

# Petrified Wood in Oklahoma

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Tahlequah Rock and Mineral Society  
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A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, extending from the right edge towards the center.

# Outline

1. Petrified Wood in Oklahoma
2. Petrification, other types of Preservation
  - a. The Mineralogy of Petrified Wood
3. Plant (Tree) Classification, Evolution, and Ecology
  - a. The Paleobotany of Petrified Wood
4. The Age of Petrified Wood
  - a. Geochronology
5. Oklahoma Occurrences
6. Petrified Wood and Architecture

# Petrified Wood Parks and Preserves in the U.S.



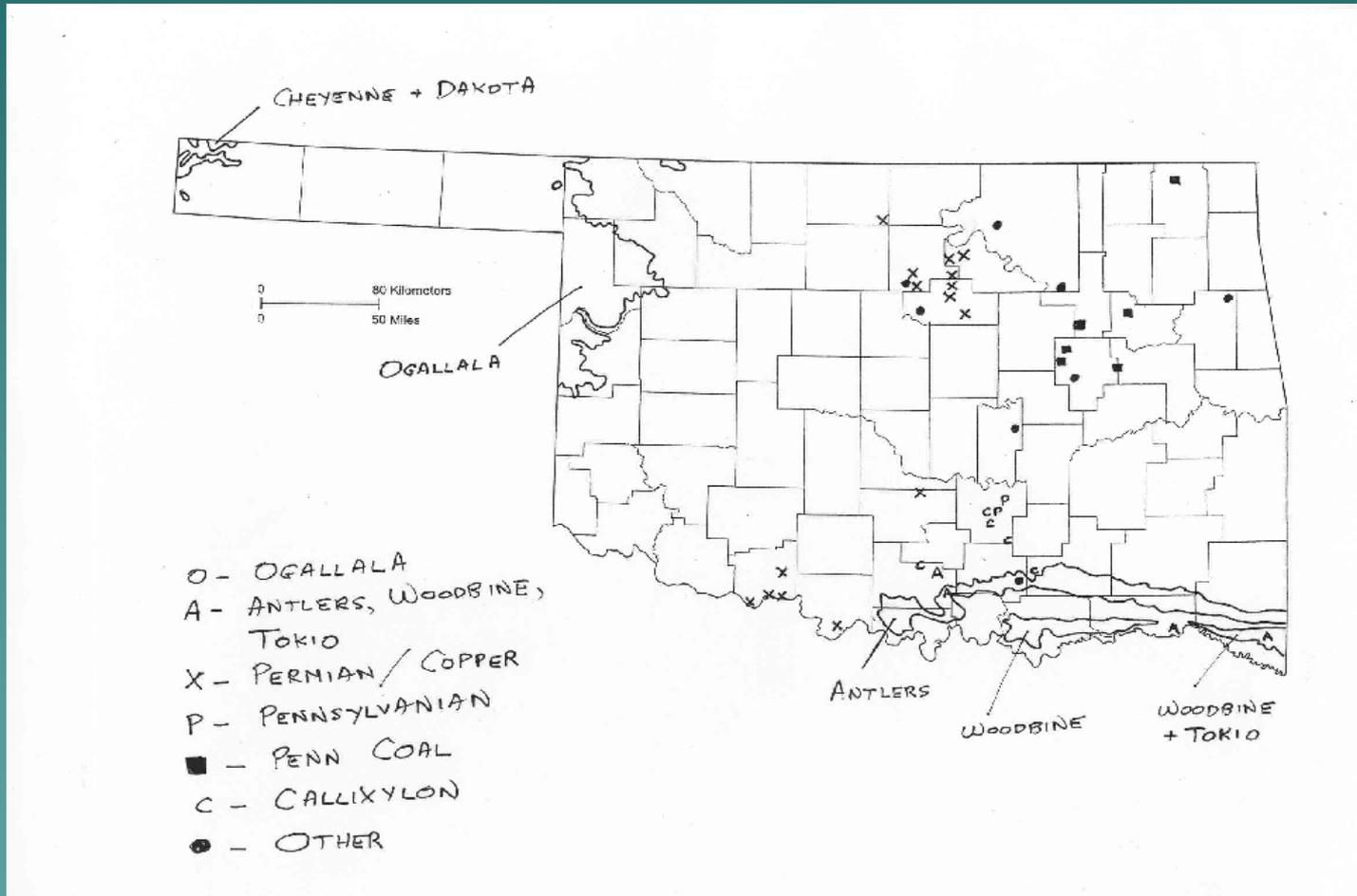
# Petrified Wood in Oklahoma

- As pebbles and cobbles in major river systems. Transported, derived from older geological formations to west
- As "in situ" logs, branches, stems. Either in growth position or, more commonly, in place where originally petrified

# Petrified Wood Gravel



# “Real” Petrified Wood in Oklahoma



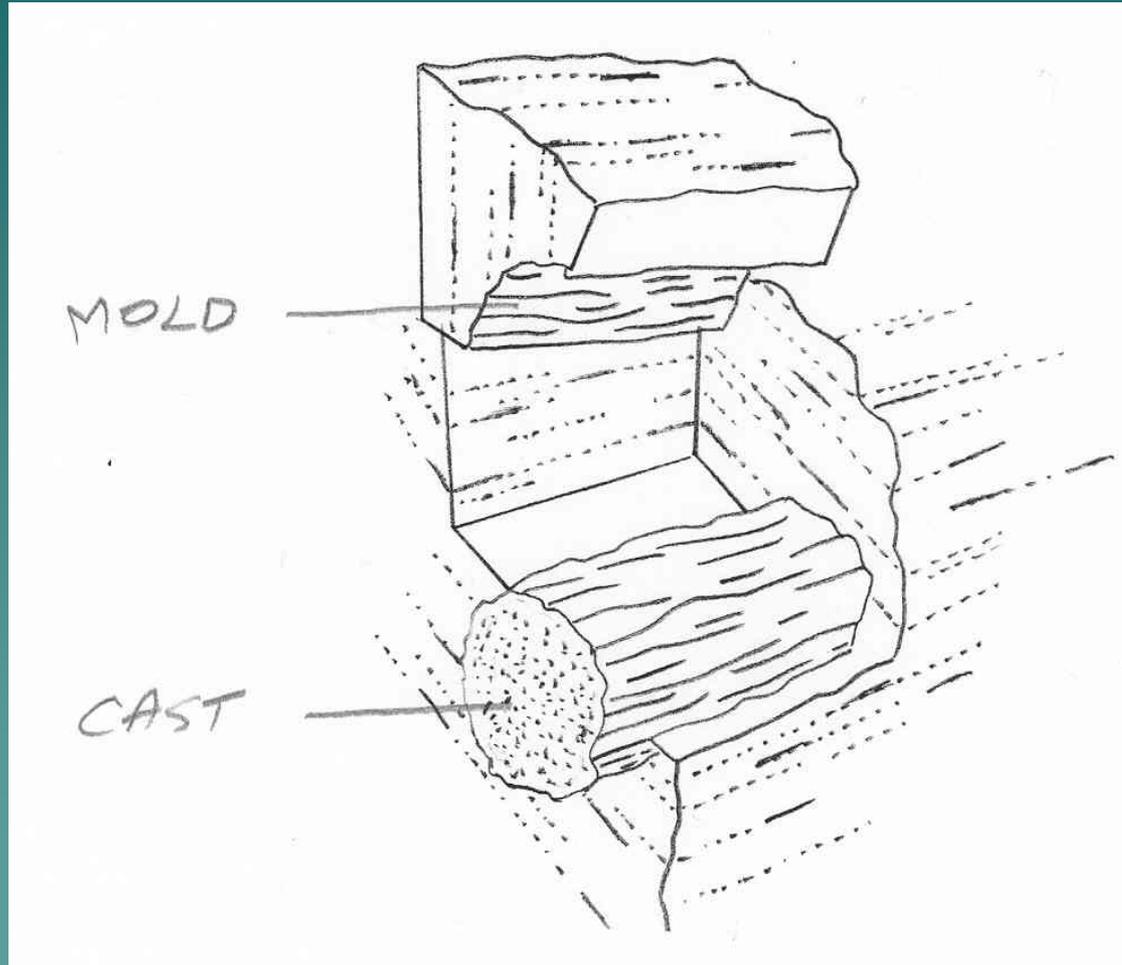
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# Preservation – Compressions and Impressions



# Preservation – Molds and Casts



# Savanna Fm., Lequire outcrop





Students looking  
at carbonized  
mold of large  
lycopod in growth  
position, Savanna  
Fm., just south of  
Lequire, OK



Cast of  
lycopod root  
system (above)  
and cast of  
lycopod stump  
(below) from  
near Kinta, OK

# Mineralization

## Carbonates

**Calcite –  $\text{CaCO}_3$**

Aragonite –  $\text{CaCO}_3$

Dolomite –  $\text{CaMg}(\text{CO}_3)_2$

Siderite –  $\text{FeCO}_3$

Magnesite –  $\text{MgCO}_3$

Hydromagnesite –  
 $\text{Mg}_5(\text{OH})_2(\text{CO}_3)_4 \cdot 4\text{H}_2\text{O}$

Nesquehonite –  
 $\text{Mg}(\text{HCO}_3)(\text{OH}) \cdot 2\text{H}_2\text{O}$

Ankerite –  $\text{Ca}(\text{Fe}, \text{Mg})(\text{CO}_3)_2$

Cerussite –  $\text{PbCO}_3$

**Malachite –  $\text{Cu}_2\text{CO}_3(\text{OH})_2$**

**Azurite –  $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$**

## Sulfides

Pyrite –  $\text{FeS}_2$

Marcasite –  $\text{FeS}_2$

Cinnabar -  $\text{HgS}$

Galena -  $\text{PbS}$

Sphalerite -  $\text{ZnS}$

Chalcopyrite –  $\text{CuFeS}_2$

**Chalcocite –  $\text{Cu}_2\text{S}$**

Bornite –  $\text{Cu}_5\text{FeS}_4$

Covellite -  $\text{CuS}$

# Mineralization (continued)

## Sulfates

**Barite – BaSO<sub>4</sub>**

Gypsum – CaSO<sub>4</sub>.2H<sub>2</sub>O

Langite – Cu<sub>4</sub>(OH)<sub>6</sub>  
(SO<sub>4</sub>).2H<sub>2</sub>O

Posnjakite – Cu<sub>4</sub>(OH)<sub>6</sub>  
(SO<sub>4</sub>).H<sub>2</sub>O

Schulenbergite –  
(Cu,Zn)<sub>7</sub>(OH)<sub>10</sub>(SO<sub>4</sub>,  
CO<sub>3</sub>)<sub>2</sub>.3H<sub>2</sub>O

Bassanite – CaSO<sub>4</sub>.1/2  
H<sub>2</sub>O

## Oxides

**Hematite – Fe<sub>2</sub>O<sub>3</sub>**

Melaconite (Tenorite) -  
CuO

**Limonite – FeO(OH).  
nH<sub>2</sub>O**

**Goethite – HFeO<sub>2</sub>**

Lepidocrocite – FeO(OH)

Uraninite – UO<sub>2</sub>

Ramsdellite – MnO<sub>2</sub>

Groutite – MnO(OH)

# Mineralization – more!!!

Fluorides (1)

Phosphates (7)

Hydrated silicates (8)

Hydrated vanadates (3)

Elemental Minerals (3)

Organic compounds and  
hydrocarbons (7)

# Silicified Wood



## Silica Minerals

Opal-A

Opal-CT

Chalcedony

Quartz

# Mineralization - Silicification

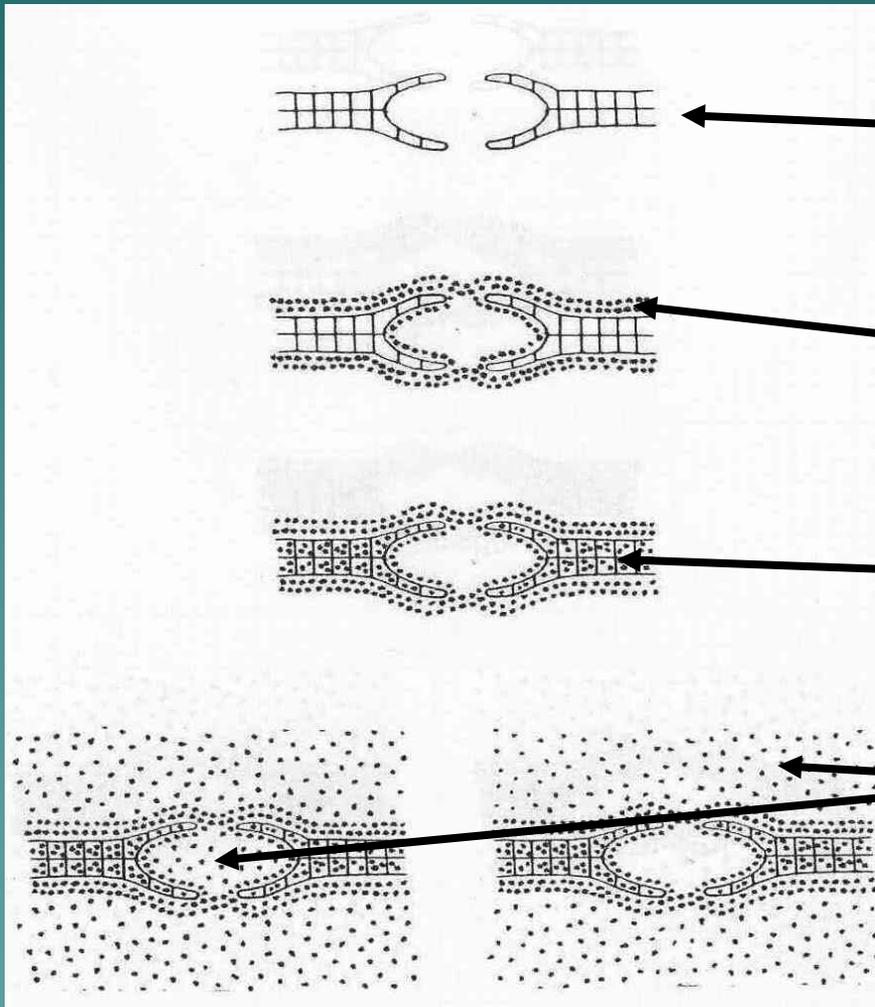
1. Rapid burial, absence of oxygen
2. pH near neutral
3. Source of silica (e.g., volcanic ash)
  - a. Silica dissolves, goes into solution as monosilicic acid  $\text{Si(OH)}_4$
  - b/c. Monosilicic acid polymerizes (forms large molecules), releases water, contains OH bonding sites
  - c/b. Form H bonds with similar OH bonding sites on organic molecules
4. Other factors – moisture, temperature, aeration, sedimentary setting

# Silicification (continued)

5. Organic molecules "templated" with layer upon layer of silicic acid monomers and/or polymers
6. Polymers form gel coating
7. Gel loses water, solidifies to amorphous opal-A
8. Over time, opal-A crystallizes and loses water, forming opal-CT (cristobalite and tridymite)
9. With continued crystallization and water loss, opal-CT transforms to chalcedony
10. Over more time, chalcedony crystallizes into quartz (wood structure destroyed)

Age a factor – recent Yellowstone wood opal-A; Pliocene and upper Miocene wood opal-CT; post-Eocene wood chalcedony and microgranular quartz (Stein, 1982)

# Templating, Filling Cells and Pore Spaces



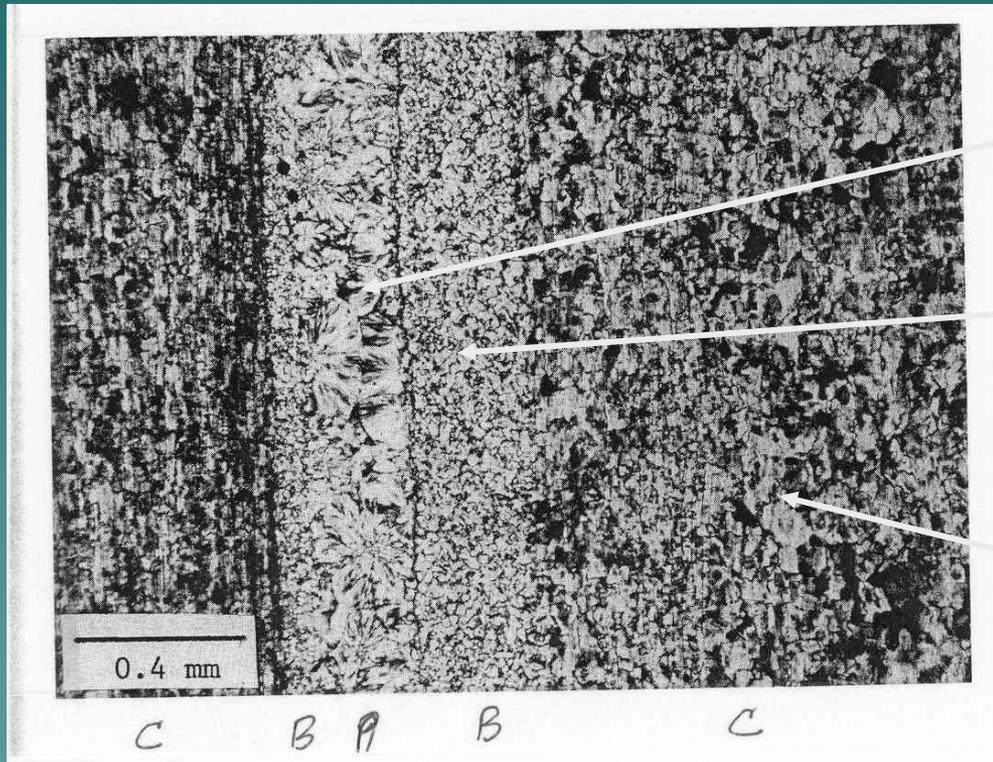
Wood cell

Templating

Wood Cell Filled

Pore Space Filled

# Silica minerals



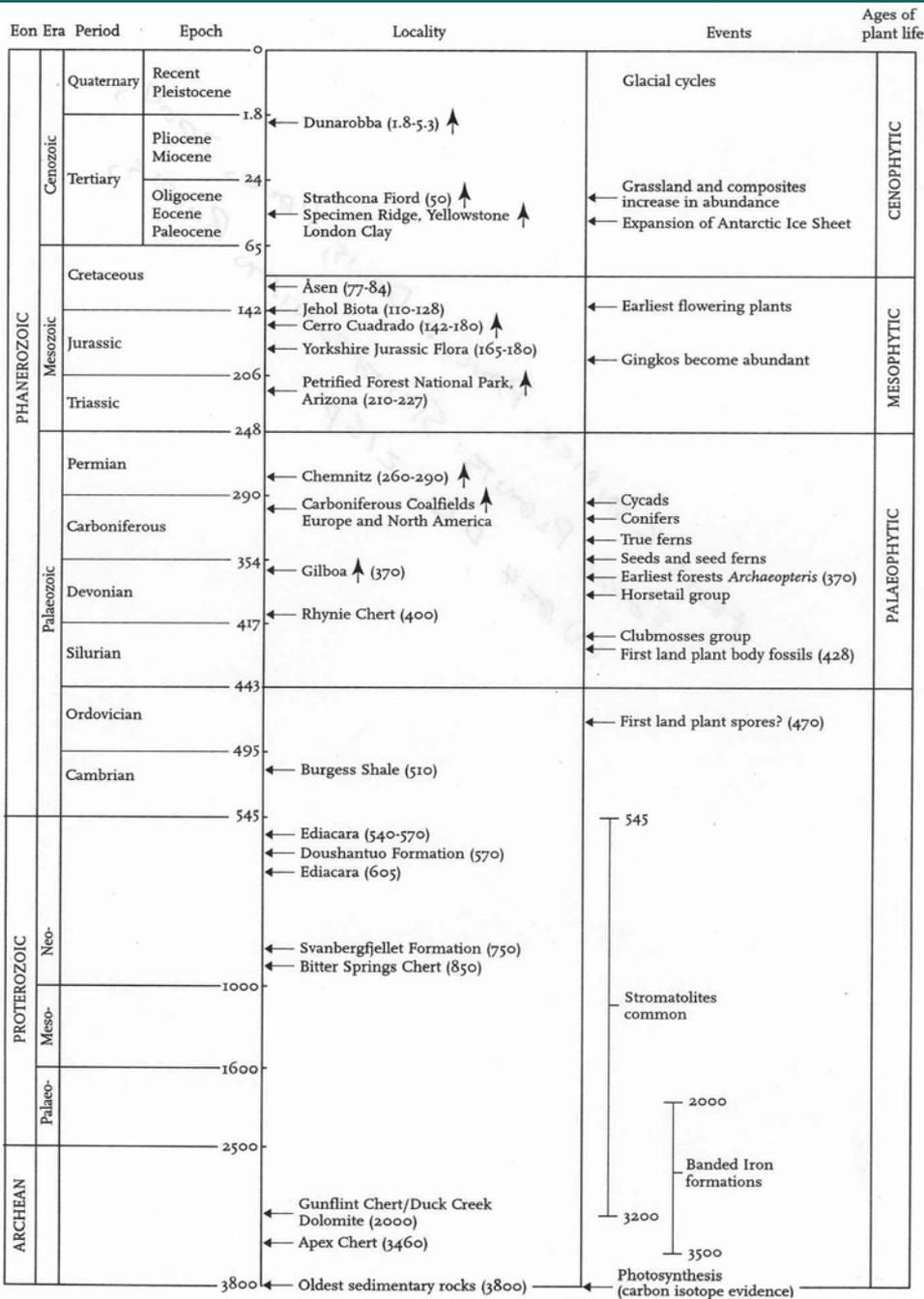
Chalcedony

Microcrystalline  
quartz

Coarsely  
crystalline  
quartz

# Outline

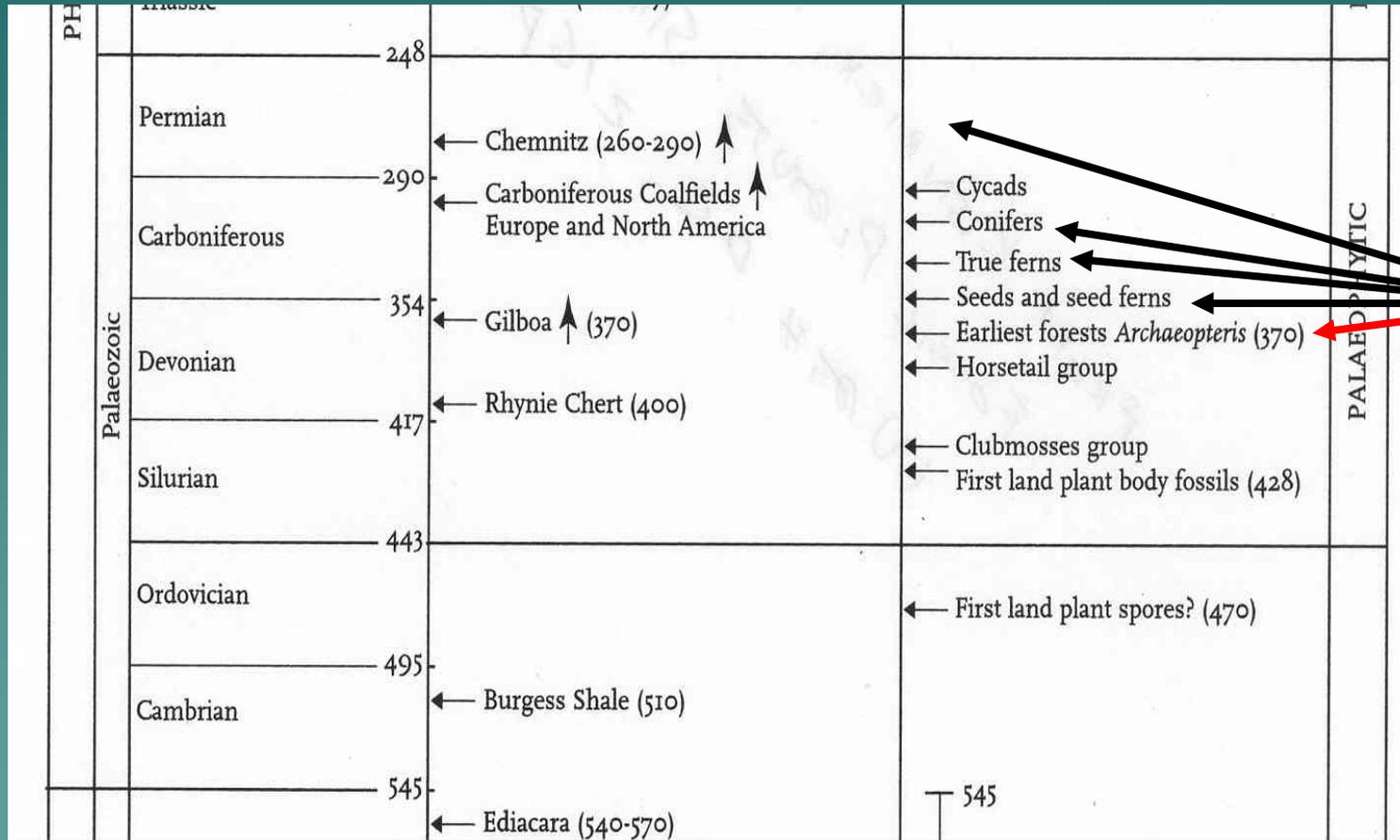
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# Plant Time Scale

Precambrian – stromatolites  
 Ordovician – first land plant spores?  
 Silurian – first land plant body fossils

# Paleozoic Plant Time Scale



PALAEOPHYTIC

OK

# Devonian – *Archaeopteris* (*Callixylon*)

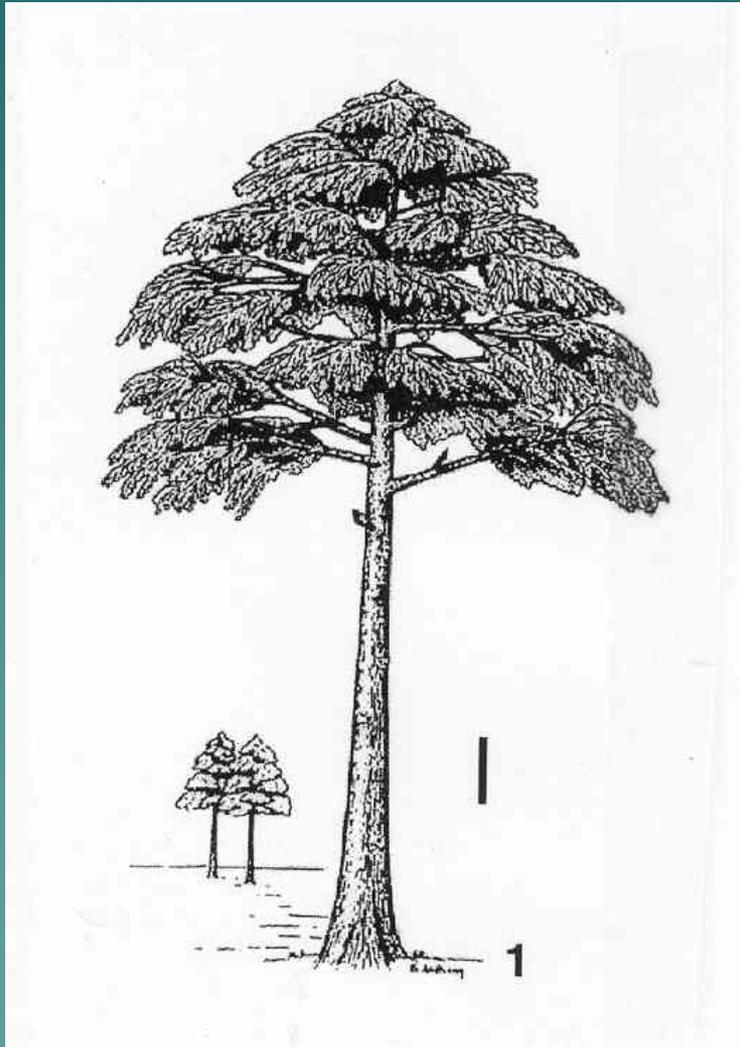
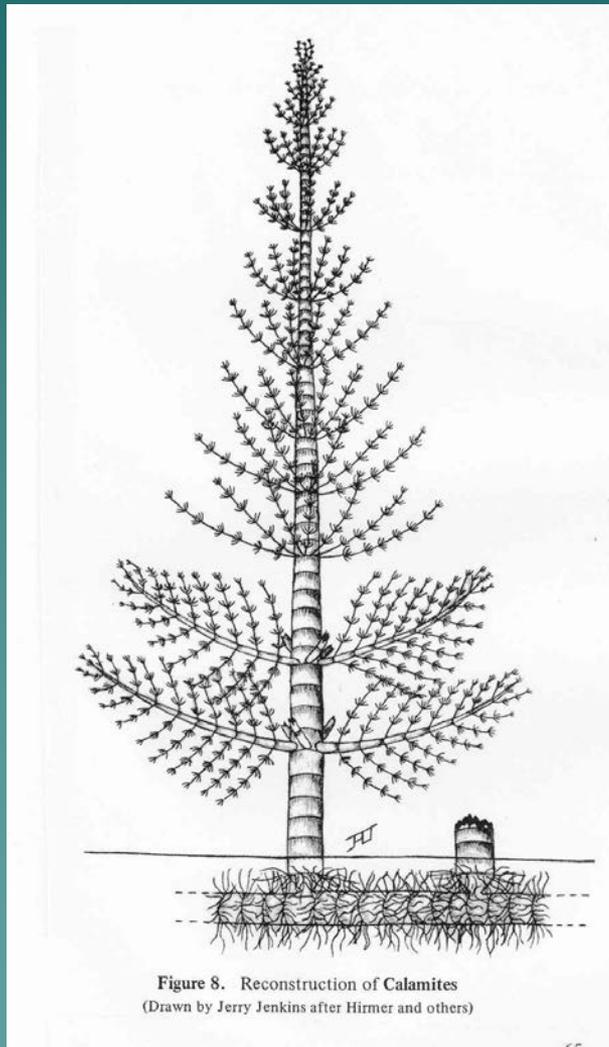
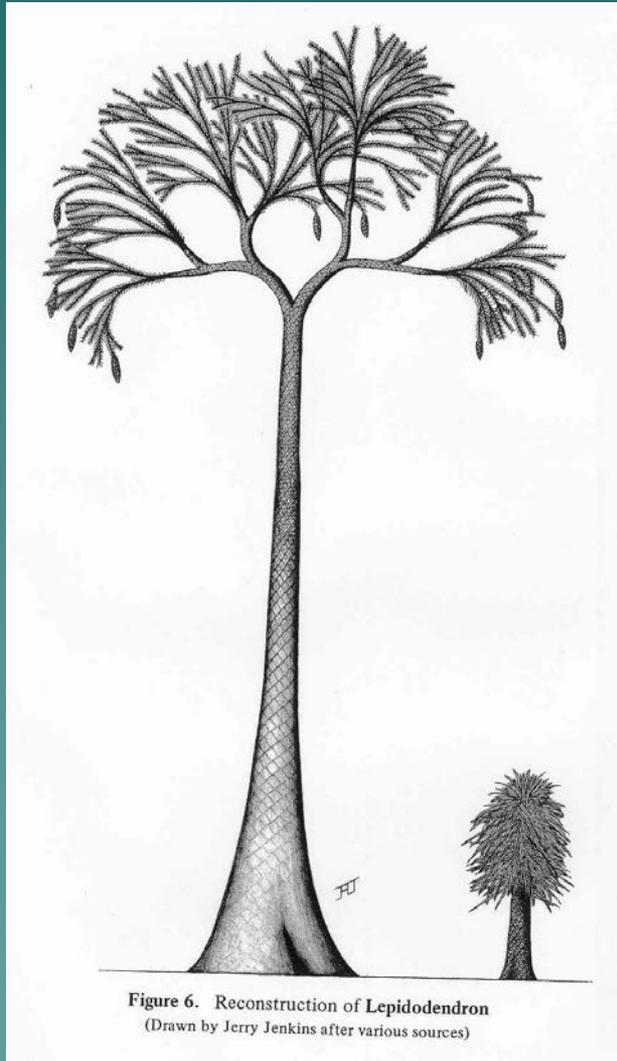


Figure 5. Reconstruction of *Archaeopteris*  
(Drawn by Jerry Jenkins after Beck and others)

# Pennsylvanian – *Calamites* and *Cordaites*



# Pennsylvanian – *Lepidodendron* and *Sigillaria*



# Pennsylvanian and Permian – *Psaronius* and *Walchia*

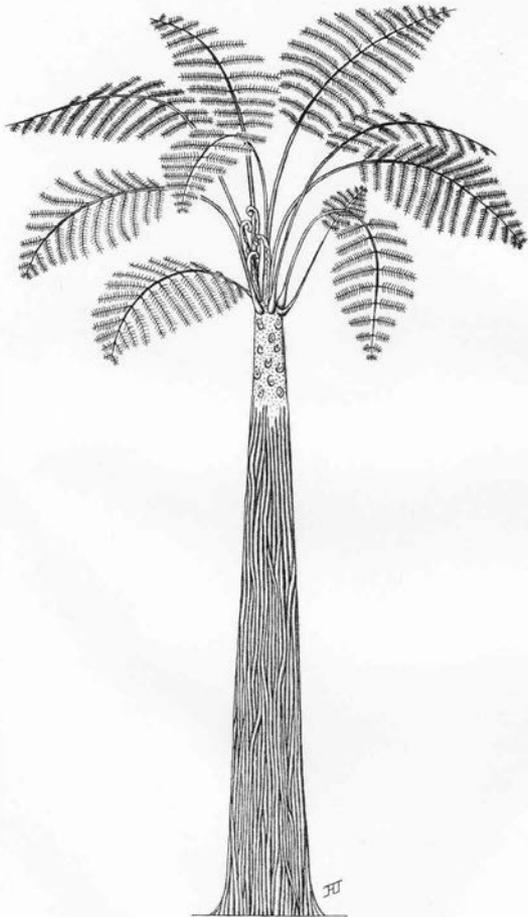


Figure 11. Reconstruction of *Psaronius*, a tree fern  
(Drawn by Jerry Jenkins after various sources)

85

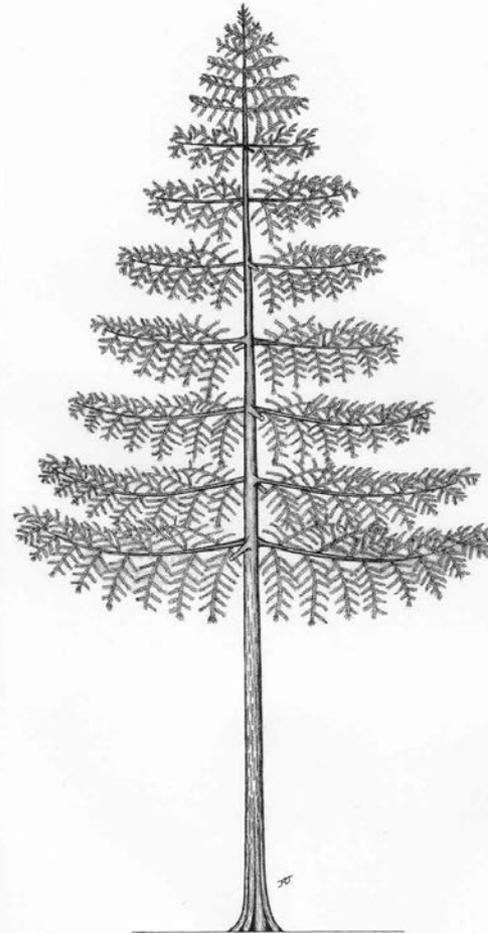


Figure 16. Reconstruction of a Pennsylvanian conifer, *Walchia*  
(Drawn by Jerry Jenkins after Cridland and Morris)

# Mesozoic and Cenozoic Plant Time Scale

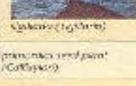
Eon	Era	Period	Epoch	Locality	Events	Ages of plant life
PHANEROZOIC	CENOZOIC	Quaternary	Recent Pleistocene		Glacial cycles	CENOPHYTIC
			1.8 ← Dunarobba (1.8-5.3) ↑			
		Tertiary	Pliocene			
			Miocene			
			24 ← Strathcona Fiord (50) ↑ Specimen Ridge, Yellowstone ↑ London Clay ↑	← Grassland and composites increase in abundance ← Expansion of Antarctic Ice Sheet		
	Paleocene	65				

PHANEROZOIC	MESOZOIC		Paleocene	65	London Clay		MESOPHYTIC
		Cretaceous		142 ← Åsen (77-84) Jehol Biota (110-128) Cerro Cuadrado (142-180) ↑	← Earliest flowering plants		
			Jurassic	206 ← Yorkshire Jurassic Flora (165-180)	← Ginkgos become abundant		
		Triassic		248 ← Petrified Forest National Park, Arizona (210-227) ↑			

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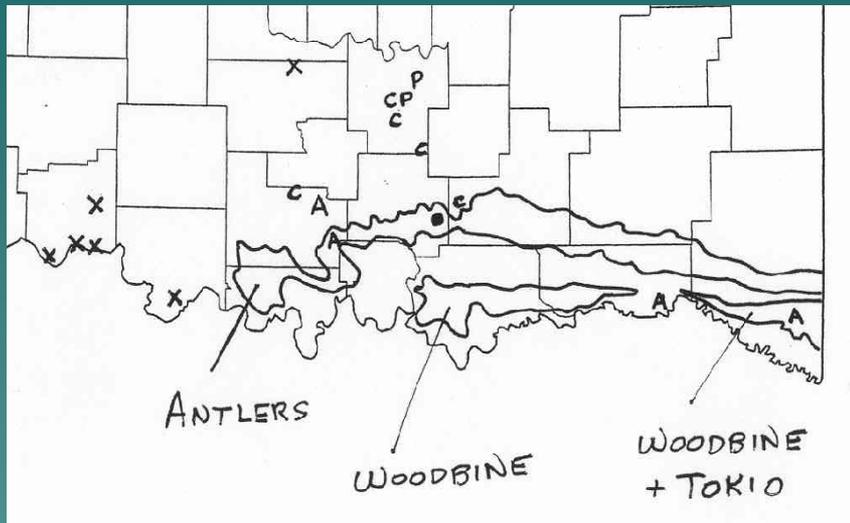
# Petrified Forests Through Time

Geological Age	Formation	Petrified Forests...	... and Their Trees
Cenozoic	Quaternary	e.g., Trunks in Chalk Sinter	Present-day Forests
	1.7 million years ago Tertiary	Florissant, Colorado, USA; Vantage, Washington, USA; Deschutes, Oregon, USA; McDermitt, Oregon, USA; Virgin Valley, Nevada, USA; Blue Forest, Wyoming, USA; Yellowstone National Park, Wyoming, USA; Calistoga, California, USA; Rio Cauca, Colombia; José Ormaechea, Argentina; Szolopelis, Argentina; Mlkófalva, Hungary; Lesbos and Lemnos, Greece; Zurl-Soddi, Sardinia; Ankara, Turkey; Istanbul, Turkey; Cairo, Egypt; Pondicherry, India; Deccan Intertrappean, India; Mandalay, Myanmar; Hubei Province, China; Mawaki, Japan	<p><b>Palms</b> <b>Deciduous Trees</b> <b>Modern Needle-bearing Trees</b></p>  fan palm ( <i>Araucarioxylon</i> )  amber tree ( <i>Euphrasioxylon</i> )  water pine ( <i>Coppinaxylon</i> )
Mesozoic	65 Cretaceous	La Calamine, Belgium; Port Edward, South Africa; Lhasa, Tibet	<p><b>First Deciduous Trees</b> <b>Needle-bearing Trees</b> <b>Cycadophytes</b> <b>Ginkgophytes</b> <b>Tree Ferns</b></p>  Ginkgo ( <i>Ginkgoites</i> )  tree fern ( <i>Pteris</i> )
	145 Jurassic	Cerro Cuadrado, Argentina; Xinjiang, China; New Zealand; Queensland, Australia; Tasmania, Australia	<p><b>Ancient Needle-bearing Trees</b> <b>Ginkgophytes</b> <b>Cycadophytes</b> <b>Later Seed Ferns</b> <b>Tree Ferns</b></p>  needle-bearing tree ( <i>Paracerascarus</i> )  Pteris  cycadophyte ( <i>Cycadites</i> )
	210 Triassic	Arizona, USA; Utah, USA; Sao Pedro do Sul, Brazil; Khorixas, Namibia; Zimbabwe; Madagascar	<p><b>First Needle-bearing Trees</b> <b>Cordaites</b> <b>Early Seed Ferns</b> <b>Tree Ferns</b> <b>Sigillaria and Lepidodendron Trees</b> <b>Calamites</b></p>  cordaites ( <i>Cordaites</i> )  tree fern ( <i>Pteris</i> )  sigillaria ( <i>Sigillaria</i> )  lepidodendron ( <i>Lepidodendron</i> )  calamite ( <i>Calamites</i> )  tree fern ( <i>Pteris</i> )  sigillaria ( <i>Sigillaria</i> )  lepidodendron ( <i>Lepidodendron</i> )  calamite ( <i>Calamites</i> )  tree fern ( <i>Pteris</i> )  sigillaria ( <i>Sigillaria</i> )  lepidodendron ( <i>Lepidodendron</i> )  calamite ( <i>Calamites</i> )  tree fern ( <i>Pteris</i> )  sigillaria ( <i>Sigillaria</i> )  lepidodendron ( <i>Lepidodendron</i> )  calamite ( <i>Calamites</i> )  tree fern ( <i>Pteris</i> )  sigillaria ( <i>Sigillaria</i> )  lepidodendron ( <i>Lepidodendron</i> )  calamite ( <i>Calamites</i> )  tree fern ( <i>Pteris</i> )  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# Archaeopteris (*Callixylon*) in Woodford Chert (Devonian)



- Located mostly in Pontotoc County and surrounding Arbuckle Mtns.
- Molds of tree trunks in Chattanooga Shale (Devonian), Cherokee County
- Rare pet. wood of unknown affinity in Arkansas Novaculite (Devonian), Pushmataha County

323	MISSISSIPPIAN	Upper	Springer Group	Springer Fm.
345			Goddard Fm.	
	Lower	Caney Shale		
		Sycamore Limestone		
363	Dev.	U.	Woodford Chert	
377-386				
409	Sil.	L.	Hunton Group	-First Vas. Plants
424				

# *Archaeopteris* in Woodford Chert (Devonian)

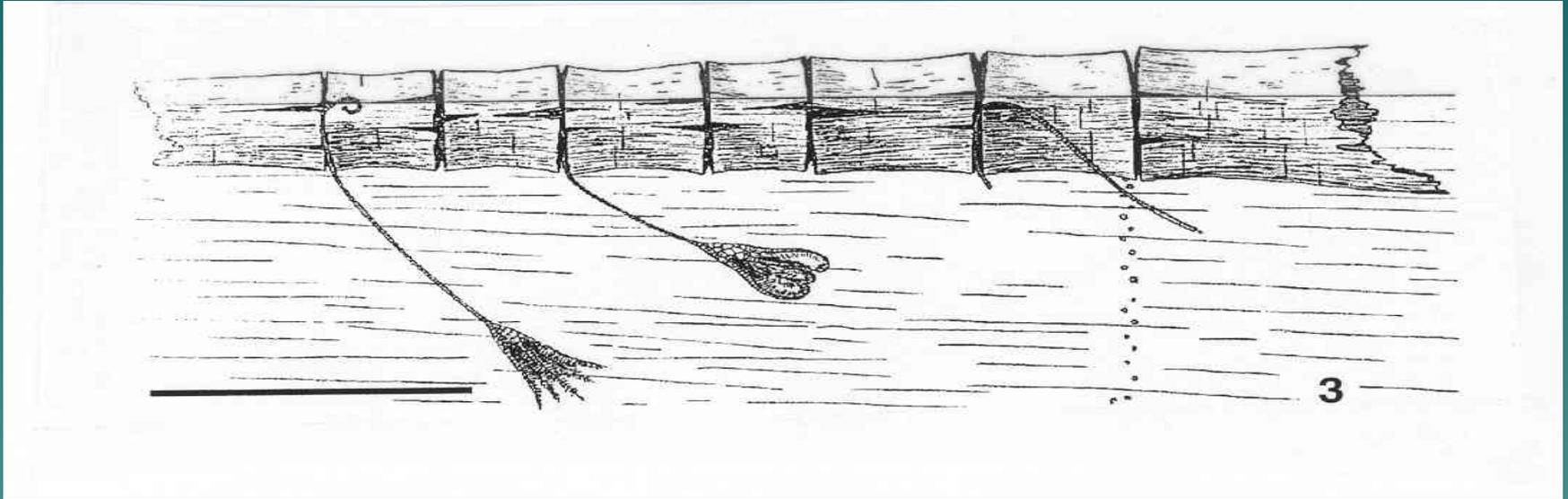


The Woodford Chert is a dark, organic-rich marine shale and is very different from the kind of rocks petrified wood is typically found in.

Why is there petrified wood in this marine shale?



# *Archaeopteris* Afloat



Crinoids attached to Devonian wood in the Woodford equivalent in Ohio is evidence that logs were rafted well into the ocean before they became waterlogged, sank, and were preserved in oxygen-deficient bottom waters.

# Petrified Wood of Unknown Affinity from Arkansas Novaculite (Devonian), Pushmataha County, OK



# Pennsylvanian Petrified Wood in eastern Oklahoma

305	P E N N S Y L V A N I A N	U P P E R	S k i a t o o k G r o u p	Dewey Limestone		
				Nellie Bly Fm.		
				Hogshooter Limestone		
				Coffeyville Fm.		
				Checkerboard Limestone		
				Seminole Fm. - Tulsa coal		
		M I D D L E	M a r m a t o n G r o u p	Holdenville Fm. - Dawson coal		
				Wewoka Fm.		
				Wetumka Shale		
				Calvin Sandstone		
			C a b a n i s s G r o u p	S e n o r a F m.	Iron Post coal	
					Mineral coal	
					Tebo coal	
				Stuart Shale		
				Thurman Sandstone		

- Associated with coals in northeastern Oklahoma
- In Wewoka, Holdenville, Seminole Fms. near Ada
- Typically molds, casts, carbonized compressions

*Dadoxylon adaense* from Wintersmith Park, Ada, and near Francis. Wewoka Fm., Penn.



# Permian Petrified Wood associated with copper mineralization, north-central Oklahoma



# ARM Site, Grant Co., OK

## Permian Wood at Garber-Wellington Contact



# Petrified Wood in Post Oak Conglomerate (Permian) near Lake Frederick, Tillman Co., Oklahoma



# Cretaceous Petrified Wood from Antlers Fm., southeastern Oklahoma

## PETRIFIED WOOD CRETACEOUS - S. OKLAHOMA

UPPER CRETACEOUS	Campanian	Ozan Fm.		
		Brownstone Marl		
	Coniac	Tokio Fm.		
		Eagle Ford Fm.		
	Turonian	Woodbine Fm.		
		Grayson Marlstone		
		Bennington Limestone		
	LOWER CRETACEOUS	Albian	Washita Group	Bokchito Fm.
			Caddo Fm.	
Fredericksburg Group		Kiamichi Fm.		
		Goodland Limestone		
		Walnut Clay		
Antlers Sandstone				
DeQueen Limestone				
Aptian		Holly Creek Fm.		
		Baum Limestone		
112				
120				
125				
130				



# 30-ft log in Antlers Fm. (Cretaceous) from near Gene Autry



# Cretaceous Petrified Wood from Cimarron Sandstone, Black Mesa area

## PETRIFIED WOOD BLACK MESA AREA, CIMARRON COUNTY

SCHOFF AND STOVALL (1943), THIS REPORT		HUNT AND LUCAS (1987)		AGE	
MARINE	Graneros- Greenhorn beds	Colorado Gr.	Bridge Creek M. Hartland M. Lincoln M. upper m. Thatcher M. lower m.	90	
MARINE (SHORELINE)	upper sandstone	Dakota Ss.	Romeroville S.	~102	
DELTA PLAIN	middle shale		Pajarito F.		
FLUVIAL, BRAIDED STREAM	lower sandstone		Mesa Rica S.		
MARINE	Kiowa Sh. M.	Purgatoire F.	Glencairn F.	146	
FLUVIAL	Cheyenne S. M.		Lytle S.		
FLUVIAL, LACUSTRINE, FLOOD-PLAIN	Morrison Formation		Morrison F.	148	
DUNES	Exeter S.		Bell Ranch F.	155	
BRAIDED STREAM	Sheep Pen S.		Entrada S.	163	
LACUSTRINE	Sloan Canyon Formation	Dockum Group	Sheep Pen S.	210	
LACUSTRINE, LAC. DELTA, PSOL, BRAIDED STREAM				Sloan Canyon F.	
FLUVIAL				Travesser F.	
LACUSTRINE			COBERT CANYON S. BED Baldy Hill F.	230	



# Petrified Wood from Cimarron Sandstone, Black Mesa area



Log and wood  
fragments in  
Cimarron  
Sandstone  
(Cretaceous)  
From near  
Kenton.

# Petrified Wood from the Ogallala Formation (Miocene-Pliocene), NW OK and OK Panhandle



# Outline

1. Petrified Wood in Oklahoma
2. Petrification, other types of Preservation
  - a. The Mineralogy of Petrified Wood
3. Plant (Tree) Classification, Evolution, and Ecology
  - a. The Paleobotany of Petrified Wood
4. The Age of Petrified Wood
  - a. Geochronology
5. Oklahoma Occurrences
- 6. Petrified Wood and Architecture**

# Residences Built from Petrified Wood

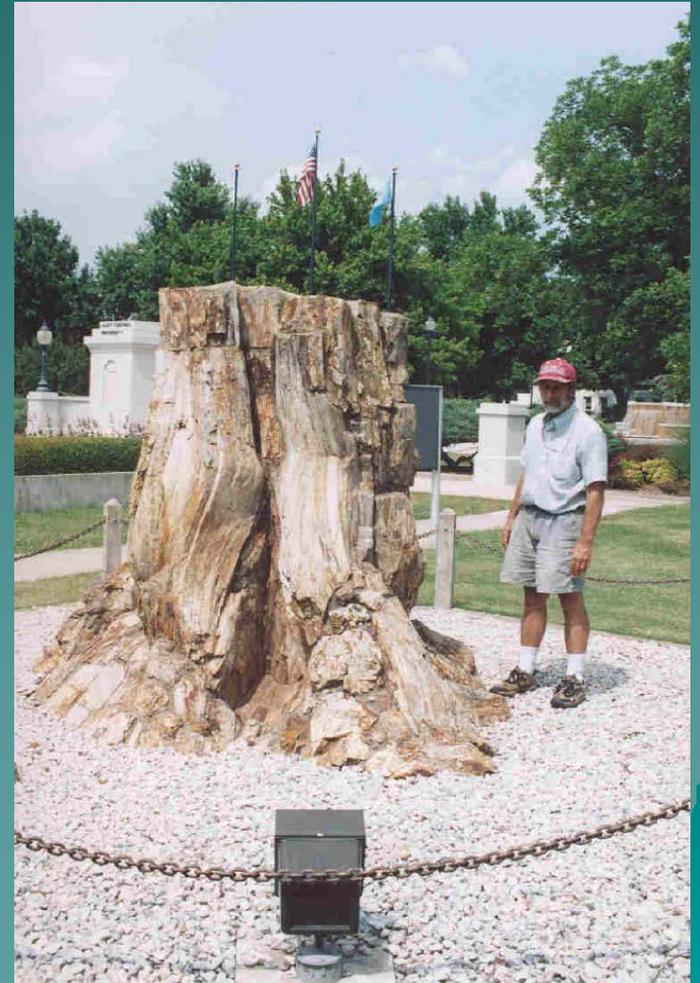


Residence in  
Lexington built  
from wood from  
near Ft. Worth, TX



Barber shop in  
Ardmore built from  
wood from Antlers  
Fm. (Cretaceous)  
near Gene Autry

# Ogallala(?) wood at Midgely Museum, Enid and *Archaeopteris* at East Central University, Ada



# Petrified Wood as Monuments



Philbrook  
Museum



El Reno  
Chamber of  
Commerce

# Petrified Wood in Oklahoma

- Geology
  - Sedimentary Environments
- Mineralogy
- Geochemistry
- Paleobotany
  - Evolution
  - Geochronology

*So many things to learn, so much fun doing it!*

*Thank you!*



# Kryptos – the Sanborn Sculpture at CIA Headquarters, Langley, VA



# Kryptos

Kryptos is a sculpture/encrypted puzzle located at CIA Headquarters. It was designed by sculptor James Sanborn and retired CIA cryptographer Edward Scheidt. It was created in the early 90's and withstood scrutiny for many years. It was only in the late 90's that it gave up some of its secrets. Parts 1-3 were solved independently by Jim Gillogly, a computer programmer, and David Stein, a CIA analyst. Part 4 remained a mystery until John Wilson discovered its initial solution in 2003. Details have been emerging ever since.

But why the log of petrified wood?