# 15636

Olivine-normative Basalt

336.7 grams

*Figure 1: Photo of 15636. NASA S87-45217. Cube is 1 inch.*

## Introduction

Lunar samples 15636 was collected by rake about 20 meters from Hadley Rille (Swann et al. 1971). At over 300 grams it is the largest of the rake samples. It is a coarse-grained olivine-normative basalt rather typical of Apollo 15. It has not been dated.

**Mineralogical Mode for 15636**

| | |
|---|---|
| Olivine | 18 % |
| Pyroxene | 44.7 |
| Plagioclase | 26.3 |
| Opaues | 6.2 |
| Mesostatis | 1.5 |
| Fayalite | 1.9 |
| Cristobalite | 1.4 |

*Shervais et al. 1990*

## Petrography

The texture of 15636 could be described as microgabbroic (figure 2). Anhedral, elongate pyroxene

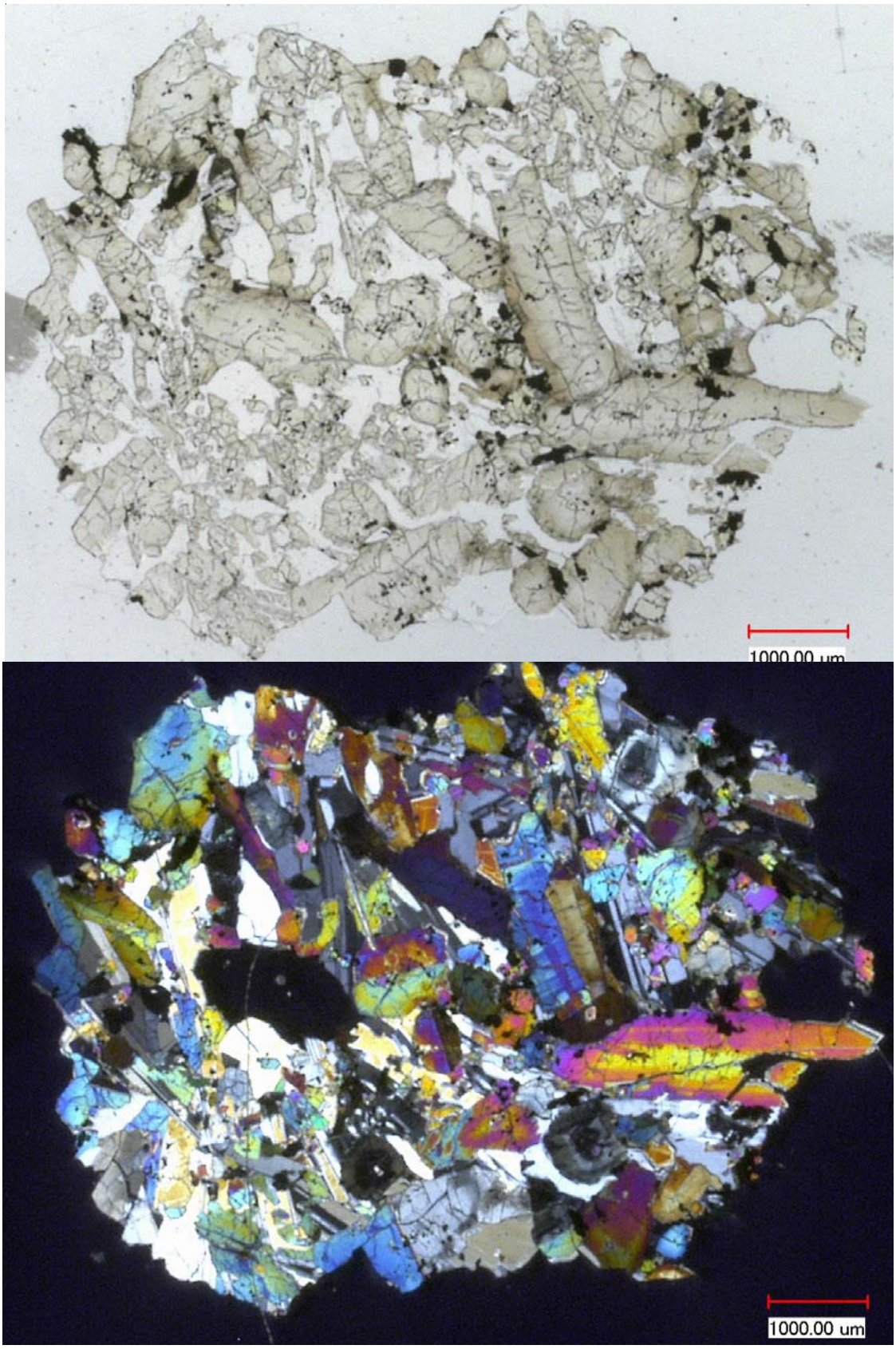



*Figure 2: Photomicrographs of thin section 15636,9 by C Meyer @ 30x (bottom is with crossed polarizers).*

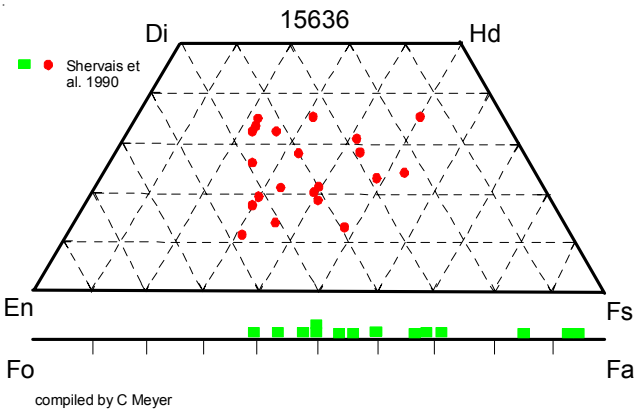



*Figure 3: Composition of olivine and pyroxene in 15636 (Shervais et al. 1990).*

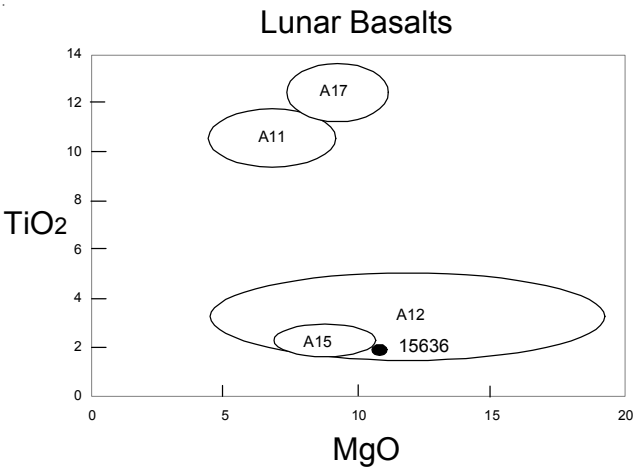



*Figure 4: Chemical composition of 15636 compared with that of other lunar basalts.*

is 1 to 3 mm, plagioclase is 1 to 2 mm, and larger embayed olivine phenocrysts are scattered throughout (figure 2). Residual phases include cristobalite, fayalite, troilite, ilmentie, ulvospinel and glass (Shervais et al. 1990). Chromite and silicate liquid inclusions are found in olivine. Ilmenite exsolution in ulvospinel is observed.

Shervais et al. (1990) describe an irregularity to the mode of 15636. Some areas are enriched in plagioclase and others in mafic minerals. Mesostasis clots up to 1 mm in size are found restricted to plagioclase-free places.

Shervais et al. (1990) determined the composition of olivine, pyroxene and plagioclase in 15636 (figure 3).

## Chemistry

Chappell and Green (1973), Neal (2001), Ryder and Schuraytz (2001), report consistent results but the analysis by Shervais et al. (1990) is low in Al and too high in Fe.

Compston et al. (1972) reported the isotopic composition of Sr.

## Other studies

Wolf et al. (1972) and Pearce et al. (1973) determined the magnetic properties.

## Processing

This large sample has not been sawn and remains mostly intact. There are three small thin section.

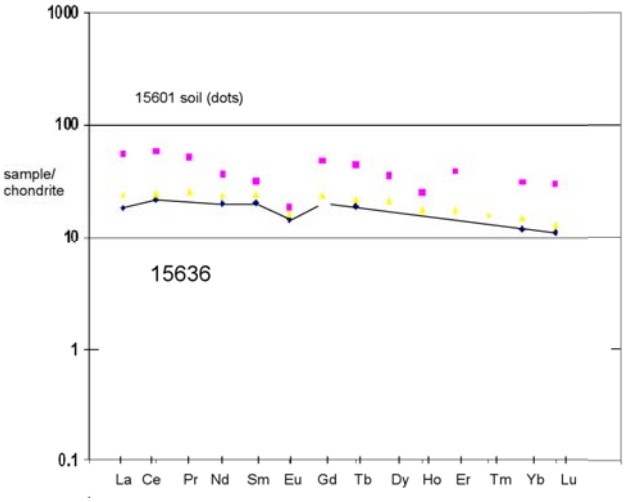



*Figure 5: Normalized rare-earth-element diagram for 15636.*

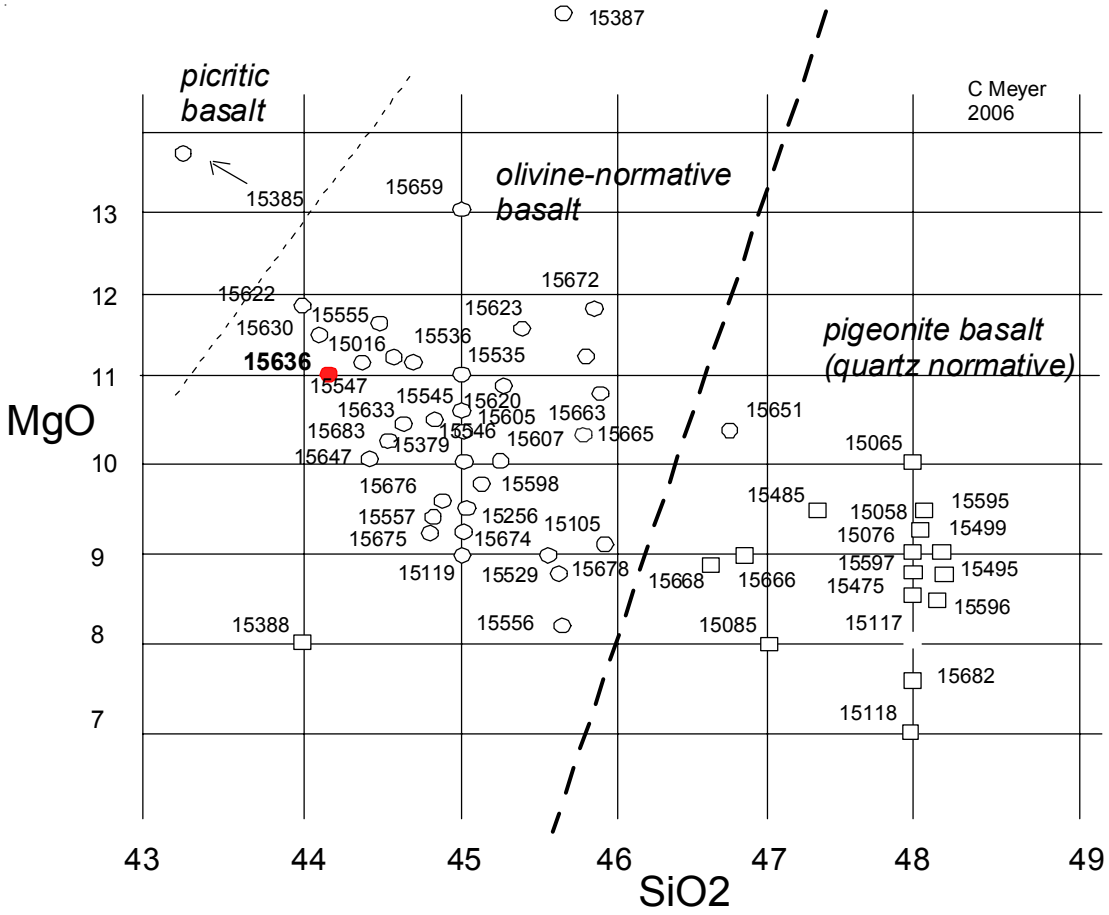
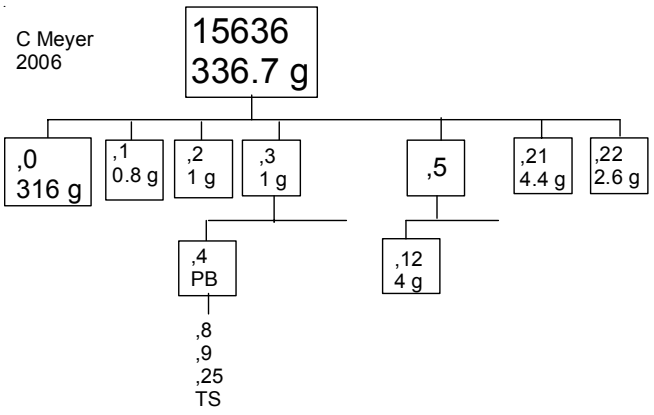



*Figure 6: The big picture.*



## Table 1. Chemical composition of 15636.

| *reference* | Chappell73 | | Ryder2001 | | | | Fruchter73 | | Shervais90 | | | | Neal2001 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *weight* | | | 5 g | | | | | | 0.2 g | | | | | |
| SiO2 % | 44.58 | (a) | 44.6 | (a) | | | | | 43.8 | (b) | | | | |
| TiO2 | 2.22 | (a) | 1.98 | (a) | | | | | 2.93 | (b) | | | | |
| Al2O3 | 8.55 | (a) | 9.44 | (a) | | | 9.82 | (c ) | 5.87 | (b) | | | | |
| FeO | 22.67 | (a) | 21.26 | (a) | 21.3 | (c ) | 19.55 | (c ) | 26.38 | (b) | 26.8 | (c ) | | |
| MnO | 0.31 | (a) | 0.27 | (a) | | | | | 0.33 | (b) | | | | |
| MgO | 11.32 | (a) | 11.39 | (a) | | | | | 10.72 | (b) | | | | |
| CaO | 9.58 | (a) | 9.4 | (a) | | | | | 9 | (b) | | | | |
| Na2O | 0.26 | (a) | 0.23 | (a) | 0.26 | (c ) | 0.25 | (c ) | 0.17 | (b) | 0.198 | (c ) | | |
| K2O | 0.04 | (a) | 0.038 | (a) | | | | | 0.04 | (b) | | | | |
| P2O5 | 0.07 | (a) | 0.053 | (a) | | | | | 0.07 | (b) | | | | |
| S % | 0.05 | (a) | | | | | | | | | | | | |
| *sum* | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Sc ppm | | | | | 39.5 | (c ) | 35 | (c ) | | | 46 | (c ) | 41.4 | (d) |
| V | | | | | | | | | | | | | 222 | (d) |
| Cr | 3831 | (a) | 4546 | (a) | 4500 | (c ) | 3540 | (c ) | 4036 | (b) | 4225 | (c ) | 5325 | (d) |
| Co | | | | | 56 | (c ) | 52 | (c ) | | | 55.6 | (c ) | 70.2 | (d) |
| Ni | | | 64 | (a) | 86 | (c ) | | | | | 90 | (c ) | 99.6 | (d) |
| Cu | | | 6 | (a) | | | | | | | | | 13.7 | (d) |
| Zn | | | | | | | | | | | | | 17 | (d) |
| Ga | 2.9 | (a) | | | | | | | | | | | 3.78 | (d) |
| Ge ppb | | | | | | | | | | | | | | |
| As | | | | | | | | | | | | | | |
| Se | | | | | | | | | | | | | | |
| Rb | 0.52 | (a) | *6* | (a) | | | | | | | | | 0.78 | (d) |
| Sr | 94.6 | (a) | 93 | (a) | 122 | (c ) | | | | | 120 | (c ) | 104.6 | (d) |
| Y | 21 | (a) | 22 | (a) | | | | | | | | | 26.1 | (d) |
| Zr | 77 | (a) | 75 | (a) | | | | | | | 180 | (c ) | 116 | (d) |
| Nb | 6 | (a) | 8 | (a) | | | | | | | | | 6.3 | (d) |
| Mo | | | | | | | | | | | | | 0.07 | (d) |
| Ru | | | | | | | | | | | | | | |
| Rh | | | | | | | | | | | | | | |
| Pd ppb | | | | | | | | | | | | | | |
| Ag ppb | | | | | | | | | | | | | | |
| Cd ppb | | | | | | | | | | | | | | |
| In ppb | | | | | | | | | | | | | | |
| Sn ppb | | | | | | | | | | | | | | |
| Sb ppb | | | | | | | | | | | | | 20 | (d) |
| Te ppb | | | | | | | | | | | | | | |
| Cs ppm | | | | | | | | | | | | | 0.02 | (d) |
| Ba | | | | | 43 | (c ) | | | | | 88 | (c ) | 52.3 | (d) |
| La | | | | | 4.25 | (c ) | 2.6 | (c ) | | | 9.65 | (c ) | 4.92 | (d) |
| Ce | | | | | 12.9 | (c ) | | | | | 27.8 | (c ) | 12.1 | (d) |
| Pr | | | | | | | | | | | | | 1.87 | (d) |
| Nd | | | | | 9 | (c ) | | | | | | | 8.48 | (d) |
| Sm | | | | | 3.01 | (c ) | 1.9 | (c ) | | | 6.67 | (c ) | 2.94 | (d) |
| Eu | | | | | 0.81 | (c ) | 0.66 | (c ) | | | 1.19 | (c ) | 0.79 | (d) |
| Gd | | | | | | | | | | | | | 3.69 | (d) |
| Tb | | | | | 0.68 | (c ) | | | | | 1.44 | (c ) | 0.65 | (d) |
| Dy | | | | | | | | | | | | | 4.12 | (d) |
| Ho | | | | | | | | | | | | | 0.8 | (d) |
| Er | | | | | | | | | | | | | 2.19 | (d) |
| Tm | | | | | | | | | | | | | 0.3 | (d) |
| Yb | | | | | 1.92 | (c ) | 1.3 | (c ) | | | 3.84 | (c ) | 1.86 | (d) |
| Lu | | | | | 0.27 | (c ) | 0.22 | (c ) | | | 0.532 | (c ) | 0.25 | (d) |
| Hf | | | | | 2.26 | (c ) | 1.3 | (c ) | | | 4.89 | (c ) | 2.79 | (d) |
| Ta | | | | | 0.31 | (c ) | | | | | 0.69 | (c ) | 0.41 | (d) |
| W ppb | | | | | | | | | | | | | | |
| Re ppb | | | | | | | | | | | | | | |
| Os ppb | | | | | | | | | | | | | | |
| Ir ppb | | | | | | | | | | | | | | |
| Pt ppb | | | | | | | | | | | | | | |
| Au ppb | | | | | | | | | | | | | | |
| Th ppm | | | | | 0.36 | (c ) | | | | | 0.85 | (c ) | 0.43 | (d) |
| U ppm | | | | | | | | | | | 0.19 | (c ) | 0.12 | (d) |

*technique: (a) XRF, (b) fused bead, electron probe , (c ) INAA, (d) ICP-MS*

## References for 15636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