TylerLine1 single-run WET/1D-Gradient starting model & once-derived Ricker wavelet 3.36 :

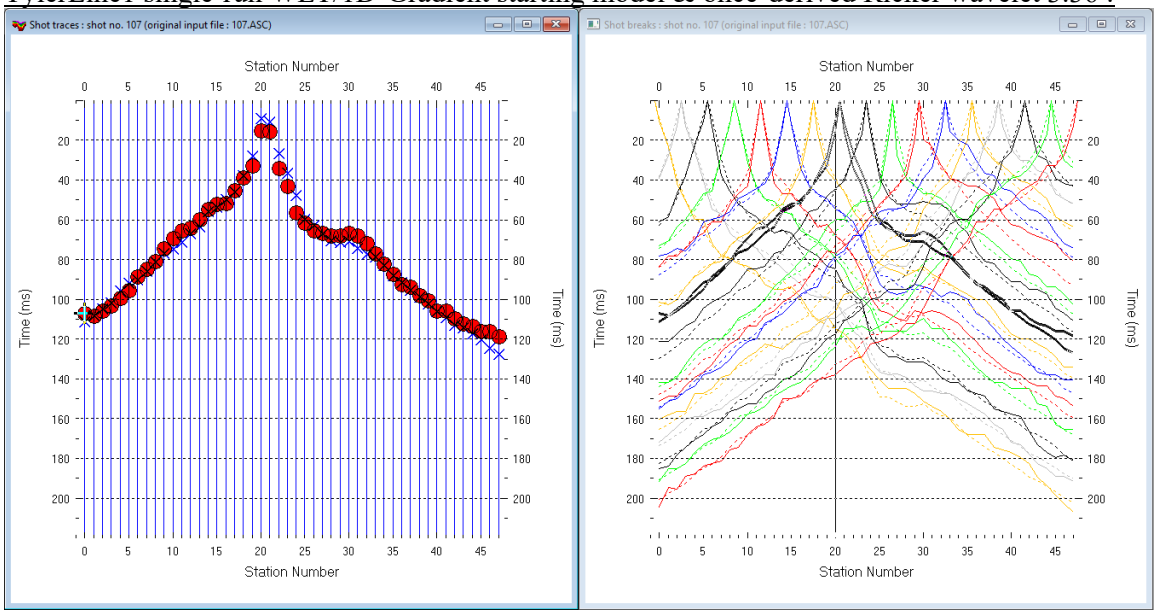

Fig. 1 : left : *Trace*|*Shot gather*, right : *Refractor*|*Shot breaks*. Shows fit between picked times (solid colored curves, red circles) and modeled times (dashed colored curves, blue crosses) obtained for single-run WET output (Fig. 10)

To create the profile database, import the data and browse the imported shots do these steps :

- ***File*|*New Profile***..., set *File name* to **`TYLERLN1`** and click *Save button*
- in ***Header*|*Profile***... set *Line type* to **`Refraction spread/line`** . Select ***Units*** **`feet`** & set *Station spacing* to 20.0 ft.
- check *box Force grid cell size* and set *Cell size[m]* to 3.0 ft. See Fig. 2.
- unzip **`TYLERLN1 input.zip`** with files **`100.ASC to 116.ASC, COORDS.COR and SHOTPTS.SHO`** in directory **`C:\RAY32\TYLERLN1\INPUT`**
- select ***File*|*Import Data***... and set *Import data type* to **`ASCII column format`**. See Fig. 3.
- click *Select button*, navigate into **`C:\RAY32\TYLERLN1\INPUT`** and select file **`100.ASC`**
- leave *Default spread type* at **`10: 360 channels`** . Check box *Batch import*.
- set *Default sample count* to 2,500 to setup the y scale for *Trace*|*Shot gather* & *Refractor*|*Shot breaks*
- click ***Import shots button***. All **`.ASC`** shot files in directory **`C:\RAY32\TYLERLN1\INPUT`** are imported.
- select *File*|*Update header data*|***Update Station Coordinates***
- navigate into directory **`C:\RAY32\TYLERLN1\INPUT`**
- select file **`COORDS.COR`** . Click *Open button*.
- *File*|*Update header data*|***Update Shotpoint coordinates*** with **`SHOTPTS.SHO`**
- select *Trace*|*Shot gather* and *Window*|*Tile* to obtain Fig. 1 . Browse shots with F7/F8 .

To configure and run *Smooth inversion* and display the 1D-gradient starting model :

- check *Smooth invert*|*Smooth inversion Settings*|*Output inversion results in Feet*. See Fig. 10.
- leave other *Smooth invert*|*Smooth inversion Settings* at defaults. See Fig. 10.
- leave *DeltatV*|*DeltatV Settings* at defaults. See Fig. 6.
- select *Smooth invert*|*WET with 1D-gradient initial model* and confirm. Cancel *WET continuation*.
- select *Grid*|*Surfer plot Limits*. Click *Reset to grid*. Navigate into profile subdirectory **`C:\RAY3\TYLERLN1\GRADTOMO`**. Click on file **`GRADIENT.GRD`** & click *Open*
- check *box* ***Plot limits active.*** Uncheck *box Proportional XY Scaling*. Set *Y Scale length* to 3.0 inches.
- set *Min. velocity* to 1,000 ft/s and *Max. velocity* to 8,000 ft/s. Edit fields as in Fig. 4. Click *OK*.
- select *Grid*|*Image and contour velocity and coverage grids* & above **`GRADIENT.GRD`** to obtain Fig. 7

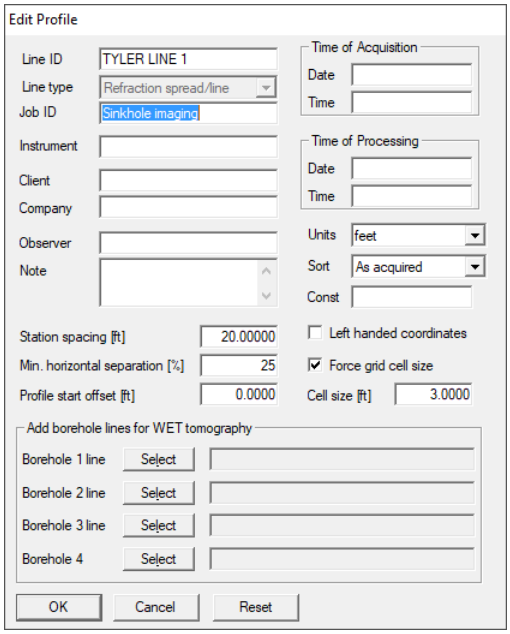

Fig. 2 : *Header|Profile*

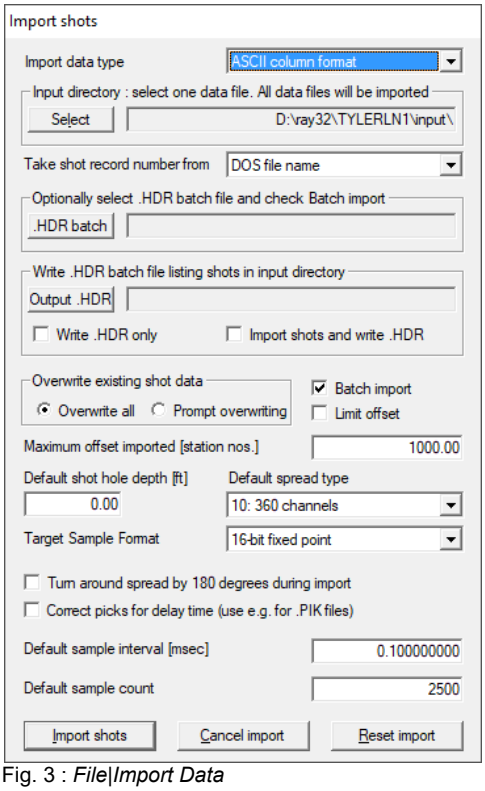

Fig. 3 : *File|Import Data*

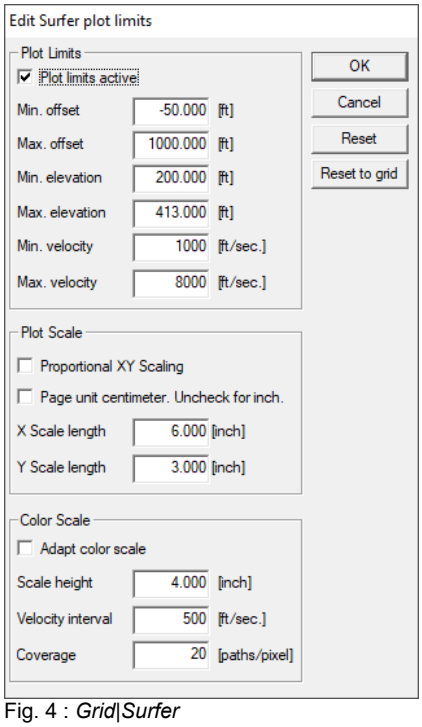

Fig. 4 : *Grid|Surfer plot Limits*

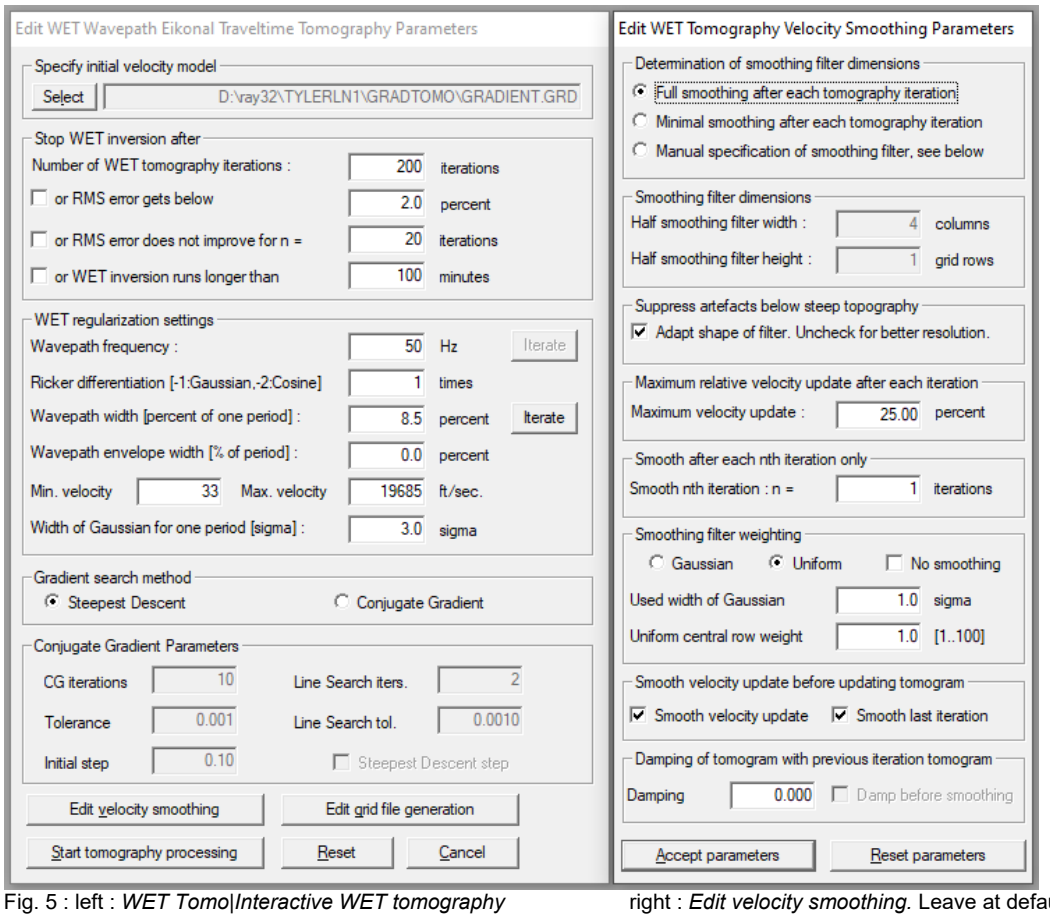

Fig. 5 : left : *WET Tomo|Interactive WET tomography* right : *Edit velocity smoothing*. Leave at defaults.

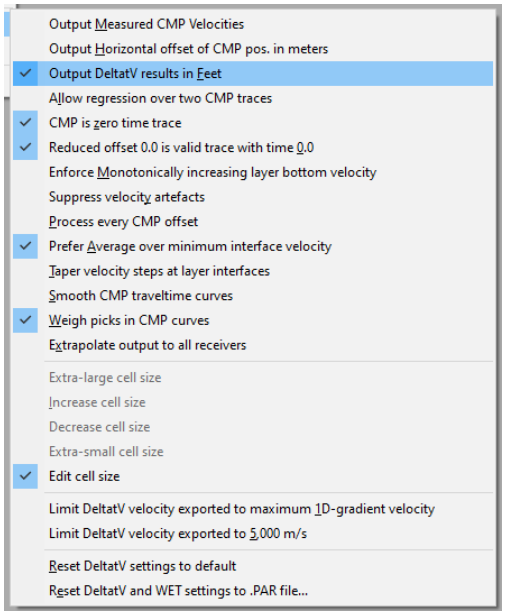

Fig. 6 : *DeltatV|DeltatV Settings*. Leave settings at their defaults.

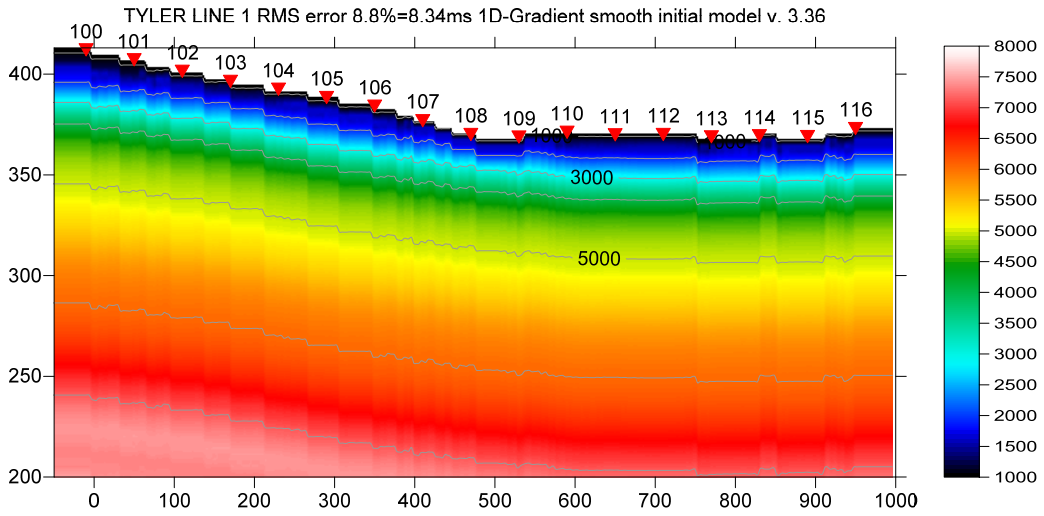

Fig. 7 :*1D-gradient starting model.* See Fig. 6&10&11 for *DeltatV & Smooth inversion & WET Tomo Settings*

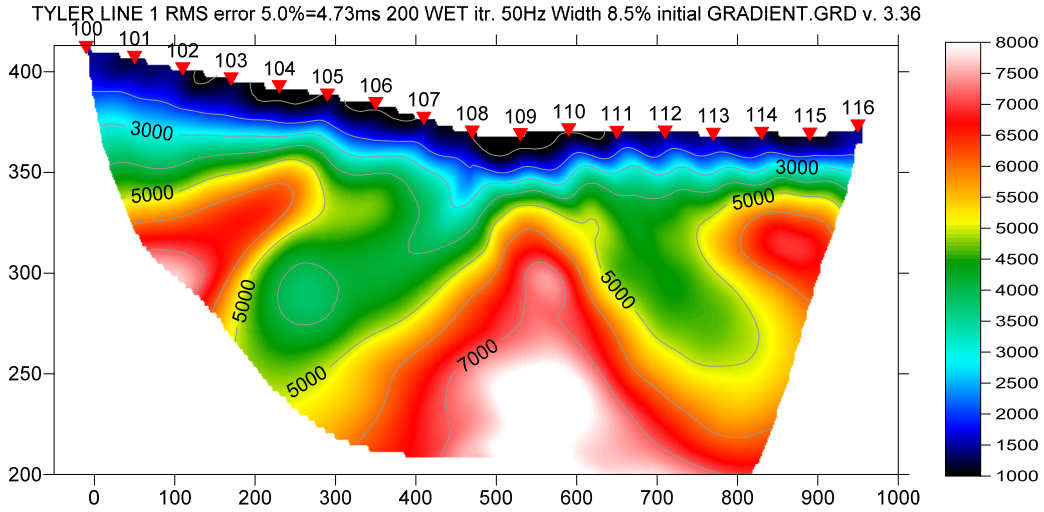

Fig. 8 : Single-run WET inversion using 200 *Steepest Descent* iterations and full smoothing (Fig. 5). Starting model is Fig. 7. See Fig. 1 for misfit between modeled and picked times.

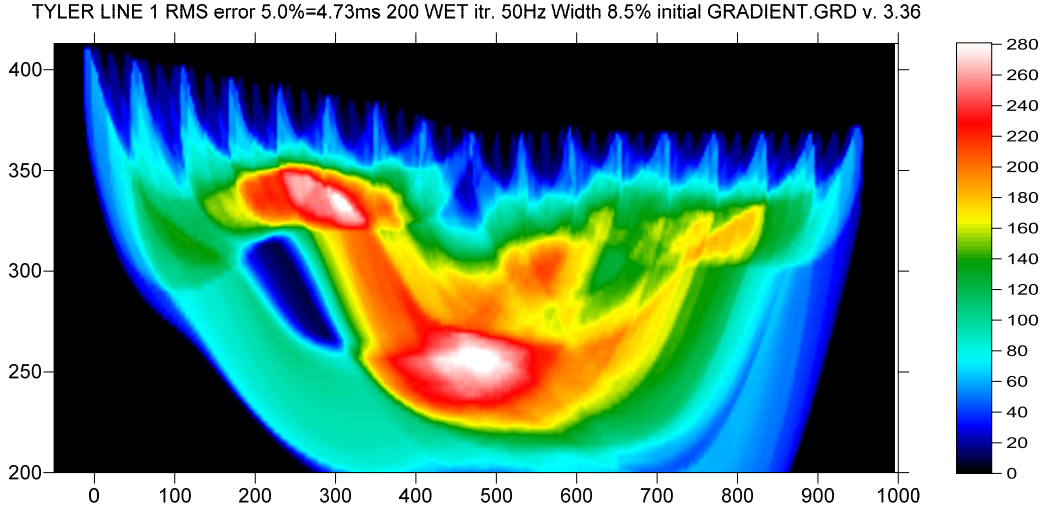

Fig. 9 : WET wavepath coverage plot obtained with Fig. 8. Unit is wavepaths per pixels.

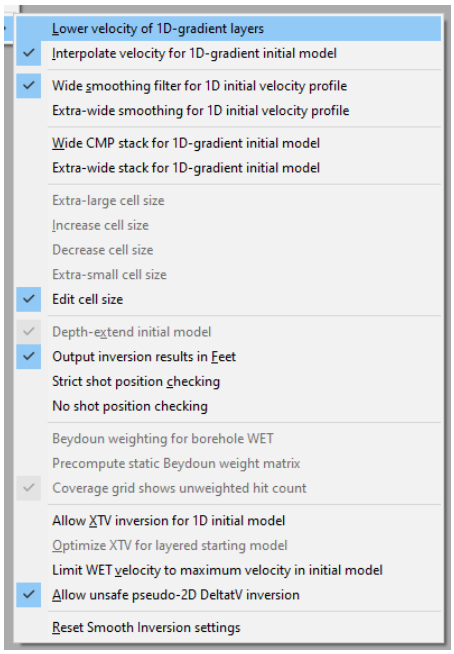

Fig. 10 : edit menu *Smooth invert|Smooth inversion Settings*. Check *Output inversion results in Feet* to obtain starting model Fig. 7 in feet.

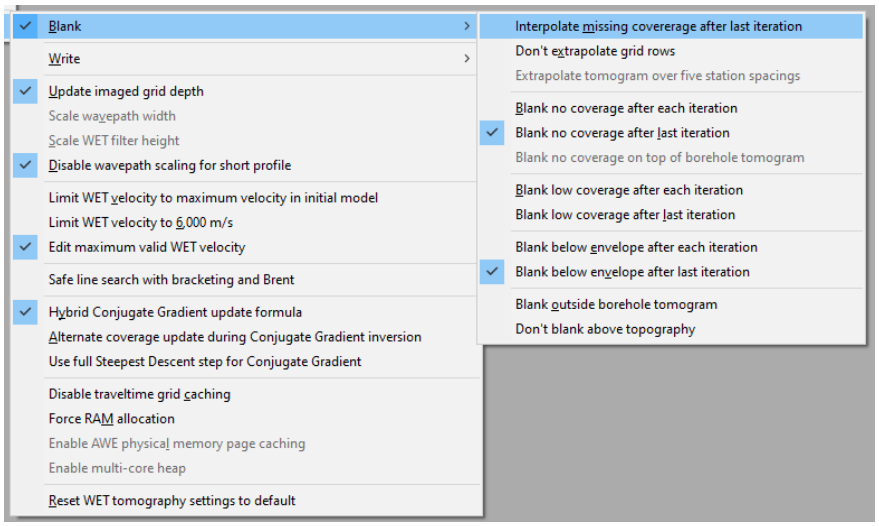

Fig. 11 : use default *WET Tomo|WET tomography Settings* and blanking settings

To configure and run *WET inversion* and display 2D inversion output :

- check *WET Tomo|WET tomography Settings|Edit maximum valid WET velocity*. See Fig. 11.
- set *WET Tomo|Interactive WET tomography|Number of WET tomography iterations* to 200 (Fig. 5)
- set ***Ricker differentiation*** to 1 *[Ricker wavelet once differentiated in time]*
- click button *Edit grid file generation* & set *Store each nth iteration only : n* = to 20. Click *OK*.
- click ***Edit velocity smoothing***. Leave all controls at their defaults. See Fig. 5 (right). Click ESC key.
- click *button* ***Start tomography processing*** to obtain Fig. 8 & 9

Summary :

In our 2006 tutorial we show almost the same output after 200 WET iterations. Also we show layered refraction interpretation using the *Wavefront method*.

WET inversion shown in Fig. 8 using 200 *Steepest-Descent* WET iterations with *full smoothing* (see Fig. 5) took about 50 seconds on 2017 Apple iMac. This iMac comes with 2.3 GHz Intel Core i5 processor running 4 OpenMP threads under Windows 10 Pro 64-bit in Parallels Desktop 14 for Mac. For even faster processing we recommend our Pro version which can use up to 16 OpenMP threads for parallel WET inversion using available CPU cores.

For a published interpretation of above data done with GeoTomo software see Fig. 9 / page 341 in Thomas L. Dobecki and Sam B. Upchurch 2006. Geophysical applications to detect sinkholes and ground subsidence. The Leading Edge, Volume 25, Issue 3, pp. 336-341 (March 2006). See Fig. 9 link.

Our Rayfract® software offers multiple interpretation methods and parameters to explore the non-uniqueness of the solution space. It is the user's job to sufficiently explore the solution space with our methods and varying parameters, and to find an appropriate combination of methods and parameters for each individual data set. This choice may be guided by a-priori information e.g. from boreholes or other geophysical methods. For good parameter combinations see our tutorials, our short manual and our SAGEEP 2010 short course. We recommend to always first run our *Smooth inversion* method with *1D-gradient starting model*. Next you can increase the ***WET iteration count*** to 100 or 200 in *WET Tomo|Interactive WET* as shown above. Vary ***Ricker differentiation*** : test values -1*[Gaussian]*, -2*[Cosine-Squared]*, 0 and 1. Values 1 and 0 will not work when increasing the *WET wavepath width* or with *multirun WET* inversion.

For processing of lines longer than the recommended minimum length of 500m for our pseudo-2D *DeltatV* method see OT0608.pdf & GEOXMERC.pdf . DeltatV and *Smooth inversion* using ***1D-gradient starting model*** obtained by laterally averaging DeltatV can match each other nicely for long lines as shown in these .pdf tutorials.

We thank Tom Dobecki for making available above input files and giving us permission to write this tutorial.

For an objective comparison of tomographic refraction analysis methods see Zelt et al. 2013 (JEEG, September 2013, Volume 18, Issue 3, pp. 183–194).