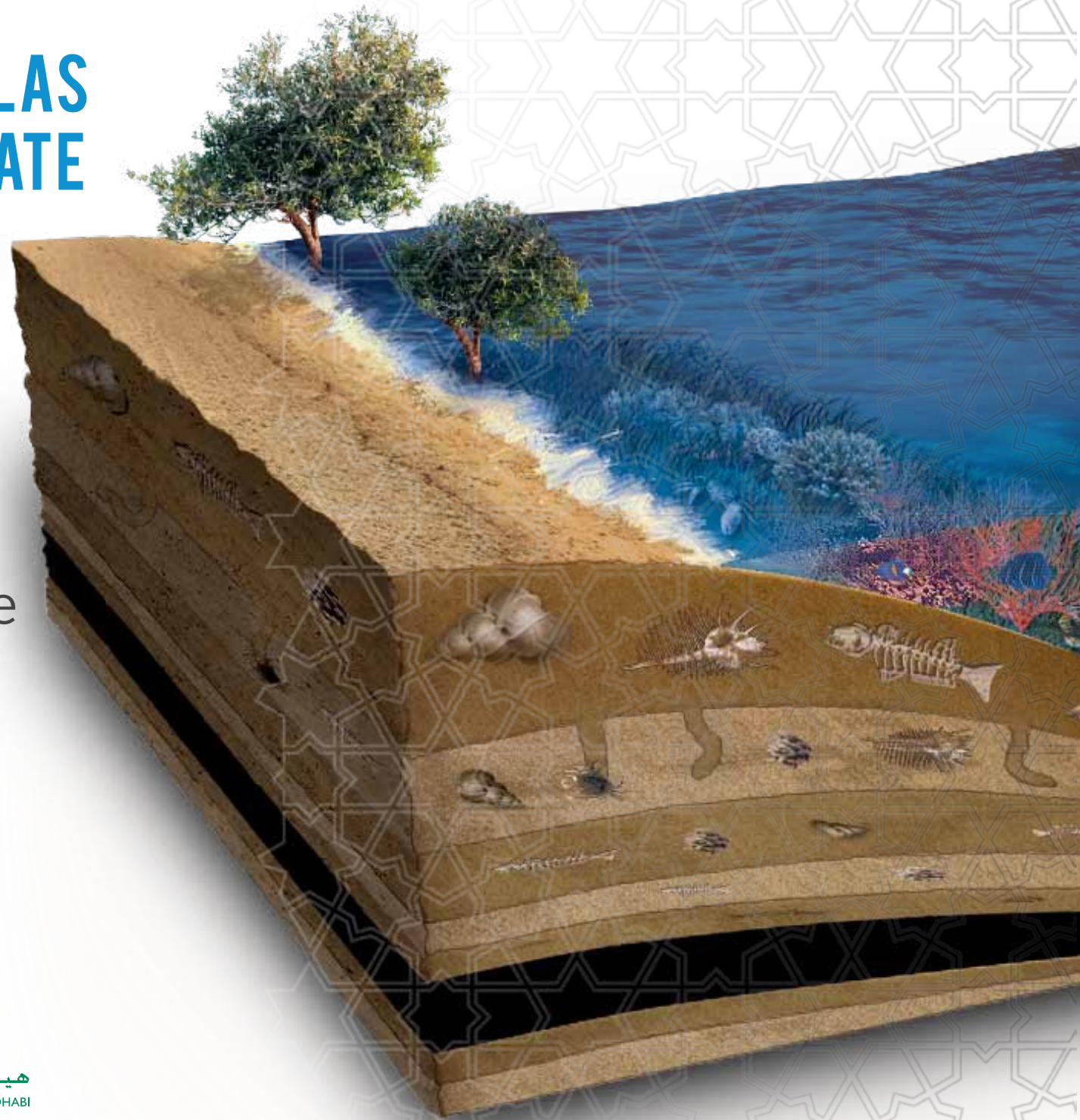
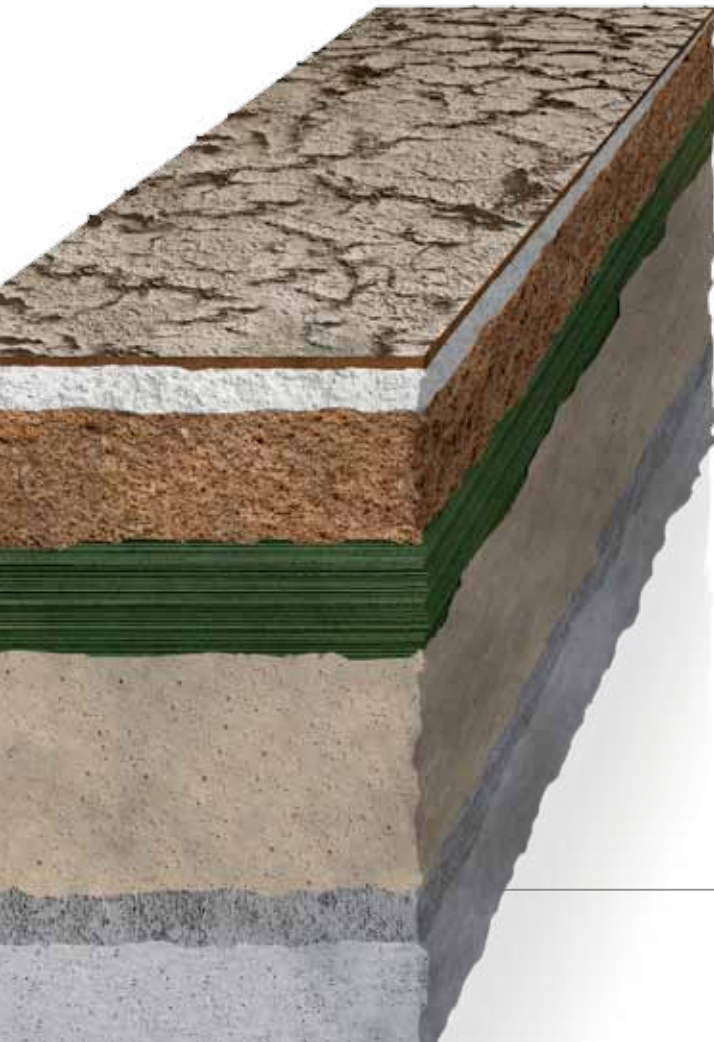


ENVIRONMENTAL ATLAS OF ABU DHABI EMIRATE

Settle down everyone
A teacher briefing on sedimentation



This teacher briefing is for teachers and other educators to give young people an understanding of sedimentation and how the physical geography of Abu Dhabi today displays the consequences of a process affecting the Earth's surface.



Sedimentation usually happens in low-lying areas such as oceans, where successive layers of sediment gradually gathers little by little⁽¹⁾.

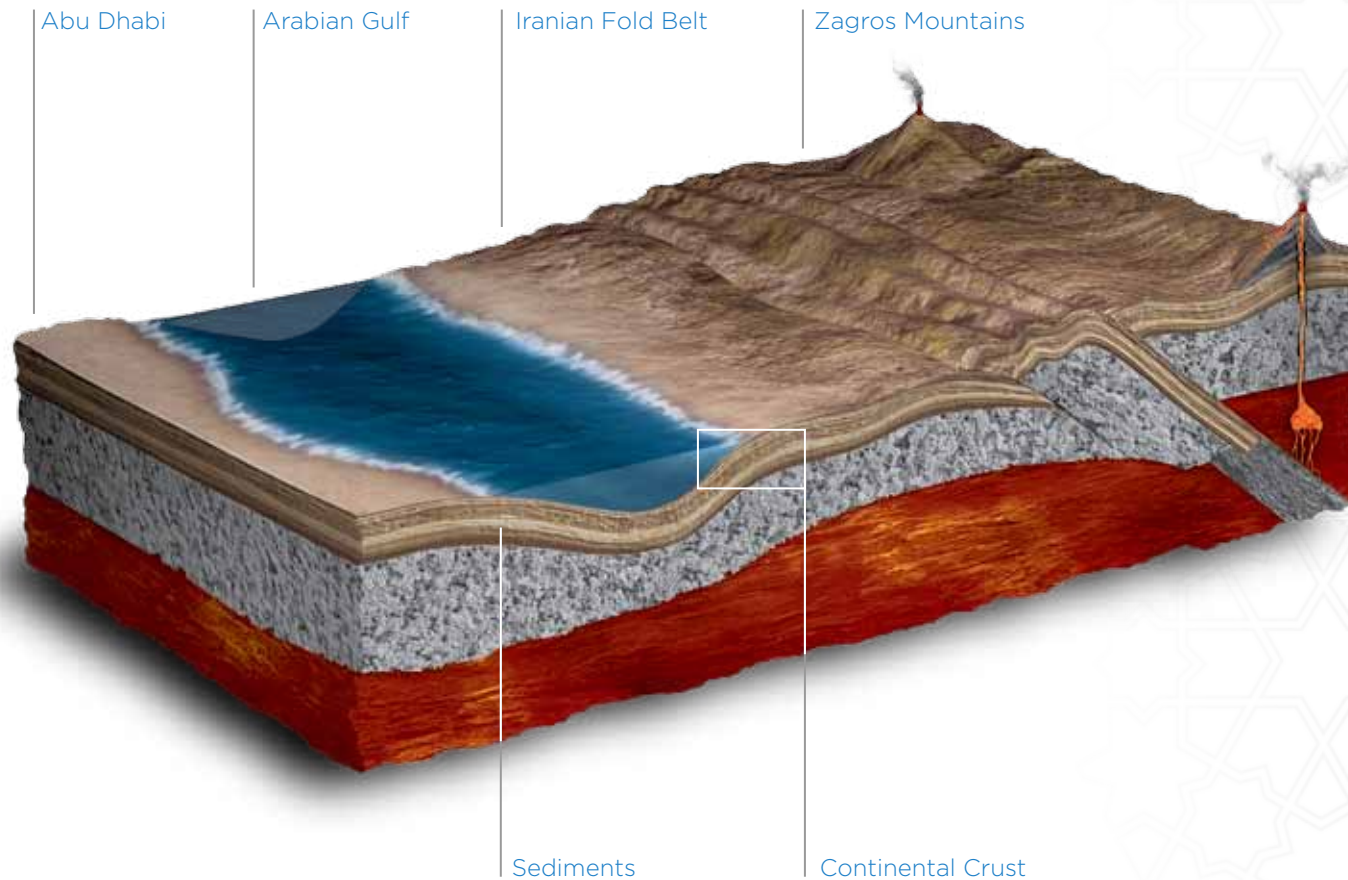
These layers start from sands carried by rivers or blown by the wind, mud and marine sands and the remnants of dead organisms such as molluscs⁽²⁾.

As their thickness increases, the layers (strata) are compressed by the overlying weight⁽³⁾. This crushing and the presence of mineral fluids cements the sediments to form rocks. These rocks record the detailed environmental history of where they were deposited.

This process affecting the Earth's surface produces only small changes in the landscape during a person's lifetime, but over a period of tens of thousands or millions of years, the effect of these processes is really big.

Given enough time, the erosive power of things like the wind, rainwater and water movement can reduce an entire mountain range to a featureless lowland. In the process, the eroded debris is transported by rivers and deposited as new layers of sedimentary rock. A series of sedimentary rock layers may be thousands of metres thick⁽⁴⁾. When exposed at the surface, each rock layer reveals information about past events in Earth's history⁽⁵⁾.

This truly remarkable record of our Emirate's history and that of the Earth is preserved in sedimentary rocks⁽⁶⁾. Each layer is a remnant of what was once the surface of Earth. Each rock layer is the result of a previous period of erosion and deposition⁽⁷⁾. In addition, details of texture, composition and fossils are important records of global change, showing how the Earth has evolved in the past and how it may change in the future⁽⁸⁾.



Sedimentary Rocks

Sedimentary rocks have been an important feature in the development of industry, society and culture⁽⁹⁾. People have used materials from sedimentary rocks since the Neolithic Age; flint and chert played an important role in the development of tools, arrowheads, and axes⁽¹⁰⁾. Great statues are often made in limestone. 90% of mineral products used by our society come from sedimentary rocks⁽¹¹⁾. The sedimentation process has also contributed to the formation of the many oil and gas deposits across our region⁽¹²⁾.



Palaeolithic stone tools collected on Jebel Barakah that may date back as much as 200,000 years ago.

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What are Sedimentary Rocks made of?

Sedimentary rocks can be made of a number of substances:

1. Pieces of other rocks and minerals, such as gravel in a river channel, sand on a beach, or mud in the ocean. Many sedimentary rocks are made from the broken bits of other rocks. These are called Clastic sedimentary rocks⁽¹³⁾. The broken bits of rocks are called sediment. Sediment is the sand you find at the beach, the mud in a lake bottom, the pebbles in a river and even the dust on furniture.

2. Minerals such as salt in a saline lake or gypsum in a shallow sea. Chemical sedimentary rocks are made of mineral crystals such as halite and gypsum formed by chemical processes⁽¹⁴⁾.

3. Organic materials such as remains of living things. The sediment particles of Organic sedimentary rocks are the remains of living things such as clamshells, plankton skeletons, dinosaur bones and plants⁽¹⁵⁾.

Why are Sedimentary Rocks Important?

Sedimentary rocks are important because they preserve a record of ancient landscapes, climates and mountain ranges as well as the history of the erosion of our region⁽¹⁶⁾. In addition, many fossils are

found in sedimentary rocks younger than 600 million years and provide evidence of the evolution of life through time⁽¹⁷⁾. Earth's geological time scale was even worked out using this record of sedimentary rocks and the fossils that have been discovered⁽¹⁸⁾.

Understanding the Process

It is useful to think about each step of the sedimentation process including:

Weathering

Weathering is the interaction between the weather and the rocks exposed at Earth's surface. The weather can break down the rock and it is the first step in making sedimentary rock. The atmosphere breaks down solid rock and forms a layer of loose, decayed rock pieces or soil. This loose material can then be transported easily by water, wind and glacial ice⁽¹⁹⁾.

Travel

Running water is the most effective form of moving sediment^(20a). All rivers carry large quantities of sediment toward the sea. This is easy to see if you consider the great deltas of the world, each formed from sediment transported by a river. Sediment is so abundant in most rivers that a river might best be thought of as water and sediment rather than simply a channel of

flowing water. As sediment is carried by a flowing river, it is sorted and separated according to grain size and composition. Large particles gather as gravel, medium-sized grains are concentrated as sand, and finer material settles out as mud^(20b). Wind, glaciers, and shoreline currents also carry sediment, but their activity is limited to special climate areas.

Deposition

One of the most important factors in the formation of sedimentary rocks is the place where the sediment is left to settle. Scientists call this process deposition⁽²¹⁾.

Compaction and Cementation

The last step in the creation of sedimentary rocks is the change of loose pieces into solid rock. Compaction happens when the weight of overlying material, which continually gathers in a sedimentary environment, squeezes the sediment buried beneath into a tight solid⁽²²⁾. Wet mud consists of 60 to 80% water⁽²³⁾, most of which is squeezed out during compaction.

Cementation happens when minerals such as calcite and quartz, carried by water, seep through small holes in the layers and makes all the pieces hold together⁽²⁴⁾.



Fossils

People have found fossils of leaves, seeds, and cones of plants that lived millions of years ago, as well as fossil bones, shells, claws, teeth, and even whole skeletons⁽²⁵⁾. People have also discovered fossil footprints, eggs, nests, and droppings, which give insight into how living things moved or behaved.

Fossils can form in different ways, but some fossils form when a living thing dies and gets buried. Over time, the soft parts get eaten by bacteria or other organisms. The soft parts break down, and the hard parts, such as shells, teeth, bones, or claws, are left behind. Over millions of years, layers of sediment pile on top of these remnants, creating pressure, which helps turn the lower layers into rock. Water can seep into the area and bring in minerals that slowly replace the hard parts and create a slow chemical change that turns the hard parts into a fossil. Slowly, erosion causes the top layers to wear away and the fossil can be found. Many fossils are found in riverbeds or on cliff sides, where water has eroded an area for thousands of years⁽²⁶⁾.

ENVIRONMENTAL ATLAS OF ABU DHABI EMIRATE

The following definitions are provided for the educator's reference. Young people should have the opportunity to explore definitions through individual activities. Some definitions may have been deliberately simplified for a young audience.

Atmosphere

The layers of gases surrounding the earth.

Composition

The nature of something's ingredients, the way in which a whole or mixture is made up.

Debris

Loose natural material made up especially of broken pieces of rock.

Delta

A triangular place of sediment deposited at the mouth of a river, typically where it parts into several outlets.

Deposition

The action of depositing something.

Erosion

The gradual destruction of something. The process of eroding or being eroded by wind, water or other natural things.

Fossils

The remains or impression of a prehistoric plant or animal embedded in rock and preserved.

Gypsum

A soft white or grey mineral consisting of hydrated calcium sulphate. It occurs mostly in sedimentary deposits.

Halite

Sodium chloride as a mineral. Typically occurring as colourless cubic crystals; rock salt.

Minerals

A solid, naturally occurring inorganic substance.

Molluscs

Animals which includes snails, slugs, mussels, and octopuses. They have a soft body and live in aquatic or damp habitats, and most kinds have a hard shell.

Neolithic

Relating to the later part of the Stone Age, when ground or polished stone weapons and implements prevailed.

Particles

A minute portion of matter: tiny particles of dust.

Remnant

A surviving trace: a remnant of the past

Sediment

Matter that is carried by water or wind and deposited on the surface of the land or the seabed, and may in time become consolidated into rock

For more teacher resources including Teacher Briefings, Lesson Plans, Activity Worksheets, and Fact Sheets, go to www.environmentalatlases.ae.

References: 1, 2, 3) P. Y. Julien (2010) Erosion and Sedimentation. 4, 5, 20) A. Gyr (2003) Sedimentation and Sediment Transport. 6, 7, 8) G. Nichols (2009) Sedimentology and Stratigraphy. 9) M. Stewart (2002) Rocks & Minerals: Sedimentary Hardback. 10, 11) M. Church (2003) Encyclopedia of Sediments and Sedimentary Rocks (Encyclopedia of Earth Sciences Series). 12, 17) J. R. Allen (1970) Physical Processes of Sedimentation. 13, 14, 15) F. H. Hatch (1978) Textbook of Petrology: Petrology of the Sedimentary Rocks. 16) H. G. Reading (1996) Sedimentary Environments: Processes, Facies and Stratigraphy. 18) D. Prothero (2003) Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy. For full references, go to www.environmentalatlases.ae.