



01 TRIASSIC CLAYS AND OOLITES OF MUTRIKU THE OLDEST ROCKS IN THE GEOPARK

These rocks were formed by evaporation in a continental environment, having a dry and warm climate more than 200 million years ago, coinciding with the first episodes of fragmentation and extension of Pangaea. These Triassic rocks developed in the Mutriku area as a result of the Beria-tau fault.



02 ANDUTZ CARBONATE PLATFORM CORALS IN THE MOUNTAINS

Mount Andutz (612m) is formed by very hard limestone containing many corals, rudist, ostrid and sponge corals typical of a coral reef. This indicates that they formed more than 110 million years ago in a tropical shallow-water platform that covered the entire Geopark.



03 CONGLOMERATES OF SATURRARAN LARGE SUBMARINE CANYONS

The fragments of these conglomerates come from the Landes massif, located to the NE, and they lie in the seabed of the Geopark about 105 million years ago through a large underwater canyon seven kilometers wide that formed in the early stages of the opening of the Bay of Biscay.



19 PALEOCENE / EOCENE BOUNDARY AT ZUMAIA THE GREAT GLOBAL WARMING

The great global warming that occurred 55.8 million years ago was recorded in a reddish clay section showing major anomalies of the oxygen and carbon isotopes, which reflect the emission of large amounts of carbon into the atmosphere. This natural warming caused a major biological readjustment in the world. It seems that history repeats itself.



20 EOCENE FLYSCH OF ITZURUMTXIKI THE AMAZING SPECTACLE OF THE TURBIDITES

The initial part of the Eocene is a natural history museum containing turbidites which show creeping structures (flutes and grooves) and very spectacular laminations. Furthermore, the almost vertical arrangement of the layers gives this particular stretch of flysch a preponderance that no photographer wants to miss.



21 TRACE FOSSILS OF ITZURUMTXIKI ENIGMATIC TRACES ON THE SEABED

The Eocene series is a museum of natural history comprising fossil footprints. Of note are the *Scoticula fossils abruptus*, unique in its genre. In most cases we do not know the original author of the prints. You can visit these trace fossils in the Algorri Interpretation Centre.



37 ABRASION PLATFORM OF ALGORRI-PORTUIXIKI A GEOMETRIC WORLD LIKE NO OTHER

Known as one of the largest platforms in Europe, it is exposed only at low tide and is home to a very rich and complex ecosystem. It was formed in response to the retreating cliffs and there is evidence to show that it reaches eight kilometers offshore.



38 TXERTUDIKO GABARLEKUA SEA CLIFFS THE PARALLEL COAST

The direction of the coast in this section is parallel to the stratification and this causes homogeneous erosion on the layers. These will uniformly collapse leading to a reclinate coast defined by the actual stratification of the flysch.



39 ITZURUM BEACH CAVES INSIDE THE FLYSCH

Erosion has opened way for vertical fractures of the reddish limestone and has produced very peculiar caves which makes it possible to delve up to eight metres into the layers of the flysch. It is one of the most photographed features in the Geopark, especially when the water is flowing through the small flooded underground chambers.



04 GIANT AMMONITES OF MUTRIKU THE PROTAGONISTS OF THE CRETACEOUS SEA

The shells were deposited just over 100 million years ago under low-oxygen conditions, where they were silicified. This process turned them into a very hard mass which has meant they have been excellently preserved. Of note are the helter-morphomic uncoiled shell specimens. Visit the collection housed at the Nautilus Museum.



05 SYN-TECTONIC SEDIMENTS OF MUTRIKU TECTONICS UNDER THE SEA

This complex mixture of sediments reflects the complexity of the environment during the opening of the Bay of Biscay. Tectonic stress, deformation and sedimentation played a role in the formation of black flysch during the Lower Cretaceous period.



06 SEPTARIAN NODULES OF DEBA SMALL NATURAL JEWELS

These surprising black flysch clay nodules with spherical morphology develop a peculiar network of radial and/or concentric fractures with angular corners and are filled mainly with calcite, barite and pyrite. You can see some examples on display at the tourist office in Deba.



22 SAN TELMO DUPLEX A 3D DUPLEX

Under the hermitage of San Telmo, we can see a series of faults and fractures which together form a duplex. The main base fault is located in the reddish limestone and has a scarp stretching about 50 m which produces the rectangle where the hermitage is located. Associated drag folds and minor duplex can also be found.



23 ORTHOGONAL CRACKS OF AITZBELTZ A BEAUTIFUL GEOMETRIC IMAGE IN THE FLYSCH

The calcite-filled fractures are very common in the flysch and reflect the different pulses of deformation. Occasionally, intersections between family groups occur, resulting geometric oddities which make it possible to establish temporal relationships between them. Which cuts which?



24 FAULT SYSTEM OF MENDATAKO PUNTA CHANNELS ON THE PLATFORM

The faults provide fractured surfaces favouring the erosion of channels. It is a conjugate fault system with small scarp in E-W and NE-SW directions. These fractures are very common throughout the entire zone and served to accommodate the phases of deformation during the Alpine Orogeny.



40 AITZURI CAPE CAVES THE EYES OF THE GEOPARK

These are two large cavities formed in calcareous flysch at Cape Aizuri opening way for multiple fractures in variable directions, related to the nearby Andutz fault. They are about 15 metres wide by 20 metres high and extend inwardly about 25 metres.



41 HANGING VALLEY OF MENDATA WATERFALLS IN THE GEOPARK

The retreating cliff has caused the catchment of the small Mendata stream, giving rise to a beautiful waterfall 22 metres high. The continuity of the old channel to the NE can be clearly seen for a further 100 metres, until it reaches the edge of the cliff.



42 DEBA ESTUARY THE SIGNIFICANT RISE IN SEA LEVEL

The sedimentary infill of the estuaries in the Geopark is approximately 30 m and has occurred over the last 10,000 years. This study provides information about the rise in sea level since the last glaciation (20,000 years), as well as major weather events throughout this period.



07 SEISMITES OF ONDARBELTZ EARTHQUAKES IN THE GEOPARK

These are deposited materials that become destabilised and glide down the slope, resulting in a set of disorderly layered rocks that are embedded in a clay matrix. These processes are related to earthquakes and movements in the seabed which are typical of the instability in the lower Cretaceous period.



08 BLACK FLYSCH OF PUNTA AITZANDI VOLCANOES UNDER THE SEA

The black flysch is formed by the interlayering of dark, loamy sediments and turbidites. In this case, the appearance of interbedded fine layers which are pyroclastic in origin. Underwater volcanic activity was quite common in the rifting episodes and opening of the Bay of Biscay.



09 KAKUTA FORMATION SCHISTOSITY ILLUSTRATIONS OF DEFORMATION IN ROCKS

These marls were deposited in a channel located between the two shallow reef platforms about 115 million years ago. Marl is "soft" rock and in response to the flattening caused by the tectonic stresses develop planes (schist) which may even mask to the original stratification.



25 ANDUTZ FAULT THE GREAT FAULT OF THE GEOPARK

It has a N-S orientation, and although it affects alpine structures, it is likely to have a much more ancient origin. About 4 million years are omitted on the cliffs and the black flysch comes into contact with the calcareous flysch, giving rise to one of the great rock faces in the Geopark, the Aizuri Cape.



26 RECUMBENT FOLD OF PUNTA AITZANDI THE FLYSCH WINGS AROUND

Large-scale spectacular fold lying inclined to the north. At its core we can see the difference in behaviour between the sandstones that fracture to accommodate the deformation and the marl that draw more continuous folds. Its interpretation is complex.



27 SESIARTE ANTICLINE A FOLDED MOUNTAIN

A large fold in which the plane is inclined on a mapping scale and in a NW-SE direction which affects the reef limestones of Mount Sesiate. It was formed during the Alpine compression and we can see an axial-plane foliation on its flanks which has conditioned the intense processes of karstification of the limestone resurfacing in significant lapies.



43 COCKPIT KARST OF ASTIGARRIBIA PYRAMIDS OF LIMESTONE

Seen from the air, the landforms in this area resemble a box of eggs. This karst modelling is typical of humid, temperate and tropical regions such as China and Thailand and is generated by dissolution from a base surface which eventually gives rise to isolated pinnacles having a similar elevation, about 130m in this case.



44 OLATZ POLJE THE HIDDEN VALLEY OF THE GEOPARK

Olatz is a closed valley covering an area of about 125 hectares and which was formed when the limestone reef from the Lower Cretaceous dissolved. In response to a recent decrease in the water table, the profile of the polje is readjusting by developing dolines and entrenching rivers, which carry their waters to the great Kobalde sinkhole.



45 LASTUR POLJE A LARGE PIT IN THE MOUNTAINS OF THE GEOPARK

Lastur is a closed valley, elongated and karstic in origin, which stretches for about 9km. The polje is impacted by a well-ordered set of sinkholes and dolines up to 75m in diameter, which as they were funnels, channels the waters of the valley leading to the source at Sasieta.



10 LIMESTONE MEGABRECCIA OF DEBA WHAT ARE THESE LIMESTONES DOING HERE?

These sediments are located in the south of town. Occasionally, the reef limestones that form in the shallows at the edge of the platform fracture and fall down the slope in large blocks, called olistoliths, which become embedded between flysch-type rocks typical of greater depth.



11 PALEOKARST OF ISTINA THE FIRST CAVES IN THE GEOPARK

About 100 million years ago, the carbonate platforms were exposed resulting in rough surfaces produced by karstification. Subsequently, new tectonic movements returned to sink the area and these irregularities were filled with turbidites. This is an excellent example of the tectosedimentary complex during this period in the Geopark.



12 CARBONATE FLYSCH OF SAKONETA EVERYTHING STARTS TO SLOW DOWN

The Upper Cretaceous. This period begins with a significant rise in sea level and a long period of tectonic calm. As a result, 700m of limestone and marl were deposited with interlayering of small turbidites. The magnificence of the section can be enjoyed along with a huge number of trace fossils.



28 ITZURUM BEACH THE FLYSCH BEACH

The reddish rock face reflects the surf and waves that reach the shore, transporting sediment along the cliffs all along the 1,400 metres of beach. The edges can up to 40cm and are generally overlapped. The profile is substantially horizontal near the cliff and towards the sea it slopes at 15°.



29 PEBBLE BEACH OF PIKOTEAZPIA A UNIVERSE OF PEBBLES

The fallen blocks are rounded and the wave energy accumulates them by size at the base of the cliffs all along the 1,400 metres of beach. The edges can up to 40cm and are generally overlapped. The profile is substantially horizontal near the cliff and towards the sea it slopes at 15°.



30 GEOMORPHOLOGY OF SAKONETA CATHEDRAL OF GEOMORPHOLOGY

A spectacular sequence of three crescent-shaped pebble and sand coves where a massive number of geomorphological features can be found such as the typical differential erosion of capes and coves, landslides, waterfalls, a large abrasion platform, basins and potholes.



46 DOLINES OF MOUNT ANDUTZ FUNNELS AT THE SUMMIT

Mount Andutz (612 m) is formed by reef limestones in an almost vertical position, which determines the appearance of dolines. In the sections which are better stratified, aligned dolines about 20 metres in diameter have developed, even very close to the summit itself.



47 SPRING OF SASIOLA A SOURCE FOR THE ENTIRE YEAR

Located on the right bank of the Deba river, the waters of the Lastur valley and other aquifers in the environment flow through. Karst environments are like sponges that capture rainwater and supply it through the springs, ensuring availability throughout the year.



48 LAPIES OF ARBIL MOUNTAIN A VERY PERMEABLE SPONGE

The lapies are like the surface of a sponge that filter the water through the cracks and channels. The predominant dissolution occurs giving way to the joints, but in steeper areas dissolution grooves can be found on flat surfaces, called rinnenkarren.



13 SANDY FLYSCH OF ARANTZAKO UNDER AN UNDERWATER RANGE

About 80 million years ago a relative drop in sea level meant large numbers of turbidites were deposited which, together with, together with the limestone and marl, resulted in a sediment thickness exceeding 1500 m. You can see and trace fossils and spectacular sedimentary structures such as Bouma sequences, laminations and ripples.



14 MAATRICHTIAN FLYSCH OF ZUMAIA THE WORLD BEFORE THE IMPACT

At the end of Cretaceous, the sea level rose once again and the turbidite fan deposits moved away. Consequently, limestone and marl are deposited with a multitude of fossils and footprints, where we can locate the extinction of inoceramids and the last ammonites before the K-Pg. The series is particularly appealing due to the contrasting red and white colours.



15 CRETACEOUS / PALEOCENE BOUNDARY OF ALGORRI THE GREAT DINOSAUR EXTINCTION

The K-Pg boundary (K-T boundary) is identified by a thin layer of dark clay where a massive extinction killed off over 80% of marine fauna alive at that time. This layer shows compositional anomalies such as iridium which relate to the Yucatan impact dating from roughly 66 million years ago. A geological sanctuary within our reach!



31 DUNES AND MARSH OF SANTIAGO BEACH THE DUNES OF THE GEOPARK

When the wind exceeds four metres a second it transports the sand to the supratidal part, where it becomes trapped by vegetation and forms dunes, which locally show good cross sections where we can see its internal structure. The area of marsh, with greater fluvial influence and more muddy sedimentation, is behind.



32 SATURRARAN BEACH THE BLACK FLYSCH BEACH

Located at the mouth of Antxiela River, it is one of the busiest beaches in the Geopark and there is a striking black flysch outcrop in the northeast section that protects the beach. In the area where wave energy is dissipated, we can see chains of pebbles which gradually decrease to the northeast until they disappear.



33 EROSION STRUCTURES OF ITZURUMTXIKI THE HOLLOWED OUT CLIFFS

In the more marly areas, there are some quite spectacular examples of erosion tunnels about 10 metres high. In the hardest and most homogeneous areas, a spectacular rounded basal cavity (erosional notch) about 2 metres high has developed, which reflects the power of wave erosion.



49 SHALLOW HOLE OF UGARTEBERRI THE ENTRENCHED STREAM

The incision of the river about 15 metres from the previous level of stability of the polje is evidence that there has been a recent decline in the ground water table. This entrenchment draws pretty, rounded meanders that eventually lead to the Ugarteberri sinkhole.



50 PRAILERAITZ CAVE THE SANCTUARY OF PREHISTORY

The geopark has more than 1500 cavities. Praileraitz is about 100 metres in length and has a large room where there have been important findings from the Upper Palaeolithic period (15,000 years). The study of its speleothems and sediments provides important information about the climatic evolution over the last thousand years.



51 KARST PINNACLE OF SALVATORE THE PYRAMID OF GALLERIES

An imposing pyramid of rock 150 metres high and 300 metres at the base. This karst morphology is typical of humid, tropical climates. Inside, there are two levels of horizontal galleries containing important archaeological remains, which reflect the different water tables in the past, possibly conditioned by the level of the sea.



16 STRATIGRAPHIC CYCLICITY OF ZUMAIA ASTRONOMY IN THE ROCKS

The layers are grouped in packs of five limestone-marl pairs that match the movements of astronomical precession (20,000 years) and eccentricity (100,000 years) based on Milankovich cycles. These variations determine the amount of solar energy received by our planet, and therefore also determine the climate and marine sedimentation.



17 SELANDIAN GLOBAL STRATOTYPE (GSSP) A GOLDEN SPIKE IN ZUMAIA

The boundary (61.1 Ma) is defined by small biological changes and a relative minimum of Carbon 13, which implies a change in ocean circulation. The golden spike that certifies the international referentiality has been placed at the base of loamy stretch interpreted as a drop in sea level of 80 metres.



18 THANETIAN GLOBAL STRATOTYPE (GSSP) A MAGNETIC EXCHANGE OF GOLD

The stratotype has coincided with a change in the magnetic polarity of the rocks and dates to 58.7 million years ago. The south pole became the north pole and vice versa. A GSSP is an internationally agreed upon reference for the geological history of the Earth. Zumaia is the only outcrop in the world with two gold spikes!



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

In the north-east corner of the Itzurium beach we can see a significant accumulation of large fallen blocks. The Eocene series is formed by thick turbidites interbedded in a set of softer marl, which when eroded, hollow out the turbidites and these fall into large blocks.



35 ROCKFALL OF PIKOTE LANDSLIDES OF DIZZING HEIGHTS

The Pikote cliffs are 150 metres high and show a relatively recent cluster of rather sizable landslides. These are produced by landslides between the layers, which happen due to the high dip angle, the difference in hardness between them and the existence of fractures in the rock layers.



36 LANDSLIDE OF BARATZAZAHARRAK A MOUNTAIN THAT IS CRUMBLING AWAY

The landslide covers an area of eight hectares and based on vegetation that grows on it, it was found that the slide occurs slowly and continuously. It begins at a height of 158 metres and its face covers over 400 metres where spectacular examples of creeping and folds that accommodate the slip deformation can be seen.



52 KIPLUTZ QUATERNARY PALEONTOLOGICAL SITE A 900 KILOS BISON

This pothole measuring about 6 meters deep acted as a natural trap for the quaternary fauna between 20,000 and 15,000 years ago, during the Last Glacial Maximum. Forty-eight deer, twenty-three deer and eighteen bison were found inside, including a spectacular 90cm complete skull of a steppe bison.



53 QUARRY OF LASTUR BLOCKS IN SIGHT

The arrangement of the corals draws the architecture of the reef seabed from the Lower Cretaceous period. Luster limestone is known for its ornamental value as well as its extraordinary hardness. In addition to being used in construction, it has traditionally been used to make the walls of the front courts and the stones are used in the game of herri kirolak (Basque rural sport).

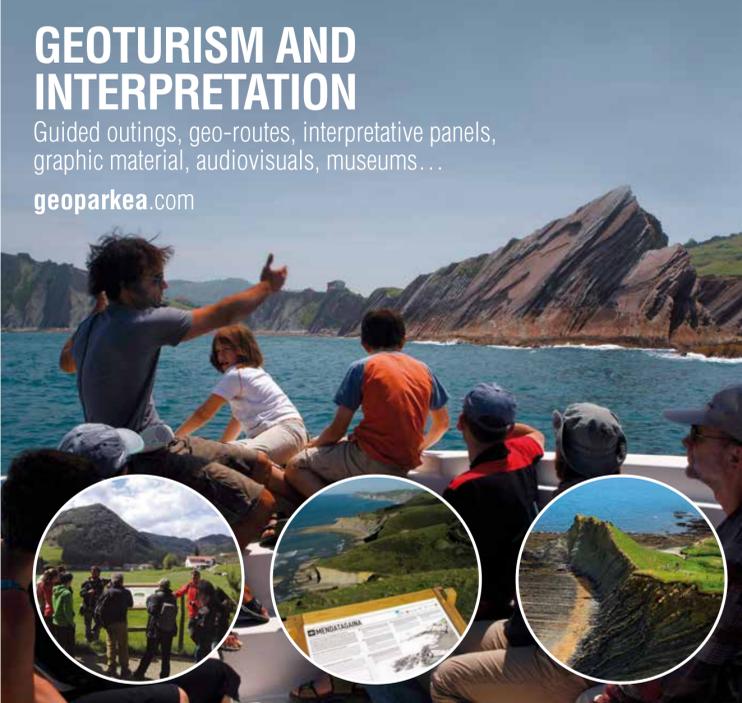
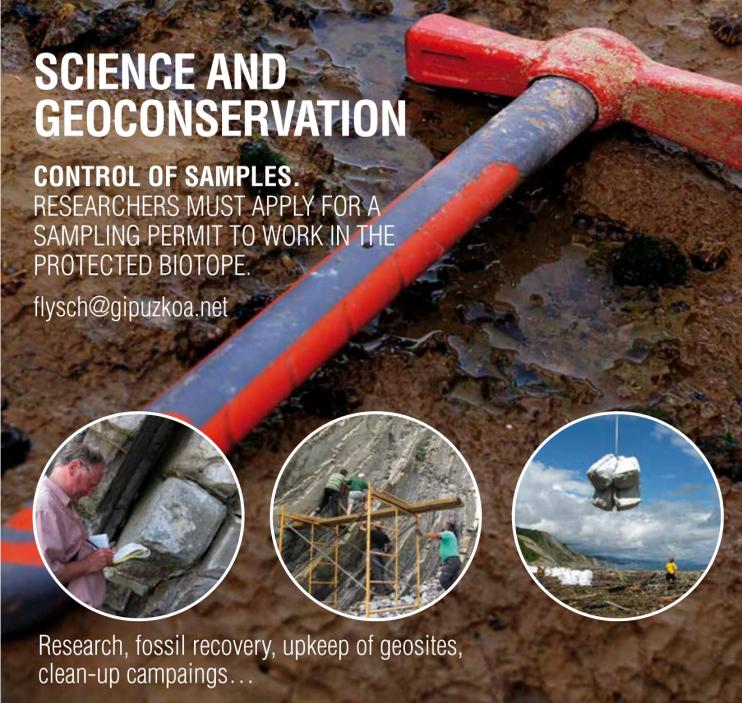
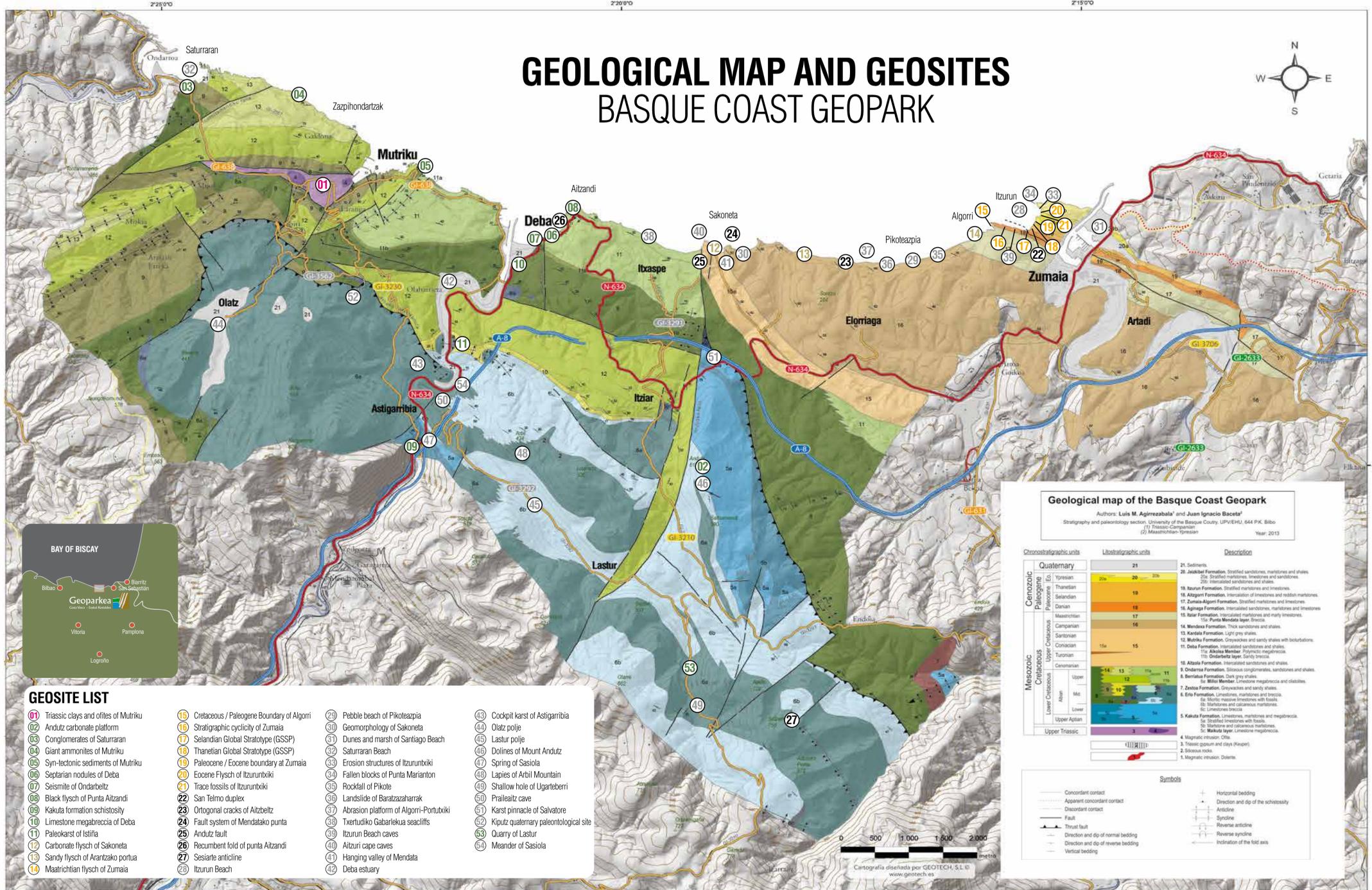


54 MEANDER OF SASIOLA A HORSESHOE ON THE MAP

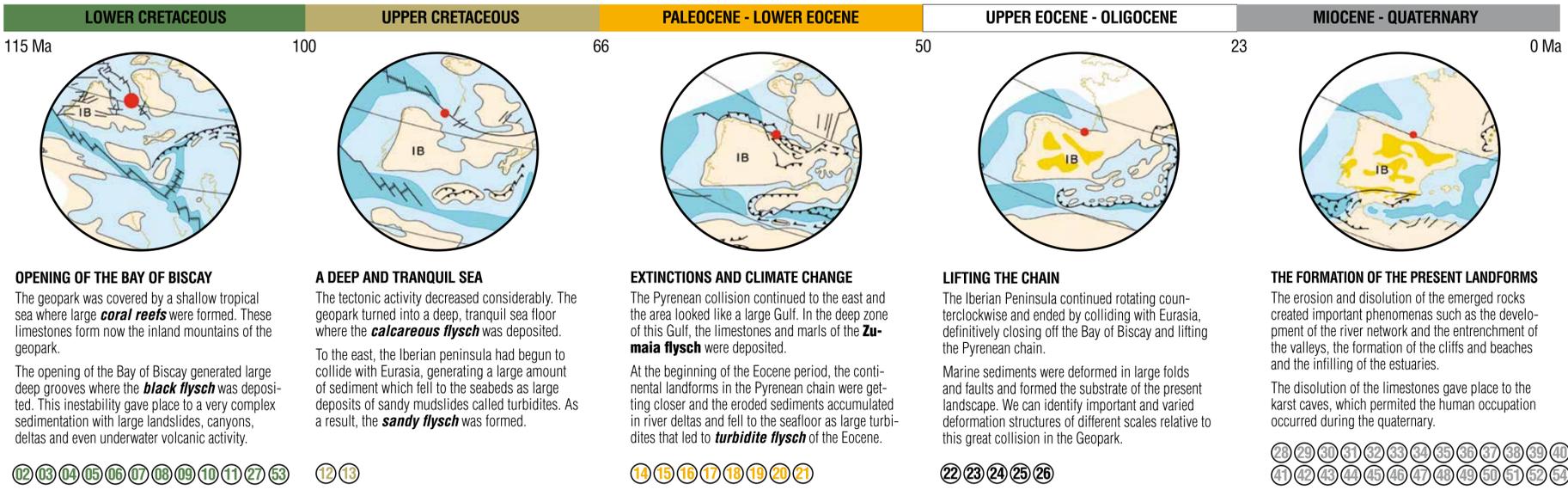
The Deba river draws a perfect meander embedded over 150 meters between the pinnacles in the Sasiola area. The channel collides with the hard limestone from the Lower Cretaceous period and circumvents the obstacle adapting to the geometry of the egg carton pinnacles.



Geopark Network
european-geoparks.org



100 MILLION YEARS OF HISTORY IN THE ROCKS OF THE GEOPARK



- Continental lands
- Interior basins
- Shallow platforms
- Deep basin
- Ocean ridge
- Fault
- Thrust fault
- Geoparkea

THE ROCKS OF THE GEOPARK

