EGU General Assembly 2022

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Outstanding Student & PhD candidate Presentation contest

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DRAMATIC DECLINE AND CHANGE IN COILING DIRECTION OF PLANKTIC FORAMINIFER *MOROZOVELLA* AT THE EARLY EOCENE CLIMATIC OPTIMUM (EECO; ~53–49 MA) FROM THE PACIFIC OCEAN

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Gerald R. Dickens

CONTENTS

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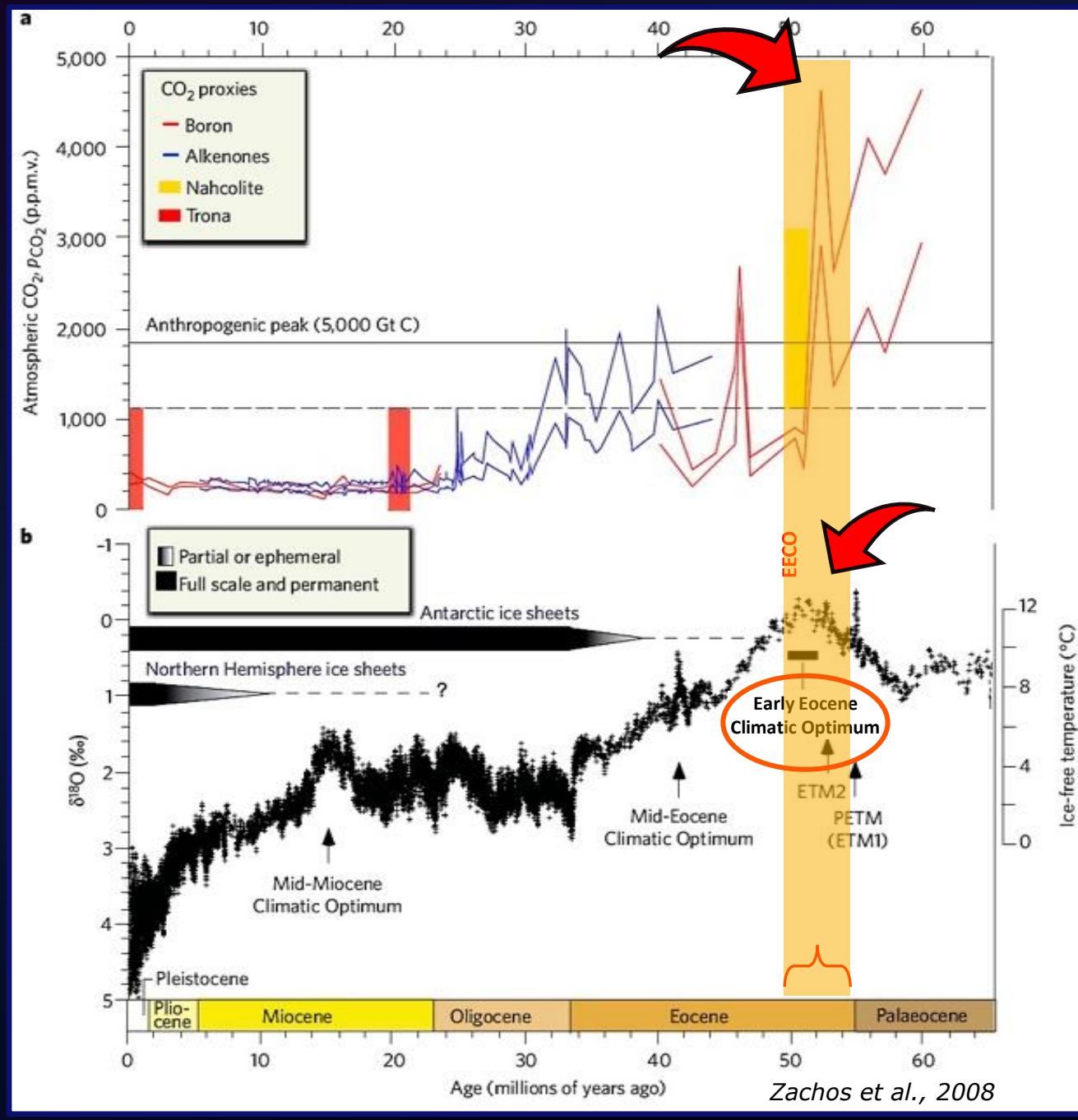
CLIMATIC CONTEXT

EECO (ca 53-49 Ma)

- **T and pCO_2:**
  the peak of the Cenozoic
- **Hyperthermals:**
  Short-term warming fluctuations
- **Crucial interval:**
  similarities with ongoing climate changes

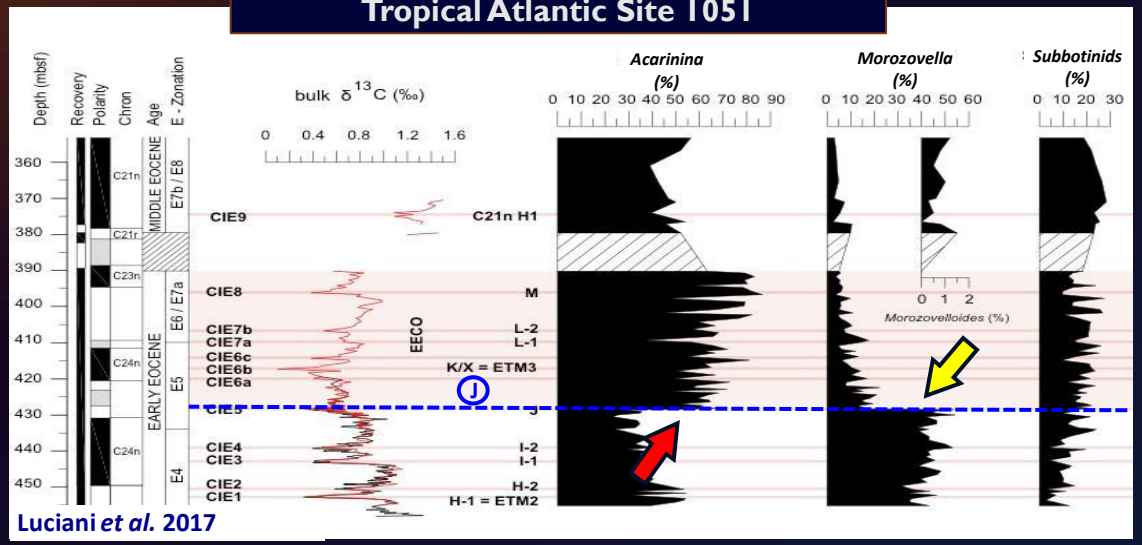


Zachos et al., 2008

FIRST MAJOR CHANGE

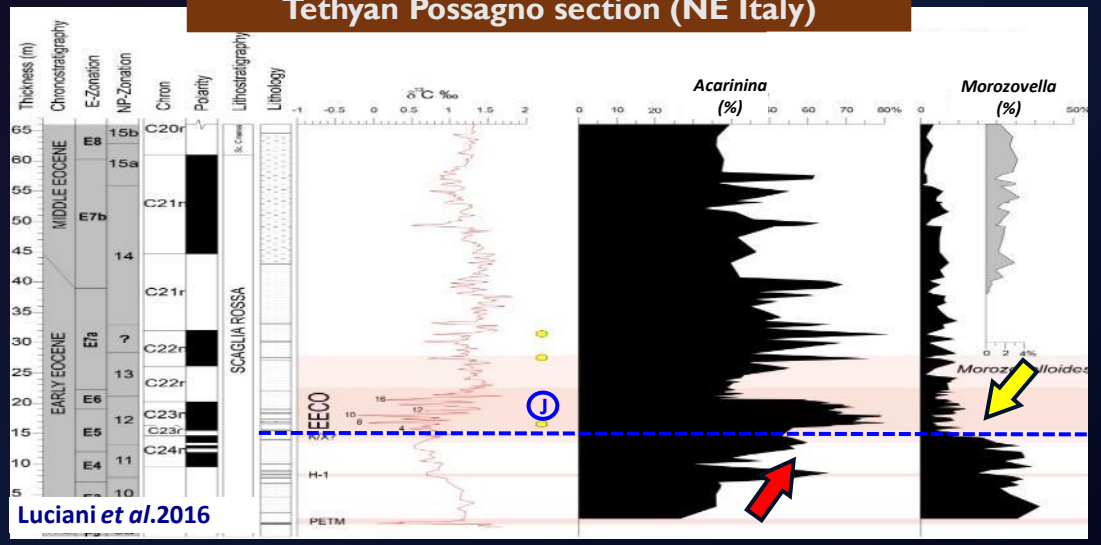
ATLANTIC SITES: THE GENUS *MOROZOVELLA* MARKEDLY AND PERMANENTLY **DECLINED** CLOSE TO THE J EVENT

Tropical Atlantic Site 1051



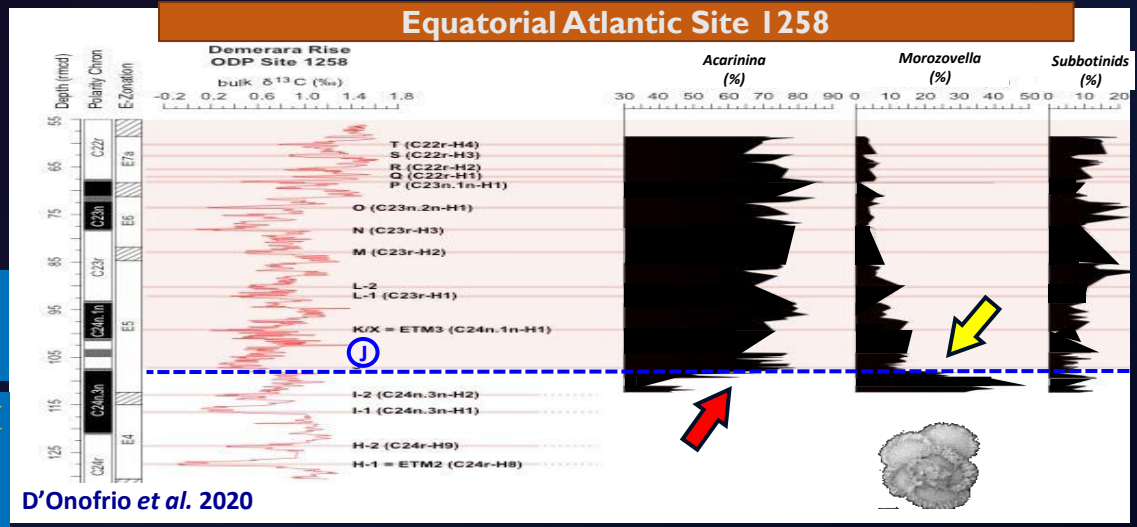
Luciani *et al.* 2017

Tethyan Possagno section (NE Italy)



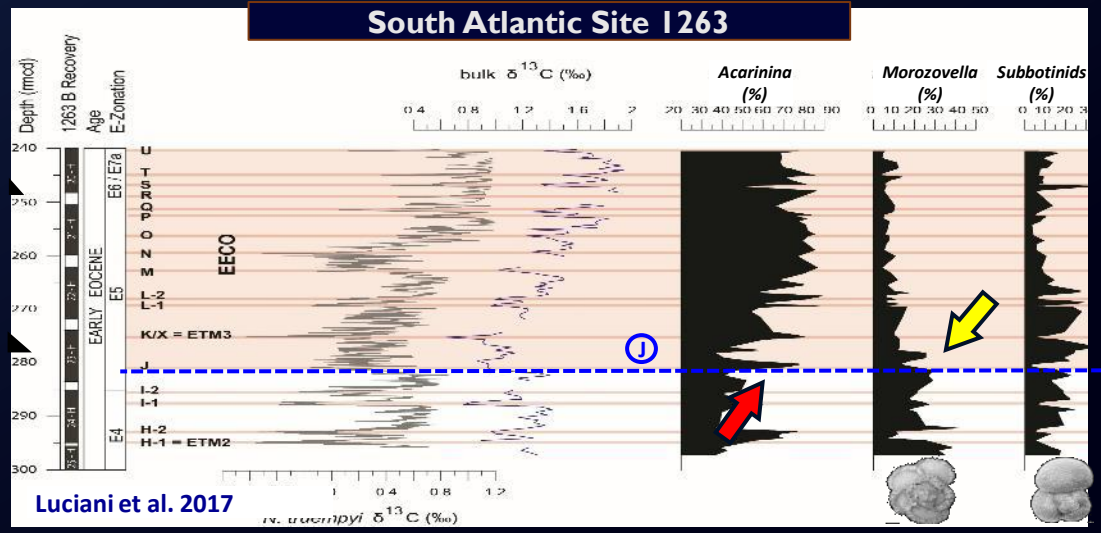
Luciani *et al.*2016

Equatorial Atlantic Site 1258



D'Onofrio *et al.* 2020

South Atlantic Site 1263



Luciani et al. 2017

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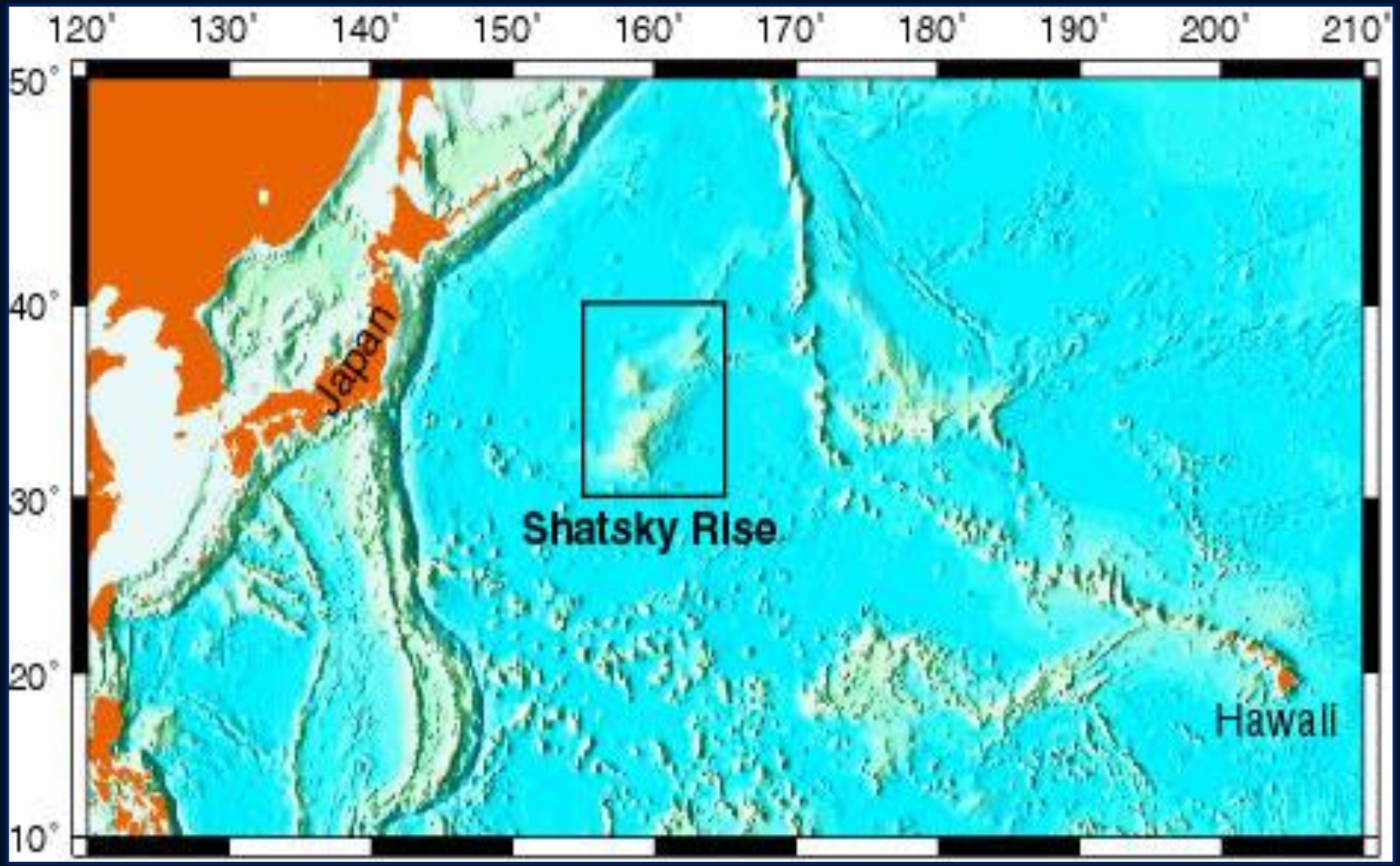
SELECTED SITES

DETAILED DATA
ON COILING DIRECTION
AND ABUNDANCES FROM
THE PACIFIC OCEAN
WERE SO FAR LACKING

PACIFIC ODP SITES 1209-1210



Shatsky Rise, Pacific Ocean (*Shipboard Scientific Party*, 2002. *Leg* 198, from Bralower *et al.*, 2002.

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RESULT AND DISCUSSIONS

PACIFIC ODP SITES 1209-1210

SHORT TERM FLUCTUATIONS recorded at Carbon Isotope Excursions *(CIEs)*

PERMANENT DECREASE in abundances of *Morozovella* at the J event

MARKED INCREASE in abundances of *Acarinina* at the J Event

Sensitive data removed because not yet published

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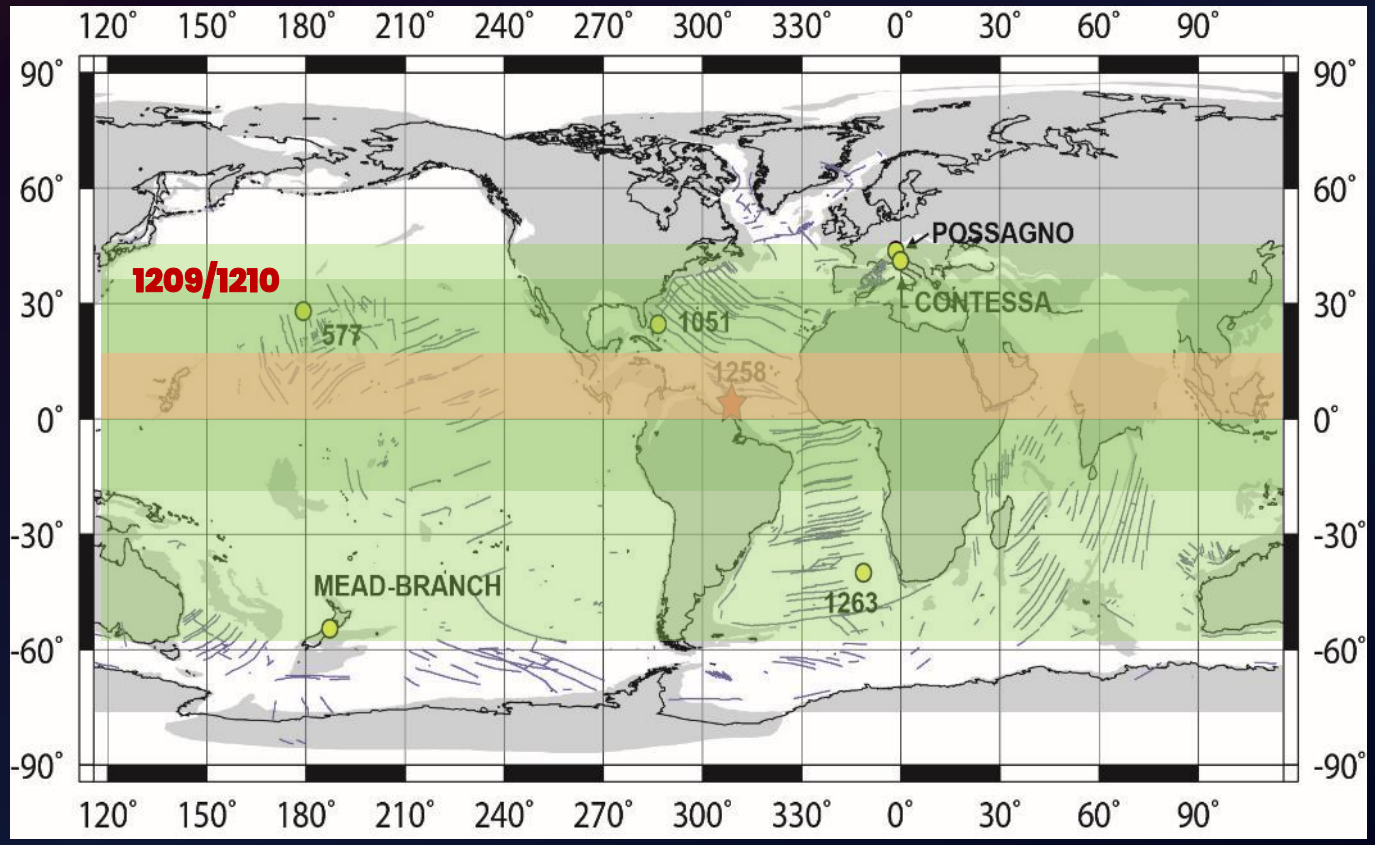
RESULT AND DISCUSSIONS

MOROZOVELLA DECREASES

~165kyr AFTER J Event — Temperate Atlantic Site 1263

AT J Event — Tropical Atlantic Site 1051; **TROPICAL PACIFIC SITE 1209/1210**

~ 20kyr BEFORE J Event — Equatorial Atlantic Site 1258



Data from Sites 1209 and 1210 CONFIRM that the permanent decline of *Morozovella* occurred ALSO AT THE PACIFIC OCEAN STARTING FIRST AT EQUATORIAL LATITUDES and then expanded to higher latitudes

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RESULT AND DISCUSSIONS

DRIVING CAUSES OF LARGE-SCALE TURNOVER

?

1 GENERA COMPETITION WITHIN THE MIXED-LAYER

→ better tolerance of acarininids to environmental variations

↓

acarininids dominated surface water habitats at the expense of morozovellids

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RESULT AND DISCUSSIONS

② REDUCED SYMBIOTIC RELATIONSHIPS (BLEACHING)

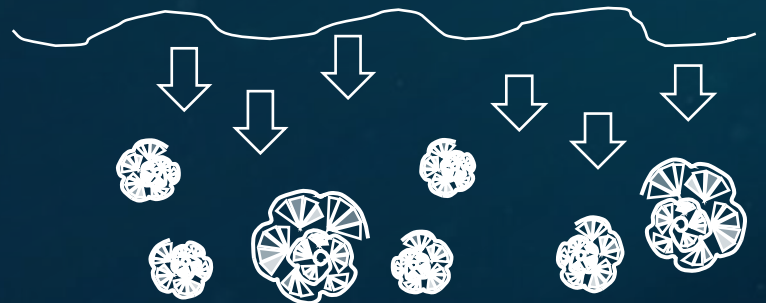
Across EECO:

REDUCTION in the **difference of $\delta^{13}C$** between *Morozovella* and *Acarinina*

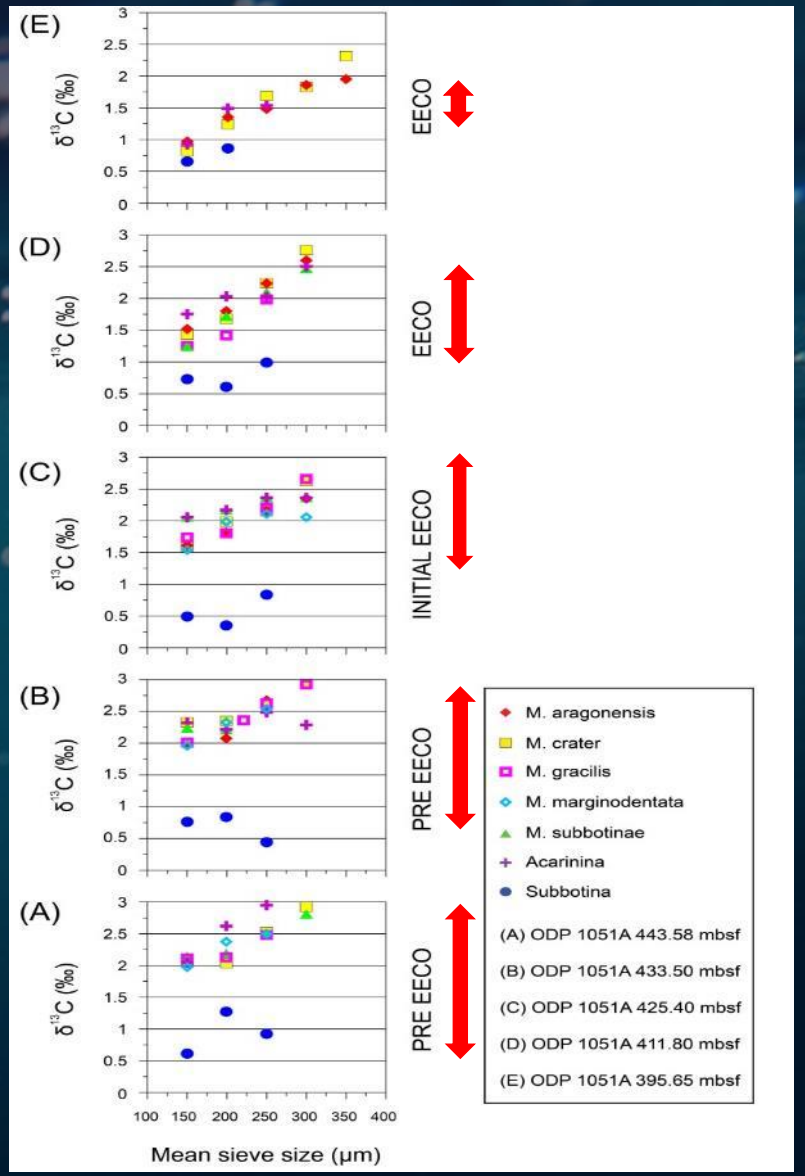
Morozovellids:

May have **REDUCED** their symbiotic relationships

May have lived **SLIGHTLY DEEPER** in the mixed-layer



Stable isotope data from Site 1051 *(Luciani et al. 2017 Paleoceanogr.)*



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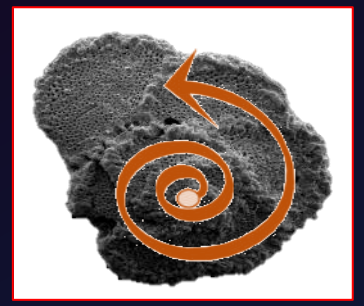
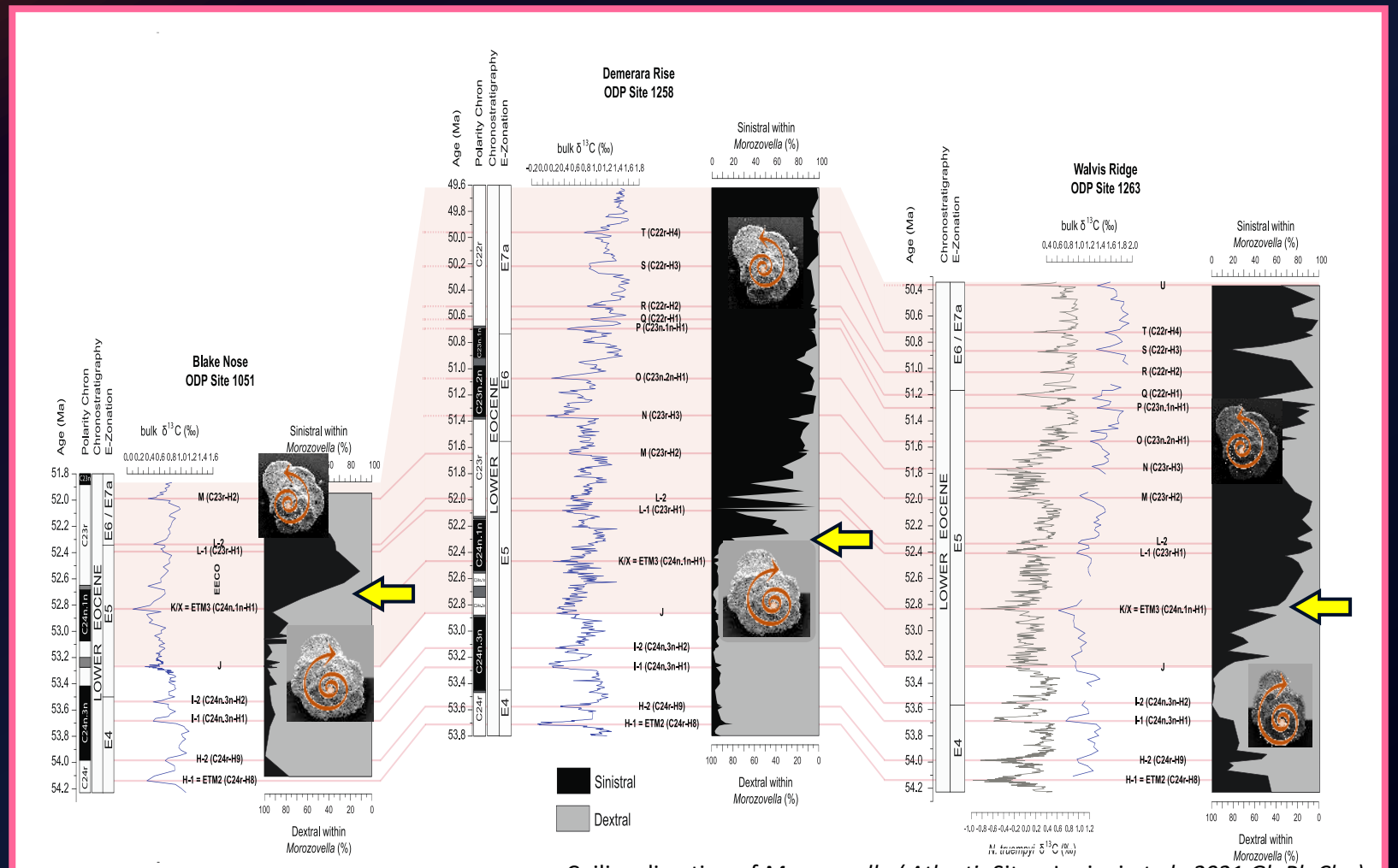
SECOND MAJOR CHANGE

Dextral



Sinistral



Coiling direction of *Morozovella (Atlantic* Sites; Luciani *et al., 2021 GloPlaCha)*

A CHANGE FROM DOMINANT DEXTRAL TO SINISTRALLY COILED MORPHOSPECIES (OR CRYPTIC SPECIES) OF MOROZOVELLIDS OCCURRED IN THE ATLANTIC OCEAN, WITHIN CA 200 KYR AFTER THE K/X EVENT

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RESULT AND DISCUSSIONS

SITE 1209-1210: COILING DIRECTION

Switch from dextral to sinistral after the K/X Event: **200 kyr of DELAY** with respect to Ocean Atlantic Sites

Sensitive data removed because not yet published

Sensitive data removed because not yet published

The sinistral morphotype demonstrated a **better resilience** to the EECO perturbations.

THIS IS AN IMPORTANT RESULT because it proves

THAT THE COILING SWITCH OCCURRED **DURING THE EECO IN THE PACIFIC OCEAN TOO**

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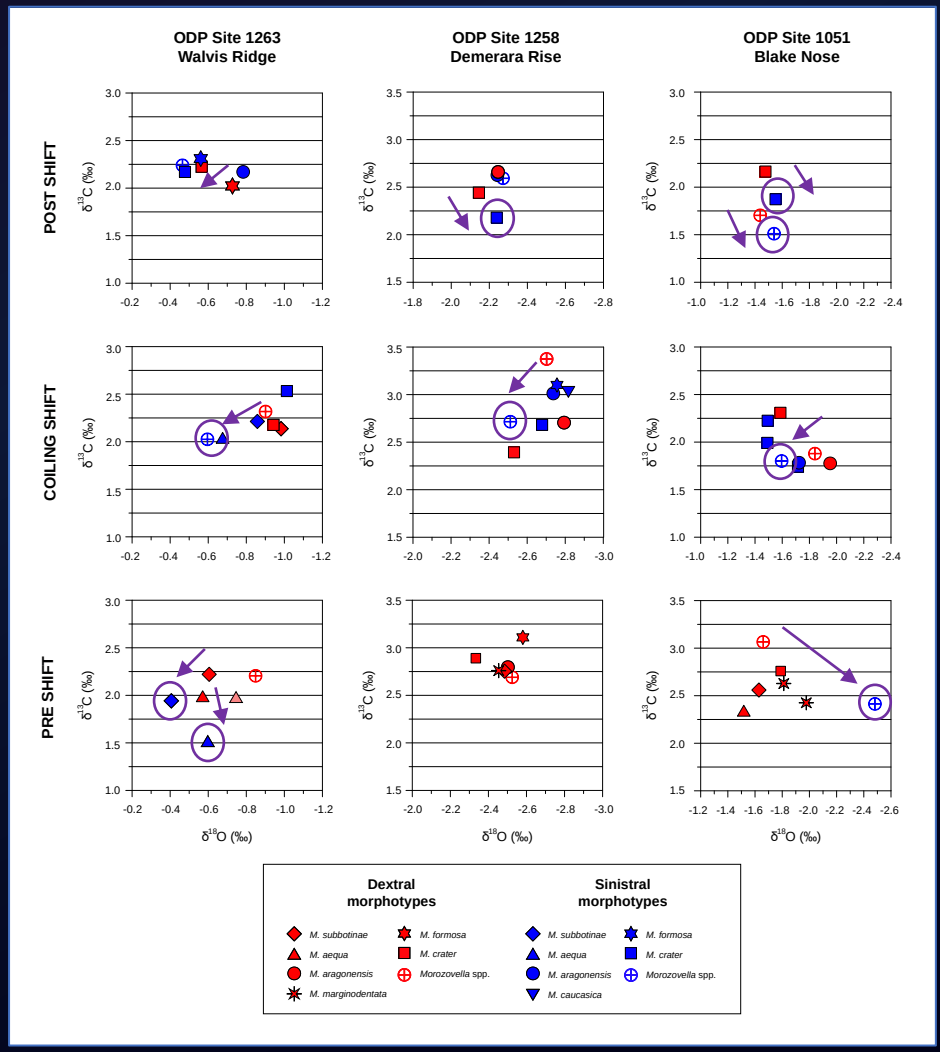
RESULT AND DISCUSSIONS

VARIATION IN COILING DIRECTION

- Additional Biostratigraphic tool
- Explained as both ecophenotypic or genetic response that may be related to the EECO environmental perturbations

Atlantic Ocean C and O stable isotopes show that SN forms have lower $\delta^{13}C$ values than DX morphotypes

This evidence confirms the hypothesis about **less dependence** on symbiotic relationships and/or a **slightly deeper habitat** for the SN forms that allow them to survive in the mixed layer



δ13C isotopic values of *Morozovella (Atlantic* Sites; Luciani *et al., 2021 GloPlaCha)*

CONCLUSIONS

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PALEOCOLOGICAL ANALYSIS

During the first ~800 kyr of EECO *Morozovella* reduced definitively the abundaces and changed coiling direction both in the Atlantic Ocean and Pacific Ocean

POSSIBLE EXPLANATIONS

- *Morozovella* was less able to tolerate the EECO environmental stress
- The survivors sinistral morphotypes (or cryptic species) proved to be more resilient by reducing the photosymbiosis relationships and deepening in the mixed layer habitat

THE EECO HEAVILY IMPACTED THE PLANKTIC FORAMINIFERAL ASSEMBLAGES:

THE GENUS *MOROZOVELLA* DEMONSTRATED TO BE LESS RESILIENT TO THE PROMINENT TEMPERATURE AND pCO_2 RISE

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THANKS FOR THE ATTENTION