GI 251 – Event Stratigraphy

Who am I
Who are you
What the class is about
What you need to know
What you need to do

Jin-Si R Over

Geographer

Woods Hole Coastal and Marine

Jin-Si Over is a geographer with the Woods Hole Coastal and Marine Science Center. A drone pilot and structure-from-motion specialist, she supports the Remote Sensing Coastal Change group and Aerial Imaging and Mapping group with GIS and surveying experience.

Education and Certifications

- M.S. Earth and Ocean Sciences University of Victoria, British Columbia, 2019,

  B.S Geology, University of North Carolina Wilmington, 2016

https://www.usgs.gov/staff-profiles/jin-si-r-over
https://www.usgs.gov/news/researcher-spotlight-jin-si-over

Ant-mimicking spider - *Myrmarachne formicaria*

We are looking for this small spider that looks like an ant.

Stiamo cercando questo piccolo ragno che sembra una formica.
Buscamos a esta pequeña araña que parece una hormiga.
Nous recherchons cette petite araignée qui ressemble à une fourmi.
Wir suchen nach dieser kleinen Spinne, die wie eine Ameise aussieht.

♂

♀

Dr. Jennifer Apple applej@geneseo.edu


DA
Saint Lawrence River
Lake Champlain
Adirondack
Lake Placid
Mt Marcy
1,629 m
Black
Tug Hill
Mountains
Toronto
Lake Ontario
Rochester
Buffalo
Finger Lakes
Syracuse
Mohawk Valley
Mohawk River
Albany
Lake Erie
Allegheny Plateau
Susquehanna River
Catskill Mountains
Hudson Valley
Hudson River
Delaware R
Boston
Springfield
Hartford
Providence
Long Island Sound
New York
Coastal Plain
Long Island
Atlantic Ocean
Pittsburgh
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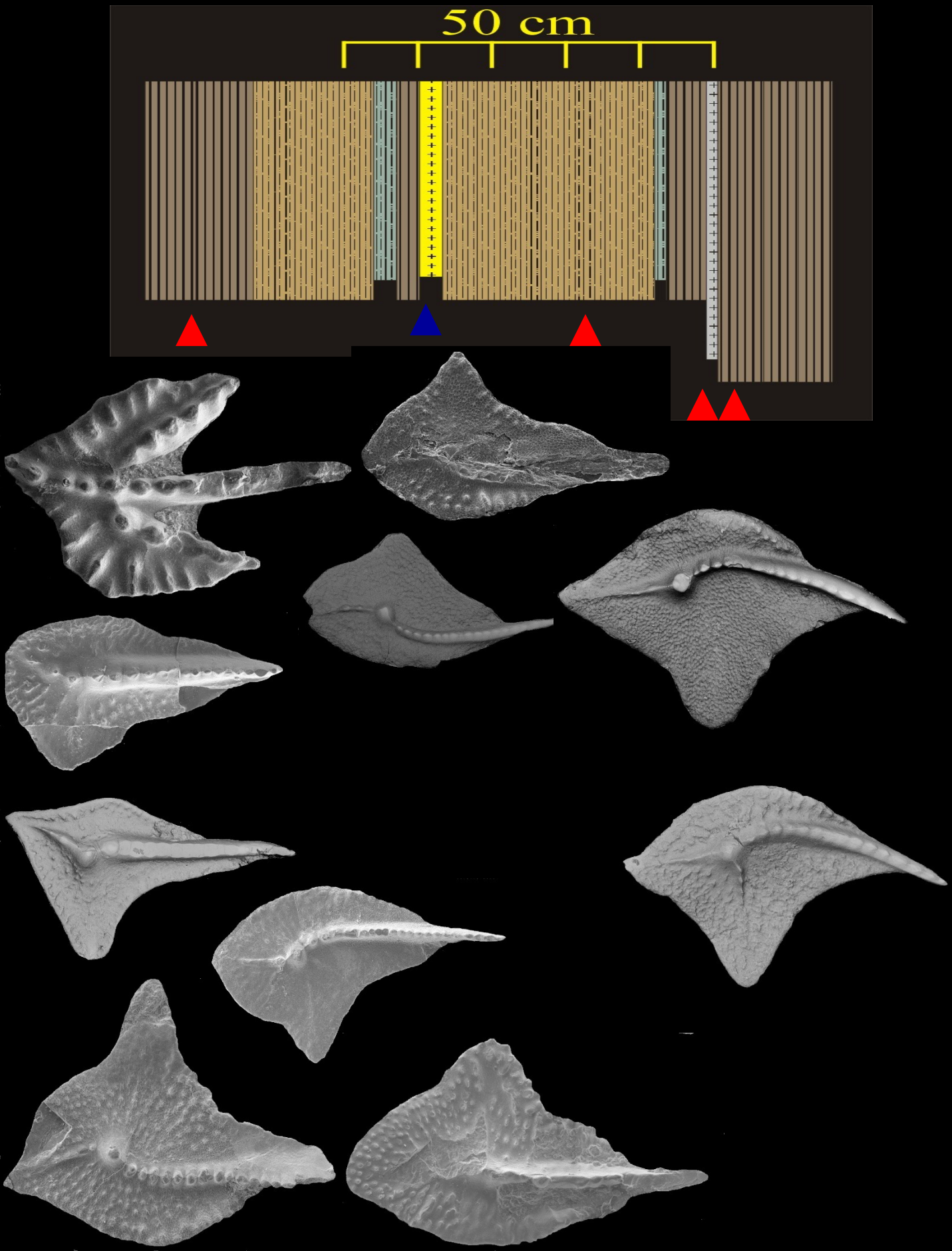
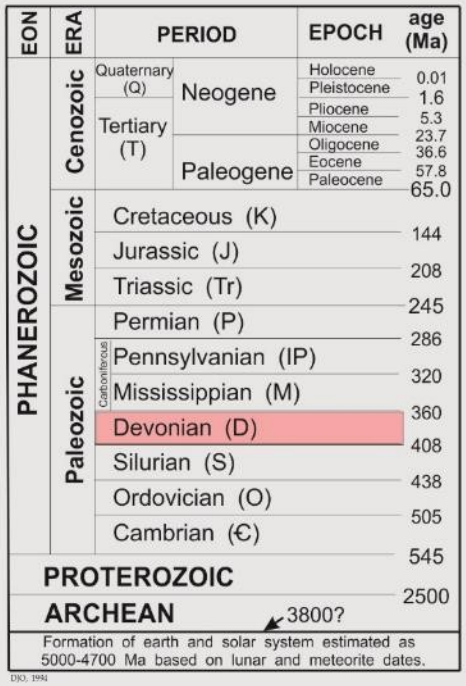
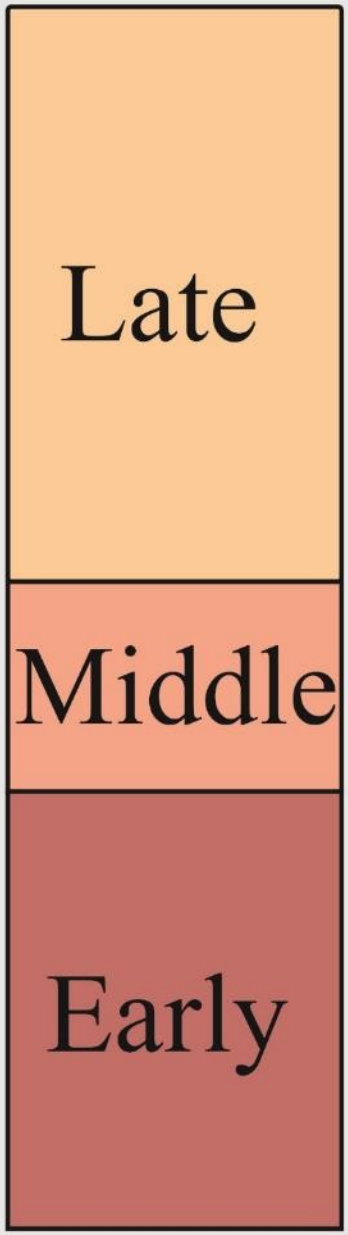
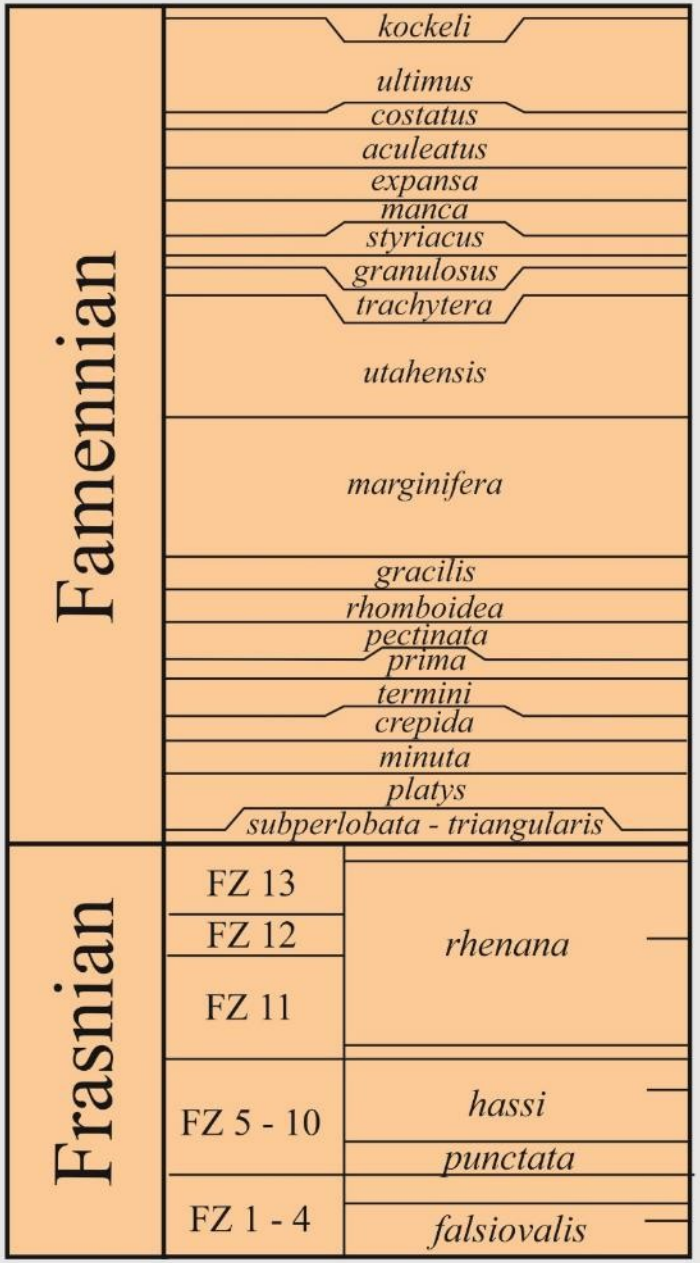
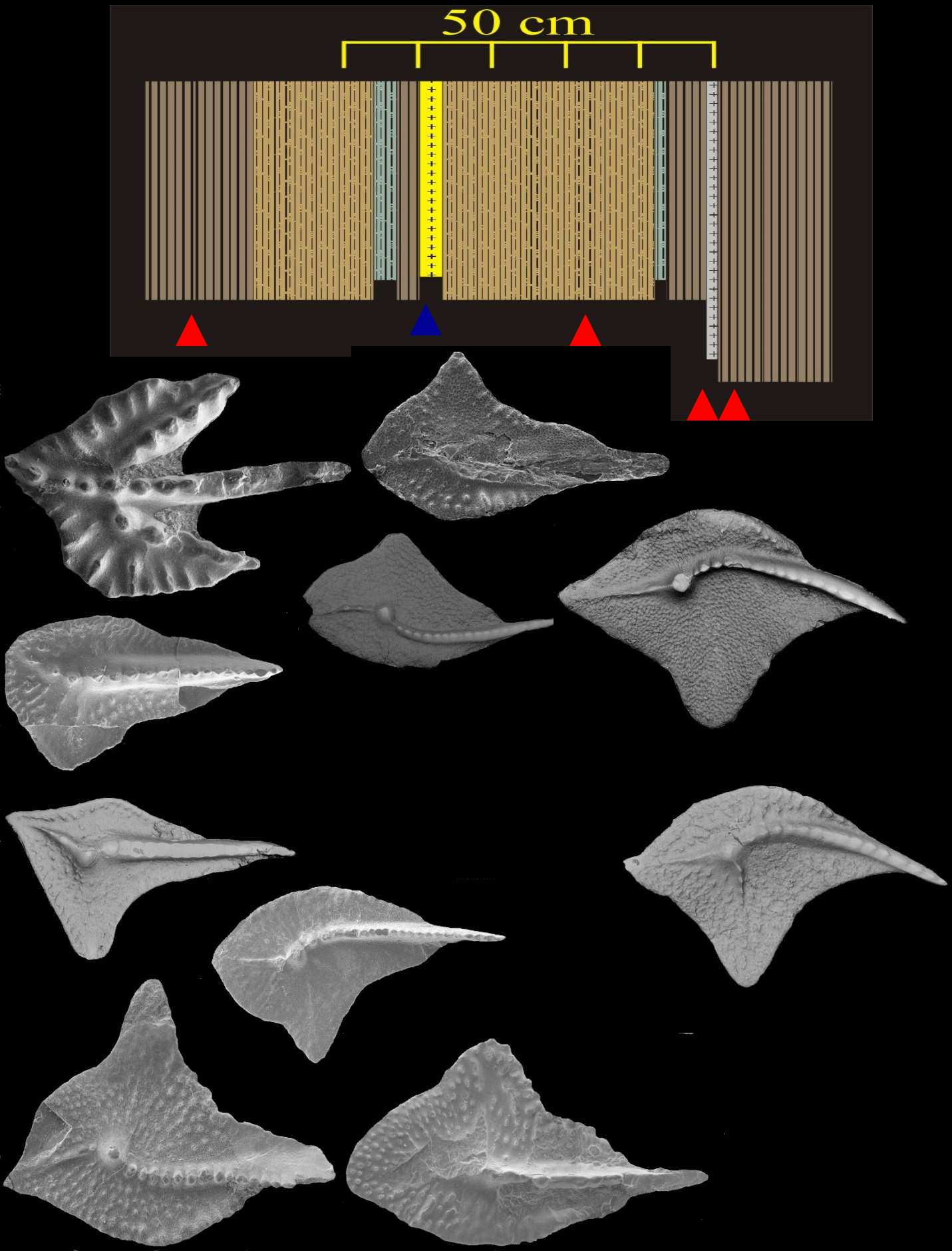
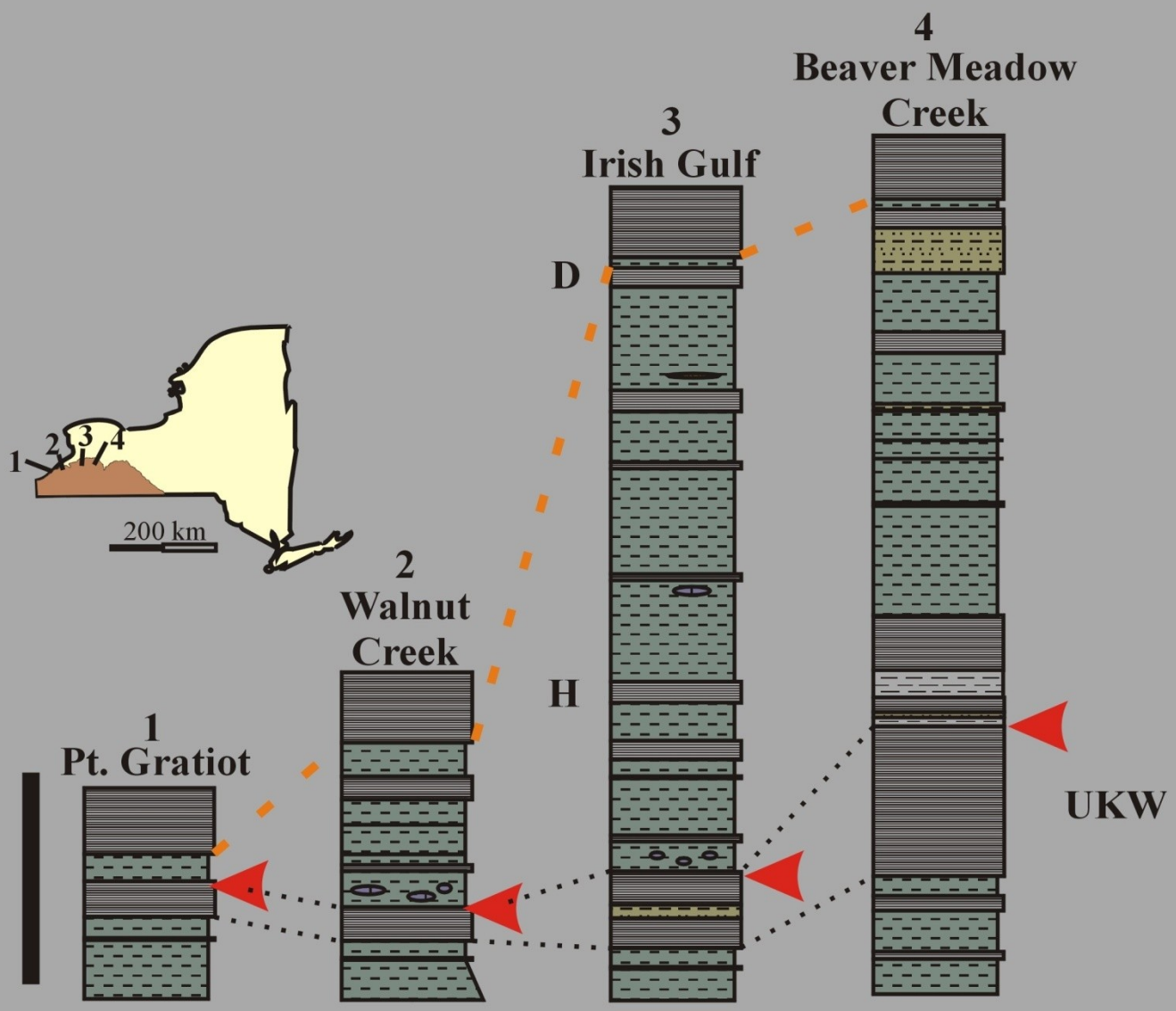

50 cm


EON
ERA
PERIOD
EPOCH
age (Ma)
PHANEROZOIC
Cenozoic
Quaternary (Q)
Neogene
Holocene
Pleistocene
0.01
1.6
Tertiary (T)
Pliocene
Miocene
5.3
23.7
Paleogene
Oligocene
Eocene
Paleocene
36.6
57.8
65.0
Mesozoic
Cretaceous (K)
144
Jurassic (J)
208
Triassic (Tr)
245
Paleozoic
Permian (P)
286
Carboniferous
Pennsylvanian (IP)
320
Mississippian (M)
360
Devonian (D)
408
Silurian (S)
438
Ordovician (O)
505
Cambrian (Є)
545
PROTEROZOIC
2500
ARCHEAN
3800?
Formation of earth and solar system estimated as 5000-4700 Ma based on lunar and meteorite dates.
DJO, 1994

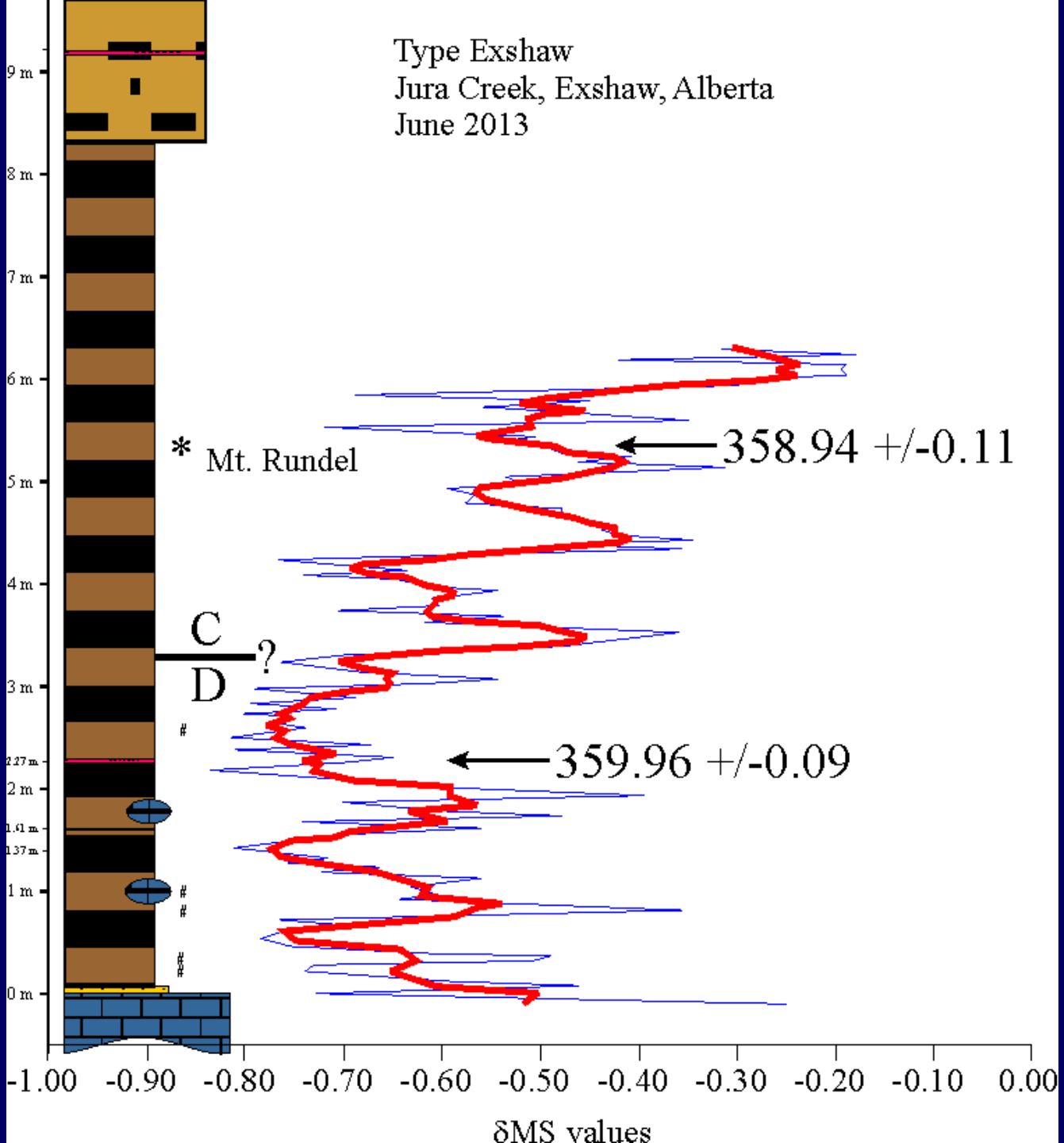

Late
Middle
Early

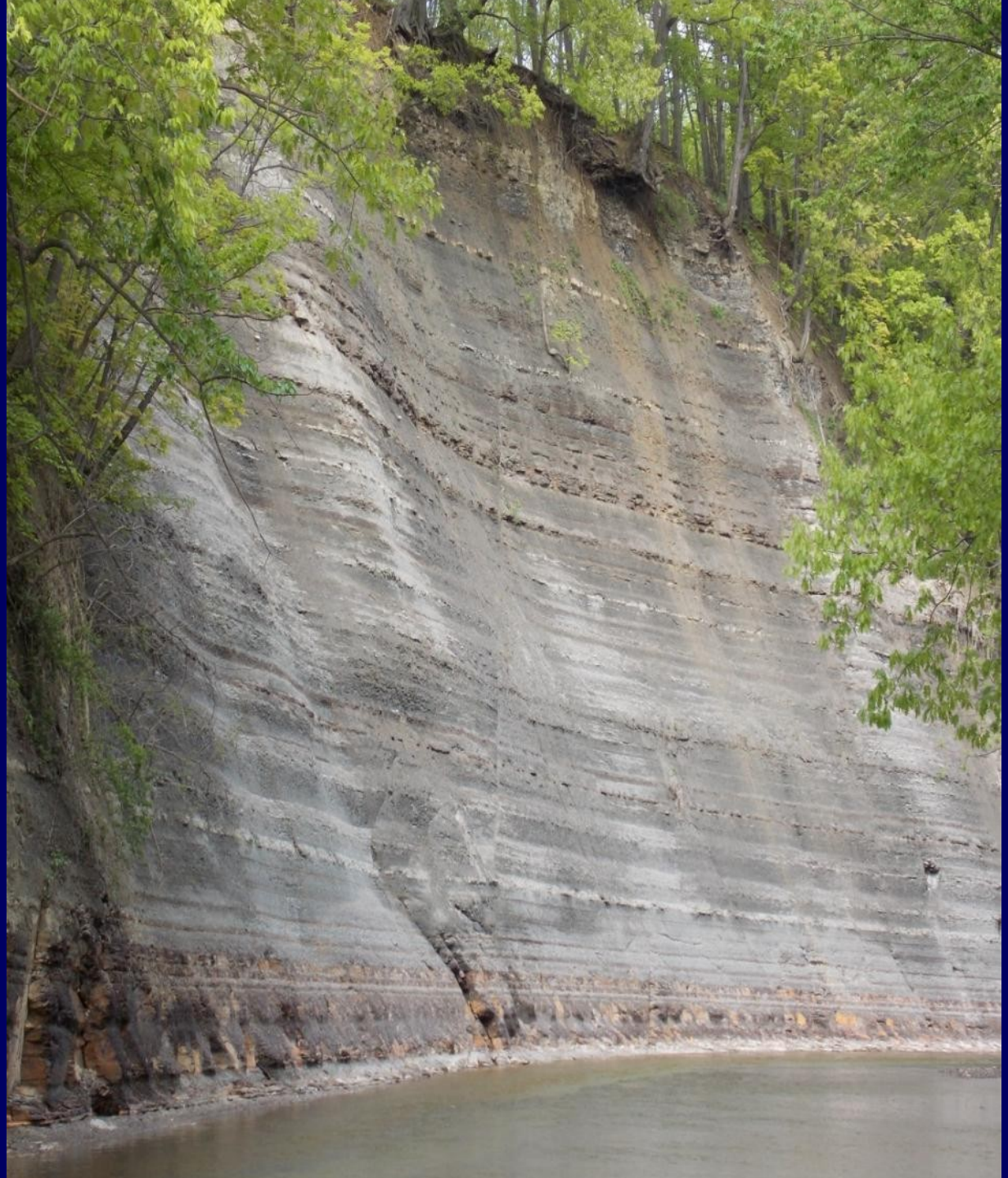

Famennian
kockeli
ultimus
costatus
aculeatus
expansa
manca
styriacus
granulosus
trachytera
utahensis
marginifera
gracilis
rhomboidea
pectinata
prima
termini
crepida
minuta
platys
subperlobata - triangularis
Frasnian
FZ 13
FZ 12
FZ 11
rhenana
FZ 5 - 10
hassi
punctata
FZ 1 - 4
falsiovalis

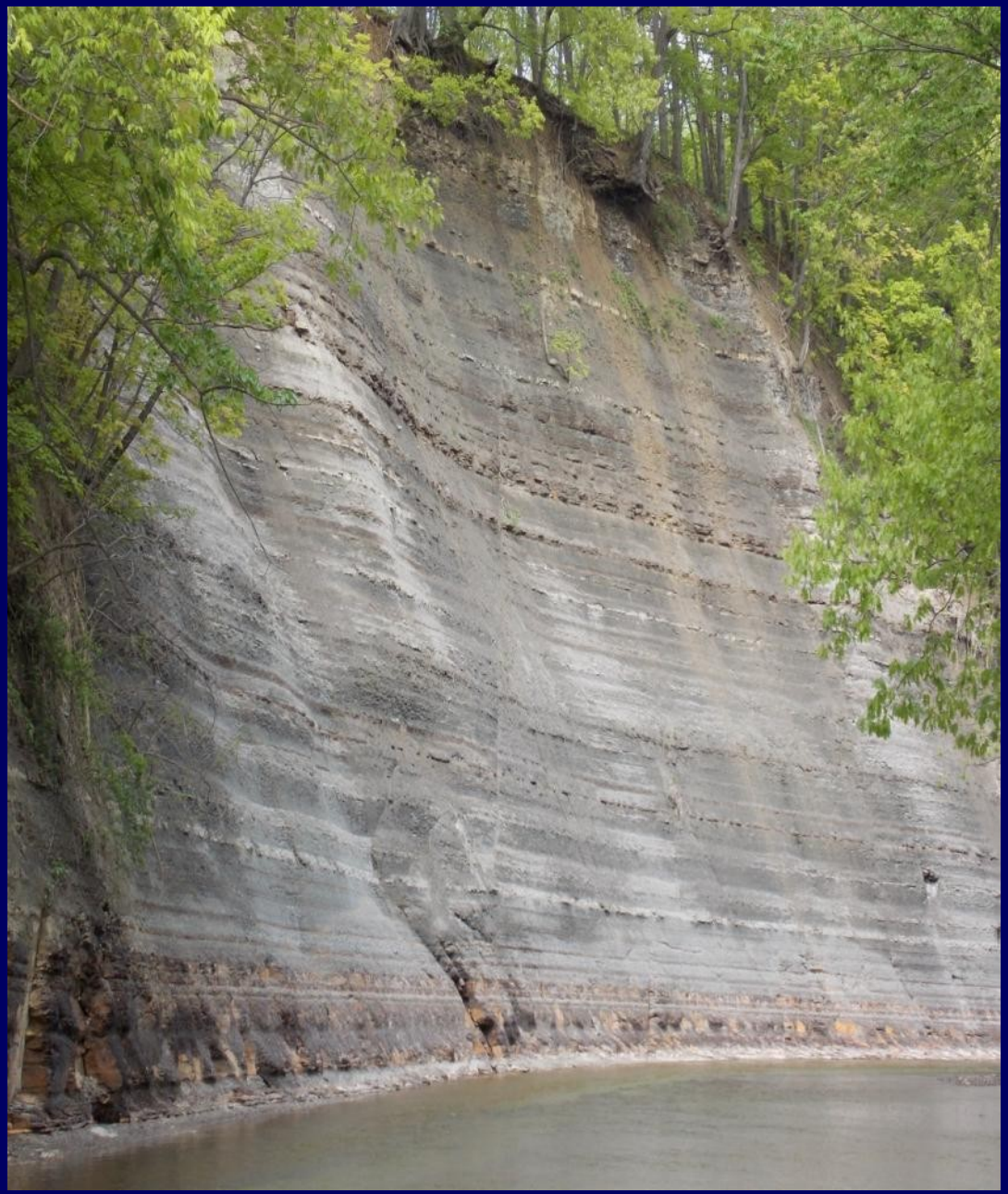

50 cm

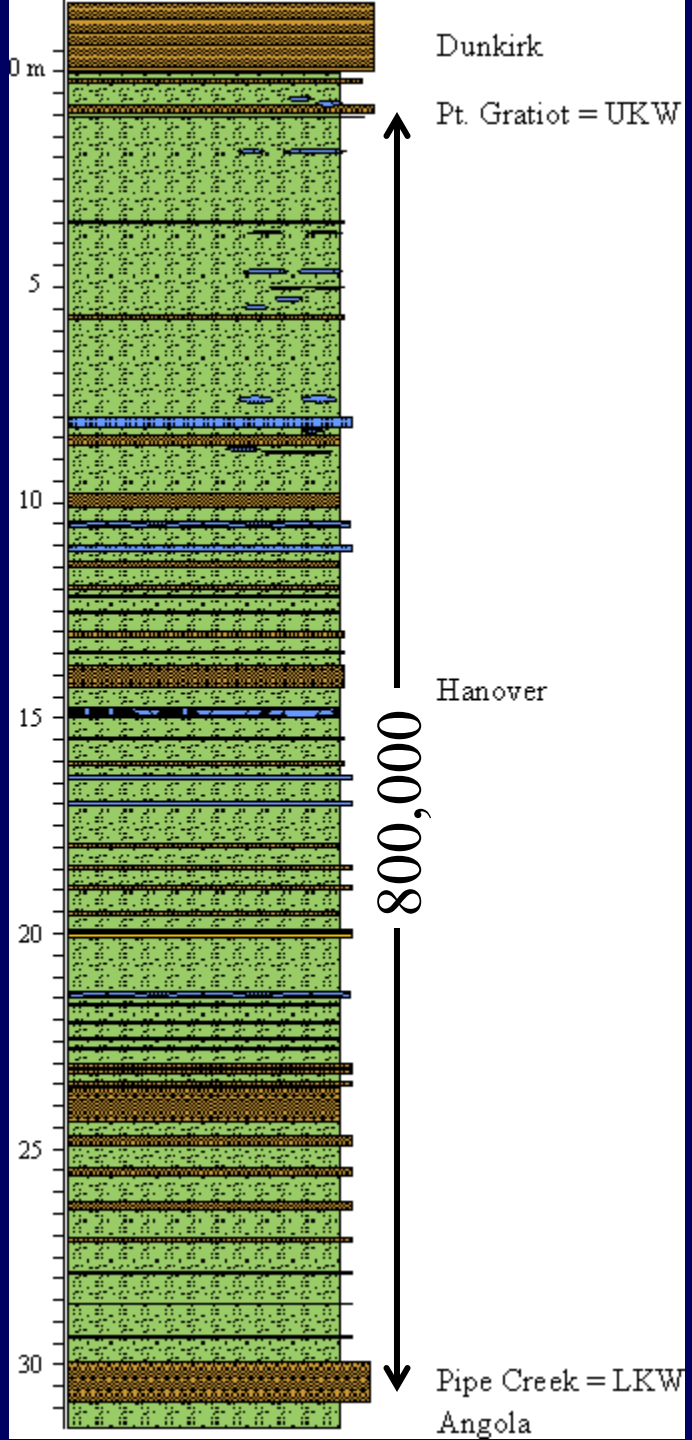

4
Beaver Meadow
Creek
3
Irish Gulf
D
H
2
Walnut
Creek
1
Pt. Gratiot
UKW
1
2
3
4
200 km

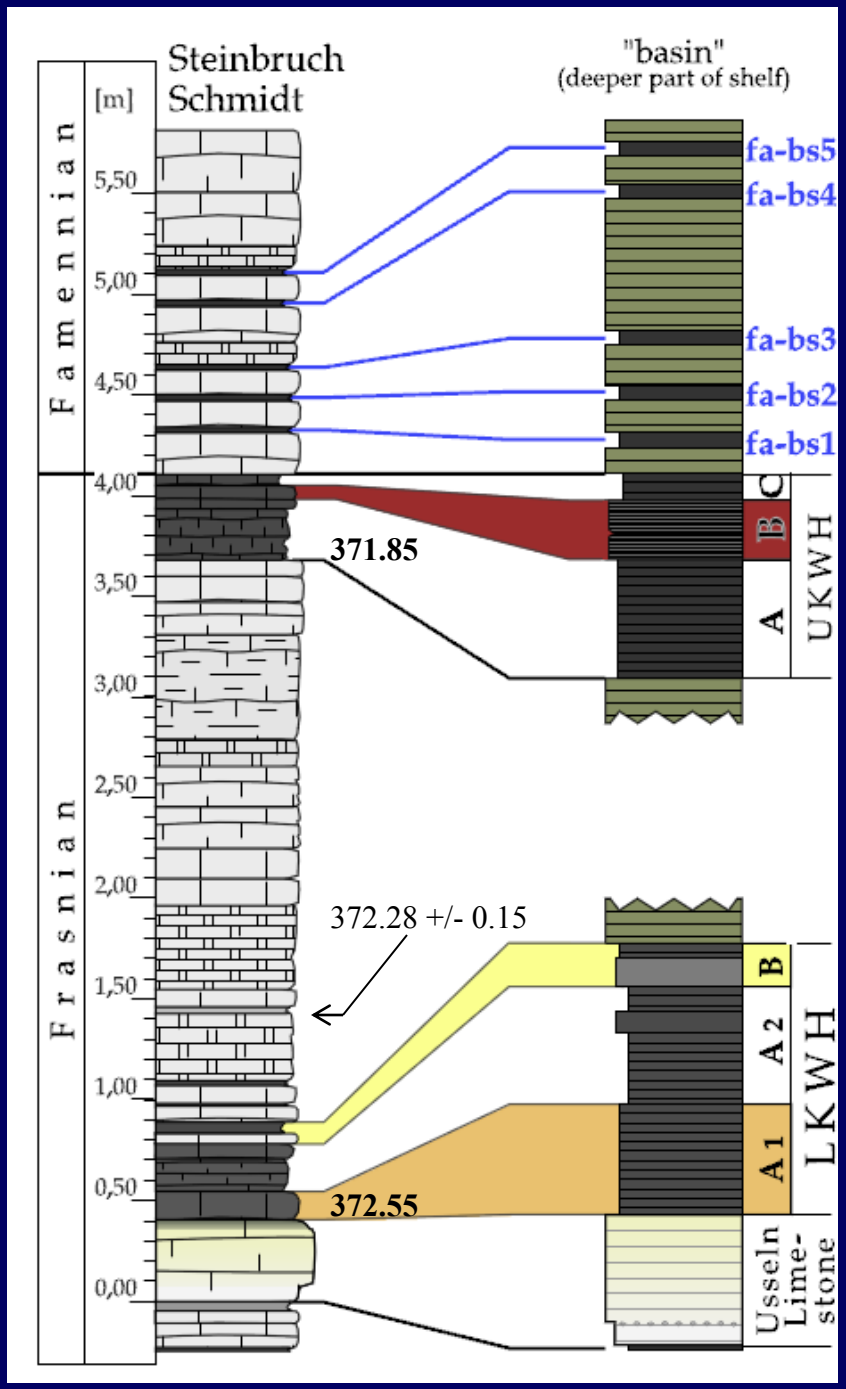

Summit Post


Type Exshaw
Jura Creek, Exshaw, Alberta
June 2013
9 m
8 m
7 m
6 m
5 m
4 m
3 m
2 m
1 m
0 m
* Mt. Rundel
358.94 +/-0.11
C
D
?
359.96 +/-0.09
-1.00
-0.90
-0.80
-0.70
-0.60
-0.50
-0.40
-0.30
-0.20
-0.10
0.00
δMS values



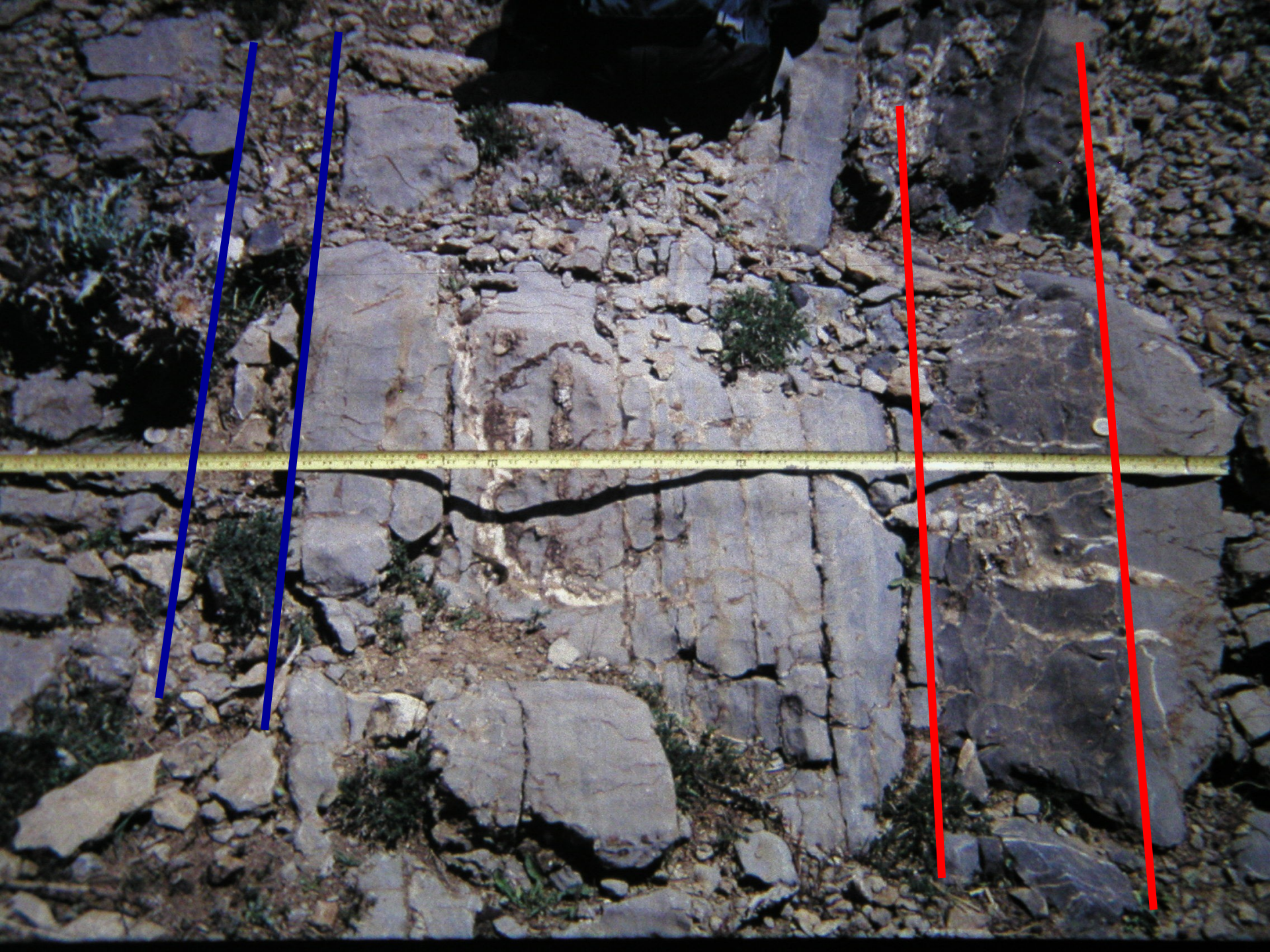


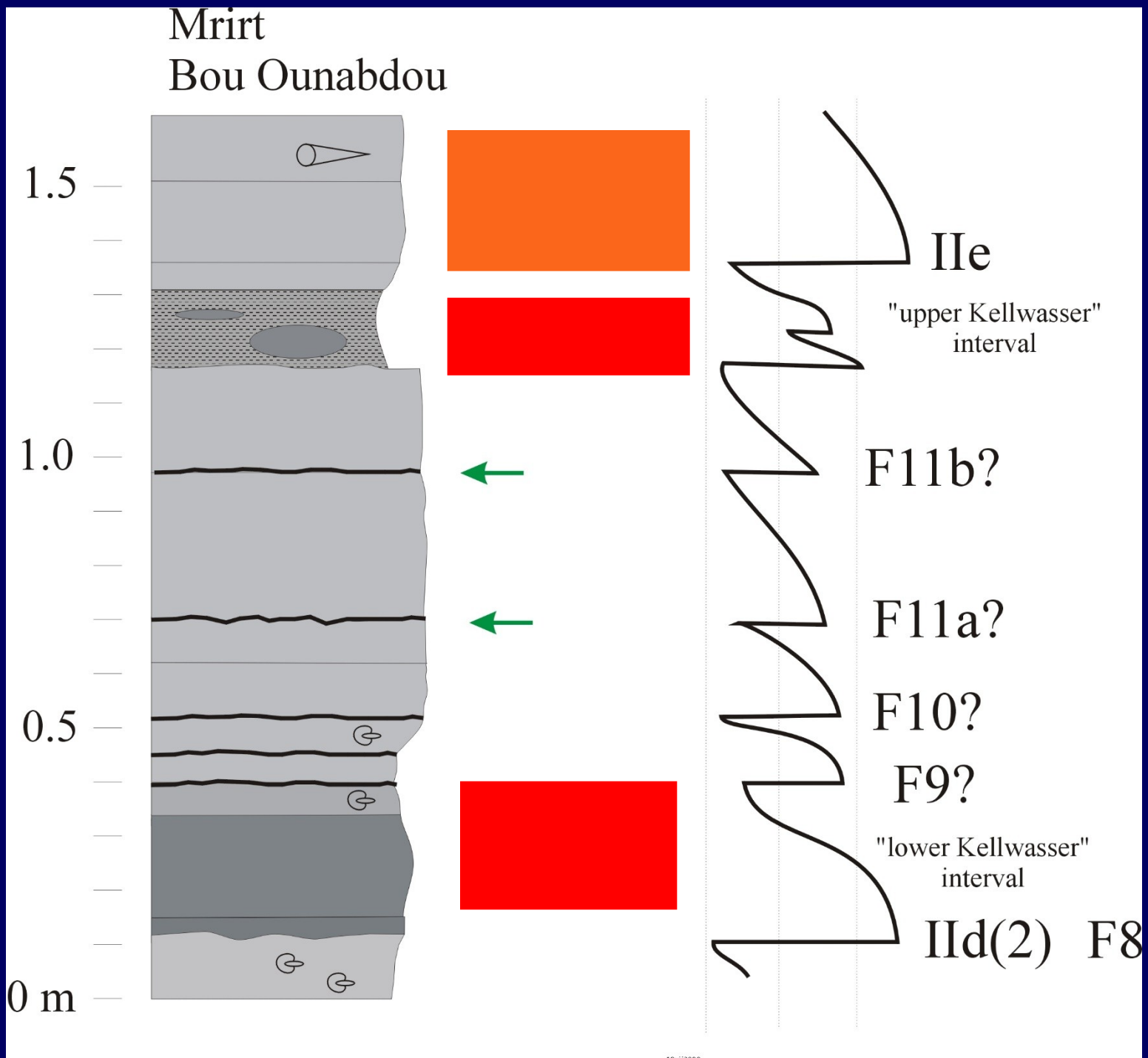

0 m
5
10
15
20
25
30
Dunkirk
Pt. Gratiot = UKW
Hanover
800,000
Pipe Creek = LKW
Angola



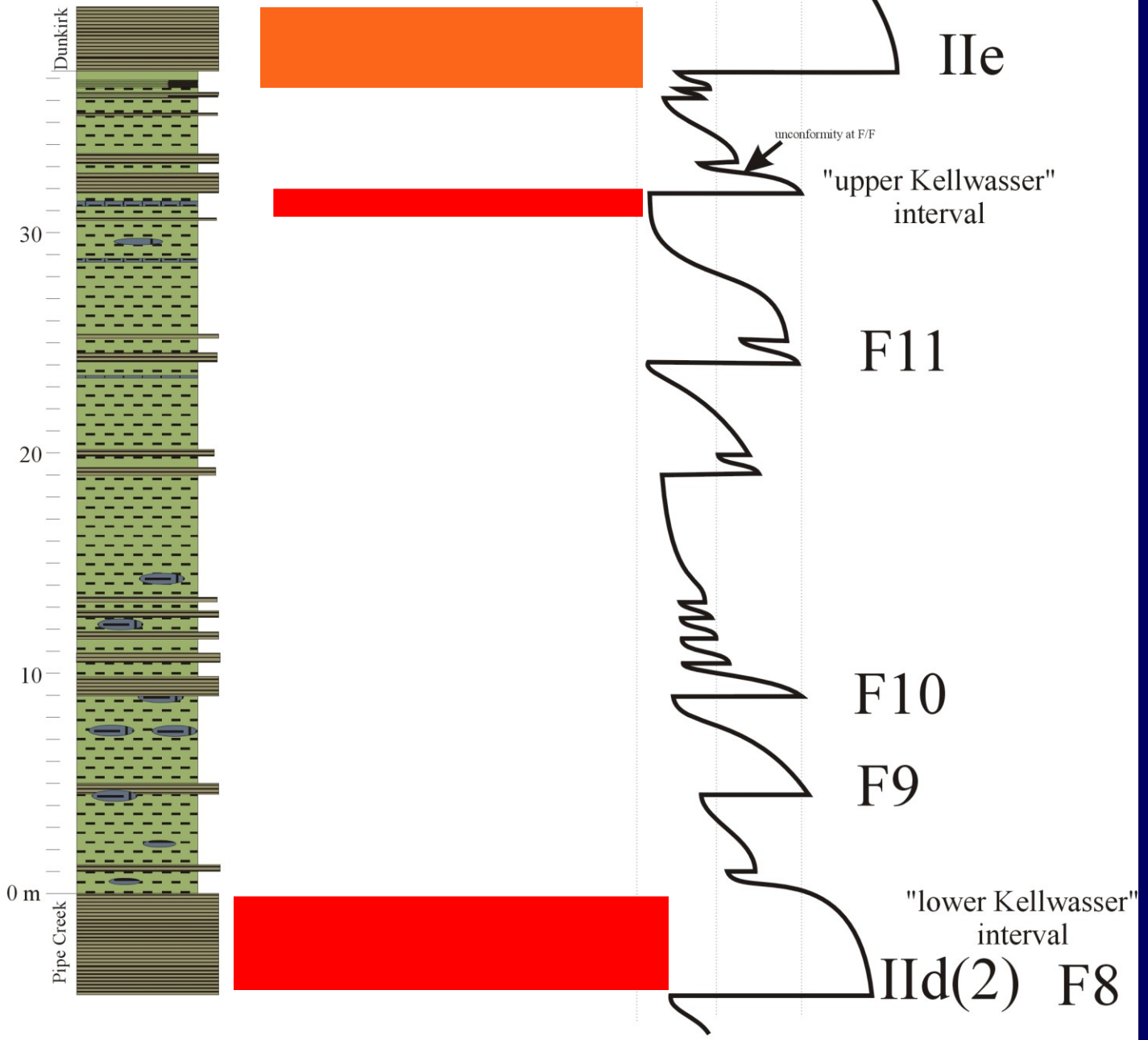
Benner Quarry

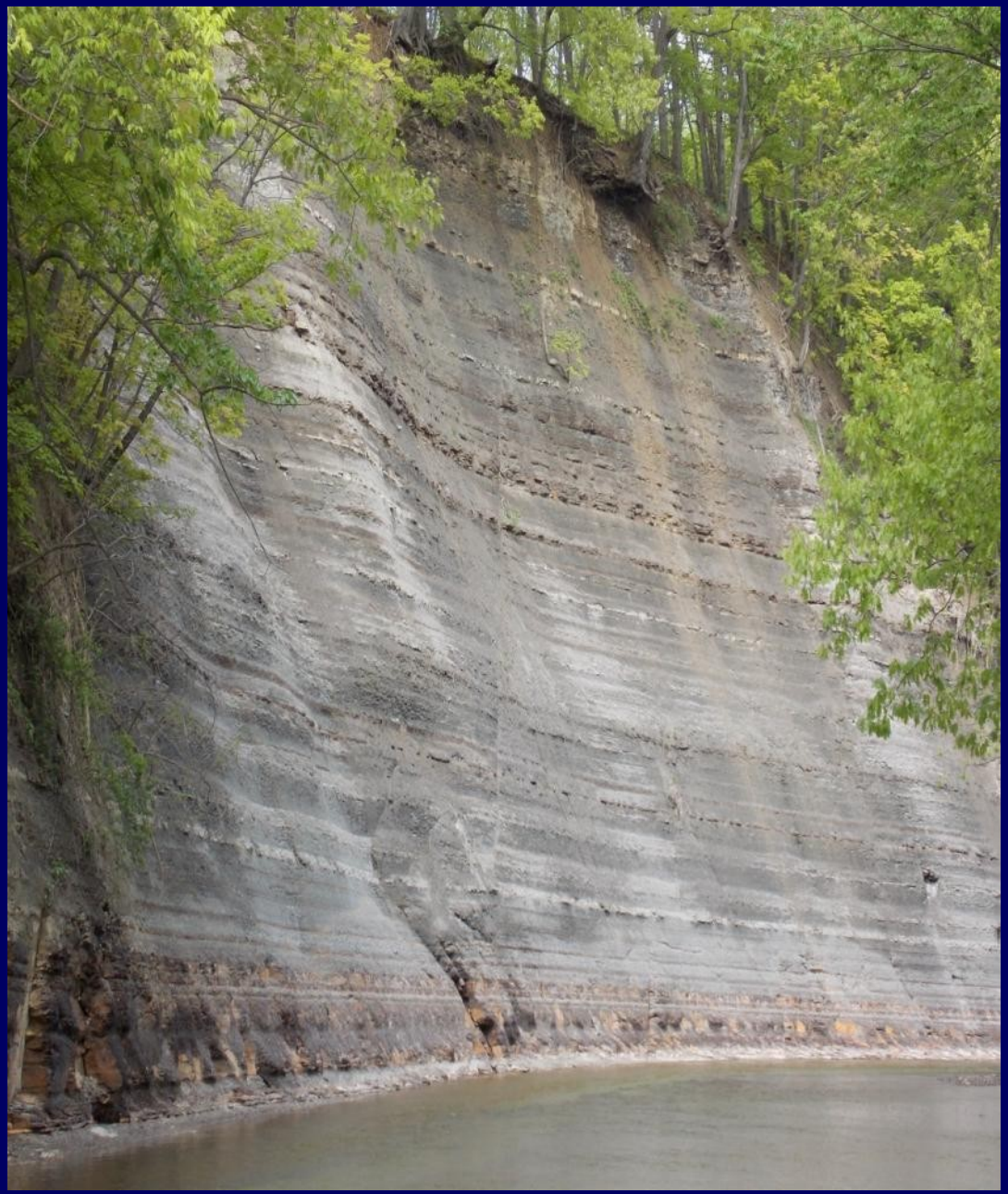
Gereke and Schindler, 2012
Schmitz pers . comm., 2014

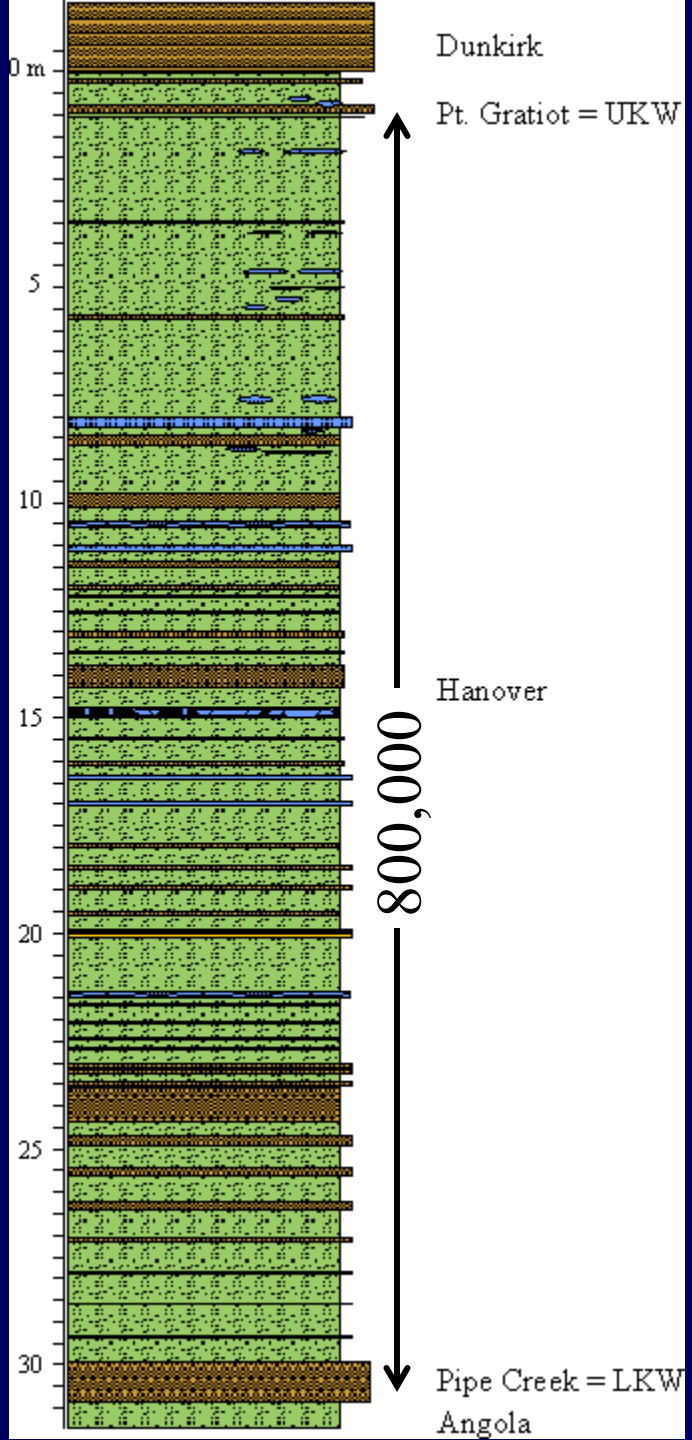



Mrirt
Bou Ounabdou
1.5
1.0
0.5
0 m
IIe
"upper Kellwasser" interval
F11b?
F11a?
F10?
F9?
"lower Kellwasser" interval
IId(2)
F8

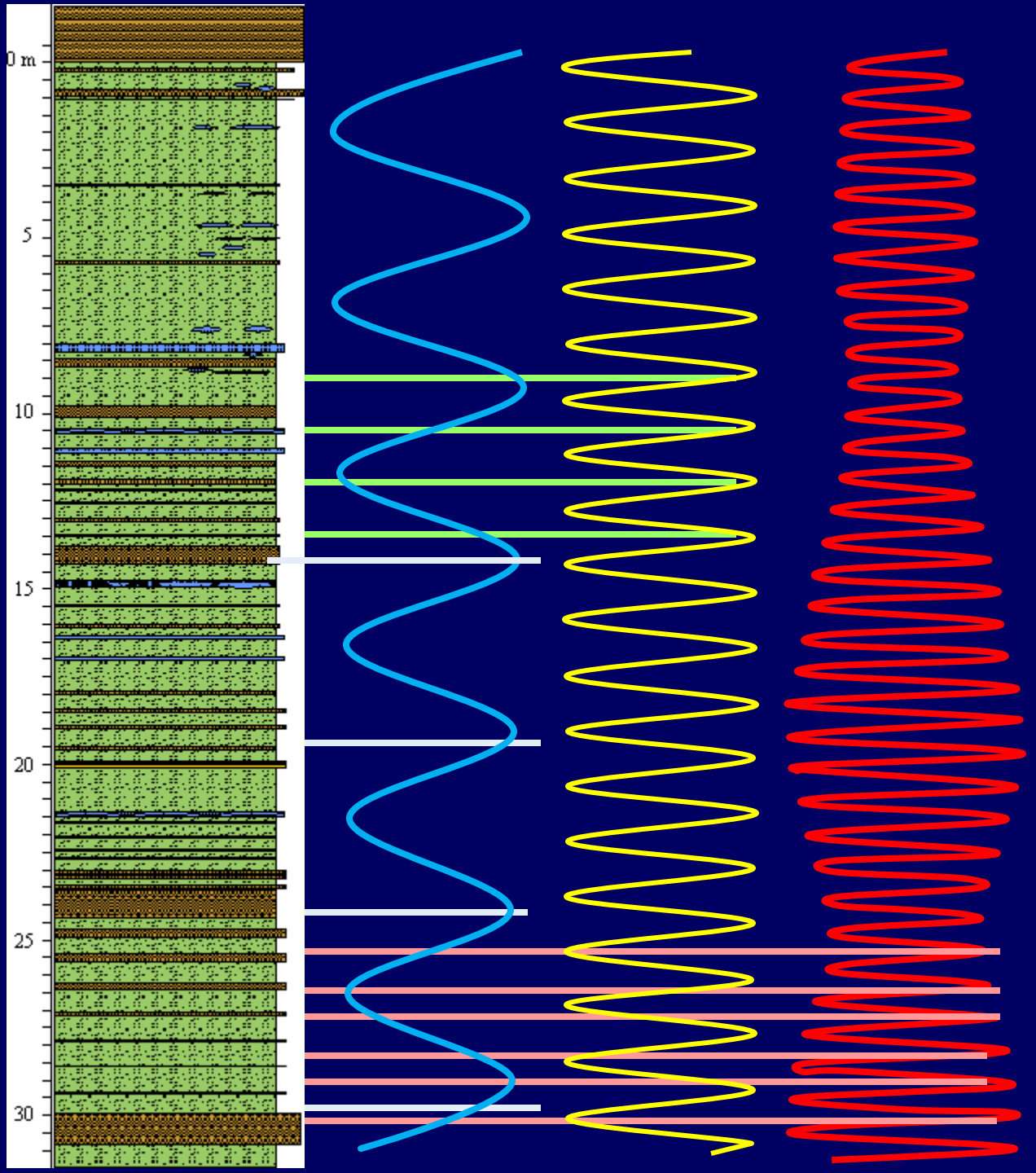
Beavermeadow Creek






0 m
5
10
15
20
25
30
Dunkirk
Pt. Gratiot = UKW
Hanover
800,000
Pipe Creek = LKW
Angola

- Short Eccentricity cycles: ~5 m
- Obliquity cycles:
- ~2 m
- Precession cycles: ~60 cm
- Cycles occur with measured accuracy
- Dominant cycle can be used to assess deposition rate, latitude, and duration
- Haalstaat cycles – subprecession millennial scale ~5cm



https://us.fulbrightonline.org/

Who am I – Fulbright scholar – funded by the Congress of the United States.
The idea is that you learn more about the United States, you get to work on your English skills; I get to learn more about Czechia and take this information back to the US, develop Czech language skills, and work with Dr. Kumpan as well as others on collaborative research projects.

Who are you?

What the class is about – Event Stratigraphy

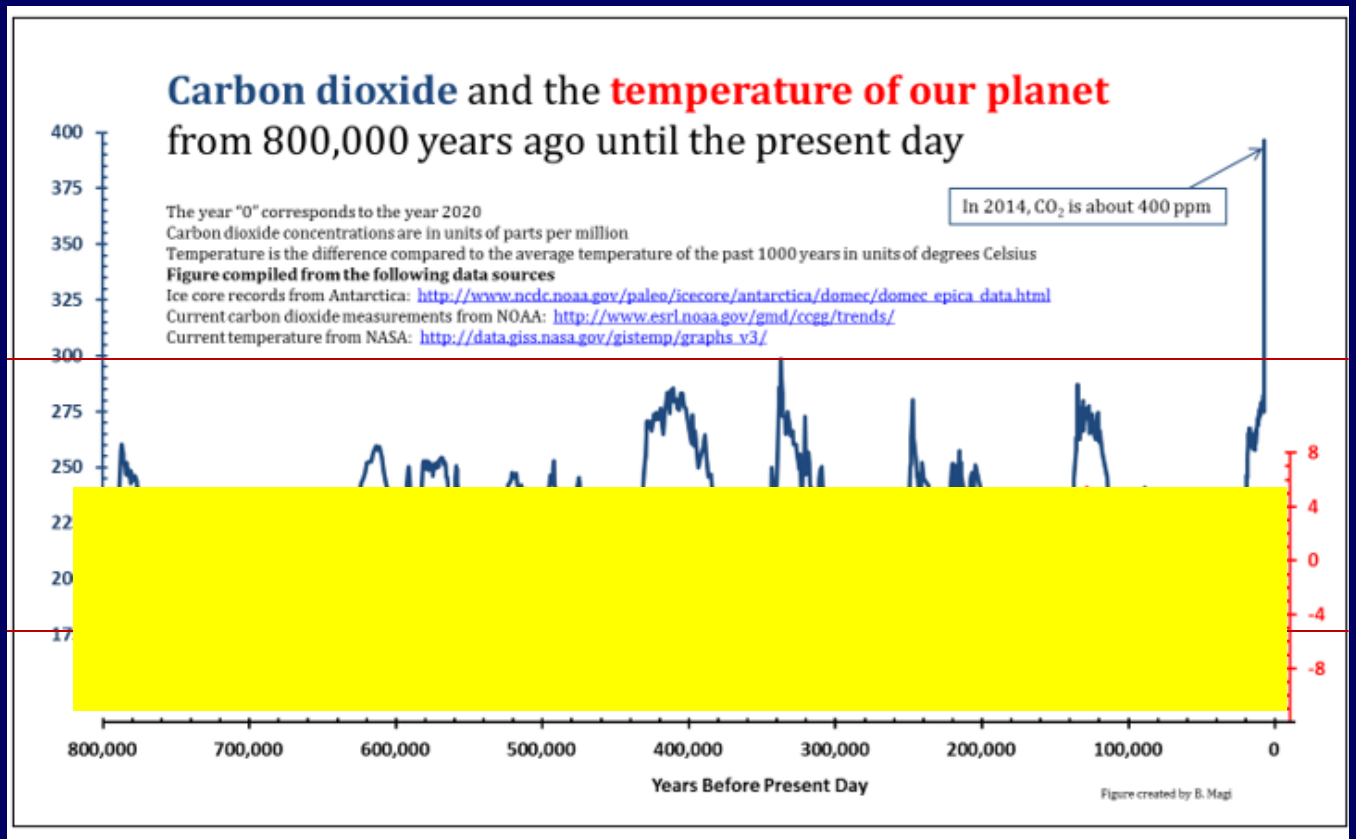
Event stratigraphy is the correlation of sedimentary sequences using prominent marker beds, isochronic horizons such as tephra beds, depositional and biotic changes, or geochemical/isotopic excursions. These are tied to a biostratigraphic framework, but also offer higher resolution than can be resolved by biostratigraphy alone. Event analysis is one of the basic underpinnings for deciphering the entire stratigraphic record.

Kauffman (1988) recognizes four broad categories:
Physical event units
Chemical event units
Biological event units
Composite event units

What the class is about – Event Stratigraphy

utility – refined correlation – knowledge of strata for such things as extraction and sequestration industry, agriculture, construction

utility – understanding earth history through investigation of global events and then a predictor for changes in the modern

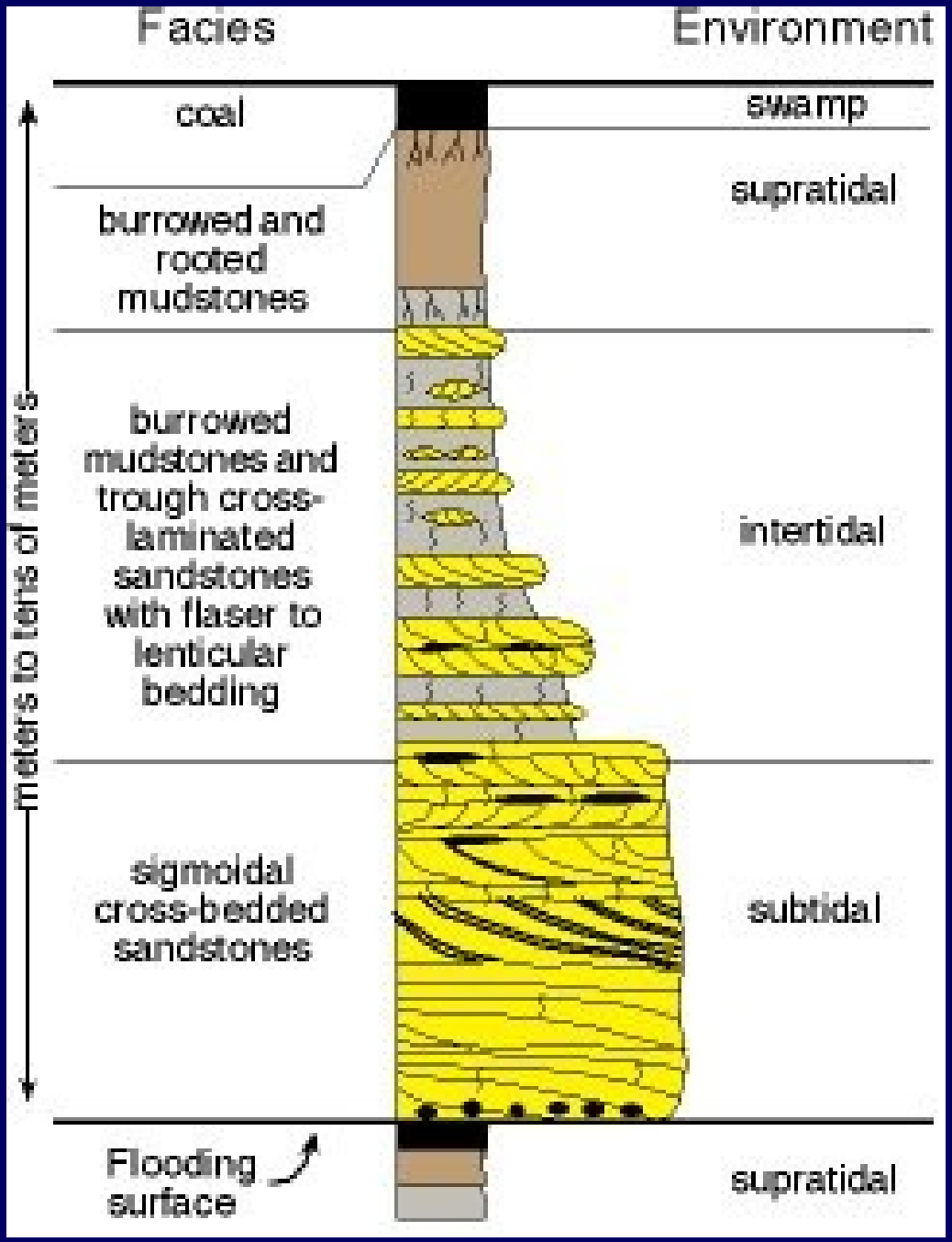


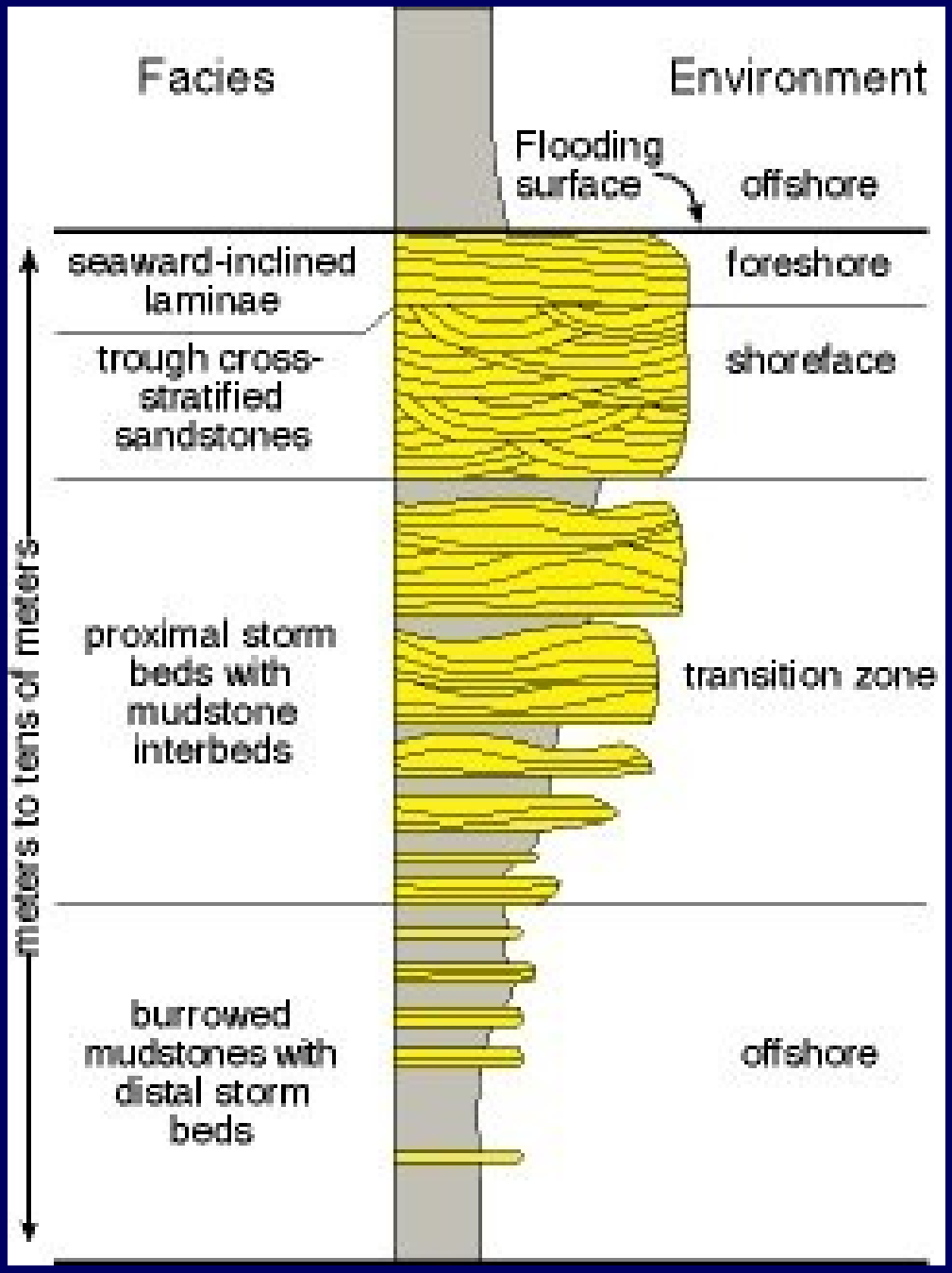
What you need to know

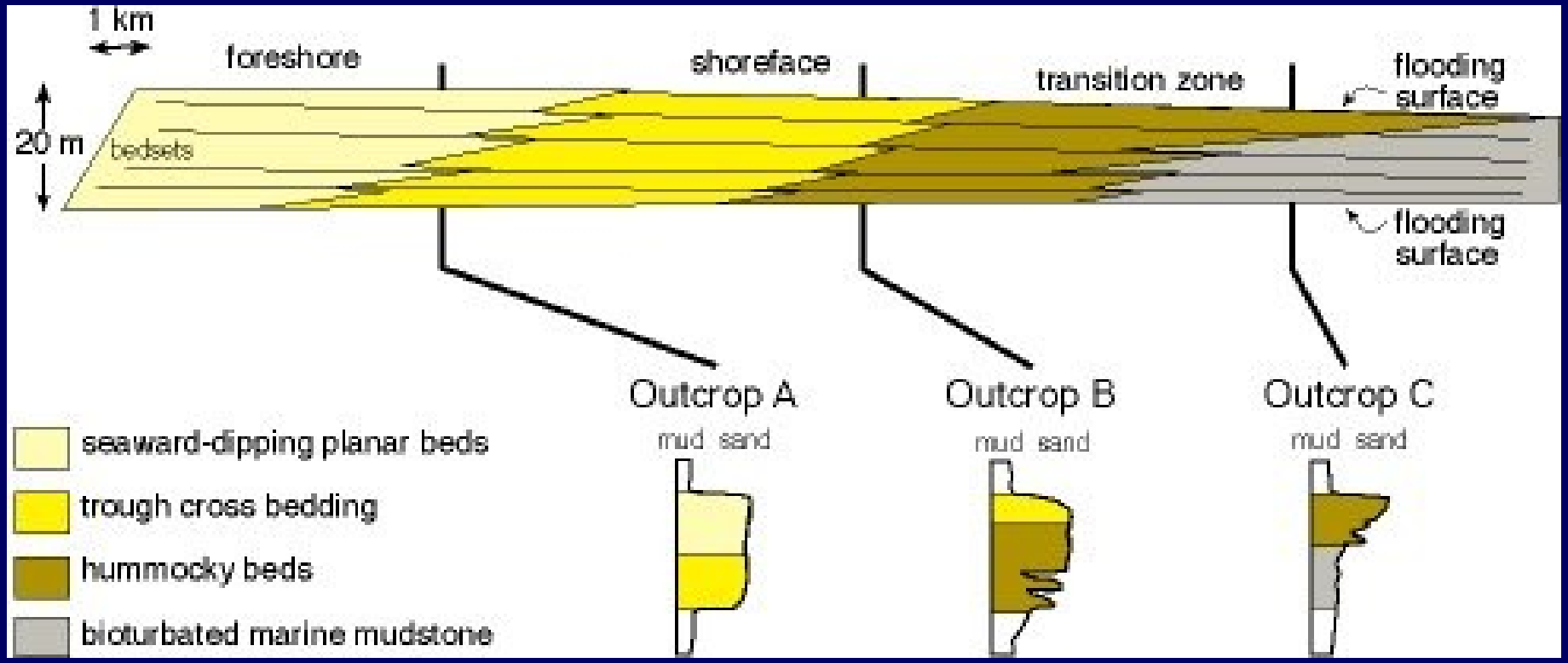
requires knowledge of stratigraphy

review of stratigraphic principles

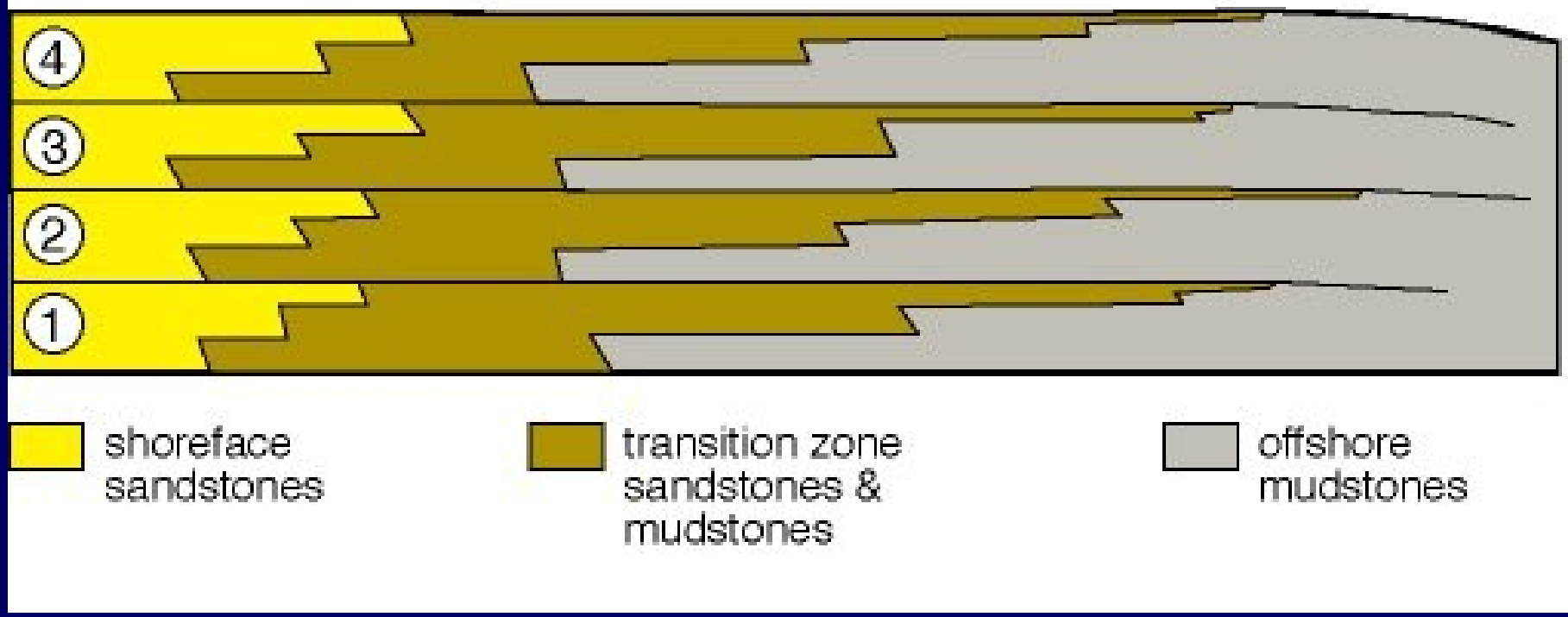
Superposition and Walther's Law


Facies
Environment
coal
swamp
supratidal
burrowed and rooted mudstones
burrowed mudstones and trough cross-laminated sandstones with flaser to lenticular bedding
intertidal
sigmoidal cross-bedded sandstones
subtidal
Flooding surface
supratidal
meters to tens of meters


Facies
Environment
Flooding surface
offshore
seaward-inclined laminae
foreshore
trough cross-stratified sandstones
shoreface
proximal storm beds with mudstone interbeds
transition zone
burrowed mudstones with distal storm beds
offshore
meters to tens of meters


1 km
foreshore
shoreface
transition zone
flooding surface
20 m
bedsets
flooding surface
Outcrop A
mud sand
Outcrop B
mud sand
Outcrop C
mud sand
seaward-dipping planar beds
trough cross bedding
hummocky beds
bioturbated marine mudstone

Aggradational Parasequence Set

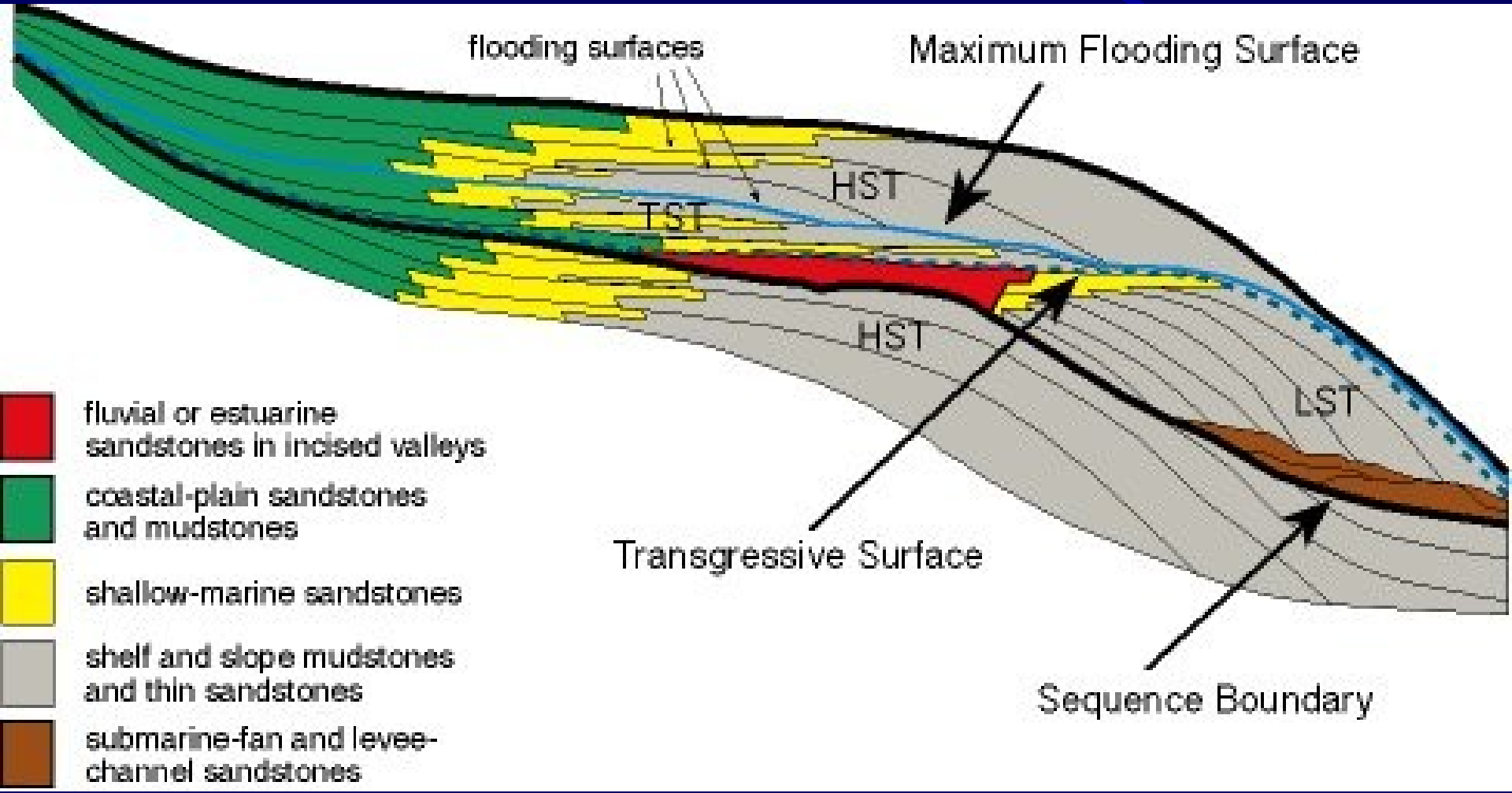


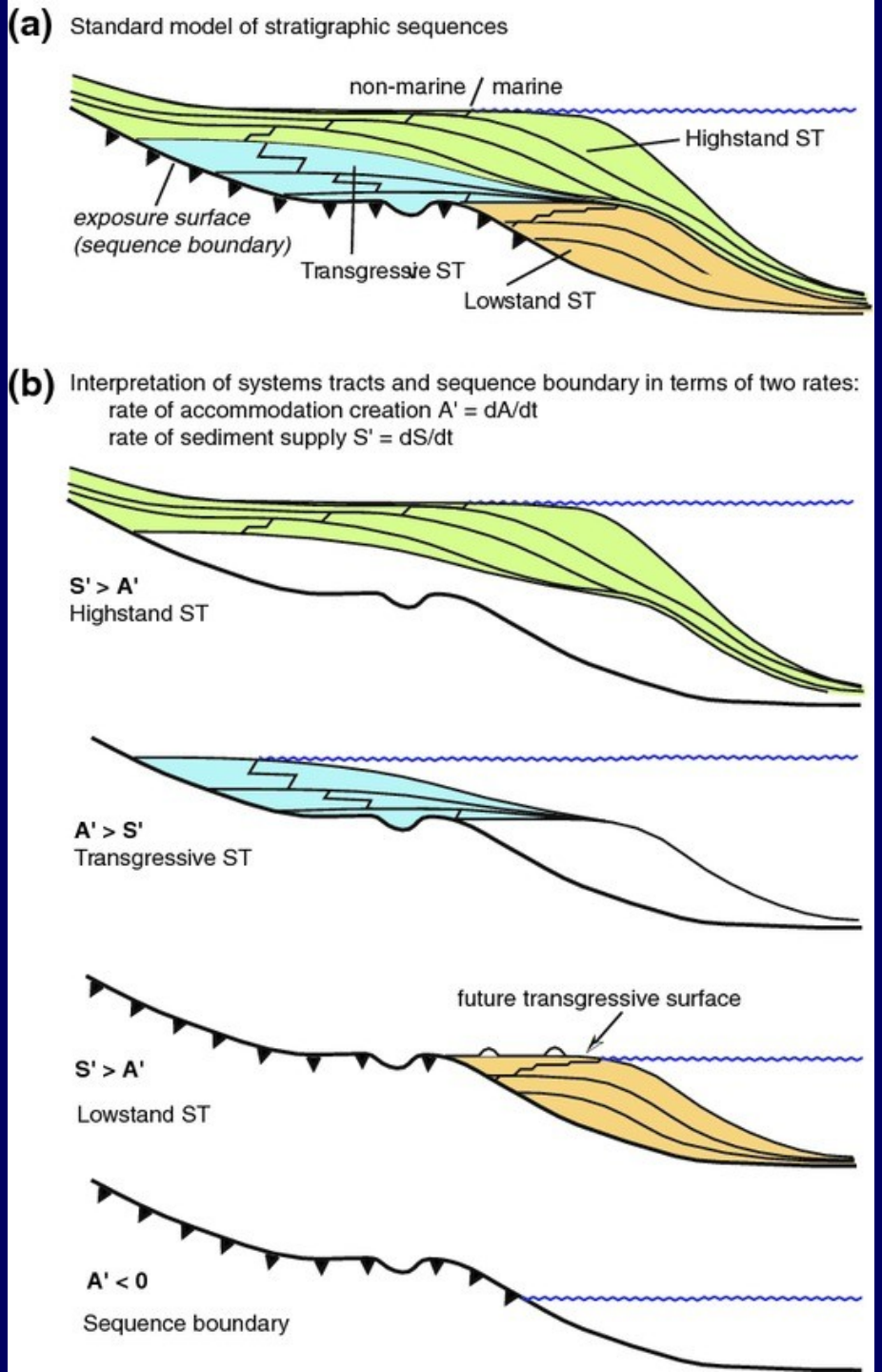
Changes in sea level
autocyclic – local and regional changes due to facies shifts and tectonics vs allocyclic – global changes due to large scale tectonism, oceanic crust dynamics, glaciation, and climate changes

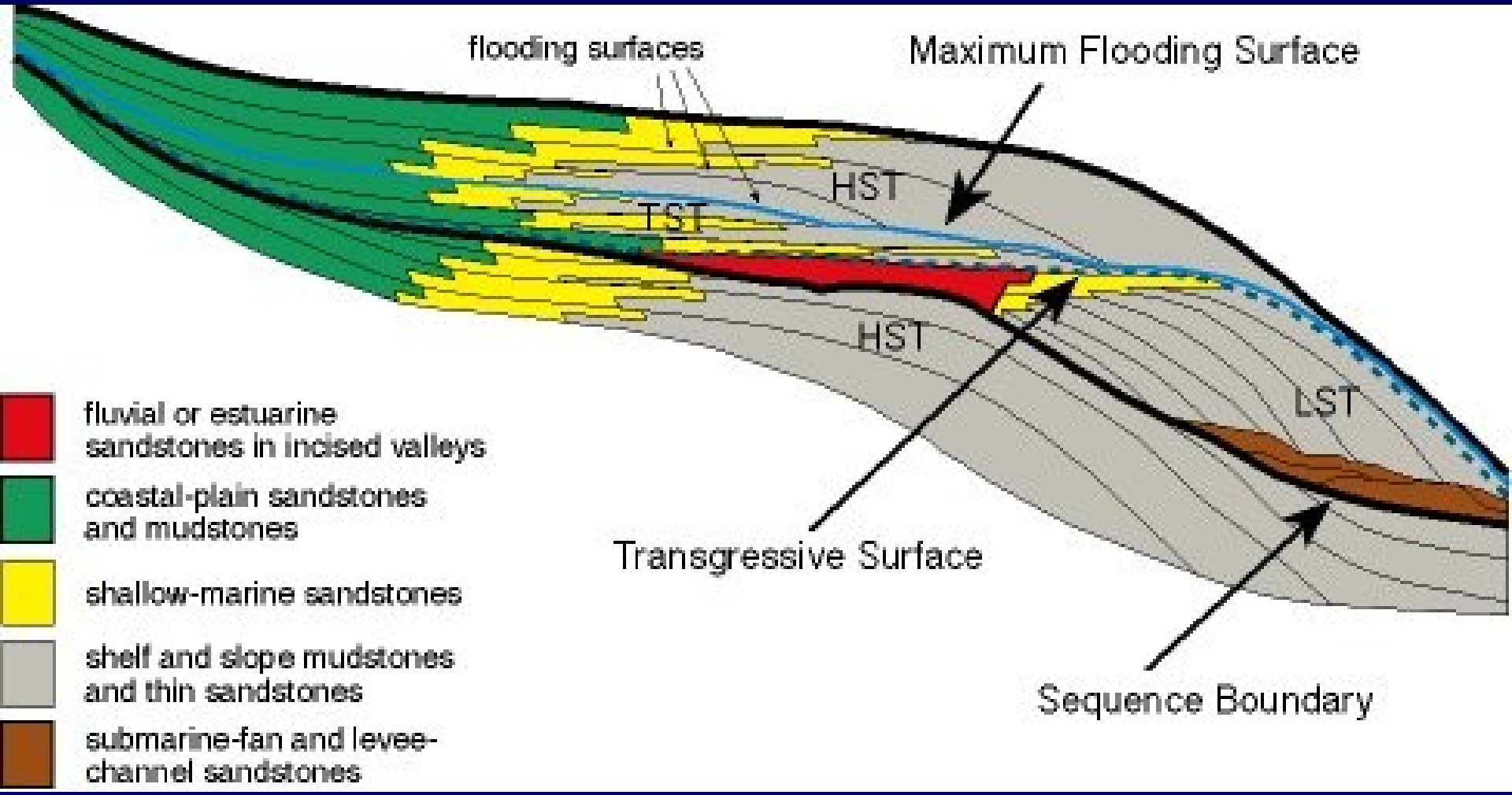
Three most important controls on the volume of sea water are:
glaciation: 10 - 200 m changes over 1 - 100 ky
ground water: 1 - 40 m over 0.1 - 100 ky
ocean temperature: 1 - 10 m over 0.1 - 10 ky

Three other controls on the displacement of sea water are oceanic large igneous provinces, global tectonics, and sediment fill.

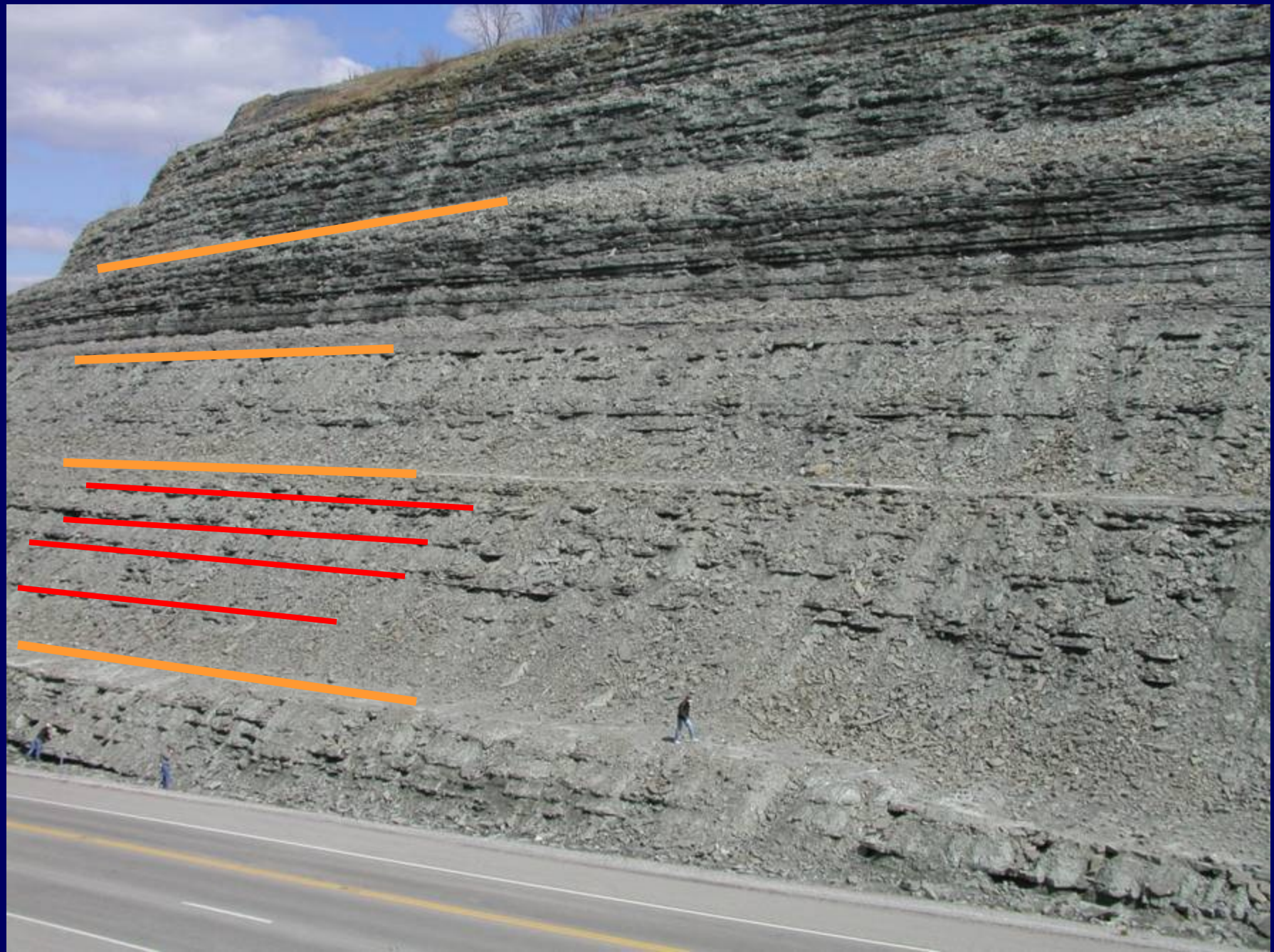
Sequence stratigraphy – recognition of genetically related strata bound by unconformities or their conformable equivalents




(a) Standard model of stratigraphic sequences
non-marine
marine
Highstand ST
exposure surface
(sequence boundary)
Transgressive ST
Lowstand ST
(b) Interpretation of systems tracts and sequence boundary in terms of two rates:
rate of accommodation creation A' = dA/dt
rate of sediment supply S' = dS/dt
S' > A'
Highstand ST
A' > S'
Transgressive ST
future transgressive surface
S' > A'
Lowstand ST
A' < 0
Sequence boundary

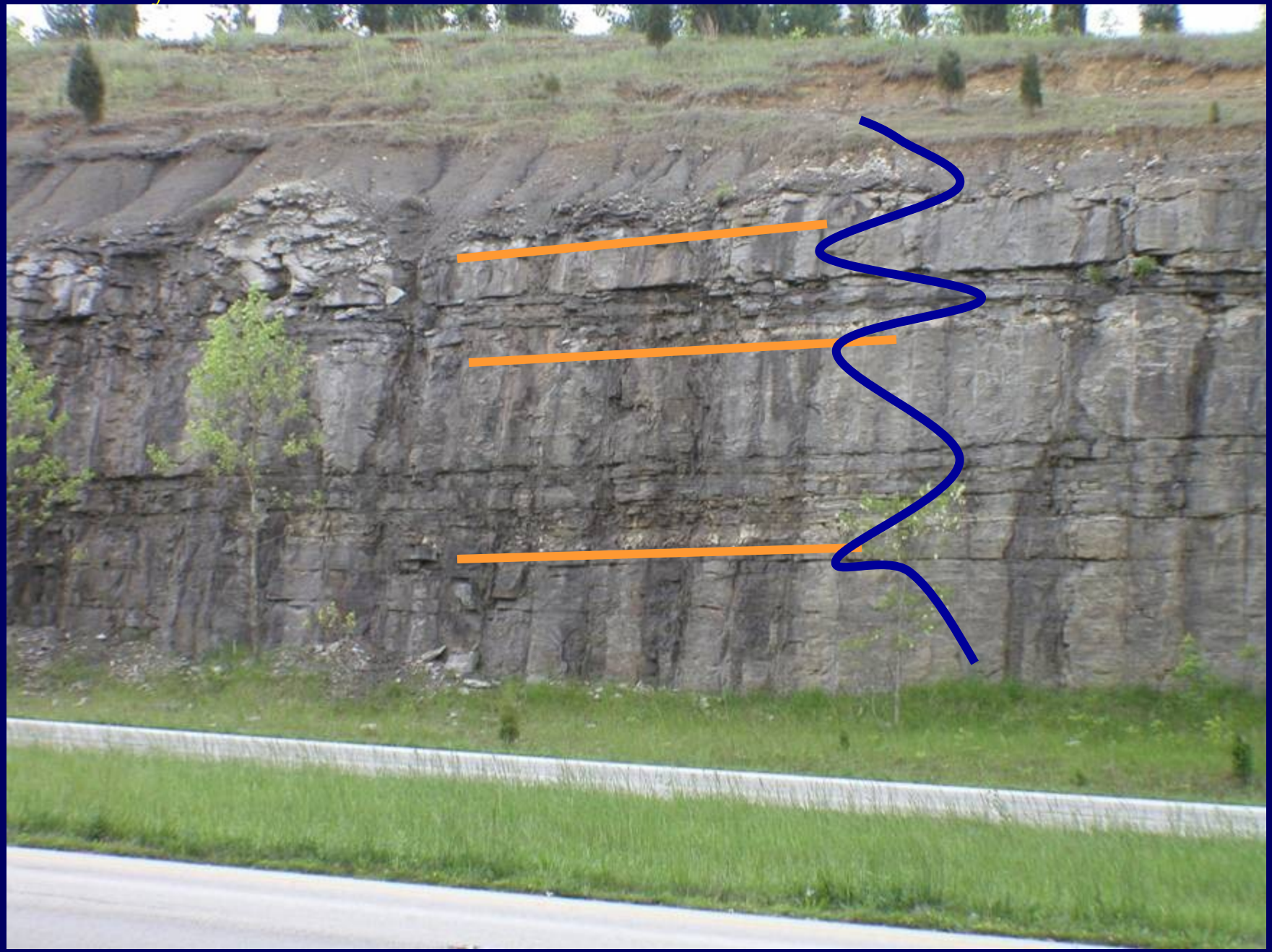

flooding surfaces
Maximum Flooding Surface
HST
TST
HST
LST
Transgressive Surface
Sequence Boundary
fluvial or estuarine sandstones in incised valleys
coastal-plain sandstones and mudstones
shallow-marine sandstones
shelf and slope mudstones and thin sandstones
submarine-fan and levee-channel sandstones

Kope-Fairfield at Maysville, KY



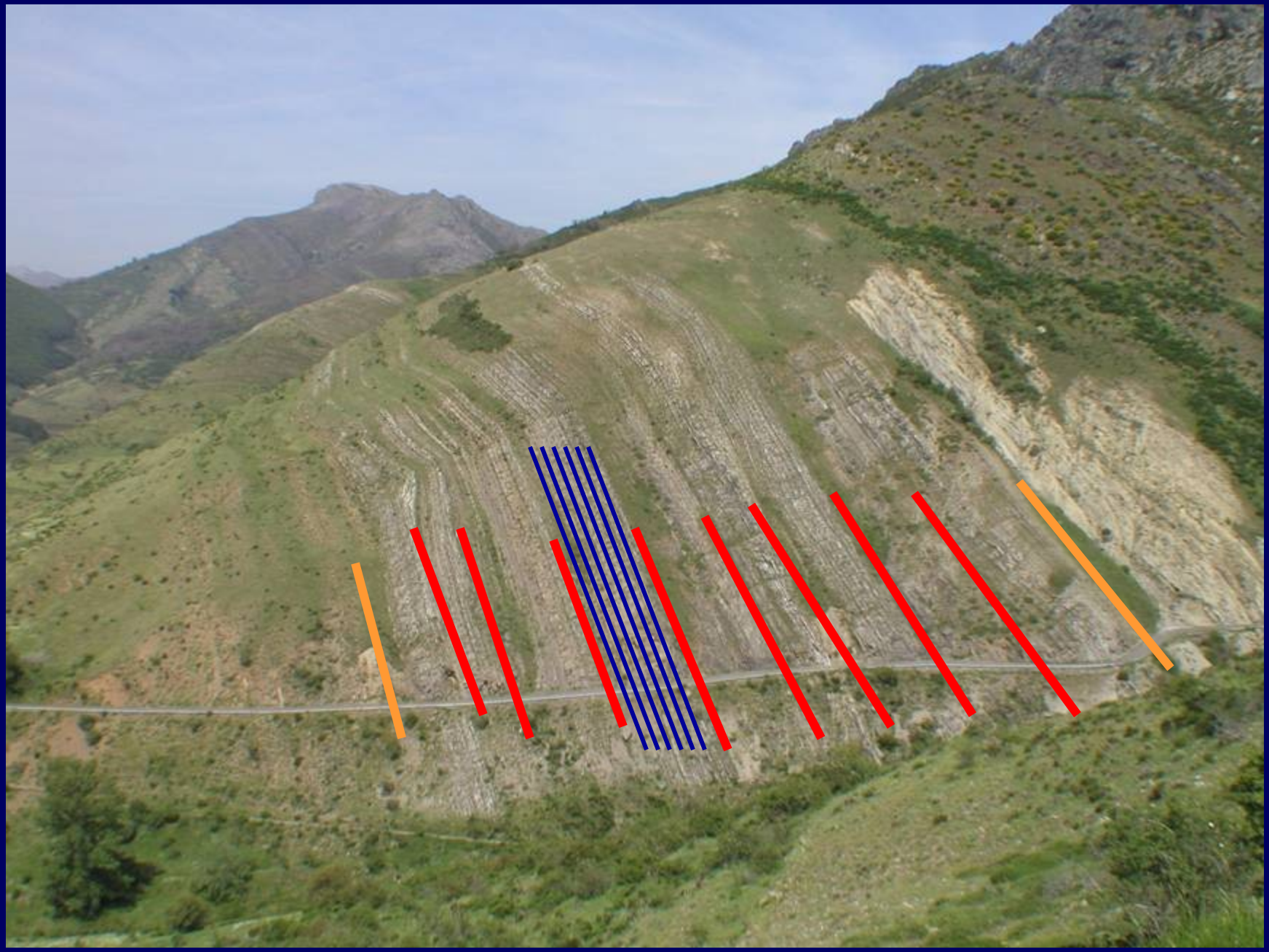
Bisher-Lily on Ohio 32-02

Bisher-Lily on Ohio 32-02



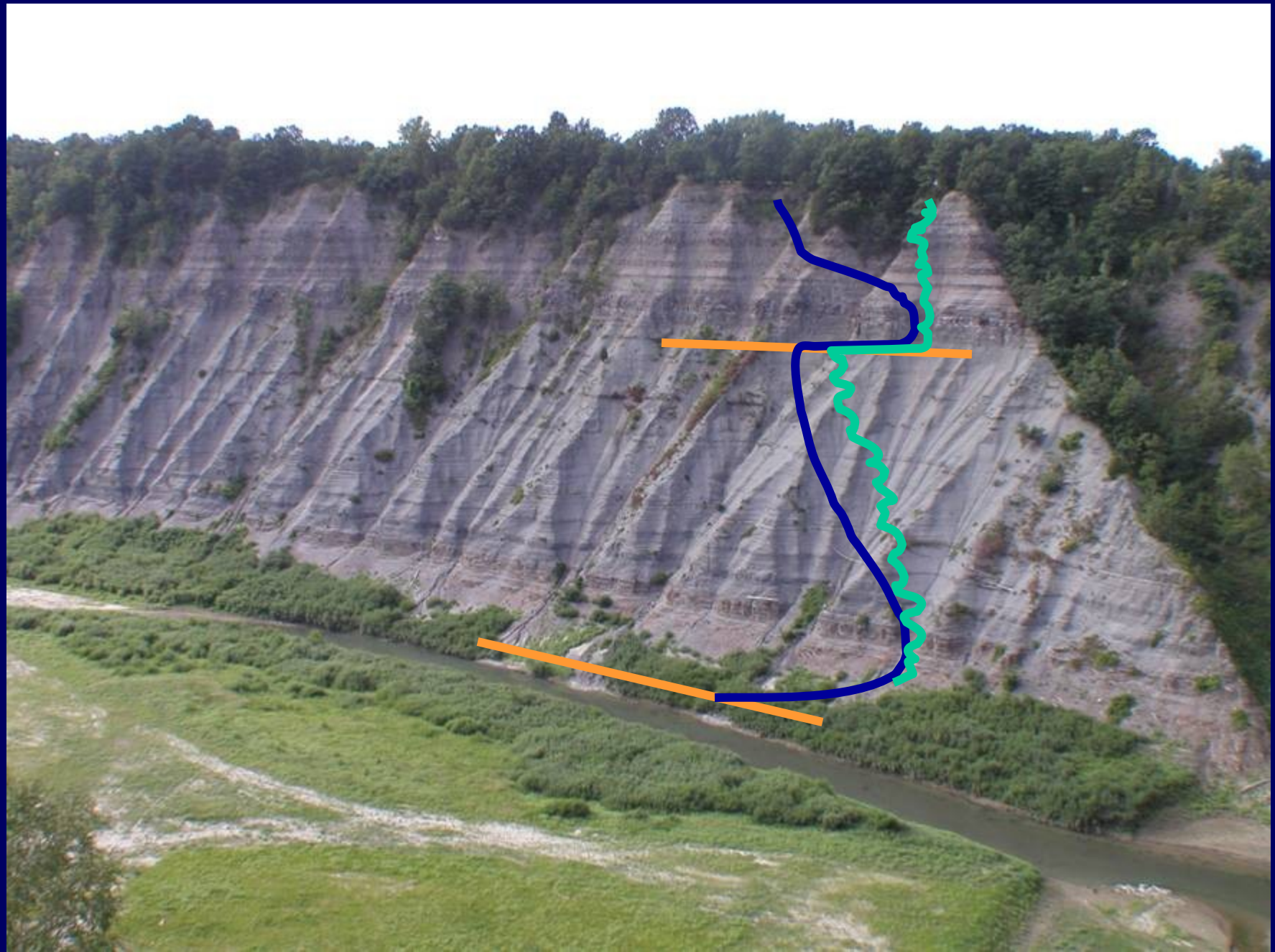
La Vid Group, Bernesga Valley, Cantabrian Zone, NW Spain

La Vid Group, Bernesga Valley, Cantabrian Zone, NW Spain

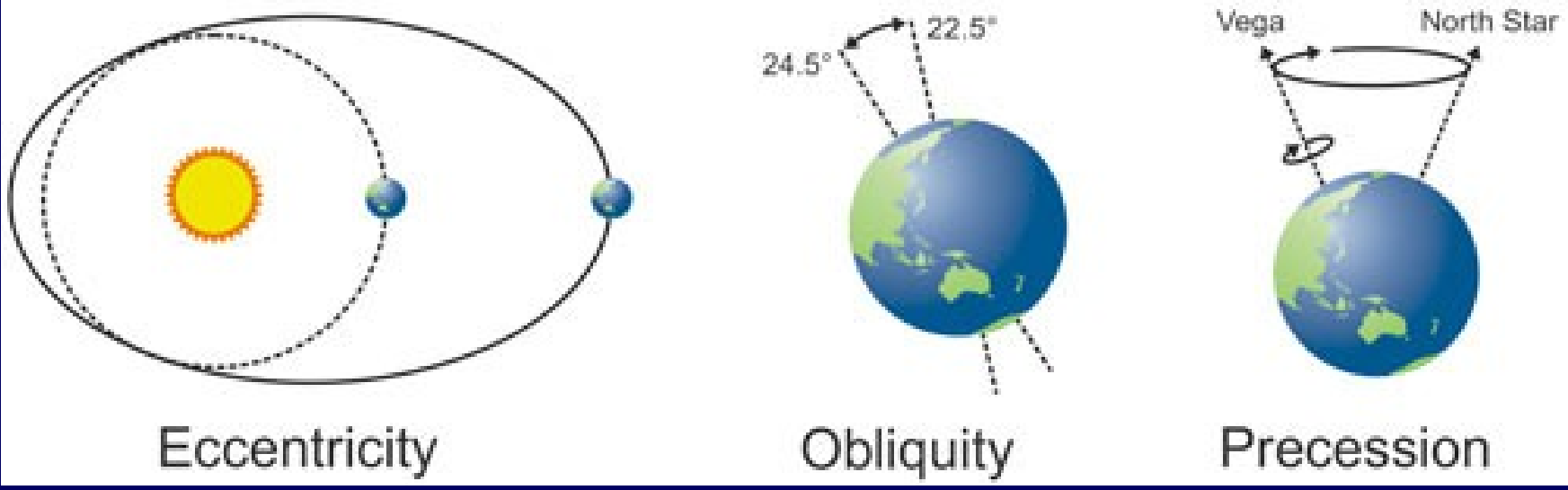


Frasnian – Mt. Morris Dam, New York

Frasnian – Mt. Morris Dam, New York

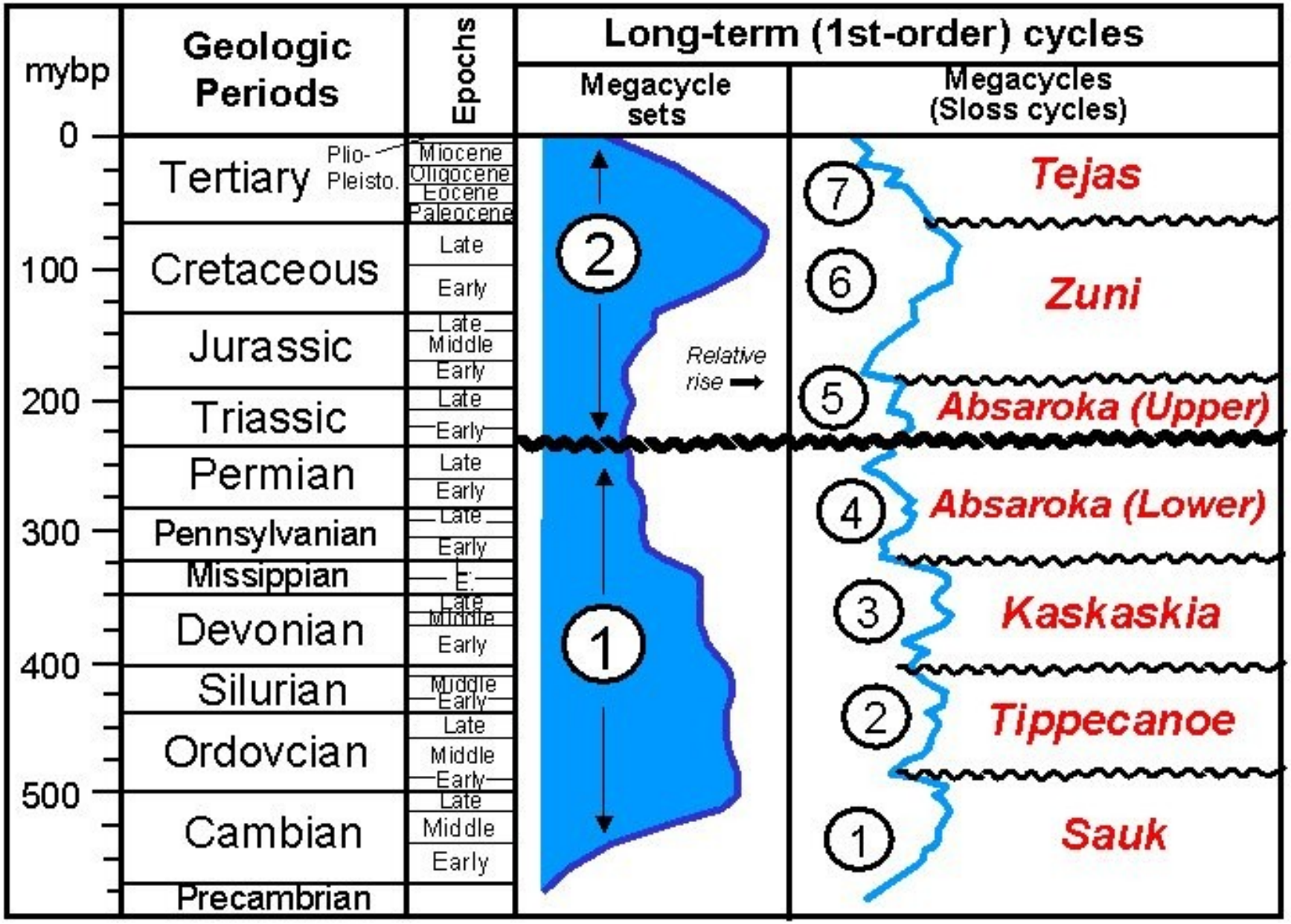


Milankovitch Cycles



Long eccentricity: 405 ky
Short eccentricity: ~ 100 ky
Obliquity: ~ 40 ky
Precesssion: ~ 20 and 16 ky

in deep time the intervals are less certain; 405 ky is stable



First-order cycles of relative sea level. Mybp = million years before present. (modified from Vail, Mitchell, and Thompson, 1977b)

What you need to do...

syllabus

readings

discussion

problem sets

research paper – presentation on an event, or some aspect of event stratigraphy; paper, presentation

What you need to do...

For our next meeting you need to read Kaufman (1988) and Simmons et al. (2020) to review event stratigraphy terminology and application.

At our next meeting we will discuss these articles and then plan for the rest of the semester which will involve your presentation of a specific event and review of events in intervals of geologic time.