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## Program with Abstracts





## Retispora lepidophyta assemblage near the Devonian-Carboniferous boundary: palynology of the Unit 4 shale in the middle Sappington Formation, Montana, USA

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The Sappington Formation of Montana spans the Devonian-Carboniferous boundary (DCB). These strata are important for understanding global biotic events and for constraining depositional environments and sequence stratigraphic interpretations of the correlative Bakken Formation, a hydrocarbon reservoir in the Williston Basin, USA. Fieldwork with palynology and conodont sampling within the Devonian-Carboniferous upper Three Forks, Sappington, and lower Lodgepole formations in southwest Montana was carried out at 9 locations including Antelope Valley, Beaver Creek, Dry Hollow, Moose Creek, Trident, and Storm Castle. This paper presents preliminary palynological results mainly from Unit 4 in the Sappington Formation. A total of 106 samples were processed following standard methodologies. Nine of 32 samples were productive from the Three Forks Formation and Sappington Units 1, 5 (none) and 6, and 46 samples of 74 from Unit 4 as well. The latter samples yielded assemblages dominated by trilete spores, a few microphytoplankton, and scarce terrestrial phytoclasts. General palynofacies characteristics reveal that palynomorphs from some locations are better preserved compared to other locations that show more fragmentation and corrosion. Tracheids and cuticles are rarely present, whereas black/brown particles are more frequent in some locations. The thermal alteration index (TAI) is generally between 2 and 4, consistent with other thermal maturity indicators. Framboidal and euhedral pyrite is present within the spores at most locations. Identifications of spores is problematic due to their locally dark brown/black color, intra to inter-species variation, and the likelihood of some new species. Among the 100 miospore species identified, 70 were found at multiple Unit 4 locations including: *Anapiculatisporites cf. semicuspidatus*, *Bascaudaspora collicula*, *Bascaudaspora submarginata*, *Claytonisporites rarisetosus*, *Convolutispora fromensis*, *Convolutispora major*, *Convolutispora oppressa*, *Cordylosporites glumaceus*, *Cymbosporites loboziakii*, *Cyrtoispora cristifera*, *Densosporites infacetus*, *Diaphanospora perplexa*, *Grandispora echinata*, *Grandispora praecipua*, *Knoxiosporites concentricus*, *Kraeuselisporites explanatus*, *Pustulatisporites dolbii*, *Reticulatisporites cancellatus*, *Retispora lepidophyta*, *Retusotriletes crassus*, *Retusotriletes incohatus*, *Spelaotriletes crustatus*, *Tumulispora rarituberculata*, *Vallatisporites drybrookensis*, *Vallatisporites splendens*, *Vallatisporites vallatus*, *Velamisporites perinatus*. Of the 12 microphytoplankton found, 8 are found at multiple locations (e.g. *Dictyotidium cf. araiomegarium*, *Gorgonisphaeridium absitum*, *G. evexispinosum*, *G. ohioense*, *G. plerispinosum*, *G. winslowiae*, and species of *Maranhites* and *Leiosphaeridia*). Almost all these species and most of the microphytoplankton are shared with the assemblages from the shale (U4) in the middle Sappington Formation at Logan Gulch in the Horseshoe Hills of Montana, where previous workers defined the *Lepidophyta* - *Nitidus* Zone. The other known *Retispora lepidophyta* assemblage of U4 at Hardscrabble (Peak 9559) in the Bridger Mountains is composed of 34 spore and 3 acritarch species sharing 15 species with the U4 assemblages at multiple locations studied herein (e.g. *Cyrtoispora cristifera*, *Grandispora echinata*, *Knoxiosporites heredatus*, *Retusotriletes incohatus*, *Tumulispora rarituberculata*, *Velamisporites perinatus*, *Vallatisporites vallatus*, *Vallatisporites drybrookensis*, *Gorgonisphaeridium winslowiae*). The global stratigraphic ranges of species recorded in U4 assemblages mentioned above and the co occurrence of the diagnostic spores *Retispora lepidophyta* and *Vallatisporites vallatus*, among others indicates a latest Famennian (Strunian) age akin to the *Lepidophyta*-*Nitidus* (Europe) and *Lepidophyta*-*Vallatus* (Brazil) Zones. Note that *Verrucosporites nitidus* has been confirmed to date from only the Antelope Valley and Logan Gulch locations. This taxon and 15 other spore species are also present in the LN Zone of the Middle Bakken Formation thus reinforcing their correlation.

The paleoenvironment of Unit 4 has been difficult to establish due to the scarcity of megafossils. For these assemblages, the presence of pyrite in the palynomorphs, and few acritarchs support a dysoxic marine depositor that is probably shallow and close to a terrestrial environment due to the high number of spores found. Some workers interpret U4 as an offshore deposit, but this study supports earlier work that concluded that it was deposited in a brackish water environment. The *Siphonodella praesulcata* Zone was regionally documented previously in Sappington units 2, 3 and 5. The lithologies of those units are generally not suitable for palynology; it remains unclear if *R. lepidophyta*, which is known to first occur in the upper expansa Zone in western and eastern Europe, appears (inception, FAD) in the underlying units. The DCB may occur in the upper part of the middle Sappington Formation (silty U5). Other potentially time-transgressive shale units such as Unit 1 are also under further microfossil study. Results obtained at Logan Gulch (di Pasquo in prep.) and on-going conodont work are being compared regionally with the results obtained here.

Keywords: *Retispora lepidophyta*, palynology, correlation, Sappington Formation, Devonian-Carboniferous boundary, Montana