

VSP survey used to constrain refraction tomography with Rayfract® version 3.35 :

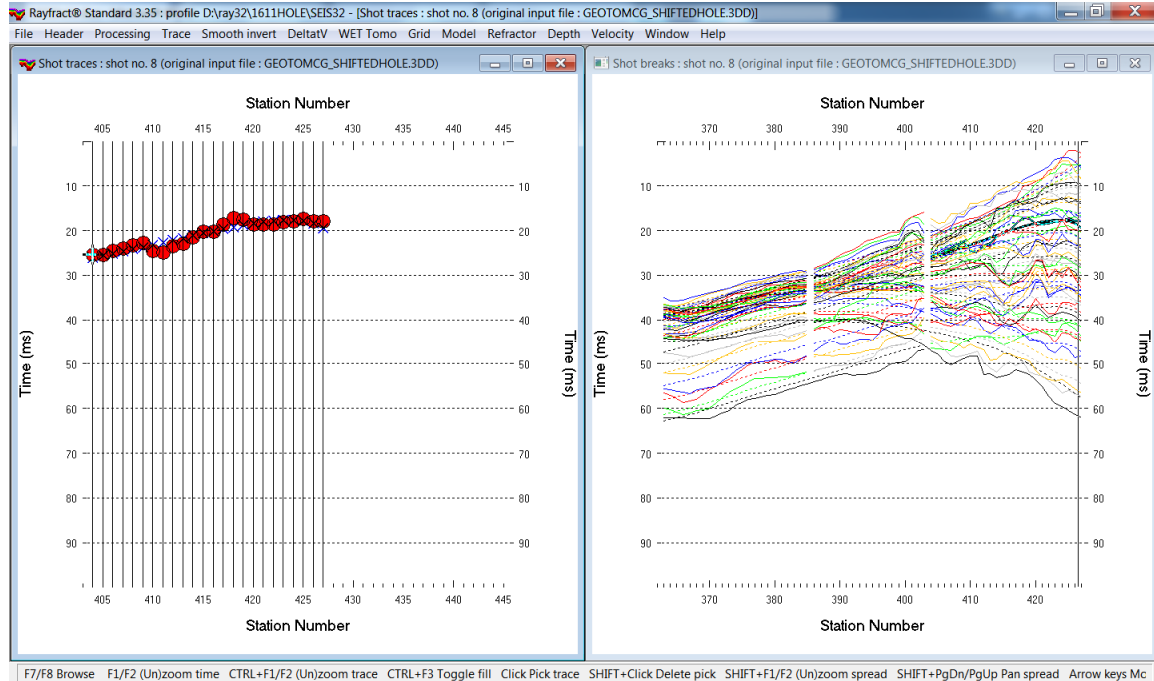


Fig. 1 : left : *Trace|Shot gather*, right : *Refractor|Shot breaks*. Shows fit between picked times (solid colored curves) and modeled times (dashed colored curves) obtained by forward modeling over Fig. 2b in tutorial [11REFR.pdf](#)

- *File|New Profile...*, set *File name* to 1611HOLE and click *Save button*
- set *Station spacing* to 1.0m in *Header|Profile...* . Set *Line type* to Borehole spread/line .
- set *Cell size [m]* to 1.0 in *Header|Profile..* Check box *Force grid cell size*.
- unzip [1611 hole shifted 3dd.rar](#) with GEOTOMCG_ShiftedHole.3DD in C:\RAY32\1611HOLE\INPUT
- check *File|Import Data Settings|X coordinate is corrected for topography already*
- select *File|Import Data...* and set *Import data type* to Tweeton GeoTomCG .3DD
- leave *Default spread type* at 10: 360 channels. Set *Default sample count* to 2000
- click upper *Select button*, navigate into C:\RAY32\1611HOLE\INPUT
- select file GEOTOMCG_ShiftedHole.3DD
- click *Open button*, *Import shots button*. Dismiss *Update profile station spacing prompt* with *No button*.
- the *Import shot dialog* is shown for each shot in the .3DD file.
- for each shot leave *Layout start* and *Shot pos.* at shown values and click *Read button*
- select *Trace|Shot gather* and *Window|Tile* to obtain Fig. 1
- for each window click title bar, press ALT+P, set *Maximum time* to 100 ms and hit ENTER key
- for *Trace|Shot gather* click title bar. Uncheck *Display|Use red cross for picked first breaks*. Check *Display|Solid color pick display & Picks always cover traces*.
- uncheck *Grid|Label shot points*. Check *Grid|Label receiver stations*.
- uncheck all blanking options in *WET Tomo|WET tomography Settings|Blank submenu*
- check *WET Tomo|WET tomography Settings|Edit maximum valid WET velocity*
- select *Smooth invert|WET with constant-velocity initial borehole model* and confirm prompts for default interpretation in Fig. 2
- select *WET Tomo|Interactive WET tomography...*
- set *Number of WET tomography iterations* to 100. Set *Max. velocity* to 4500 m/s (Fig. 4) and click *Start tomography processing* to obtain Fig. 3
- for *WET parameters* used see archive [HOLE335 Width7% 100Iters.rar](#) with starting model files CONSTVEL.GRD & CONSTVEL.PAR, VELOIT100.GRD & .PAR and .SRF Surfer 11 plots

- also see Fig. 4 for *WET parameters* used
- for help on *WET inversion* parameters see updated [.pdf reference](#) chapter *WET Wavepath Eikonal Traveltime tomography*

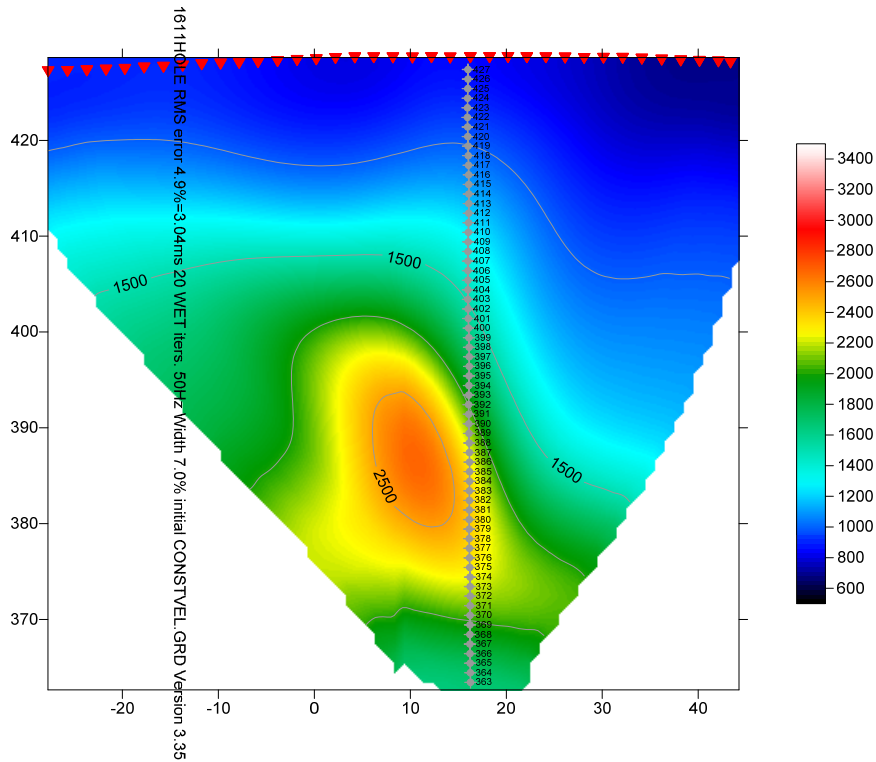


Fig. 2a : Smooth inverted WET with constant-velocity initial model. 20 WET iterations. Default settings.

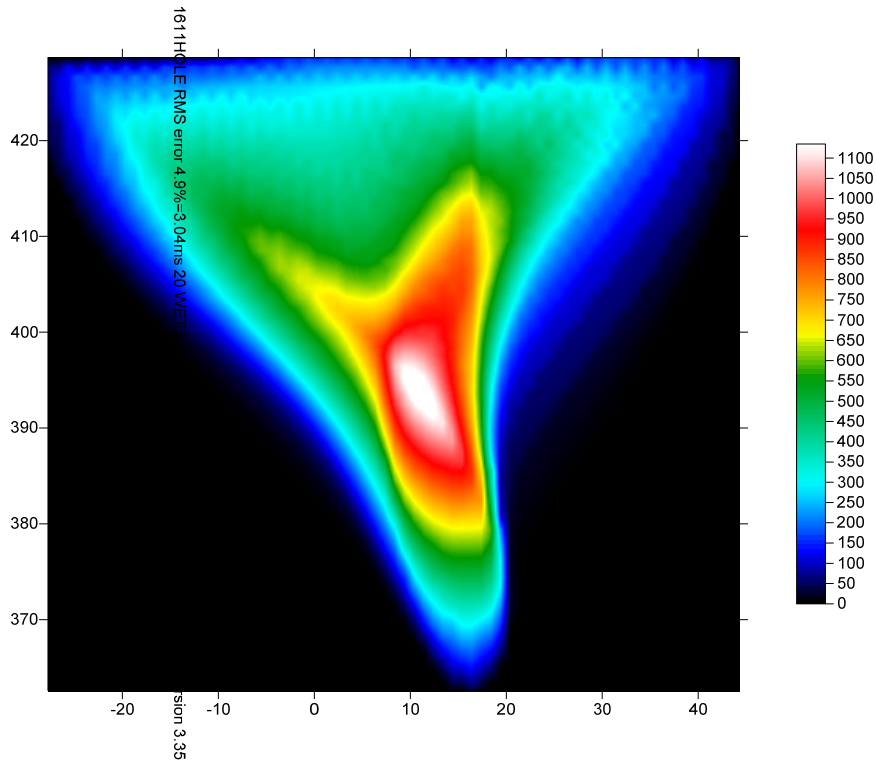


Fig. 2b : WET wavepath coverage plot obtained with Fig. 2a. Unit is wavepaths per pixel.

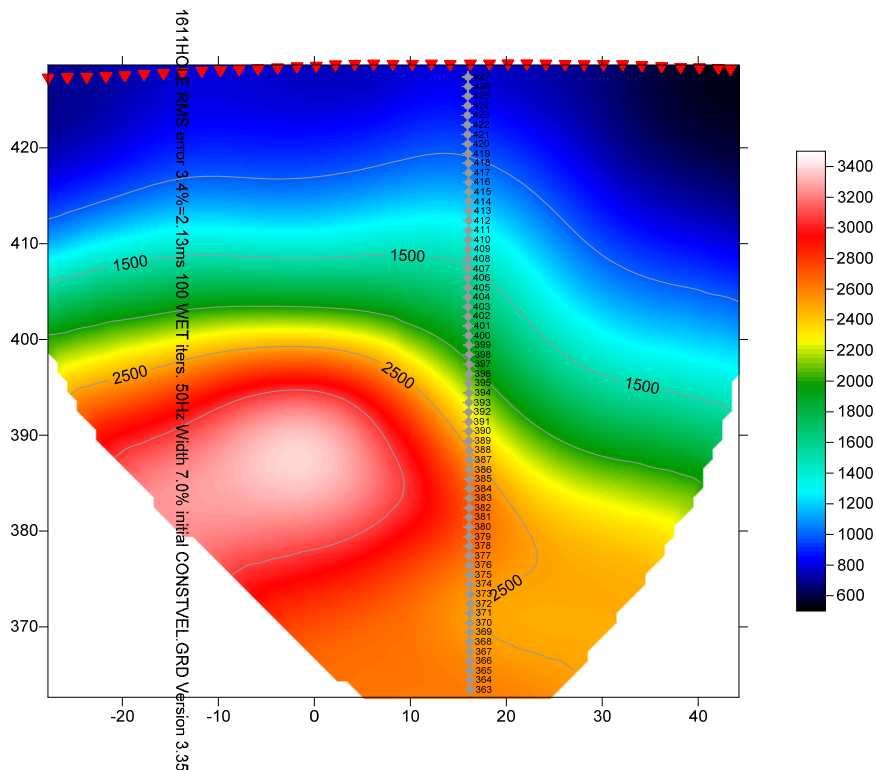


Fig. 3a : Tomogram with constant-velocity starting model, 100 Steepest Descent WET iterations, default WET settings. Wavepath width 7%, Max. velocity 4,500 m/s. WET settings as in Fig. 4.

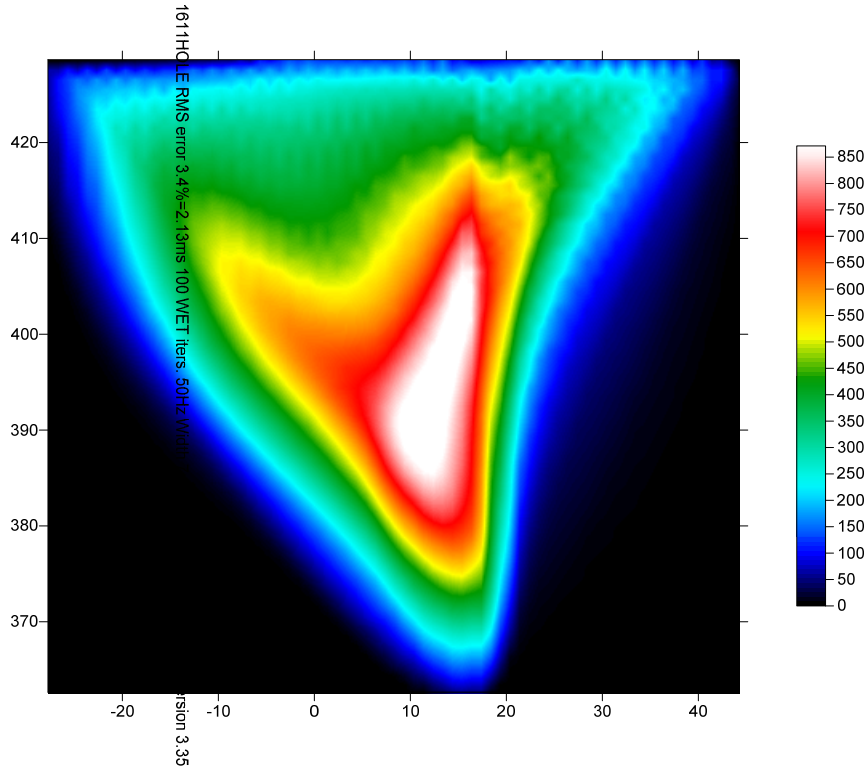


Fig. 3b : WET wavepath coverage plot obtained with Fig. 3a. Shows number of wavepaths per pixel.

Edit WET Wavepath Eikonal Traveltime Tomography Parameters

Specify initial velocity model
 D:\ray32\1611TEST\HOLETOMO\CONSTVEL.GRD

Stop WET inversion after
Number of WET tomography iterations : iterations
☐ or RMS error gets below percent
☐ or RMS error does not improve for n = iterations
☐ or WET inversion runs longer than minutes

WET regularization settings
Wavepath frequency : Hz
Ricker differentiation [-1 is Gaussian bell] : times
Wavepath width [percent of one period] : percent
Wavepath envelope width [% of period] : percent
Min. velocity : Max. velocity : m/sec.
Width of Gaussian for one period [sigma] : sigma

Gradient search method
☒ Steepest Descent ☐ Conjugate Gradient

Conjugate Gradient Parameters
Tolerance Line Search tol.
Initial step Line Search iters.
☐ Steepest Descent step CG iterations

Edit WET Tomography Velocity Smoothing Parameters

Determination of smoothing filter dimensions
☒ Full smoothing after each tomography iteration
☐ Minimal smoothing after each tomography iteration
☐ Manual specification of smoothing filter, see below

Smoothing filter dimensions
Half smoothing filter width : columns
Half smoothing filter height : grid rows

Filter shallow dipping wavepath artefacts from model
☒ Automatically adapt shape of rectangular filter matrix

Maximum relative velocity update after each iteration
Maximum velocity update : percent

Smooth after each nth iteration only
Smooth nth iteration : n = iterations

Smoothing filter weighting
☐ Gaussian ☒ Uniform
Used width of Gaussian sigma
Uniform central row weight [1..100]

Smooth velocity update before updating tomogram
☒ Smooth velocity update ☒ Smooth last iteration

Damping of tomogram with previous iteration tomogram
Damping [0..1] ☐ Damp before smoothing

Fig. 4 : WET parameter settings for Fig. 3. left : main interactive WET dialog. right : edit velocity smoothing

In tutorial [11REFR.pdf](#) we show how to constrain surface-based refraction tomography with above VSP shots.