



LOCHKOVIAN (LOWER DEVONIAN) CONODONTS FROM THE CONCA DE TREMP-MONTSEC GEOPARK PROJECT; A UNIQUE CHARACTER OF GLOBAL RELEVANCE

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Key words: Conodonts, Lower Devonian, sustainability, Geopark Conca Tremp-Montsec

BACKGROUND AND OBJECTIVES

Geoparks should play an important role in contributing to the sustainable development of territories by a multidisciplinary approach based on the exceptional geological content. Scientists, policy-makers and local entrepreneurs work together fomenting the economic growth and supporting the cultural and natural heritage through the continuous mutual cooperation and implementing programs that promote long-term scientific research in the territory. The subsequent dissemination of the geological values through the development of educational programs will diversify the cultural and touristic offering, encouraging local business to come together in benefit of local communities. It is obvious the impact of Geological heritage in developing local initiatives, that in turn will benefit local economy and will increase awareness of inhabitants regarding this heritage.

The Lower Devonian outcrops south of Gerri de la Sal represent an outstanding geological feature of the Conca de Tremp-Montsec Geopark Project. De Villalta & Rosell Sanuy (1969) described the stratigraphical section in the north flank of the Buscarró anticline spanning from the upper Silurian through the Middle Devonian and showed the international value of these rocks. Carls (1977) provided the first Lower Devonian conodont documentation of these beds and revealed the importance of this area in a palaeogeographic context. Valenzuela-Ríos (1990) presented the first detailed conodont succession from Gerri de la Sal sections, positioning the Silurian/Devonian boundary and recognizing seven biostratigraphic units. This work already showed the relevance of the Gerri de la Sal sections for global correlations and analysis of conodont evolution. Valenzuela-Ríos (1994a, b) further developed and documented this proposal. Valenzuela-Ríos & Murphy (1997) described a new genus present in the Gerri de la Sal sections, demonstrated a detailed middle Lochkovian correlation between the Spanish Pyrenees and Central Nevada and proposed a new global subdivision of the Lochkovian Stage. Valenzuela-Ríos & García-López (1998) compared sequences from Gerri and the Catalan Coastal Ranges. More recently Valenzuela-Ríos & Liao (2012) and Valenzuela-Ríos *et al.* (2015) considered the Gerri de la Sal sequences for demonstrating the indispensability of palaeontological data in correlating global events and in establishing a new Lochkovian global zonation.

The main objectives of this paper are: 1) to describe the stratigraphy and palaeontology of one selected Devonian outcrop (Gerri de la Sal) within the aspiring Geopark; 2) to present the singularity of this outcrop in the context of national Geoparks and 3) evaluate the relevance of the conodont succession in an international context.

GEOLOGICAL CONTEXT

The Gerri de la Sal outcrops are developed in the Subfacies Compte of the Southern Facies area (Mey, 1967; Zwart, 1979) and represent the southernmost Palaeozoic strata of the Nogueras Zone. The stratigraphic interval studied herein consists of about 23 m of limestone alternating with marl and shale and corresponds almost completely to the Lochkovian (Fig. 1)



Fig. 1. Geological map of Conca Trep-Montsec Geopark Project with position of sections Ge 1.1 and Ge 1.2.

MATERIAL AND METHODS

The stratigraphic sequence can be subdivided into two parts, a lower one of dominant shale and black colour and an upper one with clear colour limestone being the prevailing strata. Two sections, Ge 1.1 and Ge 1.2 were sampled bed by bed. All the samples were etched with formic acid (5-7%) and washed by decantation. Heavy liquids and magnetic separator concentrated large residues. Microfossils were handpicked with the help of a wet brush under the microscope.

RESULTS

A large and outstanding conodont collection was obtained from these two sections. It contains both endemic (*Icriodus*, *Pelekysgnathus*) and more cosmopolitan conodonts (*Ancyrodelloides*, *Lanea*, *Flajsella*, *Masaraella*, *Pedavis*, *Wurmiella*, *Zieglerodina*, "*Ozarkodina*"). The conodont succession has been thoroughly described in the papers by Valenzuela-Ríos and co-authors referred above and are briefly summarized below.

The Silurian/Devonian boundary is close to Bed 1 in section Ge 1.1. There, *Icriodus woschmidti* has been recorded together with lobolites of *Scyphocrinites*. Up to Bed 11 the endemic conodonts prevail and records document two of the three evolutive early icriodids branches, the *transiens* and the *angustoides* branches. Bed 6 yielded the holotype and paratypes of a new taxon "*Ozarkodina eladioi*". The first *Ancyrodelloides*, *A. carlsi*, enters in bed 11 and it is followed by a continuous and rich conodont sequence spanning through the middle and upper Lochkovian. This sequence contains the evolutionary steeps of the genera *Ancyrodelloides*, *Lanea* and *Flajsella* that are used for defining, subdividing and correlating the middle Lochkovian and of *Masaraella* and *Pedavis* that are the key taxa for the definition, subdivision and correlation of upper Lochkovian. Besides, some scattered records of the more endemic *Pelekysgnathus* and *Icriodus* strength correlations between neritic and pelagic facies. Occasional records of *Kimognathus* and the new taxon "*Ozarkodina malladai*" increase the biodiversity of Gerri sections and augment tie points for fine correlation.

Section Ge 1.2 mostly mirrors the middle and upper Lochkovian sequence, but with slightly lower biodiversity. Lower Lochkovian is missing due to local tectonics.

DISCUSSION AND CONCLUSIONS

The Lochkovian conodont sequence at Gerri de la Sal sections is one of the richest and more important worldwide and makes the Conca de Tremp-Montsec Geopark Project as one of the key regions for demonstrating the evolutionary steeps of several genera that are instrumental in establishing the finest Lochkovian subdivision and subsequent high-resolution correlation.

The holotypes of several taxa have been described from Ge 1.1 section ("*Ozarkodina eladioi*", "*Ozarkodina malladai*" and *Pelekysgnathus serratus* 20).

These two facts provide this aspiring Geopark with a singularity of global relevance that is neither present in the nearby UNESCO Global Geopark of Sobrarbe nor in any of the other UNESCO Global Geoparks.

Further, the combination of these sections with the section Compte-I (CP-I) just in the northern margin of the Conca de Tremp-Montsec Geopark Project and the Segre sections (Se 1-5), a few kilometre northeast of this aspiring Geopark, constitute one of the best Lochkovian data base for establishing the finest Lochkovian biostratigraphical subdivision that can be worldwide applied and, consequently, represents a relevant region for increasing our understanding on the geo-biological history of Earth. This added value of a natural resource

could be integrated in sustainable development programs to increase people awareness on their natural heritage and in seeking new ways of attracting scientist and tourist to the region, which in turn would foster local economy and help dissemination of this unique and precious geological signature.

Acknowledgements

JCL is supported by the MINECO (Juan de la Cierva Postdoctoral Program, Ref. FJCI-2015-26813). This work represents a contribution to the IGCP-596 and IGCP-652 and to MINECO CGL2011-24775 project.

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