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Tetrapod World: early evolution & diversification

Newsletter No. 8, July 2014

In June a group of us enjoyed great weather during another successful week's fieldwork in the Scottish Borders. We stayed in an excellent holiday cottage called The Paddock at Foulden. New to the group was Becky Bennion, a second year Cambridge student studying our sharks as a summer project funded by a John Ray grant. Various other team members joined us for part of the week and the team meeting on the Wednesday.



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The find of the week was an articulated lungfish skull from north of the harbour wall at Burnmouth. While not exactly eye-candy, we hope it will yield much more information than all the isolated bones we've been finding up till now.

On the Wednesday people from the NMS and BGS in Edinburgh, and Maggie Wood from Selkirk joined us for our biannual team meeting.

Jenny Clack reported that the University of Cambridge had acquired a CAT scanner which she, Ket and Tim were starting to use to look inside some of the rocks we've collected over the years.

Tim Smithson (Cambridge) told us that prior to the project starting there were only two known sites yielding shark teeth, but now there are five and we have hundreds of specimens, which will keep Becky busy! Tim observed that crushing dentition among the sharks and lungfish we've been finding is common, whereas later in the Carboniferous it's very rare. He speculated that bivalves might have been superabundant, and these fishes might have been exploiting them as food.

Tim also gave a brief account of the geology and palaeontology of the contemporary locality of Blue Beach in Nova Scotia, based on the trip that Jenny, Rob and Tim made to the site in May. It is very different from our localities in the Scottish Borders, and this is reflected in the fossil finds. Gyrogonites and lungfish remains are rare and so far eurypoterids have not been found, while ctenacanth shark spines and large actinopterygian fishes are quite common. Both areas have rhizodonts and a variety of tetrapods, but generally the Blue Beach tetrapods are much bigger. Jenny and Tim with project partners Jason

Anderson, from the University of Calgary, and Chris Mansky, from the Blue Beach Fossil Museum, are currently preparing a paper describing some of the tetrapods from Blue Beach.

Dave Millward (BGS) has been comparing cores from many boreholes from all over southern Scotland which the BGS has drilled over the years. As these boreholes were drilled at different times and for different purposes, not all include the data that are most useful for this project. However, their abundance and distribution across southern Scotland, the Borders and Northumberland means Dave can generate a regional overview of the environment and how it may have changed over time.

Tim Kearsley (BGS) showed us some brief film footage of a BGS hexakopter being flown over the foreshore at Burnmouth. This carries a camera and a GPS device and takes a photograph every second as it is flown back and forth. This gives a very much better image of the foreshore than what is available online as the tide was right and the light was good. The individual images can be stitched together and they hope to be able to use the result to derive 3D information about the rocks there.



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Tim has also been looking at the palaeosols (ancient soils) and suggested that as we move up through the sequence, the changes in the palaeosols might indicate an increase in terrestriality through time.

Janet Sherwin (Leicester) has been working at Coquetdale, Coldstream and Whitrope Burn in Northumberland, each location providing an insight into different aspects of the environment and its flora and fauna. For example, a new section at Coquetdale has abundant plant fossils, dominated by long strap-like leaves. Comparing these locations with the core and Burnmouth sections in the Tweed Basin is revealing more about the regional palaeogeography, and our observations suggest that the Northumberland sections, whilst still in close proximity to land, were more marine-influenced.

Carys Bennett (Leicester) has been doing a lot of carbon isotope analyses of bulk organic matter from samples collected in the

field and from the core alongside observations of the macro- and microfossils in the rocks. She showed a number of graphs and explained how the carbon isotopes values suggest that the source of organic matter was largely freshwater but some values may indicate occasional marine incursions. However the team is exploring some alternative, and potentially very exciting, explanations so watch this space.

Emma Reeves (Southampton) told us that about three-quarters of the samples collected from Burnmouth and the borehole had been processed palynologically, and that they hope to get them finished by the end of the summer.

The coal from the borehole was found to contain both small and large spores, the latter being much rarer but easier to spot. It's thought that the coal was formed from a thin bed of peat lying in an anoxic pool.

Nick Fraser (NMS) explained about the six taxa of eurypterid (large water scorpions) known from the Lower Carboniferous of Scotland. We have three specimens from Chirnside, all rather fragmentary.

Nick and Stig Walsh had done some exploratory work at Crumble Edge with a view to putting a plaster jacket around some bones we'd seen eroding out of the cliff last year, but the instability of the river cliff may mean this is not possible. Jenny and Rob Clack plan to visit the site in September.



Carys and Emma at Crumble Edge. © Sarah Finney.

Nick explained how misunderstandings between himself and [SEPA](#) had resulted in delays, which mean it's unlikely we'll be able to do the Chirnside excavation this year, but we still hope to proceed next year.

The NMS team are planning an exhibition for the end of the project, so as to include as many results as possible. This is down for 2016 so far, and various venues are being considered, including the Sedgwick Museum in Cambridge.

In July, Jenny and Rob Clack visited the Royal Society's [Summer Science Exhibition](#) in London and wondered whether we should be aiming to mount an exhibit there in 2017.

Maggie Wood gave the meeting an update on the development of the Stanley Wood Award and said that she hoped it would be formally announced very soon.

Later in the week a BGS cameraman took film footage of various people working in the field, and interviewed some of the team members about what they were doing.

We also visited a new site at Castle Heaton, where Chris Murray (see Newsletter No 7) had found a gyracanthid fin spine. The site is quite overgrown and shaded, but even so, Becky spotted some bone poking out of a rock and several of us (mostly Sarah Finney) hacked it out and reduced the block to manageable proportions. We've not yet had time to do any serious work on it, so don't actually know much about what it is.



Sarah Finney, Tim Smithson and Becky Bennion at the Castle Heaton site. © Rob Clack

Three masters students have now started in the Geology Department at the University of Leicester, supervised by Sarah and Carys.

- Rachel Curtis is comparing the degrees of marine influence in the Northumberland and Tweed Basins. She is jointly supervised by Dave Millward and has spent time at NERC's National Geoscience Data Centre, housed at the BGS, Keyworth. She has logged core from the Hoddum Borehole
- Hattie Dulson is looking at the variability of the ecosystems in which the tetrapods lived. Hattie will be combining sedimentology and micropalaeontology. She completed her field work in July.
- Greg Phillpotts is testing the hypothesis that a key interval in early tetrapod evolution represented a non-marine floodplain environment. Greg is also doing a multidisciplinary project and completed logging and sampling his section during July

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- Jenny Clack will present a poster about the new localities at the [SVP](#) in York in early September.
- Tim Smithson will give a talk about the Whitrope Burn sharks at the same conference.
- The BGS Open Day will be on Saturday, 27th September as part of the Edinburgh Open Doors event.
- Sarah Davies has been invited to speak to the [Shropshire Geological Society](#) in October.
- Jenny, Tim and Kelly Richards will be presenting at the [SVP](#) conference in Berlin in November.
- Sarah will be a keynote speaker for the Annual Meeting of the [British Sedimentological Research Group](#) in December.
- Carys told us that the [Yorkshire Geological Society](#) want to do a Saturday seminar on our project in March next year.