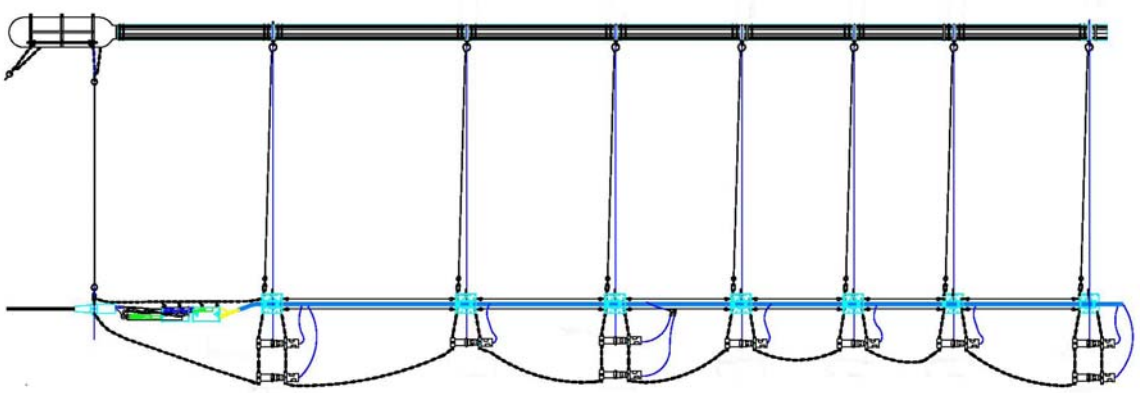
R/V Langseth seismic source arrays

The proposed R/V *LANGSETH* seismic source will comprise four identical linear arrays, or "Strings." Each string will have ten airguns. Nine airguns will be fired simultaneously, while the tenth is kept in reserve as a spare, to be turned on in case of the failure of another airgun. Flexibility is provided by the ability to use 1, 2, 3 or 4 strings at any one time, depending on survey requirements. During 3D surveys, two identical arrays, each with one or two strings, will be towed as far as 100 meters apart and triggered alternately.



One linear airgun array, drawn to scale for towing depth of 6 meters.

GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	0	5.52	360	2000
2	1500LL	0	0	6.48	360	2000
3	1900LLX	3.23	0	6	40	2000
4	1500LL	5.59	0	5.6	180	Spare
5	1500LL	5.59	0	6.4	180	2000
6	1900LLX	8.23	0	6	90	2000
7	1900LLX	10.69	0	6	120	2000
8	1900LLX	13	0	6	60	2000
9	1500LL	16	0	5.53	220	2000
10	1500LL	16	0	6.47	220	2000

For 2D reflection profiling, one, two or four strings may be deployed as required by the target. For refraction shooting, four strings can be deployed, occupying a 24 x 16 meter-square patch behind *LANGSETH*. Each string will comprise a mixture of the existing Bolt 1500LL airguns formerly used on *EWING* and new, smaller Bolt 1900LLX airguns, which will be purchased.

<u>Two strings for 3D reflection and unsedimented ocean crust 2D:</u>

For 2D, X (in-line) and Y (cross track) are referenced to a point on the centerline, ~30 meters aft of the transom. For "standard" 3D with 100m streamer spacing and flip-flop arrays, the reference points are 25 meters to port and starboard of this location. For

wide 3D with 200m streamer spacing and flip-flop firing, the reference points are ~50m aft of the transom and 50m to port and starboard of the centerline.

String 1:

GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	-4	5.52	360	2000
2	1500LL	0	-4	6.48	360	2000
3	1900LLX	3.23	-4	6	40	2000
4	1500LL	5.59	-4	5.6	180	Spare
5	1500LL	5.59	-4	6.4	180	2000
6	1900LLX	8.23	-4	6	90	2000
7	1900LLX	10.69	-4	6	120	2000
8	1900LLX	13	-4	6	60	2000
9	1500LL	16	-4	5.53	220	2000
10	1500LL	16	-4	6.47	220	2000

String 2:

GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	4	5.52	360	2000
2	1500LL	0	4	6.48	360	2000
3	1900LLX	3.23	4	6	40	2000
4	1500LL	5.59	4	5.6	180	Spare
5	1500LL	5.59	4	6.4	180	2000
6	1900LLX	8.23	4	6	90	2000
7	1900LLX	10.69	4	6	120	2000
8	1900LLX	13	4	6	60	2000
9	1500LL	16	4	5.53	220	2000
10	1500LL	16	4	6.47	220	2000

<u>Four strings for 2D reflection, where significant penetration is required:</u>

For all 2D configurations , X and Y are referenced to a point on the centerline, ~30 meters aft of the transom.

String 1:

GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	-12	5.52	360	2000
2	1500LL	0	-12	6.48	360	2000
3	1900LLX	3.23	-12	6	40	2000
4	1500LL	5.59	-12	5.6	180	Spare
5	1500LL	5.59	-12	6.4	180	2000
6	1900LLX	8.23	-12	6	90	2000
7	1900LLX	10.69	-12	6	120	2000
8	1900LLX	13	-12	6	60	2000
9	1500LL	16	-12	5.53	220	2000
10	1500LL	16	-12	6.47	220	2000

String 2:

GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	-4	5.52	360	2000
2	1500LL	0	-4	6.48	360	2000
3	1900LLX	3.23	-4	6	40	2000
4	1500LL	5.59	-4	5.6	180	Spare
5	1500LL	5.59	-4	6.4	180	2000
6	1900LLX	8.23	-4	6	90	2000
7	1900LLX	10.69	-4	6	120	2000
8	1900LLX	13	-4	6	60	2000
9	1500LL	16	-4	5.53	220	2000
10	1500LL	16	-4	6.47	220	2000

String 3:

GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	4	5.52	360	2000
2	1500LL	0	4	6.48	360	2000
3	1900LLX	3.23	4	6	40	2000
4	1500LL	5.59	4	5.6	180	Spare
5	1500LL	5.59	4	6.4	180	2000
6	1900LLX	8.23	4	6	90	2000
7	1900LLX	10.69	4	6	120	2000
8	1900LLX	13	4	6	60	2000
9	1500LL	16	4	5.53	220	2000
10	1500LL	16	4	6.47	220	2000

String 4:

GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	12	5.52	360	2000
2	1500LL	0	12	6.48	360	2000
3	1900LLX	3.23	12	6	40	2000
4	1500LL	5.59	12	5.6	180	Spare
5	1500LL	5.59	12	6.4	180	2000
6	1900LLX	8.23	12	6	90	2000
7	1900LLX	10.69	12	6	120	2000
8	1900LLX	13	12	6	60	2000
9	1500LL	16	12	5.53	220	2000
10	1500LL	16	12	6.47	220	2000

Four strings for 2D refraction, where low frequencies and significant penetration is required:

String 1:

GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	-12	11.52	360	2000
2	1500LL	0	-12	12.48	360	2000
3	1900LLX	3.23	-12	12	40	2000
4	1500LL	5.59	-12	11.6	180	Spare
5	1500LL	5.59	-12	12.4	180	2000
6	1900LLX	8.23	-12	12	90	2000
7	1900LLX	10.69	-12	12	120	2000

8	1900LLX	13	-12	12	60	2000
9	1500LL	16	-12	11.53	220	2000
10	1500LL	16	-12	12.47	220	2000

String 2:

GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	-4	11.52	360	2000
2	1500LL	0	-4	12.48	360	2000
3	1900LLX	3.23	-4	12	40	2000
4	1500LL	5.59	-4	11.6	180	Spare
5	1500LL	5.59	-4	12.4	180	2000
6	1900LLX	8.23	-4	12	90	2000
7	1900LLX	10.69	-4	12	120	2000
8	1900LLX	13	-4	12	60	2000
9	1500LL	16	-4	11.53	220	2000
10	1500LL	16	-4	12.47	220	2000

String 3:

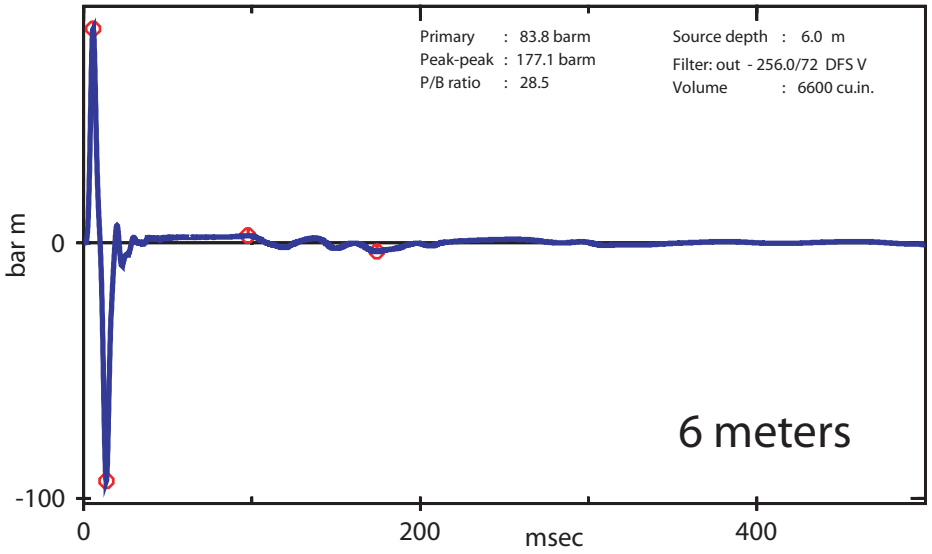
GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	4	11.52	360	2000
2	1500LL	0	4	12.48	360	2000
3	1900LLX	3.23	4	12	40	2000
4	1500LL	5.59	4	11.6	180	Spare
5	1500LL	5.59	4	12.4	180	2000
6	1900LLX	8.23	4	12	90	2000
7	1900LLX	10.69	4	12	120	2000
8	1900LLX	13	4	12	60	2000
9	1500LL	16	4	11.53	220	2000
10	1500LL	16	4	12.47	220	2000

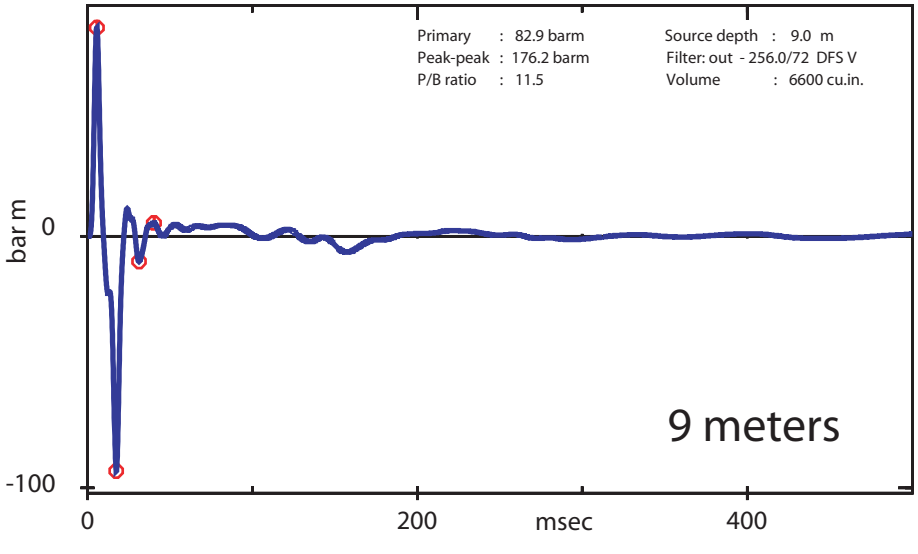
String 4:

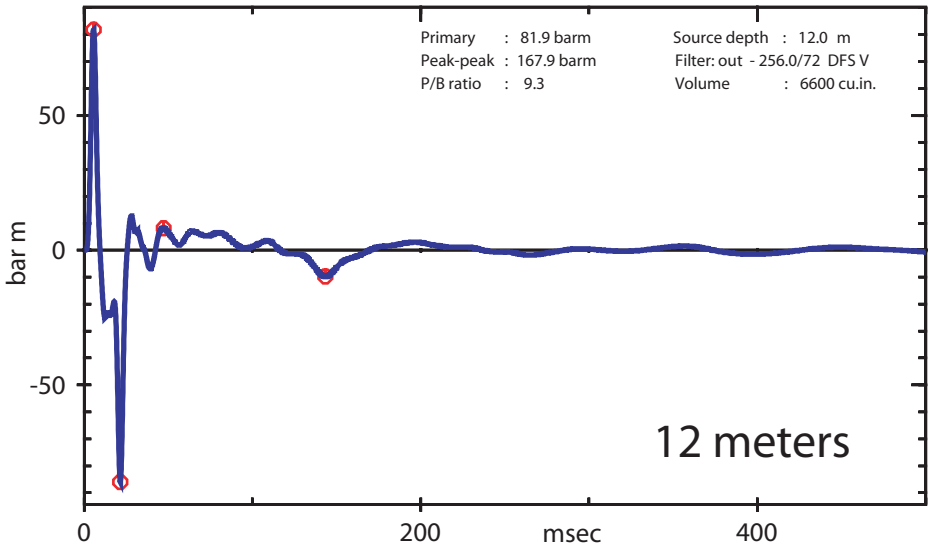
GUN	TYPE	X(m)	Y(m)	Z(m)	VOL(cu)	PR(psi)
1	1500LL	0	12	11.52	360	2000
2	1500LL	0	12	12.48	360	2000
3	1900LLX	3.23	12	12	40	2000
4	1500LL	5.59	12	11.6	180	Spare
5	1500LL	5.59	12	12.4	180	2000
6	1900LLX	8.23	12	12	90	2000
7	1900LLX	10.69	12	12	120	2000
8	1900LLX	13	12	12	60	2000
9	1500LL	16	12	11.53	220	2000
10	1500LL	16	12	12.47	220	2000

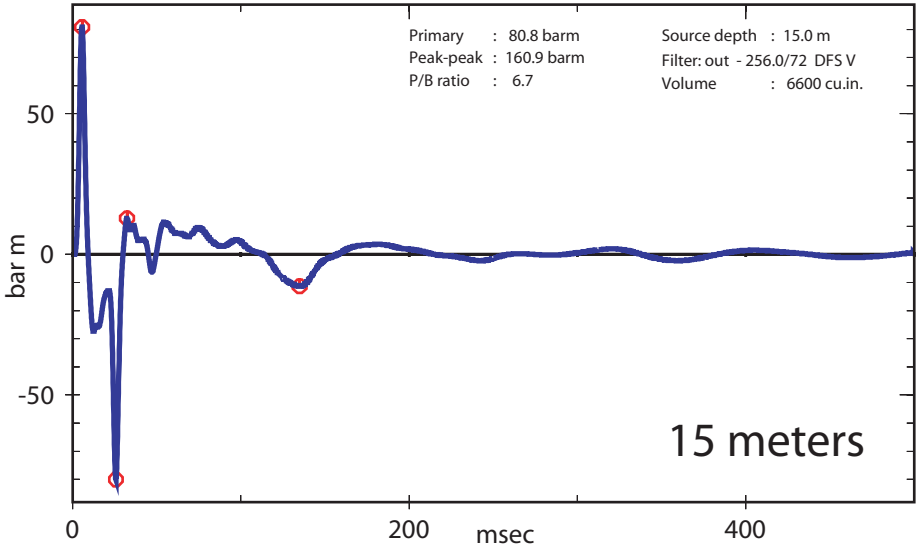
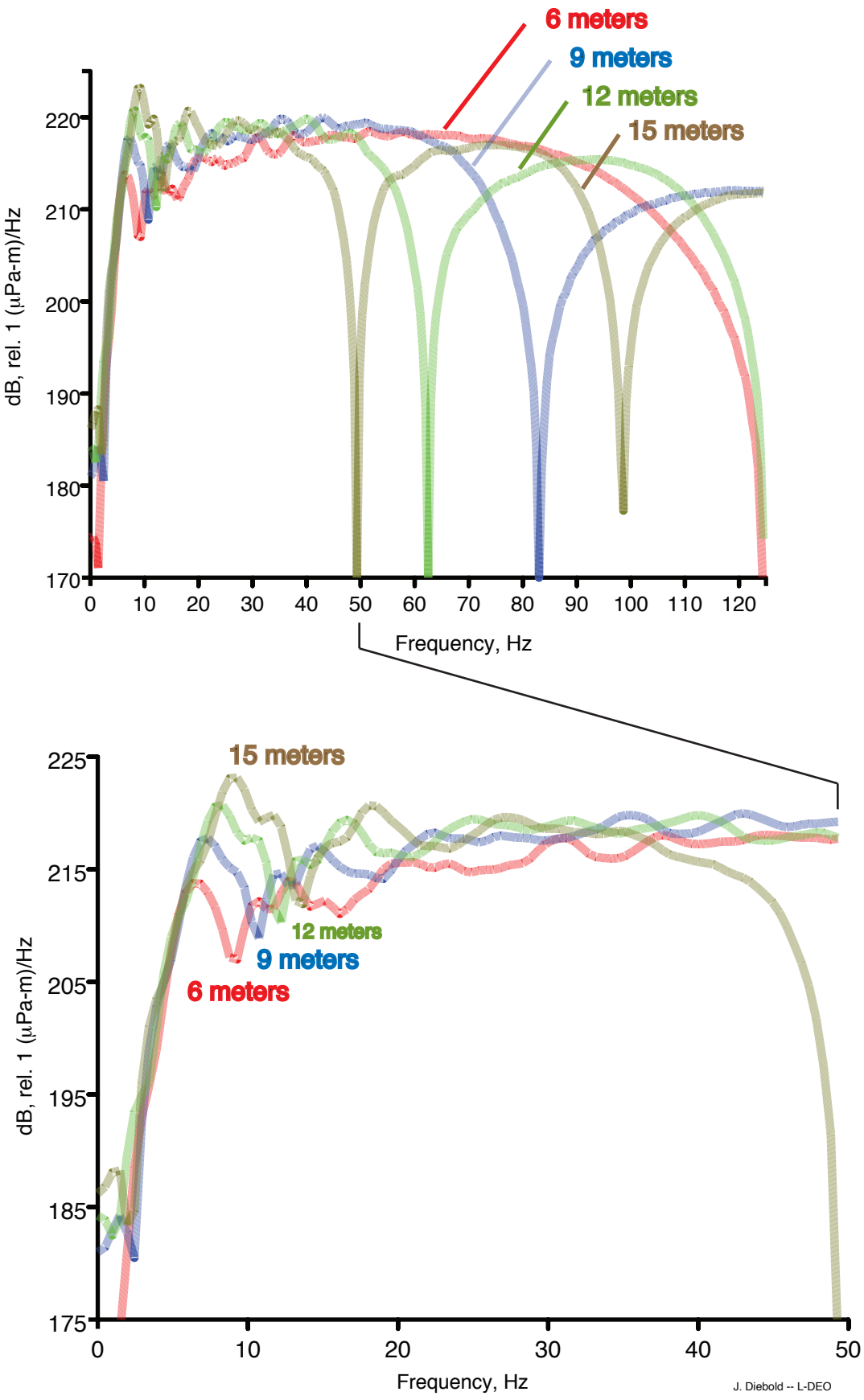
Advantages of the new arrays include superior consistency in towing depth, as well as the ability to tow deeper, which is useful in refraction shooting. This is demonstrated in the accompanying illustration comparing modeled signatures and spectra for tow depths of 6, 9 and 12 meters. The four-string version of this array provides a better tuned signature than Ewing's, with slightly larger peak values, and a smaller [78%] overall air volume.

R/V Langseth 2D source - 4 strings 6600 cu. in.









R/V Langseth 2D source - 4 strings, 4 tow depths