

Compressional Anisotropy: Understanding Sonic Logs in Non-Vertical Wells

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Though shear anisotropy is often measured with wireline dipole sonic tools, compressional anisotropy is seldom addressed and often leads to doubts about log quality. Compressional logs acquired in several wells in a field will generally have the same character and will produce similar slowness profiles for the same formations. This congruence generally holds regardless of the nature of the acoustic tool being used (wireline or LWD). When the results unexpectedly disagree in similar formations the difference is often assumed to be caused by tool or technique failure. Frequently, however, the differences are not due to tool malfunction but to the intrinsic physics encountered during logging. When the logs are acquired over different trajectories, the same formation may be logged at a variety of angles. As the wellbore trajectory varies from vertical, the normal overburden stress begins to exhibit itself to the logging tool as an anisotropy in the surrounding stress field. This anisotropy can lead to (legitimate) differences in the compressional slowness as a function of the angle between the well axis and the formation.

Similar effects in electrical tools are routinely observed and corrected using modelling programmes. While it is not a simple matter to “correct” non-vertical sonic logs using only the sonic data from a single well, it is possible to compute the results if the seismic parameters σ and ϵ are known or can be estimated. Modelling and field examples will be presented to illustrate the effects of compressional anisotropy and methods of estimating the “corrected” results.