Conjugate-Gradient Fresnel volume tomography of ZONDDATA synthetic traveltimes with Rayfract® 3.31

Horizontally averaged 1D-gradient starting model, without requiring user to assign traces to refractors :

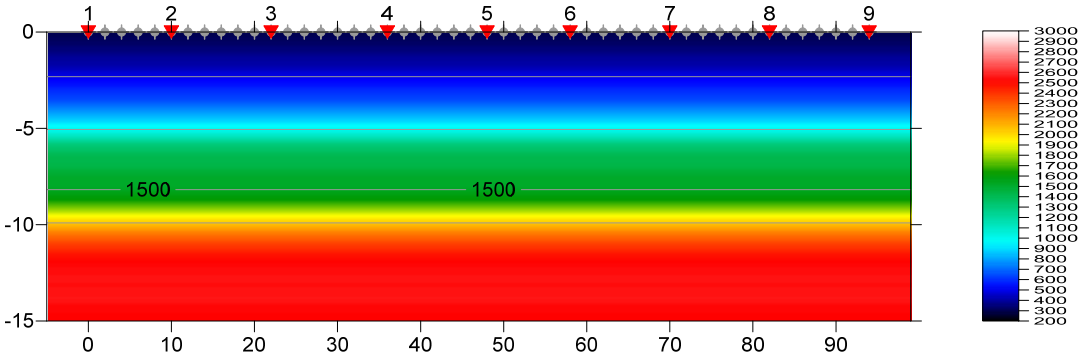

Fig. 1 : 1D-gradient starting model version 3.31, RMS error 4.8%. Horizontal averaging of DeltatV method inversion. Default Smooth inversion settings, default DeltatV settings.

2D Conjugate-Gradient Fresnel volume tomography :

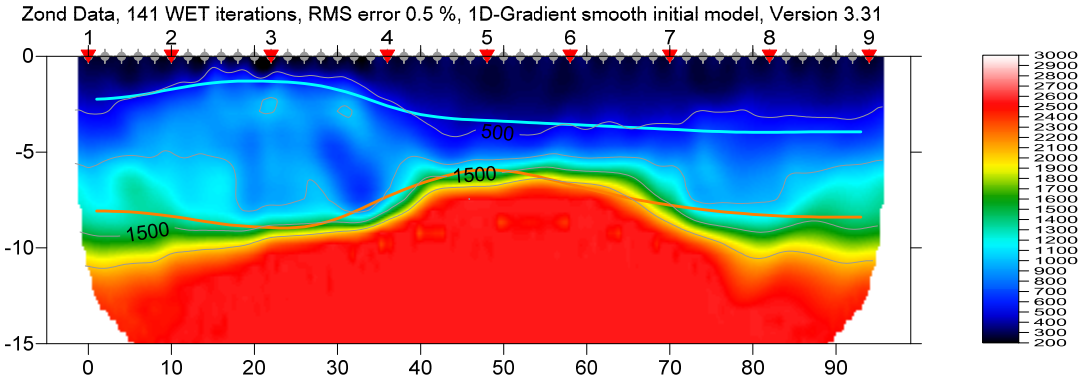

Fig. 2 : Conjugate Gradient WET inversion, 141 WET iterations, RMS error 0.5%, version 3.31. Starting model Fig. 1. Refractors obtained with CMP intercept-time refraction method are plotted in cyan and orange (Fig. 4).

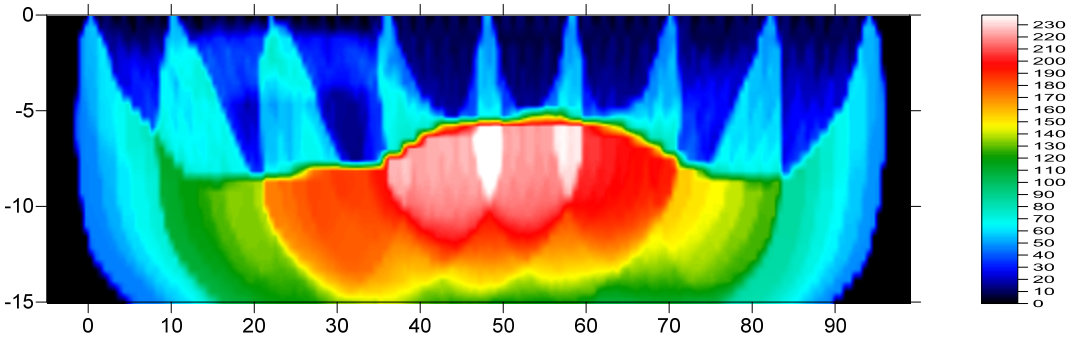

Fig. 3 : WET wavepath coverage plot obtained with Fig. 2. Color coding shows wavepaths per pixel.

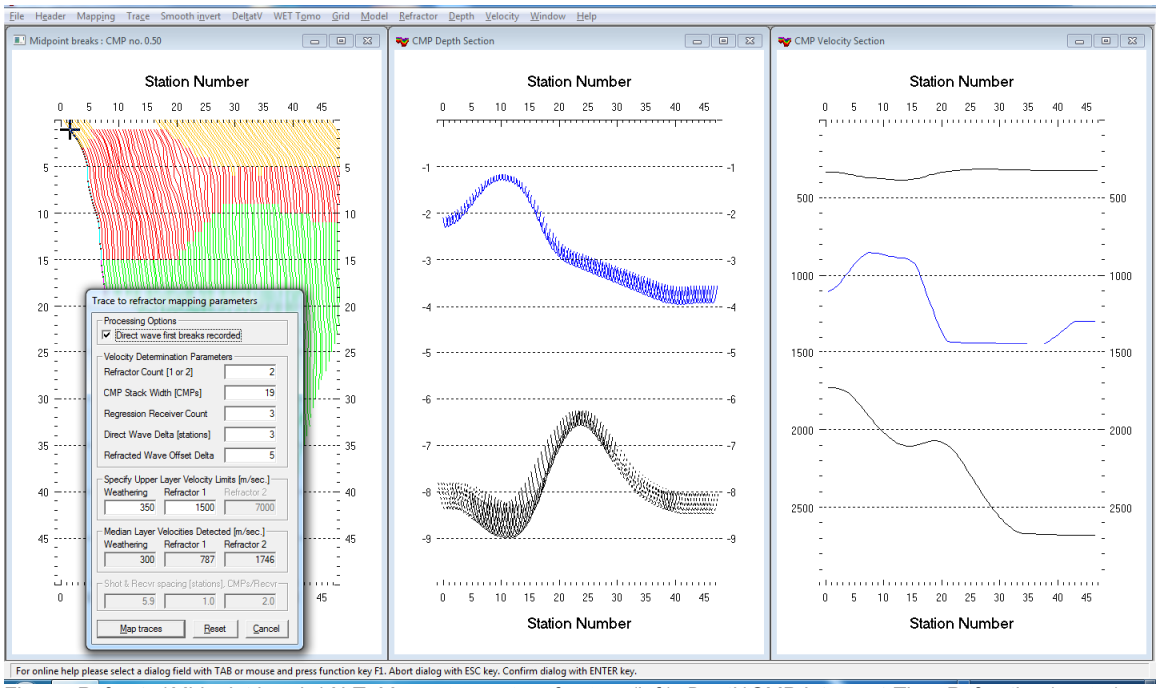

Fig. 4 : *Refractor|Midpoint breaks|ALT+M* map traces to refractors (left), *Depth|CMP Intercept-Time Refraction* (center), *Velocity|CMP Intercept-Time Refraction* (right).

For an explanation of *Refractor|Midpoint breaks display* of CMP sorted traveltime curves (Fig. 4, left) see our DeltatV paper, Fig. 2. The steeper the local dip of a CMP sorted traveltime curve, the higher the local apparent velocity.

In case of strong refractor curvature, DeltatV gives systematically too low velocity below anticlines and too high velocity below synclines due to sorting traces by CMP, see epikinv. Limiting the 1.5D DeltatV velocity to the maximum velocity in the 1D-gradient starting model helps to suppress these artefacts in the basement.

Limiting the max. velocity during 2D WET inversion also helps to eliminate DeltatV starting model artefacts from basement velocity interpretation. See our Palmfig9 tutorial.

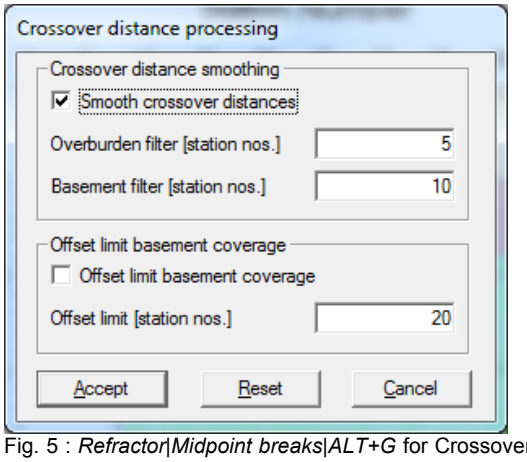

Fig. 5 : *Refractor|Midpoint breaks|ALT+G* for Crossover distance smoothing, after mapping of traces to refractors (Fig. 4). Default settings.

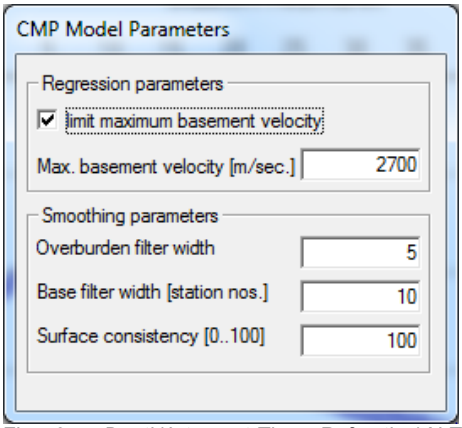

Fig. 6 : *Depth|Intercept-Time Refraction|ALT+M* for layer smoothing. *Max. basement velocity* limited to 2,700 m/s.

For detailed instructions on how to map traces to refractors (Fig. 4), smooth crossover distances (Fig. 5) and run time-to-depth conversion (Fig. 4, Fig. 6) see our jenny13.pdf tutorial.

For true model and synthetic traveltimes see http://forum.detectation.com/viewtopic.php?f=2&t=1817

For all inversion parameters used for Fig. 2 see file VELOIT142.PAR in archive

http://rayfract.com/tutorials/ZONDDATA.zip

. Restore these parameters with *Grid|Reset DeltatV and WET settings to .PAR file...* and selecting the matching .GRD VELOIT142.GRD . File DATA.ASC contains the original synthetic first break times.

We used the new *Smooth invert|Smooth inversion Settings|Extra-large cell size* resulting in a square cell sized 0.57m by 0.57m and a grid size of 41 rows vs. 183 columns with 7,503 velocity nodes.

WET inversion runtime for Fig. 2 was 20 seconds on a MacBook Air running Windows 7 in Parallels Desktop 8 using 4 CPU cores in parallel, for inversion of 421 synthetic traveltimes.

See our updated help file and .pdf reference

http://rayfract.com/help/rayfract.pdf

chapter ***WET Wavepath Eikonal Traveltime tomography*** for documentation of our new Conjugate Gradient method parameters and Gaussian smoothing parameters.

For Conjugate Gradient method theory see

http://www.cs.cmu.edu/~quake-papers/painless-conjugate-gradient.pdf