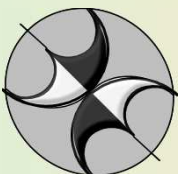


Model Building, Modeling & Processing using Well-log data -examples-



Jan-12

www.tesseral-geo.com

Thin-layered Model by 1 well -Example 1-

Illustration of practical work with the Tesseral package for creation of synthetic seismic wavefield on basis of model of the wedge layered cross-section.

Sample character of the source model, provided as *.bmp file, is shown in Fig.1
The velocity data was supplied as text file of dependency of interval velocity on depth of layer bottoms. (data table.doc).

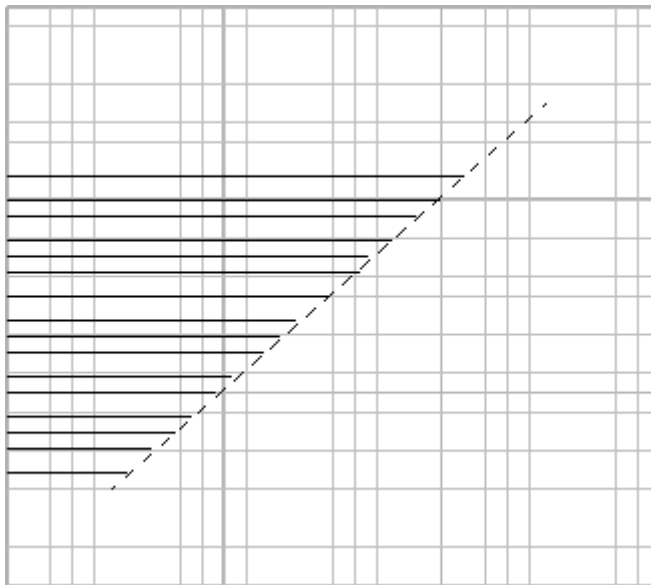


Fig.1

Step one - creation of the base model in Tesseral system.

- open Tesseral;
- create new model (icon 1 in Fig.2), assign it some name, for example, «*Thin Layer*»;
- with icon 2 call dialog of model and observation system parameters («*Framework*») and determine initial values for desirable model size, observation system (we begin from VSP observations), source characteristics etc, for example as it is shown in Fig.3 («*Horizon*» page is not used in this case);
- after «OK», in appearing «*Polygon*» dialog determine parameters of background polygon (number – 0, compressional wave velocity (from file data table.doc) for upper layer - 1000 m/s, velocity of shear waves and density - by default (from package correlation tables).



Fig.2

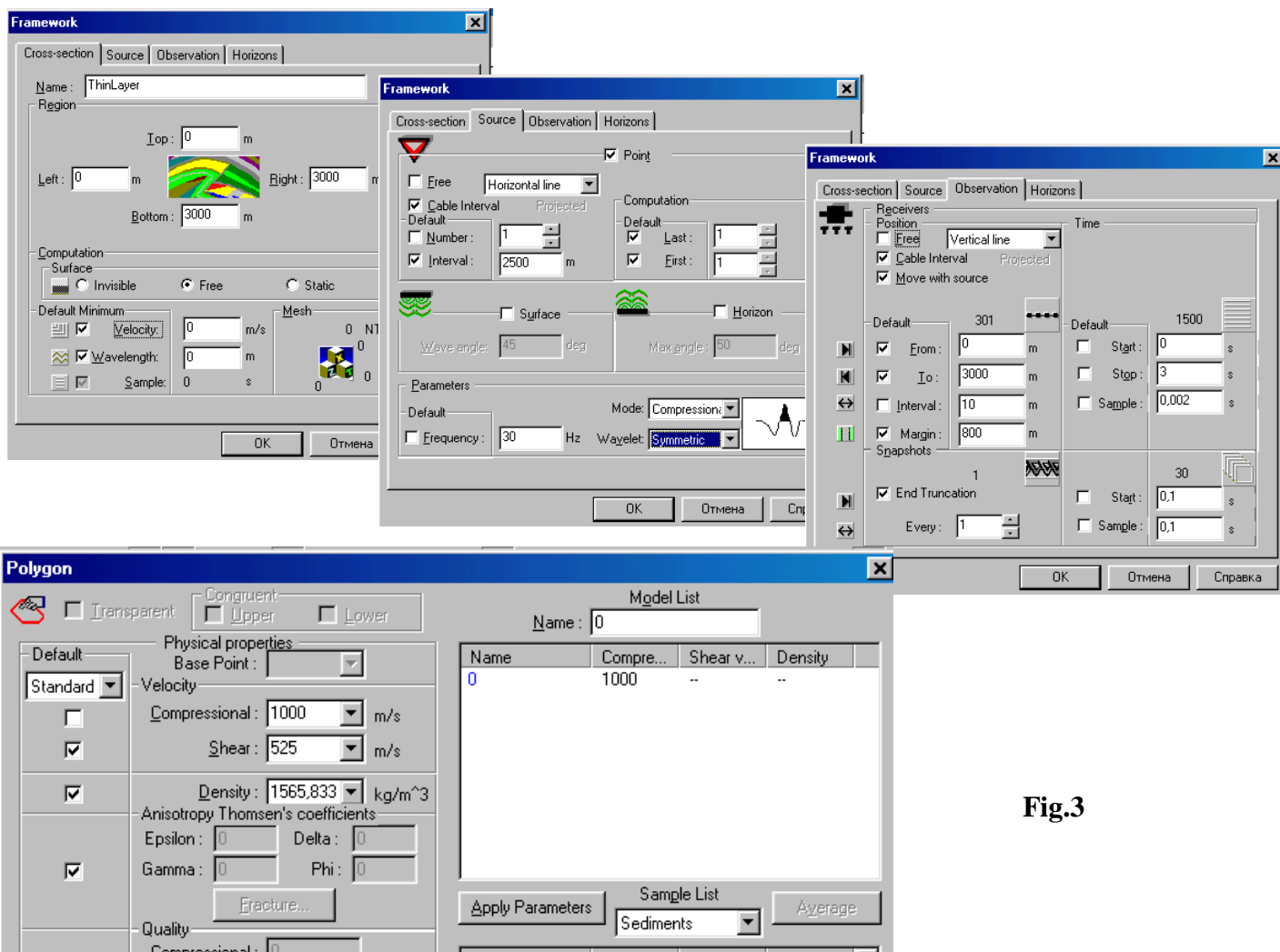


Fig.3

-after «OK» appears initial model (*.tam), on which with «mouse» in required X-coordinate is positioned receiver line and source (Fig.4).

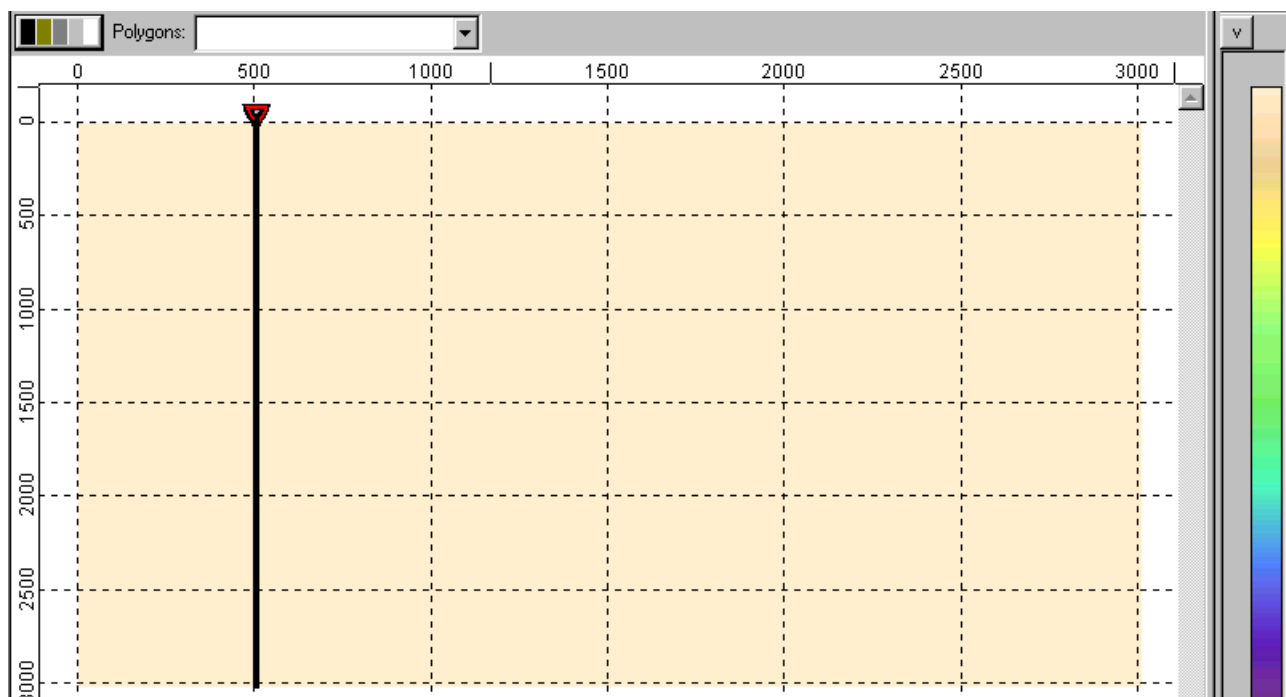


Fig.4

Second step – preparing wedge layered thickness.

- using a priori determined velocity cross section (data table.doc), transform it into LAS-file («w1.las»);
- on initial model (Fig.4) load LAS-file (icon 3 in Fig.2) in sequence of appearing dialogs (Fig.5) chose necessary LAS-file («w1.las») and click OK .

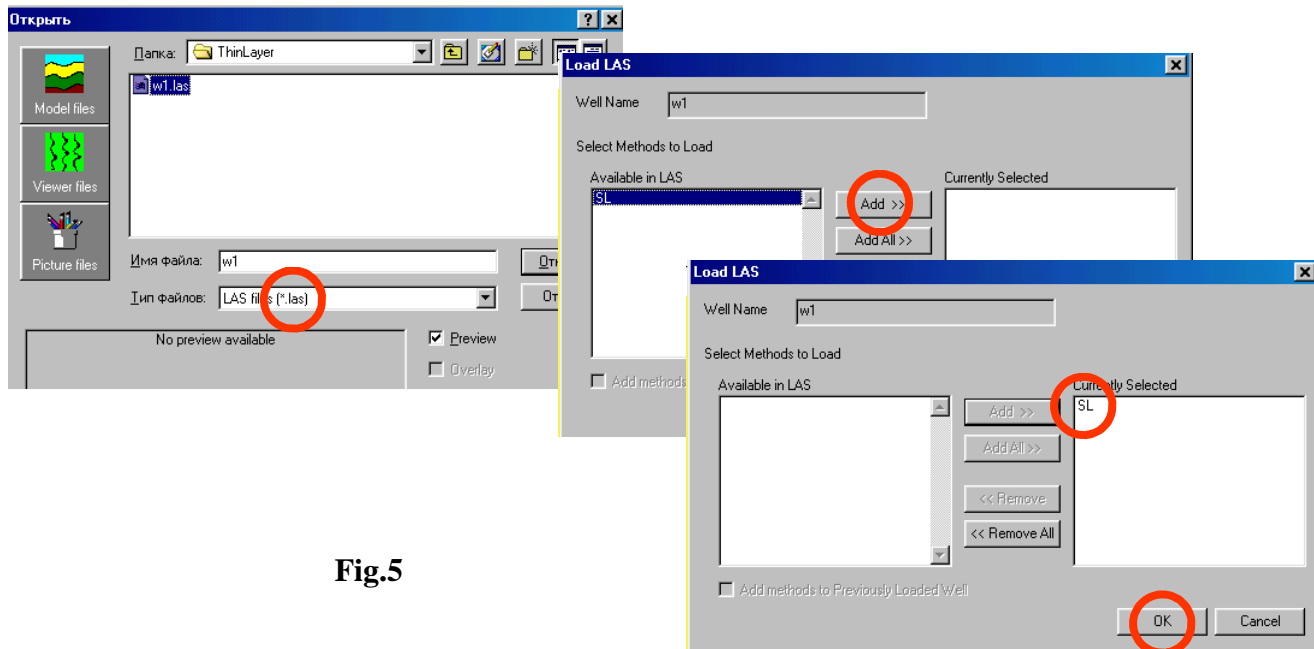


Fig.5

- on initial model appears well frame, which with «mouse» is dragged to necessary X-coordinate, velocity curve is seen after releasing left mouse button (Fig.6); user can make well frame invisible - position cursor inside well frame push right mouse button and chose actions from popup menu (for example, as it is shown in Fig.7);

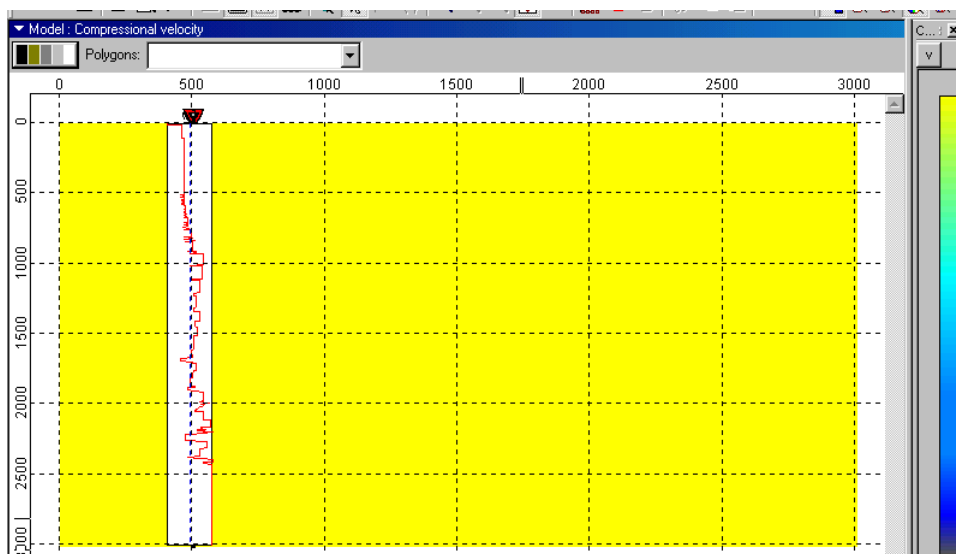


Fig.6

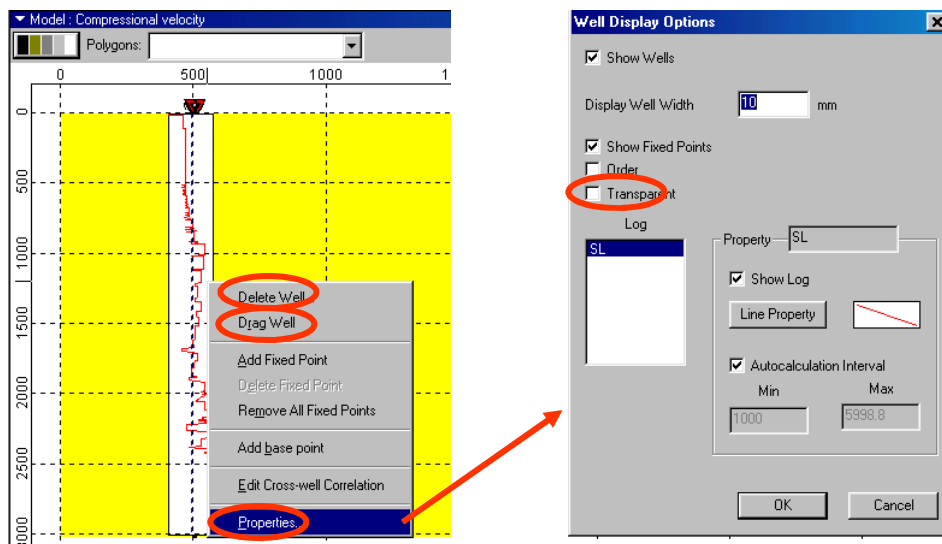


Fig.7

- for thin layered model building push main menu item «Run» and in following dialog define parameters as it is shown, for example, in Fig.8. Produced thin-layered model is shown in fig.9;

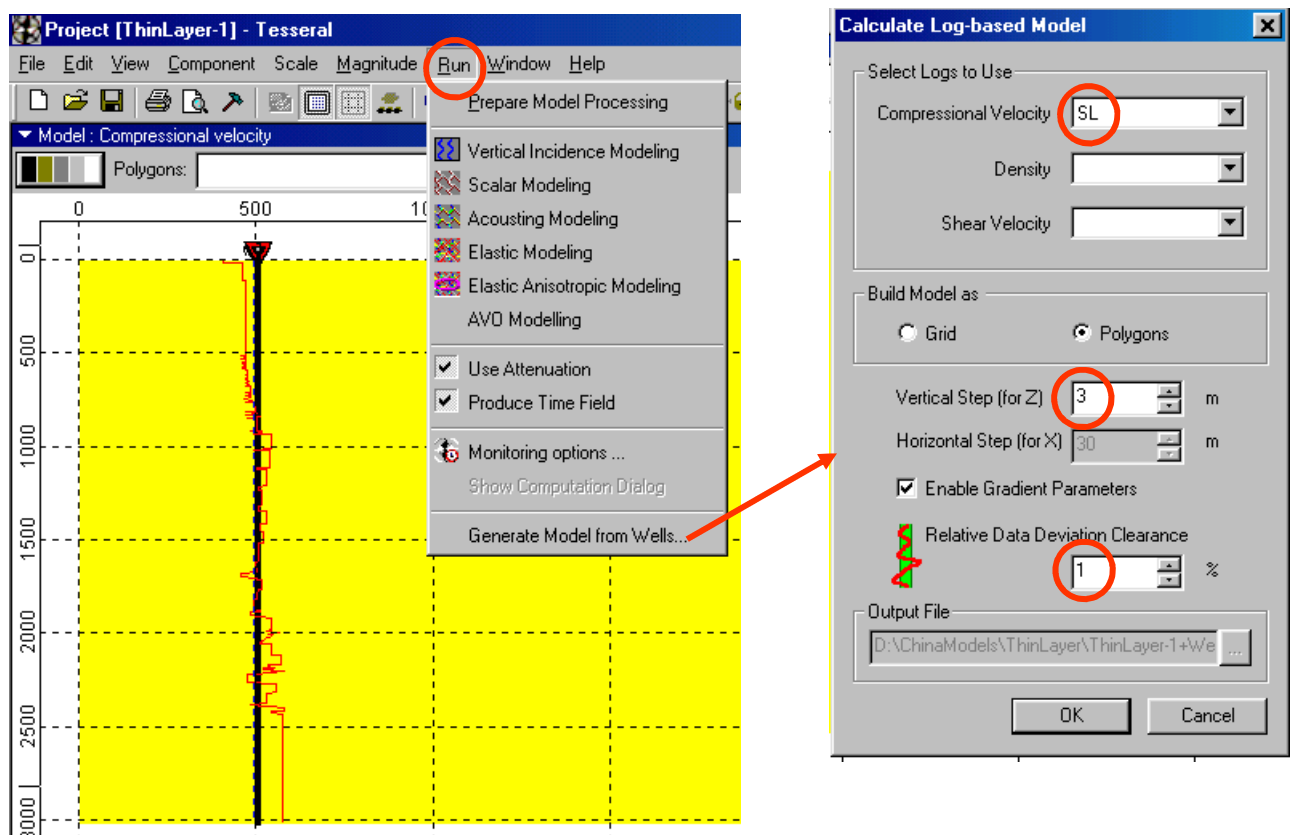


Fig.8

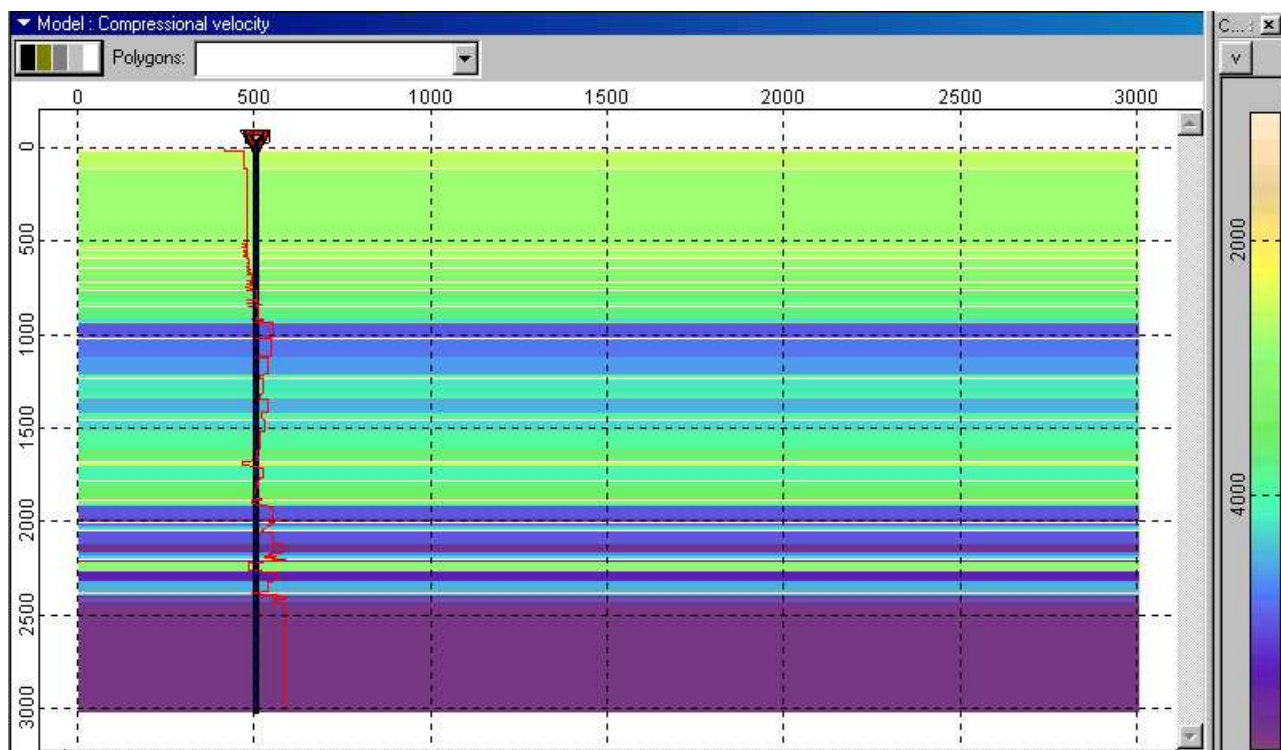


Fig.9

- for modification of the model to wedge layer type select last il the list polygon (#70 in Fig10), and using a priory model scheme shown in Fig.1 manually draw next polygon(#71);

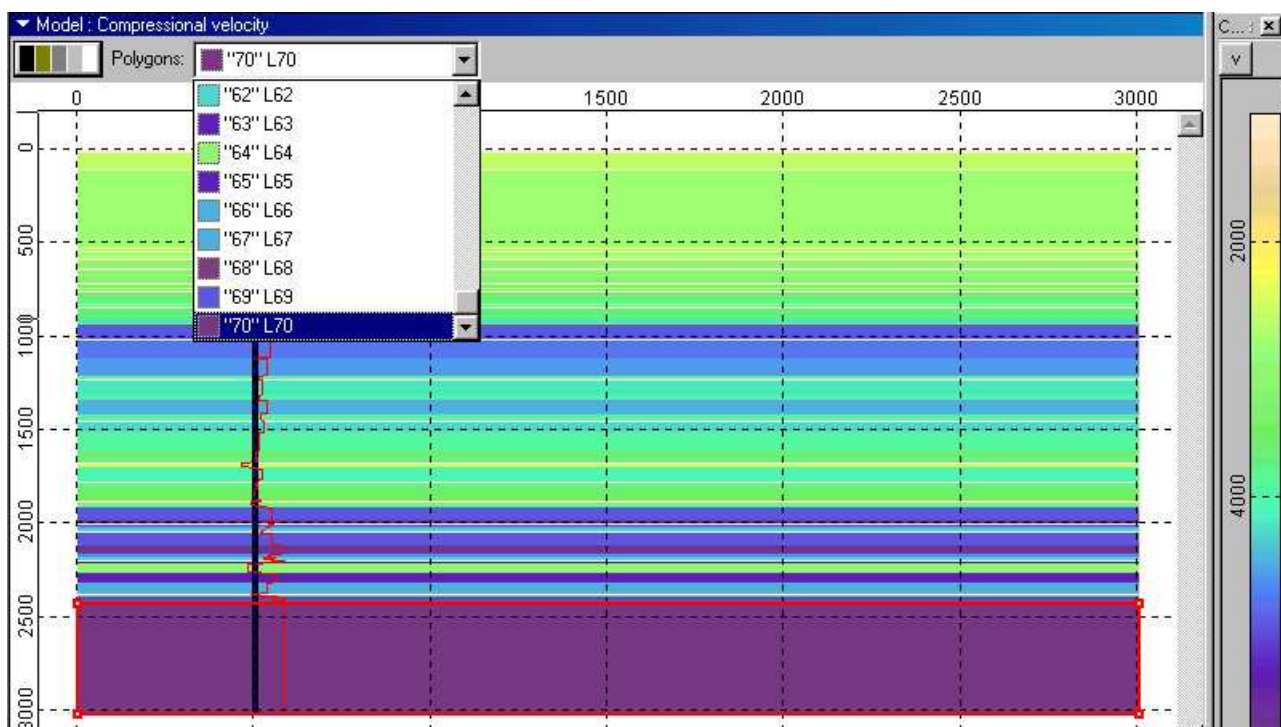


Fig.10

-after its closing in «Polygon» dialog enter velocity of dense clay (for modeled, as example, diapiр) , equal 2400 m/s, shear velocity and density - by default ; as result we obtain final target model of thin layered layer thickness pinching (Fig.11); taking into account that minimal layer thickness is 5 m, necessary resolution will be archived with corresponding gridding. Call «Framework» dialog and set effective velocity to 2600 m/s (see Fig.11).

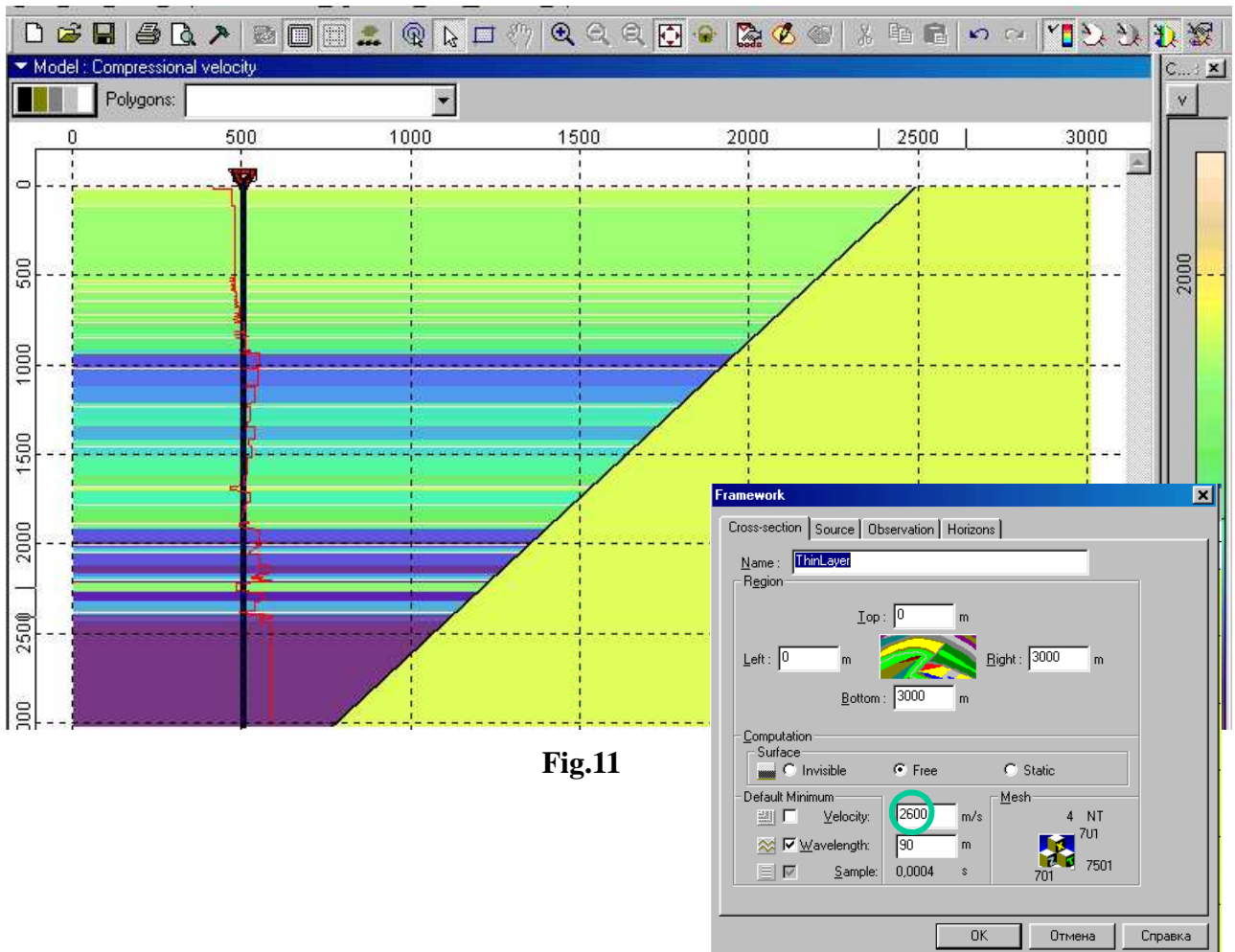


Fig.11

Step 3 – modeling wave field for VSP scheme

Let consider two variants: 1 – well inside thin layered thickness (already prepared model);

2 – in upper part well is drilled through thin-layered thickness, in lower - homogeneous clay thickness.

- to model first variant go to «Run» menu and chose «Elastic Modeling»; result of computations

is shown in Fig.12, where **a** - VSP shotgather (Z-component) and its magnified fragment, **b** - wavefield snapshots for $T=0.6, 0.8$ и 1.0 s.

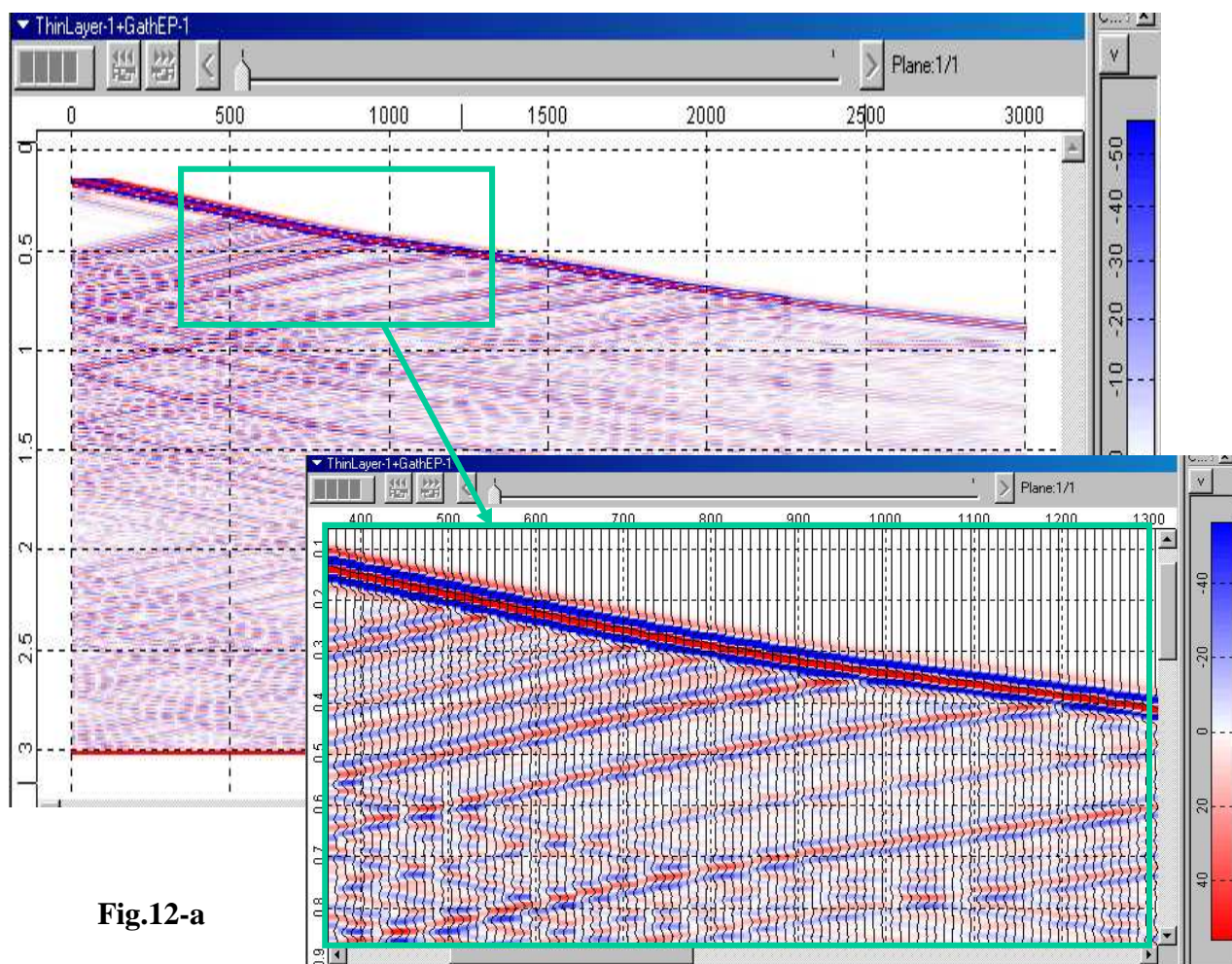


Fig.12-a

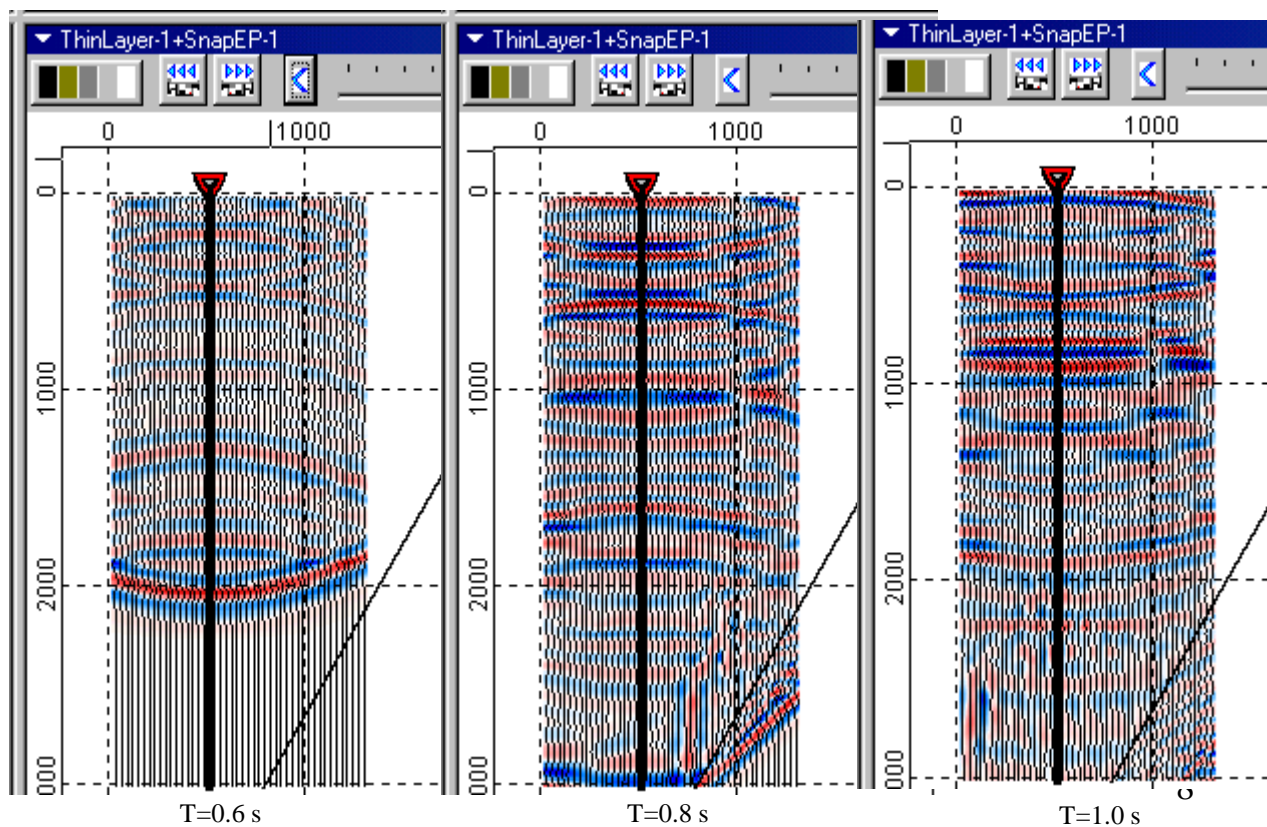


Fig.12-b

- to obtain second version using mouse move VSP layout (I.e. well and source) in X=1500 m (Fig.13), and using the same other parameters chose RUN+Elastic Modeling;

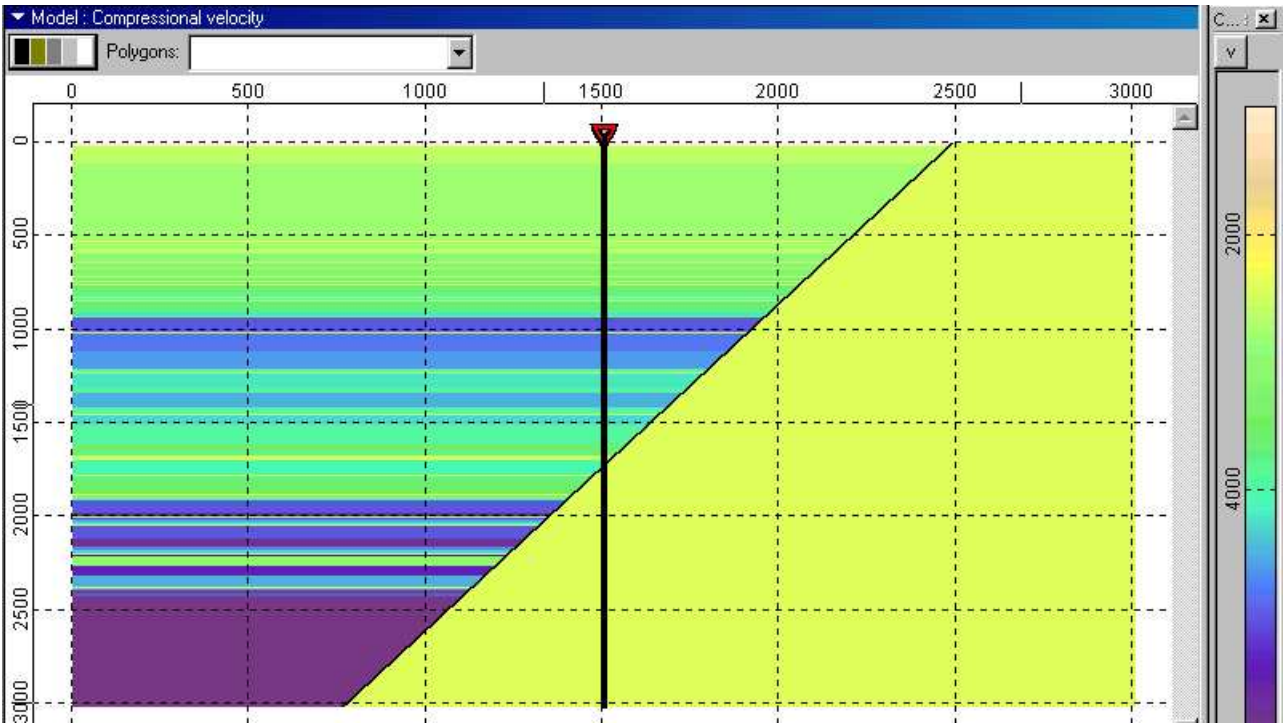


Fig.13

in Fig.14 is shown resulting synthetic VSP shotgather (Z-component);

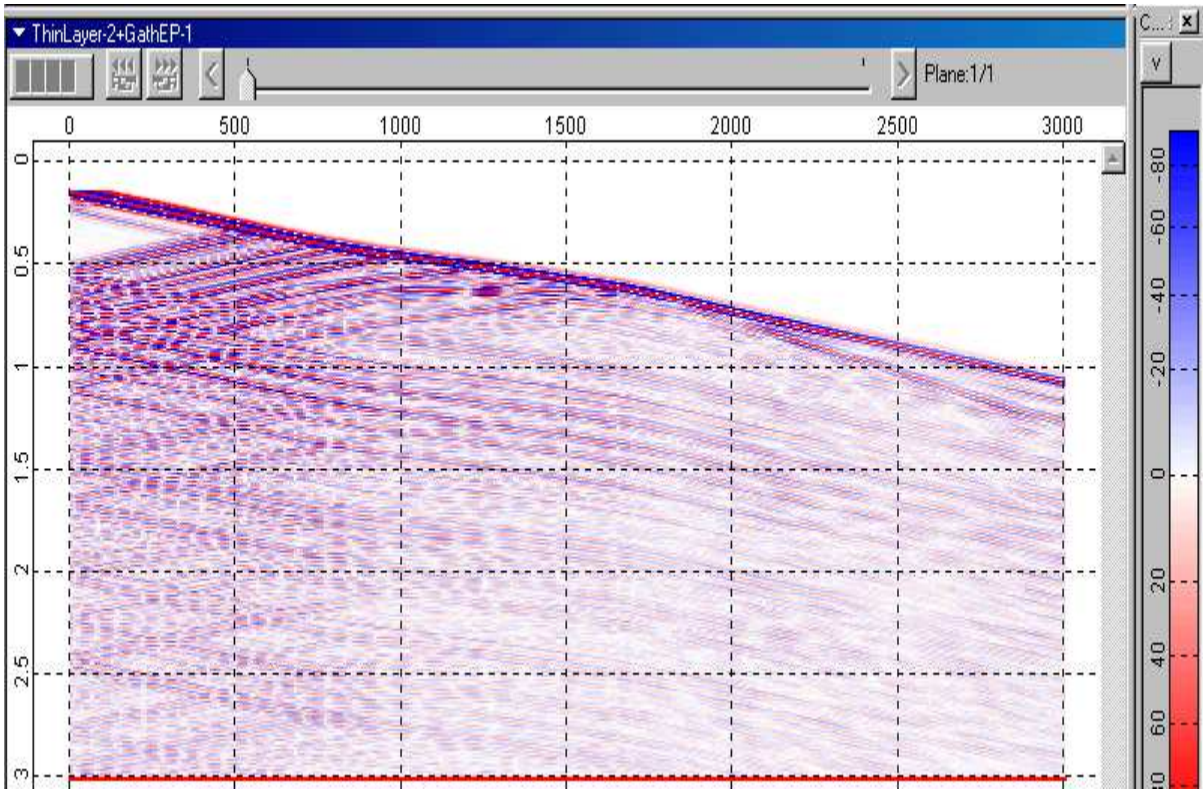


Fig.14

in Fig.15 are shown wavefield Z-component snapshots $T=0.4, 0.6$ и 0.8 s.

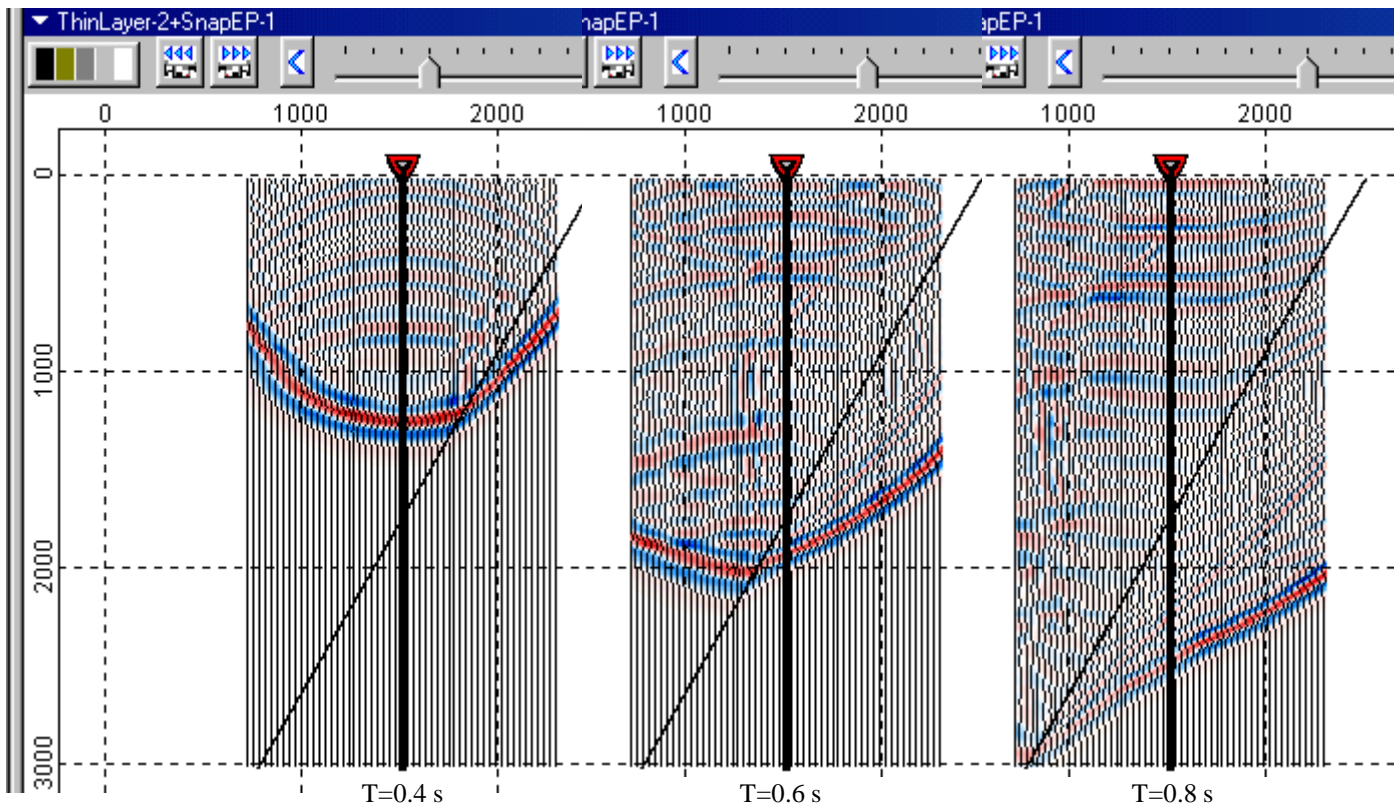


Fig.15

Step 4 – modeling CSP gather (shotgather) for surface observations.

- transform observation scheme for «Thin Layer-1» model (using «Framework» dialog «Observation» page, determining horizontal receiver orientation and interval 20 m) assign to it name «Thin Layer-3» (Fig.16);
- Modified model is shown in Fig.16;

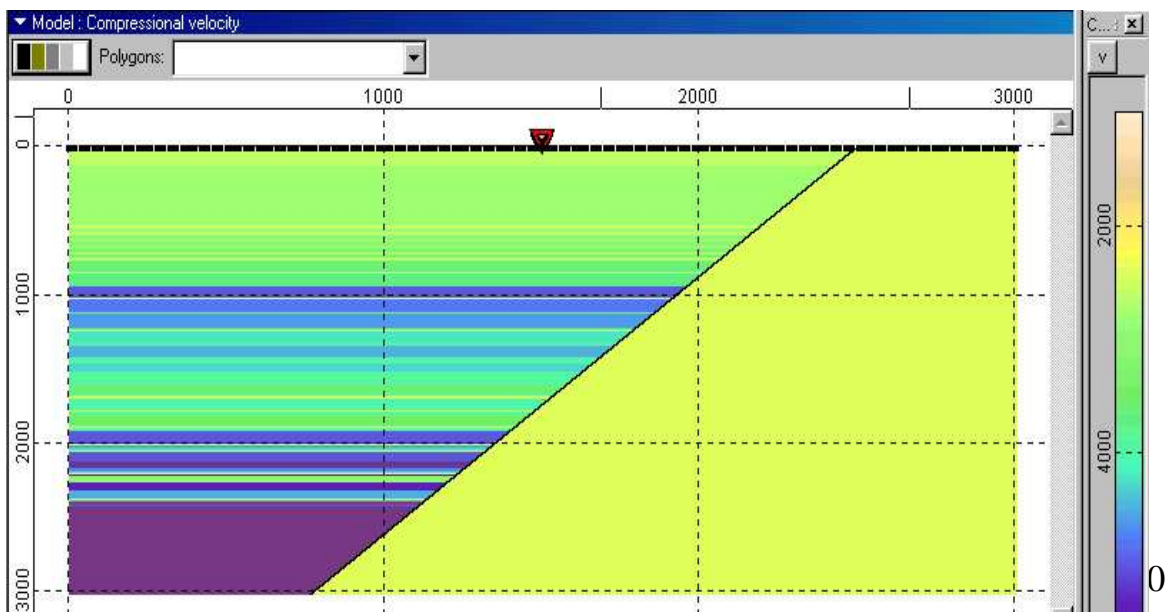


Fig.16

-obtained CSP shotgather is shown in Fig. 17 ,

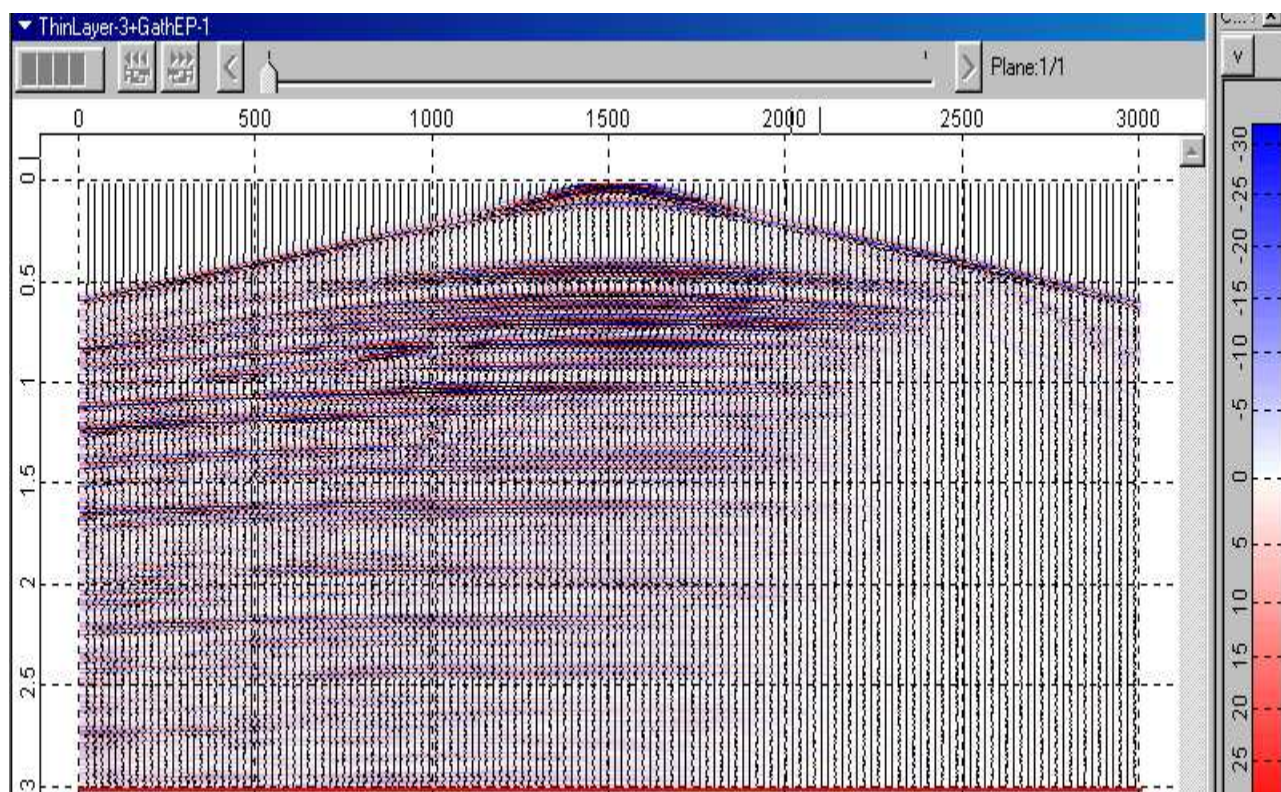


Fig.17

-wavefield snapshots for time $T=0.4$, 0.6 и 0.8 s are shown in Fig.18;

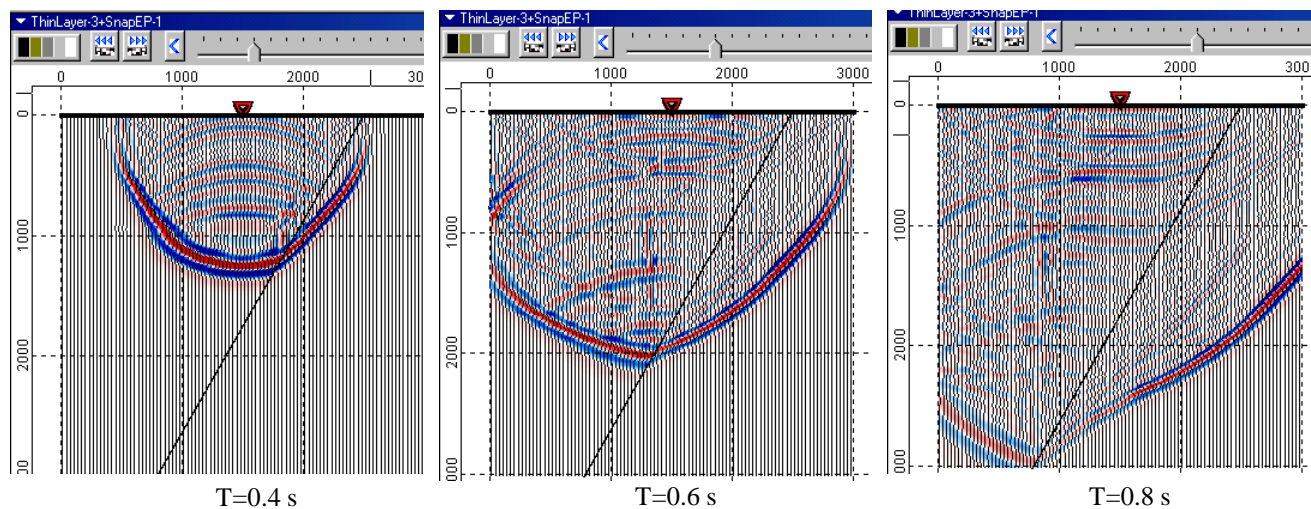


Fig.18

Step 5 – modeling of time cross-section using exploding reflectors source mode.

-to calculate time cross-section were used parameters shown in Fig.18.

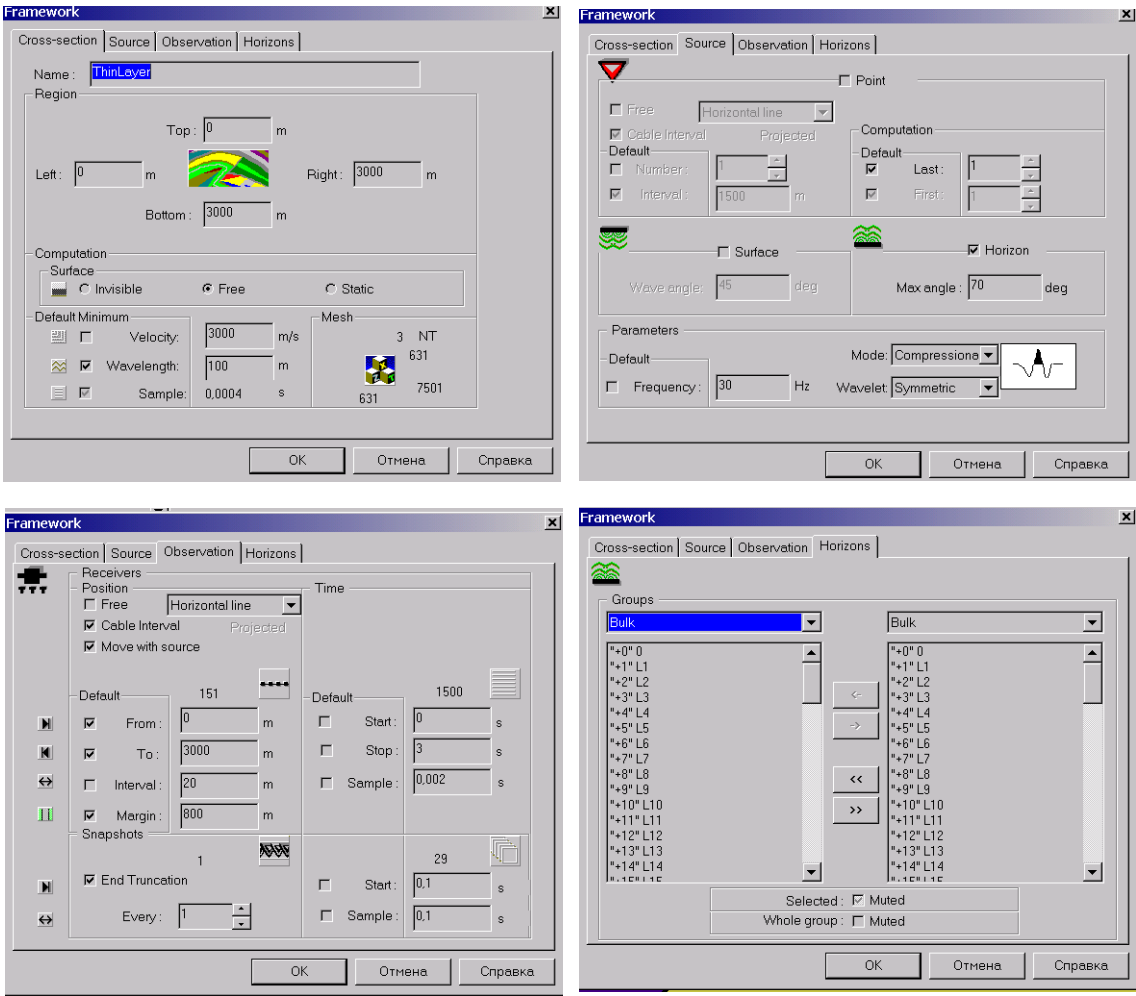


Fig.18

- active boundaries in model picture, shown in Fig.19 in this mode are blackened.

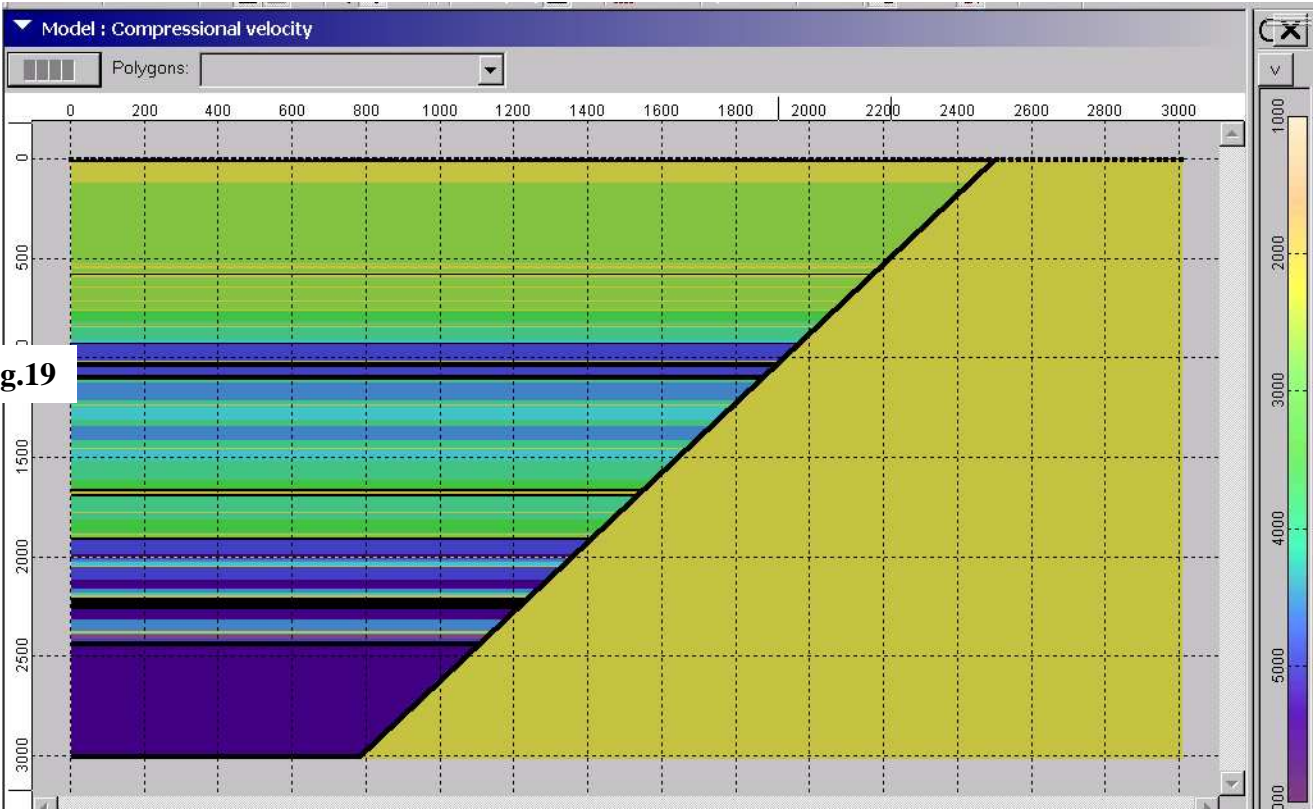


Fig.19

- in Fig.20 is shown process of synthetic time cross-section computations (numbers from 0 to 71 in Report window show active in those computations horizons, activation of horizons occurs after pushing button “Horizons” - see Fig.19)

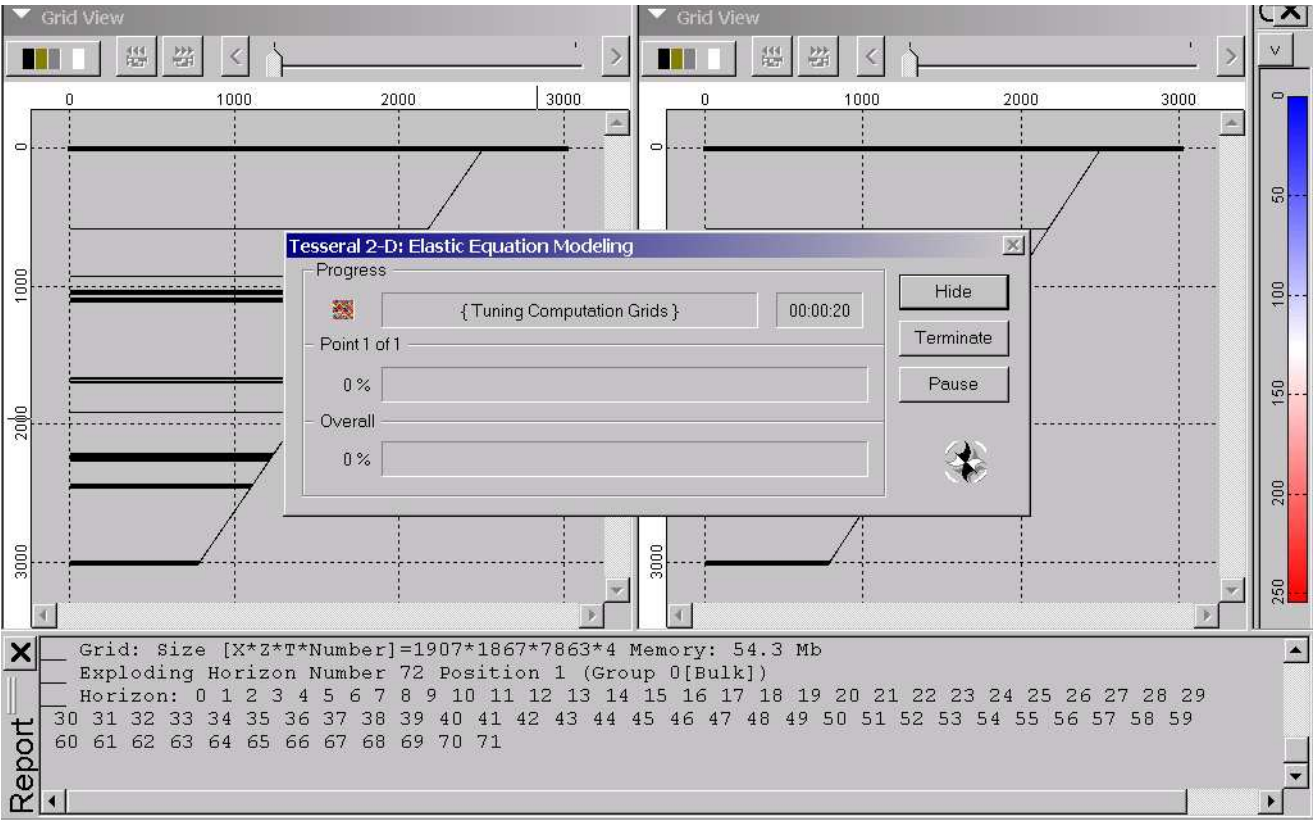
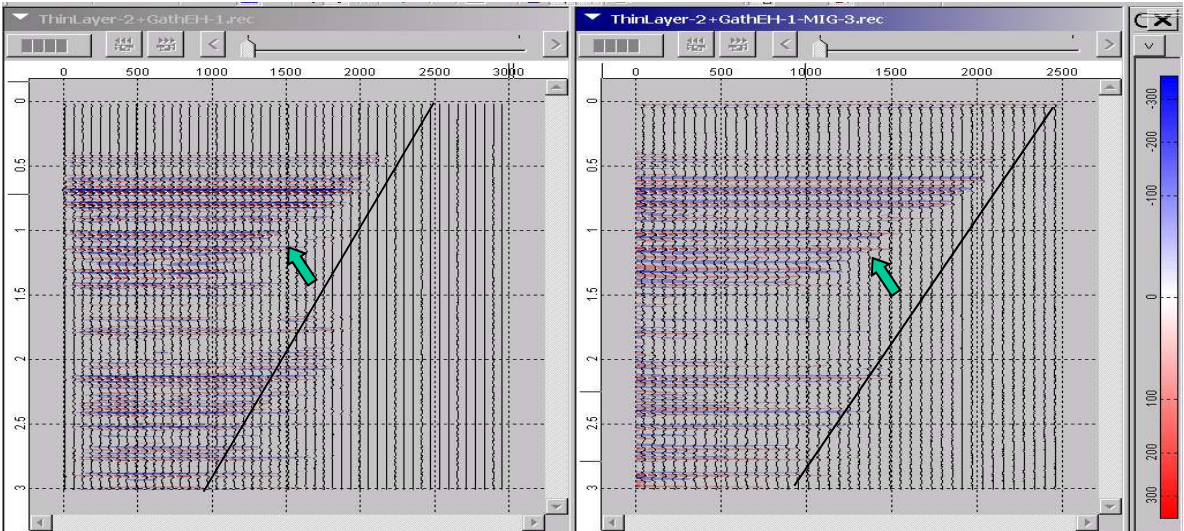


Fig.20

In Fig.21 are shown synthetic time cross-section (a) and migrated time cross section (b), obtained by application of Post-Stack Kirchhoff Migration (MIG) procedure.

With arrows is shown interferential zone on the pinching out boundary, which is manifested as seismic record amplitudes. Black line - thin layered thickness boundary.



a

Fig.21

b

Thin-layered Model by 2 wells –Example 2-

The Illustration of the Sequence of Practical Steps of Using Tesseral 2-D Software Package for Synthesis of Seismic Wave Field for a Section Model of an Actual Geological Object

The key primary objective, which in the end determines the correctness of specifying the objective of wave modeling, is the generation of a basic depth model of the section maximally resembling the real one both in terms of the geometry of boundaries and elastic parameters of layers. The total of all the a priori information on the object is used for this.

In this particular case there is the following a priori information: a migrated time seismic section ppt file and LAS files based on sonic logging data of four wells. The time section with elements of its interpretation is shown on Figure 1. The AK data is covering the depth intervals of: Y50 – 1700-3189M, Y56 – 500-3084M, Y524 – 1123-2795M and Y614 – 1400-2468M. There are no VSP data on this object.

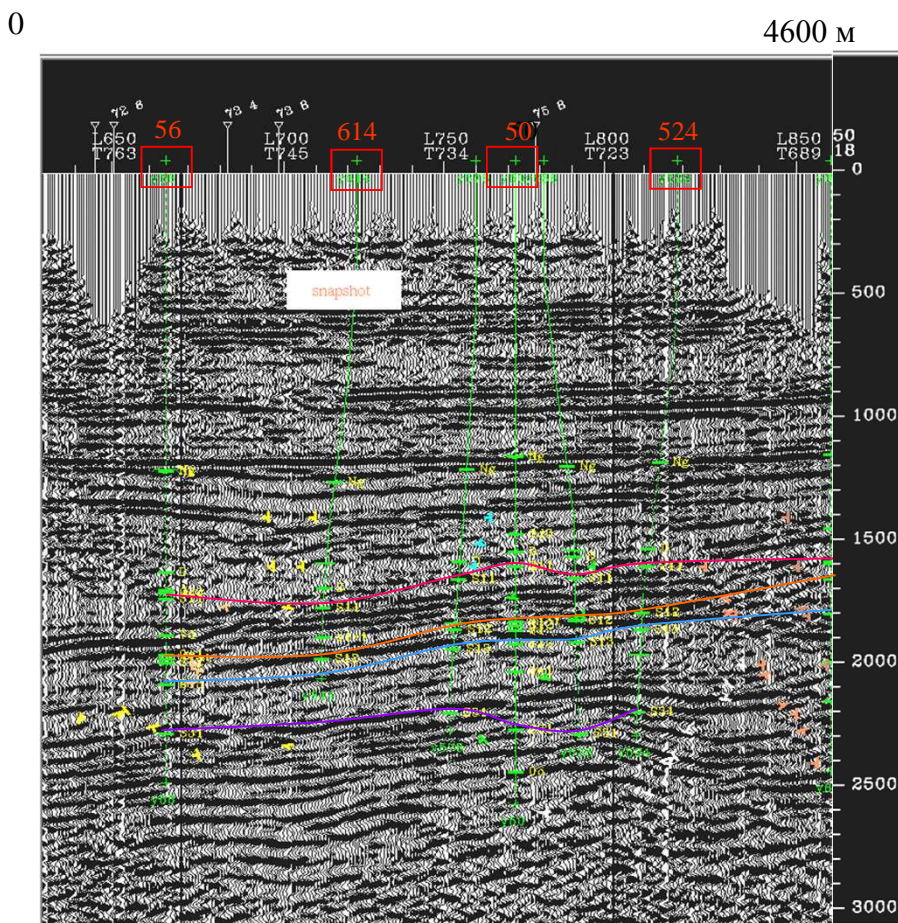


Figure 1 Migrated Time Section. Depth Interval (0, 4600M),
Trace-to-Trace Distance - 20M.

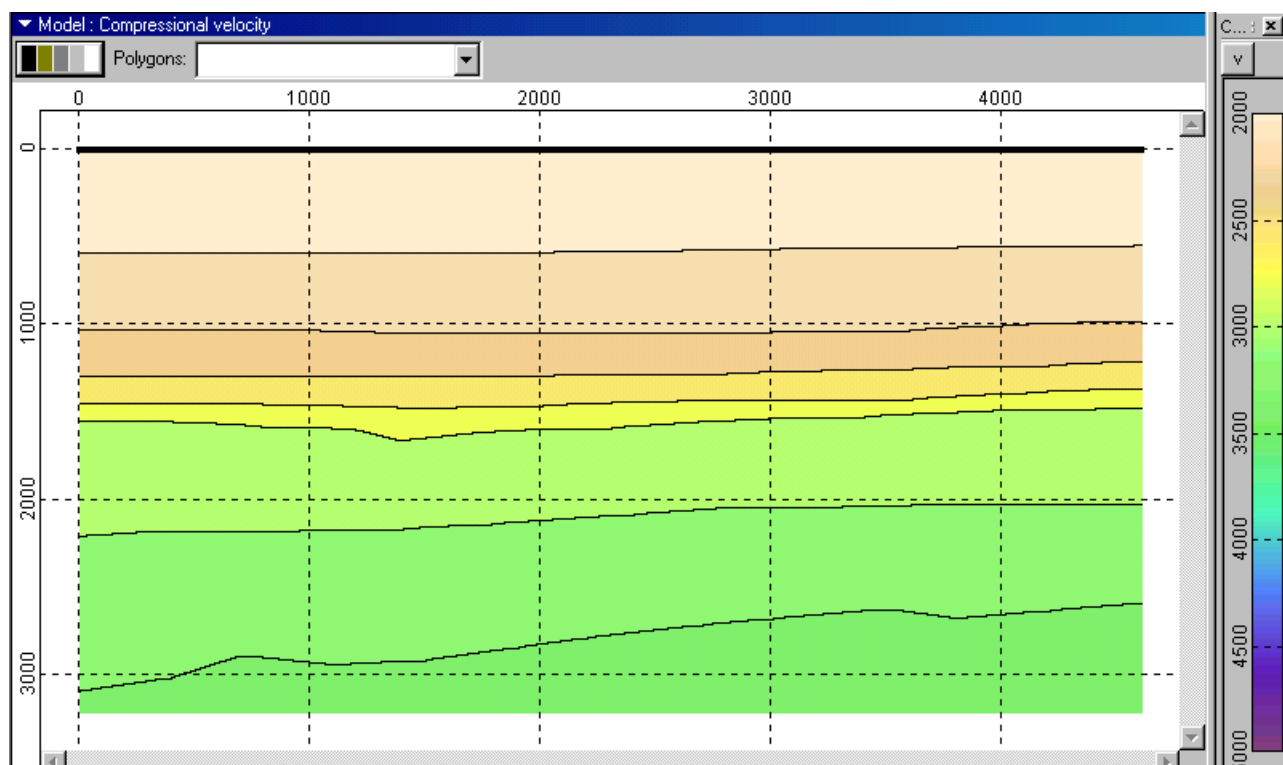


Figure 12. Depth velocity model (macro-model). The velocities in the target part of the section are fictitious. Real velocities will be specified later based on sonic logs data.

To generate a thin layered model based on a thick layered model (Figure 12), sonic logs data should be used. In this case Y56 and Y524 wells data is used, since sonic logging of Y51 and Y614 wells was done only in a limited interval of the section. To do this, choose the appropriate las file similarly to choosing a model or a tgr file from the box shown on Figure 13.

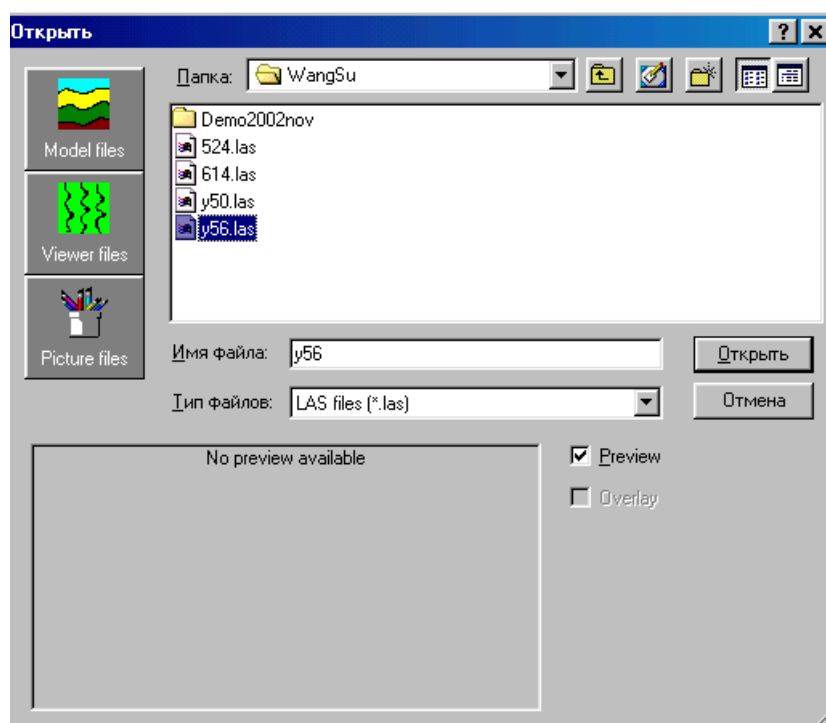


Figure 13. Las choosing box

In case there are several logging traces in a las file, choose the appropriate one from the box shown on Figure 14 (in this case there was only one trace - SL - in the las file

Bring the logging trace into the model by clicking OK button shown on Figure 14.

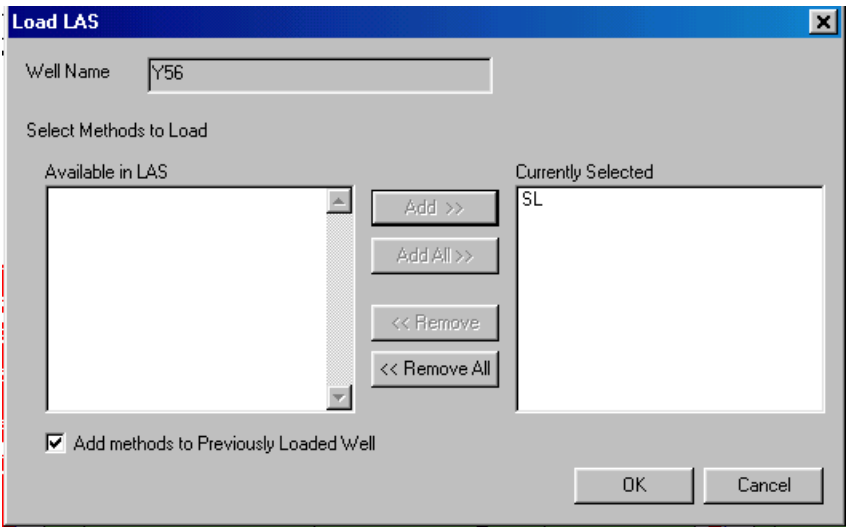


Figure 14 Pop-up box for choosing appropriate logging trace from a las file.

The logging trace is then positioned on an appropriate X-line by left clicking mouse button (the fixed positions of the wells on the model are shown on Figure 15

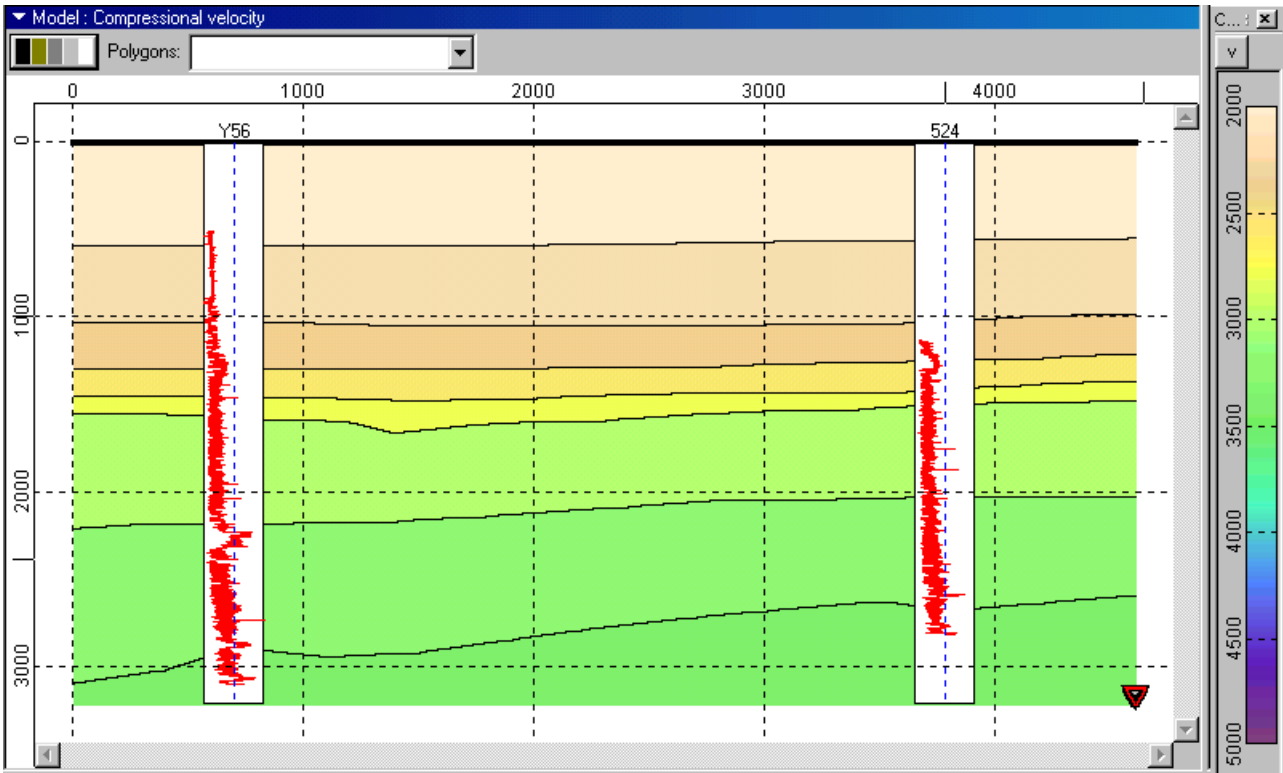


Figure 15 Macro-model of the media with sonic logging traces on it (wells Y56, Y524).

The boundaries of a macro-model shown on Figure 15 are used for the correlation of boundaries in crosswell interval
Correlated boundaries are marked by green lines (editing in process is shown on Figure 16) and black lines (editing is complete - Figure 17).

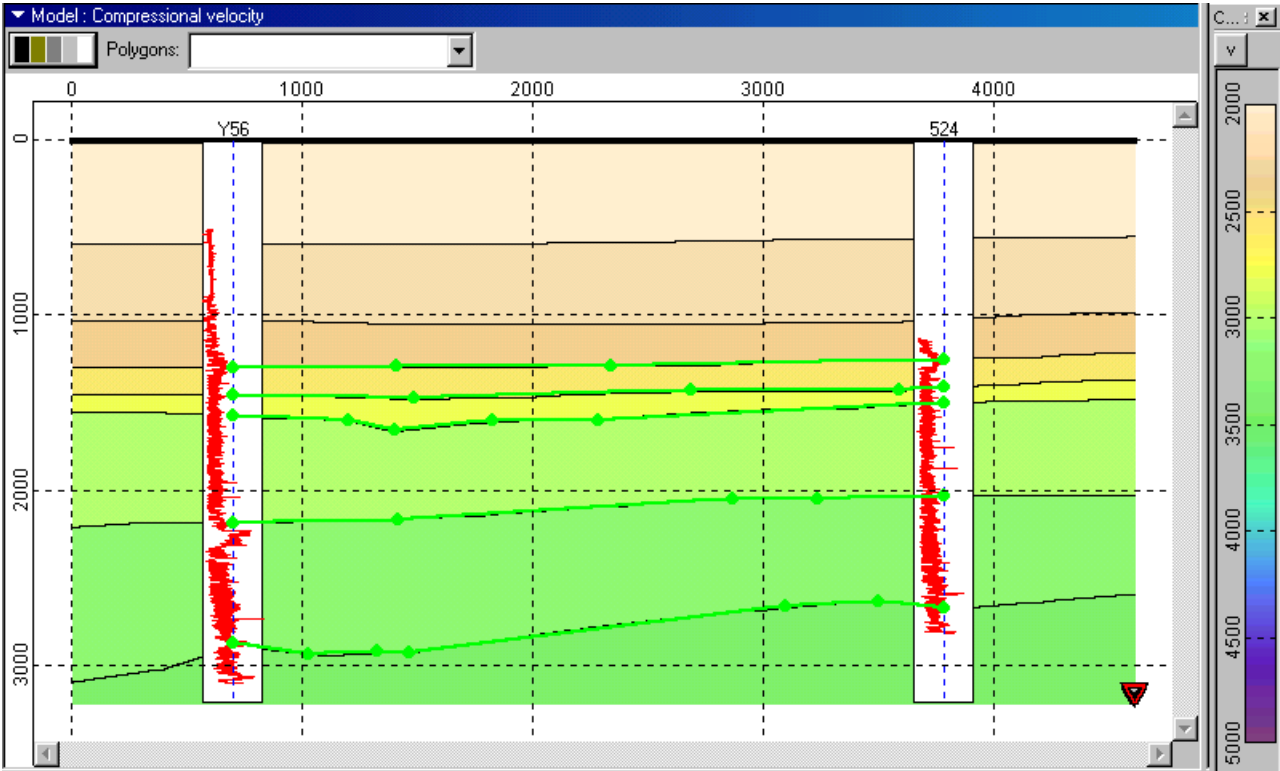


Figure 16. Editing in Process. Edit Manually button is on.

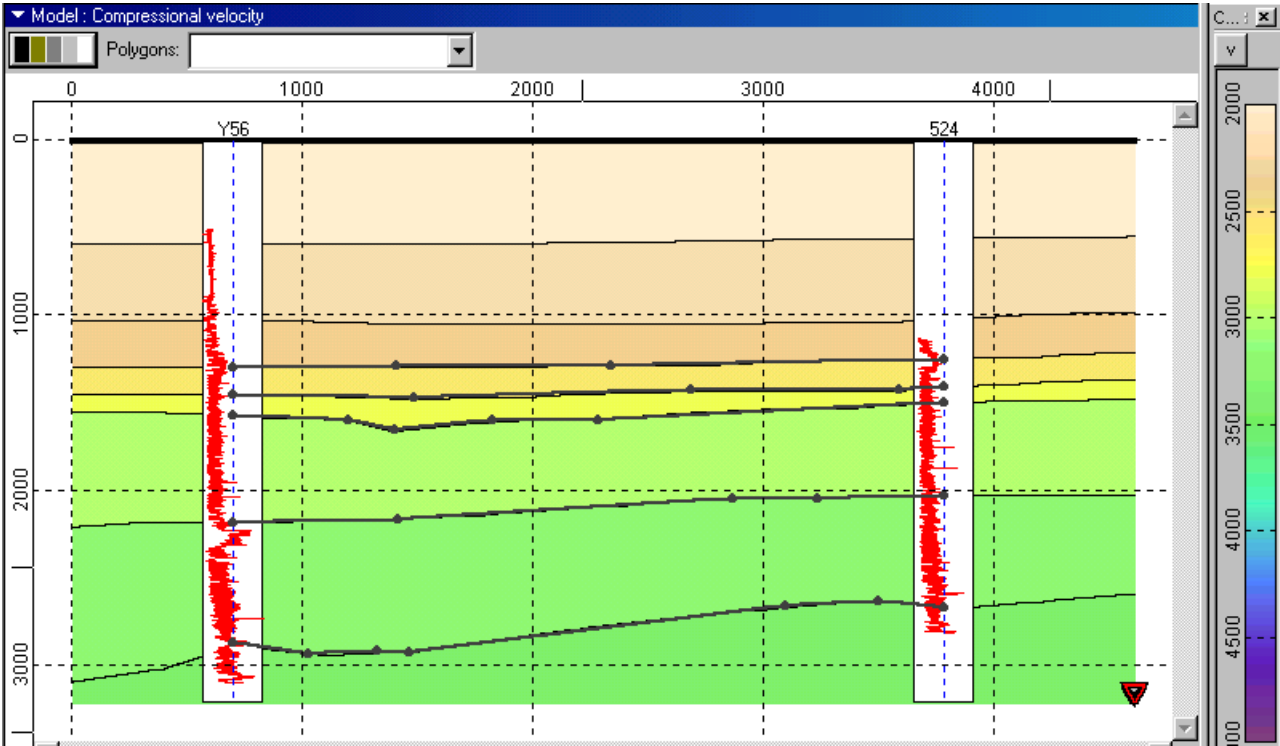


Figure 17. Editing is Complete. Edit Manually button is off.

To generate a thin layered model shown on Figures 16 and 17 using correlation between wells,

- choose Generate Model from Well from the Run menu (Figure 18);
- in the pop-up box enter the respective text boxes as shown on Figure 19;
- click OK button to generate a thin layered model as shown on Figure 20.

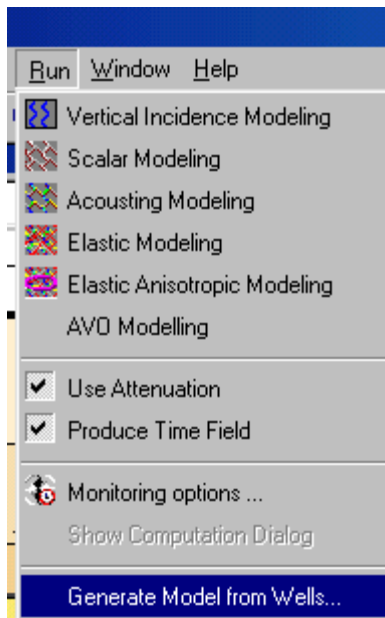


Figure 18. Run Pull-down Menu

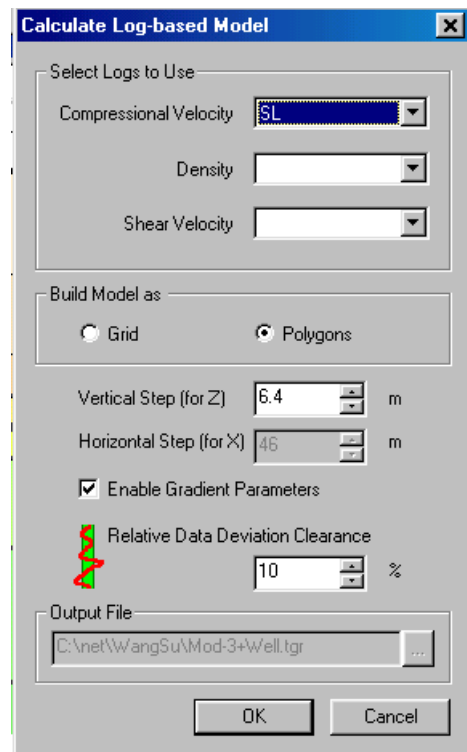


Figure 19 Pop-up Box Appearing after choosing Generate Model from Well

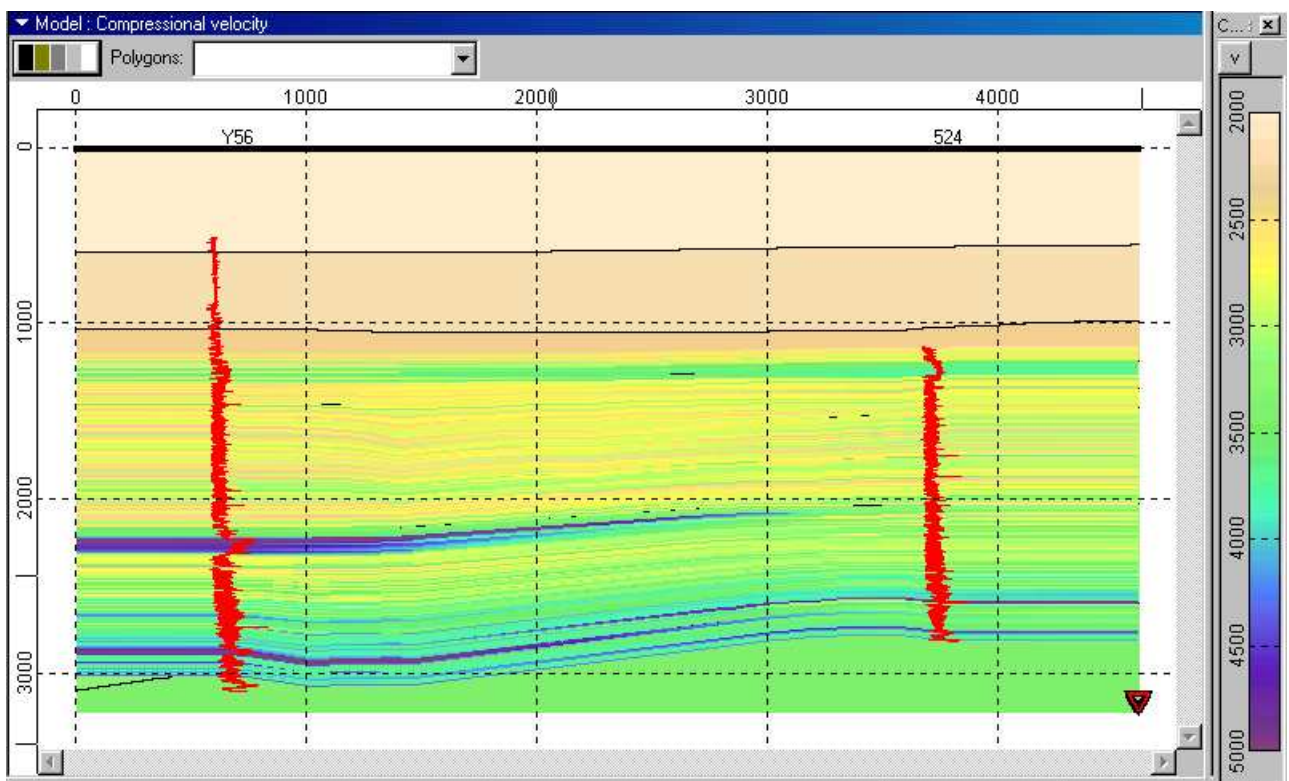


Figure 20. A Thin Layered Model of Media consisting of 239 layers.

Upon the activation of all the boundaries in «explosion boundary» mode (Horizons mode on Framework panel) the model will look as shown on Figure 21 (all the active boundaries are thicker).

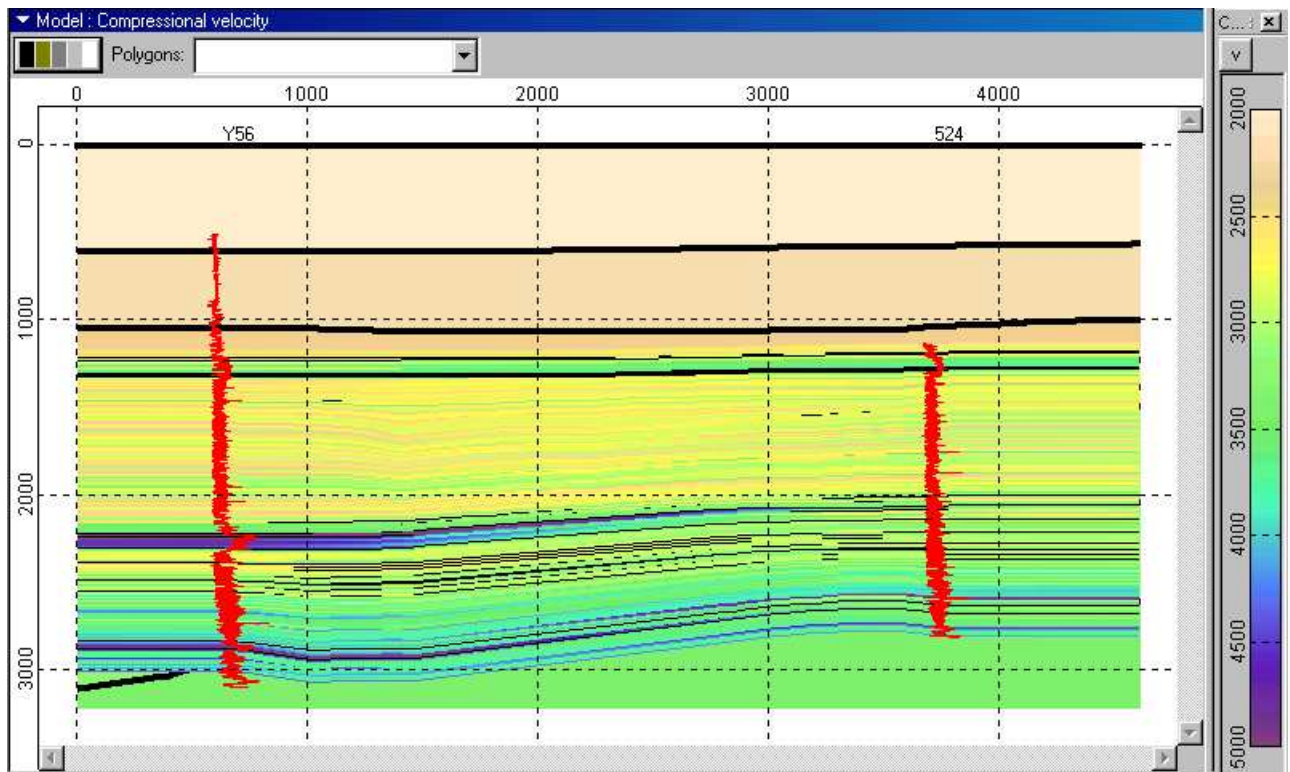


Figure 21. A Thin Layered Model with the Activated Explosion Boundaries

Sonic modeling mode was used for generating synthesized time section of a model shown on Figure 21, since in the «explosion boundary» mode this mode is practically not different from elastic modeling. Time section generated in the course of modeling is shown on Figure 22.

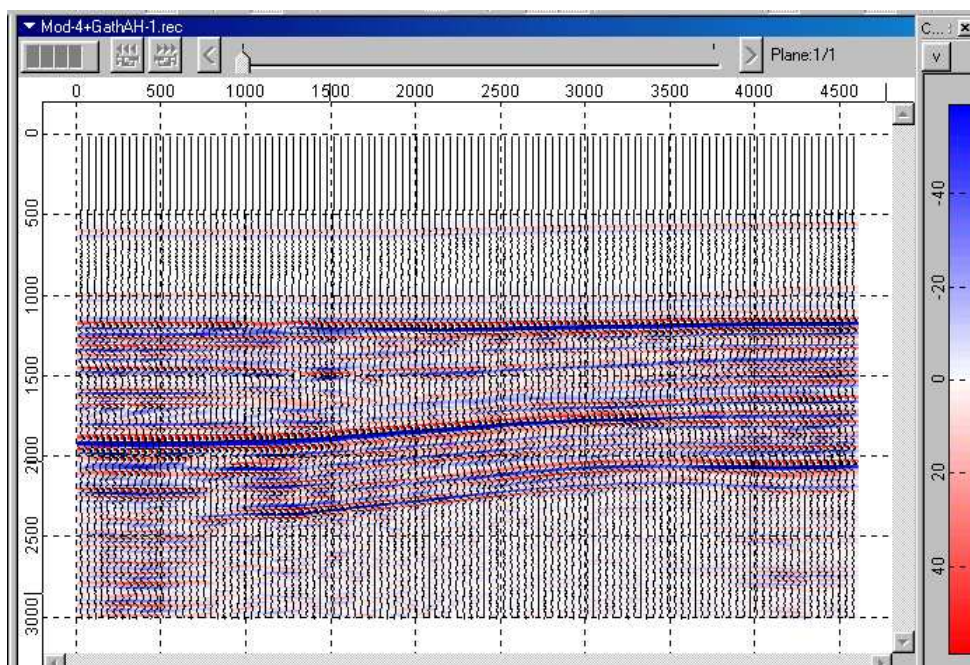


Figure 22. Synthesized Time Section

Migration of Synthetic Time Section

Migrated time section is similar to a real one. The main difference from the latter is the is a higher regularity of recording caused by homogeneity of the modeling system of observation as compared to a real one.

Of a practical interest are the intervals of these sections located between wells Y56 and Y524, since the model generated for the respective well without interpolation repeats beyond the limits of this interval.

In this case a model for time Kirchhof Migration was chosen based on the velocities received as a result of synthesizing a VSP seismogram based on sonic logging data of Y56 well.

A similar procedure for determining velocities could be performed for, say, well Y524. In that case average velocities would interpolate between two points of the section.

