Ultrasonic Velocities and Anisotropy of Coal

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Unlike the other organic rich-rocks, the rock physics aspects of coal are much less developed. Although coal seams have become promising targets for methane production, carbon dioxide sequestration, and high influence on seismic reflection amplitude, there is paucity of elastic properties information of coal. In this paper, we present the dynamic elastic properties of coal. Laboratory ultrasonic velocity measurements of different types of coal exhibit different dynamic elastic properties which correlate to coal rank and applied effective pressure. Velocities were measured in dry cubic-shaped plugs parallel and perpendicular to lamination surfaces as function of confining pressure up to 40 MPa. Compressional and shear wave velocities as well as dry bulk and shear moduli increase as function of coal rank increases. The Vp-Vs ratio is nonlinear and covers a relatively wide range of coal ranks and effective pressure. Nevertheless, pressure dependence on coal elastic properties exist for confining pressure under 5 MPa. This sensitivity is affected by the presence of cleats. Intrinsic anisotropy of coal occurs at confining pressure above 5 MPa. This might be due to the systematic fine lamination and preferred orientation of macerals. Further analysis, such as maturation analysis, scanning electron microscope (SEM) observations, and physical modeling will be developed to verify the microstructure constituent.