

Devonian of the Aran Valley Synclinorium, Central Pyrenees, Spain: stratigraphical and paleontological data.

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ABSTRACT

In the Aran Valley Synclinorium, situated in the Axial Zone of the Pyrenees, a Devonian succession crops out. This succession has been studied in three localities, two on its southern limb and one on the northern one. These series can be correlated and show the sharp lithological changes occurring in the Devonian of this area, with a predominance of sandstones towards the North and an important development of limestones towards the South.

The paleontological study has allowed, on the basis of conodonts, to date several levels in the two sections on the southern limb; in one of them the Middle- Upper Devonian boundary has been traced fairly accurately. Anomalous faunal distributions have been detected in some of the successions and it is suggested that they are related to the existence of thrusts. However, other processes such as folding or sedimentary reworking, cannot be rejected.

Key-words: Pyrenees. Devonian. Conodonts.

RESUMEN

En el Sinclinorio del Valle de Arán (Zona Axial pirenaica), afloran unos materiales de edad devónica, los cuales han sido estudiados en tres áreas diferentes, dos en el flanco Sur, y una en el flanco Norte de esta estructura. La correlación de estas sucesiones estratigráficas, pone de manifiesto la existencia de importantes cambios litológicos, siendo predominantes las areniscas en la zona Norte y las calizas en la Sur.

Se ha realizado un estudio paleontológico de estas series, a partir de conodontos. En el sector Sur, se ha podido precisar la edad de los materiales en varios niveles, llegándose a establecer el límite Devónico Medio- Superior. En algunas sucesiones se ha podido detectar la existencia de distribuciones faunísticas anómalas, las cuales han sido interpretadas como resultado de cabalgamientos. Sin embargo, otros procesos, tales como resedimentación no son excluidos.

Palabras clave: Pirineos. Devónico. Conodontos.

RESUM

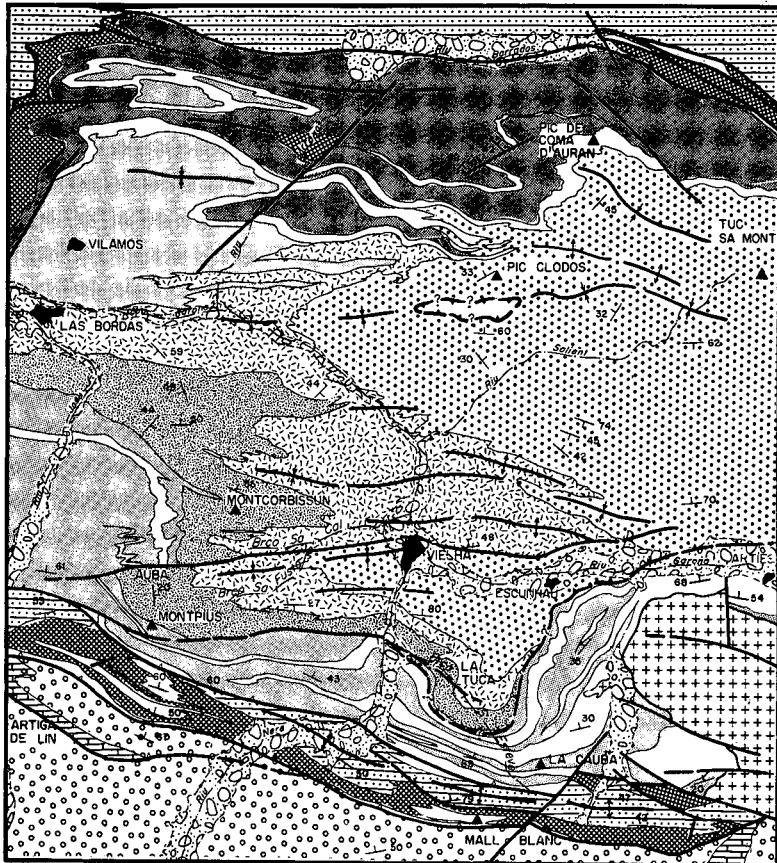
En el Sinclinori de la Vall d'Aran (Zona Axial pirenenca), afloren uns materials d'edat devoniana, que han estat estudiats en tres àrees diferents, dues al flanc Sud i una al flanc Nord d'aquesta estructura. La correlació d'aquestes dues successions estratigràfiques posa de manifest l'existència d'importants canvis litològics, essent predominants els gresos a la zona Nord i les calcàries a la Sud.

Hom ha realitzat un estudi paleontològic d'aquestes sèries a partir de conodonts. Al sector Sud hom ha pogut precisar l'edat dels materials en diversos nivells, i s'ha establert el límit Devonià Mig-Superior. En algunes successions hom ha pogut detectar l'existència de distribucions faunístiques anòmales, que han estat interpretades com a resultat d'encavalcaments. Amb tot, altres processos com ara la resedimentació no poden ésser encara exclosos.

Mots clau: Pirineus. Devonià. Conodonts.

INTRODUCTION

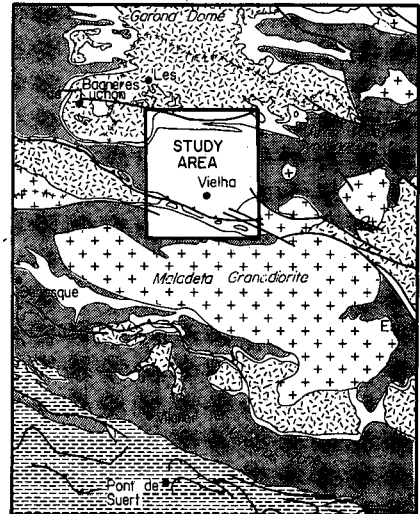
Devonian rocks cropping out in the Aran Valley Synclinorium (Zwart, 1979; Snoep, 1956; Kleinsmiede, 1960), situated in the Axial Zone of the Pyrenees, have been studied at three different localities (Fig. 1), two of them are in the southern limb of this large Synclinorium (Montpius-Montcorbissun and Tüca sections) and the other one in the northern limb (Sa Mont section). This paper refers to the existence of major lithological changes, and especially to the large amount of limestones found in the Tüca section, which is situated in the southeastern part of the area. This character differs from the great development of sandstones which appear in the rest of the Devonian sections of the Aran Valley.



LEGEND

- Undifferentiated Quaternary
- (Carboniferous) Greywackes and shales
- Limestones Uppermost Devonian and Lowermost Carboniferous
- Green shales, sandstones with sparse limestones (Riu Nere Beds)
- Quartzarenites and shales (Sa Cal Beds)
- Sandstones (Auba Beds), shales and limestones (Montcorbissun Beds)
- Limestones and shales (Entecada and La Tuca Series) and Basal Limestone
- Shales and limestones (Barrados Beds) and Auran Limestone on top
- Black shales (Silurian)
- Slates, sandstones and limestones (Cambro-Ordovician)
- Granodiorites

0 2 4 Km



LEGEND

- Cambro-Ordovician
- Silurian
- Devonian-Carboniferous
- Granodiorites
- Mesozoic-Cenozoic

0 10 Km

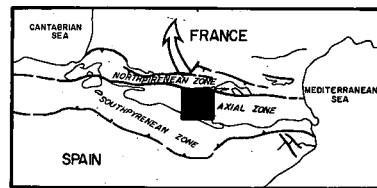


Figure 1.- Geological map of the Aran Valley Synclinorium.

Figura 1.- Mapa geológico del Sinclinorio del Valle de Arán.

In this work, micropaleontological sampling of conodonts has been carried out. The conodonts are potentially optimal biostratigraphic indicators in an area where fossils are very scarce. Their study has allowed the dating of several levels of the two sections located in the southern limb of the Synclinorium. In addition, the Middle-Upper Devonian boundary has been accurately located in one of them.

Anomalous faunal distributions have been detected

in some of the successions. Although other causes are not rejected, they are interpreted here as resulting from thrusts, whose significance is still not constrained.

MONTPIUS-MONTCORBISSUN SECTION

This section (Fig. 2), located to the SW of the Aran Valley Synclinorium, was described by Kleinsmiede

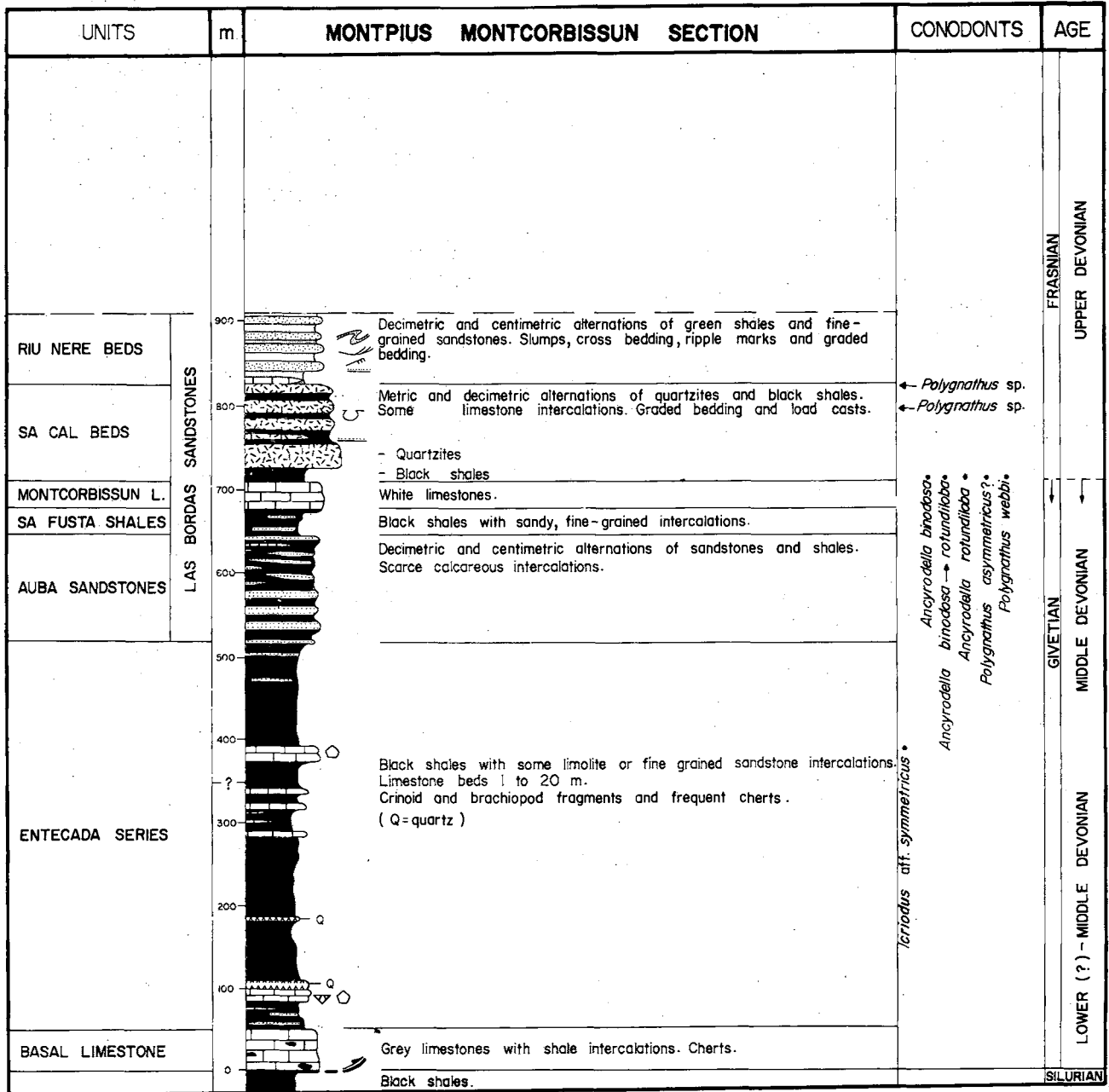


Figure 2.- Stratigraphic column and biostratigraphic data of the Devonian succession of the western part of the southern limb of Aran Valley Synclinorium.

Figura 2.- Columna estratigráfica y datos bioestratigráficos de la sucesión devónica de la parte occidental del flanco Sur del Sinclinorio del Valle de Arán.

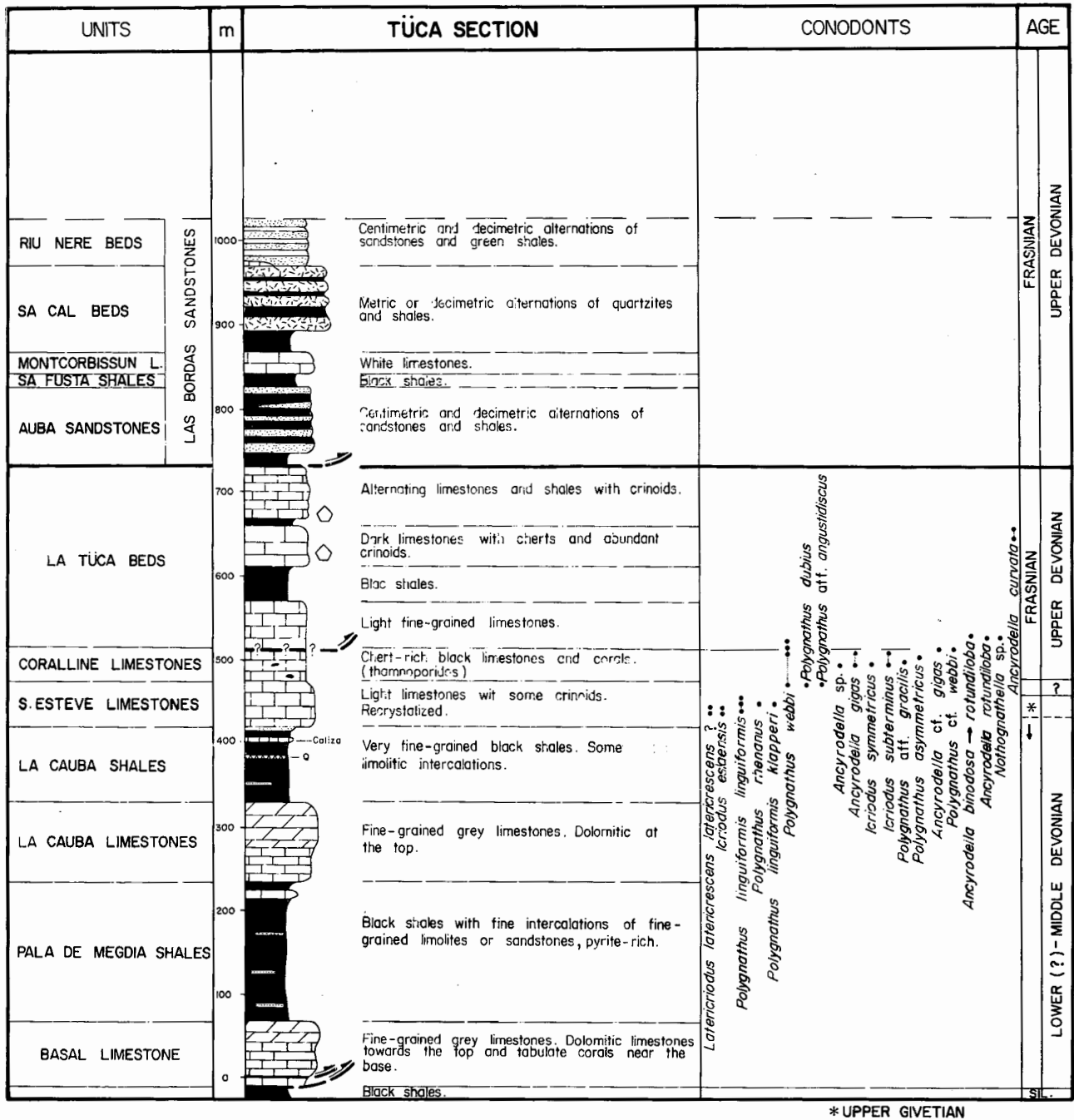


Figure 3.- Stratigraphic column and biostratigraphic data of the Devonian succession of the central part of the southern limb of Aran Valley Synclorium.

Figura 3.- Columna estratigráfica y datos bioestratigráficos de la sucesión devónica de la parte central del flanco Sur del Sincloriorio del Valle de Arán.

(1960) and was used as a pattern to define the Central facies area of the Devonian of the Pyrenees (Zwart, 1979). A subsequent study of the area (García-Sansegundo, in press) has resulted in a more detailed section (Fig. 2).

The Basal Limestone is situated directly over the Silurian shales. Since the contact is fractured it is not known whether the series is conformable with the underlying units.

The most relevant conodont fauna of the Montpius- Montcorbissun succession was found at the top of the Montcorbissun limestone; it represents the basal part of the Lower *P. asymmetricus* Zone and allows to date these rocks as lowest Frasnian.

The last calcareous bed in the Entecada series contains *Icriodus* aff. *symmetricus*. Similar forms were identified by Raven (1983) and García-López (1987) within the Upper Givetian of the Cantabrian

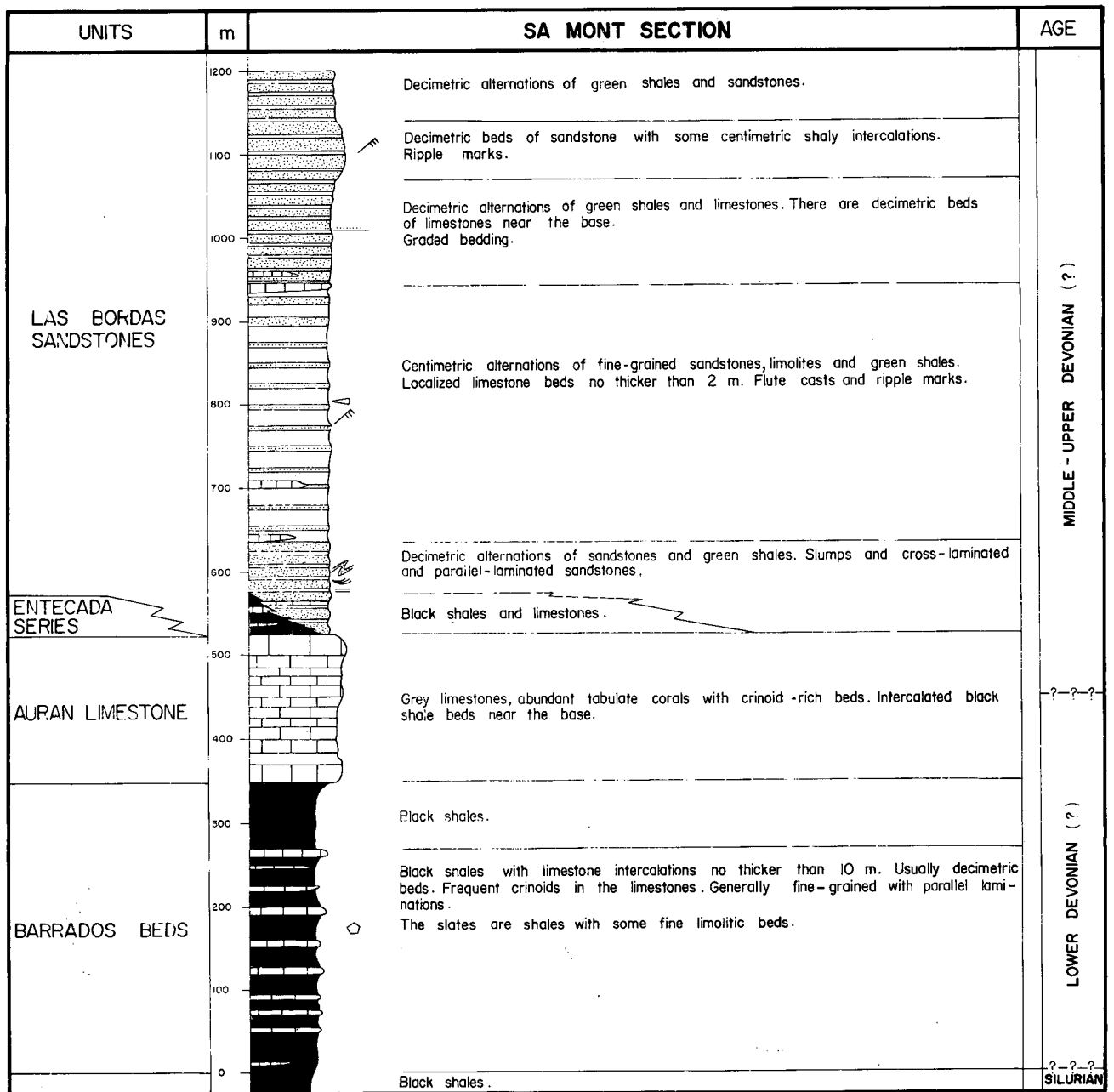


Figure 4.- Stratigraphic column of the Devonian succession of the northern limb of Aran Valley Synclinorium.

Figura 4.- Columna estratigráfica de la sucesión devónica del flanco Norte del Sinclinorio del Valle de Arán.

Zone (Hercynian Belt, NW Spain). This calcareous bed in the Entecada series is very likely to be of Upper Givetian age because also *Polygnathus dengleri* was found in it by Buchroithner (1978).

mestones in this section is remarkable. This fact had not been pointed out before, and is important because limestones are not present in the other sections, where shales and sandstones are the predominant rocks.

TUCA SECTION

This section (Fig. 3) is located in the South of the study area, and corresponds to that described by García-Sanseguendo (in press). The presence of li-

In order to determine the amount of conodonts present in the succession more than 100 samples were analysed. In some cases the results have been positive. Although the conodonts were often corroded or deformed, a certain number of forms have been identified,

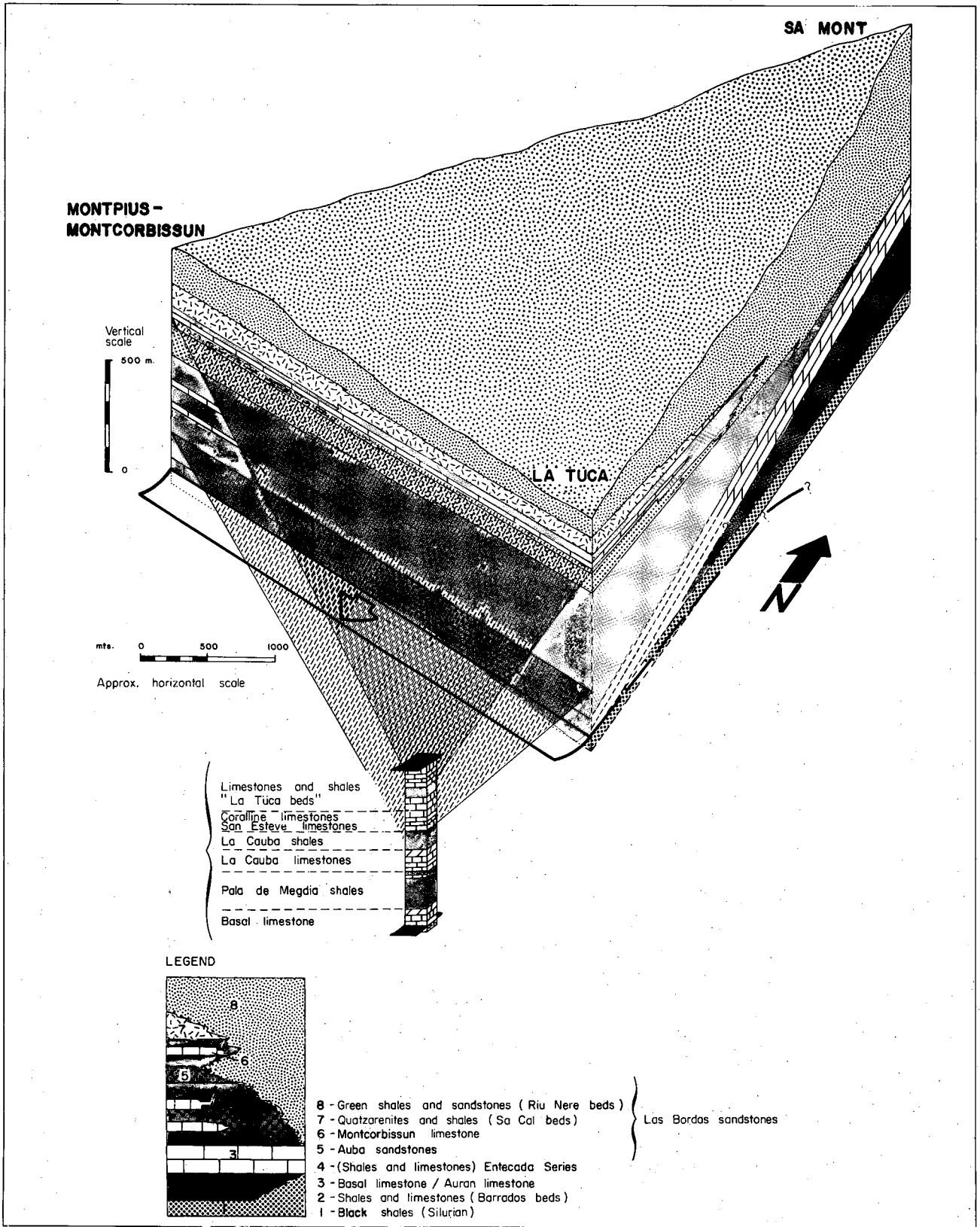


Figure 5.- Correlation chart showing the lithostratigraphic units of the Devonian succession of the Aran Valley Synclinorium.

Figura 5.- Panel de correlación en el que se muestran las unidades litoestratigráficas de la sucesión Devónica del Sinclinorio del Valle de Arán.

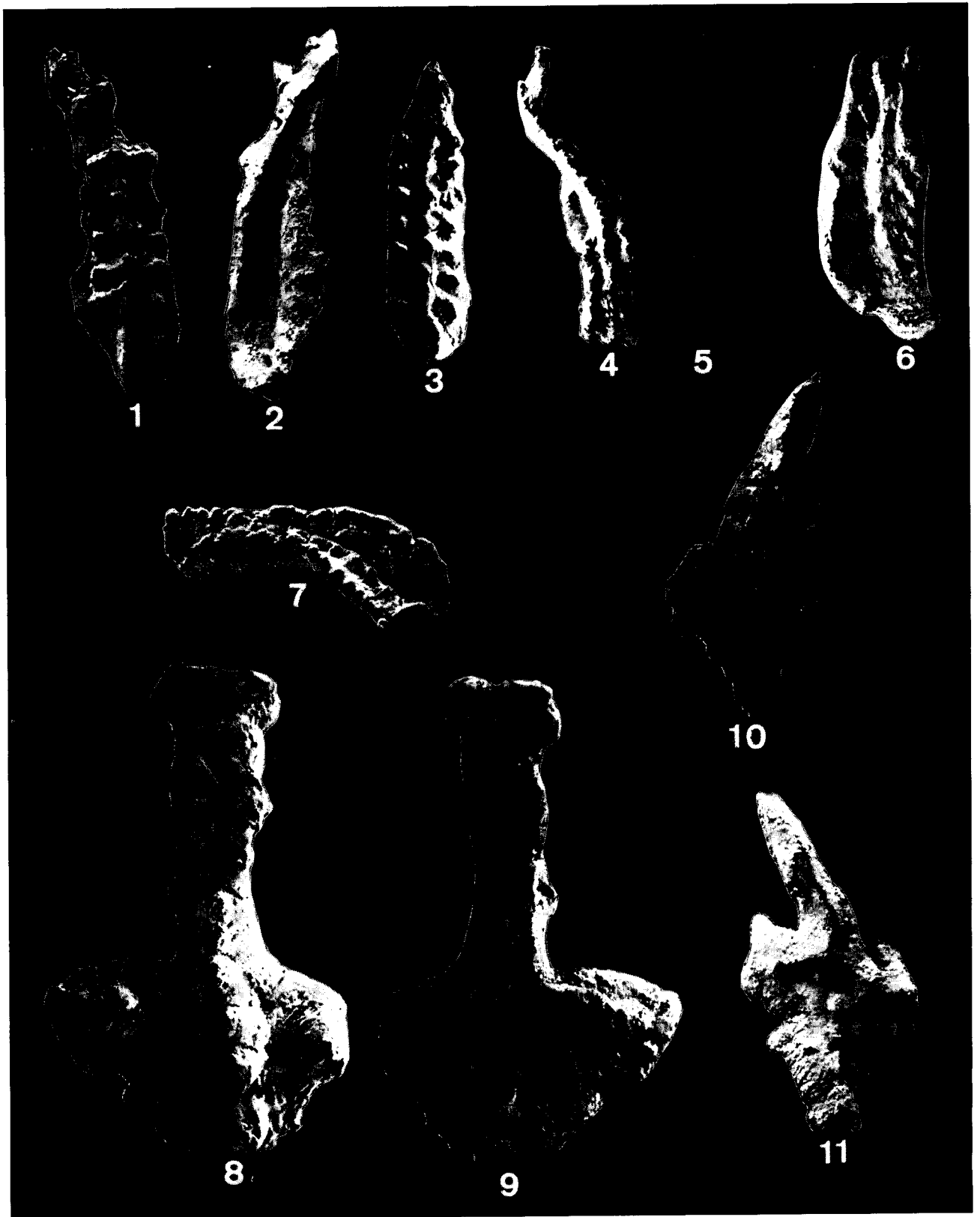


PLATE 1
LAMINA 1



PLATE 2
LAMINA 2



PLATE 3

LAMINA 3

PLATE 1

- 1-2.- *Icriodus* aff. *symmetricus* BRANSON & MEHL.
Montpius-Montcorbissun section, level MP-2. 1: oral view and
2: aboral view (x 70).
- 3.- *Icriodus symmetricus* BRANSON & MEHL
Tüca section, level TU-41. 3: oral view (x 70).
- 4-5.- *Polygnathus rhenanus* KLAPPER, PHILIP & JACKSON
DPO 114113. Tüca section, level TU-32. 4: oral view and 5:
aboral view (x 70).
- 6.- *Polygnathus linguiformis klapperi* CLAUSEN, LEUTERITZ
& ZIEGLER
Tüca section, level TU-33. 6: oral view (x 70).
- 7.- *Polygnathus linguiformis linguiformis* HINDE
Tüca section, level TU-34. 7: oral view (x 70).
- 8-11.- *Ancyrodella binodosa* UYENO
Montpius- Montcorbissun section, level AL-839 D. 8: oral view
and 9: aboral view (x 150).
Montpius- Montcorbissun section, level AL-839 D. 10: oral
view and 11: aboral view (x 70).

PLATE 2

- 1-7.- *Ancyrodella binodosa* → *A. rotundiloba*
114118. Montpius- Montcorbissun section, level AL-839 D. 1:
oral view and 2: aboral view (x 70).
Montpius- Montcorbissun section, level AL-839 D. 3: oral view
and 4: aboral view (x 70).
Tüca section, level TU-45. 5: oral view and 6: aboral view (x 70).
Tüca section, level TU-45. 7: oral view (x 70).
- 8-9.- *Ancyrodella rotundiloba* (BRYANT)
Montpius- Montcorbissun section, level AL-839 D. 8: oral view
and 9: aboral view (x 70).

PLATE 3

- 1-2.- *Ancyrodella rotundiloba* (BRYANT)
DPO 114123. Montpius- Montcorbissun section, level AL-839
D. 1: oral view (x 35).
DPO 114124. Tüca section, level TU-44. 2: oral view (x 35).
- 3-6.- *Ancyrodella gigas* YOUNGQUIST
DPO 114125. Tüca section, level TU-41. 3: oral view and 4:
aboral view (x 35).
DPO 114126. Tüca section, level TU-42. 5: oral view and 6:
aboral view (x 70).
- 7-9.- *Ancyrodella curvata* (BRANSON & MEHL)
DPO 114126. Tüca section, level TU-57. 7: oral view (x 70).
DPO 114127. Tüca section, level TU-59. 8: oral view and 9:
aboral view (x 70).

LÁMINA 1

- 1-2.- *Icriodus* aff. *symmetricus* BRANSON & MEHL
Columna estratigráfica de Montpius- Montcorbissun, nivel MP-
2. 1: vista oral y 2: vista aboral (x 70).
- 3.- *Icriodus symmetricus* BRANSON & MEHL
Columna estratigráfica de la Tüca, nivel TU-41. 3: vista oral (x 70).
- 4-5.- *Polygnathus rhenanus* KLAPPER, PHILIP & JACKSON
Columna estratigráfica de la Tüca, nivel TU-32. 4: vista oral y
5: vista aboral (x 70).
- 6.- *Polygnathus linguiformis klapperi* CLAUSEN, LEUTERITZ
& ZIEGLER
Columna estratigráfica de la Tüca, nivel TU-33. 6: vista oral (x 70).
- 7.- *Polygnathus linguiformis linguiformis* HINDE
Columna estratigráfica de la Tüca, nivel TU-34. 7: vista oral (x 70).
- 8-11.- *Ancyrodella binodosa* UYENO
Columna estratigráfica de Montpius- Montcorbissun, nivel AL-
839 D. 8: vista oral y 9: vista aboral (x 150).
Columna estratigráfica de Montpius- Montcorbissun, nivel AL-
839 D. 10: vista oral y 10: vista aboral (x 70).

LÁMINA 2

- 1-7.- *Ancyrodella binodosa* → *A. rotundiloba*
Columna estratigráfica de Montpius- Montcorbissun, nivel AL-
839 D. 1: vista oral y 2: vista aboral (x 70).
Columna estratigráfica de Montpius- Montcorbissun, nivel AL-
839 D. 3: vista oral y 4: vista aboral (x 70).
Columna estratigráfica de la Tüca, nivel TU-45. 5: vista oral y 6:
vista aboral (x 70).
Columna estratigráfica de la Tüca, nivel TU-45. 7: vista oral (x 70).
- 8-9.- *Ancyrodella rotundiloba* (BRYANT)
Columna estratigráfica de Montpius- Montcorbissun, nivel AL-
839 D. 8: vista oral y 9: vista aboral (x 70).

LÁMINA 3

- 1-2.- *Ancyrodella rotundiloba* (BRYANT)
DPO 114123. Columna estratigráfica de Montpius- Montcorbissun,
nivel AL-839 D. 1: vista oral (x 35).
DPO 114124. Columna estratigráfica de la Tüca, nivel TU-44. 2:
vista oral (x 35).
- 3-6.- *Ancyrodella gigas* YOUNGQUIST
DPO 114125. Columna estratigráfica de la Tüca, nivel TU-41. 3:
vista oral y 4: vista aboral (x 35).
DPO 114126. Columna estratigráfica de la Tüca, nivel TU-42. 5:
vista oral y 6: vista aboral (x 70).
- 7-9.- *Ancyrodella curvata* (BRANSON & MEHL)
DPO 114126. Columna estratigráfica de la Tüca, nivel TU-57. 7:
vista oral (x 70).
DPO 114127. Columna estratigráfica de la Tüca, nivel TU-59. 8:
vista oral y 9: vista aboral (x 70).

they allow, in some cases, very accurate dating and age assessments for most of the series. The boundary between the Givetian and Frasnian can be located (as shown in Fig. 3) within the Sant Esteve Limestones.

Anomalous faunal superpositions have been found in the conodont faunas. Thus, towards the middle part of the Tüca beds, samples containing *Ancyrodella curvata* are observed. This species begins in the Upper *P. asymmetricus* Zone, obviously younger than the Montcorbissun Limestone dated in the Montpius-Montcorbissun section, and which crops out here above the beds containing *A. curvata*. It is assumed that the Montcorbissun Limestone has the same age approximately in the two sections because of the proximity of both sectors and the absence of important tectonic structures. This anomalous faunal distribution can be explained by the existence of a thrust. The metamorphism and high deformation suffered by the rocks made it difficult to locate this possible thrust. Other possibilities such as sedimentary reworking or a diachronism between the units of both sections can not be rejected. Another example of anomalous faunal superposition is that found at the top of the Coralline limestones where *Ancyrodella gigas* occurs under *Ancyrodella binodosa* → *A. rotundiloba*.

SA MONT SECTION

This series was studied in the northern limb of the Aran Valley Synclinorium (Fig. 4). The only biostratigraphic data available are from an outcrop in the Las Bordas sandstones, situated nearby. At this locality a deposit of solitary corals was found, and *Angustiphyllum cuneiforme* ALTEVOGT and *Pleurodictyum* ? sp. were identified. The first species was considered until now as an autochthonous form in the Cantabrian Zone (Hercynian belt, NW Spain), where it is situated in the Upper Eifelian (Soto, pers. com.).

The Barrados Beds, located between the Silurian black shales and the Auran Limestone, consist of black shale alternations apparently equivalent, from a lithological point of view, to those in the Entecada Series (Montpius- Montcorbissun section). The Auran Limestone is a grey limestone with abundant tabulate corals and crinoids. In an intermediate area between the Sa Mont section and the Montpius- Montcorbissun section, a thick bed of limestones has been found overlying the Riu Nere Beds. These limestones are lithologically similar to the Auran Limestone. They contain *Polygnathus linguiformis linguiformis* and *Icriodus* sp., conodonts whose age encompasses the Upper Eifelian- Lower Frasnian interval. To the East of the study area, near the southern Garona Dome (Fig. 1), limestone beds equivalent to the Auran level are present, and they have been dated as Givetian- Frasnian in age (J. Sanz pers. com.).

CORRELATION OF THE SERIES

A lithostratigraphic correlation of the three series is presented in figure 5, taking into account the chronostratigraphic data. The Las Bordas sandstones in the Tüca section have not been included in the correlation chart because, as it has already been pointed out, a thrust may have superimposed the Las Bordas Sandstones over the La Tüca Beds.

On the other hand, the southern columns, partially correlated and dated on the basis of lithostratigraphic and biostratigraphic data, are also correlated to the column located in the North, which is not dated. The age of the Auran limestone is the same as the Montcorbissun Limestone. Thus, the Auba Sandstones disappear towards the North. The Sa Cal and Riu Nere Beds are laterally equivalent to the sandstones and green shales of the Sa Mont succession, and the Basal Limestone does not exist in the northern area.

COMPARISON WITH OTHER AREAS

Two sections that are situated to the west of the Aran Valley Synclinorium can be compared with those described in this paper. They are the Agudes-Cap de Pales Series (Krylatov & Stoppel, 1969) and the Sia Series (Mirouse, 1966), revised and dated by Krylatov and Stoppel (1971). From a lithostratigraphic point of view the highest beds of the Sia Series [DT1-DT5, Krylatov & Stoppel, 1971] and the upper part of the Agudes-Cap de Pales Series (E2- E6, Krylatov & Stoppel, 1969, 1971)] are equivalent to Riu Nere Beds.

The lower part of the Agudes-Cap de Pales series (E1) and the lower part of Sia series are lithologically equivalent to the Sa Cal beds. The oldest sampling of E1 corresponds to the lower part of the Lower *P. asymmetricus* Zone. This agrees with the age attributed in this paper to the limestones at the top of the Montcorbissun unit (located at the base of Sa Cal beds). If this correlation is correct, it would confirm the age of the upper part of the Montcorbissun limestone and therefore the evidence of an anomalous faunal superposition in the Tüca section.

CONCLUSIONS

- Three representative stratigraphic sections of the Devonian have been studied in the Aran Valley Synclinorium. A lithostratigraphic correlation chart is suggested for these successions.

- Micropaleontological samples of conodonts have been studied, and several levels of the two sections

have been dated (Montpius- Montcorbissun and La Tüca sections). In the Montpius- Montcorbissun section the last calcareous bed in the Entecada Series can be attributed to the Upper Givetian. The age of the top of the Montcorbissun Limestone is lowest Frasnian. In the Tüca section the Middle- Upper Devonian boundary is located within the Sant Esteve Limestone. Most of the lower half of this unit is Upper Givetian. The upper part of Sant Esteve limestone, the Coralline limestones and the greater part of the Tüca Beds are Frasnian in age.

- Anomalous faunal distributions have been detected in the Tüca section and they are suggested to be related to the presence of thrusts. Other processes, such as sedimentary reworking, have not been rejected.

- A litho- and biostratigraphic comparison between the sections of the Aran Valley Synclinorium and two sections located to the west (Agudes-Cap de Pales Series and Sia Series) can be made.

ACKNOWLEDGEMENTS

We acknowledge Drs. F. Soto, A. Pérez Estaun, J. García- Alcalde and the ITGE Geology Group at Jaca for helpful criticism and comments on this paper. We also thank P.J. Hogan, A. Ojanguren and A. Teixell for the English revision of the original manuscript. This work was funded by ITGE.

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