

## **Book H**

### **Down-sampling of the Digital Data**

**By  
Robert W. Lankston  
May 1, 2023**

Approximately one third of the seismic data that were collected on Flathead Lake in 1970 survived on a magnetic tape that was housed at the United States Geological Survey (USGS) library at Woods Hole, MA, for many years. The original field tapes are apparently lost. Deborah Hutchinson and Nancy Soderberg, of the USGS, were instrumental in finding the tape in 2006 and making it available for digitizing and archiving at UM. A summary of the discovery of the tape was given by Lankston (2007).

The USGS archive tape is recorded in FM and was digitized by Richard L. Hess of Aurora, ON, in 2006. Hess' initial sampling was at 48,000 Hz, a common .wav file sampling rate. The 48,000 Hz files are very large and represent an image of the analog data on the tape. The initial analog to digital transcriptions are not included in this archive because of their sizes. The archive tape contains approximately six hours of seismic recording which translates to approximately 8 Gbytes of digital data per track. The .wav files, however, are on a DVD that is in the University of Montana, Maureen and Mike Mansfield Library, K. Ross Toole archive along with the USGS archive tape and the paper documents from the 1970 survey. While the archive tape was in good condition in 2006 when it was transcribed, it may deteriorate with time. The digital transcription on DVD may have a longer shelf life. Additionally, the library archive has copied the DVD files to a server that should also provide longevity of the tape image.

The duration of the tape is approximately six hours. Total recording time for the entire survey based on time annotations on field-recorded seismic sections is approximately twenty hours.

In addition to the analog to digital transcription of the various tracks on the archive tape, Hess provided an extensive [README](#) file of his analysis of the tape and the procedures he went through. His README file is also on the DVD with the .wav files.

Had the seismic data been recorded digitally in 1970, the data might have been recorded with a sampling rate of 1,000 Hz. The Nyquist frequency with 1,000 Hz sampling would be 500 Hz, which is well above the expected seismic frequency band. Therefore, as part of the analog to digital conversion effort, Hess down-sampled his original .wav files to 1,000 Hz sampling to emulate how the individual traces would have been sampled digitally in the field. An intermediate stage in the down-sampling was a set of files sampled at 8,000 Hz.

The following four data files are in this book in the collection:

- Track2, demodulated and down-sampled to 1000 Hz sampling
- Track4, demodulated and down-sampled to 1000 Hz sampling
- Track2, demodulated and down-sampled to 8000 Hz sampling
- Track4, demodulated and down-sampled to 8000 Hz sampling

Seismic data were on two tracks of the seven tracks on the archive tape, i.e., track 2 and track 4. The two tracks have essentially the same data, but the signals are slightly different. The origin of the differences is not known. Whether the tracks on the archive tape are simple copies of tracks on the field tapes or the result of some processing is not known.

The down-sampled files are the typical starting points in using this subset of the Flathead Lake seismic data. For use in modern seismic industry software, the .wav files need to be reformatted into either the Colorado School of Mines Seismic Unix (SU) format or the Society of Exploration Geophysicists' common data exchange format, i.e., SEG-Y. Reformatting requires some custom programming. One approach is to write a single program to read the .wav file and output an SU or an SEG-Y file directly.

Alternatively, one could read the .wav file and output a flat ASCII file that could then be converted to the SU format by utilities in the SU package. This approach is described in [Book I](#) of this collection.

## References Cited

Lankston, R. W., 2007, Revisiting the 1970 Flathead Lake Seismic Survey: The Leading Edge, v. 20, p.1058.

## Citing this Narrative

For “books”, i.e., the ScholarWorks term for a folder or a directory, ScholarWorks will display a Recommended Citation for the entire book. Some of the books (directories) in this collection have what ScholarWorks calls “supplemental material” (files). ScholarWorks does not suggest a citation for the individual files, and you may have occasions when you want a reader to be able to find exactly what you are talking about in your own work.

Therefore, I am suggesting a citation for this narrative. My suggested citation is in a slightly different form than the ScholarWorks form, but that is not critical. Every medium has its preferred format. The important components of a digital citation are the author(s), the title of the work, the year of creation, the name of the collection in which the work appears, and the URL of the work. The following meets those specifications.

Lankston, R. W., 2023, “H. Down-sampling of the digital data – narrative on tape transcription and down-sampled files by Robert W. Lankston” in *1970 Flathead Lake Seismic Survey*. URL: <https://scholarworks.umt.edu/cgi/viewcontent.cgi?filename=1&article=1006&context=flathead&type=additional>

You can find the URL for my narrative by moving your mouse to the Download button next to the narrative title in the list of files for the book. Right click the mouse and, in the pop-up options box, choose to copy the link address. Then, the address is in your clipboard, and you can drop the text string of the address into your work.

I would suggest the same citation format and the same technique for capturing the URL of the supplemental files that form the heart of the content of this book.

**Feedback**

The standard ScholarWorks format limits how/when an author's email address is displayed. With the author convention that I use, my email address is not displayed for books such as Book D. Actually, my email address is not even in the book metadata. If you need to contact me regarding the content, a broken URL, and so forth, you can use:

[rwlankston@gmail.com](mailto:rwlankston@gmail.com)

*Last update: 5/12/2023 11:59 AM*