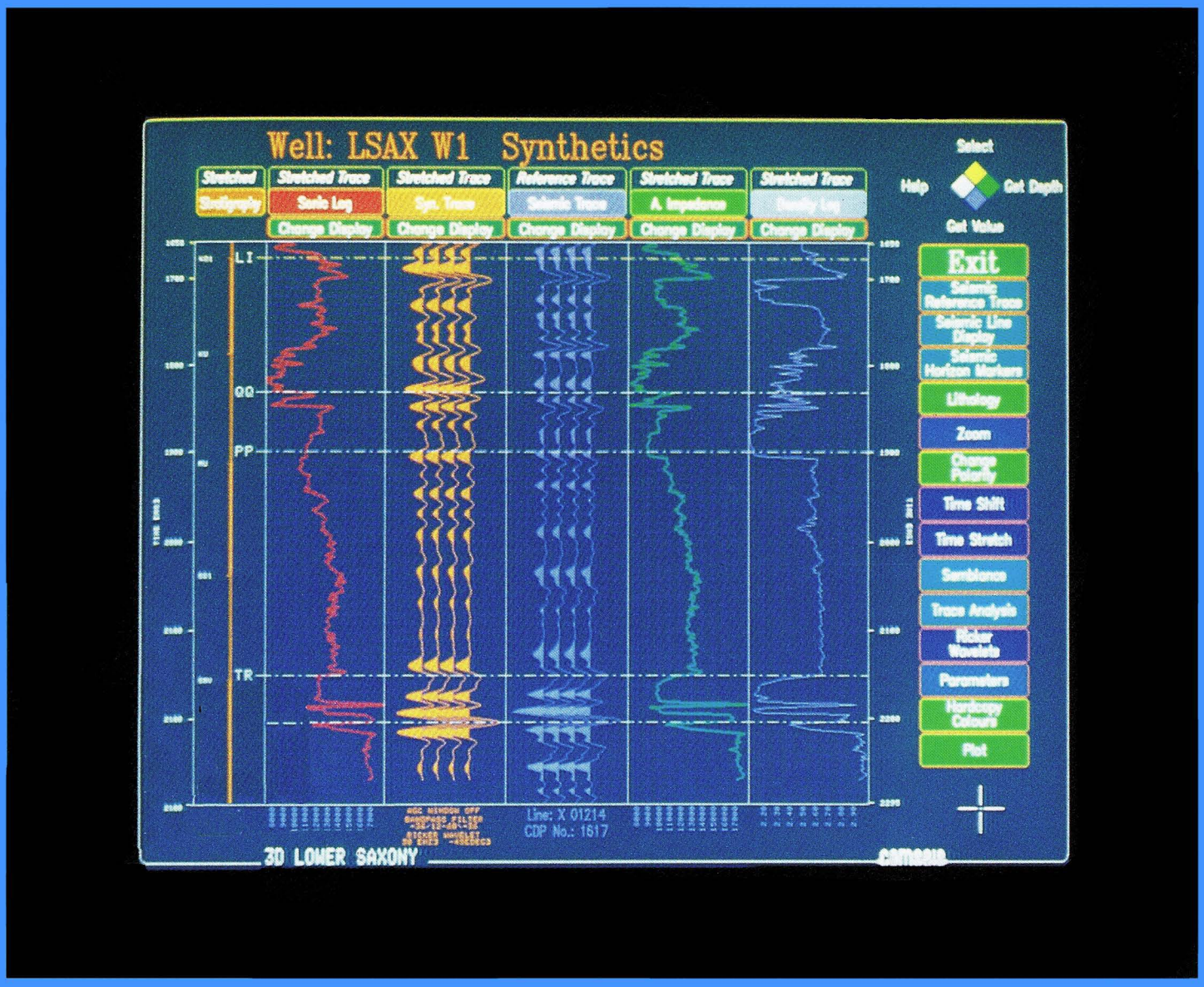
PRAKLA-SEISMOS INFORMATION No.56

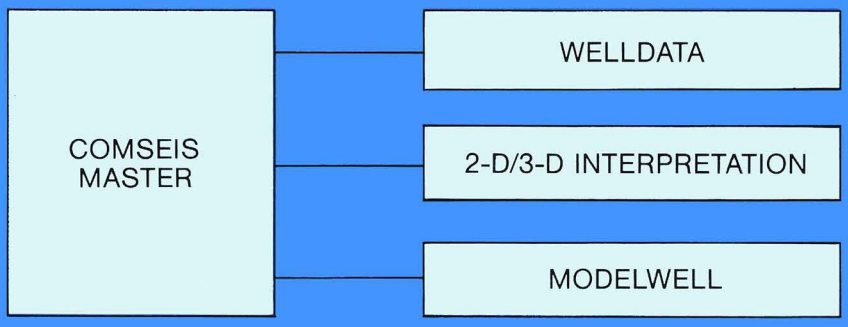
Matching Well Logs to Seismic Wiggles

PRAKLA-SEISMOS

comsets



COMSEIS, the PRAKLA-SEISMOS computer-aided seismic interpretation system, now with four years comprehensive experience and rapidly gaining broad acceptance, was last described in INFORMATION No. 54. Our new brochure introduces some selected modern fields of work and the associated modules, which have already attained a considerable degree of maturity and present the interpreting geoscientist with new possibilities.



- The COMSEIS **WELLDATA Module** enables the organization of all geological and geophysical data which are input in connection with wells. Geological, stratigraphic and tectonic information as well as log data are prepared in such a way as to permit access to these data by other COMSEIS modules. Input is made via:

  - Tape
  - Disk
  - CARDIMAGE data formats (client specified), and
  - Keyboard

  Information which has been input can be called up on the workstation's colour monitors and output on a plotter. Multifarious display modes are possible.

  The first two figures indicate two possible displays of a deviated well. The map view in figure 1 shows the horizontal projection of the deviated well; figure 2 its spatial position. An erroneous depth indication is conspicuous.

- The **2-D/3-D INTERPRETATION Module** enables the interpreted seismic horizons to be continuously controlled by well information. Figure 3 shows an example. The exact positions of wells can be shown in various ways on any of the sections in a 3-D data block. Details of the layers penetrated can be displayed at any geological time interval along the wells, which are projected onto the plane of the section. Alternatively the depths can be indicated.

- The **MODELWELL Module.** Whereas the interpretation modules are limited to the presentation of well data, the MODELWELL Module permits an exact correlation to be made between log information and seismic data using synthetic seismograms.
  The following operations exist for adjusting the synthetic seismograms to the seismic data:

  - Bandpass filtering
  - Automatic gain control
  - Static corrections (Fig. 4)
  - Application of Ricker wavelet with any desired frequency and phase (Fig. 5)
  - Time stretch (deviation correction) (Fig. 6)

  A two trace semblance can be calculated for evaluating the quality of match (Fig. 7).
  If densities and velocities are known specific parts of the log can be "lithologically" classified using the velocity/density ratio (Fig. 8).

  Another possibility within the MODELWELL Module permits the preparation of artificial logs and consequently interactive lithological modelling. Provisional lithological models can be checked by altering logs of existing wells with the aid of a seismic section. In this way variations in thickness of thin layers and porosity alterations can be simulated (Fig. 9).
  MODELWELL enables synthetic traces as well as density, velocity and impedance logs to be inserted in seismic sections and permits subsequent presentation of any part of the section at any desired scale (Figs. 10 and 11).

And what does the future hold?

Soon MODELWELL will be extended by the following possibilities:

- One-dimensional modelling of seismic sections,
- Application of extracted wavelets for synthetic seismograms,
- Introduction of lithological data bases classified according to survey area.

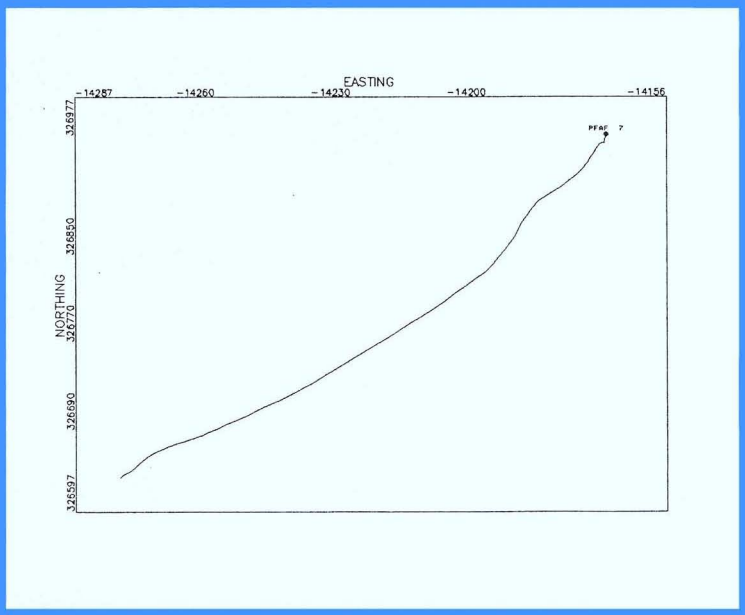


Fig. 1: Map view of a deviated well (horizontal projection)

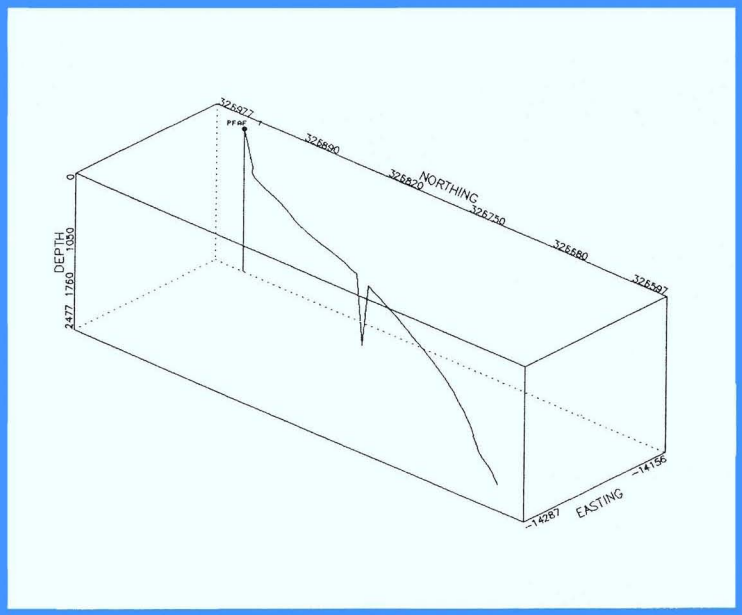
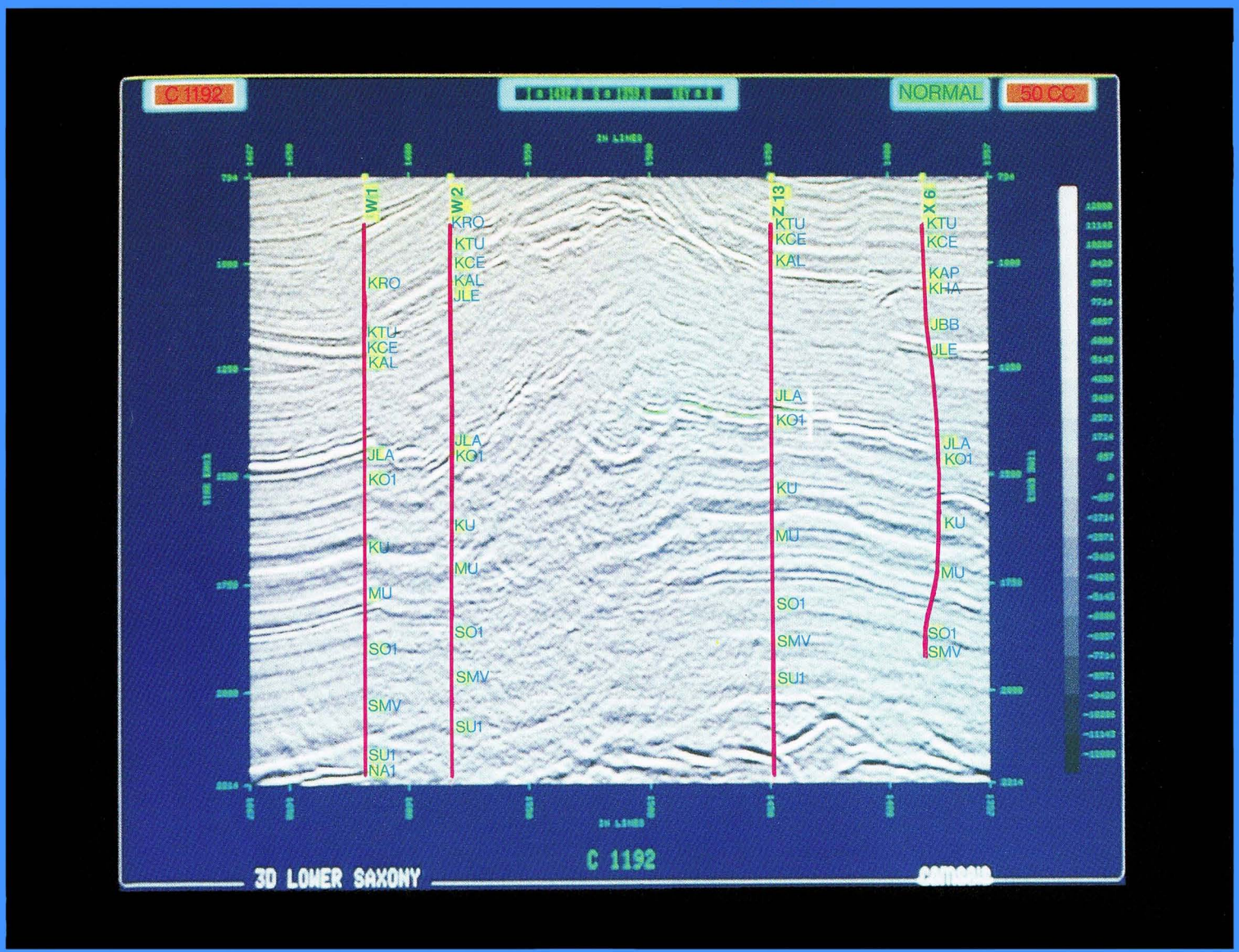


Fig. 2: 3-D presentation of the same well. Erroneous depths are immediately recognized.

Fig. 3: A variable-density display from a 3-D data block with four deviated wells projected onto the plane of the section.



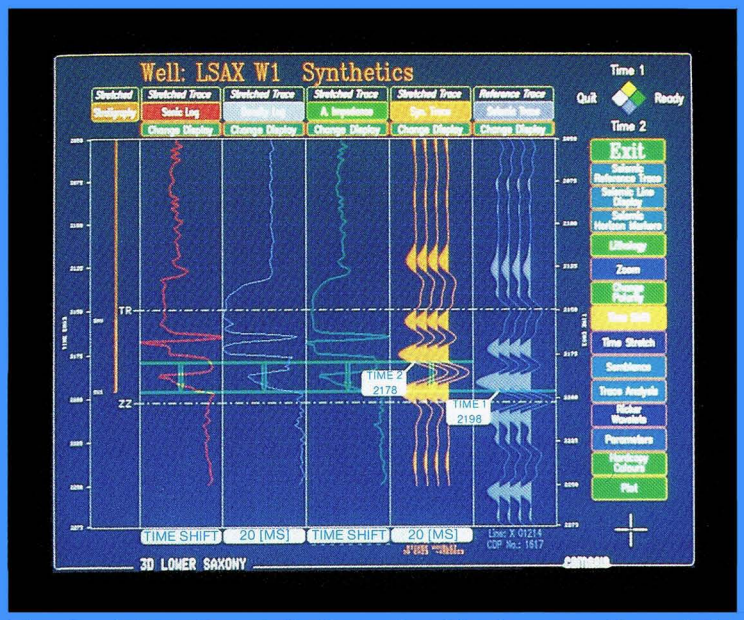


Fig. 4: Interactive definition of a block correction of the synthetic seismogram. The green lines indicate the time shift and reference time. The direction of correction is shown by the arrow.

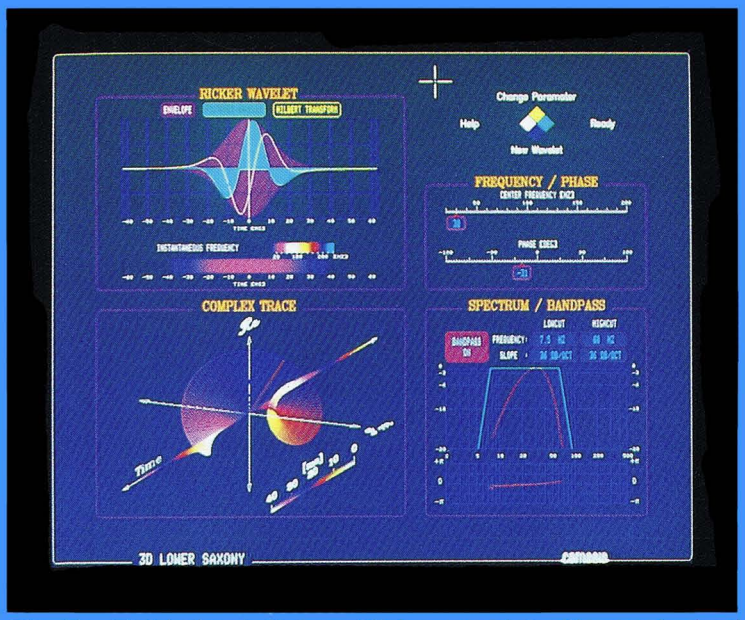
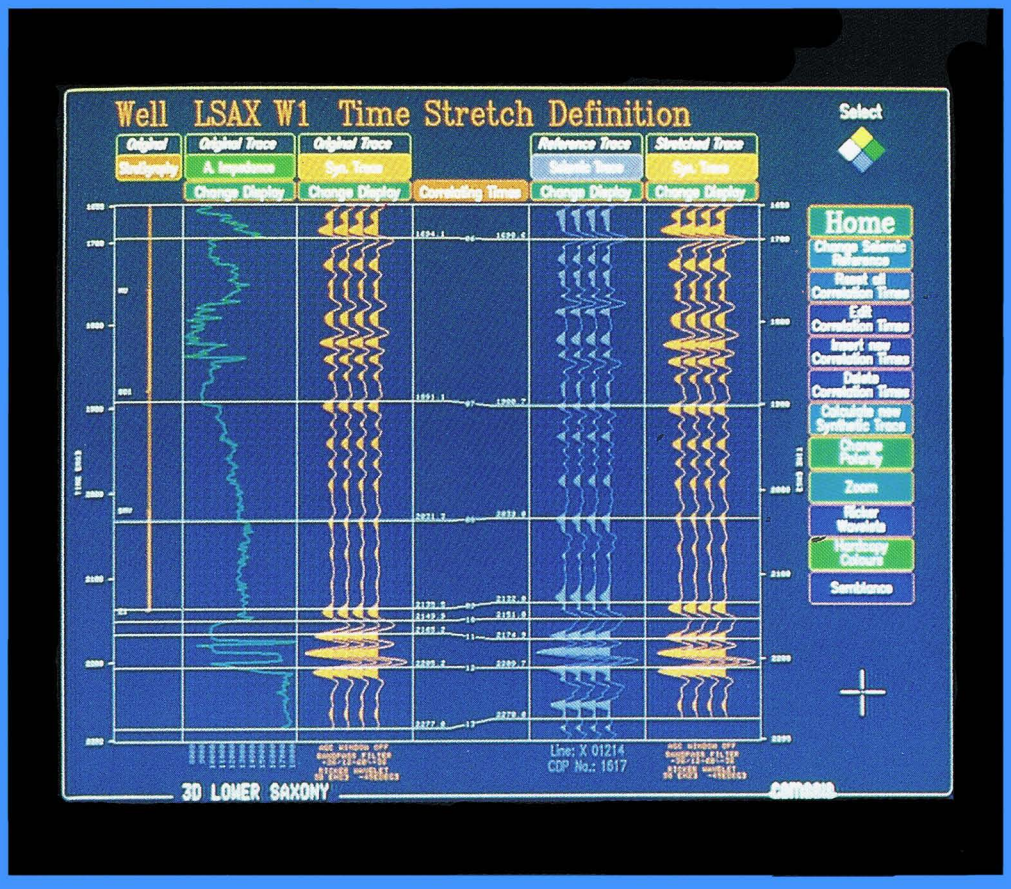
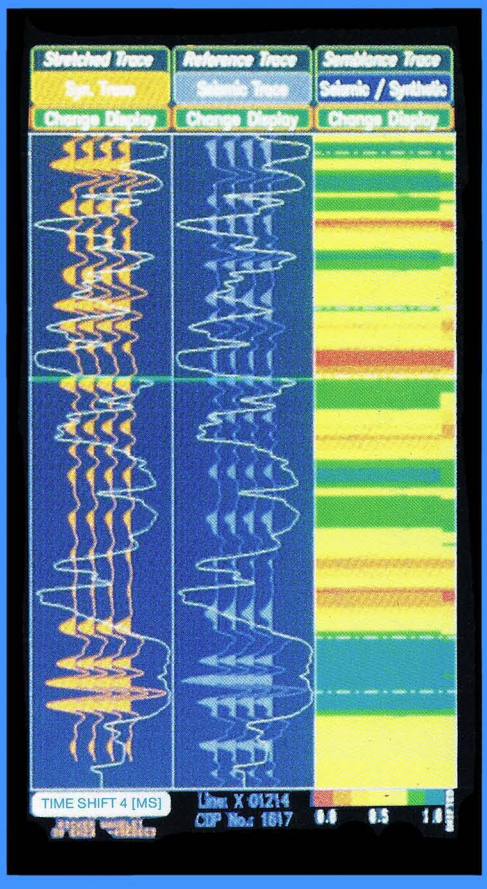


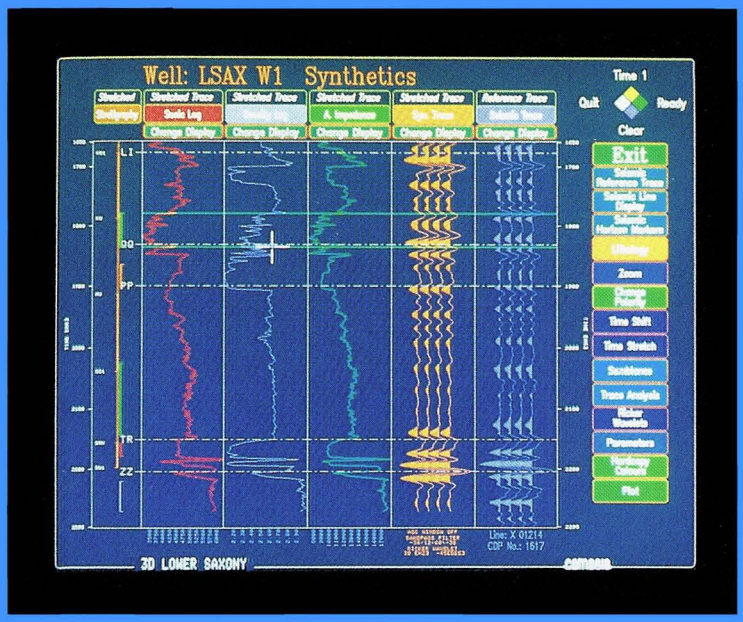
Fig. 5: Fields for defining a Ricker wavelet with any desired phase and frequency. Parameters are set interactively using graphics.

Fig. 6: Stretching on a synthetic seismogram: The correlating events on the synthetic trace and on the seismic reference trace are mutually referred to the time scale (white lines). This enables time corrections or residual corrections of the time-depth curve to be made. The calculated synthetic trace is shown to the right of the original impedance log. The synthetic trace calculated from the stretched log is shown to the right of the seismic reference trace.

Fig. 7: The match can be checked by the semblance function. This function is superimposed as a wiggle trace on the synthetic and on the reference seismogram and is shown colour-coded on the right. Green bands indicate good agreement, red ones phase errors of 180 degrees and yellow ones refer to areas in which only one trace amplitude exists. The effect of simple time shifts can be quickly tested interactively. In this example a time shift of –2 (ms) was simulated. Result: the bands of agreement at the right-hand margin of the colour-coded display have distinctly shifted.







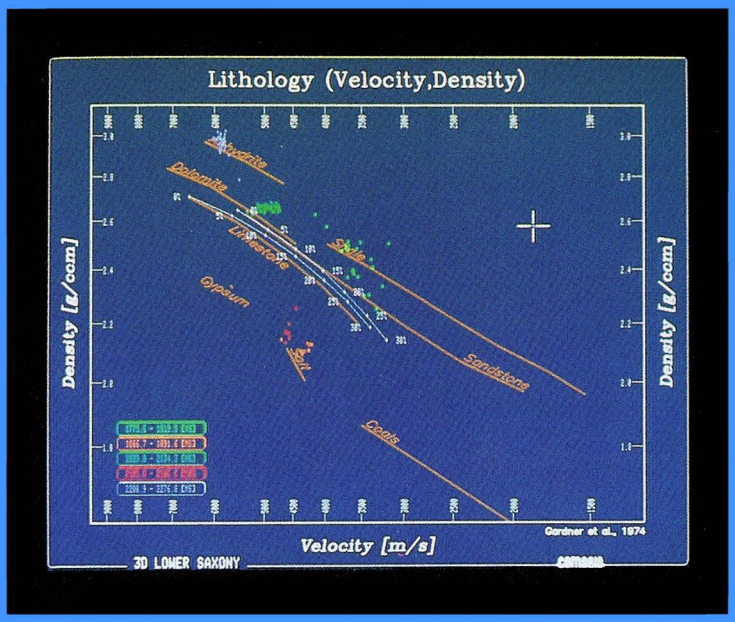
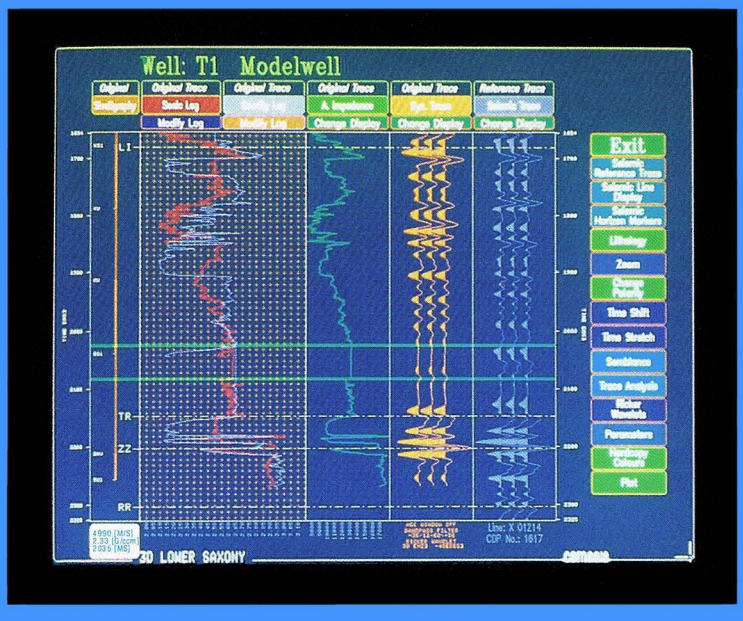


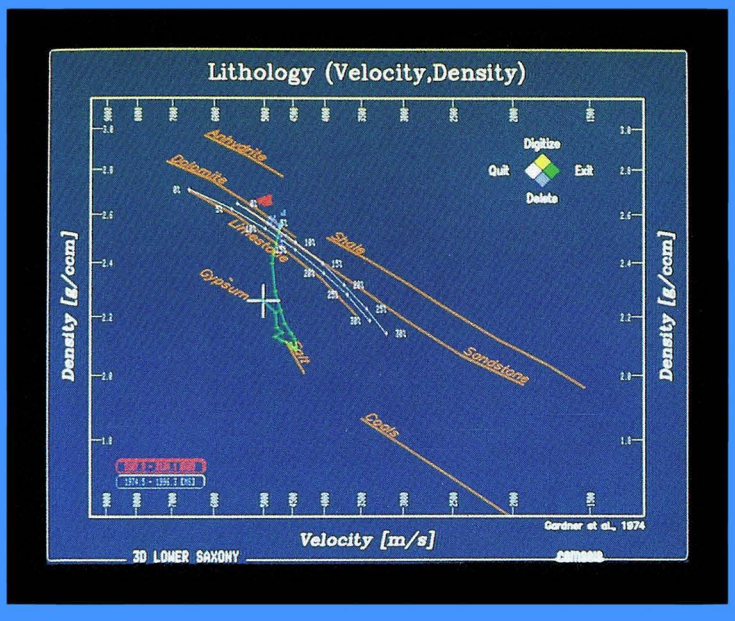
Fig. 8: For wells which have been completely surveyed with density and sonic logs it is possible to plot density against velocity over specific log intervals (right monitor). This facilitates the recognition of lithological variations within the survey area, which can then be used for the interpretation. The log intervals are defined on the left-hand monitor.

Fig. 9: Another possibility within the program is the modelling of density and sonic logs. The following log modifications can be performed:

- Re-digitization of log intervals
- Insertion/deletion/change of time intervals
- Insertion/deletion/change of depth intervals
- Lithological digitization of log intervals

In the example shown here alternate bedding of salt and dolomite was lithologically digitized.





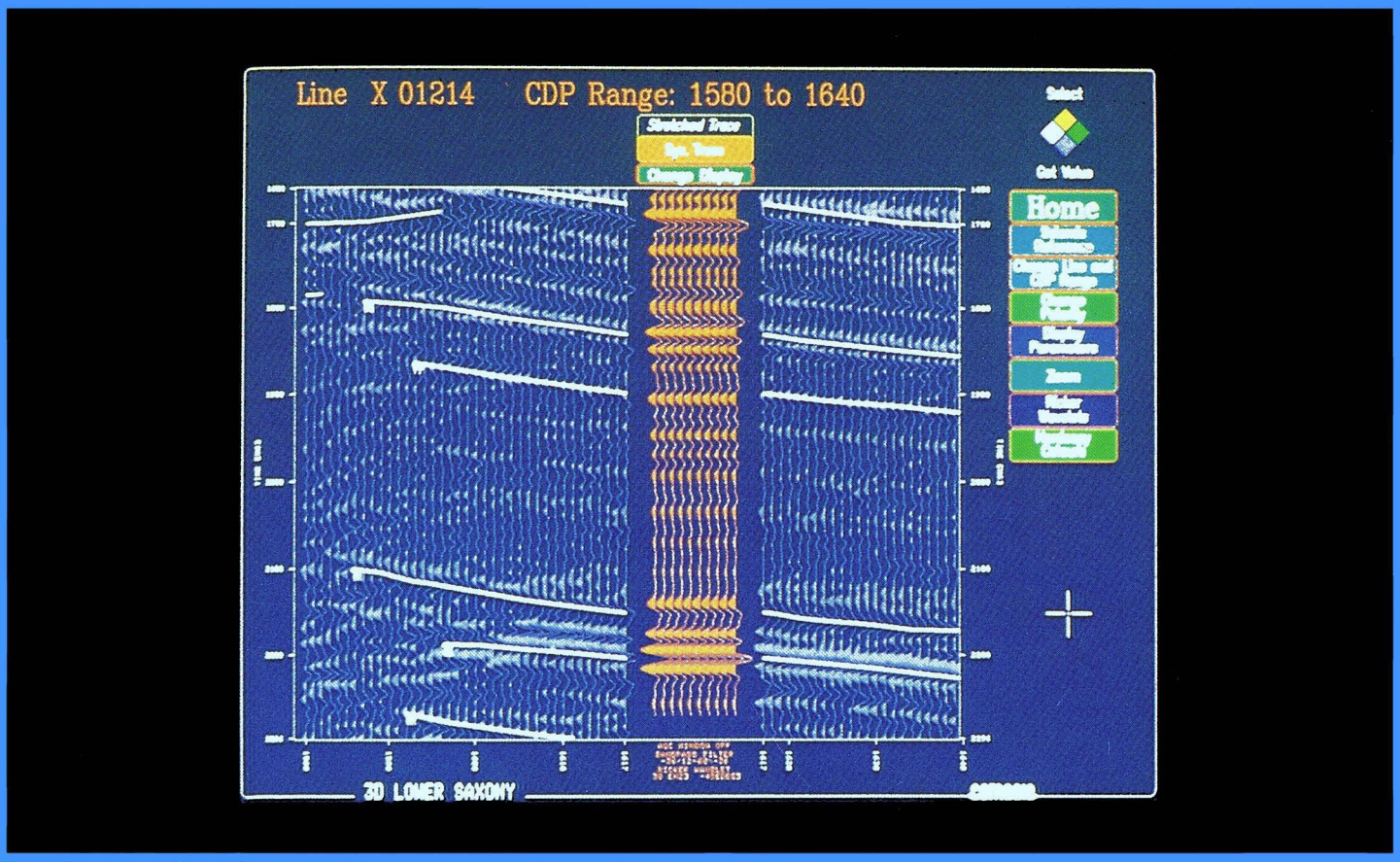
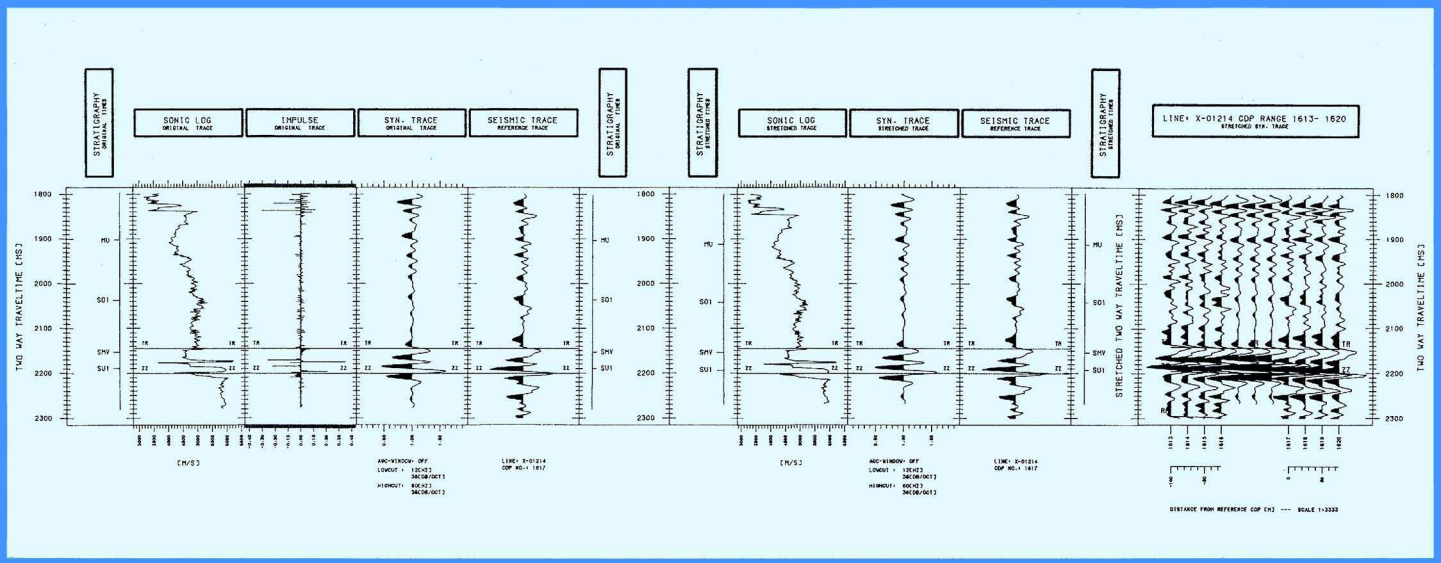


Fig. 10: Insertion of a synthetic seismogram in a seismic section. Density, velocity and impedance logs as well as reflectivity traces can be inserted at the appropriate position in the seismic section. The lithological and stratigraphic conditions obtained from a well make up part of the synthetic trace. This trace can now be compared directly with the corresponding part of the seismic display.

Fig. 11: Part of a seismic section with inserted synthetic trace. All results can be fully or partially displayed at any desired scale on any type of plotter.



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