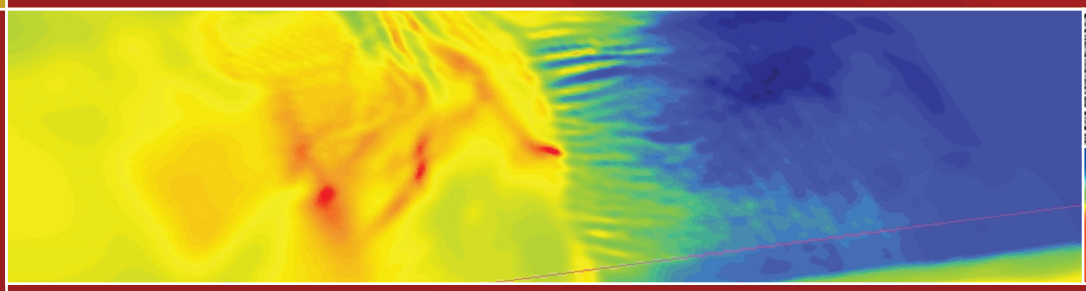
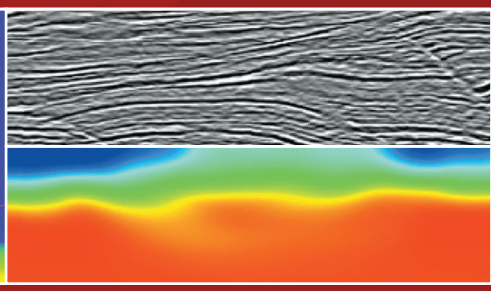
TomoPlus

Near-Surface Imaging and Statics Solutions





Solves short and long-wavelength statics problems for processing land and shallow marine seismic data with both conventional and advanced imaging technologies.

GeoTomo

EARTH MODELING AND IMAGING SOLUTIONS

www.geotomo.com

Near-Surface Technology Leader

GeoTomo leads the way in near-surface imaging and statics technologies

GeoTomo provides commercial software solutions and direct processing services to the oil and gas industry. TomoPlus, GeoTomo's near-surface software solutions package, is the most sophisticated and technically advanced software package on the market today for delivering deeper, higher resolution, and more accurate near-surface velocity models and statics in land and marine environments.

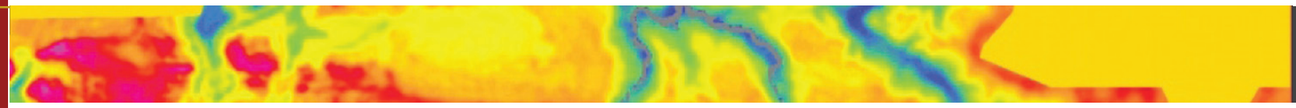
Tomography and Statics Solutions For Every Place On Earth

- Full Waveform Inversion
- Joint Gravity – Seismic Inversion
- Nonlinear Traveltime Tomography
- GLI3D Refraction Statics
- Delay-Time Refraction Statics

TomoPlus, GeoTomo's near-surface seismic solutions, designed to obtain an accurate near-surface velocity model for areas with irregular geometry and rough topography, and derive accurate long and short-wavelength statics solutions to help seismic data processing.

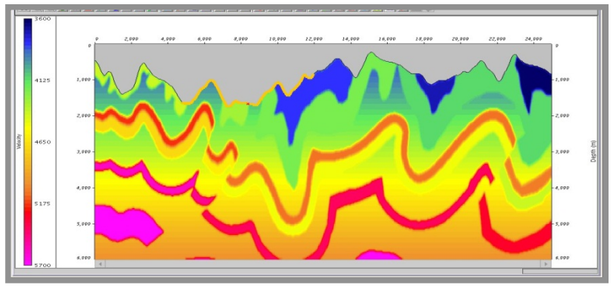
TomoPlus offers both conventional and high-end near-surface imaging solutions to handle a variety of near-surface problems. In simple situations, conventional approaches are sufficient to resolve statics issues. In complex areas, conventional methods may be applied to derive a good initial velocity model, and then high-end imaging technologies such as traveltime tomography or full waveform inversion may be further applied to resolve more detail.

FWI – Full Waveform Inversion

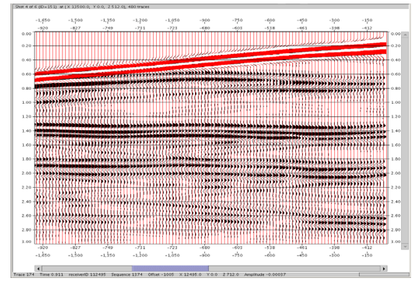


GeoTomo leads the way in near-surface statics and imaging technologies

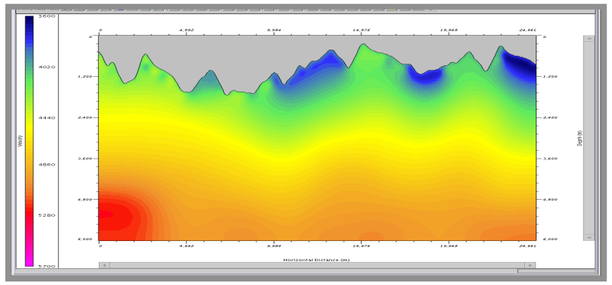
TomoPlus is the only commercial near-surface software package that offers a Full Waveform Tomography solution for solving complex near-surface statics and velocity problems in areas where karst, low velocity layers, outcropping refractors, and strong velocity contrasts exist. Other near-surface solutions such as Delay-Time, GLI and Traveltime techniques may fail in these complex environments.



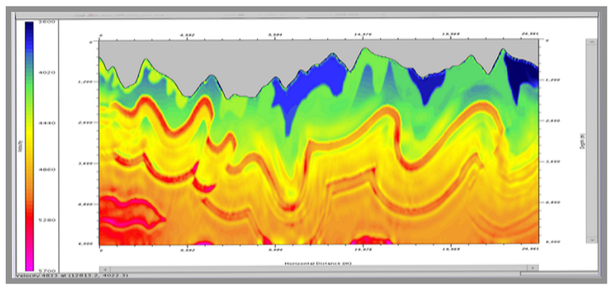
True Model



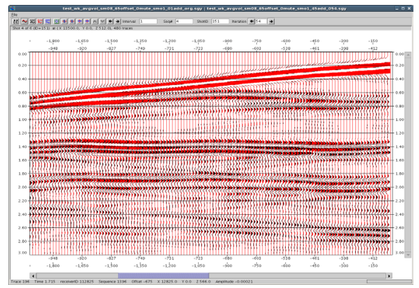
Initial Waveform Comparison



Initial Model



Final FWI Model

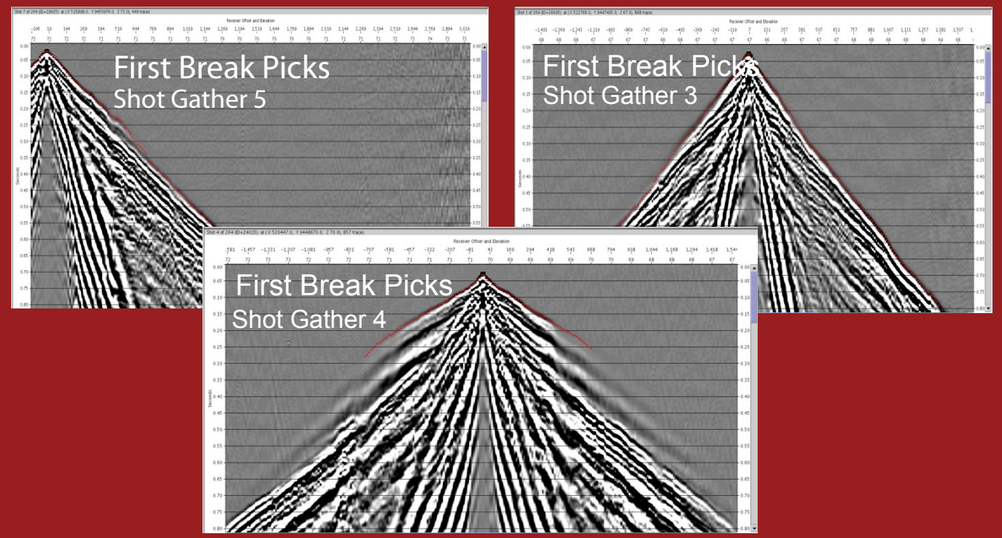


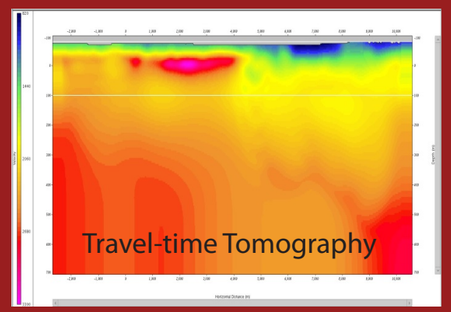
Final Waveform Comparison

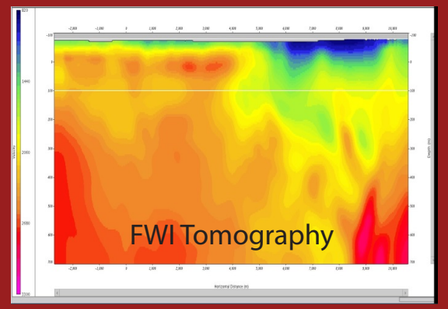
FWI – Full Waveform Inversion

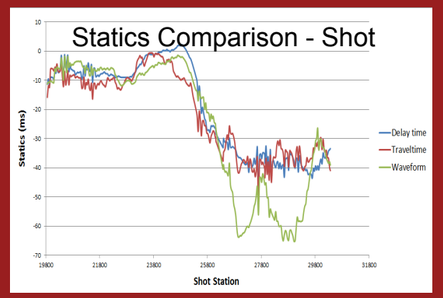
GeoTomo's FWI solution is designed for land, marine and OBC data.

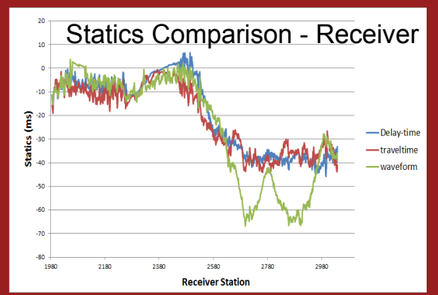
FWI & Traveltime 2D Land Example:









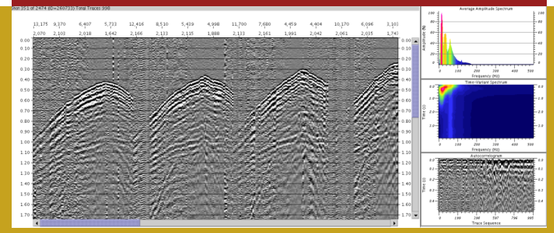


Nonlinear Traveltime Tomography

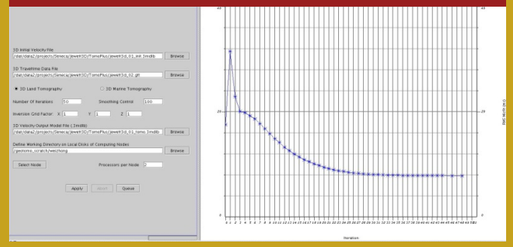
GeoTomo leads the way in near-surface statics and imaging technologies

Nonlinear Traveltime Tomography is a fundamental core technology in solving complex near-surface imaging and statics problems. Nonlinear Traveltime Tomography is a robust grid-based inversion technique that is capable of providing an accurate solution in complex geology with features such as vertical velocity gradients, dipping layers and pinch outs. Delay-Time and GLI solutions fail with these complexities.

Shot Record

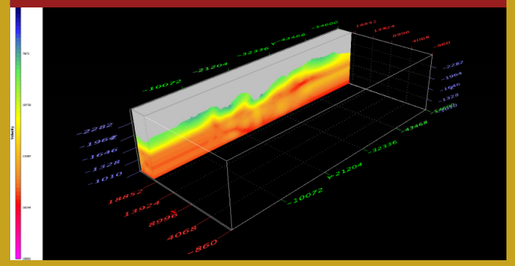


Inversion Misfit

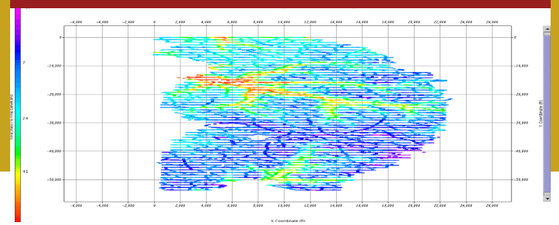


Tomography Image with Topography

Tomography Image Slice



Statistics from Tomography Model

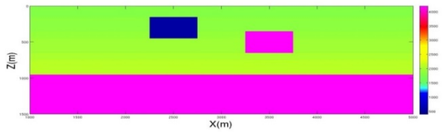


Joint Seismic-Gravity Inversion

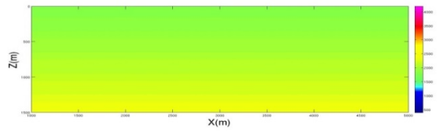
GeoTomo leads the way in near-surface statics and imaging technologies

TomoPlus is the only commercial near-surface software package that offers a 2D /3D simultaneous Joint Seismic-Gravity Tomography for solving complex near-surface statics and velocity problems in areas such as desert environments. Features such as dunes, wadis, and sabkhas and the presence of dissolution cavities in shallow limestone and evaporitic rocks (i.e. karsting) complicate the velocity distribution. When these complexities exist in the near-surface, conventional velocity analysis methods such as Delay-Time, GLI and Traveltime techniques typically fall, therefore requiring more advanced technologies and or additional information such as gravity or EM to resolve these complexities.

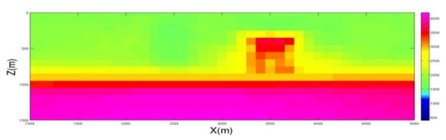
True Velocity Model



Initial Velocity Model

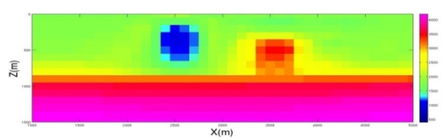


Traveltime Tomography Only



Velocity Model Result

Joint Seismic-Gravity Tomography



Velocity Model Result

Fundamental Near-Surface Solutions

TomoPlus includes all fundamental near-surface solutions

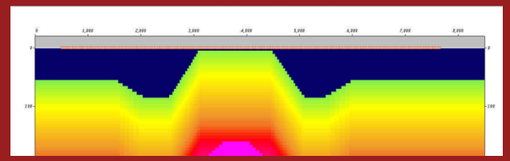
GLI3D – Generalized Linear Inversion

GLI3D was originally developed and marketed by Hampson-Russell and is now owned by GeoTomo and is an integral part of our TomoPlus package. GLI3D is layer based and has been an industry standard for many years. It is a stable and robust solution for flat or dipping layered structures and constant vertical velocities .

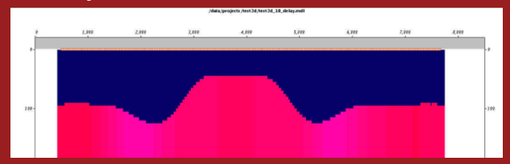
Delay Time Refraction Statics

Delay Time Statics is also layer based and has been an industry standard for many years. It is a quick, easy, and robust solution for locally flat layered structures and locally constant velocities.

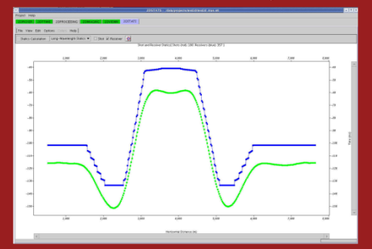
True Model: Dipping Layers with Velocity Gradient



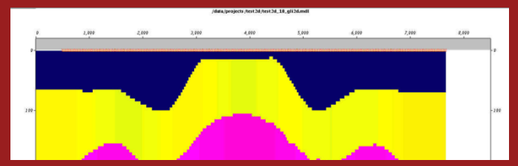
Delay Time Model Results



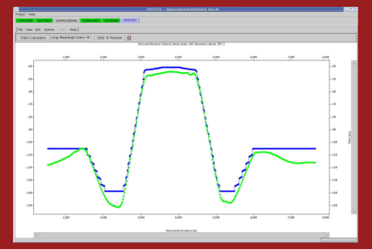
True Model vs Delay Time Statics



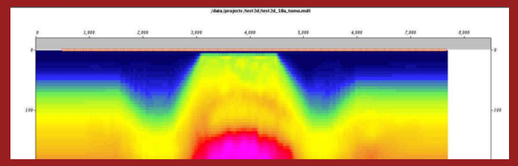
GLI Model Results



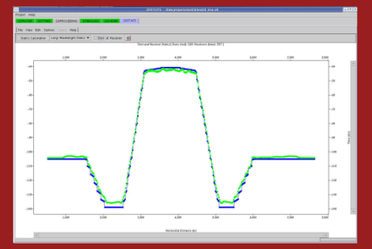
True Model vs GLI Statics



Traveltime Model Results

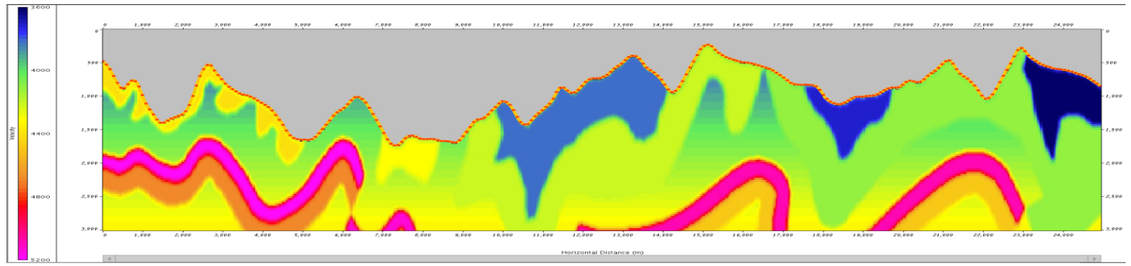


True Model vs Traveltime Statics

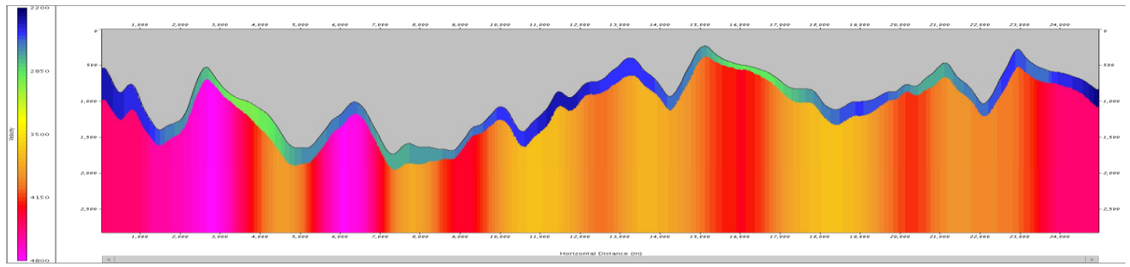


Solution Comparison on Complex Foothills Model

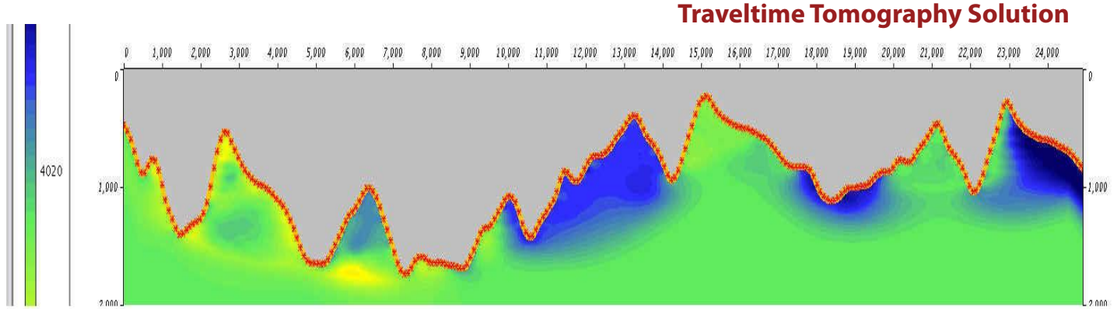
True Foothills Model



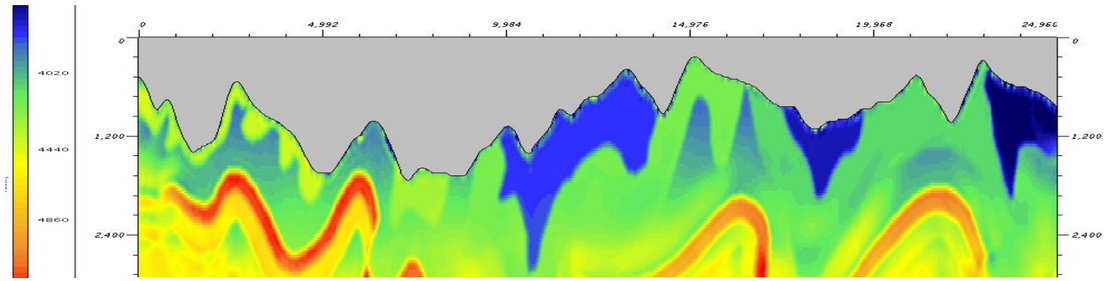
Delay Time Solution



Traveltime Tomography Solution



Full Waveform Solution



First-Break Picking

TomoPlus with advanced picking technologies

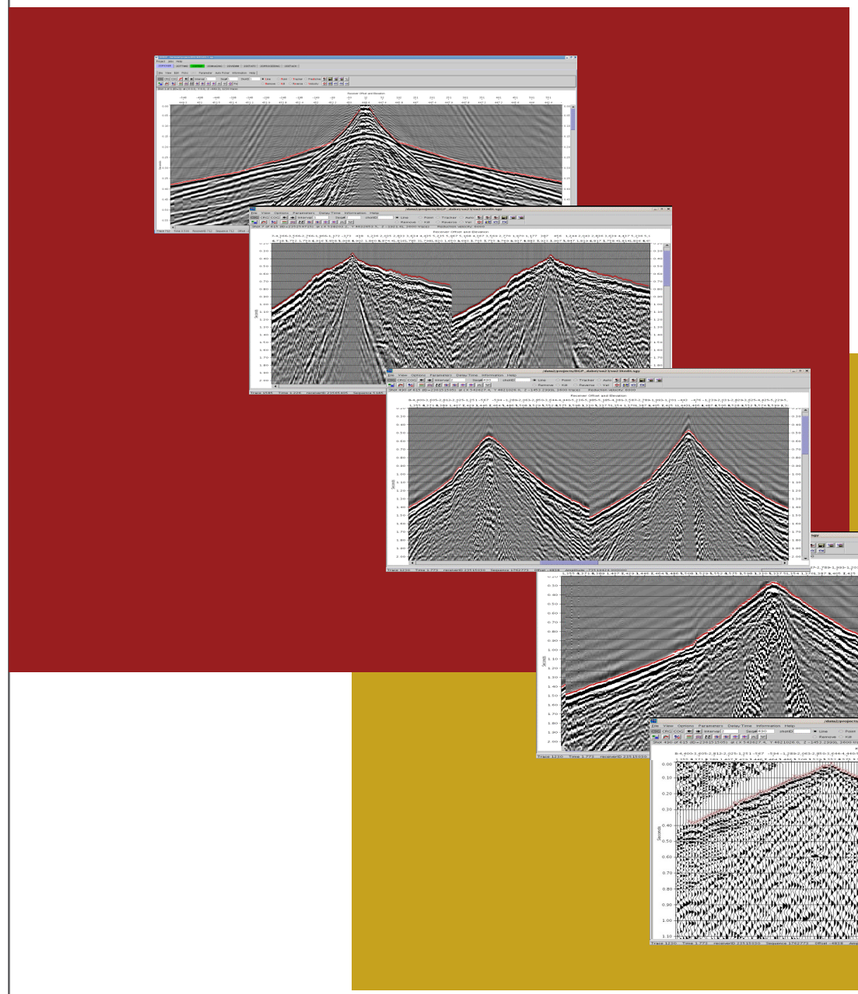
First-Break Picking continues to be at the forefront of GeoTomo's research and development. We understand that first-break picking is one of the keys to a great tomography result and is also one of the burdensome tasks that slows down turnaround time. TomoPlus includes advanced automatic picking technologies specifically designed for dynamite, airgun and vibrator data to make picking easy, fast and accurate.

TomoPlus with flexible workflow picking

TomoPlus has interactive and batch processing modules that allow any combination of processing modules (ie filtering, scaling, noise attenuation, etc.) to be applied prior to picking first breaks. Choose from over 73 processing modules.

Workflows include:

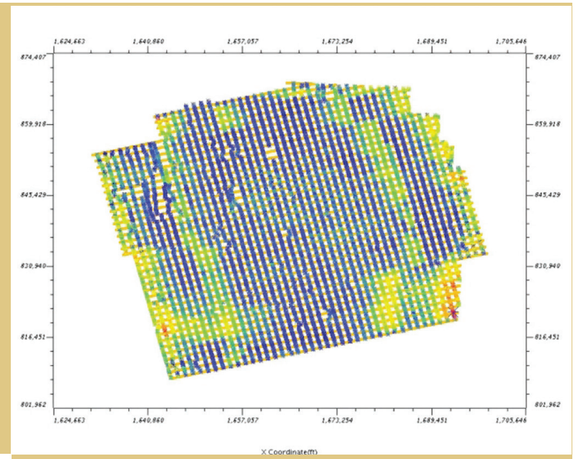
- Apply moveout functions prior to picking first breaks
- Apply statics internally to enhance coherency prior to picking
- Inversion-based picking using synthetic traveltime

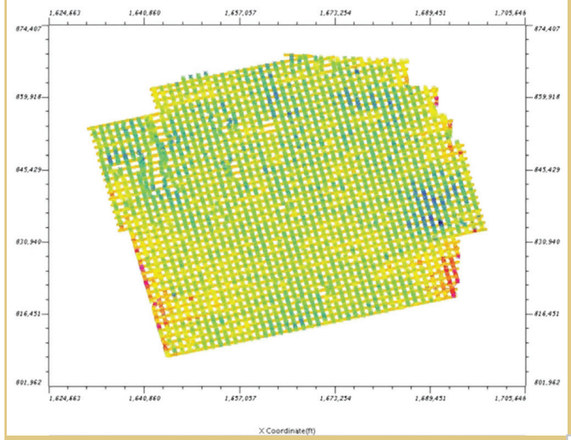


QC of the First-Break Picking

Reciprocal Traveltime Errors

During picking, it interactively calculates reciprocal traveltime errors for shots with picks available and displays on shot map. This will help users to select a different picking strategy for a subset of data that may not be picked well previously.



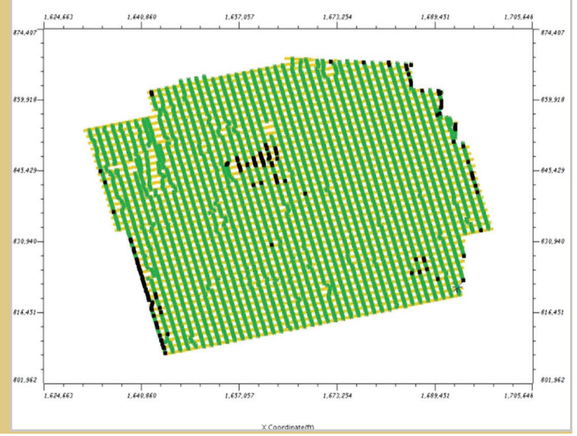


Pick Similarity

For any two closest shots, the first-arrival events should be similar, and the differences of the first breaks between the two gathers should be very small. Therefore, the RMS of the traveltime differences is a good indicator for characterizing the pick quality of a shot.

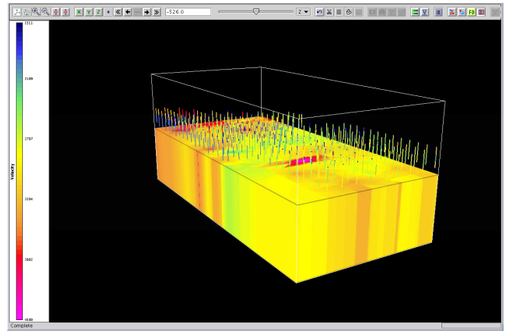
Tomography Misfit

After completing the near-surface imaging, you may select a threshold for RMS misfit, and it will highlight the shots with misfit larger than that threshold in shot map. This will help you to examine these shots with bad picks.

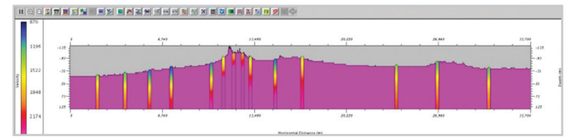


Building Initial Models

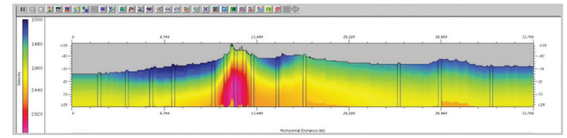
TomoPlus offers a number of methods to build initial models in 2D and 3D for GLI3D inversions, traveltime tomography, waveform tomography, and dispersion-curve inversions. These include refraction analytical solutions, delay-time solutions, and uphole velocity model builder.



3D velocity model with uphole constraints



Smoothed uphole velocity data

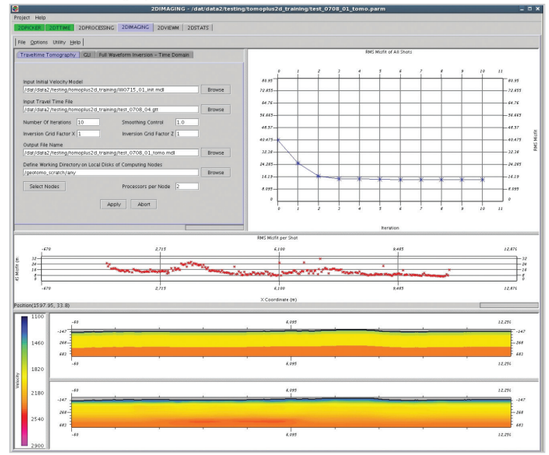


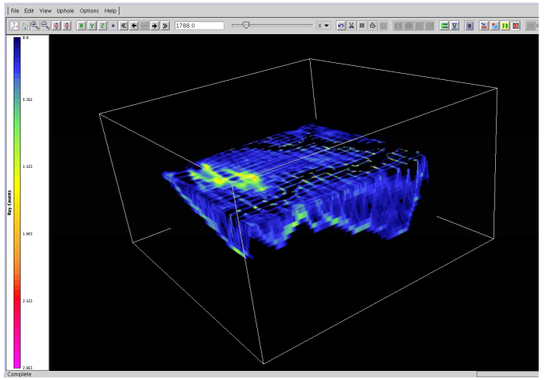
Interpolated velocity model

Near-Surface Imaging

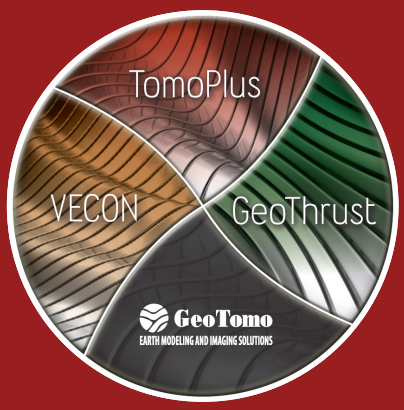
TomoPlus offers multiple imaging solutions and multiple methods for quality control. For example, during 2D tomographic inversion, it offers total RMS misfit and also misfit per shot. It also iteratively displays the updated velocity model. TomoPlus tomography input parameters are interactive. Users may change the parameters during a job and they will be taken into the program immediately. TomoPlus traveltime tomography and waveform tomography utilize cluster CPUs in an efficient manner such that all CPUs are 100% fully running at all time.

Traveltime Tomography Interface





3D ray density display



Surface Seismic Software Products

TomoPlus	TomoStatics Solution
GeoThrust	2D & 3D Data Processing
VECON	Survey Design and Modeling

Downhole Seismic Software Products

VECON	Survey Design and Modeling
MiVu	Microseismic Processing System
TomoXPro	Crosshole Imaging

Geophysical Engineering Software Products

GeoCTI	Field QC refraction tomography
GeoCTII	Full 2D tomography
TomoEapp	Full 2D/3D tomography

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