

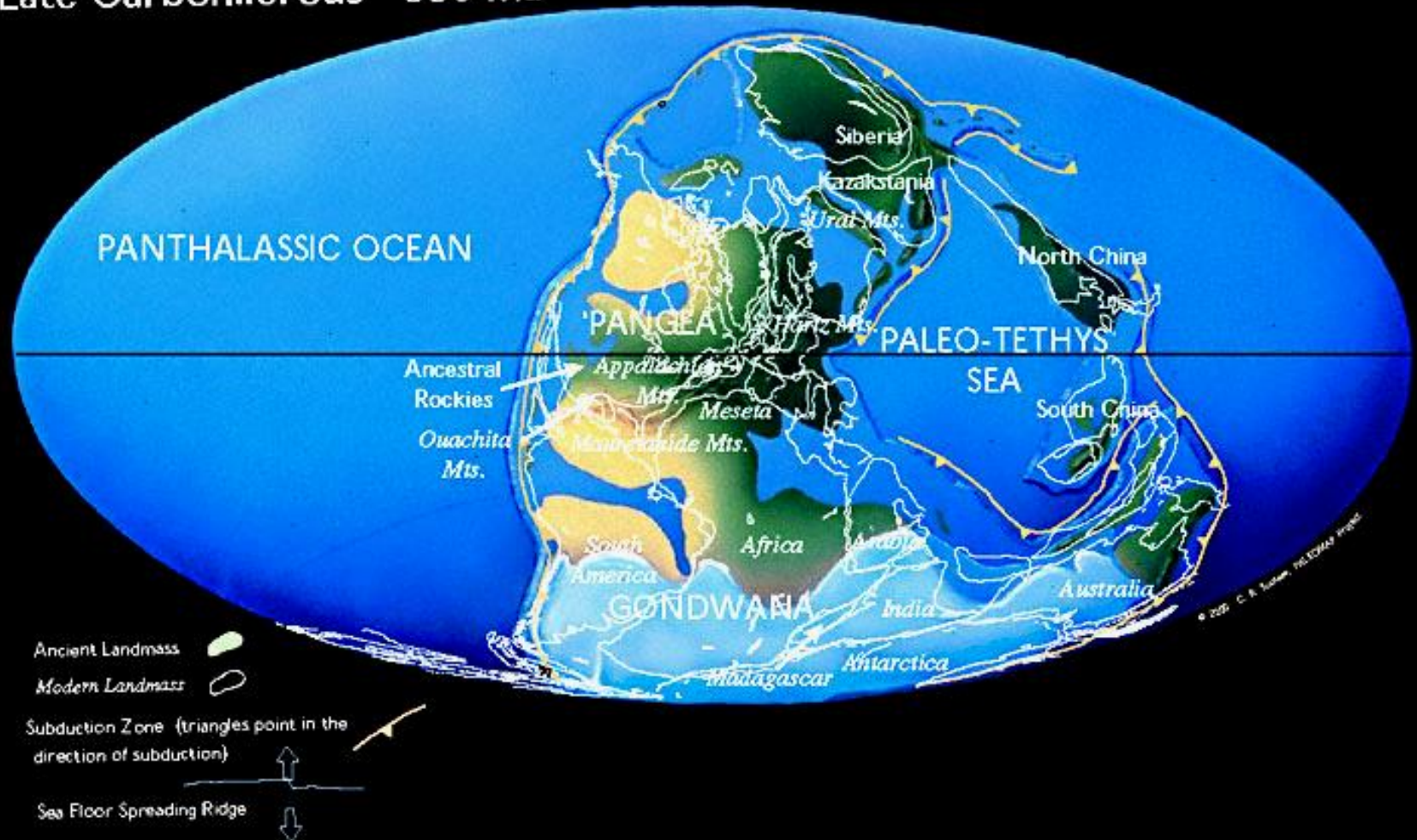
Paleontologia 2020 (Aula 10): *Vida na terra (Paleo-Mesozoico)*



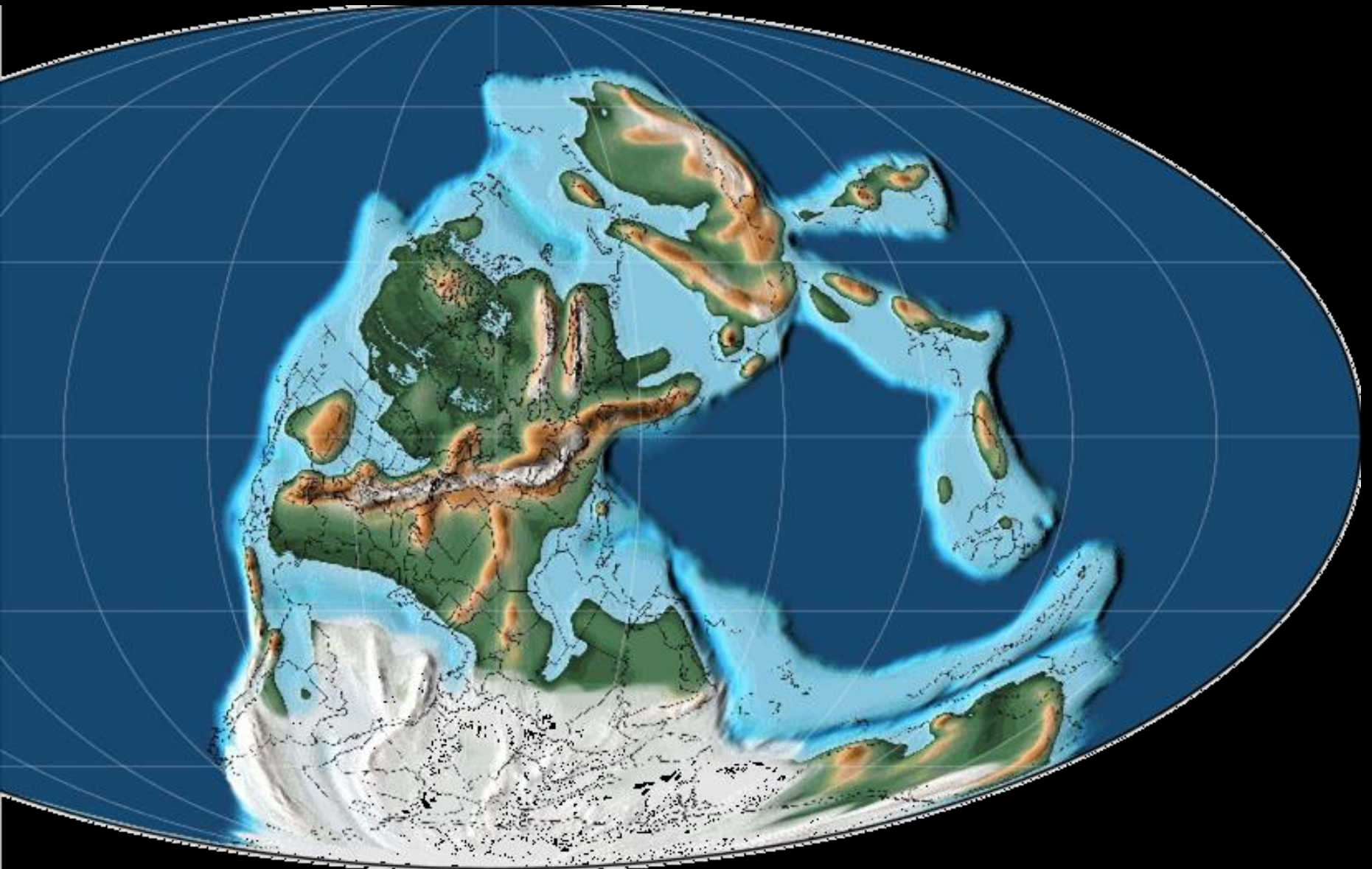
Final do Paleozoico: fase de formação do Pangea

No final do Carbonífero (300 Ma), a Laurásia choca-se com o Gondwana

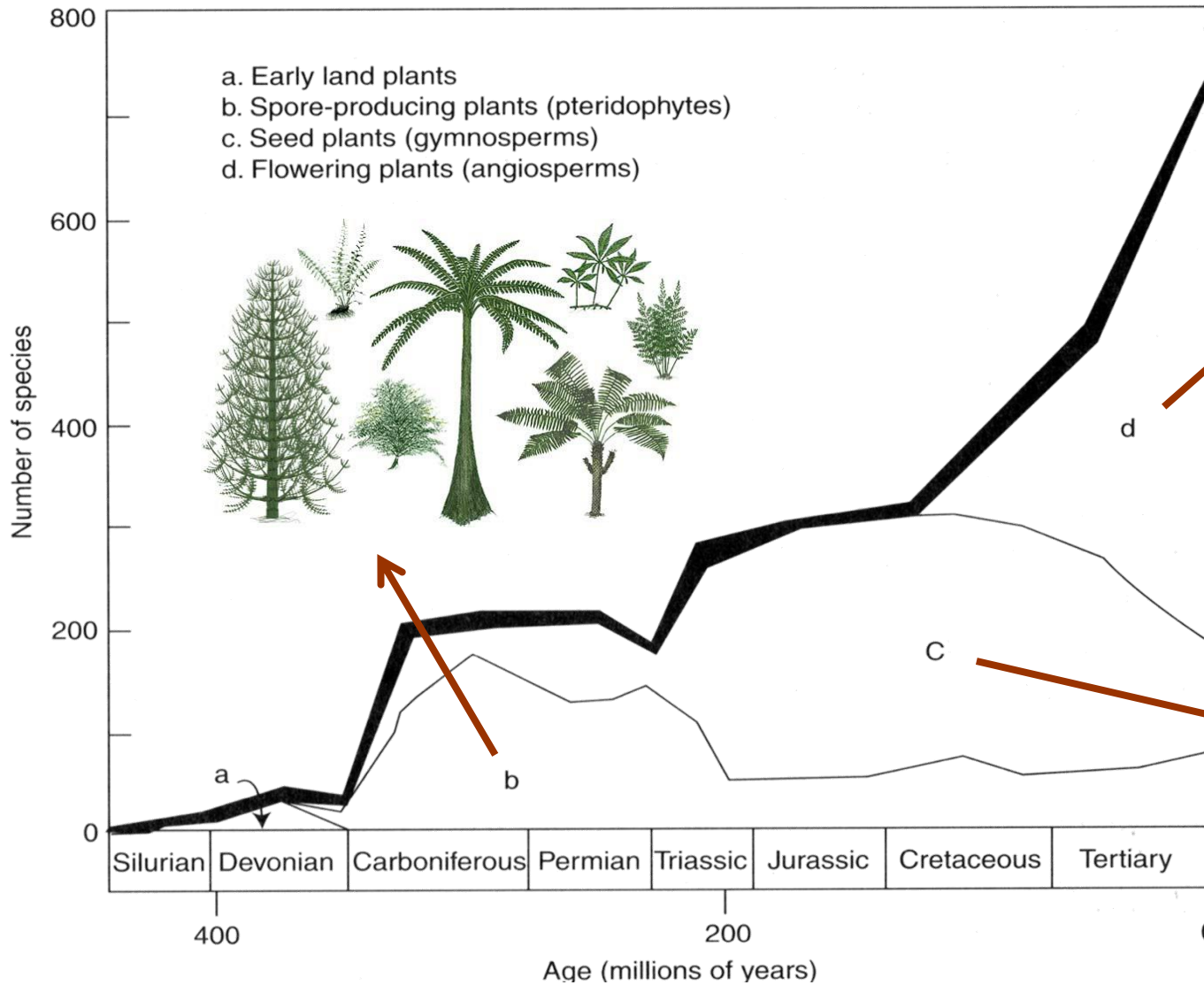
Late Carboniferous 306 Ma



Carbonífero - glaciação no Gondwana



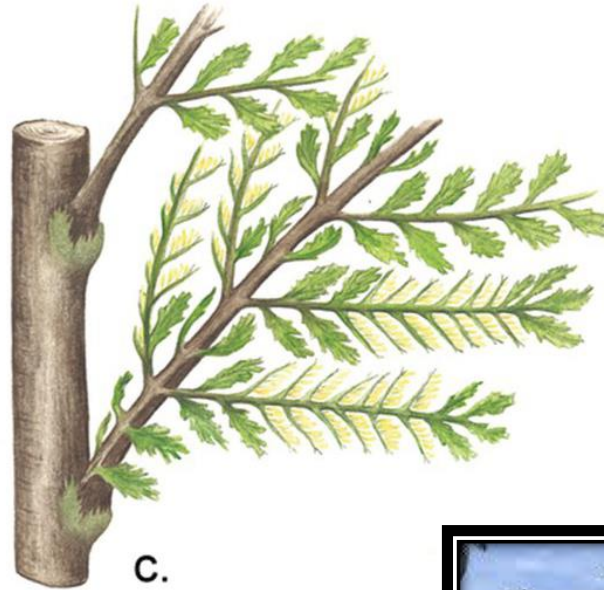
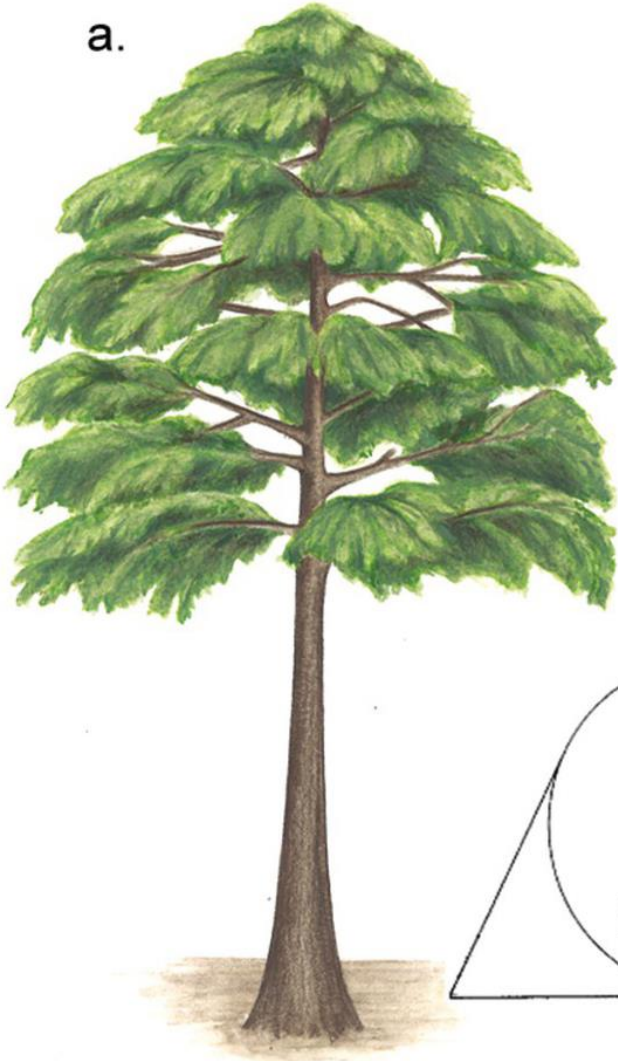
Plantas: expansão das traqueófitas



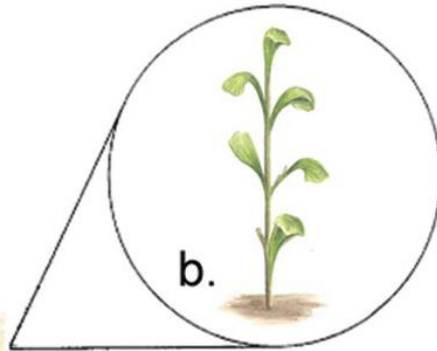
Terras altas

Primeiras espermatófitas – “progimnospermas”

a.



c.



b.

Archaeopteris



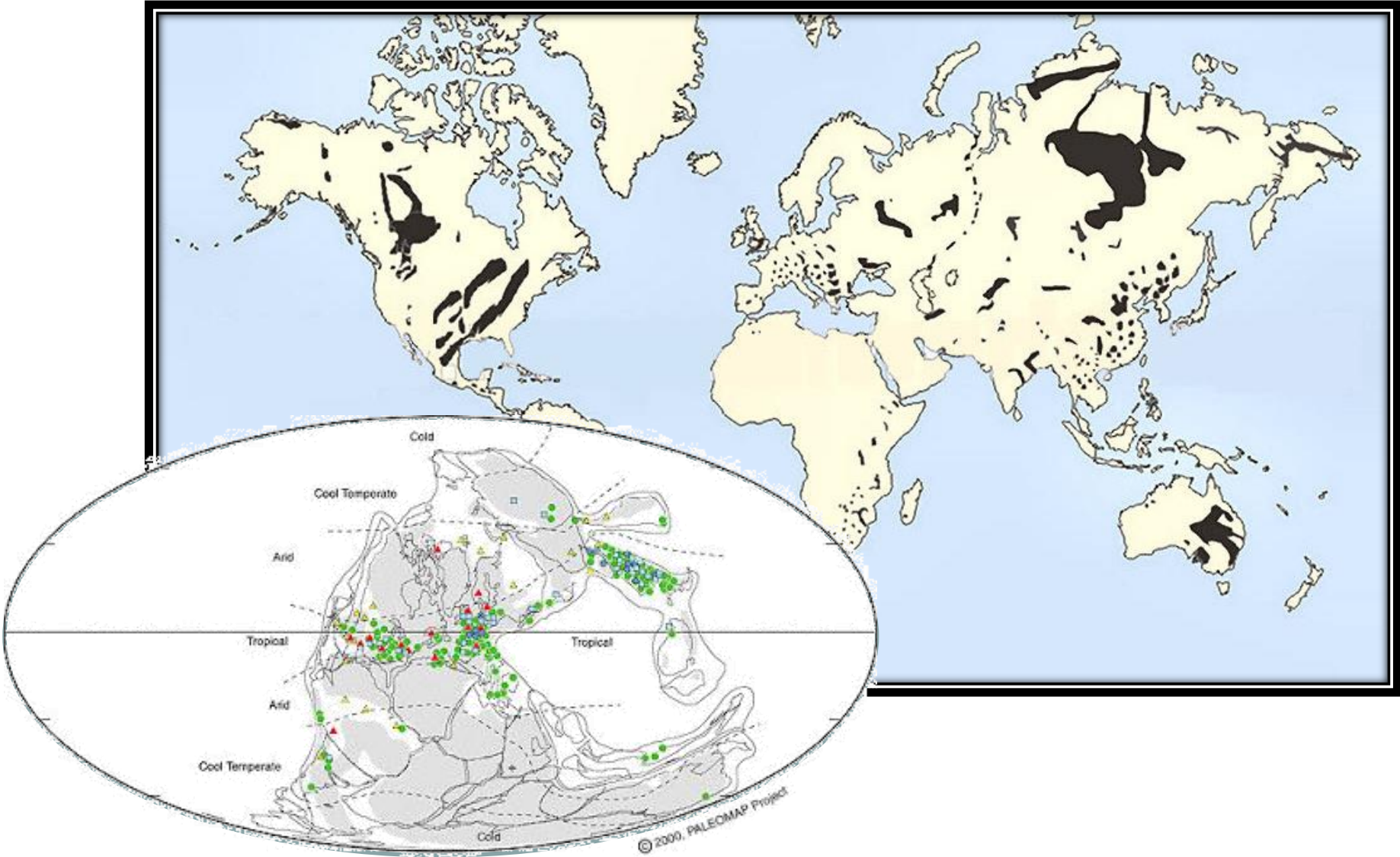
Terras baixas

Florestas de licófitas e esfenófitas arbóreas



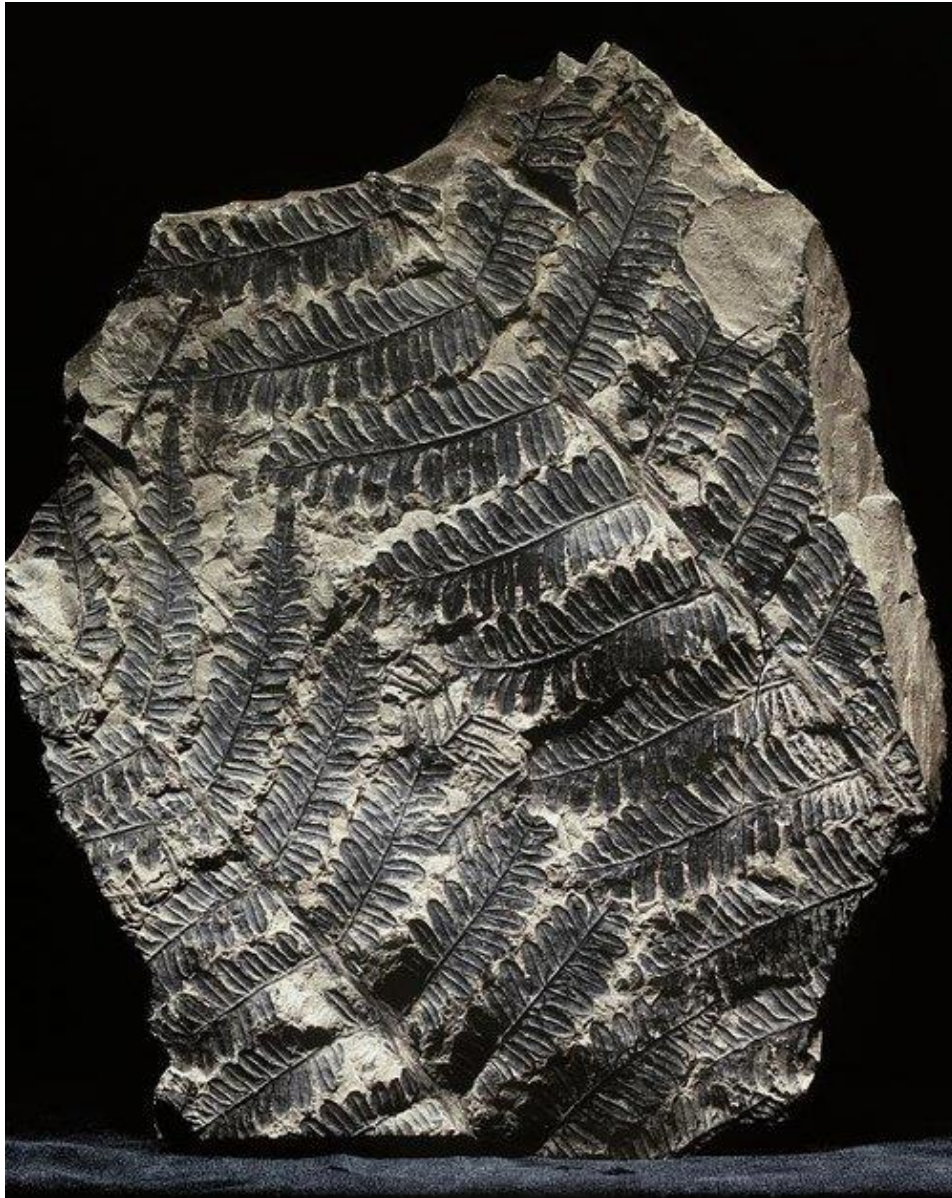


“Coal Fields”



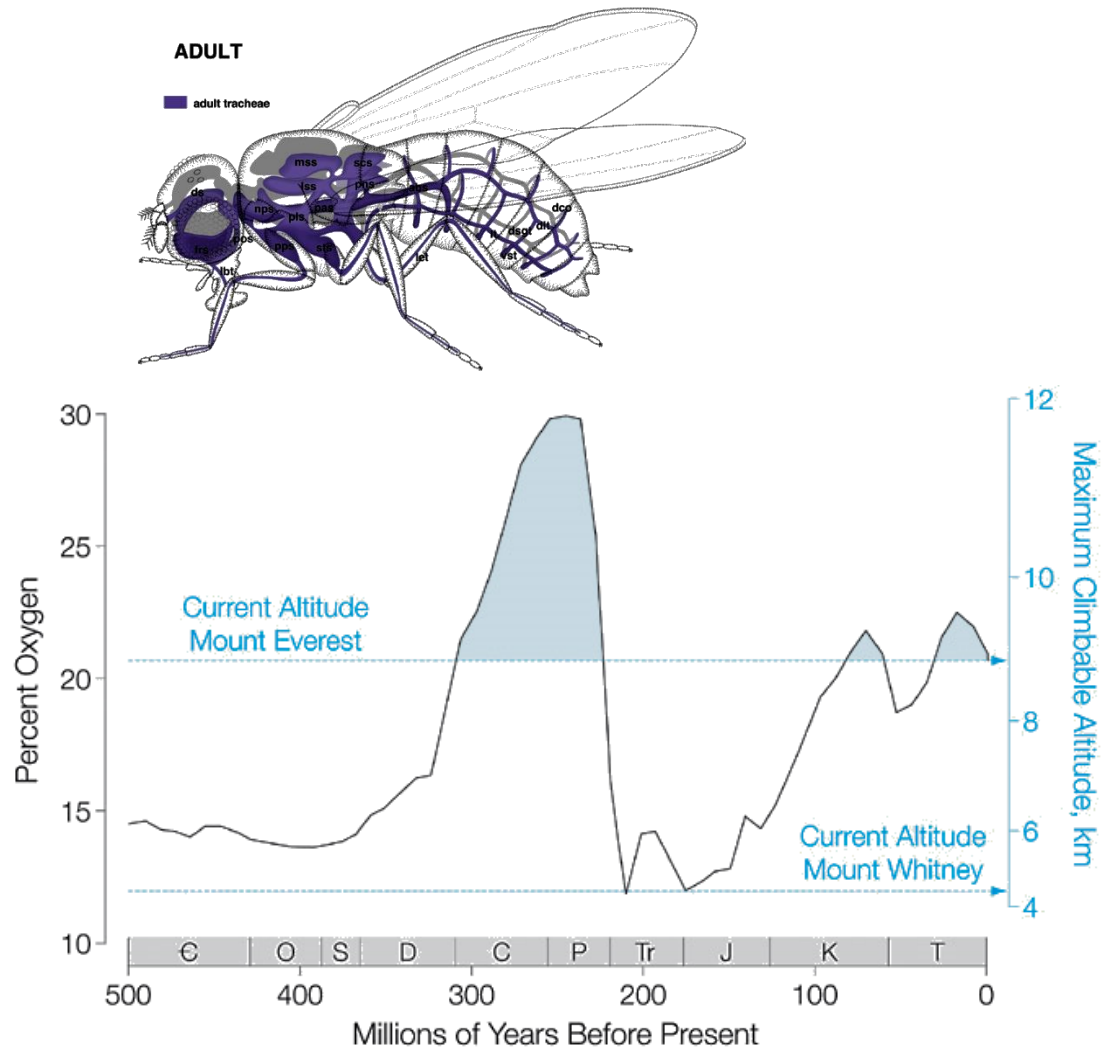
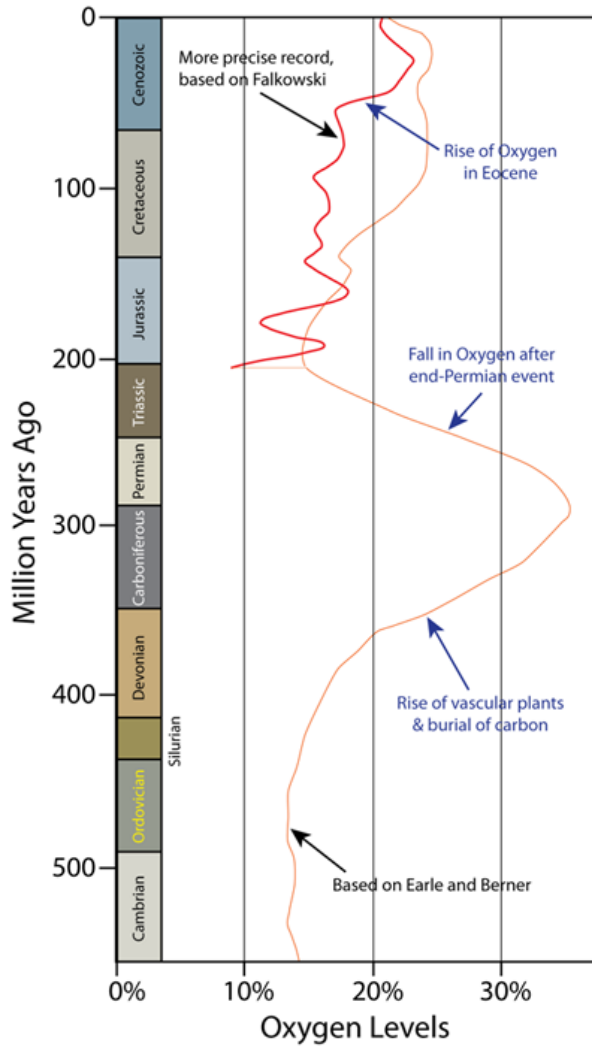
Upper Carboniferous (Gzelian)

“Coal Fields” - fósseis



“Coal Fields” - fósseis

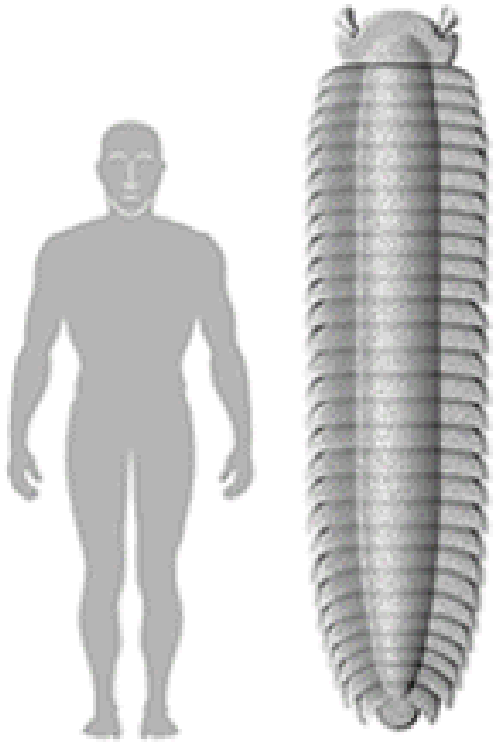
Evidência de maiores níveis de Oxigênio no Carbonífero



Arthropleurida (Devoniano - Permiano inferior)

Maiores artrópodes terrestres conhecidos (mais de 2 m)

Dois pares de apêndices por segmento indica afinidade com os diplópodos



Arthropleura
Carbonífero Superior
Joggins - Nova Scotia



Arthropleurida (Devoniano - Permiano inferior)

No Carbonífero e Permiano ocorrem em florestas equatoriais úmidas

Formas não muito ativas e herbívoras

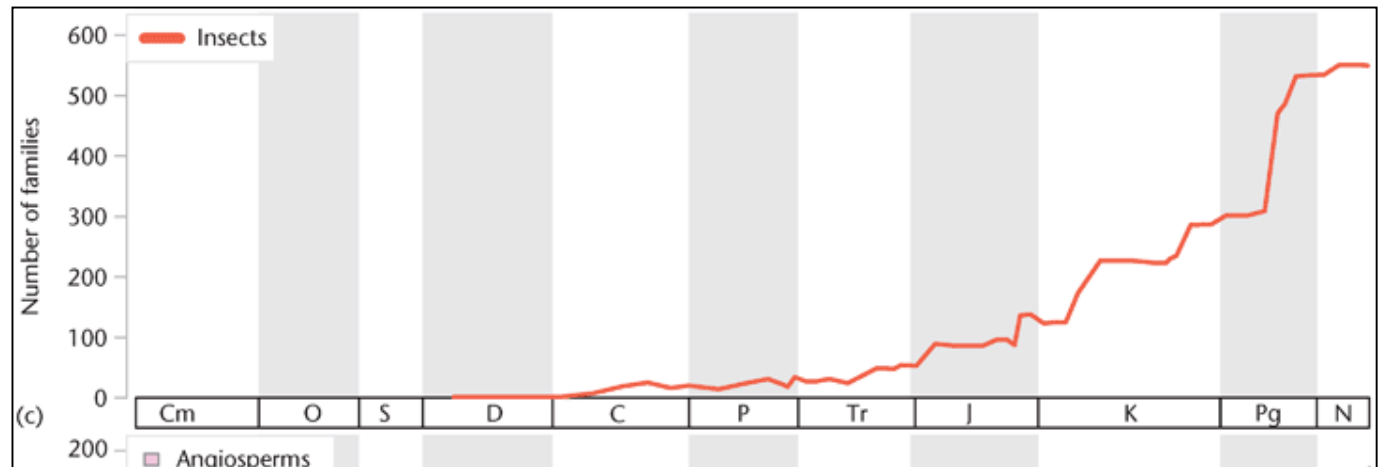
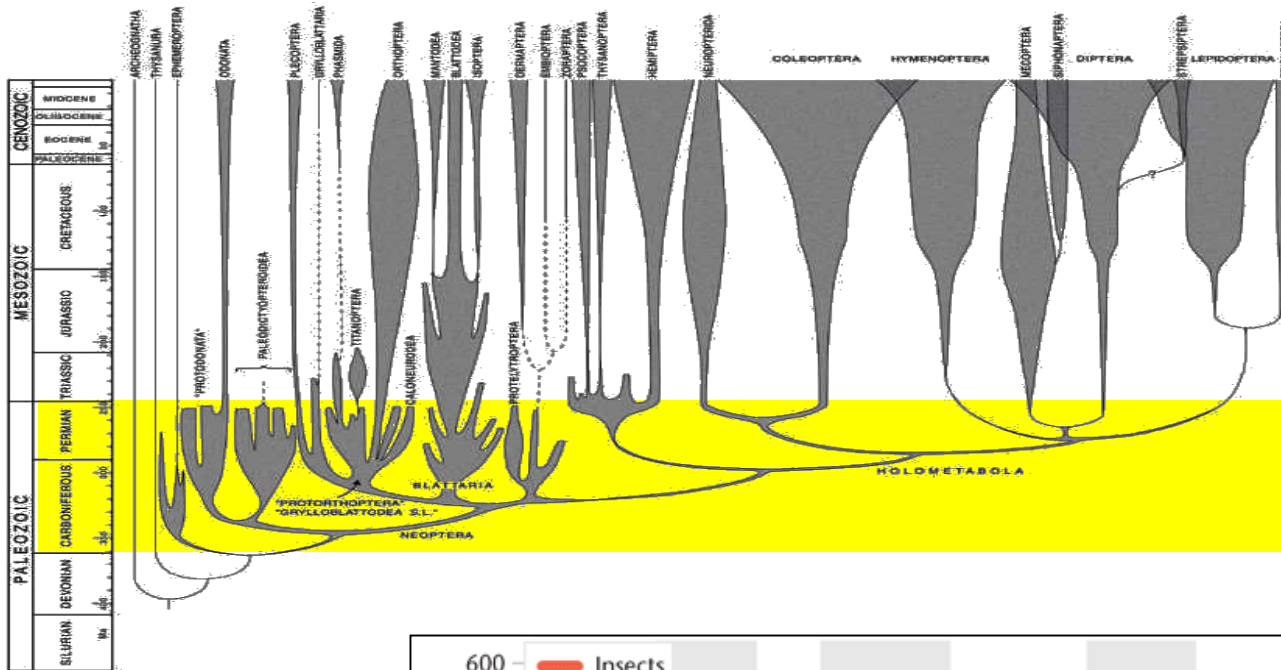
(conhecido espécime com material de "criptógamas" no trato digestivo)



Pista de *Arthropleura*
Carbonífero Superior

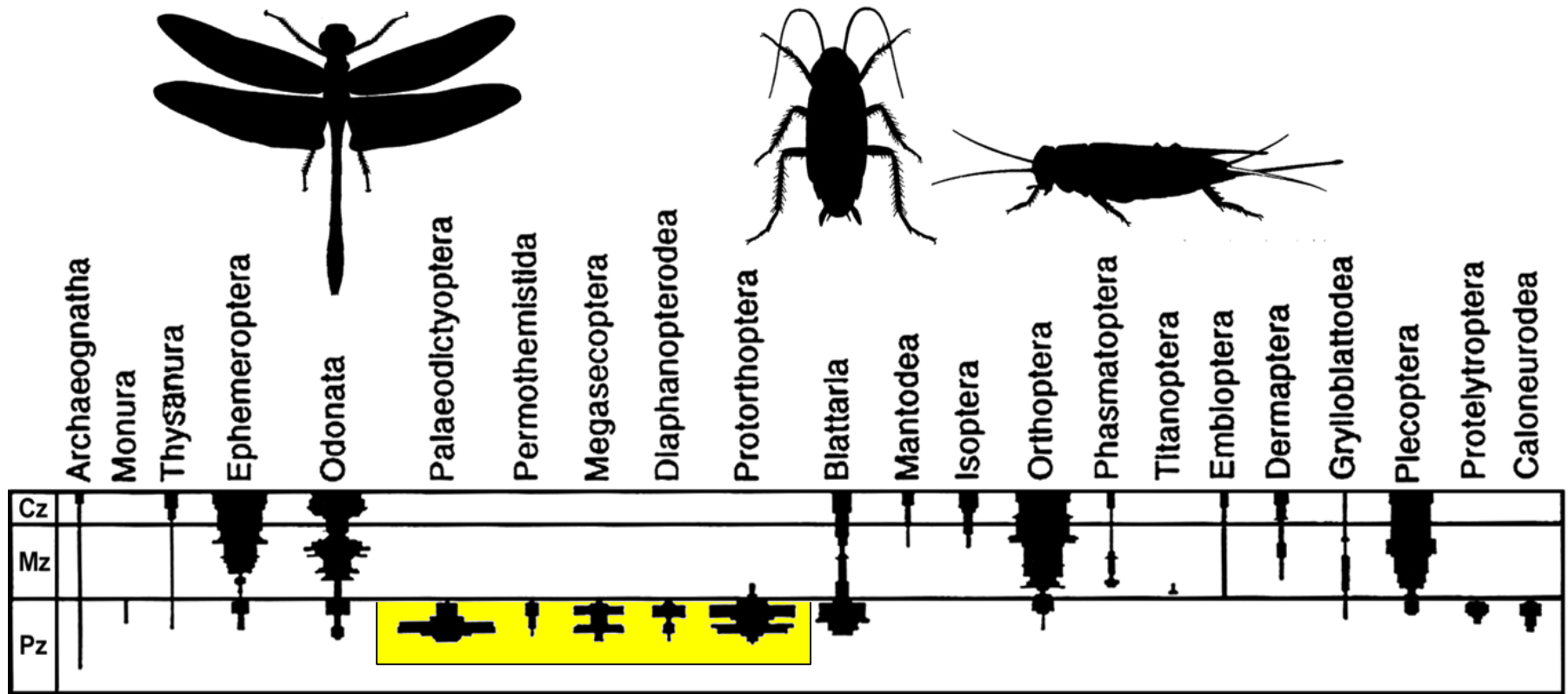
Hexapoda (Devoniano - Permiano inferior)

Irradiação no Carbonífero-Permiano



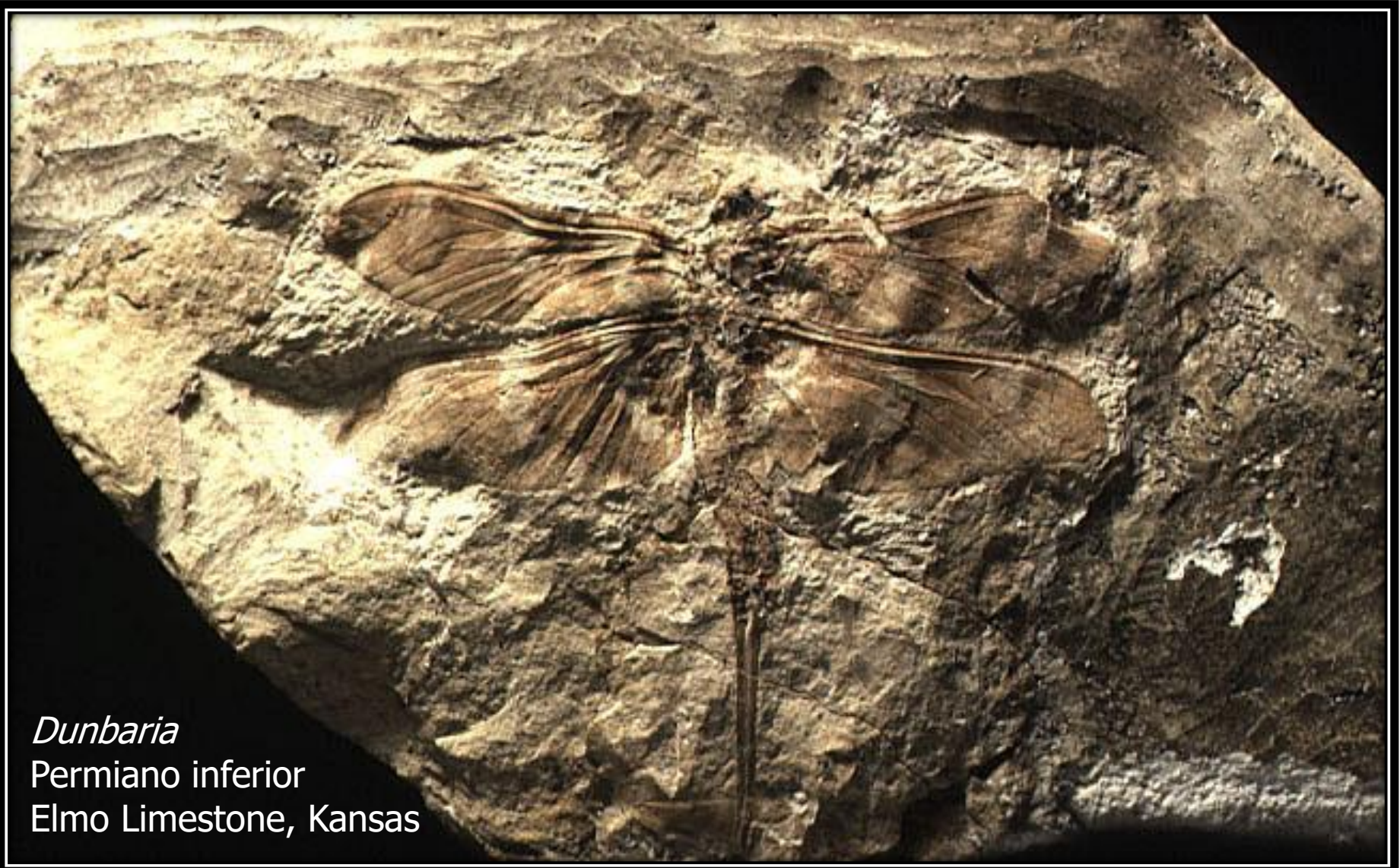
Hexapoda (Devoniano - Permiano inferior)

Irradiação no Carbonífero-Permiano



Paleodictyopteroidea (Carbonífero Superior – Permiano)

Muito provavelmente parafilético



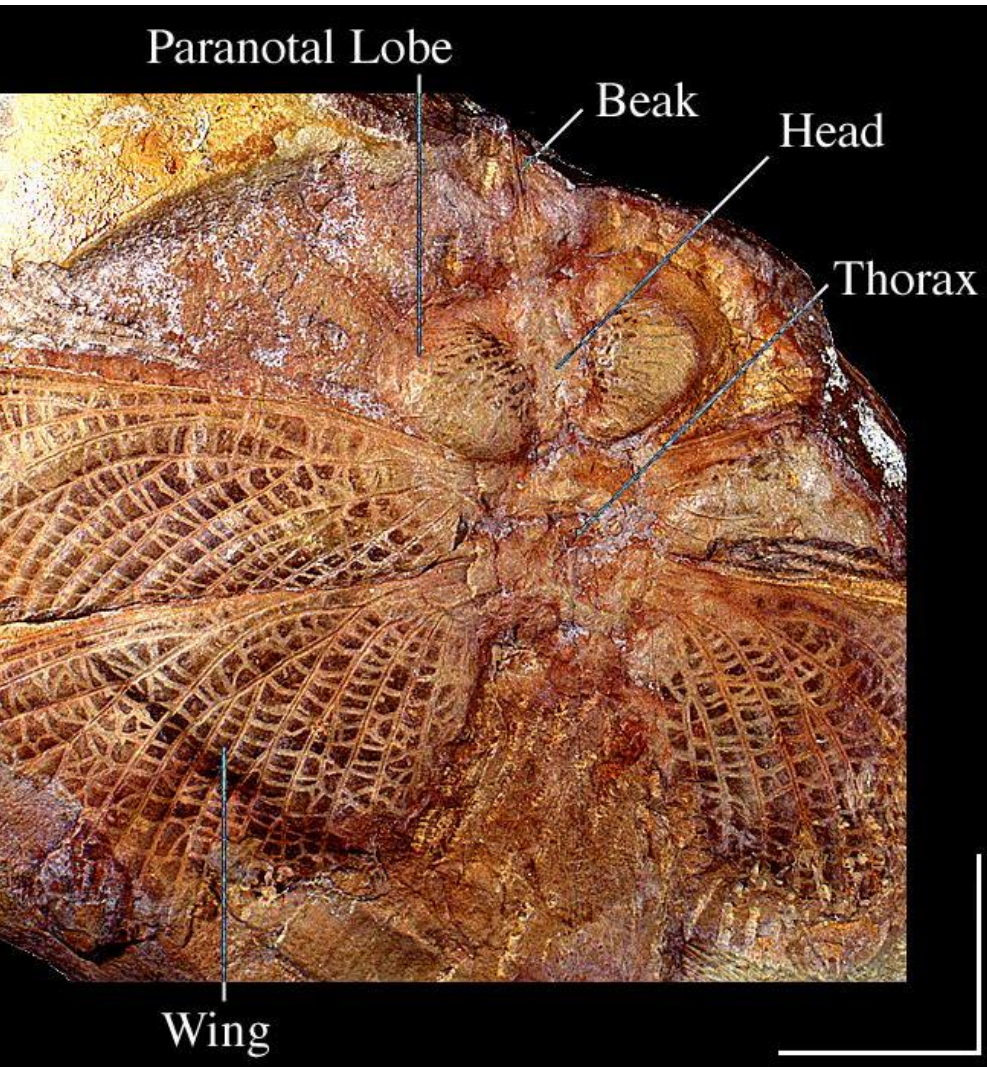
Dunbaria

Permiano inferior

Elmo Limestone, Kansas

Paleodictyopteroidea (Carbonífero Superior – Permiano)

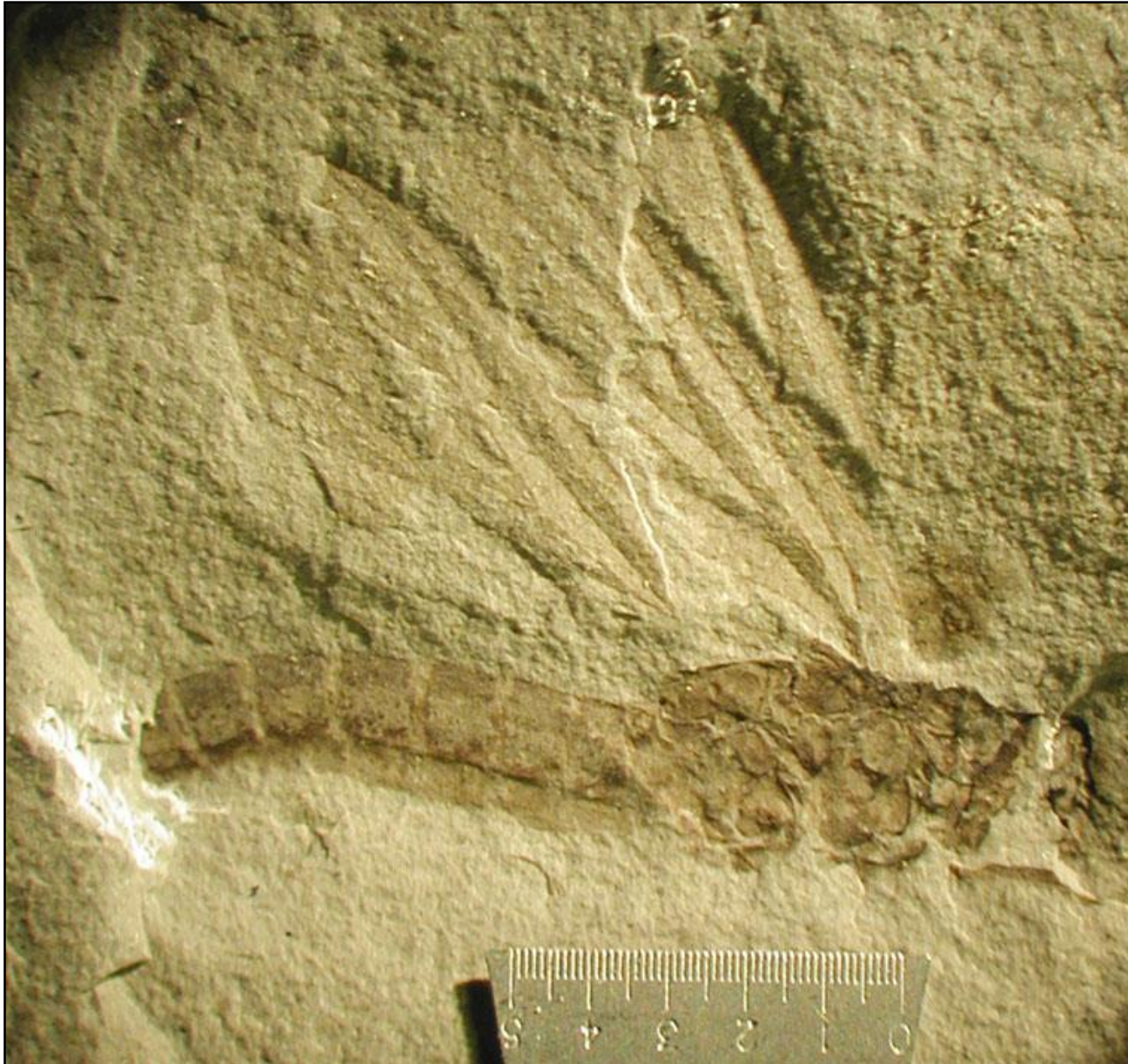
“Primeiros” insetos voadores: presença de paranoto (“asas” anteriores)



Homioptera
Carbonífero da Alemanha

Lithomantis
Carbonífero da Inglaterra

Ephemeroptera (Carbonífero Superior - Recente)



Misthodotes
Permiano inferior
Wellington Formation
Noble County
Oklahoma

Odonatoptera (Carbonífero – Recente)
Meganeuridae (Carbonífero-Permiano)



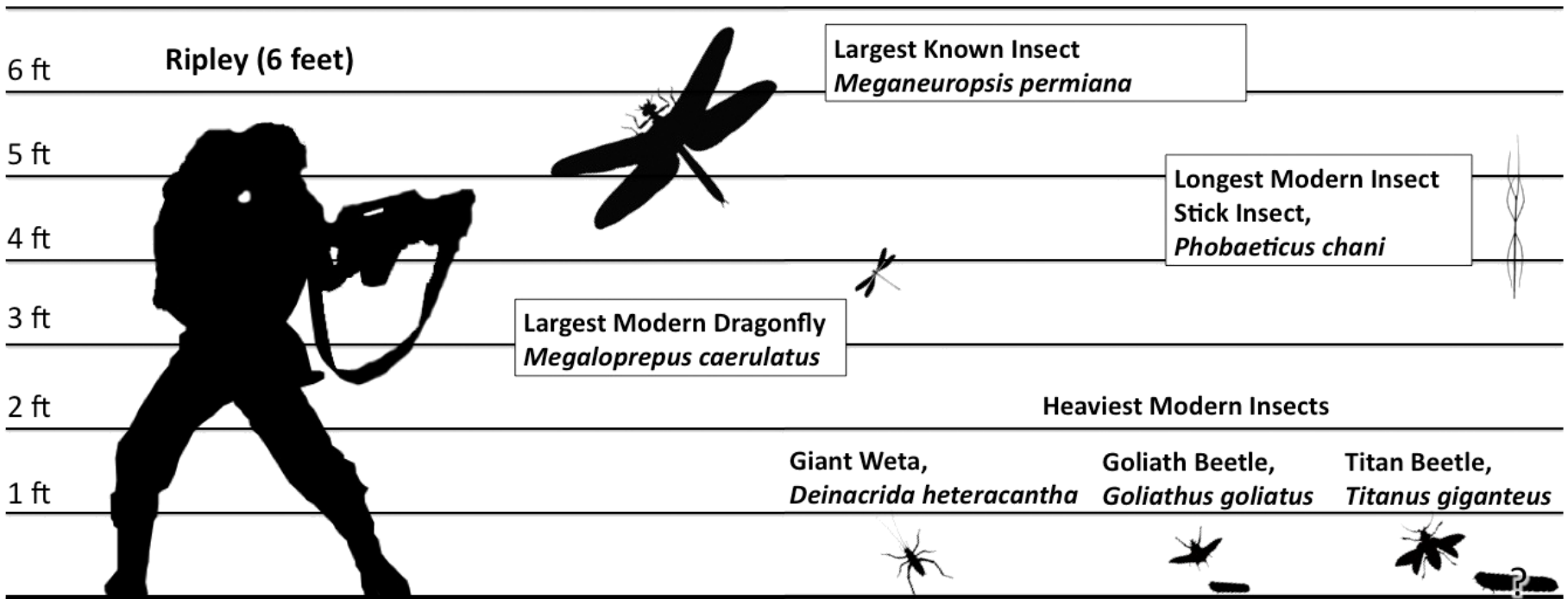
Meganeura monyi - Commentry, França
até 70 cm de envergadura



Odonatoptera (Carbonífero – Recente)

Meganeuridae (Carbonífero-Permiano)

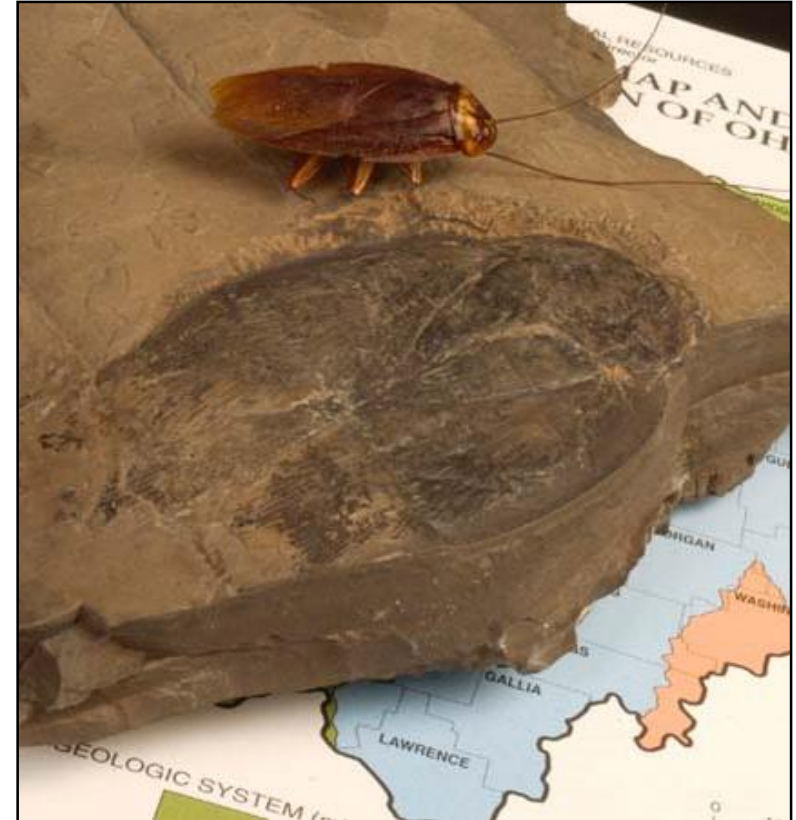
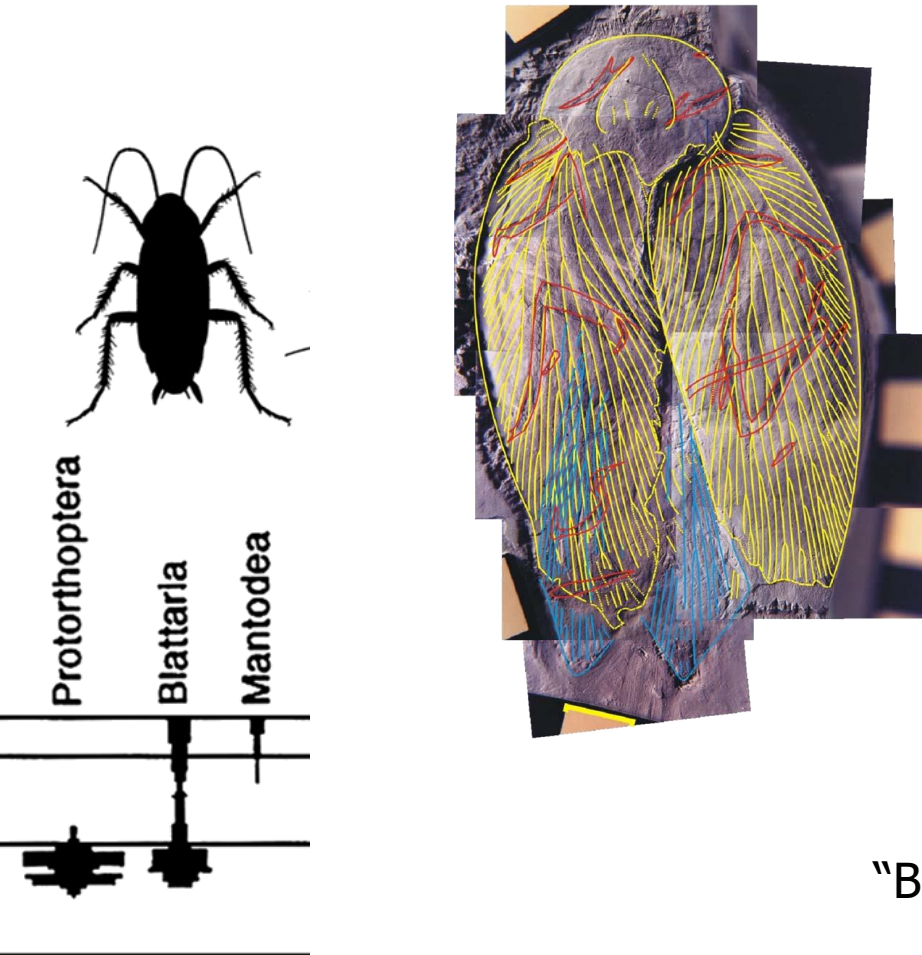
Evidência de maiores níveis de Oxigênio no Carbonífero



Neoptera (Carbonífero – Recente)

Blattaria (Carbonífero - Recente)

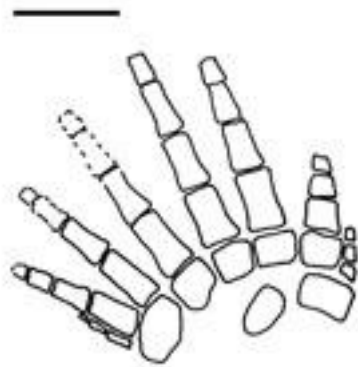
Morfologia similar à atual, mas formas de grande tamanho



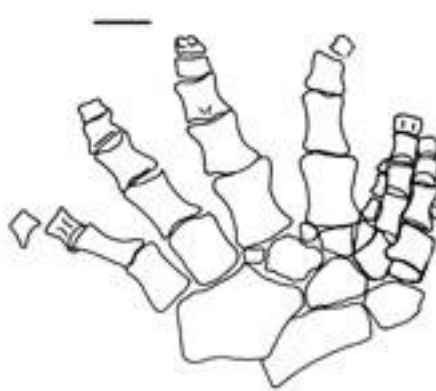
“Barata” de quase 10 cm de comprimento
Carbonífero de Ohio

Tetrápodos pós-Devonianos

Caractere derivado: pentadactilia - *Ichthyostega* 7 dedos (pé),
Acanthostega 8 dedos (pé e mão) e *Tulerpeton* 6 dedos (pé e mão)



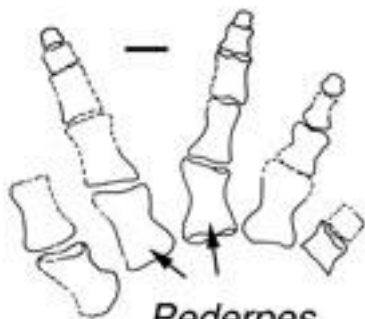
Acanthostega



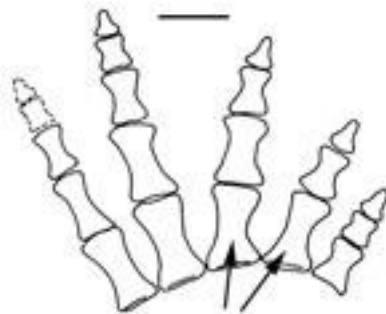
Ichthyostega



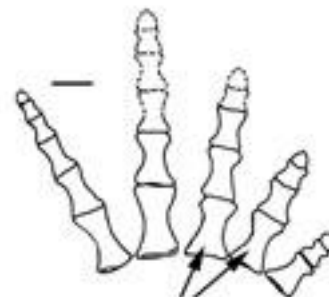
Tulerpeton



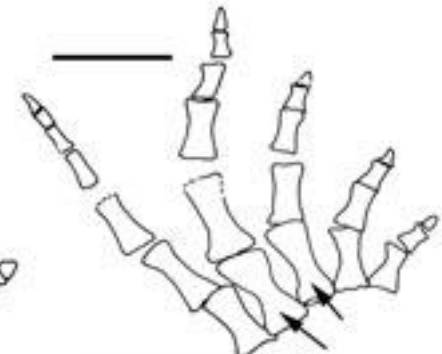
Pederpes



Greererpeton



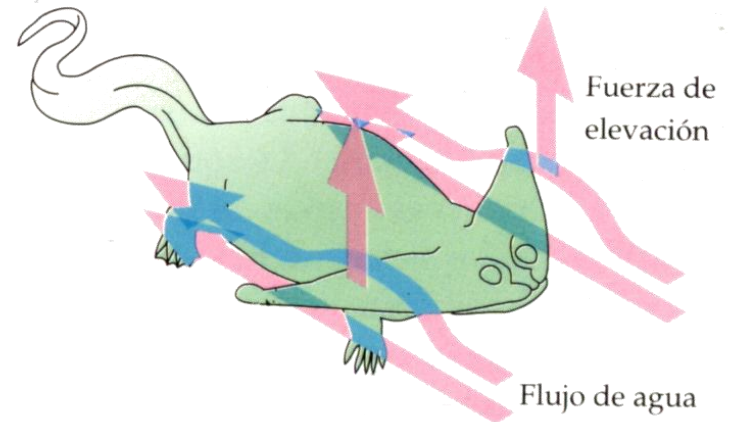
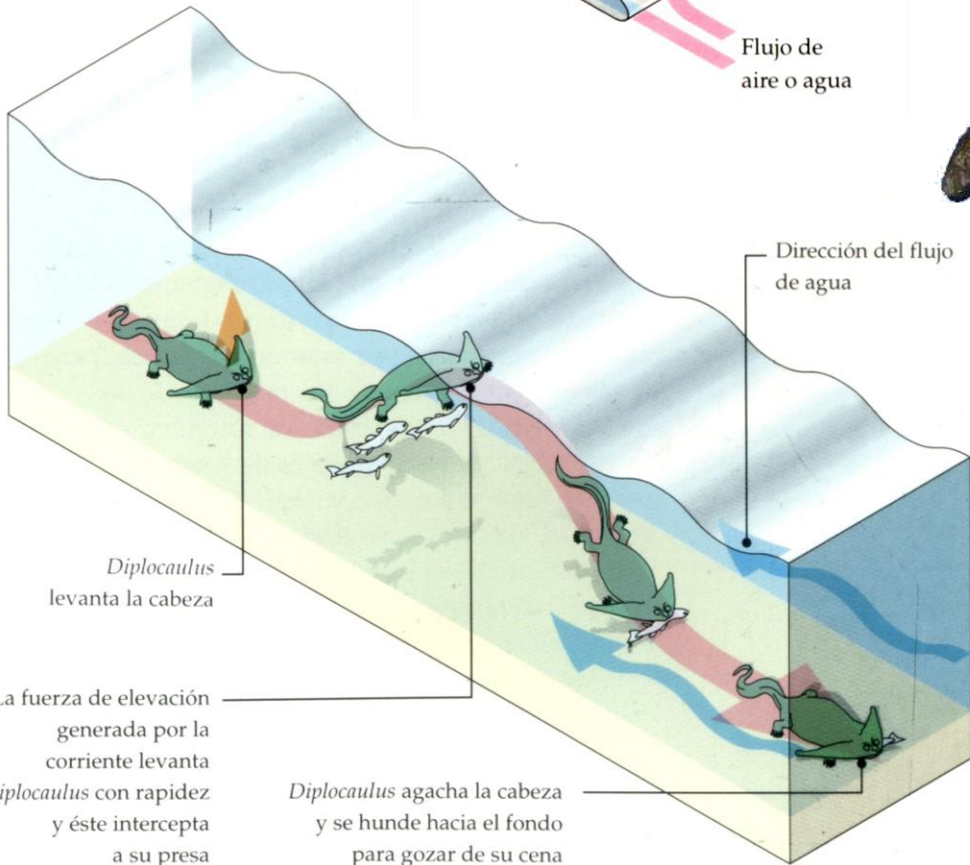
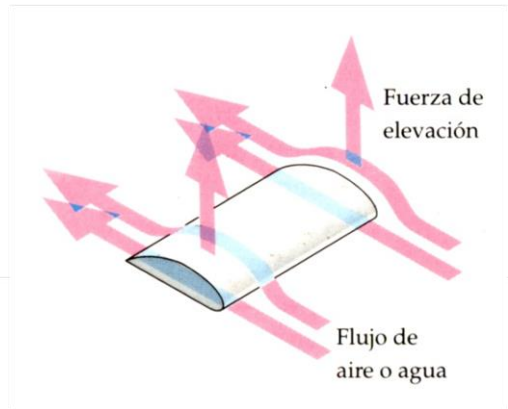
Proterogyrinus



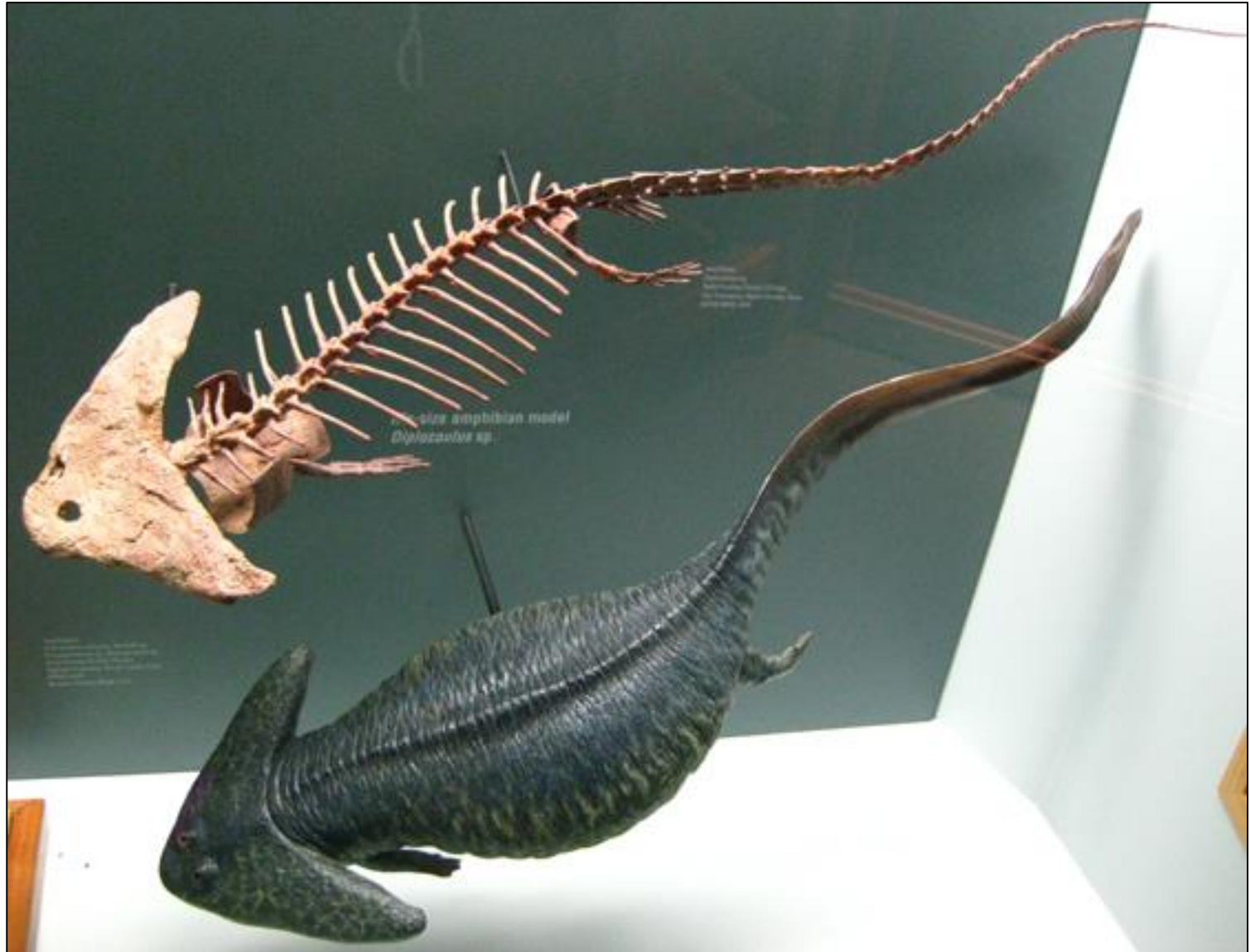
Silvanerpeton

Diplocaulus (Carbonífero – Permiano, EUA)

Crânio em forma de bumerangue (controle dos movimentos verticais na água)



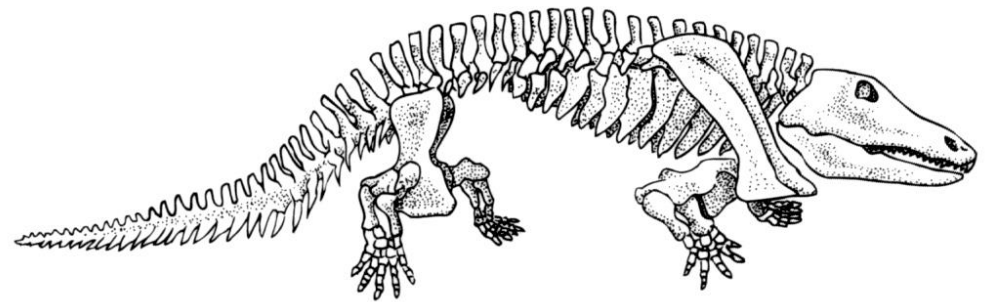
Diplocaulus (Carbonífero – Permiano, EUA)



Limnarchia (Carbonífero - Cretáceo)

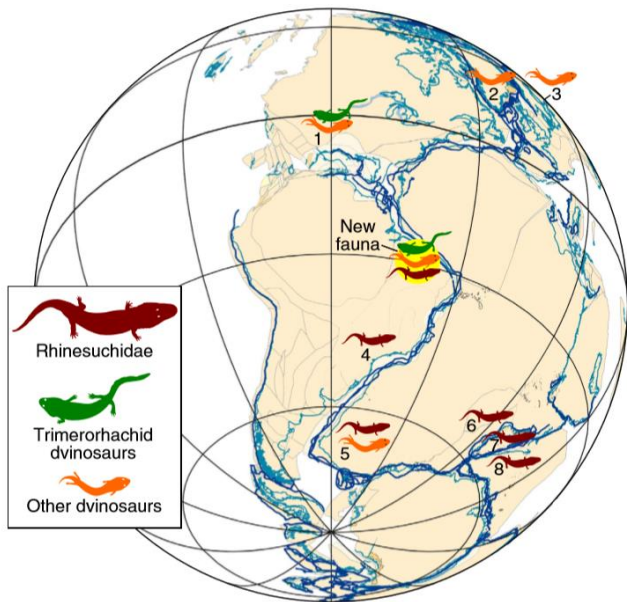
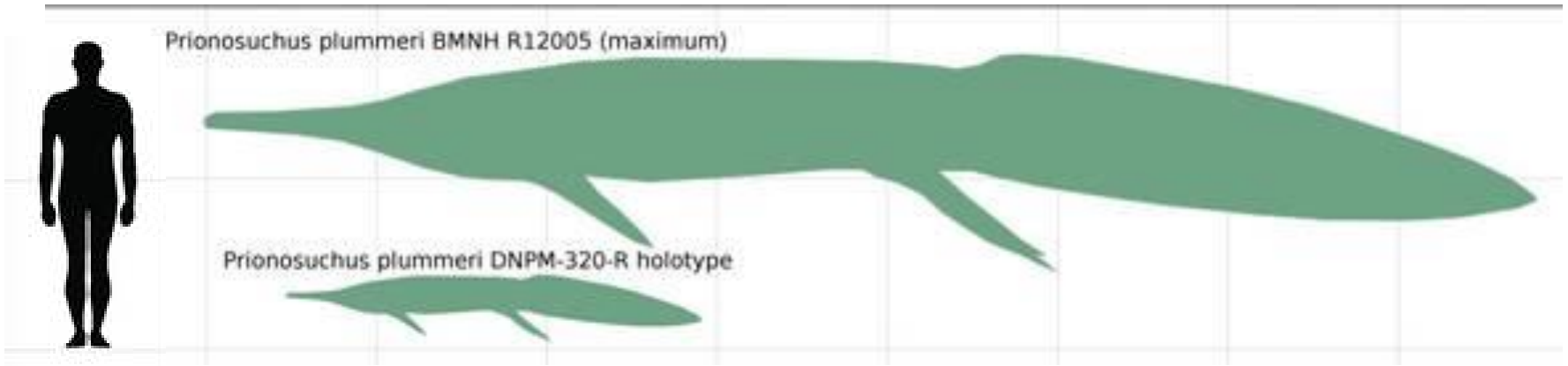
Eryopoidea (Permiano) - *Eryops*: temnospôndilo arquétipo

Grande (até 2 m) predador aquático (forma de crocodilo)



Limnarchia (Carbonífero - Jurássico) no Brasil

Archegosauria (Permiano)

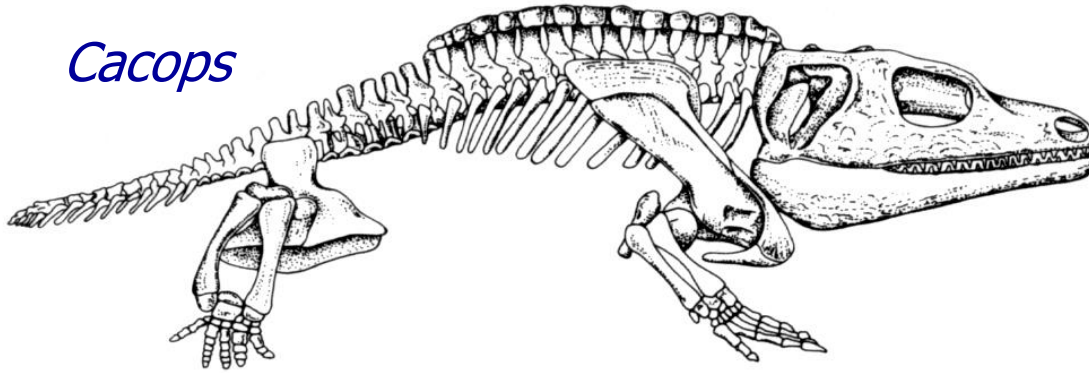


Euskelia (Carbonífero - Permiano)

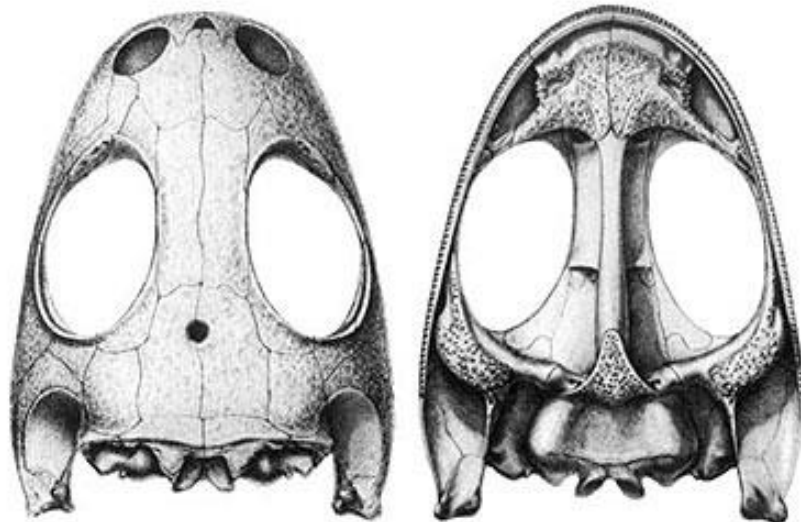
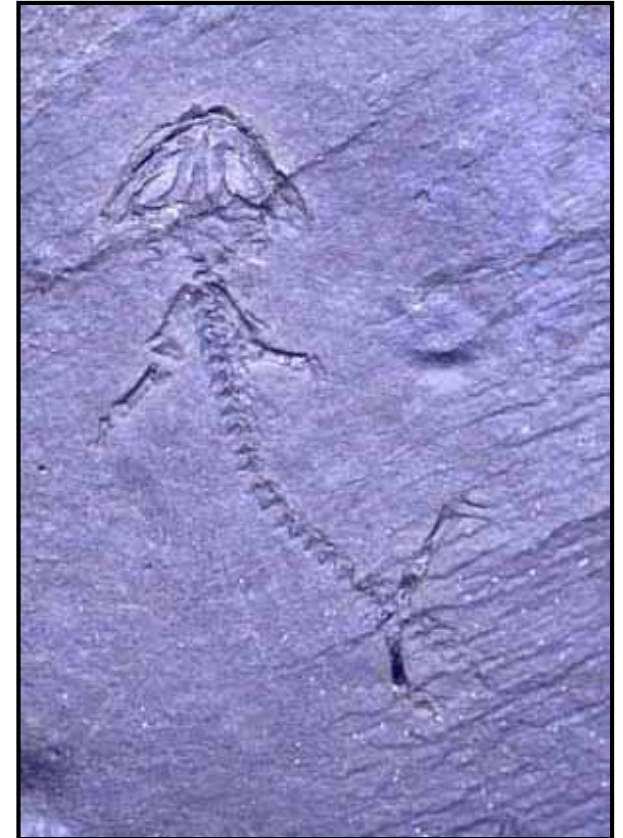
“Dissorophoidea” (*Cacops*, *Doleserpeton*, Branchiosauridae)

Formas menores e mais terrestres do Carbonífero-Permiano

Cacops

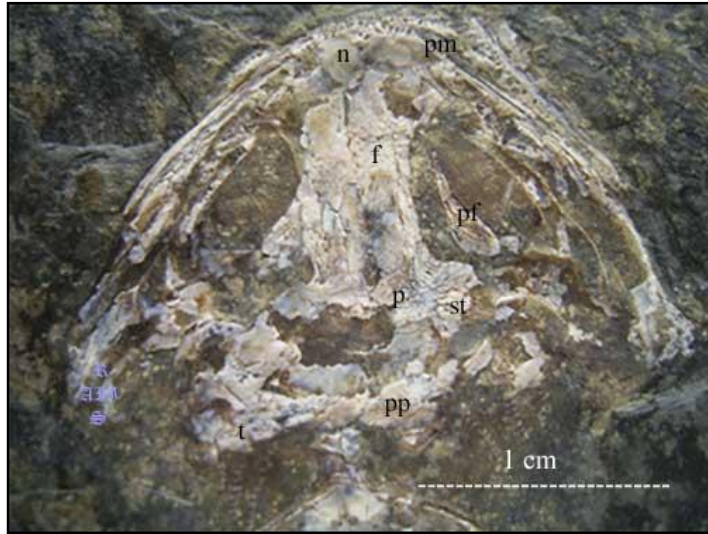


Branchiosaurus

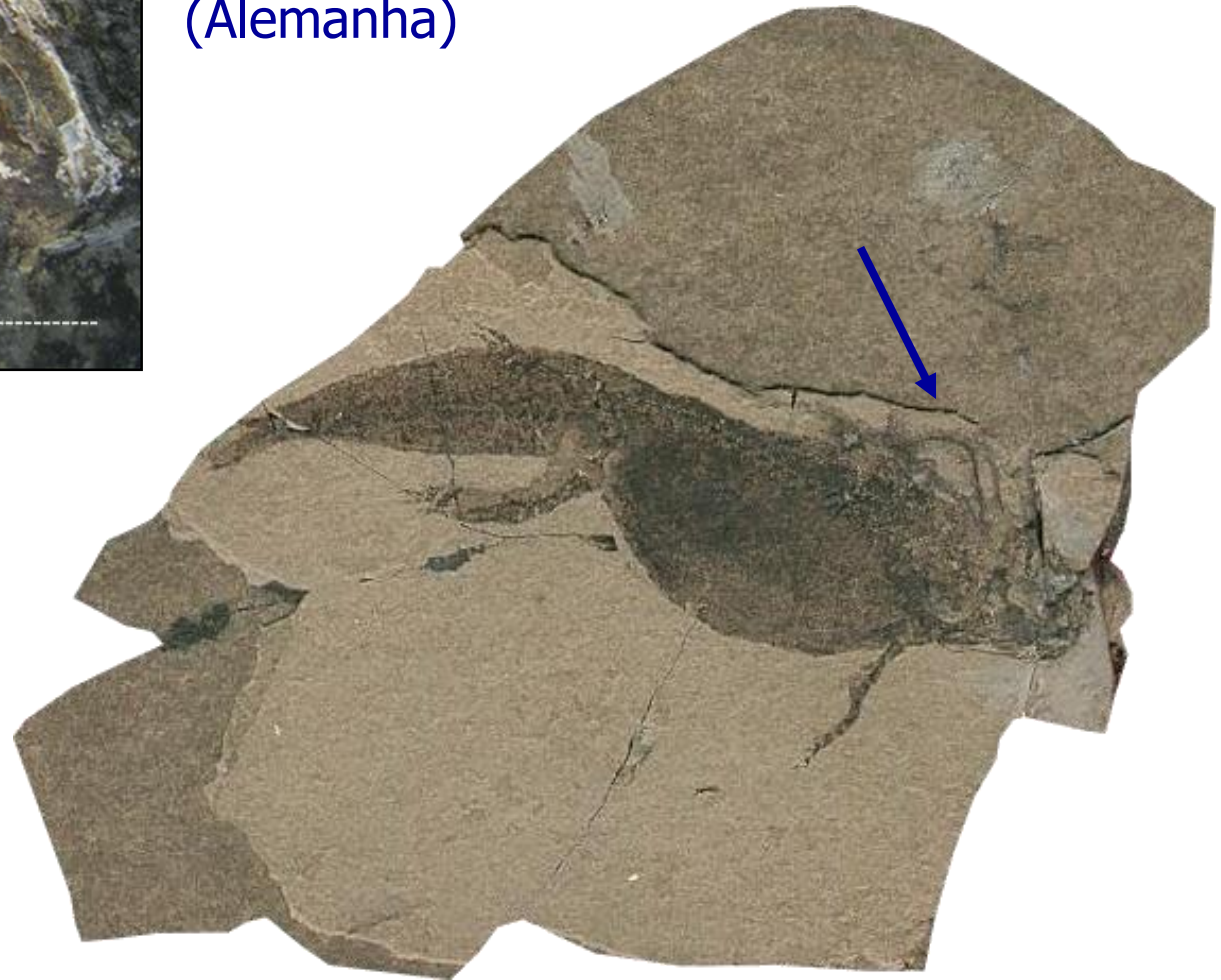


Doleserpeton

Branquiosauria: formas pedomórficas com caracteres larvais preservados
brânquias externas, crânio, carpais e tarsais pouco ossificados



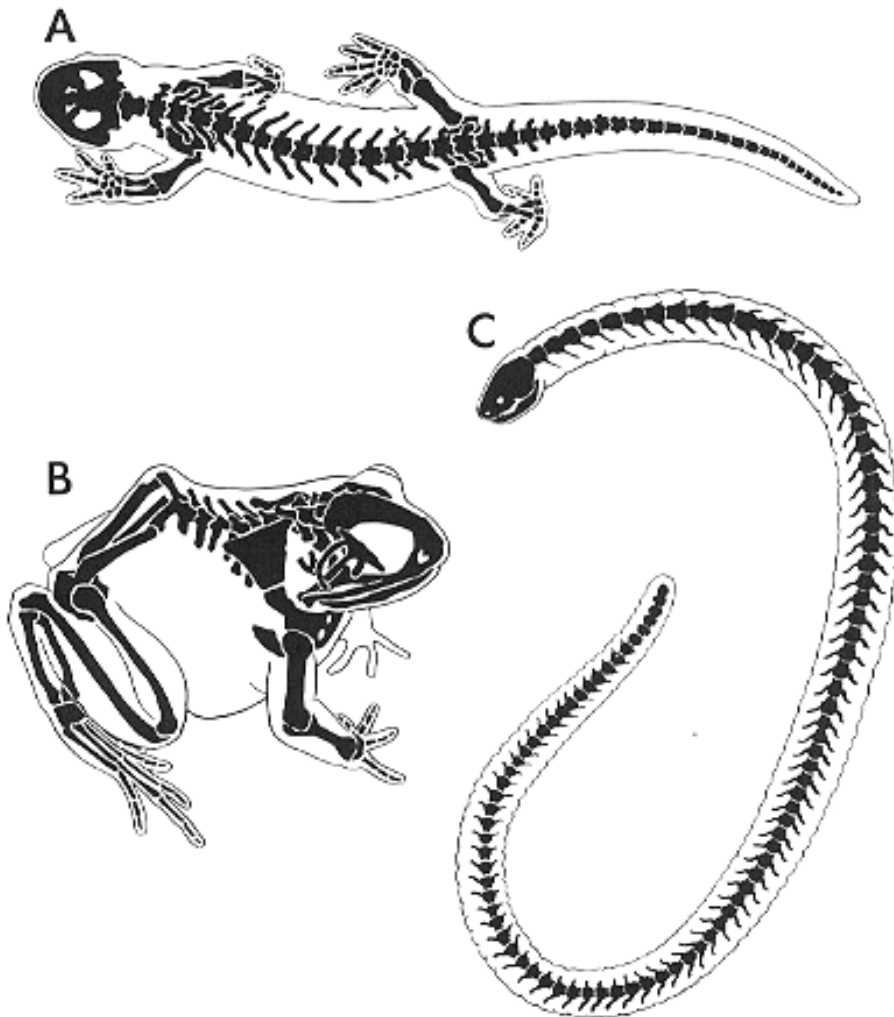
Branchiosaurus
Permiano
(Alemanha)



Apateon Permiano
(Alemanha)

“Hipótese Dissorofóidea” da origem dos lissanfibios

Branchiosauridae + Lissamphibia - Costelas curtas e retas ou ausentes



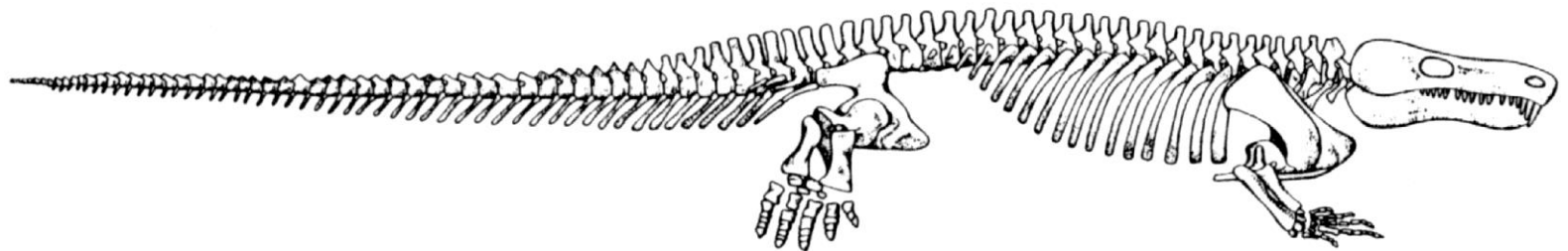
Branchiosaurus
Permiano (Alemanha)

Diadectomorpha (Carbonífero - Permiano)

Grupo irmão dos Amniota - Caracteres derivados de "Cotylosauria":
ossificação do supraocipital e duas vértebras sacrais



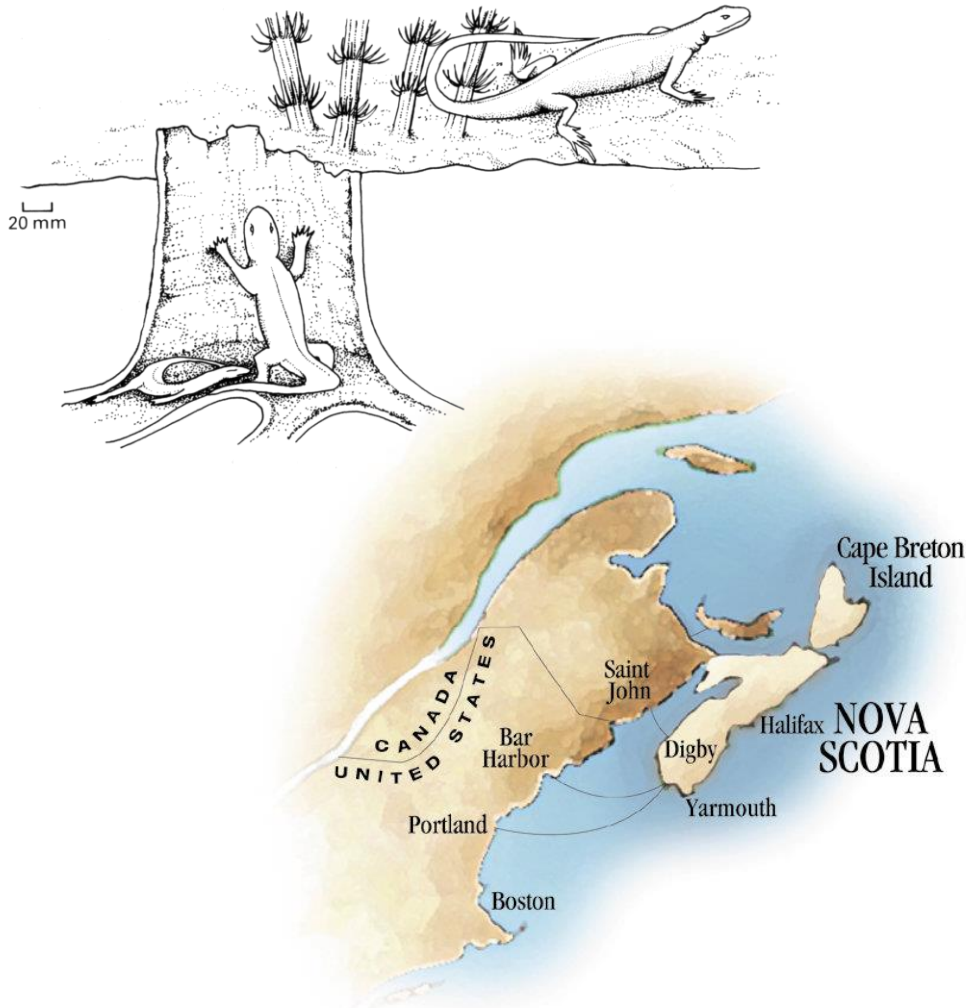
Limnoscelis
(Permo-Carbonífero
EUA)



Primeiros Amniota (Carbonífero médio)

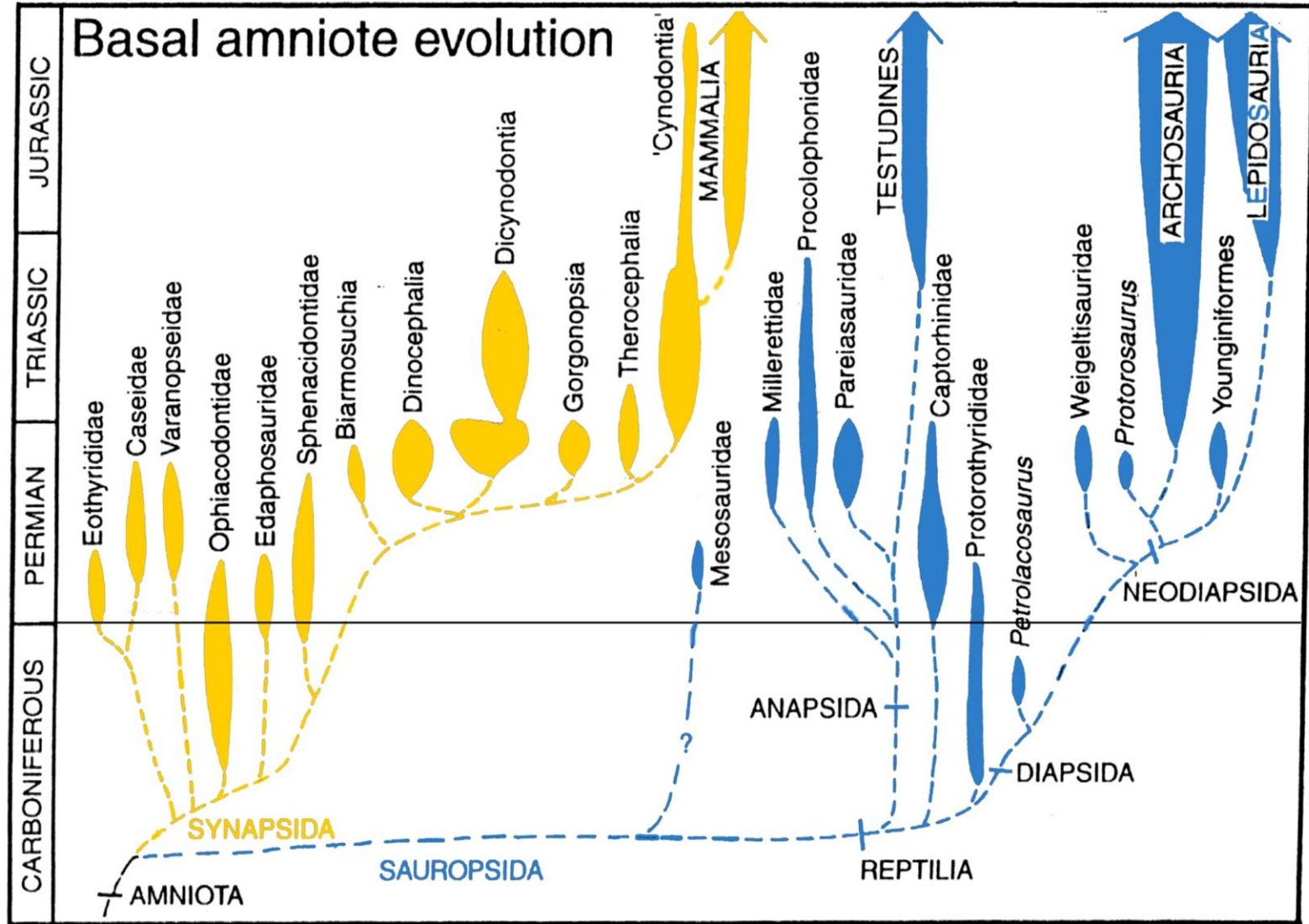
Preservados no interior de Lycopodiaes *Sigillaria*

Grupo Cumberland, Joggins (Nova Scotia, Canadá)



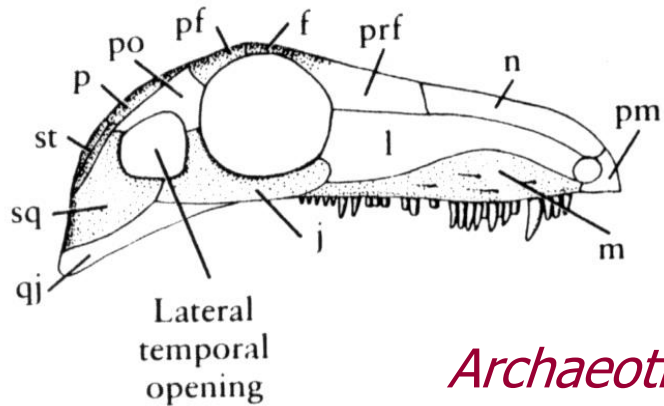
Amniota (Carbonífero – Recente)

Formas do Carbonífero nas linhagens Sauropsida e Synapsida

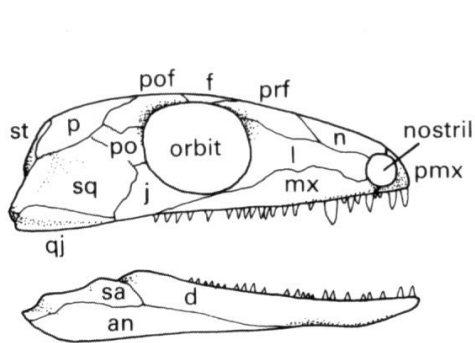


Protorothyridae (Carbonífero médio)

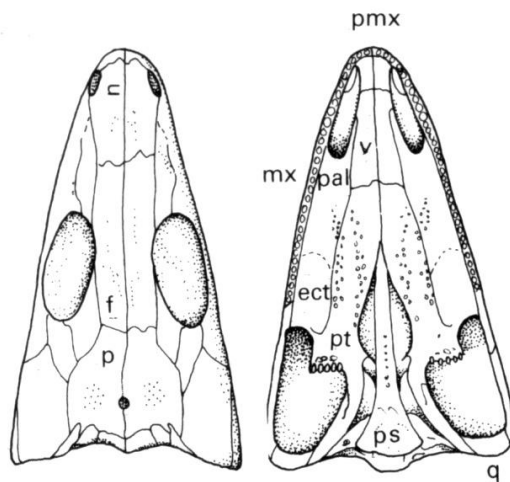
Entre os mais antigos amniotas: Pequenas formas insetívoras



Archaeothyris



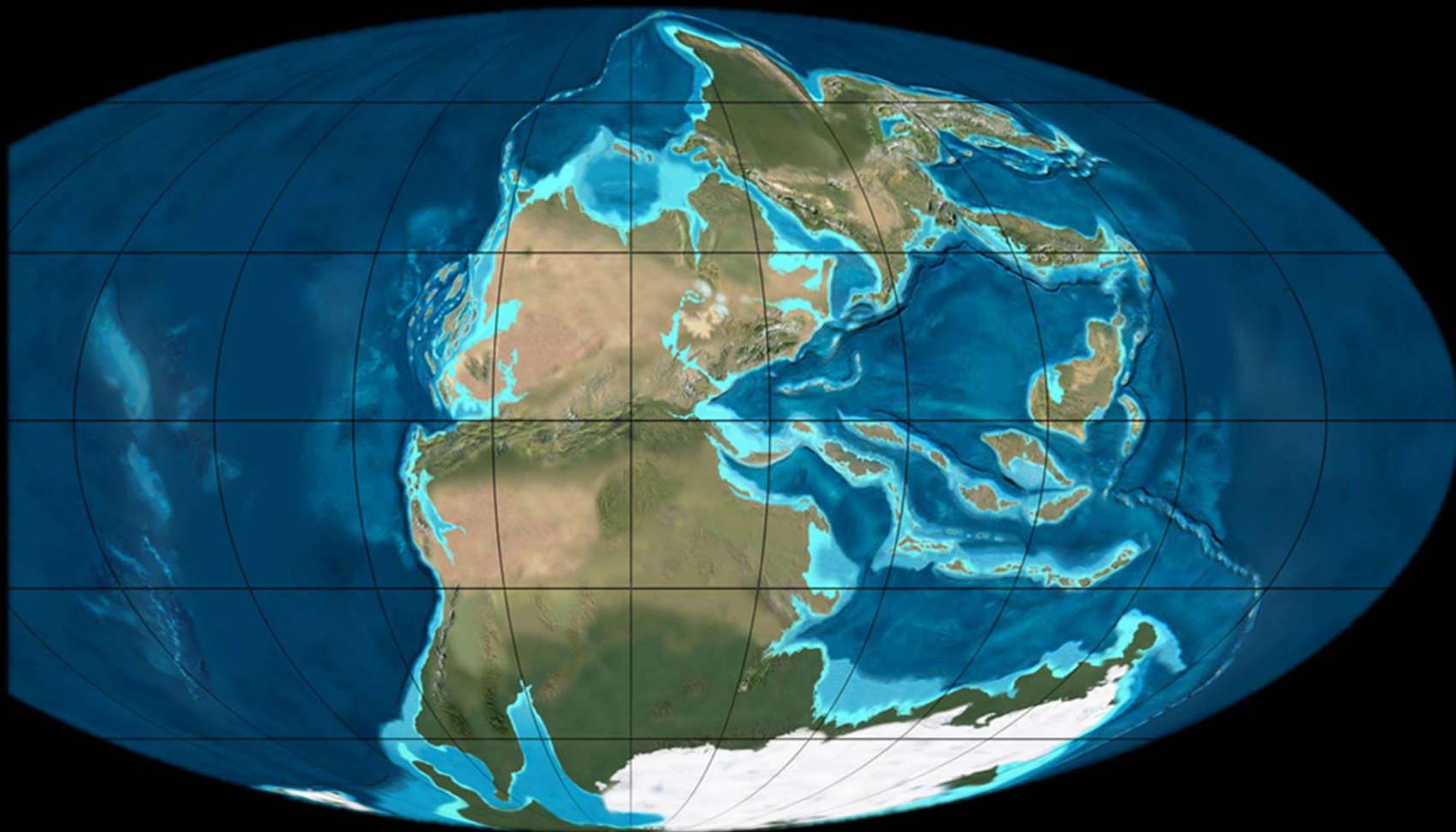
Paleothyris



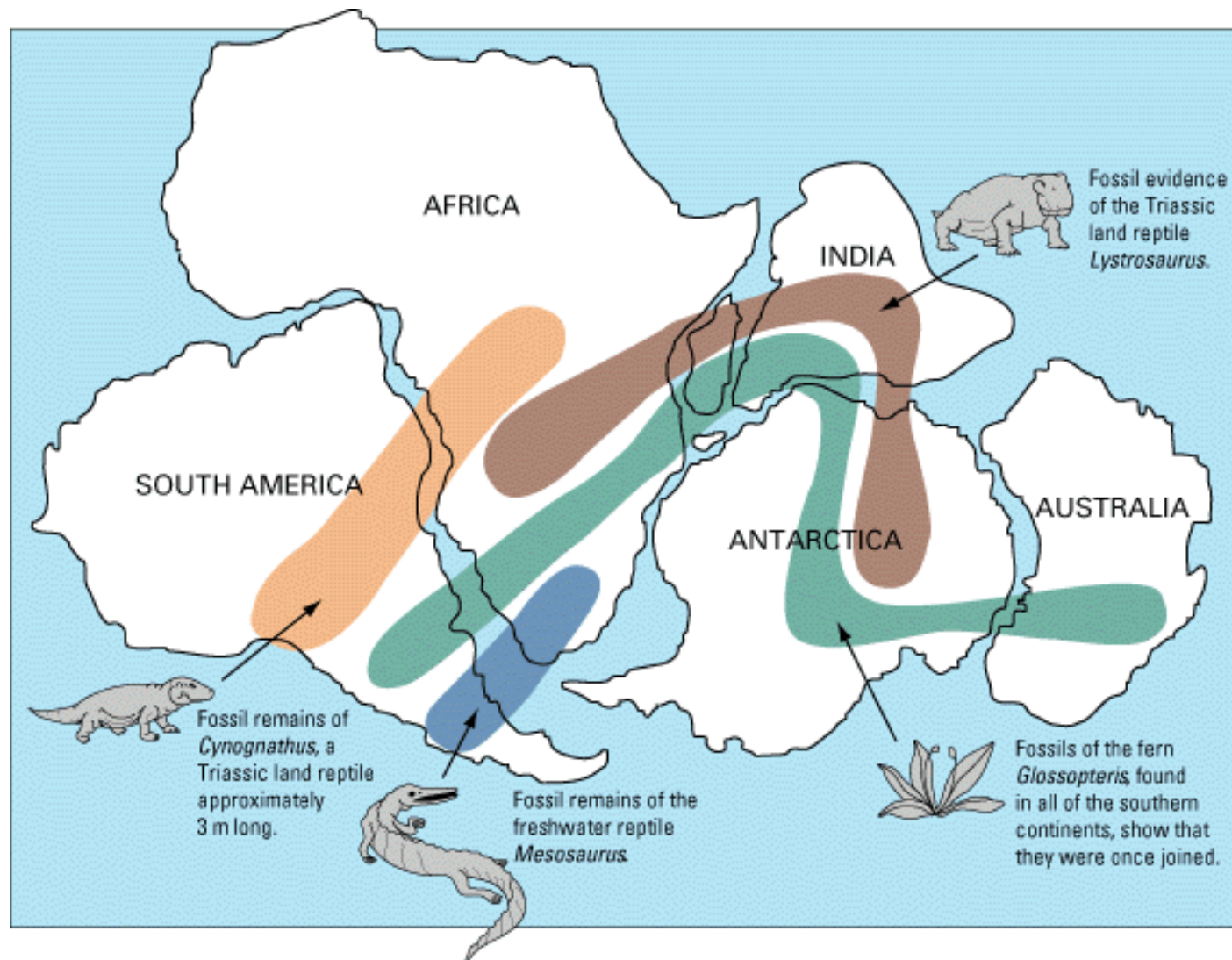
Hylonomus



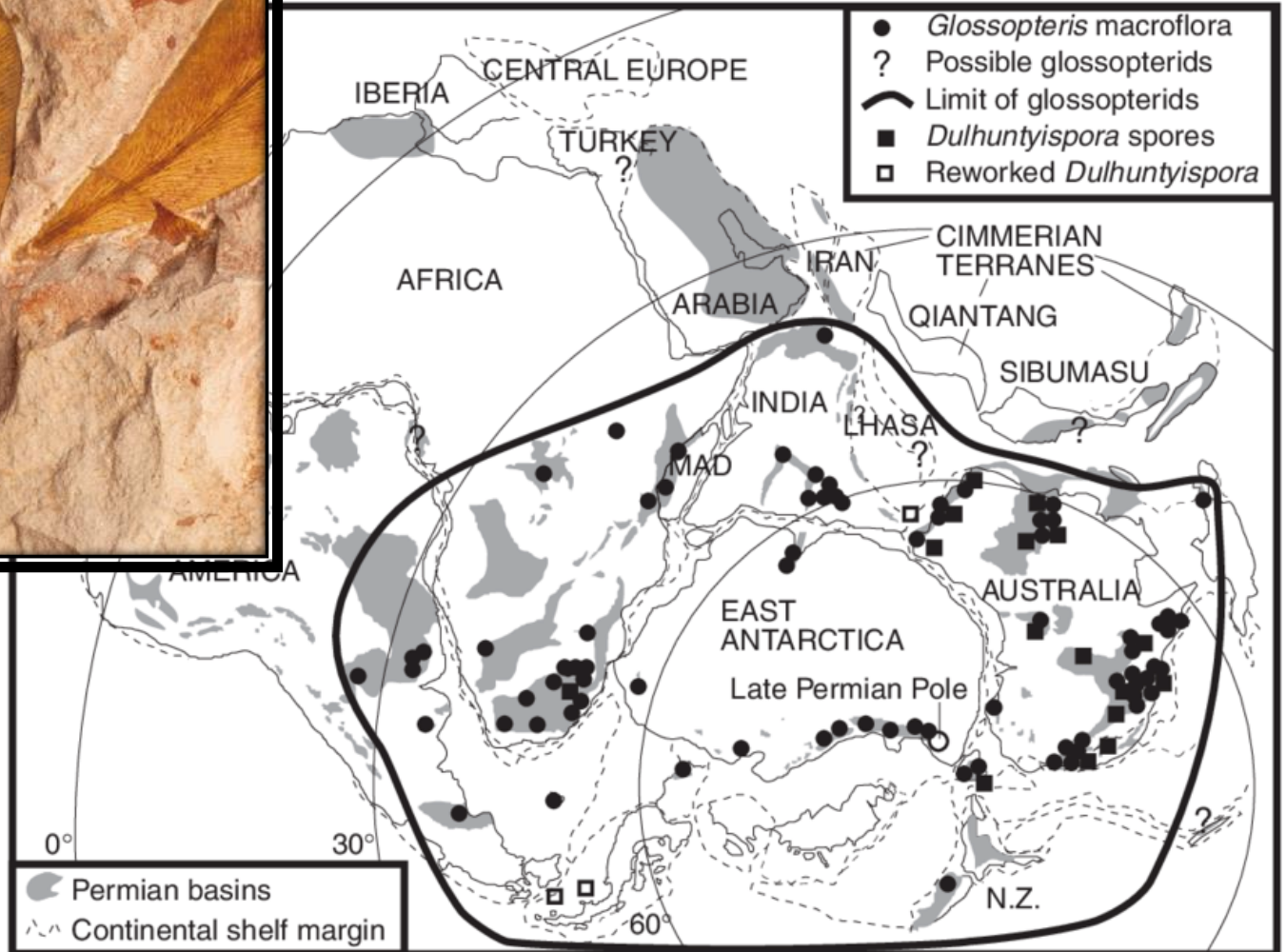
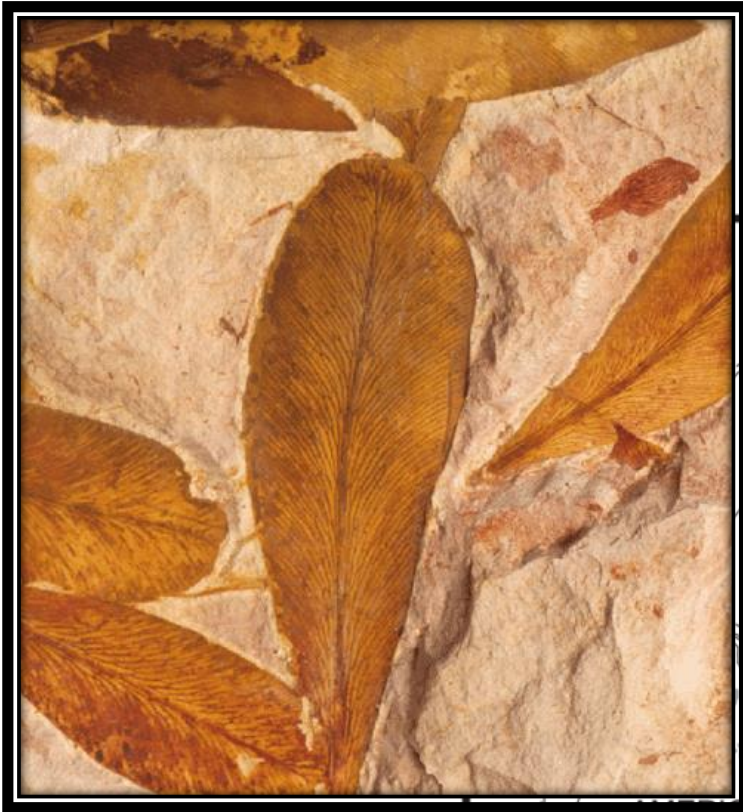
Durante o Permiano (250 Ma), a Sibéria choca-se à Laurásia gerando a orogenia Uraliana e a mais recente aglutinação global das massas continentais: o **Pangea**



Durante o Permiano (250 Ma), a mais recente aglutinação global das massas continentais: o **Pangea**

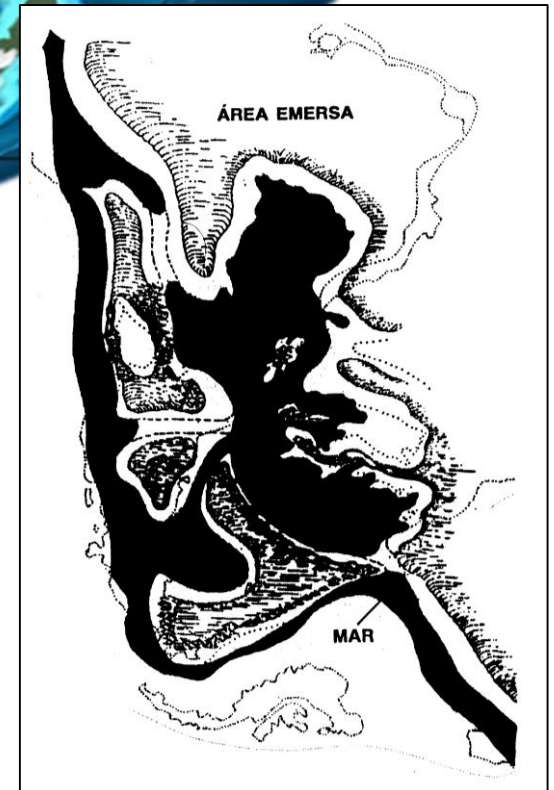
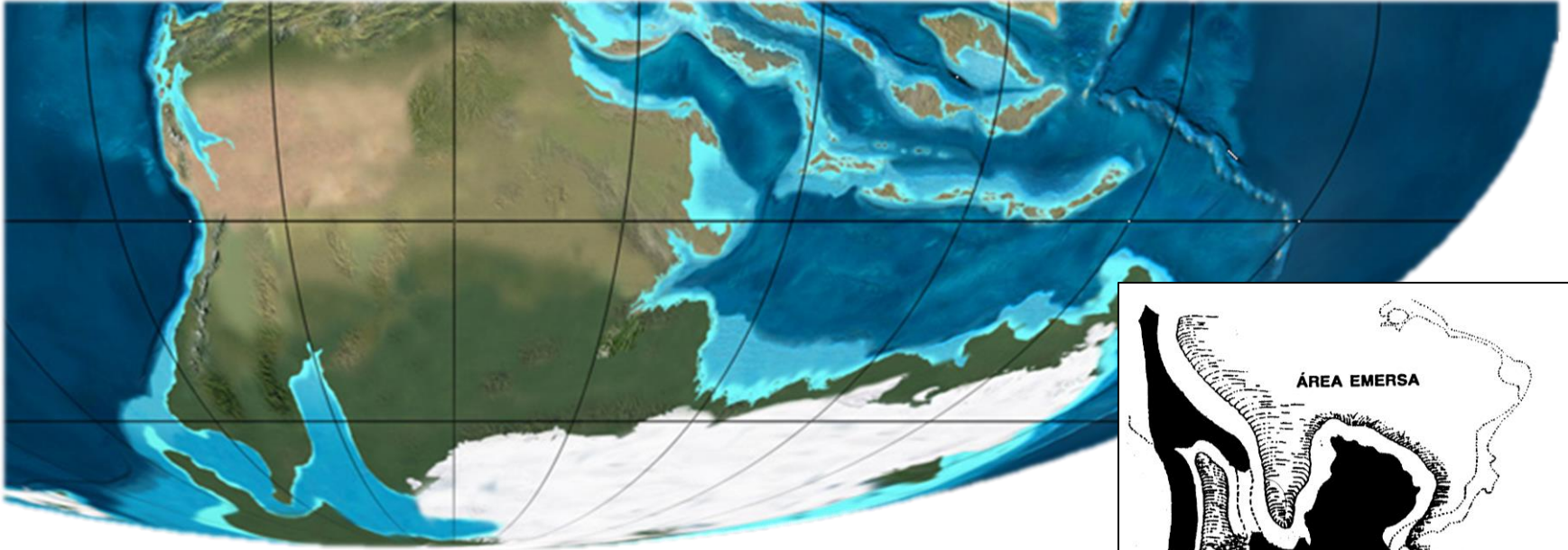


Glossopteris (Permiano inferior)



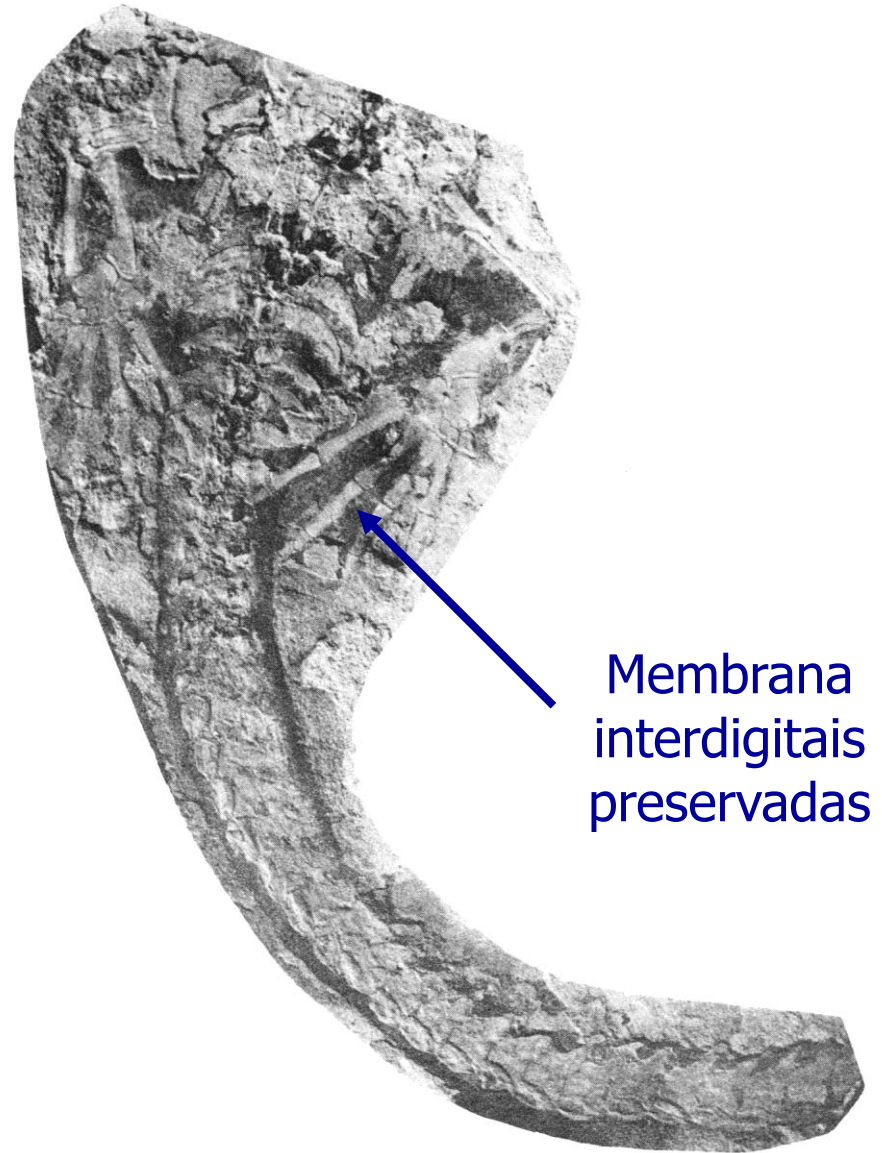
Mesosauria (Permiano inferior)

Mar Epicontinental Itati/Whitehill: máximo transgressivo da Bacia do Paraná



Mesosauria (Permiano inferior)

Primeiro grupo de amniotas aquáticos

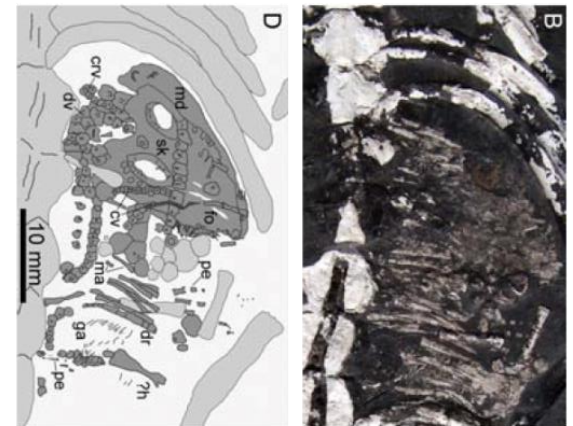
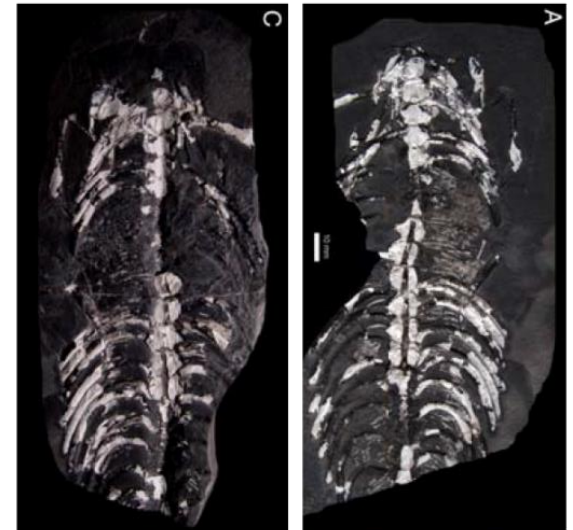
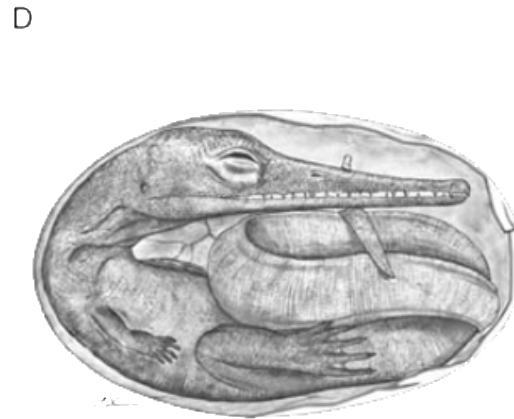
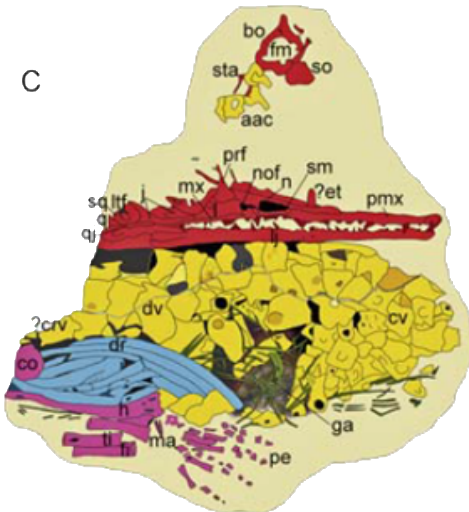


Membrana
interdigitais
preservadas

Mesosauria (Permiano inferior)

Primeiro grupo de amniotas aquáticos

Viviparidade

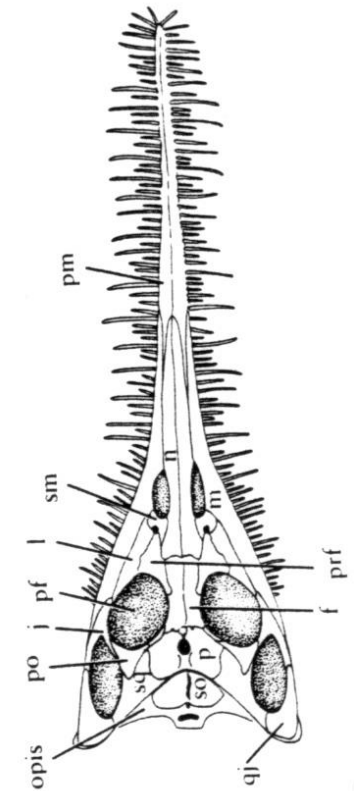
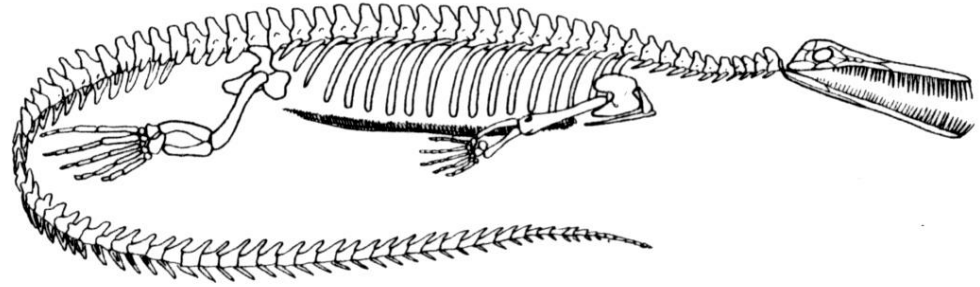


Mesosauria (Permiano inferior)

No Brasil: *Mesosaurus*, *Stereosternum* e *Brazilosaurus*

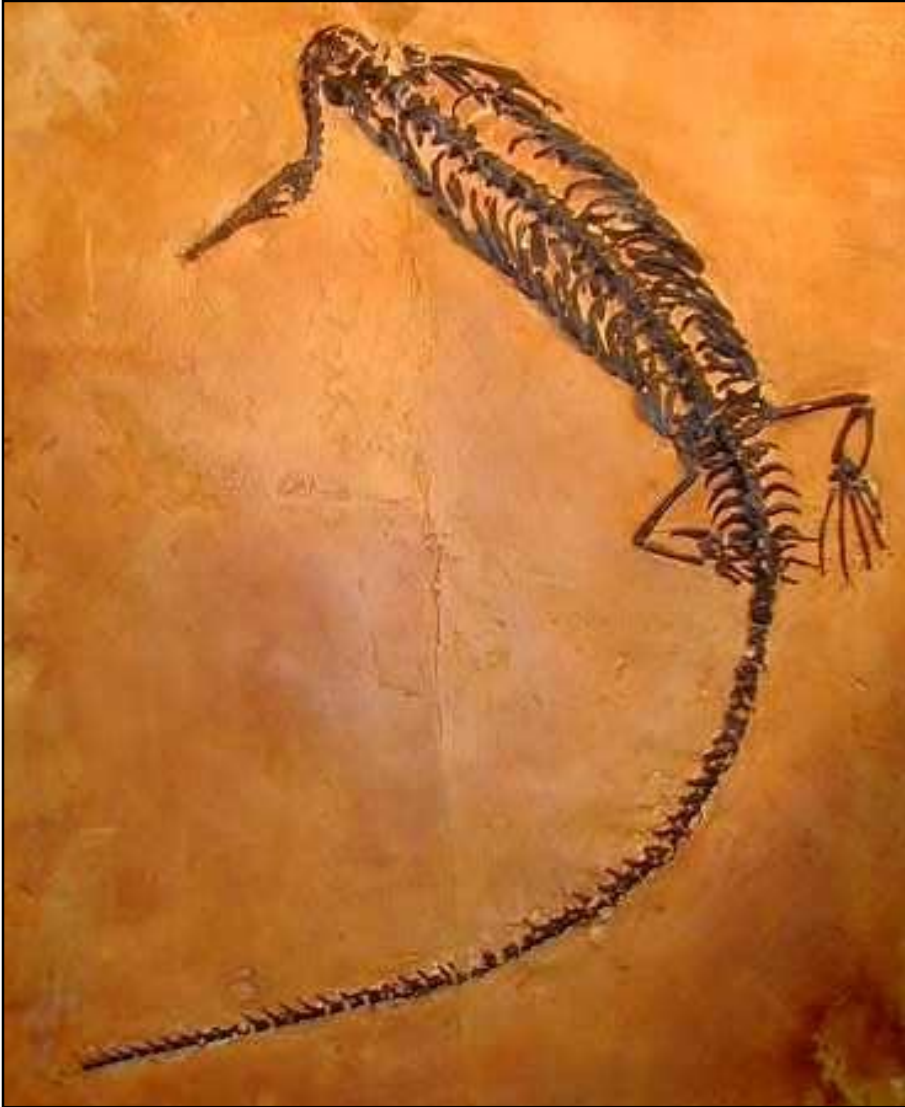


Mesosaurus brasiliensis



Mesosauria (Permiano inferior)

No Brasil: *Mesosaurus*, *Stereosternum* e *Brazilosaurus*



Stereosternum tumidum



Mesosauria (Permiano inferior)

No Brasil: *Mesosaurus*, *Stereosternum* e *Brazilosaurus*

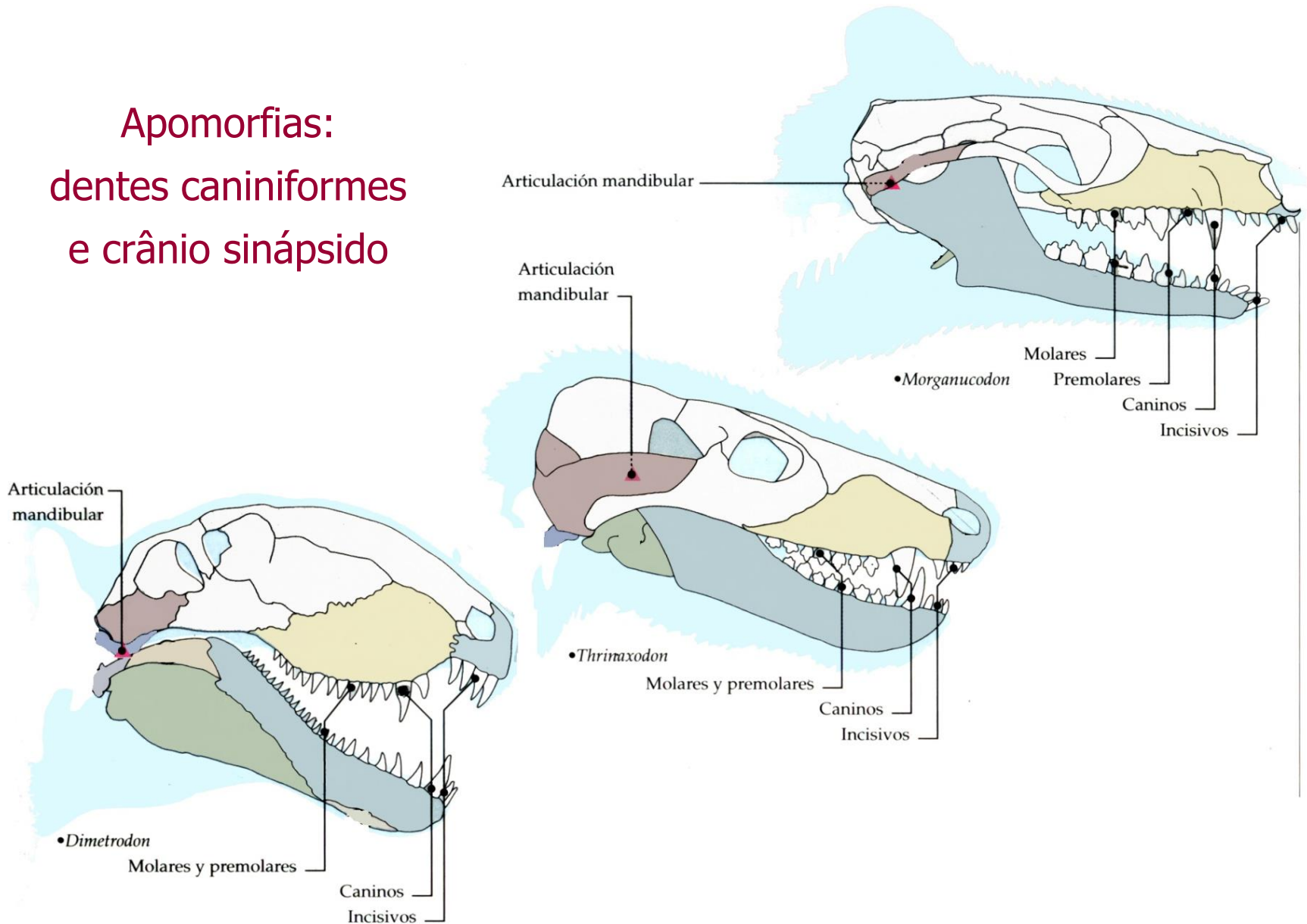


Brazilosaurus sanpauloensis



Synapsida (Carbonífero sup. – Reciente)

Apomorfias:
dentes caniniformes
e crânio sinápsido

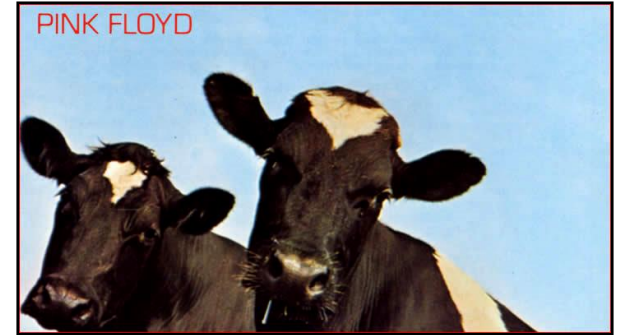


Synapsida (Carbonífero sup. – Recente)

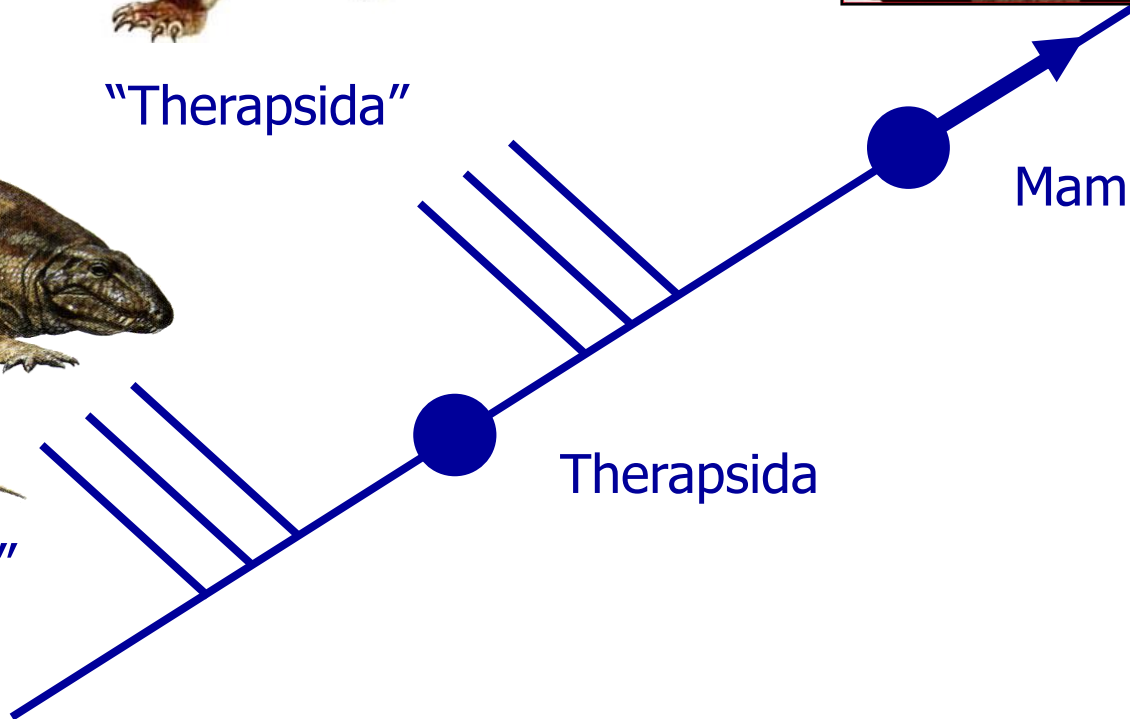
3 grandes grupos: "Pelycosauria", "Therapsida" e Mammalia



"Therapsida"



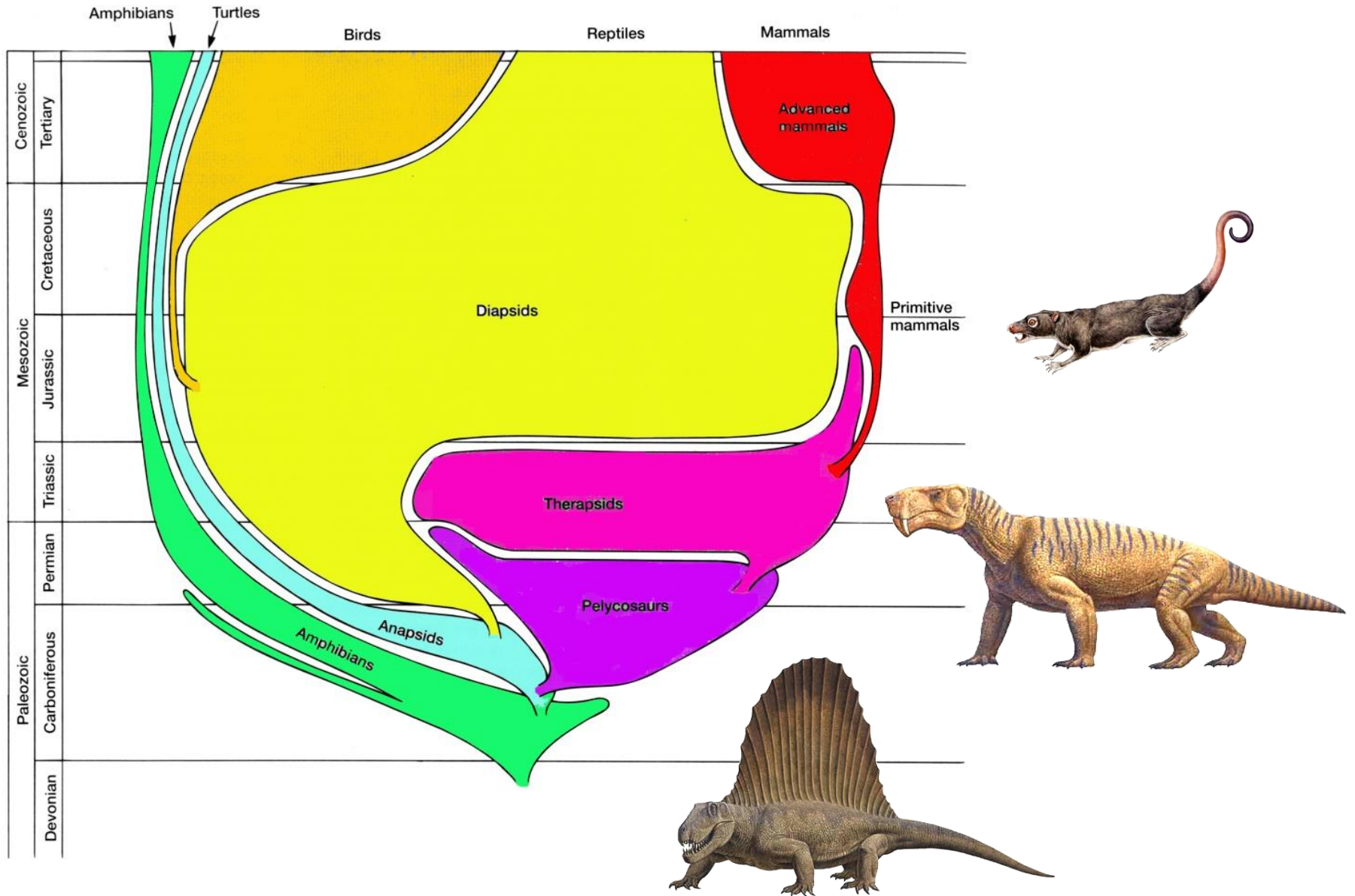
Mammalia



"Pelycosauria"

Therapsida

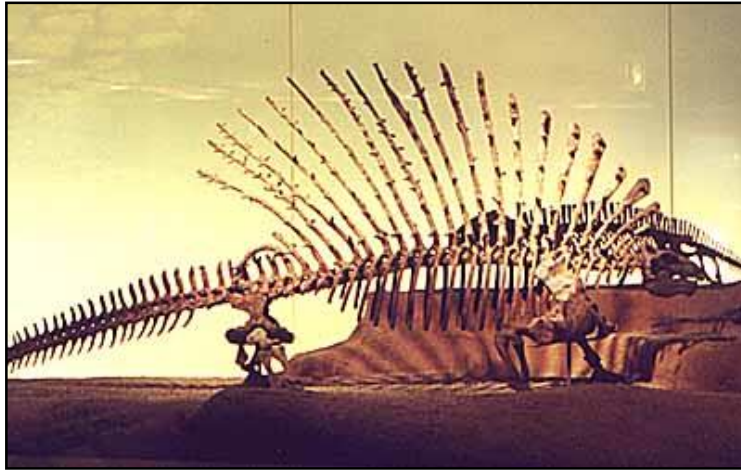
Synapsida (Carbonífero sup. – Recente)



"Pelycosauria" (Carbonífero sup. – Permiano inf.)

Edaphosauridae (Permiano inf.) - espinhos neurais alongados formando "vela"

Com tubérculos laterais que aumenta turbulência e troca de calor

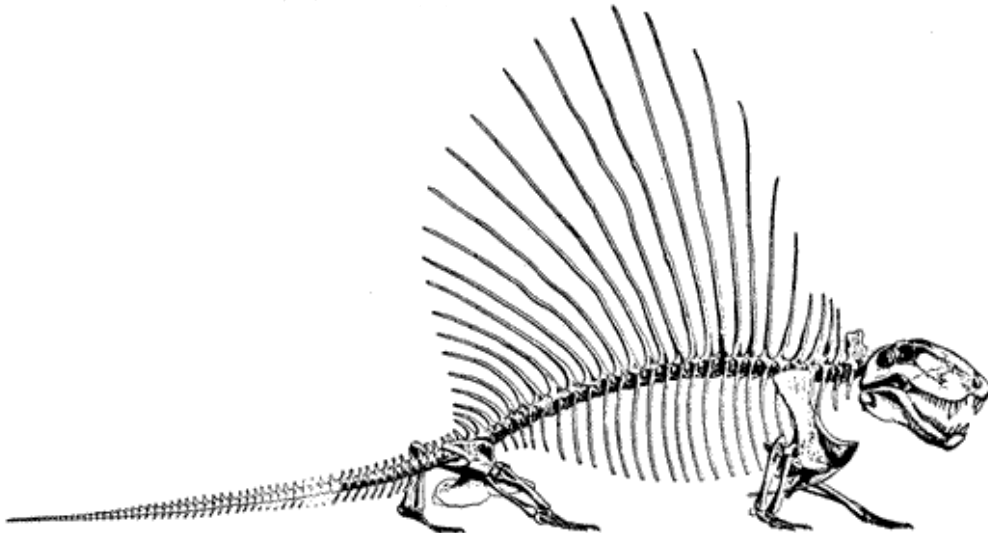
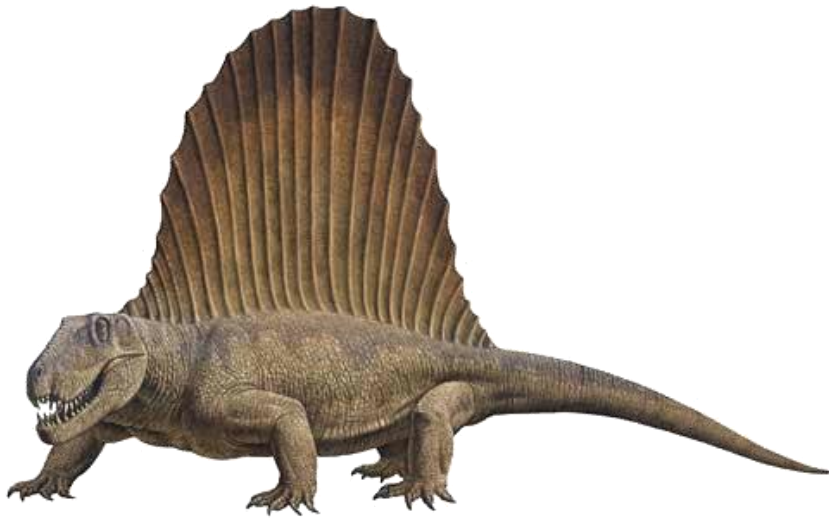


Edaphosaurus
(Permiano inf. Texas)

“Pelycosauria” (Carbonífero sup. – Permiano inf.)

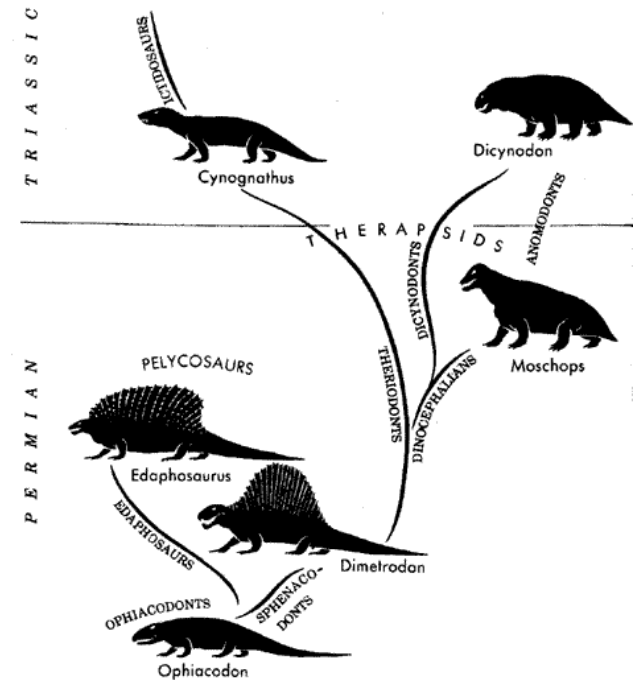
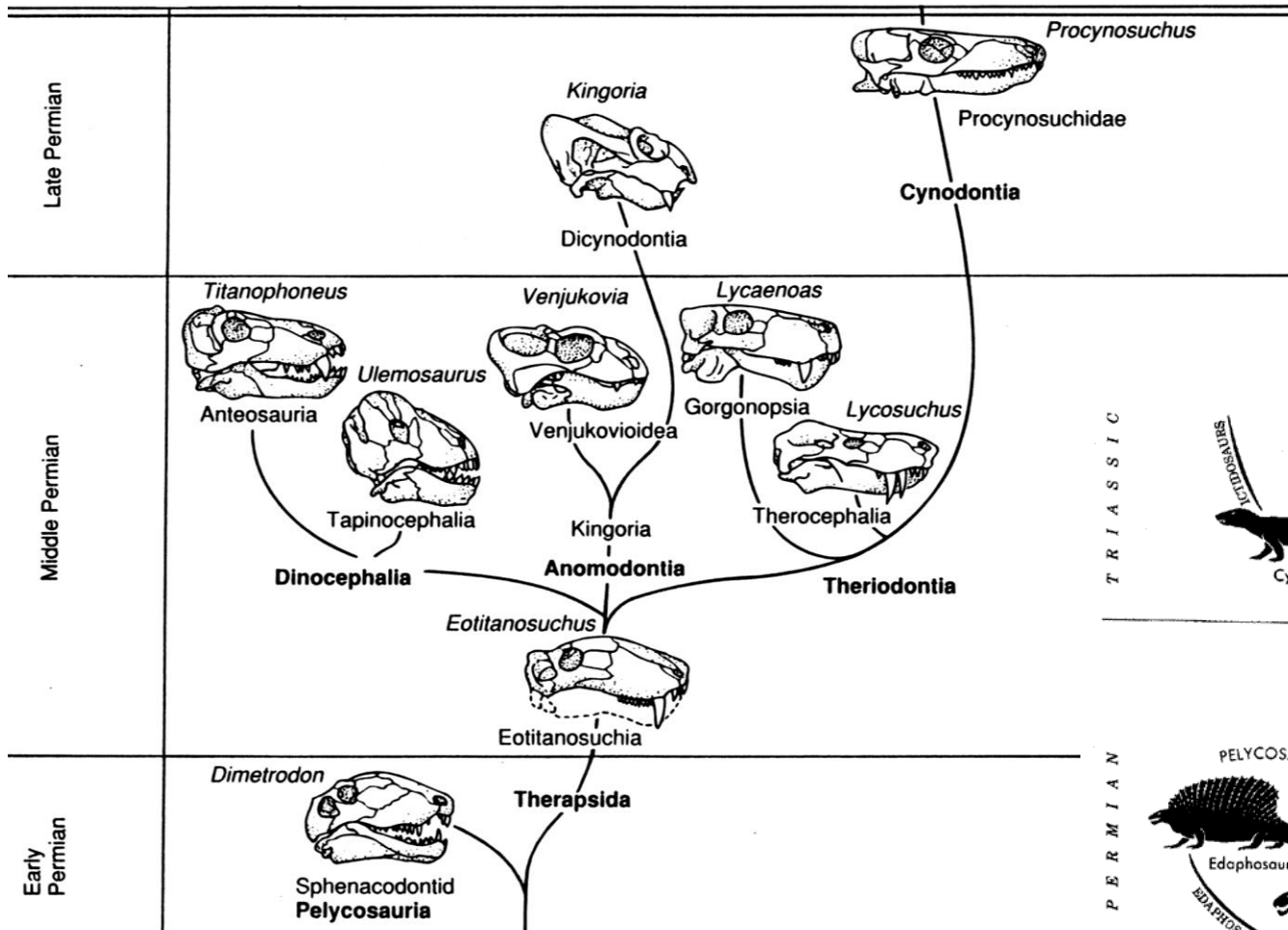
Sphenacodontia (Carbonífero sup. – Permiano inf.)

Grandes formas atingiam 3 m, algumas (*Dimetrodon*) possuíam “vela”



Therapsida (Permiano inf. – Recente)

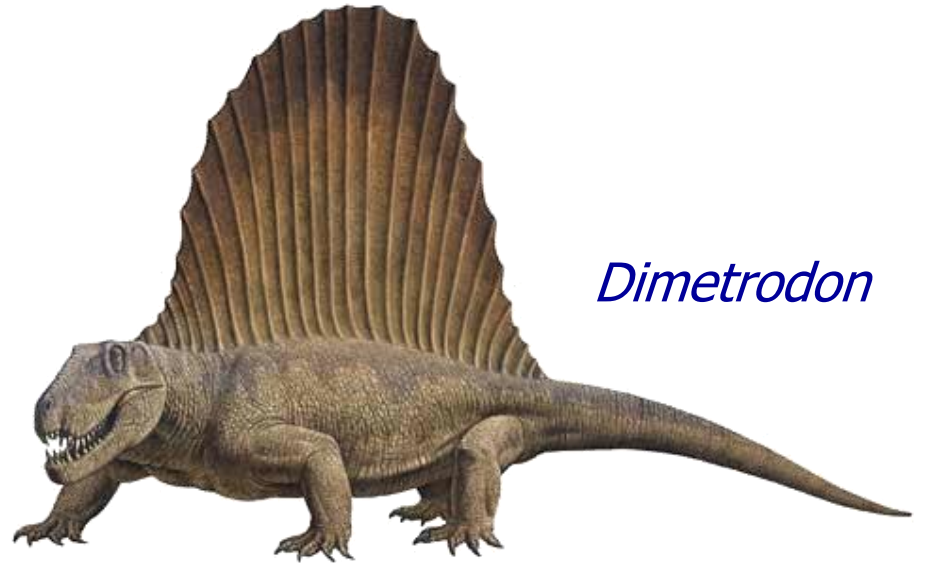
Definição clássica não inclui mamíferos, ao contrário da definição filogenética



Therapsida (Permiano inf. – Recente)



Inostrancevia



Dimetrodon

Therapsida (Permiano inf. – Recente)

Dinocephalia (Permiano sup.)

Estemenosuchus: forma basal com projeções cranianas para *display*



Dinocephalia (Permiano sup.)

Tapinocephalia = Titanosuchidae + Tapinocephalidae

Tapinocephalidae: maiores formas com 4 m e 1,5 toneladas

Sem caninos e dieta herbívora



Ulemosaurus (Cis-Urais)

Struthiocephalus
(África do Sul)



Keratocephalus
(África do Sul)

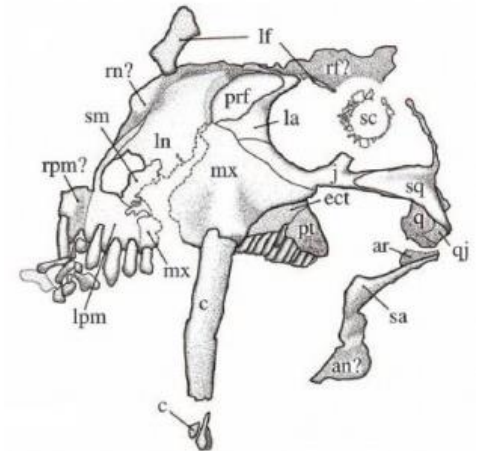


Therapsida (Permiano inf. – Recente)

Anomodontia (Permiano sup. – Triássico sup.)

Tiarajudens eccentricus

(Fm. Rio do Rasto, RS)



Dicynodontia (Permiano sup. – Triássico sup.)

Formas do Permiano em geral de tamanho pequeno (algumas fessoriais)



Diictodon (Permiano sup., África do Sul)



Dicynodontia (Permiano sup. – Triássico sup.)

Algumas formas do Permiano sup. de tamanho maior (*Aulacephalodon* = 3 m)

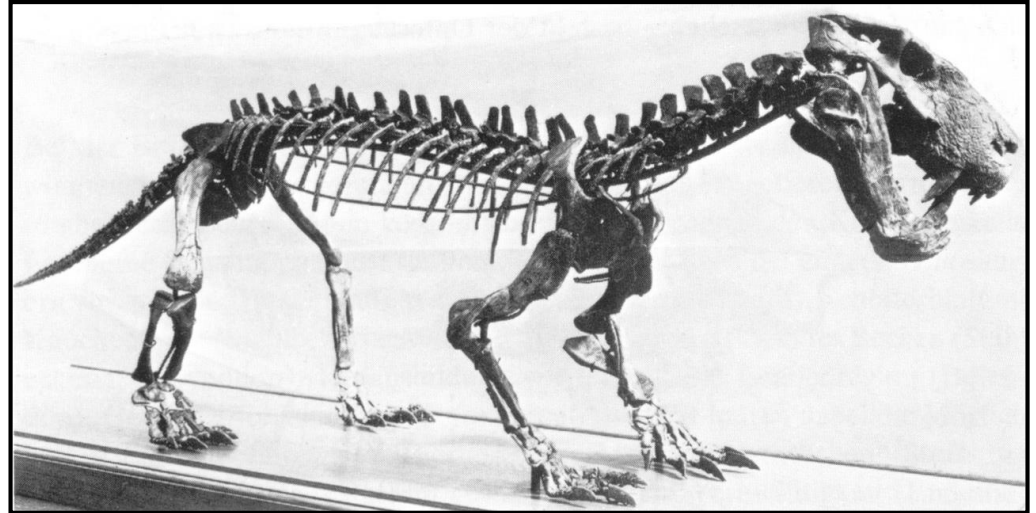


Therapsida (Permiano inf. – Recente)

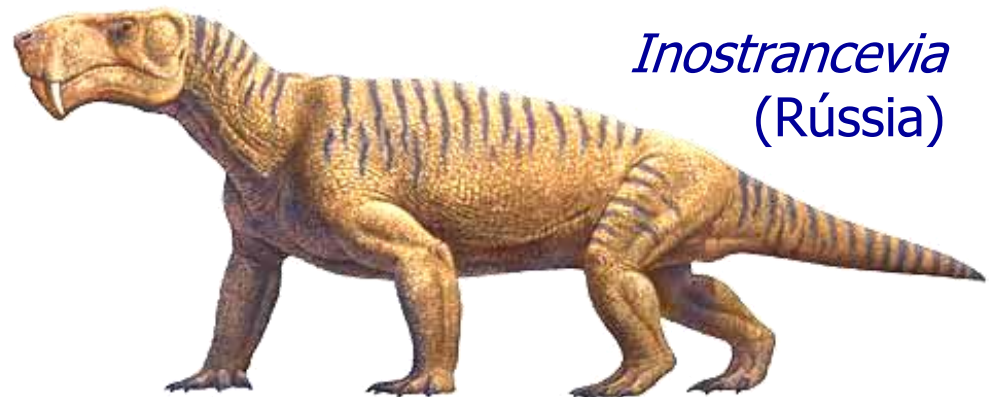
Gorgonopsia (Permiano sup.)

Registros na China, Rússia e África do Sul - Extinção no limite Permo-Triássico

Scymnognathus
(Tanzânia)



Lycaenops (África do Sul)



Inostrancevia
(Rússia)

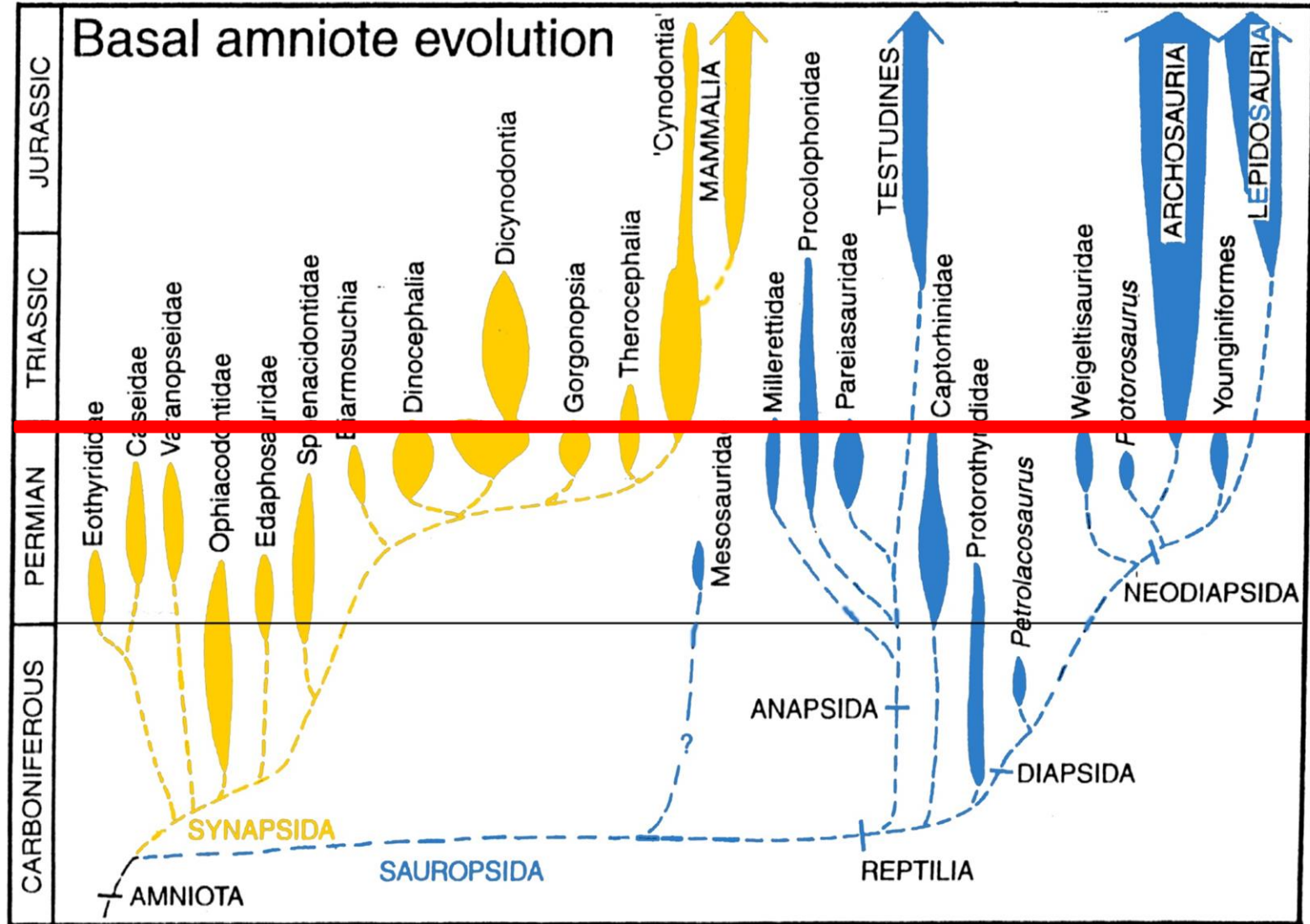
Pareiasauria (Permiano)

Maiores pararrépteis: até 3 m de comprimento e 1 ton

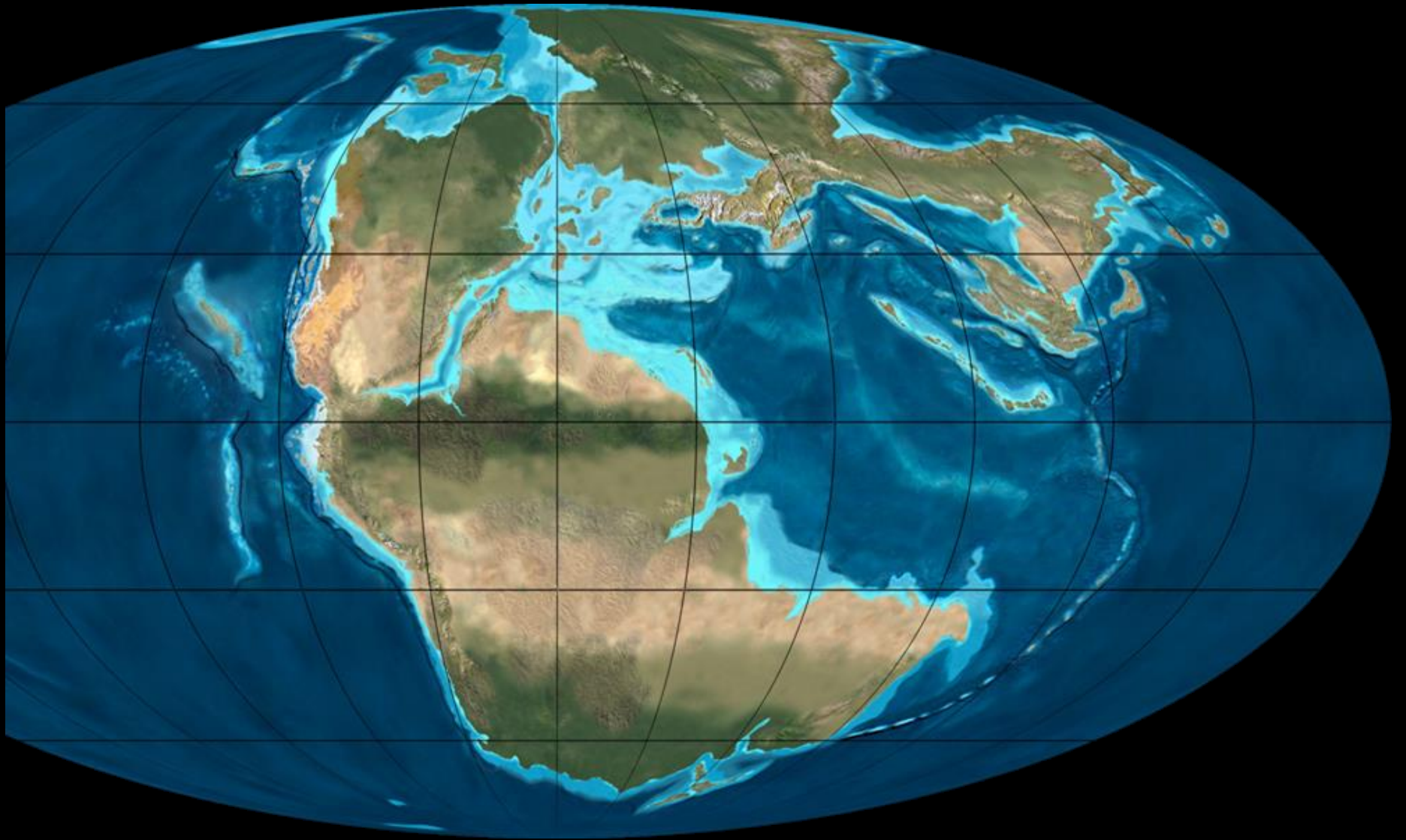


Amniota (Carbonífero – Recente)

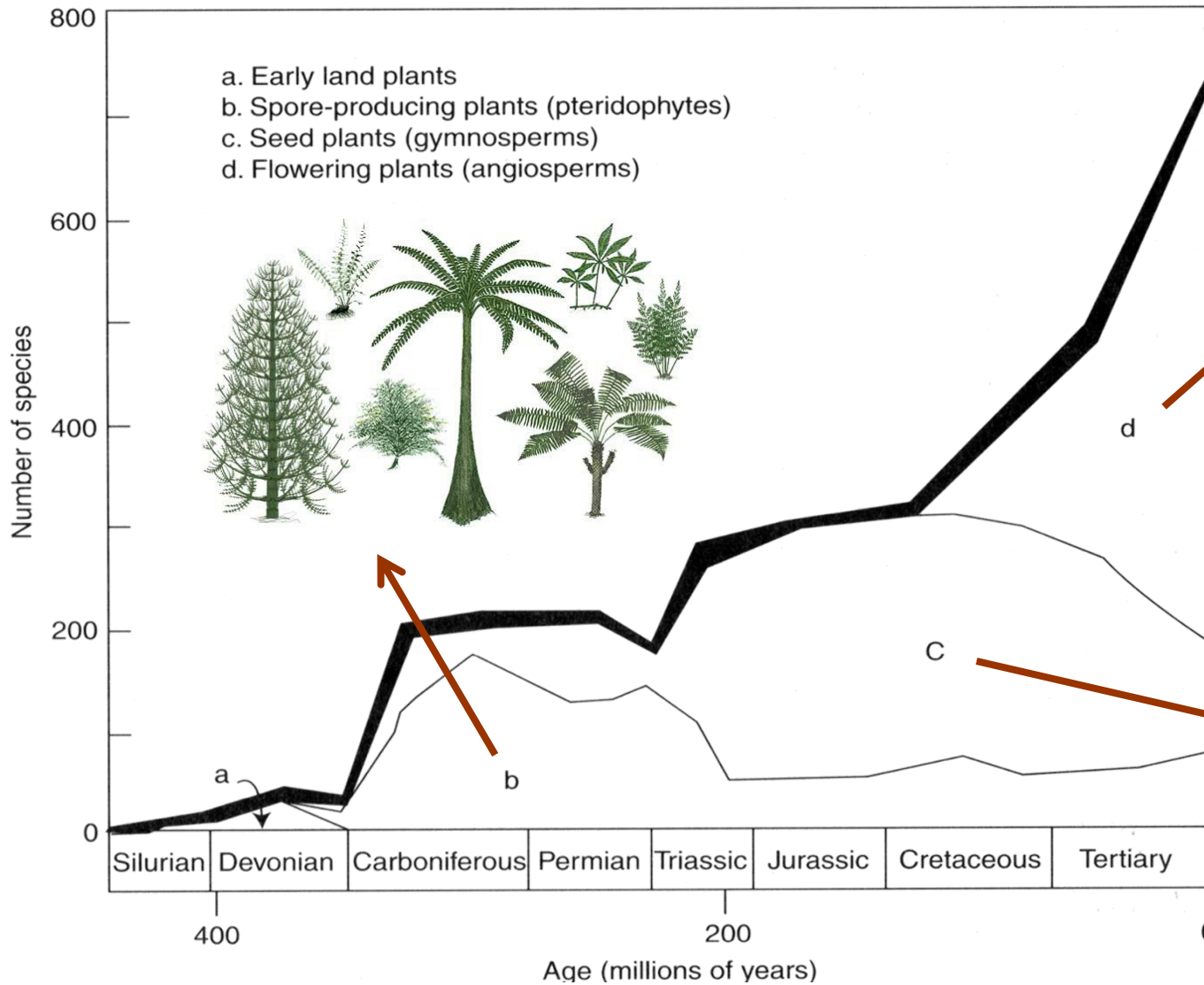
Formas do Carbonífero nas linhagens Sauropsida e Synapsida



Triássico



Plantas: expansão das espermatófitas



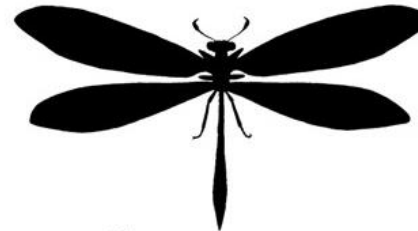
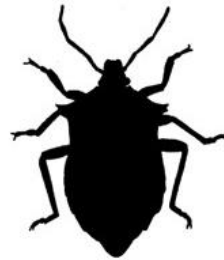
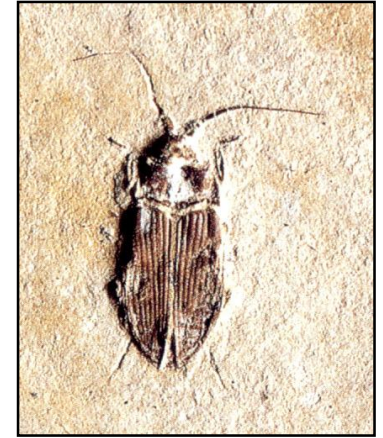
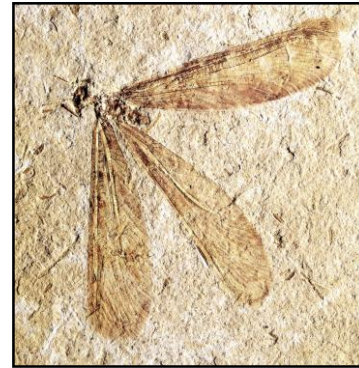
Plantas: expansão das espermatófitas



Plantas: expansão das espermatófitas



Neoptera (Carbonífero – Recente)



Hyporderida

Zoraptera

Psocoptera

Phthiraptera

Thysanoptera

Homoptera

Heteroptera

Miomoptera

Glosselytroidea

Megaloptera

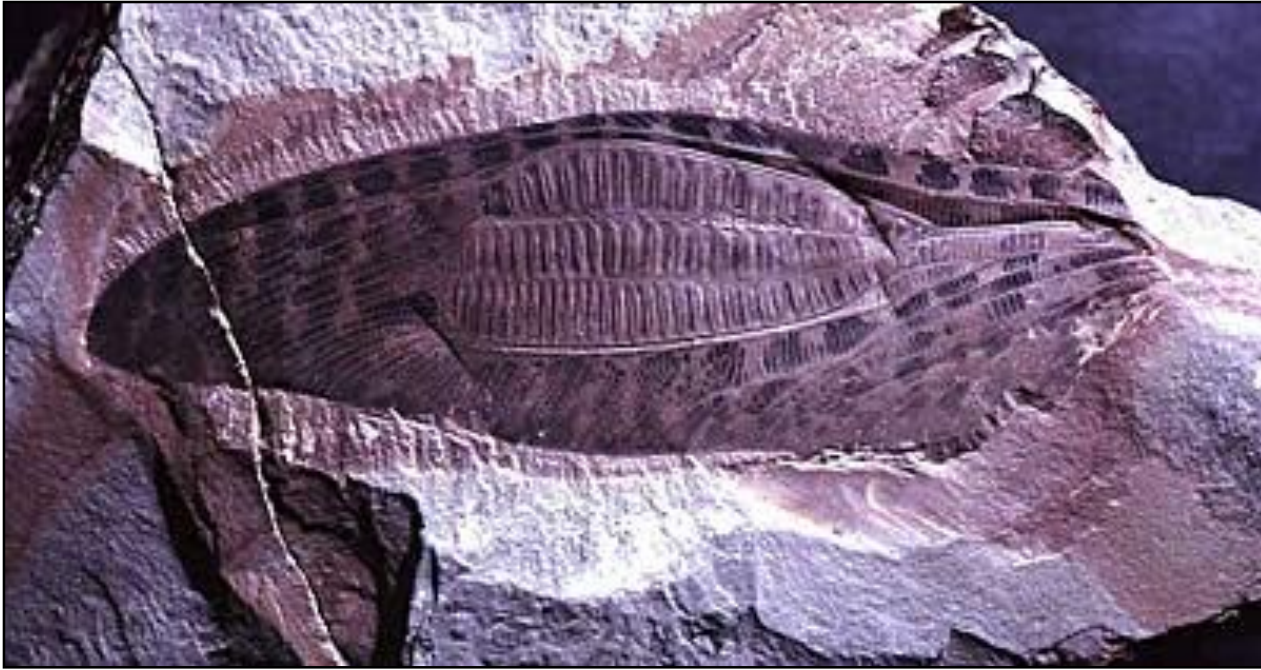
Raphidioidea

Neuroptera

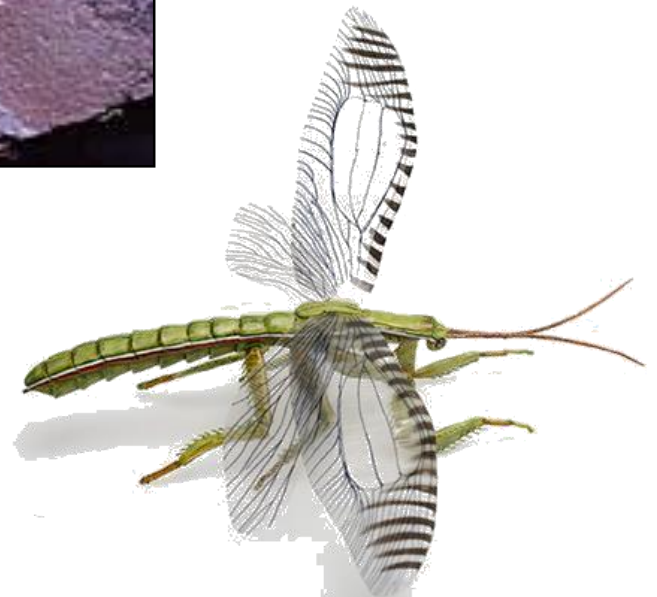
Coleoptera



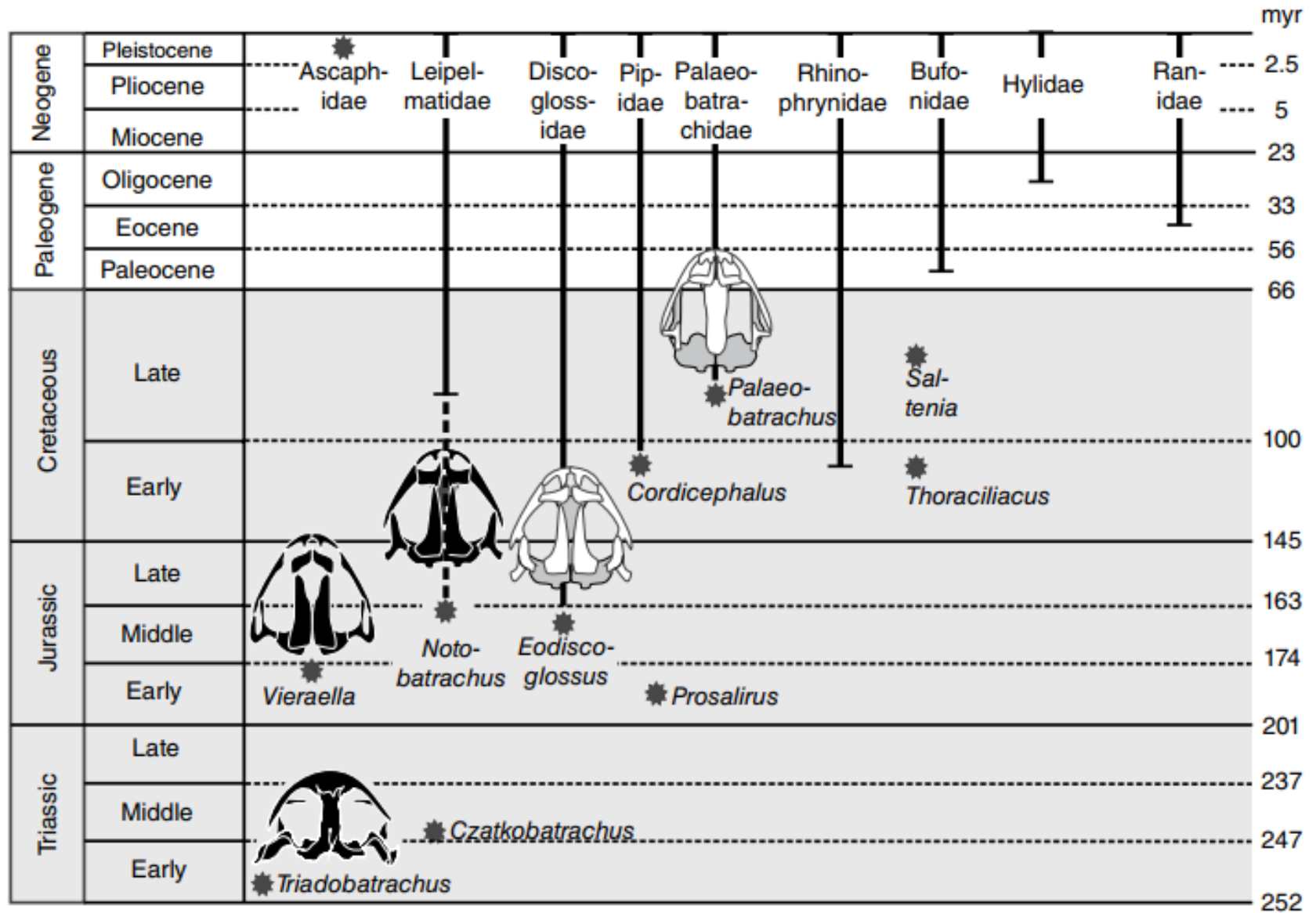
Neoptera (Carbonífero – Recente)
Titanoptera (Triássico - Jurássico)



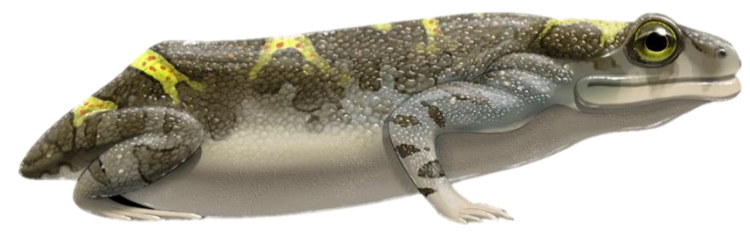
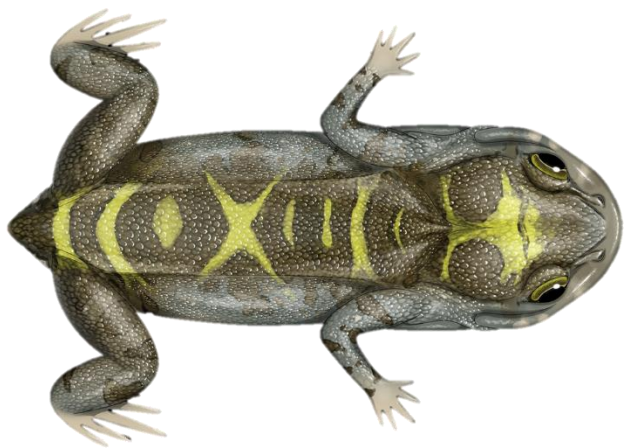
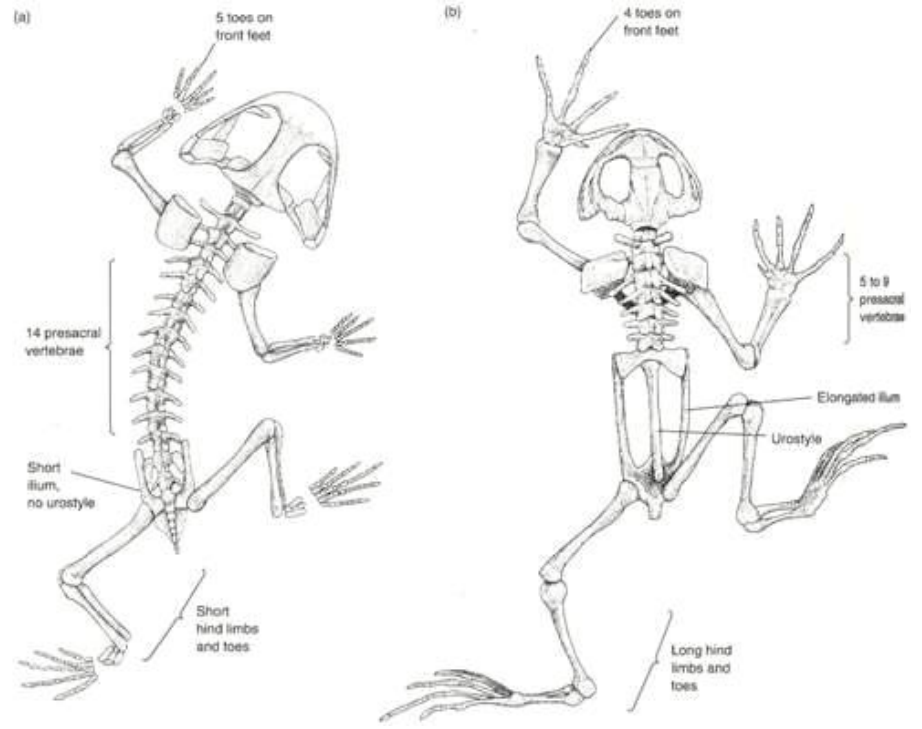
Clatrotitan
Triássico médio
New South Wales



Anura (Triássico – Recente)



Anura (Triássico – Recente)



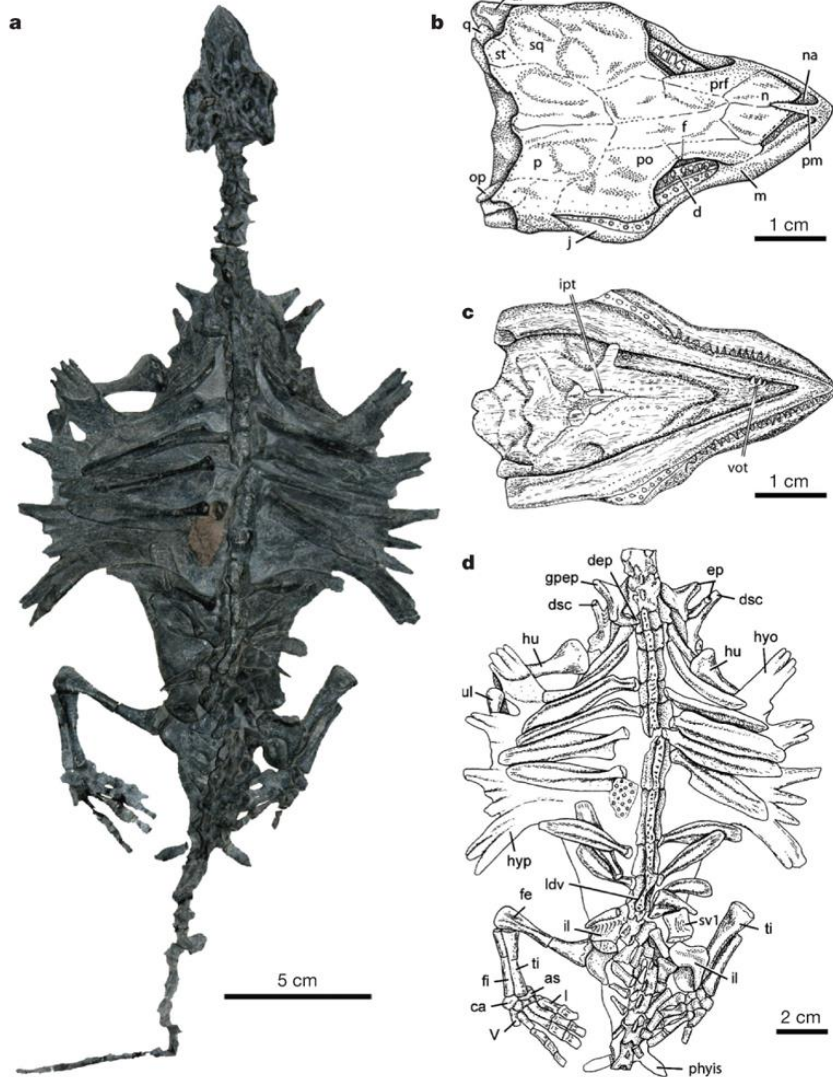
Chelonii (Triássico sup. – Recente)



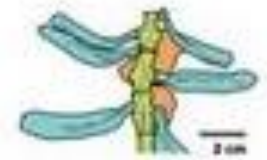
Odontochelys
(Carniano da China)

Chelonii (Triássico sup. – Recente)

Odontochelys: plastrão bem desenvolvido e costelas expandidas



Odontochelys semitestacea

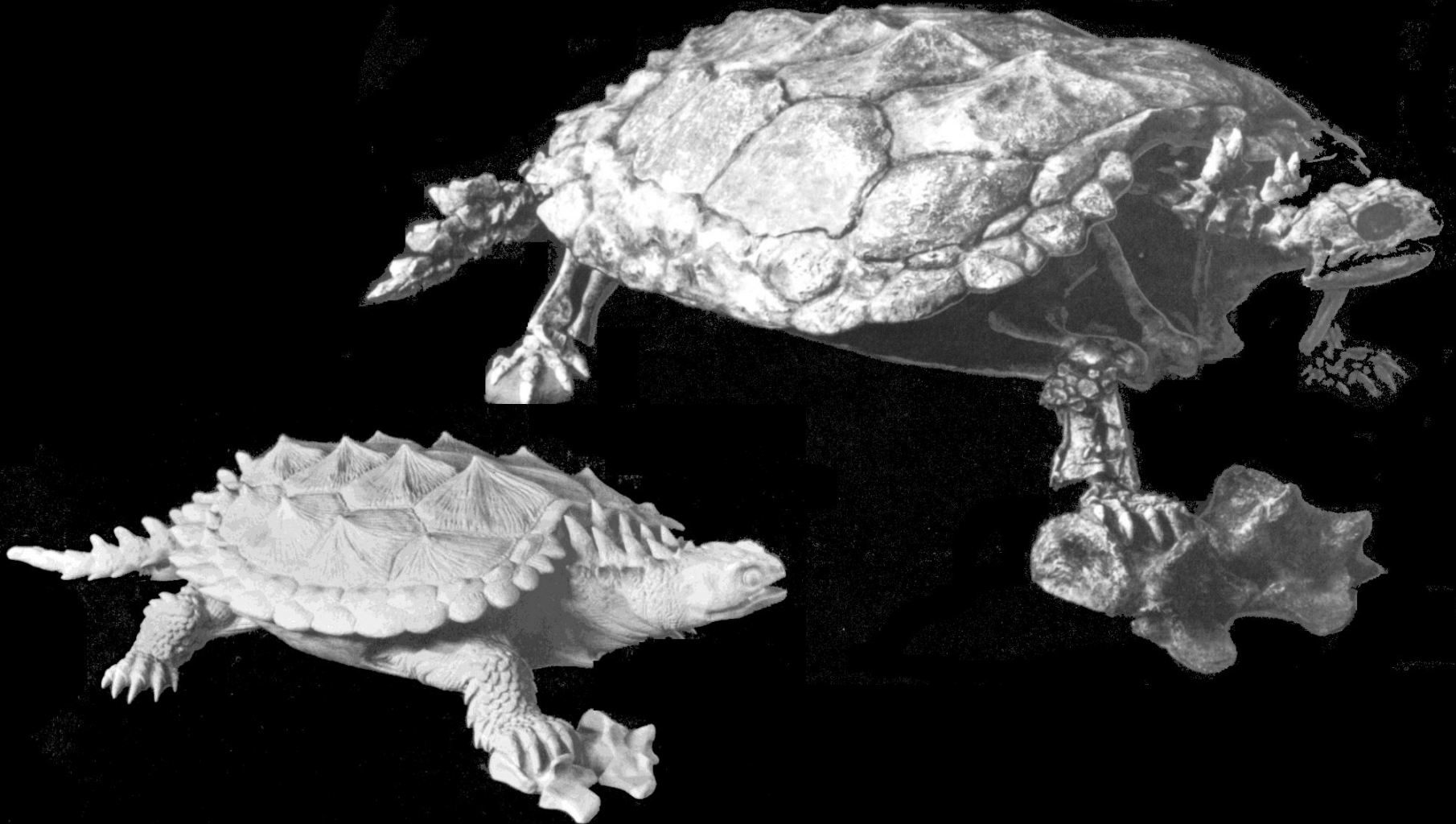


- | | | |
|------------|-------------------------|-------------|
| = ribs | = appendicular skeleton | = neural |
| = plastron | = vertebrae | = vertebrae |
| = ulnarans | = skull | = ribs |

Chelonii (Triássico sup. – Recente)

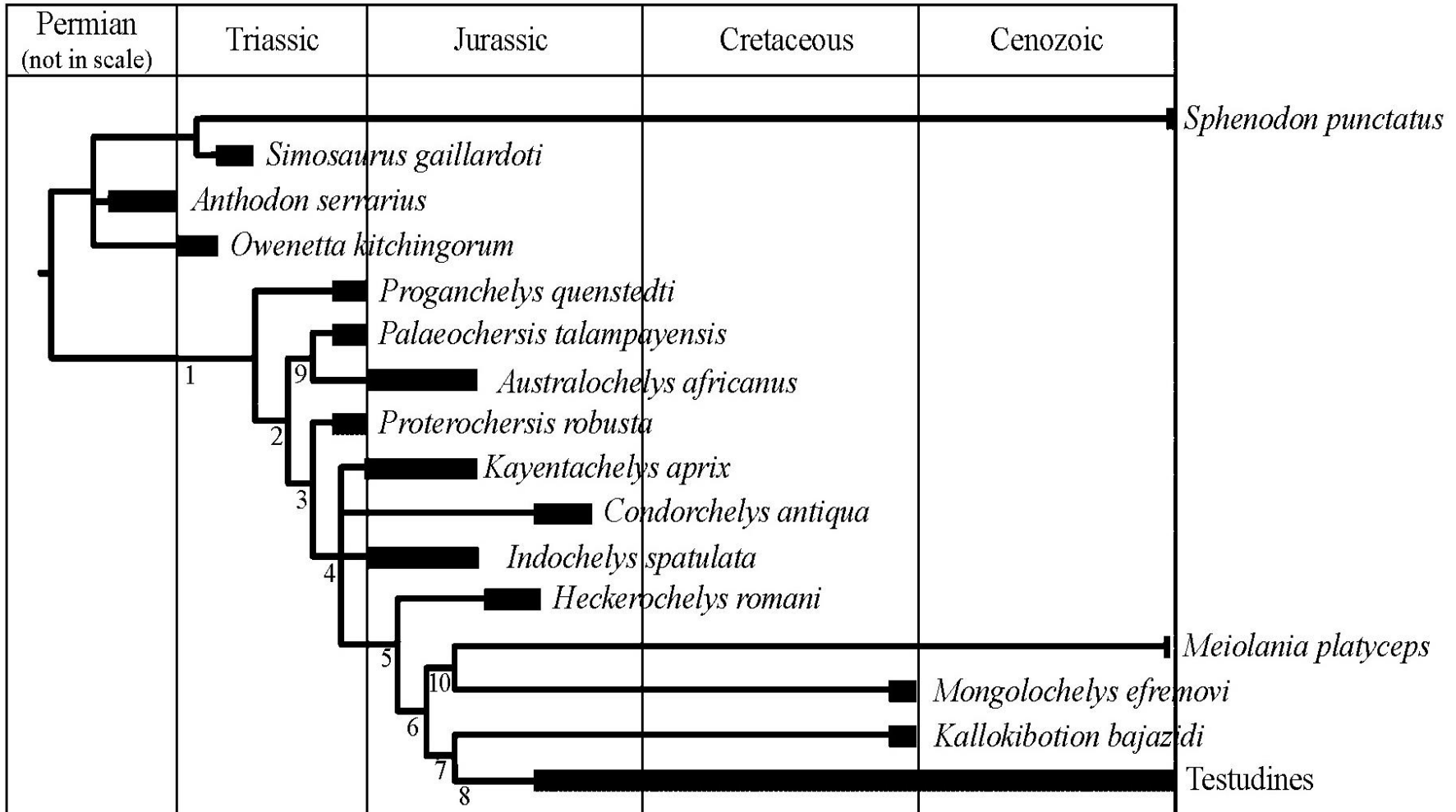
Proganochelys quenstedti (Triássico sup., Alemanha)

Caractere primitivo: cauda longa com osteodermas

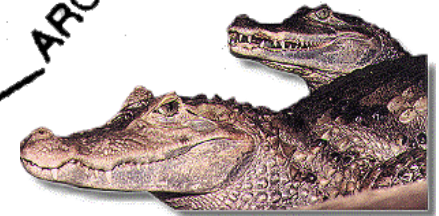
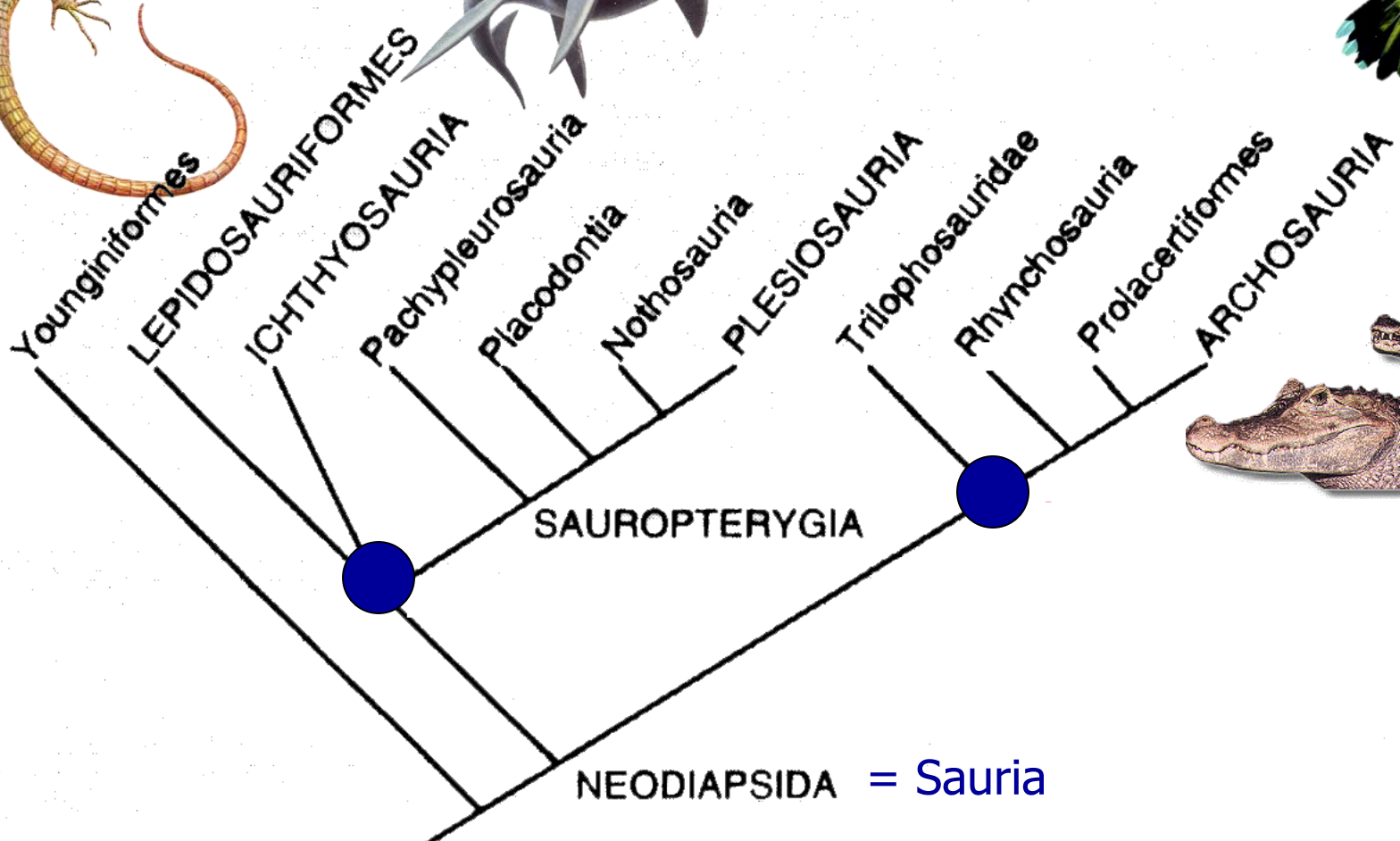
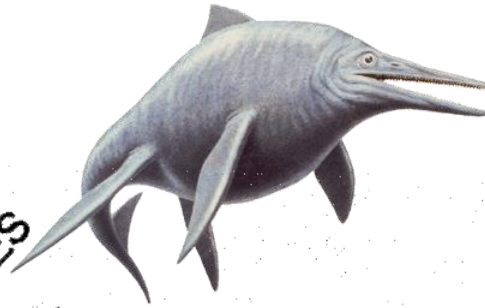


Testudines (Jurássico sup. – Recente)

Pleurodia & Criptodira



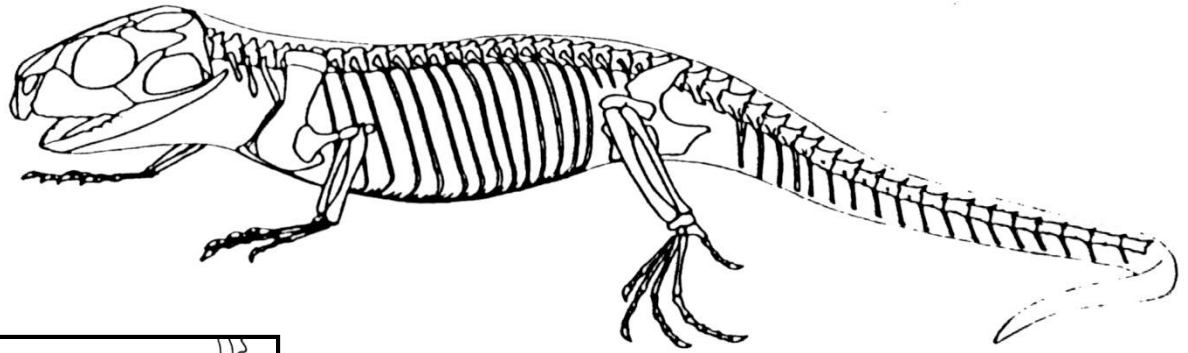
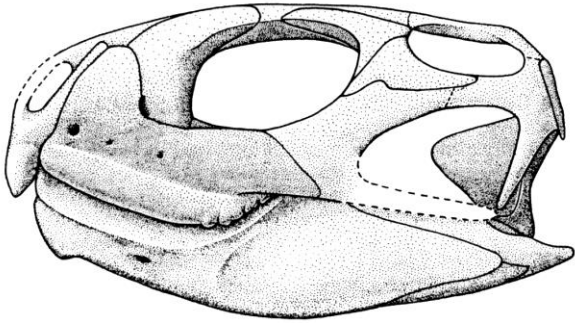
Sauria (Permiano sup. – Recente)



Dois grandes grupos: Lepidosauromorpha e Archosauromorpha

Sphenodontia (Triássico sup. – Recente)

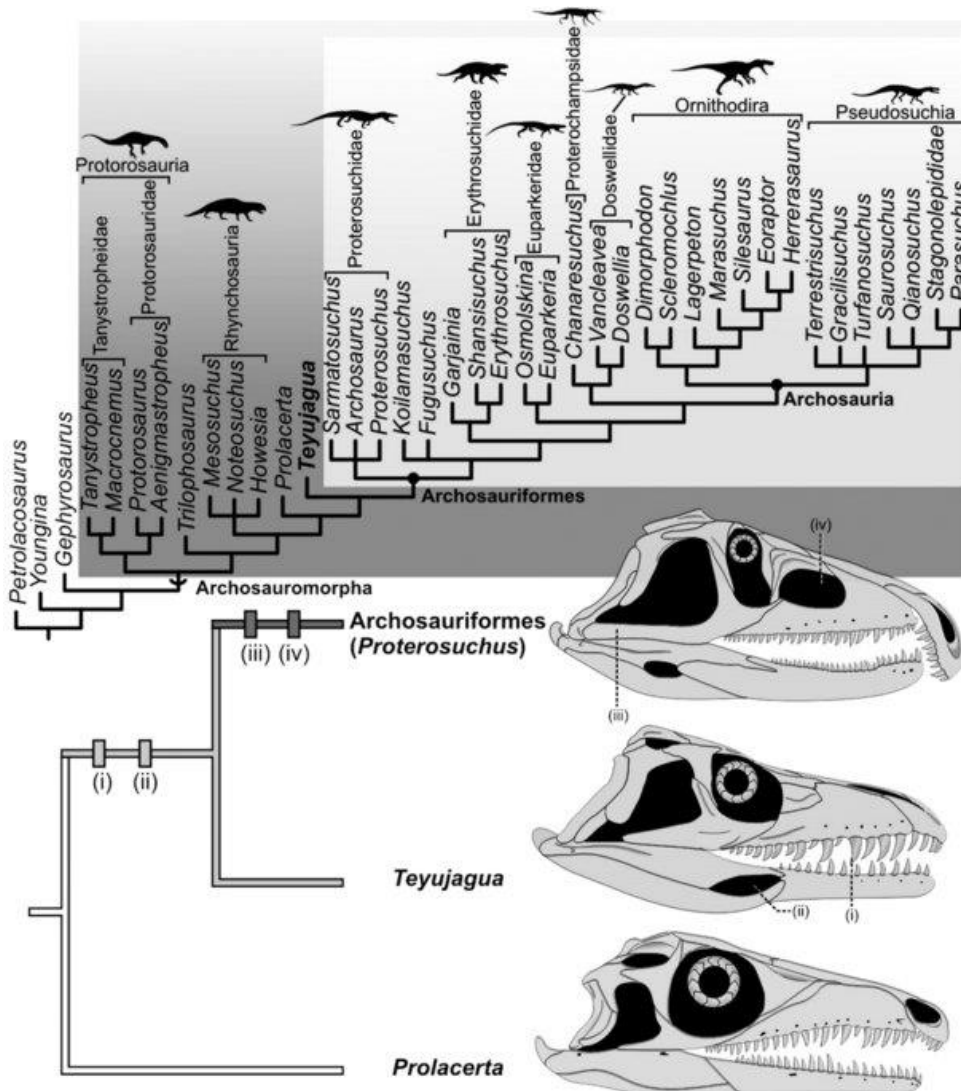
Clevosaurus: surge no Triássico sup. (Inglaterra, ?Brasil),
alcança distribuição cosmopolita no Jurássico inf.



Jurássico de Nova Scotia, Canadá

"Archosauria" (Permiano sup. – Recente)

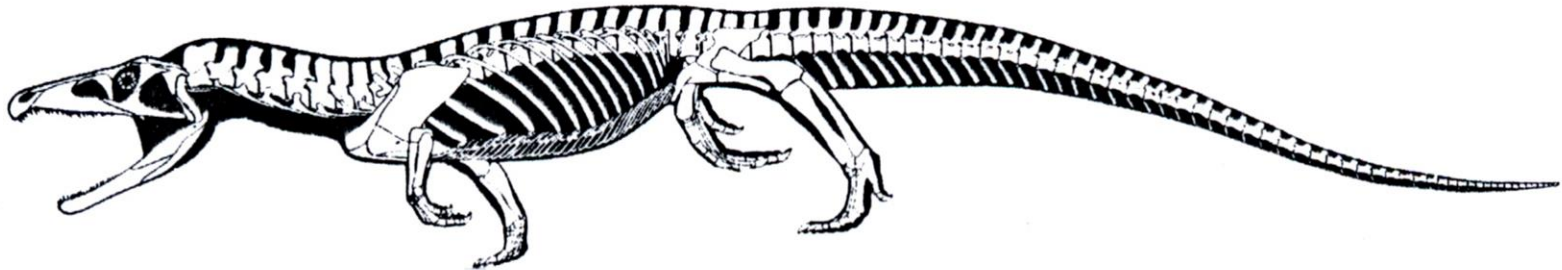
Teyujagua (Triássico inf., Brasil)



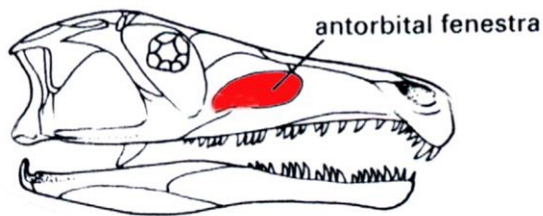
Archosauriformes (Permiano sup. – Recente)

Formas basais: Proterosuchidae (Permiano sup. – Triássico médio)

Grupo mais basal de arcossauros, inclui *Archosaurus*



Proterosuchus (= *Chasmatosaurus*)
Triássico inf., Bacia do Karoo



10 cm

“Crown-Group” Archosauria (Triássico médio - Recente)

Definição filogenética: “Todos descendentes do ancestral comum mais recente de Aves e Crocodilos”

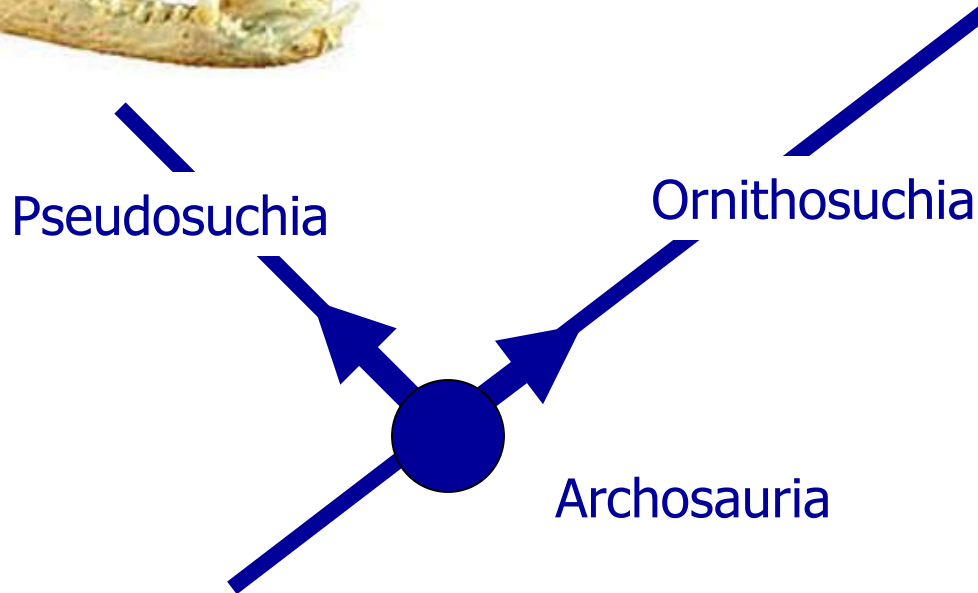


Pseudosuchia



Ornithosuchia

Archosauria

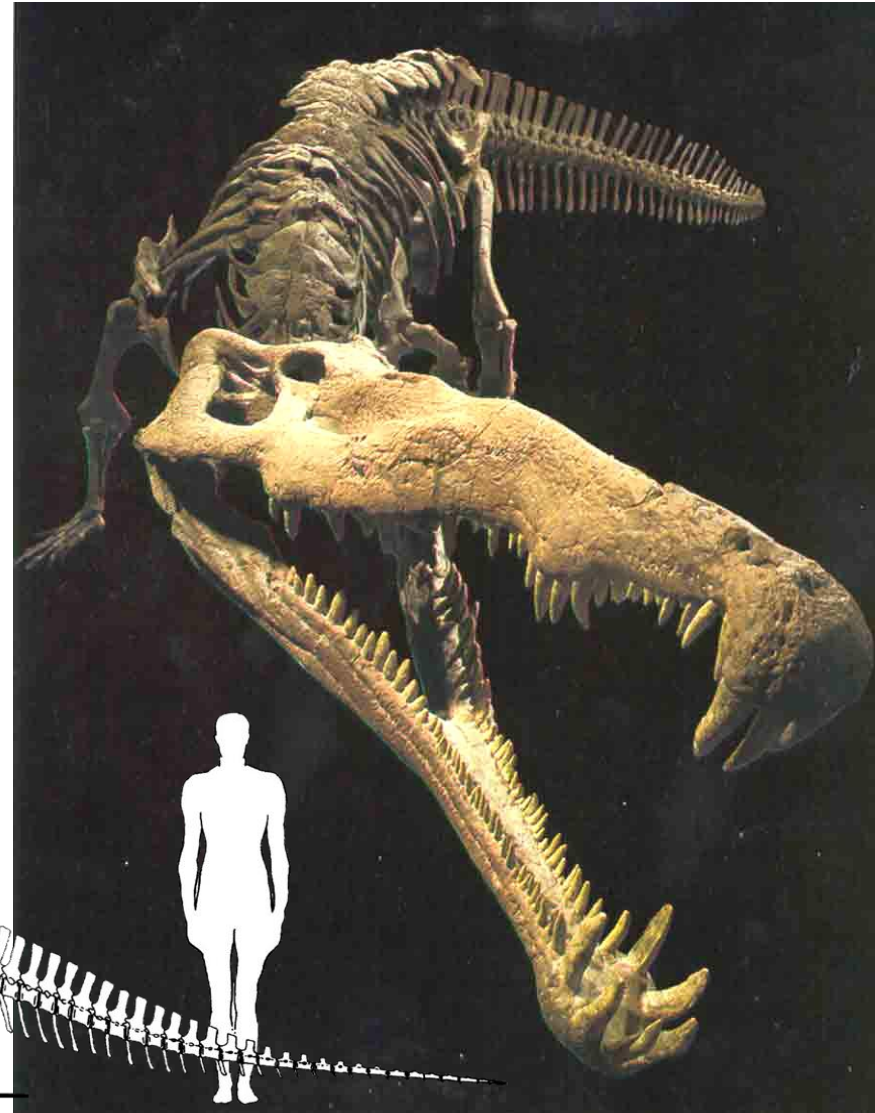
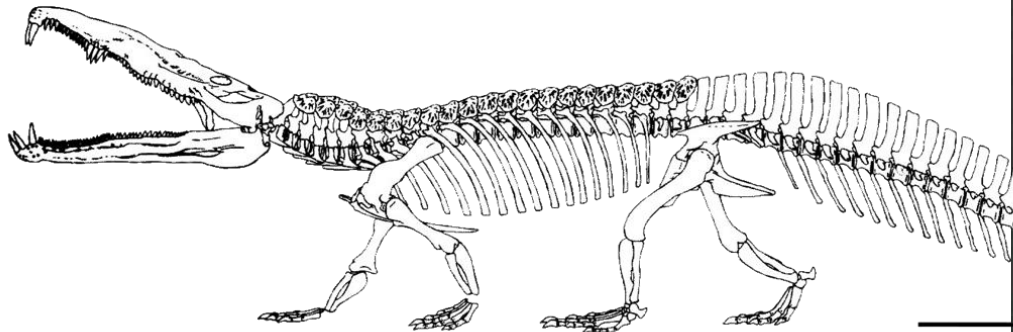


Pseudosuchia (Triássico médio – Recente)

Grupos basais: Parasuchia = Phytosauria (Triássico sup.)

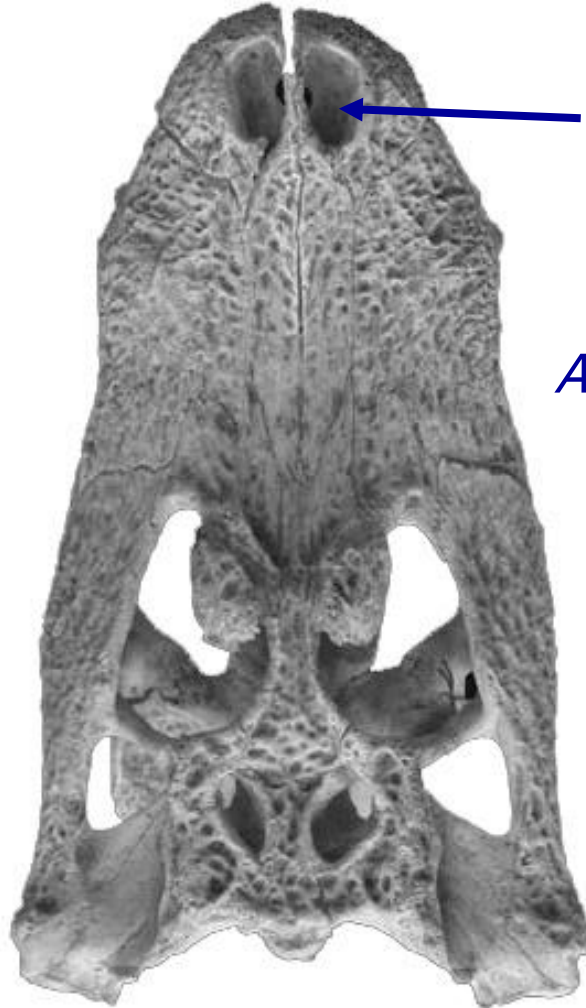


Pseudopalatus, Fm. Chinle (EUA)

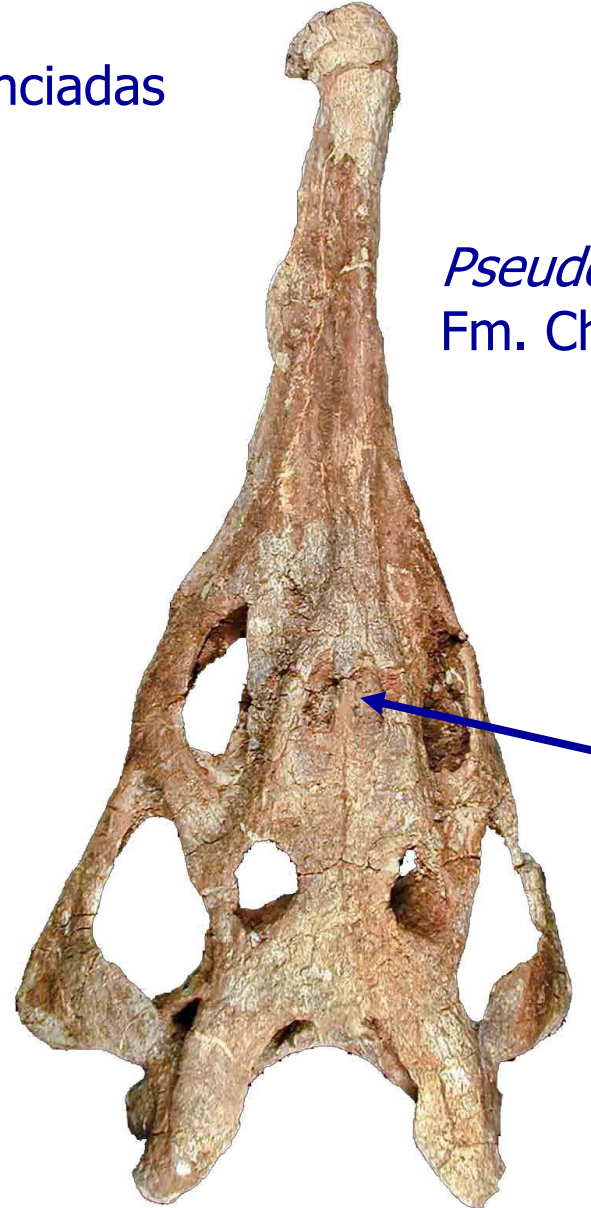


Pseudosuchia (Triássico médio – Recente)

Narinas externas em posições diferenciadas



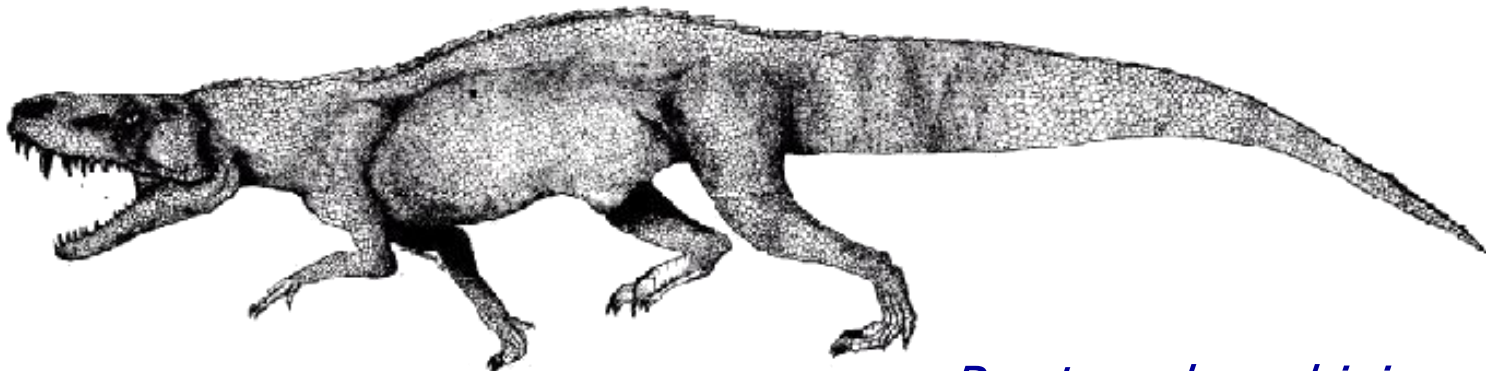
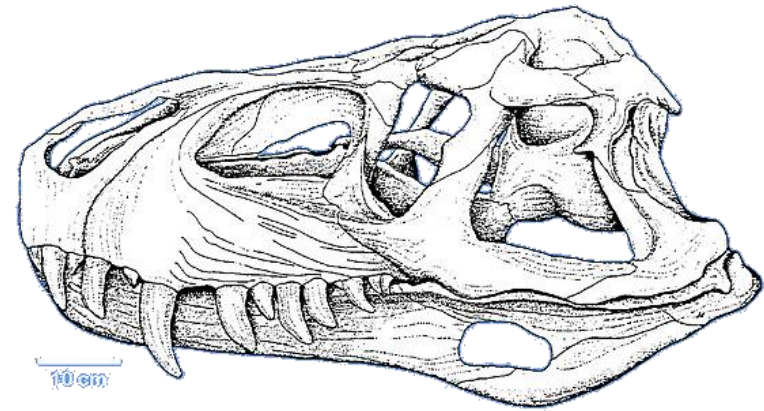
Alligator



Pseudopalatus
Fm. Chinle (EUA)

Suchia (Triássico médio – Recente)

Rauisuchia (Triássico médio-sup.)



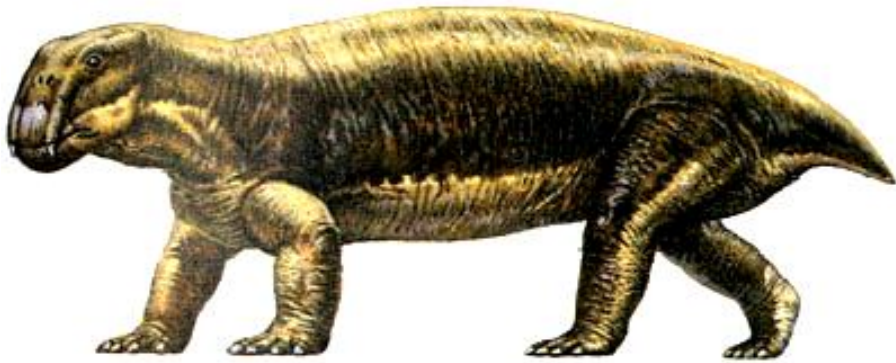
Prestosuchus chiniquensis
Região de Chiniquá (Ladiniano)



Dicynodontia (Permiano sup. – Triássico sup.)

Lystrosaurus (Triássico inf.) possível táxon irmão de Kannemeyeriidae

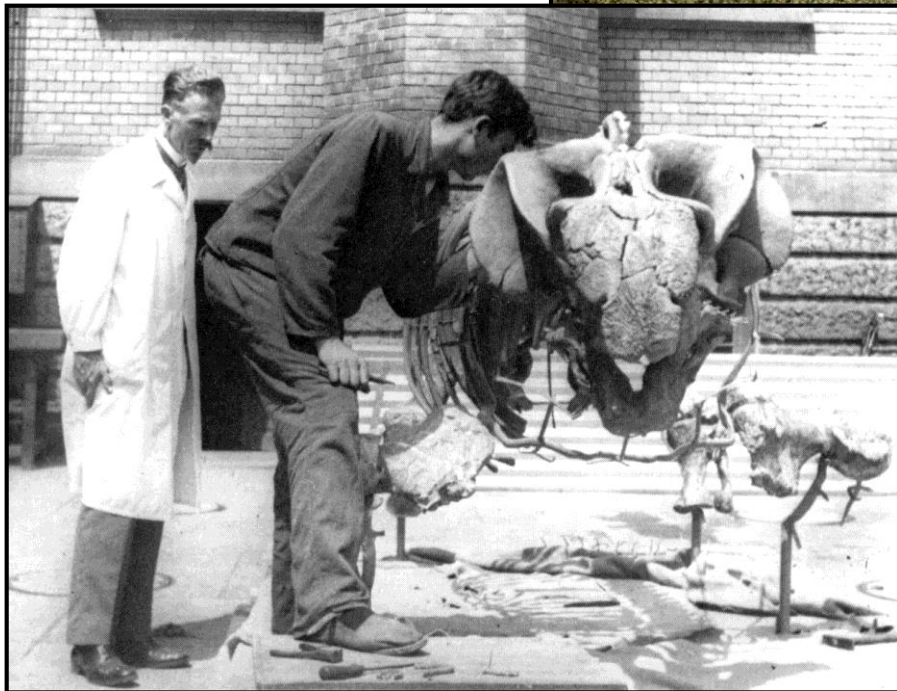
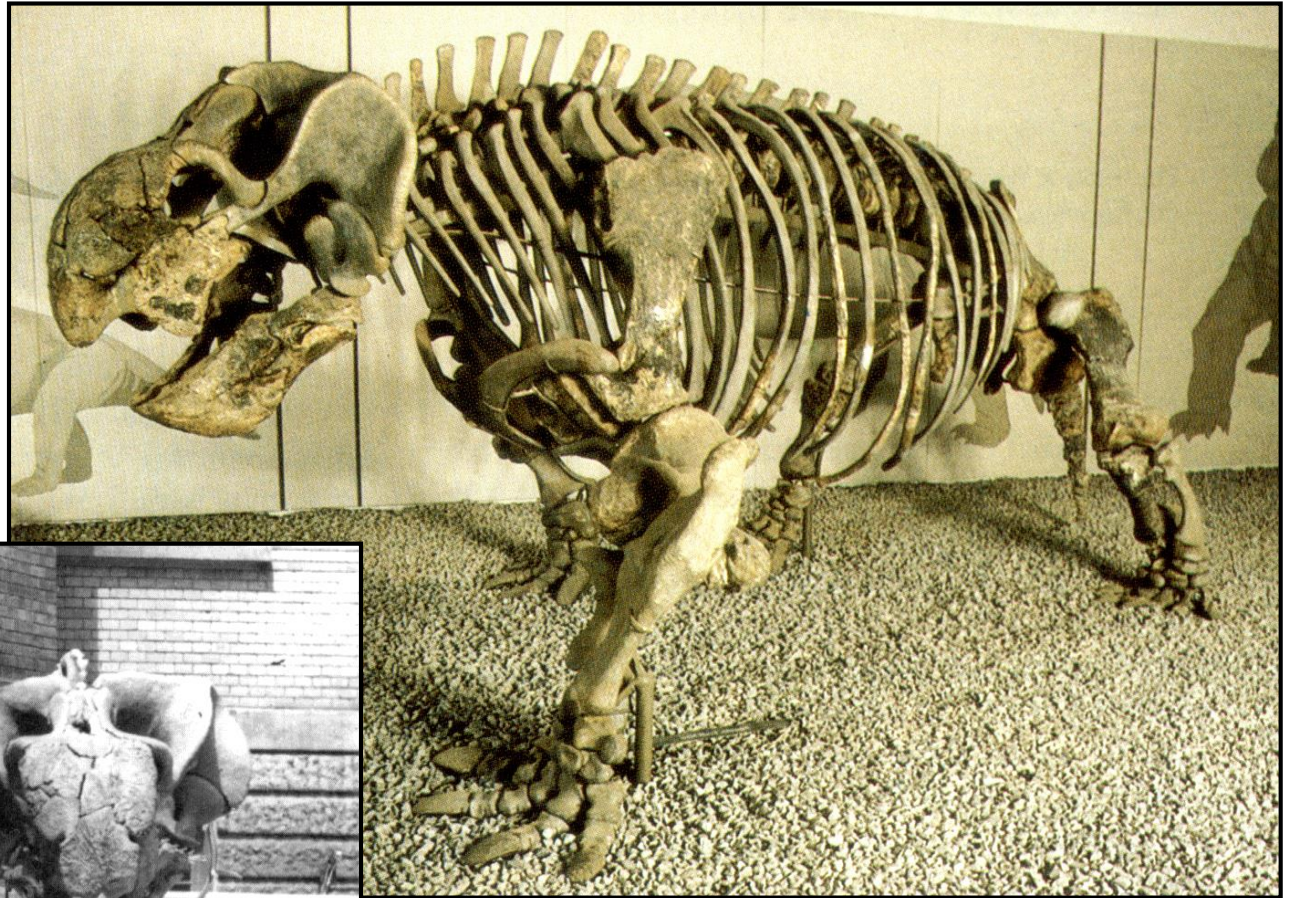
Amplamente distribuído no Gondwana após a extinção Permo-Triássica



Lystrosaurus (Triássico inf.)



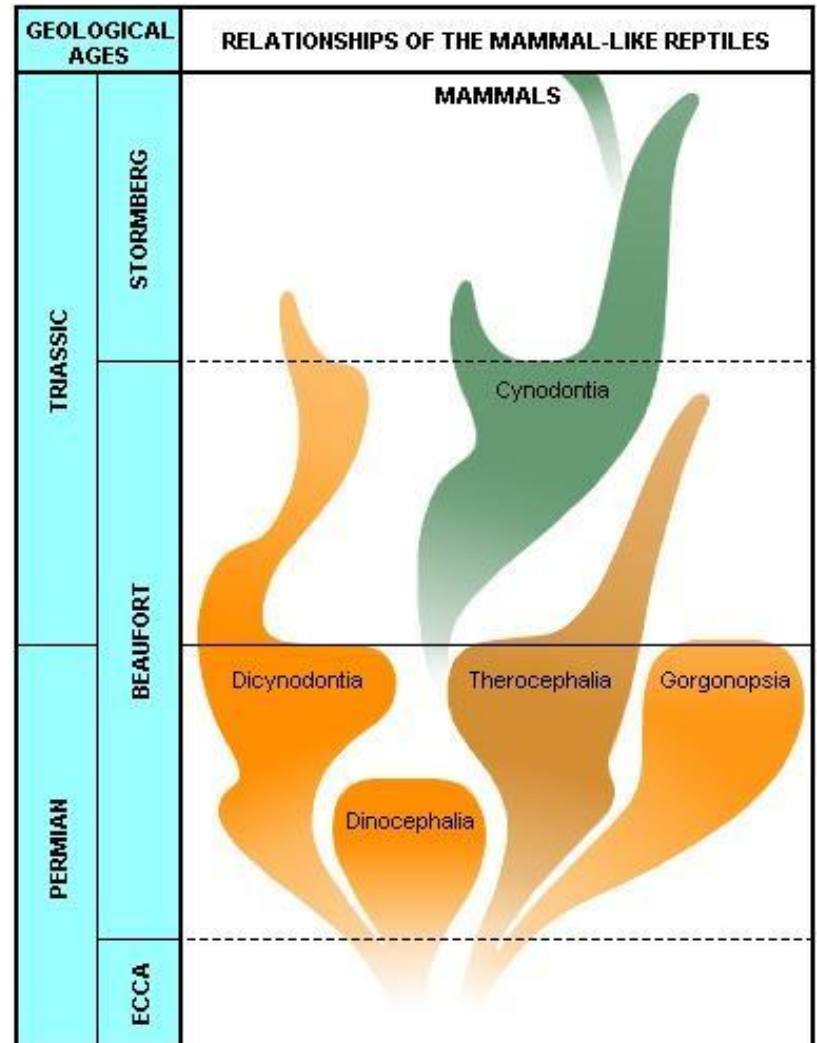
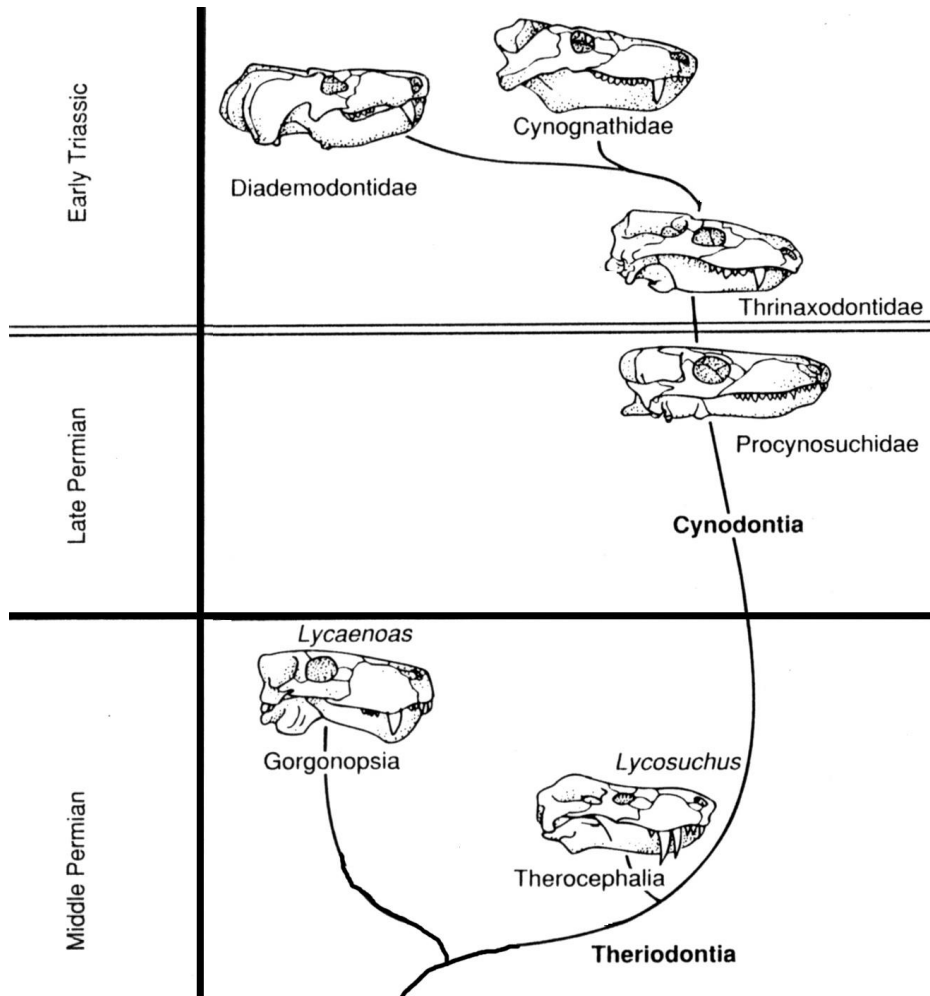
Dicynodontia (Permiano sup. – Triássico sup): no Brasil



Stahlekeria (Triássico médio,
Fm. Santa Maria, RS)

Therapsida (Permiano inf. – Recente)

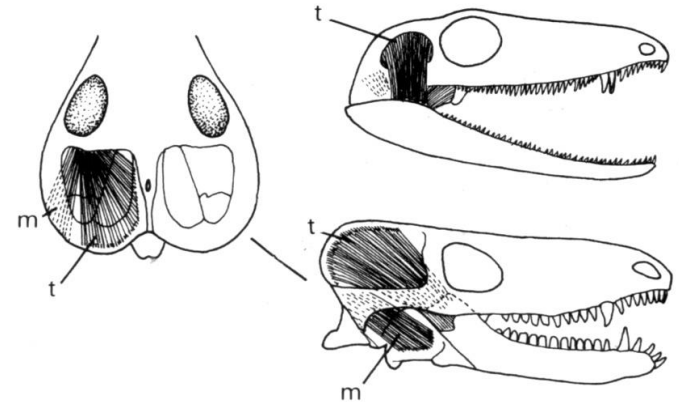
Cynodontia (Permiano sup. – Recente)



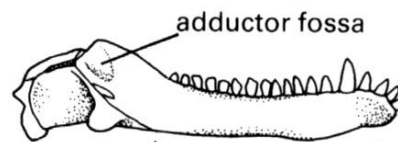
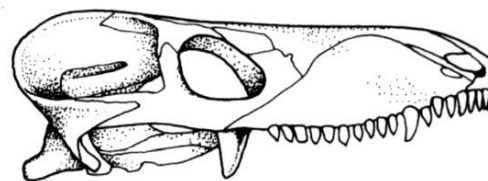
Therapsida (Permiano inf. – Recente)

Cynodontia (Permiano sup. – Recente)

- Adaptações para maior eficiência adutora: 1 - Crista sagital marcada
2 - Processo coronóide do dentário alongado com fossa adutora
3 - Arco zigomático expandido (mais espaço para os adutores)

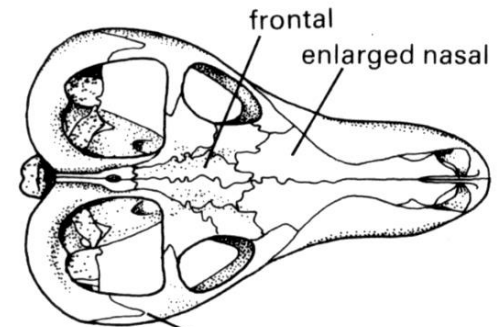


Procynosuchus



adductor fossa

enlarged dentary



frontal

enlarged nasal

flared zygomatic arch

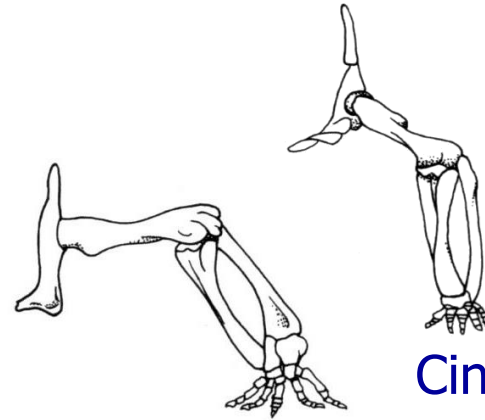
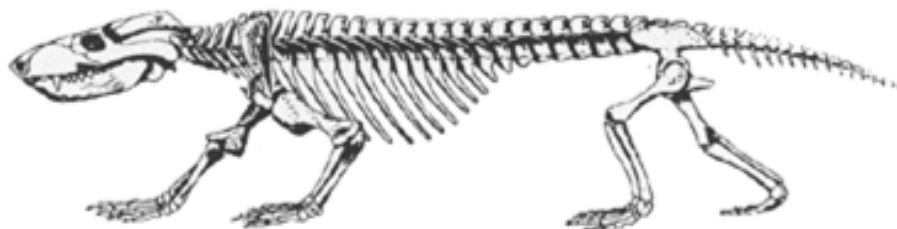
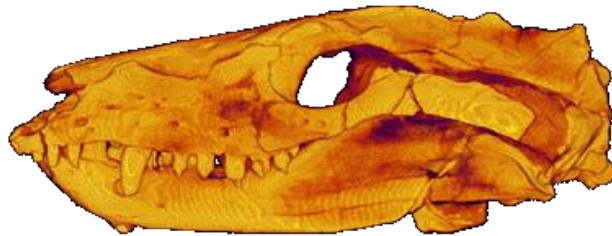
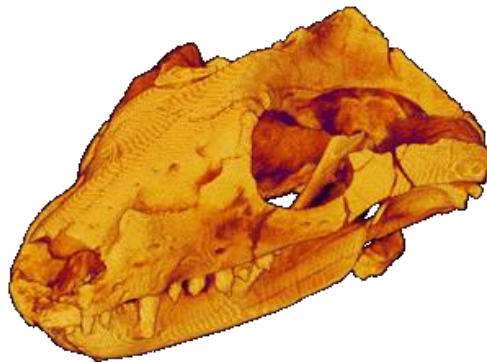


Cynodontia (Permiano sup. – Recente)

Thrinaxodon (Triássico inf. da África do Sul e Antártica)

Separação entre vértebras torácicas e lombares: evidencia de diafragma

Membros mais eretos (*semi-erect*)



Cinodonte

Pelicossáuro



Cynodontia (Permiano sup. – Recente)

Chiniquodontidae (Triássico médio – sup), América do Sul

No Brasil: Fauna muito rica na Fm. Santa Maria (RS)



Trucidocynodon

Cynodontia (Permiano sup. – Recente)

Termoregulação em pró-mamíferos: miniaturização e *pelicosaur bottleneck*

Uma vez homeotermos (pelicossauros), a redução de tamanho (vista em vários cinodontes) não se expressaria sem mecanismos de manutenção da temperatura (insulação e endotermia)



Diarthrognathus

Chalimnia
(Triássico sup., Argentina)

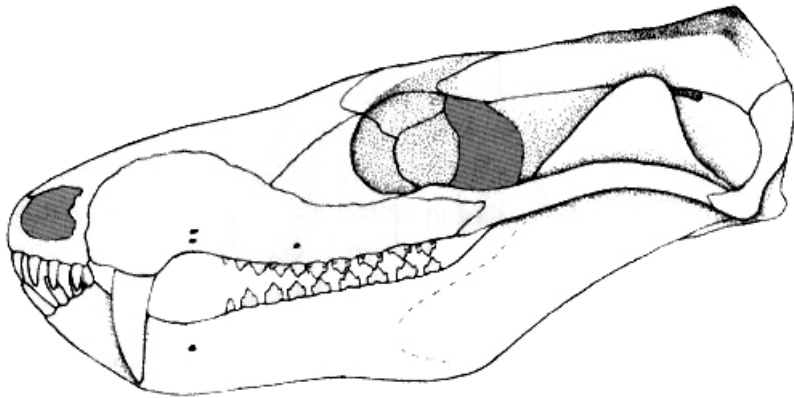


Cynodontia (Permiano sup. – Recente)

Outros cinodontes Brasileiros pró-Mammalia

Grupos irmãos de Mammalia: *Brasilodon* e *Brasilterium* (Fm. Caturrita)

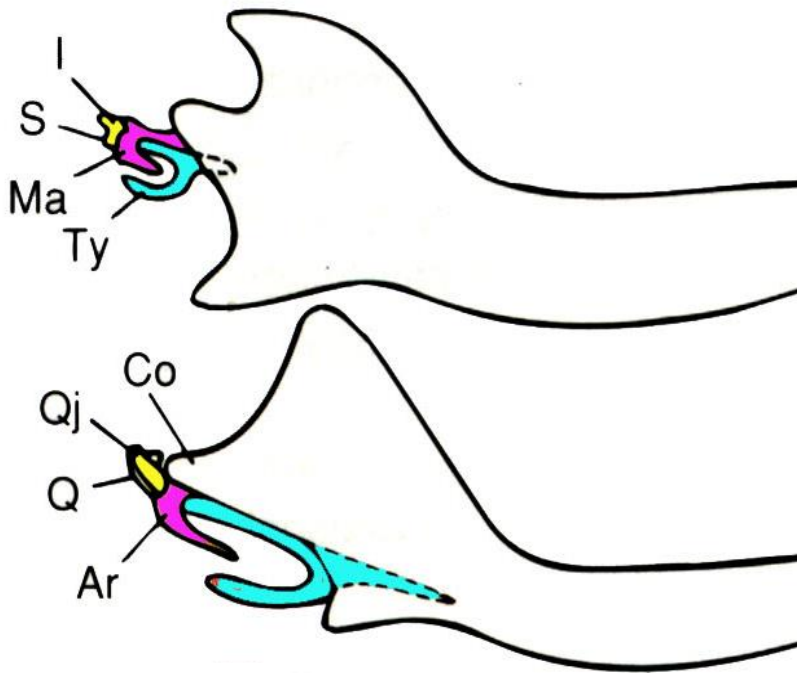
Brasilterium



Brasilodon

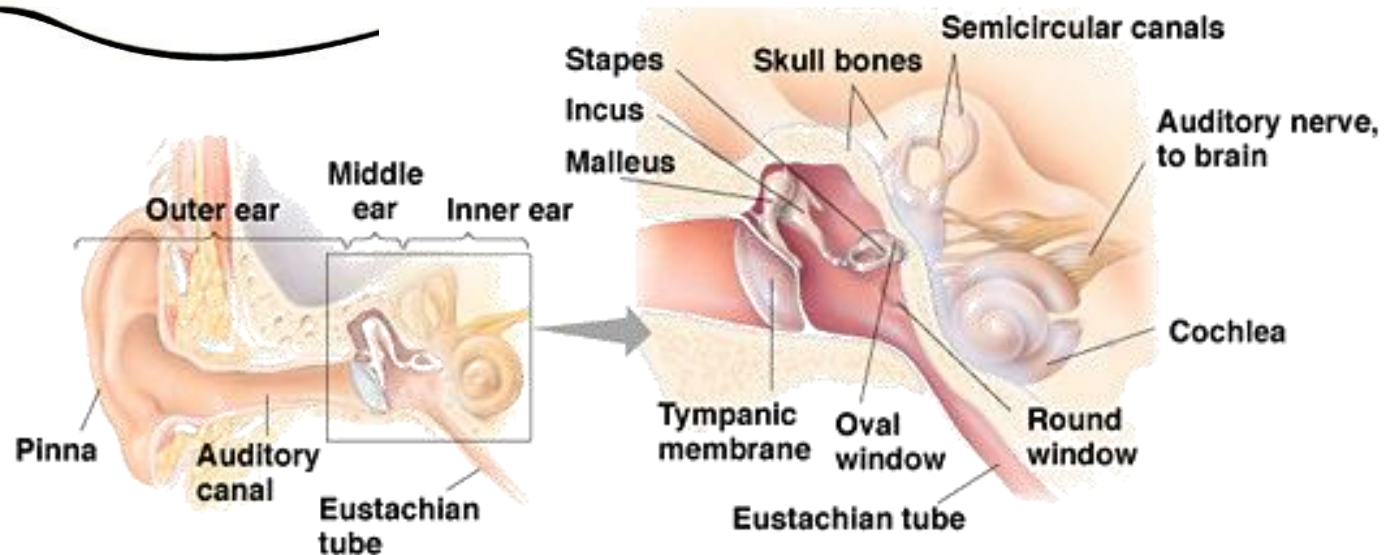


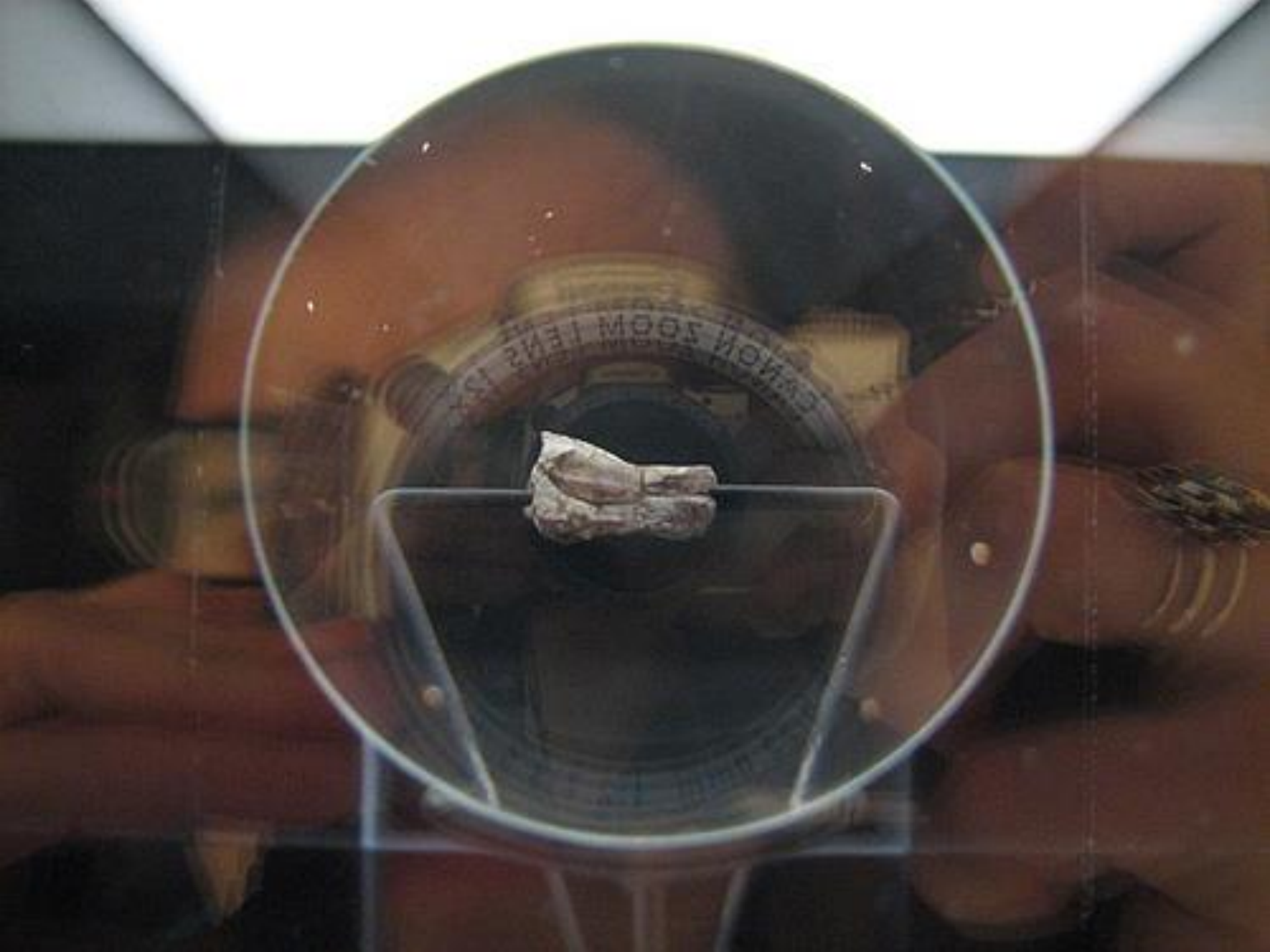
Mammalia (Triássico sup. – Recente)



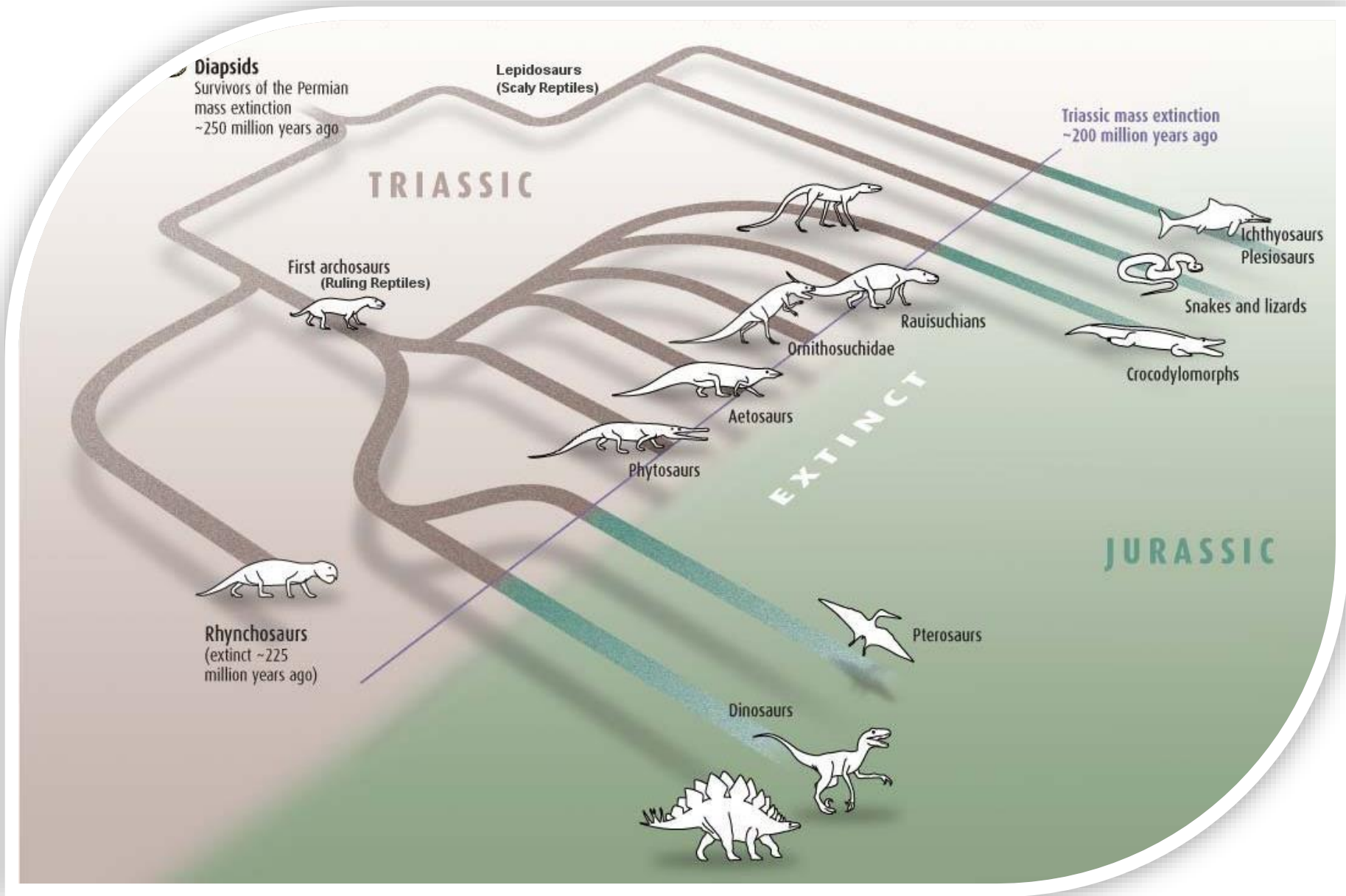
Formação do ouvido médio
surangular desaparece

Quadrado se transforma em bigorna
articular em martelo
angular no anel timpânico



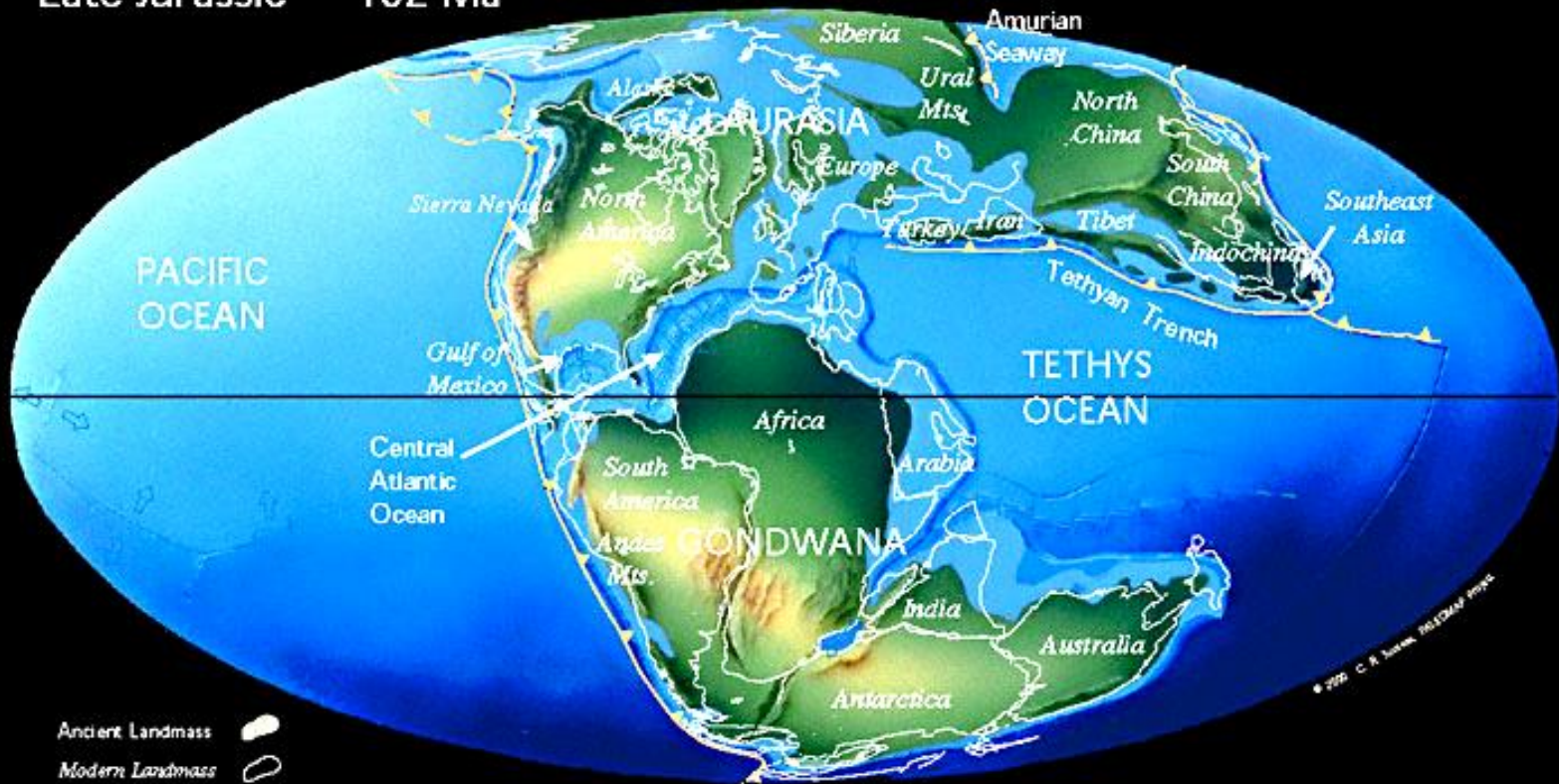


Extinção Triássico- Jurássico



À partir do Jurássico, ca. 150 Ma, os movimentos de separação passam a predominar e o Pangea se desfaz
Inicialmente a abertura do Mar de Tethys separa o Gondwana da Laurásia

Late Jurassic 152 Ma



Ancient Landmass

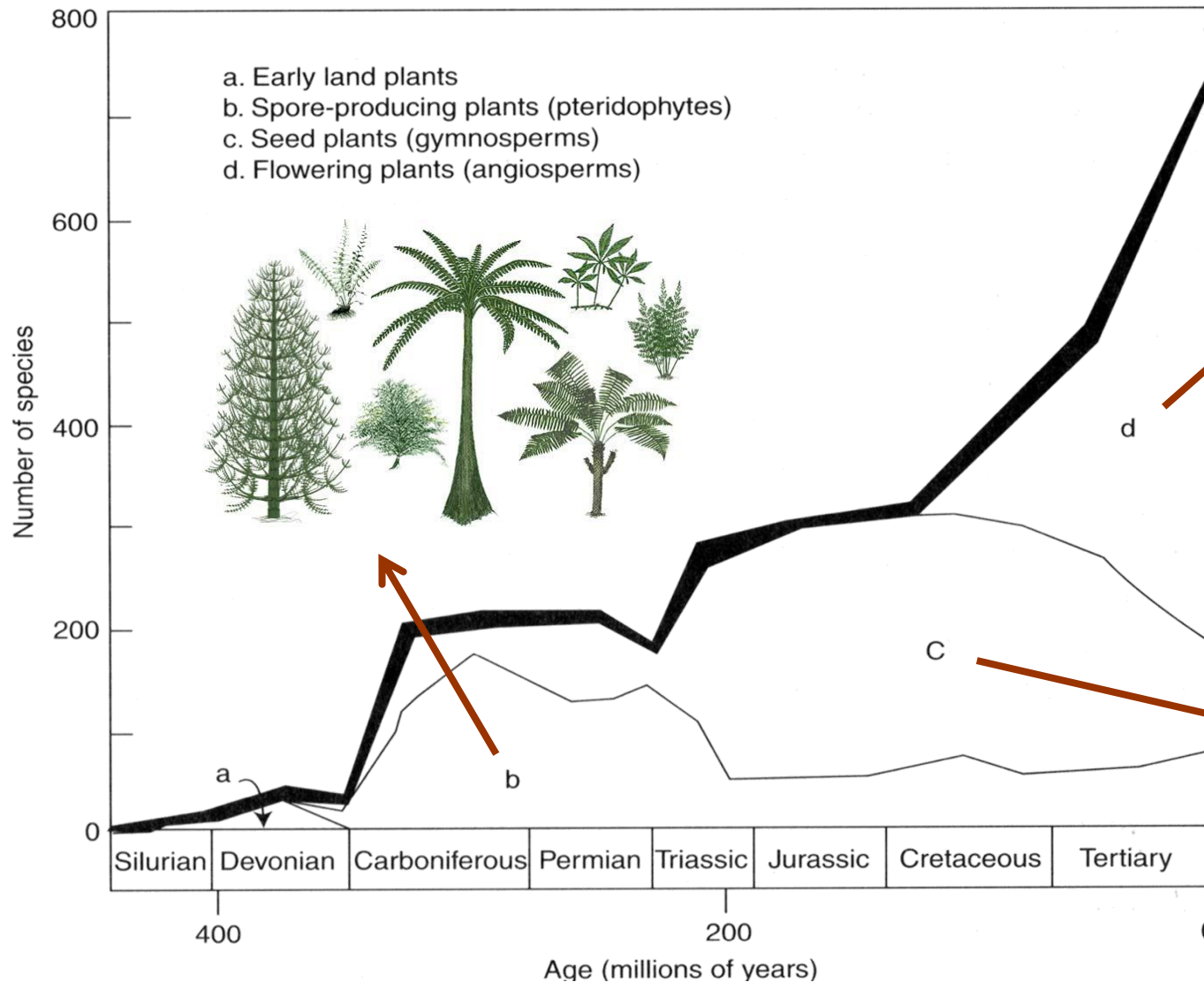
Modern Landmass

Subduction Zone (triangles point in the direction of subduction)

Sea Floor Spreading Ridge

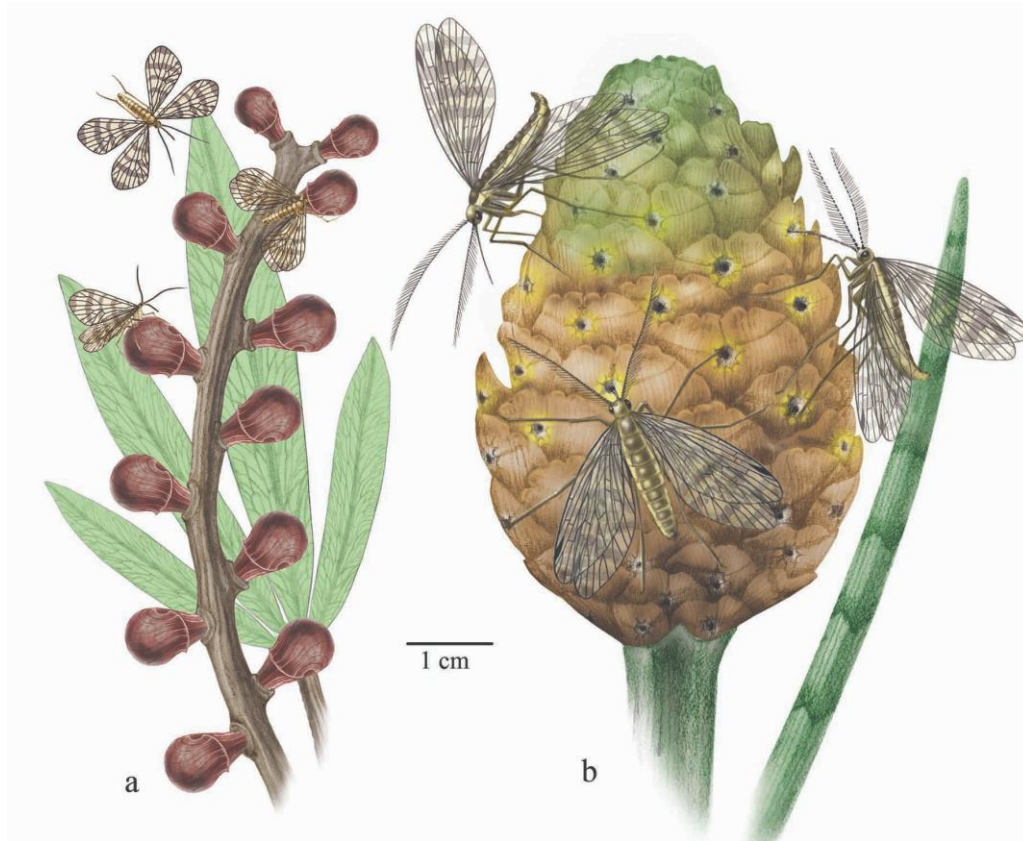
© 2000 C. R. Scotese, PALEOMAP Project

Plantas: domínio das gimnospermas





Lichnomesopsyche (Mecoptera do Jurássico da Cina): primeiro polinizador?

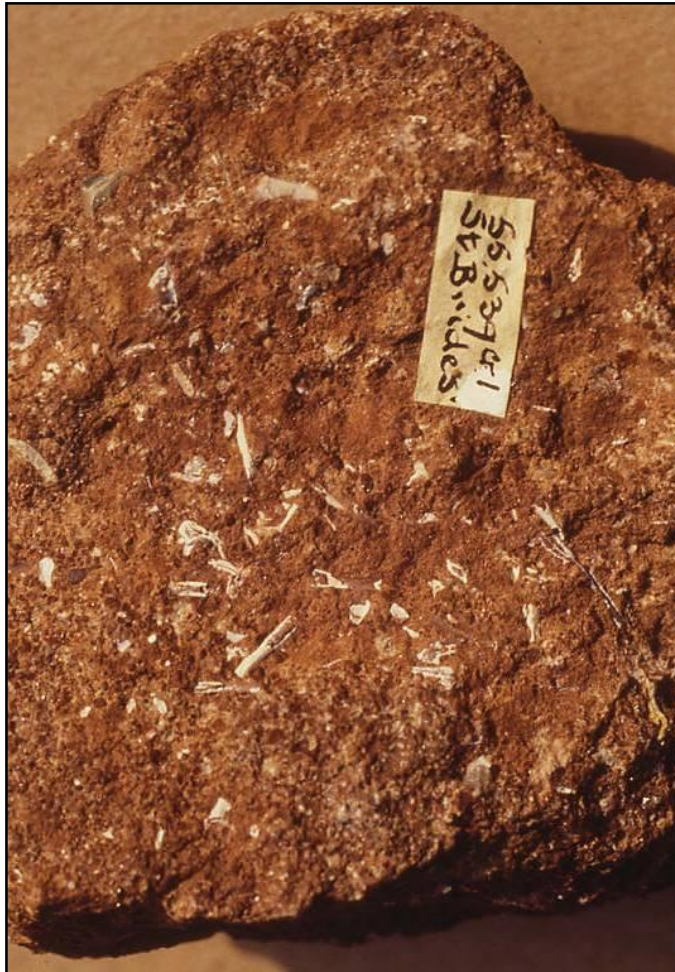


Gotas de pólen de *Caytonales*

Mammalia (Triássico sup. – Recente)

Morganucodontidae (Jurássico inf.)

Caracteres derivados: substituição difiodonte (possível amamentação)
e crescimento não contínuo

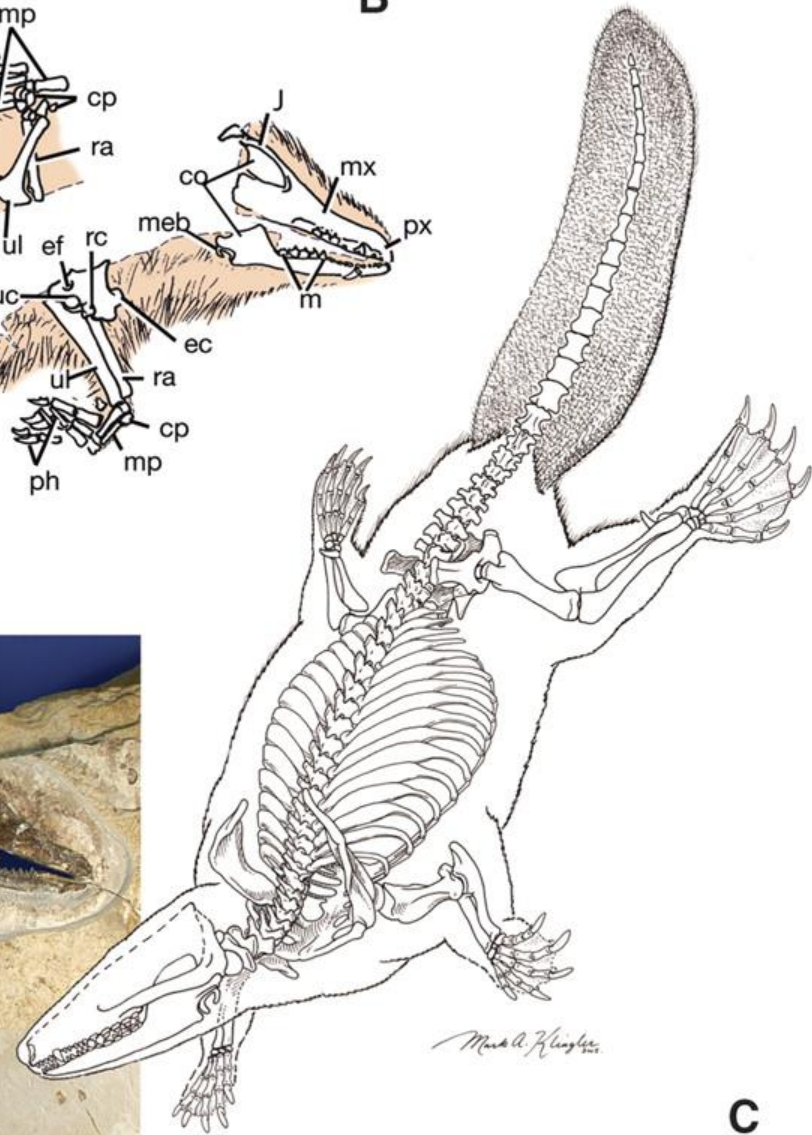
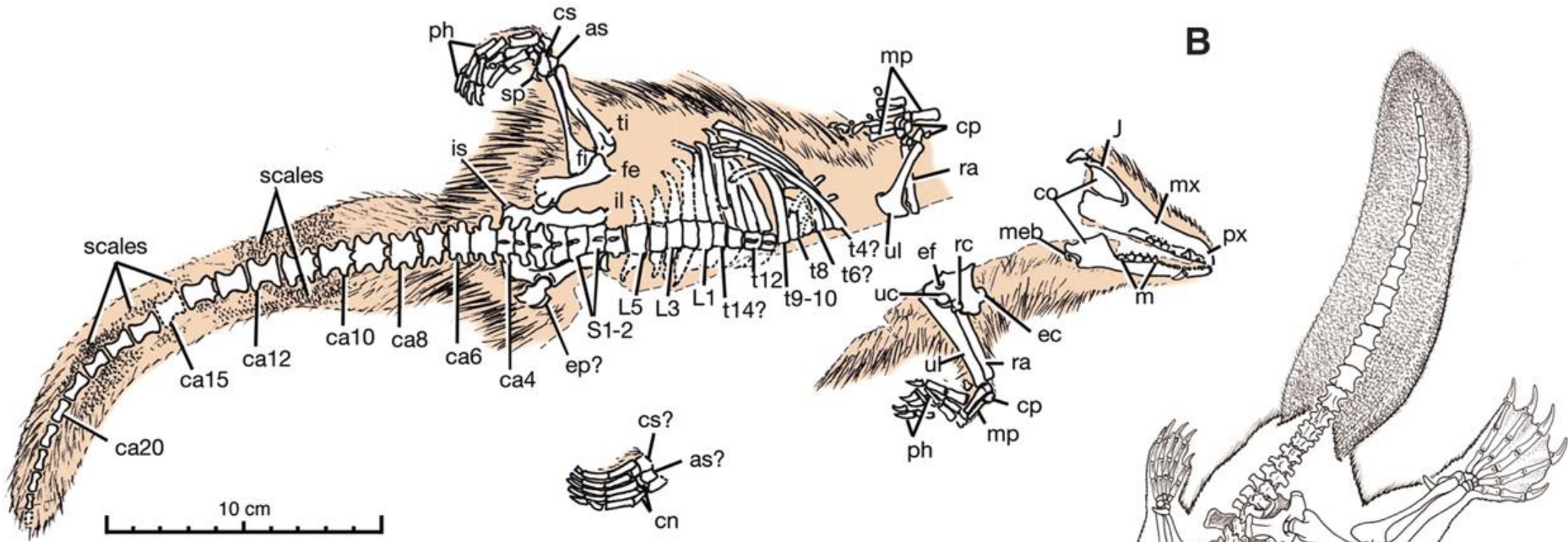


Hadrocodium
Jurássico sup., China

Distribuição bimodal de tamanho e padrão dentário em ampla amostra de *Morganucodon*

Mammalia (Triássico sup. – Recente)

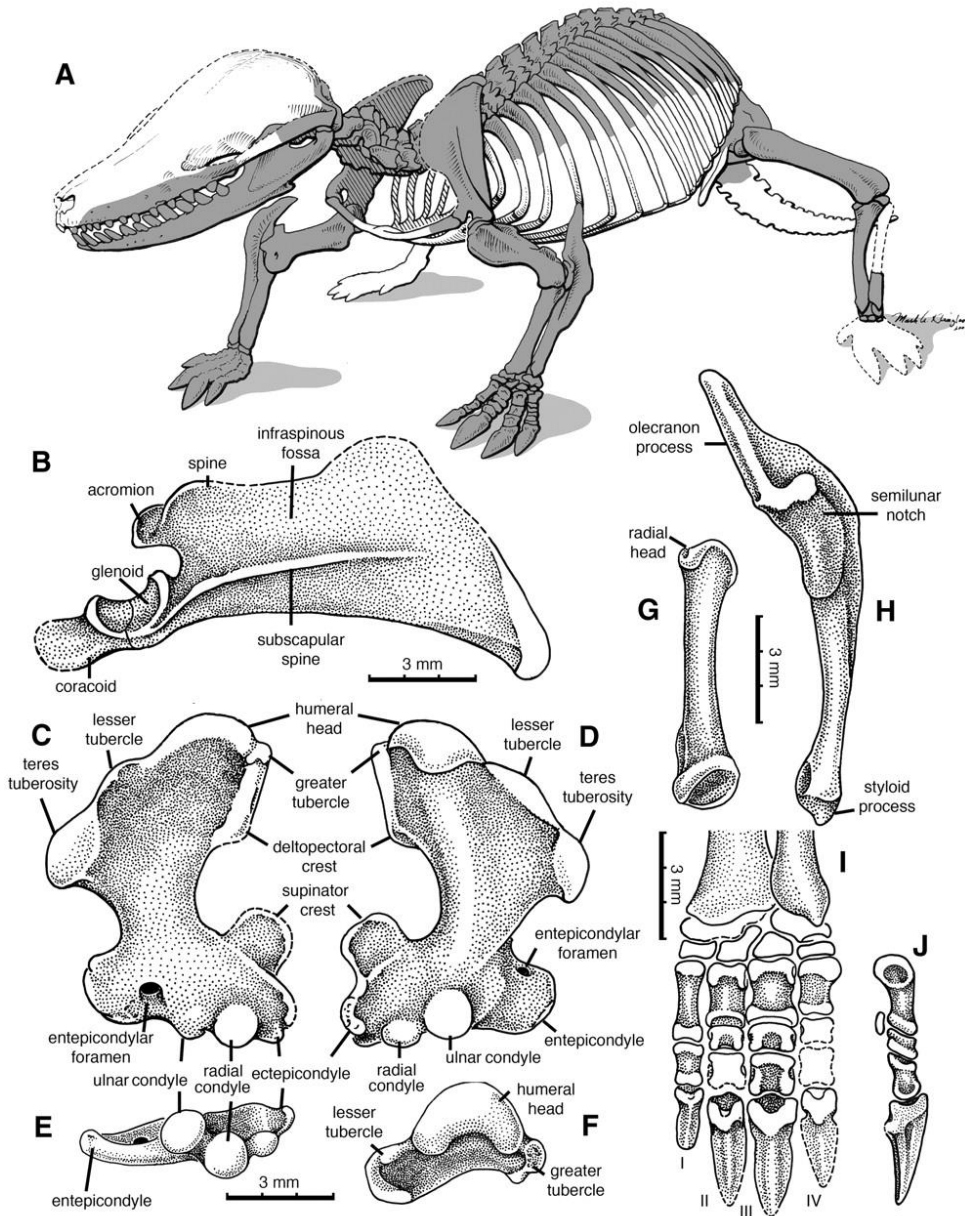
Castorocauda: docodonte aquático do Jurássico médio da China



Mammalia (Triássico sup. – Recente) - formas pró-Theria

Fruitafossor, Jurássico sup.
Formação Morrison (Colorado)

Forma fossorial na base da
linhagem pró-Theria

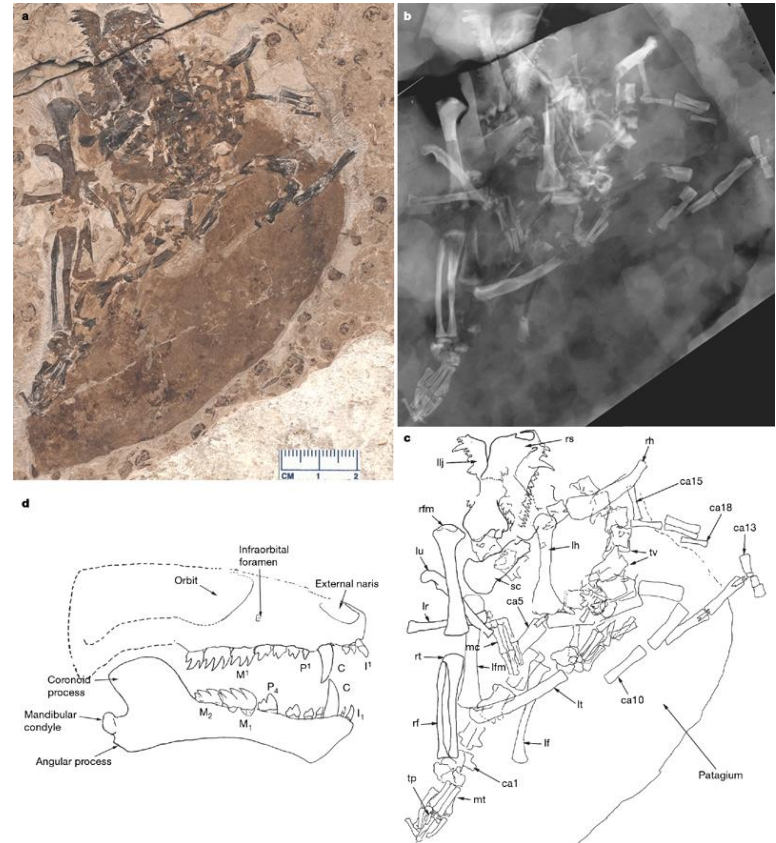


Mammalia (Triássico sup. – Recente) - formas pró-Theria



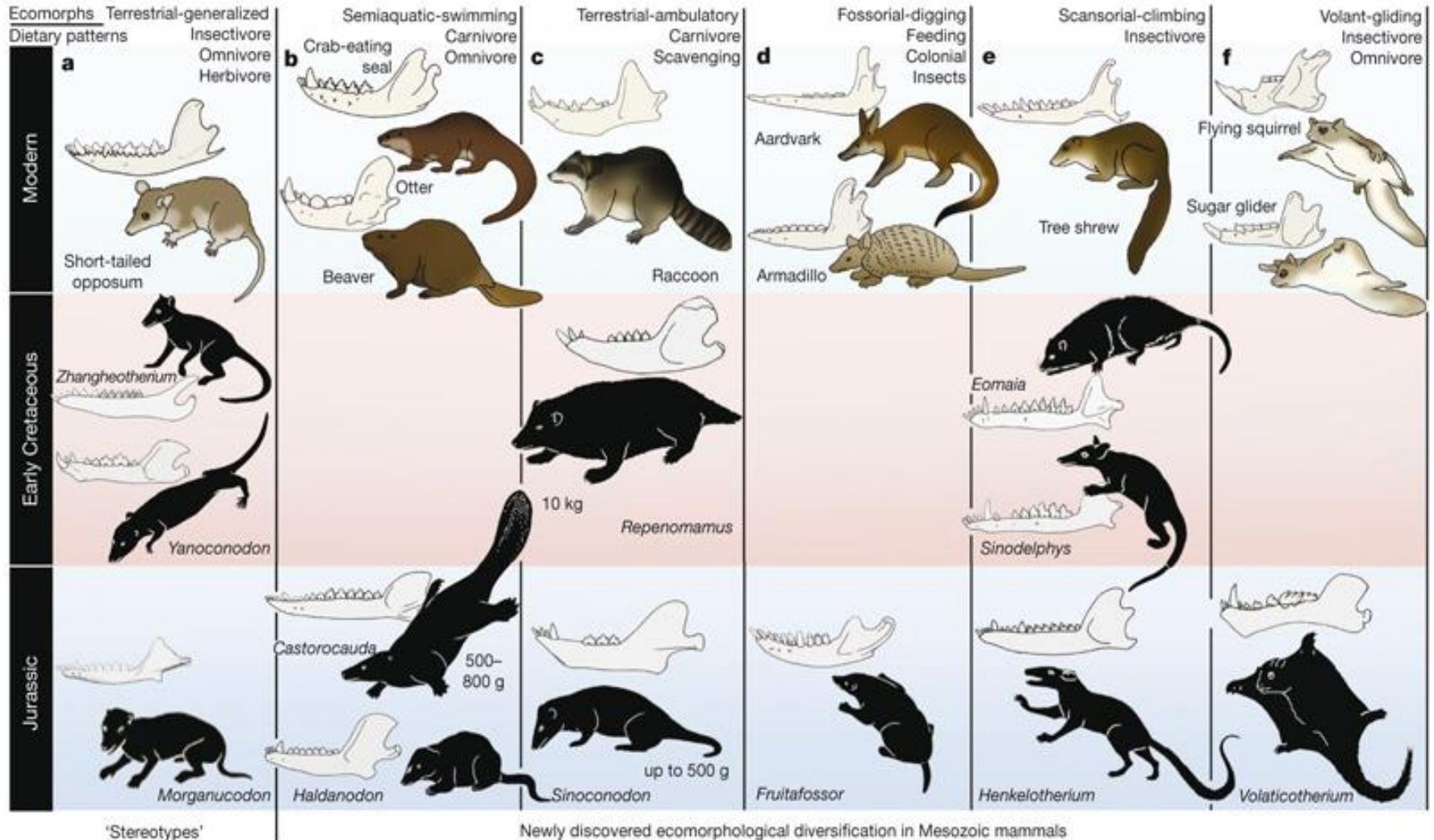
Volaticotherium, Jurássico sup.
Mongólia Interior (China)

Forma planadora na base da
linhagem pró Theria



Mammalia (Triássico sup. – Recente)

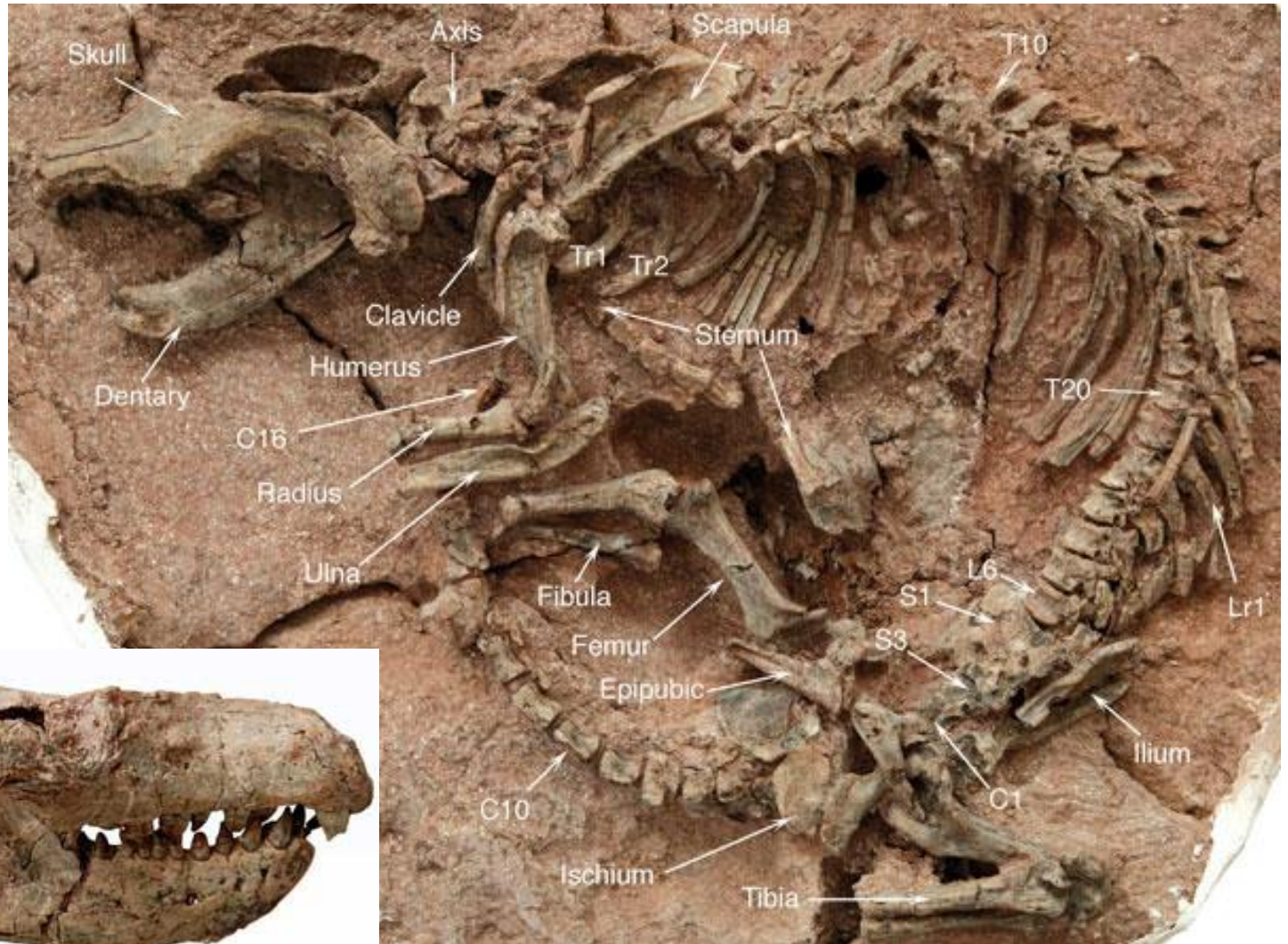
Ocupação de nichos no Juro-Cretáceo



Mammalia (Triássico sup. – Recente) - formas pró-Theria

Triconodonta (Jurássico médio – Cretáceo sup.)

Repenomamus (Cretáceo inf. de Liaoning), carnívoro de médio porte



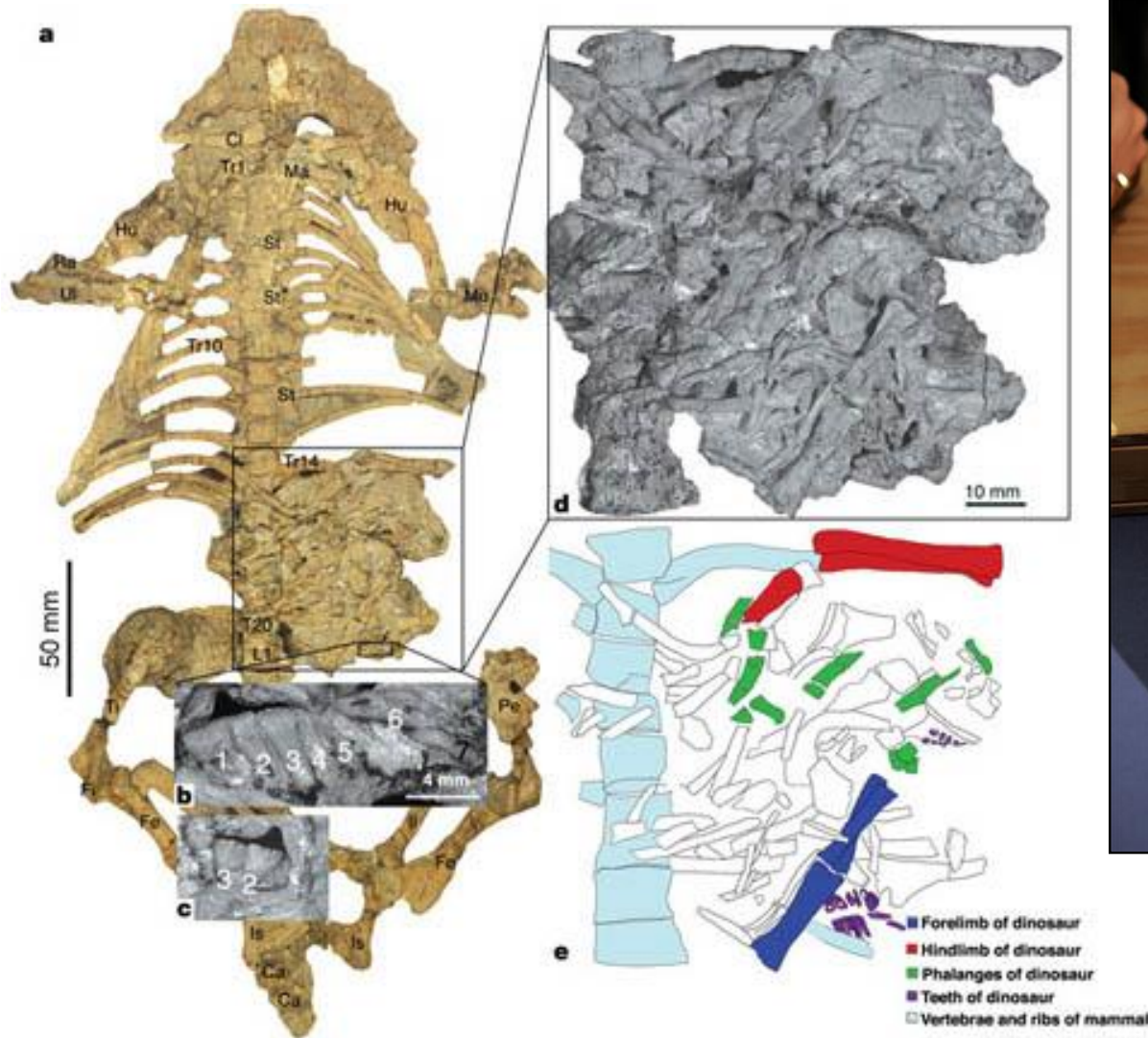
Corpo com
mais de 1 m
e crânio
de 160 cm



Mammalia (Triássico sup. – Recente) - formas pró-Theria

Triconodonta (Jurássico médio – Cretáceo sup.)

Repenomamus (Cretáceo inf. de Liaoning), carnívoro de médio porte



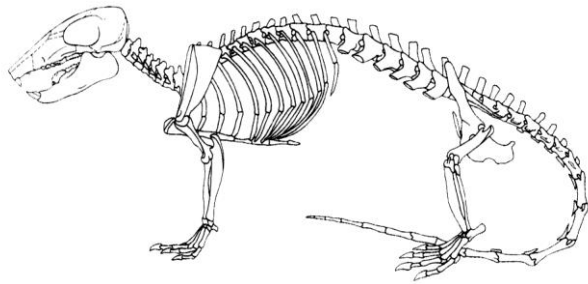
Psitacossauro juvenil na cavidade abdominal

Mammalia (Triássico sup. – Recente) - formas pró-Theria

Multiberkulata (Jurássico médio – Eoceno)

Grupo mais abundante de mamíferos mesozóicos (Américas, Ásia e África)

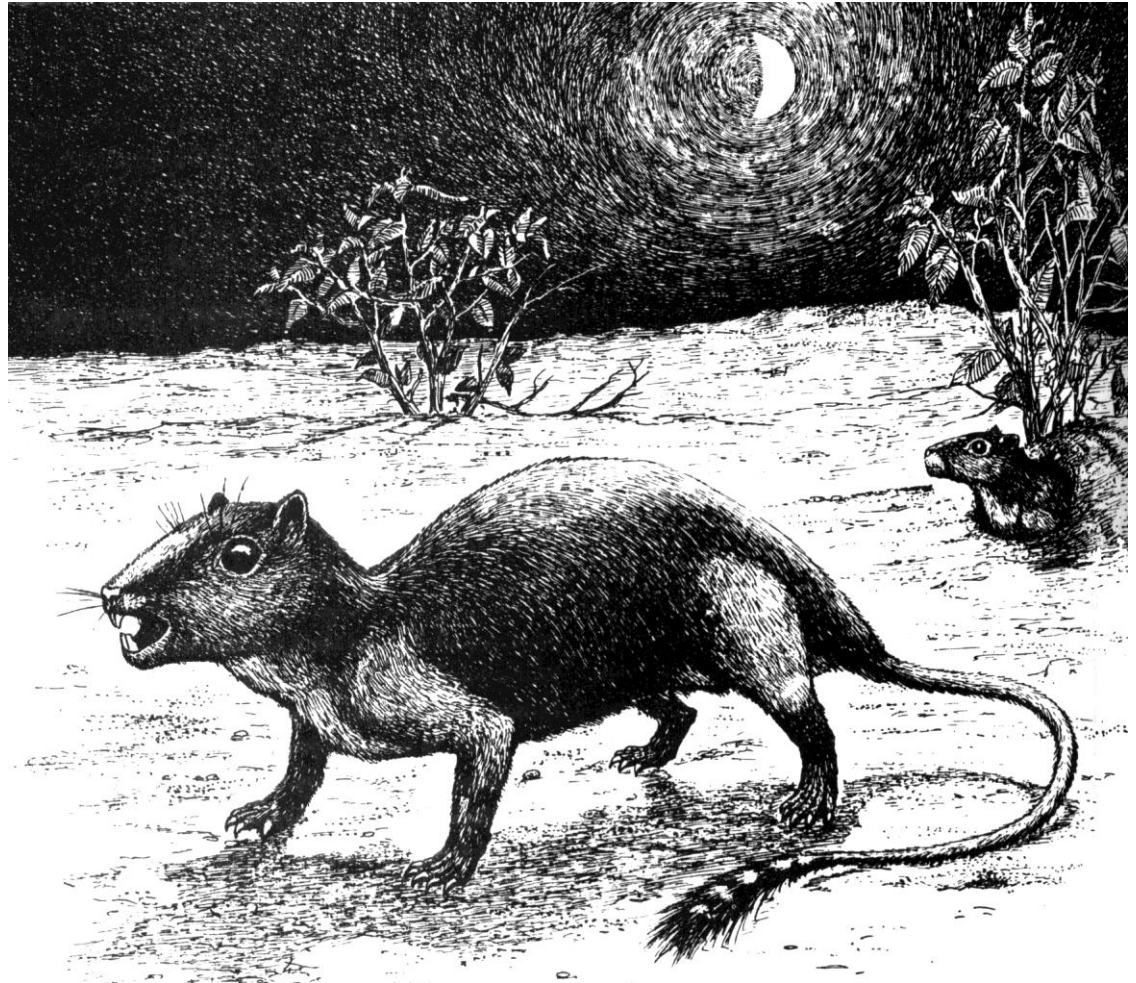
Omnívoros com forma de roedor (grandes incisivos e ausência de caninos)



Nemegtbaatar
(Cratáceo sup. Mongólia)



Kryptobaatar
(Cratáceo sup. Mongólia)

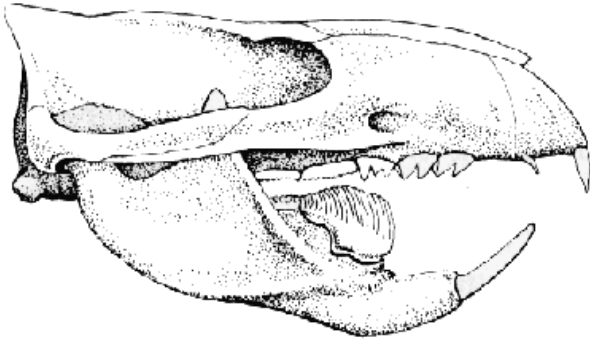


Mammalia (Triássico sup. – Recente) - formas pró-Theria

Multiberkulata (Jurássico médio – Eoceno)

Alguns com osso epipúbico, cauda preênsil e hábito arborícola

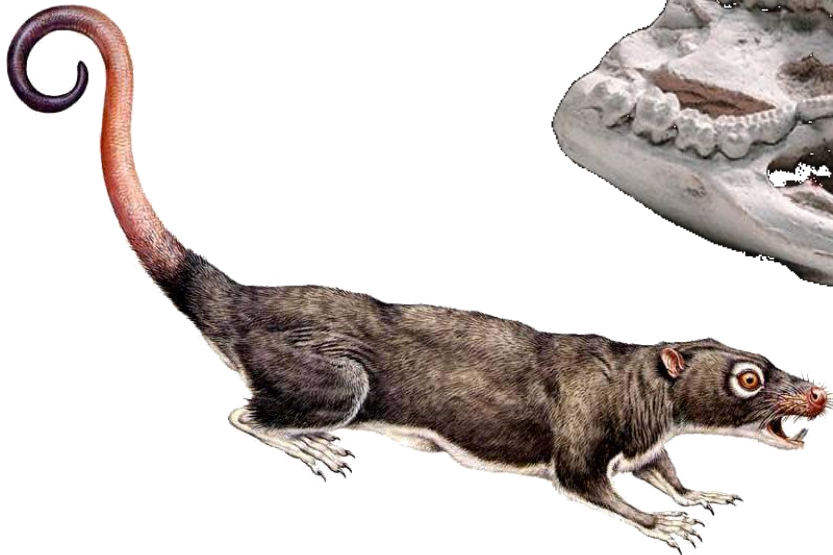
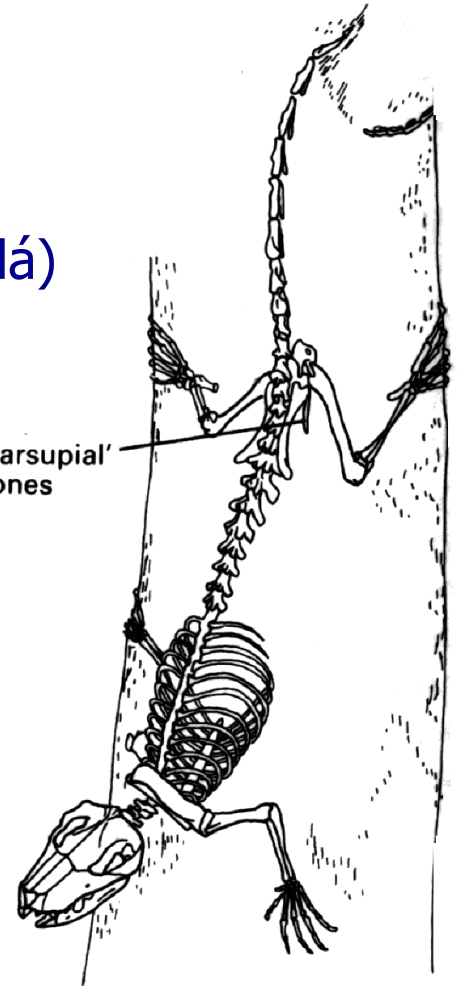
Dentes multicuspidados: possível origem dentre os Tritylodontidae



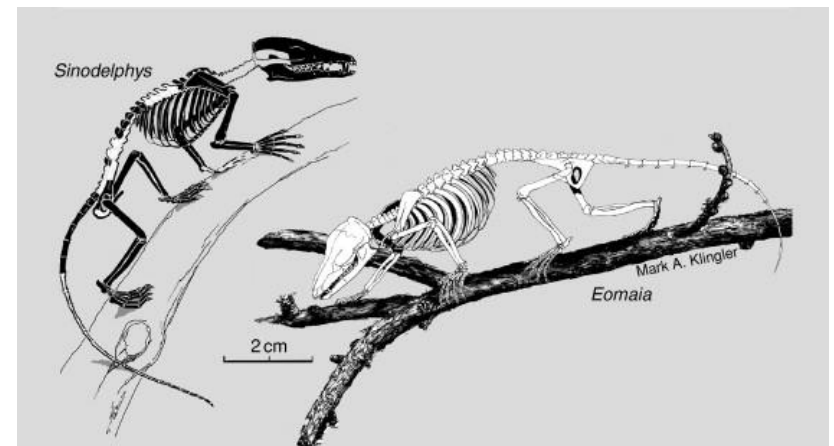
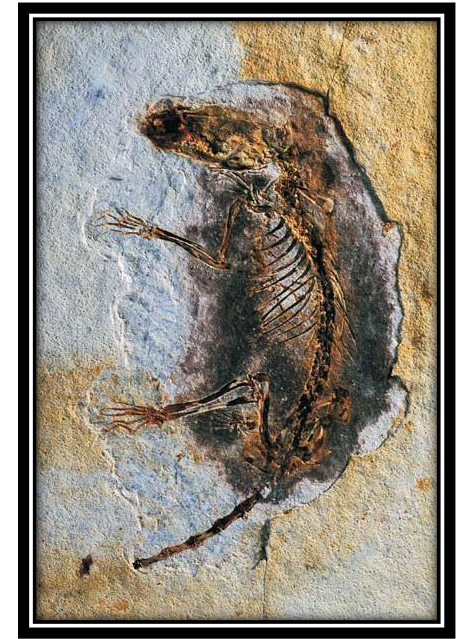
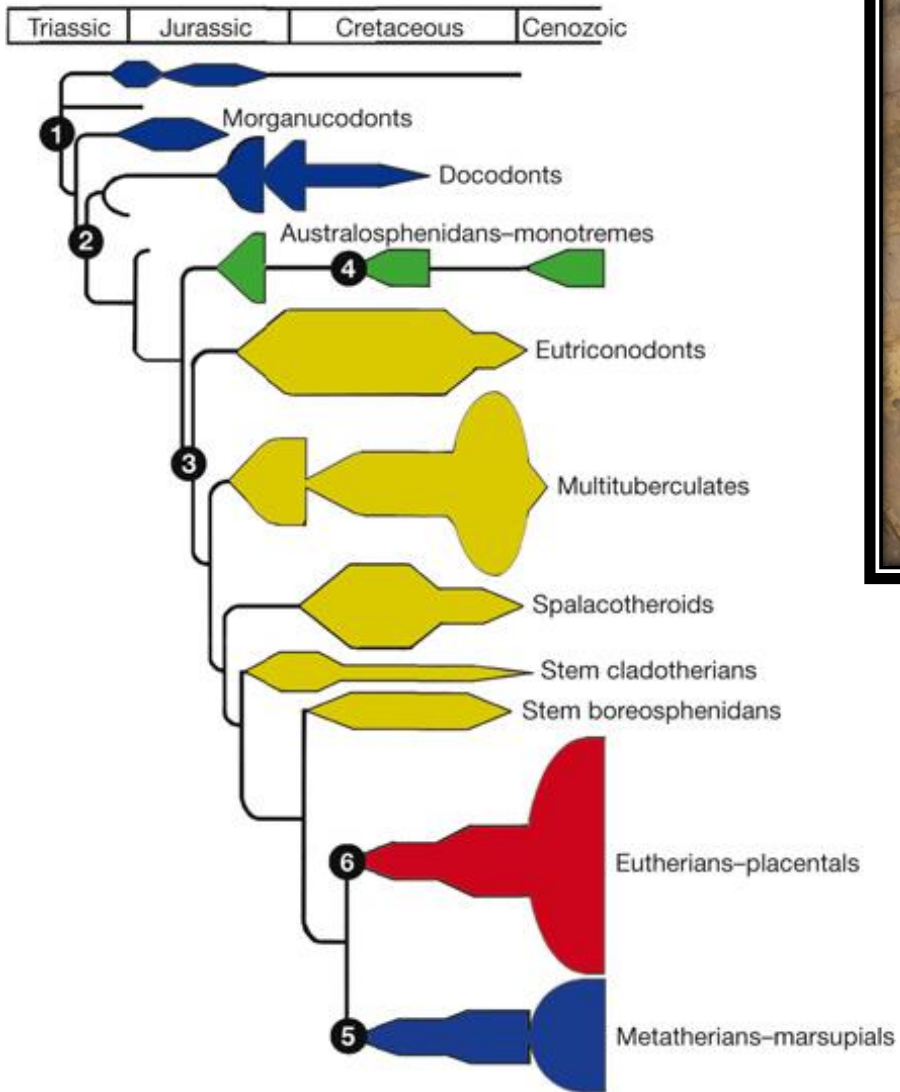
Ptilodus (Paleoceno, Canadá)



'marsupial' bones



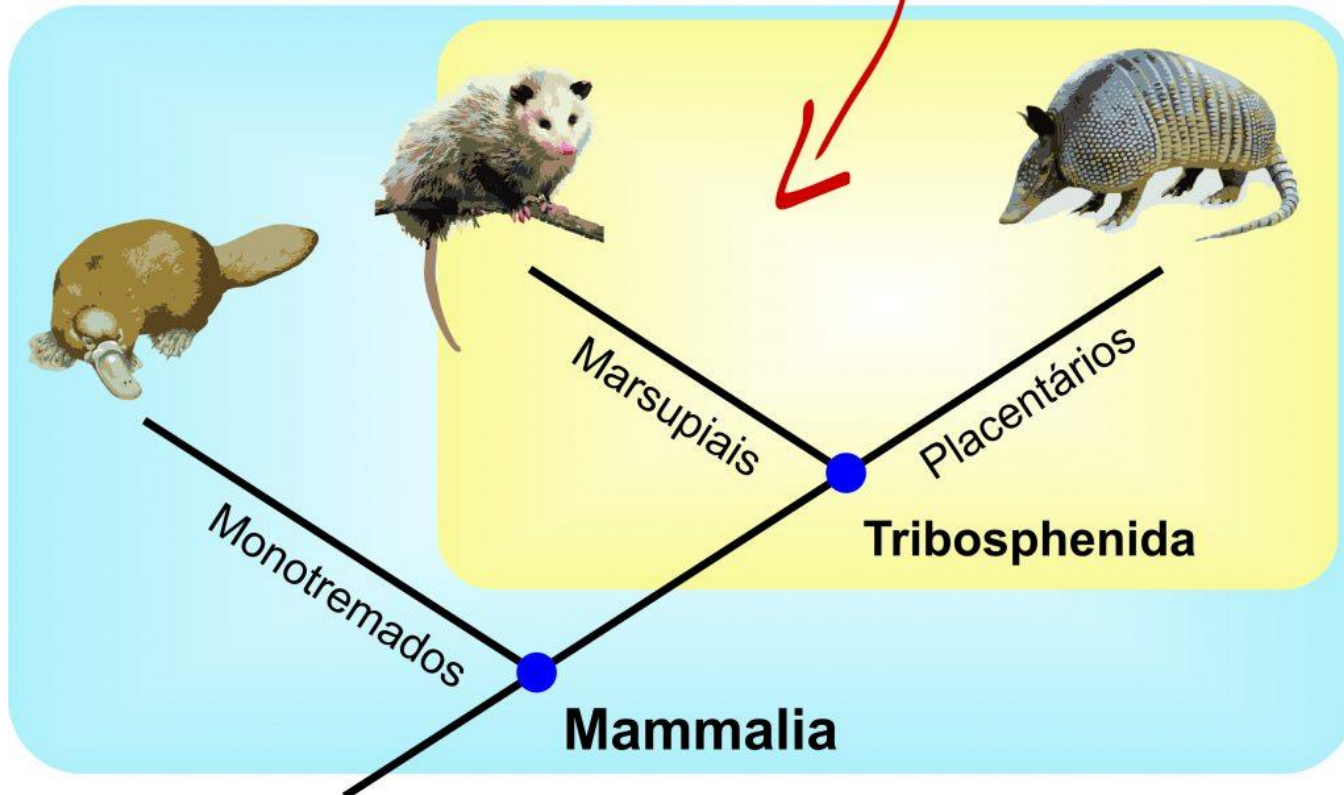
Mammalia (Triássico sup. – Recente)



Mammalia (Triássico sup. – Recente) - formas pró-Theria
Theria (Cretáceo Inf. – Recente)

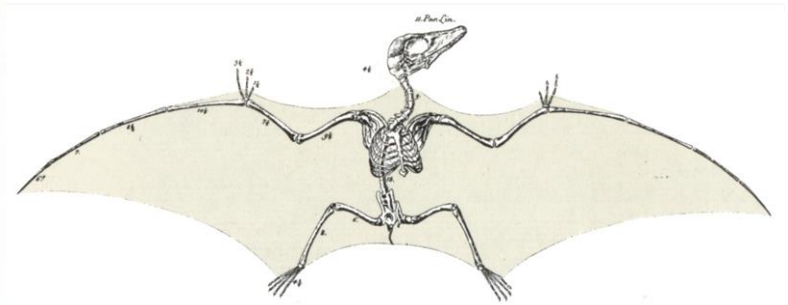
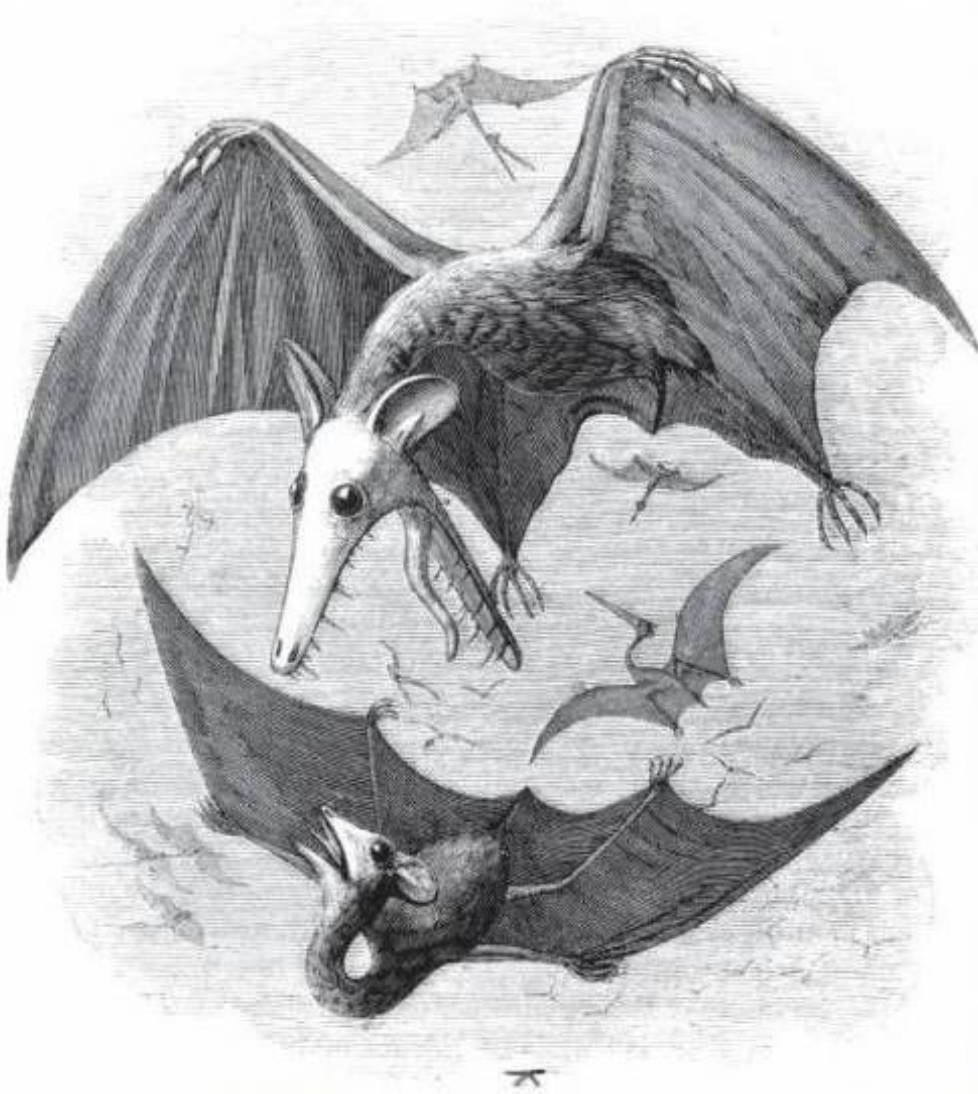


Brasilestes stardusti



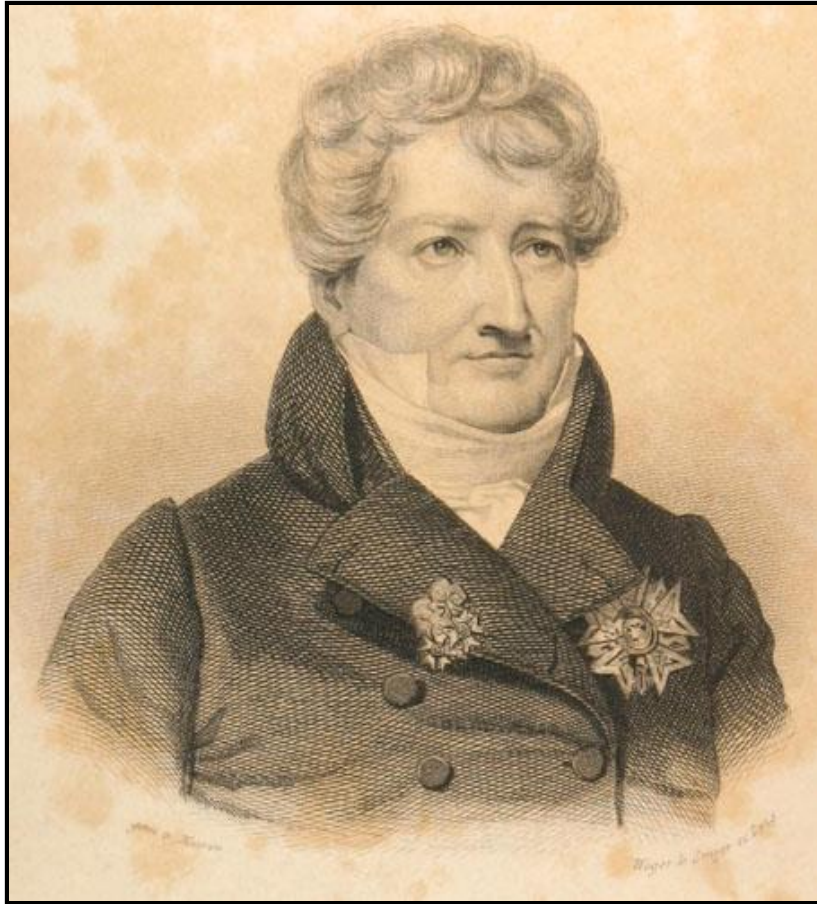
Pterosauria (Triássico sup. - Cretáceo)

Primeira descoberta: Eichstatt *Pterodactylus* (1757)

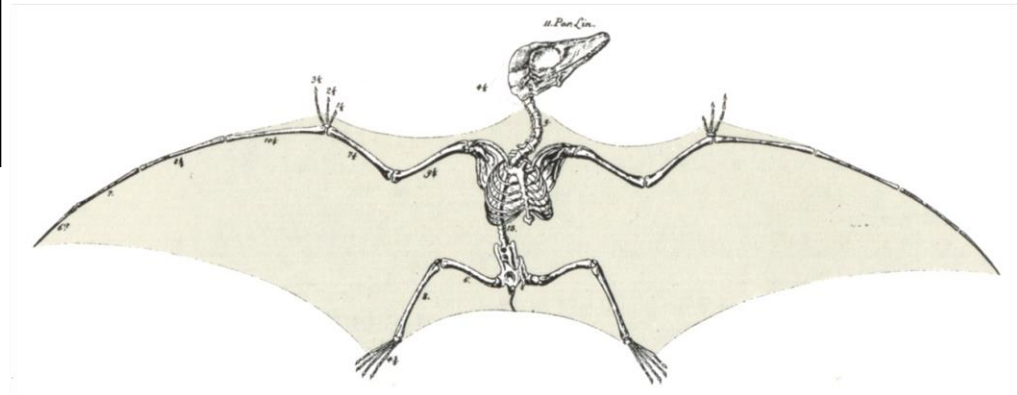


Pterosauria (Triássico sup. - Cretáceo)

Primeira descoberta: Eichstatt *Pterodactylus* (1757)

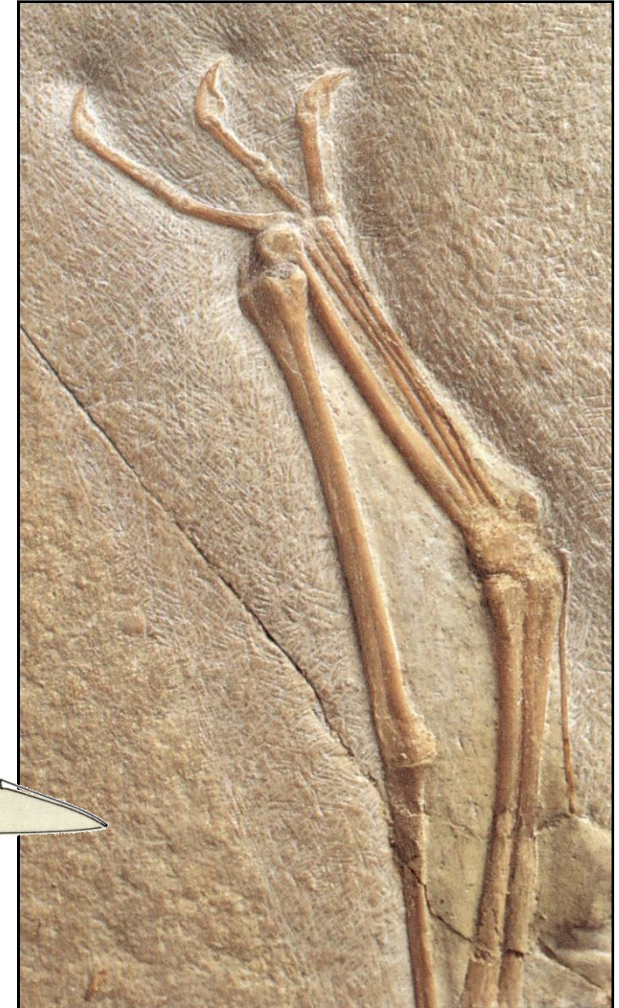
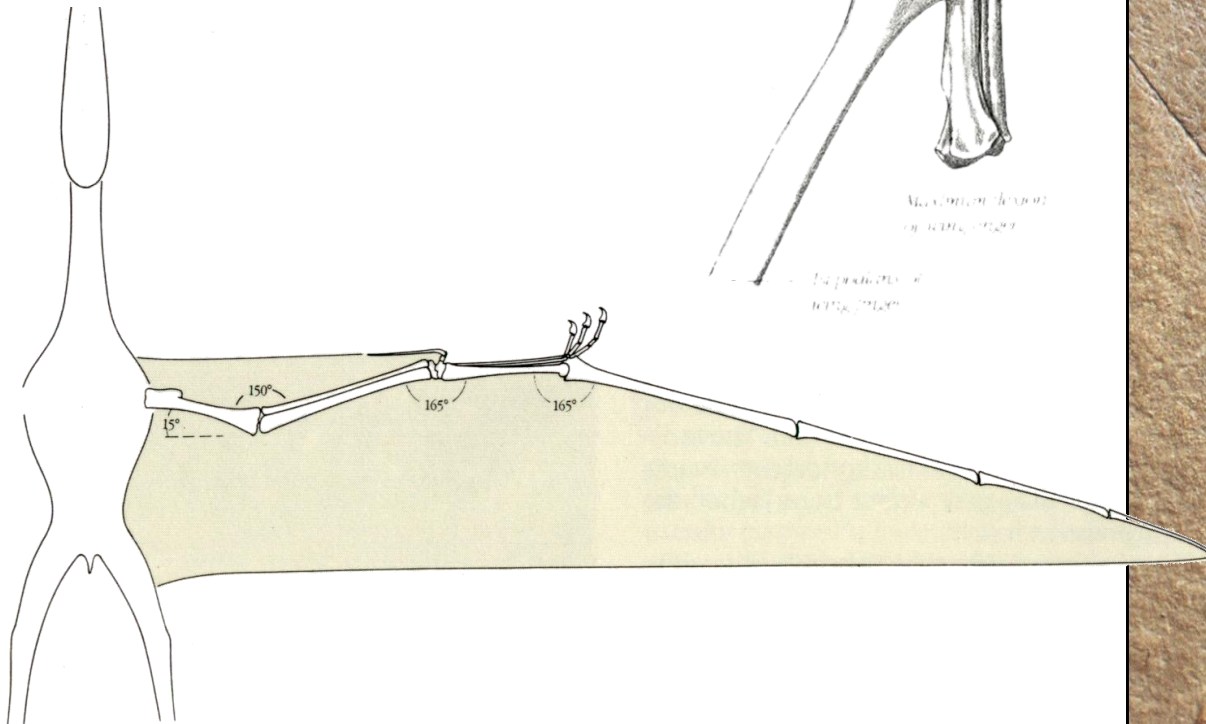
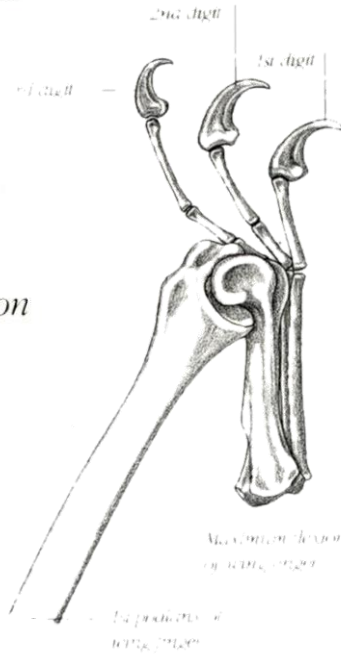
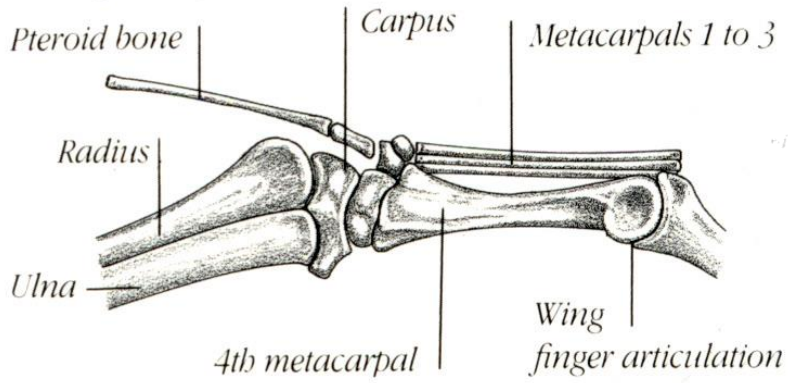


Cuvier: reconheceu natureza
"reptiliana" do grupo



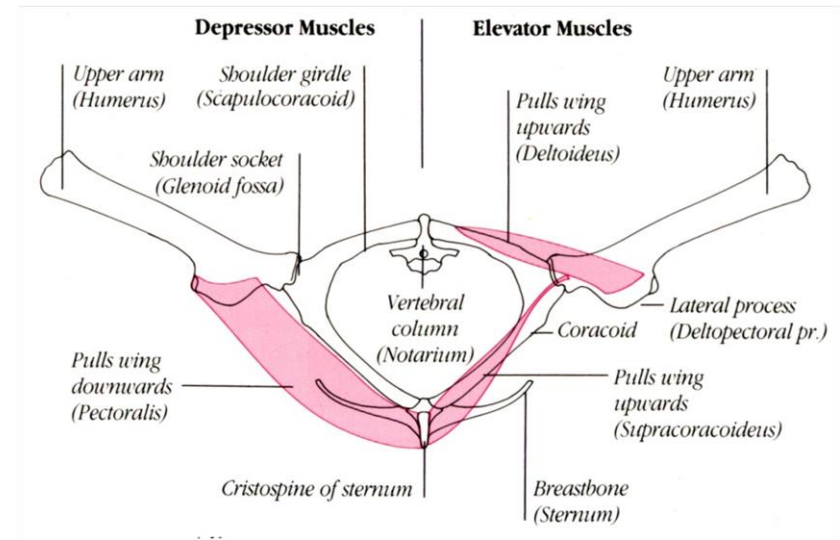
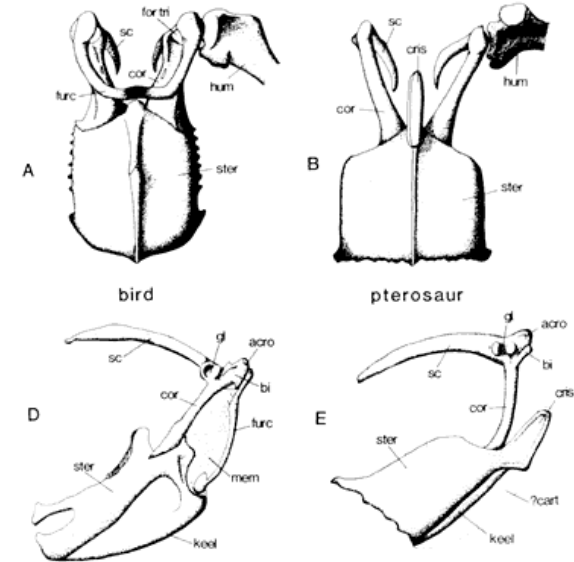
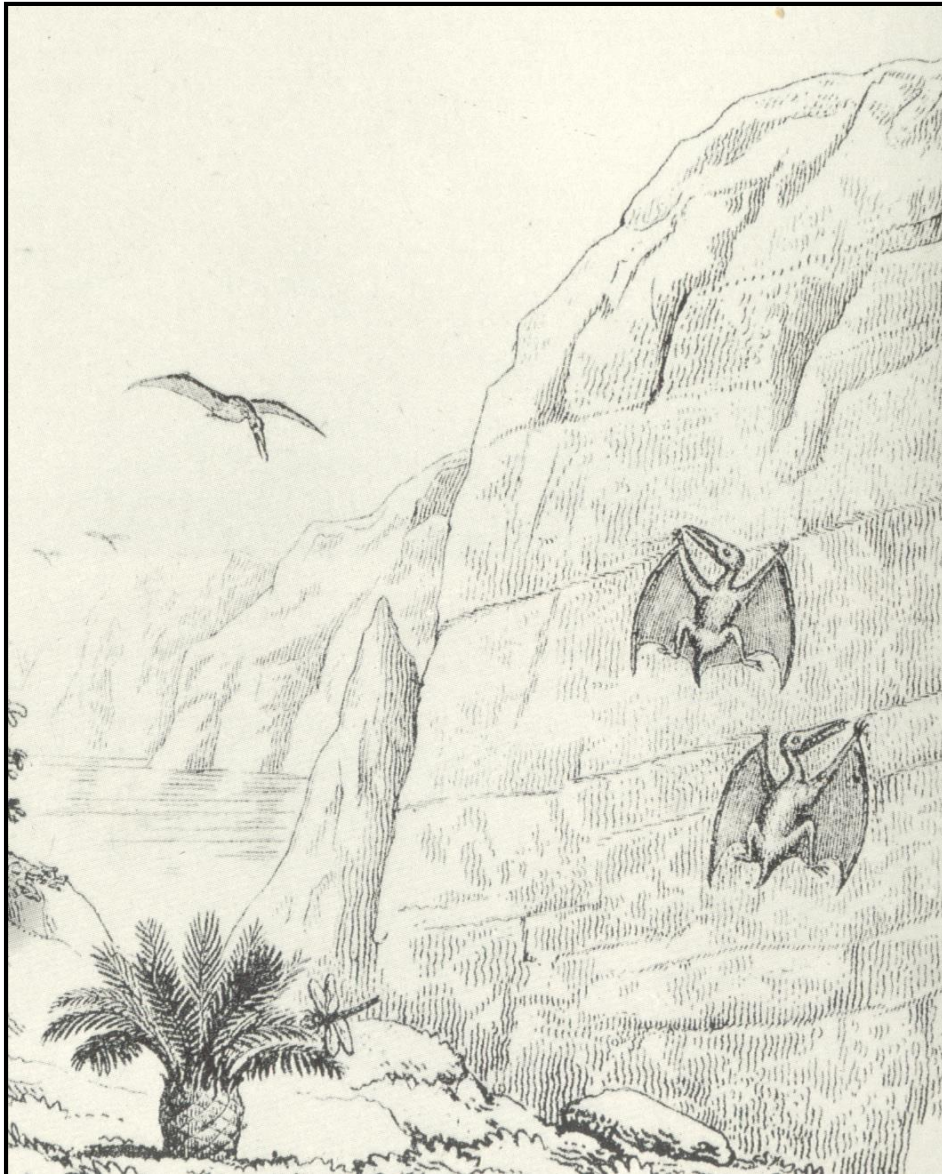
Pterosauria (Triássico sup. - Cretáceo)

Quarto dedo extremamente alongado suporta a asa



Pterosauria (Triássico sup. - Cretáceo)

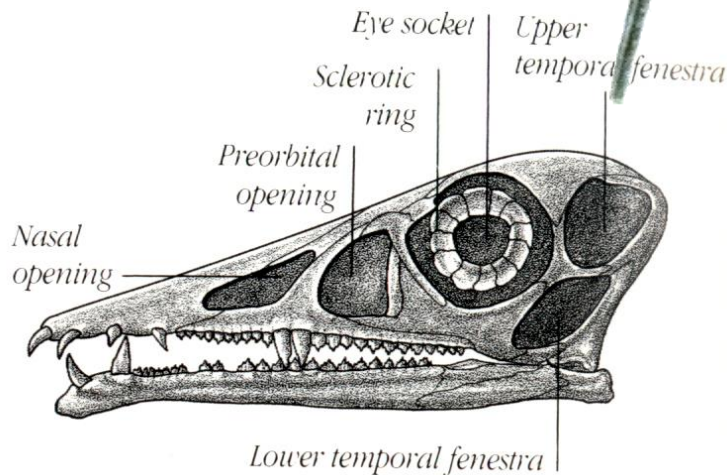
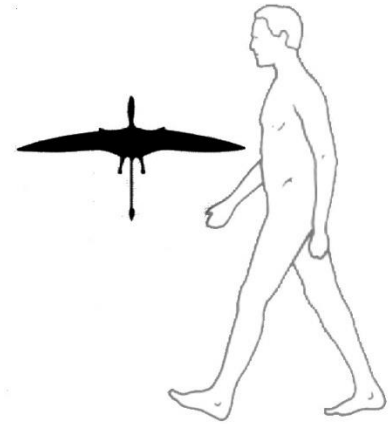
Esterno quilhado como nas aves possibilitaria vôo ativo



Pterosauria (Triássico sup. - Cretáceo)

Pterossauros do Triássico: Calcario de Zorzino, Itália

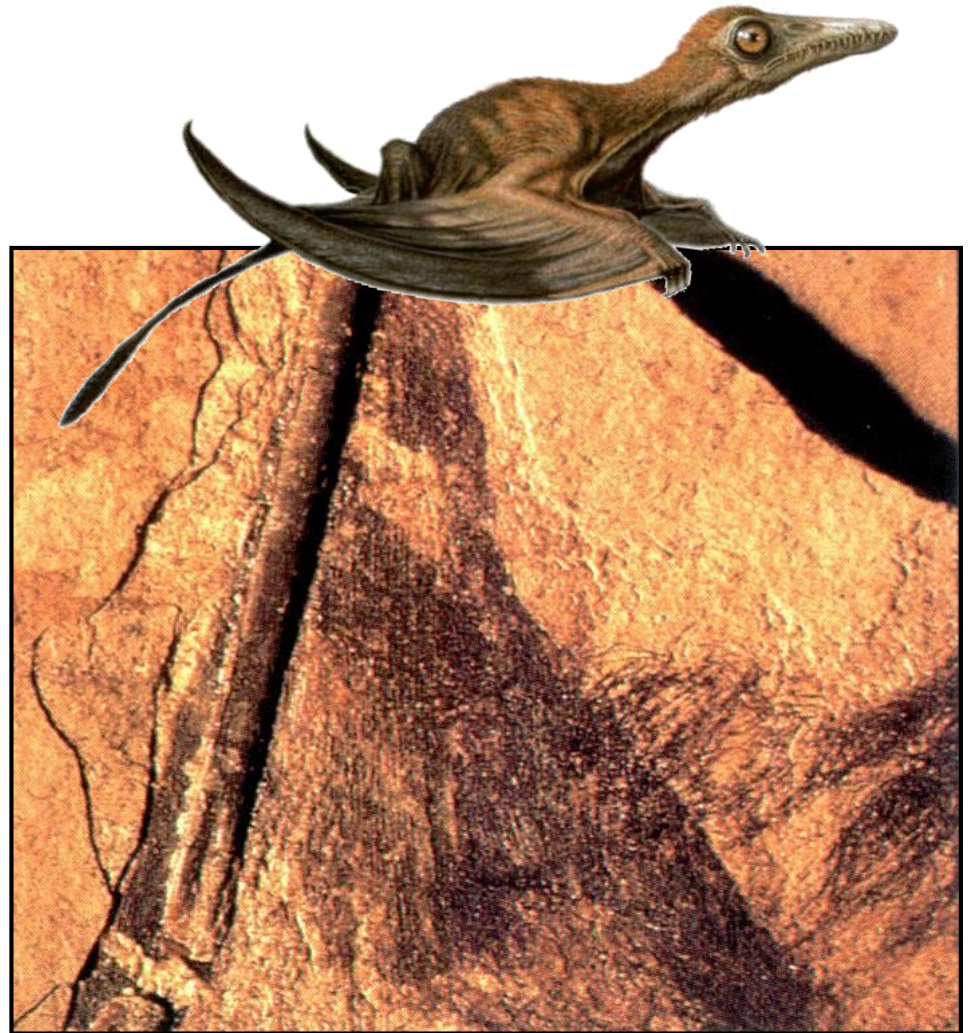
Eudimorphodon: afim aos Campylognathidae do Jurássico



Pterosauria (Triássico sup. - Cretáceo)

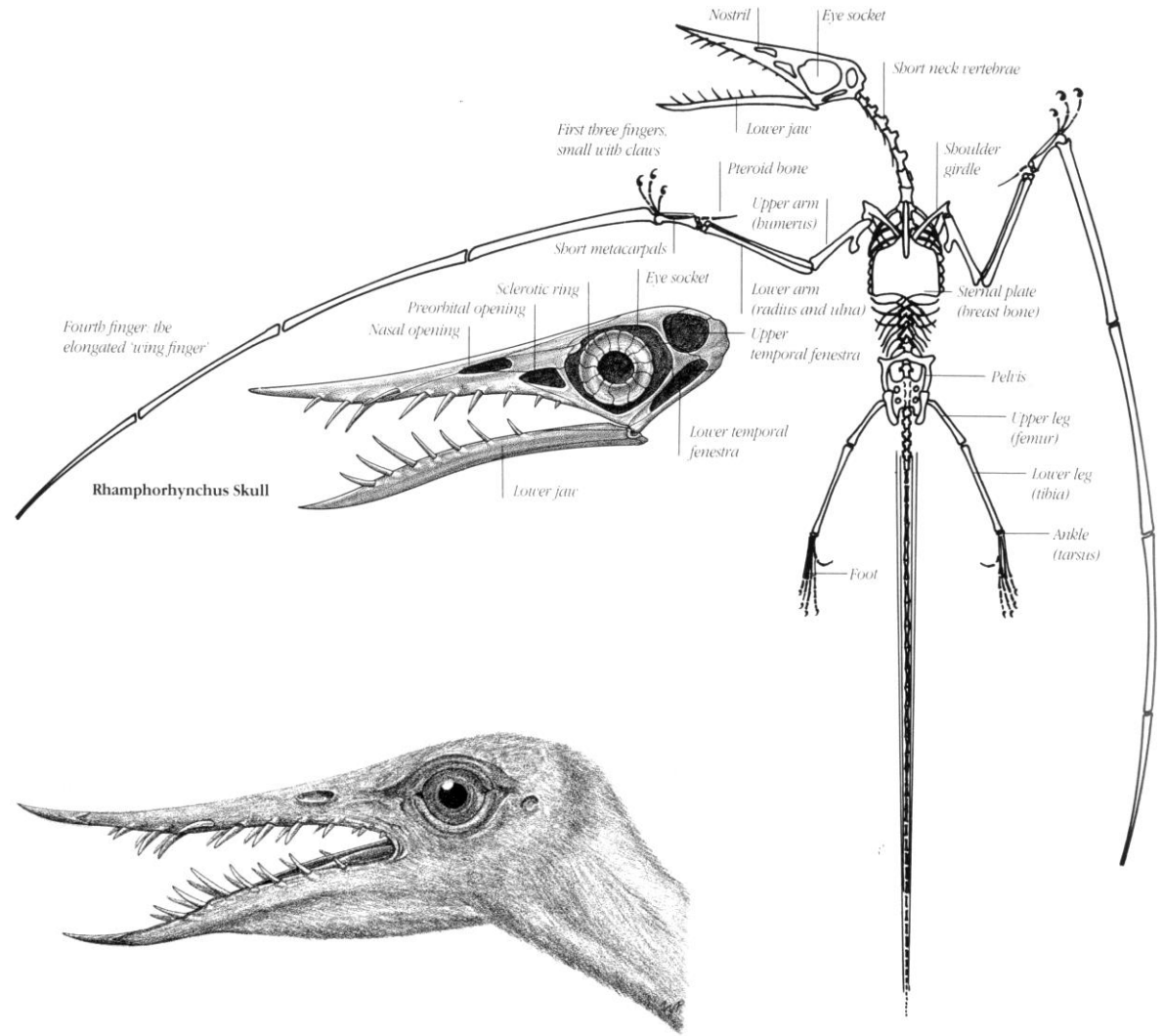
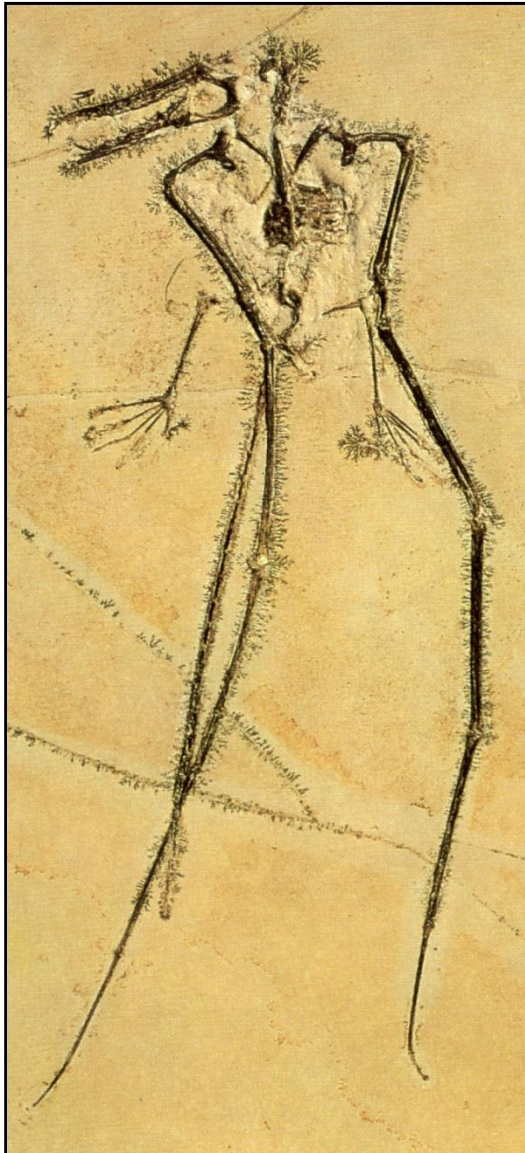
Rhamphorhynchoidea do Jurássico superior

Sordes pilosus (Karatau, Kazaquistão): registro de “penas filiformes”



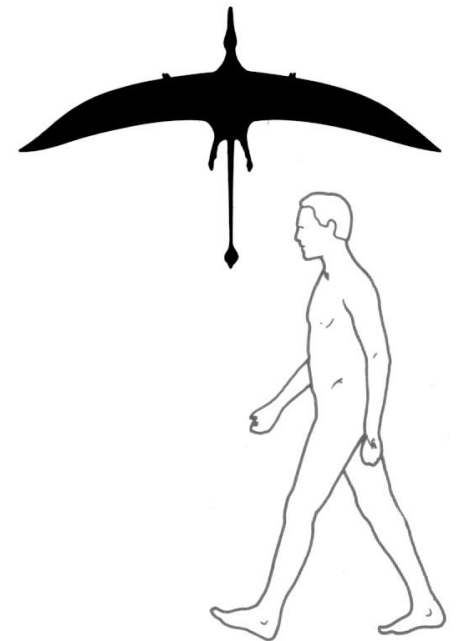
Pterosauria (Triássico sup. - Cretáceo)

Rhamphorhynchus (Jurássico superior de Solnhofen): forma arquétipa



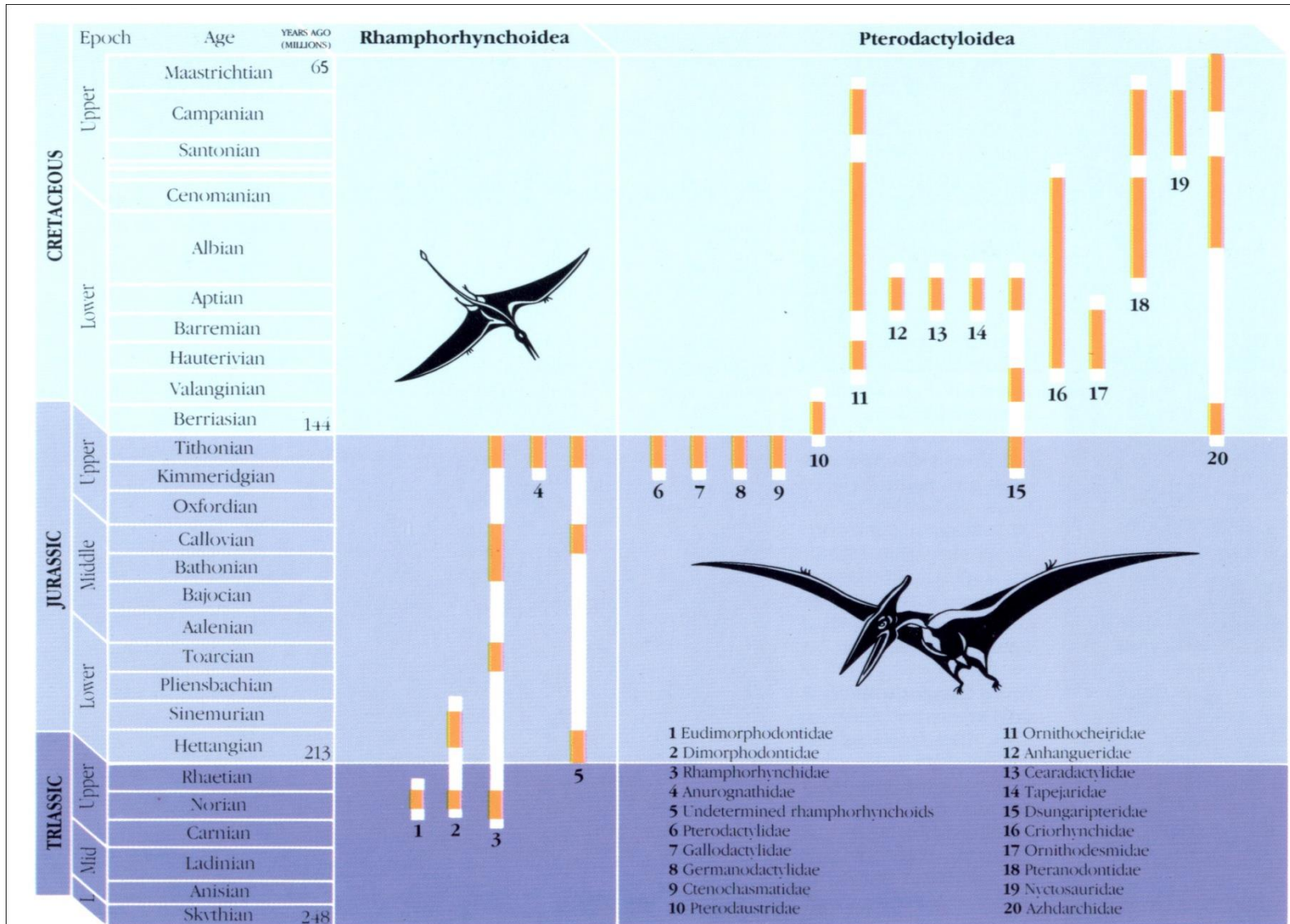
Pterosauria (Triássico sup. - Cretáceo)

Rhamphorhynchus (Jurássico superior de Solnhofen): forma arquétipa



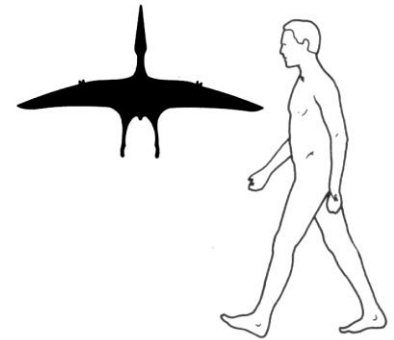
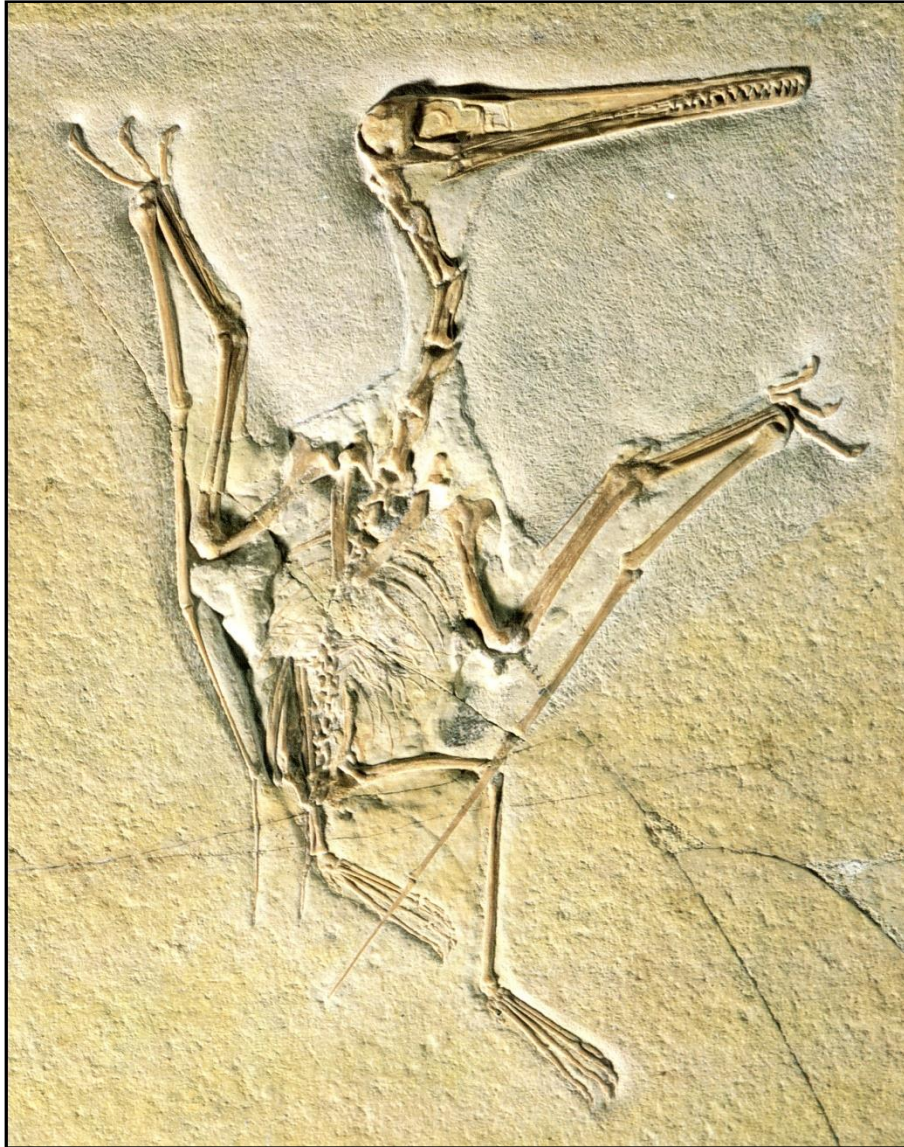
Pterosauria (Triássico sup. - Cretáceo)

Dois grandes grupos: "Rhamphorhynchoidea" e Pterodactyloidea

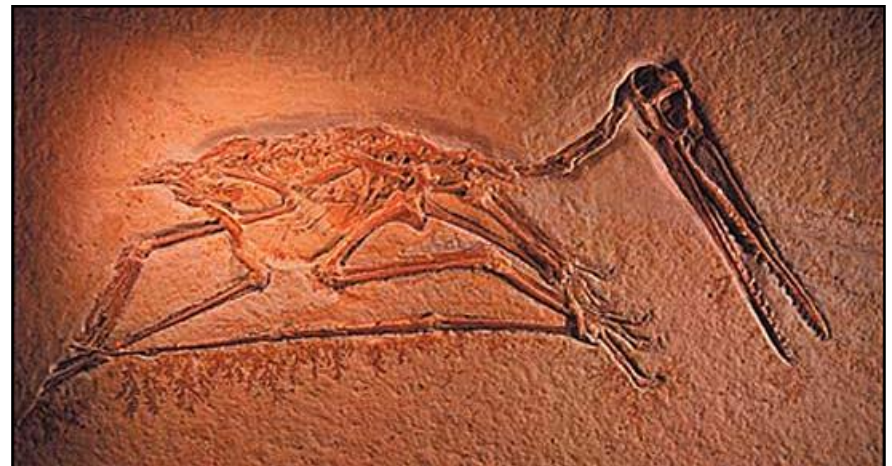


Pterodactyloidea (Jurássico sup. - Cretáceo)

Archaeopteropectyloidea: grupo basal, maioria das formas do Jurássico

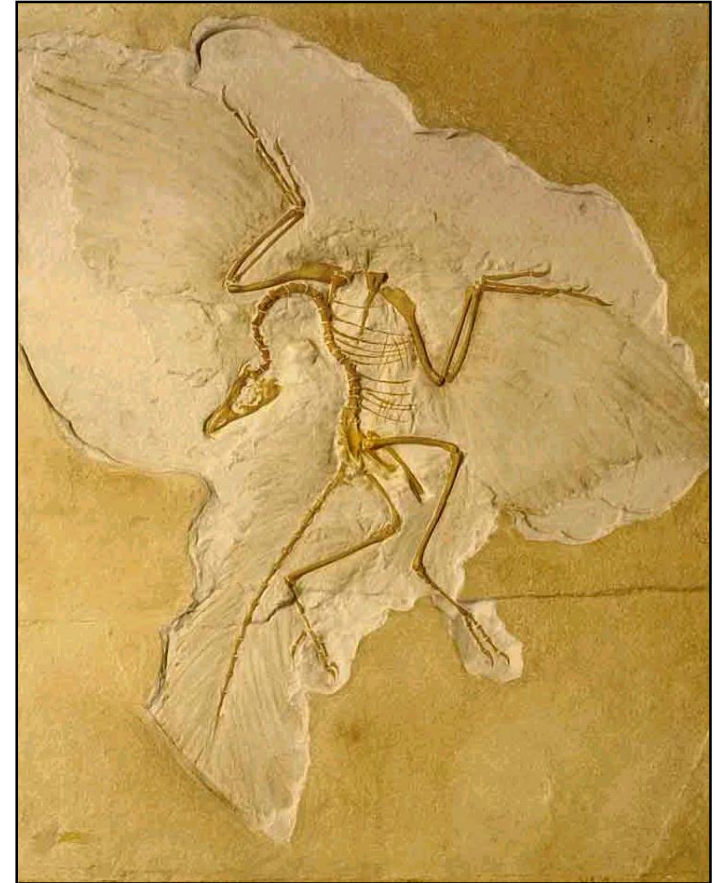
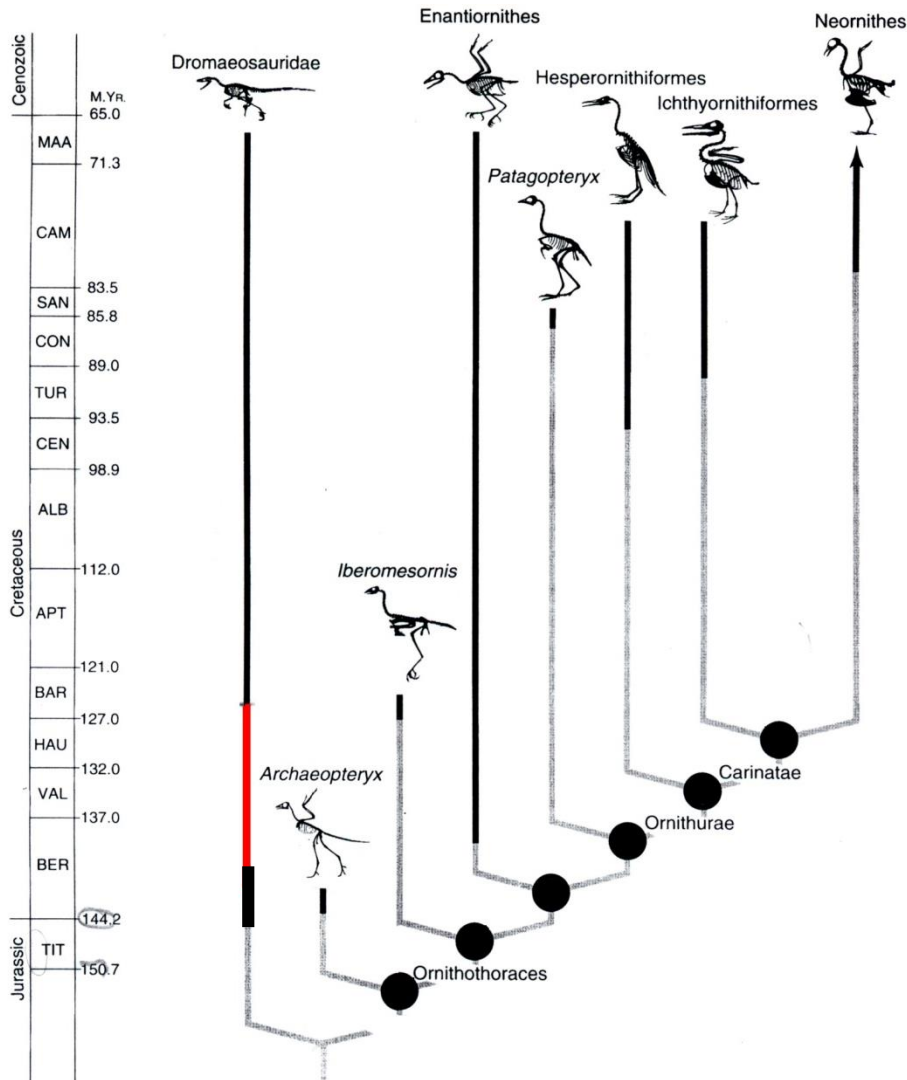


Pterodactylus
(Solnhofen)



Aves (Jurássico sup. - Recente)

Radiação com aproximadamente 150 Ma, desde o Jurássico superior

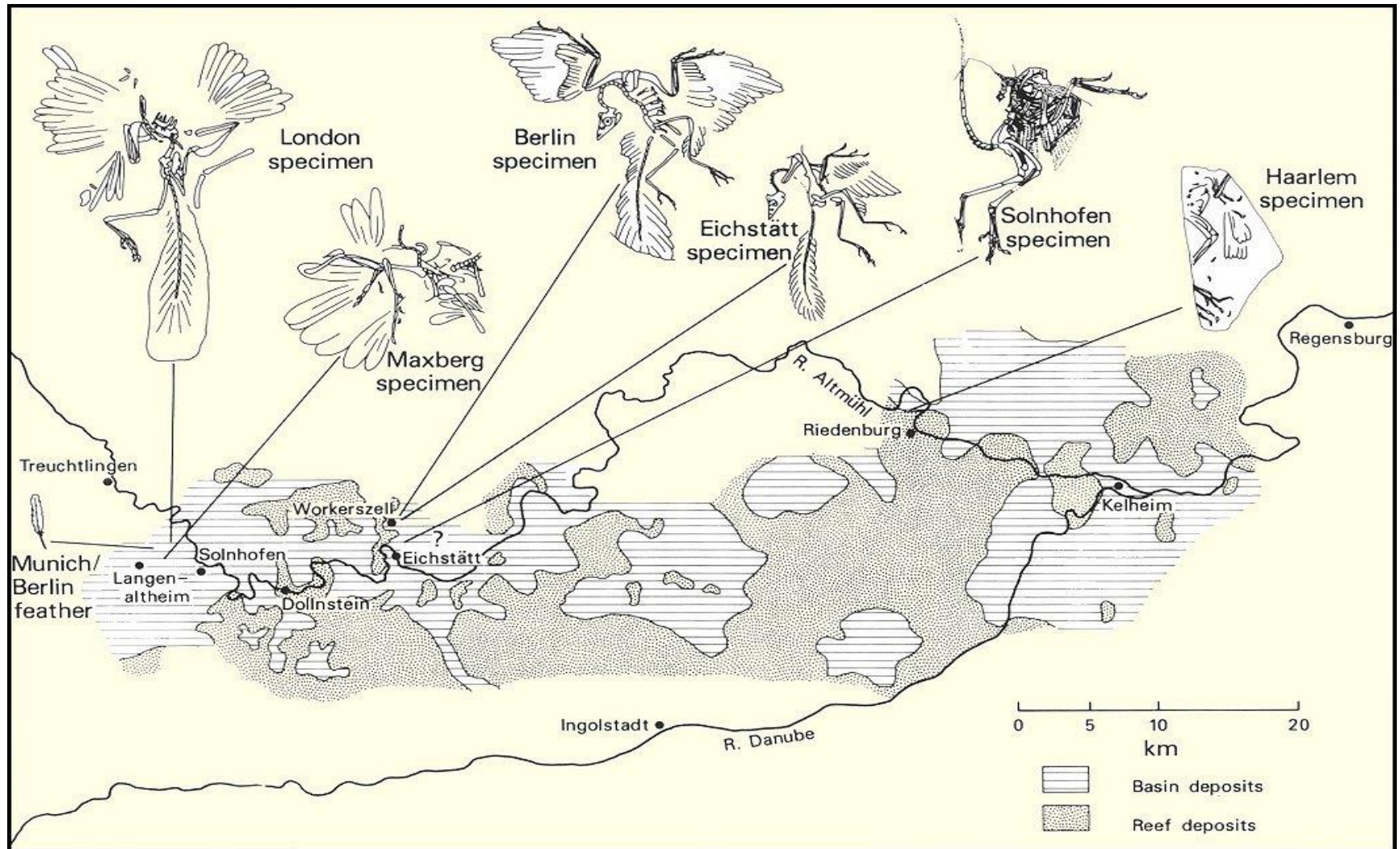


Archaeopteryx lithographica
Calcário laminado de Solnhofen
Bavária

Aves (Jurássico sup. - Recente)

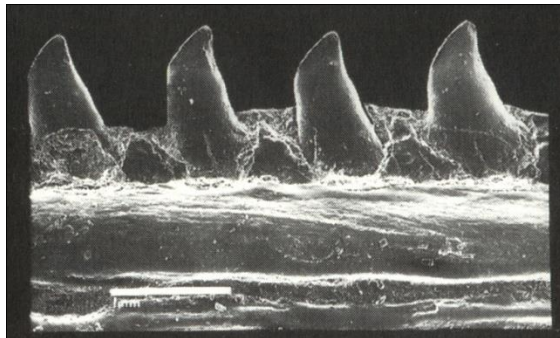
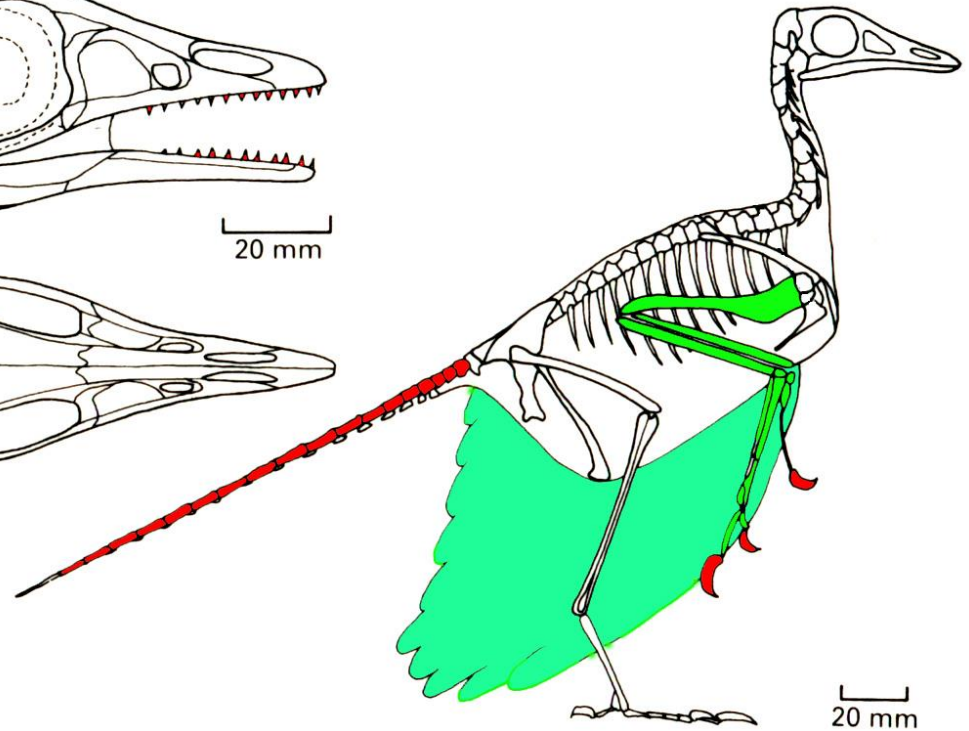
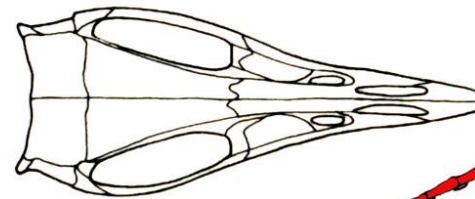
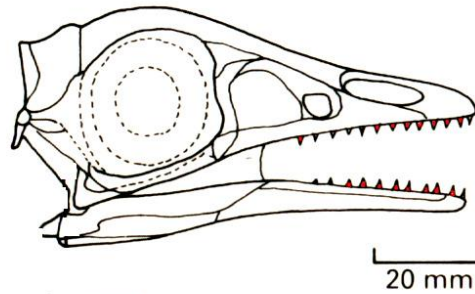
Archaeopteryx lithographica: ainda a ave mais antiga

11 esqueletos e uma pena – 3 táxons: *A. bavarica* e *Wellnhoferia grandis*?



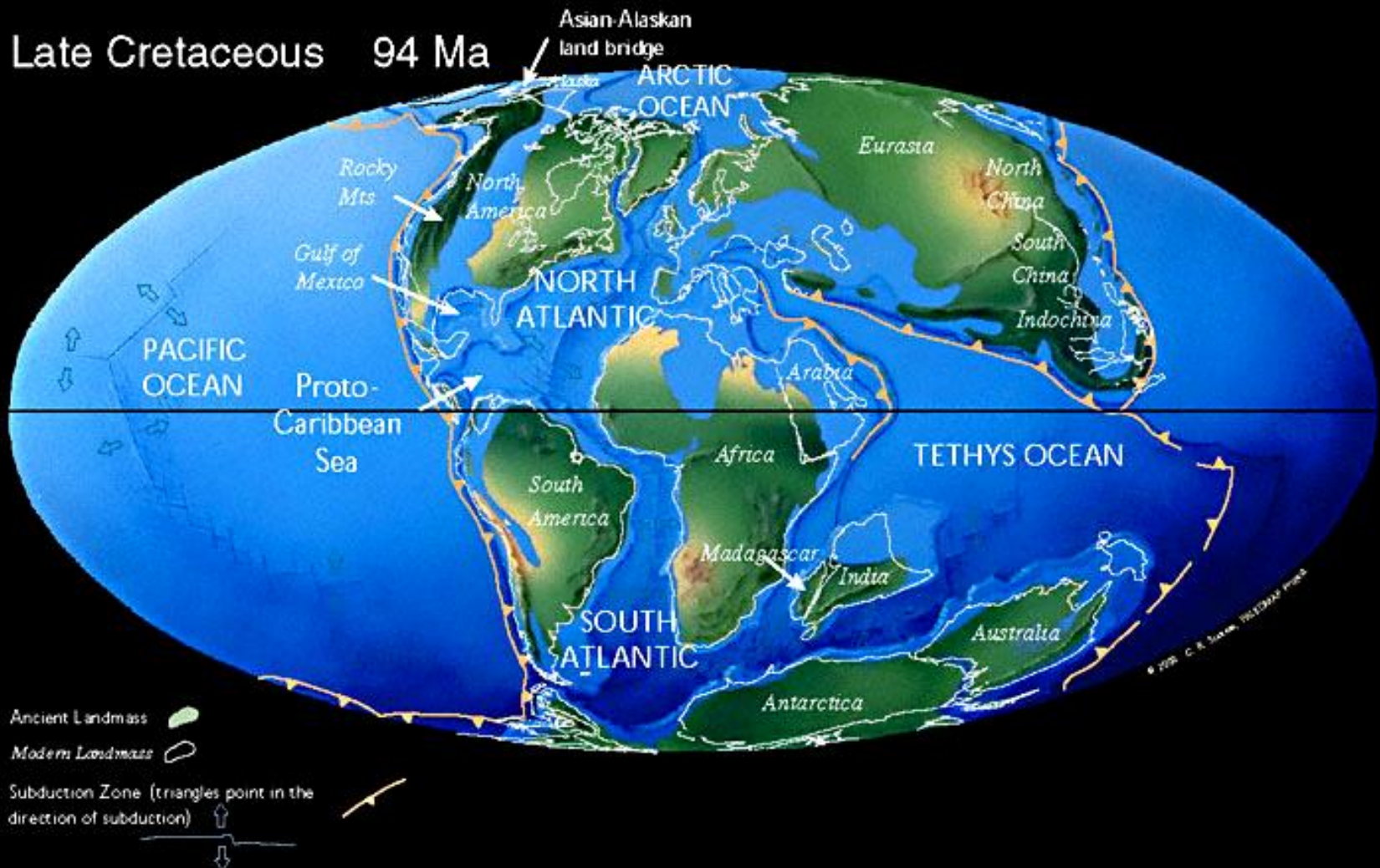
Aves (Jurássico sup. - Recente) - *Archaeopteryx*

Thomas Huxley: *Archaeopteryx* mistura de caracteres reptilianos (cauda óssea, mão com garras, dentes) e avianos (fúrcula e penas)

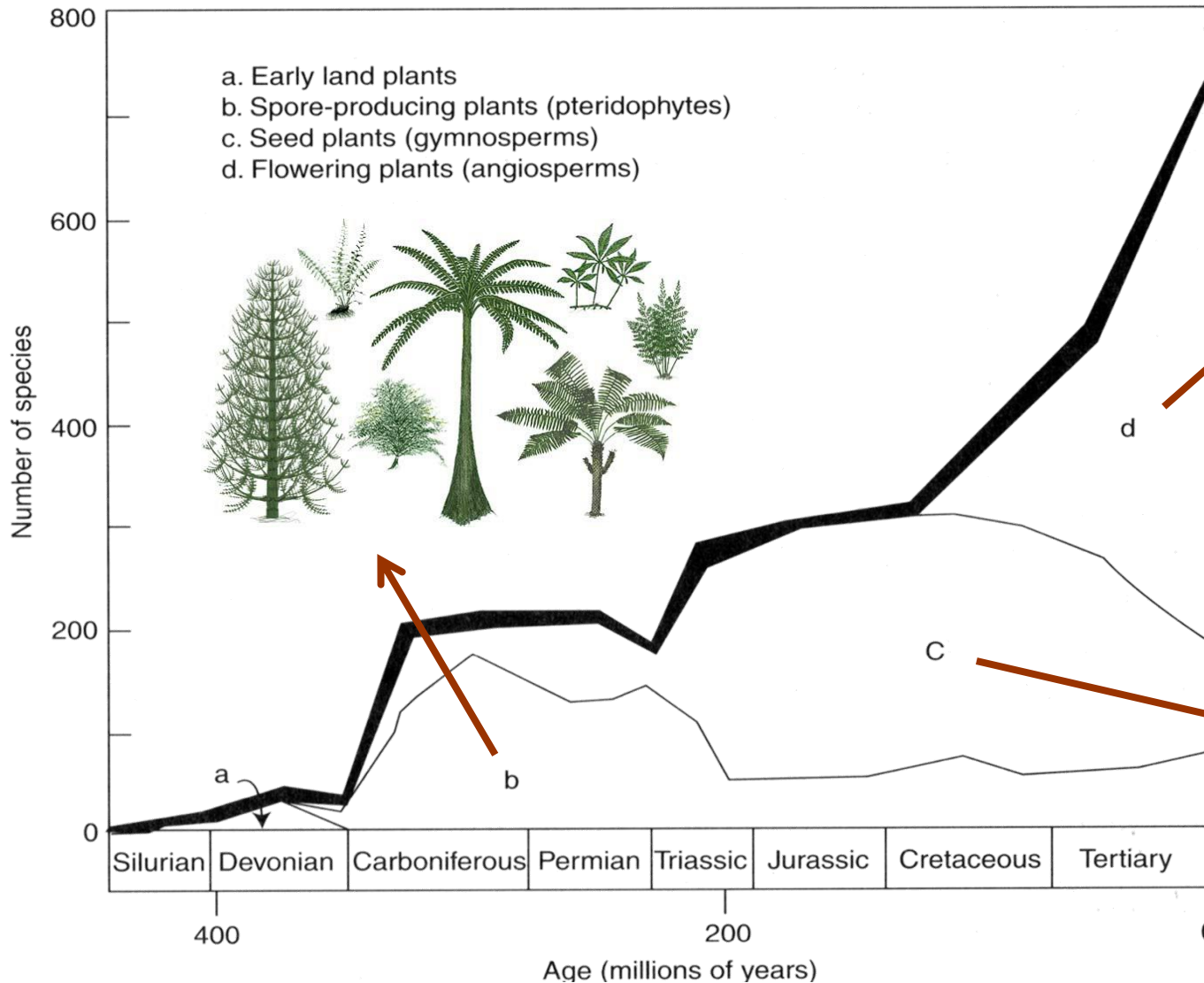


Usado como evidência da
teoria da evolução

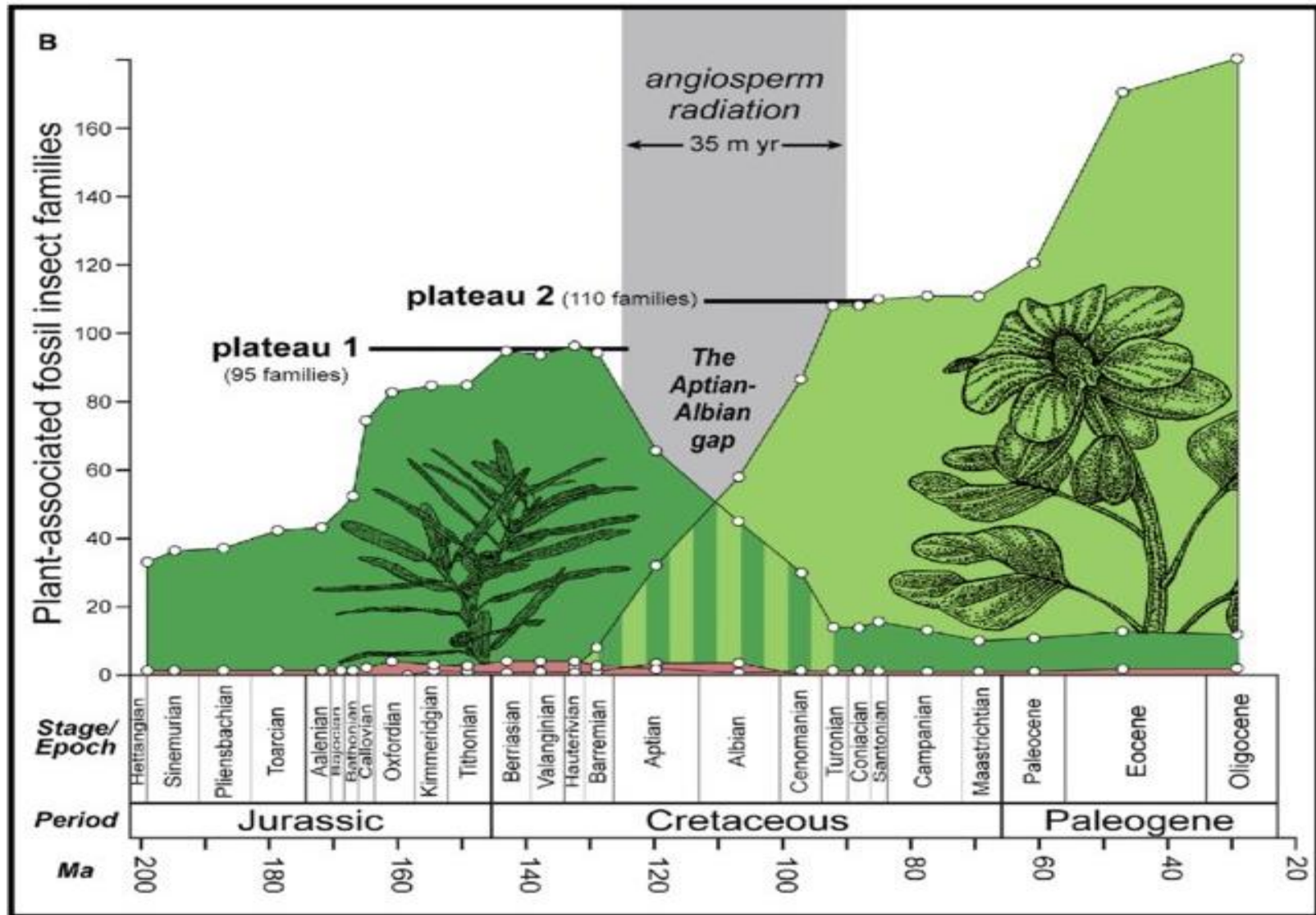
No Cretáceo (80 Ma), o Gondwana se desfaz, pela separação da África e Índia do **Neogondwana**
A América do Norte se separa da Eurásia



Plantas: expansão das angiospermas

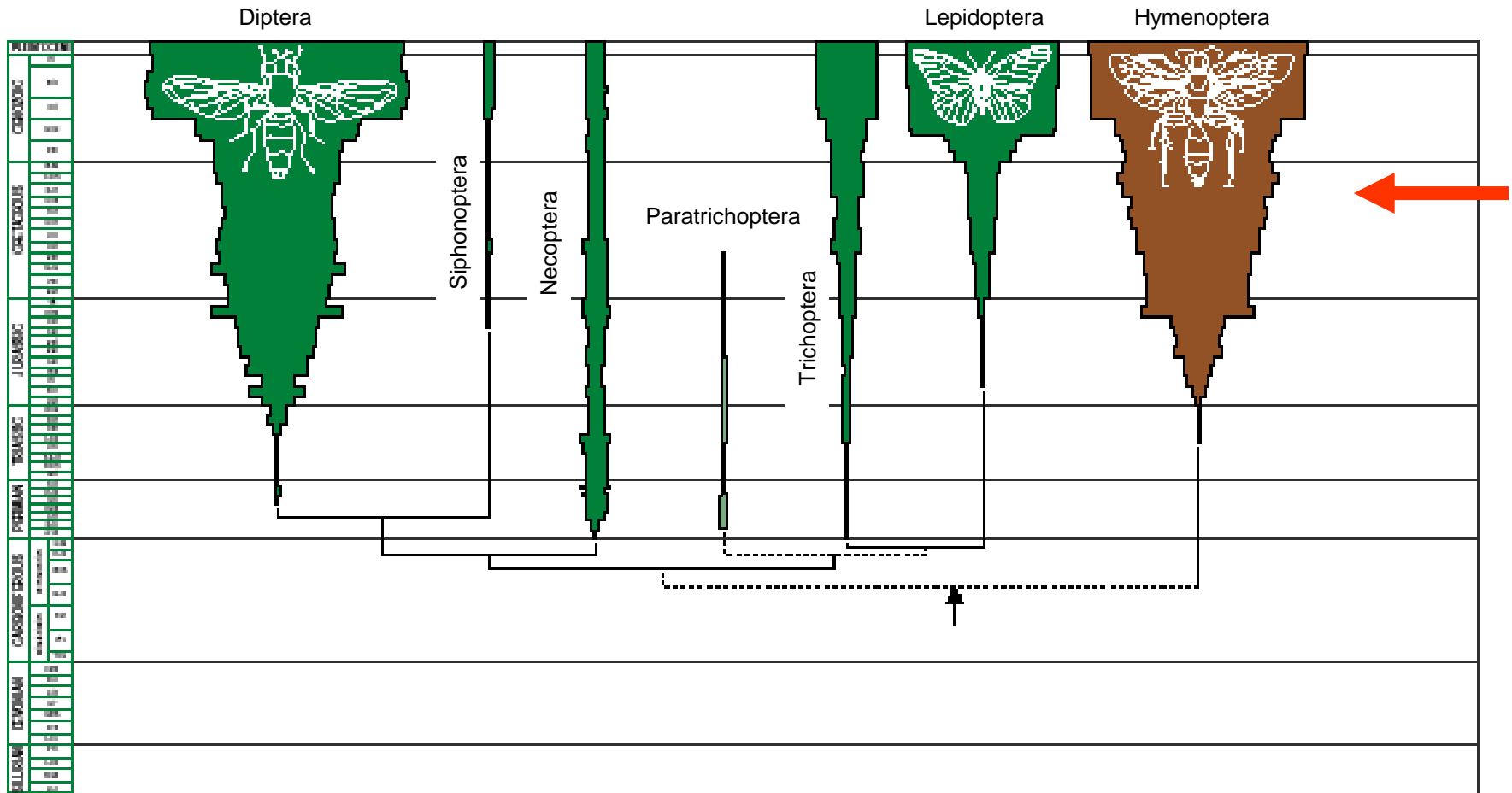


Plantas: expansão das angiospermas

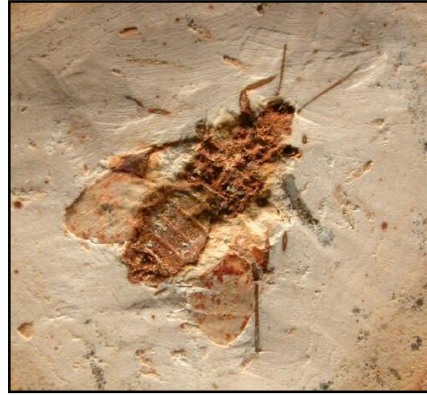


Neoptera (Carbonífero – Recente)

Lepidópteros, Hymenópteros, entre outros, tem evolução ligada à origem e diversificação das angiospermas (polinização)



Neoptera (Carbonífero – Recente)



Strepsiptera

Paratrichoptera

Mecoptera

Siphonaptera

Diptera

Trichoptera

Lepidoptera

Hymenoptera

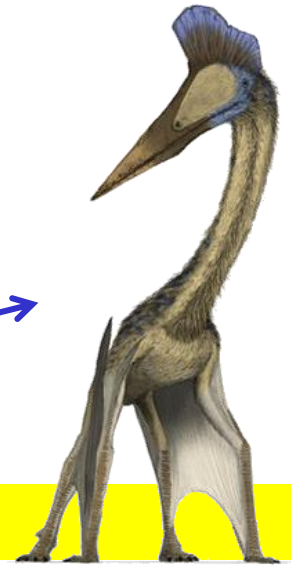


Pterosauria (Triássico sup. - Cretáceo)

Irradiação dos Pterodactyloidea



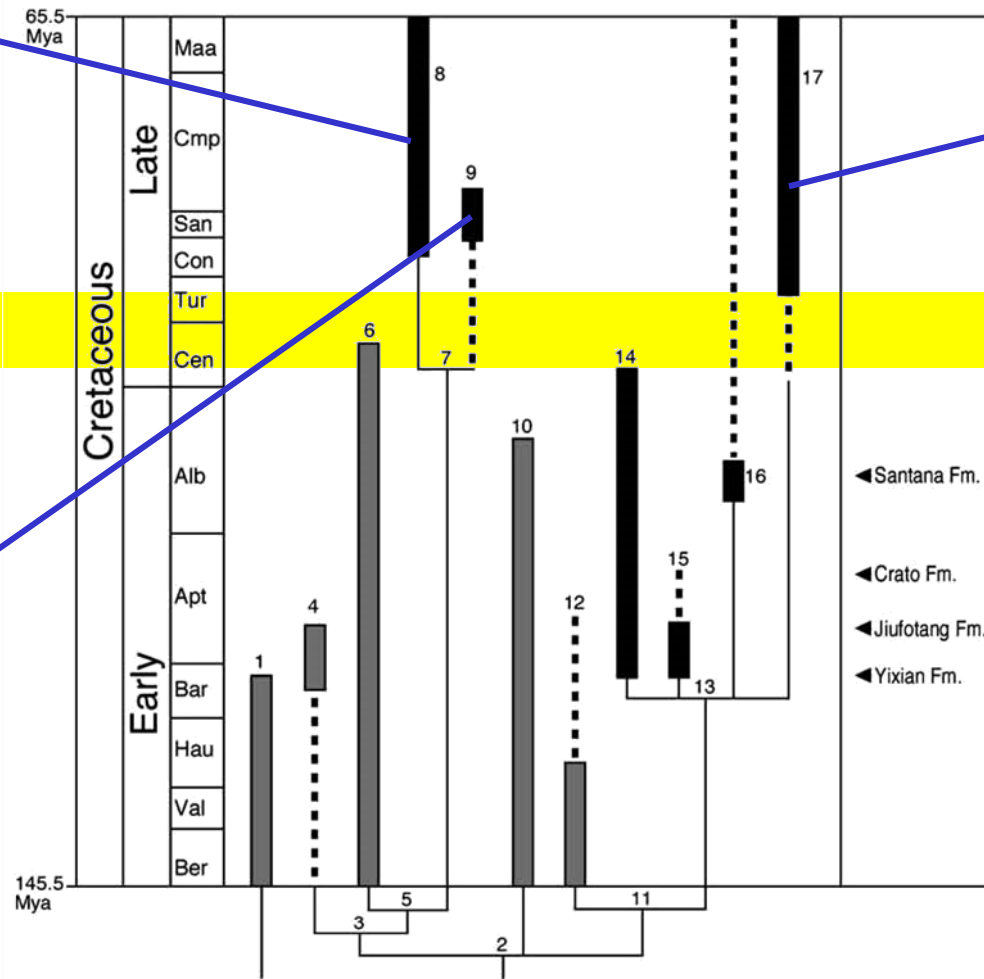
Nyctosauridae



Azhdarchidae

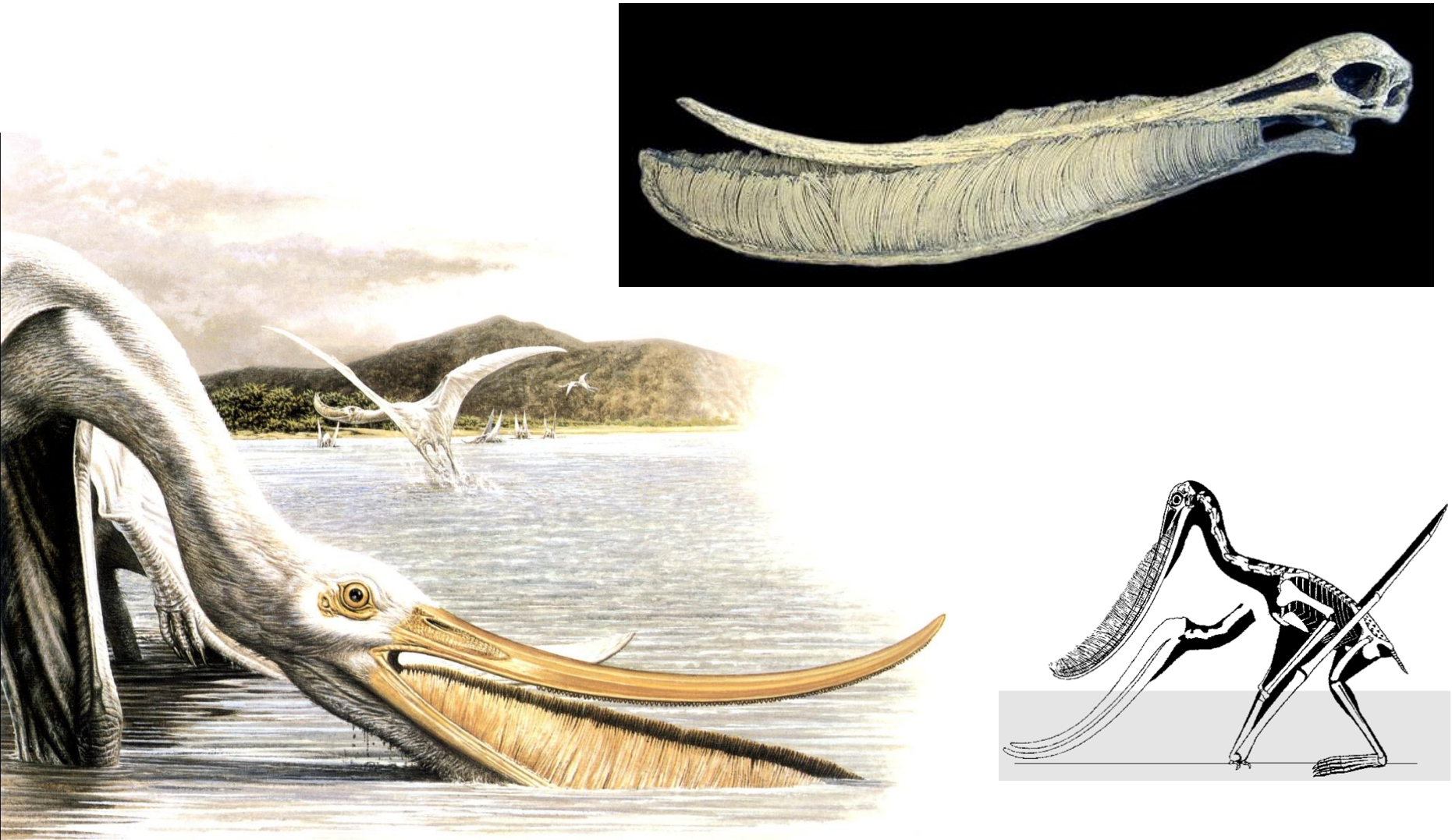


Pteranodontidae



Pterodactyloidea (Jurássico sup. - Cretáceo)

Pterodaustro: Ctenochasmatidae relictual no Cretáceo inferior
(Fm. Lagarcito, San Luis, Argentina)

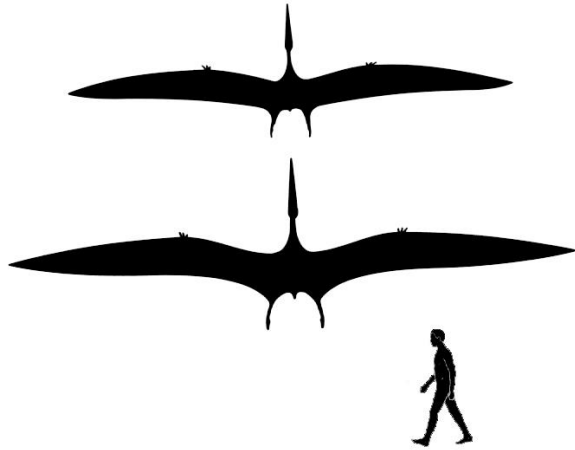


Pterodactyloidea (Jurássico sup. - Cretáceo)

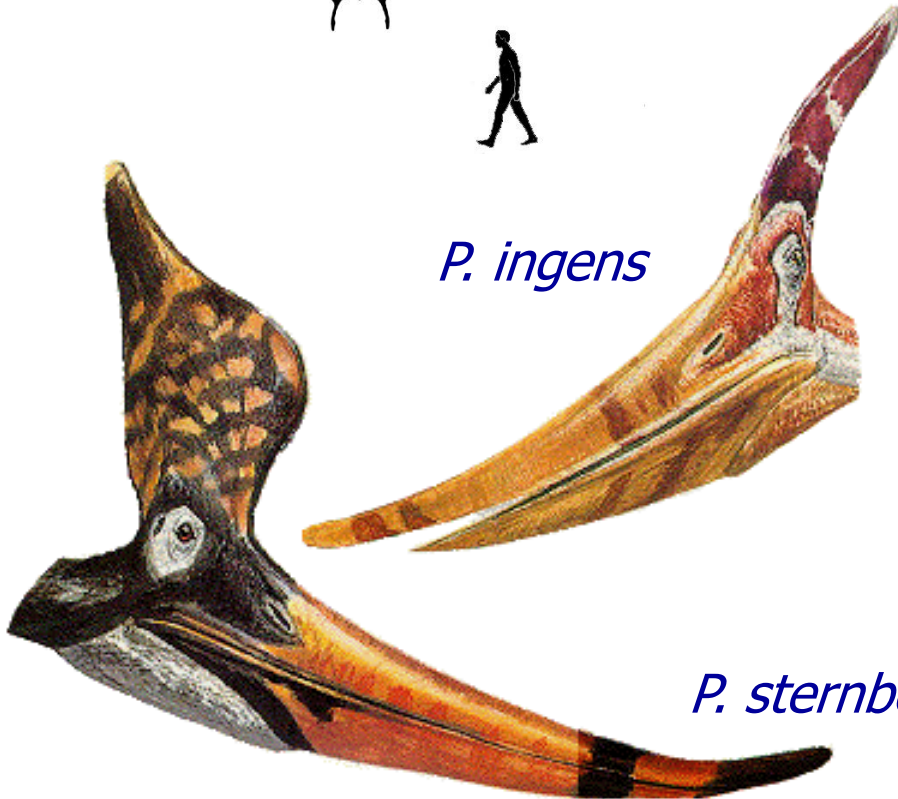


Pterodactyloidea (Jurássico sup. - Cretáceo)

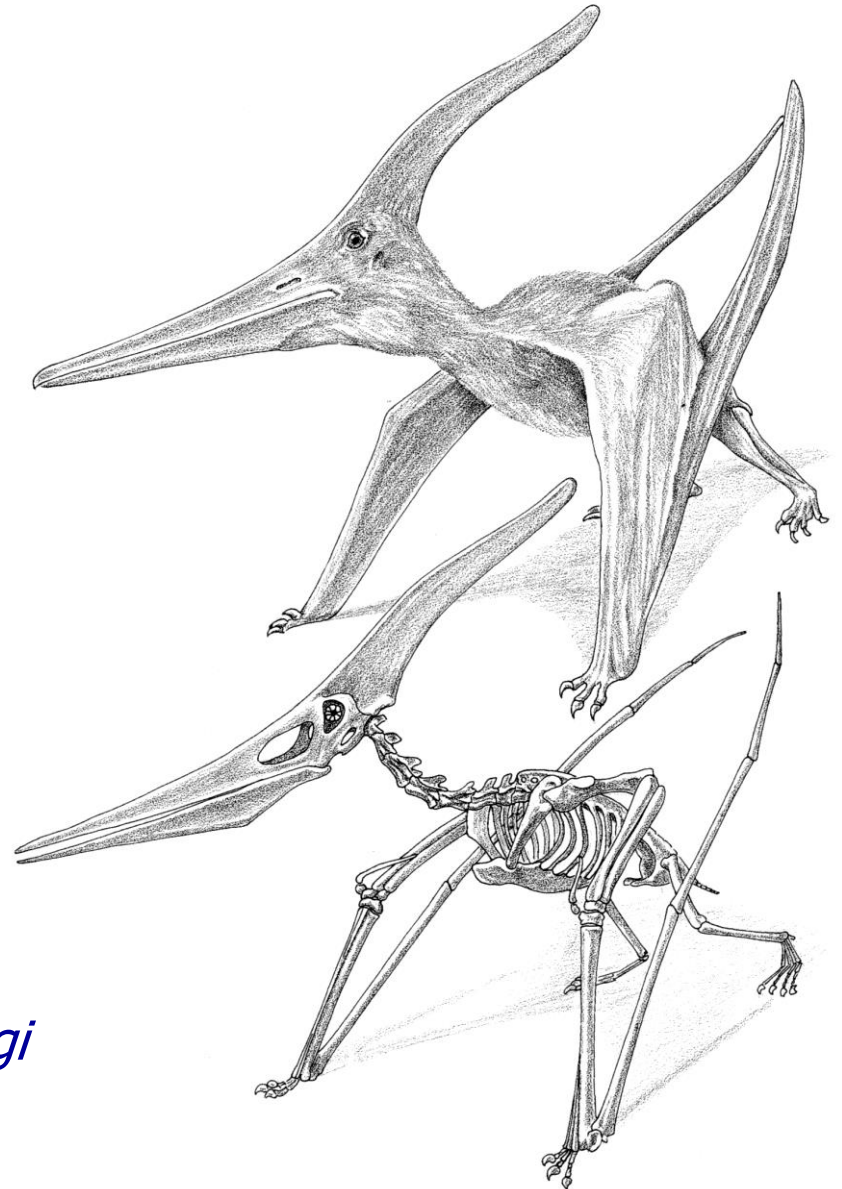
Ornithocheiroidea (Cretáceo): duas espécies de *Pteranodon* (Niobara Chalk)



P. ingens



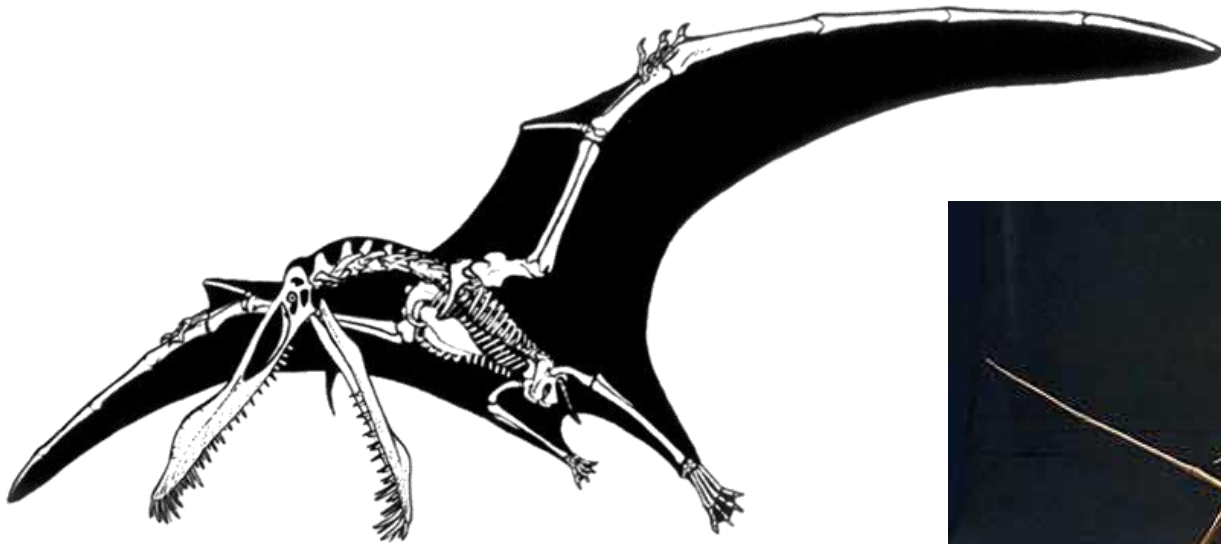
P. sternbergi



Ornithocheiroidea (Cretáceo inf. – sup.)

Anhanguera (Cretáceo inf., Chapada do Araripe)

Possíveis registro na Inglaterra, Niger, Marrocos, Austrália e Argentina



Tapejaridae (Cretáceo inf., Brasil)



Tupandactylus imperator

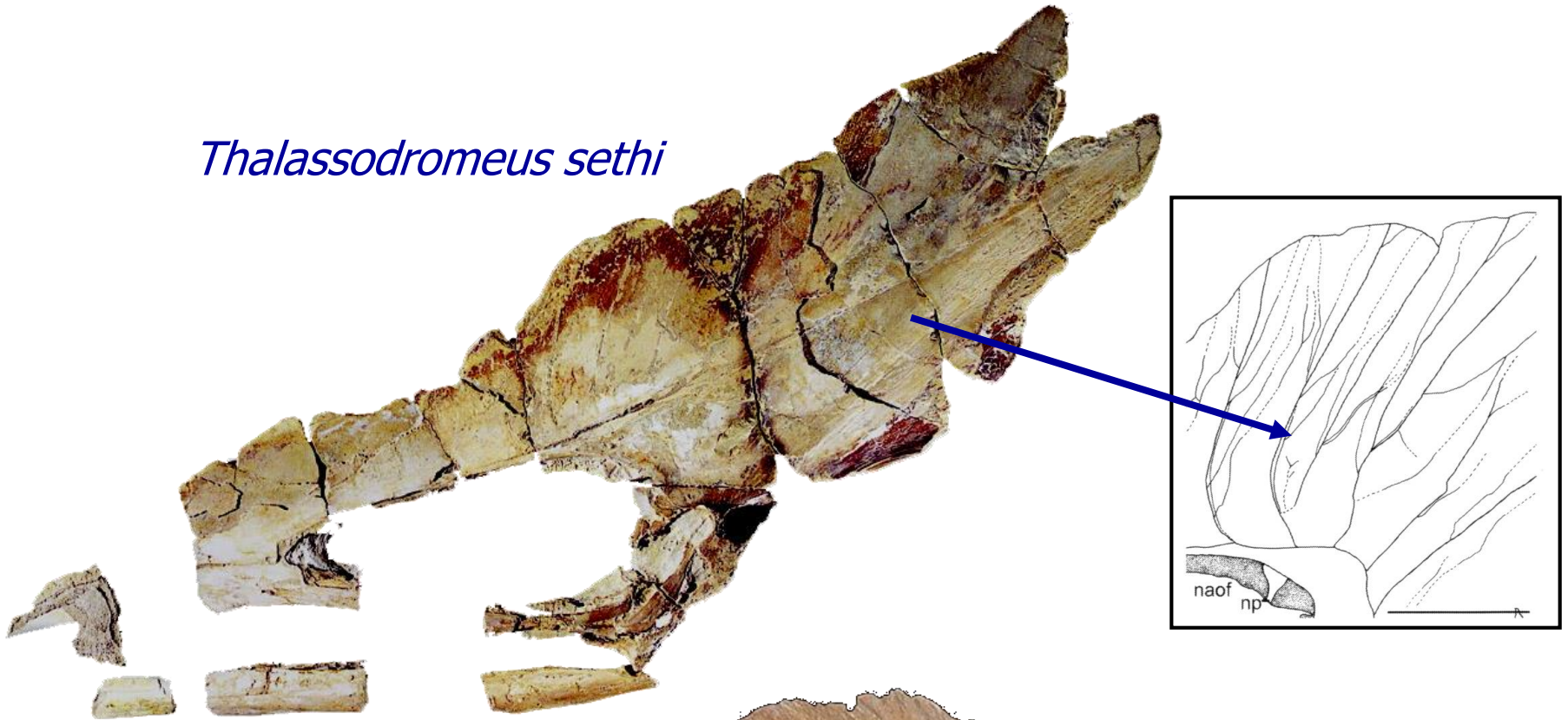


Tapejara wellnhoferi



Tapejaridae (Cretáceo inf., Brasil)

Thalassodromeus sethi



Tupuxuara



Azhdarchidae (Cretáceo inf.)

Distribuição global – vértebras cervicais alongadas

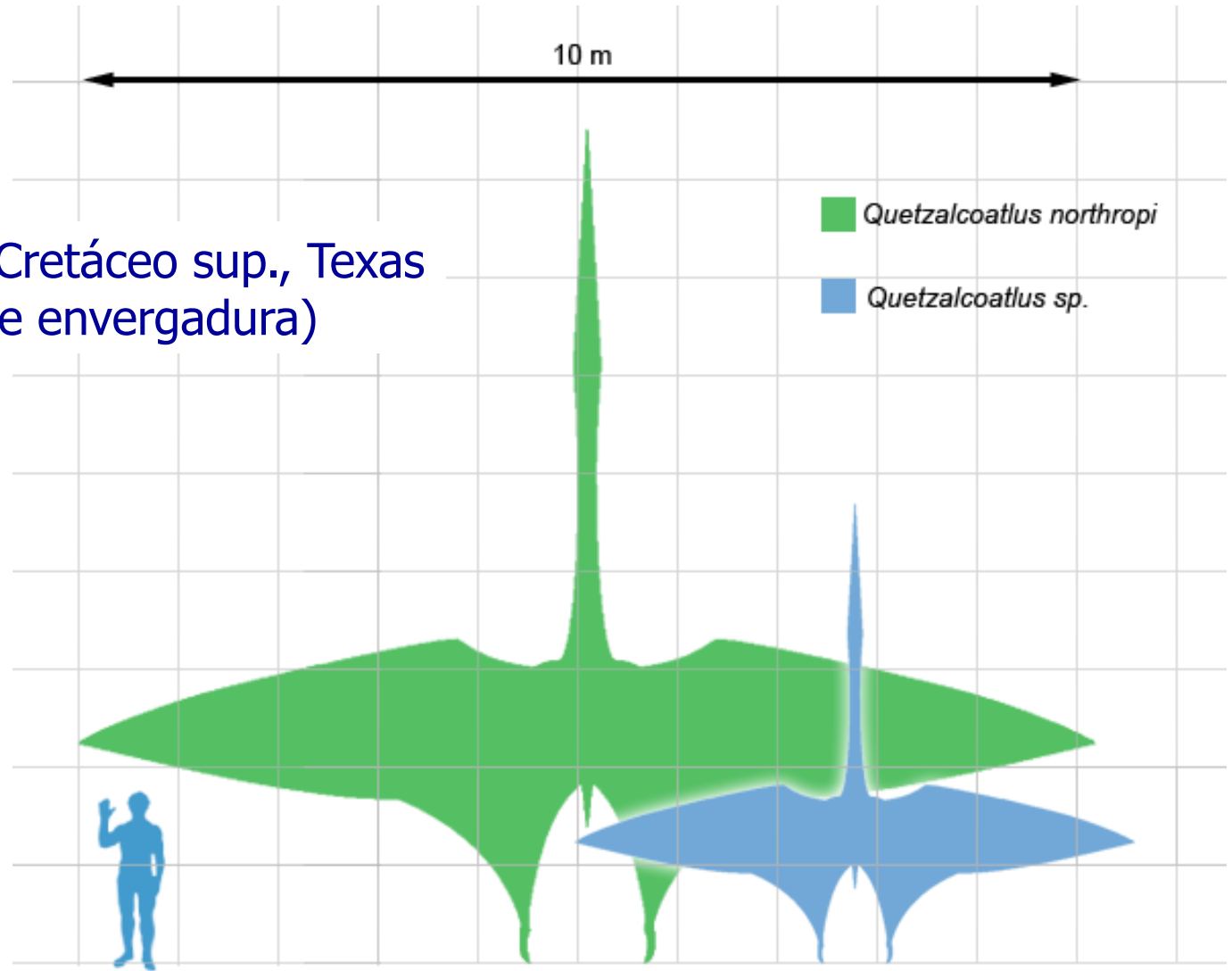


Quetzalcoatlus. Cretáceo sup., Texas
(10-15 m de envergadura)

Azhdarchidae (Cretáceo inf.)

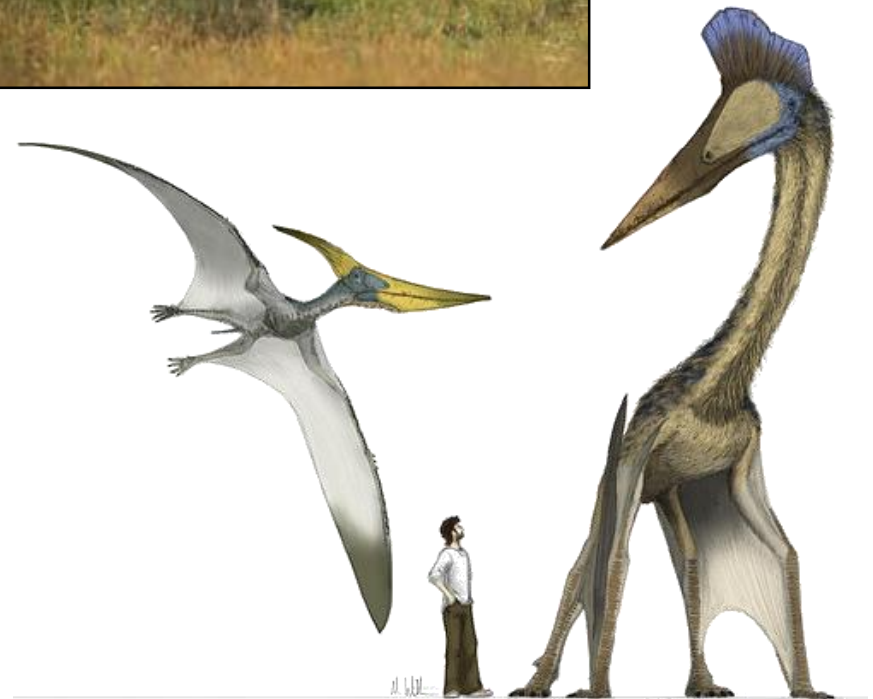
Distribuição global – vértebras cervicais alongadas

Quetzalcoatlus: Cretáceo sup., Texas
(10-15 m de envergadura)



Paleobiologia dos pterossauros

Quetzalcoatlus: condor ou cegonha?

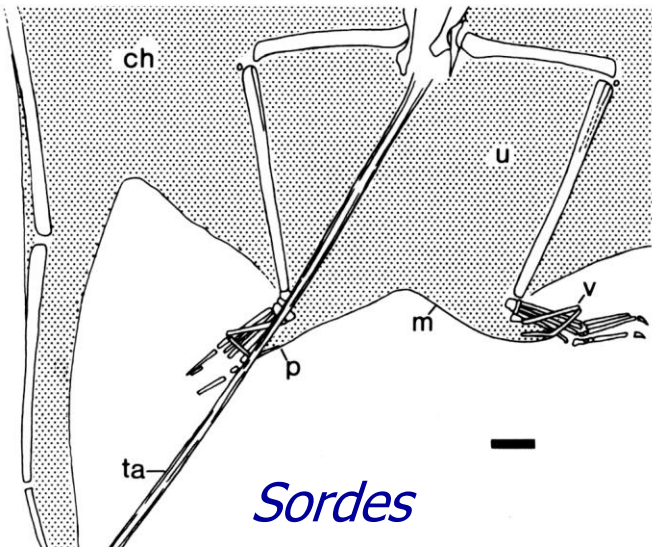
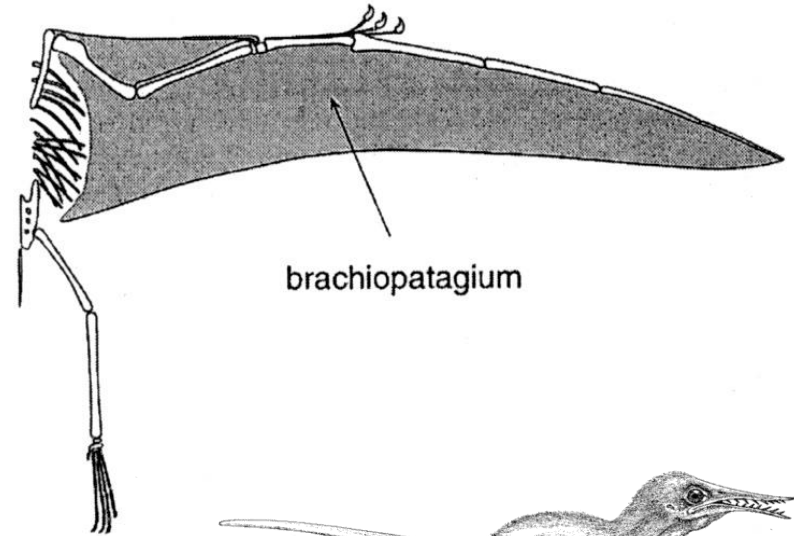
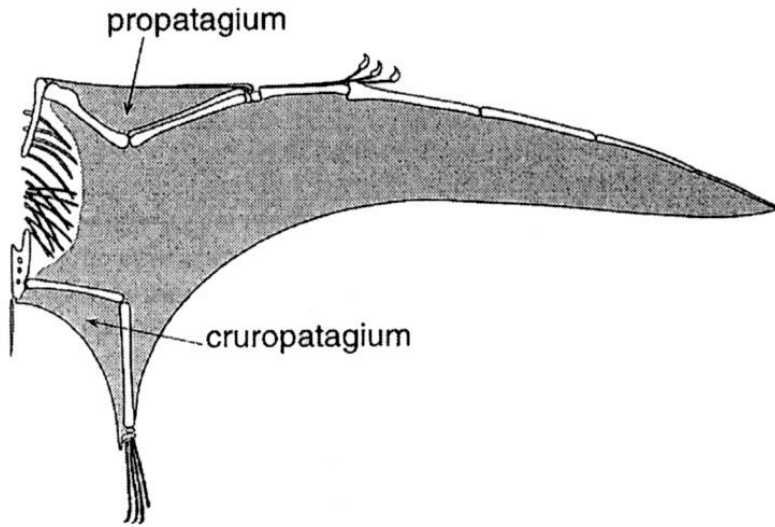


M. Witt

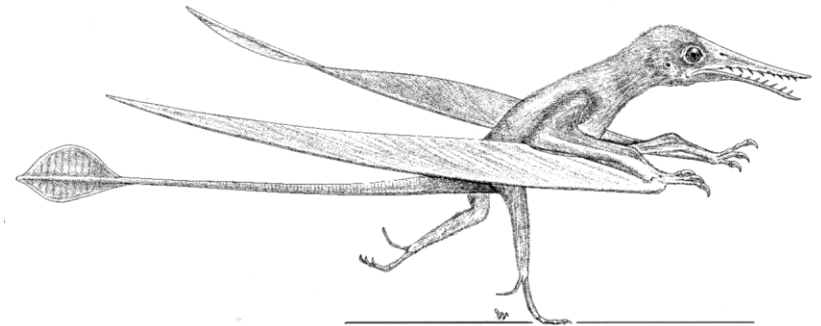
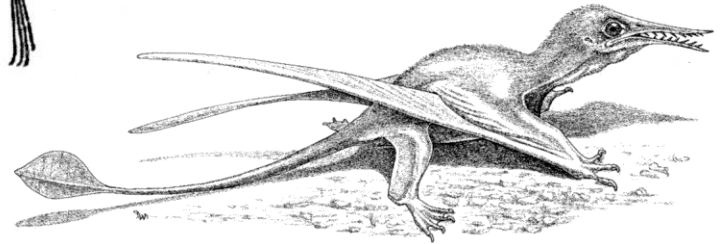


Paleobiologia dos pterossauros

Posicionamento das membranas



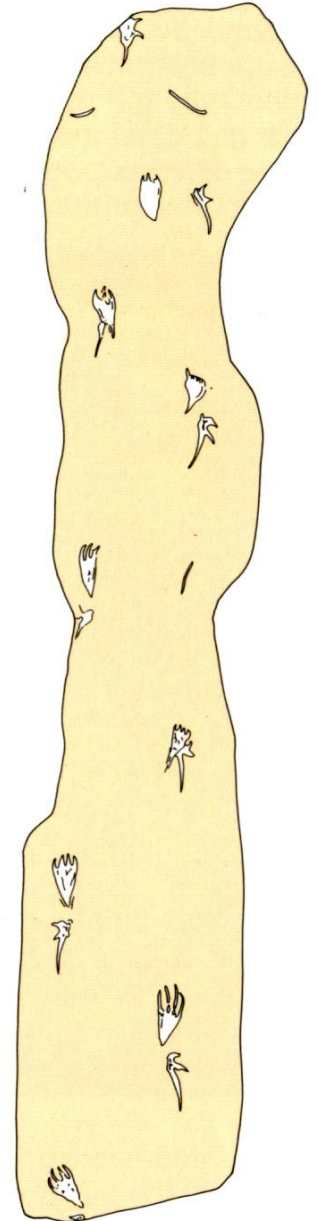
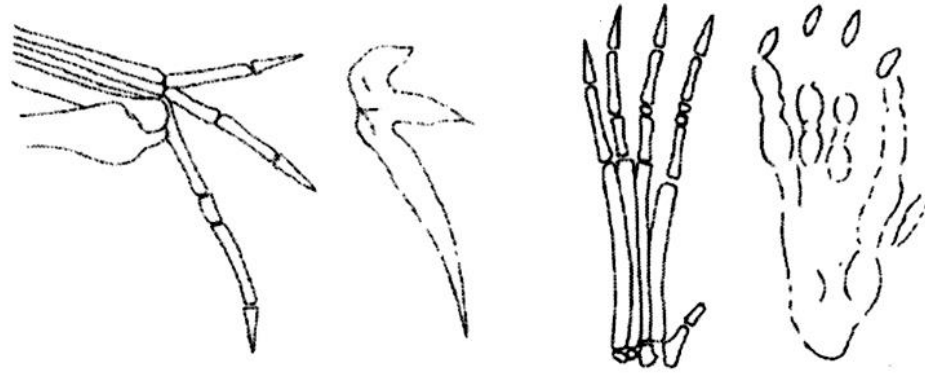
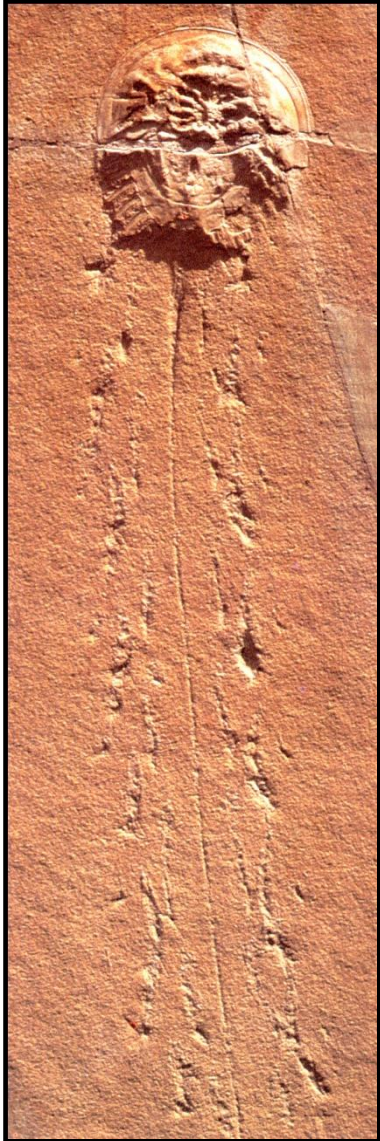
Sordes



Rhamphorhynchus

Paleobiologia dos pterossauros

Pistas (Crayssac, Fm. Morrison e Coréia)



Iguania (Jurássico médio - Recente)



Iguania indet. (Cretáceo sup., Mongólia)

Iguania (Jurássico médio - Recente)

Xioanglong: Cretáceo inf. (Liaoning, China)



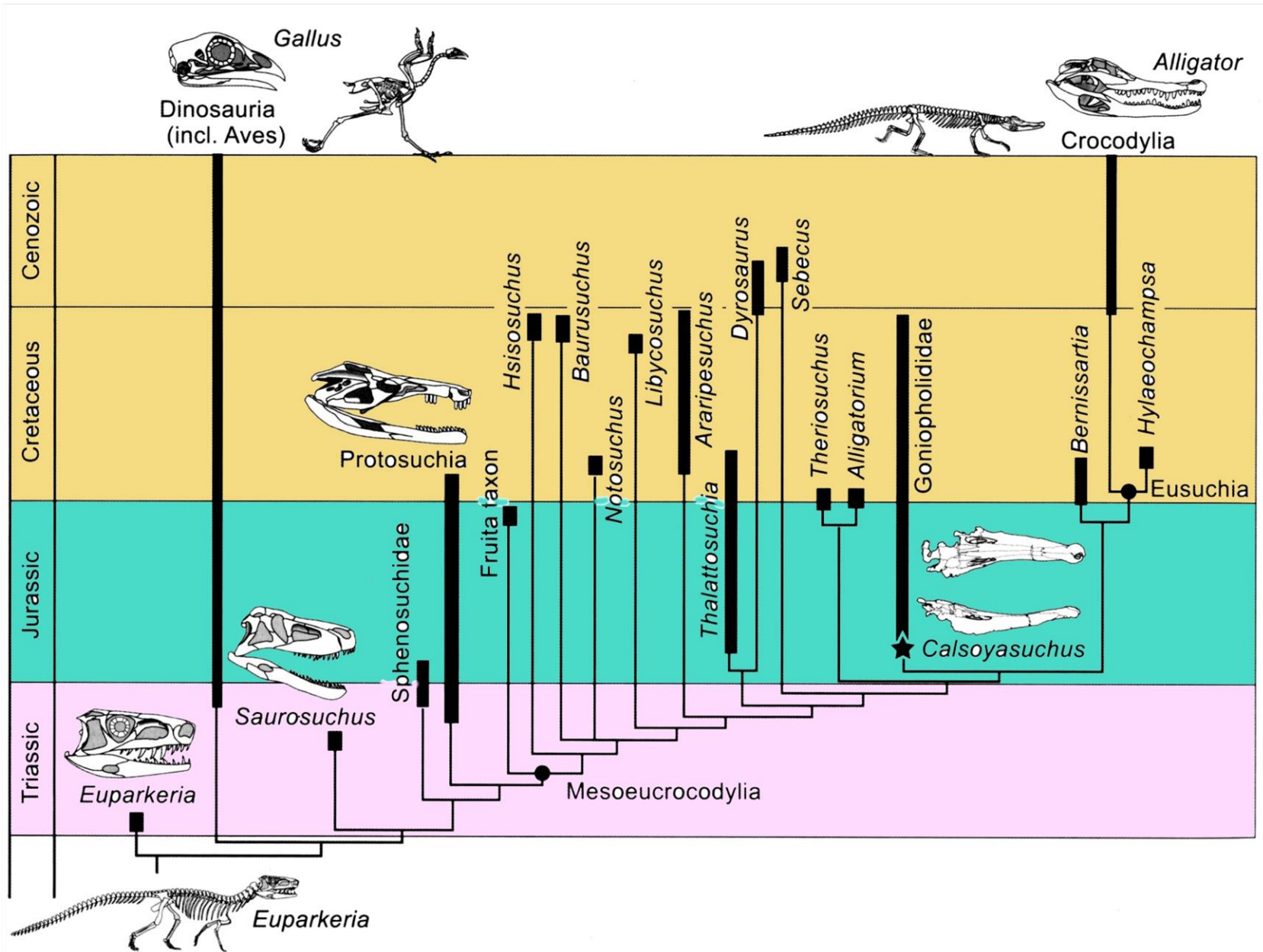
Serpentes (Cretáceo inf. - Recente)



Nahash rionegrina

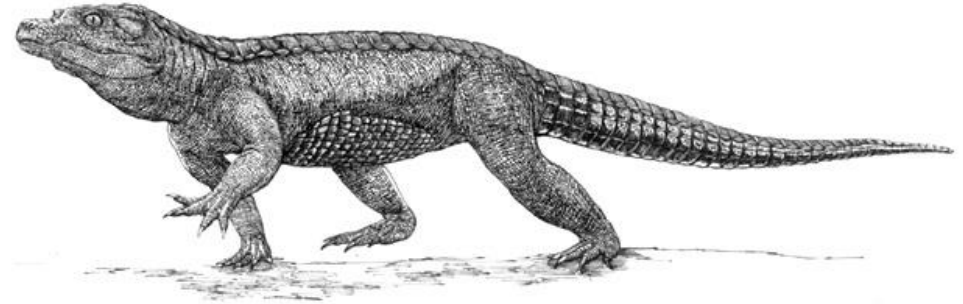
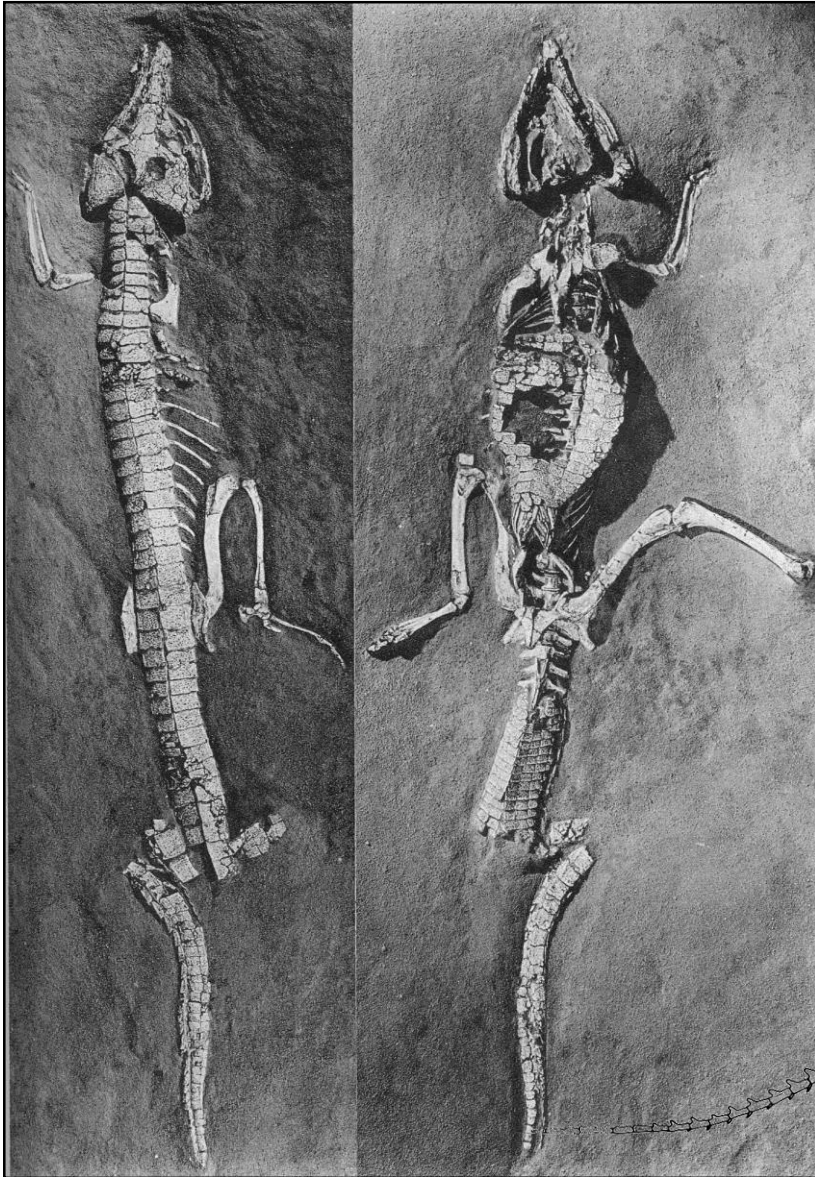
Cobra terrestre (fossorial) com patas traseiras
Cenomaniano-Turoniano da Argentina

Crocodyliformes (Triássico sup. - Recente)

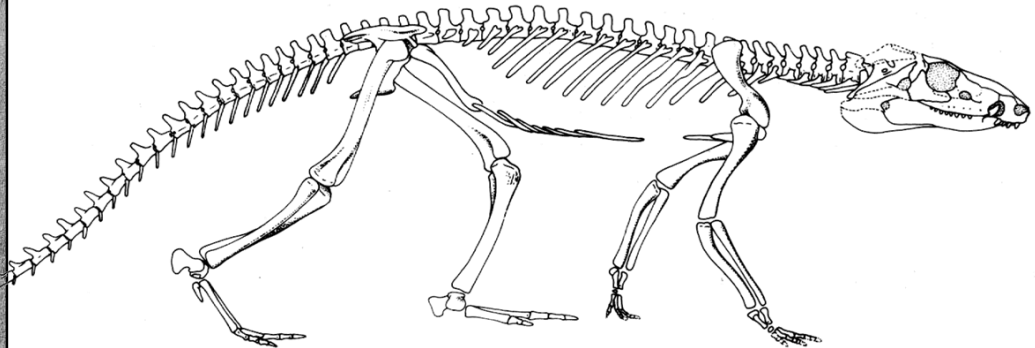


Crocodyliformes (Triássico sup. - Recente)

“Protosuchia” (Triássico sup.- Jurássico inf.): formas mais terrestres

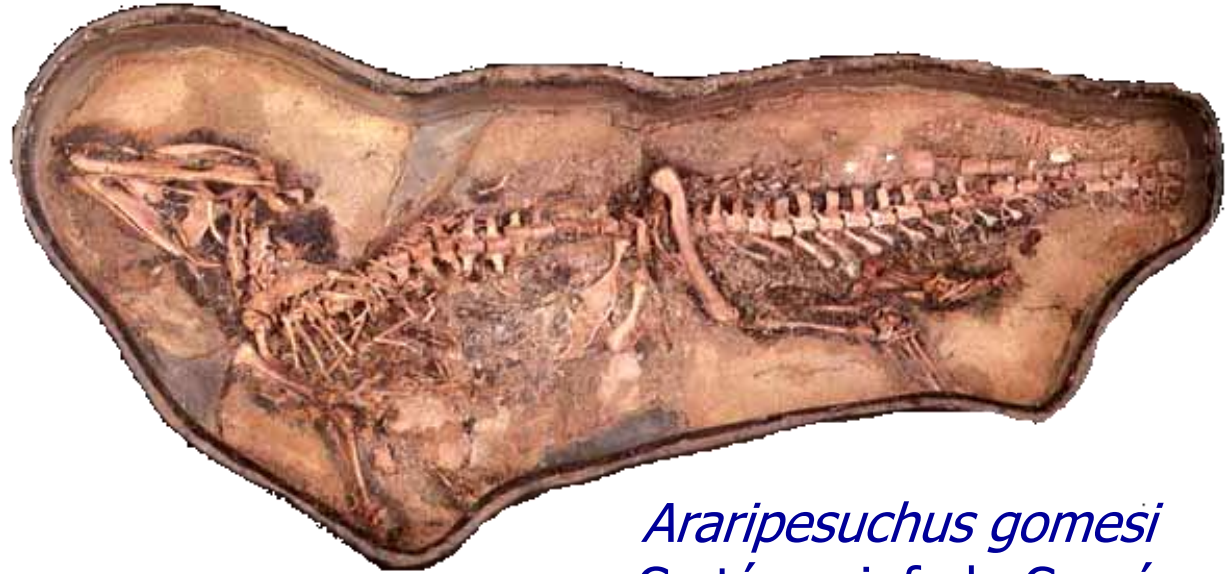


Protosuchus, Jurássico inf., EUA

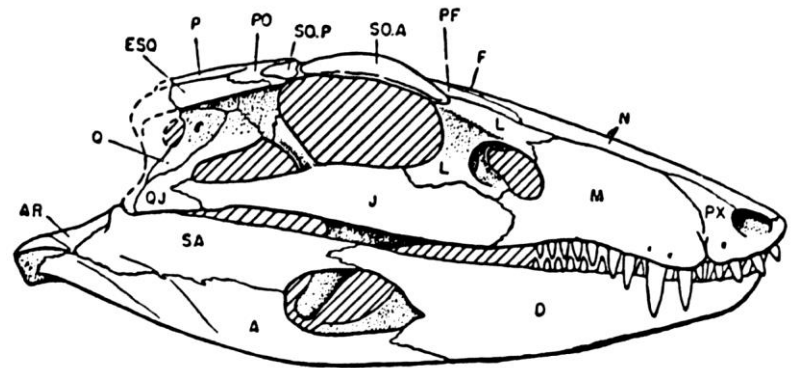
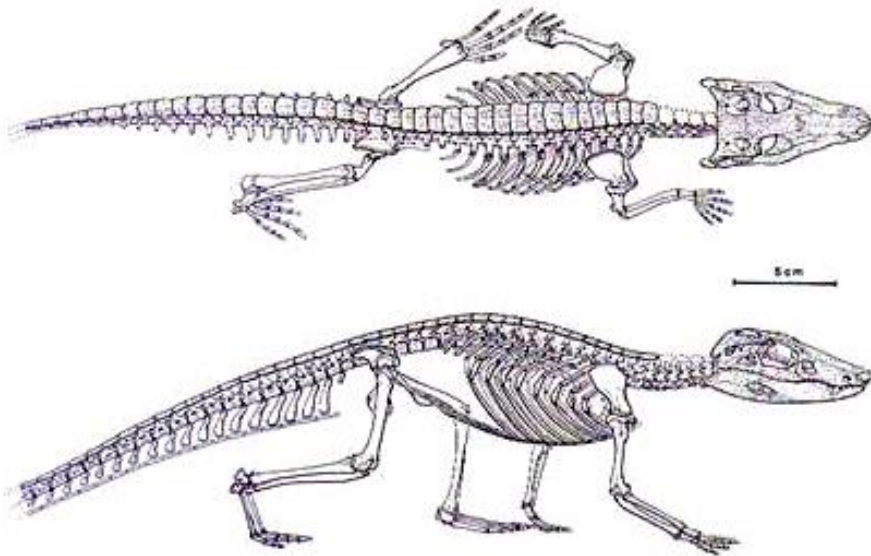


"Notosuchia" (Cretáceo inf.-sup.)

Pode incluir *Araripesuchus* na base (ou mais próximo à Neosuchia)

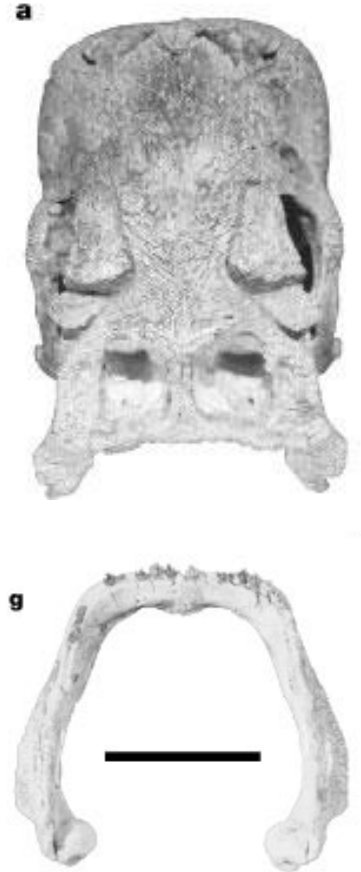


Araripesuchus gomesi
Cretáceo inf. do Ceará



“Notosuchia” (Cretáceo inf.-sup.)

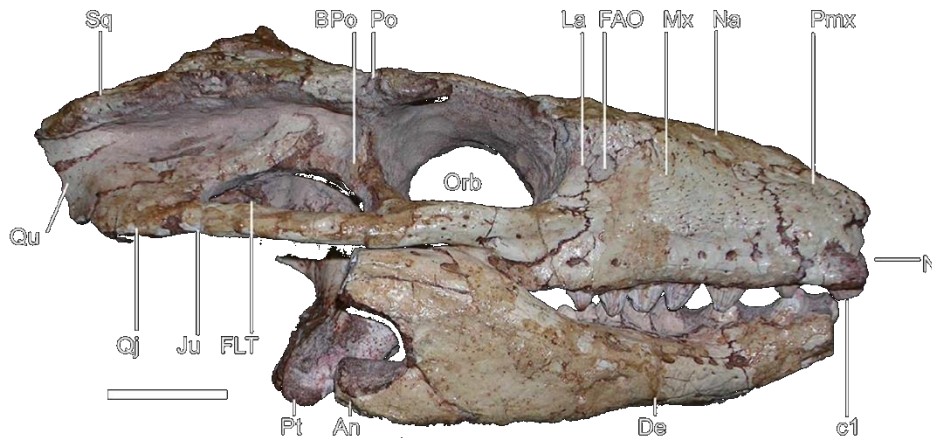
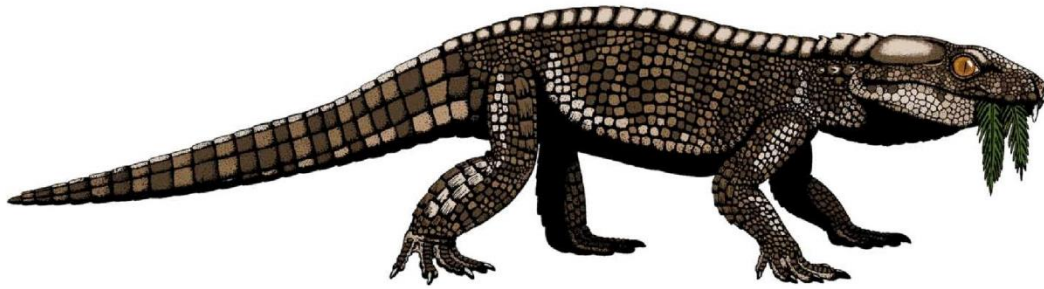
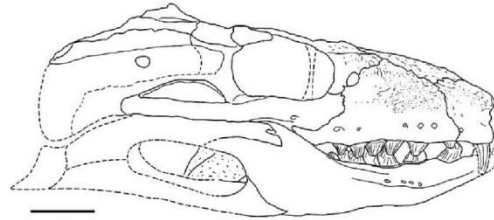
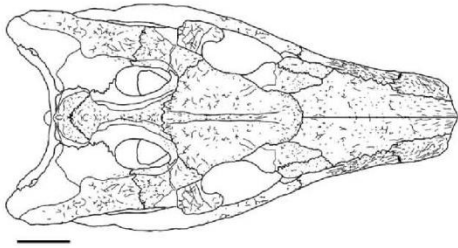
Notosuchia *sensu stricto*: formas do Cretáceo (maiormente) Gondwanico
Alguns com adaptações á herbivoria (ou necrofagia)



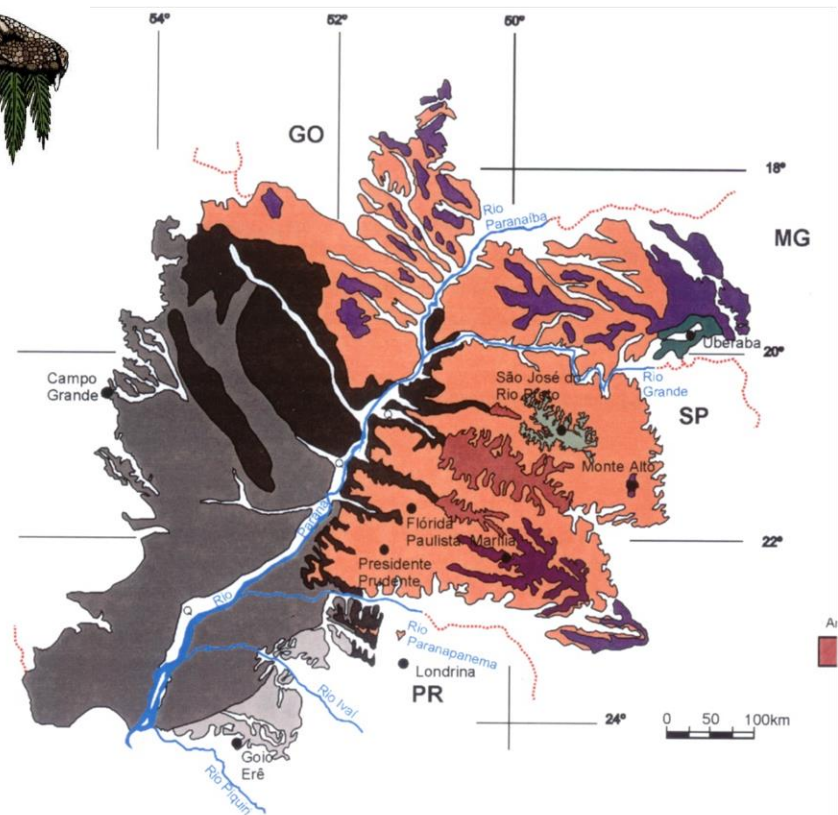
Simosuchus
Cretáceo sup., Madagascar

"Notosuchia" (Cretáceo inf.-sup.)

Notosuchia: no Brasil



Sphagesaurus montealtensis
Cretáceo sup., São Paulo

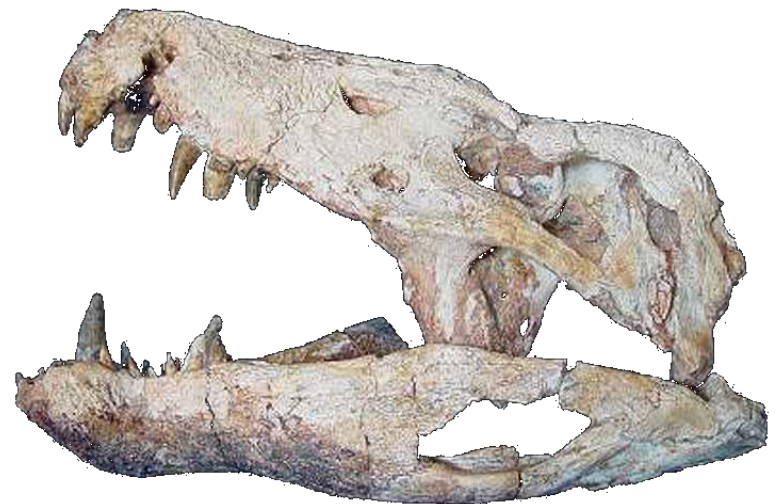
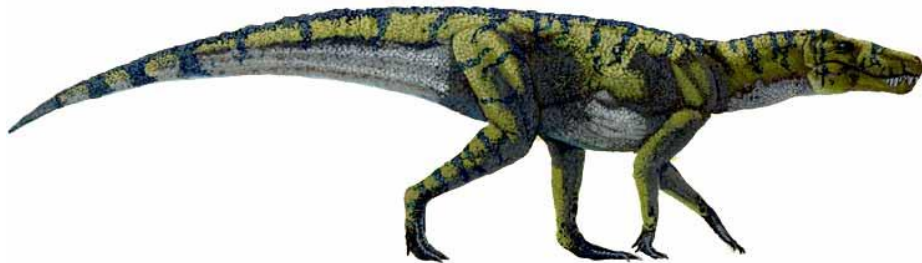


"Notosuchia" (Cretáceo inf.-sup.)

Inclui Baurusuchidae (Cretáceo sup. Brasil e Paquistão)



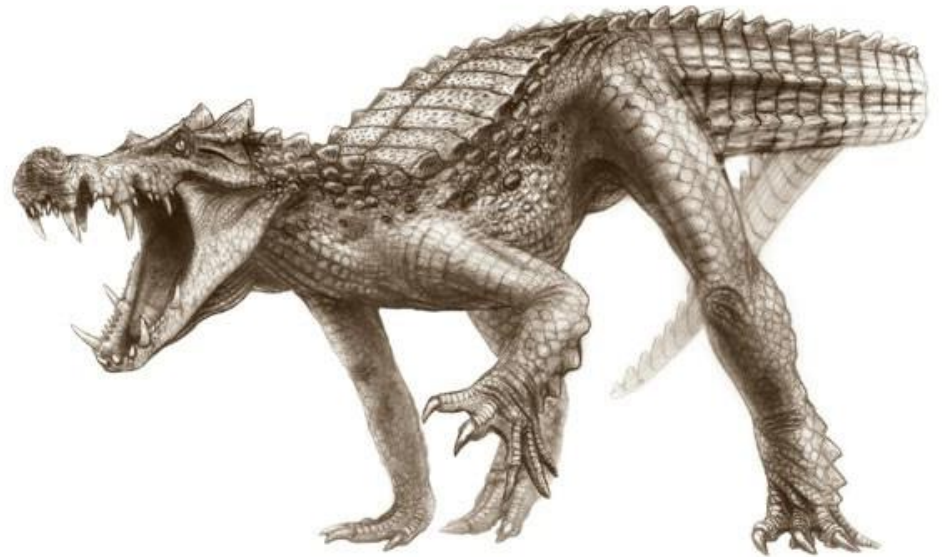
Baurusuchus pachecoi
Baurusuchus salgadoensis
Cretáceo sup., São Paulo





"Mesosuchia" pró-Neosuchia

Kaprosuchus
Cretáceo inf. (Niger)



Neosuchia (Jurássico inf. - Recente)

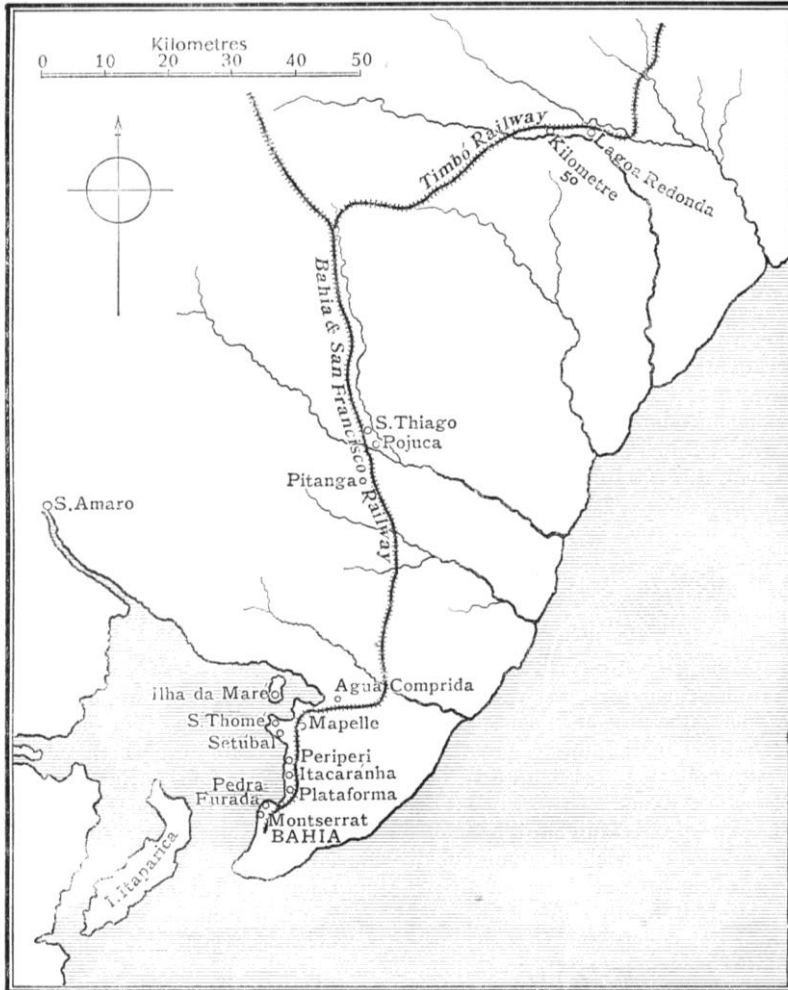
Sarcosuchus imperator (Cretáceo inf. Niger): até 12 m



Neosuchia (Jurássico inf. - Recente)

Dentes isolados e uma vértebra da Bacia do Recôncavo (Cretáceo)

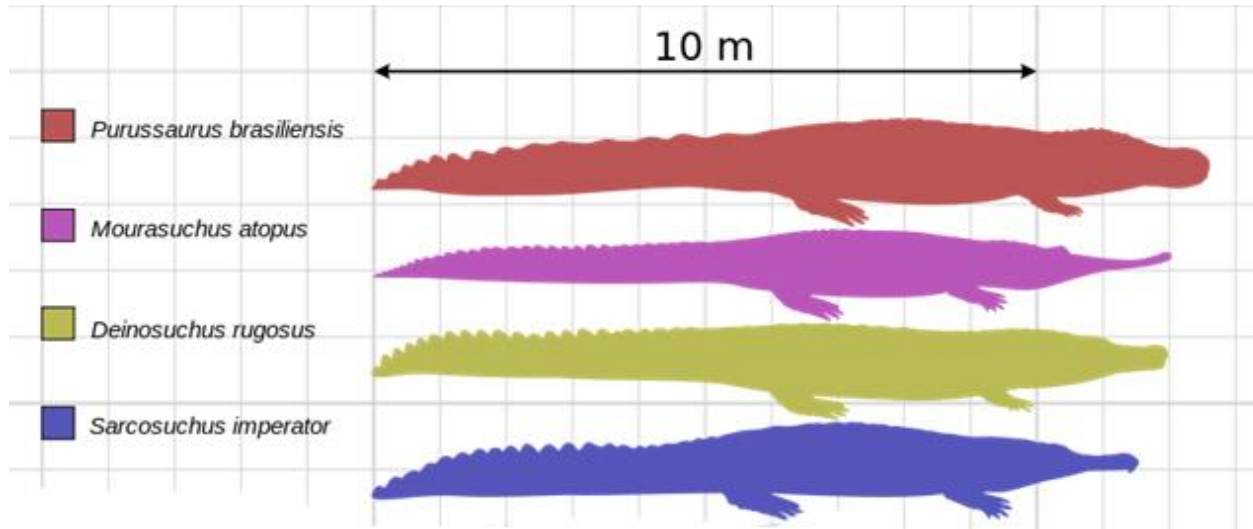
Map showing the localities where Cretaceous fossils were found.



Sarcosuchus hartti



Os maiores crocodilos

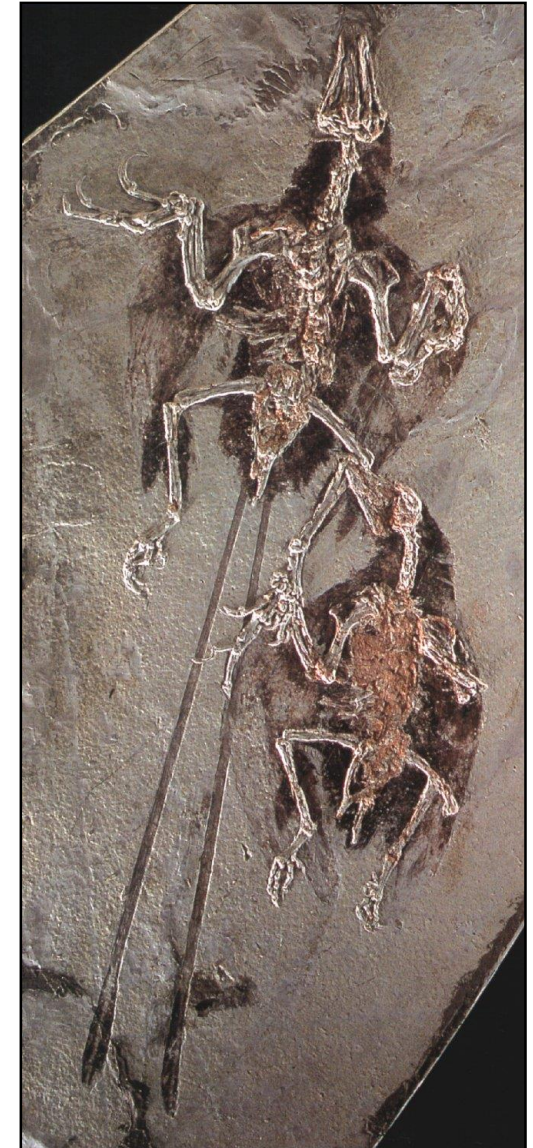


Deinosuchus
Cretáceo sup., EUA
de 10 a 15 m

Aves (Jurássico sup. - Recente)

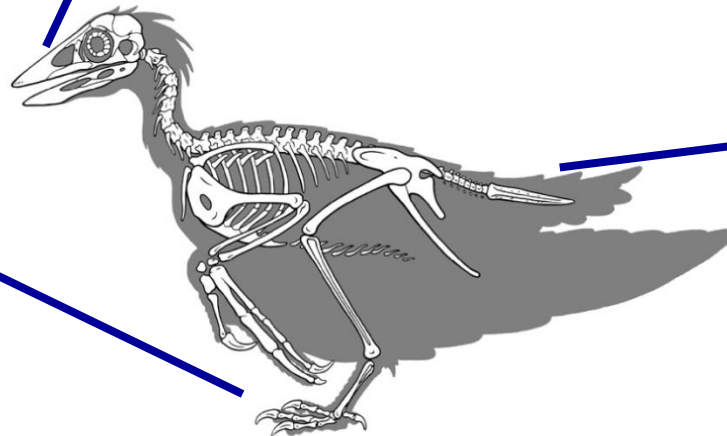
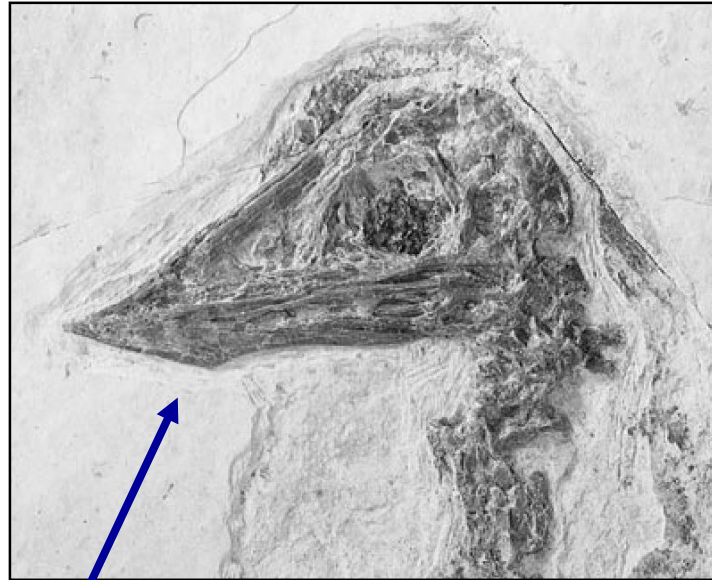
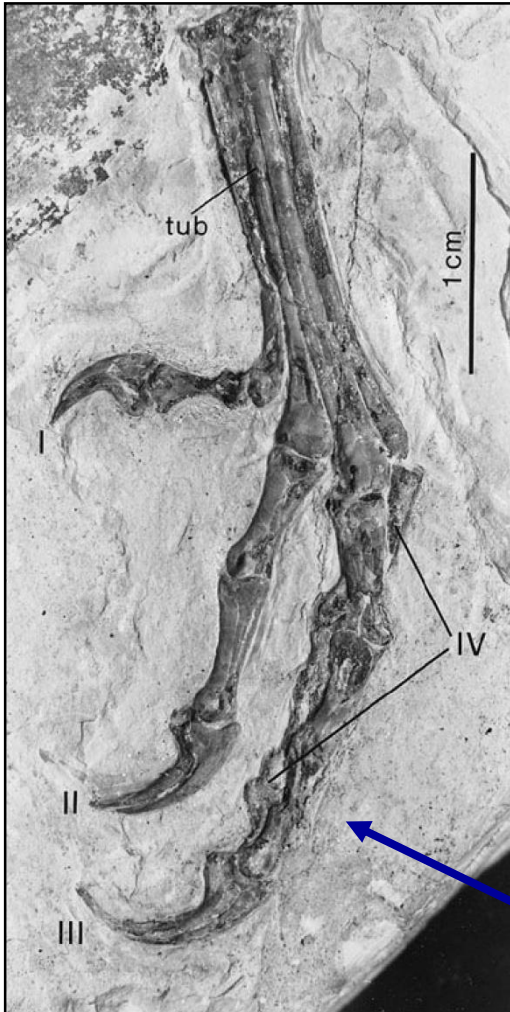
Confuciusornithidae (Cretáceo inf., China): aves de pequeno tamanho

Confuciusornis sanctus
Fm. Yichian, Liaoning
dimorfismo sexual?



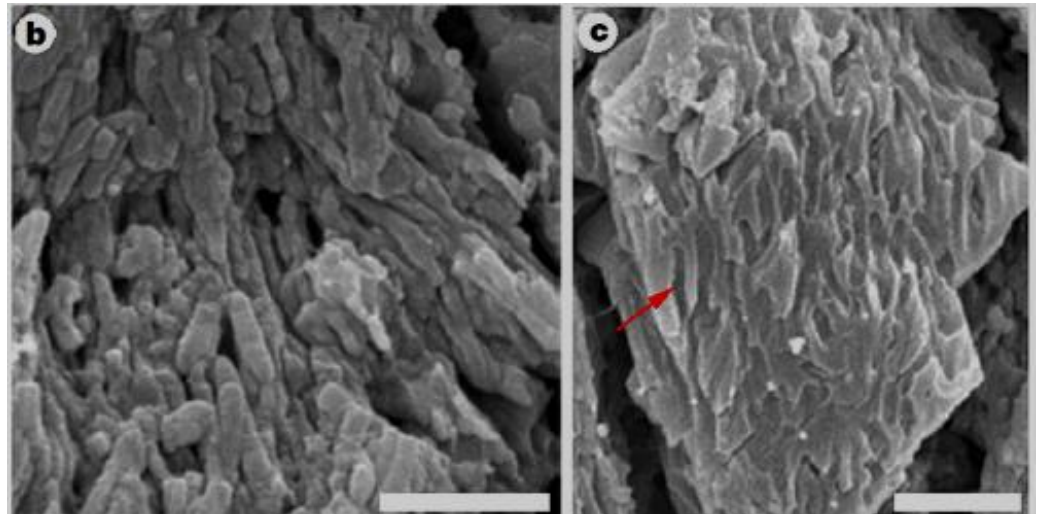
Aves (Jurássico sup. - Recente)

Confusiusornis (Cretáceo inf., China): sem dentes e com ranfoteca pigóstilo, *hallux* oponível e metatarsais fundidos proximalmente



Aves (Jurássico sup. - Recente)

Confusiusornis (Cretáceo inf., China): melanosomos sugere coloração com tons de cinza, vermelho e negro

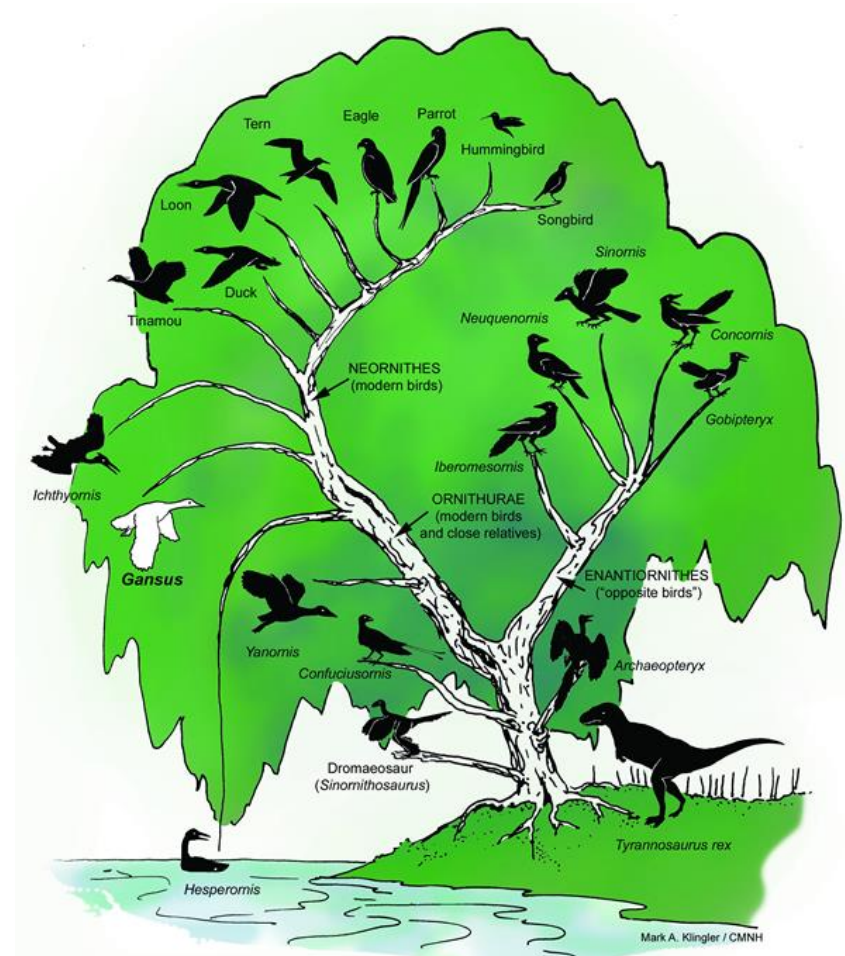
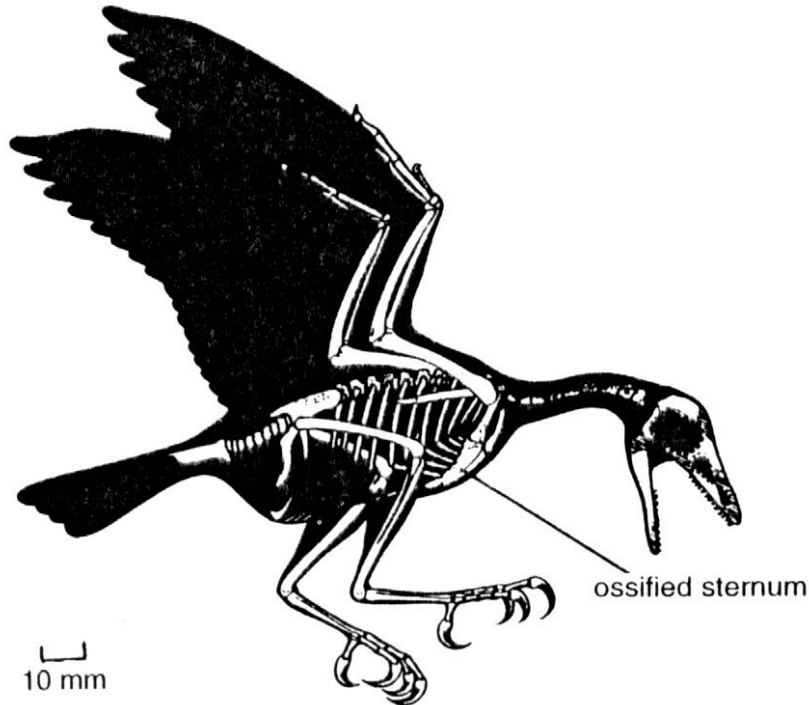


Aves (Jurássico sup. - Recente)

Enantiornithes (Cretáceo): adaptados as vida continental arborícola

Análogos aos "pássaros" atuais (capacidade voadora semelhante e *perching*)

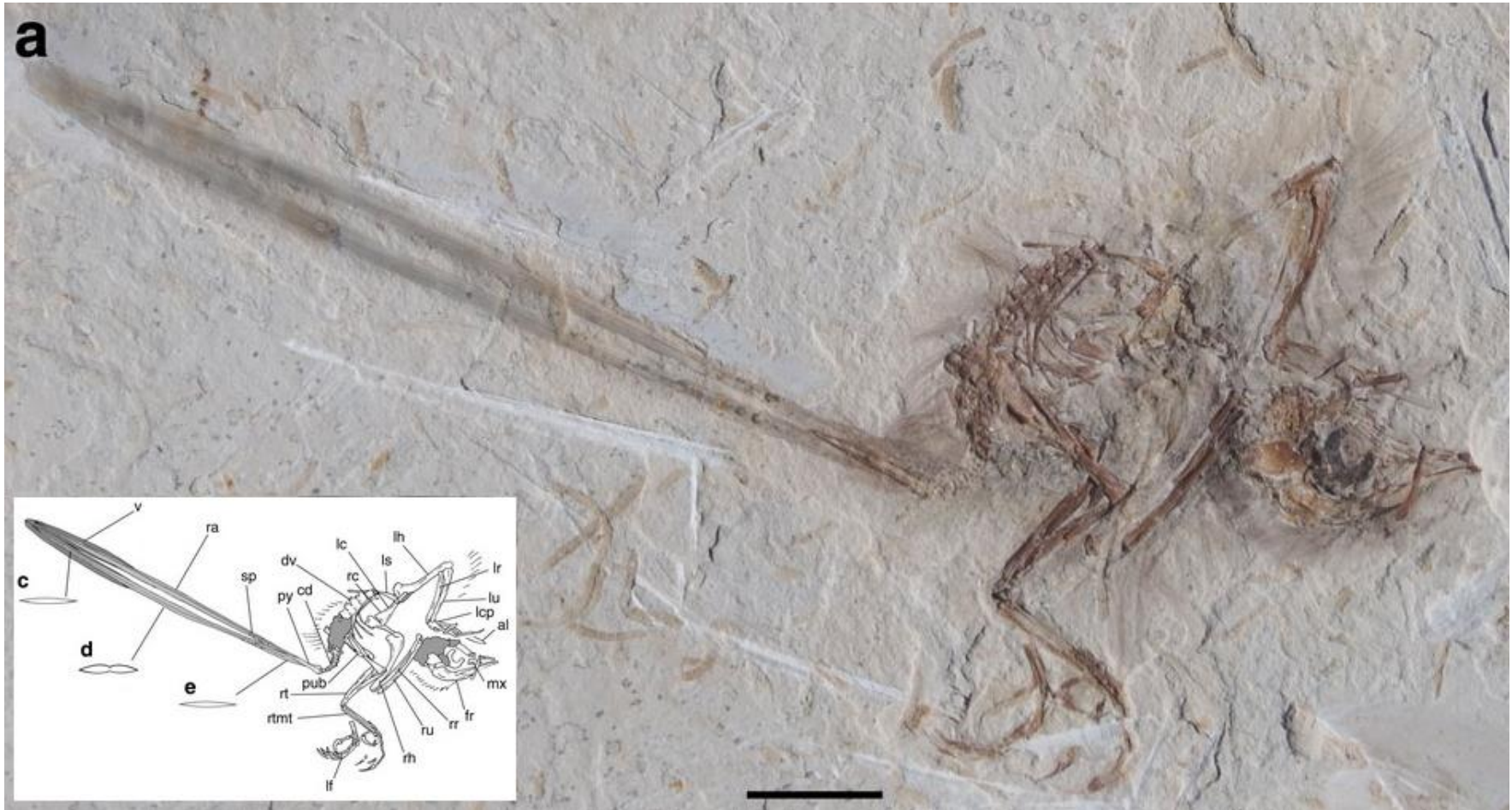
Sinornis - Fm. Yichian
Cretáceo inf. de Liaoning



Aves (Jurássico sup. - Recente)

Enantiornithes (Cretáceo): no Brasil

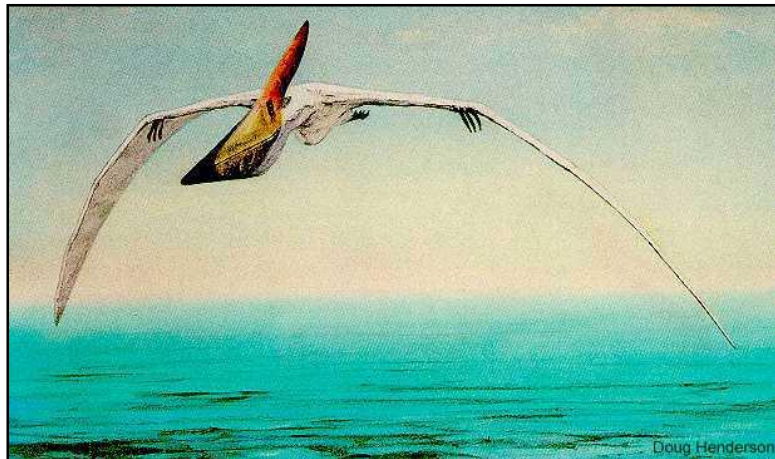
Cratoavis cearensis (Mb. Crato) Chapada do Araripe



Aves (Jurássico sup. - Recente)

Especificidade ambiental de pterossauros e aves no final do Mesozóico

Aves mais adaptadas à ambiente florestado (assas mais resistentes)



Aves (Jurássico sup. - Recente)

Hesperornithiformes (Cretáceo sup.): radiação de formas mergulhadoras

Com dentes e sem capacidade de vôo (assas reduzidas)

Hesperornis (Niobara Chalk)
Cretáceo sup., Kansas



Aves (Jurássico sup. - Recente)

Ichthyornithiformes (Cretáceo sup.)

Grupo irmão de Neornithes (formando Carinata)

Ichthyornis (Niobara Chalk)

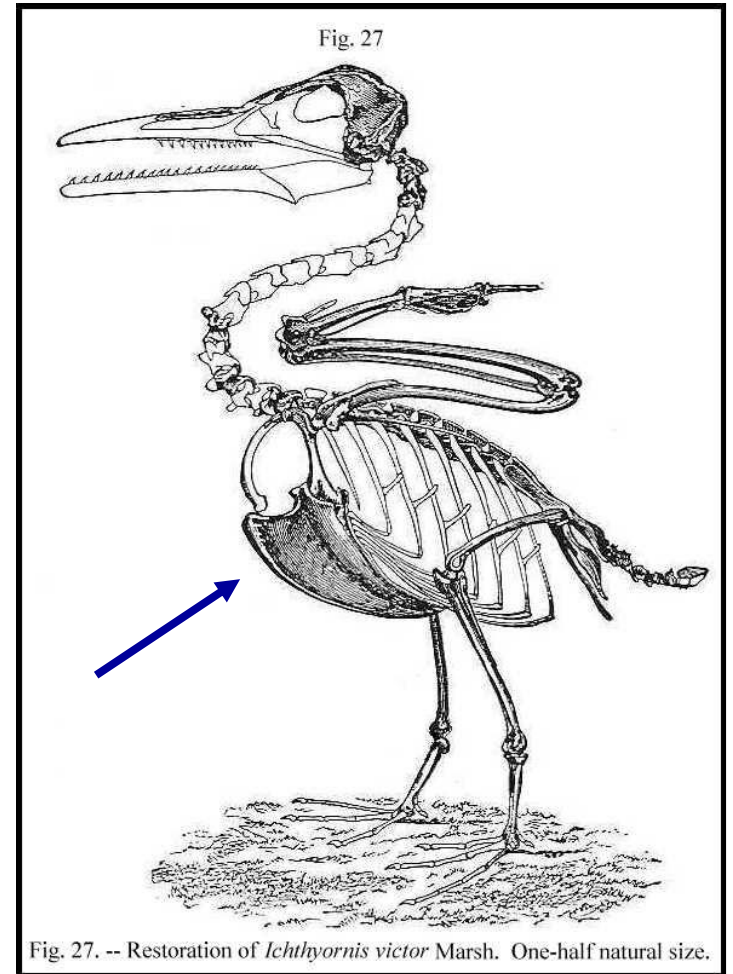
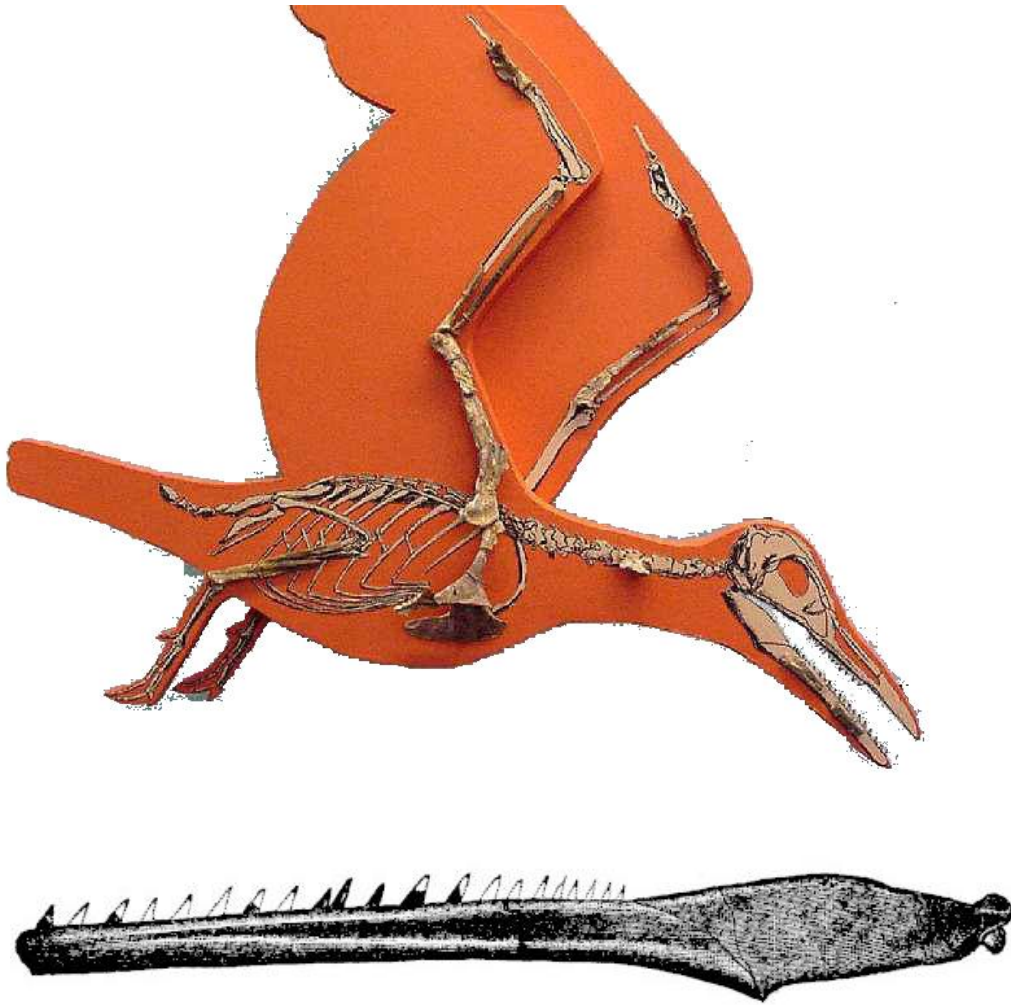
Menor que *Hesperosnis*,
assas bem desenvolvidas



Aves (Jurássico sup. - Recente)

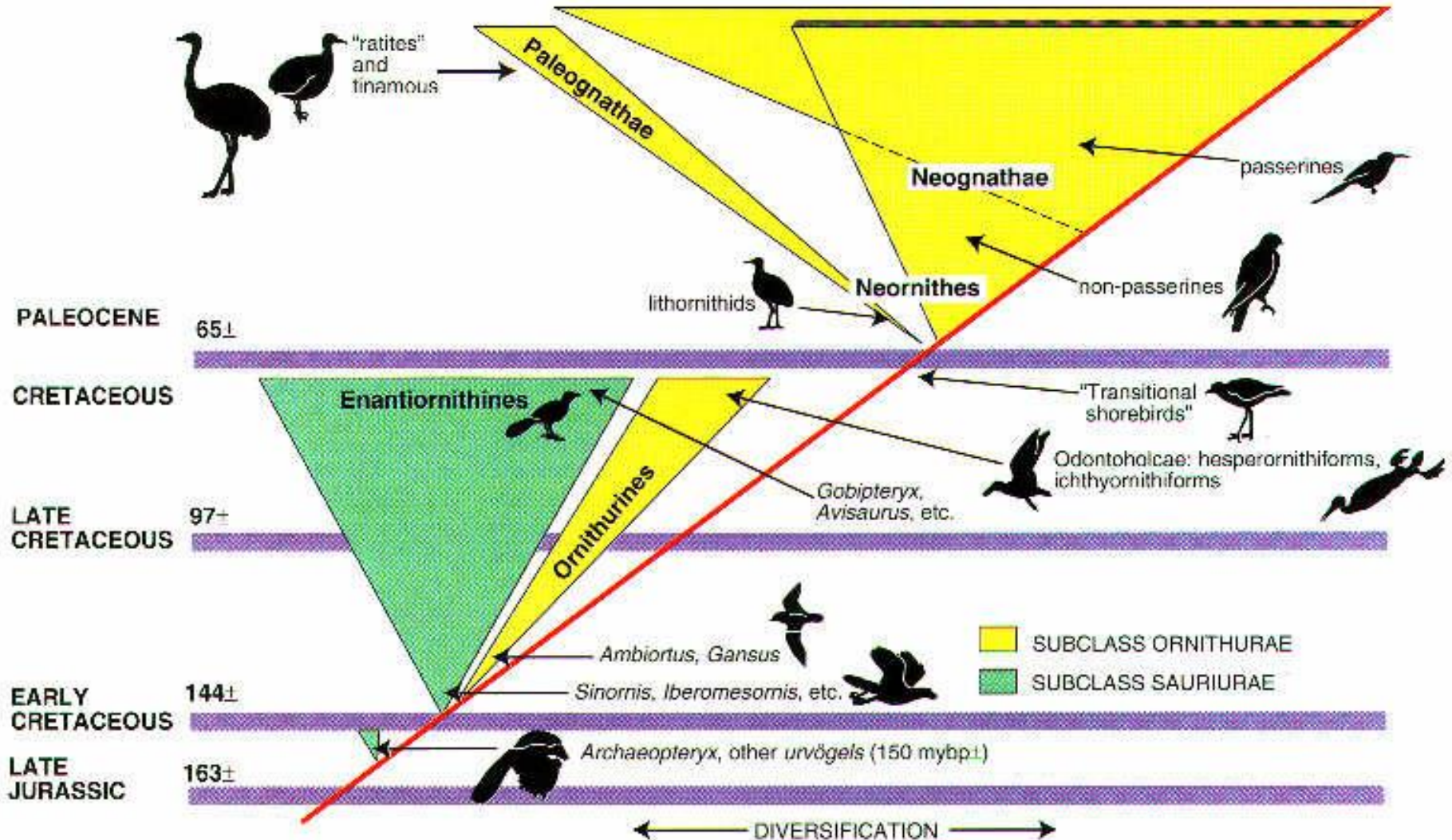
Ichthyornithiformes (Cretáceo sup.)

Apomorfia: externo com quilha bem desenvolvida

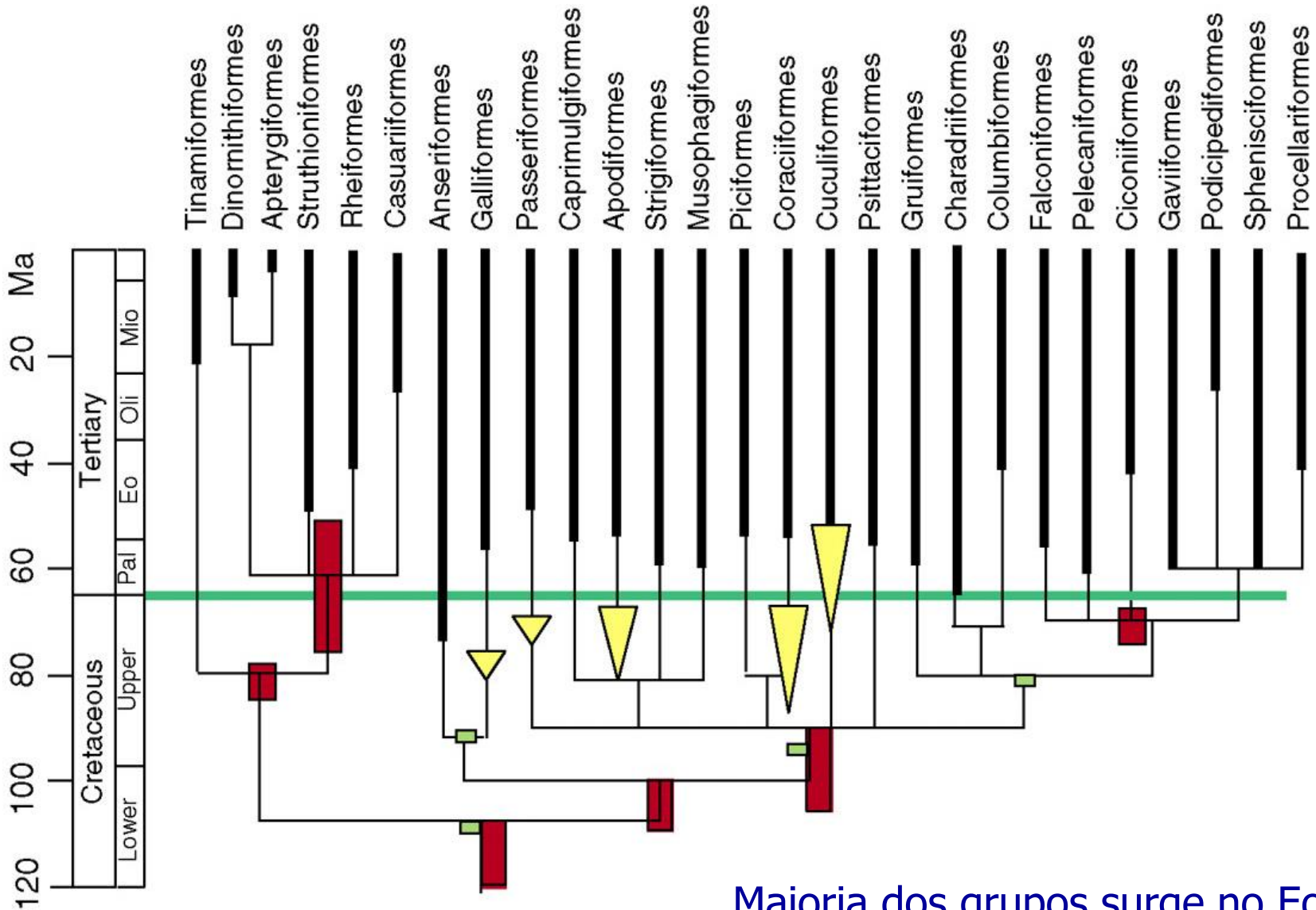


Neornithes (Cretáceo sup. - Recente)

Apomorfias: ausência de dentes e da grastrália

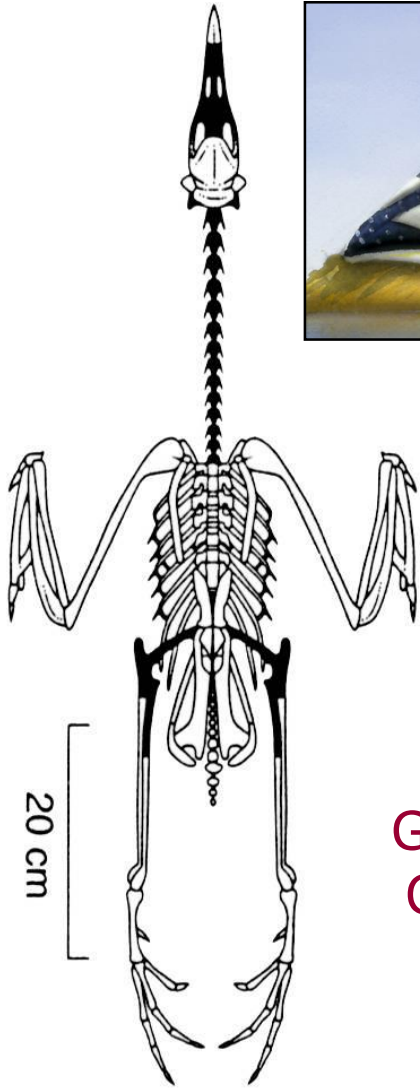


Neornithes (Cretáceo sup. - Recente)

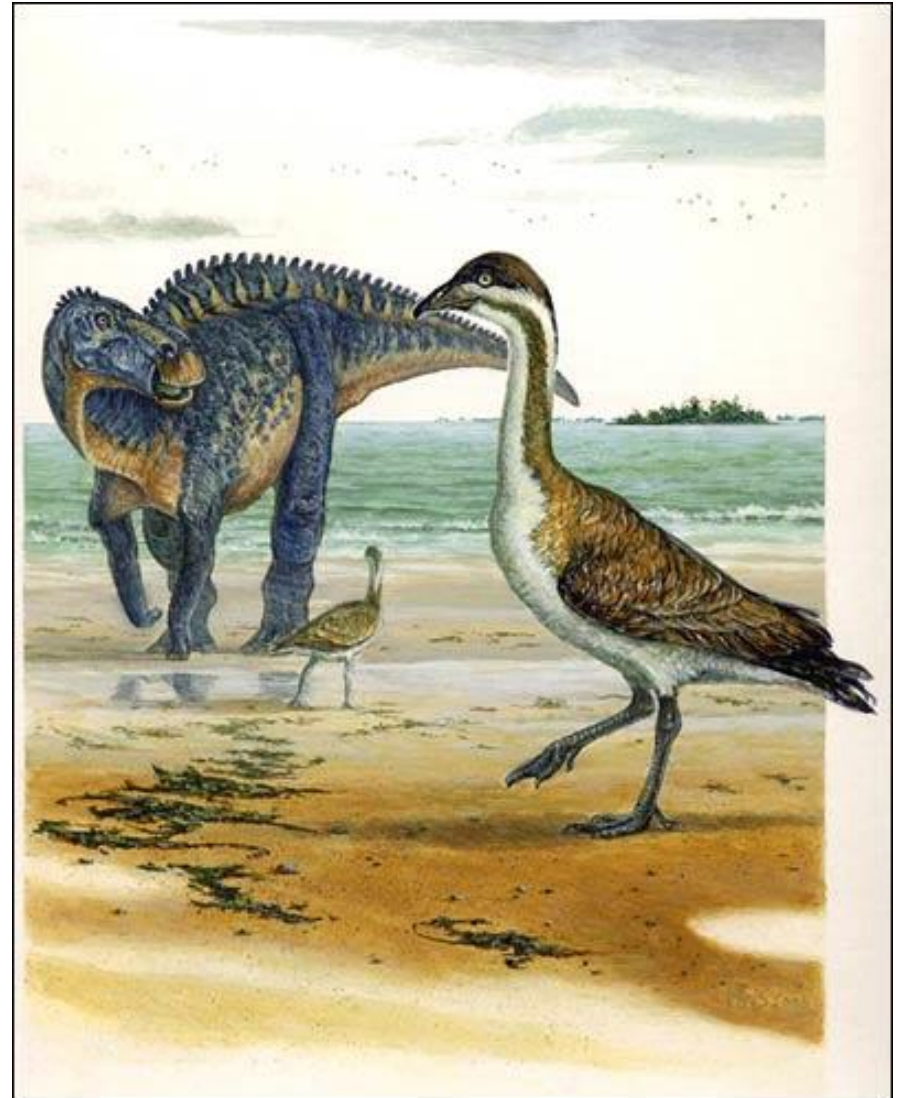


Maioria dos grupos surge no Eoceno
Divergência com relação aos estudos de relógio-molecular

Neornithes (Cretáceo sup. - Recente)



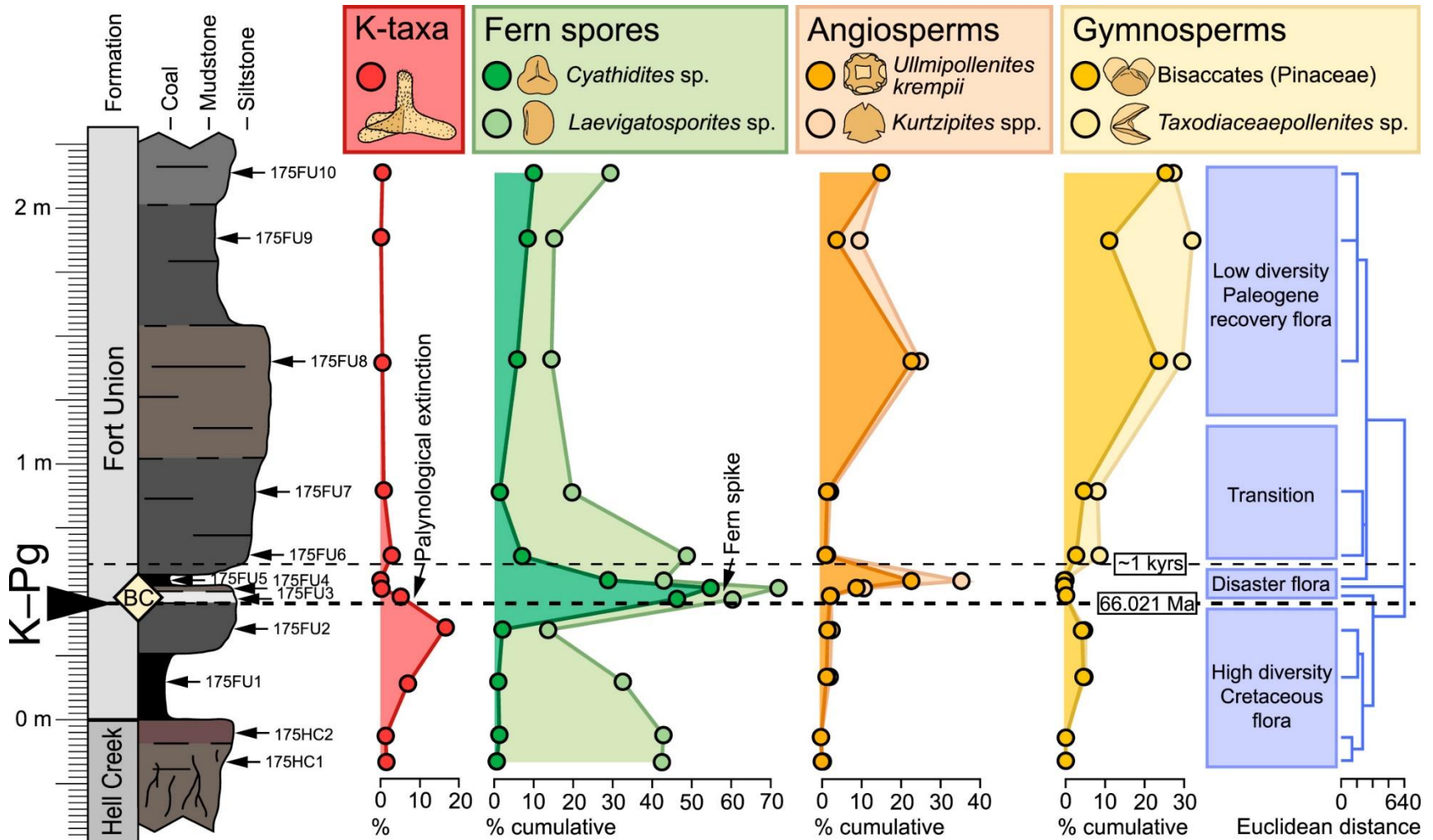
Polarornis:
possível
Gaviiformes do
Cretáceo sup.
da Antártica



Vegavis, anseriforme litorâneo
do Cretáceo sup. da Antártica

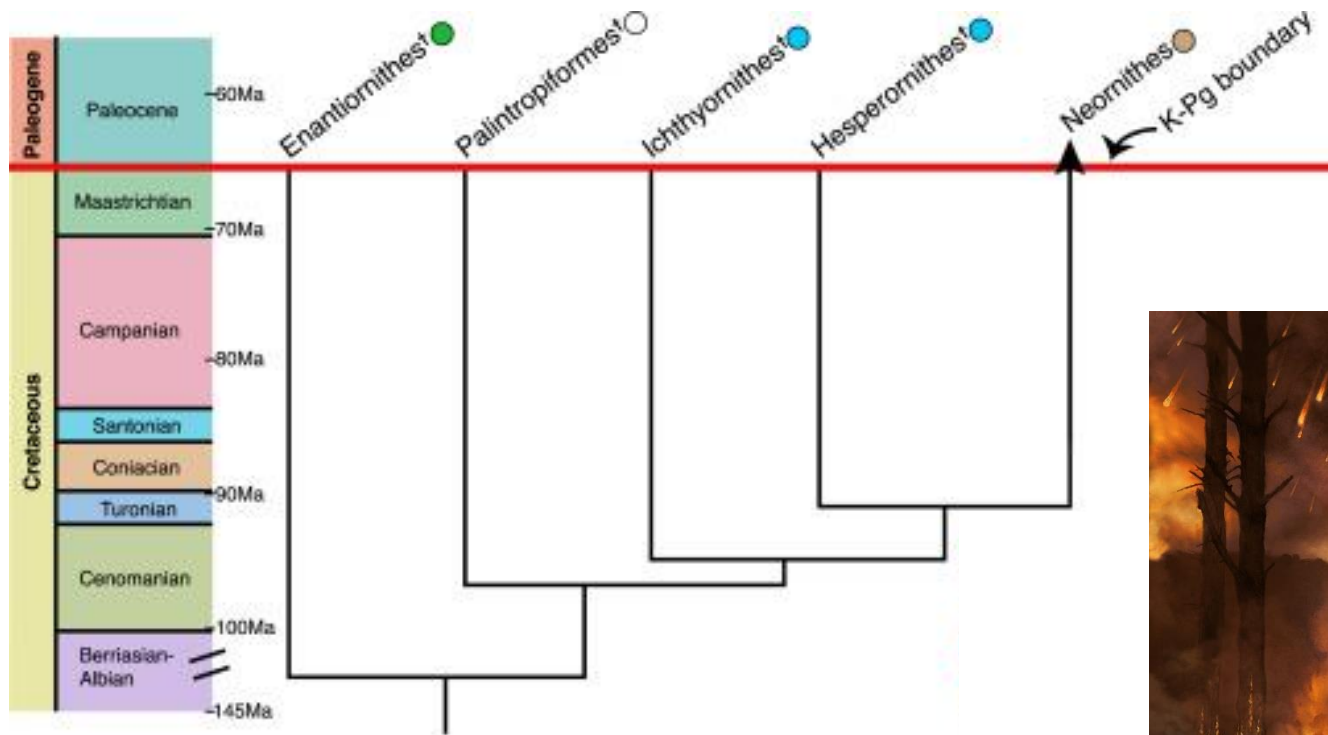
Neornithes (Cretáceo sup. - Recente)

Disater flora e formas terrestres



Neornithes (Cretáceo sup. - Recente)

Disater flora e formas terrestres



- Predominantly arboreal
- Unknown
- Aquatic
- Predominantly ground dwelling
- † Extinct stem group clade

