Optical fibre dataset registration

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Abstract

The Containment and Monitoring Institute (CaMI) Field Research Site (FRS) has three wells on the lease, referred to here (from SW-NE) as the geophysics, injection and geochemistry wells. Borehole and trenched optical fibres are connected in a continuous loop of ~5 km length in the following order: 1) helical in geophysics well, 2) straight fibre in geophysics well, 3) straight fibre in geochemistry well, 4) straight fibre from geophysics well to south end of trench, 5) helical fibre for entire length of trench and 6) straight fibre from the north end of the trench back to the geophysics well. Since we know the trace spacing for each survey, we can assign coordinates to traces once we know the position of any given trace. Tap tests in above ground junction boxes can be spread over as many as 100 traces due to gauge length effects and are not precise enough for this purpose.

For borehole registration we have calculated least-squares hyperbolic fits to first-break picks to determine which is the deepest trace in each well. Tests of this process give a result with a standard deviation of one trace for straight fibre and three traces for helical fibre for a survey acquired with 0.25 m trace spacing and 10 m gauge length (Figure s 1-4).

High-amplitude noise observed at above ground junction boxes (Figure 5) also spreads across variable numbers of data traces, depending upon source distance from the junction box. Separation of continuous loop data into discrete datasets has been performed by running a modified STA/LTA algorithm on the sum of the absolute value of uncorrelated trace amplitudes taken to the fourth power to locate the edges of junction box noise, which also gives us a starting point for determining trace location (Figures 6-8). Figure 9 shows an correlated record with 0.75 m trace spacing before(top) and after (bottom) trace mutes using the 75% threshold of the sum of STA/LTA results from 172 source gathers in this example (Figure 8).

Figures

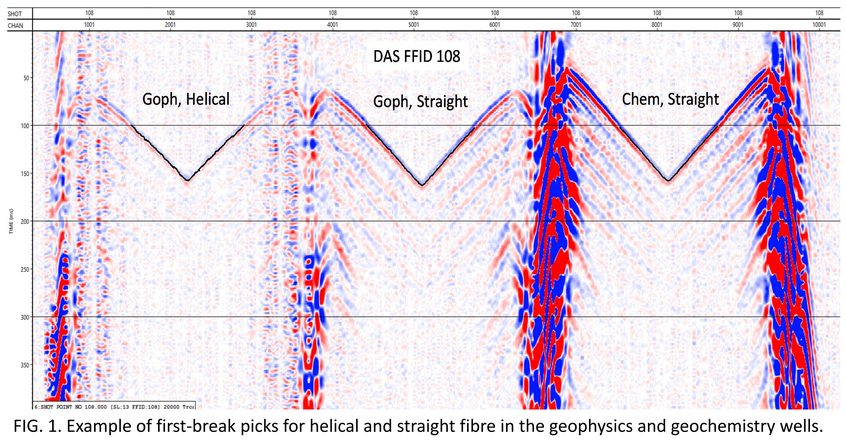

FIG. 1. Example of first-break picks for helical and straight fibre in the geophysics and geochemistry wells.

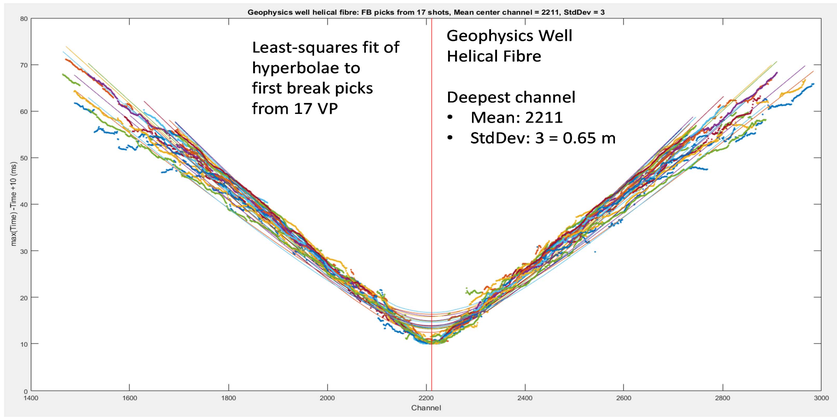

FIG. 2. Least-squares fit of hyperbolae to first break picks for 17 source gathers, geophysics well, helical fibre.

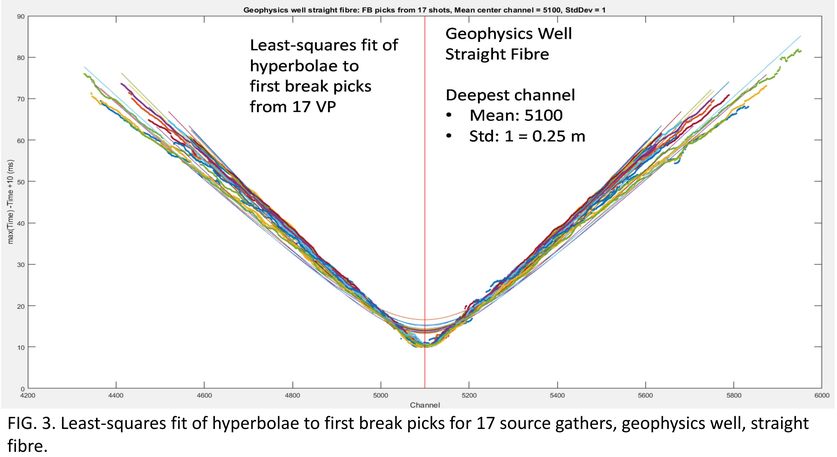

FIG. 3. Least-squares fit of hyperbolae to first break picks for 17 source gathers, geophysics well, straight fibre.

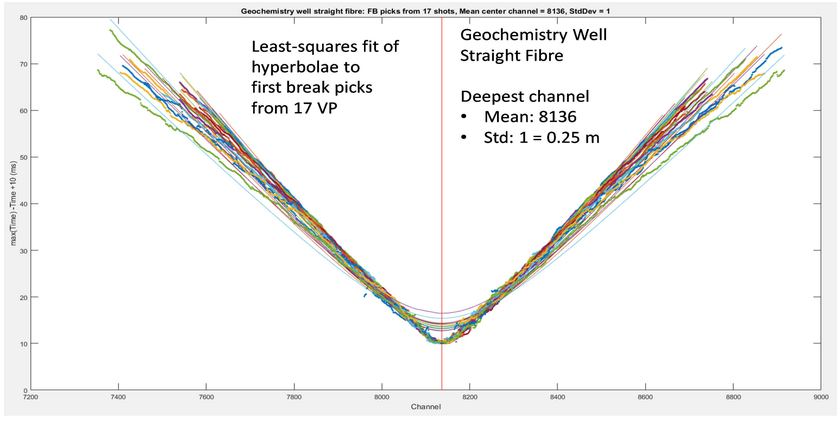

FIG. 4. Least-squares fit of hyperbolae to first break picks for 17 source gathers, geochemistry well, straight fibre.

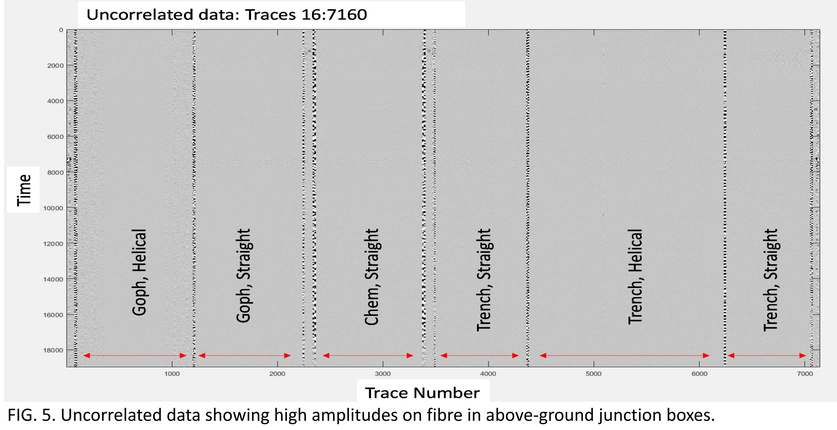

FIG. 5. Uncorrelated data showing high amplitudes on fibre in above-ground junction boxes.

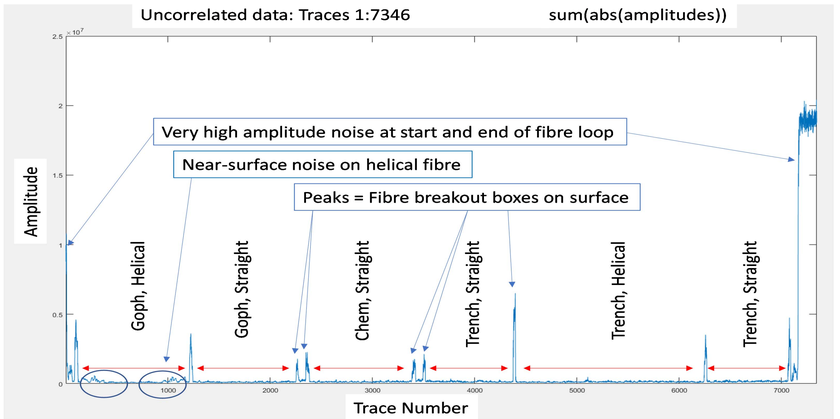

FIG. 6. Trace sum of the absolute values of data shown in Figure 5.

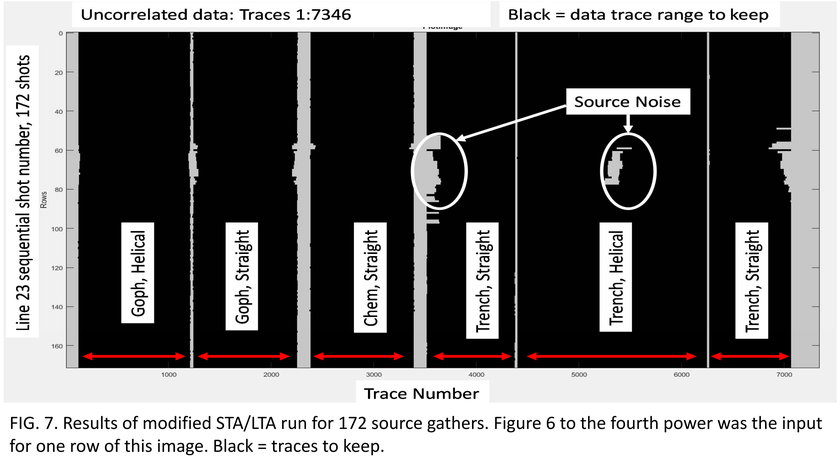

FIG. 7. Results of modified STA/LTA run for 172 source gathers. Figure 6 to the fourth power was the input for one row of this image. Black = traces to keep.

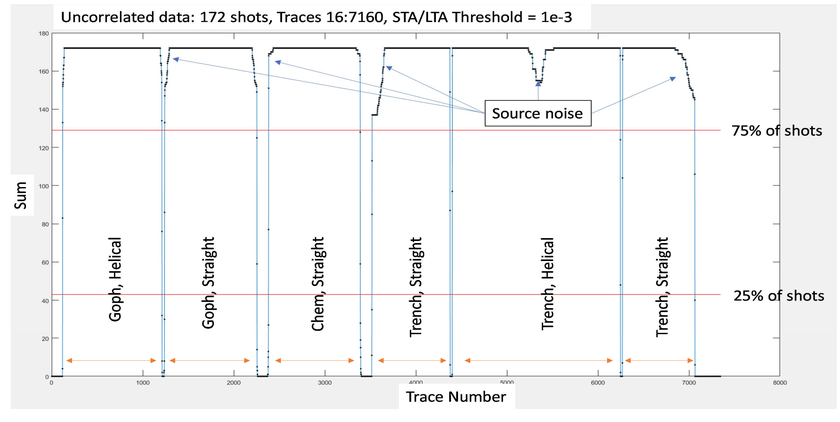

FIG. 8. Sum of the rows in Figure 7.

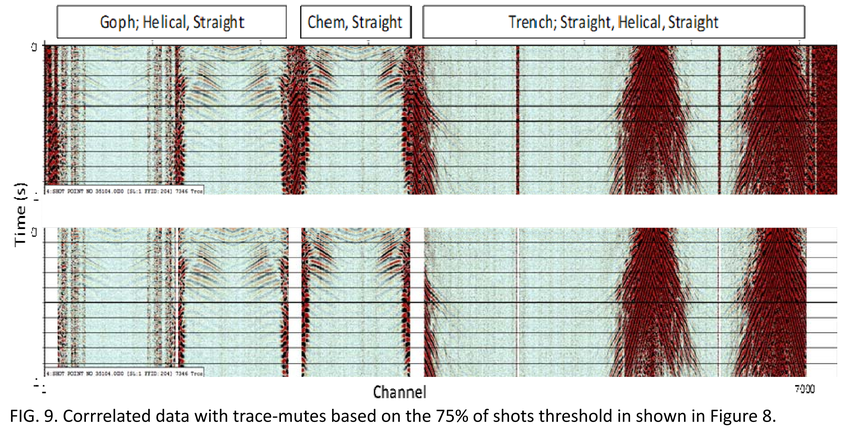

FIG. 9. Corrrelated data with trace-mutes based on the 75% of shots threshold in shown in Figure 8.