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NanoSeis

Co-Recorded Microseismic Data

Co-recorded microseismic data is that in which borehole and surface microseismic datasets are recorded simultaneously. At NanoSeis one of our areas of expertise is acquiring and processing co-recorded microseismic dataset. The 2011 SEG Abstract entitled "Comparison of simultaneous downhole and surface microseismic monitoring in the Williston Basin" by Diller and Gardner is an example of results from co-recorded microseismic data (see http://www.nanoseis.com/references/DillerGardner.pdf).

Co-recorded microseismic projects typically use separate recording instruments for the borehole and surface data. To be truly useful, the absolute recording time between the two datasets must be resolved on the order of a millisecond. Not all recording systems were designed to report millisecond accuracy of the absolute recording time, and some recording systems apparently drop whole seconds during system resets (see Figure 1). ***Many, perhaps most, microseismic co-recorded projects have failed simply because the timing could not be rectified between the two datasets***. Please contact NanoSeis for information on how to conduct a successful co-recorded microseismic project.

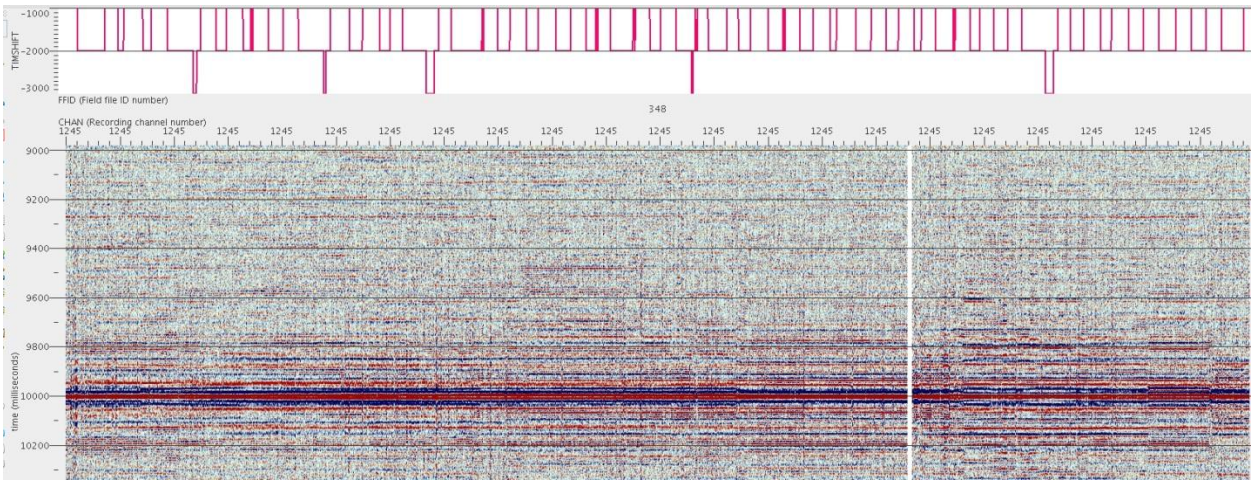

Figure 1. Correlations (lower panel) between co-located receivers of borehole and surface data show exactly 1000, 2000, or 3000 millisecond shifts (upper panel) indicating that one of the recording systems was apparently dropping whole seconds during system resets. The horizontal axis is calendar time, which represents about 3 days. It appears that one of the recording systems resets every 2-3 hours.

For maximum value, co-recorded microseismic projects require special processing. In particular, deriving velocity information that is suitable for "dual moveout" or simultaneous imaging of borehole and surface data is challenging. This is an under-constrained problem, but we have had good success deriving velocity information (see Figure 2) that is suitable for dual moveout of borehole and surface data (see Figure 3).

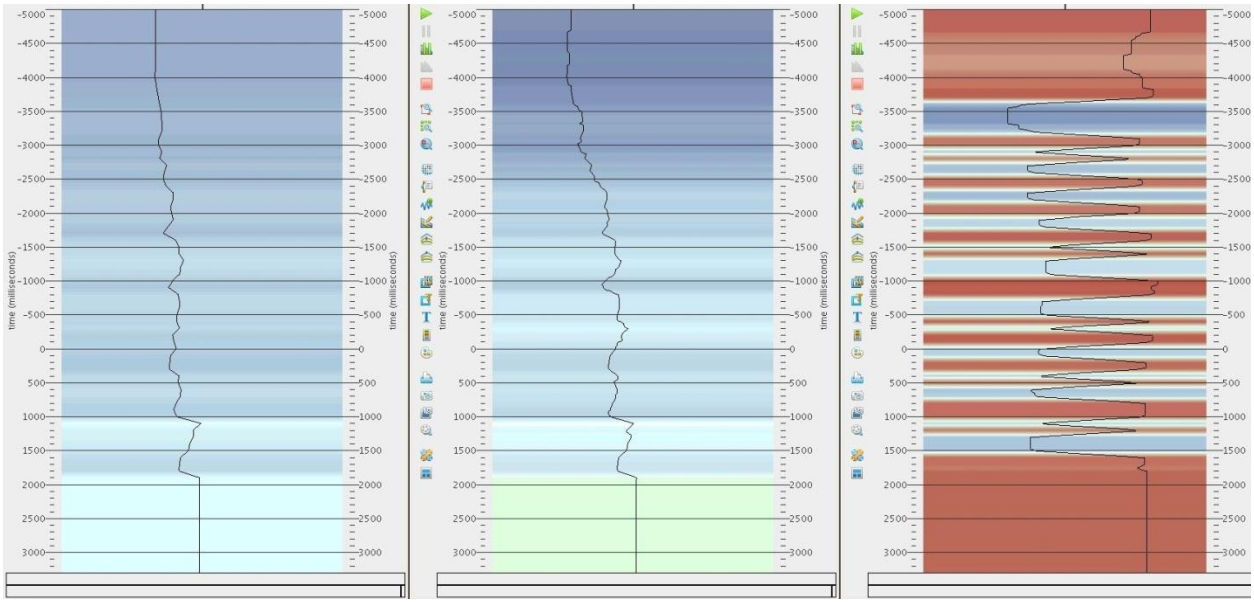

Figure 2. Results from a simultaneous velocity inversion of surface and borehole data. The left panel shows the original p-wave velocity function from the observation well, the center panel shows the p-wave velocity function that was output from the inversion, and the right panel shows the VTI epsilon function that was output from the inversion.

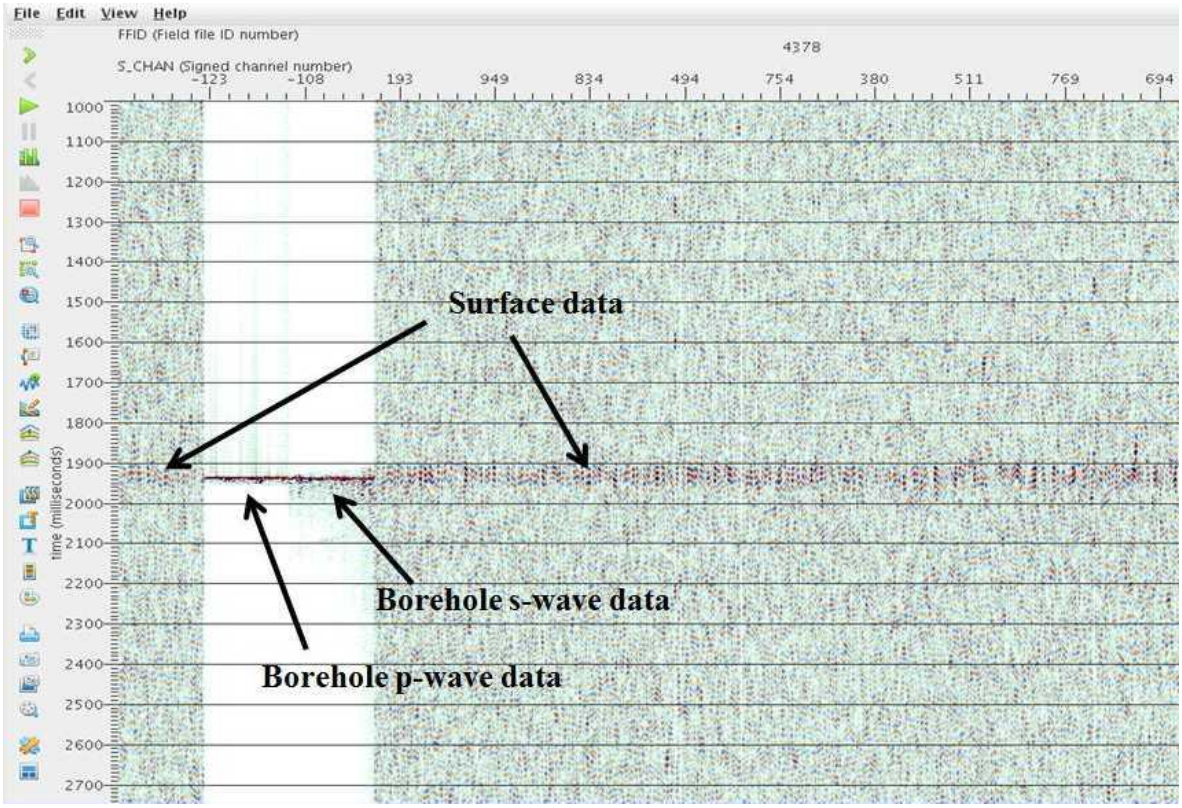

Figure 3. Dual moveout of borehole and surface data from a co-recorded microseismic project. A single set of velocity and VTI functions were used to correctly flatten borehole p-wave and s-wave data, and surface p-wave data.

For more information please email Dave.Diller@NanoSeis.com or call +1 720-320-3525.