

**© UKRIGS Education Project: Earth Science On-Site**

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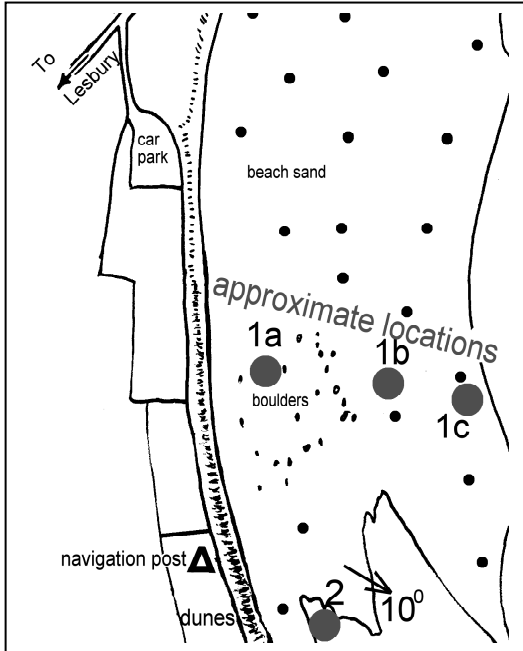
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PUPIL WORKSHEET 1

Pupil Name .....

**Site 1: Investigating Boulmer Beach Sediments.**



**1.** On the map mark and label the first 4 sites you investigate as **1a, 1b, 1c and 2.**

**2.** Circle the words below which best describe the boulders you see at **site 1a.**

**black, fine interlocking crystals,**  
**no joints, no fossils, no bedding. Igneous.**

**grey, fine grained, with fossils, sedimentary**

**yellow, made of cemented sand grains. Sedimentary.**

**Metamorphic rock.**

**3.** Take a small sample of sand (use sticky tape on dry sand) and look closely at it with a 10x hand lens. Describe the particles.

**The grains are up to 0.5 mm across.**

**They are made up of sand grains (silica) and tiny rock fragments of different colours weathered from older rocks. Also small pieces of broken shell.**

**4.** Describe how the sand moves along the beach channel of running water.

**The grains form asymmetrical ripples. They roll up the gentle side and come to rest on the downstream side. The ripple slowly moves downstream, by the burial of the steep (cross bed) face.**

**5.** Summarise in the table below the evidence for processes affecting the sediments that you have seen.

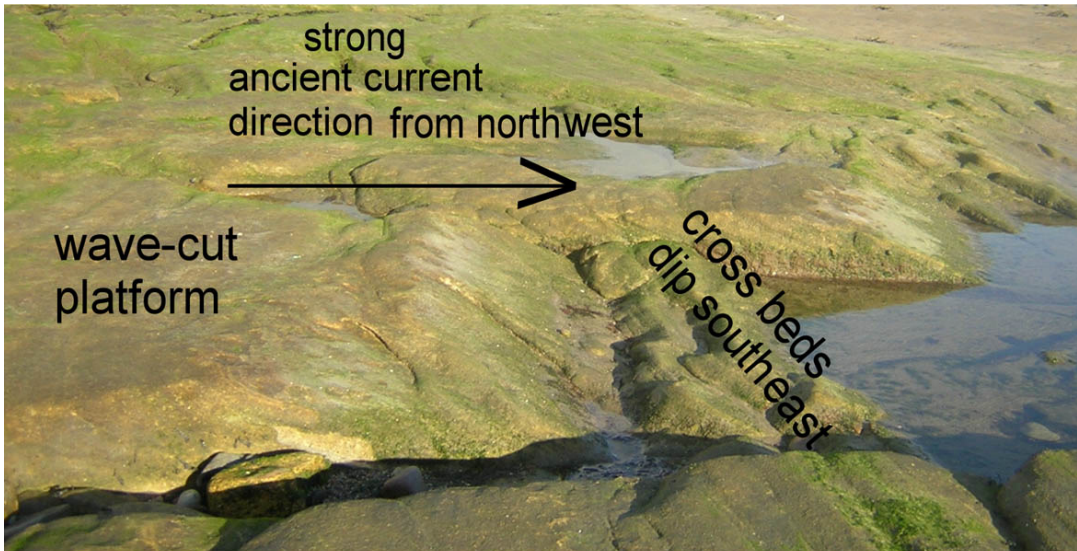
PROCESS	EVIDENCE FOR THIS GROUP OF PROCESSES AFFECTING THE BEACH
<b>Chemical</b> :	<b>FOR EXAMPLE:</b> decay of seaweed & animals (smells), brown colour of sand caused by weathered iron minerals. Crystallisation of salt. Chemical weathering of calcite shells. etc.
<b>Biologica</b> <b>l:</b>	<b>FOR EXAMPLE:</b> shells & skeletons of crabs. Seaweed, human footprints. Burrows (e.g. lugworms, bivalves.) etc.
<b>Physical:</b>	<b>FOR EXAMPLE:</b> Water waves and flows. Tides. Wind action. Biological action (humans and burrowing organisms). Gravity. Etc.

PUPIL WORKSHEET 2

Pupil Name .....

**Site 2: The Southern Wave Cut Platform.**

This exposure shows a wave-cut platform and cross bedding planes. In the box below sketch a part of the outcrop showing both the wave-cut platform and cross bedding.



1. With a compass measure the direction of dip of cross bedding (that is the same as the direction of the current) and write it on your sketch.
2. Label what the size of the cross beds tells you about the strength of the current.
3. In the table below write the following statements in the order that they describe what must have happened to these rocks. **Oldest statement is number 1.**

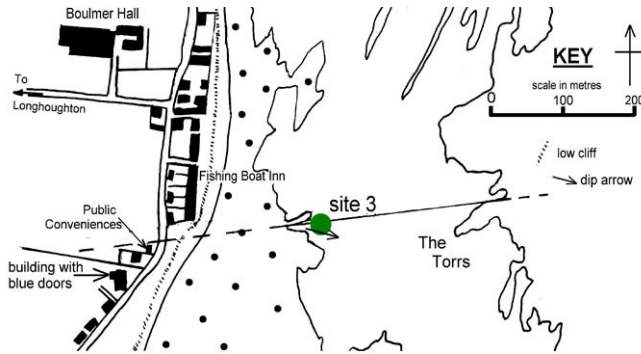
**Weathering of this sandstone to form new sand grains on the beach**  
**Uplift of the sandstone by plate tectonic forces**  
**Transport of the sand in a flowing current from the north**  
**Deposition of the sandstone by a fast flowing current**  
**Weathering of an ancient rock to form sand grains**

<b>YOUNGEST EVENT (last): 5 Weathering of this sandstone to form new sand grains on the beach.</b>
<b>4 Uplift of the sandstone by plate tectonic forces.</b>
<b>3 Deposition of the sandstone by a fast flowing current.</b>
<b>2 Transport of the sand in a flowing current from the north.</b>
<b>OLDEST EVENT (first): 1 Weathering of an ancient rock to form sand grains.</b>

**PUPIL WORKSHEET 3**

Pupil Name .....

**Site 3: The Rocks on "The Torrs".**



Site 3 has been marked on the map

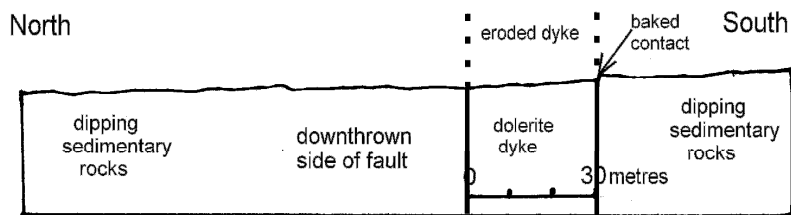
6. Label the area of sedimentary rocks.
7. Measure the dip amount of the beds and write it next to the dip arrow at site 3.
8. Measure the width of the grey rock in metres:

**Width 30,10 metres**

1. **On the map** draw in the northern edge of the grey rock. (Use the buildings in the village to help guide you) and label it. Use dotted lines to show where the rock might go under the sand and out to sea.
2. Explain how a fault may have caused the northern side to be downthrown compared to the southern side of the grey rock, without affecting the dolerite.

**The area was faulted (brittle fracture) before the igneous rock was intruded along the fault plane**

3. The section below runs through the baked contact at site 3. Draw in the two underground edges of the grey rock. (Use the scale to help you). Extend them upwards as dotted lines to show where they have been eroded away.
4. Label **a) dipping sedimentary rocks; b) dyke; c) eroded dyke; and d) downthrown side of fault.**



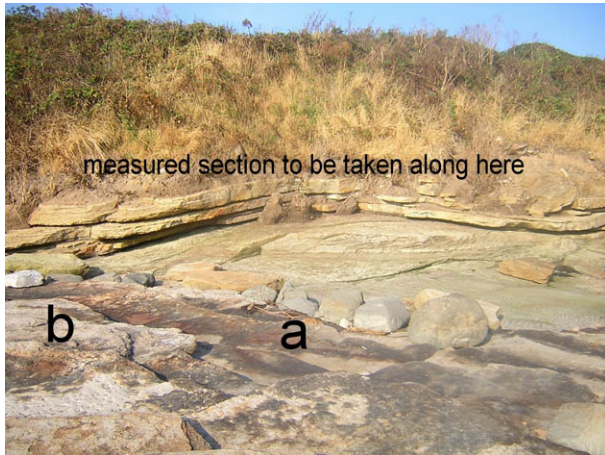
5. Number these statements in the correct order, summarising what you have seen so far. Number the oldest as "1" and youngest as "6"

- 5. weathering and erosion of sandstone by wave action**
- 6. deposition of beach sand by last tide**
- 4. intrusion of dyke and stretching of crust**
- 3. faulting (brittle fracture of crust)**
- 1. deposition of sandstones**
- 2. tilting of sandstones to the southeast**

PUPIL WORKSHEET 4

Pupil Name .....

**Site 4: Boulmer - North Foreshore.**



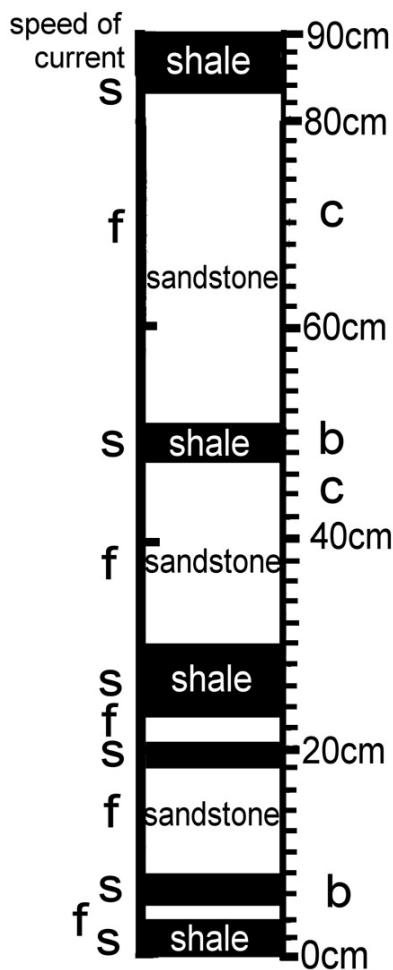
1. What features can you see on the bedding planes at "a" and "b"?

a) symmetrical ripples

b) burrows ("chisel" marks)

2. Take a dip measurement direction and amount, and record it below.

**Direction: 105°N Amount: 8°**



3. Measure a column of sediment in the low cliff, starting with the lowest shale bed. Plot the beds on the column on the left.

4. **On the right**, write **c** for small cross beds; **b** for burrows next to the beds in which you see them. **On the left**, next to each bed, write **s** for slower) or **f** (for faster) to show changes in current.

5. Look at the beds and the loose material on the beach and see if you can find evidence for each of the following. Write your evidence in the right hand column of the table.

Marine deposition	<b>Limestones with fossils</b>
Currents from the north	<b>Cross bedding</b>
Waves in shallow water	<b>Ripples</b>
Soft bodied animals living in the sediment	<b>Burrows and trails</b>
Land with plant growth not too far away.	<b>Plant fragments</b>

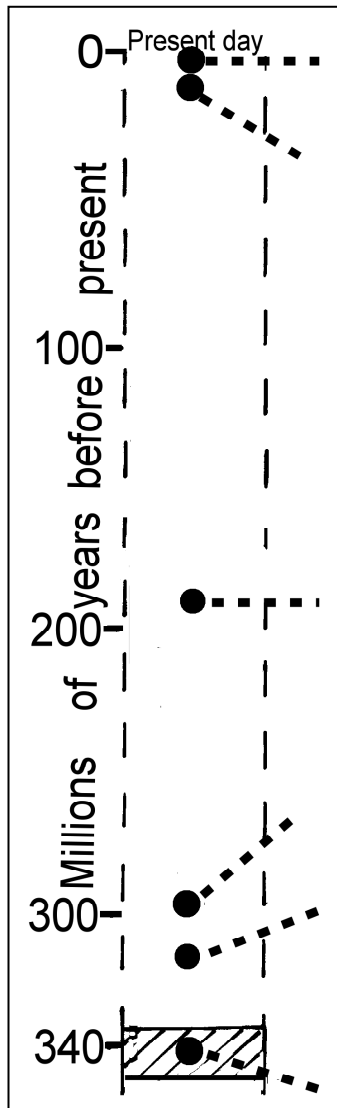
6. Summarise your findings by completing the following sentence.

**The Carboniferous limestone rocks were formed in a sea area which was silted up from the north by delta deposits that in places had plants growing on top forming coal. In the muddy deposits lived soft bodied organisms.**

**PUPIL WORKSHEET 5**

Pupil Name .....

**Summary Of Events.**



**Deposition of dune and beach sands begins.**

**End of glaciation and beginning of weathering and marine erosion continuing to present day.**

**340 million years of erosion leaving no rock evidence behind.**

**Period of dolerite dyke intrusion (crustal stretching).**

**Period of faulting.**

**Deposition of delta deposits with plant growth and burrowing animals.**

Write each of the following statements (or its letter) in the correct box on the geological event column above.

- A. Period of faulting.**
- B. Period of dolerite dyke intrusion (crustal stretching).**
- C. Deposition of dune and beach sands begins.**
- D. End of glaciation and beginning of weathering and marine erosion continuing to present day.**
- E. Deposition of delta deposits with plant growth and burrowing marine animals.**
- F. 340 million years of erosion leaving no rock evidence behind.**

PUPIL WORKSHEET 6

Pupil Name .....

SUMMARISING THE ROCK CYCLES:

**PUPIL HOMEWORKSHEET:** The Two Rock Cycles at **Boulmer**.

**FIRST CYCLE: deposition.** What can you say about the deposition of the older beds on the foreshore HINTS: Evidence for marine deposition; fossils, grain size etc.

**The beds were deposited by currents from the northwest which varied in strength from weak to very strong. These currents brought plant fragments as well as sand and mud to be deposited. When the water was quiet the muds were deposited. When the water was faster flowing sand was deposited in small and large ripples. Soft bodied animals lived and fed in these sediments. Sometimes the area was flooded to become a sea area with limestones being formed containing fossils like crinoids, corals and brachiopods.**

**FIRST CYCLE: uplift and tilting.** What can you say about the changes to the beds cause by plate tectonics? HINTS: tilting, faulting, intrusions etc.

**These beds were uplifted and tilted towards the SE at around 10 degrees. They were also faulted and afterwards, around 295 million years ago, intrusions of basic magma formed dykes along the lines of weakness in the rocks.**

**SECOND CYCLE: weathering and erosion.** What evidence of present day weathering and erosion have you seen on the foreshore?

**The rock below the sand has been eroded by wave action. On the beach there are large blocks of dolerite which have been weathered from the outcrop. The outer part of the yellow sandstones has been weathered grey by the action of air and water on the rock. On the low cliffs the shales are weathering to brown clay and are slipping and slumping down the slope.**

**SECOND CYCLE: sediment transport.** How many different ways have you seen sediments being transported on the foreshore?

**Wind, wave and flowing water**

**SECOND CYCLE: deposition.** What kinds of modern deposits have you seen and what rock types might they form in future? HINT: Don't forget plant and animal evidence – and which parts might survive as fossils.

**On the beach and dunes the sediments were sandstones. Near the low water mark they were finer grained and contained mud. Further up the beach there were coarser areas of sand with less mud. The sand in the dunes was finer and held together by the roots of plants.**

**There were traces of plants and animals like seaweed and gastropods, as well as burrowing animals. Many of these traces of living things would oxidise away, or be broken up by the wave action. Perhaps calcite shells might become fossilised, along with burrow marks.**