

The Triassic-Jurassic Transition across the Nova Scotian - Moroccan Conjugate Margin*

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Abstract

Uppermost Triassic and lowermost Jurassic strata of exposed Fundy (Nova Scotia) and Moroccan sections record the end-Triassic extinction (ETE) and the plausibly causally related eruptions of the Central Atlantic Magmatic Province (CAMP). Outcrops of strata just below CAMP lavas in all of the basins comprise distinctive thin-bedded layers of black, gray, red, and white mudstone and carbonate with halite pseudomorphs and salt-dissolution features. Most layers, even red ones, contain organic matter (in places >4%). In the Berrechid and Khémisset basins in Morocco, the variegated beds pass at depth into bedded black, red, and white halite and potash. In the Fundy basin, lacustrine carbonates and mudstones extend basinwide over the North Mt. Basalt, while in Morocco the CAMP is interbedded with lacustrine carbonates in the west, with fossils identical to Nova Scotia (1), and marginal to fully marine carbonates in the east with diverse marine bivalve, gastropod, and echinoid assemblages. Fundy sporomorphs indicate a floral extinction event occurred just prior to the eruption of the basal CAMP (2), associated with locally abundant ferns and fern spores, despite the evaporites. This floral extinction event, previously identified as the Triassic-Jurassic boundary as well as the North Mt. Basalt are within ~100 ky of the initial marine ETE(3). However, the new Global Stratotype Section and Point (GSSP) for the base Jurassic is now defined by the first appearance datum (FAD) of the ammonite *Psiloceras spelae* (4), well above the ETE. Sporomorphs from just above the North Mt. Basalt show that the ETE continued well into the time of the CAMP(5), and because the ETE itself has yet to be found below the CAMP in Morocco(6), it is plausible that eruptions were synchronous with its initiation. Likewise, marine interbeds within CAMP of eastern Morocco correlate with the “pre-planorbis zone”, and are pre-Jurassic. Therefore, CAMP eruptions were synchronous with the ETE and could have caused it, and they were associated with accelerated subsidence and a transgression of marine waters and distal brines. Thus, some of the most important biotic and depositional features of the Nova Scotian - Moroccan conjugate margins directly relate to the CAMP.

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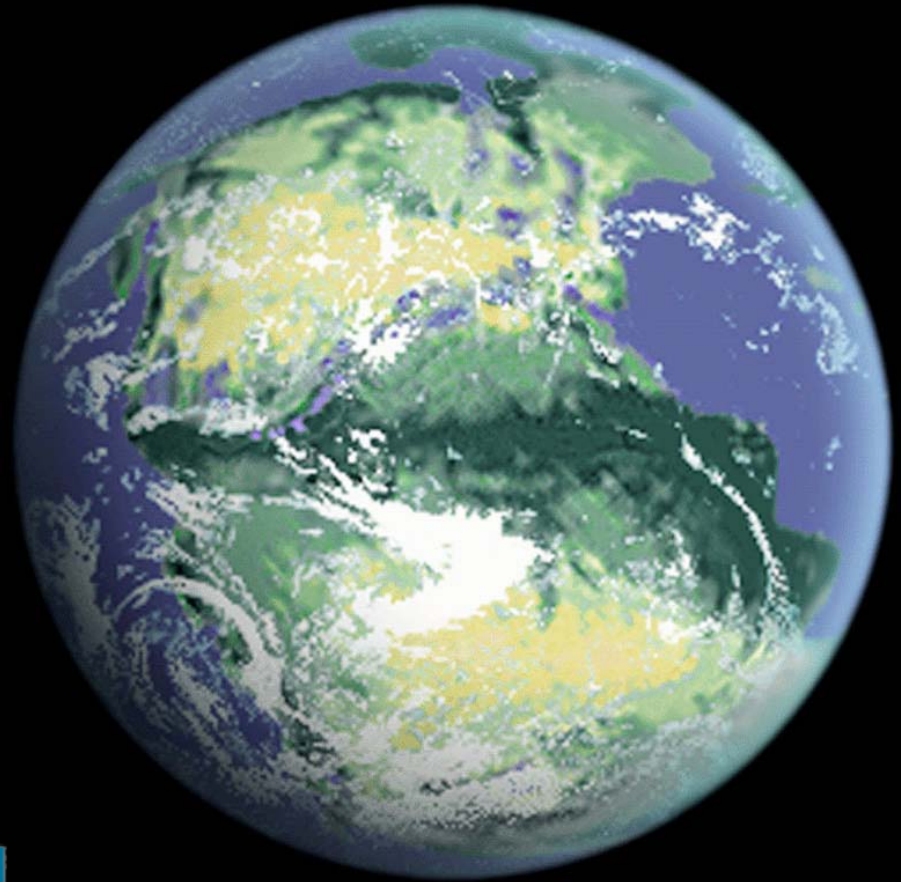
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The Triassic-Jurassic Transition Across the Nova Scotian – Moroccan Conjugate Margin

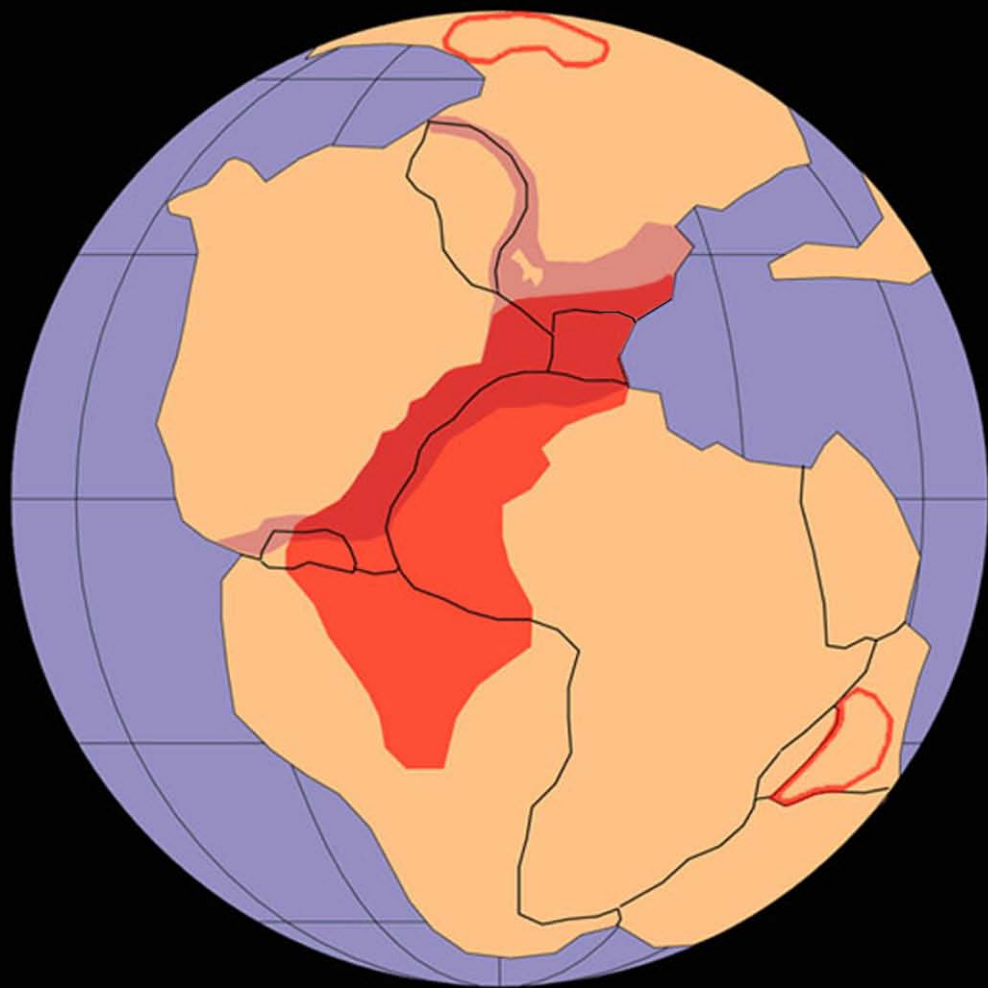
Paul E. Olsen,
Dennis V. Kent,
Mohammed Et-Touhami



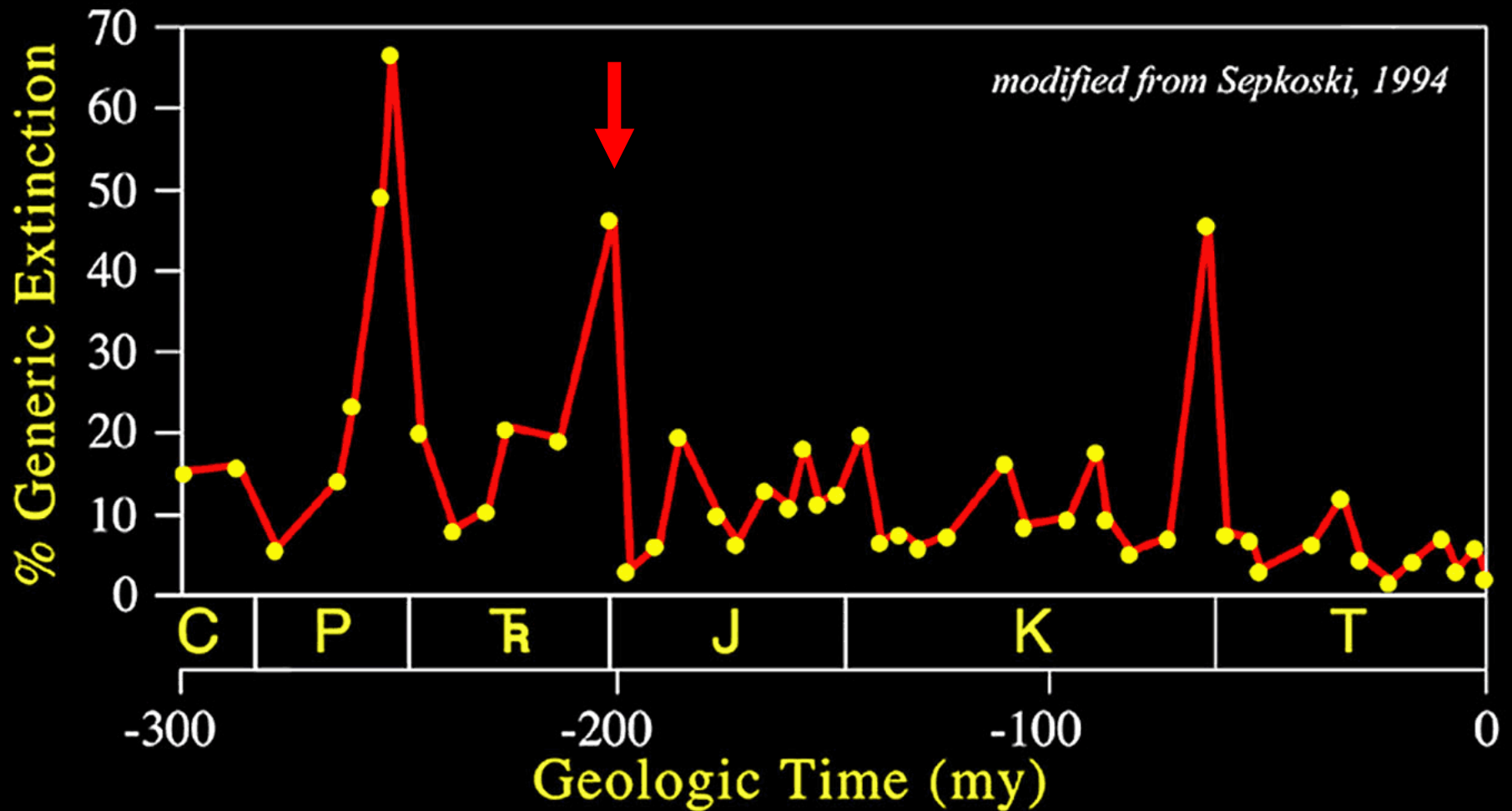
Main Points

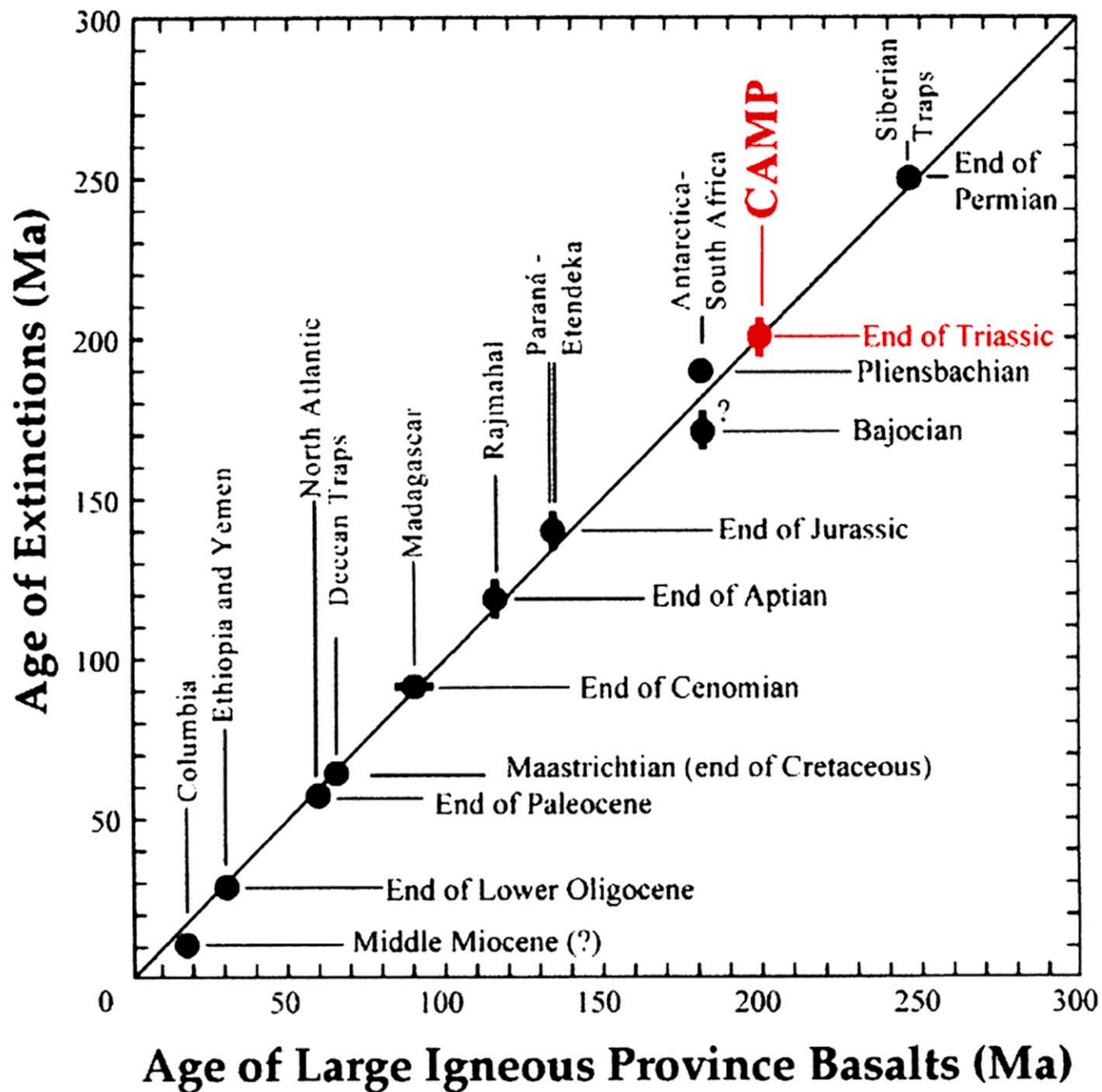
- 1.Examine a high resolution transect from Eastern North America (ENA) through Morocco focusing on the initial emplacement of the CAMP, a critical event on the conjugate margins.
- 2.Examine relationship between initial CAMP and the mass extinction and Triassic-Jurassic transition.
- 3.Look at relationship between initial CAMP major geodynamical reorganization including regional subsidence, marine transgression, and salt deposition.

Central Atlantic Magmatic Province (CAMP)

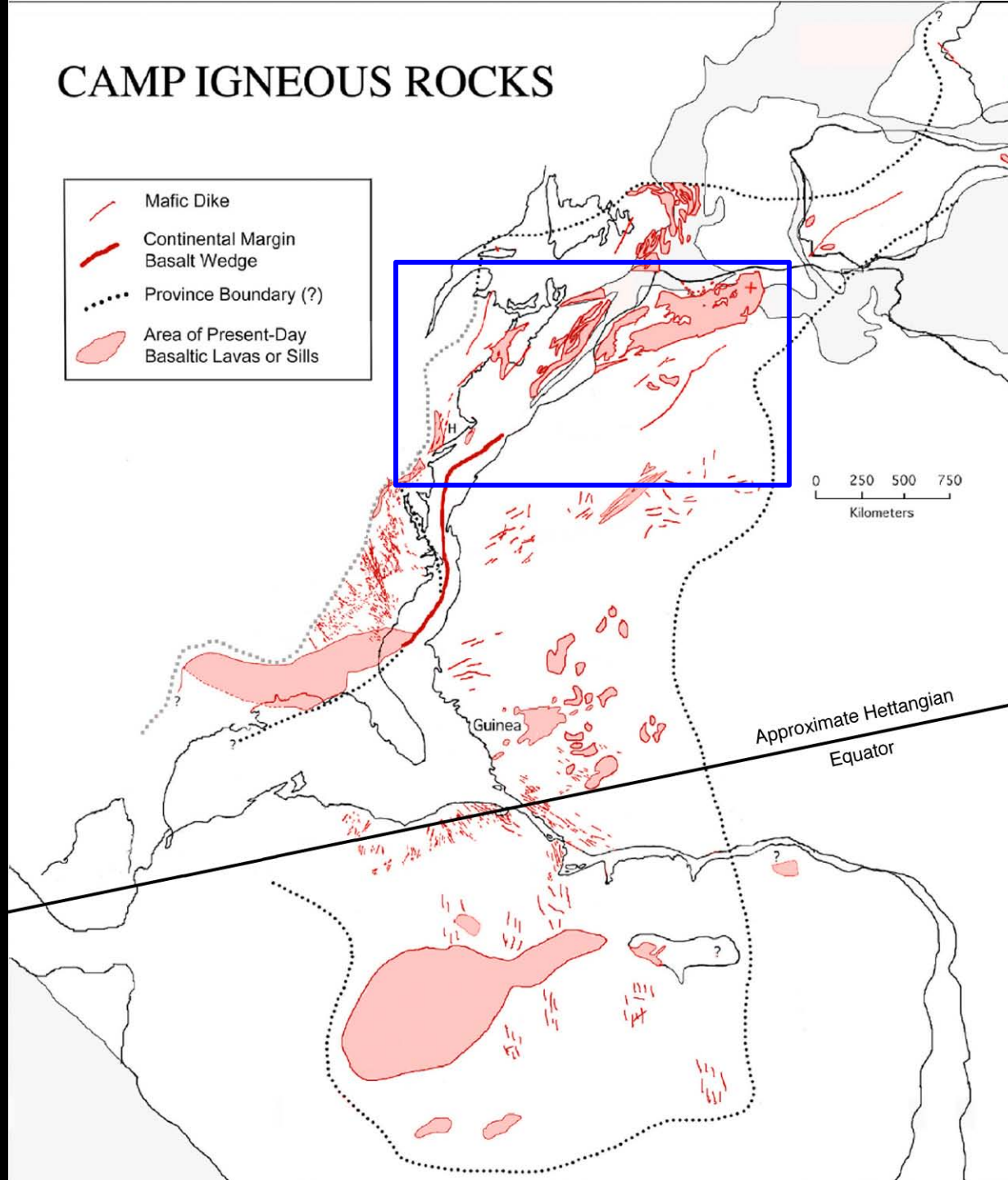


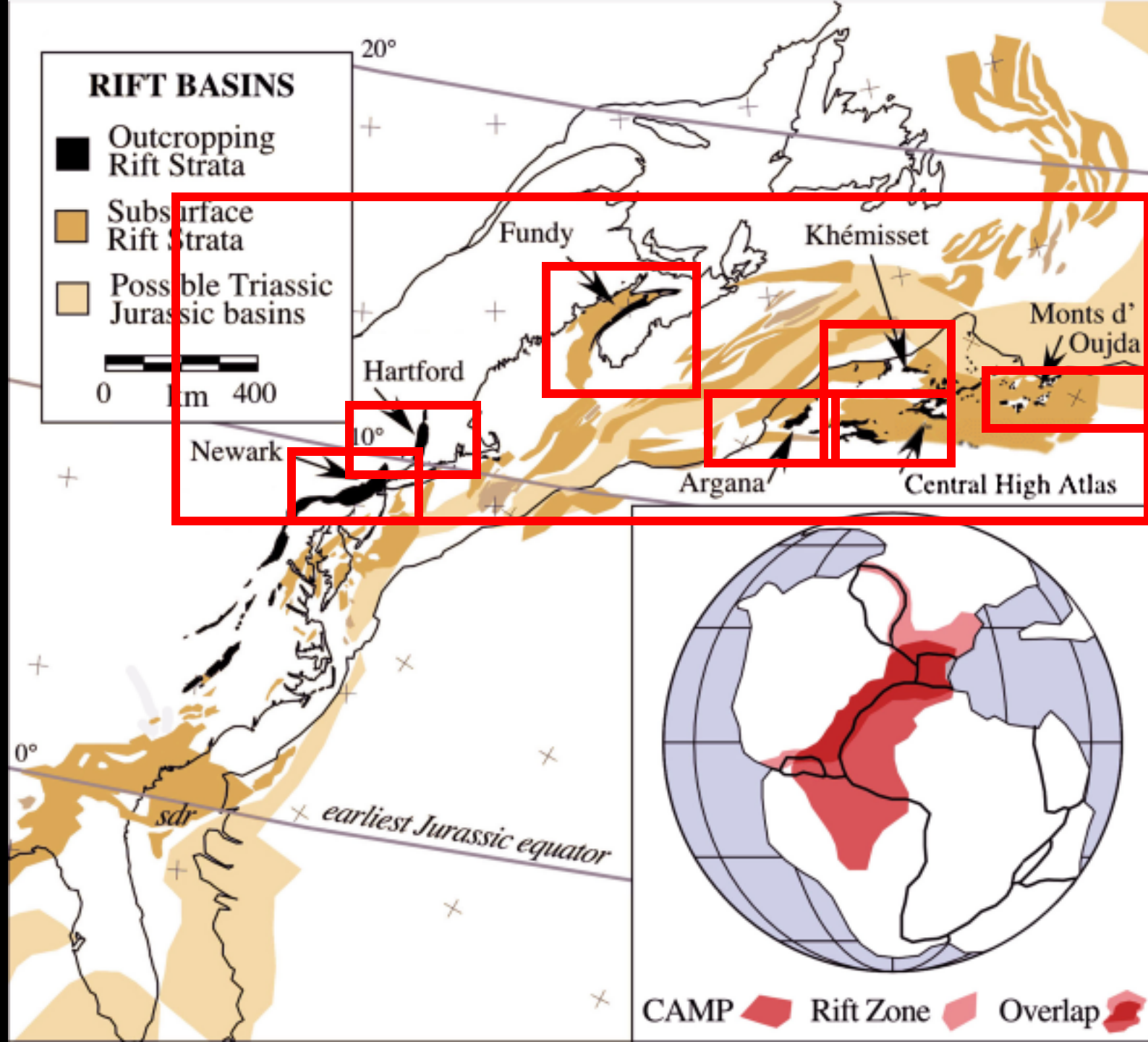
Intensity of Extinction

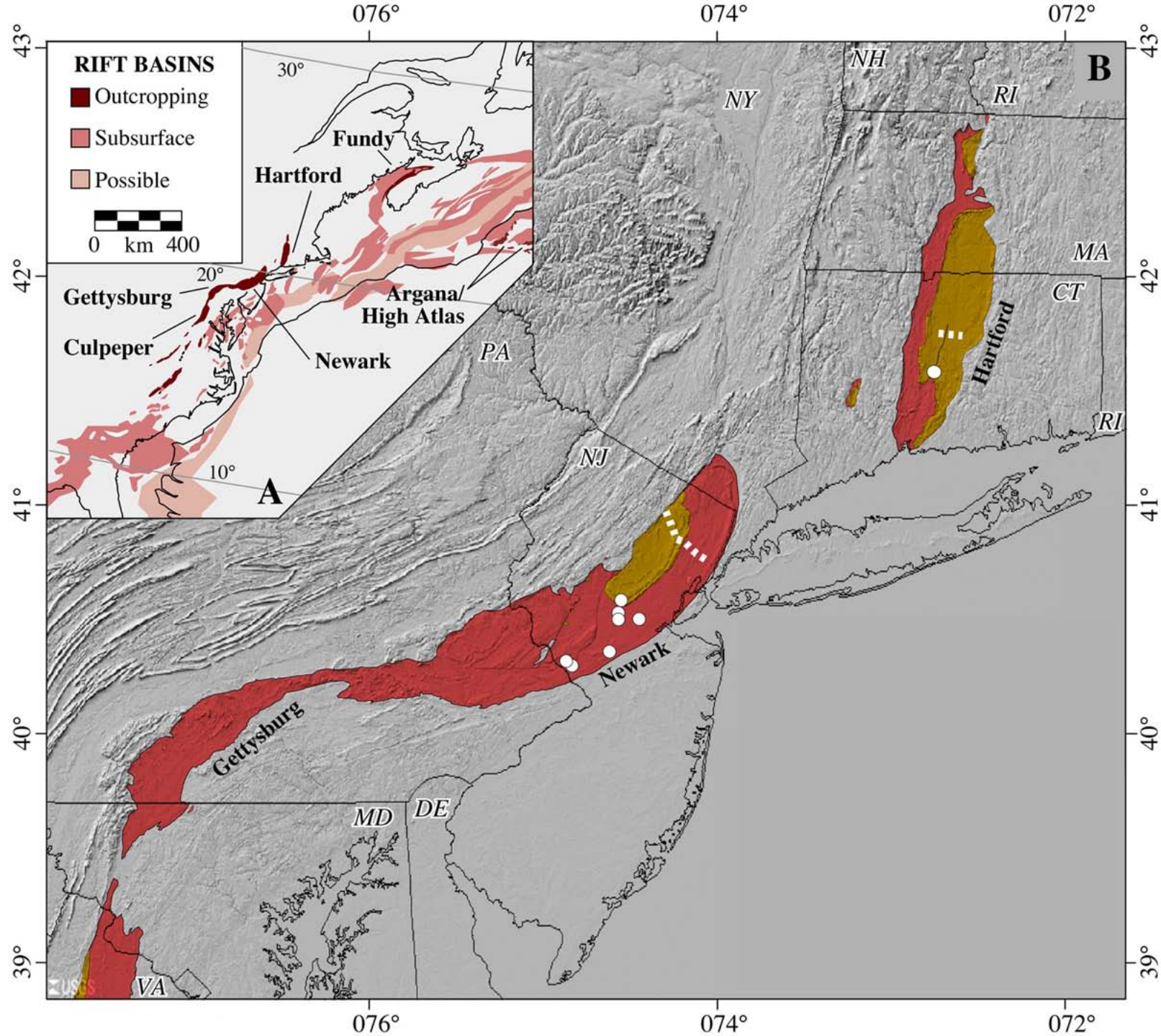




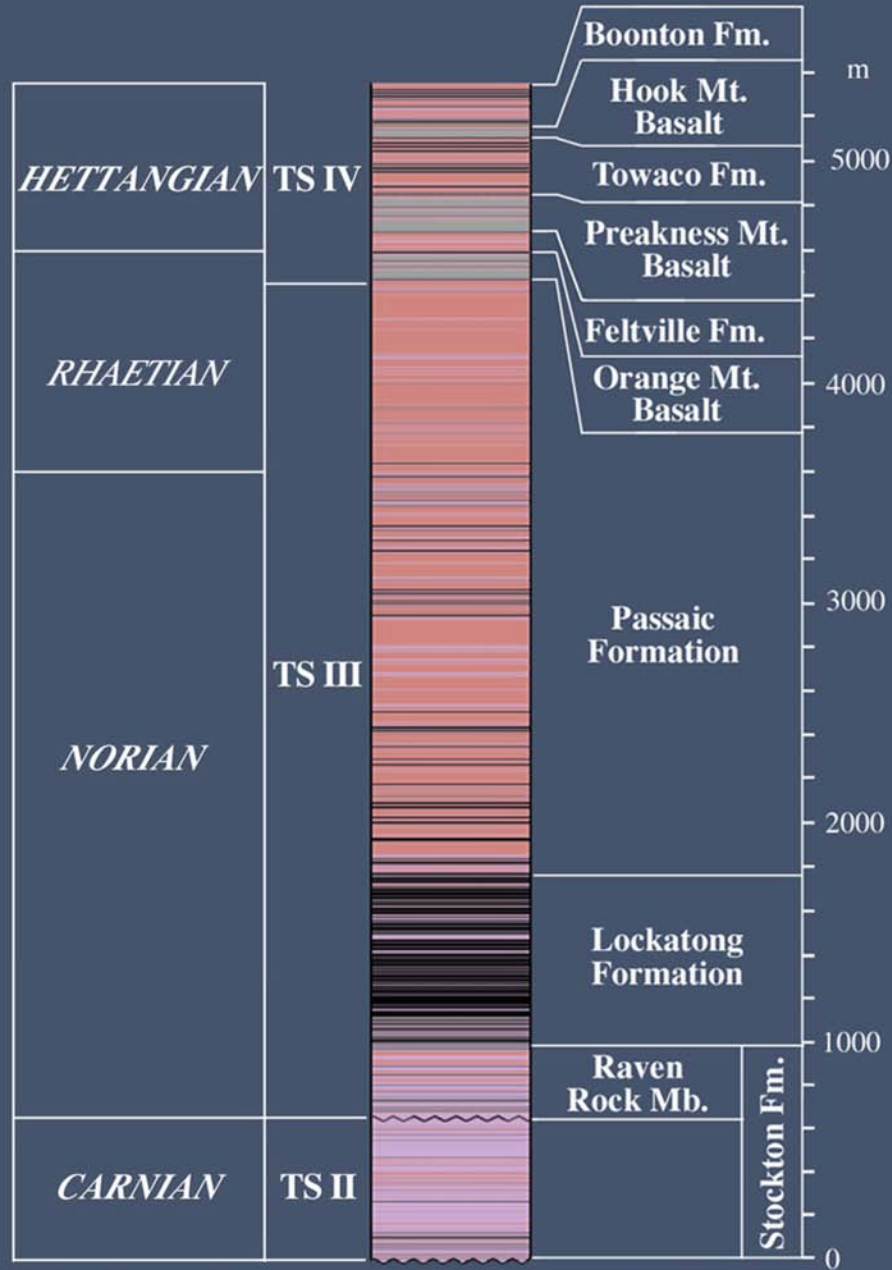
CAMP IGNEOUS ROCKS







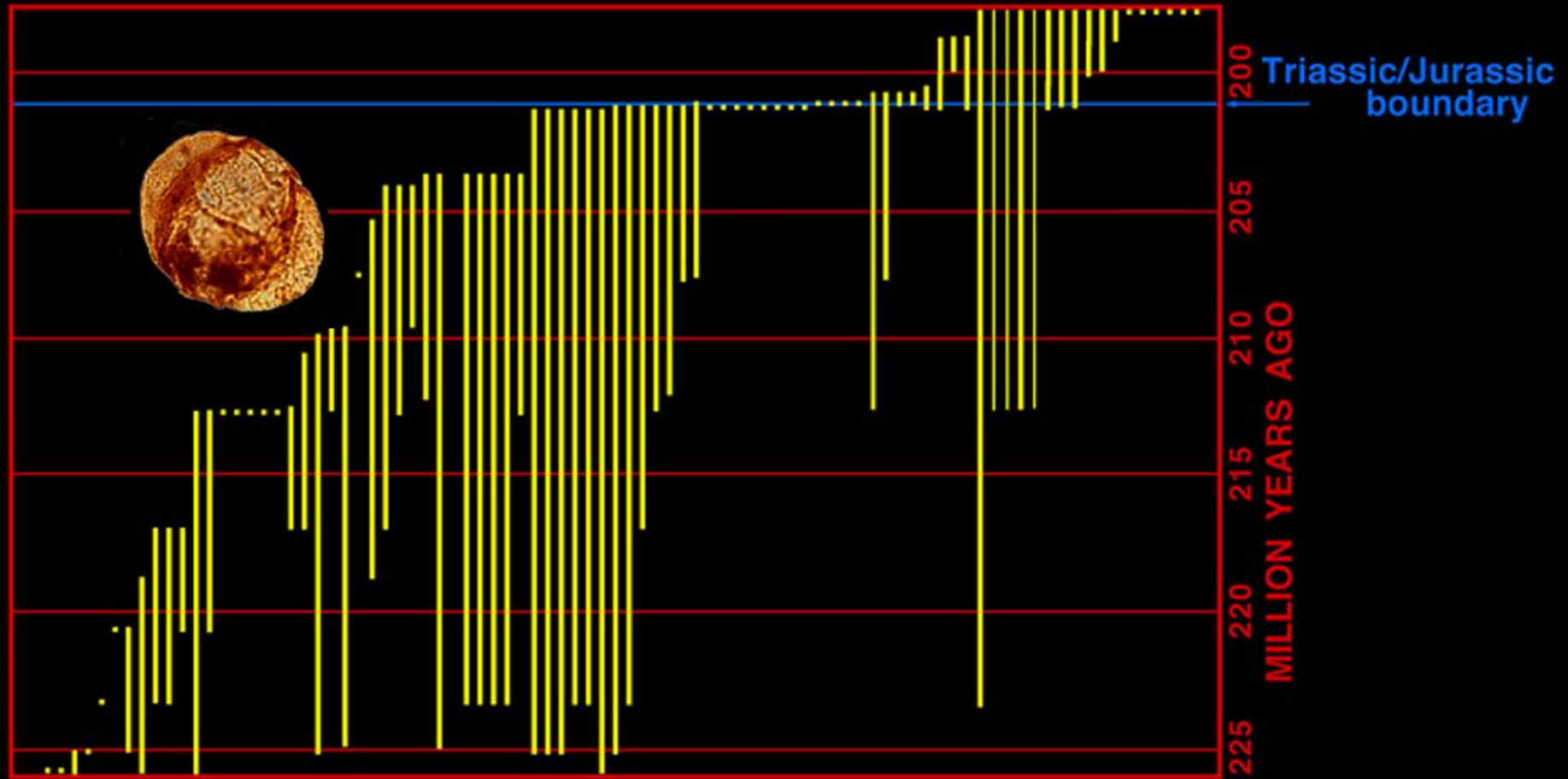
Newark Basin



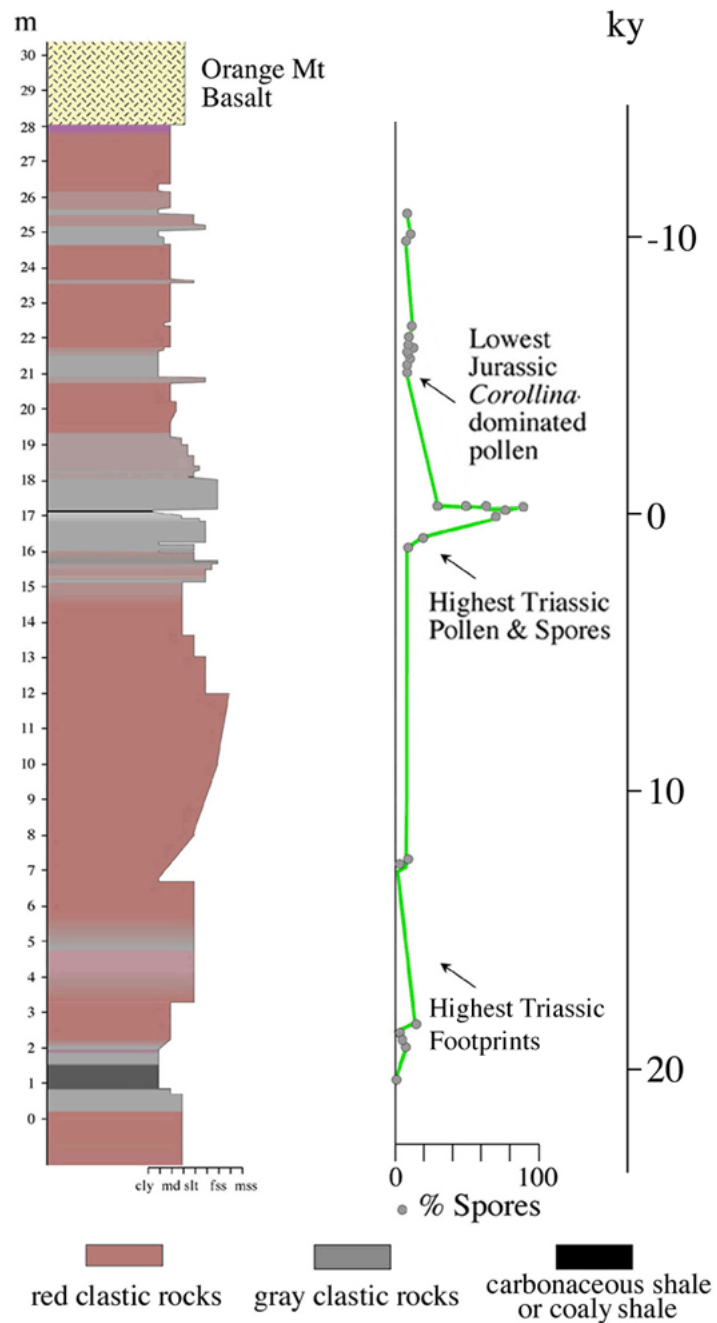




Microfloral Turnover, Eastern North America



Triassic | Jurassic

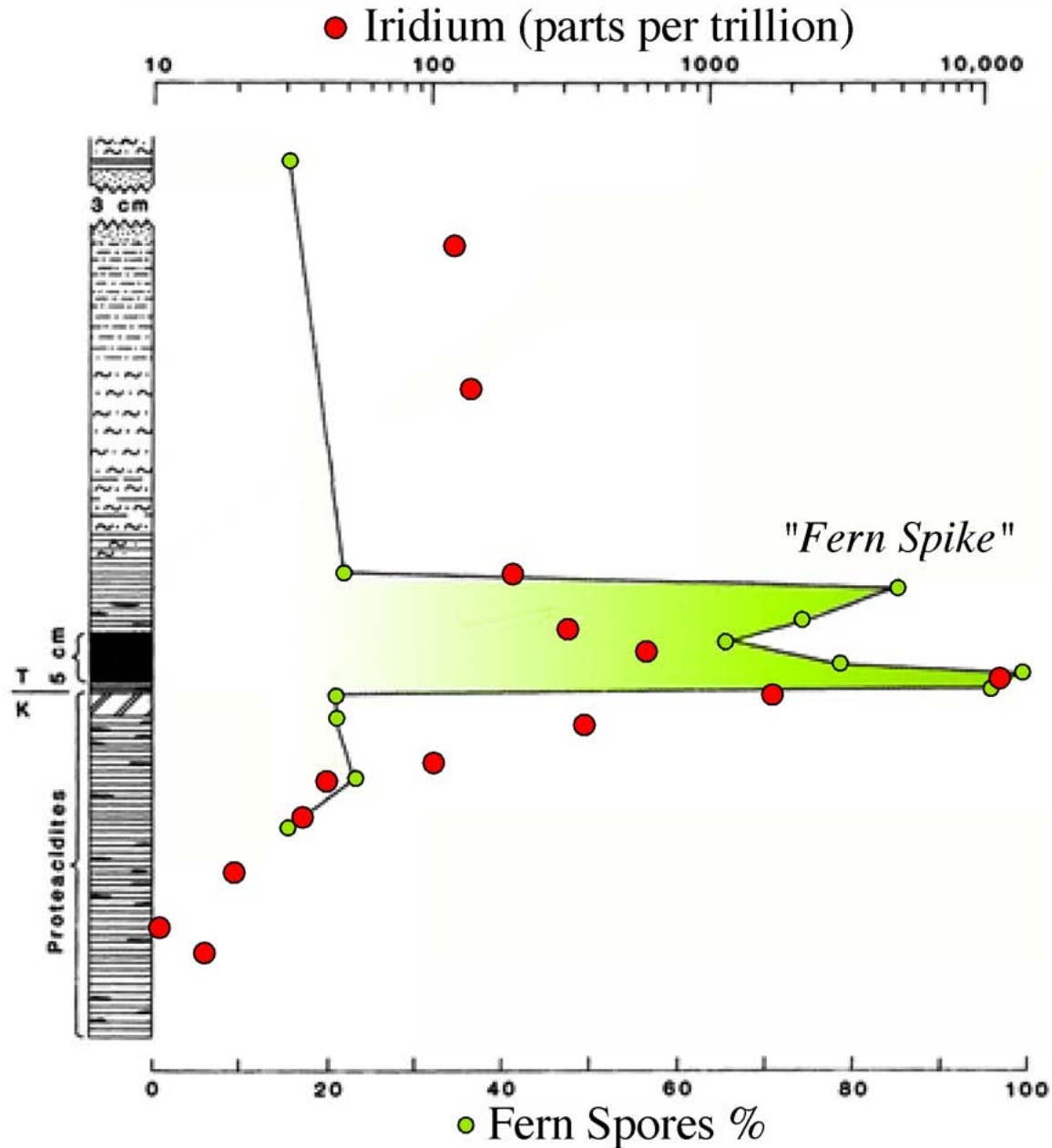


End Triassic Extinction level, Newark Basin



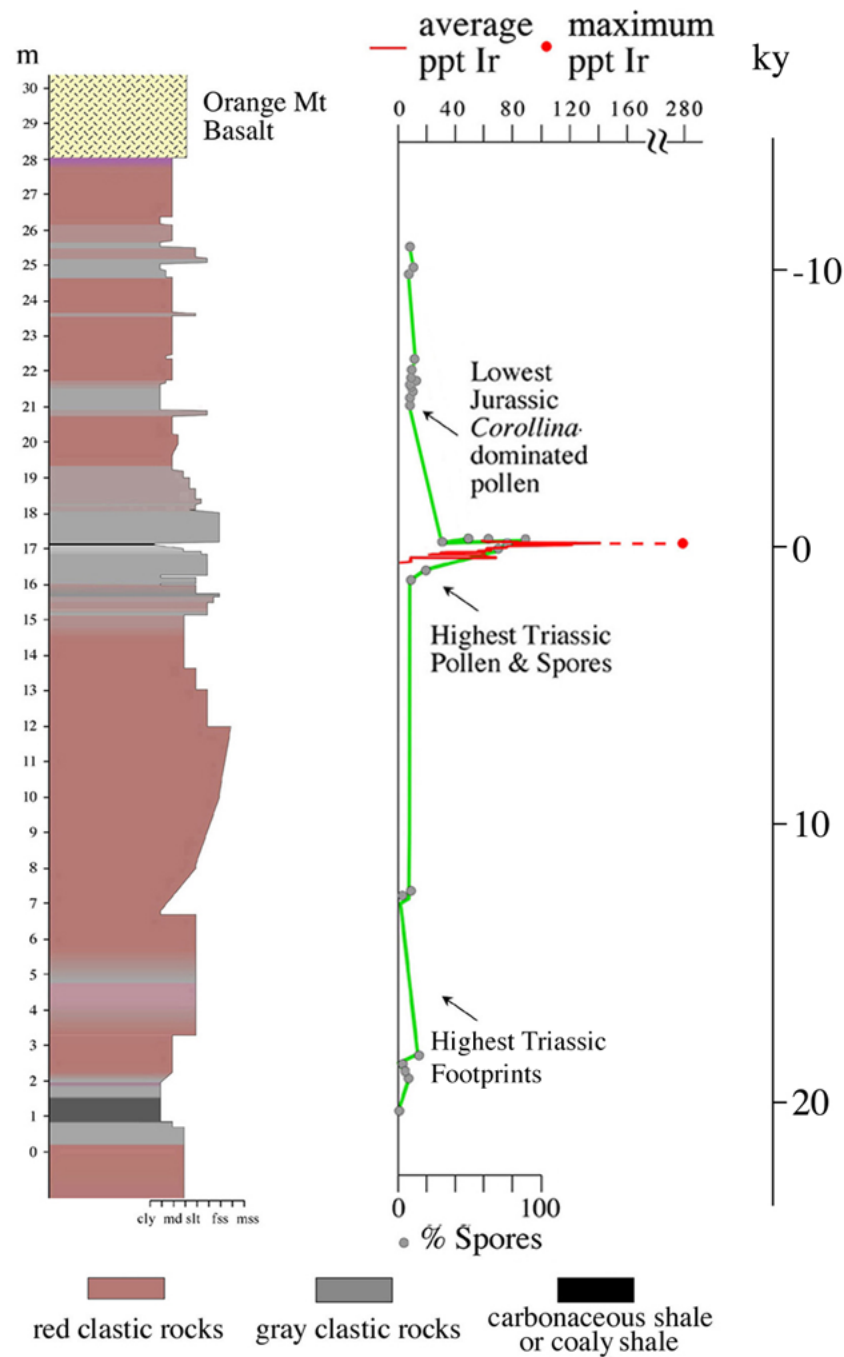
K-T Boundary, Raton Basin

K-T Boundary

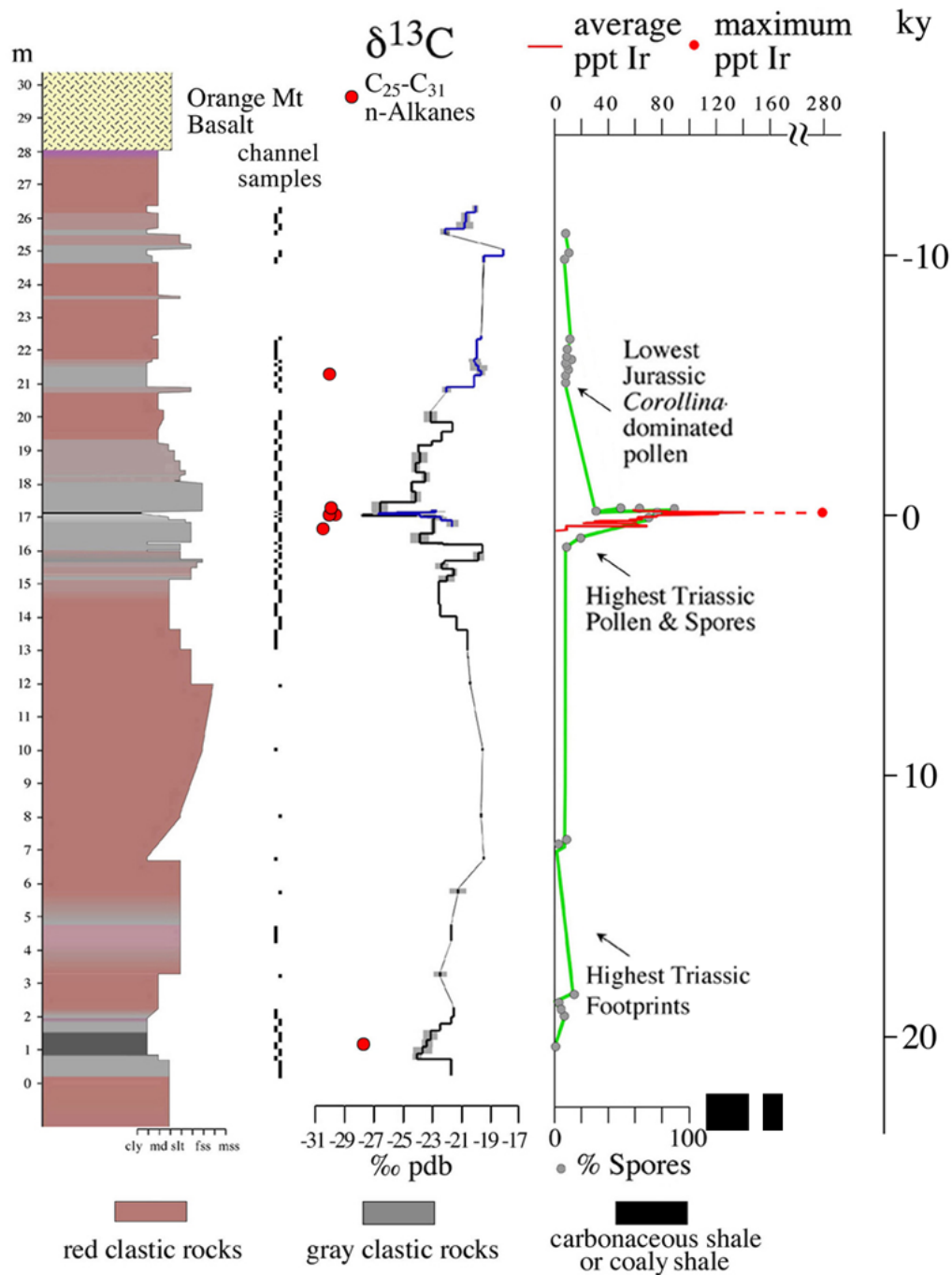


R. H. Tschudy et al.,
Science, 1984

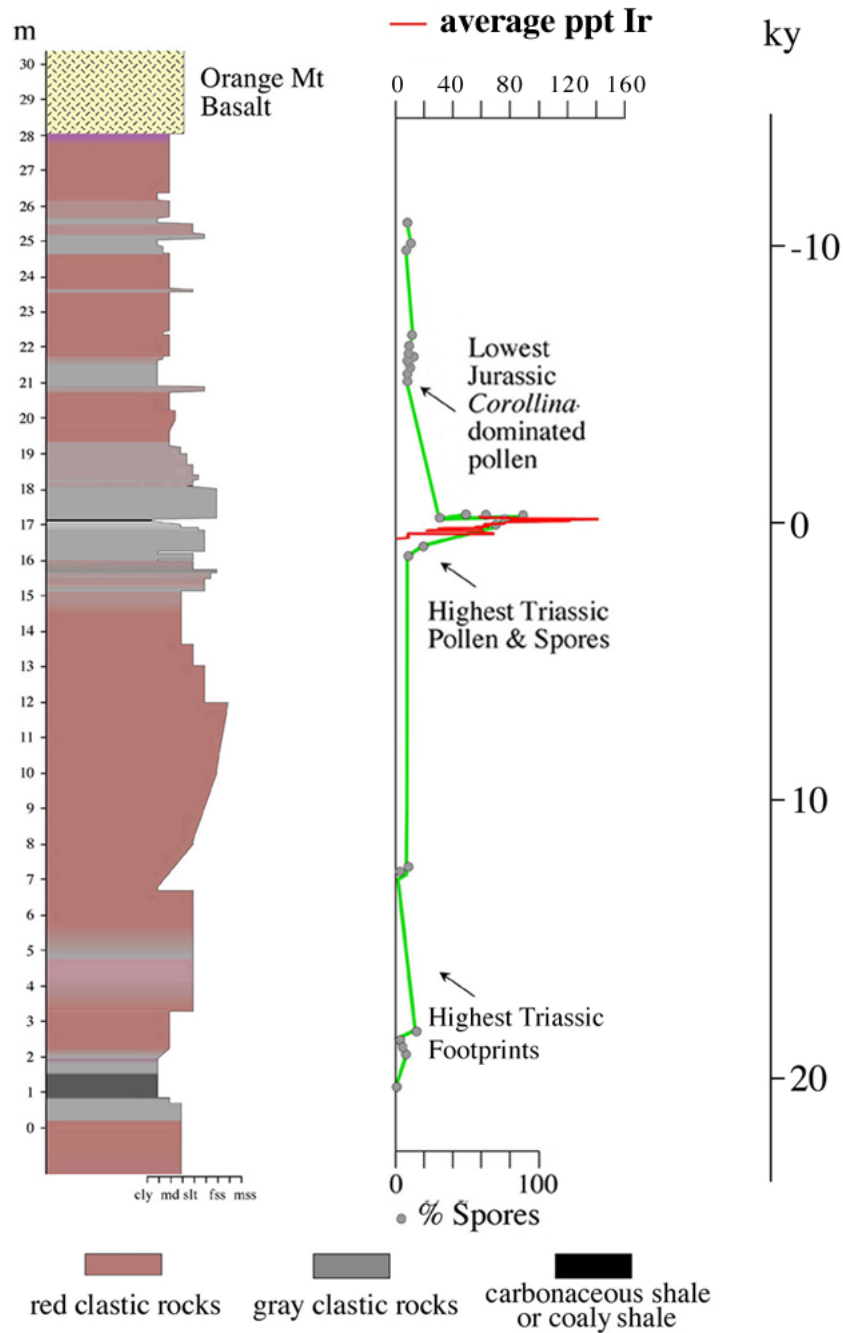
Triassic | Jurassic

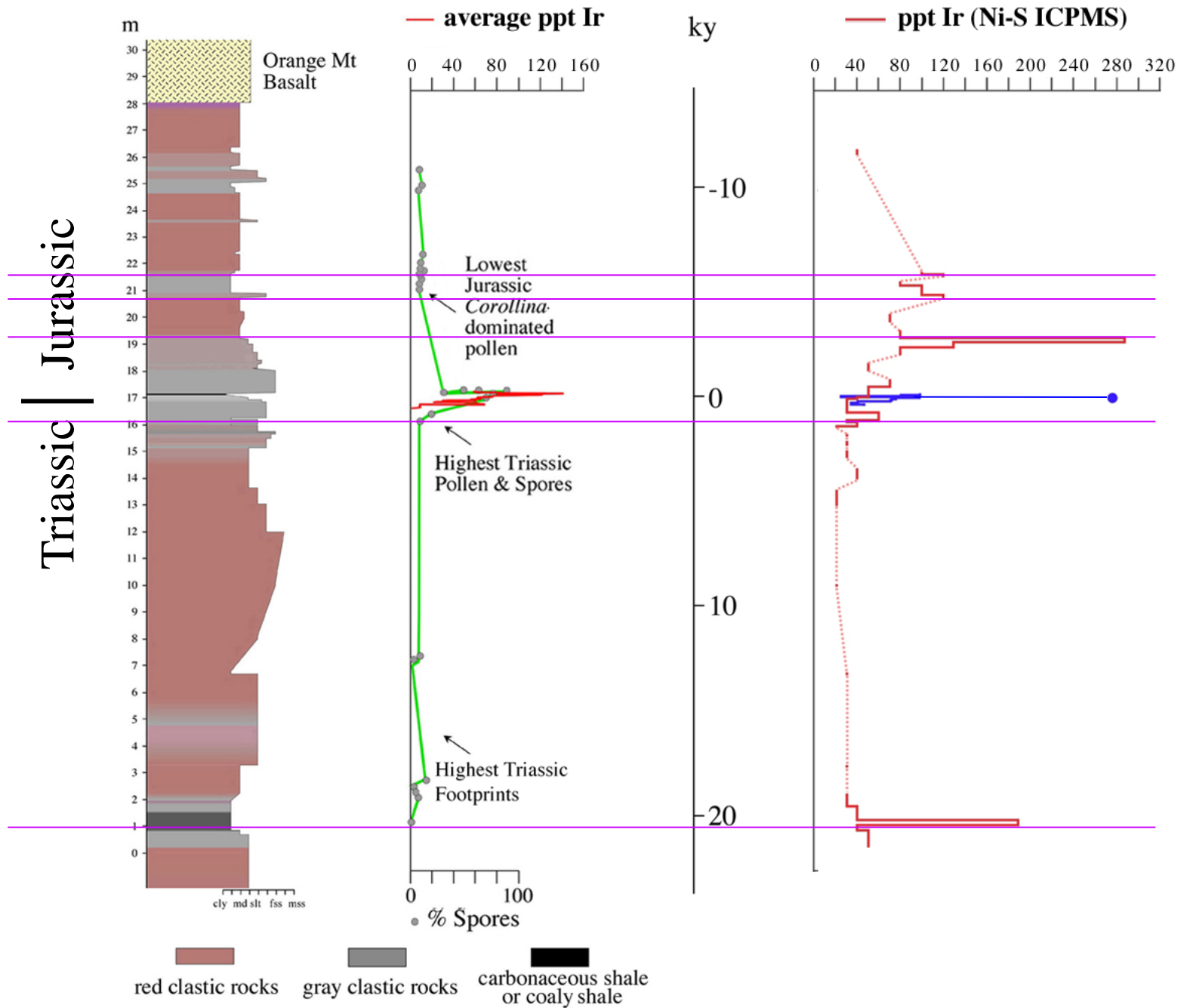


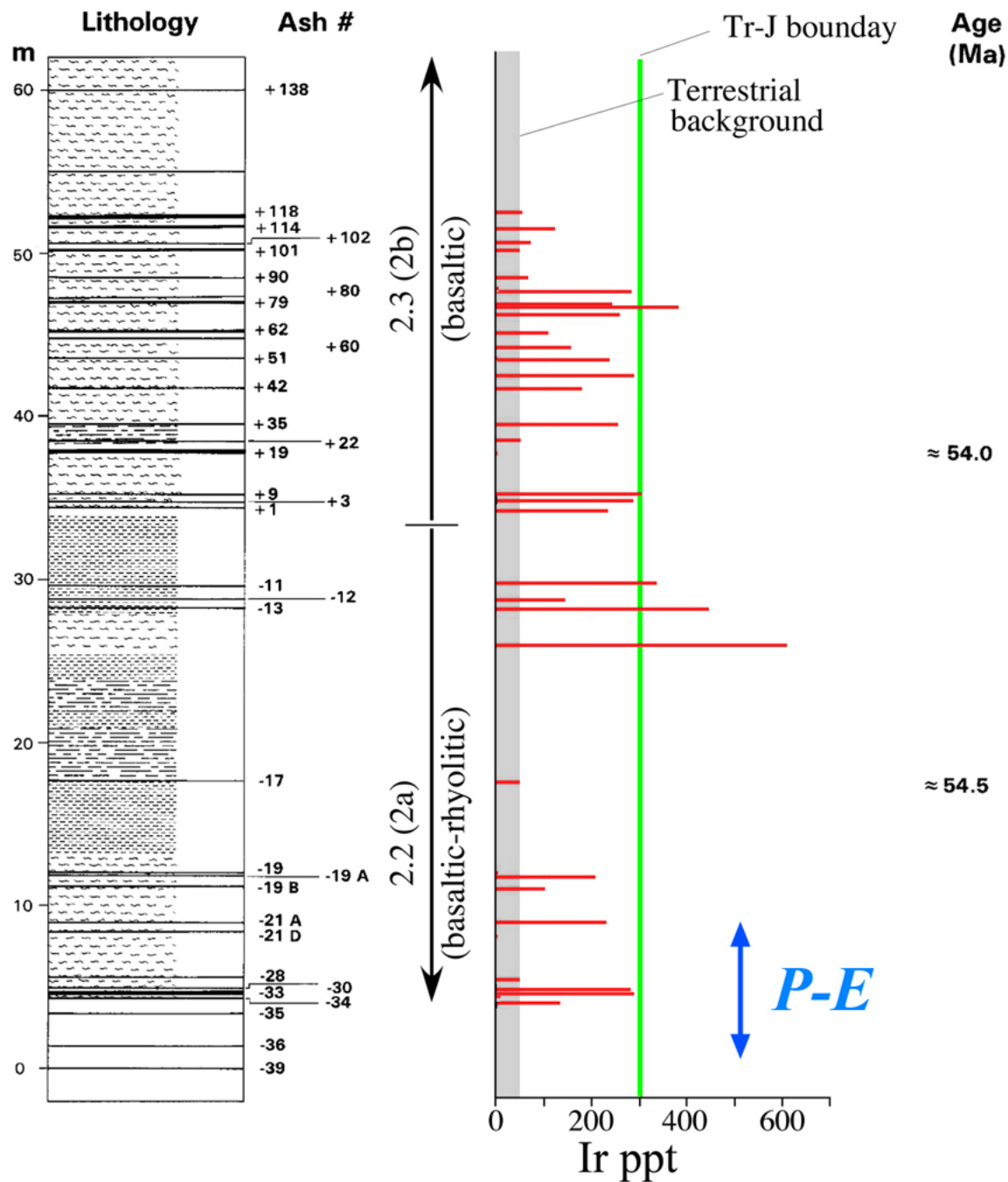
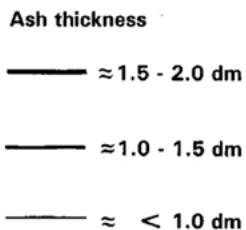
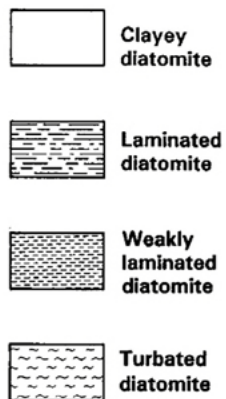
Triassic | Jurassic

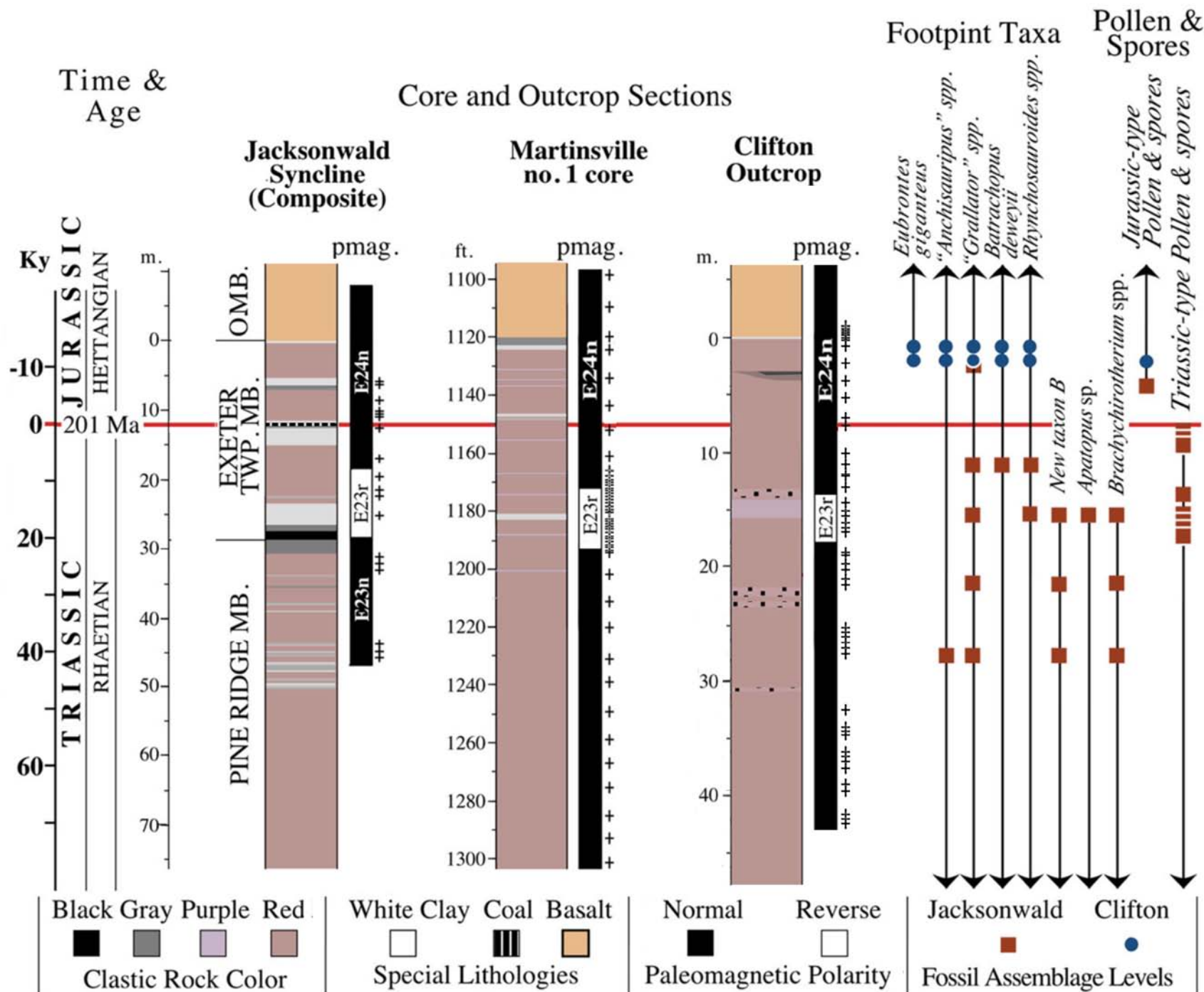


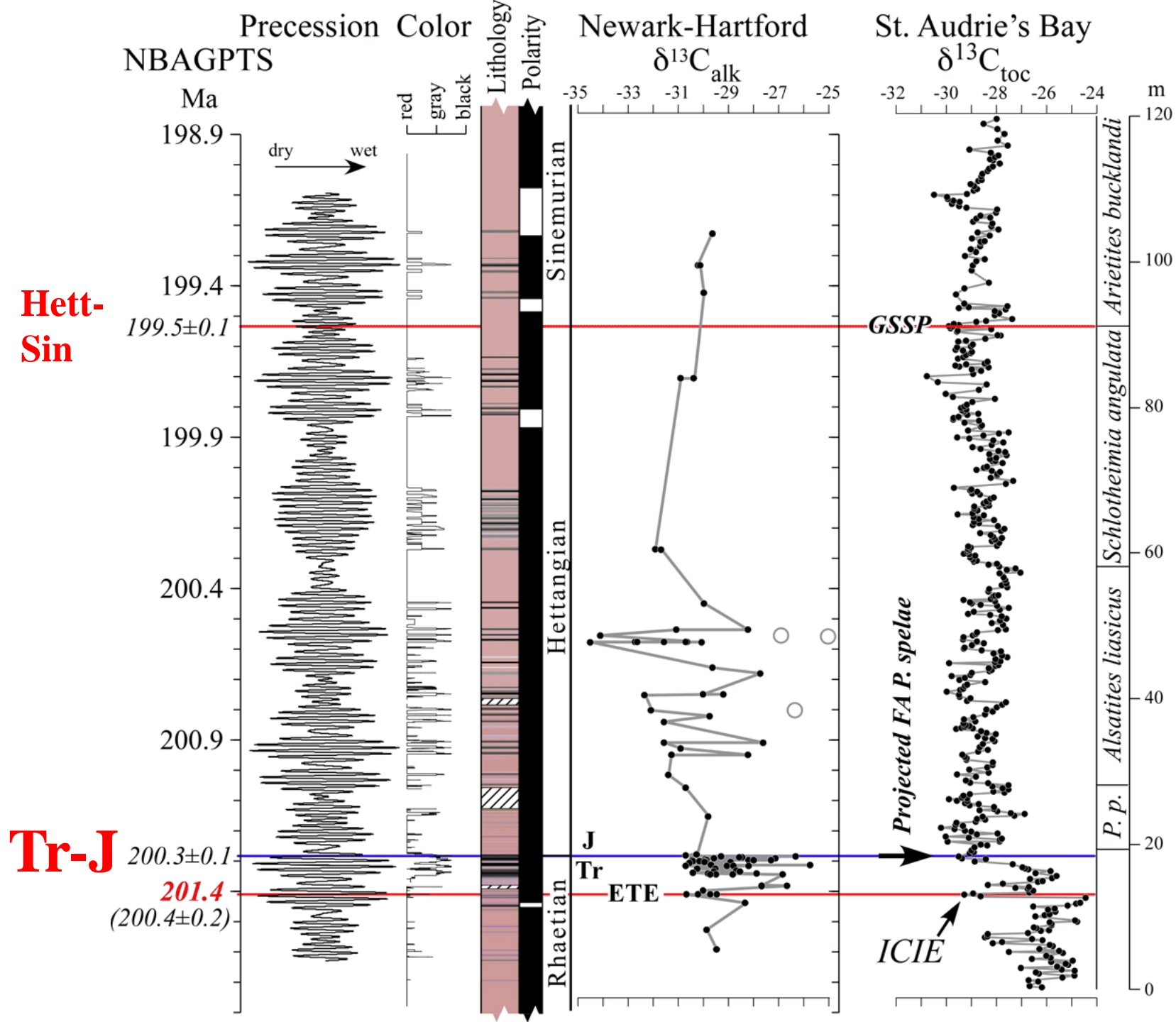
Triassic | Jurassic





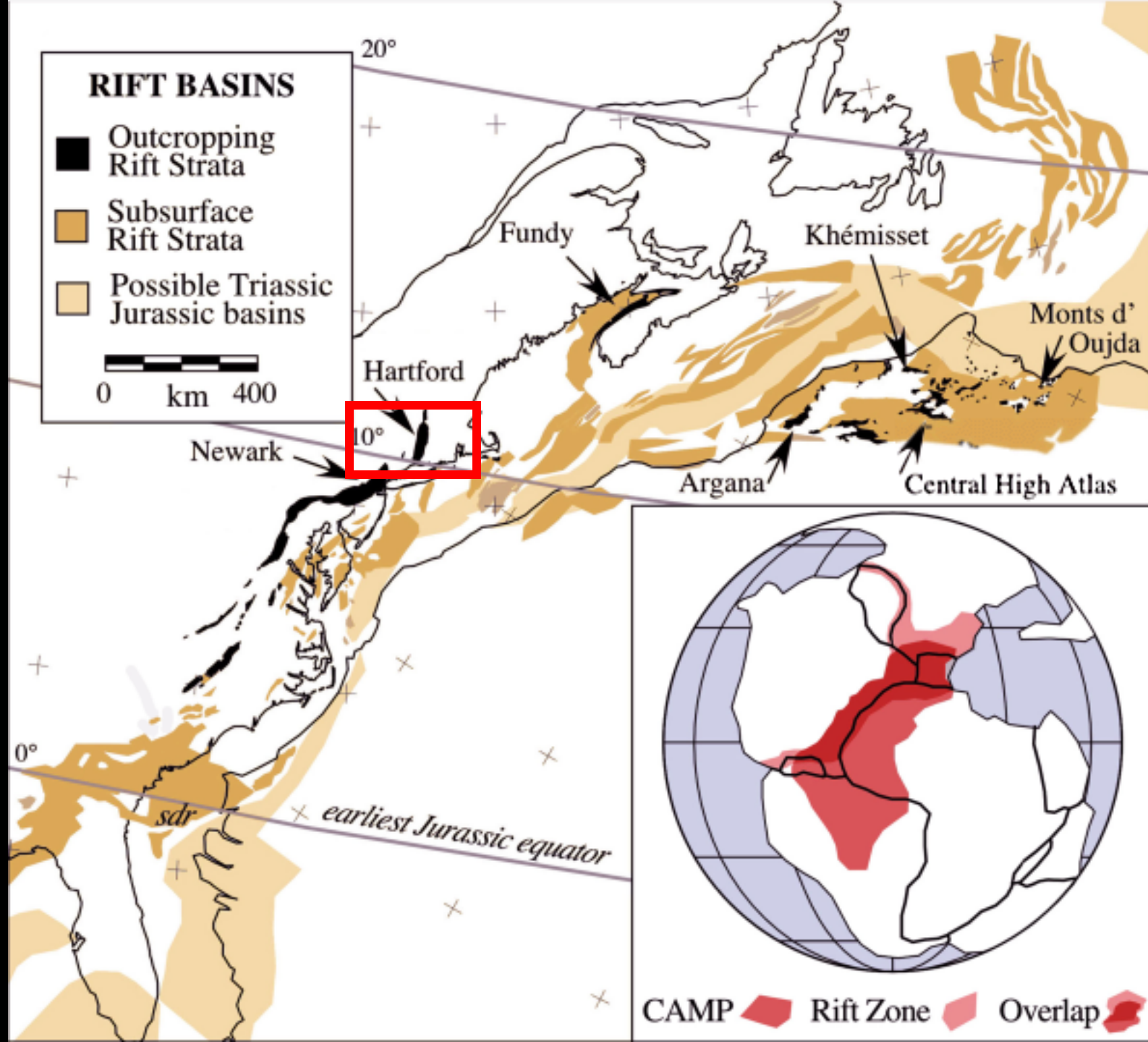




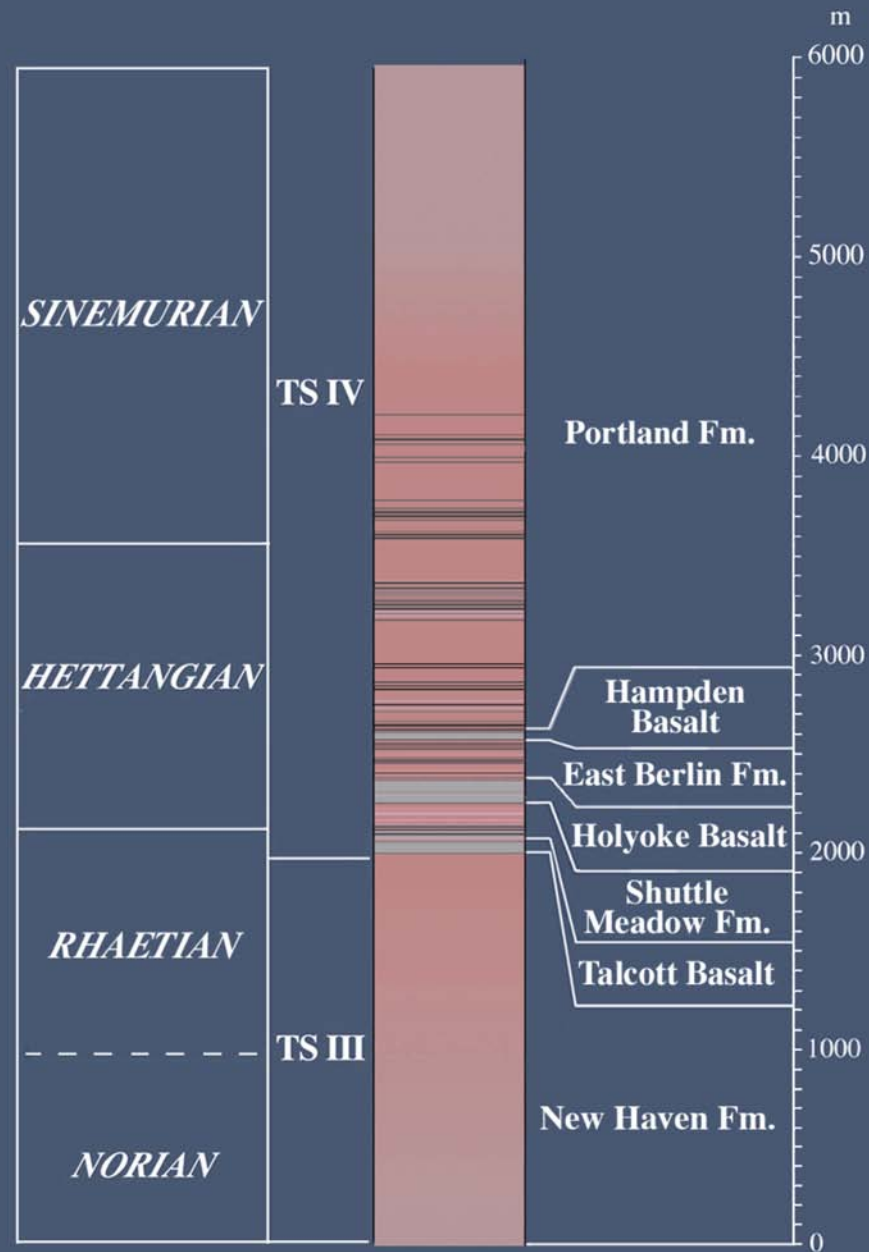


Hett-Sin

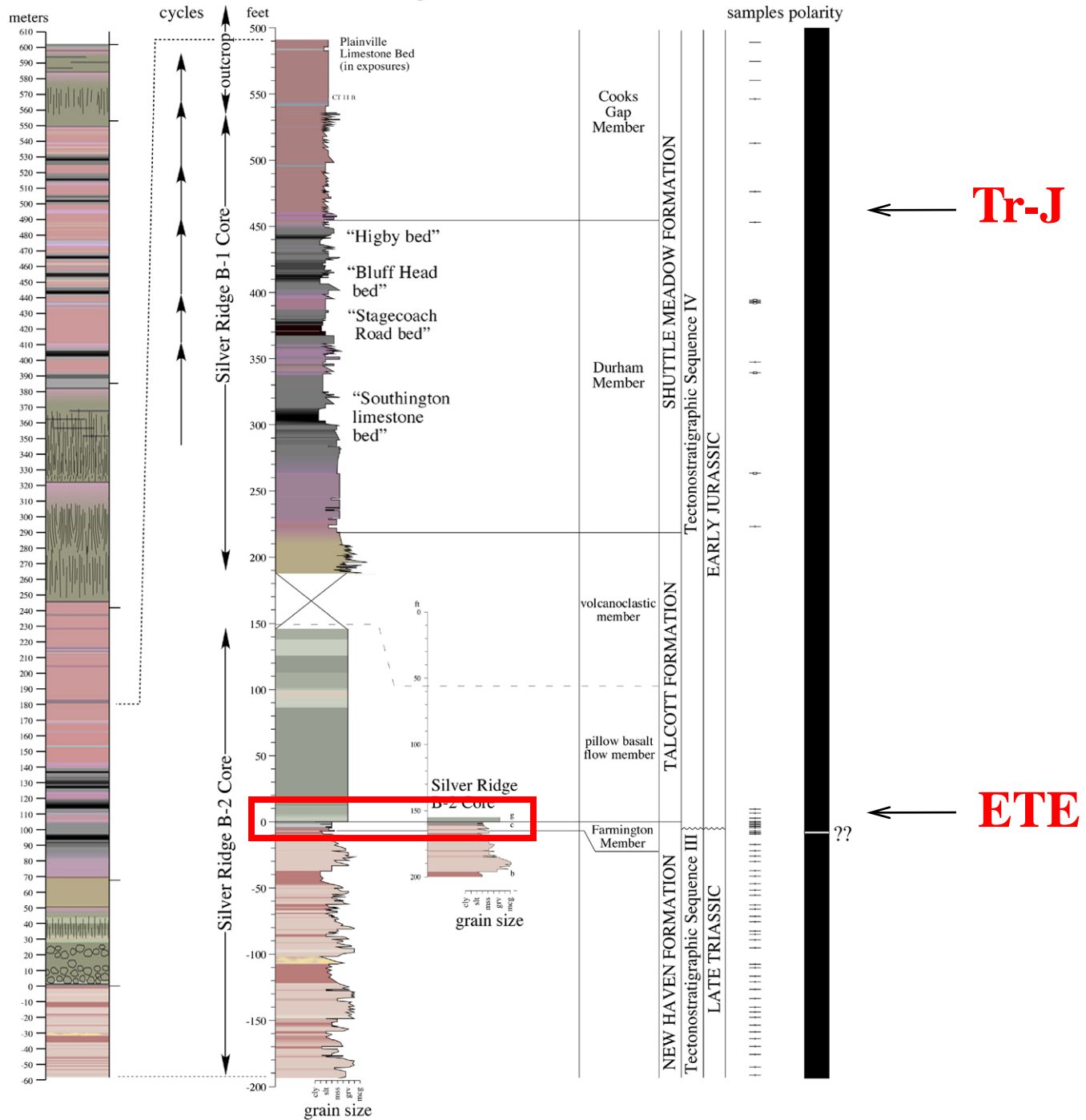
Tr-J



Hartford Basin

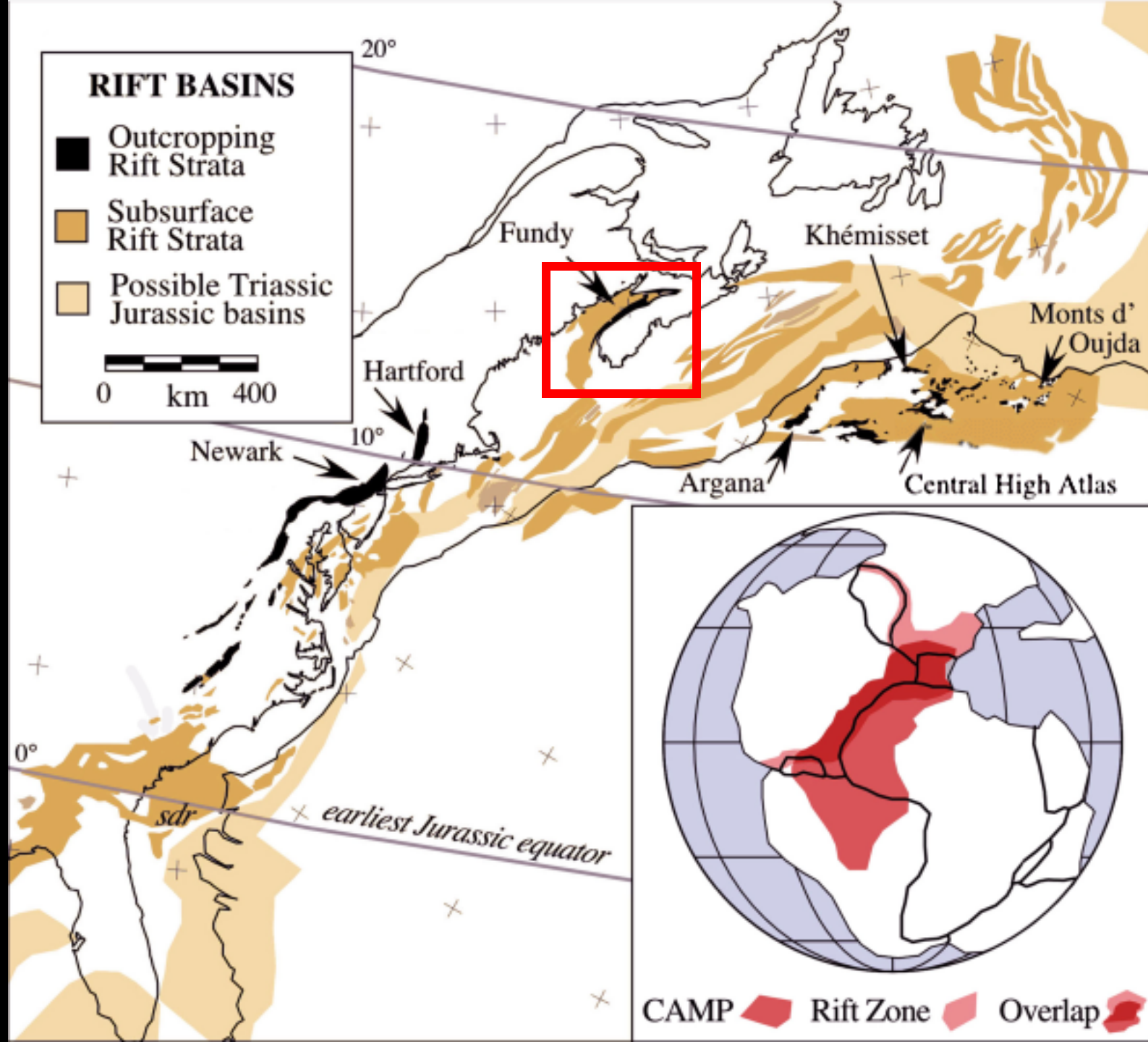


Silver Ridge B1 & B2

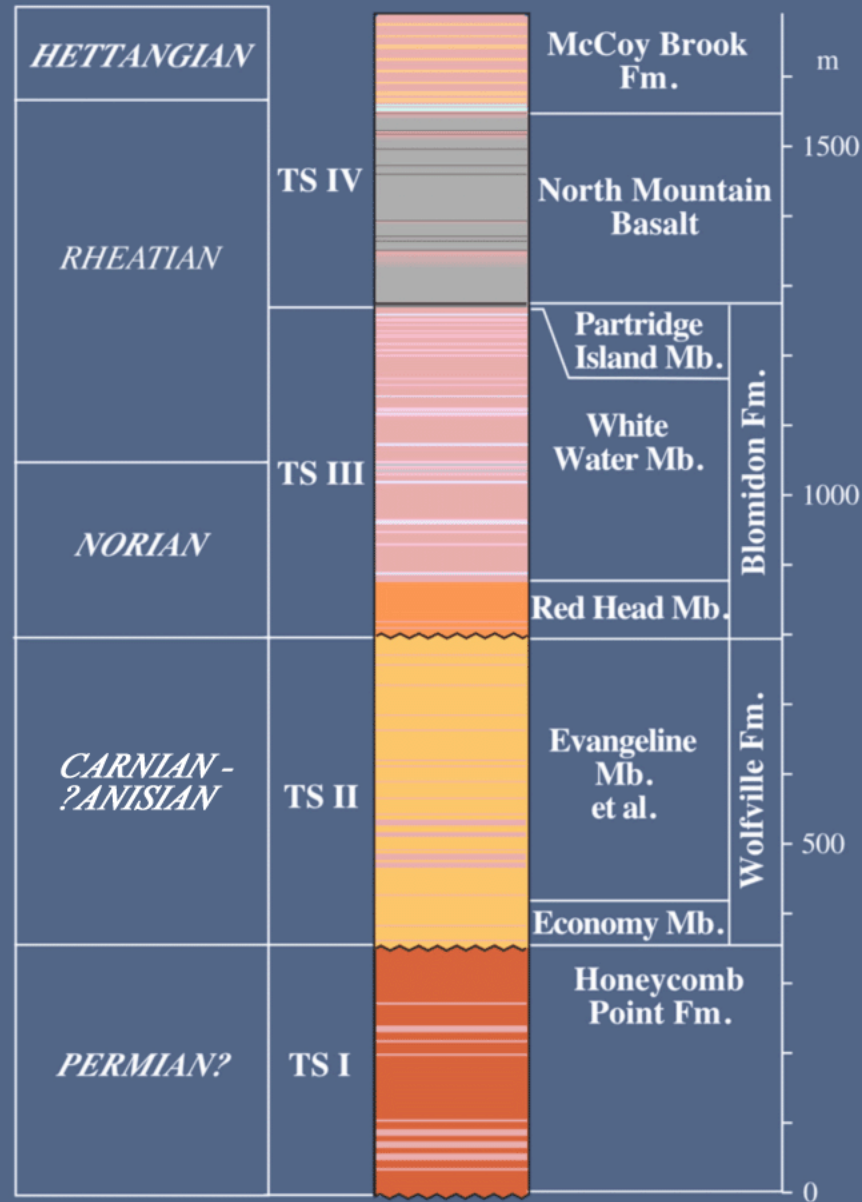








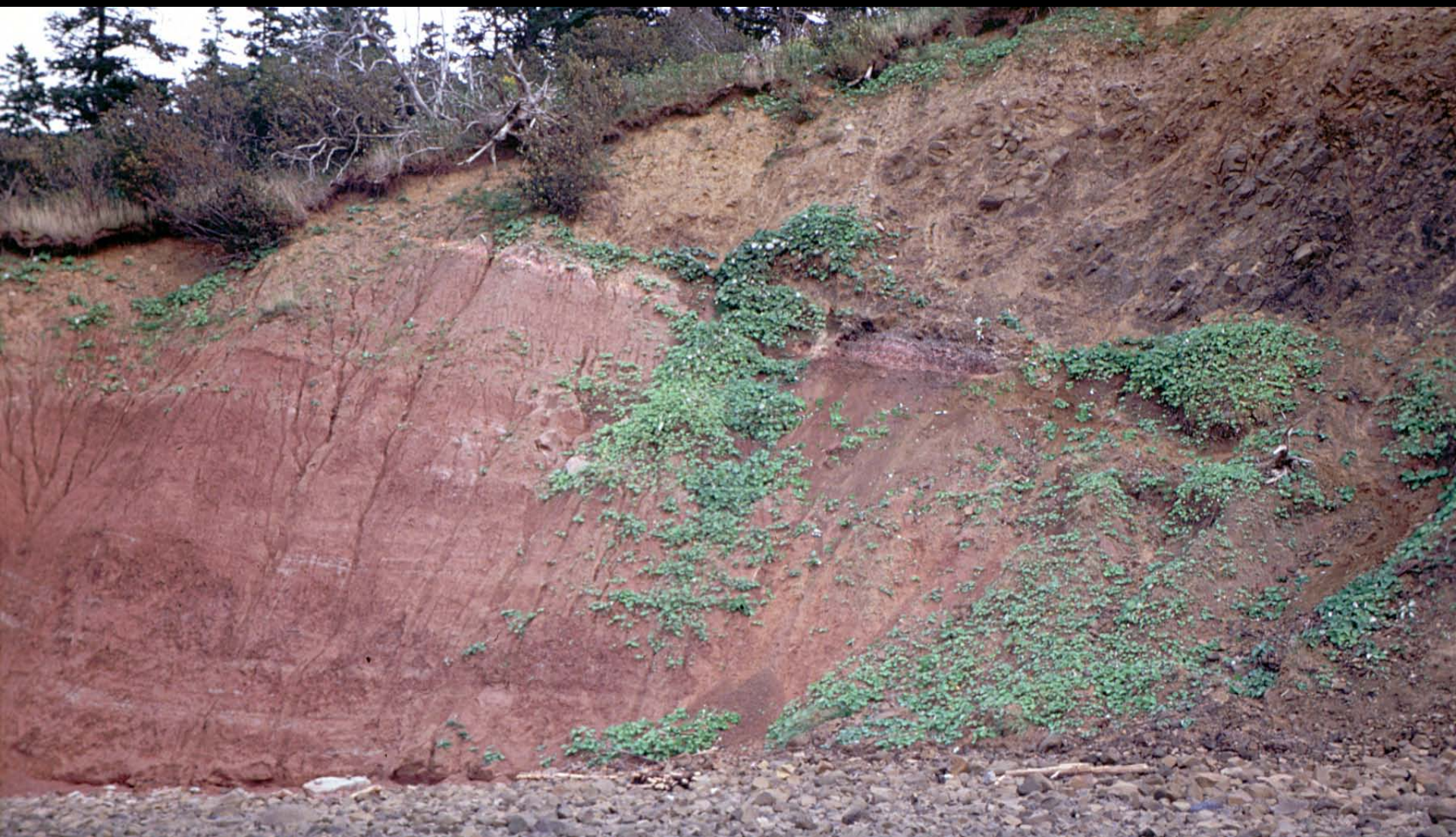
Fundy Basin



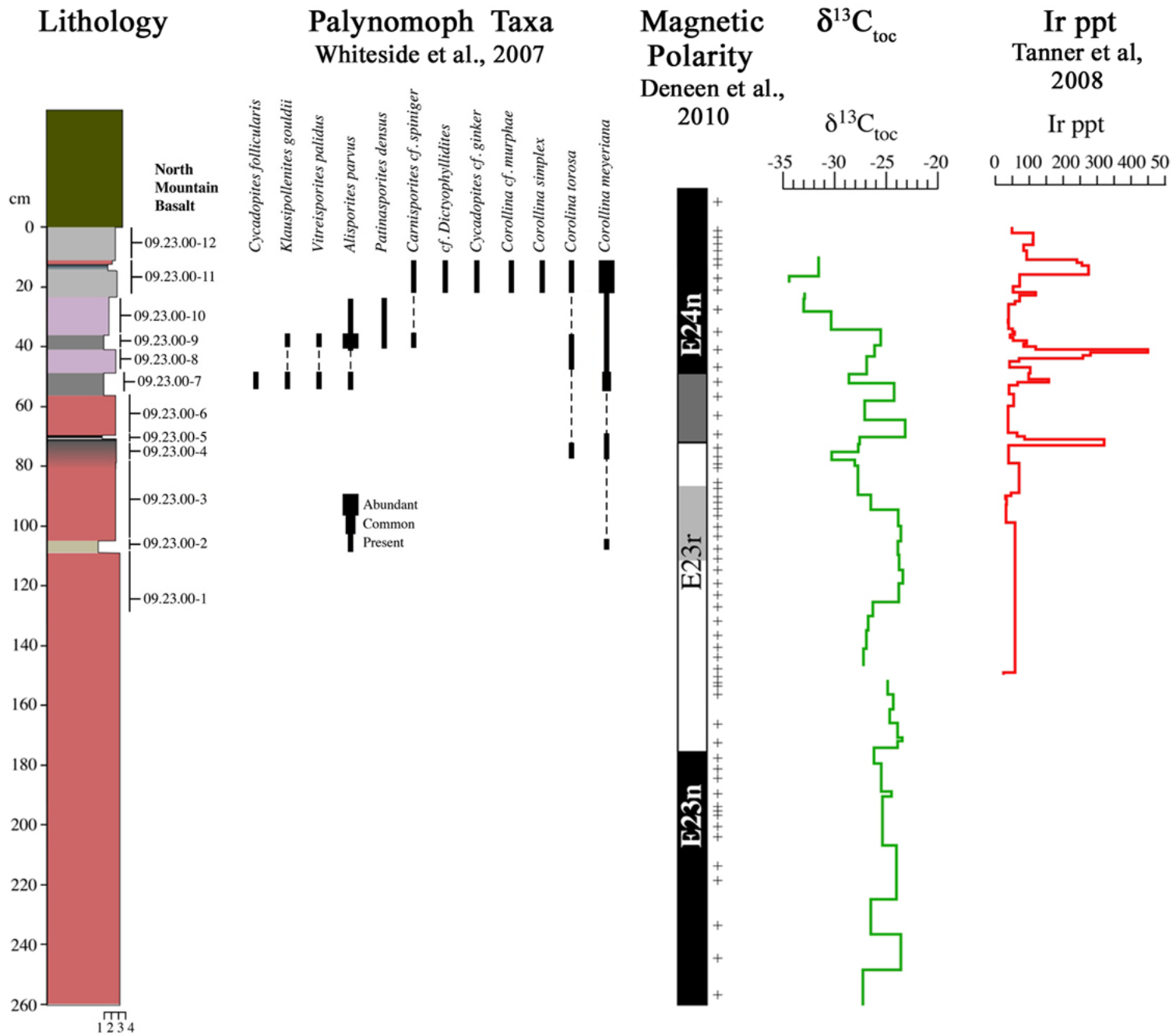


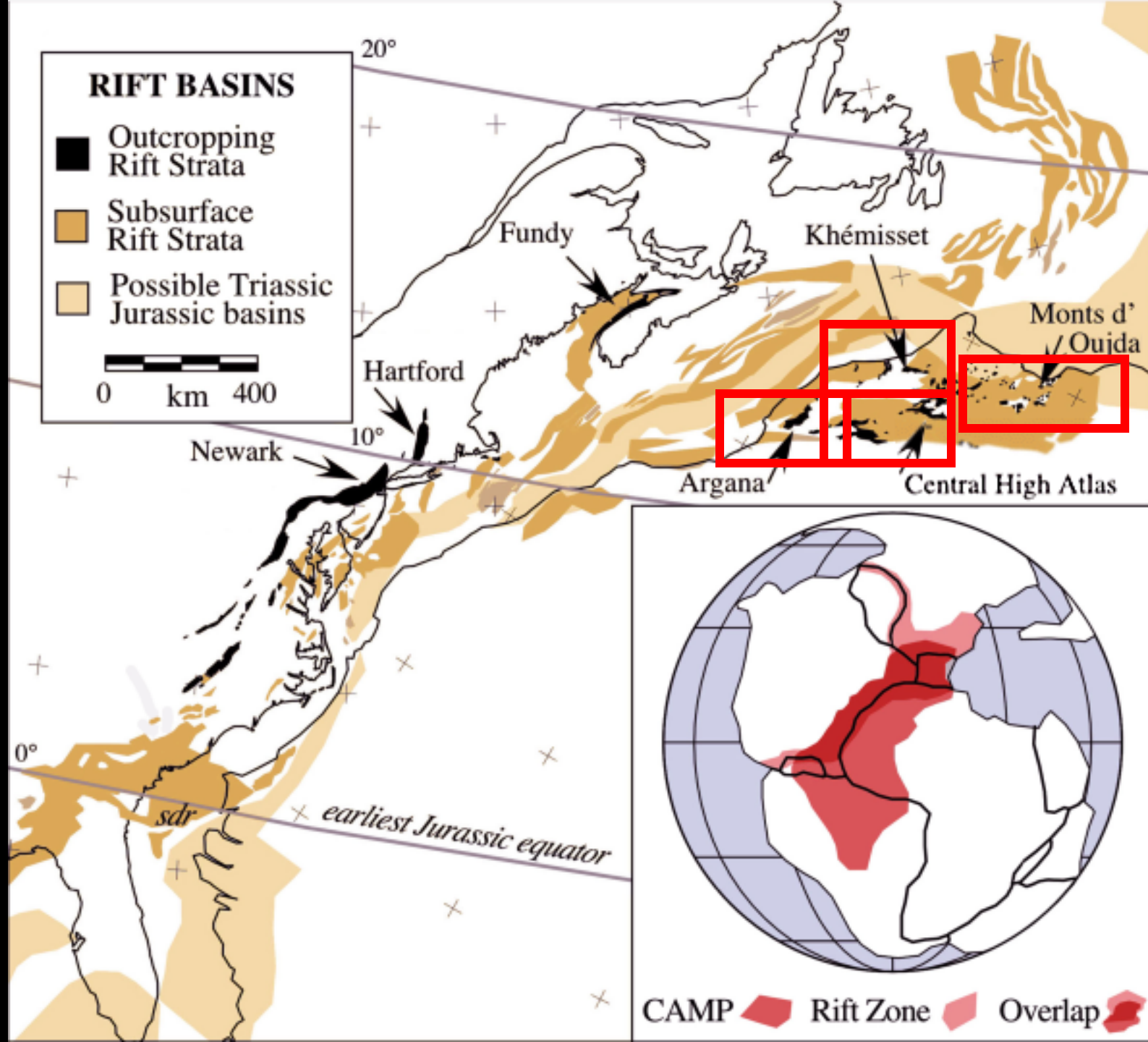
201.38±0.02



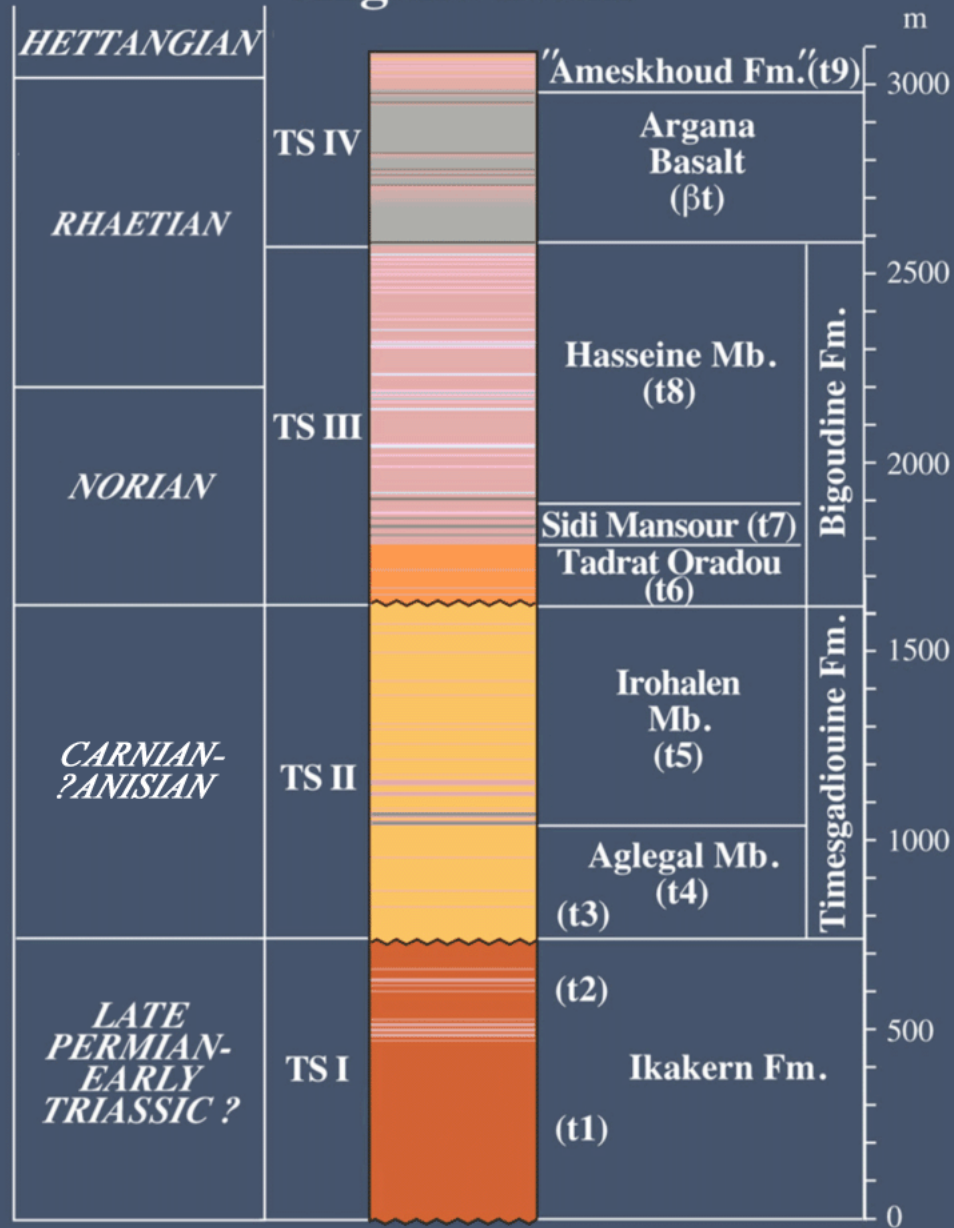


Partridge Island, Nova Scotia, Canada



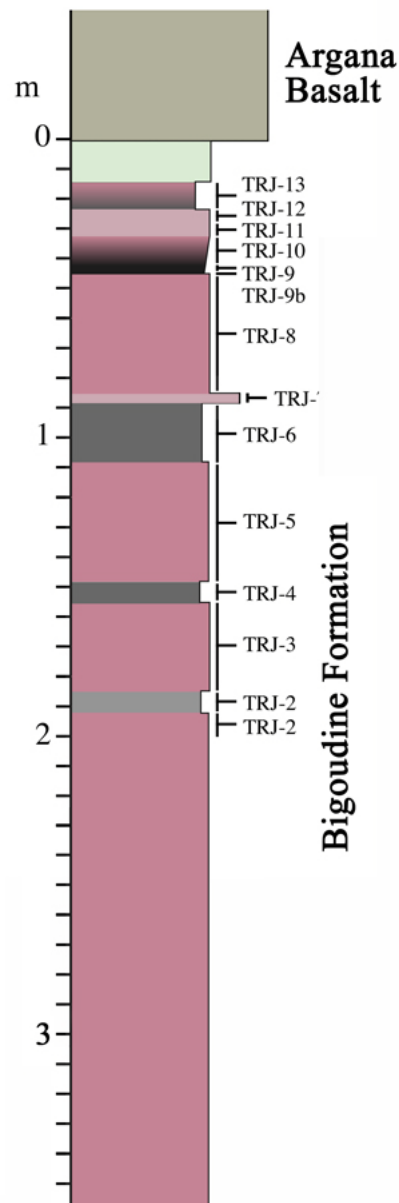


Argana Basin

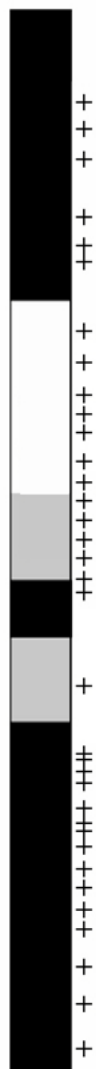




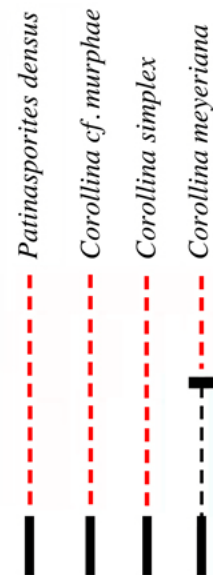
**Argana Basin
(Morocco)**
Whiteside et al (2007)



Magnetic Polarity
Deenen et al. 2010



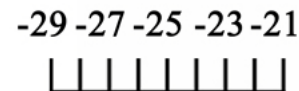
Palynomorph Taxa



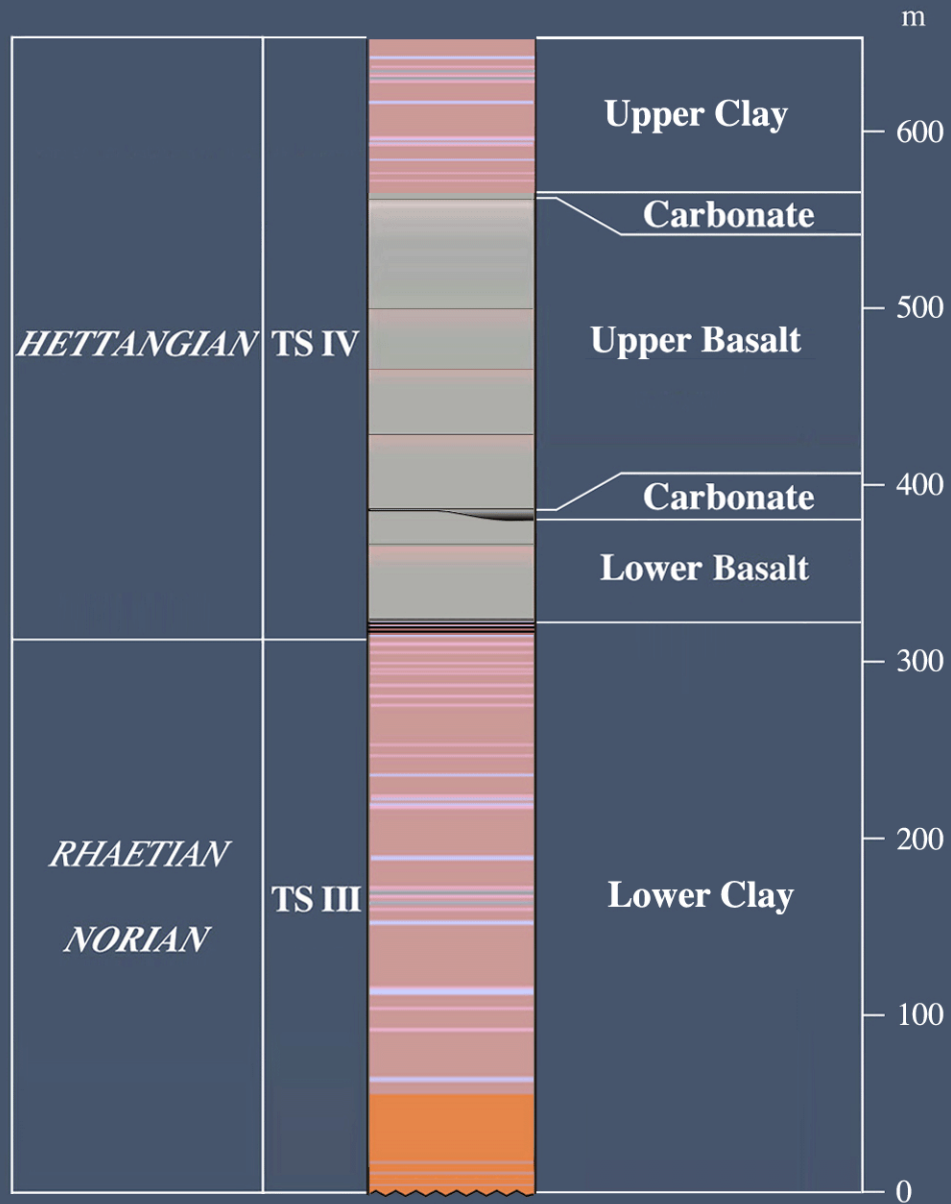
Range inferred from
Marzoli et al. (2004)
Whiteside et al. 2007

Abundant
Common
Present

$\delta^{13}\text{C}_{\text{toc}}$
Deenen et al. 2010



Khémisset Basin



Nif Gour, Morocco



Lower clay formation, Khémisset basin

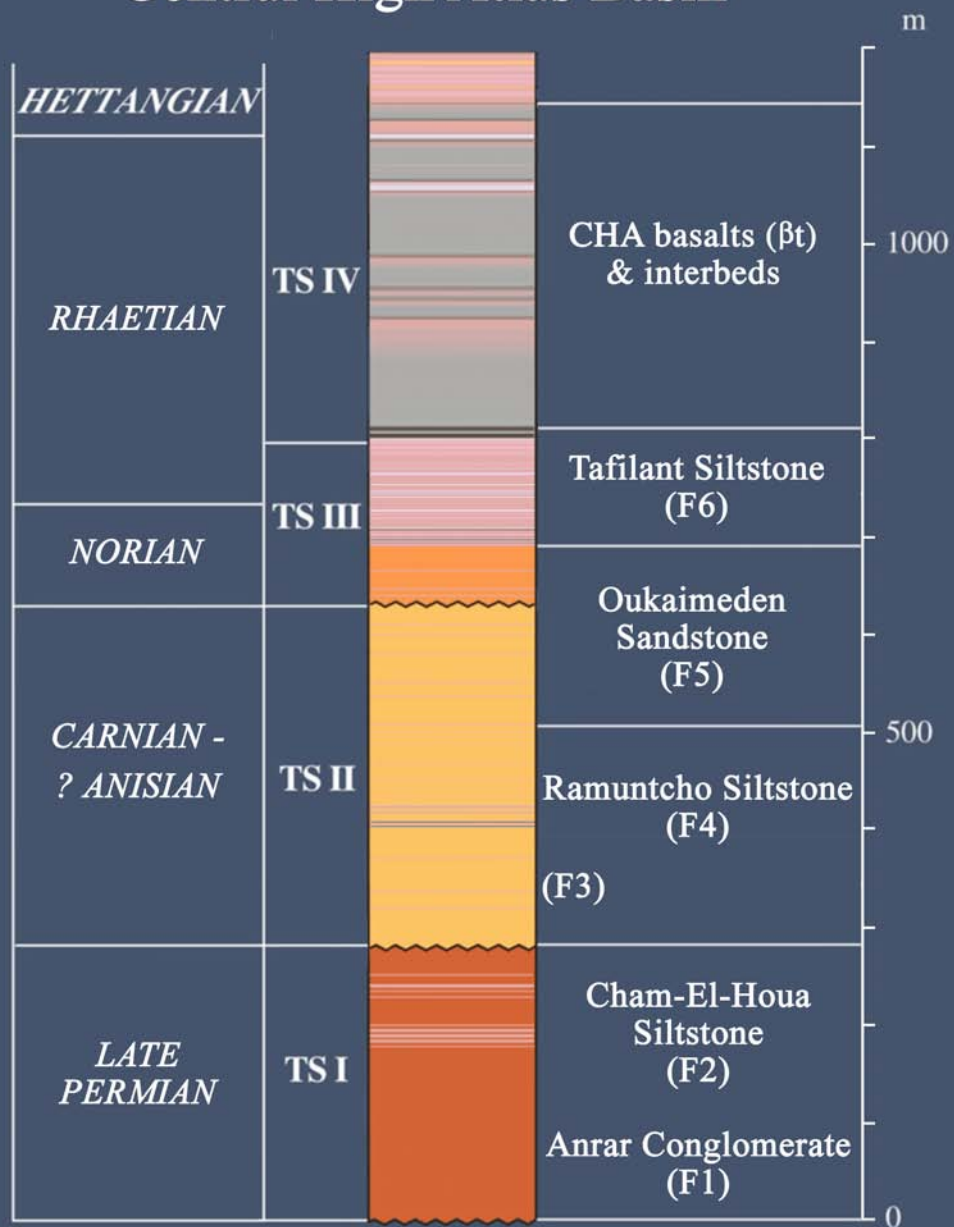
*Lower Salt Formation
Khémisset basin*

10 cm 



Et-Touhami (1999)

Central High Atlas Basin

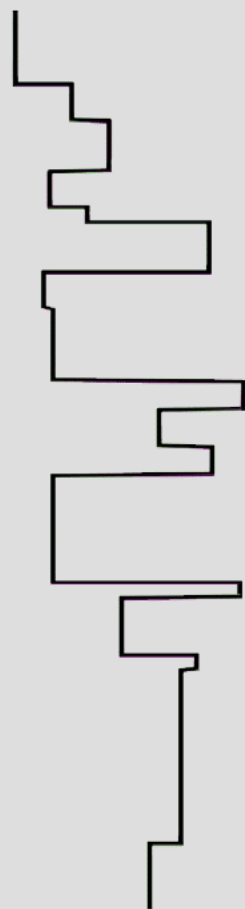
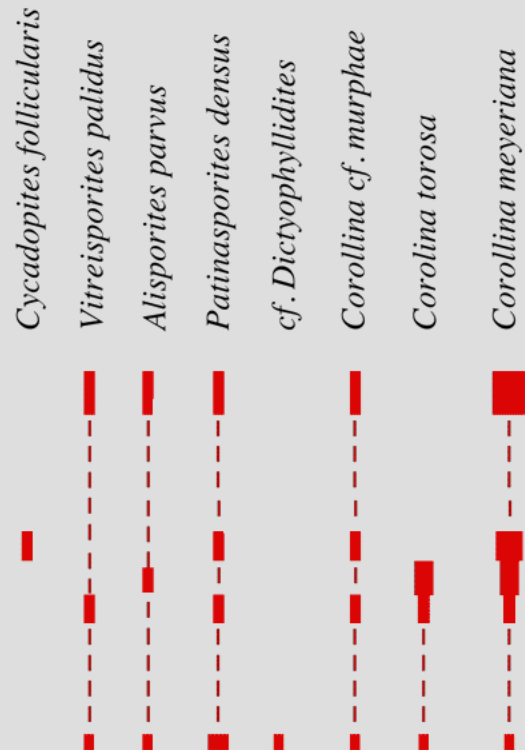




Tioujdal

Central High Atlas

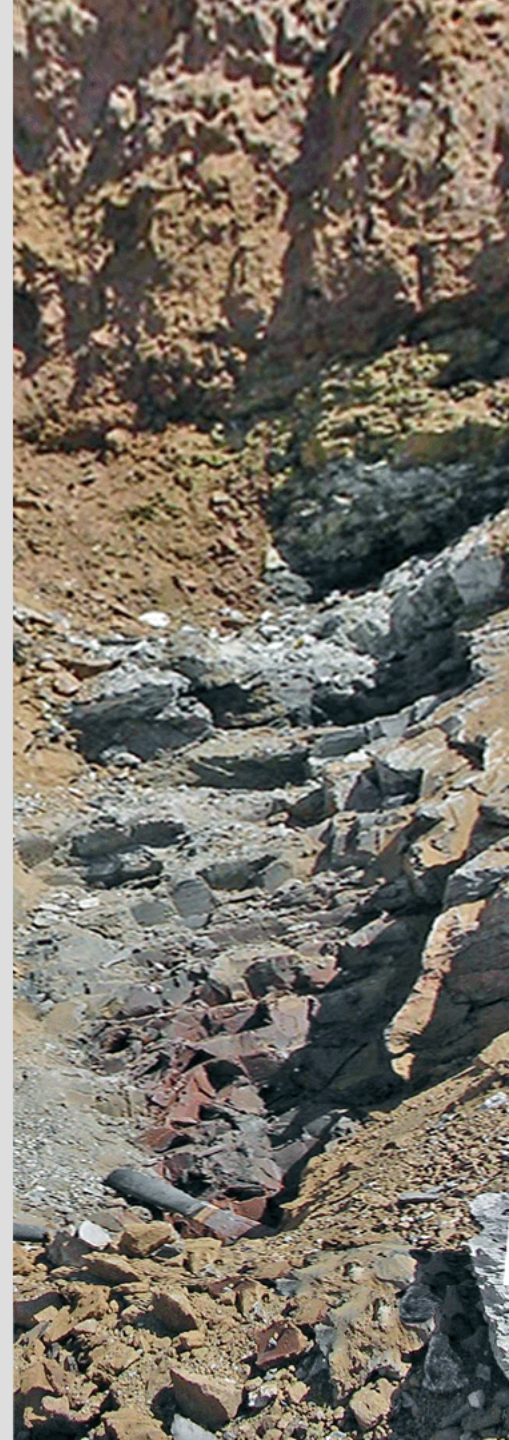
Palynomorph Taxa



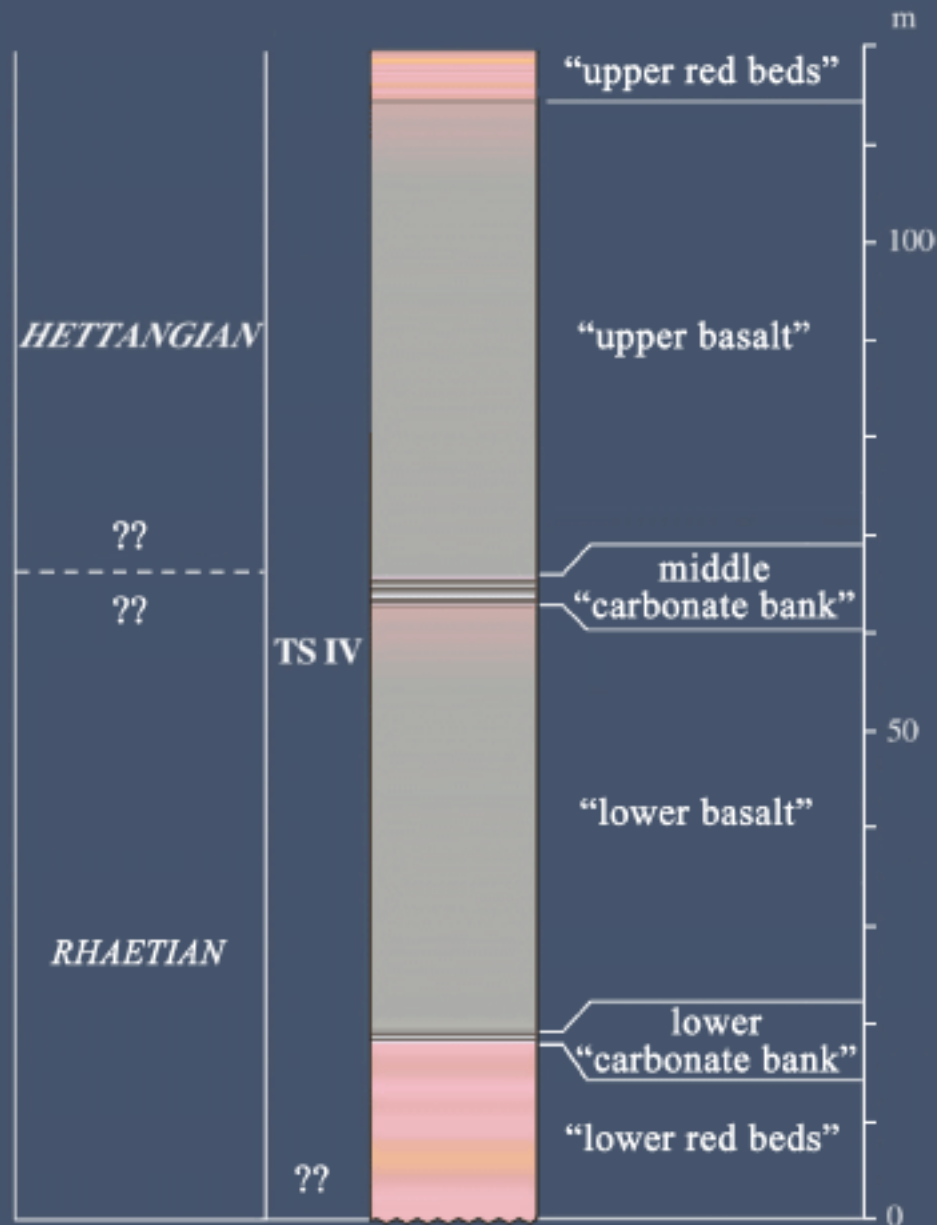
Central High Atlas Basalt (lower)

F6 (upper siltstone fm.)

Whiteside et al. in prep.



Monts d'Oujda / Beni Snassen Region









Examples of pedinoid echinoids (?*Diademopsis* sp.) from Mont d'Oujda basin: left, apical view, unprepared, natural cast of test ; right, two ambulacral plates and a spine.

Notes by Presenter:

The newly discovered echinoids in Monts d'Oujda are the first indication that euhaline conditions were present at least locally.

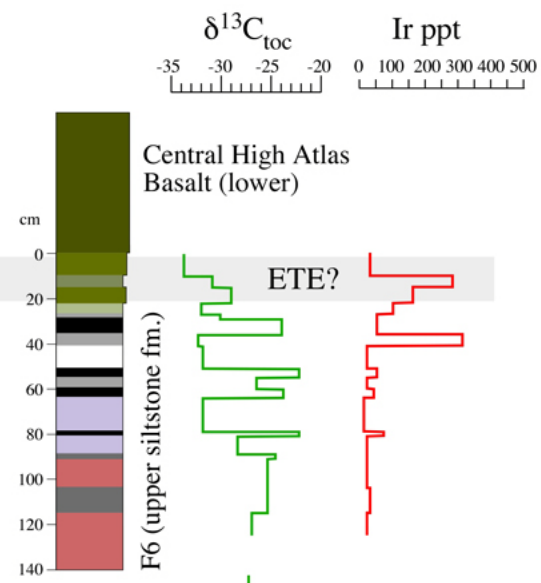
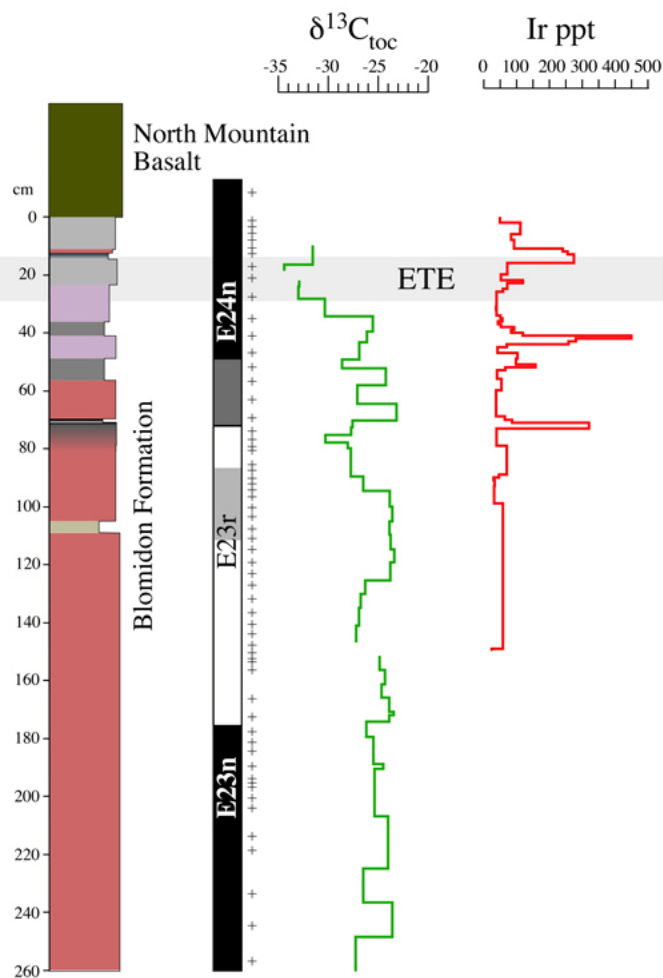
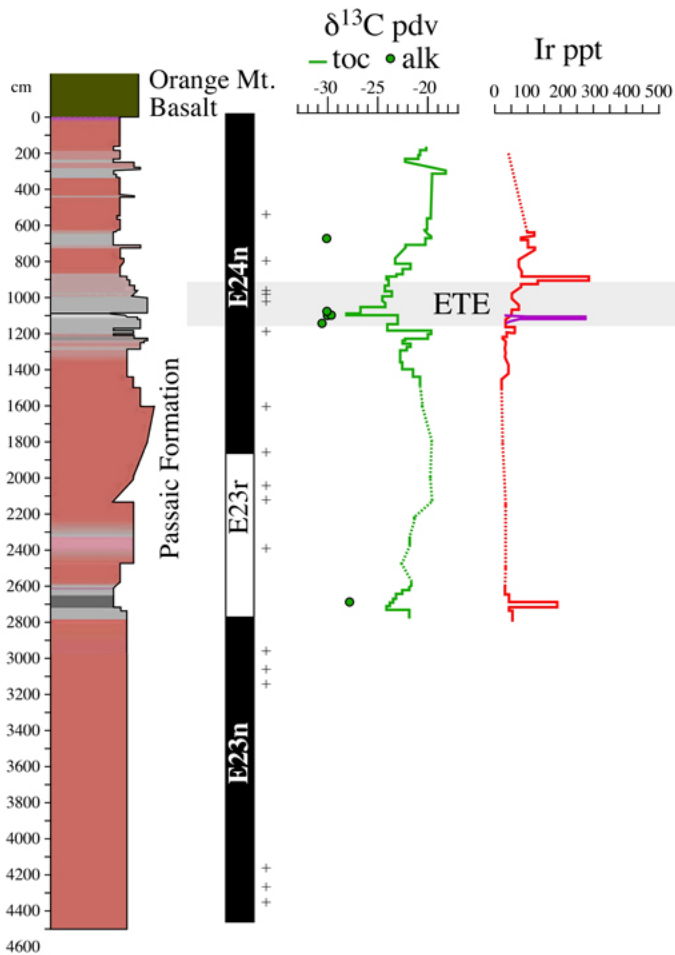
These mollusk- and echinoid--bearing strata occur some 10-15 my prior to the establishment of the hypothesized Hispanic corridor--a marine connection bridging the western Tethys and Panthalassan marine realms that would have transected portions of the Atlas mountains of Morocco.

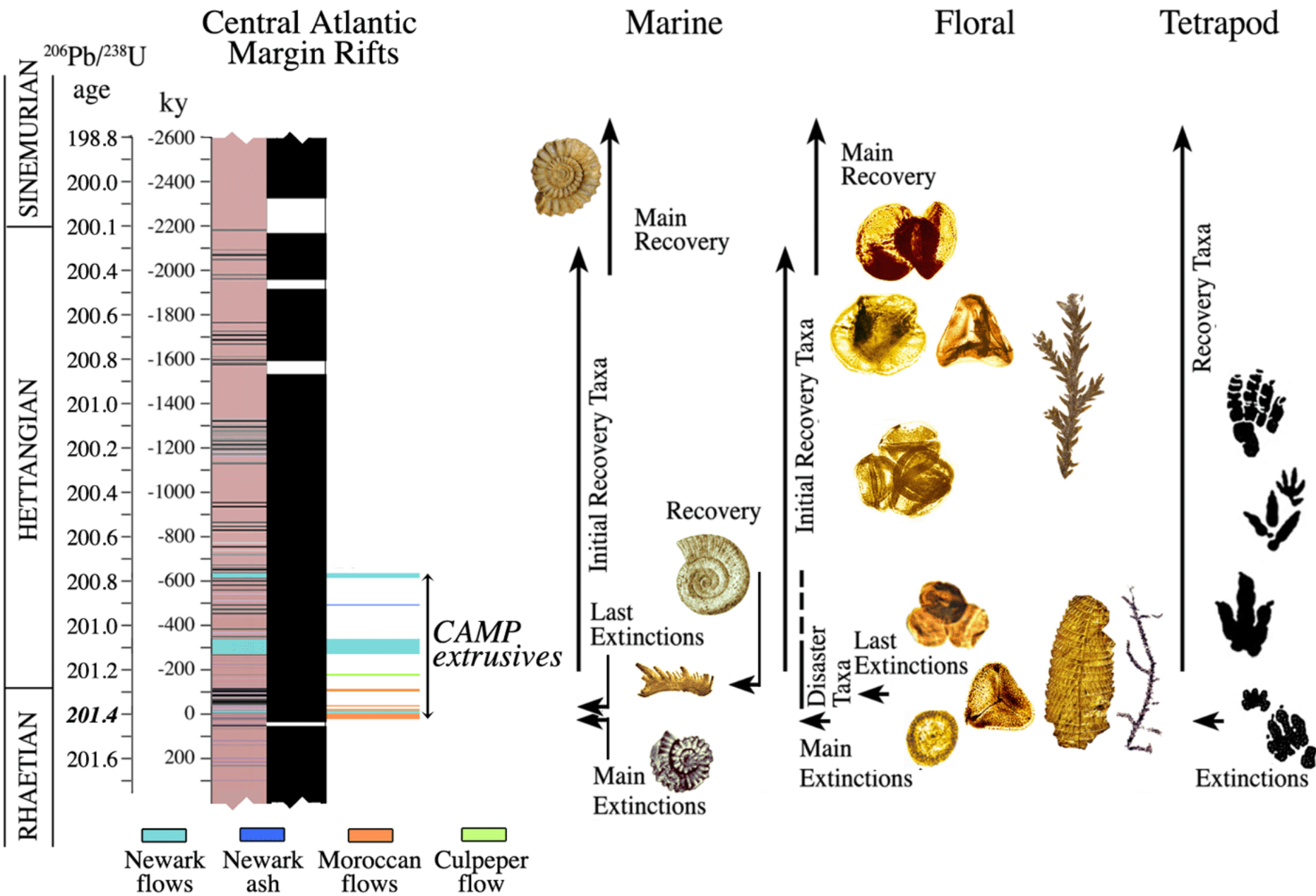
Based on the distribution and similarities of bivalve faunas on both sides of the corridor, most authors conclude that this marine connection may have been sporadically opened during Sinemurian times but did not completely exist until the Pleinsbachian.

Newark (Jacksonwald) (Eastern USA)

Fundy (Nova Scotia, Canada)

Central High Atlas (Morocco)





Observational conclusions –

Nova Scotian - Moroccan Conjugate Margin

1. Eastern North American, especially Fundy basins have strong similarities to western Morocco sequences around oldest basalts and are continental.
2. Initial extinction within or at top of variegated sequence below oldest basalts.
3. Eastern Morocco sequences are marine.
4. Terrestrial extinctions coincident with most marine extinctions.
5. Extinctions coincident with largest frequency of flows.
6. Initiation of CAMP and extinctions occur just after rifting region begins to subside (not after uplift) allowing marine incursion with development of main phase of regional salt deposition.
7. CAMP “dribbling on” through 610 ky years.