

THE CALDAS FORMATION,  
A NEW DEVONIAN UNIT IN LEON (SPAIN)

BY

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ABSTRACT

The Caldas Formation is introduced to denote a largely terrigenous sequence in the predominantly carbonate facies of the Leonesian basin in Upper Emsian and Lower Couvinian time. Some lithological and palaeontological details of the type section of the Caldas Formation are given. The Caldas Formation rests conformably on the La Vid Formation and is unconformably overlain by the Ermitage Formation.

INTRODUCTION

The Devonian stratigraphy of the southern slope of the Cantabrian Mountains (northwestern Spain) has been established in its main lines by Comte (1959). During more detailed surveys, carried out by students of the Geological and Mineralogical Institute in Leiden, under the guidance of Prof. L. U. de Sitter (structural geology) and Prof. A. Brouwer (stratigraphy and palaeontology) a Devonian sequence was discovered in the vicinity of Caldas de Luna which differs markedly from the general succession between the rivers Luna and Esla as described by Comte. This different development has been called Caldas Formation.

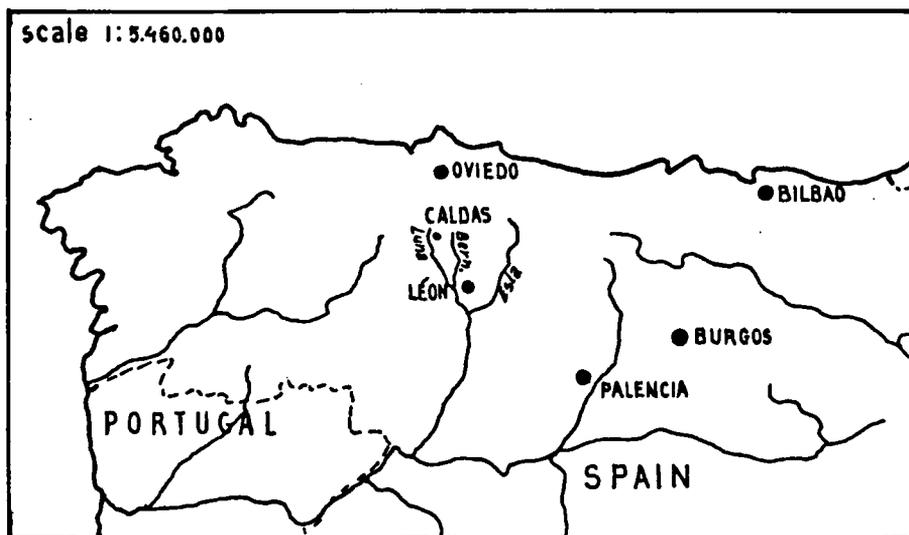


Fig. 1. Situationmap.

The Caldas Formation is called after the village of Caldas de Luna, about 70 km northwest of the city of León in northwestern Spain. The type section is found some 1,5 km northeast of the village of Caldas de Luna, above the path along the right bank of the Rio de las Caldas (see fig. 2 and 3). The Caldas Formation consists of an alternation of limestone beds and shales. In the Caldas region several outcrops make it possible to compare different sections in order to study the lateral relationships in the Caldas Formation. Figure 4 gives an isometric stratigraphic diagram to show these relationships.



Fig. 2. Type section of the Caldas Formation. On the right slope the two members of this formation are clearly visible.

#### DESCRIPTION OF THE TYPE SECTION

The base of the Caldas Formation is formed by a thick limestone bed, containing stromatoporoids, laying directly on a shale-limestone sequence of the La Vid Formation.

#### *Caldas Formation*

##### Argillaceous Limestone Member

- Unit 1 Limestone, light- to dark grey and brownish, fine-grained. With some very tough, yellow-weathering limestone bands, intercalated with marls. In the basal layers stromatoporoids and brachiopods . . . . . 38 m
- Unit 2 Calcareous shales with yellow-weathering bands of argillaceous limestone, 20-30 cm thick, some brecciated. Shale is grey, brown or yellow. This sequence yields fine examples of mudcracks in thinly laminated argillaceous limestone . . . . . 40 m



Unit 3 Limestone, dark grey, rather coarse grained . . . . .	4 m
Argillaceous limestone layers in calcareous shale, badly exposed. . . . .	12,5 m
Limestone, laminated and chertified, . . . . .	1 m
Calcareous shales, partly covered, . . . . .	6 m
Limestone, dark grey, containing algae, crinoids, brachiopods and corals . . .	1 m
Shales, overlain by a thick, dark grey-brown rather coarse grained limestone bed, and some dirty, black limestonebands . . . . .	11 m
Unit 4 Shales and calcareous shales, badly exposed, containing three limestone layers, some with corals, stromatoporoids and brachiopods . . . . .	37 m
Total thickness Argillaceous Limestone Member . . . . .	150,5 m

#### Limestone Member

Limestone, thick bedded, light- to dark grey, fragmental, locally lightbrown, fine- and medium crystalline, sucrosic dolomite. Some local red bands . . . . .	22,5 m
Red, nodular limestone, ("griotte"), containing brachiopods and fossildebris . . . . .	1 m
Limestone, very dark coloured, locally red, locally dolomitized . . . . .	10 m
Second red nodular limestone layer . . . . .	0,5 m
Limestone, light-dark grey, fragmental, containing stromatoporoids and corals. Top contains grey-brown medium grained limestone . . . . .	24 m
Total thickness Limestone Member . . . . .	58 m
Total thickness Caldas Formation here . . . . .	208,5 m

#### *Characteristics, boundaries and contact relationships*

As shown in the type section and the stratigraphic diagram (fig. 4, 5) the Caldas Formation can be divided into two members. The lower Argillaceous Limestone Member consists of:

1. A basal limestone bed with stromatoporoids, of laterally changing thickness.
2. An alternation of calcareous shales and limestone layers.
3. A laterally more shaly sequence of argillaceous limestone with a varied organic content: corals, algae, stromatoporoids, bryozoa and brachiopods.
4. Shale sequence with some limestone beds, containing algae and stromatoporoids.

Thickness of this member varies from 115–150 metres. The upper part of the Formation is the Limestone Member, consisting of a limestone series of varieing colour and composition. Two red nodular limestone beds are very remarkable. They can be used as markerbeds in the whole region. Some more red limestone and dolomitization of local significance are found.

The thickness of the Limestone Member varies from 110–0 metres. The contact between the two members is sharp and can easily be followed in lateral direction.

The Caldas Formation rests conformably on the La Vid Formation. The latter consists of a lower part of dolomites and limestones, and an upper part of alternating limestone and shale. The lower surface of the Caldas Formation is put at the beginning of a thick stromatoporoid — bearing limestonebed, overlaying the shale — limestone sequence of the La Vid Formation. This basal bed is well exposed in the field. Fifteen metres below this basal bank a red detritic crinoid-bearing limestone layer occurs, which is found too elsewhere in the upper part of the La Vid Formation.

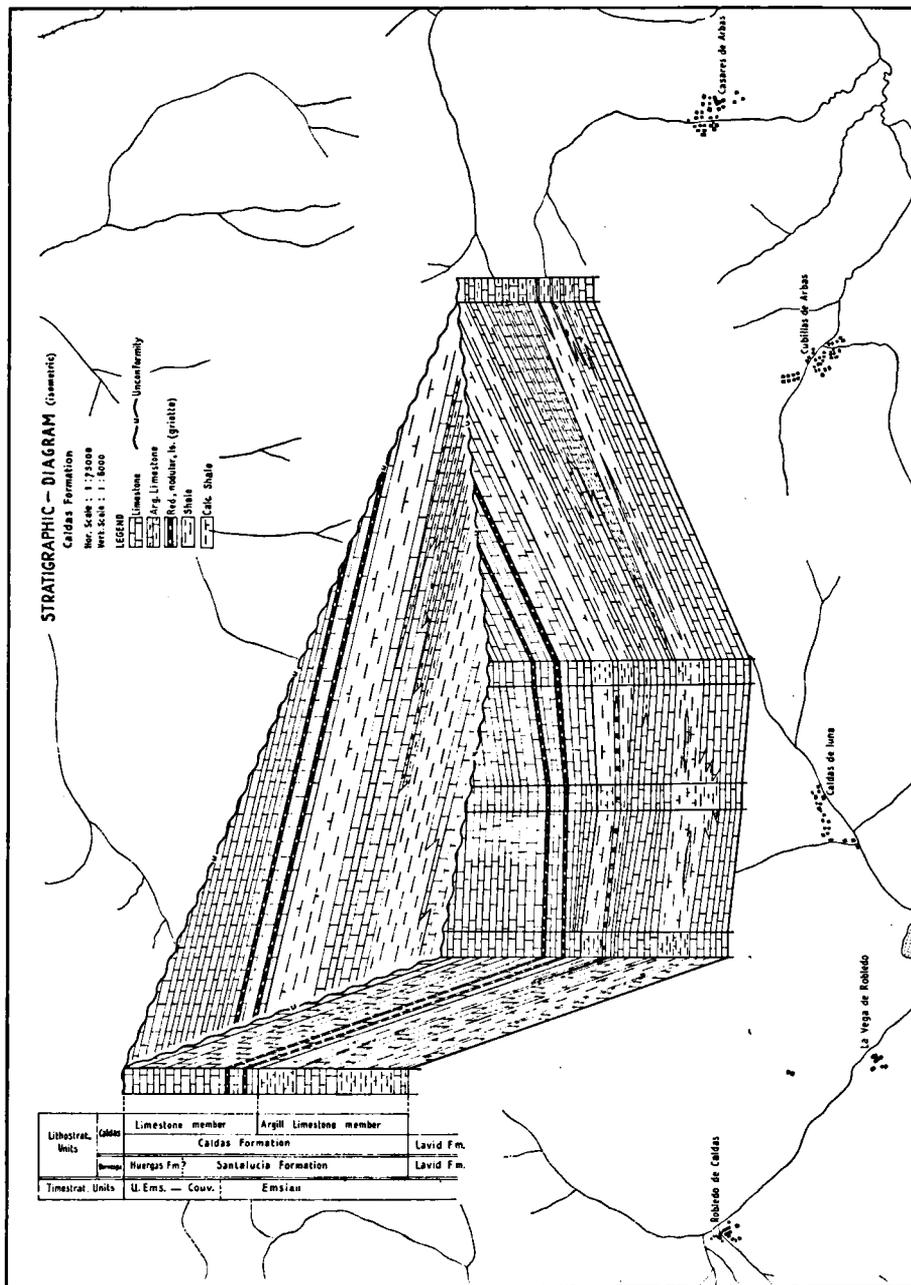


Fig. 4. Stratigraphic diagram.



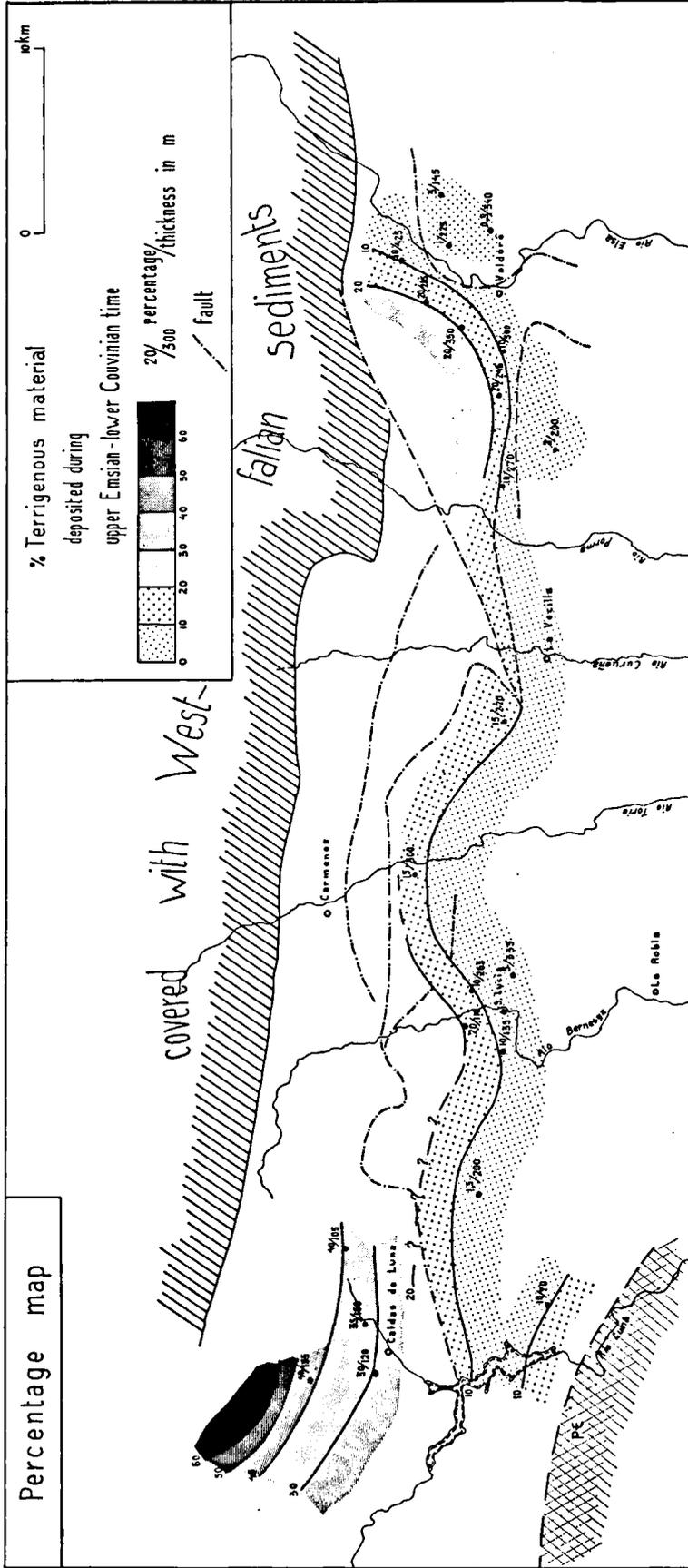


Fig. 6. Percentage map.

The upper boundary of the Caldas Formation is made by a surface of unconformity, originated after an epeirogenetic uplift in Upper Devonian (Famennian) time. Figure 4 shows that to the east this surface cuts off older rocks. The angle of the unconformity is about 0,5 degree. On this erosional surface the transgressive Ermitage Formation is deposited. The surface shows karstphenomena, so the Ermitage Formation intruded in fissures and holes in the Limestone Member of the Caldas Formation. No regular bedded Ermitage is found here. The Ermitage Formation consists here of red ferruginous sandstone, medium — grained and without fossil remains. To the east (N.W. of Casares) the unconformity cuts through the Argillaceous Limestone Member. Hardly any karstphenomena can be found here.

The geomorphological expression of the Caldas Formation leaves little doubt about differences in weathering behaviour of the composing rock types. In the field the division in two members is very clear.

#### *Dimensions and shape*

The thickness of the Caldas Formation varies from 230 m in the west to 0 m in the east because of the angular unconformity just described. More to the northwest a development of greater thickness occurs (Ubiña), but it is not yet possible, to link this with the Caldas sections because of important lithological differences.

The lateral variations in the Caldas Formation in the studied area are shown in figure 4. Note the differences in the Argillaceous Limestone Member. In the E and W the basal limestone is thinner than in the type section. In the overlaying sequence the limestone and shale content varies. In the upper part of this lower member a stromatoporoid lens occurs west of the type section. To the east the stromatoporoid growth is not continued.

#### *Geologic age*

The rather scarce brachiopod fauna has been identified and dated by Dr. J. G. Binnekamp and Dr. T. F. Krans.

The basal limestone yielded:

*Athyris pelapayensis* (Verneuil & d'Archiac, 1845)  
in León known from top La Vid Formation.

"*Spirifer*" spec. identical forms known from Santa Lucia Formation.

Conclusion: Emsian age.

From the upper part of the Argillaceous Limestone Member:

"*Spirifer*" spec. related to Emsian forms.

*Guerichella* cf. *cabedana* (Verneuil & d'Archiac, 1845)  
in León upper Santa Lucia Fm. that means Upper Emsian — Lower Couvinian age.

Conclusion: Upper Emsian age.

The part of the Limestone Member between the top and the lower red nodular limestone yielded:

*Tingella dereimsi* (Oehlert, 1901)  
in León Lower Couvinian age.

"*Spirifer*" spec. shows relations to Emsian forms.

*Athyris concentrica* (von Buch, 1834)

in León Lower Devonian and middle Frasnian age.

According to these datings the Caldas Formation is of Upper Emsian — Couvinian age.

#### CORRELATION

When we compare the Devonian sequence near Caldas de Luna with the type sections of Devonian formations along the Bernesga river (Comte, 1959) we find some striking differences.

The La Vid Formation has about the same lithology in both regions, but according to Dr T. F. Krans (personal communication) the spiriferid fauna of the Caldas region might indicate a different environment.

The Caldas Formation shows a different lithology, compared with the time equivalent Santa Lucia Formation and lower Huergas Formation (fig. 5). The Santa Lucia Formation contains an abundant coral, brachiopod and stromatoporoid fauna, sometimes in biohermal and biostromal development (Brouwer, 1964), whereas the Caldas Formation yields but few fossils. The most important feature, however, is the amount of terrigenous material in the Caldas Formation, compared with the almost pure limestone facies of the Santa Lucia Formation. A percentage map has been made, showing the amount of terrigenous material in the limestone facies deposited during Upper Emsian — Lower Couvinian time. The information about the thickness and the composition of the various sections used, was obtained from a number of unpublished reports of the Geological and Mineralogical Institute in Leiden.

The pattern of the contourlines points to a more terrigenous environment in the area around Caldas de Luna. Our surveys in the area north of the Leonesian basin (San Isidro area) have shown us that the Ermitage Formation lies there on Cambrian sediments. It could well be that this northerly area was already being eroded in Upper Emsian — Couvinian time, thus delivering terrigenous material to the Caldas area. Brouwer (1964) showed that the Santa Lucia Formation has a biohermal facies in the Ventanilla — San Martin region and a biostromal facies in the Esla area. The Caldas Formation could form the most western, terrigenous, near shore (?) facies in the, predominantly calcareous, Leonesian basin.

#### ACKNOWLEDGEMENTS

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