



GEPARK CANDIDATE'S APPLICATION

Causses du Quercy Regional Nature Park November 2015

"If stones could speak..."



Parc
naturel
régional
des Causses
du Quercy

Contents

| | | |
|-----------|---|-----------|
| A. | Identity of the aspiring Geopark of Causse du Quercy, France | 3 |
| A.1. | Name and identity | 3 |
| A.1.1. | Geological time scale | 3 |
| A.1.2. | Human time scale | 3 |
| A.2. | Location of the aspiring Geopark of Causse du Quercy | 4 |
| A.3. | Surface area, physical and human geography characteristics | 4 |
| A.3.1. | Surface area and contours | 4 |
| A.3.2. | Close multi-millennial relationship between man and stone | 4 |
| A.3.3. | Natural heritage | 10 |
| A.3.4. | Physical geography characteristics | 12 |
| A.3.5. | Population and demographic trend | 14 |
| A.4. | Lead organization and management structure | 14 |
| A.4.1. | Causse du Quercy Regional Nature Park | 14 |
| A.4.2. | Geopark bottom up process | 14 |
| A.4.3. | Organization and budget | 15 |
| A.5. | Application contact persons | 15 |
| B. | Geological heritage | 16 |
| B.1. | General geological description of the proposed Geopark | 16 |
| B.1.1. | Geological location of the proposed Geopark | 16 |
| B.1.2. | Lot county National Inventory of Geological Heritage | 16 |
| B.1.3. | Historical elements | 18 |
| B.1.4. | Scientific interest of the Quercy phosphorites | 18 |
| B.1.5. | Emplacement conditions of the phosphorite deposits: Geological story of the Quercy linked with global plate tectonics | 20 |
| B.2. | Listing and description of geological sites within the proposed Geopark | 24 |
| B.2.1. | Geosites selection method | 24 |
| B.2.2. | Integrated geosites listing | 24 |
| B.2.3. | Presentation of 3 major integrated geosites | 24 |
| B.3. | Details on the interest of those sites in terms of their international, national, regional and local value | 25 |
| B.4. | Listing and description of non-geological sites and how they are integrated into the proposed Geopark | 34 |
| B.4.1. | Description of the linked (non-geological) sites | 34 |
| B.4.2. | Partner sites outside the territory | 34 |
| C. | GEOCONSERVATION | 37 |
| C.1. | Current and potential pressure on the aspiring Geopark | 37 |
| C.1.1. | "Site by site" pressure | 37 |
| C.1.2. | Territorial threats | 37 |
| C.1.3. | Distant threats | 37 |
| C.2. | Current status in terms of protection of geological sites within the aspiring Geopark | 37 |
| C.2.1. | The Lot RNN of Geological Interest | 37 |
| C.2.2. | Other tools used | 37 |
| C.2.3. | Karstic site protection study conducted by the Park | 37 |
| C.3. | Data on the management and maintenance of these sites | 38 |
| C.3.1. | Site protection | 38 |
| C.3.2. | Unprotected vulnerable sites | 38 |
| D. | Economic activity and business plan for the proposed geopark | 39 |
| D.1. | Economic activity | 39 |
| D.1.1. | Agriculture | 39 |
| D.1.2. | Crafts and small business | 40 |
| D.1.3. | Tourism | 40 |
| D.2. | Existing and planned facilities | 41 |
| D.2.1. | Existing structures and infrastructures | 41 |
| D.2.2. | Planned infrastructures | 41 |
| D.3. | Analysis of geotourism potential | 42 |
| D.3.1. | Type of clientele and attendance | 42 |
| D.3.2. | Interest of the clientele | 42 |
| D.3.3. | Geotourism potential | 42 |
| D.4. | Overview and policies for sustainable development | 42 |
| D.4.1. | Park Charter/CETD | 42 |
| D.4.2. | Geotourism and economy | 42 |
| D.4.3. | Geoeducation | 44 |
| D.4.4. | Geoheritage | 46 |
| D.5. | Policies for, and examples of, community empowerment | 46 |
| D.5.1. | Karst water resources | 46 |
| D.5.2. | Landscape and biodiversity | 46 |
| D.6. | Policies for, and examples of, public and stakeholder awareness | 46 |
| D.6.1. | Conciliation of use and outdoor activities | 46 |
| D.6.2. | Awareness and training of economic actors in the environment | 47 |
| E. | Interest and arguments for joining GGN | 47 |

A. Identity of the aspiring Geopark of Causses du Quercy, France

A.1. Name and identity

The territory aspiring to join the *Global Geoparks Network* [GGN] covers an area that has structured itself since 2006 upon a remarkable geological heritage, namely the preserved paleokarst from the Tertiary geological era, with superimposed resumed karstic activity during the Quaternary. But it is also structured around the close relationship that humans have maintained, and still maintain, with the omnipresent limestone.

A.1.1. Geological time scale

The *causse* is a vast, dry and rocky plateau formed by marine carbonate rocks deposited between -250 and -70 million years during the opening of the Atlantic Ocean and is the result of an intense karstic activity that started 70 million years ago (Ma). As the result of unique geological circumstances, it enabled the recording within different phosphorite caves – ancient caves sealed by red clay deposits containing thousands of fossils in perfect condition of preservation – of the climatic, environmental and conditions for life evolution, between 52 and 20 Ma. It thus made this area a true “natural evolution laboratory”⁽¹⁾ of international significance. There are only four other complete chronological sequences spanning more than 15 Ma currently known in a continental domain worldwide ➡ **FIGURE 1**. This makes the Quercy paleokarst a European reference for the upper Eocene and Oligocene epochs with 5 international reference levels including 3 within the aspiring Geopark area.

A.1.2. Human time scale

Throughout the ages – the oldest preserved vestiges are 400,000 years old – humans strove to use the available resources from the karst and the paleokarst. These included cavities trapping animals, caves man inhabited or decorated thanks to the local available pigments, limestones he used to construct megalithic tombs, houses, shelters, low walls, etc., to phosphatic fissure fillings of the paleokarst that he exploited. At the same time, he developed solutions for his survival such as the carving of basins able to retain water within the limestones, the clearing of stones from the dolines and dry valleys... These anthropogenic arrangements repeated thousands of times are true adaptive treasures and literally shaped the *causse* landscape.

The ASPIRING CAUSSES DU QUERCY GLOBAL GEOPARK is so named because of both its geology – the *causse*, and its historical identity – the Quercy territory of the *Cadurques* Gallic people. In a holistic approach integrating geological, natural, historical and cultural heritage, the territory is developing a strategy for sustainable development that will ensure its durability and make this area a “preserved territory to live in”⁽²⁾.

(1) “The Quercy phosphorites: a natural laboratory of the evolution of the vertebrates”, CNRS letter, Paris [De Bonis *et al.*, 1977]

(2) Foreword from C. Marlas, President of the Causses du Quercy Regional Nature Park [Charter of the Park 2012-2024].

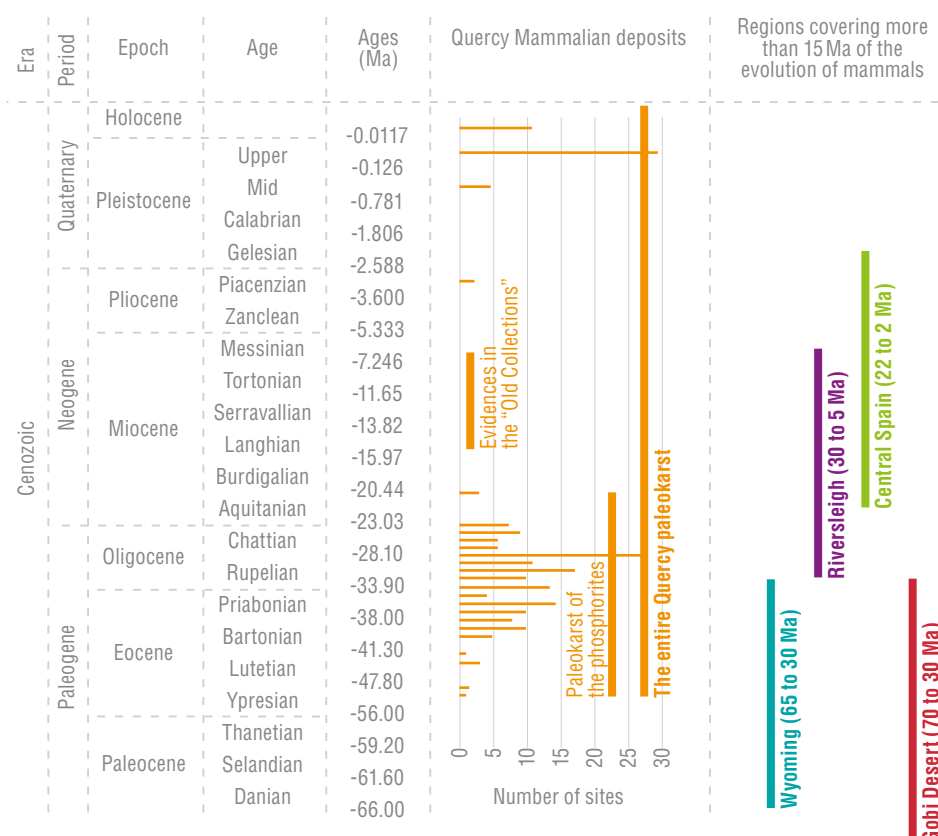


FIGURE 1B
Location map.


FIGURE 1A

Biochronological distribution of the major Cenozoic continental paleontological deposits (review T. Pélissier [after Legendre, 1989; Aguilar *et al.*, 2007; Escarguel *et al.*, 2008; Escarguel, 2009 and personal communication of J. Rémy]).

A.2. Location of the aspiring Geopark of Causses du Quercy



GLOSSARY OF TECHNICAL TERMS: APPENDIX 1.


The territory of Causses du Quercy aspiring to join the Global Geoparks Network (hereinafter called aspiring

Geopark or territory) is located in the southwest quarter of France, at the northern end of the Midi-Pyrénées region  **FIGURE 2A, 2B**. It is 100 km from Toulouse (4th largest city in France by population).


A.3. Surface area, physical and human geography characteristics

A.3.1. Surface area and contours

It is essentially a rural area covering the central third of the Lot County, between the Dordogne River in the north and the Tarn-et-Garonne County in the south  **FIGURE 2C**. Its contours are those of the municipalities that ratified the Charter of the Causses du Quercy Regional Nature Park (hereinafter called Park; details § A.4.); they follow those of the limestone plateaux of the Quercy, called Causses, whose average elevation is 300 m. These plateaux stand out from the low plains of the Aquitaine Basin bordering them to the south (avg. 135 m above sea level) and from the mountainous area of the Massif Central situated to the north and east (avg. 700 m above sea level, culminating at 1885 m)  **FIGURE 2D**.




 **SURFACE AREA:** 1 855 km².
ELEVATIONS: 70% of the territory area between 250 and 350 m.

A.3.2. Close multi-millennial relationship between man and stone


What strikes the visitor to the territory is the omnipresence of the limestone rock as a major resource: the slightest house, the slightest low wall, the slightest shelter, is an evidence of this link between man and stone. More generally, it is the way man knew, at all times, how to take advantage of the paleokarst and karst that underlies the identity of the territory, “the *caussenard* identity”  **P6 FIGURE 3**.

 **OBJECTIVES OF THE CHARTER OF THE PARK 2012-2024:** Pursue study, preservation and promotion of heritage [Measure 1.3.4].




A.3.2.1. Savoir-faire related to local geological resources

The various techniques developed to use local geological resources in building form an emblematic INTANGIBLE HERITAGE for this territory. It is timeless and alive as conservation associations and some crafts people still use them. According to each limestone facies (massive, or layered...), one can proceed either by carving in full-body (to produce containers), or by using monoliths (to make blocking elements), or by building in dry stone (only stones and no cement to raise walls, vaults, roofs)  **FIGURE 4**. Clayey sands found locally trapped in limestone cavities (locally referred to as “*aréniers*”) have been used as a binder of stonewalls (Roman style chapels, churches, castles, but also simple buildings  **P9 FIGURE 5B**) or, when indurated, as millstones  **P6 FIGURE 3P**. As for the “*castine*” (local word indicating congelifrac screens), this was used to surface paths.

 **PROMOTE** innovation and development of local resources [Measure 2.1.3] in particular by revitalising a stone building sector.

 **ETHNOGRAPHIC MUSEUMS** dedicated to rural heritage and popular traditions: Musée départemental de Cuzals, Musée des Arts et Traditions populaires, Borie d’Imbert.



A.3.2.2. Limestone: A major building material

Where limestone rock outcrops across the surface of the cause, man took advantage of the rich and deep soils of the many dolines (“*cloups*”)  **P6 FIGURE 3C**. In seeking to clear stones from the fields and paths, little by little he created this network of low-walls so typical of the territory, as well as many other buildings in dry stone such as the iconic “*caselles*” (small stone huts)  **P6 FIGURE 3F**. Some of these buildings run along the route to Santiago de Compostela  **TABLE 1**. The traditional Quercy house and its outbuildings (dovecote, bakery, barn-cowshed...) are closely determined by the use of local stone. Housing is naturally scattered: isolated farms (“*mas*”) or grouped in hamlets scattered among small villages that have kept their authenticity... A true OUTDOOR MUSEUM, the area offers countless examples of this rural heritage, which give it its visual identity and its boundaries.

 **PROTECTION/PROMOTION** of built heritage: amongst others “*Mille mains à la pâte*” (“Thousand helping hands”) for rebuilding the low dry stone walls ( **FIGURE 4D** and details in **APPENDIX 2**).

 **[DISCOVER...** the dry stone constructions of the Causses du Quercy; **GUIDANCE AND RECOMMENDATIONS** on the small rural heritage: recognise, preserve and restore].

A.3.2.3. Limestone block: Megaliths

The many megalithic remains (menhirs and particularly dolmens  **P6 FIGURE 3G, 3H**) reflect the use of massive limestone between -3,500 and -2,000 years BC  **P9 FIGURE 5A**. One example of a “*Caussenard*” dolmen, corresponding to an indigenous prehistoric culture in the Quercy, is the dolmen of Pech Laglaire 2, a UNESCO World Heritage Site. Between 2003 and 2007, the local population accompanied by prehistory researchers conducted an original experiment consisting in building a megalith: the Experimental Dolmen of Rigounenque (see **APPENDIX 2**).

 **365 IDENTIFIED MEGALITHS** within the territory (more than 800 in the Lot county).

 **[DISCOVER...** The megaliths of the Causses du Quercy].

A.3.2.4. Paleokarstic fissure fillings: Phosphorites of the Quercy

Around 1850, facing global population growth, the use of fertilizer to improve agricultural yield increased. In this context, the chemist J.-A. Poumarède, noticing the

FIGURE 2 The territory of the aspiring Geopark of Causses du Quercy, at the transition between the Massif Central and the Aquitaine Basin.
A: Map of France. B: Midi-Pyrénées region. C: Map showing access to the territory. D: Topography.

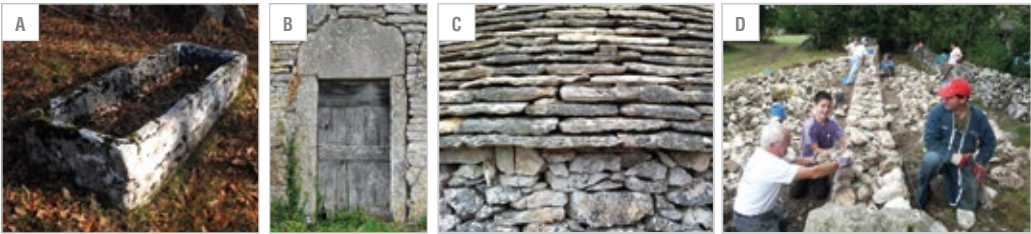
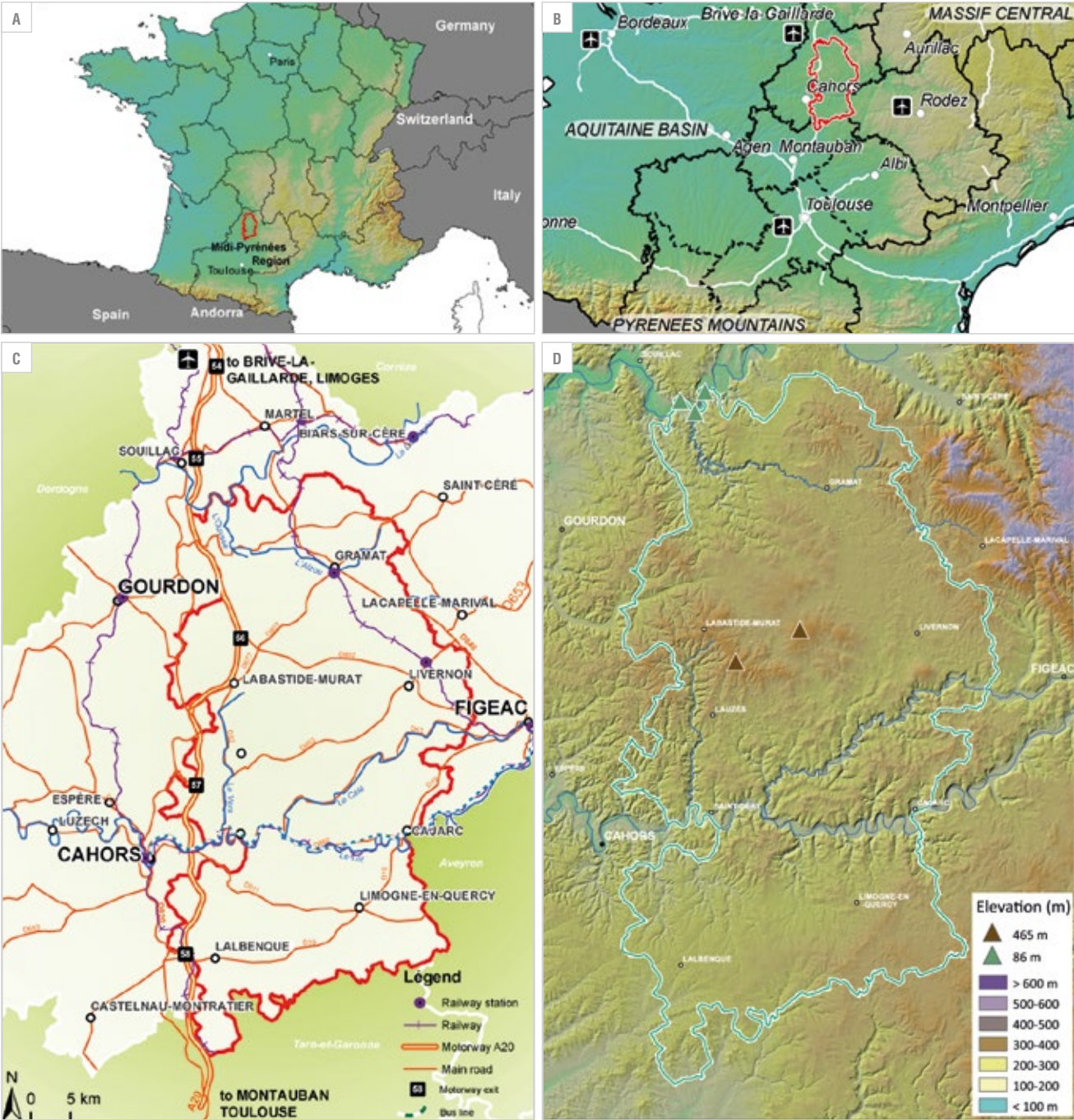


FIGURE 4 Various means of using local stone.

A: Carving in full body. © P. Cabrol
B: Monoliths. © C. David
C: Dry stone. © P. Andlauer
D: Reconstruction of low dry stone walls. © S. Noyer

TABLE 1 Protection of historical, cultural, industrial and geological heritage.

| | Protection label | Description |
|-----|--|--|
| INT | UNESCO World Heritage | <ul style="list-style-type: none">Routes of Santiago de Compostela and some associated sites,Dolmen of Pech Laglaire 2. |
| INT | Official historical monuments of France (MH) | <ul style="list-style-type: none">28 houses, city gates, covered markets, farms, windmills, dovecotes, bakery and caselle,35 dolmens and 1 menhir protected (10 listed, 26 classified),14 decorated caves, the Archéosite des Fioux and the Cloup d'Aural phosphorite cave (listed or classified). |
| NAT | National Nature Reserve (RNN) of Geological Interest of the Lot County | <ul style="list-style-type: none">85 sites (phosphorite caves, geological sites). |



"Butterfly" washing place (Varaire). © P. Cabrol



Typical village (Cabrerets). © J. Morel



"Cloup" or cultivated doline (Caniac-du-Causse). © J. Morel



Millstone (indurated sands). © T. Pélissié



Vers aqueduct. © G. Astruc



Towpath dug into the limestones (St-Cirq-Lapopie/Bouziès). © J. Morel



Phosphorite nodules and mine. © O. Arsandaux/Collection Trutat, Muséum Hist. Nat. Toulouse



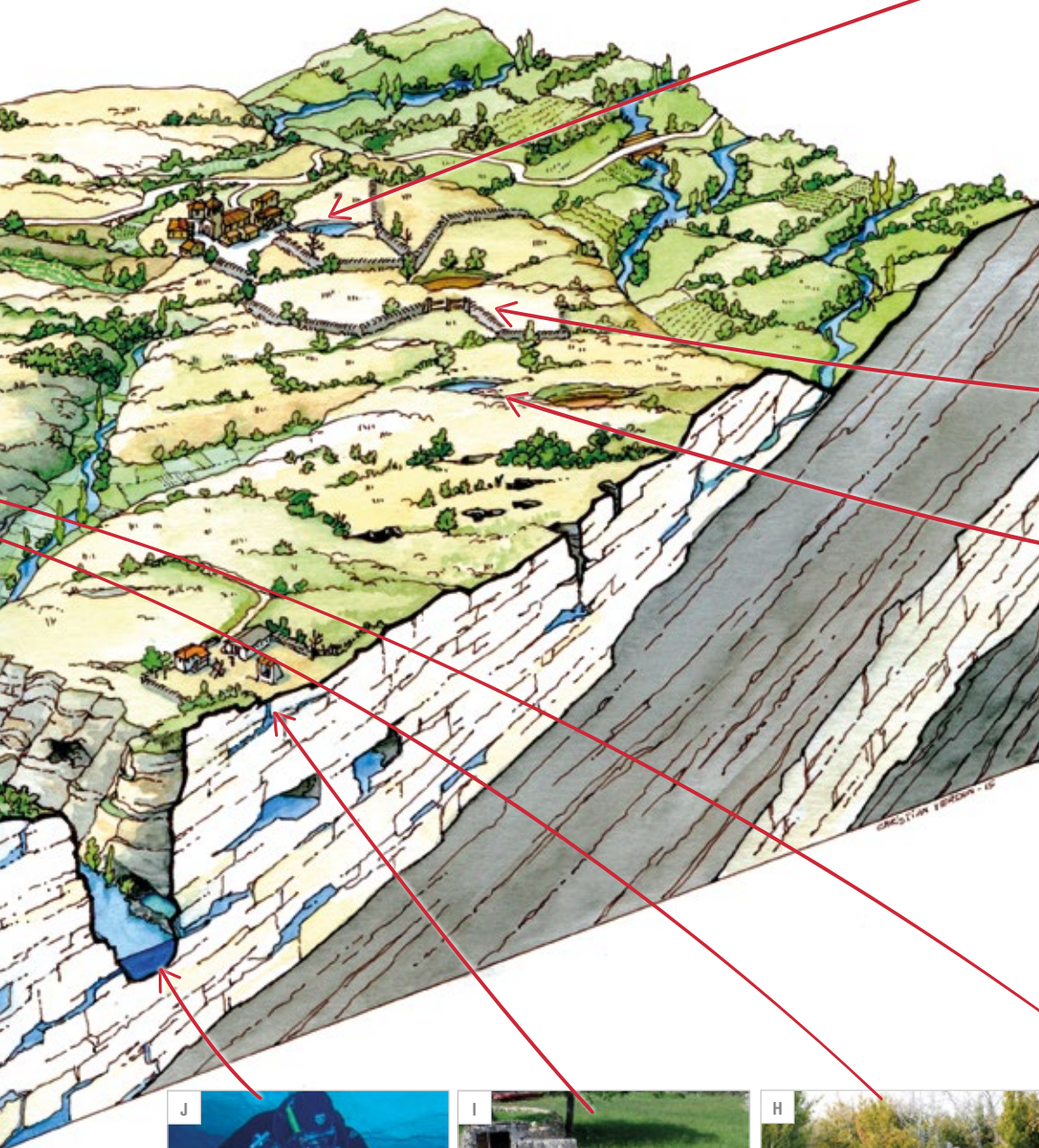
"Roque" or Château des Anglais (Bouziès). © J. Morel



Decorated cave (Pech Merle). © J.-F. Fabriol

| Period | Lower Palaeolithic | Middle Palaeolithic | Upper Palaeolithic | Mesolithic | Neolithic |
|--------------------------------------|--------------------|--------------------------|---|------------|-------------------------|
| Aspiring Geopark of Causse du Quercy | | Pradayrols Coudoulous | Archéosite des Fleux Group of Pech-Merle Group of Ste-Eulalie | | Megaliths |
| Age (yr) | >300 000 | 40 000 | +12 500 | <6 000 | <2 200 |
| Markers | | | [Chauvet] [Cussac][Lascaux] | | [Megaliths in Brittany] |

FIGURE 3
Sketch of the Causses du Quercy showing human use
of geological resources. © C. Verdun



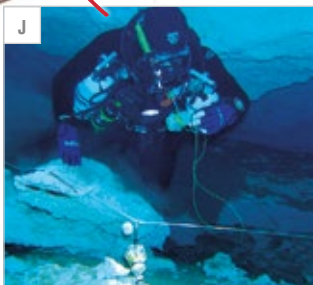
"Couderc" at the centre of the village (Artix).
© J. Morel



Low dry stone wall. © O. Arsandaux



"Caselle" and "Lac de St-Namphaise" or carved
basin (Livernon). © PNRQC



Cave diving. © L. Deharveng



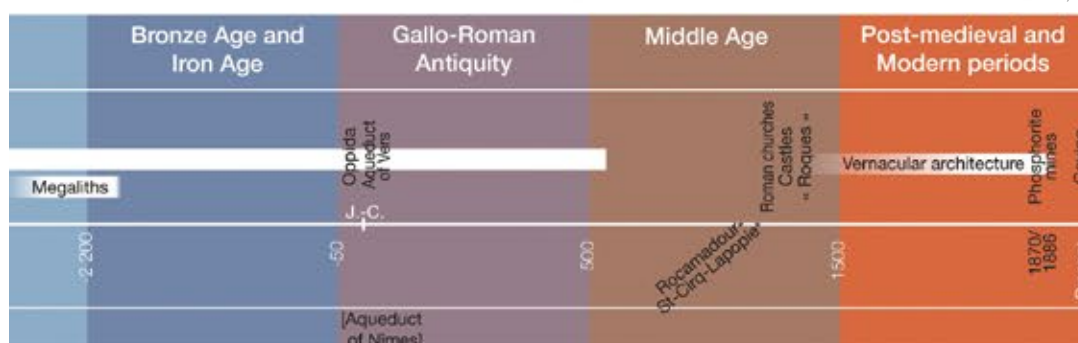
Wells (Laburgade). © R. Rocherieux



Dolmen of Mas d'Arjac (Cabrerets). © P. Cabrol



Protohistoric quarry (Pierre Martine in
Livernon). © 2014 A.B.



unusual growth of a wheat field in the south-eastern part of the Quercy, discovered abundant nodules of up to 80% tricalcic phosphate embedded in a red clay matrix. From then on, a horde of prospectors strode across the Lot and neighbouring counties, and so began the industrial exploitation of phosphorites in 1870 in the territory. Largely open-air, the cavities (phosphorite caves) are manually emptied from their infills ➔ P6 FIGURE 3M. The ore is conveyed to the Lot and Aveyron valleys, and then processed in water mills. Transported by train or ferry westward to Bordeaux, it is then exported ➔ FIGURE 5D. Sixteen years later, more profitable new deposits are found in France and in the world, abruptly interrupting mining activity; only ¼ mines continue their activity until the early twentieth century. Note that with the discovery of the deposits, J.-A. Poumarède emphasized the abundance and scientific importance of the fossil bones (see section B.).

! **1870-1886:** 161 mines, more than 2,000 workers, 500 000 tons of phosphate extracted in total.

🗺️ [DISCOVER... The phosphorite caves of the Causses du Quercy].

A.3.2.5. Natural karstic cavities: Prehistoric habitat and decorated caves

The cavities of the *cause* offered a natural habitat (site des Fieux) and served to trap animals, showing the evolution of prehistoric man's subsistence behaviour (Archéosite des Fieux, Coudoulous). In the caves, a surprising prehistoric treasure is preserved: engravings and numerous paintings, jewels of European cave art (painted cave of Pech-Merle, Merveilles, Roucadour, Fieux, Pergouset, etc. ➔ P6 FIGURE 3K) [Lorblanchet, 2010]. At Pech-Merle, prehistoric man added local ochre (red clay) and black colour coming from concretions rich in hydrated oxide of manganese from the Silex cave at Conduché (3km away) to the coal of his palette. Among the most unexpected discoveries, two 'lithophones' have been identified with certainty, using the resonance properties of two concretions: one disk at Pech-Merle, one column at Fieux.

! **16 DECORATED CAVES** (2 opened to the general public: Pech-Merle and Merveilles) and 14 prehistoric shelters (1 opened to the general public: Archéosite des Fieux) (186 decorated caves in France and about 300 in the world). **"LES PALÉONAUTES" NETWORK:** works for protection/promotion of this heritage.

A.3.2.6. Limestone cornices: Defensive bases

Limestone cornices overhanging the steep-sided valleys offered a natural fortification, of which the first evidence of occupation date back to the Gallo-Roman period with the Gallic perched oppidums of Murcens and Coronzac. In the Middle Ages, the religious sanctuary of Rocamadour and its village are built in a large rock shelter. At the same period, in the Lot and Célé valleys in particular, the construction of fortifications ("*roques*") at the entrance of vast natural caves in the limestone cornice create fortified shelters for the population. During the Hundred Years' War (opposing kingdoms of England and France) the Quercy becomes a border area, and these *roques* are reorganized, reused and take the name of "*Châteaux des Anglais*" ➔ P6 FIGURE 3L.

A.3.2.7. Surface water retention

Due to the lack of drainage networks at the *cause* surface, man strove to retain water, among others, by carving ponds into the rock serving as drinking troughs. These are the iconic lakes of "Saint-Namphaise", named after the hermit who, according

to legend, was the origin of this local know-how in the ninth century AD. In some areas, impermeable clay layers interbedded into the stratigraphic series split the karst aquifer into several groundwater aquifers that result in perched springs. Man cleverly channelled and used this "water tank", as evidenced by the Gallo-Roman Vers aqueduct 31.6 km long that supplied the town of *Divona Cadurcorum* (Cahors) ➔ FIGURE 5B. More broadly speaking, this is a set of small heritage buildings related to water that developed: the arrangement of the clay pockets (on the "*couderc*" in the centre of the villages, "*papillons*/butterflies" washing places in the south of the territory), cisterns, built fountains... ➔ P6 FIGURE 3A, 3D, 3O and ➔ FIGURE 5C.

🗺️ [DISCOVER... "Lakes" and watering places of the Causses du Quercy].

A.3.2.8. Access to underground water resources

The many wells called "Roman wells" enabled access to the shallow aquifers (epikarstic aquifers) that form because of the slow infiltration of rainfall within the weathered and fractured rock of the first tens of meters from the surface ➔ P6 FIGURE 3I. The presence of clayey sand pockets filling paleokarstic cavities already mentioned originated in the development of aquifers, such as the one of Saint-Cirq-Lapopie that is behind this perched village settlement [Simon-Coinçon *et al.*, 1995].

A.3.2.9. Underground karstic network

Streams from the east of the territory penetrate the massifs at swallow holes and water also soaks throughout the limestone surface, travelling underground in a karstic network. It is in the late nineteenth century that caving expanded in France with, among others, in the Quercy, the exploration of the Gouffre de Padirac and its underground river by the famous E.-A. Martel and his companions. Nowadays, the Causses du Quercy form a particularly well explored territory (more than 50 km of underground galleries in the Padirac network alone) but are also sought out by cavers for the specific activity of diving into siphons: clear water and large wall for training; turbid water (clayey) or very deep, difficult siphons.

! **1 SIPHON** of depth > 175 m in the Quercy: -180 m at Saint-Sauveur (9 in the world).

A.3.2.10. Occitan geological vocabulary

To "tell" a territory and its history, language is a key element. In the territory, the *langue d'oc* or Occitan is still spoken, especially by the elders in the family circle. It promotes country, social and intergenerational cohesion. This language is at the origin of the Quercy toponyms [Bazalgues, 2002] that are themselves typical of limestone and karst: from the rocky plateaux (*causses* strictly speaking) threaded by dolines (*cloups*), chasms and watering holes (*igues*), to wooded hills (*pechs*), dry valleys (*combes*), rocky escarpments (*travers*)... If French has gradually replaced Occitan from the first half of the twentieth century, the status of this language is progressing, essentially from the point of view of its recognition. Within the territory, it is now taught in two primary schools and some associations are collecting oral and popular memories in connection with daily life and traditions.

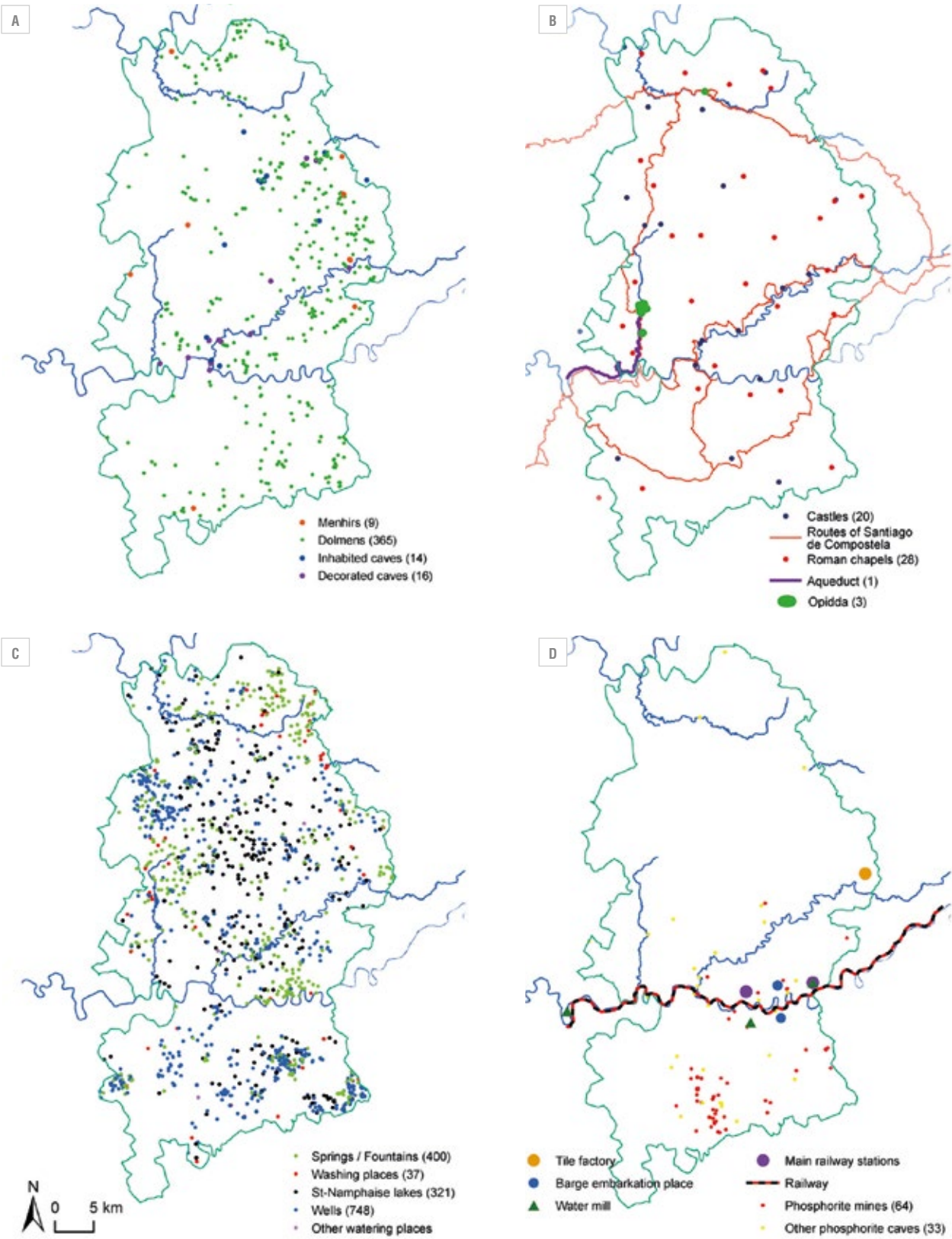
🌟 **COLLECT, CONVEY AND VIVIFY** shared cultural heritage and memory of the territory [Measure 3.3.1].

👁️ **ASSOCIATIONS:** Institut d'études occitanes du Lot, Assoc. des musiques traditionnelles et populaires du Quercy, Assoc. la Granja. Example of event organized jointly with the Park: La Prima (Occitan spring of the Causses du Quercy).

TABLE 2 Number of municipalities involved in the protection of the night sky.

| Number of involved municipalities (out of the 102 municipalities of the Park) | Having endorsed the Charter for the Protection of Sky and Environment | Laureates since 2011 of the <i>Villes et villages étoilés</i> (Starred Towns and Villages) national contest | Which achieve a total (partial) extinction of their lighting after midnight |
|---|---|--|---|
| 2011-2014 | 15 | 10 | 44 (35) |
| 2015 | +5 | +15 applicants | 48 (40) |

FIGURE 5 Historical and cultural heritage inventoried within the territory: A: Archaeological. B: Built. C: Water related. D: Industrial.



| | Protection label or inventory | Surface of the Park | Description |
|-----|--|---------------------------|--|
| INT | MAB/Biosphere Reserve, UNESCO | 30,5% (northern third) | Dordogne Basin Biosphere Reserve |
| NAT | Natura 2000 | 11,8% | 9 sites including the main valleys part of the territory, the central part of the Causse de Gramat and the "Old trees of the Quercy" |
| NAT | Natural Area of special Ecological, Faunistic or Floristic Interest (ZNIEFF) | 32,5% | 82 ZNIEFF of type 1 and 5 ZNIEFF of type 2 |
| NAT | Natural heritage or Great landscape conservation laws (1930 Law) | 8,6% | 5 listed and 4 classified sites; caves, swallow holes and underground networks (Padirac, Pech-Merle, underground network of Ouyse river) |
| REG | Regional Nature Reserve (RNR) | 42 ha | Bonnefont Marsh |
| LOC | Midi-Pyrénées Nature Conservation Areas | 1579 ha | |
| LOC | Sensitive Natural Areas (ENS) | 3% | 8 sites |
| LOC | Major Natural Sites (Park Charter) | 29,9% | 83 sites |
| LOC | Prefectural Decree for Protection of the Biotope (APPB) | 61 ha | |

↑ **TABLE 3** Protection and inventories of natural heritage.

A.3.3. Natural heritage

A.3.3.1. Night sky:

The Quercy "black triangle"

It was in 2002 that the French magazine *Ciel et Espace* (Sky and Space) revealed that the territory of the Causses du Quercy had one of the finest night skies in France: what is now called the "Quercy black triangle" → **FIGURE 6**. Thirteen years later, this story has become that of the territory, claiming its night and its stars as one of its most representative natural features → **P9 TABLE 2**. It is now in France one of the most committed territories for the preservation of its starry sky as the participation of 56 municipalities of the territory to the "Night day" in 2015 shows, among other commitments, as it represents 10% of the French territory activities.

✳ **PRESERVE** the night sky by controlling light pollution [Measure 2.4.4].

📖 **[DISCOVER...]** The night of the Causses du Quercy].

A.3.3.2. Biodiversity and biotopes

The territory has been the subject of many inventories since 1987 aimed at characterizing its biological diversity, and identifying outstanding natural areas and species "of heritage interest" for the Park. In particular, the National Museum of Natural History (MNHN) designated in that territory 87 Natural Areas of special Ecological, Faunistic or Floristic Interest (ZNIEFF). They cover 32.5% of the surface of the territory. Many protective zonings have been deployed on these sites with strong ecological issues (see **APPENDIX 3**).

There is homogeneity in the biotopes present on the territory, in direct connection with the local geological features:

- 41 % of the Park surface: natural wooded areas (mainly pubescent oak → **FIGURE 7A**). Example of species of heritage interest: Short-toed snake eagle; Violet click beetle.
- 40%: cultivated areas (including temporary grassland

→ **FIGURE 7B**). Example of species of heritage interest: *Adonis flammea*, *Nigella de France* (flowers).

- 17%: open and semi-open environment (including heaths and dry grasslands, iconic environments of the Causses, managed by agro-pastoralism → **FIGURE 7C**). Example of species of heritage interest: ocellated lizard, marsh fritillary butterfly, stone-curlew bird.
- The remaining 2% correspond to all other natural environments of the territory: aquatic, wetland and rocky terrestrial environments → **FIGURE 7D**. Despite their localized nature, these environments are very important sources of biodiversity and home to many heritage species or endemic species → **FIGURE 8**. Example of species of heritage interest: peregrine falcon, *Bythinella* of Padirac, marbled newt, greater horseshoe bat. The whole group of phosphorite caves exploited in the past form as such a particular biotope: coolness and humidity (up to 100%) allow the development of a specific flora, including Bryophytes, which undergoes assessment.

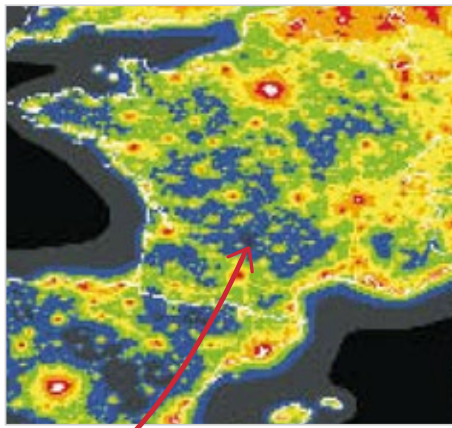
The Park continues to focus its attention on survey and inventory by performing, among others, a two year study on underground microfauna in partnership with the MNHN (Paris) and the *Comité départemental de spéléologie du Lot* (Lot County Caving Committee) → **TABLE 3**.

✳ **GET TOGETHER** for biodiversity of the territory [Orientation 1.2] - 768 species of "heritage interest" (fauna: 509; flora: 259) [lists p. 7-32 of the Annexe du Diagnostic Territorial].

📖 **[DISCOVER...]** the dry grasslands of the Causses du Quercy].

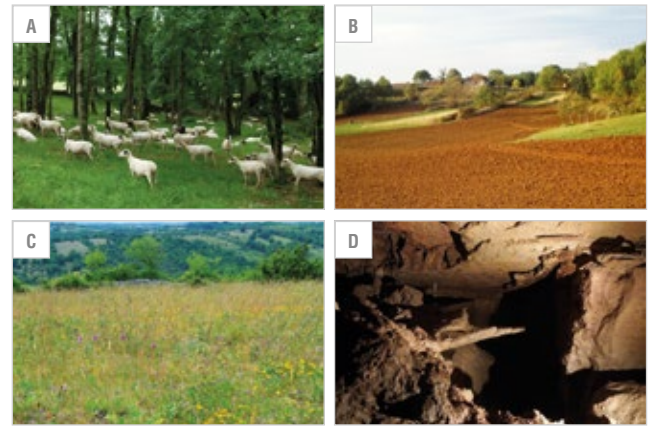
A.3.3.3. Natural dynamics

The territory is subject to rapid natural succession in the open environments. It is linked for instance to a certain abandonment of farmland and to modifications of agricultural and pastoral practices. Heaths and dry grasslands have especially been hit: in 30 years, their surface has decreased from 26% to 17% (photo-interpretation comparison 1977-2006 [Diagnostic territorial du Parc, 2010]). By contrast, the wooded areas have greatly increased (+17,000 ha in 30 years).



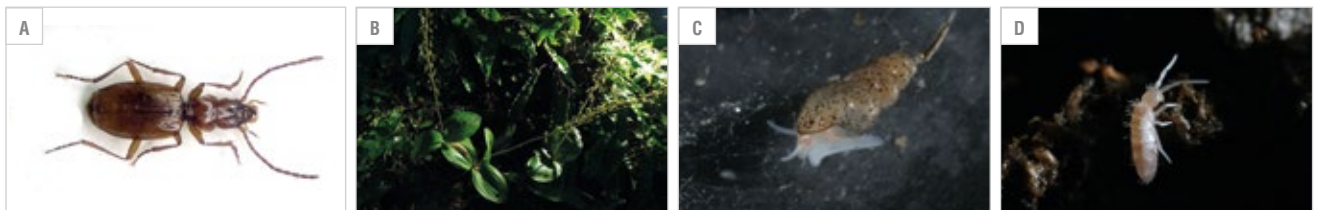
↑ FIGURE 6

The Quercy "black triangle" (artificial night sky brightness at sea level; [Cinzano *et al.*, 2001]).

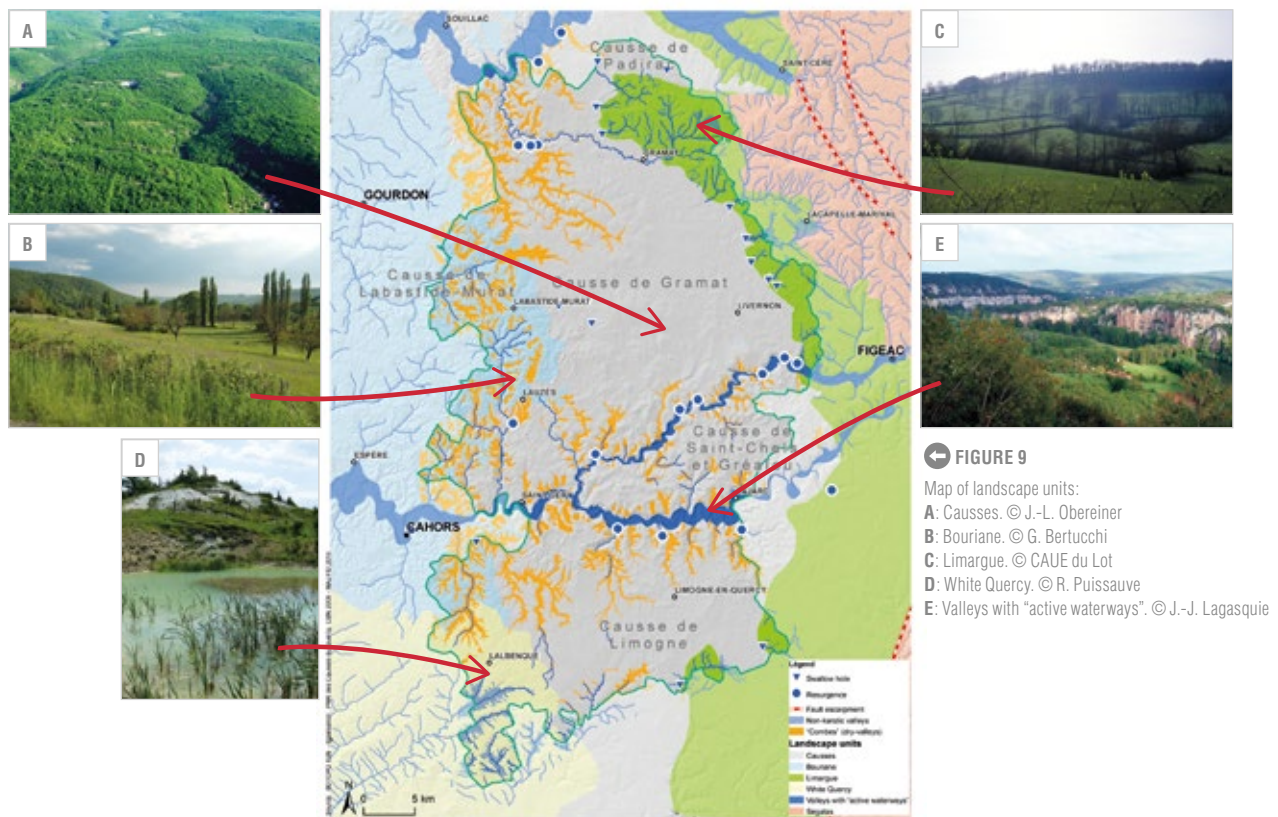


↑ FIGURE 7 Some of the characteristic habitat categories:

A: Natural wooded environments characterized by pubescent oak. © C. Conteau
B: Cultivated environments. © J. Trémoulet
C: Open and semi-open natural environments including heaths and dry grasslands. © P. Monniaux
D: Rocky underground environments. © J.-F. Fabrial



↑ FIGURE 8 Endemic species or of heritage interest from the rocky underground environment of the territory. Superficial underground environment: A: *Duvalie cadourque* (endemic beetle from the Causse de Limogne, size 5 mm). © Ref74114insecte.org. B: *Listera ovata* from the Clouf d'Aural phosphorite mine displaying anomalies: the size (very large) and the leaf number (3 instead of 2). © T. Pélissier; Lower underground environment: C: *Bythinella* (gastropod mollusc endemic to the Quercy underground gallery networks found at the Padirac chasm and at Font d'Erbie). © M. Lukic. D: *Heteromurus nitidus* (cavern Collembola partially depigmented representative of the diversity of this group in the Quercy caves). © M. Lukic.



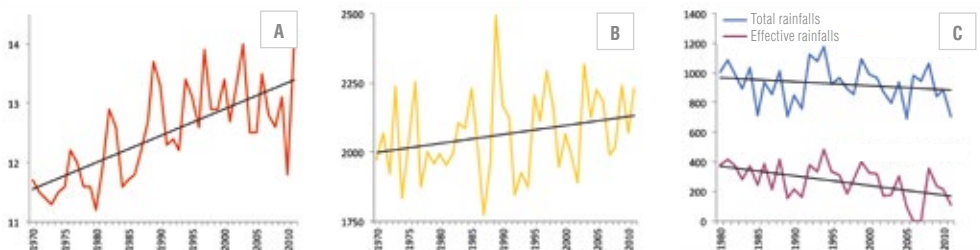
→ FIGURE 9

Map of landscape units:
A: Causses. © J.-L. Obereiner
B: Bouriane. © G. Bertucchi
C: Limargue. © CAUE du Lot
D: White Quercy. © R. Puissaube
E: Valleys with "active waterways". © J.-J. Lagasquie

→ FIGURE 10

Average annual meteorological values (1970–2010) from the weather station of Gourdon (Source: Météo France):

A: Average temperatures.
B: Cumulative sunshine.
C: Cumulative rainfall.



Many programs aimed at maintaining or re-opening the natural environment were conducted on the territory by the Park management or its collaborators during the past 20 years.

❗ **PROGRAMS** : Agri-environmental measures; LIFE NATURE “Dry grasslands” (1999-2003); “Bushy areas” program of the County Council (since 2011); etc.

A.3.4. Physical geography characteristics

A.3.4.1. Large landscape units

Five landscape units are defined on geomorphologic criteria

➔ P11 FIGURE 9:

- The “*Causses*” (71 % of the area of the territory) form a vast calcareous dry plateau, sloping to the west. Rivers, coming from the eastern Limargue, plunge into it. On the surface, a network of dry valleys (“*combes*”) indicate a dead water system. Their rich soils were traditionally cultivated and are, for the majority of them, still cultivated in addition to the karstic depressions (dolines, uvalas). Several “*Causses*” can be distinguished, separated by valleys with active waterways and this striking contrast between DRY CAUSSES AND RICH VALLEYS is emblematic of the territory. The forests of pubescent oaks, interspersed with heaths and dry grasslands traditionally dedicated to sheep farming, are the characteristic environments of the Causses.
- The “*Bouriane*” (12 %) presents a less “rigid” relief, carved into calcareous sandstones, covered by a thick sandy layer (Périgord sands). The cool and acidic physico-chemical conditions favour pines and chestnut trees.
- The “*Limargue*” (8 %) is a bocage type region with abundant waterways, carved into marly-limestones little resistant to erosion. The rich and fertile soils are favourable to grassland, wooded areas, as well as to poplar and walnut groves. While the valleys are almost exclusively agricultural, the slopes are forested, and habitations are concentrated on the hills.
- The “*White Quercy*” (6 %), of sandy-argillaceous Molasse covered by thin whitish limestone layers, is carved by multiple tributaries of the Garonne and Aveyron that form a system of parallel ridges (“*serres*”) and rivers of north-east/south-west orientation. Ridges are covered by forests, slopes by heaths, and valleys by grasslands and farming. With 95 % of their surface dedicated to agriculture, this is the highest concentration of farmed land in the territory.
- Valleys with “active waterways” (3 %) form a system of green corridors in the middle of the Causses. The landscape of the largest valleys (Lot and Dordogne) sprawls

from the waterway. The flat-bottom of the valleys is almost exclusively agricultural and housing is rare because of frequent flooding. This is concentrated higher on the alluvial terraces in hamlets and villages. The narrowest valleys (Célé, Vers and Ouisse) are also almost exclusively agricultural, with few forests.

✳️ **LEAD** a thrifty management and landscaping of the area [Orientation 1.3].

DEVELOP agriculture and add value to forests as founding principles of the economic and social life and of the maintenance of the land [Orientation 2.2].

A.3.4.2. Climate

At the interface between the harsh climate of the Massif Central and the milder one of the central part of the Aquitaine Basin, climate is of MILD AQUITANEAN TYPE SUBJECT TO MOUNTAIN INFLUENCES. The reference weather station of Gourdon, west of the territory ➔ P5 FIGURE 2C reports an annual mean temperature of 12.5°C ➔ P11 FIGURE 10A. On the territory, the climate is homogeneous overall: slight variations correlated with elevation and 2°C positive gradient from northeast to southwest. Rainfalls are distributed throughout the year (650-950 mm cumulative rainfall). Wind blows slightly (60 % of recordings < 10 km/h) to moderately. In terms of weather disasters, the territory is mainly exposed to drought events and flood events in the bottom of the valleys.

Over the last 40 years, the global trend is towards rising temperatures (+1.7°C in Gourdon ➔ P11 FIGURE 10A), with an increase of the minimum temperatures higher than that of the maximum ones. The annual average sunshine period also increased from 2,000 h to 2,125 h ➔ P11 FIGURE 10B. Finally, if the evolution of total rainfall shows a slight decrease over the same period, effective rainfalls (rainfall that seeps into the ground) were halved ➔ P11 FIGURE 10C.

❗ **ANNUAL AVERAGE AMPLITUDE**: January 2°C / August 28°C.
ANNUAL MAXIMUM AMPLITUDE IN 40 YEARS: -19°C / 40,7°C.

✳️ **IMPROVE** energy autonomy of the territory for climate benefit [Orientation 1.4].

A.3.4.3. The *cause* water tank and its vulnerability

A genuine natural water tank, the *cause* supplies the drinking water distribution network, almost exclusively in karstic emergencies, and provides the supply of 57 % of the county's homes. The knowledge of the way it works (by dye tracing, quality controls) has improved significantly in

↓ **TABLE 4** Demography (INSEE, 2008).

| | Aspiring Geopark | Lot County | Midi-Pyrénées Region | Métrop. France |
|--|------------------|------------|----------------------|----------------|
| Density (hab./km ²) | 16 | 33 | 65 | 101 |
| Demographic growth (1990-2008) | + 19,1 % | + 10,4 % | + 17,3 % | +10,3 % |
| Percentage of population living in rural areas | 85,5 % | 66,6 % | 33,4 % | 18 % |
| Portion of the -20 years old | 19,1 % | 20,2 % | 22,9 % | 24,6 % |
| Portion of the +60 years old | 33,8 % | 31,8 % | 24,7 % | 22,2 % |

FIGURE 11

A: Dye tracing. © J.-F. Fabriol
B: Automatic sampling. © J. Trémoulet

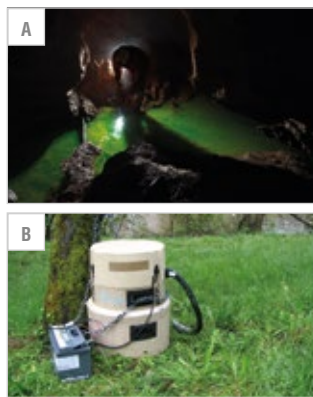


FIGURE 13 Simplified organisation chart of the Causses du Quercy Regional Nature Park:



FIGURE 12 Demography (Source: INSEE, 2012). A: Number of inhabitants per municipality. B: Demographic evolution 1999-2012.

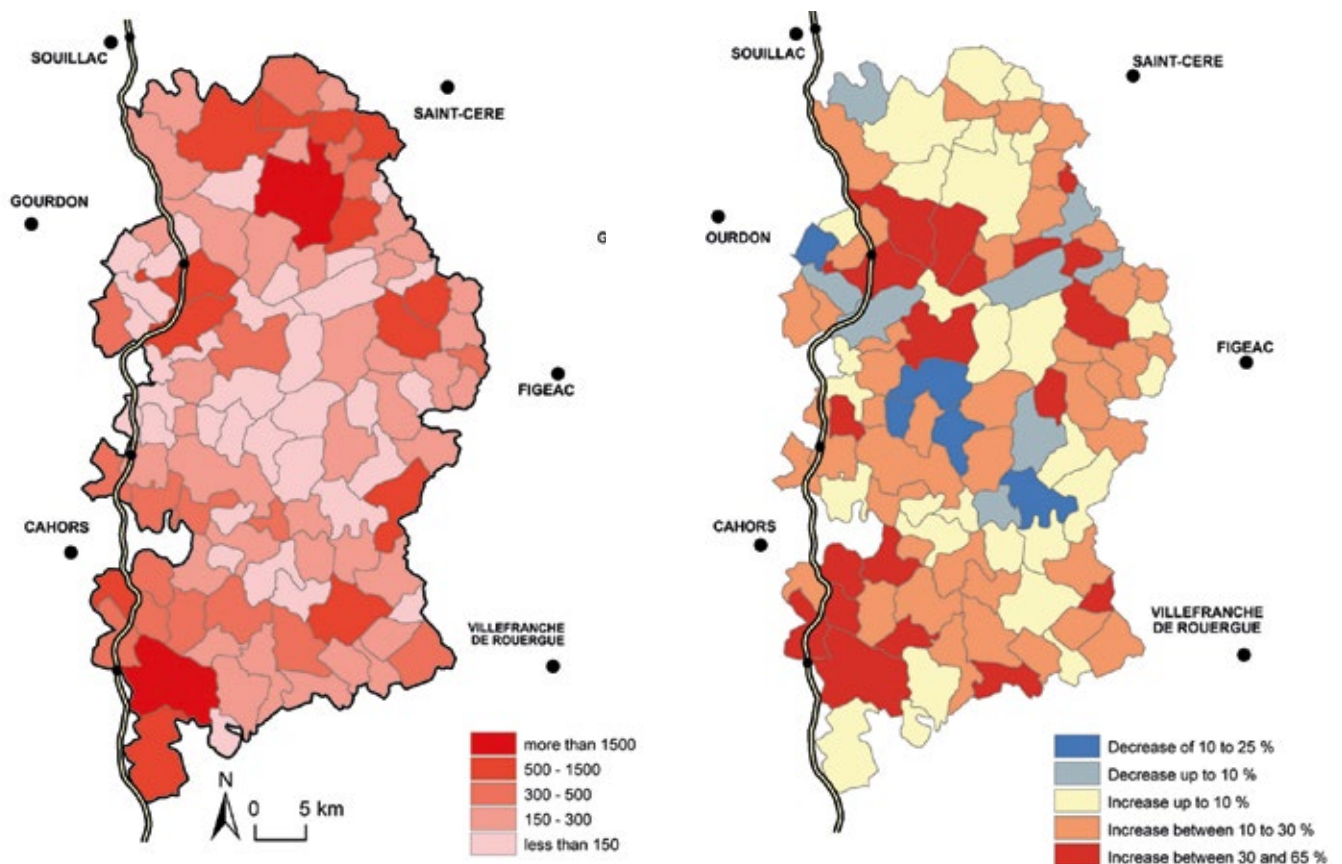
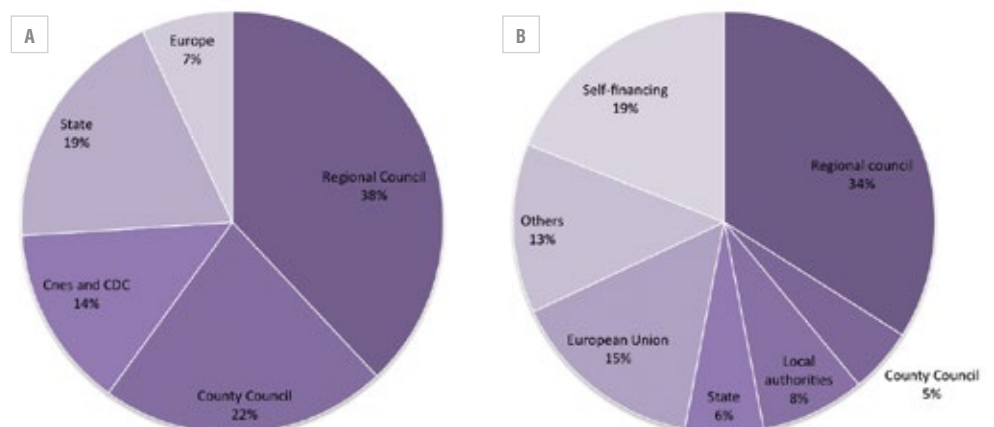


FIGURE 14

Receipts of the Park in 2014:
A: Statutory budget receipts.
B: Action programme, receipts by sponsor.



15 years thanks to the Park's actions ➔ P 13 FIGURE 11 and the contours of the springs' main catchment basins are known today (APPENDIX 4). They show large basins such as the underground Ouyse (Causse of Gramat) with an area of approximately 480 km², third karstic system in France. The effect of agriculture represents a larger potential pollution load than that of population's and vulnerability to pollution by nitrates from agricultural sources is identified for the White Quercy southwest and the agricultural valley of the Lot River.

✳️ **PRESERVE** the underground resource and ensure the quality of rivers [Orientation 1.1].

A.3.4.4. Access

The aspiring Geopark, although rural in nature, is perfectly served by various means of transport (by plane, train, bus, car; ➔ P 5 FIGURE 2B, 2C). Coming from abroad, access by air is through the airports of Brive-la-Gaillarde, Rodez, Toulouse and Bordeaux. Two lines of the national railway network SNCF serve the territory: the Paris-Toulouse line that runs along the western edge of the territory serves the stations of Souillac, Gourdon and Cahors (5 direct trains/day in 5h30 from Paris, 1 hour from Toulouse) and the Souillac-Rodez line that crosses the northern part of the territory. To the south of the territory, a bus line connects Cahors and Capdenac. The A20 Paris-Toulouse motorway enables one to reach the north of the territory in 5 hours from Paris and the south of the territory in 1 hour from Toulouse.

❗ **FLIGHTS BETWEEN BRIVE-LA-GAILLARDE AND:** Paris–Orly (1h20), London–Stansted (1h30) and Amsterdam–Schiphol (1h45).
DISTANCES: Brive-la-Gaillarde is located 50 km north of the territory, Rodez at 75 km east, Toulouse at 100 km south, Bordeaux at 200 km west.

A.3.5. Population and demographic trend

With a total population of 30,967 inhabitants, the area has a low but homogeneous density of 17 inhabitants per square kilometre (INSEE, 2010). The very rural character of the area is reflected in the traditional buildings scattered in hamlets and villages throughout the territory. Only the towns of Gramat (north), Lalbenque (southwest) and Cajarc (east) have an annual population exceeding 1,000 inhabitants (INSEE data 2008 ➔ P 13 FIGURE 12A).

Between 1990 and 2008, population growth in the territory reached 19.1 %. This growth is higher than that recorded in the Lot County and in the Midi-Pyrénées Region ➔ P 12 TABLE 4. It demonstrates the attractiveness of the area. Spatially, this population increase primarily benefits the neighbouring towns of Cahors, Figeac and Gourdon ➔ P 13 FIGURE 12B but also those close to three motorway interchanges of the A20, confirming the influence of this axis since its commissioning in 2003.

Two points are of notable concern in the demographic evolution: the significant decrease in the proportion of young people under 20 years (further education and job search) and secondly, the increasing importance of the population of retirees (return to the territory and looking for an improved quality of life).

✳️ **INNOVATE** to develop business and employment [Objective 2].
Making the Quercy a WELCOMING TERRITORY, UNITED AND OPEN [Objective/Axe 3].

A.4. Lead organization and management structure

A.4.1. Causse du Quercy Regional Nature Park

The contours of the aspiring Geopark of Causse du Quercy match those of the Causse du Quercy Regional Nature Park. The latter, established in 1999, forms a continuous area made of 102 municipalities out of the 340 of the Lot County (APPENDIX 5). The coherence of the territory is linked to the “*caussenard* identity”—a shared cultural and landscape identity—which unites its inhabitants and gives them the will to implement a common strategy for sustainable territorial development. Regional Nature Parks (51 in metropolitan France) enable the protection and highlighting of large inhabited rural areas through the application of the Charter (master plan) that defines territorial issues, objectives and implementation devices for a period of 12 years. After a complete diagnosis of activities conducted, the Park obtained the label for the second consecutive time and began its second Charter [2012-2024 Park Charter Report].

✳️ **OBJECTIVE 1:** Implement a thrifty management of the resources and guarantee the quality of heritage; **OBJECTIVE 2:** Innovate to develop business and employment; **OBJECTIVE 3:** Making the Quercy a welcoming territory, united and open.

A.4.2. Geopark bottom up process

Since 2006, the opportunity for an application to the Global Geoparks Network (GGN) has been discussed (APPENDIX 6). Meetings and study trips conducted by the Park, especially with the French Geoparks of the Global Geoparks Network, concurrently with the bottom-up approach for the protection and promotion of local geological heritage (see § D.2.), resulted in many actions of protection, promotion (georoute, interpretation panels, leaflets) and popular science teaching (public lectures, scientific conferences, educational activities in schools) by the Park in collaboration with the Earth Sciences associations of the territory.

Since 2011, concurrently, the Park has actively supported the Lot National Nature Reserve (RNN) of Geological Interest project (see § C.2.1.), which aims to ensure protection of geological heritage and accompanying scientific research. The Park is currently a candidate for its management.

A.4.3. Organization and budget

A.4.3.1 Support structure: The “*Syndicat mixte*” of the Park

The aspiring Geopark of Causses du Quercy is supported by a joint intermunicipal cooperation body called “*Syndicat mixte*” including the Midi-Pyrénées Region, the Lot County (*département*), the 102 municipalities that ratified the Charter of the Park and the 7 Public Intermunicipal Cooperation Institutions with independent tax status. The resulting Management Committee (*Comité syndical*) comprises 119 tenure holders (and 119 deputies) who meet 6 times a year. The privileged partners of the Park *Syndicat mixte*, as associate members, participate in sustainable development of the territory through temporary or renewable agreements: Consular Chambers (Agriculture, Craft, Trade and Industry), 7 Gateway cities (Cahors, Figeac, Gourdon, Souillac, Saint-Céré, Caussade and Villefranche-de-Rouergue) and local partner organisations (territorial activity structures, associations, federations, specialized and mixed cooperation bodies, economic and touristic actors).

A.4.3.2. Internal functioning

Administrative structure of the aspiring Geopark: The Park team is the core manager for the main projects of the Park *Syndicat mixte*. Staffs from local government members or partner organisations reinforce, in their area of expertise, the technical engineering of the Park. This multidisciplinary team (→ P13 FIGURE 13 and complete organisation chart in APPENDIX 7) is in the service of local authorities and partners of the Park in the framework of the action programmes taken on by the Park *Syndicat mixte*.

Management team of the aspiring Geopark: The whole team of the Park *Syndicat mixte* is likely to be mobilized for the implementation of the “Geopark action programme”, but more specifically the project team responsible for this dossier is as follows (details in APPENDIX 7):

- Coordination: Agathe Kühnel (ecologist), Head of the Environment – Natural Heritage department.
- Protection and Research: Sébastien Durant (hydrogeologist), Head of the Waste Water Treatment for sanitation department.
- Education, activities and communication: Patricia Monniaux, Education and Culture Project Manager. Sophie Delpuch, Communication Assistant.
- Development and promotion: Vincent Biot, Tourism and Outdoor activities Project Manager.

It should be noted that a strengthening of the team in the areas of Earth Sciences, in close relationship with the candidacy of the Park to the management of the Lot RNN of Geological Interest, is expected in the course of 2016 (2 available positions).

Structure of the aspiring Global Geopark steering committee:

The Park plans to set up an *ad hoc* steering committee to follow up the labelled Geopark. Chaired by the President of the Park, it will be composed of members of the various commissions of the Park, augmented by qualified persons and associate members (Regional Directorate for Environment, Planning and Housing of Midi-Pyrénées; County Territory Directorate of the Lot), local government officials (approval, implementation of the projects at a local scale) and a Scientific College that will include the members of the current “dossier group” who followed the Global Geopark application (T. Pélissié, Geologist, Chairman of the Park Scientific and Planning Council and President of the association *Les phosphatières du Quercy*; J.-P. Cadet, Geologist; F. Duranthon, Palaeontologist; J.-J. Lagasquie, Geographer; J. Rey, Geologist; A. Tarrisse, Hydrogeologist).

A.4.3.3. Budget

The operating budget of the Geopark will be integrated into that of the management of the *Syndicat mixte* of the Park. The Park *Syndicat mixte* operating costs are covered by the contributions of members defined in the statutes and by state participation. The statutory funds support institutional life, participation in the self-financing of programs of action and management and the engineering team. They thus guarantee the necessary means for the implementation of the commitments mentioned in the Charter.

Furthermore, the Park *Syndicat mixte* is seeking specific additional financing (credits from Europe, State, Region, Department, Water Agency Adour-Garonne, foundations or associations, income from the Park *Syndicat mixte*, donations and bequests...) to carry out its program of activities and investment operations or to support local or short-term projects (→ P13 FIGURE 14).

In 2014, the Statutory Operating budget of the Park came to 1,127,026€, stable compared to 2013. The amount of the actions program was 661,718€, with evenly balanced distribution between the three axes (environmental, economic and social dominant features), but in significant decline compared to 2013 (-23%).

A.5. Application contact persons

Catherine MARLAS
President of the Causses du Quercy Regional Nature Park
BP 10 – 46240 Labastide-Murat, France.
Web site: <http://uk.parc-causses-du-quercy.fr>

Chairman of the Park Scientific and Planning Council:
Thierry PÉLISSIE
Geologist
Phone number: +33 5 65 24 20 50
tpelissie@parc-causses-du-quercy.org

Leading expert:
Agathe KÜHNEL
Head of the Environment – Natural Heritage department
Phone number: +33 5 65 24 20 50
akuhnel@parc-causses-du-quercy.org

B. Geological Heritage

B.1. General geological description of the proposed Geopark

B.1.1. Geological location of the proposed Geopark

The aspiring Geopark of Causses du Quercy belongs to the northeastern edge of the Aquitaine Basin that occupies the southwest quarter of France ➔ **FIGURE 15A**. Mesozoic and Cenozoic sedimentary infills of the basin overlay the metamorphic and magmatic rocks of the peneplaned Hercynian orogenic belt extending from the Massif Central located in the north-east to the Pyrenean peaks in the south ➔ **FIGURE 15B**. In the south, these formations were folded during the Pyrenean orogeny in the Cenozoic era, whereas the basin strata in the north-east have been experiencing little or no deformation. It is in this sector, where geological history remained preserved from deformation, that the territory of the aspiring Geopark is located. In this area, early, middle and late Jurassic north-south parallel strips about 20km wide outcrop (alternation of limestone, marl and clays rocks) ➔ **FIGURES 16 AND 17**. They form the bedrock of the Causses and are locally overlaid by late Cretaceous clays, sands and quartzite. At the southwestern edge, Tertiary terrains (marl, limestone and Molasse strata) overlay the Jurassic ones, in unconformity. Furthermore, essentially within the southern half of the territory, red clayey infills seal old cavities dug into the Jurassic limestones. The Oligo-Miocene sedimentary cover of lacustrine limestones, which fossilized this karst, is still visible locally in the southeastern part of the territory. Finally, the Quaternary formations are essentially concentrated at the bottom of the valleys (alluvial terraces), at the foot of the slopes (scree) and in the bottom of the dolines. If strictly speaking the Quercy covers a broader area than that of the proposed Geopark, the territory forms a coherent ensemble both from a geological and geographical point of

view; its contours follow those of the Lot Jurassic calcareous plateaux, – as well as from an administrative point of view, since the area coincides with the boundaries of the 102 municipalities of the Lot county that ratified the Charter of the Causses du Quercy Regional Nature Park (see details §A.4.).

! **GEOGRAPHIC COORDINATES OF THE CENTRE OF THE TERRITORY:**
lat. 1,686415 / long. 44,571860.

B.1.2. Lot county National Inventory of Geological Heritage

The National Inventory of Geological Heritage (*Inventaire national du patrimoine géologique*, INPG) of Midi-Pyrénées Region carried out between 2007 and 2012 following the French national standards [De Wever et al., 2006] highlighted the rich geological heritage of the Lot County and its international significance with 25 geosites obtaining three stars ➔ **TABLE 5**. All the starred geosites of the Lot represent over a quarter of those identified in the region (Lot county: 11 % of the region surface area). This inventory, currently under review for the entire region following the updated national standards [De Wever et al., 2014], is today approved for the Lot County by the Regional Commission of Geological Heritage (*Commission régionale du patrimoine géologique*, CRPG; see **APPENDIX 8**). It confirms the quality of the Lot County geosites with 35 geosites obtaining 3* and it shows the preponderance of starred geosites in the aspiring Geopark area compared to the rest of the County ➔ **TABLE 5**.

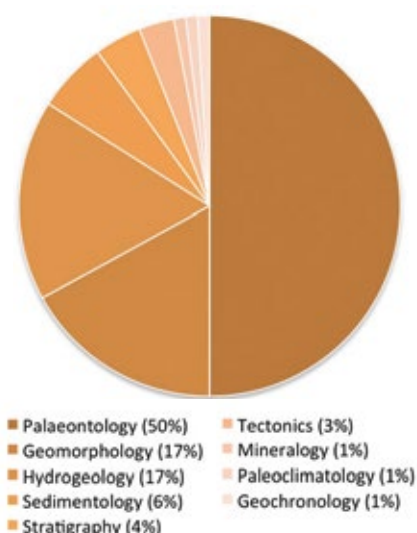
The geological heritage of the territory is secret, often hidden underground, fascinating for anyone wishing to discover it... Underground Quercy indeed holds a preserved Tertiary karst (hereinafter called paleokarst) that has fossilized millions of

! **TABLE 5** Inventory of Geological Heritage of Midi-Pyrénées region (INPG, 2012; updated in 2015 for the Lot County and the aspiring Geopark). The heritage value of each geosite is measured by a grading scale taking into account: the principal and secondary geological interest, educational value, rarity, vulnerability and threats, potentially tourism and economic interests.

| Counties (Départements) | 3*= INT./NAT. | 2*= REG. | 1*= COUNTY | 0*= LOCAL | Total number of Geosites |
|----------------------------|------------------|-------------|---------------|--------------|-----------------------------|
| Ariège | 8 | 20 | 39 | 173 | 240 |
| Aveyron | 4 | 17 | 44 | 195 | 260 |
| Haute-Garonne | 4 | 8 | 17 | 85 | 114 |
| Gers | 4 | 14 | 24 | 75 | 117 |
| Lot (2012) | 25 | 38 | 76 | 124 | 263 |
| Lot (2015) | 35 | 43 | 61 | 137 | 276 |
| Aspiring Geopark (2015) | 26 | 31 | 43 | 50 | 150 |
| Hautes-Pyrénées | 4 | 8 | 17 | 85 | 114 |
| Tarn | 1 | 24 | 79 | 150 | 254 |
| Tarn-et-Garonne | 7 | 7 | 32 | 57 | 103 |
| TOTAL | 57 | 136 | 328 | 944 | 1465 |

! **FIGURE 18**

Principal interest of Lot County starred geosites (INPG, 2012).



animals and plants in different red clay filled fissures and galleries. The front cover of this application dossier (lower picture) shows such an in-place filling. These paleontological geosites represent the majority of the inventoried geosites (50% of the starred geosites). Other geosites complete this inventory whose main interest is in hydrogeology, geomorphology, sedimentology and other topics ➡ P 16 FIGURE 18.

B.1.3. Historical elements

From 1870, the beginning of phosphatic mining in the Quercy (see § A.3.2.), the most beautiful fossil bones that were part of the ore were removed and sold by quarry-workers. They supplied prestigious collections around the world (called the “Old Collections”) but without any indication about their exact origin. The catalogue of these fossils provided numerous holotypes but gave the false impression of an *in situ* mixing in the paleokarstic fillings.

It was in 1937-38 that geologist B. Gèze rediscovered the interest of the old phosphorite mines of Quercy. On the one hand he observed that they had not been completely emptied of their content, on the other hand he demonstrated that the filling time of each deposit is short and the fossilized faunae are homogeneous from a biostratigraphical point of view. However, two neighbouring loci may have very different ages.

But, it was not until 1965 that several scientific teams prospected again in the phosphorite mines: the MNHN Paris, the Universities of Montpellier, Lyon, Poitiers, Toulouse and Dijon, and of New South Wales in Australia (see complete list in APPENDIX 6). At that time, nearly 170 fossil deposits were inventoried. Five reference levels of the Paleogene mammalian biochronologic scale are based on the Quercy faunae (details in the next paragraph). The paleontological studies continue uninterrupted [e.g. Legendre *et al.*, 1997] and several completely new fossiliferous *loci* are inventoried each year.

! **QUERCY PALEOKARST:** 13 thesis, 350 scientific papers (APPENDIX 9A).
SINCE 2007: The “Quercy Phosphorite Mines” association coordinates the excavations.

Furthermore, the calcareous rocks of the Quercy plateau incised by Quaternary erosion show the complete Jurassic marine sedimentary infill sequence associated with the opening of the central Atlantic ocean through several outcrops distributed all over the territory. As such, many cross-sections serve as regional lithostratigraphic references (Cajarc, Rocamadour, St-Géry, Vers, Cras formations: upper Bajocian to lower Kimmeridgian [Cubaynes *et al.*, 1989]) and contain holotypes of fossil species ➡ FIGURE 19, such as 2 foraminifera *Coscinoconus limognensis* (previous *Trocholina gigantea*) (upper Bathonian, St-Cirq-Lapopie outcrop [Pélissié and Peybernes, 1982]) and *Spiraloculus giganteus/Limognella dufareii* (Bajocian/Bathonian, Calvignac outcrop [Pélissié and Peybernes, 1982]), and 2 gastropods *Gyraulus balmensis* and *Exelissa costaminuera* (at the transition between Bajocian and Bathonian ages, La Balme outcrop [Gruendel *et al.*, 2000]). Besides, the oldest known sauro-pods eggs (infraorder of dinosaurs, herbivorous quadruped) of the ancient Laurasia supercontinent dating from late Bajocian age (about 170 Ma) come from La Balme outcrop within the territory [Garcia *et al.*, 2006].

! **SEDIMENTOLOGY AND STRUCTURAL ANALYSIS** of the Jurassic and Cretaceous strata: 17 thesis, 138 scientific papers (APPENDIX 9B)

B.1.4. Scientific interest of the Quercy phosphorites

The remarkable value of the Quercy phosphorite fossiliferous deposits arise from the number of fossils available in the collections (up to 12,000 specimens for a single deposit; millions in all) and from the extraordinary conservation quality ➡ FIGURE 20 that even preserves the 3D shape without flattening effect [e.g., Legendre *et al.*, 1997]. This particularity explains the frequency of preserved fragile parts (e.g., micromammalian skulls). If small vertebrates predominate in the collections, large mammal fossils are also present [e.g., Rémy and Sudre, 2006]. Complete or partial skeletons, teeth, but also mummies, insects, and concerning plants: fruit and seeds, etc., are found. The great diversity of identified orders, families and species (see list of new taxa created on the basis of the Quercy phosphorites [e.g., Legendre *et al.*, 1997; Rage, 2006; Mourer-Chauviré 2006] and APPENDIX 9A) makes the Quercy phosphorites representative of the upper Paleogene across the European continent and many holotypes of fossil species have evocative names like *Cadurciguana*, *Cadurcotherium cayluxi*, les *Quercypsittidés*, *Quercymegapodius*, *Vaylatsia garouillensis*, *D. aubrelongensis*...

! **THUS FAR:** 500 different mammal species; 81 reptiles; 75 birds; 15 amphibians, one of fish; 6 plant families.

The abundance of specimens for some taxa enabled the reconstruction of specific lineage and the analysis of their evolution over millions of years (evolutionary stages defined by the size and morphology of the teeth, the first and last appearance, taxa joint occurrence). These data support the Paleogene mammal biochronologic reference scale ➡ FIGURE 21: 3 reference levels were defined on the territory (MP19 Escamps, MP25 Le Garouillas, MP26 Mas de Pauffié) and 2 others in the Tarn-et-Garonne, south bordering County (MP23 Itardies, MP28 Pech du Fraysse) [Schmidt-Kittler, 1987]. In addition, they document what has been called the “Grande Coupure”, or biologic crisis at the transition between Eocene and Oligocene epochs 34 Myr ago. Its supposed origin is a global cooling of the climate of the Earth (global average temperature shifting from 22°C to 12°C) ➡ P21 FIGURE 22.

The analysis of the Quercy mammalian faunae weight structure (average weight depending on species) compared to the current faunae lies behind paleoecologic studies that allowed characterizing the paleoenvironments of continental Europe: before 37.5 Ma tropical rainforest; 37.5 to 33.9 Ma tropical savanna; 33.9 to 27 Ma arid savanna; 27 to 25.5 Ma tropical savanna [Legendre 1986, 1989] ➡ P21 FIGURE 23.

From the recent and new perspectives of Quercy paleokarstic faunae, it is worth noting: the extension of the records to older periods at mid and lower Eocene (up to 54 Ma) and in the recent period at lower Miocene (up to 20 Ma) most of which is continuous [De Bonis *et al.*, 1977; Pélissié and Sigé, 2006] ➡ P3 FIGURE 1; the first paleoflora found in place with 6 plant families described [Franceschi *et al.*, 2006]; karstic activity resuming in the Pliocene [Crochet *et al.*, 2006; Aguilar *et al.*, 2007] predating the incision of the plateau by the current fluvial system 3.5 Myr ago; the identification of compressive effects related to the Pyrenean tectonic activity into the lower Miocene (work in progress).

FIGURE 19 Stratigraphic fossils from Jurassic period.

A : *Coscinoconus limognensis* © T. Péliissié
B : *Spiralococonus giganteus/Limognella dufauri* © T. Péliissié
C : *Gyraulus balmensis* © J. Gründel
D : *Exelissa costaminuera* © J. Gründel

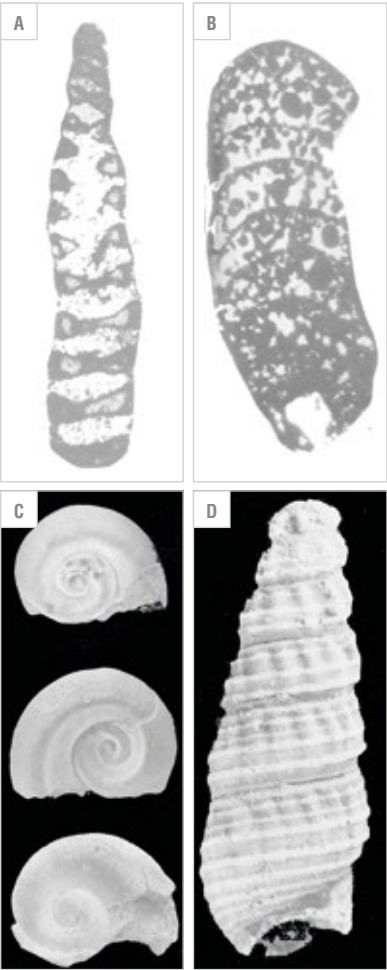


FIGURE 21 Mammalian biochronologic reference scale of the Paleogene period (Mammal Paleogene zones or MP zones) [modified after Legendre et al., 1997].

| Age (Ma) | Epoch | Age | MP | Sites from the Quercy |
|----------|-----------|------------------|-----|--|
| -19 | Miocene | Burdigalien | | Crémat |
| | | Aquitanién | | |
| -24 | Oligocene | | 30 | |
| | | | 29 | |
| | | (Late Oligocene) | 28 | Pech du Fraysse, Pech Desse, Portal |
| | | | 27 | |
| | | | 26 | Mas de Pauiffié, ... |
| | | | 25 | Garouillas, Rigal-Jouet, Belgaric, ... |
| | Early | Stampien | 24 | Lebratières 14, ... |
| | | | 23 | Itardies, Pech Crabit, ... |
| | | | 22 | Mas de Got, La Plante 2, Valbro, ... |
| | | | 21 | Aubrelong 1, Ravet, ... |
| | | | 21 | Coyrou 1-2 Grande coupure |
| -34 | Late | Ludien | 20 | Tabarly |
| | | | 19 | Escamps, Rosières 2, ... |
| | | | 18 | Sainte-Néboule, Gousnat, ... |
| | | | 17B | Perrière, Malpérié, ... |
| | | | 17A | Aubrelong 2, La Bouffie, ... |
| -38 | Eocene | Bartonién | 16 | Le Bretou, Lavergne, ... |
| | | | 15 | |
| -42 | | Lutetien | 14 | Laprade |
| | | | 13 | Cuzal |
| -49 | | Ypresien | 12 | |
| | | | 11 | Vielase, Cazals |
| | | | 10 | |
| | | | 9 | Pasturat |
| | | | 8 | |

FIGURE 20 Some major fossils from the "Old collections". A: Fossilisation of the soft tissues: example of a frog. © Laloy et al., 2013, B: Whole body 3D preservation: *Plagiolophus minor* © MNHN Montauban. C: Abundance of fossils: marsupial jawbones © MNHN Montauban. D: Chrysalid © M. Vianey-Liaud.



B.1.5. Emplacement conditions of the phosphorite deposits: Geological story of the Quercy linked with global plate tectonics

B.1.5.1. 200 to 145 Ma: The Jurassic tropical lagoons

The lithostratigraphic, sequence stratigraphy and structural studies of the Quercy Jurassic sedimentary basin, which presents a total average thickness of 1,000 m ➔ P23 FIGURE 24, show a global eustatic control on the 5 sedimentary supercycles [Rey *et al.*, 1988] with an undeniable effect of crustal stretching (for the Jurassic complete sequence stratigraphy record please refer to: Rey *et al.* [1988], Cubaynes *et al.* [1989], Lézin [2000] and the field-trip guide-book of Cubaynes *et al.* [2004]):

At the Permo-Triassic transition, the reactivation of late-Hercynian tectonic fractures creates the Quercy basin: a triangular basin about 100 km long and 30 to 80 km wide ➔ P17 FIGURE 15A. It receives detrital deposits, which come from the erosion of the Massif Central basement. At lower Hettangian age (200 Ma), the FIRST MARINE TRANSGRESSION forms a carbonate platform marking the opening of the proto-Atlantic ocean in the west.

At the transition between the Sinemurian and the Pliensbachian ages (190 Ma), THE BASIN DEEPENS and distal environments develop [Cubaynes *et al.*, 1989]. A sequence of marine transgression (calcareous marl with ammonites) and infilling ("*Barre à Pecten*" / *Pectinidae* bioclastic limestones stratum) forms. Then, the cephalopod rich (ammonites, belemnites) Toarcian black marls (180 Ma) are deposited. These marine fossils attest of an open and deeper sea indicating a new marine transgression. From Aalenian age (174 Ma), carbonate oozes are deposited that attest to a wider and less deep sea, with local erosion of the Toarcian deposits, and to an overall warm climate of tropical lagoons [Lézin *et al.*, 2007]. From Bajocian to upper Bathonian ages (from 170 Ma) many centimetre- to metre-size normal faults sealed by the overlying stratum, and, at larger scale, lateral variations in sedimentary strata thickness (onlap) corresponding to the infill of tilted blocs caused by normal fault activity are observed [Péligrié et Astruc, 1996; Lézin, 2000]. They record the opening of the two oceans surrounding the Quercy: the Central Atlantic Ocean to the west and the Ligurian Tethys Ocean at the east. A PROXIMAL CARBONATE PLATFORM located in a shallow zone develops, isolated from the open seas by reef barriers of north-south orientation.

From upper Bathonian to lower Kimmeridgian ages (165 to 155 Ma), a NEW PROXIMAL CARBONATE PLATFORM sedimentary cycle develops followed by an important emerged stage finally followed by marine transgression characterized by the presence of a littoral evaporitic complex [Péligrié, 1986; Péligrié et Astruc, 1996].

At Kimmeridgian (around 155 Ma), open sea conditions set in again in the Quercy. The facies are identical over the entire area until the basal Tithonian age (*Gravetia* ammonites). It is followed by a regressive tendency and the Jurassic sedimentary sequence ends with an intertidal to supratidal sedimentation.

It should be noted that typical karstic features have been identified within the Jurassic strata: isolated microkarstification

within the Aalenian deposits (e.g. at Calvignac); brecciation linked with evaporites dissolution phenomenon and micro-karstification within Bajocian and Bathonian deposits.

B.1.5.2. 145 to 70 Ma: Early Cretaceous gap and late Cretaceous sea

At late Cretaceous, a new marine transgression brings sediments that cover the Jurassic rocks ➔ P17 FIGURE 15A ET 16. This unconformity underlies a long period of emergence of the region during the early Cretaceous epoch (145 to 95 Ma): north of the area (Causse of Martel) all the late and part of middle Jurassic rocks are eroded; in the south only the Tithonian and part of the upper Kimmeridgian disappear. It seems – but this subject is still under discussion – that there was no significant endokarstic scouring during this period.

These new deposits (some hundred of metres thick), generally rich in sands (CALCAREOUS SANDSTONES), indicate a terrigenous source, which comes from the alteration of neighbouring crystalline rocks: the Massif Central whose relief is reactivated by the movements induced by the rotation of the Iberian Peninsula. The Cenomanian calcareous lagoonal-marine sediments are covered by Turonian reefal clayey limestones, and by Senonian chalky pelagic limestones containing flints. During Maastrichtian age, oyster lumachelles indicate the return of a littoral environment and, before the end of this age, emergence becomes permanent [Platel, 1996; Simon-Coinçon, 2008].

B.1.5.3. 70 to 24 Ma: First karstic period, Quercy phosphorite cavities setting up

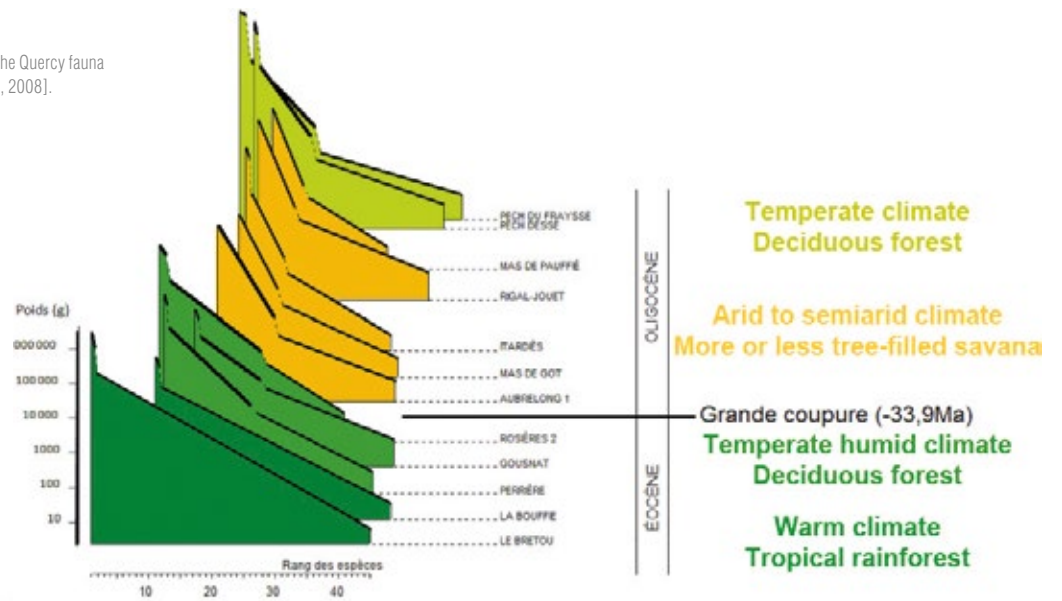
From its emergence onward, the Quercy is subject to erosion and karstification. The region looks like a tropical rainforest. Water penetrates through the fractured rocks and digs cavities within the Jurassic limestones ➔ P22 FIGURE 25A. Simultaneously, intense erosion occurs at the surface: water dissolves the calcium carbonate of the late Cretaceous strata. The insoluble elements accumulate, such as sands, clays, metallic elements or phosphates (originating from the Cretaceous marine organisms). These alterites are trapped in topographic depressions. Locally, sands become resistant to erosion since cemented by water from the groundwater table. They now form the topographic heights of the Causse (inverted relief). Clays and other insoluble elements (iron, aluminium, phosphate) constitute multi-decametric thick alterites topped with laterite crusts with typical red colour due to strong iron enrichment ➔ P22 FIGURE 25B. This layer, often reworked, is called *Sidérolithique* and still outcrops at a few places in the southwestern part of the territory.

At all scales, Jurassic and late Cretaceous rocks show evidence of moderate compression: fault reactivation, stylolite formation on normal micro-fault planes, folding at a large radius of curvature, conical folds... Around 50 Ma, these are the first consequences of the collision between Spain and Europe inducing the Pyrenean orogeny that are clearly recorded in the Quercy, more than 300 km away (bulge of the Aquitaine Basin northeastern edge). These fractures facilitate water infiltration and accentuate scour processes: drawdown chimneys and finally huge underground systems develop. At present, the first dated endokarst evidences are situated during lower Eocene with gallery-type karst containing rather coarse detrital deposits (gravels, cobbles, sands, iron pisolites).

FIGURE 22 Faunal "Grande Coupure" (34 Ma) and evolution of Quercy mammalian biodiversity.



FIGURE 23 : Cenogram analysis of the Quercy fauna [modified after Legendre, 1989; Escarguel, 2008].



At the surface, the opening of certain galleries turns them into traps: laterites, animal remains and plants are dragged in by the water ➔ P22 FIGURE 25C. Rarely do animals fall alive into such opened cavities; but they often harbour bats and raptors, and pellets are found. The chasms are gradually filled. Phosphatic nodules and crusts derived from the phosphate rich clays fossilize the organic remains (vertebrate bones, insects, plant debris) ➔ P22 FIGURE 25D. This filling is quick compared to the geological time scale, a few thousand years on average. Fossils that are contained in a phosphorite cave thus provide a snapshot of the landscape, biodiversity and climate.

? PHOSPHATE: Phosphorus is the 11th most abundant chemical element in the Earth's crust. Phosphates derive from apatite of the magmatic rocks, dissolved and fixed by plants and animals (bones, teeth, faeces) that, at their death, form phosphatic sediments. These rocks are found on the continental shelf or at its edge (50-200m thick water column).

Scouring and filling (clayey predominantly) extend to the upper Oligocene in response to changes of baselevel. Drawdown of almost all the Cretaceous alterites is achieved (a few hundreds metres) and part of the Jurassic rocks are eroded. The faunal inventory of phosphorite caves and the vast alluvial deposits identified to the west, outside the territory, indicate a marked climate change around 34 Ma: weathering goes on but under a dryer and colder climate. Large wadis going down from the Massif Central sweep out the Causse surface, shaving off the alterites and finally the bedrock limestones, before reaching the Aquitaine Basin lakes. This creates in the Quercy a flat topographic surface called "eogene" erosional surface.

B.1.5.4. 24 to 20 Ma: Diachronous sedimentary overlap from southwest to northeast

The uplift of the Pyrénées mountain chain goes on, as well as the Massif Central. Molasses, which are the stripping products of these reliefs, accumulate in the Aquitaine Basin and eventually block the emergent underground flows from the Quercy plateau. At its foot, a set of lakes develops where marl and limestones typical of the "White Quercy" are deposited. Little by little, in a diachronous way from southwest to northeast, these deposits bury the karstic topography of the Causse, sealing and ensuring preservation of the paleokarst during upper Chattian age [Legendre *et al.*, 1997] ➔ FIGURE 25E. Remains from this lacustrine sedimentary cover (containing lacustrine gastropod fossils and imprints of reed tubes) persist at the southwestern edge of the territory ➔ P17 FIGURE 16.

B.1.5.5. 18 Ma to present: Second karstic period and deepening of the valleys

The first scouring evidences of the limestone lacustrine coverage date from Burdigalian (18 Ma; Crémat phosphorite cave at Cabrerets). The large number of dolines ("cloups"), and their frequency in the northern part of the territory almost in negative with the phosphorite caves ➔ P24 FIGURE 26, might indicate that the Mollase sedimentary cover remained longer in place in the south, within the lower part of the Causse. The numerous dry valleys ("combes") are characteristic of the Causse. They are mainly located in the western third of the territory (alternation of calcareous marl beds of Kimmeridgian age), as well as on both sides of

FIGURE 25 Phosphorite deposits genesis. © E. Cassan

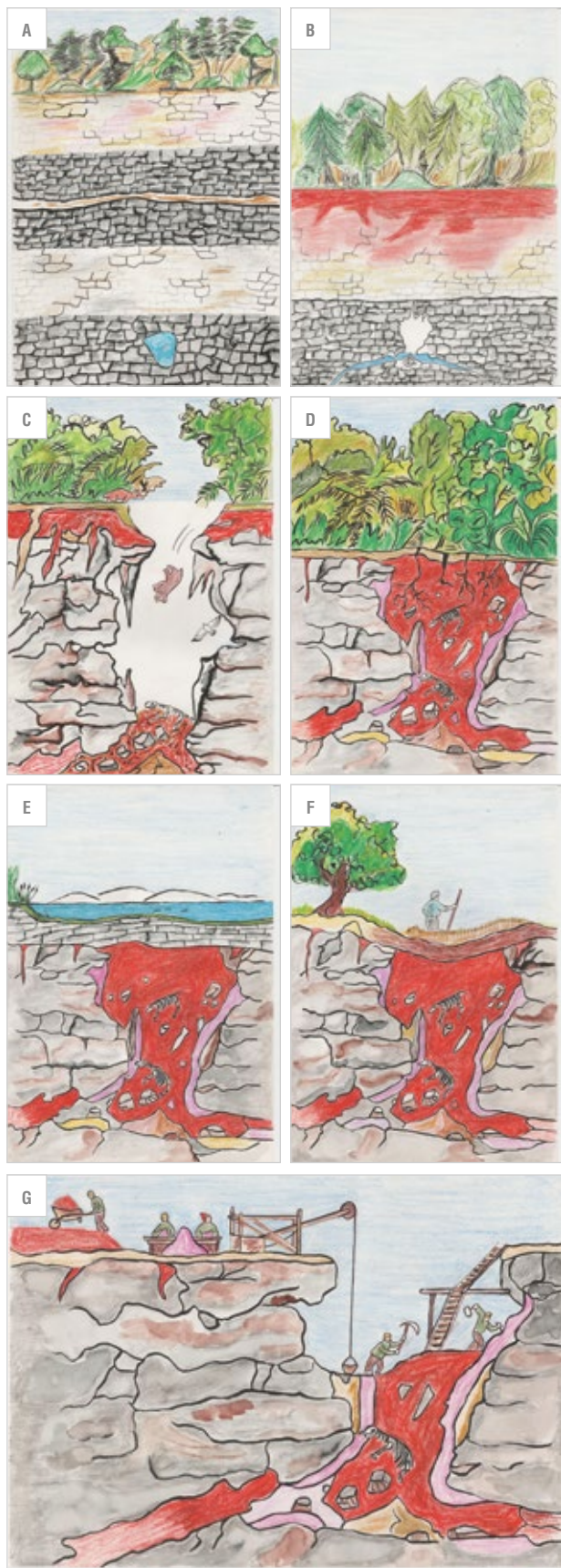
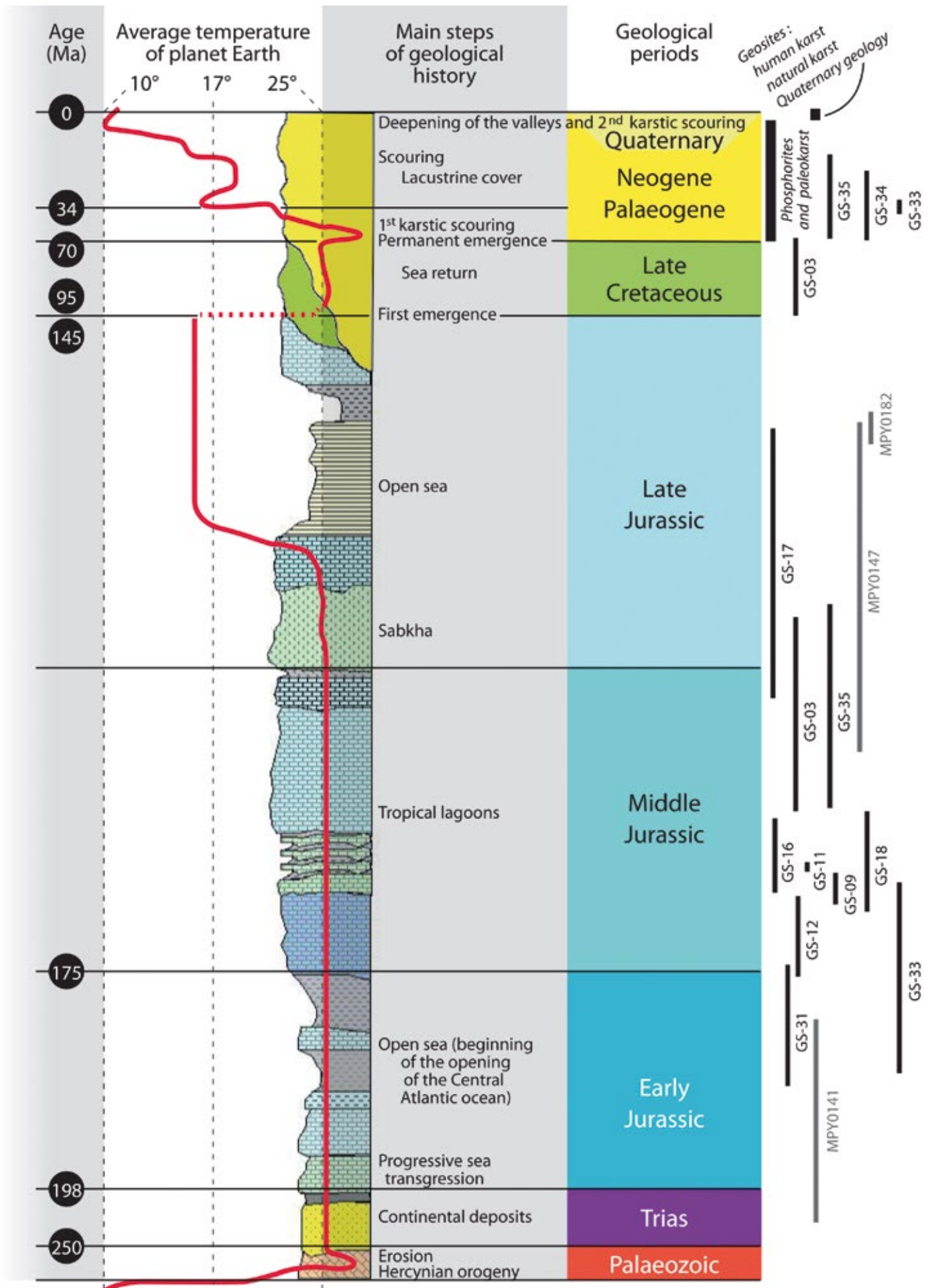


FIGURE 24 Quercy stratigraphic log (GS: integrated geosite → P28 TABLE 6; MPY: scientific geosite, APPENDIX 10).

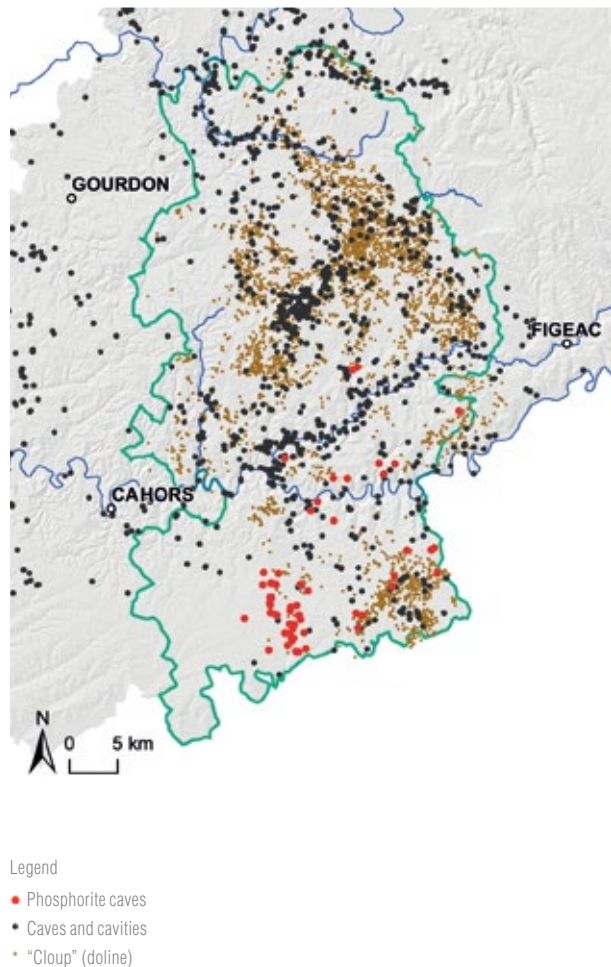


the Lot and Célé rivers ➔ P26 FIGURE 27. Upstream, the incision starts suddenly in connexion with the karstic depressions; very steep downstream (150 m or more), their bottom is narrow and flat. They indicate a period when surface water flows were more abundant.

If between 18 and 3,5 Ma data on the geological story are very sparse, the first indication of karstic activity resuming is dated at 3,5 Ma (Cremps deposit [Aguilar *et al.*, 2007]). River erosion begins with a major event: a powerful dissection that makes the rivers carve downward over about 150 m into the calcareous *causse* between 2 and 1 Ma (not dated strictly speaking). This incision, extended to the entire Massif Central edge, is most likely successive to an overall epeirogenic uplift. During the Quaternary, this downward cut goes on more slowly (50 m in average). Three levels of fluvial deposits, the alluvial terraces, are visible above the current river level ➔ P26 FIGURE 27K. They reflect Quaternary global climatic variations that affected the region. Today, all the catchment area is recaptured by vegetation, the hillsides are protected from erosional processes and discharge is reduced from evapotranspiration: rivers do not cut nor make deposits.

Linked with the downward cut of the rivers, the present karst developed, intersecting the various paleokarsts. Unlike in the Mediterranean Basin, the Messinian crisis does not seem to have any impact. Questions remain concerning subaquatic concretions (Recel at Marcilhac for example) and very deep conduits (-180 m at St-Sauveur, -150 m at the Chartreux close to Cahors, -120 m at Cabouy/Poumeysens, etc.) that could be related to low marine levels during glaciations. The calcareous plateau is characterized today, at all scales, by its karstic topography: crypto-karrenfeld, dolines ("cloups"), uvalas, chasms ("igues"), caves, swallow holes and resurgences ➔ P26 FIGURE 27.

FIGURE 26 Distribution map of phosphorite caves, "cloups" (dolines) and cavities.



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

B.2.1. Geosites selection method

The choice of the geosites that are part of the development strategy of the geological offer (scientific and/or educative and/or geotouristic value) led by the aspiring Geopark is based on the National Inventory of Geological Heritage (INPG 2012; updated CRPG 2015 for the Lot County; see § B.1.2.). Nevertheless, the aspiring Geopark, due to the numerous important archaeological and historical heritage elements (see section A.) associated or located close to the geosites, decided to develop a concept of "integrated geosite". Each of these 48 INTEGRATED GEOSITES covers some square kilometres to some tens of square kilometres. Through a major geological heritage element and some associated elements, each site tells a part of the local geological story and the close relationship man kept with the geology of its territory. Four categories describe geological interest of each integrated geosite: paleokarst, man's use of the karst, natural karst, geological history of the territory. On the other hand, the 110 OTHER GEOSITES DEDICATED

EXCLUSIVELY TO RESEARCH identified within the aspiring Geopark by the National Inventory of Geological Heritage (CRPG, 2015) complement the integrated geosites; among them, more than 60 % are phosphorite caves (see complete list in APPENDIX 10).

B.2.2. Integrated geosites listing

- ➔ P28 TABLE 6: List and description of the integrated geosites.
- ➔ P23 FIGURE 24: Integrated geosites numbers indicated on the stratigraphic column.
- ➔ P27 FIGURE 28: Location of the integrated geosites.
- ➔ P32 FIGURE 29: Pictures of some integrated geosites.

B.2.3. Presentation of 3 major integrated geosites

B.2.3.1. Phosphorite cave of Cloup d'Aural (GS-02)

The equipment, guided tours, educational activities (general public and school from primary to university level),

thematic paths and performances in and around the Phosphorite cave of Cloup d'Aural (→ P32 FIGURE 29A, site open to the public since 2000, allow the discovery of: geological (paleokarst, karst, faults), paleontological/paleoclimatic (thematic paths), mining engineering (putlogs, low walls, metal parts, reconstituted hoist) and natural heritage (flora adaptation from dry surface conditions to the 100 % humidity conditions in the phosphorite cave). This site welcomes more than 13,000 people (all public) per year. In 15 years, more than 30,000 pupils/students from 1,200 school groups, from infant school level to university Master 2 with a marked predominance of *Lycée* students (15-18 yr old pupils) have visited this geosite. It represents the showcase site of the Quercy phosphorite caves. It is also the scientific base and sieving location for the annual excavation campaigns in the Quercy paleokarst.

B.2.3.2. Outcrop of Pech Affamat (GS-09)

The outcrop of Pech Affamat (→ P32 FIGURE 29B; reference locality of the “Pech Affamat dolomite breccia”) allows the reconstruction of the middle Jurassic Quercy paleoenvironments and shows evidence, in a didactic way, of an emergence 170 Myr ago. Indeed, above the oolitic limestones cut by traces of emergence, lignites (coal) sit on top of a paleosol with root traces (vertical perforations). Millimetric teeth of fish, crocodilians and ornithischians have been found. The orangish vuggy formation that covers this level contains fibro-stellate calcite nodules typical of coastal hypersaline lagoon deposits. Above, the limestones indicate marine transgression. Besides, the vuggy level includes pockets with pisolite and sandy filling containing fossilized Eocene bats. From the geosite viewpoint, on the convex side of a beautiful meander, one can admire the two alluvial terraces showing the progressive downward cut of the river.

B.2.3.3. St-Cirq-Lapopie – Berganty area (GS-03)

The front cover of this application dossier (upper picture), showing the perched village of St-Cirq-Lapopie overlooking the

Lot River, illustrates an emblematic integrated geosite of the territory whose history covers 167 Myr:

- From the panoramic viewpoint towards the village, one has an overview of: the Bathonian to Oxfordian limestones that form the basement (type locality of *Coscinoceras limognensis*); the late Cretaceous gritty limestones that were covering the entire area, whose sandy fraction (insoluble) was drawn down into the karst during the Tertiary era, and that appears now in inverted relief in Berganty area; and the progressive downward cut of the Lot River during the Quaternary period marked by three successive levels of alluvial terraces.
- The village of St-Cirq-Lapopie, which illustrates man's use of the geologically available resources: settlement of the village on a natural defensive site located 80m above the Lot River; access to the perched groundwater aquifer that developed within the Cretaceous sands; and the charming preserved village dating from the Middle Ages, which was built using the local stone (ranked among the Most Beautiful Villages of France and elected Preferred Village of the French in 2013).
- Below, on the Lot river: mill, dam, port, lock and tow-path dug into the limestones (300m long, 2m high) dating from the second half of the nineteenth century when the Lot River was used to transport merchandise including phosphate.
- 3km southwest of St-Cirq-Lapopie, an acid subsoil vegetation (brooms, ferns, chestnut trees) characterizes the Berganty uvala. It is the continuity of the karstic pocket filled with late Cretaceous sands that is also found below St-Cirq-Lapopie. Man extracted these sands, where they were indurated by the variations in groundwater level, to carve millstones (one millstone still in place is visible → P6 FIGURE 3P).
- The Cirque de Vènes, located 700m east of the village of St-Cirq-Lapopie, offers a complementary geomorphologic approach on quaternary erosional processes (Lot canyon and widening of the valley, past streams, conglactif screens).

B.3. Details on the interest of these sites in terms of their international, national, regional and local value

The value of the inventoried geosites of the aspiring Geopark area is assessed following the criteria of the national inventory INPG (see details in § B.1.3.; [De Wever *et al.*, 2014]). In this context, sites assessed above 30 obtained 3 stars, i.e., of international and national value without distinction. The geosites in question are firstly paleontological sites, with undeniable

international value, and secondly, geological reference sections and geomorphologic objects of national value (→ P28 TABLE 6 and → TABLE 7. Nevertheless, it is worth noting that the value of a large number of scientific geosites, especially in the phosphorite caves where in place fillings are not yet studied, will be updated in the course of the excavations and scientific publications.

↓ TABLE 7 Number of geosites according to their value of the aspiring Geopark.

| | INT. | NAT. | REG. | COUNTY | LOC. | TOTAL |
|---------------------|------|------|------|--------|------|-------|
| Integrated geosites | 7 | 5 | 9 | 11 | 16 | 48 |
| Scientific geosites | 11 | 2 | 18 | 30 | 49 | 110 |
| TOTAL | 18 | 7 | 27 | 41 | 65 | 158 |

FIGURE 27 Sketch illustrating the geology of the Causses du Quercy. © C. Verdun

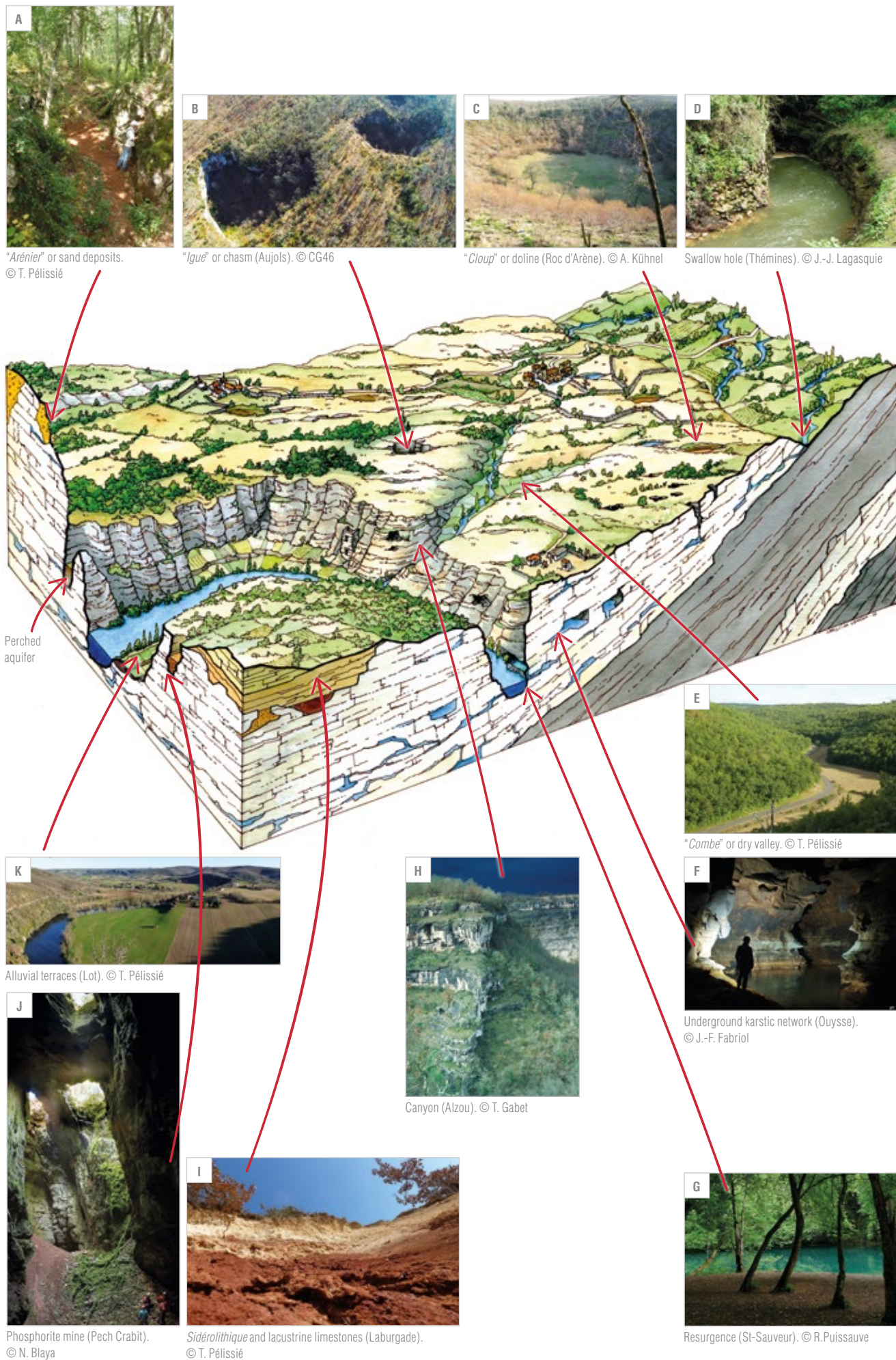


FIGURE 28 Location map of the integrated geosites (GS), linked sites (SL) and partner sites (SP).

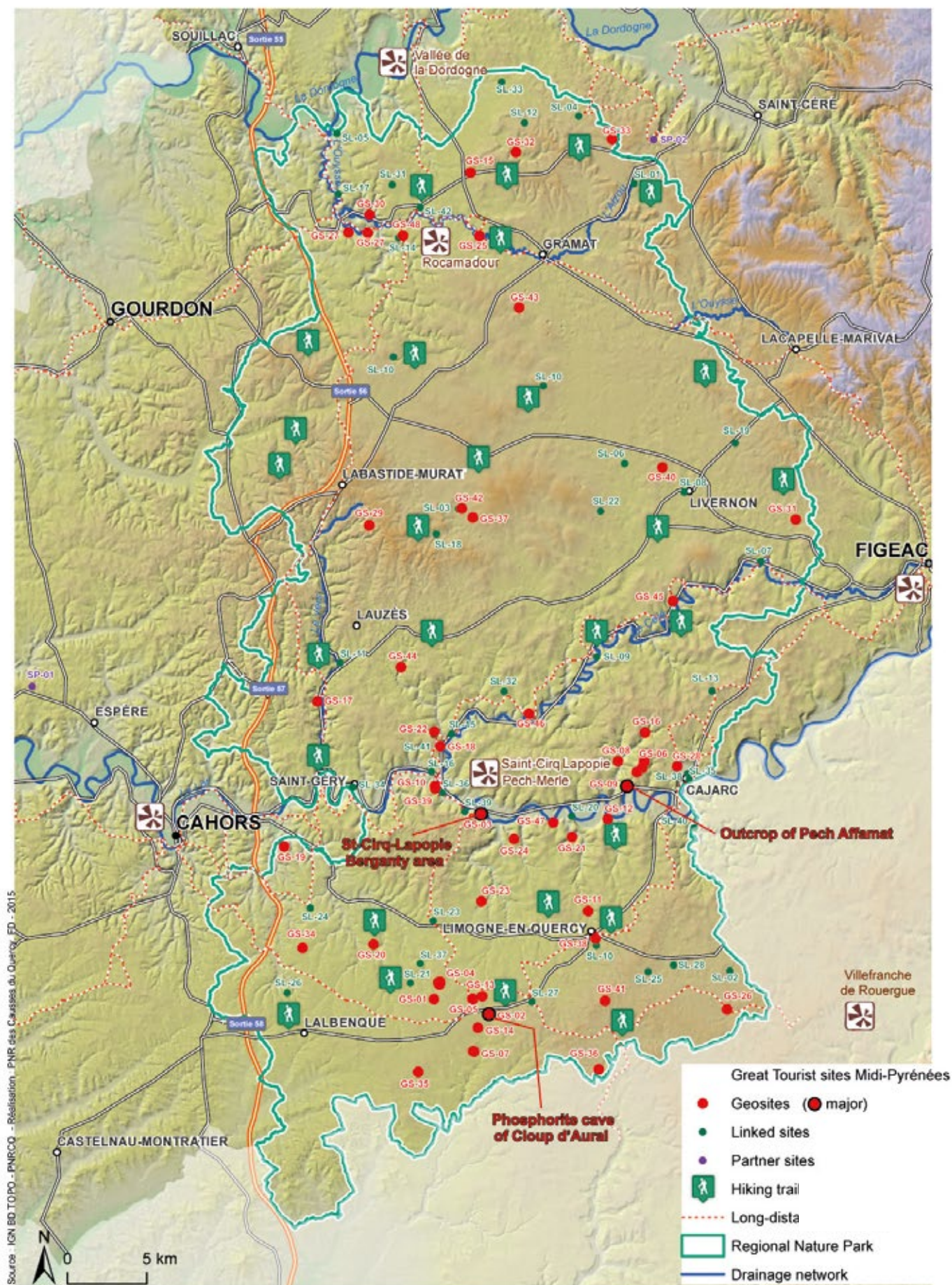


TABLE 6 List and description of the 48 integrated geosites of the aspiring Geopark of Causses du Quercy.

| | Geo Site | INPG 2015 | Value (INPG) | Geosite name | Municipality | N° INPG | Promotion | Paleokarst | Man's use of the karst |
|-----------------------------------|----------|-----------|--------------|--|----------------------------|--|---|--|---|
| Phosphorite caves (8) | GS-01 | 42 | INT. | Phosphorite cave of Tempories | Escamps | MPY0036 | Promotion through the georoute. University students in palaeontology. | Escamps phosphorite cave. Reference deposit MP19. Type locality of 3 species: <i>Palaeotrochus escampiensis</i> , <i>Paradelomys spelaeus</i> , <i>Patrittheridomys altus</i> . Ongoing study of in place fillings. | Exploitation vestiges: putlogs. |
| | GS-02 | 40 | INT. | Phosphorite caves of Cloup d'Aural | Bach | MPY0056 | Promotion since 2000: showcase site of the phosphorite caves. Scholastic + university events. Entrance fee. | MP28 phosphorite cave. Link between scouring/karstic potential/faults. Present-day biodiversity inventoried. | Listed MNHN by means of 19th C. mining heritage. Exploitation vestiges: putlogs, low walls, metal parts, excavation resumption, hoist rebuilt (with vertical drum). |
| | GS-06 | 40 | INT. | Phosphorite cave of Mémerlin Prajoux | Larnagol / Cajarc | MPY0014 MPY0038 MPY0039 | <i>Possible development as a panoramic viewpoint. Important risks of crumbling.</i> | MP13, MP14, MP18 phosphorite caves. Old mines group, part of a paleokarstic network with some unharmed places. Type locality of: <i>Paroxycloaenus lemuroides</i> , <i>Pronycticebus gaudryi</i> . Numerous <i>loci</i> with in place phosphate. | Various exploitation vestiges: low walls, putlogs, stairs, wooded gallery, gallery carved using explosive device, drawn head, wells prior to exploitation, well dug at the bottom of the phosphorite cave, etc. |
| | GS-05 | 37 | INT. | Phosphorite cave of Mas de Got/Bories | Bach | MPY0008 MPY0010 | University students in palaeontology. <i>Outdoor activity: possible caving activity (cave crossing).</i> | MP22 phosphorite caves. Type locality of <i>Paleosciurus goli</i> . Numerous in place infills undergoing research. Tectonic evidences in the lower Oligocene epoch. | Exploitation vestiges: putlogs, low walls, beams, sounding at the top of the deposits, etc. |
| | GS-13 | 35 | INT. | Phosphorite cave of Valbro | Bach | MPY0248 | Educational promotion through participatory science (sieving and sorting of sediments by high school and college pupils). | MP22 phosphorite cave. European Lower Oligocene most diversified deposit. Remarkable fauna of carnivorous. Participatory science action "Paleontologists seeds". | Exploitation vestiges: putlogs, beams, low walls, etc. |
| | GS-04 | 31 | INT. | Phosphorite caves of Rosières 1 to 6 | Escamps | MPY0031 MPY0032 MPY0033 MPY0034 MPY0035 MPY0259 | <i>Possible surface development but property issue. Outdoor activity: possible caving activity (cave crossing).</i> | MP19/MP17b phosphorite caves. Discovery place of a primate hand. Morphology: remarkable cupolas. Remarkable infills: complete channel, quartz cobbles and lateral decantation deposits. | Exploitation vestiges: excavated materials accumulated around the head of the well, in place beams, low walls, putlogs, etc. |
| | GS-08 | 31 | INT. | Phosphorite cave of Salême | Larnagol | MPY0037 | <i>Two already existing access paths = possibility of development.</i> | MP17a phosphorite cave. Type locality of <i>Pseudoamphimeryx salesmei</i> . Unusual morphology with mining exploitation in terraces on the entire hillslope. | Exploitation vestiges: walls. |
| | GS-07 | 22 | REG. | Phosphorite cave of Pech Crabit | Vaylats | MPY0048 MPY0049 | | MP23 phosphorite caves. Significant in place infill , incomplete taphonomic study (thesis Laudet [2000]). | Exploitation vestiges: shoring, putlogs. |
| Other paleokarstic sites (5) | GS-10 | 30 | REG. | Paleokarst of Bouziès | Bouziès | MPY0216 | <i>Beside a tourist road = easy development and promotion.</i> | Juxtaposed infills from Eocene MP17a and upper Pleistocene: example of the Quercy paleokarst distinctive feature. | |
| | GS-30 | 24 | REG. | Paleokarst of Castel Giroux | Rocamadour | MPY0192 | | Old karstic gallery topped by erosion. Late Cretaceous sandy infills. | Exploited sand for construction ("arène"). |
| | GS-22 | 20 | DEPT. | Bellecroix calcite of Pech Merle | Cabrerets | MPY0153 | <i>In the planning stage: integrated with the path connecting the car park to the cave.</i> | Late Cretaceous sandy infills. Bellecroix calcite. Associated with the decorated cave of Pech Merle. | Exploited sand for construction ("arène"). |
| | GS-20 | 20 | DEPT. | Paleokarst of Cremps | Cremps | MPY0266 | | Infills from the lower part of the upper Pliocene = downward cut of the Lot must have been latter to this age. | |
| | GS-29 | 8 | LOC. | Paleokarst of the Cuvette de Lauzerte | St-Cernin/Soulomès | MPY0151 | <i>Development through reading the landscape.</i> | Karstic chimney with remains of sandy infills of late Cretaceous deposits weathered and drawdown into the karst. | Favourable conditions for agriculture (loose soil vs limestones). |
| Karstic sites used by humans (12) | GS-36 | | NAT. | Swallow hole of the Cros | Saillac | | Hiking itinerary. Archaeological excavations. | | Prehistoric site at the transition between Neolithic – Bronze Age (Crosien). Converted swallow hole, mill upstream. |
| | GS-14 | 26 | REG. | Phosphorite cave of Coulou Escabasse: water in a calcareous area | Bach | MPY0005 | Existing educational promotion. Existing geowalk itinerary. | MP23 phosphorite cave. | Water reserve and exploitation in calcareous areas: St-Namphaise lakes and "butterfly" washing places, epikarstic "Roman" wells, "manhole" on the deep aquifer of the cause. |
| | GS-17 | 26 | REG. | Cross-section and aqueduct of Vers - Oppidum of Murcens | Vers / Cours | MPY0214 | | | <i>Divona Cadurcorum</i> (Cahors) Gallo-Roman aqueduct: channeling, geotechnical constraints and adaptation of the route, materials choices, etc. Closed overhang = oppidum. |
| | GS-26 | 14 | DEPT. | Swallow hole of Laramière-Rausel | Laramière | MPY0131 | <i>Possible development linked with the priory.</i> | | Swallow hole converted to a mill. Settlement of the priory. |
| | GS-32 | | LOC. | Spring of Salmière | Miers | | Restoration and promotion in progress. | | Sodium-sulphate spring arising from a confined aquifer in the lower Lias strata. An old spa used its properties. |
| | GS-39 | | LOC. | Towpath | Saint-Cirq Lapopie/Bouziès | | Heavily visited place: hiking, boating, etc. | | Concave bank and towpath dug into the cornice at the 19th C. Recent artistic and touristic reappropriation. |
| | GS-40 | | LOC. | Dolmen of Pierre Martine protohistoric quarry | Livernon | | Promotion of the megaliths. Booklet "megaliths" from the Park. | | Flagstone extraction. Dolmen. |
| | GS-45 | | LOC. | Château des Anglais | Brengues | | Hiking trail. | | Natural defensive site. |

Legend:

In italics: Planned promotion

| Natural karstic sites | Geology | Trails (t) Panels (p) Leaflets (l) | Science | Education | Geo tourism | Protection | Protection type | Pressure |
|--|--|--|---------|-----------|----------------|------------|---------------------------|----------|
| | | p | ✓ | ✓ | ✓ | ✓ | RNNIG | L |
| | | t, p, l | ✗ | ✓ | ✓ | ✓ | RNNIG MH | |
| | QUATERNARY: Gravels attributed to superficial reworking and deposits by the paleo-Lot river. Discovery site of the "l'ion de Cajarc": <i>Pantera spelaea</i> . | ✗ (-4) | ✓ | | ✓ | ✓ | RNNIG | E, S |
| Evidences of hydrogeological link with the tapped spring of Crégols. | | | ✓ | ✓ | ✗ | ✓ | RNNIG | L |
| | | | ✓ | ✓ | | ✓ | RNNIG | L |
| Dry valley. | QUATERNARY: Periglacial screes at surface and within one of the galleries. | | ✓ | ✗ | ✗ | ✓ | RNNIG | L |
| Dry valley or temporarily active. | | ✗ (-4) | ✓ | | ✗ | ✓ | RNNIG | L, S |
| | | | ✓ | | ✗ | ✓ | RNNIG | L, E |
| Canyon of the Lot river. | QUATERNARY: Cavity with important periglacial screes infill = climate variations. Viewpoint on the alluvial terraces of the Lot river. | ✗ (-4) | ✓ | ✗ | ✗ | ✓ | RNNIG, MH Natura 2000 | D |
| | CRETACEOUS: evidence of the eroded cover. | ✗ (-4) | ✓ | | ✗ | ✓ | Natura 2000 Loi 30 | |
| | CRETACEOUS: evidence of the eroded cover. | | ✓ | ✗ | ✗ | ✓ | RNNIG, MH Loi 30 | L |
| | | | ✓ | | | ✓ | RNNIG | D |
| | CRETACEOUS: evidence of the eroded cover. PALEOCENE: evidence of a deep karstification (karstic chimney). | | ✓ | ✗ | ✗ | | | |
| Swallow hole, active waterway becoming dry. | Limestones from the base of the middle Jurassic. | t | ✓ | ✗ | ✓ | | | L |
| Dry valley. Evidenced hydrogeological relation with the tapped spring of Cande in Puylaroque (82). | | t ✗ | ✓ | ✓ | ✓ | ✓ | RNNIG | E |
| | JURASSIC: Reference section. Vers dolomicrite, Breccia with black pebbles and breccia linked with evaporites dissolution. QUATERNARY: Alluvial terraces and Lot river. | t, p | ✓ | ✗ | ✓ | ✓ | Natura 2000 MH | E, S |
| Swallow holes. | JURASSIC: contact between the marly Limargue/calcareous Causse. Outcrop of the limestones from the base of the middle Jurassic. | ✗ | | ✗ | ✓ | ✓ | MH | |
| | | t ✗ (-4) | | ✓ | ✓ | | | |
| | | t | | ✗ | ✓ | ✓ | Natura 2000 MH | |
| Karrenfeld. Karstification figures. | | t, p, l | ✓ | ✗ | ✓ | ✓ | MH | |
| | | t | | | ✓ | ✓ | Natura 2000 MH, Loi 30 | E |

✓ : Present

✗ (-4) : in the four coming years

✗ : Future

L : Looting, D : Direct Destruction

E : Natural Erosion,

S : Natural Succession

TABLE 6 List and description of the 48 integrated geosites of the aspiring Geopark of Causses du Quercy.

| | Geo Site | INPG 2015 | Value (INPG) | Geosite name | Municipality | N° INPG | Promotion | Paleokarst | Man's use of the karst |
|-----------------------------------|----------|-----------|--------------|---|---|-------------------------------|---|--|--|
| Karstic sites used by humans (12) | GS-37 | | LOC. | Lake Saint-Namphaise of Font del Pech | Caniac-du-Causse | | ENS promotion (hiking itinerary). Booklet "St-Namphaise lakes" from the Park. | | Impermeability of the limestones. Legendary history +/- historical. |
| | GS-38 | | LOC. | Lake on argillaceous pocket: lavoir de Limogne | Limogne-en-Quercy | | Integrated with the georoute. Topoguide of the Park. | | "Butterfly" washing places. Statute of watering places (including nowadays, cf. "not analyzed water" since those who drink it refute the word non-potable...). |
| | GS-46 | | LOC. | Underground living of Vieux Sauliac | Sauliac-sur-Célé | | | | Construction on a natural ledge of the cornice: defensive purpose? south exposure, etc. |
| | GS-41 | | LOC. | Site of Roger Rousseau | Beauregard | | <i>Cultural activities feasible. Private site.</i> | | Surface scouring and dry stone built ensemble, philosophical and artistic purpose. |
| Natural karstic sites (10) | GS-19 | 33 | NAT. | Igues (chasm) of Aujols | Aujols | MPY0278 | ENS promotion. | | |
| | GS-15 | 23 | REG. | Chasm of Réveillon | Alvignac | MPY0128 | Currently prohibited access. <i>Discussions with the owner + safeguarding required.</i> | | |
| | GS-21 | 20 | DEPT. | Trou Madame - Spring of Girou | Cénevières | MPY0180 | University students in hydrogeology (dye tracing). Heavily visited site (tourists and cave divers). | | Close to the Pech d'Anjou quarry. Mill located downstream + identified link with the <i>cause</i> thunderstorms. |
| | GS-24 | 20 | DEPT. | Igue (chasm) of Crégols | Crégols | MPY0240 | Visited site / hiking trail. Rock-climbing and highline activities. Climbing topoguide. | | |
| | GS-43 | 20 | DEPT. | Cloup (doline) of Roc d'Arène | Gramat | MPY0280 | Climbing topoguide. | | Rim low wall, cultivated doline. |
| | GS-25 | 19 | DEPT. | Alzou canyon, Saut watermill, Rocamadour cornice | Rocamadour Couzou Gramat | MPY0142 MPY0205 MPY0236 | Existing hiking trails and developed site. Topoguide of the Park. | | Semi-troglodyte settlement on ledges in the middle of the cornice (sanctuary and village). Mill built on a waterfall. |
| | GS-23 | 18 | DEPT. | Combe (dry valley) canyon: Combe du Bournac-Font d'Erbies | Crégols | MPY0164 | Existing beginner's rock-climbing and caving activities. | | Use of the porch as a dovecote and a water-cress bed. Small prehistorical settlements. |
| | GS-27 | 16 | DEPT. | Resurgences of Cabouy and Saint-Sauveur | Calès | MPY0135 MPY0136 | Site visited by tourists and cave divers. Topoguide of the Park. | | |
| | GS-42 | | DEPT. | Igue (chasm) of Planagrèze | Caniac-du-Causse | MPY0147 | ENS promotion. Topoguide of the Park. | | |
| | GS-44 | | LOC. | Combe (dry-valley) with gentle slopes: upper Sagne valley | Sabadel-Lauzes / Lentillac-du-Causse | | | | |
| Mesozoic / Cenozoic Geology (10) | GS-09 | 38 | NAT. | Outcrop of Pech Affamat | Larnagol | MPY0222 | University students in sedimentology. Busy road. <i>Possible stop-over of the georoute.</i> | Eocene infilled pockets (identified but not yet studied). | Lignite level locally exploited close-by. Old route passing on a natural ledge. |
| | GS-03 | 37 | NAT. | Area of St-Cirq-Lapopie – Berganty – Cirque of Vènes | St-Cirq-Lapopie / Berganty | MPY0152 | Large scale geological site already developed. <i>Possibility of geowalk itinerary.</i> | Karstic pocket with sand infills locally indurated by the variations in groundwater level. Karstic cirque. | Village settlement (defensive peak, perched aquifer). Millstone extraction. |
| | GS-16 | 32 | NAT. | Cross-section of Saint-Chels | Saint-Chels | MPY0247 | On the side of the road. University students in sedimentology. | | |
| | GS-11 | 29 | REG. | La Balme – Limogne en Quercy | Limogne-en-Quercy | MPY0207 MPY0211 | University students in sedimentology and geodynamics. College pupils (geology field trip). <i>Possible stop-over of the georoute.</i> | | Experimental dolmen of Rigounenque. Building-stone extraction (abandoned lintel) and material used to surface paths. |
| | GS-12 | 26 | REG. | Cross-section of Calvignac | Calvignac | MPY0212 MPY0213 | On the side of the road. Long-standing educational promotion. <i>Possible stop-over of the georoute.</i> | Micro karst with internal sediments in the Aalenian deposits. | Medieval defensive site. |
| | GS-18 | 23 | REG. | Cornice of Cabrerets | Cabrerets | MPY0217 | University students in sedimentology and geodynamics. College pupils (geology field trip). Landscape reading. | Phosphorite cave with distinctive top since situated in the bottom of a large doline. Fossiliferous, but not yet dated with certainty, might be very "recent" = Miocene, as Crémat on the opposite side of the Célé river. | Bottom of the doline formerly cultivated (rim low wall) but completely reworked for phosphate extraction. |

Legend:

In italics: Planned promotion

| Natural karstic sites | Geology | Trails (t) Panels (p) Leaflets (l) | Science | Education | Geo tourism | Protection | Protection type | Pressure |
|--|--|--|---------|-----------|----------------|------------|------------------------------------|----------|
| | | t, l | ✓ | | ✓ | ✓ | Natura 2000 ENS | |
| | | t, l | | | ✓ | | | |
| | | t x (-4) | | x | ✓ | ✓ | Natura 2000 MH, Loi 30 | E |
| Doline, crypto-karrenfeld. | Sedimentary casts in the Bajocian/Bathonian transition series. | | ✓ | x | x | | | E, S |
| Group of 3 well-shaped dolines (collapse doline). "Manhole" on the karstic groundwater. Evidenced hydro-geological relation with the Chartreux spring in Cahors. | | t, p | ✓ | x | ✓ | ✓ | ENS | E, S |
| Majestic swallow hole. Hydrogeological relation with the Limons spring. | JURASSIC: Section of the Lias/Dogger transition series. | | | | x | | | E |
| Blind valley with emergence of the water from the Promilhanes/Limogne area. Diving exploration over 2 km. Dry valley becoming active. | JURASSIC: Outcrop of the Bajocian/Bathonian limestones series. | p | | ✓ | ✓ | | | |
| Spectacular karstic modeling: secondary network. Dry valley. | | t | ✓ | x | ✓ | ✓ | RNNIG | E, S |
| Collapse doline of large dimension. | | t | ✓ | | ✓ | | | |
| Spectacular karstic modeling. | JURASSIC: Synsedimentary sliding within the Bathonian series (at the Sirogne mill), numerous outcrops (Aalenian to Callovo/Oxfordian). | t, l x (-4) | ✓ | ✓ | ✓ | ✓ | Natura 2000 MH, Loi 30 ENS | E, S |
| Dry valley (or occasionally active), meander shaped, rimmed by cornices. Perched resurgence of Font d'Erbies. Swallow hole (temporarily active valley becoming dry). Tapped spring of Bournac. | QUATERNARY: Periglacial screes. | p x (-4) | ✓ | x | ✓ | ✓ | Natura 2000 | S |
| Resurgences of a part of Ouyse river network. | | t, p | ✓ | x | ✓ | ✓ | Natura 2000 Loi 30 | |
| Doline and chasm. | | t, p | ✓ | ✓ | ✓ | ✓ | Natura 2000 ENS | |
| Dry valley upstream and active valley (travertine). | | t | | | ✓ | | | |
| Differential weathering = morphology of the valley slopes. | JURASSIC: Reference section. Emergence sequence (subtidal to supratidal = sebkha), paleosoils, dinosaurs remains. Global overview on the mid-Jurassic serie. TERTIARY: Eocene infilled pockets. QUATERNARY: Alluvial terraces of the Lot river, convex vs concave bank. | x (-4) | ✓ | ✓ | ✓ | ✓ | RNNIG | D, E |
| Lot canyon with widening of the valley. Ouvala. Cirque. | JURASSIC: Middle/Late Jurassic transition series. Type locality of <i>Trocholina gigantea</i> . CRETACEOUS: Evidence of the late Cretaceous sedimentary cover. QUATERNARY: Inverted relief. Erosional surface and downward cut of the Lot river, alluvial terraces. Periglacial screes. | t, p | ✓ | ✓ | ✓ | ✓ | Natura 2000 RNNIG, MH Loi 30 | |
| Dry or temporarily active valley. | JURASSIC: Reference section. Alternation of limestones, breccia, tidalites, Dogger marls. Brachiopods dating. | | ✓ | ✓ | | ✓ | RNNIG, MH | |
| Dry valley. Differential corrosion of the calcareous rocks. Comparison between diaclasses/faults. | JURASSIC: Bajocian/Bathonian transition series. Sedimentary casts: ripple marks, mud cracks, stromatolite dome.... Tectonic superposition of synsedimentary distension (Central Atlantic opening) and pyrenean compression (Eocene). Type locality of <i>Gyraulus balmen-sis</i> and <i>Exelissa costaminuera</i> . Discovery of the oldest known Sauropods eggs of the ancient Laurasia supercontinent. | x (-4) | ✓ | ✓ | ✓ | ✓ | RNNIG | D |
| | JURASSIC: Reference section. Marly early Jurassic / calcareous middle-Jurassic. Type locality of <i>Limognella dufauri</i> . | | ✓ | ✓ | ✓ | ✓ | RNNIG | E |
| Doline formerly cultivated. | JURASSIC: Tilted block structure, complete overview on the mid-Jurassic series. | x (-4) | ✓ | ✓ | | ✓ | Natura 2000 RNNIG Loi 30 | S |

✓ : Present
x (-4) : in the four coming years
x : Future

L : Looting, D : Direct Destruction
E : Natural Erosion,
S : Natural Succession

TABLE 6 List and description of the 48 integrated geosites of the aspiring Geopark of Causses du Quercy.

| | Geo Site | INPG 2015 | Value (INPG) | Geosite name | Municipality | N° INPG | Promotion | Paleokarst | Man's use of the karst |
|----------------------------------|----------|-----------|--------------|--|----------------------------------|---------|--|--|--|
| Mesozoic / Cenozoic Geology (10) | GS-35 | 18 | LOC. | Area of Bach – Vaylats – Belmont-Ste-Foi | Bach / Vaylats / Belmont-Ste-Foi | MPY0244 | College pupils (geology field trip). Reading the landscape. | | Wells reaching the contact between Tertiary marls and Jurassic limestones. Windmill. Soil usage depending on geological context: cultivated areas vs wooden areas. |
| | GS-31 | 9 | LOC. | Old quarry of Puy Blanc | Cambes | MPY0111 | Old tile factory. Specific biodiversity (humid environment). | | |
| | GS-33 | | LOC. | Area of La Maresque – Le Teulié | Padirac | | University students in hydrogeology (dye tracing). | | Watering place. |
| | GS-34 | | LOC. | Area of Laburgade | Laburgade / Cieurac | | | | Align group of wells. View point on Cieurac castle. |
| Quaternary Geology (3) | GS-28 | 17 | DEPT. | Waterfall of Lacauhe | Cajarc | MPY0168 | Highly frequented place by the local inhabitants. Primary school pupils: reading the landscape, hydrogeology, man's use. Hiking itinerary. | Sandy infills of the upstream galleries (post siphon). | Presumed prehistorical usage. Mill. Meeting place. |
| | GS-48 | | LOC. | Cloup du Magès | Rocamadour | | | | Farming area. |
| | GS-47 | | LOC. | Congelifract screes quarry Cénevières-Cornus | Cénevières | | Possible stop-over of the georoute. | | Material used to surface path. |

Legend:

In italics: Planned promotion

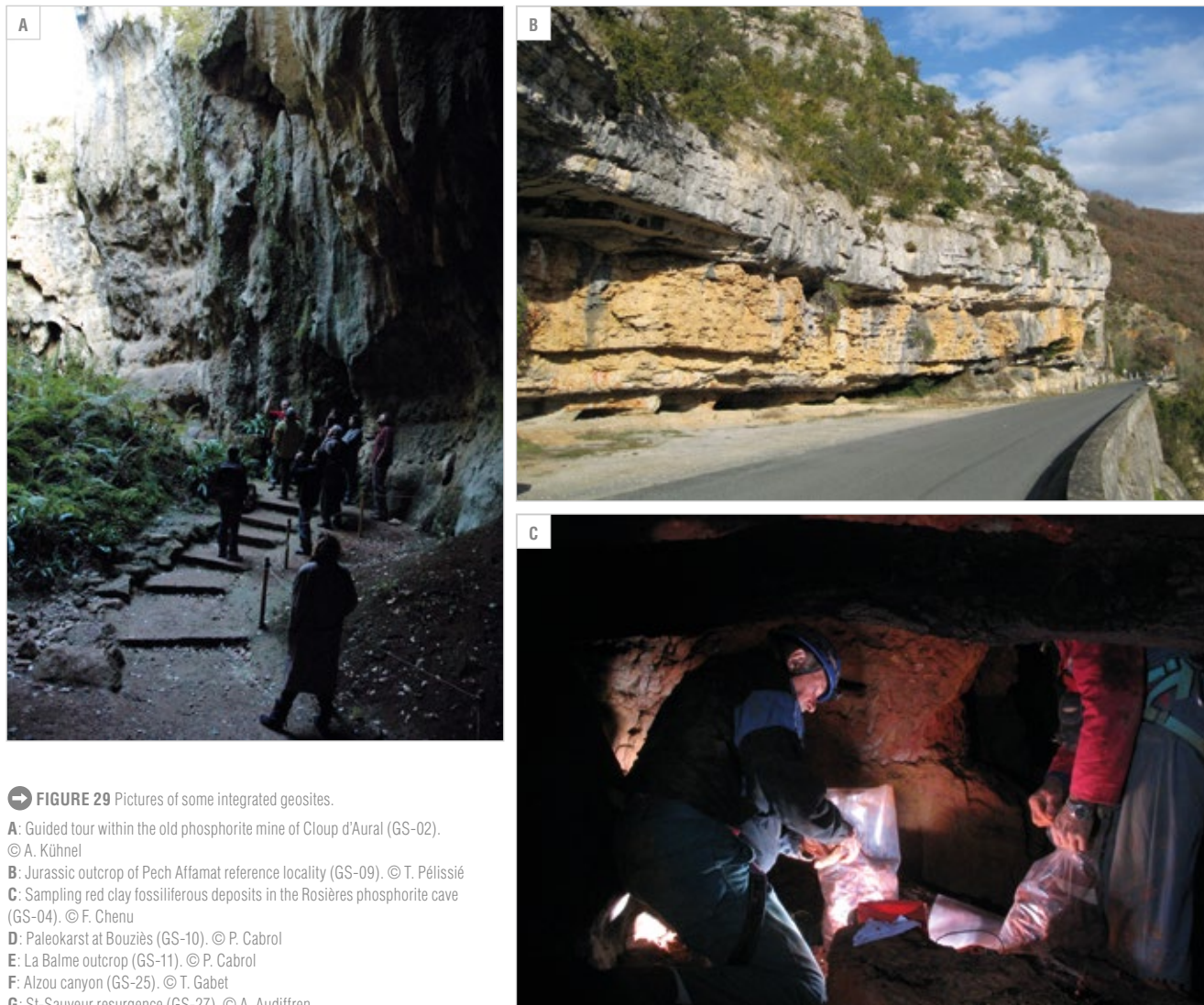


FIGURE 29 Pictures of some integrated geosites.

- A: Guided tour within the old phosphorite mine of Cloup d'Aural (GS-02). © A. Kühnel
B: Jurassic outcrop of Pech Affamat reference locality (GS-09). © T. Péliissie
C: Sampling red clay fossiliferous deposits in the Rosières phosphorite cave (GS-04). © F. Chenu
D: Paleokarst at Bouziès (GS-10). © P. Cabrol
E: La Balme outcrop (GS-11). © P. Cabrol
F: Alzou canyon (GS-25). © T. Gabet
G: St-Sauveur resurgence (GS-27). © A. Audiffren

| Natural karstic sites | Geology | Trails (t) Panels (p) Leaflets (l) | Science | Education | Geo tourism | Protection | Protection type | Pressure |
|--|---|--|---------|-----------|----------------|------------|---------------------------|----------|
| Swallow holes at the contact between Tertiary marls / Jurassic limestones. | TERTIARY: Contact between White Quercy and cause . Anticline within the Jurassic. Collapses linked to evaporite dissolution (?) in the tertiary terrains. Erosional surface and paleoreliefs, lacustrine transgression, isolated hill (outlier). | p | ✓ | ✓ | | ✓ | RNNIG | |
| Swallow hole. | JURASSIC: outcrop of Toarcian marls and contact with the calcareous mid-Jurassic series. | t, p ✗ (-4) | ✓ | ✗ | ✗ | | | |
| Swallow holes, emergences, chasms. Contact between karstic aquifers otherwise separated by the Toarcian marls. Complexity of hydrogeological relations between "Padirac" and "Source de Bonnefont" networks. | GEOGRAPHY: Padirac fault visible in the landscape. JURASSIC: Outcrop of Pliensbachian bioclastic limestones (+dip angle) and mid-Jurassic limestones. TERTIARY: Compressive faulting of the Padirac fault. | | ✓ | ✓ | | | | |
| | TERTIARY: Contact between White Quercy and cause . Facies " <i>sidérolithique</i> ", fossiliferous lacustrine limestones, limestones with vertical tubular features. | | ✓ | ✗ | | | | L |
| Perched resurgence. | QUATERNARY: Travertines deposits. Viewpoint on the valley: downward cut of the Lot river. | t | | ✓ | ✓ | | | D |
| Doline. | Dissimetric eolian periglacial deposits. | | ✓ | ✗ | | ✓ | Natura 2000 MH, Loi 30 | |
| | QUATERNARY: Congelifract screes hiding the entrance of a prehistorical cave = dating. JURASSIC: Toarcian black marls in contact with the mid-Jurassic limestones. | ✗ | | ✗ | | | | |

✓ : Present
 ✗ (-4) : in the four coming years
 ✗ : Future

L : Looting, D : Direct Destruction
 E : Natural Erosion,
 S : Natural Succession



B.4. Listing and description of non-geological sites and how they are integrated into the proposed Geopark

The promotion of the 40 LINKED SITES is part of an overall approach for sustainable development of the territory. This approach is based on both educational and touristic offers showing all different aspects of the territory (natural heritage, human-linked heritage, cultural activities) in addition to the geotouristic offer (integrated geosites). Since the link between man and the Causse is symbolic and constitutive of this territory, many of these linked sites are related with the local geology (details § A.3.).

B.4.1. Description of the linked sites

➔ P36 TABLE 8: Listing and description of linked sites.

➔ FIGURE 30A to D: Pictures of some linked sites.

B.4.2. Partner sites outside the territory

Two geological sites located outside the perimeter of the aspiring Geopark are working in close partnership with the Park:

- The “Pterosaurs beach/*La Plage aux Ptérosaures*” in Crayssac (10 km west from the Park border, SP-01 ➔ P27 FIGURE 28), is protected by the Lot RNN of Geological Interest. It obtains 41 points in the INPG ranking (i.e., of international interest). The first excavations in 1993 brought to light fossil footprints and tracks of pterosaurs, dinosaurs and other species ➔ FIGURE 30E.

The scientific interest of the site comes from the extremely fine limestone mud that deposited in what was to be a vast bay similar to the one of today’s Mont-St-Michel (France). These muds fossilized the everyday life of the beaches in those days: the pterosaurs, coming from the air to catch their prey, left their traces. The combination of footprints,

with four radiating fingers, and handprints, with three fingers having characteristic hooks, makes them definitely quadrupeds. It is this first discovery that made the international reputation of this site. More than 300 animal species have been identified since (dinosaurs, crustaceans, molluscs, fish, turtles, lizards, crocodiles...) and the exceptional fineness of the limestone muds has fossilized infra-millimetric traces (claw traces, skin, webbed fingers...). Moreover, the comprehensive study of the thin limestone layers allowed specifying the length of a year, that may have been of 373 days 140 million years ago.

The excavations go on each year (scientific coordination: J.-M. Mazin and P. Hantzbergue from Lyon 1 University; international scientific committee) and a 2,000 square meter building designed for both protection and museography has been constructed.

- The site of Autoire (a town close to the north-eastern border of the Park, SP-02 ➔ P27 FIGURE 28) obtains 34 points in the INPG ranking (national interest). It is of great interest for Jurassic geology (section of the transition between Lias and Dogger epochs; syndepositional mass sliding within a graben created by the Siran and Padirac faults around 165 Ma), for the Pyrenean compressive tectonic activity (reactivation of the two faults around 45 Ma ➔ FIGURE 30F) and for the local geomorphology (travertines waterfall and cuesta landform with the Dogger limestone cornice overhanging the gentle slopes cut into the Toarcian black marls). The beauty of the cirque highlighted by the waterfall, the presence of the ruins of a “*Château des Anglais*” built against the cornice and the medieval village (castle and church) in the valley bottom give to this site geotouristic value added to its scientific and educational interests. Various hiking trails enable the entire site to be crossed.

➔ FIGURE 30 Pictures of some linked sites and of the two partner sites.

A: Padirac chasm (SL-04). © Dimimis, Wikimedia Commons
 B: Lacave cave (SL-05).
 © A. Hok-Schlagenhauf
 C: Nouel caselle (SL-26). © P. Andlauer
 D: Bonnefont marsh (SL-01). © O. Arsandaux
 E: Crayssac, dinosaur footprint and track of pterosaur (SP-01). © T. Pélissié
 F: Cirque of Autoire (SP-02).
 © A. Hok-Schlagenhauf



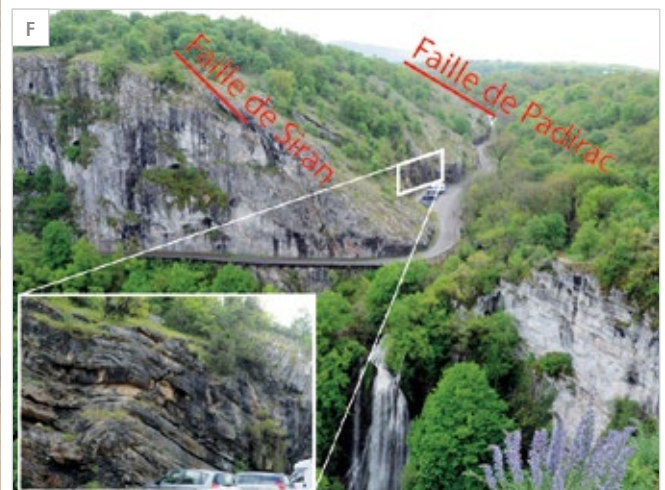
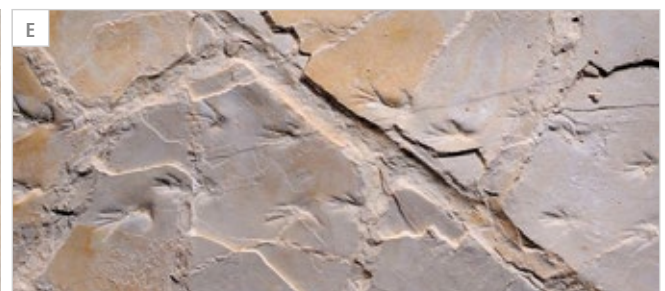


TABLE 8 List and description of the 40 linked sites (E = Entrance fee).

| | | | | |
|--|--|--|--------------------------------------|--|
| NATURAL HERITAGE | Karst | | | |
| | Code | Name | Municipality | Description |
| | SL-04 | Padirac chasm (E) | Padirac | Famous cavity equipped for tourism, chasm diameter 35 m, depth 103 m. Entrance of a karstic network more than 50 km long. |
| | SL-05 | Lacave cave (E) | Lacave | Cavity equipped for tourism. Rich concretions. One room of this cave is used for concerts (220 seats). |
| | SL-06 | Espédaillac drowned quarry | Espédaillac | Quarry showing an epikarstic free groundwater. |
| | SL-07 | Corn resurgence | Corn | Resurgence of the water that travelled vertically through 150 m of Jurassic limestones. |
| | SL-11 | Font Polémie | St-Martin-de-Vers | Resurgence converted into a washing place. |
| | SL-40 | Lantouy church and village: associated with karstic emergence | St-Jean-de-Laur | Wild place with a beautiful vauclusian resurgence, the remains of a pre-Roman church and a rich legendary history associated. |
| | Landscapes | | | |
| | SL-08 | Livernon "oasis" | Livernon | Outcrop of Toarcian marls creating a "green islet" at the heart of the dry <i>causse</i> . |
| HUMAN RELATED HERITAGE | SL-09 | Marcihac site: cornice, historical village and <i>caselles</i> | Marcihac-sur-Célé | Majestic group of buildings with a Roman abbey, numerous vernacular buildings and high cornices dominating the Célé river. |
| | Fauna / flora | | | |
| | SL-01 | Bonnefont marsh and spring | Mayrinhac-Lentour | Karstic spring supplying wetland built by man; Regional nature reserve. |
| | SL-02 | Bannac lake observatory | Laramière | Artificial lake hosting a great diversity of birds on migration or overwintering. |
| | SL-03 | Caniac heaths and dry grasslands, Brauhnie forest | Caniac-du-Causse | Short grass area, dotted with small shrub, created and maintained by sheep grazing. |
| | Astronomy | | | |
| | SL-10 | Night sky observation sites | Carlucet, Reilhac, Limogne-en-Quercy | Astronomical observation sites benefitting from one of the darkest night skies of France. |
| | Archaeological heritage | | | |
| | SL-41 | Pech-Merle decorated cave (E) | Cabrerets | A large prehistoric underground sanctuary combining mineral and painting treasures; Site classified MH. |
| | SL-42 | Merveilles decorated cave (E) | Rocamadour | Small cavity related to the Alzou canyon and hosting cave paintings. |
| Cultural activities | SL-33 | Archéosite des Fieux (E) | Miers | Karstic cavity partially topped by erosion. Usage from the Neanderthals to the medieval. |
| | SL-12 | Dolmens itinerary | Miers | Dolmens discovery hiking route. |
| | SL-13 | Dolmen of Pech Lagraire | Gréalou | Dolmen associated with a stone cross on the way to Santiago de Compostela; Listed as UNESCO World Heritage. |
| | Historical heritage | | | |
| | SL-14 | St-Namphaise lake of Magès | Calès | Small pond dug directly into non fissured limestones; there are hundreds of these on the limestone plateaux. |
| | SL-15 | Château des Anglais | Cabrerets | Also known as the Devil's Castle, it is a medieval fortification of a semi-troglodyte cave in a cornice bordering the Célé river. |
| | SL-16 | Château des Anglais | Bouziès | Fortified cave in the Middle Ages but hosting prehistoric remains. The main wall was restored by Viollet le Duc. |
| | SL-17 | Cougnaguet fortified mill (E) | Calès | Vast mill built in the 14 th C. on the Ouyse River; Classified MH. |
| | SL-18 | Caniac church | Caniac-du-Causse | Church classified MH, housing a 12 th C. crypt with ogival arches. This is the tombstone of St. Namphaise, hermit who would have dug the first lake of the same name. |
| | SL-19 | Assier castle and historical parcels of land (E) | Assier | Renaissance style castle built in the 16 th C. associated with a karstic swallow hole; Classified MH. Around the castle, relicts of parcels of land set in the Renaissance can be seen. |
| Ethnographic museums | SL-20 | Cénevières castle (E) | Cénevières | Renaissance castle whose base dates back to the 9 th C.; built on a cornice overlooking the Lot river; Classified MH. |
| | Vernacular heritage | | | |
| | SL-21 | Escamps wells and "oasis" (oligo-miocene marls) | Escamps | Evidence of the Miocene erosion surface with Cenozoic marls that enabled the development of a cultivated area at the heart of the <i>causse</i> with large wells. |
| | SL-22 | Couderc d'Espédaillac and clay related watering places | Espédaillac | <i>Couderc</i> : a common area around which the hamlets on the plateau are organized. This adds a free, shared water resource due to the presence of clay pockets. |
| | SL-23 | Concots well with watering place ("conque") | Concots | Large doline around which is structured the village of Concots. Among the watering places, stands the "well of the Lord" that has recently been restored. |
| | SL-24 | Aujols lake and "butterfly" washing place | Aujols | Large "butterfly" washing place with washing stones arranged in V shape, specific to the Causse de Limogne. This village is organized around this shared water resource. |
| | SL-25 | Promilhanes apiary | Promilhanes | Rare example of cohabitation between bees and humans: in the masonry of a house 14 beehives were built. |
| | SL-26 | Nouvel <i>caselle</i> in Lalbenque | Lalbenque | This restored set of buildings includes one of the largest dry stone <i>caselle</i> of the Quercy and an enclosure that housed thirty sheep. |
| | SL-27 | Varaire washing place | Varaire | Located at the heart of the village, this beautiful "butterfly" washing place, specific to the Causse de Limogne, reminds us of the collective status of water, scarce in the Quercy. |
| | SL-28 | Mas de la Bosse windmill | Promilhanes | Windmill reflecting the epoch when the plateau, unlike the neighbouring Ségala, was a "rich" wheat area. |
| Industrial heritage / Human activities | Ethnographic museums | | | |
| | SL-31 | Justine's farm (Borie d'Imbert)(E) | Rocamadour | Discovering 19 th C. agriculture in Quercy: sound & light show, house, garden, farmyard and interpretive path. |
| | SL-32 | Cuzals ecomuseum (E) | Sauliac-sur-Célé | Discovering rural life in the Quercy through more than 8,000 exhibited objects (20 ha), activities, exhibitions, discovery of forgotten trades, etc. |
| | Industrial heritage / Human activities | | | |
| | SL-34 | Saint-Géry railway museum (E) | Saint-Géry | Museum and railway activities in connection with the old railway line of the Lot valley where part of the mined phosphate from the limestone plateaux transited. |
| | SL-35 | Cajarc railway station (phosphate exploitation) | Cajarc | Old railway station with a water tower, piers and hydraulic system (classified MH), combined with a museum of local and regional railway heritage. |
| | SL-36 | Conduchet caves of money counterfeiters | Bouziès | Cave with some prehistoric paintings, in which were found the remains of a workshop of counterfeiters from the seventeenth century. |
| | Cultural activities | | | |
| | SL-37 | "Chemin faisant" between Escamps and Concots | Escamps, Concots | Hiking itinerary where the "little" local heritage meets contemporary art. |
| | SL-38 | Georges Pompidou arts house | Cajarc | Contemporary Art Centre organizing for instance art routes using various geological sites along the Lot Valley. |
| Cultural activities | SL-39 | Fourdonne house | St-Cirq-Lapopie | Exhibitions and events around architectural and archaeological heritage, but also of surrealism, in a renaissance house at the heart of the village of St-Cirq-Lapopie. |

C. Geoconservation

C.1. Current and potential pressure on the aspiring Geopark

C.1.1. “Site by site” pressure

Four types of risks threatening the geosites are listed → P28 TABLE 6. They concern 27 of the 48 integrated geosites: looting risk concerns 9 of them (L): fossil content of the phosphorite caves (GS-01, GS-37, GS-13, GS-04, GS-08, GS-07) and of the lacustrine sediments (GS-34), minerals (GS-22 “Bellecroix” calcite), archaeological content (GS-36); 5 risk direct anthropogenic destruction (D), mainly because of the nearby road infrastructures; 13 are threatened by natural erosion (E); 9 by natural succession (S). As for the whole group of phosphorite caves from the purely scientific geosites list (APPENDIX 10), looting risks are the main threat (essentially of the fossil content).

C.1.2. Territorial threats

Currently, there are few real territorial pressures identified that threaten the whole area of the aspiring Geopark. The territory has to deal with:

- Natural dynamics: agricultural decline, evolving agricultural practices and evolution of the natural environment have led to a marked natural increase in wooded areas,

still an on-going process despite the numerous policies adopted in this domain (see § A.3.3.3.).

- A “state of neglect” of the local heritage in the past decades, whose impact is still visible (on low walls for example). However, thanks to the Park actions and to the many restoration programs of the “small heritage”, a true sense of common ownership of the shared heritage has developed. Now, all the inhabitants support this “stone image” of the territory.

C.1.3. Distant threats

Only threats that have already been the subject of surveys or draft-projects in the past can be identified. These threats are related to the Quercy geological context. None of these projects is topical:

- Exploration and exploitation of non-conventional hydrocarbon resources (within the Toarcian black marls and at the transition between Carboniferous/Permian series).
- Low-level long-lived radioactive waste storage (Toarcian black marls).
- Strengthening of development dynamics within aggregate quarries.

C.2. Current status in terms of protection of geological sites within the aspiring Geopark

Among the 48 integrated geosites, 35 are located within the perimeter of a natural site or historical monuments protection tool (details → P28 TABLE 6: 20 integrated geosites located within the Lot RNN of Geological Interest; 13 Natura 2000, 14 MH, 9 “Law 30”, 3 ENS).

C.2.1. The Lot RNN of Geological Interest

The Lot National Nature Reserve (RNN) of Geological Interest has been designated in June 2015 [Dossier of the Lot National Nature Reserve of Geological Interest, 2013; <http://www.legifrance.gouv.fr/eli/decret/2015/6/2/2015-599/jo/texte>]. This RNN, split into 59 protected areas, covers a total area of about 750 ha in the southern half of the Park and about 50 ha outside the territory (APPENDIX 3). It comprises sites with dominant features in: palaeontology, stratigraphy, sedimentology, mineralogy, tectonics and geomorphology; namely, 298 geological objects inventoried in 2013. The Lot RNN of Geological Interest concerns 20 integrated geosites → P28 TABLE 6. It provides a legal protection (collecting minerals, rocks and fossils is banned; excavations on permit only; no harm to natural environment). Protection of the heritage will be ensured through regular monitoring of the sites by the RNN staff, together with the scientists who will be involved in the study programs.

A curator and a sworn in guard will inform and raise awareness of the general public. If necessary, they will make a report to the authorities.

C.2.2. Other tools used

Other policies for environment protection are used in the area and directly or indirectly ensure the protection of the geosites → P28 TABLE 6 and APPENDIX 3:

- Protection tools of sensitive natural sites: Natura 2000 (European policy); Sensitive Natural Areas / *Espaces Naturels Sensibles* or *ENS* (County policy).
- Protection tools of cultural and historical heritage: Official Historical Monuments of France / *Monuments Historiques* or *MH* (national policy, 1913 law; national heritage is classified as national monument and regional heritage is listed on supplementary inventory); Monuments and sites protected by the “Law 30” (national policy, 1930 law).

C.2.3. Karstic site protection study conducted by the Park

Following an initiative of its Scientific and Planning Council, the Park has undertaken a study in 2014 to define a strategy for the

protection of the major karstic sites of its territory. A panel of 6 sites has been examined, representative or emblematic of the karstic heritage: the Réveillon swallow hole (GS-15), the Crégols chasm (GS-24), the cornice of Marcilhac-sur-Célé (SL-09), the phosphorite cave of Mémerlin (GS-06), the waterfall and calc-tufa of Lacaunhe (GS-28) and the *Corniche des Anglais* at

Bouziès (SL-16). This study analysed the issues (on-site analysis, interviews with the stakeholders), the risks and the most appropriate tools to ensure protection of the sites. It also formalised a standard methodology that will be used more widely within the territory in the near future (APPENDIX 4).

C.3. Data on the management and maintenance of these sites

The Park coordinates the management and maintenance of the integrated geosites according to their protection status and in close collaboration with local actors (municipalities, associative network working in the areas of protection, promotion, culture, education and leisure activities).

C.3.1. Site protection

The Quercy Phosphorite Caves association members (*Association Les phosphatières du Quercy*) regularly inspect the geological heritage sites of the territory (potential looting check, time evolution of the sites). This follow-up will be strengthened in 2016 with the creation of the Lot RNN of Geological Interest. The access paths and geological-walks of the Phosphorite caves of Cloup d'Aural (GS-02) and of the Phosphorite cave of Tempories (GS-01) are maintained as part of their geotouristic promotion. The Lot County Caving Committee handles some caves (cave closure, access management ➔ FIGURE 31A). Since 2007, it has also organized volunteer projects to clean up phosphorite caves for geological and environmental conservation; in particular for the protection of water resource of the karst that supplies the territory ➔ FIGURE 31B. In the areas concerned by the ENS protection tool, actions of restoration, maintenance of the access

paths, setting up of general public reception areas, designing interpretation tools and activities (guided tours, annual activities programme) are carried out. Besides, in the areas concerned by the Natura 2000 policy, maintenance and restoration of the habitats (such as watering places and caves), reopening of the environment, support for pastoral practices, activities and training of elected representatives involved with a Natura 2000 site within the perimeter of their municipality are undertaken. As for maintenance and promotion of the vernacular heritage (low walls, *caselles*, dolmens, watering places, etc.), the Park has conducted many programmes since it was created. They extend and amplify the increasing involvement of local associations that work for restoration of this “small” heritage and of initiatives such as “Thousand helping hands”, etc. (APPENDIX 2).

C.3.2. Unprotected vulnerable sites

Among the 14 integrated geosites that today don't benefit of any protection measure, 5 of them are potentially at risk of erosion, natural succession of the environment, looting or of direct anthropogenic destruction. Different solutions are provided or scheduled to address the lack of legal protection ➔ TABLE 9.

TABLE 9 List of unprotected vulnerable sites and protection measures taken by the Park.

| Code | Name | Actions of protection |
|---------|----------------------------|--|
| GS - 15 | The Réveillon swallow hole | Karstic sites protection study conducted by the Park (see § C.2.3.). |
| GS - 28 | Lacaunhe waterfall | |
| GS - 41 | Roger Rousseau Site | Maintenance by local volunteers to stop vegetation development and natural filling of the site. |
| GS - 36 | The Cros swallow hole | Part of the group of karstic sites the subject of the forthcoming expansion of the Karstic sites protection study conducted by the Park (see § C.2.2.). |
| GS - 34 | Laburgade area | The small quarry will be regularly cleared of vegetation. As for the “Wells path” located in the village, it is regularly maintained and already promoted for tourism. |



FIGURE 31 Examples of protection actions. A: Cave blockage adapted to the passage of bats. © A. Kühnel B: Phosphorite caves clean up action. © A. Kühnel

D. Economic activity and Business Plan for the proposed Geopark

D.1. Economic activity

The territory of the aspiring Geopark of Causses du Quercy is a rural area. Its economy is mainly based on agriculture, craft and tourism. These last 15 years, the dynamics of population growth in the territory has led to a significant development of the services and construction sectors. Agriculture (and, in a wider sense, the agri-food sector), although weakened, is still the main sector of activity of the territory. The other economic sectors are relatively stable.

➔ FIGURE 32.

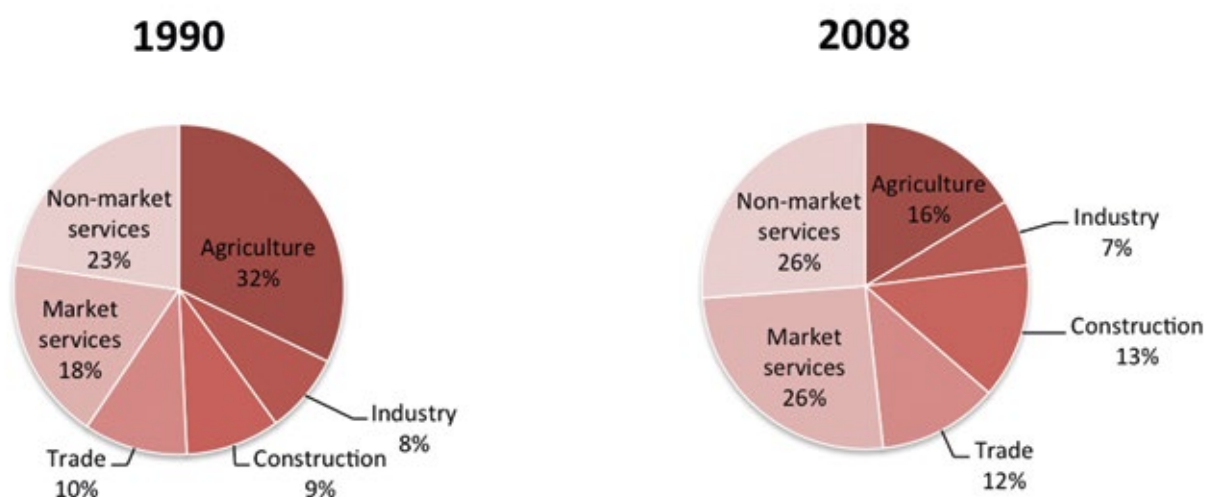
D.1.1. Agriculture

Farmland is currently being increasingly abandoned in Lot, and the number of farms and farmers is regularly decreasing. However, the total farmed area has remained stable over the last 30 years (about 85,000 ha or 46 % of the territory total area).

Sheep farming for meat is the leading industry of the area (today, 70 % of Lot County sheep are in the territory of the Park). Agriculture in Lot County, and more specifically in the territory, is characterized by the quality of its products and its recognition by official signs (quality seals or quality procedures) ➔ TABLE 10 and ➔ P 40 FIGURE 33.

Many actions were put in place to support farms that manage remarkable natural environments (setting up of agri-environmental measures, training in pastoral management, eco-pastoral diagnosis...). In recent years, the County Council had lead recovery and promotion work on abandoned career paths; 8 pastoral property associations arose on the territory, allowing 775 ha to be reutilized. Finally, the Park has undertaken various actions to support development of short supply chains and promotion of local products.

↓ FIGURE 32 Employment by economic sector (source JLEco/ COMETE/INSEE).



↓ TABLE 10 (source: Chambre d'Agriculture du Lot / Comité de promotion des produits du Lot).

| Quality Seal "Appellation d'origine contrôlée / AOC": | Quality Seal "Label rouge": | Product Conformity Certificate and Protected Geographical Indication (IGP): |
|--|------------------------------------|--|
| Rocamadour goat's cheese | Quercy farm lamb meat (IGP) | Quercy melons |
| Périgord walnuts | Milk-fed veal | Bayonne ham |
| Blue cheese of the Causses | Grain-fed pork from the South-west | Duck foie gras of the South-west |
| Blue cheese of Auvergne | Blonde d'Aquitaine beef | Rocamadour wine (IGP Côtes du Lot) |
| Cahors wine, Coteaux du Quercy wine | | |

Other local produce (some of them waiting for quality-label): Quercy saffron, black truffle, Croustillot bread, wool sector...



↑ **FIGURE 33** Agriculture.

A: Transhumance. © C. Conteau

B: Saffron. © N. Blaya

C: Truffle. © J. Gabet

D: Rocamadour vine. © PNRCQ



↑ **FIGURE 34**: Crafts. © J. Morel



↓ **FIGURE 35** Tourism.

A: Rocamadour (GS-25) © J. Morel

B: Cell phone application "Quercy for families" (FR/EN). © PNRCQ



D.1.2. Crafts and small business

The craft and small business sector is constantly progressing on the Park territory. The average density of small business is very high (far above the national and regional averages), with a homogeneous distribution over the whole territory (with an average of 6 small business per municipality). This is the major sector in terms of employment and activity prospects → **FIGURE 34**.

The Park and the Lot County Chamber of Trade and Craft have worked in partnership since 1999, i.e., since the establishment of the Park. As part of this partnership, different actions are conducted to support set up or take over of small businesses (number of supported projects in 2014: 44 business creation projects and 10 company projects) and promote environmental initiatives (workshops, site visits, attribution of the "Park Craftsmen Eco-Challenges", support for green building...). Finally, a work related to the identification and promotion of craftsmanships in stone masonry and the built heritage was initiated in 2014.

D.1.3. Tourism

The wealth and originality of the Causses du Quercy heritage make the territory attractive. It benefits from important tourism flows (including 1/4 of foreigners) due to the international renown of the **Rocamadour Marian historic town** (more than one million visitors per year → **FIGURE 35A**), the Chasm of Padirac (445,000 visitors per year → **P34 FIGURE 30A**), the **medieval village of Saint-Cirq-Lapopie** (400,000 visitors per year, see upper picture of front cover) or the **decorated cave of Pech-Merle** (80,000 visitors per year → **P6 FIGURE 3K**). However, tourist facilities are mainly concentrated around these sites, in the Dordogne, Lot and Célé river valleys.

The Park strives to develop tourism for the benefit of the whole territory. The Park also chose to favour family-type tourism and supports its collaborators in the implementation of "child-family" specific offers. In that framework, a booklet of games highlighting 16 sites involved in the process has been published in 2008. Also, since 2013, the Park offers each April a programme of activities called "The Causses du Quercy in a family group" and a mobile application "Quercy for families" displaying the facilities appropriate for families (<http://uk.parc-causses-du-quercy.fr/en-pnr-quercy/causses-du-quercy-your-mobile>) → **FIGURE 35B**.

D.2. Existing and planned facilities

D.2.1. Existing structures and infrastructures

Tourism infrastructures: 7 Tourist Information Centres work within the territory and manage 10 information sites (including 3 seasonal ones) on the territory and 6 other information sites located in the Gateway cities of the Park (see § A.4.3.1). These structures offer touristic and cultural information about the Park activities, which are also relayed by the professionals in the tourist industry (tourist accommodation, museums, leisure activities centres, etc.). These Tourist Information Centres are members of the “Doline Network” of the Park, which links tourism and education professionals from all the territory.

Geotouristic sites → P28 TABLE 6 et → P38 TABLE 8 :

- The Phosphorite caves of Cloup d'Aural (GS-02; <http://www.phosphatieres.com>) offer a guided tour into old phosphorite mines and thematic paths: “The Phosphate path” retracing the history of phosphate mining; “The Geological Time path” that enables the exploration of the geological history of the Quercy since Cretaceous geological period; “The Paleontology path” explaining how fossils can show 34 Myr of fauna and climate evolution; the game paths “Animals and Climates of the Past” and “Flora of the Causses and of the Phosphorite caves”; and the excavation sandboxes to play palaeontologist → FIGURE 36A.
- The Archéosite des Fieux (SL-33) whose museum structure has been built to both protect and present the excavation site that illustrates how prehistoric man used the karst resources → FIGURE 36B.
- The ethnographic museums show the local know-how linked with the use of geological resources : Musée départemental de Cuzals (SL-32), Borie d'Imbert (SL-31), Musée des Arts et Traditions populaires de Limogne.
- Show caves offer general public guided tour and geological guided tour of the Pech-Merle decorated cave (SL-41); guided tours of: Padirac chasm and its underground river (SL-04), Lacave cave (SL-05) and Merveilles cave (SL-42).
- Localized facilities and interpretative itineraries include the free access path running through the Phosphorite cave of Tempories (GS-01), MP19 international reference deposit; the Geological Time hiking trail in Bach (set up in 2008 for the International Year of Planet Earth) that presents along 9km the major stages of the Earth and life history at the scale 2m for 1 Myr; the ENS relay

of Ouyse and Alzou valleys (Granges de Bonnescoste) in Calès; the interpretative boards installed progressively on the Park and partners geosites → FIGURE 36C.

Natural sites: equipment within natural areas remains light and localized. Note: 4 interpretative walking tours of ENS sites that are equipped with markers enabling the discovery of nature and local heritage on the sites of the Ouyse and Alzou valleys, and of the Braunhie Massif (SL-03) → FIGURE 36D; the interpretative walking tour of the Bonnefont Marsh (SL-01) showing the largest reed bed of the Lot County → P38 FIGURE 31D, and the one of Puy Blanc (GS-31) that highlights the link between the old tile factory and the evolution of the quarry since the end of clay extraction; the Bannac lake observatory (SL-02); the scenery and truffle heritage discovery itineraries of Lalbenque (hiking or cycling); the 3 general public night sky observational sites where anyone can install their equipment.

Cultural and heritage sites: at the root of many heritage promotion activities, and artistic and cultural initiatives are the many places and associations working in the field of popular traditions and Occitan culture (La Granja, the ethnographic museums), in the field of Art (Maisons Daura), in the field of prehistory and rural heritage (Racines), etc. Note: a growing local interest around megalithic heritage (Experimental Dolmen of Rigounenque (GS-11); walking tours of the Dolmens of Miers (SL-12) and of Gréalou (SL-13)); refurbishment of Barrière hamlet (close to Miers); many artistic initiatives such as “Chemin faisant” between Escamps and Concots (SL-37); and the artistic and philosophic site of Roger Rousseau (GS-41).

D.2.2. Planned infrastructures

The **Cloup d'Aural site** converted to geotourism since 2000 stands out as the geotourism pilot site of the aspiring Geopark. However, an updating of the equipment is needed. Upgrading of this geosite of Cloup d'Aural (GS-02) is now officially recorded and the upgrading and definition of work study is in progress (budget of € 30,000).

The **geotourism strategy for the development of the territory** (see § D.4.2.1.) and the 2014-2018 Action Plan of the Park plan to continue the work started by the Park and its partners,



→ FIGURE 36

A: Initiation to paleontology. © T. Péliissié
B: Archéosite des Fieux. © CCPP, Cauvaldor
C: Interpretative board of an integrated geosite. © A. Kühnel
D: ENS board. © P. Soissons



for instance concerning the development and progressive *in situ* promotion of 9 other integrated geosites identified as priority ➔ P28 TABLE 6 (*in situ* interpretative equipment and/or signposting). Priority is given to the integrated geosites of: la Balme (GS-11), Pech-Affamat (GS-09) and Cabrerets (GS-18) concerning Jurassic geology; of Mémerlin-Prajoux (GS-06) and Salême (GS-08) concerning phosphorite caves; of Bouziès (GS-10) and Castel Giroux (GS-30) concerning paleokarst; of the Alzou canyon–Moulin du Saut–Rocamadour cornice (GS-25); and of the old hamlet of Sauliac (GS-46) concerning human use of the karst.

Finally, the achievement of the **Maison du Parc** is part of the strategy of the 2012-2024 Charter of the Park. Located in Labastide-Murat in the centre of the territory, it will host technical staff of the *Syndicat Mixte* and a meeting place for stakeholders. It will also include a resource-documentation centre – for instance on geology – open to scientists and local actors. A budget of 1,7 million of euros is now secured and the architectural competition has been launched. A thematic house incorporating a **museum project space** is also scheduled in Gramat (for more details see § D.4.2.3.).

D.3. Analysis of geotourism potential

D.3.1. Type of clientele and attendance

Tourist clientele of the Park include nearby (Midi-Pyrénées Region) and European (mainly British) holidaymakers. They are mostly families (45.3%) and couples (36.6%). The predominant age group is that of 45-54 years (26.4%). Middle class and retired people form the majority but upper class people are also present. Short stays represent 56%, with a large number of newcomers. Holiday practices are marked by a strong curiosity towards the whole local touristic potential. In 2014, visitor counts at sites with a ticket office welcoming more than 5,000 visitors per year highlight about fifteen places where attendance exceeds 20,000 entries, with 8 of them exceeding 50,000 entries. These places have been visited by 1,5 million visitors. All these numbers are considered stable or increasing.

D.3.2. Interest of the clientele

The increased interest of customers in the natural environment, landscapes and wealth of built heritage provides an opportunity to develop tourism on the whole territory through the observation and interpretation of its geologically

distinctive features. Indeed, the specific words used by customers to describe the Park are: natural environment (20.5%), scenery (19.4%), peace and quiet (14.8%); and the main reasons to stay in the Park are: to discover the towns and villages (19.4%), discover gastronomy/interest in local products (15.8%), visit tourist attractions (12.5%) and hiking (12.4%).

D.3.3. Geotourism potential

The many associations and networks established across the entire territory of the aspiring Geopark reinforce geotourism potential and contribute to the promotion of the various types of heritage, especially geological heritage. Amongst others: the association *Les phosphatières du Quercy* (management of the Cloup d'Aural site among other activities), the association *Du côté de Puy Blanc* (conservation of the old tile factory and quarries), the *Cercle quercynois des sciences de la Terre* (Earth sciences activities), the *Carrefour des sciences et des arts* (art and science, creator of the exhibition GéoLot for example), the sports Departmental Committees (DC) (Lot Caving DC, Hiking DC, Climbing DC, Lot Equestrian Tourism association), the *Paléonautes* network (network of archaeological and paleontological sites of the Quercy) and the *Doline* network (see § D.4.3.3.).

D.4. Overview and policies for sustainable development

The Charter of the Causses du Quercy Regional Nature Park is recognized as “*Agenda 21 local*”. This label is the French concrete expression of the 1992 Rio Conference undertakings in terms of sustainable development for the 21st century.

D.4.1. Park Charter / CETD

The Park tourism strategy is based on its image of natural protected area and on its territorial approach for sustainable development, committed through the Park Charter. It aims at meeting the expectations of visitors in search of nature, calm, unspoilt landscapes, and relies on promotion of its most identifying heritage (historical, natural, underground world, etc.). The “**European Charter for Sustainable Tourism in Protected Areas**” (ECST) certificated the Park in October 2008. As part of the Action Plan of the ECST, the Park has led different activities

to support local tourism professionals (quality initiatives, labelling, environmental audits, etc.).

D.4.2. Geotourism and economy

D.4.2.1. Geotouristic strategy

In 2013, the aspiring Geopark defined, with the support of a consulting firm (InSitu), its strategy in terms of touristic and educational promotion of the geological heritage. This study based on the geosites diagnosis sets the strategic directions that aim at strengthening the local geotouristic offer; in line with the goals of the Lot RNN of Geological Interest and with the expectations and projects of the local collaborators. The territory has been divided into three geologically complementary areas: the northern area with a majority of karstic geosites (theme of the karst and of underground water); the central area for its outstanding landscape and vernacular heritage (theme of the link between

human and stone); and the southern area with a majority of paleokarstic sites (theme of the Quercy geological history). A 5 years Action Plan was defined; its implementation was launched in 2015. The various future promotion actions that will be lead by the aspiring Geopark will fulfil this thematic and geographic approach (APPENDIX 11).

D.4.2.2. *In situ* promotion

A true “open air museum”, the Park favours an *in situ* strengthening of the geotouristic offer. These actions complete the already substantial range of discovery routes that connect many geosites and linked sites: walking itineraries (33 day or half-day walks; 3 days walk between Rocamadour and Padirac; Santiago de Compostela and long distance / GR paths), bike and

mountain bike riding (11 itineraries), horseback riding, canoeing (Lot and Célé rivers) and underground caving ➔ FIGURE 37. In addition to geosites development (already completed or planned; § D.2.), various recent actions promoting the geotouristic offer have been conducted: setting up of a georoute in the southern third of the Park; development of an electric cycling offer (2 itineraries); landmarks set up at the starting point of some itineraries ➔ P 44 FIGURES 38A, 38B.

Other actions have already begun for the period 2015-2017: update and republication of the “*Topoguide*” (walking guide-book including topographic map) that includes three new geohikes (2015 budget of €7,000); development of discovery of local geology through games aimed at young people (“Earth-Cache” type or paper chase, 2016 budget of €23,000).



➔ FIGURE 37 Outdoor activities. A : © J. Morel, B : © J. Morel, C : © O. Arsandaux, D : © J. Maureille, E : © J. Trémoulet, F : © Lot tourisme/P. Soissons.

D.4.2.3. *Ex situ* promotion

Currently, no museum space dedicated to geology exists within the aspiring Geopark territory. The geotourism strategy of the Park sets two medium-term objectives:

- The creation of a **thematic space dedicated to the paleontological heritage** of the southern third of the Park linked with the Lot RNN of Geological Interest.
- The development by the Park of a **museum dedicated to the karst and to an overview of the territory** in a proposed “*Maison des Causses du Quercy*” in Gramat (dedicated space of 200 m²). This thematic building will also host the Tourist Information Centre of Gramat, as well as a space dedicated to traditional know-how. It will become the main place for tourism promotion in the northern part of the aspiring Geopark territory. A study aimed at defining the project has been conducted; the business plan is in preparation.

D.4.2.4. Communication and activities

Different geotourism promotional tools have already been published: update of the “**Park Discovery Map**” (indicating about 30 geosites and most of the linked sites); edition of 3 brochures in the collection called “The Park Itineraries” presenting: the Park’s southern georoute → **FIGURE 38A**, the hiking-loop “Rocamadour/ Padirac chasm”, the “Electric bicycle” itineraries. A section dedicated to geological heritage promotion is included in the general touristic media of the Park (for example: Discovery Guidebook, Internet website, “Quercy for families” activity programme) and in those of the Park’s collaborators (such as the “Climbing Topoguide of the Park”). The Park also offers throughout the year to its visitors and inhabitants an activities programme called “**Les Causseries**”: vigils and conferences, citizen-meetings, nature or heritage discovery, performing arts... more than 50 annual events are proposed by the Park team and its collaborators on varied topics (geology: “Story of the stone that lost its memory”, “Cirque of Vènes – St-Cirq-Lapopie Geowalk”; small rural heritage; biodiversity; architecture and landscapes; astronomy; cooking and local food; etc.). Since 2013, each spring, the Park also proposes as part of the Doline network, a programme called “**Causse du Quercy for families: an animated spring**”.

D.4.2.5. “*Marque Parc*” label

The label “**Marque Accueil du Parc**” is the recognition by the Park of the professionals that are daily committed to the development of a sustainable tourism. This label is based on three main values: attachment to the land, a preserved

environment and human being at the heart of the activity. The “**Marque Accueil**” network gathers 23 structures today (20 lodgings and 3 places to visit). In the framework of this partnership, the Park provides an educational kit for the labelled accommodation places. It is composed of guide-books, books, maps, games, local heritage observation and discovery equipment → **FIGURE 38D**. Themed training is regularly offered to the labelled service providers (most recent topics proposed: astronomy; geology). The Park also provides backpacks called “Curious about nature” to the labelled tourism professionals. They contain equipment such as: compass, binoculars, magnifying glass box, wind-up light...

D.4.3. Geoeducation

D.4.3.1 Partnership with the Ministry of National Education: educational programmes

Since 2009, the programme called “**Paleontologists seeds: take part with your students in a paleontological study in the phosphorite caves of the Quercy**” has been renewed each year in partnership with the Ministry of National Education (<http://pedagogie.ac-toulouse.fr/svt/serveur/geoltheque/pages/tp-thierry/index.htm>). Pupils mainly from the 2nd year of *Collège* (12-13yr old pupils) and from the 1st year of *Lycée* (15-16yr old pupils) participated, from 34 schools within the education authorities of Toulouse, Bordeaux and Paris. This partnership between the academic world and university research has first resulted in young people’s getting aware of the value of studying and protecting the paleontological heritage, but also in the increasing number of fossils provided to paleontologists. Indeed, with more than 60 identified taxa, the Valbro deposit thus became the richest European deposit for lower Oligocene (about 30 Ma). The back cover picture illustrates this flagship initiative of the aspiring Geopark.

More generally, **the Park and the Ministry of National Education have signed up to a convention of partnership** since 2012. In this framework, different annual thematic educational programmes are elaborated and proposed by the Park. They concern pupils from secondary school and high school but also work in an extracurricular framework → **FIGURE 39** (field trips, thematic days, games, competitions, exhibition of the work of each school, etc.). Among the various themes proposed in recent years: water and rivers; architecture and habitat; landscapes; the marsh; the night...



← **FIGURE 38** Geotourism.

A: Geotouristic booklet. © PNRCQ
 B: Signposted walking itinerary. © P. Soissons
 C: Cellphone application. © PNRCQ
 D: Educational kit (*Malle Panda*). © O. Marchal

D.4.3.2. Students and interns

The Park staff, in close partnership with the local associations and the Park Scientific and Planning Council, are involved in the supervision of students' internship as part of their education, scientific or engineering curricula (University of Toulouse III, Poitiers, Rennes, Lyon, Clermont-Fd; Engineering Schools: ISA Lille, INP-ENSEEIH...). Various working themes have been addressed: hydrogeology (groundwater tracing; calc-tufa studies); territorial development (how to revitalise stone building industry; preservation and promotion of the megaliths); study of landscape evolution (by comparing maps and aerial pictures from different ages); vulnerability of the territory to climate change; faunal inventories; etc.

D.4.3.3. Doline and Paléonautes networks

Following an initiative of the Park, two networks have emerged:

- The **Doline Network**, created in 2012, which gathers tourism and education professionals. The aim of this network is to give a better structure to the existing educational offer and to make it more understandable. Various actions are conducted and proposed: labelling of services (13 labelled services in various sectors such as natural heritage, geology, prehistory, archaeology, agriculture, crafts, etc.); joint activities programme ("Causses du Quercy for families").
- The **Paléonautes Network**, created in 2006 as part of a collaborative project between the Park and the *Pays Bourien*. It gathers 8 archaeological and paleontological sites, around common objectives of heritage preservation, promotion of the sites and equipment, and reception of the public. For instance, the network has produced various educational resources, such as the booklet "Become a *Paleonaut*" and the CD-ROM "Conduct the inquiry with the *Paleonauts*". Now it is planning an educational offer dedicated to pupils from primary school and high school. The Network also organizes the annual "Limestone day" ("*Coup de Calcaire*") event at the beginning of the summer (<http://www.paleonautes.fr/>). The organisation of the Network has been independent since 2012, following the creation of the association "*Les Paléonautes*".

D.4.3.4. Educational media

The Park publishes numerous booklets, amongst others:

- "**Youth**" publications: "*Purelaine*, the Children's Journal" (29 issues published and a compilation volume). Several issues

have honored the local geology: "When landscapes tell their story...", "Discovering the ponds of the Causses", etc.

- **Collection "Discover... the Causses du Quercy heritage"**: thirty page booklets for the general public (12 issues published today, amongst others: the phosphorite caves, the cornices, *l'Archéosite des Fieux*, the megaliths, the valleys, the dry stone constructions...).

- **Collection "Look at the Park"**: articles from the Park Scientific and Planning Council (22 issues published, amongst others: the geological heritage, the phosphorite caves, the Santiago de Compostela route, the geomorphological landscapes, the karst...)

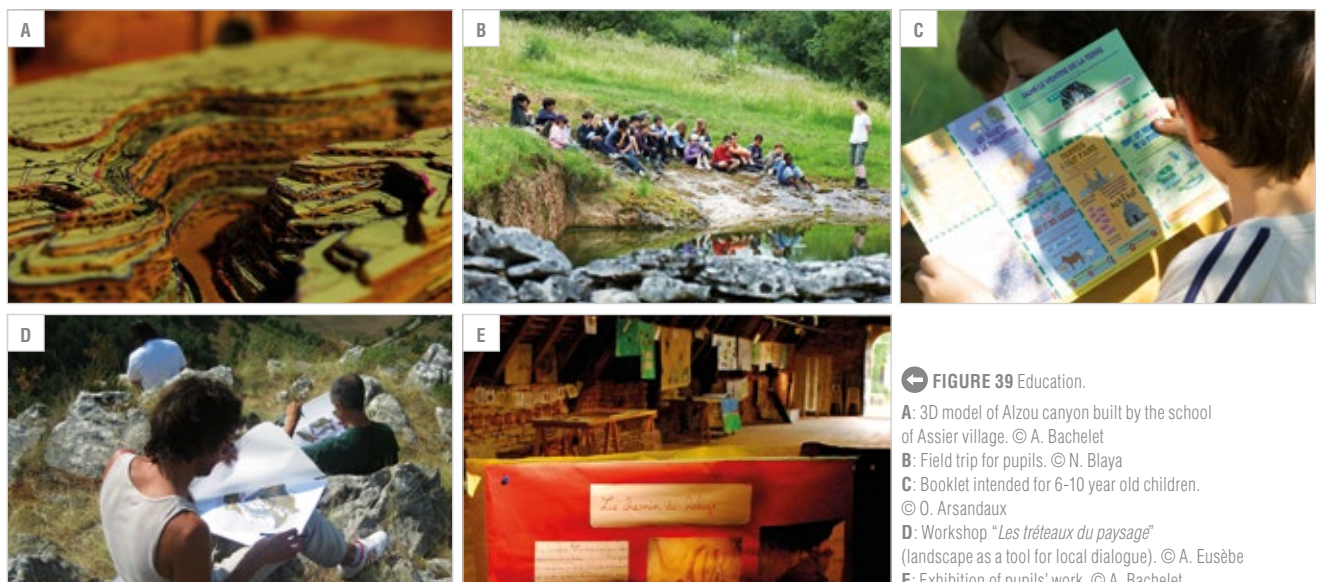
Two scientific publications complete these different editions:

- The first issue of the "**Scientific Books**" (retrospective of published issues in "Look at the Park" and "Quercy Research").
- The first issue of the new collection of "**The Essentials of the Park**", a collection of reference books on the Causses du Quercy designed by the Park Scientific and Planning Council. The first volume is dedicated to the geology and geomorphology of the territory (APPENDIX 12).

Finally, other educational resources were created by partners of the aspiring Geopark, such as the exhibition "GeoLot: The Lot County talks about its Earth" and its educational kit created by the *Carrefour des Sciences et des Arts* association; the theatrical performance "Memory Lapse" presenting the phosphorite mining history, resulting from a partnership between the association *Les phosphatières du Quercy* and the troupe *Des trucs en scope*.

D.4.3.5. From Earth Sciences to Astronomical Sciences

The quality of the night sky for observational astronomy and the efforts carried out locally to protect it, have opened new educational perspectives in Astronomical Sciences. For several years, the Park has invested in this theme, which is complementary to that of Earth Sciences, by developing various educational and awareness tools ("Discover..." booklet; exhibitions) and by proposing activities and educational programmes on night topics. A project for observational astronomy equipment is also under consideration on the site of the ecomuseum of Cuzals, in partnership with the Lot County Council.



← FIGURE 39 Education.

A: 3D model of Alzou canyon built by the school of Assier village. © A. Bachelet

B: Field trip for pupils. © N. Blaya

C: Booklet intended for 6-10 year old children. © O. Arsandaux

D: Workshop "*Les tréteaux du paysage*" (landscape as a tool for local dialogue). © A. Eusèbe

E: Exhibition of pupils' work. © A. Bachelet

D.4.4. Geoheritage

Beyond the actions related to the conservation of its geological heritage already mentioned, the aspiring Geopark is considering various actions related to its knowledge and protection. The **National Inventory of Geological Heritage** was revised in 2015 by the CRPG (revision of geosites rating according to the national criteria updated in 2014, details § B.1.2.). Since no new geosite was added, 14 of the 48 integrated geosites of the Park are still missing from the list. In close collaboration with the CRPG, the Park through its Scientific and Planning Council will therefore make every effort to ensure that the inventory is fully updated in the coming years. This inventory will also require expansion when new fossiliferous *loci* are discovered in the phosphorite caves. The master plan of the Lot RNN of Geological Interest

should include this concept of inventory, to which must be added the objectives of geological heritage protection and the coordination of scientific studies conducted on the geosites.

Finally, the aspiring Geopark is providing **specific support** to three sites. They are historical partners of the Park and especially important in the context of the Park's geotouristic strategy, but do not totally fulfill the Geoparks Charter: the Pech-Merle cave, the Lacave cave and the Archéosite des Fieux. These sites promote the sale of exotic minerals, indirectly for the first (private shop independent from the cave and the museum shop) and directly for the two others (shop run by manager). Negotiation to find an economically satisfactory solution for the three shops is underway. Pending the resolution of this problem, these sites were not identified as "integrated geosites" and are only associated with the aspiring Geopark actions as "linked sites".

D.5. Policies for, and examples of, community empowerment

The Park is leading actions in extremely varied areas (environment, biodiversity, climate, culture, energy saving, education, town planning); the examples below form a representative panel of the policies that contribute to the appropriation of the local issues and to the construction of a **shared "geopark" identity**.

D.5.1. Karst water resources

The Causses du Quercy, aquifer of the Lot, have an important responsibility in water resources management. The Park thus develops many water-related programmes: actions for a better knowledge of the karst (see APPENDIX 4) and actions for its protection. For example, the Park supports the volunteer municipalities in their "zero pesticide objective" in the maintenance of their green spaces. In this framework, in 2014, 11 municipalities were able to map the risk of product-transfer depending on the geological nature of the soils, type of surface, proximity to a water source, and they learned about alternative methods. The Park also runs a Unit dedicated to non-collective waste water treatment, to help the general public during installation or renovation projects of residential waste water treatment. Finally, the Park organizes "**Karst meetings**": a one-day exchange every two years intended for local government officials, scientists and socio-professionals that take stock of the scientific knowledge on water and karst topics.

D.5.2. Landscape and biodiversity

The Park leads several programmes whose objectives are the preservation of remarkable natural sites and biodiversity (for example: coordination of Natura 2000 sites). In this domain, its flagship action is the "**Agreement for biodiversity restoration**" conducted in close collaboration with the Midi-Pyrénées Region. It is linked with the preservation of the "Blue-green Infrastructure" (BGI: continuity of the ecological network, the ecosystems and the landscape) of the Park. In this framework, various programmes have been set up: support for local authorities to include the BGI in their general plans; restoration of natural habitat; raising awareness and coordination.

The Park has developed a "**Landscape Plan**" with the Community of Municipalities (i.e., district) of Labastide-Murat. A true participatory initiative, it involved inhabitants, economic players, associations and local government officials (scenic walks, itinerant exhibition, picture-questionnaire...).

Finally, the Park has launched the development of a **photographic observatory of landscape evolution** (agreement with the DREAL Midi-Pyrénées).

D.6. Policies for, and examples of, public and stakeholder awareness

Many of the awareness policies of the Park's public and local actors are implemented through the educational programmes mentioned above (partnership with the Ministry of National Education; organisation of the Doline Network; publications and activities to raise awareness). Note, in addition, the following programmes and actions:

D.6.1. Conciliation of use and outdoor activities

Caving, canoeing, climbing, mountain bike, hiking, horse riding, cave diving... the Causses du Quercy offer a wide range of outdoor activities. The Park and its partners undertook

several actions to raise the actor's awareness and defined conciliation of use standards.

The Lot County Climbing Committee, the State, the County Council, the Park and the local environmental associations signed a **Charter of climbing good practices** in 2010. In this framework, amongst other things, two one-day courses have been proposed on "Birds of prey in rupestrian areas" gathering climbers and adherents of the Lot County Bird Protection League in 2014. The Park also joins forces in some actions of the Lot County Caving Committee, such as **monitoring of the cavities' remarkable biodiversity** (for example: annual monitoring of bats; underground microfauna inventories). In close partnership with the Green-Sports Leisure Defence Collective (Codever), the Park and the National Agency for Hunting and Wildlife has published a **brochure to raise awareness of motorized leisure sportsmen**.

In general, the code of good practices and good behaviour is recalled in the various brochures published by the Park, in terms of heritage, environment and landscape protection. A particular effort will be made concerning raising awareness of geological heritage protection, for instance in the framework of the Lot RNN of Geological Interest and of its specific legislation. Finally, the County Council is doing important work on

underground diving sites (securing and monitoring of the site; on-site information panels for participants). The Lot County is a widely recognised destination for the practice of this activity: in September 2015, the **Lot International Cave Diving Congress** was hosted in Gramat (north of the territory).

D.6.2. Awareness and training of economic actors in the environment

As part of its European Charter for Sustainable Tourism in Protected Areas, the Park organised numerous training and awareness raising sessions for the local tourism actors. The **Sustainable Development Workshops**, which took place in 2012-2013, have mobilized 168 participants in ten thematic training sessions for example. In 2014, the Park supported 11 lodging places in this process through individual action plans completed by meetings and information/training sessions. Since 2012, the Park and the Lot County Chamber of Trade and Craft co-organise the "Park Craftsmen Eco-Challenges". It aims at encouraging and assisting small businesses in sustainable development initiatives; 53 businesses have obtained this label up to now.

E. Interest and arguments for joining GGN

Above all else, the Geopark project has matured at length through the work of all the players in the Causses du Quercy territory. It is the result of more than twenty years of a bottom-up process for the protection and promotion of its geological heritage. To mention only one example, the association *Les phosphatières du Quercy* has been working for 23 years for the preservation and promotion of the phosphorite caves' geological heritage by breaking down the barriers between disciplines (paleontology, stratigraphy, sedimentology, caving, speleology and botany), promoting education of the young generation (guided field trips and study material in the classrooms) and popularising knowledge for the general public (conferences, scientific and cultural activities for inhabitants and tourists).

Alongside scientific research of international significance conducted on the territory and the recent protection of a large part of the geological heritage through the Lot National Nature Reserve of Geological Interest, the appropriation by the inhabitants of their local geological heritage and their vernacular heritage closely linked with local rocks, has enabled the preservation of the identity of the territory and of its inhabitants (landscapes, built heritage, intangible heritage of the know-how and of the Occitan language). The local associations, the political actors and the Causses du Quercy Regional Nature Park have worked, and are still working, in concert. Promotion of the geological heritage has naturally fitted into this process over the past ten years and results today in the submission of this application dossier to the Global Geoparks Network (GGN).

The GGN label would provide international openness to the aspiring territory: it would give an international visibility in the

sector of geotourism. It would also foster scientific and educative cooperation projects. For instance, the aspiring Geopark wishes to draw closer to the Global Geoparks having present-day tropical karsts, as a comparative tool with the Quercy paleokarst. A feedback or support from the already existing network is anticipated for the short-term projects launched by the aspiring Geopark, particularly on the museography aspects and the educational component (tools, activities). At a French level, this label, thereby completing the image of Regional Nature Park by a recognised geoeducative and geotouristic interest, would also enable the Park to reach a touristic clientele, schools and University students, from a broader area than the Midi-Pyrénées Region.

Recognition of the GGN label by the International Union of Geological Sciences (IUGS) and by the United Nations Educational, Scientific and Cultural Organization (UNESCO) would enhance the territory as a whole, in addition to the already existing World Heritage Sites (the Routes of Santiago de Compostela and the associated built heritage; Biosphere Reserve of the Dordogne Basin). Besides, it would allow the territory to guard against "external" threats due to the current economic context (shale gas extraction projects).

Feedback that the aspiring Geopark would like to provide to the Global Geoparks network concerns some of its flagship initiatives, especially its participatory science programme (fossiliferous material analysed in the schools) that helps remove the barriers that usually exist between scientific research and the educational sector.

List of appendices:

(download link: <http://www.pnrcq.org/geoparc>)

Appendix 1: Glossary of technical terms.

Appendix 2: Protection and promotion actions of built heritage carried out on the territory.

Appendix 3: Protection zoning map of the territory.

Appendix 4: Summary of karst studies carried out by the Park.

Appendix 5: List and map of the Park municipalities.

Appendix 6: Geopark initiative history.

Appendix 7: Complete organisation chart of the Park.

Appendix 8: Lot County Geosites Inventory (CRPG, 2015).

Appendix 9: Complete bibliography list of scientific papers concerning,

A: the phosphorite caves, B: geology of Jurassic and Cretaceous periods.

Appendix 10: List of the 110 geosites of the aspiring Geopark dedicated exclusively to research (from the CRPG Inventory, 2015).

Appendix 11: Geotouristic strategy of the Park.

Appendix 12: Bibliography in PDF format.

Bibliography from the Causses du Quercy Regional Nature Park:

(download PDF version in Appendix 12)

- Charter of the Park Report 2012-2024.
- Territorial Diagnosis of the Park and Appendix, 2010.
- Pélissié T., Lagasquie J.-J., Trémoulet J., 2014. *Les clés des paysages des Causses du*

Quercy, géologie et géomorphologie. Les Essentiels du Parc Vol.1. 111 p.

(ISBN 978-2-9547210-3-3).

- Guidance and recommendations on the small rural heritage: recognise, preserve and restore.
- Booklets from the collection "Discover..."

Short bibliography:

- Aguilar J.-P., Michaux J., Pélissié T., Sigé B., 2007. *Early late pliocene paleokarstic fillings predating the major plio-pleistocene erosion of the quercy table, SW-France*. Acta Carsologica 36/3, p. 469-473.
- *Atlas des mammifères sauvages de Midi-Pyrénées*, Livret 1, 2013. Coordination E. Jacquot, Collection Atlas naturalistes de Midi-Pyrénées, Éd. Nature Midi-Pyrénées.
- Bazalgues G., 2002. *À la découverte des noms de lieux du Quercy : Toponymie lotoise*, Gourdon, Éd. de la Bouriane et du Quercy, 127 p. (ISBN 2-910540-16-2).
- Bonis (De) L., Crochet J.Y., Hartenberger J.L., Rage J.-C., Sigé B., Sudre J., Vianey-Liaud M., 1977. *Les phosphorites du Quercy : un laboratoire naturel de l'évolution des vertébrés*. Courrier du CNRS Paris, 25, p. 6-11.
- Cinzano P., Falchi F., Elvidge C.D., 2001. The first World Atlas of the artificial night sky brightness. Mon. Not. R. Astron. Soc., vol. 328, p. 689-707.
- Cubaynes R., Faure P., Hantzpergue P., Pélissié T., Rey J., 1989. *Le Jurassique du Quercy : unités lithostratigraphiques, stratigraphie et organisation séquentielle, évolution sédimentaire*. Géologie de la France, n°3, p. 33-62.
- Cubaynes R., Hantzpergue P., Lézin C., Mazin J.-M., Pélissié T., Rey J., 2004. *Les dépôts littoraux du Jurassique sur la bordure quercynoise (Aquitaine), Livret guide d'excursion*. STRATA, 2, vol. 42, 85 p.
- Crochet J.-Y., Aguilar J.-P., Astruc J. G., Boulbes N., Escarguel G., Michaux J., Montuire S., Pélissié T., Sigé B., 2006. *Reprise plio-pléistocènes du paléokarst quercynois*. Dans "30 Millions d'années de biodiversité dynamique dans le paléokarst du Quercy", STRATA vol. 13, p.85-95.
- De Wever P., Le Néchet Y., Cornée A. (eds.), 2006. *Vade-mecum pour l'inventaire national du patrimoine géologique*. Mém. H.S. Soc. Géol. Fr., 12, 162 p.
- De Wever P., Egoroff G., Cornée A., Lalanne A. (eds.), 2014. *Géopatrimoine en France*. Mém. H.S. Soc. Géol. Fr., 14, 180 p.
- Franceschi (De) D., Le Gall C., Escarguel G., Huguency M., Legendre S., Simon-Coignon R., Pélissié T., Sigé B. (2006). *Une paléoflore des phosphatières du Quercy (sud-ouest de la France) : première découverte, résultats et perspectives*. Dans "30 Millions d'années de biodiversité dynamique dans le paléokarst du Quercy", STRATA vol. 13, p.97-101.
- Dossier scientifique du projet de Réserve naturelle nationale (RNN) d'intérêt géologique du Lot, 2013.
- Escarguel G., S. Legendre, B. Sigé, 2008. *Unearthing deep-time biodiversity changes : the Palaeogene mammalian metacommunity of the Quercy and Limagne area (Massif Central, France)*. Comptes Rendus Geosciences 340, p. 602-614.
- Escarguel G., 2009. *Climat, adaptation, évolution et biodiversité*. Responsabilité & Environnement n°56, oct., p. 25-33.
- Gruendel J., Pelissie T., Guerin M., 2000. *Brackish water gastropods from the Middle Dogger from la Balme (Causses du Quercy, southern France)*. Berliner Geowissenschaftliche Abhandlungen Reihe E Palaeobiologie, 34 2000: 185-203. [Zoological Record Volume 137]
- Juskiewinski S., 2012. *Si les pierres parlaient...* Éd. Édicousse, 400 p.
- Labrousse M., 1993. *L'Histoire du Quercy*, sous la direction de J. Lartigaut, Éd. Privat.
- Legendre S., 1986. *Analysis of mammalian communities from the late Eocene and Oligocene of southern France*. Palaeovertebrata, 16, p. 191-212.
- Legendre S., 1989. *Les communautés de mammifères du Paléogène (Éocène supérieur et Oligocène d'Europe occidentale : structures, milieux et évolution*. Münchner geowissenschaftliche Abhandlungen, A, 16, p11-110.
- Legendre S., Sigé B., Astruc J. G., de Bonis L., Crochet J.-Y., Denys C., Godinot M., Hartenberger J.-L., Lévêque F., Marandat B., Mourer-Chauviré C., Rage J.-C., Remy J.A., Sudre J., Vianey-Liaud M., 1997. *Les phosphorites du Quercy : 30 ans de recherche. Bilan et*

perspectives / The phosphorites of Quercy : 30 years of investigations. Results and prospects. Geobios, Vol. 30, Suppl. 1, p 331-345.

- Lézin C., 2000. *Analyse des faciès et stratigraphie intégrée : application aux événements du passage Lias-Dogger sur la plate-forme du Quercy*. Thèse Université Paul-Sabatier, STRATA, 2, 35.
- Lézin C., Rey J., Faure PH., Cubaynes R., Pélissié T., Durlot CH., Deconinck J.-F., 2007. *Tectono- biosedimentary recordings at the Lias-Dogger transition: example of the Quercy carbonate platform (Aquitaine Basin, France)*. Bulletin de la Société Géologique de France, 178, p. 275-291.
- Lorblanchet M., 2010. *Art pariétal – Grottes ornées du Quercy*, Éd. du Rouergue.
- Mourer-Chauviré C., 2006. *The avifauna of the Eocene and Oligocene phosphorites of the Quercy (France): an updated list*. Dans "30 Millions d'années de biodiversité dynamique dans le paléokarst du Quercy", STRATA vol. 13, p. 135-149.
- Pélissié T., Peybernes B., 1982. *Étude micropaléontologique du Jurassique moyen / supérieur du Causse de Limogne (Quercy). Description des foraminifères Trocholina gigantea n. sp., Parinvolutina aquitana, n. gen., n. sp. et Limnognella dufauri n. gen., n. sp*. Revue de Micropaléontologie, 25(2), p. 111-132. [Zoological Record Volume 119].
- Pélissié T., 1986. *Typology and genetic interpretation of the breccia underlining the Oxfordian/Kimmeridgian boundary in the Quercy (S.W. France)*. Arch. Sc. Genève, vol. 39, Fasc. 2, pp.211-224.
- Pélissié T., Astruc J.-G., 1996. *Tectonique synsédimentaire et dissolution d'évaporites dans les dépôts du Jurassique moyen et supérieur des Causses du Quercy*. Géologie de la France, n°4, pp. 23-32.
- Pélissié T., 2006. *Risques de pollution de l'aquifère karstique par les décharges sauvages dans les phosphatières du Quercy*. Dans "30 Millions d'années de biodiversité dynamique dans le paléokarst du Quercy", STRATA vol. 13, p.59-66.
- Pélissié T., Sigé B., 2006. *30 Millions d'années de biodiversité dynamique dans le paléokarst du Quercy*, STRATA vol. 13, 284 p.
- Platel J.P., 1996. *Stratigraphie, sédimentologie et évolution géodynamique de la plate-forme carbonatée du Crétacé supérieur du Nord du bassin d'Aquitaine*. Géologie de la France, n° 4, p. 33-58.
- Rage J.-C., 2006. *L'apport des faunes du Quercy à la connaissance des grands mammifères*. Dans "30 Millions d'années de biodiversité dynamique dans le paléokarst du Quercy", STRATA vol. 13, p.175-187.
- Rémy J.A., Sudre J., 2006. *L'apport des faunes du Quercy à la connaissance des grands mammifères*. Dans "30 Millions d'années de biodiversité dynamique dans le paléokarst du Quercy", STRATA vol. 13, p.175-187.
- Rey J., Cubaynes R., Fauré F., Hantzpergue P., Pélissié T., 1988. *Stratigraphie séquentielle et évolution d'une plate-forme carbonatée : le Jurassique du Quercy (Sud-Ouest de la France)*. C.R. Acad. Sci. Paris, t. 306, Série II, p. 1009-1015.
- Schmidt-Kittler N., 1987. *European Reference Levels and Correlation Tables*. In Schmidt-Kittler N. (ed.): International Symposium on Mammalian Biostratigraphy and Paleoeology of the European Paleogene. Münchner geowissenschaftliche Abhandlungen, A, vol. 10, 13-31.
- Simon-Coignon R., Thiry M., Schmitt J.M., Legendre S., Astruc J. G., 1995. *From inland paleosurfaces towards sedimentary basins: the example of southwestern French Massif Central*. IAS – 16th Regional Meeting of Sedimentology – 5^{ème} Congrès français de Sédimentologie ASF Field Trip Guide Book, publication, ASF n°23, Paris, 254 p.
- Simon-Coignon R., 2008. *Reconnaissance de l'extension de la sédimentation crétacée*. Journées AFK/AGSO/CFH - Excursions en Quercy - Livret-Guide p. 159-162.

Self-evaluation dossier:

- Evaluation-Documents-A-Causse-Quercy.xls

- Evaluation-Documents-A-Justifications-Causse-Quercy.pdf

Acknowledgments:

The aspiring Geopark of Causses du Quercy wishes to thank all those who contributed to build up this application to the Global Geoparks Network:

- The *Comité syndical* of the Park and its 120 representatives, for the important local transmission and the evident political willpower to achieve this project.
- The four Departments of the Park – and very especially the Environment Department – for their rallying to and support for the development of this application.
- The Park Scientific and Planning Council for its involvement from the outset of the project, and the various contributions of its members.
- All technical and institutional partners of the Park, which provided their support at each stage in the elaboration of this

project, and contribute to its implementation; especially, the Midi-Pyrénées Region, the Lot County, Lot-Tourism, the Lot County Caving Committee, the Paléonautes network and the Doline network.

- The Government Services – Lot Prefecture, Gourdon Subprefecture, DDT du Lot, DREAL Midi-Pyrénées – for their encouragement and their decisive support.
- The French Global Geoparks for their valuable help and advice.
- The technical team of the Park – and more specifically the project team in charge of the Geopark – for its investment.

Special thanks to Jean-Paul Cadet

Who was one of the first to lead the Causses du Quercy to the Geoparks world, who gave us continual support throughout the process.



“If stones could speak”: the project of the Causses du Quercy takes its name from the book of Serge Juskiewenski, Founding President of the Causses du Quercy Regional Nature Park (1999-2010); a sincere thanks to his wife for allowing us to use this title as a common thread of the project.

This application dossier was written with the support of the Application Follow-up Committee:

Catherine Marlas (President of the Park), Jacques Borzo (Vice-President of the Park in charge of the Environment), Thierry Pélissié (Geologist, President of the Park Scientific and Planning Council (SFC) / association Les Phosphatières du Quercy), Jacques Rey (Geologist, SFC member), Jean-Jacques Lagasque (Geographer, SFC member), Francis Duranthon (Palaeontologist, SFC member / Director of the Museum of Toulouse), Jean-Paul Cadet

(Honorary Professor, University P&M Curie (Paris VI)), Jean-Pascal Salambéhère (DREAL Midi-Pyrénées), Alain Affraix (Lot County), Sophie Dejoux (Midi-Pyrénées Region), Philippe Andlauer (Director of the Park), Cédric Conteau (Deputy-Director of the Park), Soledad Campos (Tourism Project Manager, Park), Agathe Kühnel (Environment Project Manager, Park).

Writing, iconography and editorial follow-up:

Aloé Hok-Schlagenhauf (PhD; Correxien) under the direction of Agathe Kühnel (Regional Nature Park) and of Thierry Pélissié (SFC).

GIS maps production:

François Daval (Regional Nature Park).

Design and layout:

Studio Polka Spirit.

Translation:

Aloé Hok-Schlagenhauf (Correxien); Proofreading: Moira Morley Warland (B.Sc.Hons. Agric., M.Sc. Conservation).

Application achieved with the financial support of the Midi-Pyrénées Region.

Credits:

Front cover:

Upper picture: Perched village of Saint-Cirq-Lapopie © <http://zmz.fr>

Lower picture: Phosphorite cave of Bories © J.-F. Fabriot

Background topographic map: BD TOPO IGN

Back cover: Sieving and sorting of fossiliferous material in schools © J. Morel



Parc
naturel
régional
des Causses
du Quercy

Achieved with the financial support of:



Géoparc candidat des Causses du Quercy
Parc naturel régional des Causses du Quercy
11 rue Traversière – B.P.10 – 46240 Labastide-Murat
Tél. 05 65 24 20 50 – Fax 05 65 24 20 59
e-mail : geoparc@parc-causses-du-quercy.org
www.parc-causses-du-quercy.fr