



Windows Workplace (2D v.8.-)

User Manual

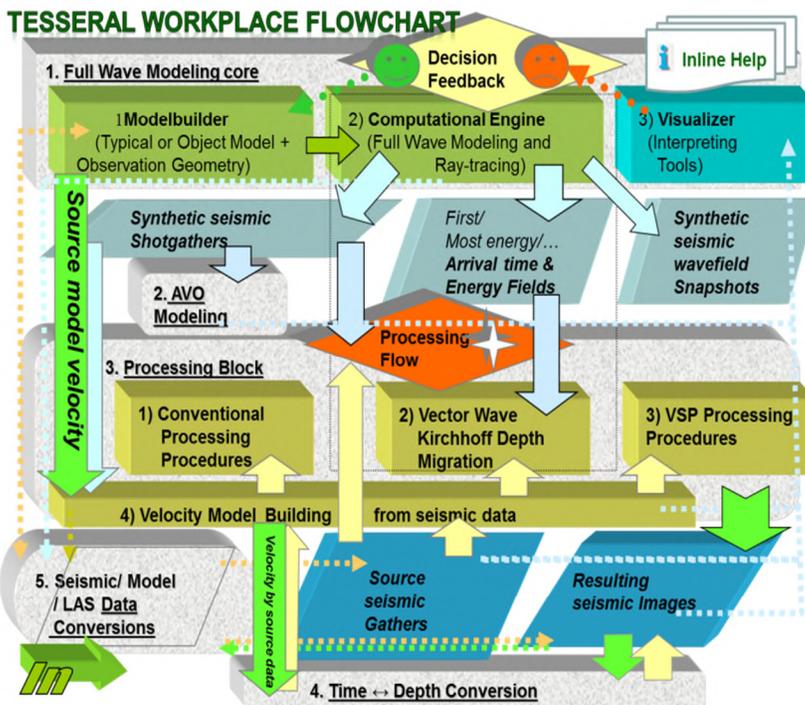
You can

... produce synthetic gathers, snapshots of the wave field, time field of the incident waves, time cross-sections and other seismic images, AVO-dependencies for:

- **Models of virtually arbitrary complexity** including the ones with strong lateral velocity contrast, steep boundaries, compartmentalization, and caustic zones, producing the waves of complex ray-path including those reflected from the vertical boundaries etc.
- Models with **complex topography and various near-surface conditions**, including the situation when

source/receivers are on different elevations, traps, permafrost, low-velocity zone of variable thickness (by correctly taking into account kinematics and dynamics of **surface waves, satellite waves, refractions, etc.**).

- **Thin-layered** models that are built on the basis of the **acoustic and density well-logs**.
- **Transversally isotropic media** models with the tilted symmetry axis, which may be complicated by tilted **fracturing systems**.
- Models with **visco-elastic properties (Q-factor)** additionally allowing simulating the **absorption of seismic energy** and such wave effects as **velocity dispersion**.
- Models for **porous fluid-saturated media (Gasman approximation)**;
- ... using different tools of (numerical) **Seismic Modeling** and **prebuilt models** allowing **smoothly start evaluation and working with the package**.
- **Model Builder** allows the user to quickly build models with any level of rock property and structural complexity. Sonic log data in LAS format can be used to input Vp, Vs, and density values to easily create thin layered models that are accurate representations of actual project reservoirs. Fracture



systems in up to three zones each with different azimuth orientation, both vertically and horizontally, can be defined.

- **Viewer** interactively presents the results of the modeling in a visual format that enables the viewing of wave propagation movies through the geologic model. The movies can be run forward or backward to enable the user to determine the origins of all events and artefacts that are observed on the synthetic shot records. Instantaneous flipping between the vertical, X- and Y-direction and pressure wave records enables a full and rich understanding of the value of multi-component recording.
- **Seismic Imaging procedures** enable the processing of the modeling (*synthetic*) data. Capabilities include *velocity analysis, CDP stacking, pre-stack time and depth migration, time and depth VSP migration, and AVO-modeling*.

The source and resulting **data in popular file formats** can be **used or output** for further analysis and processing in other packages.

The software runs **parallelized calculations** on a **variety of hardware platforms** including Windows networks and Linux clusters, employing latest **multicore and GPU technologies**.

User Documentation

... consists from a number of *Help documents available inline* using or *F1 or ? toolbar or dialogs buttons or menu items*.

- ✓ Use menu **Help/ ? User Documentation** for introductory information.
- ✓ This **User Manual** provides overview of the package core functions. In other *Help documents ?* are described particular blocks and corresponding functionalities of the package.
- ✓ **Tutorial Tutorial_2D.pdf** provides stepwise instructions for getting started.

Useful information can be found on the company's website www.tesseral-geo.com:

- ✓ **Primer** provides introductory information about the modeling in seismic and its different applications.
- ✓ **Troubleshooting & FAQ** provides explanations, answers and extended presentations to Frequently Asked Questions which may occur at using the package.
- ✓ You can also use **training movies** <http://www.tesseral-geo.com/support.en.php>.
- ✓ It is advised to download complementary **library of prebuilt models** with some templates allowing smoothly start evaluation of the package:

<http://www.tesseral-geo.com/download.en.php> /Tesseral Data Samples

.... look through *overview of prebuilt models*:

<http://www.tesseral-geo.com/documentation/en/general/DataSamples.pdf>

Starting

- ✓ You can start the program using its icon (shortcut or pinned to taskbar) icon  or by the sequence *Start/Programs/Tesseral/ Tesseral 2D*.

- ✓ The initial *model data*  are associated with the **Modelbuilder**, and *seismic data*  – with the **Visualizer**. A mouse click on these files from Explorer calls and executes the *Tesseral 2D* (2D - here, an installed variant of the package) with relevant data. You can run the package, also using the method of *drag-and-drop* method.



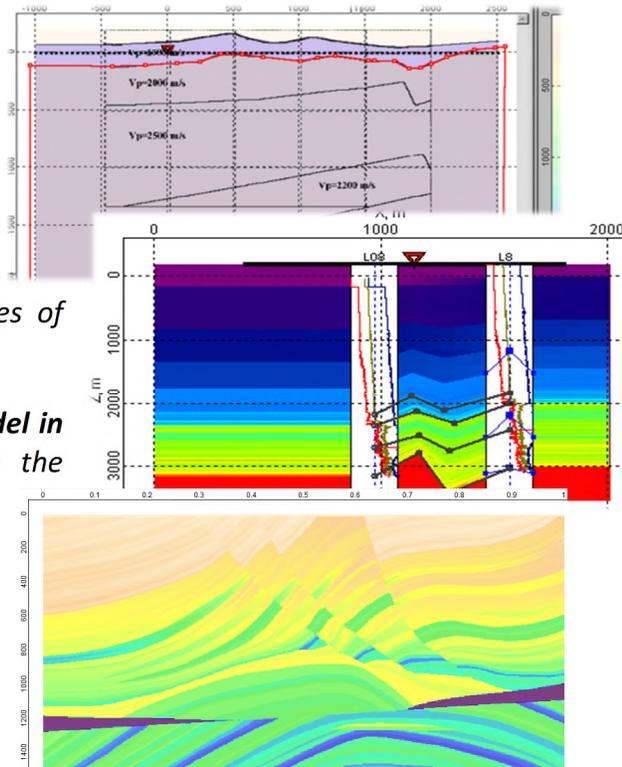
Creating Model

A simple and quite flexible scheme of presentation of **the modeled cross-section** area as **a set of overlapping polygons** is used. Polygons allow localizing the distribution of the physical properties inside the chosen area. The user normally sees the part of the polygons that is not overlain by others. This visible parts are taken for calculations as the actual model presentation (WYSWYG - what you see, what you get).

Polygons are arranged by the order in which user draws them. The next (*new*) polygon may be drawn (partially or fully) over the preceding one (*selected* before drawing). The most convenient order of their appearance during the model building is from the top to the bottom of the model. There may be later modifications of the medium model: insertions, deletions, pasting, moving, etc of polygons or their parts.

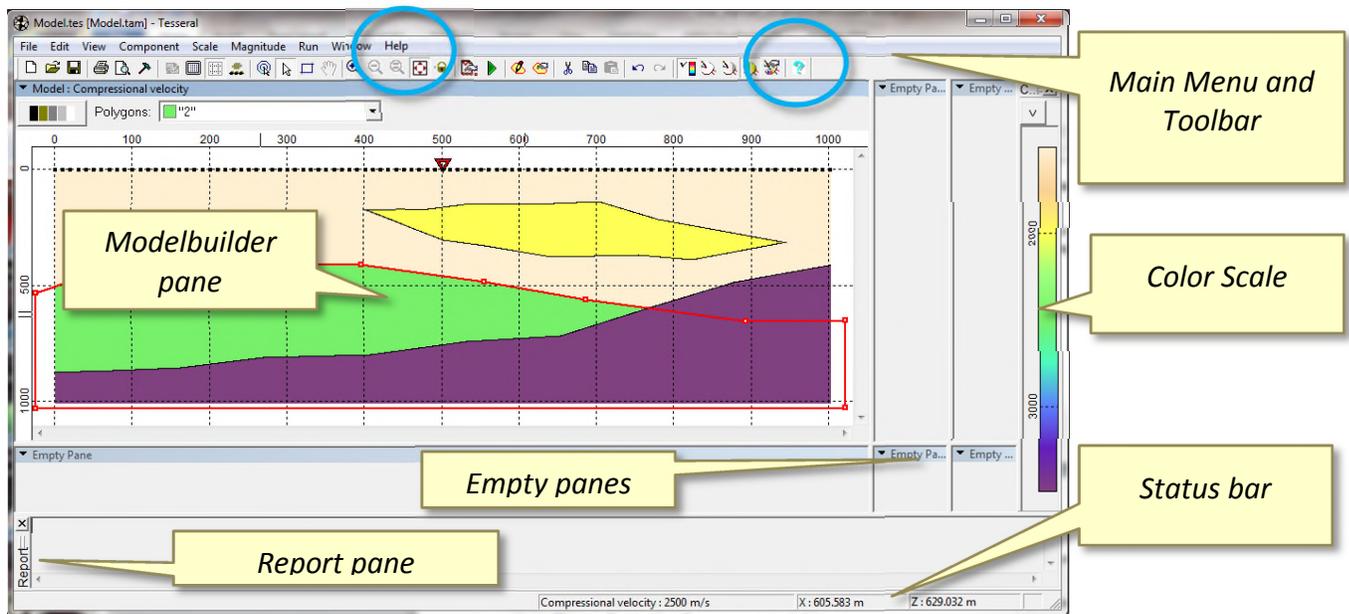
Additionally:

- ✓ You can **enter the pad image and draw polygons on top of it** (open the image using the dialog  *Open/Picture Files*, see its [? Help](#)).
- ✓ You can also enter **acoustic, shear and density well-logs in the form of LAS (format) files** and use them to build a thin-layered model ( *Open/ Files of type: LAS files (*.las)*, see the dialog's [?](#)).
- ✓ You can also use created in other packages **grid model in SEGY format** (menu *File/Import Grid Model*, see the dialog's [?](#)).
- ✓ You can enter the **model data in the text and other formats** (dialog  *Open*, see the dialog's [?](#)) for creating or completing the Modelbuilder model.



When you Start the program after the initializing dialogs the *Modelbuilder* pane is automatically opened and you can start creating (draw on screen) a *new model*.

- ✓ *The application's main window may be split in several panes.*



- ✓ **Please use toolbar button ?** to get more detailed information *для получения более детальной информации.*

Framework dialog

... initially appears at creation of a new model. It contains a number of pages: *Cross-section, Source, Signal, Observation* allowing setting the **Survey Layout** used in modeling.

- ✓ This dialog may be also called any time by pushing  Framework toolbar button or corresponding Edit popup menu item.
- ✓ **Please use ? at dialogs' pages** and see provided description.

Options dialog

... allows to set general user's Options, like **selecting measurement units, and other defaults** used by the package. Use toolbar button  **Options** or the corresponding /File popup menu item.

Polygon dialog

... allows assigning **the medium properties (velocities, density, etc.)** for the selected area - polygon.

- ✓ At the *initialization of a new model* this dialog appears for assigning properties for the **base (initial) polygon** (the area of the *base polygon* covers the whole model rectangle and has 0 number) Over it can be drawn other polygons.
- ✓ Then this dialog appears *in the end of a new polygon drawing*  or when user *double-clicks inside of the visible area* of already existing polygon. It also can be called using toolbar button  or *right mouse popup menu*.

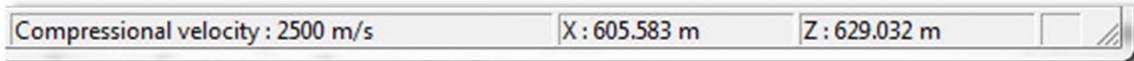
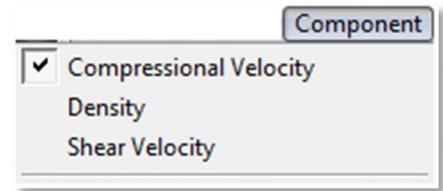
Drawing Model

- ✓ Please see *corresponding bookmark in the toolbar ? Help document.*

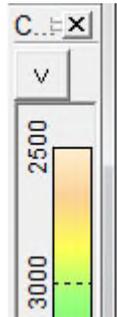
Viewing Model

View Options are presented in the **/View** popup menu list. Use the **? About ...** item and see the description.

- ✓ You can select graphical representation for particular property (component of properties vector) using **/Component** menu popup list of available components.
- ✓ In the **status bar** you can see name of this component and corresponding value at the pointer position and the pointer coordinates.



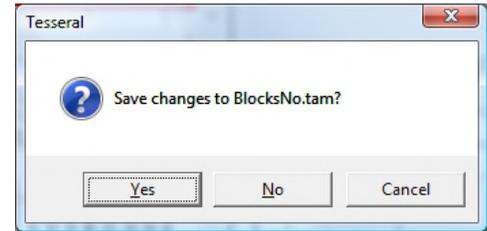
- ✓ **Color Scale** allows you to see the correspondence between the colors filling the model and property values.
- ✓ **/Scale** menu allows applying some modifications of the object image scale on the screen. You can see the model in **isometric** (same for horizontal and vertical axes) or **adjusted** scale (toolbar button 
- ✓ **/Magnitude** menu allows adjusting magnitude of graphical presentation of the property in different ways.
- ✓ You can control view of coordinate grid, make print from the active panel, or save it in a raster format, convert the model in the SEG Y grid format, ...
- ✓ By pushing button  **Tune position** you can see pointer hairs (lines parallel to axes stretching from pointer). This mode brings up dialog *Tune Position* with coordinate values which can be entered manually.
- ✓ You can view up to two **Overlain pictures** (files) in one panel. Overlain can be *model and pad bitmap* and *snapshot or cross-section in depth scale and model*. You can flip upper and lower images using  toolbar button and **tune transparency** of the upper image using pane  button.
- ✓ The **? Help** in the pane's  menu is providing **general description of manipulations with panes**.



Saving Model

- ✓ The **model data** is kept as a text file with **.tam** extension.
- ✓ Usually **different cross-section models and corresponding resulting information** are kept in separate folders.
- ✓ To **save the data** you can push the  Save button, or choose from *File menu* popup list Save item.
- ✓ To save the model under new name or into another location follow the menu sequence **File/Save As...** You can use **Create New Folder** control .

- ✓ If you did not save model data the **reminder message** will appear.
 - By choosing **Yes** button user will follow through saving sequence. If model is modified and not saved the model name with next version number, e.g. *Model-1.tam*, is proposed.
 - In case of **No** the new/modified model data will be lost.
 - **Cancel** button returns to the state preceding this message.



Loading Model

- ✓ You can create a new model by clicking  **New Model** on the toolbar, or by a sequence of menu items *File/New*.
- ✓ You can open another existing model or other data by pushing  **Open** toolbar button, or by *File/Open* menu sequence.
- ✓ Please see corresponding bookmark in the pane menu  /  *Help*.

Converting Model

...in other formats. You can use **File/Convert to/...** menu options.

Model-grids

The *model-prototype* consisting from *zero-polygon* (defining minimal velocity) must be initially created. The *model rectangle* (dialog *Framework/Cross-section*) must be tied to coordinates of the *model-grid*.

The model-grid converted (*File/Import Grid Model*) to the internal (*. tgr*) format is placed in one pane (*Overlay*) with a model-prototype. In this case it will be used for calculations along with the model-prototype. Logically the grid is placed between the zero-polygon and all subsequent ones:

- ✓ *The zero-polygon of the model-prototype will fill all gaps in the model-grid (i.e. void values, presented in the tgr-file as zeroes). For the non-zero grid nodes the background polygon does not take any action.*
- ✓ *Polygons with indexes >0 (i.e. overlaying the zero-polygon) unconditionally are overlaying all corresponding grid values, i.e. have higher priority over the grid.*

Using well-log data

The *Modelbuilder* model is used as a pad at creation of the model basing on the *LAS-files*. In setting the parameters of the model rectangle should be considered that *LAS-files* have absolute binding depths.

- ✓ To download LAS-file use dialog  *Open/Files of type: LAS files (*. las)*.
- ✓ In detail work with well data and building a model for several wells is described in the *Help System*  of the package.

Modeling

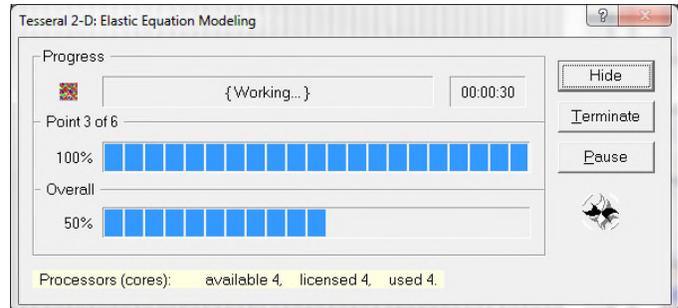
After defining the *medium model and survey layout* (dialog /  **Framework**) you are ready to start (numerical) seismic modeling.

Button  or menu **Run/Modeling** allows to see /*Modeling* dialog for configuration and executing various types of numerical simulation. Please see the dialog's .

Computation Progress dialog

... runs together with calculations.

- ✓ Pushing the button **Pause** stops the process. When the process is inactive caption of the button changes to the **Resume**. Pushing it again activates the process.
- ✓ You can iconize the dialog window by pushing button **Hide** or terminate the process using button **Terminate**. In case of canceling warning dialog appears.
- ✓ If computation dialog is hidden you can make it visible by pushing process icon in lower right main window corner or with menu sequence **Run/Show Computation Dialog**.



You can view current computation results short after their starting.

- ✓ You can change the size and state of the pane during monitoring. While monitoring you can see both shotgather and the current snapshot of the propagating wave field. You can change the picture properties.
- ✓ It takes time to draw the pictures, so the graphical monitoring slows the calculations. If you do not need it you can iconize the viewer window.

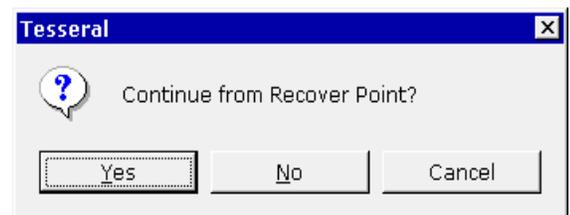
When calculation is finished the viewer panel show resulting shotgather and snapshots of the last calculated source position.

- ✓ You can not only stop the execution of the program, but continue it even after it was cancelled or crashed.

If the computation was not finished and you call the Modelbuilder you will see warning message.

Depending on answer there will be such actions:

- ✓ **Yes:** the unfinished computations will continue;
- ✓ **No:** computation is not continued and intermediate results are destroyed;
- ✓ **Cancel:** program returns to previous (before dialog appears) state.



Report Pane

Some text information relating to computations and other data manipulations is shown in the **Report** window.

- ✓ It always opens when the computations start. Otherwise use the *View* menu popup list item  *Report*.
- ✓ Data that was (during last session) in the *Report* is stored in the current folder with *Tesseral.log* name for possible later analysis.

Wave field Components

Synthetic data contains number of the seismic **wave field components**. They represent a set of dynamic physical parameters (changing with time). Most of them are basic analogues of ones that can be measured in the field observations; some are derived from the basic ones. Please see also in **Component/? About...** .

Resulting Data

... by default are saved in the current model folder. **Files** have extension **.tgr** (*internal binary format*) and **.sgy** (*SEG Y format*). Their **names are indexed as**:

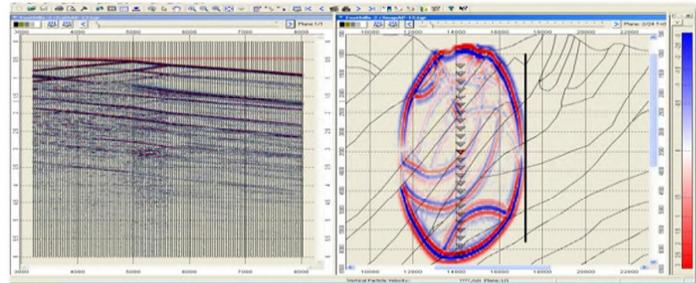
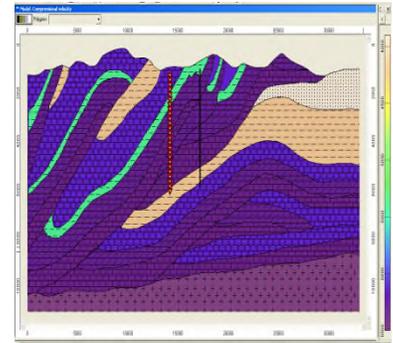
<Model name (with version suffix)>+{Gath, Snap, Wave, Time}<Method ><Mode>[-<shot generation number>].tgr

- {*Gath, Snap, Wave, Time*} corresponds with the resulting information type;
- <Method> coded by **I, C, A, E, N, V** letter corresponds to the computation formula (*vertical incidence, scalar, acoustic, elastic, anisotropic, viscoelastic*).
- <Mode> coded by **P, S, H, W** letters corresponds with the generation/processing mode (*point source, exploding surface, exploding reflectors, sum*).
- <Shot generation number> - is present in intermediate results. At (normal) completion of the program they are merged in a common resulting file (no number at the end).

VSP and Well-to-well Modeling

In difference from modeling for surface seismic for modeling of:

- VSP in the *Framework/Observation* dialog page you need to select *Vertical line* option for receivers.
- *Well-to-well survey* in the *Framework/Source* dialog page choose *Vertical line* option for sources.
- ✓ Position of wells in which sources and receivers are placed can be easily changed using mouse *dragging*. More exact numeric positioning can be done with **Tune position** dialog. You can also define a deviated well position and project receivers or sources on its trunk (described in detail in the [Tutorial](#), see the relevant section).

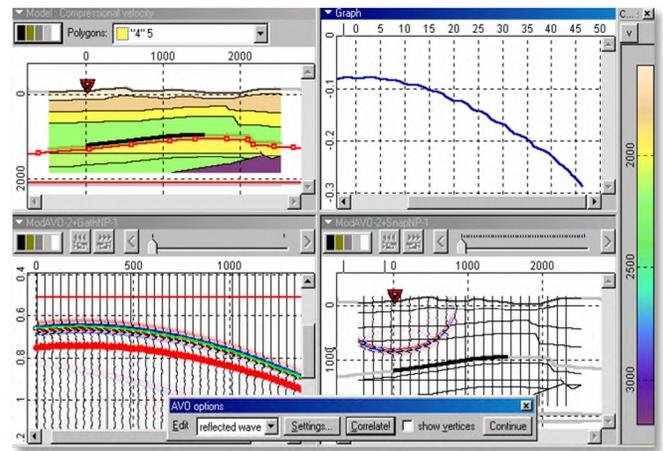


AVO-Modeling

You can obtain the curves of *reflection coefficient* for selected boundary as a function of *incidence angle* or *amplitudes* as a function of *offset from the source*.

AVO- modeling in a package is carried out in two variants.

1. **Numerical AVO-modeling** can be done for 2-2.5D models of any complexity. To carry it out you have to use option AVO-modeling (see dialog /Modeling). At this receivers are positioned at some relatively small distance from the target boundary allowing recording incoming from the source and reflected from the target boundary waves as separate events for further calculation of AVO-dependencies. For their identification procedure of picking and correlation of these waves is used and then numerically are calculated AVO-curves.
2. **Analytical 3D AVO-modeling** realized on the basis of the modernized variant of a solution of the full-wave equation by Haskell-Thompson's method **for horizontal thin-layered stack**. Unlike 2D modeling here you can set axes of TTI-anisotropy in layers in any direction, as well as a direction and an inclination of fractures. For 3D models you have an opportunity to model azimuthal AVO-effect from thin-layered stack of rock taking into account also coupled refraction (splitting of shear waves on fast and slow in case of monotypic and converted waves) and to obtain AVO-curves for the reflected and transitional compressional, fast and slow shear waves. There is a capability to analyze separately amplitude and a phase of a wave depending on frequency, an azimuth and an incidence angle. The given realization allows considering also viscoelastic frequency dependent absorption separately for compression and shear waves.



- ✓ In details please see the description in the [? Help of /Modeling and subsequent dialogs](#).

Analyzing Results with Viewer

At the end of the simulation two panes show results: the left - with the calculated synthetic seismogram, right - with a snapshot of the wave field.

Viewer Pane

... has a separate set of tools, although it has a lot of common with the *Modelbuilder* one. See *Help ?* in the *Viewer* toolbar.

Gathers

In addition to the internal grid format (*.tgr*) can be read and used gathers in SEG-Y format (*.sgy*, *.segy*) of any modification - *CSP*, *CRP* or *CMP* (*common shot-*, *receiver-*, *mid-* point).

During *sgy-gathers* loading trace headers are modified. At first opening of *sgy-gather* dialog *SegY Load Info* is produced (you can also call it using menu */Scale/Seg-Y Ruler*) allowing additional tuning before its using in the package. For more details, use dialog's button *?*.

Visualization Options

Viewer allows tuning graphical image of (resulting) data in different ways for interpretation (enhanced picture) or/and following processing (one-trace transformations and selections). For this purpose use the  *Visualization* dialog (toolbar button or by **double-clicking** inside of the pane) and pop-up menu */View*.

Data (formats) conversion

... between readable by the *Viewer* standard formats – please use menu options *File/Convert to...*

Seismic Processing

The package has a number of built-in procedures for processing of the synthetic gathers and creating seismic images. Please, use *Run/ ? About...* for more information.

