

64567 – 13.8 grams
64569 - 14.3 grams
Poikilitic Impact Melt Breccia

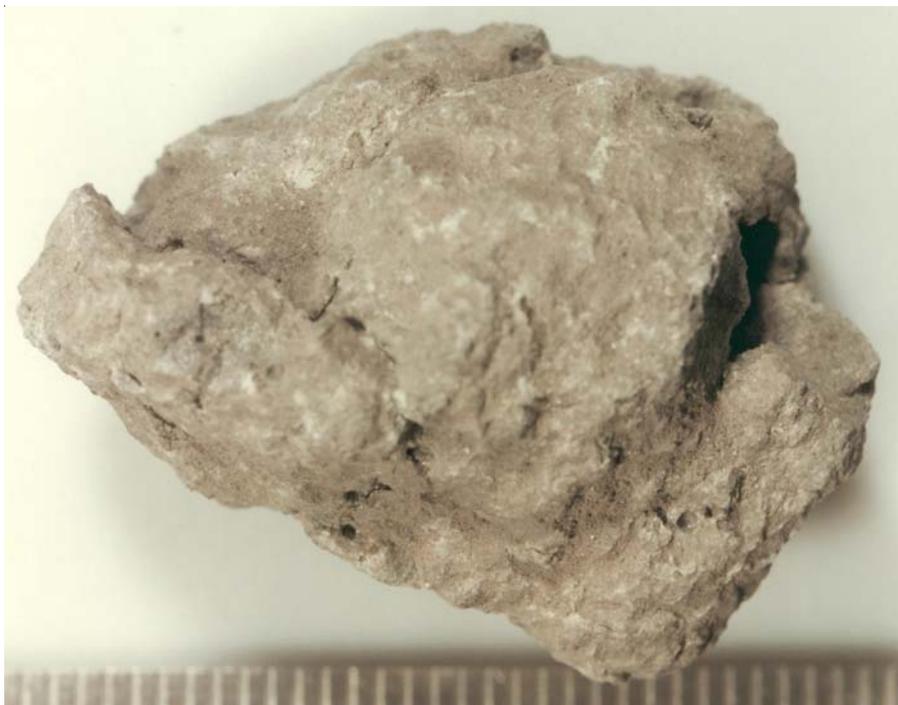


Figure 1: Photo of 64567. Scale in mm. S72-55386

Mineralogical Mode

by Simonds et al. (1973)

	64567	64569
Plagioclase	69%	57
Pyroxene	10	19
Olivine	20	21
Opaque	1	4



Figure 2: Photo of 64569. Scale in mm. S72-55366



Figure 3: Photomicrograph of thin section 64567,9, showing subophitic texture. 2 mm across (from Ryder and Norman 1980).

Introduction

64567 and 64569 are rake samples from station 4 on the slope of Stone Mountain – see section on 64501. They are dark coherent aphanitic samples with a few vesicles (figures 1, 2, 8 and 9). They are unusual in that they have abundant olivine oikocrysts and are relatively mafic. They include relict clasts of anorthite, and have relatively high Ni, Ir and Au contents. 64567 has been dated at about 3.97 b.y. – which is distinctly older than the canonical age of the Imbrium impact.

Petrography

Simonds et al. (1973) described the poikilitic rocks from Apollo 16, including 64567. 64567 and 64569 are distinct in that they have olivine instead of pyroxene as the dominate oikocryst. In any case the mafic

minerals form a network of interlocking oikocrysts that enclose plagioclase chadocrysts and xenocrysts (figure 4). Opaque and accessory minerals are usually found at the boundaries of the oikocrysts. Occasionally, there are small regions with subophitic texture (figure 3).

64567 and 64569 were classified as “VHA basalts” according to Hubbard et al. (1973), but this was disputed by Prinz et al. (1974) who showed that they were mixtures – now understood as “impact melts”, formed by large impacts in the highland crust.

KREEP-rich, poikilitic impact melt rocks from the Cayley Plains, such as 62235 and 65015, often have regions within them that naturally have subophitic (basaltic) texture (Reimold and Borchardt 1984).

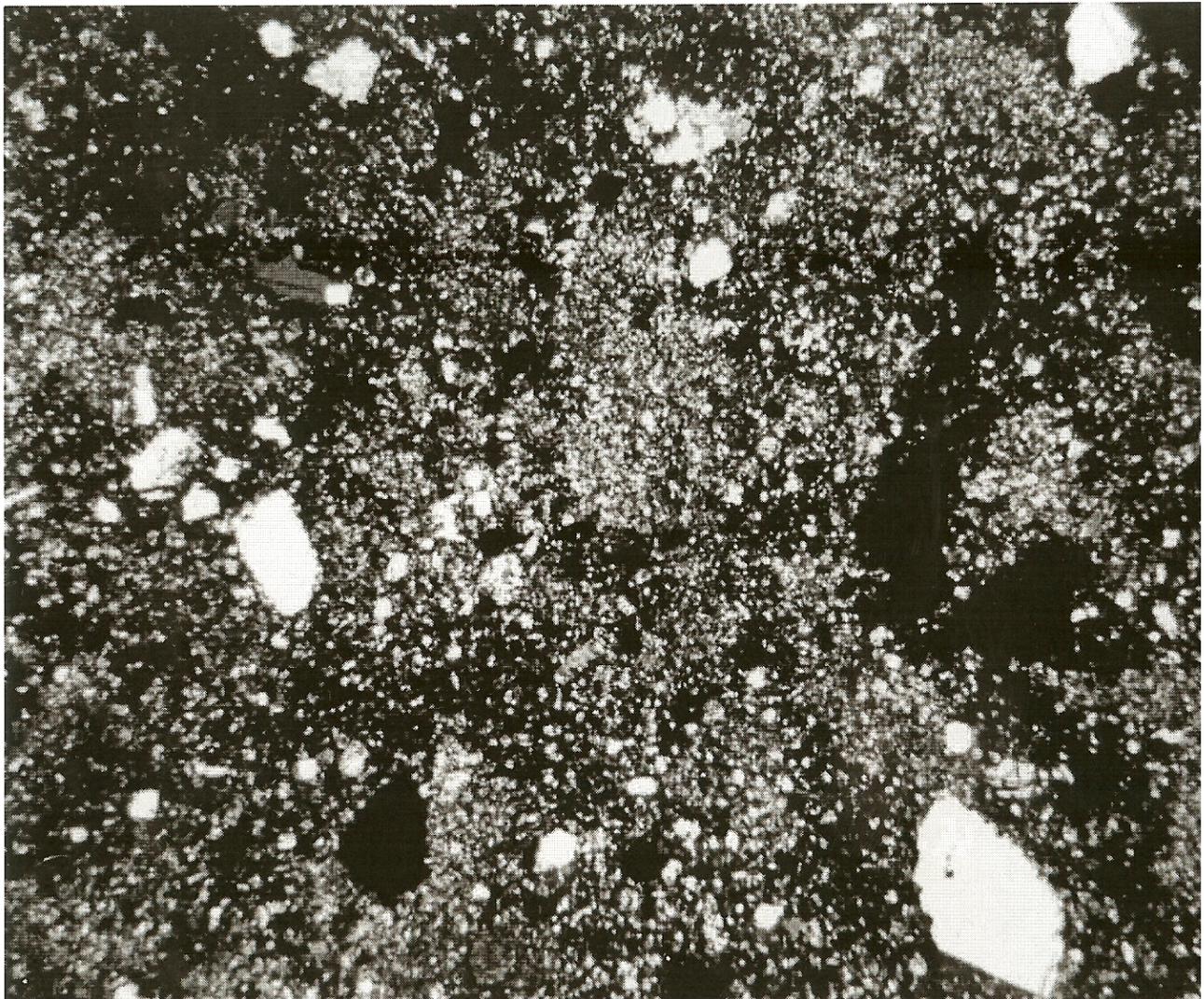


Figure 4: Thin section photo with crossed-polarizers, of 64569,4, showing poikilitic texture with included clasts. Width of field is 3 mm.

64567 was reported to have “rust” (Phinney and Lofgren 1973; Hunter and Taylor 1981).

Pyroxene: The composition of pyroxene and olivine in 64567 and 64569 is given in figure (5).

Chemistry

The composition of 64567 and 64569 was determined by Hubbard et al. (1973), Wasson et al. (1977) and McKinley et al. (1983)(table1 and figures 6 and 7).

Wanke et al. (1976) discuss the composition of 64567 in terms of a mixture of KREEP, anorthosite and mysterious “primary matter” (figure 11). Compositional variation of Apollo 16 impact-melt rocks is also discussed by Korotev (1994).

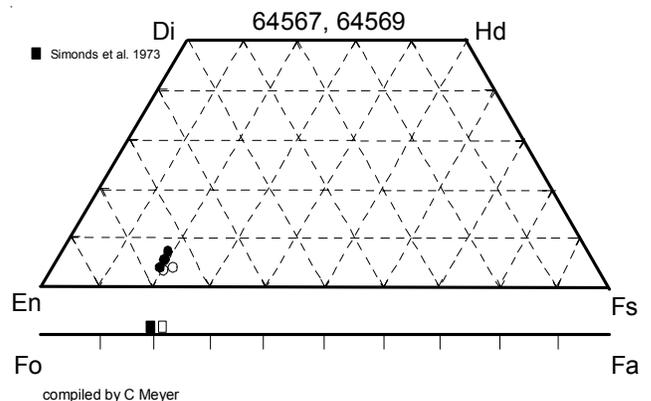


Figure 5: The pyroxene and olivine in these two samples are similar in composition (Simonds et al. 1973).

Table 1. Chemical composition of 64567 and 64569.

	64567		64569					
reference	Wiesman76		McKinley83	Wasson77	Floran76	McKinley83		
weight	Hubbard73	Hubbard73						
SiO ₂ %		45.69 (b)	46.6 (d)		46.37 (a)	47.7 (d)		
TiO ₂	0.7 (a)	0.72 (b)	0.91 (d)	1.03 (c)	0.94 (a)	0.54 (d)		
Al ₂ O ₃		21.62 (b)	23.1 (d)	22.5 (c)	20.8 (a)	26.1 (d)		
FeO		7.08 (b)	5.2 (d)	8.52 (c)	7.6 (a)	6.45 (d)		
MnO		0.07 (b)	0.08 (d)	0.1 (c)		0.07 (d)		
MgO		11.5 (b)	10.1 (d)	11.8 (c)	11.25 (a)	12.6 (d)		
CaO		12.52 (b)	12.9 (d)	12.4 (c)	12.35 (a)	11.5 (d)		
Na ₂ O	0.42	0.42 (b)	0.49 (d)	0.504 (c)	0.52 (a)	0.5 (d)		
K ₂ O	0.185 (a)	0.17 (b)	0.27 (d)	0.196 (c)	0.22 (a)	0.18 (d)		
P ₂ O ₅		0.19 (b)						
S %		0.1 (b)						
sum								
Sc ppm				13.3 (c)				
V				40 (c)				
Cr	1024 (a)			1320 (c)				
Co				59 (c)				
Ni				930 (c)				
Cu								
Zn				3.5 (c)				
Ga				4.6 (c)				
Ge ppb				2300 (c)				
As								
Se								
Rb	4.933 (a)							
Sr	147 (a)							
Y								
Zr	311 (a)			360 (c)				
Nb								
Mo								
Ru				77 (c)				
Rh								
Pd ppb								
Ag ppb								
Cd ppb				7 (c)				
In ppb				4.5 (c)				
Sn ppb								
Sb ppb								
Te ppb								
Cs ppm								
Ba	218 (a)			270 (c)				
La				26.2 (c)				
Ce	57.9 (a)			63 (c)				
Pr								
Nd	35.5 (a)			44 (c)				
Sm	9.85 (a)			11.3 (c)				
Eu	1.3 (a)			1.5 (c)				
Gd	12.1 (a)							
Tb				2.4 (c)				
Dy	13 (a)			17 (c)				
Ho								
Er	7.54 (a)							
Tm								
Yb	6.91 (a)			8.7 (c)				
Lu				1.2 (c)				
Hf	11 (a)			8.5 (c)				
Ta				0.88 (c)				
W ppb								
Re ppb								
Os ppb								
Ir ppb				19 (c)				
Pt ppb								
Au ppb				20 (c)				
Th ppm				4 (c)				
U ppm	1.1 (a)			1.1 (c)				

technique: (a) IDMS, (b) XRF, (c) INAA+RNAA

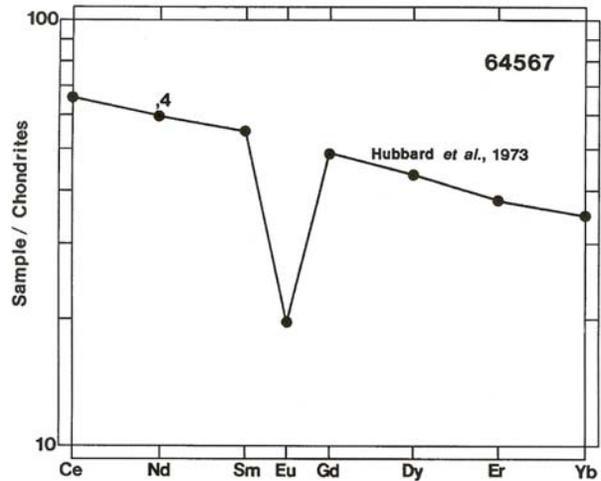


Figure 6: Normalized rare-earth-element diagram for 64567.

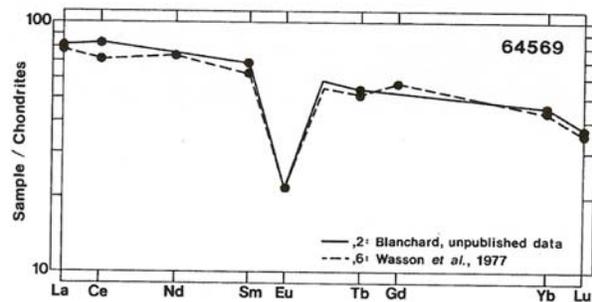


Figure 7: Normalized rare-earth-element diagram for 64569.



Figure 8: Processing photo of 64567. Scale in mm. S72-55373.



Figure 9: Processing photo of 64569. Scale in mm. S72-55367

Radiogenic age dating

Turner and Cadogen (1975) dated 64567 by the Ar/Ar plateau technique, with an age of 3.97 ± 0.05 b.y. (figure 10). Nyquist et al. (1973) reported the Rb-Sr systematics.

Cosmogenic isotopes and exposure ages

Turner and Cadogen (1975) determined an exposure to cosmic ray of 370 m.y. by the ^{38}Ar method (figure 10).

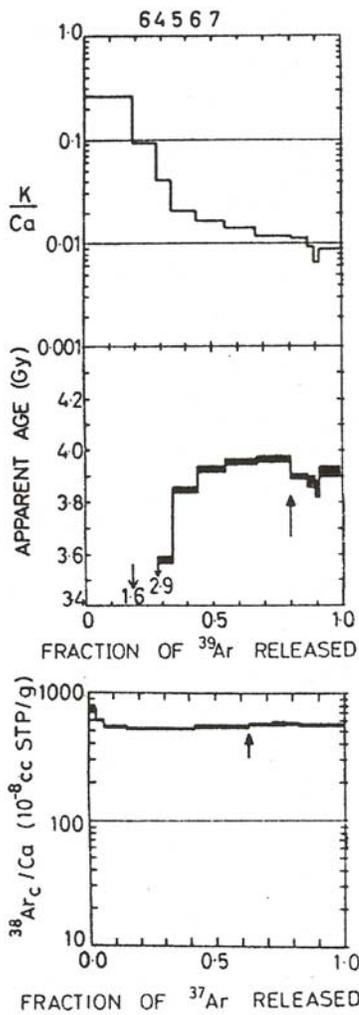


Figure 10: Ar/Ar plateau diagram for 64567 (Turner and Cadogen 1975).

Other Studies

Pearce and Simonds (1974) determined the magnetic properties.

Processing

There are 4 thin sections of 64567 but only 1 of 64569.

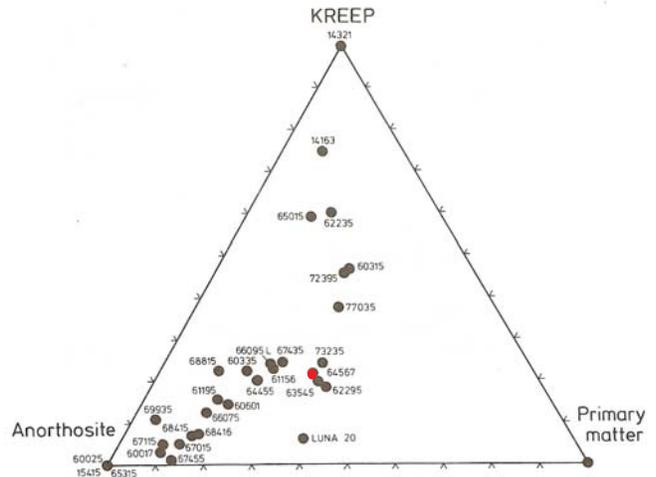


Figure 11: Mixing model calculations for Apollo 16 breccias (Wanke et al. 1976).

References for 64567 and 64569

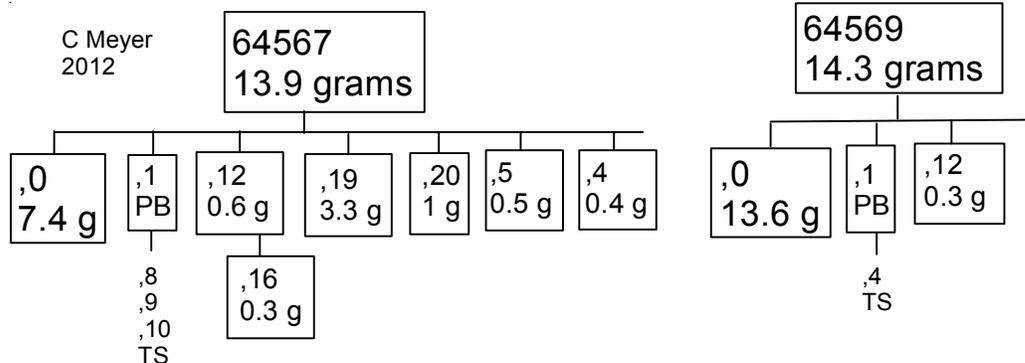
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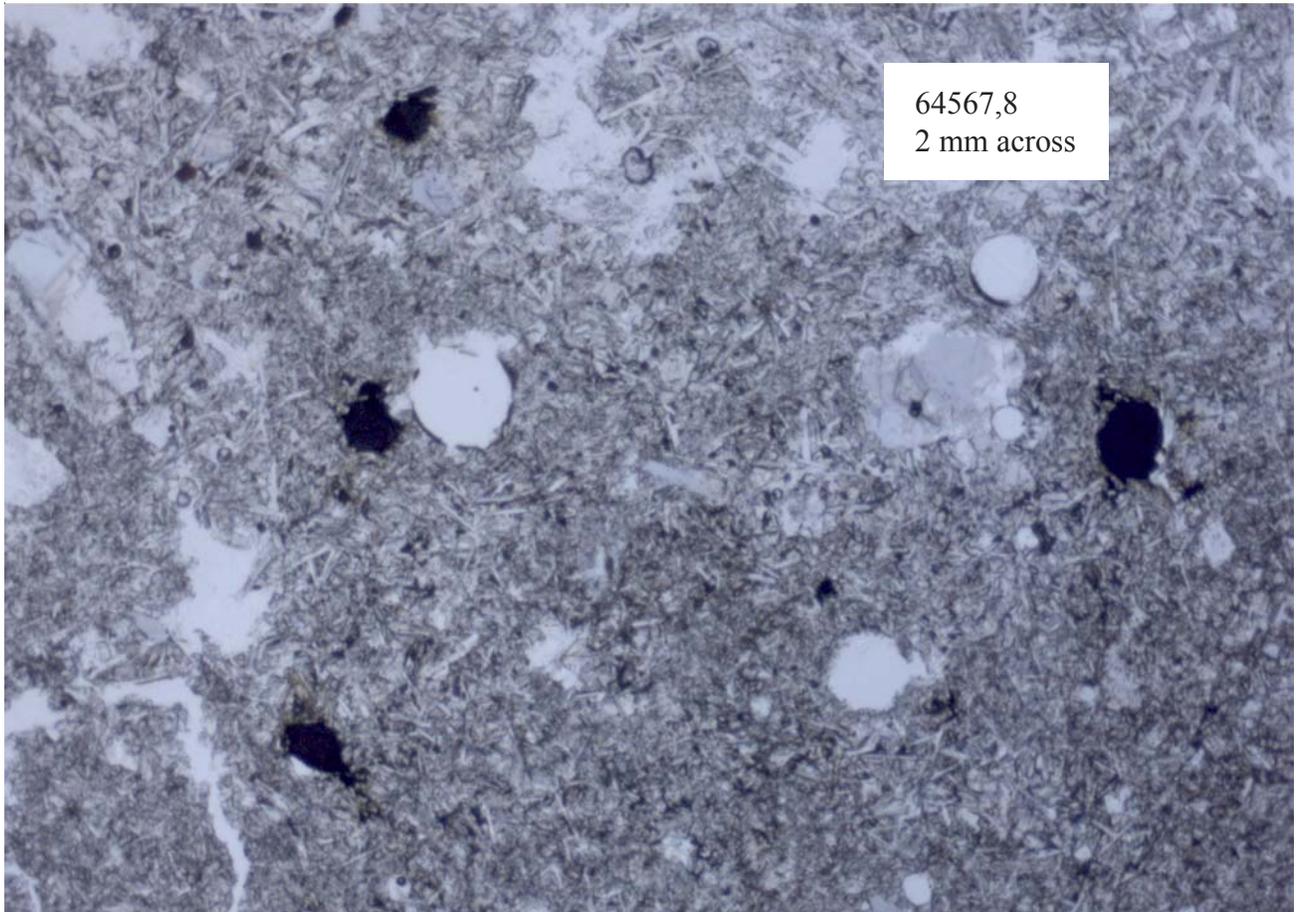
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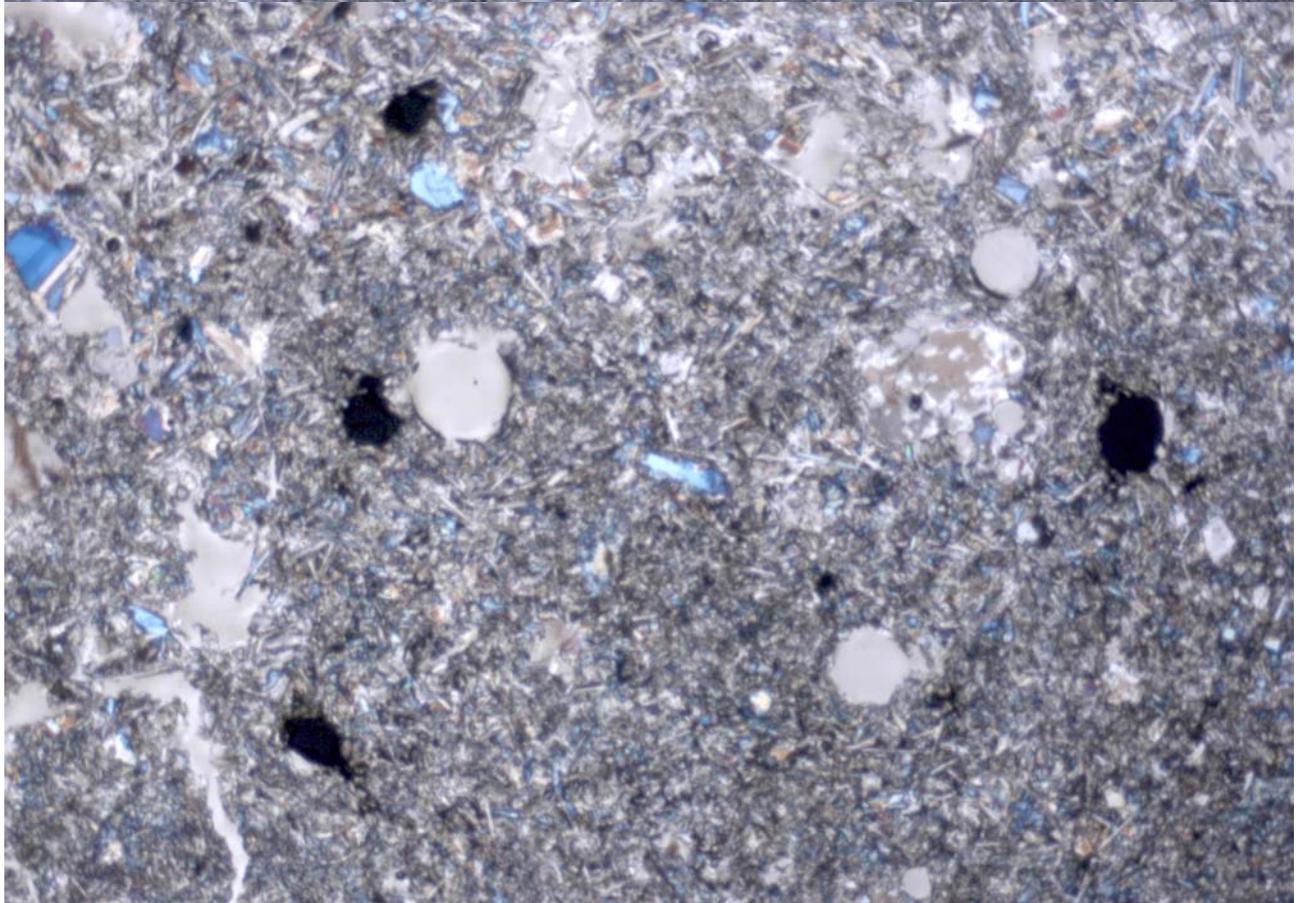
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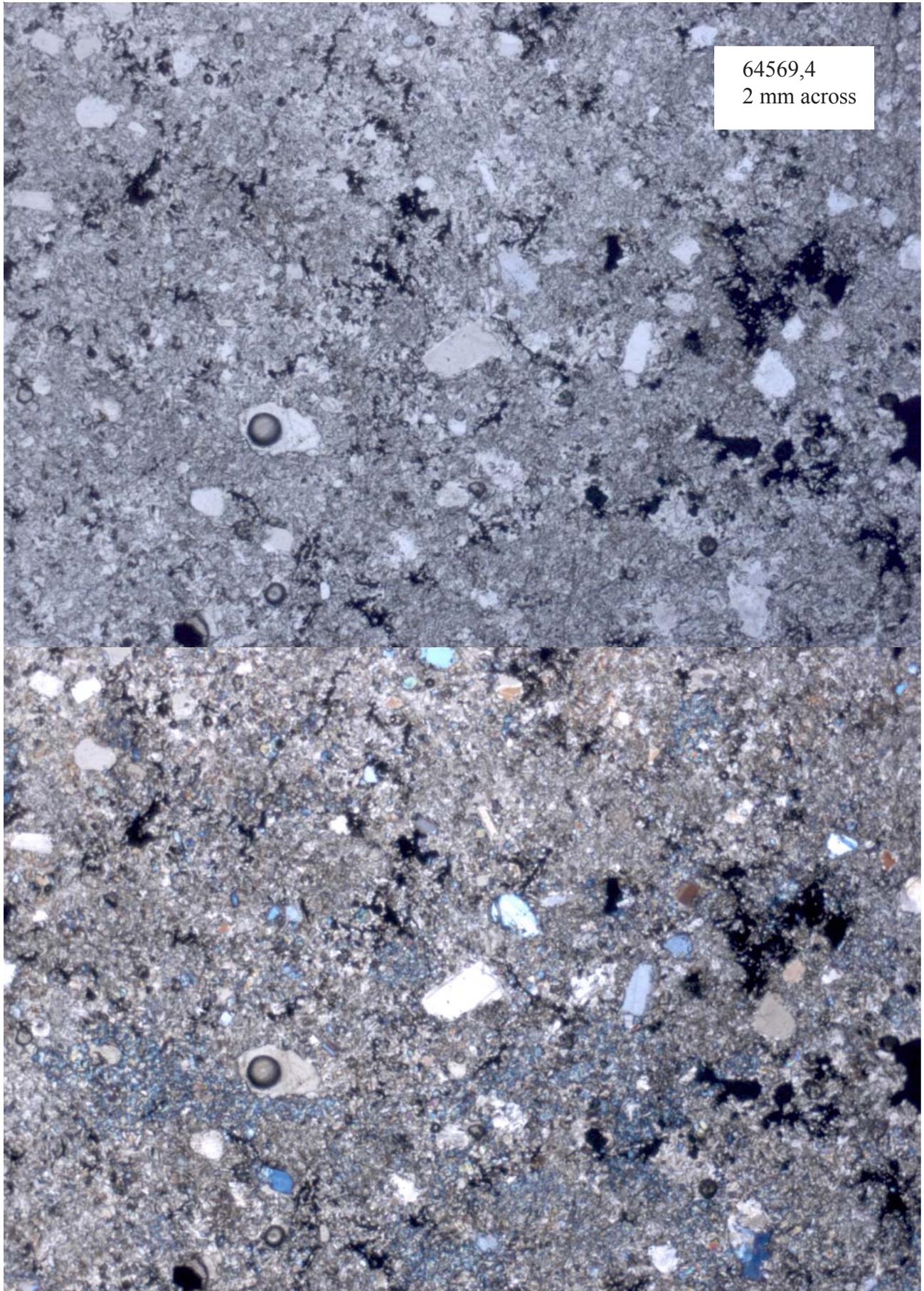


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64567,8
2 mm across





64569,4
2 mm across