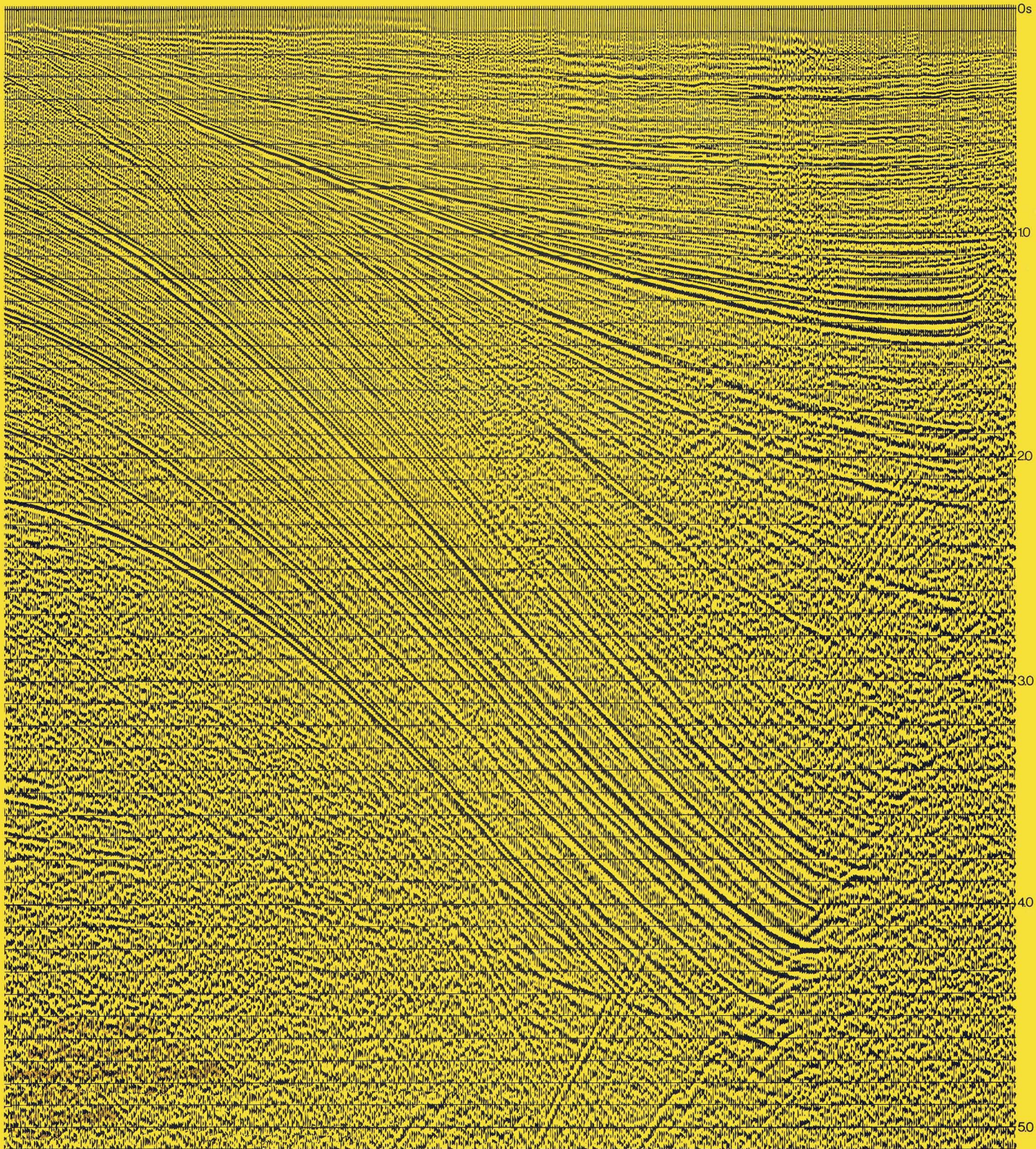




2-D Migration



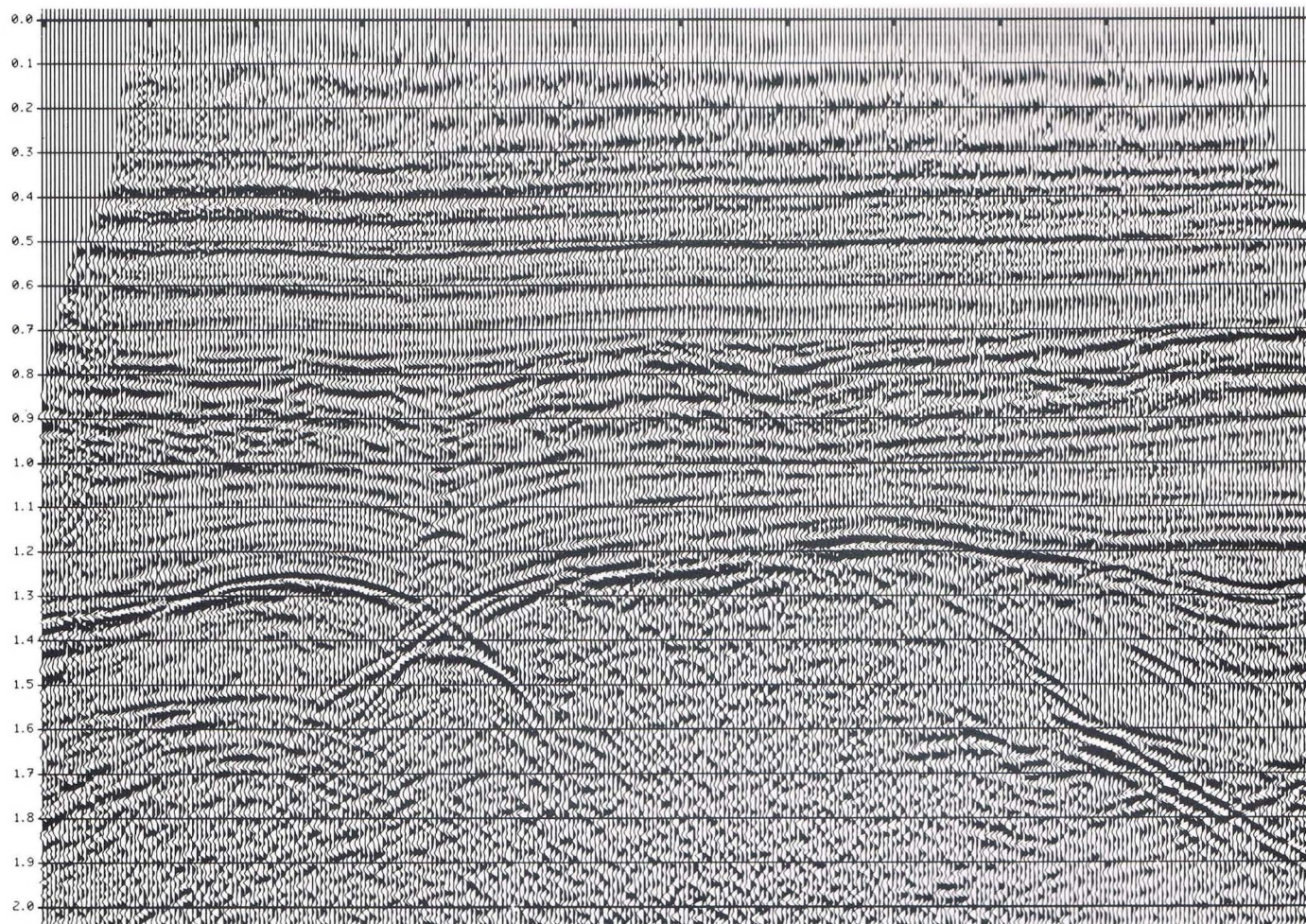


Fig. 1: Stacked Section



Fig. 2: Finite Difference Migration

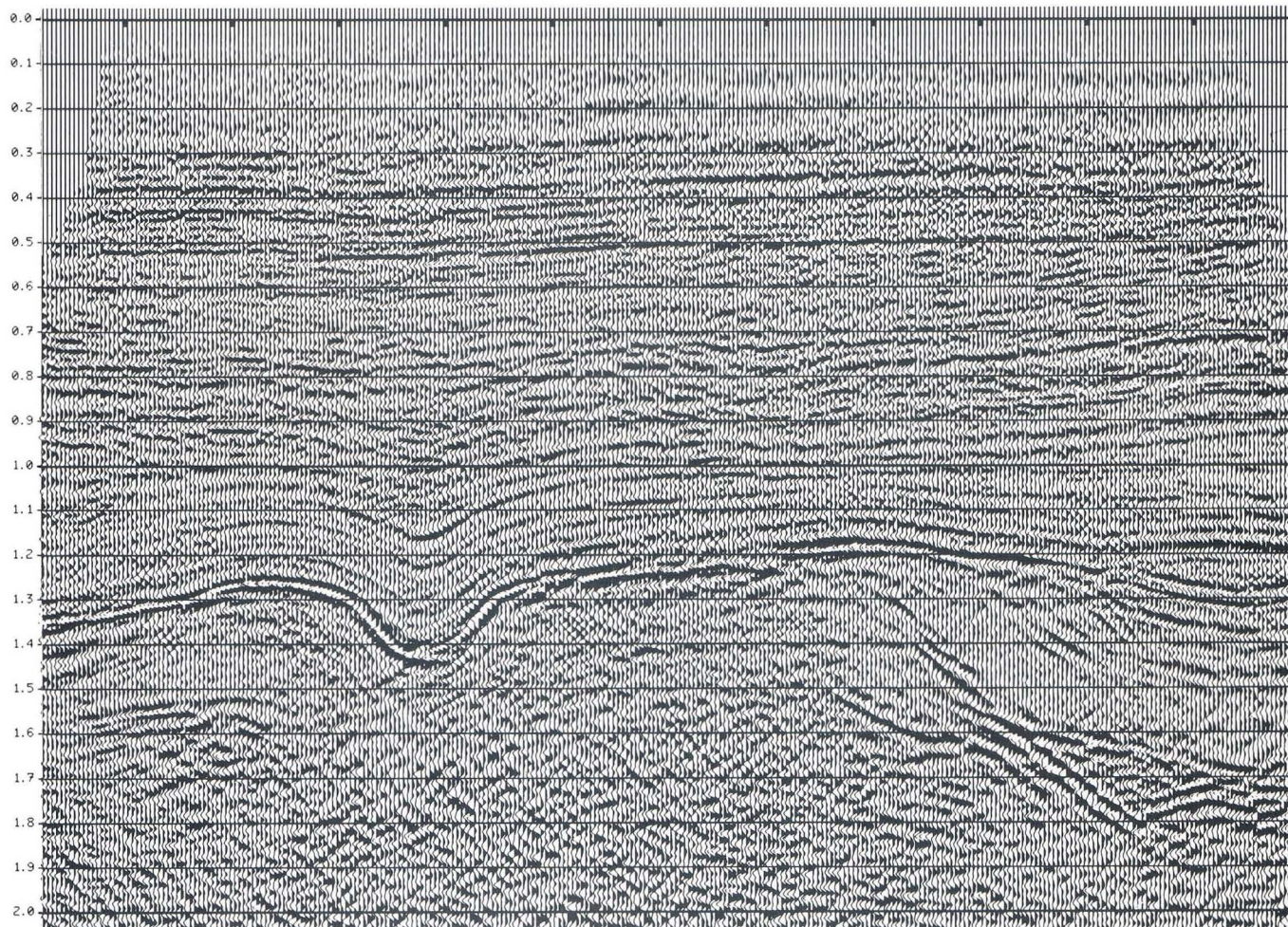


Fig. 3: Kirchhoff-summation Migration

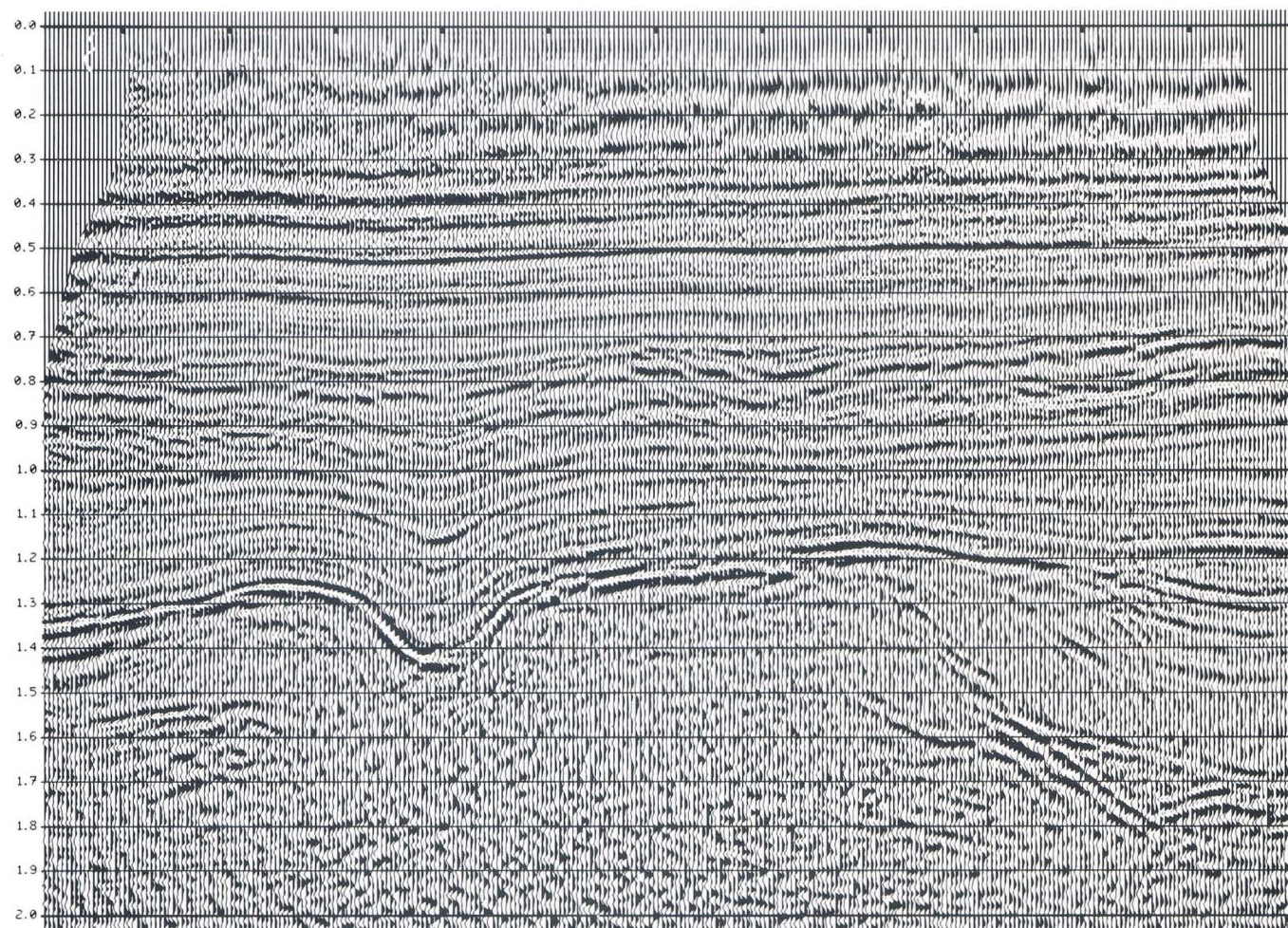


Fig. 4: Frequency/Wavenumber Migration

Fig. 5: Stacked Section

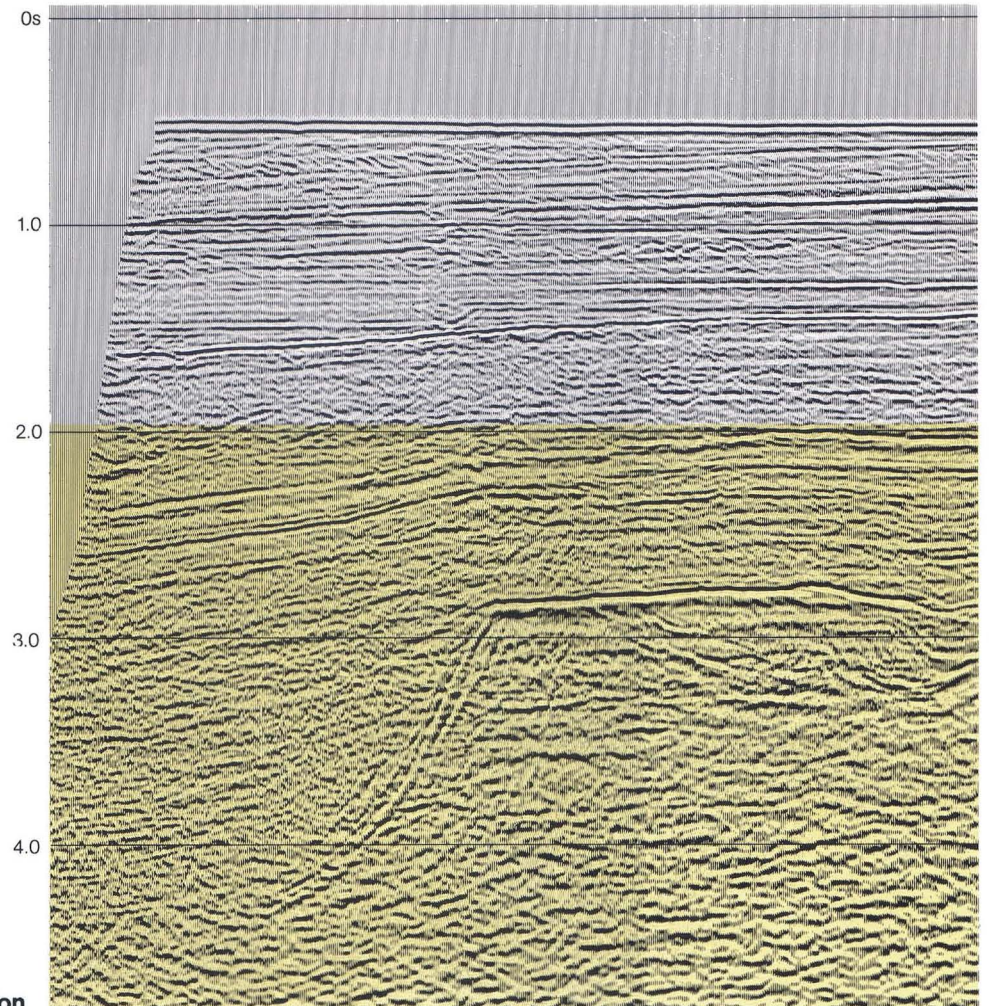
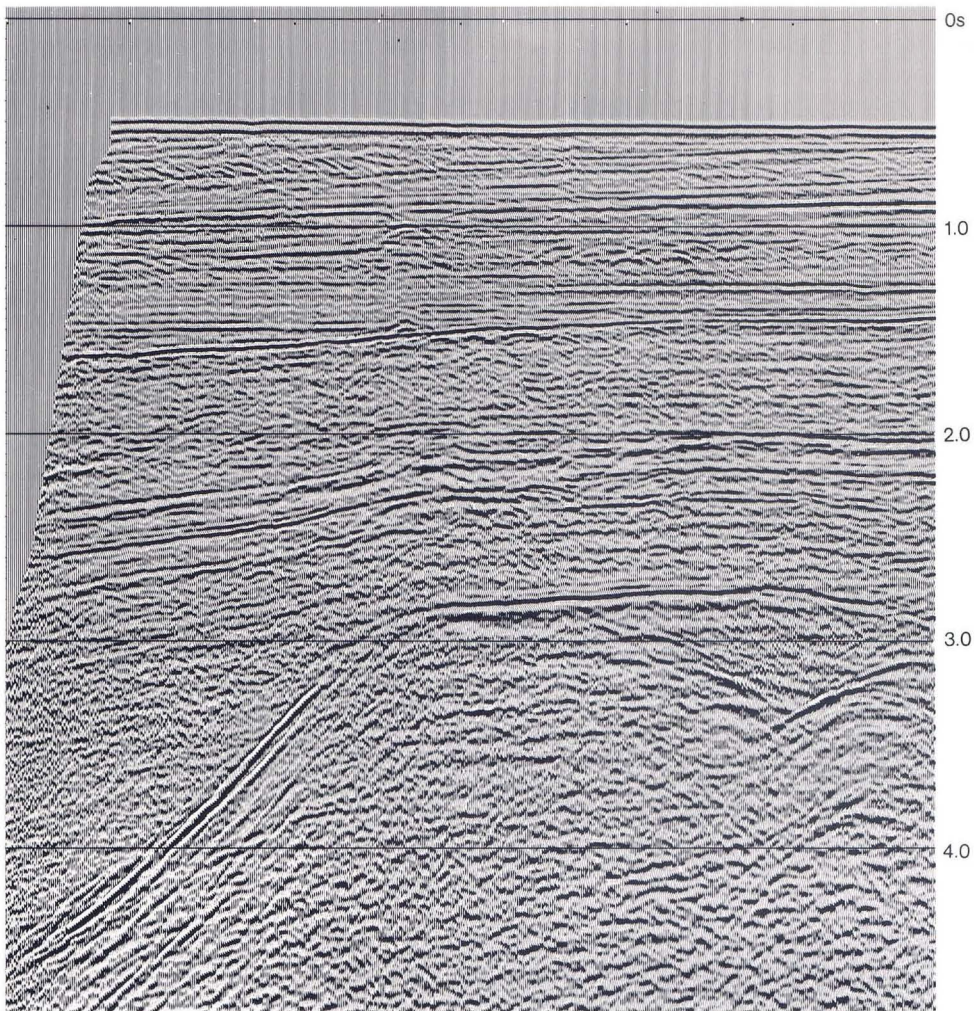
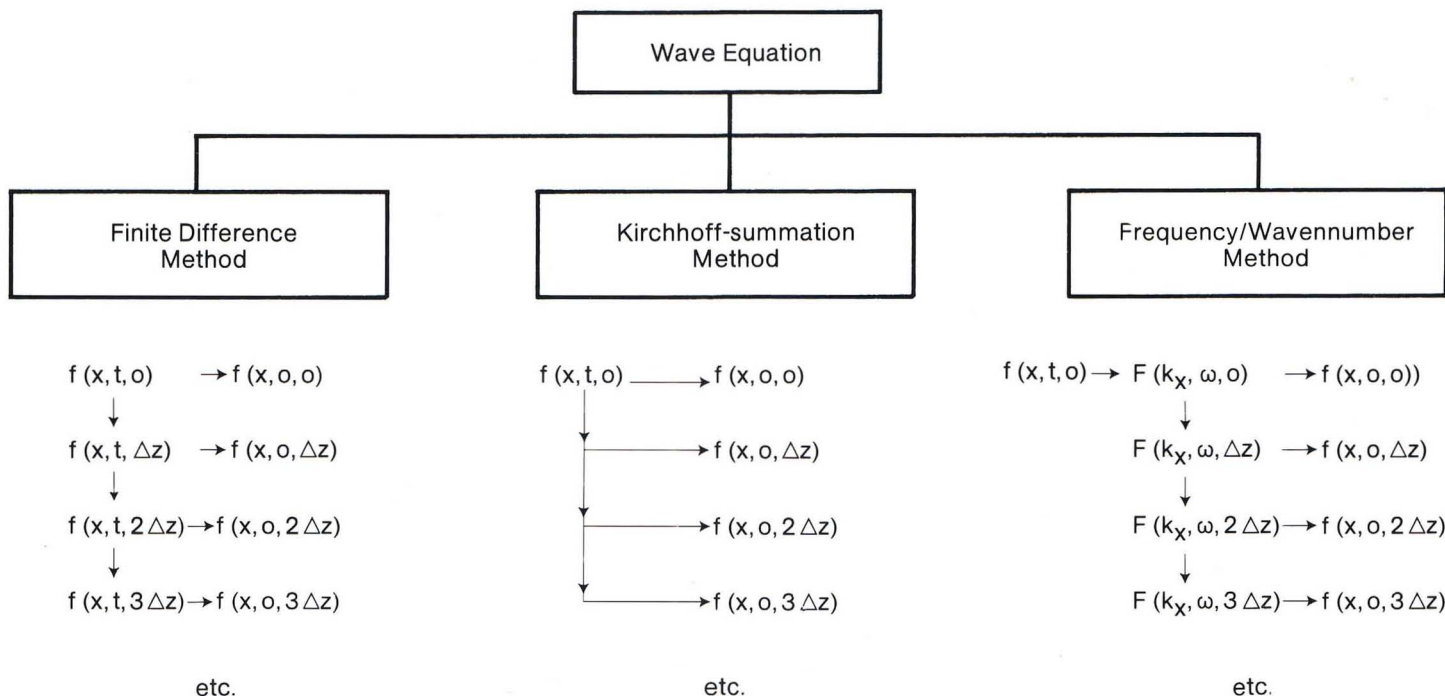


Fig. 6: Finite Difference Migration

In recent years, migration has increasingly become a fundamental process in seismic data processing. A reliable interpretation of zones of complex geology can hardly be carried out without migration. This assumes, however, that the process itself delivers reliable results. Like any other seismic process migration is also subject to continuous development. PRAKLA-SEISMOS offers migration of advanced techniques, providing high accuracy and resolution.

Section Migration without previous interpretation work is the most frequently used migration procedure in routine seismic data processing.

Physical background of the migration process is the acoustic wave equation. For solving this differential equation three approaches govern, up to now, the widely accepted procedures, as can be seen from the following diagram:



The common idea of all procedures is the downward continuation technique. That means the stacked section can be regarded as the upcoming wave field $f(x, t, 0)$ recorded at the earth's surface $z = 0$. By means of the scalar wave equation it is possible to trace these data back to any depth. Thus, automatically all origins of single waves are found, representing the true positions of the reflecting elements.

The diagram shows simply the fundamental differences in the procedures. Whereas the finite difference method sequentially computes each wave field in a recursive manner, the Kirchhoff – summation method always starts from the recorded wave field. The frequency/wavenumber method works in the frequency domain using an exact operator solution of the wave equation.

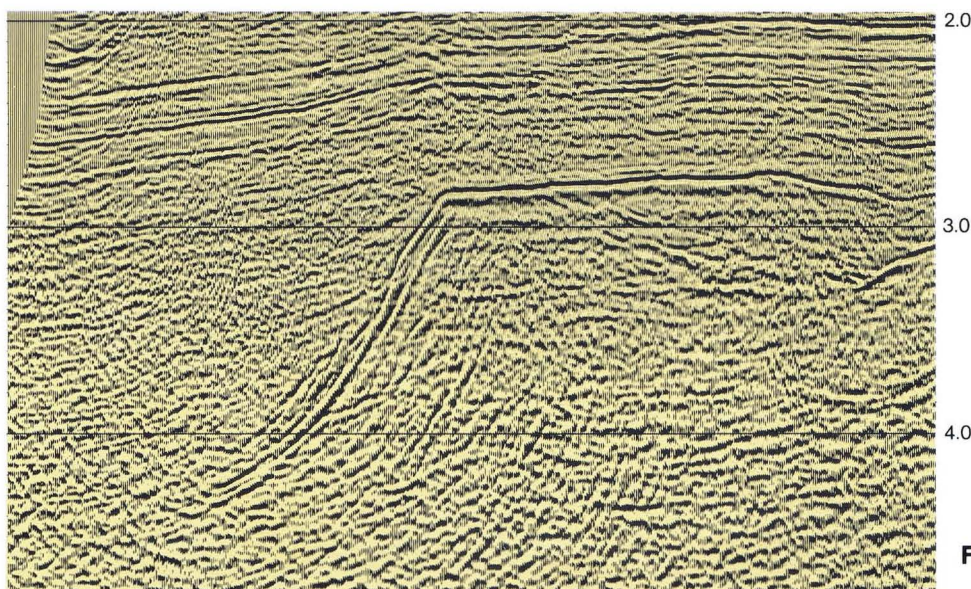


Fig. 7: Frequency/Wavenumber Migration, carried out within a selected gate

The following characteristics may be considered before application:

- | | |
|-----------------------------|--|
| Finite Difference method | <ul style="list-style-type: none"> – takes into consideration lateral velocity variation – migrates dips of up to 45 degrees – is effective on low S/N-data – produces low migration noise |
| Kirchhoff-summation method | <ul style="list-style-type: none"> – allows weighting and muting procedures according to dip or coherency – migrates steeper dips – is applicable in cases of lateral velocity variation |
| Frequency/Wavenumber method | <ul style="list-style-type: none"> – migrates dips of any gradient – is separately applicable to specified areas of interest – works in the frequency domain thus saving computer time |

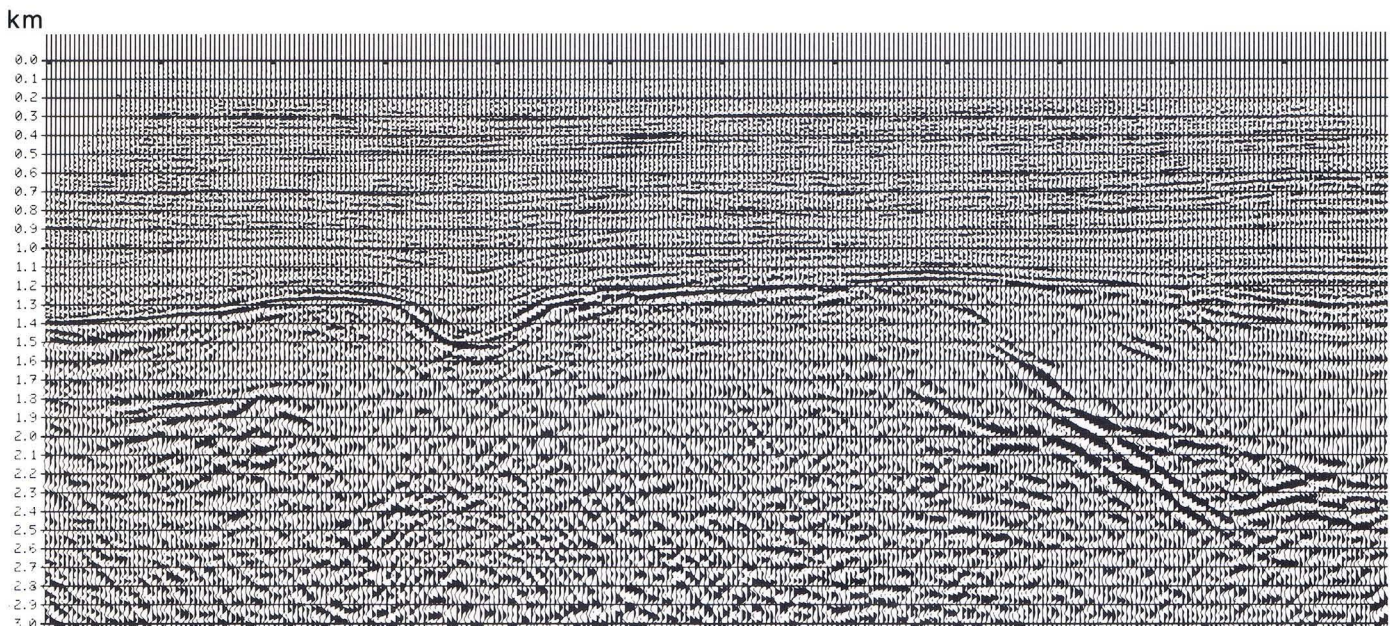
Amplitudes and reflection character of the stacked data are widely preserved in all procedures as well (compare Fig. 1 to Fig. 4). Thus, the type of data with respect to frequency content, steepness of dip and signal-to-noise ratio decides which migration method may be applicable.

If the true depth structure is to be presented, **depth migration** can easily be carried out from time-migrated sections by scaling the migrated sections according to the corresponding velocity distributions (Fig. 8).

This method is, however, only correct for such horizons at which the ray bending in the overburden is of no great importance, as the ray bending is not taken into consideration in the migration procedures mentioned above.

However, for the depth migration the ray bending can be taken into consideration subsequently by an **image ray tracing** procedure with the help of selected horizons of the migration result.

Fig. 8: Depth Migration of Fig. 3



Besides our latest automatic migrating techniques, a program proved over nearly 20 years is still successfully used for migrating manually picked horizons.

Based on interpreted time sections, reflection elements will be digitized and then migrated to their true position under consideration of ray bending. This **ray tracing** program can

also be applied to computed time sections derived from isochrone maps.

Depth dependent velocity functions can be specified in space varying fashion, taking into account faults, pinch-outs, etc. The number of reflection elements between the velocity interfaces is not restricted.

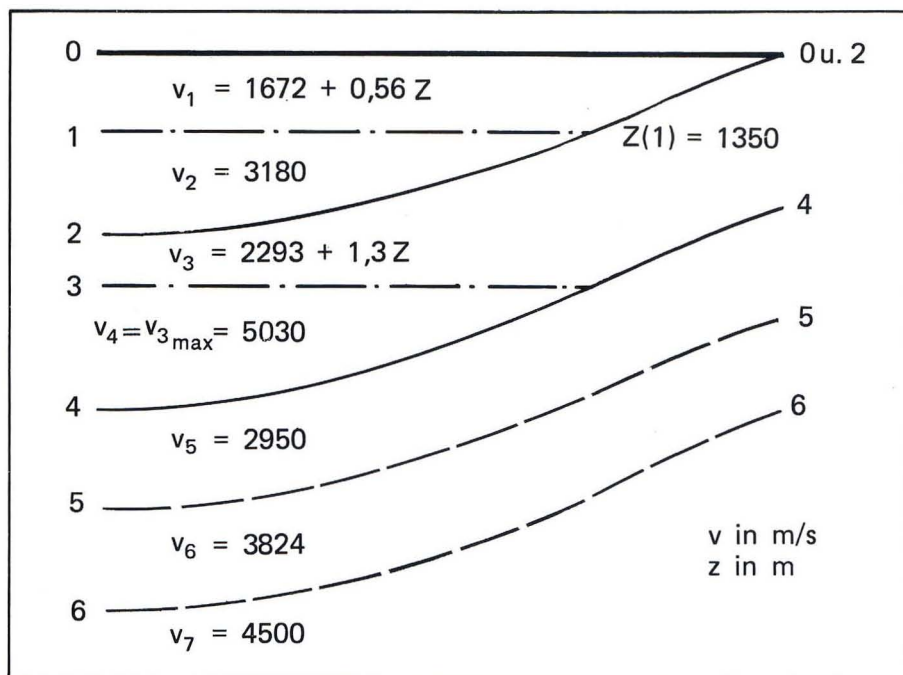


Fig. 9:
Velocity Model for Ray Tracing Migration

Legend:

- 0: datum plane
- 1 and 3: velocity boundaries at constant depths
- 2 and 4: velocity boundaries from actual reflections
- 5 and 6: velocity boundaries assumed parallel to horizon 4

Note: All types of velocity data can be accepted, e.g. from well surveys, Faust's formula etc.; they will be transformed according to formula $v = v_0 + az + bx$.

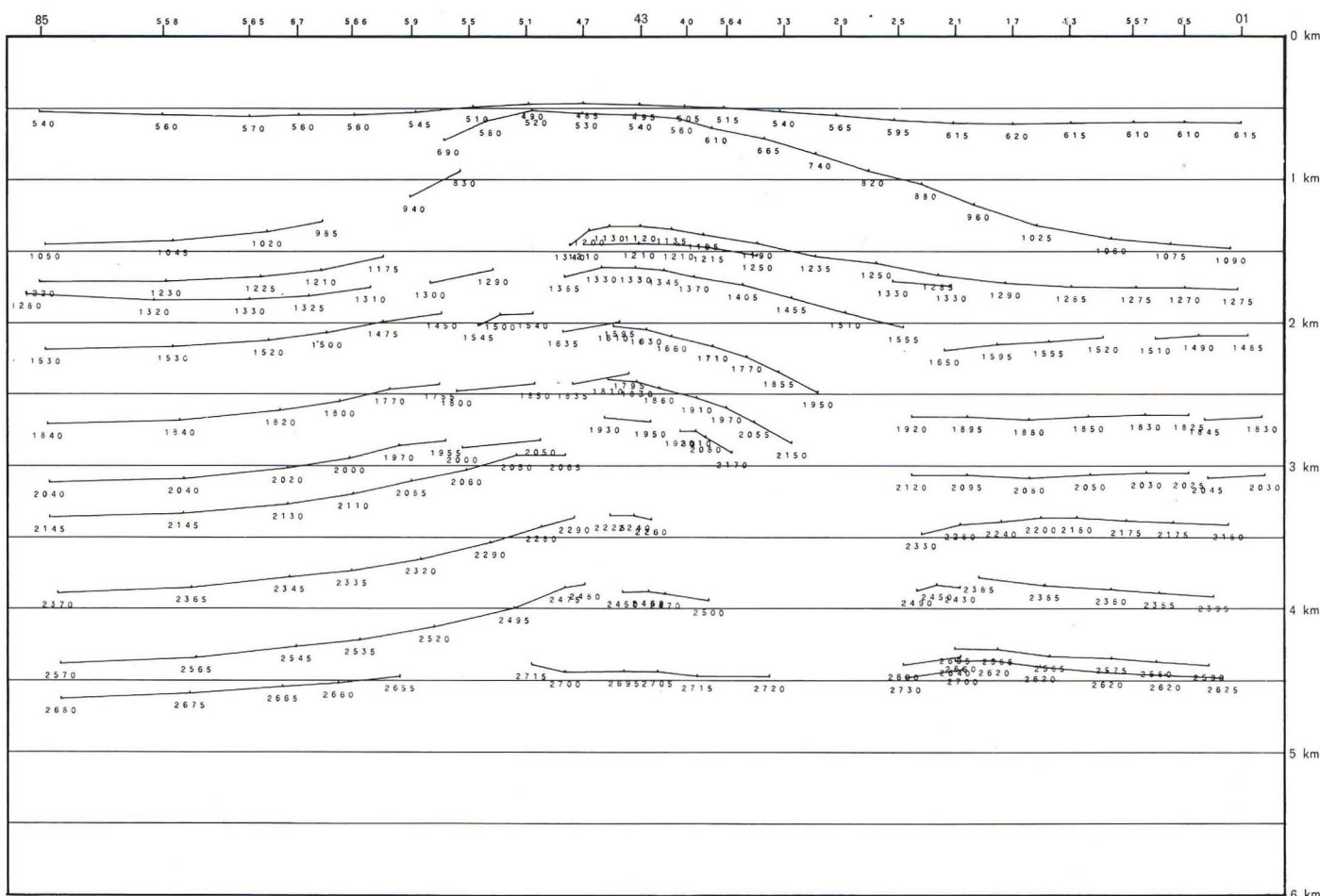
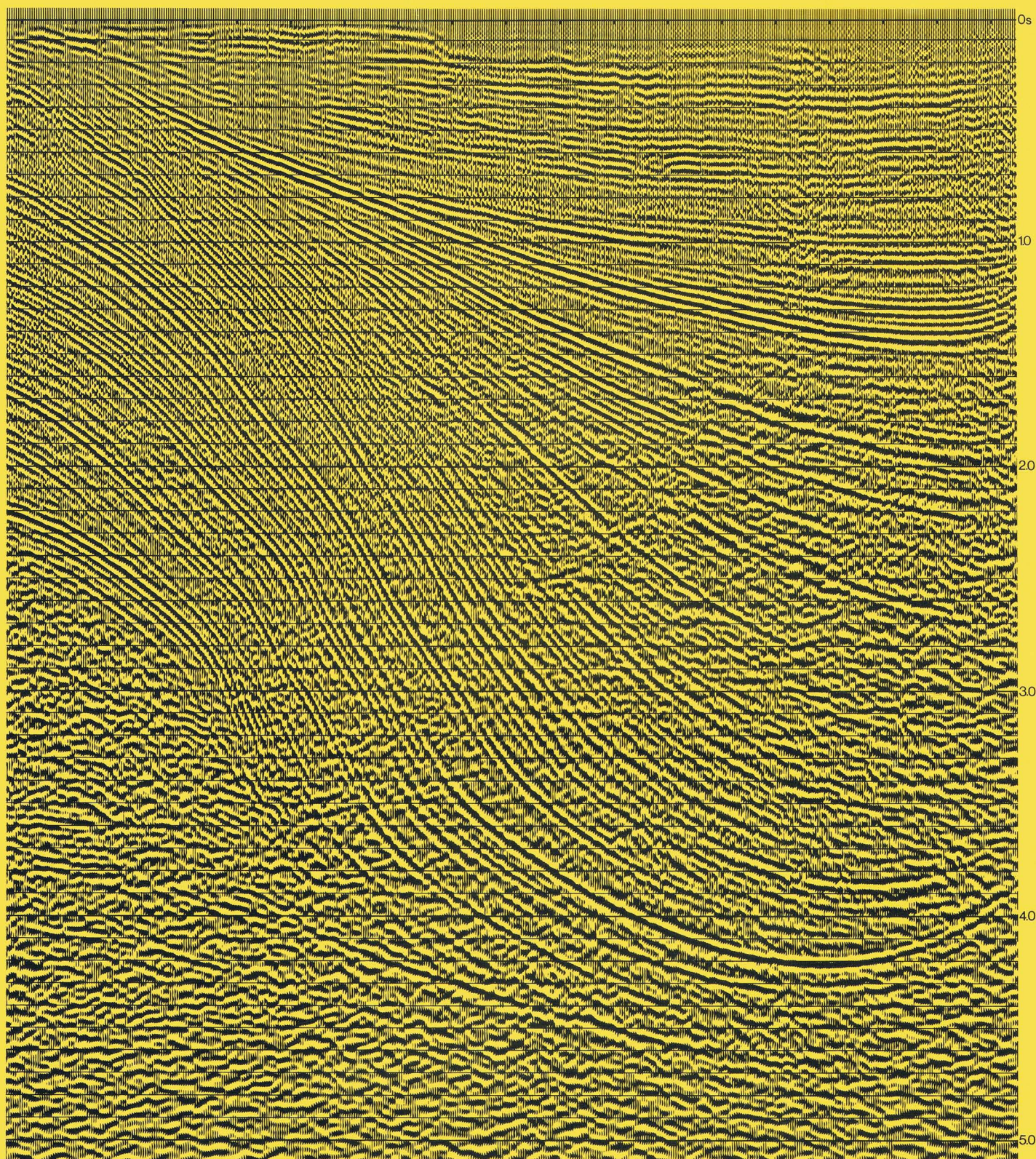


Fig. 10: Ray Tracing Migration

For migration of reflection-time maps by means of a ray tracing procedure see PRAKLA-SEISMOS Information No. 1.



Finite Difference Migration
carried out on stacked section from front cover



PRAKLA-SEISMOS GMBH · HAARSTRASSE 5 · P.O.B. 4767 · D-3000 HANNOVER 1
PHONE: 8 07 21 · TELEX: 9 22 847 · CABLE: PRAKLA · GERMANY

© Copyright PRAKLA-SEISMOS GMBH, Hannover 1978