September Field Trip, Seaton Sluice – St Mary's Island (Hard Hats essential stops 1 3,4)

Report of Field Trip provided by Gordon Liddle, photographs by Chris Burridge

Carboniferous Westphalian sediment exposures

Based on work by Brian Turner / Gill Tester (Sedimentary Geology), Robson's Geology of NE England and the Hunter-Easterbrook Geological History of the British Isles.
A sizable, enthusiastic group of members and friends enjoyed this challenging excursion.
Background
The exposed strata formed in a deltaic sequence 304-309Ma. Named the Westphalian B Coal measures. The sequences are known from much borehole evidence in addition to open casting and coastal exposures. This coast is recognised as the best exposure.
The environmental context of the sedimentation process is the outlet of a very substantial alluvial plain lying to the south of the eroding Caledonian massif. Deposition was taking place in an advancing deltaic environment of large scale, There were key distributary channels, for our purposes the environment was essentially terrestrial with rare marine incursions but much lacustrine and channel – swamp deposition. Total sedimentation reaches 900m to the south of us. This was an environment with integral erosion and redeposition. Lateral continuity of facies is restricted but the time sequence is now clear.
Factors: tropical latitude with an interpretation of monsoon type precipitation! Drifting north/ Global warming. Tectonic sinking and stretching, with sediment loading- supporting the process. Deltaic sedimentation processes will also have played a part. There were possibly 500 days in the year at this time. Coal swamps were abundant with a cyclothem type cycle of sedimentation.
A simplified sedimentary log is at the end of this report.

Site 1, a channel fill is seen. (GR339769)

This is the Charley's Garden Sandstone: a lot of shallow sedimentary structures (current and trough bedding, symmetrical and asymmetrical ripples) with coarsening up prior to a planation episode in the deposit. We see the s/s, weathered to a dark brown as the iron rich cement weathers. The jointing is widely spaced in most elements of the channel fill deposit. (Termed stacked and cluster lenses here) Note the ripple evidence helping to confirm a shallow water environment. The causal current flowed mainly in the SE to SW direction..
Coal scares indicate land originated plant (peat like?) debris whilst there are surfaces showing a heterolithic mix of debris possibly linked to an erosional phase winnowing the finer material.
The cut through the sandstone was made in 1764 by Sir John Delaval to foster the efficiency of the port. 243 cu m of rock were excavated (and sold) to make the cut which measures 9.1m wide and >16mdeep. It had sluice gates at both ends to allow ships to enter, load and leave, especially when NE winds were blowing. Salt, coal and glass were key cargo. We see lots of evidence later of flints from the south, brought for the glass industry.

Interpretation of the facies and structures suggests a channel fill sequence. This fits with the evidence of older channel fill sequences we see later.
Today the area is actively being eroded with a well-formed wave cut platform in evidence.

Leaving this location we climb back to the top of the cliff and walk south to the north ramp into Collywell Bay. 339766. Note the Bay structure, a broad synform with the stack close to the centre and complex core exposures visible. The sea wall was constructed in two phases indicating the rapid erosion of soft shale beds. We are walking back in time at this stage towards the Upper Crag Point S/S. Behind the northern sea wall lies shale beds with coal seams. (top and bottom Grey above the top and bottom Yard seams) There are doleritic stringers obscured here dating from the Tertiary and associated with the Mull Dyke swarm.
Site 2. The Bay beach is coarse conglomeritic sediment rich in flints, longshore drift is active on this material with a strong southerly movement. In the sea wall note the presence of chambers that were constructed in the wall to allow study of the strata.
The lower S/S shows deformation near the fold core, with the dip steepening rapidly to a fault related dyke intrusion, which locally has natural coke associated with it. The intrusion has a classic dyke form, linear, thickness varying up to a metre with a wall structure implying some recrystallisation and hardening in places. Note the 100 degree trend and relation to the southern point of the Bay - Crag Point.
Looking west the back wall shows a very sharp contrast to site one. The shales are exposed, pale grey with much evidence of a weak structure. The pale yellow sandstone close to the top of the cliff is Permian, the most northerly exposure of this material on land. We were able to pick out stringer intrusions through the shales aligned with the axial area of the fold. Moving south the Crag Point S/S forms a strong margin; the joints in the deposit are deeply worn by

the sea. We climbed out of the bay using the southerly ramp and looked back to the Bay to confirm the fold structure.
Moving south along the well used footpath we passed Crag Point safely. The coast is seen again, more linear with reduced headland forms. Note the wave cut platform of well-jointed sandstones. A significant fault lies beneath us; 10metres of movement has taken place along it. We noted the structure (northerly end of a large elongate antiform which persists to the Tynemouth area)
Passing through a small car park we took the steps down to the Bay GR345758.
Site 3. The steps allowed the shale, thin sandstone and coal sequence to be seen; equally the dip here is to the north so a walk along the cliff base brings each stratum to the HWM. (High Water Mark) The strong S/S (often described as the Lower Crag Point Sandstone) lies at the foot of the cliffs, displaying the excellent joint sets. The cliffs to the north of the steps are actively eroding causing exposures to change frequently.

MEMBERS NEGOTIATE THE Lower Crag Point Sandstone

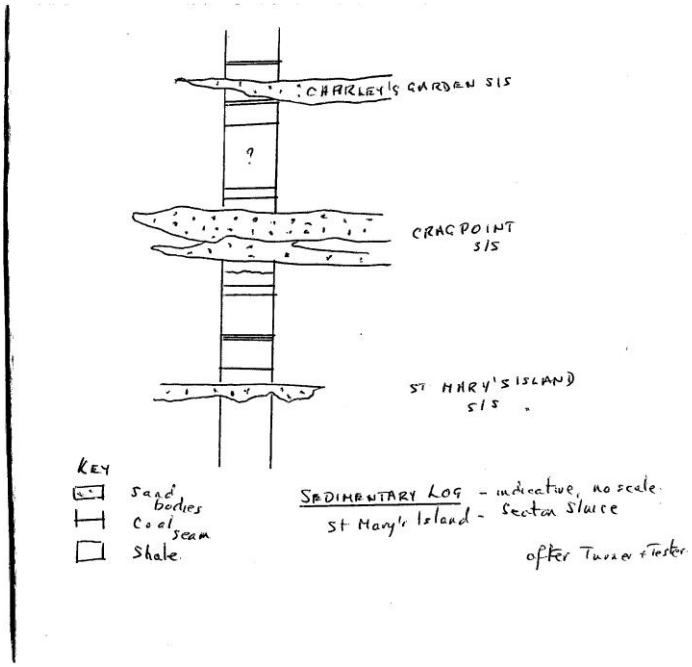
Four coal seams are identified together with mussel bands some unusual cone in cone structures in the shales (now a little rare) Study of the bedding and its surfaces demonstrates typical cyclothem conditions.
Turning south of the steps we see massive sandstone with a coal seam caught up in minor faults, about 110m south a rift structure is seen with a steeper northerly fault.

GORDON DISCUSSING THE COAL SEAM

On the south side of the structure fault breccia is seen, some claim to see slickensides.

The freshness of the northerly fault surface was excellent enabling the full character of the surface to be appreciated.
10m further a superb drag fold structure is seen with a coal seam highlighting the deformation. To the north side of this lies approx 7 small faults reflecting the stretching that was affecting the area. Several geological features lie in this area allowing individual observation and interpretation; we climbed up the steps to the cliff top.
Site 4. To the south an exposure of the shales, coals and sands forms a cliff. The bedding has multiple burrow structures as does the small fault scarp to the south.

This fault allows boulder clay to come down to HWM; north of the fault some glacial drag deformation may be discernable.
Walking along the beach to the causeway the lowest channel fill s/s of our walk is seen. This is the St Mary's Island S/S. This sandstone shows sedimentary features very similar in character to the Charley's Garden sandstone seen earlier. The exposures are not as good. Nevertheless the origin is interpreted as similar. To the south of the causeway a pivot fault is seen trending ESE.
The thick sequence describes the deltaic – fluvial conditions the area experienced in the Westphalian B times.



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