Tentamen Marine Sciences 3

28 January 2016

MAYBE WE SHOULD JUST GO TO THE PARK.

NB1: Schrijf uw naam en studentnummer op *<u>ieder</u>* 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. How much of this additional heat has been taken up by the oceans?

a. about 60%

b. about 72%

c. about 85%

d. about 93%

2. The Biological Pump consists of the organic carbon pump and the carbonate pump.

a. Briefly explain why one of these two results in CO2 export to the deep sea and the other to CO2 outgassing to the atmosphere.

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b. How does an increase in CO_2 concentration affect these two pumps?

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Naam: ***Studentnummer:***

Appy Sluijs (paleo)

1. Figure 1 (from Zachos et al. 2008) shows a compilation of deep ocean benthic foraminifer $\delta^{18}O$ generated on ocean drilling program sites from various ocean basins.

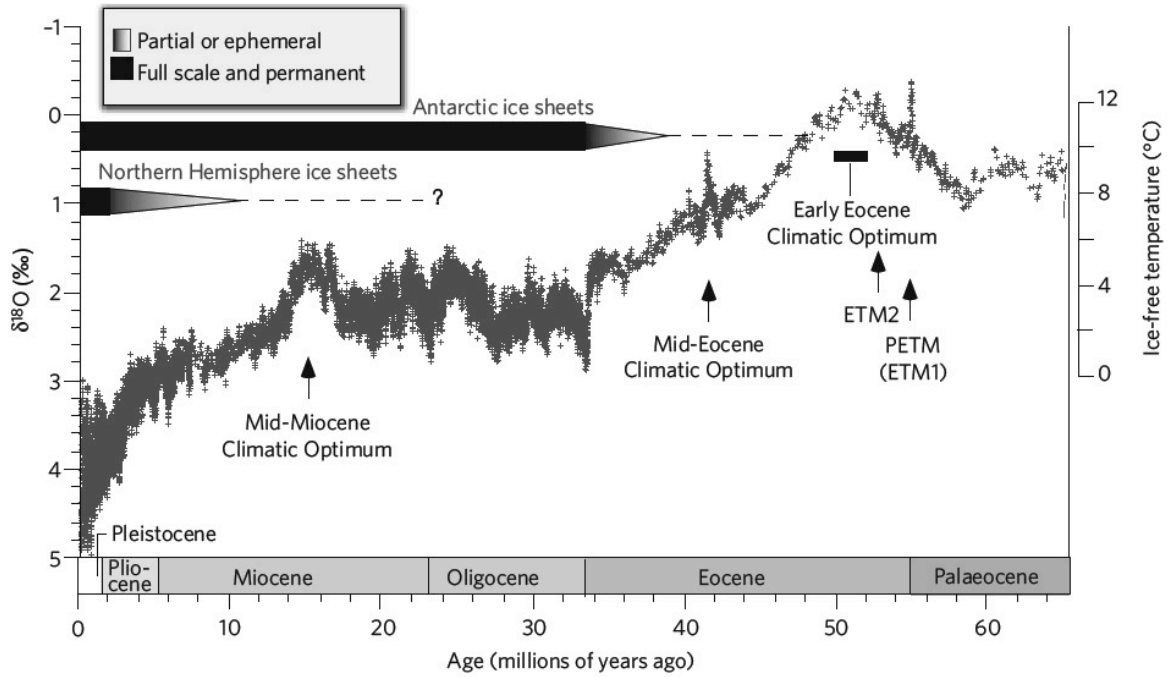

Figure. 1. Deep sea benthic foraminifer stable carbon and oxygen isotope compilation across the Cenozoic (from Zachos et al., 2008).

a) One massive episode of change apparent from this data occurs a little less than 34 million years ago, close to the Eocene-Oligocene boundary. Describe the signal in this record and explain it.

Description:

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Explanation:

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Naam: ***Studentnummer:***

The scale on the right side of the figure represents the temperature of the deep sea.

b) Why would this record be a proxy for the temperature of the deep sea?

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c) Why does this temperature scale not extend down to $\delta^{18}O$ values as reconstructed for the Pliocene and Pleistocene?

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2. Significant expansion of Antarctic ice sheets occurred during the Oligocene-Miocene transition, about 23 million years ago. Ice sheets and glaciers reached to Antarctica's shorelines.

a) Which biological or physical indicators of this event might you expect to see in sediments deposited close to Antarctica? Name at least 3 and very briefly explain. (isotopes are chemical indicators)

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b) What is your favorite microfossil?

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Naam: ***Studentnummer:***

Francesca Sangiorgi (biology)

1. "Dead zones are mostly found in the coastal areas":
a) What is a dead-zone?

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b) Why do dead zones mostly occur in coastal areas?

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c) What are the 2 main factors triggering the formation of a dead zone?

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Naam: ***Studentnummer:***

2. Complete the table: put an X in the cells for the correct combination(s) of group of phytoplankton and wall composition. Give a rating for nutrient and turbulence affinity for the 3 groups (1 will be the group with IN GENERAL the highest affinity, 3 the group with IN GENERAL the lowest affinity)

	Siliceous wall	Calcareous wall	Organic wall	Nutrients	Turbulence
Diatoms					
Dinoflagellates					
Coccolithophores					

3. At the end of the workshop "phytoplankton of the future" I asked each of you to choose the group, which in your view had the highest change of surviving in the ocean of the future among Cyanobacteria, Diatoms, Dinoflagellates and Coccolithophores. You chose either Cyanobacteria or Dinoflagellates. Given you are still convinced of your choice, answer the following questions

a) What did you chose?

b) List 3 reasons why you made that choice (3 advantages of that group)

1.

2.

3.

c) List 2 reasons why you did not chose the other group (2 disadvantages)

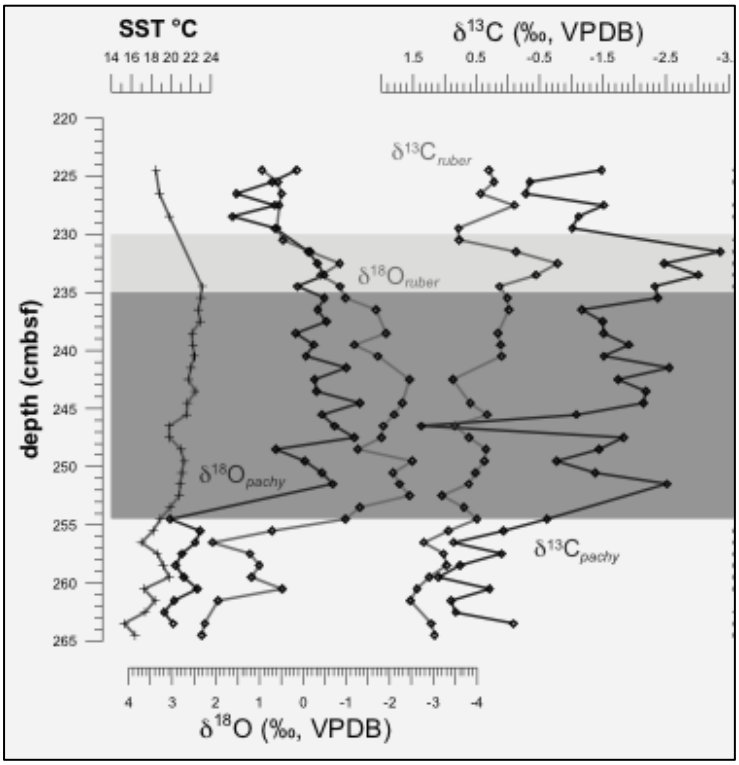
1.

2.

Naam: ***Studentnummer:***

Francesca Sangiorgi (Paleo)

1. The following plot comes from the analysis of one core located in the open Eastern Mediterranean and containing sapropel S5 (~ 125,000 years BP). The sapropel interval is in dark grey



a) Why do the $\delta^{18}O$ of *G. ruber* and *N. pachyderma* both shift towards lower values in the sapropel?

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b) Why is the $\delta^{18}O$ of *G. ruber* more negative than the $\delta^{18}O$ of *N. pachyderma?*

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Naam: ***Studentnummer:***

2. Consider the present-day ocean circulation in the Mediterranean Sea. What changes in ocean circulation occurred during sapropel formation and why?

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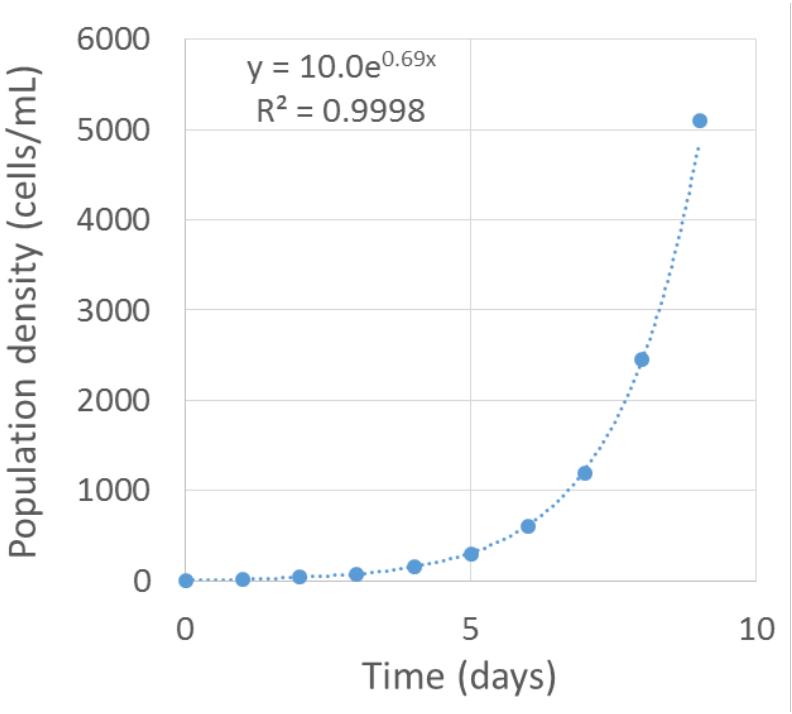
Naam: ***Studentnummer:***

Dedmer van de Waal



1. The above figure shows the development of an algal population in a simple batch experiment.

a) What is the observed growth rate (incl. correct units)?

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b) With how many cells did this experiment start (incl. correct units)?

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How many divisions does this algae have per day?

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Naam: ***Studentnummer:***

2. During the growth of this algae, various conditions will change, including the carbonate chemistry. Assume a non-calcifying algae having nitrate as a nitrogen source:

a) Explain what happens to the pH

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b) Explain what happens to alkalinity

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c) Explain what happens to pH if the nitrate is replaced by ammonium.

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3. Give three examples of how climate change may cause an increase in the carbon:nutrient ratio of phytoplankton.

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Naam: ***Studentnummer:***

Douwe Maat

1. a) Give the definitions for:

(i) Viral latent period:

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(ii) Viral burst size:

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b) Consider a virus that infects an r-selected phytoplankton host. What characteristics in latent period (short/ long) and viral burst size (high/ low) will this virus likely have? Why?

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2. a) Some mesozooplankton groups display vertical migration. Indicate the difference in underlying mechanism (cause) between diel (daily) and seasonal migration.

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Naam: ***Studentnummer:***

b) How does seasonal migration/ copepod development differ between polar and temporal regions?

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3. In a specific marine system, nitrogen uptake rates in the photic zone are as follows: ρNO_3=0.56 mmol m^{-2} d^{-1} and ρNH_4=0.14 mmol m^{-2} d^{-1}. The F-ratio can be calculated by dividing nitrate uptake by total nitrogen uptake.

a) Calculate the F-ratio, explain what this means and what kind of marine system this likely concerns

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b) Uptake of which other nitrogen component could affect the F-ratio? In what way? (different answers possible)

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4. Chose a specific ecologically important group of marine bacteria: state and describe its metabolism classification (source of energy, carbon and electrons), and specify its niche in relation to phytoplankton.

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Naam: ***Studentnummer:***

Dick van Oevelen

1a. Charles Darwin verbaasde zich erover dat tropische koraalriffen konden bestaan in een oceaan die zeer arm was in voedingsstoffen. Geef de twee verklaringen die later onderzoek hebben aangetoond waardoor koraalriffen in de zgn desert toch kunnen bestaan.

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1b. Vlakbij een tropisch koraalrif wordt een vakantieoord met strand aangelegd. Voor het strand wordt wit zand van verderop aangevoerd en geeft vertroebeling van het zeewater. Schadelijke microben in het rioolwater van het vakantieoord zullen worden gedood maar de organische en inorganische voedingsstoffen zullen in de buurt van het rif geloosd worden. Geef aan hoe je denkt dat deze aanleg van dit vakantieoord het koraalrif kan beïnvloeden.

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2. Experimenten tonen aan dat koud-water koralen kunnen groeien bij een aragonite saturation state van rond of zelfs lager dan 1.
a) Leg uit waarom dit verbazingwekkend is.
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b) Leg uit hoe koud-water koralen toch nog kunnen blijven groeien en geef aan wat de gevolgen hiervan zijn voor de koralen.
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Naam: ***Studentnummer:***

Sabine Gollner

1.What is the mean depth of the oceans? (1 point)

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2.What is a seamount and which mineral deposits are typically associated? (2 points)

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

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4.Deep-sea hydrothermal vent macrofauna communities are typically species poor but high in abundance and biomass. Name three abiotic factors that select for a small number of species. Is primary production at vents high or low and why? (5 points)

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Naam: ***Studentnummer:***

Lennart de Nooijer

1. The skeletons (tests) of foraminifera are often used as proxies to reconstruct past environments. What makes foraminifera such popular and useful proxies?

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2. Give 3 examples of proxies based on foraminifera, explain the fundamental principles on which these proxies are based and what you can reconstruct with them?

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3. Calcification by foraminifera is influenced by the presence of Mg ions in seawater. How did the ratio of seawater $[Mg^{2+}]/[Ca^{2+}]$ and changes therein affect foraminiferal calcification over the last ~500 million years?

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