COMPARISON OF AGGLUTINATES FROM APOLLO SITES; Abhijit Basu[1] and D.S. McKay[2], [1]Department of Geological Sciences, Indiana University, Bloomington, IN 47405; [2]NASA-JSC, Houston, TX 77058, U.S.A.

INTRODUCTION. Agglutinates are the principal constructional, i.e., authigenic products of space weathering on the moon and possibly on other atmosphere-free planetary bodies [4]. Production of agglutinates is accompanied by production of new phases such as glass, fine-grained Fe^0, possibly Fe-Ni metal, and some chemical fractionation including partial loss of volatile components [3]. Thus, the concentration of agglutinates affects remotely sensed properties of planetary surfaces [1,7,9]. Agglutinates also serve as recorders of lunar soil evolution and presence or absence of critical clast-types may provide some stratigraphic datum [10].

A comparative quantitative study of agglutinates in each surface soil from the Apollo sites should promote not only a better understanding of lunar soil evolution but also aid in future planetary exploration. We report a petrographic assessment of agglutinates in 18 surface and trench soils available from the Apollo 11, Apollo 12, and Apollo 14 missions.

METHODS and RESULTS. We have determined the concentration of agglutinates in the 90-150μm size fraction of each soil by counting approximately 500 grains in polished grain mounts using both transmitted and reflected light (Table 1). Small slivers (<10% of whole grain) of agglutinatic material attached to external surfaces of mineral, rock, or glass fragments were disregarded; agglutinates within regolith breccias were not included in our totals. These two criteria make our present set of data different from previously published values. Our population (500 grains) is greater than that used in some previous studies (e.g. [4]), so that the present data have somewhat better counting statistics, particularly at low agglutinate abundances. Because our data set is internally consistent it is more suitable for our purpose of comparative studies of agglutinates.

DISCUSSION. Agglutinate abundance (A%) correlates well with I_s/FeO reported in [6] (fig. 1). For Apollo 12 soils $I_s/FeO = -1.36 + 1.23A\%$ (r=0.90), and for Apollo 14 soils $I_s/FeO = -3.81 + 1.78A\%$ (r=0.94). Two different slopes for the regression lines for the two missions suggest that rates of agglutinate production are dependent also on target composition. Some characteristics of agglutinates are described and discussed below in the context of each mission.

APOLLO 11 (Sample 10084). Nearly all of the glass in Apollo 11 agglutinates are brown to deep brown as is expected in a nearly pure basaltic parent regolith. Unlike those in Apollo 12 and 14, fragments of regolith breccias in 10084 contain clasts of agglutinates (comparable to regolith breccia 10046). Therefore, a large population of such regolith breccias in a soil may also significantly affect remote sensing signals.

APOLLO 12 (Samples 12003; 12024; 12032; 12033; 12037; 12042; 12044; 12070). Of particular interest are the two most immature soils 12032 and 12033 which are unusually rich in KREEP and in ropy glasses. Ropy glass clasts are extremely rare in Apollo 12 agglutinates, including those in 12032 and 12033, indicating that the ropy glasses were either delivered to the site very recently, or, that they were delivered early, buried, and exhumed very recently. Because ropy glasses occur in primarily immature soils and are rare even in the agglutinates in these soils, we reiterate our earlier conclusion that ropy glasses are exotic to Apollo 12 site and may have come along a ray from Copernicus [11].

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APOLLO 14 (Samples 14003; 14141; 14148; 14149; 14156; 14163; 14230; 14259; 14260). Clasts of glass spheres and recrystallized melt matrix breccias are more common in Apollo 14 agglutinates than in those of Apollo 11 and Apollo 12. In addition, relatively more non-agglutinate grains in these soils have thin slivers of brownish agglutinatic material attached to their exteriors (compare "coated grains" of [2]) than those in Apollo 11 and Apollo 12 soils. Grains in Apollo 14 soils have been recycled more than those of Apollo 11 and Apollo 12, suggesting the presence of an ancient regolith component.

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Table 1. Concentration of agglutinate grains in the 90-150µm fraction of Apollo 11, Apollo 12, and Apollo 14 soils. Values quoted in [6] are given for comparison. Note that in this work we use a 10% rule to make a grain qualify as an agglutinate.

Sam	This work (90-150µm)	Other	Ref
10084	44.2	52.0	[8]
12003	34.7		
12024	28.5		
12032	17.8	29.0	[5]
12033	11.4	17.0	[8]
12037	19.4	27.0	[5]
12042	51.7		
12044	39.7	44.0	[5]
12070	49.1	45.0	[5]
14003	44.3	60.3	[4]
14141	10.2	5.2	[4]
14148	38.8	50.2	[4]
14149	24.1	26.4	[4]
14156	42.3	47.7	[4]
14163	35.1	45.7	[8]
14230	38.9		
14259	48.4	51.7	[4]
14260	43.8		

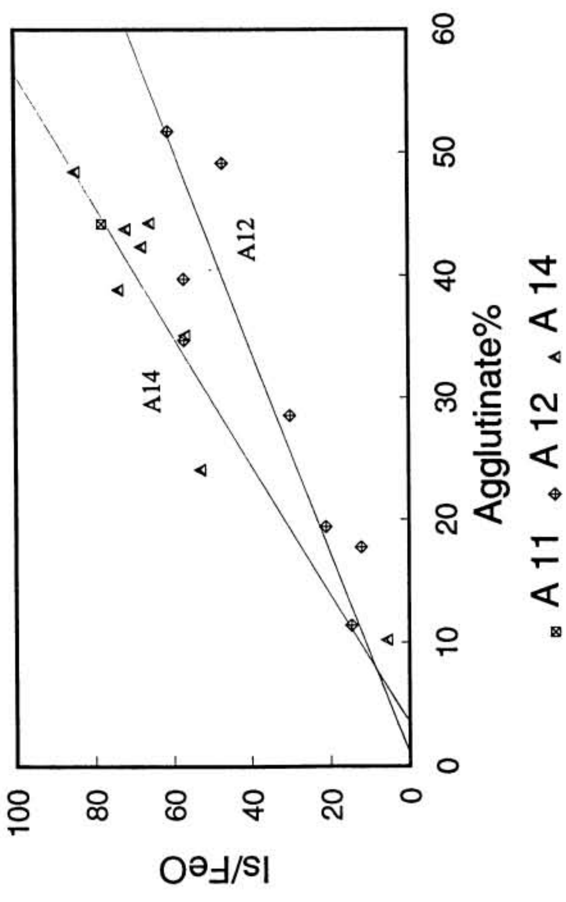

Fig. 1. Plots of agglutinate% vs. I_s/FeO show two regression lines for Apollo 12 and Apollo 14 soils.