7 May 2017

Freshwater West and West Angle Bay

Geology Background

The day started with a 50 minute drive to Freshwater West Bay during which Gareth gave us an introductory talk on geology which covered:

- Rock types – sedimentary, igneous and metamorphic.

- Clastic sedimentary rocks ie formed from eroded material so in its second cycle. Can be intraformational, that is eroded and redeposited in the same area or extraformational where the source is elsewhere and material has been transported to a new area.

- Carbonates – either bioclastc from eg shell fragments or from evaporation hence evaporates.

- South Pembrokeshire is solely sedimentary. North Pembrokeshire has some metamorphic rocks.

- Role of James Hutton in estimating the age of the earth. His maxim 'the study of the present is the key to the past'

- Origins of life in the Pre Cambrian followed by bursts of life in the Cambrian. Leads to fossils in the stratigraphic column and the law of superimposition.

- Definition of strike and dip. Then tilting and folding with anticlines, synclines and asymmetric shapes [shallow on the side facing the tectonic pressure]. Vertical dip where mega folding.

Freshwater West Bay

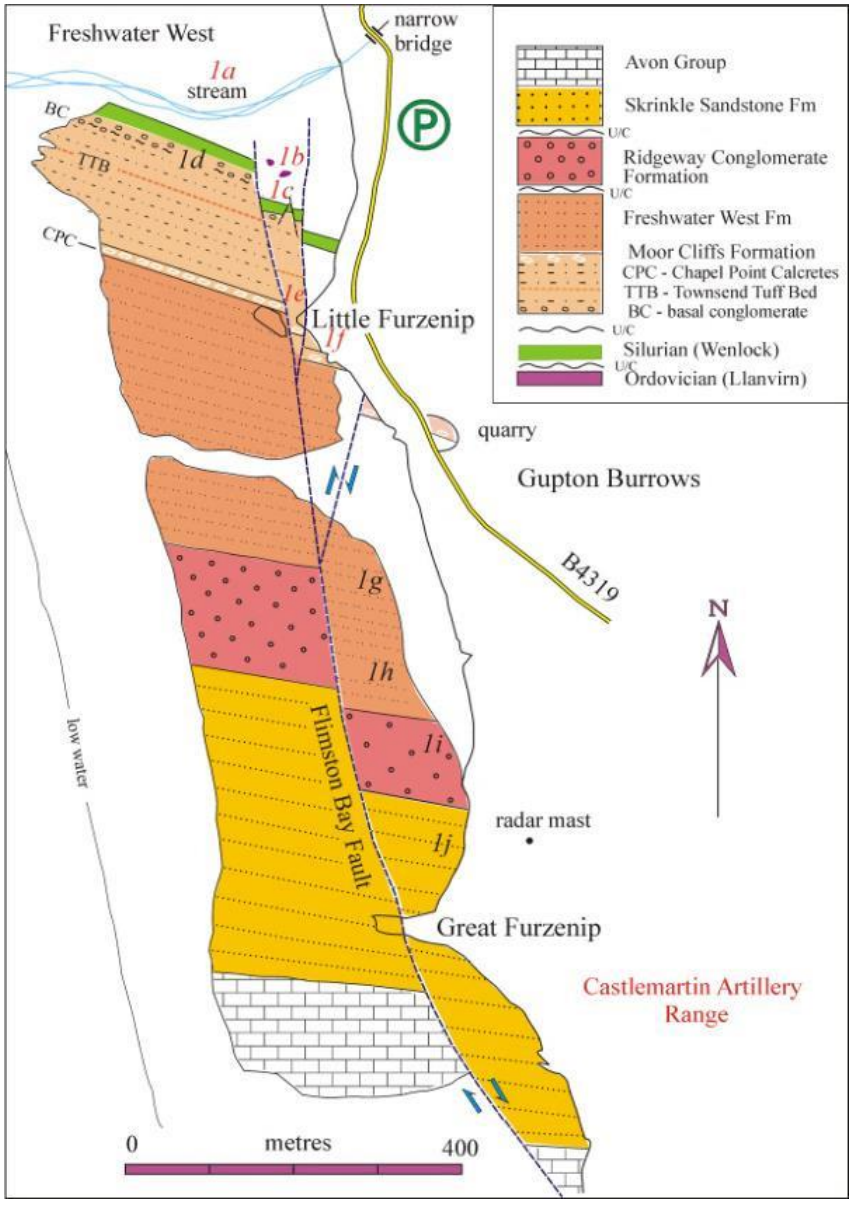
Arriving at FWB Gareth first recapped on the concepts of bedding in streams as discussed yesterday. He used an additional resin peel and a group of ORS clasts conveniently left by the car park.

Example rocks and resin peels

He described sediment as being unimodal if just laid down under the influence of gravity or bimodal where the layering has been reversed.

Thus from an initial erosional surface or planar you get a fining upwards sequence where decreasing grain size corresponds to reduced stream volume. In meandering rivers the base is the erosional surface with long periods of depositing leading to a sediment bar which migrates downstream to the flood plain. This may then develop into wet peat deposits or, if dry, carbonates.

From his plan of the Bay he highlighted a tear fault. These are either sinistral to the left or distral to the right. In this case the latter with a movement of about 200m.



Fresh Water Bay

(From the Geology of South Wales, second edition - Gareth T. George)

We next examined a stream crossing the sandy beach noting:

- Current lineation giving parallel streaks of grains which could form the basis of flagstones.

- Multi channels typical of a larger braided river.

Gareth demonstrating principles of sedimentation

Rock Sequence southward along beach

We first examined black mudstone with laminations, which contains Ordovician graptolites [not seen!] which look like a tuning fork having 2 stipes. This deposit is towards the base of the Llanvirn series. Checked the strike – NW/SE with a vertical dip. Noted quartz veining.

With the aid of a plan drawn in the sand Gareth showed us where we were on the right hand side of a major syncline -- the Castlemartin Cors Syncline -- with successive formations outcropping vertically further along the beach.

Next in the sequence was a Silurian grey and fossilised Wenlock limestone

Moving upwards there was the Moors Cliff Formation starting with a basal conglomerate and moving into a Townsend Tuff bed and then the Chapel Point Calcretes. The conglomerates were well in evidence and are comprised mainly of vein quartz and rounded greywacke sandstone. They mark the Silurian/Devonian unconformity.

We did not find the Tuffs or the eroded out narrow channel where they had been. The calcretes were impressive around Chapel Point where they were formed into a pseudo anticline. They were mature in nature displaying calcareous clasts closely bonded together. Nearby was evidence of lateral splays coming off the main tear fault.

Chapel Point calcretes

Pseudo anticline

Next in sequence was the FW Farm sandstone deposits. These are mainly fine grained red sandstones but at first they had some small green circular patches. These developed into green banding further along the beach. The green colour derives from the acidic impact from the presence of organic material. Thus the banding shows a steady flow of water containing organic matter. These sandstones also had small white calcrete patches.

FW Farm sandstone

As we moved along Gareth drew our attention to small synclines and anticlines in the cliff.

At this point he recapped on his earlier explanation of ripple formation using the sandstone exposures on the beach to illustrate the field evidence.

FW Farm sandstones with ripple build-up

Thus as we had moved from the basal conglomerates into the FW Farm sandstones, the first cycle of deposits reaching the river flood plain triggered a ripple build up. These were intraformational deriving from pieces of calcrete and

mud. He reiterated how the sloss or gentle slope gives way to the lee or steeper slope in the direction of flow. So, for example, we looked at an erosional base level above which the current had caused ripple laminations and in turn had been overtaken by a build-up of mud. On timescales he suggested that conglomerates might represent only 2 hours of rapid water flow, whilst it might take 100s of years to build a fine grained sediment into a substantial rock face.

We were now introduced to beaconite antarticus or rather to the circular sediment filed tubes cutting vertically through the original deposits and representing where the millipede like creature had burrowed to find a water source. By the end of our field trip we had become quite amazed how many of these burrows up to 8/10 cm wide we had found. Although vertical when formed we found them at all angles due to changes in the dip of the parent rock.

Beaconite antarticus

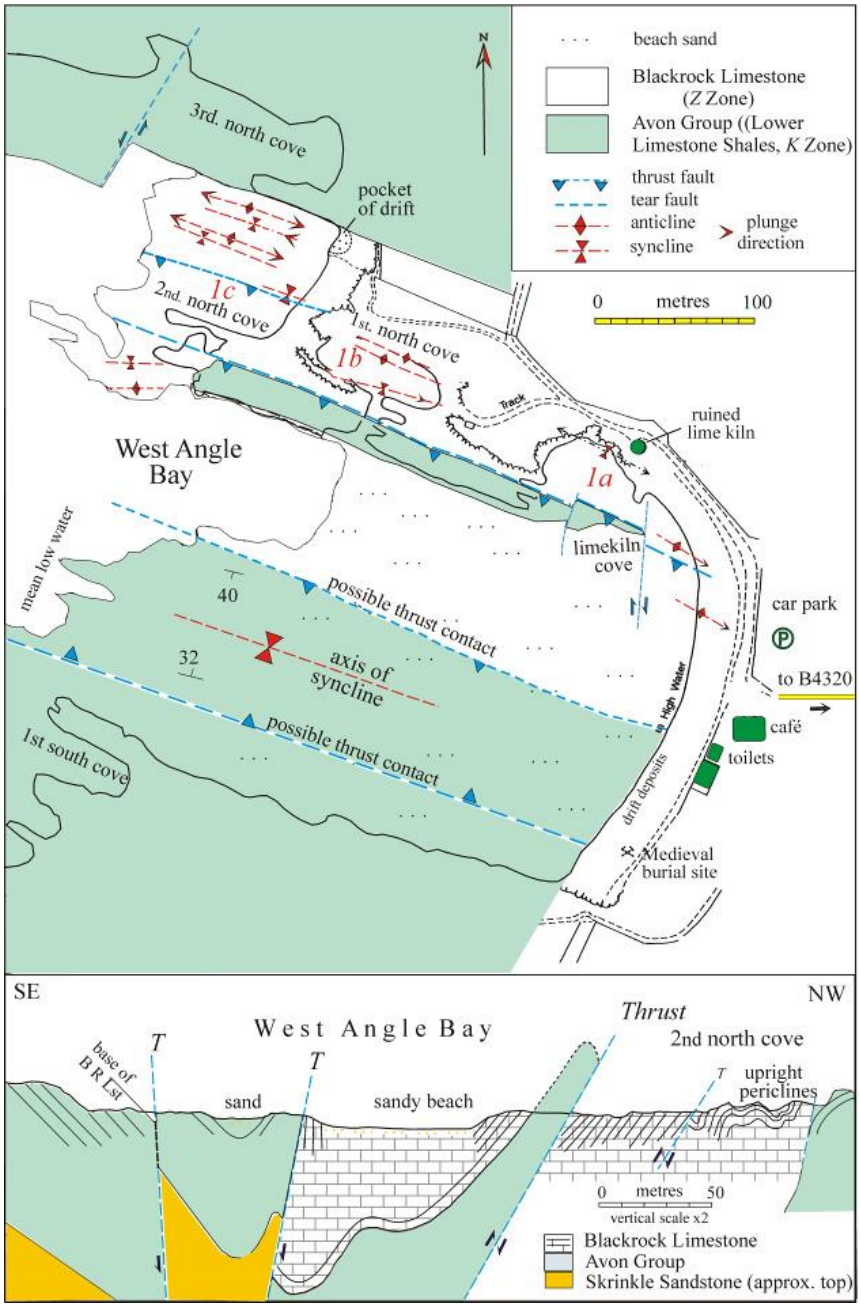
Our beach exploration concluded with more conglomerate at a further unconformity. Here we had the extraformational Ordivician quartz and sandstone clasts of the Ridgeway Conglomerate, which was the life time focus of a geologist Brian Williams. This deposit stretches across Pembrokeshire from the Bristol Channel, with very similar strata also in South Devon. Its origin lies in the Bristol Channel Fault Zone, where a major fan head formed on the hanging wall dip slope of the fault. The matrix support from a mud flow supported the clasts seen in the conglomerate.

Quartz and sandstone conglomerate

In the distance on the army range we viewed the next deposit in the series – the Skrinkle Sandstone.

West Angle Bay

This was our afternoon location.



West Angle Bay

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Initially we looked at the beach outcrop of the Avon Group Lower Limestone Shales, which included some bands of limestone and which identified the edge of a thrust fault dipping sharply into the sand. The remains of a mineralised slickensides surface where adjacent rocks had ground against each other was pointed out [but not the best of examples!].

Slickensides in Avon Group Lower Limestone Shales

Nearby we moved to the low cliff line composed of Blackwater limestones in which were examples of rugose coral. This is called a type fossil ie is a characteristic fossil wherever this rock is found. This was Zaphrentis. This exposure also gave us examples of gastropods where the original aragonite of the shell had been replaced with calcite. There were also geopetals where the shell had been partially filled with sediment and then sealed with a clear cement agent. Crinoids and worm burrows were seen too as was the outline of a minor syncline and anticline.

Silicified worm burrows

1st North Cove

1st North Cove

Here we concentrated on a plunging anticline or pericline [very much reminding us of the Whale Rock seen at Bude last year]. We looked at a nodule which proved to be a silica chert and hence prone to sparking when hit with a hammer.

Group standing on anticline or pericline

2nd North Cove

2nd North Cove

More periclines to observe here as the tide gradually covered them.

Plunging anticline or pericline

Some star shaped shatter patterns in the rock exposures on the beach were explained as evidence of explosive blasting from when this site had been a working quarry.

Shatter patterns in the rock due to blasting

One unusual feature Gareth pointed out was an irregular zig /zag contact on a limestone face. Called styolitic compaction, it bore witness to where impurities like clay minerals had been squeezed out.

Styolitic compaction

At one side of the cove was an impressive drift deposit of glacial or peri-glacial till.

Glacial or peri-glacial till

On the north side of the bay vertical cracks in the cliff had been filled with what appeared to be white calcite. But where had this come from? One idea was that it had come out of an overlying Triassic strata of which there are no other remains.

Vertical cracks filled with white calcite

For Gareth the highlight here was meeting Robin Shales leading a party of students on a visit from the Camborne School of Mining. Robin knew Gareth's book 'The Geology of South Wales' and called him a 'legend'. Also interesting was that Robin also knew our own Richard Edwards when he was a lecturer at Camborne.

A thank you to Gareth for teaching us something of the art of observation!