Symonds Yat field trip, July 15th, led by Dr. Nicholas Chidlaw

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We met on a very wet morning in July at Yat Rock car park where Nick gave us some information for the day and some background geology.

In South Wales and the Midlands at the end of the Silurian, rivers flowed across a wide plain towards an ocean in the south. The rivers carried sediment eroded from the Caledonian mountains and deposited large amounts of it over the plain; this sediment became the Old Red Sandstone (Devonian ORS). We were reminded that in Devonian times, this area lay about 20ºS and had a semi-arid climate. Much of the sediment was red, caused by a coating of the grains by iron oxides produced by decomposition of the source rocks. Nick explained that the ORS has a variety of divisions, often recognized by differences in grain size and types of bedding. In the Symonds Yat area, the Brownstones represent the Lower ORS and the Quartz Conglomerate and Tintern Sandstone, the upper ORS. There is an angular unconformity between the two caused by crustal disturbance which resulted in a gentle SE tilting of the Brownstones and their erosion, prior to the deposition of the Quartz Conglomerate. Animals and plants were only just beginning to colonise land in Devonian times so fossils are not very abundant. However, primitive fish and plants may sometimes be found in the ORS.

In Carboniferous times, Great Britain continued to move north and crossed the equator. The climate remained semi-arid/arid during the early Carboniferous but became much more tropical later. The Devonian mountains had been largely eroded by now and, with subsidence, a shallow sea spread north over south Wales, the Forest of Dean and the Bristol area. At first, sandy and muddy sediments were brought by rivers into this sea but occasionally their input stopped and limestones started to form. In our area, there was more limestone than muddy sediment. All these sediments formed the **Lower Limestone Shale.** Eventually the sea became very clear and strong evaporation in a tropical climate encouraged the concentration of dissolved lime in the sea. Large numbers of invertebrates took this lime to build their shells. Frequent storms generated powerful currents causing the shelly fauna to be fragmented, ground down to form lime sand. At times the waters became very shallow and current-swept, resulting in the formation of ooliths. Extensive limestones formed at this time, (Carboniferous Limestone).

Having absorbed this information with rain drops falling down our collars, we descended about 180m to the river; the path is very steep. The Forest of Dean plateau reaches heights of about 200m and the river Wye is at about 20m in a deep cliff-lined gorge. we were on the NW flank of the Forest of Dean. Our first adventure was to cross the river in a little boat pulled across by a man hauling on a rope, (N51º50.423 – W002º38.301).

If you are trying to follow this with GPS co-ordinates, then the following waymarks were taken to Site 1 - N51º50.384 – W002º38.411 and N51º50.416 – W002º38.428. We ascended rapidly to **Site 1**, the **Lower Dolomite Quarry,** (N51º50.362 – W002º38.501). Here the rock is hard and crystalline and ranged in colour from grey to pink and red. In the Early Carboniferous, the coastal waters lying not far to the north of the

Forest of Dean evaporated so much that they became magnesium-rich brines. These, at times, sank down through the limestones causing their chemical alteration from calcium carbonate to calcium magnesium carbonate; the rocks recrystallised as dolomite. We measured the dip here at about 10º S but Nick told us that, in fact, these rocks are part of a plunging syncline. The dips on the outer edges increase up to 42º The sites to be seen on this trip occurred on the western and central parts of the syncline only.

Having examined the dolomite in this quarry, and collected a small sample each, we continued on the path until we came to a strange circular-shaped cave, (N51º50.248 – W002º38.666). The rock here is different from the dolomite, being hard, coarse-grained and shelly. It seemed slightly dolomitised. By its circular nature we concluded that the cave had been formed by solution all round and so formed in water; a phreatic cave. This cave is in the **Crease Limestone** (overlying the Lower Dolomite) and formed under water a long time before the Wye gorge was eroded.

From the path we scrambled down at N51º50.221 – W002º38.677 to visit our next site –**Site 2, Pancake Rocks**, the Great Doward Iron Mines, (N51º50.197 – W002º38.667). These caves are in the top, very porous part of the Crease Limestone. The caves were infilled with iron deposits of probable late Triassic age. Here the limestone is pinkish with haematite and partly dolomitised. We had a very exciting climb up a narrow ravine out of this area, (figure 1). (N51º50.178 – W002º38.668 - top of ravine).

En route to site 3 we stopped to examine the **Whitehead Limestone,** (N51º50.179 – W002º38.697). Uplift across South Wales, the Forest of Dean and Bristol areas caused the sea to withdraw and the sea bed to become

Fig 1: Ravine from Pancake Rocks

exposed to the air. Karst processes took place, affecting the top of the Crease Limestone. With slight subsidence of this land area, ephemeral coastal lagoons were formed over the Crease Limestone and continuing intense evaporation in the quiet waters resulted in the deposition of the Whitehead Limestone. The Crease/Whitehead boundary is therefore a disconformity. We saw a small outcrop of this limestone and collected samples. It is a primary dolomite and here it was very fine-grained. In fact the quarryman's term for this rock was 'Chinastone' as it is porcellainous in appearance with conchoidal fracture. Similar sediments are forming today in Coorong Lagoon in the south-east of South Australia, (a search engine will provide good images).

Route followed to site 3 -
N51º50.182 – W002º39.112
N51º50.273 – W002º39.460
N51º50.249 – W002º39.482

We saw the Crease Limestone again in **King Arthur's Cave (Site 3),** (N51º50.223 – W002º39.647), (Figure 2). During the Devensian glacial (c.20,000 years ago), sediments continued to accumulate in the cave systems and in King Arthur's Cave a variety of mammalian fossils including woolly

mammoth, woolly rhinoceros, lion, bison, hyaena and reindeer have been found as well as flint tool and Palaeolithic hearths (to c.10,000BC). There are also remains of Mesolithic occupation (c.10,000 – 4,500BC) and Neolithic (4,500 – 2000BC). Finds include flint tools, pottery shards and hearths with animal remains.

Fig. 2: King Arthur's Cave

At the end of this glacial there were great quantities of meltwater and extensive tufa deposits were formed under waterfalls fed from rapidly flowing springs. We saw an excellent example of this at **Dropping Wells (site 4),** (N51º49.604 – W002º39.134) just after lunch in the grounds of the Biblins campsite.

We then re-crossed the Wye; this time on a wire bridge, (N51º49.603 – W002º39.327) and ascended the plateau, (N51º49.544 – W002º38.723). Through lack of time, we decided to cut out sites 5 (near Hearkening Rock and the Suck Stone) and 6 (Green Moss Pot) and continue to **The Dropper (site 7) (**N51º49.522 – W002º38.561). This is a collapsed doline in the **Drybrook Sandstone**. The previously mentioned Whitehead Limestone deposits were eventually exposed to the air and soil-forming processes occurred. However, rivers started to advance south from the land in the north and these deposited the Drybrook Sandstone. This has well-rounded quartz grains with frosted surfaces commonly found in desert dunes today and suggests that the sediments was picked up by the the rivers as they flowed through a desert environment. Beneath the Drybrook Sandstone here is the Whitehead Limestone with cave systems. The overlying sandstone has collapsed into the caves, resulting in the doline structure.

As we walked back towards the car park, Nick pointed out **Site 9**, the **Yorkshire Pot Chamber,** to the left at N51º49.774 – W002º38.432. We could not see it from the path but investigation has shown that there is a huge cave system beneath here. We then proceeded to our last site. Turn off the path at N51º50.059 – W002º38.302 and walk to **– Symonds Yat swallet (Site 9),** (near N51º50.059 – W002º38.355). This has the same lithology as The Dropper but here a stream suddenly disappears down into the doline.

Towards the end of the early Carboniferous, the Devonian and early Carboniferous strata in the Symonds Yat area were folded and tilted into a southerly-plunging syncline, (mentioned in the Lower Dolomite Quarry) and uplifted. The rocks were then eroded down to a level plain and for much of late Carboniferous times the Forest of Dean probably remained an area of erosion; karstic cavities containing sediments of this age are known in the area. Late Carboniferous sediments were deposited only very late into the period and were deposited by rivers. Much muddy and sandy sediment was deposited but occasionally swamp conditions prevailed. In the humid, tropical climate, vegetation flourished and much was preserved as peat which was subsequently buried to form coal. The thickest, most carbon-rich of these seams, in the Forest of Dean is the Coleford High Delf (c.1.5m). The strata below this seam form the **Trenchard Formation** and the seam together with the sediments above comprise the

Pennant Formation.

At the end of the Carboniferous, Variscan folding took place and much of the strata in the Forest of Dean suffered severe folding but not in Symonds Yat; the rocks were little affected. However, there were high hills or mountains in this area.

By late Triassic times, the mountains had been considerably eroded and Great Britain was now about 20ºN of the equator with hot, arid conditions again. Weathering of the exposed rocks concentrated iron in desert soils, staining the underlying near-surface rocks red. These soils contained organic acids in the pore water; the acids reacted with any limestones and dolomites and caused joints and bedding planes to be widened by solution as the water passed downwards, sometimes forming caves. Magnesium was also sometimes present in the water and reacted with the limestones to form secondary dolomites. When the acidic waters were finally neutralised at depth, the iron was deposited and gradually accumulated in some of the caves to form ore bodies, chiefly haematite with some ochre. As we have seen these ore deposits accumulated particularly in the porous Crease Limestone.

It is likely that both Jurassic and Cretaceous deposits occurred in this area but the Devonian and Carboniferous rocks were finally re-exposed during extensive and repeated episodes of uplift and erosion in the early part of the Palaeogene period. Karstic processes may well have resumed at this time.

We will now consider the area in Pleistocene times, from about 1.6 million years ago. It is thought that now the Forest of Dean was a low-lying plain close to sea level, across which the Wye flowed in broad meanders. In Wales, ice sheets repeatedly developed across the mountains, depressing the crust under their weight when they formed and causing the crust to rise again when they melted. Also, sea levels fell during glacials and rose in interglacials. The nett effect of these changes resulted in the Wye incising its meandering course over time forming the deep gorge. As the river cut down, older, dry caves were revealed in the sides of the gorge.

During the glacials a hard, periglacial climate, (northern Canada and Siberia today), affected the area and the bedrock became deeply frozen, water movement being confined to the surface, weathered layer. Repeated freezing and thawing, shattered the exposed bedrock, the resulting debris being carried downslope during times of melt. We saw **'block fields'** with boulders of Pennant Sandstone near Symonds Yat swallet. The hard Quartz Conglomerate has formed a monolith in the area – the Suck Stone (site 5) – at 30,000 tonnes, it is thought to be one of the largest fallen rocks in Great Britain.

This was another very successful trip led by Nick Chidlaw. As well as providing an excellent handout with maps and diagrams, he willingly shared his expert knowledge of the area, untiringly answering questions and providing explanations. Thank you again, Nick! I forgot to say that the rain stopped by Site 1 and the sun managed an appearance later in the day.

Several mine and cave entrances were seen on this trip. If anyone is interested in a visit, then contact the Forest of Dean Cave Conservation and Access Group.

Nick's hand-out notes have been used for reference. If anyone tries to follow the GPS co-ordinates, please let me know if there are problems. It would be wise to take an OS map as well!