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BRECCIA GUIDEBOOK NO. 8
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INTRODUCTION

The mission objectives for Apollo 17 were formulated with the knowledge that this would probably be the last Apollo mission. Therefore, it was important to choose a landing site most likely to provide answers to fundamental questions raised and unanswered by Earth-based and remote observations and by the previous Apollo missions. With this in mind, a geologically diverse site was chosen after analysis of high-resolution Apollo 15 photographs. This study revealed a flat-floored, 10 km wide valley, Taurus-Littrow, at the southeastern edge of the Serentatis Basin, bounded by two steep-sided mountains of highlands material, North and South Massifs; the valley was floored by basalt and mantled by both dark and light material.

More than 110 kg of sample were collected and returned by the Apollo 17 astronauts including samples taken from numerous boulders at the bases of the South and North Massifs. Among these boulders was one designated Boulder 1, Station 2, a foliated breccia boulder, aproximately 2 meters in diameter, made up of dark coherent clasts cemented by a light-gray, friable matrix. Presently, the boulder resides near the base of the South Massif, but based on photogeologic and field observations (Schmitt, 1973; Wolfe, 1974), it was originally emplaced at the top of the South Massif during the massif-forming event and subsequently rolled down the northeast side to its present location.

The South Massif is part of the third ring surrounding the South Serenitatis Basin (Wolfe and Reed, 1975) and is considered to have formed from ejecta of the basin-forming event (Wolfe, 1975). Boulder 1, therefore, probably represents a sample of this ejecta. However, the relationship of Boulder 1 to the source rock for the materials of the South Massif is complex. For example, the matrix material of the microbreccias of Boulder 1 appears to be a major component of the soils at Apollo 17 (Blanchard et al., 1975), but the granitic clasts identified in Boulder 1 have not been found in other Apollo samples. Plus, neither the granites nor the pigeonite basalts of Boulder 1 have been identified as components of Apollo 17 soils (Ryder et al., 1975a).

Breccia sample 72275 was collected from Boulder 1 as representative of its matrix material. A photograph of 72275 is presented in Figure 1. It was originally a single sample weighing 3640 grams with dimensions 17 x 14 x 12 cm. It subsequently broke into four large pieces and several smaller pieces while in transit from the moon. The original studies on 72275 were done on clasts and matrix samples from a single slab, 72275,42. Samples from ,42 were divided up, most going to members of the Consortium Indomitable organized by John Wood; the rest were retained by LRL for sample description. The distribution of 72275,42 is documented in Figures 2a and b (fig. 2b is taken from the appendix of LSI Contr. No.210D, 1974). The

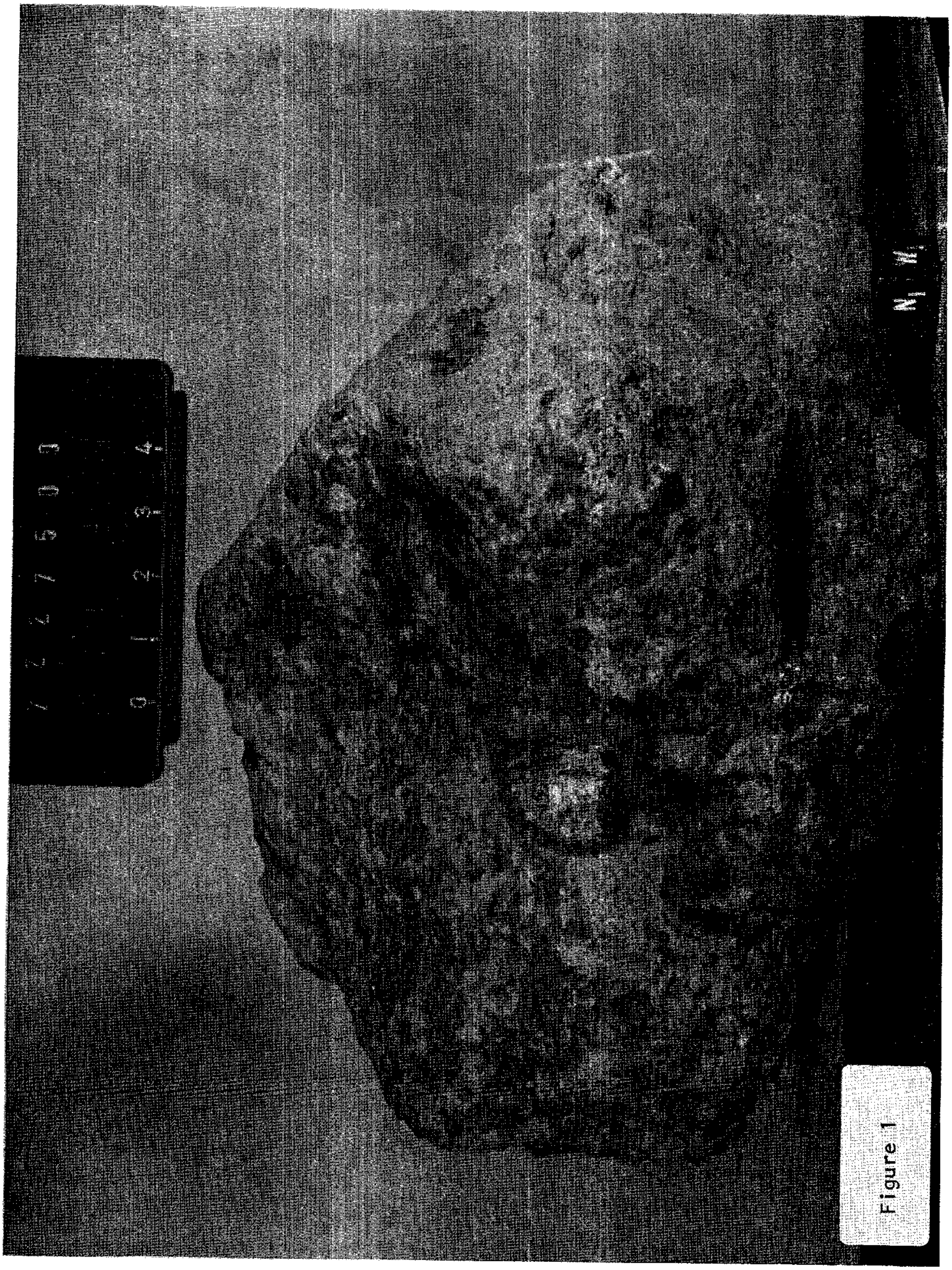
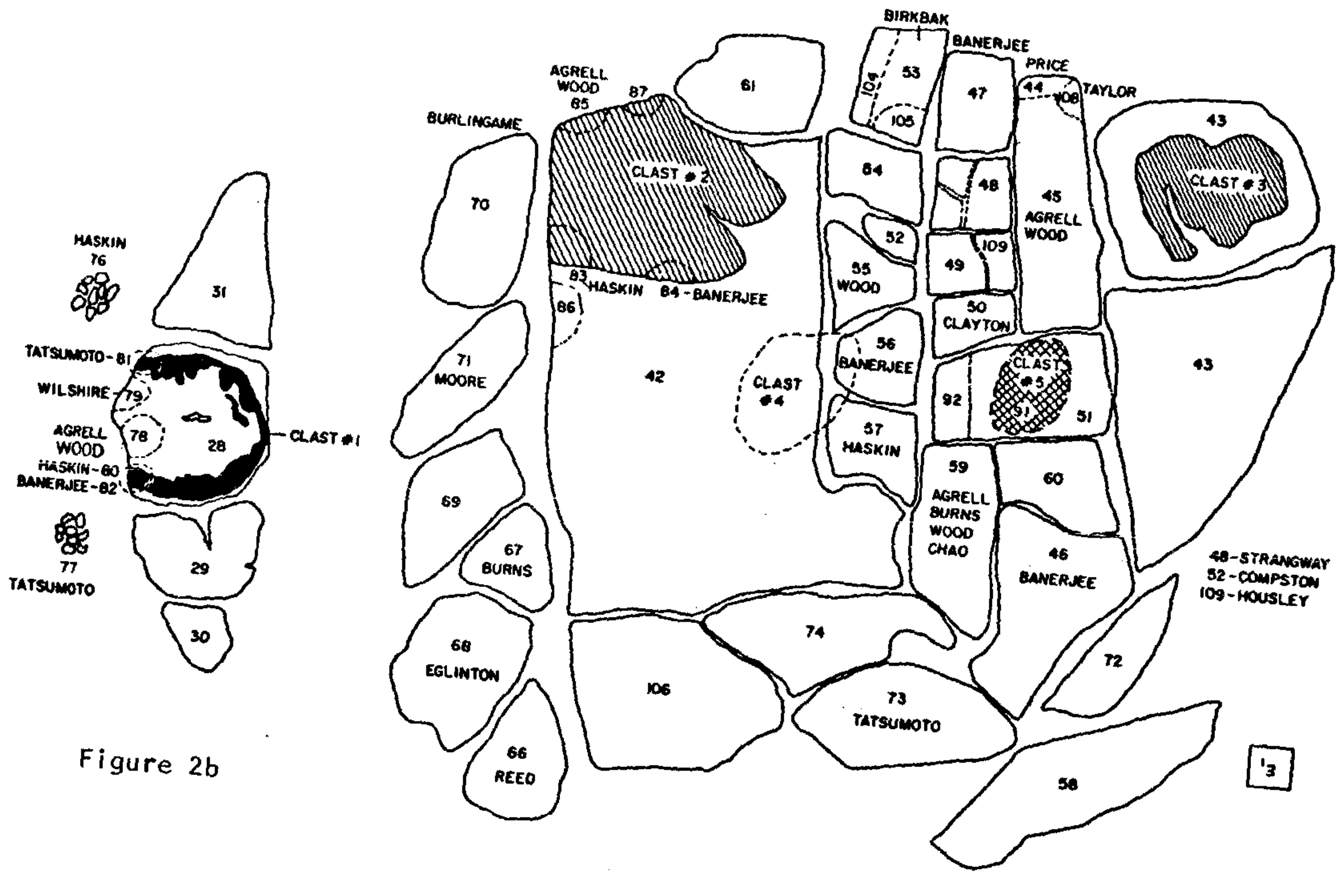


Figure 1

Figure 2a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WILSHIRE-79
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Figure 2b

exposed face on the butt-end (72275,102) opposite ,42 was left unsampled. Subsequent slabbing of 72275,102 in July, 1984 produced two new slabs and four new exposed faces. In this present contribution, a description of these faces follows a discussion of previous investigations on 72275.

PREVIOUS WORK

72275 was originally studied during an investigation of Boulder 1, Station 2 by the Consortium Indomitable. The Consortium's prelimiary findings were presented in Interdisciplinary Studies from Boulder1, Station 2, Apollo 17, LSI Contr. No. 210D and No. 211D (1974) and the final results occupy the whole of The Moon, vol. 14 (1975). Subsequent work is sparse and usually performed by Consortium members (e.g., Ryder et al., 1975 b and c; 1977). A perusal of the literature concerning 72275 reveals an intimate relationship of 72275 with the other samples taken from Boulder 1 (72215, 72235, 72255) so that chemical and petrologic classifications and descriptions apply boulder-wide. During the compilation of this guidebook, an attempt was made to restrict discussions and examples to 72275 alone. However, in some cases this was impossible, and reference is necessarily made to other Boulder 1 samples.

MATRIX

The matrix material of 72275 (LFBx) is a porous (20-40%), light-gray, friable, polymict breccia consisting mainly of poorly sintered, angular lithic and mineral fragments. The dominant lithology is anorthositic material, and the mineral fragments are mainly plagioclase with low-Ca pyroxene, olivine, Fe-metal, pink or amber spinel, chromite, ilmenite, K-feldspar, silica, zircon, and armalcolite comprising the rest.

The bulk composition of the LFBx is similar to that of the gray competent breccias (GCBx, see later) as shown in Tables 1 and 2. Based on this similarity, Stoeser et al. (1974) suggest that the LFBx is composed of crushed GCBx. However, Blanchard et al. (1975) note some distinct differences, namely that the LFBx has lower MG# (100 molar Mg/[Mg+Fe]), higher mafic to felsic normative ratio, and higher LIL element concentrations than the GCBx. They determined that the LFBx is unlike any other Apollo 17 materials. Based on the lack of relationships to any Apollo 17 soil compositional trends, they conclude that the LFBx material is exotic to Apollo 17 and not volumetrically important. Furthermore, Jovanovic and Reed (1975) conclude that the LFBx is made up of different material from the GCBx, based on Br and Hg release patterns exhibited during stepwise heating. Morgan et al. (1975) determined higher meteoritic contributions in the GCBx and higher Ge concentrations in the LFBx, a reflection of pigeonite basalt contributions to LFBx.

Cosmic-ray exposure history of 72275 indicates that the rock, along with the rest of Boulder 1, was buried prior to emplacement atop the South Massif (Goswami and Hutcheon, 1975).

Table 1. Major element data, in weight %, for clast and matrix samples. Data for samples 1 through 6 are from Blanchard et al. (1975) and for samples 7 through 9 are from Ryder et al. (1975a). 1=LFBx matrix 72275,57; 2=GCBx matrix 72235,56; 3=BCBx 72275,166; 4=GCBx 72275,83; 5=AnBx 72275,76; 6=PB 72275,91; 7=PB 72275,136; 8=PB 72275,128; 9=AnBx 72275,128.

	1	2	3	4	5	6	7	8	9
SiO_2	48.3	44.6	47	46	47	48	49.37	49.61	44.2
TiO_2	1.0	0.8	1.1	0.8	1.8	1.4	0.92	1.18	0.1
Al_2O_3	16.3	23.1	18.2	19.7	23.5	13.5	18.12	15.65	29.4
FeO	11.9	7.28	10.9	9.9	7.4	15	8.45	11.26	3.7
MnO	0.17	0.111	0.167	0.111	0.077	0.156	0.17	0.18	-
MgO	10.3	9.9	9.14	10.4	5.24	10.0	4.23	6.98	7.8
CaO	11.0	13.2	11.2	12.0	14.2	10.5	12.57	10.90	15.9
Na_2O	0.44	0.514	0.63	0.30	0.36	0.29	0.56	0.60	0.2
K_2O	0.25	0.20	0.49	0.25	0.32	0.25	0.32	0.35	0.1
Cr_2O_3	0.35	0.21	0.27	0.24	0.20	0.46	0.36	0.33	0.1
BaO	-	-	-	-	-	-	0.08	0.06	-
P_2O_5	-	-	-	-	-	-	0.43	0.58	-
Total	100.01	99.92	99.41	99.70	100.10	99.56	96.40	98.13	101.5

Table 2. Trace element data, in ppm, for clast and matrix samples. Sample numbers the same as in Table 1. All data from Blanchard et al. (1975).

	1	2	3	4	5	6
Sc	44.7	15.4	26.3	28	25	61
Co	30.4	24.0	22.5	30	18.7	37
Ni	75	190	130	-	-	-
Hf	16.5	9.5	25.1	13.7	14	18
Ta	1.7	4.0	12.8	-	-	-
Th	6.1	4.0	12.8	-	-	-
La	50.5	22.7	78	41	48	48
Ce	130	58	206	112	131	131
Sm	24.6	10.6	36	18.7	22.5	23
Eu	1.57	1.25	2.10	1.50	1.81	1.58
Tb	4.9	2.4	7.7	3.8	4.7	4.5
Yb	15.0	8.9	25.4	12.1	13.9	11.9
Lu	2.01	1.20	3.5	1.82	2.04	1.75

Similarly, Leich et al. (1975) found that trapped Ar and Ne abundances in the boulder samples are 4 to 5 orders of magnitude less than typical soils or soil breccias; furthermore, the matrix has trapped gases of the same concentrations as the igneous rocks in Boulder 1, an indication of derivation from depth.

CLASTS

Microbreccias- These are generally referred to as gray competent breccias (GCBx) and black competent breccias (BCBx) by the Consortium Indomitable (1974a, b; 1975) and are referred to as dark matrix breccias (DMB) by Stoeser et al. (1974) and Ryder et al. (1975b). The division into two classes by the Consortium is somewhat arbitrary since a complete color gradation exists between the two (Ryder et al., 1975a). Microscopically, they appear to be the same rock in different stages of recrystallization (Marvin, 1975) and exhibit a gradation in clast populations (this work). They are coherent clasts, dark-gray to black in color, aphanitic, sub-angular to rounded, and range in size from 1 mm to 3 cm. They are the dominant lithology in Boulder 1 and sometimes form rims around other breccia clasts. For instance, Clast #1 from 72275 (e.g., Ryder et al., 1975a) (referred to as the Marble Cake Clast (MCC)), is a spherical, 3 cm clast of cataclastic gabbroic anorthosite enclosed by and complexly interlayered with microbreccia to form a swirling, marble cake pattern.

The matrices of the microbreccias are opaque to semi-opaque in transmitted light and are composed of densely welded fragments usually less than 20 μm in diameter. The opacity of the matrices is due largely to abundant Fe-metal, troilit and ilmenite grains. Uncommonly, some portions of the matrix appear to be igneous, composed of pyroxenes enclosed in a matrix of plagioclase and mesostasis. These are KREEPy and appear to have crystallized from a partial melt of the breccia during metamorphism (Ryder et al., 1975a). Impact melting was ruled out by Ryder et al. (1975a) due to the low Ni concentrations in these regions.

Trace element compositions of the microbreccias are characterized by a fairly systematic variation between the KREEPy BCBx and less KREEPy GCBx (see fig.1). Blanchard et al. (1975) proposed that the BCBx consists of GCBx enriched in partial-melt material of the GCBx. One sample of GCBx, 72275,83, is intermediate in trace element abundances between typical end-member BCBx and GCBx, determined from other Boulder 1 samples (see Table 2 and fig. 3).

The genetic history of the microbreccias is complex. Ryder et al. (1975a) concluded the breccia matrices are deficient in Al and enriched in Fe and a KREEP component relative to the clasts. Therefore, the matrices cannot be mixtures of clast materials unless a second, high-Al, low-Fe, KREEP component had been added. Furthermore, they found that this extra component is not pigeonite basalt (PB). The Ge content of the PB's is

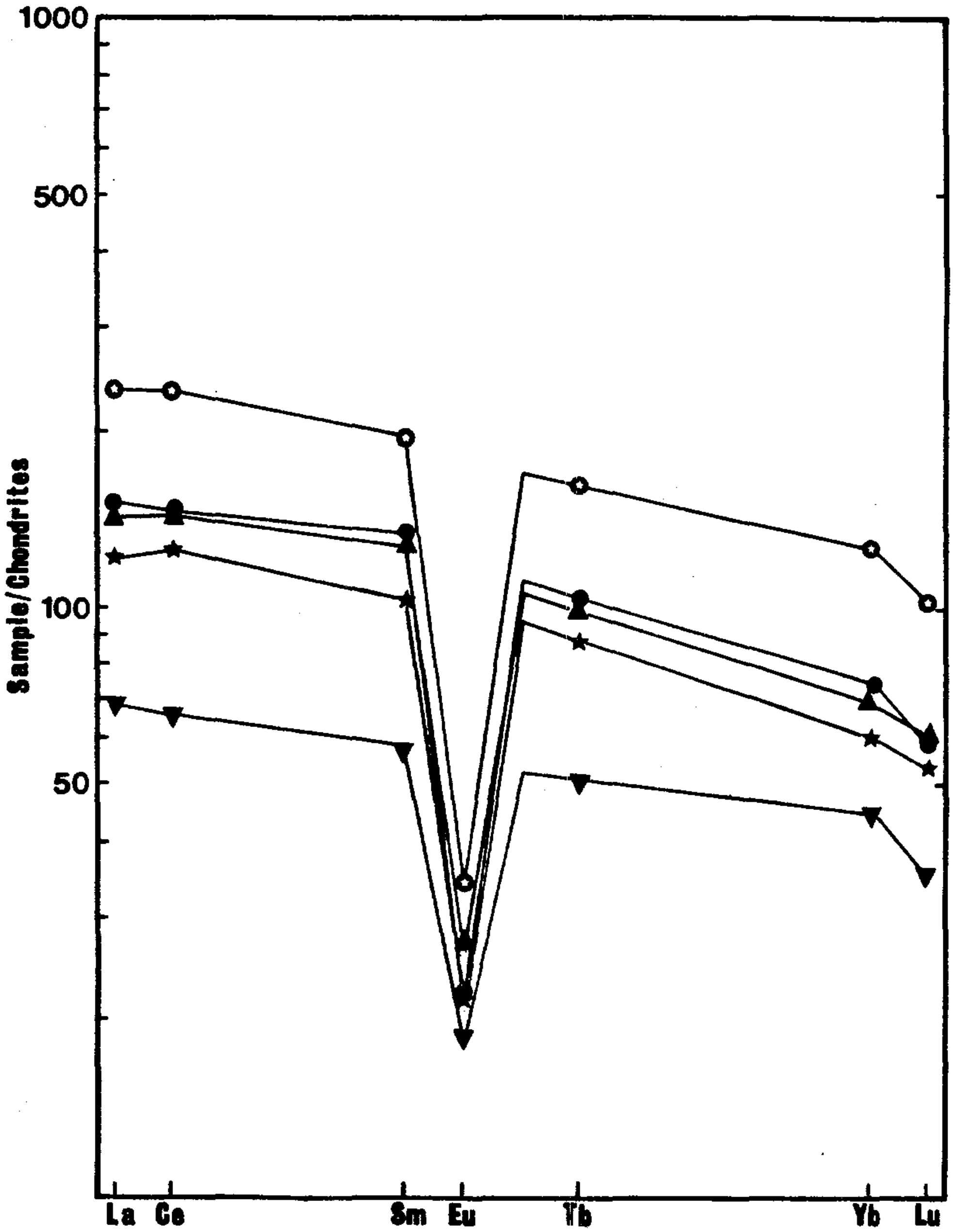

Figure 3. Chondrite-normalized REE patterns for clast and matrix samples. ✪ = BCBx (72275,166); ● = LFBx (72275,57); ▲ = AnBx (72275,91); ★ = GCBx (72275,83); ▼ = GCBx matrix (72235,46). Data from Blanchard et al. (1975).

distinctively high (Morgan et al., 1975) and would be reflected in the microbreccias if a pigeonite basalt component were mixed in large enough proportions to alter the composition of the microbreccias. Secondly, PB clasts have not been identified in the microbreccias, nor have PB fragments been identified in the microbreccia matrices based on Ti, Al and Cr analyses.

Lithic clasts in the microbreccias are generally the same as those found in the LFBx matrix of 72275 and are described below. The one exception is pigeonite basalt which is not found in the microbreccias. Granite, on the other hand, is found predominantly in the microbreccias and is sparse in LFBx (Stoeser et al., 1974; Ryder et al., 1975c) but is described below with the other clasts of 72275.

Basalts and basaltic breccias- Three types of basalt clasts were identified in 72275 by Ryder et al. (1975a).

(1) Quartz-normative pigeonite basalts (PB). Stoeser et al. (1974) and Ryder et al. (1975a) described these as non-mare basalts found only in the LFBx matrix of 72275 and occurring as basalt clasts and as breccia clasts composed entirely of fragmented PB. The basalts' textures are generally sub-ophitic to intersertal with approximately equal amounts of plagioclase (An 94 Or 1 to An 76 Or 8) and pyroxene (mostly pigeonite) with an interstitial silica phase. The mesostasis is Fe-rich and opaque, comprising 10-20% of a basalt clast. It is composed of

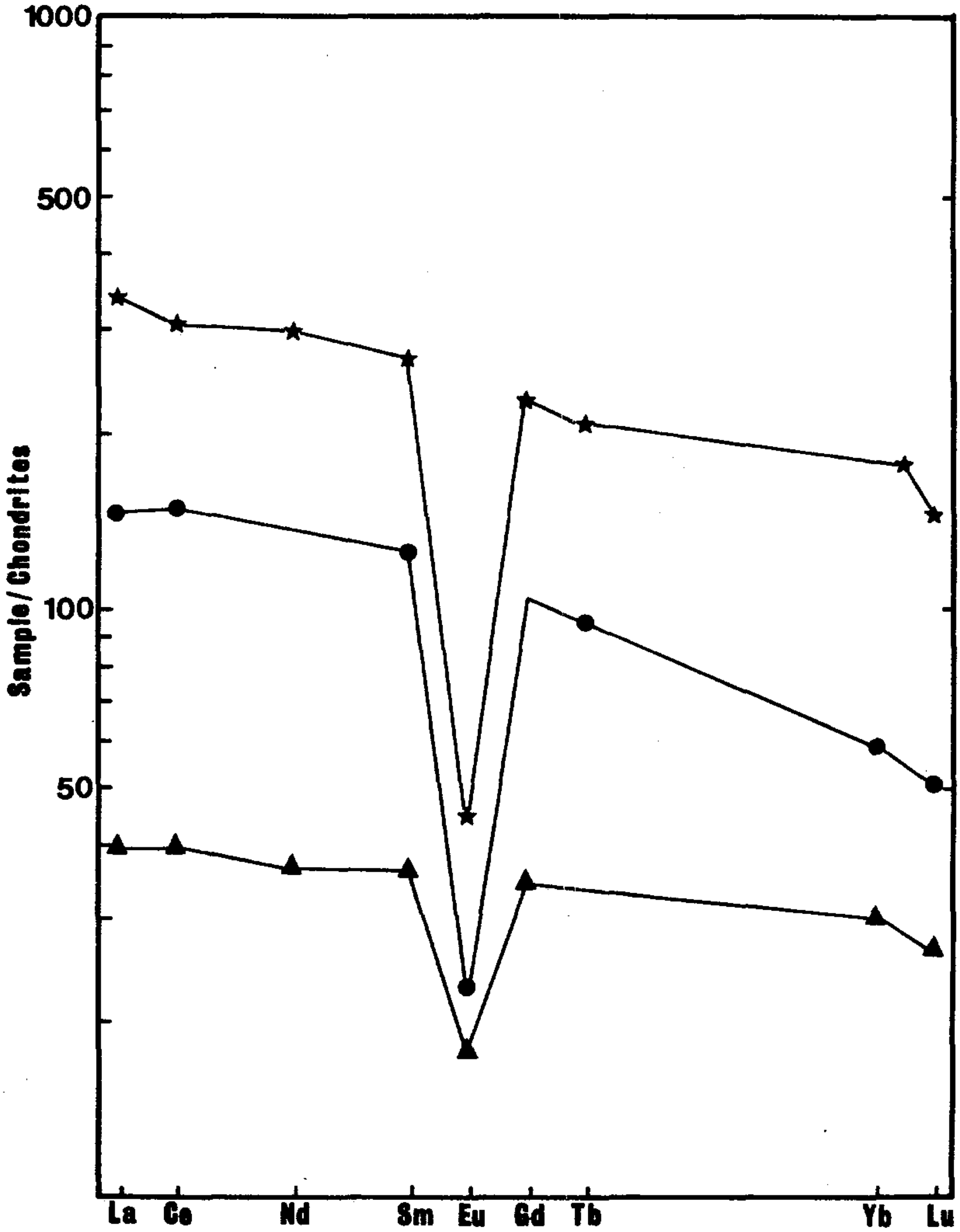

Figure 4. Chondrite-normalized REE patterns for pigeonite basalt, ● 72275,91 (Blanchard et al., 1975); KREEP, ★ (Warren and Wasson, 1979); high-Al mare basalt, ▲ 14305 (Taylor, 1982).

ferroaugite, ilmenite, Fe-metal, troilite, silica, barian K-feldspar, phosphate minerals and Zr minerals.

The REE of the PB's (see fig.4) are KREEP-like but with a steeper negative slope for the HREE than is typical of other KREEP basalts (Blanchard et al., 1975). They are also more Fe-rich than KREEP basalts, and in general, their major element compositions resemble high-Al basalts but have REE concentrations about twice as high (Blanchard et al., 1975). The chemistry of the PB's does not reflect meteorite contamination. Morgan et al. (1975) demonstrated that, aside from high Ge concentrations, the PB's have low siderophile concentrations.

Ryder et al. (1977) discuss the geochemistry of the PB's and rule out magma mixing or contamination as having played a role in the evolution of the PB's. For instance, because of the KREEP-like abundances of the REE in the PB's, a KREEP-like magma is a necessary end-member component. The low Sr concentrations in the PB's (80-90 ppm) rule out a mixture of KREEP basalt (Sr: >170 ppm) with a low-Sr component such as low-Ti mare basalts (Sr: 90-150 ppm). Major elements of the PB's may be matched by mixing KREEP basalts with other basalt types but always in different proportions. Furthermore, contamination of a mare basalt with KREEP would require approximately a 50:50 mixture to produce the high Al observed in the PB's. Evidence for assimiliation of this much material, e.g. xenocrysts, is absent from the PB's. Based on the geochemical systematics of the PB's, Ryder et al. (1977) denoted them as a distinct lunar basalt type transitional between KREEP basalt and mare basalt (e.g., fig.4).

Warren and Wasson (1979) agree that the PB's are intermediate between KREEP-type and mare-type basalts but not transitional between them. They argue that the fractionated REE (relative to KREEP) may be due to unrepresentative sampling or that the PB's attained their compositional characteristics after differentiation of a KREEPy intrusion.

(2) Mafic Troctolite Basalts (MTB). These are a rare component of 72275. MTB's are made up of euhedral olivines (Fo 90 to Fo 73) set in a groundmass of plagioclase (An 95 to An 85). Most display a distinct cataclasized texture but similarities to the non-cataclasized samples are apparent.

(3) Pink Spinel Troctolite Basalts (PSTB). These are basaltic textured spinel-bearing clasts composed of olivine phenocrysts (Fo 84 to Fo 88) set in a groundmass of fine-grained plagioclase and interstitial pyroxene, olivine, and spinel. The spinels appear to be in a reaction relationship with embayed forms; they were a liquidus phase with the olivines.

Anorthositic Breccias (AnBx)- This group includes a diverse array of plagioclase-rich lithic clasts that range in texture from coarsely cataclastic to fine-grained and granular. The smaller of these clasts are generally mono-mineralic, while the larger clasts have 20-35% mafic minerals (Marvin, 1975).

Compositions range from anorthositic to noritic to troctolitic; some granulitic anorthosites may be recrystallized single mineral fragments. Plagioclase compositions cluster around An 95 with a few falling in the range An 90 to An 85. Olivine compositions range between Fo 65 and Fo 85, and pyroxenes are generally magnesian with compositions ranging from En 65 to En 85 (Ryder et al., 1975a). AnBx is a dominant lithology at Apollo 17 and contribute significantly to the soil at that site (Blanchard et al., 1975). Chemical data for an AnBx are presented in Table 1 and on Figure 3.

Granites- As defined by Ryder et al. (1975c), these are clasts whose SiO_2 content is >65%, and their classification as granite has no textural or mineralogical implications. In gereral, the granites are composed of silica $\pm$ barian K-feldspar $\pm$ rare plagioclase $\pm$ glass and may include opaque minerals and Fe-rich mafic silicates. Stoeser et al. (1974) divided the granites into two textural groups and noted a complete gradation between the two:

(1) holocrystalline- These granites are composed mainly of silica + barian K-feldspar, where the feldspar > silica. Ryder et al. (1975b) noted the rare occurrence in these granites of unusual ternary feldspars whose compositions are intermediate between plagioclase and orthoclase.

(2) glassy- These granites commonly consist of parallel sets of

Table 3. Boulder 1 granite compositions, in weight %. All data from Ryder et al. (1975b). 1=72275,142 (holocrystalline); 2=72215,185 (silica + glass); 3=72215,180 (plagioclase + glass); 4=72215,180 (glass); 5=72215,180 (opaque-rich glass).

	1	2	3	4	5
SiO_2	76.94	76.19	71.91	74.25	61.14
TiO_2	0.08	0.34	0.42	0.31	0.31
Al_2O_3	10.98	12.38	11.37	11.81	14.76
Cr_2O_3	-	0.03	0.03	0.01	0.01
FeO	0.14	1.03	4.77	2.01	4.78
MnO	-	0.02	0.04	0.01	0.02
MgO	-	0.36	1.00	0.12	0.25
CaO	0.43	1.75	1.79	0.53	6.92
Na_2O	-	0.30	0.06	0.03	0.47
K_2O	9.20	8.22	9.06	9.55	6.24
P_2O_5	-	0.06	0.16	0.10	0.12
BaO	1.68	0.74	0.32	1.32	0.35
NiO	0.04	-	-	-	0.04
S	0.11	-	0.36	0.84	2.40
Total	99.64	96.68	101.29	100.95	97.81

silica grains embedded in a groundmass of brown, devitrified glass. Glass compositions are generally similar to whole rock (Stoeser et al., 1974) or K-feldspar compositions (Ryder et al., 1975b).

Some examples of the glassy variety consist of silica-rich glasses, variable in composition, with tiny euhedral pyroxenes and olivines (Fo 20 to Fo 45). Ryder et al. (1975b) believed these to have crystallized from the molten glass. In others, the silica-rich glass is opaque due to tiny inclusions of sulfide (troilite) and Fe-metal.

A few clasts of the glassy variety consist of large plagioclase grains adjacent to potassic, silica glass that contains small quenched pyroxene crystals. The rims of the plagioclases often are zoned ternary feldspars with increasing orthoclase component toward the glass boundary.

Representative analyses of some Apollo 17 granites are presented in Table 3.

AGES

Compston et al. (1975) determined a precise Rb-Sr age for a pigeonite basalt clast of 4.01 ± 0.04 AE and interpreted this as the age of extrusion of the pigeonite basalt lava. Nunes and Tatsumoto (1975) found a $^{207}Pb/^{206}Pb$ age for pigeonite basalt 72275,170 of 3.9 to 4.4 AE. They attributed the large range to addition of Pb from the surrounding matrix. If so, the extrusion age of the PB is during the interval 3.9 to 4.0 AE, in agreement with the Rb-Sr age.

Leich et al. (1975) analyzed five samples of 72275 with the ^{40}Ar-^{39}Ar technique. Only one sample, 72275,80 (BCBx), had a release pattern that allowed an age determination of 3.99 $\pm$ 0.04 AE. The other samples, at least one of which was a PB, have complex release patterns that probably result from remobilization of radiogenic ^{40}Ar during a metamorphic event.

CLAST DESCRIPTIONS

The following are descriptions of clasts on the newly exposed faces of 72275. Those clasts with an associated three digit sample number have already been sampled. Clast locations are marked on the maps of the slab faces which follow these descriptions.

72275,328 West Face

B-1	(10 x 19 mm) Fine-grained, subrounded basalt clast. Contains yellow pyroxenes and granular sugary-white plagioclase.
B-2 (,357)	(6 x 6 mm) Fine-grained, subangular basalt. Noticeable are criss-crossing needles of fine-grained, sugary-white plagioclase with rounded pyroxenes (<0.5mm).
B-3 (,371)	(5 x 10 mm) Fine-grained, angular basalt. One portion has criss-crossing needles of plagioclase with yellow pyroxene. The rest is sugary-white, fine-grained plagioclase and pyroxene in dark aphanitic material.
B-4 (,359)	(10 x 10 mm) Fine-grained, subangular basalt composed of fine-grained, sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
B-6 (,363)	(5 x 5 mm) Fine-grained, subrounded basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
B-7	(4 x 8 mm) Fine-grained, subrounded basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
B-8	(4 x 8 mm) Fine-grained, subrounded basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
B-9	(5 x 8 mm) Fine-grained, subrounded basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

B-10 (,365) (3 x 8 mm) Fine-grained, subangular basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

B-11 (3 x 4 mm) Fine-grained, subrounded basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

CG (6 x 4 mm) Subangular microbreccia or granulite with a center of fine-grained, gray-black material. Clast is surronded by a white, plagioclase-rich rim.

DB-1 (30 x 20 mm) Angular, dark-gray microbreccia containing four large plagioclase-rich clasts and several smaller clasts of granular plagioclase.

DB-2 (25 x 25 mm) Microbreccia consisting of light- and dark-gray material. Contains white plagioclase-rich inclusions and a small amount of yellow grains (pyroxenes?).

DB-3 (16 x 19 mm) Dark-gray microbreccia with stringers and inclusions of plagioclase-rich material.

MCC (30 x 30 mm) The marble cake clast, a black microbreccia enclosing and spiraling into a plagioclase-rich interior.

WC-1 (,377) (4 x 4 mm) Fine-grained angular anorthositic breccia or granulite composed mostly of white plagioclase with minor dark-gray or black grains and sparse reddish-brown (spinel?) grains.

72275,328 East Face

AC-1 (3 x 5 mm) Fine-grained, subrounded anorthositic breccia or granulite. Contains a few yellow pyroxenes.

B-1 (,385) (9 x 10 mm) Fine-grained, subrounded basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

B-2 (,387) (5 x 7 mm) Fine-grained, subrounded basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

B-3 (,389)	(6 x 7 mm) Fine-grained, subrounded basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
B-4	(5 x 7 mm) Fine-grained, subangular basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
B-5	(3 x 5 mm) Fine-grained, subrounded basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
B-6 (,393)	(5 x 7 mm) Fine-grained, subangular basalt composed of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
AC-2 (,397)	(4 x 6 mm) Fine-grained, angular anorthositic breccia.
DB-1	(4 x 10 mm) Angular, greenish-black microbreccia with several white, plagioclase-rich inclusions.
DB-2	(11 x 11 mm) Subrounded microbreccia similar to DB-1.
DB-3	(8 x 9 mm) Subrounded, gray-black microbreccia with a white, plagioclase-rich region.
DB-4 (,407& ,408)	(14 x 16 mm) Fine-grained, rounded clast consisting of a rim of dark-gray/black microbreccia (,407) enclosing a lighter gray microbreccia (408).
DB-5	(11 x 12 mm) Subangular, dark-gray microbreccia.
DB-6	(5 x 8 mm) Angular, dark-gray microbreccia.
DB-7	(3 x 8 mm) Angular microbreccia of mostly dark-gray material with round, white, fine-grained inclusions. Surronding the clast are small yellow grains (pyroxene?).
DB-8	(3 x 4 mm) Subangular, gray microbreccia with a single rounded plagioclase-rich inclusion.
DB-9	(5 x 6 mm) Subangular, dark-gray microbreccia with small, angular white clasts. Contains some yellow pyroxenes and and orange-red mineral (spinel?).

72275,337 West Face

AC-1	(4 x 5 mm) Fine-grained, angular anorthositic breccia or granulite.
B-1	(9 x 10 mm) Same clast as B-1 on ,328 East.
B-2 (419)	(4 x 8 mm) Fine-grained, subrounded basalt consisting of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
B-4	(4 x 5 mm) Same as B-3 on ,328 East.
B-5	(4 x 5 mm) Same as B-3 on ,328 East.
B-6 (,427)	(8 x 12 mm) A part of ,336. Relatively coarse-grained, subangular basalt with white plagioclases and greenish-yellow pyroxene.
DB-1	(4 x 6 mm) Angular, gray microbreccia.
DB-2	(9 x 10 mm) Same as DB-2 on ,328 East.
DB-3	(8 x 10 mm) Same as DB-3 on ,328 East.
DB-4	(14 x 15 mm) Same as DB-4 on ,328 East.
DB-5	(4 x 4 mm) Gray-black microbreccia enclosing a light gray interior.
DB-6	(3 x 5 mm) Subangular, gray-black microbreccia with plagioclase stringers and round, plagioclase-rich inclusions.
DB-7	(11 x 17 mm) Angular, dark-gray microbreccia with plagioclase stringers and round, plagioclase-rich inclusions.
DB-8	(3 x 5 mm) Angular, gray microbreccia with a plagioclase-rich inclusion near the center.
DB-9	(7 x 10 mm) Part of DB-9 on ,328 East.
DB-10	(4 x 7 mm) Subrounded, gray-black microbreccia with several rounded plagioclase-rich inclusions.
DC-1	(2 x 2 mm) Angular, dark-gray microbreccia with high concentration of yellow-green grains (pyroxene?).

DC-2 (2 x 3 mm) Angular, gray-black microbreccia.

DC-3 (3 x 4 mm) Subangular, gray-black microbreccia with a plagioclase-rich inclusion near the center.

DC-4 (2 x 4 mm) Subrounded, gray-black microbreccia with rounded plagioclase-rich inclusions.

DC-5 (3 x 3 mm) Subrounded, gray-black microbreccia with a pale-yellow inclusion.

DC-6 (3 x 4 mm) Subrounded, gray-black microbreccia with several large yellow inclusions (pyroxene?).

DMA-1 (4 x 20 mm) A region consisting of several subrounded, gray-black microbreccias and concentrations of plagioclase and pyroxene grains.

GC-1 (,411) (4 x 6 mm) Angular, gray-black microbreccia.

GC-2 (3 x 4 mm) Subangular, light-gray microbreccia with plagioclase-rich inclusions.

GC-3 (,415) (8 x 10 mm) Subrounded, gray microbreccia.

<u>72275,337 East Face</u>

AC-1 (,439) (7 x 9 mm) Fine-grained, angular, chalky-white anorthositic breccia.

B-1 (,431) (12 x 14 mm) Fine-grained, rounded basalt consisting of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

B-2 (3 x 3 mm) Fine-grained, subangular basalt consisting of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

B-3 (,449) (8 x 10 mm) Fine-grained, subrounded basalt consisting of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

B-4 (3 x 4 mm) Fine-grained, subangular basalt consisting of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

B-5 (,443) (8 x 10 mm) Fine-grained, subangular basalt consisting of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.

DB-1	(9 x 10 mm) Subrounded, light-gray microbreccia. Gray rim surrounds and mixes with fine-grained, plagioclase-rich interior.
DB-2	(2 x 2 mm) Subrounded, gray-black microbreccia.
DB-3	(4 x 4 mm) Subrounded, gray-black microbreccia with stringers of plagioclase.
DB-4	(3 x 4 mm) Subrounded, dark-gray microbreccia with local concentrations of plagioclase.
DB-5	(2 x 5 mm) Subangular, gray-black microbreccia with local concentrations of plagioclase and pyroxene.
DB-6	(6 x 8 mm) Subangular, gray-black microbreccia.
GC-1	(3 x 3 mm) Subrounded, gray microbreccia or basaltic breccia with local cross hatch patterns of plagioclase around pyroxene.
GC-2	(5 x 5 mm) Subangular, gray microbreccia or basaltic breccia. Similar texture to GC-1.
GC-4 (,433)	(3 x 4 mm) Subangular, light-gray microbreccia.
GC-5	(4 x 4 mm) Subrounded, gray microbreccia or anorthositic breccia with large quantities of plagioclase.
GC-6	(4 x 5 mm) Subrounded, light-gray microbreccia or anothositic breccia.
GC-7	(7 x 10 mm) Subrounded, gray microbreccia or anorthositic breccia.
WC-1	(2 x 3 mm) Fine-grained, subrounded anorthositic breccia.
WC-2	(1 x 1 mm) Fine-grained, subrounded anorthositic breccia with local concentrations of a yellow mineral (pyroxene?).
PR-1 (453)	(4 x 8 mm) Fine-grained, subrounded anorthositic breccia or granulite.
PR-2	(3 x 6 mm) Fine-grained, subrounded anorthositic breccia or granulite.

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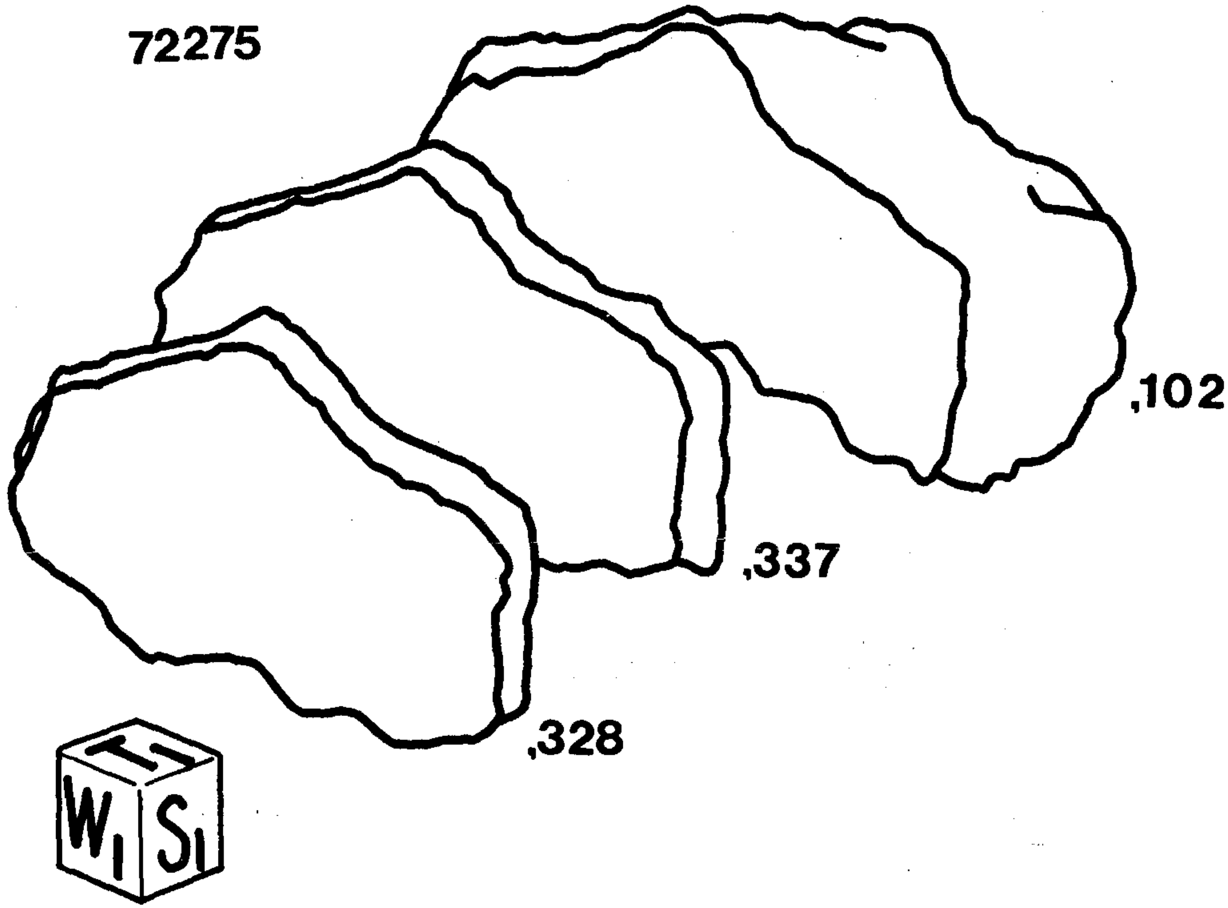
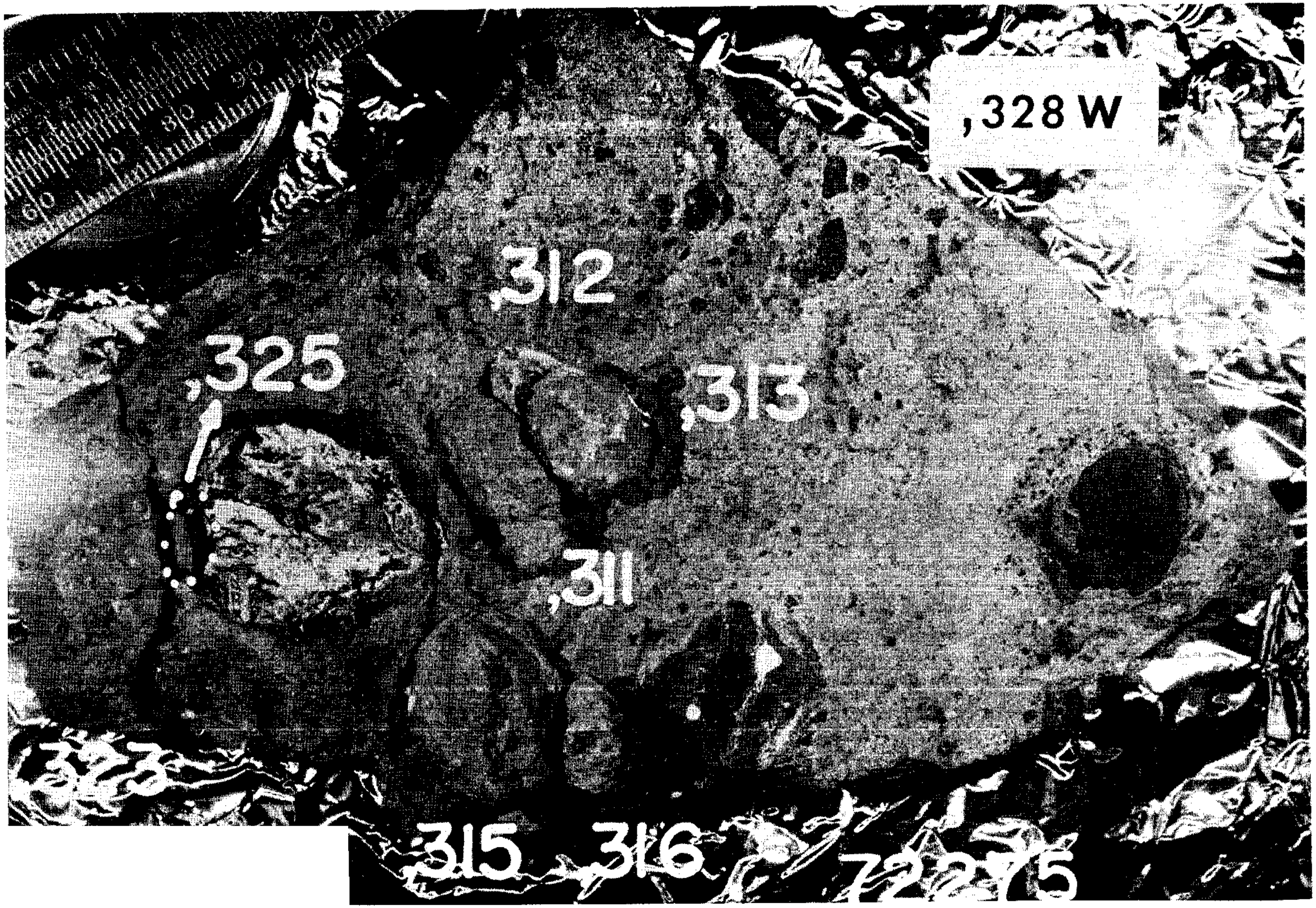
AC-1	(5 x 9 mm) Same as AC-1 on ,337 East.
AC-2 (,335)	(3 x 4 mm) Fine-grained, subrounded, chalky gray-white anorthositic breccia.
AC-3 (,351)	(4 x 5 mm) Fine-grained, subangular, chalky gray-white anorthositic breccia. Appears to have a thin coat of dark microbreccia.
B-1	(10 x 10 mm) Same as B-1 on ,337 East.
B-2 (,347)	(4 x 5 mm) Fine-grained, subrounded basalt consisting of sugary-white plagioclase in dark aphanitic material. Yellow pyroxene evident only in a small portion of the clast.
B-3	(3 x 3 mm) Fine-grained, subangular basalt consisting of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
B-4 (,460)	(6 x 6 mm) Fine-grained, subangular basalt consisting of sugary-white plagioclase and yellow pyroxene in dark aphanitic material.
DB-1	(7 x 8 mm) Same as DB-1 on ,337 East.
DB-2	(2 x 3 mm) Subangular, gray microbreccia with local plagioclase-rich concentrations.
DB-3	(2 x 2 mm) Subangular, gray microbreccia coated with fine-grained plagioclase.
DB-4	(2 x 2 mm) Angular, dark-gray microbreccia coated with fine-grained plagioclase.
DB-5	(3 x 4 mm) Subangular, gray-black microbreccia with local plagioclase-rich concentrations.
DB-6	(5 x 7 mm) Subangular, gray-black microbreccia with numerous rounded to subangular, fine-grained, plagioclase-rich inclusions. Surrounded by a thin coating of plagioclase.
DB-7	(4 x 7 mm) Subrounded, gray-black microbreccia with an inner gray-black core set off by a thin rim of plagioclase coating.

DB-8	(5 x 5 mm) Subrounded, gray-black microbreccia with numerous plagioclase-rich inclusions.
DC-1	(2 x 2 mm) Angular, gray-black microbreccia.
DC-2	(3 x 4 mm) Angular, gray microbreccia coated with sugary-white plagioclase.
DC-3	(1 x 2 mm) Subrounded, gray microbreccia coated with sugary-white plagioclase.
GC-1 (,457)	(3 x 4 mm) Subangular, gray anorthositic breccia. Local concentrations of green minerals (pyroxene?).
GC-2	(1 x 3 mm) Subangular, gray microbreccia with a thin band composed of dark, aphanitic exterior and white, fine-grained, plagioclase-rich interior.
GC-3	(3 x 4 mm) Subrounded, gray microbreccia or basaltic breccia with abundant plagioclase and numerous yellow pyroxene.
WC-1	(1 x 2 mm) Fine-grained, subangular anorthositic breccia or granulite composed mainly of plagioclase with a high proportion of yellow pyroxene.
WC-2	(3 x 4 mm) Fine-grained, subangular anorthositic breccia or granulite.

Figure 5. Diagram showing orientation of slabs cut from 72275.
For scale, the orientation cube is 1 inch on a side.

72275

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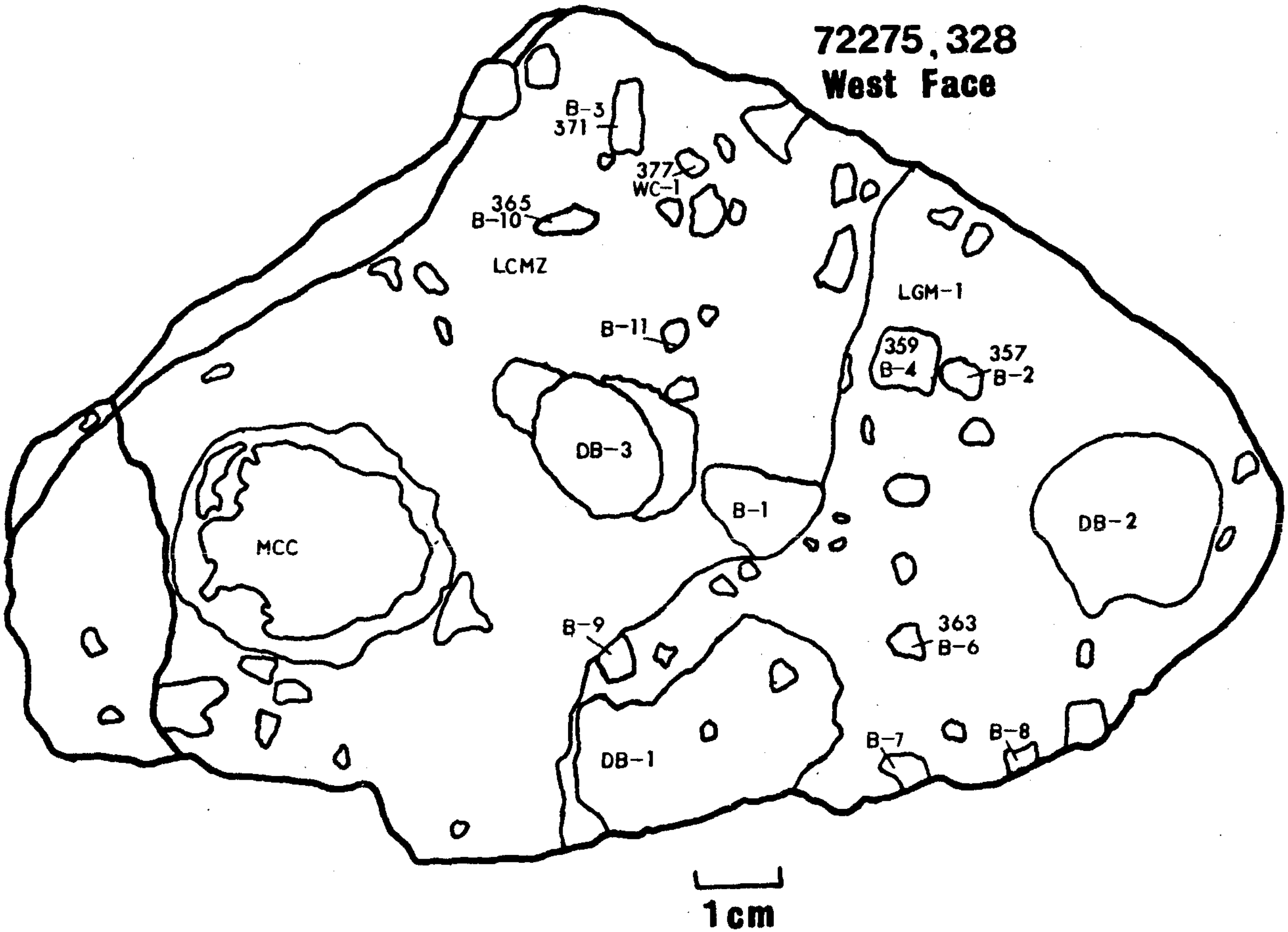

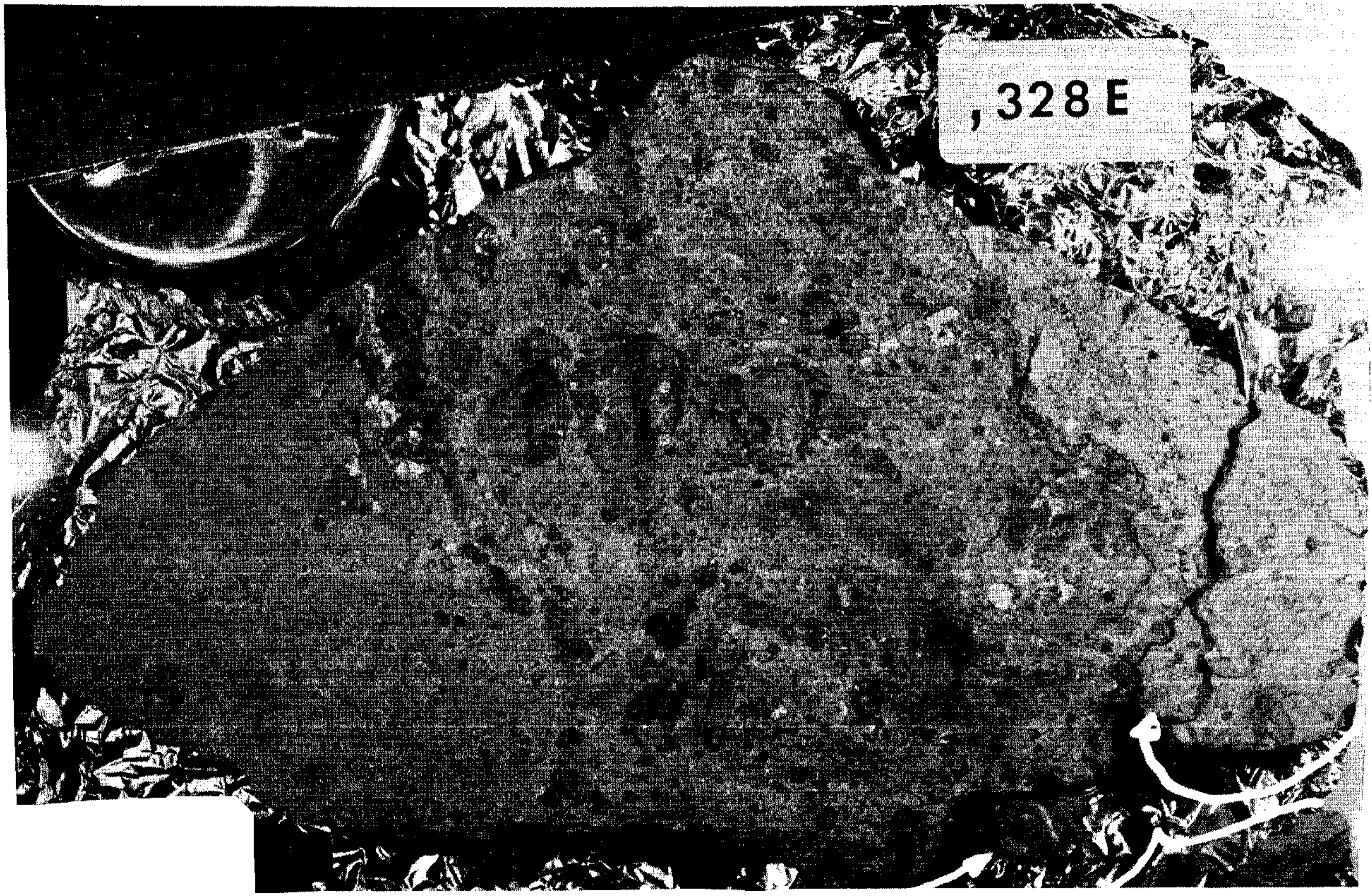
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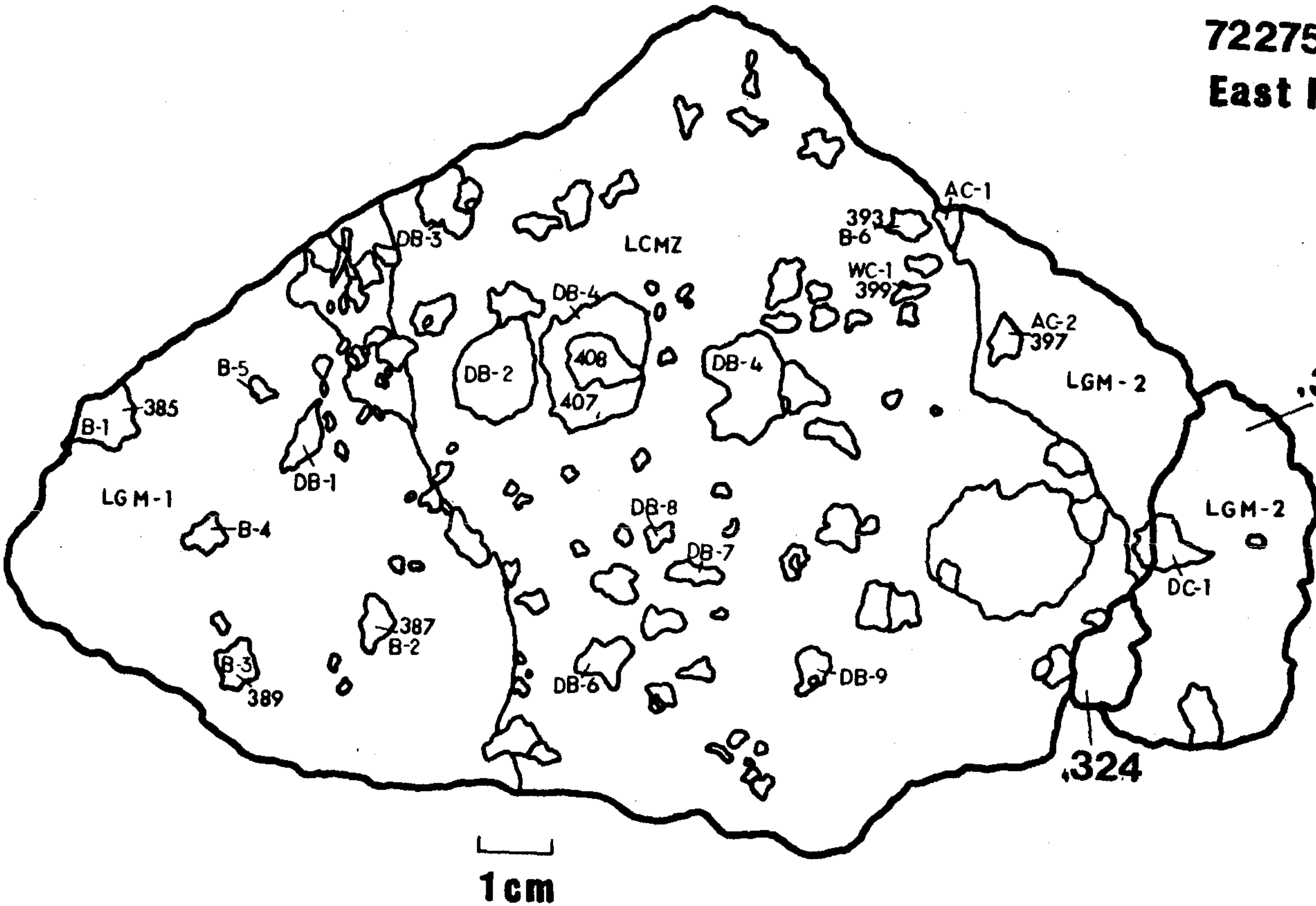

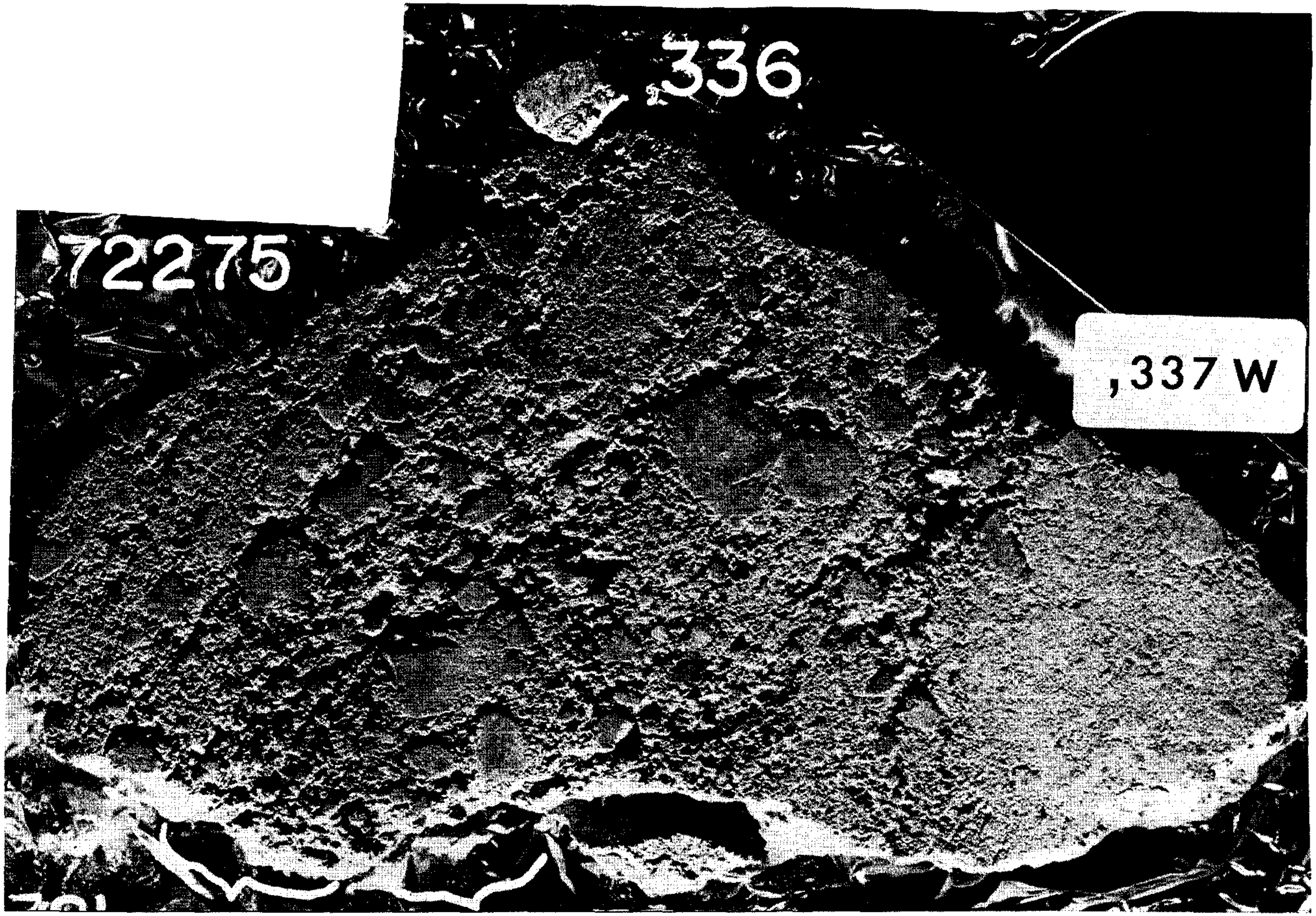
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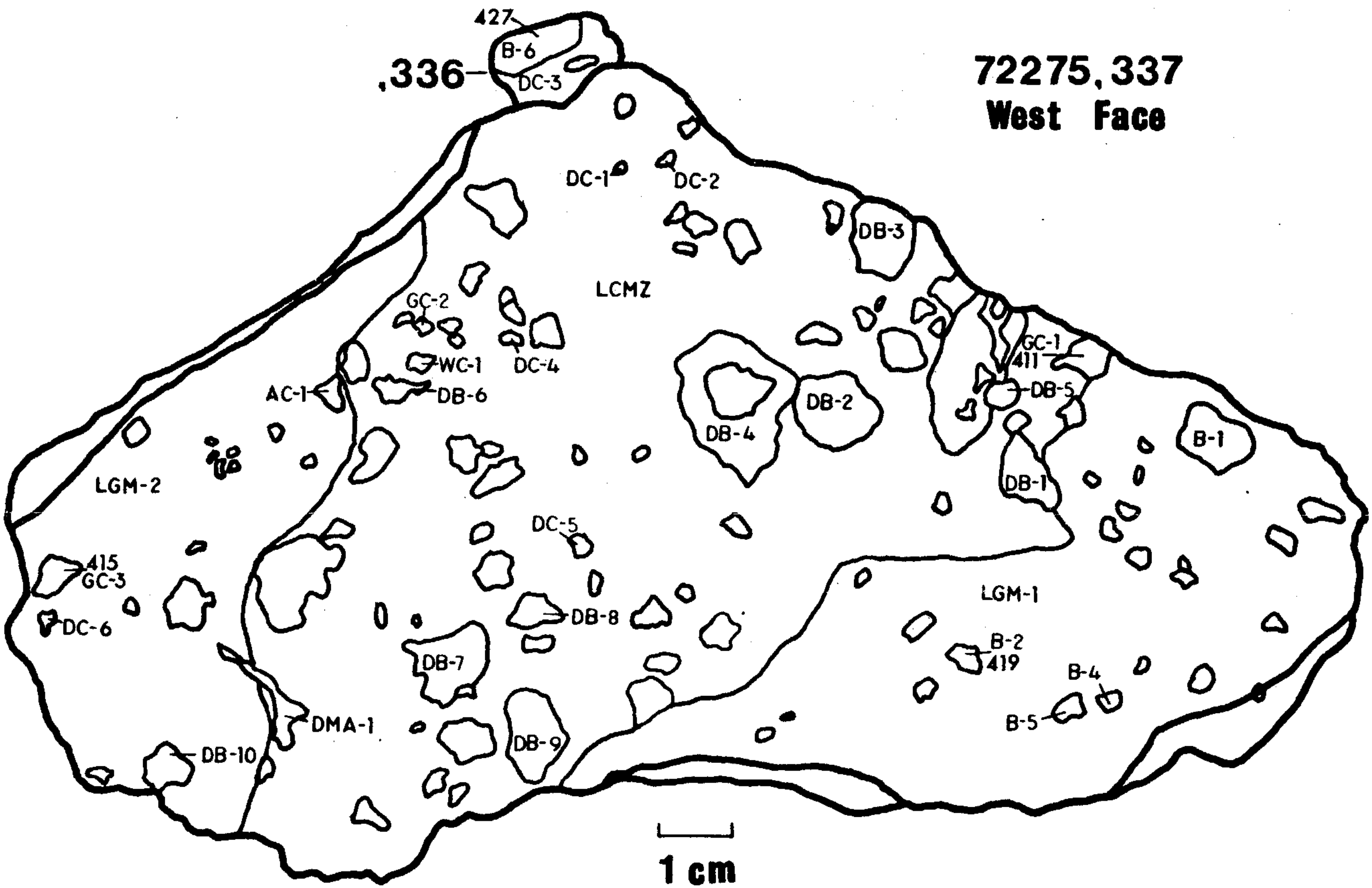

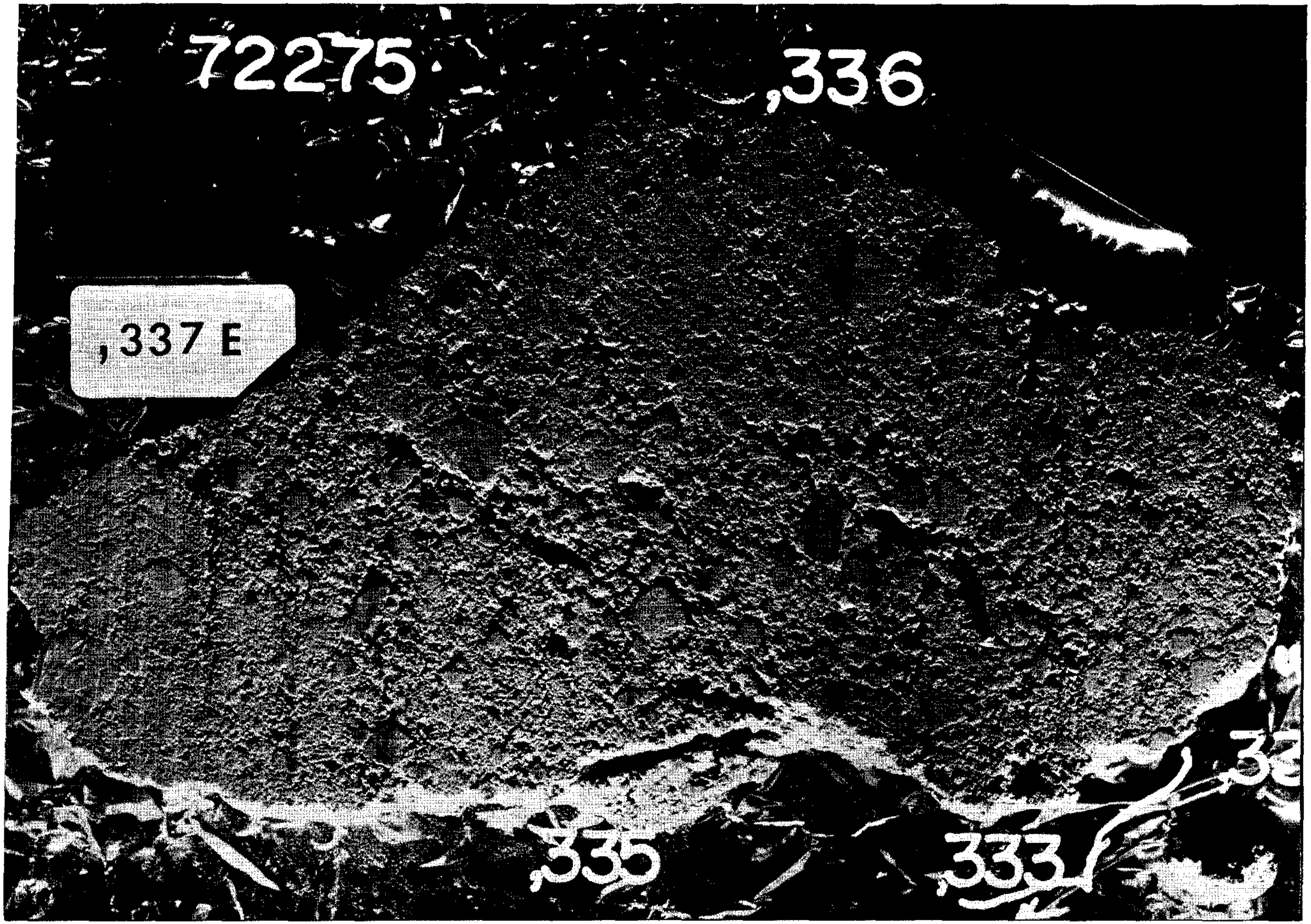
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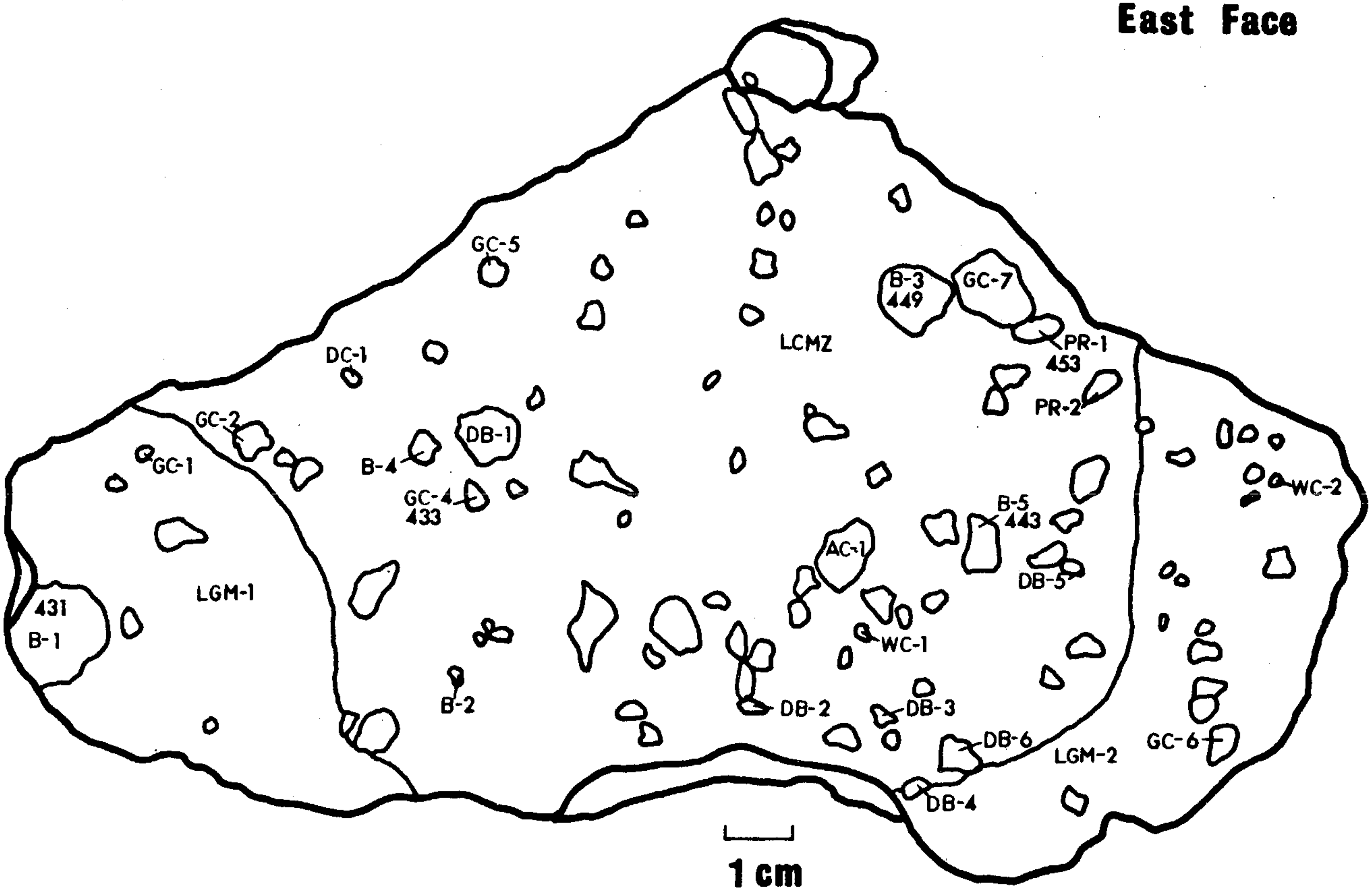

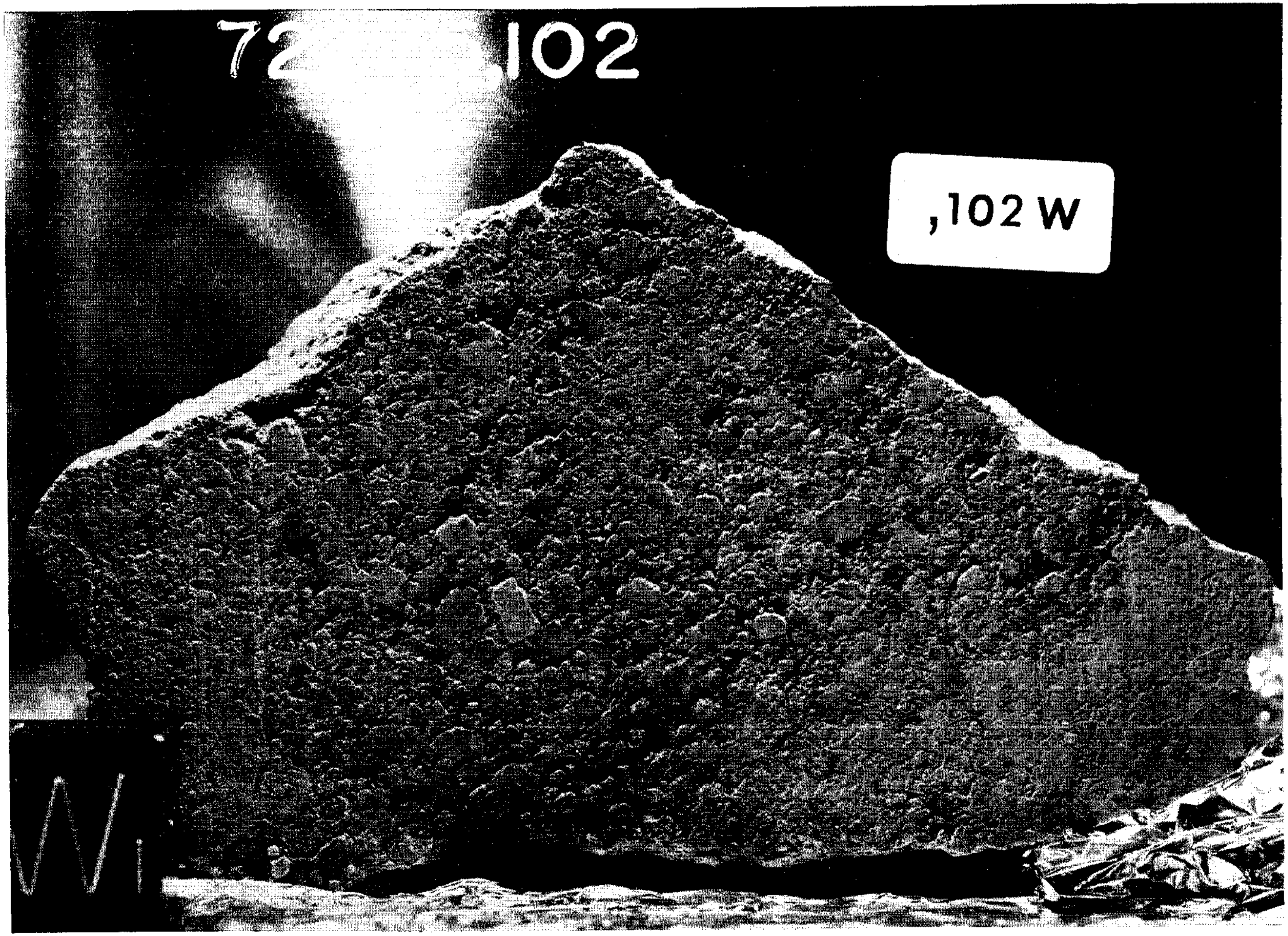

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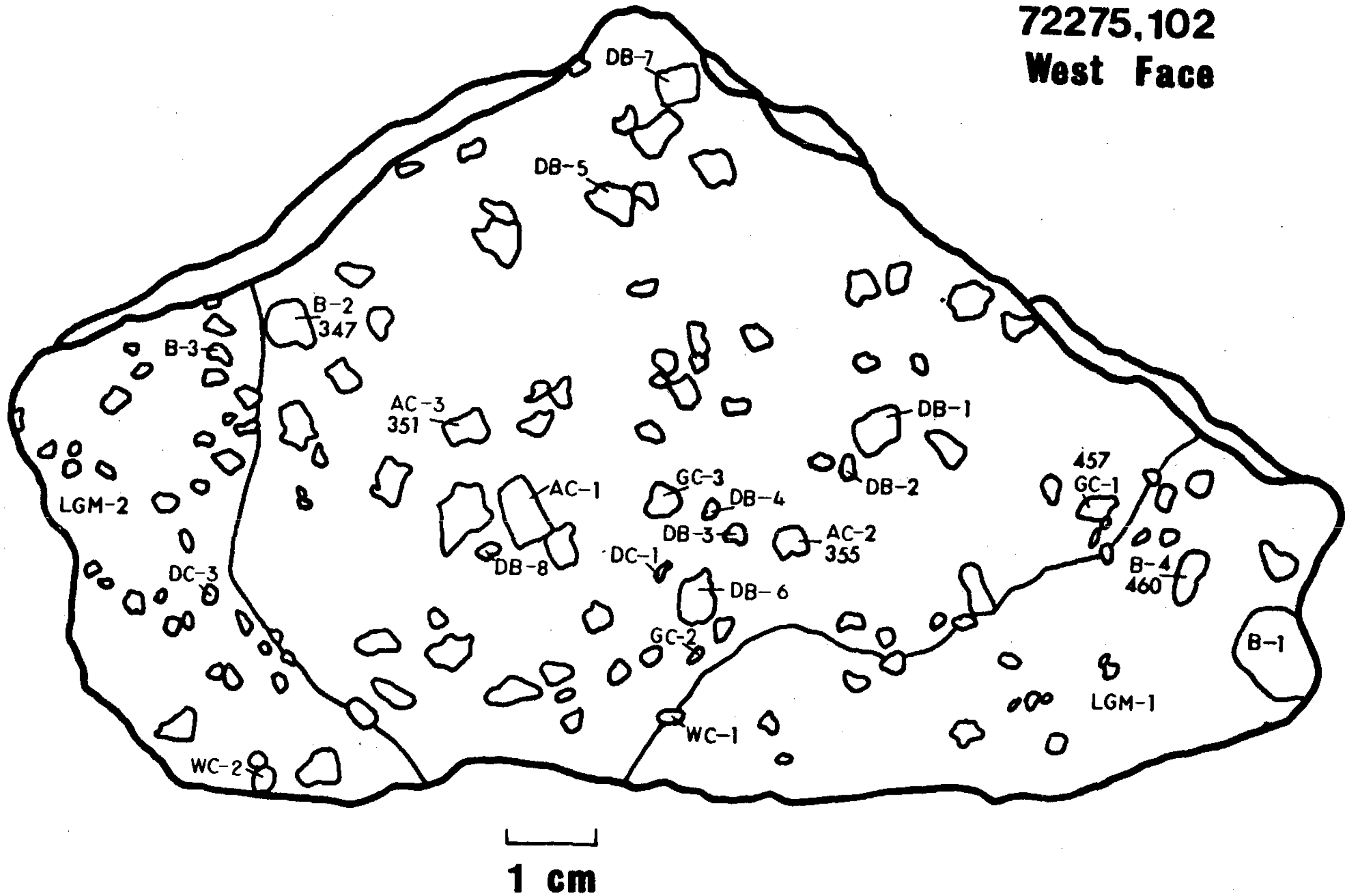
West Face



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Geol.	Min. Pet.	Pristine Clasts	Majors	Trace	Volatiles
1,2,3, 22,23, 34,35, 43,44, 45	4,17,22, 23,29,30, 31,38,39	24,25,32, 33,41	4,8,9, 15,29, 30,31, 38,39	4,8,9, 15,41	18,19,24, 25

Noble Gases	Isotopes	Physical Prop.	Cosmic Rays
20,21	11,13,26, 27,28	1,2,5, 6,7,14, 37,42	10,12,16

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