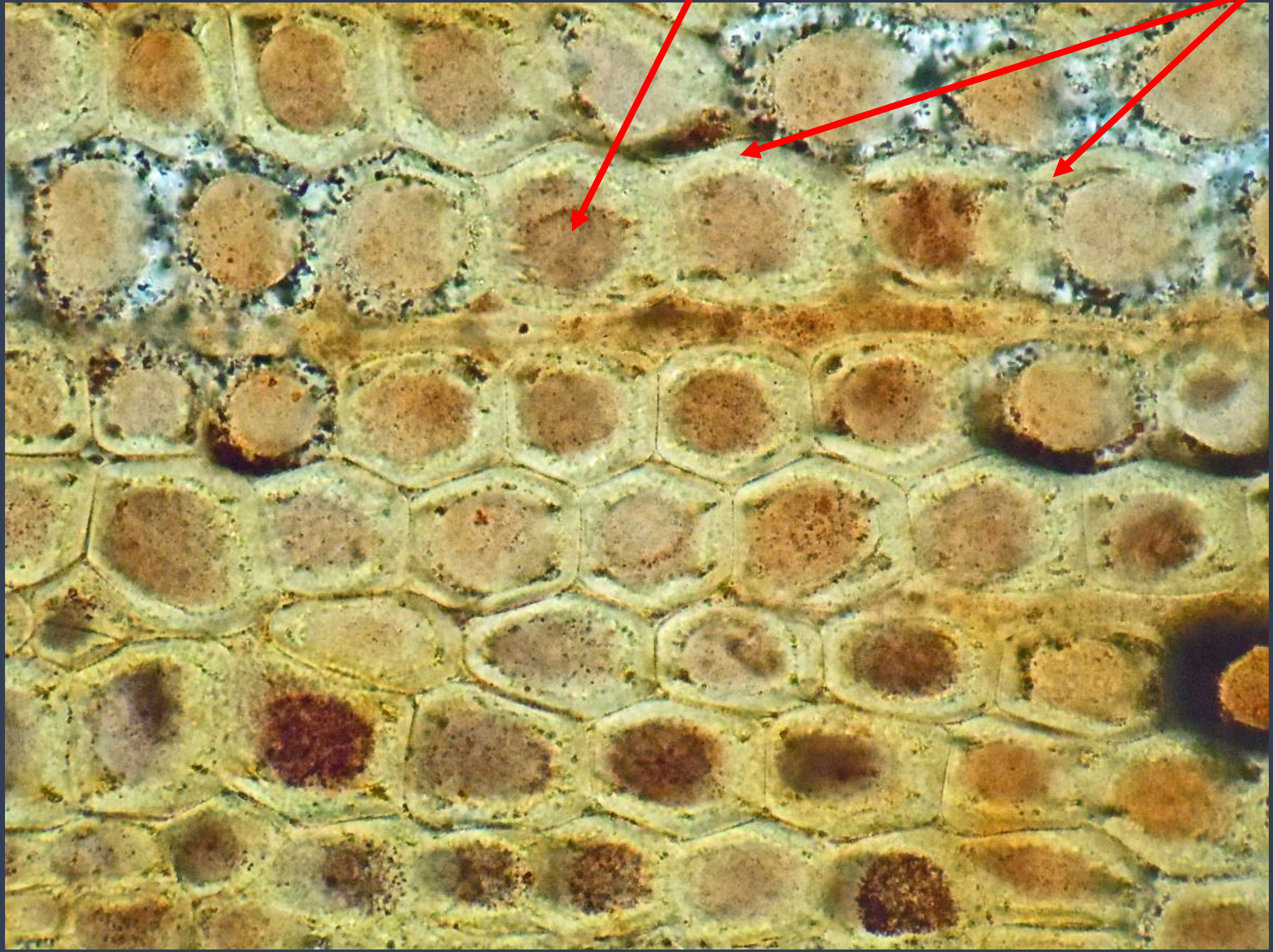
Petrified Forest National Park

CS of 215 Ma wood in thin section @ 400X (next to PFNP)

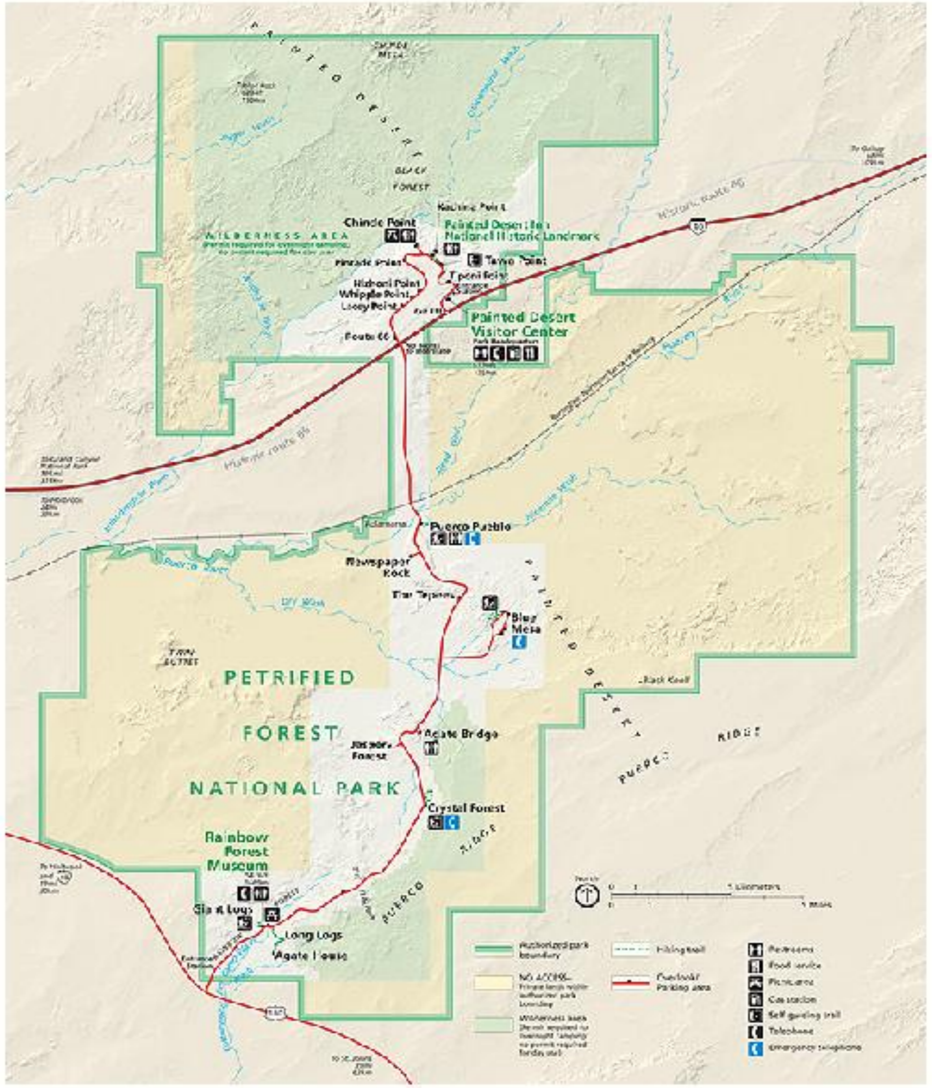
Permineralization of cell lumen, first by silica;
Second, walls are replaced by silica as Petrification.



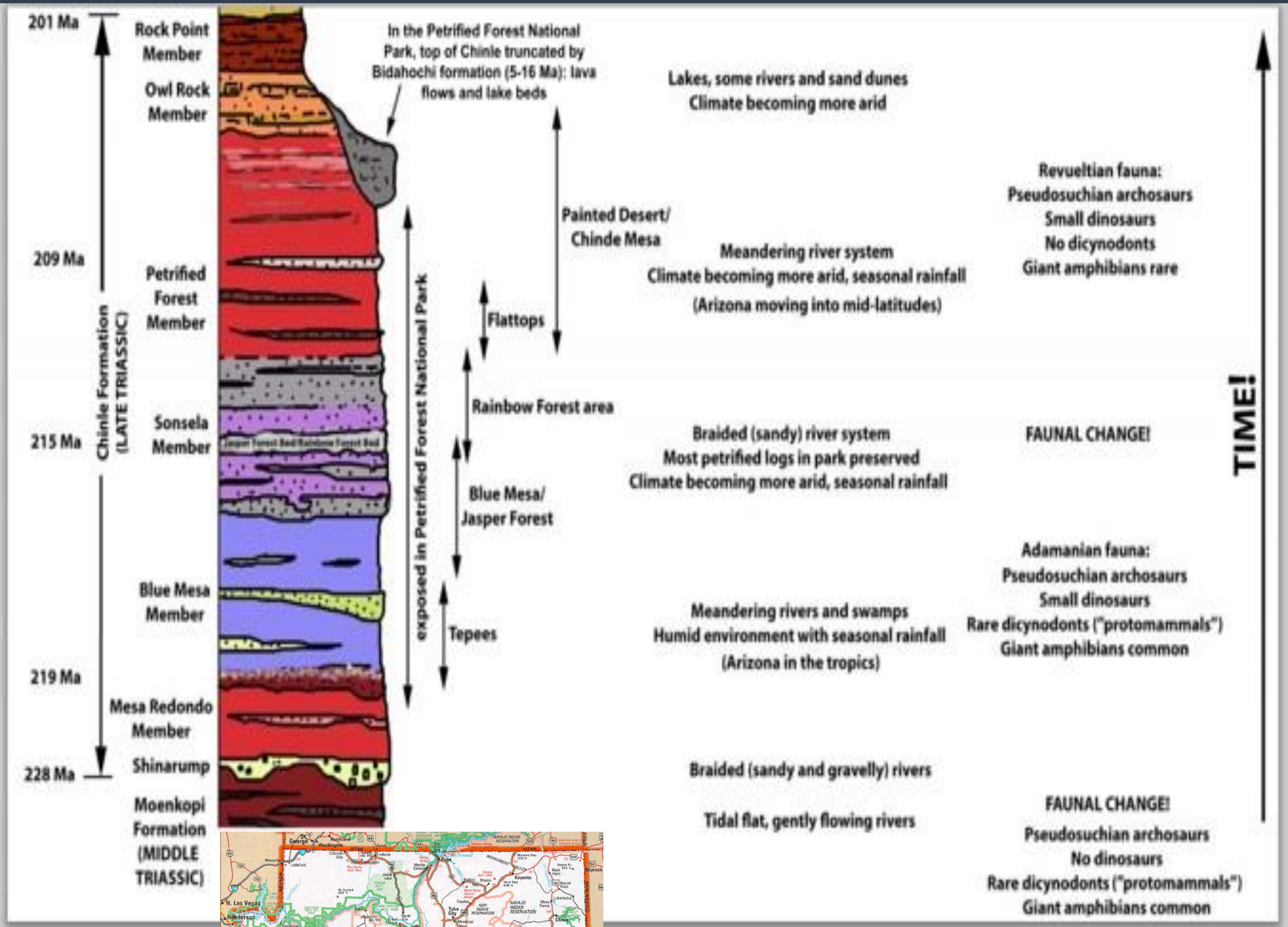
PFNP Log


Siberia
North America
PFNP:
Chinle
Newark
Supergroup
Africa
Central
Atlantic
Ocean
South
America

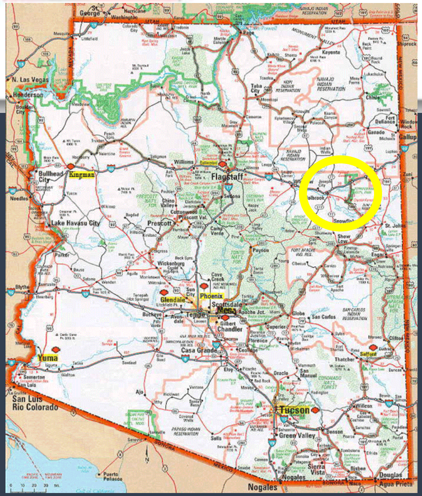

PETRIFIED FOREST
NATIONAL PARK
NATIONAL
PARK
SERVICE
Department
of the Interior
PAINTED DESERT
VISITOR CENTER



PETRIFIED
FOREST
NATIONAL PARK
Painted Desert Visitor Center
Chinde Point
Kachina Point
Tawa Point
Tiponi Point
Pintado Point
Nizhoni Point
Whipple Point
Lacey Point
Puerco Pueblo
Newspaper Rock
The Tepees
Blue Mesa
Agate Bridge
Jasper Forest
Crystal Forest
Rainbow Forest Museum
Long Logs
Agate House
Giant Logs
Black Forest
Painted Desert
Puerco Ridge



201 Ma
209 Ma
215 Ma
219 Ma
228 Ma
Chinle Formation (LATE TRIASSIC)
Rock Point Member
Owl Rock Member
Petrified Forest Member
Sonsela Member
Blue Mesa Member
Mesa Redondo Member
Shinarump
Moenkopi Formation (MIDDLE TRIASSIC)
In the Petrified Forest National Park, top of Chinle truncated by Bidahochi formation (5-16 Ma): lava flows and lake beds
Jasper Forest Bed Rainbow Forest Bed
exposed in Petrified Forest National Park
Painted Desert/ Chinde Mesa
Flattops
Rainbow Forest area
Blue Mesa/ Jasper Forest
Tepees
Lakes, some rivers and sand dunes
Climate becoming more arid
Meandering river system
Climate becoming more arid, seasonal rainfall
(Arizona moving into mid-latitudes)
Braided (sandy) river system
Most petrified logs in park preserved
Climate becoming more arid, seasonal rainfall
Meandering rivers and swamps
Humid environment with seasonal rainfall
(Arizona in the tropics)
Braided (sandy and gravelly) rivers
Tidal flat, gently flowing rivers
Revueltian fauna:
Pseudosuchian archosaurs
Small dinosaurs
No dicynodonts
Giant amphibians rare
FAUNAL CHANGE!
Adamanian fauna:
Pseudosuchian archosaurs
Small dinosaurs
Rare dicynodonts ("protomammals")
Giant amphibians common
FAUNAL CHANGE!
Pseudosuchian archosaurs
No dinosaurs
Rare dicynodonts ("protomammals")
Giant amphibians common
TIME!

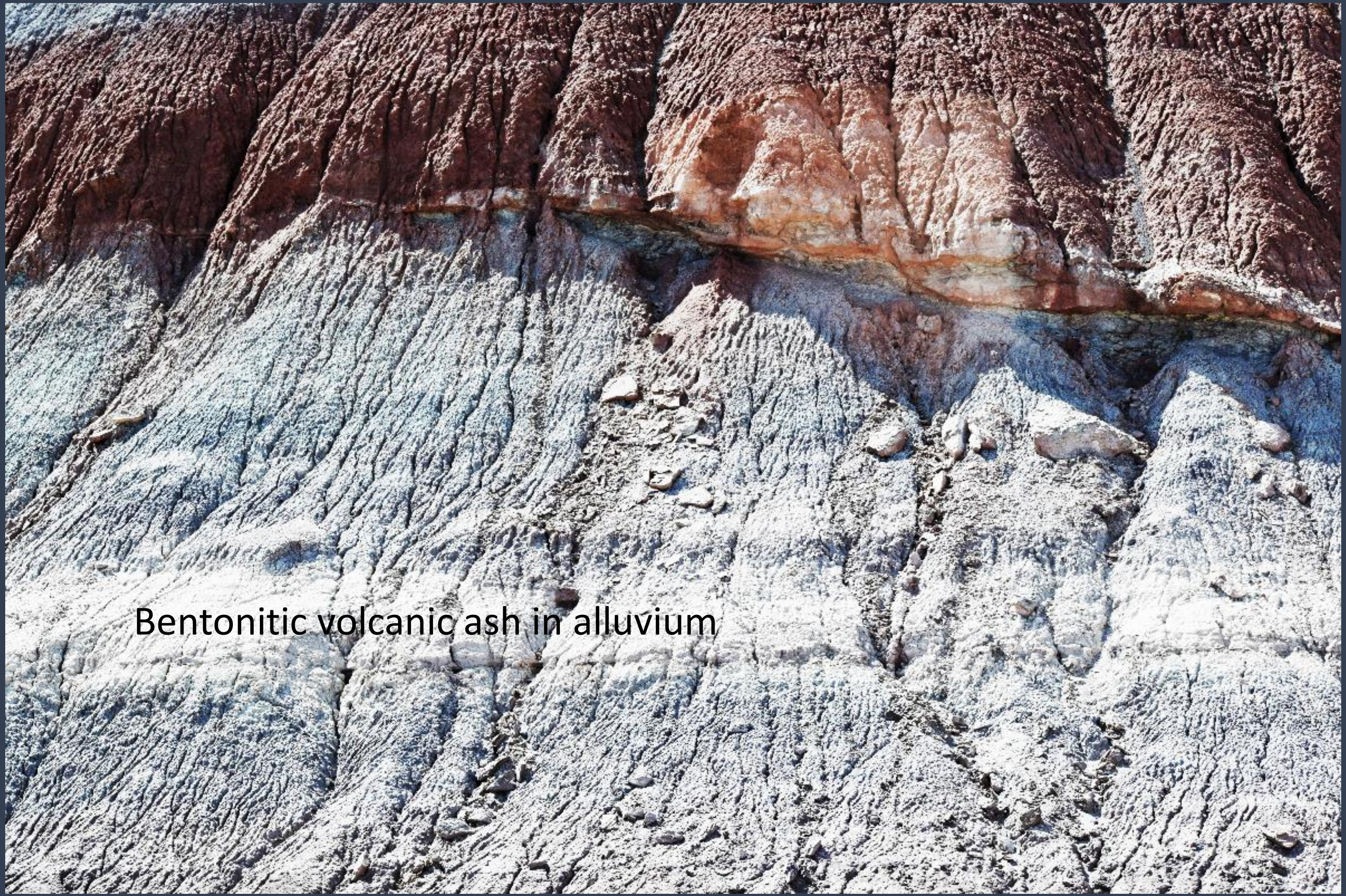


Flagstaff
Phoenix
Tucson
Yuma
Kingman
Lake Havasu City
Prescott
Mesa
Nogales

Painted Desert

215 Ma: alluvial deposits: braided & meandering streams of flood plains depositing sands, silts & clays with substantial volcanic ash from south & west. Floods brought upcountry logs of several species of pines and buried them rapidly. Volcanic ash provided silica (SiO_2) to petrify logs. CHINLE FM.

Bentonite rich beds: the volcanic ash derived clays expand and contract with water and erode quickly



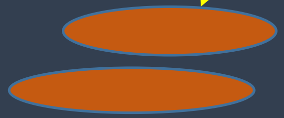
Tr. Chinle Formation

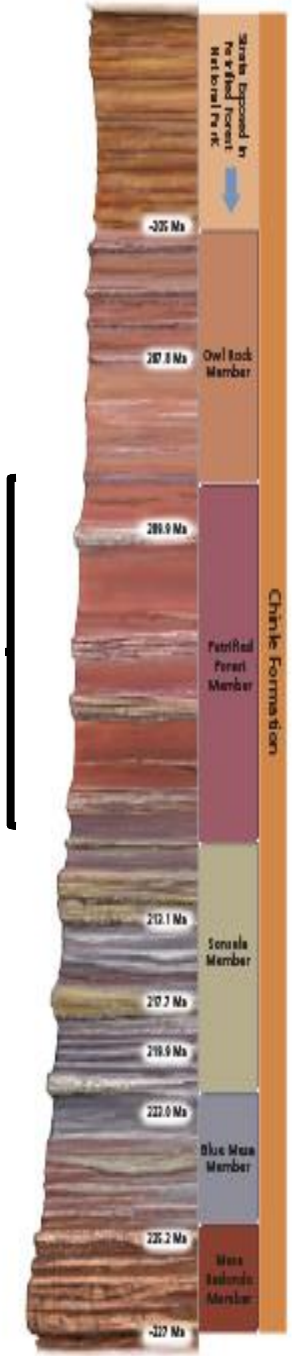

Silts & Clays with Bentonite rich Volcanic Ash
Soil surface (Paleosol)

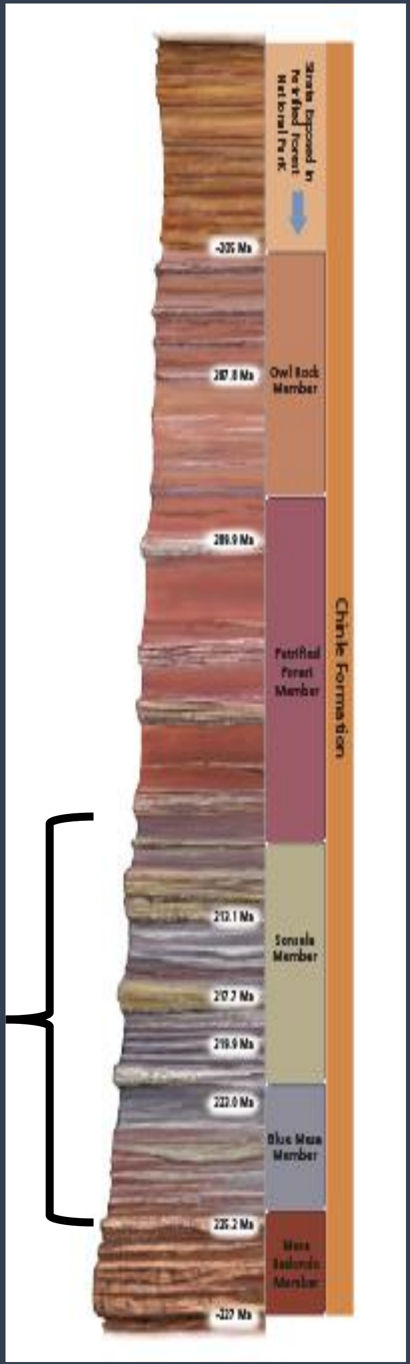

Pedestal Rocks


Agate Bridge

Lenticular (in C.S.) distributary channel beds in alluvial deposits



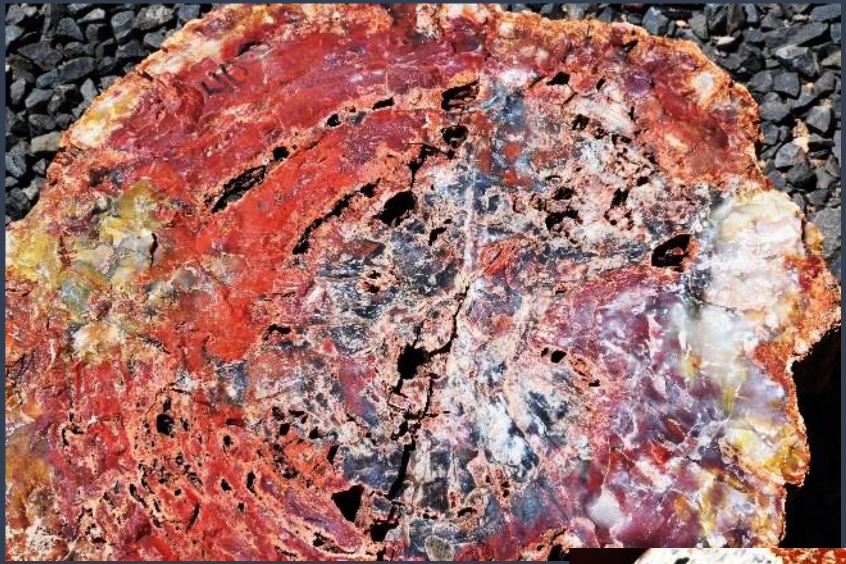

Strata Exposed in Petrified Forest National Park
~205 Ma
207.8 Ma
Owl Rock Member
209.9 Ma
Petrified Forest Member
213.1 Ma
Sonsela Member
217.7 Ma
219.9 Ma
222.0 Ma
Blue Mesa Member
225.2 Ma
Mesa Redondo Member
~227 Ma
Chinle Formation



Strata Exposed in Petrified Forest National Park
~205 Ma
Owl Rock Member
Petrified Forest Member
213.1 Ma
Sonsela Member
223.0 Ma
Blue Mesa Member
225.2 Ma
Mesa Redondo Member
~227 Ma
Chinle Formation

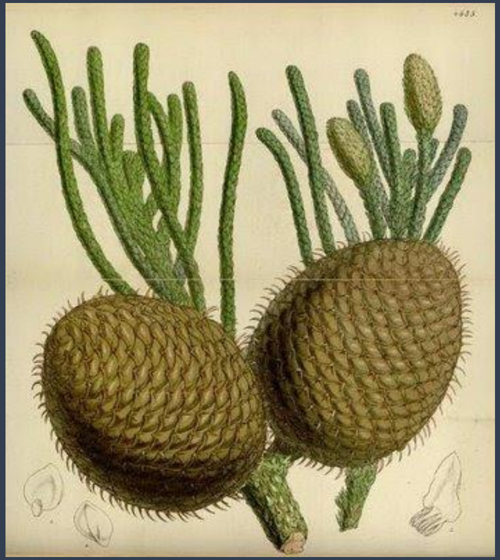
Note: cross-bedding in base of hoodoo

Petrified Forest = Conifer (*Araucarioxylon*) tree trunks ripped up and carried by streams - wood cells filled with SiO_2 from dissolution of volcanic ash and cell walls replaced by more SiO_2 as Fe rich (red) Agate or Chalcedony –Triassic Chinle Formation



cones

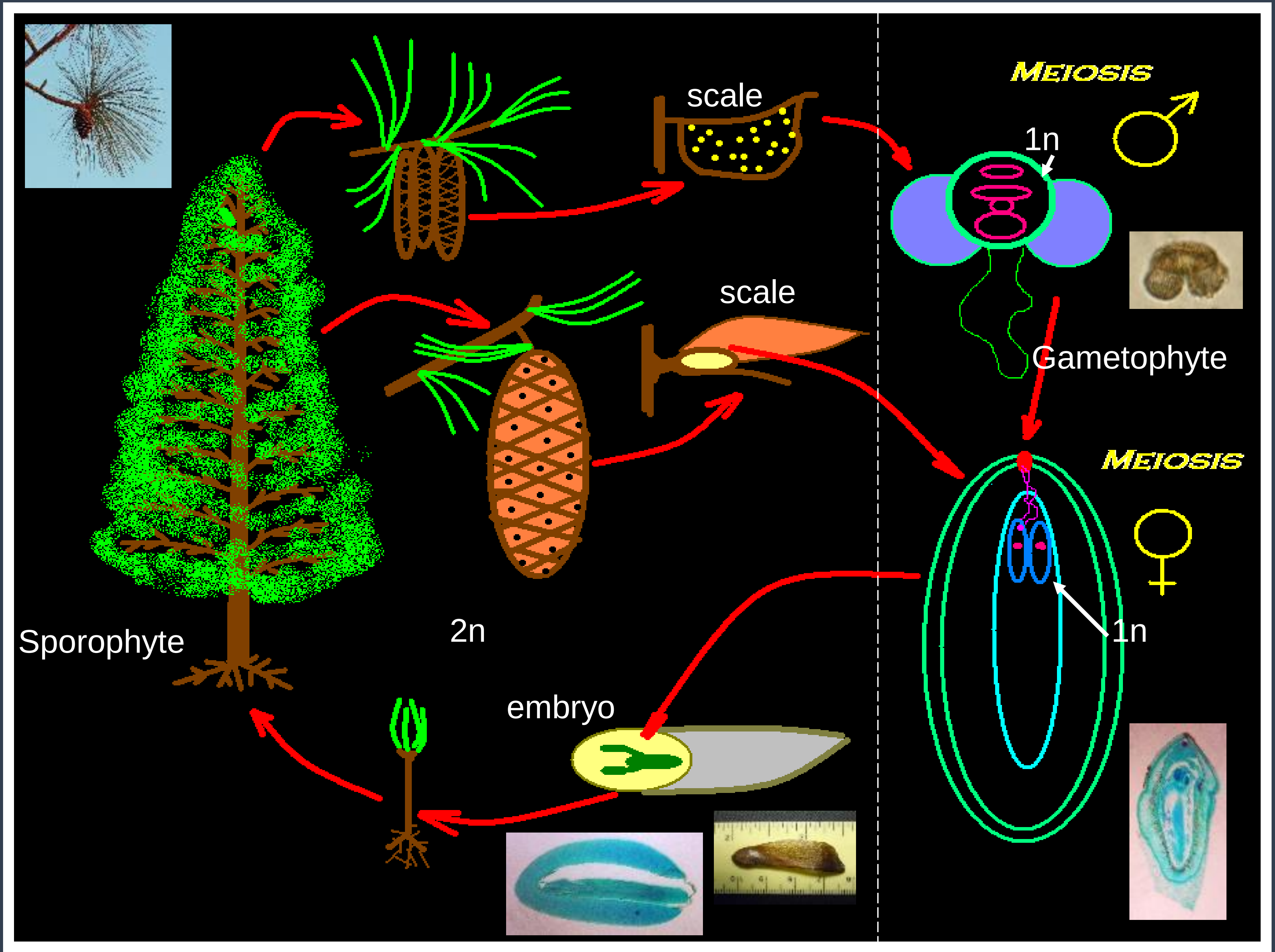

Late Triassic
Araucarioxylon
Now 3-4
species in
2-3 genera
215 Ma
2m
Tap root



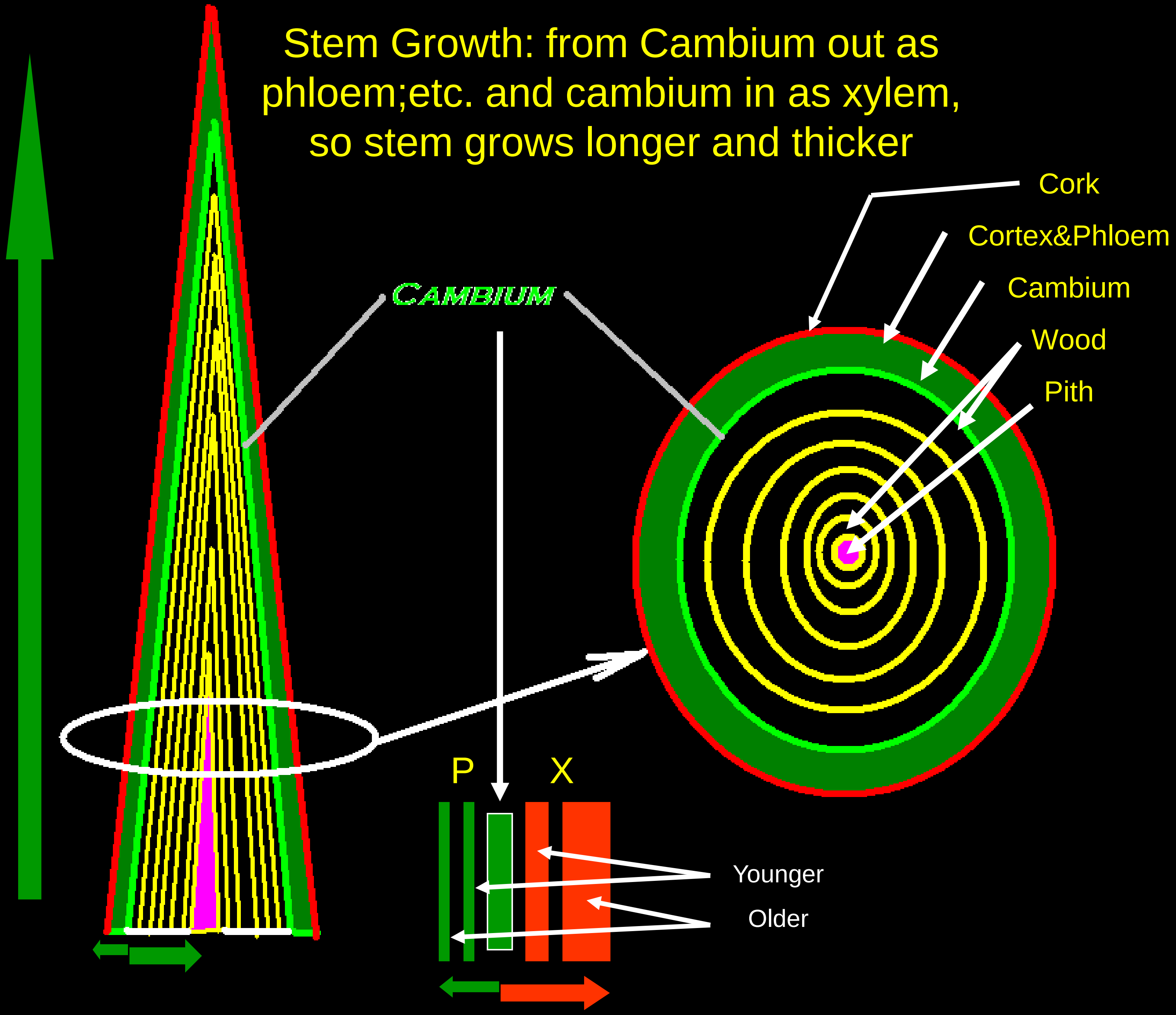

cones

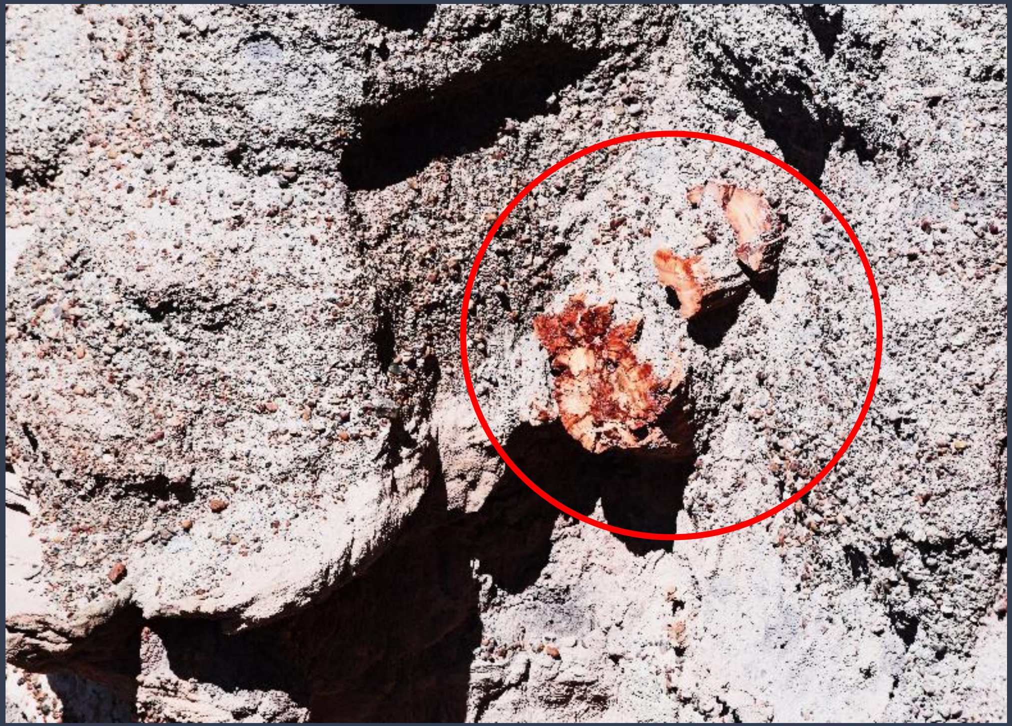

Pollen


Araucaria – modern
Norfolk pine


scale
MEIOSIS
1n
scale
Gametophyte
MEIOSIS
Sporophyte
2n
1n
embryo

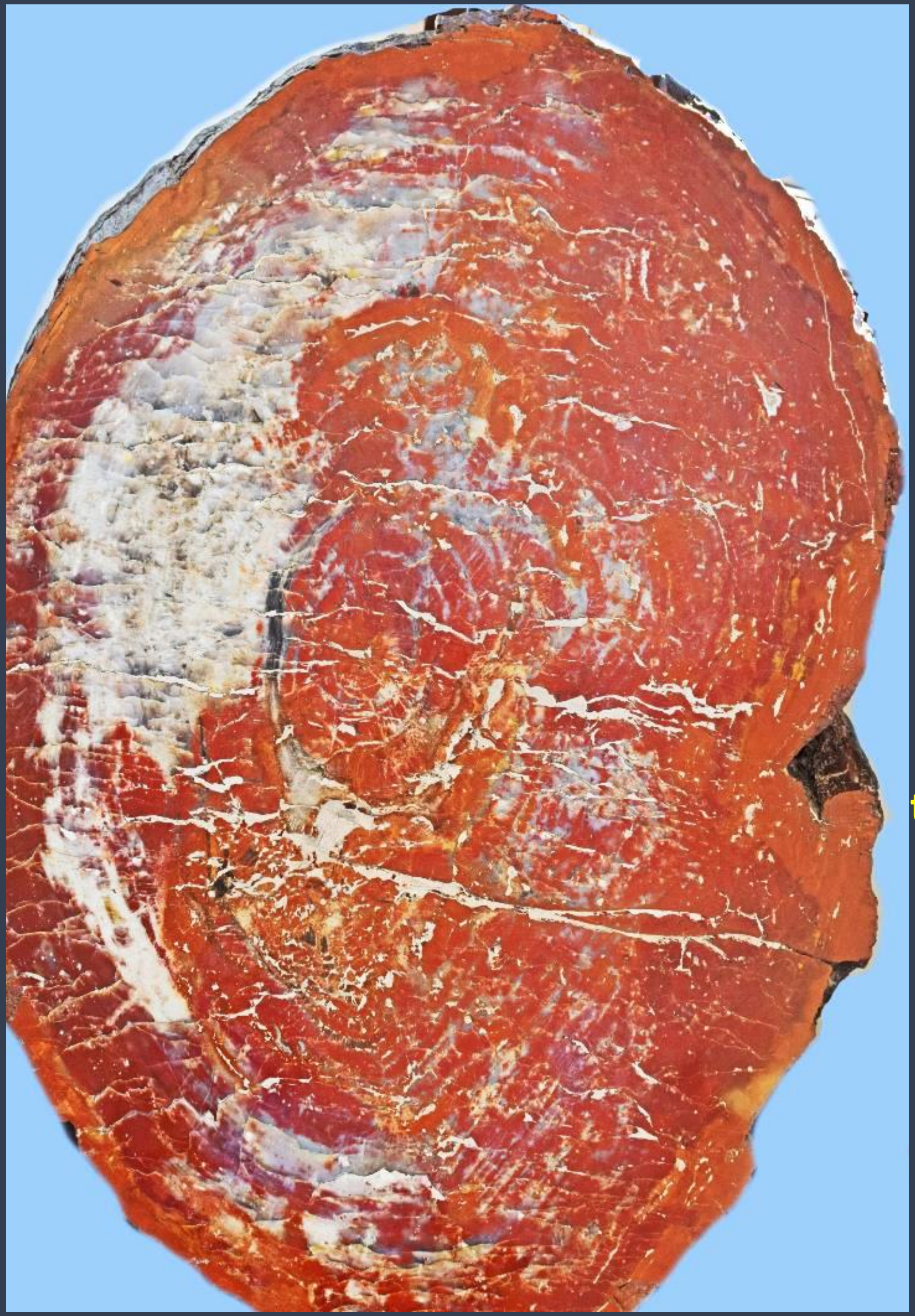
Stem Growth: from Cambium out as phloem;etc. and cambium in as xylem, so stem grows longer and thicker



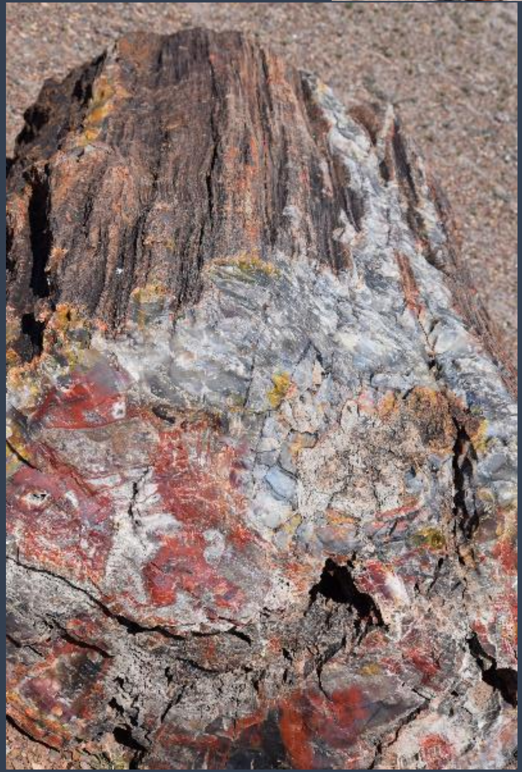





Petrified wood fragments litter desert floor



(*Araucarioxylon*)
tree trunks: petrified
and agatized

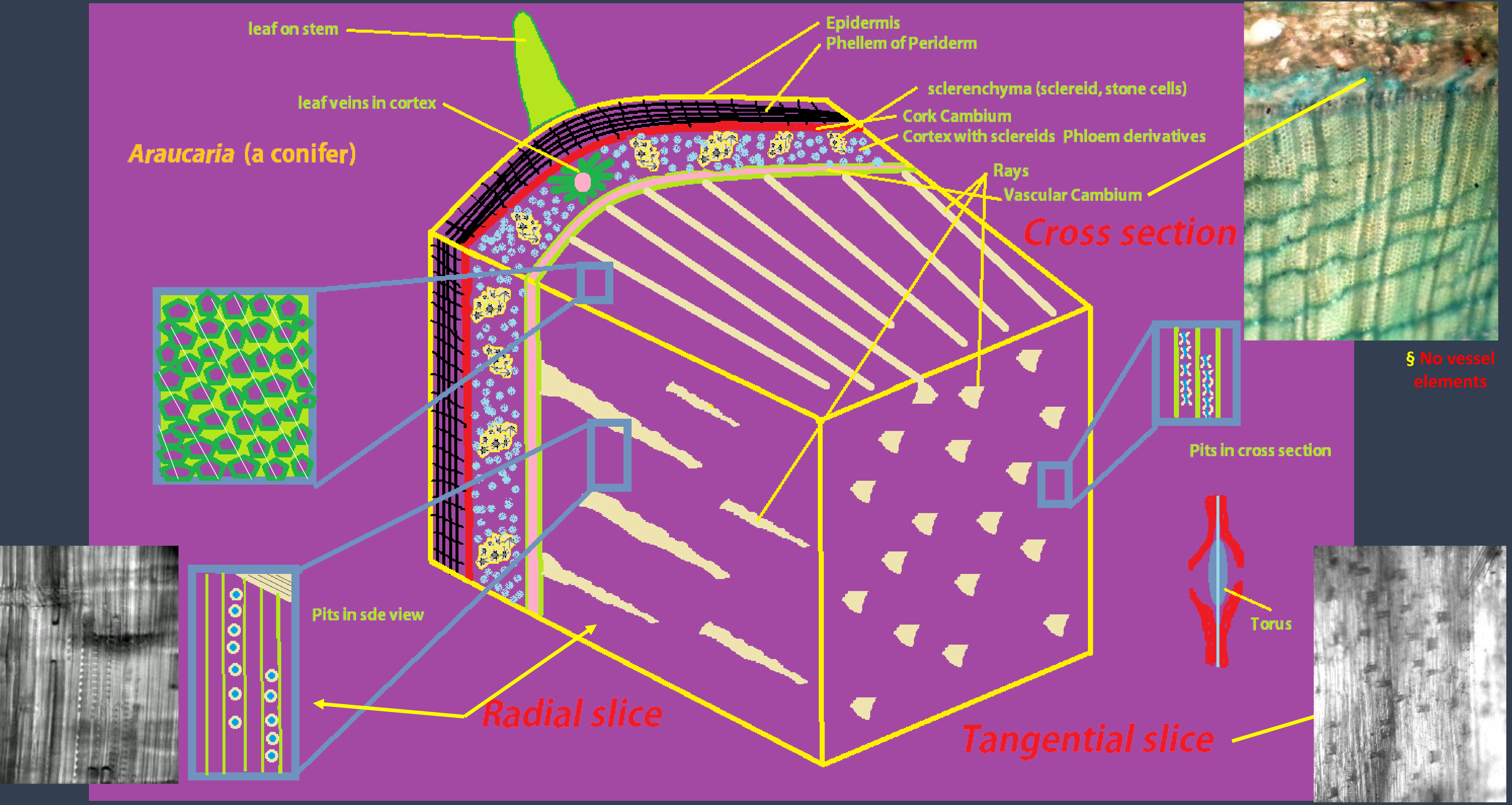


Weathering out of a hillside

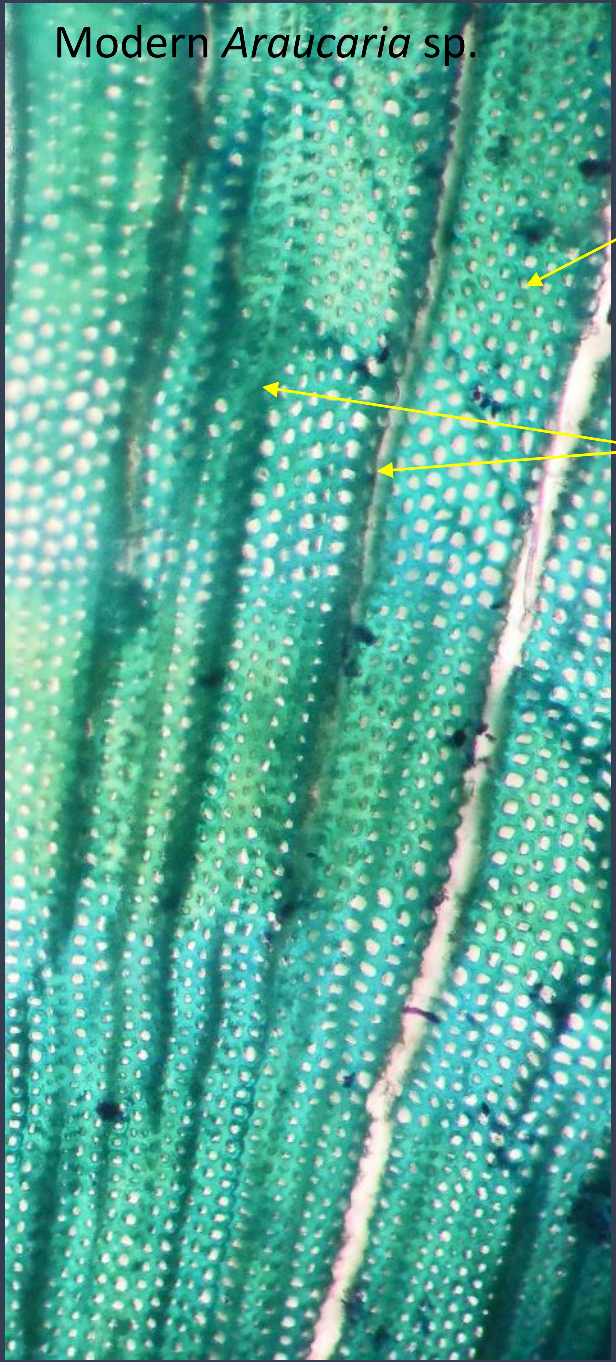


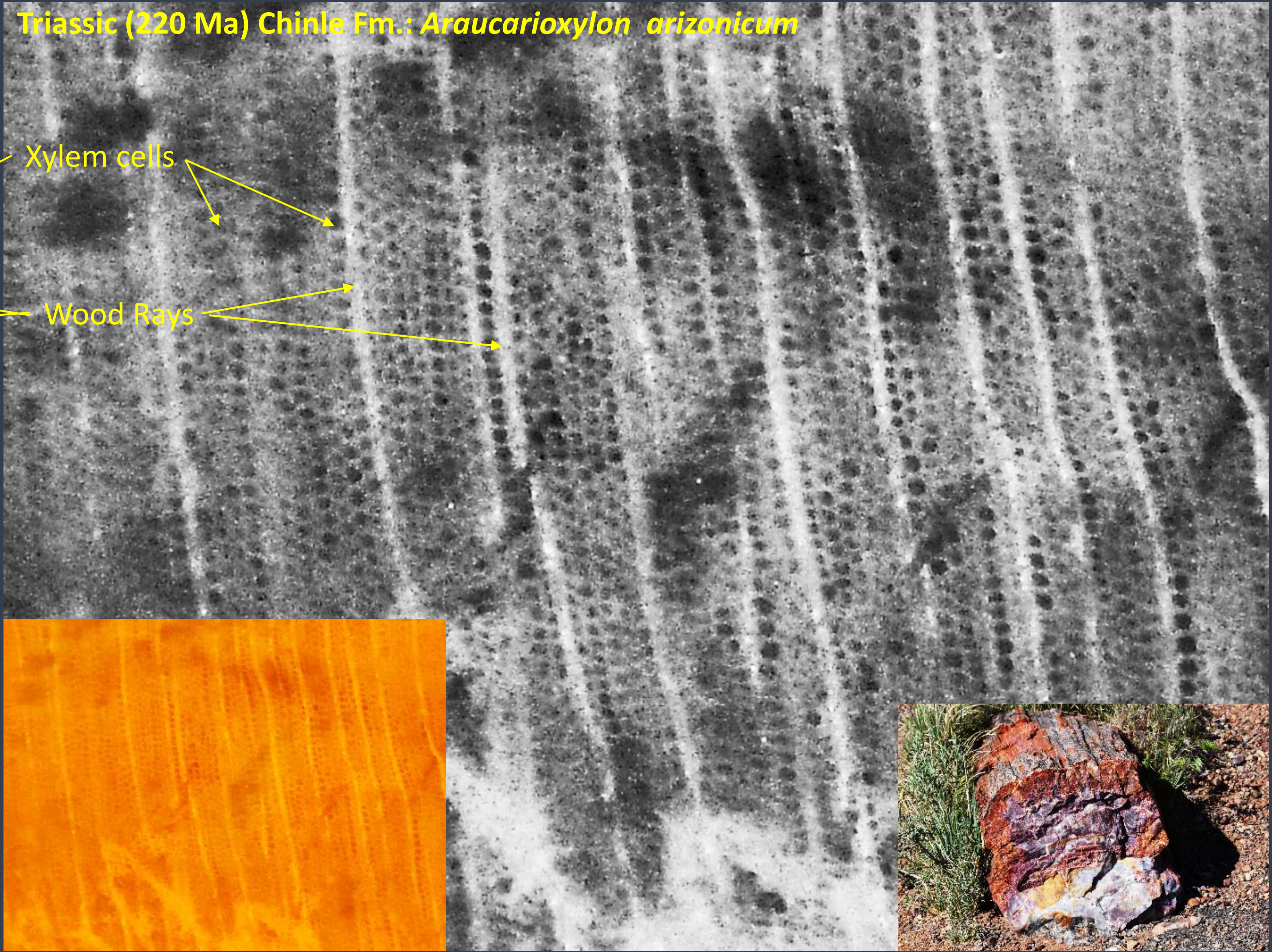
Pet. Wood chips litter mud-cracked ground

Iron stained chalcedony replaces wood cells

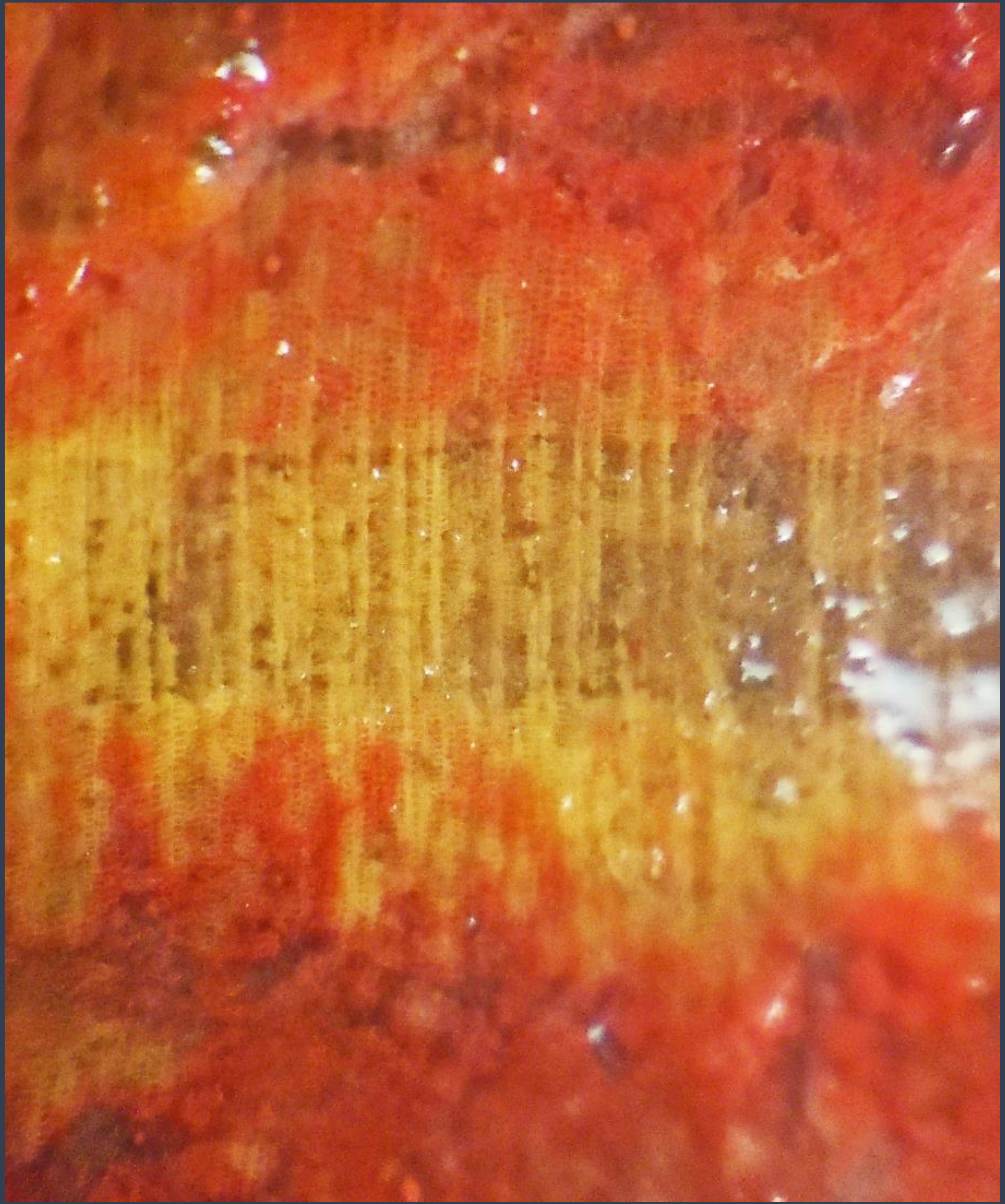

Araucaria (a conifer)
leaf on stem
leaf veins in cortex
Epidermis
Phellem of Periderm
sclerenchyma (sclereid, stone cells)
Cork Cambium
Cortex with sclereids
Phloem derivatives
Rays
Vascular Cambium
Cross section
Pits in cross section
§ No vessel elements
Torus
Pits in sde view
Radial slice
Tangential slice

Wood Microscopy: Polished hand specimens & thin sections



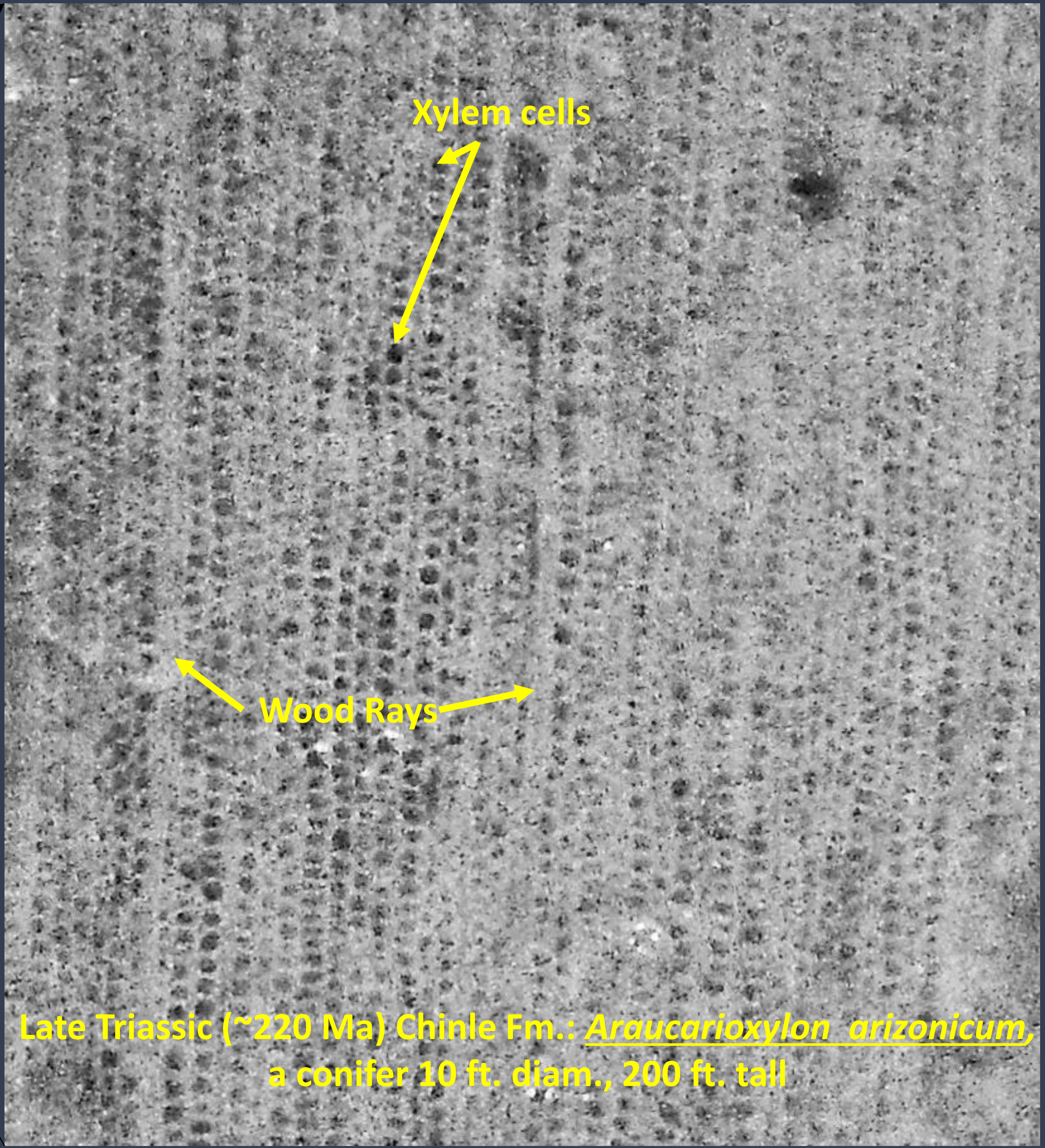


Cross sections

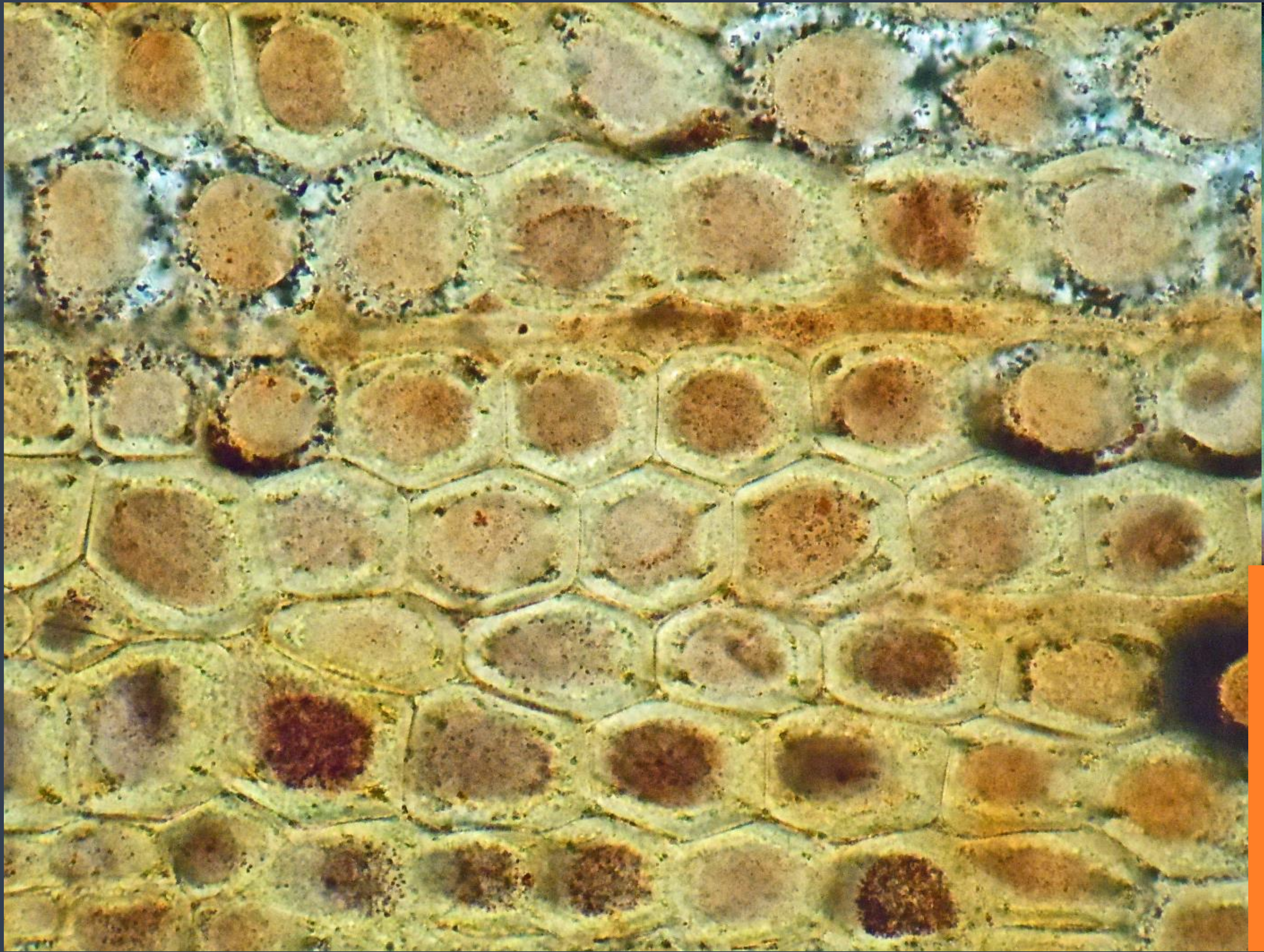


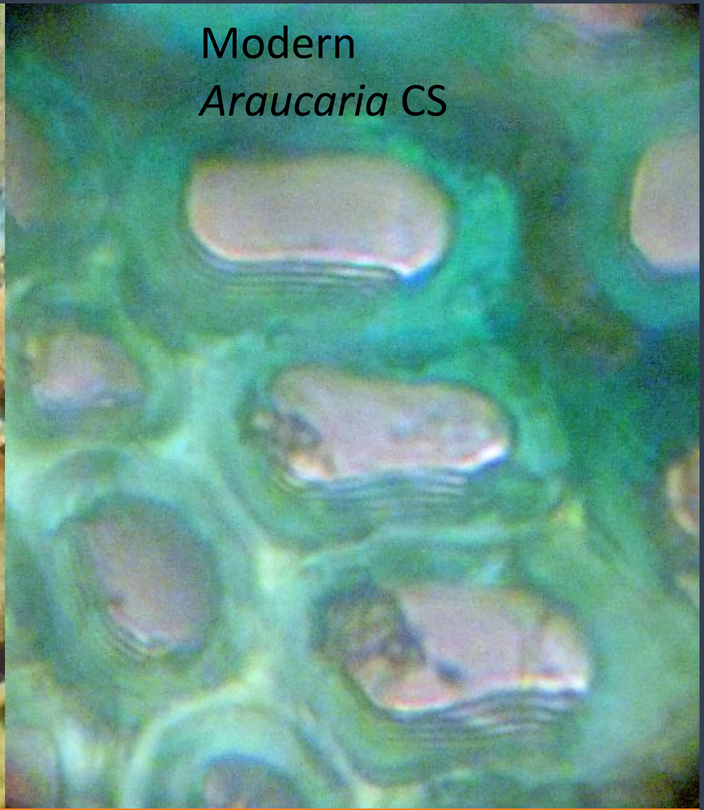
Triassic (220 Ma) Chinle Fm.: *Araucarioxylon arizonicum*

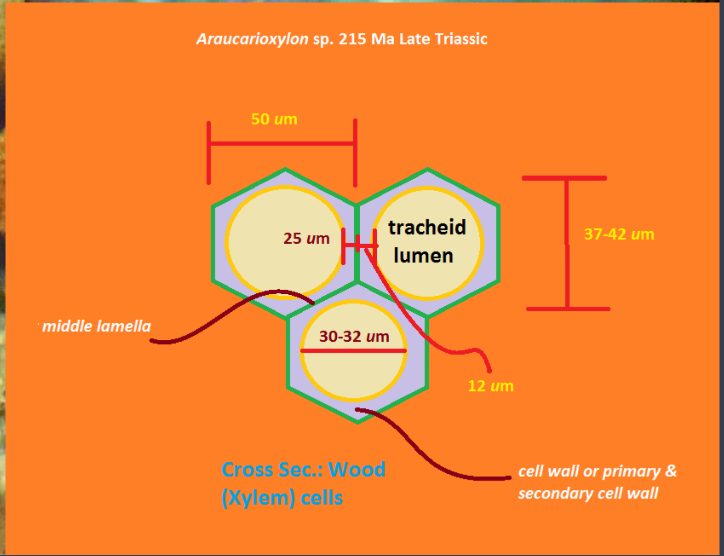
Cross section

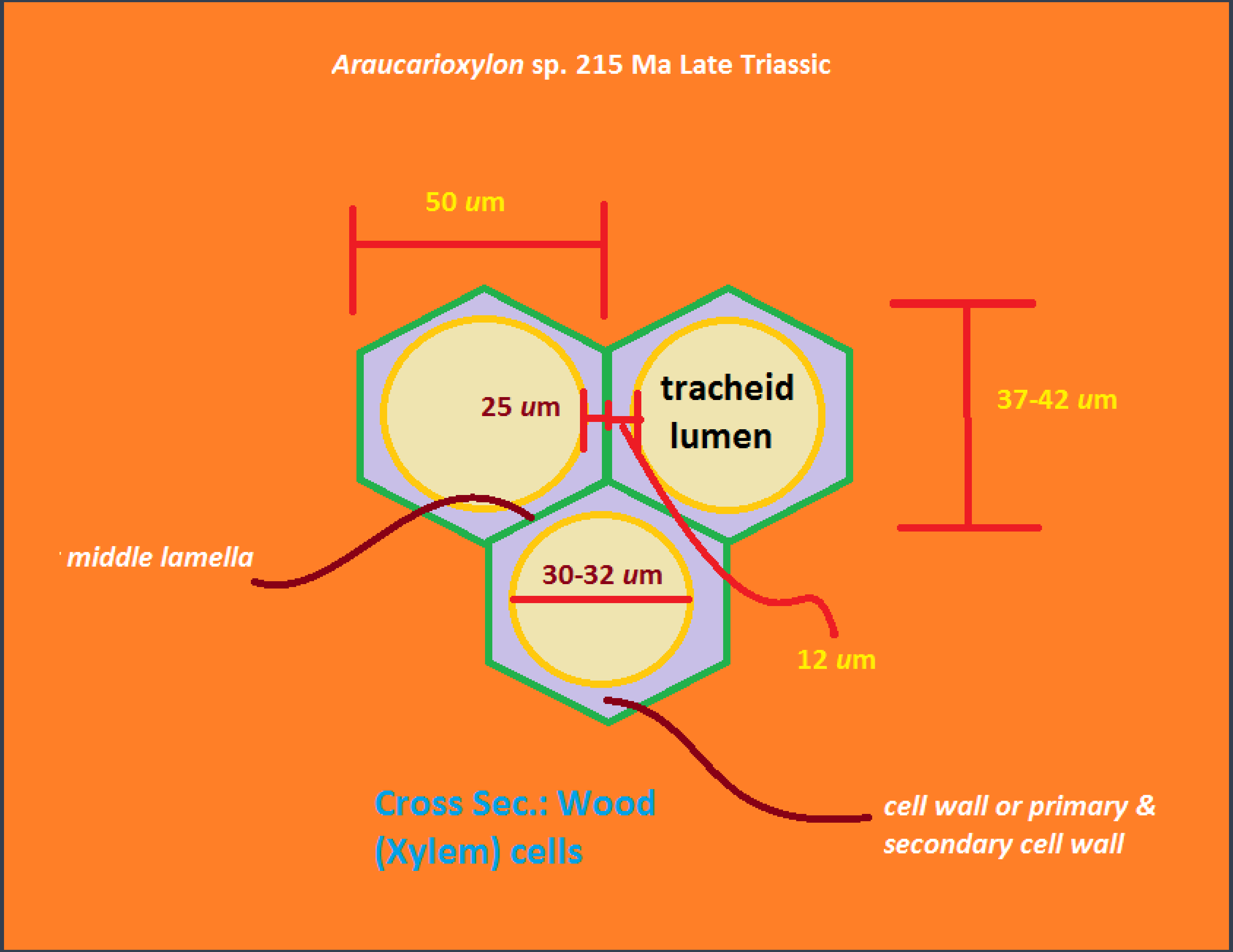


Cross sec.




Modern
Araucaria CS


Araucarioxylon sp. 215 Ma Late Triassic
50 *um*
25 *um*
tracheid
lumen
37-42 *um*
middle lamella
30-32 *um*
12 *um*
Cross Sec.: Wood
(Xylem) cells
cell wall or primary &
secondary cell wall

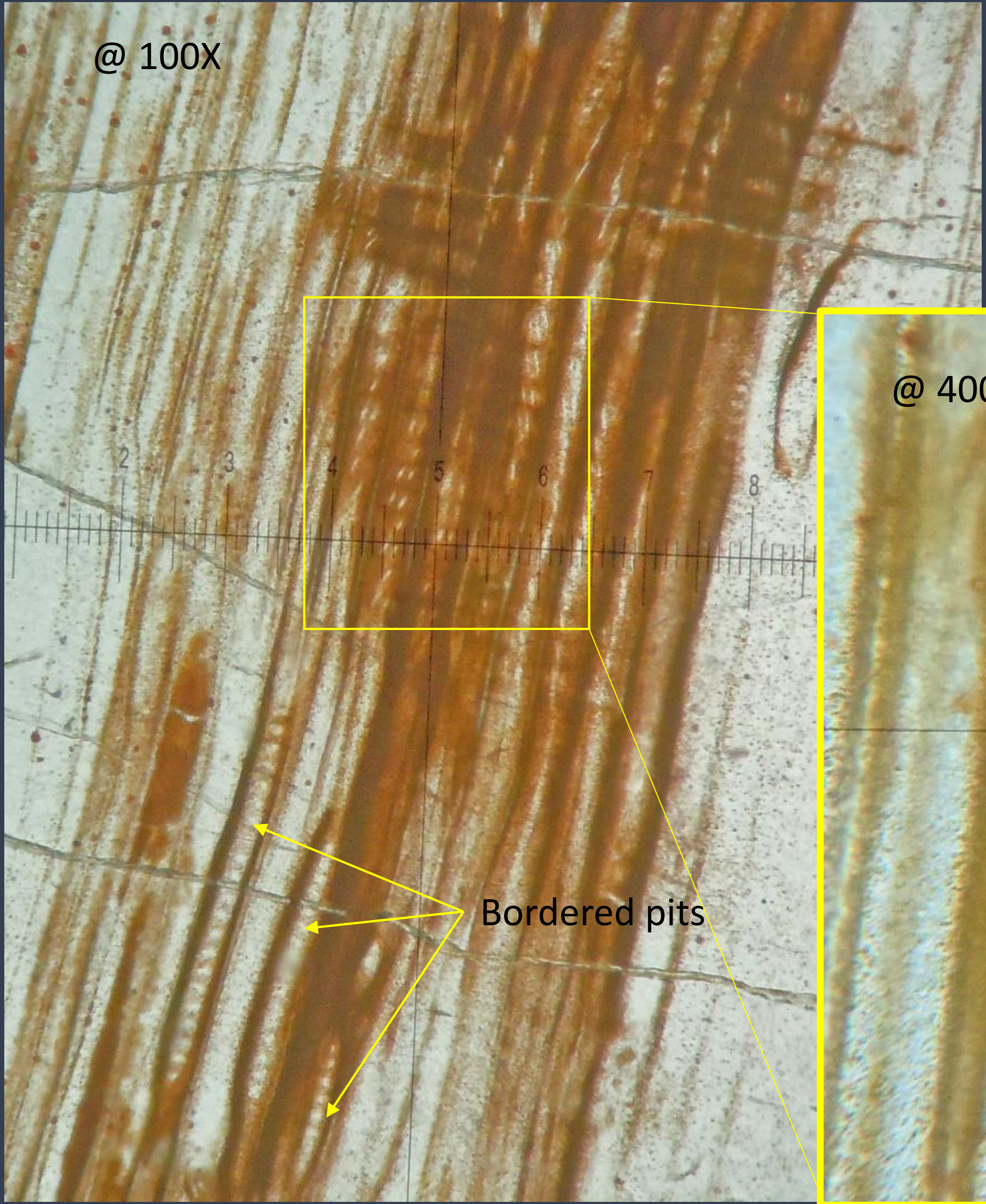


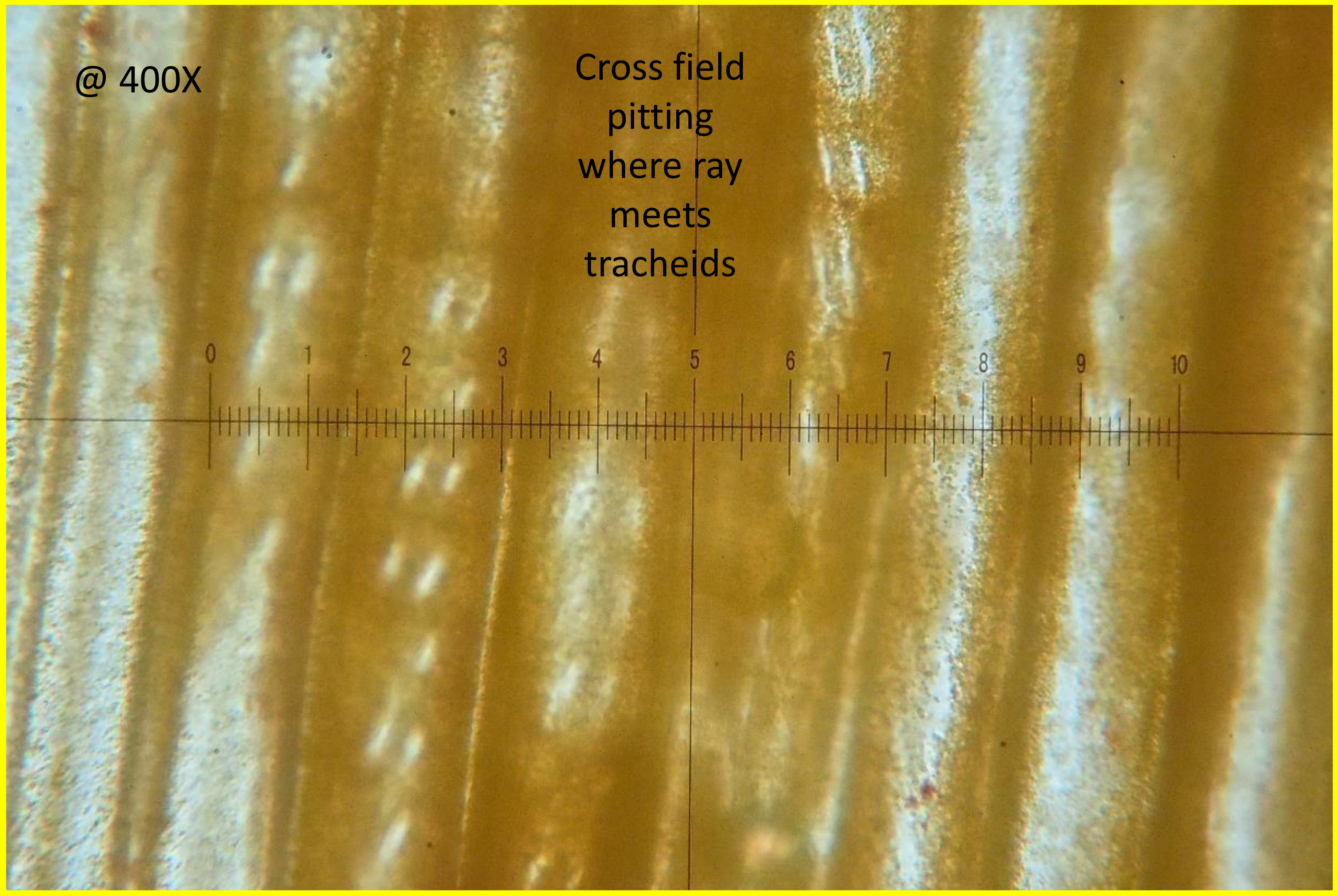
Araucarioxylon sp. 215 Ma Late Triassic
50 *um*
25 *um*
tracheid lumen
37-42 *um*
middle lamella
30-32 *um*
12 *um*
Cross Sec.: Wood (Xylem) cells
cell wall or primary & secondary cell wall

Radial section

Bordered and Cross-field pits

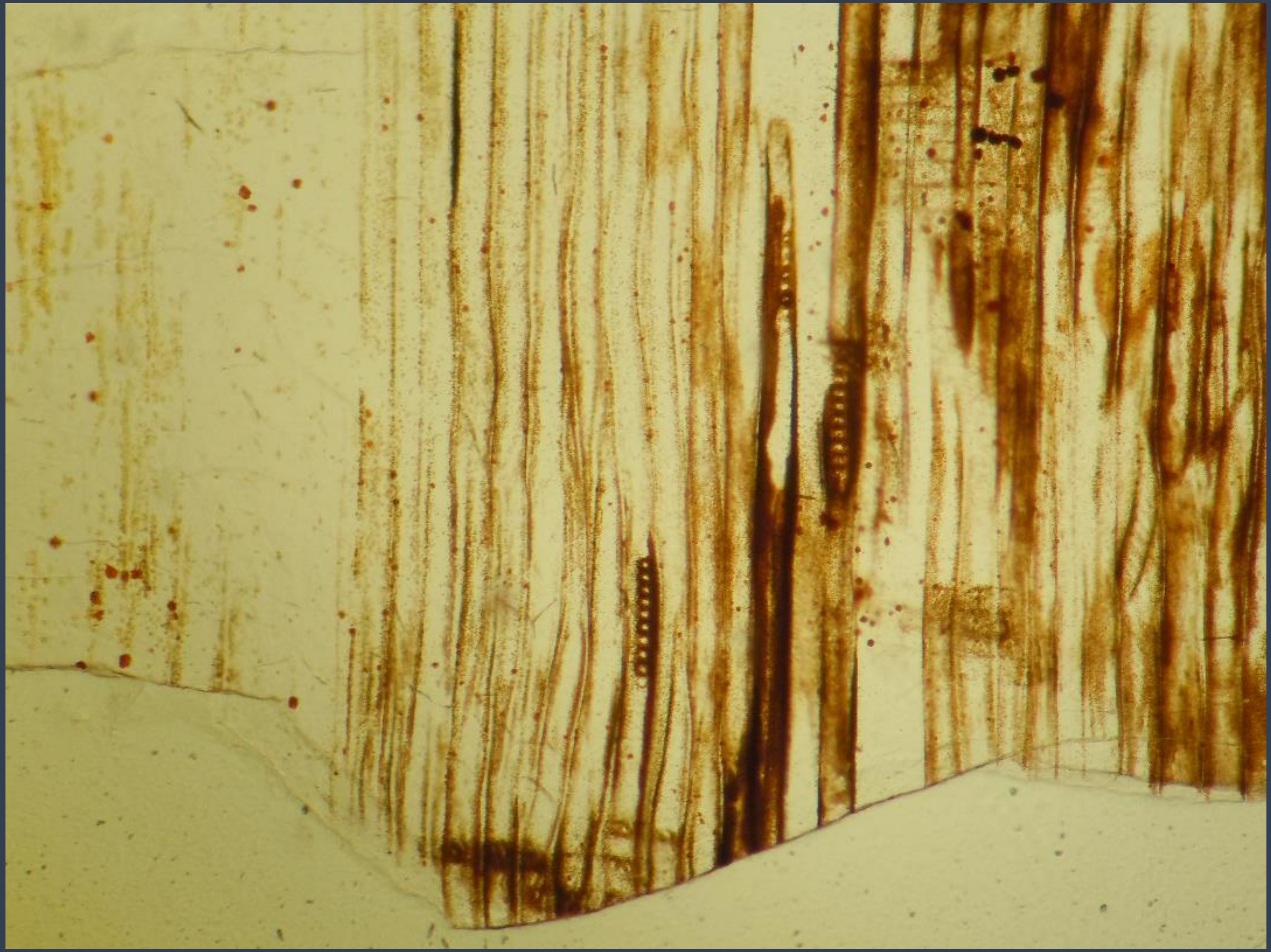
Radial sections

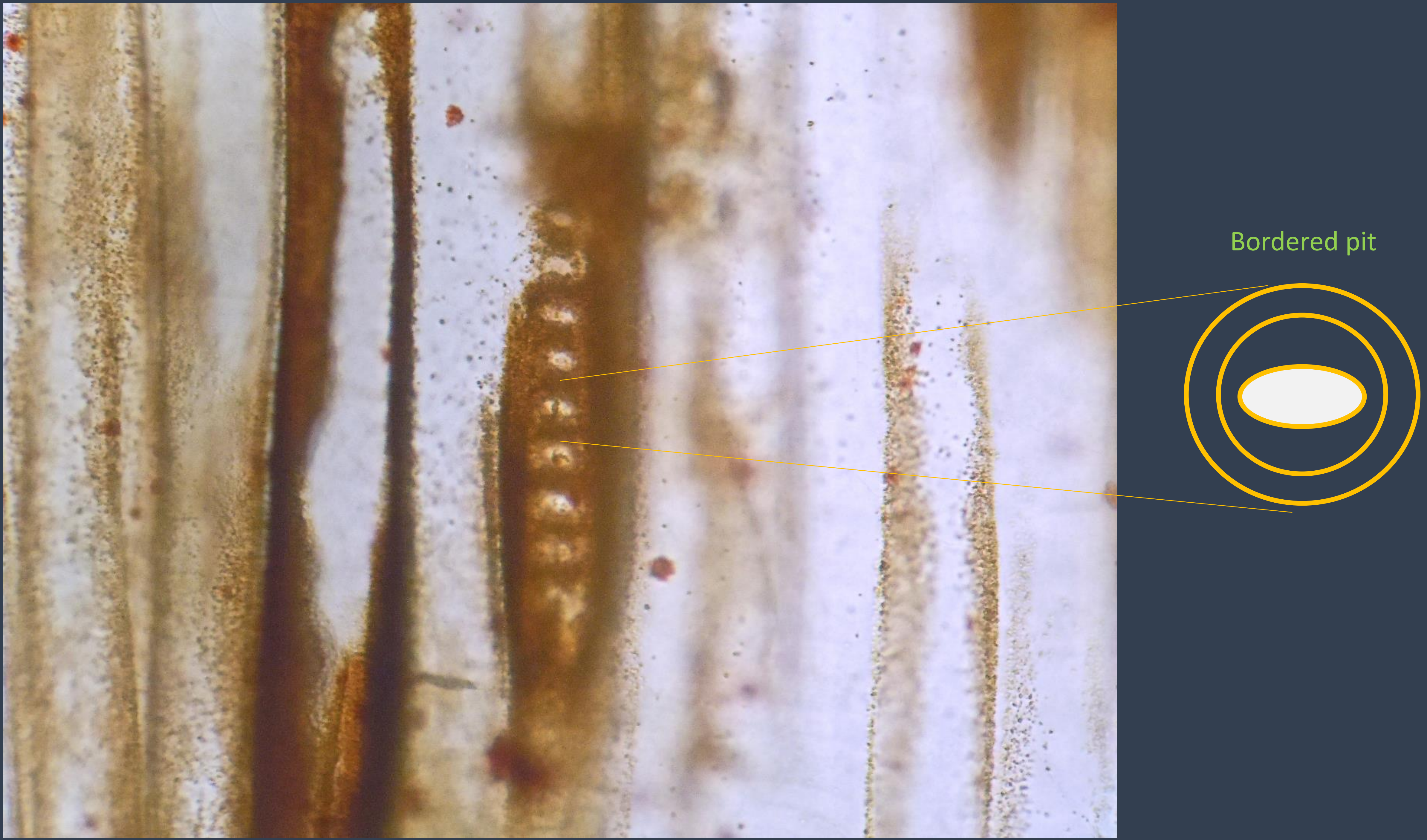




Bordered Pits

Radial sections

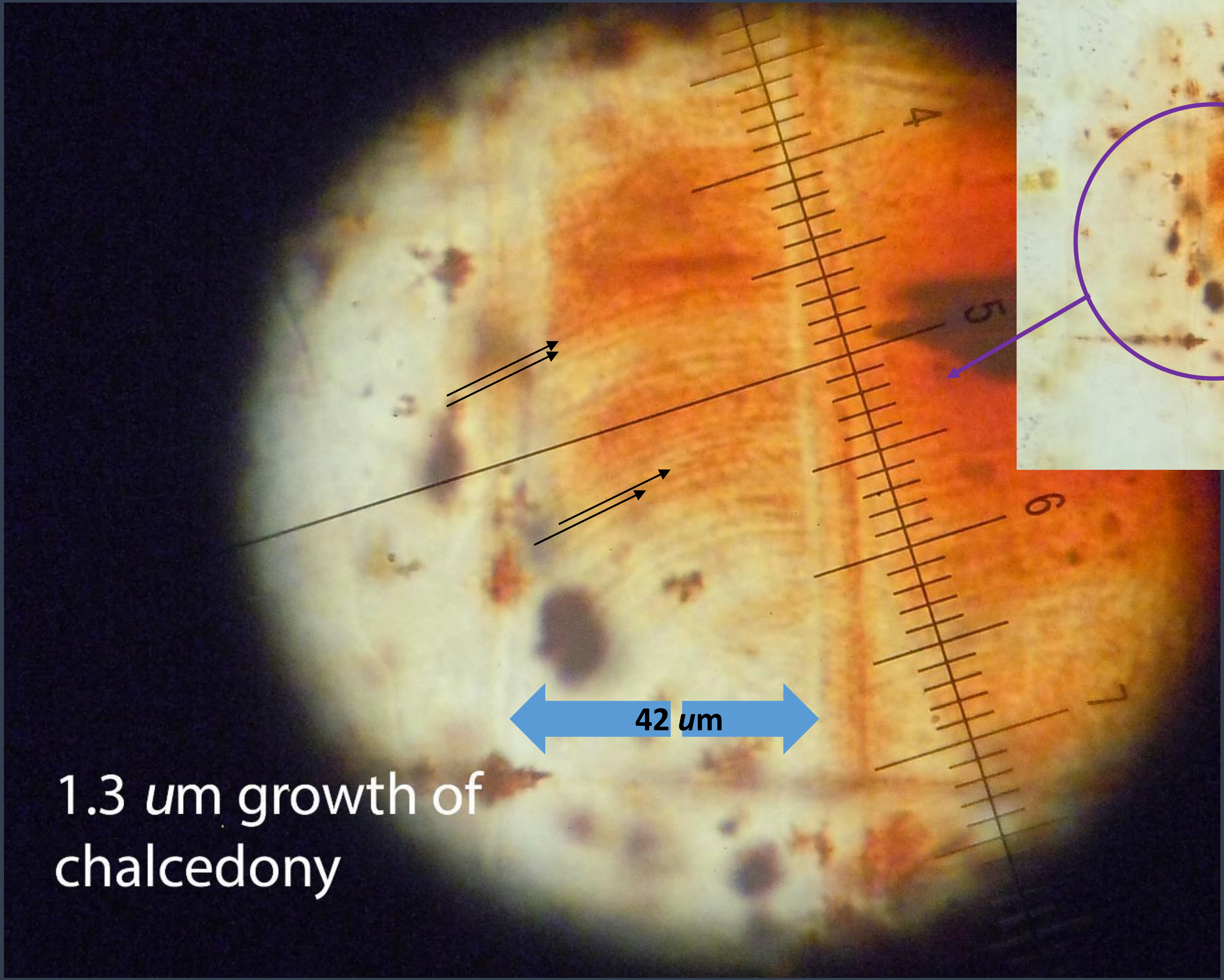



Bordered pit

Fe_2O_3 outlines successive laminae of silica as chalcedony in individual tracheids

Radial section

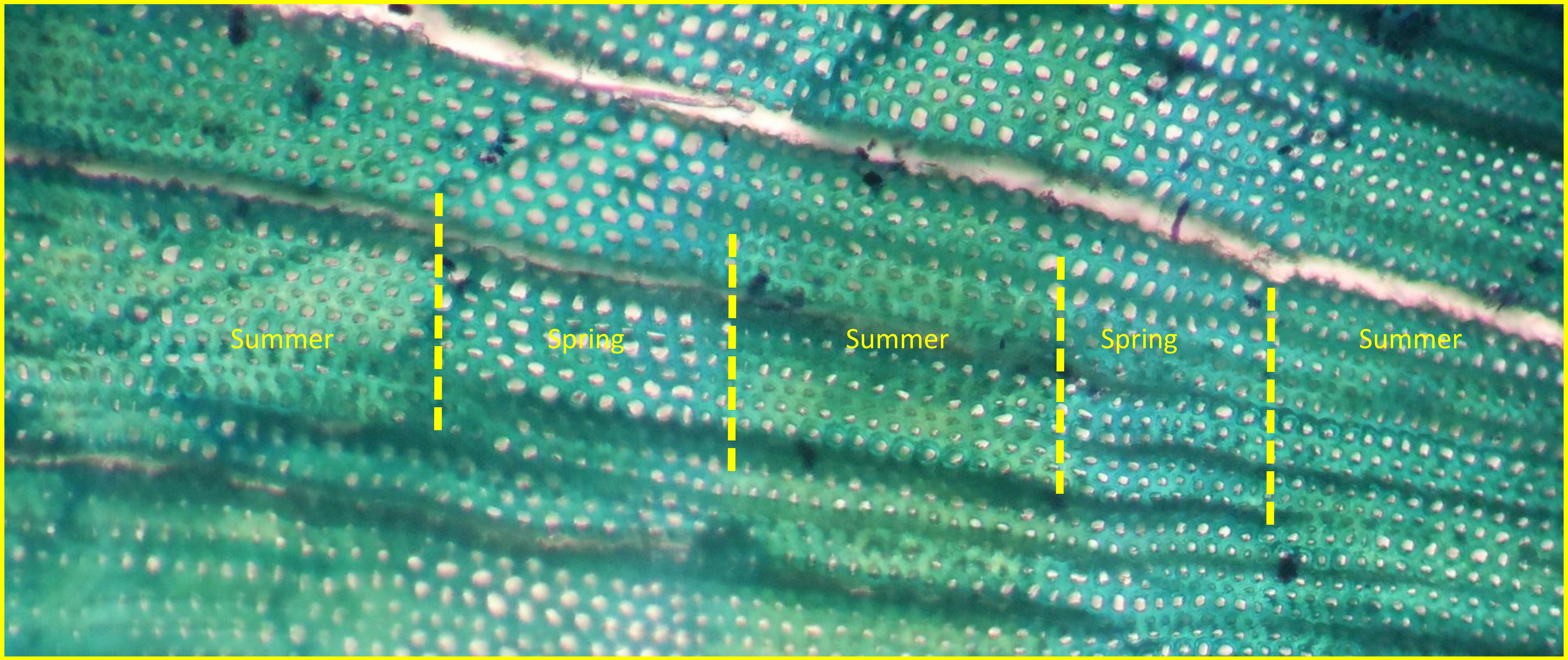
Radial section



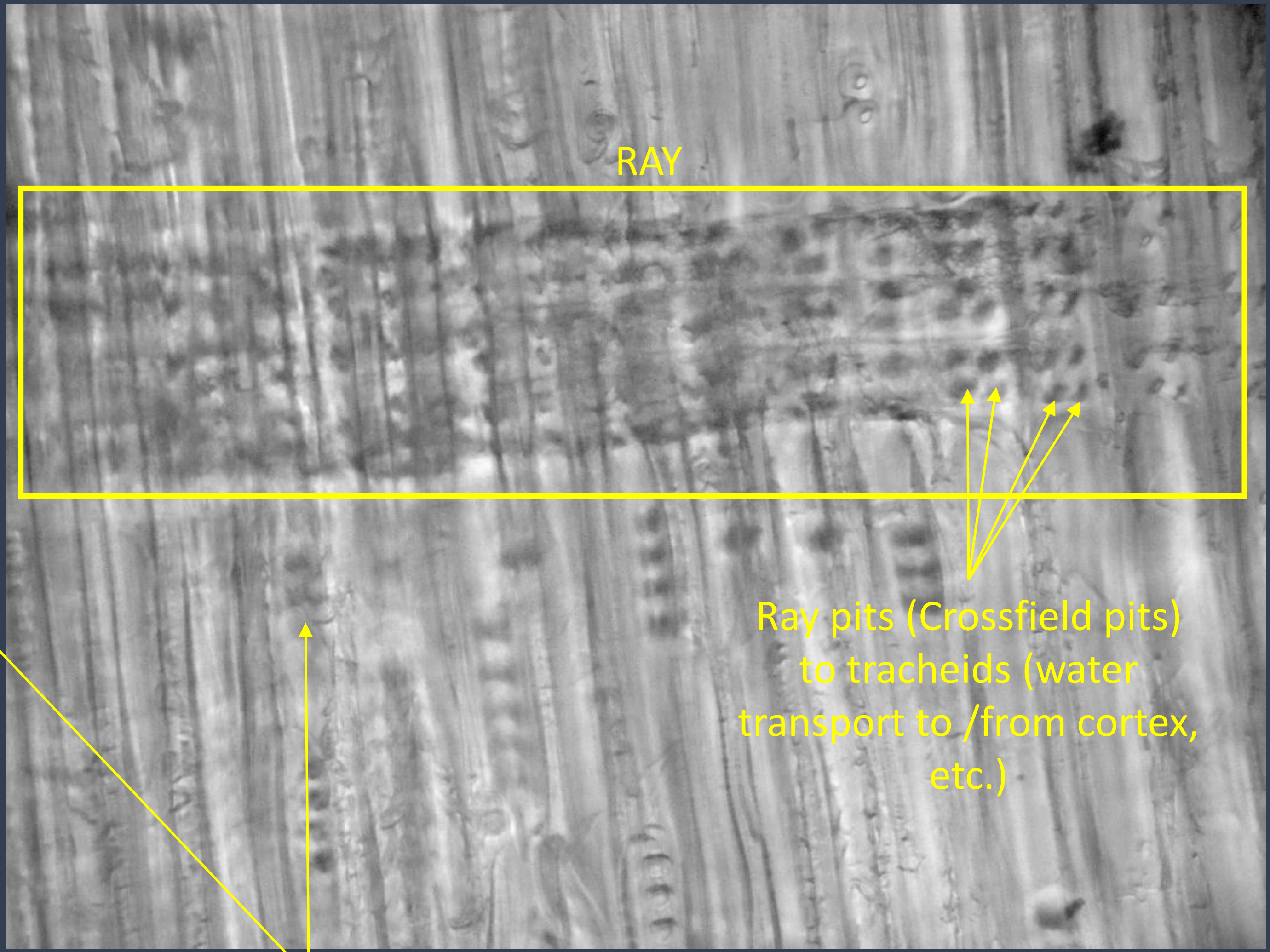
Radial section of tracheids: chalcedony growth rings @ 1.3 um intervals in lumen as outlined by iron staining

Annular growth rings (2.5 years shown)

Cross section



Modern *Araucaria*



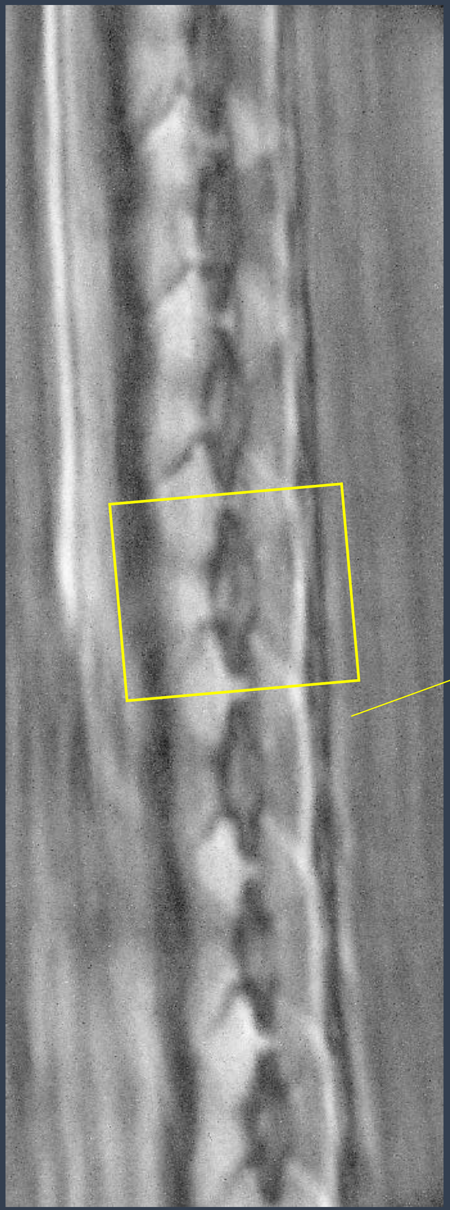
Vertical Xylem Tracheids, many with pits (no vessel elements in conifer wood)

Radial Section

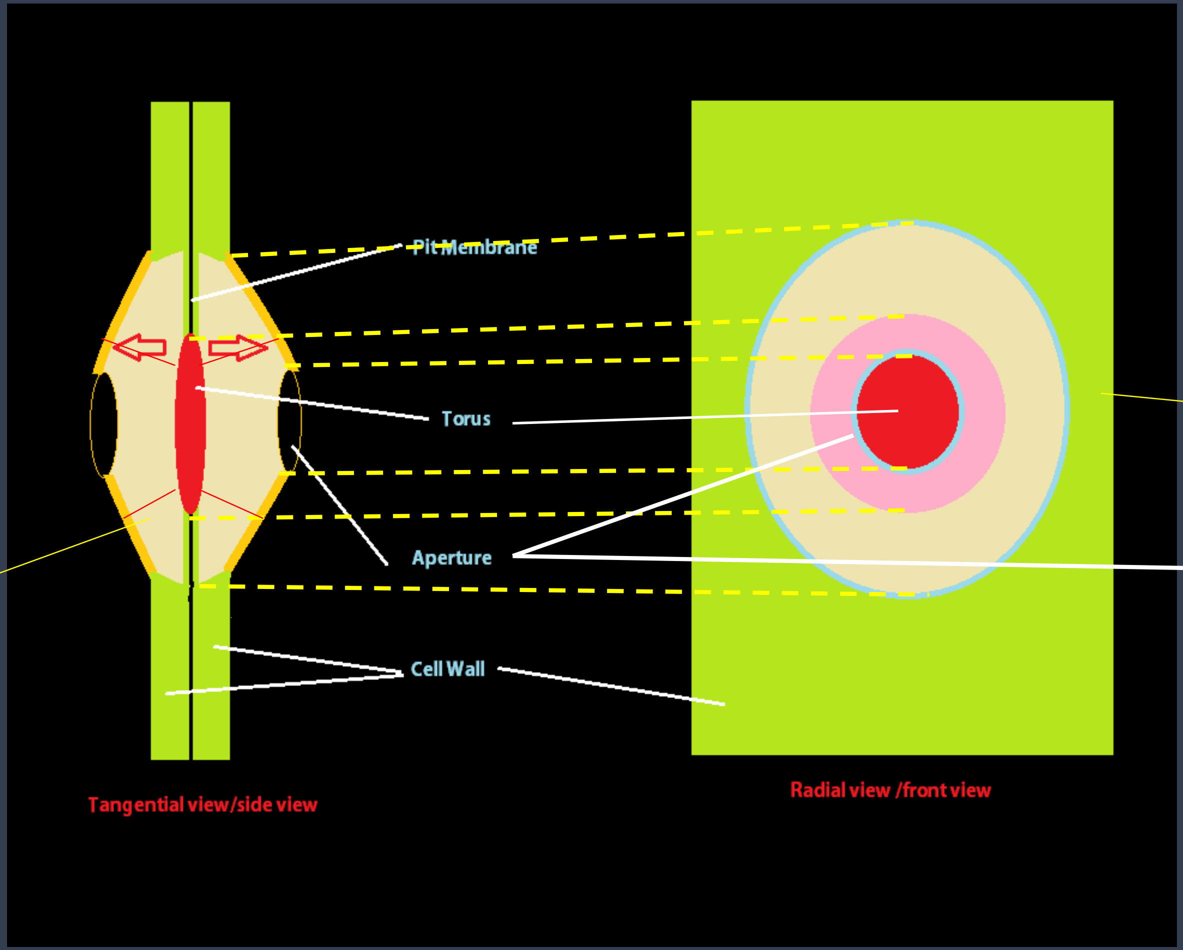
Cs of ray in tangential section

Tangential section

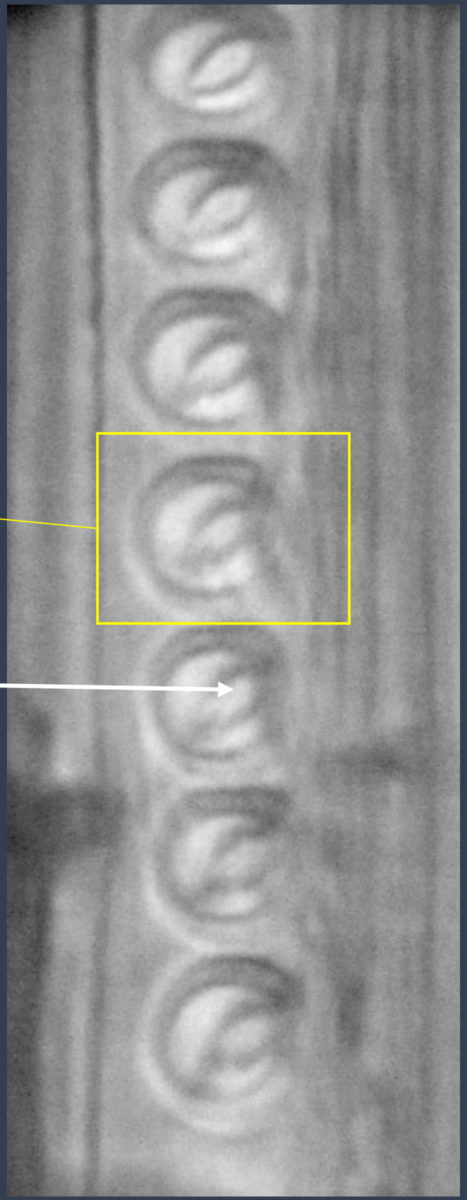
Bordered Pits



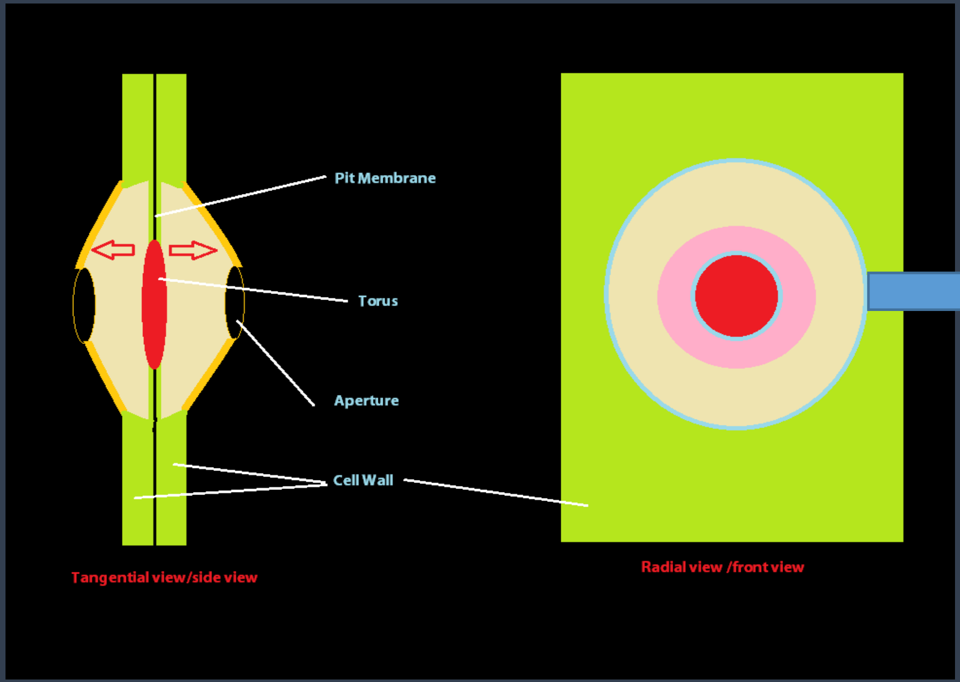
Tangential section



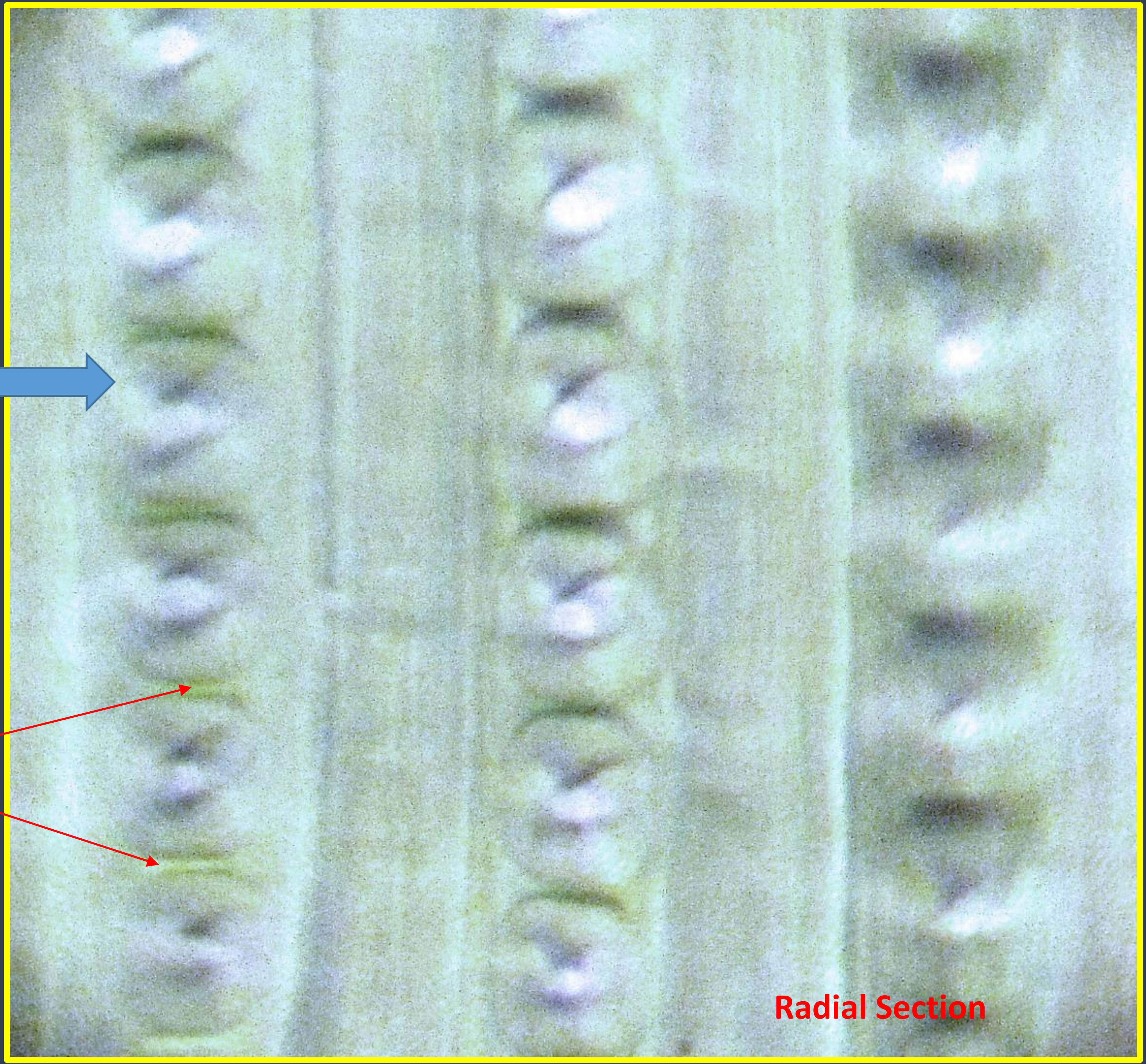
Torus and membrane move back-and-forth with turgor pressure to allow water to pass to other tracheids



Radial Section



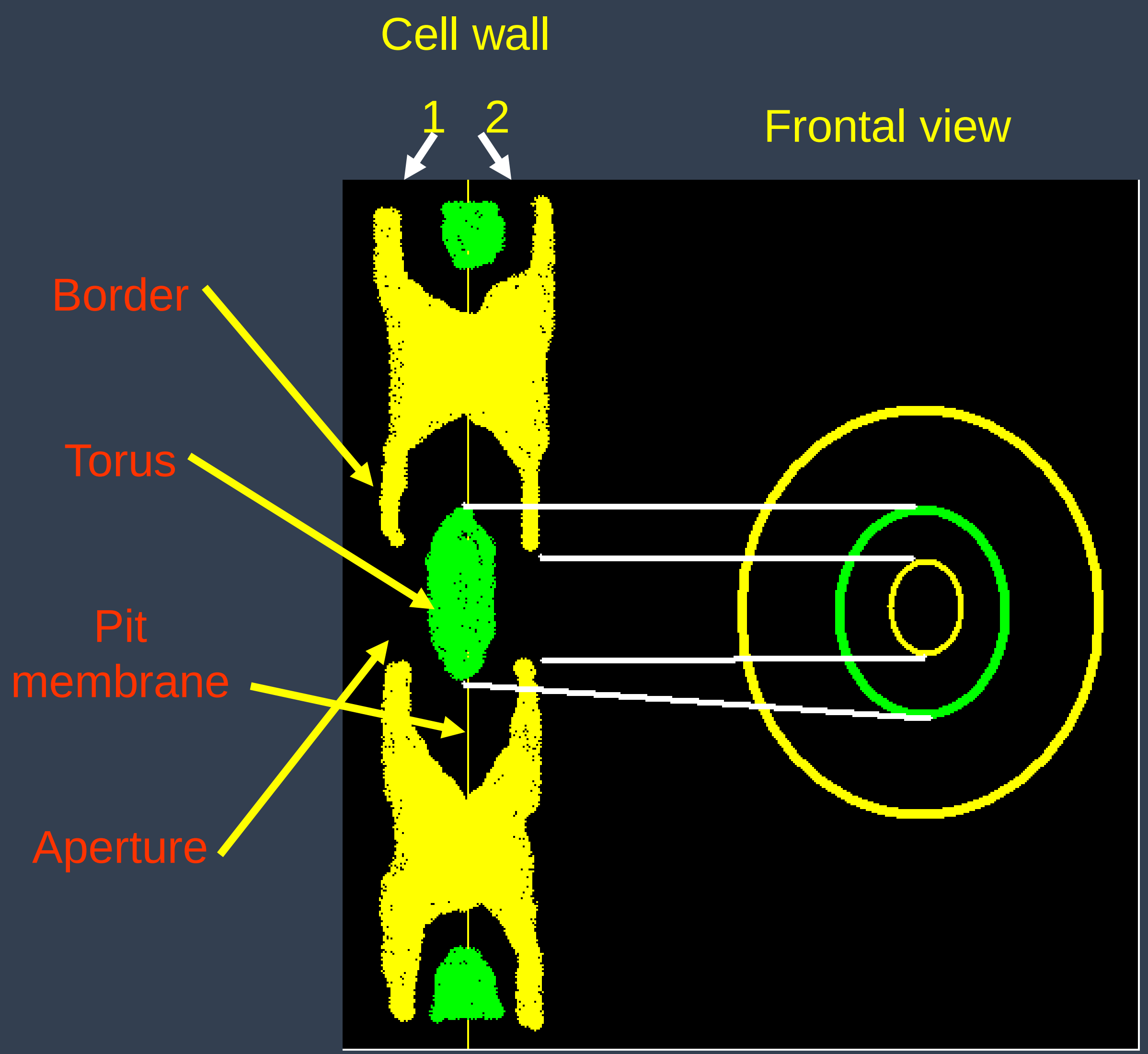
Pit Membrane
Torus
Aperture
Cell Wall
Tangential view/side view
Radial view /front view



Radial Section

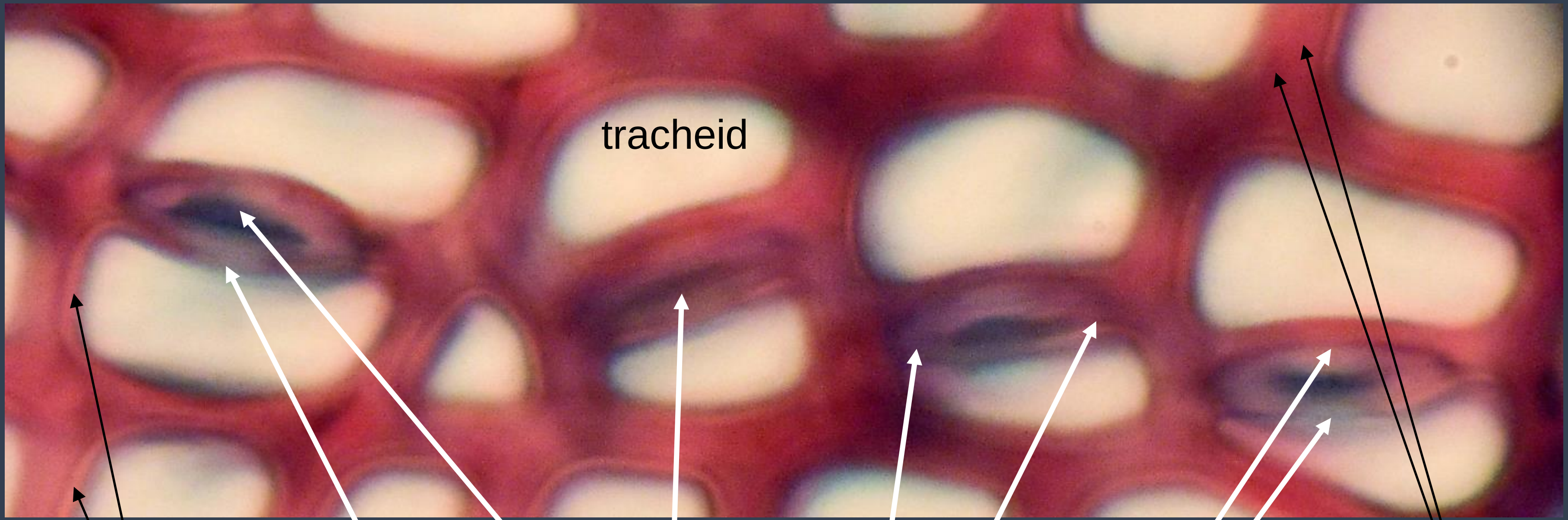
crassulae

BORDERED PITS in transfusion tissue & xylem (tracheids) of wood in stem

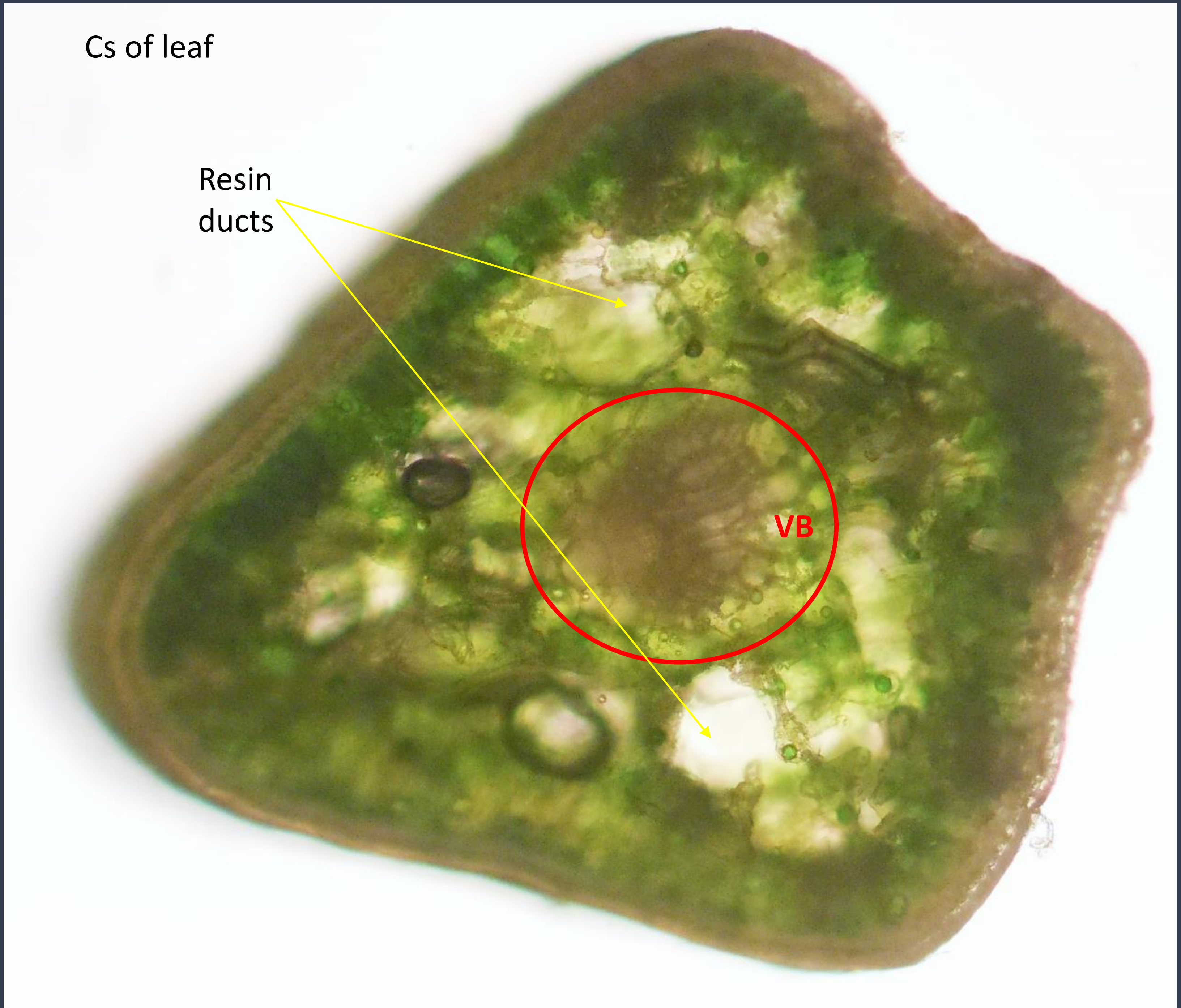


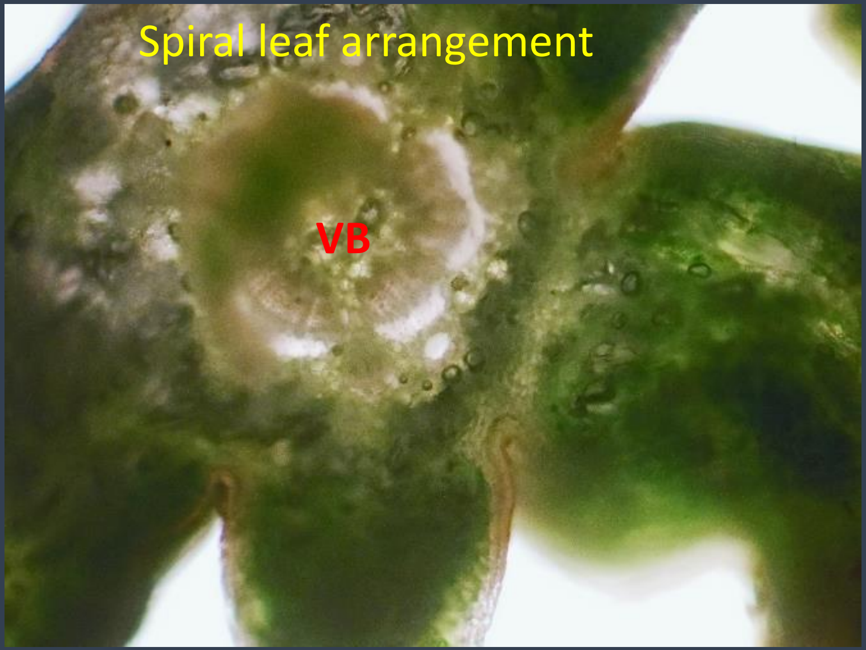
Torus moves back & forth under turgor pressure in dead xylem tracheid to regulate H_2O movements through apertures & tracheid

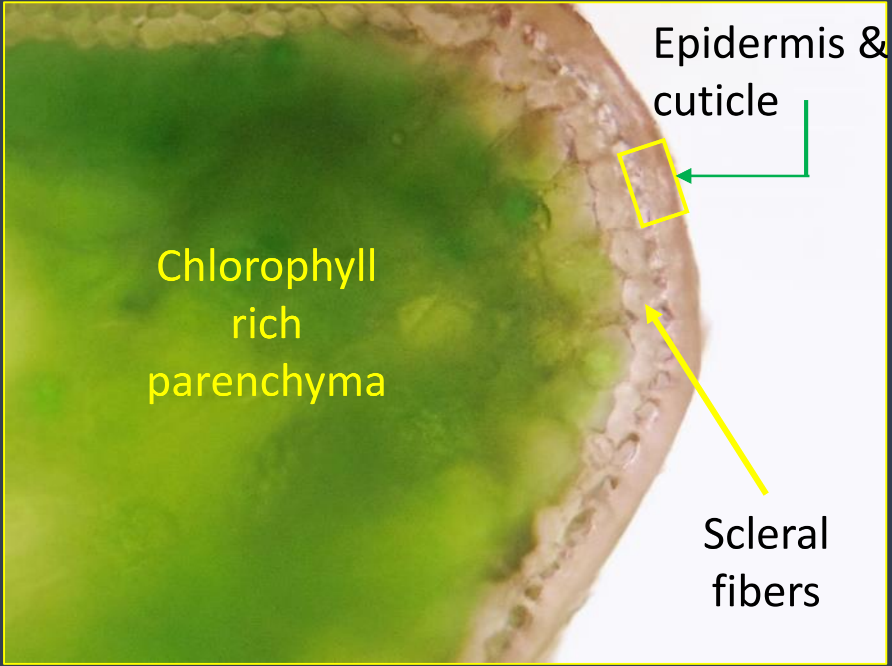
Cross section

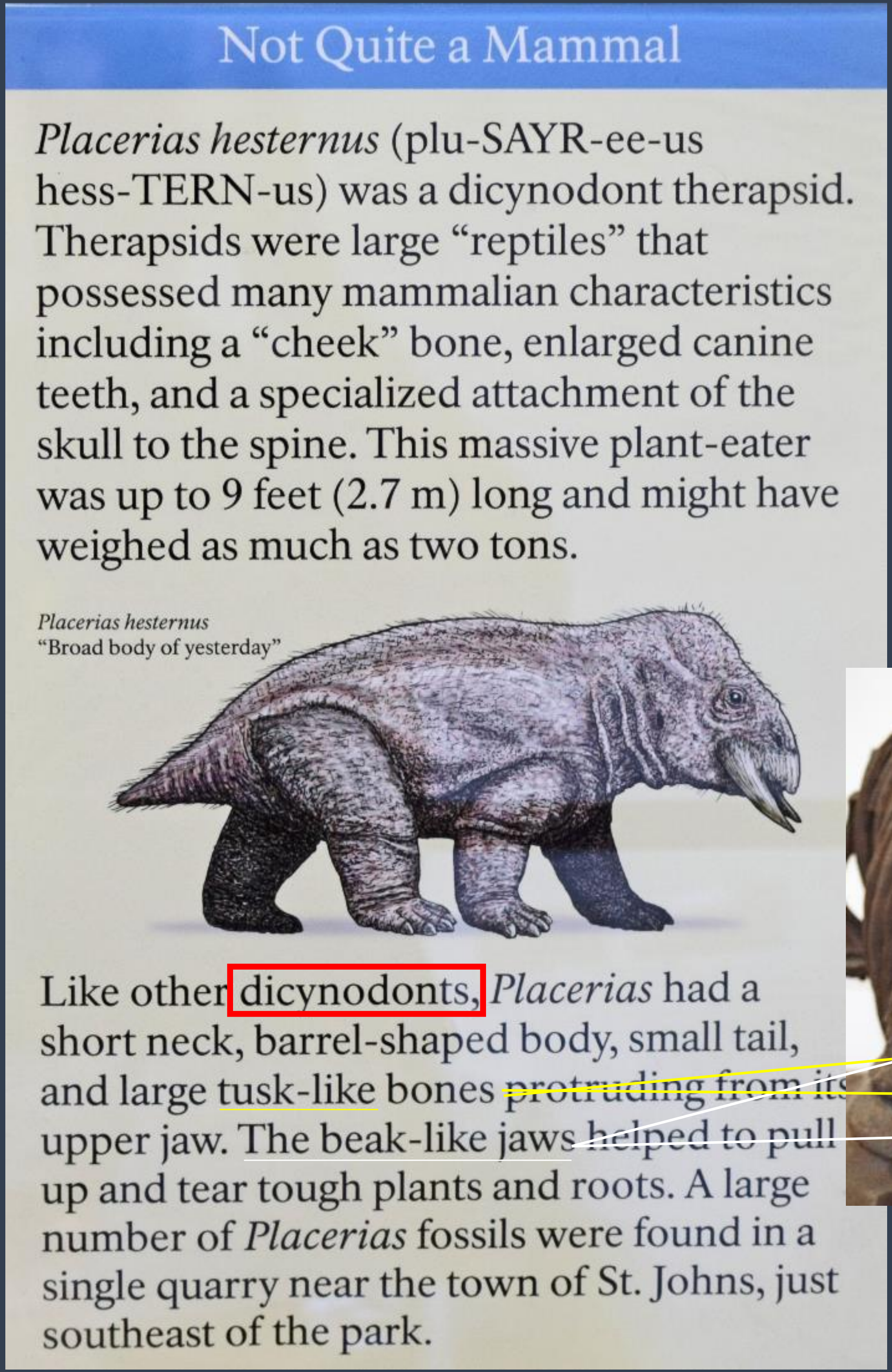


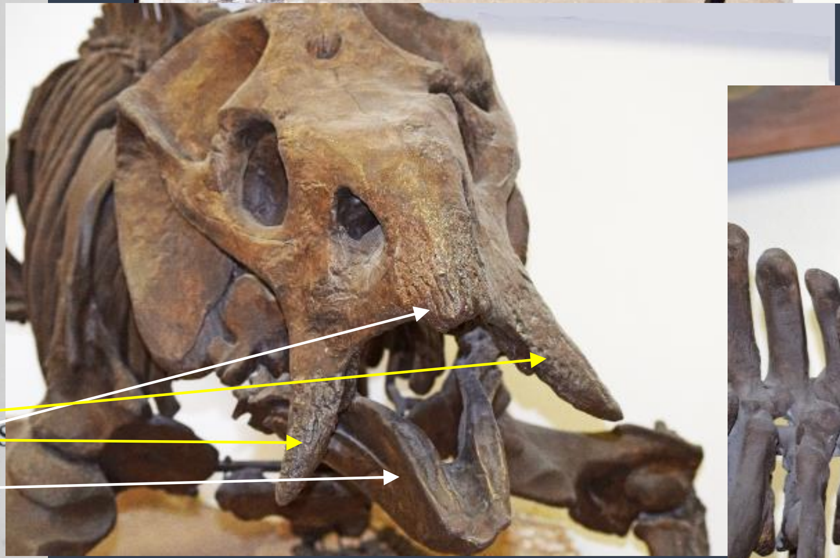
Secondary XYLEM made of Tracheids: showing Bordered Pits in pine stem wood cross section


Cs of leaf
Resin
ducts
VB


Spiral leaf arrangement
VB

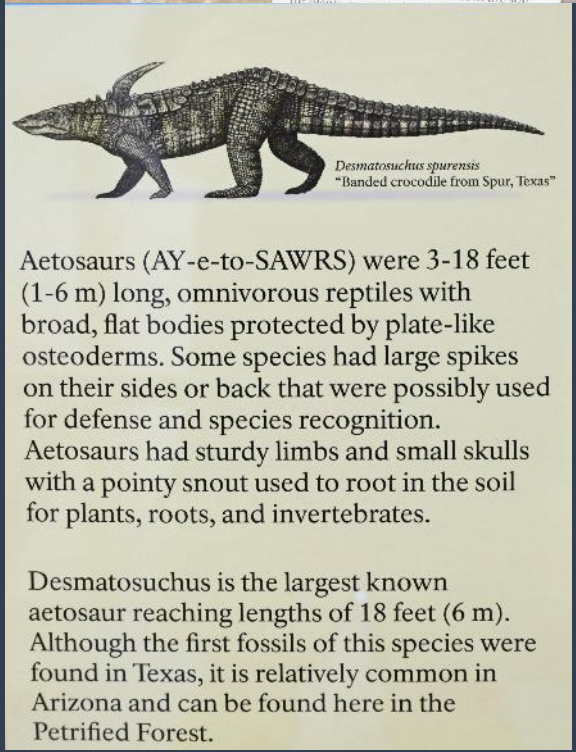

Epidermis &
cuticle
Chlorophyll
rich
parenchyma
Scleral
fibers



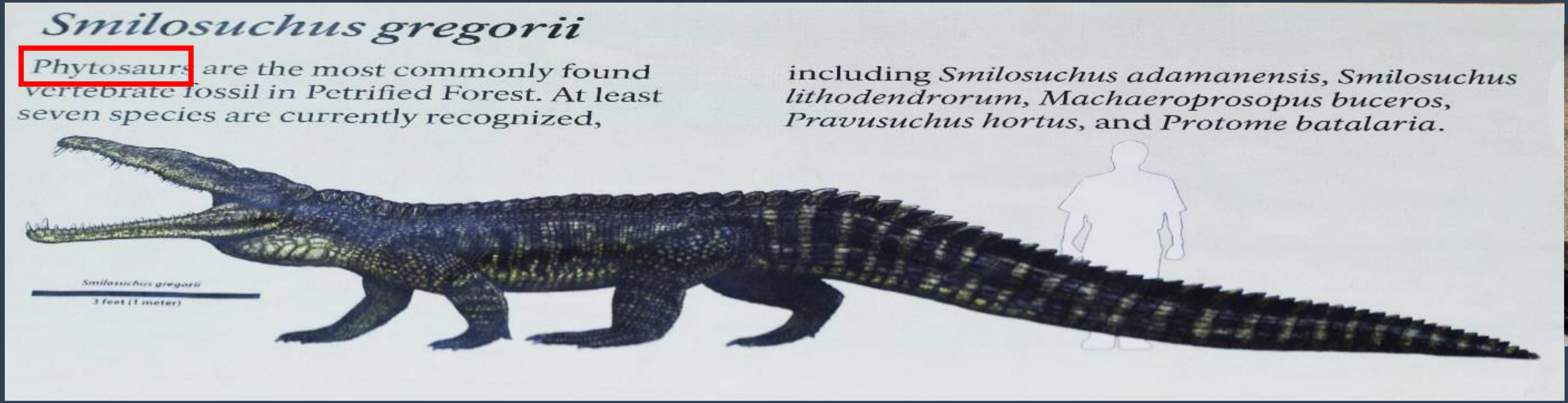


Tr. Chinle vertebrate fossils


Built for Protection

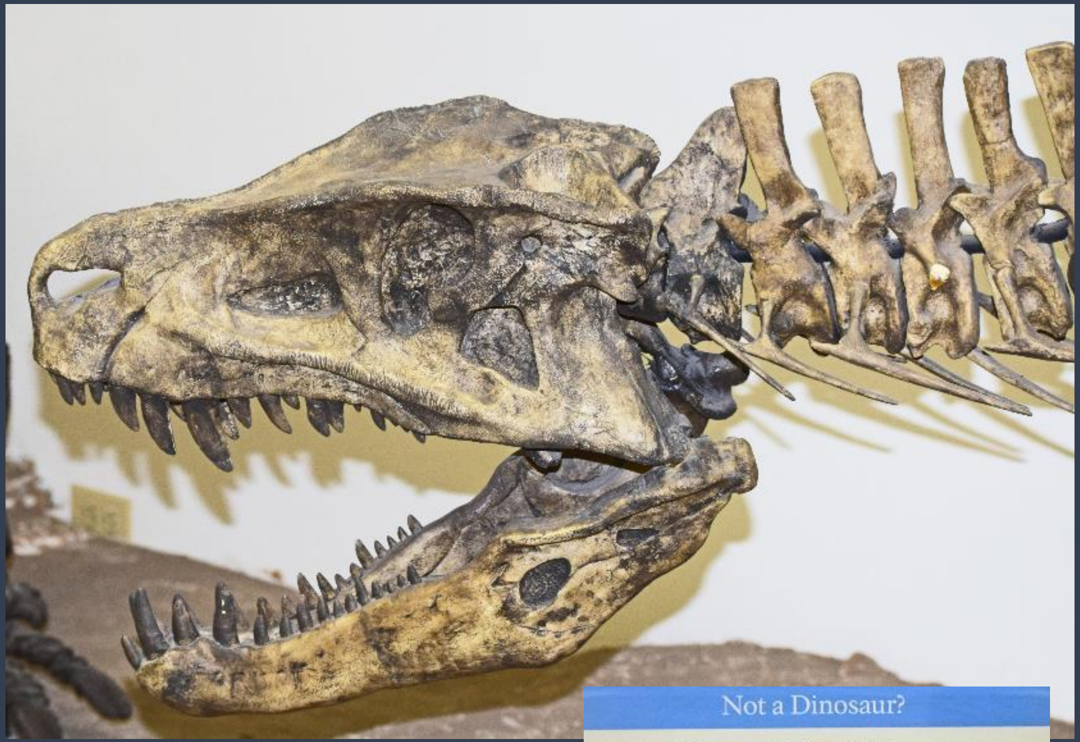

Desmatosuchus spurensis
"Banded crocodile from Spur, Texas"
Aetosaurs (AY-e-to-SAWRS) were 3-18 feet (1-6 m) long, omnivorous reptiles with broad, flat bodies protected by plate-like osteoderms. Some species had large spikes on their sides or back that were possibly used for defense and species recognition. Aetosaurs had sturdy limbs and small skulls with a pointy snout used to root in the soil for plants, roots, and invertebrates.
Desmatosuchus is the largest known aetosaur reaching lengths of 18 feet (6 m). Although the first fossils of this species were found in Texas, it is relatively common in Arizona and can be found here in the Petrified Forest.

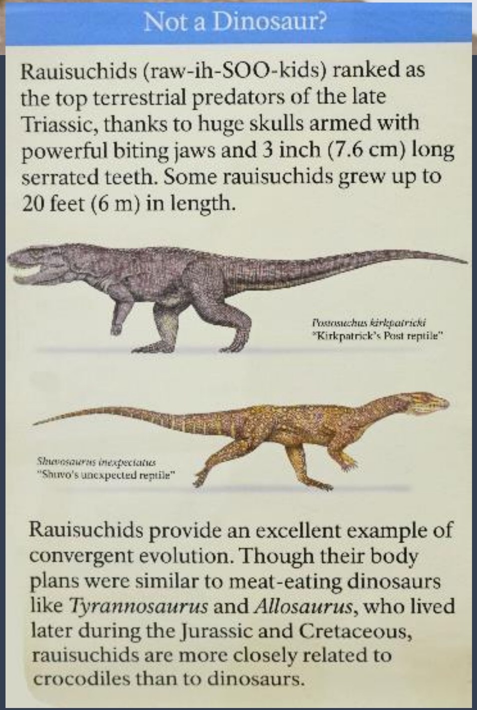

Built for Protection


Smilosuchus gregorii
Phytosaurs are the most commonly found vertebrate fossil in Petrified Forest. At least seven species are currently recognized, including *Smilosuchus adamanensis*, *Smilosuchus lithodendrorum*, *Machaeroprosopus buceros*, *Pravusuchus hortus*, and *Protome batalaria*.
Smilosuchus gregorii
3 feet (1 meter)

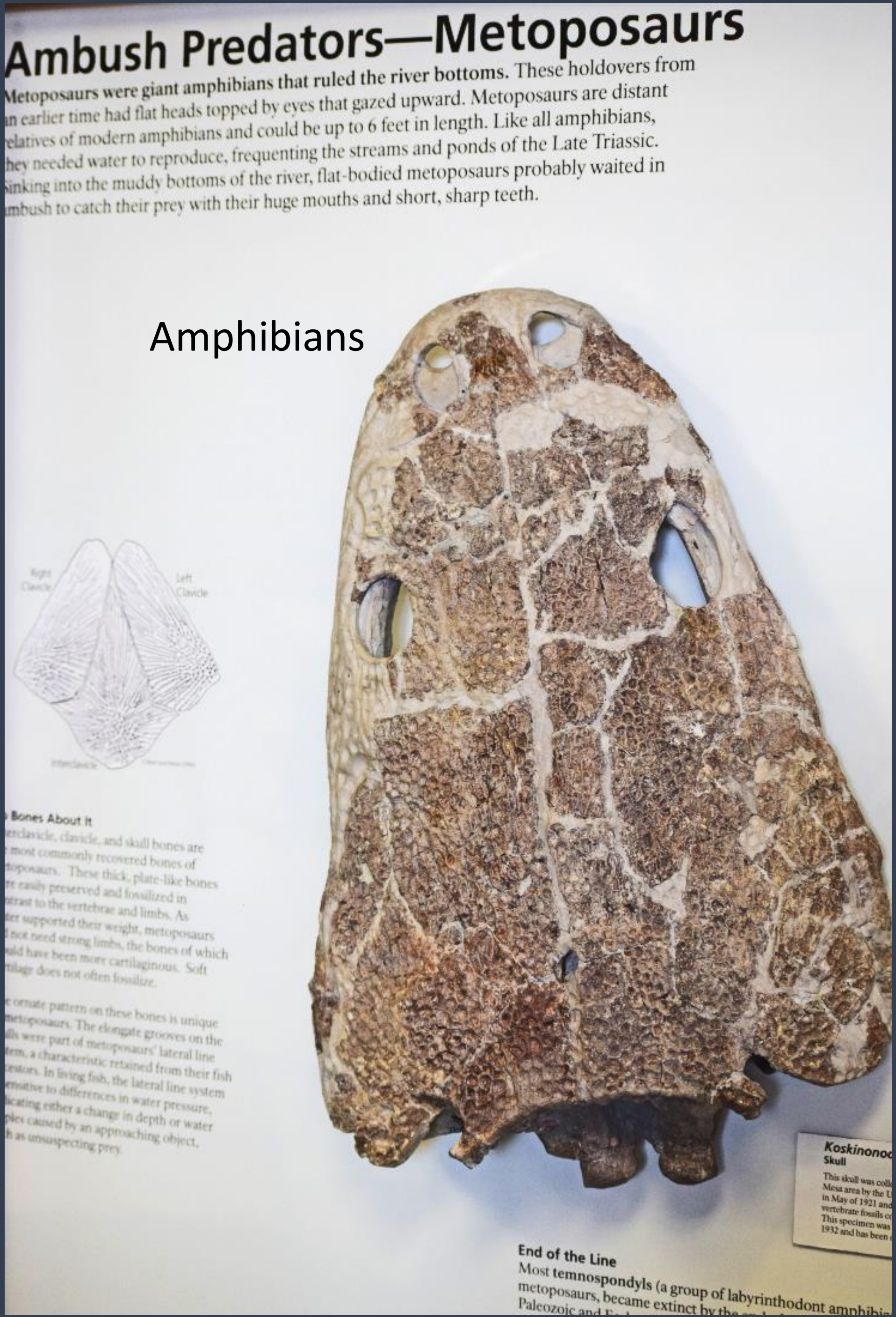

Phytosaurs

Non-dinosaur Rauisuchian Archosaurs



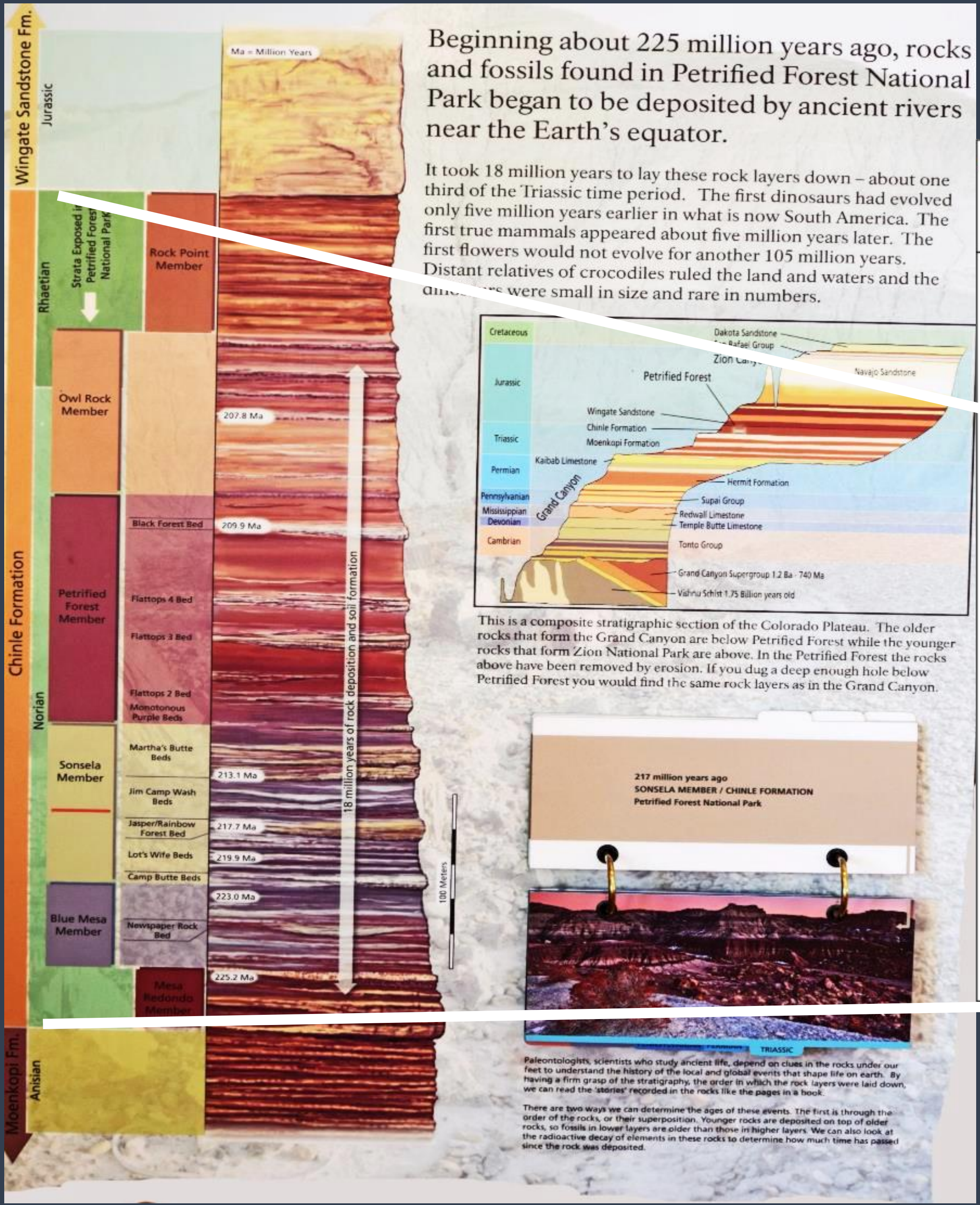


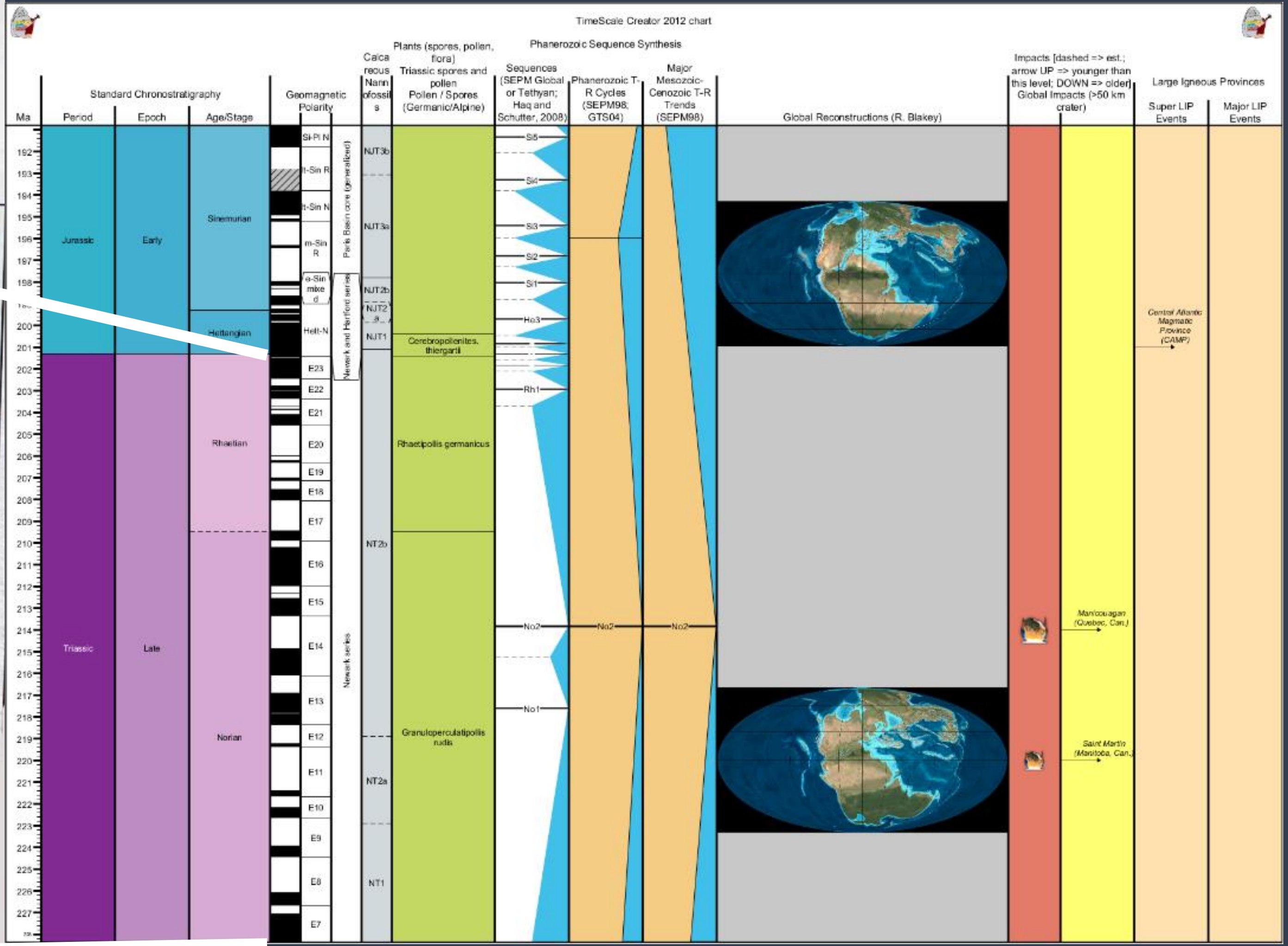
Amphibians


Ambush Predators—Metoposaurs
Metoposaurs were giant amphibians that ruled the river bottoms. These holdovers from an earlier time had flat heads topped by eyes that gazed upward. Metoposaurs are distant relatives of modern amphibians and could be up to 6 feet in length. Like all amphibians, they needed water to reproduce, frequenting the streams and ponds of the Late Triassic. Sinking into the muddy bottoms of the river, flat-bodied metoposaurs probably waited in ambush to catch their prey with their huge mouths and short, sharp teeth.
Bones About It
End of the Line
Most temnospondyls (a group of labyrinthodont amphibia
metoposaurs, became extinct by the
Skull

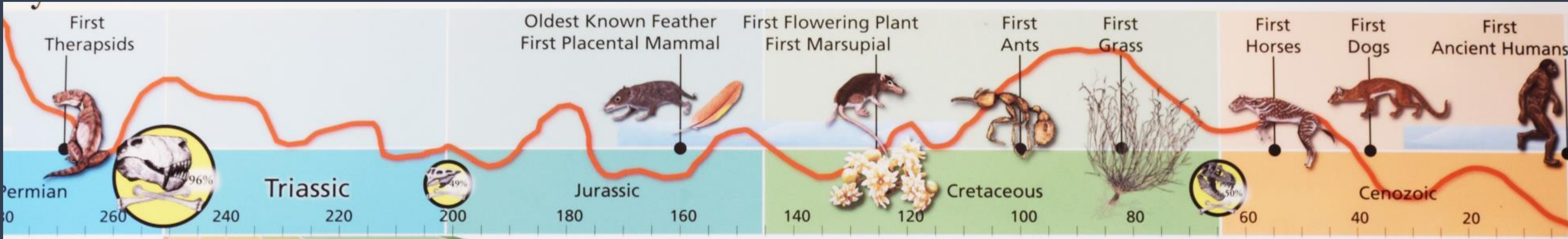

Fossils are traces of life preserved by geologic processes.
Each of these fossils was found in the Blue Mesa Member. See if you can find the plants and animals they represent in the mural.
Left ilium
Cervical vertebra
Fern leaves
Tree fern stem
Lungfish toothplates
Phytosaur dorsal vertebra
Horsetail shoot
Royal fern leaf
Cycad leaf
Phytosaur right femur

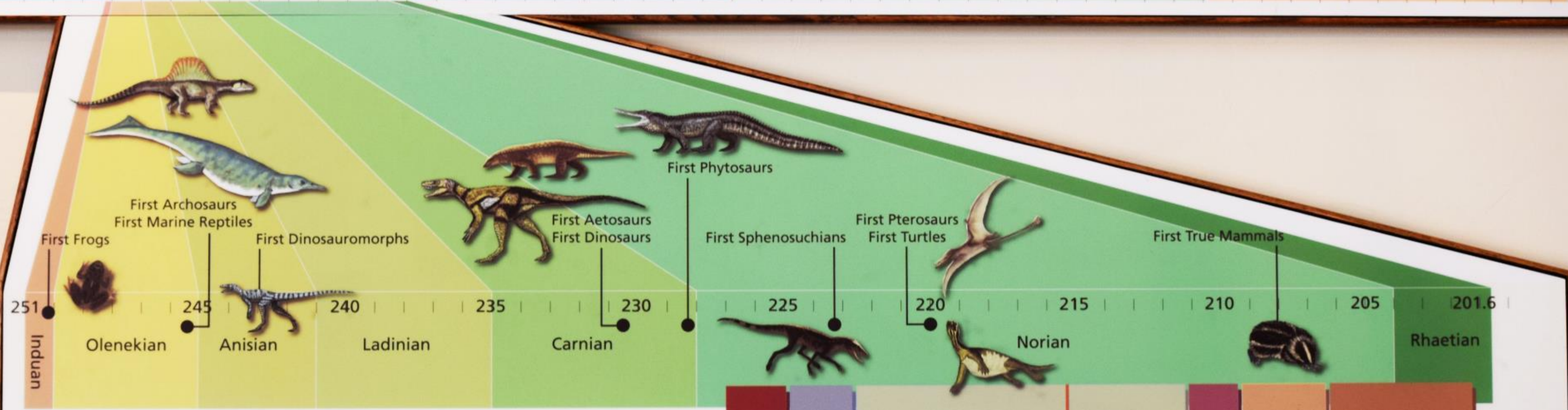
Chinle deposits in a semiarid stream deposit flood plain during breakup of Pangaea same age as NJ Brunswick red beds





Ogg, 2015





Three and a half billion years ago all living things were single celled organisms. Multicellular plants, animals, and fungi have only existed on Earth for the last 630 million years. This time period is known as the Phanerozoic Eon and represents the time that macroscopic creatures diversified and ultimately filled the oceans and covered the land. These living organisms cover our planet and greatly influence our various ecosystems.

- Glacial Period
- Extinction event and percentage of genera affected
- Relative ocean temperature based on oxygen isotopes

The numbers (ages) on this timeline represent millions of years. Particular attention is paid to the Triassic Period because it is during this time the rocks of Petrified Forest were deposited by large river systems.

The Triassic is a significant period in time because it represents the origins of our modern ecosystems. From the ashes of the great extinction at the end of the Permian, the Triassic sees the first appearance of many animal groups including the first frogs, dinosaurs (birds), crocodiles, turtles, and mammals.