# “Marine temperature variability of the last millenia and robustness of the proxy record”

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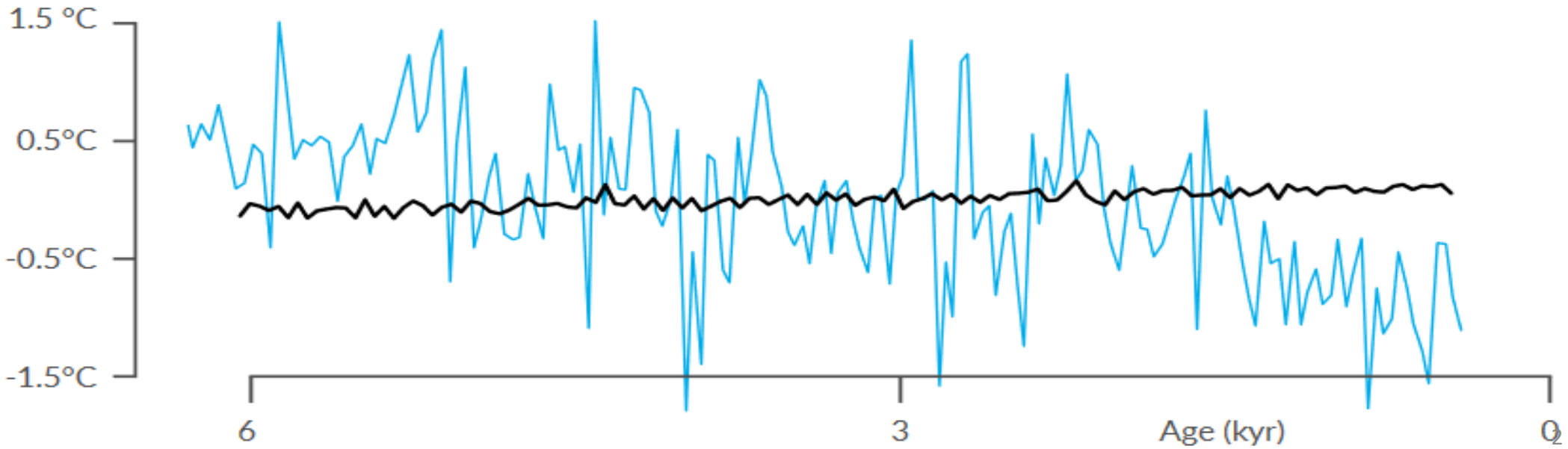
Earth System Diagnostics

Organic Geochemistry

# Climate variability

- Knowledge needed for predicting plausible range of future climates and to test climate models
- Underestimated by current climate models *(in space and time!)*:

**ECHAM5-MPIOM** vs. foraminiferal Mg/Ca sea surface temperature **proxy**



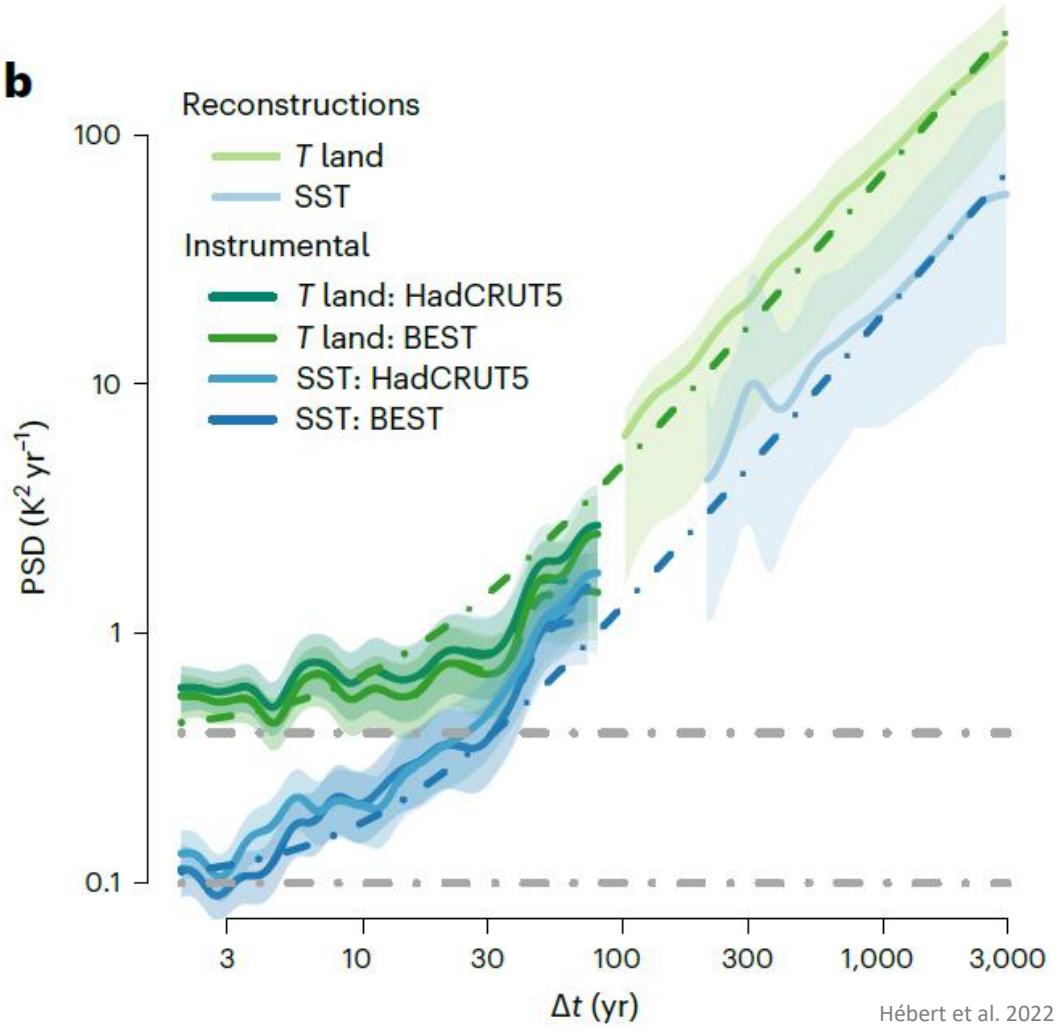

Weldeab et al. 2007, Laepple et al. 2018

# Climate variability & relevant time scales

- Past environmental variability can be inferred from the instrumental record (~100-150yrs)
  → after that: “proxies”

- Long time series with *fine** resolution needed for decadal and centennial variability

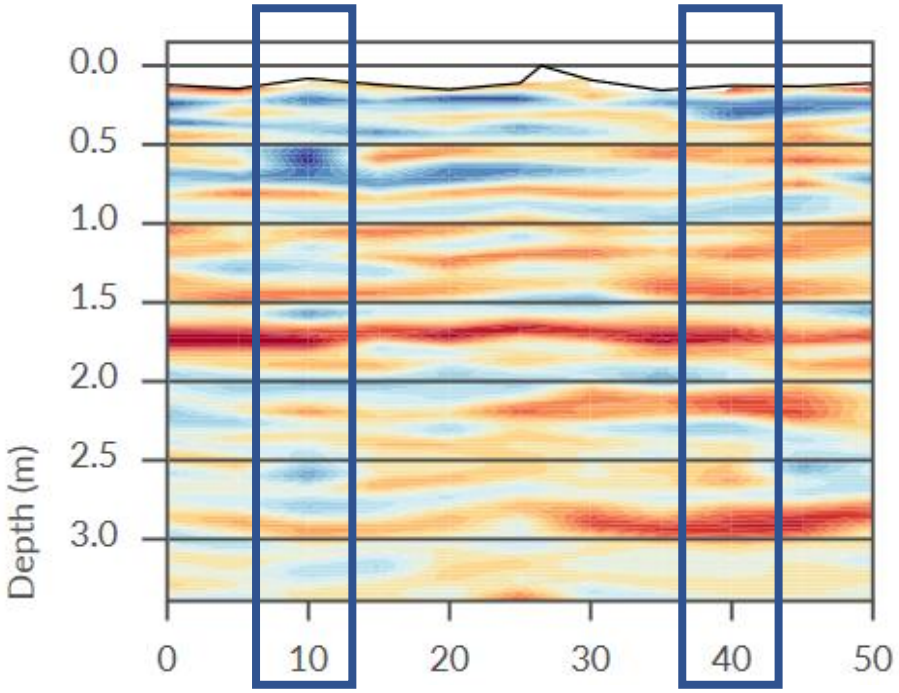
- * rare: annual resolution in varves (yearly laminated sediments), corals, tree rings
  → usually much coarser (100s of years)



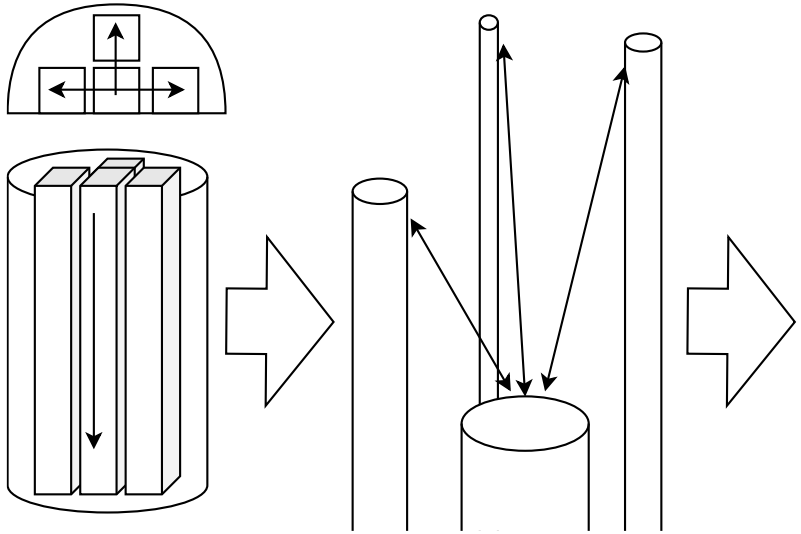

Hébert et al. 2022

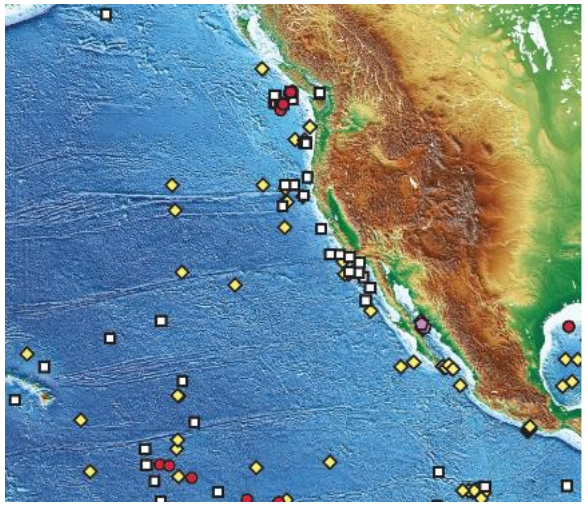
# Understanding and quantifying spatial variability
## *Regional signal vs. local noise in proxies*

- Each record consists of climatic signal + local “stratigraphic noise”
- Characterizing correlation scales of signal and noise needed for “clean signal”



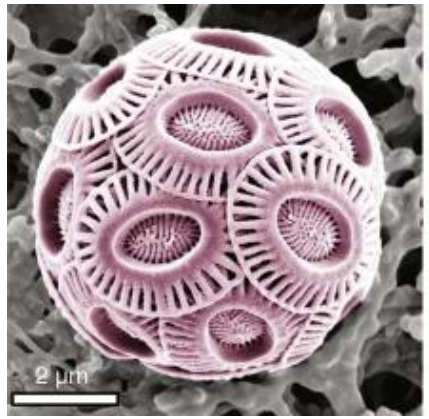

Münch et al. 2017

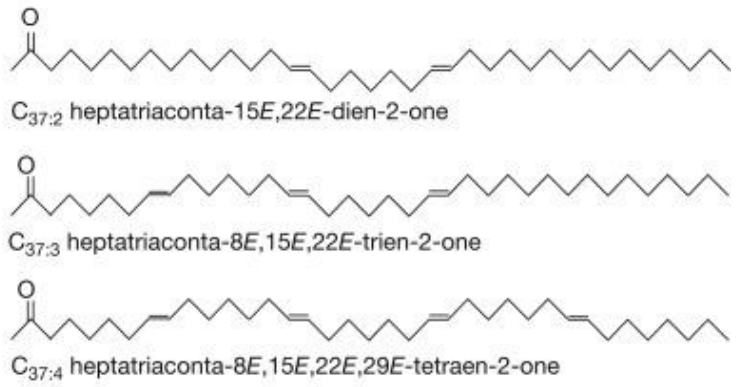




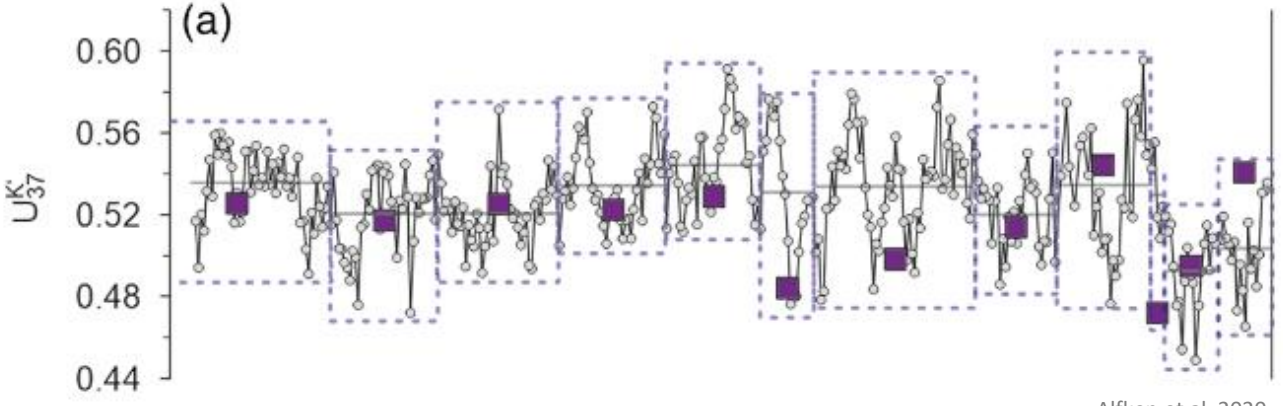
# High-resolution proxy measurements

- Sea surface temperature proxy: Uk’37 (Brassel et al. 1986)
- MSI allows high-resolution reconstruction of SST




Kucera 2019

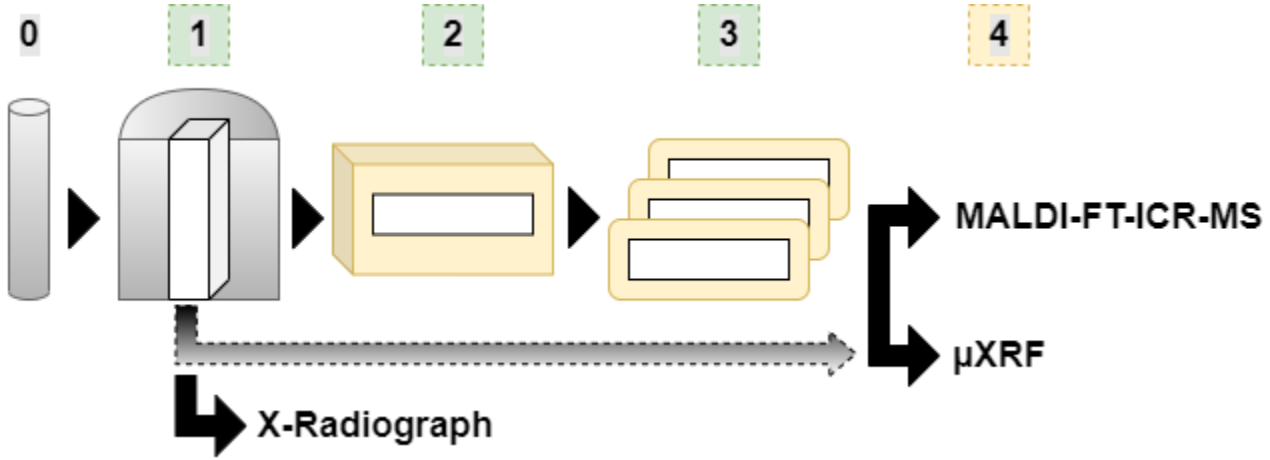



Alfken et al. 2020

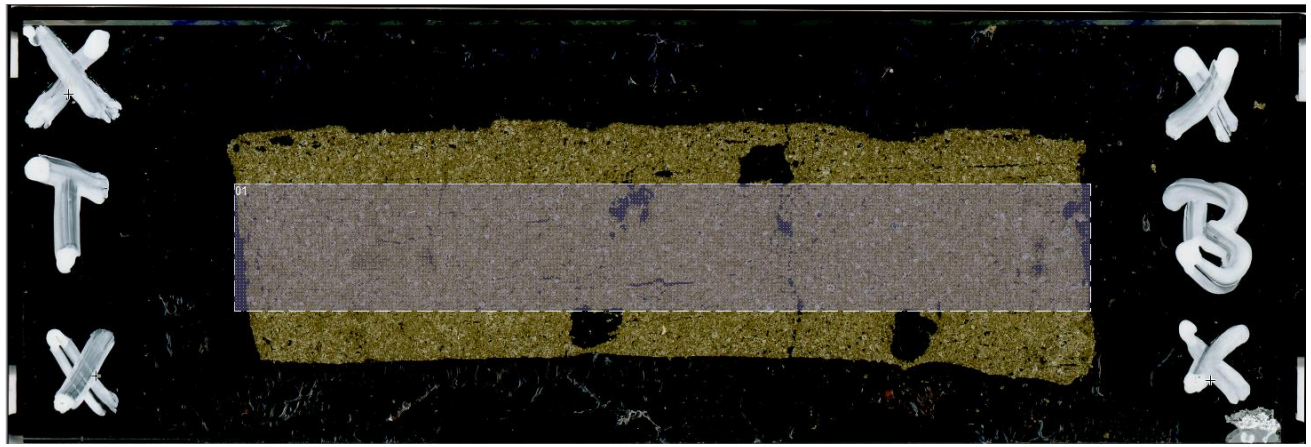
$$U_{37}^{k'} = \frac{C_{37:2}}{C_{37:2} + C_{37:3}}$$

# Workflow

- Subsampling, freeze-drying, embedding (Gelatine, CMC)
- Cryomicrotome: 60µm / 100µm slices
- µXRF elemental mapping (Bruker M4 Tornado)
- 7T solariX XR FT-ICR-MS (MALDI source, Smartbeam II laser; Bruker Daltonik, Bremen)
- Settings adjusted to each core (slice)

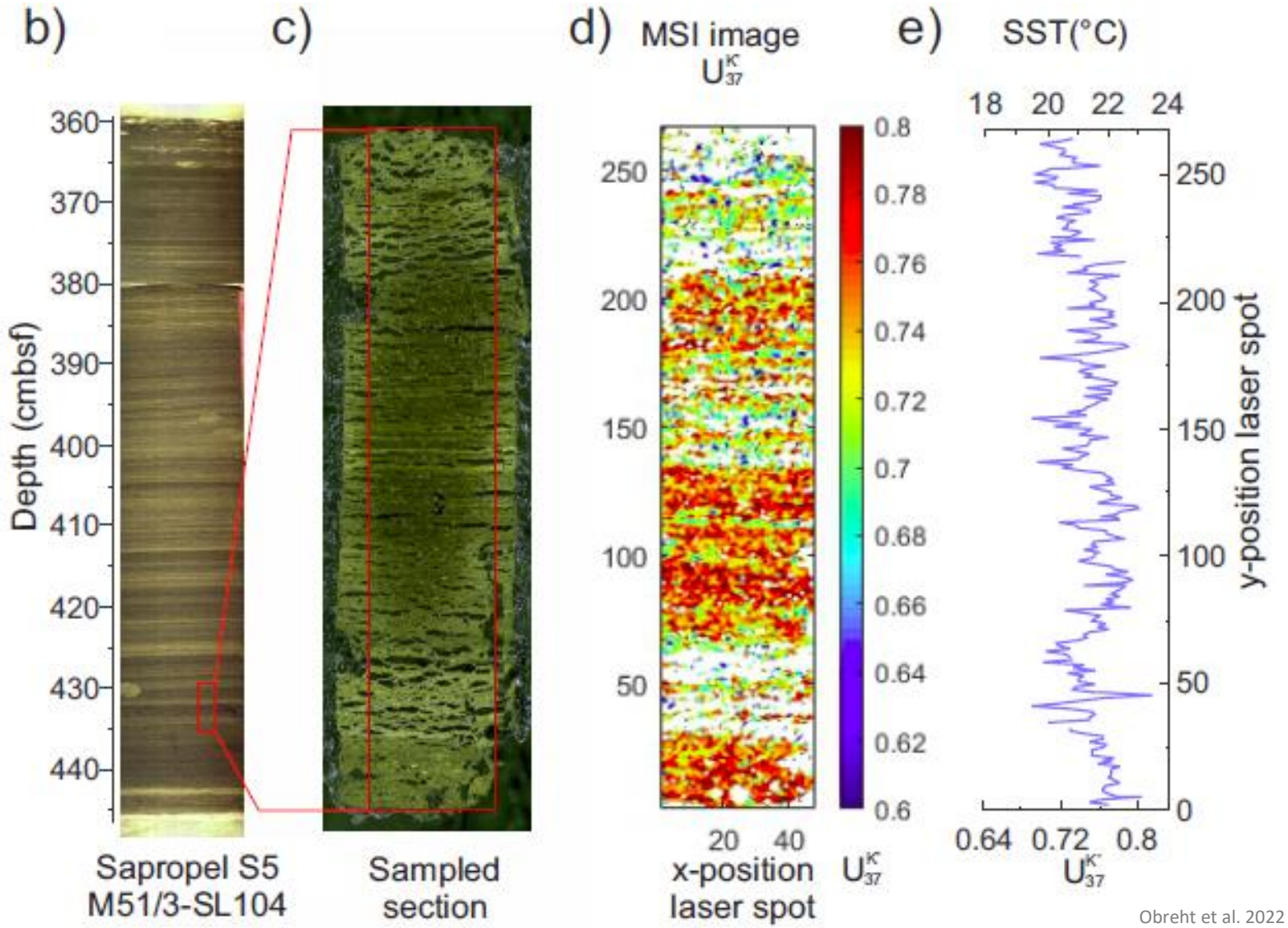


# Workflow



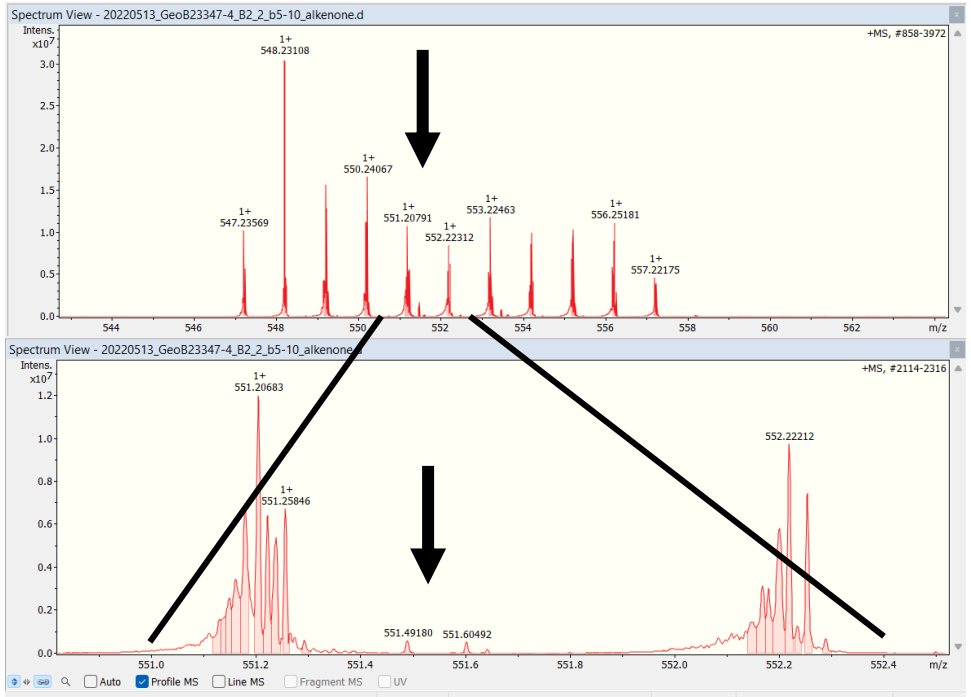
~10000 spectra per 5cm
(e.g. sedimentation rate 4mm/yr: 5cm = ~12years)

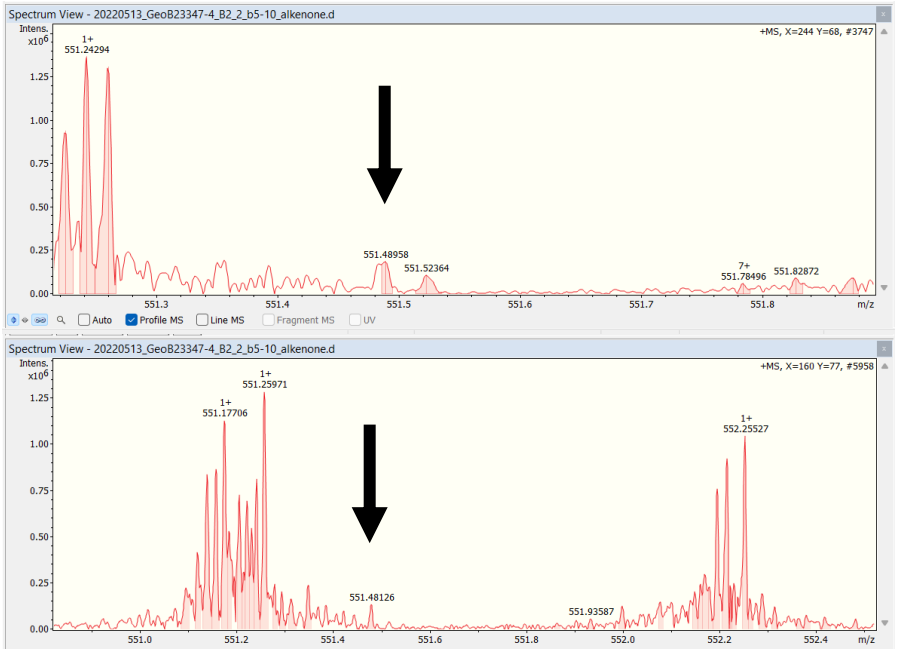
# Sediment MSI




Obreht et al. 2022

# Alkenone hunt (issues$^{222}$)




*raw; pre lockmass

C372:2

$C_{37}H_{70}NaO$ (Na adduct, most common)

553.531888

C372:3

$C_{37}H_{68}NaO$ (Na adduct, most common)

551.516238

Concentrations range from few ng to ~mg

Pheophorbide a ($C_{35}H_{36}N_4O_5$)

592.268022; 615.257791 (M+Na)

*Thank you*

# References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