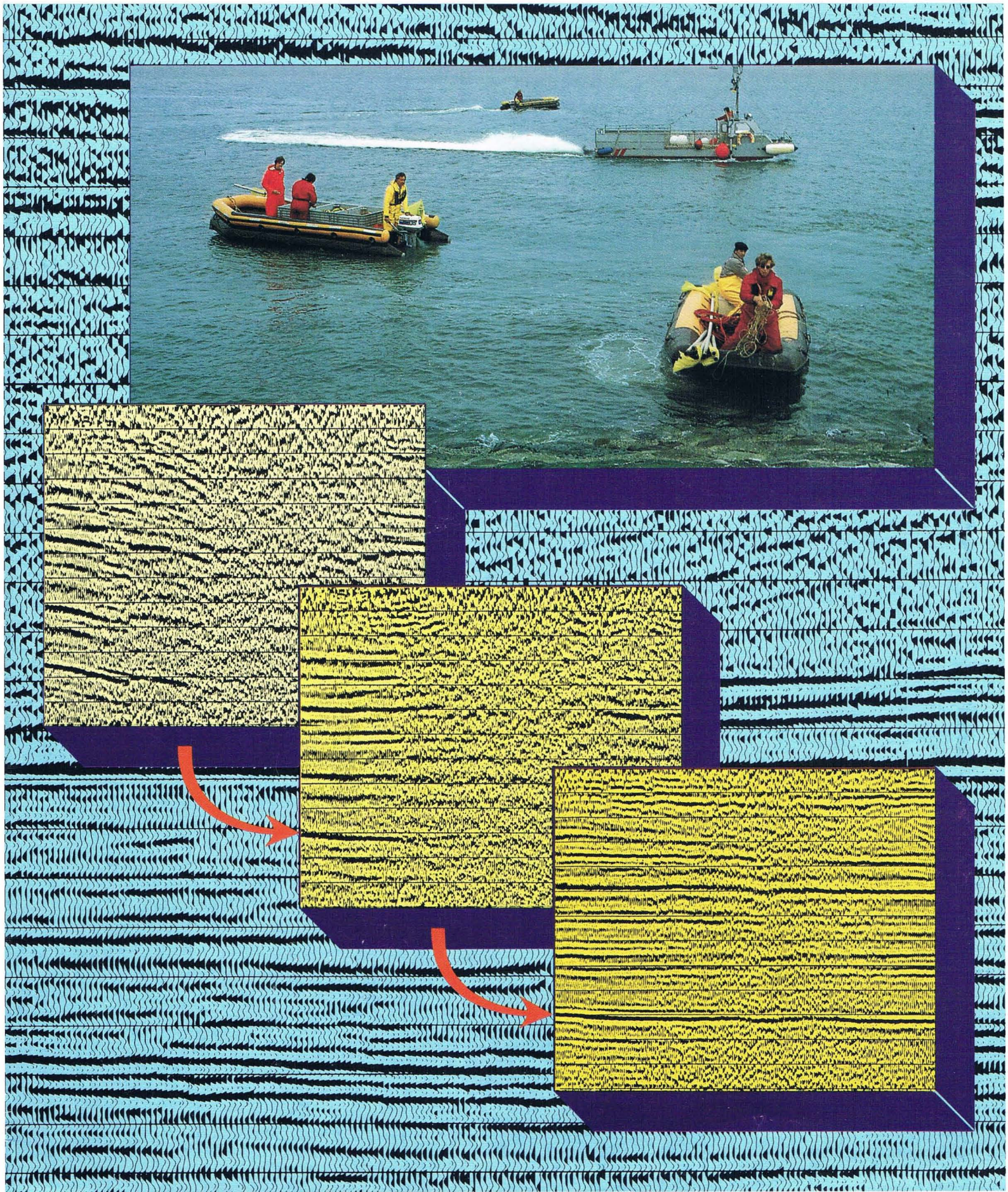
PRAKLA-SEISMOS INFORMATION No. 55

Transition Zone Processing



The seismic investigation of the vast areas between land and ocean – too shallow for standard marine seismics and too "wet" for conventional land operations – cannot be mastered by the use of a single technique alone. Utmost flexibility and versatility of methods and equipment are required when the projected survey lines enter areas with water depths less than 3 m and when small islands or reefs have to be crossed to establish seismic connections between regular marine and land surveys (land ties). Special equipment is necessary for surveys in lagoons and swamps, on lakes and rivers.

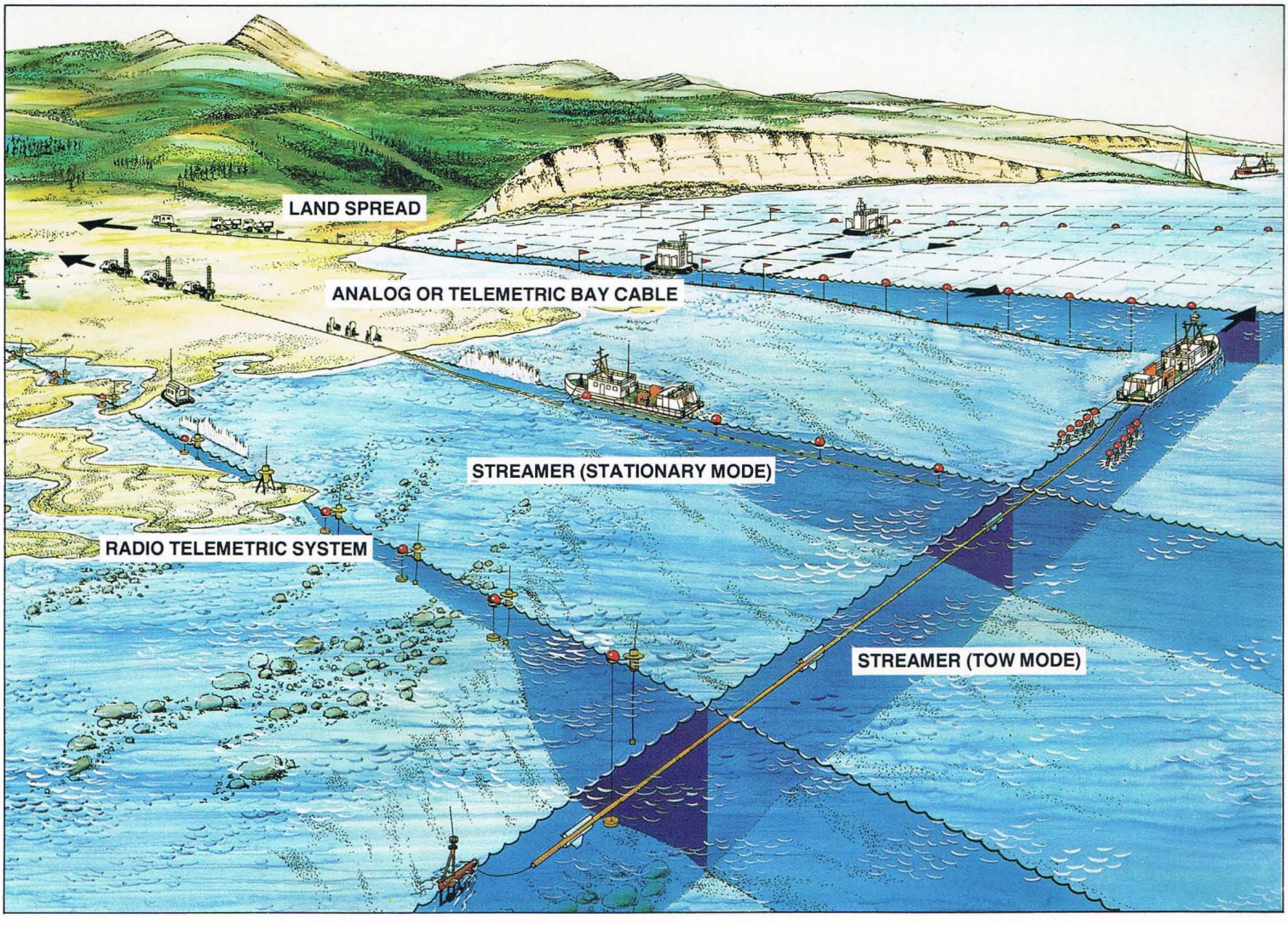
Consequently multifarious combinations of source types (airguns, dynamite, vibroseis, etc.) and receiver types (hydrophones, geophones, gimbalphones, etc.) may be used within one and the same survey for obtaining continuous seismic information.

The general view in Fig. 1 illustrates a combined shallow-water/land survey using different types of field equipment. The seismic data from these combined surveys naturally require special treatment as severe amplitude and phase differences arise as a consequence of using various source and receiver types. Only sophisticated TRANSITION ZONE PROCESSING is capable of producing continuous and well balanced seismic sections.

The appropriate strategy to be followed depends on the kind of problems involved. Basically two points must be fulfilled: the application of well designed

- MATCHING OPERATORS, and
- STATIC CORRECTION PROCEDURES.

Fig. 1: Combined Shallow-Water/Land Survey



The general processing flow diagram in Fig. 2 includes the application of an effective **PRE-STACK** procedure. A simplified **POST-STACK** procedure can be applied only if simple phase shifts are involved.

Important points for efficient
TRANSITION ZONE PROCESSING:

- Data are initially transformed to **minimum phase** as is required for spike deconvolution using the characteristics of instruments and receivers.
- Accurate **static corrections** are a prerequisite for continuous processing. Improved results can be obtained from automatic picking of first arrivals or of reflections.
- **Automatic Residual Statics** efficiently correct high frequency components.
- **Transfer Functions** are calculated, adjusting the residual phase shifts and differences in amplitude spectra of the individual stacks to a pre-defined reference. If residual static problems are involved the transfer functions are to be applied before stack. The resulting continuous stacked section can serve as a reference for a re-evaluation of the residual static corrections. A cascading procedure then provides an optimum final result.
- **Spectral Whitening** after stack provides well balanced data for the subsequent migration process.

The effective application of the PRAKLA-SEISMOS transition zone software package is demonstrated on two lines of an actual field survey* conducted in the lagoon area of Venice. The survey was carried out in Meander-Line Mode (Fig. 3) using dynamite and airguns as seismic sources with geophones, hydrophones and marshphones on the receiver side (see location map and top of the sections).

Line A illustrates how static problems are overcome. The improvement of the stack from Figs. 6a to 6c can be seen in more detail by comparing the corresponding single coverages in Figs. 5a to 5c and by considering the drastic static shifts displayed in Fig. 4.

Line B, which crosses line A perpendicularly (see Fig. 3), is affected mainly by phase errors resulting from the application of different sources and receivers. Automatic picking of first arrivals was therefore not appropriate for producing the final stack (Figs. 7a to 7c).

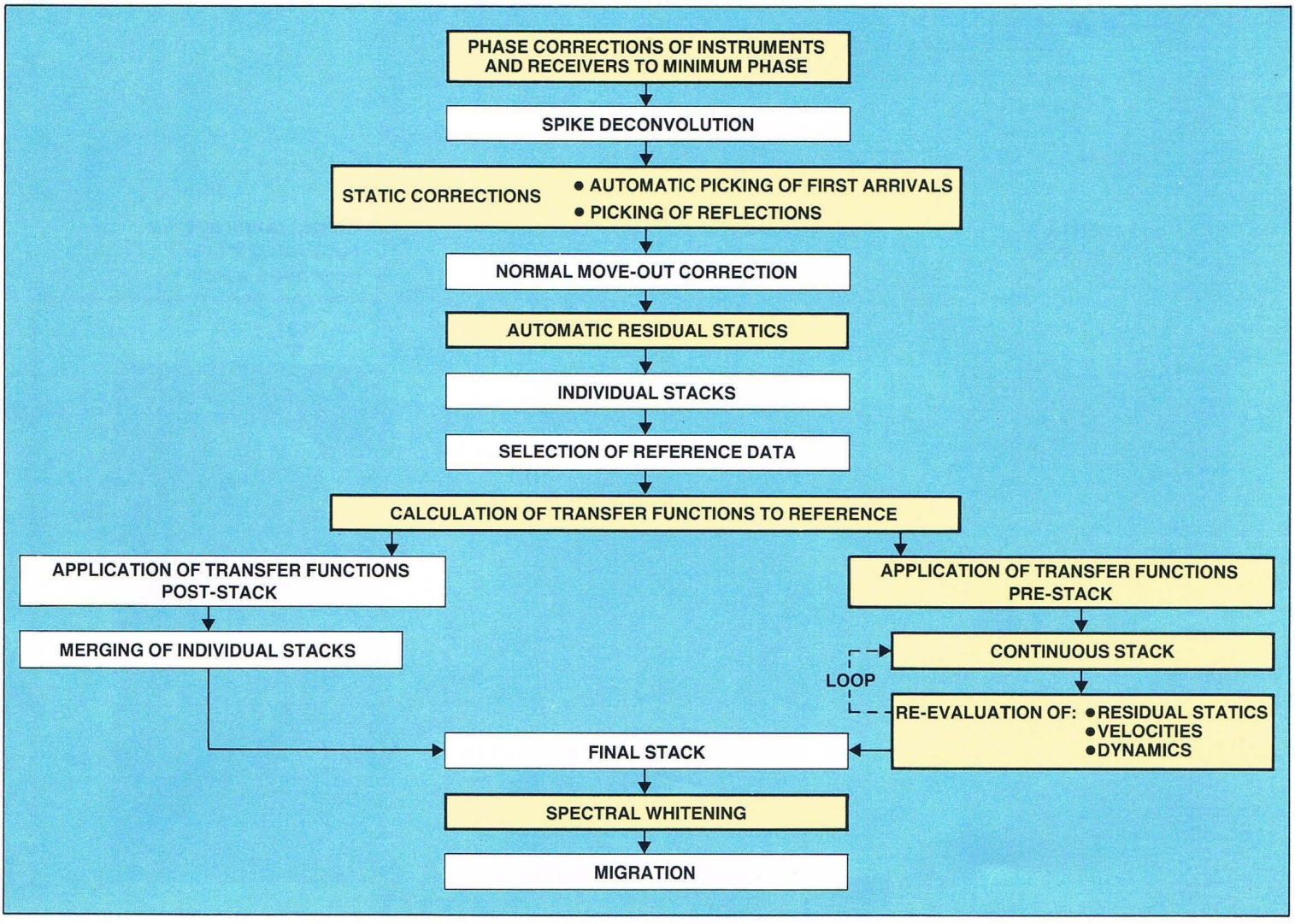
The blow-ups in Figs. 9 and 10 emphasize the effectiveness of single wavelet processing steps as applied to the complete sections of line A and line B.

Fig. 8 shows the transfer functions of the dynamite data in relation to airgun data for different time gates. The almost symmetrical operator proves the high degree of match which has already been achieved by the preceding processing steps.

The transition zone software package has been implemented to facilitate handling of 2-D as well as 3-D data sets.

* Courtesy AGIP, Italy

Fig. 2: Processing flow diagram



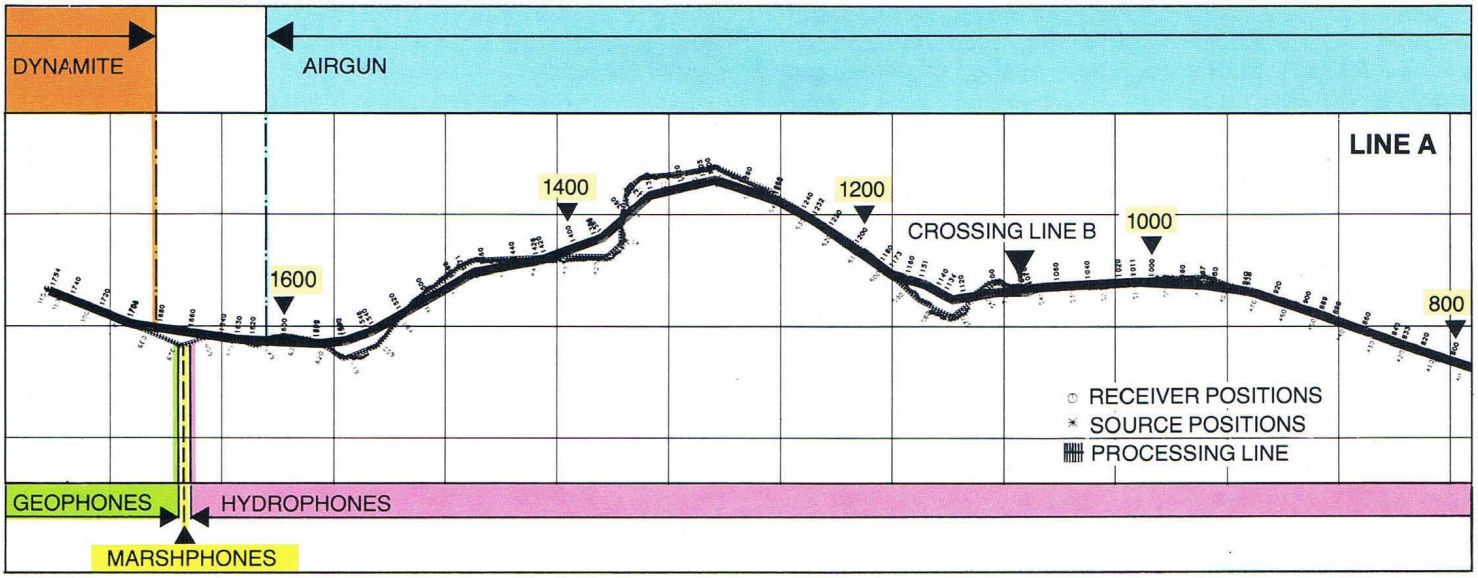


Fig 3: Location map of line A (meander line)

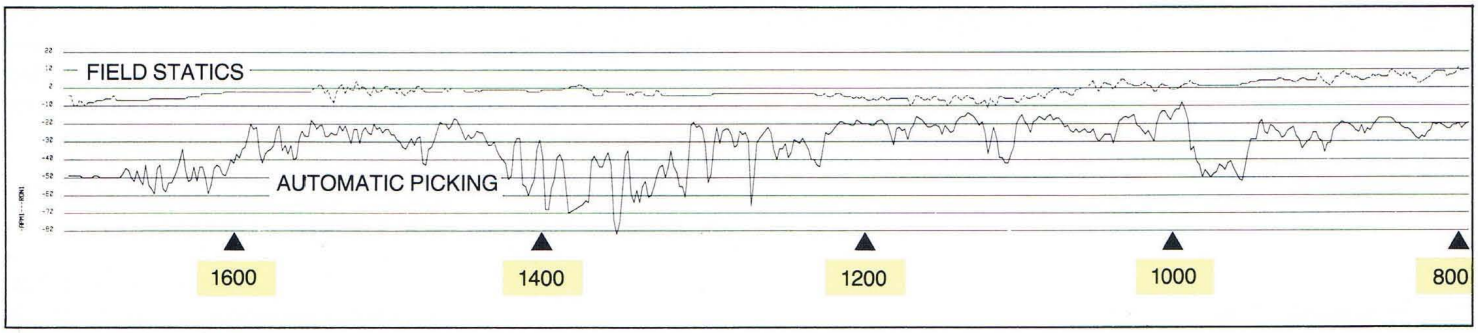


Fig. 4: Display of field statics (above) and improved statics after picking of first arrivals (below)

Fig. 5a: Single coverage of field records

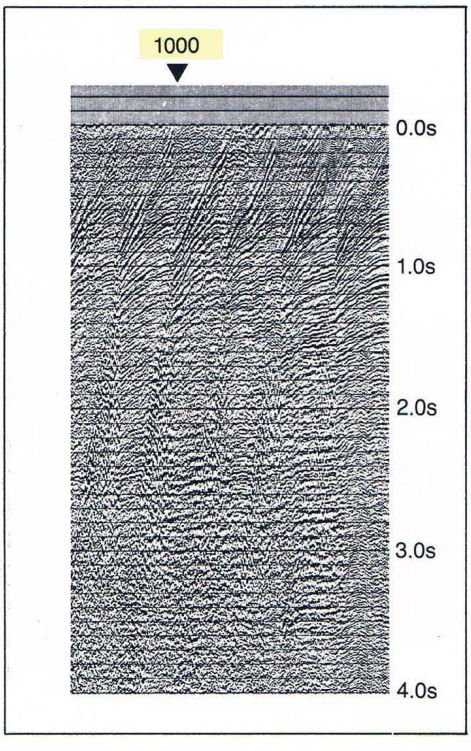


Fig. 5b: Single coverage recovered from preliminary stack

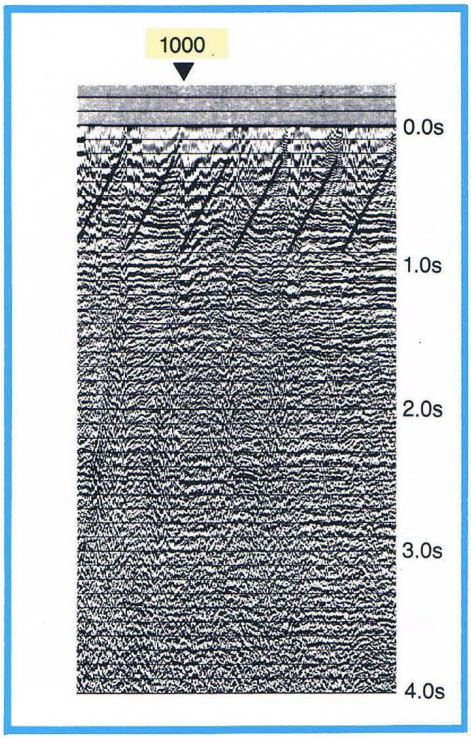


Fig. 5c: Single coverage recovered from improved stack

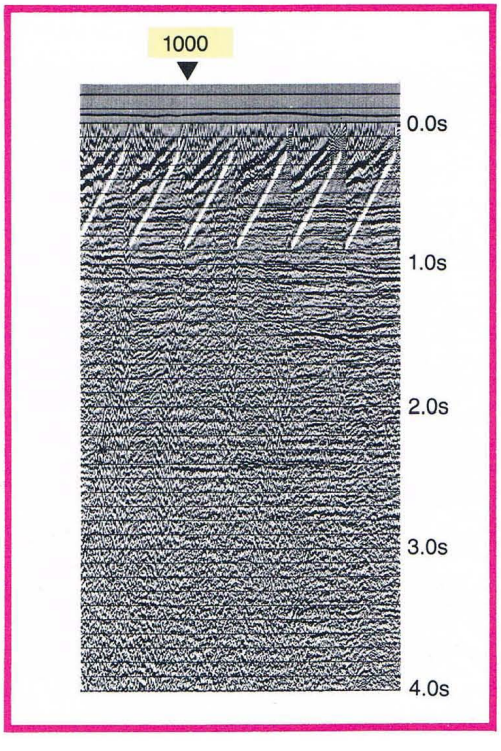


Fig. 6a: Preliminary stack
Field statics,
Phase correction of instruments and receivers,
Deconvolution before stack,
Display filter 8/90 Hz

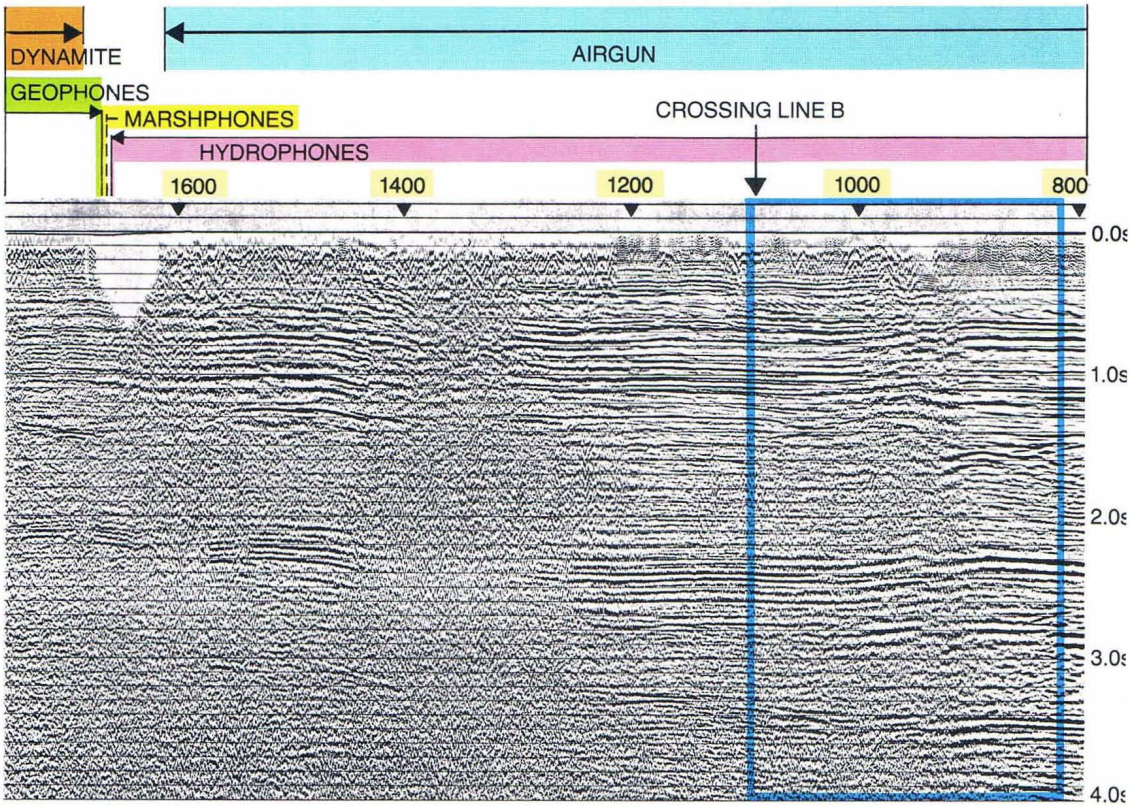


Fig. 6b: Improved stack
Basic statics from automatic picking of first arrivals (dynamics and filters identical with those in Fig. 6a)

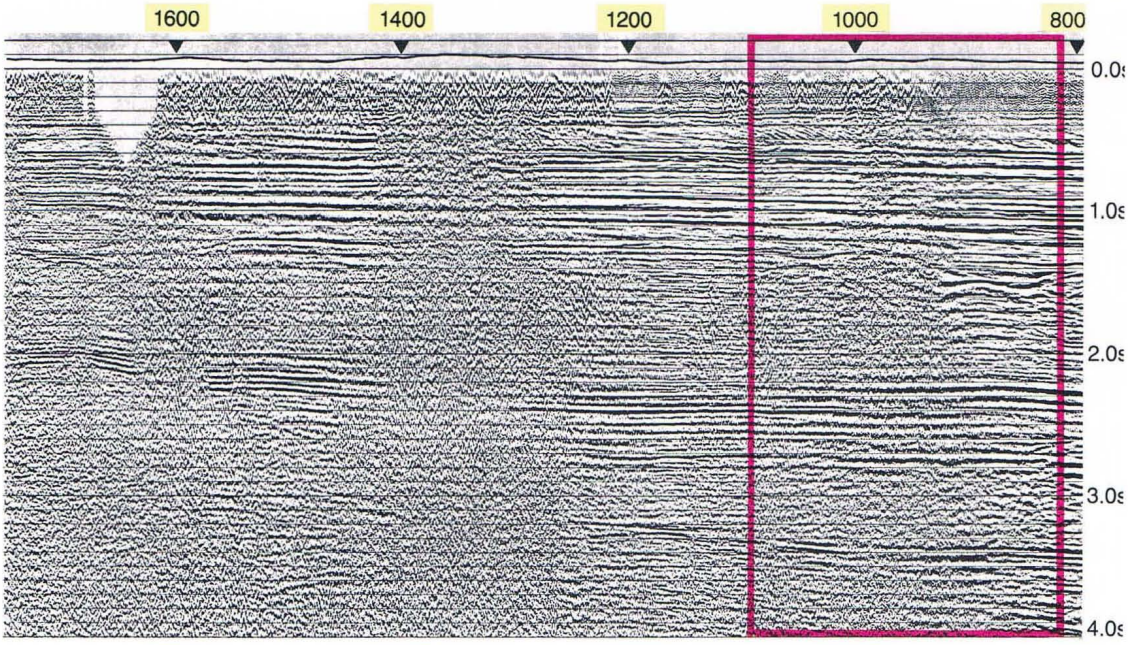
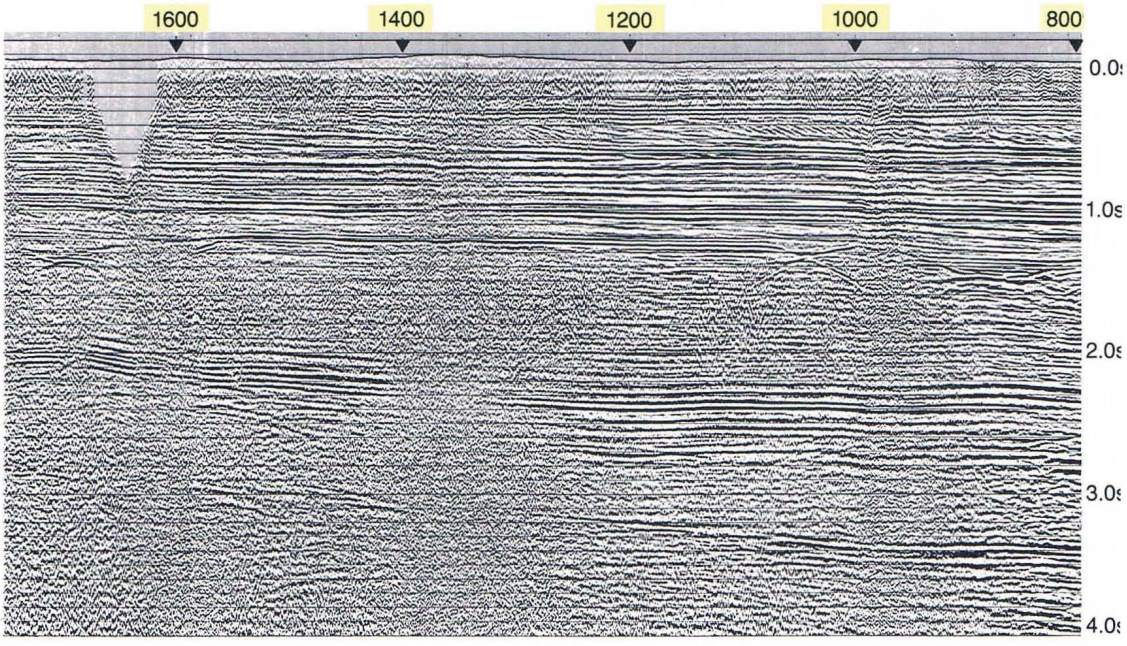


Fig. 6c: Final stack
Final dynamics,
Additional statics from reflections,
Automatic residual corrections,
Spectral balancing,
TV-filter



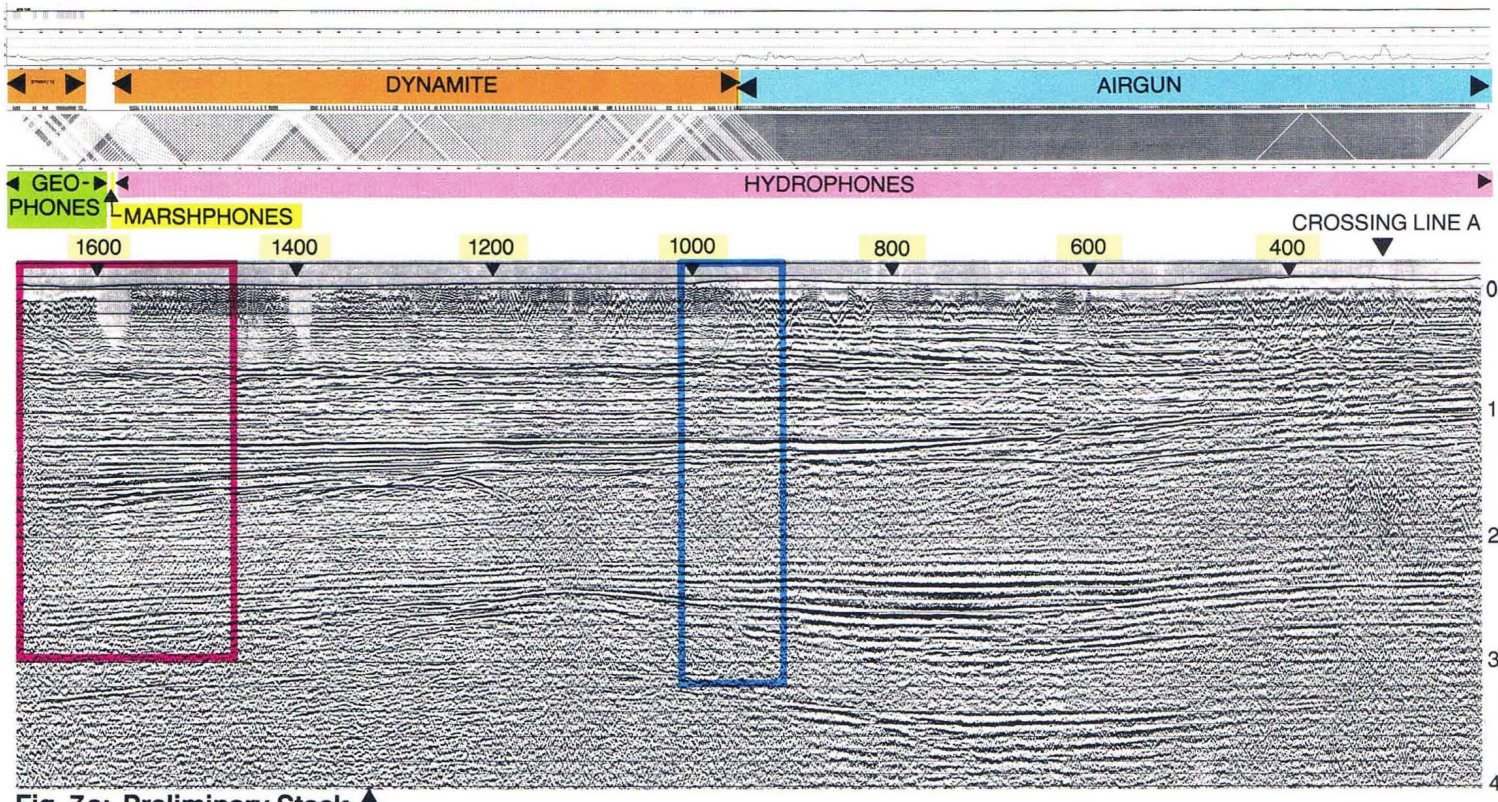


Fig. 7a: Preliminary Stack ▲
Field statics, Phase correction of instruments and receivers, Deconvolution before stack, Display filter 8/90 Hz

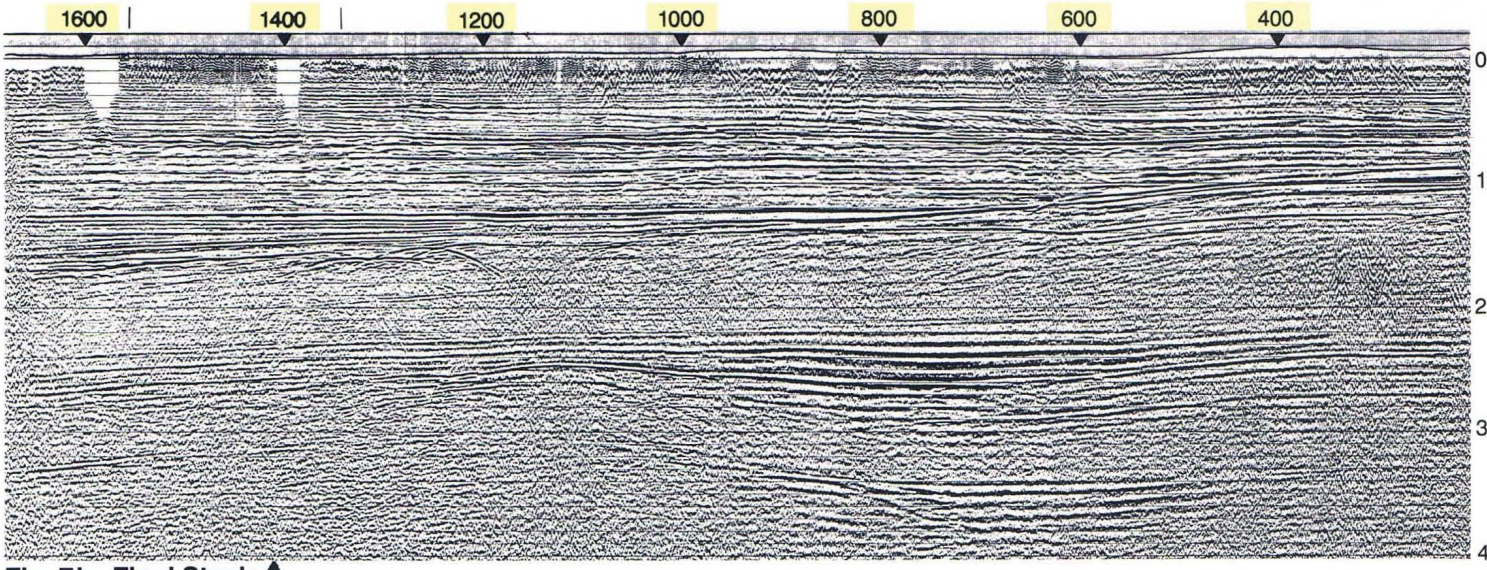


Fig. 7b: Final Stack ▲
Basic statics from reflections, Final dynamics, Automatic residual corrections (filters identical with those in Fig. 7a)

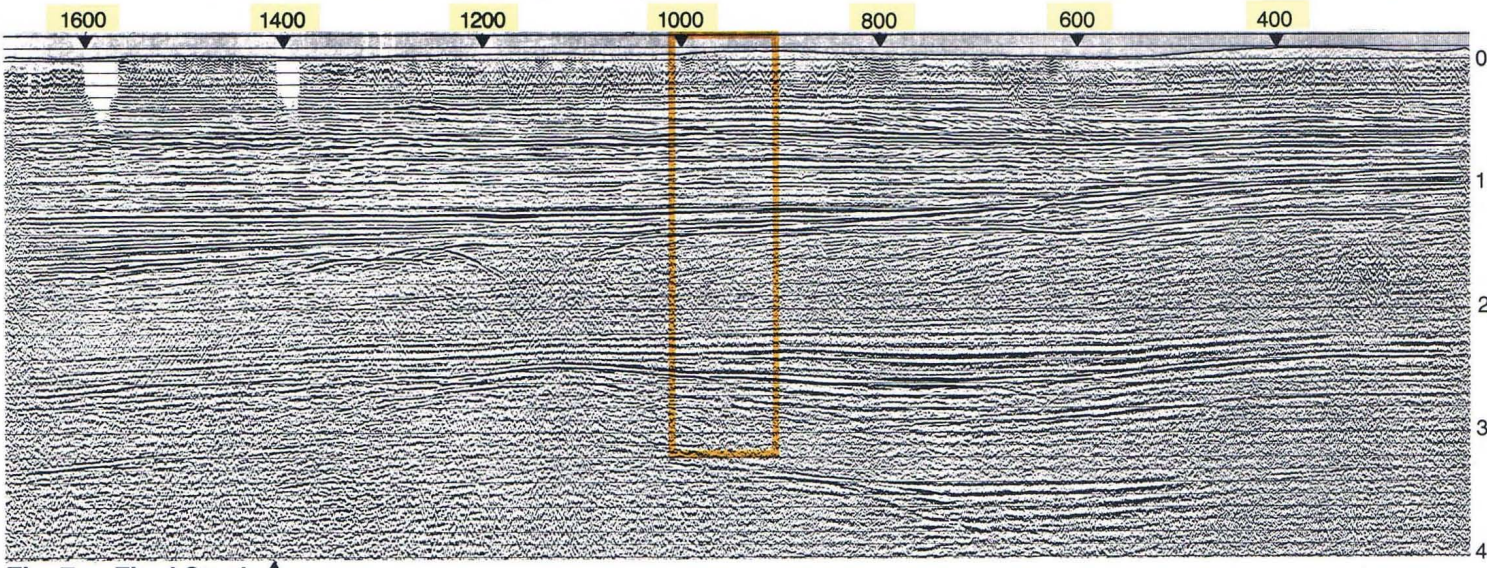


Fig. 7c: Final Stack ▲
Spectral whitening, TV-filter

Fig. 8: Transfer functions dynamite-to-airgun

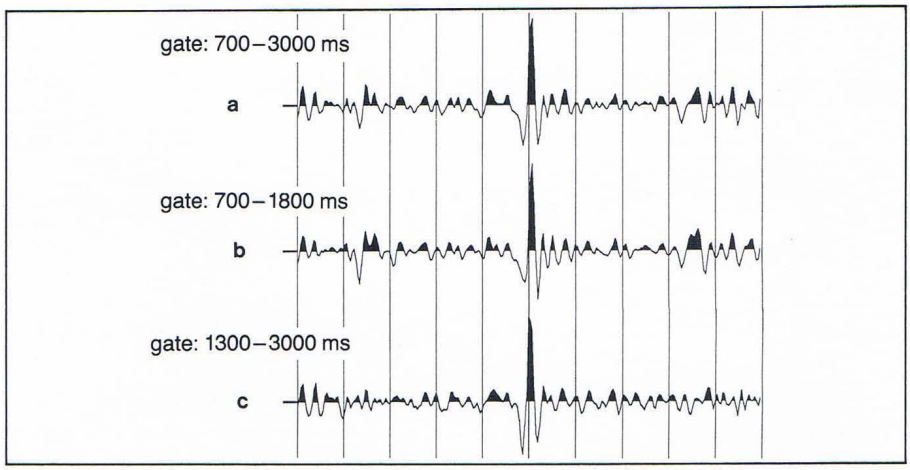


Fig. 9a: Stack without phase correction of instruments and receivers

Fig. 9b: Stack with phase correction of instruments and receivers

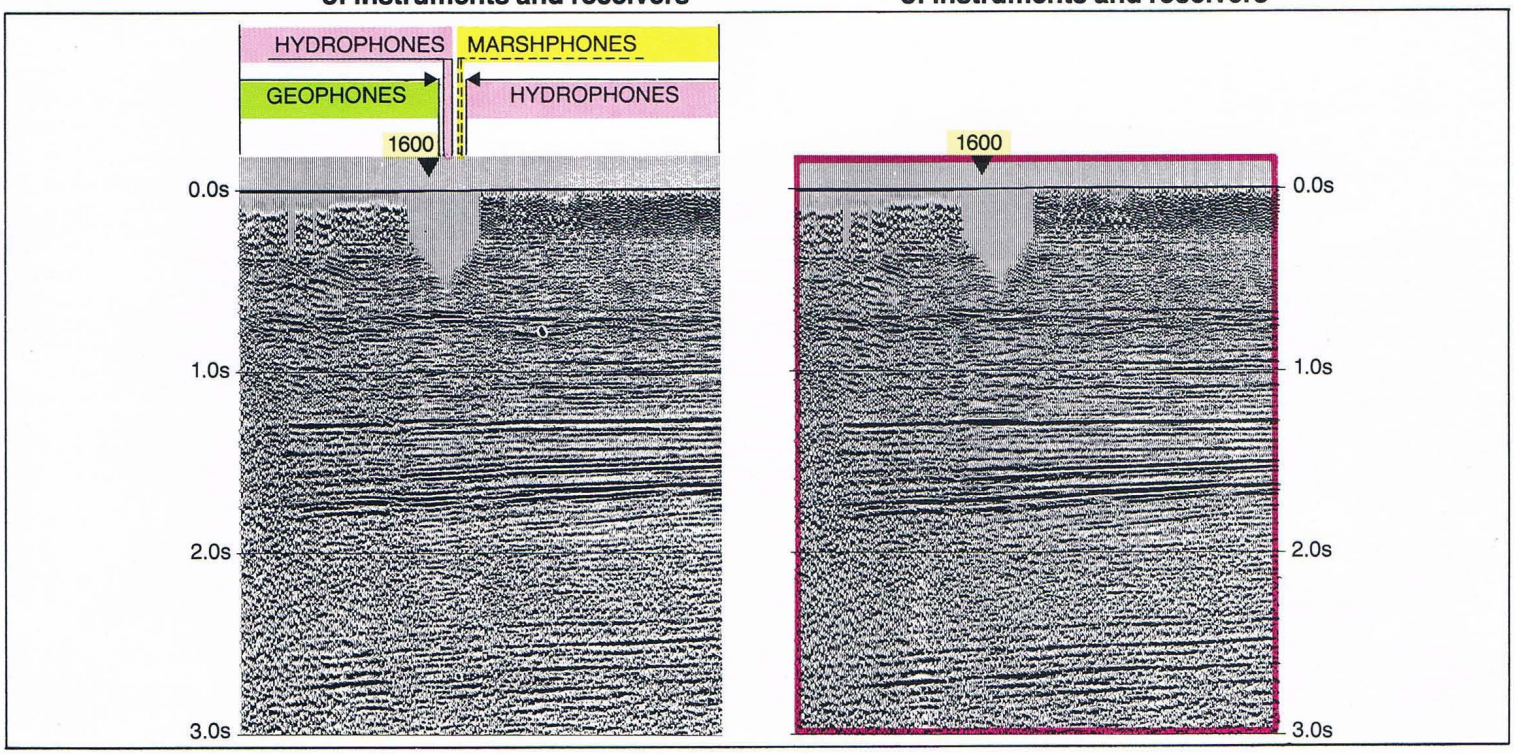
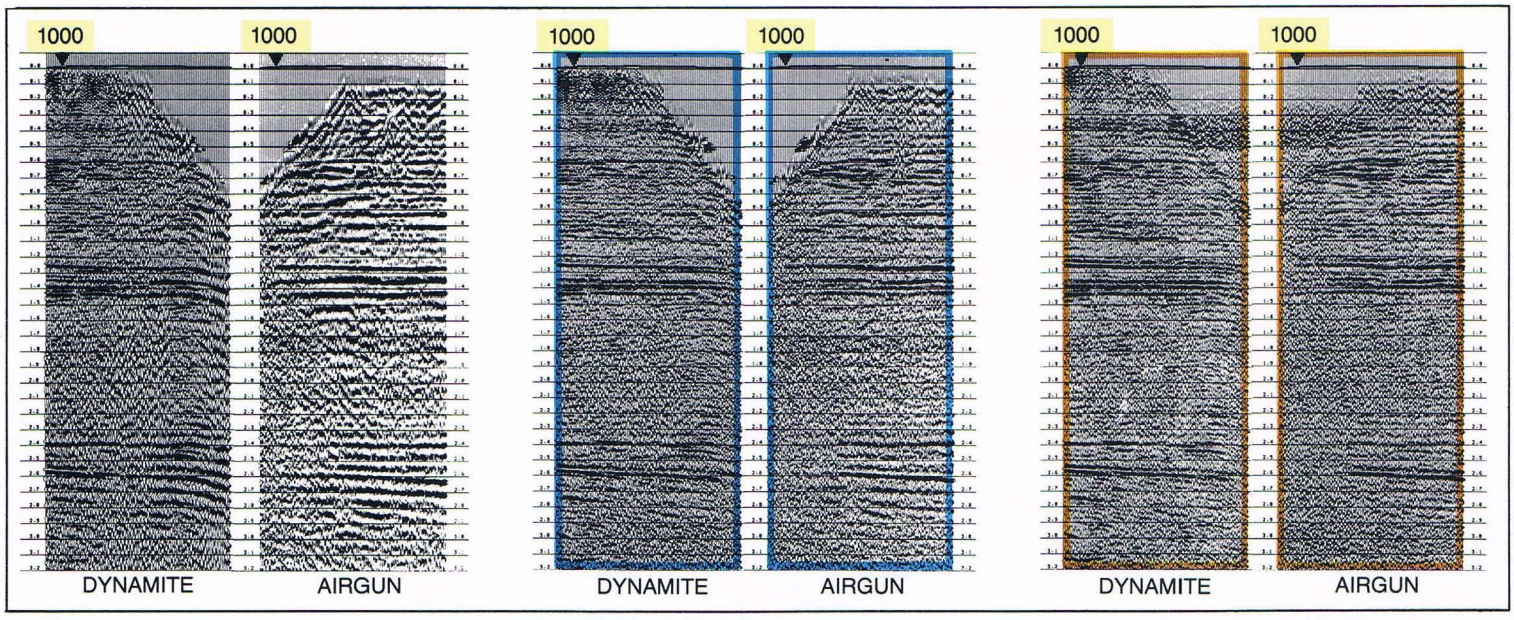


Fig. 10a: Dynamite/Airgun data without deconvolution before stack

Fig. 10b: Dynamite/Airgun data with deconvolution before stack

Fig. 10c: Dynamite/Airgun data with spectral whitening and TV-filter after stack

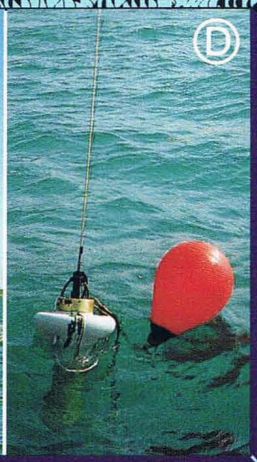


TRANSITION ZONE SURVEYS

– a Job for Experts

Our Domain since 1938

Seismic investigation of areas too shallow for standard marine surveys and too "wet" for conventional land operations demands utmost FLEXIBILITY of methods and VERSATILITY of equipment.



What we have to offer:

- a fleet of modern **Shallow-Water Vessels,** built after 1981 Ⓐ
- **Mother-Ships,** serving as bases for men and equipment Ⓑ
- special **Airgun-Pontoons** for areas shallower than shallow Ⓒ
- the **Most Modern Equipment,** such as MYRIASEIS* Ⓓ

* CGG-IFP Trademark and product development

Our speciality:

3-D seismics in extremely complicated areas, such as harbours, estuaries, and so on.

More than 600 km^2 have been surveyed – up to 1986.

PRAKLA-SEISMOS

PRAKLA-SEISMOS AG · BUCHHOLZER STR. 100 · P.O.BOX 51 05 30
D-3000 HANNOVER 51 · FEDERAL REPUBLIC OF GERMANY
PHONE: (5 11) 64 20 · TELEX: 9 22 847 + 9 22 419 + 9 23 250 · TELEFAX: 6 47 68 60

6000 387