Improvements to the Apollo 15 and 17 Heat Flow Experiment data archive. M. St. Clair[1], C. Million[2], M. Seigler[3], [1]Million Concepts, 1355 Bardstown Rd. #132, Louisville KY 40204, mstclair@millionconcepts.com, [2]chase@millionconcepts.com, [3]Planetary Science Institute

The data from the Apollo 15 and 17 Heat Flow Experiment are the only available ground truth on heat transfer in the lunar regolith. We discuss an ongoing effort to improve the AHFE data archive, by correcting and documenting errors in the data and improving data usability. Though the instruments transmitted data from 1971-77, only data from 1971-74 was initially archived. [1,2] A recent project by Nagihara, et al. (2018) has recovered some other portions of the "missing" data. [3] A number of consistent numerical errors exist in the officially archived data that were likely introduced in the reduction and transcription process. Moreover, those data that appear to have been correctly reduced and transcribed (as well as the data recovered by Nagihara et al.) contain many transient events, probably caused by errors in downlink or instrument electronics. The most obvious of these is a "bit flip" effect that causes a data rollover at temperature intervals of -2^N; this may have been the result of a byte-definition error in transcription, but it appears to be both lossy and ambiguous, so we have had to make corrections to such data manually. Aside from interfering with straightforward data analysis techniques, data errors are in many cases difficult to distinguish from transient events caused by phenomena of scientific interest such as topographic effects on solar radiation. We describe methods for correcting these numerical errors. We also introduce an error typology for the data and speculate on possible properties of the instrumentation that might be implied by these errors.

We also describe our efforts to improve general usability of the data, with the intention of reducing time-to-use for future researchers. The data—and the instruments themselves—have several "quirks" that create a surprisingly high barrier for what is otherwise a simple time series of temperature measurements. For instance, both the time and temperature are recorded in obtuse formats. We are producing several reduced datasets that optimize for likely analysis use cases. This includes, for example, describing temperature as functions of depth and time in conventional formats. Our reduced data also concatenates all data released to date, including the Nagihara et al. and the previously released data in one consistent format.

We are also producing updated documentation that synthesizes and expands on previously available documents. This will provide a clear and coherent data narrative for future researchers to understand the data more quickly. The documentation provides a full description of our reduced data sets with rationale for the reduction steps, suggested use cases, and caveats about the possible deleterious effects of the reductions for other use cases. Usability and transparency are key values of our documentation. Crucially, this documentation includes all code used to correct and flag errors and to produce our reduced data. We describe our documentation preparation process, along with some more general notes on the topic of planetary data preparation under PDS4 and the preparation and inclusion of software "as documentation" in data archives.

References: Use the brief numbered style common in many abstracts, e.g., [1], [2], etc. References should then appear in numerical order in the reference list, and should use the following abbreviated style:

[1] Langseth, et al. (1972) The Moon 4.3-4, 390-410. [2] Grodzka, G. and Bannister, T. (1975) Science 187.4172, 165-167. [3] Nagihara, S., et al. (2018) JGR: Planets, 123.5, 1125-1139.