Earth Heritage Trust Field Trip

Malvern Hills

Sunday 21st July 2019

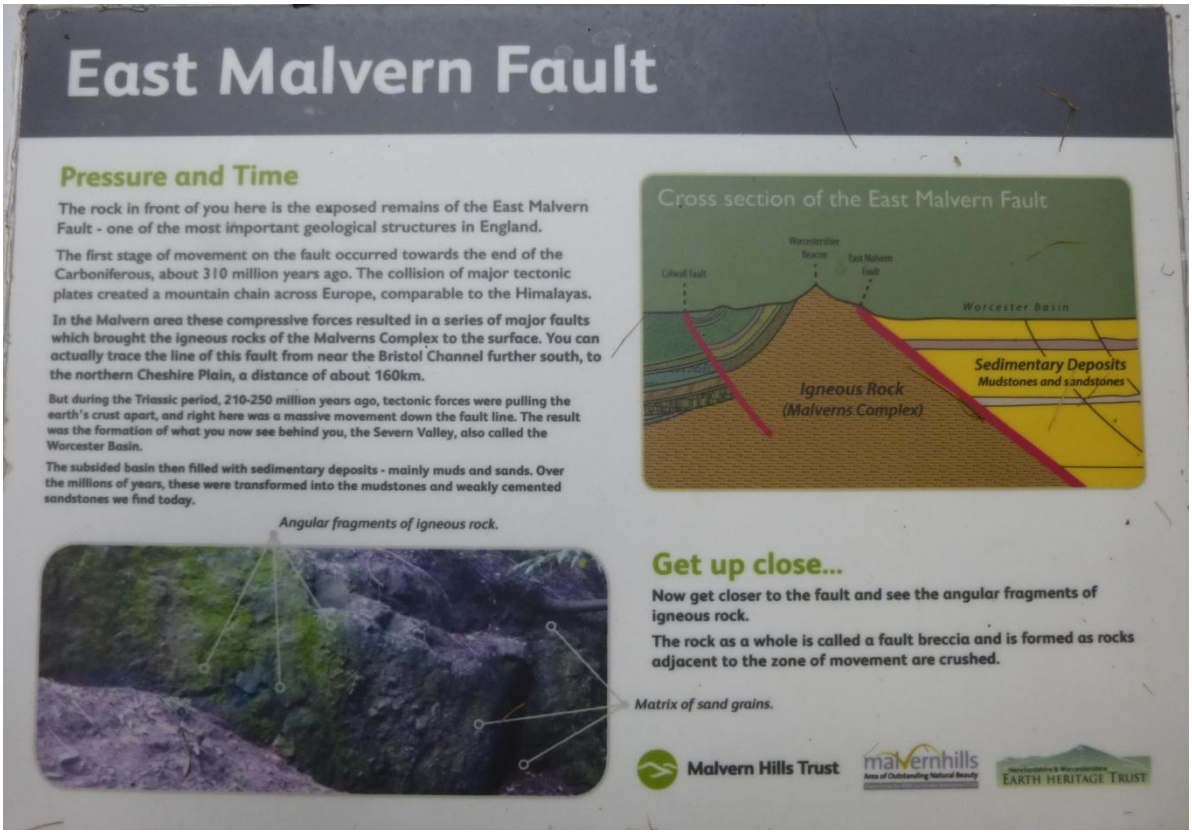
Field Trip leaders: Richard Edwards & Adrian Wyatt

Notes compiled by: Ray |Pratt

Assemble in North Quarry car park, North Malvern Rd, Malvern WR14 4LT (GR: SO 772470). Pay and display.

1. North Quarry (Richard Edwards)

The main focus is the East Malvern Fault.



Slickenside's on fault face

Looking at the map on the handout we see that the area is divided up into terranes. The Malvern hills is on the edge of the Wrekin and Charnwood Terrane blocks, separated by major transcurrent faults in late Pre Cambrian times, rejoining in the Cambrian.. Docking of slices of lithosphere. Whenever there are major tectonic events (Caledonian, Hercynian) faulting occurs along these major boundaries. Believe that the major faulting took place in Variscan times. During Permian & Triassic times there was a period of extension and normal faulting. Also believe that there has been a period of uplift during Neogene times. This fault has seen a repetition of movement during the Phanerozoic time. This is not a simple singular fault. The major fault lies closer to and beyond the road, what we see here in North Quarry is a minor fracture compared to the main (hidden) fault.

Fault Breccia. Clasts of Malvern Complex rocks set in a red sand matrix belied to have seeped into the open fractures during the Triassic. The clasts seem to be equi-dimensional. Some are long and thin at a steep angle. Elsewhere along the fault the matrix is red mud again believed to be from the Triassic. Elsewhere we see evidence of Bromsgrove sandstone matrix. Suggests the fault has periods when it is opened and filled. Some clasts appear to be rounded which could be infill's from a river system during Triassic times.

The fault has a general NS trend, but here it swings around to the NNW around the Malverns Complex. The dip of the fault forms the cliff face. The rock is a granite which displays foliations in places.

Slickensides

Slickensides

Walk out of the North Quarry car park and turn left , walking up the hill past the Morris water tower. Tank Quarry is the first entrance on the left.

2. Tank Quarry (Richard Edwards)

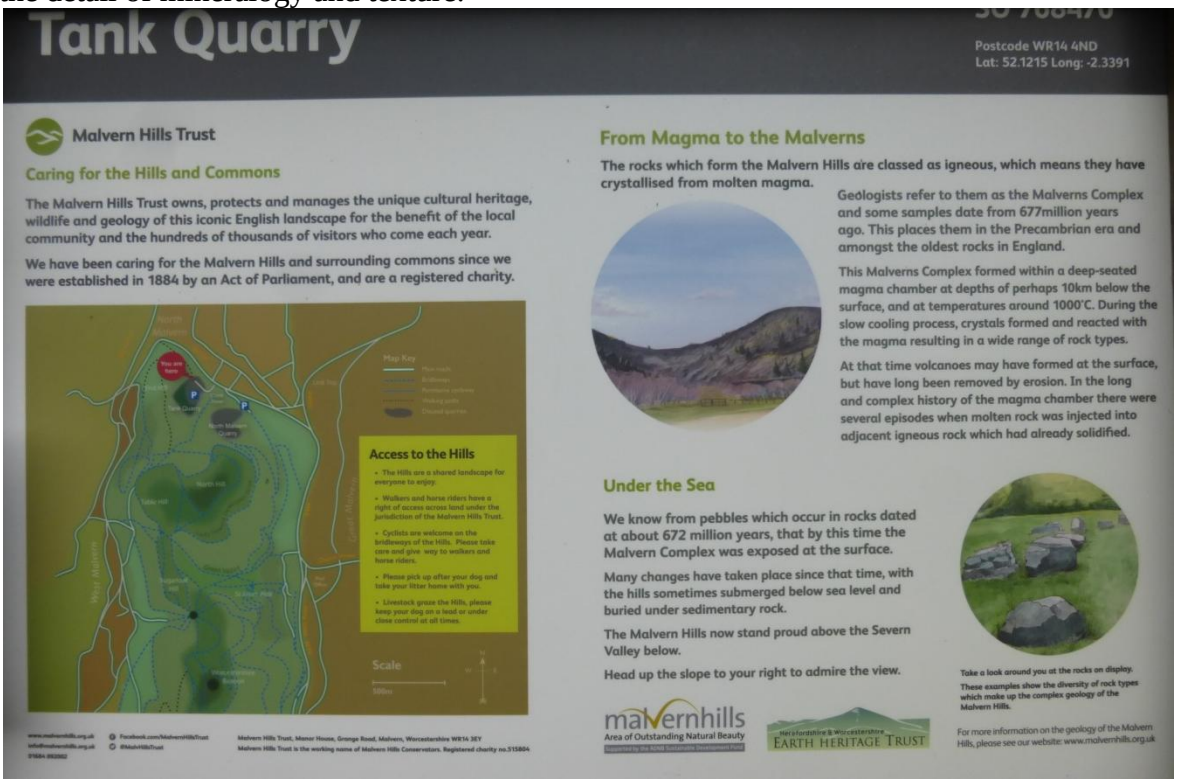
This is the principal location in the Malvern Hills for demonstrating the principal rock types within the Malverns Complex. Problems encountered in developing and mounting the new displays will be discussed.

At the entrance to Tank Quarry Richard outlining the Malverns structure and pointing out the main fault on the other side of the houses as evidenced by the topography. Bromsgrove sandstone can be found on the downthrown side. Estimated 60mm years of subsidence along the fault. A borehole to the east at Kemersy encountered the Permian at 2.2 km depth. This indicates that the throw of the fault is enormous

Polished surface on granite boulder created by the angle grinder (Not of fault origin)

The rock display, combined with hand specimens, will be used to demonstrate the general principle of magmatic differentiation. Recently clearing of vegetation within

Tank Quarry has revealed previously obscured rock faces. In addition John Payne has used a mobile angle grinder to reveal fresh surfaces where weathering often obscures the detail of mineralogy and texture.



Within Tank Quarry are a set of displays with large examples of the rock types being discussed. Around the outside of the car park are the quarry faces with a number of different lithologies which can be examined. Each has a section that has been polished with the angle grinder enabling good lithology identification.

Granite / Felsite intrusion. Radiometric dating of granites in the Malvern Complex gives an age of 677 mm years. The model is that of an island arc with Japan as an analogue. Here the oceanic plate subducts under the continental crust. The magma chambers feeding the volcanoes and 4-6km in depth. However, these are fed by magma chambers 11-15 km down. The modern idea is that there are a series of feeder magma chambers. Initially the ferro magnesium minerals crystallise and settle down to the base of the chamber. These crystals generally larger than those that crystallise out around them. Amphibolites displaying "Cumulus Texture"

Cliff face at end of car park is a shear zone. Amphibolite at right end in series of fragments.

Amphibolite to the right of the Granite / Felsite intrusion. When viewed through a handlense red haematite veins can be seen throughout .

Granite vein intruding into Amphibolites. Greenish epidote can be seen on the contact / fracture. Granite sill has been faulted in places.

Fault face

Fault surface with baryte mineralisation

Fault Plane showing slickeside lineation's and fault breccia

Slikensides on fault plane

Granite, quartz & feldspar dominate. Occur within the Diorites through fractionation ?
Primary lithology of the Malvern Complex is Diorite.

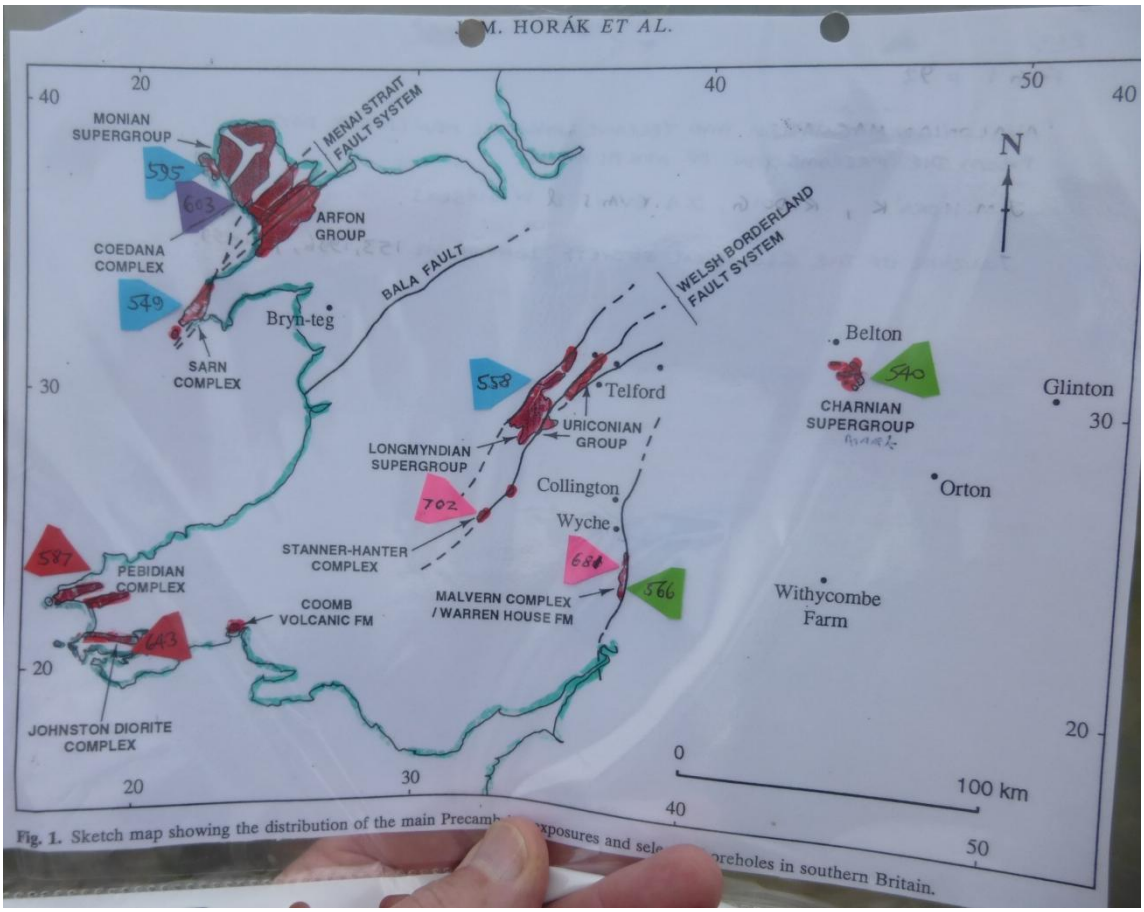
3. British Camp and the Malvern Igneous Complex. (**Adrian Wyatt**)

`Malvern WR13 6DW, (GR: SO 762403). Pay and display.`

We will ascend Herefordshire Beacon. Here I will explain the mechanism by which the Malverns Complex was thrust to the surface at a late stage in the Hercynian orogeny. At this time the Silurian sedimentary rocks were deformed into gentle open folds and this can be dramatically seen from the configuration of the local topography.

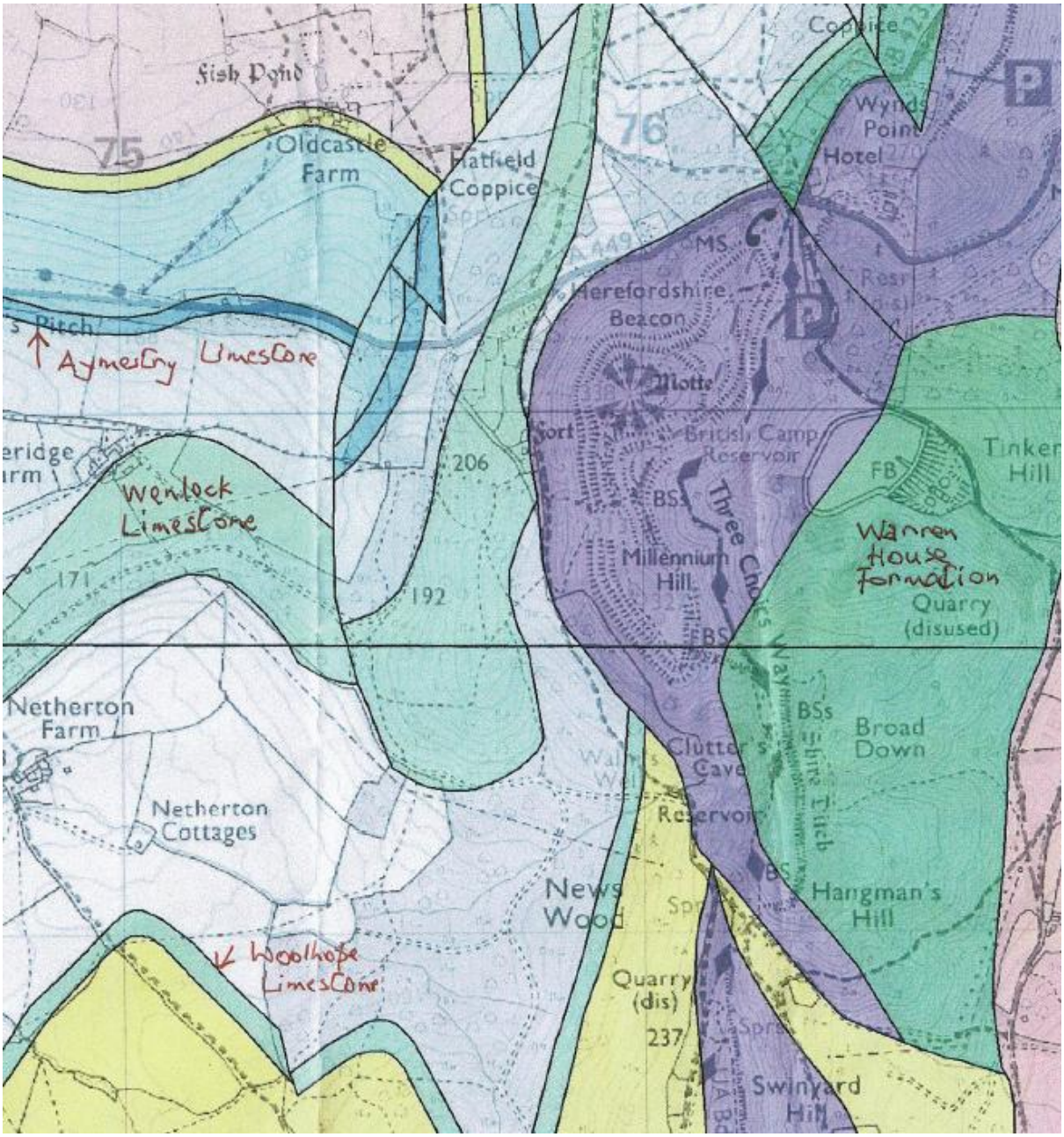
We then descend to Broad Down to examine volcanic rocks belonging to the Warren House Formation.

Maps will be provided of the northern part of the Malvern Hills and the area around Herefordshire Beacon.



Map showing ages of the intrusions.

British Land is an Iron Age fort of great historical interest. The top is man made ground, presumably made from the trench excavations around it. There are excellent views over the vales to the Cotswolds in the east and over the undulating landscape of Herefordshire and Worcestershire to the west. From this vantage point we walk to the north to examine the volcanics of the Warren House Formation (566mm yrs), the Malvern Hills complex intrusions (677-680 mm yrs) and a slther of sedimentary Silurian (366-409 mm yrs). The Malvern linearment has been formed by a series of active faults. It was suggested that the complex is made up of a series of slabs (terranes) that have been emplaced through movements along transcurrent faults.



Geological map. Purple is the intrusions of the Malvern Complex.

From the top of Herefordshire Beacon to the west we see a number of wooded areas on the flanks of the Malvern Hills. These are Silurian limestones. The fields inbetween are shales.

Invesion took place during the Hercynian / Variscan Orogeny.

The bedrock of the Iron Age fort is Malvern Igneous Complex and can be seen insitu in the footpath leading southwards away from the fort. Passing the reservoir to the east, we stop to examine the bedrock which we are infored is fine grained basalts / dolerite. (The lithology was not obviouse at this exposure due to the limited outcrop and the weathered appearance of the outer surface of the rockss). By the reservoir there is a quarry which today is inaccessible where these rocks reportedly can be seen. Adrian produced a sketch done by an earlier worker in the area (David Bullard), which shows ryolites (ignimbrites) with intrusive dolerites. At a gate we proceed left down the east flank of Hangmans Hill for a short way where we see some poorly exposed rocks protruding from the earth. These are rhyolitic ignimbrites.

Rhyolitic ignibrite. The matrix is rhyolitic lava with lots of pyroclastic inclusions.

Pink colour primarily due to heamatite (not orthoclase). It may be possible to see veinlets of epidote formed due to the decomposition of the primary minerals.

Dolerite intrusions believed to be around 450-550 mm years.

Walking along the flank of the hill we come to The Cullett on Midsummer Hill.

At this location there is a sedimentary rock in the footpath which is reportedly a Silurian sandstone (yellow on the map). Viewing this through the hand lens using a grain size scale, individual grains cannot be identified. The conclusion that this is a siltstone, not a sandstone. It did not fizz on application of acid and was concluded to be siliceous cement.

Follow the muddy track by the side of the Midsummer Hill sign leads to a moss covered outcrop. This is a pink granite. Scraping the granite with a knife and examining it with a hand lens shows this weathered rock to be loose and dominantly quartz (the feldspars having been eroded). Need to step back and look at the mass to appreciate the nature of the rock.

Walking back alongside the west side of the ridge (south of the reservoir) back towards British Camp. we come across a cave quarried out of the basalt

Is this a pillow lava structure ?

Massive basalt (566 mm yrs)

There are a couple of pillow like structures that can be seen indicating lava flowing into water, however it's not that obvious or convincing.