CREWES Channel Model: Description, acquisition, interpretation and data release

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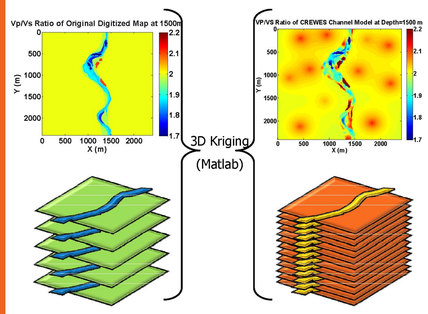
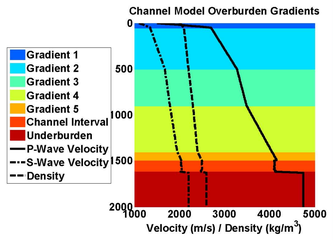
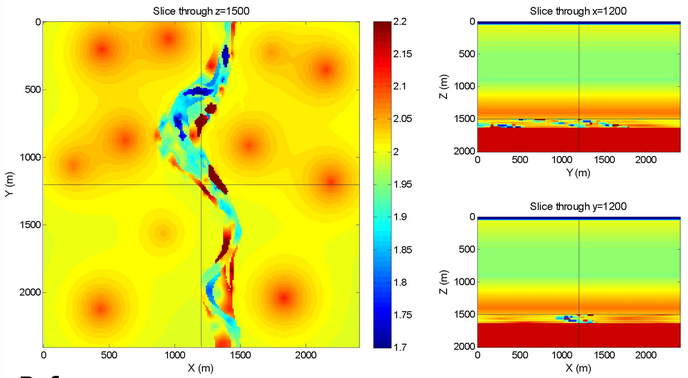
The Model



In 2008, Margrave et al. created a 3D isotropic elastic model of a channel. This velocity model consisted of 5 digitized maps which were based on the Bow river in Calgary, Alberta. These maps were created using a 10 meter grid to create a 2.4 km by 2.4 km area. The digitized maps were then run through a process called krigging, a geostatistical method of interpolation commonly used in geologic and geophysical situations. This method was used to not only smooth the digitized maps but was also used to create 8 more maps, two maps between each of the 5 original digitized maps to create a total of 13.

To create a three dimensional velocity model the krigged maps were then stacked on top of one another with a spacing of 10 meters to create a channel interval of 120 meters. The top of the channel model was placed at 1500 meters in the velocity model. Overburden gradients were applied and were derived from the Blackfoot field in Southern Alberta, Canada. These gradient values can be seen in Table 1. The figure below shows the Vp / Vs ratio of the channel model in three different cross-sections.





References

Margrave, G. F., Taylor, S., and Cooper, J. K., 2008, Towards realistic 3D elastic models of Canadian channel and reef structures: in the 20th Annual Research Report of the CREWES Project.

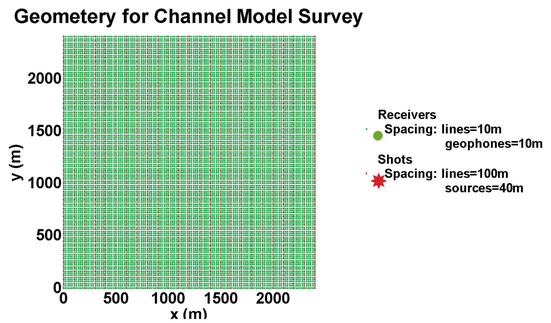
Data Release

The data is being prepared for distribution in two forms. The total data set, consists of 1525 SEG-Y files containing the 10m by 10m grid for each shot. This data set is about 0.55 Terabytes. The second data set is an abbreviated version, with receiver and shot line spacing at 100m and a receiver interval of 20m and shot interval of 40m. This geometry can be seen in FIG . This data set is about 9.2 Gigabytes and is available in SEG-Y format. Due to the size of the files this data set is available by request only. Please contact the CREWES technical manager to request the data.

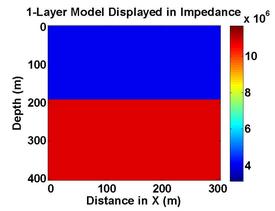
Abstract

The CREWES Channel Model was created in 2008 as a 3D volume of P and S wave velocities plus density. This 3D model represents a 120m channel interval with gradient overburdens derived from the Blackfoot field in Southern Alberta, Canada. The channel was modelled after the present day Bow River and so represents no specific buried channel, but is thought to be typical. Recently this model was used to create a synthetic seismic data using a fully elastic finite difference software package. The data set contains over 1525 shot records with 3C receivers placed on a 10m by 10m grid for each shot. A 2-D line was then selected from the data as an example and to identify its processing flow. This flow includes a bulk time shift of 0.1 seconds, a mute to remove the first breaks, and a F-K filter to remove the ground roll. A pre-stack Kirchhoff migration was then applied to the data creating a section showing undulations in the reflections indicating variations in the channel interval. This data set is very large and is available to sponsors by request.

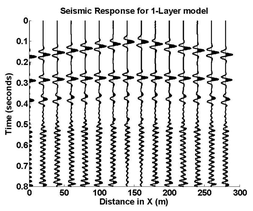
Data Acquisition

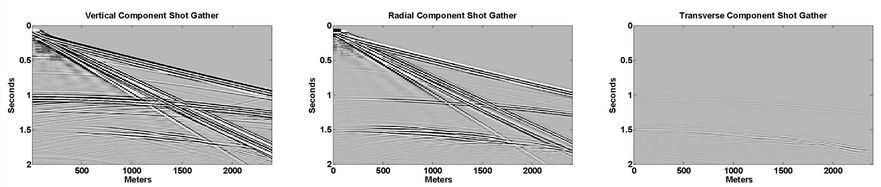


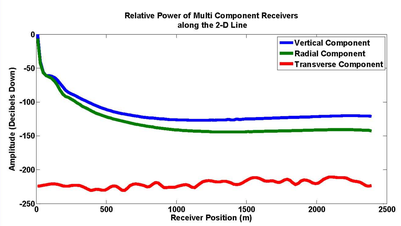
A 3-D multi-component survey was designed to have the maximum coverage possible. A fully elastic finite differencing software was used to create the data. Receivers were placed on a 10 x 10 meter grid while the shots had a spacing of 40 meters with a line spacing of 100m. A 0.1s time delayed Ricker wavelet was used as the source wavelet. 0.004s was used as a sample rate and total recorded time was 2s. A total of 1525 shots were recorded in this geometry.



To determine the polarity of the data, a test was done with a one layer model where the lower layer of the model has higher impedance. It can clearly be seen from the data collected that the response of a positive impedance contrast is a peak to the right.

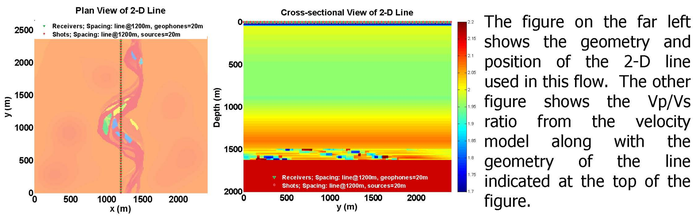






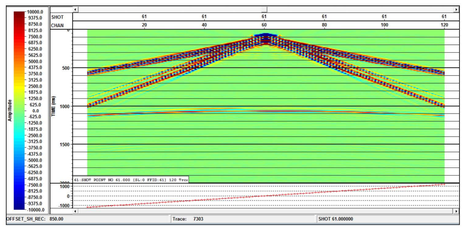
The shot records above are the three receiver components of shot 1. To compare their amplitude they are all gained, and strongly clipped, using a reference amplitude from the vertical component.
The figure on the left shows the total trace power for the three components. This display illustrates that the power for both the vertical and radial components are comparable where as the transverse component has much less power than the others.

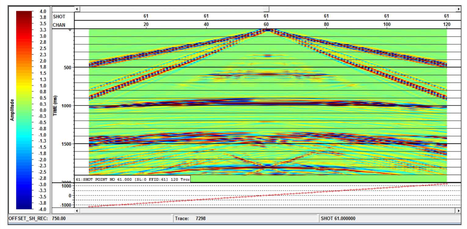
2-D Line Processing & Interpretation



The figure on the far left shows the geometry and position of the 2-D line used in this flow. The other figure shows the Vp/Vs ratio from the velocity model along with the geometry of the line indicated at the top of the figure.

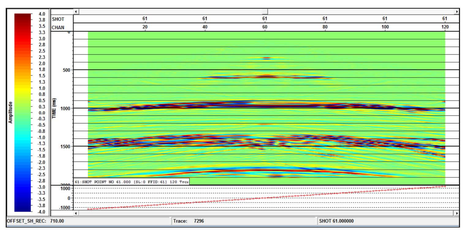
This raw shot record is at the center of the line and is shot 61. The only reflection that can be some what made out is the bottom of the channel interval due to its high impedance contrast.

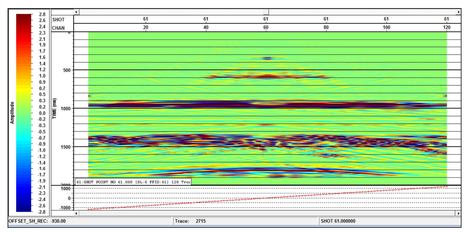




This shot record has an AGC and a scaling function applied. It has also had a bulk time shift of 0.1 seconds applied to correct for the time shift that is present in the wavelet.

This figure shows the shot record without the ground roll or the direct arrivals. The direct arrivals were removed with a mute where as the ground roll was removed with an F-K filter, in order to preserve far offset data in the channel interval





This is shot record 61, which has been NMO corrected. There are three primary events that can be seen, The first two are gradient changes at 0.35s and 0.6s and the channel interval at about 0.9s. There is also some converted wave response at 1.4s and shear response at 1.8s.

This is a post stack Kirchhoff Migrated result for this line. It shows the variable channel sands in the interval between 0.9 and 1.0 seconds