# 15256

Basaltic Breccia

201 grams

*Figure 1: Photo of 15256. NASA S71-44501. Sample is 7 cm across.*

## Introduction

15256 is a rare type of lunar breccia, made up of mostly mare basalt fragments, that are welded together. It was collected at station 6, on the bottom slope of the Apennine bench, above Spur Crater (Swann et al. 1971). This is well above the mare surface, and the sample must have been ejected from a crater into the mare below. However the origin and history of 15256 is somewhat mysterious (Ryder 1985).

15256 is rounded, aphanitic, coherent and covered with micrometeorite craters on most sides (figure 1). It is made up of fragments of olivine-normative basalt and lacks fragments of pyroxene basalt (the other main variety of Apollo 15 basalt). The sample lacks a signature of meteoritic siderophiles and was not a soil. This rock has not been dated.

## Petrography

von Engelhardt et al. (1973) described 15256 as "a breccia, composed of several mare type basaltic rocks, which was exposed for a short time to high temperatures so that the original matrix recrystallized and boundaries of rock clasts became less distinct." There is a very nice picture of a thin section of 15256 in Mason et al. (1972) which illustrates the description by von Engelhardt, but the texture of this assemblage can also be see in figure 2. Mason et al. state: "rock 15256 is a texturally heterogeneous, shock-altered rock, probably ejected to the Apennine Front from a mare impact site. Some clasts posses a well-developed vitrophyric texture containing phenocrysts or microlites of olivine ($Fo_{65-50}$) and less commonly of pyroxene." Dark areas of devitrified glass may be impact related.

Ryder (1985, 1989) also described 15256 as a "shock-produced, fine-grained, heterogeneous but clast-free melt of olivine-normative basalt composition." Ryder noted that glass is present and von Engelhardt et al. described narrow fissures filled with yellow vesicular glass.

## Mineralogy

***Olivine:*** Mason et al. (1972) reported large clasts of olivine ($Fo_{65}$).

***Pyroxene:*** not reported

**Mineralogical Mode for 15256**

| | Sample Catalog Butler 1971 |
|---|---|
| Olivine | |
| Pyroxene | 35 |
| Plagioclase | 60 |
| Silica | |
| Opaques | 2 |

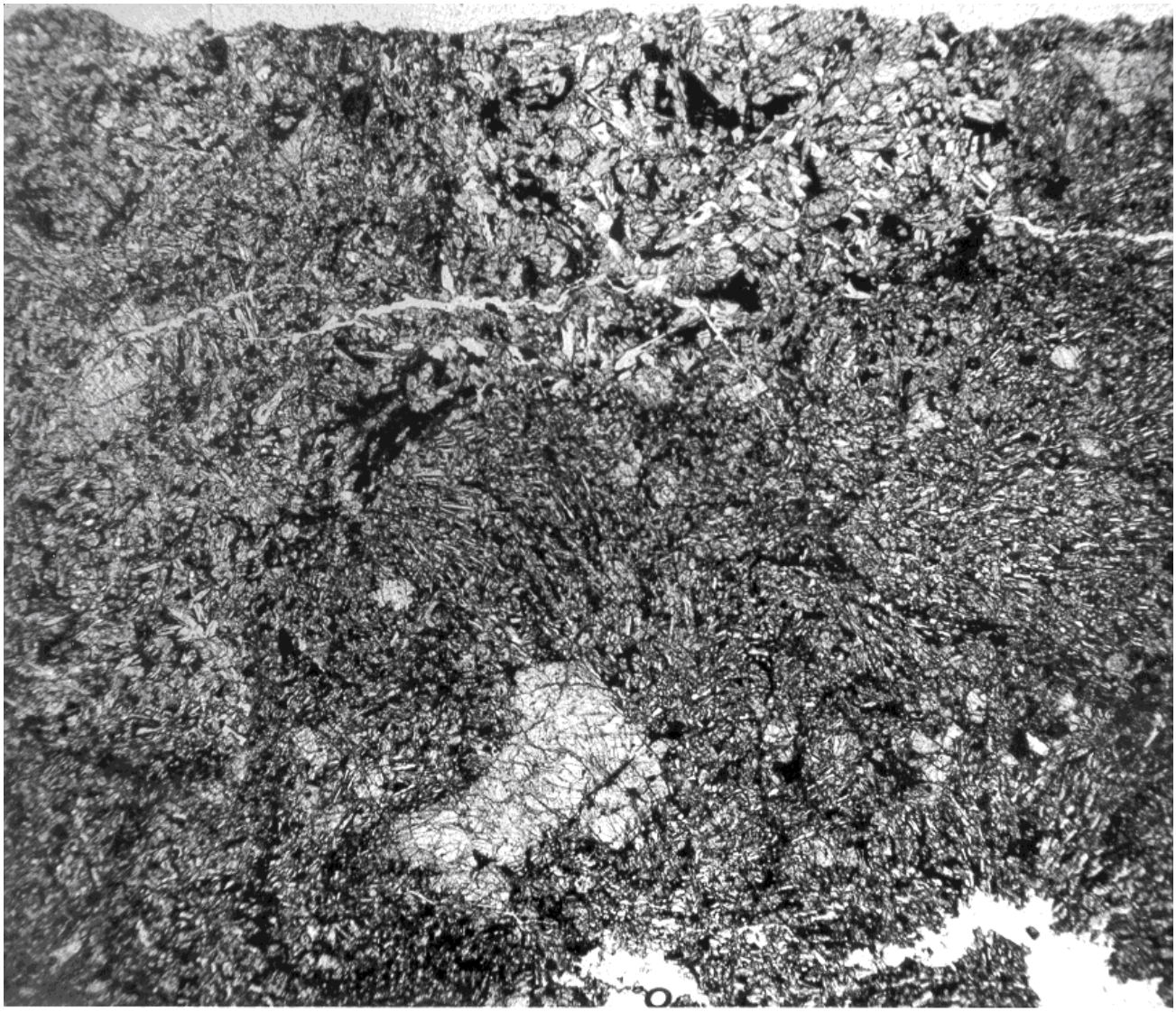


*Figure 2: Photomicrgraph of thin section of 15256 showing a variety of textures. NASA S71-52226.*

## Chemistry

von Engelhardt et al. (1973) give an analysis of 15256. Additional analyses are given in table 1 and figures 4 and 5. It has a composition typical of Apollo 15 olivine-normative basalt (figure 6).

15256 is enriched in some volatile elements (Cd, In, Br and Te), but not others (Zn, Pb). It lacks meteoritic siderophiles (Ni, Re, Ir and Au).

## Radiogenic age dating

Nyquist et al. (1973) determined the isotopic composition of Sr.

## Cosmogenic isotopes and exposure ages

Keith et al. (1972) determined the cosmic-ray-induced activity of $^{26}$Al = 97 dpm/kg, $^{22}$Na = 37 dpm/kg, $^{54}$Mn = 25 dpm/kg, $^{56}$Co = 6 dpm/kg and $^{46}$Sc = 3.6 dpm/kg.

## Processing

15256 has been broken (figure 3) and thin sections from several regions prepared.


*Figure 3: Photo of a portion of 15256,27 showing a melange of rocks. NASA S75-33761. Scale at bottom is marked in cm/mm.*

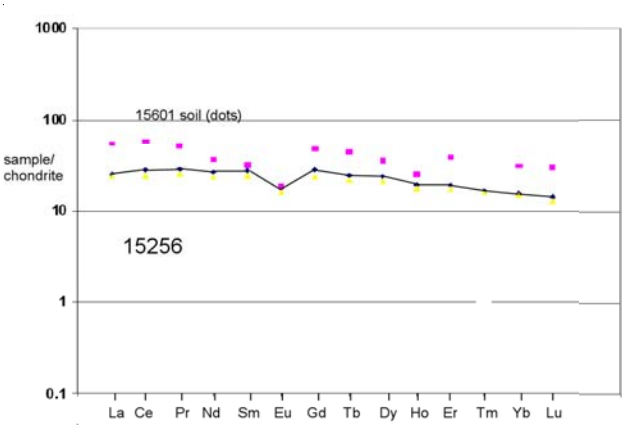



*Figure 4: Normalized rare-earth-element diagram for 15256.*

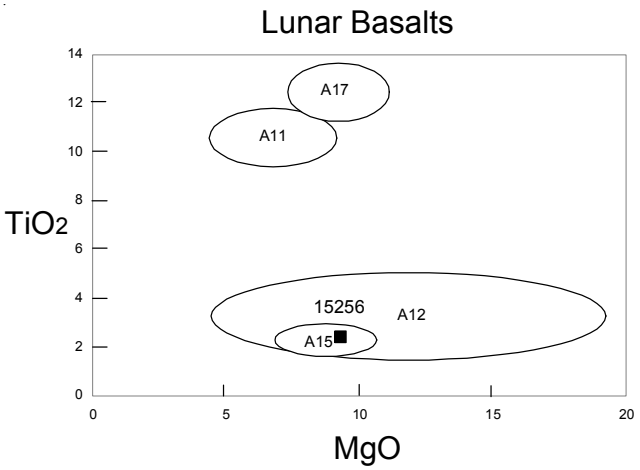
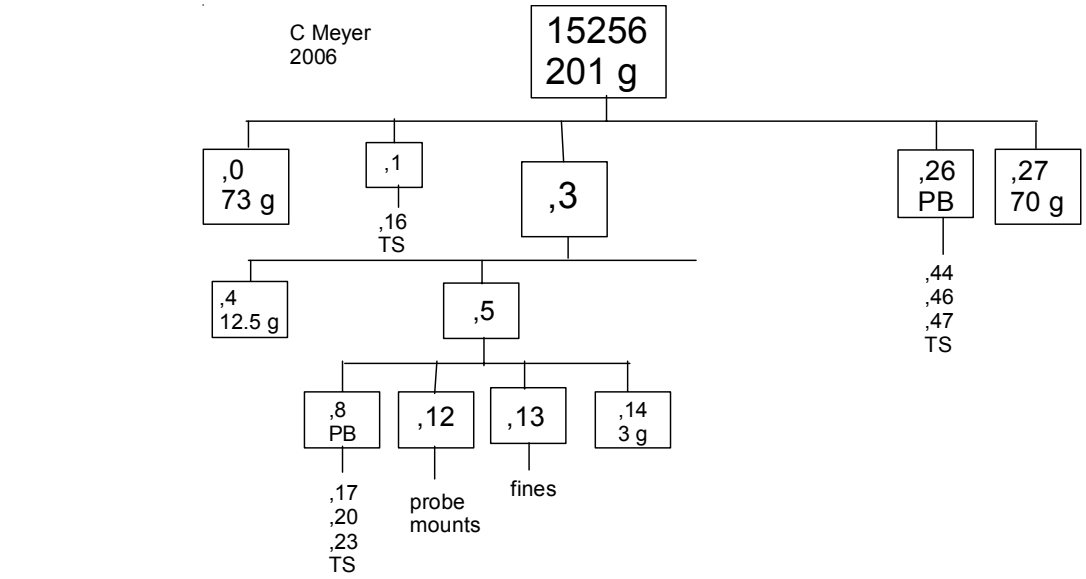



*Figure 5: Chemical composition of 15256 compared with that of other lunar basalts.*

## Table 1. Chemical composition of 15256.

| *reference* | Rhodes and Hubbard 1973 | | | | | Mason72 | | Mason72 | | Ryder2001 | | | | Ganapathy73 | | Keith72 | | Neal2001 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *weight* | Hubbard73 | | | | | 0.5 g | | | | 3.73 g | | | | Morgan72 | | whole | | | |
| SiO2 % | | | 44.93 | 45.12 | (b) | 45.32 | (d) | | | 44.9 | (b) | | | | | | | | |
| TiO2 | | | 2.54 | 2.51 | (b) | 2.54 | (d) | | | 2.46 | (b) | | | | | | | | |
| Al2O3 | | | 8.89 | 8.95 | (b) | 9.2 | (d) | | | 8.97 | (b) | | | | | | | | |
| FeO | | | 22.21 | 22.52 | (b) | 22.51 | (d) | | | 21.85 | (b) | 22 | (e) | | | | | | |
| MnO | | | 0.29 | 0.32 | (b) | 0.35 | (d) | | | 0.28 | (b) | | | | | | | | |
| MgO | | | 9.08 | 9.32 | (b) | 9.45 | (d) | | | 9.82 | (b) | | | | | | | | |
| CaO | | | 10.27 | 10.14 | (b) | 10.17 | (d) | | | 9.87 | (b) | | | | | | | | |
| Na2O | | | 0.28 | 0.25 | (b) | 0.3 | (d) | | | 0.274 | (b) | 0.267 | (e) | | | | | | |
| K2O | 0.038 | (a) | 0.03 | 0.04 | (b) | *0.12* | (d) | | | 0.045 | (b) | | | | | 0.036 | (g) | | |
| P2O5 | | | 0.06 | 0.07 | (b) | 0.07 | (d) | | | 0.067 | (b) | | | | | | | | |
| S % | | | 0.08 | 0.07 | (b) | | | | | | | | | | | | | | |
| *sum* | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| Sc ppm | | | | | | | | | | | | 43.2 | (e) | | | | | 47 | (h) |
| V | | | | | | | | 135 | (c ) | | | | | | | | | 258 | (h) |
| Cr | | | | | | 2121 | (d) | 4200 | (c ) | 4076 | (b) | 4030 | (e) | | | | | 4082 | (h) |
| Co | | | | | | | | 46 | (c ) | | | 51.2 | (e) | 46 | (f) | | | 59 | (h) |
| Ni | | | | | | | | 60 | (c ) | 59 | (b) | 83 | (e) | | | | | 68 | (h) |
| Cu | | | | | | | | 11 | (c ) | 7 | (b) | | | | | | | 17 | (h) |
| Zn | | | | | | | | | | | | | | 0.92 | (f) | | | 21 | (h) |
| Ga | | | | | | | | 4 | (c ) | | | | | | | | | 4.2 | (h) |
| Ge ppb | | | | | | | | | | | | | | 3.8 | (f) | | | | |
| As | | | | | | | | | | | | | | | | | | | |
| Se | | | | | | | | | | | | | | 119 | (f) | | | | |
| Rb | 0.68 | (a) | | | | | | | | *2* | (b) | | | 0.67 | (f) | | | 1.06 | (h) |
| Sr | 100 | (a) | | | | | | 88 | (c ) | 98 | (b) | 86 | (e) | | | | | 115 | (h) |
| Y | | | | | | | | 48 | (c ) | 27 | (b) | | | | | | | 33 | (h) |
| Zr | | | | | | | | 100 | (c ) | 90 | (b) | | | | | | | 115 | (h) |
| Nb | | | | | | | | | | 5 | (b) | | | | | | | 8 | (h) |
| Mo | | | | | | | | | | | | | | | | | | 0.32 | (h) |
| Ru | | | | | | | | | | | | | | | | | | | |
| Rh | | | | | | | | | | | | | | | | | | | |
| Pd ppb | | | | | | | | | | | | | | | | | | | |
| Ag ppb | | | | | | | | | | | | | | 0.78 | (f) | | | | |
| Cd ppb | | | | | | | | | | | | | | 104 | (f) | | | | |
| In ppb | | | | | | | | | | | | | | 6.8 | (f) | | | | |
| Sn ppb | | | | | | | | | | | | | | | | | | | |
| Sb ppb | | | | | | | | | | | | | | 0.43 | (f) | | | | |
| Te ppb | | | | | | | | | | | | | | 2 | (f) | | | | |
| Cs ppm | | | | | | | | | | | | | | 0.032 | (f) | | | 0.03 | (h) |
| Ba | 49.9 | (a) | | | | | | 41 | (c ) | | | 63 | (e) | | | | | 67 | (h) |
| La | 4.82 | (a) | | | | | | | | | | 5.43 | (e) | | | | | 6.41 | (h) |
| Ce | 14.5 | (a) | | | | | | | | | | 15.4 | (e) | | | | | 15.8 | (h) |
| Pr | | | | | | | | | | | | | | | | | | 2.38 | (h) |
| Nd | 10.5 | (a) | | | | | | | | | | 11.5 | (e) | | | | | 11.2 | (h) |
| Sm | 3.43 | (a) | | | | | | | | | | 3.78 | (e) | | | | | 3.8 | (h) |
| Eu | 0.893 | (a) | | | | | | | | | | 0.9 | (e) | | | | | 0.94 | (h) |
| Gd | 4.65 | (a) | | | | | | | | | | | | | | | | 4.87 | (h) |
| Tb | | | | | | | | | | | | 0.82 | (e) | | | | | 0.86 | (h) |
| Dy | 4.98 | (a) | | | | | | | | | | | | | | | | 5.4 | (h) |
| Ho | | | | | | | | | | | | | | | | | | 1.05 | (h) |
| Er | 2.75 | (a) | | | | | | | | | | | | | | | | 2.97 | (h) |
| Tm | | | | | | | | | | | | | | | | | | 0.4 | (h) |
| Yb | 2.25 | (a) | | | | | | | | | | 2.37 | (e) | | | | | 1.52 | (h) |
| Lu | 0.33 | (a) | | | | | | | | | | 0.33 | (e) | | | | | 0.3 | (h) |
| Hf | | | | | | | | | | | | 2.74 | (e) | | | | | 2.7 | (h) |
| Ta | | | | | | | | | | | | 0.43 | (e) | | | | | 0.47 | (h) |
| W ppb | | | | | | | | | | | | | | | | | | 30 | (h) |
| Re ppb | | | | | | | | | | | | | | 0.0049 | (f) | | | | |
| Os ppb | | | | | | | | | | | | | | | | | | | |
| Ir ppb | | | | | | | | | | | | | | 0.022 | (f) | | | | |
| Pt ppb | | | | | | | | | | | | | | | | | | | |
| Au ppb | | | | | | | | | | | | | | 0.019 | (f) | | | | |
| Th ppm | | | | | | | | | | | | 0.56 | (e) | | | 0.42 | (g) | 0.36 | (h) |
| U ppm | 0.139 | (a) | | | | | | | | | | | | | | 0.139 | (g) | 0.1 | (h) |

*technique: (a) IDMS, (b) XRF, (c ) ES, (d) classical wet chem., (e) INAA, (f) RNAA, (g) radiation counting, (h) ICP-MS*



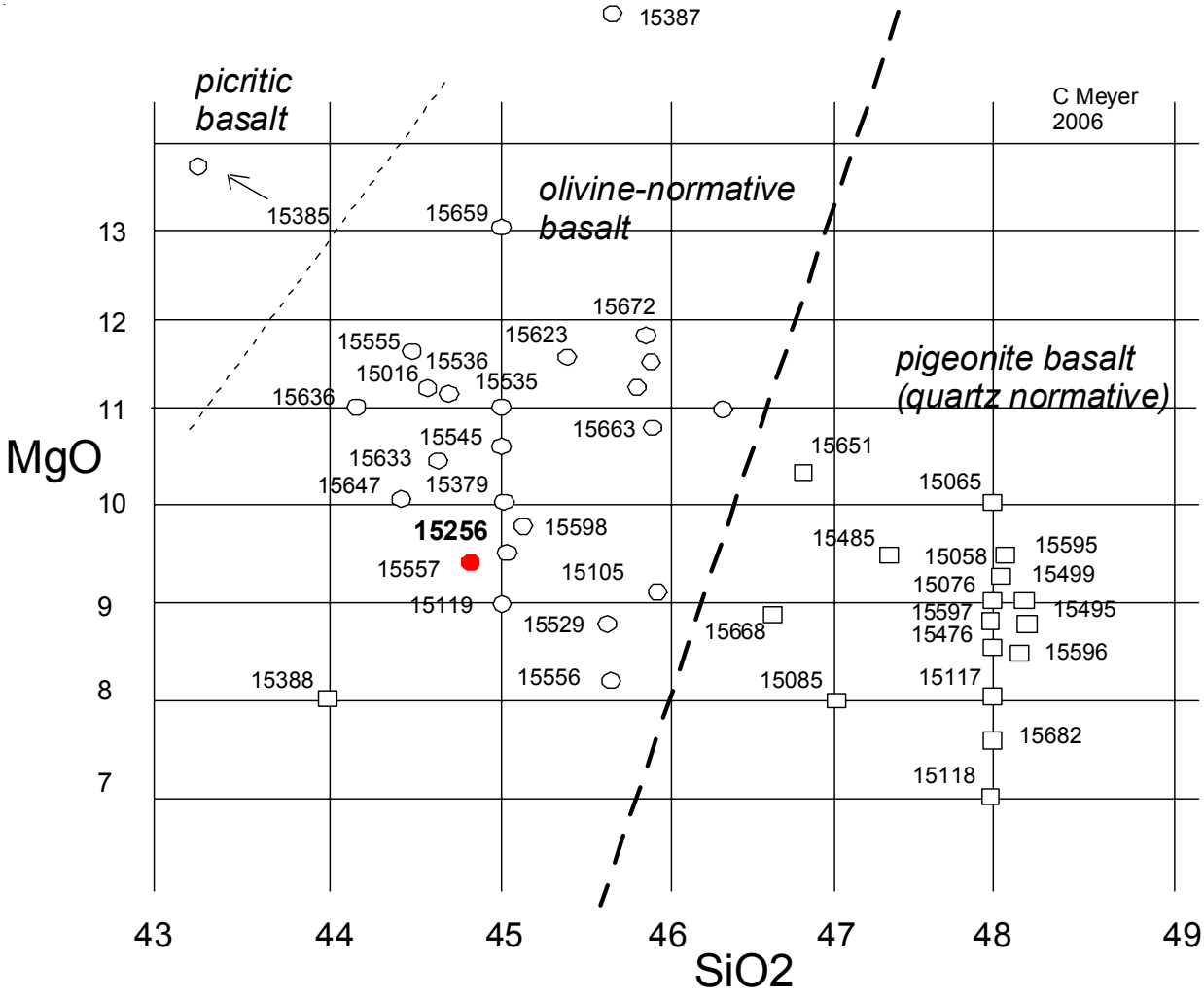




*Figure 6: Apollo 15 basalts are of tw types; olivine-normative and pigeonite-phyric. !5256 appears to be a breccia from form the olivine normative type.*

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