Using seismic data to find producible fractures

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Summary

Many unconventional gas plays rely on the presence of natural fractures to enhance or create permeability in the reservoir. These fractures cause significant, measurable changes in 3D seismic data. These changes appear as variations in seismic amplitudes and velocities with shot-receiver azimuth and are known as seismic azimuthal anisotropy.

Examples of the seismic identification of fractures are shown for a Mannville coal, unconventional shales from Alberta, and the tight gas sands of the Pinedale Field in Wyoming, which is an analog to Alberta's Deep Basin. In the latter example, seismic fracture estimates are shown to be the best predictors of well EUR (Estimated Ultimate Recoverable) and therefore they are used to predict EUR in 3D space from the seismic data.

The technology to measure seismic azimuthal anisotropy is over 20 years old and ready to be used to pinpoint areas of more dense open natural fractures in reservoirs such as unconventional shales and other tight rocks, and coalbed methane. The seismic azimuthal anisotropy response is driven by the interaction of today's stress field with the paleo-fractures generated in the past. A discussion of how to interpret today's open fractures from this anisotropy will use this concept. This can result in complex fracture behavior. The described interpretation of the seismic anisotropy allows for understanding that leads to better pad and well design.

Seismic azimuthal anisotropy measurements have achieved a technical success rate for identifying fractures upwards of 80% in unconventional gas plays. This can significantly impact economic success of wells in areas where success rates are variable.

References

Gray, D., 2020, Using Seismic Azimuthal Anisotropy to Find Fractures, SPE Geomechanical Breakfast Series, No. 2, https://specalgary.com/initiative/5dfbbee61af0bdbc7c7196e5