Mineralogy of the LAP02205 lunar meteorite: Relationship to the Apollo 12 ilmenite basalt

Takashi Mikouchi[1]; Jun Chokai[1]; Tomoko Arai[2]; Eisuke Koizumi[1]; Akira Monkawa[1]; Masamichi Miyamoto[3]

[1] Dept. of Earth & Planet. Sci., Univ. of Tokyo; [2] Lunar Exploration Technology Office, JAXA; [3] Space and Planetary Sci., Univ. of Tokyo

LAP02205 is a new lunar meteorite showing an unbrecciated basaltic texture. Because most lunar meteorites are brecciated, LAP02205 would offer useful information to understand crystallization of lunar mare basalt. We report here our petrological and mineralogical study of LAP02205 and discuss its rela-tionship to other lunar meteorites and Apollo lunar samples.

LAP02205 shows a medium-grained subophitic texture with evidence for moderate shock metamor-phism. The modal abundances are 53.1% pyroxene, 30.4% plagioclase, 6.9% olivine, 4.4% ilmenite, 2.2% silica and 3% others. Most pyroxenes are somewhat elongated grains (~0.5 mm) and irregularly zoned from the most inner core of pigeonite (En55Fs30Wo15) partly mantled by augite (En40Fs25Wo35) to nearly Mg-free rims (some are probably pyroxferroite). Al and Cr show monotonous decrease as fe# in-creases, while Ti shows increase at first (fe#=0.35-0.6) and then decreases. Plagioclase (An91Or0 to An80Or7) is equant to lath-shaped (~1 mm long) and some grains have been maskelynitized. Olivine (Fo67-48) is rounded (~1 mm in size) and usually present as clusters of a few grains. Ilmenite is generally elon-gated and reaches up to 1 mm long. Silica (~0.3 mm) is anhedral and contains ~1 wt% Al2O3. Spinel (~0.1 mm in size) is chromite in the core and the thin rim is ulvospinel. There are abundant mesostasis areas (~a few %) mainly composed of fayalite with Si-, K-rich glass, ilmenite, and silica. Fay-alte (Fo3) is irregularly shaped and often contains small blebs (~20 microns) of Si-, K-rich glass.

The texture and mineral chemistry of LAP02205 suggest fairly fast cooling history typical of mare ba-salts. Probably, olivine was the first phase to crystallize. Because the most magnesian pigeonite is in equilibrium with olivine of Fo60, pigeonite started crystallizing after the crystallization of olivine of Fo67-60. The crystallizing pyroxene was immediately changed by augite as suggested by small areas of magnesian pigeonite cores. After the onset of plagioclase crystallization, augite crystallization was replaced by Fe-rich pigeonite and grew into very Fe-rich pyroxenes. The ilmenite texture suggests that ilmenite would crystallize prior to Fe-rich pyroxenes. The compositional kink of Ti in pyroxene at fe#=0.6 may suggest the onset of ilmenite crystallization. Finally, the mesostasis formed to crystallize various late-stage phases. High degree of fractionation of magma produced silicate liquid immiscibility, forming fayalite and Si-, K-rich glass.

Although LAP02205 shows some affinities to some crystalline lunar mare meteorites, LAP02205 is most similar to Dhofar 287A in petrography and mineral chemistry. However, there are clear differences between them. Olivine abundance is different (Dhofar 287A: ~20%, LAP02025: ~7%). Dhofar 287A lacks magnesian pigeonite. Although LAP02205 contains ~2% silica, it is rare in Dhofar 287A. Thus, LAP02205 is different from any other lunar meteorites found so far. Instead, we have better matching samples in Apollo samples. The Apollo12 ilmenite basalt suite shows a wide compositional variation from olivine-rich partial cumulates to highly evolved samples. Among them, 12056 is a subophitic basalt showing many similarities to LAP02205. Pyroxene, plagioclase, olivine and spinel compositions are nearly identical between 12056 and LAP02205. The presence of the mesostasis and its unique texture is also identical. The abundances of olivine (10.8%) and silica (0.8%) in 12056 are slightly higher and lower than those in LAP02205, respectively, but the Apollo 12 ilmenite basalt shows a modal variation from quartz-normative to olivine-normative depended upon olivine control. Probably, LAP02205 became slightly more silica-rich because it contains less olivine phenocrysts than 12056. Nevertheless, minor dif-ferences are present between LAP02205 and 12056 (e.g., absence of Fe-Ni metal in LAP02205), suggesting slightly different histories.