

GEOLOGICAL EVOLUTION OF NORTH AMERICA

Final Exam Description

Fall, 2001

Geology 415 - James Madison University
Lynn S. Fichter

The final exam has four parts.

- < **Part One** are questions dealing with climatology and its application to understanding geologic history.
 - < **Part Two** is based on the review of tectonic models (Wilson cycle, rifting models, ophiolite suite, mountain building models, etc.) and associated rock types.
 - < **Part Three** is based on the lectures on Archaean, and Proterozoic development of North America we covered.
 - < **Part Four** consists of the analysis and interpretation of passages from Windley.
- Some of the questions are provided ahead of time to allow you to prepare. Others you will not know until you see them on the test. You should prepare for all questions, but will not know which questions to answer until at the time of the test.

Expectations and Guidelines

Note 1: The subject areas in the questions are minimally stated. They do not present an exhaustive list of all the themes you should cover. You are expected to tender a well organized presentation that covers all the pertinent subject matter, including basic facts, theoretical models, cross sections, maps, diagrams; i.e. thorough and complete.

Note 2: Illustrations (maps, cross sections, stratigraphic sections, models, etc.) are essential for explaining and discussing most geologic subjects. All important illustrations and maps must be included and will be evaluated not only for their pertinence to the discussion but also for their neatness, thoroughness, and accuracy. For maps I will provide outline maps showing political boundaries as a base for drawing the geology.

PART ONE

Paleoclimatology And Its Geological Implications

We discussed three case studies of how the position of North America in the past, and the corresponding climatic patterns based on modern atmospheric circulation, can be used to . . .

- (Explain the known rock record, and/or. . .
- (Predict what past climates would have been like.

These case studies were for the:

- ┆ Silurian (Laurentia)
- ┆ Devonian (Laurussia)
- ┆ Permo-Triassic (Pangaea).

Part One A. Given a map for any one of these situations (the Devonian map may not be the one discussed in class, but an outline map) do the following.

- I Draw on the map the prevailing atmospheric circulation patterns, and oceanic circulation patterns including major high and low pressure regions directly resulting from the circulation.
- I Reconstruct the paleoclimatology of the North American continent at that time and place, in as much detail as you can, including any of the major climatic zones appropriate for the time and place. For this you must incorporate your geologic knowledge. For example tropical rain forests are not likely to be found in the Silurian since trees had not evolved yet.
- D Identify and explain the location and formation of known or predictable deposits in the rock record which can be directly related to paleoclimatic and paleoceanographic conditions. These include, but not necessarily all, and not necessarily restricted to, the following.

j	Evaporates	j	Phosphates
j	Anoxic deposits	j	Any of the major climatic zones, e.g. deserts, narrow coastal regions of high rainfall, etc.
j	Redbeds		
j	Cherts		

In doing these reconstructions keep the paleogeology in mind. That is mountain ranges, inland seas, etc. are the ones known to have existed at the time of the map.

Part One B. Given a second map for one of the regions we discussed, do the same analysis and reconstruction, but under the following assumption.

Assumption: the earth is rotating the opposite direction that it is at present.

PART TWO

Review of Tectonic Models

We reviewed a series of tectonic models based on the Wilson Cycle. These models are the top-down framework on which all our interpretations are based. These models need to be firmly entrenched in our minds, and we need to be able to use them with fluidly and ease.

This portion of the test is computer graded with MarkSense cards. You will be given a series of tectonic diagrams, the same ones we studied in lecture, labeled with letters or numbers. Accompanying the diagram is a list of features - either tectonic features, or rock types - and you will be asked to match up the place on the diagram with the tectonic feature/rock. In other words, these are multiple choice questions.

The tectonic diagrams may include any or all of the following:

- < Wilson Cycle
- < Plate tectonic models
- < Rock Cycle and Tectonic Rock Cycle models

The plate tectonic models include such examples as rifting models, volcanic arcs, ophiolite suites, mountain building models, etc. In fact, any models we developed in class.

PART THREE

North American Archean, Proterozoic, and Phanerozoic Development

Part Three A: Recognition and Identification. Given either or both of the following maps or map systems . . .

- (Archean Crustal Evolution of North America,
- (Proterozoic Crustal Evolution of North America,

. . . And given the (alphabetical) list in the table below, or any part thereof

Common Deposits, Events, and Locations In the Archean and Proterozoic Geology of North America		
" Abitibi	" Granulite-gneiss belt	" Nain
" Animike	" Great Bear	" Rae
" Anorogenic magmatism	" Greenstone belt	" Richmond Gulf
" Authapusco	" Grenville	" Slave
" Belcher belt	" Hearne	" Superior
" Cape Smith belt	" Hudsonian	" Trans-Hudson belt
" Central U.S. belt	" Huronian	" Wollaston
" Churchill	" Keewenawan trough	" Wopmay
" Circum-Superior	" Kenoran	" Wyoming
" Cordilleran	" Labrador trough	
" Coronation	" Midcontinent rift system	

Three A-1 Be able to identify or describe the stratigraphic and/or tectonic characterization of the terms in the table. That is, are they deposits/events/locations, and what specific kind, e.g. aulacogen, Cordilleran orogeny, divergent margin deposit, etc.

Three A-2. Be able to accurately and precisely identify and label the deposits, events and locations from the table above on either of the maps below.

- ┌ If Given either the Archean or Proterozoic Crustal Evolution of North America, . . the deposits, events and locations must be identified on the map the first

time they appear in the record, that is, on the first appropriate map system, not before or after.

- 1 If Given the map United Plates of North America. . .the deposit, events, and locations must be identified at their present locations on the map.
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Part Three B: Writing History. Construct a quintessential sequential history of the Archean and Proterozoic geological evolution of the North American continent, in whole or part. To do this you may be given either or both of the following:

- ã The list of deposits/events/locations in the table above.
- (From the list, you should be able to arrange the deposits/events/locations in proper sequential order, grouping together those which occurred at the same time, or which represent similar events, and provide concise explanations of what tectonic events led to their existence.
- ã A blank copy (the arrows and dashed dividing lines will also be absent) of the Archean and Proterozoic Crustal Evolution of North America.
- (For the maps, you should be able to reconstruct and concisely describe in outline form what is happening in the history Divide the history into steps or stages.
 - (You should also be able to locate deposits/events/locations from the table above, and identify the type(s) of deposit(s) they are, or the tectonic regime(s) it(they) represents.
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PART FOUR

Questions Based on Seminar Readings/ Class Discussions

Preparation

- (Reread the passages in Windley that we read for the seminar, reanalyzing them as you go, and drawing appropriate cross sections. Also study the maps and cross sections accompanying the text and be sure you can analyze and describe the historical geology they contain.
- (Come talk to me about things which are just too confusing or technical to cut through.
- (Re-analyze the maps, cross sections, diagrams we discussed in class. Get together in small groups and talk about the interpretations. Clarify in your mind what you know, and what you are unsure of.

The seminar portion of the exam will consist of one or two questions drawn from the following types.

1. Interpretation of Text: Given passages from the Archean and Proterozoic chapters in Windley you are to either:
 - (A) Translate the passages into a description that a Geology 230 student would understand by defining all technical or obscure terms, and describing the geologic/tectonic/petrologic processes by which the described rocks or geologic process came into existence. If the processes are unique or unusual that fact and its significance is to be explored also.

The passages you translate may include some we did not analyze in class, but which our discussions would have prepared you for. You will be allowed to use a geological dictionary during this part. I will bring the dictionaries to the exam.
 - (B) And/Or, Draw One or More Cross Sections (as the passage dictates) that converts the description into interpretation.
2. Interpretation of Maps or Cross sections: Given a map or cross section from the Archean and/or Proterozoic, provide a descriptive analysis ascertaining and interpreting the significance and meaning of the geology portrayed on the map. Your descriptive analysis requires written appraisal but may include drawings and cross sections as well where required.