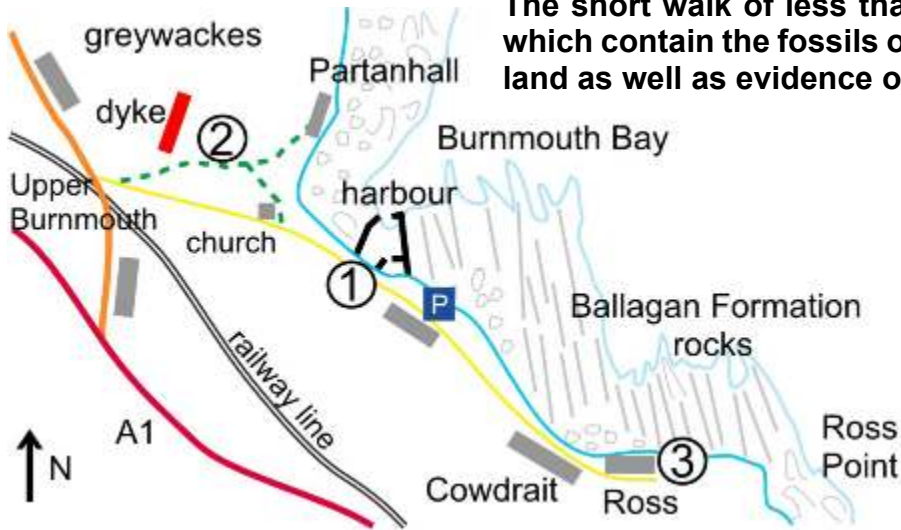




BURNMOUTH HARBOUR AND CLIFFS

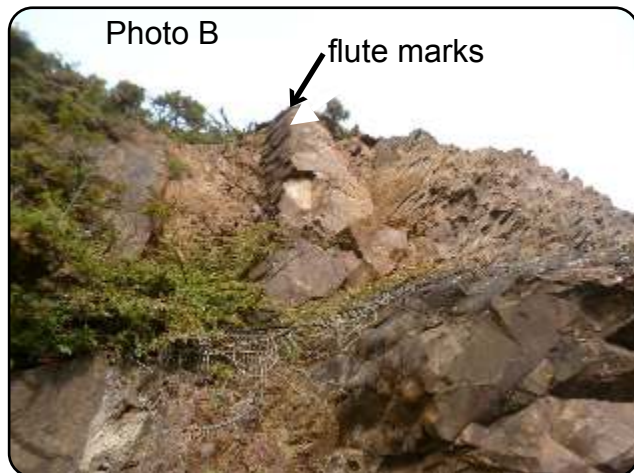
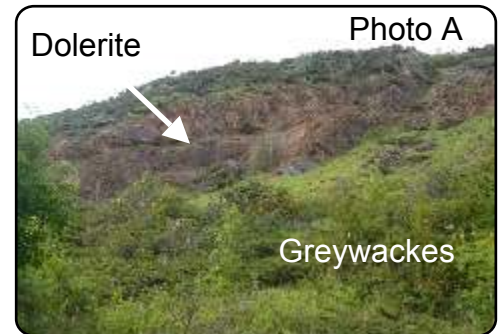
The short walk of less than a mile takes you to see vertical rocks which contain the fossils of the first four-legged creatures to live on land as well as evidence of Scotland's deep-sea past.

Visitors should park in Upper Burnmouth and walk down the steep hill to the harbour. The road is narrow and anyone wishing to drive down to the harbour should take great care. Park where the road is widest, near to the harbour [NT 959 608]. Buses from Berwick and Eyemouth (235/253) stop in Upper Burnmouth. A toilet is available at the harbour. Keep away from cliffs after heavy rain. The numbers on the map are places where you can look at features of geological interest. Binoculars are useful.



① TO SEE THE ROCKS IN SAFETY, MAKE SURE YOU VISIT AT LOW TIDE.

Facing the harbour, look to your left at the cliff above the line of cottages at Partanhall (Photo A). The grey crags are made of dark grey, impure sandstones called **greywackes** (pronounced 'greywackies'). As the greywackes weather, broken rocks create steep scree slopes covered by scrub vegetation. At the top of the hillside some of the rocks are a bright orange colour and appear to cut across the greywackes. These rocks are **dolerite**, a dark-coloured **igneous** rock which was **intruded** into the greywackes. It appears orange as the dolerite contains iron-rich minerals which rust as they weather (Photo A).



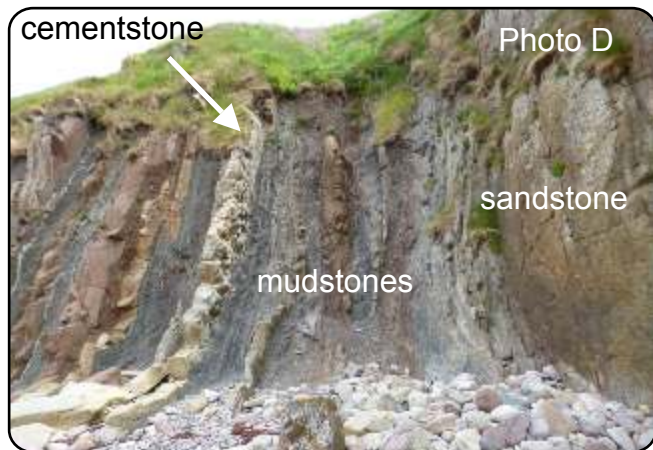
② To see more of the greywackes on the hillside, walk back up the road until you reach Burnmouth Church. The footpath to the right of the church takes you to the track to Partanhall. Turn left and in about 100 m you reach exposures of greywacke to the right of the track (Photo B).

Look up the hillside at the underside of the greywacke beds, some of which are covered with rounded **flute marks**. Flute marks are the depressions caused by swirls of rapidly moving **turbidity flows**, water currents which scoured the muddy sea floor during the **Silurian period** (430 million years ago). As the turbidity flow reduced in speed, the depressions were filled with sediment and appear as streamlined, elongated 'lumps' (Photo B).

CARBONIFEROUS ROCKS AND FOSSILS

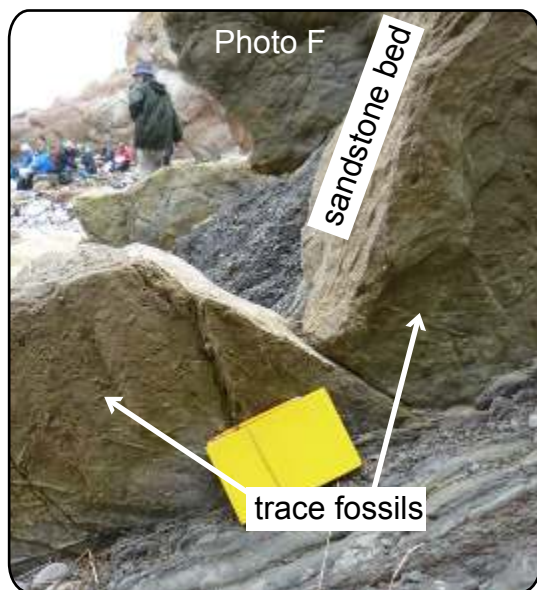
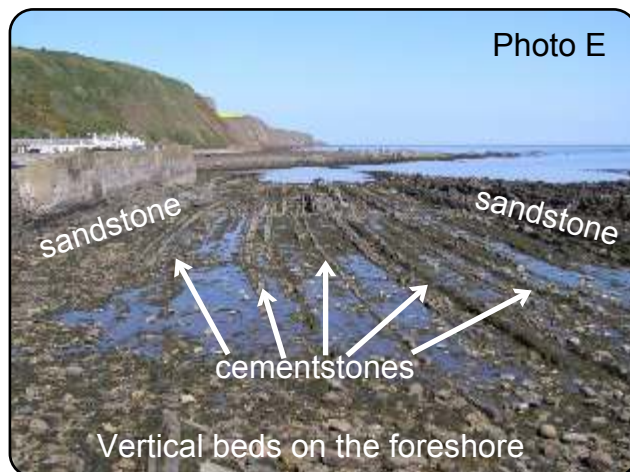
③ The rocks of Burnmouth shore and Ross Point are **Carboniferous** in age (350 million years old) and are called the **Ballagan Formation** by geologists (Photo C). To see them more closely, follow the road towards the cliffs, observing the vertical **beds** of rock on the foreshore if the tide permits. Turn left after you have walked behind the houses at Ross and take the steps onto the pebbly beach. You will be walking over boulders and clambering over rocks which may be slippery when wet, so take care.



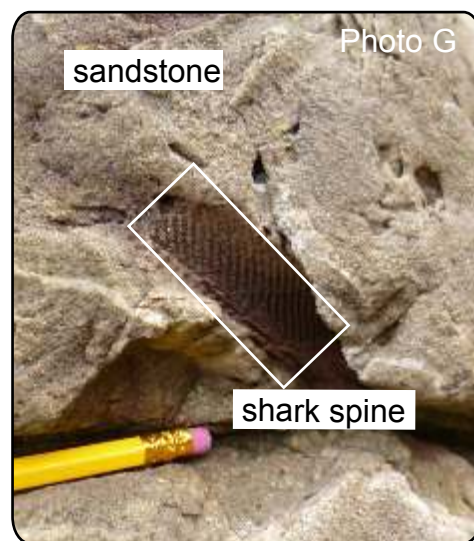


It takes a little while to recognise the three main types of **sedimentary rocks** in the cliffs and on the foreshore (Photo D). Most clearly seen are vertical beds of grey **sandstone**, several metres thick, which form small promontories on the cliffs and create ridges across the foreshore. Between the sandstones are many thin beds of yellow **cementstone** (a type of limestone) which create low walls crossing the pebbly beaches. Grey, black and reddish **mudstones** are best seen in the cliffs, sandwiched between the sandstones and cementstones; on the beach they are covered with seaweed and pebbles, as they are less resistant to marine erosion than the sandstones and cementstones.

The Silurian greywackes were intensely folded during the major **Caledonian mountain-building event** which lasted about 30 million years and culminated in the formation of a high mountain range across northern Europe and eastern America 420 million years ago. Burnmouth Bay's rocks were deposited on a relatively flat land surface after the Caledonian mountains had been largely worn away. The **Variscan mountain-building event** 200 million years ago occurred across central Europe and caused the Carboniferous rocks of this area to be uplifted, tilted and faulted, so that the beds at Burnmouth are near-vertical (Photo E).



Many of the sandstones on the Burnmouth cliffs contain **trace fossils**, such as feeding tracks or burrows (Photo F). Tree and branch fossils can also be seen, as well as occasional shark spines (Photo G). The fossils and red muddy soil horizons suggest that the environment was forest and marshland with sandy river channels and was periodically flooded by the sea. There was plenty of animal and plant life, enjoying a warm climate with wet and dry seasons.



THE EVOLUTION OF TETRAPODS IN THE EARLY CARBONIFEROUS PERIOD: THE FIRST FOUR-LEGGED CREATURES TO LIVE ON LAND

A gap in the fossil record has been filled by recent exciting fossil finds in the Ballagan Formation of Burnmouth (and in the Whiteadder river near Chirnside) by a scientific team from several universities, the National Museums of Scotland and the British Geological Survey. The discoveries have thrown light on a time when the four-limbed creatures (**tetrapods**) which lived in the lakes and river channels developed lungs and were therefore able to live on land for the first time. Their bones are tiny and easily removed by waves so it is hard to find examples on these cliffs. Further information about the Ballagan environment and the fossil finds can be found on the TW:eed Project website at <http://tetrapods.org/>

USEFUL REFERENCE BOOKS

Scottish Borders Geology - An excursion guide 1993
A.D.McAdam, E.N.K.Clarkson & P.Stone

Northumbrian Rocks and Landscapes - A Field Guide
1995 (ed. C. Scrutton) Yorkshire Geological Society

USEFUL MAPS

OS 1:50,000 Landranger 67 Duns, Dunbar & Eyemouth
OS 1:25,000 Explorer 346 Berwick-upon-Tweed
British Geological Survey 1:50,000 Scotland Sheet 34
Eyemouth (Solid)