NGU synthetic profile G1 shown in NGU report 2020.044 : bad modeled traveltimes for off-end shots no. 1 to no. 4 / remodeled with Rayfract® version 4.03 :

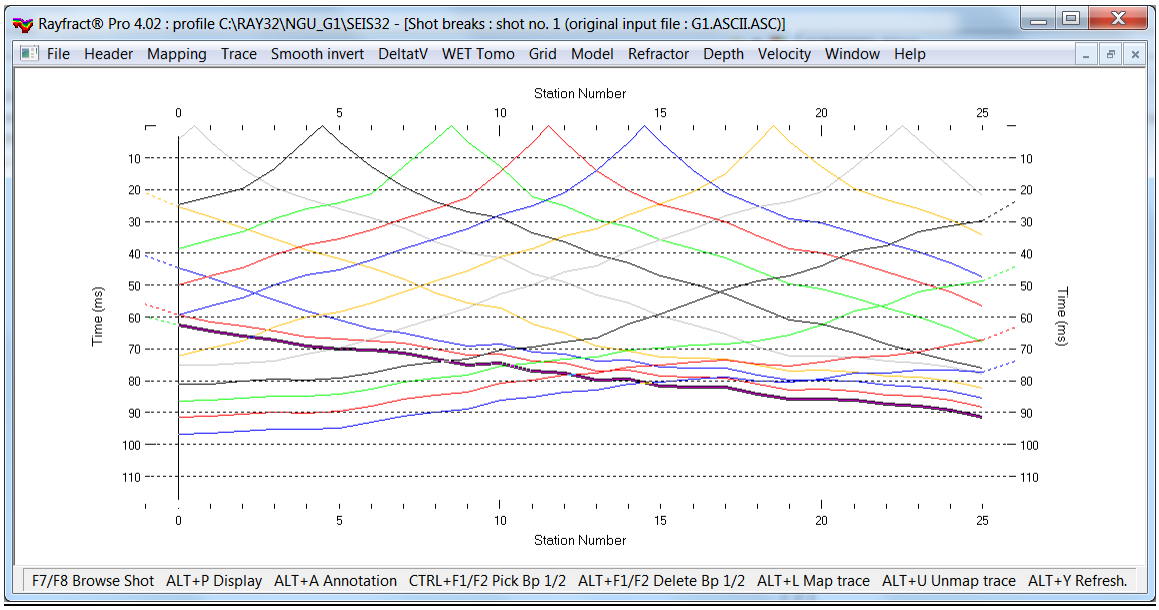

Fig. 1 : bad synthetic picks imported from G1.ASCII.ASC made available by NGU May 23, 2022. See Fig. 6 for *Header|Profile* settings.

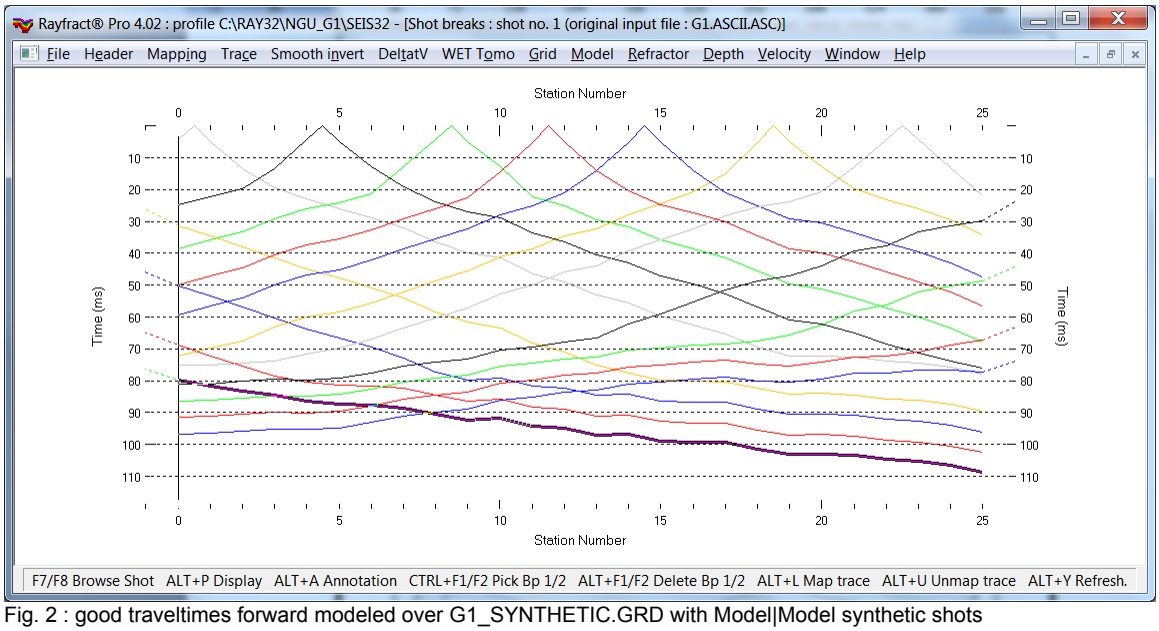

Fig. 2 : good traveltimes forward modeled over G1_SYNTHETIC.GRD with Model|Model synthetic shots

Good synthetic traveltimes in Fig. 2 can be reproduced in version 4.03 of our software by importing G1.ASCII.ASC, updating station coordinates with G1.COORDS.COR and updating shot point coordinates with G1.SHOTPTS.SHO. Then select *Model|Model synthetic shots* and G1_SYNTHETIC.GRD. See Fig. 6 for *Header|Profile* settings. For version 4.02 use fixed G1.SHOTS.COR instead of bad G1.COORDS.COR.

Bad synthetic traveltimes in Fig. 1 can be reproduced by importing G1.ASCII.ASC into a new profile database and then updating with *File|Update header data|Update Station Coordinates* and bad G1.COORDS.COR but NOT updating shot point coordinates with G1.SHOTPTS.SHO. Then select *Model|Model synthetic shots* and G1_SYNTHETIC.GRD.

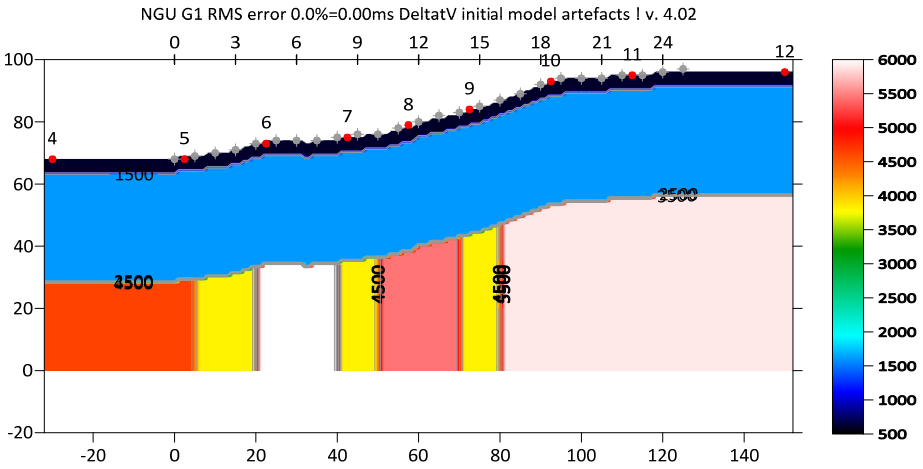

Fig. 3 : NGU G1_SYNTHETIC.GRD

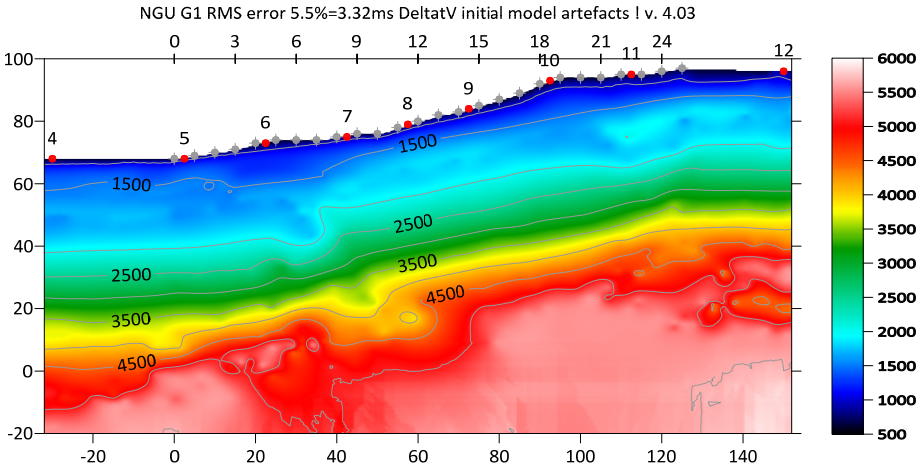

Fig. 4 : ***DeltatV|Automatic DeltatV*** inversion of Fig. 2 good traveltime data. Default *DeltatV settings*. *Max DeltatV velocity exported* increased to 5,400 m/s. Don't limit DeltatV velocity to max. 1D-gradient velocity. See NGU_G1 tutorial.

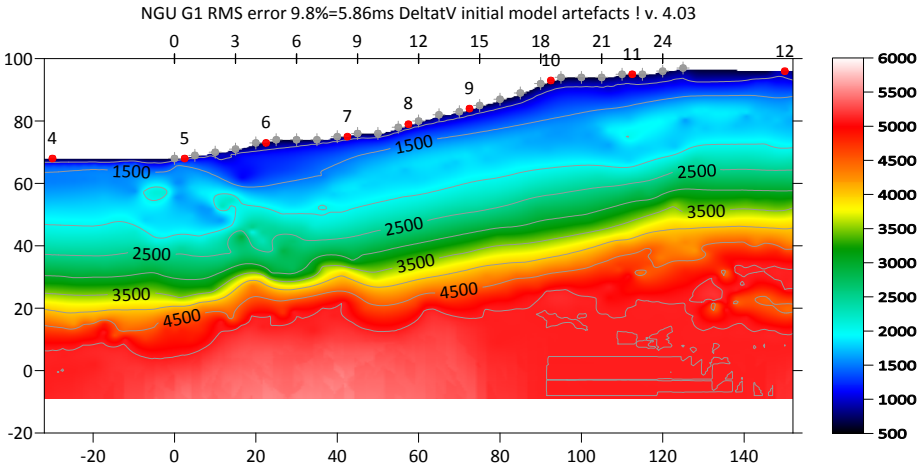

Fig. 5 : ***DeltatV|Automatic DeltatV*** inversion of Fig. 1 bad traveltime data. Default DeltatV settings.

G1.COORDS.COR has bad shot station elevations of 44m, 50m, 56m and 62m for shots 1 to 4 at shot stations -24, -18, -12 and -6. G1.SHOTPTS.SHO specifies flat shot point elevation of 68m for shots 1 to 4.

These constant/flat shot elevations match the topography in synthetic model G1_SYNTHETIC.GRD (Fig. 3). G1.SHOTS.COR is fixed version of bad G1.COORDS.COR and has correct shot station elevations.

To import above model files into a profile database with version 4.02 of our software use fixed coordinate file G1.SHOTS.COR instead of bad G1.COORDS.COR, with *File|Update header data|Update Station Coordinates*.

Here is the .zip archive with NGU model files made available by NGU May 23, 2022.
Here is the .zip archive with remodeled traveltime files done June 10, 2022.
Here is the .rar archive with seis32.* profile database files for Fig. 4.
Here is the .rar archive with DeltatV output files in TOMO folder : DeltatV files for default Fig. 4 in subdirectory GoodTimes and DeltatV files for Fig. 5 in subdirectory BadTimes.
Here is the .rar archive for Fig. 4 with optimized DeltatV settings as shown.

Here is the link to NGU 2020_044 report :
https://www.ngu.no/upload/Publikasjoner/Rapporter/2020/2020_044.pdf
Model G1 is shown in Fig. 11 in leftmost column in NGU 2020_044 report.

We show import of G1.ASCII.ASC, update of header data, remodeling of synthetic picks, DeltatV inversion, Plus-Minus layered refraction method and multiscale *WET inversion* using *1D-gradient starting model* in tutorial https://rayfract.com/tutorials/NGU_G1.pdf .

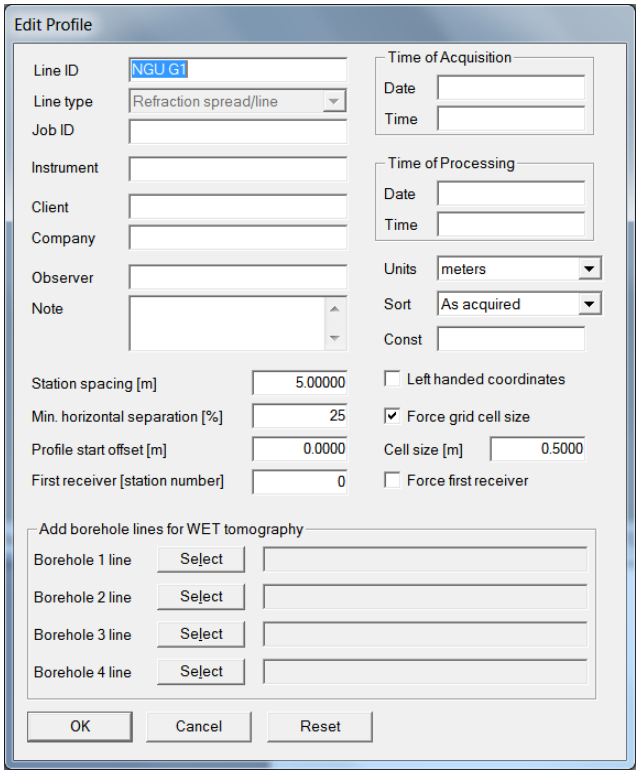

Fig. 6 : *Header|Profile*

Fig. 4 clearly shows a better match to the true model Fig. 3, both in overburden at offset 20m and in basement at offset range 40m to 80m.

The RMS error for Fig. 4 amounting to 5.5% / 3.3ms is much smaller than RMS error for Fig. 5 : 9.8% / 5.86ms. We obtained these RMS errors with our *Model menu* item *Forward model traveltimes* over grid file `C:\RAY32\NGU_G1\TOMO\DELTATV.GRD`.

The above shows again the importance of correctly specifying the recording geometry in our software, including specifying the correct elevation of off-end shot points. Garbage in garbage out. See also our earlier Aaknes-1 tutorial.

For description of input file formats COORDS.COR and SHOTPTS.SHO see our updated help file

https://rayfract.com/help/rayfract.pdf

chapter ***File formats*** on page 247 and following pages. We also describe commands in ***File menu, submenu Export header data*** for export of these file formats to COORDS.COR and SHOTPTS.SHO files.

Also in chapter ***File formats*** we describe commands in ***File menu, submenu Update header data*** for updating your currently opened profile's header data with file formats COORDS.COR and SHOTPTS.SHO. You can view and edit .COR and .SHO files with any text editor e.g. Microsoft Notepad.

Always leave option *File|Import Data Settings|Extrapolate receiver line coordinates* unchecked when importing ASCII.ASC with *File|Import Data* and when updating or exporting header data as described in chapter ***File formats***.

Also we have shown above that *Automatic DeltatV* inversion with default *DeltatV settings* gives reasonable output for this line. Attempts to optimize DeltatV settings can result in less realistic DeltatV output.

For refraction surveys, resolution at bottom and edges of tomogram is further reduced, because here rays and wavepaths are aligned predominantly parallel to each other (White 1989).

Judging from Fig. 11 in NGU report 2020_044 available at

https://www.ngu.no/upload/Publikasjoner/Rapporter/2020/2020_044.pdf

NGU made the same mistake for models G2, G3 and G4 as for above leftmost model G1 regarding shot point elevations for shot 1 to shot 4 when forward modeling synthetic traveltimes.

Shot elevations for shots 1 to 4 should all have been set to 68m as specified in NGU G1.SHOTPTS.SHO for forward modeling of synthetic traveltimes but obviously were set to 44m, 50m, 56m and 62m instead, as specified for shot stations in bad NGU G1.COORDS.COR.

NGU model grid G1_SYNTHETIC.GRD shows flat topography at elevation of 68m for shot points 1 to 4 as does NGU G1.SHOTPTS.SHO.

G1.SHOTS.COR is our fixed version of bad NGU G1.COORDS.COR and has correct elevations at off-end shot stations.

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 NGU for making available above model files.