TMS Palynology Group meeting 13th May 2009 – Abstracts

Beyond mid-Palaeozoic biostratigraphy: the benefits of combined in situ and dispersed spore research

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Traditionally, information of the dispersed spore record has been fundamental to studies on biostratigraphy, palynofacies and phytogeographic analyses and macroevolutionary patterns – all this without any detailed intelligence on the affinities of the parent plants. Using mid-Palaeozoic examples, this lecture will show how the isolation and identification of spores from a number of meso – and megafossils can enhance our understanding of regional and local vegetation with emphasis on cryptic diversity (eg in rhyniophytoids with ellipsodial terminal sporangia) and taphonomic influences (eg in the ubiquity of Rhynie Chert plants). Limited evidence to date suggest that major Lower Devonian lineages are characterised by particular spore structural types but indicates that spore sculpture changed in time. This is particularly well illustrated by the Cooksonia complex with trends in ornament seen in situ spores reflected, but in slightly older rocks from dispersed spores. Similar trends but again on a slightly different time scale, are noted in cryptospores (sensu Richardson). Fertile mesofossils from the late Silurian and early Devonian are at last shedding light on the nature of the producers (admittedly several million years after the appearance of spores in the Ordovician dispersed record) and allowing the detection of a number of lineages in the stem group embryophytes that preceded the appearance of bryophytes and tracheophytes.

Dinoflagellate cysts assemblages of the Early-Middle Jurassic boundary from the type area: unprecedented diversity, new species, high-resolution biostratigraphy and their role in early phytoplankton evolution

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The Toarcian-Aalenian is one of the key periods in early dinoflagellate cyst evolution. After their first appearance in geological history in the Late Triassic, dinoflagellate cysts diversity increases only slowly and intermittently during the Early Jurassic in several evolutionary boosts. It is not before the Middle Jurassic that most of the successful families have evolved.

In the present contribution we report on the latest results on dinoflagellate cyst assemblages from the Toarcian and Aalenian in the southwest German Jura Basin (Feist-Burkhardt & Pross 2009). Detailed analysis of core and outcrop sections with independent age calibration revealed rich and well-preserved dinoflagellate cyst assemblages with a high diversity yet unreported in the literature. Several species, including several yet to be formally described, are used to characterise the Toarcian-Aalenian boundary and to propose a palynostratigraphical scheme allowing a high-resolution subdivision of the Aalenian stage.

The key species and the characteristics of these Early/Middle Jurassic dinoflagellate cyst assemblages will be presented and the Toarcian/Aalenian dinoflagellate radiation will be discussed within the context of early evolution of modern phytoplankton.

References cited:

Feist-Burkhardt, S. & Pross, J. (2009): Dinoflagellate cyst biostratigraphy of the Opalinuston Formation (Middle Jurassic) in the Aalenian type area in Southwest Germany and North Switzerland. - *Lethaia,* 22 pp, 14 fig., 1 tab. DOI: 10.1111/j.1502-3931.2009.00170.x

Increased seasonality through the Eocene to Oligocene transition in northern high latitudes: the pollen and spore view

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A profound global climate shift took place at the Eocene/Oligocene transition (~33.5 million years ago) when Cretaceous/early Paleogene greenhouse conditions gave way to icehouse conditions. During this interval, orbital modulation and a long-term drop in atmospheric carbon dioxide concentrations resulted both in the growth of Antarctic ice sheets to approximately their modern size and the appearance of Northern Hemisphere glacial ice.

However, palaeoclimatic studies of this interval are contradictory: whilst some analyses indicate no major climatic changes, others infer cooler temperatures, increased seasonality, and/or aridity. Climatic conditions in high northern latitudes over this interval are particularly poorly known. Here we present the first northern high latitude terrestrial climate estimates for the Eocene to Oligocene interval, based on bioclimatic analysis of terrestrially-derived spore and pollen assemblages preserved in marine sediments from the Norwegian-Greenland Sea.

Our data indicate a cooling of ~5ºC in cold month mean (winter) temperatures to 0-2°C, and a concomitant increased seasonality *prior to* the Oi-1 glaciation event. These data indicate a cooling component is indeed incorporated in the $\delta^{18}O$ isotope shift across the E/O transition. However, due to the relatively warm summer temperatures at this time, it is likely that continental ice on East Greenland was restricted to alpine outlet glaciers.

Spatial dynamics of Late Paleocene paratropical forests on the U.S. Gulf Coast

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Studying spatial heterogeneity in assemblages of taxa is essential for properly understanding the patterns and processes of community change over time. Using the pollen record as a plant proxy, we evaluate compositional dissimilarity and diversity dynamics in plant communities on the US Gulf Coast from the Late Paleocene that are homologous to modern tropical to subtropical forests. Fifty samples were taken from outcrops of the Calvert Bluff Fm. in Robertson and Bastrop counties, east-central Texas, and from the Tuscahoma Fm. in the OSM#2 Wahalak core from Choctaw County, western Alabama. These study areas are approximately 900 km apart, and are taken as being representative of the western and eastern Gulf Coast, respectively. The two study areas are both marginal marine, muddy strand lines with brackish water deposits with occasional emergent swamps. There are no significant taphonomic biases between them.

Gamma (total) richness in Texas is significantly higher than in Mississippi, but proportions of alpha (within-sample) and beta (between sample) richness are similar in both areas (alpha = ~30% and beta = ~70%). A decline in within-sample evenness over time in Texas is not matched in Alabama. Compositional trends relating to subtle relative abundance changes can be identified within the two study areas, and significant compositional differences between Texas and Alabama do not simply imply sampling from one homogenous regional species pool. Whilst it is not yet possible to determine the processes that maintained this compositional differentiation, these results demonstrate that trends identified from the eastern Gulf Coast cannot be used a proxy for the whole biome. Furthermore, despite the relatively coarse spatial resolution imposed by shallow marine sporomorph deposits, within-biome spatial heterogeneity can still be rigorously determined and studied.

The modern Volga delta: an analogue for the Pliocene productive series in the Caspian Sea?

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KrA Stratigraphic

The paleo-Volga is a major hydrocarbon play in the Pliocene Productive Series in the South Caspian. Extensive palynological analyses were carried out in the ACG and Shah Deniz fields, offshore Azerbaijan and identified 3 main palynofacies types, "Caspian Lake", "Delta Front" and "Lake Margin". Analogues for each of these occur in the modern delta. The Productive Series was deposited in an isolated lake basin, with sediment influx controlled by basin subsidence and catchment climate.

A study of the modern delta was undertaken between 2006 and 2009 by Moscow State University, Technical University of Delft, BP, and others. The modern Volga delta is a low-gradient, mud-dominated delta with numerous distributaries and more than 800 outlets. Due to lowering Caspian sea levels since c.1930, much of the visible delta at present consists of new levees, formed by progradation. These are separated by brackish embayments and freshwater lakes.

70km of shallow seismic data were collected, from which 6 principal and 10 minor seismic facies types identified. 26 cores were taken and 7 selected for palynology. The palynological records give a detailed history of the evolution of the delta since the Late Pleistocene. Seven palynological zones were identified and are calibrated by radiocarbon dating. The modern Volga delta is a good partial analogue for the Pliocene. A key difference is that major river incision occurred in the Late Miocene and Pliocene.

Spore wall ultrastructure of Devonian *Emphanisporites*: evidence for rampant convergence--but why?

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Among dispersed Silurian-Devonian spore genera none are more distinctive than *Emphanisporites*. Members of this form genus possess radiating sculptural patterns on their proximal surfaces. *Emphanisporites* is widespread, diverse (with over 40 described species) and displays phenomenal morphological disparity. In an attempt to determine the parent plant(s) of this spore type, we used transmission electron microscopy (TEM) to examine numerous serial sections of several Lower Devonian species: *E. rotatus, E. annulatus* and *E. schultzi*. They all have remarkably different ultrastructural characteristics. This degree of ultrastructural variability is unexpected, and suggests that very different plant groups may have produced these spores, seemingly building their spores in different ways but converging on a common structural theme. The only specimen whose affinity seems assured is *E. rotatus* that possesses interradial multilamellated zones, which are known to be present only in lycophyte spores (and are probably a synapomorphy for the ligulate lycospid clade). It is possible that some of the differences may be attributable to natural variation, developmental stage or preservational vagaries, but we discount these as the main agents as all specimens are dispersed spores (i.e. most likely mature) and from the same sample. Such widespread appearances of generalized morphological types, that seemingly appear rapidly, diversify and dominate and then decline rapidly, occur throughout the dispersed spore/pollen record (e.g., grapnel-tipped spines, taeniate pollen, triprojectate pollen). Possible explanations for this phenomenon include adaptive radiations, convergence due to common (as yet unrecognized) internal or external function, and/or some other pathway of evolutionary/informational transmission (e.g. emergence).