

Amplitude versus offset analysis as a tool for identification of gas reservoirs in thin beds of the Carpathian Foredeep.

Abstract:

PhD thesis presents usefulness of amplitude versus offset analysis (AVO) for the purposes of verification potential gas pay zones in the thin-bedded Miocene fill in southern part of the Carpathian Foredeep.

The first chapter of the thesis covers the theoretical background of AVO effect in seismic record. The influence of elastic and petrophysical properties on the seismic waves propagation, equations that describe amplitude variations with offset/angle of incidence and classification of AVO behavior is described. This chapter also includes selecting of appropriate seismic data acquisition parameters and the principles of seismic data processing for the purposes of AVO analysis. The next chapter is devoted to detailed description of seismic reservoir characterization using AVO reflectivity and impedance methods. The geological structure of the Carpathian Foredeep and development of Miocene fill is also described. The main chapter presents application of amplitude versus offset analysis on the three selected seismic surveys located in the southern part of the Carpathian Foredeep, which are characterized by a different petrophysical properties of reservoir rocks. In the area of seismic survey Waryś – Łętowice – Wierzchosławice the AVO methods were tested for the imaging of gas saturation in thick sandstones. The Trzciana – Cierpisz – Zaczernie region was used to answer the question of the possibility of gas saturation detection in muddy sandstone reservoirs using AVO analysis. In the area of Łańcut – Kańczuga seismic survey, AVO analysis was performed for zones, where commercial gas saturation were discovered in thin-bedded sandy mudstone reservoirs.

Presented results show the usefulness of AVO analysis as a tool for aiding seismic reservoir characterization in the thin-bedded Miocene sediments of southern part of the Carpathian Foredeep. Also the AVO attributes which are the most suitable for gas reservoirs characterization were chosen. It was shown that AVO effect arise from changes in the P-wave impedance and in a decrease of V_p/V_s ratio caused by gas saturation. But this phenomenon occurs in thick bedded sandstones as well as in heterolithic sandy mudstone, which can make identification of reservoir rock difficult. Furthermore, some commercial gas accumulation in

heterolithic reservoirs can have an unconventional nature of shale gas and tight gas. As the synthetic AVO modeling indicates, this type of gas reservoirs may not be visible on seismic data. Obtained results suggest that the natural gas potential in the Carpathian Foredeep has not yet been exhausted.