PS Experience of High-Frequency Seismic Data Processing in the Black Sea Offshore*

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Abstract

During 2009-2010, on the JSC «Nadra Concern» Computer Center has executed the high-frequency seismic-acoustic data processing within the limits of the Black Sea shelf (north-western offshore part). Data processing was executed with the use of the Echos package (former Focus, Paradigm Company) on the workstations SGI O2 and SGI Origin2100 server (Silicon Graphics Inc.).

High-frequency seismic observations were executed on a ship “Topaz” (“Prychornomor DGRP” company) with use the following equipment and observation parameters:

- “Bolt” air gun, distance between shotpoints 12,5 m;
- “Xzone Bottom Fish” geophone cable with 48 channels;
- “Xzone Bottom Fish” seismic station, record length 2 s, sampling rate 0,5 ms.

At work a basic attention was paid to elaboration of the advanced processing sequence for high-resolution data with the following purposes:

- increase of information value and depth of upper part of time section;
- efficiency evaluation of different types of migration algorithms.

It should be noted, a characteristic feature of high-frequency data, namely a too small interval between the receiver point – 3,125 m, that result is the extremely high information density on the linear kilometer of seismic line – 640 CDP traces with a step 1,5625 m and complicates a visual control of information.

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It is necessary to give determination for high-frequency observation. The high-frequency seismic survey (HFS) is the seismic method, in which the acoustic waves with frequency range from 70-80 to 300 Hz are used (Bembel, 1990; Telegin, 2004). The HFS method gives a possibility to research the thin-layer objects which are specific for the Black Sea shelf, mapping of low-amplitude structures, nonstructural hydrocarbon traps etc.

As a result of the completed high-frequency data processing, observed within the north-west Black Sea shelf, it is possible to conclude the following:

- The optimum sequence of the detailed processing of high-frequency seismic data was produced.
- Most effective type of post-stack time migration in the conditions of high noise level is finite-difference migration in "omega-x" domain.
- The results of high-frequency seismic data processing are extremely detailed and testify to enough high depth of research and give rise to assert that at the further offshore seismic works with the use of high-frequency seismic method it is possible to recommend the increase of record length up to 2 s.

References

Bembel R.M., 1990, High-frequency three-dimensional seismic prospecting: (in Russian language) Novosibirsk, Nauka, Russia, 152 p.

Telegin A.N., 2004, Marine seismic survey: (in Russian language) Moscow, Russia, Geoinformmark Press, 237 p.

Experience of high-frequency seismic data processing in Black sea offshore

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INTRODUCTION

During 2009-2010 years, the high-frequency seismic-acoustic data processing got in the area of the Black Sea shelf (north-western offshore part). has been executed in the JSC «Nadra Concern» Computer Center. Data processing was performed with the use of the Echos package (former Focus, Paradigm company) on the workstations SGI O2 and SGI Origin2100 server (Silicon Graphics Inc.). High-frequency seismic observations were executed on the ship "Topaz" ("Prychornomor DGRP" company) implementing the following equipment and observation parameters:

Recording instrument details

Recording system	Xzone Bottom Fish
Format	SEG-D, 8058-IEEE
Sample rate	0.5 ms
Record length	2000ms
Low cut filter	20 Hz

Spread geometry

No. of Channels	48
Recording base	146,875 m
Station interval	3,125 m
X min	60 m
Immersion depth	2 m

Source parameters

Source type	
No. of air guns	1
No. of lines	1 line
Total volume	5 inc
Source point interval	12.5 m
Pressure	140 Atm
Immersion depth	2 m

Fig1. Seismic survey ship

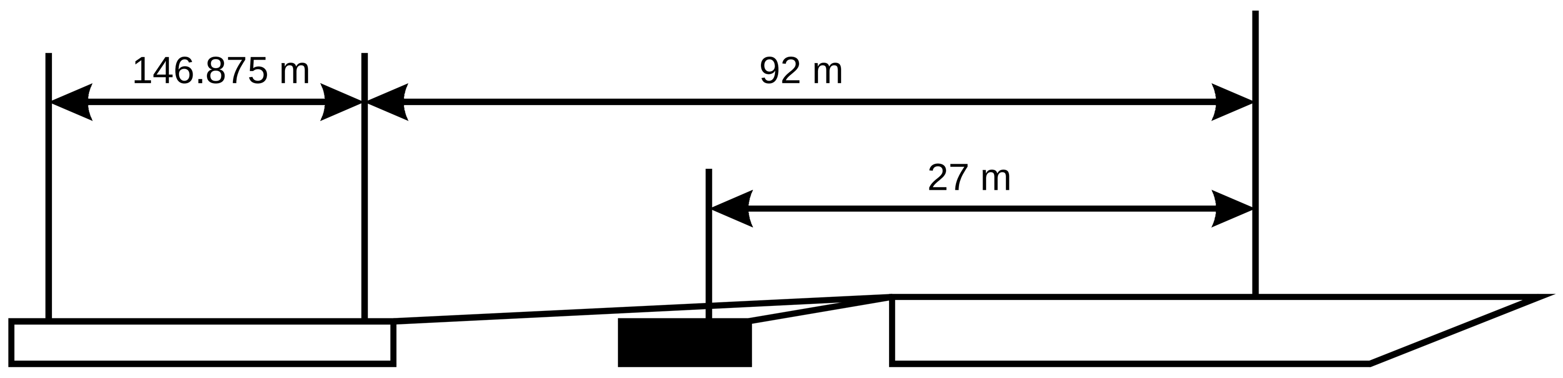
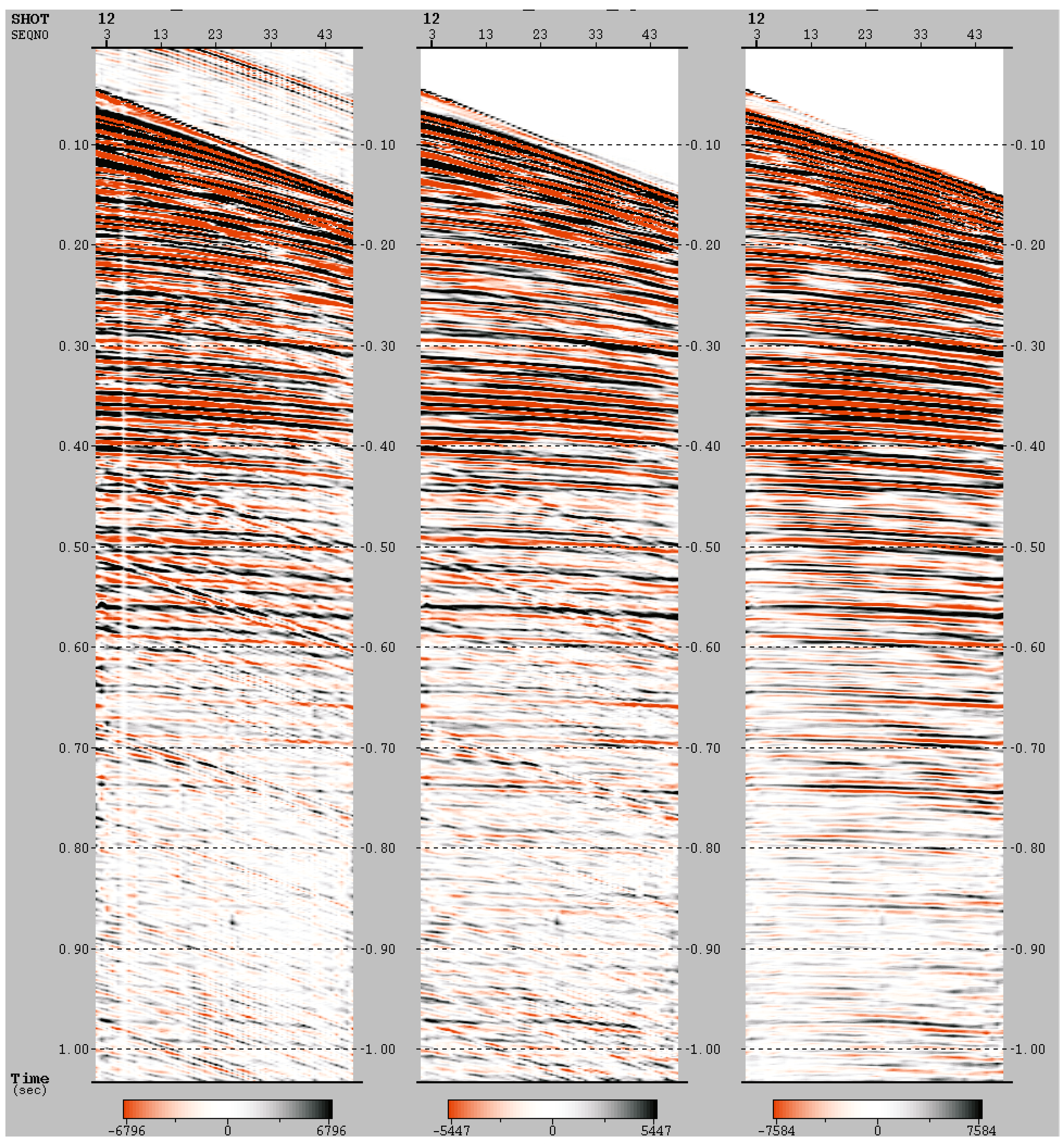


Fig2.Navigation system "Pilot"

DATA PROCESSING



a) b) c)

Fig3. Common-shot gathers illustrate a) input data, b) after deconvolution, c) multiple attenuation

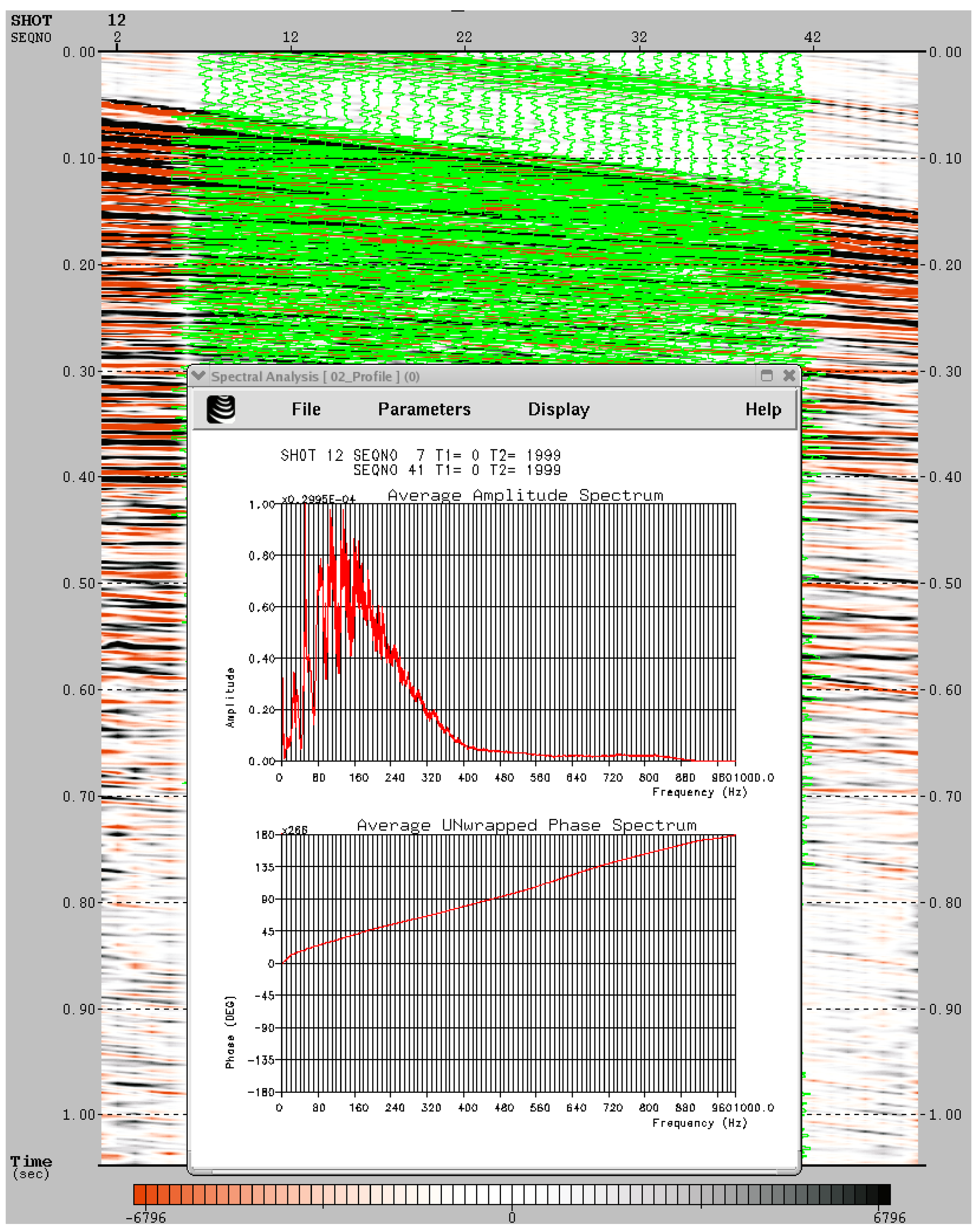


Fig4. Spectral analysis of input shot gathers

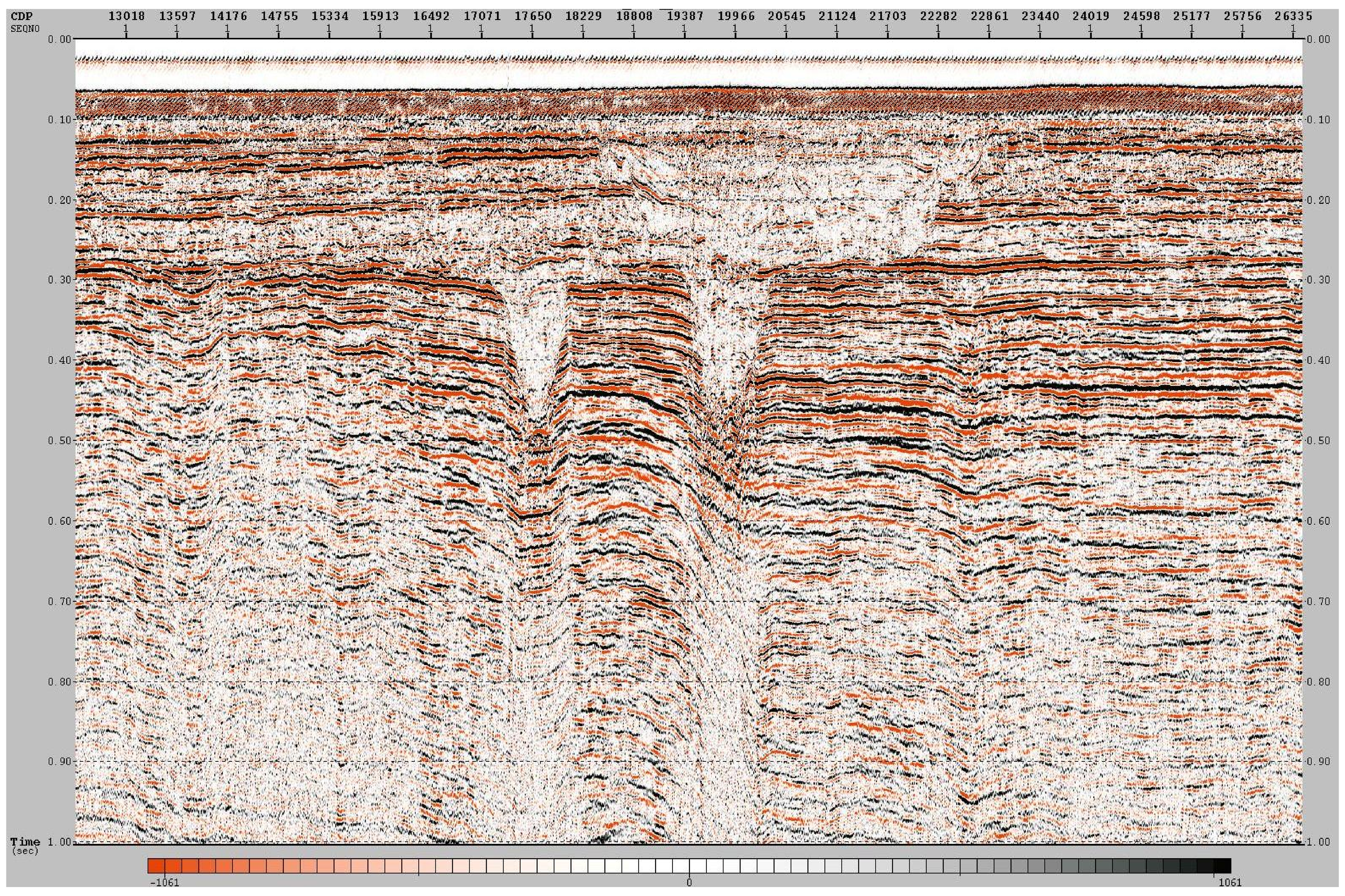


Fig 5. Raw stack

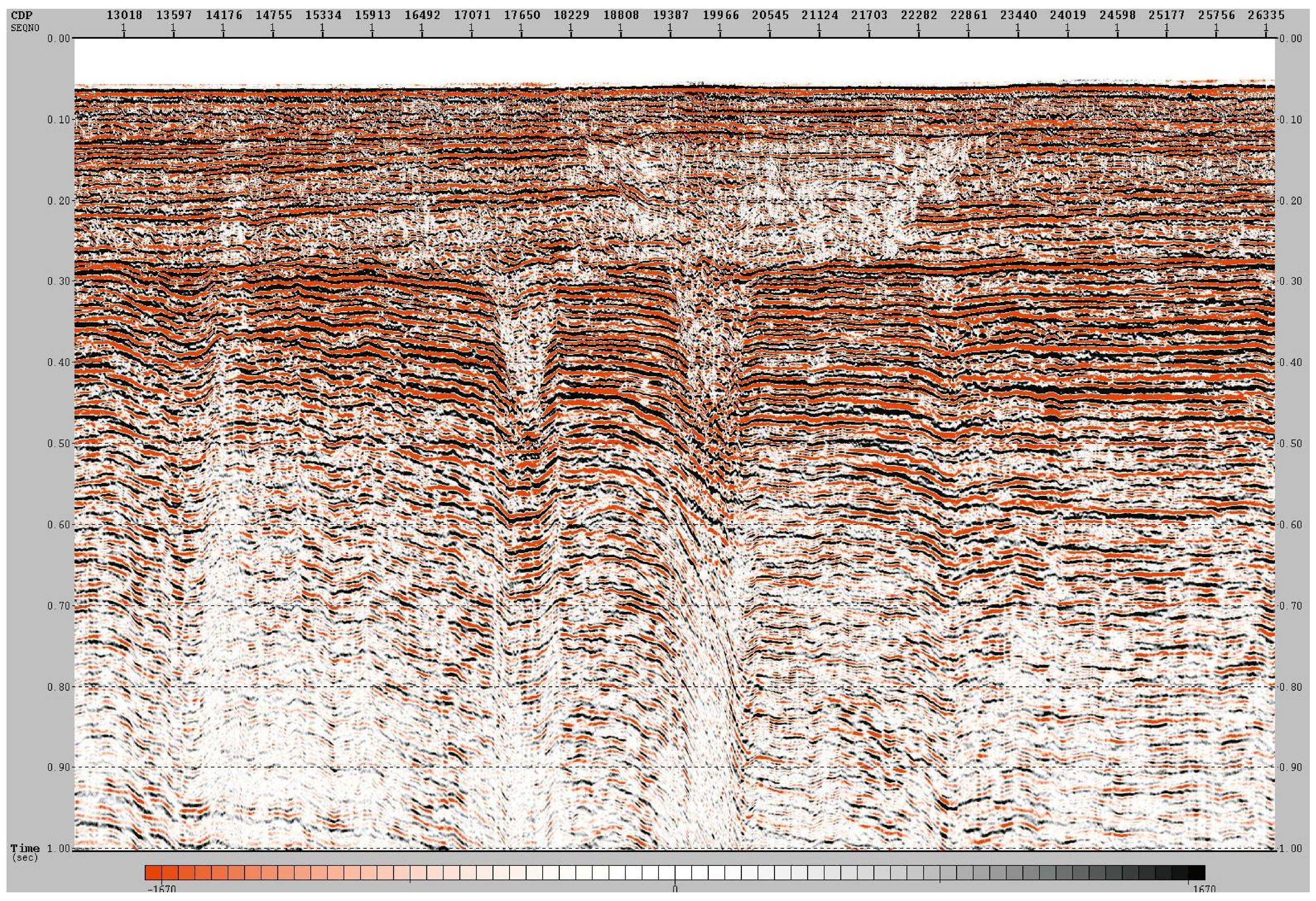
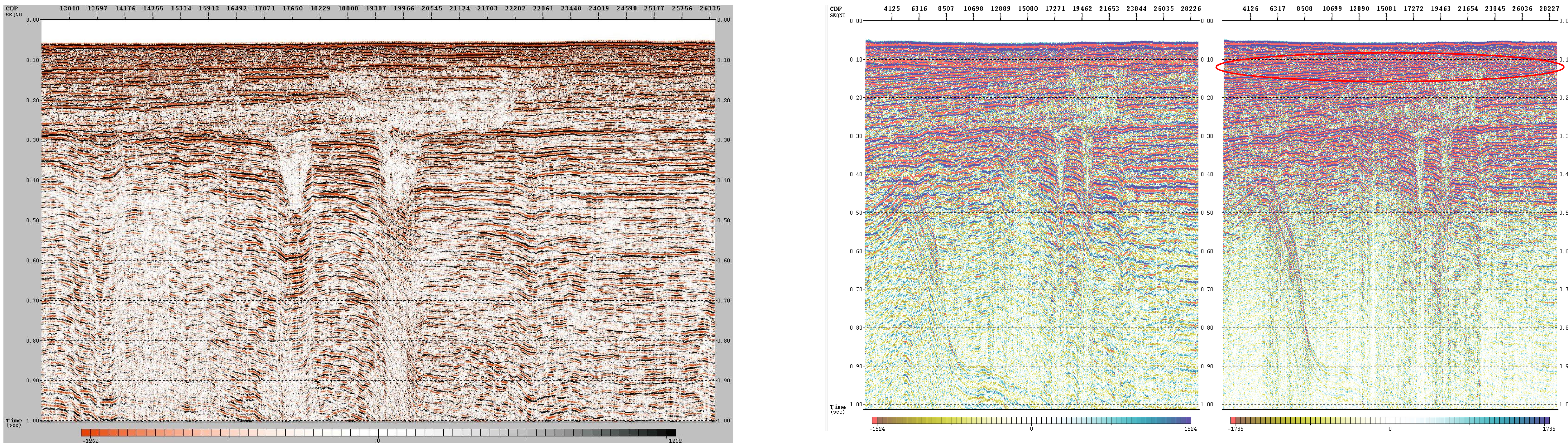


Fig 6.Stack after predictive deconvolution

Several ways of multiple attenuation



a))b

Fig 7.Illustrates two stacks after multiple attenuation based on the overcorrection method with different input parameters.

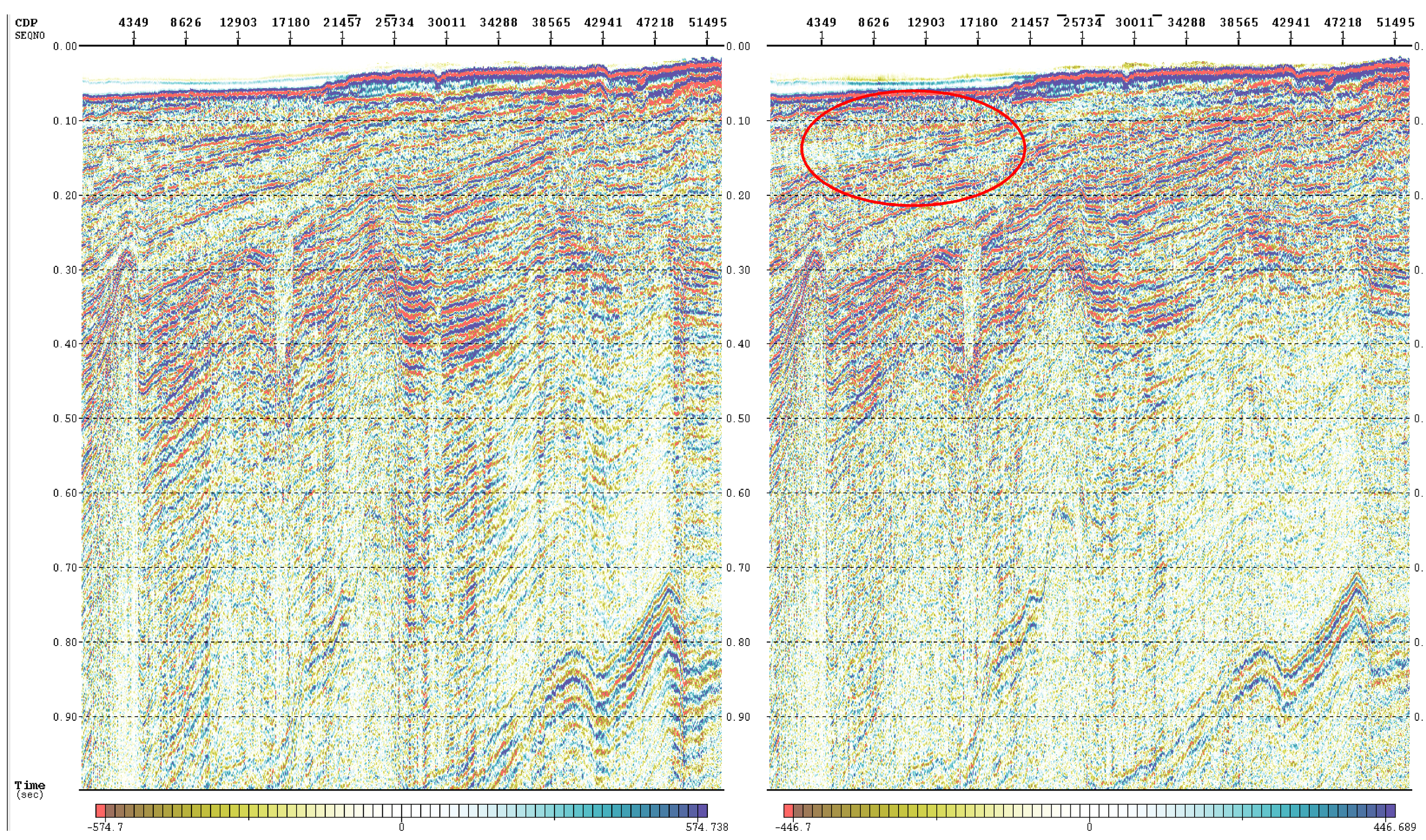


Fig 8. Stack after multiple attenuation based on the adaptive gap deconvolution method

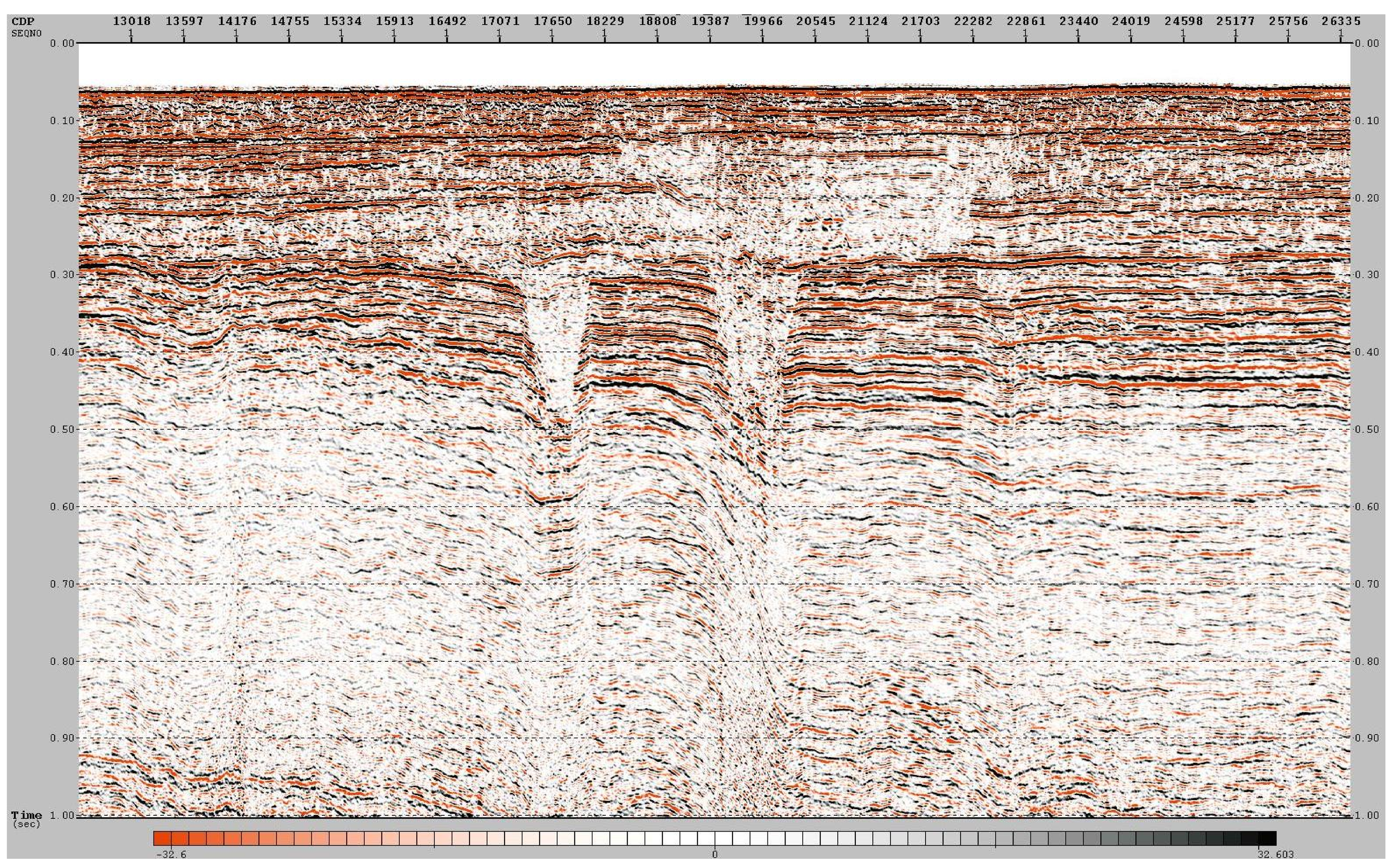


Fig 10. Omega-X finite difference migration