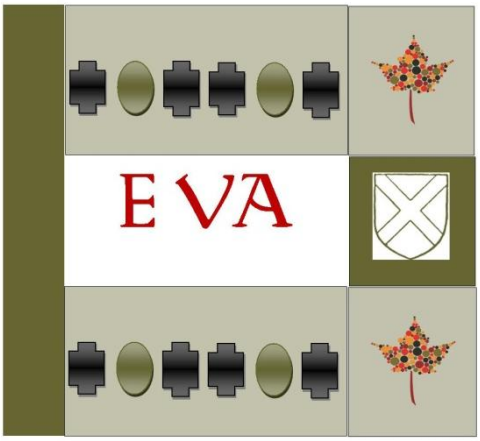
A report on the Geology and Building Stones of Elwick, County Durham

2014

LOTTERY FUNDED

Limestone Landscapes

This report was produced as part of the Elwick Village Atlas



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Their enthusiasm for the project has helped to ensure records of the village are preserved for the future.

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Elwick Village
Geology

Elwick lies approximately 4 miles west of Hartlepool and just east of the A19 trunk road. Part of the parish lies to the west of the main road. The village is largely linear with an east west orientation, the central part being occupied by a village green. The church is on the western edge of the village across a steep valley. To the south of the village the land drops away towards Teesside.

Geological evolution of the area
Deserts and tropical seas

280 million years ago, at the beginning of the Permian Period, Britain did not exist but was part of a large continent known as Pangea, situated in tropical latitudes very close to the equator (about 30˚ N). At this time most of northern Europe was a desert and the mountains caused by major earth movements at the end of the Carboniferous time were being gradually eroded. It is thought that about 500m of Carboniferous rocks were removed.

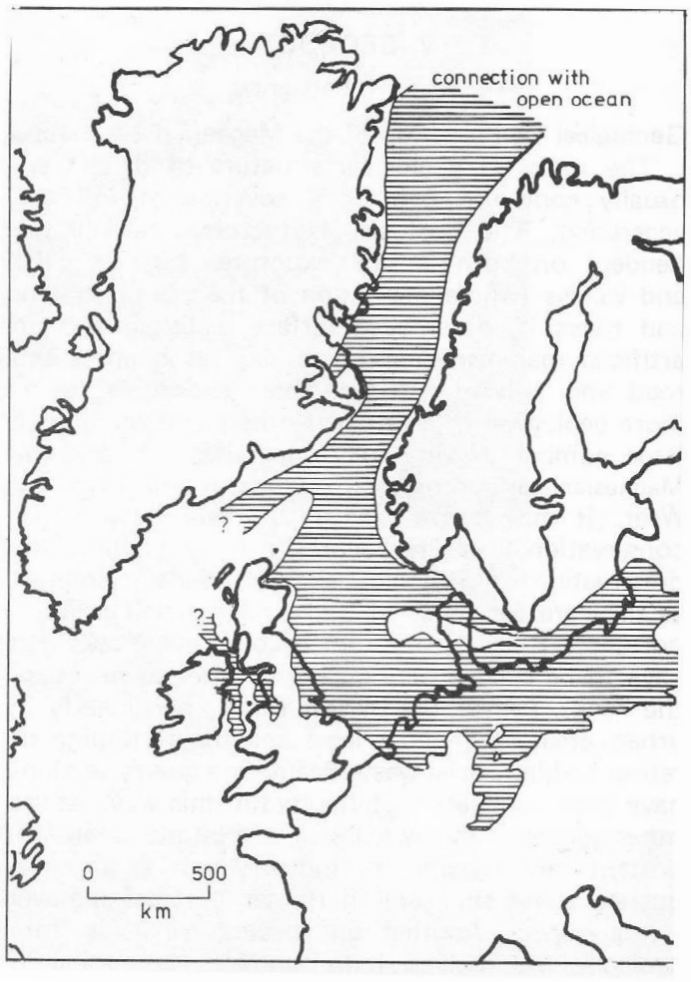


Figure 1 Map showing the position the Zechstein Sea in relation to present day topography. Adapted from Pettigrew, 1980

This erosion left behind a gently dipping plain onto which the Permian beds were deposited. The Yellow Sands Formation, which can be seen further north, are the lowest of these beds and these were deposited as desert, dune sands. After this the area was flooded by seawater and became part of the Zechstein Sea (fig 1). This sea was similar to large enclosed seas of today, such as the Mediterranean, with a tidal range of 1m or less probable and the area was sensitive to evaporation and changing sea levels. It was at this time that the Magnesian Limestone was deposited and also the evaporite sequences such as gypsum and anhydrite which have been important economically on Teesside.

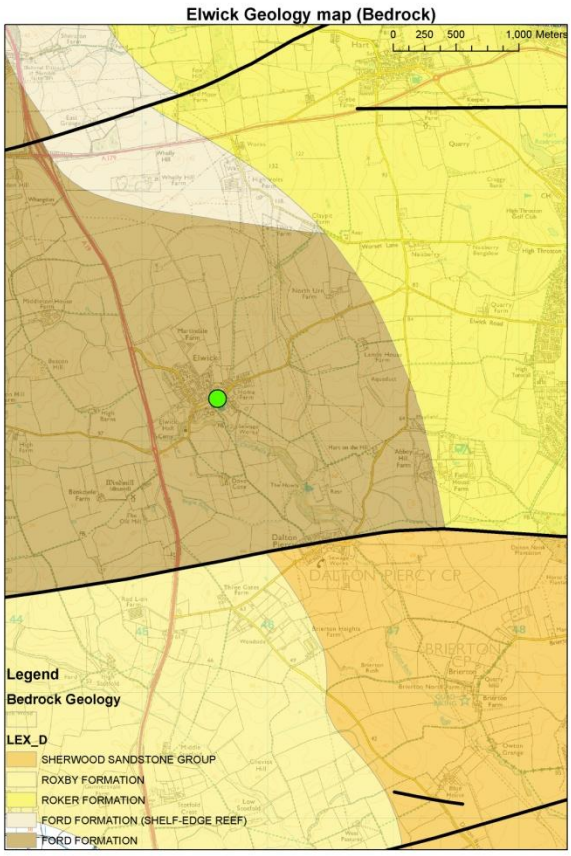
Cold and Ice

Between the Permian and the last 2 million years there is no record of the geology of the area. About 250 million years of Earth history is missing here.

Quaternary deposits are sediments that were deposited during the Quaternary episode of earth history, between 2.6 million years ago and the present day. The Quaternary is divided into two periods: the Pleistocene Period dates from 2.6 million years ago until 10 000 years ago and the Holocene continues to the present day. For a long time these deposits were collectively referred to as 'drift', but are now more commonly referred to as 'superficial deposits' to separate them from the 'bedrock' which used to be termed 'solid'.

Global cooling caused the Quaternary Period to be a time dominated by a series of 'ice ages' when the climate oscillated between colder (glacial) and warmer (interglacial) stages. Successive glaciations advanced across the landscape, sourced from the upland areas of Scotland, Wales, northern England and Scandinavia and formed extensive ice sheets that were over 1 km thick in places. Unfortunately, each glaciation tends to destroy the evidence of the previous one, so most evidence for glacial advance in northern Britain dates from the most recent cold period, the Late Devensian, from about 25 000 to 10 000 years ago. The effects of persistent freeze-thaw action in ground which was often very deeply frozen, and the deposition of a variety of glacial sediments further modified any pre-existing landscape. The deposits of the Holocene Period reflect erosion and deposition in a varied succession of environments during much milder climatic conditions. Quaternary deposits and their interpretation provide much information on the environments of the recent geological past. Information from glacial landforms and the nature and morphology of glacial deposits is essential to understanding these climatic conditions and may provide valuable insights into likely future environmental changes related to global warming.

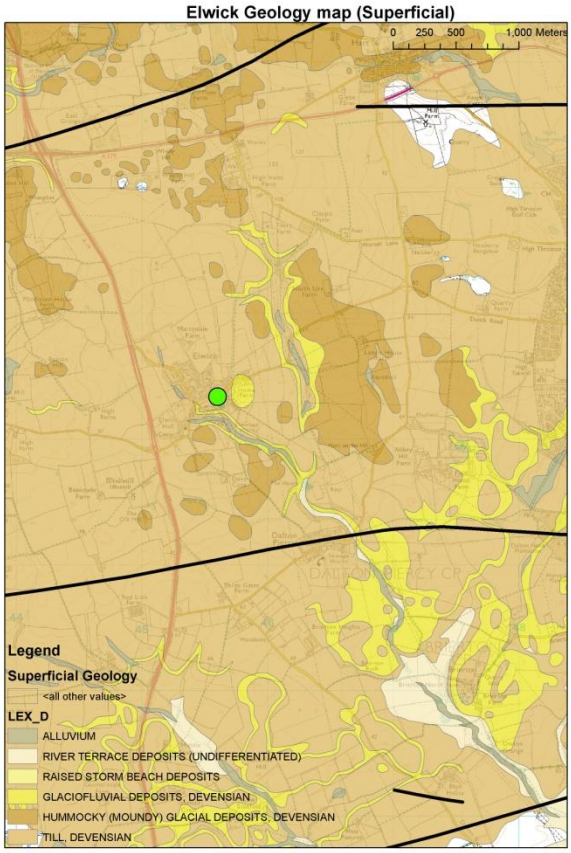
Bedrock Geology



The bedrock geology is not visible at outcrop in the area but is found at depth.

The village is situated on strata of Permian age mainly the Ford Formation, a unit of what is known as the Magnesian Limestone. This bed was laid down in warm, shallow, tropical lagoon about 250 million years ago as a limestone. During the early burial process the limestone was dolomitised by changing the calcium carbonate to contain magnesium. This process causes a slight reduction of volume within the rock and sometimes mineralised cavities can be found or shapes such as the cannonball limestone which is found close to Sunderland formed. To the north of Elwick the Ford Formation changes from being a bedded limestone to a type more associated with a reef deposit. It tends to be resistant to erosion and so forms topographically high areas such as those along the A19.

Superficial Geology



There is little record of the early Quaternary in the area as most of the material was removed and reworked by later glaciations. Around Elwick there is a Till (formerly known as Boulder Clay) which dates from the Devensian about 25,000 to 10,000 years ago. This till contains rocks from the northern part of Britain including the Lake District and Scotland. It is a tough, grey or brown, sandy boulder clay, or 'till', which contains scattered pebbles, cobbles and boulders of a variety of rock types that originated outside the district. These exotic rock types are known as 'glacial erratics' and mainly comprise fragments of grey limestone and dolerite ('whinstone') derived from the Pennines or south Northumberland, along with rarer and smaller fragments of a variety of rock types originating from south-west Scotland, the Cheviots and the Lake District. It may be possible to find lines or scratches on these boulders which are a result of the boulders scratching against each other when they moved by ice.

Structural Geology

View to south of Elwick. The drop is due to the Butterknowle Fault. Soils derived from the Till can be seen in the ploughed field.

There are faults to the north and south of the village (shown as blacl lines on the map above). Although none are visible at the surface the most obvious feature is the drop towards Teesside to the south. This is caused by an extension of the Butterknowle fault which downthrows to the south. The fault shown to the north of the village is the main Butterknowle Fault which has been active since the late Carboniferous times and is a major line of weakness in the area across to the Pennines. The faults were probably reactivated in the Tertiary causing the tilting we see today of the Permian beds. Younger rocks are found on the downthrow side and these have eroded more.

Soils

The soils in the area are derived from the Till and are mainly loams. These are good for general pasture and woodland although some are seasonally wet and waterlogged.

Building Stones

Within the village many of the houses are built from bricks which would have been made in the area. Natural stone is more rare but displays an interesting variety of types. Perhaps the most interesting aspects are the older house, barn and boundary walls which are made from boulders collected from the Quaternary till deposits.

The main stone found in buildings of the area are listed below:

<u>Magnesian Limestone</u>

A local limestone probably taken from small quarries around the village originally. The limestone is resistant to erosion, particularly from 'acid' rain and so retains a pale, buff coloured appearance. It can be seen in many of the older rubble walls and the church.

The building on the right is mainly built from Magnesian Limestone. (No2, Whitebarns)

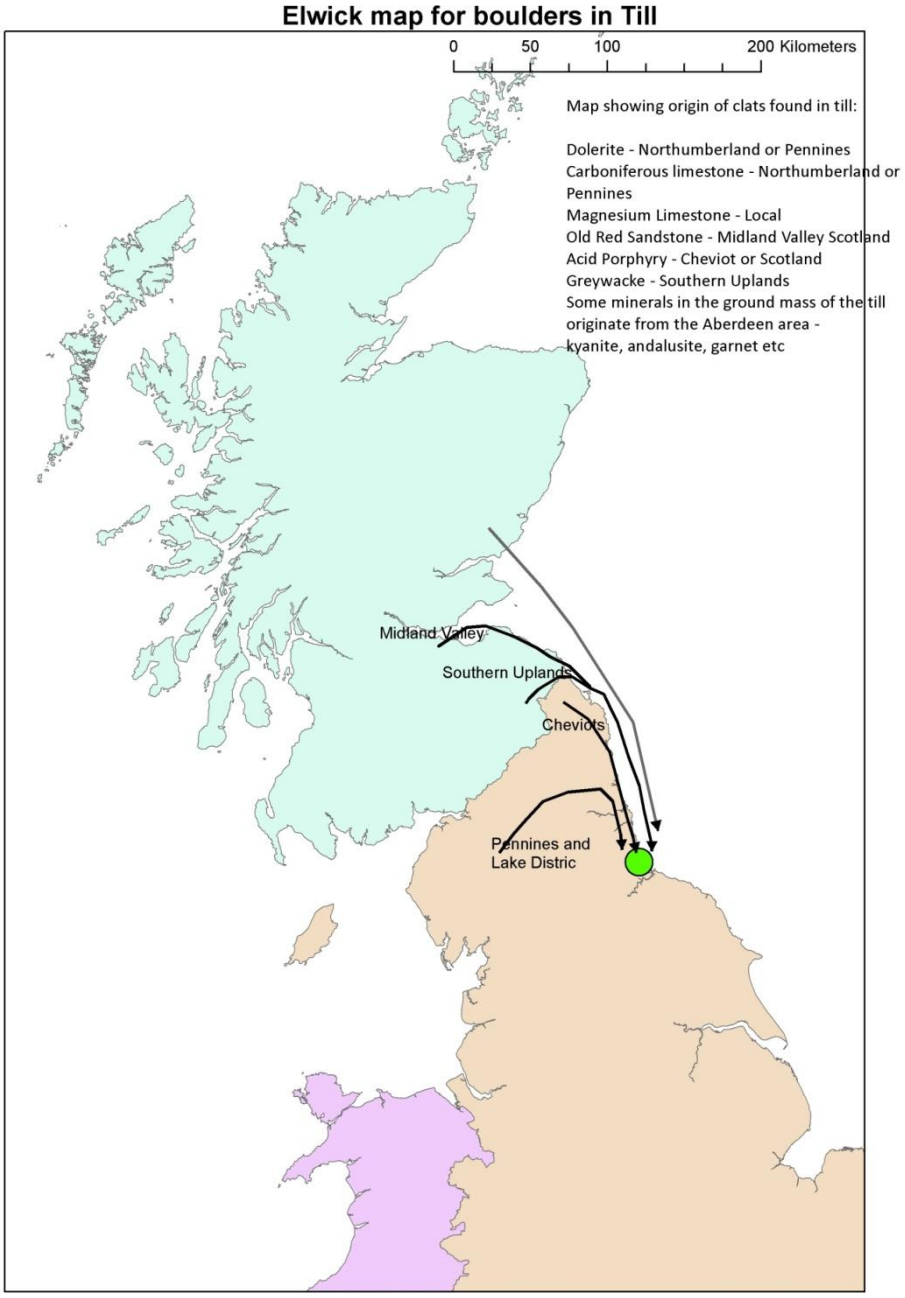
<u>Sandstone</u>

Sandstones are used in many of the buildings. Most of these are coarse grained sands and can be distinguished from the limestone by their weathered appearance. They tend to be softer and weathering causes hollows in the surface. Some of the sandstones are particularly badly affected by weathering and this is probably due to the effects of acid rain (from industrial pollution) affecting the cement which holds the grains together. If the cement is calcite (calcium carbonate) then this will be dissolved by acid. The example above shows the difference between the sandstone (pink) and Magnesian Limestone (cream).

Material from the Till

The till in the area has provided a good source of boulders that can be used directly in walls and it is possible to find examples of many Lake District, Northern England and Southern Scottish rock types in these. The ice during the Devenisan brought material through the Tyne Valley and also down the Northumbria coastline before depositing it in the residue found locally.

In particular it is possible to find many examples of dolerite, Carboniferous limestone, Old Red Sandstone, granite, greywackes. In addition to this, examination of the finer material in the till shows that some of the minerals are ones generally found in metamorphic rocks of the Scottish Highlands such as kyanite and andalusite (both aluminium silicates) and garnet. These minerals may have been reworked from earlier tills in the region.



Igneous rocks

Wall of Home Farm

The image above shows a dark grey, rounded boulder of Whin Sill an igneous rock called dolerite. The Whin Sill is about 295 million years old and intruded into the Carboniferous sediments of Northern England. It can be seen *in situ* at many places including High Force in Teesdale, along Hadrian's Wall and also at Bamburgh and the Farne Islands. There are many examples of this in the walls of Elwick.

To the right of the Whin Sill boulder is a pale, pinkish boulder which looks rougher. This is an example of an igneous Cheviot rock called a porphyry and is a type of granite. The pink crystals are feldspar and the paler ones mainly quartz. This rock was formed from a melt about 390 million years ago, during the Devonian. At that time the Cheviot area was a large volcano which formed due to the collision of two tectonic plates along a suture line (Iapetus suture). This coarse grained rock would have formed below the surface at a depth of about 5 km and has since been exposed by erosion.

Carboniferous Limestone

The limestone in the centre of the image shows a fossil shell which can be identified as a Carboniferous bivalve. The rock is surrounded by examples of Magnesian Limestone.

It is likely that this rock was picked up by the ice from Northumberland or the western part of the Tyne Valley.

Carboniferous Limestone, - Belmont, North Road

Sandstones

There are many examples of sandstones in the walls. Most of these are Carboniferous in age and have a grey or orange appearance and feel rough to the touch. This one shows a dewatering structure and is 'upside down'. Good examples can be seen in many of the walls around the village, such as, Belmont, North Road and North Farm.

Grey Carboniferous sandstone – Belmont, North Road

There is a different sandstone that can be seen and this is an Old Red Sandstone of Devonian age. This probably originates from the Scottish Borders. Good examples can be seen around the coastal towns such as Eyemouth and Dunbar as well as in the building stones of towns such as Jedburgh etc. The example shown is a coarse grained reddish colour with large quartz grains visible and is a water lain deposit at times when desert conditions prevailed. Britain was just south of the Equator at the time.

Old Red Sandstone – Home Farm

Metamorphic rocks from Southern Scotland

The rock in the image is a metamorphic rock showing banding and originates from southern Scotland. Originally it would have been formed as a deep water sediment but was metamorphosed during the plate collision. It probably dates from about 420 or more million years ago. There are other examples of metamorphosed sediments on the walls, most are fine grained, dark grey and are called greywackes. These were originally deposited as deep marine sediments in the sea (Iapetus Ocean) that separated England and Scotland but were then hardened and changed during the collision of these plates.

Belmont, North Road

Other

In the wall of Belmont on the corner of North Road there is a piece of vein quartz. This would have been eroded from an igneous body such as a granite. It is not possible to determine where it is from but likely sources are the Lake District or Cheviots.

Vein quartz

Bricks

Many of the older buildings are of a pale red brick and these would have been made fairly locally. There are records of brick and tile works using the till at Tilery Plantation and Pudding Poke Farm, Elwick. These bricks have a mixed appearance unlike some of the later more standard bricks.

Holmlea

Roofing material

The dominant roofing material in the village is a grey slate (as above) although tiles are also used. Some buildings would have had thatch originally.

Number 16

Walls

The two walls below give an overview of the range of materials that can be found.

Belmont at corner of North Road

North Farm

St Peters Church, Elwick

The church is on the western edge of the village and separated from it by the Char Beck. It is likely that an older building stood on the site. The main buildings today date from about 1195 with extensive additions and restorations in the 14th, 17th and 19th Centuries.

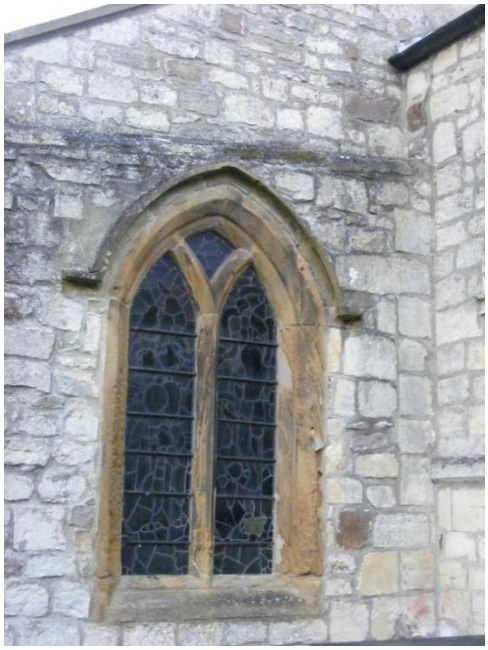
Main view of the church. Magnesian Limestone is the main building material although the tower has a mix with sandstone also used.

A walk around the church reveals many different features and is a useful teaching aid. Some of these different stones and weathering features are shown below.

A walk around the church and churchyard

Large blocks of Magnesian Limestone

Mix of limestone and sandstone (the latter showing more effects of weathering)



Sandstone of window shows much weathering

Sandstone grave marker showing effects of 'acid' rain

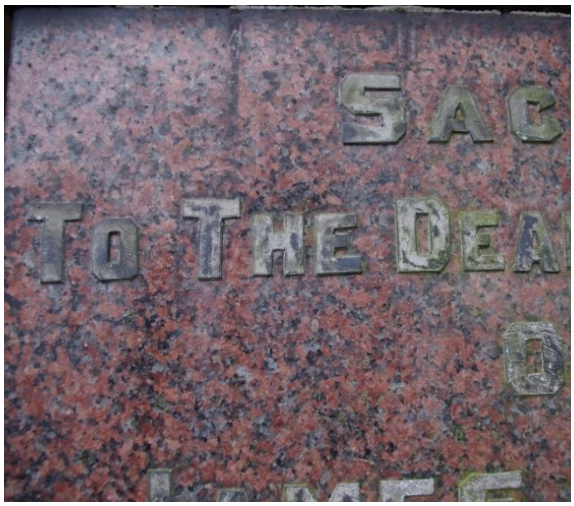
Carboniferous sandstone – probably York stone

Sandstone showing exfoliation

A pink granite probably Ross of Mull, Scotland – an even textured granite

Close up of stone on left showing pink feldspar crystals

A red granite – possibly a granite known as 'Balmoral Red' – it does not come from Balmoral. It comes from Scandinavia but was marketed under the name of Balmoral to make it more appealing to the Victorian market



Close up of stone on left showing pink feldspar crystals

A grey Scottish granite used with sandstone – an unusual combination.

Granite from south west England – these granites tend to have a coarse grained texture and are often left unpolished – as with this one

This dark grey rock is a gabbro – an igneous rock which does not have as much quartz as a granite. Often these come from South Africa

C lose up showing even textured crstals – mainly feldspar and pyroxene.

There are several marble headstones. Marble is a metamorphosed limestone and is good for carving and sculpting although like limestone it can be affected by acid rain

Marble

References

Lawrence D.J.D, 2009. Limestone Landscapes – a geodiversity audit and action plan for the Durham Magnesium Limestone Plateau. British Geological Survey, Keyworth, Nottingham

Pettigrew, T.H., 1980. Geology. In Dunn, T.C. ed *The Magnesian Limestone of Durham County*, Durham County Conservation Trust. 7-27

Smith, D.B. and Francis, E.A., 1967. Geology of the Country between Durham and West Hartlepool. *Memoir of the Geological Survey of Great Britain*, Sheet 27 (England and Wales)

Maps