# 70139

Ilmenite Basalt

3.16 grams

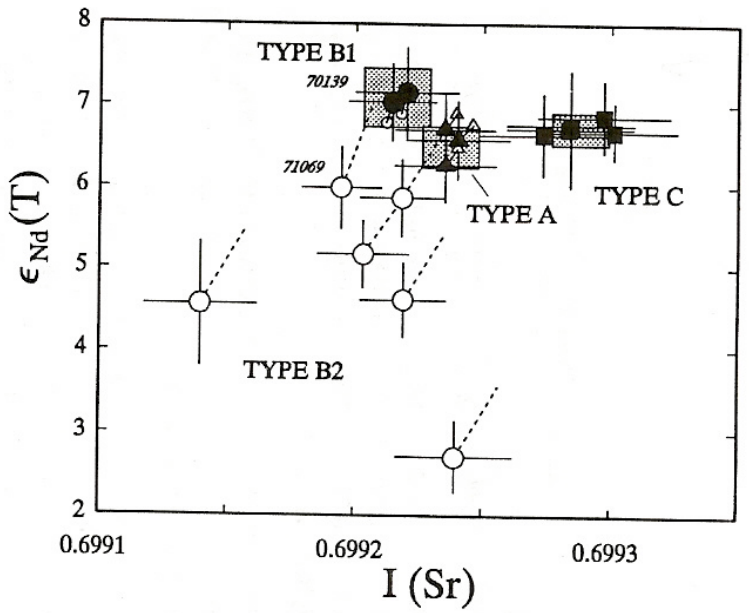



*Figure 1: Diagram of initial Sr and Nd isotopes for 3.7 b.y. old high-Ti mare basalts at Apollo 17 (Paces et al. 1991).*

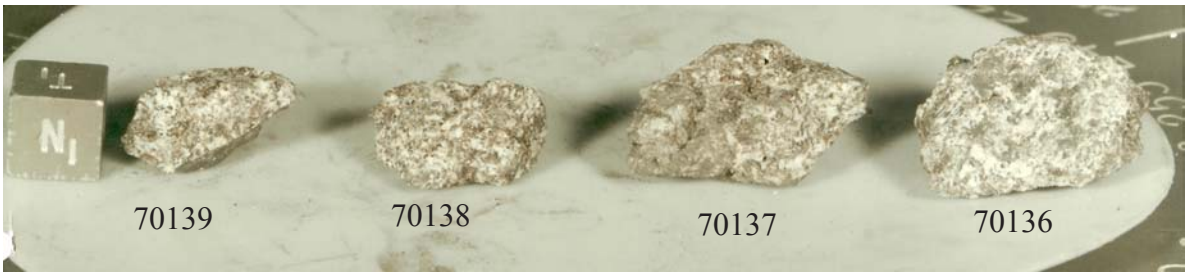



*Figure 2: Basalt chips from same bag as 70135. S73-17970*

## Introduction

This is a chip off of Geophone Rock – see section on 70135. It is a typical high-Ti mare basalt with an age of 3.71 b.y.

Geophone Rock is a basalt boulder located about 50 meters south of the ALSEP site.

## Petrography

Rhodes et al. (1975) originally postulated that there were 3 lava flows of high Ti basalt at Apollo 17 (A, B and C) and this assumption seems to have held up with further analyses (figure 1). 70139 has the same mineralogy and texture as 70135.

## Mineralogical Mode

| | 70135 | Roedder | 70139 | 70147 |
|---|---|---|---|---|
| Olivine | 2.8 | 3.8 | 2.5 | - - |
| Pyroxene | 46.2 | 51.6 | 35.8 | 48.2 |
| Plagioclase | 28.4 | 23 | 41.6 | 29.4 |
| Opaques | 21.9 | 19.6 | 18.2 | 21 |
| Silica | 0.3 | 0.6 | 1.9 | 0.2 |
| Meostasis | 0.4 | 1.4 | | |

## Chemistry

70139 (and 70135) are high-Ti mare basalts (figure 3). The REE pattern is lower than that of most other Apollo 17 mare basalts (figure 4). Please compare with composition of 70135.

**Table 1. Chemical composition of 70139.**

| *reference* | Neal90 | | Paces91 | | |
|---|---|---|---|---|---|
| *weight* | | | | | |
| SiO2 % | | | | | |
| TiO2 | 13.1 | (a) | | | |
| Al2O3 | 8.32 | (a) | | | |
| FeO | 17.6 | (a) | | | |
| MnO | 0.23 | (a) | | | |
| MgO | 9.6 | (a) | | | |
| CaO | 10 | (a) | | | |
| Na2O | 0.36 | (a) | | | |
| K2O | 0.04 | (a) | | | |
| P2O5 | | | | | |
| S % | | | | | |
| *sum* | | | | | |
| | | | | | |
| Sc ppm | 80 | (a) | | | |
| V | 143 | (a) | | | |
| Cr | 3810 | (a) | | | |
| Co | 26.2 | (a) | | | |
| Ni | 31 | (a) | | | |
| Cu | | | | | |
| Zn | | | | | |
| Ga | | | | | |
| Ge ppb | | | | | |
| As | | | | | |
| Se | | | | | |
| Rb | | | 0.281 | 0.282 | (b) |
| Sr | 180 | (a) | 146 | 146 | (b) |
| Y | | | | | |
| Zr | 160 | (a) | | | |
| Nb | | | | | |
| Mo | | | | | |
| Ru | | | | | |
| Rh | | | | | |
| Pd ppb | | | | | |
| Ag ppb | | | | | |
| Cd ppb | | | | | |
| In ppb | | | | | |
| Sn ppb | | | | | |
| Sb ppb | | | | | |
| Te ppb | | | | | |
| Cs ppm | 0.02 | (a) | | | |
| Ba | 67 | (a) | | | |
| La | 3.1 | (a) | | | |
| Ce | 13 | (a) | | | |
| Pr | | | | | |
| Nd | 15 | (a) | 12.3 | 12.4 | (b) |
| Sm | 4.8 | (a) | 5.3 | 5.38 | (b) |
| Eu | 1.4 | (a) | | | |
| Gd | | | | | |
| Tb | 1.5 | (a) | | | |
| Dy | 9.7 | (a) | | | |
| Ho | | | | | |
| Er | | | | | |
| Tm | | | | | |
| Yb | 5.4 | (a) | | | |
| Lu | 0.81 | (a) | | | |
| Hf | 5.7 | (a) | | | |
| Ta | 1.2 | (a) | | | |
| W ppb | | | | | |
| Re ppb | | | | | |
| Os ppb | | | | | |
| Ir ppb | | | | | |
| Pt ppb | | | | | |
| Au ppb | | | | | |
| Th ppm | 0.3 | (a) | | | |
| U ppm | 0.1 | (a) | | | |
| *technique:* | *(a) INAA, (b) IDMS* | | | | |

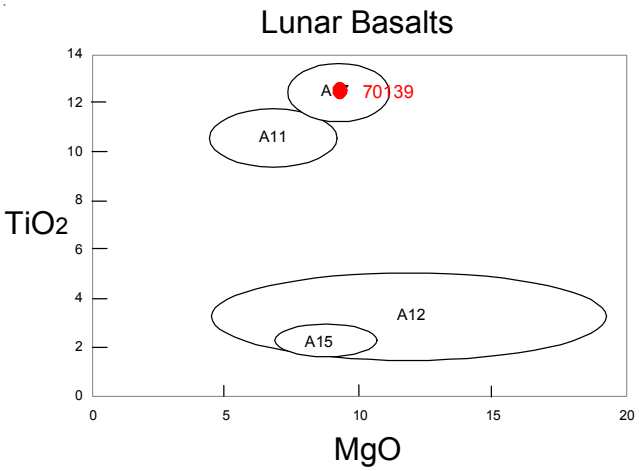



*Figure 3: Composition of mare basalts collected from Apollo missions.*

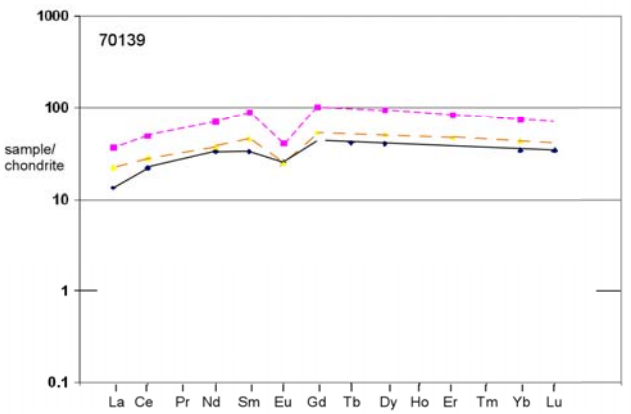


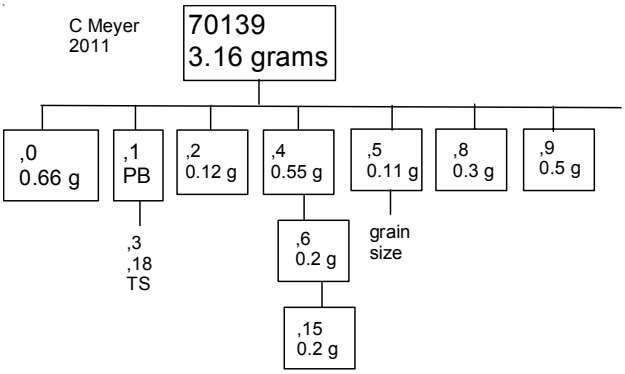

*Figure 4: Normalized rare-earth-element diagram for70139 compared with type A and type B basalts from Apollo 17 (dat by Neal et al. 1990).*

## Radiogenic age dating

Paces et al. (1991) dated 70139 at 3650 ± 120 m.y. by Rb/Sr internal isochron and 3710 ± 120 m.y. by the more reliable Sm/Nd method. This is concordant with the age for 70135 as determined by Nyquist et al. (1975).

## Processing

70139 is a basalt chip from the bag (10E) used to return 70135 and is most certainly a chip of same (Butler 1973). There are two thin sections of 70139.




## References for 70139


Butler P. (1973) **Lunar Sample Information Catalog Apollo 17.** Lunar Receiving Laboratory. MSC 03211 Curator's Catalog. pp. 447.

LSPET (1973) Apollo 17 lunar samples: Chemical and petrographic description. *Science* **182**, 659-672.

LSPET (1973) Preliminary Examination of lunar samples. Apollo 17 Preliminary Science Rpt. NASA SP-330. 7-1 – 7-46.

Muehlberger et al. (1973) Documentation and environment of the Apollo 17 samples: A preliminary report. Astrogeology 71 322 pp superceeded by Astrogeolgy 73 (1975) and by Wolfe et al. (1981)

Muehlberger W.R. and many others (1973) Preliminary Geological Investigation of the Apollo 17 Landing Site. *In* **Apollo 17 Preliminary Science Report.** NASA SP-330.

Neal C.R. and Taylor L.A. (1993) Catalog of Apollo 17 rocks. Vol. 2 Basalts

Neal C.R., Taylor L.A., Patchen A.D., Hughes S.S. and Schmitt R.A. (1990a) The significance of fractional crystallization in the petrogenesis of Apollo 17 Type A and B high-Ti basalts. *Geochim. Cosmochim. Acta* **54**, 1817-1833.

Paces J.B., Nakai S., Neal C.R., Taylor L.A., Halliday A.N. and Lee D.-C. (1991) A strontium and neodymium isotopic study of Apollo 17 high-Ti mare basalts: Resolution of ages, evolution of magmas, and origin of source heterogeneities. *Geochim. Cosmochim. Acta* **55**, 2025-2043.

Warner R.D., Taylor G.J., Conrad G.H., Northrop H.R., Barker S., Keil K., Ma M.-S. and Schmitt R. (1979a) Apollo 17 high-Ti mare basalts: New bulk compositional data, magma types, and petrogenesis. *Proc. 10th Lunar Planet. Sci. Conf.* 225-247.

Wolfe E.W., Lucchitta B.K., Reed V.S., Ulrich G.E. and Sanchez A.G. (1975) Geology of the tarus-Littrow valley floor. *Proc. 6th Lunar Sci. Conf.* 2463-2482.

Wolfe E.W., Bailey N.G., Lucchitta B.K., Muehlberger W.R., Scott D.H., Sutton R.L and Wilshire H.G. (1981) The geologic investigation of the Taurus-Littrow Valley: Apollo 17 Landing Site. US Geol. Survey Prof. Paper, 1080, pp. 280.