14051

Impact Melt Breccia

191.3 grams

Figure 1: Photo of 14051 showing zap pits and rounded surface. NASA S77-23488. Sample is 6 cm long.

Introduction

This breccia sample was picked up on the flank of Cone Crater (Swann et al. 1971). It was sitting on the surface and has been nicely rounded by micrometeorite bombardment on all sides (a potato) (figure 2). It is a blocky, subrounded rock with all surfaces lightly

covered by zap pits with or without glass linings (figure 1). Spall-like fractures occur locally. Irregular to rounded cavities 1-3 mm across may be clast molds. The sample is a coherent, fine-grained clastic rock having a small percentage of subrounded light and subordinate dark clasts in a medium-tan matrix.

Petrography

14051 has the texture of an "impact melt rock", similar to the large boulders at Apollo 17. The fine grain matrix has recrystallized with formation of distinct grains of poikilitic ilmenite (figure 4). The void space has consolidated into distinct, millimeter-sized vugs and vesicles. Stadermann et al. (1991) give the mode.

Lithic clasts are not digested (figure 4). A minor amount of glass is seen in thin section?

Twedell et al. (1978) mapped the surface of 14051 (figure 5).

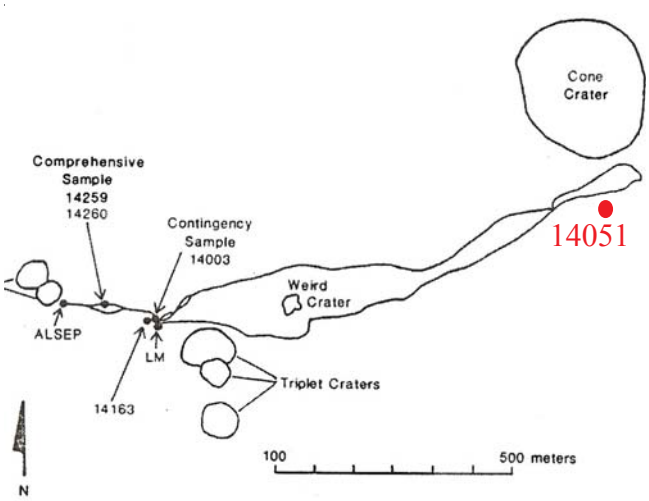


Figure 2: Map of Apollo 14 traverse to Cone Crater.

Chemistry

The chemical composition of 14051 has not been reported.

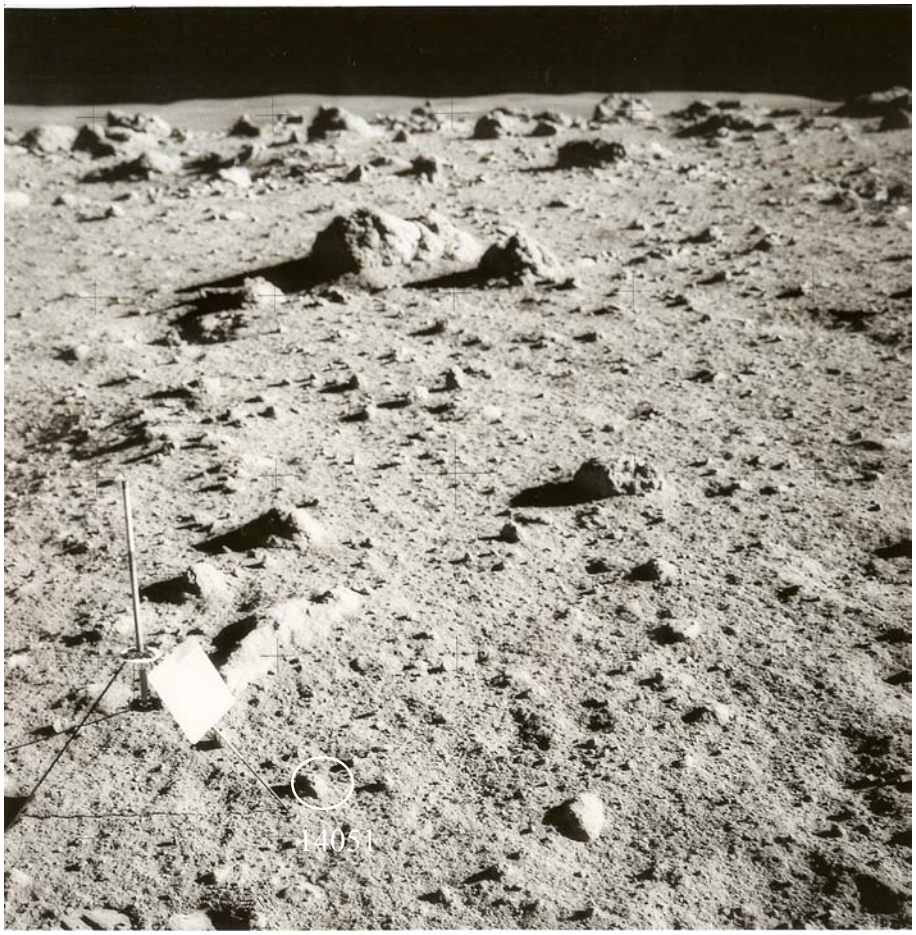


Figure 3: Photo of 14051 on lunar surface, with rim of Cone Crater in distance. AS14-68-9444.

Scale = 2.8 mm across

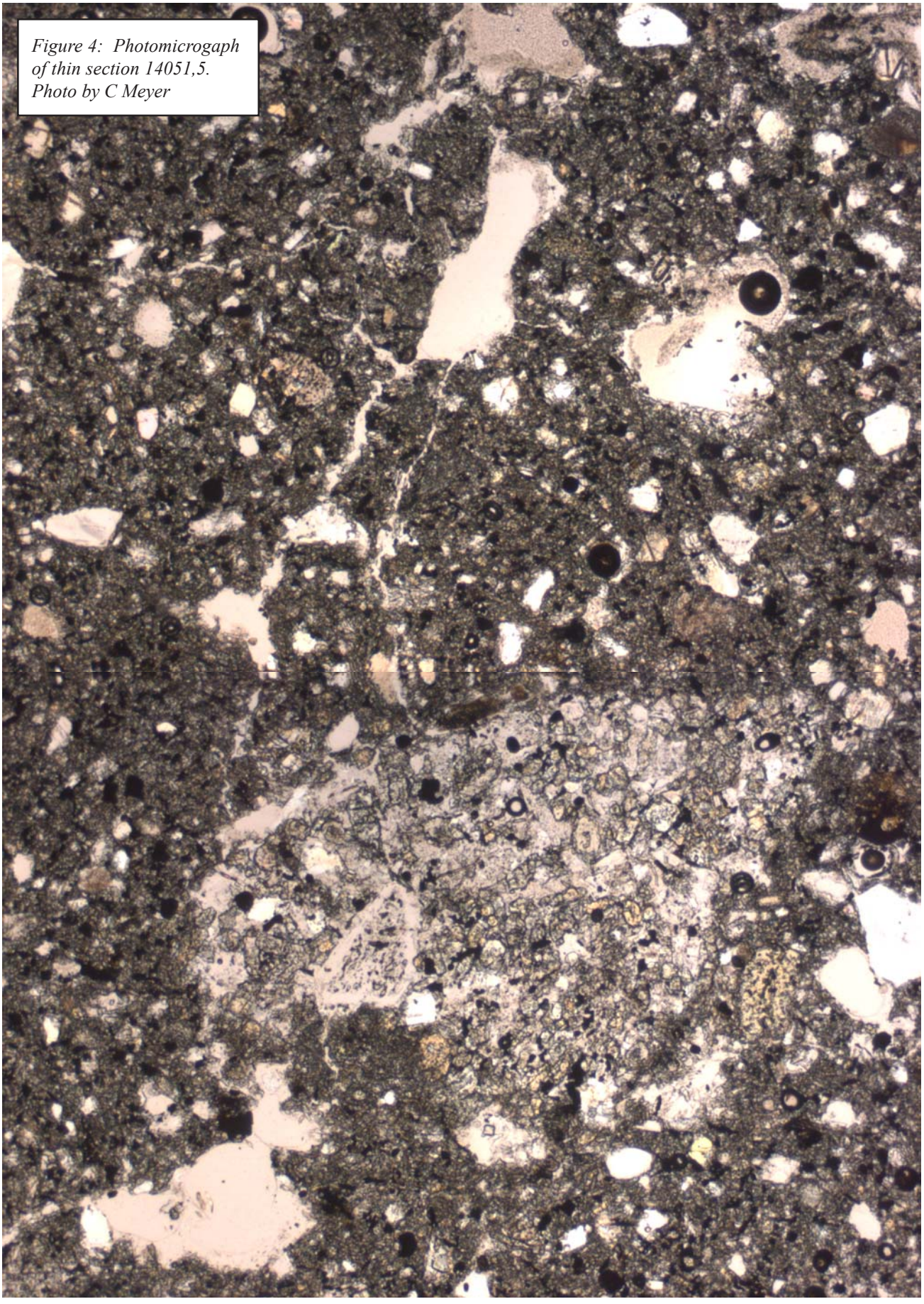


Figure 4: Photomicrogaph of thin section 14051,5. Photo by C Meyer

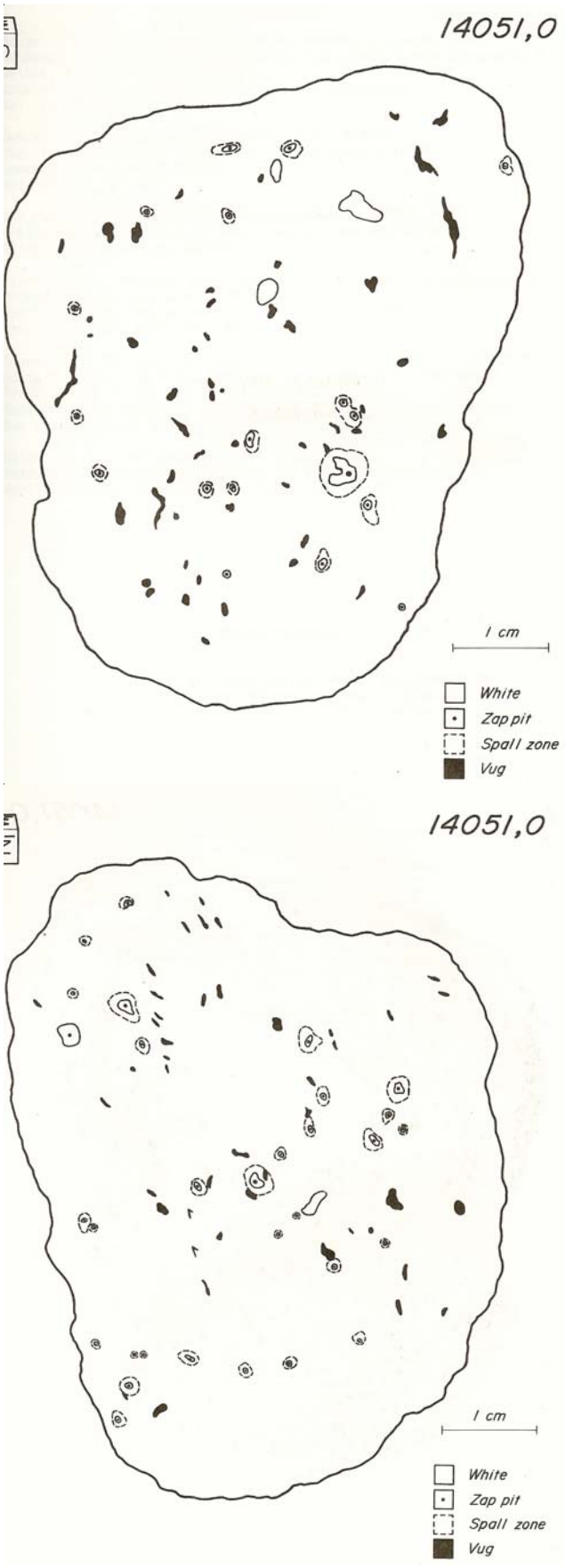


Figure 5: Maps of both side of 14051 showing zap pits (Twedell et al. 1978).

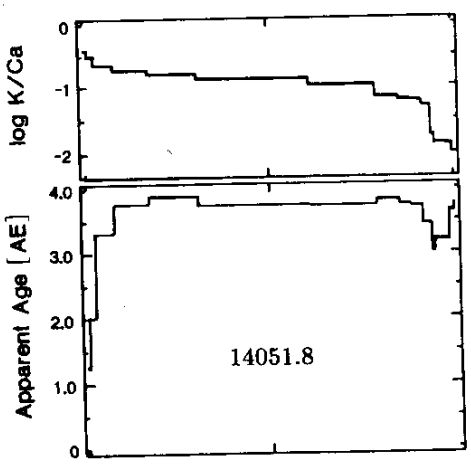


Figure 6: Ar plateau diagram for 14051 (Stadermann et al. 1991).

Summary of Age Data for 14051

	Ar/Ar
Stadermann et al. 1991	3.71 ± 0.05 b.y.

Beware Ar control standard

Modal mineralogy of 14051

Stadermann et al. 1991

Plagioclase	51.2 %
Pyroxewne, olivine	42.4
Spinel	0
Fe + FeS	0.3
Zircon	0.6
Ilmenite	3.3
Mesotasis	2.4

Radiogenic age dating

Stadermann et al. (1991) determined an Ar plateau age of 3.71 ± 0.05 b.y. for 14051 (figure 6). They argue that Imbrium can't be older than that! But since it has an exposure age greater than Cone Crater, it may be exotic to the site. Nevertheless, this is a relatively young age for an impact melt rock, and needs to be checked.

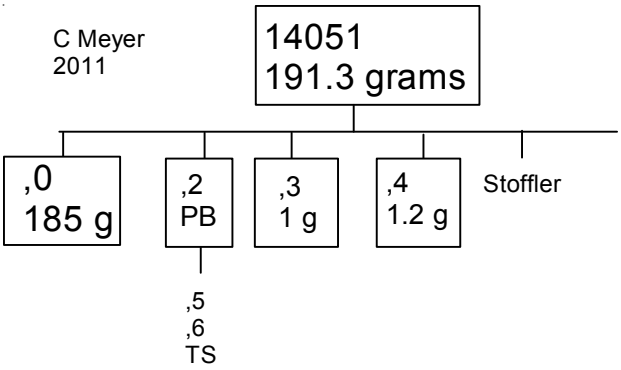
Cosmogenic isotopes and exposure ages

Stadermann et al. (1991) determined an Ar exposure age of 47 m.y., which is older than Cone Crater. However, Swann et al. (1977) believed that the sample was part of the Cone Crater ejecta.

Processing

14051 was returned in a Teflon bag in ALSRC 1006, which was sealed.

There are only two thin sections for 14051 and the sample has not been sawn.



References for 14051

Carlson I.C. and Walton W.J.A. (1978) **Apollo 14 Rock Samples**. Curators Office. JSC 14240

Chao E.C.T., Minkin J.A. and Best J.B. (1972) Apollo 14 breccias: General characteristics and classification. *Proc. 3rd Lunar Sci. Conf.* 645-659.

Deutsch A. and Stoffler D. (1987) Rb-Sr analysis of Apollo 16 melt rocks and a new age estimate for the Imbrium basin: Lunar basin chronology and the early heavy bombardment of the moon. *Geochim. Cosmochim. Acta* **51**, 1951-1964.

LSPET (1971) Preliminary examination of lunar samples from Apollo 14. *Science* **173**, 681-693.

Simonds C.H., Phinney W.C., Warner J.L., McGee P.E., Geeslin J., Brown R.W. and Rhodes J.M. (1977) Apollo 14 revisited, or breccias aren't so bad after all. *Proc. 8th Lunar Sci. Conf*. 1869-1893.

Stadermann F.J., Heusser E., Jessberger E.K., Lingner S. and Stoffler D. (1991) The case for a younger Imbrium basin: New 40Ar-39Ar ages of Apollo 14 rocks. *Geochim. Cosmochim. Acta* **55**, 2339-2349.

Sutton R.L., Hait M.H. and Swann G.A. (1972) Geology of the Apollo 14 landing site. *Proc. 3rd Lunar Sci. Conf*. 27-38.

Swann G.A., Trask N.J., Hait M.H. and Sutton R.L. (1971a) Geologic setting of the Apollo 14 samples. *Science* **173**, 716-719.

Swann G.A., Bailey N.G., Batson R.M., Eggleton R.E., Hait M.H., Holt H.E., Larson K.B., Reed V.S., Schaber G.G., Sutton R.L., Trask N.J., Ulrich G.E. and Wilshire H.G. (1977) Geology of the Apollo 14 landing site in the Fra Mauro Highlands. U.S.G.S. Prof. Paper 880.

Swann G.A., Bailey N.G., Batson R.M., Eggleton R.E., Hait M.H., Holt H.E., Larson K.B., McEwen M.C., Mitchell E.D., Schaber G.G., Schafer J.P., Shepard A.B., Sutton R.L., Trask N.J., Ulrich G.E., Wilshire H.G. and Wolfe E.W. (1972) 3. Preliminary Geologic Investigation of the Apollo 14 landing site. *In* Apollo 14 Preliminary Science Rpt. NASA SP-272. pages 39-85.

Twedell D., Feight S., Carlson I. and Meyer C. (1978) **Lithologic maps of selected Apollo 14 breccia samples.** Curators Office. JSC 13842

Warner J.L. (1972) Metamophism of Apollo 14 breccias. *Proc. 3rd Lunar Sci. Conf.* 623-643.

Williams R.J. (1972) The lithification of metamorphism of lunar breccias. *Earth Planet. Sci. Lett*. **16**, 250-256.

Wilshire H.G. and Jackson E.D. (1972) Petrology and stratigraphy of the Fra Mauro Formation at the Apollo 14 site. U.S. Geol. Survey Prof. Paper 785.