

Seismic Inversion for Geothermal Exploration

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Abstract : Amplitude Versus Offset (AVO) and simultaneous model-based impedance inversion techniques have not been utilized for geothermal exploration commonly; however, some recent publications called the attention that they can be very useful in the geothermal investigations. In this study, we present rock physical attributes obtained from 3D pre-stack seismic data and well logs collected in a study area of the NW part of Pannonian Basin where the geothermal reservoir is located in the fractured zones of Triassic basement and it was hit by three productive-injection well pairs. The holes were planned very successfully based on the conventional 3D migrated stack volume prior to this study. Subsequently, the available geophysical-geological datasets provided a great opportunity to test modern inversion procedures in the same area. In this presentation, we provide a summary of the theory and application of the most promising seismic inversion techniques from the viewpoint of geothermal exploration. We demonstrate P- and S-wave impedance, as well as the velocity (V_p and V_s), the density, and the V_p/V_s ratio attribute volumes calculated from the seismic and well-logging data sets. After a detailed discussion, we conclude that P-wave impedance and V_p/V_p ratio are the most helpful parameters for lithology discrimination in the study area. They detect the hot water saturated fracture zone very well thus they can be very useful in mapping the investigated reservoir. Integrated interpretation of all the obtained rock-physical parameters is essential. We are extending the above discussed pre-stack seismic tools by studying the possibilities of Elastic Impedance Inversion (EII) for geothermal exploration. That procedure provides two other useful rock-physical properties, the compressibility and the rigidity (Lamé parameters). Results of those newly created elastic parameters will also be demonstrated in the presentation. Geothermal extraction is of great interest nowadays; and we can adopt several methods have been successfully applied in the hydrocarbon exploration for decades to discover new reservoirs and reduce drilling risk and cost.

Keywords : fractured zone, seismic, well-logging, inversion

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