Terrestrial Planetary Geology (GEOL 420)
Colgate University, Spring 2008
Wednesday 7-9 pm
Ho Science Center 429

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Office hours: Ho 334, Tue-Wed 3-5pm

Overview
Information returning from Mars is enhancing and challenging our models of planetary formation and evolution. From a perspective of attempting to solve the most compelling problems in planetary science, this course will survey the tools and methods of planetary exploration and focus on the current geologic investigations on Mars. After a brief coverage of topics such as the principles of remote sensing and the search for extraterrestrial life, the course will delve into hands-on manipulation and interpretation of planetary datasets recently returned from orbiter and lander missions. Our focus will be to understand bodies like Mars and the Moon in the way that geologists typically approach scientific problems, and use all available data in a comprehensive investigation. A major theme will include an analysis of the analogs used on Earth, and the information that such comparisons can provide.

Text: Nowicki, et al., eds. *Geological Investigations of Mars* on-line textbook available on the course website. The interpretations we make about the geology of Mars and the satellites of Jupiter and Saturn are changing rapidly as we receive new data from active missions. Currently available textbooks are nearly outdated as soon as they are published, and can't provide the best information for a course covering ongoing investigations in planetary geology. A community of researchers in the field of Mars geology and exploration have undertaken to contribute a living, open-source textbook that will contain the new developments in the science. This text will serve as an overview as we read the most recent and compelling scientific journal articles.

Tools: Classroom and computer lab exercises will utilize applications running on a linux operating system installed on a number of computers in the geology computer lab. Although many of the applications have been modified to run on windows, there is far more flexibility in the configuration we will be using in the lab. You are encouraged to install a linux partition on your personal computers and use these applications, since they are all free and open source, and can be utilized for many types of geospatial data. Applications will include GIMP (similar to Photoshop), JMARS (planetary GIS), Davinci (similar to IDL), and other NASA and USGS image processing and data visualization tools.

Course Format: Class will meet once a week during a **2-hour seminar and lecture session (Wed. 7-9pm)**. Students are expected to have digested the assigned wikitext readings and all prescribed journal articles in preparation for in-depth discussions. Time will be spent as a mix of lecture, question and answer, and utilizing maps and visualization tools. In addition to the weekly class meeting, each student will need to attend one of the regularly-scheduled **one-hour lab/discussion sessions**, which will be conducted primarily in the geology computer lab. These sessions will focus on the mechanics of data manipulation, computer modeling, and information visualization, but may also include additional detailed discussion on course topics. A significant amount of time using these datasets outside of class time should be expected.

Expectations and Goals: As a culminating course in geosciences, *Terrestrial Planetary Geology* provides the opportunity for participants to apply much of the knowledge and many of the skills acquired over the past few years of academic work in geology. In addition to absorbing all assigned readings, students are expected to bring into the discussion their understanding of physical geology, geologic time, geochemistry, as well as math and computer skills. Thus, any unknown terms or new concepts found in the readings should be investigated independently, and that information shared during class time. The lab and computer exercises are most likely entirely new to the geology student, and many of the tasks do not have tutorials. Thus, exercises may take an enormous amount of time and effort, and must be started well in advance of the due date. With the right attitude, this course will foster a familiarity with complex geospatial data as well as an understanding of the scientific questions and answers that are driving planetary exploration and our understanding of global systems.

Grading Policy: The final grade for this course will be based on seven **exercises** and a **final project**. Each exercise will incorporate hands-on data manipulation, mapping, laboratory experiments or computer modeling as presented in the laboratory sessions, and will also require a firm grasp of the assigned readings. The final project will be submitted as a well-developed written report, and presented in class. Each exercise will be worth 10% of the final grade, and the project will be worth 30%. Participation will be included in each of these grades. Since there are only a dozen students in this course, absence or non-participation will be readily apparent during each meeting time.

Reports: For each of the seven exercises, we will spend an hour during the lab time making sure that the tools are available and functioning, and introduce the objectives. The exercise must then be completed by the start of the following week's lab session. A written report, complete with citations and figures will accompany each assigned exercise, relating it to relevant publications, and solving the major problem that was outlined in the introduction. Each exercise will build upon the last, all aiming at preparing the student to complete the final project.

Semester Project: Given this level of this group of students and the tools available, we have the ability to not only learn about the state and geologic evolution of Mars, but to actively investigate these scientific questions. The semester project will be an effort to make a significant contribution to the understanding of the surface of Mars in a collaborative effort. Our approach in this course will be to research the state of the science, define a scientific problem, investigate and test our hypotheses, and make a well-formulated case for our conclusions. The ultimate result of the class will be a peer-reviewed journal submission. The paper will incorporate the independent work of each student to build a database of information about the surface of Mars, and draw conclusions about the global distribution of features, morphologies, or composition. As part of the project, there are a number of ongoing tasks that will need to be completed, including: a weekly update on the state of analysis, draft paper submissions, and feedback on the performance of computer tools, all of which will be discussed in detail.
By the end of February, each student must select a topic and approach for the final project. The project must focus on a geologic aspect of Mars and utilize datasets available from the NASA Planetary Data System. Additional research tools or laboratory experiments may be employed, such as geochemical analysis, wind-tunnel simulations, Earth analog sites, or computer modeling, but the focus should remain on investigating geologic processes observed using planetary datasets and contribute to the theme. The projects will conclude with a short (10-minute) in-class presentation during the second to last week and submission of a final report by Friday, May 2. This final report is the text and images that are to be included in the collaborative article, which will be combine and edited, and submitted in the early summer. The effort put forth by each participant, the quality of research, and the relevance to the major topic defined by consensus will determine whether each student will contribute to the collaborative paper, and be included as an author.

Schedule: The following is the tentative list of topics, and additional exercises that will be addressed during the 1-hour laboratory sessions

Date	Topics	Notes/Assignments
Jan 23	Geology of a Planet/History of Exploration	Linux/Geospatial Tutorial
Jan 30	Remote Sensing/Search for Life	1. GIS and Navigation
Feb 6	Impact Cratering and Geologic Time	2. Craters and Dating
Feb 13	Mars: Tectonics and Planetary Interiors	Rock/Soil Sample Selection
Feb 20	Mars: Volcanology and Petrology	3. Orbiter and Lander Obs.
Feb 27	Mars: Mineralogy and Soil Geochemistry	Project Topics Due
Mar 5	Mars: Surface Materials and Aeolian Processes	4. Photogeologic Mapping
Mar 12	Mars: Hydrology and Atmosphere	
Mar 19	No Class	Spring Break
Mar 26	Mars: Ice and Polar Processes	5. Spectroscopy
Apr 2	Mars and Earth: Climate Cycles	Field Trip
Apr 9	Moon	6. Topography and Lidar
Apr 16	Icy Satellites	7. Global Modeling
Apr 23	Student Presentations	
Apr 30	Venus/Mercury/Extrasolar	Final Report Due May2