15362 CATACLASTIC ANORTHOSITE ST. 7 4.2 g

INTRODUCTION: 15362 is a friable white sample consisting almost entirely of plagioclase (Fig. 1). It appears to be a cataclastic anorthosite from a pristine, igneous precursor. It is extremely brecciated but relict grains several millimeters across are present. Most surfaces were dusty, but a few microcraters were positively identified. 15362 was collected as part of the rake sample from the north-east rim of Spur Crater.

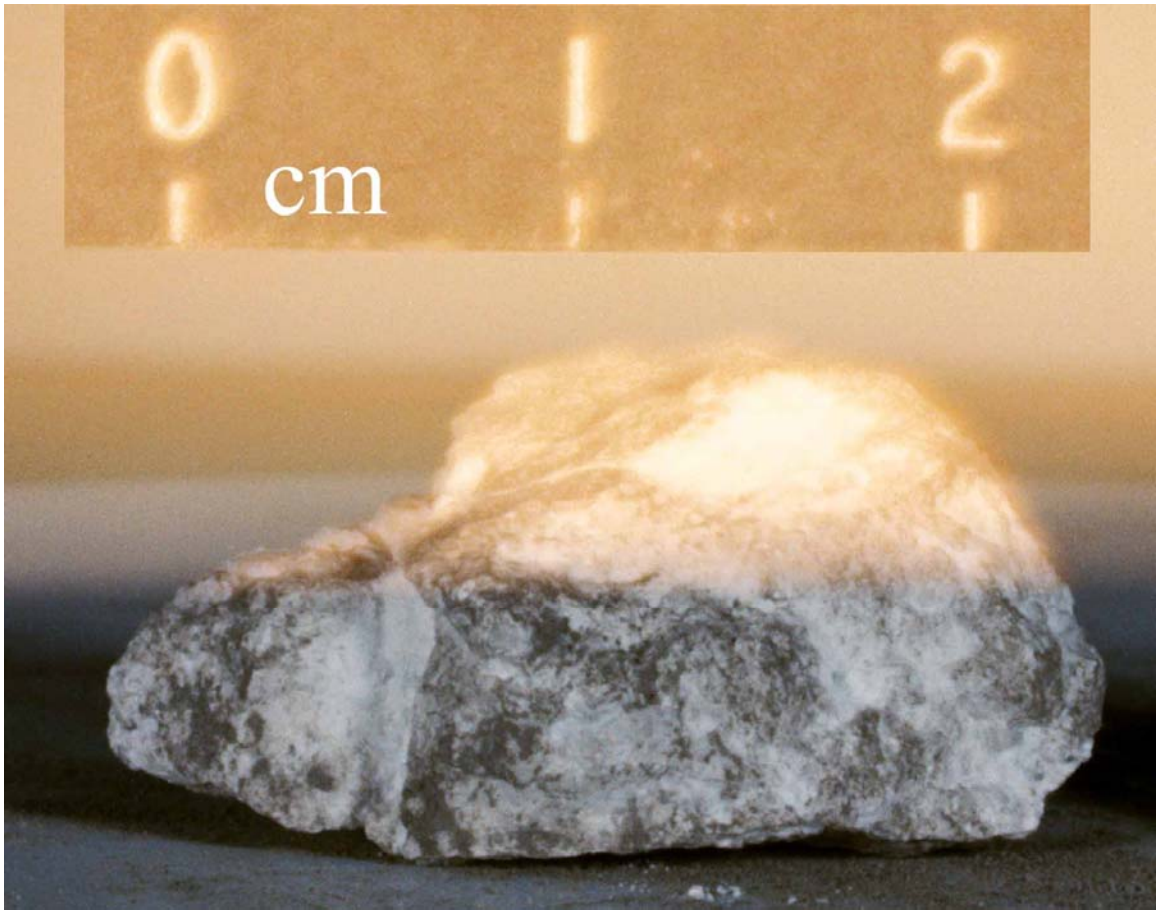

Figure 1. Pre-split view of 15362. S-71-49629

PETROLOGY: 15362 consists almost entirely of plagioclase grains, with relics up to a few millimeters across but most occurring as finer-grained material (Fig. 2). Many plagioclases are deformed. A description was given by Dowty et al. (1972), including mineral compositional data; and further mineral analyses were given by Dowty et al. (1973b), Nehru et al. (1973, 1974), Hlava et al. (1973), Hansen et al. (1979), Steele et al. (1980), Steele and Smith (1979), and Meyer (1979). According to Dowty et al. (1972), the texture is varied, and includes opaque, shock-produced plagioclase veins. It is far

more cataclasized than 15415. The sample contains accessory pyroxene and ilmenite, and chromite and troilite were also observed. Plagioclase compositions are $An_{96.7 \pm 0.6}$, and x-ray precession studies indicated that the structure is ordered. The twins are predominantly pericline. Steele and Smith (1979), Meyer (1979), and Steele et al. (1980) measured trace elements in the plagioclases with the ion microprobe (Table 1). Hansen et al. (1979) measured some minor elements in plagioclase with the microprobe, finding an Ab (3.1 mol %), similar to previous studies, and 0.036% MgO, 0.067% FeO, and 0.014% K_2O as an average of 23 analyses.

The less than 2% pyroxene present includes augite and hypersthene, with augite predominating more than 3 to 1 (Dowty et al., 1972). Smaller grains within plagioclases are only augite; larger ones (up to 500 microns) between plagioclases are intergrowths. Compositions are shown in Figure 3 and have a narrow range. X-ray precession studies on augite allowed the cell dimensions to be determined and showed no evidence for exsolved, epitaxial low-Ca pyroxene. The opaque minerals were discussed by Nehru et al. (1974) and complete microprobe analyses were listed by them and by Nehru et al. (1973). Chromite (9.1% $A1_2O_3$ average) is low in TiO_2 and MgO, and is homogeneous. The troilite was too small to analyze.

The high plagioclase content suggests that 15362 is a cumulate, a member of the ferroan anorthosite suite, but there is no longer any textural evidence for an igneous origin. The mineralogy (low-Ca pyroxene, high-Ca in augite, the pericline twinning) suggests that the sample was held at high subsolidus temperatures for some time.

<u>CHEMISTRY</u>: Chemical analyses listed in Table 2 are consistent with a very plagioclase-rich sample, a member of the ferroan, low-K anorthosite suite. The rare earths are shown in Figure 4.

Laul and Schmitt (1972a) suggested that, by comparison with 15415, 15362 was contaminated with 0.2% KREEP. However, the rare earth pattern of 15362 is flatter than that for 15415, and would not appear to indicate contamination at all. The low Co and Ni abundances would are consistent with a lack of meteoritic contamination, but determinations of the highly siderophile element abundances (It, Au, etc.) have not been made.

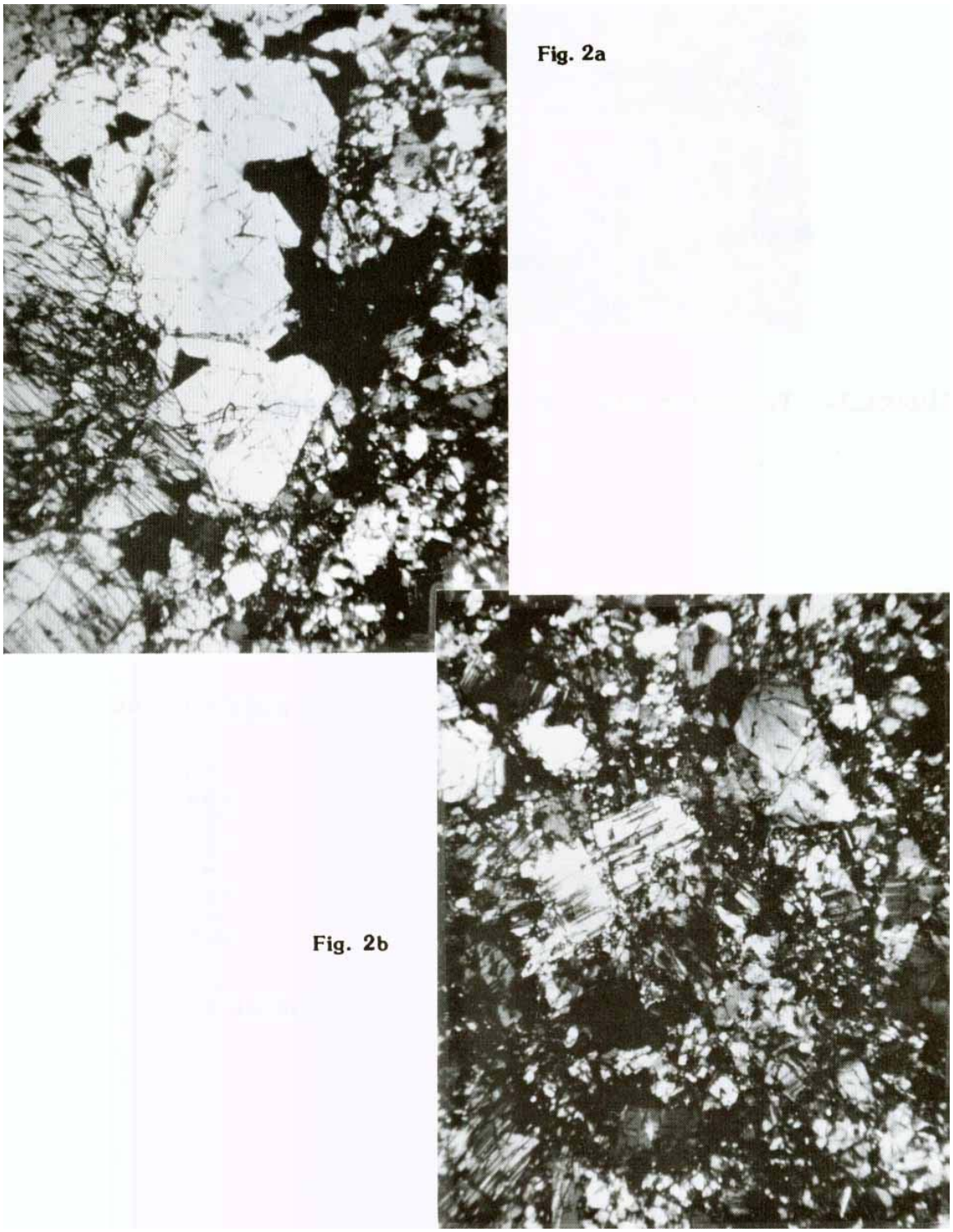

Figure 2. Photomicrographs of 15362,11, crossed polarizers, widths about 2 mm.
a) predominantly coarse grains. b) predominantly fine-grains.

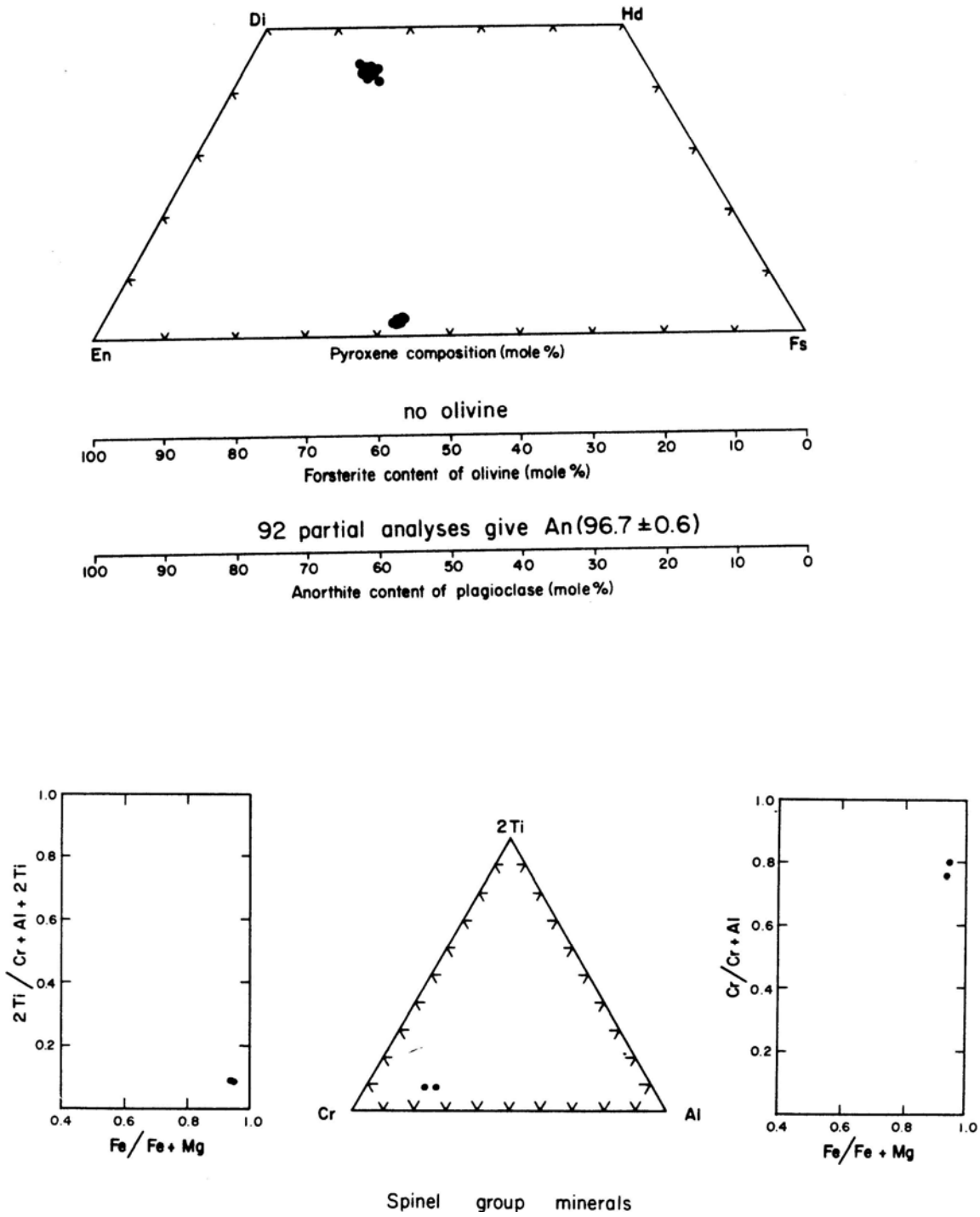

Figure 3. Compositions of minerals in 15362, from Dowty et al. (1973b).

TABLE 15362-1. Minor elements in plagioclases in 15362 (ppm)

	a	b	c
Li	1.5	2.2	1.83
Mg	300	288	232
K	—	—	108
Ti	—	91	48
Sr	—	200	179
Ba	40	26	8.2
Mol % Ab	—	—	3.5

a,b: Meyer (1979)
c: Steele et al. (1980), average of many analyses.

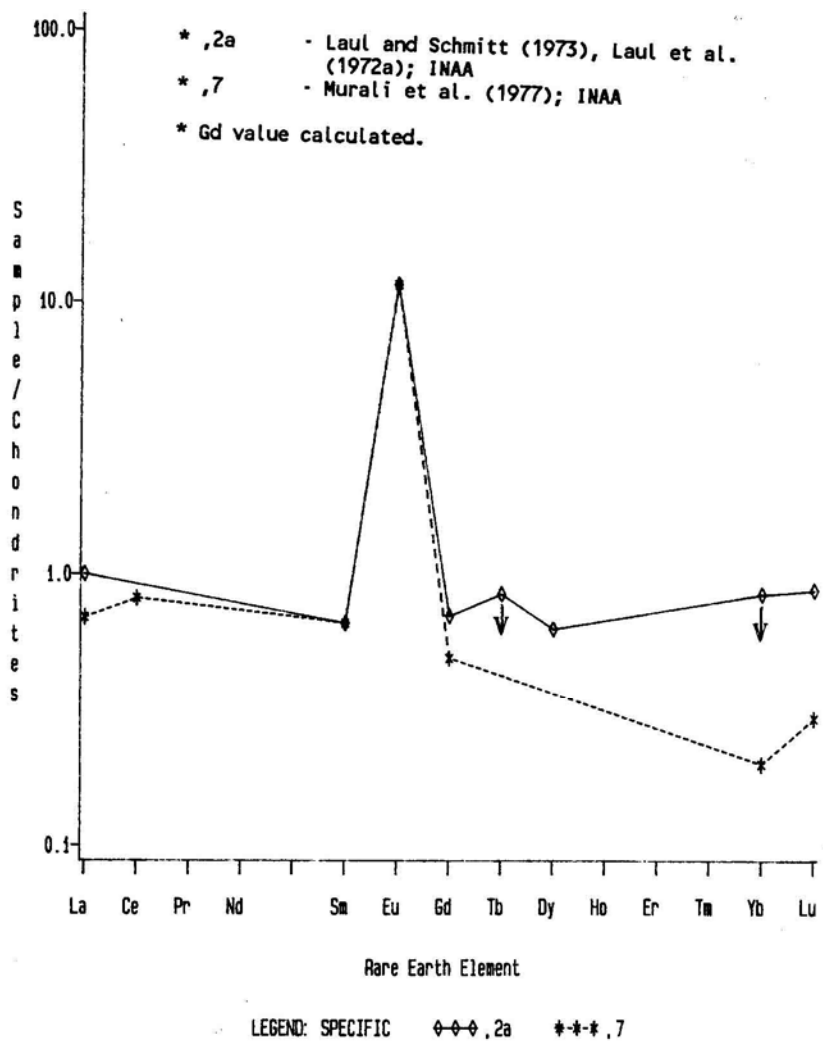

Figure 4. Rare earths in 15362.

TABLE 15362-2. Chemical analyses of 15362

		,2(a)	,7	,3
Wt %	SiO2			
	TiO2	0.2		
	Al2O3	35.4	32.3	
	FeO	0.57	0.23	
	MgO		0.3	
	CaO	18.4	17.0	22.7(b)
	Na2O	0.347	0.39	
	K2O	<0.02	0.011	0.012
	P2O5			
(ppm)	Sc	1.6	0.7	
	V	<28		
	Cr	80	30	
	Mn	110	40	
	Co	1.4	0.31	
	Ni		10	
	Rb			
	Sr			
	Y			
	Zr	<70		
	Nb			
	Hf	0.10	0.05	
	Ba			
	Th			
	U			
	Pb			
	La	0.33	0.23	
	Ce		0.72	
	Pr			
	Nd			
	Sm	0.12	0.12	
	Eu	0.80	0.80	
	Gd			
	Tb	<0.04		
	Dy	0.20		
	Ho			
	Er			
	Tm			
	Yb	<0.17	0.04	
	Lu	0.027	0.006	
	Li			
	Be			
	B			
	C			
	N			
	S			
	F			
	Cl			
	Br			
	Cu			
	Zn			
(ppb)	I			
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	Te			
	Cs			
	Ta			
	W			
	Re			
	Os			
	Ir			
	Pt			
	Au			
	Hg			
	Tl			
	Bi			
		(1)	(2)	(3)

References and methods:

(1) Laul and Schmitt (1973), Laul et al. (1972a); INAA.
(2) Murali et al. (1977); INAA
(3) Alexander and Kahl (1974); from Ar isotopes.

Notes: (a) values in Laul and ScHmitt (1973) supercede some of those from Laul et al. (1972a).
(b) unrealistically high.

RADIOGENIC ISOTOPES AND GEOCHRONOLOGY: Alexander and Kahl (1974) studied Ar isotopes. The release diagram (Fig. 5) does not show a good plateau, uncertainties are large because of the low K content, and there is evidence of recent gas loss. The simplest interpretation is that material older than 4.1 b.y. was extensively but not completely outgassed around 3.9 b.y., but this is not unique. The sample is probably older than 3.98 ± 0.06 b.y. The behaviour of the K/Ca ratio with release is consistent with release of gas from a single mineral phase.

EXPOSURE HISTORY: The study of Alexander and Kahl (1974) gave an Ar exposure age of 428 ± 43 m.y.

PROCESSING AND SUBDIVISIONS: Four chips were taken from ,0, which is now 2.95 g. ,1 was partly consumed to make the two thin sections ,6 and ,11. Two of the others (,2 and ,3) were allocated for analysis (the cutting picture on file in the 15362 data pack is erroneous, showing the sawing of an entirely F different sample).

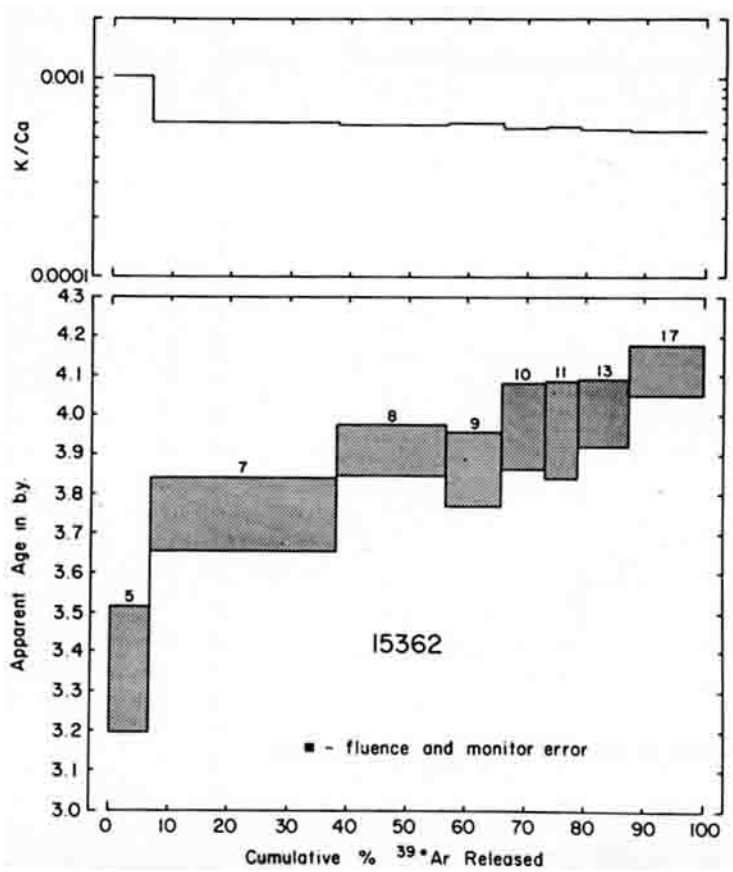

Figure 5. Ar release diagram for 15362,3; K/Ca and apparent age (Alexander and Kahl, 1974).