

Hertentamen Marine Sciences 3

21 April 2016



NB1: Schrijf uw naam en studentnummer op *ieder* in te leveren blad

NB2: Maak uw antwoorden compleet maar vooral ook zo kort/to the point mogelijk;

gezwets levert geen punten op; eerder aftrek

NB3: Schrijf netjes: slecht leesbaar voor de docent is fout

NB4: Vergeet de digitale enquête niet in te vullen!

Succes!

Namens alle docenten, Appy

Naam:

Studentnummer:

Appy Sluijs (intro warming, acidification, anoxia)

1. The rise in greenhouse gas concentrations has prevented about 270 zetajoules of heat to radiate out to space. The oceans have taken up about 93% of this additional heat.

a. In which region(s) did this heat enter the oceans?

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b. Briefly explain your answer at 1a.

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2.

a. Name two of the most dominant drivers of modern ocean deoxygenation

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b. Briefly explain how these drivers operate

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Appy Sluijs (paleo)

1. Associated with the PETM is a negative shift in the stable carbon isotopic composition of ocean DIC, reflected in the sediments as a Carbon Isotope Excursion (CIE) towards lower values. The total duration of the CIE from start to end was approximately 170.000 years.

Figure 1 (from Sluijs et al. 2007, Nature) shows a paleoceanographical data set generated on sediments from a core taken on the New Jersey Shelf, USA, across the Paleocene-Eocene Thermal Maximum. Sediments dominantly comprise sand, silt and clay that have been transported by rivers to the shelf, and some carbonate and organic microfossils.

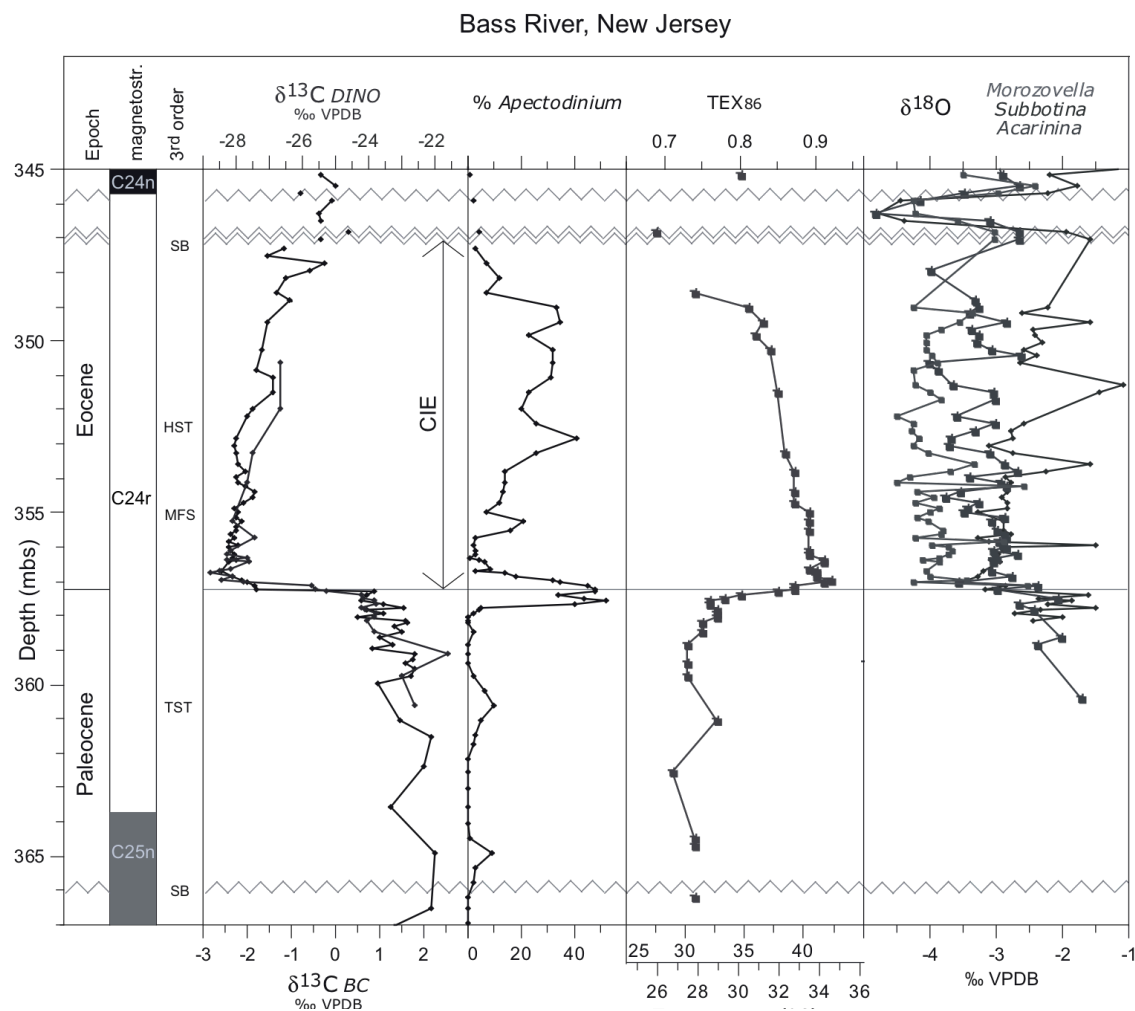


Figure. 1. Stable carbon isotope data on carbonate and dinoflagellates, percentages of the dinoflagellate *Apectodinium* relative to the total dinoflagellate assemblage, TEX₈₆ biomarker ratio and oxygen isotope ratio's of 3 planktic foraminifer species across the PETM in the Bass River Core. Mbs = meters below surface (depth in core). CIE = Carbon Isotope Excursion

- a. What dominant change do you observe in the planktic foraminifer $\delta^{18}\text{O}$ data at ~357 meters below surface (mbs)?

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Naam:

Studentnummer:

b. How do you explain this $\delta^{18}\text{O}$ change and the step towards higher TEX_{86} values?

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The genus *Apectodinium* appears in the geological record about 4 million years before the PETM but was restricted to low latitudes until the PETM.

c. What dominant changes do you observe in the abundance of *Apectodinium* in Figure 1?

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d. Formulate a hypothesis to explain these changes

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2. What is your favorite microfossil?

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Naam:

Studentnummer:

Francesca Sangiorgi (biology)

1. Let's talk about diatoms

a) Why do they undergo sexual reproduction?

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b) Why do they prefer high nutrients and high mixing zones? Give 3 reasons

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2.

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c) Why are diatom valves rarely found in the sediments?

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d) Where would you take ocean sediments to increase the chance of finding diatom valves?

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Naam:

Studentnummer:

Francesca Sangiorgi (Paleo)

1. If you were given money to **perform 3 types** of analyses in a sediment core, which contains a sapropel layer (but you do not see where it is), what analyses would you select or what proxy record would you like to generate? Why? And what trend of the proxy do you expect to see when you hit the sapropel layer?

Type 1: Analyses of

Because this indicates

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Within the sapropel layer I expect it to see

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Type 2: Analyses of

Because this indicates

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Within the sapropel layer I expect it to see

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Type 3: Analyses of

Because this indicates

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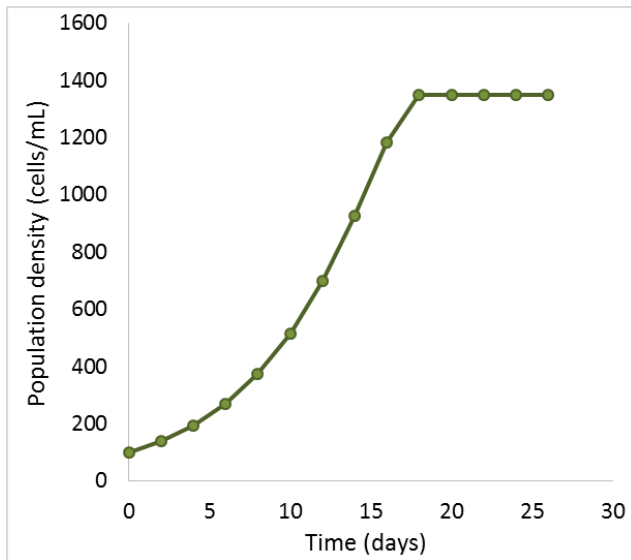
Within the sapropel layer I expect it to see

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Naam:

Studentnummer:

Dedmer van de Waal



1. The figure shows the development of an algal population grown towards nitrogen limitation in a simple batch experiment.

a) Describe the growth phases in this experiment

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b) Give two ways how a higher population density could be reached in this experiment

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c) Explain how pH will change in this experiment (note: nitrate is used as nitrogen source)

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Naam:

Studentnummer:

d) Explain how the C:N ratio of the algae will change during the course of the experiment.

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e) How may elevated pCO₂ affect the C:N ratio of the cells?

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2. Species A has a K_{1/2} for nitrate of 0.5 μmol L⁻¹, while for species B this is 0.2 μmol L⁻¹. Explain what K_{1/2} means, and which species is probably the better competitor for nitrate.

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Naam:

Studentnummer:

Douwe Maat

1. The proliferation of viruses in the marine environment is strongly affected by abiotic factors. A distinction can be made between direct and indirect effects on phytoplankton viruses. What is the difference between the two? Give one example for each

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2. a) Define the viral shunt

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b) In which way is the viral shunt hypothesized to reduce carbon export in the ocean?

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3. a) List 3 groups of microzooplankton

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b) Why is there usually a closer coupling between phytoplankton prey with micro-zooplankton grazers than between phytoplankton with mesozooplankton grazers?

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Naam:

Studentnummer:

4. a) List 3 strategies of bacterial defense against flagellate grazers

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b) Describe a process that allows coexistence of different bacteria, even with the bacteria that are less competitive under ruling abiotic (bottom-up) conditions

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5. In the lectures by Appy you learned that vertical stratification can enhance carbon export, but in the lectures by Douwe you learned that carbon export can be greatly reduced in stratified regions. Explain the difference between the two and use the words 'physical' and 'biological carbon pump'

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Naam:

Studentnummer:

Dick van Oevelen

1a. Describe Charles Darwin's paradox for warm- and cold-water corals and provide an explanation for each of them.

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2. Cold-water corals are hotspots of biodiversity and metabolic activity in the deep sea and we have only just beginning to describe their distribution and function. At the same time, we realize that these ecosystems are subjected to several global changes. What are the two most important global changes, related to the environment of cold-water corals, that will negatively impact cold-water coral reefs? In your answer, describe what the effect(s) of each of these global changes will be

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Naam:

Studentnummer:

Sabine Gollner

1. How many % of the earth's oceans are considered deep sea? (1 point)

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2. What are mid-ocean ridges? (1 point)

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3. What mineral deposits are typically associated with hydrothermal vents? (1 point)

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4. At hydrothermal vents, chemosynthetic bacteria are found free-living and in symbiosis with macrofauna. Name one example of endosymbiosis (give also the Latin name) and shortly explain where the symbionts are found. (2 points)

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5. What is the largest benthic ecosystem in the deep sea? Name three abiotic characteristics. Is faunal diversity high or low in this ecosystem? (5 points).

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Naam:

Studentnummer:

Lennart de Nooijer

1. Which two types (related to their lifestyle) foraminifera exist?

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2. Where would you expect to find them? What controls the accumulation of the two types in sediments?

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3. How could you use the abundances of the two types as a paleo-proxy? And what can you reconstruct with it?

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