Subsurface Characterization in Magnetic Geology using Spin Echoes

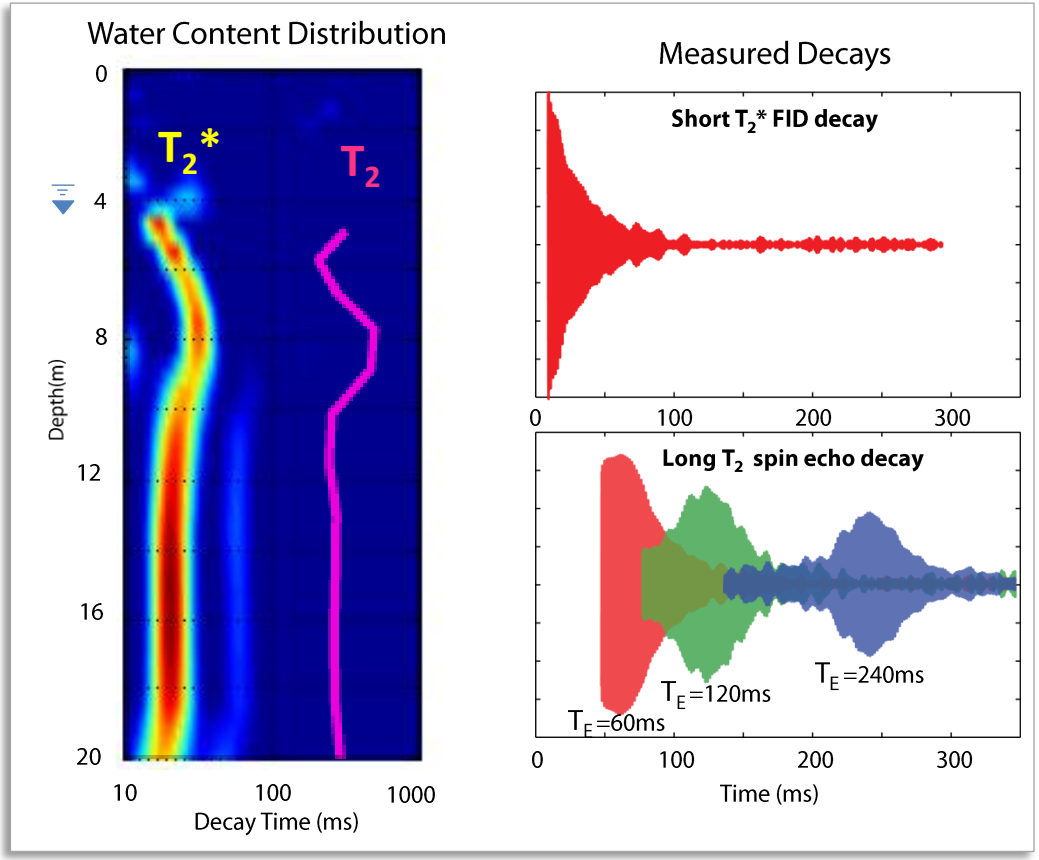
Client/Partner: United States Geological Survey

Location: White Sulphur Springs, Montana

VISTACLARA INC. 21ST CENTURY GEOPHYSICS

Instrumentation:
GMR surface NMR

Water managers and ranchers in Western Montana can use NMR measurements to inform regional groundwater flow models and to select appropriate irrigation practices. Measured decay times, which are used to estimate subsurface hydrogeologic properties, are sometimes influenced by the presence of magnetic minerals. At this field site, T_2* decay times from FID measurements were found to be very short (~15-50 ms), initially suggesting that groundwater was bound in low permeability silts. Supplemental spin echo measurements, however, revealed that the T_2 decay times were actually much longer (~100-400 ms). While FID measurements were strongly affected by the magnetic geology, robust spin echo measurements accurately reflected the high permeability of the shallow sand and gravel aquifer. This study demonstrates that the characterization of aquifers in magnetic geology requires the ability to measure very short signals and high-quality spin echo decays.



The color plot (left) shows the water content distribution as a function of depth and the FID decay time T_2*. The FID decay signal (top right) is very short due to magnetic geology. Estimates of T_2 derived from spin echo signals (bottom right) recorded at different echo-times are much longer. The ability to measure short decays and high quality spin echoes requires a short dead time as well as short high-power pulses enabled by the unique GMR hardware.

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