

Beach, river, dune, mountain, plain – what layers might be preserved here? A discussion on what evidence might be preserved in rocks from different environments

It is easy for geoscientists to work out what is likely to be preserved from a recent lava flow, since they can walk on it and test it. It is more difficult to work out what might be preserved as rock from other modern environments. This 'deep question' Earthlearningidea asks about what might be preserved in land-based environments that pupils might have experienced.

Beach

Most sediment is laid down on beaches by the swash and backwash of the front of the waves after they have collapsed on the beach. This deposits flat layers of sand or pebbles that slope gently towards the sea. Sometimes, when pools have developed, ripple marks can be preserved there too.



Sand on the Lake Michigan shoreline, Pierce Stocking, USA.
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River

Rivers have great varieties of flow rates and materials, and the deposits they lay down depend on both these things. With high flow rates and coarse materials, gravel beds are laid down, often in channel shapes, when seen from above or in cross section. The gravel may be of rounded or angular pebbles, depending on how far they have been transported. With lower flow rates and/or finer materials, flat sand layers are often deposited. However, some layers may slope downwards in the direction of flow, as cross bedding.



River sediment, showing cross bedding in the top sequence, in a sand and gravel pit near Elgin, Scotland.
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Dune

Wind blows sand up the sloping backs of sand dunes and just over the top edge so it falls on to the top of the slope below; there it builds up until the slope becomes so steep that it collapses in a single layer down the face of the dune. It is this process that deposits the sloping sand layers of dune bedding or large-scale cross bedding.



The sand in these wind-formed dunes was lightly cemented together before being eroded by the wind again. Now they show not only strange shapes, but also the sand layers of the original dunes sloping in different directions; North Head of the Hokianga entrance, North Island, New Zealand.
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Mountain

Sediment layers are deposited in hollows and flatter regions in mountain areas, but as erosion continues, so the rocks and the sediments are further eroded. Thus it is unusual for sediment layers to be preserved in mountain regions – most deposits are on the plains beneath.



Ella rock, Ella, Sri Lanka; view of eroded mountain country.
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Plain

Material eroded from mountains is deposited on the plains beneath and also in plain deposits much further away. Near the mountains, sand and gravel are often deposited in channels across fan-shaped alluvial fan deposits, as shown in the picture below. Sand and mud are washed further away during floods and are laid down in flat deposits, often called flood plain deposits.



Satellite view of the Zagros Mountains in southern Iran, showing a dry river channel coming out of the mountains onto a plain. When the river was in flood it deposited a fan of gravel and sand. Beyond the fan, the floodplain deposits have been used for agriculture.

This file is in the public domain because it was solely created by NASA.

We can use the evidence from modern beaches, rivers, dunes, mountains and plains to work out how ancient rock sequences were deposited. Sometimes there is enough evidence for us to work out in detail what the palaeogeography was like and to picture the ancient coastlines, rivers and mountain ranges and their deposits.

The back up

Title: Beach, river, dune, mountain, plain – what layers might be preserved here?

Subtitle: A discussion on what evidence might be preserved in rocks from different environments.

Topic: A discussion about the different types of layers and evidence that might be laid down and preserved in different land and coastal environments.

Age range of pupils: 14 years upwards

Time needed to complete activity: 15 minutes

Pupil learning outcomes: Pupils can:

- picture a modern environment and describe the types of sedimentary layers that might be deposited there;
- explain how the layers might be deposited and the evidence they might contain for the sedimentary processes that deposited them.

Context:

Pupils can be helped to understand ancient rock deposits by discussing or visiting modern areas of land or coast and thinking about the sedimentary layers and their characteristics that might be laid down there.

Following up the activity:

For each of the areas discussed, work out how a storm might affect the area and what evidence it might leave behind:

- beach – a storm might leave a layer of pebbles in a sandy beach, or a scatter of boulders in a pebbly beach;
- river – a river might change its course in a storm, abandoning some areas and making new channels and carrying coarse sediment into other areas;

- dune – parts of a dune might be eroded, leaving a clear erosion surface, before another dune is built up on top;
- mountains – these areas have faster erosion in storms, and so even less evidence of this is likely to be preserved than normal;
- plain – the material eroded from mountain areas in a storm will be laid down on the plains beneath, with coarse gravels and sands in fans and finer sediments beyond.

Underlying principles:

- Deposits laid down in modern environments can be used to interpret depositional conditions in past environments.
- By considering individual environments and the processes that operate there, we can work out what sedimentary layers are likely to form and be preserved.

Thinking skill development:

Picturing how layers might be deposited in modern environments is a construction activity that can then be bridged into past environments. Discussion around these issues can cause cognitive conflict and metacognition.

Resource list:

- none

Useful links:

You can see how geologists reconstruct ancient environments, particularly swamp deposits, at: <https://insider.si.edu/2013/01/how-do-paleontologists-reconstruct-environments-from-the-ancient-past/>

Try the Earthlearningidea 'Fieldwork: applying the 'present is the key to the past' at: https://www.earthlearningidea.com/PDF/187_Present_key_past.pdf

Source: Chris King of the Earthlearningidea Team.

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