PATTERN RECOGNITION STUDIES ON APOLLOS 11, 15, 16 and 17 DATA

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Similarities in chemical composition for 222 soils and rocks returned from the Apollo missions were studies with pattern recognition. The feasibility of pattern recognition for lunar data interpretation has been shown (2).

Data for Apollos 11, 15, 16, and 17 soils, basalts, breccias, and anorthosites were chosen from the lunar data base tapes compiled by Warner at the NASA Johnson Space Center. From the data available the computer program chose Al_2O_3, CaO, FeO, K_2O, MgO, TiO_2, La, Ce, Sm, Eu and Dy for use. Each species was considered a separate dimension; the original data was thus represented in eleven dimensional space. Figure 1 shows a KARLOV eigenvector plot of the data. The best species for the separation of these groups are given in Table 1.

If only the Apollo 11 mission is considered two rather diffuse basaltic groups are seen, one being quite similar to the Apollo 17 basalts as had been previously shown (1). Two Apollo 11 basalts, 10045 and 10069 (top of the plot) are very chemically dissimilar from the other Apollo 11 basalts.

Apollo 15 basalts are quite similar to those of Apollo 17 with Eu and TiO_2 being the separating features. All Apollo 15 basalts fell into the same class. Two Apollo 15 anorthosites, 15415 and 15362 are very similar to the Apollo 16 anorthosite group. The Apollo 15 breccias are similar to the Apollo 17 breccias and soils, being quite distinct from Apollo 16 breccias.

The Apollo 16 samples show a rather interesting trend. A previous study (2) showed four distinct rock groups, separating the breccias, basalts, poikilitic rocks and anorthosites. When Apollo 16 soils were considered, they form one rather tightly spaced group between the breccias and the basalts. No Apollo 16 soils was found that showed similarities to the poikilitic rocks. Table 1 shows that Sm is essentially the only species studied that defines these different Apollo 16 groups, as can be seen from the weighting values.

Apollo 17 shows three interesting basalt groups which will be studied further (3). There are two distinct Apollo 17 soil types, one resembling the Apollo 17 breccias and basalts and the other more similar to Apollo 16 basalts and soils. Apollo 17 breccias form two groups, one similar to other Apollo 17 species and the second intermediate in composition between Apollo 16 and 11 basalts. Single samples not falling into major representative categories were identified.

Pattern recognition is useful in the simultaneous studies of the various groups to find intercategory and intracategory similarities and differences.

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TABLE 1.

SPECIES MOST IMPORTANT IN THE SEPARATION OF CATEGORIES AND THEIR WEIGHTS

A - 11		A - 16		A - 17		TOTAL DATA	
Al_2O_3	.82	Sm	.94	Eu	.482	Sm	.184
TiO_2	.078	MgO	.042	Al_2O_3	.165	Eu	.17
Ce	.053	TiO_2	.003	La	.055	TiO_2	.120
CaO	.009	Ce	.0014	FeO	.051	Al_2O_3	.091
Eu	.007			Dy	.005	K_2O	.033
Sm	.003						

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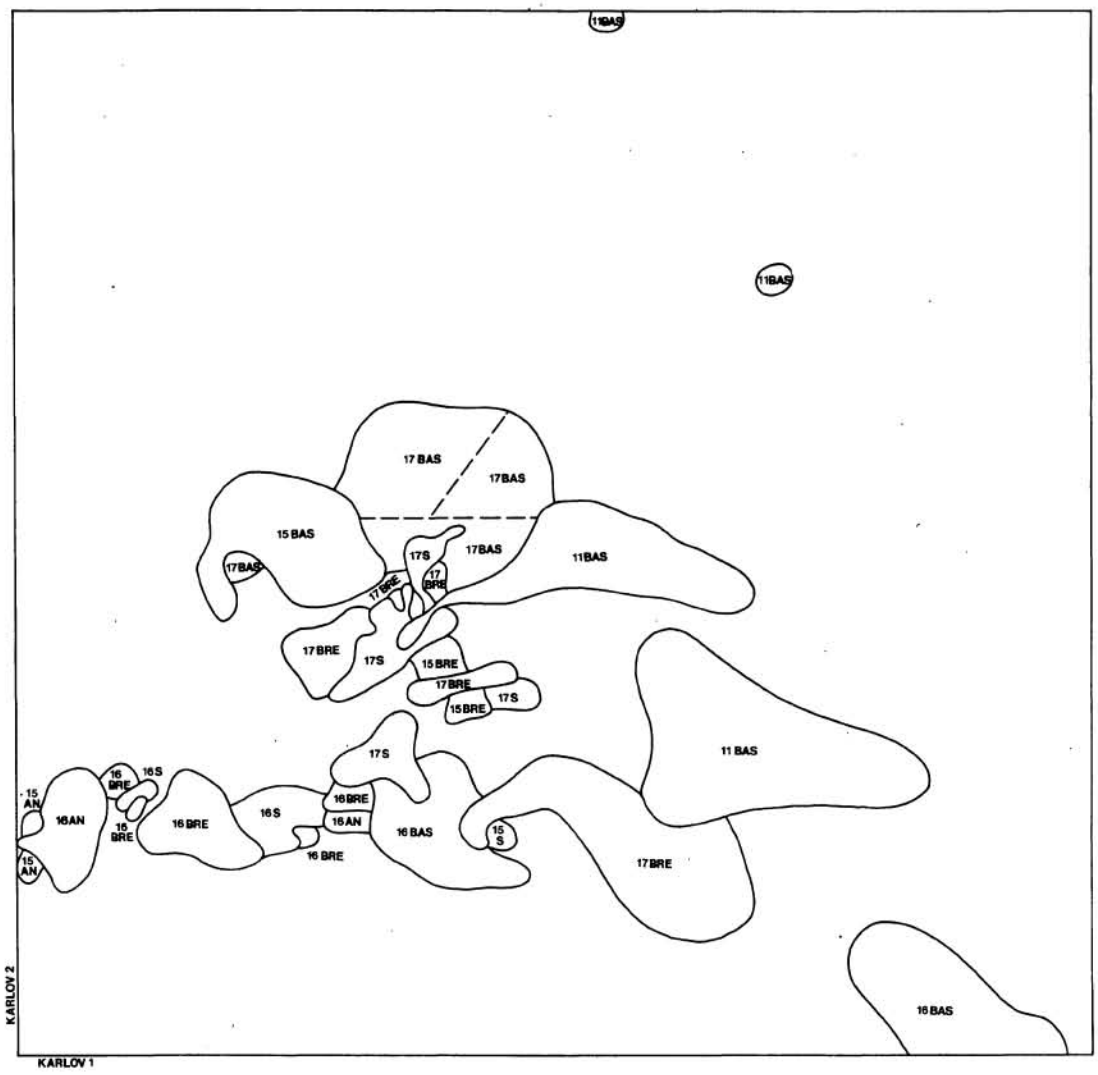

Figure 1. KARLOV eigenvector plot of the total data.