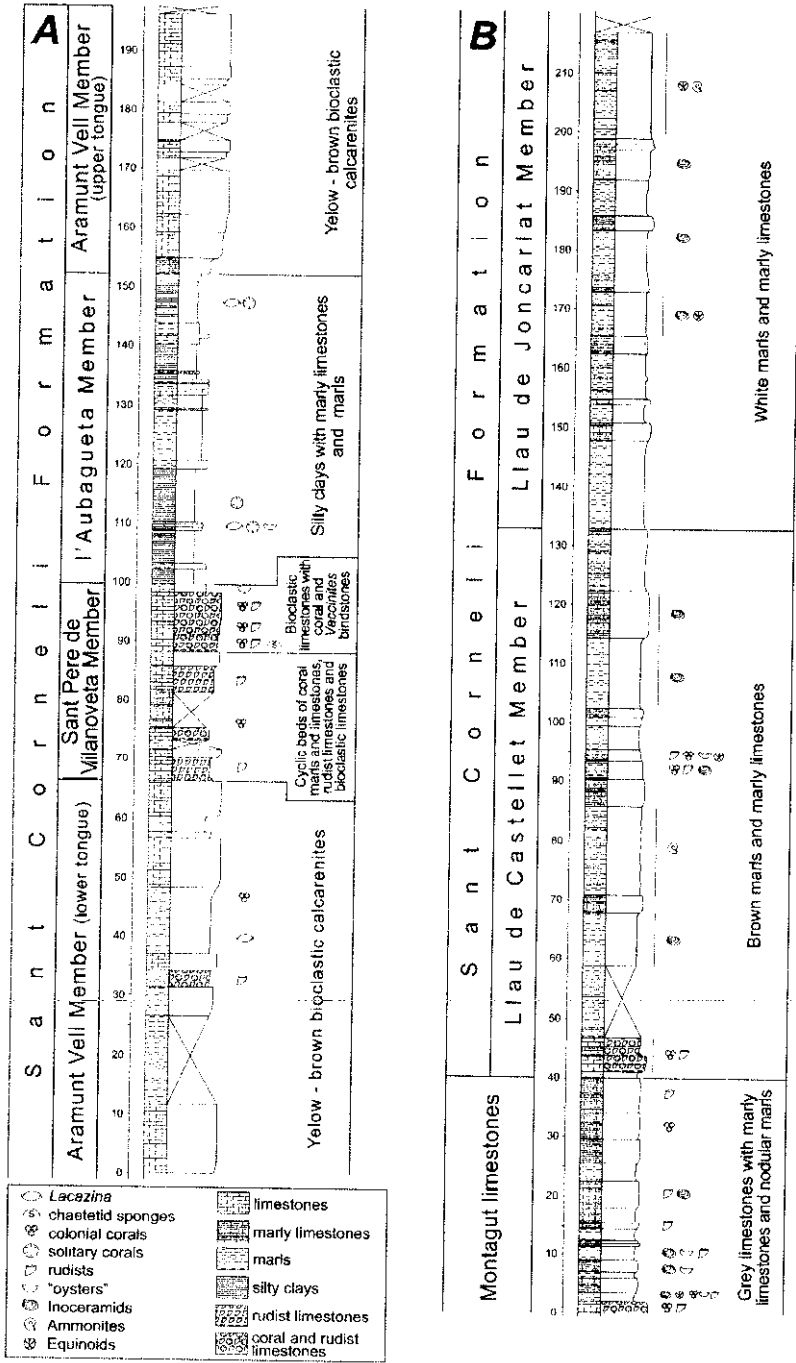
Derivation of name. The Serra de Sant Corneli forms a whaleback-shaped mountain extending eastwards from about 10km ENE of the town of Tremp (Pallars Jussà) (Fig. 1). The units described here crop out on its northern flank and further eastwards (see Geological Setting, above).

Type section. Gallemí *et al.* (1982) did not designate a type section, and nor have any subsequent workers prior to our present study. We (Gili *et al.*, 2001) selected a measured section that encompasses three out of the five constituent members of the formation as recognized herein to serve as its type (lectostratotype) section (Figs. 1, 3A). The section ascends the northern face of the river gorge of the Riu Carreu at UTM x: 336.875, y: 4.673.610 (to an approximation of 100 m), and runs to the top of the formation at the summit of the small hill called l'Aubagueta, at x: 336.855, y: 4.673.785. This section is shown in Figure 3A, and was labelled Section 4 in Gili *et al.* (1995a, Fig. 1; 1996, Fig. 1), and Section 5 in Vicens *et al.* (1998, Fig. 1).

Thickness. 196m of the Sant Corneli Formation is exposed at the type section (Fig. 3A), though its base is not exposed here (at the bottom of the gorge). However, it is likely that the base of the type section is at a relatively low level within the formation, as the contact with the underlying Montagut limestones unit (see below) can be seen further south, just over the crest of Sant Corneli, high on its southern flank.

Description of the type section (Fig. 3A) and constituent members. Three members are represented in the type section, (1) the Aramunt Vell Member, (2) the Sant Pere de Vilanoveta Member, and (3) the l'Aubagueta Member.

(1) The Aramunt Vell Member was first described by Gallemí *et al.* (1982, p. 940), though again with no designated type section. Its name derives from the abandoned village of Aramunt Vell (x: 334.625, y: 4.674.175), which is situated on a hillock of this member beside the Riu Carreu, in the western part of the study area (Figs. 1, 2). It is equivalent to 'Facies A' of Ross (1989), and the 'Aramunt Vell Calcarenites Member' of Gili *et al.* (1995a). Westwards from Aramunt Vell, this member constitutes the entire thickness of the Sant Corneli Formation, as defined here, but in the type section, further to the East, it is split into two tongues by an intercalated wedge consisting of the other two members (Fig. 4A, B). In the type section, the lower tongue is at least 66m thick (0m - 65.8m on Fig. 3A) and the upper tongue is 44m thick (151.8m - 195.8m). Both tongues consist of numerous coarsening-upwards cycles, each from a few to several metres thick (examples are clearly visi-



ble at the top of the section on the left in Fig. 4B). The cycles commence with nodular silty marls, bearing a sparse marine benthic fauna and finely comminuted plant debris, and pass up to thickly bedded, yellow-brown weathering, bioclastic calcarenites, containing abundant miliolid foraminifers and a few percent of quartz grains, and showing large-scale oblique stratification consistently directed towards the North-East.

(2) The Sant Pere de Vilanoveta Member is the new formal name for the informal 'rudist and coral unit' of Gili *et al.* (1995a). It is also equivalent to 'Facies B' of Ross (1989). It is named after the small ruined church situated beside the ruins of an unnamed castle that is perched above the cliff formed by this member on the northern side of the Riu Carreu at x: 337.350, y: 4.673.605 (Fig. 1; see also right side of Fig. 4B). In the type section for the Sant Corneli Formation, the member is 33.5m thick (65.8m - 99.3m on Fig. 3A). However, it thickens eastwards to over 70m in the vicinity of the ruined church and castle, where it extends to both lower and higher levels in the formation, interdigitating with the enclosing members (Fig. 4A). It consists of grey nodular marls and limestones, which are again arranged in coarsening-upwards cycles, each several metres thick. Complete cycles commence with coral-rich marls and marly limestones, and pass up via rudist-dominated limestones to bioclastic floatstones and grainstones (Gili *et al.*, 1995b; Skelton *et al.*, 1995). In the type section, four such cycles are visible (Fig. 3A), though more are developed in the East, while only one extends as far westwards as Aramunt Vell village.

(3) The l'Aubagueta Member is also a new formal name, for the informal 'marl and clay unit' of Gili *et al.* (1995a). It is named after a small hill (Fig. 1; see also left side of Fig. 4B), the southern flank of which contains the upper part of the Sant Corneli type section. There, the member is 52.5m thick (99.3m - 151.8m on Fig. 3A). It is a relatively recessive unit of marls, marly limestones and silty clays, with some weakly expressed cycles (especially in the lower part) each capped by a slightly more resistant nodular limestone. Westwards, it interdigitates with the prograding upper tongue of the Aramunt Vell Member (Figs. 2, 4A). Eastwards, its lower part appears to have passed laterally into the upward extension of the Sant Pere de Vilanoveta Member noted above. However, we have not been able to prove this lateral passage on the ground because of local faulting and erosion (around the field in the centre of Fig. 4B). The upper part of the member (together with the upper tongue of the Aramunt Vell Member) is erosionally truncated hereabouts (Fig. 4B, centre), but re-appears immediately to the East of the Montagut Fault, on the northern side of

FIG. 3.- (A) Synoptic log of type section for the Sant Corneli Formation, containing three of its five members (the Aramunt Vell Member is here divided into a lower and upper tongue). (B) Synoptic log of supplementary type section to the East of the Montagut Fault, showing the two basin-slope members of the Sant Corneli Formation, together with the top of the underlying Montagut limestones unit.

Thicknesses in metres. See Fig. 1 for locations.

FIG. 3.- (A) Columna estratigráfica de la serie tipo de la Formación Sant Corneli, con tres de sus cinco miembros (el Miembro Aramunt Vell está aquí dividido en una parte inferior y una superior). (B) Columna estratigráfica de la serie tipo complementaria situada al Este de la falla de Montagut, en la que aparecen los dos miembros cuyas facies han sido interpretados como de la cuenca-talud. También se representa el techo de la unidad infrayacente de calizas de Montagut. La potencia está en metros. En la Fig. 1 se señala la localización de estas series.

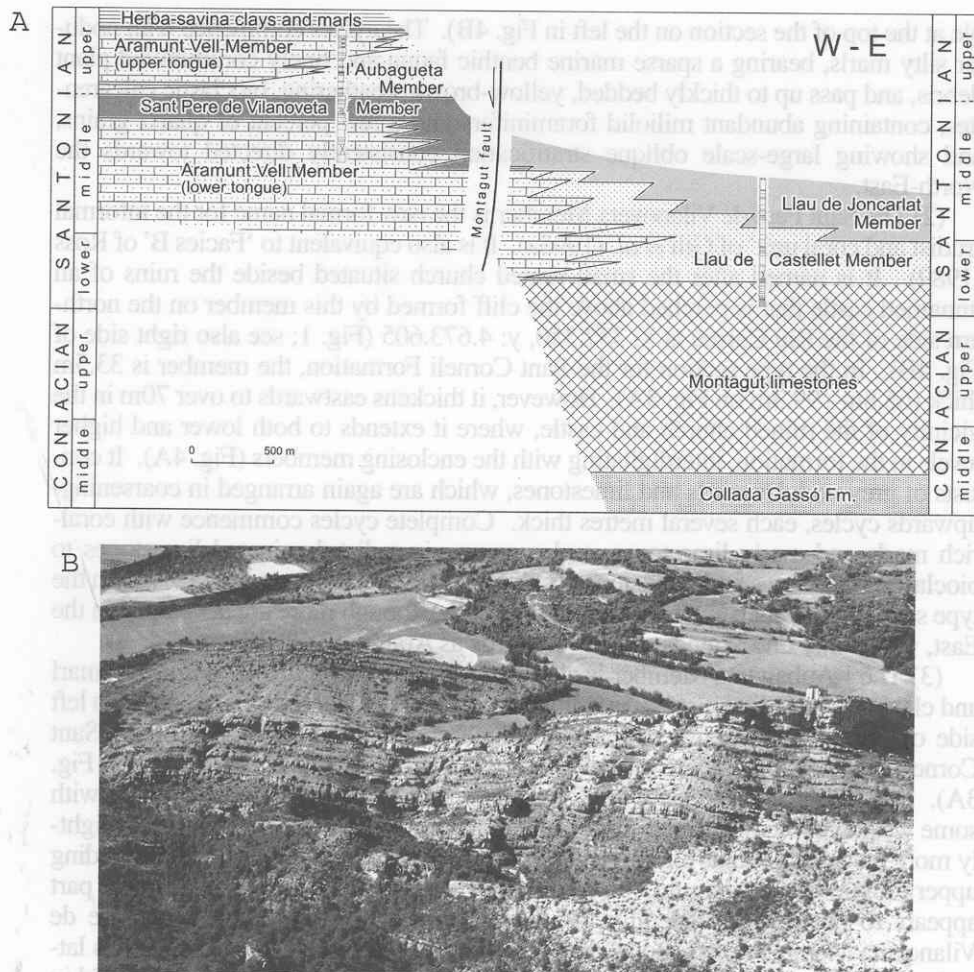


FIG. 4.- (A) Diagrammatic W-E section through the study area, approximately along the course of the Riu Carreu, showing the geometrical relationships of the five members of the Sant Corneli Formation. (B) Panoramic view (to North) of the eastern part of the Riu Carreu gorge to the North of Sant Corneli. L'Aubagueta is the small hill, behind the prominent ledge, forming the upper part of the section on the left (next to the field in the centre). The ruined castle is visible perched on the cliff-top to the right (see also Fig. 1). The limestones of the Sant Pere de Vilanoveta Member form the resistant beds approximately halfway up the section, running towards the ruined castle, while the lower Aramunt Vell Member forms the lower part of the section here. This view corresponds in large part to the left side of the scheme in (A).

FIG. 4.- (A) Diagrama de la sección W-E del área de estudio, aproximadamente a lo largo del curso del río Carreu, mostrando las relaciones geométricas de los cinco miembros de la Formación Sant Corneli. (B) Vista panorámica de la parte oriental de la garganta del río Carreu al norte de Sant Corneli. L'Aubagueta es la pequeña colina que forma la parte superior de la sección a la izquierda (cerca del campo situado en el centro), y pueden verse las ruinas del castillo en lo alto del risco a la derecha (ver también Fig. 1). Las calizas del Miembro Sant Pere de Vilanoveta forman las capas resistentes de aproximadamente la mitad superior de la sección, continuando hacia las ruinas del castillo, mientras que el Miembro Aramunt Vell inferior forma, aquí, la parte inferior de la sección. Esta vista corresponde en gran parte a la parte izquierda del esquema en (A).

the Serrat de la Guardia (Figs. 1, 2).

Together, the l'Aubagueta and the Sant Pere de Vilanoveta members form the westward-thinning wedge that splits the Aramunt Vell Member into its lower and upper tongues (Fig. 4A).

In addition to the three members cited above, two further members of the Sant Corneli Formation are recognized further to the East (Figs. 2, 3B): (4) the Llau de Castellet Member and (5) the Llau de Joncarlat Member. Their inclusion within the same formation, despite presenting contrasting facies, is justified by their interdigitating lateral relationship with tongues of the other three members that extend a short way to the East of the Montagut Fault (around the Serrat de La Guardia and Serrat de Comelletes; Fig. 1). Together, the five members thus form a single coherent depositional unit. These two remaining members are defined in a supplementary type section that runs from east of the Llau de Castellet valley on the northern flank of the Serra de Montagut (x: 340.035, y: 4.674.060), across the Riu de Carreu, and up the hillslope to the North, near the Llau de Joncarlat (x: 339.885, y: 4.674.300) (Fig. 3B; see Fig. 1 for location). This is equivalent to Section 12 in Vicens *et al.* (1998, Fig. 1).

(4) The Llau de Castellet Member is the formal name given to the informal 'brown marls and marly limestones unit' described by Vicens *et al.* (1998, p. 406). In its type section it is about 93m thick (40m - 132.8m on Fig. 3B), but it thins somewhat to the East, where it may interdigitate with the overlying Llau de Joncarlat Member. To the West, it passes laterally into the lower tongue of the Aramunt Vell Member (Fig. 2). It comprises orange-brown coloured marls and marly limestones, which become nodular towards the East.

(5) The Llau de Joncarlat Member is the formal name applied to the informal 'white marls and marly limestones unit' of Vicens *et al.* (1998, p. 406). In its type section it is at least 84m thick (132.8m - 217m on Fig. 3B), though its top is hidden by vegetated Recent scree deposits. It is only visible in the eastern part of the study area, to the East of the Montagut Fault (Fig. 2). Near the fault, it passes westwards and up with interdigitating contact to the l'Aubagueta Member (Serrat de la Guardia; see Fig. 1), though a little way to the North-East, localized exposures show overlying Herba-savina lithologies. It also locally overlies a single thin extension of the Sant Pere de Vilanoveta Member, which here caps the distal part of the lower Aramunt Vell tongue at the Serrat de Comelletes (Figs. 1, 4A, centre). Further east, it overlies the Llau de Castellet Member, though the possibility of some lateral interdigitation with the latter (as shown in Fig. 4A) is currently under investigation. It consists of creamy white marls and marly limestones, readily differentiated from the underlying units at outcrop by its white colour.

Boundaries. The lower limit of the Sant Corneli Formation is exposed to the East of the Montagut Fault, though sections in the Riu Carreu gorge to the West (including the type section; Fig. 3A) commence within the lower tongue of the Aramunt Vell Member. Nevertheless, the base of the formation can also be seen high on the southern flank of Sant Corneli, as noted earlier. At the Serrat de Comelletes (Fig. 5), a few hundred metres to the East of the Montagut Fault, the Sant Corneli Formation can be seen to overlie the Montagut limestones (see discussion below) with apparent con-

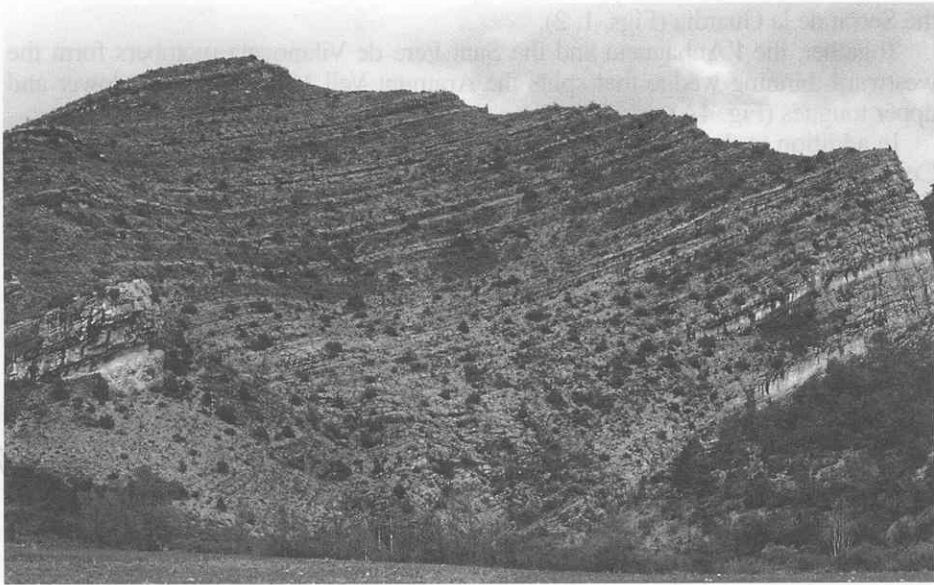


FIG. 5.- Western side of the Serrat de Comelletes (see Fig. 1 for location), showing the stepped profile of the lower Aramunt Vell Member overlying the massive Montagut limestones. The block of limestone at lower left is a slice of upper Aramunt Vell limestone enclosed within the Montagut Fault zone, which runs across the foreground.

FIG. 5.- Parte occidental del Serrat de Comelletes (ver Fig. 1 para su localización), mostrando el escarpado perfil del Miembro Aramunt Vell inferior encima de las calizas masivas de Montagut. El bloque de calizas de la parte inferior izquierda proviene de las calizas de Aramunt Vell superior y está incluido en la zona de la falla de Montagut, que pasa por el primer plano.

formity. Here, the boundary is marked by a sharp change in facies from the massive bedded blue-grey limestones, below, to the orange-brown coloured cyclic beds of the lower Aramunt Vell, above.

The top of the Sant Corneli Formation is visible in the type section, where the upper tongue of the Aramunt Vell Member is capped by a hardground, in turn overlain by the dark grey-blue Herba-savina clays and marls (Gili *et al.*, 1995a). The latter are generally recessive in outcrop, but contain thin nodular marly limestones that weather out as narrow resistant bands.

Age. According to the correlations presented by Vicens *et al.* (1998), the Sant Corneli Formation, as defined here, is contained entirely within the Santonian.

Dating of the lower boundary is based on inoceramids and ammonites found to the east of the Montagut Fault. In particular, the presence of the inoceramid *Platyceramus undulatoaplicatus michaeli* (Heinz) both in the top of the Montagut limestones unit and in the Llau de Castellet Member of the Sant Corneli Formation restricts the base of the latter to within the Lower Santonian (Vicens *et al.*, 1998, p. 408).

To the West of the Montagut Fault, foraminiferal evidence suggests that the l'Aubagueta Member ranges up into the Upper Santonian (*Dicarinella asymmetrica* Biozone; Gili *et al.*, 1996). However, the presence of Santonian ammonites (*Nowakites* sp.) still in the lower Herba-savina (Vicens *et al.*, 1998) indicates that the top of the Sant Corneli Formation remains still within the Santonian.

DISCUSSION

Gallemí *et al.* (1982, Fig. 2; see Fig. 6 herein) referred the Coniacian-Santonian strata cropping out along the northern flanks of the Serra de Sant Corneli and the Serra de Montagut to two formations. In the West, the Sant Corneli Formation was depicted as consisting of 'Montagut Member' limestones with rudists in its lower part, overlain by the Aramunt Vell Member. The Sant Corneli Formation was interpreted as being replaced laterally to the East, and overlain, by the Carreu Formation (Gallemí *et al.*, 1982, p. 943). The latter formation was divided into four members (Fig. 6). The Clot de Moreu and overlying el Grau Members were considered laterally equivalent to the Sant Corneli Formation. The Prats de Carreu Member was regarded as in part laterally equivalent in the East to el Grau, and in part overlying both it and some of the Aramunt Vell. Finally, the Herba-savina Member was depicted as overlying the Prats de Carreu member in the East and the Aramunt Vell in the West. Some of these proposed geometrical relationships of members have turned out to be based upon a miscorrelation of units across the Montagut Fault (Gili *et al.*, 1994). Revision of the lithostratigraphy in the western part was accordingly presented by Gili *et al.* (1995a) and extended eastwards by Vicens *et al.* (1998), with the adoption of several informally named units. The scheme presented here (Fig. 4A; see also Gili *et al.*, 2001) is essentially a formalization of these revised treatments. We have retained the original lithostratigraphical names of Gallemí *et al.* (1982) where possible, in the interests of nomenclatural stability, but have rejected some, which are no longer tenable in the light of the revisions.

The lithostratigraphical scheme of Gallemí *et al.* (1982; see Fig. 6 herein) did not indicate the position of the Montagut Fault and showed only a single tongue of Aramunt Vell. In the West, where the Aramunt Vell was shown immediately underlying the Herba-savina, this could only represent the upper tongue of the Aramunt Vell as recognized here (Fig. 4A, left). Both the Sant Pere de Vilanoveta Member and the lower tongue of the Aramunt Vell were evidently assigned by them to the 'Montagut Member' (Fig. 6). East of the Montagut Fault, however, only the lower tongue of the Aramunt Vell is present in the Comelletes section (Figs. 2, 4A, right), where it can be seen overlying the Montagut limestones (as noted above; Fig. 5), beside the Serra de Montagut itself. It would thus appear that Gallemí *et al.* (1982) erroneously correlated the *lower* tongue of the Aramunt Vell cropping out to the East

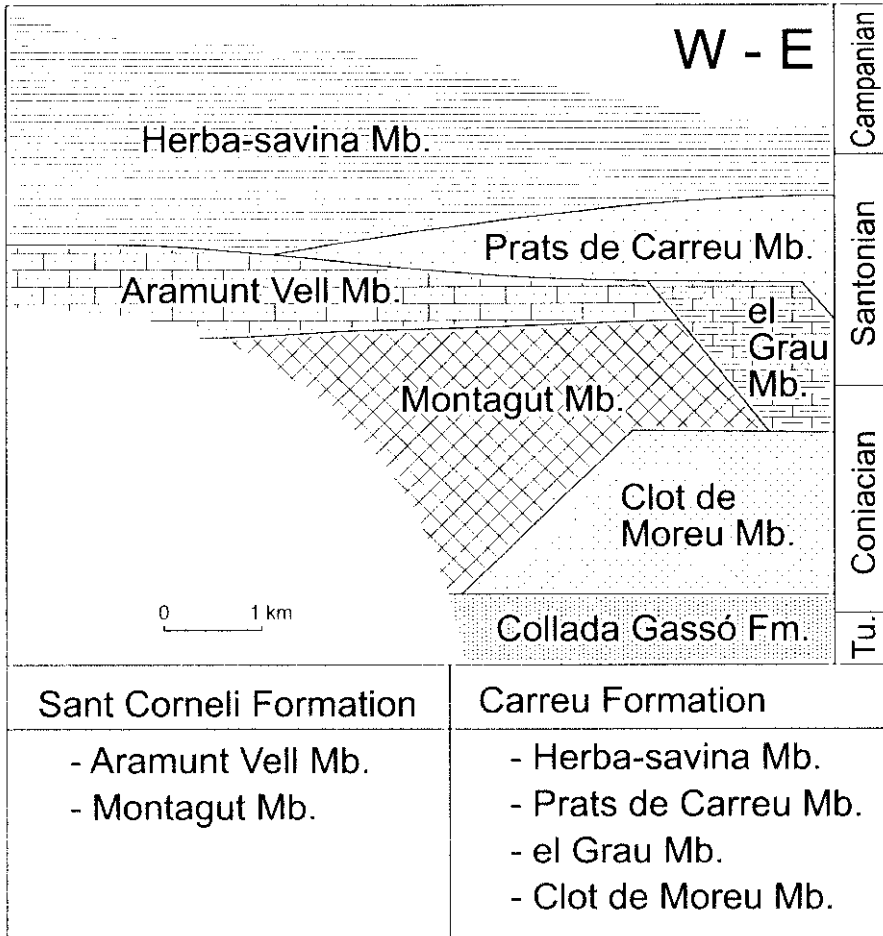


FIG. 6.- Previous lithostratigraphical scheme for the study area as proposed by Gallemí *et al.* (1982; redrawn from their Fig. 2).

FIG. 6.- Esquema litoestratigráfico del área de estudio propuesto por Gallemí *et al.* (1982; redibujado a partir de su Fig. 2).

of the Montagut Fault with the *upper* tongue, exposed to the West. Hence they supposed the Sant Pere de Vilanoveta rudist and coral beds to be laterally equivalent to the Montagut limestones exposed on the northern side of the Serra de Montagut, to the East of the fault. Their interpretation was evidently accepted by Ross (1989), who continued to refer the Vilanoveta rudist and coral beds to the 'Montagut Member'.

Gili *et al.* (1994, p. 36) first drew attention to the miscorrelation, and exclud-

ed the Vilanoveta rudist and coral beds, and the underlying Aramunt Vell facies, from the Montagut Member. Vicens *et al.* (1998) showed the corrected correlations across the Montagut Fault, and reported biostratigraphical evidence for the dating of the various units. They also combined the Montagut limestones (east of the Montagut Fault) together with the laterally equivalent el Grau and Clot de Moreu members to form a single, informally named, 'Montagut limestones unit', situated entirely beneath the lower tongue of the Aramunt Vell and its eastward extension, the 'Brown marls and marly limestones unit' (= Llau de Castellet Member, herein). The 'Montagut limestones unit' thus now comprises a stratigraphically distinct entity, underlying the Sant Corneli Formation (Fig. 4A). With further study, it would itself be a good candidate for formal status as a mappable formation.

With the exclusion of the Vilanoveta rudist and coral beds (= Sant Pere de Vilanoveta Member, herein) and lower Aramunt Vell tongue from the former 'Montagut Member' of Gallemí *et al.* (1982), the Sant Corneli Formation can now be restricted to the five members described above, all of Santonian age.

The Herba-savina is likewise recognized as a lithologically distinct unit entirely overlying the Sant Corneli Formation (Fig. 4A). With further detailed documentation, it too could qualify for formal status as a mappable formation.

One consequence of these formal revisions is that the constituent members of the former 'Carreu Formation' of Gallemí *et al.* (1982, p. 943) are now split between separate formations. The former 'el Grau Member' (in part) and 'Clot de Moreu Member' have been subsumed in the Montagut limestones unit, underlying the Sant Corneli Formation (following Vicens *et al.*, 1998). The 'Prats de Carreu Member', as well as the upper part of the 'el Grau Member', as originally defined (see below), have been included here in the Sant Corneli Formation, while the Herba-savina has been recognized as entirely overlying the latter. Since a formation name cannot be applied to any one of its former constituents when it is subdivided (Hedberg, 1976), the name 'Carreu Formation' is hereby suppressed.

For the same reason, the former 'el Grau Member' can no longer be retained. Vicens *et al.* (1998, p. 406) included it entirely within their 'Montagut limestones unit'. However, the original definition of the member by Gallemí *et al.* (1982, pp. 944-5), although lacking a designated type section, describes it as being laterally equivalent to part of their 'Prats de Carreu Member' in the east. It was also stated to be in lateral contact with the Sant Corneli Formation to the west, and their scheme (Gallemí *et al.*, 1982, Fig. 2; see Fig. 6) shows its upper part passing laterally into the Aramunt Vell. Moreover, their description refers to the upper part of the 'el Grau' as consisting of calcarenites interbedded with argillaceous beds. It thus seems that the 'el Grau', as originally conceived, straddled the boundary between the Montagut limestones, below, and the Sant Corneli Formation, as now defined, above (i.e. comprising a part, at least, of the present Llau de Castellet Member). However, the lack of an originally designated type section left its limits somewhat vague. Consequently, we also propose suppression of the for-

mer 'el Grau Member' of Gallemí *et al.* (1982).

The former 'Prats de Carreu Member' of Gallemí *et al.* (1982, p. 944) suffers from a similar vagueness of definition, and, although it would appear to include the present Llau de Joncarlat Member, the extent of its overlap with the present Llau de Castellet Member remains unclear. Again, therefore, we propose suppression of the former 'Prats de Carreu Member' of Gallemí *et al.* (1982), in favour of the members defined more explicitly here by reference to type sections.

The lithostratigraphical scheme summarized in Fig. 4A, formally proposed in Gili *et al.* (2001) and discussed further herein, now provides an unambiguous and clearly defined descriptive basis for continuing work on the sedimentary anatomy and development of the excellently exposed platform and slope deposits of the Sant Corneli Formation.

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