

Research and Geoconservation of the Albian “Giant” Ammonites Collection in the Basque Coast UNESCO Global Geopark

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Abstract

The Basque Coast UNESCO Global Geopark is known worldwide for its great thickness of Upper Cretaceous and Paleocene “flysch” formations. The K/Pg and P/E boundaries are among the most popular sites, together with the IUGS-ICS designated Selandian and Thanetian global stratotypes. However, an important section of the sea cliff outcrops is formed by an older and less known Albian “black flysch”. Its tectonic and sedimentological setting is related to the opening and spreading of the floor of the Bay of Biscay, which produced important environmental changes that triggered significant ammonoid bioevents, including the occurrence of large forms. Staff at the Basque Coast UNESCO Global Geopark (UGGp) and experts from the University of the Basque Country have carried out a research and geoconservation project based on a collection of more than 150 large-sized ammonites from a single fossil collector, who had accumulated them over 40 years from a particular location in the geopark cliffs. Integrative study of the sedimentary record and morphologies of the ammonoids collected through the section documents their distribution and evolution.

Keywords: Albian, Ammonites, ex-situ Collections, Geoconservation.

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Introduction

Paleontological heritage is a very important resource in many UNESCO Global Geoparks (UGGp) worldwide. They document the history of life, and are of great importance in geoparks as they are valuable resources for education and geotourism. They also have commercial value, which can be problematic in some cases. A UGGp should try to control fossil extraction activities and preserve the paleontological heritage inside the territory of the geopark (Hilario & Alcalá 2018). The Basque Coast UGGp has promoted an initiative to document and conserve an important fossil collection built up by a private collector; through this we have been able to explore fruitful ways to cooperate between the private-commercial world of fossil collecting, scientific research, geoconservation and educational activities (Lopez Horgue & Hilario 2019). The Geopark was able to use the collection in educational activities with local schools in 2018 and 2019 as a first attempt.

Geographic and Geological Context

The Basque Coast UGGp is located between Bilbao and Donostia-San Sebastian, on the Cantabrian coast of Spain (Fig. 1). It was designated as a member of the Global Geopark Network in 2010, and as a UNESCO Global Geopark in 2015, especially for its stratigraphic importance, being host to two global stratotypes, as well as the classic Zumaia section through the Cretaceous–Paleocene boundary, and for its giant ammonites.

The Geopark is located in the Basque-Cantabrian basin (BCB), a Mesozoic pericratonic rift related to the opening of the Bay of Biscay during the Cretaceous. It comprises a succession of sedimentary rocks from Late Triassic to Middle Eocene in age, formed during the opening and closure of the Bay of Biscay. The coastal outcrops, a 5000-m-thick flysch deposit show a remarkably continuous record of some 60 million years of the history of Earth, encompassing the end-Cretaceous mass extinction, the world-famous Zumaia (= Zumaya) section through the latest Cretaceous and Paleo-

cene marine sediments. It is also host to two Global Stratotypes defined by the IUGS, marking the bases of the Selandian and Thanetian stages, two of the three divisions of the Paleocene.

The western part of the Geopark coastline is formed by a complex Albian “black flysch” succession, whose sedimentation was controlled by intense faulting related to the opening of the Bay of Biscay (Fig 1). This faulting created an irregular seafloor morphology with deep canyons and submarine highs. Deeper basins conducted abundant turbidity currents, while highs, where most of the “giant” ammonites were collected, were mainly covered by muddy sedimentation (Fig 2A). In addition, Albian transtension permitted significant submarine magmatic activity, which created important iron fertilization and hydrothermal seeps and vents with related chemosynthetic ecosystems (Agirrezabala 2009).

Role of the Geopark in Local Development

The municipalities of Zumaia, Deba and Mutriku make up the Geopark territory and the population is approximately 20,000. Even before it became an internationally registered geopark, this stretch of coastline was declared a Protected Biotope by the Basque Government. Since 2002, geotourism has developed successfully in the area, offering an expanding program of activities on land and sea, or a combination of the two. The educational value of this environment is also very important, as shown by the success currently being enjoyed by initiatives such as the Algorri Interpretation Centre in Zumaia and the Nautilus Fossil Museum in Mutriku. Thus, this area allows comparisons to be drawn between past crises, extinctions and other events, with those we face today, thereby raising the awareness of the general public.

The Basque Coast UNESCO Global Geopark carries out strong and committed work for education. The Algorri Interpretation Centre is the key facility for geological and environmental education activities for school children, not only for locals but

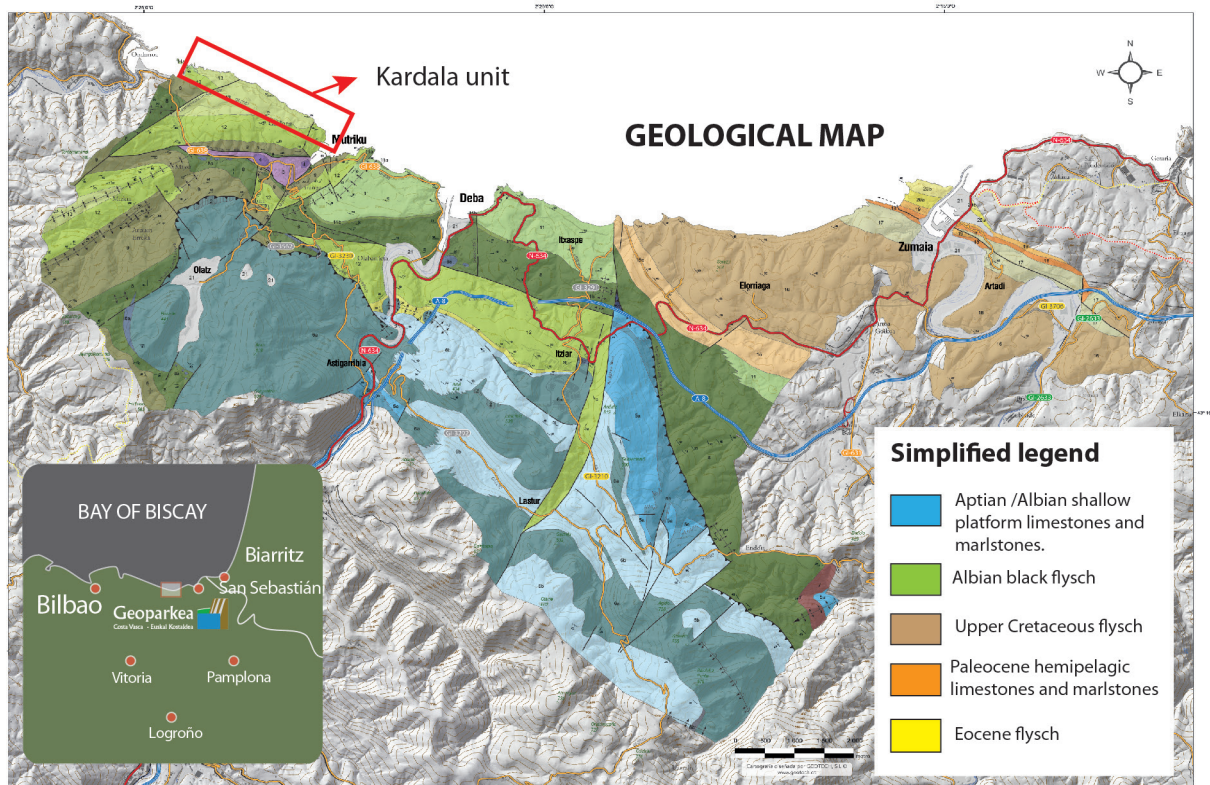


Figure 1. Geographic location and geological map (Agirrezabala & Baceta 2013) of the Basque Coast UNESCO Global Geopark.

also for other schools from the Basque Country. It has a busy program throughout the year, including workshops and field trips. It has developed suitable material for each age-group, and they improve their material every year with new activities and innovative methods of education. The UNESCO Global Geopark also promotes cooperation among farmers, restaurants, and markets to raise the value of the local product through gastronomy. Different activities like showrooms, competitions and gastronomy events are organized to raise awareness and the population and cooks on the use of local products.

Geoconservation and Research Project

We present the fossil ammonite collection-geoconservation project as a series of steps.

Step 1: The fossil collector. Jesus María Narváez has been collecting ammonites for more than 40 years, since 1975, from the Kardala unit sea-cliffs in the Basque Coast UGGp (Fig. 2A–C).

Step 2. Opening of Nautilus Museum. In 2007, Narváez reached an agreement with the municipality of Mutriku, by which an essential part of the collection could be displayed in a new museum specifically built for this purpose. That was one of the important arguments for the municipality to join the Basque Coast UGGp project (Fig. 2D).

Step 3. The geological context. The Basque Coast UGGp and experts from the University of the Basque Country (UPV/EHU) signed an agreement to inventory and research the collection of large-sized ammonites.

Step 4. Inventory. Experts and the fossil collector were able to inventory more than 150 specimens. Different morphologies were studied, and a first taxonomic classification was proposed. Most of the specimens are larger than 30 cm and belong to the families Puzosiidae and Brancoceratoidae. A first attempt to assess the heritage and scientific



Figure 2. Valorization of the giant ammonites from the Basque Coast UNESCO Global Geopark. A) Albian Kardala unit sea-cliffs. B) Jesus Maria Narváez, the local fossil collector. C) Large-sized ammonites D) Educational activities in Nautilus Museum. E) Narváez and professional paleontologist Mikel Lopez-Horgue (UPV-EHU) trying to locate all the specimens on the outcrop. F) Researchers drawing the stratigraphic column. G) Fossil oil shows (solid hydrocarbons in the center of the nodule) related to hydrothermal and bacterial activity. H) The new research and educational warehouse facility at the Basque Coast UNESCO Global Geopark.

ic value of these “giant” ammonites was made by López-Horgue *et al.* (2018).

Step 5. The stratigraphic context. Thanks to the good memory and detailed information from the fossil collector, experts could localize each of the specimens to its collection point. They drew a detailed stratigraphic column of more than 200 m, and all the specimens were placed in their geological contexts. All the large-sized ammonites occur within a minor interval representing about 2 million years (Agirrezalaba & Lopez Horgue 2017). Despite that, the fossils show evident morphological changes through this thickness, evidence for their evolution (Fig. 2E–G).

Step 6. Unification of the collection. Scientific research has given extra value to the collection. Thus, thanks to the good intentions of the fossil collector and the involvement of local institutions, all the specimens have been brought together and stored in a new research and education warehouse (Fig. 2H).

Conclusions

Paleontological collections are a fundamental part of many UGGp. Geoparks can play a significant role in coordinating fossil collectors, scientific activity and educational facilities. But such good outcomes require good will on all sides, patience and clear objectives. When everything works well, as here, all involved people can be satisfied with outcomes that are good for science and researchers from around the world on the one hand, and the private collectors and local citizens on the other.

Conflict of Interest

There is no conflict of interest. All the information provided comes from several research projects conducted by experts of the UPV/EHU and a final collaboration agreement with the Basque Coast UNESCO Global Geopark 2015-2016.

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