

Erosion and Deposition

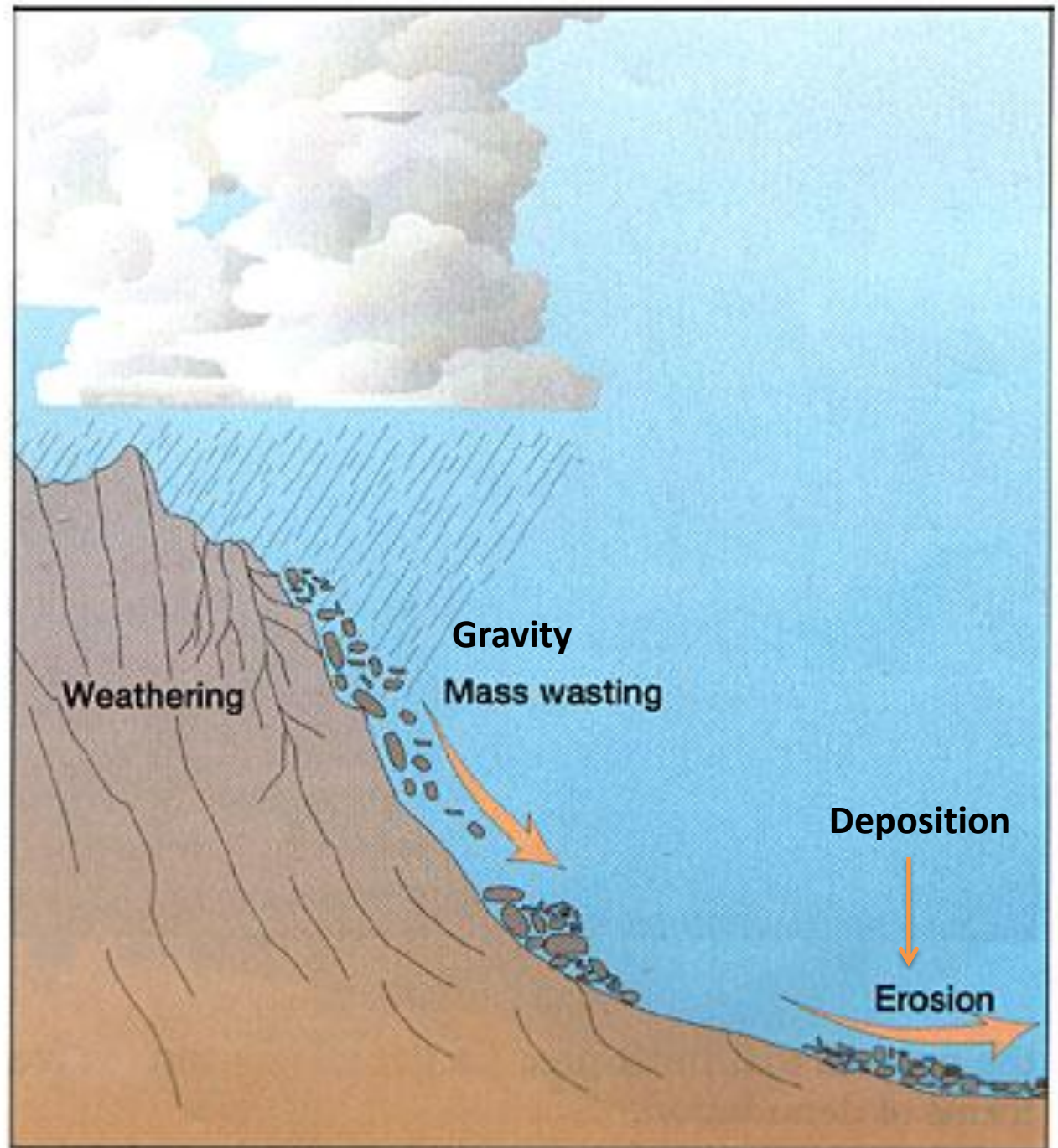
Erosion—the movement of rocks and sediment from one place to another. The main agents are:

1. Water
2. Wind
3. Ice
4. Gravity

Deposition—the dropping of sediment and/or rocks in another place follows weathering and erosion. Deposition occurs when:

1. Water carrying the sediment slows down.
2. The wind carries the sediment dies down.
3. The glacier carrying the sediment melts.

Here we see the processes acting of weathering, erosion and deposition working together.



Agents of erosion: water.

Water is the main agent of erosion.

Running water carries weathered pieces of rock from one location to another.

It can carry big pieces of rock as well as smaller rock pieces and soil.

It can also weather rock at the same time as it is eroding it (carrying it away).

Rock is worn away (weathered) at the same time that is carried away (eroded) by fast moving water.



Rocks hit
one
another
causing
them to
break.

Fast moving water can move (erode) very large rocks transporting them downhill along with smaller rocks.



A slow moving river carries mainly pebbles, sand, silt and clay (sediment). The slower water cannot carry bigger rocks.

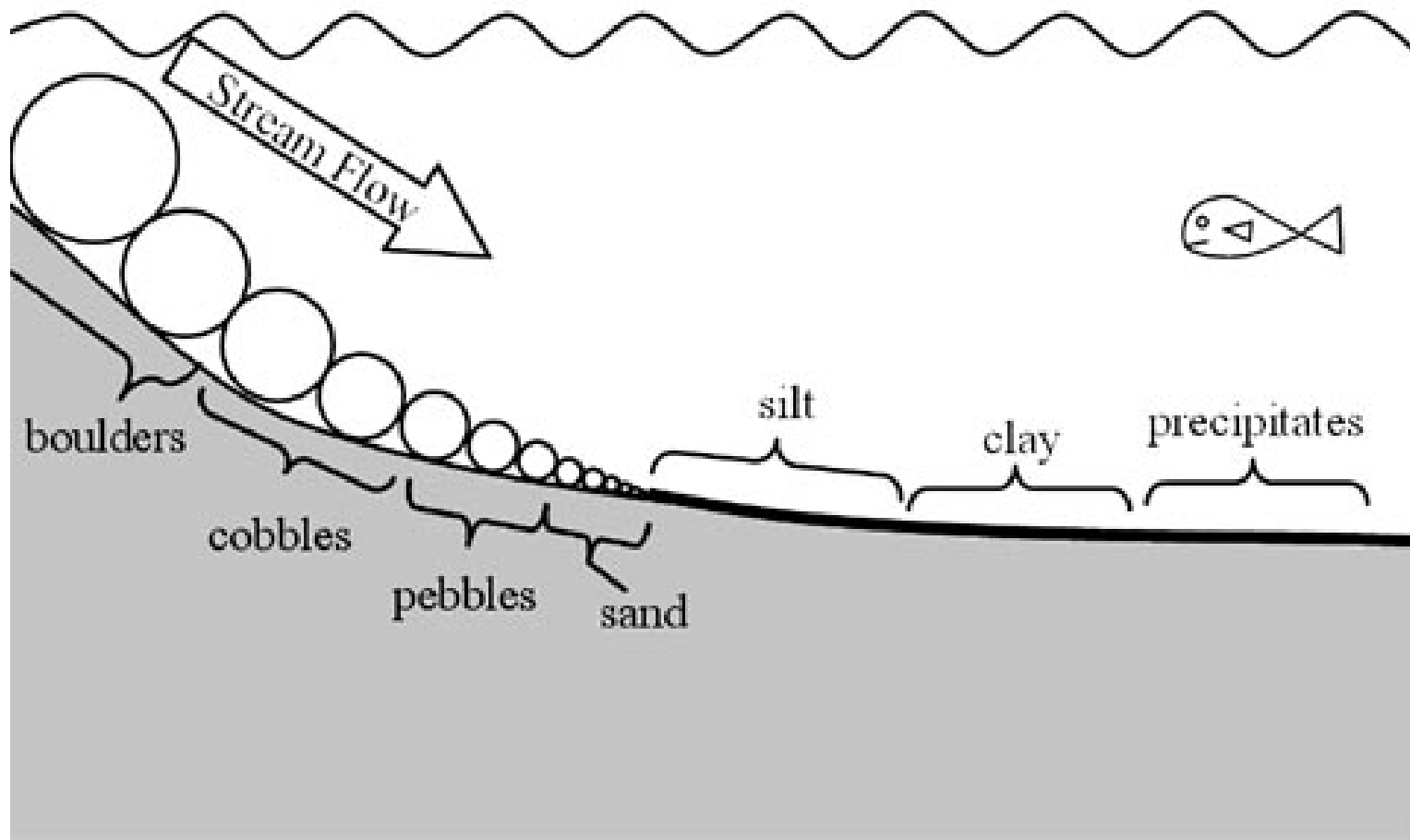




As soon as the rushing water slows down, the larger pieces of weathered material it had been carrying is deposited.

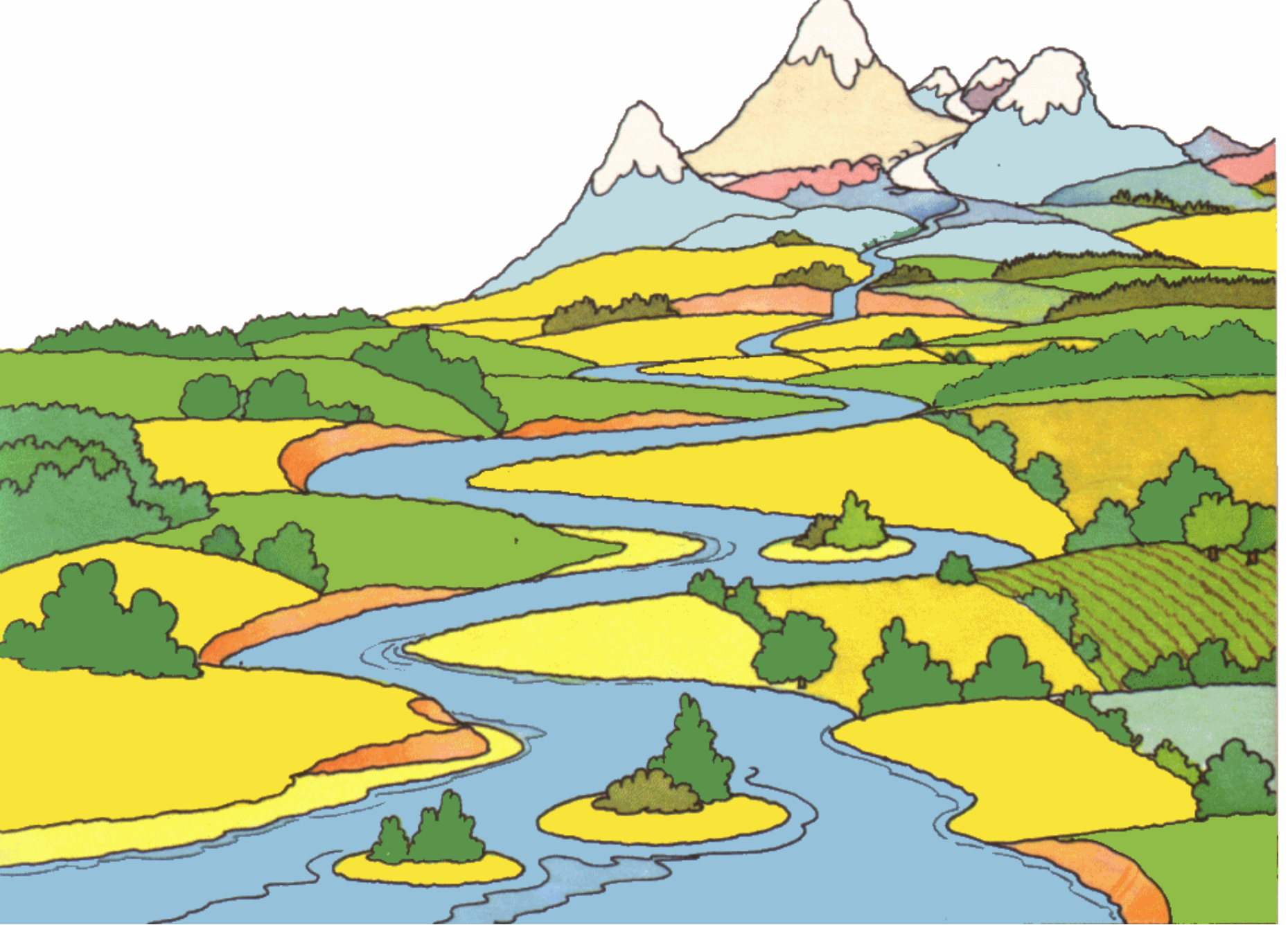
Photo courtesy [daneen_vol](#) of Flickr under [Creative Commons license](#)

As can be seen by this diagram, as the water slows down, first the larger pieces fall out. And then as it flows slower and slower, smaller and smaller pieces are deposited.





Soil and pebbles may be carried for a great distance as sediments in the river. As we said before, a river carrying a lot of sediment looks muddy. Shown here, sediments are being deposited at the mouth of a river in Lake Genoa.



<http://www.arthursclipart.org/>

When sediments (gravel and soil) are deposited at the mouth of a river, a delta may be formed. It becomes a fertile area for to grow crops such as rice.



Sediment deposited at the mouth of a river also may build a sandy beach.

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- Some of the sediment is deposited immediately at the mouth of the river.
- Most of the sediment becomes suspended in sea water and is carried along the coast by the longshore current, a stream of water flowing parallel to the beach. This current is created by waves breaking at an angle to shore.



Agents of erosion: Wind

Wind, the second agent of erosion.

Wind picks up small pieces of rock or soil and transports them from their source to another location where they are deposited.



<http://www.flickr.com> nukeit1

When the wind blows in the desert, sand is continuously deposited in a different places.

When the wind stops blowing, new sand dunes may have been formed.



In this section we see will see mesas, buttes, arches, canyons and and other strange rock formations that were created through both weathering and erosion.

The wind's remarkable ability to sculpt such odd and beautiful landforms is explained by the hardness of the rock involved. Some rocks are softer and weather faster than others.

Plateau with mesas, butte and gully



Photo of a mesa—this is what is left of the plateau that made up this entire landform before weathering and erosion carried much of it away.

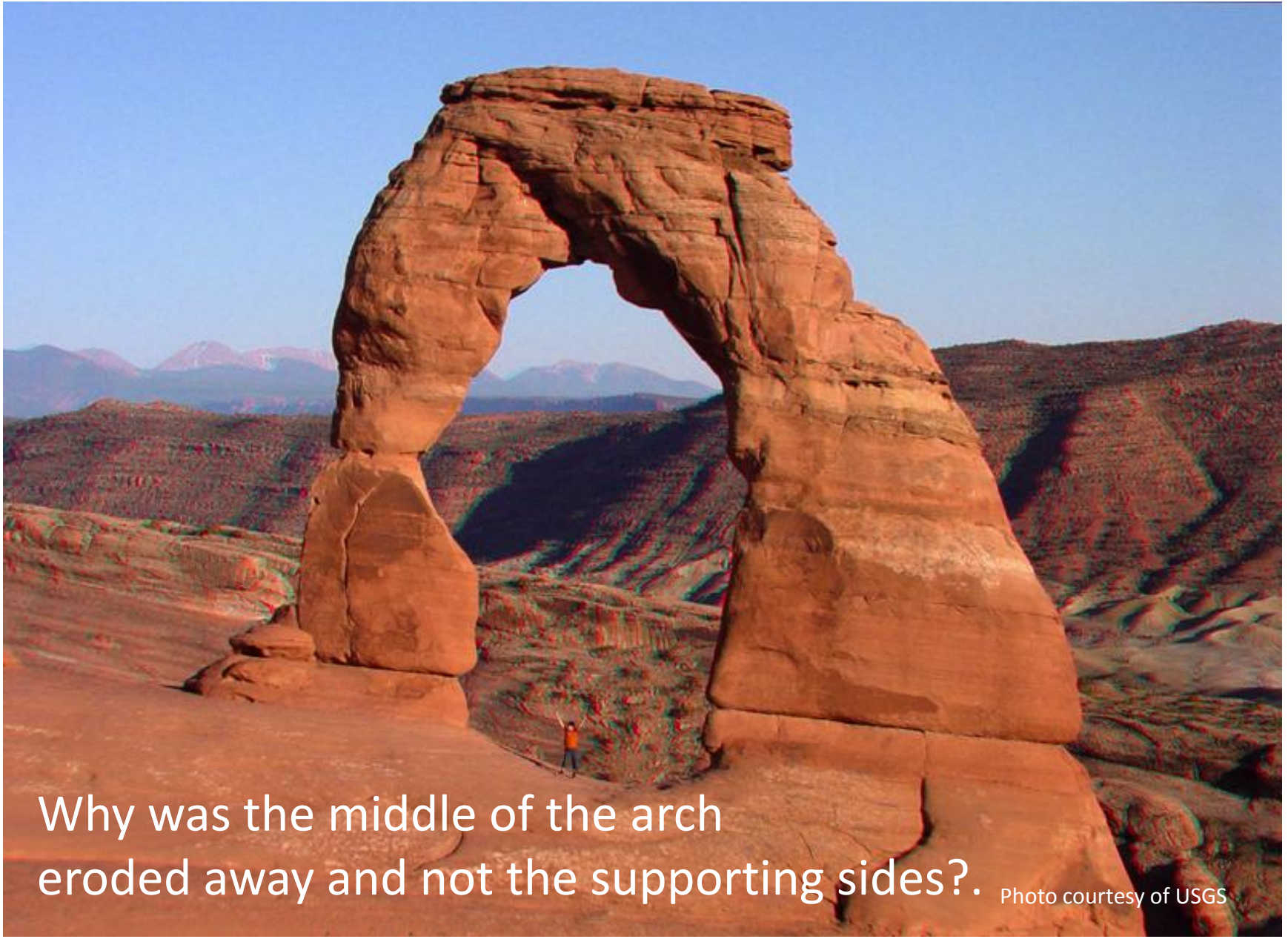


Photo of buttes



What could the red line be depicting?

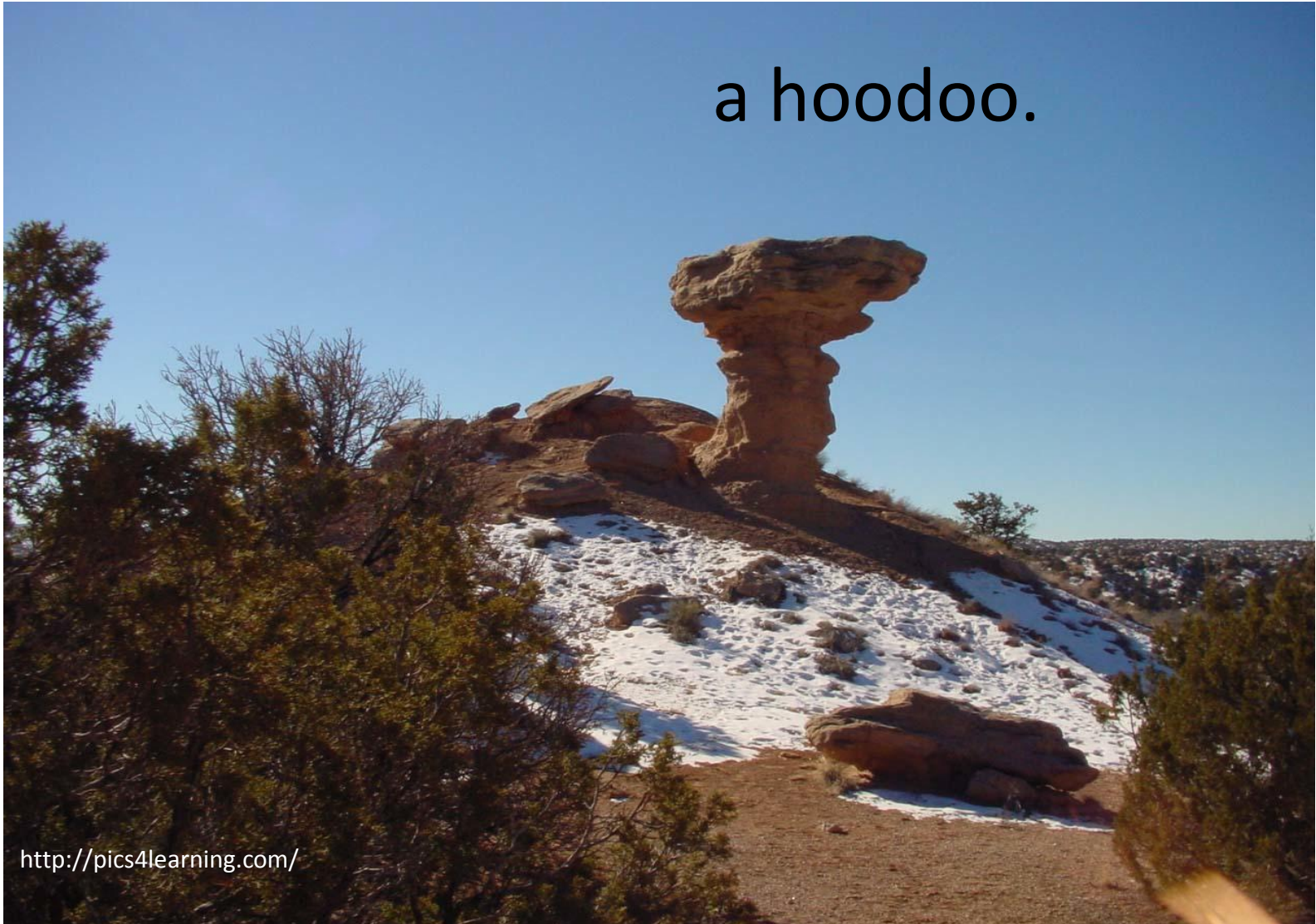
Photo of arch



Why was the middle of the arch eroded away and not the supporting sides? . Photo courtesy of USGS

The difference in hardness of the rock composing the “cap” and the rock below the cap explains why the under rock weathered faster than the cap itself.

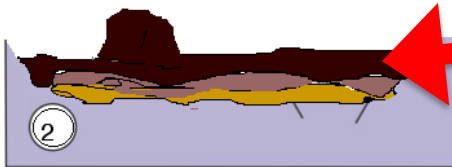
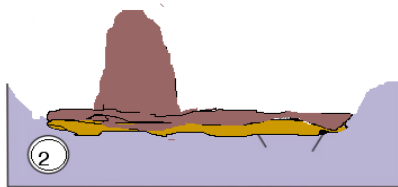
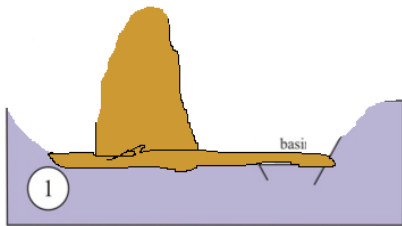
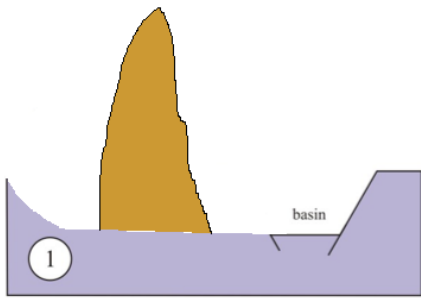
a hoodoo.



Here we can see that the weathering and erosion from these boulders is filling in the area beneath them.



Over hundreds, maybe thousands of years, it could have happened something like this.



On their way to the sea, some rivers wind across plateaus, carving deep valleys and taking sediment down stream with them.

Once the valley walls become exposed, these rocks are further weathered by the wind, rain and changing temperatures.

Over millions of year, these valleys can become giant, majestic chasms called canyons.

The Grand Canyon is just such a canyon, it is continually being carved by the Colorado River.

The Grand Canyon



Palo Duro Canyon



[Wikipedia commons](#)

Agents of erosion, weathering, and deposition:
Ice--Glaciers

Glaciers—great sheets of ice-- create landforms through both erosion and deposition.

Glaciers form when, over many years more snow falls each year than melts. As a result, a deep layer of compacted snow accumulates. This layer of snow becomes compressed into a thick sheet of ice.

What makes glaciers unique is that they move. Due to their mass and the force of gravity, glaciers flow down hill a few inches or feet per year.

There are two types of glaciers:

1. **Continental glaciers**--glaciers that form over large areas of continents close to the North and South Poles.
2. **Mountain glaciers**--relatively small glaciers that form near the tops of mountains.

Continental glacier in Antarctica



CoolAntarctica.com

<http://www.coolantarctica.com/gallery2/glaciers/Glacier-10.html>

Mountain glacier in the Rocky Mountains





2005 5 31

During the past Ice Ages, very thick continental ice sheets overlaid much of the continent of North America as shown in this diagram. These very thick glaciers covered all but the highest mountains and resulted in significant erosion.



Grey shaded area—continental glaciers

Many lakes in North America including the Great Lakes, were created by glacial moving over the rock and gouging out deep “holes” which filled with water when the glaciers melted.



In the last glaciation period, which ended approximately 10,000 years ago, 32 percent of Earth's land area was covered with glaciers.

Glaciers now cover only about 10 percent of the land area.

That glacial ice is found mainly over Antarctica.

Most of the other glaciers overlie Greenland; the remaining small percentage are mountain glaciers found in places such as Alaska, the Canadian Arctic, Patagonia, New Zealand, the Himalayan Mountains, the Rocky Mountains, and the Alps.

That glacial ice is found mainly over Antarctica. Most of the other glaciers cover Greenland; the remaining small percentage are mountain glaciers found in places such as Alaska, the Canadian Arctic, New Zealand, the Himalayan Mountains, the Rocky Mountains and the Alps.



Glaciers are not landforms. The action of glaciers, however, creates landforms.

Glaciers move, and as they do, they scour the landscape, "carving" out landforms and eroding material.

This happens because friction breaks the bedrock into pieces of smaller rock and soil. This debris becomes embedded in the bottom of the moving glacier and is carried downhill.

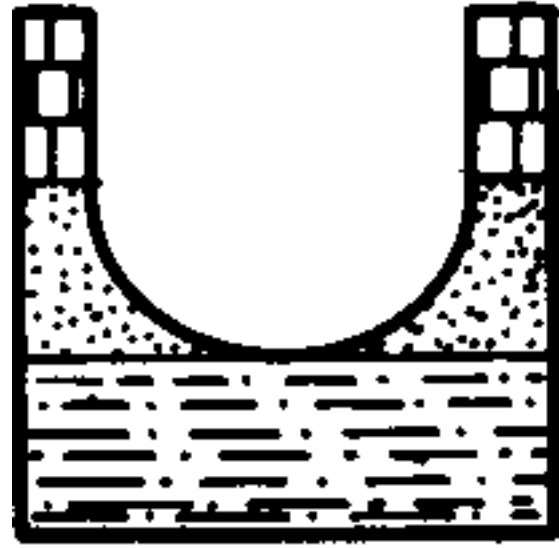
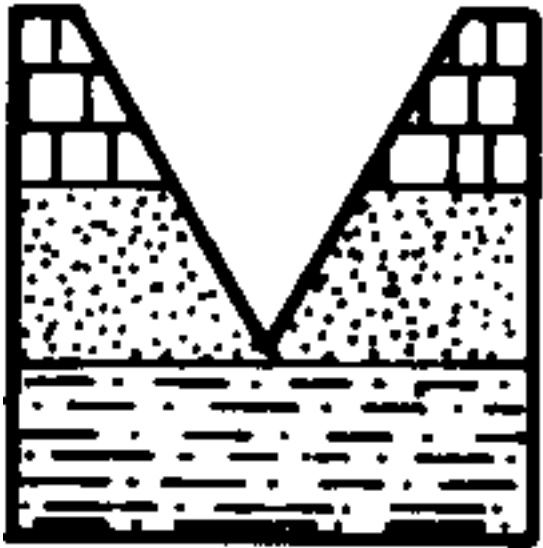
Like a big bull dozer, glaciers drag and push rocky debris downhill to the end of their travel for that winter (or for that ice age).

As they move, the rocks and soil stuck in the bottom of the glacier scrape and scratch the land underneath them.



In the photo above, you can see these “scratches”.

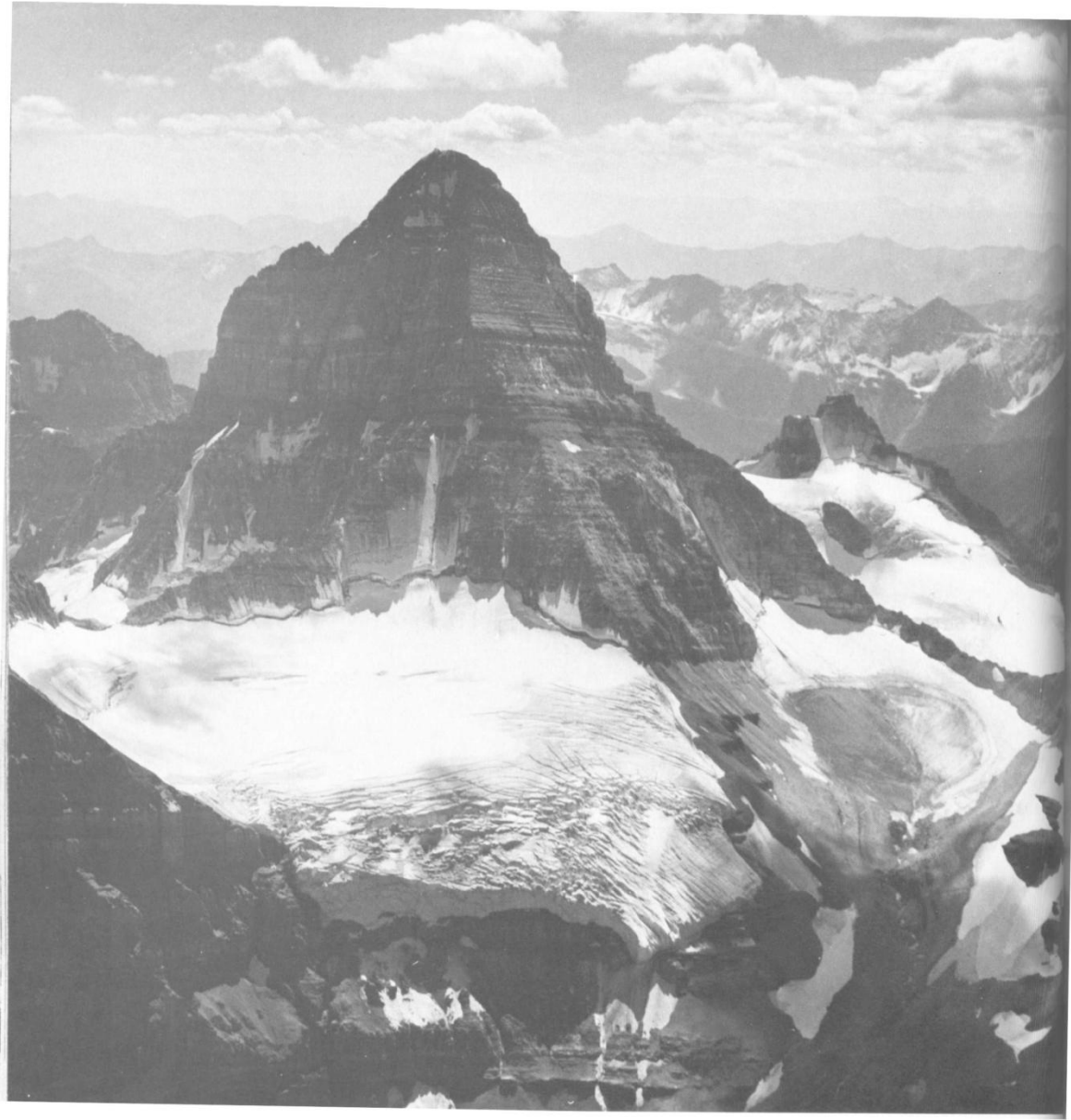
Imagine that scrapping continuing for millions of years and you can see how glaciers turn V shaped valleys into U shaped valleys.





As the glacier moves through a V-shaped valley, it sculpts a “U”.

A horn is a pyramid-shaped mountain peak created by several glaciers eroding away at different sides of the same mountain.



Glaciers leave a predictable mark on the landscape through their deposition.

As the weather warms, glaciers pull back, leaving deposits of the rocky material along the sides and at the end of their travels.

This deposition creates landform features called moraines.



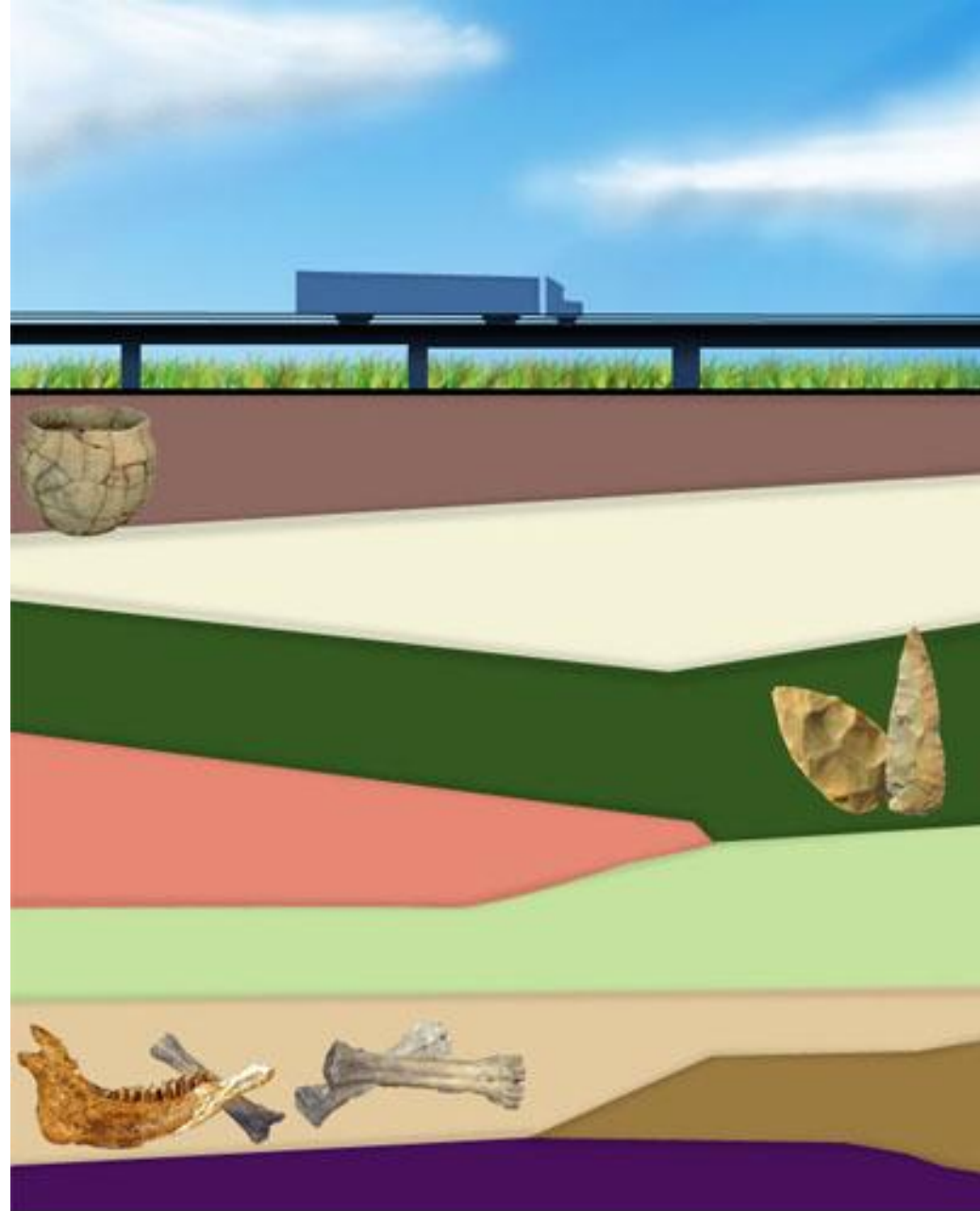
Rocks and sediment deposited on the sides or the ends of a glacier create a landform called a moraine.



Formation of sedimentary rock

When sediments are deposited by a river over a long period of time into a shallow ocean or lake, layers of sedimentary rock may be formed.

Just what is sedimentary rock?

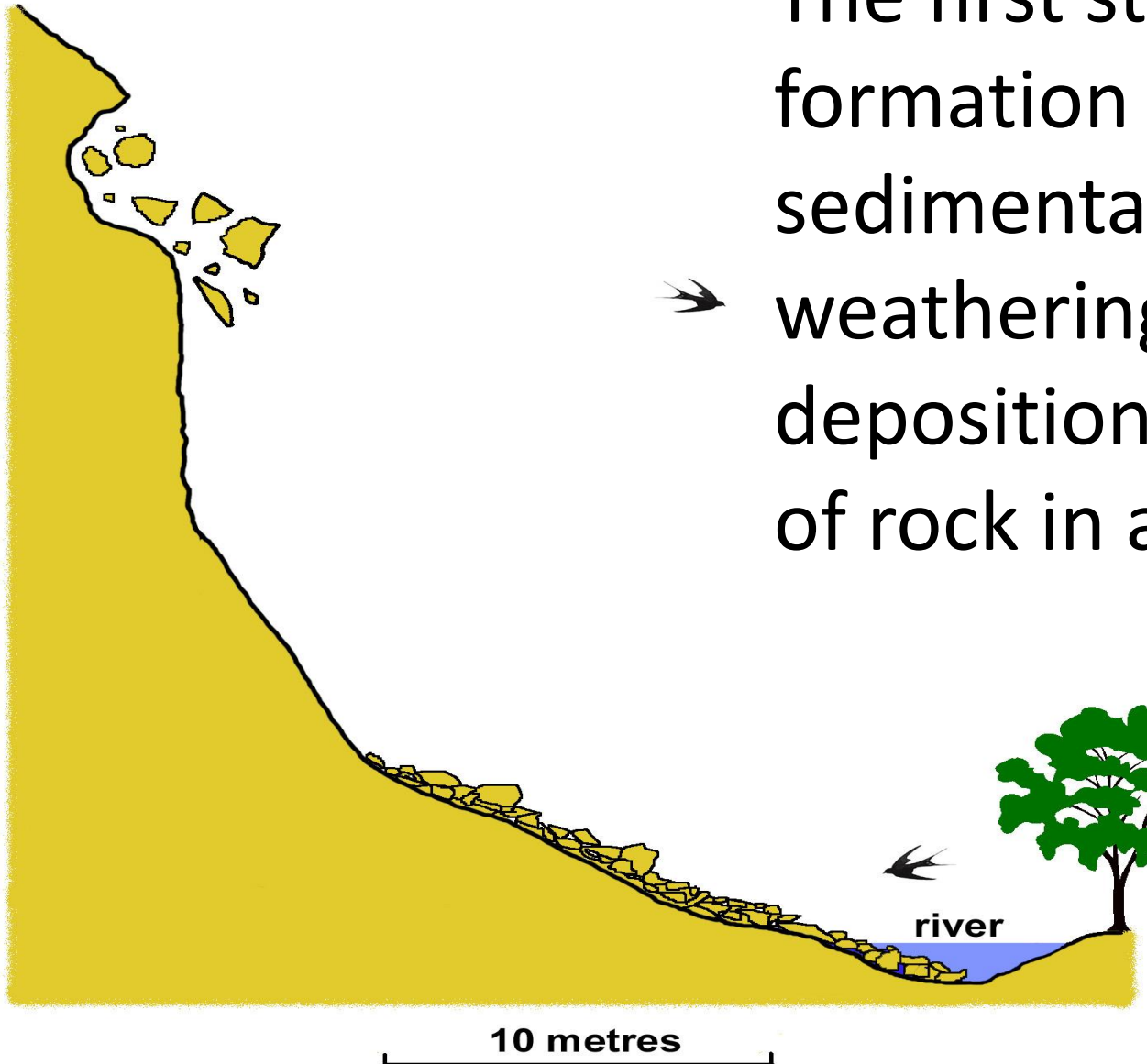


Strata, or layers of earth. The bones of Ice Age creatures are shown in layer near the bottom.

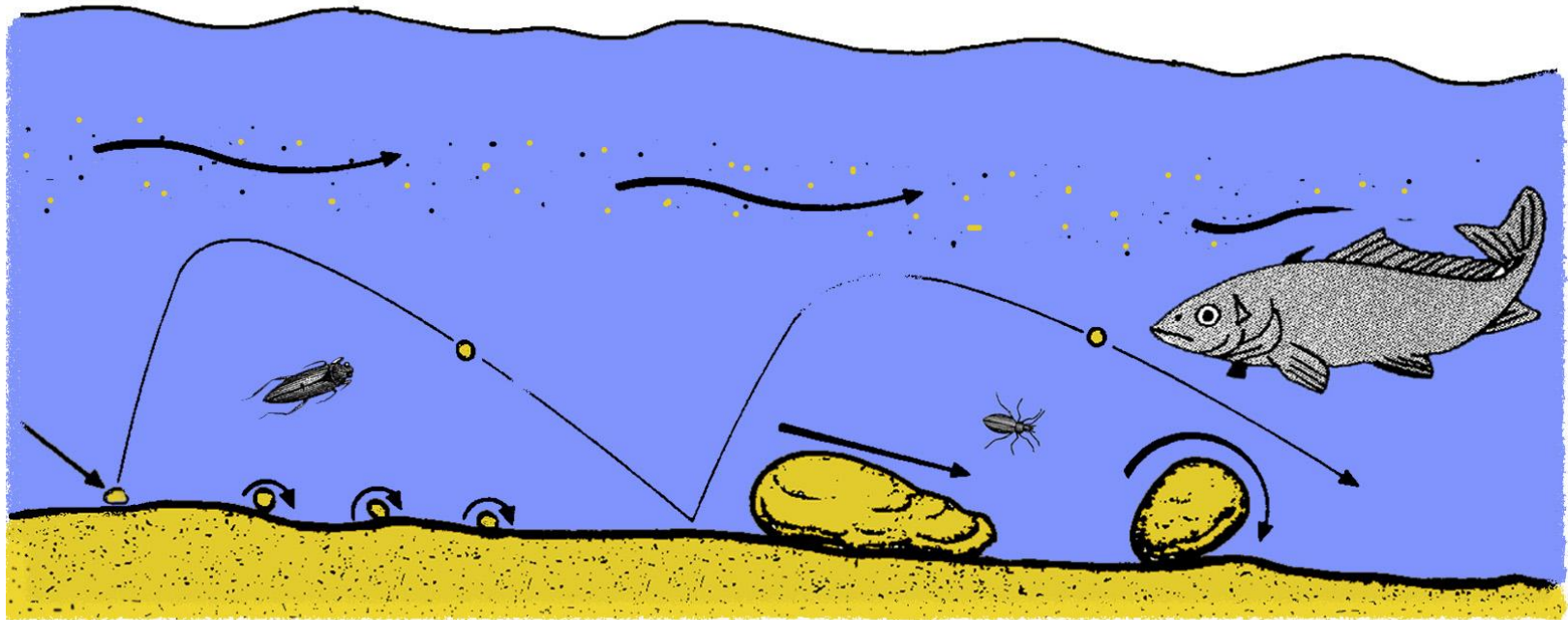
One of the three major rock types, sedimentary rock is formed when sediments such as tiny fragments of rock including pebbles, gravel, sand, silt and clay are naturally glued together under great pressure.

The next few slides will help us better understand just how sedimentary rock is formed.

The first steps in the formation of sedimentary rock are weathering, erosion and deposition of fragments of rock in a river.

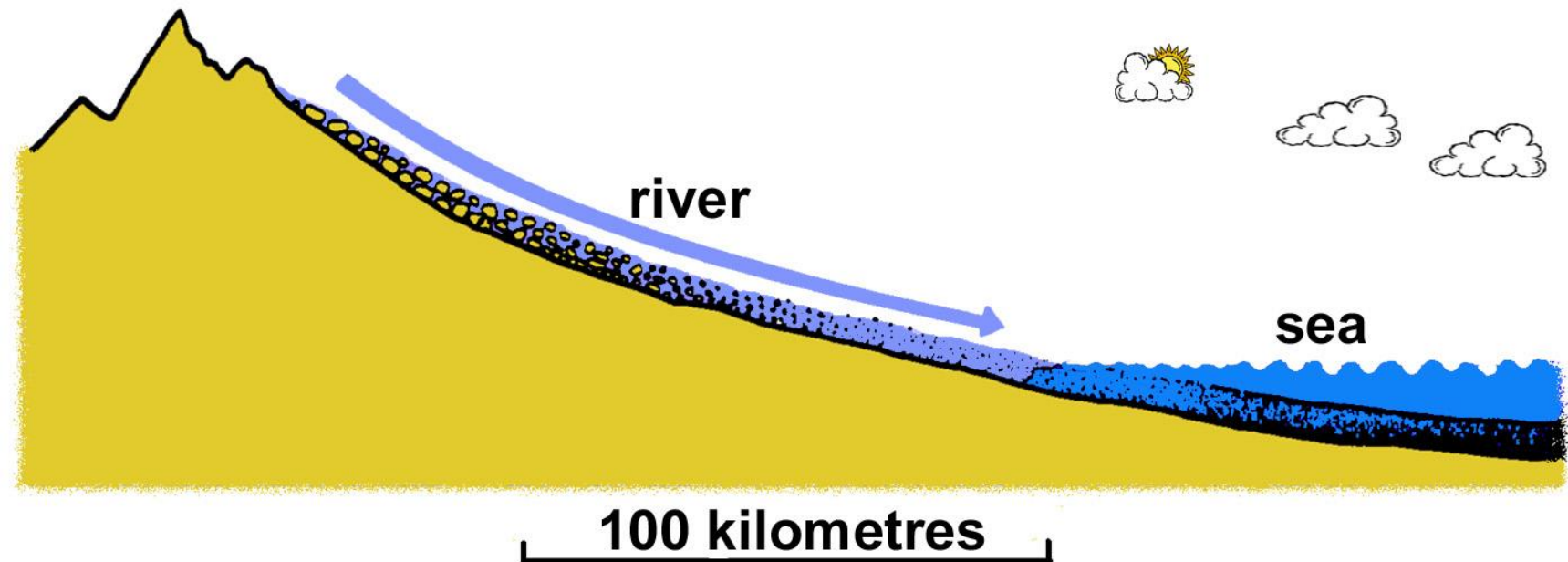


The fast moving river carries the pieces of rock. In the process, the rocks hit one another and are weathered further and further, forming tiny pieces of sediment.

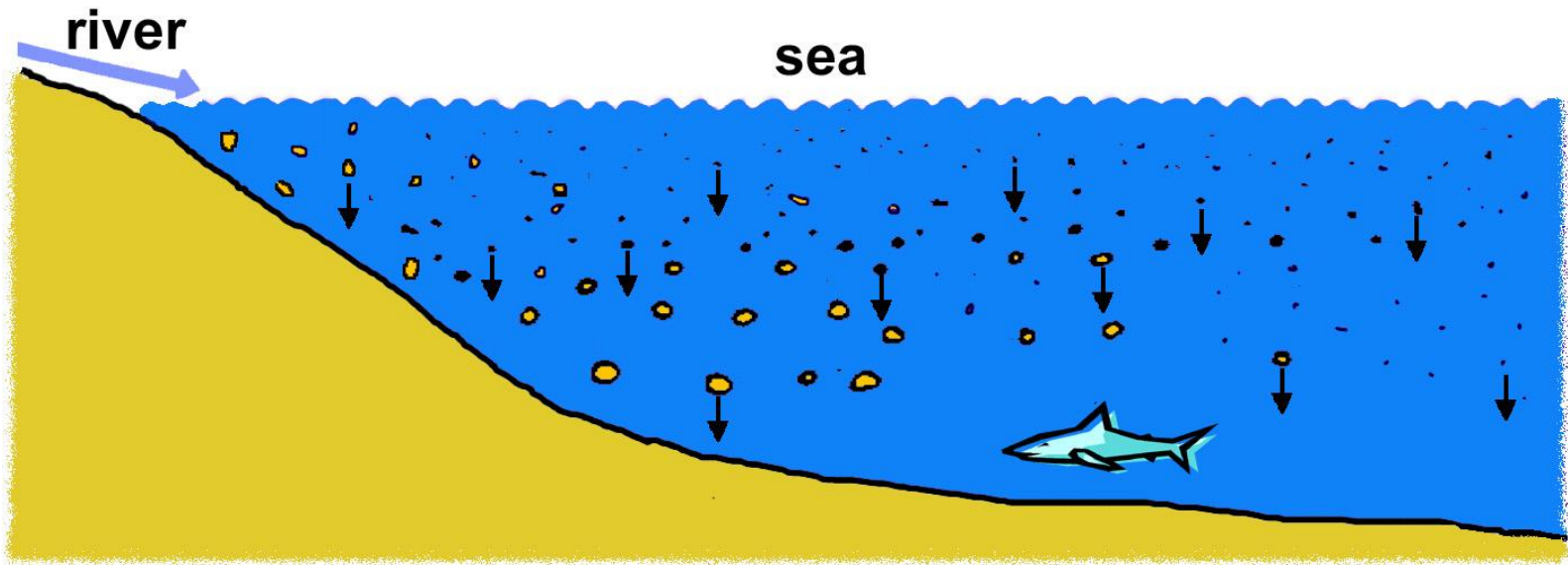


10 centimetres

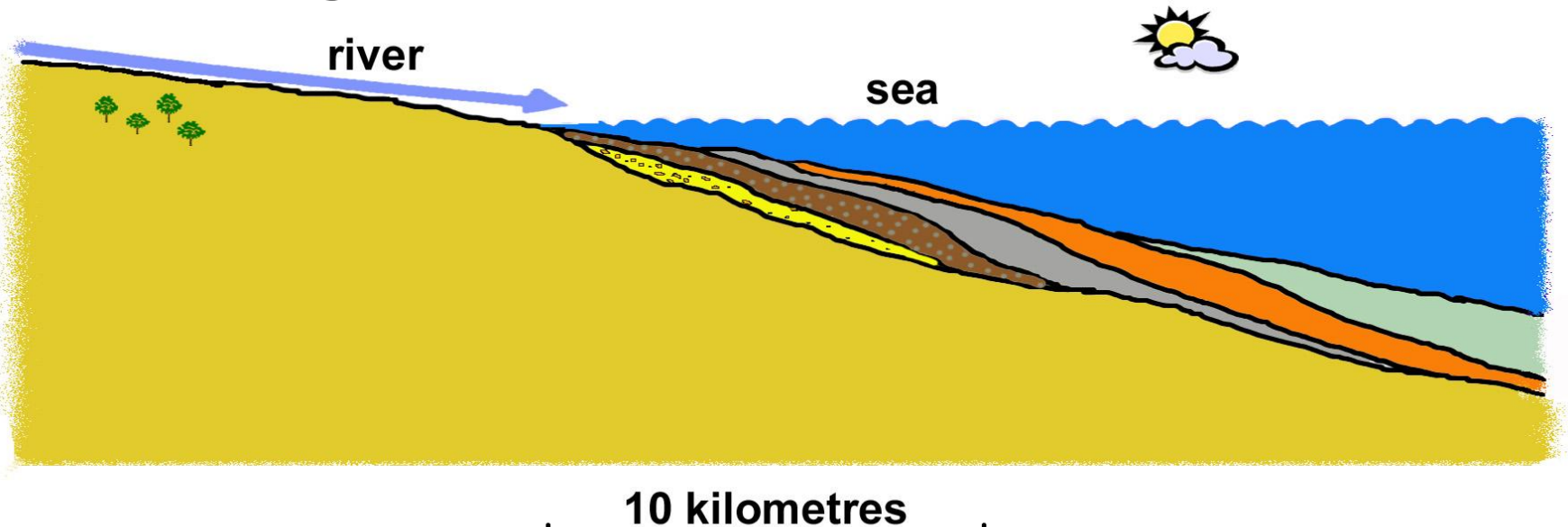
Here you can see the pieces of rock becoming smaller and smaller as the river flows towards the sea.



As it nears the sea the river gradually slows down, depositing bigger pieces of rock. By the time it reaches the sea it is mainly carrying small pebbles and soil. As it enters the sea it slows down even more and deposits the sediment it is carrying.

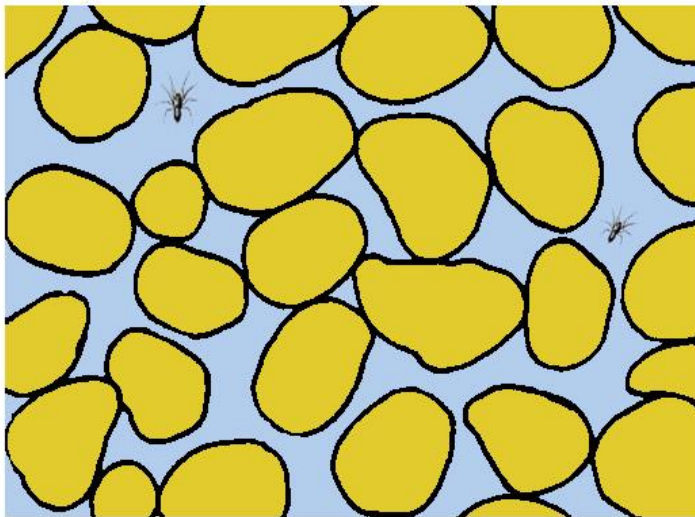


The river deposits the larger heavier pebbles first and then gradually the smaller and lighter sediments. In this way layers of sediment are deposited on the floor of the sea. The upper layers of sediment are heavy and push the sediments beneath closer together.

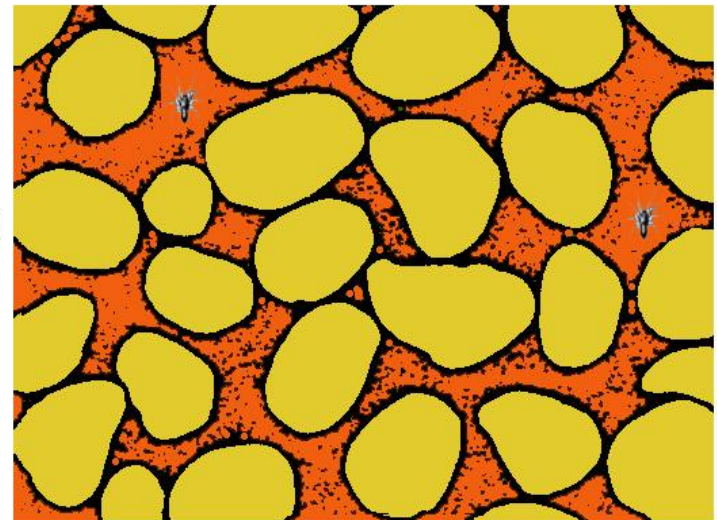


Then the process of lithification occurs. The seawater between the grains of sediment evaporates leaving behind the minerals that were dissolved in the water. These minerals glue the tiny fragments of sediment together to form a type of rock called sedimentary rock.

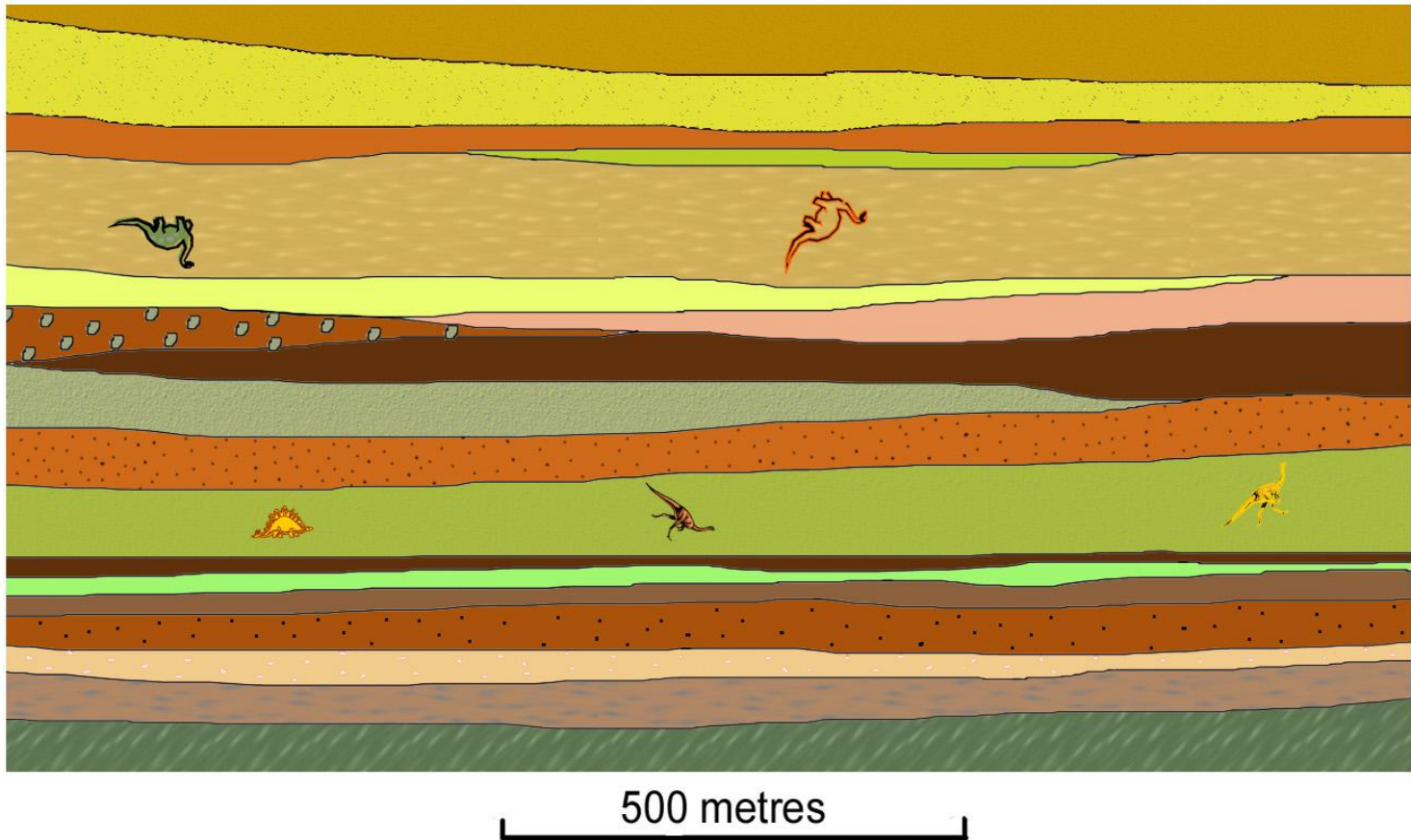
water between sand grains



chemical cement between grains



Over millions of years, the sea fills up with sediment and the water evaporates. The result--layers of sedimentary rock.



Five types of sedimentary rock are formed in this way:

- conglomerate
- sandstone
- shale
- siltstone
- limestone

The type of rock depends on what type of sediment is cemented together.

Particles of pebbles or gravel cemented together become conglomerate.



Particles of sand cemented together become sandstone.



Particles of silt
cemented together
becomes siltstone.



Particles of mud
cemented together
becomes shale or
mudstone.



Particles ground up
sea shells cemented
together become
limestone.





A layer of limestone on top of shale.

Wikipedia Commons

Most rock on the Earth's surface is Sedimentary Rock



<http://rst.gsfc.nasa.gov/>

Formation of Beaches

There are two main types of beaches

1. Rocky beaches

2. Sandy beaches

Rocky Beaches (most with cliffs)

- Are often made of volcanic rock.
- Include four kinds of landforms: sea cliffs, sea arches, sea stacks and sea caves.

Sea Cliffs



Sea Caves





Sea Arches

Sea Stacks



Rocky beaches are shaped by the weathering, erosion and desposition by the of waves (water) and wind.

The constant beating of the cliffs and sea stacks weather and erode the rock.

Eroded material is then deposited becoming available to form sand bars and barrier islands.

Because of the severe pounding of both wind and waves, these formations erode relatively quickly.

Over a long period of time sea stacks sometimes completely weather and erode away.

The following series of pictures shows the same sea stack photographed over a 100 year period.

1890



<http://walrus.wr.usgs.gov/pubinfo/jump.html>

1910



<http://walrus.wr.usgs.gov/pubinfo/jump.html>



1910



1920

1970



1990



Sea arches and sea caves are created when part of the rock making up a cliff is harder than other parts. The softer section can not stand the erosive powers of the waves for as long as the harder section and erodes faster.





The softer material in this span has already eroded, leaving the harder rock spanning the arch.



The softer rock in this cliff has already eroded, leaving a sea cave.

<http://www.flickr.com>
mikebaird

Sandy Beaches

- Are deposition landforms, meaning that they are formed by deposits of sediment.
- The sediments deposited are sand, silt and pebbles— materials carried by a river or stream from the inland into the ocean;
- River sediments are the source of most of the sand on beaches.

Washed to sea by streams and rivers, two separate processes result in the deposit of this sand and sediment on the shore.

- Some of the sediment is deposited immediately at the mouth of the river often forming a delta.
- Most of the sediment becomes suspended in sea water and is carried along the coast by the longshore current, a stream of water flowing parallel to the beach. This current is created by waves breaking at an angle to shore.

