73146

Cataclastic Troctolitic Anorthosite
St. 2A (LRV-4), 3.0 g

INTRODUCTION

73146 was picked from soil sample 73140, taken from the bottom of a 15cm-deep trench on the landslide or avalanche from the South Massif, 600 in NE of Nansen Crater. It is a troctolitic anorthosite that is probably chemically igneous although cataclasized and partly recrystallized.

The sample is subangular and blocky (Fig. 1), and very light gray (N8). It is tough and homogenous. It was described in LSIC 17 (1973) as an anorthosite, consisting of about half plagioclase clasts (up to 2 mm) and half white matrix (less than 100 microns), with only about 2% pale green mafic minerals. However the chips eventually taken show a higher percentage of green material in the form of bands; these are olivine-rich bands.

PETROGRAPHY

73146 consists mainly of plagioclase, with schlieren of olivine-rich material (Fig. 2 a,b). The plagioclase consists of fragments up to 2 mm across but with a senate size range. Individual olivine fragments are rarely as large as 100 microns. The appearance is generally that of a cataclastic rock, but the tough sample has been partly recrystallized, and in some areas bonded by a melt. The plagioclase fragments contain numerous chains of uncertain nature (Fig. 2c), although at least some of them include opaque phases; the interstitial melt has crystallized plagioclases without such chains, but with tiny mafic grains that give the spotted appearance in Fig. 2c. Most of the olivine fragments are clear, but varied inclusions occur in some. One vermicular chromite growth occurs in one olivine in thin section ,3.

Warren and Wasson (1979) and Wasson et al. (1979) gave a mode of 85% plagioclase, 15% olivine, and a trace of low-Ca pyroxene, roughly consistent with their chemical norm for two tiny sections. They noted problems with the mode in that the olivines are concentrated in one comer (however, they imply that the LSIC (1973), estimate of 2% mafic phases is an underestimate; without further knowledge of the essential sampling strategy such an implication is unsubstantiated). Microprobe analyses by Warren and Wasson of the silicate phases are shown in Fig. 3; the magnesian nature of the olivines (Fo_{85-87}) show that the sample is not a member of the ferroan anorthosite suite, whatever its plagioclase abundance. The small range in compositions of the silicate phases consistent with the sample being an igneous troctolite, cataclasized and perhaps modally unrepresentative.

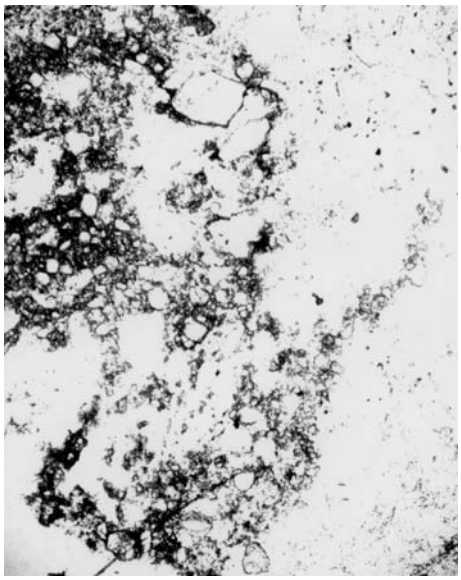
Figure 1: Sample 73146. Scale bar 1 centimeter. Part of S-73-21776.

CHEMISTRY

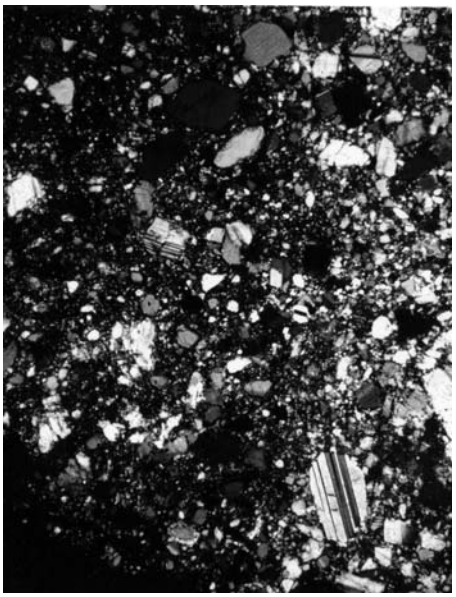
A chemical analysis of a small chip (104 mg) is given in Table 1. The incompatible elements are low and extremely fractionated relative to KREEP (Fig. 4). The Ir concentration of less than 3×10^{-4} times C1 chondrites leave little doubt that the sample is pristine igneous (Warren and Wasson, 1979). However, the Ni abundance is high for such a feldspathic igneous fragment, suggesting that the olivines may contain unusually high Ni (several hundred parts per million) among lunar magnesian suite rocks.

PROCESSING

In 1978 one end of the sample was chipped. The piece so derived was further chipped to produce 4 small pieces and some finer material. Two adjacent of these pieces were designated ,1 and ,2; both contained about half of green-rich bands. , 1 (0.11 g) was used for chemistry and to make a small thin section, while ,2 (0.10 g) was used to make two small thin sections. The other pieces remain with ,0 (total 23 g).



a



b

c

Figure 2. Photomicrographs of 73146,3. a)b) general view, width of field 2 mm, showing streaks of olivine-rich material and overall feldspathic nature. a) plane light b) crossed polarizers. c) feldspathic area showing relics with numerous chains and tiny mafics in the main fine groundmass that appears to be a mixture of melt and small plagioclase clasts. Width of field about 400 microns, plane transmitted light.

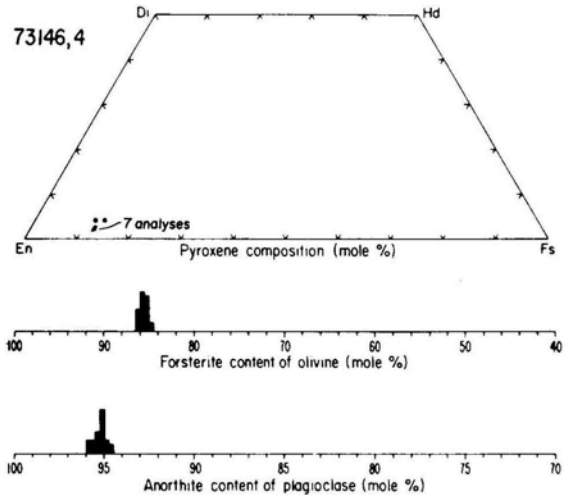


Figure 3: Microprobe analyses of silicate minerals in 73146,4; from Warren and Wasson (1979).

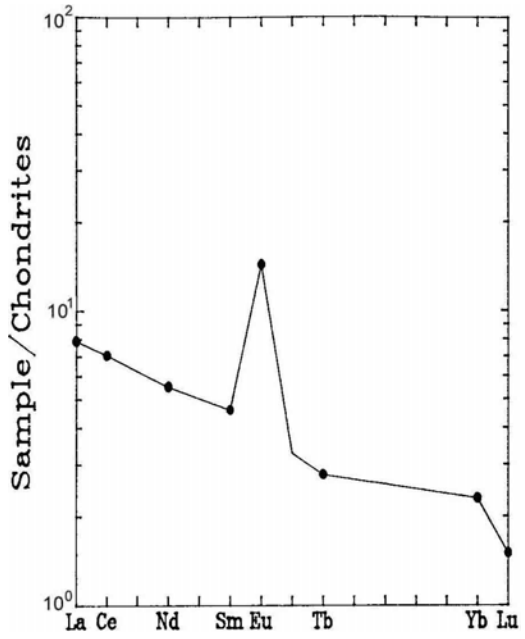


Figure 4: Plot of rare earth elements in 73146,1 (Data from Warren and Wasson, 1979, Warren et al., 1979).

Table 1: Chemical analysis of bulk rock 73146.

Split	,1
wt %	
SiO_2	43.0
TiO_2	
Al_2O_3	30.1
Cr_2O_3	0.04
FeO	2.3
MnO	0.022
MgO	7.7
CaO	16.2
Na_2O	0.34
K_2O	0.058
P_2O_5	
ppm	
Sc	1.01
V	
Co	8.7
Ni	100
Rb	
Sr	190
Y	
Zr	
Nb	
Hf	0.27
Ba	58
Th	0.17
U	
Cs	
Ta	
Pb	
La	2.6
Ce	6.2
Pr	
Nd	3.3
Sm	0.83
Eu	0.99
Gd	
Tb	0.13
Dy	
Ho	
Er	
Tm	
Yb	0.46
Lu	0.051
Li	
Be	
B	
C	
N	
S	
F	
Cl	
Br	
Cu	
Zn	9.4
ppb	
Au	0.690
Ir	0.130
I	
At	
Ga	3.2
Ge	39
As	
Se	
Mo	
Tc	
Ru	
Rh	
Pd	
Ag	
Cd	13
In	16
Sn	
Sb	
Te	
W	
Re	
Os	
Pt	
Hg	
Tl	
Bi	
	(1)

References and methods:
(1) Warren and Wasson (1979), Warren et al. (1979), Warren and Kallemeyn (1984); INAA, RNAA, MFB.