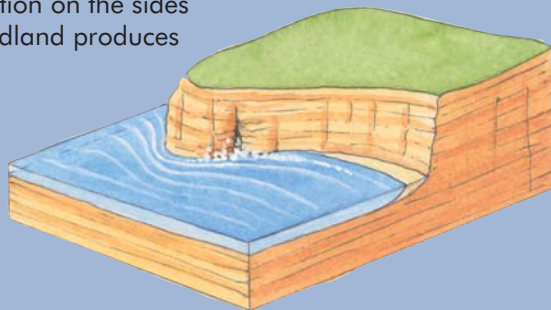


Stacked up!

The dramatic coastline on this walk is a great place to see the effects of coastal erosion. The sea has worn away softer parts of the Magnesian Limestone and exploited weaknesses to form caves, arches and stacks. Stacks like Marsden Rock were once joined to the mainland, but became stranded when the cliff retreated. The pounding waves mean that this coastline and the shape of its landforms are constantly changing, on timescales from a human lifetime to many thousands of years. Who knows what this area will look like in the future?

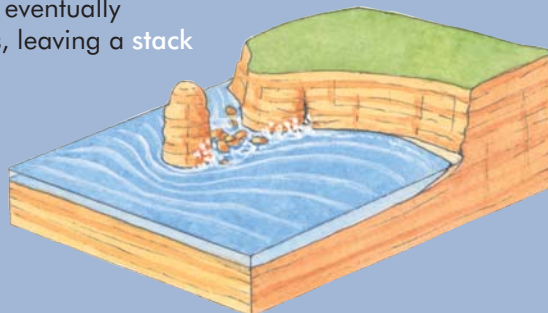
Wave action on the sides of a headland produces caves



Continued erosion breaks through to create an arch



The arch eventually collapses, leaving a stack



The Limestone Landscapes Partnership is working with many different people to conserve the landscape, wildlife and rich heritage of the Magnesian Limestone and to enable communities to learn about, enjoy and celebrate their local area.

This walk is one of five we have produced which introduce the unique geology of the Magnesian Limestone Plateau.

- 1 Marsden cliffs and Souter
- 2 Sunderland City Geotrail and Mowbray Park sensory trail
- 3 Tunstall Hills
- 4 Nose's Point, Seaham
- 5 Coxhoe



Please report any issues on this route on 0191 4277000 or email countryside@southtyneside.gov.uk

Much of the land along this route is owned by the National Trust, a charity working to preserve and protect the north east coast and other special places – forever, for everyone. To find out more visit www.nationaltrust.org.uk/durhamcoast

This project has been coordinated by Groundwork NE & Cumbria; Changing Places, Changing Lives – one green step at a time. Find out more at www.groundwork.org.uk/northeast or follow us on Facebook and Twitter.



We would like to thank South Tyneside Council, Groundwork South Tyneside & Newcastle and the National Trust for their support.



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A Magnesian Limestone Geotrail. Walk 1

Cliffs, quarries and mills

4-mile walk along the coast from Souter to Marsden Bay & back inland via Cleadon Hill



Limestone Landscapes

Making a positive difference to the unique environment of the Magnesian Limestone area

A walk on the Magnesian Limestone Plateau

This walk is one of five self-guided trails that help you to explore east Durham, South Tyneside and Sunderland and find out how the geology has influenced the area's natural habitats and the lives of local people.

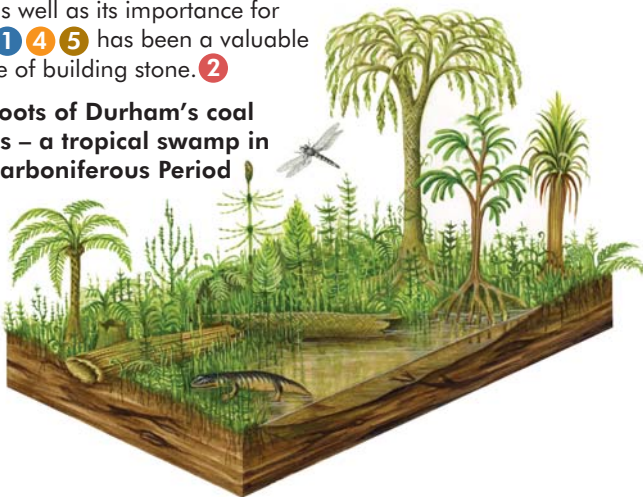
Together the walks offer a fascinating overview of the many processes that shaped the landscape you see today.

An introduction to the area's geology

The numbers in circles show which walk is best for seeing a particular geological feature.

310 million years ago, in the Carboniferous Period, this area was part of a large continent that lay across the equator. Low lying tropical swamps covered the land. Dead trees and other plants built up as a layer of peat, which was then buried under layers of sand and mud. Eventually the peat hardened to form coal seams and the sand and mud became sandstone and shale. This sequence of rocks is known as the 'Coal Measures' and as well as its importance for coal ①④⑤ has been a valuable source of building stone. ②

The roots of Durham's coal seams – a tropical swamp in the Carboniferous Period

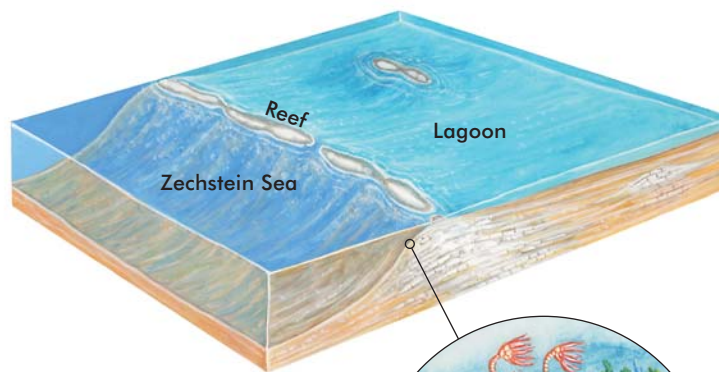


About 300 million years ago the land moved slowly further north of the equator and the climate became hotter and drier. This area became a barren desert covered by sand dunes. The remains of these dunes, the 'Yellow Sands', are quarried today for building sand. ⑤

A large part of the desert lay beneath sea level and around 260 million years ago, in the Permian Period, water from the surrounding ocean flooded it to create a shallow inland sea, known as the Zechstein Sea. Over the following several million years the sea level rose and fell several times, causing the Zechstein Sea to periodically dry up.

A reef formed a barrier running roughly in a north-south direction, separating a shallow lagoon to the west from deeper water to the east. The reef can be seen today as a

number of hills in the area, including Beacon Hill south of Seaham ④ and Tunstall Hills near Sunderland. ③ A large variety of animals lived on and within the reef. Tiny fragments of shell and skeletal remains built up as lime-rich mud on the sea floor. It is this limy mud that eventually became limestone. In places fossilised shells can still be seen in the rock. ③



The Magnesian Limestone reef and a close-up showing sea creatures such as cone-shaped bryozoans.



During periods of falling sea level, the hot arid climate caused the sea water to evaporate, making it much saltier. Salt minerals known as evaporites built up on the sea floor. Thick salt deposits still exist deep beneath the surface further south, but in this area they have dissolved, causing the rocks above them to collapse. ①④

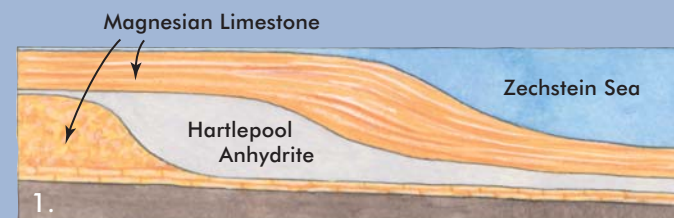
This area continued to drift north for 250 million years until it reached where it is today. We do not have any record of the geology of the area during that time as any rocks formed have been removed by the work of rivers and seas. Some of these 'missing' rocks have been quarried elsewhere and brought into the area for building stone. ②

Over the last 2.5 million years the climate alternated between colder periods ('ice ages') and warmer periods. At times, ice sheets up to 1km thick covered County Durham and the North Sea. The ice finally melted about 15,000 years ago. The action of the ice and meltwater were largely responsible for shaping the landscape you see today. Rivers and seas continue to wear away the land, deepening valleys and further altering the dramatic coastline. ①③④⑤

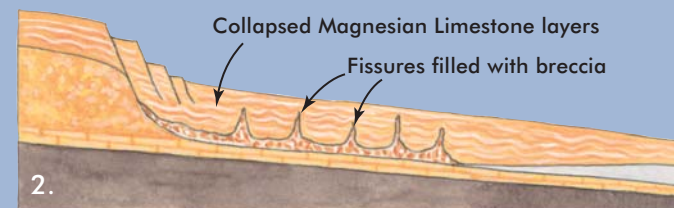
Dissolving and collapsing

The cliffs at Marsden Bay are part of a Site of Special Scientific Interest because of the fascinating geological stories they reveal. The cliffs are made of layers of Magnesian Limestone which formed in the ancient Zechstein Sea (see left). Within the original rock sequence was a thick layer of a soluble salty mineral (known as the Hartlepool Anhydrite), which formed during a period when the Zechstein Sea evaporated and became saltier.

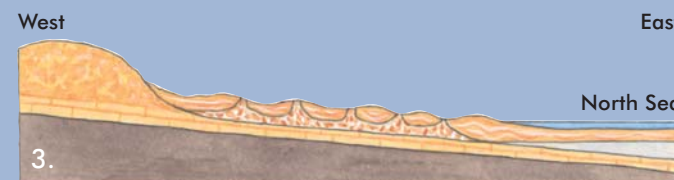
After millions of years, the sequence was tilted and uplifted above sea level and the anhydrite dissolved away. The limestone above it collapsed and broke up. These broken up rocks are known as 'collapse breccias' and can be seen in the cliffs at Marsden.



The original rock sequence after it formed in the Zechstein Sea, around 250 million years ago.



The sequence was tilted and uplifted, and most of the anhydrite dissolved. Fissures filled with breccia formed when the overlying limestone collapsed.




Millions of years of erosion have removed many layers of rock, revealing collapse breccias along today's coast.

Walk information


Souter Lighthouse, Marsden Bay and the Cleadon Hills 4 miles/6.5km

An undulating route, which can be very muddy in places. Stout shoes with good grip recommended. There are steep steps down to Marsden Beach which can be missed out if you prefer. Please take care near the cliff edge and when crossing roads – the A183 Coast Road has a 40mph speed limit. Keep dogs under control, preferably on a lead. Please pick up any mess.



P Souter Lighthouse GR NZ408640. Fee payable, free to NT members. Note that the car park shuts at 6pm. Start the walk at Marsden Grotto car park (NZ399648) if you expect to be back later than this

 Services E1, E2 and E6 operate between South Shields and Sunderland, many stopping at Marsden Grotto www.stagecoachbus.com

 Cafe at Souter Lighthouse, Marsden Grotto pub/restaurant


 Souter Lighthouse (NT) during opening hours, Marsden Grotto car park

Directions

- 1 Leave car park on seaward side, picking up path that skirts the outside of the lighthouse wall. **a** At coast path turn left and follow the coast to Marsden Grotto car park (you may have to detour inland to avoid areas affected by coastal erosion). **b**
- 2 At the far side of the car park are steps down to the beach. (At this point the walk can be shortened by turning left up to the road, left again and picking up the directions from 4.) Descend the steps to the beach **c** **d** and turn left. **e**
- 3 Leave beach at steps next to the first aid point. At top of steps turn left onto cliff top path, heading back to the grotto car park. Just before car park bear right up grassy bank to main coast road (A183) and turn left.
- 4 When you are level with the far end of the caravan site (on the other side of the road) cross road carefully  and follow the path that runs between the caravan site and a golf course.
- 5 Cross a road to Marsden Old Quarry Nature Reserve. **f** After approx 200m bear left to follow path near quarry face, eventually rejoining the main path to go through gap in high stone wall.
- 6 Keep straight on and bear right on gravel path down into woodland. Keep left at path junction and left again signed 'Public footpath'. Path climbs towards small gap in wall. Watch for golfers  and cross golf course, aiming to the left of the tower **g** – look for the footpath signs on low yellow posts.

- 7 Leave golf course through bushes then metal wicket gate. Keep on with wall on your left. At wall corner turn left through wicket gate. Head towards disused windmill, keeping wall on your left. **h** At wall corner bear left on grassy path. Aim for corner of field and wooden stile. Path bends right above small ridge and keeps to right hand edge of fields, over a couple of wooden stiles, eventually turning sharp left towards Whitburn. **i**

- 8 At farm keep straight ahead along track. At road turn left. At last house turn right on public footpath. Cross next road, turn left and

immediate right (Cedar Grove). At T-junction turn right and follow road as it turns left, bringing you to a green with windmill. **j** Walk down to main road, turn left and cross when safe. 

- 9 After farm and just before houses, take the short flight of steps on right and path back to coast. **k** Turn left at coast path and follow it for approx 1 mile back to Souter Lighthouse.



a Souter Lighthouse

Souter Lighthouse was the first lighthouse that was purpose built to be powered by electricity. It opened in 1871 with cottages for the engineer and four keepers. Today the decommissioned lighthouse is owned by the National Trust and open to the public. Check opening times at www.nationaltrust.org.uk

b A hive of industry

These impressive limekilns were built in the 1870s. Layers of limestone and coal were dropped in the top and burnt to make lime, which was used to improve acid soils and to make cement and concrete. Lime was also important for the steel and chemical industries.

Coal from Whitburn Colliery fired the kilns. A village was built to house workers for the colliery and limeworks. After the colliery closed in 1968 the village was no longer needed – people moved to new houses nearby and the village was demolished.

Today the cliff-top grassland where the village stood is a mass of lime-loving grasses and flowers in summer, including orchids such as the bee orchid (right).



c Marsden Grotto

The grotto was a cave carved out to make a house in the 1780s by a quarryman known as Jack the Blaster. It was extended and converted to a pub in 1828.

d Marsden Rock

This impressive rock stack was once part of the cliffs (see 'Stacked up!' on the panel overleaf). Marsden Rock itself had an arch, the roof of which which collapsed in 1996. This left a separate pillar of rock which was deemed unsafe, so it was demolished in 1997. Therefore the Marsden Rock you see today is about two thirds the size it was just twenty years ago. This shows just how fast this coastal landscape can change.



This old postcard shows Marsden Rock with its arch intact

e Geology on show!

Here at Marsden Bay you can see many interesting geological features, including beautiful layering and intriguing textures in the Magnesian Limestone cliffs and stacks. Look out for areas where the rock looks more chaotic and broken up. This 'breccia'

formed when an underlying layer of soluble rock (anhydrite) dissolved millions of years ago, causing the overlying rocks to collapse downwards (this process is described overleaf). More recent geological features include some small sea caves (bottom image) which are forming where the sea is widening vertical cracks in the Magnesian Limestone.



f Marsden Old Quarry

Limestone has been quarried in the area since the 19th century. Look for unusual textures in the exposed quarry faces. These are 'concretions', formed by complex chemical processes during the time of the Zechstein Sea. You can see many examples of this distinctive limestone used in walls and buildings later in this walk. Marsden Old Quarry was acquired by South Tyneside Council and in the 1940s turned into a Nature Reserve. The lime-rich soils support many nationally rare wild flowers, such as hoary plantain (below).



Above: Small cannonball 'concretions' in the old quarry face

g Cleadon Water Works

This grand tower is part of a former water pumping station which once provided water to the South Shields area. The tower is actually a fancy disguise for a chimney for the steam-powered pumps! It was designed to resemble an Italian campanile bell tower, and was placed above the works on the highest part of the hill to facilitate boiler draughting and the dispersal of smoke and steam.

Opened in 1863, the water works exploited reserves of clean fresh water trapped in the Permian Yellow Sands (see the introduction to local geology overleaf) beneath the permeable limestone.

h Cleadon Mill

This windmill was built in the 1820s on the highest part of Cleadon Hills. The building incorporates a stone 'reefing stage', a platform around the base of the windmill, which was used to access the sails. Look for the unusual rippled and dimpled textures in the tower walls. This is concretionary limestone, seen earlier in the walk in the old quarry.

i View

From here you have a great view across to Sunderland. To the right see if you can spot Fulwell Mill – the third windmill to be seen on this walk! On the hill in the far distance is an example of how the wind can be harnessed for power in the 21st century. Great Eppleton Wind Farm produces energy for over 5,000 homes, saving about 10,000 tonnes of CO₂ a year.

j Whitburn Windmill

The earliest known record of a mill on this site dates back to a 1779 coastal shipping survey, which shows a post mill (the earliest type of windmill). The tower windmill you see today was built in 1790 after the original post mill was blown down in strong gales. The building is made from local limestone.

During the Second World War the mill was used as a look out post for enemy aircraft.

k Rocky return

On the walk back to Souter Lighthouse and car park you'll see many sea stacks and arches in various stages of their evolution (see overleaf). These rocky features and the steep sea cliffs are home to an important sea bird colony of kittiwakes, fulmars and cormorants.

