

COMMENTS ON THE BULK COMPOSITION MODEL OF THE MOON PROPOSED BY DELANO AND LINDSLEY. Alan B. Binder, NRC Senior Fellow, Johnson Space Center, Houston, TX 77058

Delano and Lindsley (1) have proposed a model of the bulk composition of the moon using the compositional systematics observed in the mare volcanic glass units (2) and assuming that a "primitive" component of the moon is characterized by Ti/Al and Ca/Al elemental ratios which are cosmic, i.e., chondritic. However, as shown by even a simple inspection of Delano and Lindsley's figures and of the composition derived for their "primitive liquid", which is related [is a mixing end member? (2)] to the mare glass units, their assumptions and analyses are internally inconsistent and therefore their results are incorrect.

Delano and Lindsley show that in a plot of Ti/Al vs 1/Al, the low-Ti ends of both of the arrays of the mare volcanic glasses have a cosmic Ti/Al ratio. They take this observation as suggesting that there are "primordial lunar reservoirs" and a "primitive liquid" there retained Ca, Al, and Ti in their cosmic ratios and which is important in the genesis of the mare glasses. They then derive the composition of the "primitive liquid" in a chain of interrelated calculations in which the liquid's compositional points are assumed to lie on the lines passing through the linear arrays of the mare glass data and are defined via the cosmic ratios of Ti, Al, and Ca.

One of the critical points they overlooked is that, if their assumptions are correct, the spatial relationships of the compositional points of the liquid must be the same with respect to the mare glass data points in all compositional plots. Thus, since the low-Ti ends of both of the mare glass arrays end at the cosmic Ti/Al ratio, the "primitive liquid" compositional points would have to be at the ends of the linear arrays of mare glass data in all other compositional plots, but this is not the case.

As shown here in Fig. 1, the 1/Al liquid compositional point defined by the Ca/Al ratio is well beyond the end of the mare glass data array. Similarly, as shown in Fig. 2, the Mg-Ti point defined via Delano and Lindsley's assumptions is well within the array of data points. Similar internal inconsistencies are observed in all of Delano and Lindsley's figures.

The variations in the elemental ratios used by Delano and Lindsley needed to bring the "primitive liquid" compositional points in the figures to a common point in relation to the data vary from a factor of 1.3 for Ca/Al to more than a factor of 10 for Ti/Al, and are about a factor of 3 for Fe/Al and Mg/Ti. This internal inconsistency of the results is further demonstrated by noting that, if the 15.2% Al_2O_3 and 16.7% MgO derived by Delano and Lindsley for the composition of their "primitive liquid" is plotted in their Fig. 1, the "primitive liquid point" plots well above - and shows no conceivable end member relationship to - the two arrays of mare volcanic glasses.

These, and additional internal inconsistencies in their results clearly show that assumptions are not valid and that any proposed "primitive liquid" and parental "primordial lunar reservoirs" do not have compositions characterized by cosmic ratios of its elements. This further means that such proposed liquids and reservoirs are not primitive or primordial in the sense used by Delano and co-workers and of course that the results presented are fictitious.

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- 1) Delano J.W. and Lindsley D.H. (1983) Proc. Lunar Planet. Sci. Conf. 14, p. B3-B16.
- 2) Delano J.W. and Livi K. (1981) Geochim. Cosmochim. Acta, 45, p.

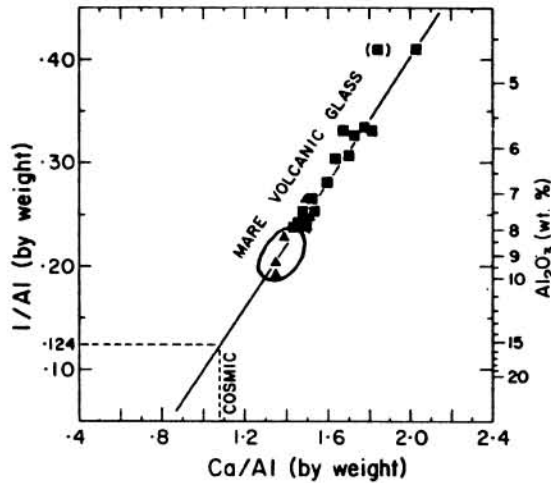


Fig. 1. $1/Al$ vs Ca/Al . The $1/Al$ compositional point of the "primitive liquid" defined by Delano and Lindsley is at the intersection of the dashed lines with the solid line. However, since the Ti/Al ratio point is at the ends of the data arrays in their Fig. 7, the $1/Al$ point is mathematically constrained to lie approximately in the ellipse at the end of the array of mare glass data in this diagram. Since it does not, their assumptions and results are internally inconsistent. This figure is after Fig. 8 of Delano and Lindsley (1).

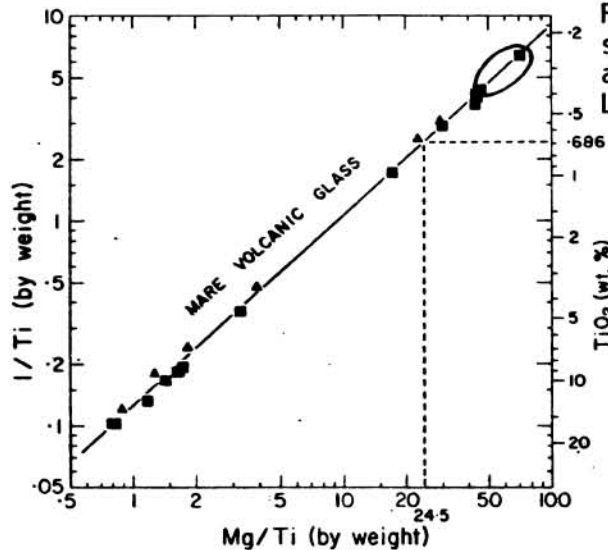


Fig. 2. $1/Ti$ vs Mg/Ti . Otherwise, same as Fig. 1. This figure is after Fig. 10 of Delano and Lindsley (1).