

# FRANCISCO NIEVA HIGH SCHOOL

## 3º ESO

### RELIEF (Topography)

#### Earth's structure

The inside of the Earth is divided into concentric layers:

**Crust:** Has a depth of up to 70 km. It is a thin outer layer formed by solid rocks. It is divided into continental and oceanic.

**Mantle:** It is from 70 to 2,900 km deep. It is the middle layer, formed by solid or half-molten rock. It is divided into upper and lower.

**Core:** It is from 2,900 to 6,300 km deep. It is the deepest layer. It is composed of iron and nickel. Its temperature is very high (4,300º C). It is divided into internal and external.

#### Lithosphere

It is the most superficial layer of the solid Earth, characterized by its rigidity. It is formed by the earth's crust, the uppermost part of the mantle. It is formed by plates that move over the semimolten mantle. That movement causes the distance, approach and collision of the plates (called tectonics), creating or destroying the relief.

#### The continental drift theory

In 1912 the German scientist Alfred Wegener formulated the theory of "continental drift": million of years ago there was a single continent, called Pangea, origin of the current ones.

It was based, among other things, on how the continents separated from one another, moving to the opposite sides of the Atlantic Ocean, such as Africa and South America.

#### Plate tectonics

The theory of plate tectonics explains relief formation. According to this theory, the Earth's crust is made up of plates which float on the top layer of the mantle. They separate, slide against each other or collide. New types of relief are then formed.

- When the plates separate, rifts are formed. In the ocean's crust, the magma inside the earth pushes up through and when it cools, it forms a new crust. This separation also takes place on the continents. The Great Rift Valley is a huge fracture crossing a large area of eastern Africa.

- A plate on the ocean's crust sometimes collides with the edge of a continental plate and is pushed down into the inner part of the Earth. The area where the crust is destroyed is called a subduction zone.

- When two continental plates collide, the pressure forms folds or faults.

Abundant earthquakes and volcanoes are produced in the areas where the continental plates collide.

**An earthquake:** Is a shaking or vibration at the surface of the earth resulting from underground movement along a fault plane. Earthquakes are caused by movements of the tectonic plates. When two plates crash, they release a large amount of energy, causing tremors that could be very violent.

**Tsunami:** Is an earthquake that is produced on the ocean floor. It is a great sea wave caused by an underwater earthquake. If they reach the coast, they can cause destruction and death.

Elements of an earthquake: These are the following:

**Hypocentre (or hipocenter):** Literally: "below the center". It is the place inside the Earth where an earthquake originates.

**Epicentre (or epicenter):** Is the point on the Earth's surface that is directly above the hypocenter.

The force of an earthquake can be measured by seismographs.

**A volcano:** Is a fissure in the earth's crust through which molten lava and gases erupt. The lava release may be joined by explosions that eject fragments of rocks, slags and ash. The volcanoes are often located on the boundaries of tectonic plates.

**Geyser:** Is a natural hot spring. Geysers can be found in the same areas as volcanoes.

Parts of a volcano: A volcano has different parts:

**Crater:** It's the top. Eruptive materials go out through it.

**Cone:** It's the place onto which the accumulated materials are expelled. When the volcanoes are found in marine waters, they can form islands.

**Pipe:** Is the tube that connects the interior and exterior parts of the volcano.

### **The Earth's relief:**

It is the form that the surface of the earth's crust (Lithosphere) has. It includes the emerged and submerged land under the floor of the oceans and seas.

**Continental relief:** The continents occupy approximately 30% of the earth's crust. They comprise the emerged land and the nearby submerged area, called continental shelf. There are seven continents in English (in Spanish six-depending on scientists): Asia, North America, South America, Africa, Antarctica, Europe and Australia. Most of the emerged land is in the northern hemisphere.

**Mountains:** Are natural elevations of the land with pronounced sides. They can be isolated or grouped together in mountain ranges. The highest mountain range in the world is the Himalayas (Asia) where the Everest is, the highest peak in the world.

**Plain:** Is a large geographic area slightly above sea level. They are usually made up of materials from erosion, known as sediments.

**Plateaus:** Are elevated regions above their surroundings. The highest plateaus are located in Tibet (Asia) and in Bolivia (South America). They are formed by ancient eroded mountains.

**Valleys:** Are sunken areas that are surrounded by high land, such as mountains. They are usually crossed by rivers.

**Basin:** Is a natural depression made up from the accumulation of sediments, produced by the erosion of the Earth's surface, for example, by a river. Some of them are below sea level.

**Coastal relief:** The sea produces different forms in the relief of coastal areas.

**A beach:** Is a geographical area that consists of the accumulation of unconsolidated sediments by the effect of the local movements of the waves. These sediments are typically sand, but there are also beaches formed by gravel and rocks.

**A cliff:** Is a significant vertical and steepy rock formation on the coast. Cliffs are made by erosion.

**A peninsula:** Is a piece of land surrounded by sea water on all its sides except on one, slightly narrow, called isthmus.

**Gulfs:** Are parts of the ocean or sea that are partly surrounded by land. If the gulf is small, it is called bay.

**A cape:** Is a part of the coast which extends into the sea. It can have a great influence on ocean currents and navigation

**An island:** Is a piece of land smaller than a continent, which is completely surrounded by water.

**Oceanic relief:** It is under the oceans and seas. It is varied and irregular. It includes:

**Continental shelf:** It is the submerged margin of the continents, extending from the shore to the first prominent break in the slope, which usually occurs at a depth of about 120-200 m. It is near the coastline.

**Continental slope:** The slope that extends from the continental shelf down to the ocean depth.

**Abyssal plain:** It is the deepest part of the seafloor, below 2,000 meters.

**Ocean trenches:** Deep-sea trenches are the deepest parts of the ocean. The deepest one, the Marianas Trench in the South Pacific Ocean, is 10,668 meters deep.

**Ocean ridges:** Large mountains located in the ocean floor. They rise up as far as 3,000 m. Some of them protrude from the surface and form islands.

## **Waters**

Water covers more than 70% of the Earth's Surface. Some water is found on the continents, but most of it is in the oceans and seas.

**Continental waters:** rivers, lakes, groundwater and ice contain fresh water. They make up about 3% of all the Earth's water.

**Rivers:** Are permanent and natural currents of water that flow through a channel and empty into another river, a lake or sea. Its origin can be from groundwater, glaciers, lakes, rainfall or snow.

**Source:** Is the place where the river starts. The tributary is a secondary river which dies into a principal one.

**Basin:** Is an area crossed by a river and its tributaries.

**Flow:** Is the amount of water that the river carries. The flow can oscillate throughout the seasons. Some rivers are dry most of the time, for example in the Mediterranean or desert areas. Other rivers always carry full flow, for example the Amazon, in South America.

Parts of a river: each river has three parts:

**High course:** Is the first part of the river, normally in the mountains. The water descends forcefully. The erosion is very strong.

**Middle course:** The slope is smaller. The waters descend more slowly, carrying the eroded materials. The river can form meanders adapting itself to the obstacles.

**Low course:** It is the final part where the river finishes its trip. It usually ends in the sea, sedimenting the materials which have been dragged.

The river mouth can have two types:

**Delta:** land formed by the materials accumulated by the river into contact with the sea.

**Estuary:** the place where the river comes into contact with the sea, where sea water enters the mouth of the river. It is submitted to strong tides.

**Lakes:** They are permanent bodies of water surrounded by land. The lakes are usually fresh. When their water is salty, they are called inland seas. If they are small, they are called lagoons. The source of the lakes' water can be from rainfall, rivers, groundwater or glaciers. The largest lake in the world is the Caspian Sea, an inland sea situated between southeast Europe and Asia. Its surface is 371,000 km<sup>2</sup>.

**Glacier:** Is a large mass of ice and snow, which moves slowly like a river. They are formed in the upper area of the mountains. The moraine is the result of the soil and stones deposited by the glacier.

**Groundwater:** Is the water which is found below the ground level. This water in most cases is derived from filtered water. It is found in those geological formations which have porosity. **When the water reaches the surface, an** impermeable layer is built up and forms underground reservoirs called aquifers. When groundwater runs through limestone rocks, it dissolves them and produces a kind of relief called karstic, forming caves with stalactites and stalagmites. Groundwater is very important. Most people depend on it and get that fresh water from wells. It represents 25% of the continental water.

### **Marine water**

Oceans and seas hold 97% of the Earth's water. They are in constant movement.

**Marine currents:** Are masses of water which move like rivers through the oceans. A warm current has a higher temperature than the surrounding water. A cold current has a lower temperature. Currents have a considerable influence on the climate of coastal regions.

**Tides:** Are the daily rise and fall of the sea level caused by the gravitational pull of the Moon and Sun. High tide is when the sea level rises, and low tide is when it falls.

**Waves:** Are the undulating movements of water on the surface of the sea. They are caused by the wind.

### **Spain's relief**

Spain consists of most of the Iberian Peninsula, the Balearic and Canary archipiélagos and the cities of Ceuta and Melilla. It's located in the Northern Hemisphere, in the south-west of Europe, creating a crossroad between Europe and Africa and between the Atlantic Ocean and the Mediterranean Sea.

Spain is the second European country with the highest average altitude, 660 metres, after Switzerland. It is because much of its territory is occupied by a high central plateau (the Meseta), around which other forms of land relief lie.

### **The formation of Spain's relief**

A long mountain range was formed in the west of the Iberian Peninsula about 300 million years ago. Over time, it was completely eroded and formed a large raised plateau. During the Tertiary Era (65 million to 2 million years ago), the internal forces of the Earth caused great changes:

- The plateau fractured. Some blocks sank down, filled with sedimentary material and became the Inner Plateau. Other blocks rose and became the Galician Massif, the western part of the Cantabrian Range, the Mountains of Toledo and Sierra Morena.
- At the edge of the plateau the deposited materials undulated and became the eastern part of the Cantabrian Range and the Iberian Mountain Chain.
- The Ebro and Guadalquivir depressions were formed at the same time as the Pyrenees and the Baetic Range.
- Volcanic activity on the bed of the Atlantic Ocean formed the Canary Islands.

### **The rocky substrate**

The substrate of Spain is very varied. There are four main types of rocks:

- Siliceous rocks** like granite. These are very old and rigid rocks from the Primary or Paleozoic era which began 570 million years ago. They are in the west of the Peninsula.
- Limestones** come from marine sediments deposited during the Secondary or Mesozoic era which began 230 million years ago. They are in the Pyrenees, the eastern half of the Cantabrian Range, the Iberian Mountain Chain, the Catalan Coastal Chain and the Baetic Chain.
- Clays** are fine rocks deposited in low areas in the late Tertiary era and the Quaternary era. They are in the Inner Plateau, Ebro and Guadalquivir basins and coastal plains.
- Volcanic rocks** were formed in the Tertiary era and are common in the Canary Islands. They can also be found in the provinces of Ciudad Real and Gerona.

### **The relief of Spain**

The Peninsular relief is organized in three parts:

- The Inner Plateau has an altitude from 600 to 700 metres. Two ancient mountain ranges run across it: the Central Mountain Chain, which divides the Plateau into two: the northern sub-plateau, which is made up of the Duero basin, and the southern sub-plateau; and the Toledo Mountains, dividing the southern sub-plateau into two, Tajo and Guadiana basin.
- The mountains that surround the Plateau are the Galician Massif, the Cantabrian Mountains, the Iberian Mountains and the Sierra Morena.
- The land relief away from the Plateau includes various young mountain ranges: the Basque Mountains, the Pyrenees, the Catalan Coastal range and the Baetic Mountains; and two depressions: the river Ebro and the river Guadalquivir.

Spain has more than 4,000 km of coast:

- The Cantabrian coasts have many high cliffs and estuaries. Galicia has the most jagged coastline in Spain.
- The Atlantic coast of Andalusia is low and sandy. It is characterised by its marshes and other sand formations such as dunes or mounds of sand created by the wind.
- The Mediterranean coasts have cliffs where the mountain ranges reach the coast, such as Catalan Coastal range and low and sandy coasts with beaches, or deltas such as the one in the Ebro.

Relief of the archipelagos are so varied:

- The Balearic Islands are an extension of the Baetic Mountains. Most of the coasts are cliffs because the mountains reach the sea, but we can also find many wide beaches. The Canary Islands have a volcanic origin. For those reasons, there are different forms of land relief of volcanic origin. In addition, the archipelago has the highest peak of Spain. It is Teide, which is 3,718 metres high.

## **Water in Spain**

The Iberian Peninsula has three watersheds:

**-The Cantabrian watershed:** the rivers which flow into the Cantabrian Sea.

These rivers are short because their source is in the mountains near the sea.

Their flow is abundant and regular throughout the year.

The main rivers are: Bidasoa, Nervión, Nalón, Narcea, Navia and Eo.

**-The Atlantic watershed:** the Galician rivers and those which cross the Inner Plateau and the Guadalquivir depression.

These rivers are long, except for those in Galicia.

Their flow is abundant thanks to their tributaries but it is irregular.

The main rivers are: Miño, Duero, Tajo, Guadiana and Guadalquivir.

**-The Mediterranean watershed:** the rivers which flow into the Mediterranean Sea.

They have very different characteristics. In general, they are short, except the river Ebro.

They have very irregular flow.

The main rivers are: Ter, Llobregat, Turia, Júcar and Segura.