DRAFT

# 72235

## Aphanitic Impact Melt Breccia

61.9 grams

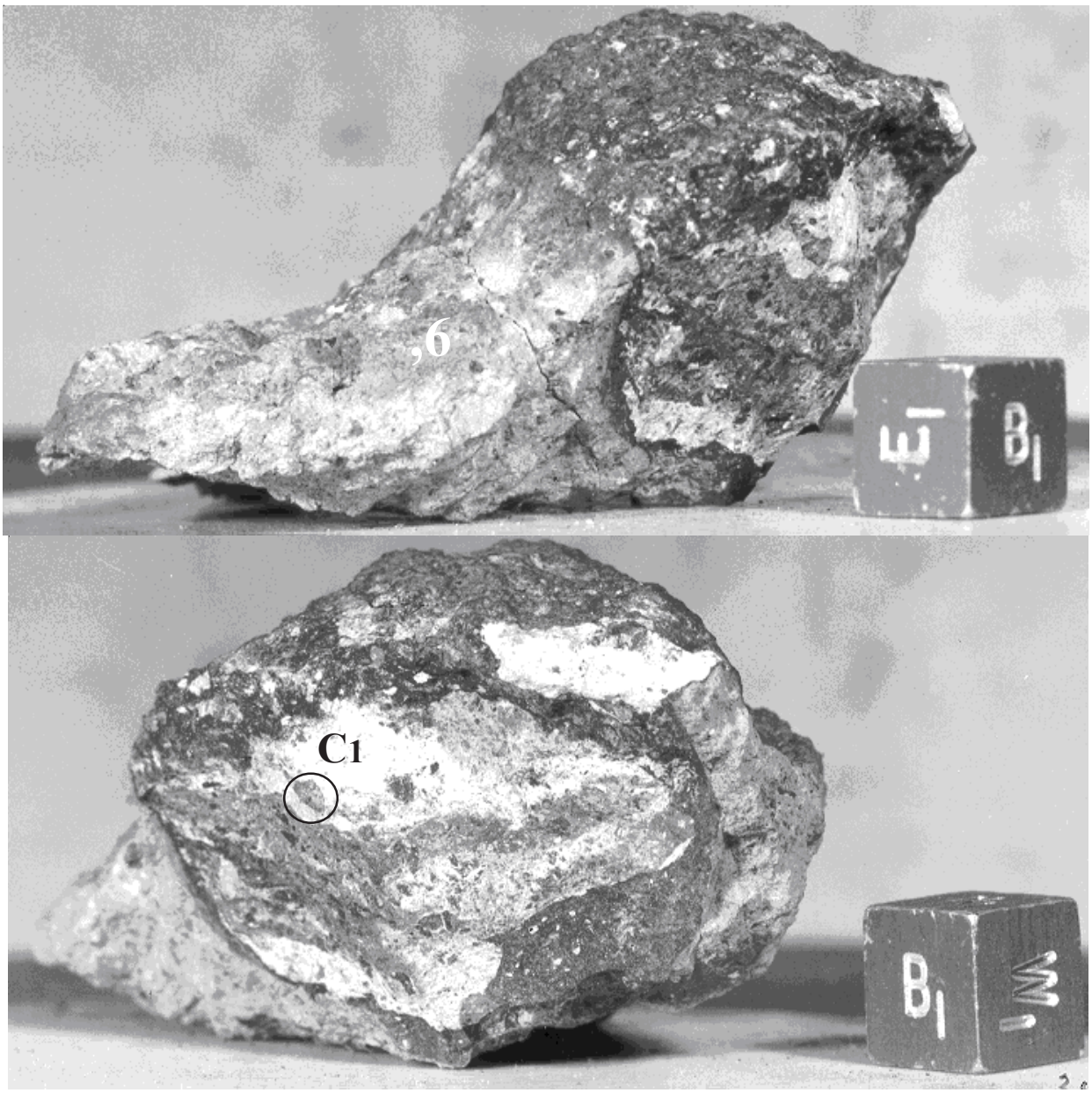
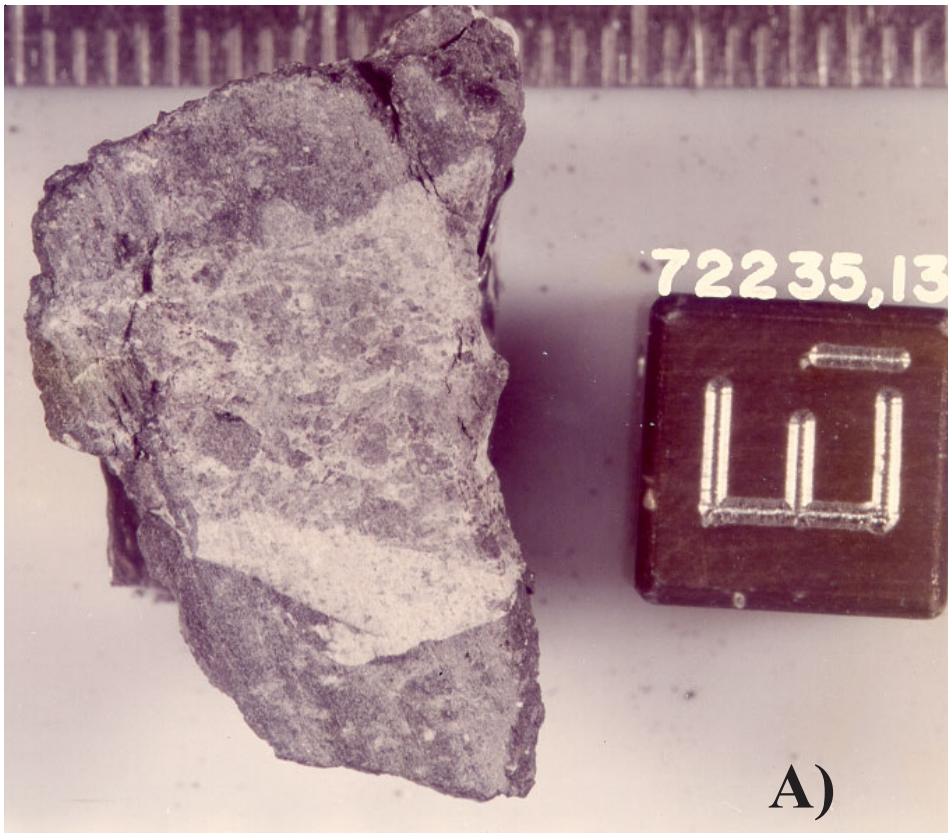


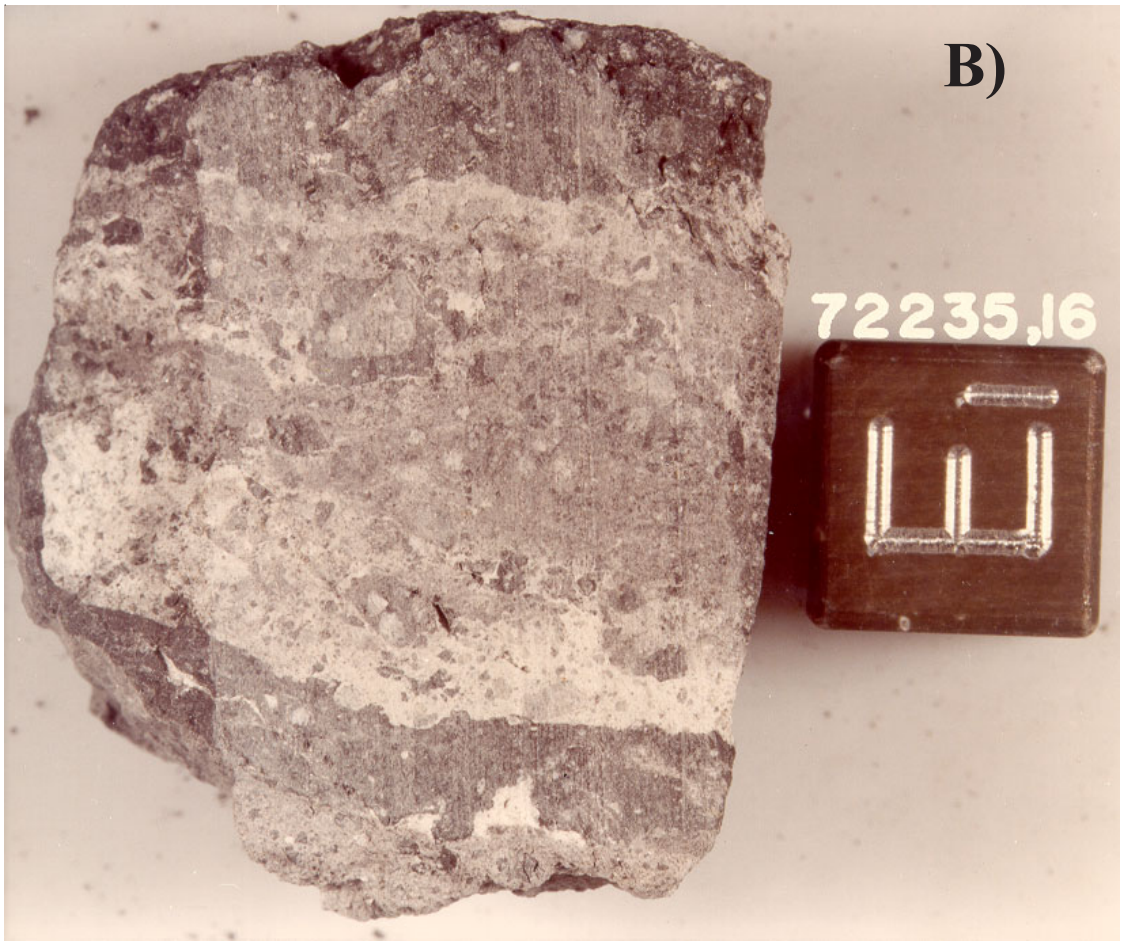

*Figure 1: Two views of 72235 before processing. Note the rounded, patina coated, top surface. Note the crack in the top photo, separating the matrix (,6) from the marbled clast. Note the small clast marked C1 in middle of bottom photo. C1 is a KREEP norite - see text. NASA S73-23590 and 585. Cube is 1 cm.*

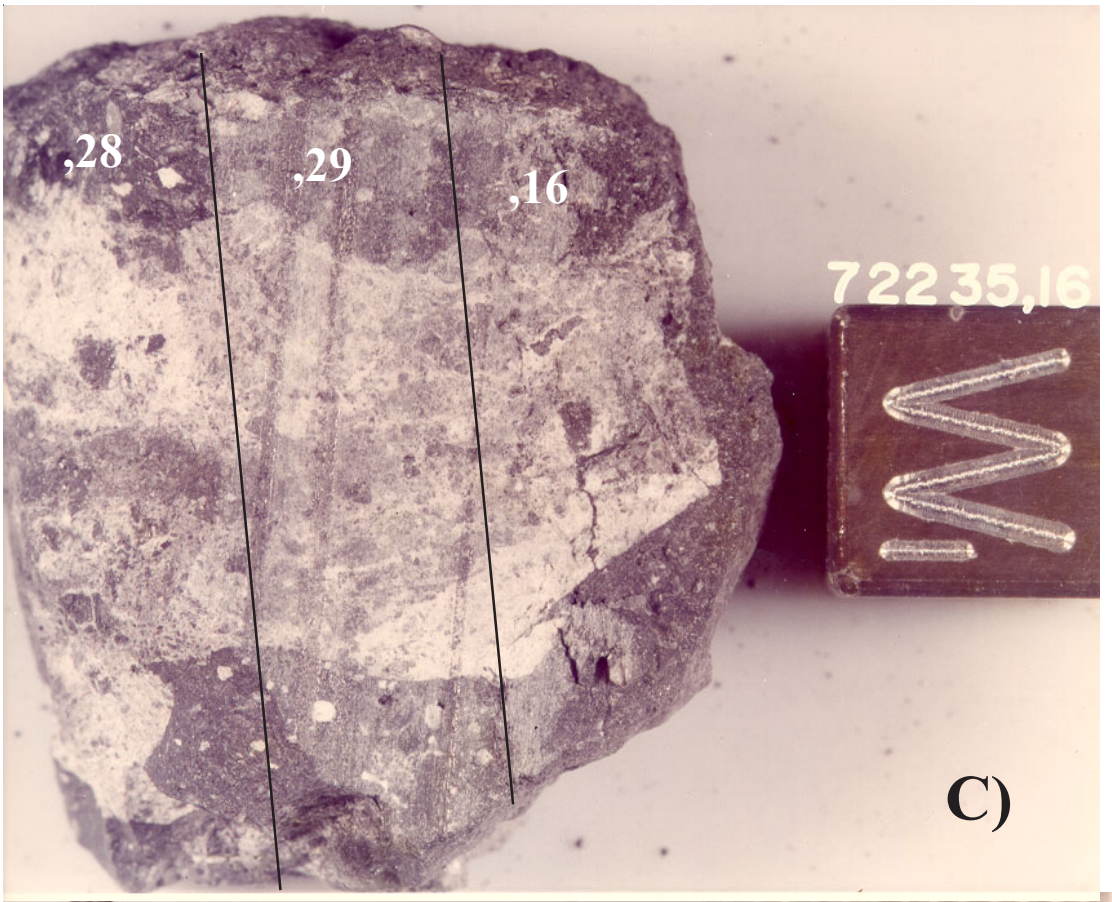
## Introduction

72235 is primarily a resistant knob broken off of boulder 1 at station 2, Apollo 17 (see section on 72215). It has some boulder matrix attached (figure 1). The knob has a marbled texture with light and dark swirls of cataclastic feldspathic breccia with approximately the same composition, but different grain size. The intermixed light and dark layers of the knob appear to have been "fluidized" and consist of crushed, feldspathic material. The dark layers are very fine-grained with abundant clastic material. The light layers are crushed feldpathic granulites, breccias and other

*Figure 2: Close-up photos of sawcuts for 72235 (knob called "dying dog", A) end piece 72235,11 S74-20174, B) slab piece 72235,16 facing ,11 S74-20177, C) slab 72235,16 facing ,13 S74-20175, D) surface of main mass ,11 facing ,16 S74-20176. Cubes are 1 cm, but not oriented correctly.*




,28
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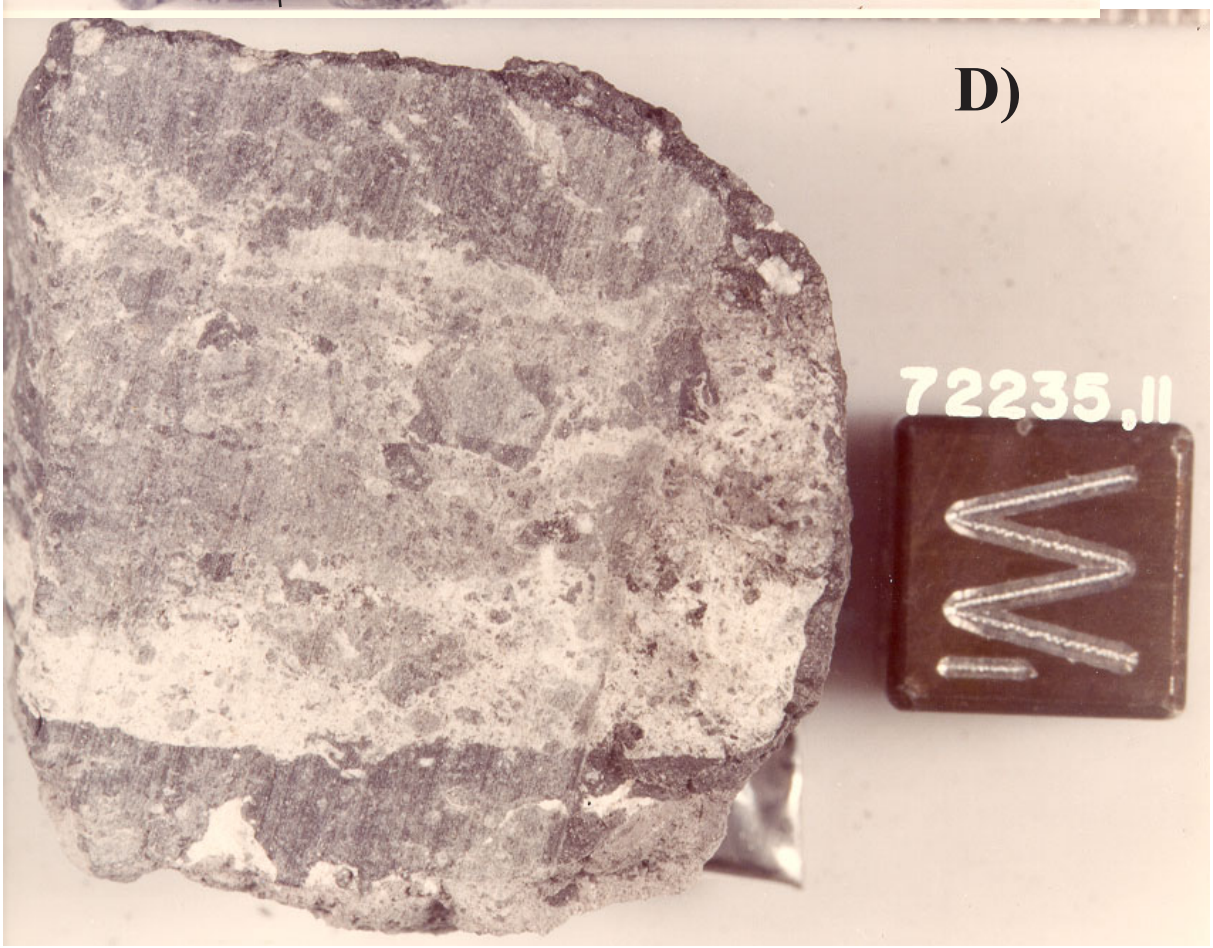
72235,16
C)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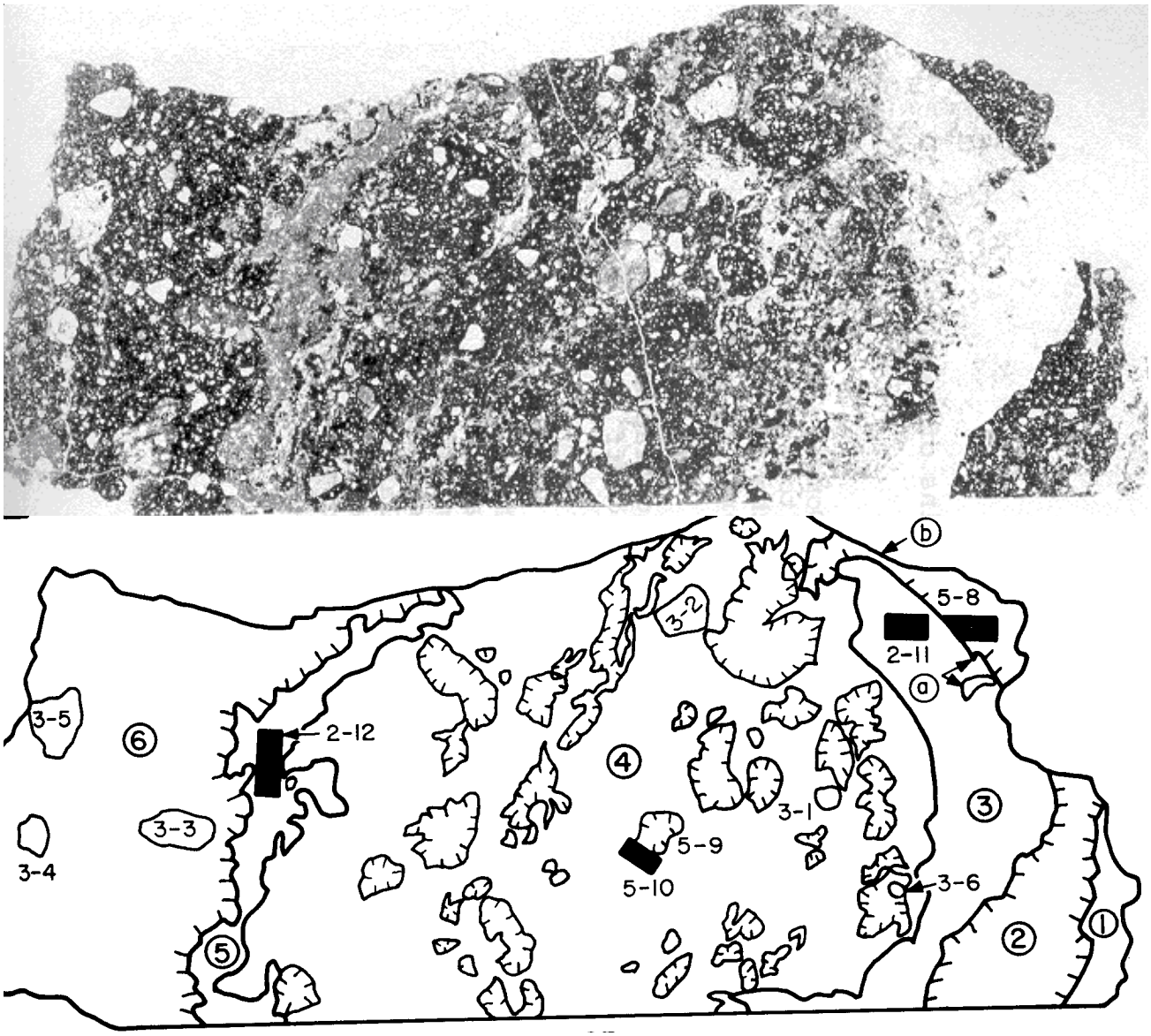



*Figure 3: Photograph of thin section 72235,59 (SAO 803) with sketch map showing different "domains" studied by Stoeser et al. (1974). This thin section goes all the way across the marbled clast called "dying dog" - about 3 cm. Compare with figure 8.*

highlands material (ANT for anorthosite, norite and troctolite). Somehow, the original group of researchers thought the large knob in this sample had the appearance of a "dying dog" – and it was so named.

This sample of boulder #1, station 2, was smaller than the others and was studied less intensively, waiting for results of the study of other samples (72215, 72255, 72275) before final allocation (*which apparently never happened*). Most of the studies are of a serial set of thin sections (,28) and preliminary allocations from an adjacent slab (,29).

**Mineralogical Mode for 72235**
(from Stoeser et al. 1974)

| | |
|---|---|
| ANT breccia | 20.6 % |
| Granulitic ANT | 29.1 |
| Other ANT | 5.5 |
| Ultramafic | 1.6 |
| Basalts | 3 |
| Microgranites | 5.3 |
| Norite | 0.4 |
| Maskelynite | 12 |
| Glass | 2.3 |
| Plagioclase | 12.5 |
| Olivine | 1.2 |
| Pyroxene | 5.9 |

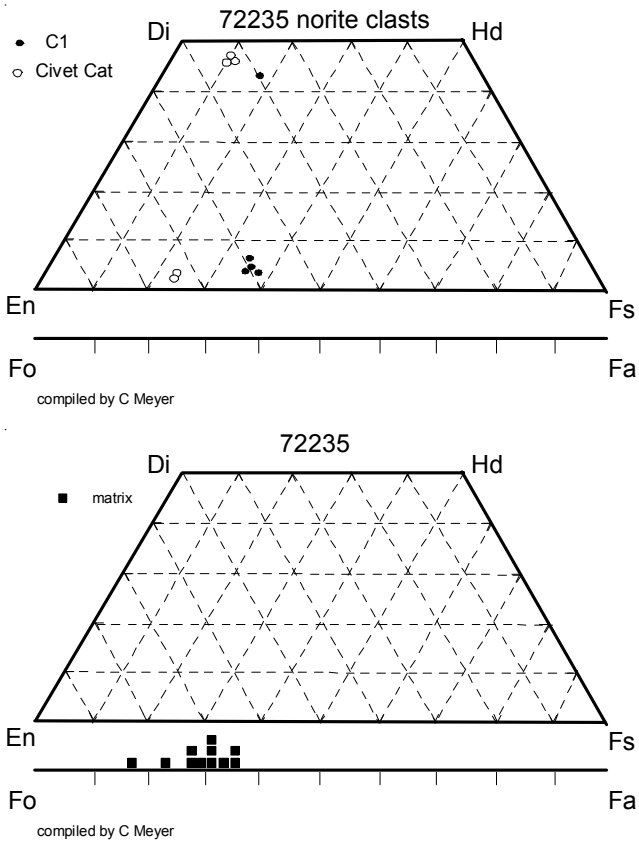



*Figure 4: Composition of pyroxenes in two different kinds of norite in 72235. C1 is a KREEP norite (Ryder et al. 1975; Ryder 1993). Olivine compositon is from the "matrix".*

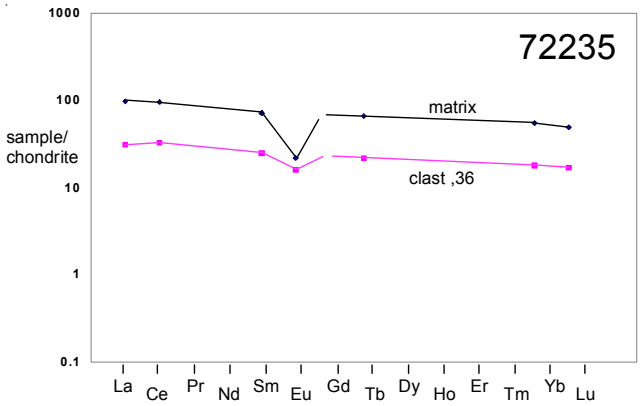



*Figure 5: Normalized rare-earth-element composition diagram for matrix and gabbroic clast in 72235 (data from Blanchard et al. 1975).*

## Petrography

Graham Ryder (1993) summarized the earlier studies of the Consortium Indomitable (led by John Wood and Ursula Marvin). Stoeser et al. (1974) and Ryder et al. (1975) describe 6 microscopic "domains" within the thin sections and give broad-beam electron microprobe analyses (figure 3). Briefly, domains 2 and 6 are the dark "rind" of the layered knob, which is non-porous, clast-poor and very fine grained (impact melt). Domain 1 is outside the rind and separated by a sharp contact from it. Domain 1 was apparently an anorthosite, before it was crushed and fragmented. Domain 3 is a monomict breccia of feldspathic granulite. Domain 4 is a complicated polymict breccia of mixed lithic clasts of highland material and vesicular crushed matrix. Domain 5 is a thin layer of monomict noritic material – about 75% plagioclase, 25% pyroxene and trace Mg-spinel.

## Significant Clasts

### KREEP Norite (C1)

Stoeser et al. (1974), Ryder (1993) describe a 3 mm clast found in 72235,28 as a KREEP norite. It has a mode of about half plagioclase (K-rich) and half pyroxene (figure 4). It was found in the center of the "dying dog" knob (see figure). It has not been analyzed.

### Granite clasts

The abundance (5 -20%) of small (5-100 micron) patches of high-silica, high-K,Ba feldspar intergrowths in 72215, 72235, 72255 and 72275 make boulder 1 from station 2, Apollo 17, unique among lunar samples (Ryder et al. 1975). These are mostly located in the darker portions.

### GA clast ,36 ,37

Blanchard et al. (1975) and Morgan et al. (1975) analyzed white material from the interior of the "dying dog" knob and found that it was feldspathic (table 1, figure 5). However, it had very high Ir (17 ppm) and must itself be a breccia (or contaminated). It may be part of domain 3 (Stoeser et al. 1974) and is crushed gabbroic anorthosite (GA).

## Chemistry

Fruchter et al. (1975), Blanchard et al. (1975), Morgan et al. (1975) and Stoeser et al. (1974) analyzed the matrix and other portions of 72235 (table 1). Obviously, it was difficult, at best, to obtain unmixed materials, as each lithology is intruded by portions of the adjacent lithology.

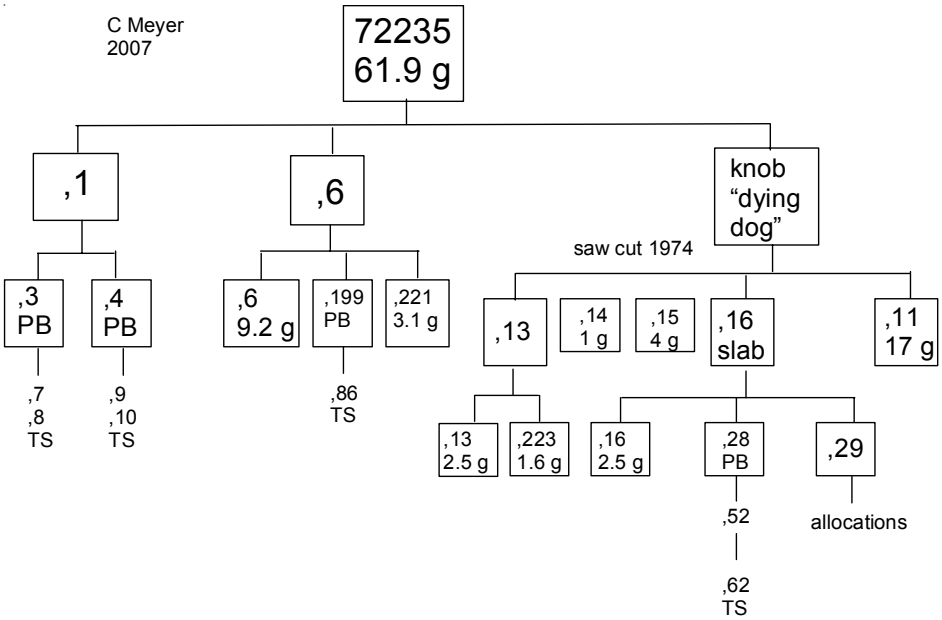
## Ages

See sections on 72215, 72255 and 72275.

## Table 1. Chemical composition of 72235.

| | | | | Higuchi75 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *reference* | Blanchard75 | | | Morgan75 | | | | Fruchter75 | | Stoeser74 | | | |
| *weight* | matrix | clast,36 | | matrix | clast,37 | rim | | 17 grams | | matrix | clast | rim | |
| SiO2 % | 44.6 | 44.5 | (b) | | | | | | | 45.68 | 46.71 | 45.81 | (e) |
| TiO2 | 0.8 | 0.8 | (b) | | | | | | | 0.7 | 2.05 | 0.83 | (e) |
| Al2O3 | 23.1 | 25.8 | (b) | | | | | | | 21.15 | 20.11 | 21.52 | (e) |
| FeO | 7.28 | 6.19 | (a) | | | | | | | 8 | 8.44 | 7.57 | (e) |
| MnO | 0.111 | 0.08 | (b) | | | | | | | 0.11 | 0.12 | 0.13 | (e) |
| MgO | 9.9 | 8.52 | (b) | | | | | | | 8.92 | 8.99 | 8.33 | (e) |
| CaO | 13.2 | 14.4 | (b) | | | | | | | 12.19 | 12.13 | 12.36 | (e) |
| Na2O | 0.514 | 0.42 | (a) | | | | | | | 0.49 | 0.68 | 0.55 | (e) |
| K2O | 0.2 | 0.11 | (a) | | | | | 0.22 | (d) | 0.25 | 0.35 | 0.2 | (e) |
| P2O5 | | | | | | | | | | 0.23 | 0.29 | 0.31 | (e) |
| S % | | | | | | | | | | | | | |
| *sum* | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Sc ppm | 15.4 | 9.84 | (a) | | | | | | | | | | |
| V | | | | | | | | | | | | | |
| Cr | | | | | | | | | | | | | |
| Co | 24 | 43.7 | (a) | | | | | | | | | | |
| Ni | 190 | 500 | (a) | 195 | 307 | 186 | (c ) | | | | | | |
| Cu | | | | | | | | | | | | | |
| Zn | | | | 1.8 | 1.3 | 2 | (c ) | | | | | | |
| Ga | | | | | | | | | | | | | |
| Ge ppb | | | | 124 | 210 | 169 | (c ) | | | | | | |
| As | | | | | | | | | | | | | |
| Se | | | | 48 | 25 | 67 | (c ) | | | | | | |
| Rb | | | | 5.1 | 1.4 | 8.6 | (c ) | | | | | | |
| Sr | | | | | | | | | | | | | |
| Y | | | | | | | | | | | | | |
| Zr | | | | | | | | | | | | | |
| Nb | | | | | | | | | | | | | |
| Mo | | | | | | | | | | | | | |
| Ru | | | | | | | | | | | | | |
| Rh | | | | | | | | | | | | | |
| Pd ppb | | | | | | | | | | | | | |
| Ag ppb | | | | 0.448 | 0.357 | 5.2 | (c ) | | | | | | |
| Cd ppb | | | | 3.1 | 4.4 | 7.4 | (c ) | | | | | | |
| In ppb | | | | | | | | | | | | | |
| Sn ppb | | | | | | | | | | | | | |
| Sb ppb | | | | 0.65 | 0.86 | 1.13 | (c ) | | | | | | |
| Te ppb | | | | 2.2 | 2.7 | 3.5 | (c ) | | | | | | |
| Cs ppm | | | | 0.22 | 0.33 | 0.075 | (c ) | | | | | | |
| Ba | | | | | | | | | | | | | |
| La | 22.7 | 7.2 | (a) | | | | | | | | | | |
| Ce | 58 | 20 | (a) | | | | | | | | | | |
| Pr | | | | | | | | | | | | | |
| Nd | | | | | | | | | | | | | |
| Sm | 10.6 | 3.66 | (a) | | | | | | | | | | |
| Eu | 1.25 | 0.92 | (a) | | | | | | | | | | |
| Gd | | | | | | | | | | | | | |
| Tb | 2.4 | 0.8 | (a) | | | | | | | | | | |
| Dy | | | | | | | | | | | | | |
| Ho | | | | | | | | | | | | | |
| Er | | | | | | | | | | | | | |
| Tm | | | | | | | | | | | | | |
| Yb | 8.9 | 2.9 | (a) | | | | | | | | | | |
| Lu | 1.2 | 0.41 | (a) | | | | | | | | | | |
| Hf | 9.5 | 2.2 | (a) | | | | | | | | | | |
| Ta | 1.1 | 0.5 | (a) | | | | | | | | | | |
| W ppb | | | | | | | | | | | | | |
| Re ppb | | | | 0.5 | 1.2 | 0.5 | (c ) | | | | | | |
| Os ppb | | | | | | | | | | | | | |
| Ir ppb | | | | 7.5 | 17.6 | 7.2 | (c ) | | | | | | |
| Pt ppb | | | | | | | | | | | | | |
| Au ppb | | | | 2.8 | 2.5 | 4.9 | (c ) | | | | | | |
| Th ppm | 4 | 1.6 | (a) | | | | | 4.67 | (d) | | | | |
| U ppm | | | | 1.35 | 0.43 | 1.69 | (c ) | 1.15 | (d) | | | | |

*technique: (a) INAA, (b) AA, (c ) RNAA, (d) radiation counting, (e) broad beam, elec. Probe*



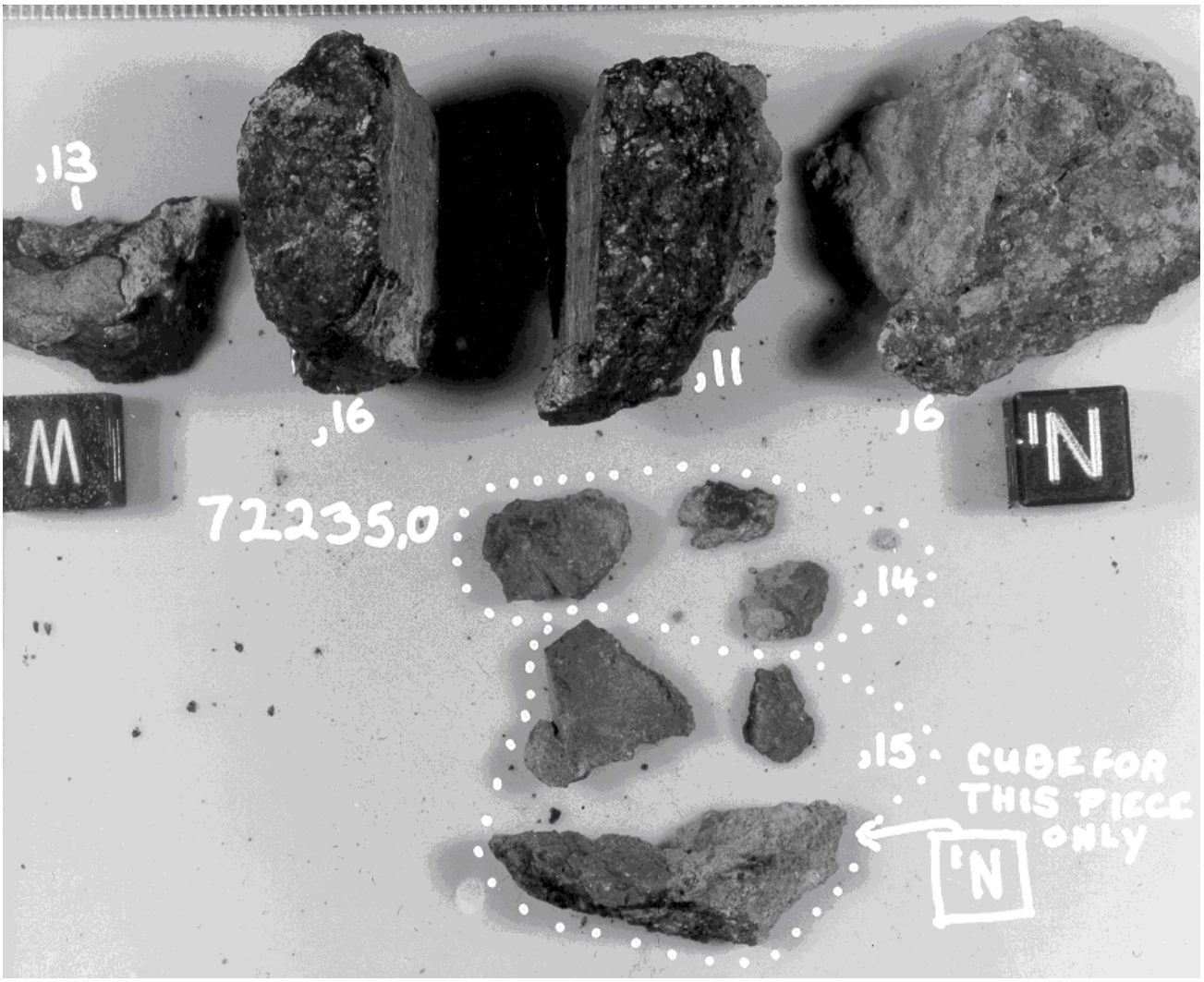




*Figure 6: Group photo for 72235 after processing, showing slab (,16) and matrix (,6). NASA S74-20428. Cube is 1 cm.*

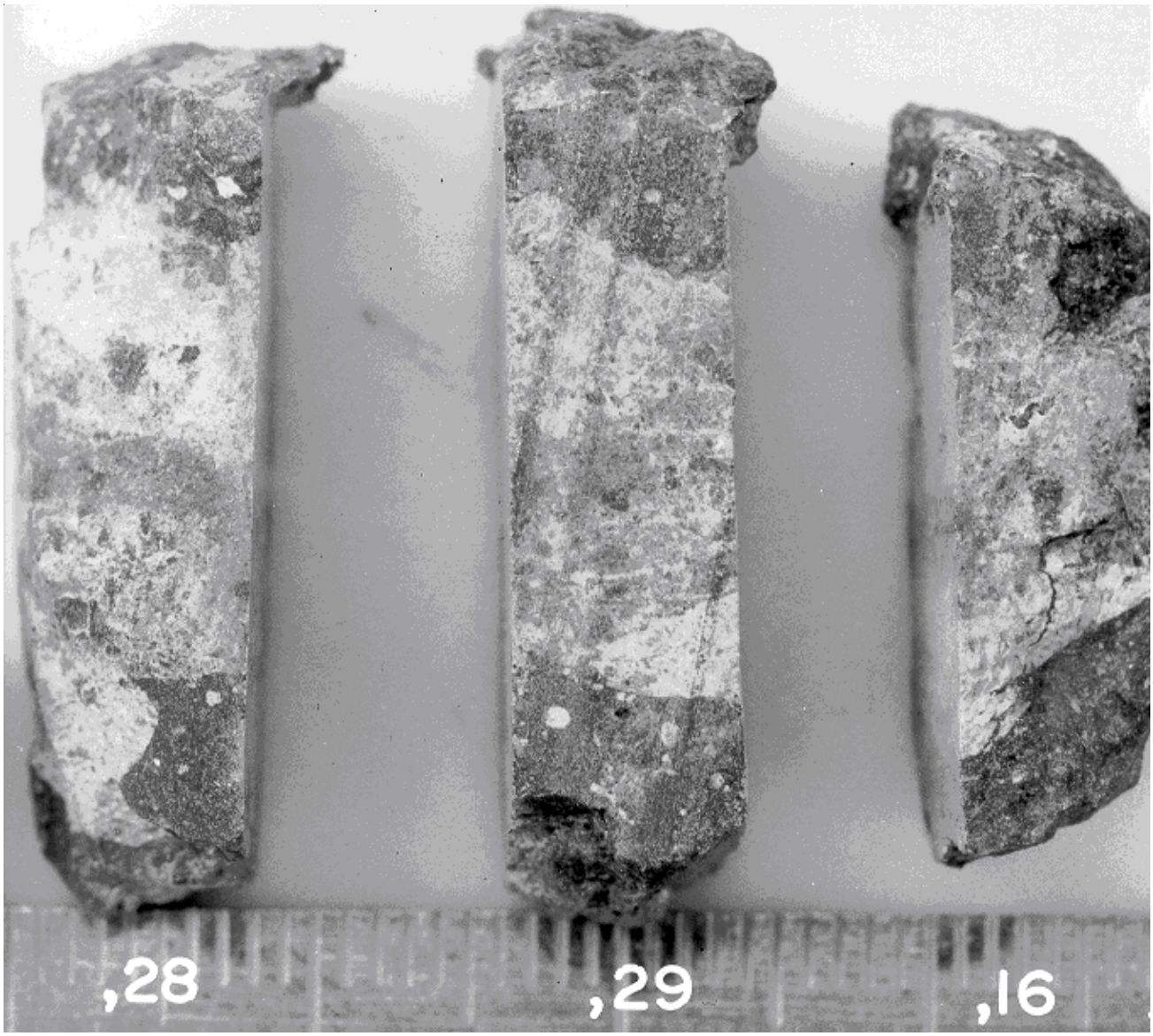



*Figure 7: Photo of column (,29) as it was cut from slab 72235,16. Most allocations were from ,29 and thin sections from ,28. Scale is in mm. NASA S74-23191.*

## Processing

Ursula Marvin has documented the subdivision of the "dying dog" clast in appendix A of the Consortium Indomitable. Briefly, in 1974, a slab (1.5 cm) was cut through the middle of the "dying dog" knob and a column was cut in the middle of the slab. A suite of thin section was made from an adjacent piece.


*Figure 8: Side view of 72235,28. NASA S74-23192. About 1.2 cm across. This piece used to make numerous thin sections.*

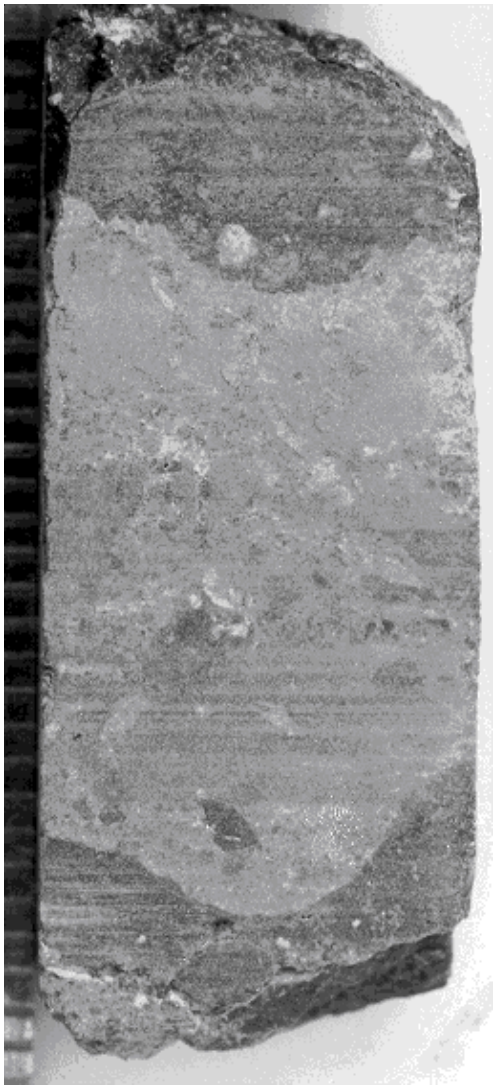
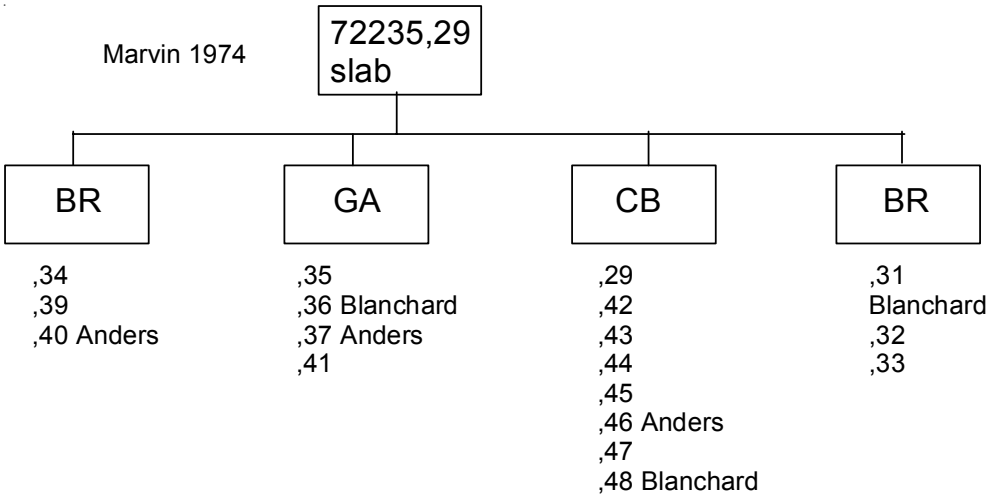


*Figure 9: Side view of 72235,29. NASA S74-23194. Scale is in mm. This column was broken up for allocations.*



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