

Title:

Acoustic Signatures and Impedance Microstructure of Oil Shales

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A big challenge in studying oil shales is to predict their maturity and kerogen content from indirect observations. As the kerogen matures, the shale texture also changes; for example, microcracks and fractures might be generated in the matrix. Assessment of maturity from indirect measurements can be greatly enhanced by correlation between physical properties, microstructure, and kerogen content. We will present relations between impedance microstructure of oil shales to their maturity, and elastic wave velocity. Microstructural variations significantly affect seismic wave propagation. Traditional techniques for studying microstructure either give surface information or are limited in resolution.

We have mapped and analyzed the impedance microstructures in oil shales using scanning acoustic microscopy. Its main advantage is that the microstructural maps, made from reflected acoustic waves, can be quantified in terms of acoustic wave propagation parameters of impedance (equals acoustic velocity times density). Since acoustic waves can penetrate below the surface, both surface and subsurface textures can be imaged. The acoustic and microstructural differences in shales from various stages of kerogen maturation (diagenesis, catagenesis, and metagenesis) show that

1. Acoustic impedance of the shale matrix is related to its total organic content and to hydrogen index
2. Pyrite, a common accessory mineral, increases impedance of the altered areas as compared to the unaltered kerogen material.
3. In high porosity shales, velocity is directly related to porosity. In low porosity shales, velocity is dependent on kerogen content.

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