MARE BASALT UNITS AND THE COMPOSITION OF THEIR MAGMAS;

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This abstract describes the synthesis of a large body of data on the composition and characteristics of the lunar mare basalts. The goals of this study were to identify the number of distinct magma units present at each mare landing site; to determine which of the basalt samples came from each of these units; and to estimate the major oxide and trace element composition of the parental magmas of each of these units. The results of this synthesis are a considerable extension of those presented in an earlier paper by one of the authors (1).

In order to facilitate the handling and analysis of the available data, we make use of a computer based data library in which we have stored most of the existing major oxide, trace element, age etc. data on the analysed mare basalts. These data stem from the general lunar literature (e.g. Proceedings and abstracts of the Lunar Sci. Conf., JGR, Earth Plant. Sci. Lett., etc.).

In order to identify the lava units and the rocks which came from each unit, we

(i) used the results of (1) and other investigators (e.g. 2,3,4) as a basic guide for our analysis;

(ii) plotted the appropriate data in pseudo-ternary phase diagrams for the Ol, An, Qtz system and in pseudo-quaternary phase diagrams for the Ol, An, Qtz, Cp and Ol, An, Qtz, Ilm systems and in a variety of oxide vs oxide, oxide vs Mg'=100 Mg/(Mg+Fe), trace element vs oxide, etc. diagrams;

(iii) used the petrological description of the samples.

After the rock units were defined, the composition of the original magma of each unit was estimated using one of two methods.

1) Vitropheric or holohyaline rocks, if available, were taken as representatives of the original magmas, since, as is accepted (e.g. 5,1) they have cooled quickly without significant differentiation.

2) When no glassy rocks are available for a unit the magma composition was assumed to be equal to the average of all the rocks of the unit.

In the cases where vitropheric and nonvitropheric rocks are available, we find that the composition of the magmas derived by methods 1) and 2) are essentially identical.

The results of the synthesis can be summarized as follows:

The APOLLO 11 basalts include two well defined units, a high K and a low K unit, and 3 poorly definable units. Despite the fact that the high K points in the various diagrams show a relatively large scatter, the currently available data are consistent with the interpretation that all high K basalts came from one lava unit. In the case of the low K basalts, which are of a much better quality than the high K points, the suggestion is made that 5 of the samples came from one flow unit and the three remaining samples came from three additional flows. The APOLLO 11 red glasses (6) may most probably represent a sixth unit, but cannot be as well defined as the green and orange glasses at the APOLLO 15 and 17 sites because of the small amount of the material.

The majority of APOLLO 12 basalts form two distinct olivine basalt flows. A third unit is represented by two high Al-basalt samples.

The APOLLO 15 basalt samples came from four well defined magma units and three poorly defined units. The four well defined units consist of two olivine microgabbro units, an olivine phyric and a pyroxene phyric unit as described in part by (2) based on the petrological characteristics of the basalts. Besides these units there are three additional basalt samples which may each represent an independent flow unit. The green glass represents an additional magma unit with a well defined composition. A high TiO_2 red glass (7) may be derived from an independent volcanic eruption and represents an identifiable but as yet poorly defined magma at the APOLLO 15 site.

The APOLLO 17 mare basalts fall into four distinct and two poorly defined compositional groups. All of these units are ilmenite rich and have very similar composition. The APOLLO 17 orange glasses are regarded to represent a seventh distinct magma type found at the site.

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The analysis of the LUNA 16 and 24 samples is hampered by the fact that the samples are basically fines. However, it appears that the samples from these two sites represent at least five magma types, which at present are very poorly defined.

Thus, the returned samples can be used to identify some 32 magma units, 14 of which are compositionally well defined.

References

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