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MAPPING THE ELEMENTAL COMPOSITION OF THE MOON: CURRENT RESULTS OF THE LUNAR PROSPECTOR GAMMA RAY SPECTROMETER

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MAPPING THE ELEMENTAL COMPOSITION OF THE MOON: CURRENT RESULTS OF THE LUNAR PROSPECTOR GAMMA RAY SPECTROMETER. D. J. Lawrence[1], W. C. Feldman[1], A. B. Binder[2], S. Maurice[3], B. L. Barraclough[1], R. C. Elphic[1], [1]Los Alamos National Laboratory, MS-D466, Los Alamos, NM, 87545 USA, djlawrence@lanl.gov; [2]Lunar Research Institute, Gilroy, CA 95020, USA; [1,3]Observatoire Midi-Pyrénées, Toulouse, FRANCE.

Introduction: One of the instruments on board the recently launched Lunar Prospector spacecraft is a Gamma-Ray Spectrometer (GRS) designed to map the surface elemental composition of the Moon. Specifically, the objectives of the GRS are to map abundances of Fe, Ti, U, Th, K, Si, O and if possible Mg, Al, and Ca. The GRS consists of a bismuth germanate (BGO) crystal placed within a well shaped borated plastic scintillator anti-coincidence (ACS) shield. Events triggering only the BGO are labeled as accepted events; events triggering both the BGO and ACS are labeled as rejected events. BGO spectra for both accepted and rejected events are telemetered to the ground for later analysis.

Results: Lunar Prospector was launched on January 6, 1998 and was placed in its mapping orbit on January 16. This orbit is polar and circular at altitudes between 80 and 120 km. Ever since January 16, the GRS has been successfully collecting data.

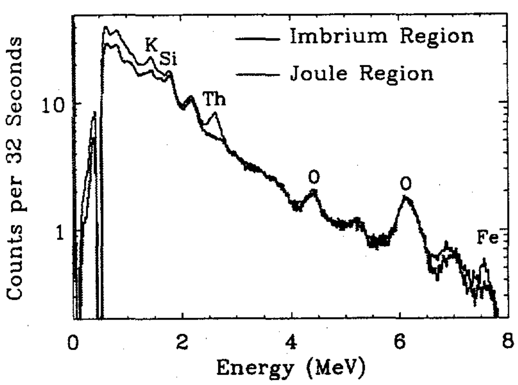

Figure 1

Figure 1 shows γ-ray spectra measured using GRS during the first 3 1/2 months in mapping orbit. These spectra were measured for a 20° latitude by 20° longitude region contained within the Imbrium basin and a similar sized region in the Lunar highlands containing the Joule crater. These spectra were created by subtracting three times the rejected BGO spectra from the accepted BGO spectra. This is done to reduce background from the 0.511 MeV escape peaks and Compton continuum γ-rays (Feldman, et al. [1]).

The spectra in Figure 1 show clear differences between these two Lunar mare and highlands regions. Count rates for Fe (7.6 MeV) and Ti (6.76 MeV) are higher for Imbrium than Joule. The most striking differences between the two regions, however, are the count rates for Th (2.6 MeV) and K (1.46 MeV). When the Th counts are plotted in a 10° by 10° grid over the Lunar surface, it is observed that the Th abundance is concentrated on the near side mare with a peak concentration near the Apollo 14 landing site at Fra Mauro. A secondary Th concentration is observed near Mare Ingenii close to the antipode of Mare Imbrium. Upon inspection, it appears that the observed Th distribution is very similar to the model Th distribution derived by Haskin [2]. The model by Haskin assumes that the entire Lunar highlands Th distribution arises mainly from Imbrium impact ejecta. However, while the observed Th distribution appears to be consistent with the Haskin model, multiple explanations may be required to describe the details of the observed distribution. It has also been observed with the GRS data that the Th and K distributions correlate very well over the entire Lunar surface. This is in agreement measurements made from returned Lunar samples (for example, see Korotev [3]).

Count maps from the 7.6 MeV Fe line have also been made over the Lunar surface. While a full year of data is needed to obtain the final 5° by 5° iron maps, data from the first 3 1/2 months already show the broad compositional variations associated with the Lunar highlands and mare. As expected, relatively high iron content is seen in the near side mare and South Pole Aitken basin and low iron content is seen in the far side highlands.

References: [1] Feldman, W. C., et al, (1998) *Nuc. Inst. Meth.*, submitted. [2] Haskin, L. A. (1998) *J. Geo. Res., 103,* 1679.[3] Korotev, R. L. (1998) *J. Geo. Res., 103,* 1691.