NORMAL AND ANOMALOUS COMPOSITIONS OF LUNAR FELDSPARS - I. LUNAR PLAGIOCLASES. Y. Miura, Department of Mineralogical Sciences and Geology, Faculty of Science, Yamaguchi University, Yamaguchi 753, Japan.

Compositions of the lunar plagioclases have been discussed from the atomic substitutions and end-member abundances of anomalous plagioclase compositions [1-6]. The chemical compositions of 230 lunar plagioclases with the terrestrial-type chemical formulae in 19 Apollo samples are summarized from the electron microprobe data as follows (cf. Table 1):

Normal plagioclase compositions: The "normal lunar plagioclase" compositions which are consistent with the terrestrial standard plagioclases with minor Fe and Mg contents and without excess Ca have been found in the ferroan anorthosite 15415 and the oldest breccia 65015 which show the highest An contents (95.7 in average) and mg-values (0.59 in average) without significant end-member abundances [2, 3, 7]. The normal plagioclase compositions are obtained in about 10% of the microprobe data. The europium anomaly of the normal lunar plagioclases which is now found in the terrestrial plagioclases gives no effect on the bulk compositions of the normal plagioclases.

Anomalous plagioclase composition: The "anomalous plagioclase compositions" in the lunar samples which shows largely deviated compositions from the terrestrial standards with less Al·Na (up to -1.8 wt% Al_2O_3 and -1.5 wt% Na_2O) and with excess Fe, Mg and/or Ca are classified into the major three types: (1) Fe and Mg-rich compositions, which are found in the younger basalt 10003 and older breccias of 67435 and 77515 ($An_{91.5}$, mg=0.48), (2) Ca-rich compositions, which are obtained in the KREEP 14310, remelt anorthosite 68415, the breccias 14321, 15455, 63355 and 75055, basalts 10062 and 70017, and the troctolite 76535, and (3) Fe, Mg Ca-rich compositions in the younger basalts 12002 and 15555, and the younger breccias 14066 and 73215. Almost all microprobe data (ca. 90%) are classified into the anomalous plagioclases.

Formation processes: The anomalous compositions of the Apollo

lunar plagioclases are obtained mainly in relatively younger and evolved lunar rocks which show the lower An contents (i.e. Na-loss) and lower mg values [5, 8, 9]. The amounts of excess Mg and Fe in the anomalous plagioclases are considered to be supplied from the coexisted mafic minerals in the meteoritic impact processes. The excess Ca plagioclases (ca. 78% in the 230 lunar plagioclases) is characteristic in the lunar plagioclases which might be supplied from the Ca-rich anorthositic rocks during the impact processes. The similar anomalous compositions of the plagioclase are recently obtained from the diaplectic labradorite glass in the Manicouagan impact crator [5, 10]. The re-crystallied and partly crystallized plagioclases in the Manicouagan samples show the anomalous and diffuse crystal structures of larger cell volumes, whereas the partly crystallized compositions suggest the anomalous compositions with less Al content. The comparative formation processes of the two different plagioclase phases indicate that the lunar plagioclases with the anomalous compositions might be formed by complicated chemical mixing (mainly by meteoritic impact processes).

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Table 1. Normal and anomalous compositional data of the representative lunar plagioclases (in average values).

Sample	Excess* Al(wt%)	Excess Mg·Fe	Excess Ca(wt%)	Excess Na(wt%)	FmAl** (mol%)	CaFm*** (mol%)	mg	An (mol%)
15415 [10]#	0.0	0.0	+0.4	0.0	0.2	2.0	0.60	96.5
15455 [12]	-1.0	-0.2	+2.2	-1.0	0.0	3.9	0.34	94.3
67435 [6]	-1.2	+1.2	+0.5	-0.5	1.8	8.2	0.48	94.3
77515 [13]	0.0	+1.3	+0.1	-1.0	4.8	6.6	0.66	91.0
12002 [12]	-1.0	+0.8	+1.4	-1.2	0.0	8.8	0.37	91.1

* Excess amounts are calculated from the terrestrial standard data.
** FmAl means $(Fe \cdot Mg)Al_2Si_2O_8$ [1, 3, 7].
*** CaFm means $Ca(Fe \cdot Mg)Si_3O_8$ [1, 3, 7]
\# Numbers of analyzed data used for discussion are shown in square brackets.