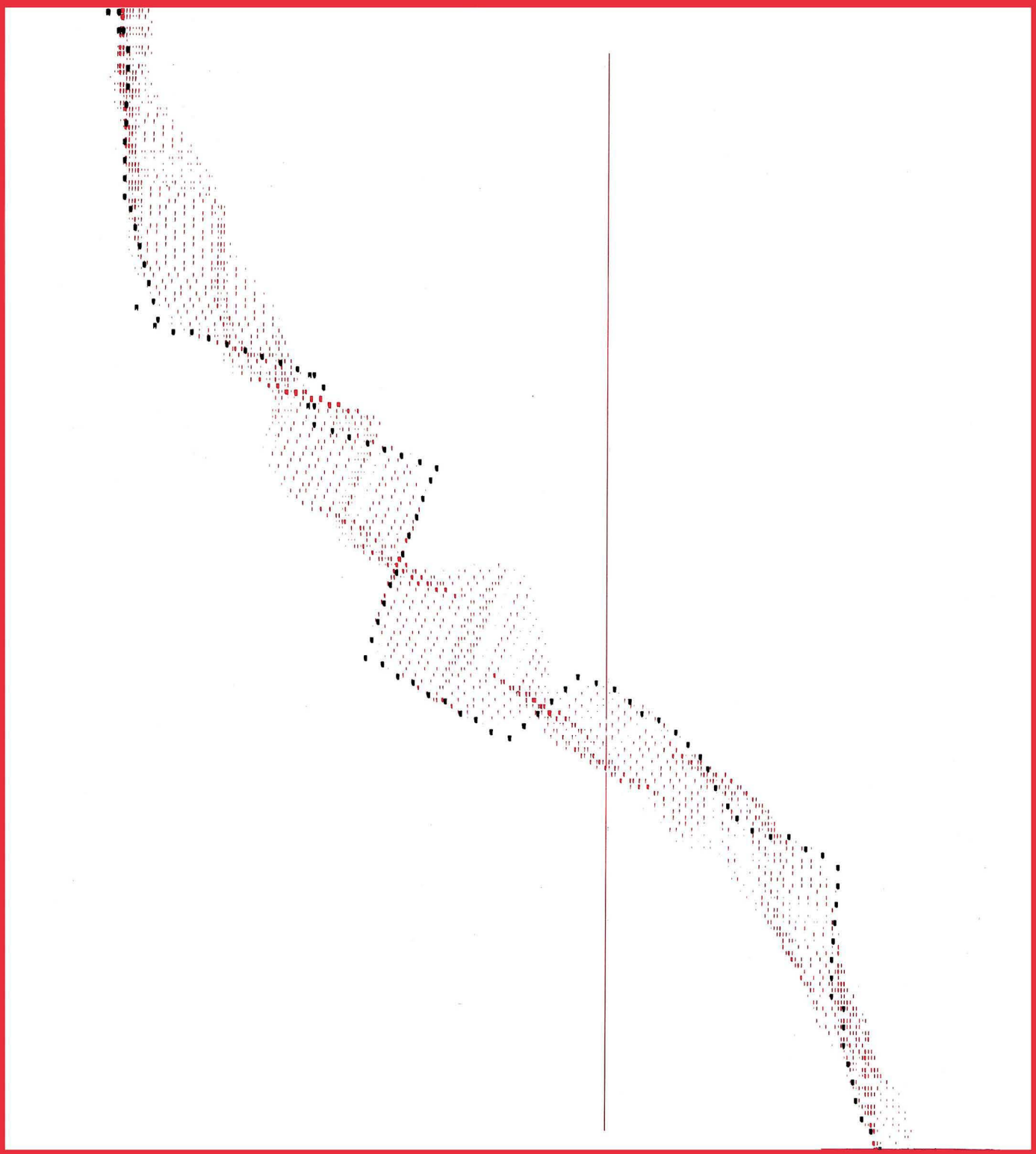
PRAKLA-SEISMOS INFORMATION No. 11

MEANDER Processing



MEANDER Processing

For the processing of arbitrary crooked geophone lines and/or arbitrary shot locations PRAKLA-SEISMOS offers MEANDER processing. The advantages are:

- working with the real shot-geophone distances
- correct geometric gathering of subsurface points
- possibility of the determination of cross dips.

MEANDER processing was developed in connection with general 3-D processing; the data processing for areal seismics and meander seismics follows the same scheme up to stacking. The corresponding flow diagram is show on the back cover.

For the processing of areal seismics and meander lines, the program requires – as well as the usual field data – rectangular coordinates of shotpoints and geophone stations. In the **preprocessing phase,** besides demultiplexing and formating, the calculation of coordinates of all subsurface points as mid-points between shots and geophones is carried out. A first map can be displayed (Position Map I), containing all shot points, geophone stations and mid-points (Scattergram), marked with different symbols and/or different colours (see fig. 1 and front cover).

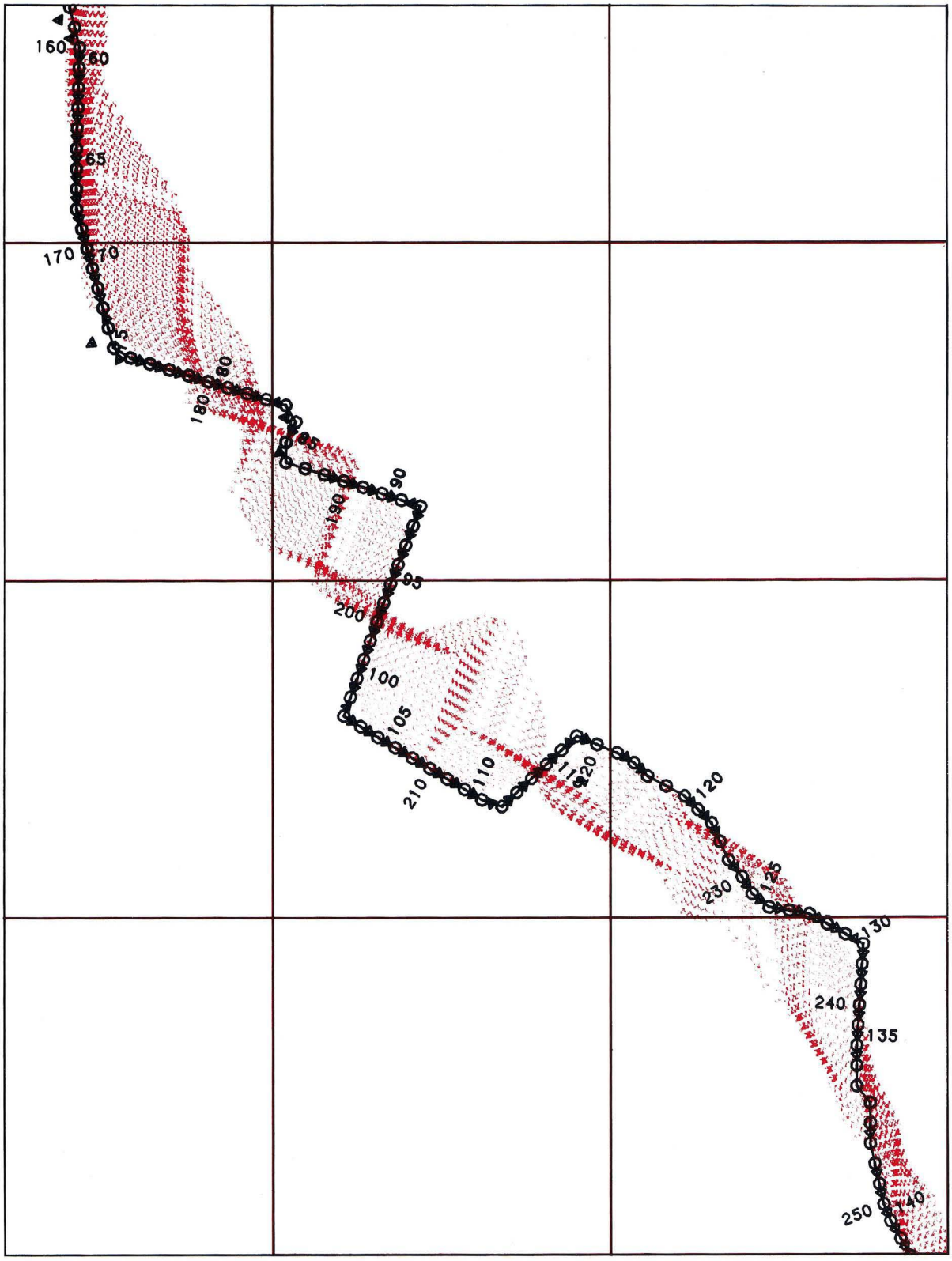


Fig. 1: Position Map I (Scattergram), showing shotpoints, geophone stations and mid-points, displayed by a Calcomp-Plotter (a display from PRAKLA-SEISMOS' Seismic Plotter KPU is shown on the front cover).

In MEANDER processing the processing direction is roughly determined by the definition of a polygonal line as a reference line (in areal seismics a series of parallel reference lines is normally selected). On this line trace distances are defined, which must not necessarily conform with the recording distances. Thus, simultaneously stripes are defined vertical to the reference line. Each midpoint is then assigned to one stripe. A second map can be displayed (Position Map II) showing the reference line and the corresponding stripes (see fig. 2).

As the original coordinates are maintained throughout 3-D processing, the velocity analyses can be executed according to the real shot-geophone-distances. By means of the velocities obtained and the static field corrections, determined by the field crew or by an interpretation group, it is possible to continue MEANDER processing in the conventional way (see flow diagram).

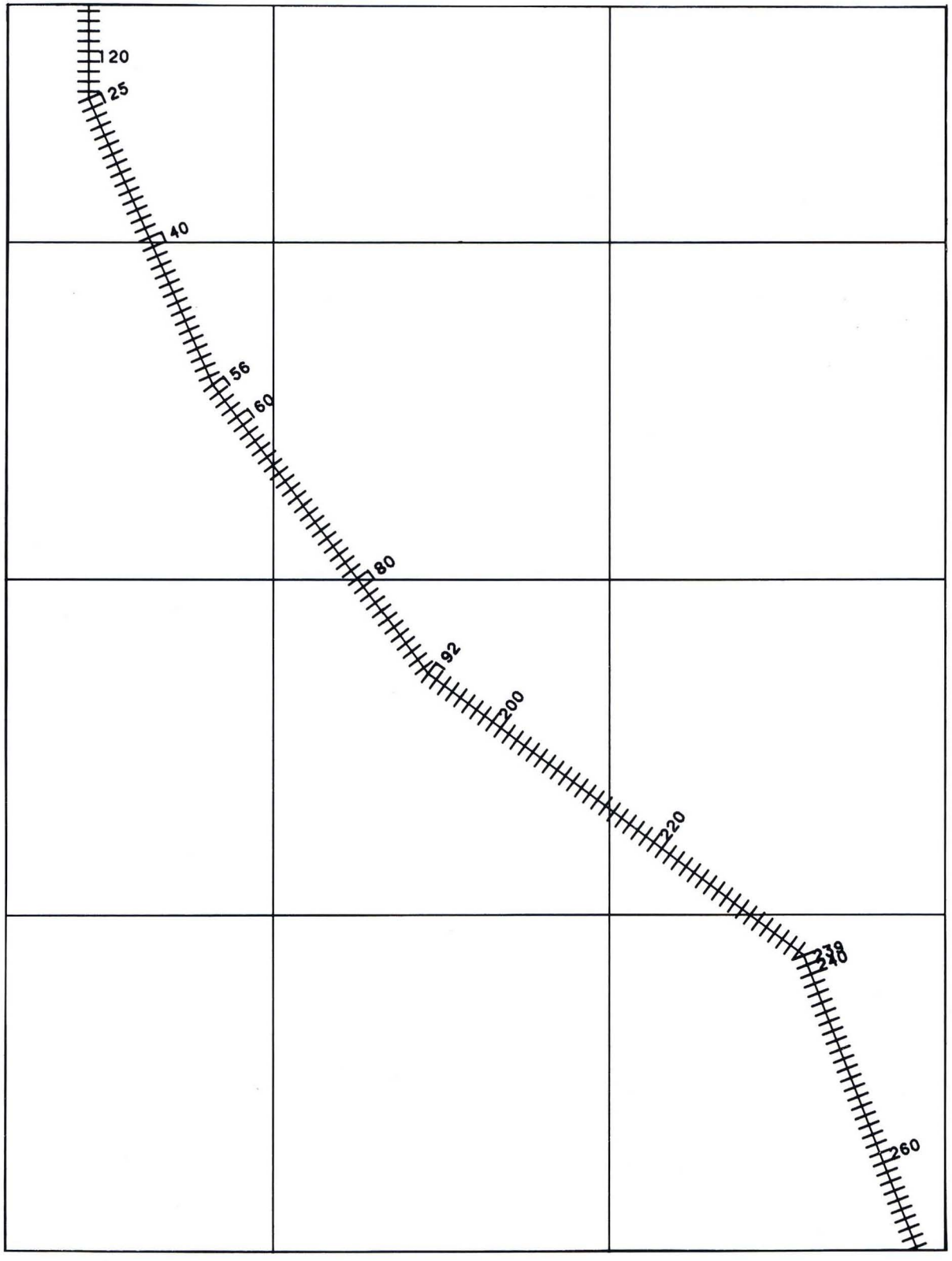


Fig. 2: Position Map II, showing the reference line

As shown in the flow diagram on the back cover, in addition to conventional MEANDER-processing, **special 3-D processing** is available, some techniques of which are important for MEANDER processing. Particularly, the 3-D stack and the weighted stack are to be considered, as well as the possibility of varying arbitrarily the position of a stacked line.

A corresponding extremely **flexible sorting program** permits:

- the definition of one or more processing lines, independent of the reference line mentioned above
- free selection of the trace distances
- sorting of the individual mid-points
  in arbitrary figures (circles, stripes in any direction with or without overlapping – see fig. 3)
  with regard to arbitrary criteria (direction, shot-geophone distances)
- stacking of individual traces with arbitrary weighting (fig. 4).

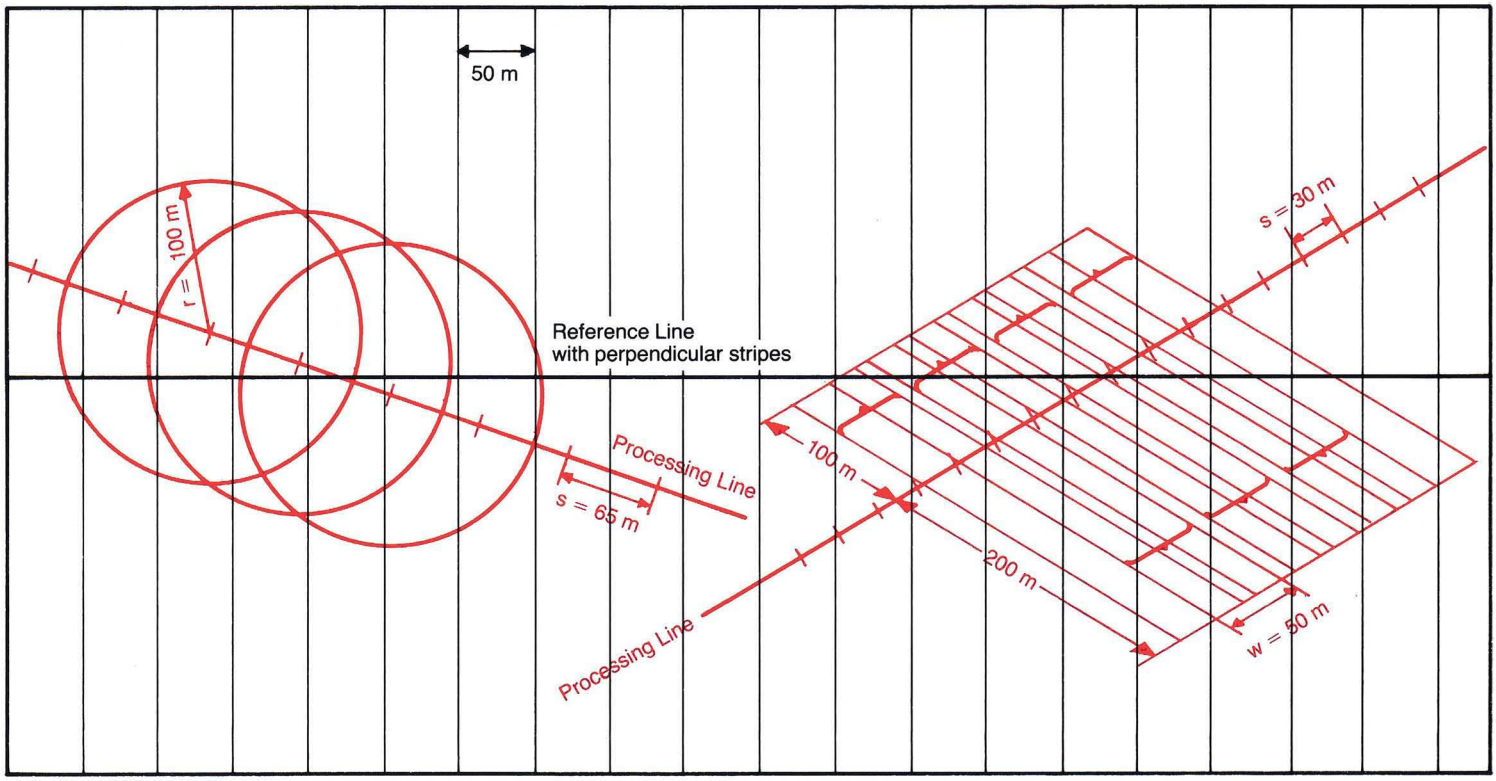
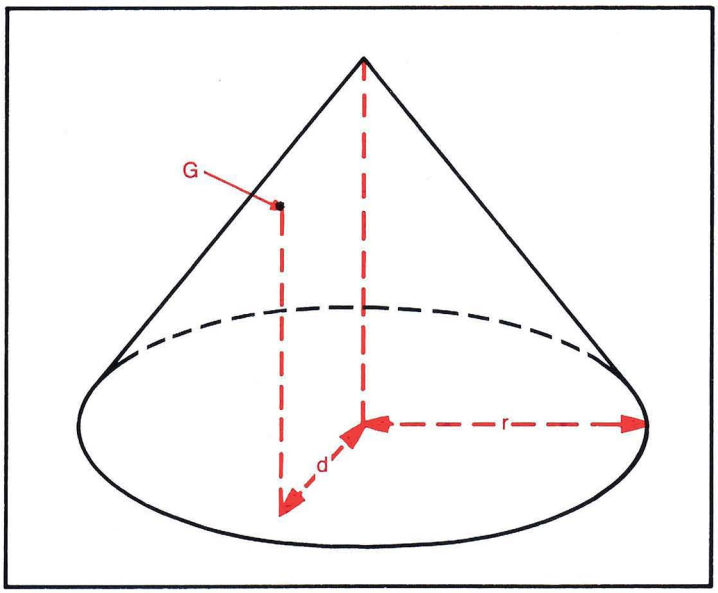


Fig. 3: Example A of the extreme flexibility of the sorting program: After a basic sorting along a reference line, a detailed sorting along processing lines was carried out with overlapping stripes not perpendicular to the processing line and with overlapping circles.



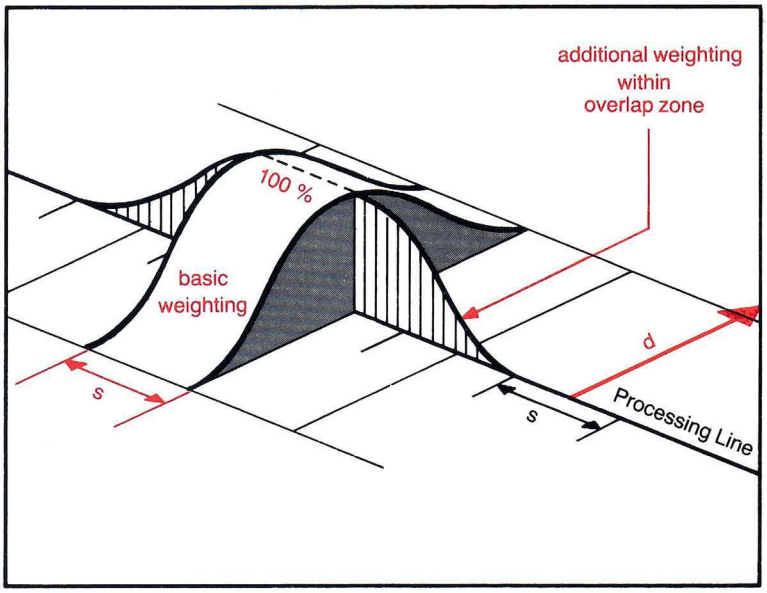


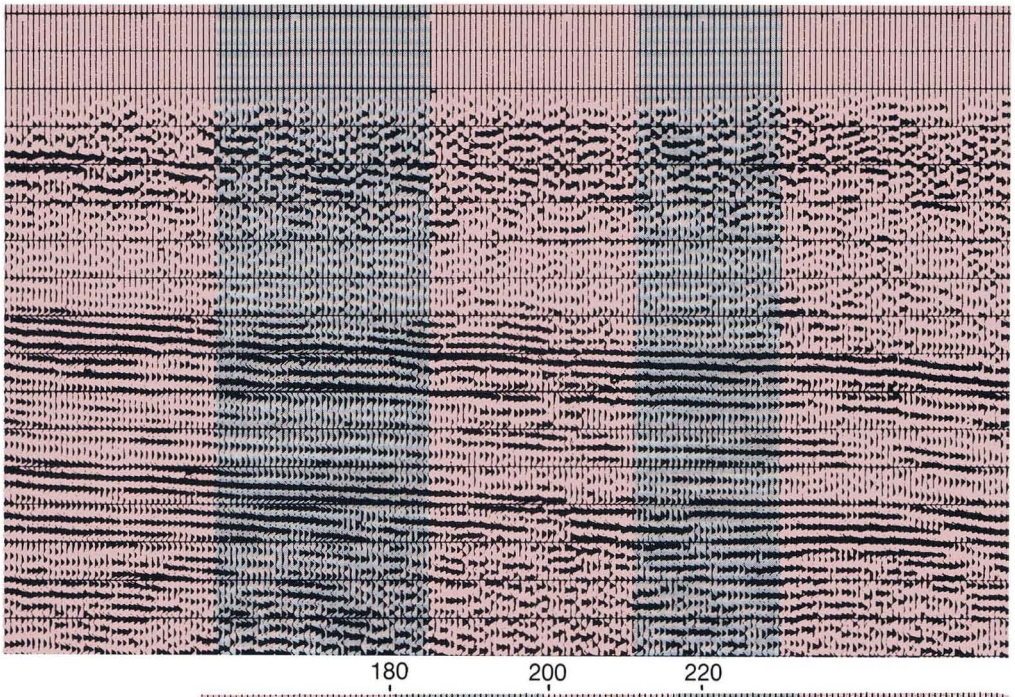
Fig. 4: Example B of the extreme flexibility of the sorting program:

a) Within the circles a weighting G = r – d is performed, where d is the distance from the single trace to the center of the common depth point.

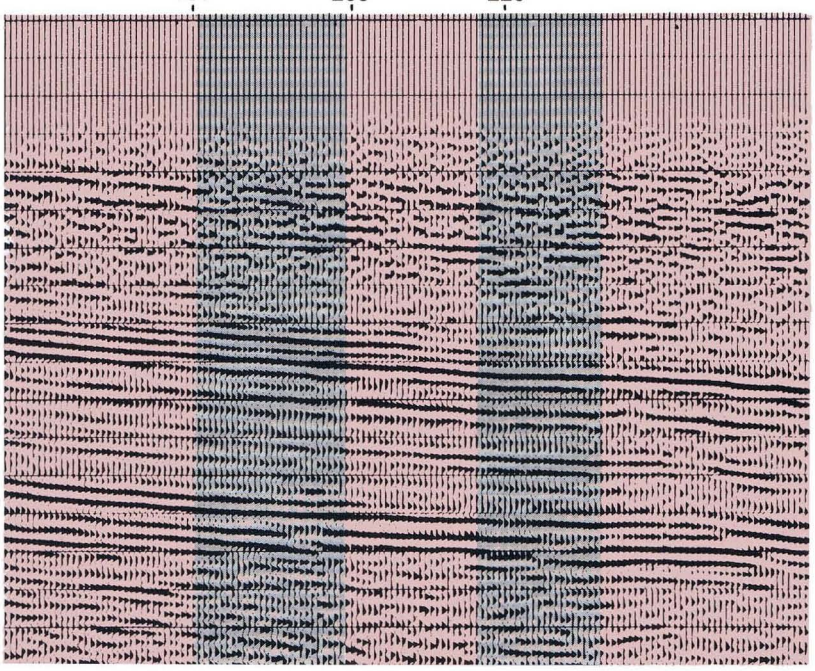
b) Within the stripes the weighting decreases with distance d from the processing line according to a Gauss-curve; within a width corresponding to the trace distance s the weighting remains constant parallel to the processing line, in the overlapping zone the weighting decreases.

Fig. 5:

a) Stacking without application of MEANDER processing



b) Stacking with application of MEANDER processing (line mapped in fig. 2).



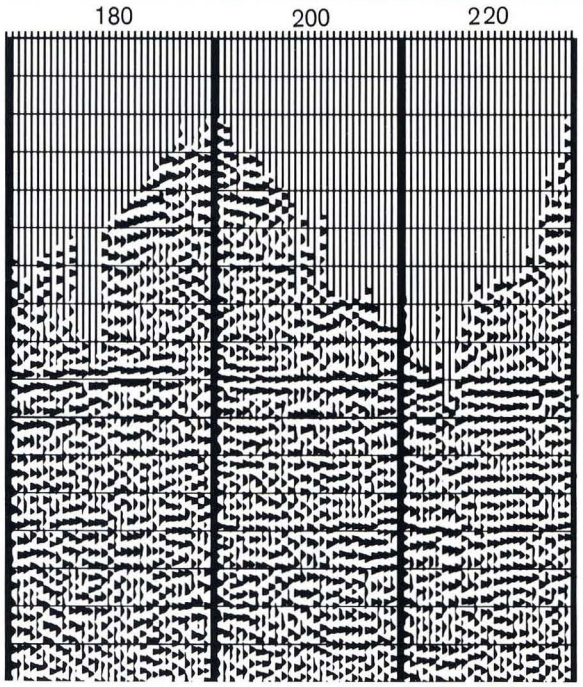


Fig 5 a and 5 b show the results of stacking with and without application of MEANDER processing of the line, the position maps I and II of which are presented on the front cover and in fig. 1 and 2. The reference line was used as processing line; the sorting of the common mid-points was carried out in stripes, 30 m in width, vertical to the processing line; the stack is weighted (weighting decreases with distance from the processing line according to a Gauss- curve).

Fig. 5 c is an example of the possibility of displaying single traces at optional common mid-points. Such displays serve i. e. for statements, at which lateral distance from the processing line the consideration of single traces becomes problematic with regard to cross dip.

c) Single traces at common mid-points
Nos. 180, 200 and 220 before application of automatic residual static corrections as a check on cross dip

In some cases it is possible, to improve lines processed in MEANDER technique by **determination of cross-dip** and by the use of **3-D stacking.** The determination of cross-dip can be performed by:

a) defining additional processing lines perpendicular to the main processing line
b) applying the ASP-System
c) applying the program DISC.

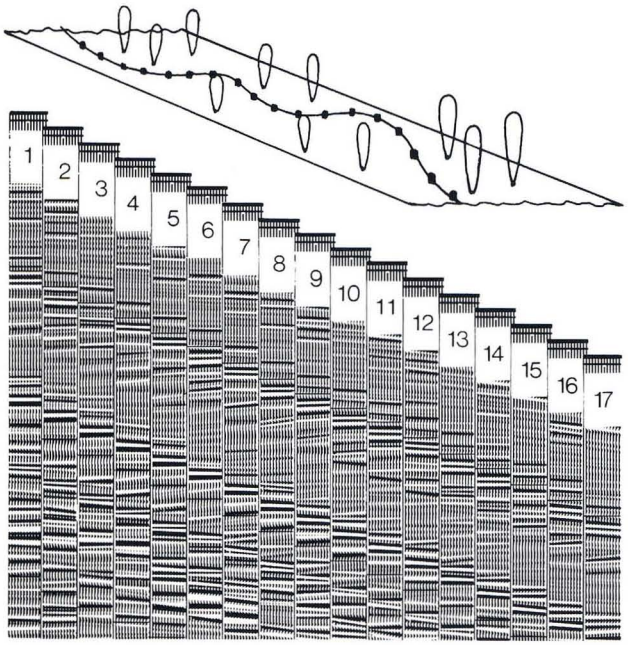
By applying the already well know ASP-system (**A**dvanced **S**eismic **P**rogram) a continuous determination of cross-dips is carried out: for each common mid-point the cross dip values are determined sample for sample from the corresponding individual traces by means of correlation techniques and an updating method (see fig. 6 a–c).

In the program DISC, traces from partial stacks parallel to the processing line are compared with each other under the assumption of pregiven discrete dip values; taking the maximum stacking energy into consideration, a dip value can be assigned to each sample of a trace of the processing line (see fig. 7 a–g).

The presentation of cross dips in both methods, ASP and DISC, is displayed in form of short synthetic cross sections, the central trace of which is derived from the processing line (see fig. 6 b and 7 e).

The example for DISC was taken from areal reflection seismics, presenting lines in X- and Y-direction. The 3 parallel lines surveyed, X-1, X-2 und X-3 presented in fig. 7 a, b and c, were used as input. From the synthetic cross sections presented in fig. 7 e, one section can be compared directly with the surveyed cross section Y, presented in fig. 7 d.

The improvements obtained by 3-D stacking – compared with a vertical stack of the 3 lines – can be seen by comparing fig. 7 f with 7 g.



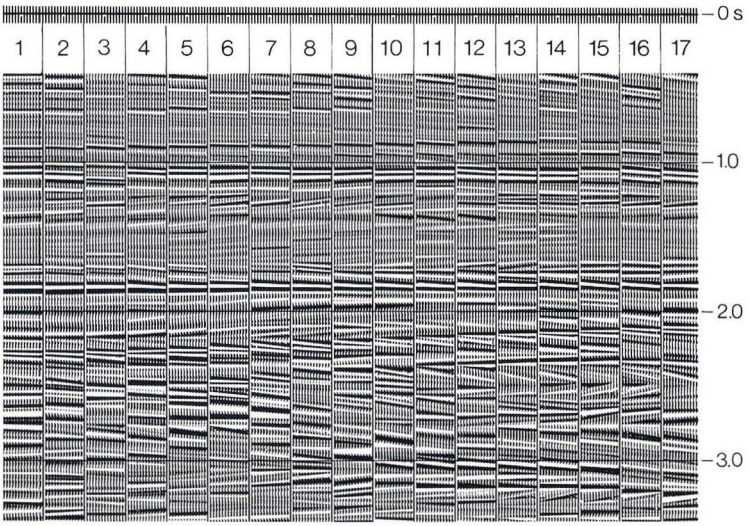
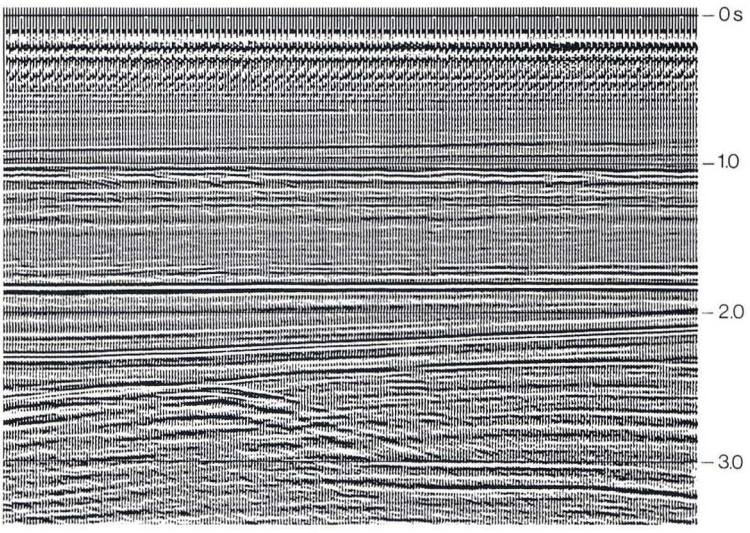


Fig. 6:

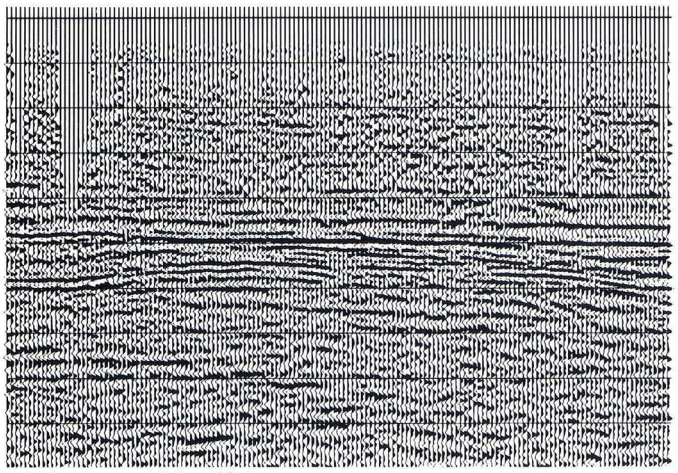
a) Quasi-perspective presentation of synthetic cross-sections

b) Synthetic cross-sections determined by ASP

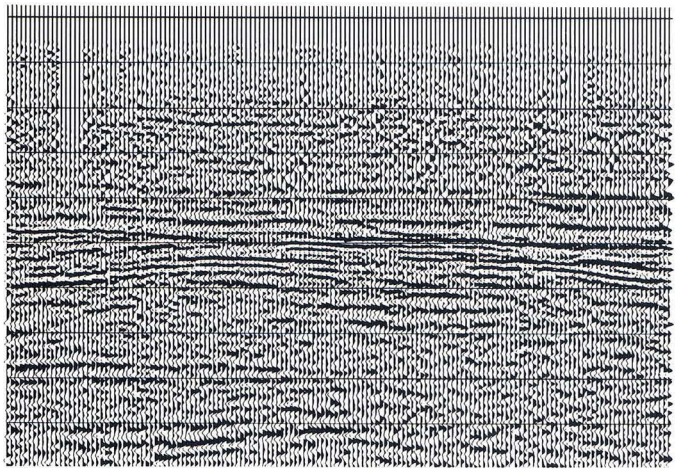


c) 3-D ASP-stack under consideration of cross dips

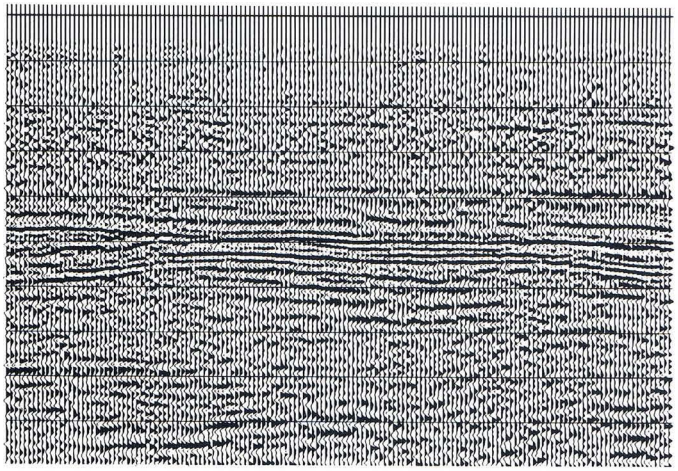
Fig. 7:



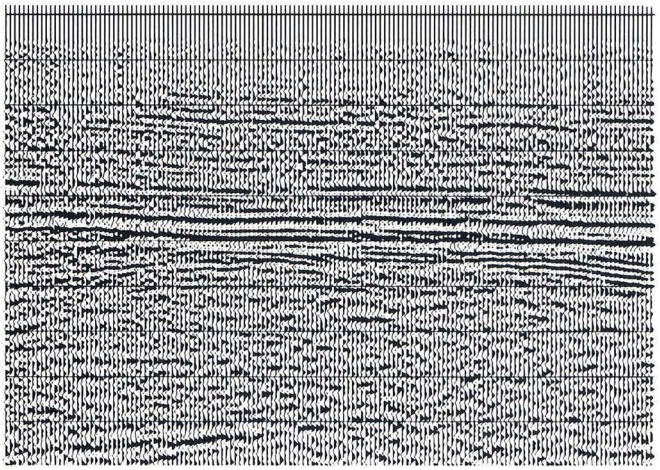
a) Surveyed Line X-1



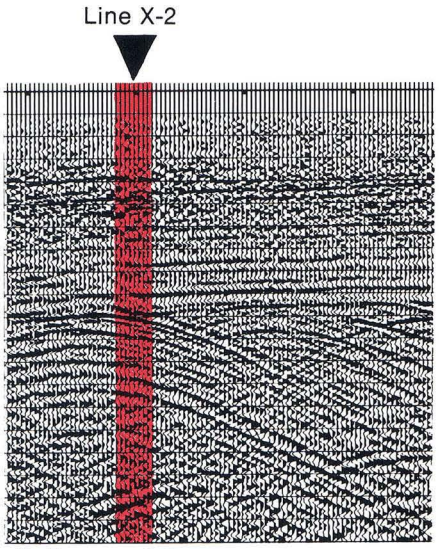
b) Surveyed Line X-2



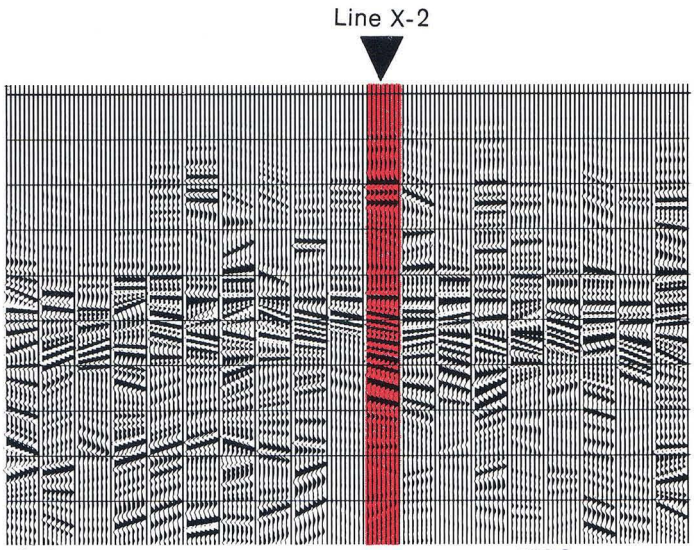
c) Surveyed Line X-3



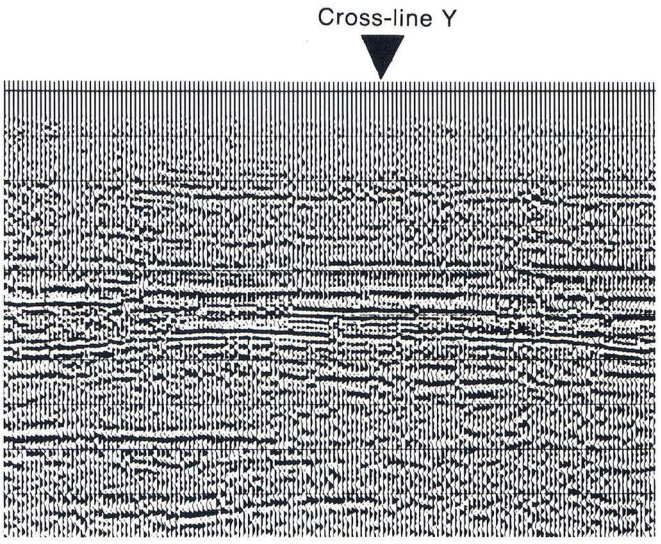
g) Vertical stack of the 3 parallel lines



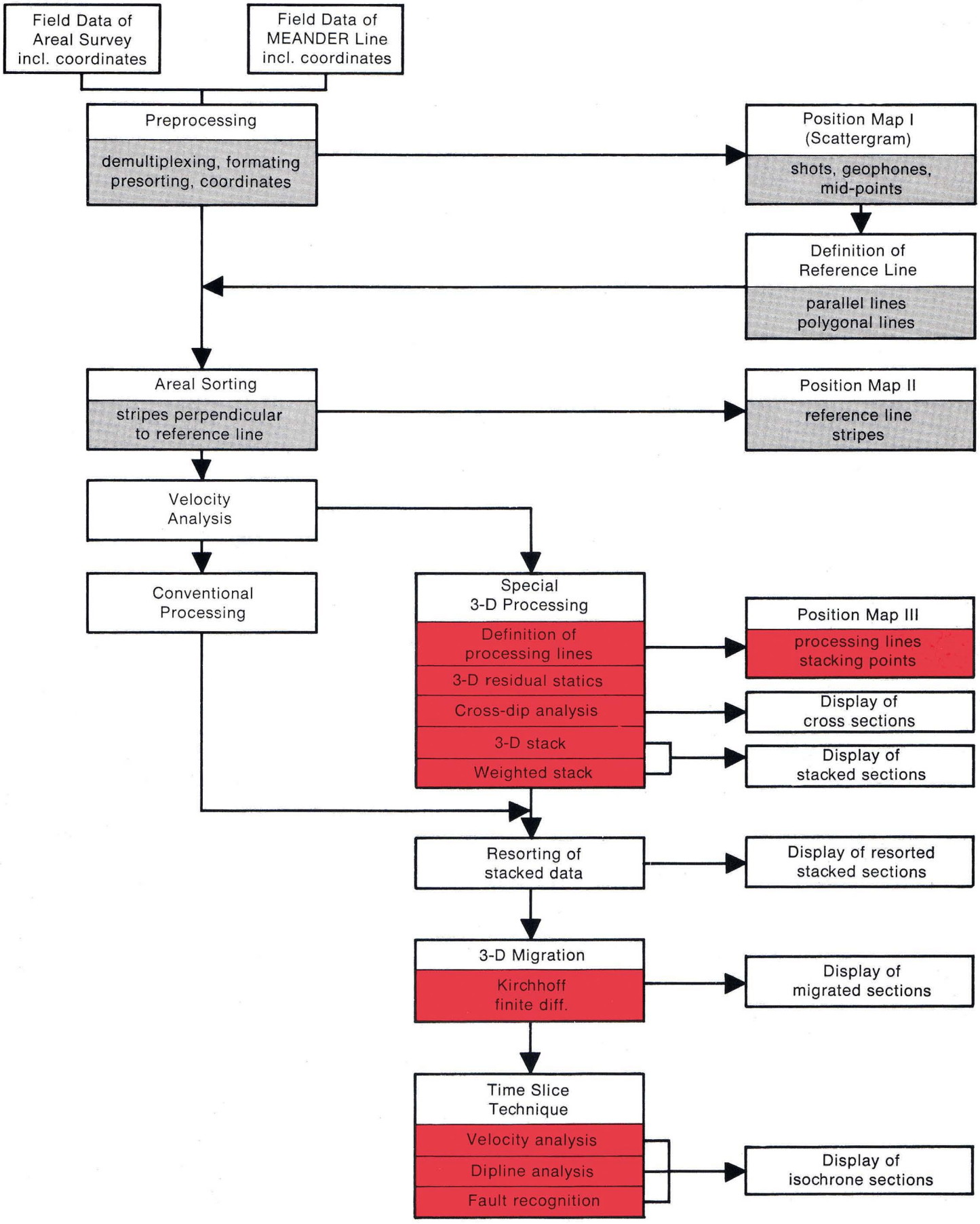
d) Surveyed Cross-line Y



e) Synthetic cross-sections determined by DISC



f) 3-D DISC-Stack of the 3 parallel lines under consideration of cross dips



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