GAMMA RAY MAPS OF LUNAR TITANIUM AND IRON, James R. Arnold, Philip A. Davis, Dept. of Chemistry, Univ. of Calif., San Diego, La Jolla, Calif.; Robert C. Reedy, Los Alamos Sci. Lab., Los Alamos, New Mexico.

The discovery of high titanium content in the soil of Mare Tranquillitatis by Turkevich et al. (1) was one of the best known early results of space chemistry. It became clear from returned lunar samples that mare basalts in some regions are rich in Ti, while others are quite low. This element, then, is a distinctive marker for particular regions, and particular episodes of lunar history (2).

The gamma ray data obtained on Apollo 15 have provided evidence for high Ti in certain broad mare regions (3, 4). Spectral reflectance data have also been used successfully to yield information on Ti content in mare regions (5, 6).

Last year we reported new maps of Th and of Fe (7) obtained by an energy band method, using the image processing computer system of Eliason and Soderblom (8). The Fe map was produced using an energy band from 2.75 MeV to 8.6 MeV. Neutron capture by iron dominates the upper part of this energy band. In the lower part the major contributions to the count rate are from O, Si, Ti, and to some degree Fe (4, 9). Since the first two vary little over the lunar surface, the variance in this lower region must be due mainly to Ti and less strongly, Fe. There was a suggestion, then, that the reported Fe map produced from the whole band contained a contribution from Ti.

This suggestion has been verified. A computer tape for a narrower Fe band from 6.4 to 8.0 MeV has been provided by A. E. Metzger and R. Radocinski. By taking the difference between the count rates in the 2.75-8.6 MeV band and the new one, a new band from 2.75-6.4 MeV has been effectively generated. In this region it is apparent that most of the variance in count rate is due to Ti, though at present a measureable Fe component still remains.

The resulting color map, after smoothing to 39x39 or 59x59 (8), exhibits striking highs in Mare Tranquillitatis, extending northward into Mare Serenitatis and southeast into Mare Fecunditatis. The other major high is in the Aristarchus region, extending to the westward. No highs are seen in the Archimedes area, near Fra Mauro, or in the Van de Graaff area, in accordance with expectations for Ti. Other interesting details will be presented in the full paper.

We have also mapped ratios of the high energy bands, as an alternative approach to removing the Fe contribution. These maps are similar, but are not as satisfactory.

Two new Fe maps have also been obtained in collaboration with A. E. Metzger and M. Bielefeld. The first uses the 6.4-8 MeV band. The

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second is obtained from a narrow band (0.813-0.874 MeV) around the Fe inelastic scatter line at 0.84 MeV (4, 9), after subtraction of the large contribution of the radioactive elements in this region. This contribution is modelled as a calculated fraction of the broad 0.55-2.75 MeV count rate. Both of these maps are similar, but not identical, to the Fe map published last year. It is particularly valuable to be able to verify, in the case of Fe, that completely different nuclear processes and energy regions can yield concordant results.

In collaboration with Eliason and Soderblom, we have also continued to develop color methods of correlating two or more variables. These are now more satisfactory than those used to compare Fe and Th last year (7). Examples will be given.

References:

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