

14306

Clast-rich Impact Breccia

584 grams

DRAFT



Figure 1: Sawn surface of 14306,21. NASA S77-22103. Sample is about 6 cm across.

Introduction

Lunar sample 14306 is a clast-rich, crystalline matrix breccia from Station G, Apollo 14 (about 3 crater diameters of Cone Crater). The crystalline matrix breccias from Apollo 14 are thought to be from the Fra Mauro Formation, which was recognized as ejecta from the giant Imbrium Basin (Gilbert 1895).

14306 was photographed on the lunar surface and has been oriented (Swann et al. 1970). It was partially buried. It is somewhat rounded and has micrometeorite craters on most surfaces. There is a prominent vein of black glass, probably produced by the last impact. The saw cuts revealed a nice clastic texture (figure 1).



Figure 2: Photo of 14306 showing end with black glass vein. NASA S71-29199.



Figure 3: Photo of 14306 S, showing numerous micrometeorite craters. NASA S71-29197.

Anderson et al. (1972) describe 14306 as a “multi generation breccia”. Interior clasts are also clastic in nature, indicating that there may have been earlier breccia-forming events.

The cosmic-ray exposure age is 25 m.y., which is thought to be the age of Cone Crater. There are more micrometeorite craters per unit area on 14306 than just about any other lunar sample (Neukum et al.1973).

Norite clasts in 14306 were dated by ion microprobe to be 4.2 b.y. old.

Petrography

Simonds et al. (1977) noted that 14306 has little matrix, but that it was made of plentiful clasts (>50%) of crystalline matrix breccia.

Wosinski et al. (1972) studied the glass vein that penetrates 14306.

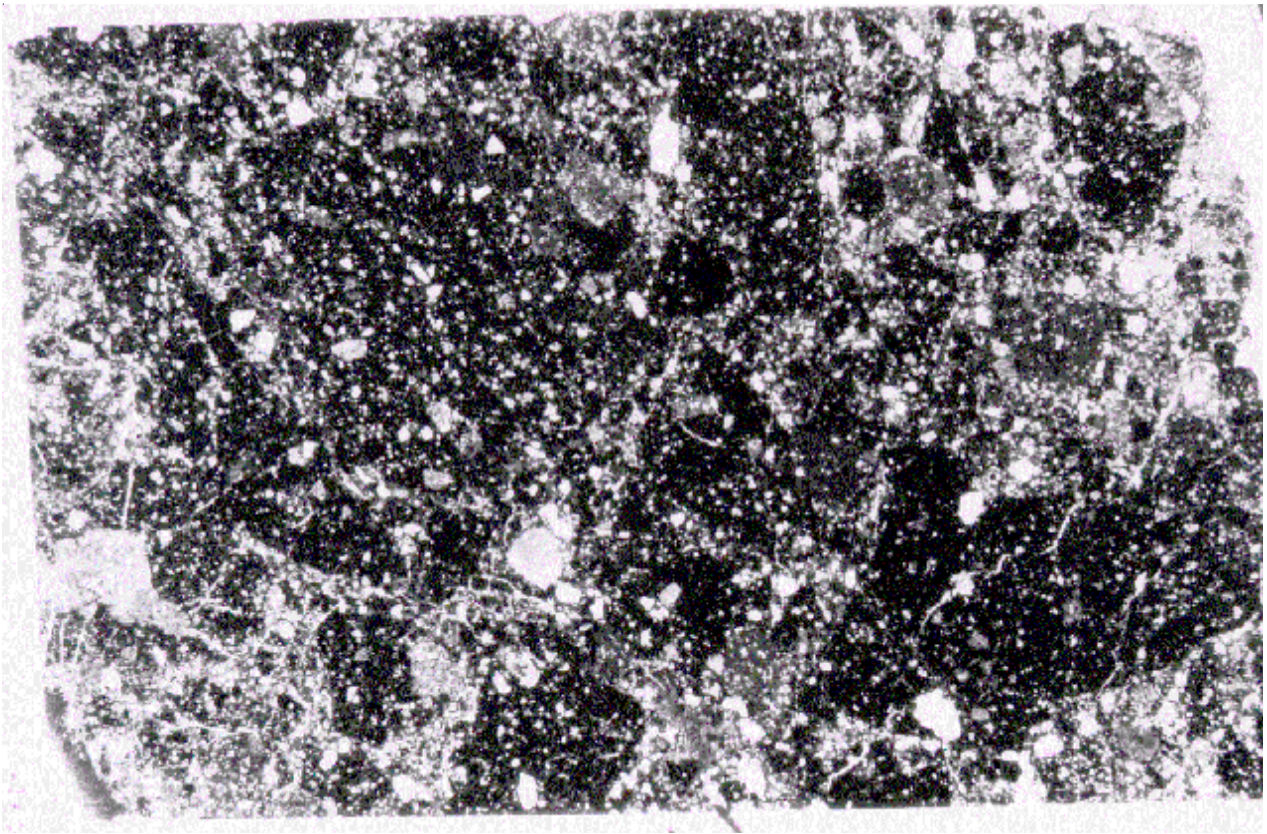


Figure 4: Thin section photomicrograph of 14306,53. Field of view about 3 cm. NASA S71-40450.

Significant Clasts

Ferroan Anorthosite ,71 ,72

Shervais et al. (1983) reported mineral modes and compositions for this small anorthosite clast found only in thin section (figure 5). It is 90% plagioclase (An_{98}), with pyroxene (En_{67}) and minor olivine (Fo_{70}) and augite.

Norite Clast ,63 ,65

Meyer et al. (1989) and Nemchin et al. (2008) reported a norite clast with zircons in 14306. The norite is fractured and broken but all the minerals within the clast have chemical compositions that are consistent with one rock (monomic breccia).

Mineralogy

Meyer et al. (1989) and Nemchin et al. (2008) studied several zircons in the norite clasts in 14306. This is one of the few cases where zircons are still attached to their mineral assemblage.

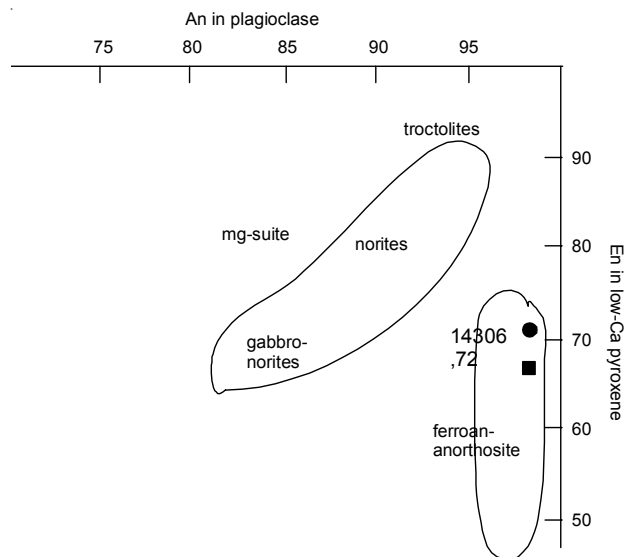


Figure 5: Plagioclase and pyroxene analysis of ferroan anorthosite clast in 14306.

Chemistry

Taylor et al. (1972), Wiik et al. (1973) determined the composition (figures 6 and 8). Ganapathy et al. (1974) discuss the trace element composition of 14306.

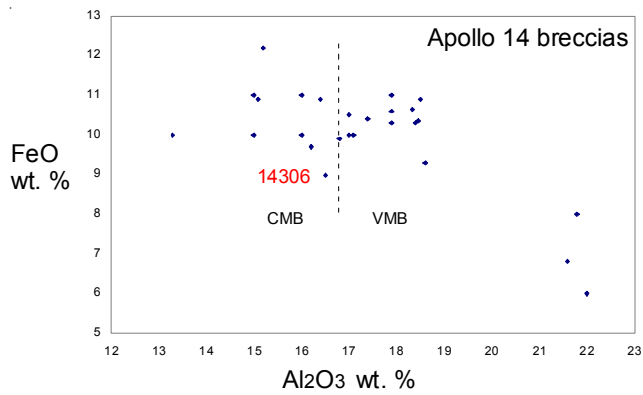


Figure 6: Chemical composition of Apollo 14 breccias comparing the vitric matrix and crystalline matrix breccias.

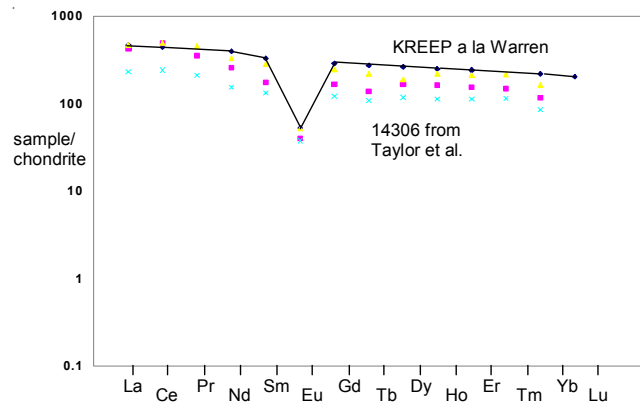


Figure 8: Normalized rare-earth-element content of 14306 compared with KREEP.

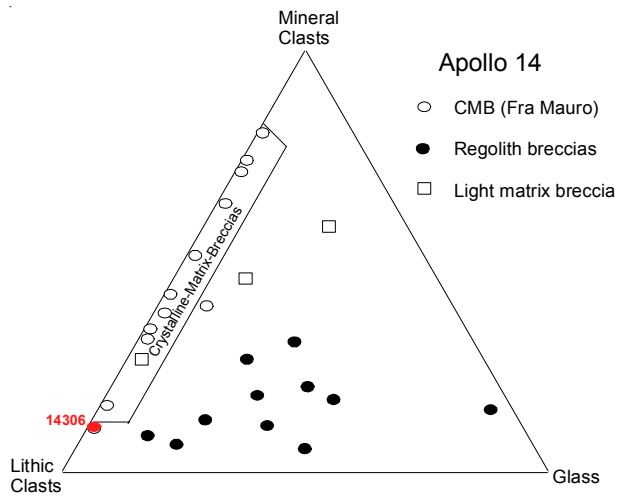


Figure 7: Diagram used by Simonds et al. (1977) to describe nature of Apollo 14 breccias.

Processing

14306 was studied in “consortia mode” led by E. Anders. A thick slice (,22) was cut from the center of 14306, yielding two large butt ends (,21 and ,23). There are 27 thin sections for 14306, some are cut orthogonal to the others. Note that there is a thin slice (,26) immediately adjacent to the set of thin sections produced from (,27).

Radiogenic age dating

The breccia event represented by 14306 has not been dated (probably 3.9 b.y., by analogy to other Apollo 14 breccias). Norite clast were dated by ion probe (Nemchin et al. 2008).

Cosmogenic isotopes and exposure ages

Crozaz et al. (1972) and Drozd et al. (1974) reported a cosmic ray exposure age of 25 ± 2 m.y. determined by ^{81}Kr , supporting the idea that Cone Crater is this age.

Other Studies

Micrometeorite craters on 14306 were studied by Morrison et al. (1972). Neukum et al. (1973) found that 14306 had a higher density of micrometeorites than other rocks (figure 12).

Summary of Age Data for 14306

Author	Age (m.y.)
Nemchin et al. 2008	Pb/Pb zircon
	4192 ± 6
	4211 ± 7
	4205 ± 6
	4202 ± 12
	4185 ± 57
	4200 ± 6
	4205 ± 7

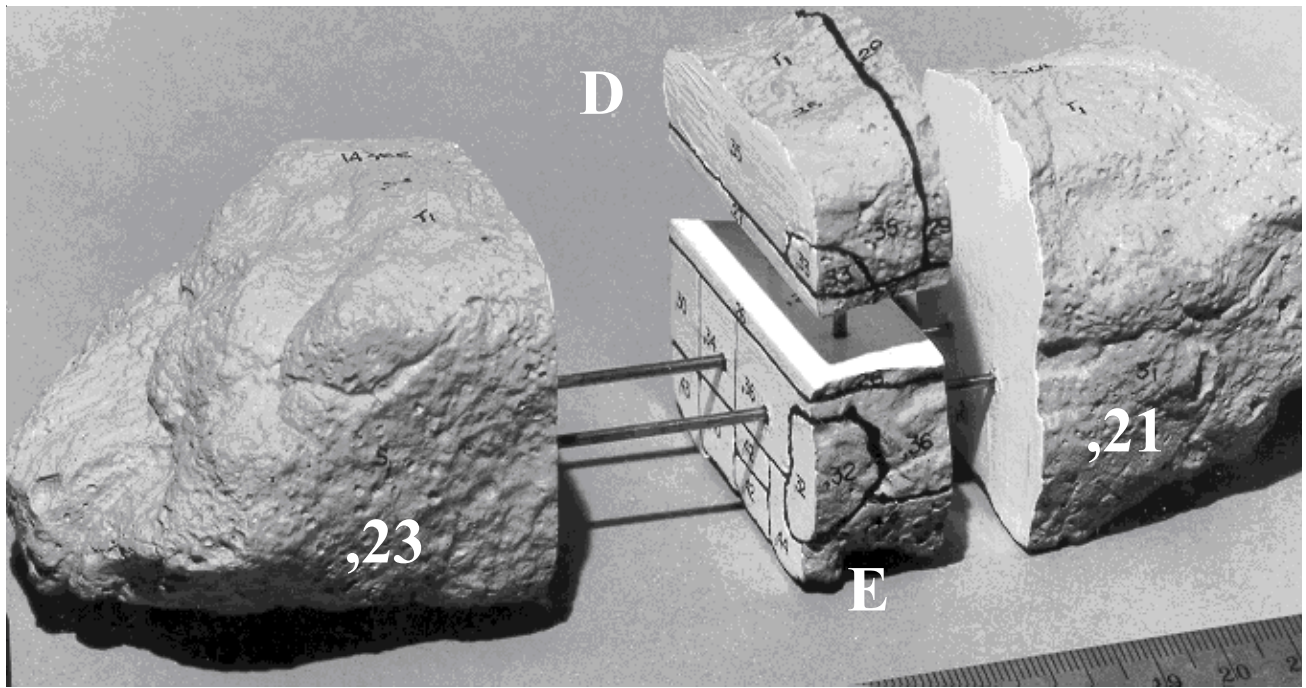
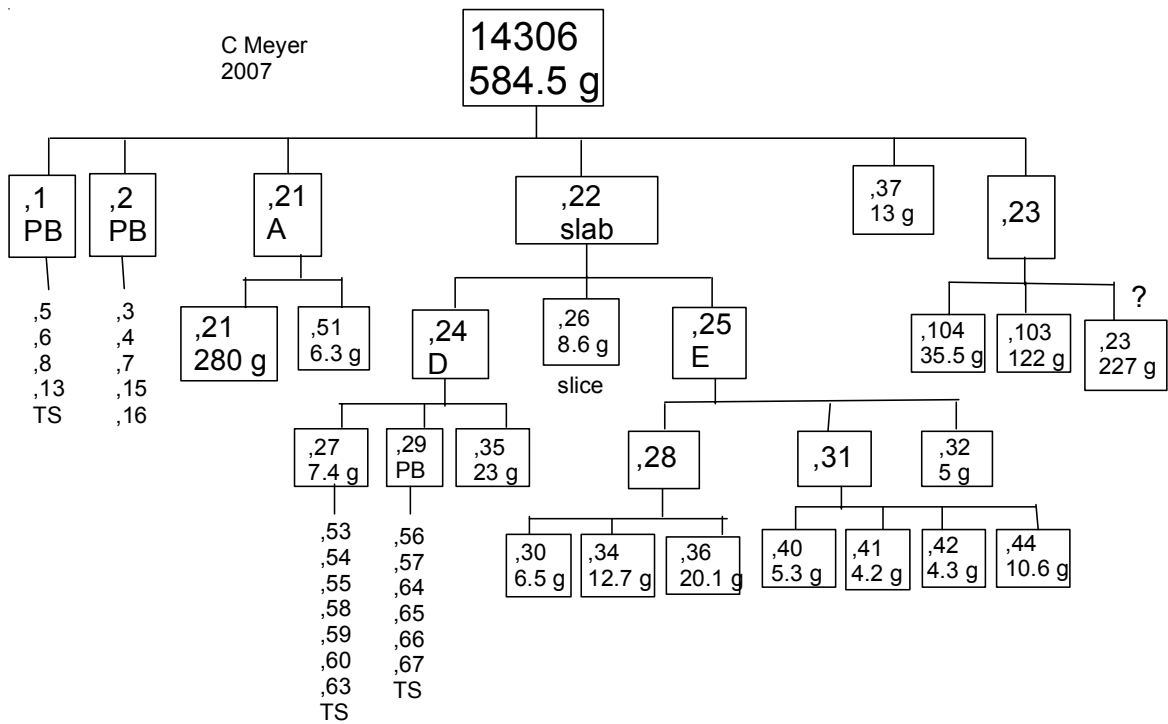


Figure 9: Photo of model of 14306 showing thick slab cut from middle. NASA S78-26756.



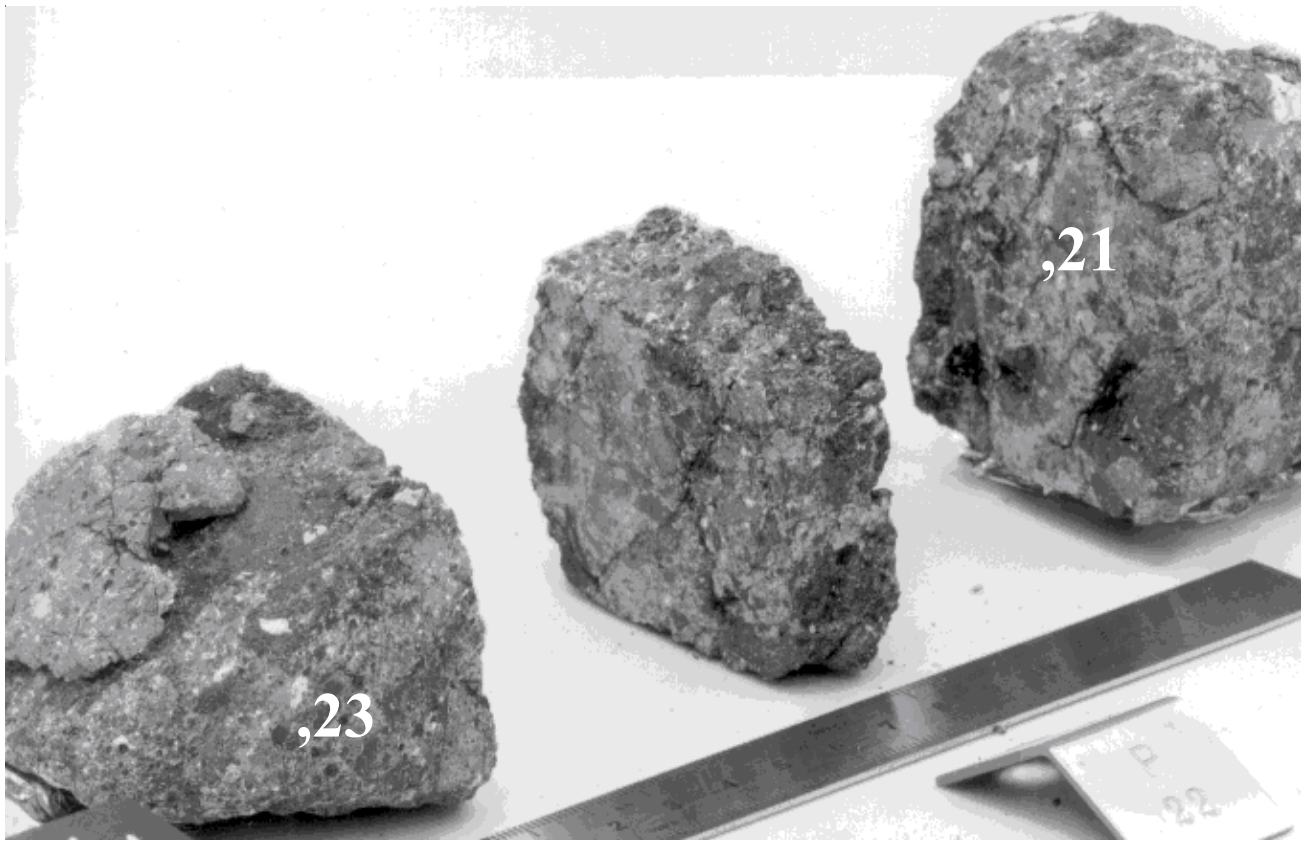


Figure 10: Processing photo of 14306 after slab was cut. Note the black glass vein. NASA S71-36707.

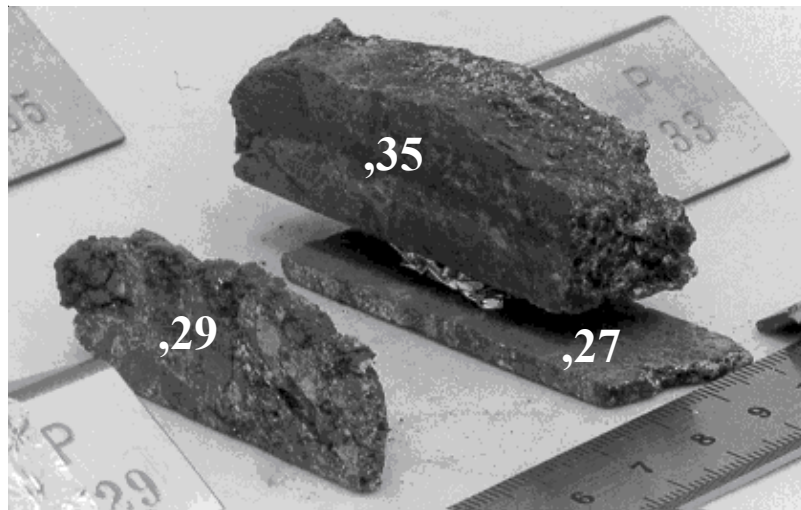


Figure 11: Processing photo of ,24 D (top of 14306 slab ,22). Numerous thin section were made for the two mini-slices shown (,29 and ,27). Scale is in cm. NASA S71-37288. (photo is from the opposite direction of figures) Cuts were made with wire saw.

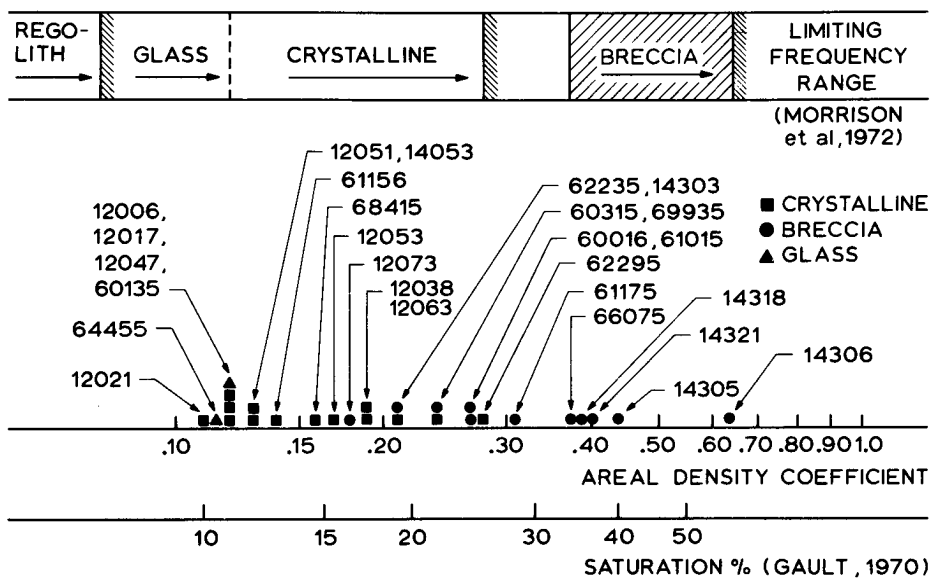
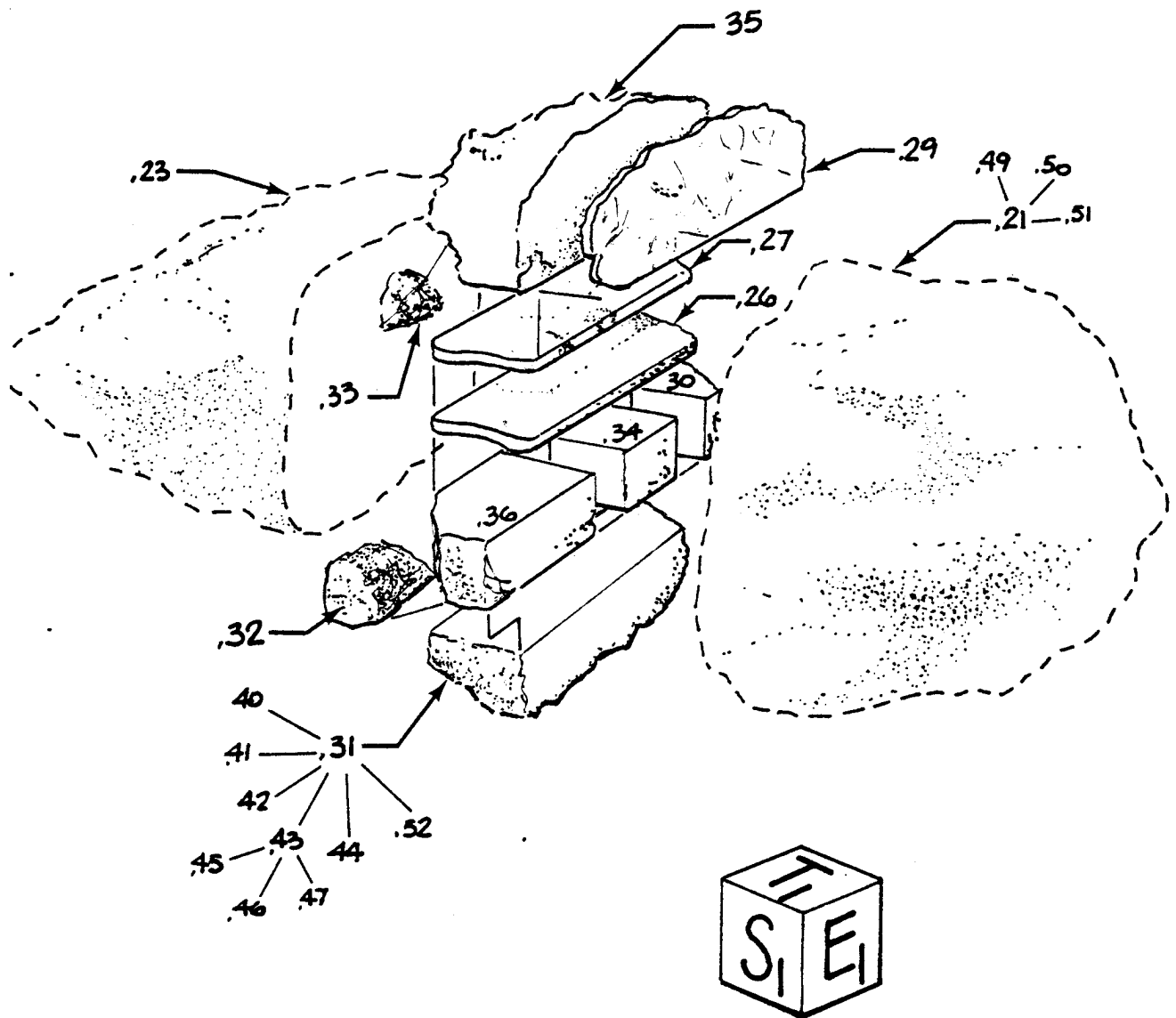


Figure 12: Highest areal density of microcraters on lunar rocks reported by various investigators (from Neukum et al. 1973).



Figure 13: Photo of 14306 showing the black glass vein (photo number missing).



Figure 14: Photo of 14306 showing large zap pit. Cube is 1 inch, for scale. Photo number ?

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