

SIZE-COMPOSITION RELATIONSHIPS IN GREEN AND ORANGE LUNAR GLASSES.

Abhijit Basu, Dept. Geol., Indiana U., Bloomington, IN 47405.

INTRODUCTION. Spherules of volcanic fire fountain glasses, terrestrial and especially those from the moon, namely the emerald green and the bright orange glasses, have always kindled an interest in the lunar science community [1]. However, no model is yet available relating the mean size of glass spherules and the style of eruption, physical properties, and the composition of the lava fountain.

As a first step in working towards such a model, an analogy may be drawn from spray formation studies of coal-oil mixtures. In a recent experiment various coal-oil mixtures, using oils of different densities and viscosities, were sprayed through an air blast atomizing nozzle [2]. The results show that the particle size of the spray depends, to a large extent, on the viscosity of the oil and the flow rates. The empirical equation derived for the mean diameter of the drops is of the form:

$$d = k_1 \sigma^{0.86} / \nu \rho^{0.5} + k_2 \{n^{0.95} / (\rho \sigma)^{0.5}\} (1 + L/A)$$

where, d = mean diameter of the drops; ρ = liquid density; σ = liquid surface tension; n = liquid viscosity; ν = relative air velocity; L = liquid mass flow rate; and, A = air mass flow rate [2]. In the lava fountain analog, the liquid is obviously a silicate melt and the air is the gas phase in the melt.

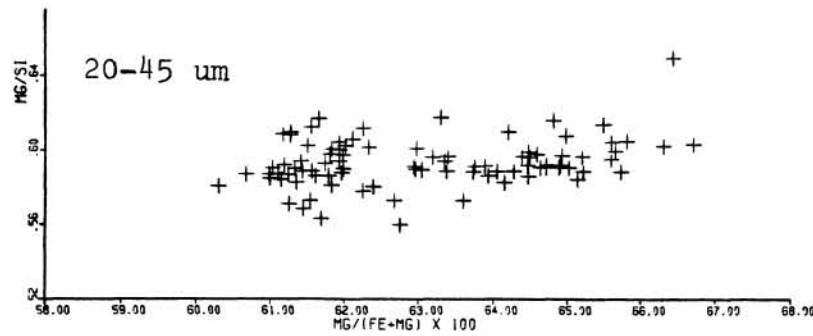
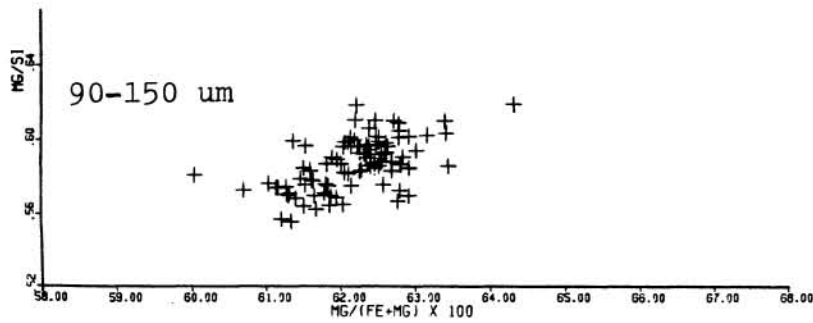
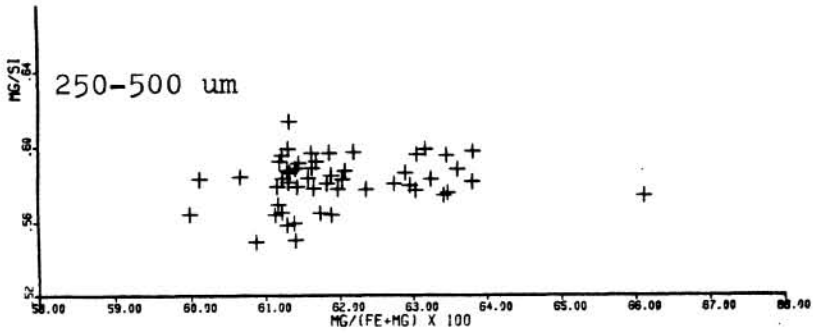
RATIONALE. We hypothesized that the compositions of silicate melts, their gas contents, flow rates, etc. would be sufficiently different for fire fountaining episodes distinctly separate in space and time. If so, the mean size of fire fountain spherules should be different in different episodes of eruption. Given that five compositional groups can be identified even within the Apollo 15 green glasses [3], it is likely that a size-compositional relationship exists in all the suites of volcanic fire fountain glasses.

RESULTS. We, therefore, undertook to analyze unbroken spherules in sieved size fractions of two green glass soils (15301; 15401) and one orange glass soil (74220) by electron microprobe. Our results (see figures) show that there is no difference in compositional variation between size fractions in each suite. Within the green glass suite the compositional variation indicates a two-fold difference in calculated viscosities at 1100°C--enough to affect the size distribution of the droplets according to the spray equation. Yet no size-compositional effect is discernible.

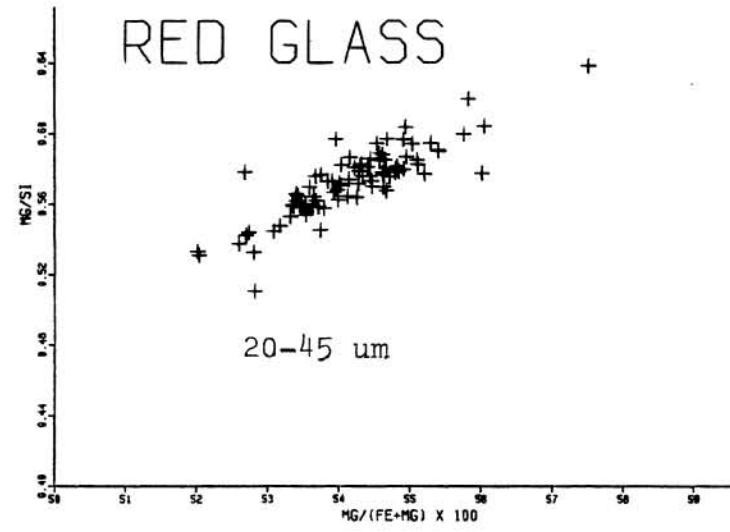
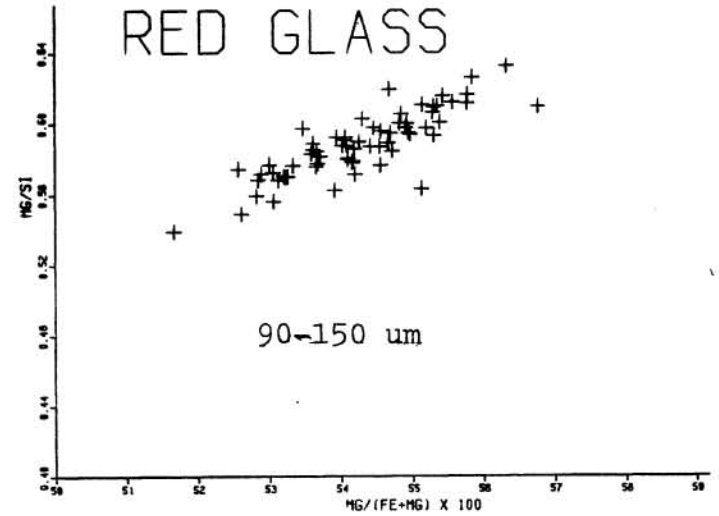
CONCLUSION. The ages of these glasses are also tightly grouped, 3.3 b.y. for the green glasses [4] and 3.48 b.y. for the orange glasses [5]. We conclude, in the light of our data, that each of these two groups of fire fountain glasses is a product of single sets of eruptions in which the physico-chemical conditions remained more or less the same. Such conditions may be indicative of primary magmas. Our results thus provide an indirect support to the proposal of Delano and Livi [6] that only a very small number of distinct primary magmas account for all the varieties of volcanic glasses on the moon.

REFERENCES. [1] Taylor, S. R. (1982) Planetary Science: A Lunar Perspective, LPI, Houston. [2] Carmi, S. and Ghassamzadeh, M. R. (1981) Fuel, 60, 529. [3] Delano, J. W. (1979) PLPSC 10, 275. [4] Heineke, J. C. et al. (1973) LSV, 377. [5] Schaeffer, O. A. and Hussain, L. A. (1973) EOS, 54, 613. [6] Delano, J. W. and Livi, K. (1981) GCA, 45, 2137.

GREEN GLASS



Plots of Mg/Si vs. Mg/(Mg+Fe) in selected size fractions of green and orange glasses from the moon.



Basu, A.