15486 VITROPHYRIC QUARTZ-NORMATIVE MARE BASALT ST. 4 46.8 g

INTRODUCTION: 15486 is a vitrophyric pigeonite basalt collected from the same vesicular boulder as the similar samples 15485 and 15499 (see Fig. 15499-1) on the south rim of Dune Crater. It is one of the most rapidly cooled of the quartz-normative basalts.

15486 is a vesicular basalt with a porphyritic, diktytaxitic texture. It is medium dark gray (surface), blocky and angular (Fig. 1) and tough. One surface is fresh where it was broken from the boulder; there are a few zap pits on other surfaces. A light olive gray "coat" on the "N" side (Fig. 1) is related to a fracture and is similar to the one on 15485.

Figure 1. Macroscopic views of original sample, showing the pale-colored coat on "N" side. S-71-44250 and S-71-44255.

PETROLOGY: 15486 contains abundant elongated pyroxene; phenocrysts (Fig. 2) which are pale-brown and up to 7 mm long. The groundmass is fine-grained and dark-colored. It was described by Albee et al. (1972) as a clinopyroxene vitrophyre, with (thin section ,20) 53% elongated pyroxene prisms, 44% groundmass of opaque devitrified glass, 3% globulose vugs, and 0.1% each of spinel and metal. No olivine was identified. The groundmass has extremely fine-grained segregations of crystallites, and is predominantly opaque, but a "fingerprint" pattern, consisting of alternating 1 m wide segregations of (pyroxene) and (plagioclase + opaques). 20 m diameter microprobe analyses show the matrix to be homogeneous at that scale, with (normative) 53% feldspar, 35% pyroxene, 7% silica, and 4% opaques. The pyroxenes have cores of low-Ca clinopyroxene enclosed by high-Ca pyroxene (compositions in Fig. 3). Minor element variation is similar to 15499. Spinel and Fe-metal is minor; ilmenite and troilite are "not present as phenocrysts". The spinels (Fig. 4) are euhedral and 20 to 100 m across, and are rimmed with Fe-rich ulvospinel; the ulvospinel rims are broader on groundmass spinels than on those enclosed in pyroxenes. The metals are spherical blebs or aggregates of equidimensional blebs; an average of 8 analyses has 6.28% Ni and 1.42% Co. Engelhardt (1979) tabulated ilmenite paragenesis.

Figure 2. Photomicrograph of 15486,22, transmitted light, showing prismatic pyroxene phenocrysts, opaque groundmass, and vesicles.

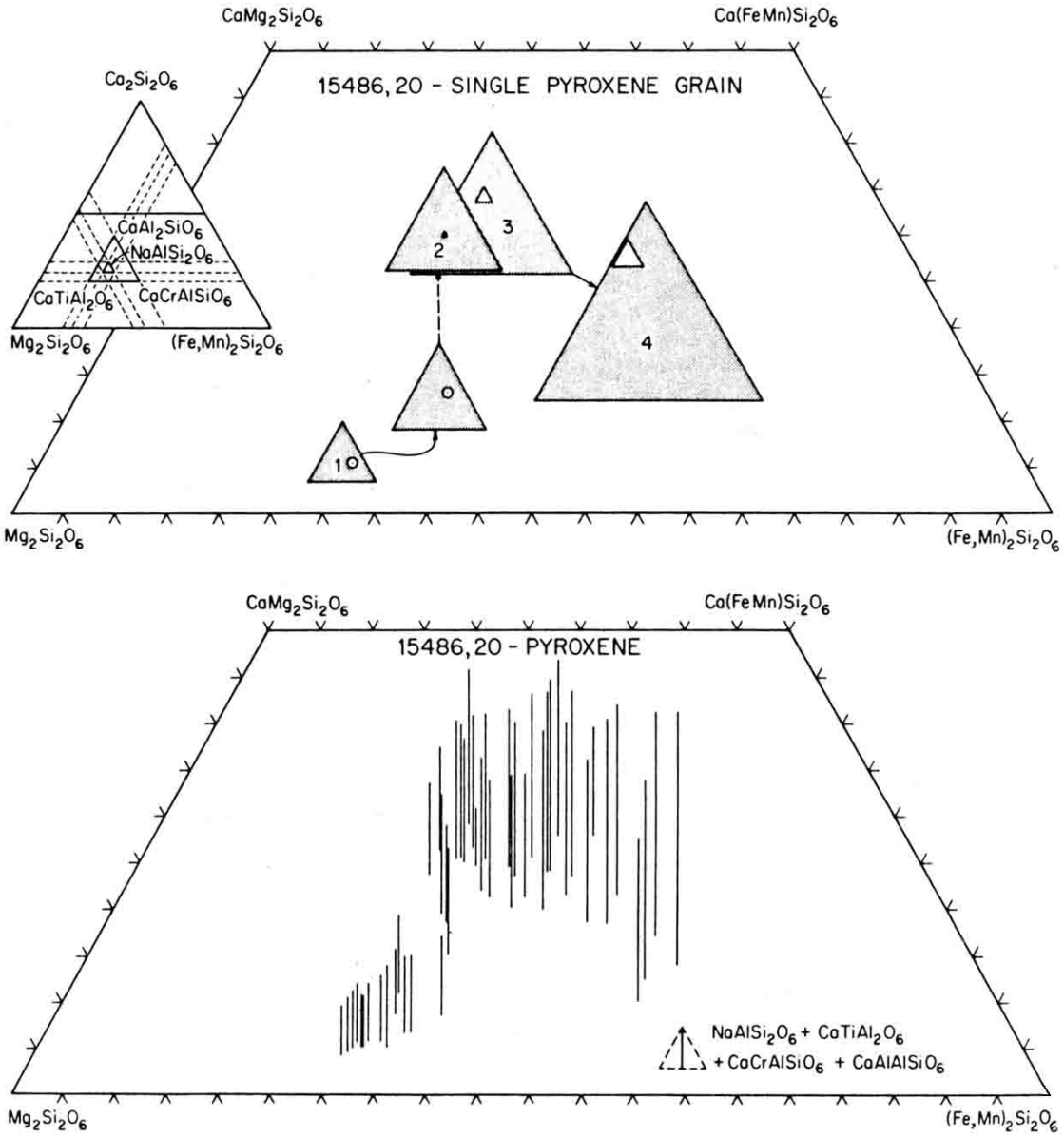

Figure 3. Compositions of pyroxenes in 15486,20
(Albee et al. 1972).

Cooling history: Lofgren et al. (1975) in a comparison of natural rock samples with the products of linear cooling rate experiments found 15486 to be one of the most rapidly cooled quartz-normative basalts. From pyroxene shapes a cooling rate of 5°C-20°C/hr was deduced; the matrix suggests >30°C/hr. Grove and Walker (1977) in a similar but more detailed study found a cooling rate during pyroxene nucleation of between 1.75°C and 3.75°C/hr from the nucleation density. An integrated rate during all phenocryst crystallization of 3.75°C/hr from pyroxene "size" and a late-stage rate of 85°C to

250°C/hr from plagioclase "size" were also estimated. They also estimated that this final cooling took place 6-9 cm from a conductive boundary.

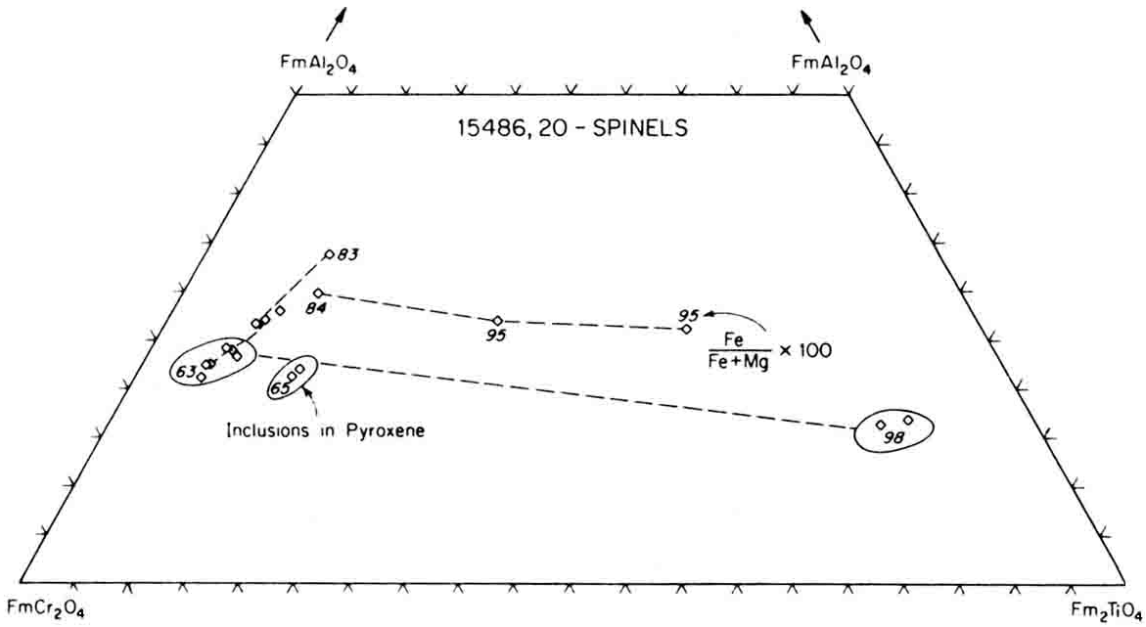

Figure 4. Compositions of spinels in 15486,20
(Albee et al. 1972).

Grove and Bence (1977) used the same experiments as Grove and Walker (1977) to compare minor element chemical data from rocks and experiments to establish cooling rates. The minor element chemistry of cores in 15486 is closest to those in 150°C/hr cooling rate experiments, suggesting rapid cooling throughout the crystallization, not just at late stage (this conflict with the result of Grove and Walker, 1977, might result from an inability to analyze actual cores). They suggested that 15486 was totally liquid 4 to 6 cm from the contact of the flow.

CHEMISTRY: Published chemical data are presented in Table 1 and Figure 5. Helmke et al. (1973) suggested that the high Sm/Eu (4.7) of 15486 (and some other samples) makes it different from other quartz-normative basalts (e.g., 15597, 15604, Sm/Eu 3.7) because a difference in this ratio cannot result from pyroxene accumulation.

EXPOSURE: Eldridge et al. (1972) provided cosmogenic radionuclide data, and stated that the sample was apparently shielded. Equilibrium values of ^{22}Na and ^{26}Al show that exposure was too long to determine by the ^{22}Na/^{26}Al method, i.e., more than 2 m.y.

PROCESSING AND SUBDIVISIONS: Only a few chips have been separated from the sample. ,0 is 34.7 g, and ,23 is 1.78 g, and no other pieces larger than 1 gram exist. Thin sections ,20 to ,22 were made from chip ,9.

TABLE 15486-1

		,10A	,10	,0
Wt %	SiO2	48.25		
	TiO2	1.81		
	Al2O3	10.00		
	FeO	19.85		
	MgO	8.80		
	CaO	10.25		
	Na2O	0.37		
	K2O	0.08		0.061
	P2O5	0.13		
(ppm)	Sc	54	44.2	
	V			
	Cr	3400		
	Mn	2250		
	Co	100	47	
	Ni	62		
	Rb	1.3		
	Sr	135		
	Y	36		
	Zr	127		
	Nb	10		
	Hf		3.0	
	Ba	74		
	Th			0.64
	U			0.15
	Pb			
	La		7.09	
	Ce		18	
	Pr			
	Nd		1.4a	
	Sm		4.57	
	Eu		0.977	
	Gd		5.5	
	Tb		0.92	
	Dy		5.96	
	Ho		1.2	
	Er		3.0	
	Tm			
	Yb	4.4	2.79	
	Lu		0.44	
	Li	8.8		
	Be	<1		
	B			
	C			
	N			
	S			
	F			
	Cl			
	Br			
	Cu	10		
	Zn			
(ppb)	I			
	At			
	Ga	7800		
	Ge			
	As			
	Se			
	Mo			
	Tc			
	Ru			
	Rh			
	Pd			
	Ag			
	Cd			
	In			
	Sn			
	Sb			
	Te			
	Cs			
	Ta			
	W			
	Re			
	Os			
	Ir			
	Pt			
	Au			
	Hg			
	Tl			
	Bi			
		(1)	(2)	(3)

References and Methods:

(1) Cuttitta et al. (1973); XRF, OES
(2) Helmke et al. (1973); INAA, RNAA
(3) O'Kelley et al. (1972); Gamma ray spectroscopy

Notes:

(a) evident typographical error; probably should be 14.0

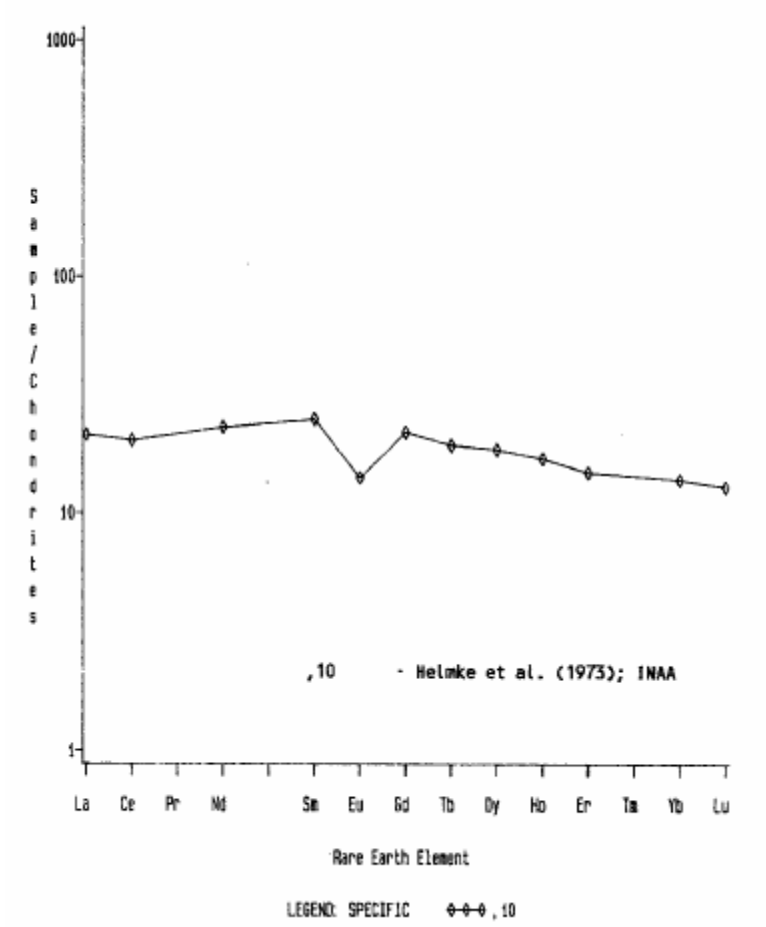

Figure 5. Rare earth elements in 15486.
Nd value is 10x that actually reported.