

12.490 Advanced Igneous Petrology NASA's Antarctic Meteorite Collection

The purpose of this lab is to introduce you to the variety of meteorites that we have in our sample collection. Below is a brief description of the petrological “high points” of each sample in the collection.

Chondrites

ALHA 77011, 39 This is an ordinary chondrite – petrologic class 3 (this is a metamorphic grade classification with 1 being lowest and 6 highest). This thin section contains abundant olivine – pyroxene – metal –glass-bearing chondrules. They come in several textural types: barred, porphyritic and radial. One important issue is what time temperature history is represented by this textural variability. Note also the rims on many of the chondrules. What do you think these represent? What are the constituents of the groundmass in this meteorite?

ALHA81015, 28 This is a type 5 high iron chondrite. Notice the differences between it and the type 3. Can you still make out chondrules?

ALHA84028, 58 This is a CV3 carbonaceous chondrite. It has a C-rich matrix, unlike the ordinary chondrites. Also, notice the chondrules. In addition to the olivine-pyroxene chondrules there are some amoeboidal fine-grained chondrules. These are CAIs, and they are very fine-grained in this sample. Also note the rimming reaction in these chondrules, again indicating a complex history.

ALHA83100, 140 This sample is a C2 carbonaceous chondrite. It contains much more carbon and organic material than the CV3. Also present are relict altered chondrules – now mostly serpentine. There is a discussion underway about whether these chondrites are primitive low-temperature condensates or whether they have experienced aqueous alteration on a carbonaceous parent body.

ALHA81021, 28 This sample is an enstatite chondrite, and consists predominantly of metal + enstatite (MgSiO_3). This meteorite is a grade 6 EC and you can see only a few relict chondrules. Most have been completely recrystallized. Plagioclase and FeS are also present.

Achondrites

ALHA78040, 82 This is a sample of a polymict eucrite breccia. It represents a surface regolith on the eucrite parent body. Notice the different textures that are present in the eucrite clasts. These are the plagioclase + pyroxene (pigeonite + augite) clasts. Also present are single mineral fragments. Some of these may be derived from a diogenite precursor. The composition of the opx will be diagnostic if it is from diogenite, because these are more Mg-rich.

EETA79001, 266 This is a shergottite. It consists of pigeonite + augite + plagioclase with a few rare olivine crystals. The plagioclase is now maskelynite. What does the texture tell you about the crystallization history of this sample? This is one of the largest SNC meteorites found in Antarctica, with the total mass of ~ 5 kg.

PCA82506, 41 This is a sample of a ureilite. The mineralogy is mostly olivine + pigeonite. The dark material between the grain boundaries is graphite. Metal is also present. In reflected light one can see that the edges of the grains have undergone a late-

stage reduction reaction that produced Fe metal. It is interpreted to coincide with the breakup of the ureilite parent body, and is one of the distinguishing characteristics of ureilites.

ALHA84007,45 This is an enstatite achondrite or aubrite. It represents a differentiated parent body that had the composition of an enstatite chondrite. It contains mostly enstatite with a small amount of diopside, metal and troilite. Minor forsterite olivine is also present. An obvious textural characteristic is the shock deformation.