Three-Dimensional AVO Analysis and Anisotropic Modeling Applied to Fracture Characterization
A. Ramos, T. Davis, R. Benson

Seismic amplitude-versus-offset (AVO) technology can be used to predict reservoir properties and fluids. Most of the work done to date using this technology, however, involves non-fractured reservoirs and two-dimensional seismic data. In this study, three-dimensional seismic data proved to be important for the AVO characterization of a coalbed methane reservoir at Cedar Hill Field, San Juan Basin, New Mexico. Prestack P-wave amplitude data are used to delineate zones of larger Poisson’s ratio contrasts (or higher crack densities) in the coalbed methane reservoir, while source-receiver azimuth sorting is used to detect preferential directions of azimuthal anisotropy.

Two modeling techniques (using ray tracing and reflectivity methods) predict the effects of fractured coal-seam zones on non-normal P-wave reflectivity. Seismic AVO analysis of none macrobins obtained from the 3-D volume confirms these model predictions. Areas with large AVO products (product of AVO gradient and AVO intercept) identify coal zones with large Poisson’s ratio contrasts, indicating high fracture density. The integration of 3-D, 3-C seismic and AVO analysis constitutes a useful approach in characterizing fractured coalbed reservoirs. Application of this new approach can reduce the risk and improve hydrocarbon productivity in coalbed methane fields.