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Lanzarote: volcanoes and life in evolution

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Evolution of the geomorphological landscape

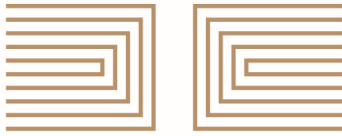
Just like the other islands on the archipelago, Lanzarote has volcanic origins: it erupted from the sea bed at a depth of some 2,500 metres but has never been connected by land to the continent of Africa. Its foundations are shared with the neighbouring island of Fuerteventura and were constructed over time by the accumulation of oceanic sediments and volcanic materials spewed from successive underwater eruptions. At some point around the middle of the Miocene period, the base of the island reached the surface of the water and from that point started to emerge gradually to form the island we know today.

Los Ajaches and Famara

Geological studies (HANSEN MACHÍN-PÉREZ TORRADO 2005) have concluded that the western region of Lanzarote is its oldest, with an estimate age of around 15 million years. It now forms the Los Ajaches massif, a highly-eroded mountain range. After a long period of relative volcanic calm, eruptions recommenced and formed another island at the eastern end of the island which now constitutes the Famara massif. The new island, which started to emerge some 10 million years ago, continued to rise progressively as a result of numerous basalt lava flows and now reaches an altitude of more than 2,500 metres. At an undetermined point in time, its stability reached a critical point and gravity caused a gigantic landslide which demolished most of its structure, dragging enormous amounts of rocks and earth into the sea. This massive collapse and the subsequent erosion caused by the waves have exposed the bowels of Famara and the result can now be seen as an impressive sea cliff (HUNT *et al.* 2014).

Ancient volcanoes and huge plains

Subsequent eruptive episodes, most of which were eruptive fissures taking place along deep crevices running from the north-east to the south-west, ended up joining the two volcanic edifices and creating for the first time ever a single island approximately 6 million years ago, although it would take a much longer time to take on its current configuration. The low altitude mountains and gentle terrain found all over the surface of the island are old volcanic cones (no older than 700,000 years) which have eroded over time. The lava flows coming from them have been completely transformed by erosion and have given rise to the huge plains of the modern-day island. The island is the result of all of these different volcanic events interspersed with shorter or longer periods of calm in which the rain, wind, sea and other erosive factors have shaped its face.

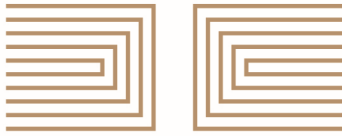


Malpaís de La Corona

One of the most important recent eruptions was that of La Corona 20,000 years ago whose lava left the *malpaís* which runs across the whole of the north-eastern end of Lanzarote. On the Canary Islands, the *malpaíses* are the most recent areas formed of volcanic action and are not suitable for growing. This is where we can find a long lava tube which can be accessed via several openings, or *jameos*, such as the *Cueva de los Verdes* and the *Jameos del Agua*, two of the leading tourist attractions the island offers. *Jameo* is a word from the ancient language of the *mahos*, the primitive inhabitants of the island, and means something like cave or shack. *Jameos* are formed when the roofs of lava tubes collapse in, leaving a way to access the inside. La Corona's lava tube begins at the base of the volcano, running underneath the *malpaís* (at different depths and with several branches) and approximately 2 kilometres into the sea at a depth of up to 80 metres (CARRACEDO *et al.* 2003). The underwater section, known as the *Túnel de la Atlántida* (Tunnel of Atlantis), houses a huge biodiversity of different marine animals, including 36 different species of invertebrates which, so far, have only been found there (WILKENS *et al.* 2009). Lava tubes only form on land because, as soon as they reach the sea, they begin to cool and stop flowing. The Tunnel of Atlantis must have formed when the sea level was lower and the current coastline was located approximately 2 kilometres from where it is now. La Corona volcano erupted during the last ice age which was at its peak some 20,000 years ago. A huge area of the northern hemisphere was covered by a thick cap of ice for thousands of years, and the sea level dropped more than 100 metres. During this time, Lanzarote and Fuerteventura formed one single island running from the north-east to the south-west, all the way from the islet Alegranza to the north of Lanzarote to beyond the Punta de Jandía at the far south-west of Fuerteventura.

Timanfaya

The most recent major volcanic event started in 1730 and lasted until 1736. When it was over, almost a quarter of the surface area of the island (around 200 square kilometres) was covered in huge lava flows, scoria and volcanic ash expelled from the more than twenty five volcanoes which appeared during those years. The existence of a residual magma chamber can still be found in some places where the temperatures at a depth of just half a metre underground exceed 100 degrees and increase progressively to 600 degrees at a depth of around 13 metres. The first eruptions began at the start of September 1730 and threw huge quantities of pyroclastic material into the air. According to writings from the time, "houses, tanks, factories, haystacks and arable and mountain land were burned" within a radius of several kilometres (ROMERO RUIZ 1997). Later on, other violent volcanoes were formed with "fire running along different paths, as fast-flowing as though they were rivers". The ever-growing lava fields, the smoke and ash which darkened the sky, the frequent thunder and lighting and the terrifying noise from the explosions drove the majority of the frightened population to emigrate to the others islands. The volcanic activity continued practically without interruption until it ended in April 1736. Almost a century later, in 1824, there were a few new eruptions, although these were less violent. The volcanic materials expelled were of a basaltic nature, just like all of the eruptions occurring on the Canary Islands over the last few thousand years. This event clearly took place along fissures, with the main areas situated along the largest crevices, most running along the north-east to south-west axis. The lava flowed mainly toward the north coast as it was stopped by the range of older volcanoes located more in the centre of the island. As a result, the area affected was reduced considerably. The Timanfaya area was declared a national park in 1974 and covers approximately 50 square kilometres which correspond more or less to the area which was most affected by the eruptions. This is one of four national parks within the Canary Islands, and receives an average of 1.5 million visitors each year. In 1993, the entire island was declared a UNESCO Biosphere Reserve.



El Jable

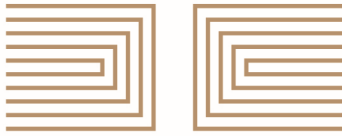
Jable is a local variation of the French word *sable*, or 'sand' in English, and refers to the vast sand plain which stretches across the entire island from north to south. The name originally comes from the Norman conquerors who arrived on Lanzarote at the beginning of the 15th century. *Jable* contains organic sediment from the ocean made up of tiny fragments of mollusc and crustacean shells, echinoderms, foraminifera, calcareous algae and minuscule remains of other marine species. The sea level dropped during the last ice ages, leaving the bottom of the sea exposed to the elements. As a result, millions of tonnes of this dried out sandy sediment were blown by the winds to the centre of the island. Along the coast, this *jable* is light in colour, but becomes increasingly darker as you move toward the centre of the island as it is mixed with other types of earth. The area covered by the *jable* started to expand at the start of the 19th century, and has even managed to completely bury some farmsteads and agricultural lands in the space of just a few years. The main reason for this phenomenon has been the clearing of the woody shrubs along the coast which used to hold back the sands but which are now used as fuel (LEÓN HERNÁNDEZ-ROBAYNA FERNÁNDEZ 1989). In the past, farmers on the island of Lanzarote used to actively promote the use of the sand by directing it where they wanted it to go with the help of *bardos*— temporary walls made of straw— as though it were irrigation water. Nowadays, some fields are planted with sweet potatoes and other food plants, although most of what is grown now is herbaceous plants for green fodder. The *jable* continues to advance across the lava fields in the eastern sector of Timanfaya and towards the south, meaning that the islanders face a constant battle to clean it away to prevent the streets and houses of recently-built residential areas disappearing under mountains of sand.

Life surrounded by volcanos

Lanzarote is the easternmost island on the archipelago making up the Canary Islands, and is located approximately 130 kilometres away from the African coast. It has a total surface area of 846 square kilometres and at its highest point is barely 670 metres above sea level. Although it is very close to the Sahara— the largest desert on the planet — the island has a subtropical-desert climate which is much less harsh. The reason for this is its location between two large climate systems in the Atlantic: the Gulf Stream, which in this region brings cold waters, and the trade winds coming in from higher latitudes which keep the island both humid and fresh all year round. The average temperatures are 17 degrees in winter and 24 degrees in summer, and the relative humidity remains between 60 per cent and 70 per cent for almost the entire year. The amount of precipitation is quite low, with a yearly average of just 50 millimetres in the most arid areas in the south of the island, and 250 millimetres in the mountains in the north. Occasionally the island experiences torrential rains, mainly the result of ocean storms, which can drop enormous amounts of water on the island in just a few hours. Lanzarote is also subjected every now and again to masses of hot air coming in from the Sahara (and generally carrying suspended dust particles), a phenomenon which can last for several days and is known as *calima* on the Canary Islands.

Transforming vegetation

Nowadays, most of the island's natural vegetation is made up of plants adapted to the prevailing semi-arid conditions. However, around 2,500 years ago, different species of tree grew on Lanzarote. Palynological (pollen) and antracological (carbon) studies of sedimentary layers and archaeological sites from the 6th century BC to the 1st century AD indicate the presence of certain tree species such as pines (*Pinus*), native palms (*Phoenix*), juniper trees (*Juniperus*), wild olive (*Olea*), firetree (*Myrica*) and heather (*Erica*), which remain characteristic trees of the more western Canary Islands, but not the easternmost ones. Pollens from other trees more typical of much higher latitudes have also been identified, although these are no longer found on the archipelago. They include ash (*Fraxinus*), alder trees (*Alnus*) and holm oaks (*Quercus*). Some of the archaeological sites mentioned are well-preserved several metres deep under lapilli from eruptions from Timanfaya and were uncovered while the volcanic material was being extracted in the mid 20th century for use in *enarenado* dry farming (ATOCHÉ PEÑA 2009).



Stratigraphic sequences show a progressive drop in tree species on the island which were replaced by shrubs and herbaceous plants which are more suited to semi-arid conditions. This decline in the range of flora does not appear to be related to a change in climatic conditions, but is more likely to be the result of better use of the more fertile soil for agricultural crops and intense livestock farming which is reflected in the increase in stony ground resulting from erosion caused by animal foraging (HERNÁNDEZ *et al.* 1991). This transformation of the vegetation was irreversible, and only a few groves of trees remained at the peaks of the Famara massif (the highest and most humid region of the island) until the beginning of the 19th century, but they have also now disappeared (KUNKEL 1982).

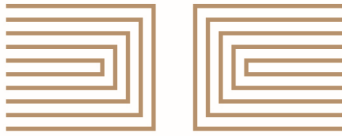
We know very little about the vegetation on the island from the beginning of the modern era until the 15th century, although it is quite reasonable to believe that its inhabitants, the *mahos*, would have continued to exploit all of the natural resources they could and increased the area dedicated to crops and grassland which were doubtless essential to their survival.

By the time the Normans arrived on Lanzarote in 1402, the island's vegetation would have already been very similar to what we recognise today. *Le Canarien*, the chronicle of the French conquest, is very explicit: "there are no trees, only small scrubland bushes used for burning and a type of castor oil plant covering the island from one end to the other which is used to produce a milky substance with medicinal properties" (SERRA RÀFOLS-CIORĂNESCU 1965). The scrubland bushes used for burning which they referred to were most likely the different, mainly endemic, shrubs on the islands such as the *tasaigos* (*Rubia fruticosa*), *joraos* (*Asteriscus intermedius*), *espinos* (*Rhamnus crenulata*), *tajinastes* (*Echium decaisnei*), *ahulagas* (*Launaea arborescens*) and many others. The castor oil plants are shrubs from the *Euphorbiaceae* family, known on the islands as *tabaibas* which contain a milky latex of questionable medicinal use. On Lanzarote, the most common species are the *tabaiba dulce* (*Euphorbia balsamifera*) and the *tabaiba amarga* (*Euphorbia regis-jubae*), which also grow on the nearby African coast. The French chronicle also confirms the results of the archaeological studies: "there is a large quantity of fountains and tanks, grassland and good soil for crops and the land produces a great deal of barley which makes very good bread" (SERRA RÀFOLS-CIORĂNESCU 1965). It is interesting to find mention of water tanks built in times predating the colonisation of Europe. Water has always been a precious commodity on the island, obviously as a result of its scarcity. Up until the middle of the 20th century, almost all of the traditional houses on Lanzarote had an underground tank (*aljibe*) or well for storing the rainwater for domestic use (RODRÍGUEZ BRITO 1995). Water was also collected in *maretas*, natural or artificially excavated hollows generally located at the base of mountains, in order to make the best use of run-off water and which were mainly used for agriculture. Nowadays, most of the freshwater on the island is produced by water-treatment and desalination plants. The older generation still remember, however, the days not so long ago of extreme drought when drinking water had to be brought over from Tenerife and Gran Canaria on boats.

After the Norman conquest, Lanzarote started to be colonised by Europeans who made a living keeping sheep or cultivating these "great soils for crops". During the following three centuries, the island economy was supported almost entirely by the production of cereal crops, the surplus of which was exported to the other islands on the archipelago. Small amounts of other crops such as lentils, chickpeas, green beans, onions, maize, vines, fig trees, melons, sweet potatoes, *papas* and many other food crops from the Old and New Worlds were also grown. More natural vegetation ended up being relegated to the less productive agricultural areas such as Famara, Los Ajaches, the *malpaís* of La Corona or more arid coastal regions (REYES BETANCORT *et al.* 1998).

Agriculture in volcanic terrain

The eruptions in the 18th century destroyed the best land dedicated to growing cereals, and agricultural methods changed radically. In order to survive, farmers on Lanzarote had to adapt to a very different environment, introducing new techniques for growing crops which had to evolve over time (GIL GONZÁLEZ 2005). The volcanoes of Timanfaya expelled huge amounts of ash and volcanic sand which was blown by the wind to the



furthest corners of the island. Lapilli, or *rofe* as the volcanic material is referred to locally, covered different mountains and meadows with a blanket which reached a depth of several metres in some areas. Shortly after the volcano stopped erupting, the areas which were only covered with a very thin layer of lapilli started to show signs of growth of native species. Their seeds had not only survived underground, but also actually produced very vigorously growing plants. Farmers started to plant them alongside the old food crops which had managed to escape the eruptions, and found that vines, fig trees and other species with long, deep roots were the ones which fared best. This can be explained by the fact that the primitive soil is able to provide the main nutrients until the roots can grow, and the lapilli can retain the little amount of rainfall and dew there is whilst preventing evapotranspiration. Plants are grown in pits dug artificially out of the ground and almost always surrounded by volcanic stone walls to protect them from the wind. The surprising current landscape of the La Geria Natural Park is the result of the experience and efforts from the island's growers who, over time, have managed to improve the yield of the *enarenados*. These growing techniques have also spread – with excellent results – to other areas of the island unaffected by recent volcanic activity, covering old agricultural land with a thin layer of *rofe*.

Basaltic lava moving over flat or only slightly inclined areas only advances very slowly, forming ripples due to the lava flowing behind it. When it cools, it results in quite smooth, even surfaces which can often be walked on barefoot. The geological term for this kind of lava flow is *pāhoehoe*, a word of Hawai'ian origin meaning 'smooth'. Lava tubes form under these surfaces, and they also result in crevices and cavities which remain humid inside (with humidity levels much higher than the surrounding area), creating a very favourable habitat for many native species to grow naturally. In Lanzarote, they are given the name *chabocos*, and local farmers also use them to grow vines and fruit trees.

Biodiversity

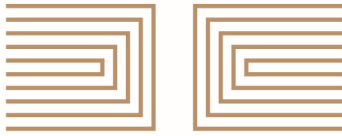
Even though the plant life may have been shaped by human activity, the island still conserves a very diverse native flora – estimated to number some 700 taxa (species and subspecies), of which 90 are endemic to the Canary Islands, and 22 are found exclusively on Lanzarote. The Famara cliffs, thanks to their particular environmental conditions, house more than half of these plants, including 50 endemic to the Canaries and 12 limited to Lanzarote. Alongside the flora live some 350 native species of insects, arachnids, molluscs and other invertebrates living on the land; 130 of these are only found in the Canaries and 37 are exclusive to Lanzarote. Bearing in mind its tiny surface area (20 square kilometres), Famara is considered one of the most important biodiversity 'hotspots' in Spain and in the European Community as a whole.

The volcanic areas from the eruptions in the 18th and 19th century remain largely untouched today, and the plant colonisation is still very much limited to its initial phases depending on all kinds of different factors such as the type of soil, orientation, distance and supply of seeds and so on (GONZÁLEZ MANCEBO *et al.* 1996). Wide areas of lava flows and landscapes remain practically sterile, whereas others are already densely populated with lichens, and some areas covered by lapilli have started to become colonised by herbaceous plants and shrubs, both native to the island and introduced from outside. The *malpaís* of La Corona, which is around 20,000 years old, is covered by xeric shrublands – plants which are well-adapted to the harsh environmental conditions and most of which are endemic to the Canary Islands. It is one of the best examples on the archipelago of an advanced phase of plant colonisation of *malpaíses* in semi-arid conditions.

The Guatiza Cactus Garden, designed by César Manrique, shows us a few examples of strategies used by plants to survive in different volcanic soils and how farmers on the island managed to turn the seemingly barren terrain into fertile growing land.

Lanzarote throughout history: between the myth and reality

Traditionally, the Canary Islands have been proposed as candidates for being the Fortunate Isles, the semi-legendary islands found in Greek and Roman mythology which were supposed to be the final place where honourable people could 'retire' after their deaths.



According to the authors of the classics, its climate was said to be salubrious and its earth was meant to grow up to three harvests of delicious wild fruits a year. They declared that these islands existed in reality, but were in an unknown location, difficult to reach, somewhere in the mysterious ocean which stretched out beyond the Pillars of Hercules, the current Strait of Gibraltar.

Thanks to archaeological studies, we now know that the islands were not entirely undiscovered, as there is evidence of human population– possibly of Phoenician origin– going far back as the 10th century BC (GONZÁLEZ ANTÓN-DEL ARCO 2009). Fragments of ceramics and the ground shells of certain marine molluscs used to obtain the ancient valuable and highly desired purple of Getulia dye discovered by the Phoenicians have been found on the island of La Graciosa, located just 2.5 kilometres north of Lanzarote. They were discovered in a sedimentary marine deposit which has been dated back to between the 11th and 10th century BC (GARCÍA-TALAVERA 2002).

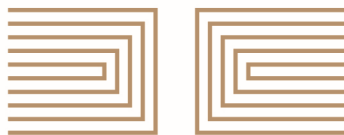
In the writings of Diodorus Siculus (1st century BC), we find references to the Carthaginians discovering an uninhabited island in the Atlantic in the 6th century BC which enjoyed a mild climate and was full of streams and mountains covered in trees. The island was visited frequently, and some Carthaginians wanted to set up a permanent colony there, however the authorities prohibited living on the island– on pain of death– because in case of an emergency they wanted to use it as a refuge where people could survive thanks to its natural resources (SANTOS YANQUAS 1988). It is quite possible that this island was Lanzarote, where permanent settlements of seafarers from Iberian and Northern African territories annexed by Carthage have been confirmed since at least the 6th century BC (ATOCHÉ PEÑA 2009).

Pliny the Elder dedicated an entire chapter of his monumental *Naturalis historia* from the 1st century AD to the Fortunate Isles. This is the oldest text which contains reliable information on the nature of the Canary Islands. Among other things, he refers to their huge fishing resources, the abundance of fruit trees and all kinds of different birds, palm trees which produced dates and pine trees producing pine nuts. The Roman naturalist also mentions the Purpuraria Islands, identified as the eastern Canary Islands, where a species of mollusc used for dyeing (*Stramonita haemastoma*) is still commonly found along its shores. Recent archaeological findings on Lobos Island located between Lanzarote and Fuerteventura have revealed the existence of a Roman factory which processed these marine molluscs and which existed between the 1st century BC and the 1st century AD. The Roman presence on Lanzarote, confirmed by other archaeological finds further inland, lasted until the start of the 4th century AD (DEL ARCO *et al.* 2017).

After the fall of the Eastern Roman Empire in the 5th century, the Canary Islands fell into oblivion for over a millennium. Its mediaeval rediscovery was attributed to Genoese navigator Lancelotto Malocello who landed on Lanzarote in 1312 and stayed there for two decades until he was expelled by the *mahos*. His presence on the island, which even takes its name from him, is well documented, with him even appearing in various mediaeval maps such as the Catalan Atlas of 1375, attributed to Majorcan cartographer Abraham Cresques.

Lanzarote entered the modern age at the beginning of the 15th century when it was subjugated by the Normans. The chronicle of the French conquest provides some very curious information regarding the native population: “the men walk around naked, apart from a cape over their backs, and they are not embarrassed to show their members. The women are beautiful and are dressed decently with leather tunics which reach as far as the ground”. The chronicle adds that “most of the women have three husbands, with each serving them for a month [...] they raise lots of very attractive and gracious children, and they are white like us, but they are roasted by the wind as they have no dresses” (SERRA RÀFOLS-CIORĂNESCU 1965). There is no doubt that the women were indeed beautiful, the proof being that many of the conquerors married indigenous women, including Maciot de Bethencourt– the nephew and heir of the Norman leader– who married the local princess Teguiuse, the current name of the former capital of the island.

The first impression the Normans had of Lanzarote– “a beautiful country inhabited by beautiful people [...] with a large number of fountains, grassland and good soil for crops”– was possibly the last memory of a myth which had persisted throughout



the centuries. Wars, famines, betrayals and other later tragedies, described in great detail in the French chronicles, changed drastically this initial idyllic impression. Lanzarote, just like the other legendary Fortunate Isles from the ancient world, had entered the crude reality of the modern world.

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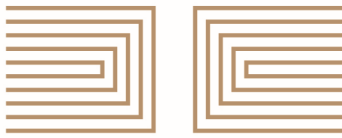
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