

MINERALOGY AND PETROLOGY OF SEVERAL APOLLO 14
ROCK TYPES AND CHEMISTRY OF THE SOIL

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Microbreccia 14305-4 and rock fragments from a one-gram sample of coarse fines (14257) were studied in detail by optical and electron microprobe techniques.

Microbreccia 14305-4 and several fragments of breccia in the coarse fines show completely recrystallized matrices and their clasts exhibit the following shock and heat effects:

- a) brecciation of single-crystal and rock fragments
- b) partial melting and reaction zones along outer edges of and fractures in single-crystal fragments
- c) microfaulting as shown by displaced twin lamellae
- d) devitrification and recrystallization of spheroidal clasts originally probably glass spherules.

Almost totally gradational contacts between some rock clasts and the matrix were also noted. Other microbreccia fragments show only partially devitrified matrices and some are completely unrecrystallized with glass clasts and glass matrix. Pyroxene compositions of various breccia types are shown in fig. 1 and compositions of glass fragments and unrecrystallized matrix (m) in fig. 2.

Five mineralogically and texturally distinct igneous rock fragments in the coarse fines were selected for study. These are (see fig. 1 for pyroxene and olivine compositions):

A-microgabbro. Very similar to the relatively coarse grained Apollo 12 material, with pyroxene ranging from pigeonite to subcalcic augite, showing relatively little chemical zonation in single pyroxene grains; plagioclase (An 88) and ilmenite and traces of troilite and iron are the remaining constituents.

B-olivine-ilmenite basalt. The olivine (Fo 57-60) is coarse-grained and set in a finer grained, finely intergrown matrix of augite to ferroaugite, plagioclase (An 76-84) and ilmenite. TiO_2 and Al_2O_3 contents, in these pyroxenes range from 1.70 to 4.55 and 2.5 to 6.1 respectively.

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P.456

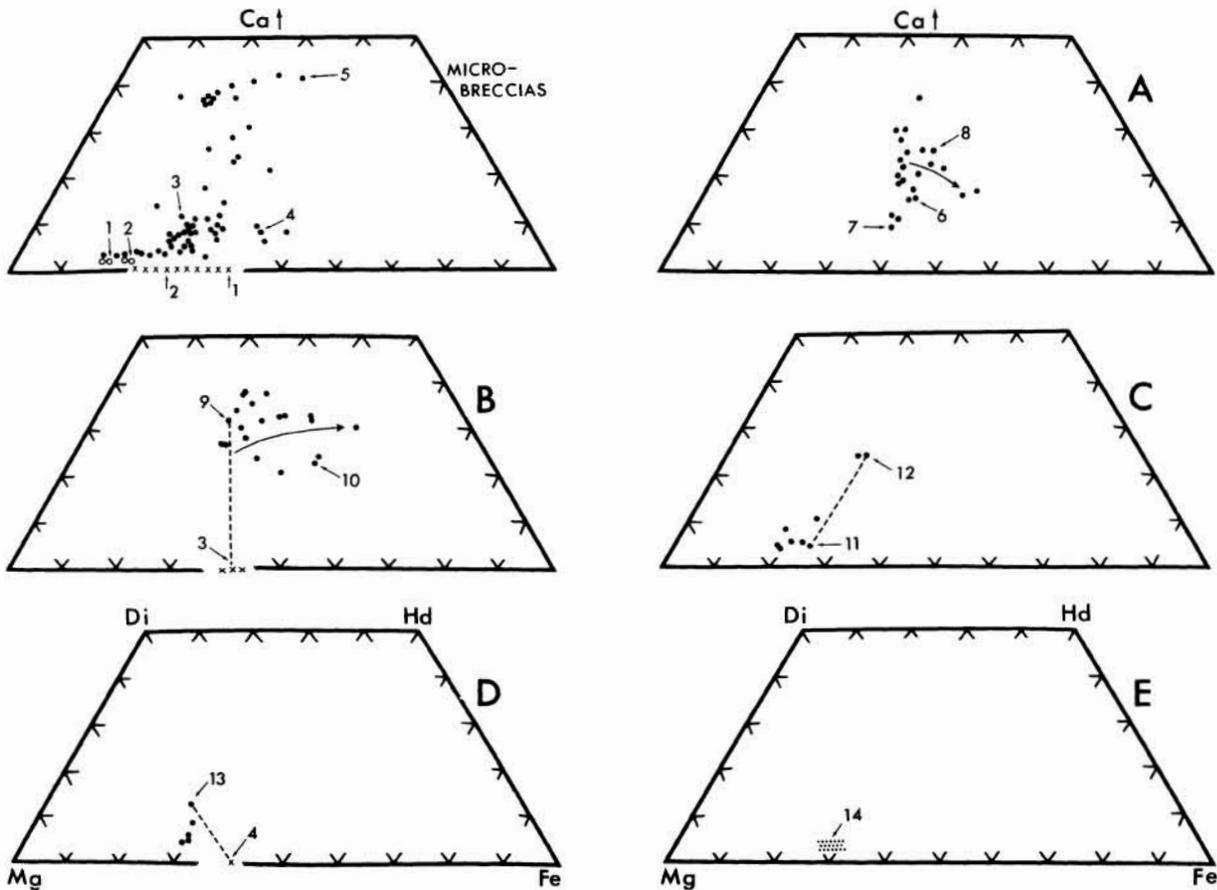


Fig. 1. Pyroxene and olivine compositions in microbreccias and igneous rock fragments A-E. ● = clinopyroxene; ○, • = orthopyroxene; × = olivine. Dashed lines connect coexisting phases and curved arrows indicate compositional zonation from core to rim in a single grain.

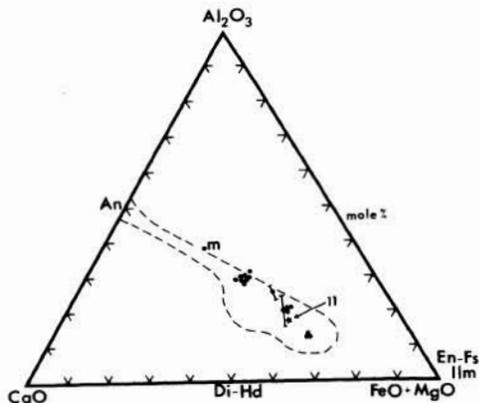


Fig. 2. Compositions of glass fragments in and matrix (m) of unrecrystallized breccia. Dashed line outlines compositional range of Apollo 11 glasses in fines. No. 11 is scoriaceous glass average for Apollo 11 (after Frondel et al., 1970 and Winchell et al., 1970).

Apollo 14 Mineralogy Petrology
Klein, Cornelius, Jr.

P.457

C-ophitic basalt. Almost identical in texture to rock 14310 (LSPET), consisting of subhedral plagioclase laths (An 86-90), some light colored magnesian pigeonite, minor dark brown augite, and traces of ilmenite and troilite. Small amounts of K-rich glass occur interstitially.

D-anorthosite. Highly granulated, fine-grained plagioclase (An 90-96) with about ten percent olivine (Fo 60) and magnesian pigeonite.

E-norite. Strongly sheared and granulated plagioclase (An 86-93) enclosing larger, anhedral bronzite grains. The basaltic rocks (A,B,C) show considerably less Fe-enrichment and zonation of single crystal pyroxene grains than was observed in the pyroxenes of the Apollo 12 basalts.

The outer surfaces of several of the rock fragments and many of the glass fragments and spheroidal bodies in the coarse fines show fine-scale spallation features and microcratering due to the impact of hypervelocity particles. Similar craters occur on some iron-nickel fragments in the coarse fines. Most of the iron-nickel occurrences are spheroidal or globular in form and their Ni and Co contents range from 2.0 to 9.1 and 0.34 to 0.68 weight percent respectively.

Three size fractions of the fines (14259-23) were analyzed chemically:

	SiO ₂	Al ₂ O ₃	TiO ₂	Cr ₂ O ₃	FeO
1) average fines (<1mm)	47.9	17.5	1.74	0.25	10.49
2) <595>177 microns	47.8	17.5	1.70	0.27	10.36
3) <10 microns	47.6	18.4	1.82	0.25	10.25

	MnO	NiO	CoO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	Total*
1)	0.14	0.06	0.01	9.35	11.09	0.70	0.56	0.55	100.34
2)	0.14	0.06	0.01	9.50	11.10	0.72	0.59	0.54	100.29
3)	0.14	0.06	0.01	8.30	11.65	0.70	0.55	0.66	100.39

*) S is present in each analysis.

The FeO and TiO₂ contents are distinctly lower than in the average analyses of Apollo 11 and 12 fines, whereas the Al₂O₃ and SiO₂ contents are much higher. These differences reflect the higher plagioclase and lower ilmenite contents of the rocks and resulting fines and the relatively magnesian clinopyroxene and orthopyroxene occurrences.