INTRODUCTION

☛ Individual groups will need measuring tapes, 10x hand lenses, grain size comparator cards, hand lenses (x10), compasses and clinometers if dip measurements are to be attempted, as well as clipboards and copies of the relevant field sheets for individual pupils. (See **BB12 Worksheets**). Callipers for measuring long axes of pebbles will be useful.
Group Leaders will need a plastic bottle of dilute HCl, a small plastic bottle of water. A roll of sticky parcel tape and a digital camera will also be useful. Groups using sites 6a and 6c should have hard hats as a precaution against falling pebbles.

☛ Field leaders should have decided which combination of the following exercises the groups are to tackle before they arrive on site:

1. Investigating the monument – use of building materials and the effects of weathering.
2. Curb and steps – man made building materials.
3. The viewpoint to the SW – The landscape and the buried rocks to the west.
4. The viewpoint to the South – Landscape, soil and geology.
5. A study of the boundary wall – dolerite blocks and their characteristics.
6. Pinfold Quarry pebble study – shapes and types of pebbles weathered from the rocks.
7. Measuring asrock sequence – close study of the sandstone layers (Hopwas Breccia).
8. Investigating a break in the rocks – study of a small fault.
9. Summary of events at Barr Beacon – a graphic column of geological events.
10. Homework summary sheet, based on the rock cycles.

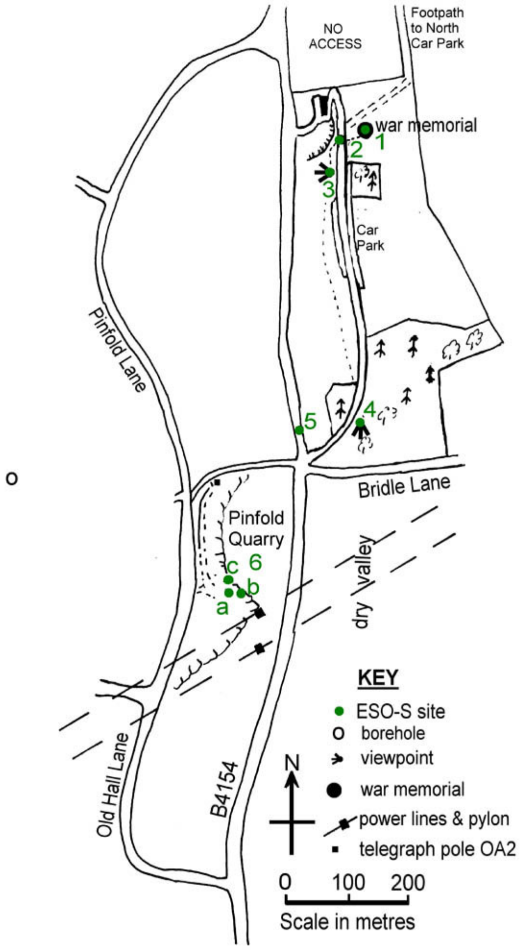


Figure 1. The field sites.

☛ It is convenient to park at the north end of the car park, close to the memorial.

Leave the vehicle and walk east for 80 metres across the grass to a point matching the view of the memorial on the worksheet, about 50 metres away on its SE side. This is **site 1.**

The intention here is to raise awareness of factors influencing the use of natural materials by humans.

Focus the group's attention on the memorial before allowing them to begin the task.

Figure 2. Site 1: The War Memorial viewed from the SE.

Worksheet 1: Investigating the War Memorial.

Suitable questions at this site	**Acceptable responses.**
Describe the roof of the building.	Domed roof. Octagonal in plan shape.
Why is the roof domed?	To allow the rain to spill off. (It also conforms to classically recognised proportions).
What is the roof made of?	Sheets of copper.
Why was this material chosen for this part of the memorial?	It is a malleable metal. Originally it would have been bright copper red, and a striking feature. It would also have been waterproof.
Why is it now green? (Copper first weathers (oxidises) to black copper oxide, then moves quickly to the green carbonate under the influence of carbonic acid in rainwater).	Weathering of the copper sheets covering the roof to the mineral Malachite, first by oxidation and then by the effects of acidic rain (carbonic acid). $CuO + H_2CO_3 = CuCO_3 + H_2O$
The columns are made of stone. How many reasons can you think of to explain why this particular stone was chosen?	1. Strong enough to support the weight (Compressive strength) 2. Easily shaped. 3. Could be cut into long enough pieces (i.e. few natural joints). Each column is in 3 pieces. 4. Attractive colour.
Where did the metal and the stone come from?	They were both taken from the ground, either in a quarry, or as ore from a copper mine.
Is the memorial new? How can you tell?	No, because there has been time for the green malachite to form & to be washed down onto the walls and the steps are blackened and have grass growing through them. i.e. it has been weathered.
Summarise: Humans take materials from the ground and use them in buildings for particular purposes according to their special properties. Once built, the structures are attacked by weathering. Ask the group to work in pairs to facilitate discussion whilst completing **worksheet 1.** (These can be found in **BB12 pupil worksheets,** and examples of the completed worksheets can be found in **BB13 Field Notes.)**	
After 15 minutes bring the groups together to inspect the columns. Have they been weathered evenly all the way around? Are all of the columns affected in the same way?	No. (The fossils stand proud more on the SW side on all of the columns, not just the ones facing SW) Yes, all columns show protruding fossils on the SW side.
Ask for hypotheses to explain the uneven pattern of weathering	Prevailing wind direction exposes all of the columns to greater weathering on the SW side.
Draw in an arrow showing the main wind direction on the worksheet diagram.	

Site 2.

☛Walk the group 30 metres to the south west, where the small posts mark the steps down to the road. This is **site 2**. Here there are more examples of human use of natural materials. Caution the group to be aware of traffic on this small but busy road.

Figure 3. Site 2 - Steps.

Figure 4. Site 2 West Side Curb.

Suitable questions at this site.	**Acceptable responses.**
East side of the road: What materials have been used to construct these steps?	Concrete slabs (limestone, anhydrite, clay) Red Bricks (fired clay) Concrete (limestone, anhydrite, clay and rounded quartzite pebbles).
Inspect the curbs on the west side of the road (watch the traffic!) what are they made of	Concrete enclosing fine grained, angular black fragments. They are dolerite, probably quarried from Rowley Hills.
What properties do these materials have that they have been selected for this purpose?	**Concrete & cement:** resistant to weathering. Easily shaped. Can be used to bind other materials. Strong. **Red brick**: resistant form of clay in standard shape. **Quartz pebbles**: Easily available, cheap and resistant to weathering. **Dolerite fragments:** resistant to weathering.

Site 3: The viewpoint to the SW.

☛Take the group across the road and along the path to the south near the fenced woodland. After 30 metres stop across from the north end of the Monument car park, and look to the south west. This is **site 3**. (See **Figure 1**).

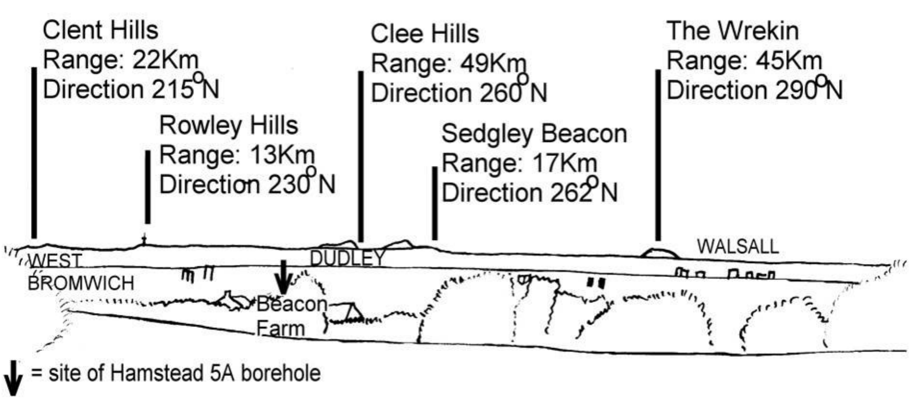


Figure 5. The view to the South West.

Worksheet 3: The viewpoint to the South West.

Suitable questions at this site.	Acceptable responses.
Use the sketch to identify the hills on the horizon. Explain why these areas are highpoints. [NOTE: **Wrekin** / Cambrian sandstone; **Sedgley Beacon** / Silurian limestone**; Clee Hills** / Devonian Sandstone; **Rowley Hills** / dolerite; **Clent Hills** / Permian Sandstones.]	The hills indicate more chemically and physically resistant rocks, and will take longer to weather down to the current surface level of the less resistant rocks.
What will eventually happen to the rocks being eroded and transported to the west of Barr Beacon?	Weathering erosion by slipping and slumping on slopes and rain wash will move material down slope to the rivers. To the west is the R. Thame, which flows south & then east to the Blythe, which then joins the Trent east of Alrewas which flows to the Humber estuary and the North Sea.
If a geologist in millions of years' time was able to study these rocks forming in the North sea today, what "fossils" might be found in them?	Apart from marine organisms with bony or shelly parts, there might also be human debris, such as hulls of sunken ships, plastic bags, beer cans, ipods, etc. Emphasise the importance of more resistant elements to allow fossilisation: so no jelly fish or paper, for example.
Look at the housing visible to the west, Dudley, Walsall etc.. What materials have been used to make it? Where did these materials come from?	**House Roofs:** Tiles from clay fired in a kiln. The clay is dug from the ground like slates which are natural stones, not man made. There are no slates on this housing estate. **House walls (inside and out**): Bricks from clay fired in a kiln. Inside will be plaster board made from gypsum or anhydrite. **Cement & concrete:** sand, limestone, gypsum. Also clay and aggregate (stone fragments) **Windows:** Pure silica sand, melted and cooled rapidly to a glass. **Gas/oil for central heating:** Drilled from oil traps and piped in. These fuels represent fossilised energy, created by organisms from sunlight, millions of years ago **Roads and driveways**: petroleum (oil) products like tarmac, mixed with stone fragments. **TV aerials, wires, garage doors, and cars:** Metals smelted from metal ores. **Garden Soil:** Formed when feldspars are chemically weathered to form clays. Soils are mixtures of naturally weathered products including sand and clay, plus some organic material. **Grass and trees:** Grow in soil. (Also use gases from the atmosphere and sunlight). All of these products have their origins in the ground, either quarried or mined, or are growing in it.

Site 4: Viewpoint to the South.

Walk the group southwards along the nature trail to the exit road. Cross the road and stop on the grass looking southwards along the valley towards Pheasey. This is **site 4**. (See **Figure 1**).

The southern edge of Barr Beacon Nature Reserve is a clear example of how faulting has affected landscape.

The rocks in the area are tilted to the east and have been cut by an east-west fault. The rocks to the south have been down-faulted by 15m

The rocks on the up-faulted side have been removed by weathering which has also emphasised differences in the resistance of the rocks in the area, forming a ridge along the Triassic rocks and lower land on the softer Carboniferous shales and sandstones.

At the level of present day erosion, however, the ridges on the two sides of the fault do not line up. On the up-thrown side the ridge is about 100 metres further east than on the south side.

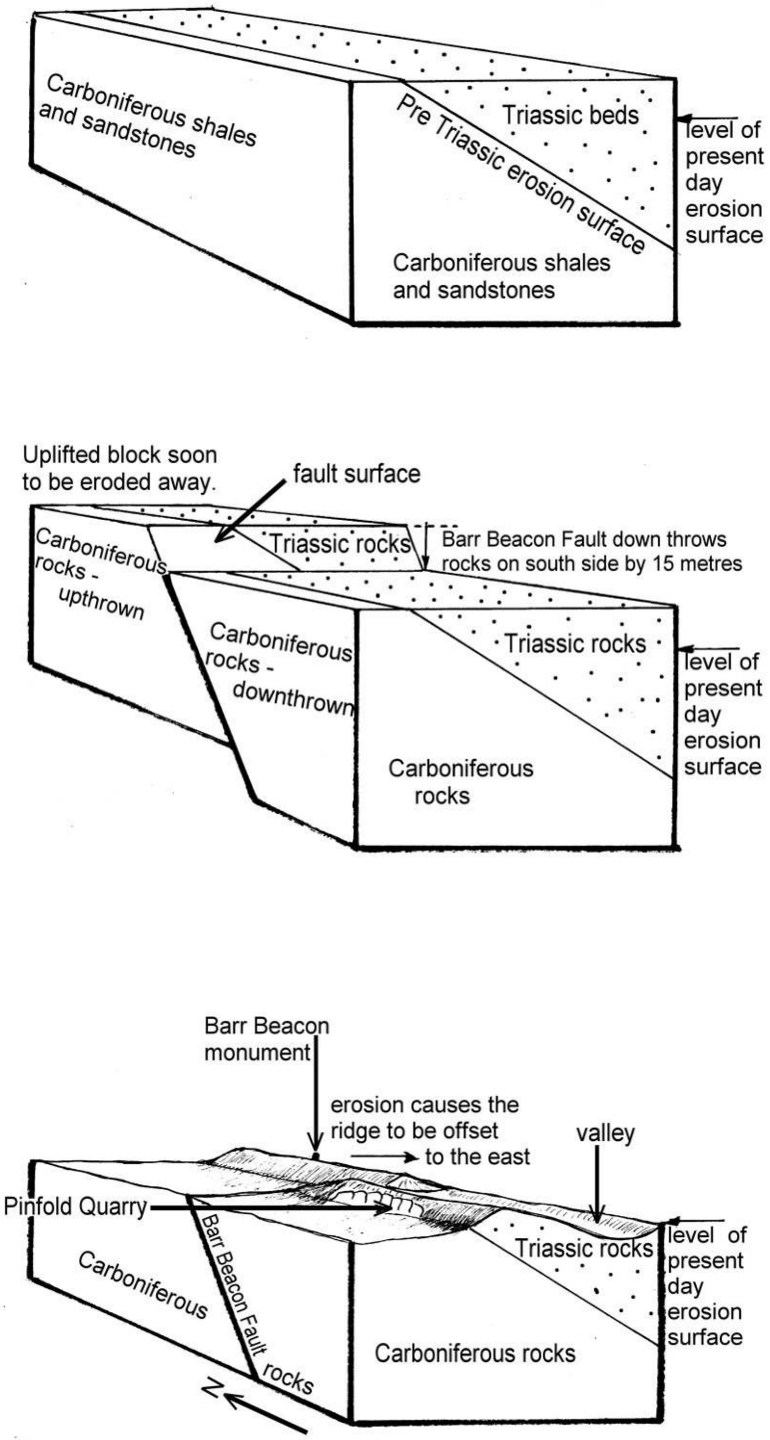


Figure 6. The Barr Beacon Fault.

Worksheet 4: The viewpoint to the South.

Suitable questions at this site.	**Acceptable responses.**
Point out to the group that they have been walking along a ridge, and yet they are now faced by a valley. Ask them where the ridge has "gone"? HINT: Use the map on **worksheet 4.**	The high ground is now to the west (right). The rocks have been displaced 15m downwards by the Barr Beacon Fault, and the ridge by about 100 metres to the west.
What forces cut the valley?	Water. (Rivers, not ice which would have made it deeper and wider, with a flatter bottom.)
What reasons might explain why a river does not flow along the valley bottom now, but did when the valley was formed?	1. Less rain now than in the past 2. The rocks are more permeable now (compared with the end of the Ice Age when they were frozen solid.)
How can we test if the soil is permeable?	Pour water onto it. It soaks in very quickly.
Where has the water gone?	Into the tiny pore spaces between the sand grains. NOTE: take care to dispel ideas of "underground lakes". The water is in spaces much less than 1mm across
What do we call a layer of rock that contains a lot of water?	An aquifer. The rock below is an important source of water for the area.
Look carefully at the soil (without digging holes) and describe what you see.	The soil is very sandy, with rounded pebbles. It has grass and other plants growing in it.
How has this soil been formed?	Weathering of the rock below (which is, therefore, likely to contain sand and pebbles).
How has weathering attacked the rock below?	Chemical weathering by acidic rain water will attack the cement holding the sand grains together.

Site 5: The boundary wall.

☛ Carefully take the group through the Barr Beacon Nature Reserve exit and onto the pavement to the right of the gate. The wall at the back of the pavement is **site 5**. Ask the group to inspect the blocks in the wall and describe them. Remind the group to beware of traffic.

Worksheet 5: A study of the boundary wall.

Suitable questions at this site.	**Acceptable responses.**
Look at the angular blocks in the wall and describe them.	Fine grained, interlocking crystals. Dark coloured, with no bedding or fossils.
Are they sedimentary, igneous of metamorphic	Igneous. Dolerite: probably from the Rowley Hills.

☛ Move the group slightly to the right, away from the Bridle Lane junction and then cross the B4154 to the path down to Pinfold Quarry. Take care across this busy road. Continue down the steep path over many rounded pebbles. Near the foot of the slope, at telegraph pole OA2, (See **Figure 7**) turn left along the narrow path through the small quarry gate. Turn right and follow the path along the quarry fence to the clearing by the yellow and black barrier. Fork left and head for the quarry face just north of the pylons visible through the trees. (See **Figure 8**)

Site 6: Pinfold Quarry.

Figure 7. The access gate

Figure 8. The approach to Site 6

The three Pinfold Quarry Sites.

☛ Bring the group together about 30 metres south of the metal fence at the foot of the face. (See **Figure 9).** Remind the group that they have just walked down to the base of the Barr Beacon ridge and are now looking at the rocks that lie below the park. Here the focus is on interpreting the evidence for an ancient rock cycle where deposition took place about 245 million years ago.

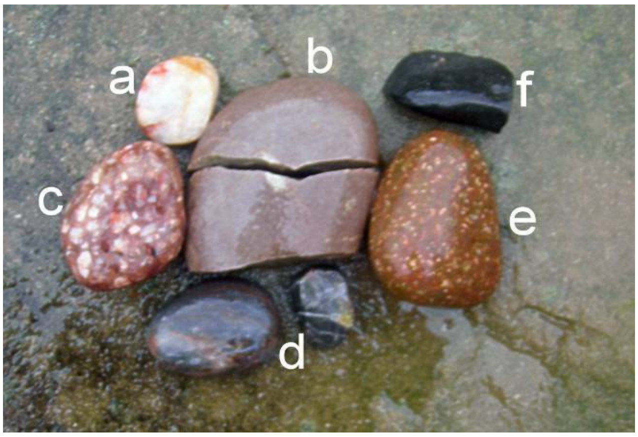
Figures 9a and 9b. The three Pinfold Quarry Sites.

☛ Before getting onto the exercises help the group get an overview of the face.

Worksheet 5: A field sketch of Pinfold Quarry.

Suitable questions at this site.	Acceptable responses.
Ask the group to estimate the height of the face.	About 10 – 12 metres
Ask how this quarry face came to be here today?	It isn't natural – there is no river, and it is too fresh to be glacial. It is a quarry face
Ask what was useful to be quarried from this site?	Pebbles for road stone and aggregate and building sand.
What features can be seen in the rocks from this distance?	Joints and bedding. Lots of pebbles at the top.
What kind of rocks are these: igneous, sedimentary or metamorphic?	Rocks made up of weathered fragments and deposited in beds, are sedimentary.
Which bed is the oldest, and which bed is the youngest in this sequence of beds?	**Principle of Superposition**: Younger beds are on top of older beds.
Ask the group what changes occur in the rock beds as they look up from the base. And what doesn't change?	The lower beds are finer grained and bedded. At the top there are many pebbles and fewer bedding planes. The beds are red / orange all the way up.
Tell the group that these rocks are Triassic in age about 245 million years old, and that the pebbles are evidence of events over millions of years of Earth History that they are to investigate. Larger groups can be split into three here and rotated between the three sites, **a, b** and **c**.	

Site 6 a.: The Pebble Scree.



Although there are many pebbles, the bulk (about 80%) are:
(a) white vein quartz and;
(b) quartzite (metamorphosed sandstone).

Of the others the most common are:
(c) conglomerates and **(d)** cherts.

Pebbles of **(e)** igneous porphyry and **(f)** fine grained black basalt pebbles may also be found.

Figure 10. A quick pebble identification summary.

NOTE: The fragments in a conglomerate are rounded and uneven pebbles, whilst those in a porphyry are regular and rectangular crystals in a fine grained matrix.
A more detailed pebble identification sheet is available in the ESO-S material for Park Hall.

☛ Approach the scree in an orderly fashion and conduct a pebble survey, using the pebble identification sheet to help with identification. Stress the need to select 20 pebbles **at random**. One way of doing this is to drop a marker and pick the 20 pebbles closest to it.
NOTE: In the process find and retain a sedimentary rock for later: preferably a conglomerate, but a sandstone pebble will do.

☛ Use the table below to help pupils work out the minimum velocity of (Triassic) water flow implied by the size (weight) of the largest pebble.
NOTE: Only the **minimum** velocity for deposition can be inferred. The maximum flow may have exceeded this value, and then all the pebbles would then have been in motion.

Name of Fragment	Diameter of Fragment in mm.	Approximate Minimum Flow Velocity to Deposit this Sized Fragment
COBBLE	Over 100 mm	400 cm per second (extremely high shooting flow)
COBBLE	Over 64mm	300 cm per second. (extremely high flow)
PEBBLE	4mm to 64 mm	100 cm per second (very strong flow)
GRAVEL	2mm to 4 mm	60cm per second (fast flowing stream)
COARSE SAND	2mm to 0.5 mm	12 to 15 cm per second (more normal stream flow)

Site 6 a: The pebble scree, summary.
These pebbles are extremely well rounded. This implies a very long period being transported in water. The maximum long axis should be around 200 mm. (make sure an unbroken specimen is measured) implying a flow velocity in excess of 400 cm per second.

☛ First draw attention to the amount of chemical separation that the rocks cycle has produced in these beds.

Worksheet 6: Pinfold Quarry pebble study

Suitable questions at this site	Acceptable responses.
What rock types did you find and how did you recognise them?	**Igneous:** made of interlocking fine – medium crystals. Porphyry. **Sedimentary**: Commonly sandstones, made of grains cemented together. (Limestones are rare here). **Metamorphic**: grey (liver coloured) quartzites are common, often cracked. They are formed by contact metamorphism of sandstones. **Vein minerals:** Commonly white quartz.
Can you recall what the main elements are which make up the lithosphere (rocky crust)?	Si, O and Al (Silica:Si O_2 makes up 59% of the crust and Alumina: Al_2O_3 makes up 15% of the crust.) Essentially we live on a planet with a glass crust (plus 40% of “impurities”).
What is the main chemical composition of the pebbles and the sandstone?	SiO_2 (Mineral name Quartz) NOTE: Even the minerals in the igneous rocks are silicates.
What major element of the crust is “missing” from these rocks?	Aluminium.
Why doesn’t the composition of these rocks reflect the composition of the crust? NOTE: The starting material for the rock cycle is igneous rock produced from partial melting of the upper mantle (basalt). All other rocks are recycled (except for the odd piece of meteorite), and in the process become separated into the common rock constituents.	Sedimentary processes can produce beds showing chemical separations. **First** by way of sorting by density and particle size. Hence sandstones are higher in Si and O, whilst clays and shales are high in Si, Al and O. **Second** by chemical (or organic) precipitation from seawater, when elements in solution (e.g. Ca, Na, etc) can become concentrated in the rocks as limestones or evaporites. **Third**, anaerobic decay of organic matter can produce concentrations of (hydro) carbon, or coal and oil.

☛ Then help the group to reach conclusions about the Rock Cycle from this exercise.

Worksheet 7: The Story of a pebble inside a pebble.

Suitable questions at this site.	**Acceptable responses.**
How did these pebbles get here?	They have been weathered from the beds at the top of the quarry face and brought here by gravity.
Are all the pebbles the same size?	No
Are all the pebbles the same rock type? How can you tell?	No: they have different colours; some are banded; some are streaked, etc.
Use the worksheet to help you describe the shape of these pebbles.	They are very well rounded.
What does the fact that they are well rounded tell us about the transport of these pebbles?	They have been transported by water (waves or flowing current) for a long period of time, and rough edges have been worn away (abraded).
Many of these pebbles have rock types that suggest they have been transported from Brittany in France. If so, in What direction would the river have been flowing?	Northwards. (It has been given the name of the "Budleighensis River)
Are these individual pebbles older or younger than the bed they were deposited in, and now exposed at the top of this quarry.?	**Principle of Included Fragments**: fragments contained within a sedimentary rock must be older than the rock itself.
What does the pebble-type tell us about the rocks exposed to weathering in this ancient desert landscape?	There was a lot of metamorphic quartzite and vein quartz, with some igneous and sedimentary rocks like sandstone and conglomerate.
Why are there no soft rocks, like shale or clay amongst these pebbles?	The violent river flow would have broken them up. Only physically resistant rock types have survived.
If no one has already mentioned it, point out that many of these hard rocks are broken, some with their halves still together. Were these broken during transport in the violent river, or after deposition?	If broken during transport the halves would become widely separated – and rounded. These fractures, and the marks on many of the pebbles, indicate pressure from adjacent pebbles during <u>very deep</u> burial since Triassic times. **Figure11: A Fractured Quartzite Pebble**. 
Remind the group they are in fact discussing the Rock Cycle, and ask them how many times "deposition" occurs in any one cycle?	Only once [This means more than one deposition event means more than one rock cycle.]
Show the group a conglomerate pebble and ask the group to **work backwards** through the story of the "pebble with pebbles inside it" [Start with the present rock cycle and work backwards through a simplified sequence of: 4. Deposition 3. Erosion &Transport 2. Weathering 1. Uplift Remind pupils that each cycle is started / ended by a period of deposition preceded by crustal uplift caused by plate movement. NOTE: **Principle of Included Fragments** allows us to suggest that these pebbles reveal evidence of at least **three** rock cycles: i) the (modern) cycle that **deposited** the pebble on the scree; ii) the cycle that **deposited** the rock which is now a conglomerate; iii) The cycle which **deposited** the conglomerate which now forms the pebbles <u>inside</u> the pebble. The oldest cycle may be 400 million years old (Devonian)] In summary emphasise the <u>endless</u> recycling of rock material through many Rock Cycles.	A. PRESENT DAY ROCK CYCLE (0 Ma) **12. Deposition** on the scree slope today. **11. Erosion & Transport** by gravity. **10.** Present day **weathering** from the quarry face releasing the conglomerate pebbles (and others e.g. quartzite). **9. Uplift** of the conglomerate to a present day height of 200m. B. TRIASSIC ROCK CYCLE (245 Ma) **8. Deposition** in a bed with other pebbles (& sand grains) and deep burial to form a the conglomerate. **7. Erosion and transport** by river flow, minimum velocity 400 cm p sec., which also rounded them off. **6. Weathering** from an older rocks, mainly quartzites and white vein quartz, but also an older conglomerate. **5. Uplift.** C. EVEN EARLIER ROCK CYCLE (400Ma) **4. Deposition** of that older rock as the conglomerate that is "inside the pebble". **3. Erosion and transportation** in water, rounding off the pebbles **2. Weathering** from an even older rock to form the pebbles that are now "inside the pebble".

Site 6b: The rocks in Pinfold Quarry.

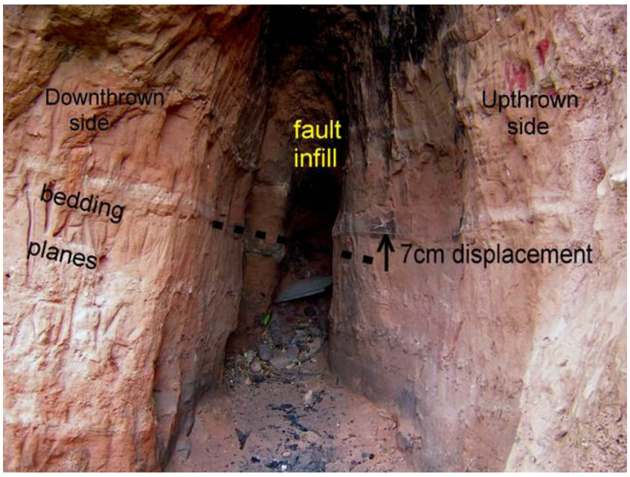
☛ Approach the foot of the quarry face five or six metres to the right of the metal fence. This is **site 6b**. (NB hard hats should be worn, even though the face is quite clean) Even though the grassed scree slope at the foot is gently inclined, warn the group to be careful of their footing. Ask the group to inspect the rock face, using hand lenses, and describe what they can see.

Worksheet 8: Measuring a rock sequence.

Suitable questions at this site.	**Acceptable responses.**
What do you observe about this rock? What is it made of? Sticky tape can be used to detach grains for inspection with hand lenses and grain size comparitor.	Red in colour. Fine grains which can be rubbed off. Bedding planes; cross bedding planes; it contains pebbles. This confirms the original suggestion they are sedimentary.
Can you see any fossils in these sedimentary rocks?	No. (They are almost certainly not there, so don't spend too long looking!)
Explain that the colour is due to staining by the red mineral haematite (Fe_2O_3). In our climate iron weathers to brown limonite (familiar as rust) and is browner in colour. Can the group recall any TV pictures of a landscapes coloured red and deduce in what kind of place these beds were deposited?	Most familiar red landscapes are likely to be American or Australian. Red sediments are indicative of <u>arid terrestrial</u> conditions of deposition. (**Principle Of Uniformitarianism**: fragments of minerals with reduced iron mixed with the sediment, become chemically oxidised, as they do today)
How might this explain the absence of fossils in the red sandstone?	Very few animals live in desert environments (not enough food or water). Any plants or animals which died there would oxidise very quickly, or have skeletons abraded away by sandblasting in the wind.
If the red colour suggests these rocks were deposited in an arid (dry) environment in the Triassic, how can we explain river flows of 400 cm per second to bring in the pebbles?	Modern deserts have flash floods when rare, but extremely heavy rain causes temporary and violent river flows. **(Principle of Uniformitarianism).**
What hypotheses can we think of to explain desert weathering here at Barr Beacon during the Triassic period?	There are two types of hypothesis: 1. Plate tectonic forces have moved the lithospheric plates northwards from the tropics to our present position. 2. The whole global climate was warmer in the past. (It might have been, but the weight of other evidence (palaeo-magnetism, fossil zones etc.) supports hypothesis 1.)
Look at the pebbles in this sandstone. Are they like the ones we have looked at in the scree?	No. These are sub angular, mainly hard sandstones, with a few white quartz or quartzite). Also they are less frequent than in the pebble beds on top. NOTE: These pebbles match rock types in the Lickey Hills, outcrops near Nuneaton, and the Clent Hills. These represent the <u>local</u> rocky outcrops being weathered in Triassic times
What does the more angular shape tell us about these pebbles	They have had less time being transported by water.
Ask the group what this means about the changes in conditions of deposition between the sandstone and the conglomerate?	Water velocities increased. Rivers were much larger, bringing pebbles from much greater distances.
☛ Summarise: These beds were deposited in a desert environment close to the rocky outcrops that were being weathered. Later a sudden change to powerful river flows from the south brought in large amounts of rounded pebbles. Ask the group to work in threes: one to hold the tape, one to read off, one to record and all 3 to discuss and decide how to do the task. The task is to measure the lowest 1m thickness of rock in the face and see what changes they can see from the bottom up to 1m high.	

Site 6c: The fault plane.

☛Bring the group back to the scree at **Site 6a,** and then up the other side of the fencing. At the top is a cave hollowed out along a break in the rocks. (NB Hard hats should be worn, even though the face is quite clean.) This is **site 6c.** Here the grassy slope is a little steeper, and requires care. Ask the group to inspect the joint in the rock, hollowed out into a cave in its lower part, but traversing the upper slope as well.



NOTE: It is the fault infill that has been removed to form the "cave".

Figure 12. Site 6c

Worksheet 9: Investigating a break in the rocks.

Suitable questions at this site.	**Acceptable responses.**
Ask the group to identify the bedding, and decide if it is horizontal or not.	The bedding is picked out by paler beds. They are not horizontal.
Work with the group to decide the amount and direction of dip. (It is tricky at this site and group leaders may want to just tell the groups the answer.)	Use a clipboard as an extension to the bedding (See figure 12). Use a clinometer to find the horizontal direction on the clipboard, then measure the dip at right angles to this direction. Its about 10^0 towards the SE.
Ask the group the difference between a joint and a fault.	Both are breaks in the rock, but a fault has movement of one side compared with the other.
Can the group decide if this is a joint or a fault, i.e. can they confirm movement on one side compared with the other by "projecting" a bedding plane across the gap?	It is a fault. The right (south) side is up-thrown by a few centimetres.
Try to measure the amount of down throw and which side has gone down.	There is a small downward movement of about 7cm of the rocks on the left (north) side compared with those on the right.
When did the faulting occur, before or after the red sandstone was deposited?	**Principle of Cross-Cutting Relationships**: the cross-cutting fault came after the bed was formed.
If you had been standing on the surface when this fault occurred what might you have felt?	An earthquake.
Use a compass to measure the direction of trend of the fault (into the quarry face). And draw it in on the map on the worksheet. Is it parallel to the Barr Beacon Fault?	030^0 North. No it is not parallel.
What evidence would we need to see in order to say that this fault was older of younger then the Barr Beacon fault?	**Principle of Cross Cutting Relationships**: we would need to see which one cut the other. (This is not visible here).
Ask the group to look at the upwards continuation of the fault. What can they see?	It is in-filled with rounded pebbles and blocks of bedded sandstone.
How might this infill have formed?	Then faulting opened up gaps along the fault plane and material ripped off the sides fell down into the space.

☛ Use the event column on **Worksheet 10** to summarise the sequence of geological events at this site.

Summarise the geological events you have seen today
7. Human use of stone as aggregate, cement, brick, and building stone.
6. Weathering and erosion of the surface today, including soil formation.
5. Recent (since the Ice Age (12,000 years ago) erosion of dry valleys.
4. Faulting of the rocks e.g. Barr Beacon fault.
3. Deposition of red sandstone and conglomerates in a desert environment 245 million years ago. This material being brought in by flash flood first from the SW (and later from the south.)
2. Uplift and erosion of those older rocks with flash floods bringing sediment into a desert basin.
1. Deposition of older rocks underlying the Triassic rocks, including Coal Measures.

Emphasise that there have been many rock cycles, not just one, endlessly repeating throughout geological time. The end products of one cycle (rocks) become the raw material for the next cycle, and the most resistant materials (sand and hard pebbles) can become re-cycled several times, becoming well rounded without becoming physically or chemically degraded.

☛ Return to your transport by the same route you descended to Pinfold Quarry.

Worksheet 11 may be used as a homework summary.