

A new moonquake catalog from Apollo 17 geophone data

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New lunar seismic events have been detected on geophone data from the Apollo 17 Lunar Seismic Profile Experiment (LSPE). This dataset is already known to contain an abundance of thermal seismic events, and potentially some meteorite impacts, but prior to this study only 26 days of LSPE “listening mode” data has been analysed. In this new analysis, additional listening mode data collected between August 1976 and April 1977 is incorporated. To the authors knowledge these 8-months of data have not yet been used to detect seismic moonquake events. The geophones in question are situated adjacent to the Apollo 17 site in the Taurus-Littrow valley, about 5.5 km east of Lee-Lincoln scarp, and between the North and South Massifs. Any of these features are potential seismic sources.

We have used an event-detection and classification technique based on ‘Hidden Markov Models’ to automatically detect and categorize seismic signals, in order to objectively generate a seismic event catalog. Currently, 2.5 months of the 8-month listening mode dataset has been processed, totaling 14,338 detections. Of these, 672 detections (classification “n1”) have a sharp onset with a steep risetime suggesting they occur close to the recording geophone. These events almost all occur in association with lunar sunrise over the span of 1-2 days. One possibility is that these events originate from the nearby Apollo 17 lunar lander due to rapid heating at sunrise. A further 10,004 detections (classification “d1”) show strong diurnal periodicity, with detections increasing during the lunar day and reaching a peak at sunset, and therefore probably represent thermal events from the lunar regolith immediately surrounding the Apollo 17 landing site. The final 3662 detections (classification “d2”) have emergent onsets and relatively long durations. These detections have peaks associated with lunar sunrise and sunset, but also sometimes have peaks at seemingly random times. Their source mechanism has not yet been investigated. It’s possible that many of these are misclassified d1/n1 events, and further QC work needs to be undertaken. But it is also possible that many of these represent more distant thermal moonquakes e.g. from the North and South massif, or even the ridge adjacent to the Lee-Lincoln scarp. The unknown event spikes will be the subject of closer inspection once the HMM technique has been refined.