

PALYNOLOGICAL CHARACTERIZATION OF THE CANEY SHALE AND ASSOCIATED STRATA, OKLAHOMA, USA

Thomas Demchuk (Houston, TX)

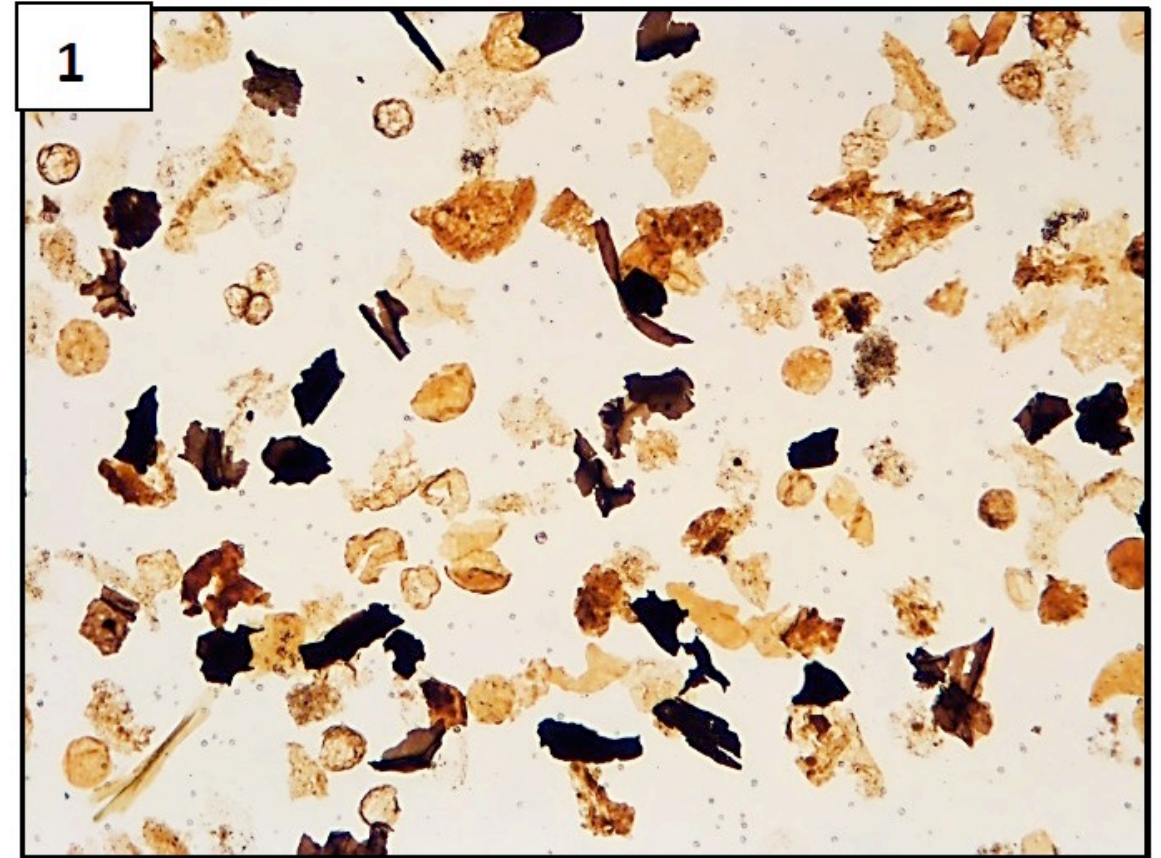
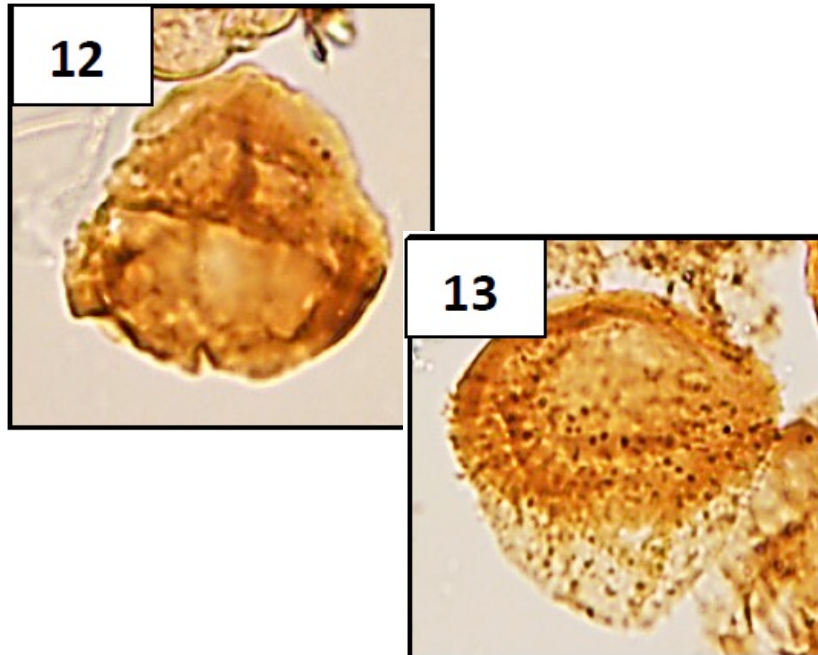
Salih Mahdi (Northwich, UK)

Fernando Mantilla (Northwich, UK)

RPS Energy/Group

Presentation Outline

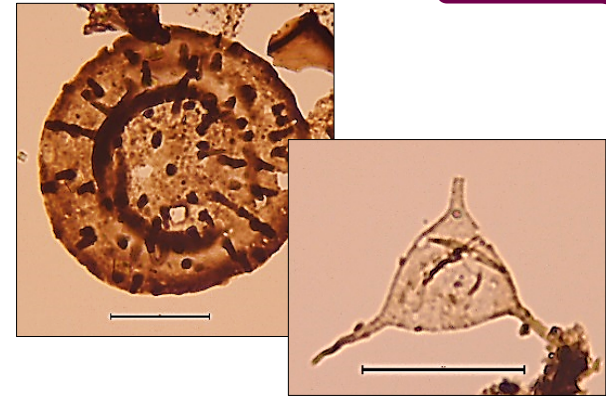
- Background
- Methodology
- Caney Shale Bio/Chronostratigraphy
- Conclusions and Path Forward



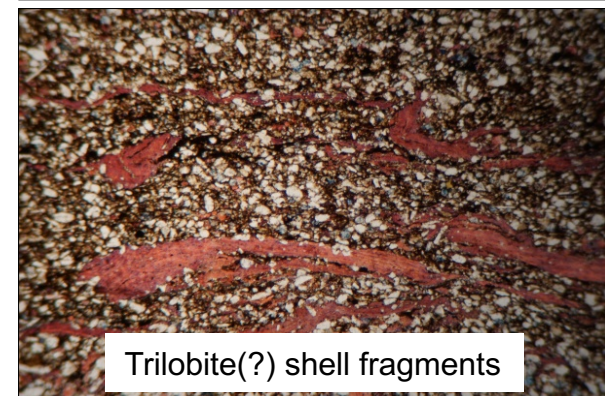
Caney Shale Bio/Chronostratigraphy

■ Background

- RPS is a global consultancy with over 5000 full-time employees
- RPS Energy consists of Specialist Geology, Well Operations, Seismic Operations, Laboratory Services
- Biostratigraphic Services including all disciplines
- Oklahoma Paleozoic strata amenable for biostratigraphic study
 - Palynology/Kerogen: dependent upon maturity
 - Other microfossil groups: fusulinids, conodonts
 - Thin-section micropaleontology: bio- and lithofacies
 - Have conducted studies for major Operators in the OK Scoop/Stack



Sponge Spicules



Trilobite(?) shell fragments

■ Current Study

- Part of the Caney Shale Consortium under direction of the OGS
- Have currently analysed 38 samples for palynology from outcrop and core
 - Additional samples currently being analysed by the Northwich Lab
 - Recovery has ranged from barren/poor to very good
 - Barren samples due to maturity, bacterial action
- Semi-quantitative evaluation of raw (unoxidized) kerogen
- 300 counts of palynofloral species where possible: further identification of age-significant species
- Full report with plates provided to the OGS

Caney Shale Bio/Chronostratigraphy

SYSTEM/SERIES		ANADARKO BASIN, SW OKLAHOMA	ARBUCKLE MOUNTAINS, ARDMORE BASIN	ARKOMA BASIN, NE OKLAHOMA	OUACHITA MOUNTAINS
QUATERNARY		Alluvium and Terrace Deposits			
TERTIARY		Ogallala Formation			
CRETACEOUS		Dakota Group			
JURASSIC		Morrison Formation			
TRIASSIC		Dockum Group			
PERMIAN	Ochoan	Elk City Sandstone Doxey Shale			
	Guadalupian	Cloud Chief Formation Whitehorse Group El Reno Group			
	Leonardian	Hennessey Shale Garber Sandstone Wellington Formation	Garber Sandstone Wellington Formation		
	Wolfcampian	Chase Group Council Grove Group Admire Group	Pontotoc Group	Pontotoc Group Chase Group Council Grove Admire Group	
PENNSYLVANIAN	Virgilian	Wabunsee Group Shawnee Group Douglas Group	Ada Formation Vamoosa Formation	Ada Fm. Vamoosa	Wabunsee Shawnee Douglas
	Missourian	Ochelata Group Skiatook Group	Hoxbar Group	Hilltop Fm. Skiatook Group	Ochelata Group
	Desmoinesian	Marmaton Group Cherokee Group	Deese Group	Marmaton Group Cabaniss Group Krebs Group	
	Atokan	Atoka Group	Dornick Hills Group	Atoka Formation	Atoka Formation
	Morrowan	Morrow Group		Wapanucka Union Valley	McCully Sausbee
		Springer Formation	Springer Formation		
MISSISSIPPIAN	Chesterian	Chester Group	Goddard Formation Delaware Creek Shale	Pitkin Limestone Fayetteville Shale Hindsville Formation	Stanley Group
	Meramecian	"Meramec Lime"	Sycamore Limestone	Boone Group St Joe Group	
	Osagean	"Osage Lime"			
	Kinderhookian	Woodford Shale	Woodford Shale	Chattanooga Shale Sylamore Sandstone	
EVONIAN	Upper	Misener Sandstone		Sallisaw Fm.	
	Middle				

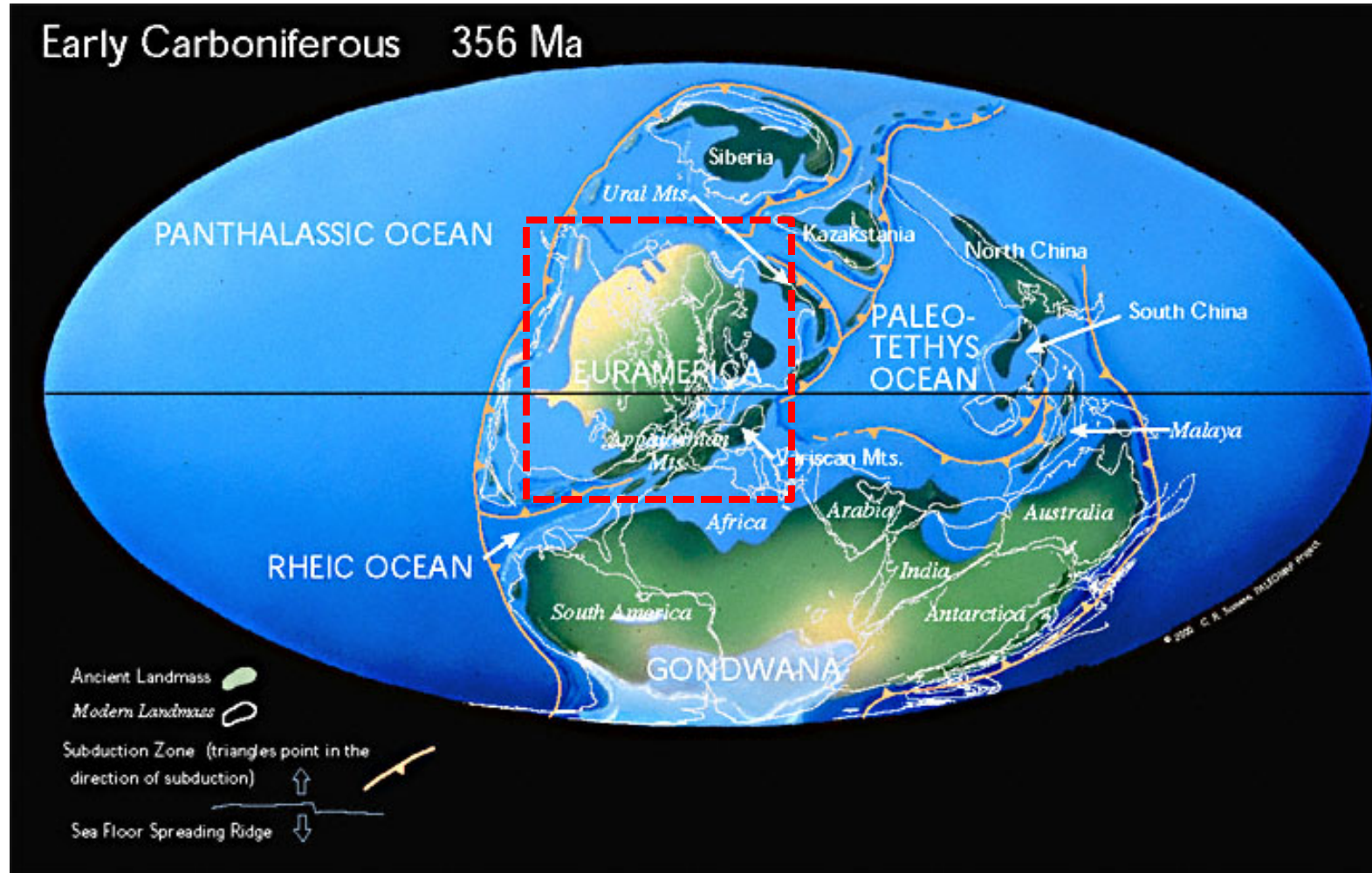
- Cardott (2017)
Oklahoma Shale Resource Plays
- Caney Shale may range in age through the Mississippian (Kinderhookian to Chesterian)
- Previous publications:
Caney Shale is Meramecian to Chesterian in age, or limited to Meramecian

Caney Shale Bio/Chronostratigraphy

Chronostratigraphy		North America Stages	Western Europe Stages				Miospore Biostratigraphy	
							Clayton et al., 1977 & Higgs et al., 1988	Smith & Butterworth, 67
P e n n s y l v a n i a n	Gzhelian	Virgilian	Silesian	Stephanian			<i>P. novicus/bhardwaji</i> - <i>C. major</i> (NMB)	
	Kasimovian	Missourian			C		<i>A. splendidus</i> - <i>L. triletes</i> (ST)	
		Desmoinesian			B			
					Barruelian			
	Moscovian	Atokan		Cantabrian		<i>T. obscura</i> - <i>T. thaesseni</i> (OT)	<i>T. obscur</i> (XI)	
				D	Asturian	<i>T. securis</i> - <i>T. laevigata</i> (SL)		<i>T. securis</i> (X)
				C	Bolsovian	<i>M. nobilis</i> - <i>F. junior</i> (NJ)		<i>V. magna</i> (IX)
	Baskirianh	Morrowan		B	Duckmantian	<i>R. aligerens</i> (RA)	<i>D. bireticlatus</i> (VIII)	
				A	Langsettian		<i>S. rara</i> (VII)	<i>R. aligerens</i> (VI)
							<i>T. sinani</i> - <i>C. saturni</i> (SS)	<i>D. anulatus</i> (V)
M i s s i p p i a n	Serpukhovian	Chesterian		Namurian	C	Yeadonian	<i>R. fulva</i> - <i>R. reticulatus</i> (FR)	<i>C. kosankei</i> (IV)
					B	Marsdenian	<i>C. kosankei</i> - <i>G. variocorneus</i> (KV)	
					A	Kinderhookian	<i>L. subtriqueta</i> - <i>K. ornatus</i> (SO)	
						Alportian	<i>M. trigallerus</i> - <i>R. knoxi</i> (TK)	
	Visean	Meramecian		Visean		Arnsbergian	<i>B. nitidus</i> - <i>R. carnosus</i> (NC)	<i>R. knoxi</i> (III)
					Pendelian	<i>T. vetustus</i> - <i>R. fructa</i> (VF)	<i>D. saetosus</i> (II)	
					Brigantian	<i>M. margodentata</i> - <i>R. ergonulii</i> (ME)	G.	
					Asbian	<i>T. distinctus</i> - <i>M. pathenopia</i> (DP)		
	Holkarian	<i>P. tessellata</i> - <i>S. camylotera</i> (TC)						
	Arundian	<i>K. triradiatus</i> - <i>K. stephanephorus</i> (TS)						
	Tournasian	Osagean		Tournasian	Chadian	<i>Lycospora pusilla</i> (Pu)		
					Courceyan	<i>S. claveger</i> - <i>A. macra</i> (CM)		
						<i>S. pretiosus</i> - <i>R. clavata</i> (PC)		
						<i>S. balteatus</i> - <i>R. polyptecha</i> (BP)		
		Kinderhookian				<i>K. Hubernicus</i> - <i>U. distinctus</i> (HD)		
					<i>V. verrucosus</i> - <i>R. incohatus</i> (VI)			

- Clayton et al. (1977)
Carboniferous Miospores of Western Europe
- Much more detailed miospore biozonation allows for more accurate age interpretations

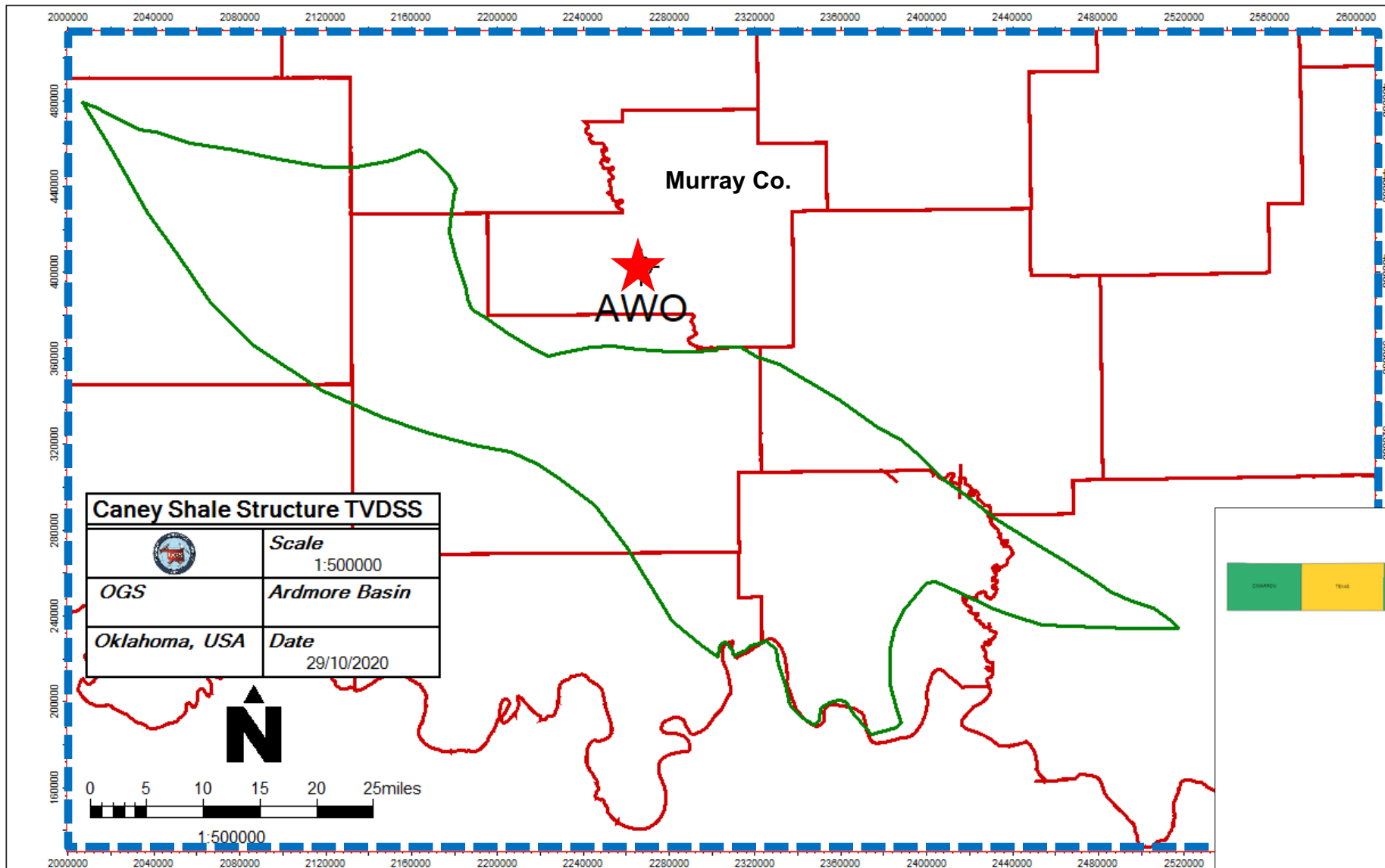
Caney Shale Bio/Chronostratigraphy



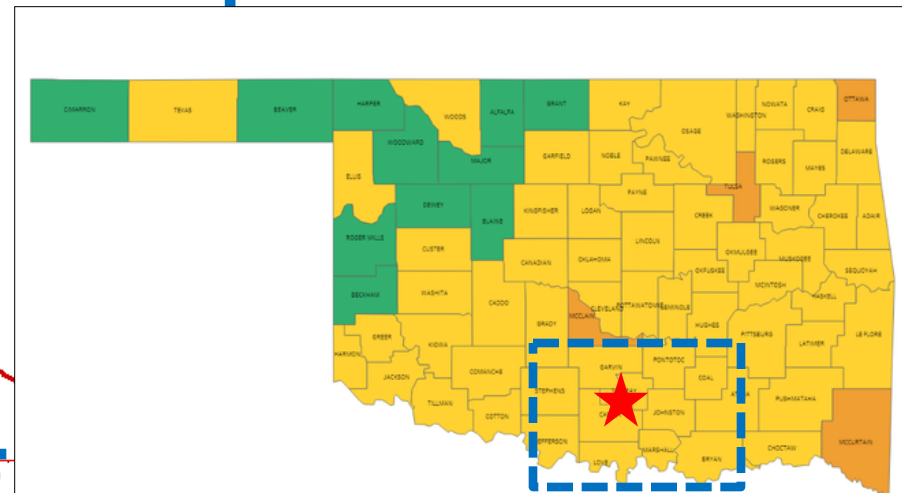
Scotese:PaleoMaps

- Early Carboniferous Paleogeography
- The Euramerican continent and juxtaposition of North America and Europe allows for translation of the miospore biozonations

Caney Shale Bio/Chronostratigraphy



- Arbuckle Wilderness Outcrop
- Ardmore Basin/ Arbuckle Uplift
- Murray County



Arbuckle Wilderness Caney Shale Outcrop

50 ft

Upper Caney Outcrop

Middle Caney Outcrop

Lower Caney Outcrop

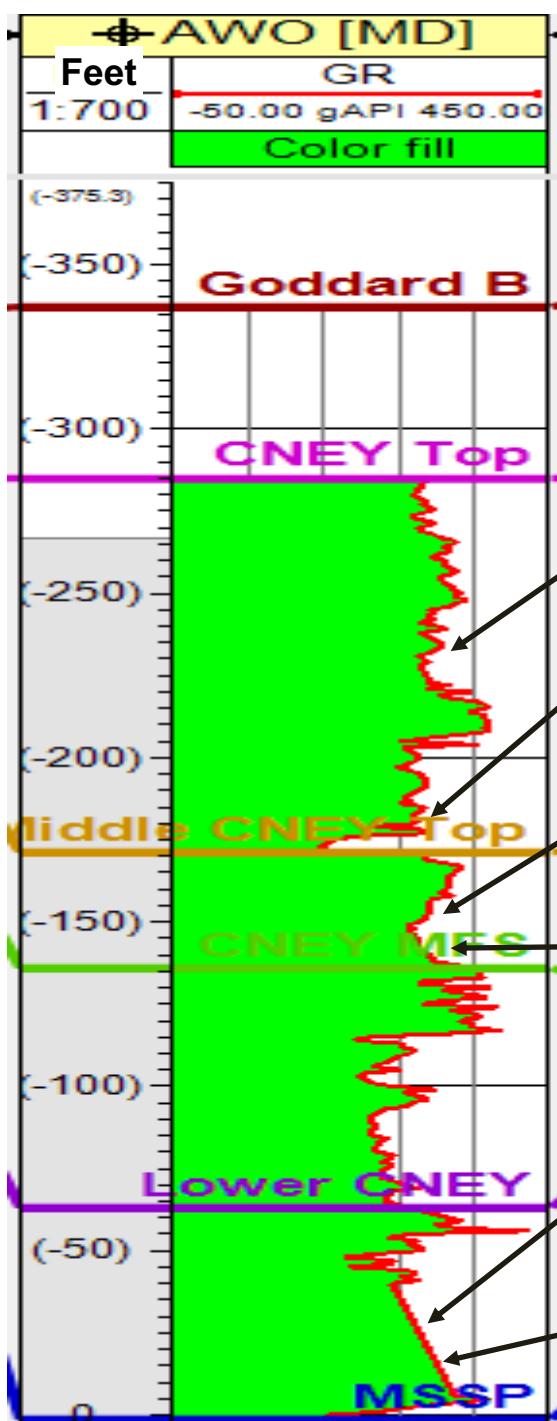
Sycamore Outcrop

Map

Google

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Caney Shale Bio/Chronostratigraphy



Sample location across the AWO, measured from base to the top.

Upper Caney: 235ft. Silica-rich light gray mudstone. Clay rich.

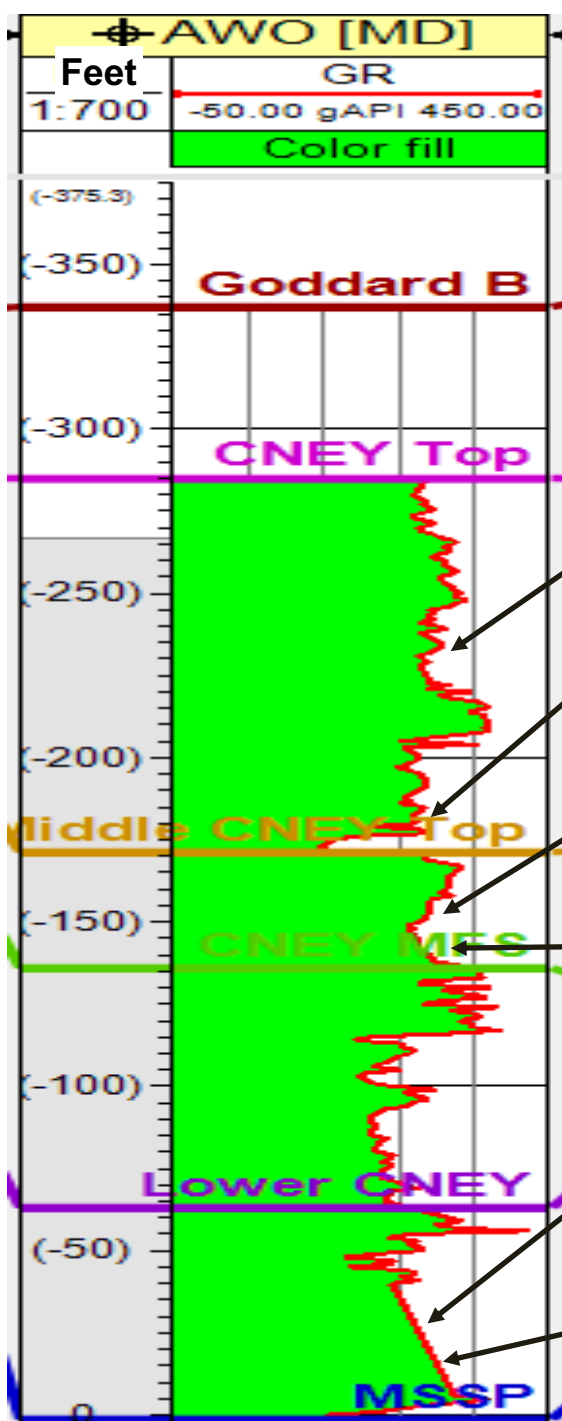
Upper Caney: 185ft. No description provided.

Middle Caney: 150ft. Very fine sandstone. Dark gray color.

Middle Caney: 140ft. Dark yellow very fine slit rich mudstone.

Lower Caney: 24ft. Light gray clay-rich mudstone

Lower Caney: 22ft. Black clay-rich mudstone. Swelling clay-rich, probable organic-rich.



Caney Shale Bio/Chronostratigraphy

Kerogen Descriptions

235ft.: Very rich but poorly preserved assemblage.

Dominated by mixed amorphous matter and structured black/brown wood (inertinite/vitrinite) with acritarchs and scolecodonts

185ft.: Moderately rich but poorly preserved assemblage.

Dominated by highly degraded/structureless amorphous matter, with acritarchs

150ft.: Rich but poorly preserved assemblage.

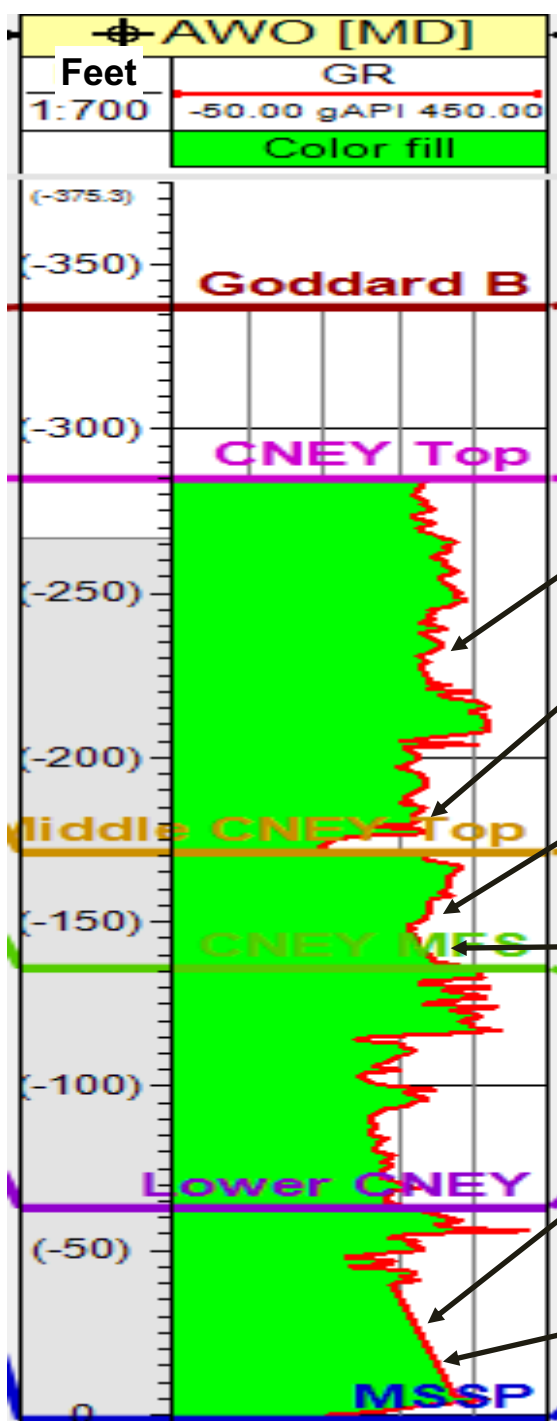
Dominated by mixed amorphous matter and structured black/brown wood (inertinite/vitrinite) with acritarchs and scolecodonts

140ft.: Rich but poorly preserved assemblage.

Dominated by high degraded/structureless AOM (amorphous organic matter)

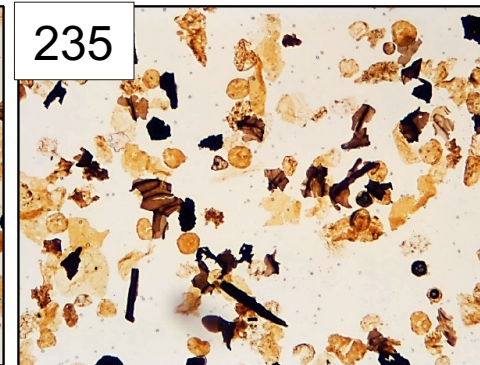
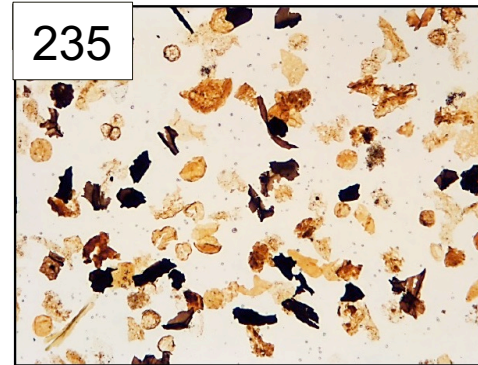
22ft. & 24ft.: Rich but poorly preserved assemblage.

Dominated by high degraded/structureless AOM (amorphous organic matter)

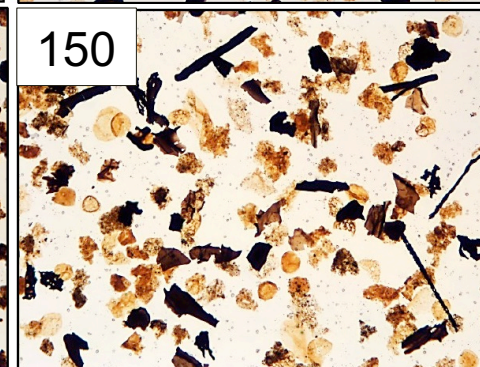
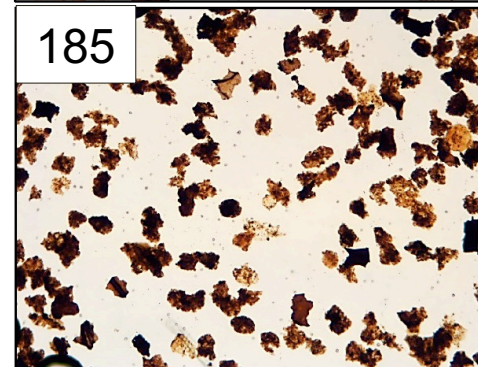


Caney Shale Bio/Chronostratigraphy

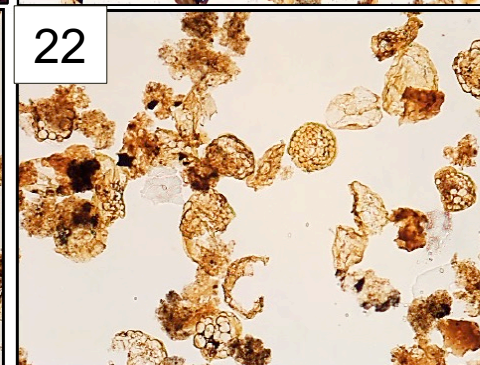
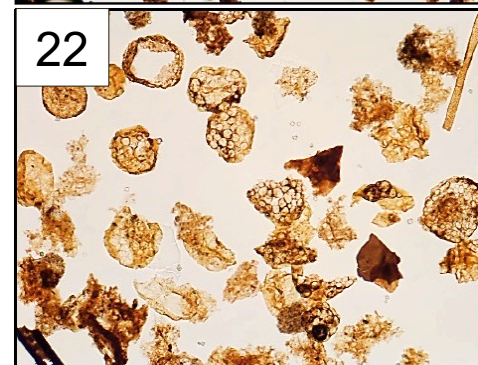
Kerogen Descriptions



235ft.: Mixed AOM, structured black/brown wood

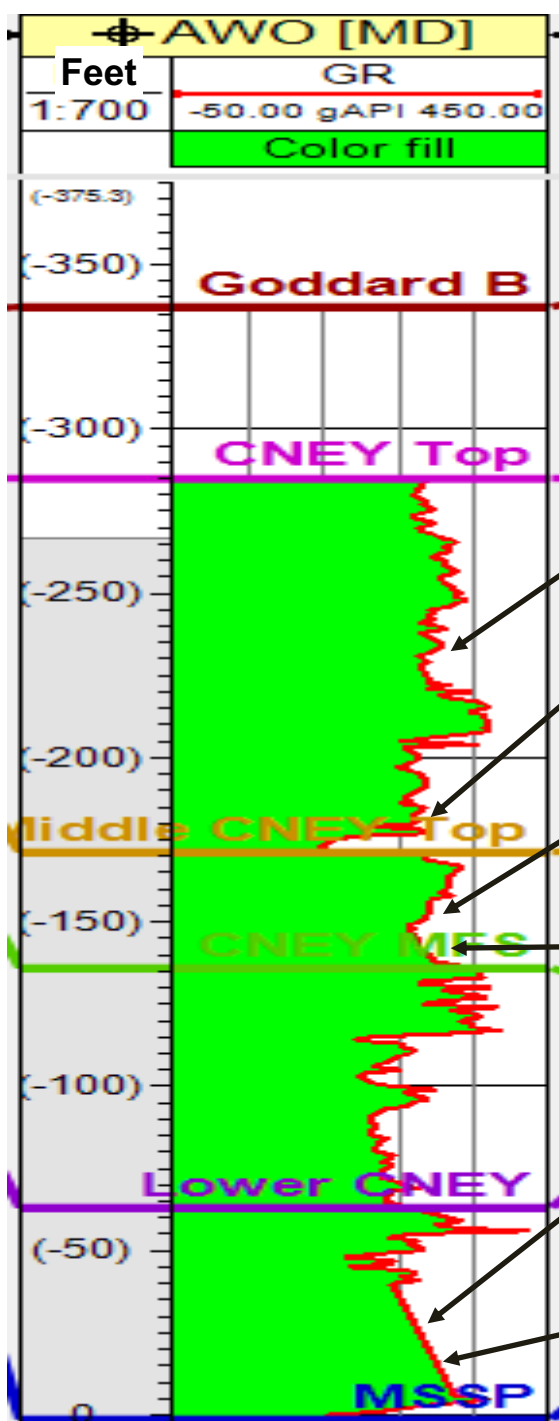


185ft.: Highly degraded AOM
150ft.: Mixed AOM, structured black/brown wood



22ft.: Highly degraded AOM



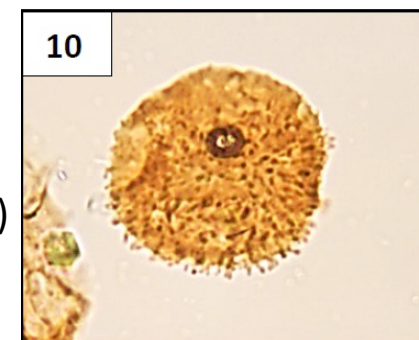


Caney Shale Bio/Chronostratigraphy

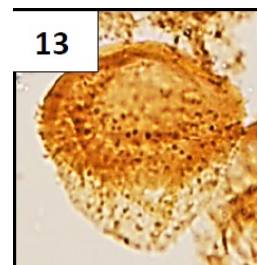
Chronostratigraphy from Palynology



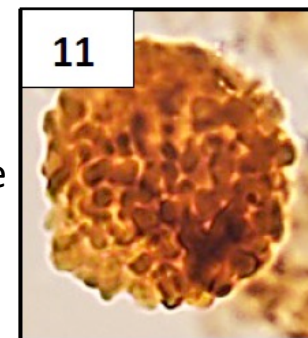
Scolecodont
(marginal marine)



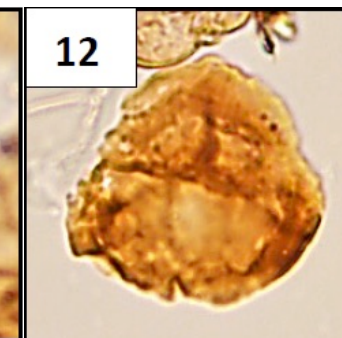
Schopfites
claviger



Speleotriteles sp.



Verrucosisporites
nitidus



Lycospora
pussila

Indeterminate

Indeterminate

Visean: no younger than Asbian stage (earliest Chesterian)

Indeterminate

Visean: no younger than Holkarian stage
(Meramecian)

Caney Shale Bio/Chronostratigraphy

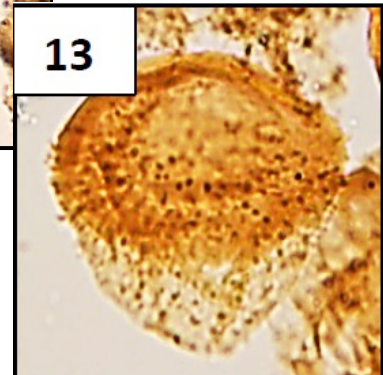
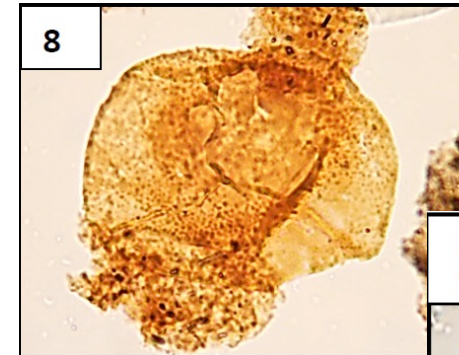
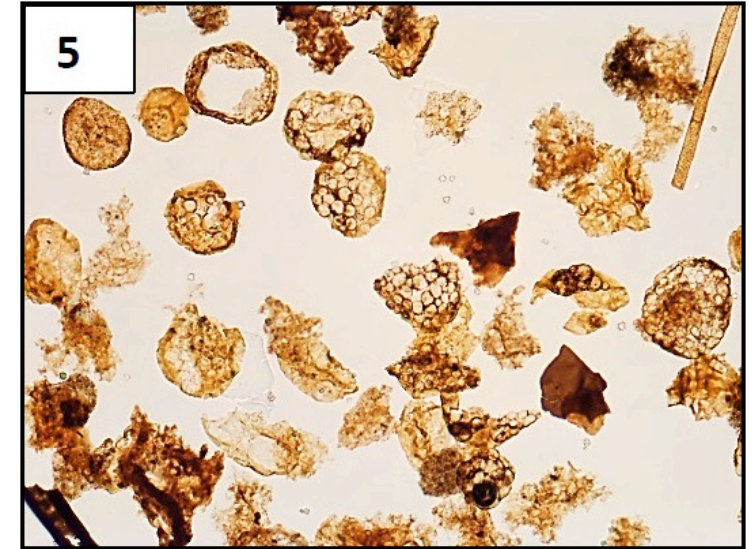
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	Kasimovian	Missourian		Stephanian	C				
					B				
					Barruelian			<i>A. splendidus</i> - <i>L. triletes</i> (ST)	
	Moscovian	Desmoinesian			Cantabrian		<i>T. obscura</i> - <i>T. thaesseni</i> (OT)	<i>T. obscurus</i> (XI)	
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M i s s i s i p p i a n	Serpukhovian	Chesterian		Namurian	C	Yeadonian	<i>R. fulva</i> - <i>R. reticulatus</i> (FR)	<i>D. anulatus</i> (V)	
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							Kinderscoutian		
							Alportian		
	Visean		Dinantian	Visean		Chokierian	<i>L. subtriquetra</i> - <i>K. ornatus</i> (SO)		
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						M. macrodonatus - R. ergonensis (ME)	<i>T. distinctus</i> - <i>M. pathenopia</i> (DP)	G.	
						Asbian	<i>P. tessellata</i> - <i>S. camylotera</i> (TC)		
	Meramecian					Holkarian	<i>M. macrodonatus - R. ergonensis (ME)</i>		
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						Chadian	<i>Lycospora pusilla</i> (Pu)		
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Tournasian	Kinderhookian				<i>V. verrucosus</i> - <i>R. incohatus</i> (VI)				

- Samples 22ft.-24ft.
 - Visean, no younger than Holkarian Stage
 - TS Miospore Zone
 - **Meramecian**
- Sample 150ft.
 - Visean, no younger than Asbian Stage
 - TS/TC Miospore Zone
 - **Earliest Chesterian**

Caney Shale Bio/Chronostratigraphy

■ Conclusions/Review of WOA Samples

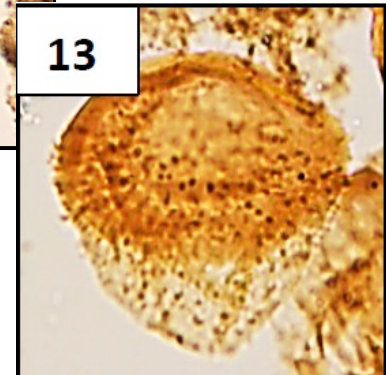
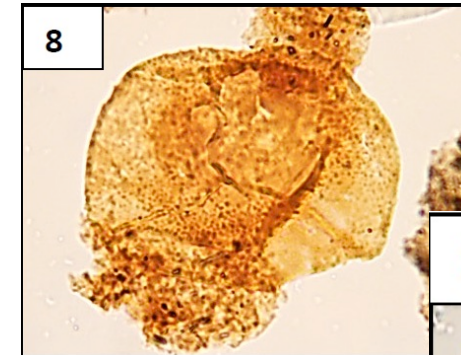
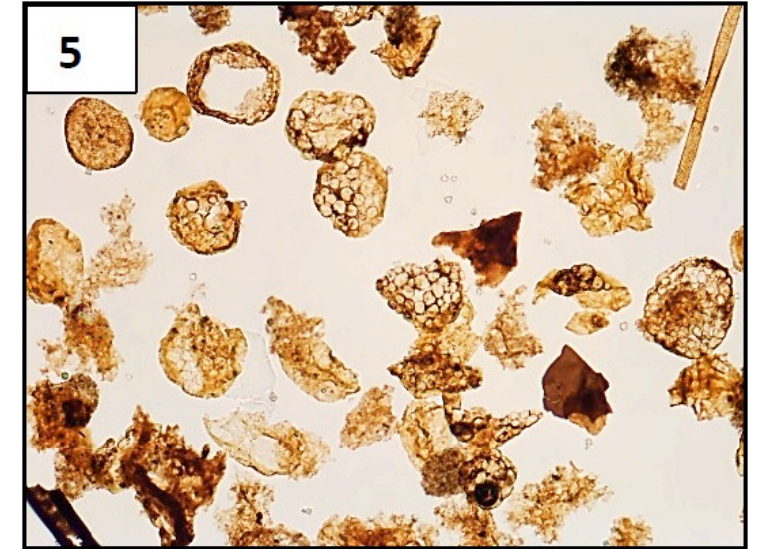
- Chronostratigraphy:
 - Miospore assemblages indicate a Meramecian to earliest Chesterian age
 - Holkarian-Asbian European Stages
 - TS/TC Miospore Zones
- Depositional Paleoenvironments:
 - Lower samples (22ft.-140ft.): dominated by miospores with mixed AOM and structured black/brown wood
 - Upper samples (150ft.-235ft.): miospores with acritarchs/scolecodonts with mixed AOM
 - Pro-delta paleoenvironment: significant terrestrial input to a marginal marine paleoenvironments



Caney Shale Bio/Chronostratigraphy

■ Path Forward

- Integration of data/interpretations from the Elliott, Davey Jones, AS Moore Estate and other core samples
- Additional samples from the Caney Shale, Goddard Shale, and Sycamore Limestone currently under investigation
 - Sycamore Limestone: thin-section micropaleontology for bio- and lithofacies analysis
- Interpretation of data considering geographic and lithostratigraphic context
- Integration of interpretations with other geological data as part of the ongoing consortium



Thank You!



Oklahoma