

**10094**  
Regolith Breccia  
30.3 grams



*Figure 1: Lunar breccia 10094 is about 3 cm across. NASA S76-25993.*

**Introduction**

10094 is a typical Apollo 11 regolith breccia. Its outer surface was bombarded with micrometeorites (figures 1 and 2). It has a high percentage of fine dark matrix, and an abundance of small clasts of mare basalt (figure 3).

**Petrography**

Simon et al. (1984) included breccia 10094 in their comprehensive study of Apollo 11 regolith breccias – their mode is given in the table. They calculated that it had about 24 % highland component, but couldn't directly identify that many clasts of highland rock.

**Chemistry**

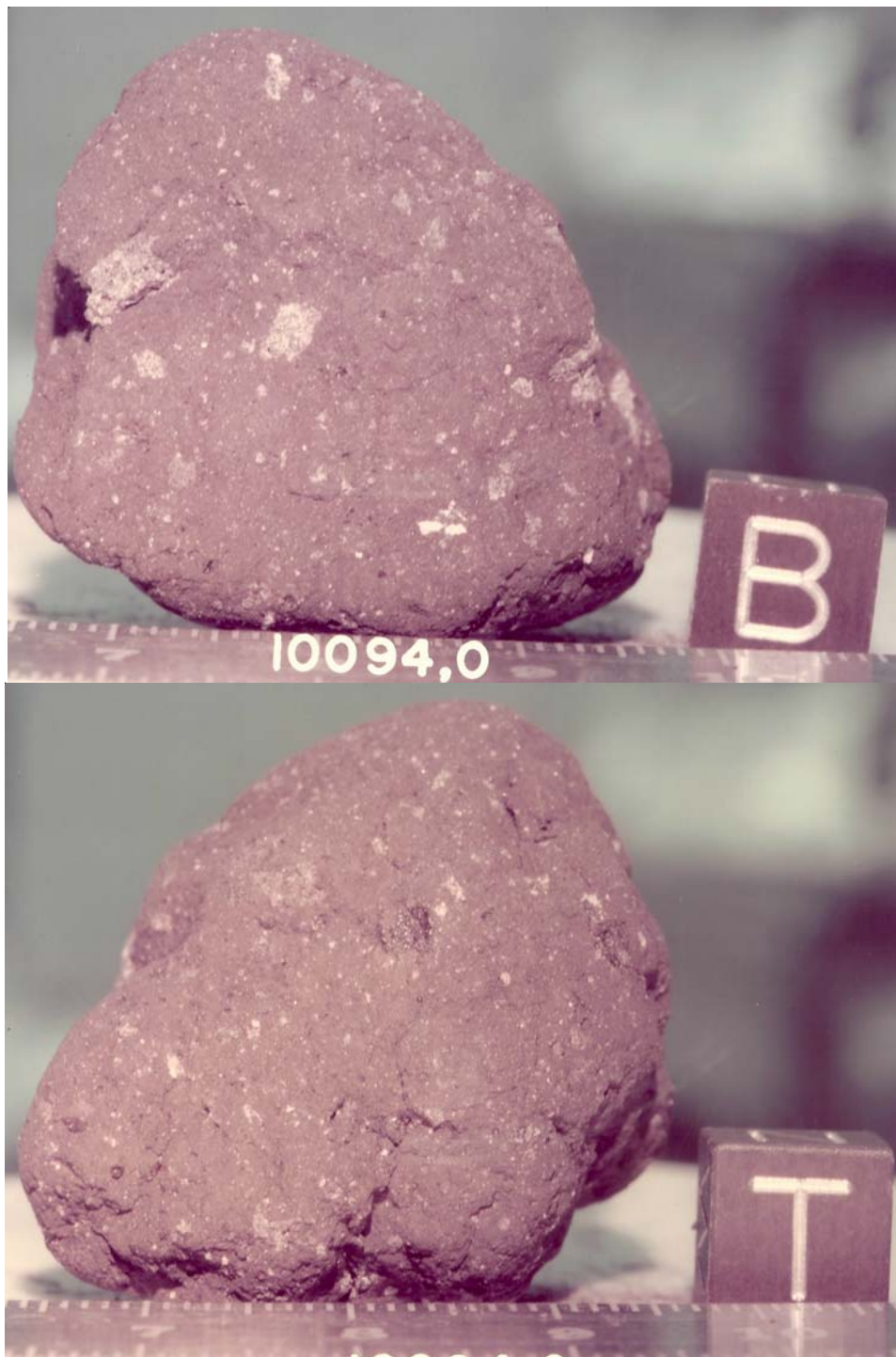
Rhodes and Blanchard (1981) found that the composition of 10094 was similar to the other regolith breccias and 10084 (figures 4 and 5).

**Processing**

Apollo 11 samples were originally described and cataloged in 1969 and “recataloged” by Kramer et al. (1977). There are 4 thin sections.

**Simon's Mode for 10094**

	<b>S</b>	<b>L</b>
Mare Basalt	8.2	6.2
Highland Component	0.5	0.5
Regolith breccia	3.3	
Agglutinate	5.5	3.3
Pyroxene	4	
Olivine	0.5	
Plagioclase	4	0.1
Ilmenite	2.6	
Orange glass	1.4	
Other glass	3.4	
Matrix	56.5 %	



*Figure 2: Two more photos of 10094. Cube is 1 cm. S76-26001 and 2.*

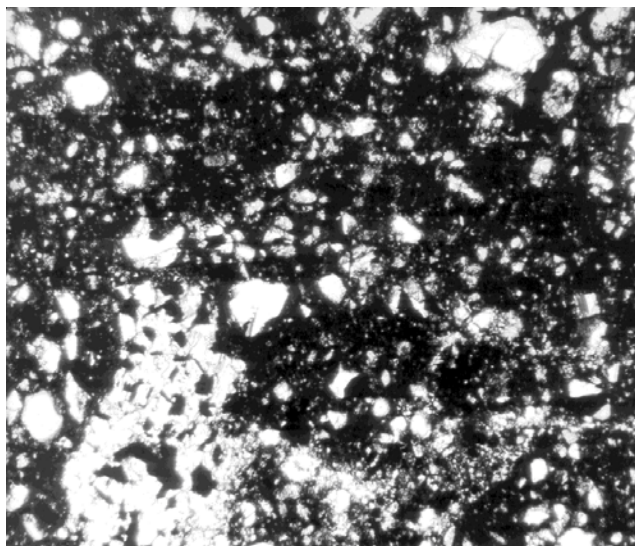


Figure 3: Photomicrograph of thin section 10094,6 showing dark matrix including mineral and basalt clasts. NASA S76-28122. Scale 2.5 mm.

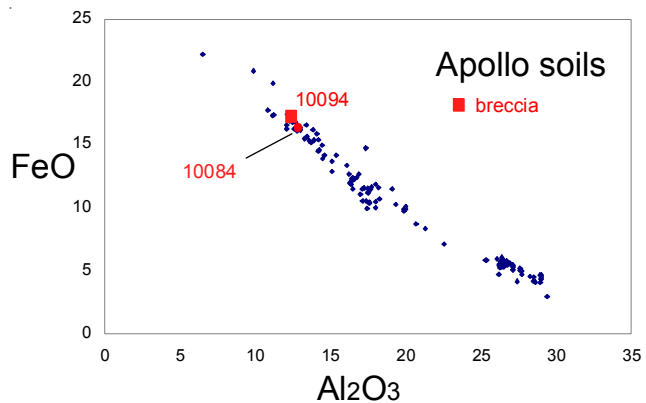


Figure 4: Composition of 10094 compared with Apollo soils.

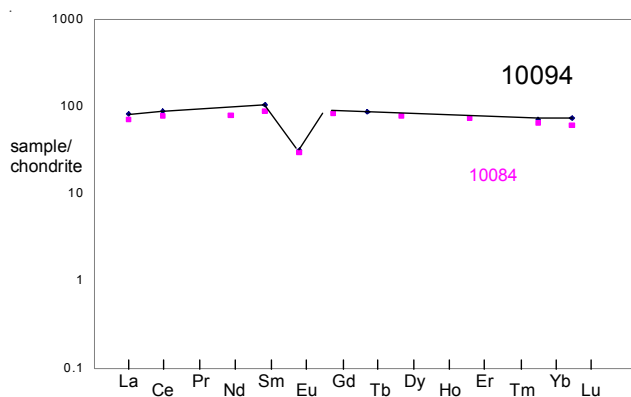
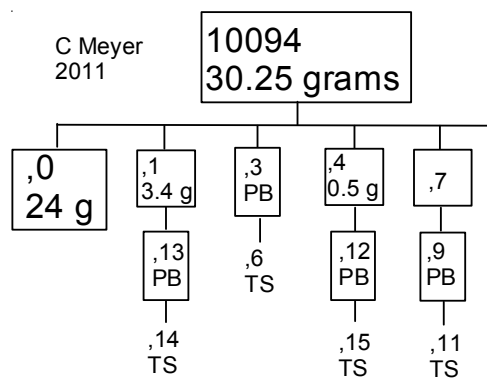


Figure 5: Normalized rare earth element diagram for breccia 10094 compared with soil 10084 (data from Wiesmann et al. 1975).



**Table 1. Chemical composition of 10094.**

reference weight	Rhodes81	
SiO <sub>2</sub> %	41.9	(a)
TiO <sub>2</sub>	7.86	(a)
Al <sub>2</sub> O <sub>3</sub>	12.84	(a)
FeO	16.29	(a)
MnO	0.25	(a)
MgO	8.01	(a)
CaO	11.78	(a)
Na <sub>2</sub> O	0.49	(a)
K <sub>2</sub> O	0.19	(a)
P <sub>2</sub> O <sub>5</sub>	0.12	(a)
S %		
sum		
Sc ppm	63	(b)
V	48	
Cr	2190	
Co	32	
Ni	201	
Cu		
Zn	48	
Ga	8	
Ge ppb		
As		
Se		
Rb	3.9	(a)
Sr	160	(a)
Y	112	(a)
Zr	345	(a)
Nb	21	(a)
Mo		
Ru		
Rh		
Pd ppb		
Ag ppb		
Cd ppb		
In ppb		
Sn ppb		
Sb ppb		
Te ppb		
Cs ppm		
Ba	230	(b)
La	19.4	(b)
Ce	54	(b)
Pr		
Nd		
Sm	15.4	(b)
Eu	1.79	(b)
Gd		
Tb	3.2	(b)
Dy		
Ho		
Er		
Tm		
Yb	11.7	(b)
Lu	1.79	(b)
Hf	11.6	(b)
Ta	1.7	(b)
W ppb		
Re ppb		
Os ppb		
Ir ppb		
Pt ppb		
Au ppb		
Th ppm	2.2	(b)
U ppm		

technique: (a) XRF, (b) INAA

**References for 10094**

- Fruland Ruth M. (1983) Regolith Breccia Workbook. Curatorial Branch Publication # 66. JSC 19045.
- Goles G., Randle K., Osawa M., Schmitt R.A., Wakita H., Ehmann W.D. and Morgan J.W. (1970) Elemental abundances by instrumental activation analyses in chips from 27 lunar rocks. *Proc. Apollo 11 Lunar Sci. Conf.* 1165-1176.
- King E.A. *and a cast of thousands* (1969) Lunar Sample Information Catalog, Apollo 11. Lunar Receiving Laboratory, MSC 412 pp
- Kramer F.E., Twedell D.B. and Walton W.J.A. (1977) **Apollo 11 Lunar Sample Information Catalogue** (revised). Curator's Office, JSC 12522
- Lofgren G.E. (1971b) Devitrified glass fragments from Apollo 11 and Apollo 12 lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 949-955
- LSPET (1969) Preliminary examination of lunar samples from Apollo 11. *Science* **165**, 1211-1227.
- Phinney W.C., McKay D.S., Simonds C.H. and Warner J.L. (1976a) Lithification of vitric- and clastic-matrix breccias: SEM photography. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2469-2492.
- Rhodes J.M. and Blanchard D.P. (1981) Apollo 11 breccias and soils: Aluminous mare basalts or multi-component mixtures? *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 607-620.
- Schmitt H.H., Lofgren G., Swann G.A. and Simmons G. (1970) The Apollo 11 samples: Introduction. *Proc. Apollo 11 Lunar Science Conf.* 1-54.
- Simon S.B., Papike J.J., Shearer C.K. and Laul J.C. (1983) Petrology of the Apollo 11 highland component. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf. in J. Geophys. Res.* **88**, B103-138.
- Simon S.B., Papike J.J. and Shearer C.K. (1984) Petrology of Apollo 11 regolith breccias. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf. in J. Geophys. Res.* **89**, C109-132.