Fracture Detection Using Stoneley Wave Reflectivity: A Case History from a Deep Well in California

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Surface seismic techniques regularly used in oil and gas prospecting have been applied to the well bore to identify and quantify fracturing within a deep well in California.

Stoneley waves are generated in the well bore with a low-frequency pulse of the sonic tool. This type of energy propagates along the mud–formation interface within the well bore. When the Stoneley energy encounters open fractures, borehole irregularities, or bed boundaries, some of the energy is reflected back toward the sonic tool and is recorded. Processing techniques are aimed at enhancing the reflections from fractures (signal), while discriminating against reflections from borehole irregularities and lithology changes (noise). Open fractures within a well bore give rise to a significant acoustic contrast between mud-filled fractures and formation and, therefore, generate high amplitude reflections. Closed fractures are essentially invisible to the tool. Discrimination between open and closed fractures is an advantage of this technique over some other tools, like the Oil Based Micro Imager, which responds in a like fashion to both open and closed fractures.

Correspondence between fractures identified by Stoneley reflectivity, mud log gas shows, and production influx (production logging tool) is one-to-one. Stoneley-identified fractures, coupled with mud-log gas shows and other available information, form a strong framework for making completion decisions.