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# P-Wave and S-Wave Angle Dependent Velocity Prediction by Elastic Modulus

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Worldwide interest in shale as hydrocarbon resources is setting off a new wave of shale research. Shale is a rock composed of mud-sized particles, such as silt and clay (Boggs, 2001). Although it forms probably 70% of sedimentary rock, there are a lot remains to be learned for these rocks (Hart, 2011). Rock physics models, which are the links between measurements (seismic attributes, well log, lab measurements, et.) and rock properties, are meaningful for exploring this field. However, due to shale's intrinsic anisotropic properties (mostly VTI), the existing isotropic rock physics models are no longer suitable in this case. So, it is important to build or use anisotropic rock physics models for shale on behalf of further research. These anisotropic models should account the velocity with non-zero propagation angle respect to the anisotropic reference frame. My project was aimed at developing feasible methods to calculating angle dependent P-wave and SH, SV-wave velocity in VTI system. In such an anisotropic system, wave velocities are determined by five independent stiffness tensor components ($C_{11}$, $C_{33}$, $C_{44}$, $C_{66}$, and $C_{13}$). I applied two methods to approach these components and calculate velocity in further. The first method combined well log data and rock anisotropic assumptions (Wang, 2002). The second one was building an anisotropy model from stress dependent vertical and horizontal lab measurements (Pervukhina, 2011). Results showed two version of polarized S-wave split at none zero propagation direction. And both P-wave and SH-wave velocities increased with incident angle. While SV-wave velocity increased with incident angle first and then turned out to decrease.

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