OFFICIAL APPLICATION DOSSIER GEOPARK OF EL HIERRO PROJECT

THE ISLAND OF THE 1000 VOLCANOES CANARY ISLANBDS (SPAIN)

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ProyectoGeoparque
El Hierro

GOBIERNO DE ESPAÑA
MINISTERIO DE INDUSTRIA, ENERGÍA Y TURISMO
SECRETARÍA DE ESTADO DE TURISMO
SEGITTUR turismo e innovación
Cabildo de El Hierro
La Isla del Meridiano

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OFFICIAL APPLICATION DOSSIER: GEOPARK OF EL HIERRO ISLAND PROJECT

Note: Find all the documents at the website http://www.proyectogeoparqueelhierro.com
See "**Application documents"**
User: **geoparkprojet ;** Pasword: **elhierro**

A.1 Name of the proposed Geopark

El Hierro Geopark

A.2 Surface area, physical and human geography characteristics of the proposed Geopark

A.2.1 Area of the applicant territory

Its extension, 278 km^2, makes El Hierro the smallest island in the Canary Islands archipelago, and its territory accounts for only 3.59% of the region's total area (Canary Islands Autonomous Region). Its coastal perimeter is 96 km in length.

The territory proposed for the Geopark covers the whole of the island of El Hierro, and includes the area of the Mar de Las Calmas Marine Reserve (created in 1996). The total combined area of the terrestrial part and the marine part (4.5 km^2) of the territory in the Geopark application is 282.5 km² (Figure 1).

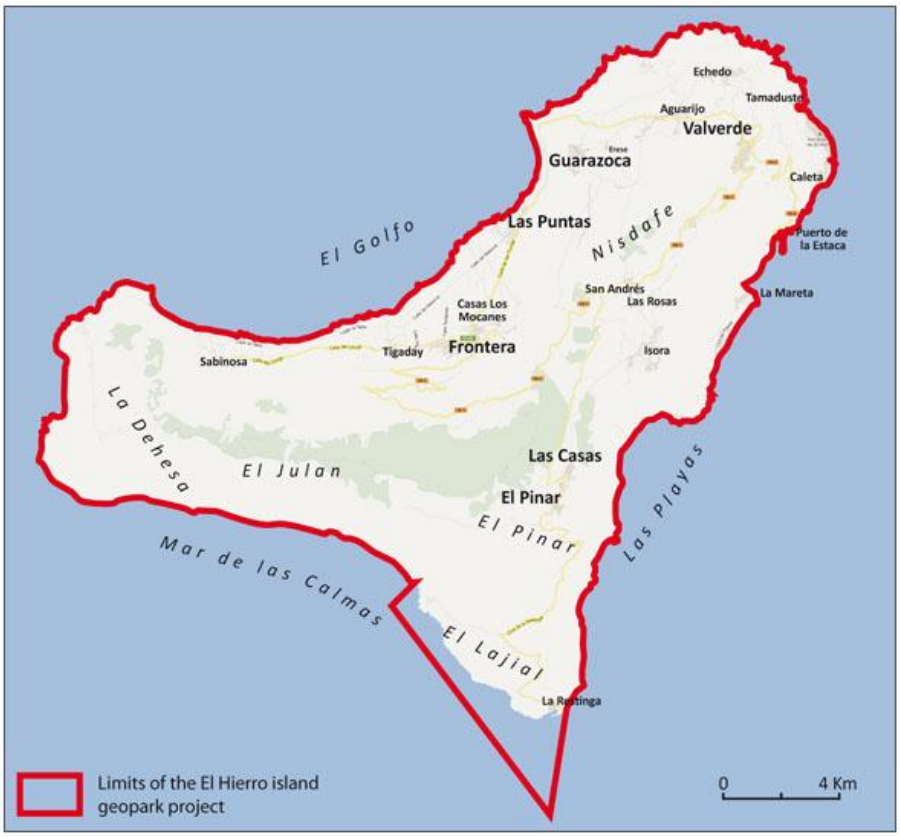

Fig. 1. Area of the territory proposed for the Geopark (terrestrial and marine parts). Source: Google Maps Service.

A.2.2 Physical geography

El Hierro is the island located at the very southwest part of the archipelago (see B.1), and for this reason, prior to the discovery of America, its western end –the cape of Punta Orchilla– was used as the meridian of reference (longitude 0^o) for calculating longitudes until it was moved to Greenwich in 1884. This is why El Hierro is known as "The Meridian Island".

The island (Figure 1) is shaped roughly like a triangle oriented from northeast to southwest. It is no more than 30 km in length and the distance at its widest point is about 17 km. Its most salient points are approximately the Punta Norte, where it broadens at the north-eastern end; Punta de La Restinga at the pointed southern end of the island; and Punta de Orchilla in the westernmost part. The island's relief resembles a pyramid with its highest point near the centre on the summit of Malpaso, with a height of 1501 m. The island's small area in relation to its height makes El Hierro the island with the steepest average gradients in the archipelago.

The pronounced differences in level on the island and the geological nature of El Hierro have hindered the installation of sheltered harbours, as the coast has very few indentations, and almost all the island's edifice is bordered by cliffs, with only a few points with sandy beach formations.

Three geographic regions can be distinguished:

- The central plateau, which differentiates it from the rest of the Canary Islands. It is shaped like an arch that opens out towards the north.
- The gulf valley, to the NW. This is the only area where there are coastal plains.
- The area of gentle slopes (El Julan) in the SW.

In the general orographic layout of the island, the most spectacular morphological feature is the broad escarpment of El Golfo, which opens in a semicircular shape towards the north and has a length of about 25 km from its western (El Rincón) to its north-eastern end (Las Puntas and Los Roques de Salmor).

One of the most noteworthy general features of the island of El Hierro, in comparison with the rest of the archipelago, is the absence of gorges of the size found on the other islands. This is due precisely to the youth of the island's edifice –the reason for its relatively unevolved and highly porous soils– which also has had very little time to evolve. As a result, the most important gorges are in the oldest areas of the island, which have the greatest difference in level, particularly on the eastern slope in the sector between Punta de la Bonanza point and the port of La Estaca. This area is the site of various rain runoff channels, which are shallow but with a considerable lengthwise extension, such as the channels of Las Playecillas, El Balón, Honduras and Tiñor.

In common with the rest of the archipelago's western islands, the island of El Hierro has exceptional climate conditions, as the relatively high altitude of its relief –with a string of summits over 1000 m along the El Golfo escarpment–, and the arrangement of the island's edifice with regard to the direction of the trade winds, means that a broad area of the island, from the slopes of the gulf until the zone of Valverde and including the Nisdafe plateau, is exposed to both the action of humidity and the mists from the northeast winds. The annual average temperatures range from 18º C to 21º C at altitudes below 250 m, and from 12º C to 14º C at heights above 1000 m.

The steep terrain and the lack of agricultural land and water resources on the island have curbed its population throughout most of its history. The "horizontal rain" caused by condensation in trees served as an important supply of water until 1610. The legend of the Sacred Tree (the Garoé) derives from this phenomenon of condensation, and is a singular element in El Hierro's cultural heritage.

A.2.3 Natural resources

The unique relationship which has evolved between the local inhabitants and nature through a model of traditional agricultural development earned the island the title of Biosphere Reserve from the UNESCO in 2000.

El Hierro's outstanding geological and botanical originality, which, in an area of reduced dimensions, combines volcanic phenomena and biological processes which are usually dispersed over much wider extensions, in addition to the moderate demographic pressure on

the use of traditional agricultural resources in recent decades, have meant that more than 60% of the island's area has been included in some type of protection regime, within the conservation framework of the Canary Islands' legislation. This legislation has led to the creation of the new integral nature reserves of Mencafete and Los Roques de Salmor, the Special Nature Reserve of Tibataje, the La Frontera Rural Park, the Natural Monument of Las Playas, and the Protected Landscapes of Ventejís and Timijiraque. The framework of this protection has also been extended to the island's shoreline and to the maritime band near the coast with the creation of the Mar de las Calmas Marine Reserve, the site of the eruption of an underwater volcano in October 2011 which considerably affected the island's economic structure, particularly with regard to its fishing industry and to sports tourism in the form of scuba-diving.

A.2.4 Human geography

El Hierro belongs administratively to the province of Santa Cruz de Tenerife and is divided into three municipal districts: La Frontera, with 81.6 km² and 4029 inhabitants; El Pinar de El Hierro with 82.9 km² and 1898 inhabitants; and Valverde, the capital of the island, with an area of 104 km² and 5,068 inhabitants (Source: Canary Islands Institute of Statistics, ISTAC, 2011).

Due the island's reduced area and its natural impediments, El Hierro is also the least populated island in the archipelago, with a population of less than 10995 inhabitants –representing only 0.5 percent of the region's demographic volume (Canary Islands Autonomous Region), and a population density of 41 inhabitants per km^2 (Source: ISTAC, 2011).

Generally speaking, the population of El Hierro is relatively concentrated. It has become distributed into 19 population centres in function of the island's topography and the availability of land and water for growing the subsistence crops of the past. These natural conditioning factors make El Hierro the island whose population inhabits the highest altitudes in the Canary Islands in relative terms: around half of its population lives above an altitude of 500 m, an indicator that does not exceed 15% on the regional scale. However, and since the 1970 population census, there has been a gradual move by the inhabitants towards the population centres located along the island's coastal band (below 300 m in altitude).

Demographically, the migratory phenomena of the 1960s drove thousands of natives of El Hierro to leave the island, which led to a decline in population. Throughout the last ten years, the island's demographic dynamic has changed to a point where the balance of arrivals is now greater than departures, and the population has grown thanks to immigration and to the return home of numerous emigrants.

The departure of the island's young people during the 1950s and 60s in conjunction with a subsequent decline in the birth rate has led to an acute ageing of the population, with the resulting social and economic consequences for El Hierro.

In spite of the island's distance from Africa, which is one of its main sources of immigration, the island has a higher percentage of foreign population than corresponds to the Canary Islands as a whole: 12.61% compared to 11.29%.

A.3 Organization in charge and management structure (description, function and organigram) of the proposed Geopark

A.3.1 Management body

For the management of the Geopark Project, the government of the island of El Hierro (the El Hierro Island Council "Cabildo de El Hierro") created in 2012 a specific management body (Board), under the Law regulating Local Ordinances (Law 7/1985 of 2 April) amended by Law 57/2003 of 16 December regarding measures for the modernisation of local government.

The **Board of the Geopark (Project) of El Hierro Island** is an autonomous body with its own legal character which ensures that its continuity and independence are guaranteed in the case of political change. This management body has the support of the Regional Government

(Canary Islands Autonomous Region) and has been approved by the government of El Hierro and the town councils of the three municipalities, after a debate with the island's main stakeholders (business associations, neighbourhood associations, etc.).

A.3.2 Statutes of the management body (synthesis)

The Board has been established for the purpose of formalising the management of the natural and cultural resources that has taken place on the island in recent years, and which coincides with the objectives of the geoparks, as expressed in the statutes, in the section "Aims of the Board":

- The sustainable and balanced development of the proposed territory of the Geopark of El Hierro Island, with particular emphasis on its geological, natural and cultural values, through the promotion of actions and the implementation of activities whose effects will benefit the people who live in this territory.
- The protection and conservation of the natural heritage of this territory, and particularly of its geological heritage, and the promotion of its value as a resource, for the ultimate purpose of promoting the economic and social development of its population.
- The promotion of Earth Sciences in this territory in the fields of investigation, education (both regulated and unregulated) and dissemination, and the support for other natural and environmental sciences.
- The promotion of activities relating to the tangible and intangible cultural heritage (traditions, customs, trades, oral history, artistic creation, etc.), prioritising those activities which are most closely aligned with geological, palaeontological and archaeological heritage.
- The promotion of environmental education, with particular emphasis on the particular values of the territory.
- The improvement of tourism quality and supply in the territory.
- The dynamisation of economic activities which are compatible with the objectives of the Geoparks, with particular support for initiatives related to local products.

The Board has two management levels in order to guarantee its capacity to meet these objectives, both in the territory itself and within the collaboration framework of the EGN and the GGN. These are the decision-making level and the consulting level. Special emphasis is placed on encouraging citizen involvement in the Project. Figure 2 shows the Board's organisation chart.

Decision-making level (Government bodies)

This comprises the President of the Island Council and the Governing Board, which is formed, among others, by: **one Earth Sciences expert, one tourism management expert**, one communications expert, the mayors of the three towns on the island, etc. Other experts may also participate as required.

Advisory level (Advisory bodies)

It is formed by three consulting commissions: the Scientific Commission, the Tourism and Business Commission, and the Citizens' Commission.

Members of the Scientific Commission: the Coordinator of the Scientific Commission; the Island's Environment Councillor; the Island's Education and Culture Councillor; one representative from the Island Water Board of the Autonomous Region; the Chairman/chairwoman of the company *Gorona del Viento El Hierro, S.A.*; the Manager of the El Hierro Biosphere Reserve; one representative from the University of La Laguna, and one representative from the University of Las Palmas.

Members of the Tourism and Business Commission: the Coordinator of the Tourism and Business Commission; one representative from the Hotel and Accommodation Association of Tenerife, La Palma, La Gomera and El Hierro (ASHOTEL); one representative from the

Association of Small and Medium Enterprises on El Hierro Island (APYME EL HIERRO); one representative from El Hierro's rural tourism associations, and one representative from the company in charge of scheduled public passenger transport in El Hierro.

Members of the Citizens' Commission: the Coordinator of the Citizens' Commission; one representative from a neighbourhood association in the town of Valverde; one representative from a neighbourhood association in the town of La Frontera, and one representative from a neighbourhood association in the town of El Pinar de El Hierro.

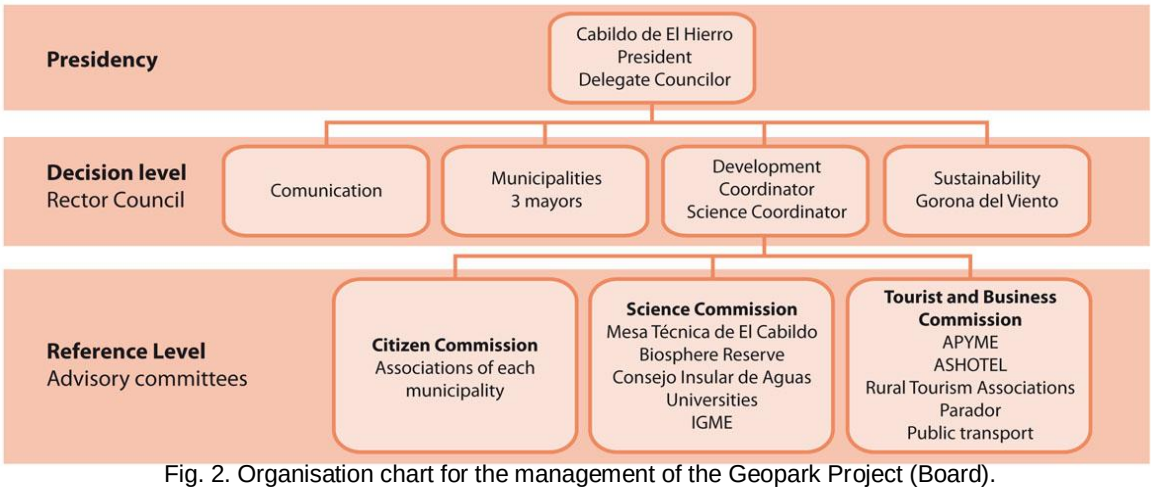

Fig. 2. Organisation chart for the management of the Geopark Project (Board).

A.3.3 Human and economic resources

The Board has the necessary staff, whose number, category and functions are determined on the staff rosters by the Governing Council, and then approved by the island government. The salaries are reflected in the Budget for the Autonomous Body (Board). It should be noted that the public company EL MERIDIANO is responsible for the management of the main visitor centres for the Geopark Project. This guarantees a more uniform standard of management quality.

Financial resources	**2011**	**2012 (Forecast)**	**2013 (Forecast)**
Management area	9,407.66	18,815.32	18,815.32
Administrative tasks	24,081.60	26,474.69	37,501.35
Technical area	87,878.97	123,600.75	145,337.86
E.I.S. EL MERIDIANO S.A.U.	67,329.36	67,329.36	90,894.63
TOTAL (€)	**188,698**	**236,220.12**	**292,549**

As a general rule, the staff dedicated to the Geopark Project also carry out other assignments as part of their regular jobs. However, a dedication time (annual %) has been defined in each case, as follows:

Assignment	**Time dedicated to the Geopark Project (annual %)**		
	2011	**2012 (Forecast)**	**2013 (Forecast)**
Manager	20%	40%	40%
Tourism management expert	50%	100%	100%
Scientific coordination	20%	60%	75%
Education expert	0%	10%	25%
Communications expert	10%	30%	50%

The Board (Management body of the Geopark Project) has its own budget, as follows. The Board's Statutes specify that the management body itself is responsible for administering this budget, which comes from the following sources, among others:

a) The annual contribution received from the El Hierro Island Council (*Cabildo de El Hierro*).
b) Subsidies and contributions from other public bodies, either in the form of non-recoverable funds or through the implementation of collaboration agreements for the achievement of their aims.
c) Revenues obtained from public fees or prices paid for the provision of the services within their competence.

Some of the items pertaining to the activities of the Geopark Project to be covered from the budget are listed below.

Activities related to the Geopark Project	2011	2012 (Forecast)	2013 (Forecast)
TOURISM			
SCUBA-DIVING PROMOTION	40,000	75,000.00	60,000.00
EL HIERRO, A VOLCANIC EXPERIENCE (Education Program)	159,167.00	253,499.00	354,001.00
TOURISM PROMOTION	108,274.03	91,950.00	70,000.00
IMPROVEMENTS TO VISITOR CENTRES	782,185.60	822,817.00	750,000.00
AGRICULTURE			
BIOSPHERE RESERVE ACTION PLAN	20,976.00		20,000.00
CONSERVATION OF THE FOOTPATH NETWORK	56,980.00		30,000.00
ORGANIC FARMING COURSE	2,048.61		
SUBSIDY FOR THE FISHERMAN'S GUILD	13,500.00		
SUBSIDY FOR THE WINE REGULATORY BOARD	7,600.00		
ENVIRONMENT			
RESEARCH ON THE GIANT LIZARD	106,159.94	193,840.06	100,000.00
BIOSPHERE RESERVE VISITOR CENTRE	263,953.31	136,016.69	66,000.00
FIRE PREVENTION CAMPAIGN	225,195.09	333,852.74	320,000.00
WEATHER STATIONS	2,656.85		
NATIVE BIRD POPULATION STUDY	1,420.00		
BIODIVERSITY STUDY	4,000.00	44,000.00	
LAS CANCELITAS SUSTAINABILITY PARK	641,842.31	650,000.00	
VEGETABLE OIL WASTE MANAGEMENT		103,000.00	20,000.00
IMPROVEMENTS TO THE NATURE EDUCATION CENTRE (El Pinar)		9,154.09	
HERITAGE			
ARCHAEOLOGICAL MUSEUM	67,202.09	464,118.11	
RESTORATION OF TRADITIONAL FOOTPATHS	232,412.08	33,587.90	15,000.00
SPORT			
SPORTS PROMOTION CAMPAIGN	25,323.05	14,000.00	12,000.00
ARTS AND CRAFTS			
ARTS AND CRAFTS FAIRS	15,544,.90	15,000.00	15,000.00
TOTAL (€)	**2,836,291**	**3,239,835.59**	**1,832,001**

A.4 Application contact person (name, position, tel/fax, e-mail)

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PART B GEOLOGICAL HERITAGE

B.1 Location of the proposed Geopark

The island of El Hierro is located geographically between latitudes 27′ 38° and 27′ 51° North and longitudes 17′ 53° and 18′ 9′ West, which makes it the southern and westernmost island in the Canary Islands archipelago (Figure 3).

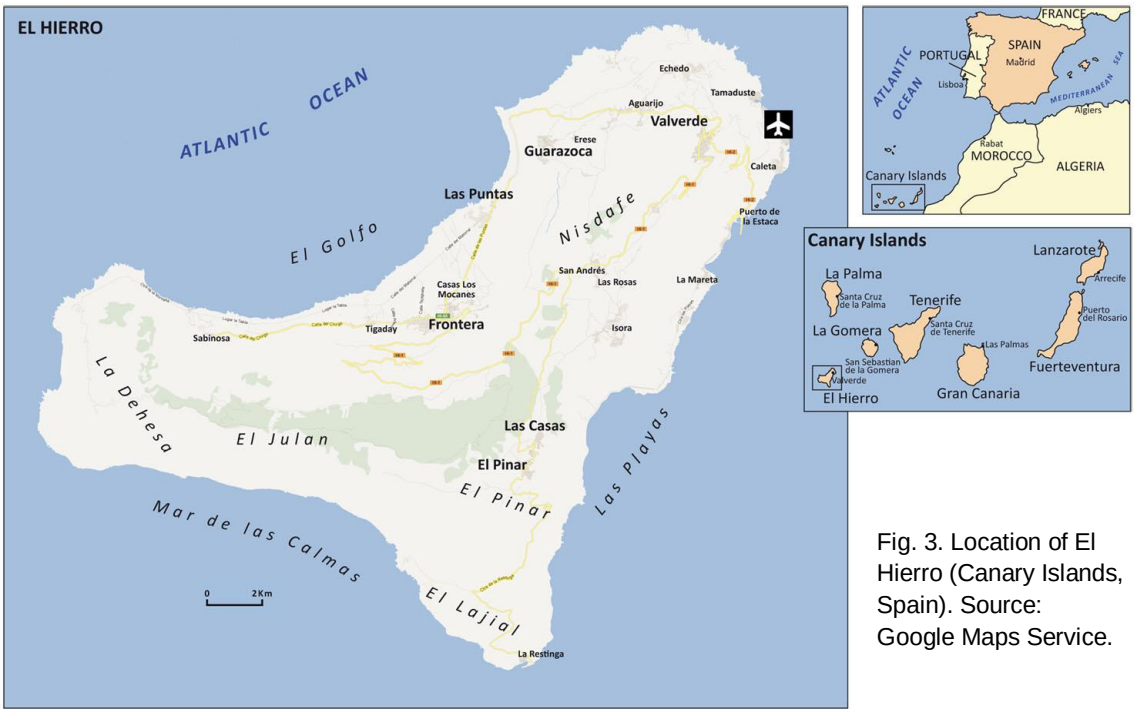


Fig. 3. Location of El Hierro (Canary Islands, Spain). Source: Google Maps Service.

El Hierro has a small airport and a harbord near the capital, Valverde. The island has air connections to the other islands of the archipielago. There are two ways to reach El Hierro. The first step is to go to Tenerife or Gran Canaria, and then to connect either by sea or by air.

In addition to a network of footpaths, El Hierro has a good road system (Figure 1) in excellent condition, making car rental a good option for moving around the island. However for some time the island has been a staunch supporter of sustainable mobility, and its public transport system offers a convenient way of accessing some of the nature and culture areas of interest. The use of electric cars is also being promoted.

There is no geopark in the Canary Islands. The nearest are located in mainland Spain and Portugal (Figure 4).

Fig. 4. Situation of El Hierro with regard to the nearest geoparks.

B.2 General geological description of the proposed Geopark

B.2.1 General features

The Island of El Hierro is the emergent summit, 278 km^2 in area, of a volcanic shield which rises from a seafloor with an age of 156 million years (My) at a depth of 3700-4000 m. The characteristic trilobate form of the island is similar to that of other oceanic islands with three-armed rifts (Carracedo, 1994, 1996). In El Hierro, the rifts form topographic ridges at angles of 120°, oriented in NW, NE and S directions.

The island's construction was very rapid, and this has led to the creation of highly unstable reliefs over short periods of time, causing several giant landslides. Some of these have their morphological expression in the form of arch-shaped megastructures, whereas others have been fossilised by subsequent emissions. These landslides are known by the local names of Tiñor I, post Tiñor or Tiñor II, El Julan and El Golfo (Figure 5). These spectacular features of the island have been studied by several authors including Holcomb and Searle (1991), Soler and Flores (1992), Fúster *et al*. (1993), Carracedo (1994, 1996), Navarro and Soler (1995), Masson (1996), Urgelés *et al*. (1996), Day *et al*. (1997), Carracedo *et al*. (1999).

B.2.2 Geological context

El Hierro is the seventh and last volcanic island in the Canary Islands archipelago to emerge above the level of the sea. It rose to the surface 1.2 million years ago (Ma).

The volcanic history of El Hierro comprises the entire Brunhes normal polarity epoch and the upper Matuyama inverse polarity epoch, including the Jaramillo normal polarity event.

Another interesting aspect is that the islands of La Palma and El Hierro are the first in the Canary Islands that are forming simultaneously, possibly alternating their eruptive activity between both islands, at least in the most recent period. This "double" alignment of islands and the greater depth of its base explain the length of time required for it to come to the surface since the emergence of La Gomera, the previous island to form.

The island of El Hierro is geologically somewhat younger than La Palma and, as it formed on top of a stationary magmatic source, it offers in comparison a perfect concentric development with superimposed edifices in a regular triple-rift system.

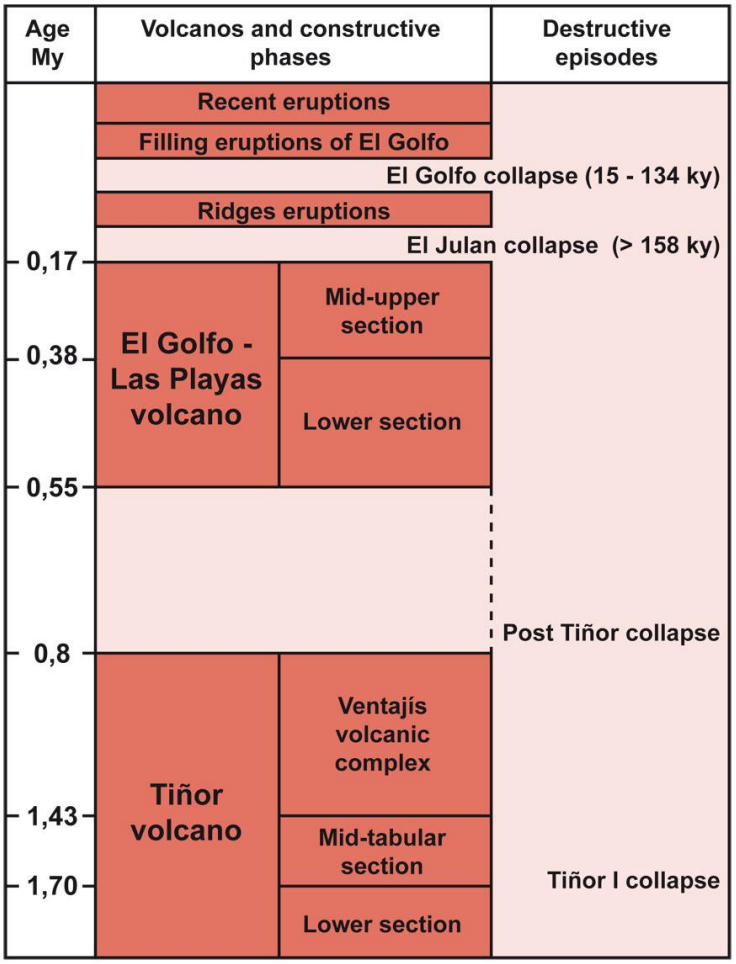


Fig. 5. Synthesis of the chronology of the construction phases of the island of El Hierro. Source: Ancochea & Hernán, 2004.

El Hierro is in the early stages of construction of an oceanic island, and is the island with the greatest density of volcanoes in the Canary Islands. It has over 500 open craters and another 300 which have been covered by more recent lava flows.

When the underwater phase of the island began –today submerged below the surface– the magma rose and formed the seamount prior to the subaerial emissions. Once near the surface, the vertical upward thrust of the rising magma caused the appearance of a Y-shaped volcano-tectonic structure through which the magma was channelled. These are the three main axes of eruptive rift which are still visible on the surface, as they are marked by a line of strombolian cones.

The most active phase of the island's formation took place around the year 10,000 B.C. The younger eruptions lasted from 4,000 B.C. until 1,000 B.C. The lava flows covered the coastal areas of the south, north and west of the island.

On 19 July 2011 a seismic crisis began which spread south to the Las Calmas sea. On 10 October, an underwater eruption occurred at a depth of 300 m, 1.5 km to the SW of La Restinga. Eleven days later another seismic crisis took place, centred mainly in the sea in the northern part of the island, halfway along the coast of El Golfo. A lesser seismic crisis occurred once again at the end of June 2012.

B.2.3 Geological domains

Three geological domains can be distinguished on the island of El Hierro (Barrera & García, 2011):

The Tiñor domain. This is located mainly in the NE zone and comprises the first volcanic edifice on the island representing the shield phase. It is mostly only visible in the zone of Ventejís and in some eroded zones of the El Golfo-Las Playas domain. It is affected by faults, and is where the oldest material on the island appears, eroded into deep gorges. According to dating carried out by the Spanish Geological and Mining Institute (Plan MAGNA), the primitive island (underwater) is known to have begun to take shape a little over 1.7 Ma ago, and this first edifice is mainly basalt.

El Golfo-Las Playas domain and the central plateau: this comprises the second stratovolcanic edifice which was superimposed over practically the whole of the Tiñor domain, plus the final volcanic episode associated to the three rift axes outlined by the final strombolian cones.

Domain of the El Golfo fill-in: this comprises the whole of the volcanic activity which took place after the giant landslide on the NW coast of the island (El Golfo), which filled in the whole of the area of the collapse. The emergence of the great volcano Tanganasoga is the most important feature in this domain.

B.2.4 General stratigraphy

According to both field criteria and geo-chronological and palaeomagnetic criteria, the history of El Hierro can be divided into three main construction episodes:

- Volcanism of the lower-middle Pleistocene. The Tiñor edifice was built during a time interval of 1.2 - 0.88 Ma.
- Volcanism of the middle Pleistocene. Construction of the El Golfo-Las Playas edifice, with a range of ages from 0.54 - 0.176 Ma.
- Volcanism of the middle-upper Pleistocene. Emission of the rifts, with a range of ages from 0.158 - 0.012 Ma.

Figures 6 and 7 show the geological map of the island of El Hierro according to the Geological Map of the Canary Islands (Barrera-Morate & García-Moral, 2011; GRAFCAN).

B.2.5 Description of the geological units which reflect the geological history of El Hierro

Tiñor edifice (1.20 to 0.88 Ma)

The oldest materials appear at the bottom of the gorges in the NE sector of the island and in the lower part of the Las Playas arch. They correspond to the *lower section* of the first edifice of the island, the Tiñor edifice (Guillou *et al*., 1996). The first flows are underwater basalt lavas which evolved to subaerial lavas, and can be seen to be highly altered and intensely affected by Filonian intrusion, and in which flow structures can barely be recognised. These are materials with a brecchiated appearance, monomictic, traversed by sprawling dykes which are identical in composition, and corresponding to autoclastic or collapsed domes.

The tephra edifices appear interspersed in this lower part of the landfill, and are more abundant in the Las Playas sector. Pahoehoe flows can be seen on top, with a similar composition and reduced strength, which as a whole dip some 15º-20º to the ESE and can reach a total thickness of as much as 200 m. There was then a lateral collapse of the western flank of the edifice which gave rise to a debris avalanche (Tiñor I landslide).

Subsequently (Figure 5) the emission of the *intermediaries section* –the tabular section– began, which can be seen discordantly on the materials of the lower section. This was a landfill of "aa" flows with interflows of slag which create a staggered relief. These constitute the fundamental part of the Tiñor edifice and have a somewhat complex structural arrangement, although there is a predominance of E and ESE dips with variable tilts of between 3º and 15º. In the outcrops in the northeast sector, these flows adopt an almost horizontal arrangement with tilts of less than 3º. These have been dated to 1.49 Ma and 1.70 Ma (Balcells and Gómez, 1997). In conjunction,

both these flows and those of the lower section are affected by normal faults with a NE-SW component which give rise to a graben.

This first phase of activity culminates with the emission of the *Ventejís Volcanic group*, whose earliest flows have been dated to 1.43 Ma (Balcells and Gómez, 1997). These are a group of volcanoes which are located in an irregular arrangement over the tabular section in the NE sector of the island, and whose flows are easily identifiable due to their considerable xenolith content. The Ventejís eruptions may have been a terminal explosive stage, as suggested by the cone morphology and the high xenolith content. This explosive stage may have preceded the collapse of the NW flank of the Tiñor volcano.

A new landslide subsequently occurred on the western flank of the Tiñor edifice (*post-Tiñor or Tiñor II landslide*) which is currently hidden by the subsequent emissions of the El Golfo-Las Playas edifice and by the rift volcanism.

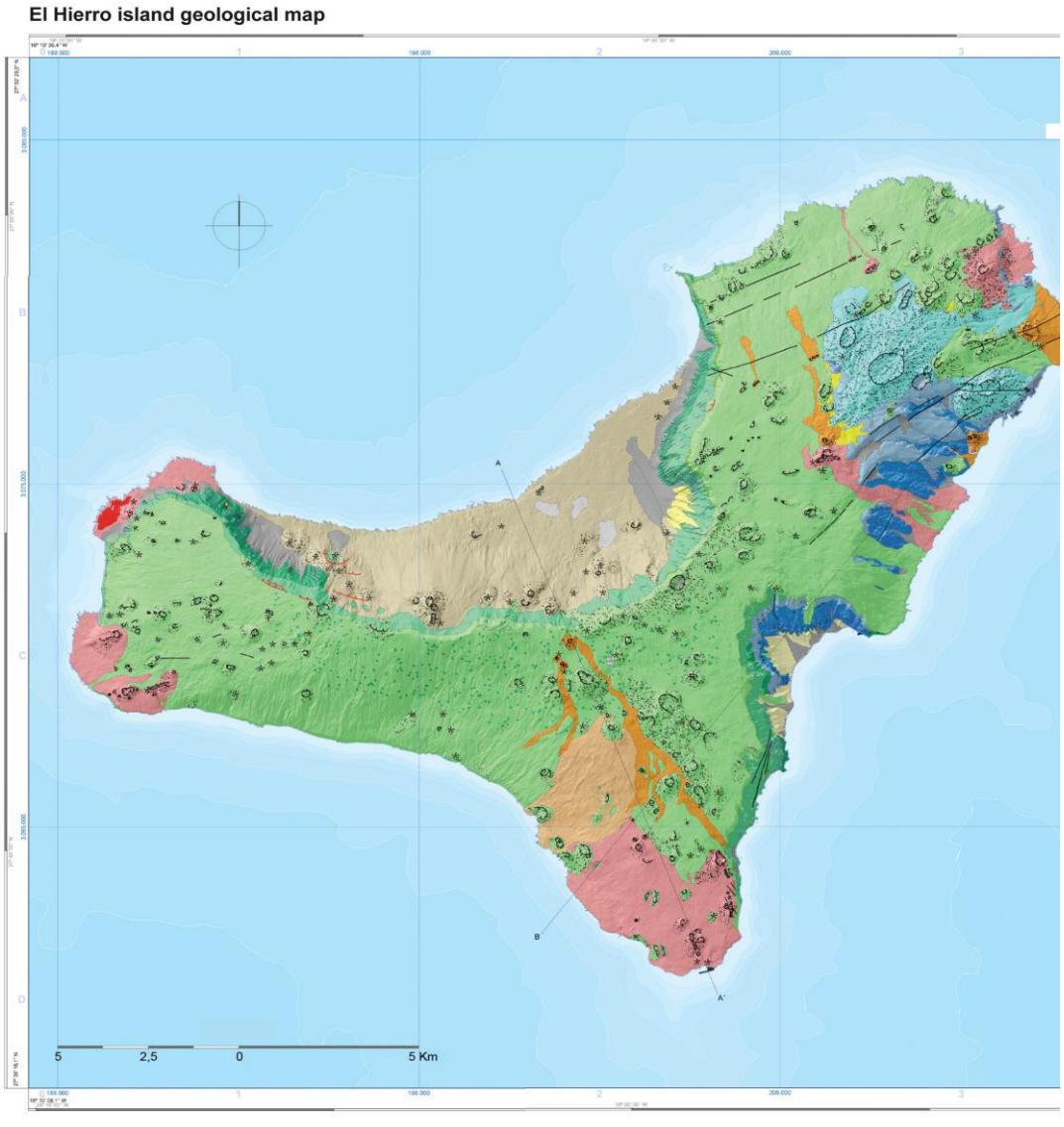
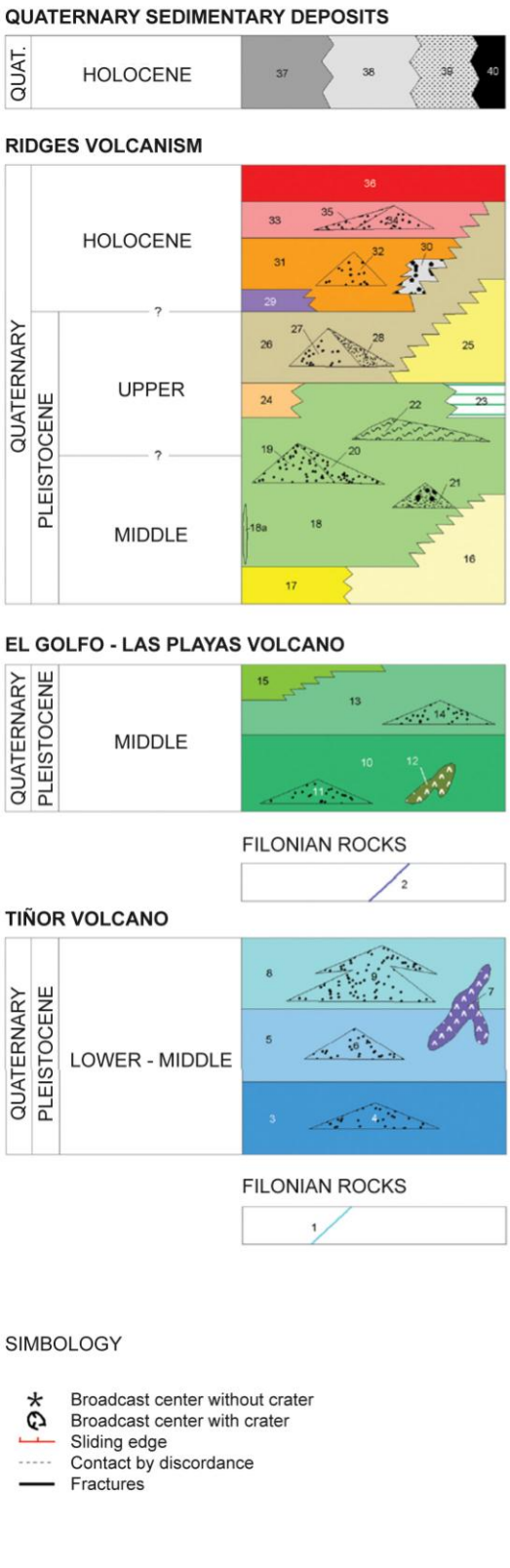


Fig. 6. Geological map of the Island of El Hierro. Source: Barrera-Morate, J.L. & García-Moral, R. (2011). *Geological map of the Canary Islands.* GRAFCAN.



QUATERNARY SEDIMENTARY DEPOSITS
- 40.- Annthropogenic deposits
- 39.- Beach deposits
- 38.- Alluvial deposits and funds from ravine
- 37.- Colluvium and slope deposits

RIDGES VOLCANISM

RIDGES VOLCANISM (s.s.)

POSSIBLE HISTORICAL ERUPTION
- 36.- Basaltic flows (s.l.)

RECENT EMISSIONS
- 35.- Basaltic dispersion pyroclasts (s.l.), basanitic and foiditic
- 34.- Basaltic tephra cones (s.l.), basanitic y foiditic
- 33.- Basaltic flows (s.l.), basanític y foiditic

SUBRECENT EMISSIONS
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- 29.- Levels of fossil beach

VOLCANISM OF THE FILL OF THE EL GOLFO
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- 27.- Basaltic tephra cones (s.l.), basanitic and tephritic
- 26.- Basaltic flows, basanític and tephritic
- 25.- Detrital sedimentary deposits of the slopes of the El Golfo

RIDGES VOLCANISM (s.l.)
- 24.- Late basaltic flows (s.l.)
- 23.- Trachytic flows
- 22.- Surge type pyroclastic deposits and salic pumice
- 21.- Phreatomagmatic pyroclastic deposits
- 20.- Basaltic dispersion pyroclasts (s.l.), trachybasaltic, basanitic and tephritic
- 19.- Basaltic tephra cones (s.l.), trachybasaltic, basanitic and tephritic
- 18.- Basaltic flows (s.l.), trachybasaltic, basanític and tephritic
- 18a.- Lapilli mantles on flows

MIDDLE PLEISTOCENE SEDIMENTS
- 17.- Sandy-muddy sediments
- 16.- Detritic sedimentary deposits, glacis-cone...

EL GOLFO - LAS PLAYAS VOLCANO

MIDDLE-UPPER SECTION
- 15.- Trachytic flows and mafic trachytes
- 14.- Basaltic tephra cones (s.l.), trachybasaltic, basanitic and tephritic
- 13.- Basaltic flows (s.l.), trachybasaltic, basanític and tephritic

LOWER SECTION
- 12.- Basic intrusive bodies
- 11.- Basaltic tephra cones (s.l.) and hydromagmatic
- 10.- Basaltic flows (s.l.), trachybasaltic and tephritic

FILONIAN ROCKS
- 2.- Basic diques of the El Golfo - Las Playas volcano

TIÑOR VOLCANO

VENTEJÍS-PICOS-MOLES VOLCANIC COMPLEX
- 9.- Basaltic tephra cones (s.l.) with hydromagmatic intercalations
- 8.- Basaltic flows (s.l.) and tephritic

TABULAR SECTION
- 7.- Basic intrusive bodies
- 6.- Basaltic tephra cones (s.l.)
- 5.- Basaltic flows, basanític and tephritic

LOWER SECTION
- 4.- Basaltic tephra cones (s.l.)
- 3.- Basaltic flows, basanític and tephritic

FILONIAN ROCKS
- 1.- Basic diques of the Tiñor volcano

Fig. 7. Legend of the geological map of the island of El Hierro. Source: Barrera-Morate, J.L. & García-Moral, R. (2011). *Geological map of the Canary Islands*. GRAFCAN.

El Golfo - Las Playas edifice (0.54 to 0.18 Ma)

For around 300,000 years it is uncertain whether there was any magmatic activity on the island. Magmatic activity was reactivated during the middle Pleistocene (about 0.5 Ma ago) in an area located to the WSW of the Tiñor edifice. This is the El Golfo - Las Playas edifice, which developed entirely during the normal Brunhes polarity period. The radial dips of the lava flows indicate that the volcanic edifice had its centre near the town of La Frontera, and reached a maximum height of 1500-2000 m.

Two subunits can be identified, based on morphological evidence and from the development of local discontinuities: 1) one basal unit (lower section, Figure 5), composed principally of strombolian and surtseyan pyroclasts (cinder cones and tuff rings) with subordinate lava flows; and 2) an upper unit (middle-upper section) formed principally by lava flows. The lower unit is interrupted by numerous dykes that are grouped together with specific NE, SNE and WNW orientations, coinciding with the current distribution of the volcanoes and indicating that the triple rift system was an important feature of the El Golfo - Las Playas edifice. The highest part of the upper unit is formed by various differentiated lava flows (trachybasalts, trachytes) and block-and-ash deposits. Carracedo et al. (2001) interpret these deposits as the final stage of the activity of El Golfo - Las Playas, prior to the establishment of rift volcanism (eruptions of the dorsals).

Sediments of the middle Pleistocene

The volcanic construction of the El Golfo - Las Playas edifice was followed by an intense erosive period which is recorded in the significant deposits coating the Las Playas arch. These are detritic and glacis-cone sedimentary deposits.

Rift volcanism

The rapid and excessive growth of the El Golfo edifice may be the cause of the collapse of its flank, generating the great escarpment and current depression of El Golfo. This depression had its origins in a giant landslide of over 300 km^3 that destroyed the NW zone of the island, and which is considered the most modern such event in the archipelago (between 134,000 and 15,000 years ago according to Masson, 1996; Urgelés *et al*., 1996 and 1997, and Carracedo *et al*., 1999).

The start of the eruptions of the rifts took place after this. The volcanic activity tends to concentrate along three convergent rifts or structural axes which give the island its ground plan in the shape of a pseudo-triangle, and its pyramid-shaped profile.

Although a multiple rift system was present on the El Golfo - Las Playas volcano, Carracedo et al., (2001) define rift volcanism as the last stage of growth of the island, when the three branches of the rift were active simultaneously. The succession of rift lavas shows local discontinuities, particularly near the old coastlines. As a result of the broad distribution of emission centres, a layer of basic lavas covered a large part of the island. These lavas also filled in the area of the collapse of El Julan (the El Julan landslide) and partially the zone of the El Golfo collapse (El Golfo landslide).

This volcanism covered a large part of the island and persisted almost until the Holocene era, although for cartographic effects, the "Eruptions which fill in the El Golfo depression" can be distinguished from the "Subrecent and Recent eruptions". In general there is a predominance of "aa"-type flows with thicknesses varying from 2 to 9 metres, resulting in accumulations with a thickness of over 150 m.

The El Golfo depression was filled in by means of various basalt flows which swept down to the sea and today form a wide subhorizontal platform. Most of the emission centres of the volcanism of the El Golfo fill-in are located in the zone at the head of the "scar". The most important edifice belonging to this unit is the Tanganasoga volcano.

Old Holocene sediments

Fossil beach levels (in El Golfo, some corresponding to the last glaciation, 12,000 years); colluvium and compacted rifts on the north wall of El Golfo.

Subrecent emissions

These emissions correspond to isolated volcanic edifices which appear within the structural axes of the rift, but which are notable for having a better state of conservation than previous emissions. Three zones of subrecent emissions can be distinguished: the central area of the island, the Nisdafe plateau, and the coastal sector in the NE. In some cases, the flows have been channelled through gorges carved into the surface of flows from the rift, and are characterised by their malpais morphology.

Recent emissions

The latest episodes of volcanism have mainly occurred at the ends of the three structural axes of the rift which feed the volcanism of the island. This fact has contributed to an increase in the island's perimeter, particularly at the southern end, in the area of La Restinga. These edifices are very well conserved and comprise layers of lapilli, slag and blocks, with some bombs. The flows are in a good state of conservation, and it is particularly worth noting the areas of pahoehoe flows where volcanic tubes frequently develop, some of them of considerable size.

Possible historic eruption (1793)

There has been speculation as to the occurrence of a historic eruption of Lomo Negro in the Hoya del Vorodal, 45 m from the coast, which occurred in 1793. Although there is no historic documentation or eyewitness accounts, there are references to strong seismic activity in that area.

Underwater eruption of 2011

On 10 October 2011, an underwater eruption occurred at a depth of 300 m and 1.5 km SW of La Restinga. Among the abundant volcanic material that came to the surface were numerous patches of sulphur compounds and "zoned" pyroclasts rich in silica, known as "restingolites", with a black border (basanites) and whitish cores. The eruption lasted several weeks.

Quaternary sedimentary deposits

Due to the abrupt relief and the youth of this island, there is very little accumulation of sedimentary deposits, apart from the deposits on slopes and on some beaches.

B.2.6 Selected references

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B.3 Listing and description of geological sites within the proposed Geopark

The 35 geological sites are selected from a range of scientific works, principally from the Spanish Geological and Mining Institute (IGME), the research works at the University of La Laguna in Tenerife (ULL), the University of Las Palmas in Gran Canaria (ULPGC) and the El Hierro Island Water Board. Although there is no university in El Hierro, these institutions collaborate assiduously within the framework of the Geopark (through research agreements) with the Government of El Hierro Island (Island Council), which heads the Project.

The criteria for this selection are based on the geological importance and the use (tourism, education, science) of these elements of the island's geodiversity. The map in Figure 8 shows the location of the selected sites of interest.

Geosites (GS) & Geozones (GZ)	Description
GSH-01 San Andrés fault in the Tiñor Gorge (*Falla de San Andrés en el Barranco de Tiñor*)	The San Andrés fault system is recognised to lie along the E flank of El Hierro. Based on field evidence of geochronology, its structure can be said to derive from an aborted collapse which has remained inactive for 250,000 years (Day et al., 1997). The best exposures of all are along a recently-excavated road cut into the north side of the Tiñor Gorge. The wall of this cut is formed by the spectacularly grooved fault plane itself; the footwall and hanging-wall rocks adjacent to the fault plane are exposed in an adjacent section of the road and in the gorge. This outcrop is described in detail in Day et al. (1997), in which the microscopic petrographic characteristics of the fault rocks are also described. In this locality, both footwall and hanging-wall rocks are mainly basaltic lavas of the Tiñor series, with a few thin intercalated lapilli beds and soil horizons. Lava flows, red soil and lapilli beds, and even individual flow lobes can be traced to within a metre of the fault surface on both sides. The footwall rocks appear undeformed outside the fault zone.
GSH-02 Isora viewing point (*Mirador de Isora*)	Overview of the Las Playas Gorge from the Isora viewing point. The Las Playas gorge is a large topographic embayment with a roughly triangular plan, open to the sea to the southeast and bounded by cliffs up to 900 m high on the other sides. Its proportions in plan are different from those of other known collapse embayments in the Canaries, which are typically longer (along the coast) than they are wide (perpendicular to the coast and to the rift zones at their heads), or else of subequal proportions, and have a discrete headwall: they thus have a quadrilateral rather than triangular shape in plan. Detailed mapping indicates, furthermore, that the Las Playas gorge lies along the line of a strike-slip fault system, trending NW - SE, which bounds the southern end of the San Andrés fault system.
GSH-03 La Peña viewing point (*Mirador de la Peña*)	La Peña viewing point overlooks the El Golfo embayment from its northern end. The cliffs at this point are around 700 m high and rise to over 1 km to the south. The far side of the embayment at Punta Arenas Blancas is about 15 km away, and the most south-easterly parts of the embayment cliff behind La Frontera and Tigaday are 10 km behind the mouth of the embayment at sea level. The cliff-forming sequence consists of young, rift-series lavas at the top –the remaining half of a scoria cone of this series is at the very rim of the cliff to the north of the viewing point– overlying rocks of the El Golfo volcanic edifice. The top of the El Golfo edifice is marked in the cliffs to the south by thick pale trachyte lava flows, 150 - 200 m below the top of the cliffs. The rift-series lavas are generally conformable to these, but a significant erosional unconformity occurs in places.
GSH-04 Path of the La Peña Shrine (*Sendero de la Ermita de la Peña*)	This path provides an almost continuous section through this part of the El Golfo embayment cliff, and for this reason it has been used extensively in palaeomagnetic and geochronological studies of the El Golfo edifice (Guillou et al. 1996; Szeremeta et al. 1997).The uppermost, rift-series lavas form the sequence down to 620 m a.s.l. (Dated sample at base of rift series, 650 m a.s.l., 158 ± 4 ka) and are generally phenocryst-poor alkali basalts, although with some olivine- and clinopyroxene- phyric flows. The relatively primitive composition of these rocks is consistent with the distributed nature of the rift-series volcanism and the implied lack of a shallow magma chamber.
GSH-05 Tigaday	Overview of the structure of the El Golfo volcano. The loop road on the north side of Tigaday provides convenient viewpoints from which to examine the stratigraphy and structure of the rocks exposed in the El Golfo embayment. The towns of Tigaday and La Frontera lie close to the inferred centre of the El Golfo volcano and the intersection of the associated volcanic rift zones, whereas the modem volcanic rift zones intersect on the rim of the embayment to the south. The main elements of the embayment-filling sequence that are visible from this

	viewpoint are:(1) The young volcanic sequence; (2) Screes and alluvial fans at the foot of the embayment cliffs, and (3) Pre-El Golfo collapse sequences.
GSH-06 **Fuga de Gorreta cliff**	The Fuga de Gorreta cliff is about 1 km high and is largely formed by upper El Golfo series lavas (with a few scoria cones, indicating that some flank eruptions did occur on the upper El Golfo central vent volcano): only the lowest 300 metres or so of the cliff is composed of lower El Golfo series rocks (mainly scoriaceous pyroclastics, cut by numerous dykes). The contact between the two is here flat-lying and without a marked erosional break, in contrast to the contact in the Ermita de la Peña section. A very fresh, wedge-shaped rockfall scar, some 600 m high and 200 m wide at the top, cuts the cliff at the western end of Fuga de Gorreta. The vertically-elongated wedge-shaped geometry may have in part been controlled by the dykes in the cliff. This rockfall occurred in 1910 and the talus cone which formed buried a small village at the foot of the cliff.
GSH-07 **Punta Grande**	Punta Grande marks the northernmost end of the embayment-filling lava sequence as presently preserved. To the north, the El Golfo cliff is still being eroded by the sea and exposures of the pre-collapse sequences of rocks are particularly good. Coastal bathymetric data suggest that the cliff in this area has retreated 0.5 km to 1 km, leaving a shallow abrasion platform, in the recent past.
GSH-08 **Sabinosa window**	This outcrop shows the transition from steep coastal terrain and cliffs cut into young lavas. Most of the cliff is composed of lower El Golfo series rocks. Most of the southern wall of the El Golfo embayment is draped with young, rift-series lava flows and volcanic vents, one of which (Tanganasoga) is very large. West of the village of Sabinosa, a steep-walled small embayment, possibly representing the scar left by a recent moderate-sized (2 - 4 km^3) slope failure, exposes rocks of the El Golfo-Las Playas edifice.
GSH-09 **Tuff ring**	This outcrop is one half of the exposure of a large surtseyan tuff-ring, which is also exposed in the cliff (to the SW, consistent with the north-easterly dip of the beds in the tuff outcrop). Cauliform bombs occur within the tuff and it moves up into a drape of strombolian scoria over the top of the ring. Subaerial ol, px - phyric lavas of the upper El Golfo series cover the tuff ring.
GSH-10 **Tajanara viewing point** **(*Mirador de Tajanara*)**	This viewing point provides a view over the scoria cones of the SSE-trending (axis bearing 165º) rift zone of El Hierro. This rift zone has numerous scoria cones and lava flows of recent appearance (especially at its admittedly arid southern end), which form extensive coastal lava platforms.
GSH-11 **Tacoron Cove** **(*Cala de Tacoron*)**	The El Julan embayment dominates the topography of the south-western side of El Hierro. Bathymetric data also indicate that it extends well offshore. It was first identified as a lateral collapse structure on the basis of seafloor imaging sonar data (Holcomb and Searle, 1991). At either end of the embayment there are relatively young lavas which pass laterally into platform-forming lavas, but there are cliffs over 100 m high in the centre without any evidence of a coastal lava platform at all.
GSH-12 **Alluvial fan of Tibitaje-Guinea**	This highly active alluvial fan is located in the NE of the island. With an area of 0.241 km^2 and a difference in height of 357 m, this is a composite, polycyclical fan constituted of several segments. The receiving basin is constrained by the escarpment, with a vertical wall formed by alternating lava and pyroclastic materials with a pronounced intrusion of dykes. The fan has been generated by dynamic slope processes induced by gravity, and particularly by slope processes of the *debris flow* type associated to the development of torrential rains. The apex appears fragmented due to the erosive action of a torrential event in 2007.
GSH-13 **Fossil beach of La Caleta in Valverde**	"Raised beaches" are common on the island of El Hierro; the coasts of Los Cangrejos and La Caleta in Valverde are classic examples, featuring beaches of over 3 m, with pebbles, fossilipherous sand and larger shells. On the northern coasts of El Golfo there are fossil beaches raised some 10 to 12 metres above the current sea level. Assuming an annual elevation of 1 mm, their age can be calculated at around 12,000 years, the date of the last glaciation. Rounded blocks of plutonic rocks have been found on these beaches, brought in the icebergs by the Cold Canary Current. Moraines brought by blocks of ice have also been found on the island of Madeira.

GSH-14 Don Justo Cave	Volcanic tube 6 km in length located in the far south of the island between the Hiramas mountain and the fishing village of La Restinga, near the Los Muertos mountain, about 100 m from the road which links the towns of El Pinar and La Restinga. The volcanic tubes are known locally as "juaclos".
GSH-15 Lava tree moulds (Chamuscada Mountain)	Recent eruptions like Chamuscada mountain (c. 2,000 years) have a lava field with several tree moulds.
GSH-16 Feeder dyke at La Restinga (*Dique de alimentación*)	The feeder dyke is near the maritime dyke of La Restinga, and has a thickness of 32-34 cm, and no deformation. It has a basalt composition and stands on an inserted rock formed by spatter-type soldered pyroclasts. The dyke has a deep red, non-vitreous cooling film with a thickness of 2-3 cm.
GSH-17 Tanganasoga Volcano	Volcanic edifice (rift volcanism) with various superimposed craters located on a structural plane (possible volcanic explosion caldera). The whole tephra deposit is composed of slag, bombs, and basalt, basanite, tephrite, olvine basalt and olivine-pyroxenic basalt cinders. The Tanganasoga volcano is located in the centre of the El Golfo escarpment. Its materials include deposits with fragments of pumice, basalt blocks from the Older Series and fragments of gabbro and pyroxenites. Another deposit has a thickness of about 10 cm and is white, contains cinders and has a trachytic composition, and is the only one of its kind found on the island.
GSH-18 Las Arenas Blancas Beach	The small beach of Las Arenas Blancas is in the western part of the El Golfo embayment, at what is known as the Punta de La Dehesa point, in the town of La Frontera. This is the only fine white sandy beach on the island, although it also has gravel and pebbles. However, it is the colour of the sand deposited between the rocks by the strong waves that gives it is name. This white sand is the product of decomposed and ground seashells and the remains of molluscs, crustaceans and other organisms which sparkle attractively in the sunlight. The colour of this light makes it stand out against the predominantly black volcanic background in the surrounding area.
GSH-19 Mouth of Taguasinte Gorge: Pozo Las Calcosas	The lavas which reached the coast entered the sea, and as they lost speed along their route, formed an area with a corded morphology where they met the sea, giving rise to a small coastal platform. The cliff of this bay has various fine examples of columnar basalt disjunctions. Coastal zones with cliffs, such as the Pozo de las Calcosas, have a propensity to collapse in blocks. The vertical nature of the walls, the alternation of materials with differing resistance to erosion and the existence of diaclasses due to the cooling of the lava flows are three of the main factors which condition rockfalls in this area.
GSH-20 Giant landslides: Las Playas viewing point (*Mirador de Las Playas*)	The valley of Las Playas is a large semicircular escarpment which is the head of a giant landslide. It has a diameter of approximately 6 km and a height of about 1075 m. The first landslide that occurred in this area, known as Las Playas 1, is the oldest landslide on the island of El Hierro, and took place between 545-176 thousand years (ka). It has been estimated that the material in the landslide occupies an area of 1700 km^2. The second landslide which formed the valley of Las Playas, “Las Playas 2”, took place between 176 and 145 ka and has been estimated to have involved a volume of displaced material of nearly 50 km^3 and an area of 950 km^2.
GSH-21 Feeder dyke of the Verodal edifice	Feeder dyke with a high to near vertical angle of orientation, this is the vent of the Lomo Negro volcanic cone.
GSH-22 Los Barcos Cave	One of the most recent rockfalls, and the one which has had the greatest repercussion on the island, took place at the beginning of October 2010 in El Tamaduste. The Los Barcos cave is an emblematic site in this town, and has traditionally been used for mooring fishing boats. Rockfalls are frequent in this area. The most recent of these, although it caused no human casualties, destroyed a large part of the seafront promenade built only one year earlier.
GSH-23 Los Picos fault	Located in the area near the port of La Estaca, the Los Picos fault is one of the numerous examples that can be seen on El Hierro. This fault is represented by a subvertical fracture plane which causes some materials to slide in relation to

	others. No movements are currently recorded in these faults, and they are thus considered inactive.
GSH-24 La Vieja Gorge	On 26, 27 and 28 January 2007, a violent storm struck the island of El Hierro with episodes of intense rains which affected the whole of the island, and with particular virulence, the district of El Pinar. The rainfall recorded in this area, as much as 500 l/m2 in barely a day, far exceeded any type of precautionary measures and produced multiple overflows of the streambeds in the gorges, which swept away houses and vehicles and caused major damage to various infrastructures.
GSH-25 Fuga de La Peña-Tibataje cliff	The El Golfo escarpment comprises a succession of lava flows and subaerial episodes from the great stratovolcano which constituted the volcanic edifice of the same name, once the largest shield volcano in the evolution of El Hierro, with a diameter of 20 km at its base and a height of over 2000 m. This landslide represents the most recent and best-defined of all this type of events which have occurred in the Canary Islands, and the resulting scar can be seen both at its head (maximum height: Pico Malpaso, 1501 m) and in the abyssal slope of the island (3.00-3200 m below sea level). There are frequent slope movements on all of its sides.
GSH- 26 Los Padrones well	Carved out of a major post-collapse fill-in flow which forms the coastal platform of El Golfo, with a depth of around 54 m and gallery of over 1100 m, it represents the best capture of underground water on the island's territory.
GSH- 27 Drill cores Storehouse (*Litoteca insular*)	It has over 8.5 km of drill cores taken from all over the island's geography, with particular emphasis on the area of El Golfo. It is precisely there, specifically in the Pozo de Fátima in Los Mocanes-La Frontera, where over 80% of these samples are currently stored. A large part of this material has been tested and studied on several occasions, although it would be worthwhile employing new approaches to improve the existing knowledge so far.
GSH- 28 La Salud Well	The Sabinosa well has been in existence for over 300 years, and was initially considered unusable as the water was the most brackish of all the waters to be found on the island. However its therapeutic properties and benefits soon became known, to the point that they were recognised as being mineral and medicinal waters in 1898, declared as waters for public use in 1949, and were subsequently used for treatment in the spa which was created for this purpose.
GZH-01 Young lava flows	Coastal lava platform. These lavas have been attributed by Hernandez Pacheco (1982) to a supposed eruption in 1793. However, examination of the original eye-witness account (Montañez, 1793) shows that it contains clear references to a swarm of earthquakes but none at all to the likely manifestations (tire fountains, lava flows, explosions and steam clouds from where the lava entered the sea) of the eruption which produced these lavas, which would have been clearly visible to the inhabitants of the island.
GZH-02 Bifurcation of the Western Rift Zone	This bifurcation is likely to be related to near-surface stresses set up by the local topography. In this case the dominant features of the topography are the steep west-facing underwater slope and coastal cliffs in the west of the island, together with the back-to-back collapse structures of El Julan and El Golfo: the presence of the latter two features so close together is unusual and may account for the unusual stresses implied by the bifurcated rift zone.
GZH-03 El Lajial	Accumulation of highly fluid basalt flows of pahoehoe lavas visible from the road from Tigaday to Sabinosa, at the top of the place known as La Tabla. They present surface areas twisted in coils, small volcanic tubes, digitised lobes, etc. The most usual compositions are basalts, basanites, tephrites, olivine basalts and olivine-pyroxenic basalts. Part of the Lajial Liso, near La Restinga, is covered by a thin layer of lapilli (jable).
GZH-04 Nisdafe Plateau	The most recent volcanism on the island is distributed primarily along three structural axes with a characteristic Y-shape. The Nisdafe plateau corresponds to one part of the NE axis and is dotted with volcanoes. One of the most characteristic features of this unit is the presence of cones aligned in a NE-SW direction. Almost all the plateau is located at a height of between 900 and 1200 m, with only the volcanoes exceeding this height.
GZH-05 Ventejis Maar	The largest known maar in our island, its range is about 2000 m (6000 ft) in diameter and a depth up to 300 m (984 ft). Its large size is due to the explosive

	reaction that occurs when magma comes into contact with water (seawater or underground water). It is difficult to find any similar examples of the maar in the Canary Islands. This phreatomagmatic caldera (maar) is located within the protected landscape of Ventejis.
GZH-06 **El Julan**	This gently arching amphitheatre is located in the SW of the island. Its formation was initially believed to have derived from a rocky avalanche (Holcomb and Searle, 1991), although it is actually an aborted rockslide, in which most of the volume of the material affected has not undergone the desegregation characteristic of this type of processes. The hypothesis of a series of limited slides with a rotational-translational character in the area of the head would have facilitated the total burial of this head, still in the early stages of its development, by younger volcanic materials. The instability of El Julan affects an area of 1800 km^2, with an estimated value of re-mobilised material of 130 km^3. This event is thought to have occurred more than 160 ka ago (Masson et al., 2002).
GZH-07 **El Faro-Orchilla detritic fans on lava flows**	They are fed by the largest basin in the NW of the island, La Dehesa, and have differences in level of over 900 m converging in a practically straight section which outflows onto the platform of Los Negros (Orchilla lighthouse). This gives rise to a branched arrangement of the transported material which is well-separated into hierarchies, and whose growth is curbed by recent lava flows (the historic eruption in 1793 of the Lomo Negro volcano). The predominant regime is debris-flow generated by torrential processes.

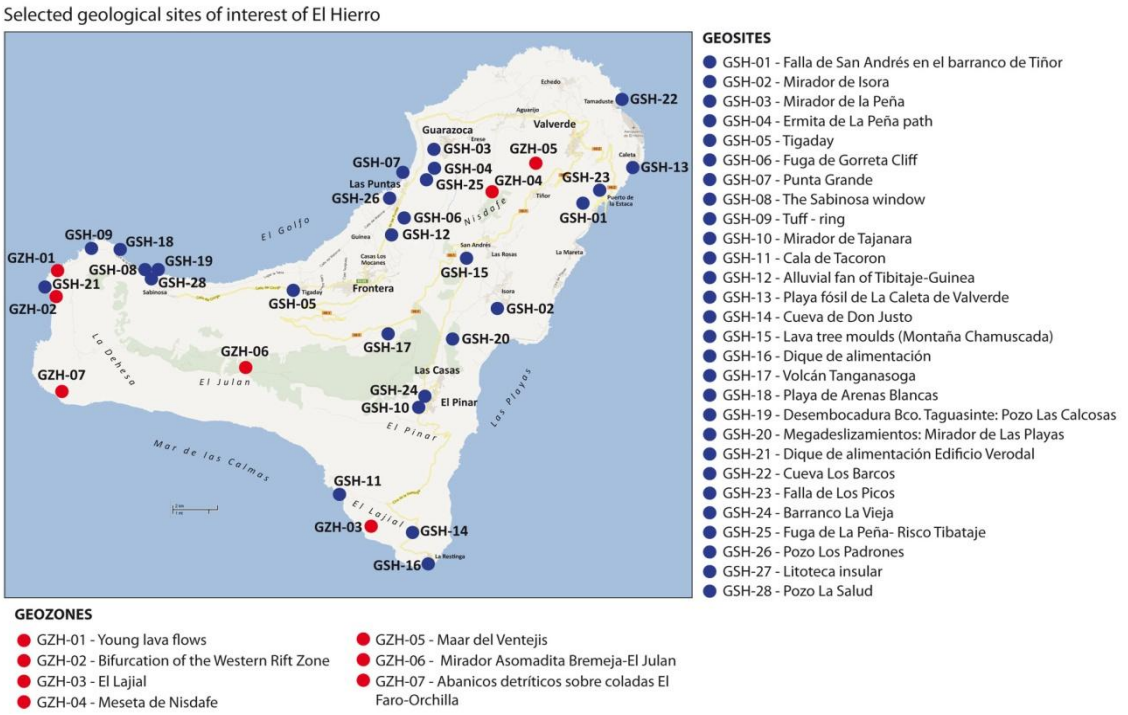

Fig. 8. Map showing the location of sites of geological interest.

Volcanic cavities on the island of El Hierro

In the *Catalogue of Volcanic Cavities on the Canary Islands*, a study directed by Dr. Pedro Oromí, the volcanic caves on El Hierro (excluding those made by erosion) with internal dimensions of over 50 metres in length in the case of tubes, and 10 metres in depth for pits, is 35 in number. Some of these, such as the El Lajial cave, are located in wild areas which are infrequently visited, suggesting that there may be others remaining to be discovered. Of these 35 cavities known so far, seven are volcanic pits (produced by the vertical emptying of the eruptive chimneys), one (the Las Palomas pit) is a mixed pit-tube cavity, and 27 can be considered tubes in the strictest sense.

B.4 Details on the interest of these sites in terms of their international, national, regional or local value (scientific, educational, scenic,...)

Geosites (GS) & Geozones (GZ)	Details of interest (value)	Main use
GSH-01 San Andrés fault in the Tiñor Gorge	**International value** This is a unique structure in the Canary Islands Archipelago –and possibly in the world–, with a strong potential for providing key information on the structure and mechanics of the early stages of a process which, under other circumstances, leads to giant collapses.	Scientific Educational
GSH-02 Isora viewing point	**International value** The San Andrés fault system can be inferred to have an asymmetric geometry, with the main rift parallel to normal faults bounded by an arched set of splay faults with oblique slip at the down-rift end and by a discrete set of strike-slip faults at the up-rift end, closest to the intersection of the three volcanic rifts of El Hierro. This has some similarities in geometry (although not in kinematics) to the south rift of Kilauea: the main normal fault is analogous to the Hilina faults, and the strike-slip faults to those near Kilauea which link the south and east rifts of that volcano (Swanson et al. 1976; Denlinger and Okubo 1995).	Scientific Educational Scenic Tourism
GSH-03 La Peña viewing point	**Regional and local value** This observation point offers a view of the series of outcrops which characterise the different phases of construction of the El Golfo- Las Playas edifice.	Scientific Scenic Tourism
GSH-04 Path of the La Peña Shrine	**Regional and local value** The study of the stratigraphy and geography of this whole section is an opportunity to interpret the evolution of the magmatic composition of the El Golfo edifice, and to date the tectonic structures which are a key to understanding the geological history of the island.	Scientific Educational
GSH-05 Tigaday	**Regional and local value** Taken in isolation the radiometric ages of the screes indicate merely that the embayment is older than 21 ± 5 ka. However, in many of the boreholes drilled during the course of water exploration on the floor of the embayment, a broad, horizontal marine abrasion platform, up to 2 km wide, was found beneath the young lava sequence The formation of this abrasion platform indicates a long period of post-collapse erosion whose duration can possibly be evaluated by consideration of Quaternary sea level variations.	Scientific Educational Scenic Tourism
GSH-06 Fuga de Gorreta cliff	**Regional and local value** This outcrop gives information about the reactivation of rift volcanism: the disappearance of the central vent complex and reactivation of the triple-rift system may have been a precursor to the El Golfo lateral collapse. Fuga de Gorreta provides the best surface exposures of evidence for the marine abrasion platform, with multiple generations of screes and coastal cliff development in the El Golfo embayment.	Scientific Educational
GSH-07 Punta Grande	**Regional and local value** The very rapid lateral variations in the cliff-forming sequence and the steep northward dips of many units suggest that this outcrop lies close to the pre-collapse palaeo-coastline, and that no large (more than a few hundred metres wide) abrasion platform has developed due to the retreat of the coastline since the El Golfo collapse.	Scientific Educational Tourism Scenic
GSH-08 Sabinosa window	**Regional and local value** El Golfo Series rocks contain many west to WNW-trending dykes, representing the western rift zone of the El Golfo-Las Playas volcano, but the upper El Golfo lavas dip north, implying eruption from vents to	Scientific Educational Scenic

	the south. This may suggest a northward migration of the rift zone with time.	
GSH-09 Tuff ring	**Regional and local value** The presence of this tuff ring at (more or less) the present sea level provides important evidence for the stability of El Hierro, at least during the past 250,000 years.	Scientific Educational
GSH-10 Tajanara viewing point	**Local value** Overview of the recent scoria cones and lava flows of the SSE-trending rift zone of the island.	Scientific Educational Tourism Scenic
GSH-11 Tacoron Cove	**Local value** Information on the El Julan embayment regarding the possibility that cessation of the eruption of lava flows to the south of this section of the western rift is related to the El Golfo collapse.	Scientific Educational Tourism Scenic
GSH-12 Alluvial fan of Tibitaje-Guinea	**Local value** Well-conserved example representing the inventory of geological hazards on the island (Agreement between the Spanish Geological Service, IGME, and the El Hierro Island Water Board, CIEH). Cartographic monitoring since 1998 to the present day.	Scientific Educational
GSH-13 La Caleta fossil beach in Valverde	**Local value** Classic example of a fossil beach. These elements provide information from which the climate changes of the past can be deduced (glaciations).	Scientific Educational
GSH-14 Don Justo cave	**Local value** Volcanic tube in a good state of conservation. Limited access (guided visits only).	Scientific Educational Tourism
GSH-15 Lava tree moulds (*Montaña Chamuscada*)	**Local value** These conserved moulds provide useful information on the evolution of the island's vegetation. They serve to explain the fossilisation process within the framework of volcanism.	Scientific Educational
GSH-16 Feeder dyke at La Restinga	**Local value** Example of a dyke in a good state of conservation and with easy access which has been studied in detail (Database for the Analysis of Volcanic Hazard in El Hierro, 2012).	Scientific Educational
GSH-17 Tanganasoga volcano	**Regional and local value** This can be considered the island's most significant explosive episode.	Scientific
GSH-18 Las Arenas Blancas beach	**Local value** Beach with only minor alterations caused by anthropic factors which, unlike the rest of the beaches on the island, is formed primarily from the remains of marine vertebrate skeletons.	Educational Tourism
GSH-19 Mouth of Taguasinte gorge: Pozo Las Calcosas	**Local value** Coastal platform formed by lava which reclaimed land from the sea. Columnar basalt disjunctions. Rockfalls and other slope processes.	Educational Tourism Scenic
GSH-20 Mega-rockslides: Las Playas viewing point	**Regional and local value** At least four large-scale landslides have taken place in El Hierro. The first landslide that took place in this area, known as Las Playas 1, is the oldest landslide on the island of El Hierro.	Scientific Educational Tourism Scenic
GSH-21 Feeder dyke (Verodal edifice)	**Local value** One of the best-conserved feeder dykes on the island.	Scientific Educational
GSH-22 Los Barcos Cave	**Local value** One of the recent (2010) rockfalls which had major repercussions on the island, as it affected an area dedicated to mooring fishing boats.	Educational
GSH-23	**Local value**	Educational

Los Picos fault	Although this fault is currently inactive, it provides the opportunity to see clearly the parts of a normal fault.	Scientific
GSH-24 La Vieja gorge	**Local value** Example of the effects of recent floods (2007) caused by exceptional torrential rains.	Educational Scientific
GSH-25 Fuga de La Peña- Tibataje cliff	**Local value** Deposits from the slope processes can be seen on the El Golfo outflow. These have been frequent in the past and continue to occur.	Scientific
GSH- 26 Los Padrones well	**Local value** This is the most important gallery for the capture of fresh water on the island. It offers exceptional access to the flows and pyroclastic waves of the El Golfo edifice. Its most significant aspect is that along its short itinerary there are over 90 generally aphanitic basalt dykes.	Scientific
GSH- 27 Island mineral collection	**Regional and local value** This space contains over 8.5 km of drill core samples taken from all over the island's geography, particularly in the area of El Golfo.	Scientific Educational
GSH- 28 La Salud well	**Local value** Well with mineral and medicinal waters used for skin ailments which was an attraction for health tourism as far back as the late 19th century (mentioned in the British guidebook by S. Brown, 1889). This site has been refurbished and transformed into a modern spa.	Tourism Educational
GZH-01 Young lava flows	**Local value** This outcrop gives crucial information about the problem of the supposed 1793 eruption. Easy access and new viewpoints (2011).	Scientific Scenic Tourism
GZH-02 Bifurcation of the Western Rift Zone	**Local value** This clear bifurcation of the young volcanic rift zone is an unusual feature which is very important to an understanding of the structure of the island.	Scientific
GZH-03 El Lajial	**Regional and local value** Strategic space for providing information about geological processes relating to volcanism. A wide range of volcanic elements, very well conserved and easily accessible, corresponding to the latest non-historic eruptions on the island.	Scientific Educational Tourism Scenic
GZH-04 Nisdafe Plateau	**Local value** This is a key geomorphological unit on the island, and is characterised by the presence of cones aligned from NE-SW.	Educational Tourism Scenic
GZH-05 Ventejis Maar	**Local value** This is the largest crater of its type conserved on the island.	Scientific
GZH-06 El Julan	**Regional and local value** The outcrops in the natural amphitheatre of El Julan suggest that it originated in an aborted rockslide.	Scientific Educational Tourism Scenic
GZH-07 El Faro-Orchilla detritic fans on lava flows	**Local value** Fans with good outcrops which allow detailed observation of the different types of alluvial deposits.	Scientific Educational Tourism Scenic

PART C GEOCONSERVATION

C.1 Current or potential pressure on the proposed Geopark

The whole island has been a Biosphere Reserve since 2000, and more than 60% of the territory is also protected by six specific protection regimes (see section C.2). Each protected nature area has a Management Plan designed to prevent and remedy the impacts (current and potential) on the natural environment, the landscape and on cultural resources. The factors representing a current or potential pressure on the island and which have been the subject of study have been extracted from these documents and are summarised below.

C.1.1 Current and potential impacts

Scope	Current impacts	Potential impacts
Geological environment	The island has substantial differences in level, and thus a propensity to slope processes that may erode the outcrops of interest, for example, alluvial fans. The extraction of aggregate has eroded and damaged the cones nearest the areas close to activities or population centres, and has affected particularly the western mountains (La Torre, Tomillar, La Fara, Tagasaste) and the area of Los Lomos and Ventejís.	Actions derived from farming activities (alteration of the land). Increase in number of visitors and users.
Soil environment	Erosion of the terrain due to the reduction of plant cover (e.g. Los Lomos). Impact on the soil horizons deriving from farming activities. Extraction of aggregates (e.g. La Fara mountain).	Fires. Torrential rains. New farming areas (e.g. Sabinosa). Extraction of litterfall.
Biological environment	Alterations in the biota deriving from cattle grazing and forestry production. Extraction of plant species (e.g. Mocán timber). Planting of non-native species after fires (e.g. *Pennisetum setaceum*). Impact on bird nesting areas due to changes in land use.	Actions deriving from farming activities (alteration in the land). Increase in number of visitors and users. Introduction of exotic species. Game poaching activities.
Landscape	Natural or man-made erosion processes. Changes in the type of construction. Mobile telephony masts and power lines (e.g. Pico Ventejís). Increase in vehicle traffic on forest trails.	Growth of population centres. New communications infrastructures. Increase in number of visitors and users.
Natural resources	Abandonment, and failure to maintain obsolete resources (walls, water cisterns, etc.). Increase in visitors to archaeological areas (e.g. area around El Garoé, Los Frailes spring, etc.).	New transport infrastructures.

C.1.2 Natural hazards

Flood hazards

The exceptional torrential precipitations are associated with the development of adverse weather events (very infrequent) known as "SW storms", which take place in the winter months. In the area of El Pinar de El Hierro, in the SSW of the island, the gorges may exceptionally break their banks (Geosite GSH-24).

Volcano hazard

The last eruption in El Hierro took place in October 2011. The eruption was underwater and was controlled by an eruptive corridor running N-S which crossed from the coastal zone of El Golfo to the Las Calmas sea. The whole of this area, and a parallel area towards the east, are zones of maximum volcanic hazard on the island.

Seismic hazard

Unlike volcanic eruptions, seismic movements cannot be either predicted or detected with any advance notice (early warning). According to the data from the National Geographic Institute's seismic network, two types of earthquakes can occur on El Hierro: either with volcanic or tectonic origins. The former are statistically more common, and occur at various points in the interior of the island and in the surrounding marine zone.

Risk of rockfalls

Throughout the geological history of El Hierro there have been giant gravitational collapses associated to the instability of the large volcanic edifices. The most representative landslides are those of El Golfo, El Julan and Las Playas (Geosite GSH-20). These processes have

modelled part of the island's landscape, which is distinctive in that it has the steepest gradients in the archipelago.

There are two zones which are particularly sensitive to rockfalls: the zones of Las Playas and El Golfo. In the first case, the verticality of the wall is very pronounced and there are numerous unstable blocks which can fall at any time, particularly with the aid of rains and earthquakes such as those of the 2011-2012 seismic-volcanic crisis. In the case of El Golfo, the hazardous area is in the far north, in the area of the Fuga de Gorreta cliff (Geosite GSH-06), the tunnel of Los Roquillos, and partly in the arch of La Sabinosa.

Certain sections of road are also hazardous due to landslides, including the road which links Sabinosa with La Salud well, and the road which circumvents the Juajiva mountain in the area of La Candelaria.

Risk of collapse

The collapse of land is associated to volcanic tubes of pahoehoe-type fluid flows from recent ages (less than 100,000 years). In El Hierro, many of these flows are near La Restinga, in the S of the island (Geozone GZH-03).

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

The evolution of the legislation, both at the national level and in the legislation of the Canary Islands Autonomous Region, represents an improvement with regard to the mandatory studies on geodiversity and advances in the classification and conservation of geological resources.

Spanish Law 42/2007 on Natural Heritage and Biodiversity explicitly includes new developments in the protection of geological heritage and geodiversity:

• It establishes the functions of the public authorities by specifying the objectives and measures necessary for the conservation and valuation of natural heritage and geodiversity.
• The Ordination Plans for the natural resources must include, at a minimum, the description and interpretation of local physical, geological and biological characteristics.
The island of El Hierro, which is a Biosphere Reserve (UNESCO, 2000), is a forerunner in the application of this legislation, and 60% of its area is also included in a series of protection regimes: seven Sites of Community Interest (SCI); two Special Protection Areas for Birds (SPA); three Nature Reserves, and one Natural Monument. Some of these designations have been awarded for reasons of their geological value.

The island has the following main legislative tools for the conservation of the natural environment: the El Hierro Island Ordination Plan, municipal regulations, and Law 19/2003 whereby the guidelines for general ordination and tourism are approved.

In addition to the strategies for protection of the geological environment specified in the new **Management Plan (2012) for the Biosphere Reserve**, below is a list of the geodiversity elements preserved in the protected nature areas which affect the most populated municipalities, as specified in the corresponding management plans.

Protected nature area	Protection of geodiversity
El Hierro Island Biosphere Reserve	Millennium Ecosystems Assessment: services of soil fixation and formation. Actions in the area of Los Lomos due to the confluence of soil, topographic and anthropic factors causing an accelerated process of water erosion. Action in areas affected by the extraction of earth for Sorribas (El Jorado and La Albarrada). Restriction on motor vehicles outside the road network in the most vulnerable areas, and particularly the practice of motorised tourism.
Tibataje Special Nature Reserve (601.6 Ha) Municipalities: La Frontera and	Prevention of processes of marine erosion in the marine rock area.

Valverde	
Mencafete Integral Nature Reserve (463.9 Ha) Municipality: La Frontera	Protection of the land in the aquifer refilling area. Protection of the only natural spring on the island. Prevention of erosion processes on the slopes of El Golfo by limiting access by motor vehicles.
Roques de Salmor Integral Nature Reserve (3.5 Ha) Municipality: La Frontera and Valverde	Prevention of coastal erosion processes (marine rocks).
La Frontera Rural Park (12,488 Ha) Municipalities: La Frontera and Valverde	Protection of significant geomorphological structures (El Lajial, El Verodal). Protection of the land in the aquifer refilling area. Protection of paleontological sites (Arenas Blancas, Juaclo de la Molera).
Las Playas Natural Monument (984.8 Ha) Municipalities: La Frontera and Valverde	Prevention of Ecological Impact (Law 11/1990). Prevention of slope erosion processes in the geomorphological escarpment unit of Las Playas.
Ventejís Protected Landscape (1143.2 Ha) Municipality: Valverde	Protection of the scenic values of isolated volcanic cones. Protection of the land in the aquifer refilling area (Ventejís caldera).
Protected Landscape of Timijiraque (383.4 Ha) Municipality: Valverde	Prevention of erosion in gorges with a surface presence of the oldest materials on the island (Tiñor edifice).

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

C.3.1 Management of areas of geological interest

Direct management of areas of geological interest is carried out by the agents of: (1) SEPRONA (Service Nature Protection), (2) Environment Service (Forestry Agents), and (3) The Inspector of Historical Heritage. The management of geological areas focuses on the following points:

a) Visitor attention

The Valverde Tourist Office (site of the Geopark Project) provides information on the areas of geological interest (typology, accessibility, guided visits, etc.) and coordinates the information supplied by the visitor centres associated to the Project.

b) Material for visits without guides

There are different materials available on geodiversity. For example:

Official website of the Island of El Hierro: http://www.elhierro.travel/elhierro/index.php (Languages: Spanish, English, German, French and Italian). The new website specifically for the Geopark Project will be available at the end of 2012 (http://www.proyectogeoparqueelhierro.com).

Mobile phone application "El Hierro is following you" (http://www.elhierrotesigue.com/)

Mobile phone application developed by the Tourism Department of the Island Council of El Hierro. It is currently operative in Spanish and will soon be available in several languages. This application will allow access to content, including geological information, on points of natural and cultural interest such as: Lomo Negro viewing point, La Hoya de Fireba viewing point, El Julan viewing point, etc.

The scanner incorporated into the application can be used to read the QR codes deployed throughout the island's territory by the Tourist Board (*Consejería de Turismo*) of the Island Council of El Hierro, or else by using the option 'Explore' in order to find out more about all the distinctive sites and secrets of the island.

Tourist guides with geological content: "Tourist Guide to El Hierro", "La Frontera Route Guides", "Nature Areas in El Hierro", etc.

Publications on geological subjects:

- "The Route of the Volcanoes" (Digital version)
- " Hoya de Los Roques- Montaña de El Julan" (volcano route)
- "Don Justo Cave: discover it to conserve it"
- "We know about volcanoes" (Booklet for pre-school children)
- "Visit La Hoya de Los Roques-Montaña de El Julan" (Booklet for primary school students)
- "Hoya de Los Roques- Montaña de El Julan volcanic complex (Booklet for students of secondary education)

c) Services in the visitor centres associated to the Project (see also D.2)

Each centre covers an area of the island and focuses on a specific theme of El Hierro's heritage; however visitors are always given information on the Project, and its natural and cultural values are promoted in an integrated manner.

To assist in moving around the island, the Environment Department of the Island Council of El Hierro offers the following services:

- Support for hiking for private individuals and schools for children with mobility problems.
- Loan of two *joëlette* wheelchairs to interested persons or companies, who must present a certified licence for their operation.

Below are some examples of management affecting specific geological areas:

Centre	**RESTINGOLITA centre**	Location (Municipality)	La Restinga (El Pinar de El Hierro)
Services related to areas of geological interest	Guided visits around Los Lajiales		
Geological areas affected	Geozone GZH-03 and Geosites GSH-10, GSH-11, GSH-14, GSH-16.		

Centre	**Visitor Centre at the *El Julan Cultural Park***	Location (Municipality)	El Pinar de El Hierro
Services related to areas of geological interest	Guided visit to the archaeological zone with supplementary geological information.		
Geological areas affected	Geosites GSH-05, GSH-06, GSH-12		

Centre	***Árbol Garoé* Visitor Centre**	Location (Municipality)	San Andrés (Valverde)
Services related to areas of geological interest	Guided visits on local biodiversity with supplementary geological information.		
Geological areas affected	Geozone GZH-04, Geozone GZH-05		

d) Environmental education programmes with information on geodiversity

Centre	***El Pinar* Nature Education Centre (Aula de La Naturaleza de El Pinar)**	Location (Municipality)	El Pinar (El Pinar de El Hierro)
Services related to areas of	Annual environmental education programmes		

geological interest	
Geological areas included	Geosites GSH-02, GSH-10, GSH-20, GSH-24.

e) Signposting

Some viewing points have panels (Figure 9) with geological content (i.e. GSH-20 Las Playas viewing point "Mirador de Las Playas" or GZH-06 El Julan viewing point). The signposting (following the European legislation) of the extensive **Network of Footpaths of El Hierro** ensures easy access to sites of geological interest . (See annex 5 "Figures_and_maps" on the website http://www.proyectogeoparqueelhierro.com).

Fig.9. Panel with geological information at El Jinama viewing point (2012).

f) Raising awareness in the local population

Regular environmental education campaigns are conducted with the aim, among others, of raising awareness among the local community so they understand and value the island's geodiversity (see section D5).

3.2 Maintenance of areas of geological interest

There are no large infrastructures in the areas of geological interest. Due to the minimal pressure to which they are exposed (see section C1) and the high degree of protection of the territory (see section C2), no large infrastructures were required to ensure their conservation and sustainable use. In each case, efforts were focused on maintaining the access routes and signposting, and on cleaning rest areas (the viewing points have conditioned areas and parking areas). In some cases access is restricted to visitors, and only small groups of guided visits are permitted, as in the case of visits to Don Justo cave, for example (Volcanic tube, GSH-14). In the case of risk of fire, access is closed to certain protected nature areas. These tasks are undertaken by the El Hierro Island Council (*Cabildo de El Hierro*) together with the local councils.

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

The Management Body for the Geopark Project conceives of the Geoparks as a model for the integrated management of the territory's natural and cultural heritage. In the case of El Hierro, the ubiquitous presence of geology throughout its landscape has intensely conditioned the island's traditional way of life, and facilitates the task of integrating geological values into the natural and cultural heritage. The recent episodes of seismic and volcanic activity have merely served to reinforce the population's awareness of Gaia's processes.

Below is a list of some examples of the means of integrating selected non-geological areas.

Selected areas	Integration in the Geopark Project
Biosphere Reserve Protected nature area occupying the whole of the island, in addition to a maritime section.	**Natural heritage** Following recommendations by the UNESCO, the new Management Plan (2012) for the Reserve now includes common objectives with the Geopark Project. The new Visitor

	Centre at the Isora Biosphere Reserve (inauguration scheduled for end 2012) is due to include a space dedicated to the Geopark Project.
Marine Reserve's Bureau at the Punta de La Restinga Investigation and information on the marine ecosystem in the Las Calmas sea. Management of the traditional fishing industry and scuba-diving activities.	**Natural heritage** In coordination with the **RESTINGOLITA Centre** (La Restinga), it explains the relationship between coastal geological processes and biodiversity. It also conducts studies on how the recent volcanic activity (2011) has affected marine and coastal biodiversity.
Sacred Tree-Garoé Visitor Centre (San Andrés) Ethnohistorical site dedicated to the holy tree which was worshipped by the island's original inhabitants (Bimbaches) and its relation with the search for fresh water.	**Cultural heritage (tangible and intangible)** This centre, in addition to the legend of the Sacred Tree (Garoé), also provides a scientific explanation for the phenomenon of "horizontal rain" and the hydrogeological characteristics of the island.
Guinea native village and Lagartarium Ecomuseum (Centre for the Recovery of the Giant Lizard of El Hierro) (La Frontera) Investigation and information on archaeology and ethnography. Investigation and information on the ecosystem of the giant reptile.	**Cultural heritage (tangible and intangible)** **Biological heritage** The guided visits (Spanish, English, German) offer information on archaeology and herpetology (study of reptiles), in addition to explaining the geological features (formation, type of soil, etc.) in the area which have shaped the habitat of the reptiles and of the original inhabitants.
Visitor Centre at the El Julan Cultural Park (El Pinar) Information on the Bimbache culture, with particular emphasis on rock carvings.	**Cultural heritage (tangible and intangible)** Guided visits (small groups) to the archaeological area, with additional information on the geological features (formation, type of soil, etc.).
Sabinosa Well of La Salud (Municipality of La Frontera) Centre for medicinal waters and a source of attraction for health tourism.	**Natural heritage** Information is given on the origin and characteristics of the water from the Sabinosa spring, in addition to its healing properties.
Casa de las Quinteras Ethnographic Centre (Valverde) Conservation and information on local ethnographic values and sale of local handicrafts.	**Tangible cultural heritage** In addition to information on the techniques and skills of the clay potters, visitors can also learn about the source, origin and characteristics of geological material.
Monument to the Zero Meridian (Punta de Orchilla, Municipality of El Pinar de El Hierro) Monument commemorating the period when the meridian of El Hierro was the Zero Meridian for geographical calculations.	**Tangible and intangible cultural heritage** Information on the theme of "The Meridian Island", it examines the island's situation at the outermost edges of Europe. This feature has been part of the island's identity since the time of Ptolemy (2nd century), and is one of the elements highlighted by the Geopark Project. A visit certificate is sold to visitors.
Camino de la Virgen path (GR-131) Every four years the Virgin of Los Reyes, the patron saint of El Hierro, is carried along this route on her "Descent" from the shrine of La Dehesa to the church of La Concepción in Valverde.	**Tangible and intangible cultural heritage** This itinerary covers a large part of the island and passes through areas of geological interest. The Geopark Project integrates this spectacular cultural and religious procession by indicating various geomorphological elements with cultural significance at strategic points along the route.

Figure 10 shows a more comprehensive list of the non-geological sites selected by the Geopark Project.

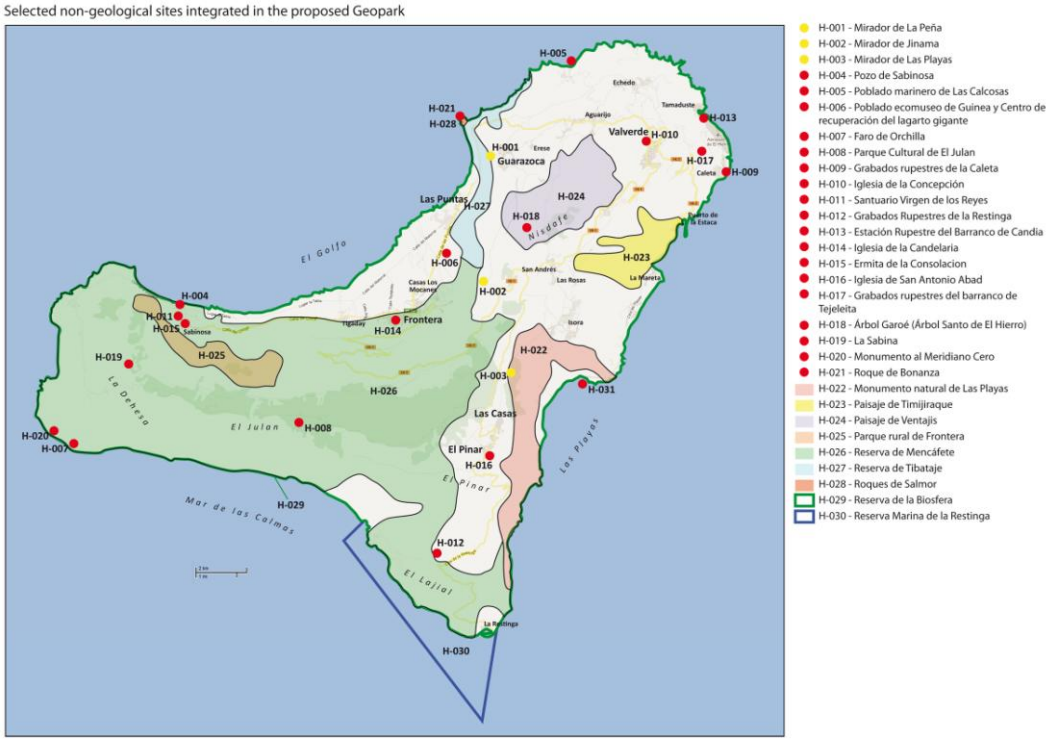

Fig.10. Location of non-geological sites selected by the Geopark Project.
Compiled by the authors. GRAFCAN cartographic base.

One of the main strategies for integrating these and other elements of the natural and cultural heritage is the use of the Island's Network of Footpaths, which includes the **"Natural Route of the Traditional Footpaths of El Hierro".** This offers a convenient means of connecting geological and non-geological elements all over the island, and includes a section of the following long-distance trails:

- The GR-131, known as the **Camino de la Virgen** ("path of the Virgin"), which crosses the centre of the island from north to south. This route covers a distance of 42 km and is divided into four sections. It passes through some of El Hierro's most significant and emblematic sites, such as Valverde, the capital, and the shrine of the Virgin de los Reyes.
- A **circular footpath** which runs around the perimeter of the island and follows the layout of what are known as the island's "traditional paths", formerly used by the local inhabitants for moving around the territory. It is divided into 15 sections, over a length of more than 100 km, and passes through various protected nature areas.

PART D ECONOMIC ACTIVITY & BUSINESS PLAN (Including detailed financial information)

D.1 Economic activity in the proposed Geopark

D.1.1 Synthesis of economic activity

The economy of the island of El Hierro is based on the primary sector (agriculture, cattle farming and fishing), with secondary revenue from tourism, clearly differentiating it from most of the other islands. The main economic engine of El Hierro continues to be the public sector, which through different channels and either directly or through the mechanism of investments, each year introduces a considerable volume of resources into the island's economy,
which have unquestionably resulted in progressive improvements in the population's living standards in recent decades (Figure 11).

In agriculture, the main models of agricultural production continue to be crops grown on terraces and on irrigated land, and in recent years there has been a clear tendency to adapt to the environmental and organic market. It has the following main characteristics (González, 2012):

- Generalised presence of subsistence farming. The main crops are cereals, leguminous vegetables, potatoes, fruits and vines. The wine growers have formed a cooperative association and their wines are protected by their own designation of origin.
- Due to the limited use of technology, the characteristics of the soil and the irregular rainfall, the prevailing model has consisted of un-irrigated farming, in addition to bananas and pineapples.

The fishing industry is concentrated in the southern part of the island. The most important species with regard to volume and the value of the catch is skipjack tuna, but other types of tuna are also caught, and the richness of its marine resources allow a variety of coastal species to be fished (parrot fish, sea bass, moray…). This sector has not advanced beyond its traditional state, due to the morphology of the coastline which has prevented the use of any natural fishing harbours.

The importance of the local fishing sector increased progressively after the creation of the Mar de las Calmas Marine Reserve (7.46 km² along the southern side), which has encouraged the recovery of local species thanks to the sustainable fishing of marine resources. A considerable number of families in La Restinga make a living from this activity, and the Reserve also serves as a support for the implementation of new activities related to the tourism sector and to leisure activities for visitors, such as scuba diving, sports photography and so on.

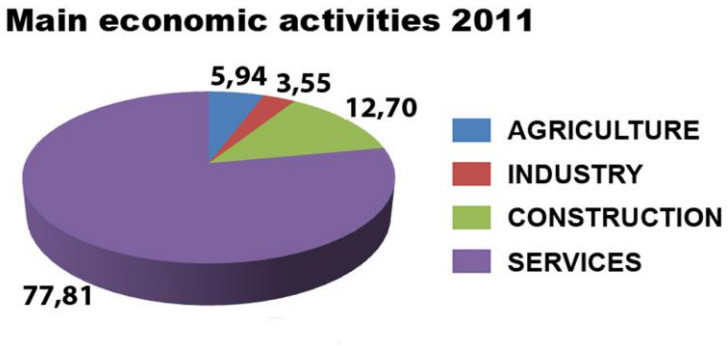

Fig. 11. Economic activity (percentage of people employed) on the Island of El Hierro (2011). Source: Canary Islands Institute of Statistics (ISTAC).

The island's economy is complemented with a modest tourism sector linked to the appreciation of the natural and cultural heritage, which is currently undergoing moderate growth. Today, the total hotel and accommodation places on the island amount to 1240, including both hotel spaces and other accommodation, with a maximum annual licensing quota of 200 places. Current demand does not succeed in completely filling available places (for example, tourist occupation in August 2012 did not exceed 70%). The places available are distributed as follows:

NUMBER OF AUTHORISED TOURIST ACCOMMODATION ESTABLISHMENTS (2010)

	Municipal district of Valverde		Municipal district of La Frontera		Municipal district of El Pinar		Total establishments	Total places
	No.	Places	No.	Places	No.	Places	No.	Places
Hotels	3	151	4	82	0	0	7	233
Guesthouses	2	40	6	98	1	13	9	151
Apartments	5	94	12	260	9	177	26	531
Tourist lodges	6	21	6	21	4	18	16	60
Country house lodges	43	175	11	40	12	50	66	265
Total	**59**	**481**	**39**	**501**	**26**	**258**	**124**	**1240**

Source: Tourism Department of the Island Council of El Hierro (González, 2012).

As an example, in 2010, visitors' average stay on the island was 3.1 days, and the number of overnight stays was 13,020. The seasonal nature of tourist visits can be seen in the graph in Figure 12, which shows the hotel occupation in 2011.

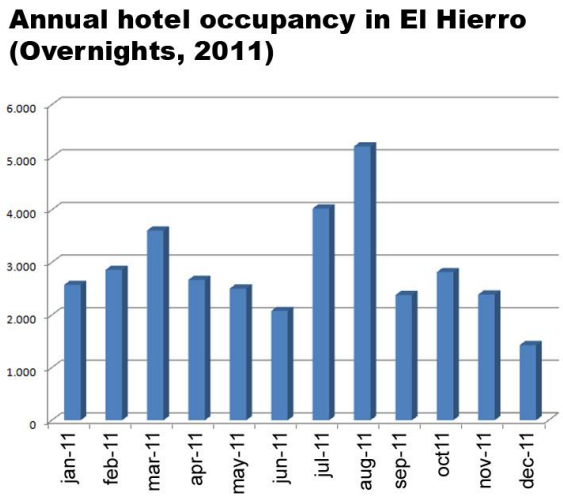

Figure 12 Monthly hotel occupation in El Hierro (2011). Source: Canary Islands Institute of Statistics (ISTAC).

The period of seismic and volcanic activity in 2011-2012 had a major negative impact on the island's economy, particularly in the southern part and on tourism (see Figure 15), from which it is gradually recovering. One of the pillars of this recovery is the Geopark Project which encourages quality tourism, among other economic activities, within the framework of sustainability.

In order to assist in achieving a high level of quality, the Hotel and Accommodation Association of Tenerife, La Palma, La Gomera and El Hierro, with the collaboration of the Sub-department of the Environment of the Government of the Canary Islands, the Chamber of Commerce of Santa Cruz de Tenerife and the Department of the Environment of the Touroperator TUI, has published a practical guide to improving environmental hotel management (2005). The objective is to ensure that environmental management is continually upgraded according to the **EMAS/ISO 14001 quality certificate**. This document is used in training courses for businesses and entrepreneurs in the tourism sector (54 pages, 2012).

D.1.2 Examples of significant tourism activity

Several tourism companies are associated to the Geopark Project. By way of example, the following activities are worth noting due to their sustainability and the integration of local values, respectively.

Organisation	Activity
El Hierro Scuba-diving Centre (La Restinga) http://www.centrodebuceoelhierro.com/isla.html	Scuba-diving activities in the Mar de Las Calmas Marine Reserve. Also worth highlighting are underwater photography activities (international competition).
El Hierro-Rural Association **Poblado Jirdana.** Isora, Valverde **Abuelo Pancho.** El Pinar **Casa El Lunchón.** La La Frontera **Casa Tilde.** El Pinar **La Pestilla.** El Pinar **Casa Juaclo.** El Pinar **Casa de Cecilio y María.** San Andrés, Valverde	Rural tourism featuring typical houses in the traditional architectural style of El Hierro, built between the 18th century and the early 20th century, and recently restored according to the Rural Tourism Law of the Canary Islands.

D.2 Existing and planned facilities for the proposed Geopark (geo-education, geo-tourism, tourism infrastructures, etc.)

D.2. 1 Current infrastructures

Currently the task of welcoming visitors and disseminating the values of the Geopark Project is provided and coordinated by the Tourism Office of the Island Council (Municipality of Valverde, **Headquarters of the Geopark Project**). This office (Figure 13) opened in 1984 and has three full-time employees. From this site the information is distributed through five satellite centres associated to the Project. These are publicly-financed centres, most of them managed by a public company (EL MERIDIANO), specialised in providing information on the natural and cultural values of the island. This management model facilitates the flow of information and maintains a uniform level of quality in tourism services.

Each satellite centre focuses on a specific theme of El Hierro's heritage; however visitors are always given information on the Project, and its natural and cultural values are promoted in an integrated manner. Below is a description of some of the centres in operation associated to the Geopark Project.

Fig. 13. The Tourist Office of the Island Council (Headquarters of the Geopark Project, Valverde) centralises the information and promotion of the Geopark Project.

D.2.1.1 Geo-education and Geo-tourism

Centre	**"El Pinar" Nature Education Centre**	Municipality	La Frontera
Equipment	The Centre has has all necessary services to meet educational groups, including a wide range of educational resources (maps, video, books, etc.) and specialised staff to advise the group during their stay on educational and environmental activities.		
Activities	The activities are guided by the specialised staff at the Centre, and tend to be structured around: **guided itineraries** to study various natural and cultural aspects of the environment in an interdisciplinary manner, **environmental workshops** (recycling, solar		

	energy, etc) which allow the practice of environmentally-friendly behaviour in everyday activities, **geology workshops** to learn more about local geodiversity, **simulation games** for arriving at environmental decisions, fieldwork techniques of observation and/or research, **classroom activities**: talks, audiovisual displays, etc. (Figure 14).		
Staff	Two part-time staff members	Inauguration	1996
Schedule	Schedule by agreement with the groups. Reservations system.	Ownership	Public. *Island Council of El Hierro*
Annual budget	Staff: €57,274.27; maintenance: €12,000.00		
Comments	Conducts activities for students with reduced mobility. Currently out of service due to maintenance works. Scheduled reopening date: 2013.		

Centre	**RESTINGOLITA Centre**	Location (Municipality)	La Restinga (El Pinar de El Hierro)
Theme	Geological environment of the island, with particular attention to the recent volcanic activity in the south of El Hierro.		
Staff	One part-time staff member	Inauguration	2011
Schedule	Open all year round. Opening times: Monday through Friday, 9 am to 2 pm	Ownership	Public. *El Pinar Town Council*
Annual budget	Staff: €20,761.08 ; maintenance: €5,352.00		
Comments	Guided tour: "Los Lajiales in La Restinga. A volcanic landscape to be discovered". Themed exhibition on the underwater eruption in 2011.		

Centre	**Visitor centre at the El Julan Cultural Park**	Location (Municipality)	El Pinar de El Hierro
Theme	Natural and cultural values of the island, the reason it was declared a World Biosphere Reserve by the UNESCO. Most characteristic features of the Bimbache culture, with emphasis on the rock carvings known as "the letters" and "the numbers".		
Staff	One full-time staff member	Inauguration	2008
Schedule	Open all year round. Summer: Tuesday to Saturday, 10 am to 5 pm. Public holidays, 9 am to 2 pm.	Ownership	Public. *El Meridiano* company
Annual budget	Staff: €28.350.41		
Comments	The archaeological zone of El Julan was declared a Property of Cultural Interest in 1985.The space has two accommodation units for researchers. The archaeological zone can only be visited with a guide (small groups). Due to its location, this centre may be closed to the public during periods when there is risk of forest fire, as a preventive measure.		

Centre	**Guinea native village and "Lagartarium" Ecomuseum (Centre for the Recovery of the Giant Lizard of El Hierro)**	Location (Municipality)	La Frontera (La Frontera)
Theme	The Ecomuseum recreates the uses and customs of prehistoric and traditional life on the island based on archaeological and ethnographic research which guarantees the accuracy of the project. The work of the "Lagartarium" involves the recovery of a species of giant reptile which was believed to be extinct until 1974 (*Gallotia simonyi*).		
Staff	Ecomuseum: five full-time staff members one part-time staff member Lagartarium: three full-time staff members	Inauguration	1986
Schedule	Open all year round. Summer: Tuesday to Saturday, 10 am to 2 pm and 4-6 pm. Sundays, 11 am to 2 pm.	Ownership	Public. *El Meridiano* company
Annual budget	Staff: €264,976.00; maintenance: €19,969.67		
Comments	Offer of guided geology, biology and archaeology routes (Spanish, English and German).		

Figure 14. Chidren's activity on the origin of earthquakes in the "El Pinar" Nature Education Centre (Municipality of the El Pinar de El Hierro).

D.2.1.2 Tourism

Centre	***Árbol Santo-Garoé* Visitor Centre**	Locality (Municipality)	San Andrés (Valverde)
Theme	Ethnohistoric site comprising a replica of the ancient holy tree or Garoé, worshipped by the original inhabitants of the island, the Bimbaches, and a series of associated pools.		
Staff	One full-time staff member	Inauguration	2003
Schedule	Open all year round. Summer: 10:30 am to 2:30 pm, Tuesday to Saturday. 3-7:30 pm. 11 am to 2 pm on Sundays	Ownership	Public. *El Meridiano company*
Annual budget	Staff: €28.350.41		
Comments	Theme related to the search for drinking water. It belongs to the Ventejis Protected Landscape (Protected Nature Area). The Garoé tree is a clear example of the continual struggle of the original inhabitants and the population of El Hierro to ensure a constant supply of fresh water.		

Centre	***Casa de las Quinteras* Ethnographic Centre**	Location (Municipality)	Valverde (Valverde)
Theme	Ethnographic exhibits from the island: blacksmith's workshop and loom, traditional textiles, woodwork and pottery.		
Staff	One full-time staff member	Inauguration	1997
Schedule	Open all year round. Monday-Friday, 9 am to 2 pm. Saturdays: 10:30 am to 1:30 pm and 4:30-6:30 pm. Sundays: closed.	Ownership	Public. *El Meridiano* company
Annual budget	Staff: €36,885.00		
Comments	Contains the ethnographic collection of the Island Council of El Hierro.		

It is particularly worth mentioning the **Network of Footpaths of El Hierro** as it constitutes a very important infrastructure which offers a means of connecting geological sites of interest. This Network includes the **Natural Route of the Traditional Footpaths of El Hierro** which comprises part of the paths and trails that the inhabitants of rural environments have traditionally used for exploring their geodiversity and biodiversity.

D.2. 2 Infrastructures under preparation

The following infrastructures integrated into the Geopark Project are currently in the process of preparation:

Infrastructure	Scheduled activities
Biosphere Reserve Visitor Centre (Isora). **Scheduled: end 2012.** **Budget: €465,970**	Investigation, education and integrated information to promote the natural and cultural heritage of El Hierro, with particular attention to biodiversity and geo-diversity.
Don Justo Cave Geotour **Scheduled: end 2012.** **Budget: €53,761.70**	Offer of guided visits to places of interest such as the Don Justo cave (Volcanic tube, GSH-14).

"Las Cancelitas" Sustainability Centre **Scheduled: end 2012 (phases 1 and 2)** **Budget: €1,251,842.31 (phases 1 and 2)**	Information on the island's sustainability strategy (energy, organic farming, waste management, etc.), including the promotion of the values of the proposed Geopark.
Refurbishment of the Árbol Santo - Garoé Visitor Centre (San Andrés) **Scheduled: 2013** **Budget: €3,489.90**	Refurbishment of the information panels inside the Centre. The influence of geomorphology will be added to the information currently available on the phenomenon of "horizontal rain". Awareness-raising activities for the population on the improvement of water management on the island.
New Volcanology Centre (New Visitor Centre for the Geopark Project) **Scheduled: 2014** **Budget: €229,660 (excluding content)**	New visitor centre dedicated to the promoting knowledge of the volcanological heritage. This centre will also offer a series of routes, specifically designed for the purpose, to visit the main volcanological areas of the island. These will be georeferenced and explained by means of augmented reality technology accessible through mobile devices.

D.3 Analysis of geo-tourism potential of the proposed Geopark

D.3.1 Orientation to Geotourism

The particular geological configuration of the island and its climate differences means its ecosystems can be divided into a differentiated geomorphological environment, in which the volcanic landscape is particularly important. Its geology is highly visible and facilitates its interpretation and promotion for tourism. However in spite of the legendary "eternal spring" enjoyed by the islands in the archipelago, El Hierro is the least exploited for tourism and constitutes a genuine paradise waiting to be discovered.

The tourism sector is limited by the difficult transport connections (low frequency of flights to the island), and by the fear of incurring in the same errors as in the rest of the islands, where speculation, unbridled construction and a lack of regulation has fragmented the fragile balance between progress and sustainability. However the government of the island has clearly expressed its orientation to tourism in the **Special Territorial Plan for Tourist Ordination of the Island of El Hierro (2007)**:

The island of El Hierro has undertaken a special commitment to uphold the sustainable nature of the tourist actions to be developed, with special consideration for the environment in the decision-making process and careful management of natural resources and the territory. On this island it is possible to develop a type of tourism which is more closely linked to the natural environment and to agricultural and fishing activities than to the conventional offer of coastal tourism, and territorial ordination of tourist activity is one of the instruments for addressing the special economic and social circumstances of the island, offsetting its drawbacks and improving the island's economic system.

D.3.2 Analysis

The seasonal nature of tourism and the negative effect of the recent seismic and volcanic activity (2011 - 2012) are patiently obvious in the visitor centre records. For example the graph (Figure 15) of the *Sacred Tree - Garoé* Visitor Centre shows a decrease in visitors when the seismic activity began in autumn of 2011 (red line) with regard to the previous year (blue line). The number of visitors continued to be low in the early months of 2012 (green line).

Since 2003 the government of El Hierro has been sponsoring the development of several studies on the model of tourism that would be the most beneficial to the island within the framework of sustainability. The diagnostic document was submitted for analysis and in-depth debate in various Thinking Groups, to which all the political parties, social and economic organisations, environmental groups and experts were invited. Subsequently a detailed survey

was taken of institutional authorities and technicians in the various departments of the Island Council, the Cooperatives, the Local Development Group (ASHERO), business associations (APYME), professional associations, neighbourhood associations etc., which enabled the contributions of the technical studies and the initial view of the Thinking Groups to be enriched and amplified. Based on these studies, the Geopark Project team has updated the DAFO analysis (González. 2012):

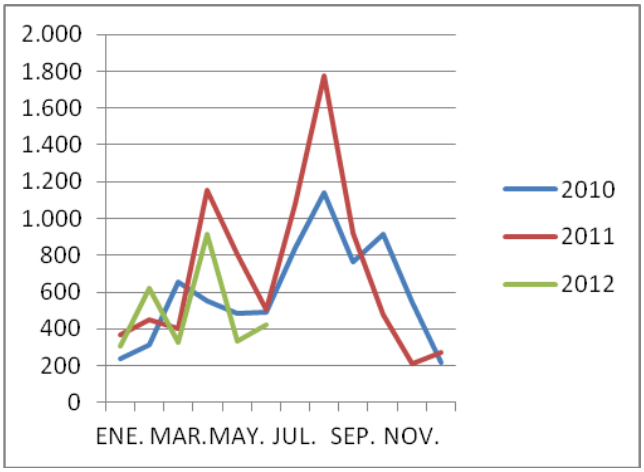

Figure 15. Graph showing monthly visitors to the *Árbol Santo - Garoé* Visitor Centre in 2010, 2011 and 2012. Source: Tourism Department of the Island Council of El Hierro (González, 2012).

WEAKNESSES	STRENGTHS
-Destination far from Europe. -Transport costs. -Limited frequency of air and sea transport. -Limited offer of tourist accommodation. -Poorly defined tourist model. -Lack of models for the profitable tourism exploitation which stimulate the "multiplier effect". -Low expectations of immediate profitability for newly created exploitations. -The value of geodiversity has only been exploited to a very minor degree.	-Differentiated geographic framework (Biosphere Reserve). -Geological heritage which has been extensively studied and outcrops which are suitable for geotourism. -High rate of protection of nature areas (60%). -Reduced population. -Associated values: peace and quiet, seclusion, relaxation… -Differentiated option of low-volume activities (hiking, scuba diving, sports in the natural environment, walks, ethnography, folklore, water recreation...

THREATS	OPPORTUNITIES
-Possibility that El Hierro may be definitively excluded from tourist destinations, with the resulting impoverishment of island's inhabitants and economy. -No resolution for the problems of access to the island. -Insufficient telecommunications connectivity (broadband). -Lack of incentivisation for possible hotel investors due to the difficulty in obtaining sufficient accommodation quotas under the Special Territorial Plan for Tourist Ordination on the Island of El Hierro.	-Political will to improve the current tourist situation and commitment to the Geopark Project. -Possibility of being able to learn from other unsuccessful tourist models on other islands. -Opportunity of creating the island's own differentiated tourist model based on the Geoparks model (laboratory effect). -Quantitatively requires small economic investments. -Opportunity for development of tourism experiences which integrate the environment, sustainability criteria, clean energies, organic farming and sustainable mobility within the framework of the Geopark Project. -Possibility of attracting specialised and discerning tourists: geotourists, environmentalists, naturalists, scuba-divers, etc. -Scientific and technical tourism attracted by the

	possibility of understanding and investigating in the fields of R+D+I based on the experimental Hydroeolic Plant of El Hierro.

D.3.3 Conclusions

Although nature is the main tourist attraction, the Island also has various additional resources such as its rich historic and cultural heritage and its involvement in research into renewable energies for over 30 years, with the example of the hydroeolic plant, a worldwide reference for innovation, which offers the possibility of attracting scientific and research tourism.

The territory has a very high potential for geotourism thanks to its richness in elements of geodiversity. The motivations related to geotourism (*s. l.*) and types of possible tourist have a very broad range of characterisations, and can be listed as follows:

- Geotourism (*s.s*) based on routes and itineraries around the points of geological interest in the area.
- Scientific and university tourism linked to the presence of geological elements of international scientific importance.
- Cultural tourism linked to elements of geocultural interest in a territory in which numerous legends, myths, traditions, evocative place names, enclaves and sacred landscapes, etc. constitute an exceptional heritage. The area contains numerous elements of geocultural interest which can be linked together to form themed routes based on existing paths or infrastructures.
- Nature tourism, green tourism and rural tourism: involving possibilities for activities in the rural environment, mountain routes, hiking routes, MBT routes, guided walks through nature, horse-riding routes, etc., as well as rural tourism and local products. Another outstanding attraction is the wide diversity of nature areas in such a reduced territory.
- Health tourism at the La Salud well (La Frontera).
- Religious tourism and pilgrimage tourism linked to the procession (Descent) of the Virgin of Los Reyes.

D.4 Overview and policies for the sustainable development of: a) geo-tourism and economy, b) geo-education and c) geo-heritage

D.4.1 Strategies for sustainable development in El Hierro

The inhabitants of El Hierro feel proud to live in a habitat which is practically untouched by the hand of man. This is because the Island Council of El Hierro, from the early 1980s, has made a firm commitment to an original and groundbreaking model of development, based on respect for the island's heritage, the revitalisation and conservation of its natural resources, and the promotion of associationism in the productive sectors. These guidelines at one time appeared to be in contradiction with the social and economic dynamic in the Canary Islands as a whole, which was geared to the capture of mass tourism, and in addition undergoing a spectacular boom in the construction sector.

The Island Council of El Hierro was the first in the Canary Islands to venture to speak of “sustainability”, and the first to enact a **Sustainable Development Plan** in 1997 (updated in 2006), an action which was satisfactorily compensated and ratified by the UNESCO with the declaration of the whole of the island as a World Biosphere Reserve. At the same time, it promoted and enabled the approval of the **Island Ordination Plan of El Hierro (PIOH)** and the municipal urban planning projects in force in El Hierro.

This strategic framework establishes the basis for the enactment of specific projects in El Hierro, in keeping with an integral and sustainable development, sensitive to its geographical

singularities and characteristics, with an extrainsular vision, and encouraging the harmonisation of the local economy with the environment and the quality of life of the inhabitants of the Meridian Island.

Among the various documents containing the sustainability strategies, it is worth noting the **Strategic Plan (2012-2017)** by the managing body of the Geopark Project (Board), which establishes the guidelines for the primary lines of work: (1) Science area (research, education, publications, promotion of scientific knowledge, etc.), (2) Sustainability and environment area, (3)Tourism and geotourism area, (4) Area of local development with cultural values, and (5) Area of (future) collaboration with the EGN and the National Geoparks Forum.

As part of its conservation function, the new **Action Plan for the El Hierro Biosphere Reserve (2012)** includes the opportunity of promoting the integration of El Hierro within the Geopark Network. The Biosphere Reserve and the Geopark Project are closely linked, with numerous common objectives geared to the sustainable development of the territory based on the management of its natural resources. Some of the objectives of the Action Plan for the Biosphere Reserve which concur with the Geopark Project are as follows:

Objective	Representative actions
Protection and promotion of the value of the landscape	"Routes around the landscape of El Hierro" Action for the identification and recognition of the value of the landscapes of El Hierro, creating the concept of the scenic route based on the classification used by the UNESCO. For example: *Landscapes related with Gaia*: particularly exceptional landscapes which represent the different periods of the history of the Earth, including evolutionary records, the major geological processes in course, the development of landforms, and significant geomorphological and physiographical elements. Manual of good practices on the landscape. Incorporation of the dimension of the nocturnal landscape.
Recognising, protecting and enhancing the value of the geological heritage	Campaign "El Hierro: the island of a thousand volcanoes". Promoting the integration of El Hierro in the EGN and GGN. Collaboration with UNESCO's programmes and initiatives.
Improvement and protection of farming productivity. Maintenance of agrodiversity.	Recovery of traditional varieties. Creation of a Germobank for traditional varieties. Promotion of traditional seeds among producers and consumers. Study of alternative treatments for pest control. Support for farmers through the El Hierro School of Organic Farming and Cattle Rearing. Development of processed products. Improvement of distribution channels.
Development of research, information and economic exploitation of protected nature areas	Incentivise economic activities of a sustainable nature. Complete the network of educational and tourist routes in the protected areas, with the installation of the corresponding explanatory panels and signposts, and the publication of specific informative material.
Improvement of the water cycle	Campaign for saving water targeted at the population and the tourism sector (objective 15% savings for 2015). Water conservation programme for farming and cultural landscapes. Pilot project for a biological water purification plant in farms.
Supply 100% of the island's electricity consumption from renewable energy sources.	Project "Hydroeolic Plant". Its start-up (scheduled for 2013) has the objective of avoiding the emission into the atmosphere of 18,700 tons of CO_2 a year, saving an annual consumption of 6000 tons of diesel. Campaign "Energy-efficient homes and businesses" Drafting of the Island's Action Plan for Sustainable Energy.
Minimising waste generation. "Zero Waste Island".	Actions to support local agroindustry, farm and cattle production with strategies to encourage the consumption of products from El Hierro. Involvement of business organisations through voluntary agreements for waste minimisation.

	Generalisation of composting of municipal solid waste.
Consolidate an island model of sustainable mobility. Prioritise public transport.	Maintenance of the Internet portal "Getting around on El Hierro". Improvement of connectivity through collective transport to tourism and leisure attractions. Pilot project for the implementation of an electric microbus in Valverde. Pilot project for biodiesel and recycling (used vegetable oils). "El Hierro by bike" programme Project for a maritime leisure route in the south: Restinga - Tacorón - Faro.
El Hierro: sustainable tourist destination	Integration of the Island into the Tourism Product Club of Spanish Biosphere Reserves. Creation of an agrotourism guide featuring places of interest. New products based on science and knowledge (volcanoes, renewable energy, biodiversity, etc.). Project for certifications as a sustainable tourist destination. Marketing actions: reinforcement of the portal "El Hierro Travel", Campaign "Tourism in the Zero Meridian Reserve". Creation of the quality brand "Biosphere Reserve".
Applied research to improve the management of biodiversity and geodiversity	Development of monitoring stations for volcanic activity. Creation of the Permanent Observation Centre. Development of agreements with scientific institutions. Soil regeneration studies. Creation of a technological reference centre on renewable energies and alternative transport. Creation and maintenance of a documentary repository for research works, doctoral theses and scientific documentation related to the Biosphere Reserve.
Raise awareness among the population and visitors as to the importance of the El Hierro's heritage and the responsible use of resources.	Development of activities for training and information in order to integrate traditional fishing activity into tourism activity. Actions to recruit new tourism products: agrotourism, active tourism, cultural tourism, new gastronomy, etc. Permanent actions to promote awareness of the primary values of the Biosphere Reserve (geodiversity, biodiversity, culture). Recruitment actions on innovation and efficient use of technology.
Improvements in citizen information and participation	Design of a participative system for the use of indicators. Use of indicators in sustainability training. Development of the official website of the Biosphere Reserve.

D.4.2 Strategies for the sustainable development of geo-tourism and the economy

Within the framework of Law 6/2002 of 12 June, on measures of territorial ordination of tourism activity on the island of El Hierro, La Gomera and La Palma, the following objectives can be highlighted in the Development Plan for El Hierro (2007-2020) with regard to the strategies for geotourism and related tourism activities (nature, culture, etc.):

- Preparation of the Strategic Marketing and Tourist Commercialisation Plan of El Hierro.
- Design of an Integral Quality Plan for the Tourist Destination.

Order IET/460/2012 of the Ministry of Industry, Energy and Tourism establishes sectorial measures to support the promotion of tourism, the dynamisation of industry and business and support for ICT on the island of El Hierro (Official Gazette of 9/03/2012), which will be implemented through a programme (**PAE/El Hierro 2012**) that includes the following measures from different departments in this Ministry:

I. A **programme of special measures for the promotion and support for the commercialisation of tourism** through the Spanish Tourism Institute.
II. An **operative programme for the incorporation of ICT** through the public company SEGITTUR (that is, a free wi-fi network over most of the island).
III. The design and provision of **volcanogical visitor centre** on the island.

IV. A **support plan for entrepreneurs**. This takes the form of a series of training modules to improve the qualifications of tourism companies; and in a programme of tutoring to support companies in improving their business models.

V. **Commercial reactivation of the Parador de El Hierro**.

In order to develop the strategic lines relating to geotourism and associated tourism, the Government of the island has set up the following agreements:

DATE	AGREEMENT	PARTICIPANTS
27-10-2004	Specific collaboration agreement for the development of an advertising campaign for the common promotion of the natural and cultural heritage of the network of footpaths in the territories participating in the TOURMAC project.	Members of TOURMAC and the Association for Rural Development of the Island of La Palma.
11-04-2005	Collaboration agreement for the use of the El Julan archaeological zone in the municipality of La La Frontera and the management of its visitor centre.	Department of Education, Culture and Sports of the Canary Islands Government.
14-11-2005	Collaboration agreement for the development of tourist actions included within the Canary Islands Infrastructures and Quality Tourism Plan (2001-2006).	Department of Tourism of the Government of the Autonomous Region of the Canary Islands.
04-04-2006	Transnational cooperation agreement for the development of the project: "Hiking tourism. Themed trails in Macaronesia". (TOURMAC-II)	Community initiative programme Interrreg IIIB-Azores-Madeira and Canary Islands.
14-01-2010	Agreement for the development of the Canary Islands Strategy for the Improvement of the Public Tourism Area.	Department of Tourism of the Canary Islands Autonomous Region and the Island Councils.
16-12-2010	Collaboration agreement for the development of the Tourism Competitiveness Plan “Canary Islands. A Volcanic Experience II”. The budget for El Hierro is €766,667.00.	Turespaña, Canary Islands Autonomous Region, Island Councils of La Palma, Fuerteventura, La Gomera, El Hierro and the Fuerteventura Hotel, Catering and Tourism Association
12-04-2011	Promotion agreement between the Island Council of El Hierro and the airline Islas Airwais, S.A. for the promotion and dissemination of El Hierro.	Islas Airwais airline.
01-04-2011	Collaboration agreement with Promotur Turismo Canarias, S.A. and the Island Council of El Hierro for the promotion of tourism and the improvement of transport connections to El Hierro in 2011.	Promotur Turismo Canarias, S.A.

In order to reinforce the safety of tourists in the case of risk from volcanoes, since 2011 the Government of El Hierro has had an ISLAND-WIDE PLAN OF ACTION FOR EL HIERRO DERIVED FROM THE SPECIAL EMERGENCY ASSISTANCE AND CIVIL DEFENCE PLAN DUE TO HAZARDS FROM VOLCANOES IN THE CANARY ISLANDS AUTONOMOUS REGION (PEVOLCA).

The primary strategic objectives of the El Hierro Development Plan (2007-2020) in the area of the island’s economy are contained in the **Environmental Economic Model (2011-2020):**

- Study of the tourist load capacity and uses of the territory.
- Zero Waste Strategy (El Hierro 100% recyclable – Zero Waste Island project).
- Energy cost-savings programme.
- Campaign for the management of used vegetable oils for obtaining biodiesel (AVU-BIODIESEL-El Hierro project).
- Strategic Plan for Organic Production (includes a plan for encouraging consumption of local organic products targeted at school dining rooms, care services and residential tourism consumption).

The Infrastructure Ordination Guidelines in the area of transport establish as one of their objectives the reduction of air pollution processes generated by this activity, orienting their policy to the reduction of emissions by at least the removal from circulation of the oldest, most contaminating vehicles, incentivising the use of public transport and vehicles which run on renewable energies, and maintaining an efficient control of emissions in the current fleet according to the guidelines contained in the **Management Plan for Sustainable Mobility of the Island of El Hierro (2011)**. In order to progress in this area, the following agreement has been established:

DATE	AGREEMENT	PARTICIPANTS
21-09-2011	Framework collaboration agreement with the companies *Nissan-Renault* and *Endesa* for the implementation of electric vehicles in El Hierro.	Nissan Motor Co. Ltd. Renault S.A., Endesa S.A., and El Hierro Island Council.

D.4.2.1 Examples of strategic actions

a) Project "Herreño, patea tu isla" ("Inhabitant of El Hierro, walk around your island") (2012)

This initiative is conducted with the collaboration of the Government of the Canary Islands, the Canary Islands Mountaineering Federation, Ministry of Industry, Energy and Tourism and the project "Canary Islands, a Volcanic Experience II".

Within the framework of the Geopark Project, it promotes the activity of hiking and discovery of the natural environment of El Hierro by the local population. This is a programme of guided visits around three circular paths with average and low difficulty, aimed at encouraging the greatest number of people to take part (for all ages from eight years old).

b) *Empleaverde* Programme: employment for sustainable rural development (2011-2012)

The objective of the project is to encourage sustainable economic development on the island of El Hierro through the sustainable use of the local island resources, in both food and agriculture, culture, landscape, ecology and tourism.

The aim is to highlight the value of local quality food and farm products over those from other regions, which are predominantly used in the establishments on El Hierro. It will also promote knowledge of the natural and scenic resources of the island, which are generally underexploited and which have the possibility of being used in the active tourism sector.

D.4.3 Strategies for sustainable development of geo-education

Education on Earth Sciences in Spain is very poor in the compulsory education stage. To improve this situation, the island of El Hierro offers some magnificent educational material, particularly in the field of volcanoes and external geodynamic processes (coastal, slope, etc.). The whole island constitutes a first-class educational space of the highest order, and also has didactic materials and infrastructures available. Furthermore, the **Strategic Plan for the Geopark Project of El Hierro (2012-2017)** describes the strategic lines concerning geo-education and related environmental education.

In synthesis, this strategy centres on the following actions:

- Improvement and expansion of the existing educational areas. For example, the Nature Education Classroom "El Pinar" in the municipality of El Pinar de El Hierro.
- Development of a training programme for secondary school teachers and tourist guides such as the intensive course "Everything about our volcanoes (2012)".
- Collaboration with universities and other scientific institutions operating on the island, such as the Canary Islands Association for Science Teaching, for the purpose of creating an annual educational programme for all ages.

- Creation of a bibliographic collection on the Geopark Project regarding the teaching of geology in volcanic islands. There are very few relevant publications available, such as "The Geology of the Canary Islands. Construction and evolution of the landscape (Teacher's guide)". Department of Education, Culture and Sport. Government of the Canary Islands (1987)
- Development of a programme of science education courses, both in-house, and in coordination with other geoparks and geological parks. It is particularly worth noting the courses carried out by the Department of Investigation into Geological Hazards and Risks, the Department of Investigation and Geoscientific Prospection, the Spanish Geological and Mining Institute (IGME) together with the Island Water Board (CIA, Island Council of El Hierro); and Science Week (November, 2009): Geological risks of alluvial fans; and Science Week (November, 2010): Geological risks of rockfalls.

D.4.3.1 Examples of strategic actions

a) University Outreach Courses conducted in El Hierro during the period 2008-2012 (summer courses).

Year	Course title	Students	Cost (€)
2008	Biodiversity and conservation of the marine environment	33	5,149.05
2008	Renewable energies: basic principles, technological developments and economic implications	30	6,329.48
2009	Internet and citizenship: techniques and strategies of Internet use	22	4,957.58
2010	The new technologies applied to environmental pollution	15	3,253.59
2011	Physical activities. Organisation for leisure and recreation	24	3,483.03
2012	El Hierro, an island of contrasts: cultural tourism, and wine and gastronomic tourism	17	2,850.00

b) "Climadat" project (started 2010)

The “la Caixa” Foundation and the "Institut Català de Ciències del Clima (IC3)" Foundation have established an agreement for the purpose of creating a **network of eight climate observation and investigation sites** in critical or particularly sensitive natural systems, either due to their location, physiographic characteristics or the singularity of their ecosystems, and to make this a system of direct observation of climate change and its impact on a regional scale, becoming an international reference in the field. One of the locations selected is the island of El Hierro. This network will provide the relevant data, freely accessible, for the understanding of the interrelationship between the climate system and biosphere processes, by means of its insertion in *Near Real Time* in international scientific databases. Activities and information distribution systems will be developed for a comprehensive and socially active broadcasting of the data obtained with regard to climate change and its impact.

The educational and informative activities which will be generated from the data provided by the ClimaDat network on sites comprise a system of reception, processing and distribution of data which allows free access both to the international scientific community and to the general public in almost real time. In parallel, educational contents will be created aimed at promoting the socially active broadcasting of the data for the purpose of raising public awareness of climate change and its impacts.

D.4.4 Strategies for the sustainable management of geological heritage

The sustainability of the management of geological heritage includes the continuity of scientific investigation and the recognition of the value of georesources, in addition to their conservation. Priority has been given to volcanism, hydrogeology and geological hazards.

Water management, always so difficult on this island, is the subject of particular strategic attention. This strategic priority is expressed in the **El Hierro Island's Hydrological Plan** (1999) published by the Island Water Board of El Hierro.

In order to achieve the strategic objectives, described in the Strategic Plan for the Geopark Project (2012-2017), the Government of El Hierro, as the sponsor of the Project, has signed the following agreements:

a) Current agreements of a general nature:

DATE	AGREEMENT	PARTICIPANTS
24-05-1996	Framework collaboration agreement with the University of La Laguna.	University of La Laguna.
01-04-1999	Global collaboration agreement with the University of Las Palmas de Gran Canaria.	University of Las Palmas de Gran Canaria.

b) Specific agreements:

DATE	AGREEMENT	PARTICIPANTS
06-02-1998	Collaboration agreements for carrying out actions in coastal infrastructures.	Ministry of the Environment and the Government of the Canary Islands.
27-10-2003	Collaboration agreement on nature conservation	Department of the Environment and Territorial Ordination of the Government of the Canary Islands.
25-07-2007	Specific collaboration agreement for the consolidation of activities of investigation, teaching and dissemination of the marine environment in El Hierro, under the protection of the framework agreement existing between both organisations.	University of La Laguna.
2009 - 2012	Specific collaboration agreement for the enactment of projects and research works on the subject of geological hazards.	Island Water Board of El Hierro and the Spanish Geological and Mining Institute (IGME).

Within the framework of the El Hierro Island Ordination Plan, the protected nature areas on the island have management plans which specify strategic action lines with regard to their geological resources. For example, the objectives of the **Management Plan for the Mencafete Reserve** include:

I. Guaranteeing the natural dynamics of the ecosystems with particular attention to the influence of geological processes (for example, alluvial fans).
II. Promoting scientific investigation in the study of natural resources, with particular emphasis on the knowledge of ecosystems.

D.5 Policies for, and examples of, community empowerment (involvement and consultation) in the proposed Geopark

D.5.1 Strategies for citizen involvement

Without the active participation of the public it would be impossible to develop an integral rural development project such as a geopark. For this reason, the Management Body for the

Geopark Project (Board) has a permanent consulting committee of citizens' associations who meet periodically. Specifically, the following strategies have used in order to ensure public involvement in the process of preparing the Geopark candidacy:

- Following the process of preparation of the application in the local and regional press (see a selection of articles in the digital annexes) and also on El Hierro's tourism website and the website of the Geopark Project.
- Informative meetings and debate forums in the three municipalities.
- Presence of a stand for the Project at the main events in the island's cultural calendar. This activity of information and promotion is supplemented with the recruitment of volunteers who become "Friends of the Geopark Project".
- Raising awareness of the Project through specific marketing tools (leaflets, roll-up, T-shirts, etc. Figure 16).

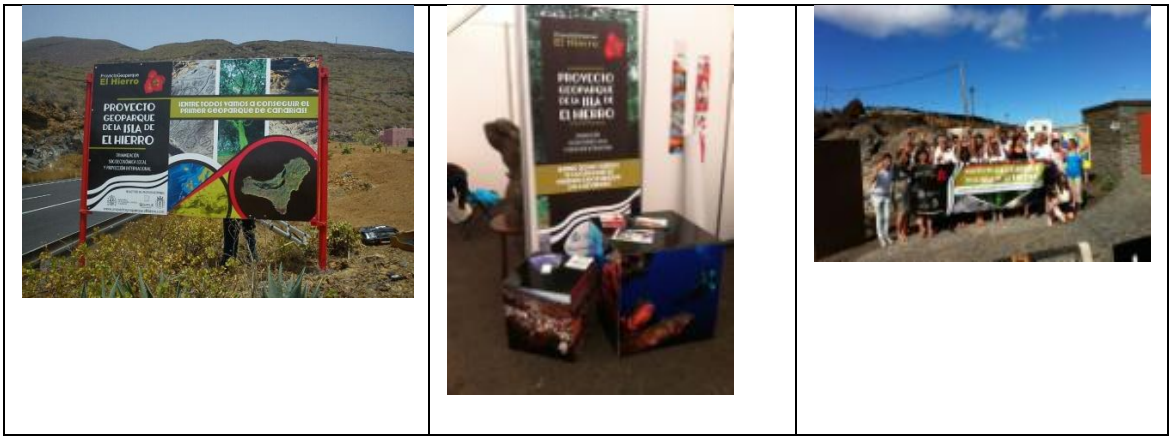

Fig.16. Elements of the marketing strategy for publicising and promoting the Geopark project: road panel, promotional stand, and promotional event (2012). With the promotional stand, 184 people have already joined as "Friends of the Geopark Project".

On a small island such as El Hierro, there is a long tradition of public participation. Thus for example during the review of the **Sustainable Development Plan of the Island of El Hierro (2006)** the citizens' opinions were collected by means of exhibitions, debates and telephone surveys. These opinions were taken into account and the current Plan focuses on finding solutions to the needs that were detected, including:

- Problems in the water and purification cycle
- Tourism development which takes into account the fragile ecosystem and the high value to tourism of nature areas, and particularly the geological environment.
- Problems of energy and mobility sustainability.
- Waste management problems.

Another strategic line which has been followed to raise awareness and involve the community in the values of the geoparks consists of taking advantage of the environmental education programmes which have been developed since 2004 by the Department of the Environment of the Island Government.

D.5.2 Examples of activities to raise awareness and involve the community

a) Activities with the island's school population (around 1400 students and 150 teachers)

The classroom activities are supplemented with fieldwork and homework. The main themes refer to the knowledge of the protected nature areas, paths and waste management (Project "My school recycles because I sort"), among others.

b) Campaigns and routes set up after the volcanic crisis (2011)

b.1) Reinforcement of the Campaign for **safety and emergencies: "En un pis-PAS" ("Quick as a flash"): Seek protection, alert 112 and help the injured"** for schools and nursery schools, with particular emphasis on the correct protective actions in the case of volcanic eruptions and earthquakes.

b.2) Information session on a town-by-town basis: **"El Hierro: a living island. Living together with our volcanoes".** With geologists specialising in volcanism.

b.3) **Volcanological route "Hoya de Los Roques-Montaña de El Julan"** including talks on the situation of the Mar de Las Calmas Marine Reserve (affected by the volcanic activity of 2011), material with information for schoolchildren (pre-school, primary school and secondary school) and visits to the information office of the National Geographic Institute (IGN) which has documented the seismic and volcanic activity.

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

D.6.1 Strategies

The Strategic Plan for the Geopark Project (2012-2017) includes the involvement of collaborating partners, both public and private, who are assigned a place in the consulting structure of the Management Body (Board): the Tourism and Business Commission.

The following members of this Commission meet periodically:

- A representative from the Hotel and Accommodation Association of Tenerife, La Palma, La Gomera and El Hierro (ASHOTEL).
- A representative from the Association of Small and Medium Enterprises on the island of El Hierro (APYME EL HIERRO).
- A representative from El Hierro's rural tourism associations.
- A representative from the company in charge of scheduled public passenger transport in El Hierro.

Similarly to section D5, a strategic line to raise awareness and involve business associations and neighbourhood groups in highlighting the values of the geoparks consists of taking advantage of the environmental education programmes developed since 2004 by the Department of the Environment of the Island Government.

<u>For business associations</u>

Initiatives with business groups (bars, restaurants, shops, workshops...) to raise awareness and provide information on the guidelines, systems and the regulation of standards for the improvement of environmental actions on the island. Actions such as:

- Campaign for the implementation of door-to-door collection of paper and cardboard from the island's businesses.
- Campaign for the collection of vegetable oils in restaurants and community canteens.
- Distribution of containers and information in bars and restaurants on the island on how to sort waste.

<u>For neighbourhood associations</u>

Actions with the neighbourhood associations on the island, in addition to various citizens' groups, include:

- Cleaning the coasts
- Awareness-raising talk on sorting and recycling waste.
- Distribution of bags for separating waste and informative talks in markets and supermarkets on the island.
- Information on the new system of waste collection.

In order to advance in this awareness-raising strategy, the government of the island has the following agreement:

DATE	AGREEMENT	PARTICIPANTS
14-04-1998	Framework collaboration agreement for the management of Recycling Points.	Department of Territorial Policy and the Environment of the Government of the Canary Islands.

D.6.1.1 Strategies for the partners in the tourism sector

The "Report on “Friends of the Geopark Project” Tourism Companies in El Hierro (2012)" contains a list of the companies and business associations who share the tourism quality objectives of the Geopark Project for the development of sustainable tourism on the island. There are currently 16 associated companies, and new companies committed to highlight the values of the Geopark Project among their visitors continue to volunteer for membership. These companies are promoted through the tools of the Geopark Project, and they undertake to participate actively in the training and refresher courses which are organised annually on the values of the geoparks and on quality management.

Some examples of associated companies (see also D.1.2):

Company	Contact	Outstanding values
Hotel **IDA INES** (La Frontera)	Sr. Amós Lutzardo Castañeda - E-mail: info@hotelidaines.com - Website: http://www.hotelidaines.com	Landscape (Tibataje cliffs) **GSH-12** Gastronomy
POBLADO JIRDAMA country house lodges (Valverde)	Sr. Enrique Febles González - E-mail: informacion@pobladojirdana.com - Website: http://www.pobladojirdana.com	Traditional architecture of El Hierro Alternative energies
ATLANTIDEA (Valverde)	Sra. Enrica and Sr. Paolo - Website: http://www.atlantidea.net - E-mail: atlantidea@hotmail.com	Guided nature visits Cultural tourism
LA JARITA country house lodge (El Pinar de El Hierro)	Sr. Rubén Acosta Morales - Website: http://www.casaruraljarita.com/	Landscape (Las Playas). **GSH-20**

D.6.1.2 Strategies for the partners in the primary sector

A strategic programme for this sector is the **First Programme of Sustainable Rural Development (2010-2014).** This involves the enactment of a series of multisectorial and environmental measures and actions, in a transversal manner and by agreement between the public administrations, in favour of rural areas. The scope of this set of measures is intended to encourage development in rural areas, thereby guaranteeing improvements in the living conditions of its inhabitants through the widespread development of services provided to the population and the development of all the endogenous potentialities of the territory.

The real and effective participation in the decision-making process of the local authorities, the population, and the economic, social and environmental stakeholders in each rural area is guaranteed through the **Assembly of Rural Development Associations**.

For the strategic development of the primary sector, the government of the island has signed the following agreements.

DATE	AGREEMENT	PARTICIPANTS
17-02-2004	Agreement with the La Frontera Rural Cooperative for the commercialisation of organically grown pineapples.	Cooperativa del Campo de La Frontera.
03-07-2002	Agreement for the commercialisation of organically grown bananas.	Cooperativa del Campo de La Frontera.
26-06-2005	Proyecto Europeo Biologi@	Municipal Association of *l'Ave*

		Amave Valley.
01-12-2011	Agreement between the Department of Agriculture, Farming and Water of the Government of the Canary Islands and the El Hierro Island Council for the actions designed to improve the irrigated lands of interest to the Autonomous Region and other rural infrastructures.	Department of Agriculture, Farming and Water of the Government of the Canary Islands and the El Hierro Island Council.

D.6.2 Examples

a) Proyecto Biologic@ (2005-2007)

This was a European project within the programme of the community initiative Interreg IIIC.

A series of initiatives are being carried out in the field of organic farming on the island of El Hierro, whereby the Island Council grants the use of land to be farmed by young people who take up agriculture and cattle rearing. Moreover there are projects in the Island Council's Experimental Farm involving tests on the organic farming of crops such as bananas, tropical fruits and pineapples.

Objectives of the project:

- Raising awareness of organic farming and training in the sector.
- Creation of an International Symposium on agriculture and bioeconomics
- Creation of a Bioeconomics Interpretation Centre to serve as a guide for organic farmers where they can obtain advice and information on the subject.

Total cost of project	**1,276,731.00 €**
Community contribution (FEDER TOTAL)	**983,130.95 €**
Total national contributions	**293,600.05 €**

The project ended in December 2007, but in spite of that and continuing the line followed by the Island Council so far, this initiative still continues to be active and to conduct a range of different activities related to organic farming. These include collaboration with schools through informative talks on organic farming, vermiculture, composting, etc.; school visits to the experimental farm, as well as visits by groups of technicians who wish to learn more about the experiment in organic crops such as bananas, pineapples, mango, etc.; technical advice on both organic farming and cattle rearing; farms are leased to farmers for organic farming of forage crops and also for the organic cultivation of vegetables, etc.

b) *"100% Renewable" project*

In the coming years El Hierro is set to become a world reference in the area of sustainability thanks to the high percentage of its electricity that will be supplied from renewable energy sources. The “100% Renewable” project has been promoted by the Island Council of El Hierro with the support of the Institute for Energy Diversification and Saving (IDAE), and the participation of the energy company ENDESA and the Government of the Canary Islands. Its objective is to build a **hydro-wind plant**, and it stands as one of the most emblematic actions at the international level in the area of energy self-sufficiency from renewable energy sources. Furthermore, El Hierro has set up an ambitious "Savings and Energy Efficiency Plan" which complements the production activities for electrical energy scheduled in the “100% Renewable” project.

Gorona del Viento El Hierro, S.A. is the company associated to the Geopark Project charged with developing the “El Hierro Hydroeolic Plant”, whereby the aim is to cover 100% of the island's electricity needs using exclusively renewable energy sources.

Gorona del Viento is 60% owned by the Island Council of El Hierro, 30% by the company Endesa, and 10% by the Canary Islands Institute of Technology. It has been created with the

following purpose: “Analysis, development, promotion, construction, operation and maintenance of the hydroeolic plant for the production of electricity in El Hierro through the use of a range of available renewable energies, and its subsequent delivery to the distribution company for final delivery to all the inhabitants of the island of El Hierro”

The project for 100% Renewable Energies for El Hierro includes the construction of a hydroeolic plant, with a total cost of 54.3 million euros, of which 35 million will be subsidised by the Ministry of Industry, Tourism and Commerce and the IDAE, through the Spanish national budget.

This project will avoid the annual consumption of 6000 tons of diesel fuel, equivalent to 40,000 barrels of oil which would have to be imported by boat to the island, representing a savings of over €1.8 million a year.

PART E INTEREST AND ARGUMENTS FOR JOINING THE EGN/GGN

E.1 The territory’s interest in joining the European Geopark Network

The geopark model of rural development coincides with the lines of work enacted in the territory in recent years and is fully integrated in the territory's strategy for sustainable development. It responds to a growing interest by the community, and consolidates the territory's vocation to claim recognition for the value of its geological heritage as a part of the rest of its natural and cultural heritage (tangible and intangible).

In conclusion, it can be said that all the lines of work that are developed under the "Geopark Model" are considered to be beneficial in improving the quality of life of its inhabitants.

E.1.1 Contributions of the El Hierro Geopark Project to the territory itself

The territory thus wishes to be incorporated into the Network for a variety of reasons, which are listed below:

- The development of the Geopark Project within the framework of the Network (EGN & GGN) will enable some of the limitations of the territory to be overcome, primarily concerning its geographic situation and the area's difficult orography.
- It will provide a means for promoting this exceptional natural and cultural heritage on a local, regional, national and international scale.
- Open up new opportunities for employment and the creation of businesses.
- Promote values related to sustainable development.
- Develop geotourism and improve the quality of tourist services.
- Promote the management of the El Hierro Biosphere Reserve
- Implement a team of volunteers entitled "Friends of the Geopark Project".
- Develop a quality brand for local products.
- Differentiate the territory from other tourist destinations.
- Improve awareness of the geological heritage among the people who visit the island and among the residents themselves.
- Improve the use of sites of geological interest and infrastructures to incentivise the exchange of students and thus to further research which will ensure a continued increase in the knowledge and dissemination of geology.

E.1.2 Contributions of the El Hierro Geopark Project to the Network (EGN & GGN)

The Geopark Project team comprises experts in various disciplines which play a role in the socio-economic development of the territory, including the areas of environmental education (geo-hazards, ITC-geo-information), drinking water management, sustainable mobility, and particularly the field of renewable energies (project for the El Hierro Hydroeolic Plant). The exchange of these human resources can be considered to be of benefit to other territories in the Network with a similar set of problems. El Hierro can contribute its experience in the

management of European programmes such as Interreg in order to develop joint projects with other territories within the framework of the new *Horizon 2020* programme, which is due to begin in 2014. This proposal may be very useful for other islands which share similar problems, particularly in Macaronesia.