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# Separation of thin layered geological medium fields

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Within geological medium, as is known, various types of waves appear and multiply quickly and their propagation is accompanied by interferential phenomena. Complication of wave field is especially observable under condition of thin layered medium while conducting prospecting works by high frequency seismic methods. Application of more complex wave fields for studies of quantitative and qualitative features of geological medium is able to bring to incorrect conclusions. Therefore, for example, for solving the problems of seismic studies based on dynamic factors wave fields are to be of the same type and not damaged by accidental and regular waves-disturbances.

In our case difference method will be used which has physical basis under it [Gryn' M., Gryn' D., 2003]. The process of appearance, propagation and multiplying of various waves is accompanied by their interference. Therefore it seems natural to use procedures inverse to additive process: the search of algorithms for definition of form of separate waves or their groups and successive separation of the wave fields and their extraction. Difference method of target wave separation which is worked out is such one when according to direction of dominant wave on the temporal section or according to direction of assumed travel-time curve the differences between each pair of adjacent tracks are being determined successively. In this case, let us remind shared elements are extracted. However adjacent tracks of residual wave field superpose with inverse sign, in other words they are dubbed and on the edges of running processing windows the signals of target waves remain, therefore edge effects arrear, and for solving the problem we have conditions on the edges. Operators of bringing residual waves to initial form but with already extracted target waves have been worked out for elimination of dubbing and taking into account edge conditions.

Temporal section of target waves was determined as difference between input wave field and residual one. The procedure of target wave separation may be repeated in the direction of other dominant waves or according to other travel time curves.

Let us note that under land surface conditions of observation essential reason of instability of wave field effects of HFF may be considered with its variability of parameters, conditions of excitation and observing, and the major disturbances strong surface channel and main fields which superpose all the band of frequencies of reflected waves. Residues of these waves-noises have negative effect on the results of data processing by their dynamic properties.

Let us give an example of application of difference method on averaging of several tracks in the running window along the given direction according to the results of CMP obtained in the area near West Donbas mine, the Ternavska anticline (Fig. 1, *a*). The main disturbances for these data are residual modes of surface wave which frequency range coincides with frequency of useful reflected waves. The velocity of such waves is about 350 (±100) m/s. They have the same energy of amplitude as reflected waves and are present along all the profile.

The running window within which seismic tracks are averaging and separation of target waves and waves-noises takes place was realized on the base of 60 m, that is only 3 tracks are involved with a step of observation between them $\Delta x$=30 m. Sharpness of characteristics of the direction of a group of seismic receivers depends on the observation base. Under conditions of sub-horizontal occurrence of reflecting horizons the effect of the base upon tar-

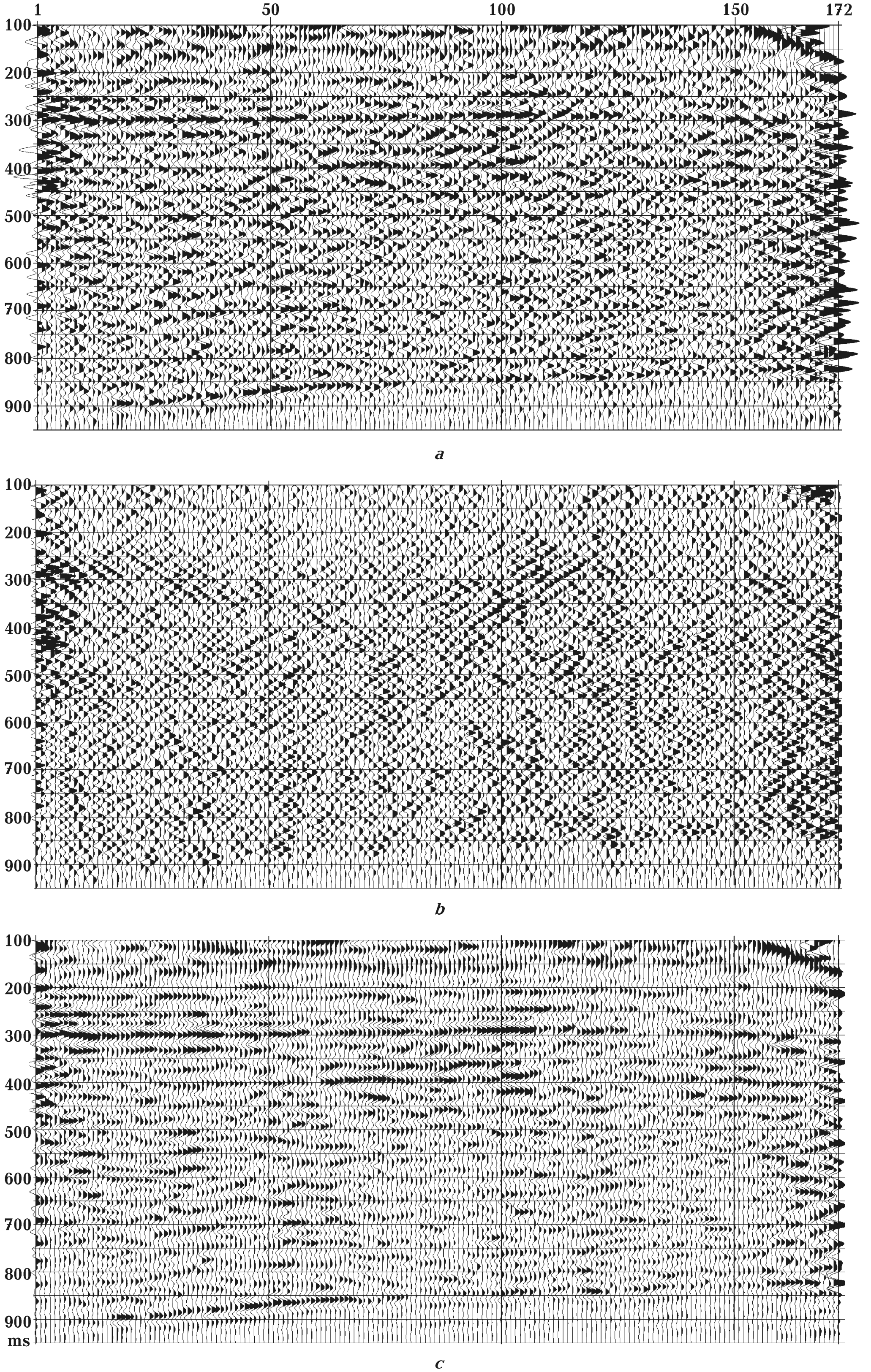


Fig. 1. Results of separation of reflected waves and waves-disturbances by difference method (Ternavska anticline, areas near West-Donbas mine): *a* — input data CMP; *b* — residual temporal section; *c* — temporal section of target reflected waves CMP.

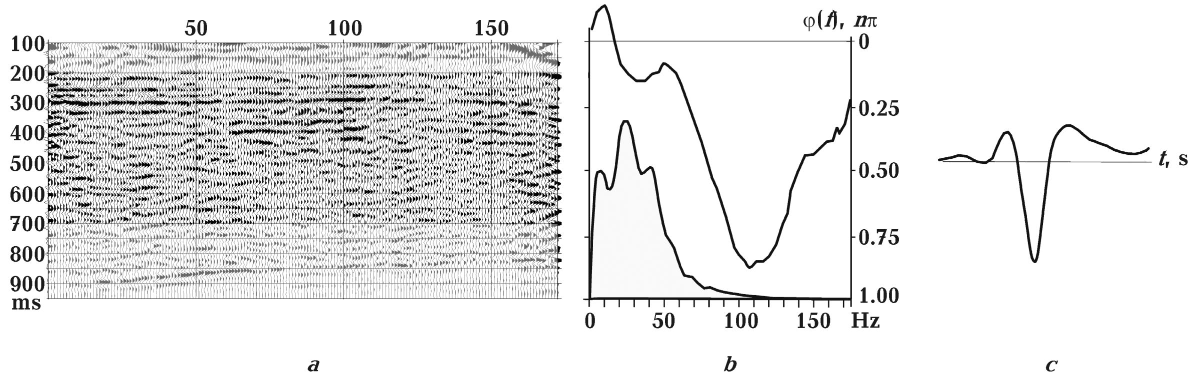


Fig. 2. Elementary signal obtained from the temporal section of target (sub-horizontal) reflected waves (CMP, Ternavska anticline, the area near West-Donbas mine): *a* — wave field used for statistical accumulation, *b* — AFH of elementary signal, *c* — elementary signal.

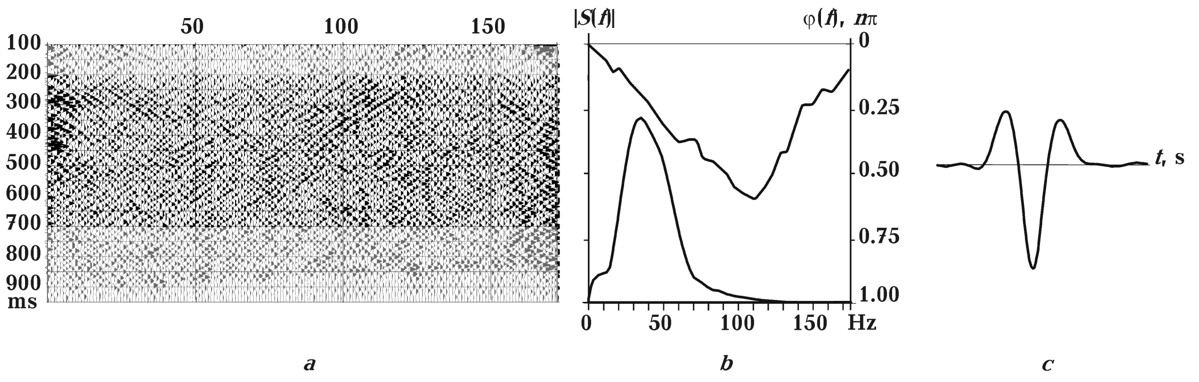


Fig. 3. Elementary signal obtained from the temporal section of the field of the residues of surface waves (CMP, Ternavska anticline, the area near West-Donbas mine): *a* — wave field used for statistical accumulation, *b* — AFH of elementary signal, *c* — elementary signal.

get waves is not strong but is observable on the residual temporal section. In this case the base is small and the angle of direction is wide. As a result of applying differential algorithm, on the residual temporal section (Fig. 1, *b*) diffracted waves and residual modes of surface waves have been revealed as well as disordered vibration slightly intense process.

Target waves on the temporal section (Fig. 1, *c*) are not complicated by disturbances, their dynamic and kinematic indications are not changed. They acquire stability and accuracy concerning input reflected waves, they are well correlated.

Non-complicated wave fields can be used, in particular, for determination of elementary signal that is an important stage for interpretation of seismic data. It is known that seismogram consists of impulse characteristics, elementary signal and different by their origin waves-disturbances. Temporal and spatial change of elementary signal gives additional information about physical properties of geological medium. It is as well important for increase of resolving capacity of seismic data because it is used in deconvolution.

For separation of elementary signal from seismograms statistical method of accumulating amplitude spectrum and continuous phase spectrum in complete angles [Gryn' M., Gryn' D., 2005], because there is a possibility of application of some elements of statistical analysis to them, in particular, determining of their mathematical expectation $M[\varphi(\omega)]$ through the whole range of frequencies of the signal spectrum.

As one can see from the given Figures elementary signal obtained from the target waves is change to some extent. It can be explained with the fact that reflecting boundaries coincide with the direction of statistical summation. As a result amplitude spectra are reinforced and complicated by deflections. The signal, depicted in Fig. 3 does not have this deficiency and looks as a "classical" elementary signal. It can be used for processing of fact materials by the method of phase de-convolution.

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# The atmosphere heating due to wideband acoustic and shock waves propagating

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Acoustics waves propagating in the stratified atmosphere influence on its state. One of such mechanisms is the heating of atmosphere due to wave dissipation. It is well known [Golicyn, Romanova, 1968; Romanova, 1970] that the stratification of the atmosphere leads to some important effects associated with acoustics wave propagation. First of all is the exponential increase of velocity of particle of medium. It's mean that the nonlinear effects must be taken in account. The second effect is the significant increase of effective coefficient of dissipation. In addition, nonlinearity leads to formation of shock waves with narrow shock front. Finally the wave dissipation and corresponding energy flow is more significant in stratified atmosphere.

Acoustic waves are the important mechanism of interaction between different geospheres. Waves generated due to seismic activity and earthquakes influence on the atmosphere state. This phenomenon is important for prediction of long distance wave propagation, weather forecast and so on. Another application is the investigation of seismic activity themselves and prediction of strong seismic events [Gusev, Sobisevitch, 2010].

For wave profiles in stratified atmosphere the analytical solutions at large heights were obtained :

for periodical initial sinusoidal signal

$$V_S = \frac{1}{1+s}\left(-\theta + \pi \tanh\left[\frac{\pi}{4\Gamma(1+s)}\left(1+\sqrt{1+\frac{8\Gamma(1+s)^2}{\pi^2 s_0}}\right)\frac{\theta}{1+s/s_0}\right]\right), \quad -\pi < \theta < \pi ,$$

where the term with hyperbolic tan describes the shock front; and for positive phase of single *N*-shaped impulse

$$V_N = -\frac{\theta}{1+s} + \frac{1}{2\sqrt{1+s}}\left(1+\tanh\left[\frac{1}{4\Gamma\sqrt{1+s}}\left(1+\sqrt{1+\frac{8\Gamma(1+s)}{s_0}}\right)\frac{\theta+\sqrt{1+s}}{1+s/s_0}\right]\right), \quad -\sqrt{1+s} < \theta < 0 \cdot$$

Here $\theta = t - x/c_0$ is the retarded time, $s = \frac{2H}{z_{nl}}\int_0^x e^{x/2H}dx = 2H\left(e^{x/2H} - 1\right)$ is the effective distance, $x$ —