Geophysical Research Abstracts
Vol. 18, EGU2016-16509, 2016
EGU General Assembly 2016

A micropalaeontological and palynological insight into Early Carboniferous floodplain environments

Carys Bennett (1), Timothy Kearsey (2), Sarah Davies (1), David Millward (2), John Marshall (3), and Emma Reeves (3)

(1) University of Leicester, Department of Geology, Leicester, United Kingdom (ceb28@le.ac.uk), (2) British Geological Survey, The Lyell Centre, Heriot-Watt University, Research Avenue South, Riccarton, Edinburgh EH14 4AS, (3) Ocean and Earth Science, National Oceanography Centre, University of Southampton, SO14 3ZH, UK

Romer's Gap, the interval following the end Devonian mass extinction, is traditionally considered to be depauperate in tetrapod and fish fossils. A major research project (TW:eed -Tetrapod World: early evolution and diversification) focusing on the Tournaisian Ballagan Formation of Scotland is investigating how early Carboniferous ecosystems rebuilt following the extinction. A multi-proxy approach, combining sedimentology, micropalaeontology and palynology, is used to investigate the different floodplain environments in which tetrapods, fish, arthropods and molluscs lived. The formation is characterised by an overbank facies association of siltstone, sandstone and palaeosols, interbedded with dolostone and evaporite units, and cut by fluvial sandstone facies associations of fining-upwards conglomerate lags, cross-bedded sandstone and rippled siltstone.

Macrofossils are identified from 326 horizons within a 520 metre thick Ballagan Formation field section at Burnmouth, near Berwick-upon-Tweed, Scottish Borders. Common fauna are ostracods, bivalves, arthropods, sarcopterygians, dipnoans, acanthodians, tetrapods and chondrichthyans. Quantitative microfossil picking of the three sedimentary rock types in which tetrapods occur was undertaken to gain further insight into the palaeoecology. The sediments are; 1) laminated grey siltstones, deposited in floodplain lakes; 2) sandy siltstones, grey siltstones with millimetre size clasts. 71% of these beds overlie palaeosols or desiccated surfaces and are formed in small-scale flooding events; 3) conglomerates, mostly lags at the base of thick sandstones, with centimetre sized siltstone, sandstone and dolostone clasts.
Grey siltstones contain a microfauna of common plant fragments, megaspores and sparse actinopterygian and rhizodont fragments. Sandy siltstones have the highest fossil diversity and contain microfossil fragments of plants, megaspores, charcoal, ostracods, actinopterygians, rhizodonts, eurypterids and rarer non-marine bivalves, chondrichthyan teeth and denticles. Conglomerates have a microfauna of fragments of lungfish, rhizodonts and chondrichthyans, with rarer ostracods and an absence of megaspores or arthropod cuticle. The dominance in abundance of the most common fishes (actinopterygians and rhizodonts) varies between successive beds. Rhizodonts occur in a range of environments, while acinopterygians are most common in facies representing short-lived shallow lakes or ponds. Chondrichthyans are most abundant within conglomerate lags and this may represent either a habitat preference for rivers or potential anadromous behaviour.

Palynological analysis of sediments from Burnmouth, and a correlative borehole section, reveals common miospores and megaspores. A preliminary analysis of data from over 100 samples throughout the formation indicates significant fluctuation in the relative abundance of dry and humid-tolerant species. It would appear that there were successive times when a largely lycopod scrub and/or arborescent vegetation dominated the system. Between these episodes the vegetation degenerated to dry-tolerant species. The upper part of the formation is dominated by humid-tolerant species. The sandy siltstones contain a higher proportion of humid tolerant species compared to the other two tetrapod-bearing sediments. This, in combination with the common occurrence of palaeosols, desiccation cracks and evaporites, indicates that a seasonally wet to dry climate with monsoonal rains was operating. Our results open a window into the redevelopment of the earliest freshwater ecosystems and are helping us to elucidate the character of these new habitats and ecosystems.