# 60055 - 60059

Friable Anorthosite

35.5, 16.1, 3.1, 2.1 and 1 grams

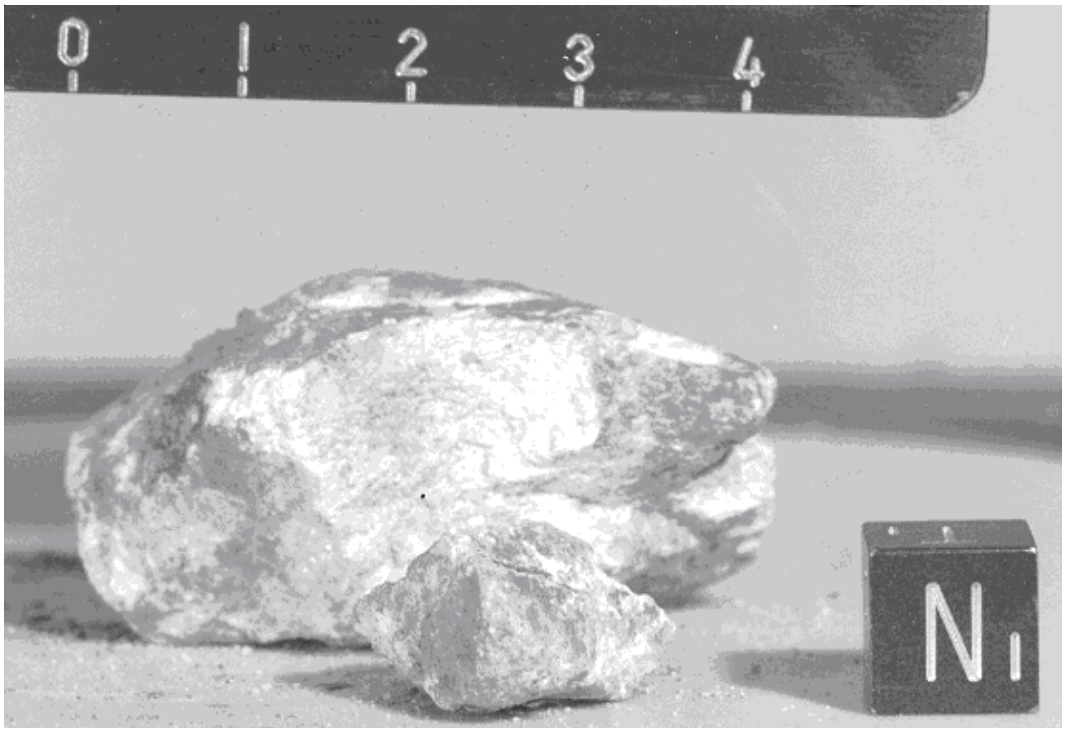



*Figure 1: Photo of 60055. Cube and scale are 1 cm. NASA S72-41417.*

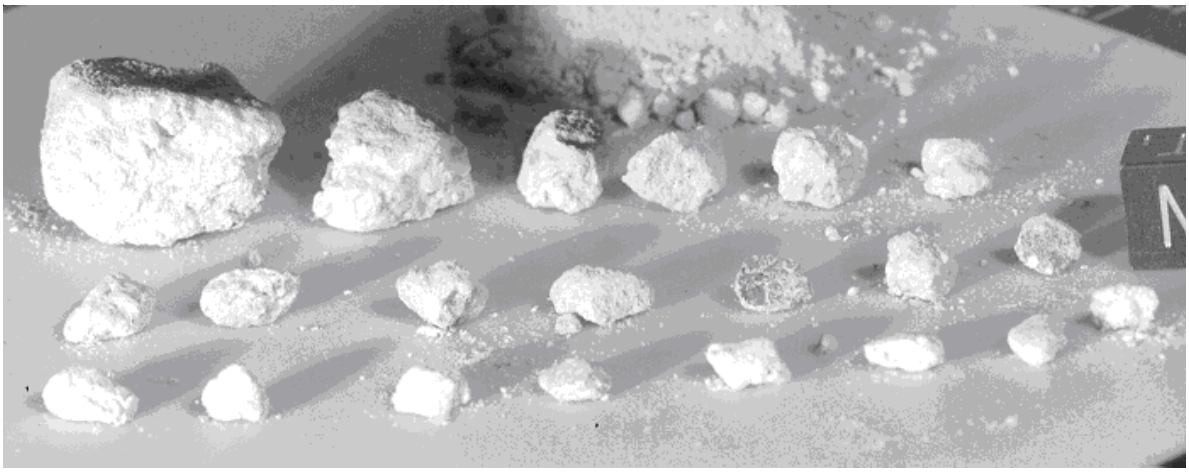


*Figure 2: Photo of 60056. Note pile of crumbs. Cube is 1 cm. NASA S72-41420.*

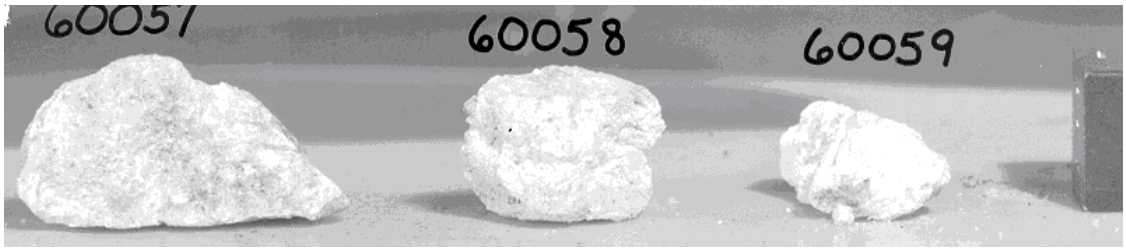



*Figure 3: Photo of 60057, 60058 and 60059. NASA S7241305.*

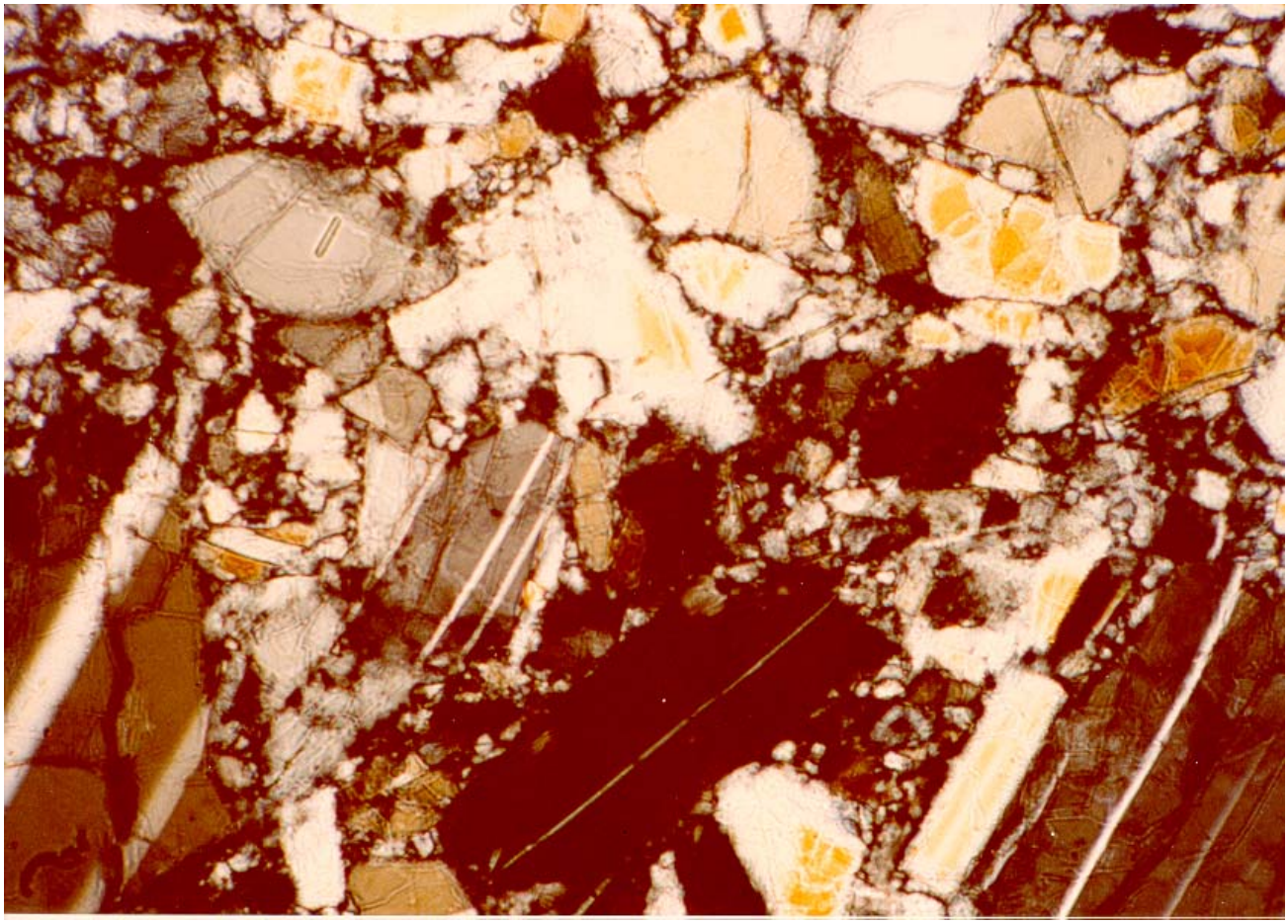


*Figure 4: Thin section photomicrograph (crossed polorizers) of 60055,4. Field of view is 1.4 mm. NASA S79-27802. Note lack of "kink banding".*

## Introduction

These walnut-sized particles from soil sample 60050 are what gave the soil a "white" appearance on the lunar surface. They are made up of 95-98 % plagioclase and have been highly factured (figures 1 – 3). However, shock features are lacking.

## Petrography

Ryder and Norman (1979, 1980) describe these samples as porous, cataclastic anorthosite. Warren and Wasson (1978) and Warren et al. (1982) reported that 60055 and 60056 were 98 % plagioclase ($An_{97}$) with about 2% augite ($Wo_{43}En_{42}$) and rare orthopyroxene ($Wo_2En_{61}$) and olivine ($Fo_{60\text{-}67}$). Only rarely are relict grain boundaries between mafics and plagioclase present (figure 4). Bersch et al. (1991) report precise olivine and pyroxene compositions in 60055 and 60056.

James et al. (1989) group 60055 with ferroan anorthosites (figure 6).

## Chemistry

60056 has higher trace element content than 60055 (figure 5) and also has higher content of meteoritic siderophiles. Either the split was contaminated with soil, or it is itself a mixture.

There are additional fragments of this lithology in the coarse-fine fraction of the soil, and it is clear that breakup of these rocks have contributed to the soil chemistry.

## Table 1. Chemical composition of 60055.

| | 60055 | 60056 | | 60055 | |
|---|---|---|---|---|---|
| *reference* | Warren78 | Warren83 | | Ebihara92 | |
| *weight* | rake s. | rake s. | | | |
| SiO2 % | 44.3 | | | | |
| TiO2 | | 0.13 | (a) | | |
| Al2O3 | 34 | 35.14 | (a) | | |
| FeO | 0.33 | 1.7 | (a) | | |
| MnO | 0.096 | 0.026 | (a) | | |
| MgO | 0.33 | | | | |
| CaO | 19 | 18.6 | (a) | | |
| Na2O | 0.45 | 0.48 | (a) | | |
| K2O | 0.1 | 0.028 | (a) | | |
| P2O5 | | | | | |
| S % | | | | | |
| *sum* | | | | | |
| | | | | | |
| Sc ppm | 0.55 | 3.2 | (a) | | |
| V | | | | | |
| Cr | 33.4 | 224 | (a) | | |
| Co | 0.84 | 4.9 | (a) | | |
| Ni | 1.9 | 22 | (a) | 2.3 | (b) |
| Cu | | | | | |
| Zn | 0.6 | 1.8 | (a) | 0.413 | (b) |
| Ga | 3.8 | 4 | (a) | | |
| Ge ppb | 16.6 | 240 | (a) | 4.14 | (b) |
| As | | | | | |
| Se | | | | 1.1 | (b) |
| Rb | | 3 | (a) | 0.086 | (b) |
| Sr | | 179 | (a) | | |
| Y | | | | | |
| Zr | | 71 | (a) | | |
| Nb | | | | | |
| Mo | | | | | |
| Ru | | | | | |
| Rh | | | | | |
| Pd ppb | | | | 0.9 | (b) |
| Ag ppb | | | | 2.08 | (b) |
| Cd ppb | 0.57 | 1.1 | (a) | 0.732 | (b) |
| In ppb | 3.6 | | | 2.82 | (b) |
| Sn ppb | | | | | |
| Sb ppb | | | | 0.32 | (b) |
| Te ppb | | | | 2.7 | (b) |
| Cs ppm | | | | 0.006 | (b) |
| Ba | 11 | 29 | (a) | | |
| La | 0.13 | 1.41 | (a) | | |
| Ce | 0.27 | 3.6 | (a) | | |
| Pr | | | | | |
| Nd | | 2.3 | (a) | | |
| Sm | 0.04 | 0.61 | (a) | | |
| Eu | 0.76 | 1.1 | (a) | | |
| Gd | | | | | |
| Tb | | 0.141 | (a) | | |
| Dy | | | | | |
| Ho | | 0.022 | (a) | | |
| Er | | | | | |
| Tm | | | | | |
| Yb | 0.035 | 0.4 | (a) | | |
| Lu | 0.004 | 0.067 | (a) | | |
| Hf | | 0.39 | (a) | | |
| Ta | | 0.057 | (a) | | |
| W ppb | | | | | |
| Re ppb | | 0.063 | (a) | 0.001 | (b) |
| Os ppb | | | | 0.06 | (b) |
| Ir ppb | 0.013 | 1.7 | (a) | 0.006 | (b) |
| Pt ppb | | | | | |
| Au ppb | 0.014 | 0.46 | (a) | 0.004 | (b) |
| Th ppm | | 0.163 | (a) | | |
| U ppm | | 0.06 | (a) | 0.0009 | (b) |

*technique: (a) INAA, (b) RNAA*

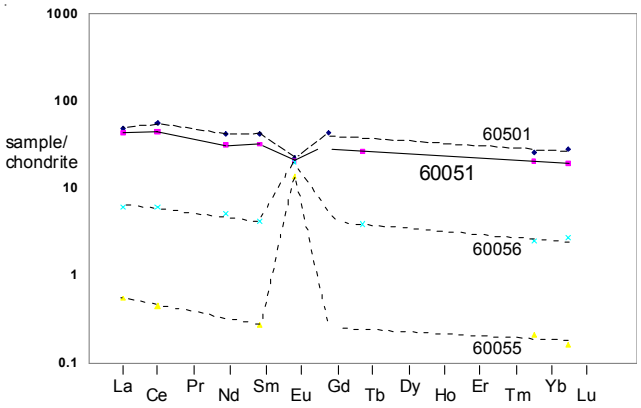



*Figure 5: Normalized rare-earth-element diagram for 60055 and 60056 (with soils). Data from Warren et al.*

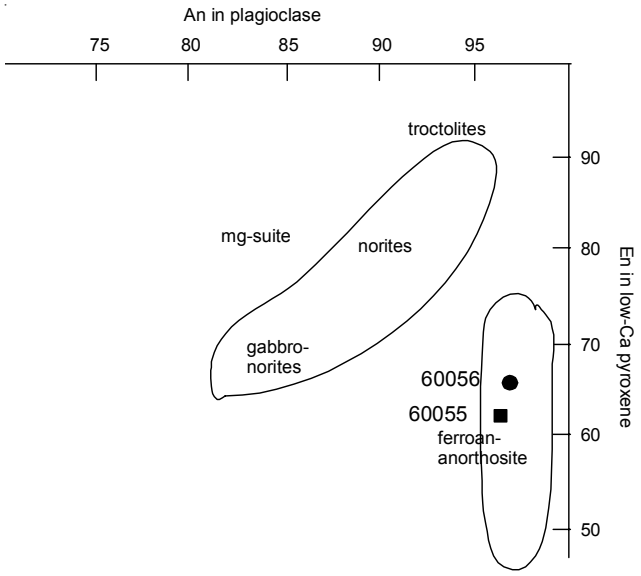
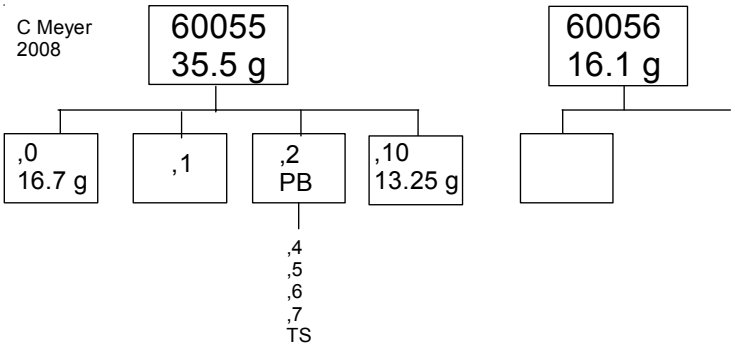



*Figure 6: Compsition of plagioclase and low-Ca pyroxene in anorthosites 60055 and 60056 (from Warren et al).*



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