AN ANALYTICAL STUDY OF IRON IN PLAGIOCLASE FROM APOLLO 16 SOILS 64501, 64502, 64802, ROCK 66095, AND APOLLO 15 ROCK 15475. P. M. Bell and H. K. Mao, Geophysical Laboratory, Carnegie Institution of Washington, Washington, D.C. 20008.

The problems in interpreting the chemistry of Apollo 16 anorthositic rocks and soils are caused, in part, by the occurrence of oxidation and hydration products, namely "rust," or goethitic alteration. It is important to determine the degree of pervasiveness of the alteration and, of course, its cause. The latter has been attributed by us to atmospheric reaction of the meteoritic mineral lawrencite in rock 66095 (see Taylor, Mao, and Bell, this volume), and therefore it is useful to compare 66095 feldspar with those of Apollo 16 soils and an Apollo 15 rock (15475) reported to contain ferric iron (R. Weeks, personal communication).

Similarities between Apollo 16 soils and the Russian Luna 20 samples make it expedient to use a common base for correlation between crystal-field effects and electron microprobe analyses of iron in constituent plagioclase (see Bell and Mao, and Adams, et al, both in press, 1973, The Luna 20 volume, Geochimica et Cosmochimica Acta). First, all plagioclases studied in these Apollo 15, 16 and Luna 20 samples contain variations in iron concentration that are not systematically localized to a "core" or "rim." Iron values range from a few hundreths of a weight percent to several tenths of a weight percent in various parts of a single plagioclase crystal. The occurrence of metallic iron alloy crystals oriented crystallographically in several of the Luna 20 plagioclase crystals are not found in the Apollo 15 and 16 plagioclases but otherwise there is no evident difference in the iron content (oriented inclusions of an unidentified silica-rich phase are noted in several plagioclase crystals of soil 64501, but no metallic phases other than globular masses are identified).

There is a linear relationship between the "average" iron content and the absorption coefficient of a strong polarized crystal field band at 1250 nm in the Luna 20 (plagioclase), a soil that is not reportedly oxidized or hydrated (Bell and Mao, op.cit.). However, the iron values of plagioclase crystals from the altered Apollo 15 and 16 samples fall off this line, a factor that may be related to the presence of significant proportions of ferric iron. Table 1 gives electron microprobe analyses of plagioclases from samples 15475, 64501, 64502, 64802, and 66095. The range of iron content within a given plagioclase crystal is too great to make possible use of the averages as accurate indicators of the quantity ferric iron, but in most cases the entire range falls consistently aside of the Luna 20 "line."

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Crystal field spectra may provide the information needed to support the contention of the existence of ferric iron in the present samples. It is not yet possible to resolve high energy, ferric, charge transfer absorptions in plagioclase with conventional techniques. However, it was noted in the present study that a broad, steep edge at the appropriate energy (3 - 4 eV) occurred, in the "oxidized" crystals, and it may be feasible to resolve the bands. Nevertheless, the plarized absorption at 1250 nm, caused by ferrous iron, is reduced in intensity in the plagioclase crystals, compared to the Luna 20 crystals.

The implications of this study are as follows:

(a). Iron concentration varies nonsystematically within a single plagioclase crystal in the samples under study. The cause of this variation, apparently not a conventional zoning, is unknown.

(b). Comparison of plots of iron concentration versus obsorption coefficient of the ferrous iron band at 1250 nm suggests that part of the iron content is not ferrous.

(c). If part of the iron content is ferric, it probably resulted from the lawrencite reaction, suggesting a highly penetrative oxidation. This may be an important factor in assessing the controls of oxidation in the Moon based on other Apollo samples.

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TABLE 1. ELECTRON MICROPROBE ANALYSES OF REPRESENTATIVE PLAGIOCLASE CRYSTALS (WEIGHT PERCENT)

Sample No.:	15475,22 (Weeks)	64501,1	64502,1	64802,13	66095,51,1	66095,51,2
Cr_2O_3	0.00	0.00	0.01	0.00	0.00	0.00
MnO	0.00	0.00	0.01	0.00	0.00	0.00
FeO	0.66	0.18	0.20	0.16	0.20	0.33
(range)	0.49-0.89	0.16-0.21	0.13-0.24	0.10-0.20	0.15-0.28	0.27-0.39
NiO	0.00	0.00	0.01	0.00	0.00	0.00
Na_2O	1.21	0.36	0.38	0.32	0.33	0.27
MgO	0.29	0.05	0.11	0.07	0.07	0.11
Al_2O_3	31.76	35.12	34.80	34.98	35.57	35.17
SiO_2	47.91	45.73	45.60	44.61	45.81	45.33
K_2O	0.02	0.00	0.00	0.00	0.00	0.00
CaO	16.85	18.41	18.82	19.20	18.82	19.18
TiO_2	0.05	0.01	0.05	0.02	0.02	0.02
TOTAL	98.74	99.86	100.04	99.36	100.84	100.42