KS2 National Stone Centre Teaching Trail Summary.

On the journey to the National Stone Centre pupils should be encouraged to look out for ways in which stone is being used in the environment.

Items to bring on the Visit
Appropriate clothing & footwear. Wellies are easy to clean.
Enough copies of worksheets etc:
Notebook, sketchbook, camera, tape recorder, magnifiers, water dropper bottles, tape measure, compass.
Teachers and adult helpers should each have dropper bottle with dilute acid for testing limestone. Domestic lime de-scaler may be used, and should be diluted to adequately react [try x 10 dilution]. Tissues should be kept handy.
Equipment for collecting soil samples.
Ten metre length of string with weight attached – for measuring depth of a mineshaft.
A small selection of minerals would be useful eg: galena, pyrite, calcite, baryte.

On Arrival
From the coach/car park walk down towards the railway bridge, passing what remains of a lime kiln on the left. This can be investigated later. Walk under the bridge and follow the path to the right, down to the Discovery Centre. In this area there is plenty of space to assemble and there are toilets and small shop in the Discovery Centre as well as the exhibition – The Story of Stone.
The Trail is a walk linking sites together. Sites can be visited in any order, but please keep to the footpaths. Large school parties should be divided into small groups, each group starting at a different site, though the Millennium Wall can accommodate several small groups at once.
There are plenty of opportunities to record information by taking photographs, sketching, mapping and note-taking to aid follow-up work. When soil samples are taken the location should be marked on the map.

Remind the children of Health & Safety issues.
Avoid dog poo on this public open-access site

Earth Science On-site Trail

In the notes for each locality are teaching points related to key observations and interpretations on the formation of rocks, minerals and soils. As there is some duplication over several sites, they are listed together as a summary in a table [Key Observations & Interpretations section NSC7e].

Remember that you are walking around large holes dug into an ancient tropical reef.

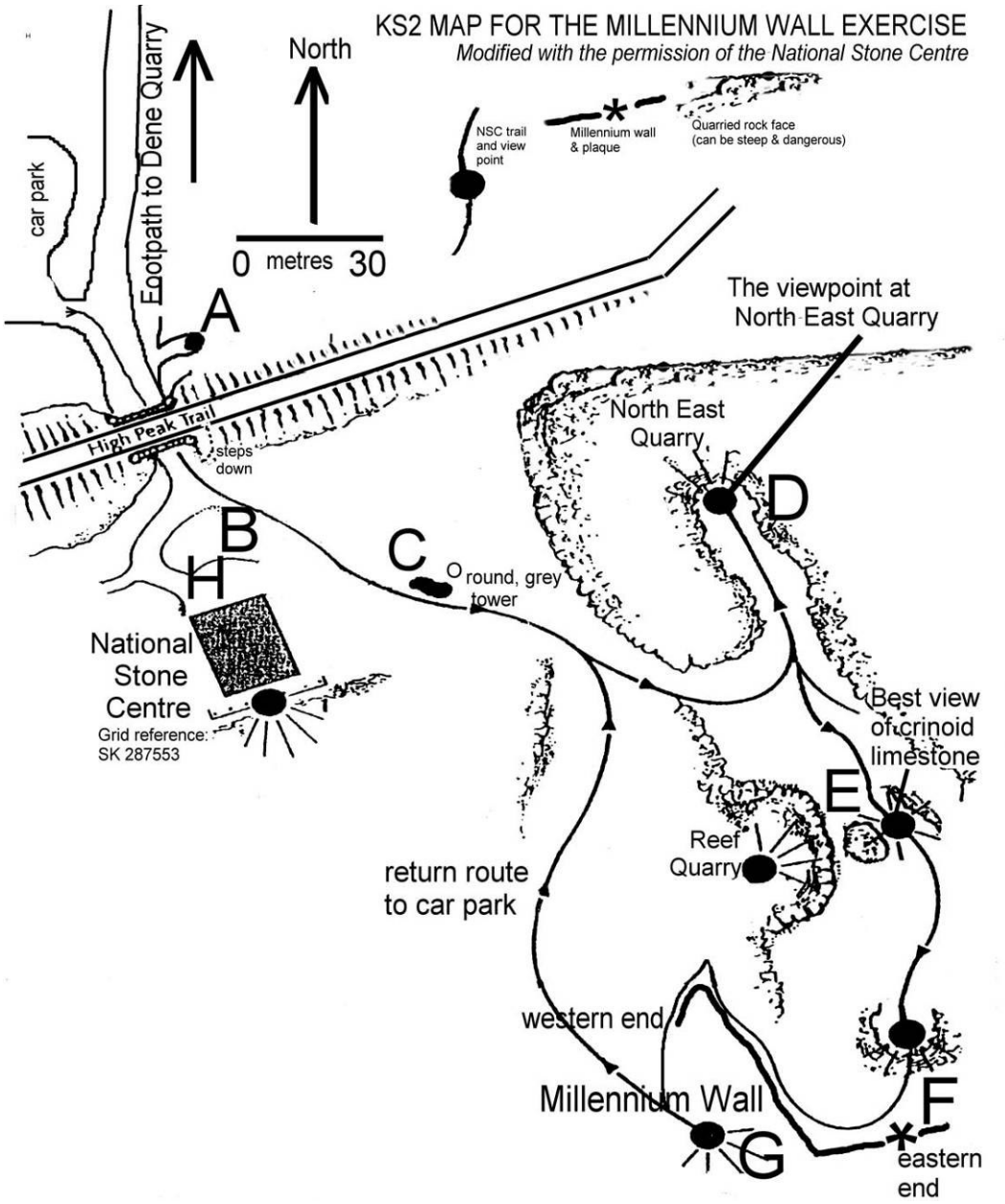

Figure 1. Map of the Sites on the Trail

The Lime Kiln and Railway Bridge - Site A

From the Discovery Centre walk back under the railway bridge. Beyond, and to the right, is what remains of a lime kiln. Here limestone was" burnt" with coal/wood to make quicklime that was used for mortar, agriculture and paint known as lime wash. The early quarrying can be related to history work and the industrial processes can be related to reversible and non–reversible changes, part of the science curriculum.

The bridge is now part of the High Peak Trail, which follows the line of the old railway, which ran from High Peak Junction [near Cromford] to join the Buxton – Ashbourne line near Hartington. These lines linked many limestone quarries to the rest of the railway network in the 19th and 20th Centuries.

The railway bridge and adjacent wall are built of blocks of two local sedimentary rock types - limestone and gritstone [millstone grit].
The limestone was formed in the sea by the deposition and compaction of shelly material and lime mud (not clay mud) as part of a large reef during the early part of the Carboniferous Period. Millstone grit was formed later, from coarse grained sand deposited as deltas of a large river system which spread into the sea, covering up the limestone. Layers of mud were also deposited and vegetation grew in the delta swamps, which in time became compacted and formed coal. The Carboniferous Period began about 345 Ma and ended about 290 Ma.

Possible Questions	Possible responses
Ask the children to see if they can spot more than one rock type.	Yes, there are several
How are these rock types different?	Limestone tends to feel smoother than the rough gritstone, though fossil shells stand out. Limestone reacts with dilute acid, gritstone does not.
Are the blocks of rock "fresh"?	No, they have been here a long time.
What has happened to them since being made into the wall of the bridge over 100 years ago?	Attacked by weathering! Note that acid rain dissolves limestone & makes stronger fossil shells stand out!
Do the individual blocks show signs of layering?	Some do. [Look out for fossil shells. Link to sedimentation activity in preparation].
Notice that mortar has only been used in the arched part of the bridge, for extra strength. Elsewhere it is dry-stone walling.	

The Lead Mine Shaft – Site B

Walk under the bridge. Follow the tarmac footpath to the left for 25 metres to the lead mine shaft on your right. The top of the shaft is faced with limestone blocks and capped by a gated grid. Abandoned mine chimneys, buildings and shafts show that minerals have been mined in the area for many years, since Roman times. This is one of thousands of small mineshafts sunk in limestone areas to obtain the mineral galena, the chief ore of lead. Samples of this shiny grey heavy mineral can be seen in the shop. Other minerals include pyrite, calcite and baryte. Having samples to hand would be useful for passing round. These minerals are found in veins, filling up cracks in the limestone. During Earth movements hot watery fluids containing chemical elements rise through the Earth's crust. As they cool they precipitate minerals on the walls of cracks to form mineral veins.

The story of mining is a topic in itself and could be a follow-up point for research, linked to the history of the area. A visit to the Peak District Mining Museum in Matlock Bath would be useful to illustrate the danger: explosives, rock falls, hand tools, candles, ladders, buckets, lead poisoning. Young children worked on the surface & "dressed" the ore by hammering it to smaller pieces for further separating of the galena from the waste minerals. The latter process used water.

This process can be linked to the "gem" panning activity available on site at the National Stone Centre.

Possible Questions

Possible questions	Possible responses
Ask about the sensation of handling the minerals.	Galena is very heavy for its size, barite is quite heavy, and calcite more "normal"
Ask for pupil views on the occupation of mining	Dark, dangerous etc.

Maths activity**.** Estimate, then measure the diameter of the shaft.
Discuss how to measure the depth of the shaft.

Use a plumb line. Drop a weight, tied to a length of string and allow it to just reach the bottom. Mark the top end, pull it back up and measure the length. (It is only about seven metres deep, as it has been mostly filled in with waste. It was originally much deeper).

Note that the shaft was likely sunk before quarrying began at this part of the site.

First Exposure – Site C
Continue down the path for 20 metres. On your left is a small exposure of limestone, with soil on top, in front of a stone tower. You may find the Fossil Identification Sheet a useful aid. See the document "**NSC8 Info fossils**"

Figure 2. The First Exposure Site C

Note the following hands-on observations which can be made in this field teaching situation, together with the interpretations.

Observations	Interpretation
The rocks are layered in beds	The layering indicates that the sediments were deposited in water. Relate to sedimentation experiment as part of your preparation.
The rocks are mostly grey-white in colour	Look out for fossil shells of sea creatures, often broken, [including corals, brachiopods and crinoids] set in lime mud. The fossils indicate a Lower Carboniferous age when they were deposited. Test with dilute acid – the rocks fizz -They are limestones, formed in the sea.
The fossils include corals,	Today corals live mostly in shallow warm tropical waters, indicating that the water in which these rocks formed was likely shallow and warm [within the Tropics, near the Equator].
Here the beds slope [dip] gently north eastwards [use a compass] and are broken by near-vertical cracks called joints	Long after they were laid down in the sea, the rocks were uplifted, broken and tilted by great Earth movements.
Test the limestone for porosity. (pour water on it)	Often it is not porous, but as water goes down the cracks the limestone is permeable. [see prep: Working with Rocks].
A thin, yellowish, clayey soil rests on the limestone and includes limestone fragments from rocks beneath. Ask how it got there. [There is a thin humus horizon. A soil sample may be taken here for later work.]	Plant acids and acid rain are involved in the weathering of limestone. The clay impurities in the limestone are left behind to form soil.
The thin soil supports limestone grassland, a distinct wildlife habitat, & reminder of the links between geology and wildlife at this SSSI site.	
Farming in the area is mostly pastoral.	

North East Quarry – Site D

Follow the path round to the left for 25 metres. Turn left to the quarry viewpoint by the display board [headed Lagoons]. You are walking along a fossilised sea floor – look out for brachiopod shells. There is no need to go beyond the fence.

Note the following observations which can be made in this field teaching situation, together with the interpretations.

Observations	Interpretations
At one time the ground was level with the top of the cliff face	This is clearly a quarry from which limestone has been removed. Look out for signs of drilled holes for blasting. [Unfortunately no large machines on-site]
A brief discussion on uses of limestone could be done here or later as follow-up.	Limestone from this quarry was used in building the M1. The quarry closed in 1966.
The rocks are layered in beds.	The layering indicates that the sediments were deposited in water. From earlier experiments on sedimentation, note that the oldest beds are at the bottom, youngest at the top. *The layering varies from place to place. In North East Quarry the bedding is very clear. This is the quiet lagoon at the back of the reef.
In North East Quarry the beds slope [dip] gently eastwards and they are broken by near-vertical cracks called joints. In North East Quarry the beds slope [dip] gently eastwards and they are broken by near-vertical cracks called joints.	Long after they were laid down in the sea, the rocks were uplifted, broken and tilted by great Earth movements. In places the rocks were severely broken and moved, forming faults.

To the south (behind you) Reef Quarry shows some bedding and South East Quarry [Not part of the KS2 Trail] shows bedding sloping away to the south. Here waves broke off lumps of reef material which rolled down the front, southwards, into deeper water.

Field Sketch Activity: Assist pupils to annotate the quarry sketch on the pupil activity sheet with the following labels:

Original land surface, Youngest and oldest beds of limestone Quarry face, Quarry floor is ancient sea floor. Use scale to estimate height of face.

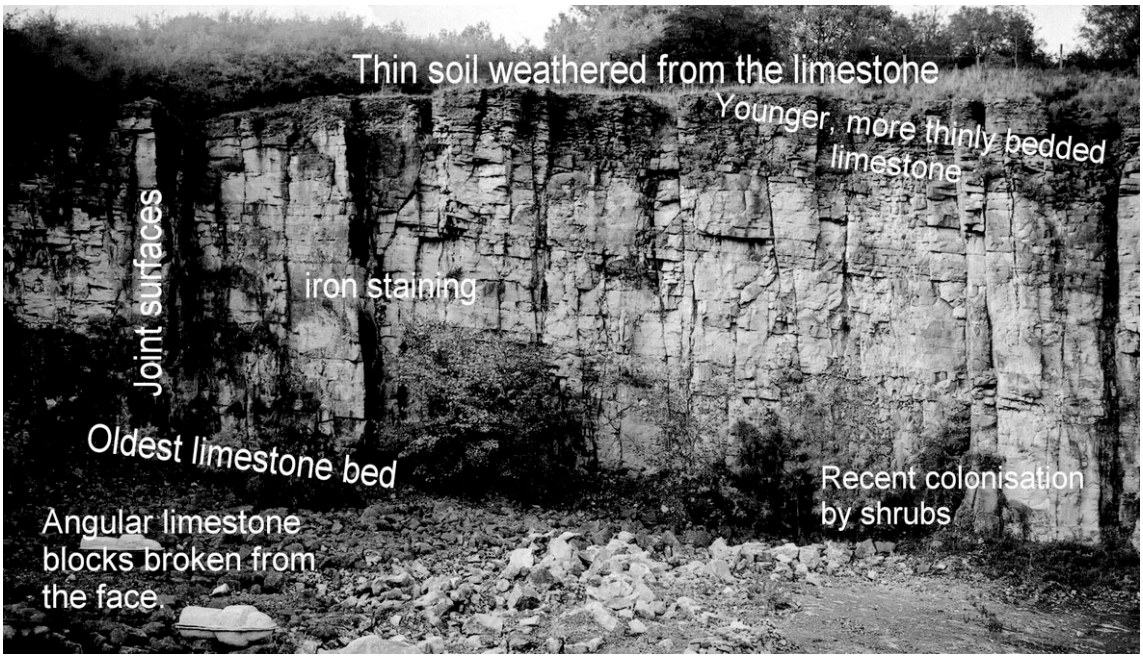

Figure 3. Labelled photograph of NE Quarry

The Crinoid Bed – Site E

Retrace steps to main footpath and bear left along the lower/middle path. At about 25 metres on the right is a fenced-off exposure of dark limestone [next to a wall of a mineral vein with barites. It also shows marks from the miners' pick axes].

Possible Questions
Remind the children that this was once part of the sea bed and to look out for the remains of sea creatures. You may find the Fossil Identification Sheet a useful aid. See the document "**NSC8 Info fossils**"

Possible questions or observations	Possible responses
Can you see any fossils in the rocks?	Several fossil crinoids can be seen. They are a group of animals, related to starfish and sea urchins, and today live mostly in shallow water. They are often called sea lilies, though they are certainly not plants!
Using the sheet, can you see which parts of these animals are fossilised here?	Mostly they are fragments of the stem. These appear to have died here all at the same time and are not broken up. This indicates that they died in quiet conditions.
They are covered in a black coating.	Other limestones in the area are black and smell oily. This indicates that the organic muds were buried under quiet stagnant conditions. The remains of microscopic animals have been heated up during burial and Earth movements and been converted into oil and gas. [Compare with plant material growing in swamps becoming coal].
Note the fence as simple conservation measures taken to protect these rare fossils. Check display board for further information.	

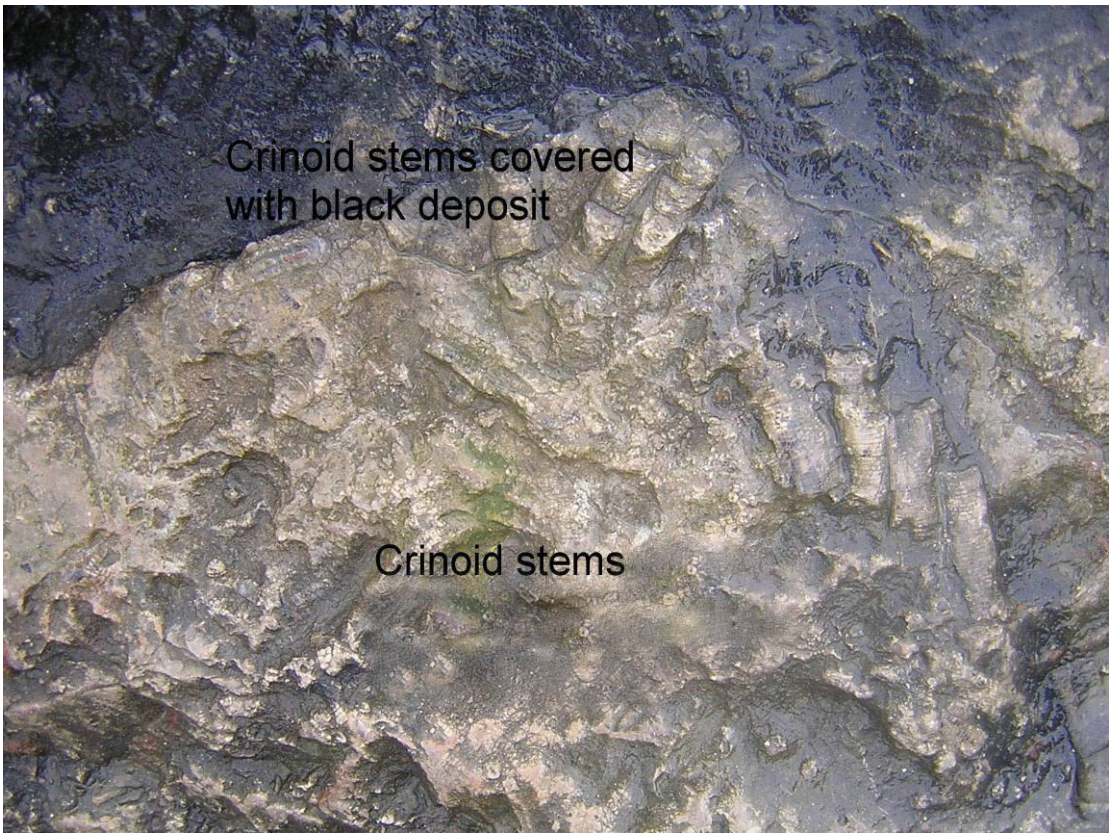

Figure 4. Crinoid stems at Site E

The Millennium Wall – Site F

Continue along the footpath for 25 metres, through the enclosure, to the long dry stone wall. This wall was built to demonstrate the variety of styles of dry stone wall construction seen in various parts of Britain. Different types of rock were transported here from their area of origin for a special event in 2000. The nature of the local rocks helps to determine the style and construction techniques used to build the walls. Beside each section of wall there is a plaque giving detailed information about the rock used.

This one locality provides pupils with a unique opportunity to observe, test and compare a range of different rock types in use.

Millennium Wall Activities

1) One way of using the wall to observe and learn about different rocks is to use the identification technique of the ESTA "Working with Rocks" pack and ESTA rock kit. This involves a short rock description to be matched with a sample. However, it would be tedious to attempt to work through all of the rocks in the wall, including the several limestones and sandstones/gritstones, so we can ask the children to be selective and choose one example to match each of four rock descriptions. The plaques can provide the additional details. These are: gritstone, limestone, basalt/dolerite and slate

2) Using their observable characteristics it is possible to group most rocks according their mode of formation, into sedimentary, igneous and metamorphic.

3) This is a useful opportunity to test the rocks for porosity, using the water dropper bottle. Testing with dilute acid can be done or supervised by adults.

4) It is also useful to see the effects of weathering since 2000 on different rock types. Note that the gritstone and limestone coping stones are placed vertically, exposing the bedding to attack by freeze-thaw. Many light coloured rocks get darker and dark ones lighter. Many blocks are beginning to get lichen and moss growing on them.

5) If a record is kept of the names, ages and places of origin of all rocks used in the wall it should be possible to mark their positions on a time line or geological column [see notes on preparation] and on a copy of the UK Geology Wall Map. This could be part of follow-up work.

Give the pupils the Millennium Wall Activity Sheet [two sides]
Adult helpers can use the "possible answers" sheet. See NSC7d.

South East Quarry – Site G

From the end of the wall follow the path down for 25 metres to the viewing point.
This is the view into South East Quarry. As this is the lowest part of the old quarries that make the National Stone Centre site you would expect there to be some water visible as a pond. There are a few small gullies on the floor as signs that water has flowed there recently. This needs to be related to porosity and permeability. You have tested and found that the local limestones are not really porous, but the rainwater goes down the joints into the ground, making the limestones permeable. This is covered in "Working with Rocks".

Discovery Centre and Geo Steps – Site H

Return to the Discovery Centre area. Here the exhibition – The Story of Stone - should be visited, one group at a time. There is a small charge. There is also a gift shop selling a wide range of rocks, minerals and fossils. Drinks and snacks are available. There are also toilets. Children must be supervised.

The Geo Steps in front are undergoing reconstruction (April 2005). They show a variety of rocks in order of age – oldest at the bottom. It may be possible to identify some of them using work done at the Millennium Wall. Note how easily one wall has weathered.

Final Assembly

This should be by the Discovery Centre area, with children returning up the path to the coach/car park.

Booked activities available at NSC
These must be booked in advance and are normally done in the vicinity of the Discovery Centre

"Gem" Panning – Separation of "gem" samples from sand by use of water. This is one of several water-based methods of separating minerals. Relate to local lead mining and possible visit to the Peak District mining Museum in Matlock.

Fossil Casting – using plaster of Paris and moulds to replicate samples of fossils.

Fossil Rubbing – using templates of fossils for paper rubbing with crayons.

Extension visit to the Peak District Mining Museum

A useful extension visit linking with history would be to the Peak District mining Museum in Matlock Bath.

Extension visit to view Dene Quarry.

A useful extension visit would be to look into the adjacent Dene Quarry, north of the NSC site. Take the footpath to the road and cross to go along Dark Lane. The access is a footpath across a field which can be very wet after rain. (See **Figure 5.)** The quarry viewing platform gives the "wow" factor of the scale of modern quarrying and the display panel shows the processes involved. Note size, depth, benching, blasting, dumper trucks, crushers, road versus rail transport, environmental impact, reclamation, jobs etc. This extension could be related to other quarrying local to the visiting school and to homework/research on uses of limestone.

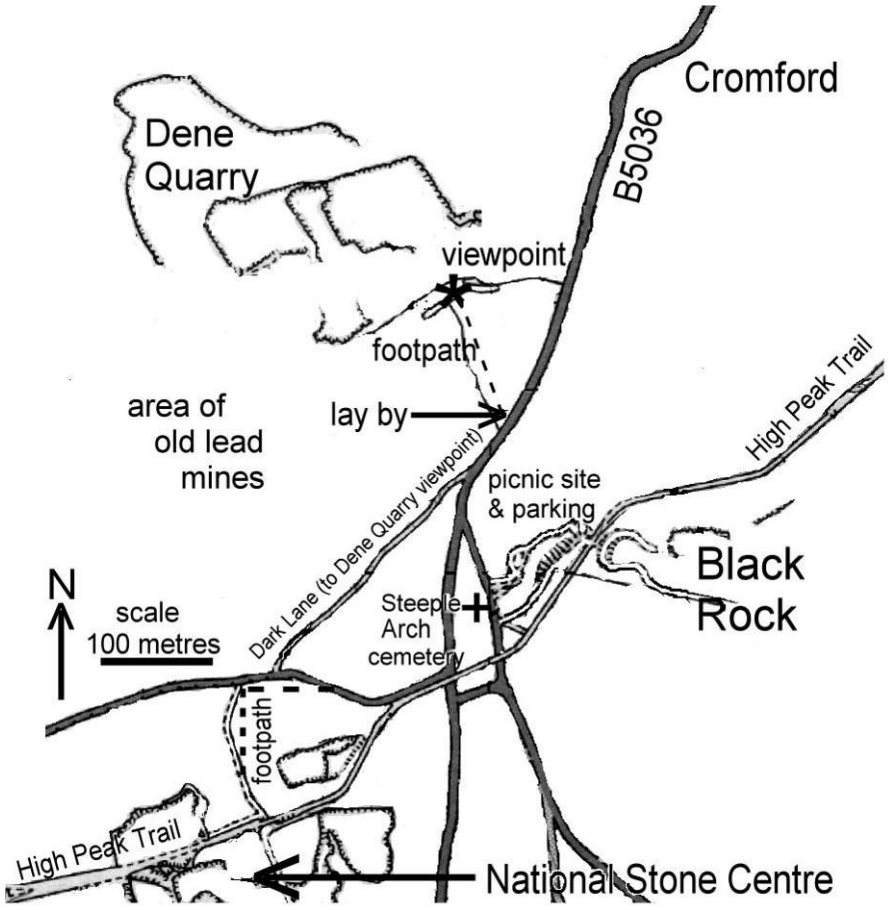

Figure 5. Route to Dene Quarry Viewpoint.