



TESTING METHODOLOGY OF ACQUISITION PARAMETERS OF 3D HIGH DENSE SEISMIC TO INVESTIGATE LOWER PALEOZOIC SEDIMENTS FOR THE DETECTION OF UNCONVENTIONAL GAS DEPOSITS - WIERZBICA AGH 3D PROJECT

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Introduction

The Wierzbica AGH 3D project was undertaken in order to verify the effectiveness of the high-resolution 3D seismic method to identify the Silurian and Ordovician layers in the area of the Lublin basin. They are characterized by low impedance contrasts, which lead to a low signal-to-noise ratio observed on previously recorded seismic data, where traditional acquisition parameters were applied. The high dense method is based on decrease of the shot/receiver points and lines intervals. It significantly rises the acquisition costs, but in return we obtain several times higher fold of coverage, highly affecting the imaging quality of final migrated sections. Additionally increase of the sampling of the seismic wavefield ensures the better performance of the data processing procedures. The applied testing methodology aimed at optimization of the acquisition parameters at the stage of preliminary works and later on recording of 3D high dense data. It can be implemented in similar seismic projects in the future.

Methodology

As the first step, 2D archival seismic data located in the vicinity of the selected boreholes were processed up to the depth migration stage. The interpretation of the processed datasets included the analyses of seismic attributes to the deepest expected target, i.e. Ordovician layers. The seismic records were investigated in terms of the velocity field distribution of primary and multiple reflections, necessary offset ranges as well as estimation of the approximate muting parameters for the needs of seismic imaging of the particular Paleozoic horizons. The observations helped to design the short, three days acquisition test program based on recording of seismic wavefield along the single receiver line in eight parameterization variants. They differed in: number and duration of the sweeps; sweep frequency range; sweep type. The prestack time migration work flow elaborated during processing of the archive lines was applied in order to compare the tests results. A nested 3D survey, located around Stręczyn OU-1 well, was recorded during acquisition of classic, low fold 3D survey (Wierzbica OU 3D project) of about 150 sq. km. The high density (up to 2400 fold of coverage) Wierzbica AGH 3D survey enabled the series of tests allowing, among others, to analyse the impact the acquisition parameters such as: the interval of the receiver and source lines, as well as the distance between of source and receivers points. The tests were evaluated through comparison of prestack time migration section. Furthermore, we employed procedures dedicated primarily for other purposes than those applied in this study, i.e. the seismic inversion procedures (SparseSpike method) and seismic attributes (amplitude variance) distribution maps analysis.

Results

The authors have developed a comprehensive test evaluation method in order to research geological regions characterized by seismic boundary with low reflectivity. Additionally, this study resulted in compiling of a list of recommendations for survey design that include suggestions for vibrator source parameters selection (sweep time, number of sweeps, etc.) and acquisition geometry parameters of the survey (intervals of; source and receiver lines, points, maximum offset, etc.). Presented proposals take into account the need to optimize the costs of seismic works.

The comparison of migrated high resolution seismic section Wierzbica AGH 3D recorded within the fragment of the Wierzbica OU 3D seismic project, where the receiver and shot points lines distances have



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not been reduced, shows that this technology increases the wavefield resolution, allows to confirm ambiguous tracking of researched horizons or modify the structural interpretation based on traditionally recorded data.

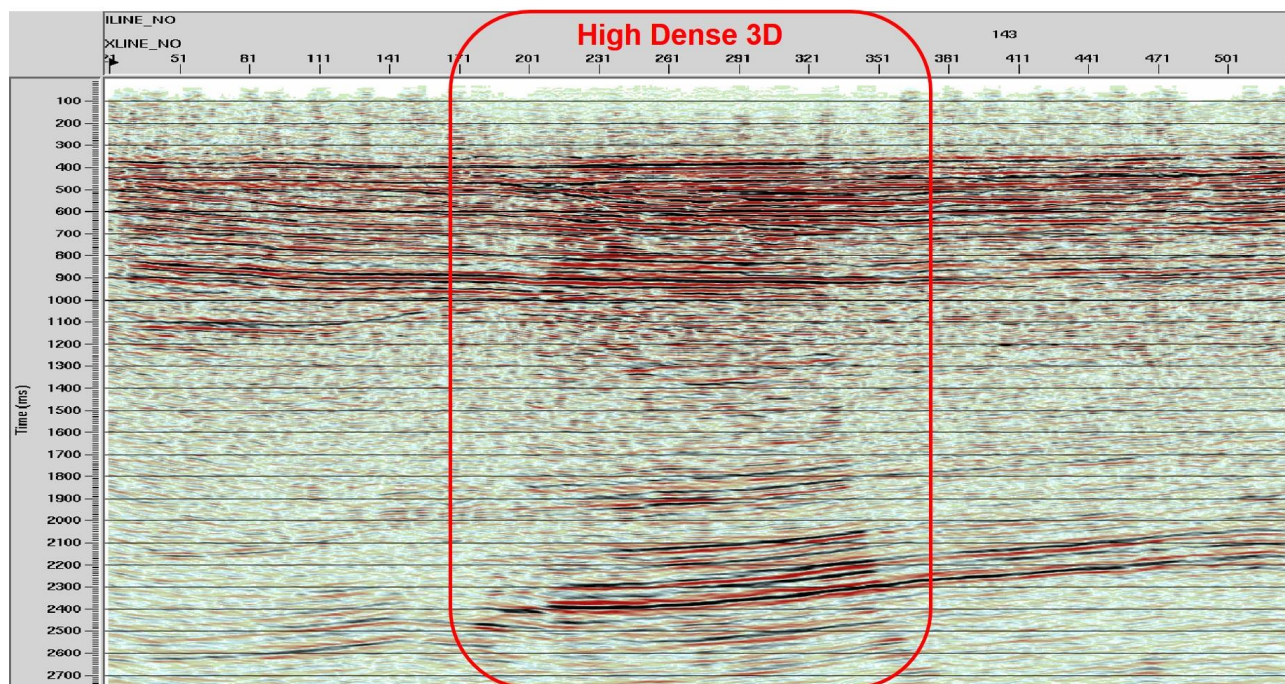


Figure 1 Inline 143. Prestack time migration. High dense Wierzbica AGH-3D data (in red frame) imposed on processing results of traditionally (nine times smaller fold of coverage) parameterized 3D seismic survey.

Conclusions

A multi-aspect analyses of initial 2D test program (recorded at preliminary stage) and acquired 3D high dense seismic data allowed to present the recommended methodology of verifying tests results related to acquisition parameters. It contains instructions related to source and receiver patterns, sweep attributes, which can be implemented during designing of future seismic surveys focused on research of the Lower Paleozoic strata.

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