# Geologic Evolution of North America

**Syllabus**

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<th>Credit hours:</th>
<th>03</th>
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<td><strong>B</strong></td>
<td>Miller Hall</td>
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<td>Room 209</td>
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<td>MWF 12:00 PM to 12:50 PM</td>
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<td><strong>L</strong></td>
<td>Lynn S. Fichter</td>
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<td>Miller Hall, Room No. 233</td>
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<td>568-6531</td>
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<td><a href="mailto:Fichtels@jmu.edu">Fichtels@jmu.edu</a></td>
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<td>M 8:00 - 9:00, 10:00 - 2:00, Th 8:00 - 9:00; By Appointment</td>
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<td><strong>E</strong></td>
<td>Wednesday, December 10, 1:30 - 3:30</td>
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- Lecture Notebook from the Copy Center
I have two reasons to teach a course like this, one practical, one aesthetic. Practically, the basis of geology is the rocks in the earth. Having a fundamental knowledge of those rocks, and how they are related to each other through space and time, is the grammar of geology. By all rights the course should be the Geological Evolution of the World, but that is a chunk much too big to be chewed and swallowed in one semester. And since most of us will work in North America it seems the logical place to start since everything we do geologically must begin with an understanding of the rocks at our feet.

The aesthetic reason for a course like this is that the history we have at our feet almost defies the imagination, even for those familiar with it. To realize that at one time this spot was inside a molten magma chamber, at another time was a carbonate tidal flat, at another time was a deep basin, and at another time was a mountain, inspires wonder. And for the curious asking, "How do I know all this?" it sparks a creative satisfaction.

Yet when it comes time to teach "North American" my reaction often is "I wish I knew something about this subject." Relatively speaking it may seem like I know a lot. But the geological history of North America is a vast subject, often buried in technical and arcane literature, running on for thousands upon thousands of references.

I teach geological evolution because I am fascinated by the subject, because I like the arm waving that comes with the discussion of great historical events. But I teach it also because I know so little about the subject and each time through I have a chance to learn more. So this course is a journey and an adventure for me, and I hope it will be for you too.

Most of you have been with me in other "core" classes where the work load and my demands on your reasoning and writing skills have been very high. Those demands are there because I believe that if you are to become a scientist your mind must be exercised by tackling challenging problems, with rigorous demands on your ability to demonstrate your knowledge.

Yet at the same time I am also sensitive to the fact that if a course becomes too onerous then the pleasure one takes in a subject gets blunted, stunted, and eventually atrophied. I never intend to sacrifice a rigorous and intellectually challenging examination at a subject, but I think it is possible to change emphasis, to have fun with a subject, to do grand arm waving about great events and to stimulate the imagination. That is what this course is for, to let your imagination get swept up in the awe of contemplating immense expanses of time and great historical events. To allow you to apply with pleasure the knowledge and skills you have gained to this point. More practically this course contains fundamental knowledge which you will find necessary in your later geological studies and professional work.
Thus, although I ask you to do some work in this class, and although I expect you to do that work to the greatest extent of your intelligence, skills, and knowledge, I will try to keep the pressure and demanding schedule at a minimum. Join me on this adventure. I think we can enjoy this, and you can extend your knowledge and professional skills as far as you want.

There are two ways to approach this subject. One is to begin with details and piece them together into a whole puzzle. The second is to begin with an overview and work toward more and more detail. It is easy to get lost in details, to get so good at seeing trees that the forest is missed.

In this course the forest is most important. We want to clearly see the relationships among all the pieces, and understand the basic processes that have operated through time before we look closely at any one piece. So we will . . .

B

1. Some basic geography, like all the states and Canadian provinces, and the major river systems in North America. Unless we know intuitively where we are geographically none of the geology makes sense.

   The test consists of identifying the states, provinces and rivers from the map used in class. Details later.

2. Some physiography/structure. That is, the major geological divisions of the continent, and their structure and basic geology. To an alert traveler the landscape is continuously changing, and it does not change just for the hell of it. There are always excellent reasons why certain kinds of topography are found in certain places, but we need to know what those places are.

   The test consists of identifying physiographic/structural divisions labeled on various maps, and drawing structural cross sections. Details later.

3. An introduction to atmospheric circulation and climatology. It must have been baffling to early geologists who discovered coal and evaporite deposits in modern cold climatic zones, or desert deposits in modern humid zones. From a "fixidist" viewpoint, stratigraphically stacking rocks formed in markedly different climates requires a contortionist's abilities. A major part of understanding the earth's geology is understanding a little about climate. So, we do a brief review of the basics, and their application to some specific situations.

   . . .and:
An outline of major Archean, Proterozoic, and Phanerozoic events. The earth has undergone irreversible evolution. The eon divisions reflect fundamental changes in the evolution of tectonic, life, atmospheric, astronomic, and geochemical conditions. We need to have those broad changes and trends clearly in mind.

...and:

Basic Phanerozoic history. We know the most about the Phanerozoic, and thus its history seems the most complex. In fact it is not. But, we will spend some time creating a summary time/space chart of the major Phanerozoic riftng, cratonic, and orogenic geological events in North American history (we already did this in 230, at the end of the course... but I suspect you don't remember much of that.)

The test of these three sections is more comprehensive than the first and consists of essay questions, charts and diagrams to reproduce and explain.

The rest of the course. Here we select specific case studies of North American Archean, Proterozoic, and Phanerozoic geology, as many as we have time for, and study them in depth. Accompanying these discussions are readings of the technical literature. Also if the class as a whole has some particular interests, we can pursue them. The possible subjects are almost unlimited.

One of our purposes here is to discover some fundamental and characteristic processes that constitute geology. Each case study is not just an isolated entity but provides lessons for the study of other provinces, and a basis of comparison allowing generalizations about earth processes.

Lecture, Seminar, and Review Questions
This last, more detailed portion of the course is a mixture of lecture, seminar, and periodic review questions.

For the seminar portions you are expected to do preparatory reading, mostly from Windley's book, and come to class ready to discuss the geology. Seminar class meetings and accompanying reading assignments will be announced ahead of time. During these meetings I will not lecture, but will spend the whole class asking questions about what you have read, and your understanding and interpretation of it. Details later

For the weekly review questions you will be given questions and several days to write up analyses. Details later.
This course is divided into stages beginning with rote memory, going to surveys of essential knowledge and major earth events, and ending with more detailed analysis of evidence. Tests reflect these transitions. Simple minded short quizzes of rote memory are worth small amounts, and large scale items more.

The grade scale is 12-point, as follows:

| 12 - 11 | =A+ | 8.9 - 8 | =B+ | 5.9 - 5 | =C+ | 2.9 - 2 | =D+ |
| 10.9 - 10 | =A  | 7.9 - 7 | =B  | 4.9 - 4 | =C  | 19 - 1  | =D  |
| 9.9 - 9  | =A- | 6.9 - 6 | =B- | 3.9 - 3 | =C- | 0.0 - .9 | =D- |

The following procedures apply to the 12 point scale.
- No rounding of test scores or final averages is done.
- Test or assignment grades can be in the negative range (e.g., -2)
- Grades for final exam questions are calculated by adding together all question grades, finding the average, and multiplying that times the percentage. Thus, the more questions that are answered, the less each one is worth in the total.
- Failure to take any test or complete any assignment results in the loss of one final grade for each test/assignment not completed. In addition, an "0" will be averaged into the final grade for each missed test/assignment before the final grade is lowered for missed assignments.

A more detailed description of each portion of the course is below, with their percentage of the final grade.

5% ① GEOGRAPHIC IDENTIFICATION: Correctly identify all the states and Canadian provinces and major rivers from an outline map identifying the features by number and/or letter. This test comes one or two lectures after we finish discussing it.

10% ② STRUCTURE AND TECTONICS: There are two parts to this test. First, locate the physiographic provinces and principal structural/tectonic divisions of the continent on the physiographic and tectonic maps we use. This may consist of labeling copies of the maps, or having the maps with the featured identified by letter and/or number and filling out an answer sheet.

Second, draw detailed, accurate, and precise cross sections of the structures for some of the provinces.

This test comes a lecture or two after we finish discussing it. Details later.
This test contains questions dealing with the following topics and comes within a week or so after we finish discussing it: Details later.

3. Atmospheric Circulation and Climate, principles and applications.
4. Outline of major Archean, Proterozoic, and Phanerozoic events.
5. Basic Phanerozoic history.¹

(A) For any given span of geological time you should be able to describe all the processes and responses occurring across the North American continent:
- Conditions of epicontinental seas on the craton
- Any activity associated with plate boundaries: convergent, divergent, transform
- Climatic patterns affecting the geology of the time
- And conditions unique to the period

(B) For any region of North America, (i.e. central interior, Southern Appalachians, West coast, etc.) you should be able to write a complete, coherent history covering any span of time, i.e. Paleozoic, Mesozoic, Pennsylvanian to Permian, Jurassic-Cretaceous, etc.)

The final exam has two parts.

20% Part One is a series of questions drawn from lecture and textbooks. These are provided ahead of time to allow you to prepare. This portion of the exam is take home but you have to write your essays from memory. During the exam you will not answer all of them but only one or two chosen at the time of the exam. These questions deal with the geological/paleogeographic/climatic/sedimentologic/etc. evolution of portions of North America. (Last time there were 17 to choose from.)

20% Part Two consists of the analysis and interpretation of the seminar topics, text from Windley, maps, charts, and/or cross sections discussed during seminar portions. You will not know what the questions are until the time of the exam. This portion is taken during the regularly scheduled exam time. More details later.

20% As we begin the systematic discussion of the history of North America from the Archean to the Cenozoic we begin a series of weekly review questions. More information later.

100% Total

¹ I deliberately set conditions A and B up to channel your thinking temporally (i.e. what is happening sequentially), and spatially on the other (i.e. how are events related from place to place). Geologists must continuously relate processes and events occurring through time and space. I want you to hone your thinking in this multidimensional way.
Note: The last time I taught this course I did some major rewriting, and this time I may also do some major rewriting. That’s good! After all, we don’t want to stagnate and decline into mediocrity. But it does mean that things might change. So if there are changes I will announce them in class. If they are major changes I will write them out for you. And if the changes involve significant changes in testing or the grading scale, we will discuss and vote on it.