

Cap Fréhel refraction line 14-2 interpreted in Rayfract® 5.03 Standard Apr 2026 / grid cell size forced to 0.5m / with WDVS frequency scaled with depth below topography :

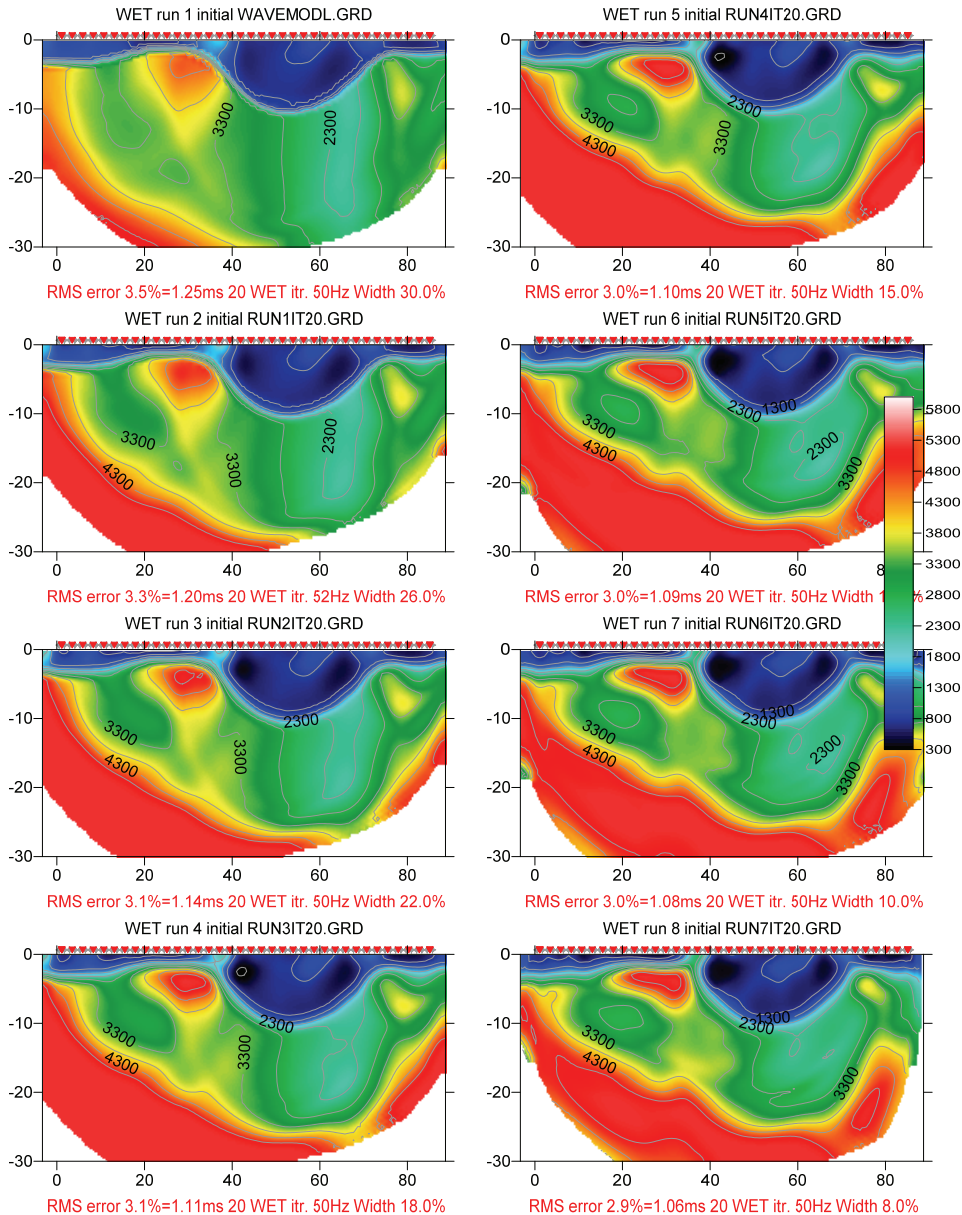


Fig. 1 : plot first 8 Steepest-Descent WET runs (20 WET iterations per run) for profile ZILLM14-2 multiscale WET on one page with new Grid menu command **Plot multiple WET runs on one page** available with our 5.03 Standard version. Starting model for first WET run is our Wavefront layered refraction method model (Fig. 6). Grid cell size forced to 0.5m in *Header|Profile* (Fig. 3).

As shown in Fig. 1 and in Fig. 2 our new Grid menu command **Plot multiple WET runs on one page** available with our 5.03 Standard version allows visualizing multiple runs in one Surfer plot. This multiscale plot enables easy comparison of multiple WET runs (here 20 Steepest-Descent WET iterations per run) and allows to visually determine how well the multiscale WET inversion is working with your current WET and WDVS settings. Observe the decreasing RMS error shown in red in each plot's caption, with increasing run number as shown in each plot's title.

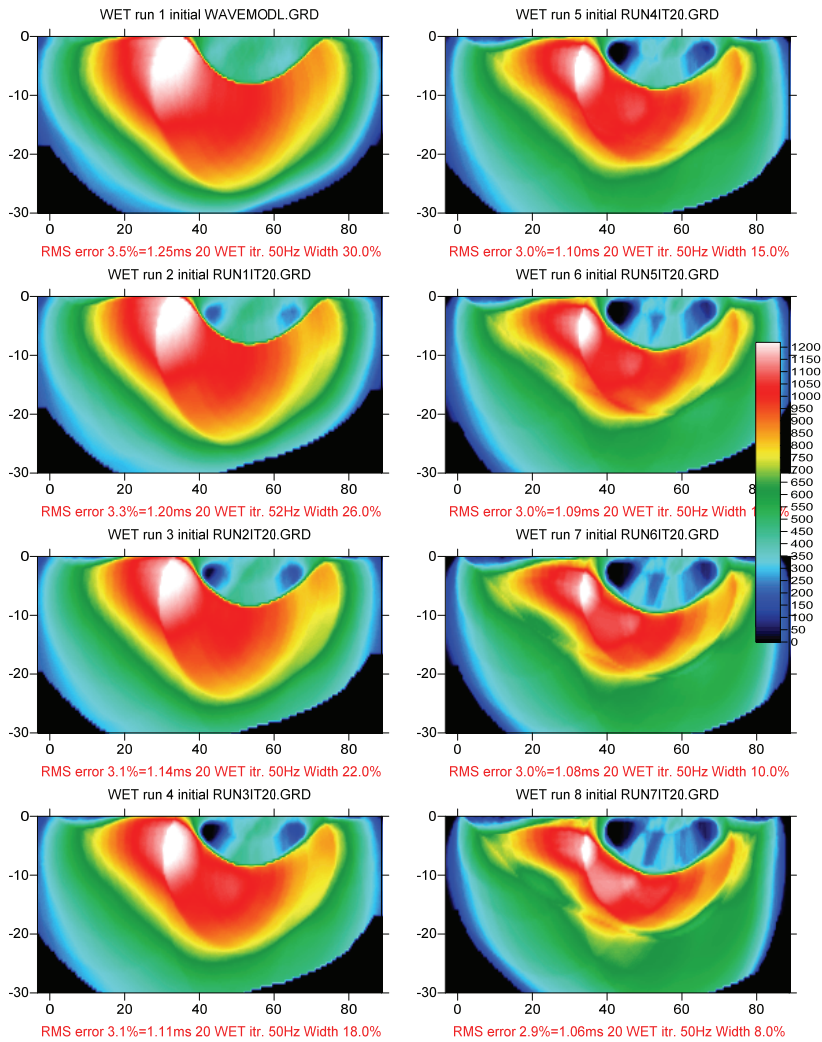


Fig. 2 : WET wavepath coverage plots obtained with Fig. 1. Unit is wavepaths per grid cell.

**Edit Profile**

Line ID:  Time of Acquisition: Date:  Time:

Line type:  Time of Processing: Date:  Time:

Job ID:

Instrument:

Client:

Company:

Observer:

Note:

Units:  Sort:  Const:

Station spacing [m]:  ☐ Left handed coordinates

Min. horizontal separation [%]:

Profile start offset [m]:

☒ Force grid cell size Cell size [m]:

☐ Force first receiver station number for profile

First receiver [station number]:  ☒ Force first receiver

☐ Extrapolate starting models and WET tomograms

Extrapolate [station spacings]:  ☐ Extrapolate tomograms

☐ Add borehole lines for WET tomography

Borehole 1 line:

Borehole 2 line:

Borehole 3 line:

Borehole 4 line:

Fig. 3 : Header/Profile. Edit as shown. Force grid cell size to 0.5m.

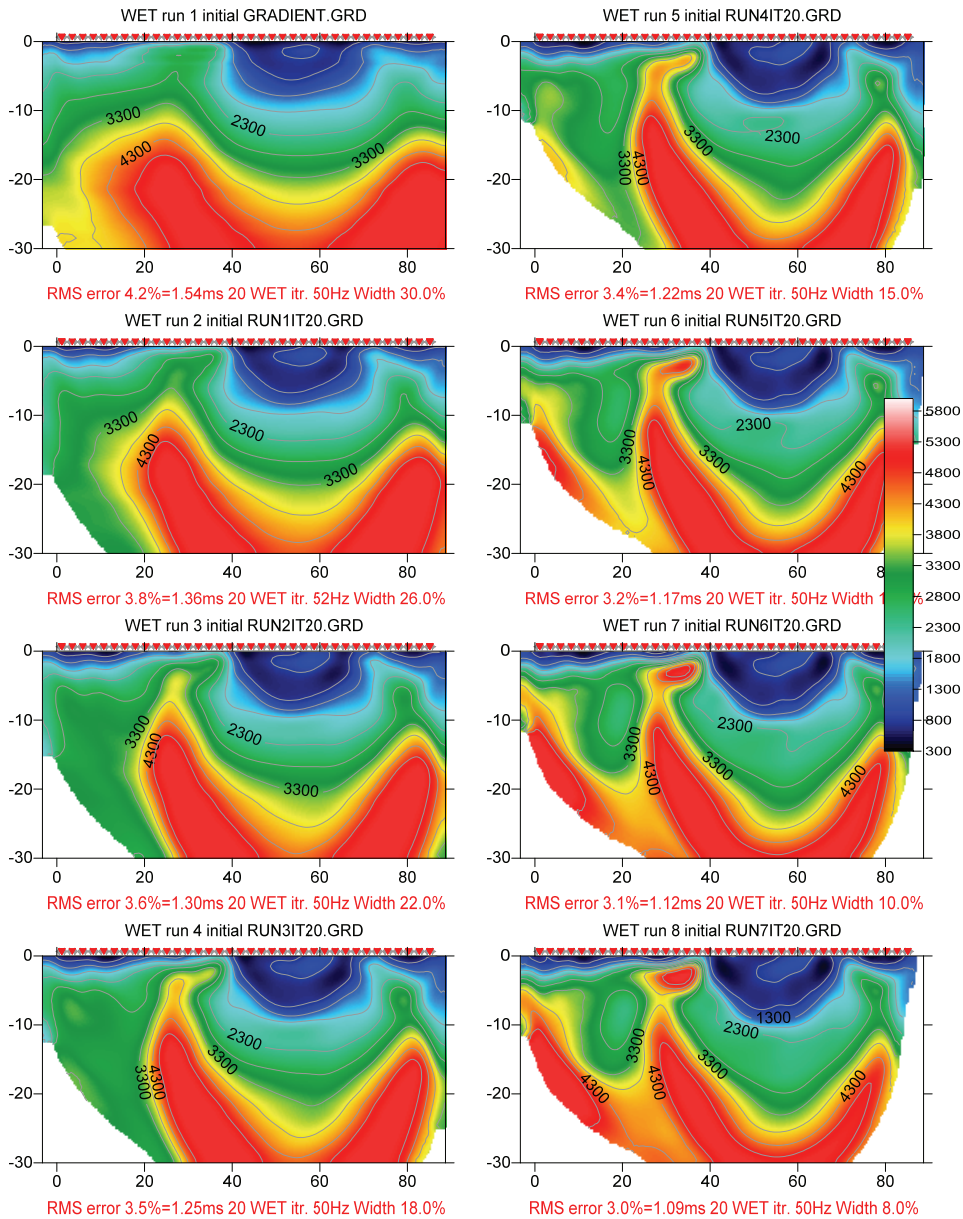


Fig. 4 : plot first 8 Steepest-Descent WET runs (20 WET iterations per run) for profile ZILLM14-2 multiscale WET on one page with new Grid menu command **Plot multiple WET runs on one page** available with our 5.03 Standard version. Starting model for first WET run is our default 1D-gradient initial model obtained by laterally averaging the pseudo-2D DeltatV starting model (Gibson 1979, Sheehan 2005; Fig. 7).



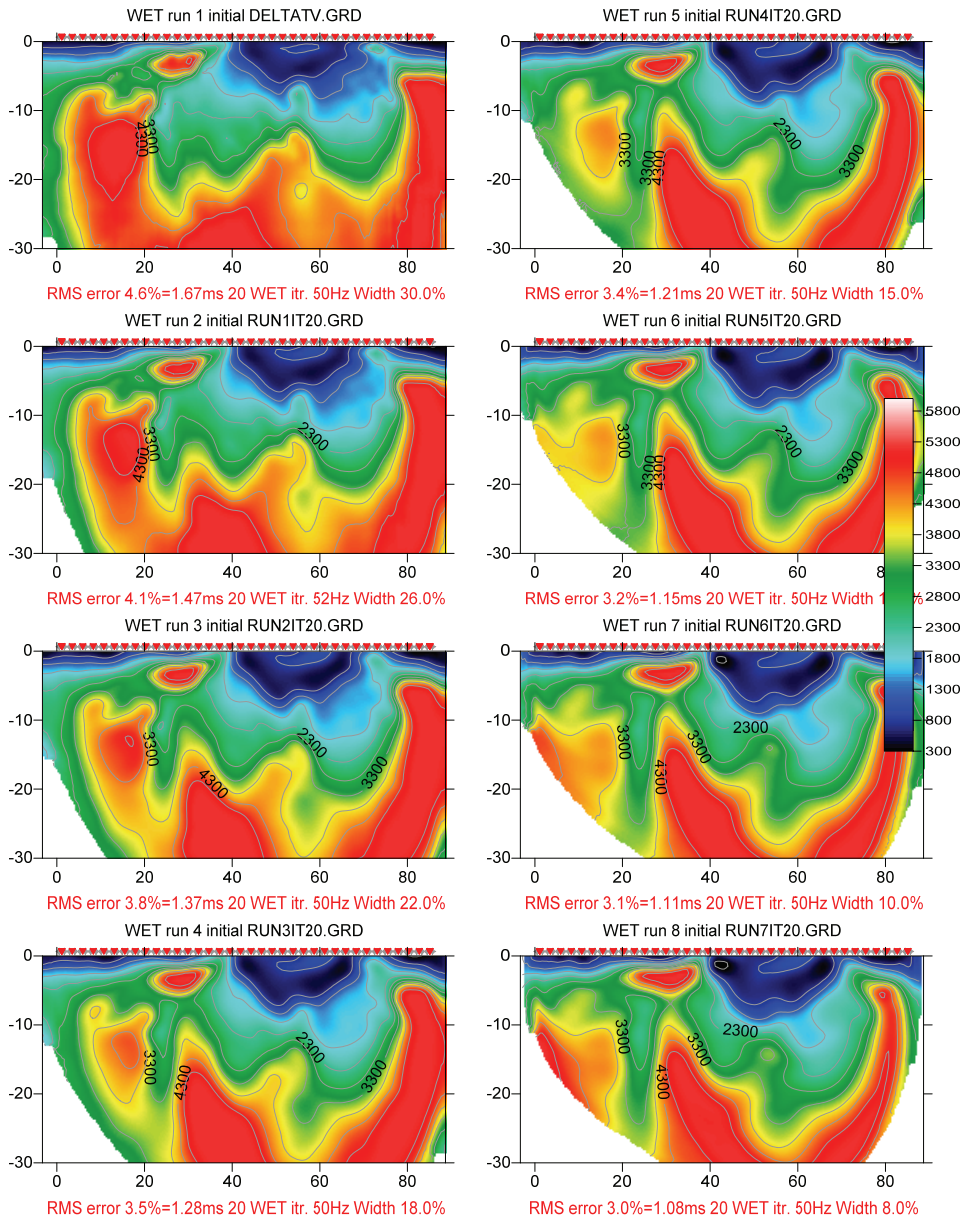


Fig. 5 : plot first 8 Steepest-Descent WET runs (20 WET iterations per run) for profile ZILLM14-2 multiscale WET on one page with new Grid menu command **Plot multiple WET runs on one page** available with our 5.03 Standard version. Starting model for first WET run is our pseudo-2D DeltatV starting model (Gibson 1979, Rohdewald 2026; Fig. 8).

Here is the DropBox download link for the .RAR archive for the profile folder ZILLM14-2 :

[https://www.dropbox.com/scl/fi/8s5wv34ofzt6mjcwl7g6/Zillm14-2\\_Apr30\\_26.rar?rlkey=nyg3cj9I9v0pgrzzie3cwindn&st=h6v09lwd&dl=0](https://www.dropbox.com/scl/fi/8s5wv34ofzt6mjcwl7g6/Zillm14-2_Apr30_26.rar?rlkey=nyg3cj9I9v0pgrzzie3cwindn&st=h6v09lwd&dl=0)



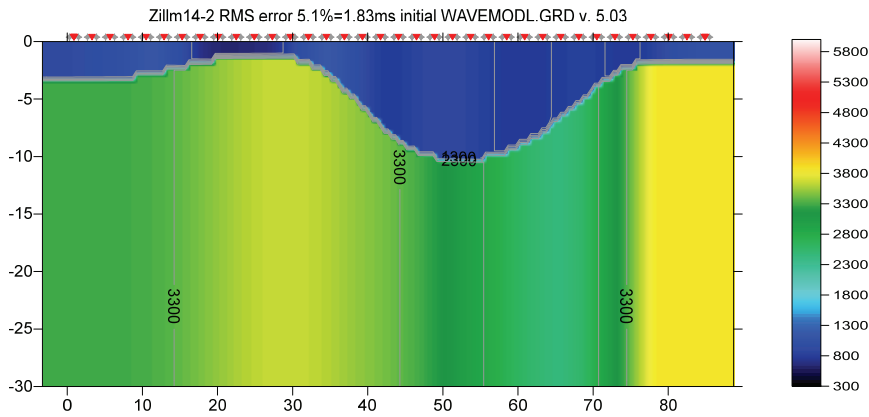


Fig. 6 : Wavefront layered refraction method starting model used for Fig. 1 (Jones and Jovanovich 1985)

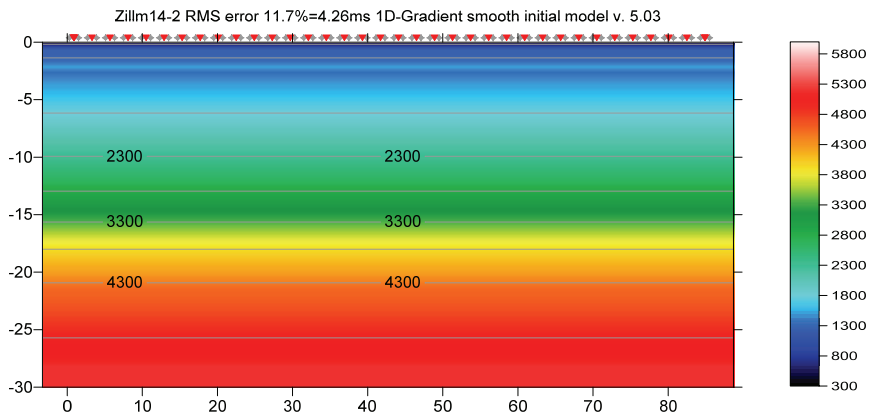


Fig. 7 : 1D-gradient starting model used for Fig. 4 and obtained with command *Smooth invert|WET with 1D-gradient initial model*. The pseudo-2D DeltatV starting model is laterally averaged to obtain this artefact-free 1D-gradient starting model (Gibson 1979, Sheehan 2005).

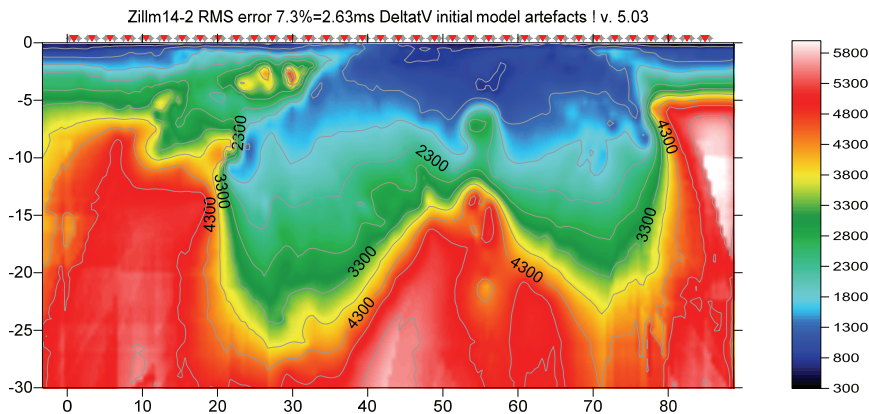


Fig. 8 : pseudo-2D DeltatV starting model used for Fig. 5 and obtained with command *DeltatV|Automatic DeltatV and WET inversion*.

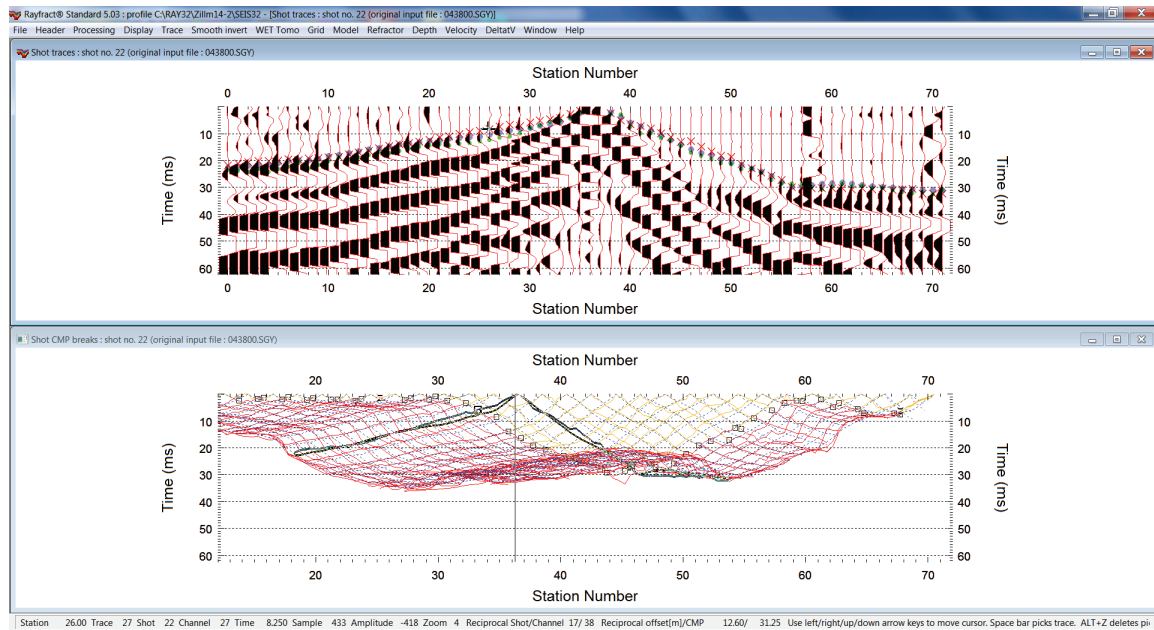


Fig. 9 : *Trace|Shot gather* Shot 22 / Channel 27(top). Reciprocal pick is Shot 17 / Channel 38. See Fig. 10. Red crosses are picked first breaks. Green dots are the reciprocal picks. Blue dots are the modeled picks after the last WET run. *Refractor|Shot CMP breaks* (bottom). Outlined squares separate the direct wave (yellow) from the basement refracted wave (red). Dashed blue curves are the forward-modeled traveltimes after the last WET run.

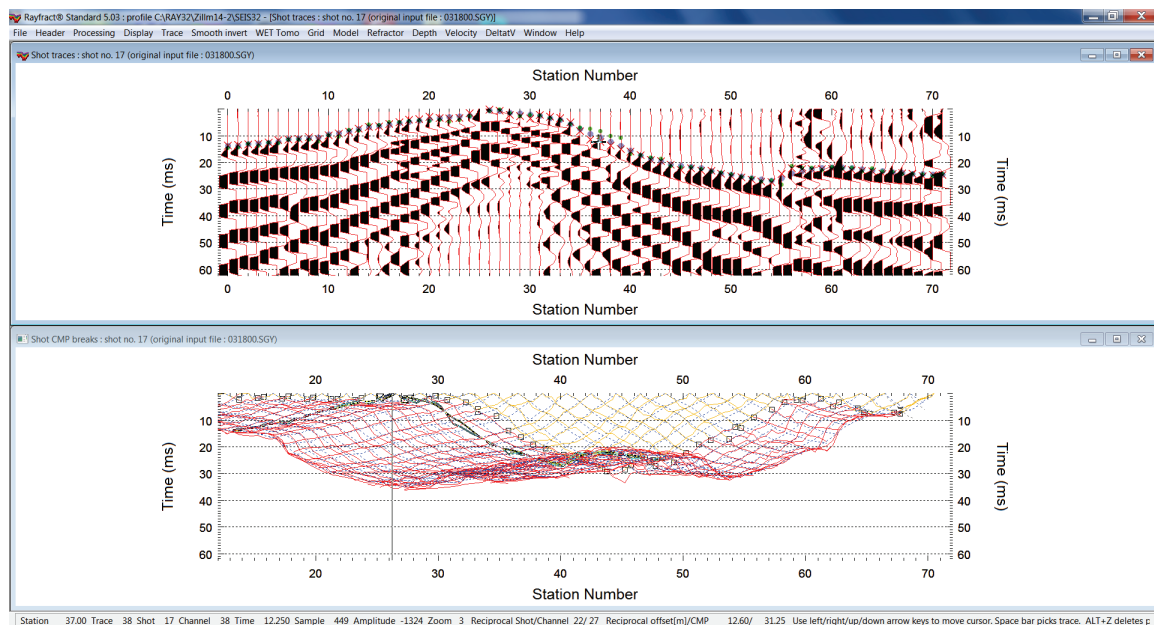


Fig. 10 : *Trace|Shot gather* Shot 17 / Channel 38 (top). Reciprocal pick is Shot 22 / Channel 27. See Fig. 9. *Refractor|Shot CMP breaks* (bottom). Outlined squares separate the direct wave (yellow) from the basement refracted wave (red). Dashed blue curves are the forward-modeled traveltimes after the last WET run.

As shown in Fig. 9 and Fig. 10 the reciprocal picking error is up to 5ms which is too large. Possibly the actually used field recording geometry deviates from the geometry specified in (Zillmer 2026) and used for processing of this line. These large reciprocal picking errors can explain the uncertainty and variance in basement velocities between above WET tomograms in Fig. 1, Fig. 4 and Fig. 5.

Also the apparent velocity inversion (velocity decreasing with increasing depth) in elevation range -5m to -10m visible at inline offsets 30m and 80m (Fig. 1, Fig. 4 and Fig. 5) contributes to the uncertainty and variance in shown basement velocities. These apparent velocity reversals are also visible on the shot-sorted traveltimes curves shown in Fig. 9 and in Fig. 10.

## Discussion

We show multiscale steepest-descent WET inversion of Cap Fréhel refraction line 14-2 (Zillmer 2026). We use 3 different starting models : our Wavefront layered refraction starting model for Fig. 1, our default 1D-gradient starting model obtained by laterally averaging the pseudo-2D DeltatV starting model for Fig. 4, and our pseudo-2D DeltatV starting model without lateral averaging for Fig. 5. Also we show forcing the grid cell size to 0.5m (Fig. 3).

The basement velocity is not well constrained by the refraction first breaks due to too short maximum source-receiver offsets and due to strong lateral velocity inhomogeneities as stated in (Zillmer 2026). Unweathered Dolerite aka Diabase (see <https://en.wikipedia.org/wiki/Diabase>) with low porosity can have P-wave velocities of up to 5,000 m/s to 6,000 m/s (see <https://doi.org/10.1002/2014GC005537>). Fresh sandstone with low porosity can also have a P-wave velocity up to 5,000 m/s. See [https://wiki.seg.org/wiki/Velocities\\_in\\_limestone\\_and\\_sandstone](https://wiki.seg.org/wiki/Velocities_in_limestone_and_sandstone) . These high theoretical velocity limits can explain the fast P-wave velocities shown at bottom of WET tomograms published in Zillmer et al. 2026 and shown above. We limit the maximum WET velocity to 5,000 m/s in the *WET Tomo|Interactive WET* dialog (Schuster 1993, Rohdewald 2026).

The large reciprocal picking errors shown in Fig. 9 and Fig. 10 and the apparent velocity inversion shown in Fig. 1, Fig. 4 and Fig. 5 in elevation range -5m to -10m also contribute to uncertainty and variance in shown WET basement velocities. These apparent velocity reversals are also visible on the shot-sorted traveltimes curves shown in Fig. 9 and in Fig. 10. Our DeltatV and WET+WDVS inversions can detect and model velocity inversions (velocity decreasing with increasing depth) for some subsurface geological settings (Gibson 1979, Gebrande 1985, Gebrande 1986, Schuster 1993, Zelt 2016, Rohdewald 2026).

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<https://ised-isde.canada.ca/cipo/trademark-search/1176887?lang=eng>

**Eidgenössisches Institut für Geistiges Eigentum 2025.** Swiss Trademark Details: Titel RAYFRACT . Markennummer 443830  
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### Acknowledgements

We thank Dr. Zillmer for his publication and for including the download link to the SEG-Y formatted shot-sorted trace files.

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