# THE BECERRIL CRYSTALLINE GRAPHITE DEPOSIT

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## 1. INTRODUCTION

Some superficial evidence of old graphite mining led us to study a zone on the North of "Sierra de Ayllón" in the Spanish Central System. Encouraging results led to an investigation license around the townships of Becerril and Serracín.

Cortazar, D. (1.891) gives an account of gold and iron mines in Becerrill which were worked during the last century, but due to poor communications, all were closed after a few years operation. The same author refers to some interesting graphite deposits in the area which have never been studied until this work.

## 2. GEOLOGY (see sketch)

The ore deposit is placed in the "Macizo Hespérico", in Silurian lands bounded by Ordovician to the east and the south. In the north it is covered by Mesozoic and Cainozoic sediments. Over the system there are "Ollo de Sapo" materials which are later than the Sardinian discordance, but we consider the Silurian only, because it is relevant to the graphite deposit. The Ordovician top is formed by grey micaceous slates, with thin sandstone benches.

It is very difficult to define the boundaries between the Ordovician and Silurian, because no author has dated by paleontology the upper Ordovician in this zone. With others [Dereims, A. (1.898), Lotze, F. (1.929), Trunit, P. (1.967), Bellido, F. (1.981) etc.] we think that the Silurian begins at a quartzite level, but others [Sacher, L. (1.966) and Carls, P. (1.975)] think that it begins at a former slate level. Over this quartzite, alternate clayey slates and sandstones called "Formación Cañamares" (Soers, E., 1.972), crop out. Over this, there is a thick black slate level (100 - 200 m) with many graptollytes of the Llandoverian; the black colour is due to the presence of carbon and there are graphite sub-levels; we have discovered near Becerril highly mineralised graphite levels more than eight metres thick. Cortazar, D. reported Monograptus Halli (Barrande) and Monograptus Convultus (Hisinger) of the Llandoverian and we found Panencas and Scoolithus (Haldeman) which placed the graphite deposit into the context of lower Silurian. Small pyrites cubes were observed in black slates, indicating reducing conditions which have also preserved the organic material. The probable source of carbon is the graptollytes accumulation, mixed with other thin sediments. Over the black slates there is a thick level (400-500 m) of green carbonated slates.

All of these materials are slightly folded with axes separated by one or two kilometres, in a NW-SE direction. A report, published by the Geological Institute of Spain (I.G.M.E.) about the metamorphism of the Central System, shows that the folding and metamorphism of these Silurian materials are Hercinian and occurred during the first two tectonic phases of the four referred to in this report.The materials are slightly metamorphosed, being in the chlorite-muscovite range near the zone where biotite appears. They are placed between 450-550 ± 50°C isothermals and between 4-4'5 isobarics.As already mentioned, there is regional folding, but we also found some local foldings, in the graphite zone only, because of the plasticity of the bituminous materials.The folding caused migration of the bituminous material to the anticlinal axes, where

the main graphite concentration is found; porous structures can be seen in the tectonic decompression fissures.

## 3. MINERALOGICAL PARAGENESIS

The ore contains graphite crystals which are several millimetres in size. Associated with the tectonic fissures of the mineralised formation are quartz veins several centimetres in size with slates fragments. Pyrites nodules are found in synclinal zones, but occur less frequently in anticlinals.Due to pyrites alteration, sulphurous fluids are formed and also iron sulphate, so that aluminium and potassium cations are leached from the slates, forming aluminium sulphate and iron oxide deposits in the north of the graphite deposit, as noted by many authors. Thus, secondary minerals include aluminium sulphate, metallic sulphides, silver and arsenical pyrites.There is much graphite in the adjacent iron deposits, indicating that they are formed from the graphite slates. It is noteworthy that occurrence of the bituminous material is a regional phenomenon, but graphitization only occurs to a significant extent near Becerril where very good examples of pure crystalline graphite are found, some of which have been acquired by prestigious European museums.

## 4. CONCLUSIONS

We have found some superficial evidence for a high quality deposit of crystalline graphite near Becerril in the Spanish Central System. This is a scarce and expensive mineral in high demand in Europe.

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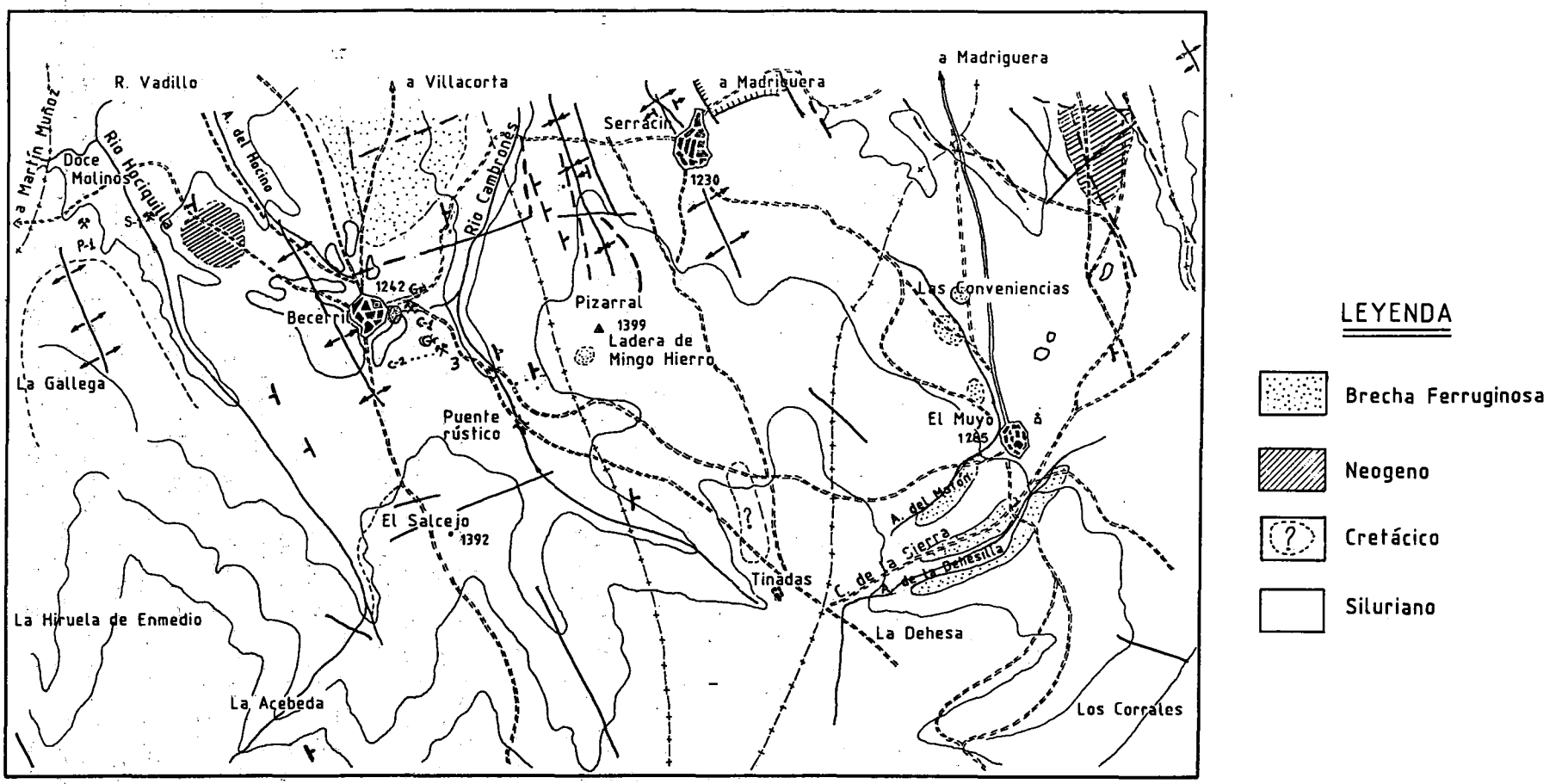


Fig.1. Geological map of the Becerril region of the Central System, Spain. Scale 1: 50.000