Book L

Dots to Data: Manufacturing Digital Seismic Traces from Scanned Images of the Paper Sign Bit Sections for the 1970 Flathead Lake Seismic Survey

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The files in this book relate to a lecture that I presented on October 13, 2014, in the University of Montana, Department of Geosciences Colloquium lecture series.

The thesis is offered that more value can be gained from the 1970 Flathead Lake seismic sections if they are converted to digital traces and then georegistered for easy use in a modern seismic workstation and for processing with modern deconvolution and migration tools. A timeline with three segments from the early 1960's to the present shows:

- the mid-1960's to mid-1970's era that includes the summer when the Flathead Lake seismic data were recorded
- a long period from 1980 to 2005 when relatively little was done with the data, i.e., one published report (Wold, 1982), one PhD dissertation (Hofmann, 2005), and one informal evaluation of the data (Book G)
- the efforts since 2006 that include ongoing construction of a digital archive of the project at the University of Montana Maureen and Mike Mansfield Library and experiments with the image to data workflow.

The relationship between the threshold-crossing style of recording of 1970 and the modern notion of sign bit seismic traces is presented, and examples of the difficulties in interpreting the data on paper or even using graphical editors on computer scans of the paper sections are given. The bubble pulse problem is explained, and examples of the bubble pulse event that follows the water bottom reflection are given.

Highlights of the image-to-data, casually referred to as "dots-to-data", conversion process are presented with examples of defining the pixel value threshold that sets the positive and negative sign bit ranges, rotating the scanned image such that the timing lines are "perfectly" horizontal, and correcting for the skew in the alignment of the dots burned into the original section because of the continuous movement of the paper under the moving stylus of the chart recorder.

Many options for filtering the sign bit traces that emerge from the image to data conversion stage are mentioned but are not discussed in detail. To date, only filtering with a zero-phase, trapezoidal band pass operator has been performed. An example of the result of the image-to-data process is compared to a segment of the same seismic line for which full waveform data are available digitally, and all of the gross features visible in the seismic section generated from the digital traces are preserved in the image-to-data result.

A screen capture image of several lines in the Skidoo Bay area of Flathead Lake illustrates that the manufactured and georegistered traces can be viewed successfully in a modern interpretation workstation, and the image shows the water bottom horizon that was picked in the workstation environment. In addition, one of the lines in the 3D rendering is from a high-resolution sparker survey that was conducted in 1980 (Kogan, 1980). The "dots-to-data" process can be applied to those data also. The converted sparker traces can readily be

correlated with the 1970 air gun data in the workstation environment, i.e., a much easier process than previous manual techniques.

An example of applying deconvolution to the manufactured traces from one line is given. The objective of the deconvolution processing was to remove the bubble pulse events from the data. While the bubble pulse event from the water bottom reflector is not totally removed in the example, the bubble pulse event that follows the water bottom reflection is attenuated. The degree of attenuation is illustrated by flattening the seismic section on the water bottom horizon, i.e., a typical workstation process, and identifying the bubble pulse event as a feature parallel to the flattened water bottom event at the appropriate lag time. The bubble pulse event is clearly attenuated in this example. A comparison is made using the autocorrelation of the data before and after the deconvolution process. The before image clearly shows the presence of the bubble pulse energy, and the autocorrelation of the deconvolved traces shows that the bubble pulse feature has been attenuated.

Greater attenuation of the water bottom bubble pulse event was expected as a result of the deconvolution process. A likely explanation for the limited success is the fact that the true amplitudes of the primary and bubble pulse reflections were lost in the initial threshold-crossing recording process when the sections were produced in the early 1970's.

The presentation concludes by stating that:

- the image-to-data workflow is successful, though some steps may benefit from some polishing
- that the converted traces can be viewed in 3D perspective in a modern seismic workstation
- that deconvolution can be applied to the manufactured traces with some success.

References Cited

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