RESTORATION AND VERIFICATION OF SEISMIC DATA RECORD ON VIKING LANDER 2 MISSION.

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Introduction: The seismometer of the Viking Lander 2 mission measured some signals on the surface of Mars. Unfortunately, there was no evidence of seismic activities on Mars during the mission periods due to the instrument sensitivity and the background noise of Martian wind [1]. Over a long time period, a new Martian seismic experiment is planned in upcoming Insight mission. It is meaningful to re-evaluate the Viking seismic data using the latest technologies. Before scientific analysis, we try to recover the seismic data and confirm the validity.

Data tapes: There are three different tapes for the Viking seismic data: SEIS tape, USEIS tape, and EDR-2 tape. The Institute for Geophysics of the University of Texas at Austin (UTIG) processed the SEIS tape and the USEIS tape, and the Jet Propulsion Laboratory (JPL) generated the EDR-2 tape. Currently, their data in each tape are stored as files respectively and downloadable from the National Space Science Data Center (NSSDC) website. The relationship between the SEIS tape and EDR-2 tape is unknown.

UTIG processing: The UTIG technical report No.118 [2] shows the list of Viking tapes together with Apollo Lunar Seismic Experiment (ALSEP) tapes. The report provides a brief description of the Viking data, but it is not enough to obtain the seismic data from their files.

The format of SEIS tape is still unknown since the data structure is pretty complex and the document is not opened. However, the USEIS tape is an unwrapped version of the SEIS tape, and it is interpretable referring to former documents.

The format of USEIS tape is a binary format which starts from a header part followed by a layered data part: each physical record consists of 25 frames, and each frame consists of 75 words, and each word consists of 36 bits. The bit allocation of the frame cannot be found in an open document. Therefore, we research the past note and old processing software. Finally, we clarify the bit allocation and develop the software to obtain the seismic data from the USEIS tape.

JPL processing: The EDR-2 data is ASCII format packed in NSSDC Archival Information Package (NSSDC AIP) and downloadable from NSSDC website. NSSDC AIP attaches a primary collection ID to each data. PSPG-00070 is the ID of the seismic data records of Viking Lander 2 mission. In addition, the old conversion program is also accessible which ID is PSPG-00472. This program is not necessary to achieve the seismic data from PSPG-00070, but it is available to understand the conversion process at the time. This program is written in PL/I language, and the character sets are not ASCII but EBCDIC-US.

To extract the seismic data from PSPG-00070 files, two tasks are needed: (1) Unpack the NSSDC AIP (2) Fix the lost two characters. These lost characters express the line length and they are predictable considering the line pattern.

Unlike the USEIS tape, the information of EDR-2 tape is well documented [3], and it can be obtained from the Internet.

Time conversion: On Viking Lander 2 mission, the guidance command and sequencing computer (GCSC) managed the spacecraft clock. Each frame has the GCSC count that is a 24-bit integer count kept by GCSC for timing. Normally, one bit in this count represents 160 milliseconds, and the GCSC count cycles through 0 approximately every 31 days. To compare with some other Viking data or some reports, the time conversion is essential from the GCSC count to elapsed time in the Martian solar day (SOL). We refer to the document of Meteorology pressure tape of Viking 1 & 2 [4] to determine the epoch of the elapsed time. In actual processing, we adopt the conversion algorithm in an old FORTRAN program. The Earth-received time is also used to select one day from the candidate days corresponding to the cyclic GCSC counts.

Verification: First, we investigate the difference between the USEIS tape and the EDR-2 tape. As a result, most of the contents in both tapes are the same.

Secondly, we verify the restored data comparing with a report. The calibration data reported in 'Seismology on Mars' [4] is appropriate to verify since the precise time is readable and the wave shape is characteristic. Figure 1 shows the comparison between the original data reported on 'Seismology on Mars' and the restored data from EDR-2 tape. These two data are almost identical except for the time difference of about 26 seconds.

Future work: We will provide these extracted data with software from the JAXA's scientific data archives: DARTS (http://darts.isas.jaxa.jp/). These Viking data will be available to archive in SEED format.

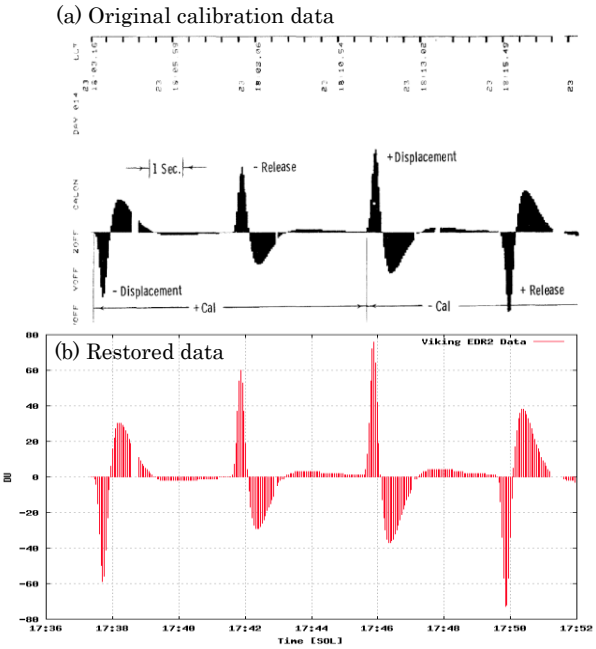

Figure 1. Comparison between original data and restored data. (a) Original calibration data reported on 'Seismology on Mars' (b) Restored data of this work.

References: [1] Lazarewicz, A.R. et al. (1981), *The Viking Seismometery Final Report, NASA Contractor Report 3408*. [2] Y. Nakamura (1992) *University of Texas Institute for Geophysics Technical Report No. 118*. [3] *NSSDC Data Set Catalog #410.* [4] *NSSDC Data Set Catalog #431.*