64535, 64536 and 64537

Dilithologic Breccias

257, 177 and 124 grams

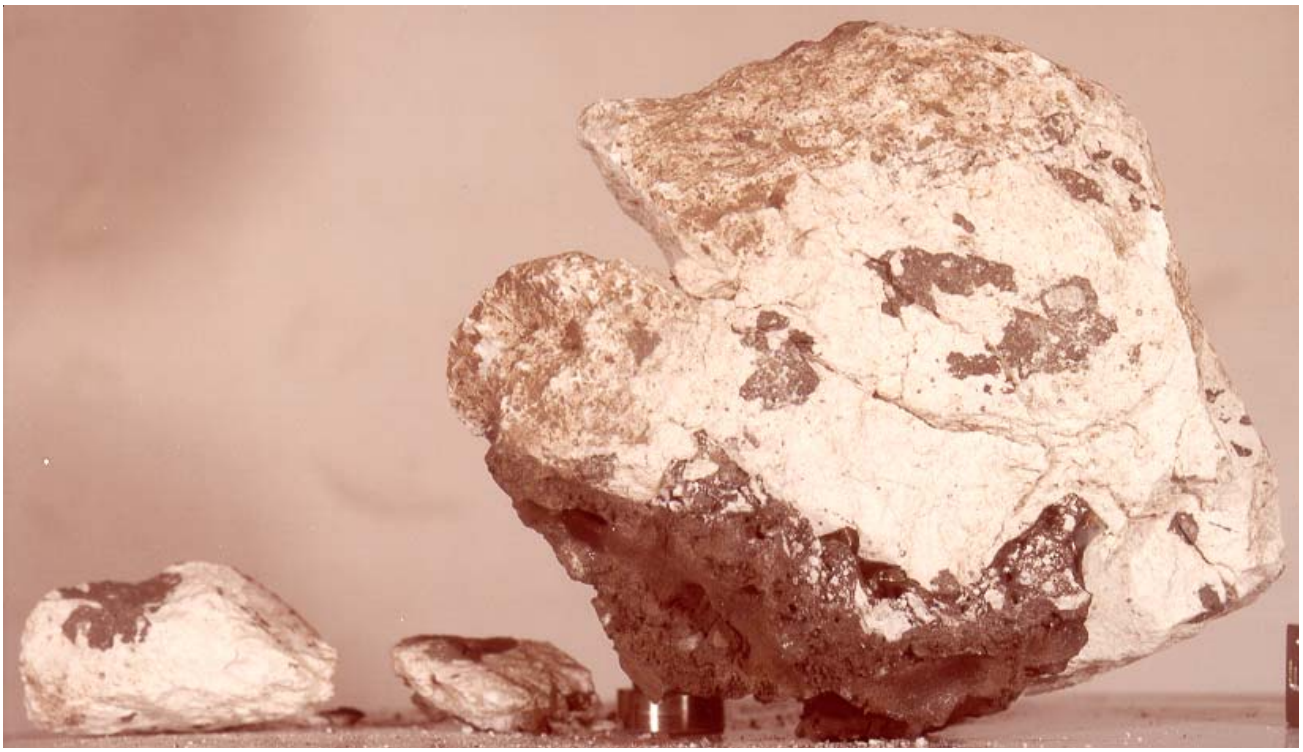


Figure 1: Photo of 64535 (off color). NASA S72-43420. Sample is 7 cm.

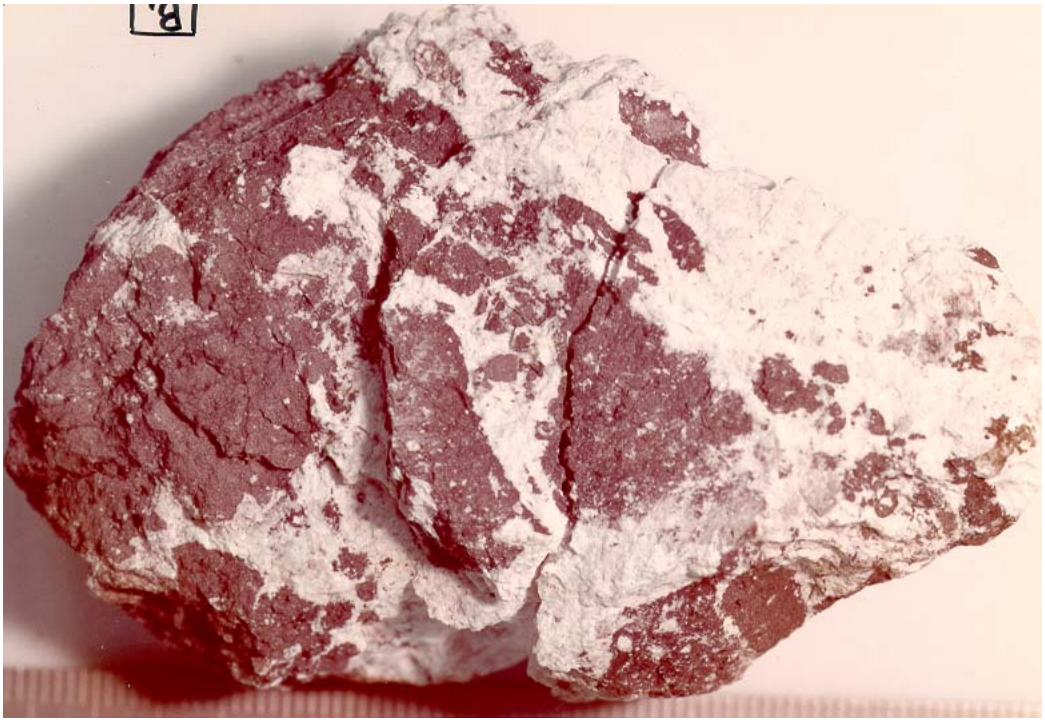


Figure 2: Photo of 64536. Sample is 8 cm. NASA S75-22681.

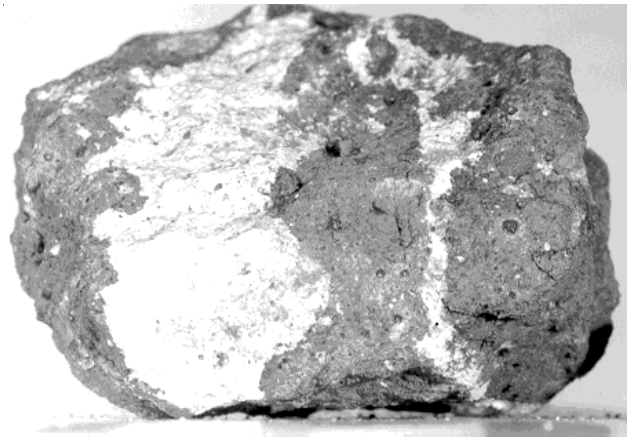


Figure 3: Photo of 64537. Large zap pit. NASA S72-44436. Sample is 5 cm.

Introduction

64535, 64536 and 64537 were collected as rake samples from a blocky area, high up on Stone Mountain, Apollo 16 – see section on 64501. They are so like each other that it can be assumed that they were portions of the same rock (figures 1 – 3). However, 64537 has zap pits on all surfaces. 64539 – 64558 are additional pieces of the same fractured rock.

64535 has a cosmic ray exposure age of 1.9 m.y., possibly that of South Ray Crater.

Petrography

Ryder and Norman (1980) give the only descriptions of 64535 etc. Warner et al. (1973) include these samples in their classification scheme. James et al. (1984) discuss aspects of this lithology in their paper on dimict breccias (e.g. 61015). The samples have a mix of cataclastic ferroan anorthosite with impact melt. In some cases they also have a thick black glass coating.

See also the descriptions of 64425, 64435 and 64475 - 64476, from the same location.

Chemistry

See et al. (1986) and Ebihara et al. (1992) provide analyses of the anorthosite while McKinley et al. (1984) give an analysis of the impact melt lithology. Morris et al. (1986) determined the glass composition (figure 4).

Radiogenic age dating

Jessberger et al. (1977) determined the age by $^{40}Ar/^{39}Ar$ plateau technique as 3.98 ± 0.02 b.y. for the anorthosite clast in 64535, and 3.97 ± 0.01 b.y. for 64536. They argue this was reset by the impact event.

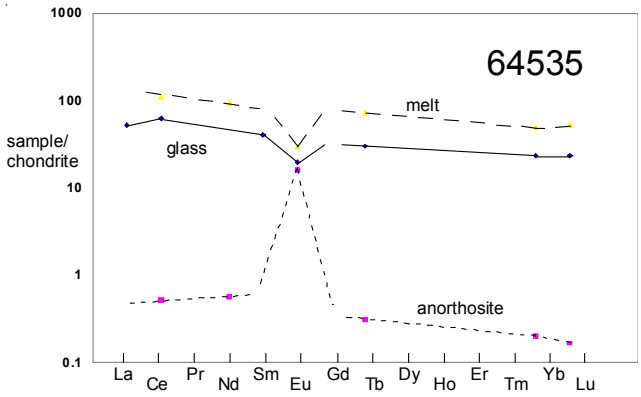


Figure 4: Normalized rare-earth-element diagram.

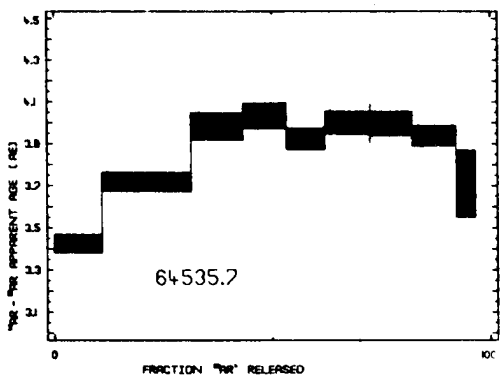


Figure 5: Ar/Ar plateau diagram. Jessberger et al. (1977).

Summary of Age Data for 64535, 64536

	Ar/Ar
Jessberger et al. (1977)	3.98 ± 0.02 b.y.
	3.97 ± 0.01 b.y.

Caution: Old decay constant.

Cosmogenic isotopes and exposure ages

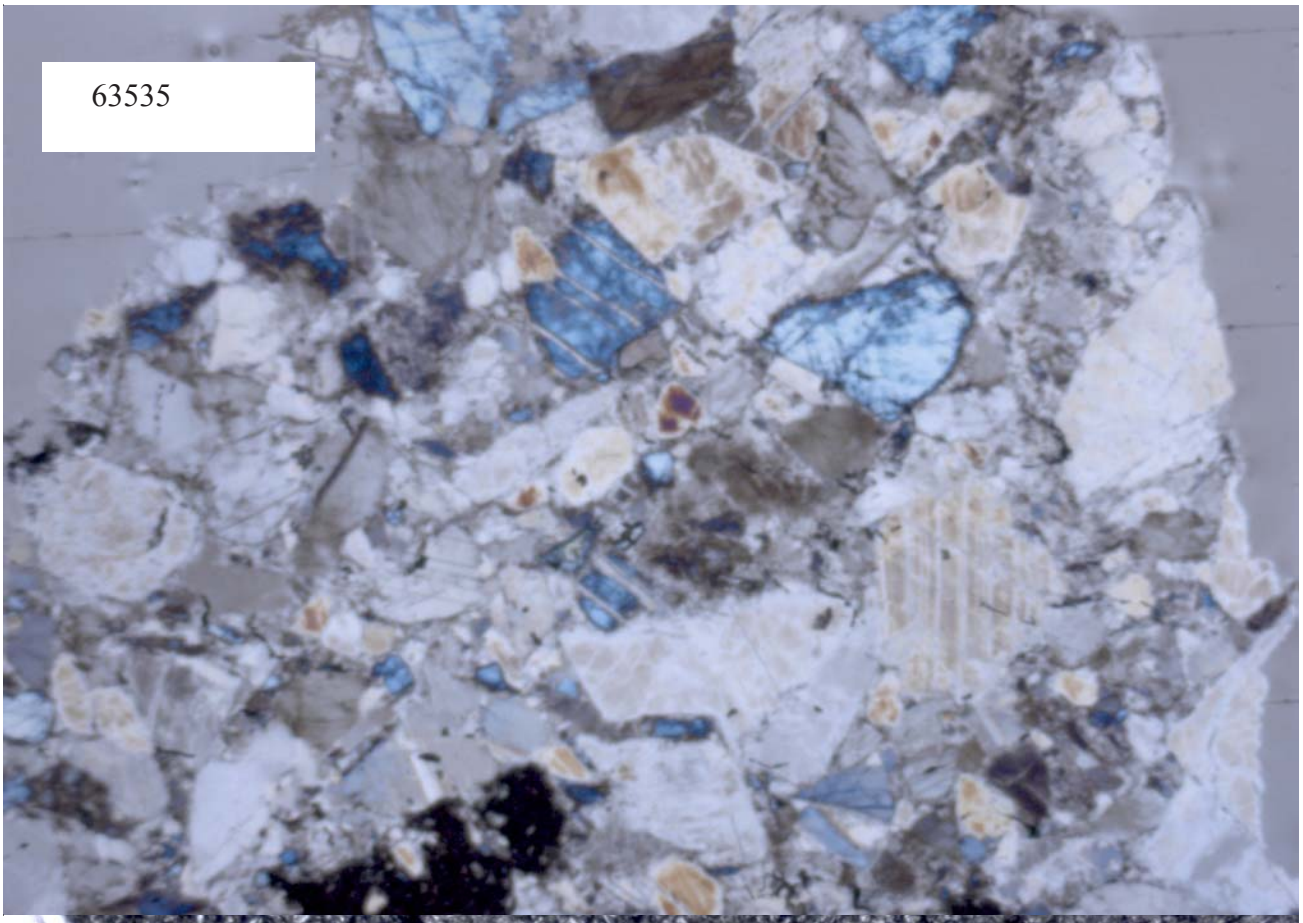
Jessberger et al. (1977) determined the ^{38}Ar exposure age as 1.9 ± 0.2 m.y., consistent with excavation by South Ray Crater.

Other Studies

Pearce and Simonds (1974) report results on both the light and dark lithologies from magnetic studies of 64537.

Processing

Sample 64535 – 64559 were returned in documented bag #395. There are 7 thin sections of 64535, 6 thin sections for 64536 and 5 thin sections for 64537.


63535

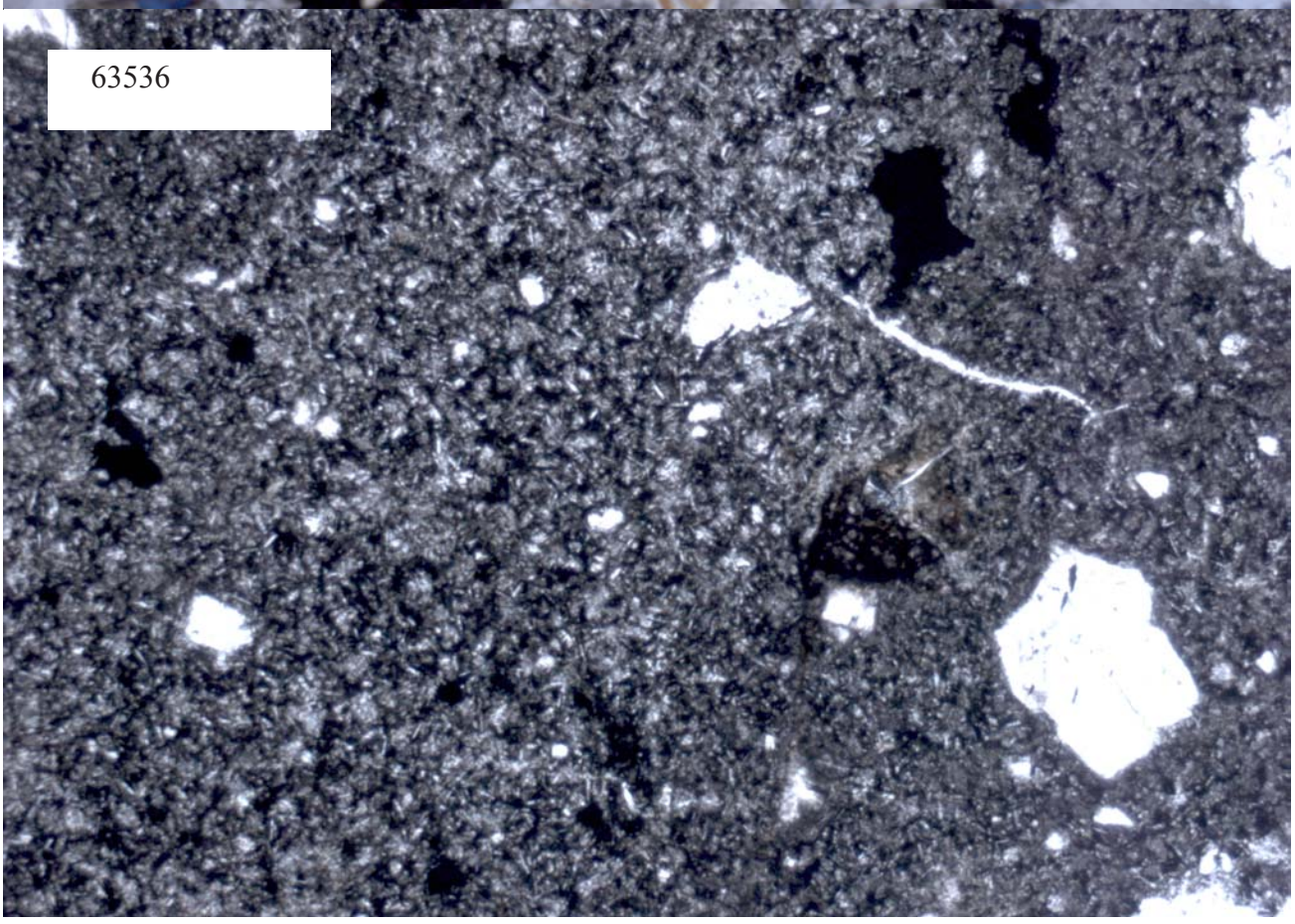

63536

Table 1. Chemical composition of 64535.

						,15	,16			
reference	See 86			Morris 86		Ebihara 92			McKinley 1984	
weight	anor.	glass		glass		anor.	impact melt			ave
SiO2 %	44.23	44.75	(a)	44.75	(a)				*47.12*	*(d)*
TiO2	0.01	0.38	(a)	0.38	(a)				*0.85*	*(d)*
Al2O3	35.72	27.25	(a)	27.25	(a)				*21.6*	*(d)*
FeO	0.19	5.03	(a)	5.68	(b)				*5.75*	*(d)*
MnO		0.07	(a)						*0.08*	*(d)*
MgO	0.08	6.52	(a)	6.52	(a)				*10.65*	*(d)*
CaO	19.58	15.24	(a)	15.24	(a)				*12.8*	*(d)*
Na2O	0.39	0.53	(a)	0.52	(b)				*0.6*	*(d)*
K2O	0.03	0.11	(a)	0.11	(a)				*0.2*	*(d)*
P2O5									*0.2*	*(d)*
S %										
sum										
Sc ppm				6.64	(b)					
V										
Cr				838	(b)					
Co				49	(b)					
Ni				940	(b)	3.09	730	(c)		
Cu										
Zn						0.197	46.8	(c)		
Ga										
Ge ppb						0.366	1890	(c)		
As										
Se						344	1.31	(c)		
Rb						0.175	5.59	(c)		
Sr										
Y										
Zr										
Nb										
Mo										
Ru										
Rh										
Pd ppb						0.54	33.5	(c)		
Ag ppb						1.14	5.9	(c)		
Cd ppb						16.4	1560	(c)		
In ppb						0.436	35.5	(c)		
Sn ppb							0.18	(c)		
Sb ppb						0.47	5.32	(c)		
Te ppb						0.73	10.1	(c)		
Cs ppm						14.2	225	(c)		
Ba				113	(b)					
La				12.23	(b)					
Ce				37.3	(b)	0.308	66.9	(c)		
Pr										
Nd						0.256	42	(c)		
Sm				5.82	(b)					
Eu				1.09	(b)	0.912	1.65	(c)		
Gd										
Tb				1.08	(b)	0.0111	2.61	(c)		
Dy										
Ho										
Er										
Tm										
Yb				3.74	(b)	0.0327	8.04	(c)		
Lu				0.55	(b)	0.004	1.26	(c)		
Hf				3.92	(b)					
Ta				0.53	(b)					
W ppb										
Re ppb						0.0154	1.55	(c)		
Os ppb						0.15	13.8	(c)		
Ir ppb						0.06	12.2	(c)		
Pt ppb										
Au ppb						0.062	13.8	(c)		
Th ppm				2.73	(b)					
U ppm				0.71	(b)	0.002	1.07	(c)		

technique: (a) emp, (b) INAA, (c) RNAA, (d) strange and uncertain

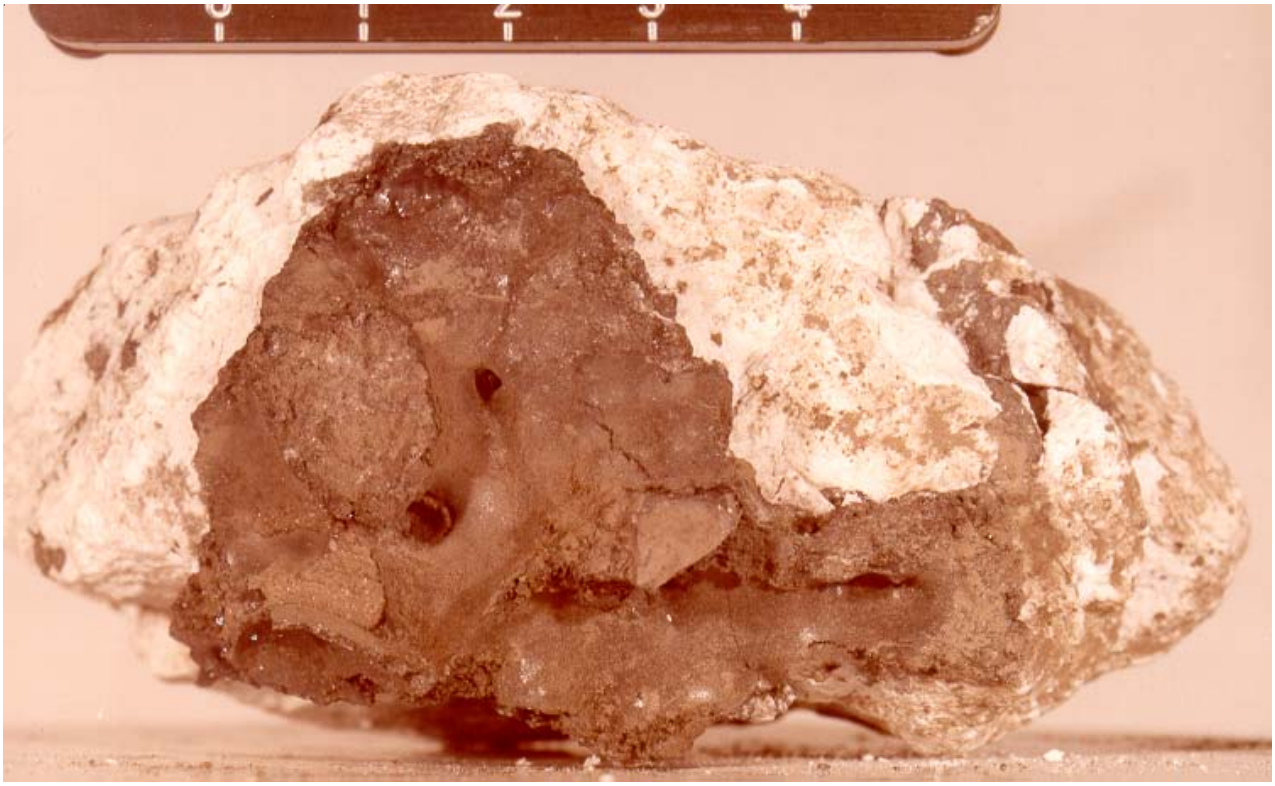
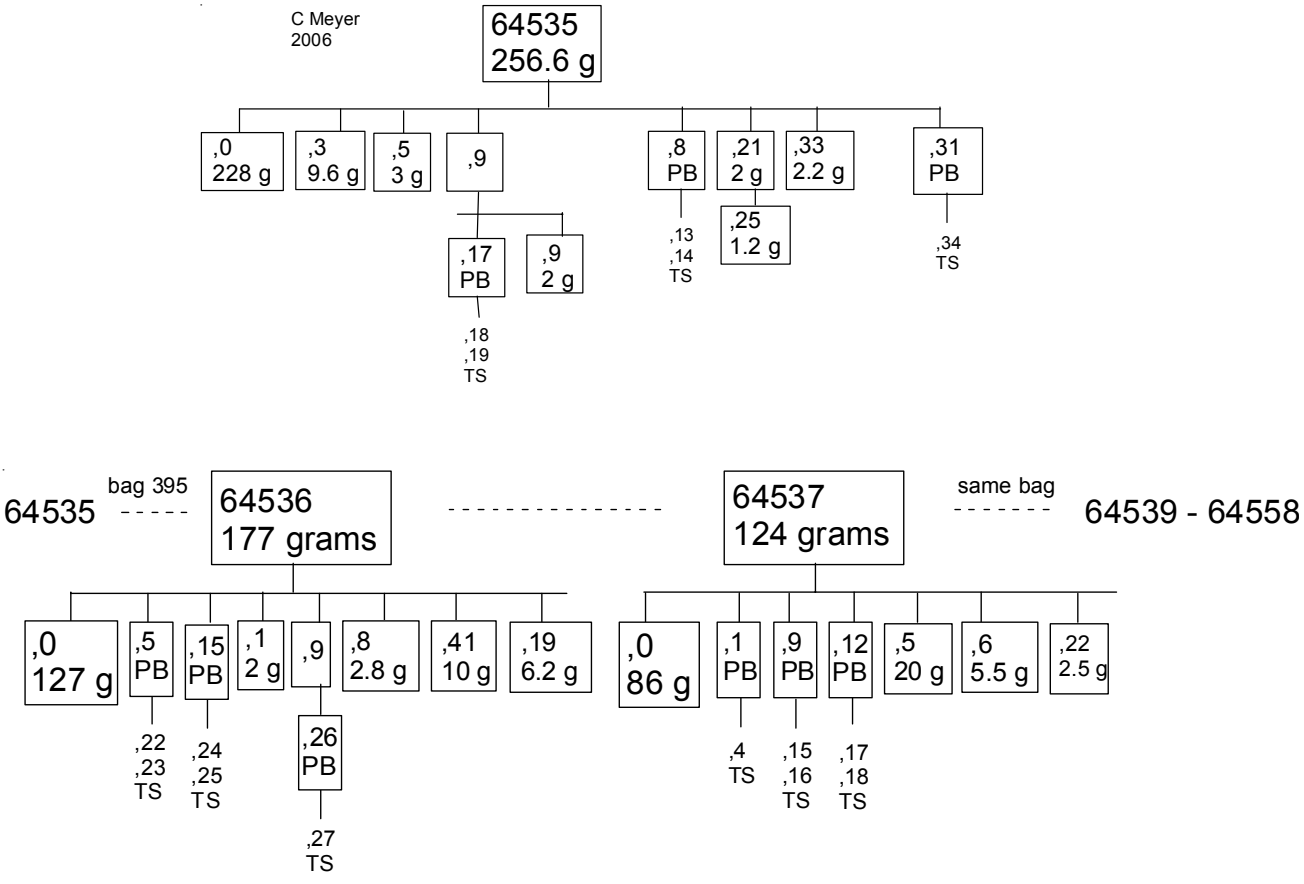


Figure 6: Photo of 64535 (off color). NASA S72-43409. Tick marks at top are 1 cm.



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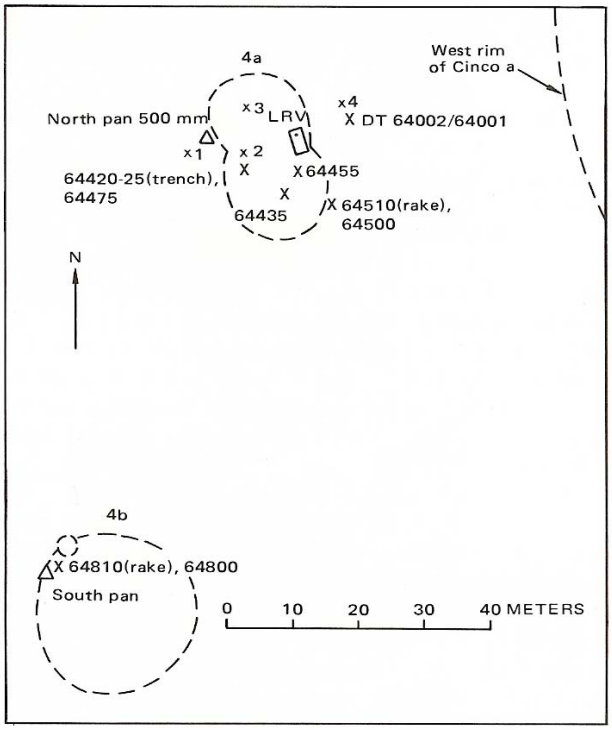

Figure 7: Map of station 4 on Stone Mountain.

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