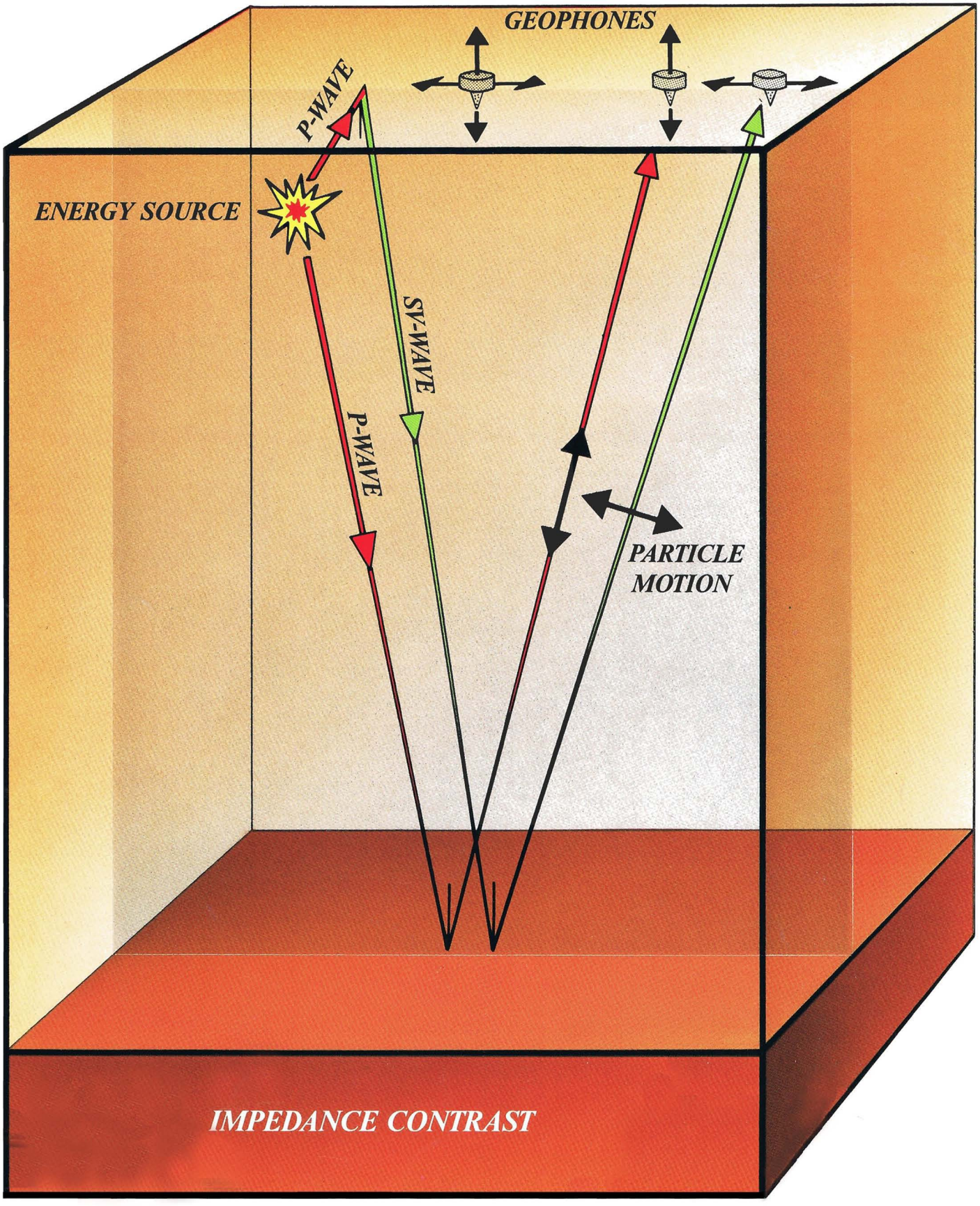
PRAKLA-SEISMOS INFORMATION No. 66

Recording and Processing of Two-Component Data Using a Conventional P-Wave Source



In two-component seismic recording with vertical and in-line horizontal geophones (or with two-component geophones) the compressional (P-)wave amplitudes as well as the vertically polarized shear (SV-)wave amplitudes are observed by both types of geophones. Using a conventional P-wave source, SV-waves result from mode conversions related to the near-surface layers (see front page). The individual P-arrivals and SV-arrivals can be separated using 2D convolution filters derived from the geophone receiving characteristics and the near-surface P-wave and S-wave velocities.

The main advantage of two-component seismic observations is two-fold: firstly a clean P-wave section (Fig. 1) is obtained if the SV-energy is cancelled by applying the above separation filter, and secondly we obtain an additional SV-wave section (Fig. 2) at almost no extra cost (concerning data acquisition). These two sections can be used especially to distinguish between real and false bright spots, ie they are direct hydrocarbon indicator (DHI) tools. A very important post-stack processing step applied to the SV-wave section is the time-depth-time (TDT) transformation resulting in a SV-wave section (Fig. 3) which is transformed into the P-wave section time frame, ie SV-wave and P-wave sections now have the same time scale.

The actual data shown here were recorded with a dynamite P-wave source and two sets of geophones to obtain the vertical and horizontal components. Four different bright spots show up and are framed in the P-wave section in Fig. 1. For convenience the same time gates are also marked in the TDT-transformed SV-wave section in Fig. 3. Note that it is very difficult to find amplitude anomalies in the SV-wave section without the TDT-transformation (Fig. 2) corresponding to the anomalies in the P-wave section. The time gates B and C in Fig. 4 have bright spots in the P-wave sections which are confirmed as real bright spots by the fact that no events exist in the SV-wave data; time gate A, however, clearly shows considerable amplitudes also in the SV-wave data set. As is known from well results, this anomaly is caused by a water-bearing gravel layer, while the anomalies in the time gates B and C are due to gas-filled sand layers.

These results clearly show the advantage of such recording and processing techniques for the solution of DHI-problems.

Reference: Mazzotti, A; Ferber, R.G.; Marschall, R.; 1989: Two-component recording with P-wave source to improve seismic resolution

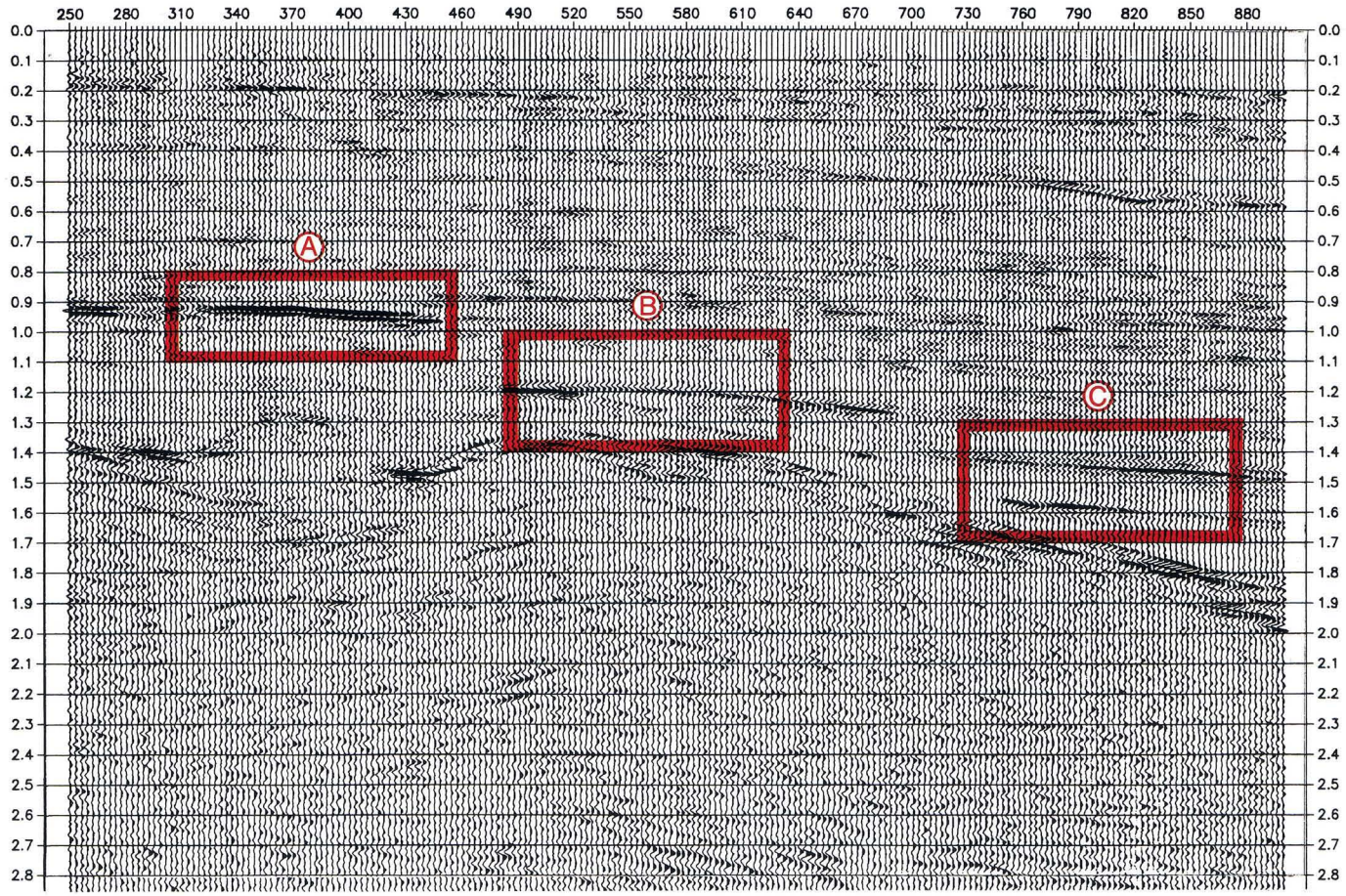


Fig. 1: P-wave section with three bright-spot areas

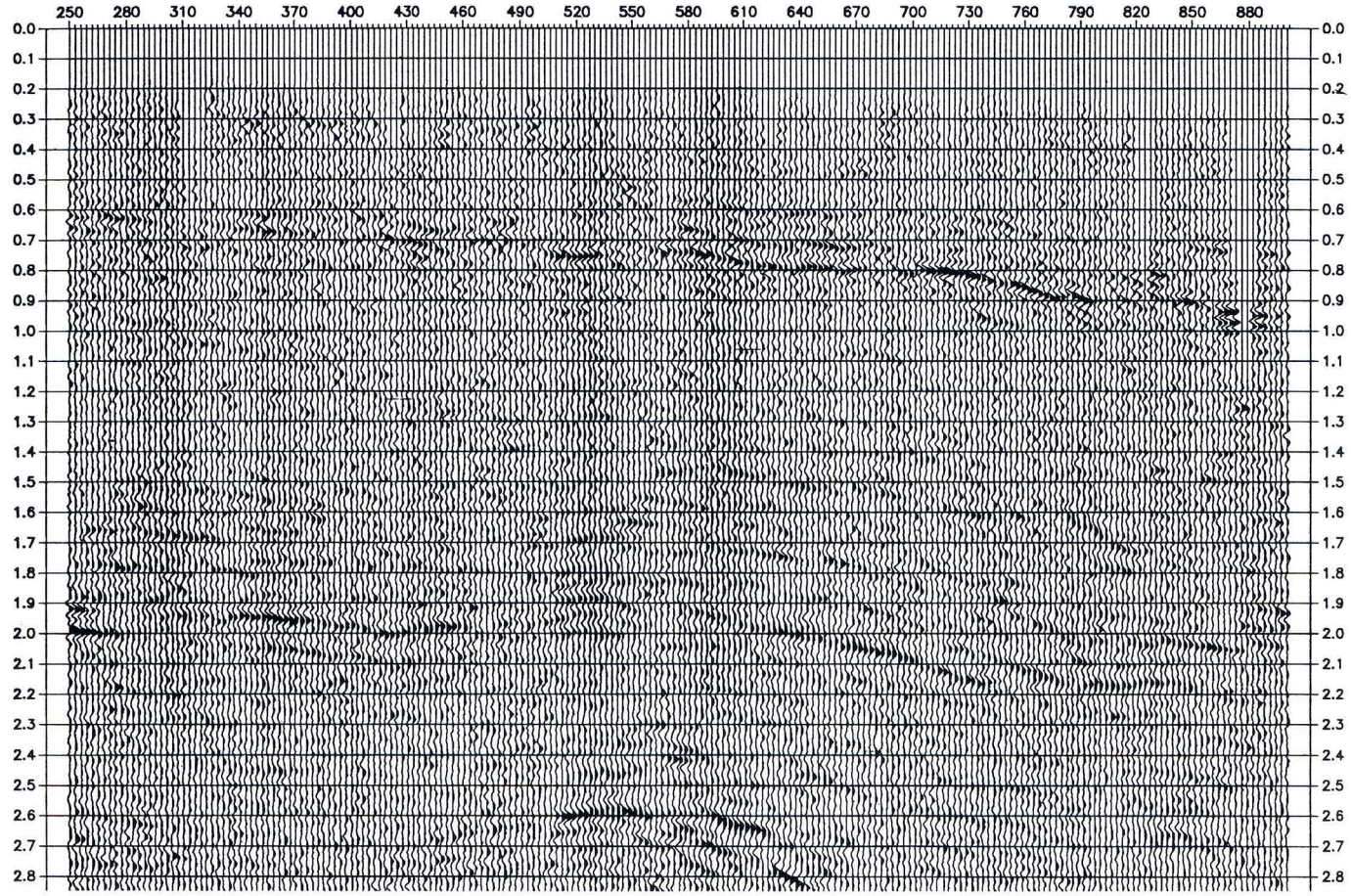


Fig. 2: SV-wave section

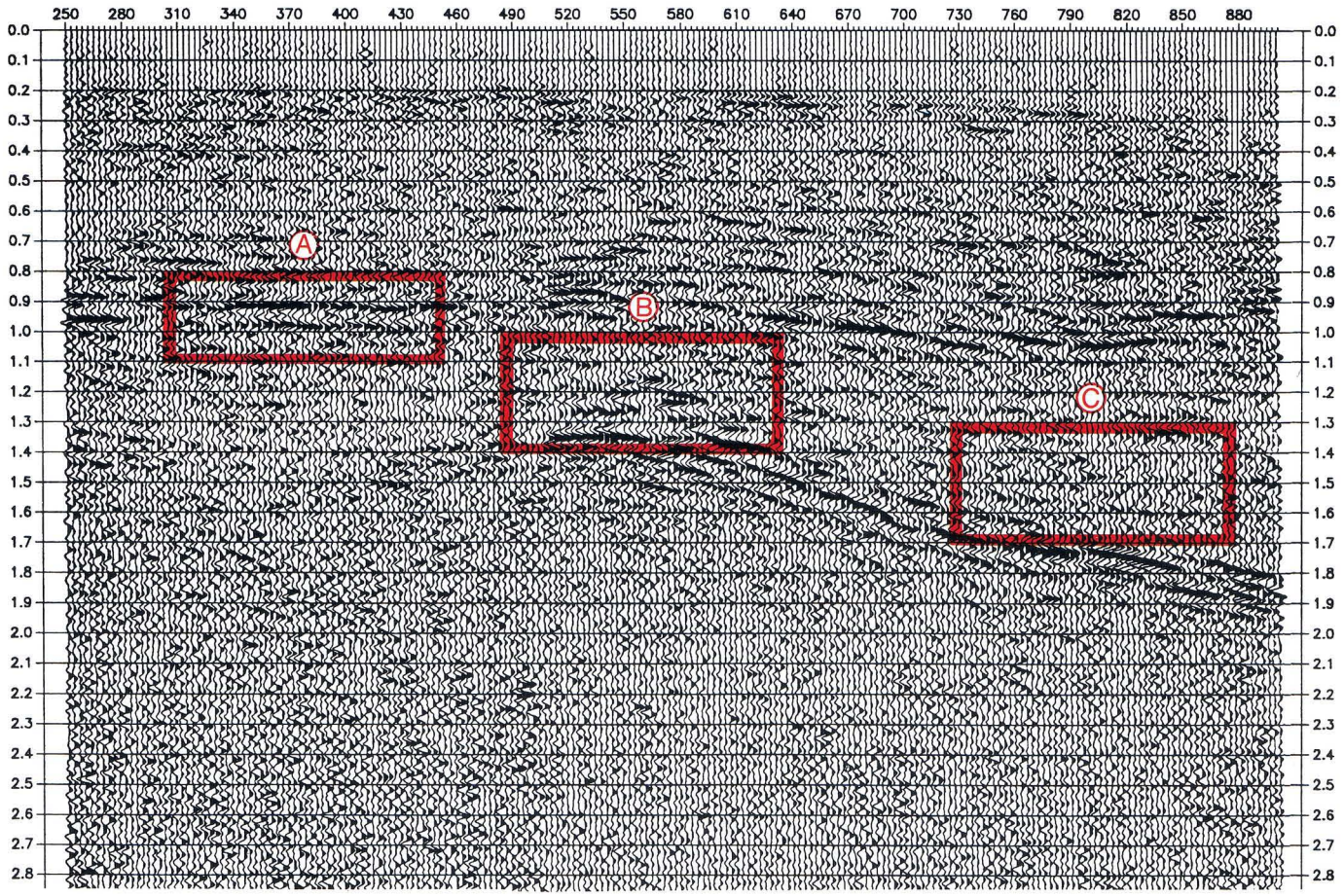


Fig. 3: Time-Depth-Time (TDT) transformed SV-wave section

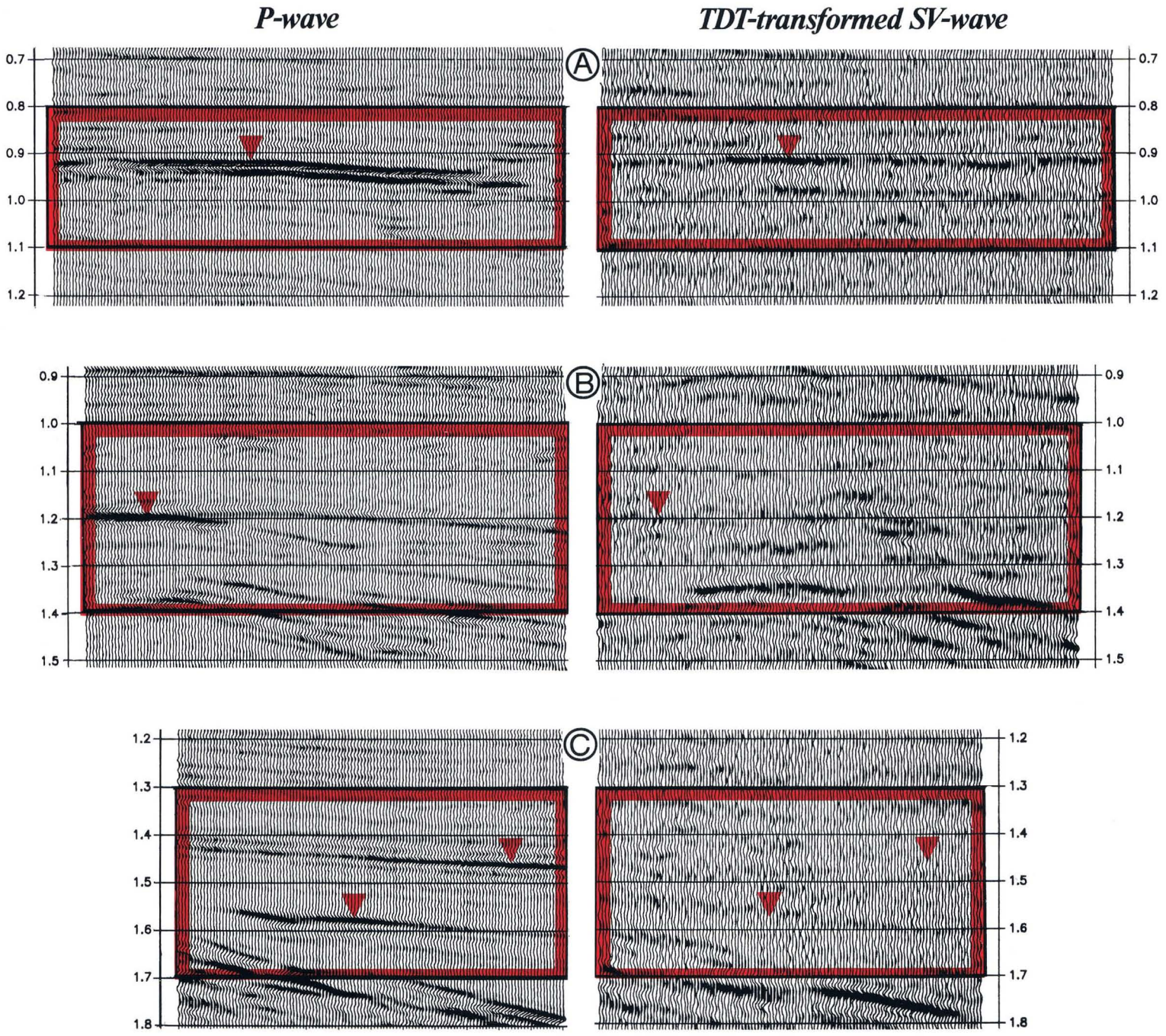


Fig. 4: The bright spots in the P-wave sections of B and C are "real", for no comparable reflections exist in the corresponding SV-wave sections. (The considerable amplitudes in the SV-wave section of A are caused by water-bearing gravel layers.)

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 389

ISSN 0933-7768