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Tetrapod World: early evolution & diversification

Newsletter No. 6, February, 2014

In January, we held our fourth team meeting, with almost everyone able to join us in Cambridge. Two from BGS Edinburgh, three from NMS, three from the University of Leicester, three from the University of Southampton, two from BGS Keyworth, one from the Natural History Museum and one from the University of Lincoln, as well as eight of us from Cambridge.

Cambridge

Tim Smithson spoke about the lungfish we've found, mentioning that Stan Wood had observed that where you find tetrapods, you usually find lungfish. Tim had then speculated that the reverse might also be true, something which influenced where he and Stan were looking for fossils. At the start of the investigation, only one lungfish locality was known from the region, but we have now found lungfish remains in Burnmouth, Coquetdale, Cove, Chirnside, Wark, Cumledge, Broomhouse, Whitrope Burn, Tantalons Castle and the Isle of Bute, yielding five taxa new to science. The range and diversity of the lungfish was a most unexpected and exciting finding. Tim and Jenny Clack have submitted a paper on the lungfish (now in review) to PNAS.

Jenny Clack spoke about the rocks in Nova Scotia which are equivalent to ours in Northumberland and the Borders Region of Scotland. There is a huge collection of largely isolated bones which have been amassed over the years. Some are housed at Blue Beach Fossil Museum and others at Yale Peabody Museum. Not much has been published about them yet. Tim Smithson visited the Peabody Collection last October and noted that some of the bones look distinctly Devonian, while others seem more derived and similar to what we find in the Carboniferous, though not the same as what we have found in Burnmouth and Chirnside. We are planning a trip to Blue Beach later this year to study the material.

Kelly Richards is very excited about the chondrichthyan (sharks, skates and rays) teeth, like these below, found by



Tim Smithson and Stan Wood. Before now, only two chondrichthyan teeth were known from the UK Tournaisian; we now have many hundreds, representing at least 10 taxa, several of which may be new to science.

The BGS has sent Rob Clack statistics showing that the English website has been visited 30,000 times by nearly 5,000 visitors, and the Spanish one nearly 5,000 times by almost 1,200 visitors, many from Spanish speaking countries. The newsletter is distributed to about 80 people and a further 85 download it from the website. Please forward this to friends who might be interested, so we can increase this. Please visit our Facebook page at facebook/TWeedProject. Carys Bennett reports 16,000 hits on the project blog at tetrapodworld.com.

BGS

Dave Millward told us how the borehole core had been split lengthways, half being kept for reference, the other half having been broken up and examined in detail, to extract sedimentary, stratigraphical, isotope and fossil information. More than 2000 samples were extracted for further analysis, and just over 1000 fossil specimens recorded from 600 horizons.



Tim Kearsey and Carys Bennett logging the core.

Tim Kearsey had presented information at the British Sedimentological Research Group conference and findings were also presented at the BGS Open Day in September, at a core workshop in Keyworth for NEFTEx (an Earth Science research company), NERC Knowledge Exchange network and the Edinburgh Geological Society. Video footage of the borehole process is being prepared for future release.

Tim reported how they'd been trying to match the borehole core with the sediments logged in Burnmouth, which is proving trickier than we'd hoped. The core has many more palaeosols and indicates a highly vegetated, and thus terrestrial, sequence. Although there do seem to have

been marine incursions, the vast majority of the section is terrestrial, particularly higher up in the sequence. The many different types of palaeosol suggest a wide variety of different environments.

Leicester

Carys Bennett has been slaving away crushing borehole samples for isotopes and palynology, taking thin sections, and looking for fossils. Siltstones, microconglomerates and palaeosols are very common, although there's far more information in the core, and it's quite hard to correlate the beds. She has found rather a low diversity of bones, teeth and scales, and some, mostly non-marine, bivalves.

Janet Sherwin has been working on samples from fossiliferous sequences in Coquetdale and logging her interpretations from the bottom to the top of the sequence. At different points in the succession she sees evidence of a freshwater bay with marine influence, perhaps a brackish lagoon or lake, suggestions of waterlogged floodplains and wave-reworked bars.

BGS Keyworth

Andrea Snelling has been looking at the carbon isotopes and so far her results indicate that they are from a terrestrial source and that the sandstones are predominantly fluvial in origin. More borehole data will be added in the next few months.

Southampton

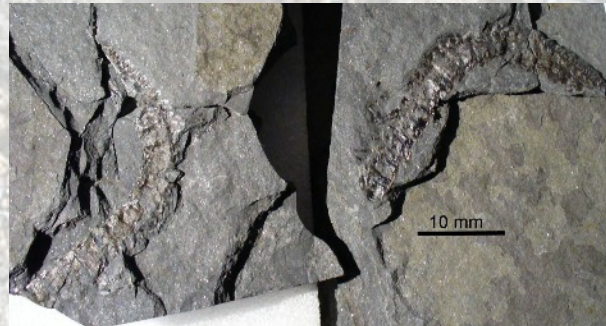
John Marshall has tested 70 out of 301 palynological samples taken. Results so far are mixed. Grains are very rare at the lowest point in the Ballagan Formation, some species which we would expect to be present at the base of the sequence are missing, there's a much higher abundance of spores coinciding with the basal Carboniferous and some spores have been found which we would only have expected to find higher up the sequence.

Emma Reeves has processed part of the lowest section of the core, with 82% of samples yielding spores of varying abundance. Spores provide a means of dating the rocks, but so far it's unclear where the boundaries are in our sequences.

Dave Carpenter talked about the coal and charcoal he's been looking at. Thick layers of peat indicate significant periods of terrestriality, since peat accumulates quite slowly. One charcoal mineral he can detect correlates with the temperature of the fire that formed the charcoal, which tells us about the oxygen levels in the atmosphere at the time. He thinks the fires in Romer's Gap may not have been as big as those occurring in the Late Devonian. He found abundant megaspores in a thin (previously known) coal seam in the core, which is the oldest coal known in the UK. Dave has also been working on the Ballagan Formation on the Isle of Bute, but very little has been published and most of that seems to have come from a Geology BSc thesis. The implications so far are of an alluvial plain with shallow water bodies. Fossils seem to have been from a range of fishes and lungfish.

NMS

Andy Ross reported that there are quite a few myriapod (millipede) specimens known from the Early Carboniferous of Scotland, though two of those turn out to have been misidentified and are not actually myriapods! Among the material recently collected by Stan Wood there are five specimens and all are different from each other, indicating a high diversity of millipedes in the earliest Carboniferous.



Part and counterpart of one of Andy's myriapods.

Nick Fraser went back to Cumledge with Stig Walsh to collect anything more that had eroded out of the cliff and to bund up the unstable base of the cliff to reduce the chance of loss of material over the winter. They tested a sample plaster jacket to see whether it would set in the inclement conditions, and although soft, it did set adequately, an encouraging result.

We're planning a major excavation at Chirnside in the summer, but this will depend on the Scottish Environmental Protection Agency agreeing, and also on the weather. The River Whiteadder can vary wildly in flow, depending on the rainfall upstream, so we hope for a drought in May, June and July.

They need to start planning the exhibitions they'll be putting on in the future, where they'll be situated, whether they'll travel around, which other institutions might want to be involved, etc. Thoughts include the Natural History Museum in London, Leicester, the Sedgwick Museum in Cambridge, possibly the Hunterian in Glasgow, as well as something in Halifax, Nova Scotia. Nick will send out a schematic of his plans and we'll reconvene before the end of March to discuss how we're going to proceed.

Maggie Wood, sadly unable to join us, has been archiving Stan's fossils from the Tweed Basin - field notes and photo's, articles and journals and his fossil inventory.

Future

- Jenny Clack and Tim Smithson are preparing a paper on the tetrapods to be submitted to Nature magazine.
- Carys Bennett, Tim Kearsey, Sarah Davies and Dave Millward are preparing papers on microconglomerates and palaeosols this year.
- We are planning fieldwork in March and June this year.
- Next meeting: June, in the field.