WESTON-SUPER-MARE VOLCANICS FIELD TRIP
18th MAY 2008 with Dave Green
Alan Holiday

There are two horizons of volcanic rocks in the Weston-super-Mare area, a lower one at Middle Hope (Black Rock Limestone) and a higher one seen at Spring Cove, near Birnbeck Island (Black Rock Dolomite). There are further outcrops of the higher volcanic horizon at Broadfield Down (Bristol Airport).

The first observations were made from the top of the peninsula of Middle Hope looking south over Sand Bay towards Weston-super-Mare, to the north towards Clevedon and Portishead and west across the Bristol Channel to Cardiff seen clearly because of the excellent visibility. As we walked up to the viewpoint we saw outcrops of Carboniferous Limestone in the path. The views to the south displayed the furrowed mudflats of Sand Bay well exposed by the falling spring tide. Using the BGS map for Weston-super-Mare (sheet 279), we could see that the limestone ridges of Middle Hope and Brean Down could be extended out into the Bristol Channel to the islands of Flat Holm and Steep Holm up to 10 km offshore. Infilling the valleys in between the limestone ridges are superficial deposits (alluvium). The landscape is controlled by the underlying structural geology with anticlines forming the ridges and the valleys coinciding with intervening synclines.

Succession:

Quaternary		Alluvium
	unconformity	
Triassic		Mercia Mudstone
	unconformity	
Carboniferous		Carboniferous Limestone

Upper Carboniferous, Permian and some of the Triassic rocks was eroded away following the Variscan Orogeny at the end of the Carboniferous. The orogeny was associated with the formation of Pangaea resulting in an extensive land area experiencing arid tropical conditions with significant erosion affecting the ridges and salt lakes in the troughs. At the end of the Triassic, Jurassic and Cretaceous rocks were deposited but these have been mostly eroded away following earth movement in the Tertiary. The post glacial rise in sea level allowed the development of the Quaternary deposits. What we see now is an exhumed post Variscan landscape although much eroded. The folds structures run W/E or WNW / ESE but the folds also close and plunge showing culminations and depressions developing periclines and basins. The depressions between the ridges have been filled with superficial deposits which have been drained and reclaimed in recent centuries.

The Middle Hope volcanic rocks are exposed at four locations on the north side of Middle Hope; the most westerly one at Swallow Cliff received our detailed attention. The sequence starts with Carboniferous Limestone containing crinoids, corals and brachiopods with chert and some evidence of bioturbation. Some of the corals are nicely weathered out such as *Amplexizaphrentis (Fig 1).*

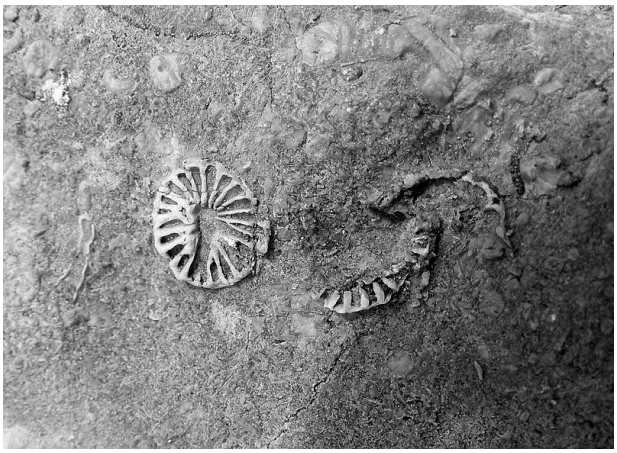


Fig 1: Etched out corals, Amplexizaphrentis

Moving up the sequence (the rocks dip to the south) brown, fine-grained, bedded ash (tuff) is seen, which is poorly lithified. It has a rusty colour as it is iron rich because of the basaltic nature of the volcanism, the basalt containing ferro-magnesian minerals such as pyroxene. The material would have been lapilli from explosive volcanism (water mixing with the volcanic material would have created phreatic events). Because of the relatively weak (less competent) nature of the tuff, its outcrop coincides with a small bay. The lower strength has also resulted in greater deformation by tectonic processes. There are abundant calcite veins which must have been derived from the nearby limestone during later

diagenetic processes. Above the tuff is a series of interbedded tuff and limestone. The environment would have been a shallow tropical sea (at this time the UK was approximately on the Equator) with periodic volcanic events. The volcanism was probably related to hot spot type activity.
Succeeding the tuff is a layer of sandstone with symmetric ripples suggesting the role of wave or tide in its formation. This is followed by bioturbated limestone with corals, then massive tuff with calcite veins and pillow lavas. These have amygdaloidal structures with calcite amygdales. A fault can be seen displacing the boundary between the pillow lavas and the tuff. There are also good examples of herring-bone cross bedding in the tuff related to tidal conditions. These are succeeded by massive limestone.

Further east, along the strike of the rocks of Middle Hope there are other outcrops of volcanic material. Outcrops 2, 3, and 4 are nearer St Thomas Head. We only had time for exposure 2. The volcanic sequences thins to the east so we must have been moving away from the centre of activity which must have been somewhere between Swallow Cliff and Flat Holm.

The sequence seen at locality 2 was:

- Periglacial Head
- Raised Beach with Macoma shell debris indicating temperate conditions. (Ipswichian Interglacial)
- Periglacial Head
- Carboniferous Limestone and volcanics.

The volcanic material is exposed on the east side of the bay and not to the west because a fault, running N/S across the bay, has moved the volcanic sequence to the south. The volcanic sequence here is just tuff as it is further from the volcanic centre. Here the tuff material is coarser, which may appear odd being further from the volcanic centre, but it has been transported by currents. There are horizons with para-conglomerate material showing transport had occurred. This was possibly a lahar type deposit, a volcanic mud flow.

Higher up there is the 'pipe rock' (Fig 2) where the inarticulate brachiopod *Lingula* burrowed into the sediment.

After lunch we moved to the north side of Birnbeck Island in Weston-super-Mare to study

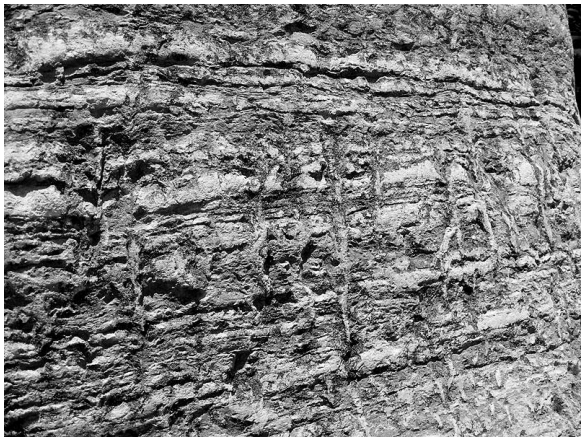


Fig 2: Pipe rock close-up

the Spring Cove sequence which is slightly higher in the succession. Carboniferous Limestone outcrops with solution hollows, (karstic processes) which were subsequently filled with haematite carried down in solution from the overlying post Variscan sediments were seen here. There are also numerous large solitary corals (*Caninia*) some of which have also been haematised (Fig 3). The sediments here are red

Fig 3: Haematised Canina

but it is not the volcanic ash seen at Swallow Cliff and Middle Hope. The volcanic material above the limestone contains large fragments of limestone but the material is predominantly basaltic pillow lavas. These sediments include amygdaloidal textures (calcite infilling) suggesting shallow water volcanism as there was insufficient pressure to stop the degassing of the lava. Some of the material in between the pillows is brecciated forming a hyaloclastite. The water producing the explosive activity may have been derived from wet sediments below the lava

sequence. Above the pillow lavas is tuffaceous limestone which shows some evidence of cross-bedding. Oolitic textures are also developed in the limestone, indicating shallow water tropical marine conditions. Vertical fissures can be seen cutting the massive limestone above and these are filled with reddened well lithified sandstone material (non-carbonate) which are Neptunean dykes infilled with Triassic sediment when there were arid continental conditions and sediment filled joints in the limestone.

Further information on the volcanic rocks of the area can be found in:

T. J. Faulkner:. The early Carboniferous (Courceyan) Middle Hope volcanics of Weston-super-Mare: development and demise of an offshore volcanic high. Proc. Geol. Assoc. Vo. 100, pt 1, pp. 93-106.

R.J.G Savage (editor): Geological Excursions in the Bristol District. University of Bristol. 1977. ISBN 0 901239 22 4. Volcanic Rocks in the Bristol Region. pp.49-54.

W. A. Macfadyen: Geological highlights of the West Country. Butterworth .1970. ISBN 0 408 70002 5. pp. 250-252.

Photographs by Alan Holiday

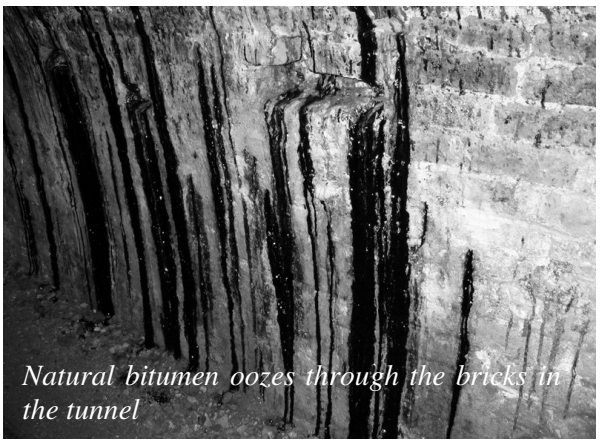
"THARS OIL IN THEM THAR HILLS!"

Charles Hiscock

Some years ago, we flew to New Zealand via the United States, landing at Los Angeles for a 24 hour stopover. After a good night's rest, we had many hours to kill before our onward flight to New Zealand and so decided to go on a morning excursion around LA. We boarded the small tourist bus and, while waiting for others to join us, I asked the driver if we drove anywhere near the Brea Tar Pits in the centre of the city. He was rather surprised that we had heard of them – most tourists were only interested in Hollywood and the high spots such as the Kodak building. He knew where they were but said that the tour did not go past the pits and anyway, it was not possible to stop. We set off and after a short while, the driver pulled up on a busy street and told us that, if we looked over the road, we would be able to just see the Tar Pits. Indeed, we could see fossil skeletons and other 'exhibits' beside a pond of black tar. We thanked him for he had clearly made a detour so that I could see them, albeit at only a distance. Maybe, we will go back one day and visit the Brea Tar Pits and Museum properly.

Last year, we were on holiday in Shropshire and paid a visit to The Ironbridge Complex and Gorge. The fascinating history and geology of the Gorge could be seen as we walked along the banks of the River Severn and it was with some surprise that I read a sign directing us to the Tar Tunnel on the north bank of the river. It was a lovely warm day and we decided that it was time for a coffee in a little café beside the canal and found that alongside was the entrance to the Tunnel – I had to go and look!

On paying my entrance fee, a leaflet explained that a local ironmaster, William Reynolds, started digging a tunnel from close to the river into the hill towards the mineshafts at Blists Hill so that coal from the mines could be moved to a canal. After about 300 yards, the men digging the tunnel came upon a spring of black tar. The thick black exudate that oozed through the bricks was natural bitumen, which, like coal and oil, is made from the organic remains of plants and animals that have been preserved in the rocks, particularly in the Coal Measures. Reynolds immediately realised the potential of this discovery and set about exploiting the supply. He set up large cauldrons near the Tunnel and boiled the bitumen to convert it into pitch, used to preserve the timbers of ships. Some was turned into varnish while he also produced 'British Oil' for the treatment of rheumatic and skin diseases. Initially, the Tunnel produced about 4500 gallons a week but this reduced to about 1000 gallons a week for many years. By the 1820's, only 10 barrels a year were being collected and by the1840's the sales had stopped.



Natural bitumen oozes through the bricks in the tunnel

The Tunnel continued to be used to transport coal and to ventilate the mines until the 1930's and was used as an air raid shelter in the Second