Determining the shallow surface velocity at the Apollo 17 landing site

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Many studies have been performed to determine the shallow surface velocity model at the Apollo 17 landing site. The Lunar Seismic Profiling Experiment (LSPE) had both an active component with eight explosive packages (EPs) and a passive experiment collecting data at various time intervals. Using the eight EPs, the initial shallow surface velocity model was determined with variations in subsequent models[1,2,3,4]. Recent studies have also been re-analyzing the passive LSPE data and have found three different thermal moonquake event types occurring at different times within the lunar day[5]. The current goal of the project is to co-locate these thermal moonquakes to physical surface features to determine the cyclic breakdown of rocks over the course of a lunar day.

Relocations of the EPs with the velocity models from previous studies did not produce results within acceptable parameters[6]. However, the velocity models all used single arrival time methods without including uncertainty estimations. A velocity model is found by plotting distance versus time and fitting straight lines to various segments. The inverse slope is the velocity while the depth can be found via the intercept. The given velocity models apply a single best fit line per segment of data points, while the uncertainties can provide various fits within a given error parameter.

The first step in finding the uncertainty range was to find arrival times and accurate coordinates for all eight EPs. Heffels et al. demonstrated changing the coordinates of the EPs change the velocities and layer depths significantly[3]. Haase et al. published a new set of coordinates for all eight EPs and four geophones using a combination of LROC images and original astronaut images from the surface[7]. New arrival times for all eight EPs can be found by using various filters, including a bandpass filter, an average magnitude filter, a sliding window polarization filter, a short term-long term average (STA/LTA) ratio, and a Wiener filter. All these filters have been used in various forms to choose arrival times for Apollo 12-17 data, with new parameters chosen specifically to fit the Apollo 17 LSPE EP data. Combined with the new coordinates provided by Haase et al., these new arrival times can be used to find a new model for the shallow surface velocity at the Apollo 17 landing site.

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