MINERALOGY OF DOMINANT CLASTS IN LUNAR REGOLITH BRECCIA 60019 AND COMPARISON TO YAMATO LUNAR METEORITES. Hiroshi Takeda, H. Mori and T. Tagai, Mineralogical Inst., Faculty of Science, Univ. of Tokyo, Hongo, Tokyo 113, M. Miyamoto, Coll. of Arts and Sci., Univ. of Tokyo, Komaba, Tokyo 153, Japan.

It is important to study variability of clast types and matrices of lunar highland regolith breccias within a large sample and in different samples within the one landing site, to establish genetic processes important in the formation of lunar meteorites, and to deduce the impact site, from where the lunar meteorites were ejected. Since two large slabs were sawn from one of the largest lunar highland regolith breccia 60019 analogous to lunar meteorites, we have studied dominant clasts in 60019 and Yamato lunar meteorites by mineralogical techniques.

Clasts exposed on the cut surfaces of the new slabs of 60019 were mapped and described by C. Galindo (1). Mineralogy of a basaltic clast similar to Luna 16 basalts has been reported together with pyroxenes in the matrices (2). Three polished thin sections (PTS) of dominant clasts were prepared. 60019,205 is a PTS of a subangular, greyish white, fine-grained clast (WF-1) in slab ,135 10 x 15 mm in size. 60019,208 is a PTS of another large fine-grained clast (WF-4) in slab ,127. It is an elongated greyish white clast 8 x 17 mm in size. 60019,207 is a coarse-grained milky white clast (WC-1) 20 x 20 mm in size in slab ,124. Clasts in new PTS's of Y82192, Y82193 and Y791197 from NIPR have been studied in comparison with 60019.

Pyroxenes in the old PTS's of these lunar meteorites have been reported (3,4), but they did not contain large clasts.

The matrices of these clasts in 60019 are fine-grained crystalline and show a texture similar to Apollo 16 poikilitic breccias. The difference in grain size is mainly attributed to the sizes of the plagioclase fragments in the matrices. The texture of 60019,208 resembles that of low-K Fra Mauro poikilitic breccia 65015. The matrix is rich in opaque minerals and contains very few fine-grained subrounded plagioclase fragments. 60019,207 includes large fragments of plagioclase up to 0.63 x 0.80 mm in size and one large olivine fragment (Fa23) 0.92 x 1.11 mm. The matrix shows well developed poikilitic texture and the grain boundaries of the mineral fragments are not sharp. Mafic minerals in a granulitic breccia clast are continuous to those in the matrix, and the coarsest grains in the matrix approached those in the clast. The compositions of olivine Fa21-25 and pyroxenes CaMgFe78 are also not much different from those of the matrix. The texture of 60019,205 is different from the above two and is unique as a breccia. The plagioclase fragments are abundant, fairly uniform in size and very angular. The sizes are between 0.1 and 0.8 mm in the longest dimension. The range of the An content of the plagioclase fragments is within 95-97 and is smaller than that of other fragments in the entire matrix. A few large blebs of metal are present. The matrix minerals are olivine, pyroxene and plagioclase. The poikilitic texture of the matrix is not as pronounced as that of ,207 but the pyroxene compositions (Fig. 1) distribute in a manner similar to the Apollo 16 poikilitic breccias (e.g. 65015).

Large, dominant clast types in the new PTS of Y82192 include shocked plagioclase, devitrified glassy clast, impact melt breccias with plagioclase fragments, and granulitic clasts. The old PTS contained a large regolith breccia clast in the breccia (3). Three granulitic clasts (GRL-3) up to 1.02 x 0.79 mm in size include small rounded olivines and pyroxenes in a
granoblastic plagioclase matrix. The Fa contents of olivines of GR1, GR2 and GR3 are 27, 29, 18 and the pyroxene compositions of GR2 and GR3 are Ca$_3$Mg$_{60}$Fe$_{37}$ and Ca$_3$Mg$_{81}$Fe$_{16}$, respectively and the An ranges from 95 to 97. A rare lithic clast includes olivine with Fa$_{22}$, pyroxene with Ca$_3$Mg$_{77}$Fe$_{19}$, and plagioclase with An$_{97}$. These mineral compositions lie in the range of the Mg-suite rocks, but they may be the Mg-rich extension of the ferroan anorthosite trend as was found in Y791197 (3). The poikilitic breccias dominant in 60019 are rare in the Yamato lunar meteorites. The EPMA analyses of the shocked plagioclase show considerable concentration of MgO and FeO, which increases with decreasing (Si+Al). The analytical TEM observation showed the matrix materials of Y791197, Y82192 and ALHA81005 consist of angular fragments of plagioclase and pyroxene and interstitial glass. All of interstitial glass of ALHA81005 and Y82192 are devitrified to very fine-grained minerals (4). In Y791197, however, interstitial glass in matrix is undevitrified. This observation indicates a different metamorphic annealing history of this meteorite from the other lunar meteorites.

Our previous comparison of the distribution of the pyroxene compositions of 60019 and lunar meteorites demonstrated that ALHA81005 and Y791197 contain Fe-rich pyroxene components from the VLT basalts but 60019 and the Y82 meteorites are poor in these components. 60019 includes mare pyroxenes of the Luna 16 type, having small amounts of the Fe-rich components. The impact sites of the Y82 meteorites may be far from a mare basin with a VLT-type lava flow. The poikilitic clasts dominant in the Apollo 16 breccias have been proposed to have derived from a large basin-forming impact event (5). The absence of such clast in the Y82 meteorites suggests that the impact site may be far from the large circular basin. This conclusion is in agreement with the proposed far-side origin of the lunar meteorites. The predominance of the granulitic breccia clasts in the Y82 meteorites is in line with the proposal that the crustal composition of the far side may be rich in the granulitic rock type by Lindstrom and Lindstrom (6).

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60019,205

Fig. 1 The compositions of the matrix pyroxenes in WF-1 clast 60019,205 plotted in the pyroxene quadrilateral (Mol. %).