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Sounding Better!

Sound Velocity Vertical Errors and What To Expect

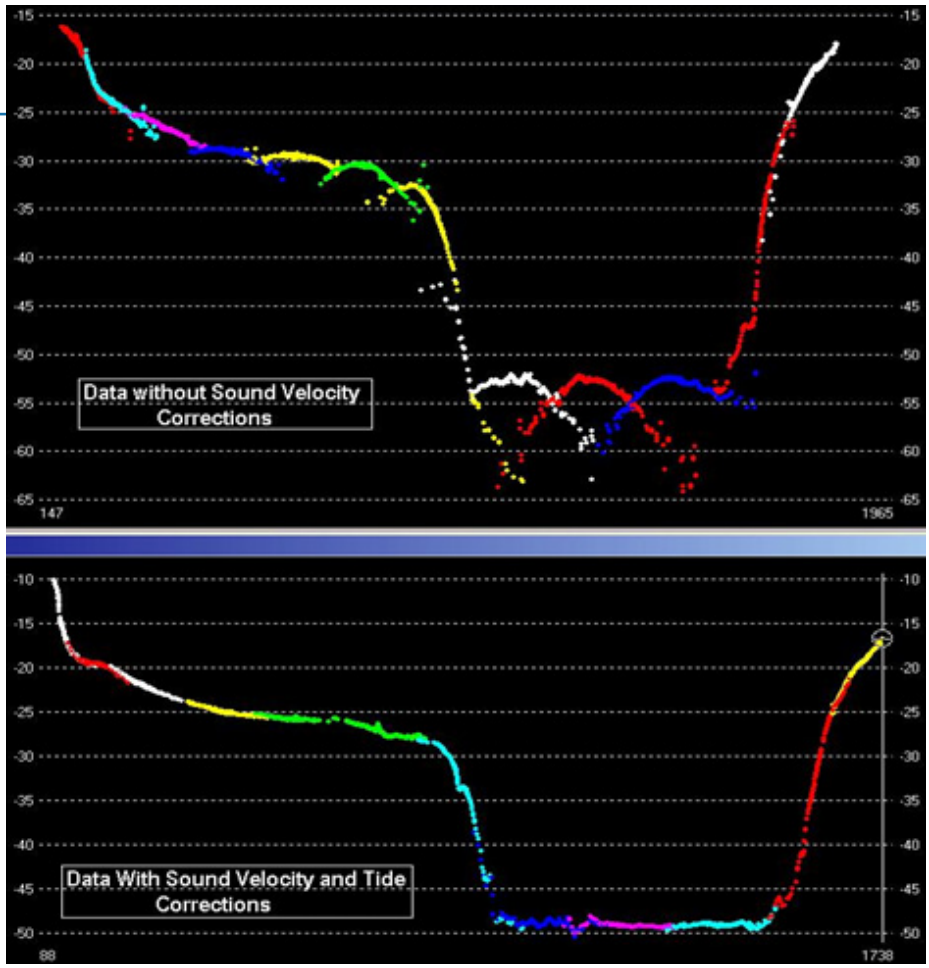
By Christian Shaw

We have come across all types of data over the years and very few things are surprising for us here in Support these days! From inverted tides to wrongly entered offsets, we have seen almost everything. Looking at bathymetry data from different systems gives us a close look at how hydrography can show its nasty head when things are not done properly. Most of the time we spend here in support deals with bad data. For the untrained eye, it can be a little tedious to figure out the cause.

One example that came up recently was when overlaying pre- and post-construction survey data, there was a noticeable 4 foot shift!

After doubling down on checking offsets and patch test numbers for the multibeam system, everything looked OK; however, the data still had a very bad relationship. What could be the cause? Many of these multibeam surveys have issues with the sound velocity! Typically, if sound velocity is incorrectly measured, or not even entered, you will see something like this:

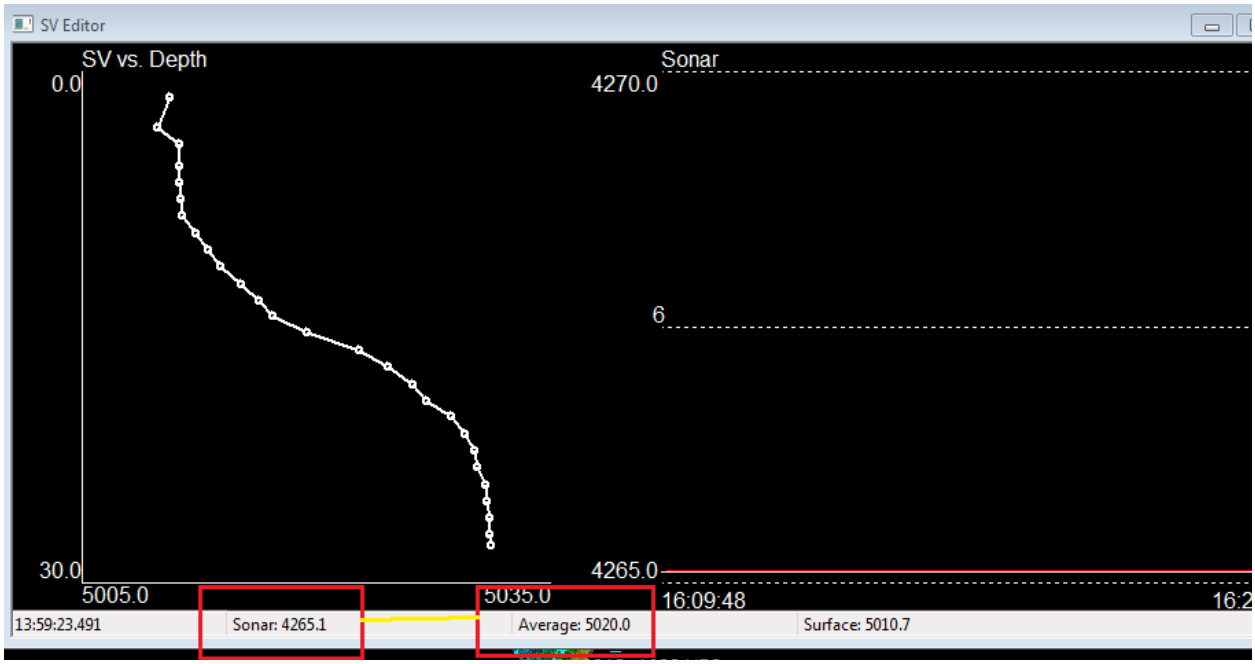
FIGURE 1. *Data With and Without SV Correction*



The frowny faces and the smiley faces are the first visual you see.

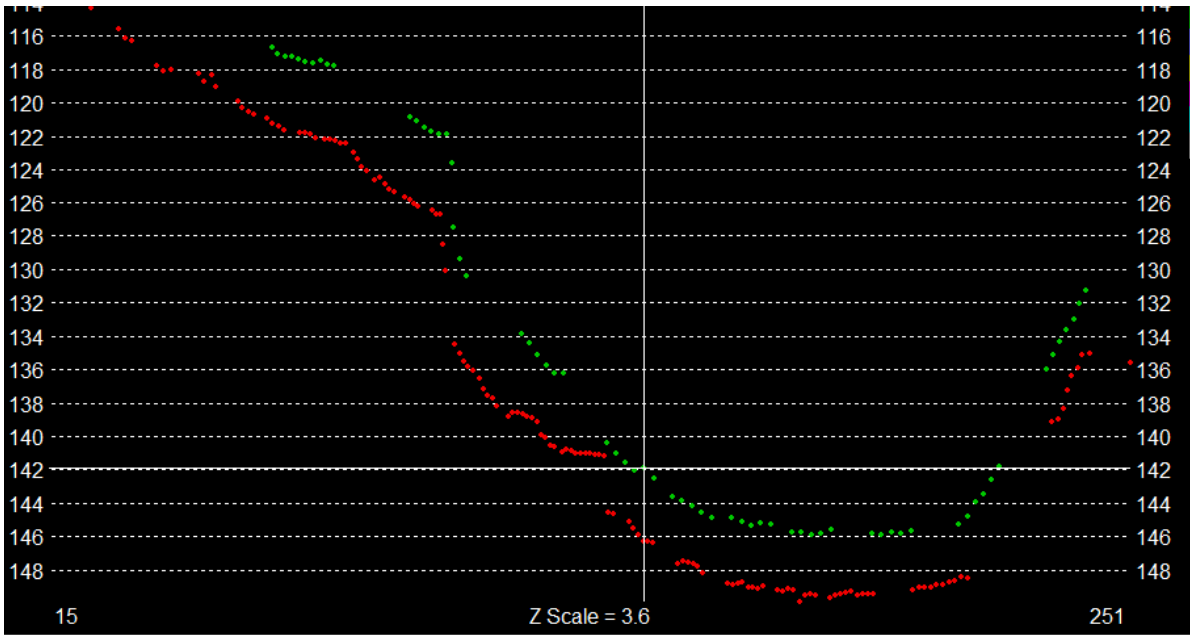
Here is what we finally saw with the data: There was no real-time sound velocity of the head. It was manually entered into the sonar as a static number. When comparing the cast data for that day and the probe sound velocity, we see a 755 ft/sec difference from the value entered in for the sonar and what the cast data showed. Notice the sound velocity at the Head (4265.1) vs. Cast (5020.0)

FIGURE 2. *Sound Velocity at the Sonar Head vs in the Sound Velocity Cast*



When overlaying the post-dredge survey, which has a good sound velocity entered, and the pre-dredge survey, the shift is a vertical difference of over 4 feet!

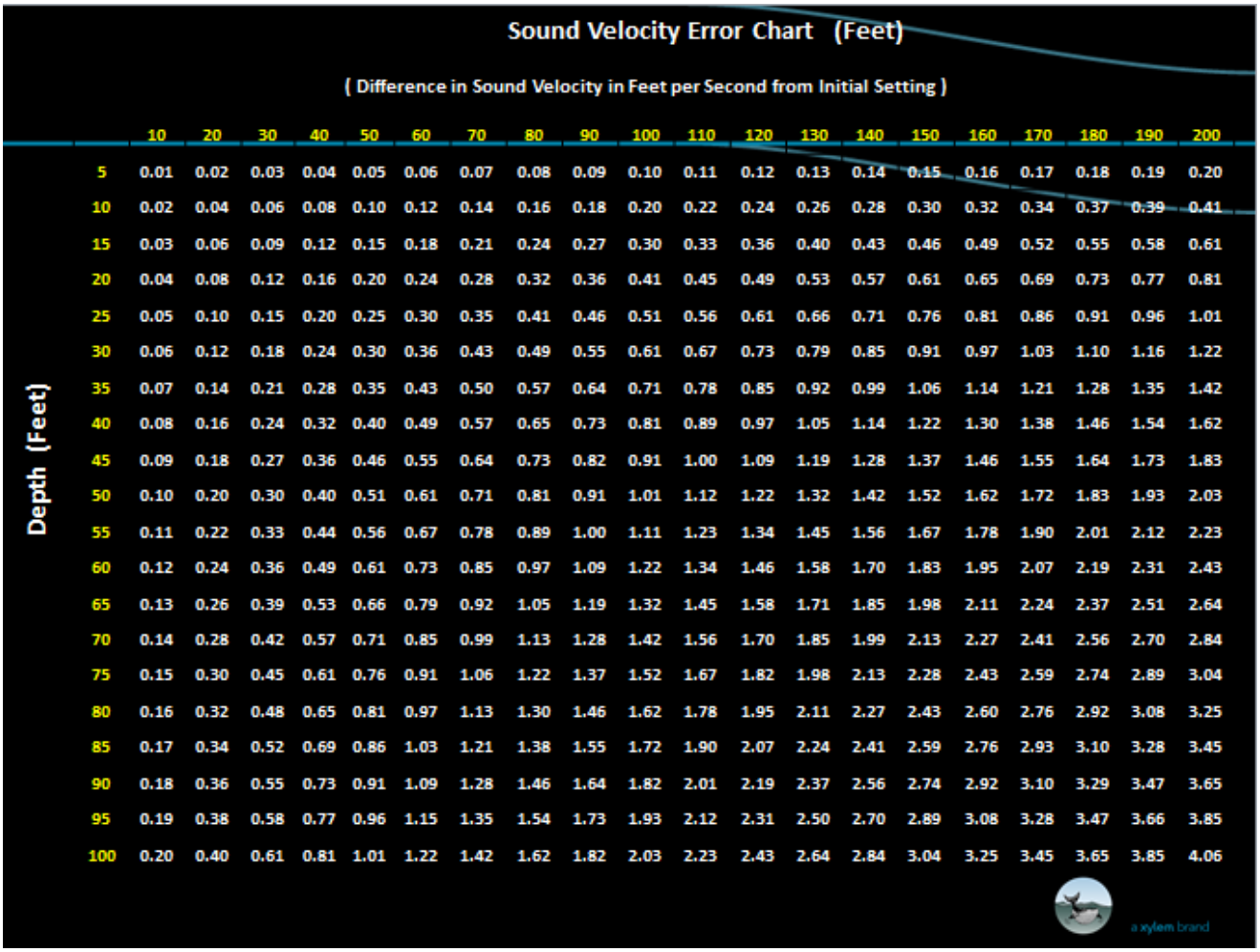
FIGURE 3. *Shift between the Pre-dredge and Post-Dredge Surveys*



The moral of the story is that the operator must always check that the sound velocity of the probe at the multibeam head is functioning or entered correctly. A good sound velocity cast and a sonar that is beam forming with the proper sound velocity are 100% imperative to great multibeam and single beam surveys! It has a direct impact on the repeatablility of the bottom depths when comparing surveys.

If sound velocity is the problem that you are investigating, this table will help you understand how much the depths can change based on the measured range and offset from the initial to the measured speed of sound.

FIGURE 4. *Sound Velocity vs Depth*



Sound Velocity Error Chart (Feet)

(Difference in Sound Velocity in Feet per Second from Initial Setting)

Depth (Feet)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
5	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
10	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.37	0.39	0.41
15	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.30	0.33	0.36	0.40	0.43	0.46	0.49	0.52	0.55	0.58	0.61
20	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.41	0.45	0.49	0.53	0.57	0.61	0.65	0.69	0.73	0.77	0.81
25	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.41	0.46	0.51	0.56	0.61	0.66	0.71	0.76	0.81	0.86	0.91	0.96	1.01
30	0.06	0.12	0.18	0.24	0.30	0.36	0.43	0.49	0.55	0.61	0.67	0.73	0.79	0.85	0.91	0.97	1.03	1.10	1.16	1.22
35	0.07	0.14	0.21	0.28	0.35	0.43	0.50	0.57	0.64	0.71	0.78	0.85	0.92	0.99	1.06	1.14	1.21	1.28	1.35	1.42
40	0.08	0.16	0.24	0.32	0.40	0.49	0.57	0.65	0.73	0.81	0.89	0.97	1.05	1.14	1.22	1.30	1.38	1.46	1.54	1.62
45	0.09	0.18	0.27	0.36	0.46	0.55	0.64	0.73	0.82	0.91	1.00	1.09	1.19	1.28	1.37	1.46	1.55	1.64	1.73	1.83
50	0.10	0.20	0.30	0.40	0.51	0.61	0.71	0.81	0.91	1.01	1.12	1.22	1.32	1.42	1.52	1.62	1.72	1.83	1.93	2.03
55	0.11	0.22	0.33	0.44	0.56	0.67	0.78	0.89	1.00	1.11	1.23	1.34	1.45	1.56	1.67	1.78	1.90	2.01	2.12	2.23
60	0.12	0.24	0.36	0.49	0.61	0.73	0.85	0.97	1.09	1.22	1.34	1.46	1.58	1.70	1.83	1.95	2.07	2.19	2.31	2.43
65	0.13	0.26	0.39	0.53	0.66	0.79	0.92	1.05	1.19	1.32	1.45	1.58	1.71	1.85	1.98	2.11	2.24	2.37	2.51	2.64
70	0.14	0.28	0.42	0.57	0.71	0.85	0.99	1.13	1.28	1.42	1.56	1.70	1.85	1.99	2.13	2.27	2.41	2.56	2.70	2.84
75	0.15	0.30	0.45	0.61	0.76	0.91	1.06	1.22	1.37	1.52	1.67	1.82	1.98	2.13	2.28	2.43	2.59	2.74	2.89	3.04
80	0.16	0.32	0.48	0.65	0.81	0.97	1.13	1.30	1.46	1.62	1.78	1.95	2.11	2.27	2.43	2.60	2.76	2.92	3.08	3.25
85	0.17	0.34	0.52	0.69	0.86	1.03	1.21	1.38	1.55	1.72	1.90	2.07	2.24	2.41	2.59	2.76	2.93	3.10	3.28	3.45
90	0.18	0.36	0.55	0.73	0.91	1.09	1.28	1.46	1.64	1.82	2.01	2.19	2.37	2.56	2.74	2.92	3.10	3.29	3.47	3.65
95	0.19	0.38	0.58	0.77	0.96	1.15	1.35	1.54	1.73	1.93	2.12	2.31	2.50	2.70	2.89	3.08	3.28	3.47	3.66	3.85
100	0.20	0.40	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.23	2.43	2.64	2.84	3.04	3.25	3.45	3.65	3.85	4.06

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