15668 FINE-GRAINED OLIVINE-NORMATIVE MARE BASALT ST. 9A 15.10 g

INTRODUCTION: 15668 is an olivine-bearing mare basalt which is vesicular (Fig. 1). The groundmass is the finest grained of all olivine-normative mare basalts. The olivines form phenocrysts macroscopically conspicuous and up to about 2 mm across. In chemistry, the sample appears to be a fairly average member of the Apollo 15 olivine-normative mare basalt group. It has a ^{40}Ar-^{39}Ar plateau age of 3.13 ± 0.06 b.y. Vesicles occupy 15-20% of the volume. Most surfaces are rounded and saturated with zap pits, with only a few fresh areas. 15668 was collected as part of the rake sample from Station 9A.

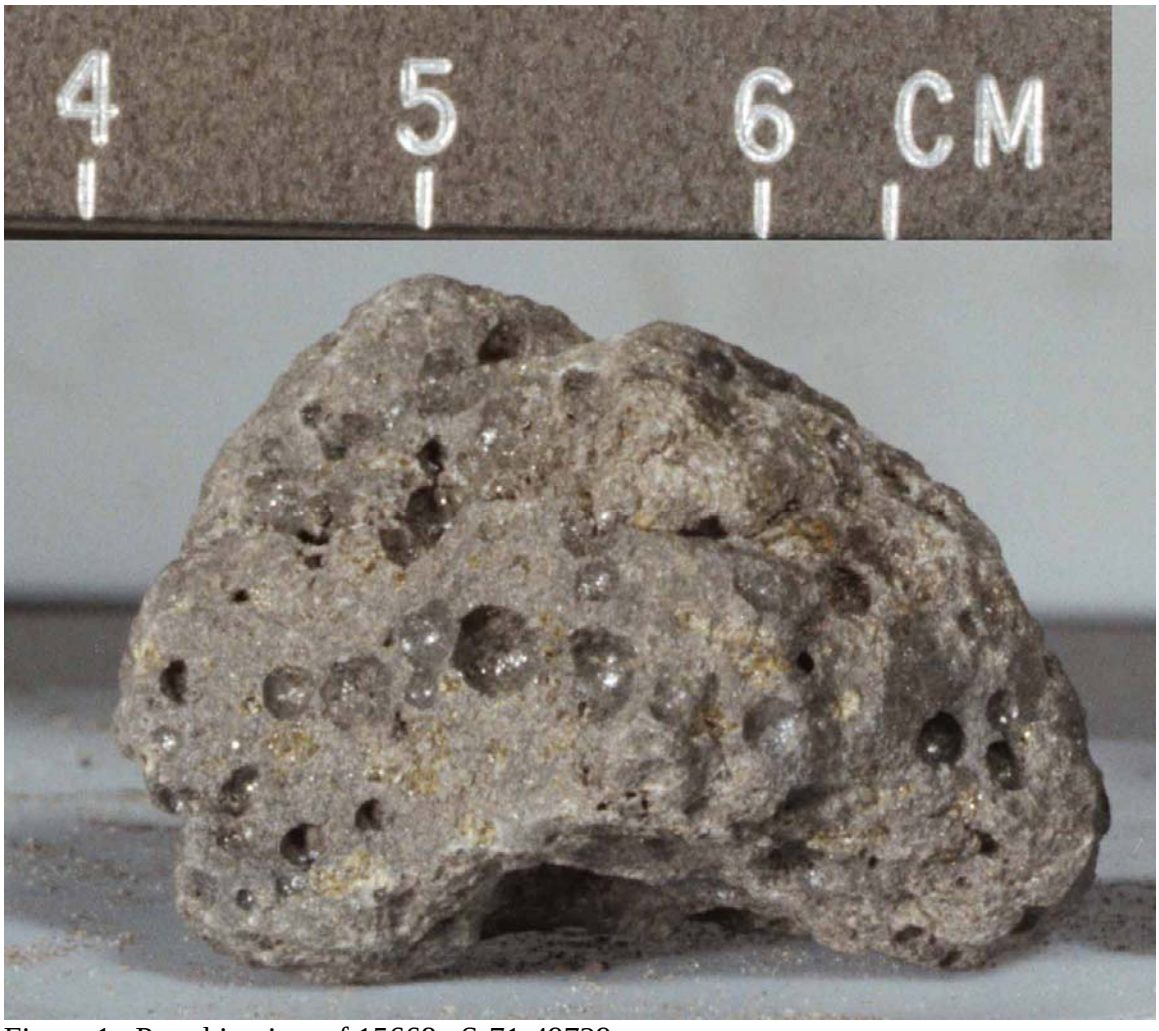

Figure 1. Pre-chip view of 15668. S-71-49729

PETROLOGY: The thin section (,13) is of a very fine-grained olivine porphyritic basalt (Fig. 2), with a vesicle on one side. Only three small olivine phenocrysts are in the section; the large (2 mm) conspicuous olivine phenocrysts macroscopically visible are lacking. Rhodes and Hubbard (1973) reported a mode of 59.6% pyroxene, 31.2% plagioclase, 1.1% ilmenite, 0.3% chrome spinel, 3.5% ulvospinel, 3.0% mesostasis, 0.5% vesicles, and only 0.8% olivine.

The groundmass is very fine-grained and distinctly subophitic, and quite unlike most olivine-normative mare basalts. Tiny plagioclase laths or needles are partly embedded in pyroxenes. A few plagioclase laths are curved. The small olivine phenocrysts contain euhedral chromite, but the most common opaque phase in the sample is ulvospinel. There is in most instances a sharp boundary from chromite to ulvospinel rims. Residual phases are glass, minor fayalite, and ulvospinel; cristobalite is absent and ilmenite is rare (although a few large grains are present). Some interstitial glasses show immiscibility, and the residual opaques commonly show a dendritic growth.

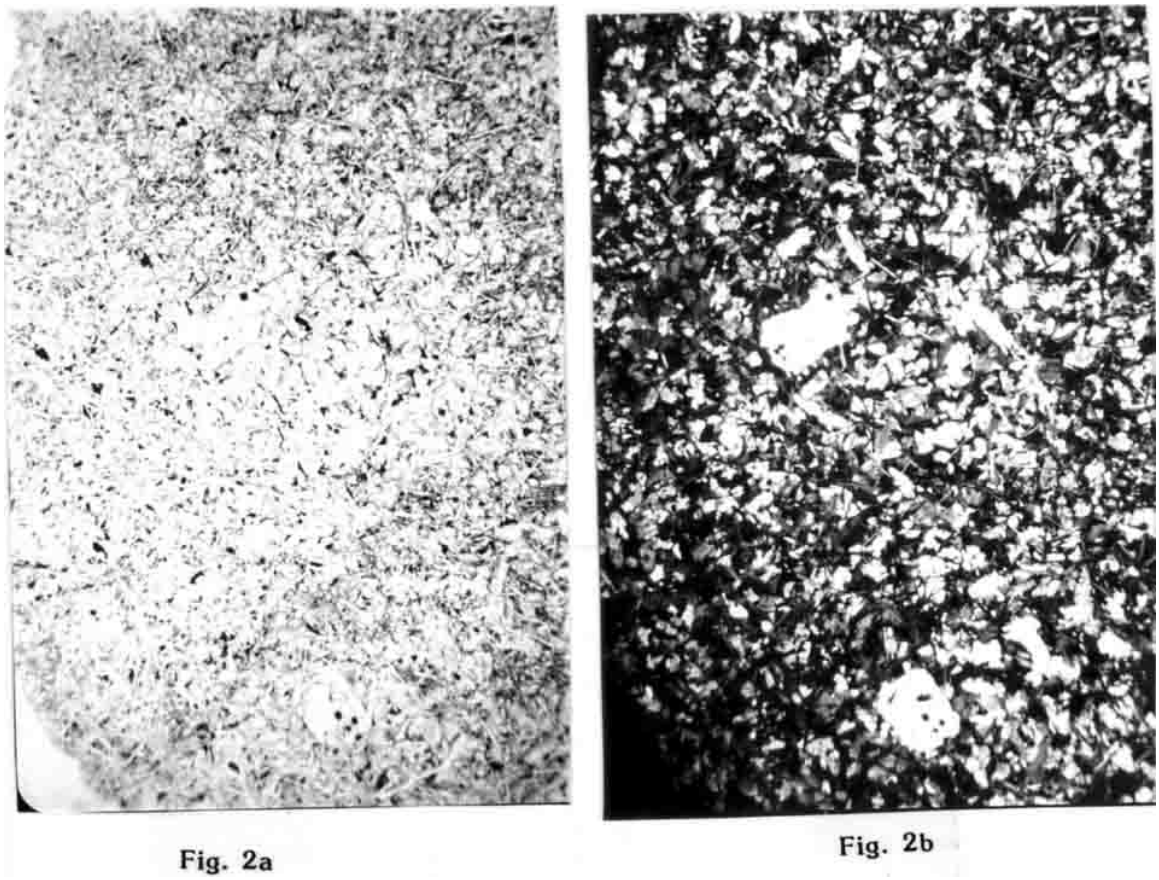

Figure 2. Photomicrographs of 15668,13.
Width about 3 mm. a) transmitted light; b) crossed polarizers.

CHEMISTRY: Bulk rock chemical analyses (Table 1, Fig. 3) are quite consistent, and suggest that all either completely avoided olivine phenocrysts or contained a representative amount of them. The normative olivine content of about 10% suggests the latter is the case. Chappell and Green (1973) found the composition to be so similar to their analyses of 15658 and 15674 that they suggested all were fragments of the same rock; however, 15668 is much finer-grained than either.

RADIOGENIC ISOTOPES AND GEOCHRONOLOGY: Husain (1972) reported a ^{40}Ar-^{39}Ar plateau age of 3.15 ± 0.06 m.y., a little lower than other Apollo 15 mare basalts. Husain et al. (1972) increased the uncertainty to 0.08 m.y. and reported a K-Ar age of 2.50 b.y., indicating extensive gas loss. Husain (1974) reported Ar-isotopic step-wise heating data with extensive discussion and reported the plateau age as 3.13 ± 0.06 b.y., from the 1100°C to 1600°C fraction (Fig. 4). The highest temperature fraction alone has an age similar to other Apollo 15 basalts. Husain (1974) reported the K-Ar age as 2.607 ± 0.025 b.y., with the $^{40}Ar^*$ loss being 30%.

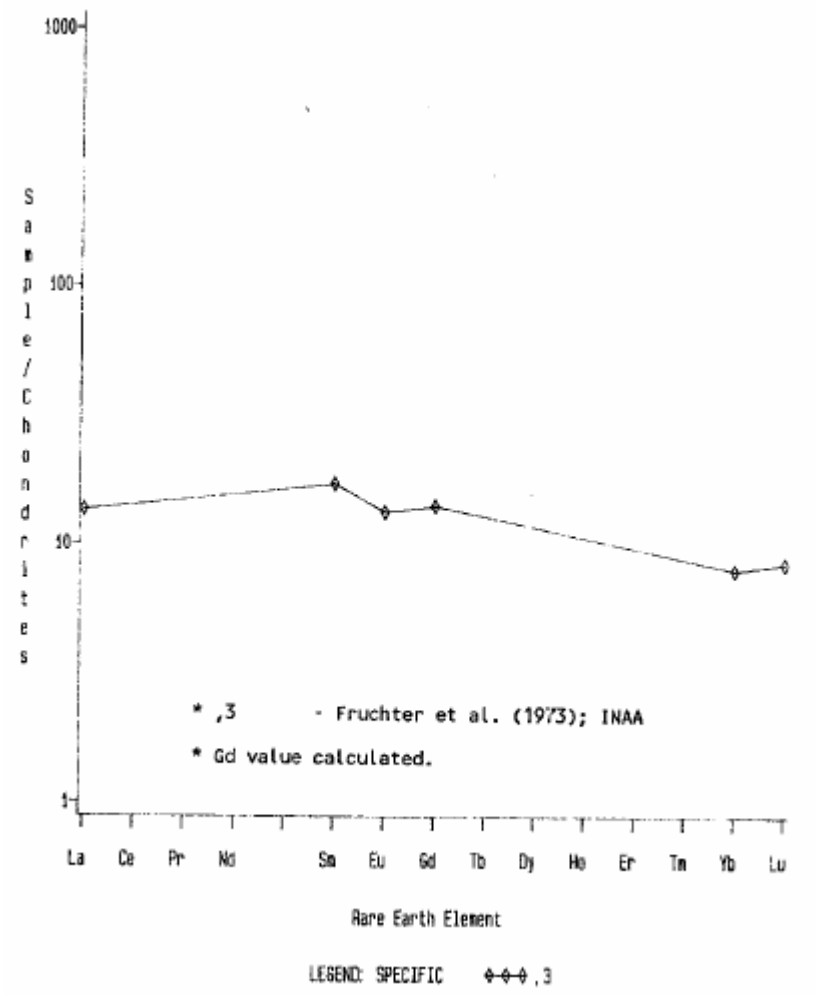

Figure 3. Rare earths in 15668.

TABLE 15668-1. Bulk rock chemical analyses

		,2	,4	,3	,5	,2
Wt %	SiO2	45.48	45.01			
	TiO2	2.56	2.53	2.74		
	Al2O3	9.09	8.73	8.20		
	FeO	22.22	22.58	22.3		23.0
	MgO	9.19	9.96			
	CaO	10.23	10.16		11.2	
	Na2O	0.26	0.28	0.266		
	K2O	0.05	0.04		0.045	
	P2O5	0.08	0.07			
(ppm)	Sc			44		
	V					
	Cr		3700	4250		
	Mn	2405	2405			
	Co			55		
	Ni					
	Rb					
	Sr					
	Y					
	Zr					
	Nb					
	Hf			2.3		
	Ba					
	Th					
	U					
	Pb					
	La			4.5		
	Ce					
	Pr					
	Nd					
	Sm			3.1		
	Eu			0.92		
	Gd					
	Tb					
	Dy					
	Ho					
	Er					
	Tm					
	Yb			1.6		
	Lu			0.29		
	Li					
	Be					
	B					
	C					
	N					
	S	800	500			
	F					
	Cl					
	Br					
	Cu					
	Zn					
(ppb)	I					
	At					
	Ga					
	Ge					
	As					
	Se					
	Mo					
	Tc					
	Ru					
	Rh					
	Pd					
	Ag					
	Cd					
	In					
	Sn					
	Sb					
	Te					
	Cs					
	Ta			370		
	W					
	Re					
	Os					
	Ir					
	Pt					
	Au					
	Hg					
	Tl					
	Bi					
		(1)	(2)	(3)	(4)	(5)

References and methods:

(1) Rhodes and Hubbard (1973); XRF
(2) Chappell and Green (1973); XRF
(3) Fruchter et al. (1973); INAA
(4) Husain (1974); irradiation, Ar-isotopes
(5) Pearce et al. (1973); magnetic

RARE GAS AND EXPOSURE: Husain (1974) used his step-wise release Ar-isotopic determinations to calculate a ^{38}Ar-Ca exposure age of 486 ± 20 m.y. for 15668, in contrast to the 520 ± 32 m.y. age previously reported (Husain et al., 1972).

PHYSICAL PROPERTIES: Pearce et al. (1973) reported room temperature magnetic properties for ,2. J_s was 0.10 emu/g and χ_p was 38.9 emu/g Oe. The magnetic measurements indicated 0.045% metallic iron equivalent and 17.8% ferrous iron (23.0% FeO equivalent).

PROCESSING AND SUBDIVISIONS: About 1/3 of the sample was chipped off (,1) and subdivided to give ,1 to ,5 which were used for the allocations. Part of ,2 was used to make thin section ,13. ,0 is now 9.77 g.

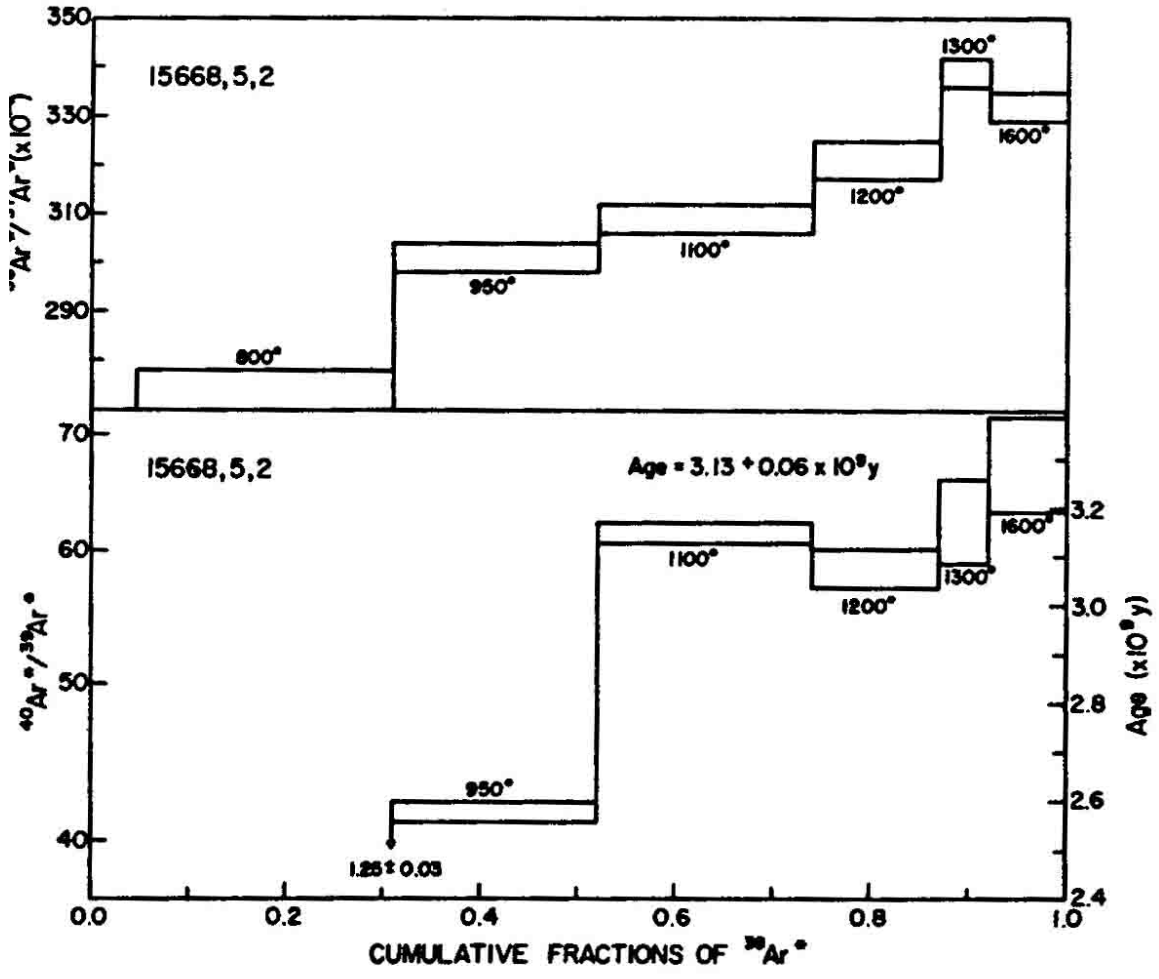

Figure 4. Ar-release diagrams and age for 15668 (Husain, 1974).