Pilot Knob, an Extinct Cretaceous Volcanic Ecosystem

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North America Now & Then

Now

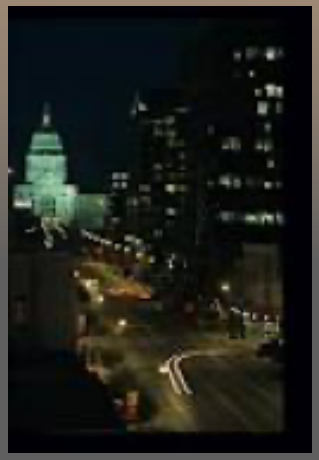
80 MYA

Texas Now & Then

Texas – Now

Texas – 80 MYA

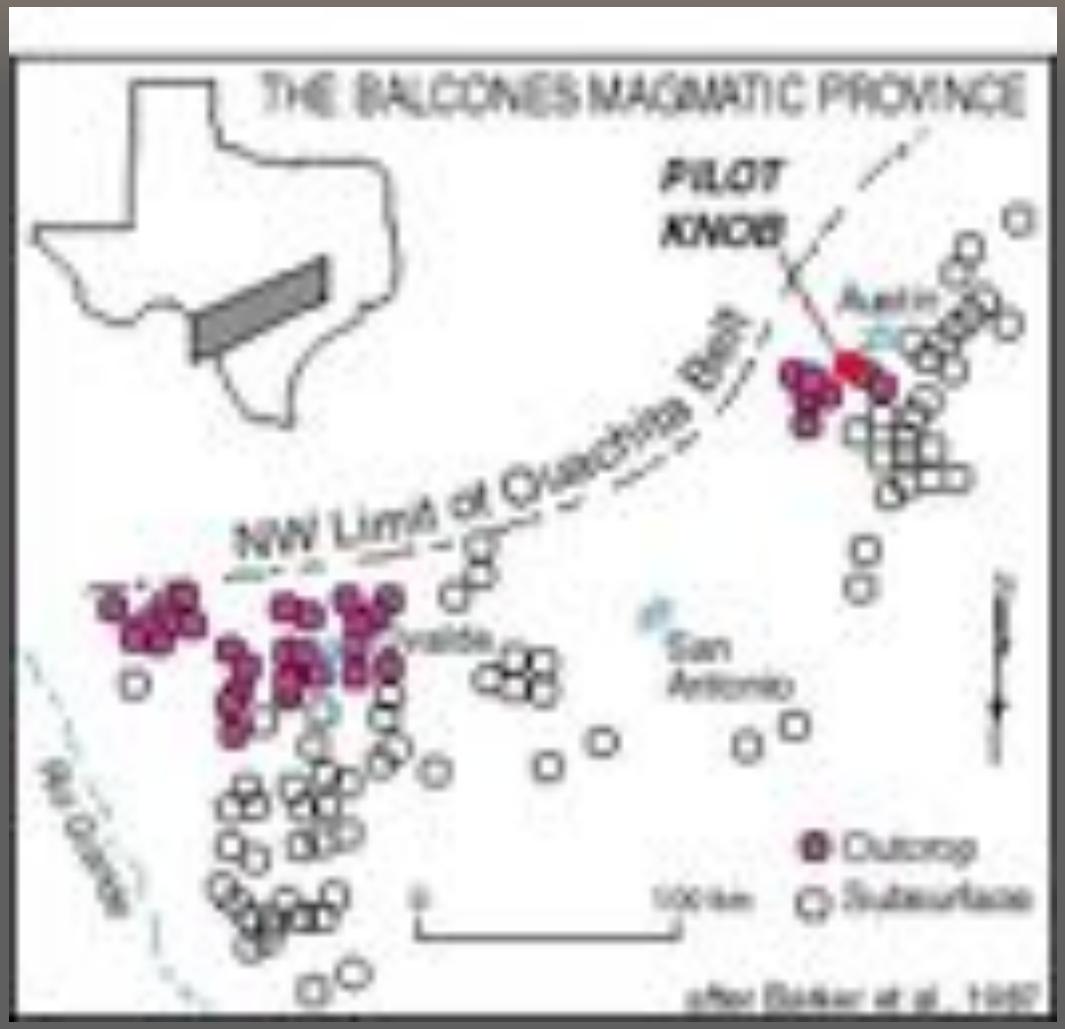
Austin, TX – Now



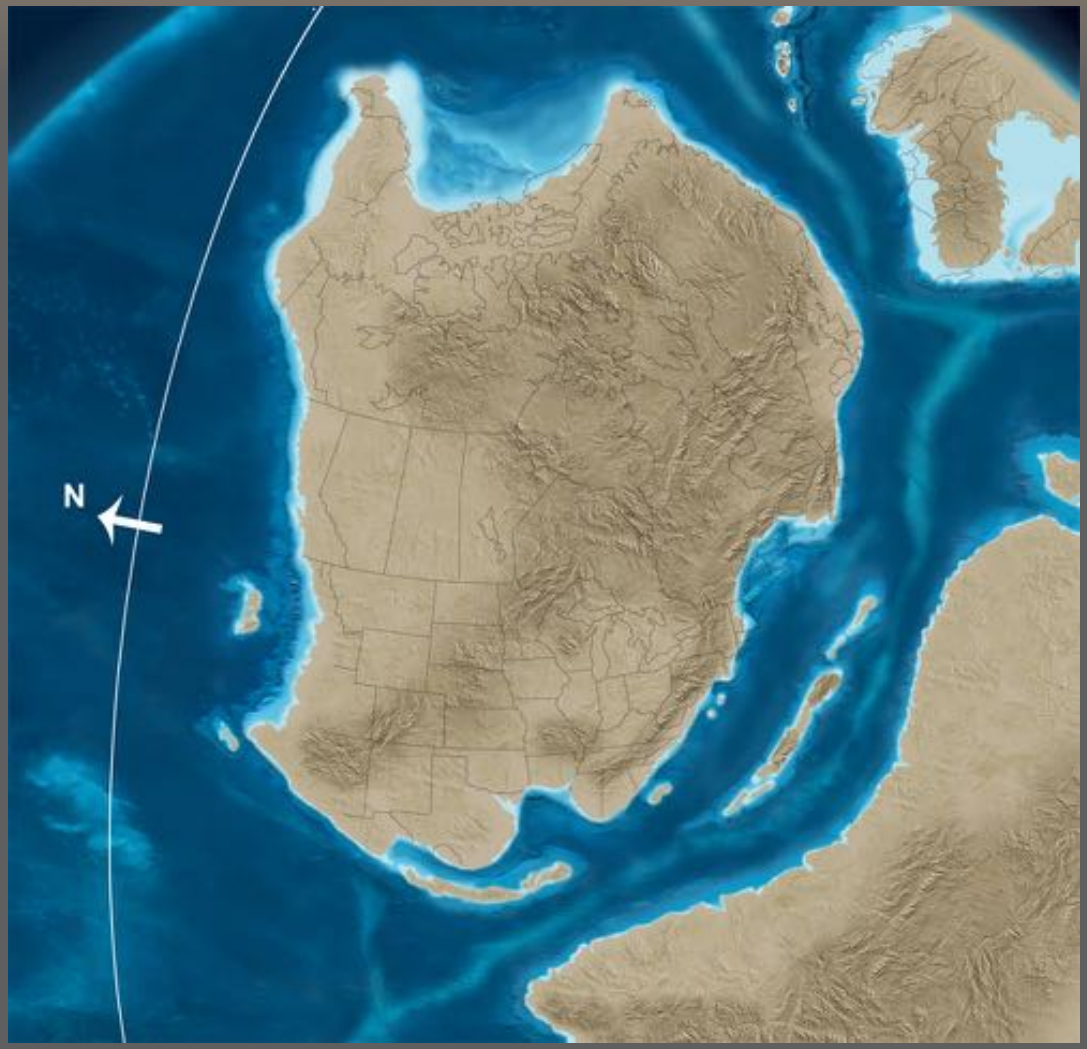
Austin – 80 MYA

Pilot Knob – SEU – 80 MYA

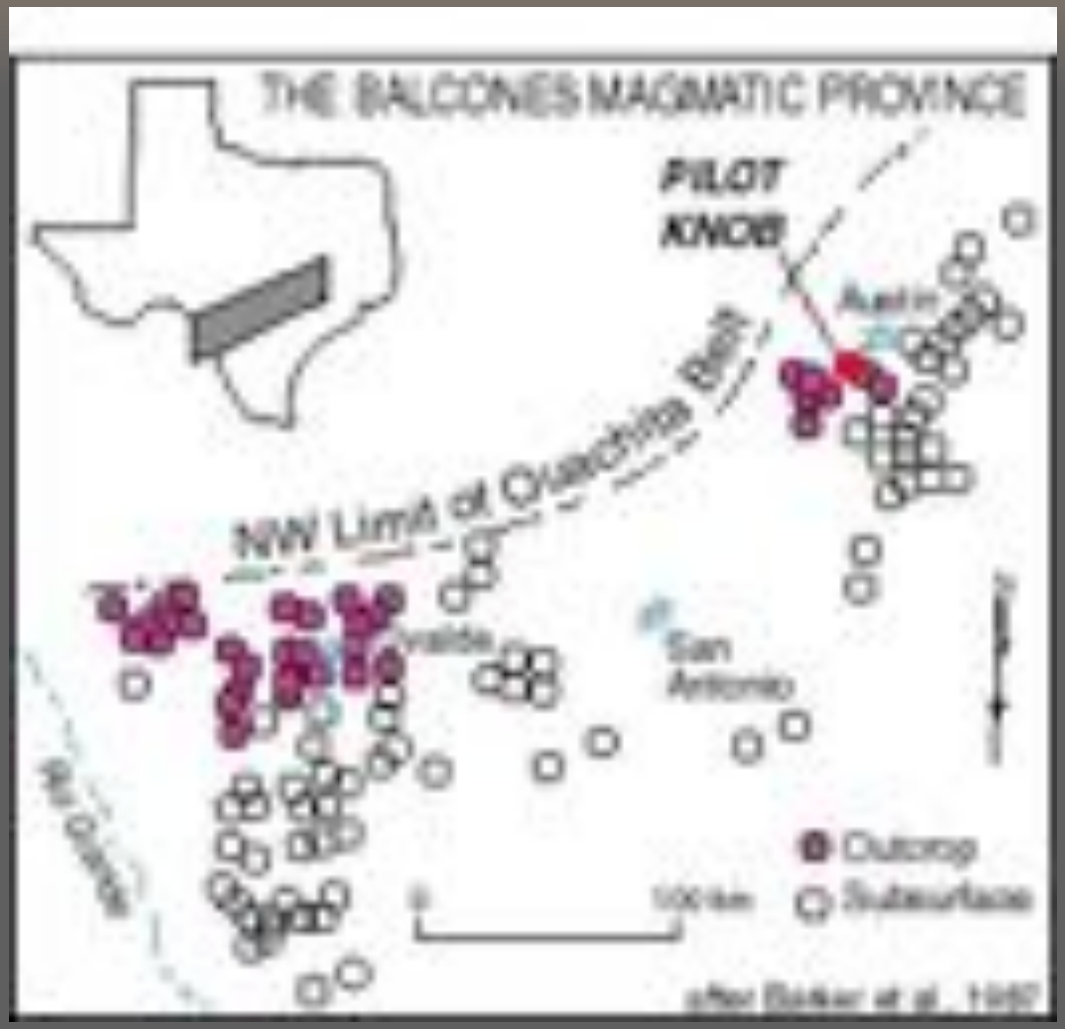
Central Texas Magma Zone

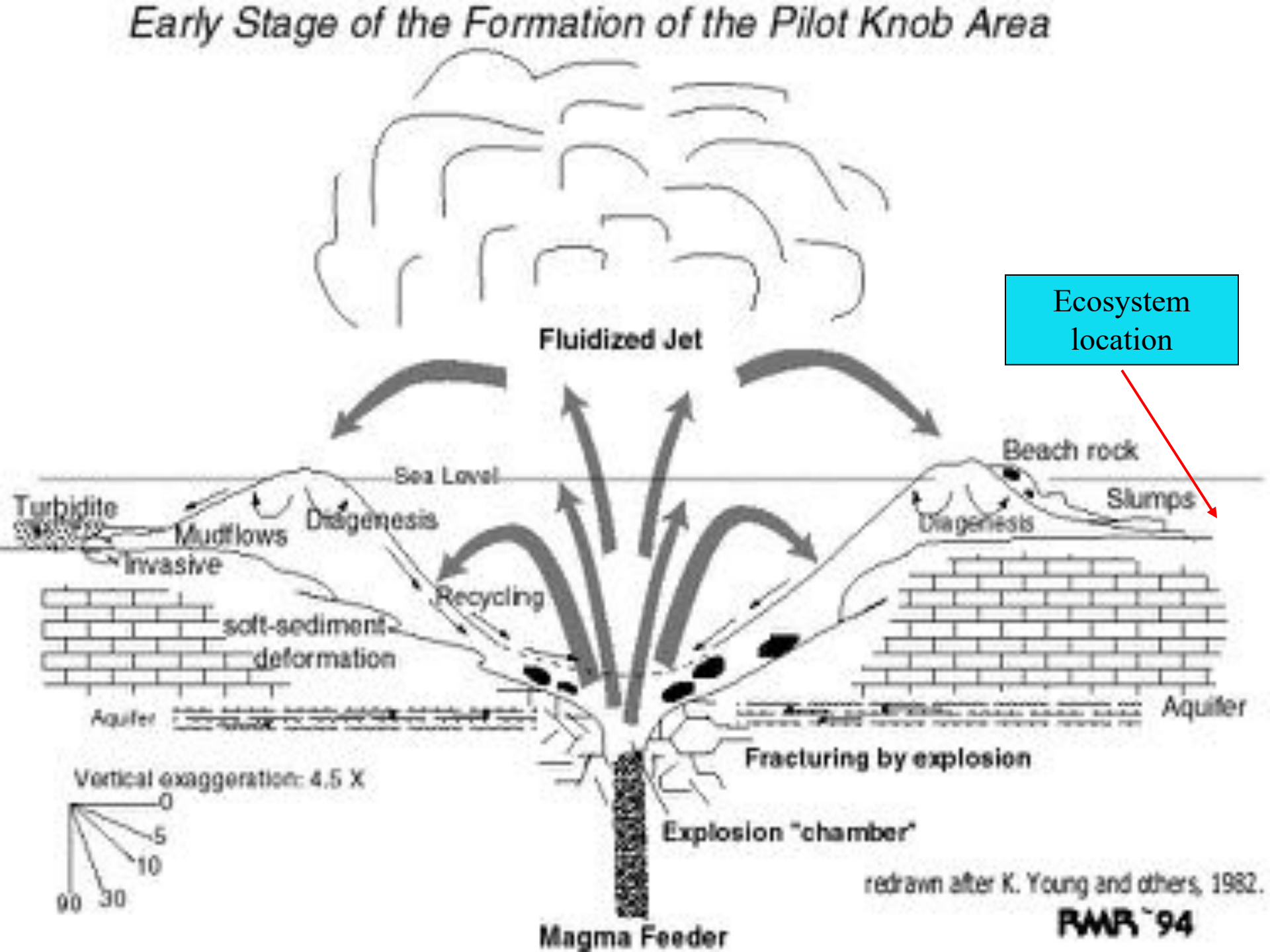


Late Precambrian – 550 MYA

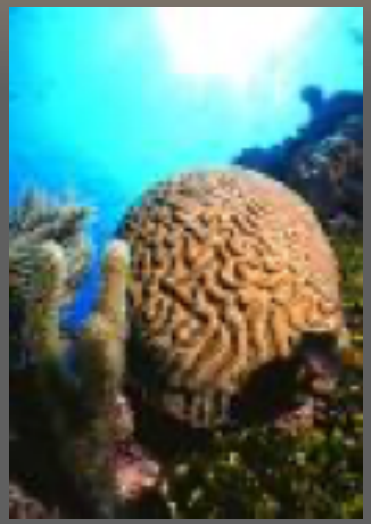


Central Texas Magma Zone




Early Stage of the Formation of the Pilot Knob Area
Fluidized Jet
Ecosystem location
Beach rock
Sea Level
Slumps
Turbidite
Mudflows
Diagenesis
Diagenesis
Invasive
Recycling
soft-sediment deformation
Aquifer
Aquifer
Fracturing by explosion
Vertical exaggeration: 4.5 X
0
5
10
30
90
Explosion "chamber"
redrawn after K. Young and others, 1982.
PWRI '94
Magma Feeder

Pilot Knob Ecosystem – 80 MYA

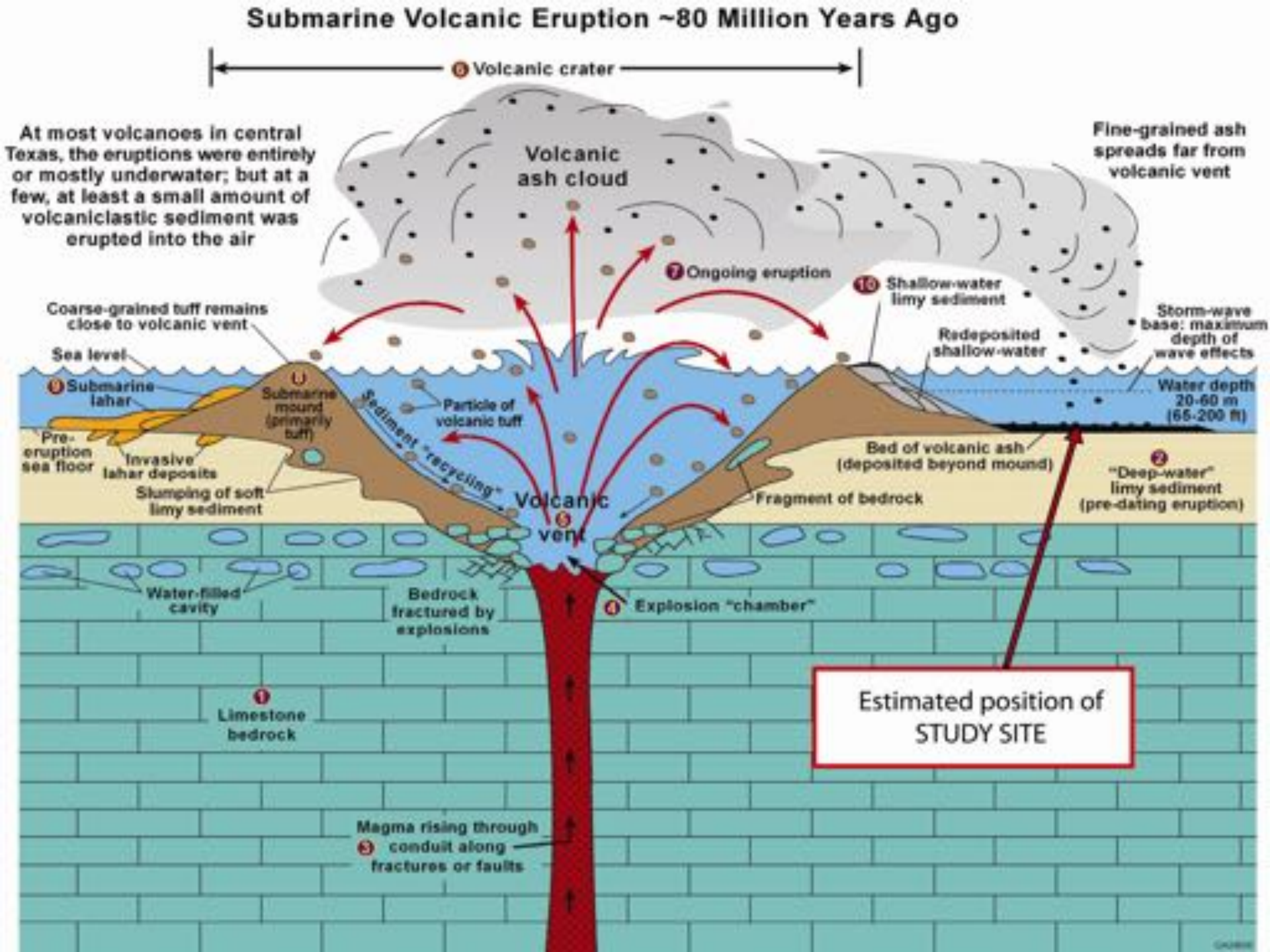


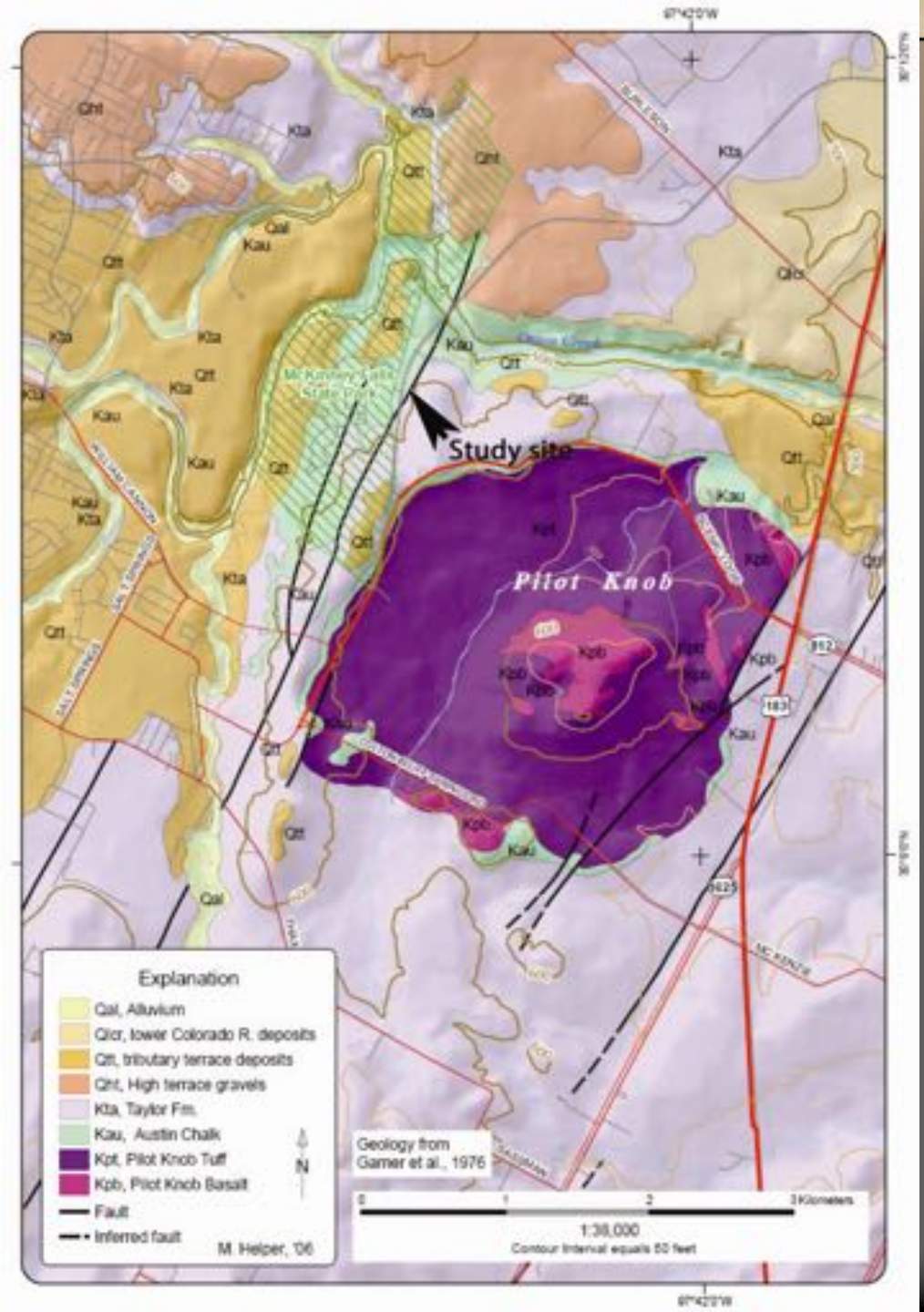






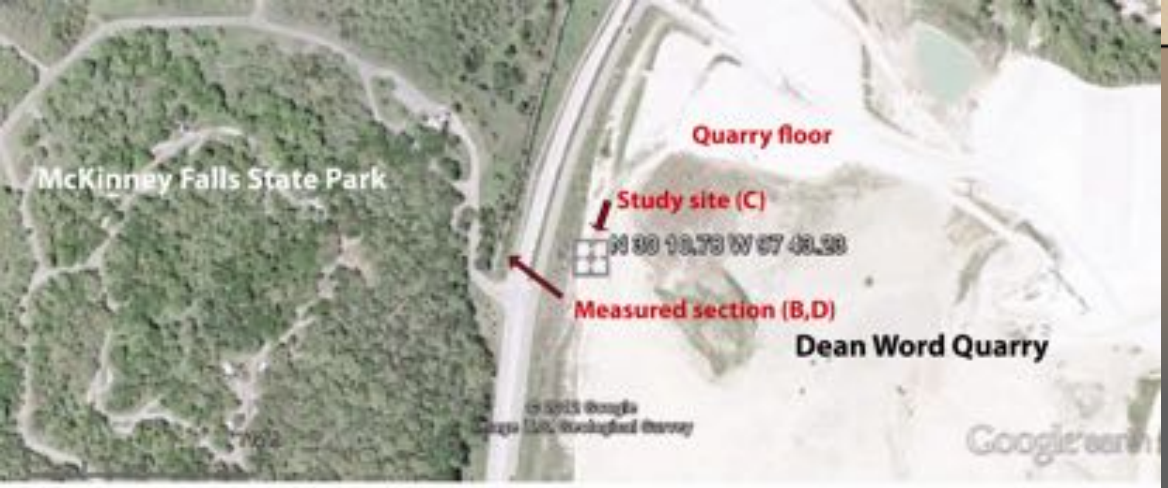


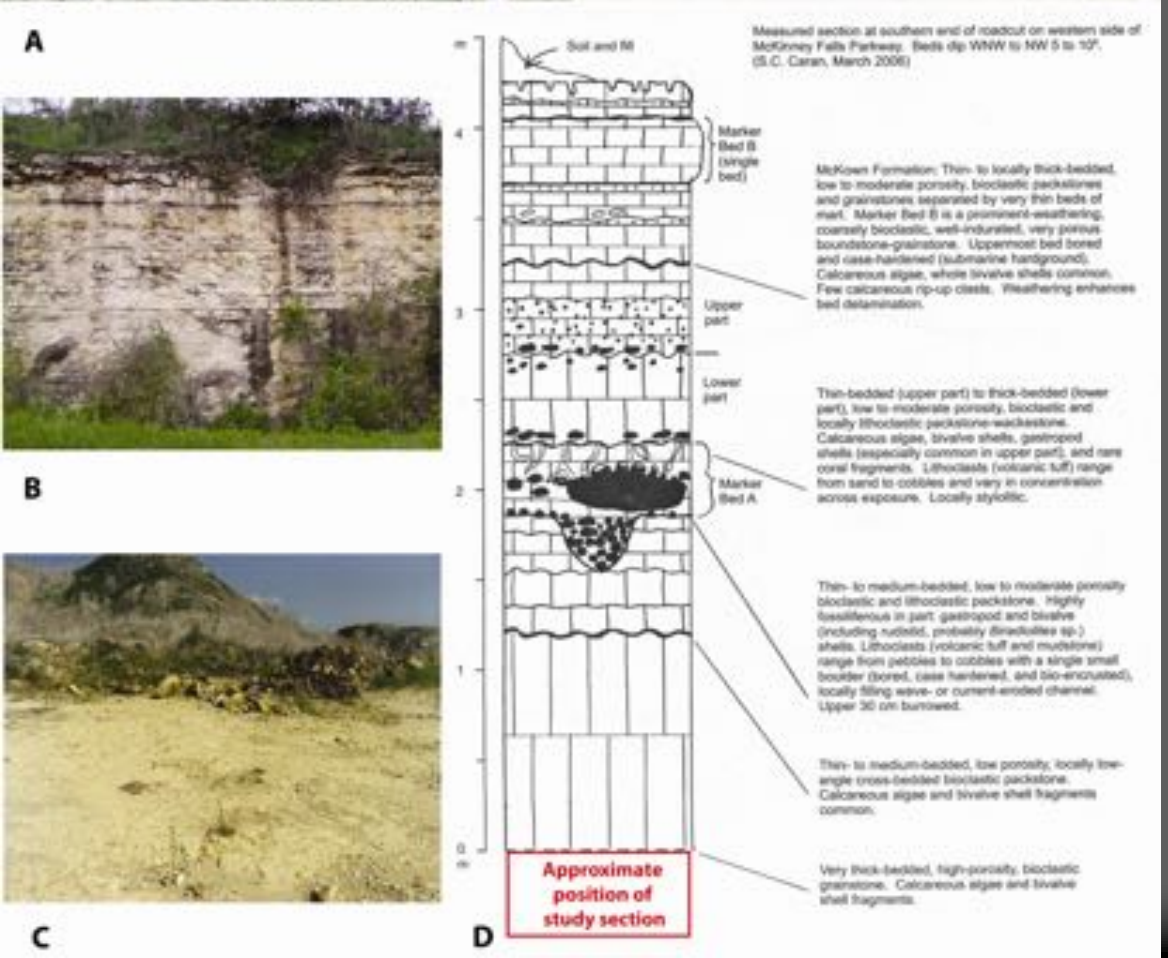

Submarine Volcanic Eruption ~80 Million Years Ago
0 Volcanic crater
At most volcanoes in central Texas, the eruptions were entirely or mostly underwater; but at a few, at least a small amount of volcaniclastic sediment was erupted into the air
Volcanic ash cloud
Fine-grained ash spreads far from volcanic vent
7 Ongoing eruption
10 Shallow-water limy sediment
Coarse-grained tuff remains close to volcanic vent
Sea level
Storm-wave base: maximum depth of wave effects
Redeposited shallow-water
Water depth 20-60 m (65-200 ft)
9 Submarine lahar
Submarine mound (primarily tuff)
Particle of volcanic tuff
Sediment "recycling"
Pre-eruption sea floor
Invasive lahar deposits
Slumping of soft limy sediment
Bed of volcanic ash (deposited beyond mound)
2 "Deep-water" limy sediment (pre-dating eruption)
Fragment of bedrock
5 Volcanic vent
Water-filled cavity
Bedrock fractured by explosions
4 Explosion "chamber"
1 Limestone bedrock
Estimated position of STUDY SITE
Magma rising through 3 conduit along fractures or faults



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



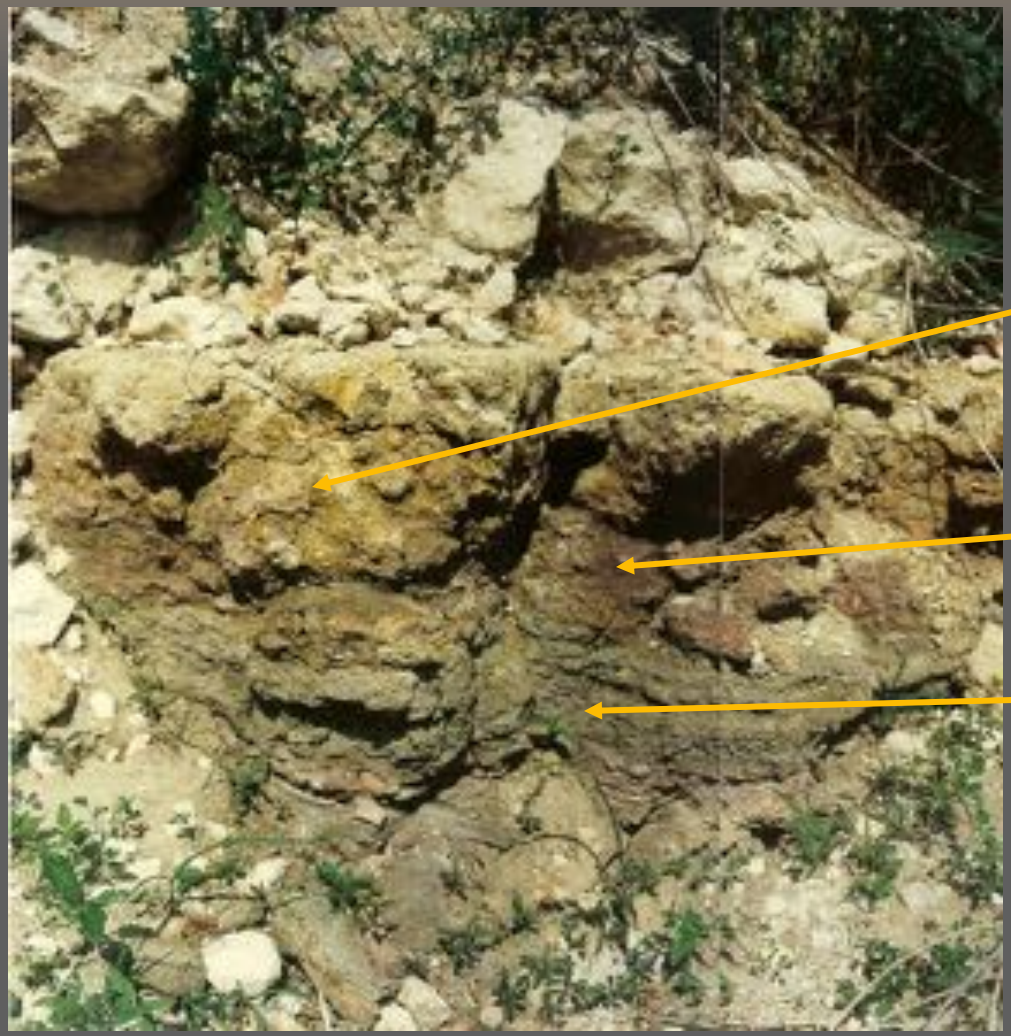


Pilot Knob area

- 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

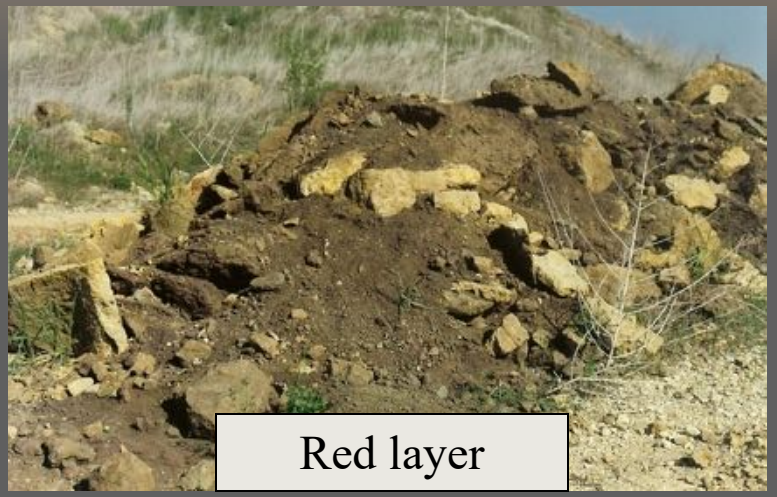
(shallow water, highly fossiliferous, numerous sponges, crustaceans)

Green Layer

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

Color/Strata Zones


Yellow layer


Red layer


Green layer


Red & Green layer

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	
		Kincaid Kemp	
	Navarro	Corsicana	
	Taylor	Bergstrom Pecan Gap Sprinkle	
Cretaceous (Gulfian)	Austin	**Pilot Knob basalt** **Pilot Knob tuff** Pflugerville Burditt Dessau Jonah Vinson Atco	McKown Local interfingers of tuff
	Woodbine	Eagle Ford Pepper	
	Washita	Buda Del Rio Georgetown	
Cretaceous (Comanchean)	Fredricksburg	Edwards	4 3 2 1
		Comanche Peak	
		Walnut	Keys Valley Whitestone Cedar Park Bee Cave Bull Creek
	Trinity	Glen Rose	5 4 3 2 1
		Hensel Cow Creek Hammet Sycamore	

When - Stratigraphic Ages

- Pilot Knob – 80 MA
- Upper Cretaceous, Upper Austin Chalk, concurrent with the McKown, Dessau and Burditt formations
- Ammonites Scaphites hippocrepis, Scaphites leeii, 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

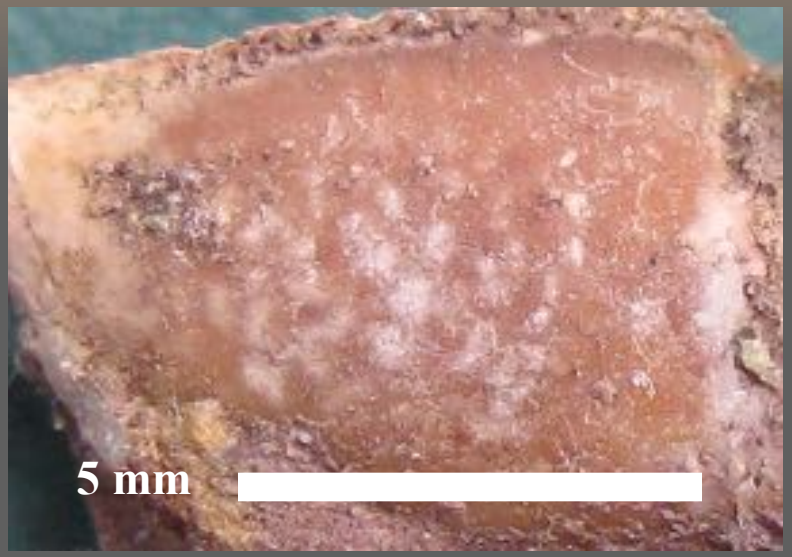
Texasia dentatocarinata

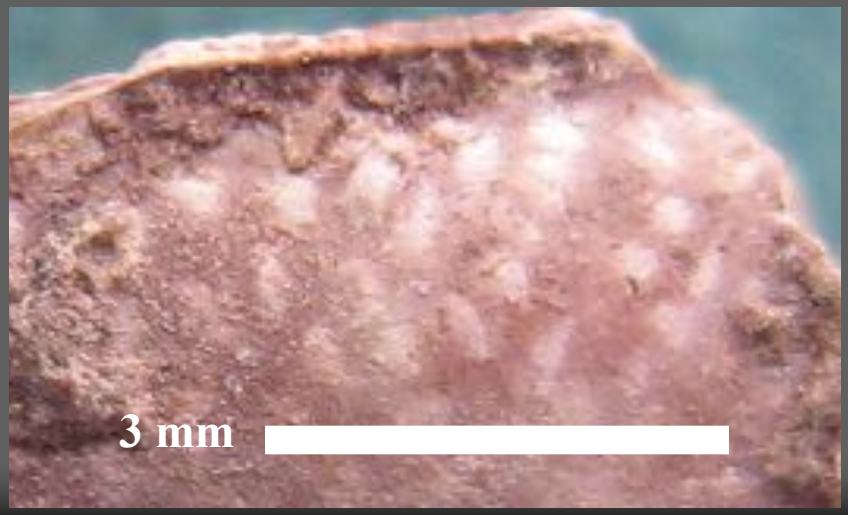
Scaphites leeii

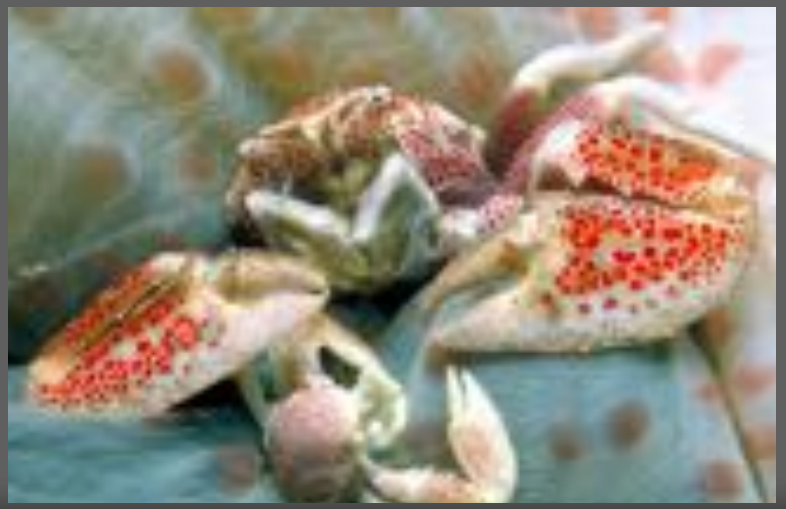
Crustaceans (mud shrimp) – 80 MYA

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

Neithea 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)

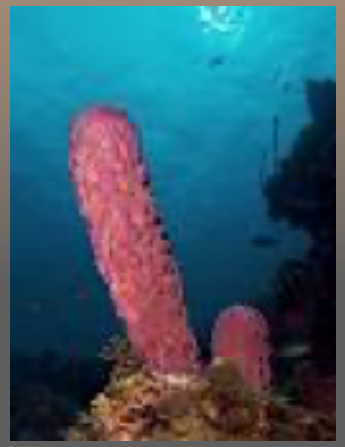
Acar sp.

Liothyris sp.

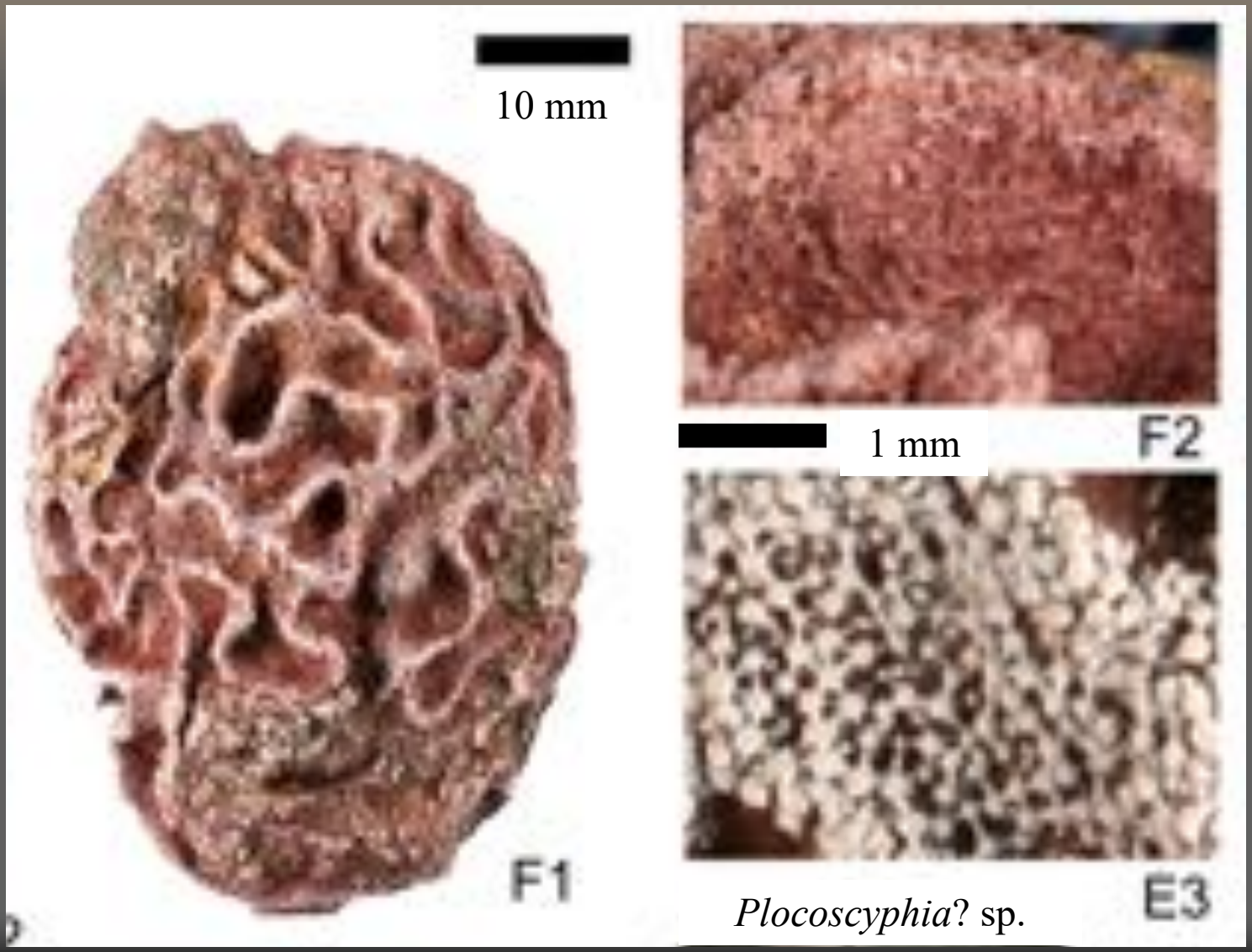
Bivalves

Exogyra sp.

SpongesToday



Rare Sponges



Plocoscyphia? sp.

Rare Sponges

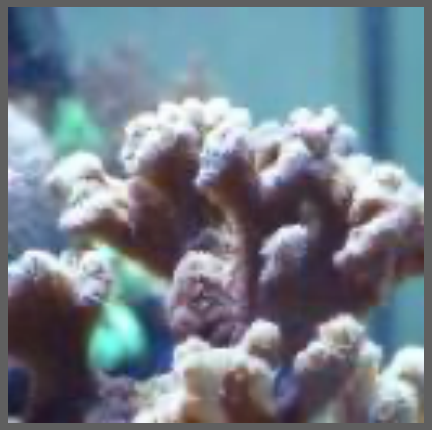
Plocoscyphia? sp.

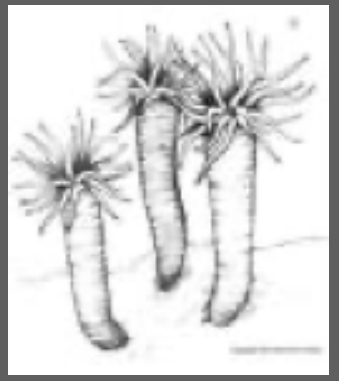
Rare Sponges

Rare Sponges – 80 MYA

Sponge Borings – 80 MYA

Horn Coral Today





Solitary Coral

Parasmilia sp.

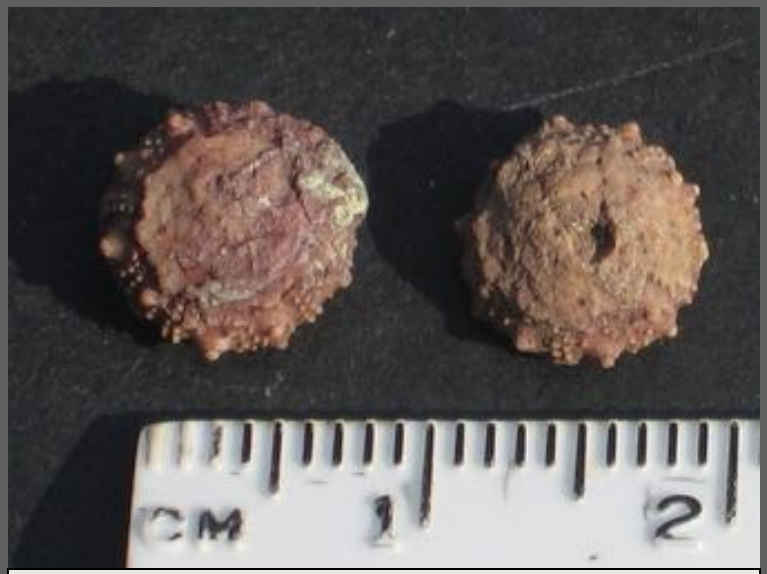
unidentified coral sp.

Bryozoan – 80 MYA

Echinoids (sea urchins) Today

Echinoids (sea urchins) – 80 MYA

Sea Urchin spine



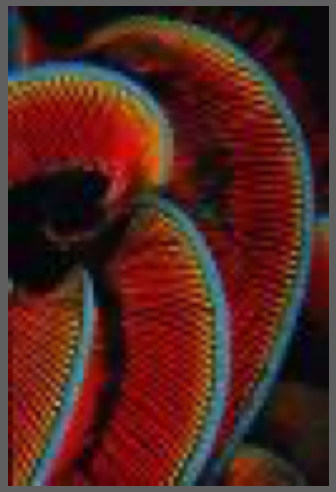
Salenia cf. *pseudowhitneyi*

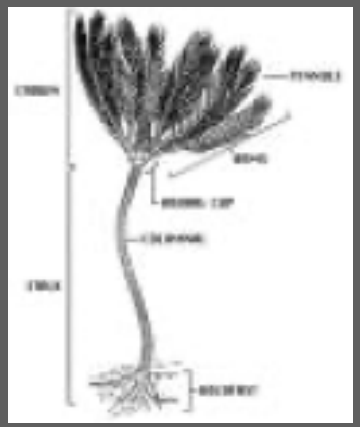
cf. *Washitaster* sp.

cf. *Washitaster* sp.

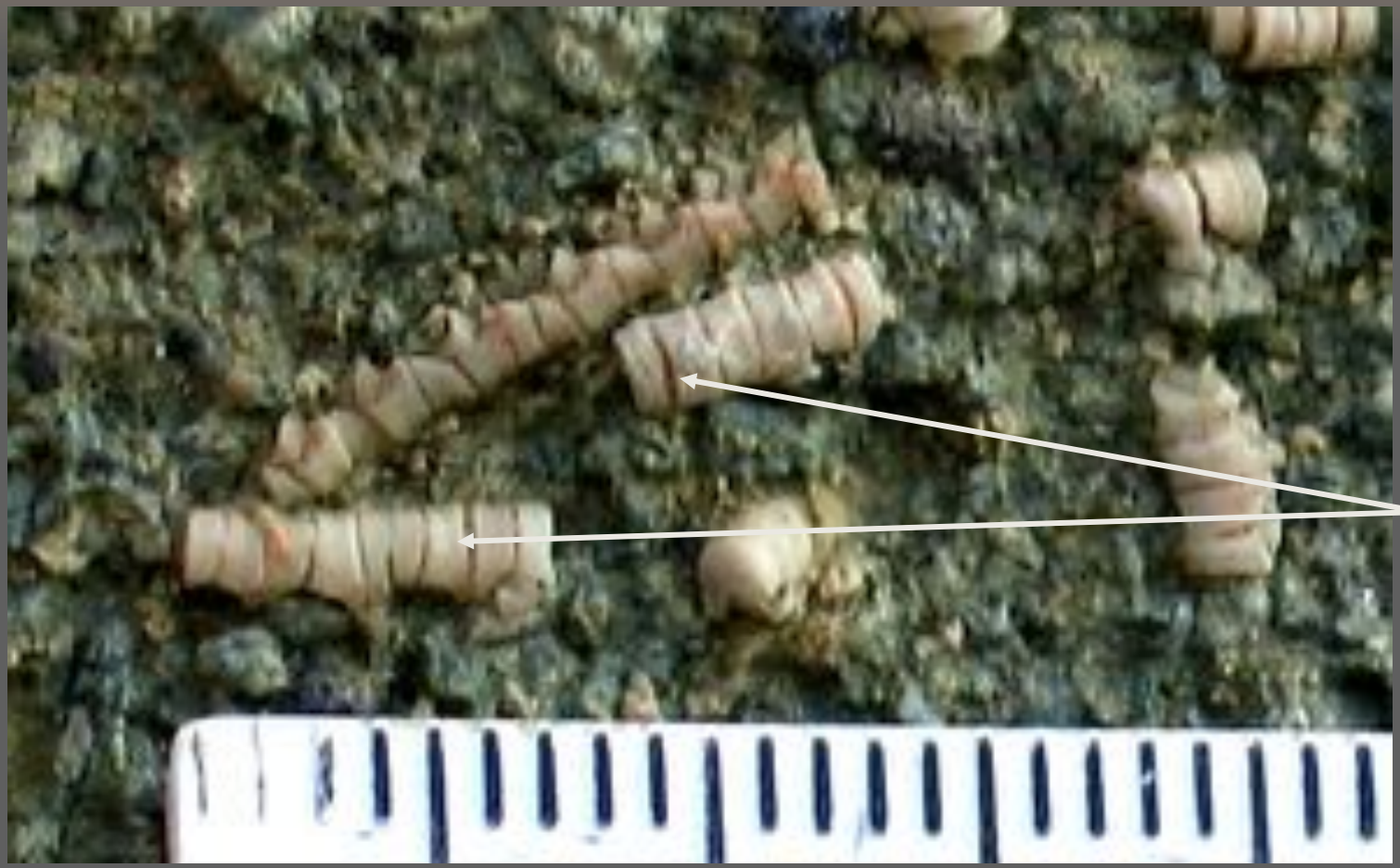
Sea Urchin spine

Crinoid (sea lily) Today





Crinoid (sea lily) – 80 MYA



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 leeii

Volutomorpha sp. 2

Solariella sp. 1

Exogyra laeviuscula

Preservation

Scaphites leeii

Astarte sp.

Scaphites leeii

unknown ammonite

Corbula sp. 2

Scaphites hippocrepis

Preservation

Gyrodes sp.

Parasmilia sp.

Parasmilia sp.

Cretalamna appendiculata

unidentified shark tooth

Protocallianassa cf. *mortoni*

Preservation

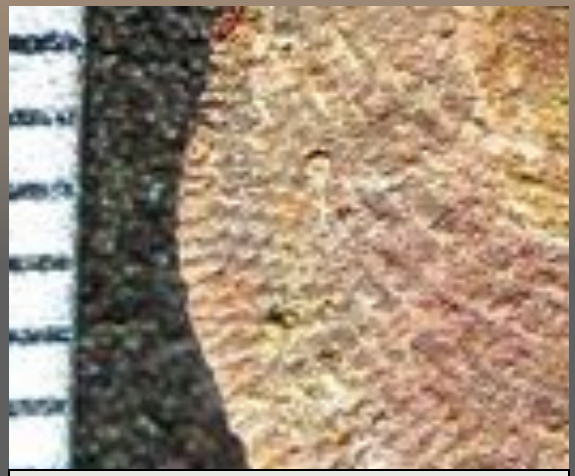
Scaphites leeii – green layer

Scaphites leeii – red layer

Preservation

Unidentified bivalve w/worm tubes

Solariella sp.



Camptonectes bensoni

Monodonta sp.

Preservation

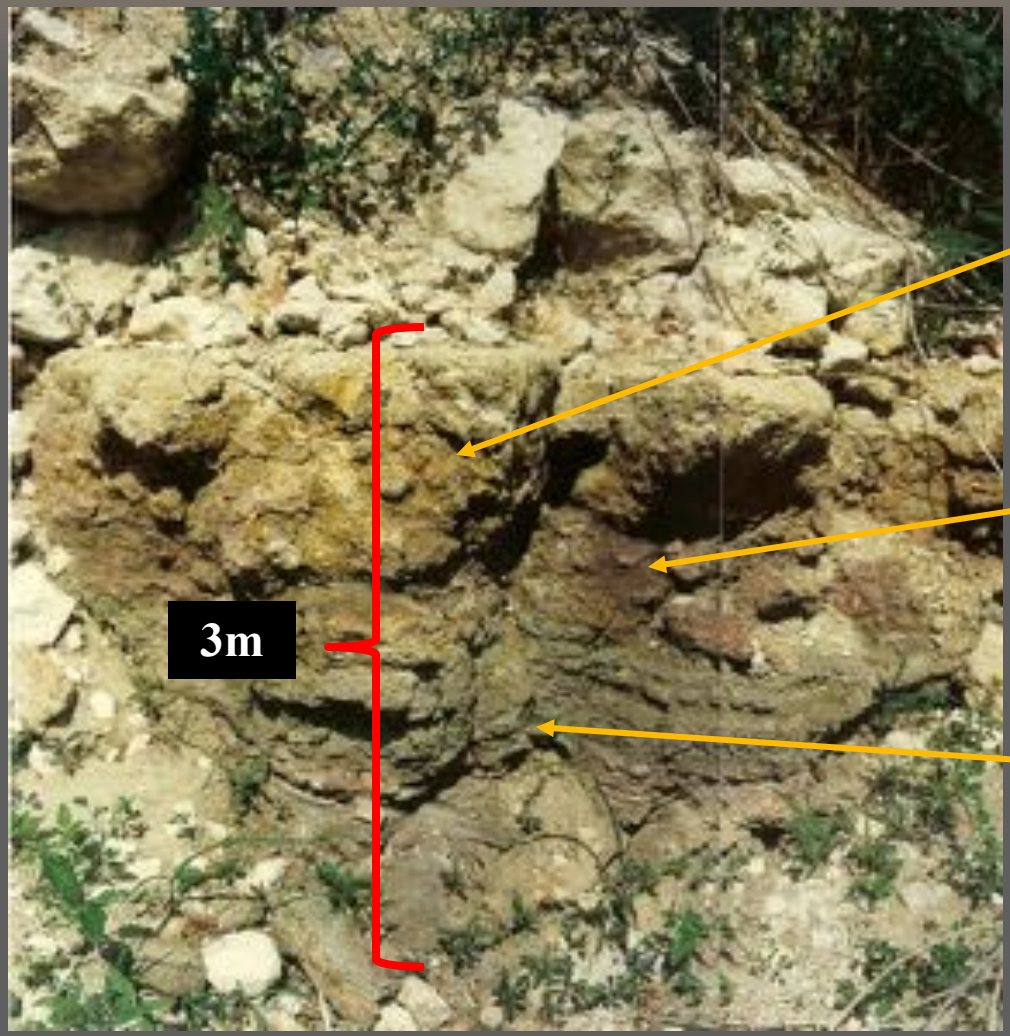
Plocoscyphia? sp.

Parasmilia sp.

Preservation

Preservation

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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- Please refer to paper for full references on identifications
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