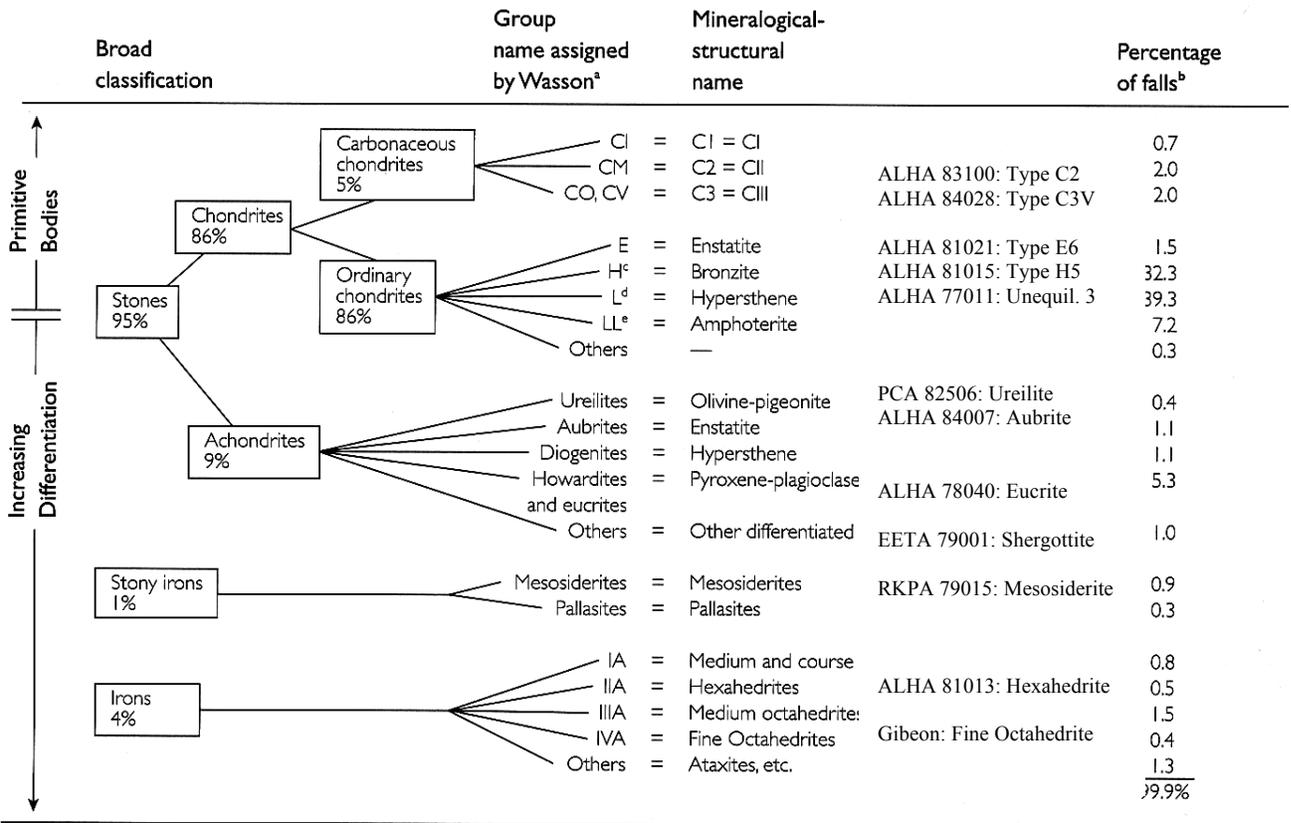


Name _____

In-Class activity 6: Meteorite Petrology

This week, we have on loan from NASA a set of meteorite thin sections representing a variety of meteorite types, from the common chondritic meteorites to the rare shergottites and mesosiderites. We will use this opportunity to explore the petrology of meteorites. 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.



^aFrom Wasson (1974).

^bFrom Scott (1978) and Dodd (1981).

^cH = high iron content.

^dL = low iron content.

^eLL = very low iron content.

Figure from Hartmann, *Moons & Planets*, 2005.

Chondritic meteorites are by far the most common (86%) meteorites, and also some of the most fun to examine in thin section. Chondrites are made up largely of chondrules, which are small, bead-like objects that likely formed from rapid cooling of drops of molten material in the solar nebula. As such they are older than the planets and can give us insight into the initial “building blocks” of the planets.

Select a chondritic meteorite thin section (ALHA 77011, 81015, or 84028). Explore the thin section, picking out the individual types of chondrules and the matrix. Choose a spot where you can see at least two different types of chondrules, and sketch. Remember to label your sketch!

Now describe your main observations. What minerals do you see?

Part 2: Carbonaceous chondrites

Carbonaceous chondrites also contain chondrules, but often also have inclusions of older “refractory” minerals, along with water, carbon, and even organic compounds.

Examine ALHA 84028. Can you find a “refractory inclusion”? How can you distinguish it from a chondrule or a simple fragment?

Question 3: Altered or metamorphosed chondrites

Not all carbonaceous chondrites have refractory inclusions. Others are dominated by altered chondrules or other fragments, now composed of low-temperature hydrous alteration minerals like serpentine (e.g. ALHA 83100). In other cases (e.g. Enstatite chondrite ALHA 84007), the original chondrules were reheated and recrystallized. In both cases, their prior chondritic natures can be difficult to identify.

Examine ALHA 83100 or ALHA 84007. Why is this meteorite considered a chondrite? Can you make out the outlines of any original chondrules?

Draw or describe the appearance of the serpentine (ALHA 83100) or relict chondritic texture (ALHA 84007) in your thin section. A quick sketch is fine here.

Question 4: Achondrites

Achondrites are a little younger than chondrites, and likely show us processes that occurred within larger planetessimals during the early days of planetary accretion. In some ways these are the most similar to Earth rocks: some (like ALHA 78040) are even basaltic! Yet even these have some features unlike those commonly seen on Earth.

Select a thin section from the following: ALHA 84007 (Enstatite achondrite), PCA 82506 (Ureilite), or ALHA 78040 (Eucrite). All of these show evidence of shock metamorphism. Find a clear example of shock features and draw it below (make sure to label!)

Do you think your sample was the result of slow cooling (interior of a planetesimal?) or rapid cooling? Why?

Question 5: Who needs Mars sample return?

EETA 79001 is a shergottite, an exceedingly rare type of meteorite from the planet Mars. These meteorites provide us with a sample of Martian rocks. What do you think?

Question 6: Mesosiderites and iron meteorites

Iron and stony iron meteorites make up 4% and 1% of all meteorites, respectively. However, these are the most likely to be correctly identified as meteorites in the field, since they are so “unearthly.” Unfortunately, without a reflected light microscope, we will be unable to look at them in any detail.

Sample RKPA 79015 is a mesosiderite (stony iron) dominated by metal, but with many pretty olivine crystals. Take a peek!