GEOPARK PROJECT COUREL MOUNTAINS

THE RELATIONSHIP OF THE HUMANITY WITH THE PALEozoICO
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INTRODUCTION

The “Courel Mountains” are the perfect showcase to observe a part of the geological history of Earth, specifically the Lower and Middle Palaeozoic and, to a lesser extent, the end of the Tertiary and Quaternary periods. This territory, located in the Iberian Massif, is made up of rocks from the Neoproterozoic to the Carboniferous Era. Many singular elements produced by the Variscan Orogeny—with the great Courel recumbent synclinal as a reference— and related to stratigraphy and tectonics are conserved in this geographic part of the world. These and other geological characteristics gathered in this area contribute to the distinction and enhancement of the territory. Furthermore, many palaeontological, mineralogical, metamorphic and glaciological remains, as well as karst cavities, landscape and cultural heritage can be found. These elements increase even more the value of the zone. In summary, at a geological level this is one of the most diverse points of the peninsular Northwest.

The most outstanding value of the “Courel Mountains” is the relation of Humanity with the Palaeozoic Era. The common thread of this Geopark project is the indissoluble union of humans and geology. Between the I and II centuries the Roman Empire had more than a hundred active auriferous exploitations due to the Palaeozoic raw gold associated with quartz dikes and their subsequent erosion and concentration in Neogene deposits which concentrate in Plio-Quaternary terraces when eroded again. In this territory there are documented a total of fifteen blackssmiths of the Modern Age because of the existence of ferruginous levels and crusts in the Arenigian fault and the siltstone found in the pre-Silurian karst.

Despite being scarce in Galicia, lime could be produced in six ovens or “Caleiros” distributed throughout the territory because in the “Courel Mountains” there are three different calcareous formations (the Cambrian limestones of Cândana and Vegadeo and the one of La Aquiana, from Late Ordovician).

The primary role of slate should also be acknowledged: it has been a commodity since the Neolithic and the economic engine of the territory until only a few years ago. The slate used in roofs was extracted essentially from the Soldón and Luarca formations from the Early and Middle Ordovician.

Conveying this intimate relation between natural environment and human beings, manifested in the “Courel Mountains” territory, is the main purpose of this project.
A. Identification of the Area

A.1. Name of the proposed Geopark

The name proposed for the inclusion of this territory in the UNESCO Global Geoparks Network is “Montañas do Courel” (Courel Mountains). This name references the mountainous surroundings recognised as the mainstay of the identity of the region. “Courel Mountains” are a synonym of nature and traditional culture in Galicia, a synonym of a way of life adapted to environment and dedicated to its protection and sustainable use. The term “Courel” could come from the Latin word “Courillum”. This word is composed from the pre-Latin roots “Cau-” or “Co-” which means cave or stone respectively, followed by the Latin suffix “-illum” with diminutive connotations. Popular tradition says that the toponym comes from the Latin word “aurum”, which means gold. The reason is the huge amount of gold mines of the Roman Age that are distributed throughout the whole territory proposed as Geopark.

A.2. Location of the proposed Geopark

The suggested area for the Geopark is located between the geographic coordinates 42,715º N, 42,32º N and 7,023 W, 7,42 W in the province of Lugo, within the Autonomous Community of Galicia, in the Northwest of Spain. These limits have been established according to the territory that has already been cooperating in geotourism for more than a decade and is administratively attached to the region of Quiroga, including the municipalities of Folgoso do Courel, Quiroga and Ribas de Sil. To get to the territory from Madrid, the A6 motorway must be taken for 413 km, until the N-120 link in Toral de los Vados. From this point, we should take the N-120 highway that leads directly to the municipalities of Quiroga and San Clodio, in the South, after 67 km. The access to the North of the area proposed as Geopark can be done through the A6 motorway from Pedrafita do Cebreiro, bordering on the municipality of Folgoso do Courel and 440 km from Madrid. From this point a series of mountain roads lead to Seoane do Courel after 25 km. We can also reach this area by train (with a station in the municipality of San Clodio). Considering Quiroga as the most developed administrative centre of the Geopark project, the distance from the nearest cities would be: Lugo 84 km, Santiago de Compostela 154 km, Ourense 78 km, Monforte de Lemos 33 km, Ponferrada 80 km.
A.3. Surface area, physical and human geography characteristics of the proposed Geopark

The Geopark proposal “Montañas do Courel” covers a surface of 577.85 km², administratively attached to the region of Quiroga. This territory has a resident population of 5,406 inhabitants (INE 2016), distributed in the following manner: 3,354 inhabitants in the municipality of Quiroga, 1,060 inhabitants in Folgoso do Courel and 992 inhabitants in Ribas de Sil.

The territory is divided in two well-differentiated areas. The northern one, covering the totality of the municipality of Folgoso do Courel and the northern half of Quiroga, is where the Courel Mountains are located, one of the so-called eastern ranges. These mountains, with a SW-NE orientation, were originated essentially during the Variscan Orogeny over metamorphic materials such as slate, sandstone, quartzite and, to a lesser extent, calcareous levels. The rivers Lor, Louzara, Quiroga, Soldón and Selmo are placed over these Palaeozoic stones as a consequence of the Alpine Orogeny that has continued until today. Those rivers are accompanied by a multitude of streams that highly matches within the above-mentioned materials, creating a morphology of deep valleys and canyons profusely carved by erosion. In this mountainous zone some of the highest summits of the region can be found, showing clear remains of glacial modelling. The most important summits are Formigueiros, 1,639 m, Pía Paxaro, 1,616 m, and Mountouto, 1,542 m. The Lor river is the main channel of the northern sector of the region, cutting the whole Courel range from N to S, in its western region.

From a landscape perspective, agriculture and livestock have generated many places of highly ethnographic interest. Thus, the less climatically exposed areas are almost totally occupied by the traditional chestnut production. In this regard, meadows and steep slopes are also remarkable. As we get to the highest levels, crop species give way to oak forests, beech trees and, despite being unusual in Galicia, holm and cork oak woods on calcareous substratum.
Villages are located halfway up the hillside and South-oriented. Farmlands, chestnut cultivations and drinking water supplies can be found in their surroundings. There are no newly built dwellings. These villages are always built with materials extracted from the regional environment—slate, quartzite, sandstone, chestnut tree—, narrow streets and roof overhangs close to one another to create a protection from the harsh mountain climate.

Climatically, this zone is part of Atlantic domination. Annual average temperature in the highest parts hardly overcomes 8,5 ºC, while in the valleys the annual mean is 1,5 ºC. The level of rainfall is around 1,434,5 mm per year.

The South of the territory has different characteristics from the North. It is composed of the municipalities of Ribas de Sil and the southern half of Quiroga. The Sil river valley characterises this space cutting the Palaeozoic materials of the southern foothills of Courel Mountains, with a general direction ENE-SWS first and NE-SW later. In its central part this channel expands due to the tectonic depression of Quiroga, where San Clodio and Quiroga are located. This trench, created during the Alpine Orogeny, is characterised by being clogged by Neogene deposits. Just a few kilometres from this depression, the Sil river takes direction NE-SW in the place where it joins the Lor river and creates the so-called Sil Canyon (extended until the mouth of the Miño river). This canyon has grades up to 70% and slopes that reach 500 metres high.

The river has been very humanised since the Roman Age until now. In the second century, in the village of Montefurado a tunnel was dug to divert its channel and exploit the existing sands. In the middle of the twentieth century this stretch of the river was dammed twice in order to produce electric energy and in the last third of the twentieth century it was diverted again to build the N-120 highway.

The villages of this territory keep a clear traditional structure. The materials used in the buildings are of local origin—slate, “Ollo de Sapo” gneiss, boulder, chestnut wood—and the habitat type tends to be concentrated, although this feature decreases. San Clodio and Quiroga present traditional and newly built constructions. Even though agriculture parcels are predominant, there are other destined to leisure activities (such as swimming pools, gardens, etc.).

The weather of the Sil valley is established in the Oceanic-Mediterranean domination. This climate is known for its strong thermal gradient. In summer there is an average of 22ºC, while in winter it is of 6ºC, with an annual rainfall of 1000 mm.

Demographically, this region is suffering a population decline. From the beginning of the twentieth century, it lost more than the triple of the population and for the last twenty years young population departure has become extreme. Nowadays, the average age is 55 years old - and more than a third are currently over 65 -, with a net population growth of -78. These data show an obvious sign of population ageing. The population density has been estimated at 9,7 inhabitants/km², the second lowest in the province of Lugo. Around 80% of the population is concentrated in the Sil valley area.

The activity rate is close to 40% and occupancy is around 30%. The tertiary sector is the one which offers more employment: hospitality business and trade are the main activities in the region, followed by viticulture and forestry. Until a few years ago, slate extraction was one of the key factors in regional activity, but its importance decreased as exploitations have been closed. A feature worthy of mention is that the southern part of the territory is under the “Ribeira Sacra” designation of origin, one of the five Galician designations of origin.

A.4. Organization in charge and management structure (description, function and organogram) of the proposed Geopark

According to the common thread of this Geopark project, the organization structure is designed to include local empowerment, using competences of the people who live in the territory. Given that this project has been launched and managed with a bottom-up focus, it is intended that the future management structure keeps this focus, allowing the population of the territory to lead this structure by coordinating, planning, directing and carry out the decisions taken.
The promoter of the candidature is the Association for the Territorial Promotion of Courel Montains was constituted in 2016. It is a non-profit organization established at the Museum of Geology of Quiroga and created by the municipalities of Folgoso do Courel, Quiroga and Ribas de Sil.

The aims stated by the statutes of the Association include:

1. To promote the different socioeconomic sectors.
2. To boost, revalue and preserve the geological heritage and the natural, cultural, historic and artistic resources of the territory.
3. To increase public awareness on the necessity of protecting the environment (particularly the rural environment) and taking an active part in it.
4. To articulate participation dynamics which enable social and economic development throughout the region.
5. To develop Geotourism.
6. To formulate and convey to the population the appropriate strategy to achieve the development of the territory, especially the possible recognition as a member of the UNESCO Global Geoparks Network and the values that this initiative promotes and protects, in order to get them integrated into the own culture and socioeconomic dynamic.

The management structure of the Association and candidate Geopark would be:

The Association “Courel Mountains” is represented by the General Assembly, constituted by all members, who will appoint a President among the members. The President will chair the Board of Directors.

The Board of Directors will have a General Coordinator in territorial development through an agreement between the Rural Development Group Ribeira Sacra - Courel, manager of the LEADER programme in the territory. The General Coordinator must coordinate the members of the Territorial Rountable, the geologist and the scientific coordinator. This scientific coordinator, a municipal civil servant and the Director of the Museum of Geology, will have under supervision the coordination of the scientific committee. For that purpose, support staff will be created, besides the geologist, the archaeologist and the tourism technician.
The Territorial Roundtable will be composed by a partnership of public institutions such as town councils in the area, Department of Natural Heritage of Xunta de Galicia, the Galician Agency of Rural Development, the Department of Rural Areas, the Deputation of Lugo, the Rural Development Group Ribeira Sacra - Courel, the Tourism Consortium of Ribeira Sacra, the Regulating Council of the Denomination of Origin “Ribeira Sacra” and private associations from cultural, social and economic sphere, such as Colegio Uxionovoneyra de Folgos do Courel, Asociación Cultural Fonte do Milagro, Asociacion socio-cultural A Coroa, Asociación socio-cultural San Bartolomé de Hospital, Club Montaña Formigueiros, Asociación Cultura A Boca do Monte, Asociación Moto Clube a Curuxa, Asociación Turística Serra do Courel, Consorcio de turismo da Ribeira Sacra, Centro de Animación Rural Remansinho do Sil, Asociación Arumedo Queiruga, Asociación Qui-Roma, Asociación Coral Polifónica de Quiroga, Asociación Banda de Gaitas San Martiño, Asociación Camiño do Inverno, Asociación Cofradía del Vino de Quiroga, Asociación de empresarios de Quiroga, Asociación comerciantes de Quiroga, Asociación socio-cultural comarca de Quiroga, Asociación de vecinos de Margaride. The objective pursued with this public-private partnership is to join forces to find solutions and contribute to the development of the territory and geotourism together.

The scientific committee will be composed by all the institutions and/or people in the field of geology, geomorphology, biology, botanic, archaeology and history who can contribute to the study and knowledge of the resources of “Courel Mountains” territory and help implement the development strategy based on the geological heritage and the development of geotourism, education, investigation and divulgation. So far, the committee is composed by the following institutions and representatives: Antonio Rigueiro Rodríguez (Director of the Scientific Station of Courel, USC), Augusto Pérez Alberti (Professor of Physical Geography, USC), Juan Ramón Vidal Romani (PhD in Geology, Director of the University Institute of Geology Isidro Parga Pondal), Aurora Grandal D’Anglade (PhD in Geology, University Institute of Geology Isidro Parga Pondal), Javier Guitian Rivera (Professor of Botanic, USC) Ramón Fábregas Valcarce (Professor of Prehistory, USC), Arturo de Lombera Hermida (Archaeologist), Xosé Pedro Rodríguez (Research Director, Universidad Rovira i Virgili), José Bienvenido Diaz Ferrer (PhD in Stratigraphy, Department of Marine Geosciences, University of Vigo), Juan de Dios Martín Aparicio (President of the Official Mining Chamber of Galicia), Pablo Núñez Fernández (Geologist of the Official College of Geologists of Galicia), Lourdes G Sotelo (teacher of Biology of the Uxionovoneyra school in Folgos do Courel), Daniel Ballesteros (Oviedo University geologist) y Manuel García Ávila (Galician Palaeontological Association).

A key fact to ensure the financial viability of the Geopark Project is that the staff assigned to it will be ceded by these collaborating entities, town councils and the Rural Development Group. This guarantees the day-to-day management without being a financial burden for the Association. The only contractual relation required by the “Courel Mountains” Association is the working relationship with the geologist, as it has been done so far.

A.5. Application contact person (name, position, tel./fax, e-mail)

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B - Geological Heritage

B.1 General geological description of the proposed Geopark

B.1.1. Introduction

The European Variscan Orogeny is a great mountain chain that runs the centre and Southwest of this continent. It was a consequence of the collision of two super-continents (Laurasia and Gondwana), where continental zones and the microplates of Armorica and Avalonia – among others – were located, in the end of the Palaeozoic.

The most complete section of this Orogeny is set in the western part of the Iberian Peninsula, in the southern zone of the Iberian-Armorican Arch, and represented by the Iberian Massif.

The main structures of this massif were created by the Variscan Orogeny, although there were previous and later deformations that shape the current geological situation.

B.1.2. Geological situation

According to the classical definition of Paleogeographic zones of the Iberian Massif (Lotze, 1945), modified by Julivert et al. (1972; Fig. 1), in the Courel mountain chain two zones are represented: the West Asturian-Leonese Zone (WALZ) and the Central Iberian Zone (ZIC).

The first one is constituted by the Courel domain (CD) and occupies approximately the northern third of the territory. The rest belongs to the Central-Iberian Zone (ZIC) and, inside this one, to the “Ollo de Sapo” domain (OSD) and more precisely to the Courel - Peñalba sector (Martínez Catalán et al., 1992).

The limits between this Paleogeographic zones or even between domains are often set through great faults of regional significance, creating scientific controversy: some authors have proposed changes in the position of the limits over time.

Figure 1. Zonation of the Iberian Massif according to Pérez-Estaún et al. (2004); based on Lotze (1945), Julivert et al. (1972) and Farias et al. (1985). The red box indicates the position of the proposed “Courel Mountains” Geopark.
B.1.3. Stratigraphy

The outcropping rocks in this territory extend from the Neoproterozoic (600-590 m.a.) to the Quaternary (< 2 m.a.). There are hardly any post-Devonian deposits until the Neogene (30-23 m.a.).

The following table shows the different outcropping formations in the “Courel Mountains” Geopark, in connection to macrostructures.

<table>
<thead>
<tr>
<th>WEST ASTURIAN-LEONESE ZONE (WALZ)</th>
<th>CENTRAL IBERIAN ZONE (ZIC)</th>
</tr>
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<tbody>
<tr>
<td>Normal flank of the Courel syncline</td>
<td>Reverse flank of the Courel syncline</td>
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<tr>
<td>Seceda layers</td>
<td>Secedalayers</td>
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<td>Folgoso dormation (Silurian)</td>
<td>Folgoso Formation (Silurian)</td>
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<td>La Aquiana limestone</td>
<td>La Aquiana limestone</td>
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<tr>
<td>Luarca slate</td>
<td>Luarca slate</td>
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<tr>
<td>Armorican quartzite</td>
<td>Armorican quartzite</td>
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<tr>
<td>Villamea (Vilamea) layers</td>
<td>Soldón slate</td>
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<tr>
<td>Vegadeo limestone - Picture 1</td>
<td></td>
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<tr>
<td>Transition layers</td>
<td></td>
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<tr>
<td>Cándana group - Picture 2</td>
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<tr>
<td>Villalba (Vilalba) Series</td>
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</tbody>
</table>

Table 1. Outcropping formations of the proposed “Courel Mountains” Geopark and their connection to Variscan major structures.

Picture 1. Panoramic view of Vegadeo limestone and Villamea layers, near to the village of Visuña.
The West Asturian-Leonese Zone (WALZ) is basically composed by a siliclastic series from the Cambrian-Ordovician Era. The western limit of this paleogeographic zone is the Viveiro fault. The southern limit would be more diffuse, located between the Courel and Peñalba synclines. In this territory the zone would be represented by the Courel domain defined by Martínez Catalán (1981), although a large proportion would be part of the Central Iberian Zone (CIZ). The stratigraphy of the Courel domain is characterised by a quite complex Cambrian (although with a minor thickness than other domains in the WALZ), the presence of La Aquiana limestone, a Silurian disconformity over the Middle and Late Ordovician, and the existence of a Devonian in the Courel syncline.
Figure 2. Legend and geological map of the proposed "Courel Mountains" Geopark.
**B.1.3.1. The lithostratigraphic succession in the West Asturian-Leonese Zone**

The units present in this part of the WALZ are, from wall to ceiling, the following ones:

**Villalba series (Neoproterozoic)**

The Cadomian sedimentary cycle is represented by this lithostratigraphic series that outcrops in the North of the territory in an anticline structure, an extension of the southern termination of the Sarria anticline. Studied by several authors, especially by Capdevilla (1969), it consists of a monotonous seque

In the Variscan sedimentary cycle the following lithostratigraphic succession can be identified:

**Cándana group (Lower Cambrian)**

This group comprises the materials situated between the Neoproterozoic slates and the Middle-Upper Cambrian carbonate level. It was defined by Walter (1966) and is composed by the following formations:
Cándana lower quartzite

It is constituted by sandstone, quartzite and slate with some conglomeratic levels towards the base. It creates an unconformity above the Villalba series. The thickness of the unit varies from the 30-150 m. Dozy (1983) even proposes an Eocambrian Age for part of this formation and the overlying one.

Cándana slates

They are formed by green and grey slates, limestone and dolomite (“Calizas de Cándana”), am- pelitic slate with slender intercalations of sandstone, quartzite and lens-shaped carbonate levels. On the upper part it may present a thick continuous detrital level: “Cándana upper quartzite”. Its power is normally between 30 and 210 m.

Transition layers

They are composed by green and grey slates with slender intercalations of sandstone, calcareous lens-shaped level, a continuous amelpitic slate level, conglomerates and sandstone in metric banks. Thickness ranges from 90-100 m. Trilobites and archaeocyatha have been found, so this layers can be dated as Lower Cambrian.

Vegadeo limestone (Lower-Middle Cambrian)

Continuous carbonate level of highly variable thickness (between 20 and 250 m) composed by limestone and dolomite. Zamarreño et al. (1975) distinguish three members in this formation: V1, V2 and V3. Among the populations of Piedrafita and Visuña, Russo and Bechstädt (1994) carry out a detailed study of the sedimentological and paleogeographic evolution of this formation. In the lower and medium members oolites, oncolites and archaeocyatha can be found, the upper member (V3) is not outcropped. Sediments of the lower member have been interpreted as carbonated tidal plain deposits.

Los Cabos series (Lower Cambrian - Ordovician)

Described by Lotze (1958), this powerful detrital formation is constituted by alternations of quartzite, sandstone and slate. This series is well represented in the western sectors of the Mondoñedo, Navia and Alto Sí mantle domain. It is considered to be formed by low energy sediments from shallow marine platform sporadically submitted to high energy events caused by storms. This formation is related to the set formed by the formations of Villamea layers and Armorican quartzite.

Villamea layers (Upper Cambrian – Lower Ordovician)

They outcrop along the normal flank of the Courel syncline, and are concordant upon the Vegadeo limestone. They are composed of an alternation of grey slates, sometimes of ampelitic character, and light sandstones in slender levels. Thickness is very variable because Silurian is discordant upon it, being estimated at least at 250 m.
Armorican quartzite (Lower Ordovician)

It is overlying the previous one and it is formed by white or grey orthoquartzites in important banks, alternating slender slates layers. Its power is very variable, but lower than in other zones of the Courel syncline, and it is conditioned by the Silurian unconformity. Evidences that state an Arenigian Age can be found.

Luarca slates (Middle Ordovician)

Formation essentially constituted by monotonous black or bluish-grey slates. Their power is very variable in the core of the Courel syncline, disappearing eastward. Gutiérrez Marco et al. (1999) studied the whole Middle Ordovician in the peninsular NW, especially in this formation. They found many fossiliferous localities that had provided abundant graptolites. This evidences an Oretanian Age (Middle Ordovician).

La Aquiana limestone (Upper Ordovician)

It consists in not very powerful lenses of grey or white banded limestone. It is discordant at a regional scale since it lies on different age formations (Villamea layers and Luarca slates). Remains of crinoids can be found frequently. In the upper parts there is a ferruginous brecciod level produced by the Pre-Silurian karst.

Folgoso formation (Silurian)

Named as such by Dozy (1983), they are formed by a basal section of black amplitic slates and lydite with graptolite. On this level slates overlap with chloritoids and sandstone, quartzite and limestone levels. Its power is estimated at 150-400 m. This variation is attributed to the mechanic behaviour of these materials during deformation. The formation is discordant upon the Luarca slates, Armorican quartzite and the Villamea layers. Given the transgressive character, it is supposed to belong to the Llandoverian or Ludlowian Age.

Seceda layers

The core of the Courel syncline shelters some outcrops of Devonian materials: slates with chloritoids, quartzite, sandstone and slender levels of limestone. Brachiopoda and tentaculites can be found in these materials. Thickness is around 50 m.

B.1.3.2. Lithostratigraphic succession in Central Iberian Zone (CIZ)

Stratigraphy emphasises the transgressive character of the Lower Ordovician quartzite and the uniformity of the Ordovician-Silurian materials. The boundaries with the WALZ have already been described. The zone would be represented by the “Ollo de Sapo” domain, which occupies most of the territory. The lithostratigraphic relationship has been compartmentalised according to the great regional structures, as reflected in Table 1. All the sequences described below correspond to the Ordovician-Devonian pre-orogenic succession, except the San Clodio synorogenic succession.
B.1.3.2.1. Reverse flank of the Courel syncline and the Piornal anticline

From wall to ceiling the following units outcrop

Soldón slates (Lower Ordovician)

They are constituted by black and grey slates with abundant intercalations of sandstone levels. This lithology is similar to the Villamea layers from the Courel domain (Martínez Catalán, 1981) and to Los Montes layers from the “Ollo de Sapo” domain (Riemer, 1981). The denomination Soldón slates (Barerra et al., 1989) obeys to the fact that the underlying formations are unobservable. For this reason, the materials can be assigned to the West Asturian-Leonese Zone or to the Central Iberian Zone. This unit outcrops in the core of the macrostructure called Piornal anticline.

The age of this formation is not known accurately. It can only be dated by correlation with other stratigraphic units with similar lithology located under the Armorican quartzite. It is admitted that the upper part can belong to the Areginian-Tremadocian (Lower Ordovician), while the lower part could belong to the Upper Cambrian.

Barros and Rodríguez Suárez (1992) distinguish three members inside this formation:

Lower member

It is composed by an alternation of sandstones and quartzite in decimetric to metric banks, slates with arenaceous laminations and some levels of slates.

Middle member

It is a basically slaty succession, which allows the distinction from the underlying (described above) and overlying units, both with more detrital rocks.

Upper member

It is formed by an alternation of sandstone or quartzite and intercalations of slate levels with abundant arenaceous laminations.
Armorican quartzite

White or grey orthoquartzites alternated with slender sandstone and slate layers. This formation usually occurs in the highest zones and the most pronounced relieves, standing out in the field and outlining the “Pliegue do Courel” landscape. The power of this formation ranges from 50 m (W) and 300 m (E).

Transition layers

This unit constitutes the transit between a series formed by quartzite and sandstone and another one composed by slates (Luarca slates). Riemer (1966) called them Rubiana layers, characterised by the presence of one or several slender levels (from few centimetres to 2 m) of ferruginous composition. These characteristic layers are brownish or green, thick and sometimes with a microconglomeratic texture. Traditionally, the set composed by the Armorican quartzite and the transition layers are assigned to the Arenigian.

Luarca slates

They are defined as a formation constituted by a succession of dark grey slates, with sporadic arenaceous intercalations. The power of these slates varies from N to S and W to E. The greater thickness (around 600 m) can be found in the western and central parts of the reverse flank of the Courel syncline (mainly in the province of León) and it decreases towards the NW (in Serra da Trapa), due to the Silurian unconformity. The outcrops of this formation in the southern part (normal flank of the Piornal anticline) are narrower and usually do not overcome 30-50 m of thickness. In this formations are sheltered the slate deposits of Palacios da Serra-Vilarbacú, within the limits of the Geopark.

La Aquiana limestone

It has already been described. Very variable thickness (0-30 m) due to its lens-shaped form.

Upper Ordovician

Over La Aquiana limestone or directly between the Luarca slates and the Silurian black graptolitic slates a pack of white or grey quartzite with a power of 2-8 m can be observed. Over these banks there is also a level of slates with arenaceous laminations that Guillou (1969) relates to glaciomarine diamicrites.

Folgoso formation (Silurian)

Seceda layers

Both described above.

B.1.3.2.2. Normal flank of the Piornal anticline or the Sil syncline

Located in the central part of the Geopark unitl the Sil river. It presents almost the same succession described in the previous section. However, in this case the outcrops of glaciomarine diamicrites are clearly visible. It is a slate facies characterised by calcareous clastic, dissolved or not, and interpreted as “dropstones”. This variety is well developed in the Truchas syncline, where the Rozadais formation from the Upper Ordovician (Barros, 1989) is located. The presence of these diamicrites and the “Ollo de Sapo” outcrop in the eastern part of the Teleno anticline (which is the lateral continuation of the Pieronl anticline) led Martínez Catalán et al. (2004) to assign this anticline and the Sil one to the “Ollo de Sapo” domain in the Central Iberian Zone.

B.1.3.2.3 Sil syncline and “Ollo de Sapo” anticlinorium

These formations comprise the southern strip of the territory, on both sides of the Sil river channel. Two new formations outcrop: the porphyritic “Ollo de Sapo” and, over the synorogenic materials, the “San Clodio series”.

The “Ollo de Sapo” domain outcrops visibly in the core of the Vilachá anticline and it is defined by the presence of some very characteristic glandular gneiss. It is supposed to have a volcanic-detrital origin and belong to the Cambrian-Ordovician.
The rest is a succession from the Ordovician-Silurian (Los Montes layers, Armorican quartzite, Luarca slates and Silurian).

From wall to ceiling the following formations outcrop:

Porphyritic of “Ollo de Sapo” (Cambrian-Ordovician)

This porphyritic formation outcrops in an anticline structure that continues from the coast of Lugo until the Sanabria region (Zamora), disappearing under the tertiary deposits of the plateau and outcropping again in the eastern part of the Central System - NE Madrid (Parga Pondal et al., 1964).

Depending on the size of the grain, two facies can be distinguished:

“Coarse grained facies” (glandular quartz - feldspar gneiss).

“Fine grained facies” (microglandular gneiss, differentiable from the previous one by the lack of mega- crystals, with a mixture of coarse and fine grained facies, metapelites and quartzites). This facies is the one that outcrops in the Vilachá anticline.

![Appearance of the “Ollo de Sapo” gneiss, coarse grained facies.](image)

Many different explanations have been given to the genesis of the “Ollo de Sapo”. The prevailing interpretation opts for its volcanic and volcanic-detrital origin. In the outcrop in the region of Sanabria, two facies can be distinguished (Díez Montes et al., 2010): glandular gneiss, epiclastic tuffs, coarse grained tuffs, welded ignimbrite and metariolites. Furthermore, this region is composed of two great volcanic structures, rhyolitic-rhyodacitic domes, separated by a slender sedimentary succession. The domes are zoned and their cores are formed by glandular gneiss (which has a subvolcanic character).

The age of this formation has been discussed and is currently set in the Cambrian-Ordovician limit (Gebauer, 1993; Díez Montes et al., 2010).

Los Montes layers (Lower Ordovician)

Defined by Riemer (1963) as “Montes Schichten”, this unit is composed by black and grey slates, some ampelitic levels and arenaceous intercalations. In the base, there is often a quartzitic or microconglomeratic level. Thickness is quite constant and is estimated at 300 m.

On the discordant character of this unit, most of the authors opt for the existence of a discontinuity more or less clear, originated in the Toledanic phase. Other experts consider that there is no appreciable discontinuity.

It is considered to belong to the Tremadocian by correlation with similar lithology where Cruziana has been found (Matte, 1968, Pérez-Estaún, 1978).
Armoricane quartzite (Lower Ordovician)

This lithostratigraphic unit, related by Matte (1968) to the quartzite of the same name of the Armocian French Massif, is formed by white quartzite and some slender slate levels. Its power varies between 40-250 m.

In some parts over the Armoricane quartzite an alternation of quartzite, slate and sandstone banks can be found, with some ferruginous levels called “transition layers” (Riemer, 1963; Nollau, 1966).

Luarca slates formation (Medium Ordovician)

It was described for the first time by Barrois (1882) in the Asturian coast and specified by Barros (1989) in the southern part of the Truchas syncline. This formation is constituted by a monotonous succession of grey and black slates, with sporadic arenaceous intercalations (of centimetric to decametric thickness).

Upper Ordovician

In the zone of Peites, SE corner of the territory, under the black slates and with chloritoids, siltstone has been localised, possibly with pebbles, and laminated slates. This evidences that the formation could match to the Upper Ordovician.

Upper slates (Silurian)

They are similar to the Folgososo formation previously described. They are composed by a basal section of black slates and lydite with graptolites. Over this section overlap slates with chloritoids and sandstone and quartzite levels.

Synorogenic succession of San Clodio (Carboniferous)

They are the most recent Palaeozoic sedimentary materials in the region and occupy the Sil syncline. These deposits are contemporary to the first and second phases of the Variscan deformation.

They are composed of argillites, greywacke, lydites (radiolarites) and microconglomerates with metamorphic rock pebbles that show several tectonic foliations which are previous to the foliation that encompasses them. This evidences their synorogenic character. The presence of vegetables is outstanding, although they are unclassifiable. Ichnofossils have also been cited.

The synorogenic succession of San Clodio was dated by using detrital zircons. Martínez Catalán et al. (2004) found that the most recent populations include carboniferous zircons: the youngest one is 324 m.a. (Serpukhovian, Upper Mississippian). The succession is integrated into others complexes in the Galicia-Trás-os-Montes Zone (GTMZ).
The succession of San Clodio is an exception because it is outside the GTMZ (although it is close to this zone) and it is discordant upon the autochthon to the ZCI. It is also discordant upon the reverse flank of a recumbent syncline from the first phase of the deformation, equivalent to the Courel syncline and situated a few kilometres Southwest (Fig. 4; Martínez Catalán et al., 2016). These authors found that the synorogenic formations from the peninsular NW have more modern zircons as they occupy lower positions in the interweaving of the paraautochthon. San Clodio is the one that includes the most recent ones. They deduce that this type of succession was deposited in a diachronic way in grooves formed by the flexion of the lithosphere as the overthrust of the allochthon is produced.

B.1.3.3. Cenozoic

Cenozoic materials are scarcely spread. They are mainly situated over depressed zones as remains of sedimentary basins dismantled by erosion.

The most important are the Neogene deposits that are located in tectonically depressed zones originated during the Alpine Orogeny. The trench of Quiroga would be the most representative one. They are non-consolidated sediments formed by conglomerates, gravel and clay. Many auriferous exploitations were located in these deposits.

The Quaternary is formed by a group of superficial formations and developed soils, preferably slopes and valleys. There are two types of deposits: alluvial, terraces, colluvial deposits, glacial moraines, etc.

B.1.4. Plutonic and subvolcanic rocks

In respect of plutonic rocks, only outcrops a little portion of granite in A Rúa, in the SE part of the territory, near to the locality of Ferreira. The subvolcanic rocks are represented by the quartz dikes, especially by the diabase ones.

A Rúa Massif

It is a Variscan two-mica granite, post-tectonic to the third phase of the deformation. The most common materials are muscovite biotite porphyritic granite, medium-coarse grained and grey, pink tones are also possible due to episienitization processes.


It produces a contact aureole with an outcropped width of more than 1 km. It affects the Ordovician materials and the Silurian-Devonian series, presenting a low-grade regional metamorphism. The effects of the contact metamorphism are revealed in the blastesis of andalusite and biotite.

Quartz dikes

They are represented at all scales, filling tardi or post-Variscan fractures in a NW-SE or NE-SW direction. Occasionally mineralised.

Diabase dikes

They consist in asubvolcanic formation of NE-SW direction that intrudes in a subvertical way and great continuity the Upper Cambrian and Ordovician Series.

They occupy a large strip of about 10 km in length and more than 4 km wide in the centre of the territory. The individual power of dikes is highly variable, from 1 to 10 metres. Outcrops are yellowish-green, mottled, non-foliated and strong.

Geochemistry indicates a possible association of basic alkaline and subalkaline magmas derived enriched during the Cretaceous magmatism, as in other sectors of the Iberian Peninsula, with processes of rifting in the opening of the gulf of Vizcaya.
B.1.5. Tectonics

There are tectonic movements previous to the Variscan Orogeny, responsible for the majority of the observable structures. They are translated into stratigraphic discontinuities and low angle unconformities. They would be epeirogenic movements, soft ballooning or tilting in block tectonic.

The main observable structures were formed during the Variscan Orogeny. The first phases were compressional but once the continental crust had been thickened and warmed, it experimented a gravitational collapse that resulted in the extensional phases.

Subsequent movements to the principal Variscan created two fault systems of NW-SE and NE-SW directions. Saint Eufemia fault would be an example.

In the end of the Carboniferous and the beginning of the Permian, erosive processes started and so the dismantling of the mountain chains created by Variscan Orogeny. As a consequence, a razing and a levelling happened, creating penepains and making possible the outcrop of the deepest zones of these chains, turned into a base or a plateau sloping down towards the Mediterranean.

In the beginning of the Mesozoic a deformation is produced. It is called tardi-Variscan and compartmented the super-continent of Pangea. In this Era tardi-Variscan faults work vertically.

The Alpine Orogeny produced the reactivation of ancient faults in the Variscan basement, as a consequence of the efforts transmitted from the borders of the Iberian microplate, due to the approach of the Eurasian and African plates. The movement of these high-angle reverse faults produced raised blocks (as the main part of the territory) and depressed zones that were filled with materials from the erosion of those raised zones (such as the trench of Quiroga). This movement would also be responsible for the intrusion of the diabase system tract, occupying an extended strip in the central part of the territory,
It can be concluded that the current situation could not be attributed exclusively to tardi-Variscan movements: fractures would have an important role during the Alpine Orogeny. This Orogeny would produce tectonic trays filled by Neogene deposits later. The last phases of this Orogeny would create the current geomorphological relieves and the different types of Plio-Quaternary deposits.

The main structures from North to South are:

- Seo anticline. The Villalba series outcrop in its core.
- Seoane-Oencia monocline. Normal flank of the Courel syncline, where the stratigraphic succession comprised between the Neoproterozoic and the Devonian outcrops.
- Courel syncline.
- Piornal anticline.
- Chao do Couso fault.
- Sil syncline.
- San Clodio fault.
- Vilachá anticline. The porphyroid “Ollo de Sapo” outcrops in its core.

It is important to mention the post or tardi-Variscan fractures of NE-SW direction, Santa Eufemia and Eiriz faults, with more than 30 km and a vertical slump of several hundred metres.

Figure 4. Geological section through the reclined folds of Courel Mountains, the Sil syncline and the Vilachá anticline, according to Martínez Catalán et al. (2016).
B.1.6. Metamorphism

In the Geopark area, regional metamorphism is low to medium grade. It is represented in the chlorite-chloritoid and biotite zones. Some places in the Piornal anticline and the Courel syncline shelter associations with disthene, relating them to important structural features, such as the Chao do Couse fault.

In the southern strip of the normal flank of the Piornal anticline, there is also a metamorphic blastesis with the presence of porphyroblast of andalusite and chloritoid. This mineral growing is produced especially in the middle member of the Luarca slates, above all in the western part. This shows an increase in the metamorphic gradient in those zones, which is probably related to the presence of non-outcropping granitic pluton.

Regional metamorphism

Metasedimentary materials have been affected by a regional prograde metamorphism, simultaneous to the Variscan deformation. Its intensity increases from NE to SW, from outer to inner sectors of the chain and making the gradient perpendicular to the Variscan major structures. In certain zones regional metamorphism is overlapped by a later plutonometamorphism that cuts the metamorphic zones.

Disthene is present in some points of the Courel Mountains, related to important tectonic features (Barrera et al., 1989).

According to index minerals in metasediments, the following zones can be distinguished:

Chlorite-Chloritoid Zone

It occupies most part of the “Ollo de Sapo” Anticlinorium domain and the West Asturian-Leonese Zone. Chloritoid levels are related to appropriate composition rocks.

The most frequent mineral associations in metapelites and metapsammites are: quartz + muscovite, quartz + muscovite + chlorite, quartz + muscovite + chloritoid + chlorite, quartz + muscovite + chlorite + albite.

Biotite Zone

It is only limited to some areas in WALZ and the “Ollo de Sapo” domain. The most frequent paragenesis are: quartz + muscovite + biotite, quartz + muscovite + chlorite + biotite.

Retrograde Metamorphism

It happens in relation to the last phases of Variscan refolding and after them.

Contact Metamorphism

Granitic bodies intrude in epizonal domains, producing a contact metamorphism over the regional one. Early and postkinematics biotitic granitoids are the ones with higher intensity of metamorphism, creating aureoles, as horny recrystallizations or textures with fossils and muscovization phenomena.

B.1.7. Economic geology

This territory comprises many mining traces, which may be grouped in two categories: metallic minerals, grouped by their most common mineralizations, and rocks and industrial minerals.

METALLIC MINING

Iron mineralizations

Some are associated to ferruginous levels of the Arenigian ceiling (“Capas de Rubiana” and transition layers). Others are limonite, found in the pre-Silurian karst and used as ochre source.

Lead-zinc mineralizations

Lead-zinc from Vegadeo limestone, especially in the surroundings of Visuña.
Antimony mineralizations

Antimony mineralizations of La Aquiana limestone. The Vilarbacú zone had great importance in the past and remains of mining installations are conserved.

Gold mineralizations

They are sedimentary deposits of gold. Raw gold is originated in the Palaeozoic and its dismantling caused its concentration in alluvial mining deposits. After being eroded, these deposits are reconcentrated in Plio-Quaternary terraces. They were exploited by the Romans between centuries I-III, reaching a high economic value. There are many examples in the territory, like in Montefurado, where the Sil river was diverted by a tunnel to exploit these deposits.

![Roman tunnel of Montefurado, in the Sil river.](image)

Furthermore, native gold was extracted. It was associated to quartz dikes in Portas zone and the mine of A Toca.

INDUSTRIAL ROCKS AND MINERALS

This sector is represented by slates, quartzites, sandstone and calcareous rocks. Among these lithologies the first one stands out. It was used as roof material.

Slates

There have been many attempts to extract this rock and some of them continue nowadays. The most important quarries zone in set in Pacios da Serra, in the municipality of Quiroga. There are also active exploitations in A Campa and Vilarbacú, in the municipality of Folgoso do Courel. This zone along with the other in the provinces of Orense and León contributed to the fact that Spain is the main producer of roofing slates in the world.

The potentially exploitable slate formations are two: Soldón slate and Luarca slate. Most of the exploitations or mining traces are set at this point in the Courel Mountains.
Soldón slate outcrops in the core of the megastructure of the Plornal anticline. There are some traces in Villarmiel, Fisteus and Montouto, although they do not have the same significance as the ones in Vilamartín de Valdeorras (Orense).

Outcrops and deposits in the Luarca slate are located in the reverse flank of the Courel syncline, in the surroundings of Pía Páxaro.

**Limestone**

Over the calcareous formations: Cándana, Vegadeo and La Aquiana limestone. There are also mining activities in Seoane do Courel, Moreda y Vilarmor, in the municipality of Folgoso do Courel. Limestone and dolomite have been traditionally used as building materials and recently as crushed aggregates. There are also attempts of ornamental use.

**Sandstone and quartzite**

There are also works on these stones, essentially on Armorican quartzite. These traces are placed upon sandy layers that permit their slabbed into thin plates, in slopes which are sub-parallel to the dip of the layers where surfaces are more easily stained. They are used as Stone masonry, coatings and welded. They are used as Stone masonry, coatings and welded. The most important exploitation is the Rairos quarry, in the municipality of Ribas de Sil. *(Appendix 6. Geology of the Geopark Bibliography)*

**B.2. Listing and description of geological sites within the proposed Geopark**

For the establishment of this inventory the conventional investigation method has been used. First of all, the most complete and updated geological information has been researched. Also, a contact network has been created in order to enrich the local geological knowledge, by involving regional, national and international university researchers. Additionally, a Geographic Information System has been developed by using high resolution LIDAR information and ortho-rectified aerial images, cartographic bases from Xunta de Galicia, altimetric and planimetric information from the Geological and Mining Institute of Spain) (MTN25, MTN05, WMS). The geosites and other interesting places have also been visited and explored. Further fieldwork includes paleontological characterization, geomorphological cartography and active processes and other research. The organization of the classification of the considered geosites departs from the Spanish geological contexts of global relevance and described in the Law 42/2007, of Biodiversity and Natural Heritage of Spain. Each context is chronologically ordered.
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<td>Lead-Zinc of Vegadeo limestone (Morteira)</td>
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<td>Lead-Zinc in Vegadeo limestone (Corvos)</td>
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<td>Antimony mineralizations of La Aquiana limestone</td>
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<td>Neogene basins with gold mineralizations (Montefurado)</td>
<td>Plio-Pleistocene</td>
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</table>
B.3. Details on the interest of these sites in terms of their international, national, regional or local value.

Generally and due to the described characteristics (such as environment, the adaptation of the population to the environment or the fact that more than a half of the territory is protected by the Natura Network), the landscape and aesthetic value of the proposed geosites and their surroundings is prevailing. This causes that elements of scientific or educational interest are also wonderful landscapes, which is an added value and widens the interest of potential visitors.

The geosites of scientific interest in the “Courel Mountains” Geopark Project are headed by the four points recognised as Spanish Place of Geological Interest of International Importance (PGI). These places, gathered in the inventory with the numbers 1 to 4, create a structure known as “Pliegue de Courel” (Courel fold). This reclined fold was formed during the first stage of the Variscan deformation. It is 10 km wide and results clearly visible due to the folding suffered because of the Armorican quartzite layers. The erosion occasioned by the Alpine Orogeny dug at least four valleys that cut almost transversally the Variscan structures, facilitating its viewing and interpretation. It is remarkable that this circumstance does not happen in the rest of the peninsular Northwest. The points of interest number 5 and 6 are the lateral conformity of this macrostructure in adjoining zones.

Among the Geosites of scientific interest the folds of the Sil syncline (number 7 of the inventory) stands out. This structure is a succession of hectometre order folds and other minor structures, created by the interference of the first and third phases of the Variscan deformation. The synorogenic succession of San Clodio is also relevant since these deposits are originated simultaneously with the second phase of the Variscan deformation. The appearance of the fluvial net, as a result of the Alpine Orogeny, created several cliffs and waterfalls (by differential erosion of the different materials that traverses – essentially, slate, quartzite and limestone –). Besides the landscape value, these structures hold educational significance, since they allow explaining the geomorphological processes and are a great area for the practise of canyoning.

Glacial phenomena occurred in the region during the Quaternary complement the educational and scientific value of the Courel Mountains. Although these processes are less developed than in other zones, they add high value: they are considered one of the few traces of glaciology in the middle mountains regions of southern Europe. The investigations carried out in this region show datings of more than 38.000 years, which proves that Glaciology in the Iberian NW is earlier than it was thought (the dating of other mountains showed less than 14.000 years). (Appendix 7. Glacier forms and deposit traces in Courel Mountains.)

In the territory 25 caves are documented. These caves are developed over Cambrian limestone, one of the oldest in the world, which adds an evident scientific value. This interest increases regarding the palaeontological remains and, above all, in the possibility of reconstructing a climatic sequence of 500.000 years (the longest reconstruction in the Iberian Peninsula) by studying several stalagmites of these caves. Additionally, the easy access to these cavities converts them in an essential resource for scholars to learn the formation process of karst. (Appendix 8.8. Noceda Caves: educational resource for the teaching of endokarst processes.)
**B.4. Listing and description of other sites of natural, cultural and intangible heritage interest and how they are related to the geological sites and how they are integrated into the proposed Geopark.**

<table>
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<tr>
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<td>Roman auriferous exploitation over alluvium.</td>
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<td>Formigueiros mine</td>
<td>Archaeological site with iron and gold mines from the Roman Era to the Modern Era.</td>
<td>Vieiros</td>
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<td>Montefurado tunnel / Boca do monte</td>
<td>Roman tunnel dug in the centuries I-II to drain one of the meanders of the Sil river and exploit gold.</td>
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<td>Roman tunnel dug in the centuries I-II, destined to bring water to mining exploitations.</td>
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<td>Roman bridge over the Bibei river, built for the crossing of Vía XVIII or</td>
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<td>Medieval castle in the pilgrimage route to Santiago (Camino de Santiago)</td>
<td>O Castelo</td>
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<td>Rock castle with visual control of the territory.</td>
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<td>Santiago) cross the Lor river.</td>
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<td>21</td>
<td>Historical set of Hospital</td>
<td>Historical complex related to the “Encomienda de San Juan de Jerusalén”. It</td>
<td>Hospital</td>
<td>Urban Development Plan (PXOM)</td>
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<td>is composed by the XII century church, the tower, a calvary (“cruceiro”)</td>
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<td>and “la Casa de la Encomienda”. In the pilgrimage route of Santiago (Camino</td>
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<td>22</td>
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When choosing the appropriate location for each activity, the human being establishes a form of using the space adapted to environment and the place becomes an indissoluble part of the work to be performed. Human and territory are melted in the original idea of the project. From the territory “Courel Mountains”, we understand that the history that we have to tell is the relationship between humans and nature. The places of cultural interest throughout the territory support this proposal.

Talking about the cultural heritage of this region is talking about geology, about how the inhabitants of this territory seized the materials offered by the environment to meet their needs: Palaeozoic rocks, slate, quartzite and limestone. Nature was part of religious principles, which are difficult to interpret, although some have remained up until today. The Fiais petroglyphs, carved in two slate flagstones and hung towards the deep Soldón river valley, are an example.

Since Antiquity, when it comes to building a house, this territory granted everything the constructors needed. Stone, iron, lime and wood. Slates, extracted from the surroundings and easy to carve and install, allowed the construction of walls and roofs quickly and safety. The use of this material started with the construction of the first villages, as seen in the Castro settlements of Vilar or Sobredo. Traditional architecture is also provided of this rock. Almost every village of this territory is built in this way or alternating slate with quartz or lime. Houses, sheds or walls are constructed with materials found in its immediate environment, with Palaeozoic stones. Outstanding examples are villages such as A Cubela, A Seara, Seceda or Froxán (the last two have been declared places of cultural interest). Iron was extracted from the ferruginous levels of the Lower-Ordovician transition layers or from limonite of the pre-Silurian karst, in exploitations like the “Veneira de Formigueiros", a listed archaeological site which operated
until the end of the XIX century. Iron exploitations are distributed throughout the territory and supplied
the Castro settlements of the I century, as the discovery of a forge in Sobredo proves. Later, the fifteen
blacksmiths that worked until the end of the XIX century supplied with iron the regional industry. Two
examples of these blacksmiths are Ferrería Nova de Seoane do Courel and Ferrería de Rugando. Hand-
crafted locks, nails and handles made of iron were used in every village of the territory. To embellish
the buildings (from the Castro Era) or as mortar (from the Medieval Era), the calcareous stones of the
territory were calcined in any of the six ovens or “Caleiros” documented in the region. This activity is
unusual in Galicia because the calcareous outcrops are scares and are limited to a reduced strip in the
Community. The use of lime is extended throughout the Geopark area, as ornament or building material.
The Medieval castle of Carbedo or the Roman bridge over the Bibei river are good examples of this use.

The key to understand the relations between cultural heritage and geology and how is it integrated into
the Project and in our vision is the auriferous exploitations of the Roman Era. The region sheltered about
a hundred of these mines.

Between the I and II centuries, around 20,000 pounds of gold were extracted each year in Asturica and
Gallaecia by workers of the Roman Empire. Almost 6,500 kg. This Paleozoic raw gold, associated to
quartz veins among slates and quartzites or deposited in the sandstones of the rivers or the Plio-Qua-
ternary terraces as a result of the erosion of primary deposits, was profusely exploited in our territory.
Almost every exploitation system is documented, along with the evidences of the necessary infrastruc-
tures to carry out the activity. The archaeological sites known as “Túnel de Penafurada” or “Túnel de Ro-
meor” are actually two excavated galleries to give continuity to the water supply of the gold mines. The
exploitations of Montefurado or Margaride are mines where secondary gold was extracted from fluvial
terraces, while A Toca or Covallón mines are primary gold exploitations. The Tunnel of Montefurado is an
impressive engineering work destined to drain one of the meanders of the Sil river to wash its auriferous

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<td>Val da Fonte chestnut forest</td>
<td>Example of Castanea sativa.</td>
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<td>3</td>
<td>Orchids (Alto do Couto Microreserve)</td>
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<td>A Rogueira meadows</td>
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<td>Cereixido yew forest</td>
<td>Example of Taxus baccata L.</td>
<td>Cereixido</td>
<td>Decree 10/2015, of 22nd January, that modifies the Decree 67/2007, of 22nd March, that regulates the Galician Catalogue of singular trees / Urban Development Plan</td>
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The region of Quiroga is one of the most famous Galician regions, at institutional and popular level when it comes to natural heritage. Mediterranean-weather species, exceptional in northern Spain, such as olive tree, corn oak, holm oak or strawberry tree, can be found in the South. Nevertheless, chestnut is considered the most important species in the region, since it supplies food, wood and economic incomes. Autochthon woods abounds in the territory, granting its acknowledged natural prestige. These woods produced the wood needed for construction or source of heat, but their real importance lies in their common-property character: the property of these woods belonged to the whole village. This communal tradition has its origin in the X century and implies that the whole community work in the maintenance and care of the forest mass. This kind of property strengthens social bonds and creates collective identity. This is the reason to consider it one of the values that we try to enhance in this Geo-park Project. Communal forests are one of the greatest values of the intangible heritage of the territory.

The “Devesa da Rogueira” is a good example of these autochthon woods magnificently conserved and with thousandstons of visits every year. It is an Atlantic forest of 3 Km2 and steep slopes protected by a cirque glacier. As we get into this biological jewel, vegetation changes. In the lower zone, meadows and chestnuts evidence the anthropogenic utilisation of the territory. As level raises, density of tree coverage increases and species change, appearing hazelnut and oak trees. In the upper part, diversity increases with beech, holly, birch and sorb tree. 90% of the botanic species of Galician are present in this forest.

C. Geoconservation

C.1. Current or potential pressure on the proposed Geopark

Currently, the surface proposed as Geopark has activity-related risks under control for several reasons. Most of the surface of the Geopark (53%) is integrated into the Natura Network. This limits the possible enlargement of the slates quarry or the creation of new exploitations. In addition, is establishes the duty of asking for permission to visit any of the caves in the region, which allows an exhaustive control of visits. Regional tourism is increasing due to institutional and private efforts, but is far from saturating the capacity of the territory. Accordingly, negative impacts related to mass tourism would be avoided by the design of a policy orientated to quality tourism.

The territory proposed as Geopark contains several quarries in use: three of slate and one of quartzite. Two are located in the municipality of Quiroga, occupying almost the same space since long ago and working at slow pace. The third one, situated in Folgos do Courel, is currently working in underground galleries with minimal impact. The fourth exploits quartzite at extremely low pace of work and is located in the municipality of Ribas de Sil. It must be accepted that this industrial activity could generate a negative impact. However, the exploitation zone is set inside the proposed area and it is completely surrounded by the Natura 2000 Network and, consequently, its development is strictly controlled. Moreover, the region is working to keep the compatibility of these exploitations, which provide direct and indirect employment, and the conservation of environment by mitigating the possible negative impacts. For this purpose, we have been working closely with the Official Mining Chamber of Galicia, which is integrated into the structure of the Geopark.

The last potential risks factor, and perhaps the most important for the interests of the Geopark Project, is the strong loss of population and the emigration of the young population. Without the native human factor, connoisseur and lover of the environment and its traditions, keeping this space alive will become a difficult task. The lack of generational replacement produces the abandonment of the villages and farmlands and the disappearance of a way of live and one of the mainstays of the Candidacy. The inclusion of this territory in the UNESCO Global Geopark Network would help to reverse this situation significantly.
C.2. Current status in terms of protection of geological sites within the proposed Geopark

Among the applicable protection figures, the declaration of the Campoloda-Leixazós fold as Natural Monument (Reference 1 of the Inventory of geoisites) stands out. This designation became effective after the publication of the Decree 120/2012, of 26th April, that declares natural monument the geological fold of Campodola-Leixazós (Quiroga).

84.4% of the geoisites gathered in the inventory of the Geopark Proposal are integrated into the Natura 2000 Network. This guarantees their protection and shows the great natural value of the territory proposed as Geopark. Each geoisite, besides its declaration as place of cultural or natural interest, has its respective protection measures. Thus, every archaeological site is protected by the Law 5/2016, of 4th May, of the Cultural Heritage of Galicia, and by the urbanistic planning of each municipality. Some of them, such as the elements 1, 17, 18, 19, 25 and 26 of the inventory of places of cultural interest, enjoy the highest protection level: place of cultural interest. The places number 1 and 4 of the inventory of places of natural interest are protected by the Decree 67/2007, of 22nd March, that regulates the Galician Catalogue of Singular Trees, and the urbanistic planning of the corresponding municipality.

Among the places of natural interests the protection of the orchids of Alto do Couto, Carbedo and Visuri stands out. This protection consists in a particular agreement between the proprietors and the Galician Association for Territorial Custody signed in 2015. This shows the interest of the inhabitants of the territory in the conservation of their resources.

Finally, the Law 42/2007, of 13th December, of Natural Heritage and Biodiversity says:

Article 49. Areas protected by international instruments:

1. The natural spaces formally designated according to International Conventions and Agreements entered into by Spain will be considered areas protected by international instruments. Particularly, the following ones:

   e) The Geoparks declared by UNESCO.

It is worthy of mention that the most important points of interest within the territory proposed as Geopark are protected under these figures.

C.3. Data on the management and maintenance of all heritage sites (geological and non-geological)

From a general view, the administration that holds the competences of management and preservation of the territory proposed as Geopark is Xunta de Galicia. More accurately, the General Direction of Natural Heritage of the Department of Environment and Territorial Planning, General Direction of Rural Development of the Department of Rural Areas and the General Direction of Cultural Heritage of the Department of Culture, Education and University Organisation. However, the day-to-day management and preservation is run by the Association for the Territorial Promotion of Courel Montains, a non-profit organisation formed by the municipalities of Folgoso do Courel, Quiroga and Ribas de Sil. The staff members assigned to the association (a geologist, an archaeologist and a geographer) and the human resources of the cited municipalities are responsible for the preservation of heritage. For example, municipalities must keep in optimal conditions hiking trails, information panels, route indications, etc. Staff from the Museum of Geology of Quiroga belong to the municipality, so will the staff members of the future Folgoso do Courel caves interpretation centre and the Roman auriferous mining of Ribas de Sil one.
D - Economic Activity & Business Plan (including detailed financial information)

D.1. Economic activity in the proposed Geopark

The region of Quiroga is a territory immersed in a process of demographic regression, which is shared with the rest of the mountainous regions of the Autonomous Community. From 10,447 inhabitants in 1986, the population decreased to 5,406 in 2016: a population loss of 50% in 30 years. The lack of working opportunities caused the migration of young population since the middle of the XX century. This impacted negatively on the main economic sector of the region (agriculture), letting the development of industry and the service sector. Currently, the service sector concentrates 65% of the labour force and it is mainly situated in Quiroga. In the other most important localities in the territory, San Clodio and Folgoso (municipal capitals of Ribas de Sil and Folgoso do Courel), tertiary sector is represented by the same services but in lower quantity and number, except for tourism. In the end of the XX century and the beginning of the XXI, industry represented an authentic value for the region. The three slate quarries that fully operated absorbed an important volume of workers. By 1996, this sector employed 508 workers, 26% of the working population, while today it only has 246, 16% of the working population. Economic crisis damaged one of the most important regional resources: slate quarries. Nowadays, their production is lower than before, although it is still relevant. Another sector was impacted by crisis: construction, which only occupies 8% of the working population.

85% of the territory is forest. However, this activity is not very developed in the region. Chestnut production involves 1800 ha (3’11% of total surface) and it is considered as economic support and a family activity, not in an industrial way. The activity is limited to harvest and selling to distributors outside the territory. The situation is different in the winegrowing sector. The 587 ha of vines represent 23’48% of the surface of the demarcation of the Regulation Council of Ribeira Sacra. This sector employs many people during harvest, although the activity in wineries has few workers. The production is around 339,000 litres of wine, which represents more than 6% of the production of the Denomination of Origin.

Oil production is starting to recover. A group of new producers is planting olives due to their perfect adaptation to the regional weather and the quality of oil. Studies show that the two species used in this activity are endemic and were not catalogued until now. Besides oil, honey is just beginning to take up: in 2002, a group of beekeepers created the Cauru cooperative, producing ecological honey.
In conclusion, it is evident that since the disappearance of the slate quarries as motor of regional development and given the limited and seasonal character of the other economic sectors, growth perspectives are also poor. Service sector, despite being the largest, is composed by self-employed with hardly any hired staff. This sector offers services to a dwindling population with high unemployment (over 16% of the labour force). The only growing sector is tourism. The region of Quiroga is favoured since it is part of two of the most recognised spaces in Galicia: Ribeira Sacra and Courel Mountains. We have prestige, quality products, landscape and infrastructures, etc.

Becoming one of the UNESCO Global Geoparks is the greatest boost to development that the region can ask for. An acknowledgement of the work done for the last years, oriented to offer growing possibilities to our inhabitants and keep this land alive.

2. Existing and planned facilities for the proposed Geopark (e.g. geo-education, geotourism, tourism infrastructure etc)

The “Courel Mountain” Geopark Project has been working several years to create installations that offer the visitors all the necessary information to understand this space. Thus, along with the existing facilities promoted by the regional business and municipalities, the Association designed and launched some points of interest related to geotourism and education. We are also working on the development of new infrastructure. Currently, the territory has four interpretation centres and two more will be ready for next year. The Museum of Geology of Quiroga, the Museum of Ethnography of Quiroga, the Museum of Ethnography of Vilar and the Nature Classroom of Moreda introduce visitors to geology, cultural heritage and the regional environment. The future interpretation centre of the Roman auriferous mining of San Clodio and the interpretation centre of Meiraos caves will complete the offer of knowledge centres in the region. In order to understand the Geology and history of the Courel Mountains in a more relaxed way, 15 viewpoints are situated in the places of interest of the region. The Campodola fold, the meander of the Sil river in La Cubela, the glacier valley of A Seara, the Roman tunnel of Montefurado or the castle of Carbedo are some of the places of interest interpreted. It is planned the construction of other 5 new viewpoints that will help to know and enjoy the landscape. There are 9 homologated hiking routes and 5 in stage of homologation, all oriented to leisure time and learning. These routes run through the main geological and historical locations and are fundamental to understand the strong relation between the inhabitants of the region and the environment, the common thread of this Geopark Project. Among these routes, one stands out because of its social, historical and human value: the winter pilgrimage route to Santiago (Camino de Invierno a Santiago). This route is the natural entrance to Galicia from the plateau, following the Sil river valley. Additionally, this route was used by the Romans in order to find auriferous sites in the sandstones and terraces of the river and, probably, it was also used for Quaternary fauna to get into the territory. Among the infrastructures related to education, the Scientific Station of Courel is outstanding: a centre managed by University of Santiago and equipped with installations destined to support investigation and teaching. Moreover, the region has 839 hospitality units, a parking area for motor homes and two municipal offices of tourism, one in Quiroga and another one in Folgos do Courel. (Appendix 10. Facilities of the Candidacy.)
D.3. Analysis of geotourism potential of the proposed Geopark

The departure point is a territory where the demand for tourism is far from saturating the offer. Visits are gradually increasing. These visits usually take place at the weekend, in the case of couples or groups of friends, or only extend for a day or a few hours in the case of package tours.

One of the objectives to achieve is to prolong these visits. However, the tourist that enjoys the Courel Mountains is faithful, since is coming several times a year. Touristic potential lies in the relation between humans and Palaeozoic and the adaptation to geology as a way of life. Next paragraphs develop this common thread.

- The spectacular landscape of the territory marks the first impression of the visitor. This is one of its attractions. In the northern zone there is a succession of cliffs and valleys created by the Alpine Orogeny, standing out the strong relieves caused by the erosion of Palaeozoic slate, quartzite and lime. In the South, the channel of the Sil river opens a wide valley in the tectonic depression of Quiroga/San Clodio: new landscapes and a great contrast.

- The fluvial net produced by Alpine Orogeny permitted that waterway profusely eroded the Palaeozoic materials folded millions of years before, in the Variscan Orogeny. These erosive processes formed valleys that allow to see the Courel Syncline in several points. The most important is the Campodola-Leixazós fold. This Global Geosite is also a Natural Monument since 2012 and the highlight of the Geopark Proposal.

- The northern zone of the territory the glacier modelling creates very attractive and poorly known landscapes. Although these are not the most spectacular remains of our environment, they stand out because of their scientific and educational value. Middle mountain glaciers are rare in southern Europe and almost unique in the European Geopark Network. After several studies, it was concluded that this kind of glaciology is more ancient than it was thought, delaying its origin to 38,000 years. Until that moment, datings situated this formation in 14,000 years.

- Calcareous outcrops hardly occupy 4% of the territory. However, they have a high touristic potential due to their scientific and educational importance, besides their leisure and landscape interest. There are 25 documented caves with 6 km of pipes. In the field of research, these cavities have provided information about the Quaternary fauna of the peninsular northern. The most outstanding species is the cave bear. The study of 6 stalagmites of these caves allowed recovering a climatic sequence of more than 500,000 years, the longest in the Iberian Peninsula and two species of endemic beetles have been documented. Concerning leisure, karsts are important for speleology in the Autonomic Community; given that this type of stone is scarce in Galicia (it is only present in Sima Aradelas, with 173 m). Many of these cavities are suitable for everybody. Therefore, they are optimal for scholar to learn karst processes. This proposal has already been developed.

- Additionally, the relation between humans and the Palaeozoic is even more important in calcareous zones. Thanks to this kind of stone, the inhabitants of the territory were able to construct buildings. The calcination of calcareous stones in the 7 ovens distributed throughout the space provided the necessary lime for the Medieval mortars or the embellishment of traditional buildings. The exokarst Val das Mouras is a geoform of international importance because of the antiquity of its rocks (Lower Cambrian) and the landscape development. This landscape could not be understood without human action: the narrow corridors created by the dissolution of the calcareous stone in the Quaternary were exploited to plant chestnut forests. The result is of spectacular beauty.

- Geology and geomorphology also mark the archaeological sites of this space. From the Prehistory to the Medieval Age. In the South, the terraces of the Sil and Quiroga rivers provide the necessary elements for the settlement of the Palaeolithic habitats: diaphanous areas that permit a great visibility of the environment, the climatic protection given by the Alpine northern mountains and the quartzite pebbles used as raw material, made these settlements possible (for example the settlement of Gándana Cha). The existence of primary gold and its later secondary deposit on fluvial beds or Neogene clays gave rise to more than 100 gold mines, which were exploited in the Roman Era. Castro settlements find over the quartz and slate spurs an excellent topography for their construction.
Strong natural falls originated in stream erosion give natural defences impossible to emulate in an anthropogenic way. Stones from the surroundings were used in walled defences and building. This topography benefits the settlement of Medieval castles. Two of the five castles documented are preserved. Their construction following the same process than the protohistoric and Roman Castro settlements: the utilisation of the Palaeozoic materials of the surroundings. These castles were also built to protect roads, for example the winter pilgrimage route to Santiago. This route is 240 km length and 35°5 cross the southern part of the territory. Although the recognition of this route is recent (Law 5/2016, of 4th May, of the Cultural Heritage of Galicia), its touristic potential is considerable. The global acknowledgement of these routes and the fact that it was chosen by many pilgrims before being officially recognised guarantee the positive impact of this route in the region.

- Iron extracted from ferruginous levels of the transition layers from Lower Ordovician or from limonite from pre-Silurian karst is the origin of the former iron industry. It was the third most important in the Iberian Peninsula (after the industries of Basque country and Navarra) in the Modern Era. The most important mine for extension and period of exploitation is the so-called “Veneira de Formigueiros”, in the upper part of the territory. In order to extract this mineral, 15 blacksmiths were created and many of them continue in use (like the so-called Ferrería Nova de Seoane do Courel, which has been restored, and Ferrería de Rugando, that has become a rural tourism business).

- Again, geology marks one of the touristic potentials of the region: ethnography. As explained previously, the Palaeozoic substratum determines the structures and traditions. Hydraulic cereal mills, oil mills, chestnut dryers or “alvarizas”, structures risen as wall to protect hives are built with slate or quartzite. The utilisation of these materials adapts the anthropogenic spaces to environment in a perfect way. This region has been working for years in the enhancing and preservation of these ways of life. A clear example is the interpretation point of A Granxa “Alvariza”, the recovery of calcareous stones oven (Vilamor or Cereixido), the chestnut drying festival of Froxán or the recovery project of the mill of Carballido. It is worthy of mention the recovery of villages such as A Cubela, Froxán or Seceda due to their high ethnographic interest.

- Devesa da Rogueira is an autochthon wood, unique in Galicia, where biological diversity is only possible due to its geology. Its location in a cirque glacier and the existence of a slate and quartzite substratum and the Vegadeo lime make the coexistence of chestnut, holly, beech and birch possible. Devesas or autochthon woods were the main source of wood for construction and firewood from the first settlements.

- The South is under the Denomination of Origin Ribeira Sacra. This winegrowing denomination, one of the five existent in Galicia, was approved in 1996 by Xunta de Galicia. Among its duties appear guarantee the quality of wine, promoting and protecting their name. The acknowledgement of their quality lies in the slate and lime substratum where vines are set. Geology plays again a fundamental role.

- Gastronomic and cultural festivals are important when it comes to the touristic potential of the territory. The oil festival (“Muestra del aceite”) of Quiroga and the chestnut festival of Folgoso do Courel have been declared as festivals of touristic interest of Galicia. The number of editions of these celebrations shows their importance for the regional development: 16 editions in the case of “Muestra del aceite” and 30 in the case of the chestnut festival. Without any institutional acknowledgement, but with a long history by the increasing number of attendants, the region promotes its products with several events: the wine festival of Quiroga (35 years), honey festival of Folgoso do Courel (26 years), the cherry and oil festival of Ribas de Sil (15 years). There are also historic and ethnographic festivals: the Craftspeople of the Courel Mountains Meeting, the “pisa de la castaña” festival or the Culture and Tradition Festival, “Fiesta castrena-romana QUI-ROMA”, the mototouristic concentration organised by the cultural association A Curuxa and the Roman Festival organised by the neighbourhood association of Margaride.

- From a didactic point of view, the territory has several interpretation centres dedicated to geology, ethnography and environment. By the end of 2017 a centre about the caves will be opened and by the end of 2018 it is planned another centre dedicated to the Roman auriferous mining. Additionally, in the field of leisure and educational tourism, we have signposted many hiking/cycling routes that run through
the territory leading to the most important sites in the Geopark Project and interpreting them. A total of 15 interpreted viewpoints (5 more are planned) are distributed throughout the region to convey its geological, archaeological and natural values.

In the above paragraphs it can be seen how our touristic project is a reality. It is working due to the developed infrastructure and the promotion of the traditional products. Now it is time to disseminate this work by cooperating with the social agents of the territory and implementing the development strategy helped by the Candidacy for UNESCO Global Geopark. We must produce leaflets about the Geopark, its territory and points of interest and create a geological guide of the region. These documents should also be available in English to generalise the information. In addition, audio-visuals explaining the characteristics of the Geopark and its points of interest will be done. Signposting the territory will be one of the priority actions: indicate where the Geopark starts and guide the visitors to the points of interest will facilitate the visit. The website of the territory will also be launched. It will include the points of interest and a complete list of the services and infrastructure existent in the region.

D.4. Overview and policies for the sustainable development of:

D.4.1. Geo-tourism and economy

In summary, sustainable development consist in the processes of development oriented to meet the current need without jeopardising the prospects of future generations. We recognise the need to live in harmony with nature and orient our activities towards regional self-sufficiency, an efficient use of resources. The aim is to improve the quality of live at all levels through economic activity, restore the damaged ecosystems, encourage recycling and reutilisation and get involved in the implementation of renewable and clean energies. This is certainly the path that this project wants to follow.

Geotourism adapts perfectly to these requirements. It is a kind of sustainable tourism focused on geological heritage and interested in its conservation and dissemination. Geotourism also cares about cultural aspects and biodiversity. This is not a fast consumer product, but a development factor.

Getting the tourists’ involvement and taking advantage of it requires the development of a management plan and a marketing strategy to guide the actions to be carried out. For that purpose, we have the engagement of the different sector of the territory: neighbours, business, town councils, the Rural Development Group, the Provincial Deputation of Lugo and Xunta de Galicia, each one providing their ideas and means: the integrity and preservation of the territory by neighbours, the launch of sustainable products by business, investment in human resources and facilities by municipalities and the management of LEADER funds by the RDG Ribeira Sacra – Courel. This entity is in charge of the development of the Local Development Strategy of the territory in rural areas, according to European Union regulations, letting rural society to decide priorities in the application of the Leader measure of the European Agricultural Fund for Rural Development.

The Courel Mountains territory has been working under these premises, getting funds for the implementation of infrastructure linked to geotourism as local development factor. For example, the operating interpretation centres, the collaboration fellowship IGME – RDG Ribeira Sacra – Courel – Courel Mountains Association, or the agreements with Deputation of Lugo, Xunta de Galicia and the Galician Agency of Rural Development. However, there is still a lot of work to be done. Until now, there is no coordination among touristic businesses. Each one is working freely without considering the creation of synergies with other regional business. For example, there are companies dedicated to traditional products (chestnut processing, D.O. wines, handicrafts with olive wood) but there is no tourism-oriented shop to sell them.

Implementing a management plan of the territory and a marketing strategy for an initial period of 4 years will become a priority since today.

An important element of the Candidacy is that the main structures required to carry out the Geopark are already built after years of work. As a consequence, it does not require large investments. The major
effort will be focused on implementing the territorial identity, developing promotion, dissemination and broadcast actions, improving the coordination among the touristic sector, developing and promoting education and, to a lesser extent, implementing small infrastructure for geotourism.

In the next four years, it is foreseen the destination of an annual budget of 200.000€ for the development educational activities for scholar centres. For the financing of this budget, the formalisation of agreements with Xunta de Galicia and the Deputation of Lugo is being outlined. In addition to the contribution made by the three municipalities, this will allow achieving the annual average.

The availability of a rural development LEADER programme, the third with higher funds in Galicia, that includes the supporting of this Candidacy to UNESCO Global Geopark will guarantee the access to co-funding in order to provide infrastructures for geotourism and fulfil the dissemination, investigation and educational activities.

A former rural school is being equipped with museum facilities to create the interpretation centre of the Courel caves. A budget of 50.000€ will be invested through an agreement with the Department of Culture and the municipality of Folgos do Courel. The municipality of Ribas de Sil is also in the stage of public exhibition of the construction project of a geocamping, with an investment of 600.000€ provided by the town council, the Deputation of Lugo and the RDG Ribeira Sacra – Courel.

**D.4.2. geo-education**

Transmit knowledge as a form of personal enrichment, and promote responsible and respectful attitudes towards the planet makes part of the basic principles we are trying to convey. Knowledge as a method to preserve the environment, understood as Geo as well as Culture, as human. From this point of view, we use our endeavours in order to extract and transmit knowledge relating to the territory of the candidacy at all levels, from university to primary school, from the geotourist to the accidental visitor as well as the inhabitant of the territory. Both formal and informal education.

We have carried out many educational activities for all the aforementioned levels (formal and informal) so far. From the formal point of view, we are working eagerly with local schools. A lot of talks about geology, history and archaeology have been held in those schools. Together with master classes, guided visits to the Geological Museum and the Ethnographic Museum of Quiroga take place periodically, and, every year, at least one tour to learn about regional heritage is given to the students. Currently, at the request of secondary school teachers, we are designing a series of lessons relating to the territory so that they become part of the educational curriculum of the school. We also counsel the teachers, giving them guidance on the regional knowledge and dissemination based activities they organise on their own initiative. Explaining what a Geopark is to students is one of the lessons we will develop within the present year. We think it is of utmost importance that secondary students become ambassadors to the project.

With regard to the primary and secondary educational levels, we have been collaborating with “Proyecto Terra” for a few years. It is a project of the Official College of Architects of Galicia in partnership with the Galician Government (Xunta de Galicia), whose objective is to collaborate with education in order to improve knowledge and critical sense with regard to the places we live in. This programme allows us to keep in touch with primary and secondary students of other regions of Galicia in order to show them how societies adapt to geology within their territory.

So far, we have organised three “Montañas do Courel” Conferences on Geology, oriented towards an adult audience, in which university professors and researchers discuss topics relating to the region. These conferences, albeit having geology as a common bond, also address topics relating to geomorphology, history, archaeology, palaeontology and local cuisine.

The Interpretation Centres present in the territory and the viewpoint with interpretative panels amount to the core of informal education. Besides, we offer guided visits to the territory and interpretative routes, such as those taking place in the autochthonous forest “A Devesa da Rogueira” or the geological and archaeological ones “Ruta del Oro y camino real” and “A Cubela”, with a clear-cut territory disseminating purpose, understood from the ample perspective of multidisciplinary knowledge.
Conceived as dissemination handbooks, we edited the books “Unha historia xeolóxica de 500 millóns de anos. O pregamento xeolóxico de Campoloda e Leixazos e as pegadas glaciares dos vales de A Seara e Vieiros” (2006) ISSN 1887-052X, and “Minería romana nas bacias dos ríos Sil e Lor” (2007) ISSN 1888-7376. These publications introduce us to the guiding thread of the Geopark, namely, geo-logy and mankind, in a simple yet enjoyable manner.

Over the years we have been working on this Geopark candidacy, we have developed an intense disseminating work in the field of geo-education. Nonetheless, we think it is necessary to make rapid progress on the offer. Even though we will keep our basic guidelines of transfer of knowledge, we intend to be more active when it comes to broaden the scientific knowledge that the territory can provide. In this vein, we consider appropriate to carry out the following activities in the years to come:

- We will develop residency and feeding fellowships for university students interested in the study of the geology of the “Courel Mountains” territory. Possible this fellowship will be extended to other fields of knowledge. Given that the University of Santiago de Compostela has facilities in the region (the scientific station of Seoane do Courel), we will promote congresses and seminars linked to the territory. This activity includes courses destined to the knowledge of the territory in any field.

- We will provide assistance, facilitating the location of sites, informing about services, liaising between organism and people, etc., to the people without fellowship offered by the region but decided to develop their researching activity in any field of knowledge related to the region.

- We will continue the guided visit for teachers and students. They will be extended to their parents and the staff of the centres. We think that neighbours are the best ambassadors of their region. To get this, it is necessary to provide a minimum formation.

- We will promote an annual meeting with students of ludic character to exchange experiences and participate in games and workshop. The principal nexus of this meeting would be geology.

- We will propose the possibility of giving lecturesto the school centres of the surroundings of the Geo-park. The aim of this activity is to disseminate the geology of the region and the relation that the human being has with it. It also remarks that, despite being from different regions, the relation with bordering regions is very close.

- The staff of the project will guide the groups that require this service, paying special attention to the requests from educational centres.

- Interested professional touristic guides will be given classes related to any field of knowledge present in the territory. This activity will be organised in collaboration with the Professional Association of Tour-istic Guides of Galicia.

- Leaflets will be distributed. They will contain the basic information about the territory and will be written, at least, in Spanish, English and Galician.

- Individualised sheets of the main geosites will be designed. These sheets will be given periodically in different establishments (touristic or not), in order to let the local population collect them and completing the fundamental file of the regional sites. Each sheet will contain the main characteristics, images and a map. After fulfilling the collection, the inhabitant of the territory will be able to become a guide of the region.

- An application for mobile phones and electronic devices will be designed. They will use QR codes and/or geolocation allowing to get information about the point where the visitor is. This application will also permit the orientation in the proposed routes.

- The staff of the interpretation centres will advise and inform about the different fields of knowledge present in the proposed Geopark. This information will not be restricted to the specific centre to which they are assigned.

- Art as an excuse to learn. The art of learning. In collaboration with the Project “Outono Fotográfico”, the leading photography festival in Spain and the second most ancient of the world, we will organise a
photography contest with the territory as a topic. The proposal will be completed with the creation of a catalogue of the works received and their exhibition, which will promote the territory throughout Spain and Portugal.

- Specific itineraries will be created by subject to make easier the visit of the main points of interest. These itineraries will include:

  - The Variscan Orogeny in the “Courel Mountains”. This route will guide the visitor towards the points of interest of the Courel Syncline and the Sil Syncline.
  - Karst in the “Courel Mountains”. This itinerary will lead to the geosite Val das Mouras, the calcareous outcropping called O Taro Branco, the calcareous structural relief of A Teixeira, Visuña valley and the upwelling of the Buraca das Choias cave.
  - Roman gold. A route through the Roman auriferous exploitations.
  - Medieval fortresses. This itinerary will guide towards the medieval fortresses of the territory, including the Castro da Torre, because of its relation to the King Alfonso II.
  - Museums. This route leads to interpretation centres. Applications for mobiles and electronic devices will assume the functions of browser and guide.
  - Literature of the region. This route will guide towards emblematic spots related to regional authors – or linked to it – and their works. Spaces, buildings and environment will be the interpreted points.

D.4.3. geo-heritage

The territory has a wide inventory of elements of interest. Geology, geomorphology, biology, art, archeology and ethnography are some of the fields we are working on to enhance the common thread proposed for the project: the Palaeozoic and the human being. However, work has just begun. We are developing an exhaustive catalogue of each geosite. This catalogue is not limited to the description of the element in question: it will include a study of its conservation and the proposal of the optimal measures for its preservation and enhancing.

From a conservation point of view, it is important to evaluate if any of the elements should be included in the geosite catalogue but in list of the points that can be visited. An example of this would be the Palaeozoic fossils present in the territory. The visits to this point should be restricted to researchers and specialists, since the risk of alteration is elevated.

A funding line will be created for researchers interested in the study of any of the fields present in the region.

According to the Scientific Roundtable and the Socioeconomic Roundtable, we will propose new studies about the territory. This will become especially interesting if we succeed in joining forces among different disciplines, getting a comprehensive project which would show the authentic value that the region can provide: the union between natural and human.

The dissemination of our heritage will be a prominent matter. No matter the quality of our natural or cultural environment or the attention of neighbours and business can provide, if the territory is remained unknown: leaflets, website and other digital tool will be a fundamental part of the dissemination process.

The mutual understanding with local media is a value that we have always highlighted. The photography contest proposed is also along these lines. The task of attracting potential visitors coexists with the promotion of the respect and preservation of this geological and non-geological heritage. We have the duty of passing on this heritage to future generations.
D.5. Policies for, and examples of, community empowerment (involvement and consultation) in the proposed Geopark

From the “Courel Mountains” Geopark Project, we know that the support and complicity from the business and inhabitants of the territory is imperative to achieve our objective and the quality standards in our services. Additionally, these business and inhabitants are the main beneficiaries of the synergies in development which may result of the hoped consecution of the Geopark. Therefore, we have designed several actions oriented to listen to the suggestions of professionals and neighbours and other destined to make them feel the project as their own, as something achieved by their effort and implication. As it should be.

So far, we have had meetings with hospitality business, neighbourhood associations, touristic guides and the slate sector. The aim of these meeting was always the same: explaining what a Geopark is and its repercussions on each sector. The result with these partners has always been very satisfactory. The meetings were completed with a visit guided by technicians of the Candidacy, destined to neighbours and scholars. The results were excellent.

One of the activities developed in order to let citizens participate directly in the Geopark Project was the organisation of international work camps for people of 18 – 30 years old. In 2016, weed covering the Castro settlement of Sobredo, Folgoso de Courel and the castle of Os Novais was cleaned out. In 2017, the cleaning continued in Sobredo and the so-called “Ruta da Encomenda” was conditioned and signposted. During those activities, the participants were given information about the Geopark Project and their points of interest. They also had the chance to see some of the most outstanding places of geological interest.

The measures to follow from this moment onwards are related to the previous ones:

- We will continue the meetings with the productive sectors and neighbours of the region. These meetings will be oriented to explain what a UNESCO Global Geopark is and who can it benefit their activity.
- We will keep our working meetings with the regional business – especially with those related to tourism – in order to listen to their ideas and demands to improve the service offered and make them feel participant of the progress of the territory.
- It is intended to create an Association of Entrepreneurs of the Geopark that will include tourism sector and business related to typical products of the territory.
- We will continue the free guided visits offered to inhabitants. The purposes of these visits are that they know the potential of their territory, that they feel proud of it and that they work actively on its protection and dissemination.
- We will develop a volunteer programme which will let interest people collaborate in the Geopark projects. Its functions will cover: waste removal, the conditioning of routes and the placing of signs or the participation in stripping and excavation campaigns, among others. The international work camps will take this line.

D.6. Policies for, and examples of, public and stakeholder awareness in the proposed Geopark

This dossier contains the guidelines we wish to develop to create public awareness for visitors and the inhabitants of the territory.

- Education is a fundamental mainstay: making the territory known. It is important that people understand the geological processes developed over millions of years and how the Palaeozoic materials that form this site define the traditions of the different populations the settle in the territory.
- Getting people to feel participant of the process is also indispensable: social agents, inhabitants, visitors, volunteers and associations must take part of the project in an active way.

- Along with regional businesses, we will promote a specific imagen of the Geopark products. This proposal would include a distinctive mark for the traditional products elaborated in the region. This initiative will lead to an image of seriousness that will give an added value and quality to regional products.

- The photography contest proposed will help convey the Geopark image/idea to population sector that are not close to rural nature. The prestige of the Outono Fotográfico Festival will strengthen this image.

- The edition of a promotional audio-visual about the territory is imperative in order to convey our ideas. It is thought as a quick and direct summary of what the region offers and its importance in different fields of knowledge.

- Media has been disseminating and creating awareness about the Geopark Project for years. This cooperation relationship will continue in the future. See Appendix 11. Press dossier.

- Current media, such as websites, Facebook and other digital tools are important channels of dissemination. Their use and update allow to get to potential visitors we would not reach otherwise. These tools are more than communication: they are learning platforms. The launching of these services will be immediate once the Candidacy of the "Courel Mountains" Geopark project is presented.

E. Interest and arguments for becoming a UNESCO Global Geopark

In 2001 and as a result of a press article that recognised the geological potential of Courel Mountains, the idea of enhancing the value of this natural heritage started to gain momentum. Initiatives such as the construction of the first geological viewpoint of the region (2004), the Geological Viewpoint of Campo-dola-Leixazós, meant to facilitate the viewing and interpretation of the Campodola-Leixazós Geological Fold, were aimed to achieve this objective. After this beginning and a large number of uninterrupted initiatives in successive years, including geological conferences, the organisation of guided tours throughout the territory, visits to different Geoparks in order to learn and exchange views, the launching of the Museum of Geology, the strong conviction that the geologic heritage – along with the historical, archaeological and natural interest – could become one of the fundamental pillars of the development of the region was already a reality. Thus, the "Associations for the Territorial Promotion Courel Mountains" arises in 2016. One of the aims of this Association is the achievement of the UNESCO Global Geopark recognition for the territory.

Being part of the UNESCO Global Geoparks Network signifies for us the necessary impetus to strengthen a socioeconomic system based on sustainable development, as a way of aiding the recuperation of a territory that is going through an important demographic crisis. A depressed zone in Galicia and with few economic alternatives that allow resettle the population and generate wealth.

The prestige and confidence UNESCO transmits would be the incentive the Association would need in order to influence public administrations and to increase the protection measures for the natural environment, which is a genuine raw material of our territory. An incentive for slow, quality tourism, oriented towards geological heritage in particular and towards culture in general. A kind of quality tourism aimed at knowing a territory thoroughly and leisurely, at integrating in the territory, having a comprehensive knowledge of its history, its natural spaces, cuisine and culture. UNESCO quality assurance implied in the declaration would be paramount for the inhabitants of the territory to feel proud of their homeland and integrate into the project. This would be one of its most satisfying consequences. Entering the Global Geoparks Network would be the ultimate boost in order to consolidate scientific research projects on and from our territory, on local geology, but also, and undoubtedly, about a fair share of fields of knowledge, such as biology, palaeontology or archaeology, amongst others.

But being accepted in the Global Geoparks Network would undoubtedly mean the acknowledgment of the work we have undertaken for so many years. We started off promoting one of the most important archaeological sites in the world: the recumbent fold of Campoloda-Leixazós. We completed our work
step by step, undertaking research into the potential of our region, compiling an inventory of places of interest in a constant and honest manner, with the help of our visits to other Geoparks. We designed and built geotourism-oriented infrastructures all over the territory. Upon completion of those infrastructures, we are now working on the development of tools that allow us to disseminate our heritage, namely Geopark “Montañas de Courel”, effectively. The link between the Palaeozoic and the man.

The Geopark “Montañas do Courel” would provide the Network with some aspects related to the geological history of our planet, namely:

1) From the summits of the Courel, to the Quiroga/San Clodio valley, anthropogenic impact shaped unique landscapes. In the territory of “Montañas do Courel”, we can learn a lesson of adaptation to the environment from the origins of human settlement in the region. The anthropogenic factor is responsible for its uniqueness and its overall homogeneity: stone and water, wood and mountains, slate and chestnut trees, respect and symbiosis.

2) The northernmost part of the proposed territory, West Asturian-Leonese Zone (“Zona Asturoccidental-Leonesa”), provides an exceptional context for the observation and study of the formations that encompass uninterruptedly from the Upper Proterozoic to the Lower Devonian. In this territory, the Silurian creates an unconformity from the La Aquiana limestone, to the Luarca slates and the Vilameá layers.

3) In the central sector, a unique several-kilometre-long recumbent macrostructure, named O Courel syncline, is located. Its viewing is possible due to the lithological setting; important, massive quartzite banks belonging to Armorican quartzite, and the glaciofluvial erosion which introduced a-hundred-metre-high cracks in the ground and shaped the current valleys in a perfect orthogonal-oriented geological section.

4) In the core of the Sil synform, synorogenic deposits coeval with Phases 1 and 2 of the Variscan compressive deformation, remarkable for its singularity within the Iberian Massif.

5) The development of the karst through its cavities and exokarstic formations make it unique within the Iberian Massif. The karst is carved over Palaeozoic limestone and its morphologies are singular due to their Atlantic karstic character.

6) Examples of Quaternary glaciology of the “Montañas do Courel” territory are highly valuable geological elements, for there is little evidence of middle mountain glaciology in Southern Europe. Thus, they constitute representative and almost unique examples within the UNESCO European Geopark Network.

7) With regard to the fossil record present in the territory, it is prolix and diverse, representing the outcropping geological formations.