

Paleo MSc-exam 3 Nov.2009 Min. 012/019

1.

a) Give a list of proxies you may use to determine the paleoproductivity. Explain the principle of each method briefly.

b. Which proxy(ies) would you prefer in areas of high productivity and which proxy(ies) in areas of low productivity?

b) Some of the paleoproductivity proxies (or group of proxies) can also be used as paleo-oxygenation proxies. List all possible paleo-oxygenation proxies.

(12 pt.)

2.

a. What factors influence the $\delta^{13}\text{C}_{\text{carbonate}}$ for planktonic foraminifera ?; explain briefly, indicating the qualitative effect.

b. What factors influence the $\delta^{13}\text{C}_{\text{carbonate}}$ for benthic foraminifera ?; explain briefly indicating, the qualitative effect.

c. Is there usually a difference (or not) in the $\delta^{13}\text{C}_{\text{carbonate}}$ for planktonic and benthic foraminifera from the same deep-sea core-top sample ?; explain briefly why not, or what qualitative difference you expect and why.

d. would your answer be different for a sample from the same site but for the Last Glacial Maximum; motivate why/why not.

e. under what circumstances would you expect differences between answers c and d.

(15 pt.)

3.

After deposition, often oxic degradation results in the partial removal of Organic Matter (OM). If a substantial amount of OM has been removed from a sediment sample, then answer the following questions. Always give a brief motivation and if possible give a direction of change.

a. what is the likely qualitative effect for the sediment CaCO_3 content ?

b. what is the likely qualitative effect for the sediment opal content ?

c. what is the likely qualitative effect for the ratio of terrestrial OM versus marine OM

d. what is the likely qualitative effect for the $\delta^{13}\text{C}_{\text{OM}}$

e. is the likely qualitative effect for the sediment barium content ?

f. what are the two main sedimentary barium components; is each equally influenced ?

(13 pt.)

4.

Explain or give a definition in your own words of:

a) Ice elevation feedback

b) Equilibrium line (in context of glaciers)

c) Ice albedo feedback

d) Coral reef hypothesis

(10 pt)

5. Using the methane concentration of the gas bubbles trapped in ice Thomas Stocker correlated Greenland and Antarctic ice core records. This correlation showed that climate at the poles was in anti-phase on a millennial time scale.

- a) The stable oxygen isotope composition of ice is a proxy for what?
- b) Why was methane used for correlating the ice cores?
- c) What caused the observed anti-correlation according to Stocker?

According to McManus et al. (1999) the occurrence of circulation changes during interglacials suggests that a binge-purge ice berg discharge mechanism cannot explain the observed variability.

- d) Explain why and what alternative mechanism could explain the observed changes? (more than one answer possible)

(20 pt)

6. The El Niño-Southern Oscillation.

- a) Explain what a La Niña event is.

The typical periodicity of in El-Niño events has been attributed to two different mechanisms: the coupled oscillator and the recharging theory.

- b) How do these two theories relate to the observed “glacial dampening” by Tudhope et al. (2001).

The reconstruction of El Nino cyclicity in the western pacific warm pool relies on analyzing stable oxygen isotopes in coral records.

- c) Explain how El Nino events influence the isotopic signature of corals in the western pacific warm pool, e.g. offshore Papua New Guinea.

Also records from other locations are frequently used for reconstructing El Nino cyclicity in past. In different places the impact of El Nino is obviously different.

- d) Give 2 examples from other locations where El Nino cyclicity could be reconstructed and explain which proxies could be used

(18 pt)

7. The incorporation of trace metals in biogenic carbonates (mainly) depends on 1) the sea water ratio of this trace metal to calcium, 2) the crystal structure and 3) for some elements sea water temperature.

- a) The incorporation of which two elements in biogenic carbonate are often used as temperature proxy and in which crystal structure.
- b) The application of Mn incorporation in benthic foraminiferal tests in the reconstruction of bottom water oxygenation is based on what?

In addition to the 3 main factor mentioned before, also pH and salinity potentially influence trace element incorporation. The pH is influenced not only by seawater chemistry but also by the biological processes taking place in the micro environment of the foraminifer itself.

- c) Explain how pH in the foraminiferal microenvironment changes. (hint: consider calcification and respiration)

(12 pt)

BONUS QUESTION

- d) Explain why the oxygen isotopic signature of foraminiferal test carbonate changes as a function of the organisms biology.

(3 pt)