

FINAL WRITING ASSIGNMENT

Geology 121, Spring 2020

Important Note

I understand that this continues to be an incredibly challenging time for us all. You may have very limited time or attention, depending on your personal circumstances. Therefore, **this final assignment will only be graded on completion**. I encourage you to put as much effort into this as you are able, but please know that your course grade will not suffer if you are unable to do more than the basics.

Introduction

There are **two parts** to the final assignment. The first part asks you to reflect on what you have learned over the semester by making connections between the course content and two articles written about Snowball Earth. The second asks you to reflect on ways in which learning about the Earth's surface may have affected how you think about your relationship to the landscape and the values that guide your decisions and actions.

Due Date

Friday, May 15 at 11:59 PM in your local time zone.

Extensions

If you think you might need an extension, please be in touch as soon as possible. The situation is different depending on your class year.

For first- through third-year students: Extensions will require permission of your class dean after you and I decide on the extended deadline.

For seniors: In order for you to graduate on time (i.e., with the class of 2020), I must submit your grade on Monday, May 18. If an extension is required to complete the course, you would graduate with the class of 2021E this fall. If you think this is going to be necessary, please contact me ASAP. We will also need to be in touch with your class dean.

1. The Snowball Earth Hypothesis

For me, one of the most fascinating chapters in Earth history is the story of the Snowball Earth. There are several times in the deep past when geological evidence suggests that the surface of the oceans froze over from the poles to the equator and stayed that way for millions of years, with the most recent of these Snowball Earth episodes ending 635 million years ago. This bizarre state of the Earth's climate has always captured my imagination. It is a particularly relevant topic for our class in that it involves many of the aspects of the Earth system we have learned about this semester.

For this part of the final assignment, you need to do some background. First, watch a 10-minute video in which Prof. Dan Schrag explains the fundamentals of the Snowball Earth hypothesis. Second, read the *Scientific American* article by Schrag and Paul Hoffman that goes into greater detail.

After working through the introductory material you will be ready to write. I'm interested in reading about the intellectual connections you make between the material in Surf and the Snowball Earth hypothesis.

A. For each of the following **feedbacks**, explain a) what your understanding is of the feedback in general, and b) how it applies to the Snowball Earth hypothesis:

ice albedo feedback

silicate weathering feedback

B. Explain what you understand to be the puzzle about the association of **glacial sediments overlain by marine carbonate rocks**. Try to address each of the following in your answer:

how do you recognize a glacial sedimentary deposit?

in what kinds of environments are shallow water carbonate rocks usually formed? why?

how does the Snowball Earth hypothesis reconcile the association of these two deposits? what is the origin of the cap carbonates, and how does it relate to the feedbacks you described in part A?

The goal of this writing is to extend what you have learned about the Earth system. You will review some of the key concepts of the course and apply them to a new geological situation.

If you are feeling interested in learning more and have the bandwidth, read the article on Snowball Earth, volcanoes, and albedo. Then do part C. *Your grade will not be based at all on completing part 1C.*

C. Previously, we have thought about the possible **effects of massive volcanism on climate**. In particular, we asked if the eruption of the Franklin LIP could increase global weatherability and reduce atmospheric CO₂ in order to initiate Snowball Earth. This additional *Scientific American* article reports on a different possible climatic effect of the Franklin LIP. How do you understand this process to work? What is the key mechanism for destabilizing the climate and initiating a Snowball Earth?

There are not set length expectations for your responses to Part 1.

2. Places and Values Revisited

One set of goals for our course has to do with “Caring and Values”, articulated as follows:

- Develop a relationship to, and responsibility for, the natural landscapes you inhabit, as well as those you will never visit.
- Use scientific knowledge and process to inform your thinking about the roles humans take in shaping the landscape, altering the climate, and interacting with the rest of the biosphere.

You may recall that in your first writing assignment of the semester you wrote about a particular place to which you feel connected. It is my hope that by this point in the semester you might have some new ways of seeing that place, or new questions about that place, informed by what you have learned about Earth surface processes.

For this part of the assignment, I want you to write about your place again. Identify at least one specific theme/topic from the semester that allows you to ask new questions about your place. Write about what that theme is, what questions it provokes in you about your place, and, crucially, what observations you could make that would help you answer those questions. For example, I might write about how learning about glacial environments piqued my curiosity about where my house is situated, wondering what kind of glacial landform I live on. I could look at topographic maps to study the geomorphic context and I could dig a hole in my backyard to investigate what kind of material is below the soil.

After writing about those themes, questions, and potential observations, I want you to reflect on how an awareness of such issues affects the way you think and feel about your place, and places in general. Continuing with my example, I might write about how I think differently about tending my backyard garden, knowing that the soil has developed over ~10,000 years on top of a drumlin. Furthermore, I might develop my thoughts about how working that garden soil connects me with the carbon cycle, talking about the short term organic carbon cycle, as well as the long term inorganic carbon cycle involved in the chemical weathering of the glacial deposits. This all has a profound impact on how I experience myself in time and how I register my actions in the context of geologic process and history.

Our main goal here is to make explicit the human dimensions of scientific and geologic inquiry, and to make explicit to ourselves the ways in which acquiring scientific and technical knowledge can shape our values.

An essay of 3-5 double spaced pages would likely allow for the level of reflection I am hoping for here for Part 2.