Note on Walkaway, circular, Zero-offset VSP data

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Checkshot results

Please use "Time-Depth-ZOVSP_6-8-2009.xls" and see "Jamstec-xyz_ZVSP.ppt" in "20090808_checkshot_rev". Schulumberger revised the checkshot results from their original "Survey_report_ZOVSP.pdf".

SEGY data

- See Appendix for SEGY header list
- Data files
  - s1 data
    - WVSP and CVSP: Trigger pulse (PTB, "10" in the timing chart, Appendix B)

      Note that this is not real shot waveforms. The shot first-break time should be used from the value of (Fire pulse "3" – External trigger "8" in SEGY header) (see the timing chart, Appendix C)
    - Zero offset VSP: Air-gun monitor hydrophone.
  - nascent_shot [bits]: original hardware measurement data, no gain applied, unstacked data trace (This data is not usually delivered to customers. Please use geophone response below for reflection data processing.)
  - raw_shot_geo [m/s]: geophone response, gain applied, unstacked data trace
  - raw-stk-geo [m/s]: stacked data trace, geophone response, gain applied.
- Procedure to transformation from "Nascent data" to "geo data" is following.

  "Nascent data" is transformed to "GAC response" with the formations following.

  GAC (mv) = 1/GAIN * MvPerBit * Nascent (bits),

  where MvPerBit = 1.3019147E-05, GAIN we used "1".

  To calculate acceleration from "Nascent data," following should be applied.

  0.546933 volt = 1G ====> 1 mV = 1.7930 x E-2 m/s2.

  "GAC response" is transformed with the formations following.

  Acceleration is transformed to velocity (geophone response) with 10Hz natural frequency and 0.7 damping. The output is in m/s.

- Source navigation in header

  Kairei's navigation data was combined to this SEGY data. The position is center of gun array, "Sline" in Kairei's navigation .

- First break time in Schlumberger's zero-offset VSP reports look ~60ms shift from original waveforms

  Time zero in original raw SEGY data is system start time (start recording).

  VSI_010_A_nascent_shot_s1.sgy

  Waveform recorded at the hydrophone beside the airgun

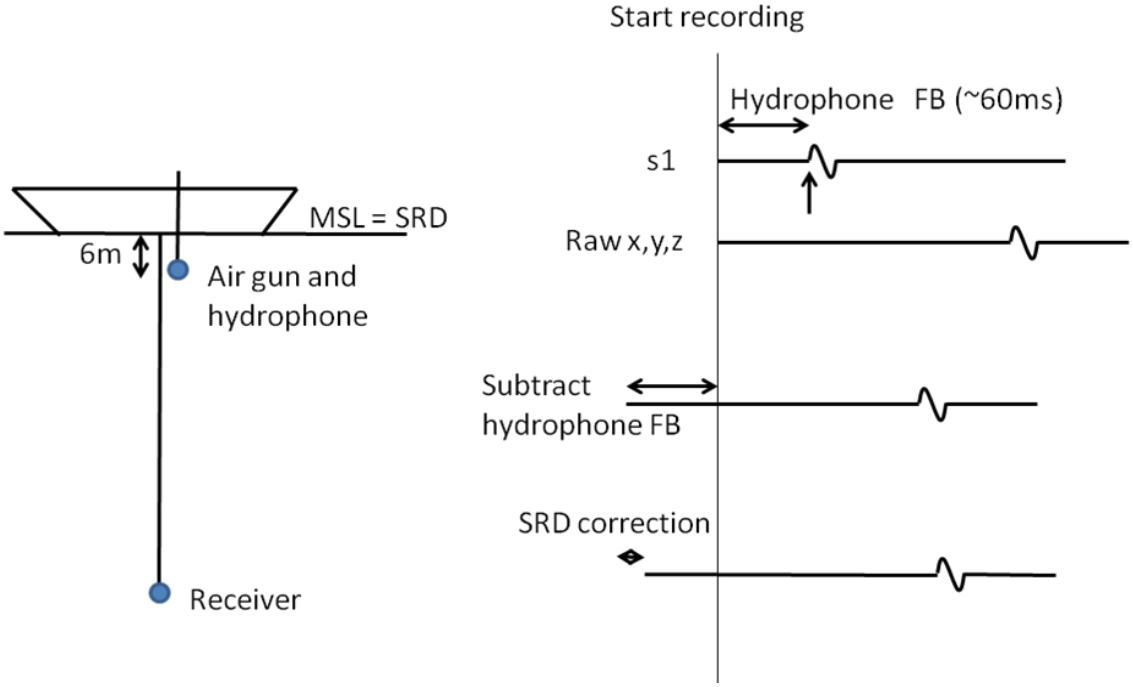
  VSI_010_A_nascent_shot_[xyz].sgy

  Wavefroms recorded at the recivers

  Procedures Schlumberger did on their reports

  1. Substract hydrophone FB time from receiver record to calculate the transit time between the source and the receiver
  2. SRD (Seismic Reference Datum. MSL in this case.) correction (6m gun depth and 60m distance between the gun and the borehole)
  3. Stack data (with some gain control)

  Therefore the waveform plot of raw receivers looks delay ~60ms from that in SLB report.



Acquisition

- Polarity conventions of VSI tool

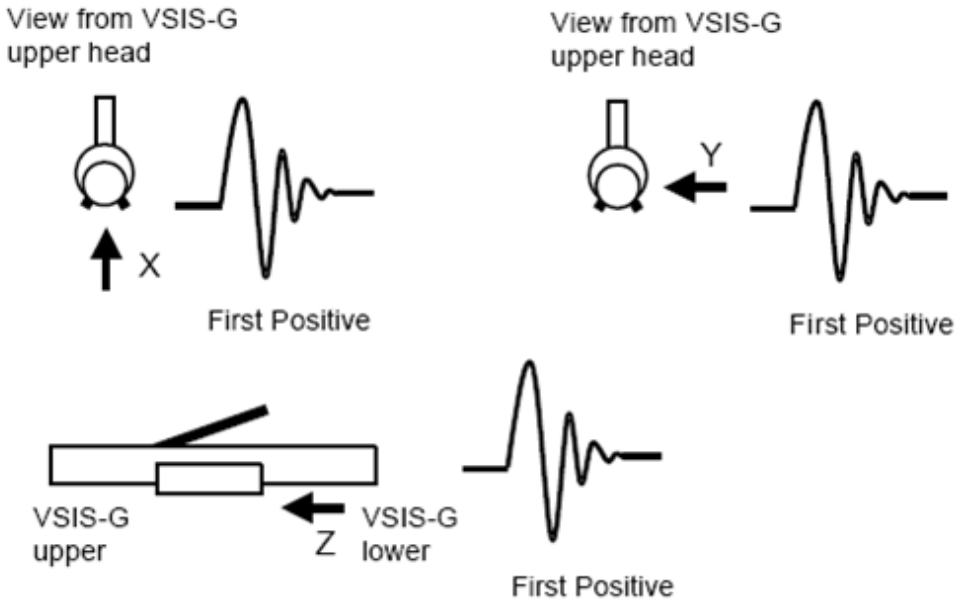


Figure 2-6: The polarity conventions of the VSIT-G

- VSI sensitivity
  - 79 V / m/s is the open circuit sensitivity
  - VSI has anti-aliasing filter with 80% Nyquist.
  - The DC block is a first order 0.3Hz cut off."

- Timing chart of the WVSP, CVSP surveys using radio communication (Appendix B)
  - 1412ms delay for the fire pulse was specified, so that the timing of the fire pulse was consisted with PTB in Kairei Macha. The value 1412ms was measured on Kairei shooting system and Macha we used.
  - 410ms delay (10ms START DELAY and 400ms SYNC DELAY) on Chikyu Macha was specified.
  - We observed PTB delay ~1.2ms +/-100us between Kairei and Chikyu Macha.

- Delay from the record start pulse until the first data is sampled (only for WVSP and CVSP)

  The delay from start pulse (Katsumata-san' box) to the first sampling in VSI shuttles is 2ms < L <= 4ms.

  " VSI does NOT start the acquisition synchronous with the external trigger input.

So the improvement VSI provides is to the latency of the external trigger input.
The synchronous acquisition to the external trigger input (which is ideal for simultaneous acquisition with surface seismic) requires additional work with the GPS time based synchronization scheme."
In order to avoid the race condition, the WITM ensures at least one VSI sampling interval as the minimum latency to the external trigger input.
Because the external trigger input is asynchronous to the VSI sampling, the acquisition latency to the external trigger input drifts within one VSI sampling period.
For our case, the VSI is running at 2msec sampling interval, the latency is at least 2 millisecond, and always less than (or equal to) 4 milliseconds (2ms < L <= 4ms), please see the attached diagram.

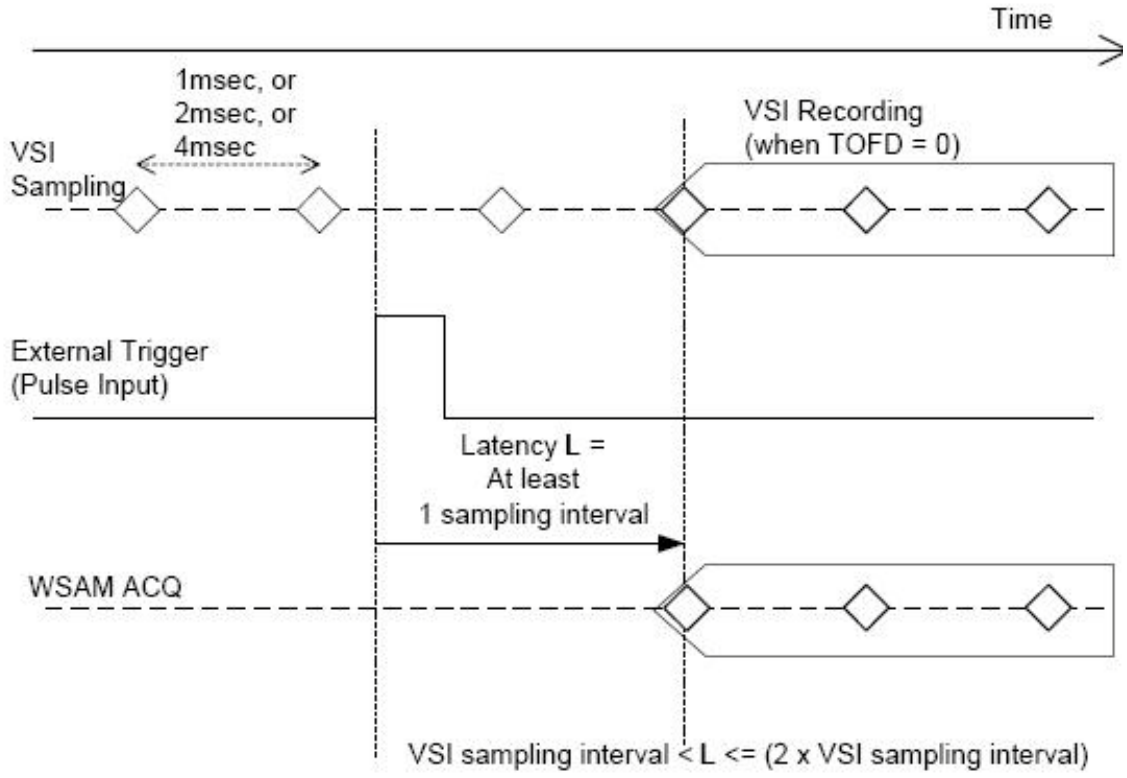


Figure 3-35: External Trigger Firing Timing Description

Appendix : List of the SEGY header

1-4: sequential number in line
5- 8: sequential number in reel
9- 12 file number
13-16: trace number within field record
17- 20: energy source point number provided from Kairei's nav log.
Either "#shot" in "WVSP_num_loc_time_summary.txt" or ukooa p190 file "Line1R_X_Spos.1.P190" columns 21-25
25- 28: trace number within CDP ensemble
29- 30: data identification
37- 40: distance from source point to receiver group (negative if opposite to direction in which the line was shot)

41- 44: receiver group elevation from sea level (above sea level is positive)
45- 48: source elevation from sea level(above sea level is positive)
-8 (m)
49- 52: source depth (positive): 8 (m)
61- 64: water depth at source: with echo sounder (m)
65- 68: water depth at receiver: 2054 (m)
69- 70: scale factor for previous 5 entries (41-68): -10000
71- 72: scale factor for next 4 entries: -100
73- 76: X source coordinate
77- 80: Y source coordinate
81- 84: X group coordinate
85- 88: Y group coordinate
109-110: delay recording time
115-116: number of samples
117-118: ssampling period
121-122: gain
123-124: sensitivity
157-158: year data recorded from SLB system
159-160: day of year from SLB system
161-162: hour of day (24 hour clock) from SLB system
163-164: minute of hour from SLB system
165-166: second of minute from SLB system

201-204: Start_shot (micro sec) from "WVSP_num_loc_time_summary.txt"

205-208: TB_start (micro sec) from "WVSP_num_loc_time_summary.txt"

209-212: TB_shot (micro sec) from "WVSP_num_loc_time_summary.txt"

213-216: Microsecond of second "Frac_sec" from "WVSP_num_loc_time_summary.txt"

Timing chart of walkaway and circular VSP using radio syncronization and MACHA (The Shooting System)