



## Geoscience | 2013-2014 Assessment Report

Geoscience 203 (Geologic Evolution of the Earth) is a required course for Geoscience Majors and Minors, as well as those pursuing a Broad Field Science Licensure in Education. Learning Outcome #1 was assessed during the Final Exam on May 13, 2014 in Geoscience 203 using two separate questions. One of these was a new question designed for this assessment (#1). The other (#55) was a question that I typically ask on the final exam each time the course is offered.

Learning Outcome #1: Students will demonstrate a knowledge base in the principles of physical and historical geology with special emphasis on the unifying theory of plate tectonics and the linkage between geological processes and global biogeochemical cycles.

Two separate written questions on the course final exam were used to assess this learning outcome, and the detailed rubric and assessment results are presented on the pages below. The first question evaluated (#1) was a rather difficult essay question that asked students to remember large scale processes that link geologic processes and biogeochemical cycles on Earth in the distant past. Overall, nearly all students performed at an acceptable level for all of the questions, with two exceptions. Average scores for the three criteria used were acceptable in 11 of 12 cases.

The second question evaluated (#55) was a short answer question. Students were asked to list and explain the causes two specific changes on a given graph that were the result of major plate tectonic changes in Earth's history during the Cenozoic Era (the last 66 million years). Overall, nine of the twelve students answered the question at an acceptable level or above

The data were useful to determine whether students understood some of the large-scale processes that have operated in Earth's history. Based on the results, I feel that the students performed well, and I don't believe that curricular changes or faculty development changes are necessary. However, the results of the assessment will be presented to the geoscience faculty for further discussion. I will likely use similar questions in the future on the final exam.

Essay Exam Question #1 (1 of 2): This course has dealt a lot with the linkage between geological processes and global biogeochemical cycles that operate over long time scales. Describe in detail at least one of these processes, along with an explanation of what evidence was used to understand these systems. Topics could include carbon burial cycles, seawater chemistry change, etc.

**Rubric for Assessment of Outcome #1, using Question #1 on the Final Exam:**

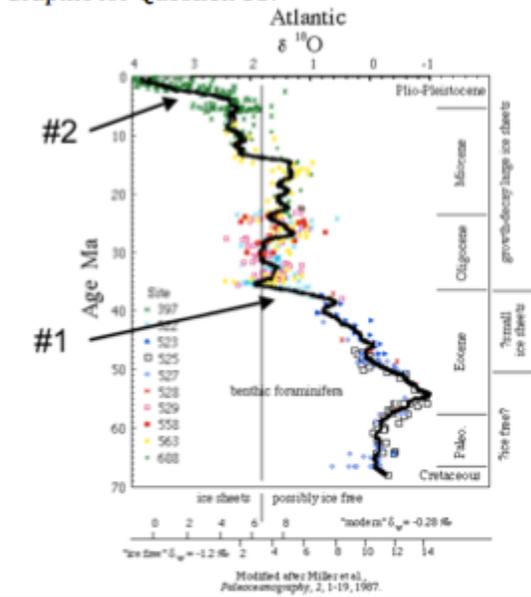
Criterion	1 = Unacceptable	2 = Acceptable	3 = Good	4 = Outstanding
A. Identification of geological process (GP) and a related global biogeochemical cycle (GBC)	Failed to communicate both a geologic process and a related biogeochemical cycle.	Identified a relevant GP or GBC but not both.	Identified both a GP and GBC.	Clearly and fully identified both the geologic process and the global biogeochemical cycle involved.
B. Mechanism or Hypothesis	Failed to explain the mechanism for how GP relates to GBC and failed to describe a system that operated over a long time scale.	Mentioned causal mechanism, but it was not fully explained or had some errors.	Adequately communicated the mechanism linking the GP and GBC.	Clearly defined the hypothesis that explains how the GP and GBC are linked through a causal mechanism.
C. Evidence	Failed to provide any correct evidence from the rock record.	Mentioned only one piece of evidence in support of a GP/GBC.	Adequately communicated the evidence for this GP/GBC. No major errors in evidence.	Clearly identified multiple lines of evidence used to support the linkage between one or more GPs and GBCs. Explained how the evidence supports the link.

**EXAM QUESTION #1: Data for the 12 students taking the final exam. Up to four (4) points were possible for each criterion.**

Student #	Criterion A	Criterion B	Criterion C	Average Score	Student #	Criterion A	Criterion B	Criterion C	Average Score
1	4	4	3	3.6	7	4	4	3	3.6
2	3	4	2	3	8	3	2	3	2.6
3	2	2	2	2	9	3	1	2	2
4	3	2	2	2.3	10	4	4	3	3.6
5	4	4	3	3.6	11	2	1	2	1.6
6	4	3	3	3.3	12	4	4	3	3.6
					<b>Average (n=12)</b>	<b>3.3</b>	<b>2.9</b>	<b>2.6</b>	<b>2.9</b>

Short Answer Exam Question #55 (2 of 2): Two major plate tectonic changes are thought to be partly responsible for climatic cooling and glaciation during the Cenozoic. These are indicated by oxygen isotopic records in benthic foraminifera fossils indicated by arrows #1 and #2 below. Briefly explain the plate tectonic changes thought to be responsible for each of the two changes indicated below.

Graphic for Question 55:



**EXAM QUESTION #55 Results: Data were for 12 students taking the final exam. Up to four (4) points were possible.**

Student #	Criterion "Plate Tectonic Changes"
1	4
2	3.5
3	1.5
4	3
5	3
6	3
7	4
8	3
9	2
10	3.5
11	1
12	1.5
<b>Average</b>	<b>2.75</b>

**Rubric for Assessment of Outcome #1, using Question #55 on the Final Exam:**

Criterion	1 = Unacceptable	2 = Acceptable	3 = Good	4 = Outstanding
Plate Tectonic Changes responsible for cooling of Earth's climate during the Cenozoic Era (Cases #1 and #2)	Failed to correctly identify <u>either</u> of the plate tectonic changes responsible for climate cooling.	Correctly Identified only one one of the plate tectonic changes responsible.	Identified both plate tectonic changes responsible; correct explanation for one of the cases	Clearly and fully identified both the plate tectonic changes responsible for climate cooling AND supplied additional details to explain why <u>both</u> changes occurred.

## OUTCOME #3

### I. INTRODUCTION

Students will apply their knowledge base and research skills to current Earth-system based issues such as mining and management of Earth resources with emphasis on related economic, social, and public policy dimensions.

Course Assessed

Special Topics in the Earth Sciences—Ore Deposits is an upper level course designed to integrate many aspects of the geosciences. The course explores environmental, economic, and political ramifications of mining in addition to the core material of the course—how ore deposits form.

Nature of Assessment

In February of 2014, I assigned individual research projects that focused on a target material (e.g. thorium, mercury, rubies, etc.). Students were tasked with discovering properties and uses for their material, how ore deposits formed regarding their material, and hazards associated with their material.

Assessment of Outcome #3 took place as an exam question regarding their target material that was researched earlier in the semester. Because the course was designed to be integrative, I wanted the students to attempt to integrate multiple lines of thought into the feasibility of ore extraction.

## II. ASSESSMENT

### Exam Question

Using your term project target material, discuss the decision process as to whether or not an ore deposit of your target material (or containing your target material) is mined. (20pts)

Consider:

1. supply and demand fluctuations over time,
2. environmental and physical hazards,
3. location,
4. politics,
5. any other considerations

### Rubric Used

Criterion	0 = Unacceptable	1 = Acceptable	2 = Exceeds Expectations
A. Economics	Did not discuss any supply and demand issues	Considered supply and demand with at least one specific example	Includes several specific examples on supply and demand, including technological advancements
B. Hazards	Did not consider any health or environmental issues	Considered either a health hazard or environmental hazard associated with mining their target material	Includes discussion on both health hazards and environmental hazards associated with their target material
C. Politics	Did not consider any governmental regulation or public opinion	Brief discussion on governmental regulation or public opinion	Thorough discussion of government and public interaction

## III. RESULTS

Student	A	B	C	Average
1	2	2	1	1.7
2	2	2	2	2
3	1	1	2	1.3
4	2	1	1	1.7
5	1	2	0	1
6	2	1	2	1.7
7	1	1	1	1
8	2	0	2	1.3
9	1	1	1	1
<b>Average</b>	<b>1.6</b>	<b>1.2</b>	<b>1.3</b>	<b>1.4</b>

#### IV. DISCUSSION

I was fairly pleased with the results of the assessment. All criteria assessed resulted in above acceptable averages (A=1.6, B=1.2, C=1.3). Most students did very well answering all aspects of the question (6 out of 9), whereas all did well in at least two of the three criteria. I do not believe that the outcome warrants a major overhaul of the course content, however, I do plan to tweak conversations in the next course offering to tie in environmental and political aspects more strongly.