60618 BASALTIC IMPACT MELT/ANORTHOSITE 21.7 g

INTRODUCTION: 60618 is a tough, light gray rake sample consisting of basaltic impact melt and cataclastic anorthosite (Fig. 1). The anorthosite is not ferroan. Possible clast-matrix relations have not been determined but the anorthosites are probably clasts in the basalt. A few 2-3 mm vesicles are present, some of which appear to be lined with metal.

60618 is a rake sample collected about 70 m west southwest of the Lunar Module. Zap pits are rare.

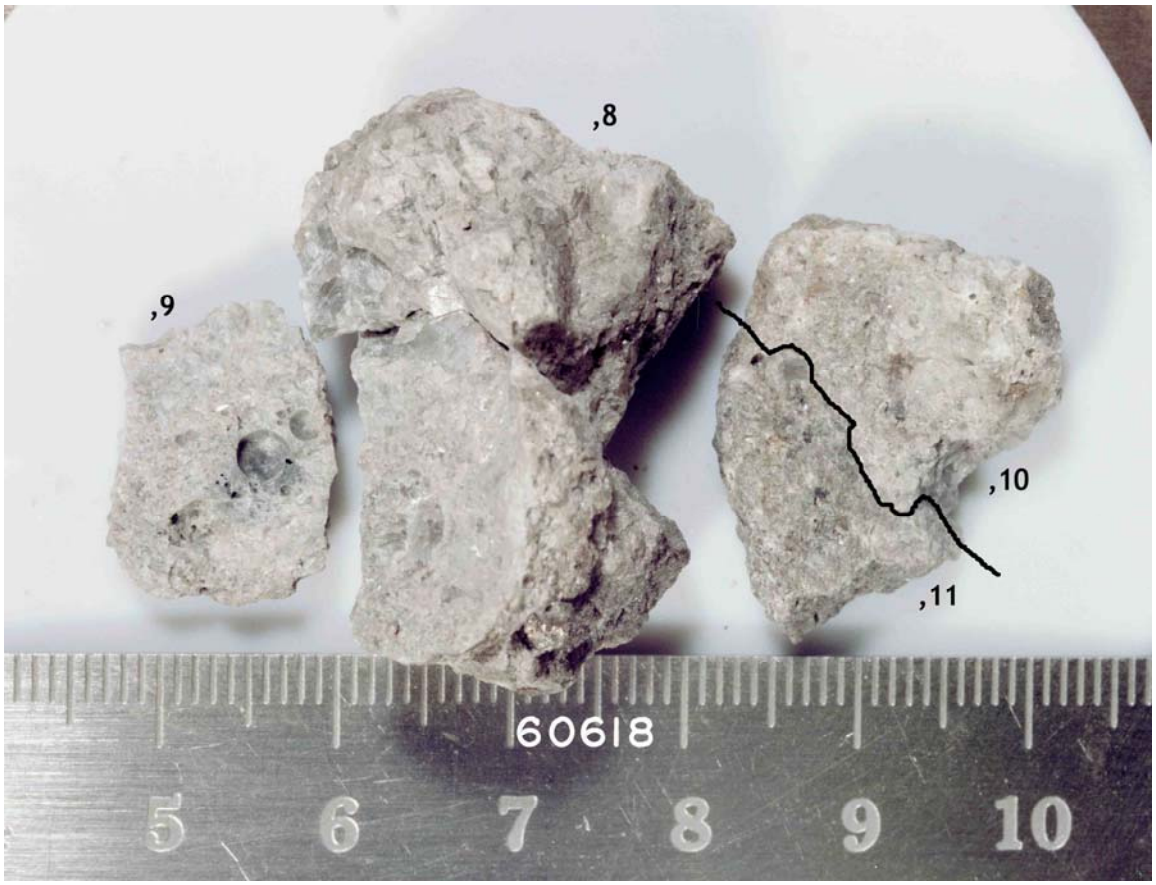

FIGURE 1. Smallest scale division in mm. S-73-20462.

PETROLOGY: Two distinct lithologies, a coarse-grained, cataclastic spinel bearing anorthosite and a finer-grained basaltic melt have been recognized in this rock. Petrographic descriptions are given by Dowty et al. (1974a,b) and Warner et al. (1976b).

The anorthosite described by Dowty et al. (1974a) and Warner et al. (1976b) consists of a single large (2 x 3 mm) plagioclase crystal in a granulated matrix of feldspar, minor olivine, spinel, pyroxene, ilmenite, metal (6.1% Ni, 1.3% Co),and schreibersite (Fig. 2). Pyroxene occurs mainly in fine veins that cut both the large crystal and the matrix. Mineral compositions are shown in Figure 3 and tabulated by Dowty et al. (1976), and show that the anorthosite has much more magnesian mafic minerals than typical ferroan anorthosites.

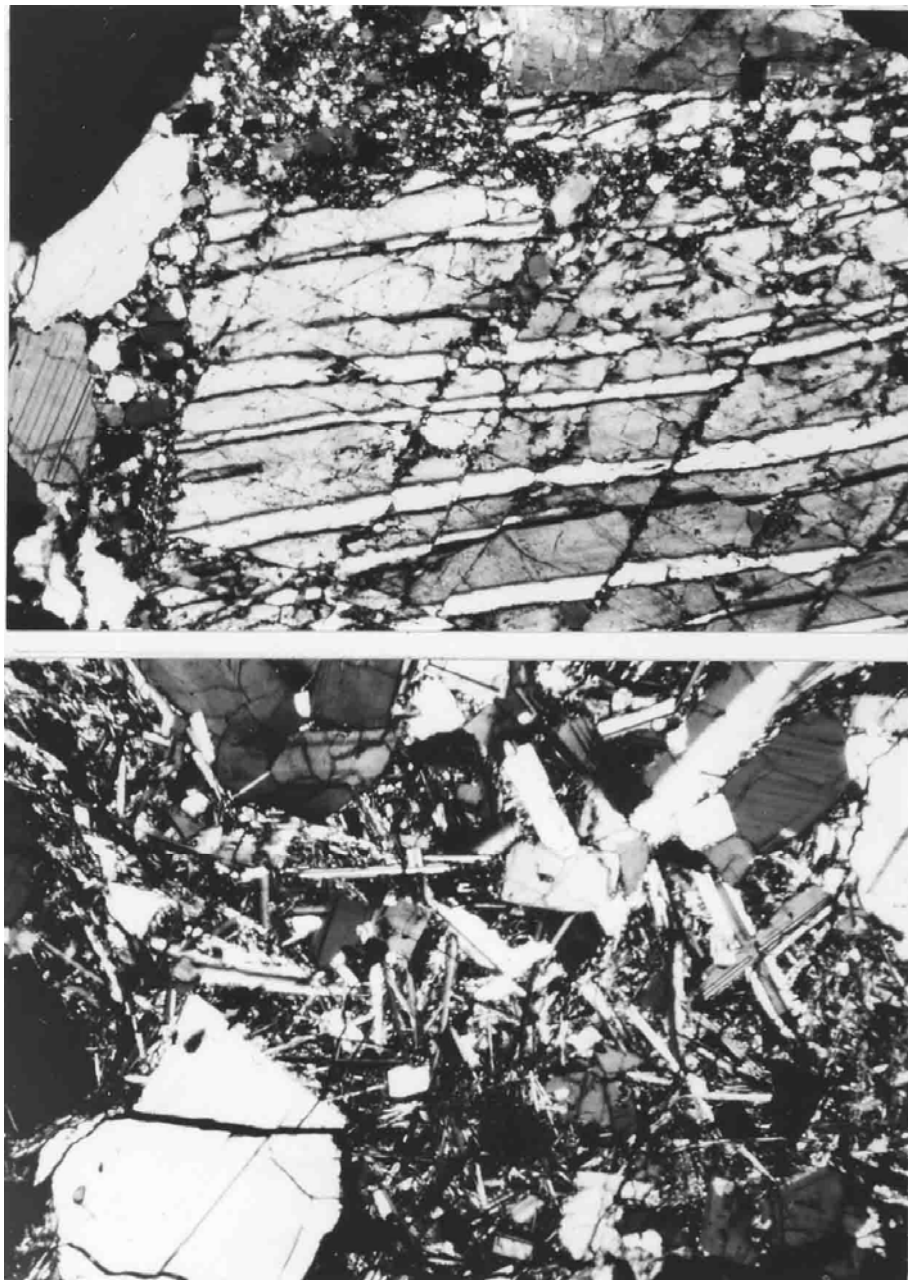

FIGURE 2.
a) 60618,4. Cataclastic anorthosite, xpl. Width 3 mm.
b) 60618,3. Basaltic melt, xpl. Width 3 mm.

The basaltic impact melt portion consists of many equant, but somewhat irregular, relict plagioclase grains (~0.5 mm) in a subophitic melt matrix of plagioclase laths (up to 0.5 mm long), olivine, and pyroxene (Fig. 2). Mineral compositions are shown in Figure 4 and tabulated by Dowty et al. (1976). Accessory minerals include ilmenite, armalcolite, Fe-metal (2.5-6.9% Ni, 0.6-1.2% Co), schreibersite, and troilite.

Meyer (1979) reports ion probe analyses of minor elements in plagioclase from an unspecified section of the rock (Table 1).

TABLE 1. Minor elements in 60618 plagioclase (ppm) (Meyer, 1979).

Li	Mg	Ba
4	800	16

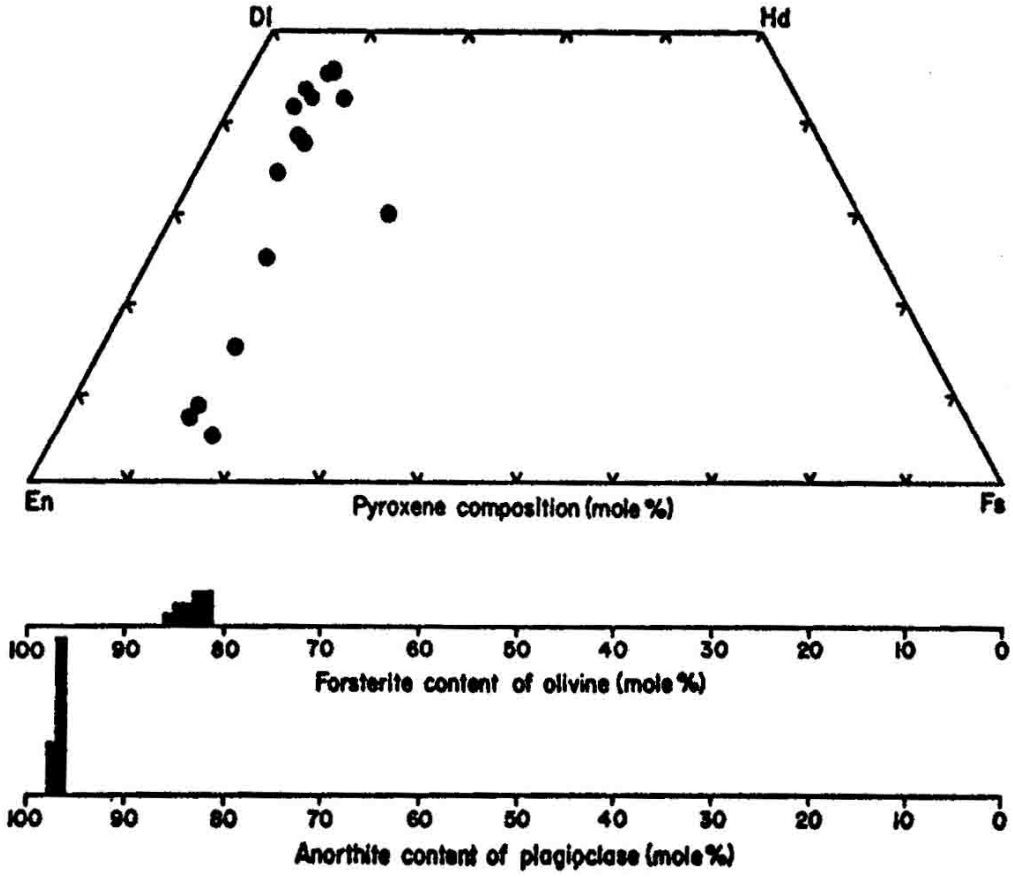

FIGURE 3. Anorthosite mineral compositions;
from R. Warner et al. (1976b).

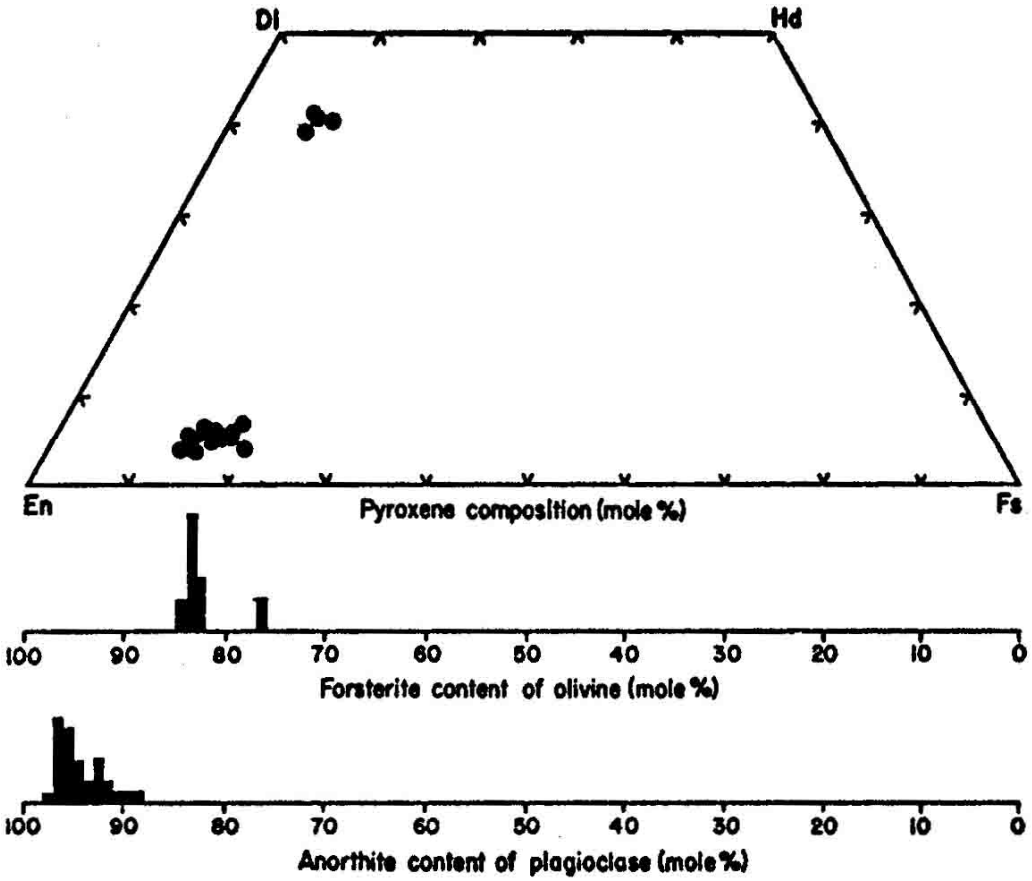

FIGURE 4. Basaltic melt mineral compositions; from R. Warner et al. (1976b).

CHEMISTRY: Major and trace element analyses of the anorthositic and the basaltic melt portions are given by Murali et al. (1977) and Ehmann et al. (1975). Eldridge et al. (1975) report whole rock abundances of natural and cosmogenic radionuclides. Jovanovic and Reed (1976b) provide halogen and other trace element abundances for a split probably rich in anorthosite. Microprobe defocussed beam analyses (DBA) of each lithology are reported by Dowty et al. (1974a,b) and Warner et al. (1976b). Ca and K abundances of an anorthosite-rich split are given by Schaeffer and Schaeffer (1977) in an Ar isotopic study.

Whole rock abundances of K, U, and Th show that the rock is very low in incompatible elements (K 670 ppm, U 0.28 ppm, Th 0.63 ppm). Eldridge et al. (1975) note the unusually low Th/U ratio (2.3) of this rock.

The anorthositic material is nearly pure plagioclase, with low abundances of incompatible elements (Table 2). Siderophile element abundances indicate meteoritic contamination.

The basaltic melt portions are less aluminous and have higher levels of incompatible elements than the anorthositic material (Table 2).

TABLE 2. Summary chemistry of 60618 lithologies.

	Anorthosite	Basaltic impact melt
SiO_2	44.3	45.8
TiO_2	0.03	0.27
Al_2O_3	33.2	28.8
Cr_2O_3	0.01	0.061
FeO	1.1	2.0
MnO	0.02	0.03
MgO	3.4	4.9
CaO	16.9	15.9
Na_2O	0.40	0.49
K_2O	0.047	0.15
P_2O_5	0.009	
Sr		
La	3.2	6.0
Lu	0.13	0.29
Rb		
Sc	1.5	3.2
Ni	228	50
Co	12	4.1
Ir ppb	5	
Au ppb	3	15
C		
N		
S		
Zn		
Cu		

Oxides in wt%; others in ppm except as noted.

RADIOGENIC ISOTOPES/GEOCHRONOLOGY: Schaeffer and Schaeffer (1977) report an ^{40}Ar-^{39}Ar plateau age of 4.00 ± 0.02 b.y. over the 900-1100°C temperature interval (Fig. 5). Large losses of low temperature Ar with an age of ~2.17 b.y. are also noted.

RARE GASES/EXPOSURE AGES: Whole rock ^{22}Na and ^{26}Al data indicate that 60618 is probably saturated in ^{26}Al activity (Eldridge et al., 1975). Excess ^{38}Ar at all temperatures preclude the calculation of an Ar exposure age (Schaeffer and Schaeffer,1977).

PROCESSING AND SUBDIVISIONS: In 1973, the pieces of 60618 were numbered ,8 - ,11 (Fig. 1). The melt rock splits came from ,9. The anorthosite splits were taken from ,10.

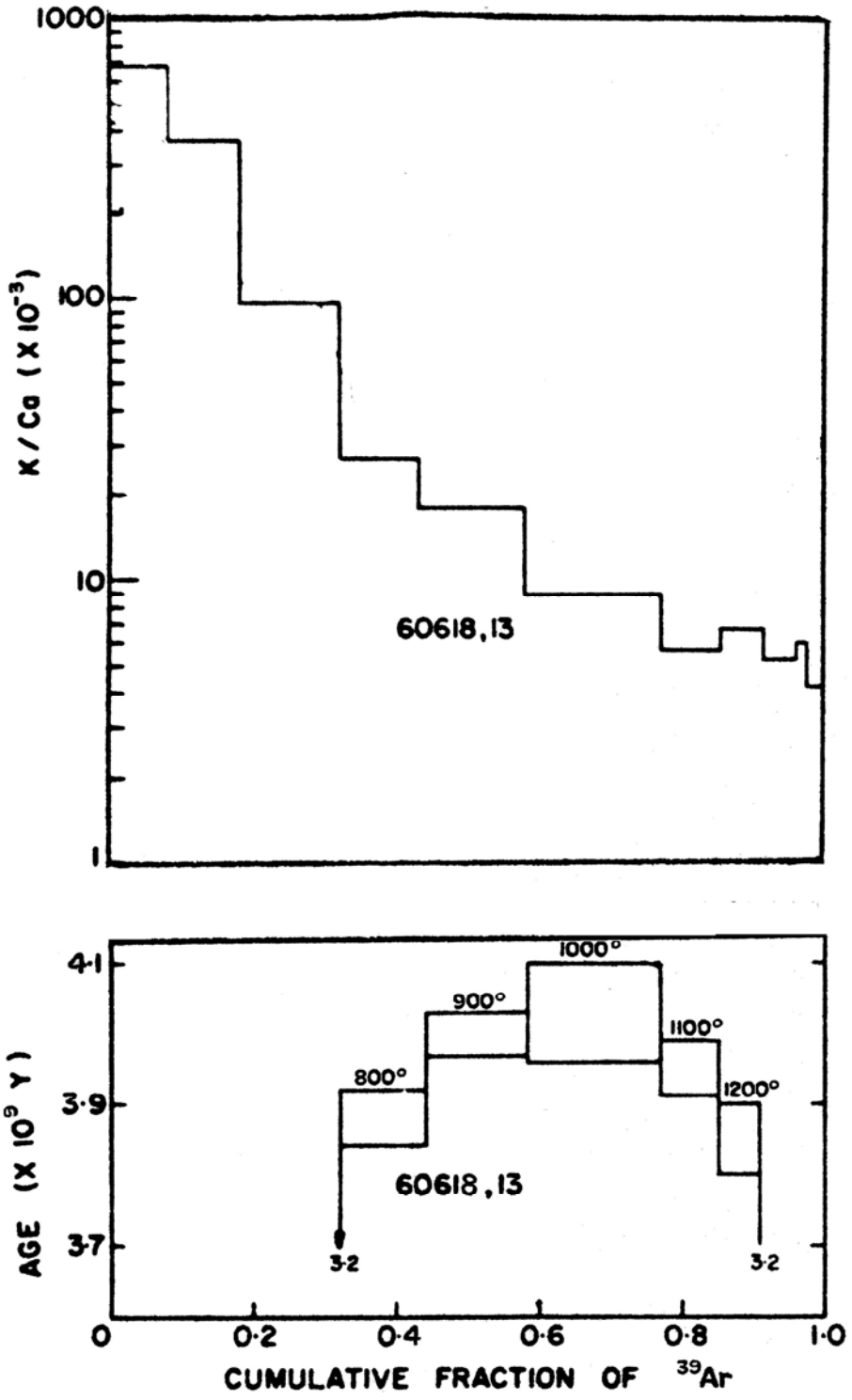

FIGURE 5. Ar release;
from Shaeffer and Shaeffer (1977).