Correlations between Thermal and Sonic Anisotropy for Low-Permeable Reservoirs

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Rock anisotropy plays an important role in geophysics. Knowledge of thermal anisotropy is necessary for reconstruction of thermal history of a basin and analysis of temperature logging data, while an acoustic anisotropy in sedimentary rocks has a significant impact on seismic processing and reservoir characterization. However, determination of anisotropy for real problems is a complex procedure usually. Common measurements on cores require sampling several plugs in different directions that led to the problem of rock heterogeneity influence. Moreover, full size cores will be destroyed in this case, that makes the approach time-consuming and not reliable often. Determination of anisotropy from sonic logging depends on the quality of the acoustic signal, borehole and mud conditions as well as the direction of the borehole with respect to the anisotropic axes of symmetry.

To improve quality of rock anisotropy study we combined the sonic logging data with fast, non-contact non-destructive measurements of principal thermal conductivity tensor components on more than 2000 full-size cores. It provided a comprehensive analysis of variations in thermal and acoustic anisotropy along two wells drilled in low-permeable formations in West Siberia (Russia). Strong correlation between thermal and acoustic anisotropy was established within Bazhen formation (B.fm.). It can be used for prediction of acoustic anisotropy via results of thermal profiling on cores in the intervals, where quantitative analysis of sonic log is impossible (If core is absent, thermal anisotropy can be estimated on cavings and large cuttings using optical scanning method).