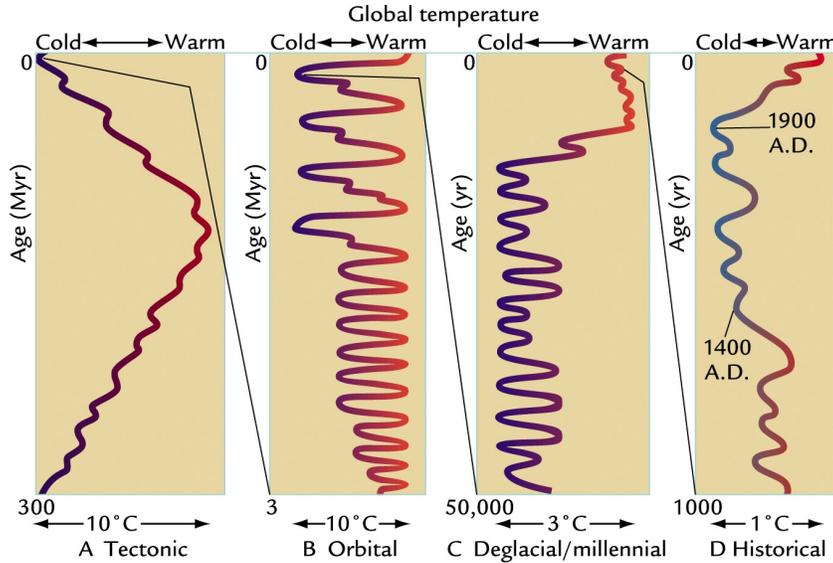


Paleoclimatology - Review for exam 1 on Chapters 1-6.

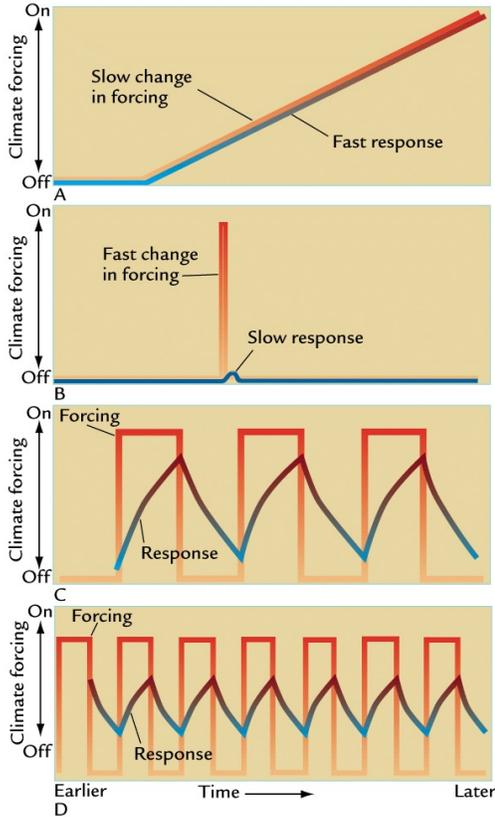
Chp 1

1. Examine the following figure to determine which of the statements is correct.



- a. Regardless of the scale, global temperature changes display a regular, cyclic pattern.
 - b. Rapid climate change is characteristic of large-scale (tectonic) climate trends.
 - c. Millennial climate variations are resolvable on tectonic time scales.
 - d. Historical changes in global temperature are small relative to those that have previously occurred during Earth's long history.
2. Climate differs from weather in that
- a. Climate is a broad composite temperature conditions, while weather addresses temperature as well as precipitation, snow and ice cover, and wind conditions.
 - b. Climate change occurs over longer durations than do weather changes.
 - c. Climate change is exclusively global, whereas weather is exclusively regional.
 - d. Climate and weather do not differ, they are interchangeable terms.

3. Examine the following figure and decide which of these diagrams could schematically represent the response of vegetation on a continent that is shifting latitudes because of plate tectonic motion.



- A
 - B
 - C
 - D
 - Both C and D
4. Examine the previous figure and decide which of these diagrams could schematically represent day-night atmospheric temperature cycles on Earth.
- A
 - B
 - C
 - D
 - Both C and D
5. Past climate change
- Informs scientists about climate drivers and system interactions, which are necessary for predicting future climate change
 - Occurred only in the last 300 million years
 - Has been influenced by both natural and anthropogenic drivers
 - All of the above
 - Both A and C

Chp 2

6. Consider the study of past climate change and determine which of the following is (are) correct.
 - a. The resolution of climate archives is generally greater in the recent past than for the distant geologic past.
 - b. The types of climate archives available are generally more diverse in the recent past than they are for the distant geologic past.
 - c. Climate proxies allow scientists to directly read the temperature of the past.
 - d. Both A and B are correct.
 - e. None of the above is correct.

7. The half-life of the radioactive isotope Carbon-14 decaying to the stable isotope Nitrogen-14 is 5780 years. Measuring the amount of parent and daughter isotope in a particular organic sample indicates a parent to daughter ratio of 1:3. The age of the sample is
 - a. 1926 years old
 - b. 2890 years old
 - c. 11,560 years old
 - d. 17,340 years old
 - e. Cannot be determined because carbon-dating is only useful for dating material >100 Myr

8. Ice cores are valuable climatic archives because
 - a. Annual layers are often resolvable, enabling age determination and correlation
 - b. The ice contains geochemical proxies of atmospheric composition and temperature of the past
 - c. The geographic distribution of coring sites ranges from the tropics to both polar regions
 - d. All of the above
 - e. Both A and B

9. The science of reconstructing past climates advances best when
 - a. Mismatched data from geologic archives and model outputs are disregarded or thrown out
 - b. Climate models strive toward using the largest grid box possible
 - c. The strengths and limitations of both the data derived from geologic archives and the models are constantly tested against one another
 - d. All of the above
 - e. Both B and C

Chp 3

10. The greenhouse effect
 - a. Keeps Earth's average temperature such that liquid water can exist at Earth's surface
 - b. Describes the process by which incoming solar radiation is trapped in the atmosphere
 - c. Is a synonym for global warming
 - d. All of the above
 - e. None of the above

11. Chemical weathering of silica-rich rocks on the continents by hydrolysis
 - a. Adds silica to the atmosphere
 - b. Adds CO₂ to the atmosphere
 - c. Transfers carbon-containing ions to the ocean where they are later stored in the shells of marine plankton
 - d. Transfers silica-containing ions to the ocean where they are later stored in the shells of marine plankton
 - e. Both C and D

12. Atmospheric water vapor
 - a. Is part of a negative feedback, in which more water vapor leads to cooler temperatures
 - b. Is the most important greenhouse gas in the atmosphere today
 - c. Is controlled by chemical weathering
 - d. Concentrations are fairly uniform globally
 - e. None of the above

13. Supporters of the Gaia hypothesis argue that
 - a. Life evolved for the purpose of regulating Earth's climate
 - b. Living organisms played a significant role in regulating Earth's climate
 - c. Chemical weathering is strictly biologically controlled
 - d. All of the above
 - e. Both A and B

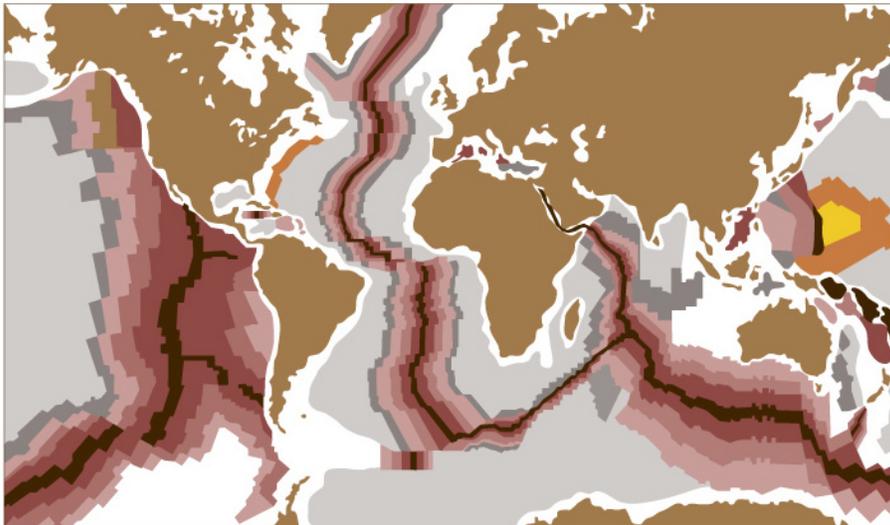
14. Earth's early atmosphere became oxygenated
 - a. After multi-celled algae evolved
 - b. By 4.4 Byr, due to volcanic outgassing of greenhouse gasses
 - c. By 2.3 Byr, as indicated by the widespread appearance of oxidized iron minerals in the geologic record at this time
 - d. Both A and B
 - e. Both A and C

15. Which of the following changes in the organic carbon cycle would cause rapid reductions of CO₂ in the atmosphere and therefore climate cooling?
 - a. High productivity
 - b. Rapid, widespread burial of organic carbon
 - c. Rapid, widespread recycling of organic carbon
 - d. Both A and B
 - e. Both A and C

16. Why has Earth remained habitable throughout its history?
 - a. Because chemical weathering of continental rocks both responds to and modifies the level of CO₂ greenhouse gases in the atmosphere over geologic time scales
 - b. Because it is exactly the right distance from the Sun
 - c. Because Earth is balanced between warming and cooling as it rotates on its axis
 - d. Because the incoming radiation from the Sun has been consistent over time
 - e. Both B and D

Chp 4

17. A negative magnetic anomaly indicates
- A time period of reversed polarity in geologic record
 - The position of a continent
 - That Earth's magnetic at the time the rock formed was aligned similar to that of today's magnetic field
 - None of the above
 - Both B and C
18. The solid Earth is differentiated into layers. Which of the following is a correct statement about these layers?
- The continental crust includes part of both the lithosphere and asthenosphere.
 - The density of oceanic crust is greater than that of continental crust.
 - The density of the crust is greater than that of the mantle.
 - The lithosphere is partially molten, whereas the asthenosphere is a hard, ridged layer.
 - All of the above are correct.
19. Examine the following figure and determine which of the following statements about seafloor spreading is correct.



Age (Myr) 0-5 5-21 21-38 38-52 52-65 65-140 140-160 > 160

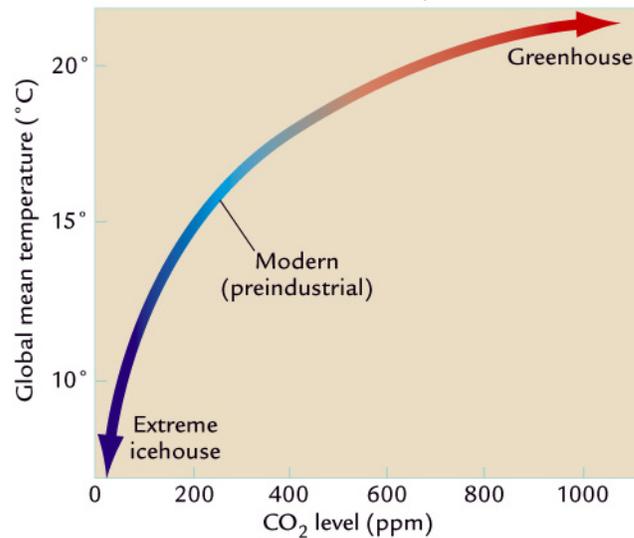
- The spreading rate is uniform everywhere in the world's oceans during the last 5 Myr.
- The only oceans that existed before 160 Myr were located in the western equatorial Pacific.
- Plate motion occurs at the same rate but in opposite directions perpendicular to the ridge.
- All of the above are correct.
- None of the above is correct.

20. Modern ice sheets exist at high latitudes because of
- Cold temperatures caused by high angles of incoming solar radiation
 - Low albedos resulting from the low reflectivity of snow and sea ice
 - Sufficient moisture supply to maintain ice sheets despite any melting that occurs along ice margins
 - All of the above
 - Both A and C
21. The BLAG spreading rate hypothesis
- Proposes how Pangea formed
 - Proposes how continents move into polar positions
 - Proposes how plate tectonic-control processes controlled CO₂ atmosphere and ocean input, and thus influenced long-term global climate trends
 - Proposes how hot spots form
 - Both A and B
22. Chemical weathering increases when
- There is an increase in the rate of physical weathering
 - Continental collisions create high uplifted plateaus
 - Internal feedbacks are triggered by an increase in the rate of seafloor spreading
 - All of the above
 - Both A and B
23. Why is chemical weathering faster in the eastern Andes than in the Amazon lowlands?
- The eastern Andes are wetter than the Amazon lowlands.
 - The eastern Andes have more fresh rock exposed than do the Amazon lowlands.
 - The eastern Andes cover a larger geographic area than the Amazon lowlands.
 - All of the above are correct.

Chp 5

24. Characterizing the Cretaceous climate, the geologic record indicates
- Warmer temperatures globally
 - A time of low rates of seafloor spreading
 - A latitudinal temperature gradient that was greater than today's gradient
 - Lower sea level
 - Both A and C
25. Which of the following causes relative global sea level to rise?
- Slower rates of seafloor spreading
 - Global cooling
 - Ice sheet formation
 - Thermal expansion of water molecules
 - Both B and C

26. What do the GCM sensitivity test results summarized in the following figure show?



- a. Greater warmth for higher CO₂ concentrations
 - b. A linear relationship between CO₂ and global mean temperature
 - c. That a doubling of pre-industrial CO₂ levels would increase global mean temperature by about 1°C
 - d. All of the above
 - e. Both A and B
27. What evidence is there for an asteroid impact 65 Myr ago?
- a. Sediments containing grains of quartz with shocked lamellae texture
 - b. Ocean sediments containing a layer enriched in Iridium
 - c. Discovery of the intact asteroid in the Yucatan Peninsula, Mexico
 - d. All of the above
 - e. Both A and B
28. The long-term (many thousands to millions of years) effects of an asteroid impact on climate include
- a. Atmospheric cooling because of soot and dust production
 - b. Atmospheric warming because of higher CO₂ levels
 - c. Atmospheric warming because of the heat generated by the impact itself
 - d. Both B and C
 - e. No significant long-term effects on climate
29. Which of the following characterizes climate 55 Myr ago?
- a. Rapid and abrupt warming in the oceans and on land
 - b. Greater warming in the low latitudes than in the high latitudes
 - c. Rapid global warming followed by equally rapid global cooling
 - d. All of the above
 - e. Both A and C

Chp 6

30. The tectonic uplift of the Tibetan Plateau and the Himalayas
- Produced a unique high elevation area in the Cenozoic
 - Resulted in increased rates of sediment accumulation in the northern Indian Ocean
 - Resulted in the development of a strong monsoon system
 - Occurred ~15 Myr
 - All of the above
31. The modern glacial ice
- Is more enriched in oxygen-18 than is the ocean
 - Is more depleted in oxygen-16 than is the ocean
 - Has the same oxygen-isotope signal as the ocean
 - None of the above
 - Both A and B
32. Tectonic-scale processes affecting climate
- Occur at very slow rates
 - Occur on human-time scales
 - Initiate only negative feedbacks
 - Will likely be the primary driver of climate change in the next 100 years
 - All of the above

Short Answer Questions

Describe and sketch one positive and one negative feedback loop in the climate system.

Explain how changes in the rate of chemical weathering could impact Earth's temperature. Are these positive or negative feedback loops and how do they work? Compare hydrolysis with dissolution in their ability to remove CO₂ from the atmosphere.

What are Earth's major carbon reservoirs and estimate the approximate amount of carbon stored in each in gigatons. Which of the carbon reservoirs exchange significant amounts of carbon over: (a) years to decades? (b) centuries to millennia? (c) millennia and longer? Approximately how much carbon is exchanged between these reservoirs in gigatons per year.

What is a reasonable rate of sea level rise over the coming centuries?

What are 4 internal and one external climate forcings?

How has atmospheric CO₂ concentrations varied over the last 3 glacial cycles? Compare this with sea level? Ice volume? Sketch a graph of these 3 variables over the last half million years.

How have humans impacted the climate system?

Explain the difference between external and internal forcing and give examples of both.

Why does sea ice respond faster to climate change than land based ice sheets?

What is the albedo of sea ice vs. open ocean?

Rank the response times of the atmosphere, ice sheets, sea ice, vegetation, surface ocean, land surface, and deep ocean.

How do changes in temperature, precipitation, and vegetation change weathering rates?

Diagram and explain one positive and one negative climate feedback.

At what timescale do changes in sea floor spreading rates impact the earth's climate system?

When was the last glacial maximum (i.e. the peak of the last ice age)?

What was the Little Ice Age and when did it occur? What might have caused it?

During the peak of the last ice age – the last glacial maximum – how much lower was sea level?

Sketch a graph of sea level, ice volume, Atmospheric CO₂, summer insolation (65°N) and winter insolation (65°N).