# Petrified Wood in Oklahoma

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Oklahoma Geological Survey

Tahlequah Rock and Mineral Society
July 21, 2009

# Outline

1. Petrified Wood in Oklahoma
2. Petrifaction, 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

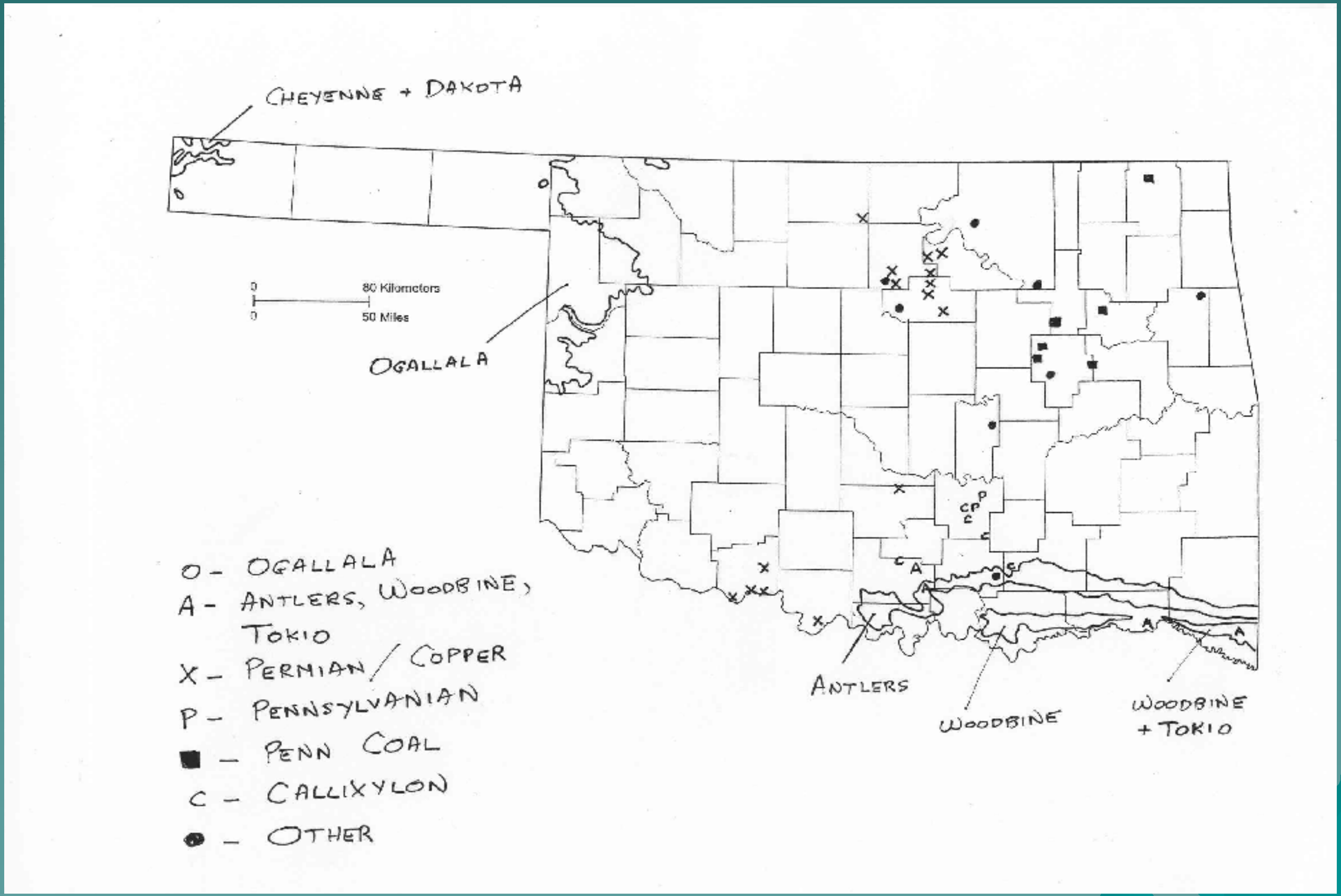
# Petrified Wood Parks and Preserves in the U.S.

# 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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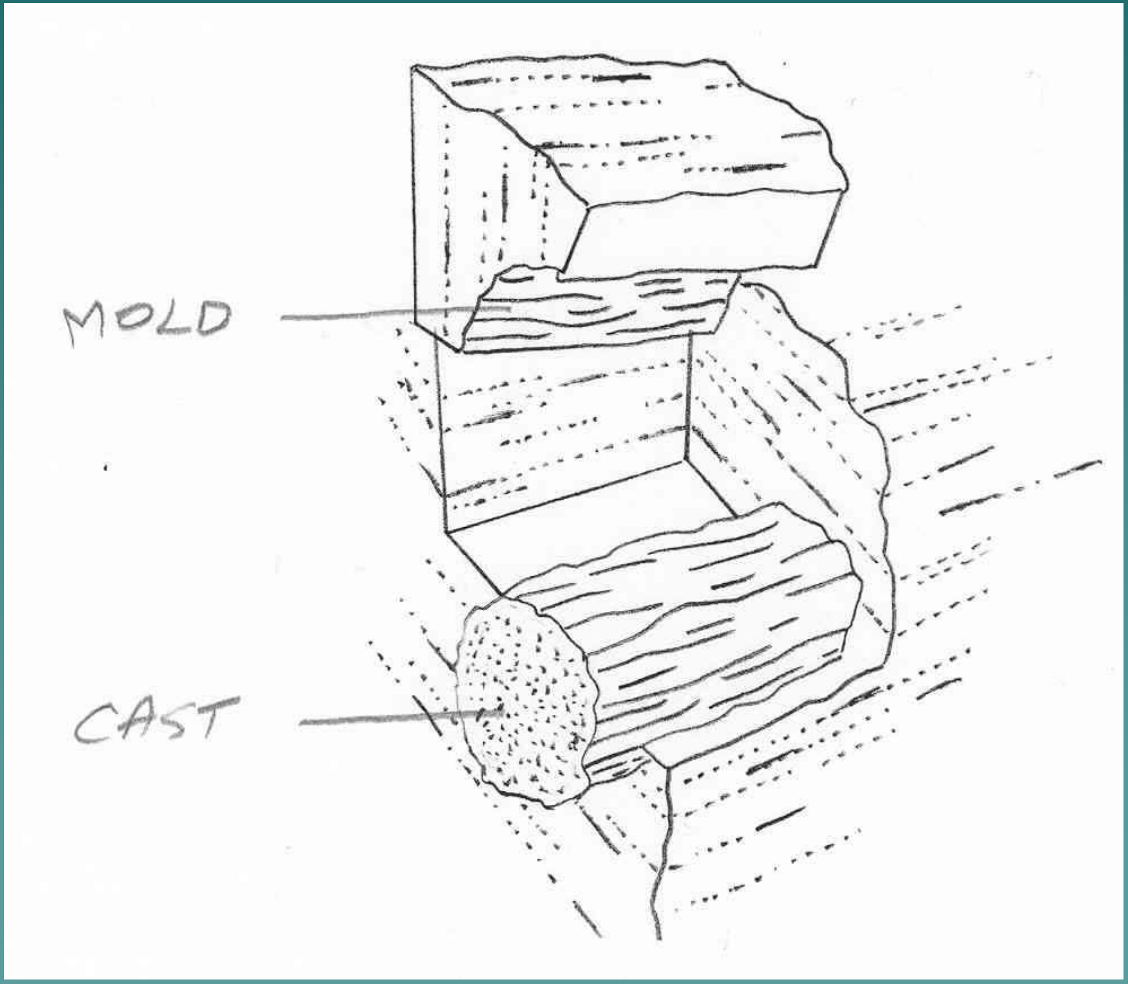
# Preservation – Compressions and Impressions

# 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 – CaCO3
Aragonite – CaCO3
Dolomite – CaMg(CO3)2
Siderite – FeCO3
Magnesite – MgCO3
Hydromagnesite – Mg5(OH)2(CO3)4.4H2O
Nesquehonite – Mg(HCO3)(OH).2H2O
Ankerite – Ca(Fe,Mg)(CO3)2
Cerrusite – PbCO3
Malachite – Cu2CO3(OH)2
Azurite – Cu3(CO3)2(OH)2

## Sulfides

Pyrite – FeS2
Marcasite – FeS2
Cinnabar - HgS
Galena - PbS
Sphalerite - ZnS
Chalcopyrite – CuFeS2
Chalcocite – Cu2S
Bornite – Cu5FeS4
Covellite - CuS

# Mineralization (continued)

## Sulfates

- Barite – $BaSO_4$
- Gypsum – $CaSO_4.2H_2O$
- Langite – $Cu_4(OH)_6(SO_4).2H_2O$
- Posnjakite – $Cu_4(OH)_6(SO_4).H_2O$
- Schulenbergite – $(Cu,Zn)_7(OH)_{10}(SO_4,CO_3)_2.3H_2O$
- Bassanite – $CaSO_4.1/2H_2O$

## Oxides

- Hematite – $Fe_2O_3$
- Melaconite (Tenorite) - $CuO$
- Limonite – $FeO(OH).nH_2O$
- Goethite – $HFeO_2$
- Lepidocrocite – $FeO(OH)$
- Uraninite – $UO_2$
- Ramsdellite – $MnO_2$
- 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

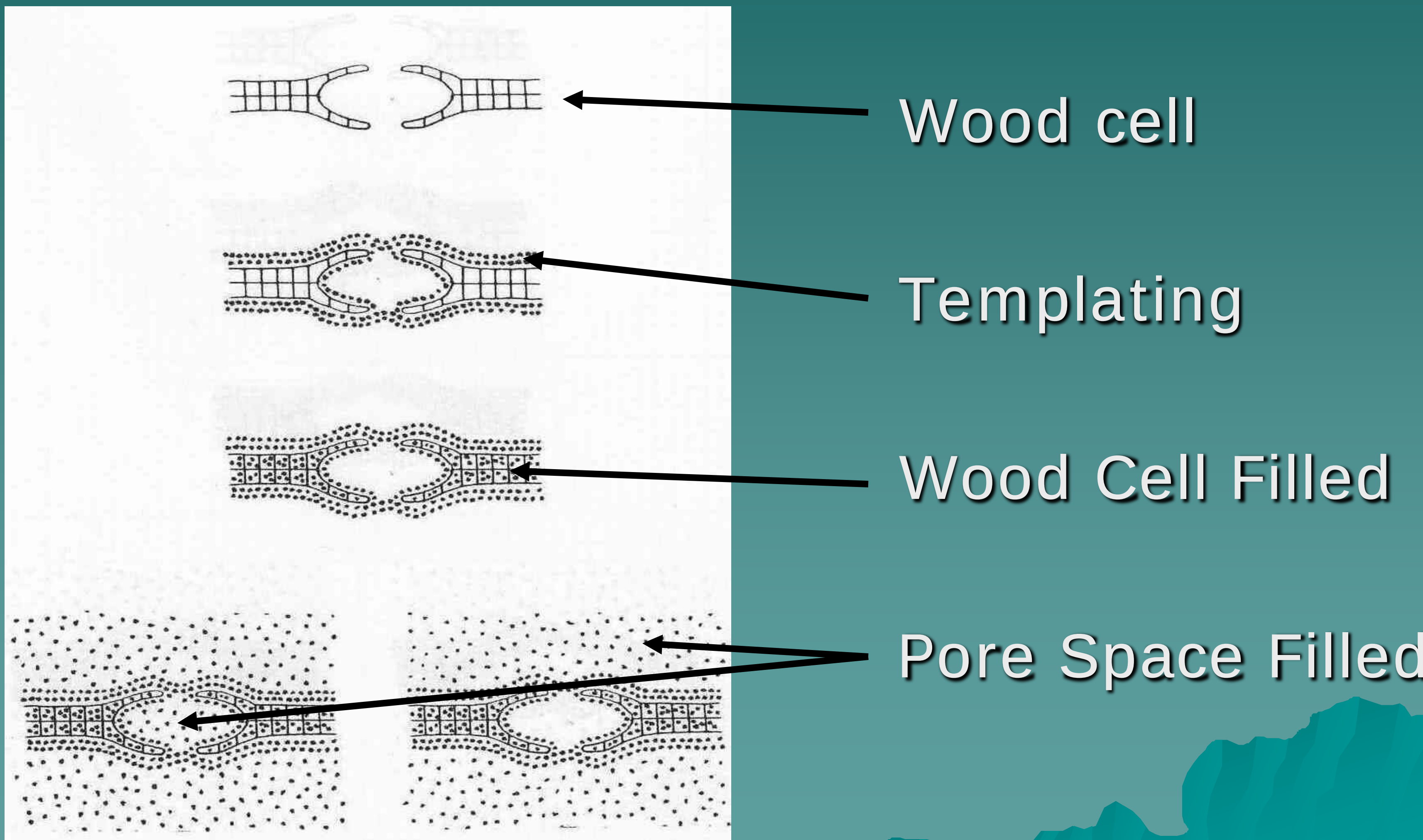
1. Rapid burial, absence of oxygen
2. pH near neutral
3. Source of silica (e.g., volcanic ash)
   a. Silica dissolves, goes into solution as monosilicic acid Si(OH4)
   b/c. Monosilicic acid polymerizes (forms large molecules), releases water, contains OH bonding sites
   c/b. Form H bonds with similar OH bonding sites on organic molecules
4. Other factors – moisture, temperature, aeration, sedimentary setting

# Silicification (continued)

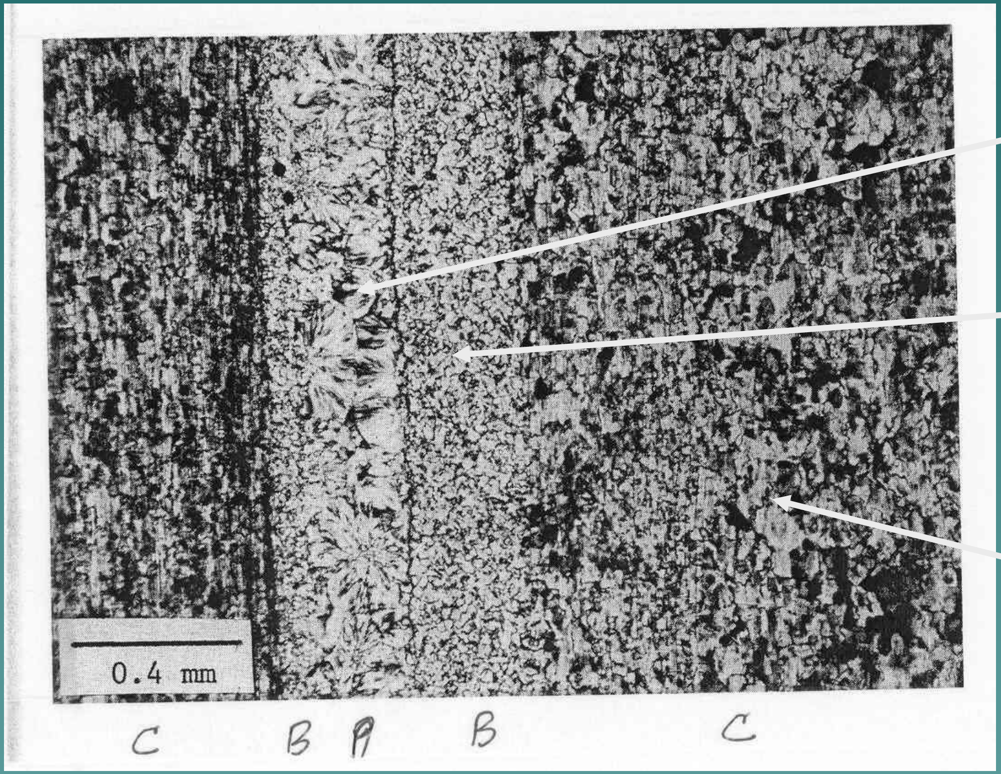
5. Organic molecules “templated” with layer upon layer of silicic acid monomers and/or polymers
6. Polymers form gel coating
7. Gel loses water, solidifies to amorphous opal-A
8. Over time, opal-A crystallizes and loses water, forming opal-CT (cristobalite and tridymite)
9. With continued crystallization 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



# Silica minerals




Chalcedony

Microcrystalline quartz

Coarsely crystalline quartz

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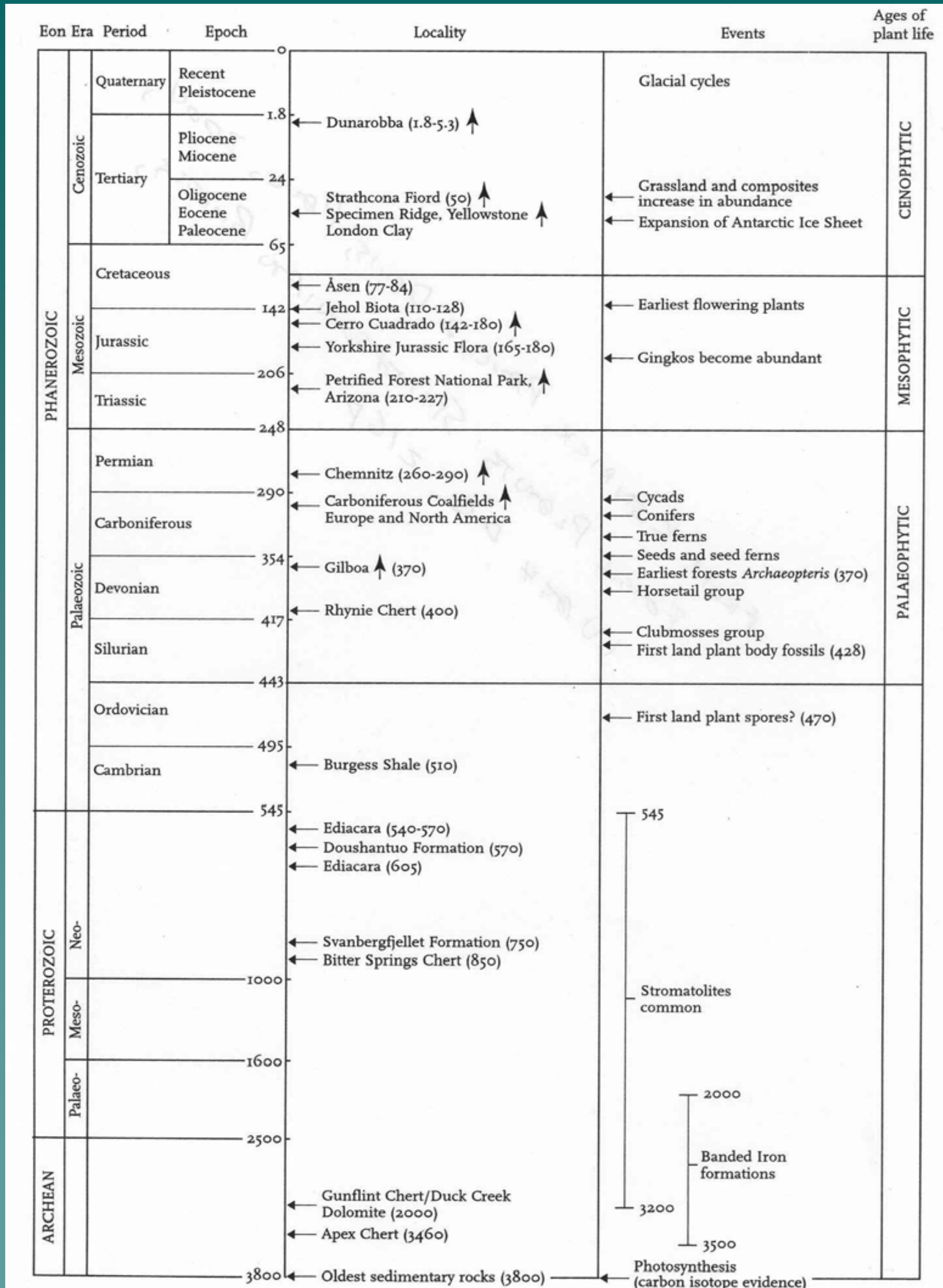
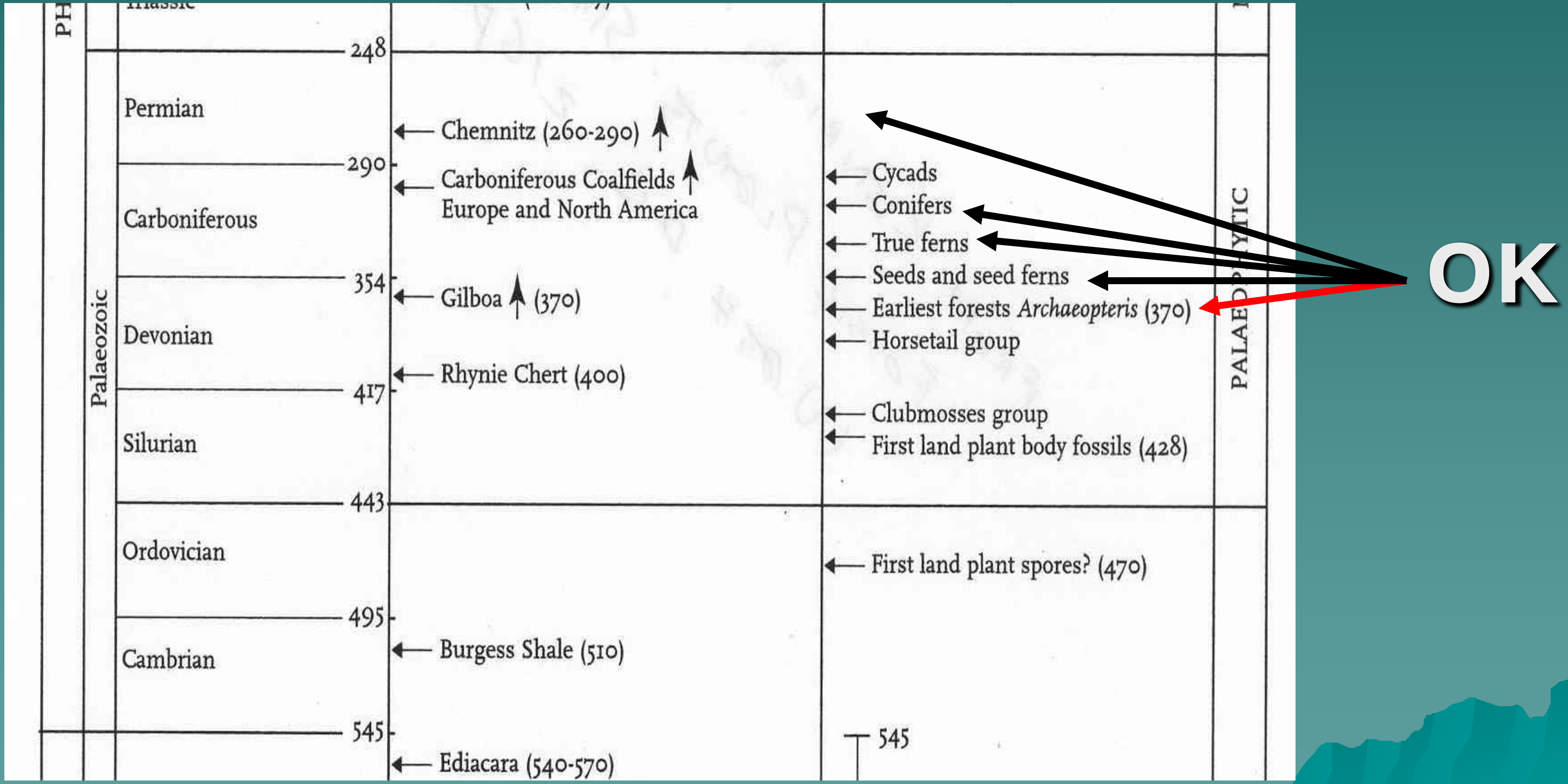



# Plant Time Scale

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

# Paleozoic Plant Time Scale



# Devonian – *Archaeopteris* (*Callixylon*)

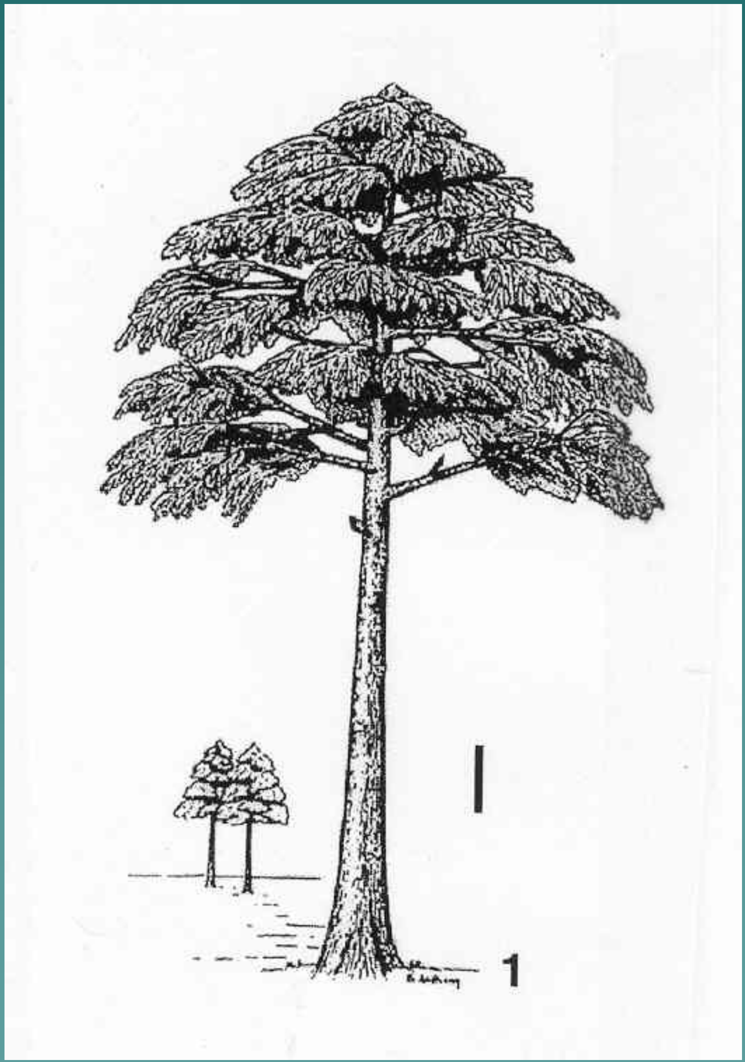



**Figure 5.** Reconstruction of **Archaeopteris**
(Drawn by Jerry Jenkins after Beck and others)

# Pennsylvanian – *Calamites* and *Cordaites*

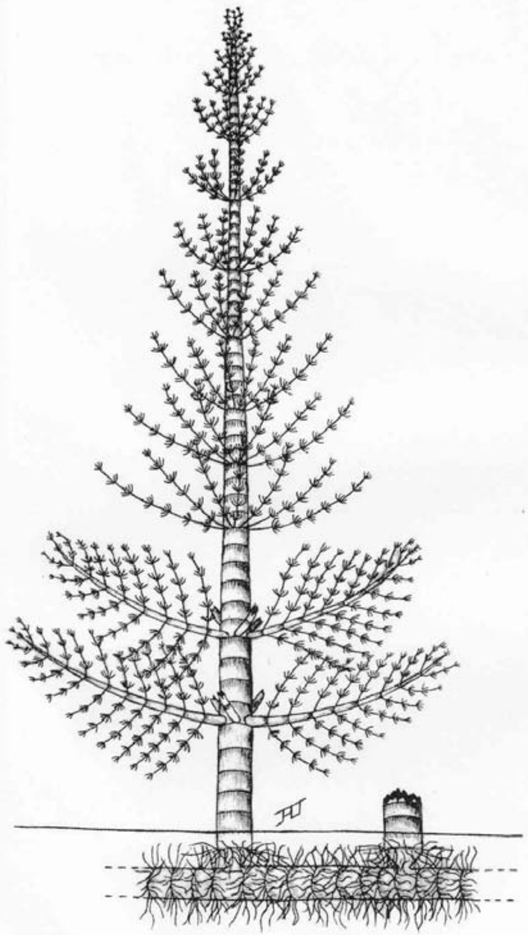


**Figure 8.** Reconstruction of **Calamites**
(Drawn by Jerry Jenkins after Hirmer and others)

**Figure 14.** Reconstruction of an arborescent-type **Cordaites**
(Drawn by Jerry Jenkins)

# Pennsylvanian – *Lepidodendron* and *Sigillaria*

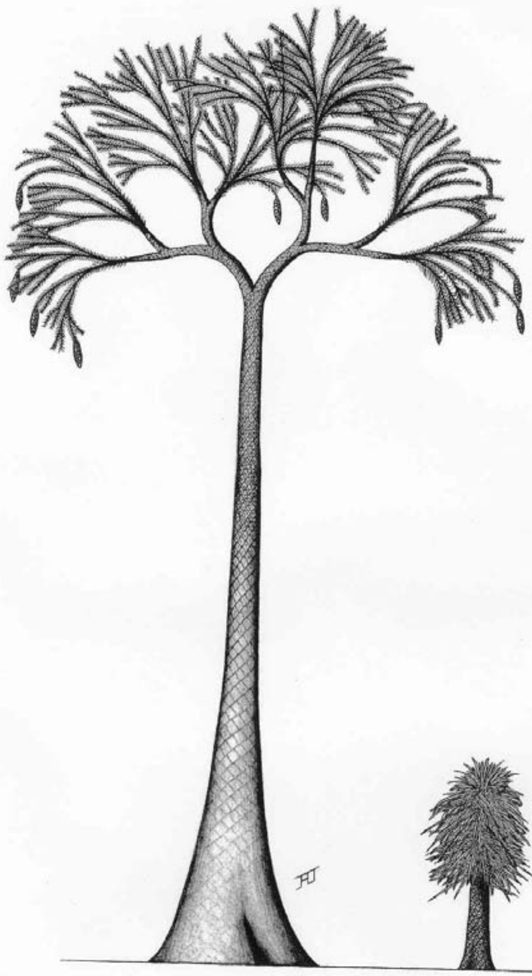


**Figure 6.** Reconstruction of **Lepidodendron**
(Drawn by Jerry Jenkins after various sources)

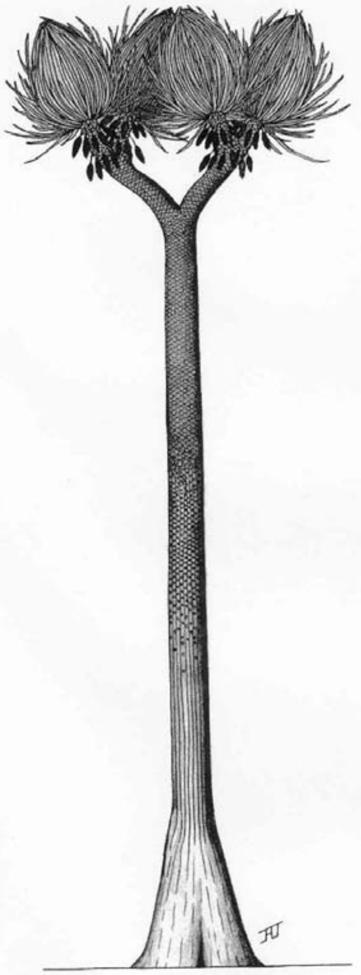


**Figure 7.** Reconstruction of **Sigillaria**
(Drawn by Jerry Jenkins after Hirmer and others)

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

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

85

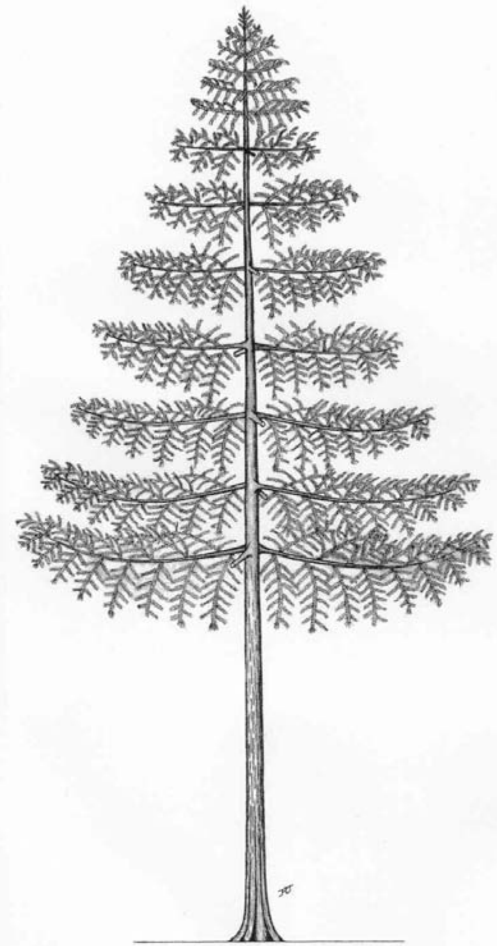
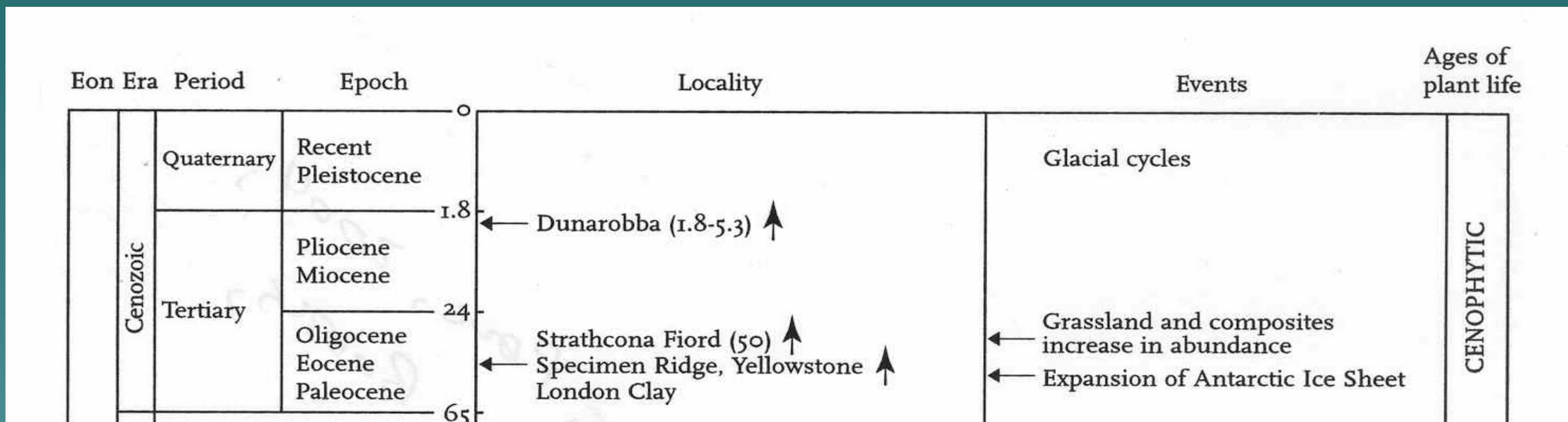
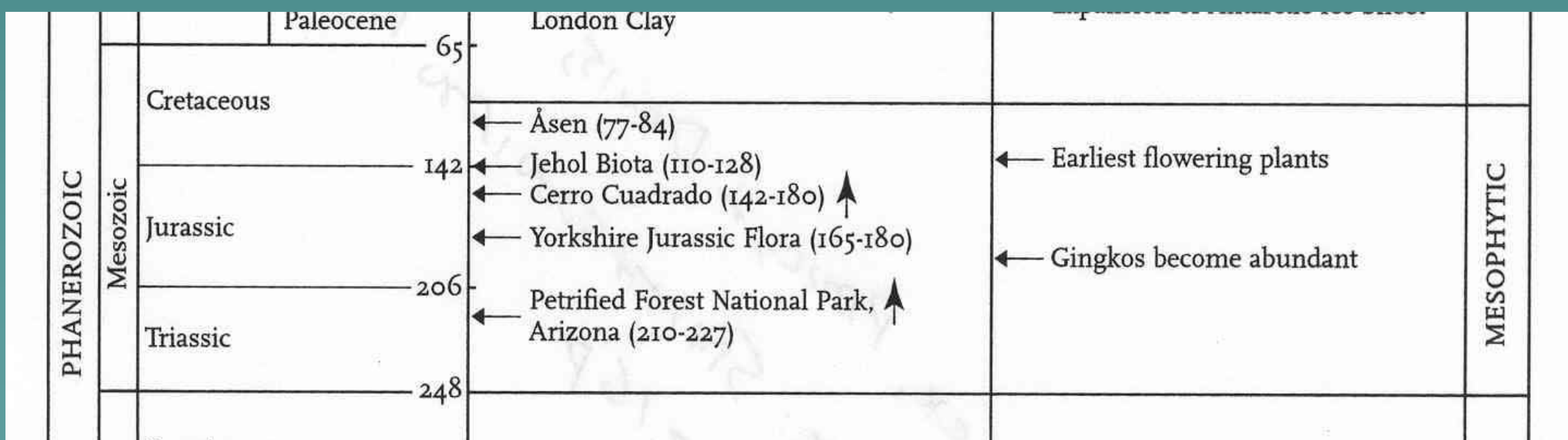


**Figure 16.** Reconstruction of a Pennsylvanian conifer, **Walchia**
(Drawn by Jerry Jenkins after Cridland and Morris)

# Mesozoic and Cenozoic Plant Time Scale



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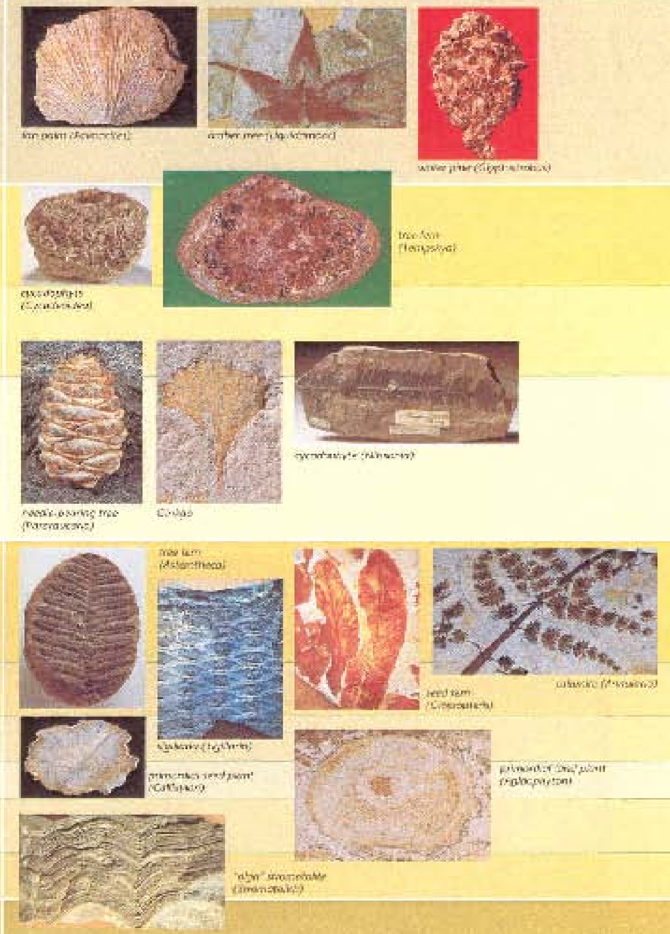
# Petrified Forests Through Time

| Geological Age | Formation | | Petrified Forests... | ... and Their Trees |
|---|---|---|---|---|
| Cenozoic | Quaternary | 1.7 million years ago | e.g., Trunks in Chalk Sinter | Present-day Forests |
| | Tertiary | 65 | **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; **Szlapelis,** Argentina; **Mikófalva,** Hungary; **Lesbos and Lemnos** Greece; **Zuri-Soddi, Sardinia; Ankara,** Turkey; **Istanbul,** Turkey; **Cairo,** Egypt; **Pondicherry,** India; **Deccan Intertrappean,** India; **Mandalay,** Myanmar; **Hubei Province,** China; **Mawaki,** Japan | Palms<br>Deciduous Trees<br>Modern Needle-bearing Trees |
| Mesozoic | Cretaceous | 145 | **La Calamine,** Belgium; **Port Edward,** South Africa; **Lhasa,** Tibet | First Deciduous Trees<br>Needle-bearing Trees<br>Cycadophytes<br>Ginkgophytes<br>Tree Ferns |
| | Jurassic | 210 | **Cerro Cuadrado,** Argentina; **Xinjiang,** China; **New Zealand; Queensland,** Australia; **Tasmania,** Australia | Ancient Needle-bearing Trees<br>Ginkgophytes<br>Cycadophytes<br>Later Seed Ferns<br>Tree Ferns |
| | Triassic | 245 | **Arizona,** USA; **Utah,** USA; **Sao Pedro do Sul,** Brazil; **Khorixas,** Namibia; **Zimbabwe; Madagascar** | |
| Paleozoic | Permian | 290 | **Araguaina,** Brazil; **Chemnitz,** Germany; **Nová Paka,** Czech Republic; **New Caledonia** | First Needle-bearing Trees<br>Cordaites<br>Early Seed Ferns<br>Tree Ferns<br>*Sigillaria* and *Lepidodendron* Trees<br>Calamites |
| | Carboniferous | 360 | e.g., *Stigmaria* roots | |
| | Devonian | 410 | Gilboa, New York, USA | First "Petrified Forest" |
| | Silurian | 440 | no forests | |
| | Ordovician | 510 | no forests | Bacteria and Algae |
| | Cambrian | 570 | no forests | |
| Archaic | Precambrian | 4600 | no forests | No Organisms At First |



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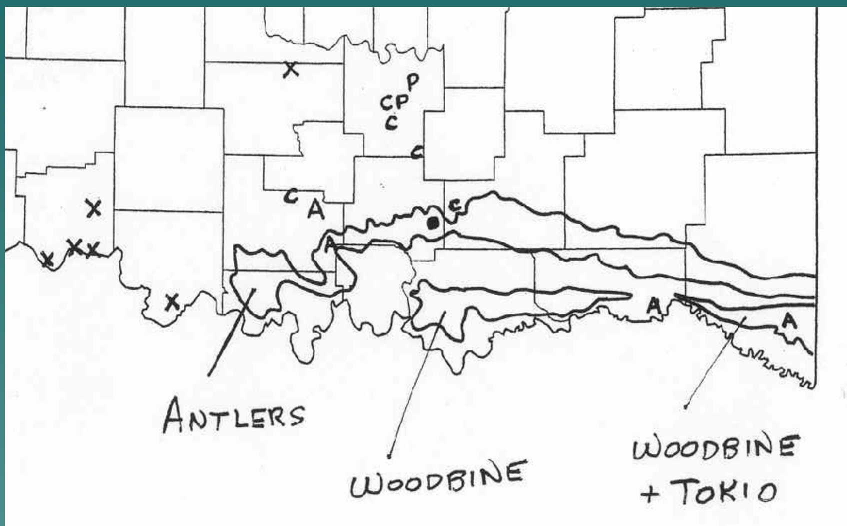
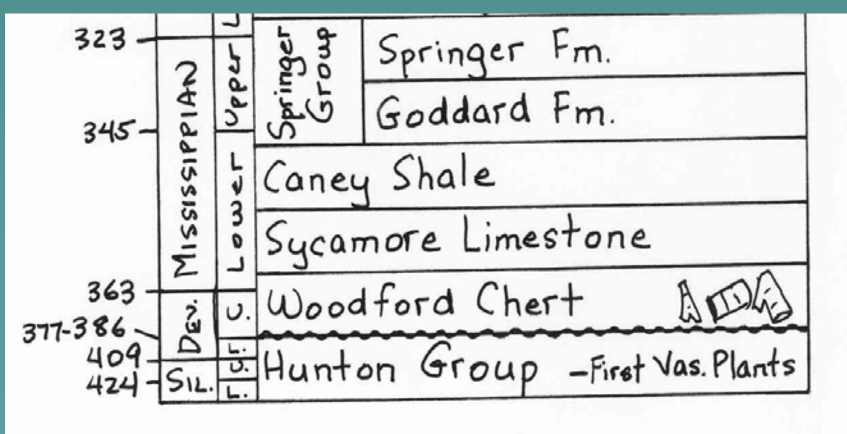
# *Archaeopteris* (*Callixylon*) in Woodford Chert (Devonian)



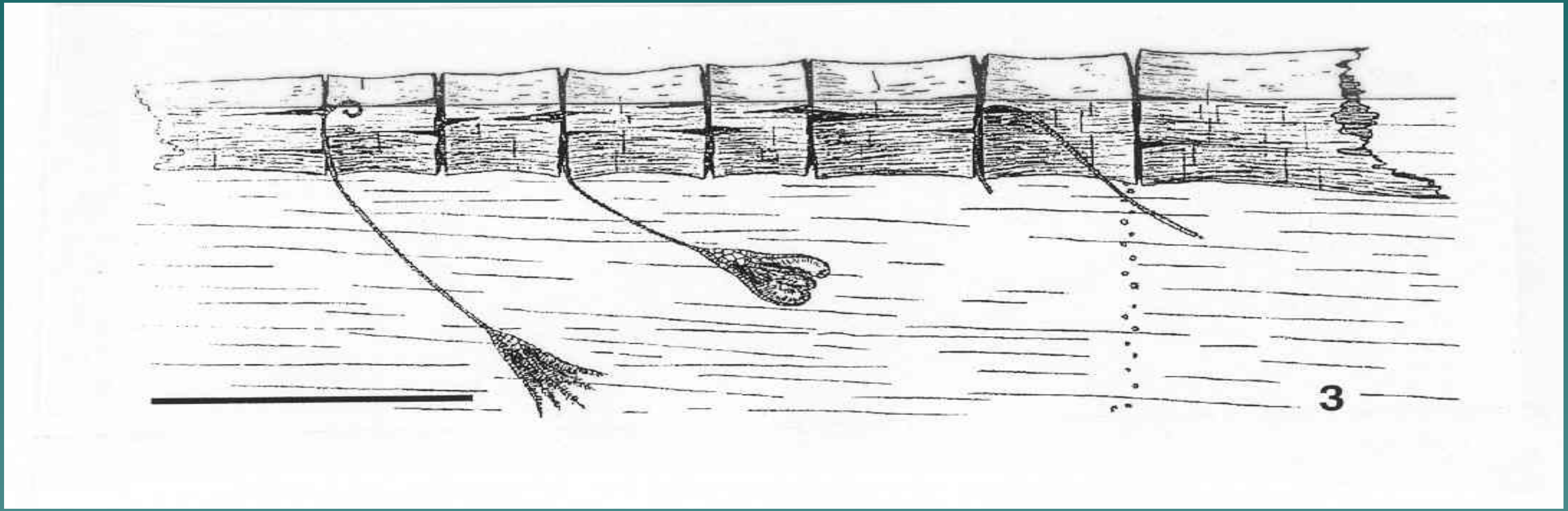

- Located mostly in Pontotoc County and surrounding Arbuckle Mtns.
- Molds of tree trunks in Chattanooga Shale (Devonian), Cherokee County
- Rare pet. wood of unknown affinity in Arkansas Novaculite (Devonian), Pushmataha County

# *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?

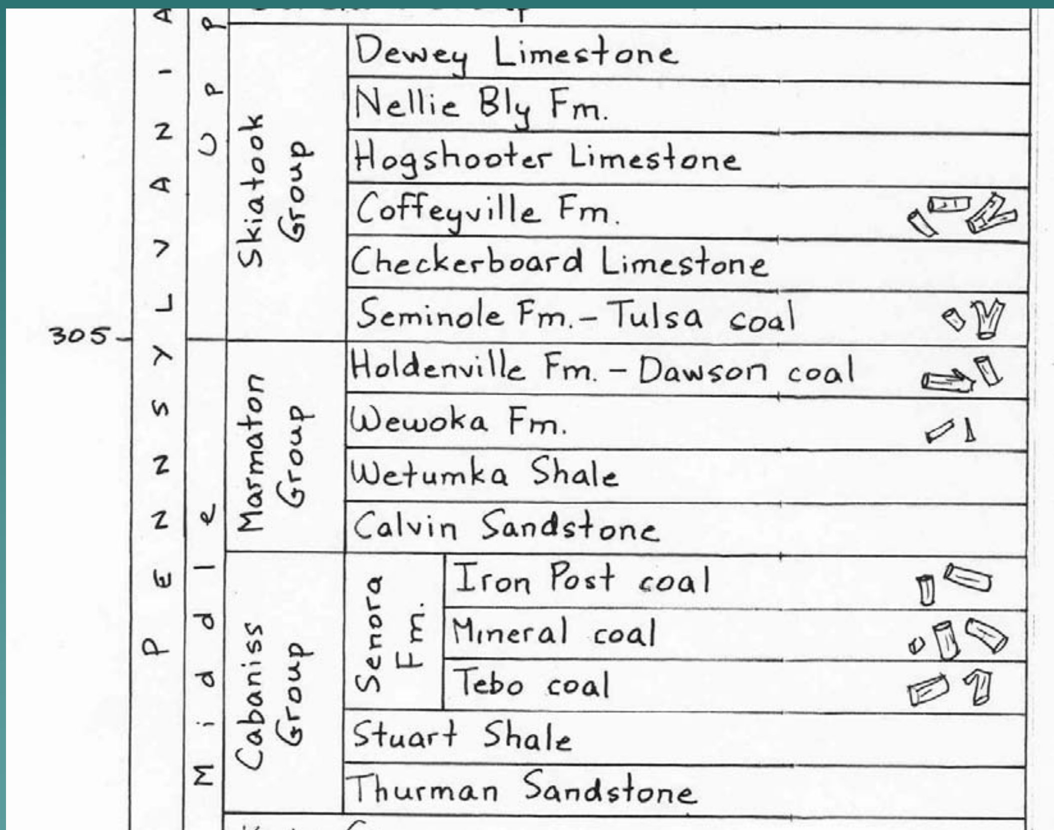
# *Archaeopteris* Afloat




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




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

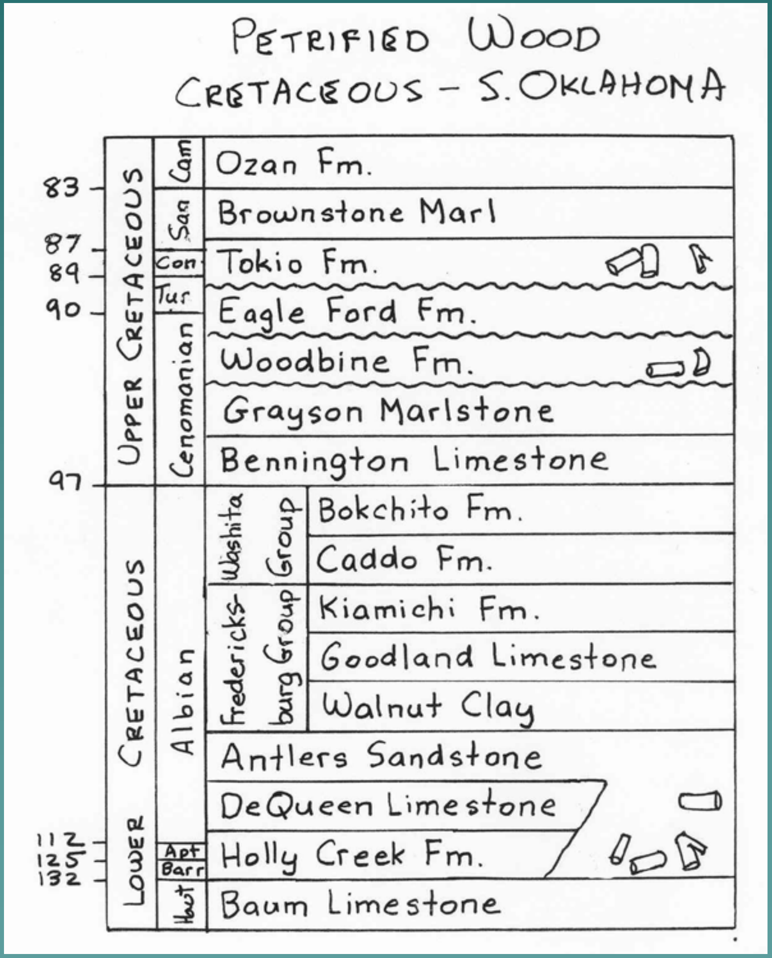
# *Dadoxylon adaense* from Wintersmith Park, Ada, and near Francis. Wewoka Fm., Penn.

# 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

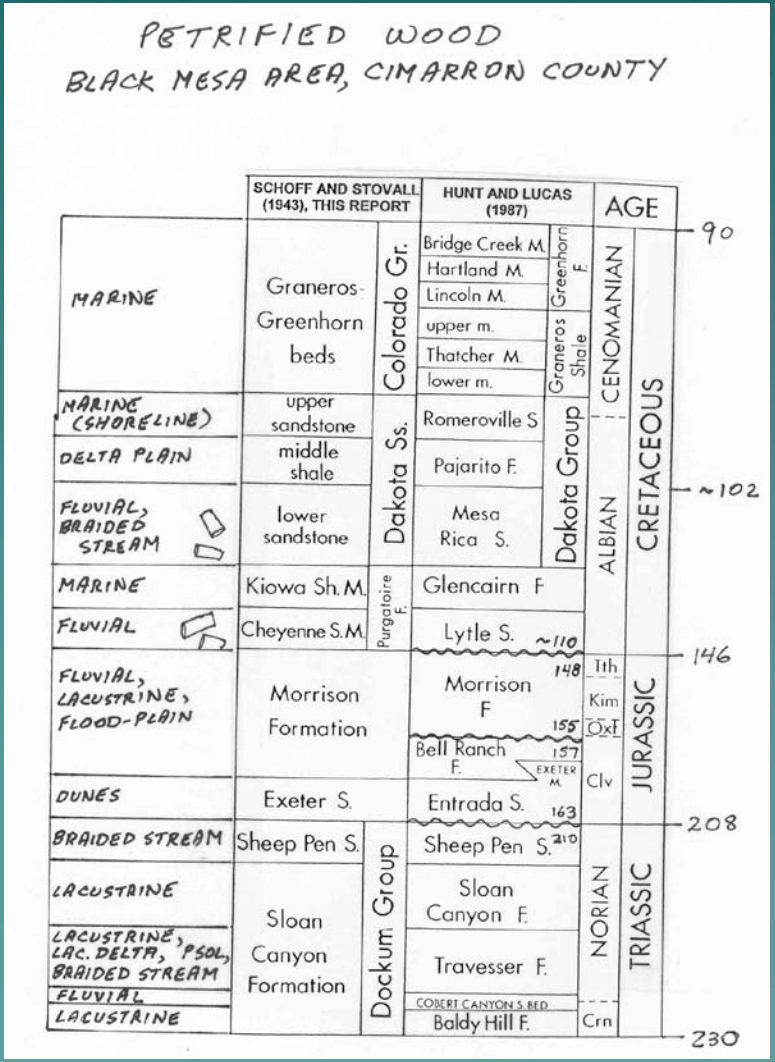
# Cretaceous Petrified Wood from Antlers Fm., southeastern Oklahoma





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

# Cretaceous Petrified Wood from Cimarron Sandstone, Black Mesa area




# 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

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# 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?