

Facies and depositional settings during the Smithian in the Torrey area (Early Triassic, Utah, USA)

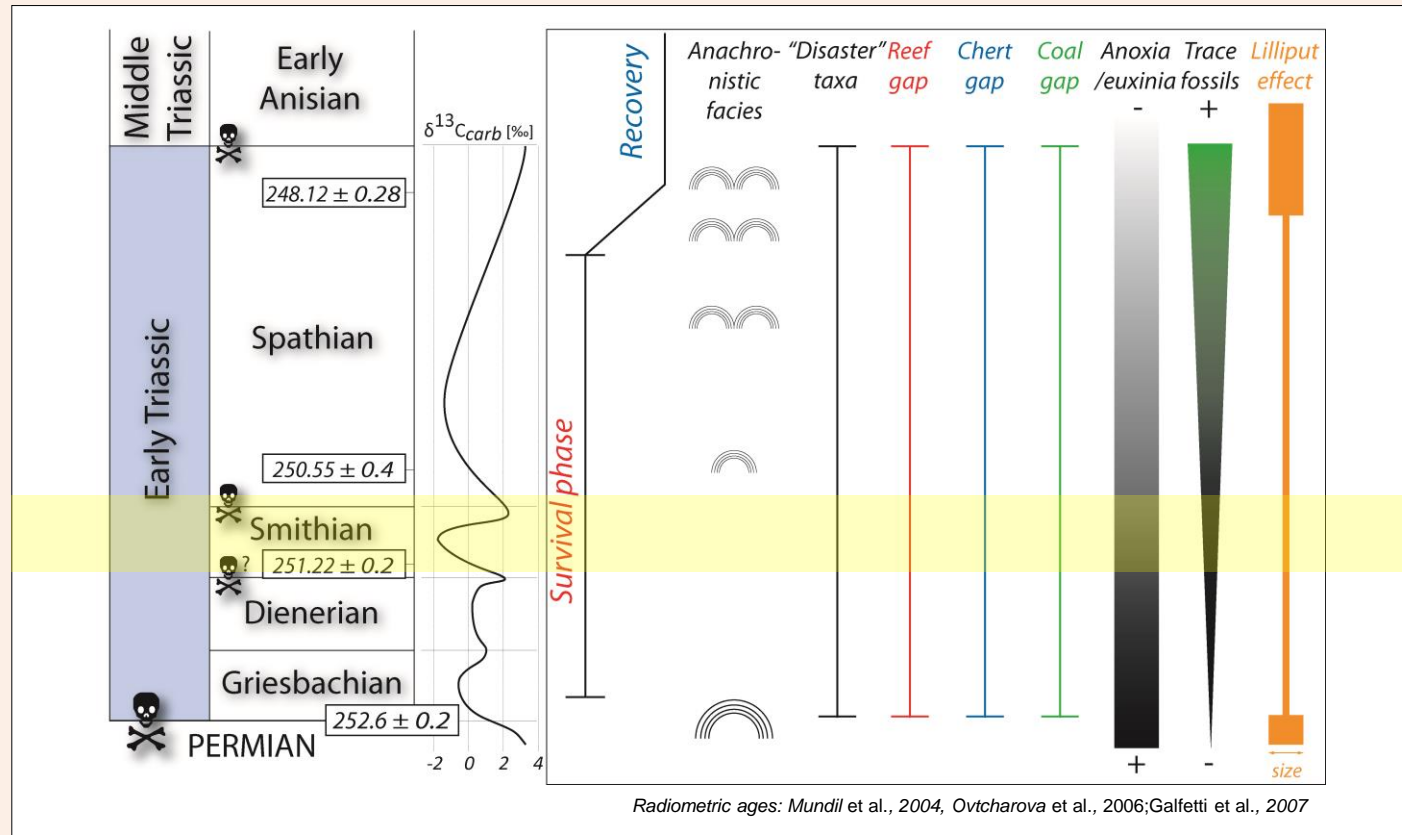
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Context of the study

Studied interval

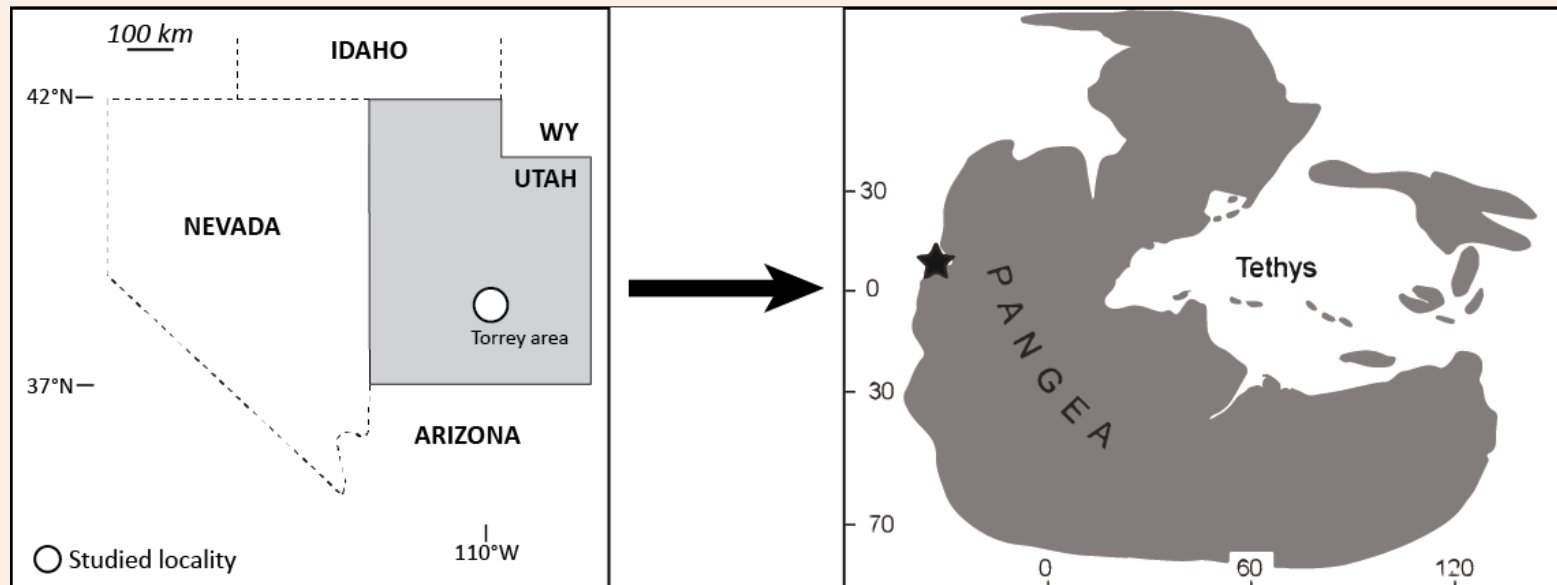


- High ecological impact after the Permian/Triassic boundary
 - 90 % of marine species being eradicated
 - Paradigms about the ecosystems and their recovery: “disaster” taxa, Lilliput effect, anachronistic facies
 - Associated causes: anoxia, euxinia, ocean acidification, fluctuating productivity

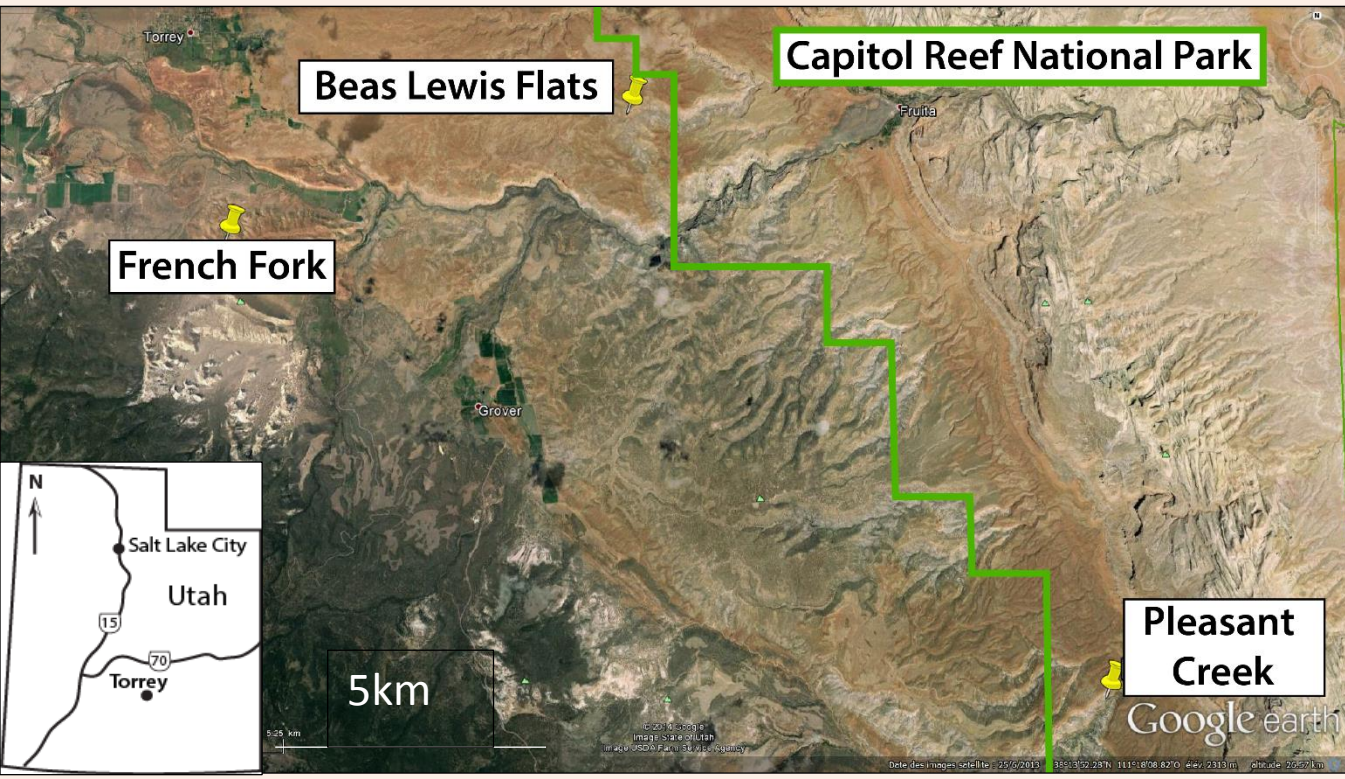
⇒ Deleterious environmental conditions during the Early Triassic

Aim of this work

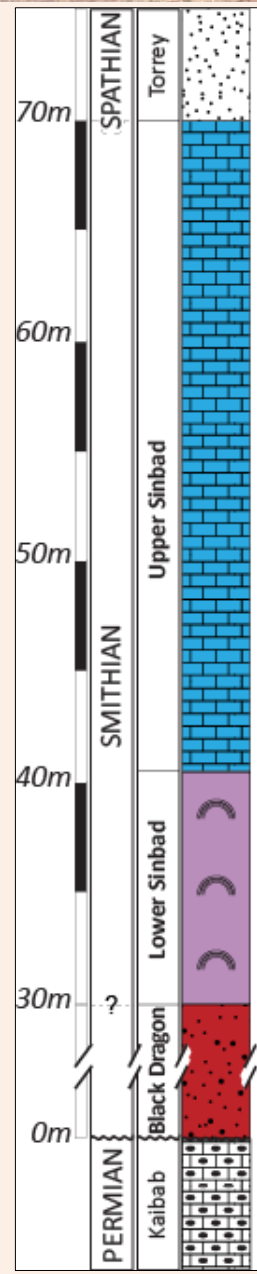
- Study the spatial distribution of the main facies and the depositional environments
 - ⇒ Are these deleterious conditions present in the Western USA basin?
 - ⇒ To discuss local observations in the global context of the rediversification during the Early Triassic



Localisation



- Torrey area (Eastern-central Utah, USA)
- 3 regional formations:
 - Black Dragon Fm.
 - Sinbad Fm., subdivided into Lower and Upper

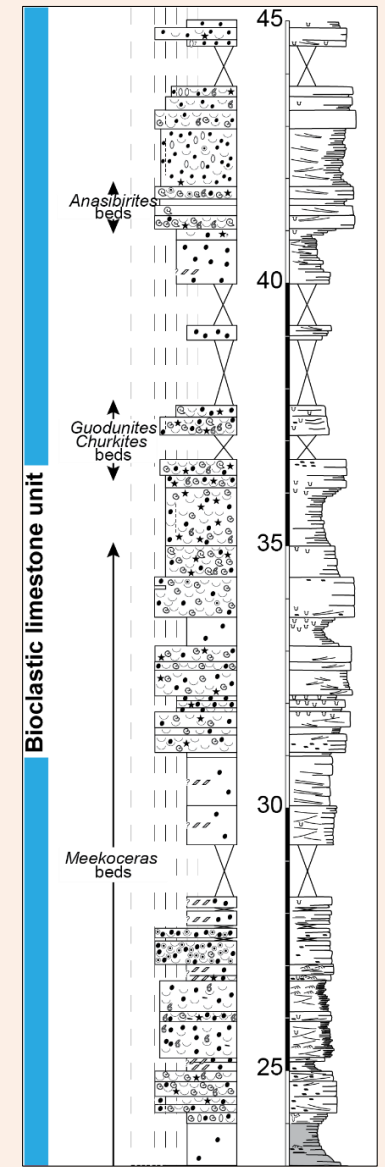
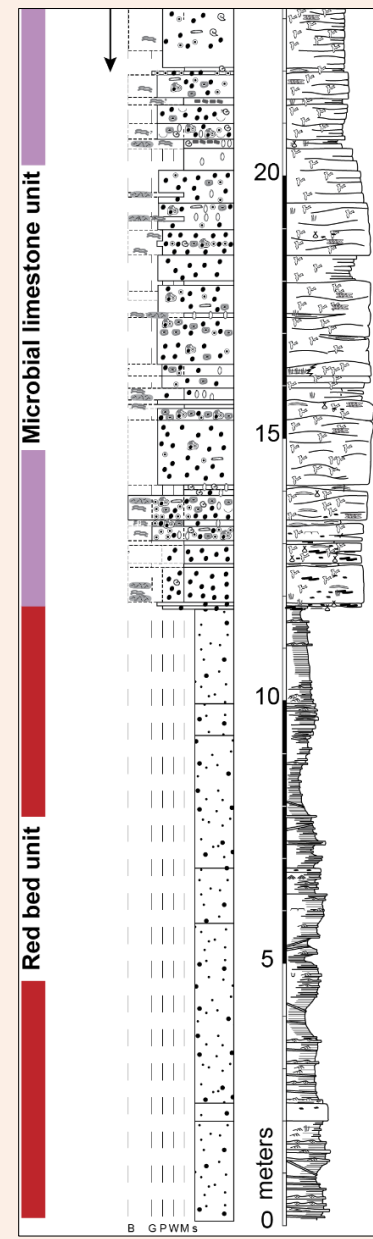
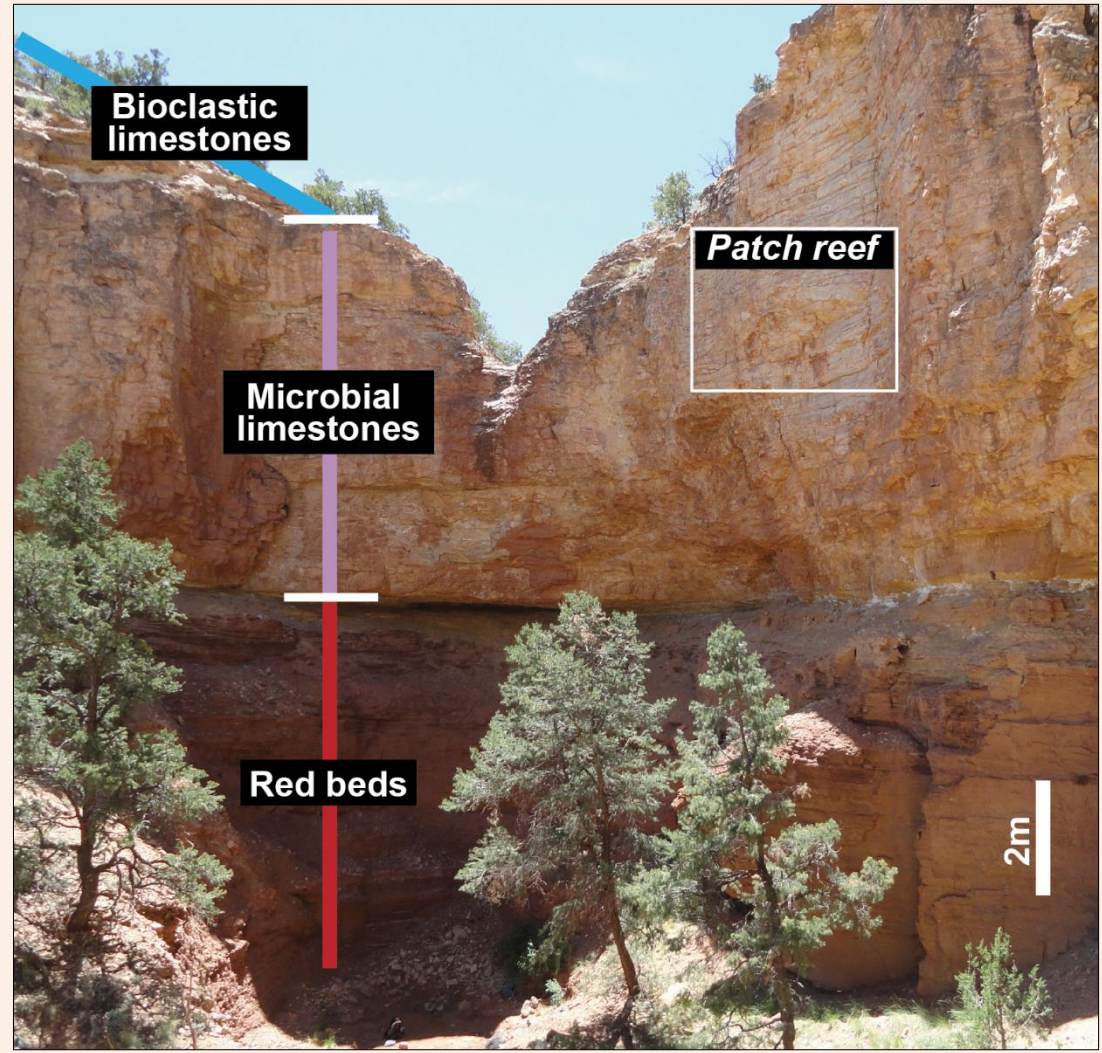
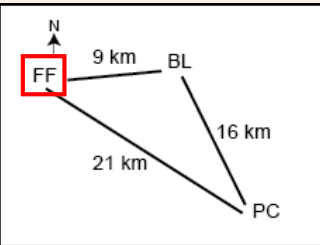


Synthetic section

(after Brayard et al., 2013; Dean, 1981; Goodspeed & Lucas, 2007)

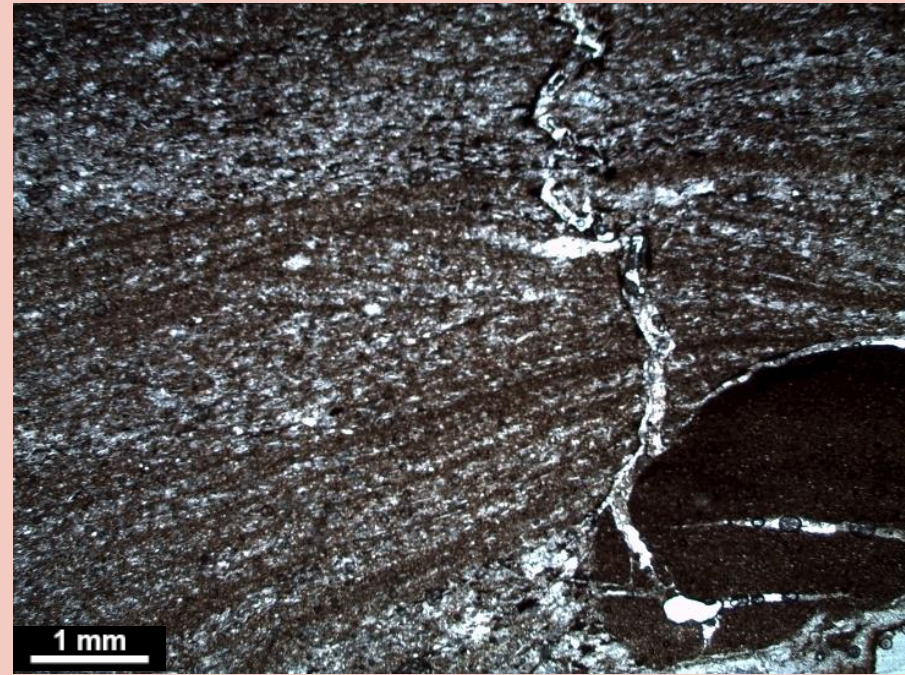
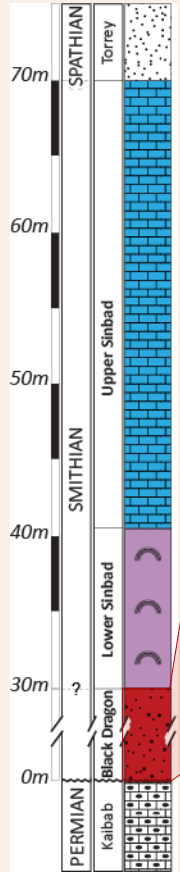
- Upper Sinbad Fm.:
 - Bioclastic limestones
 - Dolostones
- Lower Sinbad Fm.:
 - Microbial limestones
- Black Dragon Fm.:
 - Dolosiltstones (“red beds”)

French Fork section



French Fork section

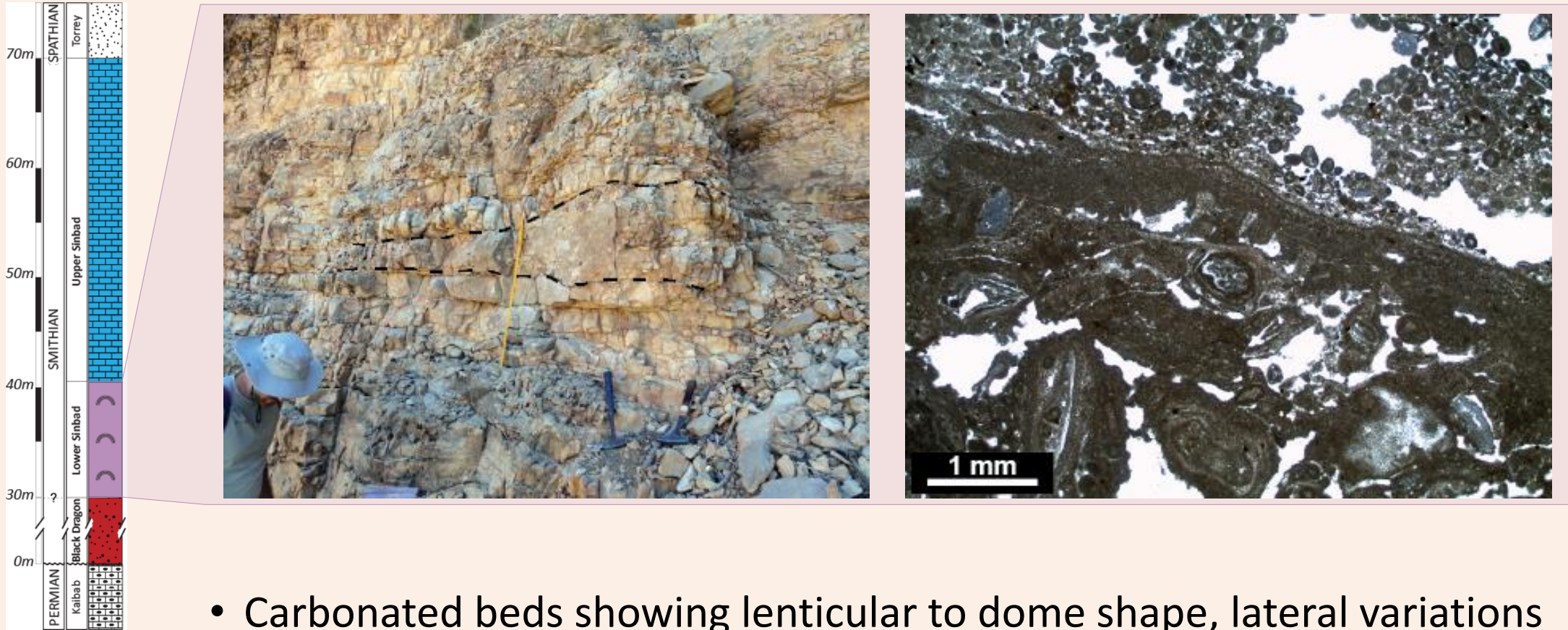
“Red Beds” from the Black Dragon Fm.



- Mm to cm-scale dolosiltstone levels, asymmetrical and bidirectional ripples, megaripples; rich in subangular quartz grains, some mudclasts present
⇒ **Intertidal** environment

French Fork section

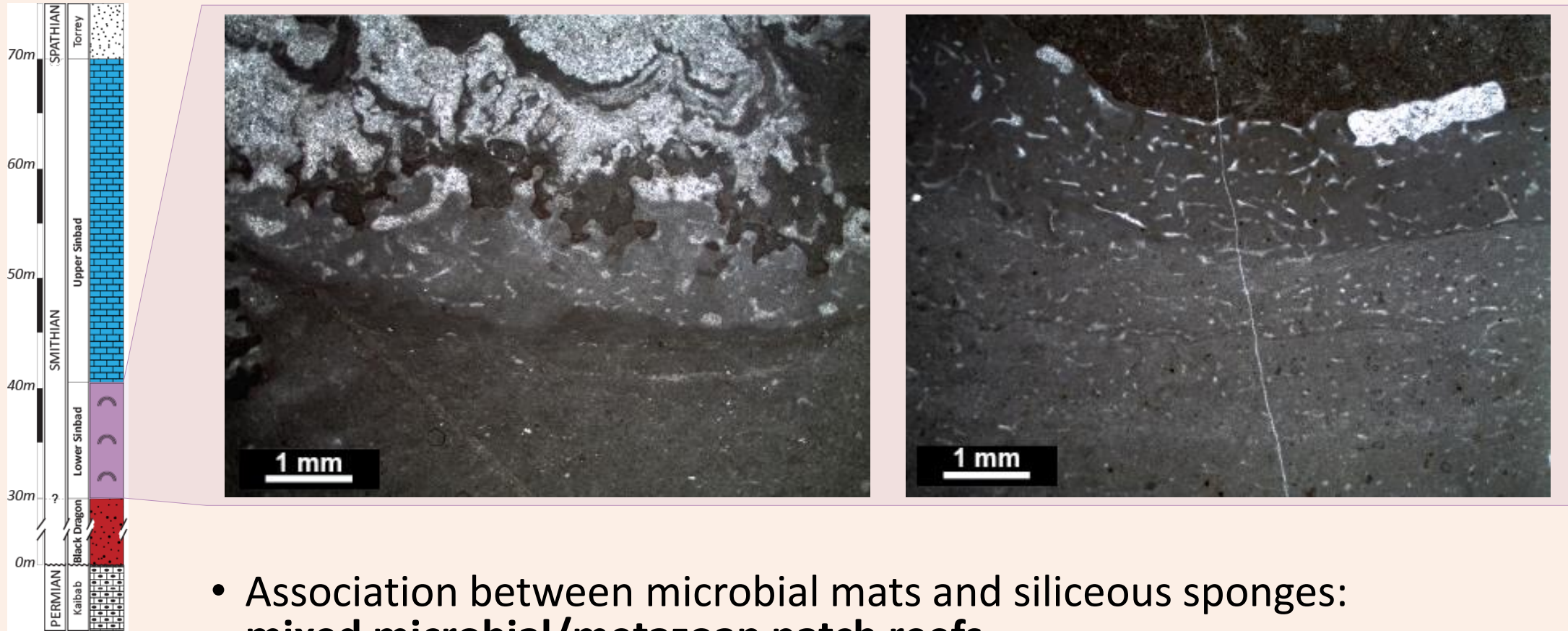
Microbial limestones from the Lower Sinbad Fm.



- Carbonated beds showing lenticular to dome shape, lateral variations in thickness, biofilms and fenestræ
⇒ **Peritidal** microbial constructions

French Fork section

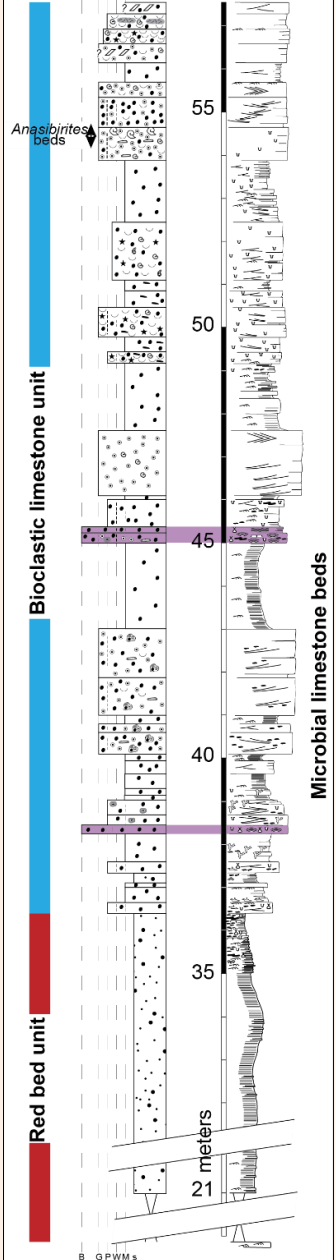
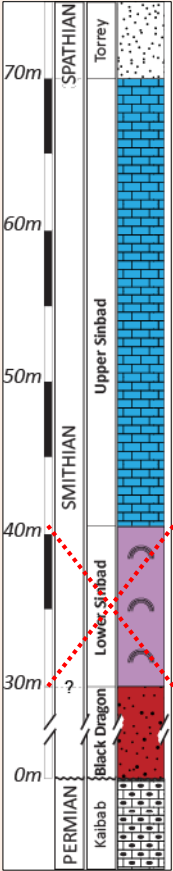
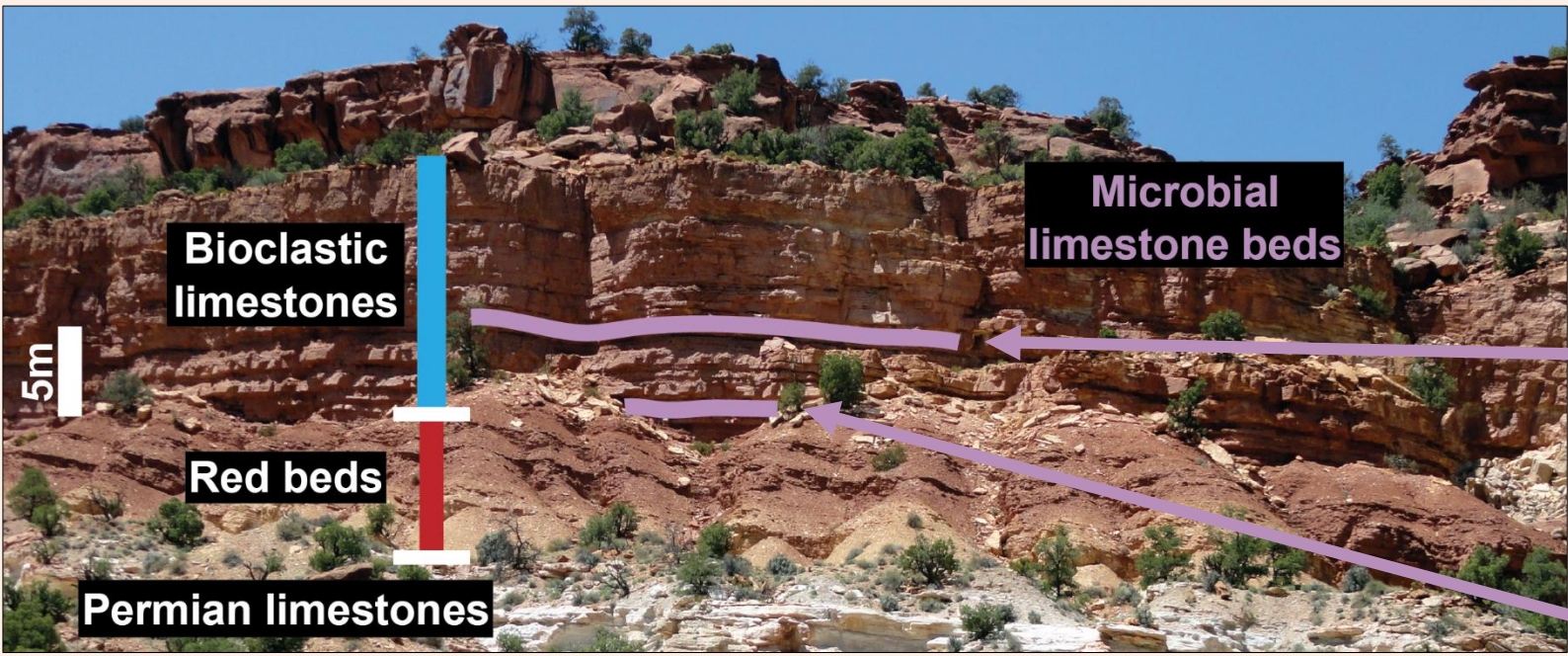
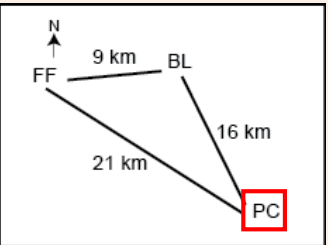
Microbial limestones from the Lower Sinbad Fm.



- Association between microbial mats and siliceous sponges:
mixed microbial/metazoan patch reefs

⇒ **Basin-scale distribution** of these patch reefs in the Western USA basin
(Brayard et al., 2011, *Nat. Geosci.*; Olivier et al., 2014, *Geol. Mag.*)

Pleasant Creek section

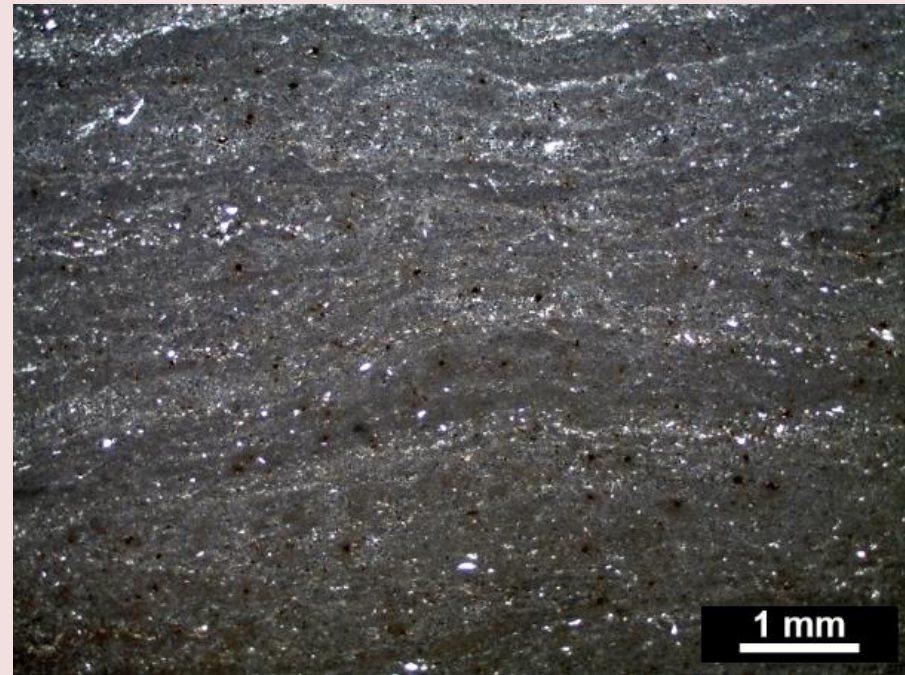
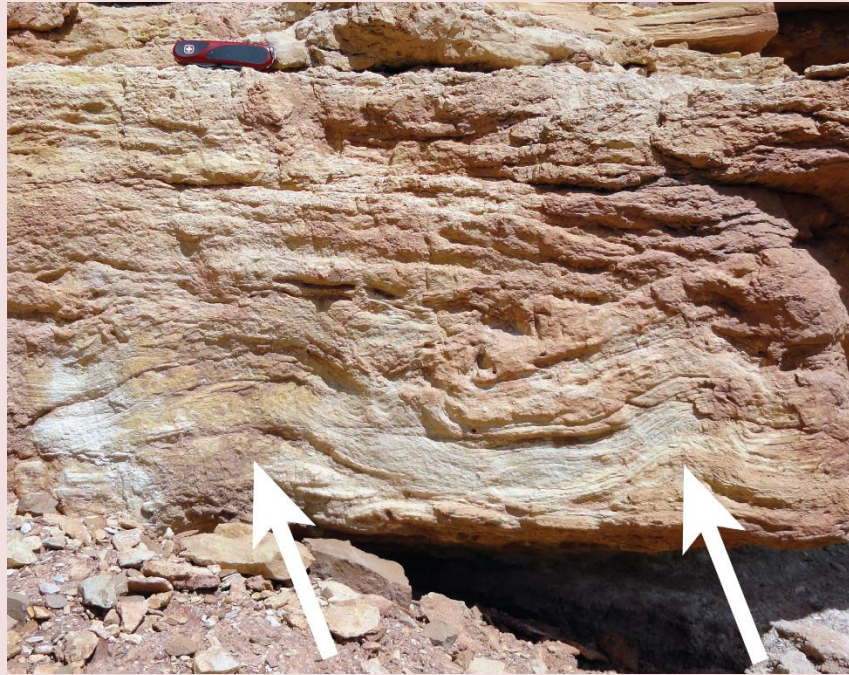
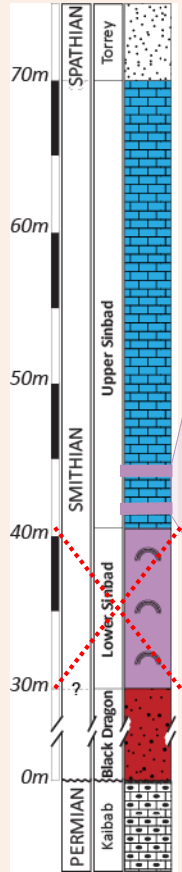


- Lower Sinbad Fm. is absent
- Microbial limestones are present as beds in the bioclastic Upper Sinbad Fm.

Pleasant Creek section



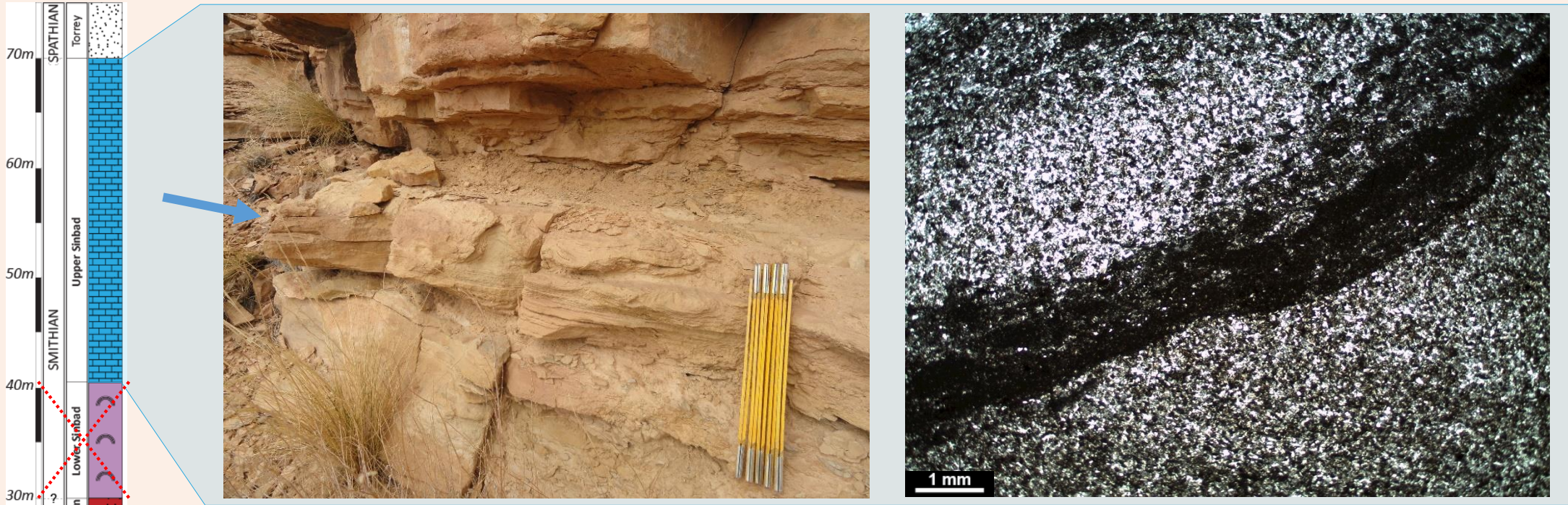
Microbial limestones from the Upper Sinbad Fm.



- Carbonated beds showing dm-scale stromatolitic domes and dense micritic undulated biofilms
⇒ Intertidal to supratidal **interior platform**

Pleasant Creek section

Dolostones from the Upper Sinbad Fm.

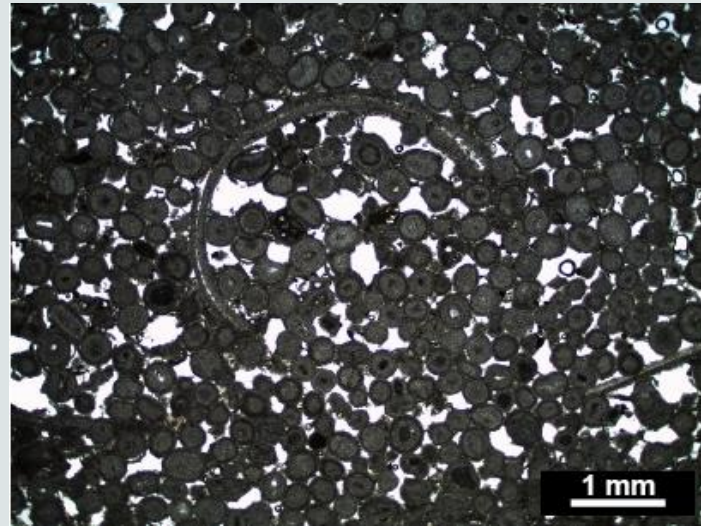
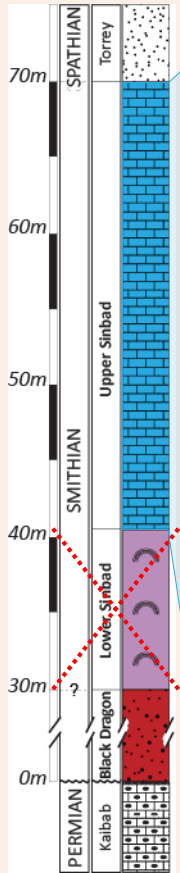


- Dm to m-scale beds with local through cross-stratifications; poor in bioclasts, but locally rich in subangular quartz grains
⇒ Subtidal to intertidal **interior platform**

Pleasant Creek section



Bioclastic and oolitic limestones from the Upper Sinbad Fm.

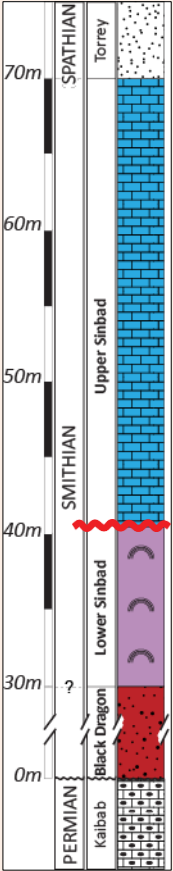
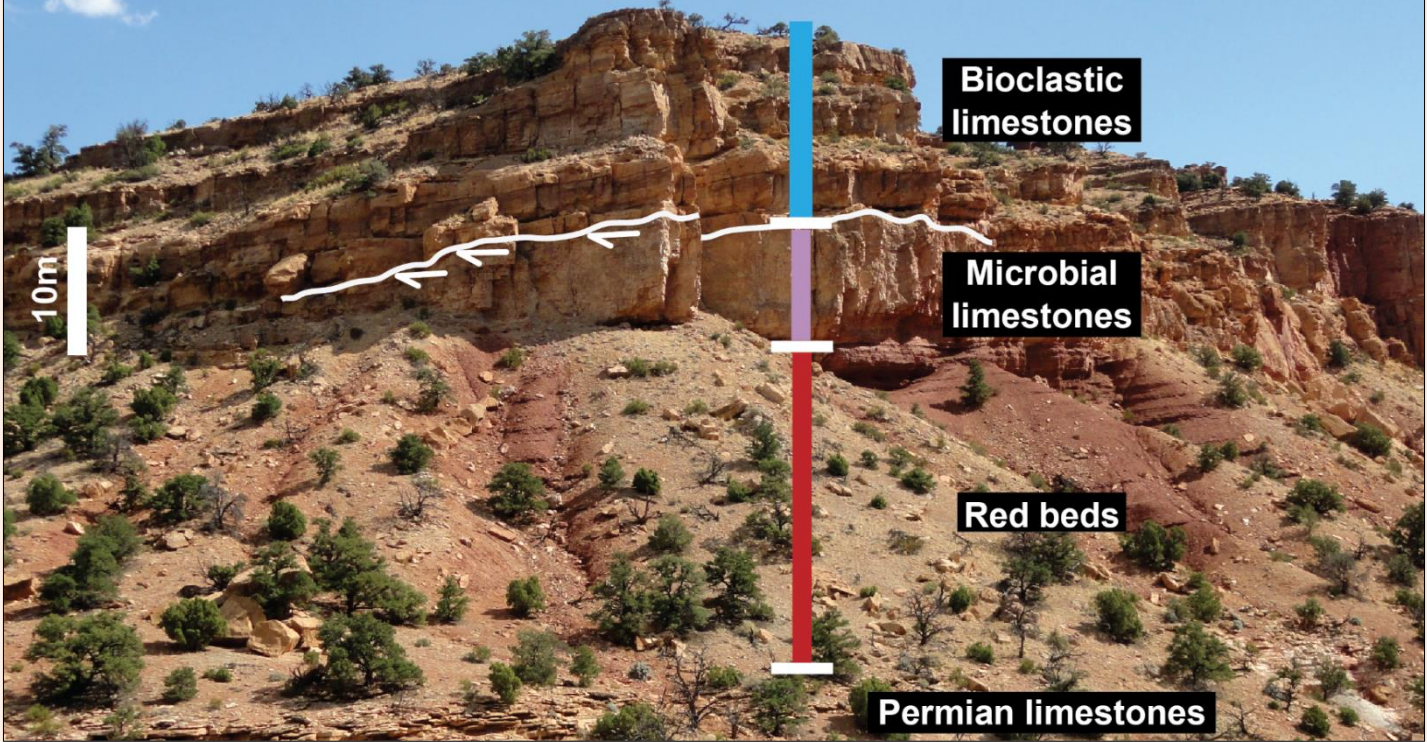
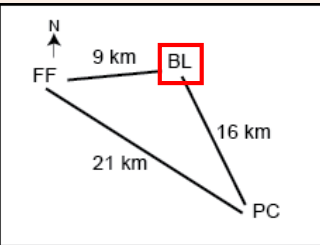


- Dm-scale beds of oolitic and bioclastic grainstones, with high energy macrostructures (bidirectional ripples, megaripples)
- ⇒ **Tide-dominated shoal complex**

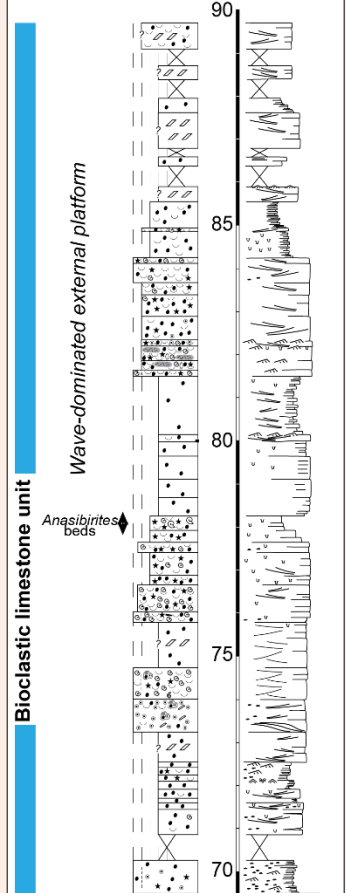
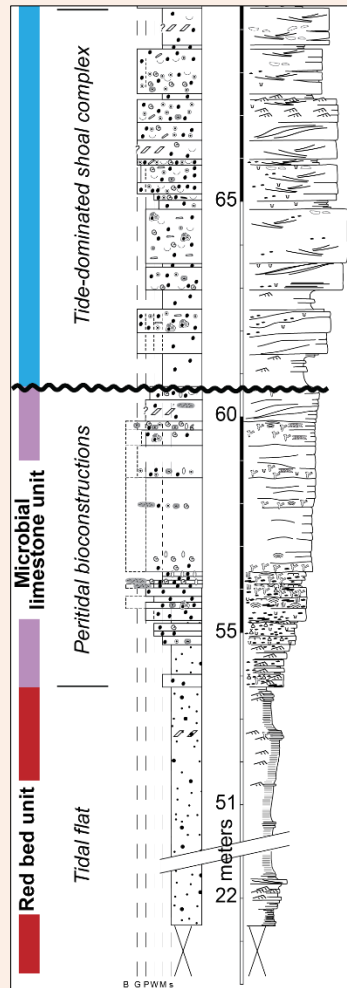


- Cm to dm-scale bioclastic wackestones to packstones showing through cross-bedding, rich in fauna and with different degree of bioturbation
- ⇒ **Open wave-dominated external platform**

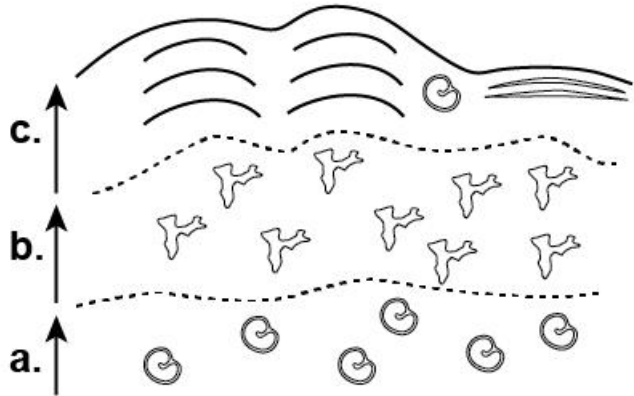
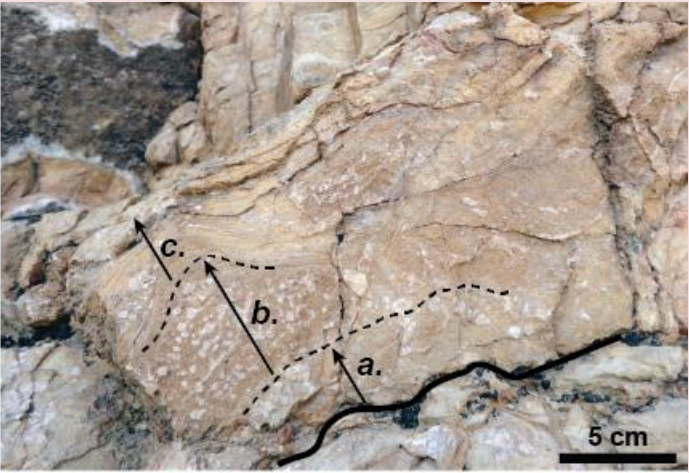
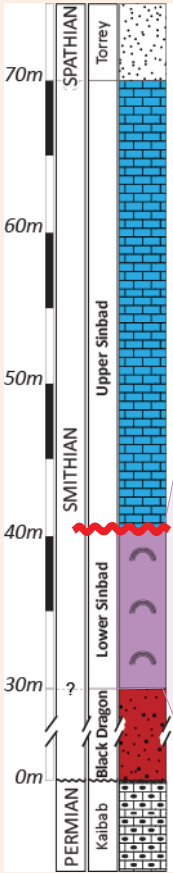
Beas Lewis Flats section



- Truncation surface at the top of the microbial limestone unit



Beas Lewis Flats section

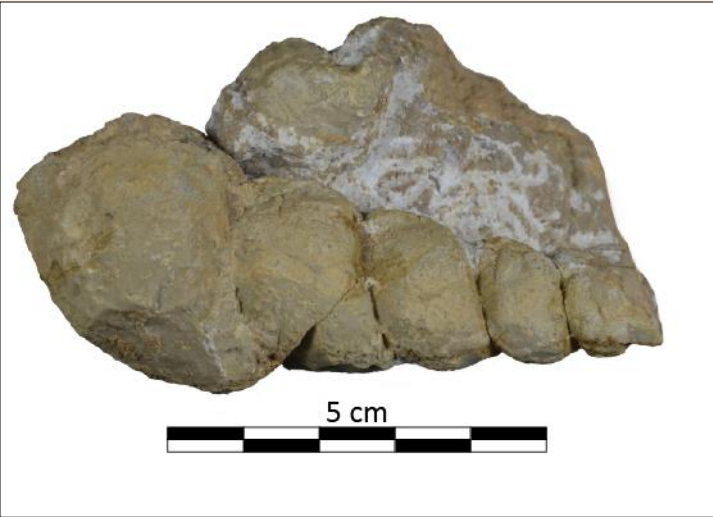


- **Elementary sequences** within microbial limestones

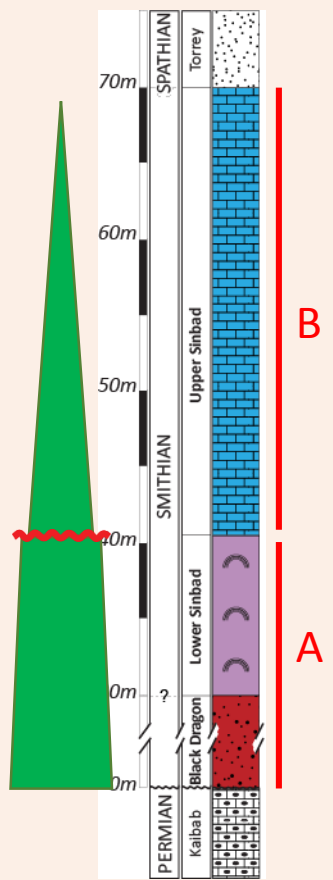
- a) gastropod-rich level
- b) fenestral limestones
- c) laminated mudstone

⇒ Inferred origin: **autocyclic processes**

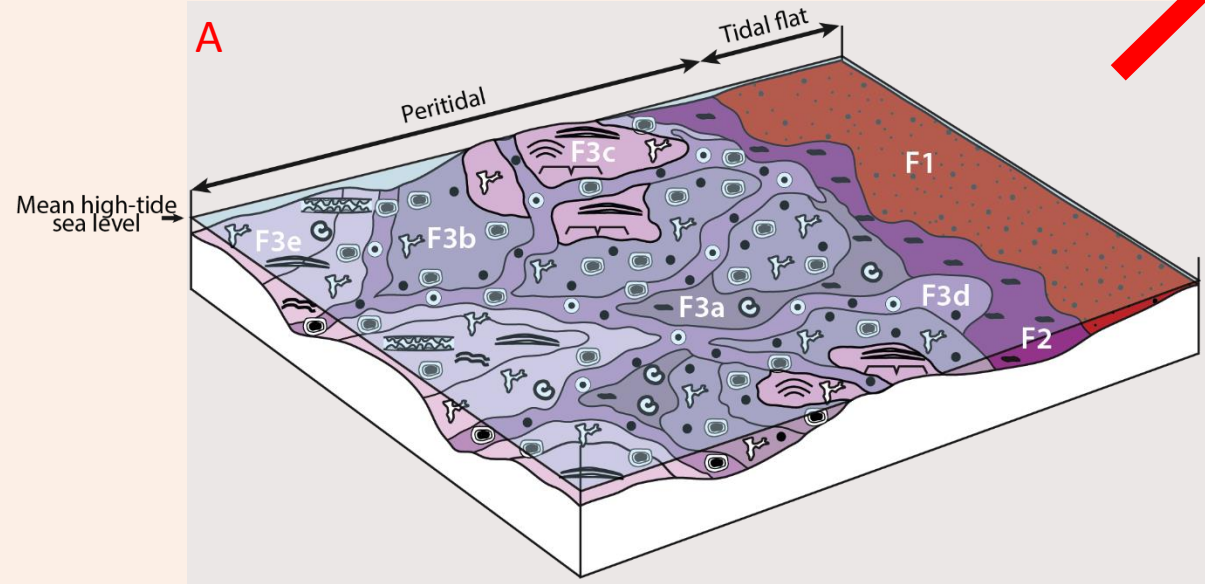
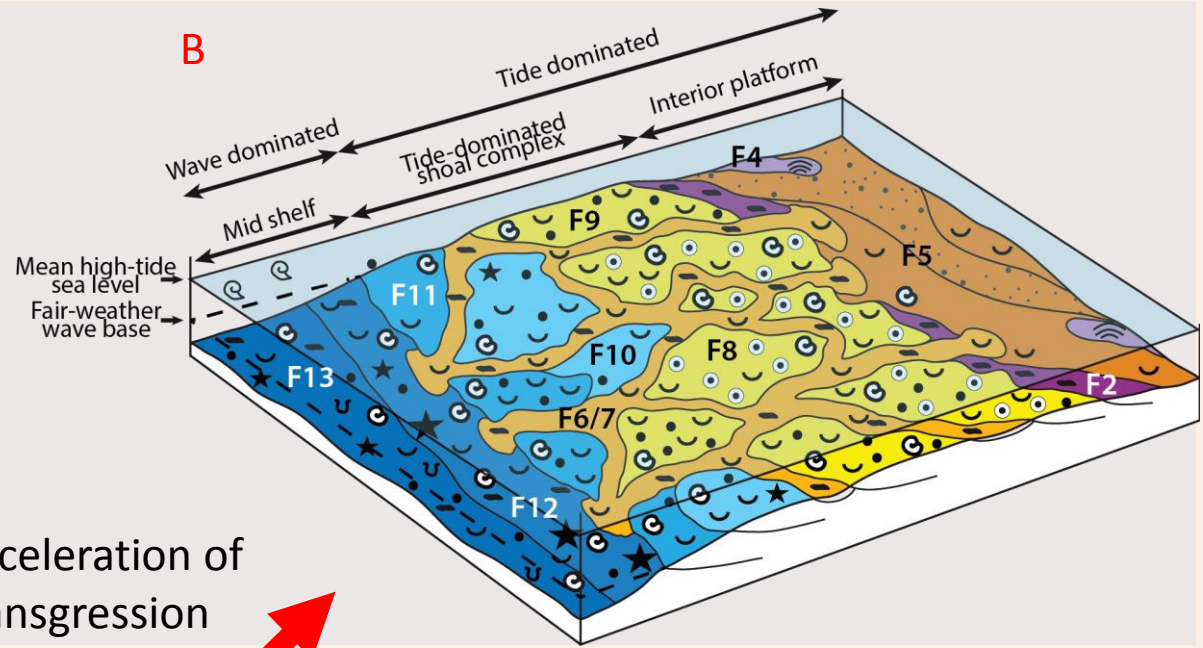
- **Cm-scale gastropods**



Depositional models



Upper Sinbad Fm.
 ⇒ **Wave- and tide-dominated mixed open platform**



Black Dragon and Lower Sinbad Fms.
 ⇒ **Tide-dominated intertidal and peritidal proximal environments**
 ⇒ **Patchy facies distribution (facies mosaic) in microbial deposits**

Correlations

High resolution sequence analysis with biostratigraphic control (*Anasibirites* beds)

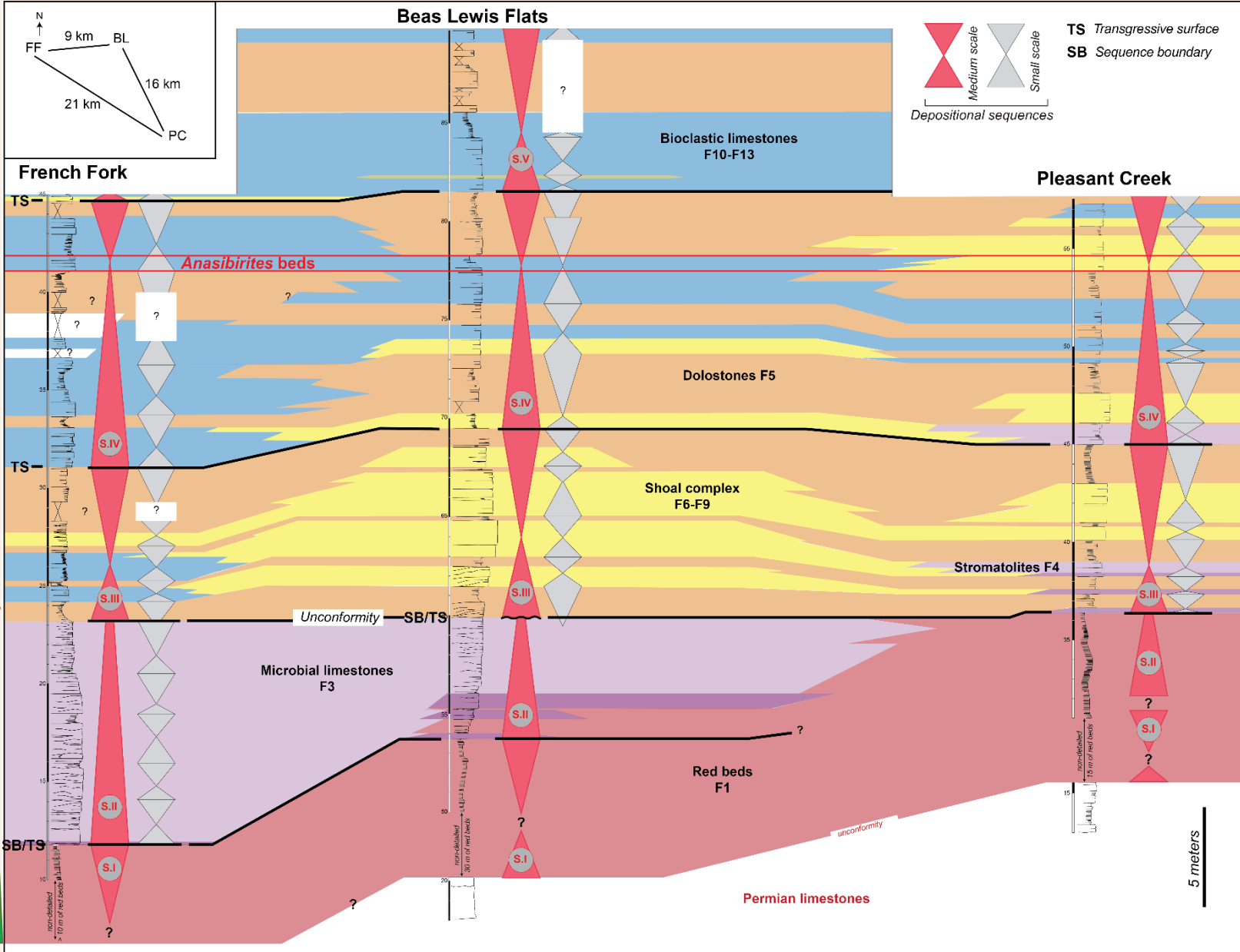
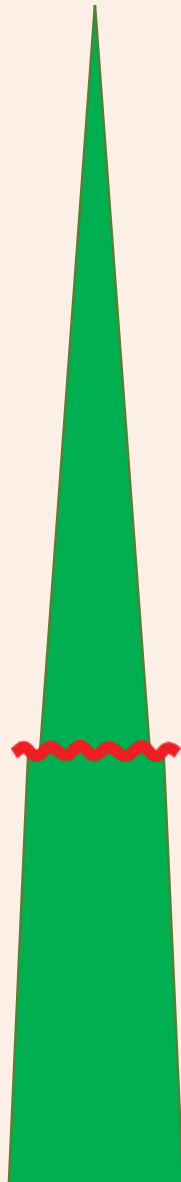
- Large-scale transgressive trend

⇒ **Smithian 3rd order transgression**

(Brayard et al., 2013, *Swiss J Palaeontol*; Olivier et al., 2014, *Geol. Mag.*; Vennin et al., *in press, Sedimentology*)

Mixed wave- and tide-dominated system

Tide-dominated system



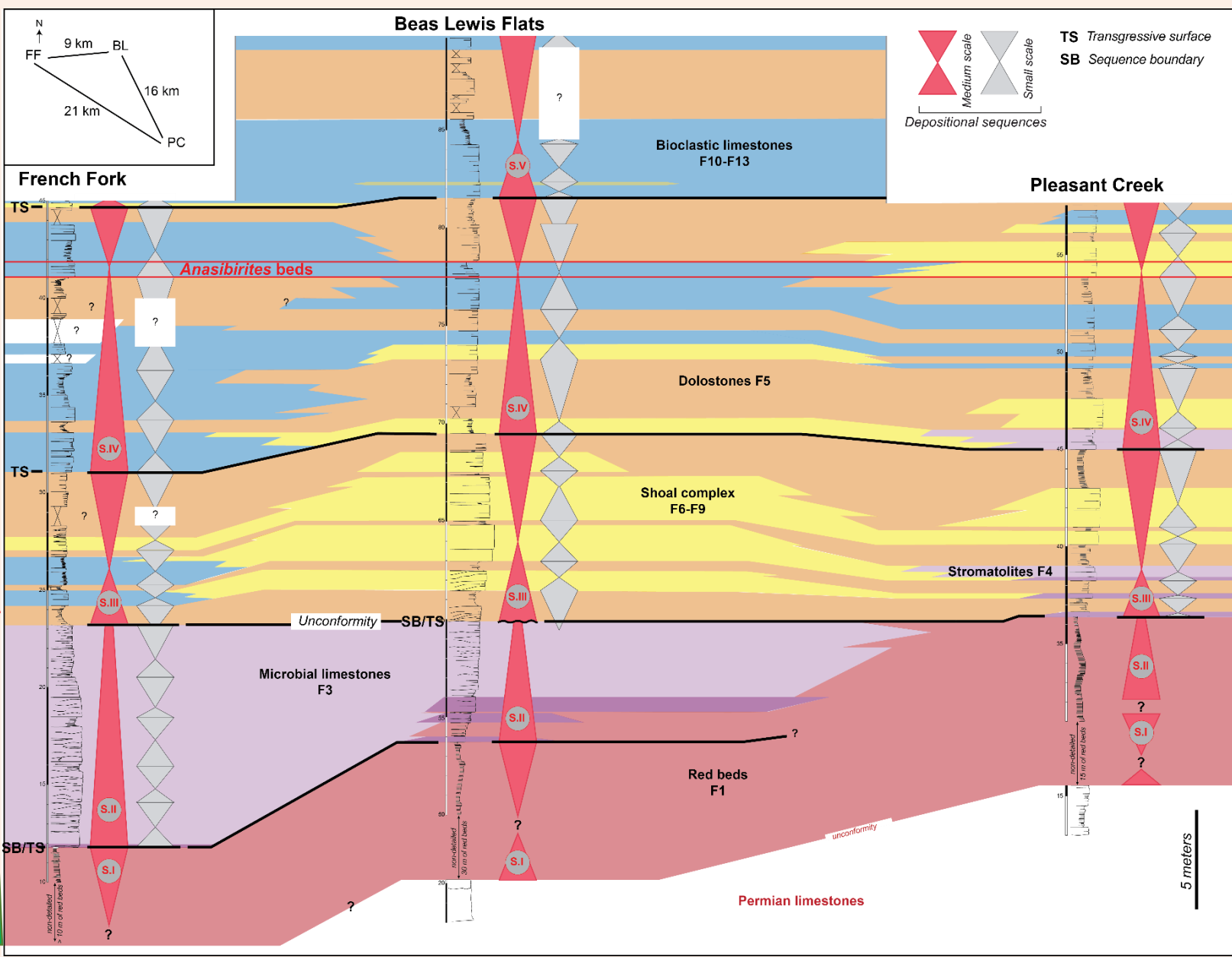
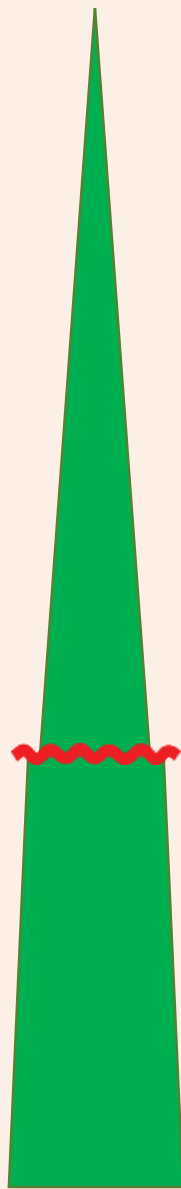
Correlations

High resolution sequence analysis with biostratigraphic control (*Anasibirites* beds)

- Large-scale transgressive trend
 ⇒ Smithian 3rd order transgression
- 5 medium-scale sequences, good correlation between the sections
 ⇒ Allocyclic processes, climatic origin?

Mixed wave- and tide-dominated system

Tide-dominated system



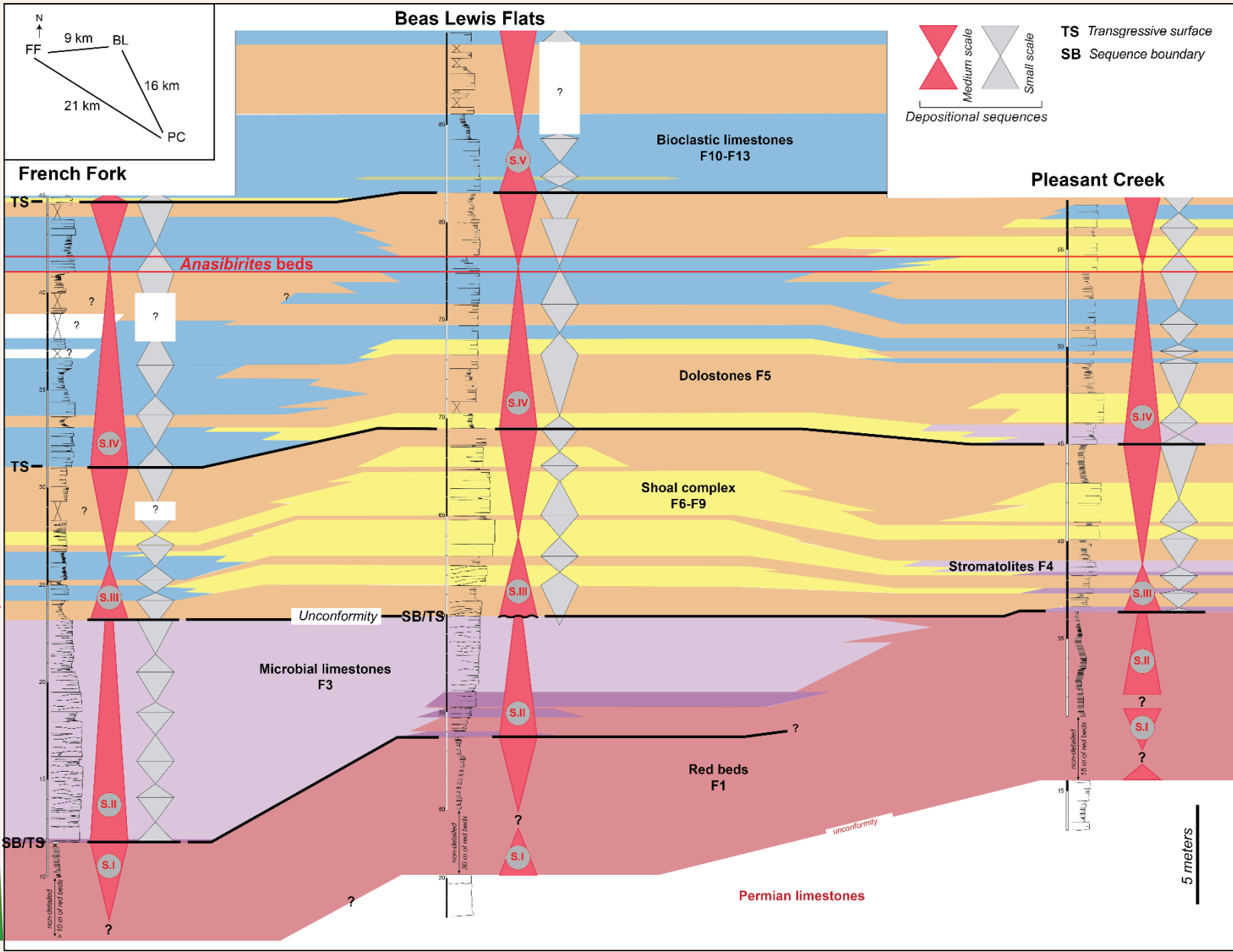
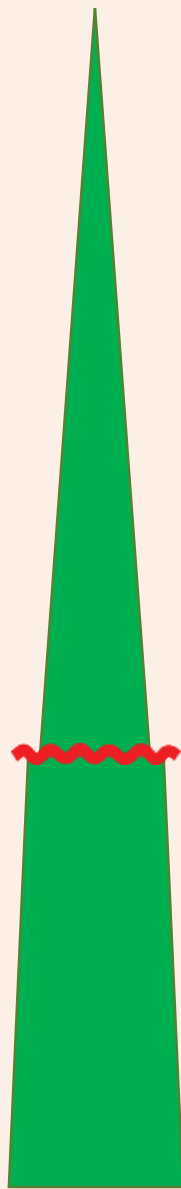
Correlations

High resolution sequence analysis with biostratigraphic control (*Anasibirites* beds)

- Large-scale transgressive trend
 - ⇒ Smithian 3rd order transgression
- 5 medium-scale sequences, good correlation between the sections
 - ⇒ Allocyclic processes, climatic origin?
- Small-scale sequences, no correlation
 - ⇒ Autocyclic processes

Mixed wave- and tide-dominated system

Tide-dominated system



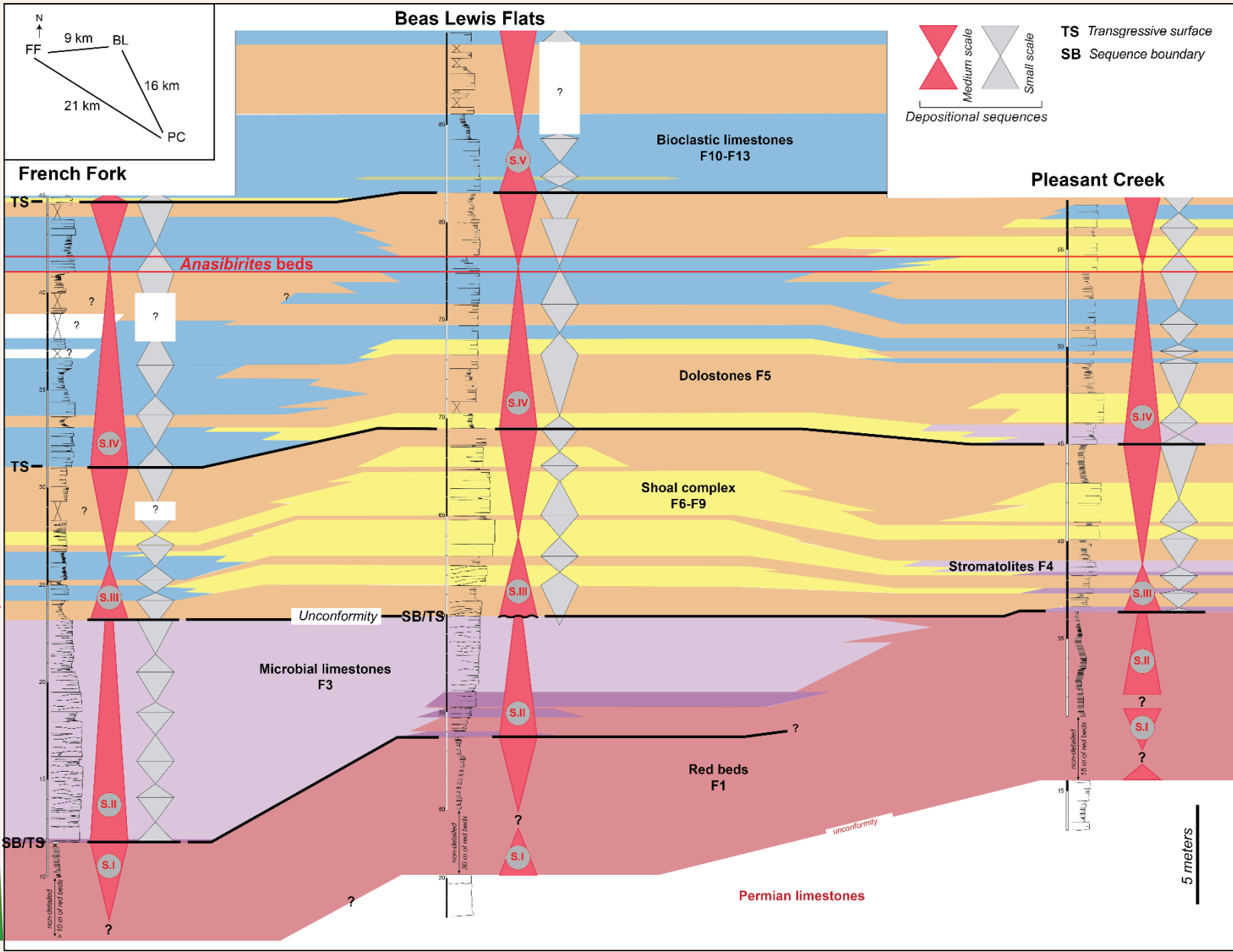
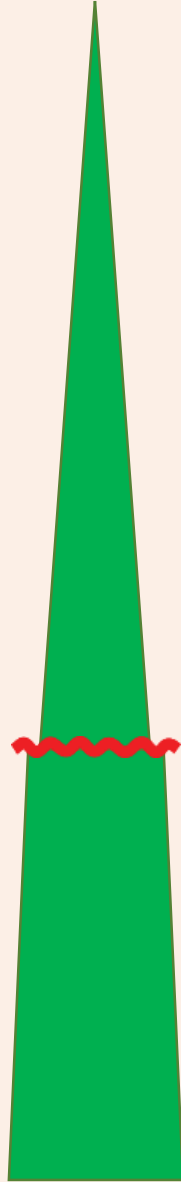
Correlations

High resolution sequence analysis with biostratigraphic control (*Anasibirites* beds)

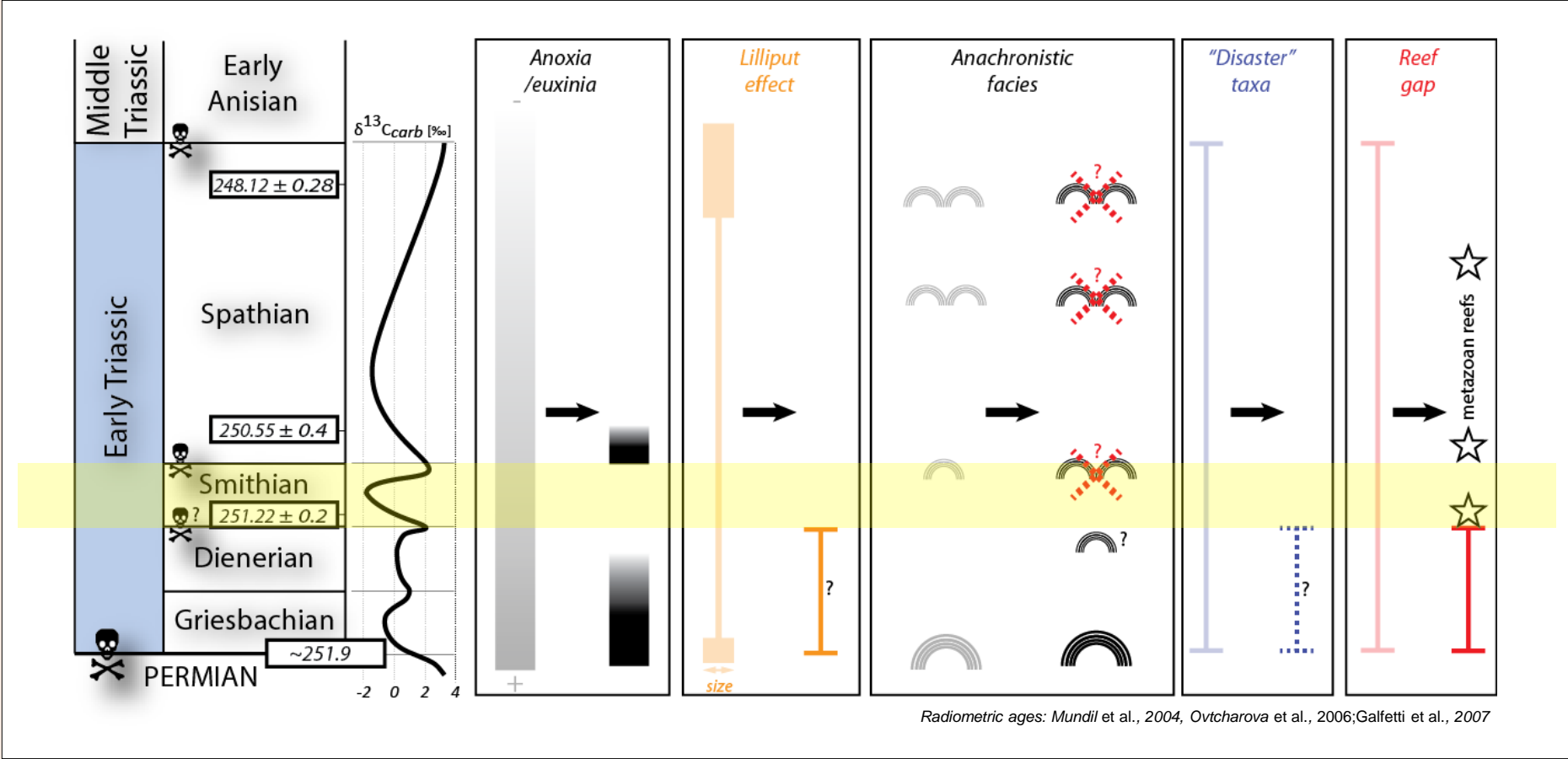
- Microbial facies: not continuous but **present in both systems**

Mixed wave- and tide-dominated system

Tide-dominated system



Conclusion



Conditions prevailing in the Western USA basin during the Smithian **question the accuracy of global interpretations** for the Early Triassic

Thank you for paying attention!