Leader: Sylvia Woodhead 5 September 2018

Members and visitors met in Sandwith village (NX 965 147), and shared cars for the drive up the private road to park outside Birkhams quarry on St Bees Head (NX 955 164). The area is geologically important; the quarry, headland and beach cliffs form a Site of Special Scientific Interest (St Bees Head SSSI), and there are 5 Geological Conservation Review sites (GCR). St Bees Head is composed of the St Bees Sandstone Formation, the lower formation of the Sherwood Sandstone Group. To the north lie the Carboniferous rocks of the former West Cumbria coalfield.

Birkhams Quarry and St Bees Head have been visited many times in the past by CGS members, and excursion reports have appeared in all three CGS Excursion Guides, in 1982 and 1992 by Tom Shipp & in 2008 by David Kelly.

The Quarry was designated a Local Geological site (LGS 4_030) in 1994, because it exhibits a wide range of sedimentary structures; parallel lamination, planar and trough bedding, and leached layers in the St Bees Sandstone. This was deposited by a large ephemeral river, the Budleighensis River, which flowed north, in braided channels over a desert area. The sandstone layers are often thickly bedded and sparsely jointed, with erosive bases indicated by rip-up mud clasts. Further examples of ripple marks and other sedimentary structures may be seen in the loose blocks. There was much discussion on the origin of the bleached layers.

Sylvia explained that Cumbria GeoConservation (CGC) had become involved with the quarry in 2015, when responding to a Cumbria County Council (CCC) planning application to extend quarrying until 2030. CGC had suggested some planning constraints; geological interpretation, access to rock faces, and visits for geologists, all of which have been adopted. Two interpretation boards have been designed, the one covering geology by Dr Elizabeth Pickett, in consultation with Marshall Stancliffe (MS), the quarry owners, agents Stephenson Halliday, CCC and the National Trust. CGC now attends the annual quarry monitoring meeting. Each information board is mounted on stone blocks from the quarry, which were chosen by CGC and transported to Locharbriggs quarry near Dumfries to have an angled face cut. The mounted boards were 'unveiled' in 2016 by Mervyn Dodd, who had drawn up the original LGS designation. The boards are now seen by the thousands of walkers who pass along the Coast to Coast path each year.



Working quarry face Birkhams Quarry

After examining the interpretation boards and finding examples of the sedimentary structures mentioned, members entered the quarry, where they were welcomed by Steve Boam, quarry manager. Steve explained that the quarry had been worked for many years, and is now operated by MS. It is worked in winter only, from September to March to reduce disturbance to nesting peregrines and the C2C walkers. The stone is now extracted on a contract basis when required. Steve explained that the stone, a finite resource, provides high quality (and expensive) building stone. A 12 tonne block would sell for over £1000. It is extracted carefully to reduce wastage. The current working area has very thickly bedded uniform sandstone, which is much sought after. It is extracted using the natural joints, though thicker beds need to be drilled and loosened using black powder. The leached layers help ease out the blocks. MS now concentrate on providing good high quality building stone for specific projects. Recent projects have been in Rotherham, Chester bus station and Monmouth School extension. Further quarry visits can be organised on request to MS. Members thanked Steve



Ripple marks in Birkhams Quarry

Boam for a most interesting visit and applauded the vision to utilise the stone in the best possible way.

St Bees

Members now transferred to St Bees beach, taking lunch on the rocks below St Bees Head, where further sedimentary structures could be seen in the St Bees Sandstone. After lunch, the layers of glacial drift resting directly on the sandstone bedrock were examined. The LGS designation (LGS 4_009) identified two tills formed in glacial re-advances. The Lowca Till Member, a well consolidated coarse lodgement till with locally derived clasts suggesting a northerly derivation, is identified as Late Devensian and occurs at the foot of St Bees Head. This is separated by contorted outwash sands and gravels (St Bees Sand and Gravel Member), thought to be the product of high energy meltwater flow. An overlying fine grained till (St Bees Till Member) is almost pebble-free sand and silt grade with marine fossils, identified as the Gosforth Oscillation.

The afternoon visit was to the golf course cliffs (NX 954 118 to NX 969 107), also an SSSI, GCR site and LGS 4_009, for their importance in interpreting late Devensian glacial events, and late glacial environmental conditions. The cliffs are a key site for showing evidence of the Windermere interstadial and Loch Lomond stadial events. They have been variously interpreted at different times, and have been the subject of some recent research (Lee & Phillips 2013).

During the last Ice Age the St Bees area was glaciated by radial ice from the Lake District (Ennerdale) and by unstable, surging and fast moving Irish Sea ice, from the Solway. To the north the 'St Bees valley', a former lake now peat filled, is blocked by glacial deposits. The St Bees 'golf course'cliff section has been identified as a push moraine, with folded and faulted glacifluvial and glacigenic sediments thrust to the south west as a thick ice wedge. The folds are very clearly displayed in the St Bees Sand and Gravel Member (Williams et al 2001).

In the low cliffs at the south end of the Promenade (NX 962 116) folding and deformation of the St Bees Sand and Gravel Member are clearly seen. Williams et al estimate a 22% shortening of the sediments due to glacitectonics. Deformation occurs as the ice overrides or pushes into pre-existing sediments. This deformation is recognised as being similar in nature, though much smaller in scale, to thrust belts in continental collision, producing thrust structures and nappes. Evidence for an upwardly displaced ice wedge could be seen in these small cliffs. Lee & Phillips (2013) note that these deformation structures exert a dominant control on the development and style of landslide.

A large BVG erratic at NX 962 117 was examined & found to be a peperite. Erratic pebbles possibly originating from Criffel were identified. The high till



Sylvia and Fred at St Bees looking at the folding and deformation



Glaciotectonics St Bees

cliffs were examined for evidence of ice wedge deformation. There was much discussion about conditions at the end of the Ice Age, and how the ice pushed and distorted the previous glacial deposits which it overrode.

A search on the lower beach for the submerged forest was unsuccessful on this occasion. During a Westmorland Geological Society visit on 11 September 2019, the submerged forest was found to be exposed opposite the southern end of the promenade among boulders at the shingle-sand boundary (NX 961 117). A soft layer of dark peat about 15 cms thick was exposed. Clear tree roots could be seen, which might have been pine, and possibly the boles of large trees. The forest has been dated as 8-9000 years old, i.e. during the Boreal Zone. This showed that the coastline was once much further out, and that the area now St Bees Bay was dry land where forests grew, and people may have settled. As the climate changed these were flooded as the sea level rose in the Flandrian marine transgression. Members walked back along the beach, re-assessing the structures revealed in the cliffs.

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