WET Walkaway : Steepest Descent & Gaussian weighting 3.36 constant-velocity initial model :

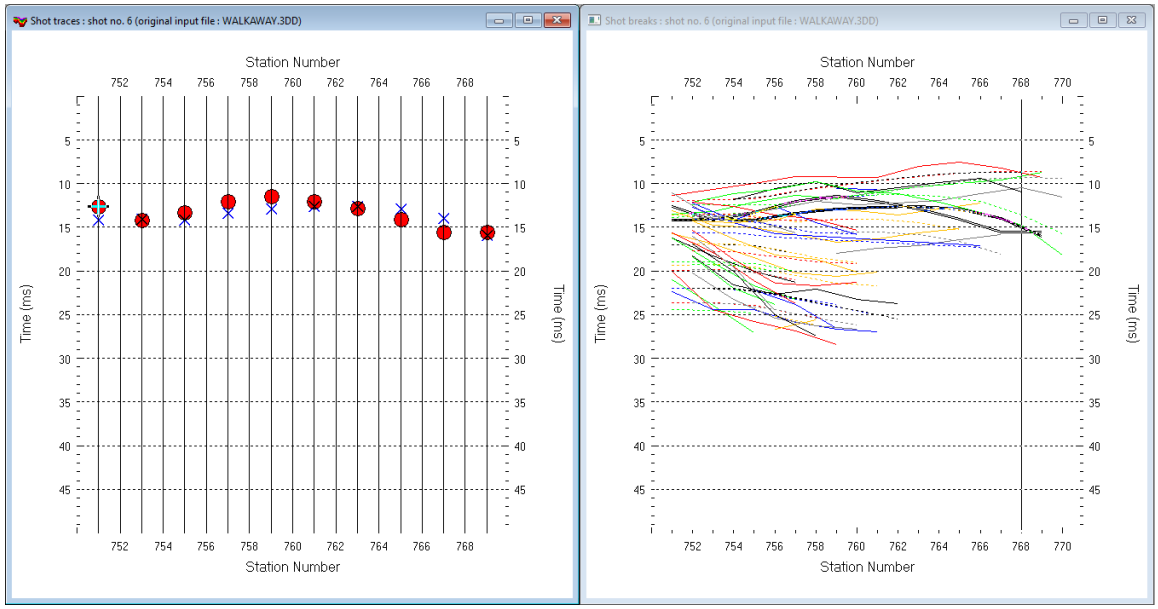

Fig. 1 : left : *Trace|Shot gather*, right : *Refractor|Shot breaks*. Shows fit between picked times (solid colored curves, red circles) and modeled times (dashed colored curves, blue crosses) obtained for 2D WET inversion output (Fig. 10)

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

- ***File|New Profile***..., set *File name* to **`WALKAWAY`** and click *Save button*
- in ***Header|Profile***... set *Line type* to **`Borehole spread/line`** . Set *Station spacing* to 1.0 m. See Fig. 2.
- unzip archive **`WALWAWAY.ZIP`** with files **`walkaway.3dd`** and **`digitized.bln`** in directory **`C:\RAY32\WALKAWAY\INPUT`**
- select ***File|Import Data***... and set *Import data type* to **`GeoTomCG .3DD`**. See Fig. 3.
- leave *Default spread type* at **`10: 360 channels`**
- click *Select button*, navigate into **`C:\RAY32\WALKAWAY\INPUT`** and select file **`walkaway.3dd`**
- set *Default sample count* to 500 to setup the y scale for *Trace|Shot gather* & *Refractor|Shot breaks*
- click ***Import shots button*** and click *Read button* for each shot shown in *Import Shot* dialog
- select *Trace|Shot gather* and *Window|Tile* to obtain Fig. 1. Browse shots with F7/F8 function keys.

To configure and run Smooth inversion and display the constant-velocity starting model :

- leave *Smooth invert|Smooth inversion Settings* at defaults. See Fig. 7.
- select *Smooth invert|WET with constant-velocity initial &borehole model* and confirm. Cancel *WET continuation*.
- select *Grid|Surfer plot Limits.* Click *Reset to grid*. Navigate into profile subdirectory **`C:\RAY3\WALKAWAY\HOLETOMO`**. Click on file **`CONSTVEL.GRD`** & click *Open*
- check *box* ***Plot limits active.*** Uncheck *box Proportional XY Scaling*. Set *Y Scale length* to 2.0 inches.
- set *Min. velocity* to 500 m/s and *Max. velocity* to 6,500 m/s. Edit fields as in Fig. 4. Click *OK*.
- select *Grid|Image and contour velocity and coverage grids* & above **`CONSTVEL.GRD`** to obtain Fig. 9

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

- leave blanking options in *WET Tomo|WET tomography Settings|Blank* at defaults. See Fig. 8.
- leave *WET Tomo|WET tomography Settings* at default settings. See Fig. 12.
- select *WET Tomo|WET Velocity constraints*. Check *box Polygon blanking active*. See Fig. 5.
- click button *Select blanking file* and navigate into **`C:\RAY32\WALKAWAY\INPUT`** directory.
- left-click file **`digitized.bln`** and click *Open* button. See Fig. 5 . Click *OK button*.
- select *WET Tomo|Interactive WET tomography*. Click *Select* button twice.

- navigate into directory **C:\RAY32\WALKAWAY\HOLETOMO** and left-click **CONSTVEL.GRD**
- click *Open button* and *Accept parameters* button
- set *Number of WET tomography iterations* to 200
- leave ***Ricker differentiation*** at default -1 [Gaussian] as used in the following processing. Or change to 0.
- leave all other *interactive WET controls* at their default settings. See Fig. 6 (left).
- click *Edit grid file generation* & set *Store each nth iteration only : n* = to 40. Click *Accept parameters.*
- click ***Edit velocity smoothing***. Uncheck box *Adapt shape of filter*. See Fig. 6 (right).
- set ***Uniform central row weight*** to 20
- leave all other smoothing controls at their default settings. See Fig. 6 (right). Click *Accept parameters*.
- click *button* ***Start tomography processing*** to obtain Fig. 10 & 11

Here some references to help file chapters and other relevant tutorials and publications :

- pick the …\INPUT\DIGITIZED.BLN ***topography blanking file*** in Golden Software Surfer on CONSTVEL starting model plot Fig. 9 with Surfer ***Map|Digitize command*** as described in https://support.goldensoftware.com/hc/en-us/articles/226661208-How-can-I-create-a-BLN-file-in-Surfer option ***4. Digitize the Boundary*** :

  - pick the upper left corner of the tomogram at elevation 770m
  - move down vertically along left tomogram border until you intersect the topography
  - click again at top of leftmost red shot symbol
  - move one shot symbol to the right and click again at top of red shot triangle
  - repeat this for all shot triangles until you hit the right tomogram border
  - move up the mouse to upper-right corner of tomogram and click again
  - move the mouse left back to upper-left corner and click again
  - click on *File menu* in ***Digitized Coordinates window*** and select *Save As*
  - navigate into **C:\RAY32\WALKAWAY\INPUT** directory and set *File name* to **my digitized**
  - click *Save button* to save your coordinates as **C:\RAY32\WALKAWAY\INPUT\my digitized.bln**

- picking and using above topography blanking file in *WET velocity constraints* in Fig. 5 is not necessary for profiles with *Line type* **Refraction spread/line**
- for our interpretation of above data with version 3.09 of our software see our Walkaway tutorial
- for our ***multiscale WET*** inversion see updated help file chapter ***WET tomography processing***
- our SAGEEP11 tutorial shows ***Conjugate Gradient WET*** inversion using 1D-gradient initial model for SAGEEP11 synthetic data forward-modeled over fault zone model
- Ostrowski et al. show fault zone imaging using our WET inversion and dense shot spacing

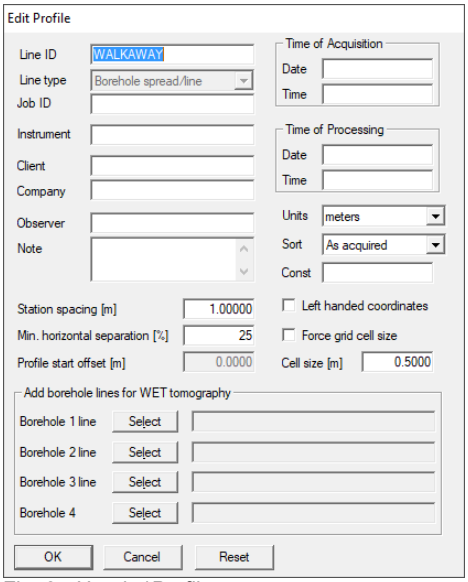

Fig. 2 : *Header|Profile*

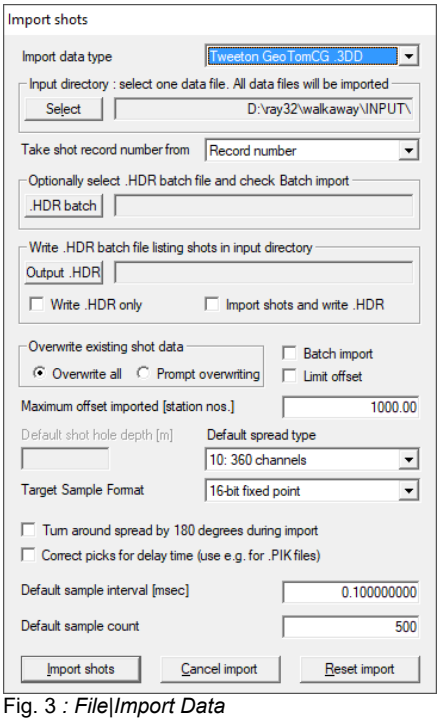

Fig. 3 *: File|Import Data*

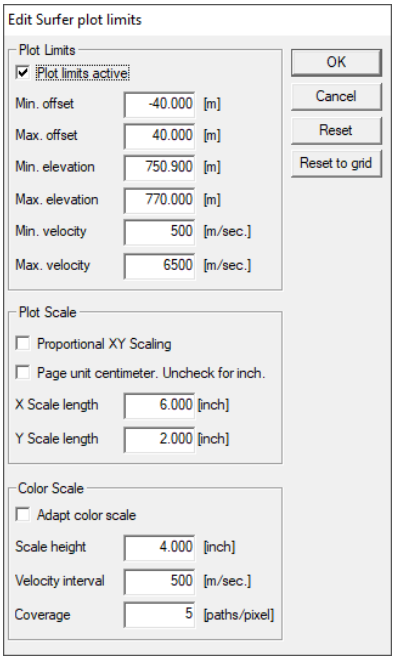

Fig. 4 : Grid|Surfer plot Limits

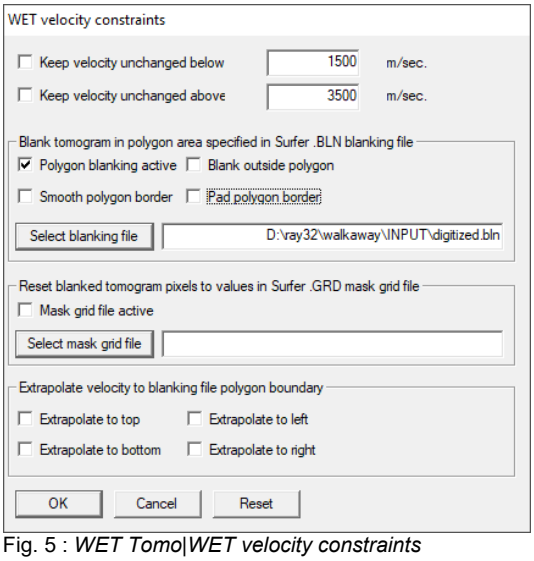

Fig. 5 : *WET Tomo|WET velocity constraints*

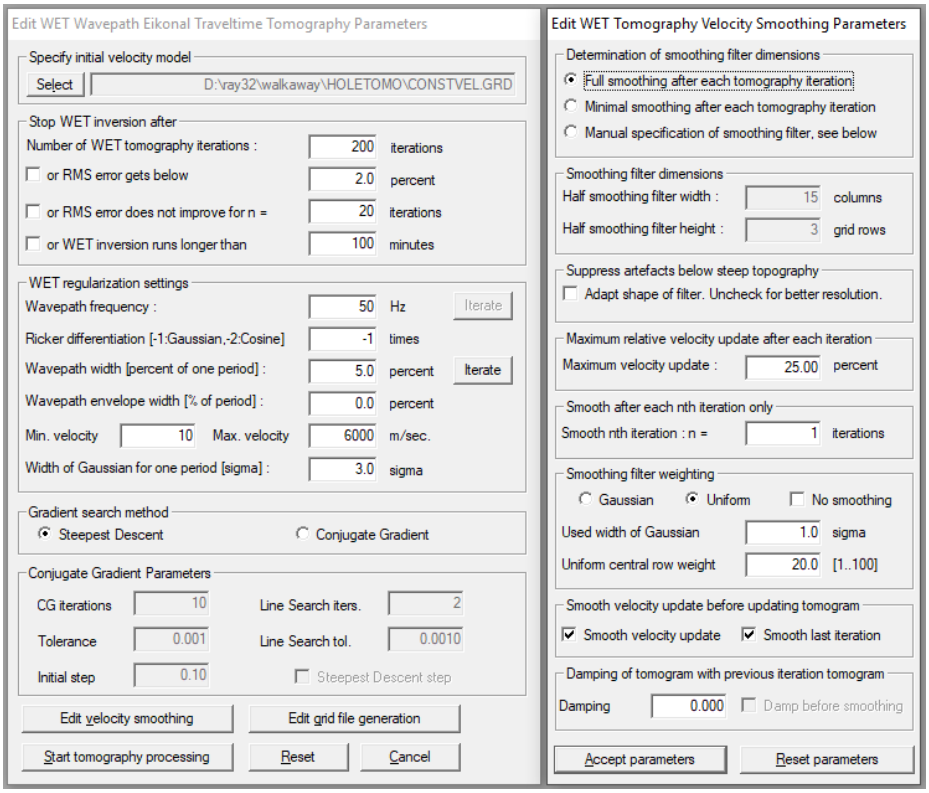

Fig. 6 : *WET Tomo|Interactive WET* (left) . *Edit velocity smoothing* (right).

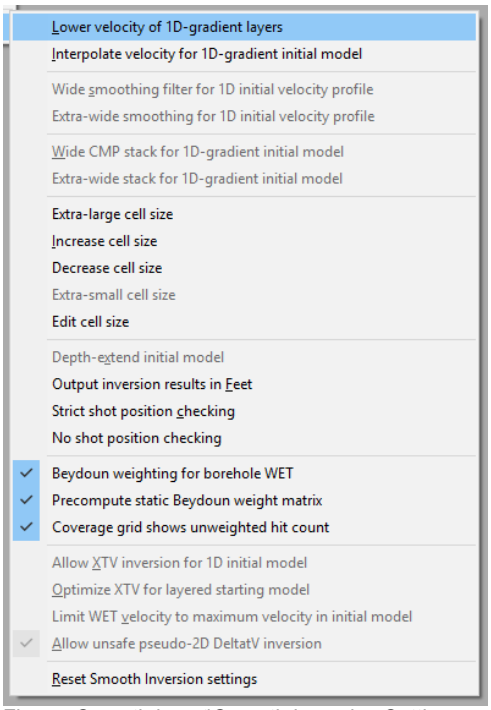

Fig. 7 : *Smooth invert|Smooth inversion Settings*

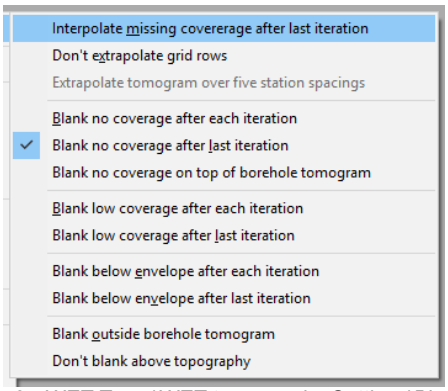

Fig. 8 : *WET Tomo|WET tomography Settings|Blank*

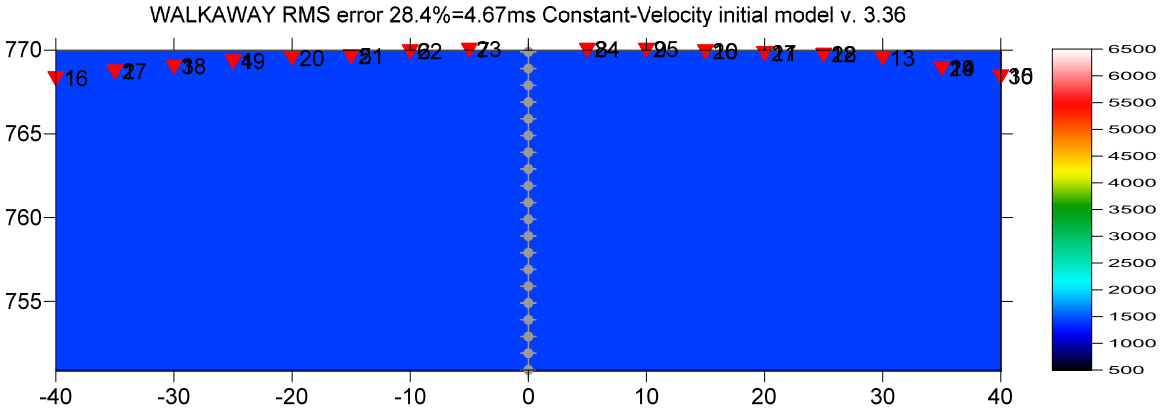

Fig. 9 : *Smooth inversion* starting model .

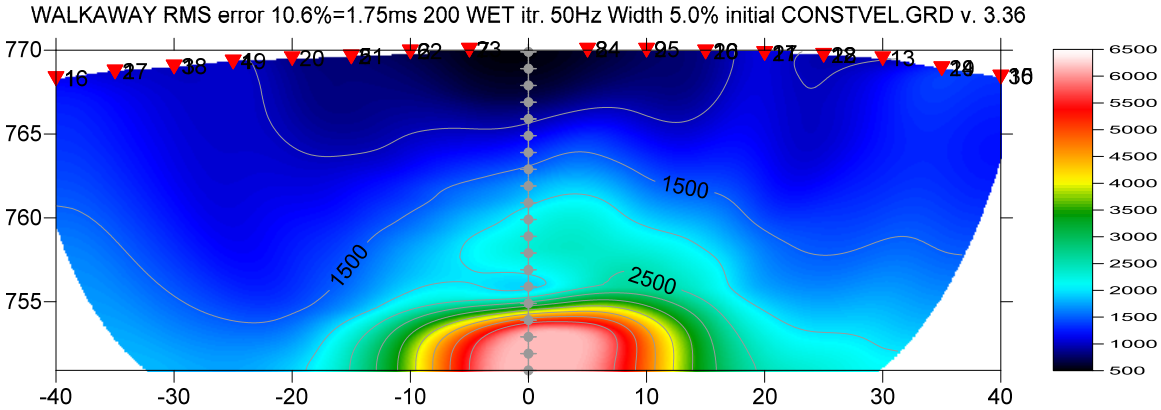

Fig. 10 : WET inversion output after 200 iterations. See Fig. 6 for parameters. See Fig.1 for misfit. Grid cell size is 0.0914m.

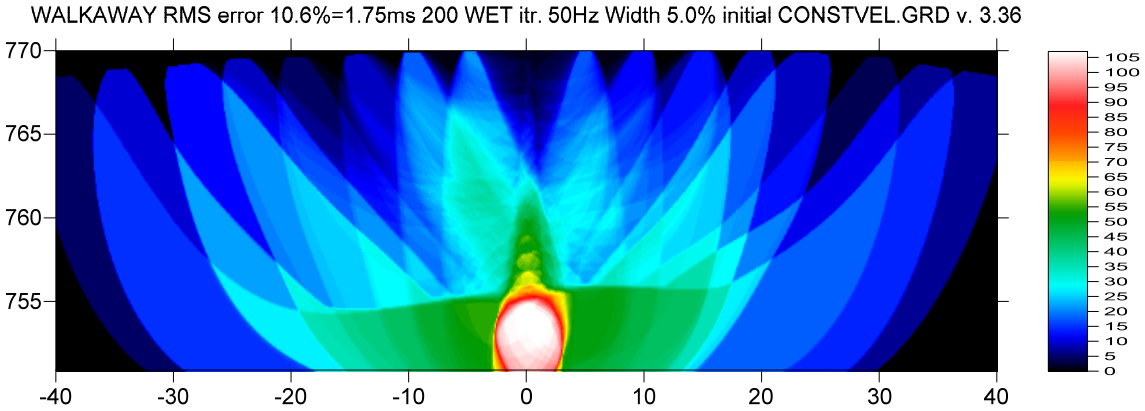

Fig. 11 : Wavepath coverage plot obtained with Fig. 10. Unit is wavepaths per pixel.

To restore database files and result files :

Subdirectories **`C:\RAY32\WALKAWAY\HOLETOMO`**, …**`\INPUT`** and …**`\seis32_July5_2019`** are available in this .RAR archive. Open the …**`\HOLETOMO\VELOIT200.PAR`** file e.g. with Windows Notepad editor to review *WET inversion* parameters used.

Use Rayfract® 3.36 command ***Grid|Reset DeltatV and WET settings to .PAR file…*** with file …**`\HOLETOMO\VELOIT200.GRD`** to reset your profile's *DeltatV and WET inversion settings* to …**`\HOLETOMO\VELOIT200.PAR`**.

Or quit our software via ***File|Exit***. In Windows Explorer copy all 34 **`seis32.*`** database files from directory …**`\seis32_July5_2019`** into **`C:\RAY32\WALKAWAY`** directory. Now reopen your profile with ***File|Open Profile…*** and **`C:\RAY32\WALKAWAY\SEIS32.DBD`** .

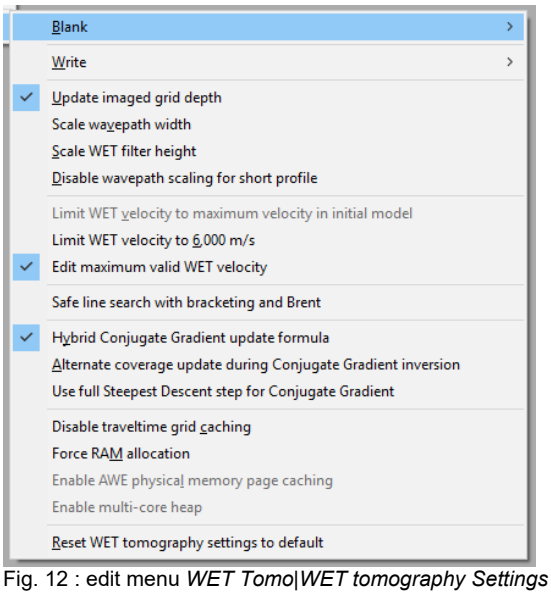

Fig. 12 : edit menu *WET Tomo|WET tomography Settings*

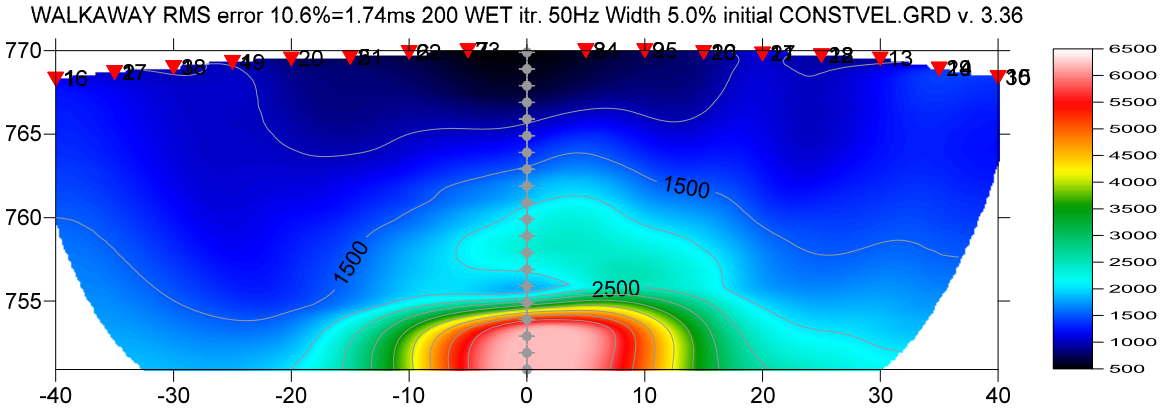

Fig. 13 : 200 WET iterations with cell size forced to 0.2m in *Header|Profile* (Fig. 2). Compare with Fig. 10 obtained with default cell size 0.0914m.

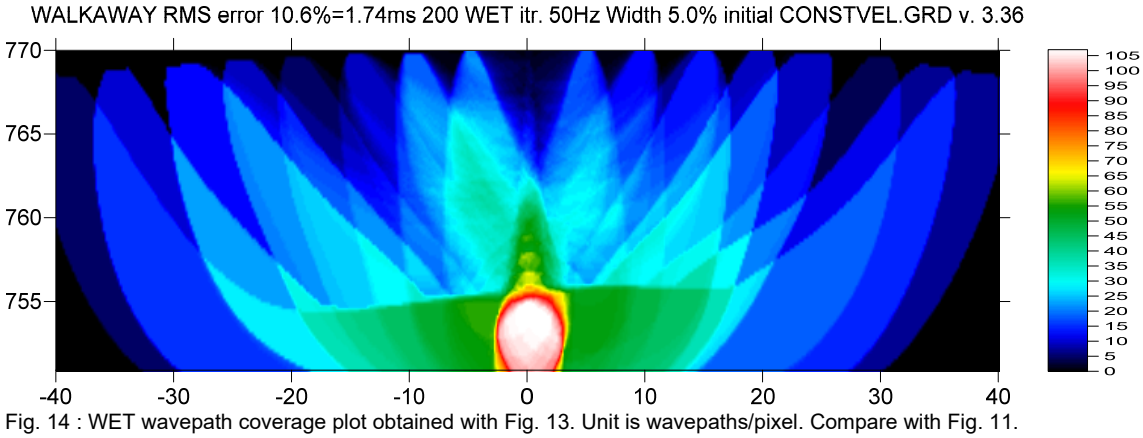

Fig. 14 : WET wavepath coverage plot obtained with Fig. 13. Unit is wavepaths/pixel. Compare with Fig. 11.

Next we force the grid cell size to 0.2m in *Header|Profile* instead of using the default cell size of 0.0914m :

- check *WET Tomo|WET tomography Settings|Write|Keep WET smoothing record in database*
- select *Header|Profile*. Check *Force grid cell size*. Edit *Cell size* to 0.2m. Click OK & confirm prompts.
- select *Smooth invert|WET with constant-velocity initial borehole model*. Cancel *WET continuation* prompt.

- select *WET Tomo|Interactive WET tomography*
- click button *Edit velocity smoothing* to let the software redetermine the default smoothing regarding the changed cell size in the starting model. Click button *Accept Parameters* without editing any controls.
- click button *Start tomography processing* and confirm prompts to obtain Fig. 13 and 14 after about one minute. Fig. 13 is practically identical to Fig. 10.

Summary :

WET inversion shown in Fig. 10 using 200 WET iterations and parameters shown in Fig. 5/6/7/8 took about 4 minutes 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.

When forcing the grid cell size to 0.2m instead of using the default cell size of 0.0914m we obtained Fig. 13 in just about 1 minute i.e. four times faster than Fig. 10.

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

We thank our Australian client Coffey Geotechnics Pty Ltd. for making available above VSP data set.