CRYSTALLOGRAPHIC STUDIES OF SOME APOLLO 14 PLAGIOCLASES

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We are reporting results from preliminary optical, chemical
and X-ray studies of lunar plagioclases from Apollo 14 rocks
14053 and 14310 (basaltic), from rock 14301 (fragmental) and from
sample 14163 ( fines). Some specimens were investigated before
and after heat treatment.

It is known that calcic plagioclase single crystals may be
composed of "domains". The size of these "domains" depends on
sodium content and temperature and can be characterized by the
intensity and diffusiveness of certain X-ray reflections
( c-reflections ) [Laves and Goldsmith, (1954), Laves, Czank,
Schulz (1970)]. In addition, c-reflections investigated at
room temperature provide information on the history of the
earlier life of the crystal. The room temperature behaviour
of the reflections informs on conditions which must have
occurred in earlier times before the crystal was cooled down
to the present state.

CHEMICAL AND OPTICAL DATA

Chemical analyses of the plagioclases have been carried out by
electron microprobe (sample 14301) and by optical methods
(samples 14310, 14053). The weakly zoned cores of the crystals
from samples 14310 and 14053 have An89–93. Four crystals from
sample 14301 range from An77 to An94 / Ab19 to Ab5 / Or3 to
Or0.7. Thin margins of lower An content (down to ~An40) were
noticed. No antiperthitic exsolution in the feldspars
investigated was observed.
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Nearly all the plagioclases are intimately twinned. The twin laws observed are albite, carlsbad, albite-carlsbad, baveno and pericline. There are indications of twin lamellae smaller than 1 micron.

SINGLE-CRYSTAL X-RAY DATA

Seven plagioclase single crystals were examined by the precession method. These crystals were chosen to be optically as little twinned as possible. All crystals show very similar diffraction patterns with respect to and \( b \) reflections \( (h + k + l \text{ even}) \) which are always sharp. The \( c \) reflections \( (h + k \text{ even, } l \text{ odd}) \) are fairly weak and are always very diffuse; they are elongated approximately parallel to \( b^* \) in the \( b^*c^* \) plane.

Two of the crystals have been heated at \( (1015 \pm 10)^\circ \text{C} \) for 36 hours and then re-examined at room temperature. The diffraction pattern of a crystal from sample 14163.166 (from fines) shows \( c \)-reflections which are less diffuse and slightly more intensive than before the heat treatment. The pattern of a crystal from chip 14053.45 (from a basaltic rock) has \( b \)-reflections whose intensity and size are not basically changed but \( c \)-reflections which are weaker. No basic change of the twinning was observed in these two crystals after heating.

Considering twin orientations, all diffraction patterns can generally be correlated with the optical observations. The X-ray intensity ratio of twins according to the albite and the carlsbad laws is in accordance with the estimated volume ratio. However, in one case there is a discrepancy between X-ray intensity and optical volume ratios, thus indicating that this particular crystal might be submicroscopically twinned.

CONCLUSIONS

1) The chemical composition of the plagioclases is similar to the results found for Apollo 11 and 12 samples.

2) The twin laws observed are similar to those reported for Apollo 11 and 12 plagioclases. However, it has to be further investigated if these twins should be considered as growth or transformation twins.
3) The heat treated plagioclase from the basalt (14053.45) must have been cooled down from about 1000°C in a longer time than the cooling rate in our experiment (from 1015°C to 300°C in 1 hour).

4) The thermal history of the crystal from the fines (14163.166) may be comparable with the conditions of heat treatment in our experiment, i.e. the material cooled slowly from ~1000°C, or was later annealed not higher than ~1000°C.

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Literature