# Prediction of reservoir properties in carbonate and clastic sediments in the South Ural Foreland based on the results of elastic inversion

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Prediction of reservoir properties based on the results of elastic inversion is an important phase of oil and gas fields study. The performance of seismic class prediction is directly related to subsequent success in exploration and further production of the fields. The proposed approaches allow the identification of the saturated part in carbonate and sandy reservoirs. The study area is located in the south of the Ural Foreland. The main exploration targets are in the Middle Devonian to Lower Carboniferous sedimentary succession, which includes massive limestones, dolostones, interlayers of calcareous mudstones, argillaceous-bituminous carbonates, sandstones, coarse-grained siltstones and other clayey-silty-sandy rocks. The oil and gas deposits in the region are associated with both carbonate and terrigenous deposits of Devonian and Carboniferous age. The total thickness of the studied interval is about 2 km. The basement consists of deposits of Riphean-Vendian age, and its surface dips in an easterly and southeasterly direction. The structures of the sedimentary foreland are characterized by a regional subsidence of the strata in a south-southeast direction and a steady flattening of the structures from older to younger ones. The 3D seismic pre-stack and post-stack data as well as petrophysical logs from 4 wells were used to predict the reservoir properties and link the individual seismic lithoclasses. To determine the elastic properties, an AVO seismic inversion transformation was performed and a number of required parameters were calculated: P- and S-acoustic impedances, Poisson`s ratio (PR), Young`s modulus, rock brittleness, Lame parameters (MuRo and LambdaRo), porosity and other attributes. The average correlation of the obtained inverted attributes compared to the petrophysical data can be estimated at 79–84 % over the entire study interval. To separate the reservoir part of the carbonates of D2-L (lower Middle Devonian) and D3-M (middle Upper Devonian) formations, the distinction between density (Den) and porosity (Por) obtained by seismic inversion was applied. Cross-plot analysis of (Den) = f (Por, Br) with brittleness (Br) highlighted helped us to indicate the zone of carbonates development, which is divided into two parts: 1) zone of host carbonate rock; 2) zone of carbonate reservoir. The defined reservoir of the D2-L Formation is characterized by relatively low porosity, high density and high brittleness, which is usually present in fractured reservoirs represented by dolostones. Next, a cross-plot discrimination (Den) = f (PR, Br) was performed for the C1-T (Early Carboniferous) strata. In this reservoir, high density, high porosity and high brittleness are reported. To obtain sandy Lower Devonian (D3-P) reservoirs, cross-plots of MuRo = f (LambdaRo) and PR = f (AI) were used. Low value of MuRo, LambdaRo. PR and AI (P-Impedance) helped to indicate the sand type of the reservoir. Based on the derived information of the reservoir parts of carbonate formations D3-M, C1-T and the sandy formation D3-P, the seismic facies and net pay thickness maps were generated. The determined results were used for further reserve estimations and drilling programs.