3C SEISMIC DATA PROCESSING AND INTERPRETATION – A CASE STUDY FROM CARPATHIAN FOREDEEP BASIN

Żaneta SZYMAŃSKA-MAŁYSA[1] and Paweł DUBIEL[1]

[1]*AGH University of Science and Technology, Faculty of Geology Geophysics and Environmental Protection, Department of Geophysics, al. Mickiewicza 30, 30-059 Krakow, Poland; zmalysa@agh.edu.pl*

Introduction

Multicomponent seismic plays significant role in supporting reservoir analyses related to accumulations of oil and gas. 3C data, which were being analyzed, consisted on standard PP records and 2 non-standard PS components of the wavefield (PSx and PSy). In general, converted wave recordings generate significant costs and difficulties in acquisition, processing and interpretation (Farfour and Jung Yuun 2016). The aim of the research was to develop the optimal relative amplitude processing (RAP) sequence which would increase the reliability of the seismic interpretation of 3-component data in the area of Chałupki Dębniańskie. Due to the specific properties of S wave we could provide valuable information regarding amplitude anomalies and verify the potential gas accumulations.

Data characterization and processing flow

The experimental 2D-3C profile is located in the Carpathian Foredeep Basin, Poland. Gas reservoirs are generally located in Miocene which is represented by the following sediments: lower Badenian, middle Badenian, upper Badenian and Sarmatian (Jezierska and Keller-Utracka 2003). In direct vicinity of seismic profile two wells are located (CHD-2 and CHD-3 – location shown on figure 1). Both are reaching the top of the Precambrian. Wells contain basic logs (GR, RHOB, DT, VSH, NPHI, SW and SP), but there is no measurement of the interval time of the S wave for the entire cross-section.

Processing flow of PP recordings included typical processing steps, such as: preprocessing, coherent and random noise attenuation, field and residual statics, velocity analyses, surface consistent amplitude scaling and deconvolution, prestack time migration, stacking and standard post-stack processing. The fundamental differences in PS processing were related to the specific properties of converted waves (Brown et al. 1999), in particular: (1) data rotation, (2) estimation of the receiver statics and (3) estimation of V_P/V_S and common conversion point binning.

Results

As the result of relative amplitude processing authors generated three sets of prestack gathers, as well as three seismic sections: PP, PSx and PSy. Wells were tied to the seismic section with the statistical wavelet extracted from seismic data. Main difficulty regarding well-to-PS seismic sections tying was the use of correct S wave velocity, which was interpreted during processing (Dubiel 2018). PSx and PSy sections were recalculated using interpreted V_P/V_S. On figure 1 two seismic sections are presented (PP and PSy). On PP seismic section (figure 1a) water saturation (green curve), gamma ray (black curve) and selected top formations are shown. Potential gas accumulations are related to high amplitudes on PP section and are located in red boxes. There is strong correlation between CH-2 well log results and seismic image in the central part of the PP profile (figure 1a – high amplitudes correlate with decreased water saturation). In CH-3 well water saturation indicates increased gas content in the whole well interval. Therefore, seismic anomaly around 1100-1300 CDP does not correlate with gas content information. PSy section (figure 1b) gives additional information about potential gas accumulations. Amplitudes of the signal in red boxes on figure 1b are also increased, which can indicate that anomalous amplitudes are not the result of a gas existence.

Conclusions

Obtained datasets with preserved relative amplitudes can be the basis for detailed seismic interpretation which can give answer to very important question: Which of the perspective zones are worth drilling? On the

datasets several reservoir analyses, including seismic attributes, seismic inversion and AVO/AVA analysis, were conducted. The integrated analysis confirmed existence of reservoir which was characterized by good reservoir parameters (central red box on figure 1), as well as existence of non-productive zones which have been misinterpreted in previous studies (Jezierska nad Keller-Utracka 2003).

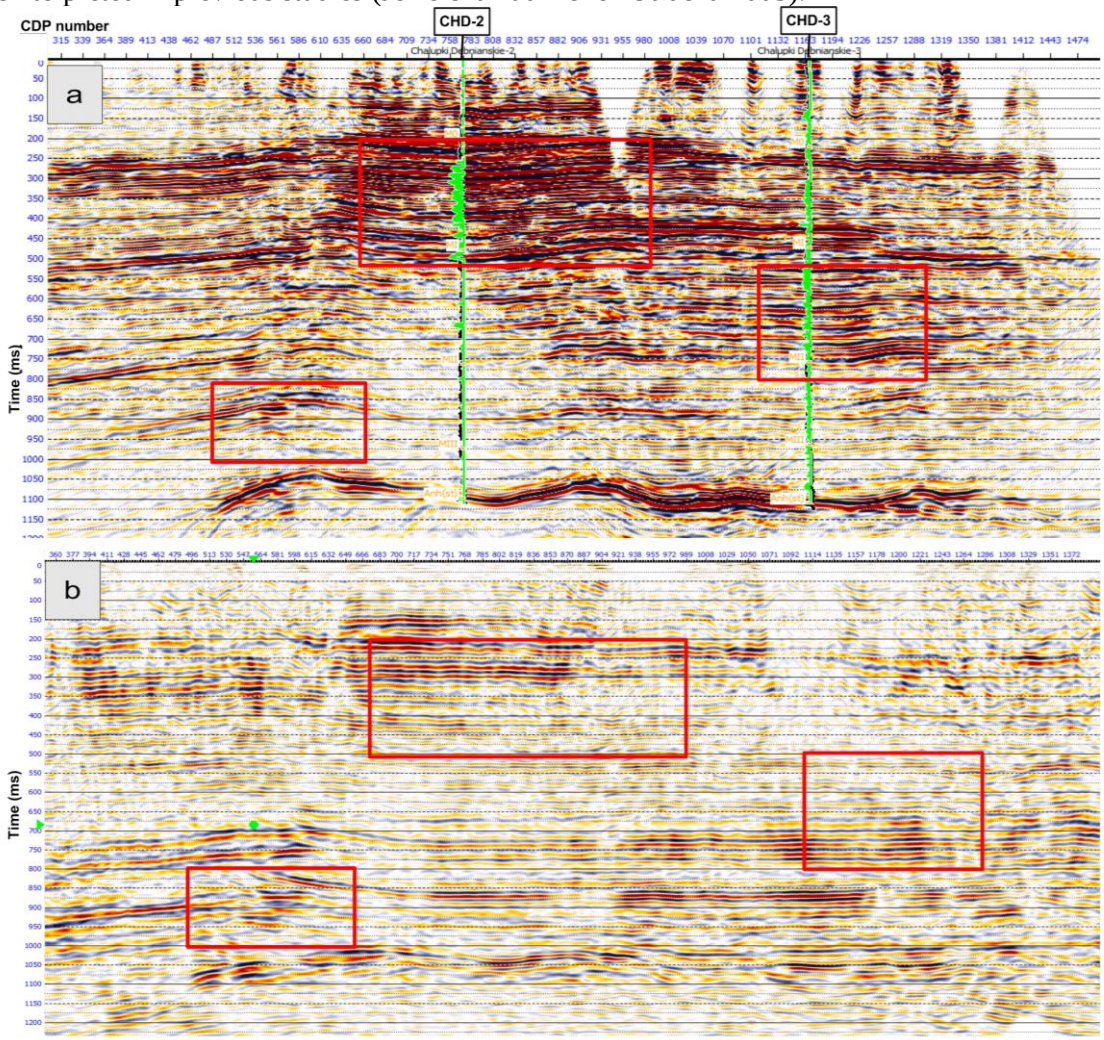

Figure 1. *Comparison of (a) PP seismic section and (b) PSy wave seismic section (in time of PP wave). Two wells are shown. Potential gas accumulations are located in red boxes.*

Acknowledgements

The analyzes used in the article come partly from the master's thesis (Dubiel 2018). Authors thank Polish Oil and Gas Company, Warsaw, Poland for providing seismic and well log data.

References

Dubiel P., 2018. Reprocessing of seismic line Chałupki Dębniańskie 2D-3C for reservoir analysis. MSc thesis. AGH UST, Faculty of Geology, Geophysics and Environmental Protection, The Main Library, AGH (in Polish with English abstract).

Brown J.R., Gaiser J.E., Lawton D.C., Stewart, R.R, 1999. Converted-wave seismic exploration: a tutorial. CREWES Research Report, 11.

Farfour M., Jung Yoon W., 2016. A review on multicomponent seismology: A potential seismic application for reservoir characterization. Journal of Advanced Research, 7(3), 515-524.

Jezierska E., Keller-Utracka E., 2003, Opracowanie wyników badań sejsmicznych Chałupki Dębniańskie 2D-3C, Geofizyka Kraków SA (in Polish).