

PALEOPALYNOLOGY OF SELECTED SAMPLES FROM  
CORES CLAY 513, PRESTON 119, WAYNE 1549 AND WOO-351

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*Introduction.* --- During July, 2003 a series of samples was collected by Paul Strother and John Beck (Boston College) and Charles Wellman (The University of Sheffield) from several cores housed at the West Virginia Survey. Our interest was in recovery of non-marine palynomorphs (organic-walled microfossils) from lower Paleozoic shales. More specifically, we are interested in the evolution of the earliest land plants, a group whose earliest fossil record is expressed in the form of dispersed spores, called cryptospores. In the United States, this fossil record begins stratigraphically near the Ordovician-Silurian boundary (Beck and Strother, 2008; Gray et al., 1985; Strother and Traverse, 1979). Elsewhere in the world, the fossil record of plant spores commences in the Ordovician (Strother et al., 1996; Wellman and Gray, 2000), so we were interested as well in looking for samples from Ordovician shales. There are also reports of even older spore-like microfossils from Middle Cambrian units in the southern Appalachians (Strother and Beck, 2000) and in parts of the western (Baldwin et al., 2004; Taylor and Strother, 2009) and mid-western US (Taylor and Strother, 2008). These palynomorphs are somewhat controversial in terms of their relation to the land plants and their taxonomy is still in its earliest stages of development. Therefore some presumed Upper Cambrian units were sampled from the Sandhill deep well in Wood County (WOO-351) (Woodward, 1959). The samples were processed at the facility at the University of Sheffield. Acid extractions were mounted in artificial mounting medium on 1x3 inch glass slides.

*Results.*-- Results of the extractions are presented in Tables 1 through 4. These represent summaries of the different taxa present in each sample along with an indication of the kerogen type: **A** for amorphous organic matter (o.m.) which is essentially of a granular to microgranular nature, **S** for structured o.m. which appears as blocky fragments but which cannot be identified to any particular source, and **P** for samples in which identifiable palynomorphs for a significant fraction. The taxon indications are expressed qualitatively: **A** indicates abundant forms which dominate the assemblage, (over 10 % of the assemblage population), **C** indicates the taxon is common (perhaps 1 to 10%), “•” indicates that the taxon is present through the population, and, **R** indicates a taxon that was encountered only once or twice per slide.

The samples from Clay 513 were identified as being from the Tuscarora Fm. Preservation is good. The samples contain a moderately diverse assemblage of acritarchs with a minor component of freshwater algae and cryptospores which indicate terrestrial provenance. Overall, the assemblages are dominated by sphaeromorph acritarchs which are not diagnostic – either of biological affinity or provenance. The acanthomorph acritarch, *Diexallophasis denticulata* is also quite abundant – this form has been recovered from from the Rose Hill Shale in central Pennsylvania (Cramer, 1969). Both *Comasphaeridium* and *Moyeria cabottii* are known from surface samples in the Tuscarora Fm in central Pennsylvania (Johnson, 1985), but the remaining acritarch species (other than the sphaeromorphs) are not typically found in the Pennsylvania sections of the Tuscarora Fm. In Pennsylvania the Tuscarora shales are dominated by either sphaeromorphs or by cryptospores (Beck and Strother, 2008; Strother and Traverse, 1979), so the assemblage from the West Virginia subsurface is distinctly different from that seen in Pennsylvania.

Four samples from Preston 119 contained diverse assemblages of acritarchs, again with a minor cryptospore component. The organic matter is a grayish color, which is probably due to burial. In spite of this, preservational detail is good. The most interesting, and quite distinctive, taxon is *Proteolobus* Wood 1997 (Figure 1G) which is known from The Devonian of Bolivia (Wood, 1997) and the Llandovery of Saudi Arabia. Acritarchs, including a variety of acanthomorphic forms dominate the assemblages with only a very few simple cryptospores present. Some taxa such as *Quadrisporites* (family Hydrodictyaceae) and *Proteolobus* are likely from freshwater sources, especially the later which is considered to be a coenobial green alga (Wood, 1997). So there is clearly freshwater influence in the assemblage, even though a strong terrestrial from cryptospores and trilete spores is missing.

The samples from Wayne 1549 were mostly barren of organic walled microfossils except for two basal samples from the Keefer Ss. These assemblages contain a mixture of acritarchs, chitinozoans, cryptospores and trilete spores – essentially a well-mixed shallow marine assemblage in which marine and non-marine elements are expressed equally. *Tasmanites* is present, including in some of the samples which are essentially barren. This form has been associated with the open marine prasinophyte, *Halosphaera*

(Wall, 1962), however, in recent years this association has come under review (Cohen et al., 2009).

Most of the samples from the Wood 351 well were disappointing, reflecting, no doubt, that these are largely carbonate units which are, therefore, not conducive to the preservation of palynomorphs. Four samples considered to be from the Mt Simon Ss equivalent contained abundant cryptospore-like microfossils, but these were too poorly preserved to characterize. A few samples contained rosettes of cell clusters (Figure 1I) which are also known from the upper Cambrian Nolichucky Shale (Conausaga Group, Brian Pedder, Sheffield, personal observation). In some cases, preservation allows for the placement of simple morphologies into previously described taxa, e.g. *Sphaerasaccus* (Figure 1 H). Intriguingly, some of these forms, which are yet to be described, are similar to sets of cryptospore dyads and clusters recovered in Dapingian to Darriwilian (Ordovician) strata in Utah (Vecoli, Beck & Strother, in revision). The Martinsburg Shale sample (9498) contains a chitinozoan assemblage which is possibly age diagnostic.

*Conclusion.*--- The Silurian elements in the cores examined show a stronger marine influence than is seen in surface samples of the Tuscarora Fm in Central Pennsylvania. This difference in spore and cryptospore content probably reflects a degree of heterogeneity in the sampled lithofacies, from a range of near shore and shallow shelf depositional settings, but likely indicates a more distal setting within the basin. The assemblage from the Cambrian sequence in Wood 351 was not well preserved, but shows some signs of similarity to upper the upper Cambrian of Tennessee (Nolichucky Sh) and west central Wisconsin (Lone Rock Fm) (Taylor and Strother, 2009), which is consistent with its designation as “Mt Simon Sandstone”(A *Symposium on the Sandhill Deep Well, Wood County, West Virginia*, 1959) . But this assemblage also overlaps to a degree with the cryptospore component from a Dapinginian (Ordovician) deposit from the Kanosh Shale in Utah (Vecoli, Beck & Strother, in revision).

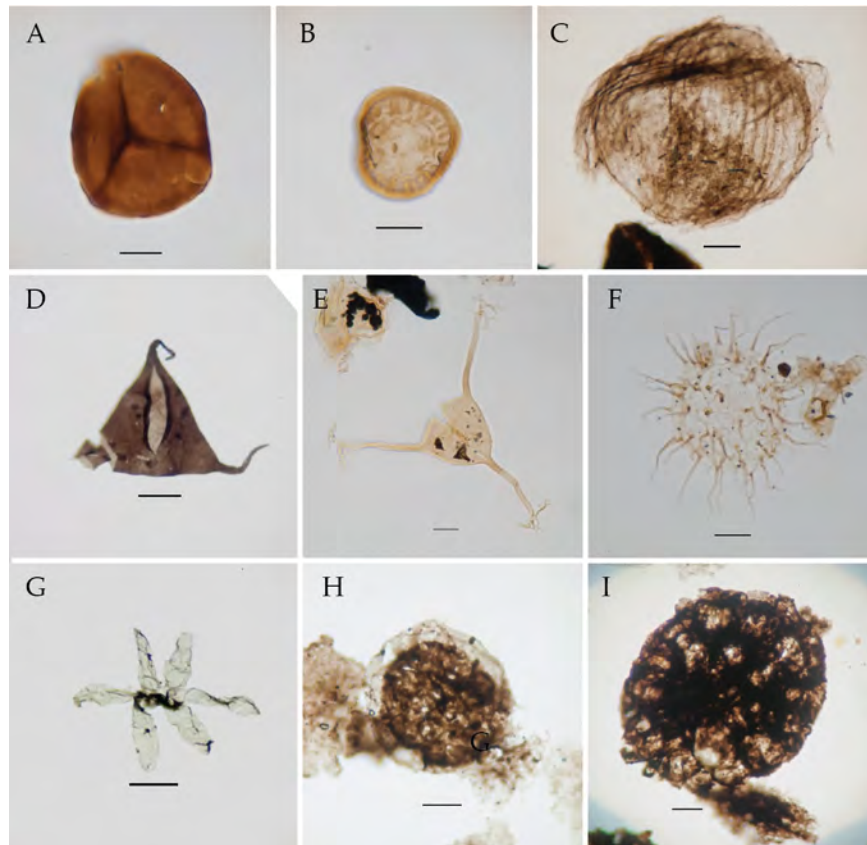


Figure 1. Various palynomorphs recovered from wells, Clay513, Preston119, Wayne1549 and WOO-351 . All scale bars are 10  $\mu$ m. **A.** *Ambitisporites dilutus* – a simple trilete spore, Wayne1549 3524 ft, Keefer Ss. **B.** *Dicryptosporites radiatus* Strother 1991 – a cryptospore, Wayne1549 3524 ft, Keefer Ss. **C.** *Moyeria cabottii* Thusu 1973 – a presumed euglenid, Clay513, 7493 ft, Tuscarora Fm. **D.** *Veryhachium* sp., Preston119 7333 ft., Tuscarora Fm. **E.** *Dateriocradus polydactylus* Tappan & Loeblich 1971 – an acritarch, Wayne1549 3524 ft, Keefer Ss. **F.** *Filisphaeridium williereae* Lister 1970 – an acanthomorph acritarch, Wayne1549 3531.5 ft, Keefer Ss. **G.** *Proteolobus* sp. – a presumed planktonic green alga, Preston119, 7322 ft., Tuscarora Fm. **H.** *Sphaerasaccus glabellus* – a simple cryptospore, WOO-351 1306.5 ft, Cambrian. **I.** Unnamed cellular rosette, WOO-351 1306.5 ft, Cambrian.

Table 1. Preston 119

Formation	well	depth	rD	OM type: AOM, SOM, PALY	<i>L. tenuissima</i> s.l.	cf. <i>L. tenuissima</i> (granular)	cf. <i>L. minutissima</i> (gray)	<i>Synsphaeridium</i> sp.	<i>Eltasum</i> sp.	<i>L. minutissima</i>	<i>Quadrasporites</i> sp.	<i>Lophosphaeridium</i> quartet	<i>Proteolobus</i> Wood 1997	<i>Trematosphaeridium</i> sp.	cf. <i>Tylospalla</i>	asymmetric baltisphaerid	<i>Lophosphaeridium edense</i>	<i>Multiplicisphaeridium</i> sp.	other acanthomorphs	<i>V. lairdi</i>	cf. <i>Petaliferium</i>	<i>Retisphaeridium</i> sp.	<i>Petatosphaeridium</i> sp.	<i>Rimosotetras problematica</i>	<i>T. grayae</i>	<i>Nematothallus cuticle</i>	comments
Tuscarara Fm?	Preston 119	7199		P																							
Tuscarara Fm?	Preston 119	7221	-22	S																							
Tuscarara Fm?	Preston 119	7223	-24	P		R	A	R																			
Tuscarara Fm?	Preston 119	7287.5	-88.5	S			R	R	R																		grey flakes
Tuscarara Fm?	Preston 119	7322	-123	P	•	•	•	•	C	•	C	A	R	R	•	R	•	•	R	R	R			R	R		grayish om
Tuscarara Fm?	Preston 119	7324	-125	P	•		•	•	C	•	A						•	•				R			•	grayish om	
Tuscarara Fm?	Preston 119	7326.9	-127.9	P	•		•	C	•	•	C		R	R	R	•			R							grayish om	
Tuscarara Fm?	Preston 119	7327	-128	P			•	C	C	•	•		R			•	•						R			grayish om	
Tuscarara Fm?	Preston 119	7337.5	-138.5	S	R	R																					poor recovery
Tuscarara Fm?	Preston 119	7345.5	-146.5	S		R																					poor recovery
Tuscarara Fm?	Preston 119	7366.5	-167.5																								barren
Tuscarara Fm?	Preston 119	7374.5	-175.5	P	•																						poor recovery
Tuscarara Fm?	Preston 119	7384	-185	S																							barren
Tuscarara Fm?	Preston 119	7390	-191																								barren
Tuscarara Fm?	Preston 119	7406.5	-207.5																								barren
Tuscarara Fm?	Preston 119	7420	-221																								barren
Tuscarara Fm?	Preston 119	7423	-224																								barren
Tuscarara Fm?	Preston 119	7425	-226																								barren





Table 4. WOO-351

Formation	well	depth	rD	OM type: AOM, SOM, PALY	blotchy sphaeromorphs	Agamachaetes ?	Trachysphaeridium	L. minutissima s.l.	organic tube, 16µm	unnamed cryospore dyad	Sphaerascoccus sp.	rosette cell clusters	Synsphaeridium sp.	Laevotaraxia divellomedium	Rimosoteras problematica	degraded Comasphaeridium	Dixalophasis spp.	Tylotopalla sp.	chitinozoans	graptolite fragments	metazoan cuticle	Nematothallus cuticle	comments
Martinsburg Sh	WOO-351	9498	TOP	P															A	A			dark brown
Black River Ls	WOO-351	9856	-358	P	•	•	•			R	•		•	R	•	R	R						dark brown, poor recovery
Black River Ls	WOO-351	10537	-1039	S			•																mixed macerals
Glenwood-St Peter Fm	WOO-351	11034	-1536	A			R																med brown, barren
Glenwood-St Peter Fm	WOO-351	11070	-1572	A																			clean particulate om, barren
Oneota Dol	WOO-351	11629.5	-2131.5	S			R																mixed macerals, barren
Mt Simon Ss	WOO-351	13025	-3527	A																			barren, med brpwn
Mt Simon Ss	WOO-351	13025.5	-3527.5	A						R	R												nearly barren
Mt Simon Ss	WOO-351	13039	-3541	A																			barren
Mt Simon Ss	WOO-351	13063.5	-3565.5	S	•	•	C		•	•											R		dirty mixed, dark brown
Mt Simon Ss	WOO-351	13088	-3590	S																			clean, structured, med brown om; barren
Mt Simon Ss	WOO-351	13127.5	-3629.5	P	A	A	•														•		dark brown, blotchy sphaeromorphs
Mt Simon Ss	WOO-351	13130.5	-3632.5	P	A	A	•	•	•														dark brown, blotchy sphaeromorphs
Mt Simon Ss	WOO-351	13133.5	-3635.5	P	A	A	•																dark brown, blotchy sphaeromorphs
Mt Simon Ss	WOO-351	13142	-3644	P	•	•																	dark brown, poorly-preserved clusters
Mt Simon Ss	WOO-351	13159	-3661	P	A	A	R																dark brown, poorly-preserved clusters
Mt Simon Ss	WOO-351	13170	-3672	S																			dark brown, barren

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