

# Miocene seep carbonates in Northern Italy: Any evidence of paleo-gas hydrates?

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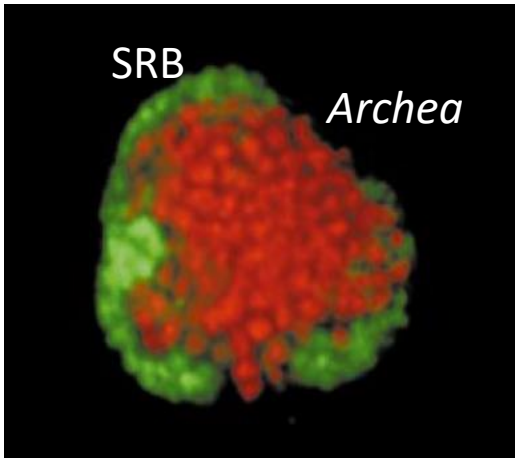
# Anaerobic oxidation of methane (AOM)

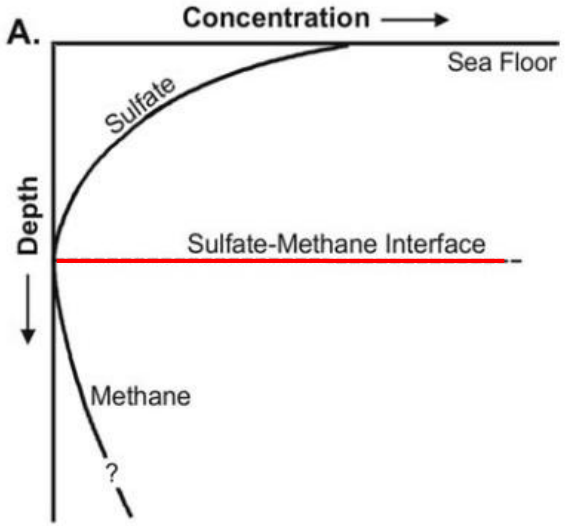
$$CH_4 + SO_4^{2-} \rightarrow HCO_3^- + HS^- + H_2O$$

$HCO_3^-$ → **Ca-Mg carbonates (MDAC)**

$HS^-$ → $FeS$, $FeS_2$ → **Chemosynthetic fauna**




Boetius et al. (2000)



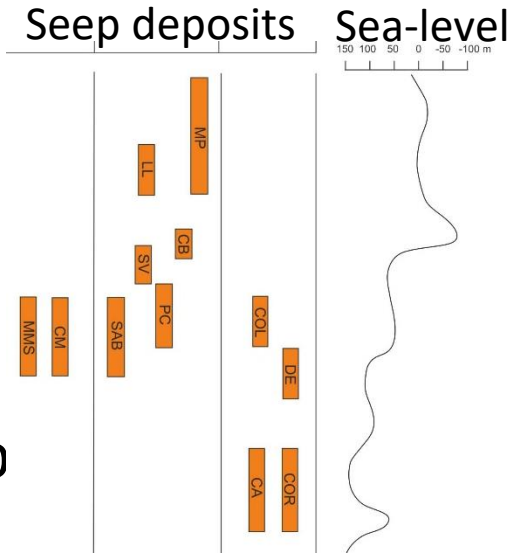

Jørgensen and Kasten (2006)

**Identification of paleo-SMT in the geologic record**

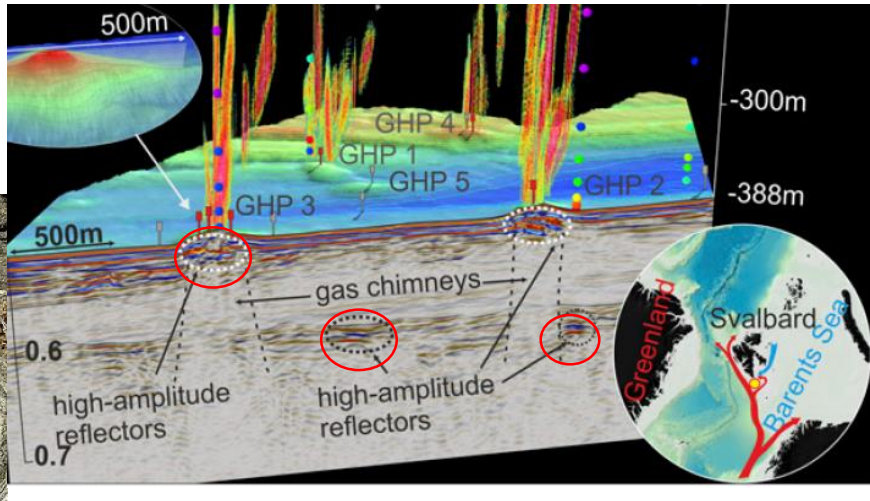
# Implications:

- Relationships with **climate, tectonics**
- **Past GH destabilization**
- Improve the accuracy of seismic interpretatio

  (e.g. buried MDAC➡ PHAA?)
- Chemosynthetic communities
- …

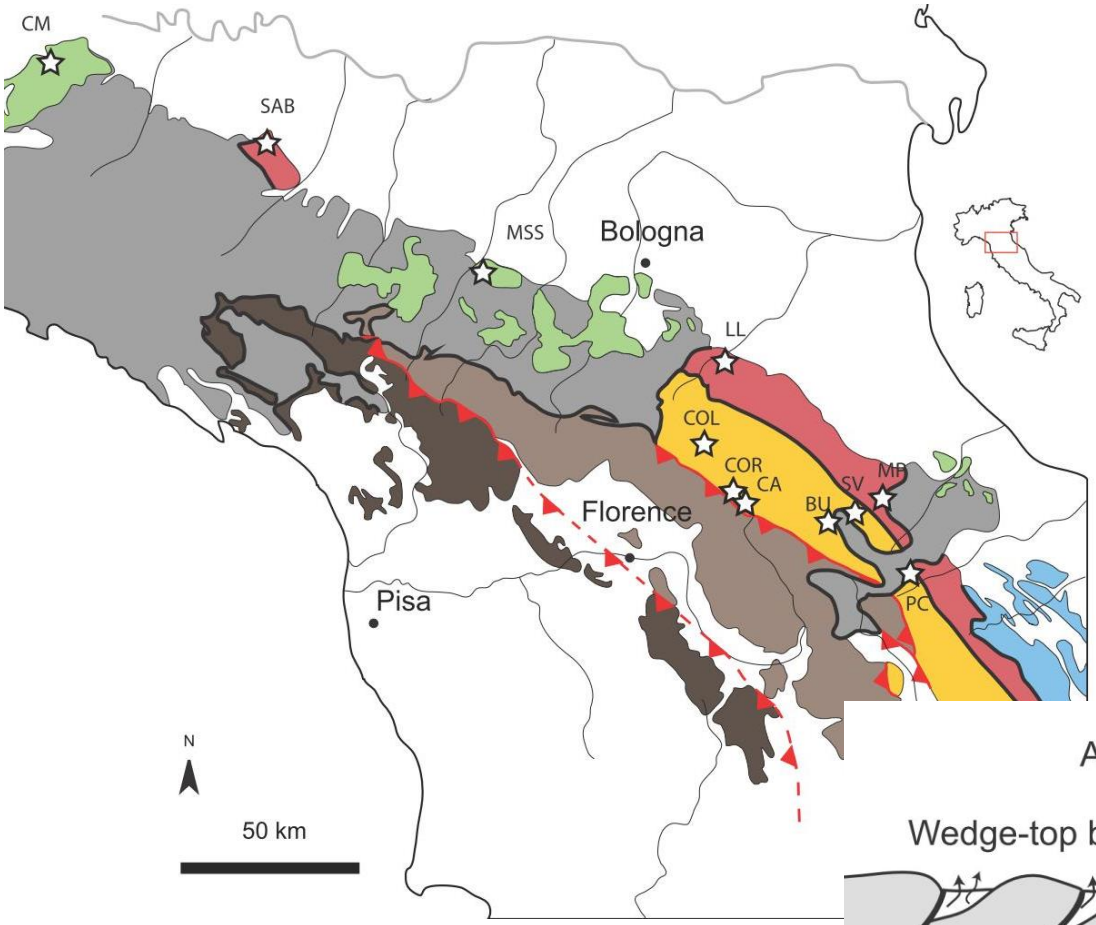



Argentino et al. 2019 Geosci

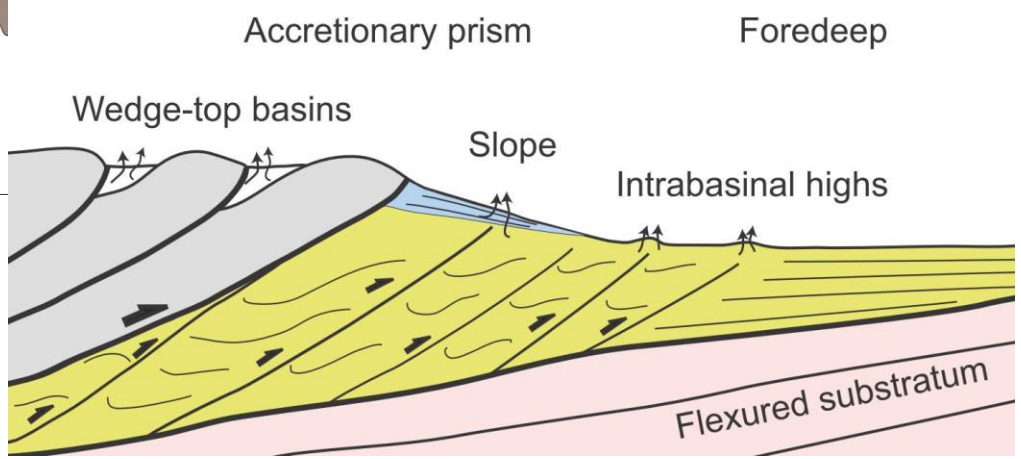



Serov et al. 2017 PNAS


# Miocene outcrops in northern Italy




- **Exposed accretionary wedge (Tertiary turbidite successions)**
- **Paleo-seeps developed on wedge-top, slope, intrabasinal highs**




Argentino et al. 2019 Geosci

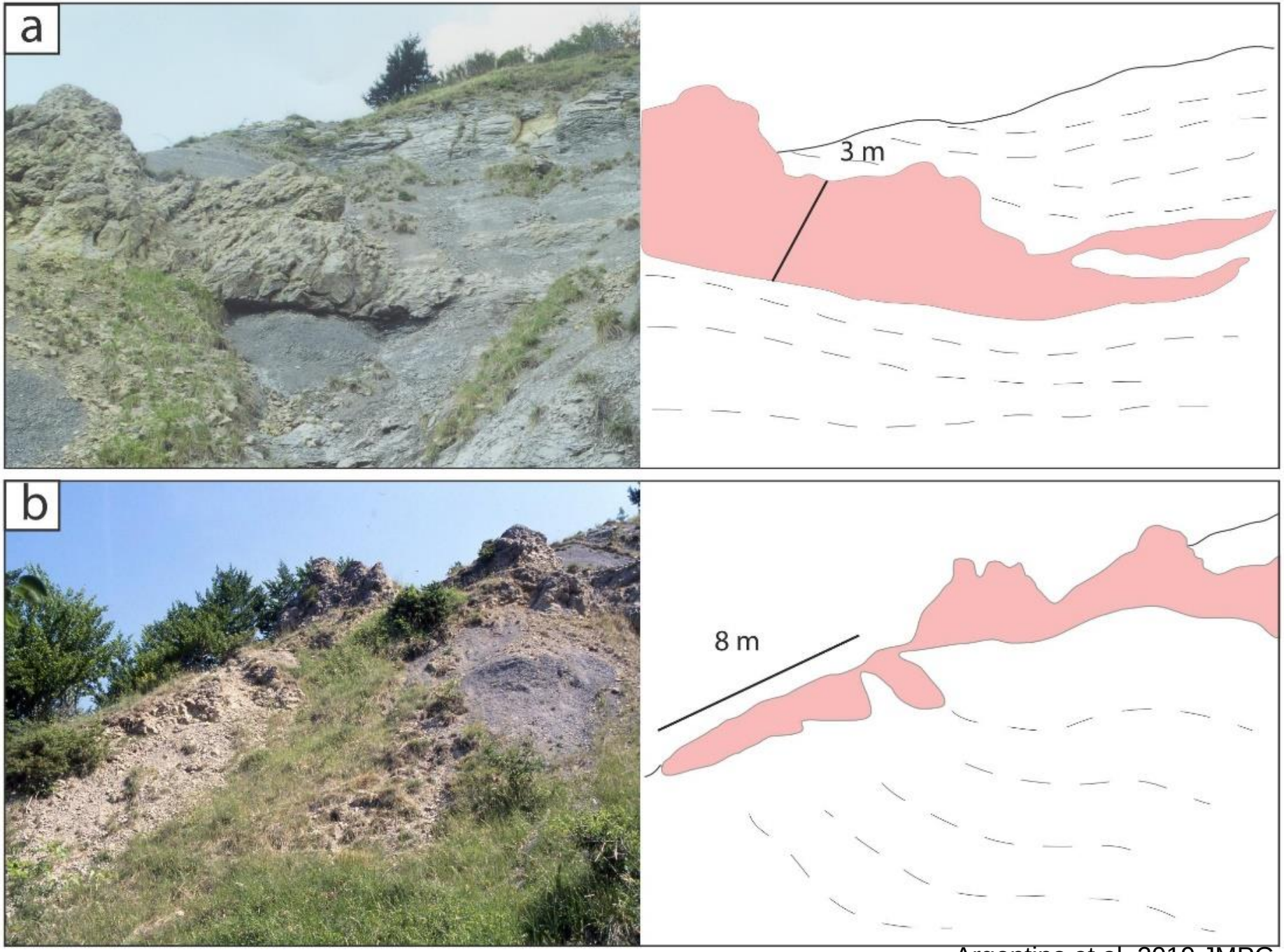
# Research activities during the PhD

| Methane-derived CARBONATES | HOST SEDIMENTS |
| --- | --- |
| **Geological mapping**<br>**Carbonate Facies** | **Mapping SSD** |

**Stable C, O Isotopes**
**XRPD +SEM**

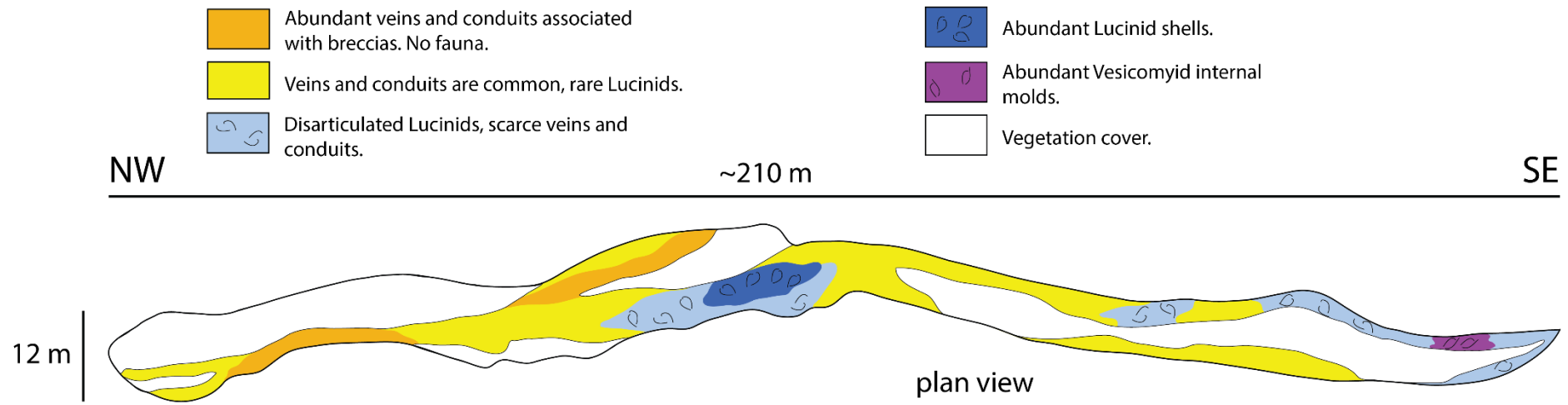
| | |
| --- | --- |
| Trace metal proxies **(REE, Mo-U)** | **TOC, C/N** |
| Sr isotopes **($^{87}Sr/^{86}Sr$)** | **TS, S isotopes ($\delta^{34}S$)** |

# What do MDACs look like?




Argentino et al. 2019 JMPG

# Carbonate facies







**Overpressure dissipation**

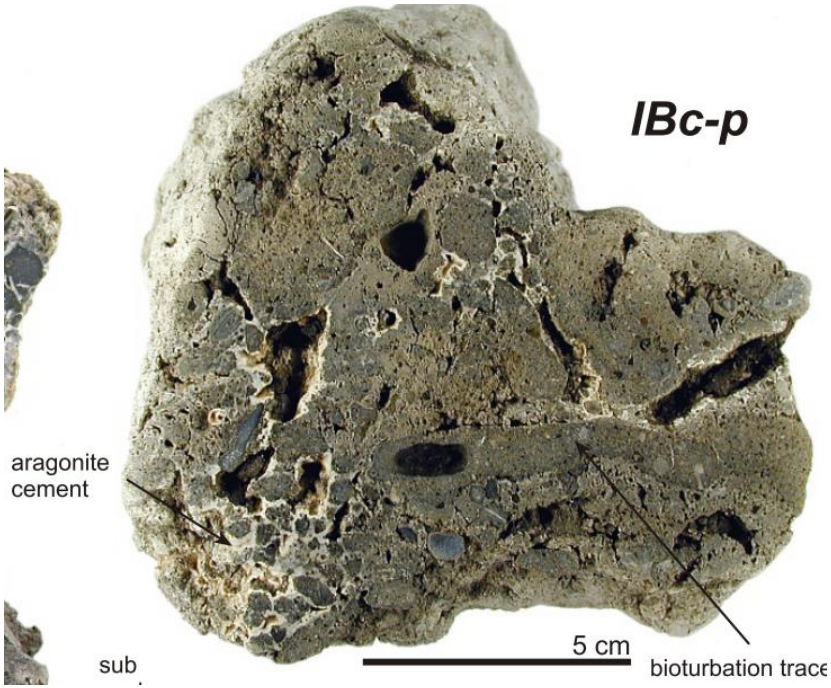
Vesicomyids

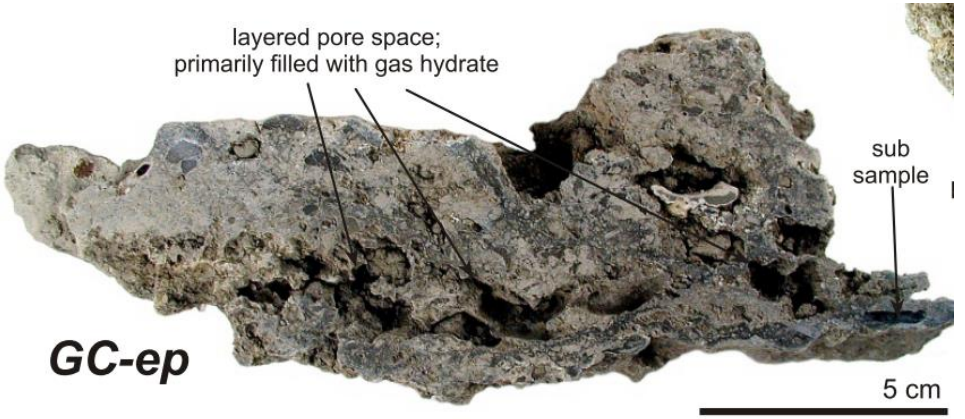
**Shallow SMT**

Lucinids

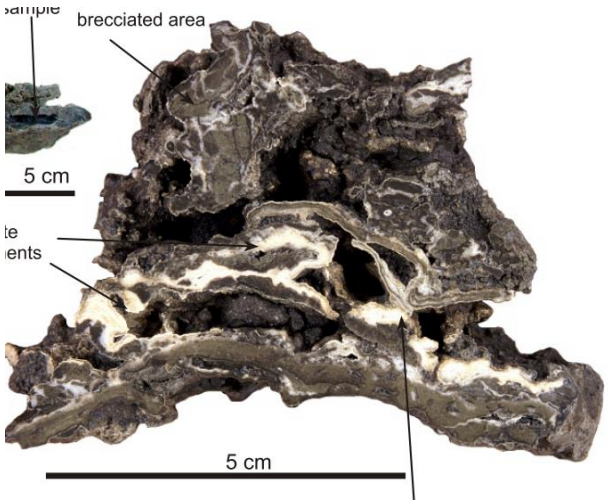
WARNING WEAR
SAFETY GOGGLES

# Clathrite facies




Vuggy fabrics and collapse breccias





Greinert et al. (2001) and Bohrmann et al. (1998)

# Clathrite facies - Apennine samples

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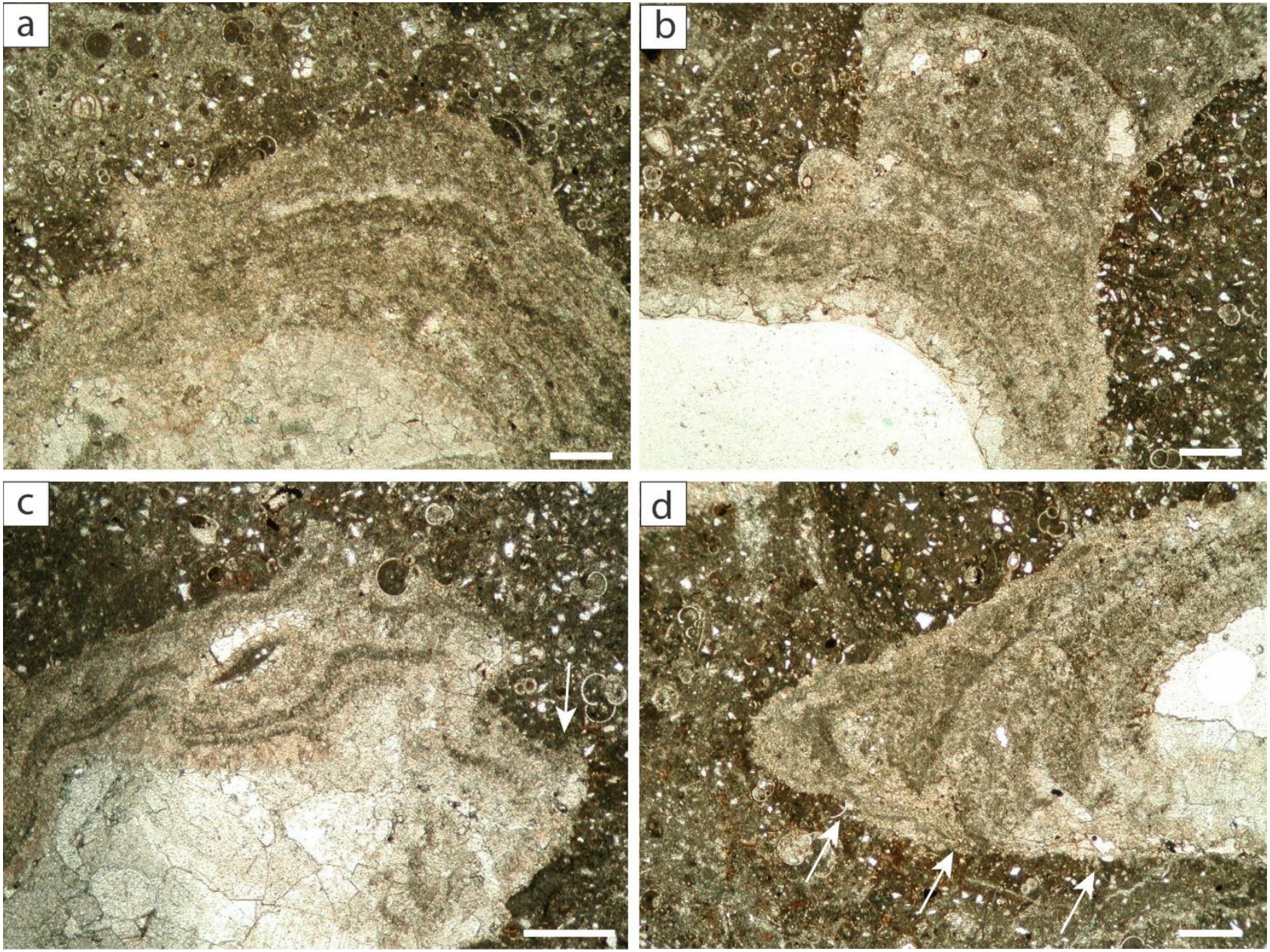
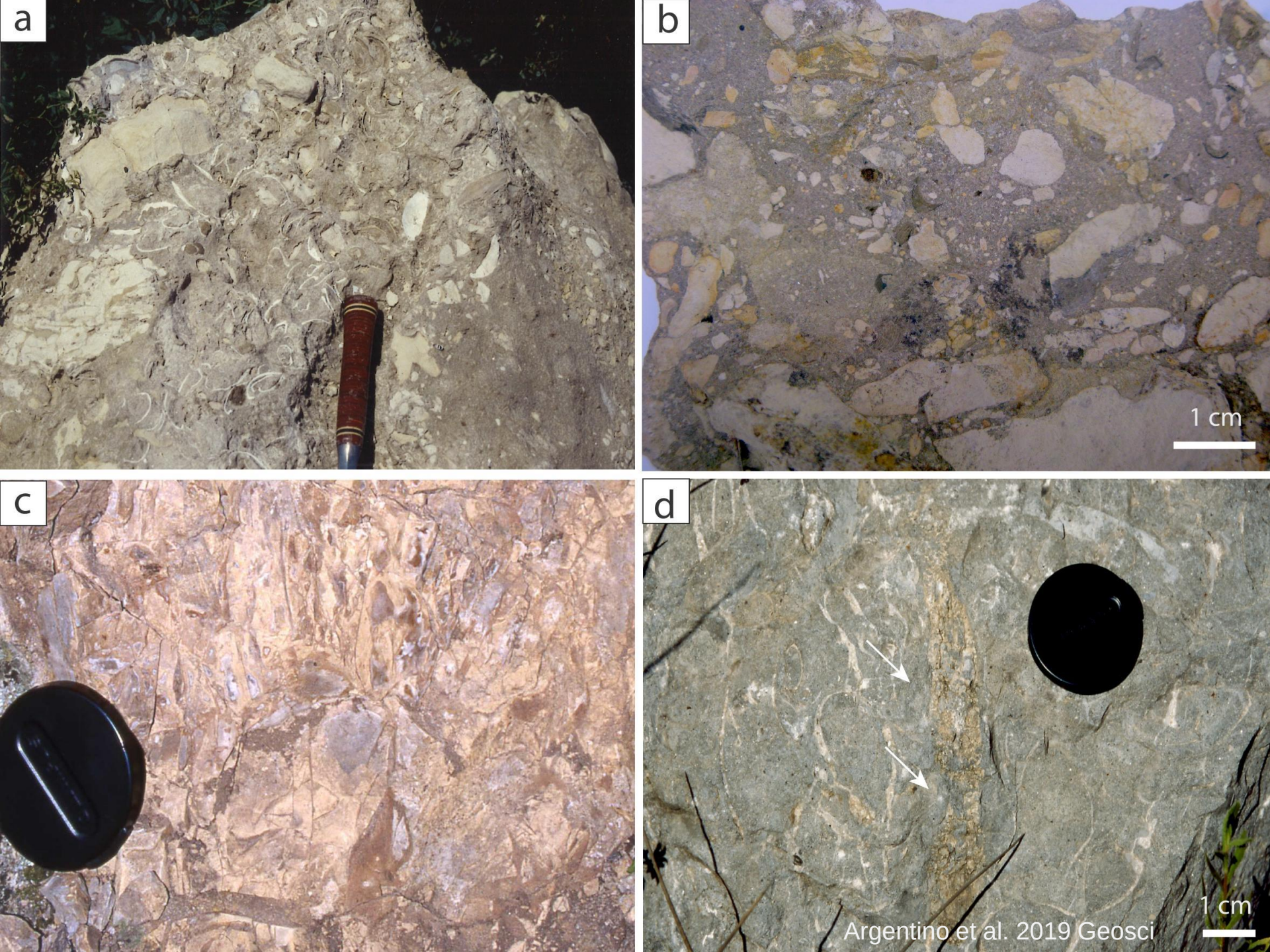
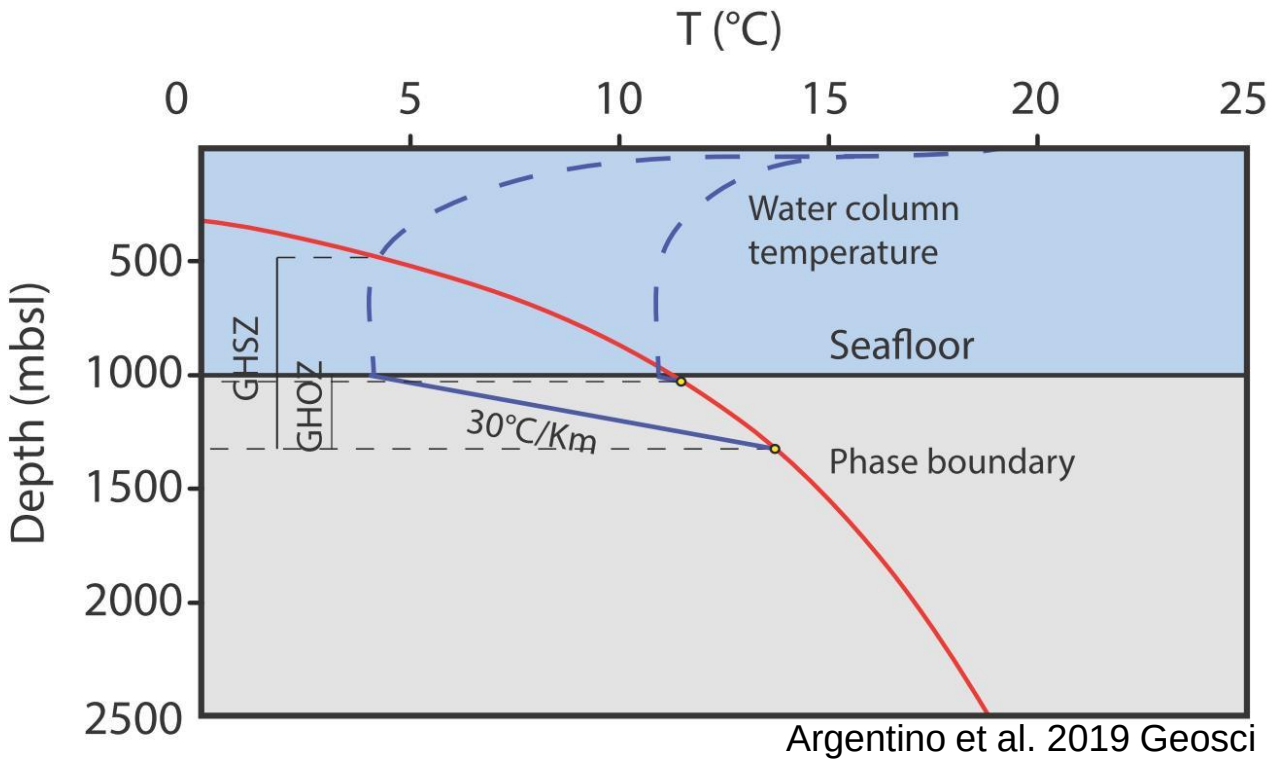



Argentino et al. 2019 Geosci

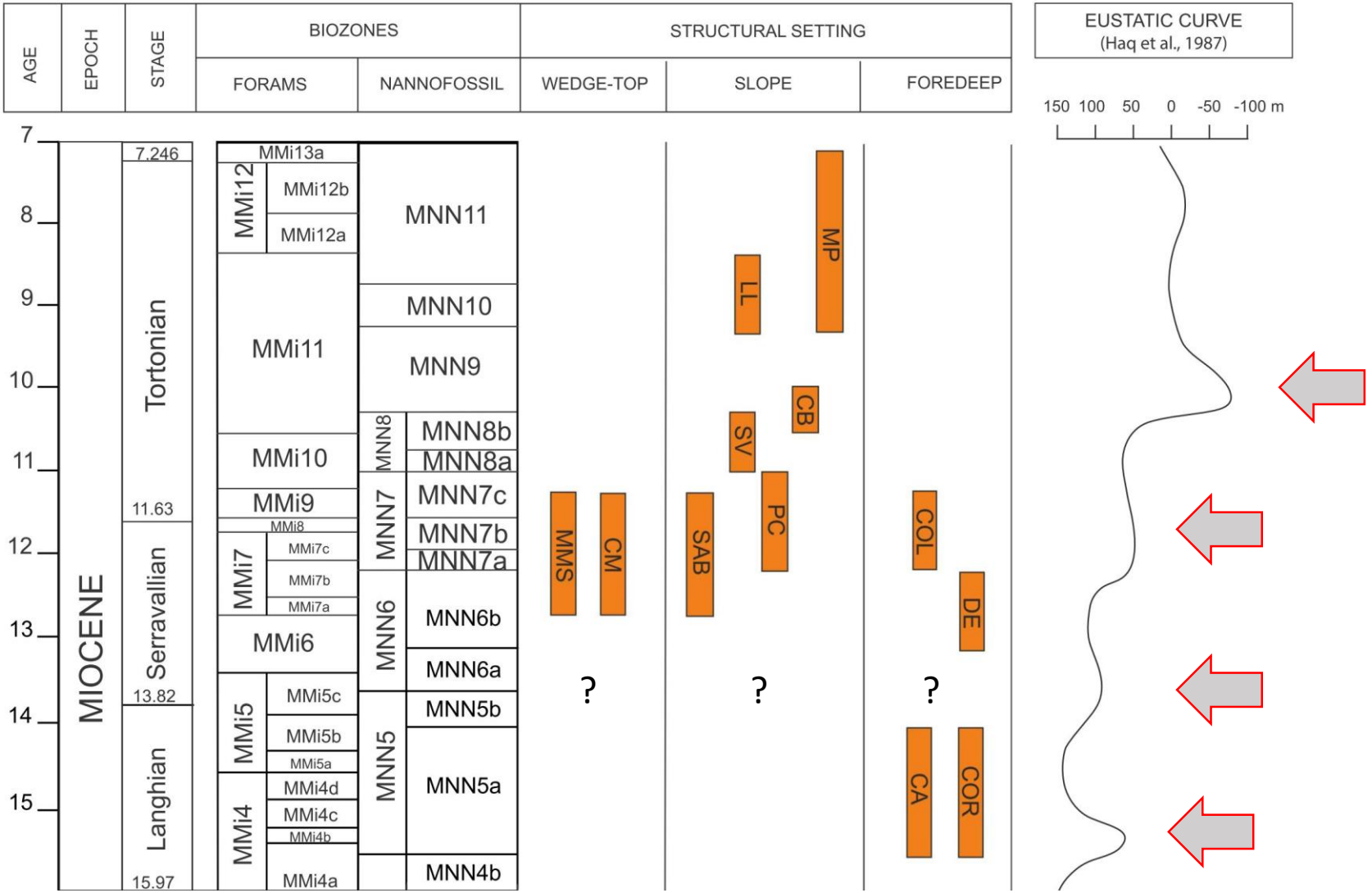

a
b
1 cm
c
d
1 cm
Argentino et al. 2019 Geosci




Argentino et al. 2019 Geosci

Inputs:
Paleobathimetry = 1000 m
Geothermal gradient = 30 °C/km
Bottom water temperature =4 ° , 11 °C
Salinity= Mediterranean salinity (3.8 %)

GHOZ ~ few tens of m




Argentino et al. 2019 Geosci

Chlatrite occurrence seems to coincide with third-order low stands…


REMARKS:

- Fossil clathrites are rarely reported in the literature due to the elusive criteria for their recognition
- The northern Apennines (Italy) host several examples of chlatrites and paleo-methane seepage
- We can investigate how climate changes influenced cold seeps and gas hydrate systems in the past.

$R^G$

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