TRACE ELEMENT CONTENT OF FELDSPAR FROM ACHONDrites
AND LUNAR BRECCIAS

J.S. DELANEY1, S.R. SUTTON2,3, and J.V. SMITH3; (1) Dept Geology,
Rutgers University, New Brunswick, NJ 08903; (2) Brookhaven Natl Lab., Upton,
NY; (3) Dept Geophysical Sci., University of Chicago, Chicago IL.

INTRODUCTION: Lithic clasts from basaltic achondrites and lunar breccias
are being studied for major, minor and trace element compositions using
electron, ion, and synchrotron XRF microprobes. The goals of this work are
(1) to unravel the complex histories of polymict samples using in-situ
analyses on individual monomict components, (2) to investigate clast - matrix
interactions, and (3) to determine the original petrogenesis of the lithic
clasts. The availability of trace element microprobes allows trace elemental
partitioning experiments to be performed on -10μm spots.

Exploratory experiments completed include SXRF analyses on plagioclase
from 4 eucritic specimens (Stannern, Juvinas, Serra de Magé, and clast 559
from the mesosiderite Vaca Muerta) and 3 lunar rocks (ferroan anorthosite
60025, microgabbro 15555, and a glass-rich norite 78235). SXRF spectra
typically contain peaks due to Ca, Ba, Ti, Cr, Mn, Fe and Sr and occasionally
Ni, Cu, Zn, and Ga. Ion microprobe analyses of Ba, Ti, and Sr have been
reported for plagioclase from Juvinas, 60025, and 78235. The three eucrites
reflect much of the variability of the basaltic lithologies on their parent
body while the three lunar samples represent the extremes of known lunar rock
types. The mesosiderite clast is typical of many gabbroic clasts in these
complex meteorites.

As previously reported, we found that Sr correlated with Ab and that Ba
contents are variable. In addition to Ba, Ti and Sr content, the elemental
ratios Sr/Ba and Fe/Mn appear to be useful petrogenetic fingerprints. Fe/Mn
were comparable for the 3 eucrites (about 30) but much lower for the meso-
siderite (20). The norite Fe/Mn (70), an analysis of feldspathic glass, was
significantly greater than those of the other two lunar samples (24, 33)
despite the similar major element compositions (An#-An%) Sr/Ba was
distinct for plagioclase from each of the meteorite and lunar samples. Cu
and Zn were detected at concentrations between 1 and 20 ppm. Recent
measurements on terrestrial feldspars show comparable concentrations and
demonstrate that these two elements occur in solid solution.

The observed variations of Fe/Mn are particularly intriguing. Feldspar
gains in 60025 and 15555 have low Fe/Mn ratios near 30, (cf. anorthosite
grains measured by Palme et al.1). The norite 78235 has feldspar with Fe/Mn
about 70. The bulk Fe/Mn for all these samples are in the range 60 - 80 so
that the partitioning of Fe/Mn between feldspar and the mafic silicates
(DFe/Mn, felds/mar) varies radically (0.4 - 1). The achondrite samples studied
all have D's of approximately 1. The D values from the 'pristine' samples
60025 and 15555 are 0.4. If this represents equilibrium partitioning between
the feldspar and the melt, then the higher D values in 78235 and the
achondrites reflect subsequent reprocessing. 78235 has a complex history of
cumulus crystallization and shock melting that has severely altered the
texture of this norite. Shock melting of feldspar may result in melting of
small amounts of Fe – bearing minerals that remain in solution in the
feldspathic glass. For example, mass balance constrains the amount of Fe0
needed to increase the Fe/Mn ratio of the 78235 feldspar from 30 to 70 is
less than 0.1 wt%. Solution of a similar amount of metal into shock melted
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Pyroxene in the same rock would hardly alter its Fe/Mn. If the equilibrium D is about 1, then some mechanism to enrich Mn in the feldspar of the anorthosite 60025 and in 15555 is needed. Since the present data are for only seven samples, few conclusions can be reached. Systematic measurements using SXRF of feldspars from a variety of carefully selected lunar samples and achondrites are needed to identify the nature of Fe/Mn partitioning between feldspar and coexisting melts and minerals. In addition, calibration of the partitioning in synthetic systems would be useful.

Given the large difference between the bulk Fe/Mn of lunar and achondritic samples, the similarity between the ratios in the feldspars from both bodies is remarkable. However, the similarity appears to be coincidental and results from processes reflecting different segments of their history. More systematic analyses are needed on both lunar rocks and achondrites to determine more precisely the ranges of Fe/Mn ratios in pristine and modified plagioclases. If the distinction between these two generations can be demonstrated on a large scale, Fe/Mn ratios in plagioclase may prove to be a useful parameter for identifying pristine clasts from planetary breccias.

REFERENCES: (1) Palme et al., (1983) PLPSC 14. (2) Ostertag et al. (1986) GCA

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