Comparison of pseudo-2D Delta-t-V initial model with 1D gradient initial model, for synthetic data set "Depression" as made available by Jacob Sheehan :

The "Depression" model from which the synthetic data was generated is shown in (Sheehan 2005, Fig. 5) as Model 3. Interpretation with our Smooth inversion method and default parameters is shown in (Sheehan 2005, Fig. 10).

Please download the data from http://rayfract.com/tutorials/depress.zip . DEPRESS.ASC specifies 25 synthetic shots into 48 receivers. The receiver spacing is 1 m. Please process the data as described in our previous tutorial http://rayfract.com/tutorials/broadepi.pdf , with a station spacing of 1 m (in Header|Profile).

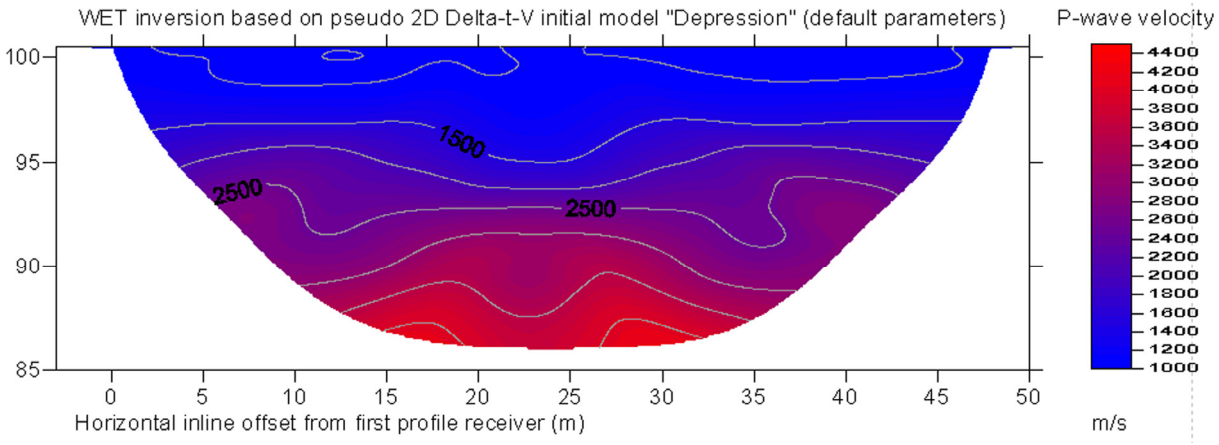

Fig. 1: WET inversion with pseudo-2D Delta-t-V initial model (Fig. 3), with method "Automated Delta-t-V and WET inversion". Note the systematic velocity artefacts, shown e.g. by contour 3,000 m/s : too high velocities below syncline (offset 23 m), too low velocities below anticlines (offsets 12 m and 34 m).

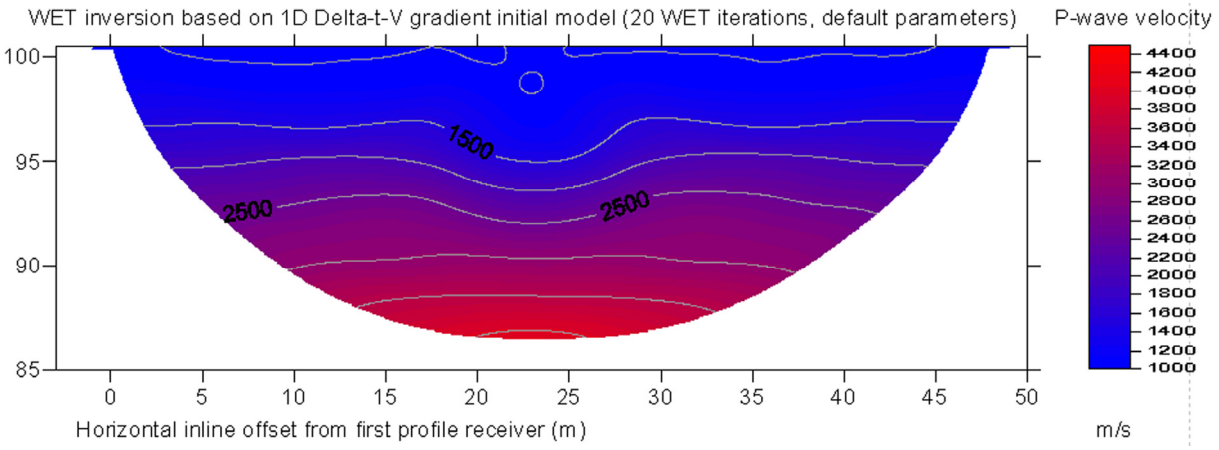

Fig. 2: WET inversion based on 1D gradient Delta-t-V initial model (Fig. 4), with method "Smooth inversion". Note how the artefacts shown in Fig. 1 have virtually disappeared.

Note how in Fig. 2 the systematic velocity artefacts (too low below anticline, too high below syncline) shown in Fig. 1 have been filtered out by true 2D WET inversion (Schuster and Quintus-Bosz, 1993) based on the 1D gradient initial model (Fig. 4). Fig. 2 completely agrees with (Sheehan 2005, Fig. 10).

Based on above interpretations, and on our earlier tutorial http://rayfract.com/tutorials/broadepi.pdf, we strongly recommend to always invert your data with our "Smooth inversion" method.

The artefacts shown in (Palmer 2006, Fig. 4) obviously are caused by using a pseudo-2D Delta-t-V initial model, and not the recommended 1D gradient initial model. See our Windows help file http://rayfract.com/help/rayfract.hlp , chapters "Smooth inversion" and "Delta-t-V inversion".

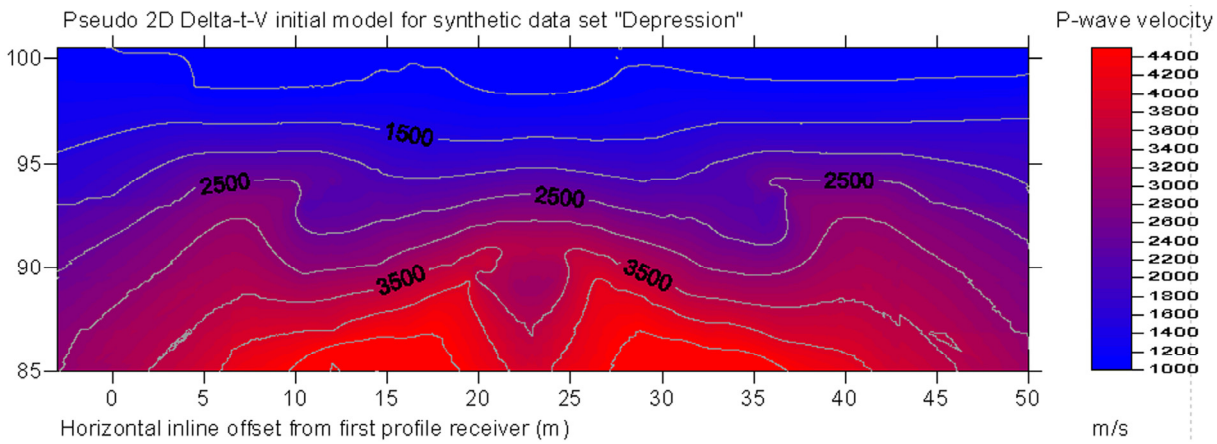

Fig. 3: Pseudo-2D Delta-t-V initial model for synthetic data set “Depression”, obtained with “Automated Delta-t-V and WET inversion”. Note the systematic velocity artefacts, as shown e.g. by velocity contour 3,000 m/s: too high below syncline (offset 23 m), too low below anticlines (offsets 12 m and 34 m).

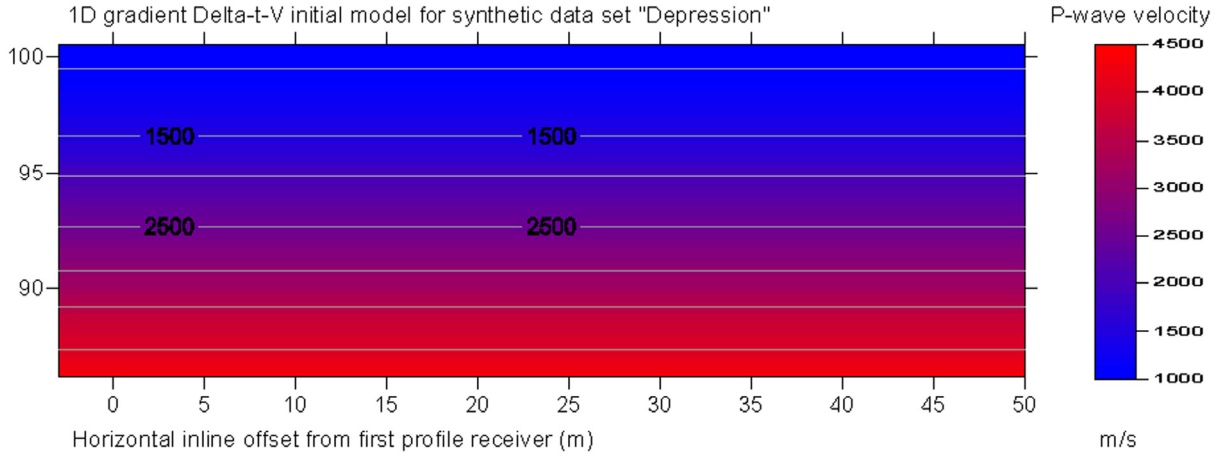

Fig. 4: 1D gradient Delta-t-V initial model for synthetic data set “Depression”, obtained with “Smooth inversion”. Obtained by lateral averaging of velocities in pseudo-2D initial model, shown in Fig. 3.

We would like to thank Jacob Sheehan for making available this data set, and for his benchmark study (Sheehan 2005), comparing our “Smooth inversion” method with OYO SeisImager and GeoTomo LLC GeoCT-II based inversion.

References :

Derecke Palmer 2006. Integrating Amplitudes and Traveltimes with High Resolution Refraction Methods. SAGEEP 2006 Proceedings, pp. 1222-1240.

Schuster G.T. and Quintus-Bosz A. 1993. Wavepath eikonal traveltime inversion: Theory. Geophysics, volume 58, pp. 1314-1323.

Sheehan J.R., Doll W.E. and Mandell W.A. 2005. An Evaluation of Methods and Available Software for Seismic Refraction Tomography. Journal of Environmental and Engineering Geophysics, volume 10, pp. 21-34. ISSN 1083-1363, Environmental and Engineering Geophysical Society. JEEG March 2005 issue.