

Smooth inversion borehole survey GHD MDW2011, with SEG-2 input files, Rayfract® version 3.20 :

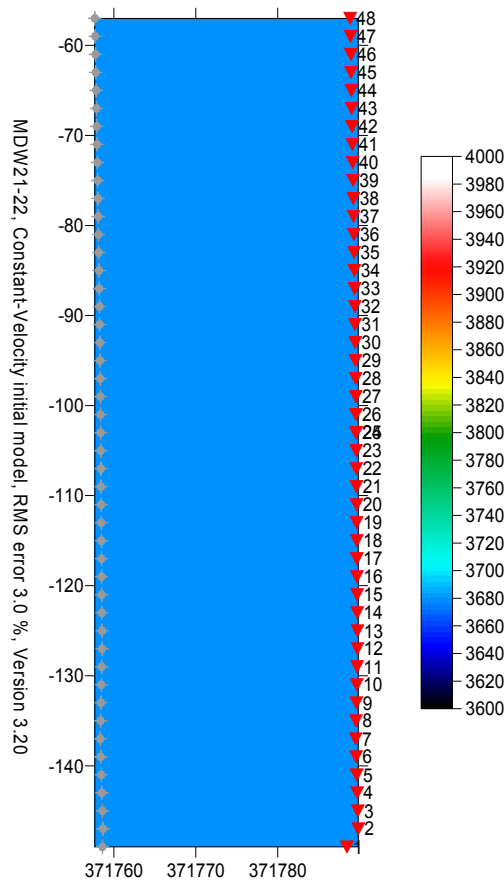


Fig. 1 : Constant-velocity initial model

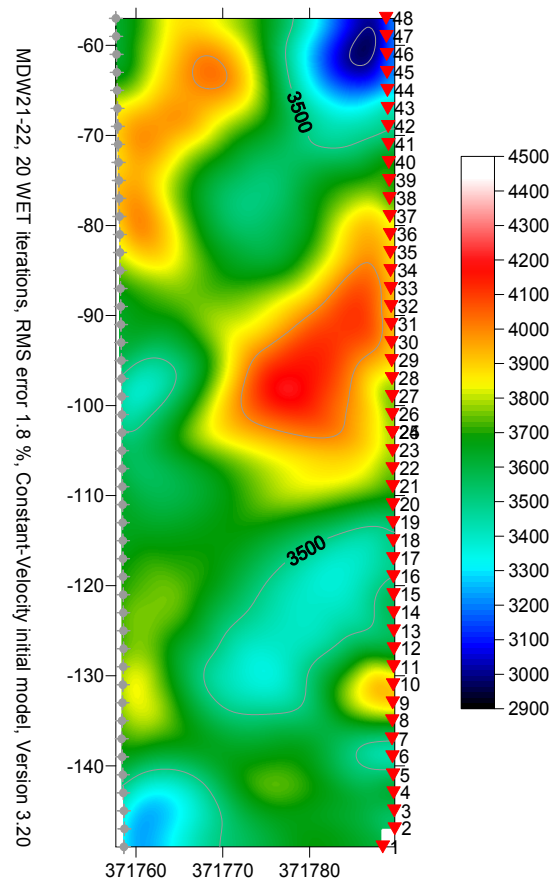


Fig. 2 : Smooth inversion, default parameters, 20 WET iterations, WET wavepath width 1.7%

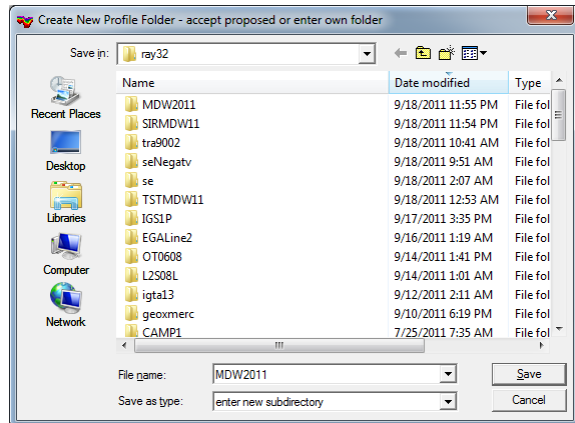


Fig. 3 : File|New Profile...

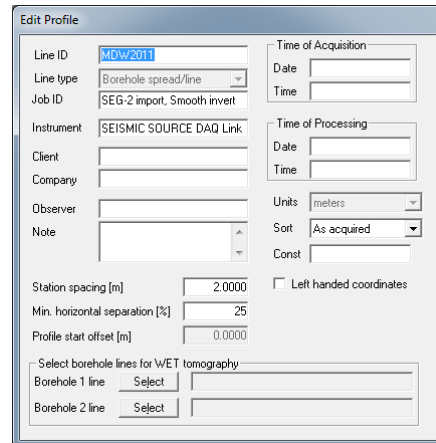


Fig. 4 : Header|Profile

To invert the data, please proceed as follows :

- start up Rayfract® via desktop icon. Select *File|New Profile...* . Set *File name* to MDW2011 and click *Save* button. See Fig. 3 above.
- select *Header|Profile* and set *Station spacing* to 2m. Specify *Line type* Borehole spread/line . See Fig 4.
- set *Line ID* to MDW 2011, *Job ID* to any text, *Instrument* to SEISMIC SOURCE DAQ Link, hit RETURN.
- download the SEG-2 and coordinate files from <http://rayfract.com/tutorials/mdw2011.zip>
- copy MDW2011.ZIP into \RAY32\MDW2011\INPUT and unzip to obtain SEG-2 files and coordinate files
- select *File|Import Data...* . Specify *Import data type* SEG-2, *Default shot hole depth* of 0.0. Leave *Default spread type* at 10:360 channels, or choose 02: 48 channels.

- click *Select button* and navigate to directory \RAY32\MDW2011\INPUT. Change *Files of type* from default .DAT to .SG2 . Select one .SG2 file e.g. SHOT0001.SG2 . Click *Open button* and *Import shots button*.
- for shot no. 1, set *Layout start* to -74 and *Shot pos.* to -74. Then click *Read button*.
- for shots 2 to 24, leave *Layout start* at -74, and set *Shot pos.* to -73, -72, ..., -51. Import with *Read button*.
- for shots 25 to 48, set *Layout start* to -51, and *Shot pos.* to -51, -50, ..., -28. Import with *Read button*.
- select *File|Update header data|Update Station Coordinates...* and COORDS.COR .
- select *File|Update header data|Update Shotpoint coordinates...* and SHOTPTS.SHO .
- select *File|Update header data|Update First Breaks...* and BREAKS.LST .
- review traveltimes with *Refractor|Shot breaks* as usual. See our manual, chapter 1.3.
- check *Post...* and *Label...* menu items at bottom of *Grid menu*, to show sources and receivers on tomogram
- check *Smooth invert|Smooth inversion Settings|Precompute static Beydoun weight matrix* , for conservative weighting . See [http://rayfract.com/help/release\\_notes.pdf](http://rayfract.com/help/release_notes.pdf) , notes for versions 3.02 and 3.03 .
- select *Smooth invert|WET with constant velocity initial borehole model* to invert the data. First obtain initial model shown in Fig. 1. Then obtain WET tomogram after 20 iterations, as in Fig. 2.
- uncheck *Smooth invert|Smooth inversion Settings|Precompute static Beydoun weight matrix*
- select *Smooth invert|WET with constant velocity initial borehole model* to reinvert the data. Obtain WET tomogram after 20 iterations, as in Fig. 5, and wavepath coverage plot as in Fig. 6.

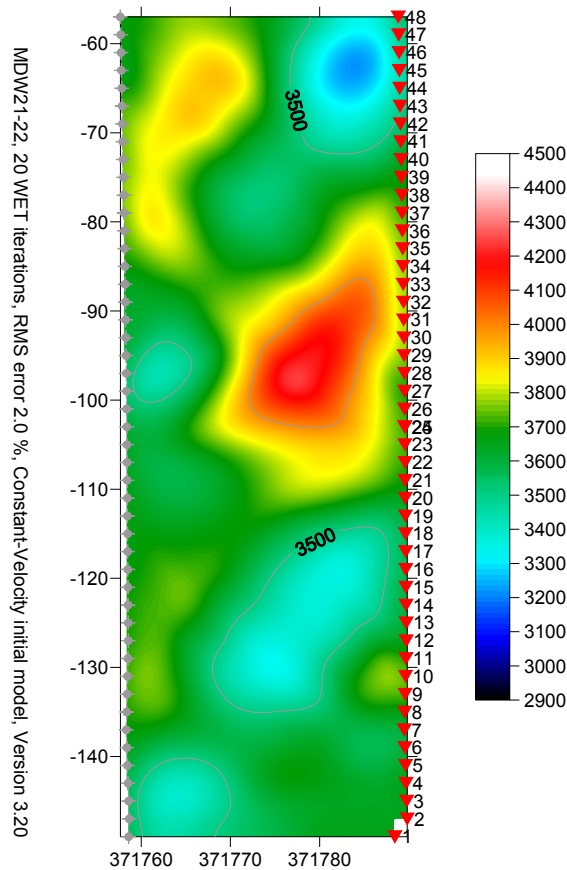


Fig. 5 : Smooth inversion with dynamic Beydoun weighting, 20 WET iterations

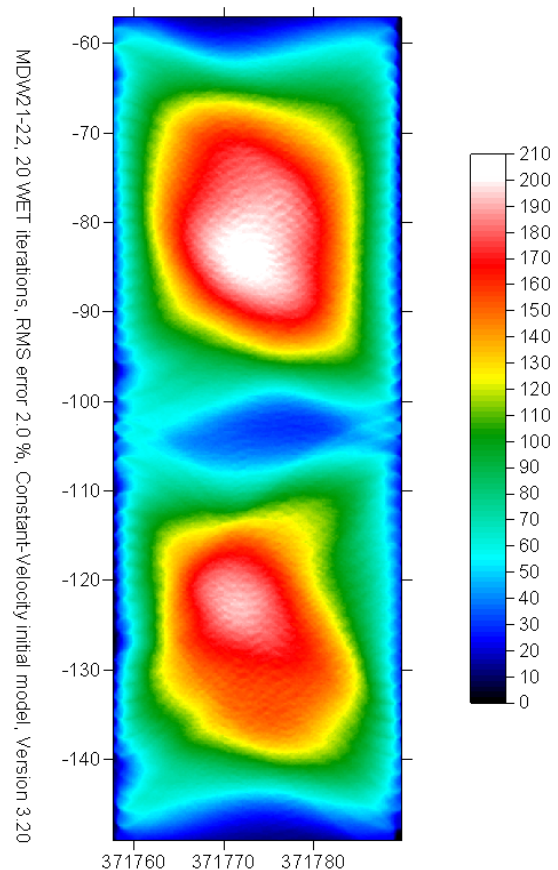


Fig. 6 : WET wavepath coverage for Fig. 5. Coverage of subsurface with first break energy.

With dynamic Beydoun weighting (Fig. 5), imaged velocity anomalies are less pronounced than without (Fig. 2), especially in corners of tomogram, with low wavepath and seismic ray coverage. Also, the RMS error in Fig. 5 (2.0 %) is slightly higher than for Fig. 2 (1.8 %).

Select *Trace|Shot gather* to compare modeled (blue) to picked (red) first breaks. See Fig. 7 below.

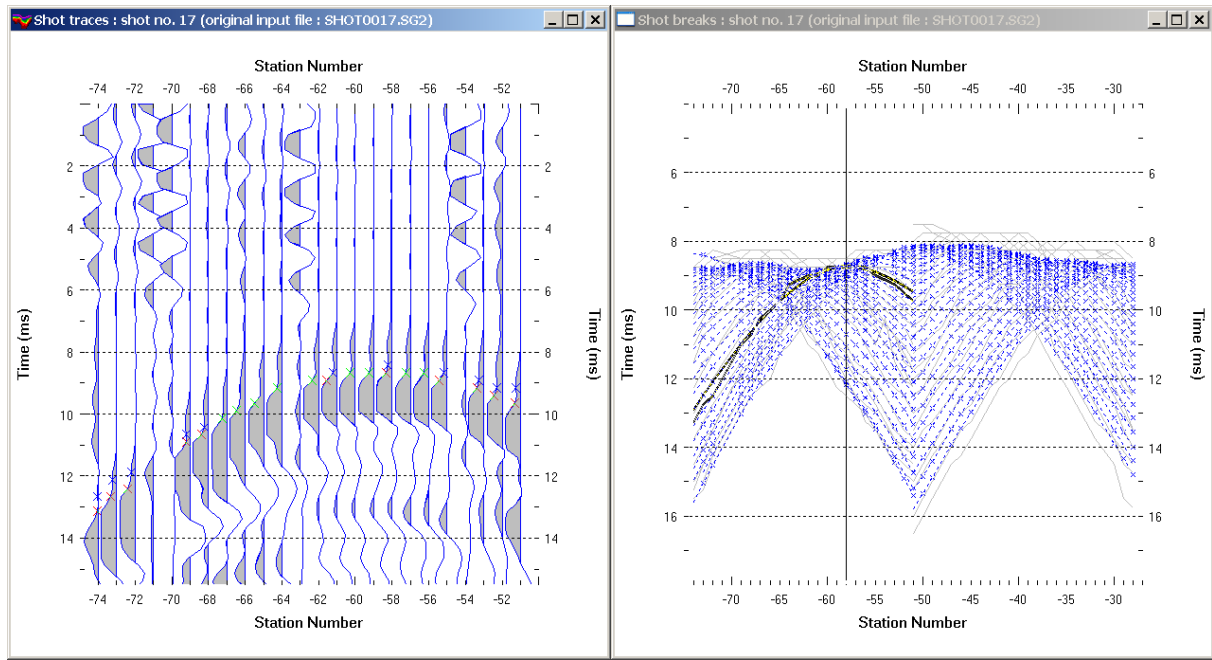


Fig. 7 : Trace|Shot gather (left) for shot no. 17, Refractor|Shot breaks (right)

Note the good agreement between picked (red) and modeled (blue) first break picks (Fig. 7, left). First breaks are picked quite consistently for the whole borehole profile (Fig. 7, right).

We thank Zivko Terzic at GHD in Australia, for making available this nice borehole data set.