Seismic Characterization of Kerogen Maturity for Source Rocks

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Abstract

Even though shales compose about 75% of the sedimentary column, studies of the elastic and seismic response of shales are scarce. One of the major differences between conventional reservoirs and unconventional shale reservoirs is the presence of organic matter (also known as Total Organic Carbon, TOC) in shales. TOC consists of bitumen and kerogen. Bitumen dissolved in organic solvents whereas kerogen does not. When kerogen is subjected to pressure and heat over geological time, it transforms to generate hydrocarbons. This process is known as maturation. Kerogen maturity creates additional pore space in the organic matter. Transformed hydrocarbons are stored in these nano-scale pores. The “sweet spot” identification in shale reservoirs usually includes mapping the distribution of organic richness (TOC), thickness of the organic-rich formation, levels of thermal maturity and network of natural fractures.

This talk illustrates how TOC and its level of maturity will affect the seismic elastic properties (anisotropy). The examples include micro-scale (SEM/Micro-CT scan) to macro-scale (seismic) measurements from cores, well logs and surface seismic data. The talk also demonstrates the effects of TOC on seismically derived geomechanical properties such as Young's modulus and Poisson's ratio.