

Landscape's shape

The landscape around volcanoes

In volcanic regions the landscape is also characterized by a series of minor but very fascinating phenomena, like geysers in Iceland. They are fountains of extremely hot water that comes out directly from the ground and is pushed very high. In Italy, instead, fumaroles are very popular. They are emissions of gases and vapours originating from fractures on the volcanic structure. For example solfatares belong to this type of phenomenon. They are particularly popular in the Campi Flegrei areas, in Campania region. They develop especially when the volcano is almost extinct. They are emissions of water vapour, carbon dioxide and hydrogen sulphide that come out and deposit as sulphur on the surrounding surface. Also the boric-acid fumaroles in Tuscany are fumaroles that produce a vapour full of boric acid. And finally, it is necessary to mention thermal springs, which are also popular in Italy, and produce water that is very rich in hot gas, sometimes enriched with minerals.

River and lake landscape

As a consequence of rainfalls, the waters that runs on the soil surface forms a rivulet that, joining other rivulets, becomes a stream. While the stream runs towards the valley, it receives water from other rivers (tributaries) and runs into the track it has formed, which is called bed or riverbed.

The flow of a river has different gradients: the river is flatter as it gets towards its mouth. Suddenly, the gradient can increase if the riverbed is made of more compact and non-erodible rocks. In these areas rapids form and if the bed has a vertical gradient, waterfalls form.

Abandoning the steepest part of its flow, and entering the flat area, the river current becomes slower and a part of the transported materials deposit: in this way a floodplain is formed. In these wider areas the river can become more meandering: it can form bends or serpentes, which are called meanders. The river flows into a lake or into the sea.

River erosion

Water, while running, manages to shape the landscape, since it erodes the rocky surface it runs on, it incorporates the eroded fragments, transports and deposits them when it gets to the valley. The erosive capacity of water depends on its speed, and it is higher when the riverbed is more inclined and during floods. The river water and current transport a mixture of organic and inorganic substances, as well as salt. They also transport clay, slime and sand particles, while big bits of sand, gravel and stones roll on the riverbed.

This form of erosion is called abrasion and creates typical shapes:

- Potholes: when the current is more powerful, the river manages to dig some cracks that gradually become deeper (see image "Potholes")
- Ravines, narrow and deep incisions that are created by the river on a compact rock, that keep vertical walls stable. Those incisions that become wider towards to top part are called gorges. Some examples are: the gorges of Alcantara, at the bottom of Etna mountain, or the fascinating Grand Canyon in the United States (See image "Ravines and Gorges");
- River valley: by constantly carving its own bed, a water stream digs a deeper and deeper crack until it shapes a valley. This represents a wide and deep depression of the Earth's surface, and is limited by two mountainsides.

The shape of rivers

Watercourses are classified according to the shape of their flow:

- Plaited: they are formed of numerous and small canals that separate and re-join once they arrive at the valley. In these cases the river transports big quantities of sand and gravel. This is typical of dry, semi-dry areas and

piedmont areas. In Friuli region, in the northern Veneto plain, watercourses are named grave (like Tagliamento, Medusa and Cellina when they arrive at the plain)

- Straight: watercourses with this shape are very rare and are normally located close to faults and where different types of rocks are located.
With meanders: the water flow is narrow and with frequent curves on flat land. The movement of meanders and the silt and sand that deposit during floods form floodplains, like the Po plain.

The river flows into the sea

When a river gets to the sea, sometimes it manages to scatter the transported material. In this case an estuary is formed, like the river Thames.

When the river deposits the transported material on its mouth, a river delta is formed.

The Nile, that flows into the Mediterranean, and the Mississippi river, that reaches the gulf of Mexico, shape the coast forming a delta with several river branches. The delta of Tevere river, that flows into the Mediterranean sea, is modelled by the waves and sea currents and has a pointed shape. Instead the Seine, that reaches the English Channel, is shaped by sea tides and forms an estuary.

The delta of large rivers can extend for several thousands of square kilometres, according to the quantity of debris that are transported by the river and deposited close to the sea. A delta landscape (a river delta) is characterized by canals, lagoons, islands and isolated water basins.

Lakes

Lakes fill the depressions of the Earth's surface and have a limited duration in time. They can be classified as:

- River lakes, when a river plain is flooded or a river branch completely separates from the river
- Barrier lakes, when a landslide or a lava flow interrupts a river flow. They can also originate from the deposit of rocky materials that are transported by a glacier
- Tectonic lakes form on depressions that are created after movements of the Earth's crust. Examples of them are the Dead sea (the most salty in the earth), the Bajkal lake (the deepest lake, 1741 metres), the lakes that occupy the Rift Valley in Africa, and the Caspian sea (an old sea that has been left isolated)
- Crateral lakes form inside extinct or exploded volcanoes like: the lake of Bolsena, Vico, Bracciano, Albano and Nemi
- Karstic lakes when, above carbonate rocks, there is a layer of clay that makes the rocks waterproof like the Lake of Scutari in Albania
- Artificial lakes are built by men to collect irrigation water or to produce energy.

The evolution of a lake and the marshland

Lakes do not have a long life because they tend to be filled with sediments and be invaded by the vegetation. The first transformation is the creation of a pond, which is quite shallow. Later, a marsh is formed. The marsh is a land that is covered by a thin layer of water. These waters can be rich in natural substances that favour vegetation growth. Algae, canes and floating plants are typical of this kind of landscape. They decorate the whole water surface.

Karst landscape

The word karst derives from the name of a region, the Carso, at the border between Italy and Slovenia, which is characterized by this type of landscape. Karstic environments develop in places with calcareous rocks, which are highly soluble like limestones, dolomites and evaporitic rocks. Carbonates and evaporites are rocks made of minerals that are very soluble in the water and for this reason they are easily shaped by rainfalls. Also raindrops manage to melt these

rocks and dig holes, sometimes very deep ones. The erosion of calcareous rocks in a Karstik territory is called corrosion.

The soil

The dark red colour of karstik soil is due to oxides and the clay content of calcareous rocks. When soluble minerals are melted by water and detached from the rock, some residual deposits are left on the spot. They consist of insoluble minerals, like iron oxides and clay minerals.

Superficial shapes

The most evident superficial phenomena are dolines: funnel-shaped depressions, 1-30 metres deep and hundreds of metres wide. The continuous action of water can favour the widening and union of several nearby dolines. In this way a single depression is formed, which is called uvala. A continuous corrosion leads to the creation of a wider and wider depression, on a flatland, called polje. These depressions can host small lakes that still have some little protuberances of harder and un-dissolved rocks.

Polje can be seen in the Italian and Slovenian Carso, where they are called piani or campi, like campo Imperatore on Gran Sasso.

The karstik landscape that we can see has no stable hydrographic network, with a total absence of water streams or rivers. The water, by dissolving carbonate rocks, digs the subsoil, where it creates typical underground shapes.

Underground shapes

In large karstik landscapes there are no rivers or streams running on the surface. Water streams run deep underground and, after spending some time underground, they come back to the surface. The underground karstik cavities are made up of caves and canals that can host underground water streams. An example of them is the Timavo river, in Carso in Trieste area: after running on the surface, close to San Canziano, the river goes underground and re-emerges 40 kilometres afterwards, near Monfalcone.

The walls of caves that no longer host rivers are full of juts and encrustations. The most famous are stalactites that hang from the ceiling, and stalagmites that lift from the cave floor. The two protuberances, with time, can join and form columns.

Glacial landscape

A glacier is a moving mass of ice. This movement has an erosive action that shapes the Earth's surface in cold regions. In the history of the Earth, during the Quaternary period, almost a fourth of the lands that had emerged from the sea were occupied by icecaps. Icecaps stretched to the northern regions of America, Europe and Asia that today are characterized by a mild climate. They were thousand of metres thick. When glaciers started to move forward, they deeply modified the land surface, changed river flows, stopped vegetation growth and forced animals to withdraw towards southern regions. During the hottest periods, the ice withdrew to the north, leaving deposits of the materials that they were transporting on the land. The regions that got free from the ice were now covered by forests and populated by animals, but kept the traces of erosion and accumulation of glacier materials.

Examples of erosion and accumulation and glacial landscapes can be seen nowadays on the Alps and the Himalayas.

Glacial erosion

The downward movement of a glacier acts on the rocks that compose the land as if it was a bulldozer: it collects and transports various blocks, of different sizes. At the end of a glacier there can be a watercourse, which exercises an erosive action on the underlying rocks, like any other river that runs on the surface. The result, once the glacier has withdrawn, are smooth rocks and cracks and grooves on the rocks. The land irregularities are reduced and the rocks look like flat humps: roche moutonnée. By observing these rocks geologists can re-build the history of the territory, since according to the hump direction it is possible to understand the direction the glacier moved to.

In an Alpine landscape, the main and the secondary valleys are shaped by the glaciers action that has eroded the valleys and the mountainsides. These valleys have a U-shape, while those valleys that have been created exclusively by the action of a watercourse or a river are narrow and have a V-shape. Glacial valleys, on the top, have a semicircular shape, which is occupied by a small glacier or a small lake surrounded by steep rocky walls. This is the glacial cirque, the place

where the snow piles up. That snow is later transformed into the ice that feeds the glacier. When the depositing snow is more than the snow that melts during the hot periods, the glacier grows and moves towards the valley.

Some typical glacial valleys were invaded, after their creation, by ocean waters. They are called fjords (they are typical of Norwegian coasts). Fjords are U-shaped valleys that were carved by the glaciers that had run down from the nearby mountains during the ice periods. During those periods, the sea level was lower than today. A big quantity of water at that time existed as ice. The following ice melting provoked an increase in sea level. The water invaded the valleys near the coasts.

Types of deposits: moraines

When the ice of a glacier melts and disappears, it leaves the transported rocky material on the ground and forms:

- Moraines, formed by the debris coming from the glacier surface;
- Floor moraines, formed by the debris that came from the glacier floor;
- Erratic blocks, that are very big and weigh some tons. They are transported for hundreds of kilometres and left on completely different rocks. When geologists find a rock that is completely different from the near ones, they understand that in ancient times that rock was transported and deposited by a glacier.

The information that can be conveyed by moraines and erratic blocks is very important, as it helps us reconstruct the events and the climate of past geological periods. Moraines indicate the shape, help us reconstruct the movements and the maximum dimension reached by the glacier. It is very important to study hills and small moraines that are present in the Plain of the Po, as they show that the area was covered by icecaps.

Aeolian landscape

The dry regions of the Earth are the most exposed to wind action, which blows in a regular way and with a speed that can range from few kilometres an hour to 200 kilometres an hour in case of a hurricane or a typhoon. Compared to water, the wind transports lighter fragments: sands and silts are transported by wind that exceeds 30-40 kilometres an hour. Trees, bushes and grass create obstacles to the wind. Also the presence of water makes soil particles heavy and hinders their transport.

Very fine particles are kept in continuous suspension by the wind that lift them very high and keeps them high for days, weeks or months and then deposits them far away. Saharan fine sands are transported by the wind towards the Mediterranean Sea until they fall down on the Plain of the Po when it rains. The result of this process is the red sand that falls on cars. Sand, silt and clay particles are dragged and rolled by the wind, that makes them jump 1-2 metres high. When the wind removes fine materials from the soil surface, this results in gravel deserts, made of gravel, stones and big blocks. These materials together form the desert floor.

Wind erosion

The sandy particles that are more easily transported are those made of quartz minerals. Quartz is a very hard mineral, which erodes the rocks close to the ground and the materials it encounters (for example telephone and electric poles). The result is the creation of grooves and slots on clay rocks, while rocky walls and soil blocks are smoothed.

Particles deposited by the wind

When the wind stops or reduces its speed, the transported material is deposited. The sands pile up as dunes, which can be 10-100 metres high. Dunes are never isolated, but they are grouped and form dune fields that move as the wind pushes them. When, as a consequence of environmental and climatic change, dunes are covered by vegetation, they acquire a fixed shape and position.

Thin sands are transported by the wind from desert regions to far away places. They deposit onto several layers and form the loess. Deposits of loess can be found in central-northern Europe, Chile and North America.

Deserts and desert regions

Desert regions are characterized by draught, and water streams are called uadi: they are almost always dry, because the water evaporates or filters into the subsoil before reaching the sea. When the water collects into a depression, it

evaporates and leaves layers of evaporitic rock sediments. In this way the chotts form. They are "salt deserts", located in Tunisia. Or the playa of California desert is formed. Or a black layer is created due to water evaporation and oxidation of the salts that are contained in the desert minerals. This is called desert paint.

A desert cannot be completely flat. It can have heights and steep slopes, with a debris base, without vegetation. Characteristic of desert landscapes are the wide plateaux called mesa or meseta (what is left of a wide eroded flat area) and buttes (tower-shaped heights).

Coastal landscape

The coast is a strip of soil between the mainland and the sea. The coast is constantly shaped by the action of the sea (waves and tides), the wind and atmospheric agents. We do not have to forget that some organisms, such as corals and algae, can destroy or build a part of the coastal landscape. Coasts can be low or high, rocky or sandy. High and rocky coasts are characterized by steep cliffs whose base is excavated by the waves. This can favour the collapse of the higher walls and therefore the withdrawal of the coast. Typically, this landscape is characterized by bays and creeks that facilitate the construction of ports. The most typical shape of low coasts is a beach, made up of stones in the most internal part and sand that becomes finer and finer towards the sea. The waves and the material that is deposited on a river mouth manage to constantly pile up debris close to the coast, by forming borders, barriers, banks and shores. The different types of coast are:

- high coasts with cliffs: they are characterized by a vertical rocky slope straight on the sea (ie. Coasts of Normandy, English coasts on the English Channel, coasts of Scotland and Ireland). At the bottom of the walls the waves carve some deep cracks that form spectacular shapes like arches, rocks and caves. The cracks can be quite deep and provoke the collapse of the rocky wall. In this way the cliff wall withdraws. Coasts are not only shaped by the action of the sea, but they are also shaped by tectonic movements of the Earth's crust and by sea movements. In fact, we can find some sea caves that are now located tens of metres above the current sea level, while others are completely submerged. Examples are the sea caves of Circeo, of the channel of Otranto, Capo Palinuro, Capri, Sardinia and Liguria;
- rias coasts: they originated as a consequence of the sea invading old river valleys. The heights form peninsula and capes. Examples are Galicia, western Corsica, central-southern Greece. Deep gulfs and creeks that host ports are typical of this type of landscape. Old valleys that were occupied by glaciers and that are now invaded by the sea have formed the fjords, while the skjars (rocks garden) are coasts formed of several small islands and rocks. They are typical of Finland and Sweden;
- low coasts: they form when the destructive action of the sea is weaker and the river material settles. This material is distributed along the coast by weak sea currents and deposited on shallow waters, in areas that are protected by promontories. Waves move these deposits by forming long submerged piles that gradually emerge from the sea surface in order to form sandbanks and the typical beaches with a tongue or arrow shape that extend from the promontories. These beaches can stretch more and set the borders of the bay, forming a lagoon. The evolution of the lagoon into a coastal lake occurs when there is a complete separation from the sea (Lakes of Lesina and Varano in Puglia region). Tombolos are created when sand strips connect the island with the mainland (Argentario mountain and Orbetello ponds). Beaches are a typical deposit of low coasts.

Lagoons

A lagoon is a stretch of sea, often some kilometres wide, with shallow waters and a low and sandy coast. The lagoon can be connected to the open sea by canals that facilitate water exchange and the lagoon cleaning. Usually, with time passing, the canals close and form coastal lakes. These small lakes are gradually filled with river material. Among the most famous lagoons in the world is the lagoon of Venice, located between the Po delta and Piave mouth.

Industrial landscape

Industrial landscapes are obviously typical of those areas where industrial activities are very intense. Therefore it is necessary to make a distinction between industrialized and poorly-industrialized countries. The latter are located in the so-called South of the world. They are scarcely developed and their populations live in poverty. Instead, the North of the world is populated by highly industrialized countries, the rich ones, i.e. North America, Western Europe, Japan. Also Australia and New Zealand can be included in this group.

The north, more developed, hosts $\frac{1}{4}$ of the world population, but owns 80% of global incomes and 90% of the industrial production. Between the north and the south are all those countries (Hong Kong, Taiwan, Singapore, Brazil and Mexico) that, in the latest years, have experienced a gradual industrialization process. These countries, in order to reach a higher industrial

development, exploit their raw materials and low-cost labour force.

Agricultural landscape

As agriculture is the first human activity, agricultural landscapes are spread in all continents and populations. Like the industrial landscape, agricultural landscapes are not equally distributed between the developed and underdeveloped world. North America and Europe are characterized by a wide presence of rural landscapes, with intensive agriculture. In these areas, large agricultural fields are subject to a periodic rotation of crops. In this way, by using modern equipment, huge quantities of produce are exported and devoted to industrial production. Also animal farming is very developed: it represents the main economic support for Denmark and Ireland.

Instead, in most of African, Asian and South American countries, agriculture still represents a subsistence activity. Agricultural production, obtained with primitive techniques, only manages to satisfy the needs of few people. Moreover, travelling agriculture is very popular. It is a very precarious activity, which is also very dangerous for the landscape. It is based on the deforestation of surfaces, after setting the vegetation on fire. Subsequently, the soil is farmed but, as it is not taken care of, nor fertilized, it becomes sterile and it is abandoned. In these countries monoculture is very developed. Wide lands are farmed with a determined type of plant, generally the most requested for exports. This, of course, impoverishes the heterogeneity of the landscape.