DISCRIMINANT ANALYSIS OF THE PRISTINE LUNAR GLASSES: IMPLICATIONS FOR A MAGMA OCEAN. M.M. Fernandez and J.W. Delano, Dept. of Geological Sciences, State University of New York, Albany, NY 12222

INTRODUCTION: Based upon a less extensive set of data than presently exists, Delano and Livi [1] initially proposed that the pristine lunar glasses defined 2 major groupings that they termed "arrays". This suggestion was predicated on the consistent appearance of two, parallel groupings of glasses in their diagrams. To examine their claim for two arrays among the pristine lunar glasses, discriminant analysis was performed on the data using the procedure DISCRIMINATE of the Statistical Package for the Social Sciences [SPSS; 2].

RESULTS: Three separate runs were made in this study using different input-parameters in order to test the uniqueness of the proposed "two arrays" among the lunar glasses. Run #1 used the weight percentages of SiO_2, TiO_2, Al_2O_3, FeO, MgO, and CaO as potential discriminating variables. The Table shows the statistical parameters associated with the resulting function. All parameters indicate that there is a high degree of separation into two groups. The strong discriminating power of the variables is shown by the very low (0.089) value of the Wilks' Lambda and the high (0.954) Canonical Correlation Coefficient. The Figure is a histogram of the discriminant scores for the 25 glasses showing that the groups are cleanly separated with no overlap. However, while the assumptions of normality and equality of covariance matrices are not satisfied by the data set of RUN #1, the usual effect of such violations is a loss of accuracy, in the sense that group centroids may not be well-separated and the number of misclassifications may increase. It is evident that such effects are not present in RUN #1 (Figure) either because (a) the violations are minor or (b) the discriminating variables are so powerful that the method is able to detect the differences despite the violations.

To avoid any significant effects of violations that may have existed in RUN #1, the coefficients of the variables were inspected to determine which ones had the greatest discriminating power and were least correlated with other variables. It was found that Al_2O_3 and MgO satisfied these constraints and were used in RUN #2. The results listed in the Table show that the differences between RUNS #1 and #2 are small, thereby indicating that the effects from violations in RUN #1 had been negligible. In RUN #2 the Wilks' Lambda remained low (0.158) and the Canonical Correlation Coefficient was high (0.918). The Figure is a histogram showing that the groups are again cleanly separated with no overlap. It is clear that the RUN #2 function is a powerful discriminator having the statistical advantage of including only two, relatively uncorrelated ($r = 0.313$) variables (i.e. Mg, Al).

RUN #3 used the normative compositions of the 25 pristine glasses, specifically % feldspar, % ferromagnesian silicates (olivine + pyroxenes), and % ilmenite. The results of this run also show a high degree of separation between the two groups of glass. The Table again shows that the Wilks' Lambda was low (0.116) and the Canonical Correlation Coefficient was high (0.940). All samples were correctly classified using this function and the lowest probability of group membership was 0.9998. The groups are cleanly separated in the Figure.

We conclude from these 3 runs that the 25 varieties of pristine lunar glass display a high degree of separation into two major groups. This separation is particularly evident in Al_2O_3 and MgO for the run using the major-element abundances, and in % feldspar and % ferromagnesian silicates for the run using the normative components. These results strongly support the

original proposal of Delano and Livi [1] that two "arrays" exist among the pristine lunar glasses.

IMPLICATIONS FOR A MAGMA OCEAN: The two "arrays" of pristine lunar glass were apparently caused by assimiliation of discrete cumulate components in the lunar mantle source-regions during partial melting [3]. The fact that these "arrays" are observed in glasses from all of the Apollo landing sites indicates that these discrete mantle components were (a) chemically quite uniform and (b) regionally, if not globally, persistent. A magma ocean during the early history of the Moon would appear to be required in order to account for these two major aspects, which derive entirely from the observation that two arrays exist among the pristine glasses.

REFERENCES: [1] Delano and Livi (1981) Geochim. Cosmochim. Acta, 45, p. 2137-2149. [2] Nie, Hull, Jenkins, Steinbrenner, and Dent (1975) Statistical Package for the Social Sciences. McGraw-Hill. [3] Delano (1986) PLPSC 16th, in press.

Table. Parameters associated with discriminant functions for each run.

	RUN #1	RUN #2	RUN #3
Wilks' Lambda	0.089	0.158	0.116
Canonical Correlation	0.954	0.918	0.940
Smallest probability	1.000	0.997	0.999