REMOTE SENSING CHEMISTRY OF GEOLOGICAL UNITS

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In conjunction with the La Jolla Consortium on remote sensing of the moon (1) recent studies (2, 3) which presented the Apollo orbital X-ray data (4) in array format found that the frequency distribution of the Al/Si data was bimodal. A cursory inspection of the Al/Si image (1, Plate 4) suggests the two modes to be mare and non-mare material. A systematic study is presented here which uses the generalized geologic map of the stratigraphy of the moon (1, Plate 10) to identify more carefully the nature of this bimodality. In addition the orbital Mg chemistry is also investigated.

The total coverage of the X-ray data shown in Figures 1-3 is about 5% of the lunar surface, that is, approximately 30,000 quarter degree square surface units. The frequency distributions in Figure 1-3 have been smoothed using a least squares cubic spline in order to faithfully reproduce the shape of the curves. The profile of the distributions are more significant than the magnitudes which are mainly function of the orbital coverage.

Figure 1 shows the frequency with which Al chemistry of each of the 30,000 quarter degree square surface units appears in the Al/Si X-ray image of the La Jolla Consortium data set. (1, Plate 4). The absolute values of percent Al by weight assumes a 21% uniform composition for Si and the ground truth procedure outlined by Bielefeld (5). The geologic map (1, Plate 10) was used as a mask to differentiate the total distribution. Clearly, the maria and the composite of earlier material (Prenectarian, Nectarian, Nectarian craters and Imbrian materials) resolve the bimodality of the Al data.

Figure 2 which displays the Mg frequency distribution records the result of multiplying the Al/Si image (1, Plate 4) with the Mg/Al image (1, Plate 5) and using the same Si and ground truth assumptions mentioned above. Although the range of mare and non-mare Mg values are similar, the most probable values clearly favor lower Mg values in Al rich non-mare materials. A companion abstract to this (6) associates these early non-mare units with higher topography than the majority of mare material.

Figure 3 shows the distribution of the very discriminating parameter Mg/Al. Prenectarian material has the lowest Mg/Al. The bimodality in the chemistry of the Imbrian materials is most easily seen in this presentation. A remapping of this data will show the geographical location of these two chemistries relative to to the center of the Imbrium event. The location of the surface units in the tails of the frequency distributions will be important in the search for extreme soil and rock types (7).

The wealth of information contained in Figures 1-3 and a companion image which maps the geographical location of the distributions of Al and Mg is only suggested in this abstract. This systematic study of all of the available orbital X-ray chemistries in the context of the stratigraphy of the moon validates on a global scale many of the conclusions of returned sample analysis and suggests areas of further investigations.

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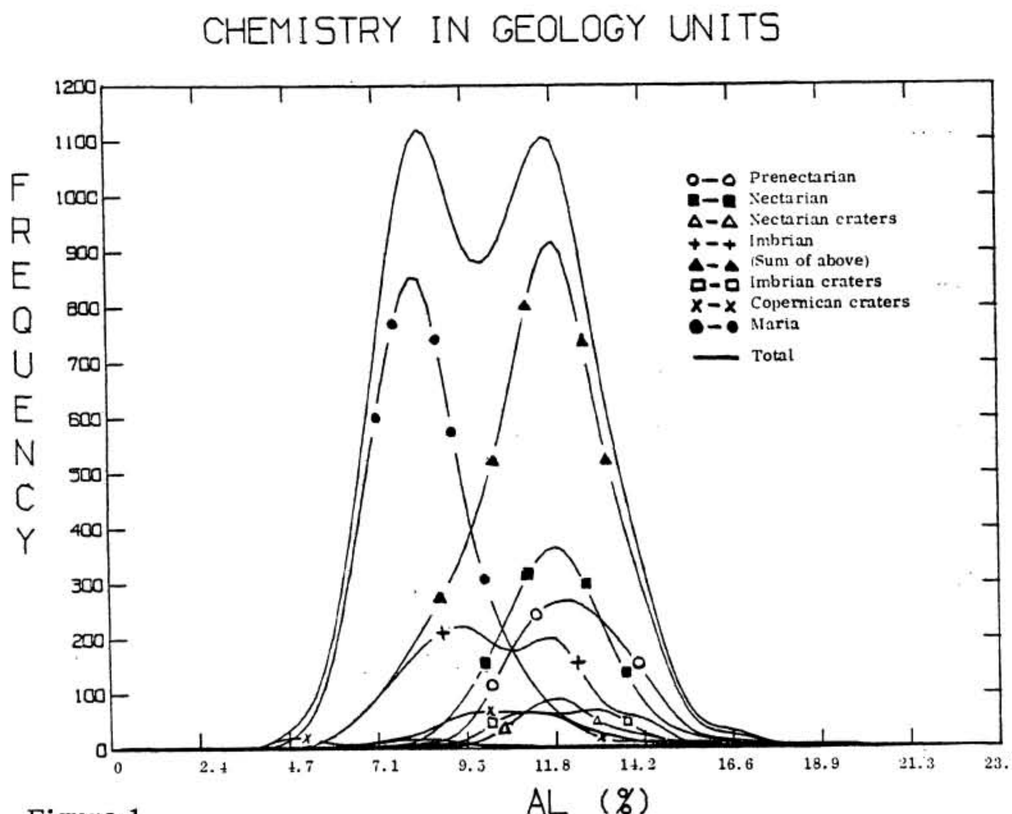

Figure 1

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References:

(1) Frontispiece (1977) Proc. Lunar Sci. Conf. 8th Plate 1-25. (2) Bielefeld, M. J. et al (1977) Proc. Lunar Sci. Conf. 8th p. 901-908. (3) Andre C. G. et al (1977) Science 197, p. 986-989. (4) Adler I. et al (1973) Proc. Lunar Sci. Conf. 4th p. 2783-2791. (5) Bielefeld, M. J. (1977) Proc. Lunar Sci. Conf. 8th p. 1131-1147. (6) Bielefeld, M. J. this volume. (7) Schonfeld E. and Bielefeld, M. J. (1978) Proc. Lunar Planet Sci. Conf. 9th in press.

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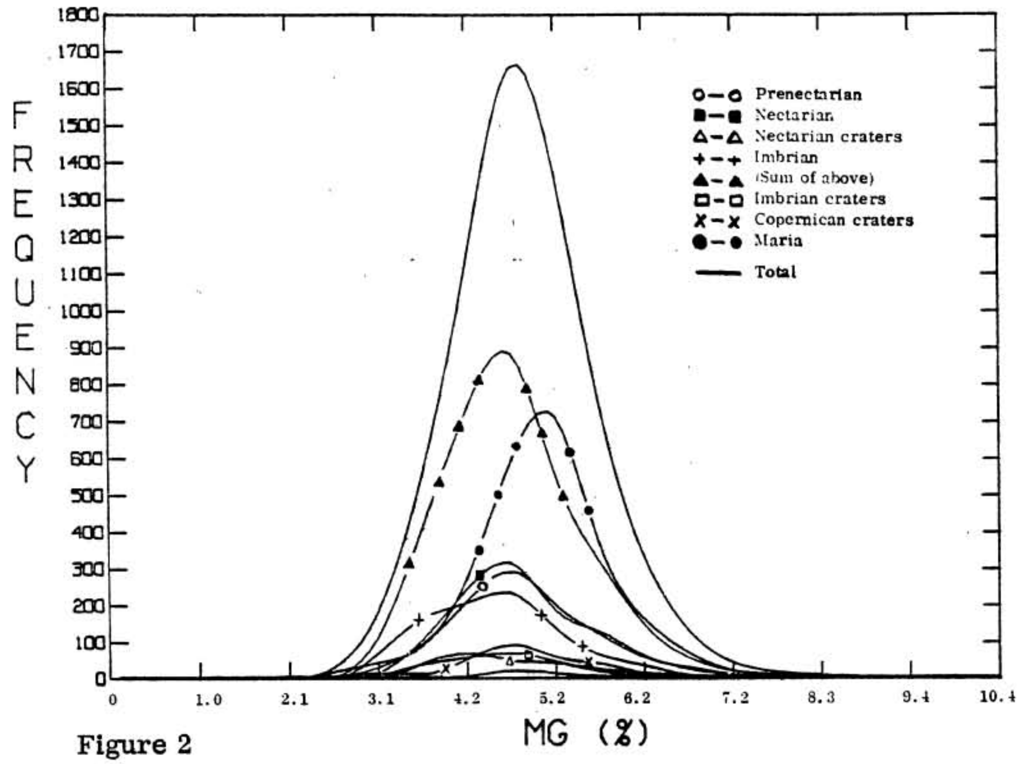

Figure 2

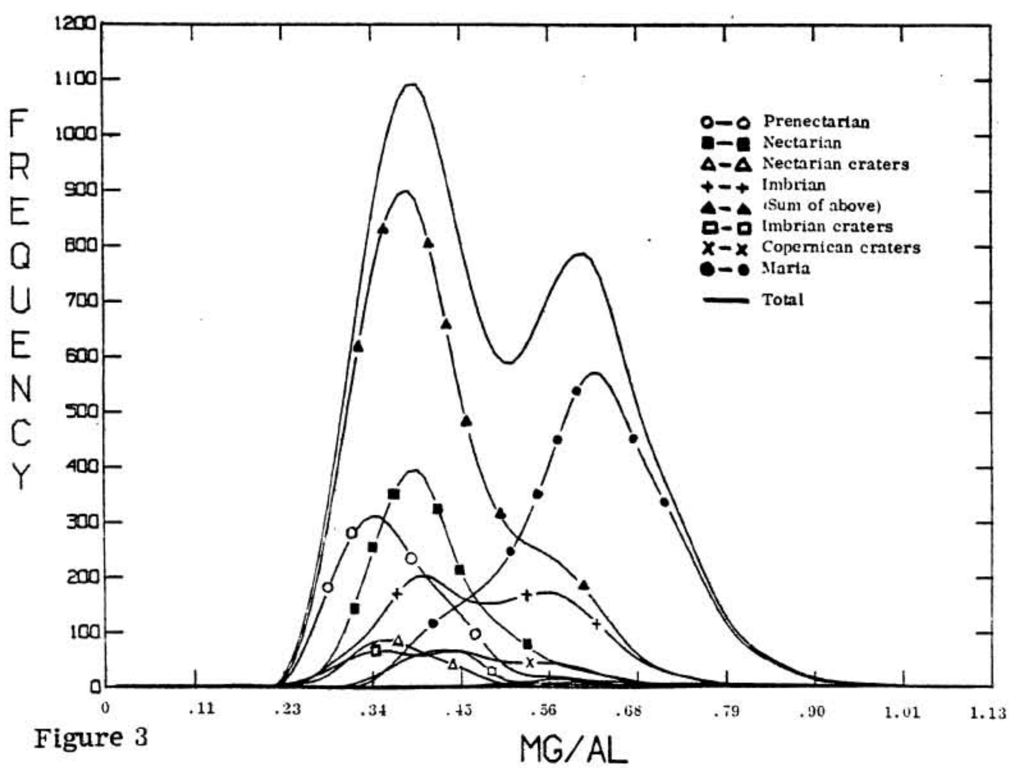

Figure 3