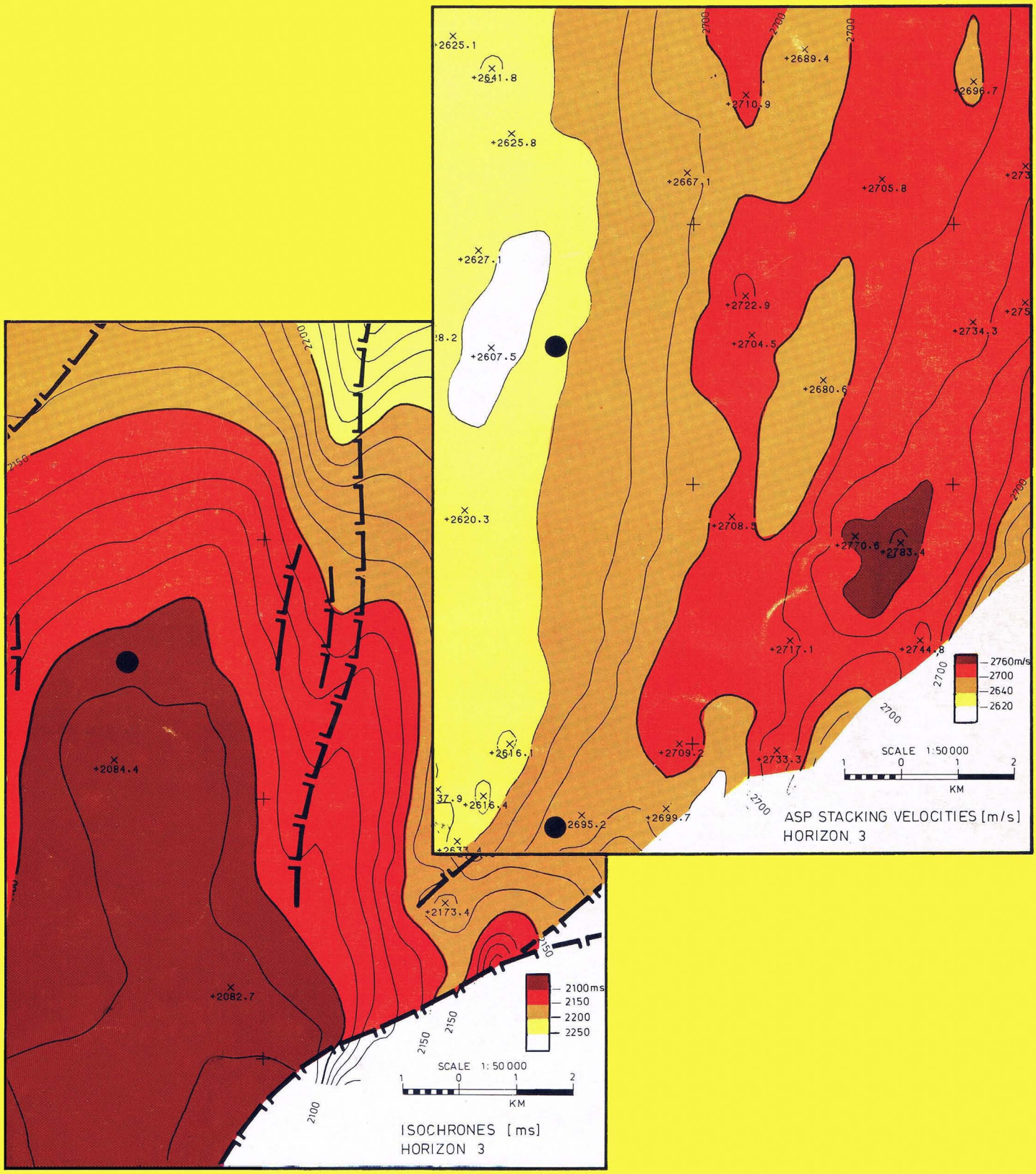
PRAKLA-SEISMOS INFORMATION No. 14

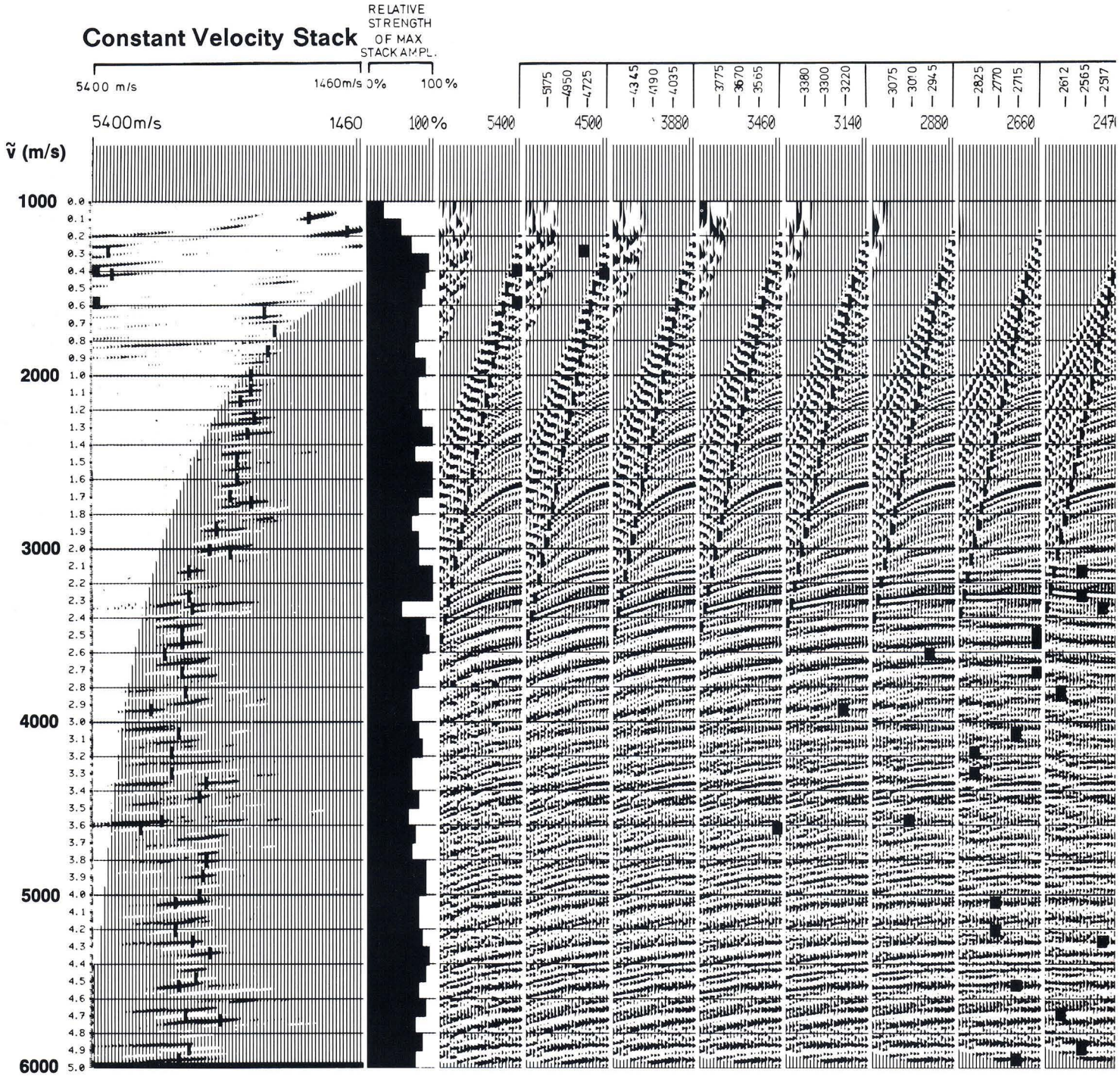
Determination and Presentation of Velocities derived from Seismic Data



The velocity analysis GERA is preferably used for routine processing as well as for special examinations.

The traces of one common depth point (or of several neigh-bouring CDP's) are stacked after dynamic correction with 80 different constant velocities. Processing parameters e.g. filtering, deconvolution are optional. The resulting 80 traces are scanned for their amplitudes and presented in the **Constant Velocity Stack.** In this presentation the maximum stacking amplitudes – ascertained within small time gates continuously determined over the whole processing length – are marked. These marks indicate, by which velocity one would obtain the best stack.

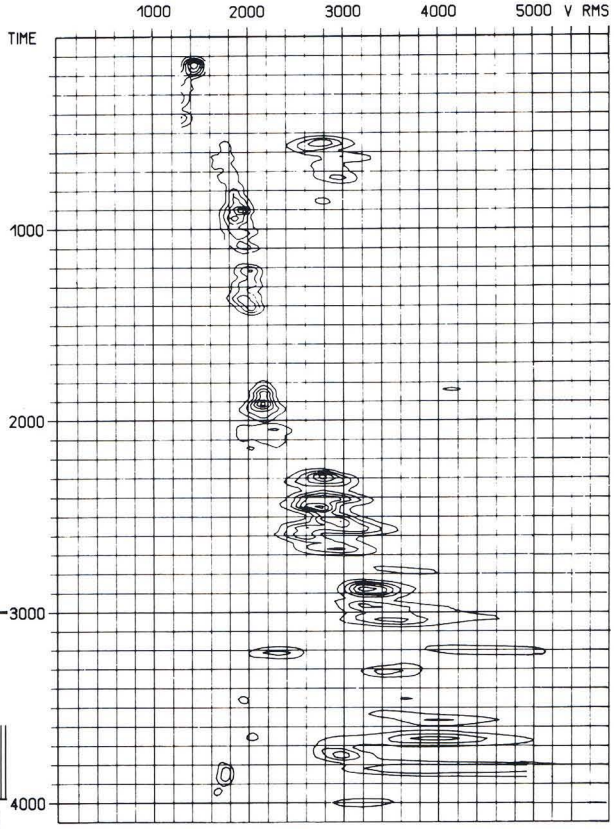
In the **Constant Velocity Gather** corrected CDP traces are presented (20 different constant velocities). Its interpretation is simplified by the automatic amplitude measurement.



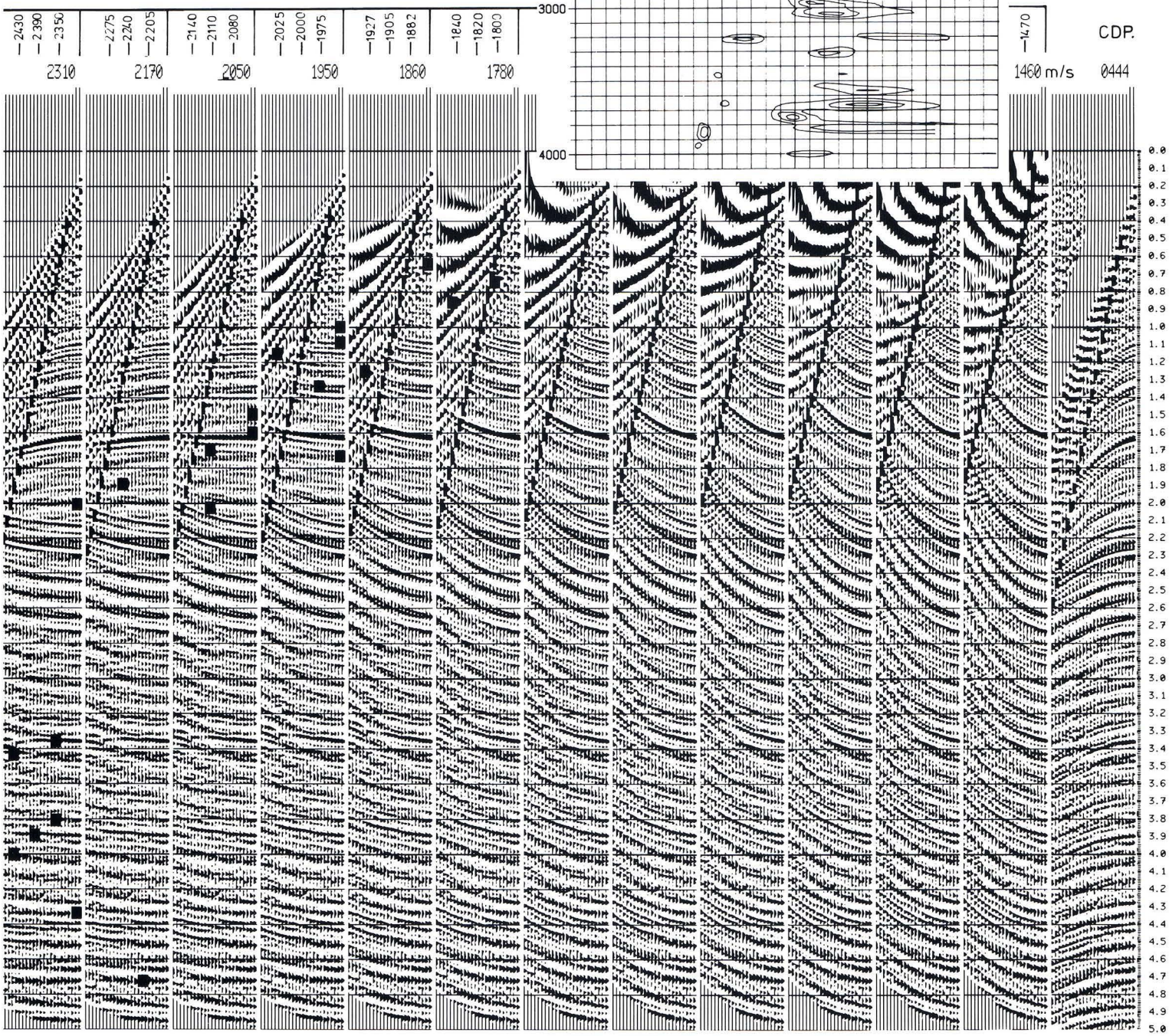
ALYS is a velocity analysis with automatic coherency measurement. Input data for ALYS are sets of CDP-traces, corrected with increasing stacking velocities.

The process is carried out in 3 steps:

1) Coherency measurement of the corrected CDP traces within gates of optional lengths.
2) Gridding of the data in the time-velocity-space.
3) Contouring of the results as isolines (lines of equal coherency in a time-velocity coordinate system.



Constant Velocity Gather



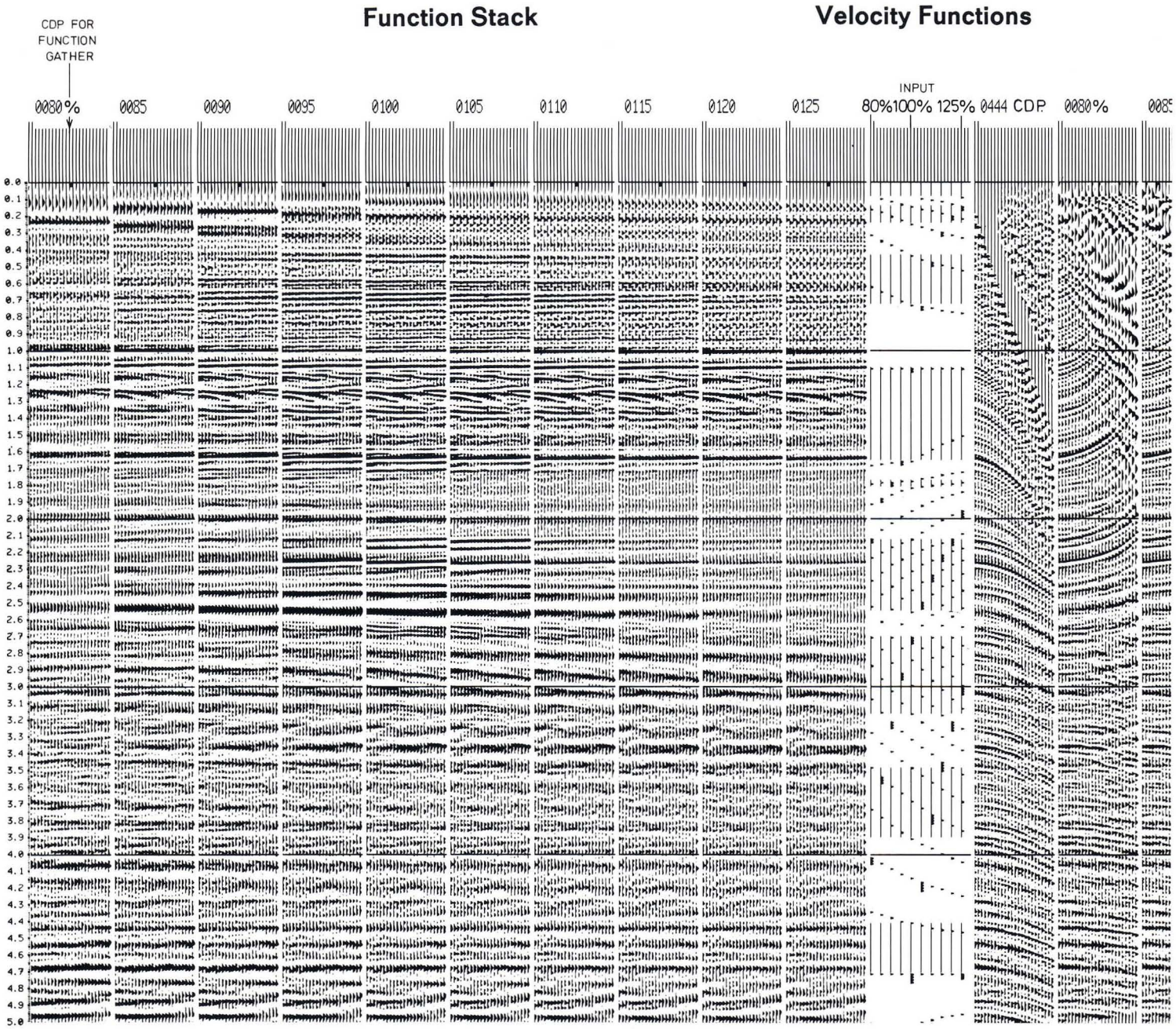
On selected parts of seismic lines test stacks are performed with various stacking velocities. Input and alteration of these velocities can be carried through by several possibilities:

1. Input of different constant velocities
2. Input of selected velocity functions
3. Variation of a given function by constant $\Delta\Delta$ t-steps
4. Variation of a given function by variable percentages.

After stack with different velocity functions no normalization is carried out, just a constant scaling for presentation as the **Function Stack** has to be applied.

In the **Function Gather** the single traces of one selectable CDP are displayed NMO-corrected with all used velocity functions.

In addition the single traces of the same CDP are processed in the same way as the **Constant Velocity Stack** in the GERA analysis.



FUSA with variation of a given "100 %" function in 5 % steps

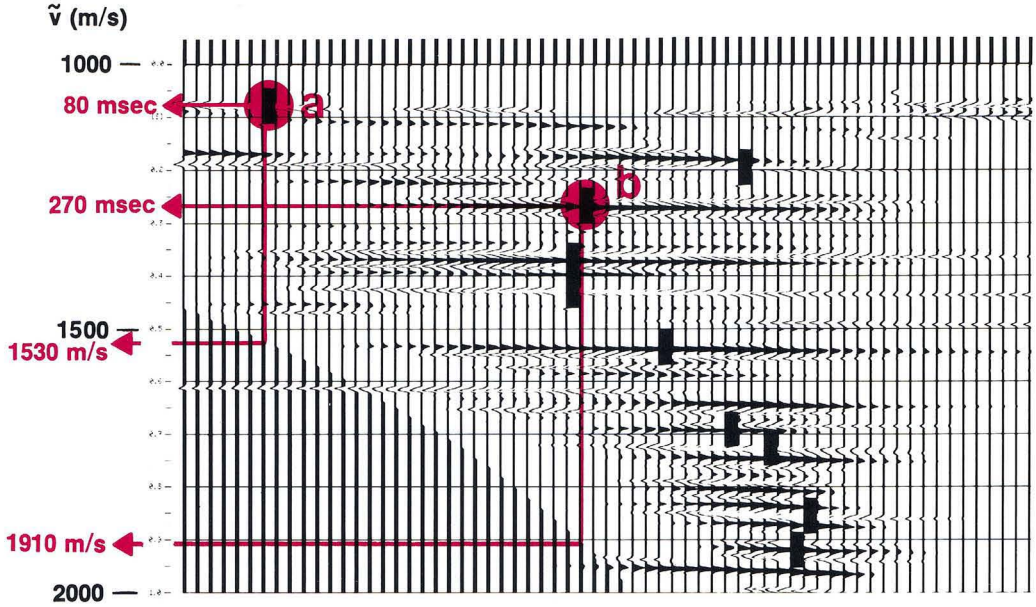
Explanation of maximum stacking amplitude:

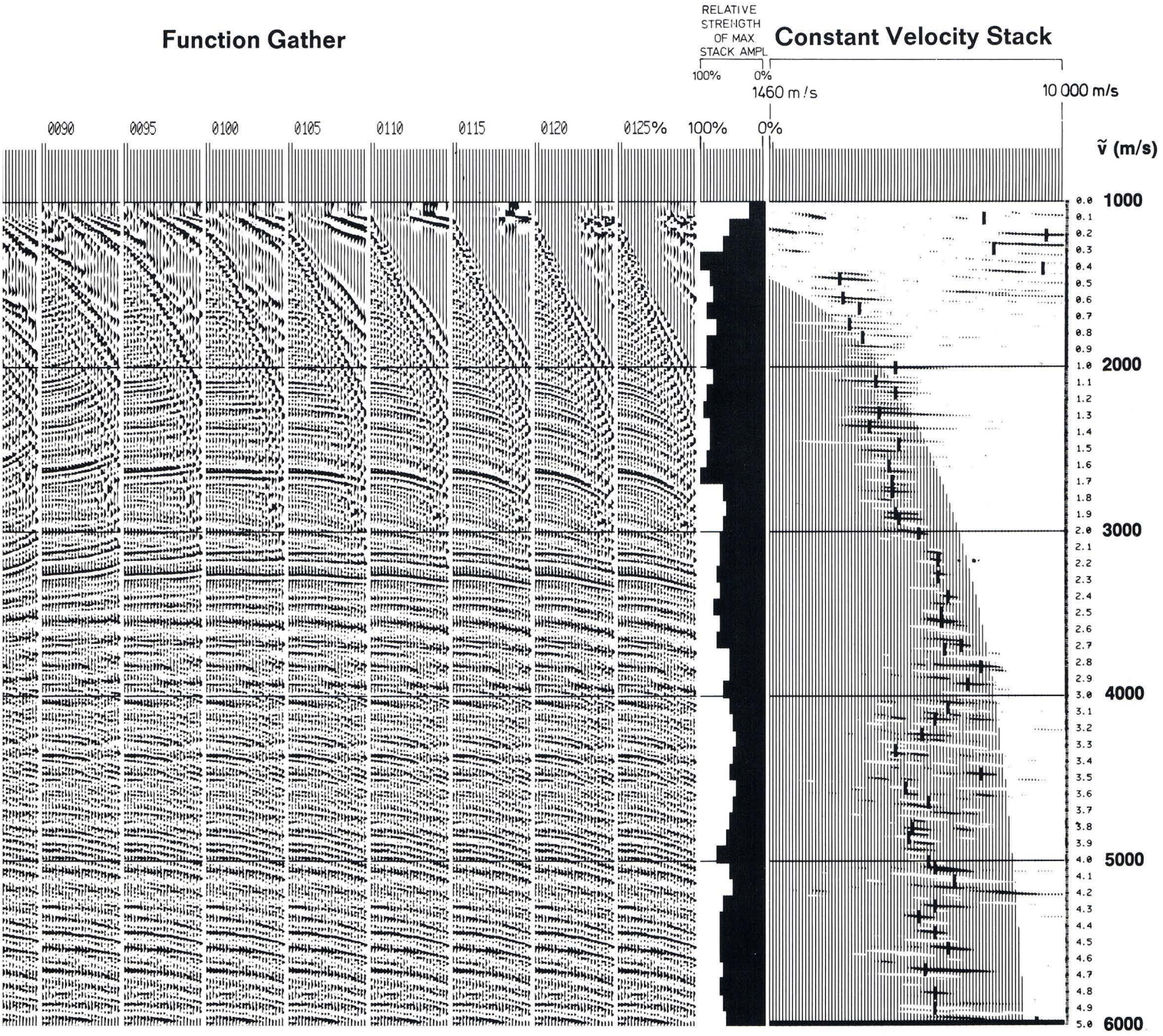
reflection a:

traveltime : 80 msec
stacking velocity : 1530 m/s

reflection b:

traveltime : 270 msec
stacking velocity : 1910 m/s

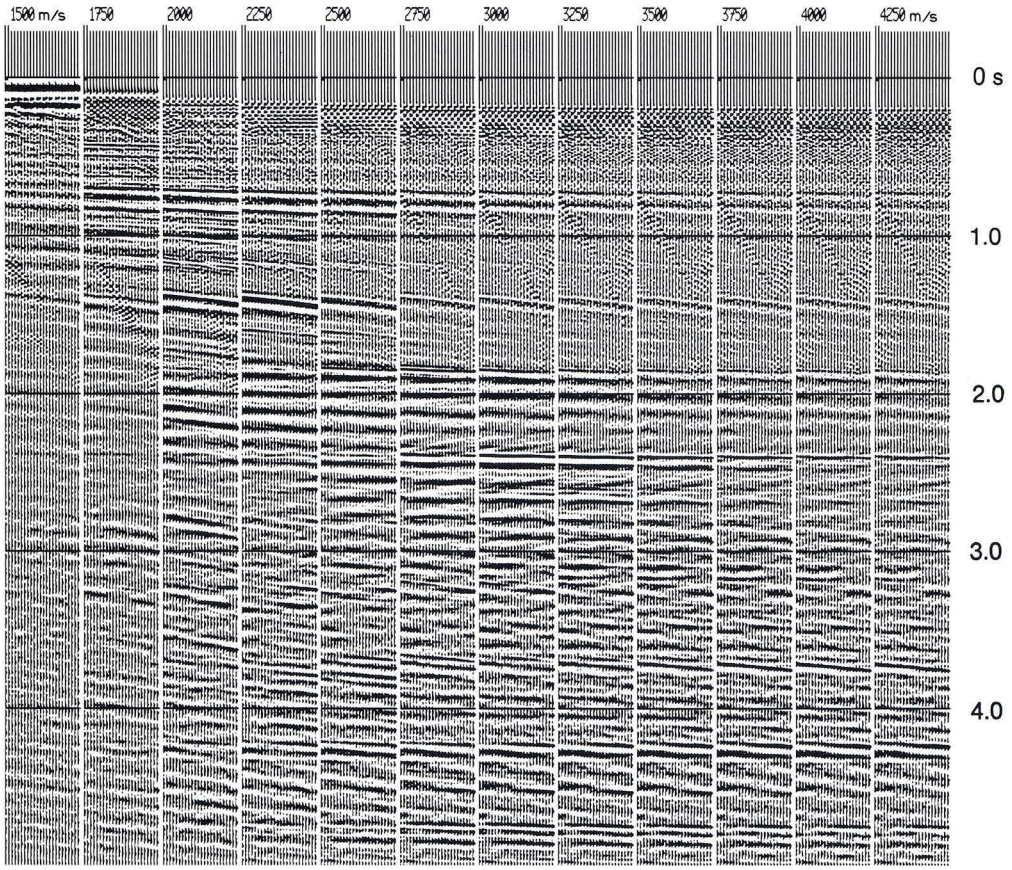




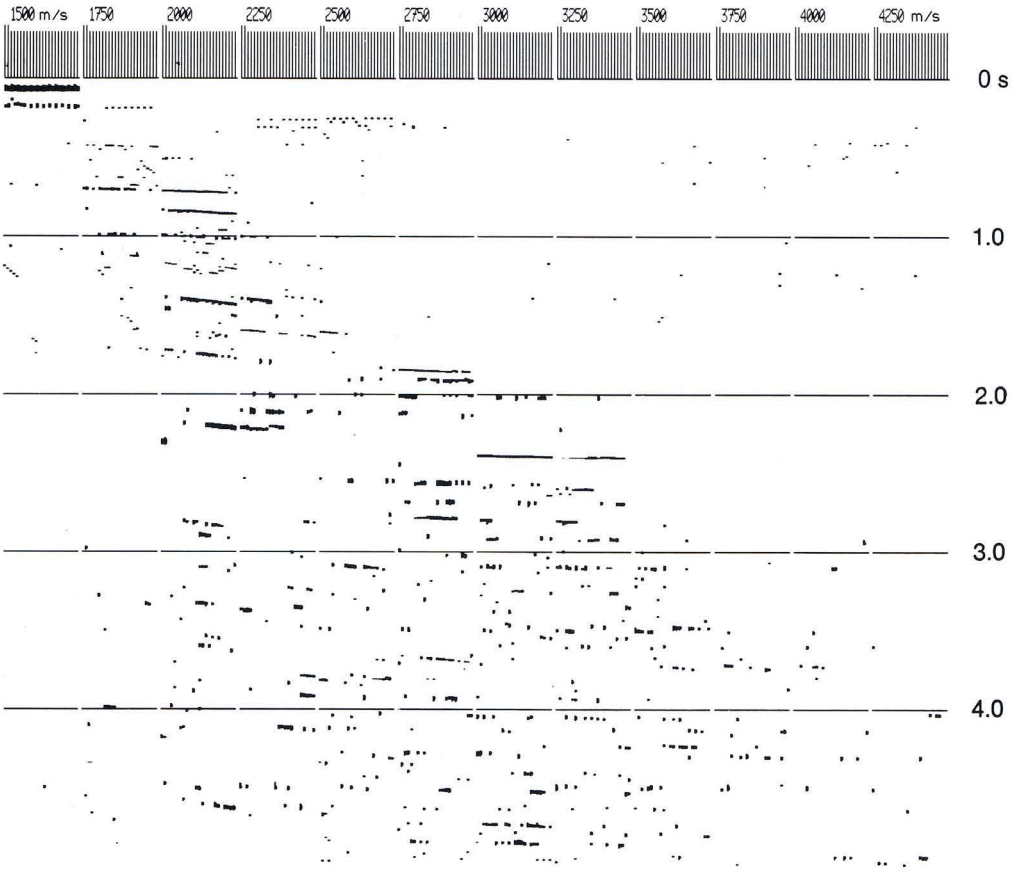
FUSA — Scanning Presentation

If automatic determination of maximum stacking amplitudes for all processed CDP's is requested, scanned maximum stacking amplitudes within optional time gates for every CDP can be displayed as separate overlay. By means of Scanning Presentation the evaluation of the best stacking velocities is optimized.

FUSA with different constant velocities



Normal presentation



Maximum amplitudes

Maximum stacking amplitudes, which can be seen on page 6, are coloured in the original traces. This kind of analysis enables a precise examination of velocities for everey CDP direct from one display.

Stacking Amplitude

Normal

Maximal

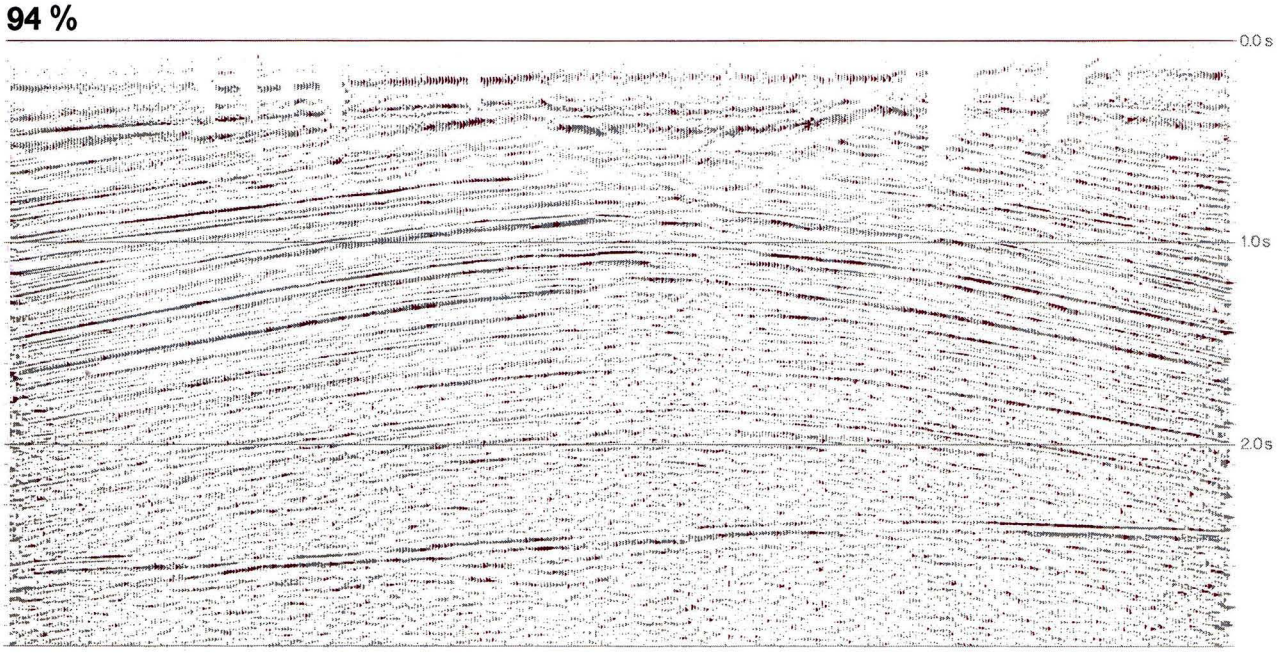
FUSA with different constant velocities

FUSA — Section-Stacking Test

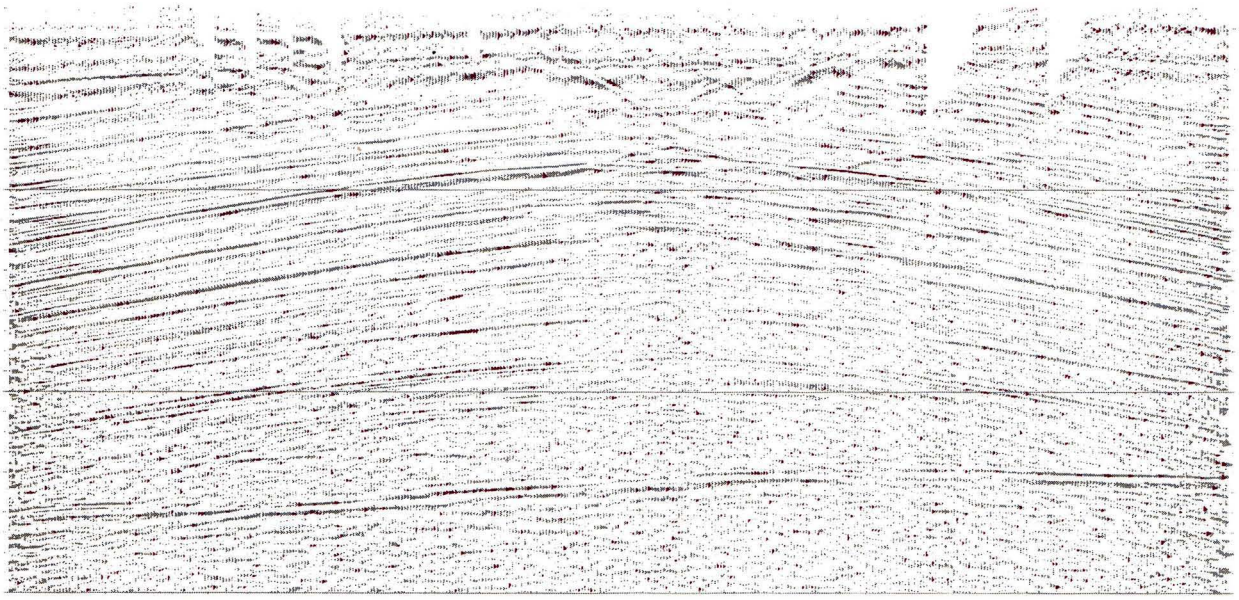
In cases of more complex geological conditions whole sections can be analysed by FUSA. The coloured maximum stacking amplitudes permit easy evaluation of the stacking velocities and their variations. In addition to the print-outs the used velocity functions are presented graphically on the side label.

FUSA with variation of a given "100%" function in 6% steps

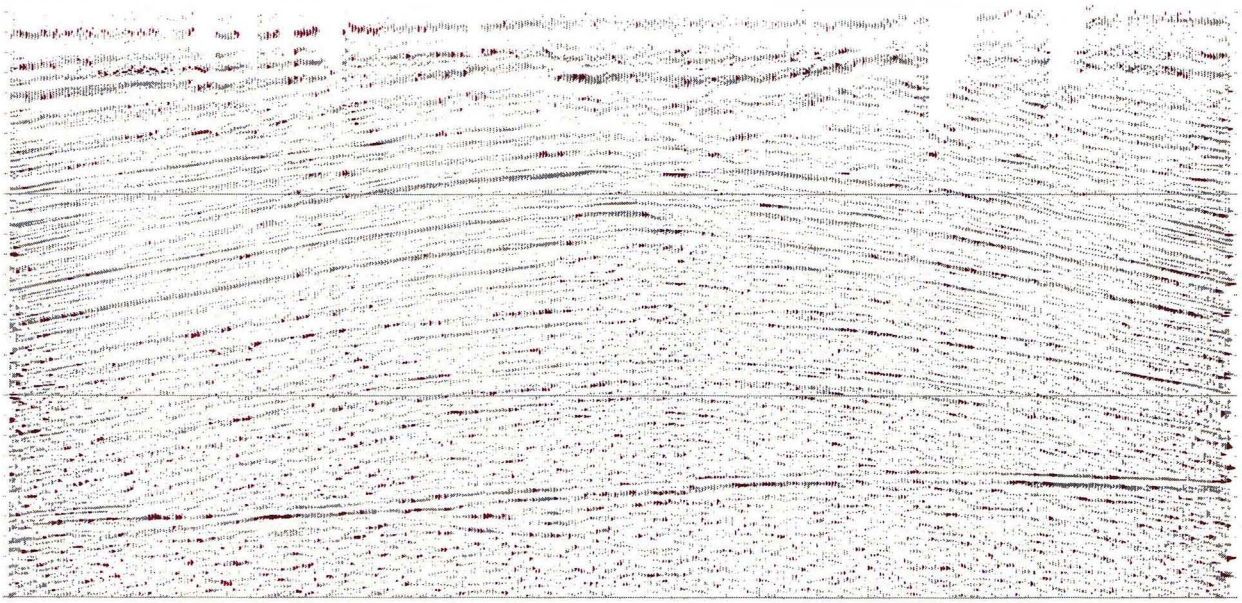
94 %



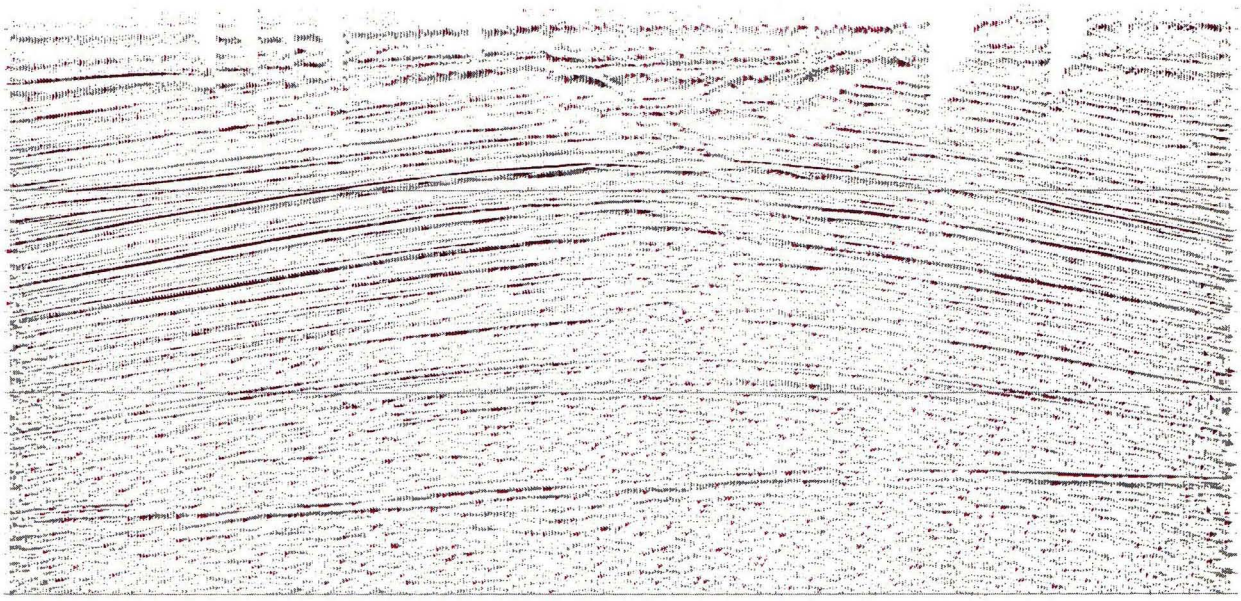
106 %



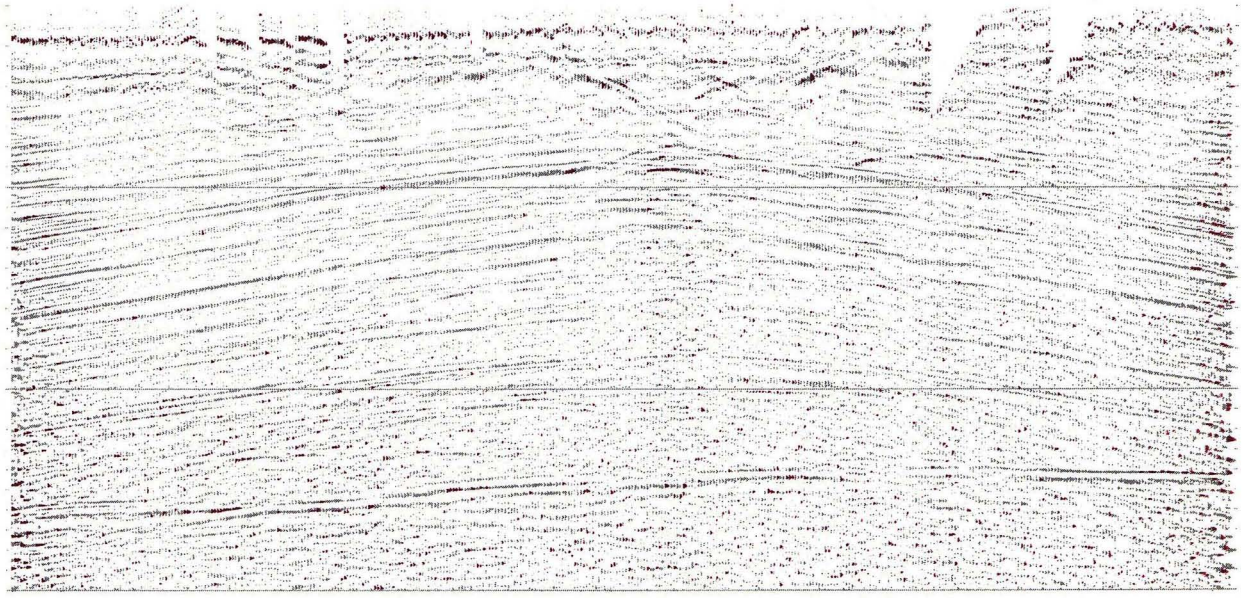
88 %



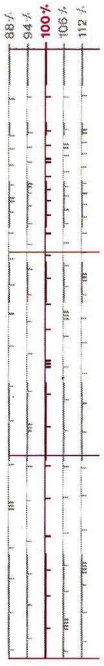
100 %



112 %



Used velocity functions



ASP-System for Automatic Velocity Determination

One of the various possibilities of the well-known ASP-System (**A**dvanced **S**eismic **P**rogram) is the automatic determination of velocities. Hypothesis is that change of stacking velocity functions occurs continuously along a line. The principle of the ASP-system is an updating or predicting method:

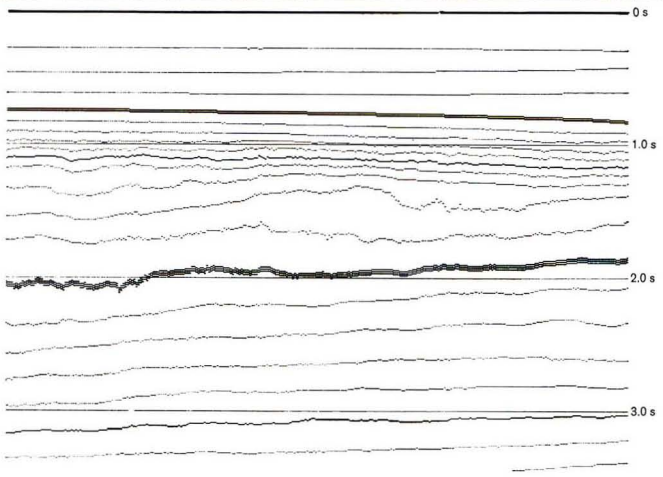
Assuming a velocity function is given for one CDP n, a prediction of velocities is made for the next point n+1. Normally, there would be a small residual normal moveout value from which an improvement of the velocity function for n+1 can be derived. After that the velocity function for n+2 is predicted and improved, and this procedure is continued for the whole section. Velocity determination by ASP is performed sample by sample for the whole processing length or within optional time gates along interpreted horizons; the possibility is also given to determine the velocities between given velocity limits.

The **stacking velocities** are a direct result of the ASP-analyses and can be used for an automatic stack. They can be presented in the form of isoline sections.

By taking into consideration the dip as determined by ASP, stacking velocities are converted to **RMS-velocities** and presented in the same way.

Applying the Dix-Krey formula over a small sliding interval, it is possible to indicate the (local) **instantaneous velocities** at every point. The presentation is also displayed in form of isoline sections.

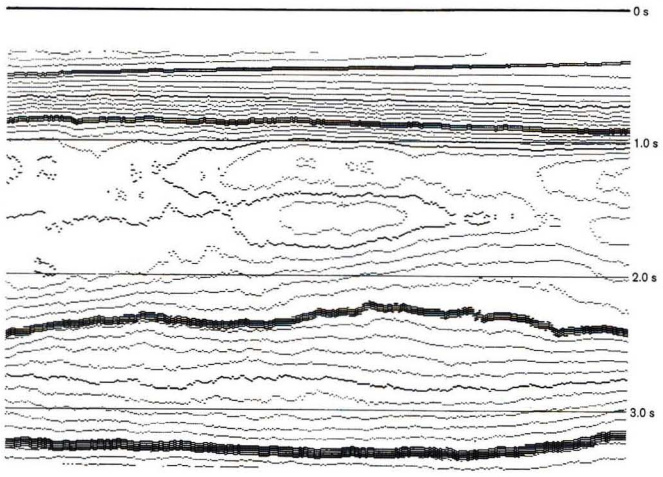
By specifying the intervals corresponding to geological horizons, **interval velocities** can be calculated and presented graphically.



Stacking Velocities

Isoline 2000 m/s

Isoline 3000 m/s



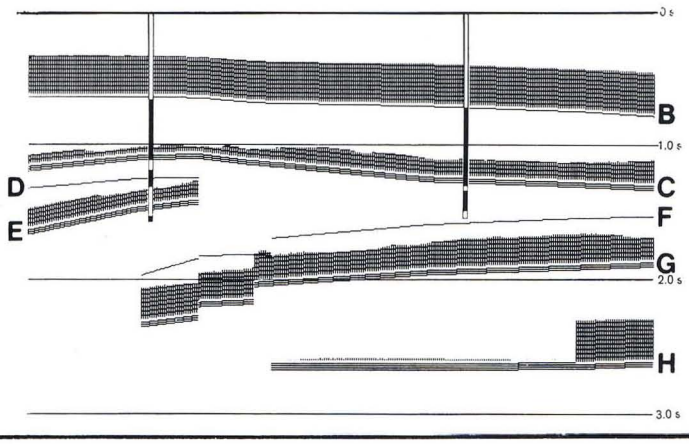
Instantaneous Velocities

Isoline 2000 m/s

Isoline 3000 m/s

Isoline 4000 m/s

Isoline 5000 m/s



Interval Velocities

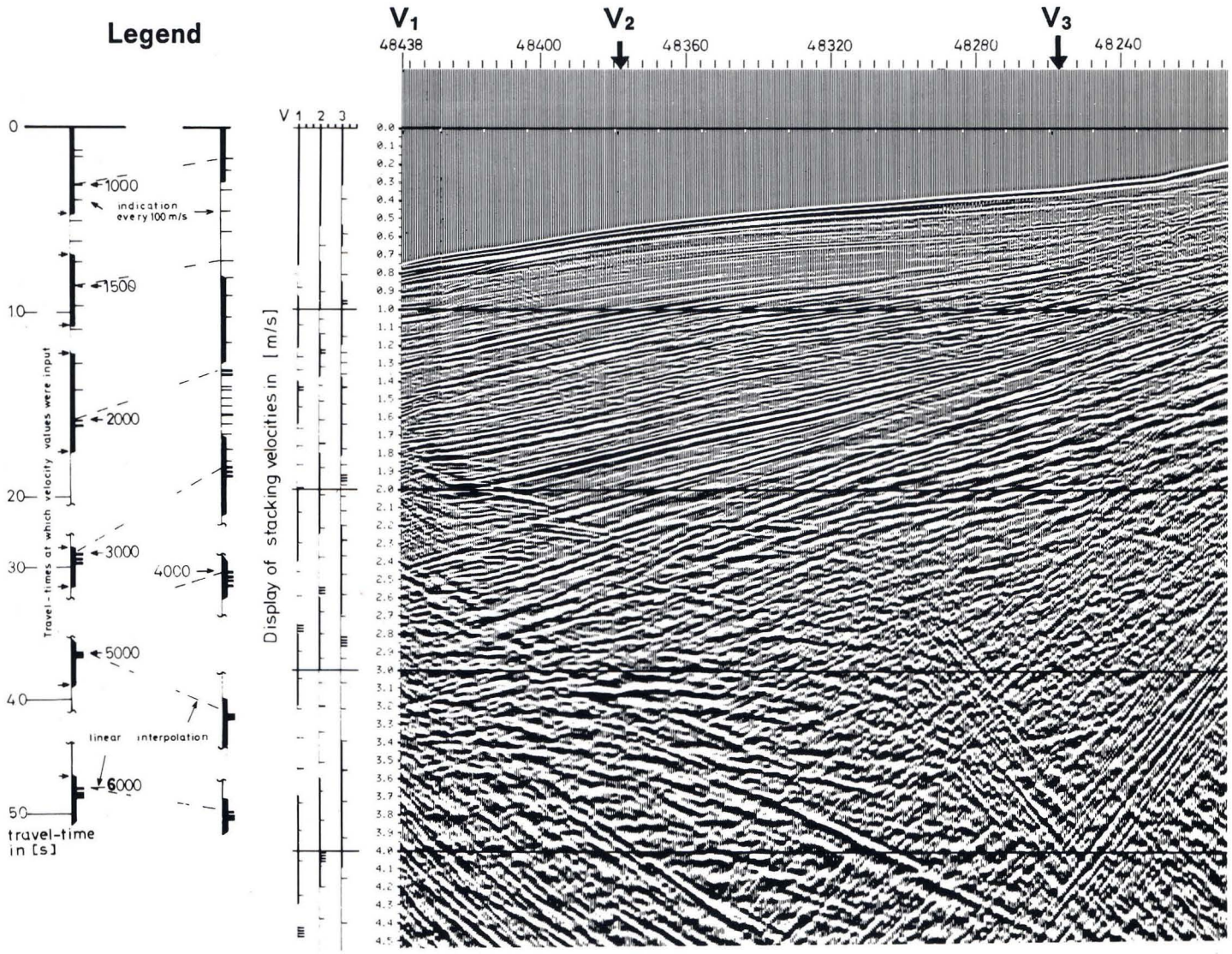
Interval Velocities indicated:

between horizons	0s and B:	1900—1950 m/s
	B and C:	3100—3500 m/s
	D and E:	3300—3400 m/s
	F and G:	3700—3500 m/s
	G and H:	4050—3900 m/s

Linewise presentation of velocities for each CDP as explained on the previous page for the ASP-system can be derived from the other routine analyses correspondingly.

Regional presentation of each kind of data, i.e. travel times and velocities can be carried out by our Contour-System. Data from lines covering a certain area are extrapolated to points on a regular grid by the least mean squares method. The application of this program to velocity data leads to regional velocity maps for each horizon (examples on the front cover).

On the side label of processed sections the **applied stacking velocities** are presented as shown below. By means of this presentation one can easily obtain an impression of the velocity distribution along the whole section and can pick the velocities for each travel time. Between two neighbouring functions a linear interpolation is performed during the stack.



Interactive Interpretation of Velocity Analyses

If you want to transfer the determined velocities directly to the computer or to a storage medium such as punch card, tape etc.

If you want to have immediately an idea of interval velocities, depths etc.

This is possible by means of our interactive geophysical system "IGS", consisting of

1. Tektronics 4954 Graphics Tablet
2. Tektronics 4631 Hard Copy Unit
3. Tektronics 4081 Interactive Graphics Terminal connected to our Control Data computer system (Cyber 175)

The system operates either stand alone or as intelligent terminal for the Control Data Cyber 175 computer.

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