Progressive increase in organic-matter burial and preservation from the "Weissert" event to the Faraoni event in Umbria-Marche (central Italy)

Sébastien Wouters, Johann Schnyder, Sara Satolli, Mathieu Martinez, Frédéric Boulvain, Thomas Goovaerts, Bruno Meyvis & Xavier Devleeschouwer

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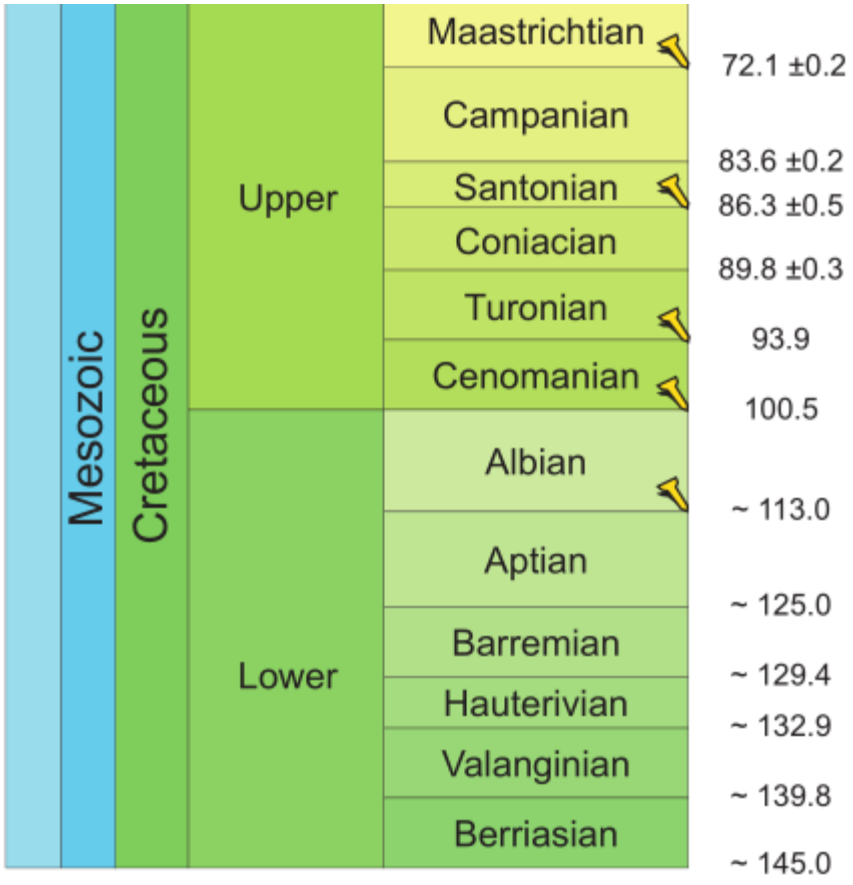
Introduction

- The **CRASH** project:

Checking the **R**eproducibility of **As**trochronology in the **H**auterivian



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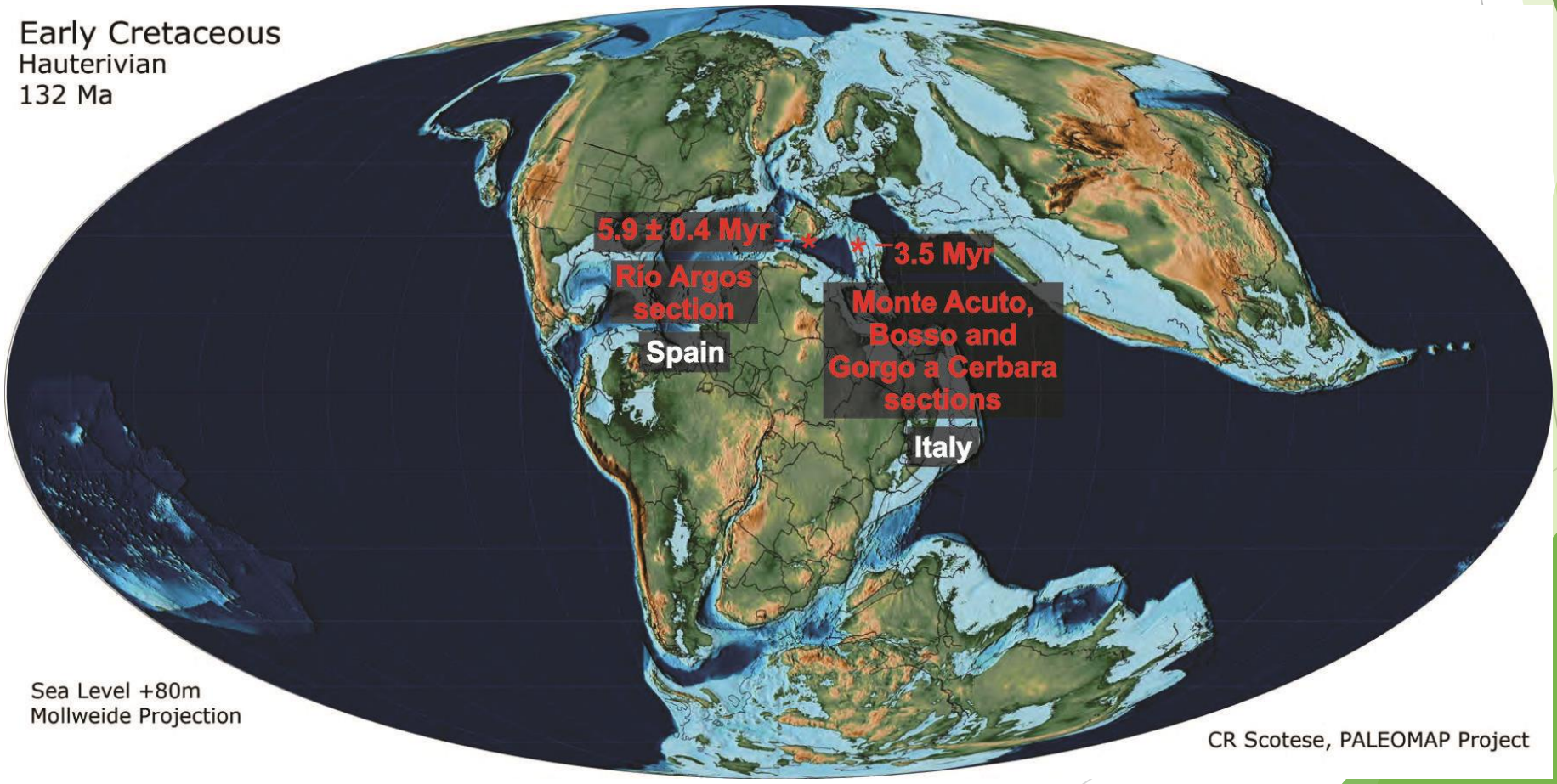

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- Discrepancy of astrochronological duration of the Stage:
  - **5.9 ± 0.4 Myr** in Río Argos (Spain)
  - **3.5 Myr** in Italian sections (Bosso and Monte Acuto)

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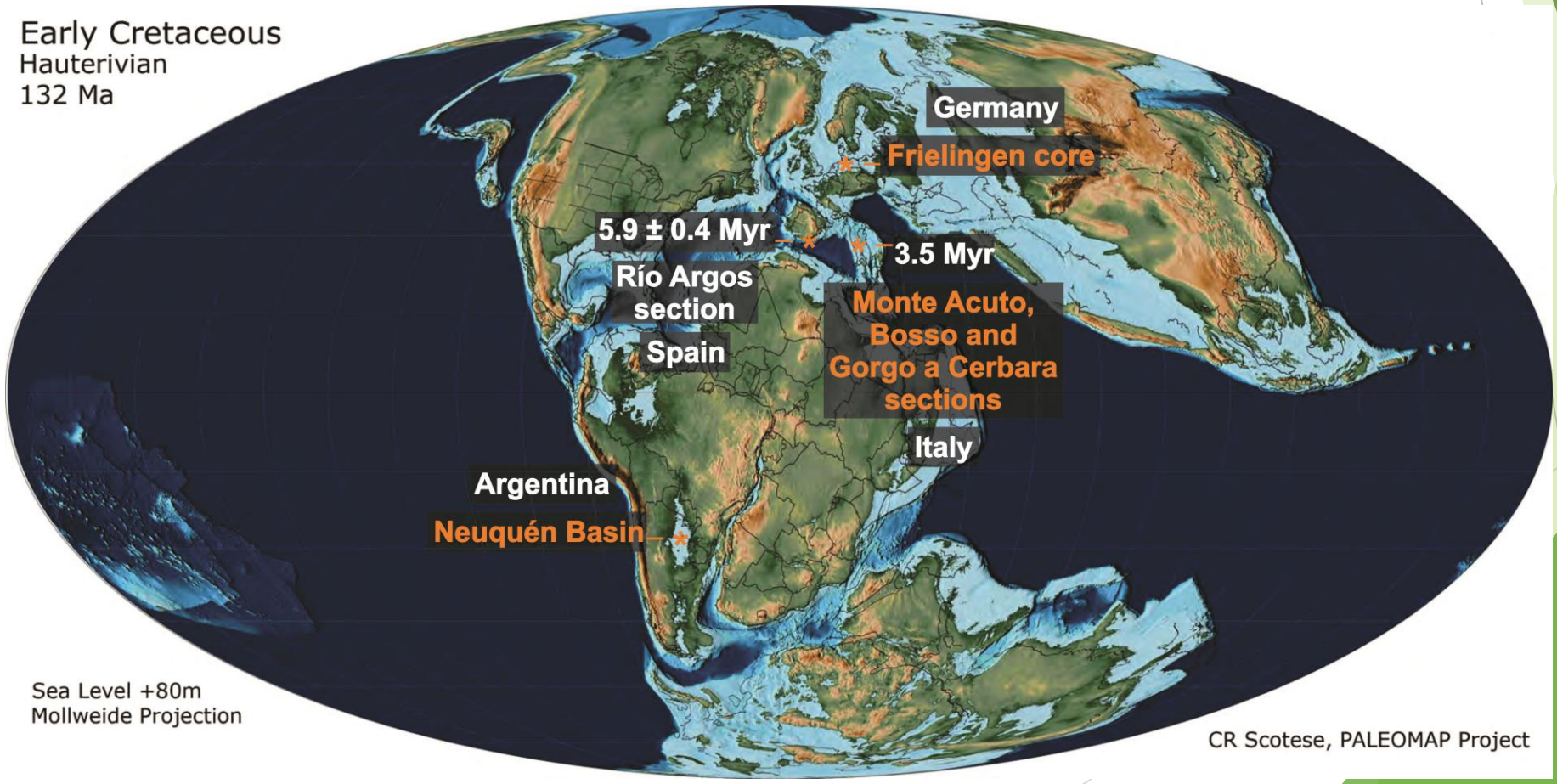

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  - **3.5 Myr** in Italian sections (Bosso and Monte Acuto)

- Problems of correlations (between bio- and magnetostratigraphy)

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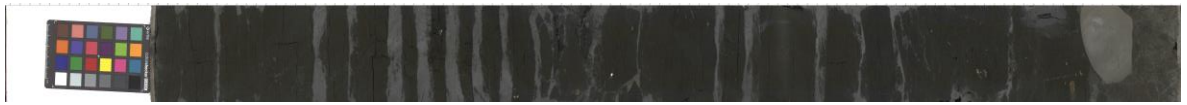
Italy

Argentina



Germany

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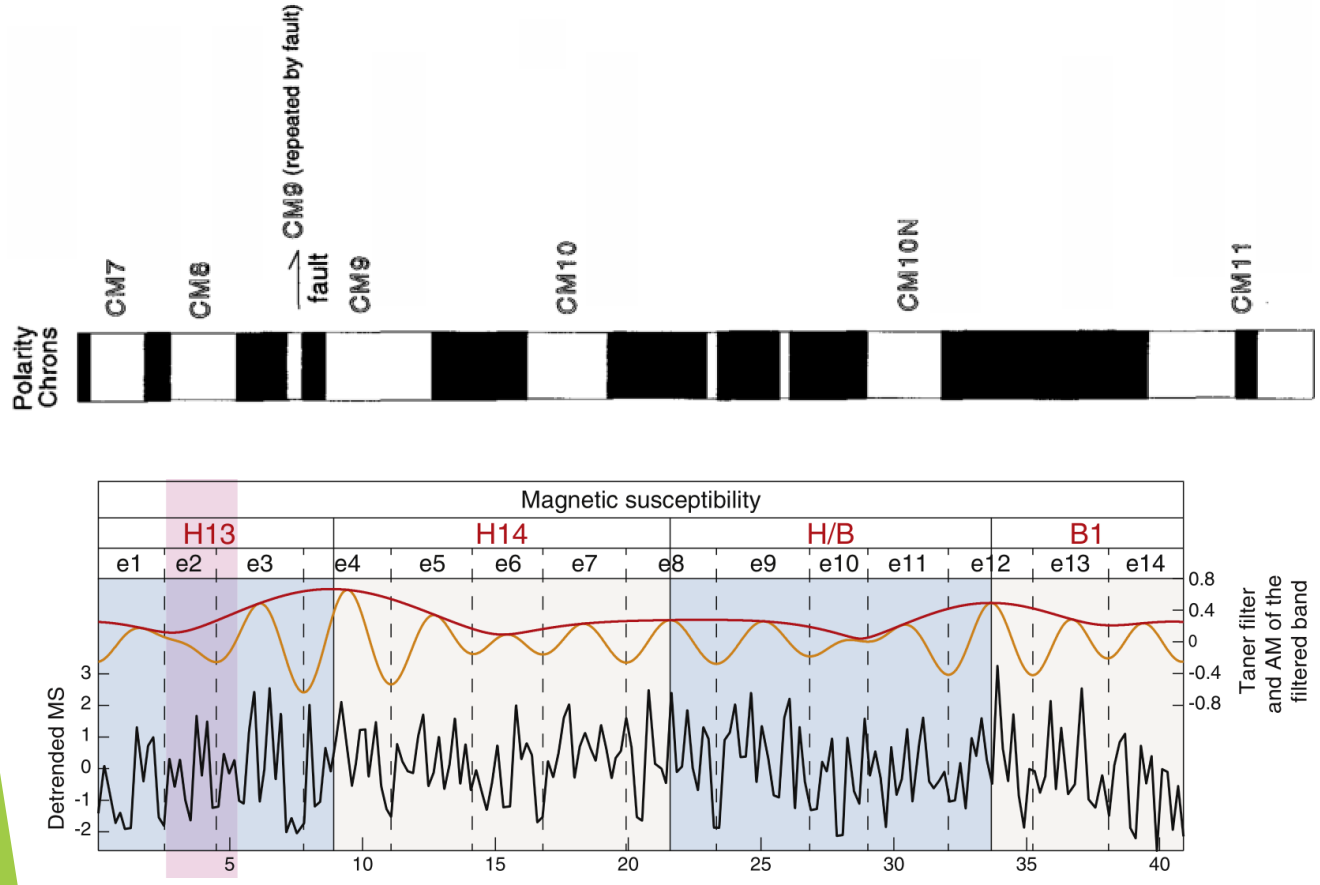
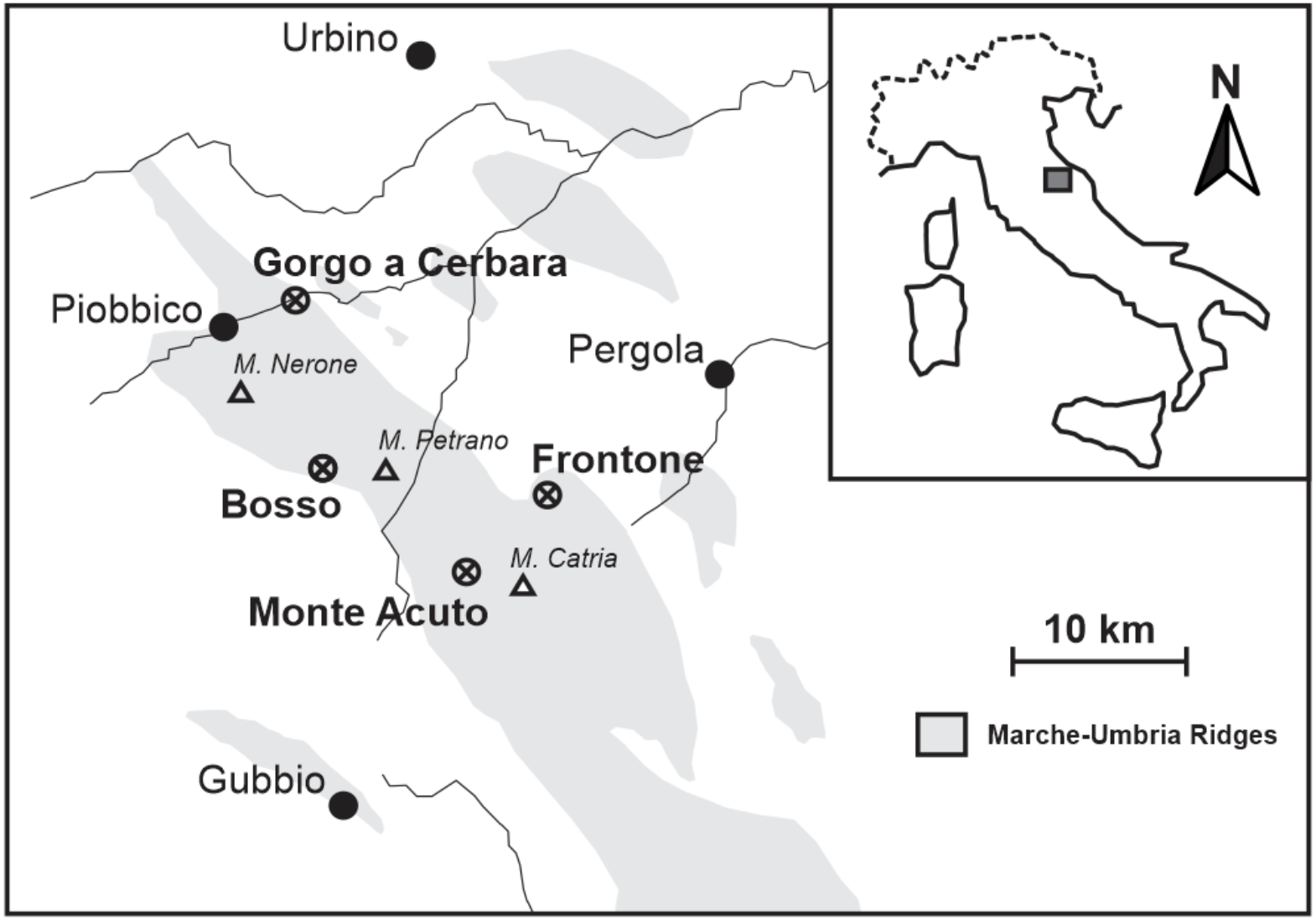


Examples of cyclo- and magnetostratigraphy in the Hauterivian (Channell et al., 1995, Martinez et al., 2015)

Geological setting



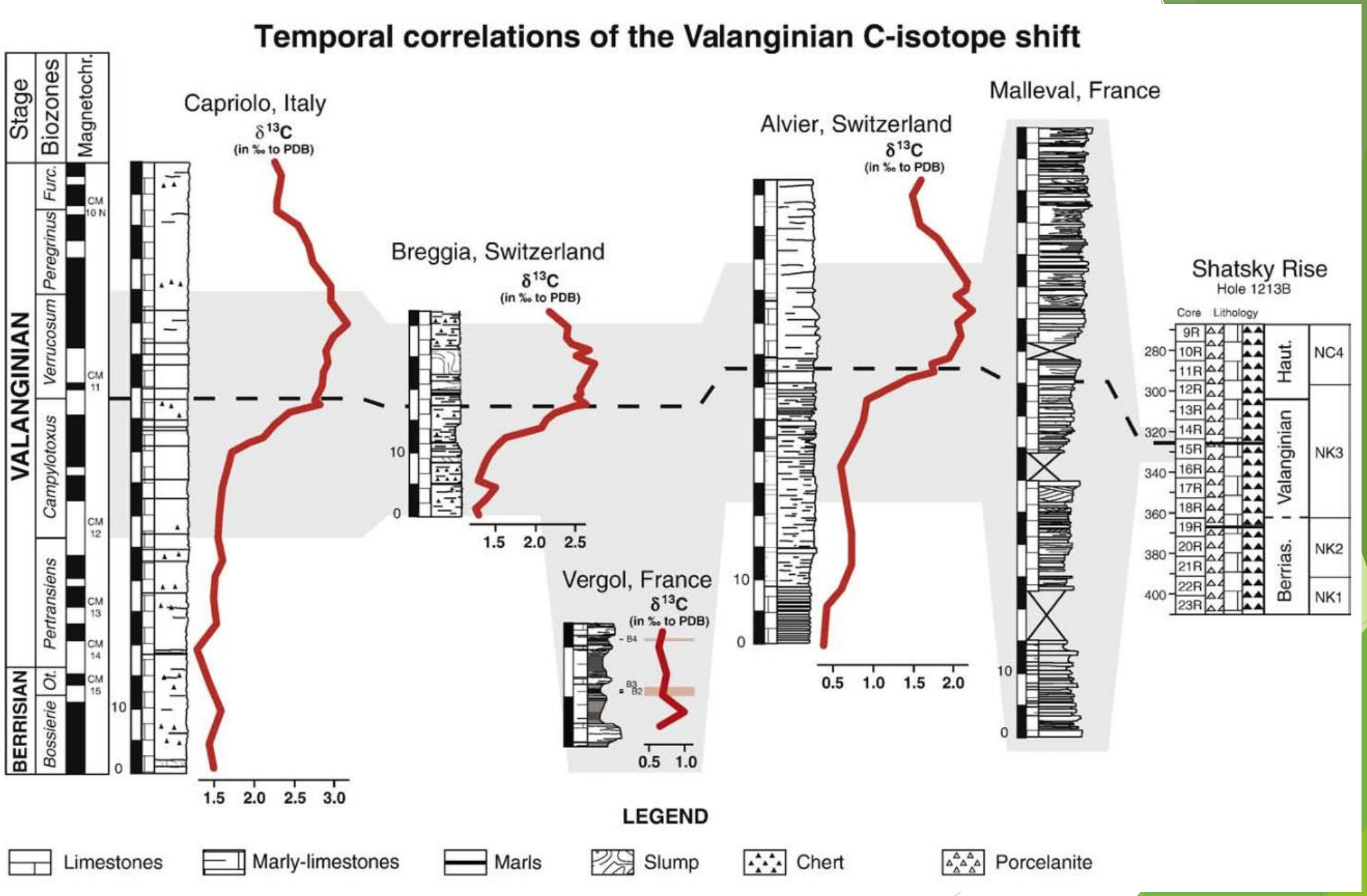
Geological setting

- Pelagic sequence in the Marche-Umbria Apennines (Italy)

- Early Jurassic to late Tertiary
- Extensive magnetostratigraphic record, very stable remanent magnetisation

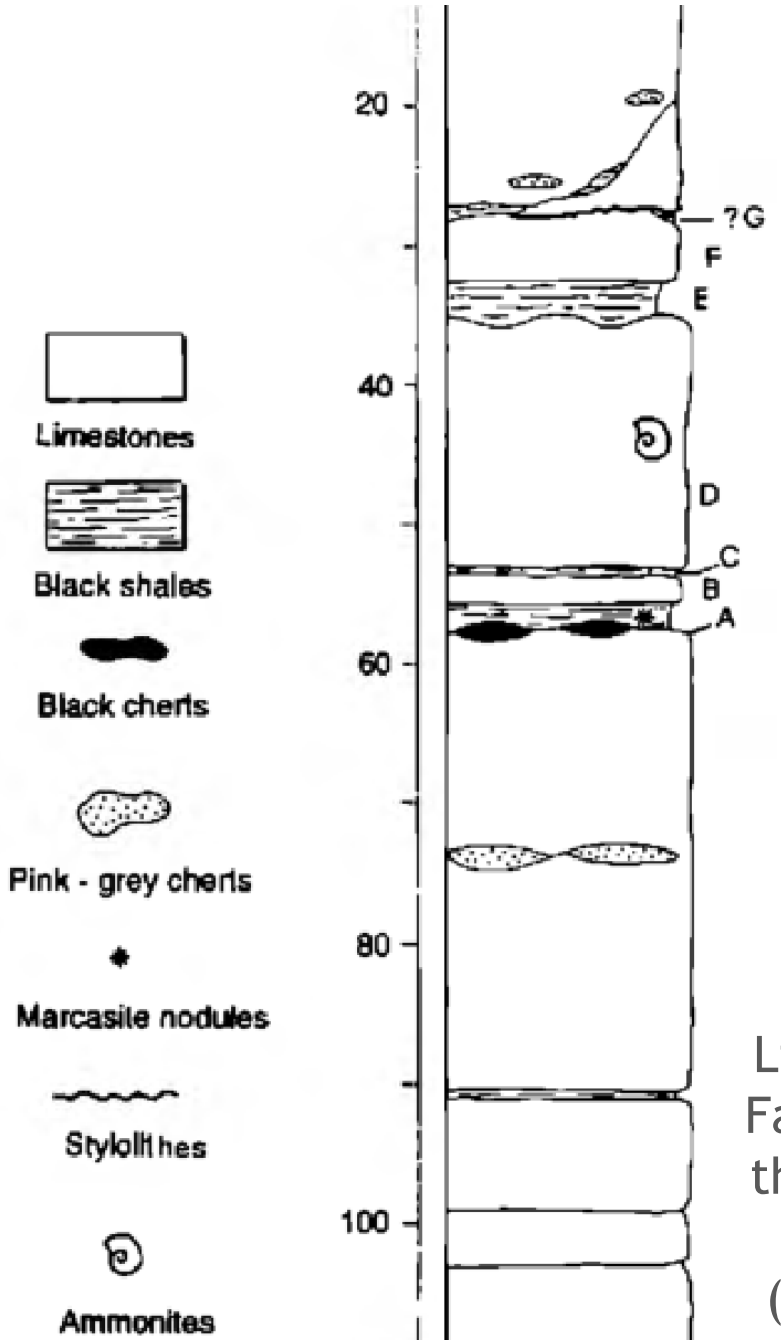
- OAEs (Oceanic Anoxic Events) in the Early Cretaceous:
  - Faraoni in the Hauterivian
  - Selli (OAE 1a), Bonarelli (OAE 2) among others

- "Weissert" event: important $\delta^{13}C$ positive shift



(Westermann et al., 2010)

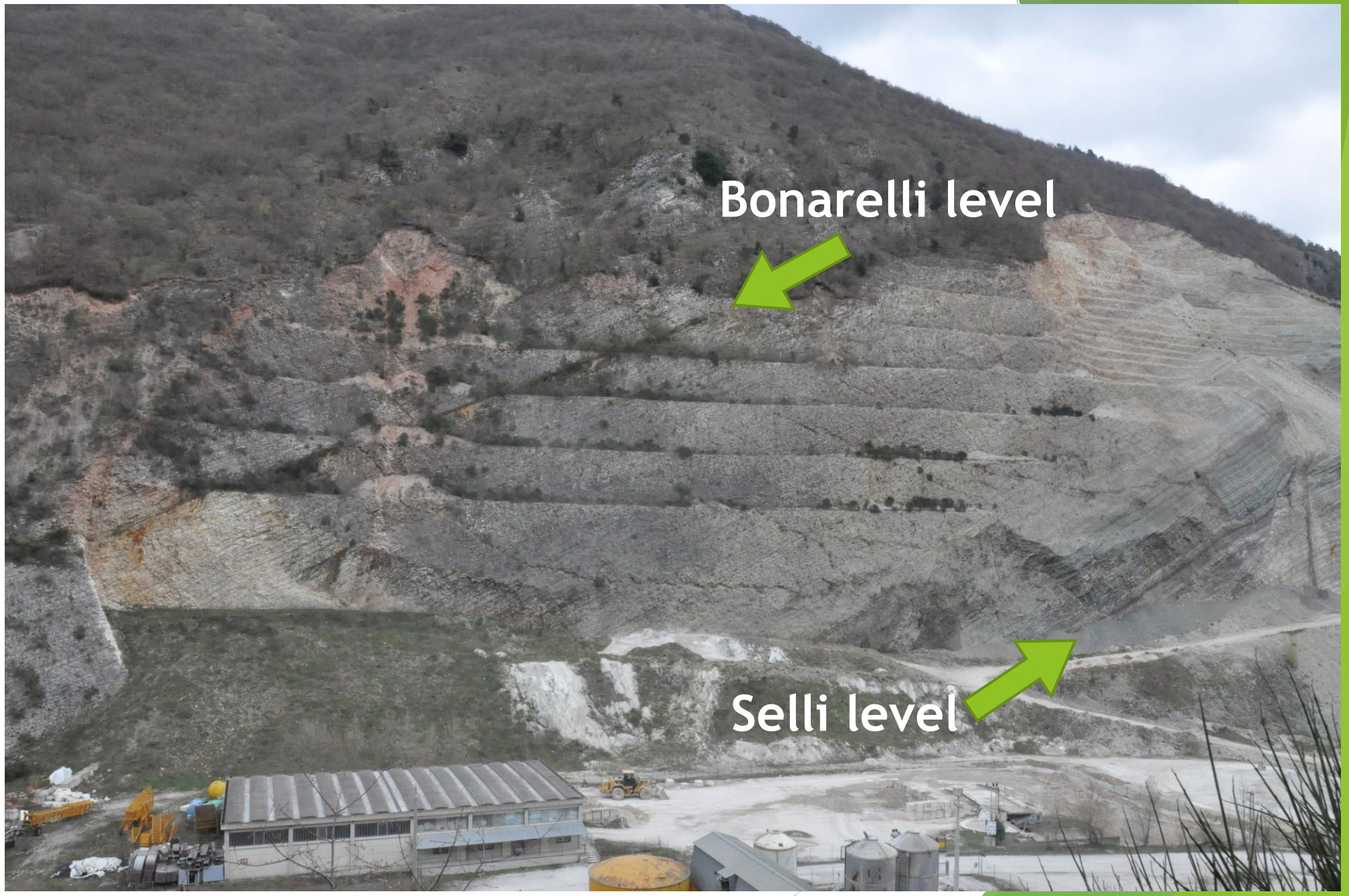
Contessa Quarry (Italy)



Litholog of the Faraoni level in the Apecchiese road section (Cecca et al., 1994)

Faraoni level in the Frontone section

Contessa Quarry (Italy)

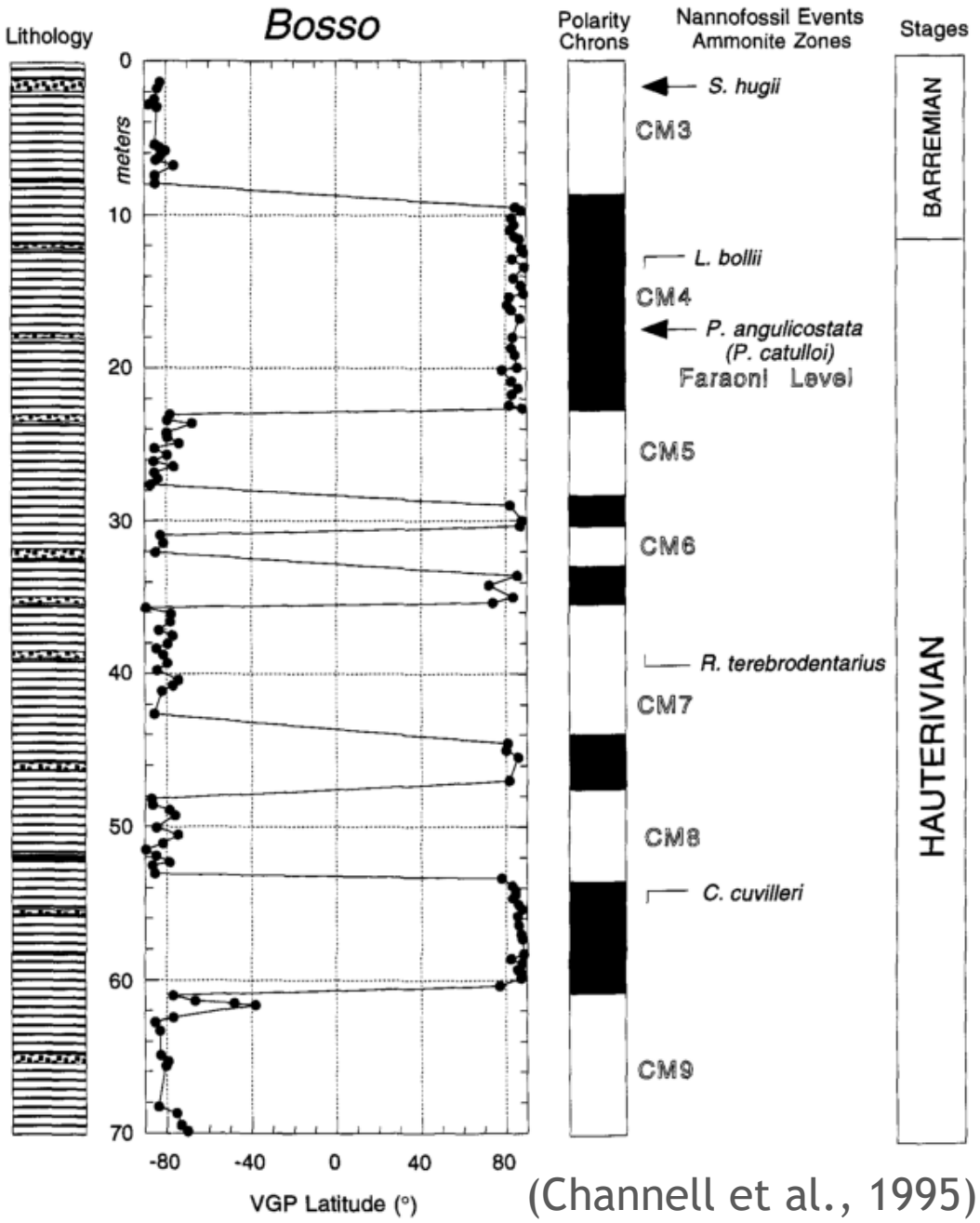


Contessa Quarry (Italy)

Avoiding the loss of information

- Cyclostratigraphy and stratigraphic correlations require working with high resolution data

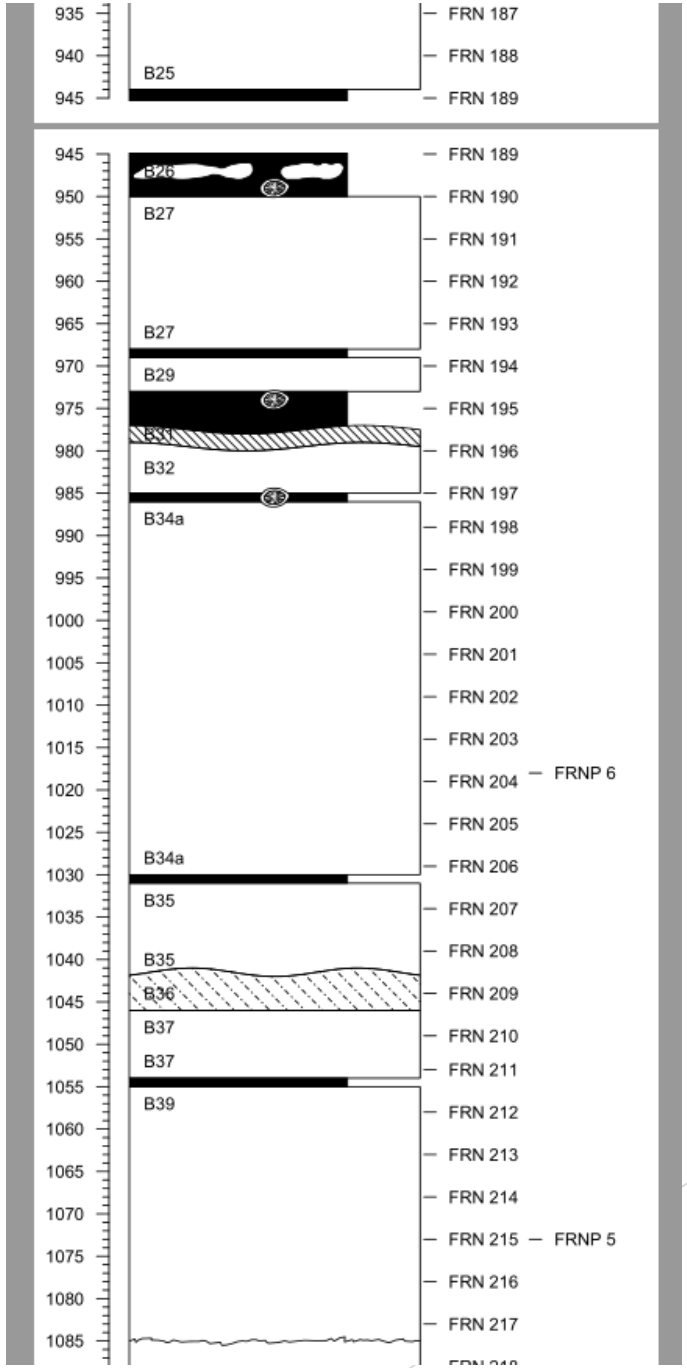
- Loss of exact sample positions previously collected when working in the same sections during different missions



(Channell et al., 1995)

Avoiding the loss of information

- Development of an R package to draw lithologs: **StratigrapheR**
- Data is kept explicit
- Logs are generated at the desired resolution
- **Beta-testing open to interested researchers**



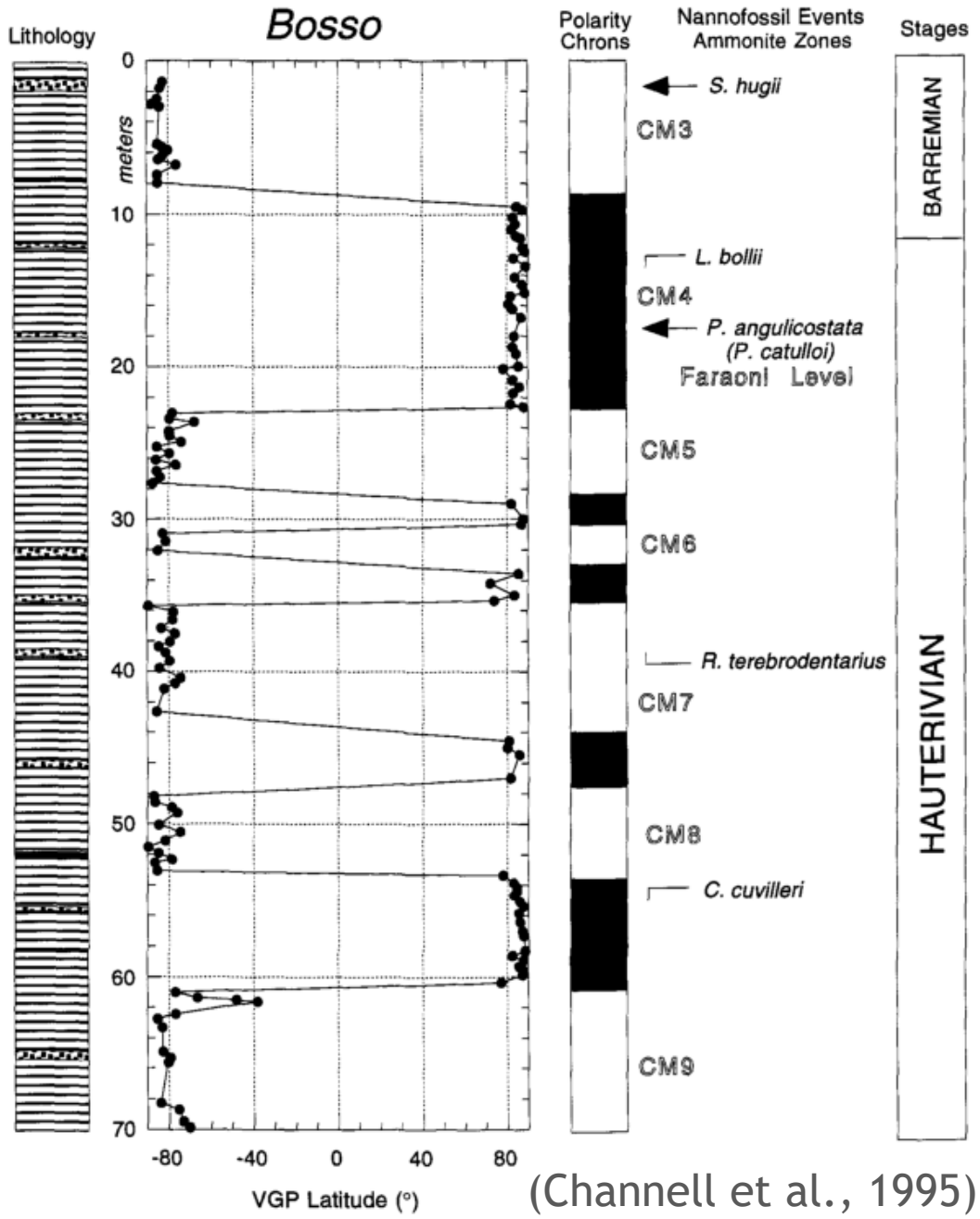
New magnetostratigraphic framework

- We refined the magnetostratigraphic framework:

Increased resolution at the magnetic inversions

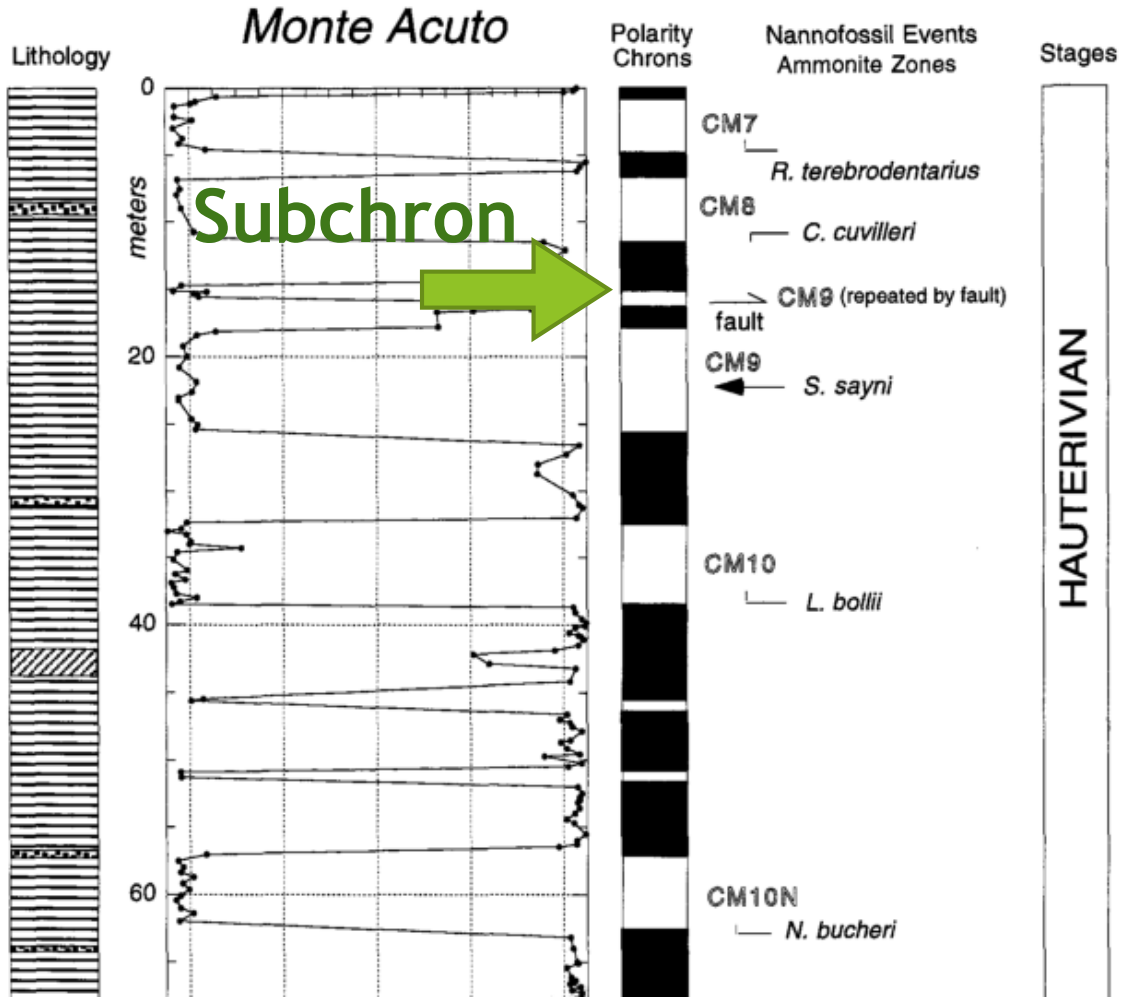
Palaeomagnetic samples well positioned against high resolution litholog and cyclostratigraphic samples

- Identification of possible new subchron (confirmation in progress)



(Channell et al., 1995)

New magnetostratigraphic framework



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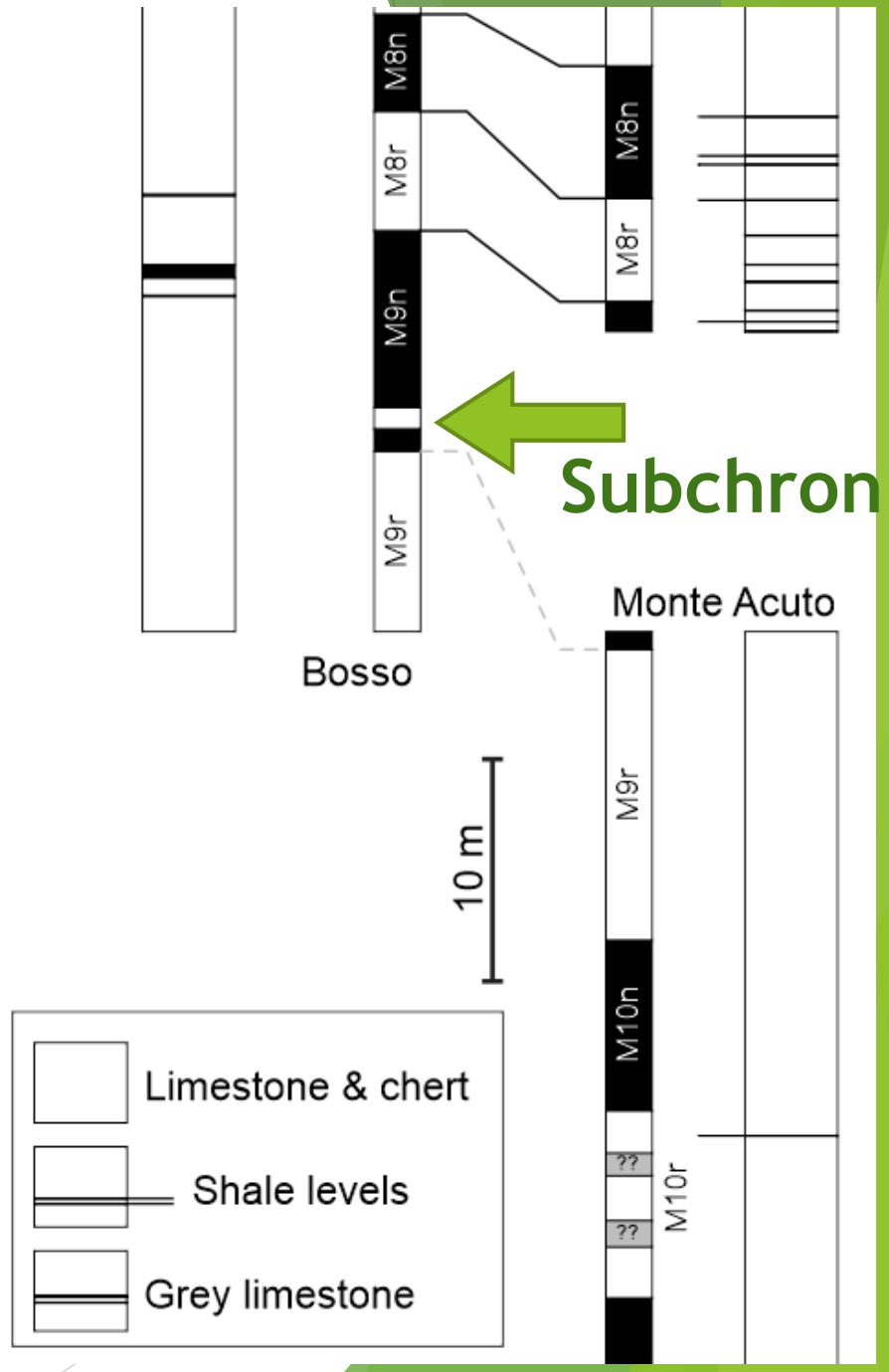
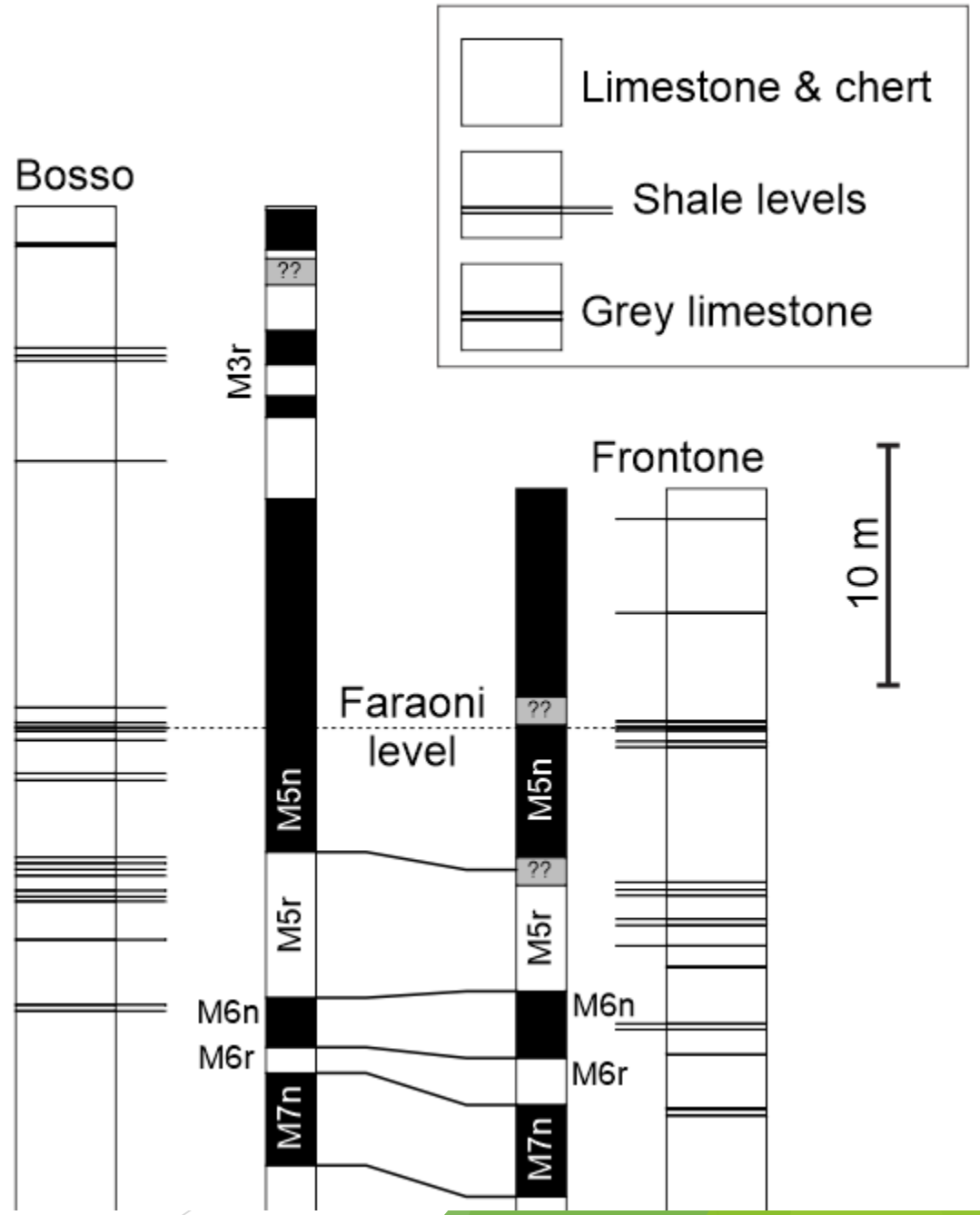


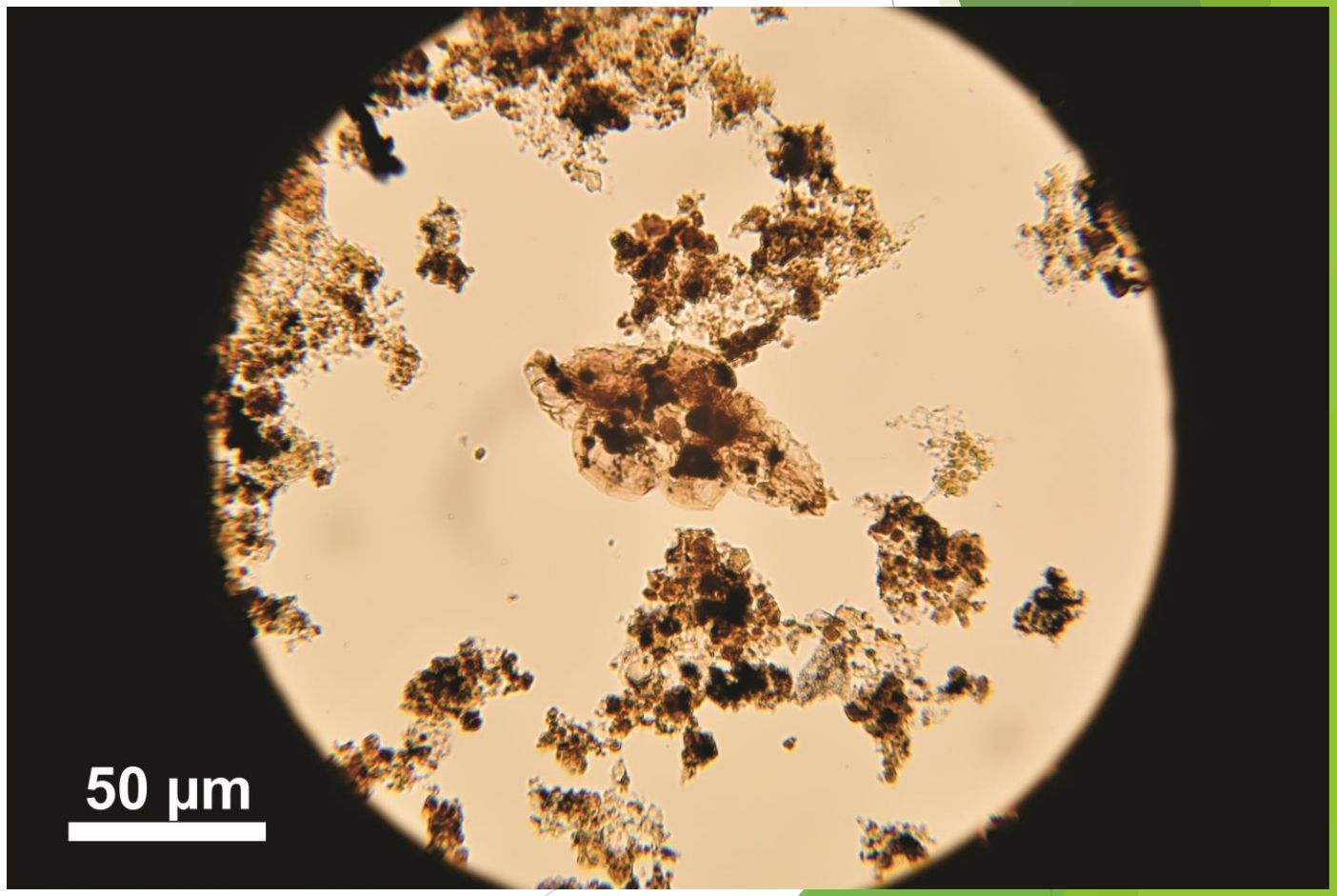
New magnetostratigraphic framework

- Correlation of patterns of black shales levels in Bosso and Frontone (sections of overlapping stratigraphic age)



New insights on organic matter burial and preservation

- Palynofacies and Rock Eval 6 analyses for black shales samples

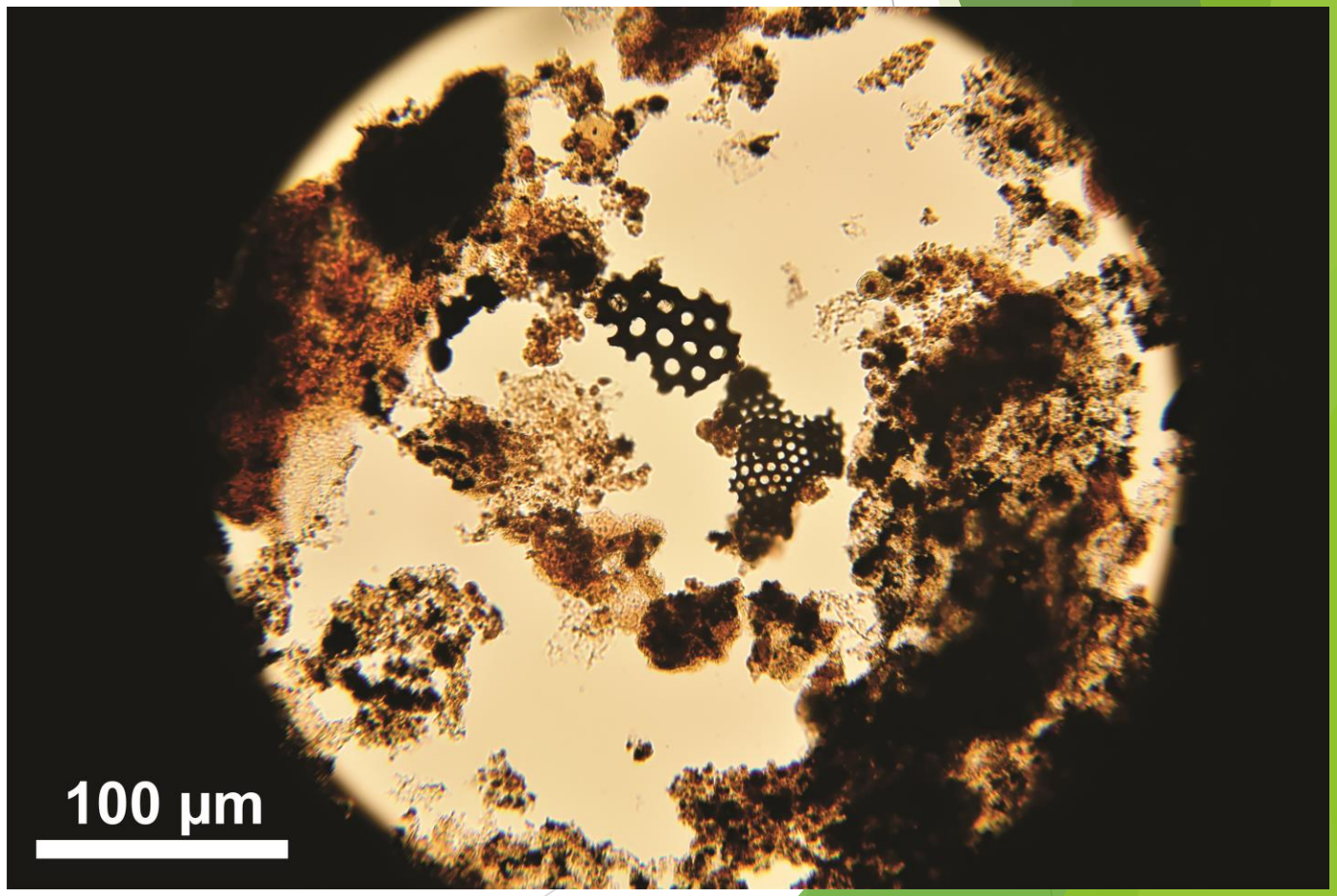


Foraminifera lining

New insights on organic matter burial and preservation

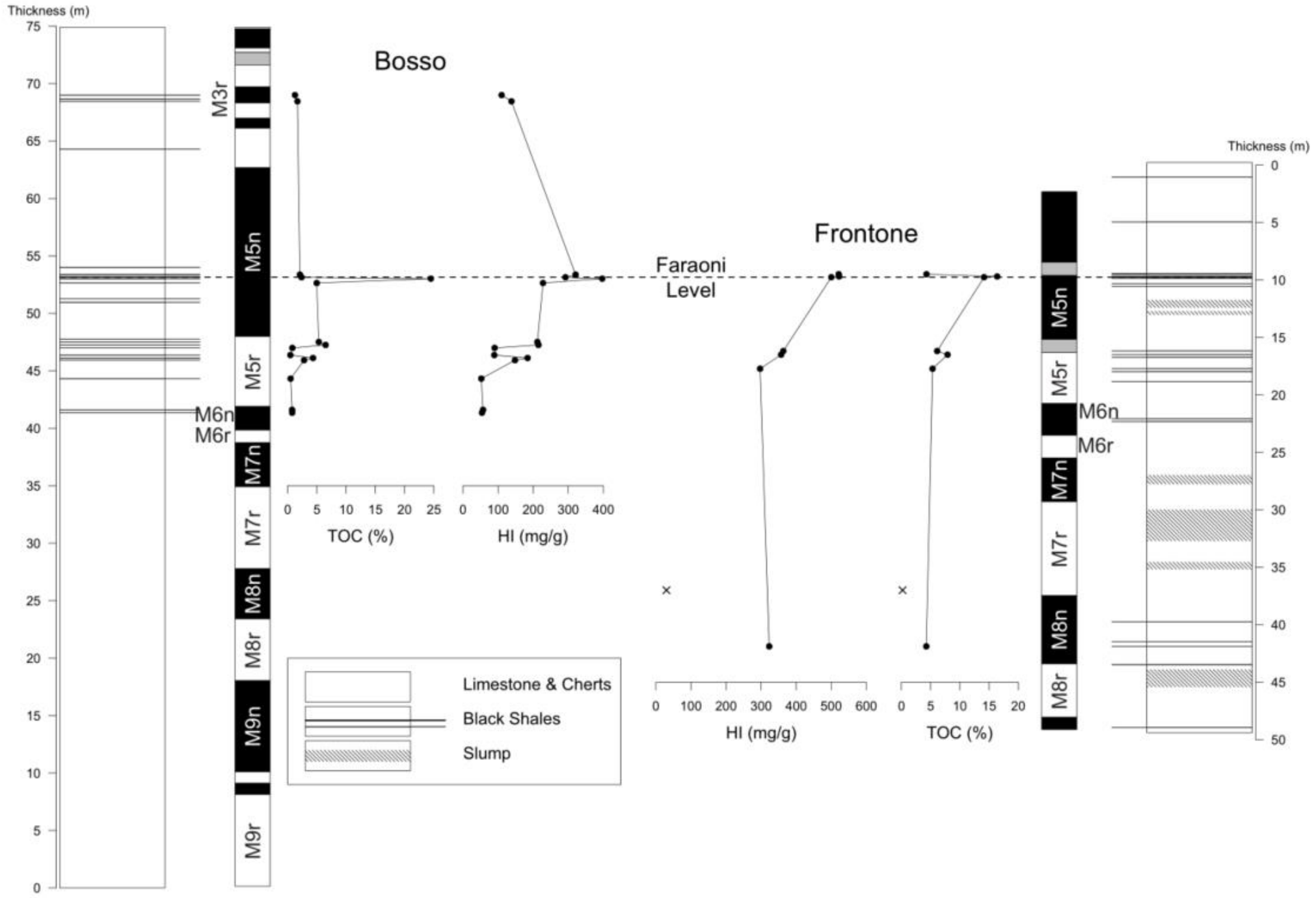
- Palynofacies and Rock Eval 6 analyses for black shale samples

- Observation of well-preserved parenchyma and wood (with alveolar structures) in Frontone only: indicates a better preserved continental input



New insights on organic matter burial and preservation

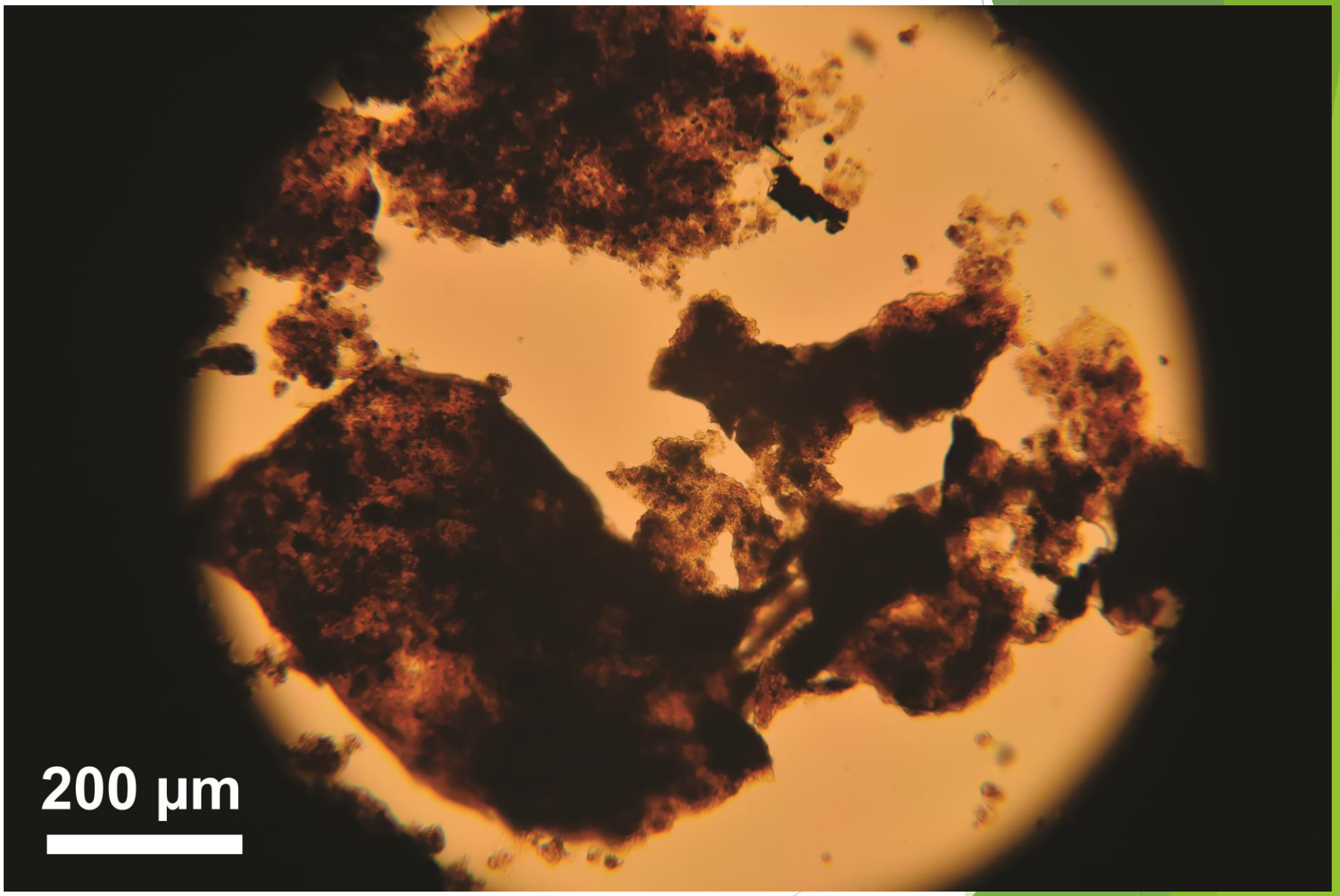
- Increase of organic matter burial and preservation before the Faraoni, around the M5r/M5n magnetic inversion


Thickness (m)
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
M3r
M5n
M5r
M6n
M6r
M7n
M7r
M8n
M8r
M9n
M9r
Bosso
Faraoni
Level
Frontone
0 5 10 15 20 25
TOC (%)
0 100 200 300 400
HI (mg/g)
0 100 200 300 400 500 600
HI (mg/g)
0 5 10 15 20
TOC (%)
Limestone & Cherts
Black Shales
Slump
Thickness (m)
0
5
10
15
20
25
30
35
40
45
50

- BOS B211

HI of 397 mg/g

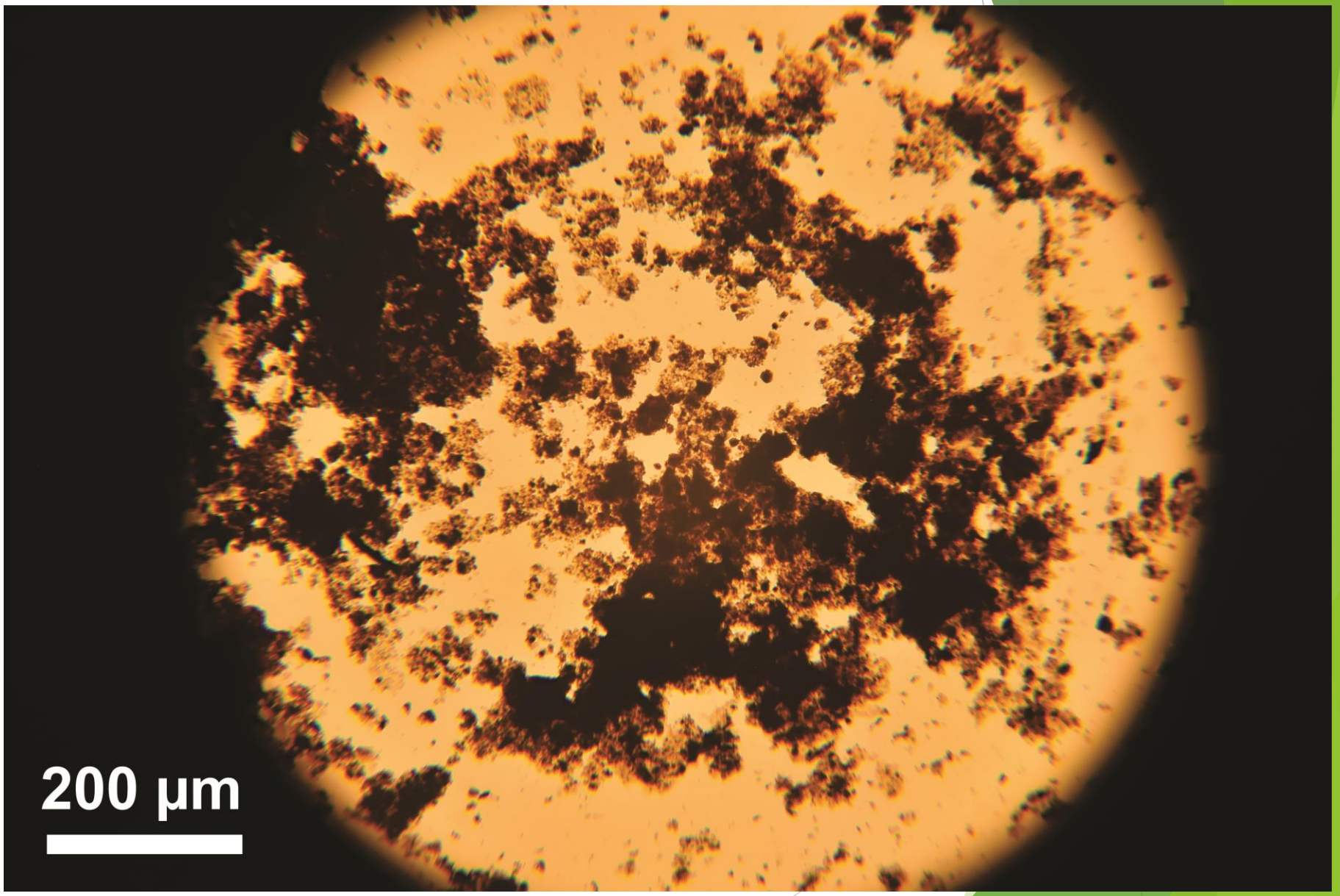
TOC of 24.49 %



- BOS B186

HI of 215 mg/g

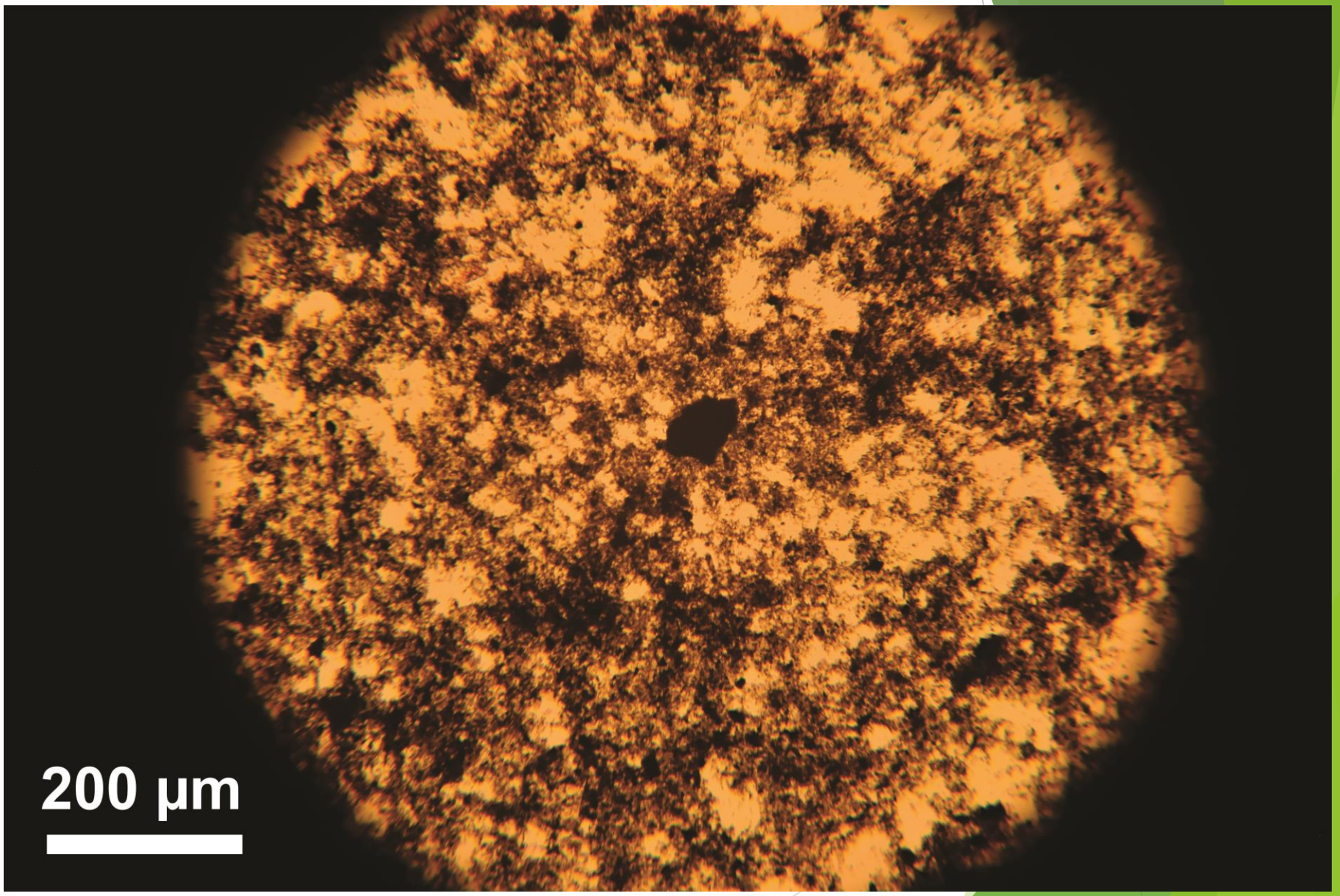
TOC of 6.48 %



- BOS B151 (unfiltered)

HI of 57 mg/g

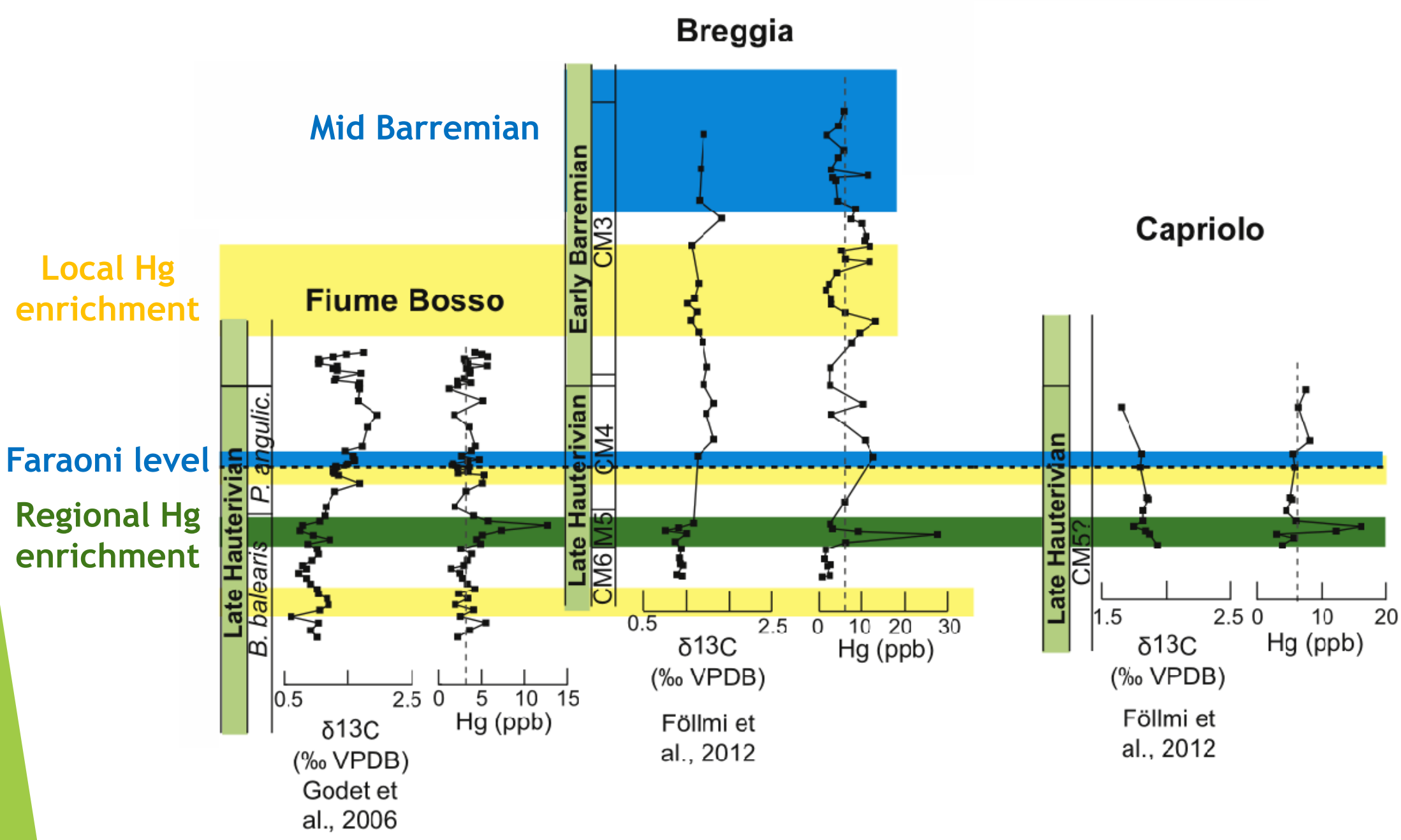
TOC of 0.75 %



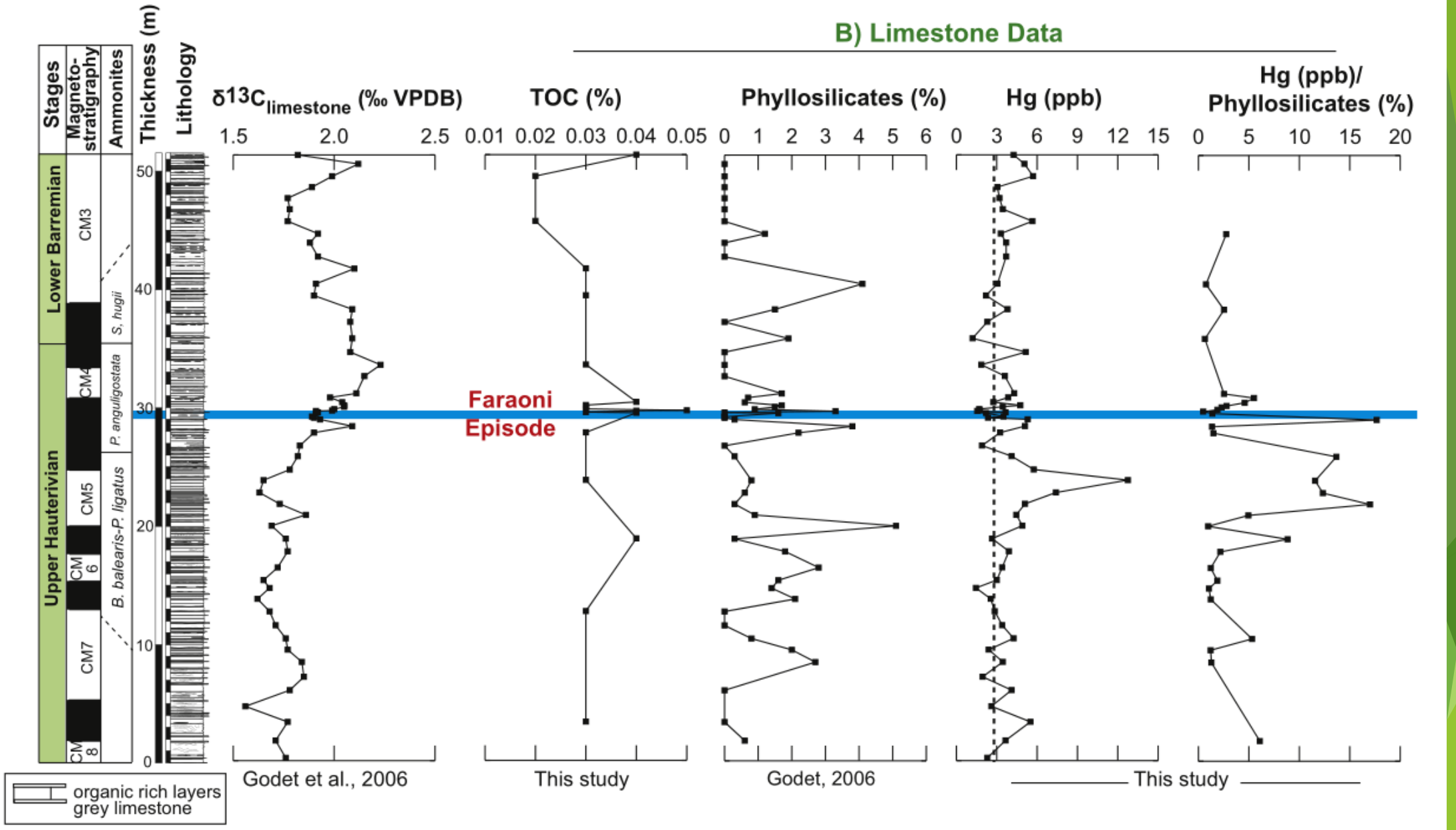
New insights on organic matter burial and preservation

- Increase of organic matter burial and preservation before the Faraoni, around the M5r/M5n magnetic inversion

- A regional enrichment of Hg has been measured around that same inversion, as well as a negative $\delta^{13}C$ excursion
- It is interpreted to be linked to volcanic activity (Charbonnier et al., 2018)



(Charbonnier et al., 2018)



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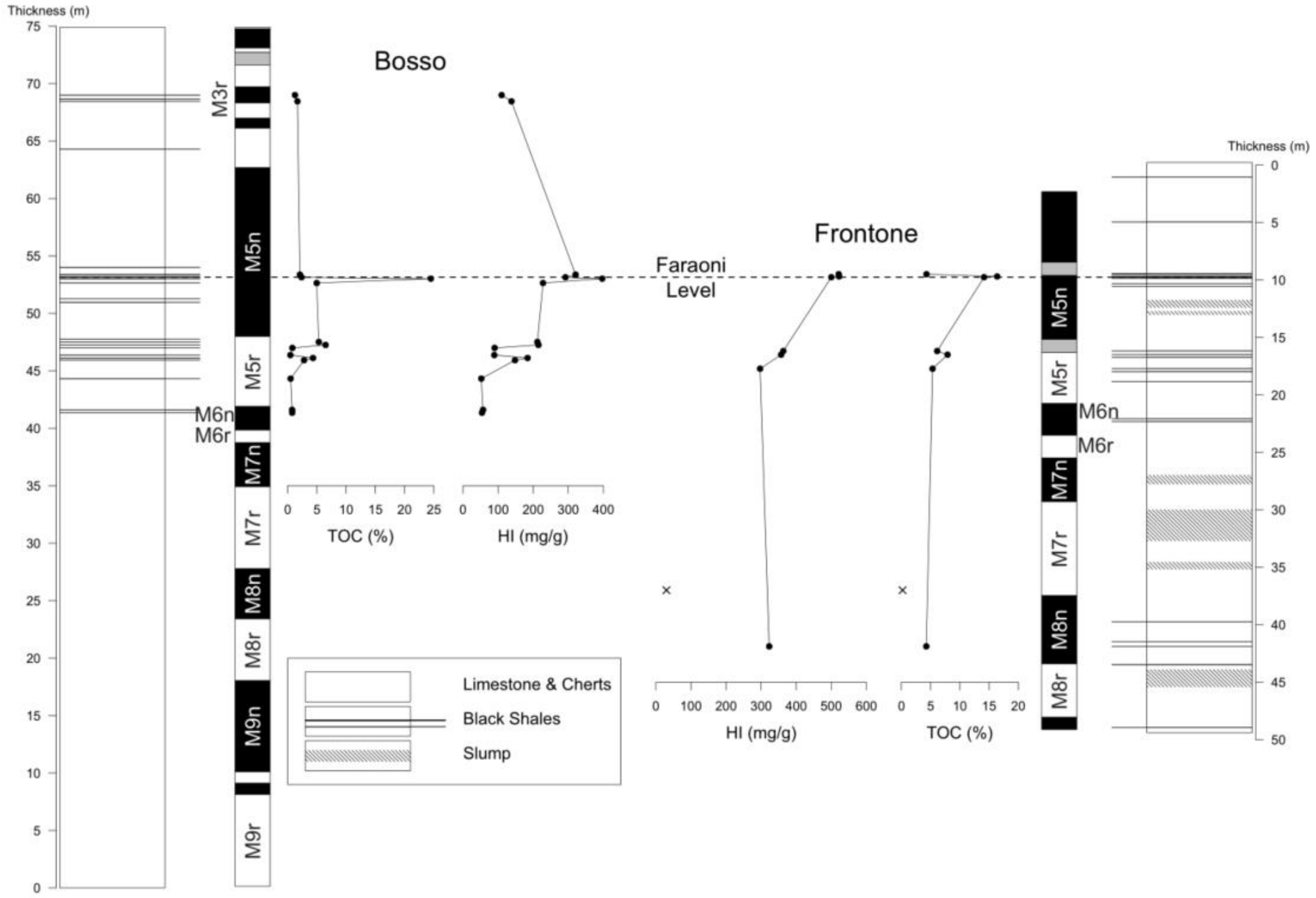
Thickness (m)
75
70
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M3r
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Limestone & Cherts
Black Shales
Slump
Thickness (m)
0
5
10
15
20
25
30
35
40
45
50

Conclusions

- New insights on magnetostratigraphy indicate a possible new subchron
- Black shales levels have specific patterns correlated with magnetostratigraphy
- Better preserved continental input in Frontone (vs Bosso)
- Good organic matter preservation is shown at the M5r/M5n magnetic inversion
- Could be linked to increased volcanic activity


Thank you for
your attention

References

- Cecca, F., A. Marini, G. Pallini, F. Baudin, and V. Begouen. 1994. 'A Guide Level of the Uppermost Hauterivian (Lower Cretaceous in the Pelagic Succession of Umbria Marches Apennines (Central Italy): The Faraoni Level', 1994, Riv. It. Pal eon t. Strat. v.99 n. 4 edition.
- Channell, J. E. T., F. Cecca, and E. Erba. 1995. 'Correlations of Hauterivian and Barremian (Early Cretaceous) Stage Boundaries to Polarity Chrons'. *Earth and Planetary Science Letters* 134 (1): 125–40. https://doi.org/10.1016/0012-821X(95)00111-O.
- Martinez, Mathieu, Jean-François Deconinck, Pierre Pellenard, Laurent Riquier, Miguel Company, Stéphane Reboulet, and Mathieu Moiroud. 2015. 'Astrochronology of the Valanginian–Hauterivian Stages (Early Cretaceous): Chronological Relationships between the Paraná–Etendeka Large Igneous Province and the Weissert and the Faraoni Events'. *Global and Planetary Change* 131 (August): 158–73. https://doi.org/10.1016/j.gloplacha.2015.06.001.
- Speranza, Fabio, Sara Satolli, Emanuela Mattioli, and Fernando Calamita. 2005. 'Magnetic Stratigraphy of Kimmeridgian-Aptian Sections from Umbria-Marche (Italy): New Details on the M Polarity Sequence'. *Journal of Geophysical Research: Solid Earth* 110 (B12). https://doi.org/10.1029/2005JB003884.
- Westermann, Stéphane, Karl B. Föllmi, Thierry Adatte, Virginie Matera, Johann Schnyder, Dominik Fleitmann, Nicolas Fiet, Izabela Ploch, and Stéphanie Duchamp-Alphonse. 2010. 'The Valanginian Δ13C Excursion May Not Be an Expression of a Global Oceanic Anoxic Event'. *Earth and Planetary Science Letters* 290 (1–2): 118–31. https://doi.org/10.1016/j.epsl.2009.12.011.