Geophysical Research Abstracts
Vol. 21, EGU2019-3845, 2019
EGU General Assembly 2019

Joint PP- and PSV-wave AVO inversion of thin interbed reservoir

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With the deepening of oil and gas exploration, the simple large structural reservoirs in the world are almost exhausted. Subtle lithostratigraphic reservoirs will become one of the important targets of exploration in the future. In some basins in the east and west of China, most Mesozoic and Cenozoic petroliferous basins are dominated by thin-layer sandstone and mudstone deposits. Sand bodies in thin interbed reservoir are usually striped and abundant, which thicknesses are much less than seismic resolution, and lithology and thickness change transversely sharply. Therefore, there are great problems in seismic exploration for thin interbed reservoirs. In seismology, the whole formation of thin interbedded layers is often equivalent to vertical transversely isotropic (VTI) medium, which properties can be described by three elastic parameters and two anisotropic parameters. These five parameters can expressed by the functions of the elastic parameters of sandstone and mudstone in interbedded units and N/G (net-to-gross), respectively. N and G represent the total thicknesses of sandstone and thin interbed, respectively. Thus, we can also find the relation among the reflection coefficients of PP- and PSV-waves, the elastic parameters of sandstone and mudstone in interbedded unit and N/G. In this work, we propose a joint PP- and PSV-wave AVO inversion method for thin interbed reservoir. By using the difference method, we establish the partial derivative relationship between the Rüger's reflection coefficients of PP- and PSV-waves on the elastic parameters of sand and mudstone and N/G. Based on that, we build Jacobian and Hessian matrices for the least squares prestack inversion. Our method has been proved to have good anti-noise performance in the test of forward simulation data. In the application of practical work area, we have successfully identified thin interbedded tight sandstone reservoir using our inversion method.