

# Off-Center Transmitters and Receivers in Acoustic Logging: Modeling and Observations

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## **ABSTRACT**

When an acoustic logging source is off-centered, multiple modes are generated. The resulting mode interference leads to erratic amplitude variations with increasing offset, as opposed to a monotonic amplitude decrease when the source is centered. Mode interference may also deteriorate the quality of the processing. Such effects are analyzed for both a monopole and a dipole source using synthetic seismograms and are illustrated with field data.

In an open hole situation, the effects of an off-center source are predominant in the presence of slow formations for which the formation shear wave velocity is less than the bore fluid velocity. With a monopole source, the amplitude of the P-wave leaky modes wave-train can be strongly affected. With a dipole source, the interference between the flexural mode and the Stoneley wave can be significant. The effects increase with increasing eccentricity with respect to the borehole radius but also with increasing borehole radius due to the mode excitation properties. For a given eccentricity, measurements along the direction of eccentricity or perpendicular to it do not exhibit the same level of interference.

In a well-bonded cased hole situation, an off-center dipole source generates a Stoneley wave that is poorly coupled to the surrounding formation and that propagates at a velocity close to the compressional velocity of the borefluid. This Stoneley wave can obscure the formation shear wave signal associated with a slow formation.