

Pilot Knob, an Extinct Cretaceous Volcanic Ecosystem

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North America Now & Then



Now



80 MYA

Texas Now & Then



Texas – Now



Texas – 80 MYA

Austin, TX – Now



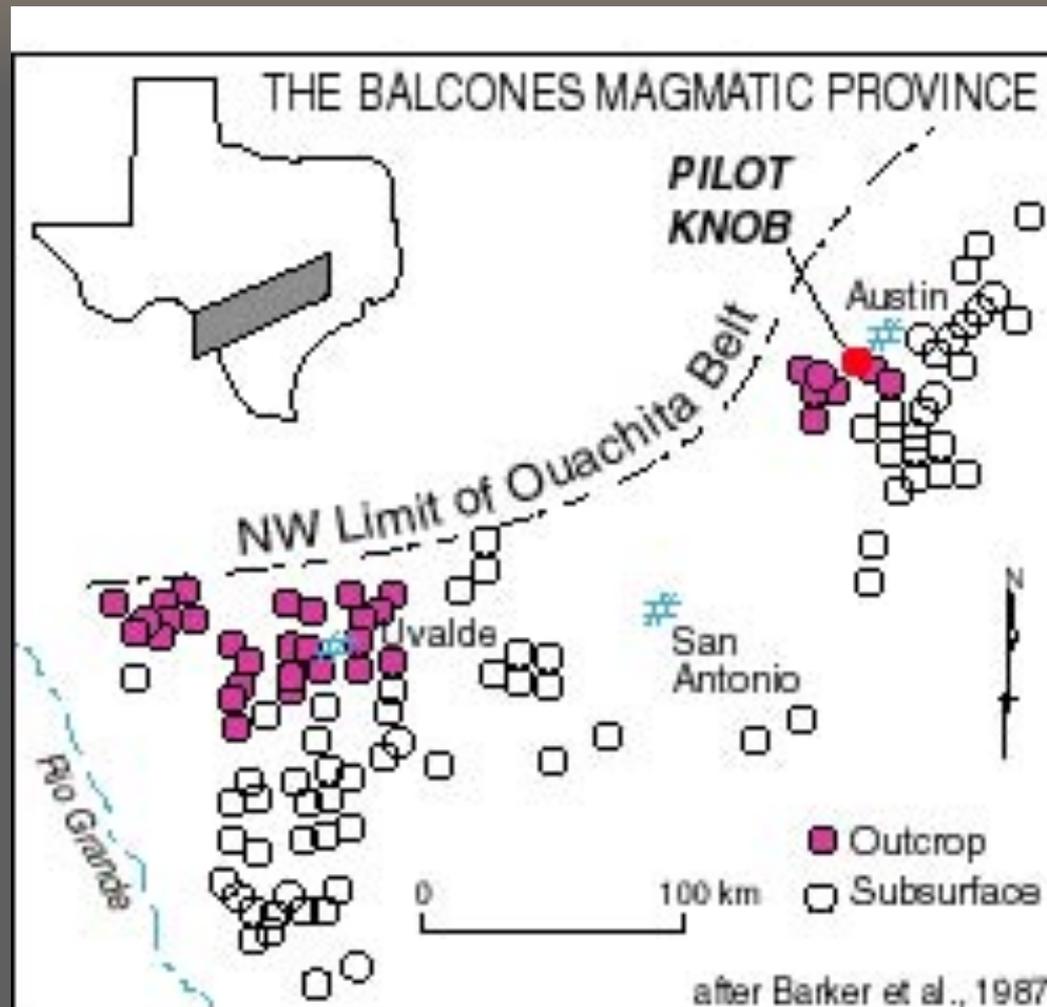
Austin – 80 MYA



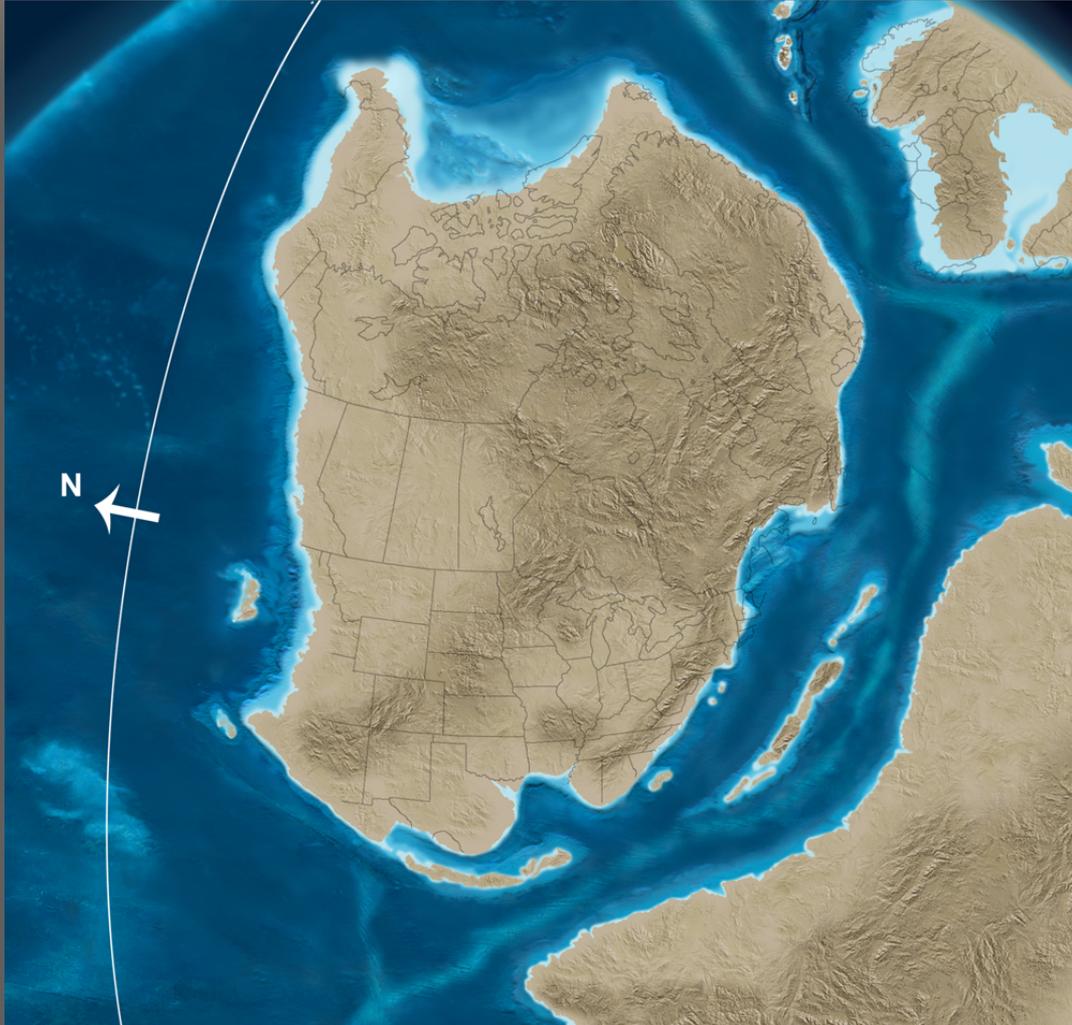
Pilot Knob – SEU – 80 MYA



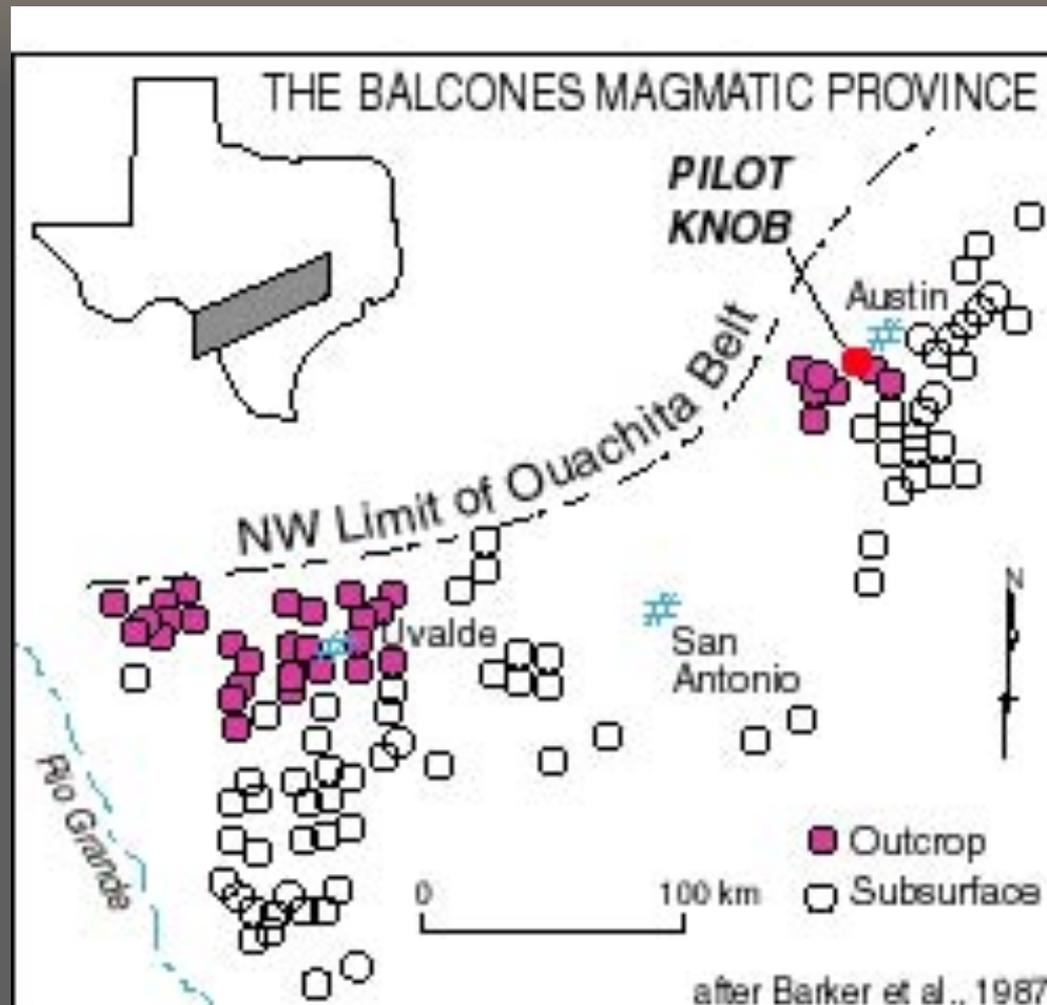
Central Texas Magma Zone



Late Precambrian – 550 MYA

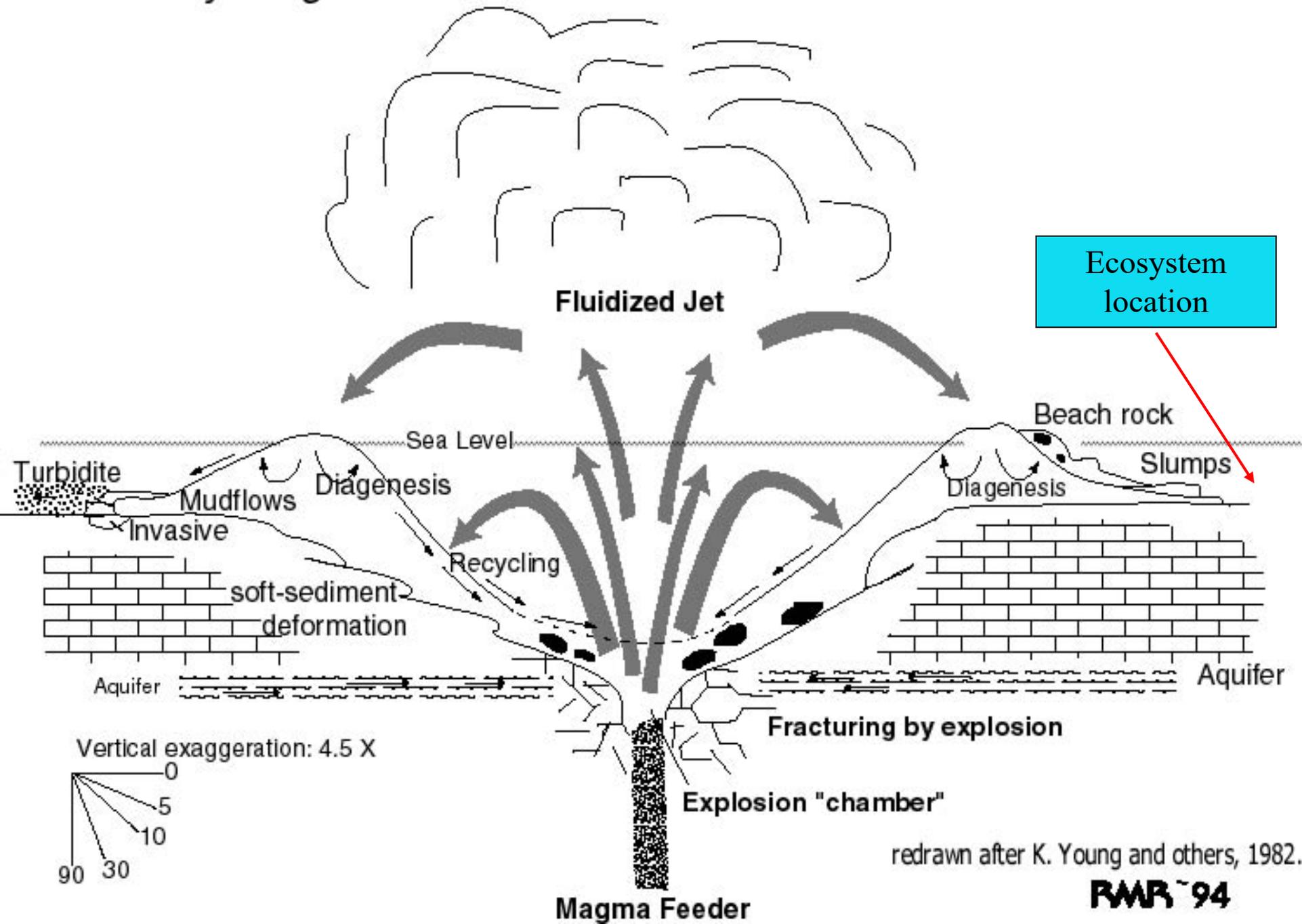


Central Texas Magma Zone





Early Stage of the Formation of the Pilot Knob Area



Pilot Knob Ecosystem – 80 MYA

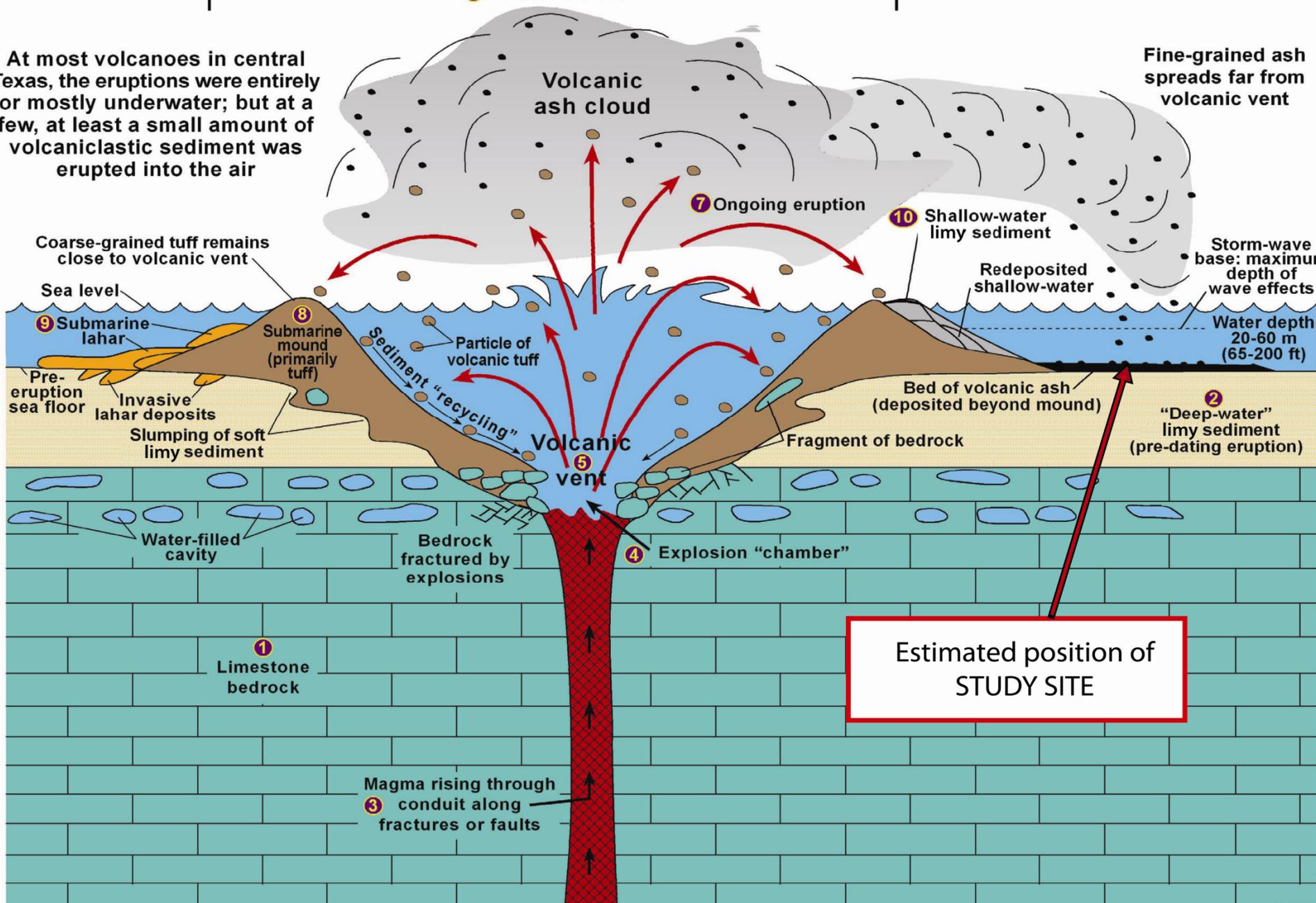




Submarine Volcanic Eruption ~80 Million Years Ago



At most volcanoes in central Texas, the eruptions were entirely or mostly underwater; but at a few, at least a small amount of volcanoclastic sediment was erupted into the air



6 Volcanic crater

Volcanic ash cloud

Fine-grained ash spreads far from volcanic vent

7 Ongoing eruption

10 Shallow-water limy sediment

Storm-wave base: maximum depth of wave effects

Water depth 20-60 m (65-200 ft)

Coarse-grained tuff remains close to volcanic vent

Sea level

9 Submarine lahar

8 Submarine mound (primarily tuff)

Sediment "recycling"

Particle of volcanic tuff

5 Volcanic vent

Bed of volcanic ash (deposited beyond mound)

Fragment of bedrock

2 "Deep-water" limy sediment (pre-dating eruption)

Pre-eruption sea floor
Invasive lahar deposits
Slumping of soft limy sediment

Water-filled cavity

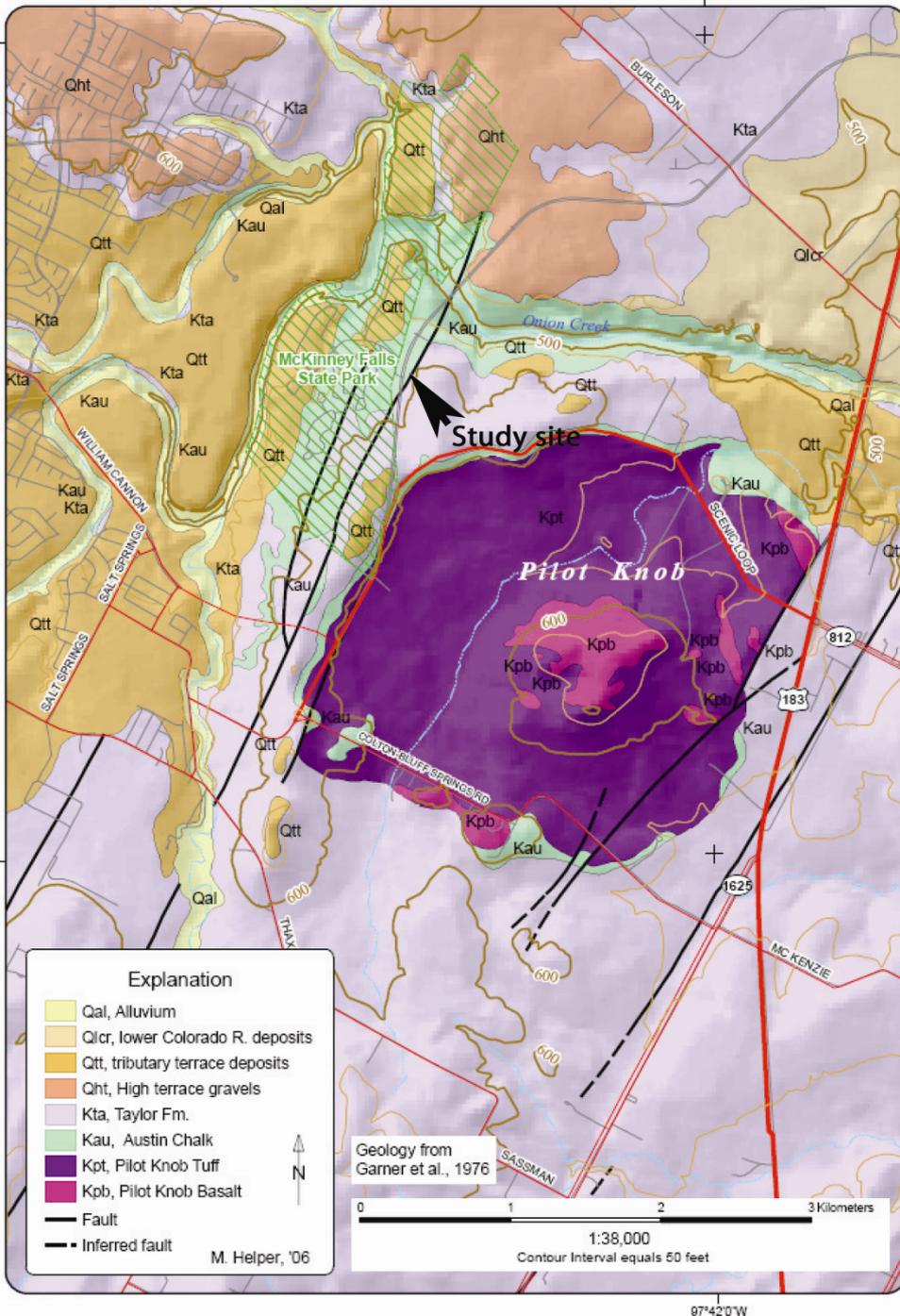
Bedrock fractured by explosions

4 Explosion "chamber"

1 Limestone bedrock

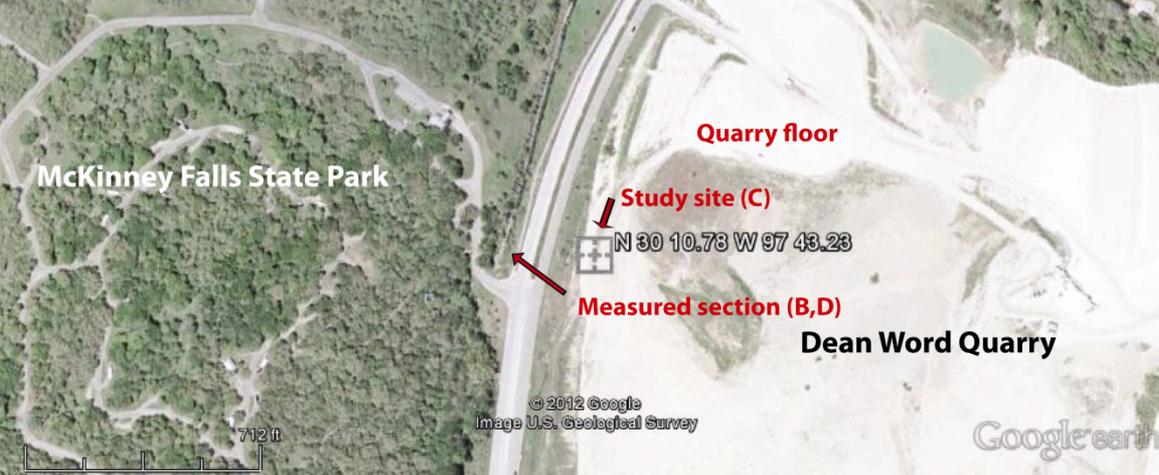
Magma rising through conduit along fractures or faults

Estimated position of STUDY SITE



Fast Forward – Modern

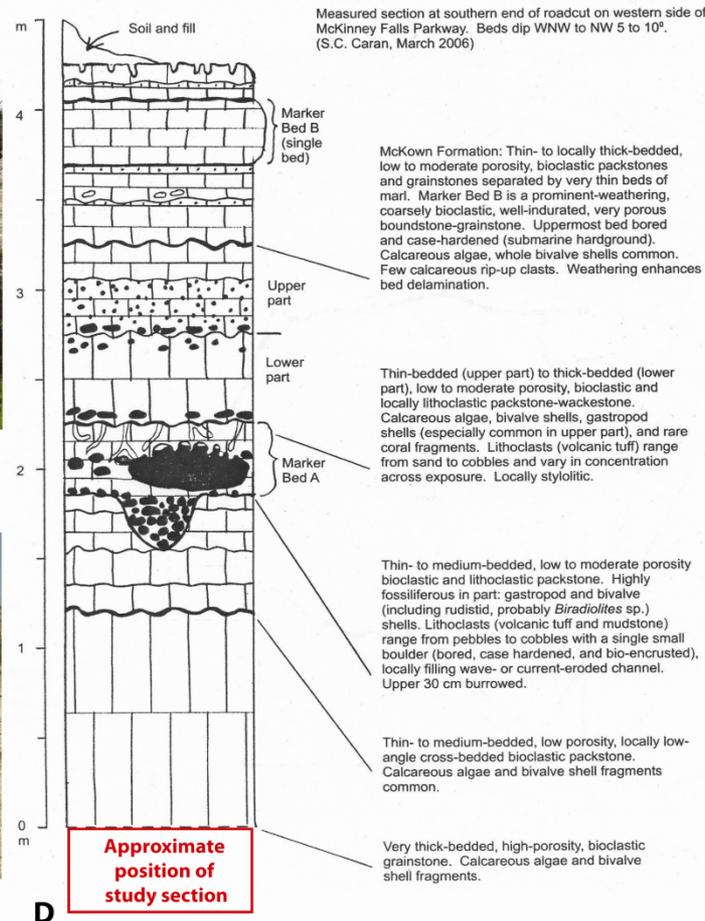
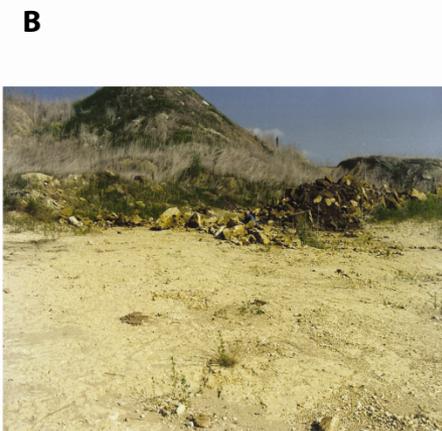
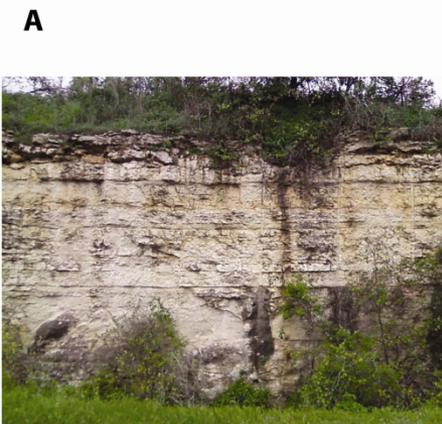
- ➔ Pilot Knob is a low rise of basalt and tuff near Austin International Airport with an area of sediment build-up to the north and north-west
- ➔ The area is quarried for limestone deposited after the eruptions ended
- ➔ Fossil clubs hunted the area frequently



Pilot Knob area

⇒ Quarries routinely left a foot or so of limestone in place to keep their equipment from getting mired in volcanic muds below

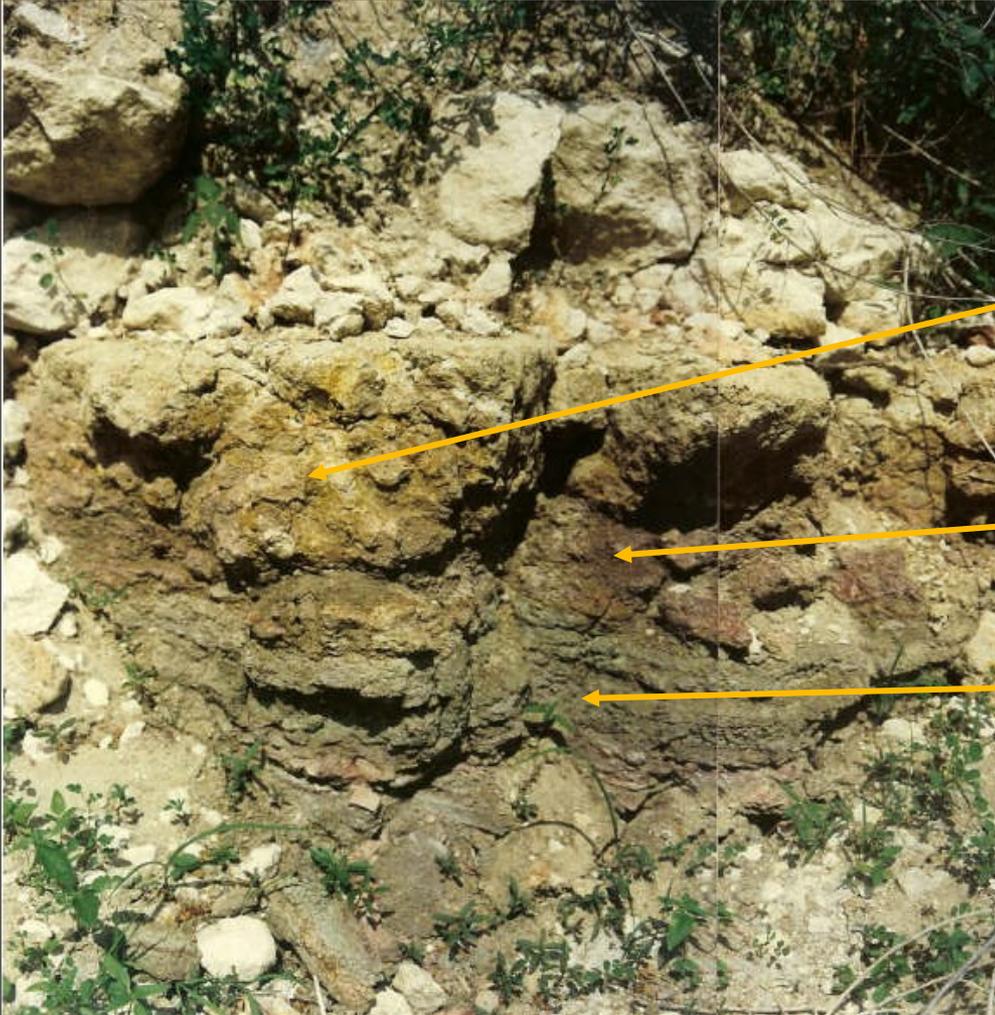
⇒ In 1996 we found something new at the Dean Word Quarry – a drainage ditch dug into the volcanic clay underneath



1996 Drainage Ditch



Stratigraphic Sequence



Yellow “Beach” Layer

(shallowest water, bio-clastic, large Inoceramus clams, crustaceans)

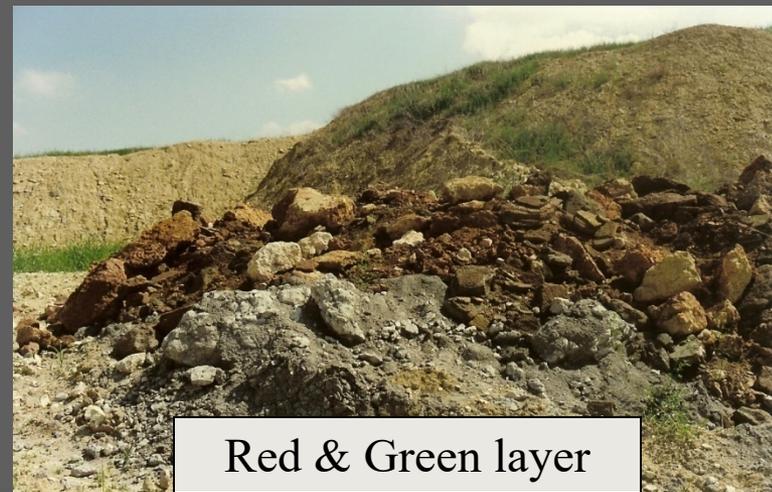
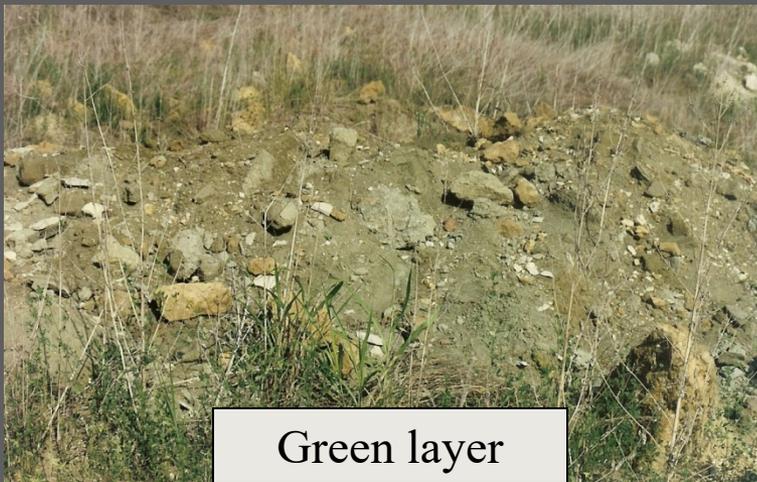
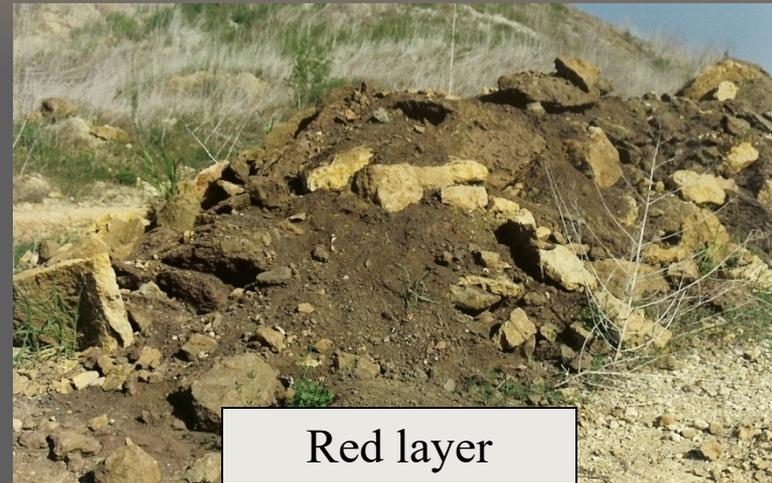
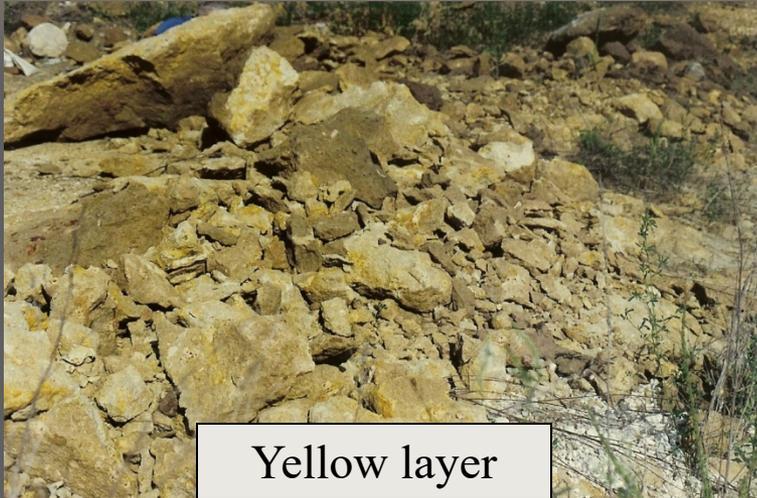
Red Layer

(shallow water, highly fossiliferous, numerous sponges, crustaceans)

Green Layer

(deeper water, fewer fossils, many crustaceans some ammonites, sponges and crinoid material)

Color/Strata Zones



Collecting Site, 1996 – 1997



- The clay (altered ash) extracted from the drainage ditch was dumped to the side and eroded over time to reveal a diverse fauna – the Pilot Knob Ecosystem.



- Unique site – preserving specimens not found in contemporary Austin Chalk deposits

Composite Stratigraphic Section of Cretaceous and Cenozoic Units in Travis County, Texas

SYSTEM	GROUP	FORMATION	MEMBER	
Quaternary		Alluvium		
		Colorado River terraces (lower)	Sand Beach Riverview First Street Sixth Street	
		Colorado River terraces (upper)	Capitol Asylum	
		Tributary terraces		
	Tertiary	Midway	High terraces	
			Wills Point	
		Navarro	Kincaid	
			Kemp	
	Cretaceous (Gulfian)	Taylor	Corsicana	
			Bergstrom	
Austin		Pecan Gap		
		Sprinkle		
		Pilot Knob basalt Pilot Knob tuff		
Woodbine	Austin	Pflugerville	Local interfingers of tuff	
		Burditt	McKown	
	Dessau			
	Jonah			
	Vinson			
Washita	Woodbine	Atco		
		Eagle Ford		
	Washita	Pepper		
		Buda		
Cretaceous (Comanchean)	Fredricksburg	Del Rio		
		Georgetown		
		Comanche Peak	4 3 2 1	
	Trinity	Walnut	Keys Valley	
			Whitestone	
		Glen Rose	Cedar Park	
			Bee Cave	
	Trinity	Trinity	Bull Creek	5 4 3 2 1
			Hensel	
		Sycamore	Cow Creek	
Hammet				

When - Stratigraphic Ages

⇒ Pilot Knob – 80 MA

⇒ Upper Cretaceous, Upper Austin Chalk, concurrent with the McKown, Dessau and Burditt formations

⇒ Ammonites Scaphites hippocrepis, Scaphites leei, Texasia dentatocarinata support these dates

Ecosystem

Unique Crustacean- dominated ecosystem

~168 Different Taxa/Traces

New & Rare Species and Range Extensions

- ⇒ 63 GASTROPODS
- ⇒ 51 BIVALVES
- ⇒ 10 WORM TUBES
- ⇒ 8 ECHINOIDS
- ⇒ 7 CRUSTACEANS
- ⇒ 5 AMMONITES
- ⇒ 4 BURROWS

- ⇒ 4 SHARK
- ⇒ 3 SPONGES
- ⇒ 2 CORAL
- ⇒ 2 BRYOZOAN
- ⇒ 2 FISH
- ⇒ 1 VERTEBRATE
- ⇒ Numerous FORAMS

Nautiloids Today



Ammonites – 80 MYA



Baculites sp.



Scaphites
hippocrepis



Texasia
dentatocarinata



Scaphites *hippocrepis*



Texasia
dentatocarinata



Scaphites *leeii*

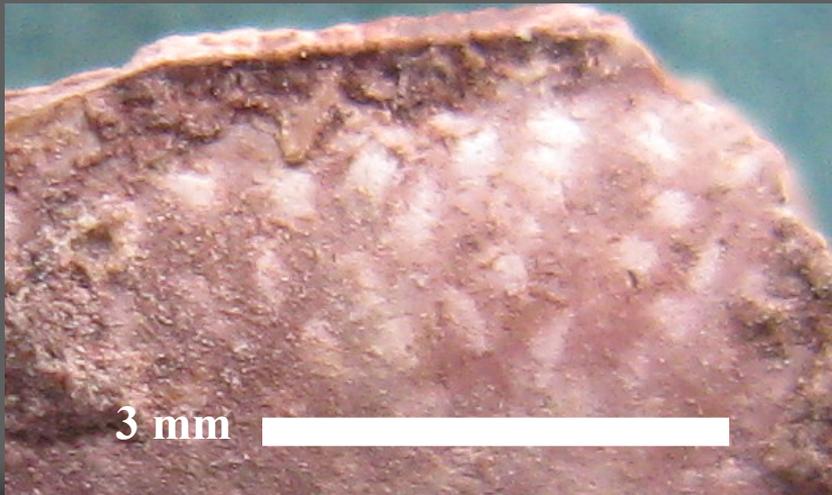
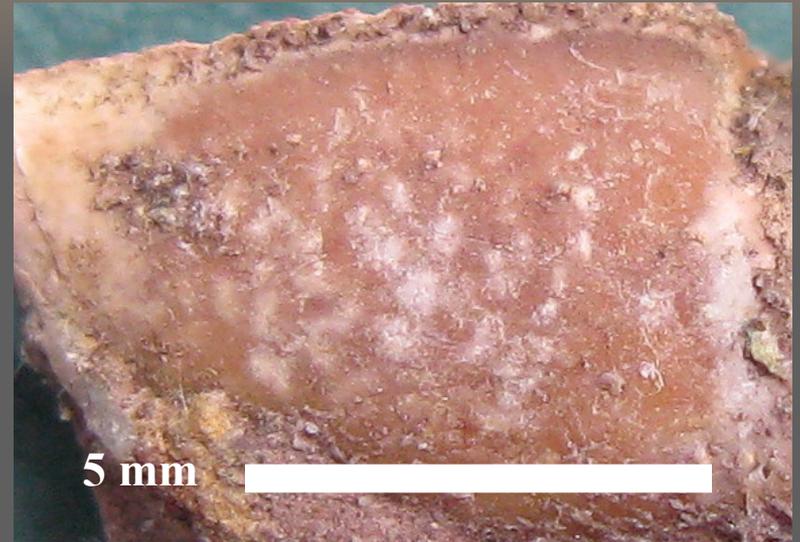
Crustaceans (mud shrimp) – 80 MYA



Protocallianassa cf. mortoni



Crustaceans (color pattern retention)



Crustaceans – 80 MYA



Unidentified crustaceans

Cretaceous Trilobite – 80 MYA



Crustaceans (squat lobster) – 80 MYA

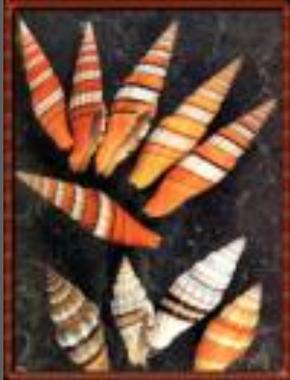


Galathea cretacea
juvenile - top



Galathea cretacea
Juvenile - bottom

Gastropods



Gastropods – Austin Group



Anchura texana



Xenophora leprosa

Gastropods - New



Gegania sp.



Gyrodes sp.



Cerithiella sp.



Oligopytcha sp.



Paraturbo sp.



Volutomorpha sp.

Gastropods (range extensions)



Architectonica sp.



cf. Falsifuses sp.

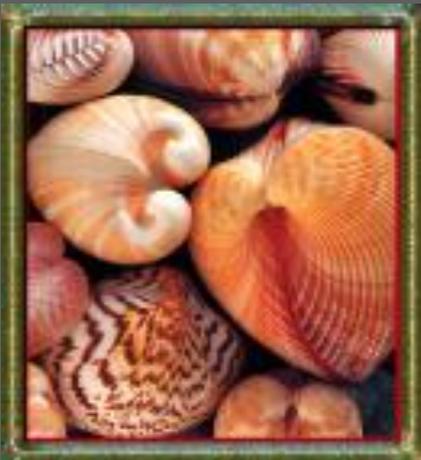


Calyptraea sp.



Laxispira lumbricalis

Bivalves



Bivalves



Lima crenulicosta



Inoceramus sp.



Camptonectes bensoni



Liopistha elegantula



Pycnodonte aucella



Neitheia hartmani

Bivalves 80 MYA



Pycnodonte (Phygraea) aucella



cf. *Exogyra* sp.



Agerostrea cf. *falcata*

Bivalves New



Crassatella sp.



Astarte? sp.



Barbatia sp.



Glycymeris sp.



Barbatia sp.

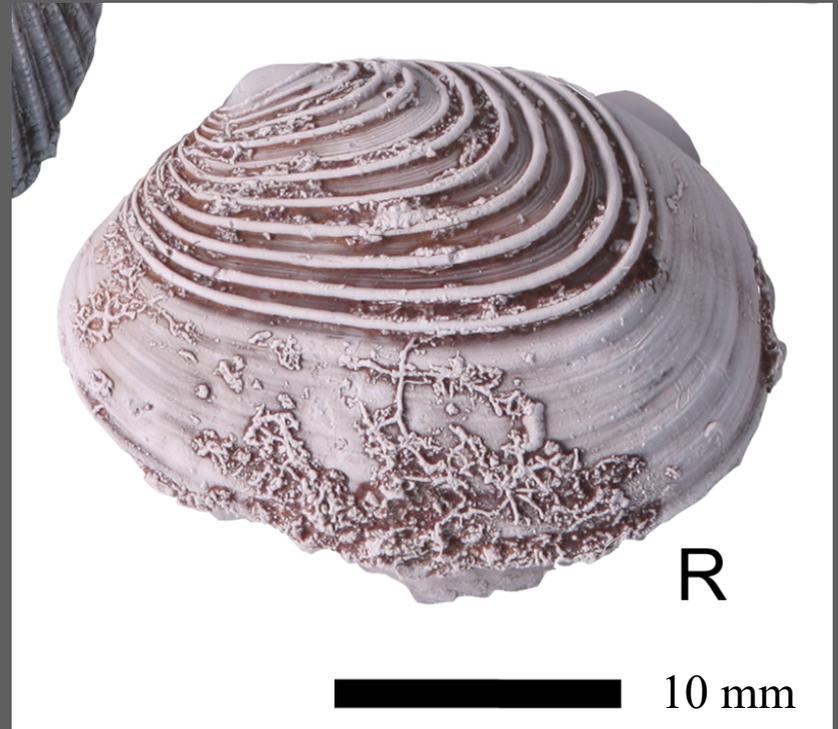


Corbula sp.

Bivalves (range extensions)



Acar sp.

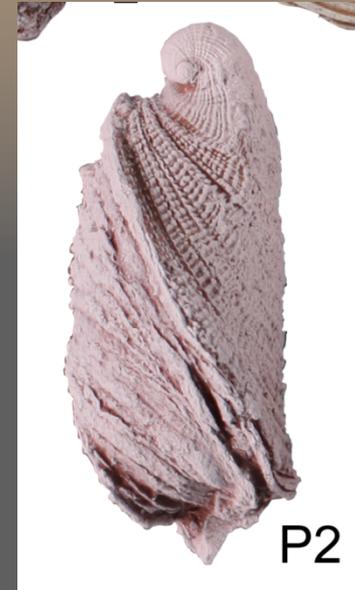


Liothyris sp.

Bivalves



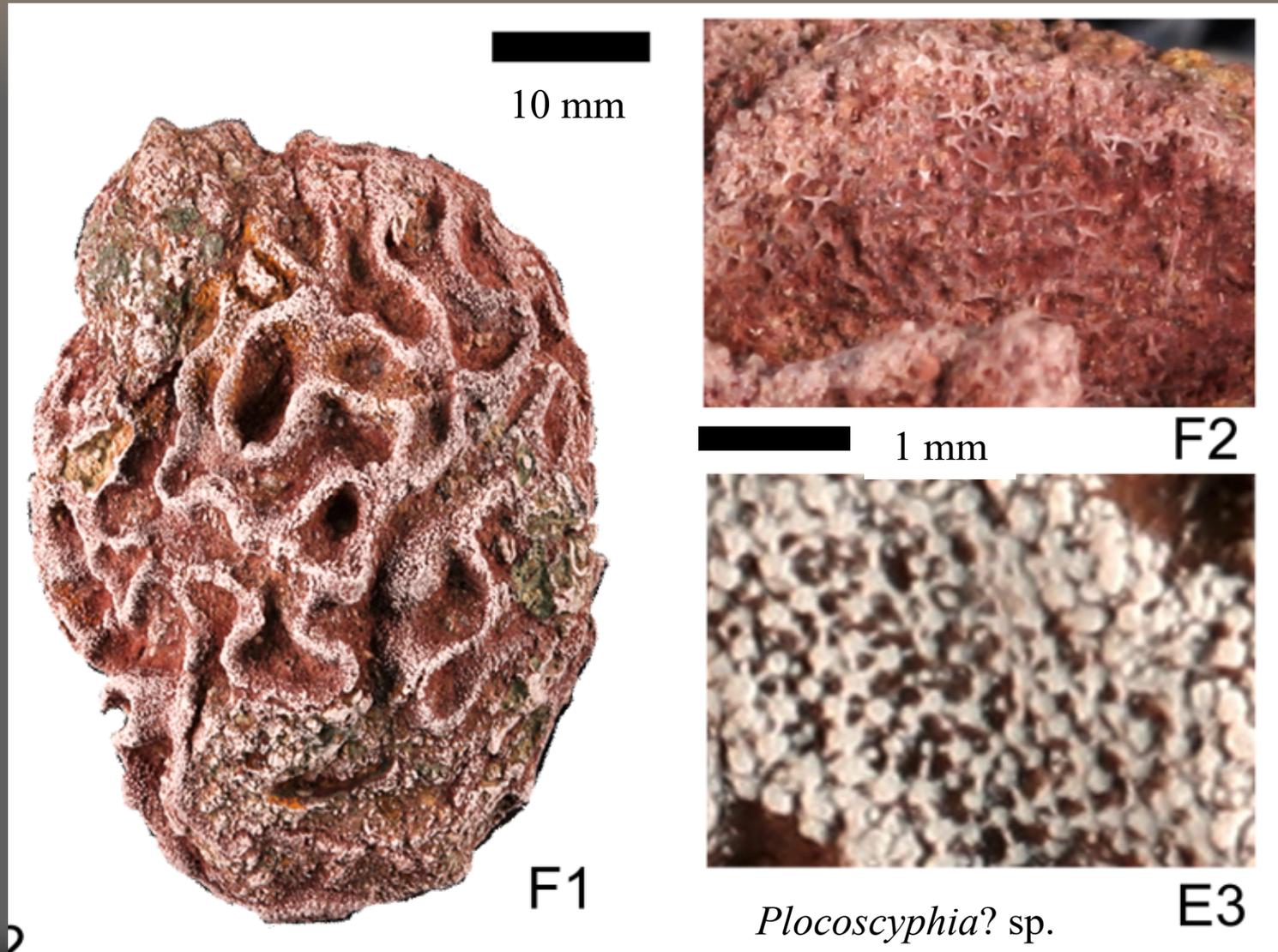
Exogyra sp.



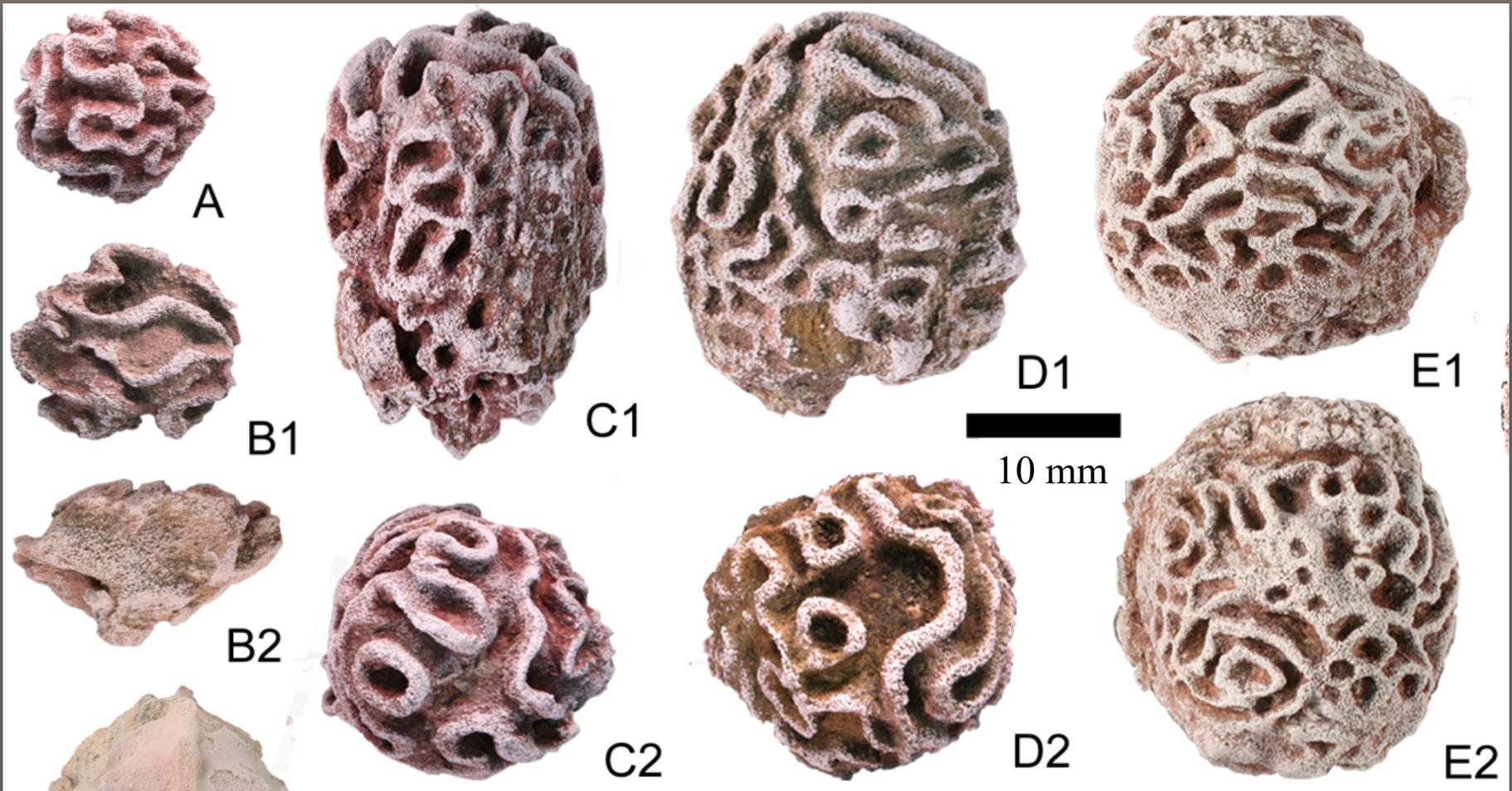
SpongesToday



Rare Sponges



Rare Sponges



Plocoscyphia? sp.

Rare Sponges



D2

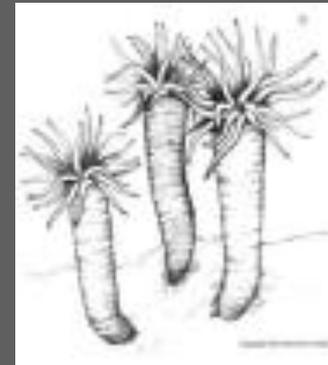
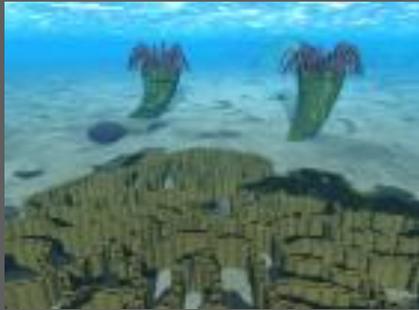
Rare Sponges – 80 MYA



Sponge Borings – 80 MYA



Horn Coral Today



Solitary Coral



Parasmilia sp.



unidentified coral sp.



Bryozoan – 80 MYA



Echinoids (sea urchins) Today



Echinoids (sea urchins) – 80 MYA



Sea Urchin spine



cf. *Washitaster* sp.



Salenia cf. *pseudowhitneyi*

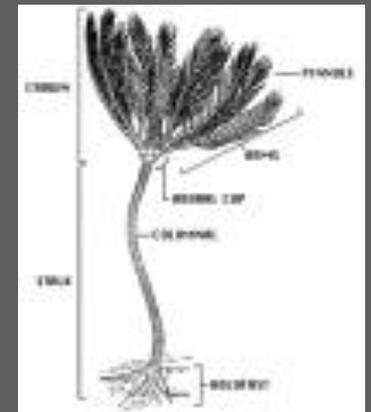
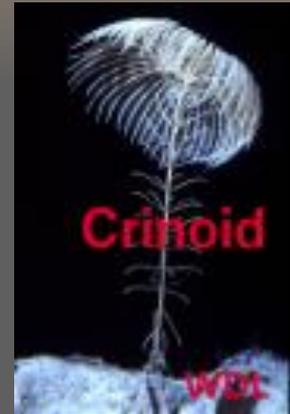


cf. *Washitaster* sp.

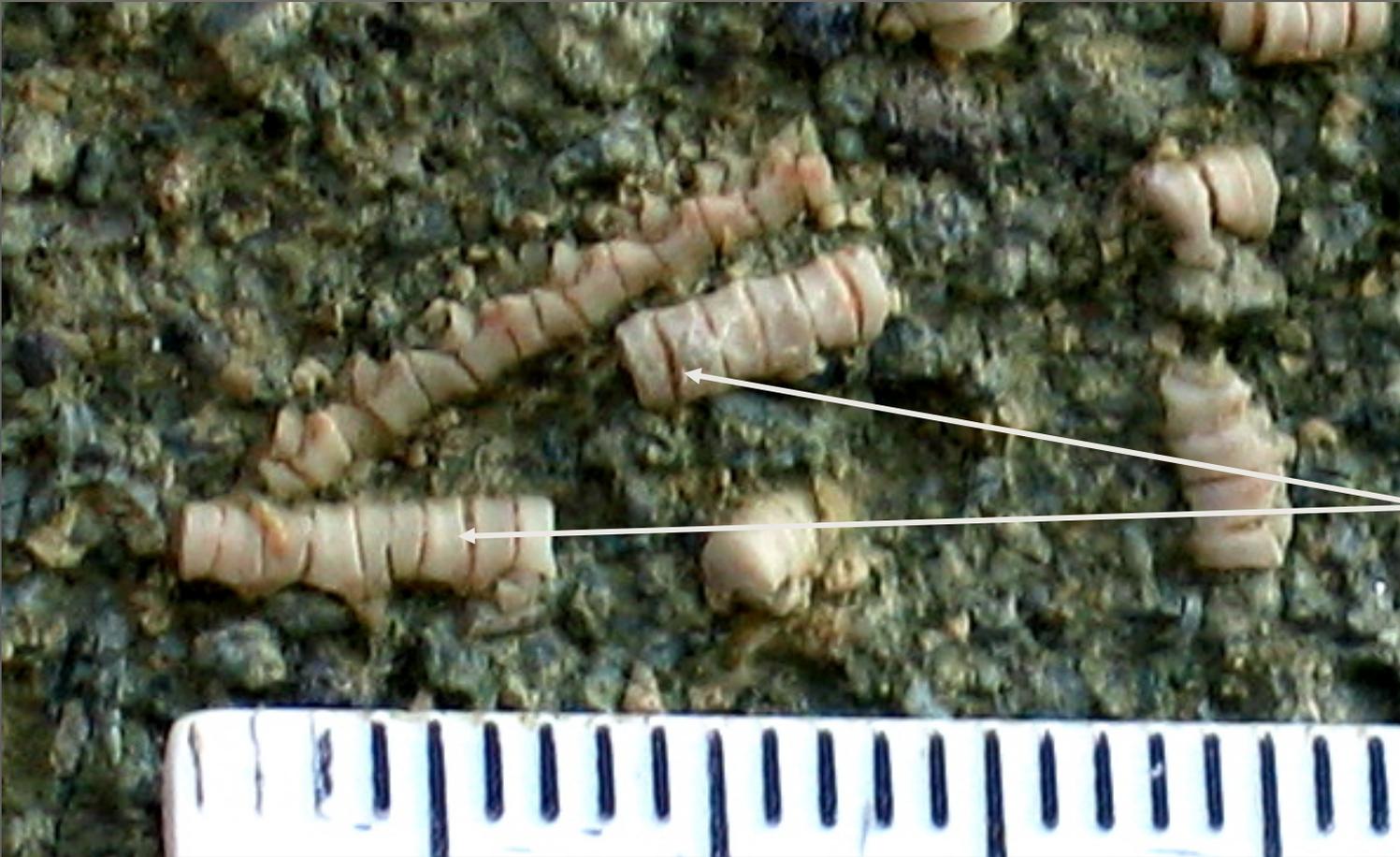


Sea Urchin spine

Crinoid (sea lily) Today



Crinoid (sea lily) – 80 MYA



“Arm”
sections

Worm Tubes Today



Worm Tubes 80 MYA



vrs. Worm sp.



Burrows – 80 MYA



Burrows – 80 MYA



Burrows – 80 MYA



Sharks Today



Shark Teeth – 80 MYA



Cretalamna appendiculata



Cretalamna appendiculata

Shark Teeth – 80 MYA



Squalicorax falcatus



Hybodont fin spine

Fish Tooth – 80 MYA



Vertebrate Bone – 80 MYA



Forams – 80 MYA



Odd – 80 MYA



Preservation



Preservation



Texasia dentatocarinata



aff. *Miltha* sp.



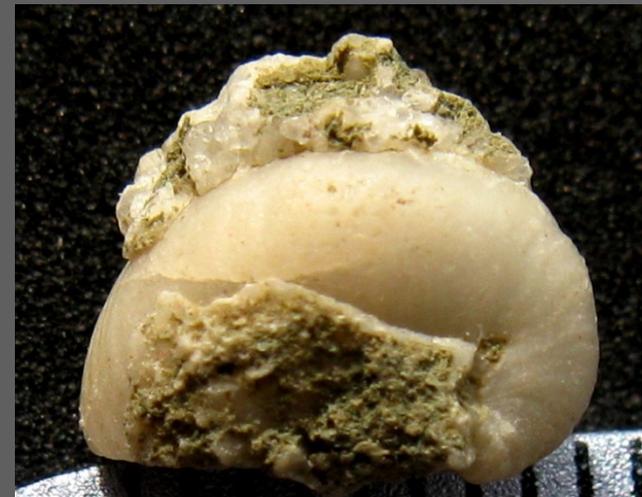
Scaphites leei



Volutomorpha sp. 2



Solariella sp. 1



Exogyra laeviuscula

Preservation



Scaphites leei



Astarte sp.



Scaphites leei



unknown ammonite



Corbula sp. 2



Scaphites hippocrepis

Preservation



Gyrodes sp.



Parasmilia sp.



Parasmilia sp.



Cretalamna appendiculata



unidentified shark tooth



Protocallianassa cf. *mortoni*

Preservation



Scaphites leeii – green layer



Scaphites leeii – red layer

Preservation



Unidentified bivalve
w/worm tubes



Solariella sp.



Camptonectes bensoni



Monodonta sp.

Preservation



Plocoscyphia? sp.



1



GG2

Parasmilia sp.

Preservation

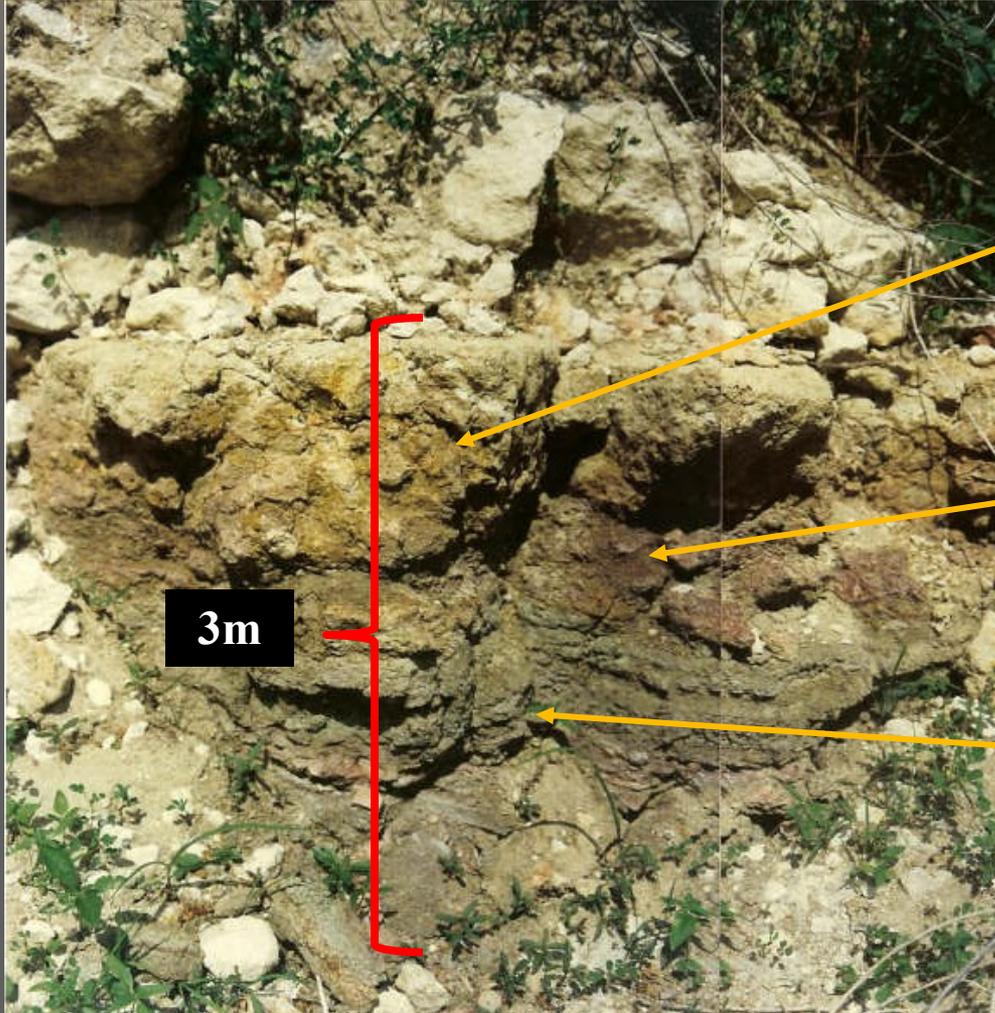


Preservation



Nacre on
Inoceramus

Summary



Yellow Layer

(37 sp. – active eruptions ceased – shallow water, bio-clastic, large *Inoceramus* clams, solitary corals & shrimp)

Red Layer

(149 sp. – final eruptive phase – shallow water, highly fossiliferous, gastropods, bivalves, numerous sponges & shrimp, solitary corals, ammonites etc.)

Green Layer

(79 sp. – active eruptive phase – fewer fossils, numerous sponges & shrimp, ammonites, and crinoid material)

Conclusion

- ⇒ Little published / ecosystems / late Cretaceous submarine volcanoes / rare / overlooked?
- ⇒ Important for understand shallow-water inhabitants / helping locate future hydrocarbon traps
- ⇒ Pilot Knob / exceptional preservation / rare fauna / unprecedented look at Santonian volcanic habitat
- ⇒ Further research planned

Acknowledgements

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- ➔ Ed Elliot and Mike Smith, the Central Texas Paleontological Society and Austin Paleontological Society, for the loan and contribution of specimens
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