

Choshi Group in the Outer Zone. Pollen grains were observed combining LM/SEM/TEM that permitted us to confirm the presence of the *Retimonocolpites* Group, which represents typical early angiosperms. *Retimonocolpites* are reported worldwide from Early to mid-Cretaceous pollen assemblages and attributed to a variety of non-eudicot angiosperms. The present report represents the oldest record of angiosperms in Japan and the whole Ryoseki-type province of Asia, and the first pre-Albian report of the *Retimonocolpites* Group in eastern Asia. This appearance period is consistent with other Asian reports, and further details the appearance of angiosperms in eastern Asia.

## Darriwilian (Middle-Ordovician) elements of primitive vegetation, marine palynomorphs and problematic microfossils, from the Saq/Qasim transitional beds in core QSIM 801, central Saudi Arabia. Discussion with eustatic and climatic events

TALK IN SESSION S37

Le Hérisse, Alain<sup>1</sup> [alain.le.herisse@univ-brest.fr]; Steemans, Philippe<sup>2</sup>; Wellman, Charles H.<sup>3</sup>; Vecoli, Marco<sup>4</sup>

<sup>1</sup>Université de Bretagne Occidentale, Brest (France)

<sup>2</sup>Université de Liège, Liège (Belgique)

<sup>3</sup>Department of Animal and Plant Sciences, University of Sheffield, Sheffield (UK)

<sup>4</sup>Saudi Aramco, Dhahran (Saudi Arabia)

Core samples from the QSIM-801 well (central Saudi Arabia), drilled in a marine sedimentary section through the transition between the Saq and Qasim Formations (Dapingian-Darriwilian, Middle Ordovician), yielded abundant and well preserved palynomorphs comprising cryptospores, acritarchs, chitinozoa, cuticle-like fragments, and other problematic organic-walled microfossils, mixed with more or less abundant amorphous organic matter. The Hanadir Member of the Qasim Formation is biostratigraphically well constrained by the presence of chitinozoans of the successive *formosa* and *pisotensis* Zones of early (not earliest) to late Darriwilian age. The biostratigraphic age of the Sajir Member is considered to span through the Dapingian-Darriwilian boundary although definitive age evidence is lacking. Cryptospores and cuticle-like fragments are dominant in the fluvio-marine, fine grained sandstones of the Sajir Member,

although they are also recurrent at several levels within the Hanadir Member. The present results confirm the important expansion of non-vascular plants in the Middle Ordovician of Saudi Arabia, and are consistent with other records in coeval strata from the Czech Republic and Argentina, all situated on Gondwana and its margins. Cryptospore assemblages include well known taxa, such as *Tetraedraletes medinensis*, *Dyadospora murusattenuata*, and *Gneudnaspora divellomedia*, together with rare, more problematic forms featuring an enveloping membrane and/or characterized by extremely fine, conate to faveolate surficial ornament. Acritarchs from the Sajir Member of the Saq Formation are rare and poorly diversified. Conversely, highly diverse assemblages of acritarchs and chitinozoans occur in the transgressive Hanadir Member of the Qasim Formation, consisting mainly of middle to outer shelf graptolitic mudstones. FADs of diagnostic acritarch taxa can be observed such as *Frankea longiuscula*, *Baltisphaeridium ternatum*, *Dasydorus cirritus*, *Dicrodiacrodium ancoriforme*, and *Uncinisphaera fusticula*. They are associated to other typical forms known to range across the Lower-Middle Ordovician boundary, like *Aremoricanium rigaudae*, *Aureotesta clathrata*, *Barakella fortunata*, *Baltisphaeridium klabavense*, *Focusphaera elongata*, *Peteinosphaeridium trifurcatum*, *Peteinosphaeridium* spp., and *Striatotheca* spp. Problematic microfossils such as organic filaments, cuticle-like tissues, possible algal spores, aggregates of small, striated and pigmented leiospheres, suggest terrestrial and freshwater inputs. Specimens previously attributed to the acritarch species *Tyrannus* sp. A, are now reinterpreted as representing fungal spores. The observed variations in the main categories of palynomorphs along the section are discussed in the background of the eustatic and climatic changes occurring during the Middle Ordovician.