SEISMIC INVESTIGATION OF THE LUNAR INTERIOR, A.M. Dainty, N.R. Goins, and M.N. Toksöz, Department of Earth and Planetary Sciences, M.I.T., Cambridge, Mass. 02139

The anelastic attenuation of seismic waves in a material depends on the physical state of the material. We have determined the quality factor Q for compressional waves in the frequency range 1-10 Hz to a depth of approximately 1200 km in the moon using data from the Apollo Passive Seismic Experiment. To calculate Q, we use two short period records from the same event recorded at two different stations, form the smoothed Fourier transform of the first minute after first arrival and take the ratio of the magnitude of the transforms as a function of frequency (by convention, the seismogram at the lesser source-receiver distance is used as the denominator). If the effects of the source function and scattering are the same for both seismograms, if there are no frequency-dependent effects due to diffraction, and if Q is sensibly constant over the frequency range used, then the natural logarithm of the ratio of transforms plotted as a function of frequency will have a negative linear slope due to the effect of anelastic attenuation. Such a plot is shown in Fig. 1. From data such as this, and our previous models of the lunar velocity structure, we have derived a simplified Q model given in Table 1 based on the depth of penetration of P waves for the seismogram trains used. The layered nature of this model is due to the sparseness of the data - Q almost certainly varies continuously with depth. The model shows high values of Q above 500 km depth, indicative of dry, subsolidus conditions. Below 600 km depth, Q is much lower, probably because of the addition of a very small amount of partial melt. The conclusions are in agreement with results presented at previous conferences by our group.

In the analysis of body wave phases, up to now only first (P) arrivals, prominent S wave arrivals, and P wave reflections from the base of the crust have been used. In an effort to find other body wave phases in the complex, scattered wave trains of the lunar seismogram, we have been applying a polarization filter due to Flinn (1965) to three-component long period seismograms. This filter emphasizes portions of the seismogram that are coherent from component to component; Fig. 2 shows an unfiltered seismogram and the same seismogram after filtering. It can be seen from Fig. 2 that the oscillatory character of the original seismogram is changed to a set of discrete phases on the filtered version. It must be emphasized, however, that phases can arise on the filtered seismogram by random chance (i.e., two or more components may become temporarily coherent by chance). To separate true body wave phases from spurious events, we have been carefully examining seismograms at similar distances to find events that are common to all of them. We have tentatively identified deep reflections from this study, and we will report on the implications of these and other phases that may be identified.

Reference: E.A. Flinn (1965), Signal analysis using rectilinearity and direction of particle motion, Proc. IEEE 53, 1874-1876.

Table 1 - Q Model

Depth Range (km)	0-500	500-600	600-950	950-1200
Q	5000	3500	1400	1100

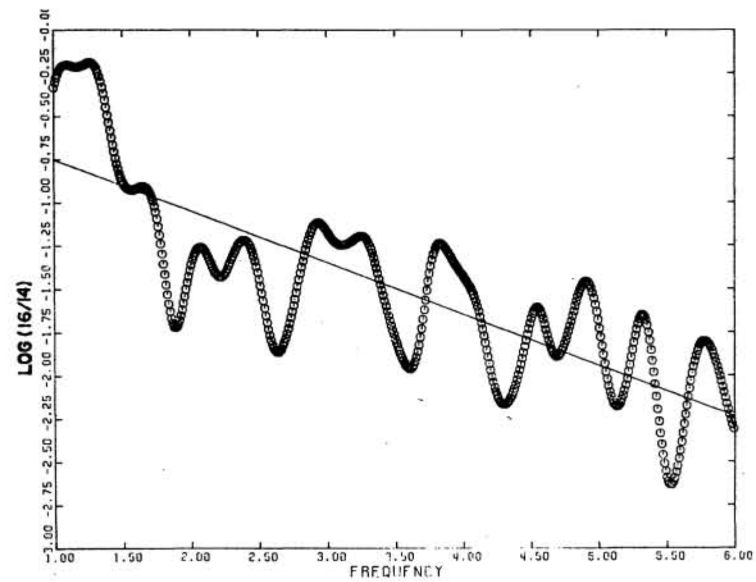

Figure 1 - Spectral ratio of the P wave coda, 3 January 1975 near surface moonquake. Short period records from ALSEP stations 16 and 14 used. The depth of penetration into the moon of the P wave recorded at 16 is about 950 km, at 14, about 600 km. Frequency is in Hz.

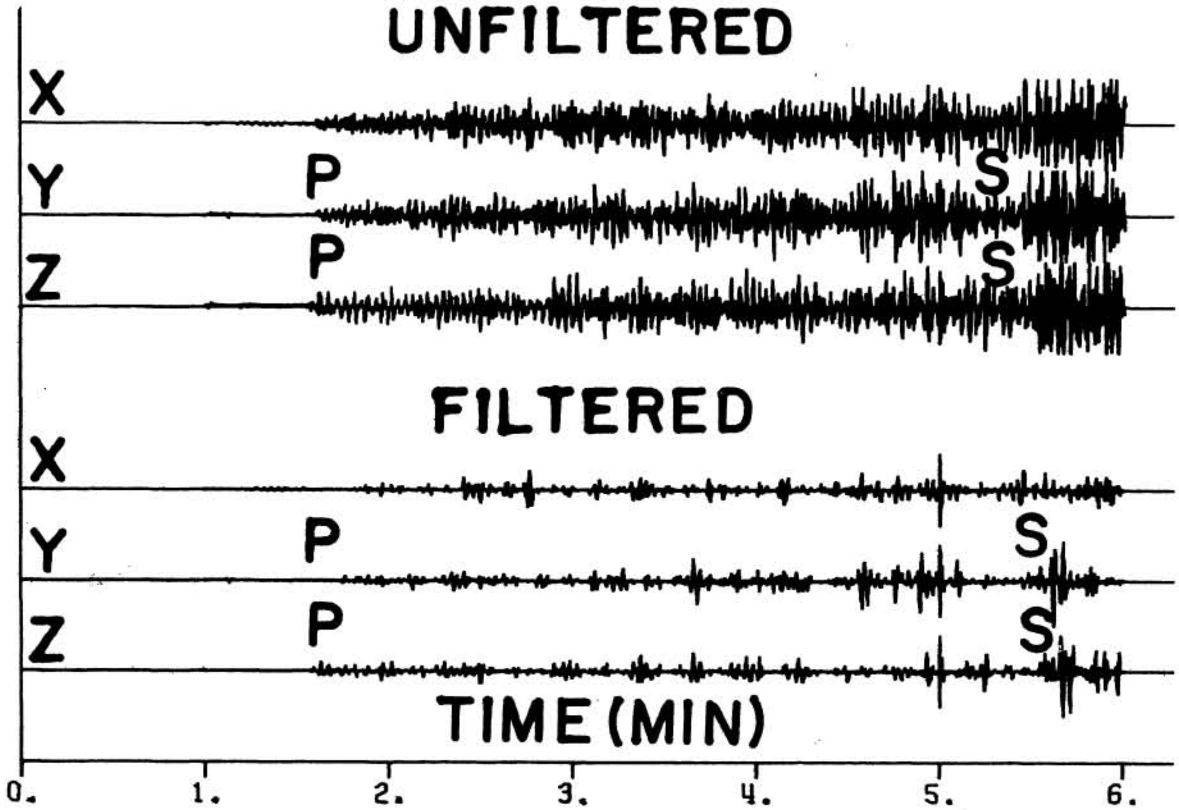

Figure 2 - Unfiltered (top) and filtered 3 component long period record, 13 May 1973 near surface moonquake recorded at ALSEP 12. Record starts at 0800 hrs UT; P and S phases marked.