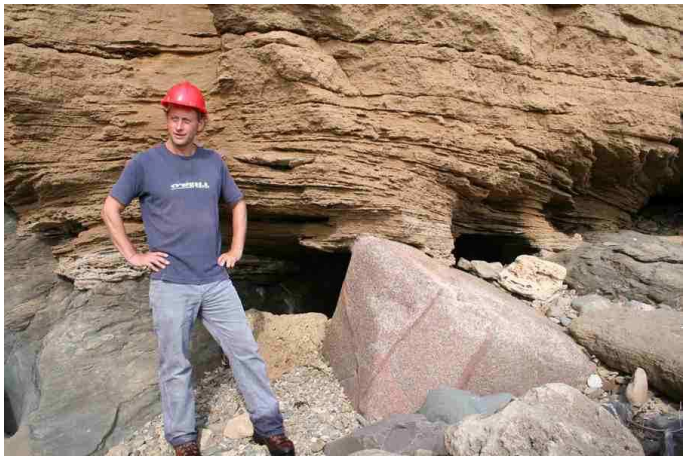
FGS Field Trip to North Devon – 5 to 9 September 2005

After much hard work by Shirley Stephens in organising this trip, 12 members left Fleet on Monday 5th September in a hired minibus driven by Mike Weaver and George Harrison (**Fig 1**), veterans from the minibus trip around Arran in April of this year. We headed westwards, our final destination for that day being the Hallsannery Field centre a few miles south of Bideford where we were to stay for 4 nights. This centre has been used by the society on previous occasions but regretfully it is now closing as a field centre providing accommodation.



On the way down a stop was made at Saunton Sands where our guide for the next 5 days, Dr Ranald Kelly (Ran) was awaiting our arrival. He took us on to the beach to show the unconformity between the exposures of Devonian age Picton Shales at the foot of the cliff and the overlying Quaternary Sandstones which are in turn topped by glacial deposits from the Anglian Ice Age 450 thousand BP. Further proof of the glacial episode was by way of the many erratics lying on the beach; the one shown in the photo (**Fig 2**), with Ran acting as a marker, is thought to have travelled from Scotland.

For the next 2 days the group was to study the coastal exposures of Carboniferous strata along the coast from Westward Ho! through to Hartland Point, and then south to beyond Bude at Milhook. A brief outline of the geological history of this area is given below.

Before the super continents of Laurasia and Gondwanaland came together to form Pangea in Carboniferous times around 300 Ma the area now known as North Devon was on the southern margin of Laurasia. To the north were the Old Red Devonian Mountains and it was the erosion of the mountains that provided most of the material that flowed south to fill the huge Culm Basin located on the continental shelves of the two converging super continents. The particular part of this synclinorium of relevance to the study of the North Devon cliffs has been named Lake Bude. During late Devonian and early Carboniferous times this basin was filled with deep water sediments in the centre and thick shallower water sediments of sands and muds at the margins. The various stages of basin fill are highly

complex but in essence a series of sediment wedges pro-grading southwards, were formed from the erosion of the Welsh mountains.

Whilst the basin was being filled the two super continents collided leading to the creation of the Variscan mountains and the compression of the intervening basins to produce dramatic folding and faulting of the sediments in Lake Bude. The eroded surface of these mountains is now visible in the cliffs of Westward Ho, Hartland Quay and Milhook and it is the folding and faulting that took place at depth that the group was to study in the next two days.

Starting from Westward Ho! and walking along the beach, the following sequences, as illustrated in the following 3 photographs (**Figs 3, 4, 5)**, can be seen.

Fig 3: An exposure in the basal member of the Bideford Formation showing contorted mudflows and thin layers of sand

Fig 4: Sandstone wedges which are probably the result of turbidite flow into the basin.

At the end of the walk westwards a sudden break in the sequence occurs with the arrival of a massive cross bedded sandstone. This is the site of an Anglian Ice Age river now captured by the sea (**E**).

Fig 5: River profile

The next stop was Hartland Quay round the corner from Hartland Point where lunch was taken in the pub gardens supplemented by ice creams. The descent to the beach revealed the superb chevron folding in the cliffs (**Figs 6)**.

In the evening at Hallsannery, Ran talked about *'Near-earth-surface'* thermal heating. One of the accommodation houses on the estate uses this system, the heat being supplied from a pipe that loops round the garden at a depth of 8 feet. A heat exchanger, about the size of a fridge, extracts this heat to provide hot water and under floor heating. Heat extracted from the soil/rock in Winter is replenished by Summer sunshine. This system was installed whilst the house was being built; for a house in a built up area a deep hole would need to be bored to tap the heat from the ground over a 30 feet stretch. Ran is converting his Victorian terrace house and reckons that the investment will break even in 12 years, or earlier if the property is sold with the installation already installed.

The following morning a long drive southwards to Milhook some 3 miles south of Bude where exposures of older Crackington Formation lying beneath those at Westward Ho! and Hartland

Quay are to be seen. On view here there is a section of zig-zag folds tipped over by about 90 degrees so that their axes are horizontal, rather than vertical (**Fig 9)**. Close inspection, especially of the dip and cleavage indicated that the sides dipping to the north were upside down, that is the crests of the folds were pointing southwards rather than northwards as would be expected by the overall movements in the area. There are various possible explanations, but as the anomaly is bounded north and south by two faults, it was decided that the most likely, was that the complete section, after tipping by 90 degrees was rotated on a vertical axis by 180 degrees by the two faults in which movement occurred laterally in opposite directions.

Back northwards along the coast to Widemouth where the youngest beds of the whole sequence, the Bude Formation, are to be seen. The photo (**Fig 10**) shows an excellent example of rarely seen box folding.

After lunch we travelled to Peppercombe to see the Permian outlier, a red sandy breccia, lying unconformably in a hollow (two "half grabens") in the Bude Formation. The clasts are angular, varied in size and are not well cemented. The Permian dating is by lithography and analogy; indicator fossils have not been found. At the base of this exposure some root-like structures were seen. These are composed of carbonate and could be trace fossils or roots substituted by carbonate, or branching fractures filled with calcite by percolation of solutions from above.

The fourth day of our visit was to Dartmoor. It was wet when we got there after a long drive south from Hallsannery. A climb to Haytor through the mist allowed the study of one of the best known geological features of Dartmoor. There are many tors on both Dartmoor and Bodmin Moor and their formation is by a combination of deep weathering - some 3 ½ Km of sediments removed – of the original batholith which was the granite mass formed at depth 270 m.a. and the exhumation of the underlying granite. The weathering concentrated down the cooling joints to produce these high tors which are jointed both horizontally and vertically. The composition of the Dartmoor granite is of large crystals of quartz, biotite and feldspars together with locally abundant hornblend.

The next stop was at Burrator where there is a huge reservoir. Two small quarries by the roadside displayed examples of contact between the granite and the original country rock. Veins of granite and hornblend cut into the country rock whilst late-stage quartz-tourmaline veins cut into the granite.

Friday saw the party driving back home via Watchet on the Somerset coast. Before going down to the beach a stop at the Watchet railway station allowed us to see both the Jubilee Wall (**Fig 11**) built by local youngsters under the guidance of Dr Eric Robinson incorporating all the local stone; and a steam train en route to Minehead (**Fig 12**).

On the beach Ran assured us that somewhere along the cliff was the junction between the top of the Triassic (the Rhaetic) and the Liassic base of the Jurassic beds. The Triassic sequence of beds is the result of the flooding of the Permian desert landscape by the marine transgression which accompanied the break-up of Pangea. The beds are red and whitish but are completely unfossiliferous following the mass extinction that had occurred when 95% of marine and terrestrial invertebrates were wiped out. Proceeding westwards along the beach in the direction of "younging" black beds begin to dominate the cliff exposure and a faint smell of oil is present – with the "nose of faith." On breaking open a piece of shale Ran produced an ammonite fossil showing that life had re-established itself at the beginning of the Jurassic.

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