Geo Sci 697: Planetary Geology Spring 2011
University of Wisconsin- Milwaukee
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Name _____

In-Class activity 5: Lunar Petrology

We are fortunate enough to have the Lunar Petrographic Thin Section Package for the next week, and we will take advantage of this by examining actual lunar rocks in thin section!

First, a few rules:

1. If you have not previously taken a course involving optical mineralogy or petrology, you must work with a partner who has.

2. DO NOT TOUCH the top of the thin sections. These are highly polished sections with no cover slips and cannot be washed, so no fingerprints, please.

3. ALWAYS start with the lowest magnification, and focus before switching to higher magnification. The #1 cause of thin section breakage is smashing a high-powered objective through it when not in focus.

4. In general, be careful with these thin sections.

The 66-page writeup for this collection is available online at
http://curator.jsc.nasa.gov/lunar/letss/contents.cfm
This gives a good, basic introduction to the mineralogy and petrology of Mare basalts, Highland anorthosites, lunar breccias, and lunar soil samples. Use it as a reference. The writeups for the individual thin sections will be available at each lab station.

Question 1: Lunar anorthosites and shock Metamorphism

Most of the oldest rocks on the moon have been directly affected by impacts. Even when the heat of impact is insufficient to melt a rock, the shock associated with impact can metamorphose the rock via shock metamorphism. This is a form of instantaneous, high-pressure metamorphism quite different from non-impact terrestrial metamorphism, and can lead to unusual changes in the minerals. Here we will concentrate on changes to plagioclase (the dominant mineral in lunar anorthosites).

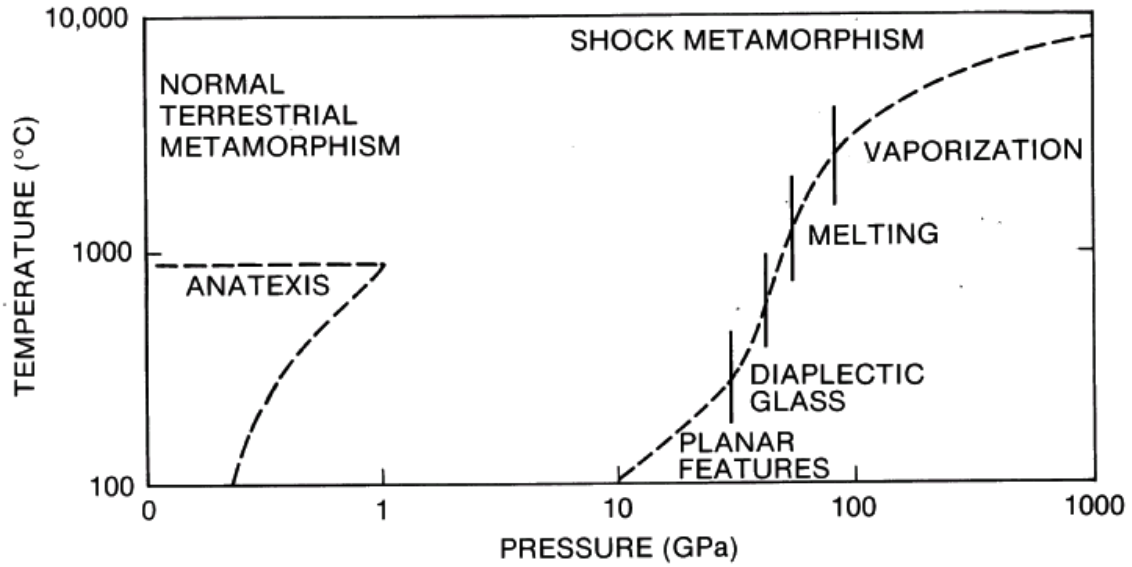

Figure from NASA Lunar Petrographic Educational Thin Section Set, C Meyer- 2003.

Select a thin section from 60025 (shocked plagioclase), 78235 (highly shocked plagioclase, maskelynite, shocked pyroxene), or 70181 (shocked plagioclase grains in regolith). Find a grain or multiple grains that display one or more shock features, and sketch a label it. Your sketch should include the magnification used, XPL or PPL, and what thin section you observed.

Next, observe one of the samples of a terrestrial anorthosite (10298 or 1388R). How does this differ from the lunar sample?

Draw a single plagioclase crystal from the terrestrial anorthosite for comparison to your lunar sample (use XPL). Note any features that are different.

Question 2: Terrestrial vs. Lunar basalts

While basalts are common on Earth and the moon, there are differences between them. For example, some lunar basalts (including sample 70017) are exceptionally high in Ti, leading to a higher concentration of opaque, Ti-rich phases such as ilmenite and armalcolite. They also lack hornblende and other hydrous minerals.

Compare one of the terrestrial basalt thin sections (e.g. 6701, BM68-78) to one of the lunar basalts (12002, 12005, or 70017). Make a note of major similarities and differences.

Does your lunar basalt show evidence for fast or slow cooling?

Draw a part of the lunar thin section that exhibits features consistent with slow or rapid cooling. Note: which one you see will depend on which sample you are looking at! Again: magnification, XPL/PPL, thin section name.

Question 3: Lunar vs. terrestrial glass

Explosive basaltic volcanism has produced volcanic glass on both Earth and the moon. Compare the glass spheres in 74220 (or included in 70181) to the grain mount of Hawaii basaltic ash. How are they similar? How do they differ?

Question 4: Breccias within breccias and regolith

Most lunar rock samples are breccias consisting of fragments of pre-existing rocks, often formed by impacts. Some (like 65015) even contain some related impact melt. The young surface of the moon was hit so often that some of the breccias contain clasts of previous breccias!

Examine a lunar breccia (14305, 65015, 72275) or regolith (68501, 15299) thin section. Can you find an instance of "breccia within a breccia?"

Make a sketch of an area of your breccia that contains more than one kind of clast.

Question 5: Mare vs. Highland regolith

The regolith (loose soils and rocks) on the Mare and in the Highlands is different, both in thickness and in content.

Compare a sample of Mare regolith (70181) and highlands regolith (68501). How do they differ in terms of clasts present and texture? What sources do you envision for each?