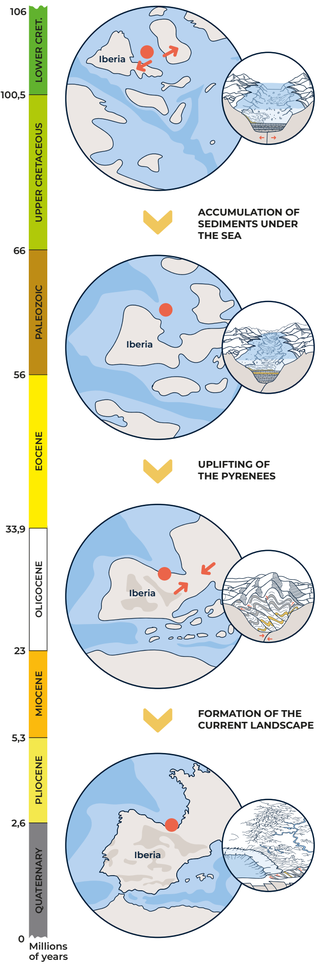
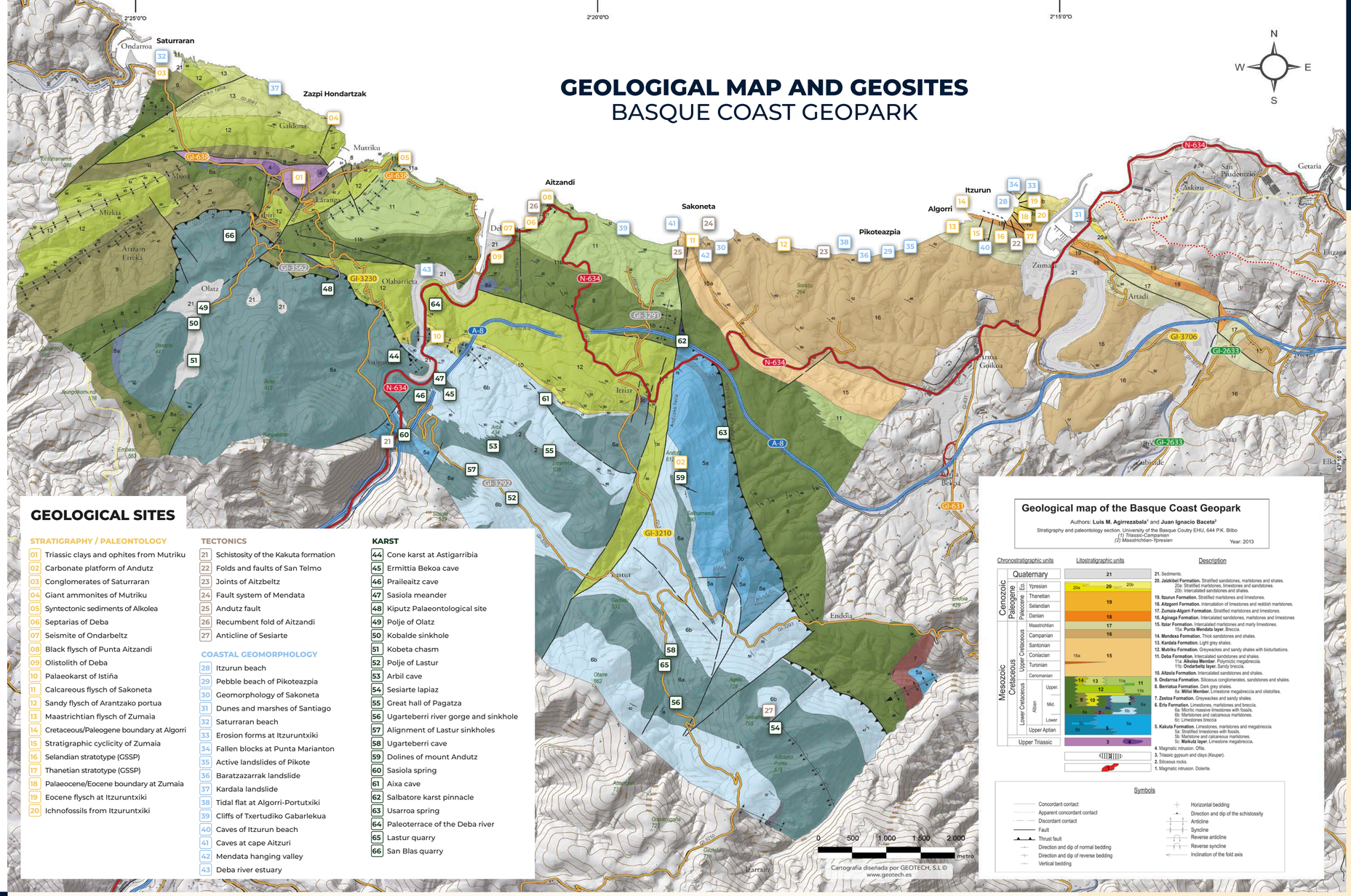
GEOLOGICAL EVOLUTION

100 MILLION YEARS

The perfect geological record of the opening and closing of the Bay of Biscay.



GEOLOGIGAL MAP AND GEOSITES
BASQUE COAST GEOPARK



GEOLOGICAL SITES

STRATIGRAPHY / PALEONTOLOGY

01 Triassic clays and ophites from Mutriku
02 Carbonate platform of Andutz
03 Conglomerates of Saturraran
04 Giant ammonites of Mutriku
05 Syntectonic sediments of Alkolea
06 Septarias of Deba
07 Seismite of Ondarbeltz
08 Black flysch of Punta Aitzandi
09 Olistolith of Deba
10 Palaeokarst of Istiña
11 Calcareous flysch of Sakoneta
12 Sandy flysch of Arantzako portua
13 Maastrichtian flysch of Zumaia
14 Cretaceous/Paleogene boundary at Algorri
15 Stratigraphic cyclicity of Zumaia
16 Selandian stratotype (GSSP)
17 Thanetian stratotype (GSSP)
18 Palaeocene/Eocene boundary at Zumaia
19 Eocene flysch at Itzuruntxiki
20 Ichnofossils from Itzuruntxiki

TECTONICS

21 Schistosity of the Kakuta formation
22 Folds and faults of San Telmo
23 Joints of Aitzbeltz
24 Fault system of Mendata
25 Andutz fault
26 Recumbent fold of Aitzandi
27 Anticline of Sesiarte

COASTAL GEOMORPHOLOGY

28 Itzurun beach
29 Pebble beach of Pikoteazpia
30 Geomorphology of Sakoneta
31 Dunes and marshes of Santiago
32 Saturraran beach
33 Erosion forms at Itzuruntxiki
34 Fallen blocks at Punta Marianton
35 Active landslides of Pikote
36 Baratzazarrak landslide
37 Kardala landslide
38 Tidal flat at Algorri-Portutxiki
39 Cliffs of Txertudiko Gabarlekua
40 Caves of Itzurun beach
41 Caves at cape Aitzuri
42 Mendata hanging valley
43 Deba river estuary

KARST

44 Cone karst at Astigarribia
45 Ermittia Bekoa cave
46 Praileaitz cave
47 Sasiola meander
48 Kiputz Palaeontological site
49 Polje of Olatz
50 Kobalde sinkhole
51 Kobeta chasm
52 Polje of Lastur
53 Arbil cave
54 Sesiarte lapiaz
55 Great hall of Pagatza
56 Ugarteberri river gorge and sinkhole
57 Alignment of Lastur sinkholes
58 Ugarteberri cave
59 Dolines of mount Andutz
60 Sasiola spring
61 Aixa cave
62 Salbatore karst pinnacle
63 Usarroa spring
64 Paleoterrace of the Deba river
65 Lastur quarry
66 San Blas quarry

11 CALCAREOUS FLYSCH OF SAKONETA
THE CALM BEGINS

The Upper Cretaceous began with a sea level rise and a long period of calm, resulting in 700 metres of limestones and calcareous marls with small turbidites and many fossil traces. 98 – 80 Ma.

12 SANDY FLYSCH OF ARANTZAKO PORTUA
A BIG UNDERWATER FAN

A relative drop in sea level caused many turbidites to reach the deep basin, resulting in 1,500 metres of sandy flysch with many trace fossils. 80 – 70 Ma.

13 MAASTRICHTIAN FLYSCH OF ZUMAIA
THE WORLD BEFORE THE IMPACT

Limestones and marls where we can study the extinction of inocerамids and the last ammonites before their disappearance at the K/Pg boundary. 72 – 66 Ma.

14 CRETACEOUS/PALEOGENE BOUNDARY AT ALGORRI
THE GREAT EXTINCTION OF THE DINOSAURS

80% of marine fauna disappeared in this thin layer of dark-coloured clay containing iridium and microtektites related to the Yucatan impact. 66 Ma.

15 STRATIGRAPHIC CYCLICITY OF ZUMAIA
ASTRONOMY IN THE ROCKS

One of the best global examples of stratigraphic cyclicity related to Milankovitch's precession (limestone-marl pair) and eccentricity cycles (5 pairs). 66 – 61 Ma.

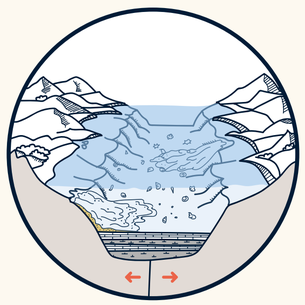
16 GSSP. SELANDIAN STRATOTYPE
A GOLDEN SPIKE IN ZUMAIA

Global reference section and point with a golden spike (2010) defined by a relative minimum of Carbon 13 interpreted as a change in ocean circulation in the Palaeocene. 61 Ma.

OPENING OF THE GULF OF BISCAY

LOWER CRETACEOUS

110 – 100 Ma



Geoparkea was a shallow tropical sea where large **coral reefs** formed. The opening of the Gulf of Biscay fractured the seabed, creating deep basins where ***black flysch*** was deposited under conditions of constant movement and great tectonic instability.

01 TRIASSIC CLAYS AND OPHITES FROM MUTRIKU
THE OLDEST ROCKS IN THE GEOPARK

They were formed by the evaporation of large saltwater lagoons during the fragmentation of Pangea. They appear in Mutriku thanks to the Berriatua fault. 220 Ma.

02 CARBONATE PLATFORM OF ANDUTZ
CORALS IN THE MOUNTAINS

Limestones with a large number of fossils of corals, rudists, ostreids and sponges typical of a tropical coral reef that was formed in the geopark. 110 Ma.

03 CONGLOMERATES OF SATURRARAN
THE OPENING OF THE BAY OF BISCAY

The seabed fractured, causing large avalanches of coarse sediments to fall to the deep sea through a 7 kilometres wide underwater canyon. 105 Ma.

04 GIANT AMMONITES OF MUTRIKU
AN OASIS OF LIFE IN THE DARKNESS

The large size of the shells may be related to black smoker-type hydrothermal vents that enriched the environment around the Mutriku fault. 104 - 100 Ma.

05 SYNTECTONIC SEDIMENTS OF ALKOLEA
TECTONICS UNDER THE SEA

Angular discontinuities and a syncline with sediments from the limbs incorporated into its core. Deformation and sedimentation coexisted during the formation of black flysch. 103 Ma.

06 SEPTARIAS OF DEBA
SMALL NATURAL GEMS

Spherical siderite nodules produced by microbial activity. They have spectacular internal fracturing filled with white calcite. Collection open to visitors in Deba. 103 Ma.

07 SEISMITE OF ONDARBELTZ
EARTHQUAKES IN THE GEOPARK

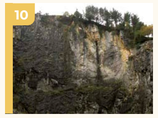
An earthquake on the seabed destabilized the sediments, giving rise to a disordered set of folded rock fragments enclosed in a clayey matrix. 103 Ma.

08 BLACK FLYSCH OF PUNTA AITZANDI
FLYSCH AND VOLCANOES UNDER THE SEA

Typical section of black flysch with black shales and turbidites. Thin pyroclastic layers ca be also found. The opening of the Bay of Biscay generated significant underwater volcanic activity. 102 Ma.

09 OLISTOLITH OF DEBA
THE REEF COLLAPSES

A large block on the edge of the reef fractured and fell down the slope, becoming embedded in the black flysch clayey sediments of the deeper basin. 107 Ma.



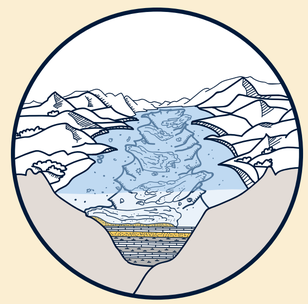
10 PALAEOKARST OF ISTIÑA
THE FIRST CAVES IN THE GEOPARK

Due to tectonic movements the carbonate platforms remained exposed for a while and became karstified, giving rise to an irregular surface that was later filled with deep turbidites. 100 Ma.

A DEEP AND CALM SEA

UPPER CRET. - PALEOCENE - EOCENE

100 – 66 Ma



The Geopark became a deep and calm seabed where the ***calcareous and sandy flysch*** of the Upper Cretaceous and Palaeocene were deposited, recording major events such as the K/Pg extinction in the **Zumaia section**. The Eocene turbidites indicate incipient instability related to the uplift of the Pyrenees.

17 GSSP. THANETIAN STRATOTYPE
A GOLDEN MAGNETIC CHANGE

Global reference section and point with a golden spike (2010) located just above the Mid-Paleocene Biotic Event (MPBE) and defined by a change in the magnetic polarity of the rocks. 58.7 Ma.

18 PALAEOCENE/EOCENE BOUNDARY AT ZUMAIA
THE GREAT WARMING EVENT

This reddish clayey section with anomalies in Oxygen and Carbon isotopes reflects one of the greatest greenhouse warming events in Earth's history. 56 Ma.

19 TURBIDITES OF EOCENE FLYSCH AT ITZURUNTXIKI
TURBIDITES ARE BEAUTIFUL

The nearby uplift of the Pyrenees caused a large number of turbidites to fall, displaying a natural museum of sedimentary structures such as *flutes and grooves* and spectacular laminations. 54 Ma

20 ICHNOFOSSILS FROM ITZURUNTXIKI
ENIGMATIC FOOTPRINTS ON THE SEABED

Spectacular display of a set of *Scolicias* and the largest *Saerichnites abruptus* ever described. Original pieces and replicas on display at Flyschenea museoa. 54 Ma.

GIPUZKOA
Fun Aldundia - Diputación Foral

EUSKO JAURLARITZA
GOBIERNO VASCO
TURISMO, MERKATARITZA ETA KONTSUMOA
COMERCIO Y CONSUMO

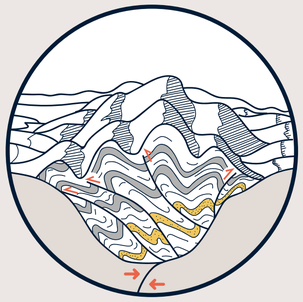
GEO PAR KEA
BASQUE COAST · CÔTE BASQUE

unesco
Global Geopark

geoparkea.eus

TECTONICS
THE UPLIFT OF THE PYRENEES
OLIGOCENE - MIOCENE - PLIOCENE

40 – 5 Ma



The collision of Iberia with Eurasia closed the Bay of Biscay from east to west and slowly uplifted the Pyrenean mountain range. Marine sediments were deformed, forming **folds and faults** of varying scales, giving rise to the substrate of the current landscape.

21 SCHISTOSITY OF THE KAKUTA FORMATION
DEFORMATION PLANES IN ROCKS

Marls are "soft" rocks and respond to the compression produced by tectonic forces by developing planes called schistosity.

22 FOLDS AND FAULTS OF SAN TELMO
A PERFECT DUPLEX

The set of faults located under the San Telmo chapel forms a perfect duplex with a drop of about 50 metres that repeats the upper Danian section and produces the promontory where the chapel is located.

23 JOINTS OF AITZBELTZ
THE GEOMETRY OF DEFORMATION

Fragile deformation produces fractures that are later filled with calcite. They are normally organized into families whose intersections allow the understanding of the chronology of the deformation.

24 FAULT SYSTEM OF MENDATA
CHANNELS ON THE COASTAL PLAIN

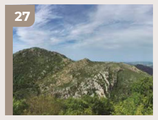
An excellent example of small faults with E-W and NE-SW directions that affect the flysch and mark channels produced by differential erosion on the tidal flat.

25 ANDUTZ FAULT
THE GREAT FAULT OF THE GEOPARK

It is the main tectonic feature affecting the flysch. It brings the black flysch (Lower Cret.) into contact with the calcareous flysch (Upper Cret.), changes the orientation of the layers and forms the Aitzuri big wall.

26 RECUMBENT FOLD OF AITZANDI
THE FLYSCH TWISTS

Spectacular large-scale recumbent fold. At its core the sandstones create fractures while marls accommodate the deformation with folds.



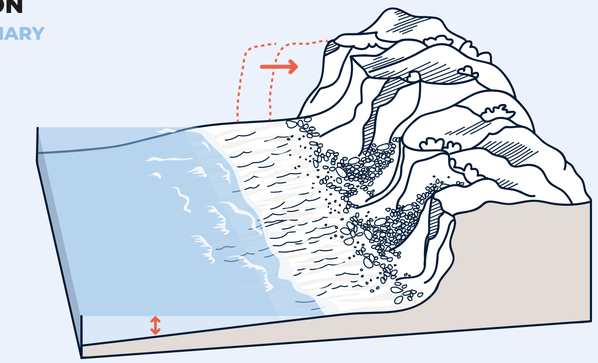
27 ANTICLINE OF SESIARTE
A FOLDED MOUNTAIN

A cartographic-scale structure that folds the reef limestones of Mount Sesiarte with a schistosity on its flimbs that has favored intense karstification processes.

GEOPARKEA

COAST
CONSTANT EROSION
QUATERNARY

1 – 0 Ma



The current configuration of the geopark's coastline is very recent, dating back only a few thousand years. Its evolution is linked to the latest **sea level variations** related to the Quaternary glaciations and interglaciations.

Flysch is a very unstable formation that is easily eroded. It causes **large landslides** and very active cliff retreat.

The coastline of Geoparkea is a dynamic and changing spectacle.

28 ITZURUN BEACH
A BEAUTIFUL FLYSCH BEACH

A beautiful sandy beach nestled beneath unstable flysch walls that produce a large number of rockfalls. The beach is highly vulnerable to the current sea level rise.

29 PEBBLE BEACH OF PIKOTEAZPIA
A UNIVERSE OF PEBBLES

1,400 metres of beach formed by thousands of rounded pebbles up to 40 cm in diameter. At the top, the high tide marks a practically horizontal profile.

30 GEOMORPHOLOGY OF SAKONETA
EROSION IS SPECTACULAR

A sequence of three wild coves of sand and pebbles with landslides, waterfalls and a large abrasion platform with giant potholes and kettle holes makes this place unique.

31 DUNES AND MARSHES OF SANTIAGO
A MINIATURE ESTUARY

Despite its high level of anthropogenic impacts, the mouth of the Urola River preserves one of the best dune systems on the entire basque coast. This bar protects the marshes of Santiago.

32 SATURRARAN BEACH
A CRESCENT IN THE BLACK FLYSCH

A sandy beach that stands out for its perfect crescent shape, protected from the Cantabrian Sea by a striking cape of black flysch known as "Saturrarango haitzak".

33 EROSION FORMS AT ITZURUNTXIKI
THE BARE CLIFFS

A series of wave-cut holes up to 10 metres high and a striking 20 metre-long *erosive notch* at the base of Talaimendi are among the best erosional features of this area.

34 FALLEN BLOCKS AT PUNTA MARIANTON
BLOCKS THE SIZE OF A CAR

A surprising accumulation of large blocks detached from the few thick turbidites interbedded among the marls of the cliff. An excellent marker of the retreat of the coastline.

35 ACTIVE LANDSLIDES OF PIKOTE
A SCARY GIANT

Spectacular active landslide favored by the inclination of the flysch layers and the fractures. It is 360 m wide and 150 m high and there are blocks the size of a building sliding into the void.

36 BARATZAZARRAK LANDSLIDE
A CRUMBLING MOUNTAIN

A large, complex and currently inactive landslide with striking load folds. It cover 8 hectares and its front, now eroded, deformed the flysch on the tidal flat.

37 KARDALA LANDSLIDE
A HIDDEN AND VERY UNSTABLE GIANT

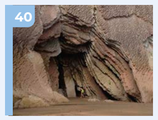
The homogeneity of the black flysch of Kardala allows for a perfect landslide with a large escarpment on the upper part of the cliff and an active front of 400 metres wide currently eroded by the sea.

38 TIDAL FLAT AT ALGORRI-PORTUTXIKI
THE TRACE OF RETREAT

When the cliffs retreats, they leave behind a huge horizontal abrasion platform that is only visible at low tide. It is one of the best examples in Europe.

39 CLIFFS OF TXERTUDIKO GABARLEKUA
THE PARALLEL COAST

The coastline runs parallel to the stratification. This causes uniform erosion, resulting in a straight coastline defined by the orientation of flysch layers.



40 CAVES OF ITZURUN BEACH
JOURNEY INTO THE FLYSCH

A group of very striking caves up to 30 m deep, opened up by differential erosion produced by the rock fractures. Sometimes they function as small siphons.

41 CAVES AT CAPE AITZURI
THE EYES OF THE GEOPARK

Two large cavities measuring around 20 metres in diameter and over 25 metres deep, formed by differential erosion facilitated by several fractures related to the Andutz fault.

42 MENDATA HANGING VALLEY
WATERFALLS IN THE GEOPARK

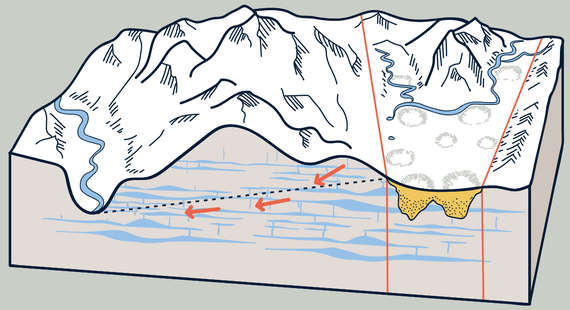
The retreat of the coastline has caused the small Mendata stream to be captured by the cliff, creating a beautiful 22 metre high waterfall.

43 DEBA RIVER ESTUARY
THE GREAT RISE IN SEA LEVEL

The estuary of Deba is formed by about 30 metres of sediment: clay, sand and pebbles which provide accurate information about the great Flandrian transgression over the last 10,000 years.

KARST
THE UNDERGROUND WORLD OF THE GEOPARK
MIOCENE - QUATERNARY

15 – 0 Ma



The first reliefs of Geoparkea emerged just over 10 Ma ago. **The limestone began to dissolve**, giving rise to poljes such as Olatz and Lastur separated by large pinnacles. There are kilometres of underground horizontal galleries that reflect the evolution of the water table as the land rose.

The existence of a large number of caves so close to the sea encouraged the occupation of many of them since 200,000 years ago. Discover the incredible journey into the past in **The Valley of Prehistory** in Deba.

44 CONE KARST AT ASTIGARRIBIA
LIMESTONE PYRAMIDS

This Karst morphology is typical of a subtropical climate. It is created by dissolution from an initial surface, which eventually gives rise to isolated pinnacles of the same height.

45 ERMITTIA BEKOA CAVE
THE UNDERGROUND LABYRINTH

A cavity with more than 10 kilometres of predominantly horizontal galleries arranged on different levels with a large number of speleothems and fluviokarstic deposits.

46 PRAILEAITZ CAVE
THE SANCTUARY OF PREHISTORY

A cave known for the exceptional discovery of Magdalenian necklaces dating back 15,000 years. It is notable for the large number of paleoclimate studies using pollen, sediments and speleothems.

47 SASIOLA MEANDER
A HORSESHOE ON THE MAP

The Deba river adapts to the "egg box" morphology by forming a perfect meander nestled more than 150 metres into the limestone pinnacles of Sasiola.

48 KIPUTZ PALAEONTOLOGICAL SITE
A 900 KILOGRAM BISON AND MUCH MORE

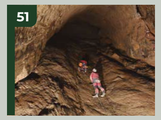
This small chasm was a natural trap where 48 deer, 23 reindeer and 18 steppe bison fell during the last ice age. The largest bison skull of the iberian peninsula stands out.

49 POLJE OF OLATZ
A PERFECT DEPRESSION

Olatz is a big depression covering some 125 hectares, formed by the dissolution of reef limestone. It has a large number of sinkholes and the surface water disappears into the Kobalde cave.

50 KOBALDE SINKHOLE
THE HIDDEN SECRET OF OLATZ

A large cave where the Olatzgoikoa and Añoerreka streams disappear. After travelling 3 km under Mount Arno, the water emerges in several springs at the bank of the Deba River.



51 KOBETA CHASM
IN THE HEART OF ARNO

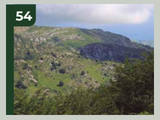
This is the largest cavity in the Arno massif. It is about 5 kilometres long and has a drop of about 350 metres, with vertical shafts exceeding 40 metres. An underground river flows at its base.

52 POLJE OF LASTUR
THE HIDDEN VALLEY OF THE GEOPARK

This depression of karstic origin is approximately 3 kilometres long. Its base is carved out by a series of sinkholes and dolines that carry its waters to the Sasiola spring.

53 ARBIL CAVE
A FOSSIL GALLERY

The spectacular shape of the Arbil cave indicates that its formation was related to a significant flow of underground water. In the past, it may have functioned as the main sinkhole of the Lastur polje.



54 SESIARTE LAPIAZ
THE ROUGH SKIN OF THE KARST

The fracturing of the Sesiarte limestone has led to the formation of the most prominent lapiaz in the geopark. It is formed by dissolution and its cracks filter surface water to the underground system.

55 GREAT HALL OF PAGATZA
A FOOTBALL FIELD INSIDE THE MOUNTAIN

After a slightly vertical entrance, the largest chamber in the geopark opens up, with an area of 100 x 80 m and a significant number of stalactites, stalagmites, flags and some eccentric formations.

56 UGARTEBERRI RIVER GORGE AND SINKHOLE
THE UPPER LEVEL OF THE LASTUR POLJE

The river cuts about 15 metres from the base level of the polje, creating beautiful meanders that eventually lead the water to the Ugarteberri sinkhole.

57 ALIGNMENT OF LASTUR SINKHOLES
THE FUNNELS OF THE GEOPARK

The final part of the Lastur polje is marked by a striking alignment of sinkholes up to 50 metres in diameter and about 20 metres deep, which carry surface water into the interior of the karstic system.

58 UGARTEBERRI CAVE
A HIDDEN TUNNEL IN LASTUR

A horizontal gallery approximately 280 metres long located at the bottom of the valley and running parallel to it. Currently, it carries very little water, but in the recent past it functioned as an important drainage system for the Lastur valley.

59 DOLINES OF MOUNT ANDUTZ
FUNNELS AT THE SUMMIT

Mount Andutz (612 m) has an elongated shape. At its summit several sinkholes 50 metres in diameter capture and directly infiltrate rainwater to the Andutz aquifer.

60 SASIOLA SPRING
A YEAR-ROUND SPRING

After travelling about 4 kilometres inside the mountain, the waters of the Lastur valley flow into the Deba River at this spring with a minimum flow of 10 litres per second during low water or dry periods.

61 AIXA CAVE
THE UNDERGROUND LABYRINTH OF THE GEOPARK

This is the largest cavity in the geopark. Its large entrance contrasts with the labyrinthine interior of horizontal galleries, siphons, meanders, canyons and several underground streams.

62 SALBATORE KARST PINNACLE
A PERFECT PYRAMID WITH GALLERIES

A beautiful rock pyramid 150 metres high and 300 metres in diameter. It contains two levels of horizontal galleries produced by ancient water tables. Important archaeological remains have been found.

63 USARROA SPRING
THE UNDERGROUND WATERS OF ANDUTZ

The limestone of Mount Andutz forms an aquifer isolated from the rest, which drains continuously through the Usarroa spring with an annual average of 50 litres per second. During floods, it forms a *trop plein*.

64 PALEOTERRACE OF THE DEBA RIVER
THE RIVER OF THE RECENT PAST

A line of boulders located 40 metres above the current riverbed provides excellent information about the river's incision history.

65 LASTUR QUARRY
CORALS IN SIGHT!

The front of the quarry shows the original arrangement of the Lower Cretaceous corals. Lastur limestone is known for its ornamental value and extraordinary hardness.

66 SAN BLAS QUARRY
A PEDIMENT CARVED INTO THE ROCK

This quarry is currently abandoned, but you can still see the traditional methods used to cut and polish limestone with a saw or diamond wire.

+ INFORMATION:
Inventory fo Geological sites of Geoparkea.

GEOLOGICAL MAP AND GEOSITES

GEOPARKEA