Lunar and Planetary Geology (GEOL 3060): Laboratory Exercise on Geologic Mapping on Mars

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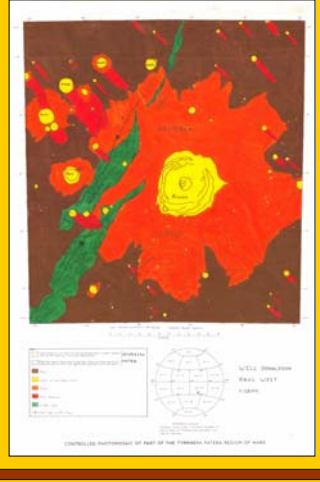
*I*n this exercise students learn the basics of geological mapping using easily obtainable photomosaic base maps. Students are provided the hardcopy photomosaics, which are available in a lab room. Students need some supplies, which are described below. The exercise allows students to choose which area they wish to map from among some varied Martian terrains. The exercise uses simple, easily obtainable materials and is not dependent upon access to the internet. Because there is a mixture of geology majors and non-majors in the course and a variety of backgrounds ranging from students with freshman physical geology only to students with four years of geology classes including field camp, a collaborative approach is used in assigning mapping partners. Two weeks are allowed to complete this exercise, which is done largely in a laboratory room with large tables. Lecture instruction supplements the students' knowledge of planetary nomenclature, planetary mapping, Martian stratigraphy and geology, and related topics.

INSTRUCTIONS TO STUDENTS

*F*rom the three Photomosaic Quadrangles (MTM-20247, -25247, and -25252) of the Tyrrhena Patera Region, Mars, students will select *one* for geologic mapping. MTM-25247 is recommended because it has a spectacular crater with flow lobes in the center of the quadrangle, but the choice is up to the student. The objective is to make a quadrangle geologic map of part of Mars. NOTE: This exercise will take more than one visit to the laboratory room in order to finish. Follow the steps given below and make the simplest interpretations possible. Always work in pencil first, then add ink later. Students will need color pencils, a ruler, non-smearing ink pen, and a 24" x 30" sheet of tracing paper (velum or similar) to complete this exercise. Students may work alone, in a pair, or a triumvirate. The name(s) on the finished map should reflect authorship. However, please note that your instructor may expect a better effort from multi-authored maps! *If you intend to collaborate, students must register with the instructor during the first week of this exercise.* The exercise will be graded on neatness, completeness, accuracy, and attention to geologic detail. Map lettering should be done in block letters with a steady hand (or use a letter guide of some kind).

ORDER OF WORK

1. After selecting a quadrangle to use, note the location of the quadrangle on the planet Mars (see shaded area on "quadrangle location" map at bottom).
2. Note the latitude and longitude of the borders of your chosen quadrangle.
3. Go to the *Geologic Map of the Eastern Equatorial Region of Mars* (Geologic Map I-1802B) that is also on reserve along with the Martian quadrangles, and there locate your quadrangle position approximately using the latitude and longitude just noted. *DO NOT WRITE ON THE MAPS!*
4. Using Geologic Map I-1802B, study the general area where your quadrangle is located, note the geological units mapped there and read about them in the legend. Make notes on these units and their various features. Note the line symbols in use in this plains region, and check their meaning in the map legend.
5. Spend time looking over and studying your chosen quadrangle to see terrains, features, and geological units described on the large-scale geologic map. It may be useful to review your lecture notes on the "order of work" in geologic mapping, map symbols, units, etc. *DO NOT WRITE ON MAPS!*
6. Using Geologic Map I-1802B, make a list of geological units that you think can be applied to the quadrangle geologic map you will be making (e.g., Hr, Ridged Plains Material, and c, impact crater materials). Make a list of additional small-scale geological units that you can identify at on your map, but are too small to see on the large-scale map. Make a list of other detailed features that you see on your quadrangle (e.g., wrinkle ridges, crater terraces and ejecta lobes, wind streaks, scarps, grabens, faults, rilles, etc.). For help in identifying these features, refer to Geologic Map I-1802B, your textbook, or the other books on reserve that feature images of Mars. You can also ask me or your GTA.
7. Place a large sheet of tracing paper over the quadrangle and mark where the corners of the quadrangle so that it can be lined up again in the same way with the tracing paper (i.e., you can reposition it later). Hold the tracing paper down with a book or paperweight of some kind. If you have masking tape, that is okay to use but avoid regular tape as it will ruin the quadrangle map (and the librarian will get us both in trouble). DO NOT TAPE MAPS!
8. First in pencil (you will go over later in ink), mark the locations of the following kinds of features: geological contacts, crater rims, terrace slumps, rebound peaks, ejecta flow lobes, lava flow fronts, rilles, faults, wrinkle ridges, wind streaks, etc. Use the symbols as in the lecture notes and on the legend of Geologic Map I-1802B. Try to show as many impact crater rims as possible, even the small ones. You may have to lift the tracing paper up to see features clearly and then put it down to draw. You may not be able to map the whole area in one sitting, so plan for this step to take a few days. *DO NOT WRITE ON MAPS!*
9. After you have added all the features in step 8, go over that detail in ink and erase any extra pencil marks. Also, add the feature names shown on the "location of features" map at the bottom of the quadrangle (e.g., crater names and name of the plains or ridges). NOTE: I recommend a fine Sharpie© marker or similar. A ball-point pen's ink usually smears on tracing paper. Color each geological unit (including those from the large-scale map and the small-scale units you picked from studying your quadrangle).
10. Make a color legend similar to Geologic Map I-1802B showing the units you have and their relative age. The legend may be on a separate page. Provide a brief description on your map or on an attached page. Use the geologic age names as on Geologic Map I-1802B (i.e., Hesperian and Amazonian), and use the same major geological unit names (e.g., Hr, Ridged Plains Material). However, for your own new additional geological units, select appropriate names given the mapping rules discussed in class. If you think that any of the craters are Amazonian, show them with a different color and indicate in your description why you separated those younger craters.
11. Add direction arrows (as in legend on Geologic Map I-1802B) to directional features like wind streaks, lava flows, and ejecta lobes.
12. On your map, at bottom, show a reference map indicating where the quadrangle is located on Mars, an appropriate title, your name(s), date, and scale. Add any comments or explanation to separate page(s) and attach to map.



REFERENCE MATERIAL

Theory

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Pedagogy

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Maps

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NASA, 1991, Controlled photomosaic of the MTM-20252 quadrangle, Tyrrhena Patera region of Mars (1:50,000): Denver, U.S. Geological Survey, Miscellaneous Investigation Series Map I-2222.