Analysis of Rediscovered Data from Apollo 17's Lunar Seismic Profiling Experiment: Evidence for Seismic Events Associated with Lunar Sunrise

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Abstract. Rediscovered data from Apollo 17's Lunar Seismic Profiling Experiment (LSPE) are a new untapped resource for probing lunar structure. LSPE, the last seismic experiment deployed on the Moon, was designed to detect artificial seismic sources, but also listened passively from August 15, 1976 to April 24, 1977. This 40-year-old data went unstudied after the cancellation of the Apollo program. Our initial analysis shows no clear evidence for events concurrent with those in the Apollo 12–16 seismic event catalog. However, the LSPE geophones functioned effectively as a small-aperture seismic array and detected local thermally induced events. Supporting evidence comes from a strong association with the lunar diurnal signature in the Apollo 17 heat flow data. Seismic event rate enhancements are consistent with lunar sunrise, and include a secondary rate increase delayed by nine-hours. Existing hypotheses for event enhancements around lunar sunrise and sunset focus on both thermal events from the lunar module and thermally induced stresses in rocks, based on results from Apollo 12–17. The delayed secondary enhancement has not been discussed before; we hypothesize that the first peak in event occurrence is associated with sunrise at the lunar module, while the delayed peak is associated with thermally induced stresses in rocks. It may be possible to discriminate between the two sources. The delay may in part be due to the varying time interval between initial insolation and peak temperature as rocks have a higher thermal inertia than metal, and may warm slower than the lunar module. Over time, these thermally induced events will break down the rock surrounding the landing site of Apollo 17, possibly contributing to the production of lunar regolith. These results extend our knowledge of lunar seismology and facilitate future comparative studies, such as those anticipated for the InSight mission to Mars.