

**77538****Unusual Fragmental Breccia****47.2 g, 4 x 3.5 x 3 cm****INTRODUCTION**

Rake sample 77538 is a light grey, fragmental breccia that is composed of abundant mineral and lithic clasts set in a porous, poorly sintered matrix (Fig. 1). It has a very high, KREEP-like trace element content.

An important feature of this unusual breccia is the occurrence of both high-Si, high-K clasts along with high-Fe lithic clasts whose compositions resemble those of immiscible-melts produced during late-stage magmatic crystallization via apparent silicate liquid immiscibility.

**PETROGRAPHY**

Warner et al. (1978) have described 77538 as a clast-rich, friable breccia with abundant mineral and lithic clasts in a poorly sintered matrix. Mineral clasts are generally subequant and subangular, with the majority being about 100  $\mu\text{m}$ . Lithic clasts range up to 1 mm. Fig. 2 illustrates a granitic clast in the ground-up matrix of 77538.

The collection of mm-sized clasts of high-Fe and high-K, high-Si composition in 77538 probably represents the best example that

silicate liquid immiscibility took place on a scale larger than the glassy mesostasis in lunar basalts (Warner et al., 1978; Taylor et al., 1980).

**MINERAL CHEMISTRY**

The compositions of minerals in 77538 are given in Fig. 3 (from Warner et al., 1978). Note the Fe-rich olivine in this rock.



Figure 1: Photograph of 77538. Scale is 1 cm. S73-19064.

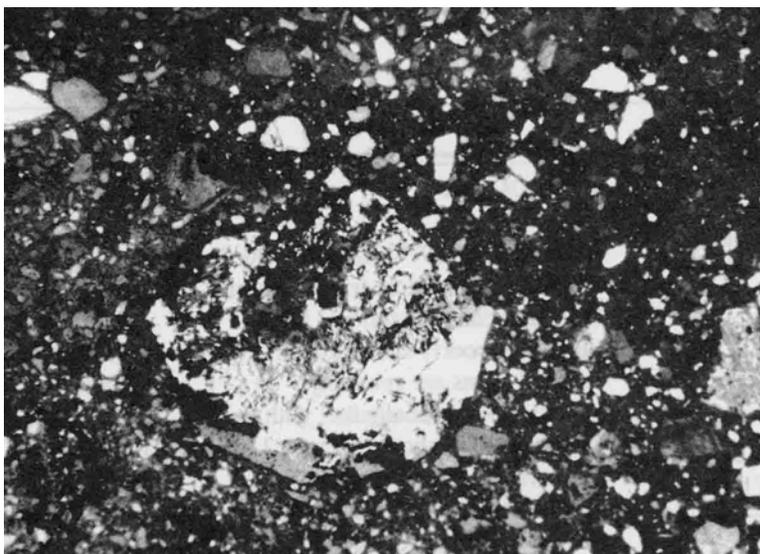


Figure 2: Photomicrograph of 77538 illustrating one of the granitic clasts in the porous breccia matrix. Field of view is 2 x 3 mm. From Warner et al. (1978).

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### WHOLE-ROCK CHEMISTRY

Laul and Schmitt (1975c) have reported the chemical composition of 77538 (Table 1 and Fig. 4). This sample has a very high trace element content.

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### SIGNIFICANT CLASTS

Both graphic-textured high-K, high-Si clasts and high-Fe clasts are present as small patches that have

been analyzed by broad-beam, electron microprobe analyses (Warner et al., 1978).

The high-Si clasts consist mostly of silica and K-feldspar ( $An_{1-4}Ab_{4-5}Or_{88-93}$ ), frequently intergrown in a barred texture, with small amounts of sodic plagioclase ( $\sim An_{68}Ab_{30}Or_3$ ), fayalitic olivine ( $Fo_{4-13}$ ), ferroaugite ( $Wo_{40-44}En_{6-9}Fs_{48-51}$ ), ilmenite, metal, troilite, and a Ca-rich phosphate mineral.

The high-Fe clasts are mainly ferro-augite ( $Wo_{32-40}En_{15-22}F_{42-48}$ ) and ferropigeonite ( $Wo_{14-15}En_{30-36}Fs_{49-56}$ ) that enclose blebs of silica and fayalitic olivine ( $Fo_{12-17}$ ), troilite, metal, and ilmenite.

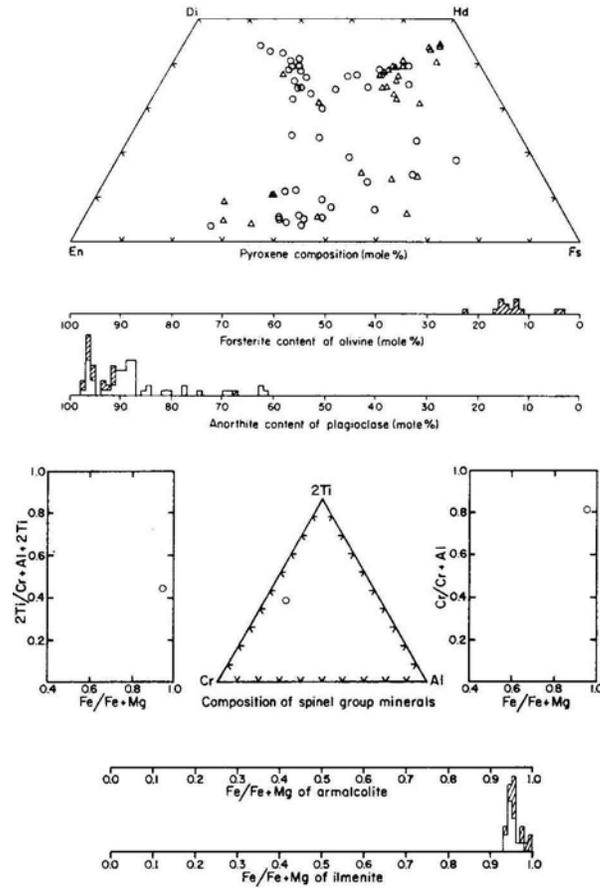


Figure 3: Pyroxene, olivine, and plagioclase composition of 77538. From Warner et al. (1978).

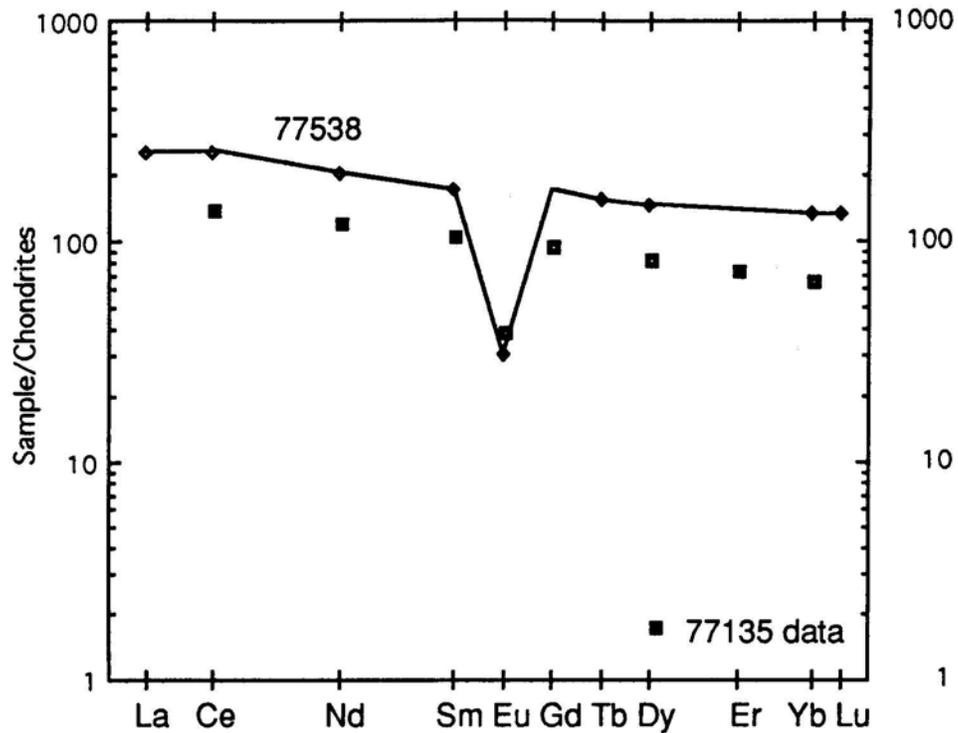


Figure 4: Normalized rare earth element diagram for 77538 compared with 77135. Data from Laul and Schmitt (1975).

**Table 1: Whole-rock chemistry of 77538.**  
a) Laul and Schmitt (1975); b) Warner et al. (1978)

Split Technique	,2 (a) INAA whole rock	average (b) BB e-probe 5 clasts	average (b) BB e-probe 4 clasts
SiO <sub>2</sub> (wt%)	–	74.0	50.3
TiO <sub>2</sub>	1.2	0.54	2.82
Al <sub>2</sub> O <sub>3</sub>	14.5	12.5	0.96
Cr <sub>2</sub> O <sub>3</sub>	0.24	<0.01	0.17
FeO	10.6	2.21	<b>31.3</b>
MnO	0.15	–	–
MgO	5.0	0.08	4.3
CaO	10.3	1.86	9.8
Na <sub>2</sub> O	0.75	0.90	0.12
K <sub>2</sub> O	<b>1.04</b>	<b>7.6</b>	0.29
P <sub>2</sub> O <sub>5</sub>		0.07	0.28
Nb (ppm)			
Zr	730		
Hf	21.5		
Ta	3.3		
U	4.2		
Th	<b>16</b>		
Ba	700		
Ni	–		
Co	13.5		
Sc	22		
La	59		
Ce	150		
Nd	90		
Sm	25.1		
Eu	1.7		
Gd			
Tb	5.5		
Dy	35		
Er			
Yb	21.7		
Lu	3.2		
Ge (ppb)			
Ir			
Au			