

KIWI 12 Description of Seismic Data

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On the Kiwi 12 survey of the Manihiki Plateau, seismic data was acquired with a two airgun, 3-channel streamer system. The survey was done on the R/V Revelle operated by Scripps Institute of Oceanography. Some 4,200 km of seismic reflection data were acquired during the two week period. A total of 9 sonobuoys were also deployed.

In this writeup, we document the parameters of the seismic survey, the data formats, and the initial processing that was done onboard the ship. The ISIS processing system referred to in this document is a product of Subsurface Exploration Company and was written by C. Bruce Worden and Karen D. Turner.

Seismic System Hardware

The source for the survey was a pair of 210 cubic inch Generator-Injector (GI) airguns from Seismic Systems Inc. For regular profiling both guns were used with a firing interval of 10 secs. Occasionally only one gun was in use while the other was being serviced. The data quality was clearly better with two guns in operation. When a sonobuoy was placed in the water the gun interval was changed to 20 secs to prevent time wrap-around of the later signals. The guns were deployed about 20m aft of the ship at a depth of approximately 5m. During the initial part of the survey, the guns had floats attached to them but these were lost during the first two legs, and the source signal actually seemed to improve as a result. The GI guns generate a signal with up to 150 Hz energy by actual measurement. The injector delay on the GI guns was set to 54 msec for the entire survey. A typical source spectrum is included in this report.

The streamer used in the survey was a 3-channel hydrophone array, with 50m between channels. The streamer is an oil-filled tube with 42 individual hydrophones summed into each channel. The first channel (closest to the ship) was 155m aft of the stern. If anyone cares, the stern of the ship is 41m aft of the mast which is the GPS location point for the ship. All channels appeared to be about equal in signal quality. All channels were

recorded. When a sonobuoy was present, it was placed on channel 4 and recorded, except the single sonobuoy deployed on line K12-02 (sonobuoy #2), which it was exchanged for the regular streamer signal on channel 3. The sonobuoy was received and filtered by a custom radio system adapted specifically for this project by Seth Mogk of SIO. The sonobuoys themselves have the following description on their side "SONOBUOY AN/SSQ-53B (8W62)". For all deployments the sonobuoys were set to 8 hours life and a hydrophone depth of 90 feet, except sonobuoys #4 and #5, which were set to depths of 400 feet and 1000 feet respectively.

The recording system is custom one in which the signal from the streamer is amplified, filtered (25-350 Hz in our case) and digitized. The digital acquisition system is the 'a2d' system written by SOEST (U. of Hawaii). All data were sampled at 1 mil (0.001 sec).

Seismic Data Formats

The data as delivered by the 'a2d' system is in SEG Y format with each trace containing the following information:

- time and date of recording (time to the second)
- digitization rate
- record length
- shot number
- recording delay
- data in IBM real*4 format

To locate these data there is a navigation file which contains the latitude and longitude of the ship at specific times. The files contain the ships position approximately every minute. The minute-sampled location file is derived from the "NAV/DPinpf.98may**" files provided by the underway data stream. Note the raw "DPinpf" contain errors, particularly in the chronological order of their locations, and occasional lat/lon readings of 0.0/0.0. The data are format converted and resampled from position every second, to position every minute. The program that does this is "convertnav.c". The master navigation files that is used for all lines is called "nav.master".

The initial data (lines 1 and 2) were recorded with a variety of record lengths and record delays. Starting with line 3, regular profiles were done with a 2 second delay and 7 second record length. Note that there is an additional 1 sec gap between successive shots. Thus, for the

purpose of calculating the travel time of multiples on the record, assume the record length is 10 sec. For the cases when a sonobuoy was in the water, the recording parameters were 0 delay and 19 second records. Again for the purpose of multiple travel times, the record cycle time is 20 sec.

To process the data, they were reformatted to an "ISIS" format which involves merging the navigation data with the raw SEG Y traces. At the same time, the lat-lon coordinates are converted in a modified Universal Transverse Mercator (UTM) projection (northings and eastings), in which the coordinates are now meters east (x) and north (y) from a reference point. The reference point for the entire Kiwi12 survey was chosen to be:

15.0S 165.0W (Reference Point)

The reformatting was done with the program "newconvert.c", which takes as input the raw SEG Y file and the navigation file, and produces the data in "Isis" format in northings and eastings.

Lines

Line K12-01 This is a two segment line defined by the way points:

12.670S	167.000W
12.670S	166.000W
11.100S	163.400W

The line pasts over the Samoa Basin (5500m depth) and then heads NE up the Nassau Plateau (4500m), and ends on the Manihiki High Plateau (3000m). The line crosses the Suvorov Trough on the NE end, just prior to crossing onto the Manahiki. The line is 440 km long, and the average ship speed of 7.5Kts. The recorded data consists of 11,000 shots with an average spacing of 45m. The initial recording was set for 5 sec records with a 4 sec. delay. This results in a clipped seamount at (~12.1,~164.5), so the basic recording parameters were changed to 7 sec records with a 2 sec delay.

Line K12-02 This a 414 km SW line that is defined by the way points:

11.100S	163.400W
14.359S	165.254W

The average ship speed was again 7.5 kts. This line crosses the Suvorov Trough on its NE end and ends in the Samoan Basin. The average sampling interval is 41m.

Line K12-03 This line is a short (120 km) E-W transit line with the way points:

14.359S	165.254W
14.469S	164.143W

The line is completely within the deep (~5400 m) Samoan Basin. The average speed for this line was 8.0 kts, which gives an average spatial sampling interval of 28 m.

Line K12-04 This line heads approximately NE for 440 km, but has two short NW segments near the projection of the Suvorov Trough. The way points for the line are:

14.469S	164.143W
12.438S	163.127W
12.615S	162.794W
12.385S	162.667W
12.154S	163.175W
11.692S	162.692W

Line K12-05 This line heads initially SE and then SSW. It is 440 km in total length. The line descends from the Manihiki Plateau to the Samoan basin. The way points for the line are:

11.692S	162.936W
12.350S	162.250W
14.215S	163.078W

Line K12-06 This line starts with a SE transit line in the Samoan Basin and then heads NE up to the Manihiki Plateau. It crosses a sequence of block like steps until it reaches the thick sediments of the plateau itself. The line is a total of 301 km long and has an average spatial sampling rate of 41 m. The way points for the line are:

14.215S	163.078W
14.585S	162.766W
12.600S	161.700W

Line K12-07 This line contains two ESE profiles of the Manihiki Plateau and two NNE transit lines. The profile lines are approximately subparallel and 60 km apart. Both profiles show the sharp, block-like scarp of the High Plateau and its thick sediment cover (~ 1 second). The profiles cross the Eastern Scarp. The total length of the line is 622 km, and a 45m spatial sampling. The way points for the line are:

12.600S	161.700W
13.150S	159.500W
13.700S	159.600W
13.000S	161.600W
13.700S	161.900W

Line K12-08 The line is the most southern ESE profile from the Manihiki to the Penrhyn Basin. It crosses the Eastern Scarp. The length of the profile is 270 km. The way points are:

13.700S	161.900W
14.667S	159.637W

Line K12-09 This line is another of the WNW lines over the Eastern Scarp. There are 6904 shot points in the line. The way points are:

12.592S	159.030W
12.031S	161.766W

Line K12-10 Line 10 contains a profile NE across the Manihiki Plateau, and then descends down to the ENE. There are 10370 shot points in the profile. The way points are:

12.031S	161.766W
10.938S	161.125W
10.608S	159.090W
10.000S	159.600W

Line K12-11 This line is the northern most of the profiles on the NE side of the Manihiki. It has 5478 shot points. The port-side air gun failed half way through this line and was not repaired. The way points are:

10.000S	159.600W
9.328S	161.672W

Line K12-12 The final leg is a straight run NE. The profile has 10161 shot points. The way points are:

9.328S	161.672W
5.875S	159.935W

Sonobuoys

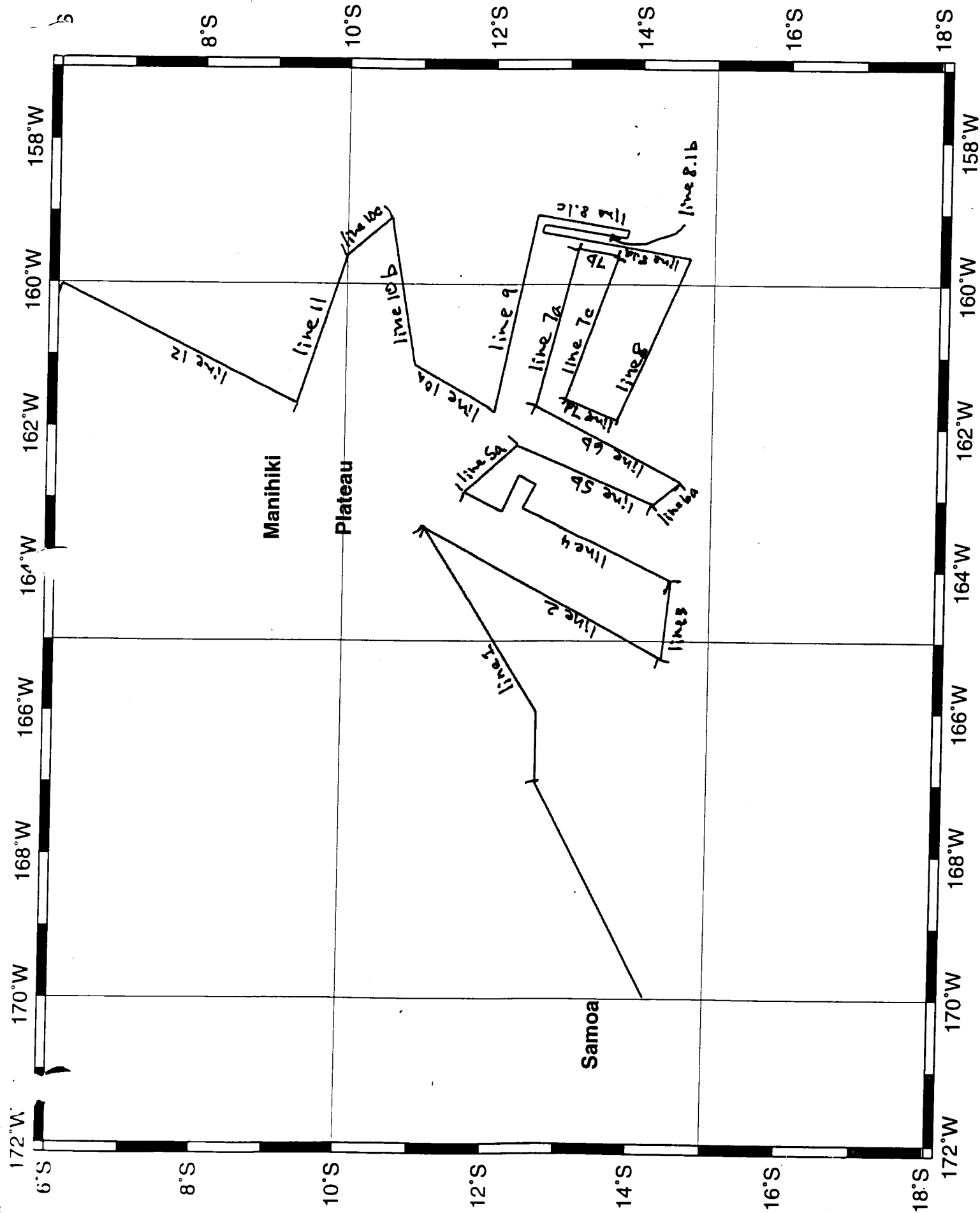
A total of 9 sonobuoys were deployed on Kiwi-12. A table of the deployment locations and parameters is attached. Also a map that shows the locations is included. The Generator-Injector airguns used in the survey were tuned to reduce the air bubble, and consequently enhance the reflection profiles. This unfortunately reduced the source energy below 30 Hz, which probably hurt the sonobuoy data. The choice was made to focus on the reflection data. Only refractions from the shallow sedimentary layers are evident from a cursory onboard look at the data. No 6+ km/sec arrivals were seen, except in one possible case on sonobuoy #7.

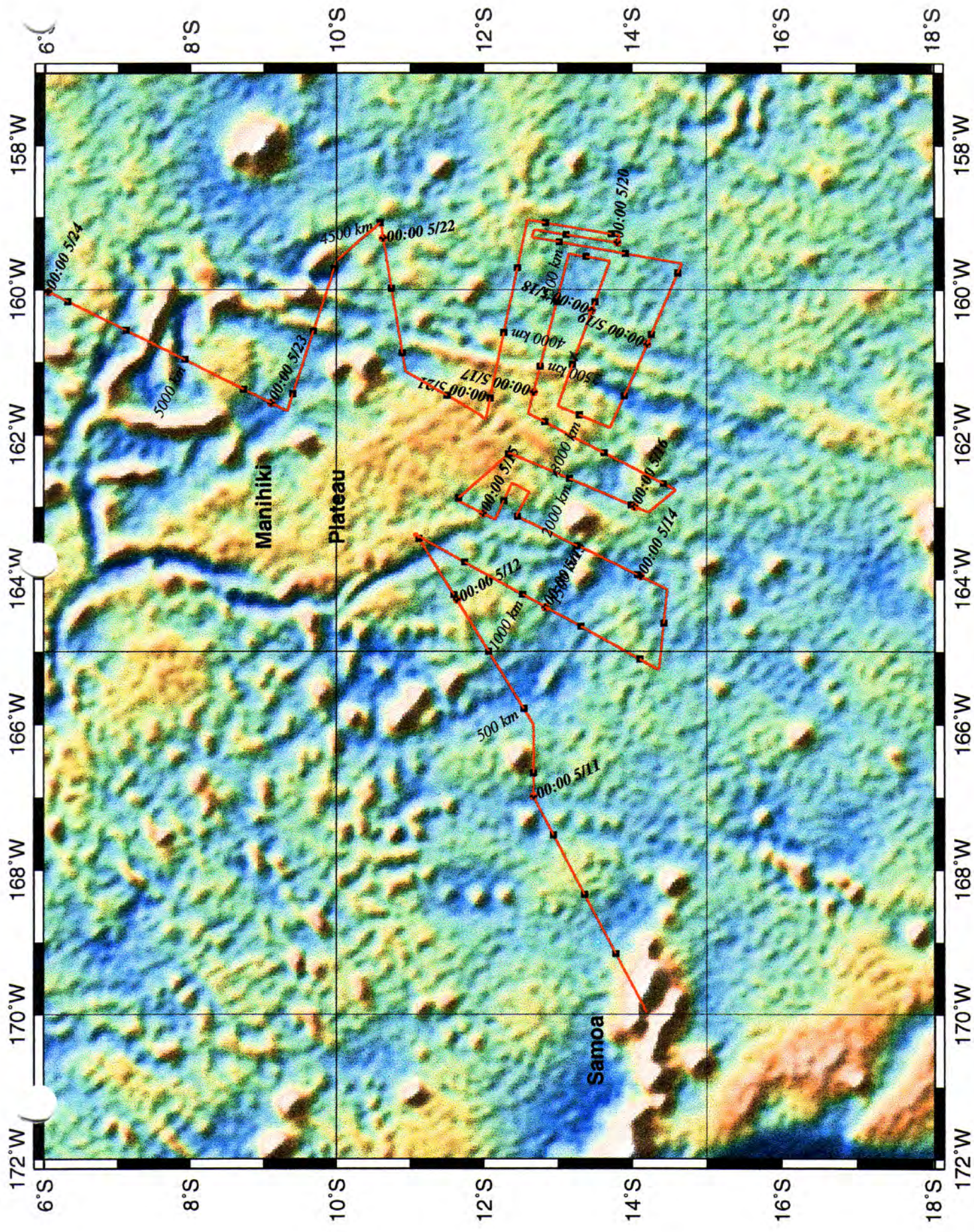
The sonobuoy data were recorded along with the streamer data with the 'a2d' system. For all profiles except #1 and #2, the sonobuoy data are placed on channel 4, which was only active during the deployment. The data can be easily separated from the other data by simply pulling off channel 4 from the raw SEG Y files. For sonobuoys #2, the data were put on channel 3, replacing the streamer channel usually recorded there. Sonobuoy #1 is partially on channel #3 and channel #4, but is probably a lost cause due to a faulty connector in the analog system.

For onboard processing, the sonobuoy data were first separated from the streamer data with "newconvert", putting it in ISIS format. Using ISIS, the sonobuoy profile was isolated by judiciously selecting the display line, then refining with the trace-edit facility. The result was saved as a zero offset section, from which the apparent sonobuoy location was measured. The northings and eastings of the line were also determined from ISIS. With the x-y location of the endpoints of the line and the sonobuoy offset relative to the line ('doffset'), the program "getsono" was used to convert the zero-offset section into a source gather (by reciprocity equivalent to a receiver gather, which is what it should be). This format was then used to further process the data.

Way Points

KIWI LEG 12 WAYPOINTS										
wypt	Total dist	interval	long	lat	cumulative	MAY		interval	speed (kts)	
	Naut miles	dist			time hours	est. serial day	local time	time hours	before after wypt	
1	0.0000	0.0000	-170.6800	-14.2750	0.0000	9.7125		0.0000	0	11.85
Pago Pago/ deploy maggie ASAP										
2	232.6920	232.6920	-167.0400	-12.6900	19.6400	10.5308		19.6365	11.85	3
deploy seismics										
3	235.3231	2.6311	-167.0000	-12.6700	20.5170	10.5674		0.8770	3	7
4	293.8620	58.5389	-166.0000	-12.6700	28.8797	10.9158		8.3627	7	7
5	473.2376	179.3756	-163.4000	-11.1000	54.5048	11.9835		25.6251	7	8
6	696.8571	223.6195	-165.2540	-14.3590	82.4573	13.1482		27.9524	8	8
* or turn sooner if magn/bathy grain of seafloor can be established										
7	761.7552	64.8981	-164.1430	-14.4690	90.5695	13.4862		8.1123	8	8
8*	897.2705	135.5153	-163.1270	-12.4380	107.5089	14.1920		16.9394	8	8
8.1	919.4787	22.2082	-162.7940	-12.6150	110.2850	14.3077		2.7760	8	8
8.2	935.1562	15.6775	-162.6670	-12.3850	112.2446	14.3894		1.9597	8	8
8.3	968.0070	32.8508	-163.1750	-12.1540	116.3510	14.5605		4.1064	8	8
8.4	999.0756	31.0686	-162.9360	-11.6920	120.2346	14.7223		3.8836	8	8
9	1055.4610	56.3854	-162.2500	-12.3500	127.2827	15.0159		7.0482	8	8
10	1177.3593	121.8983	-163.0780	-14.2150	142.5200	15.6508		15.2373	8	8
11	1206.0229	28.6636	-162.7660	-14.5850	146.1030	15.8001		3.5830	8	8
12	1340.3705	134.3476	-161.7000	-12.6000	162.8964	16.4999		16.7935	8	8
13	1473.2149	132.8444	-159.5000	-13.1500	179.5020	17.1917		16.6056	8	8
14	1506.7270	33.5121	-159.6000	-13.7000	183.6910	17.3663		4.1890	8	8
15	1630.8076	124.0806	-161.6000	-13.0000	199.2011	18.0125		15.5101	8	8
16	1676.3128	45.5052	-161.9000	-13.7000	204.8892	18.2496		5.6882	8	8
17	1733.9644	57.6516	-161.0000	-14.1000	212.0957	18.5498		7.2065	8	8
18	1820.1766	86.2122	-159.6370	-14.6670	222.8722	18.9988		10.7765	8	12
18.1	1943.0230	122.8464	-159.2750	-12.6500	233.1094	19.4254		10.2372	12	12
18.2	1949.6481	6.6251	-159.1670	-12.6830	233.6615	19.4484		0.5521	12	12
18.3	2017.5428	67.8947	-159.3530	-13.8000	239.3194	19.6841		5.6579	12	12
18.4	2023.8622	6.3194	-159.2500	-13.8330	239.8460	19.7061		0.5266	12	12
19	2099.4229	75.5607	-159.0300	-12.5920	246.1427	19.9684		6.2967	12	8.5
20	2263.3003	163.8774	-161.7660	-12.0310	265.4224	20.7718		19.2797	8.5	8.5
21	2338.9391	75.6388	-161.1250	-10.9380	274.3211	21.1425		8.8987	8.5	8.5
24	2460.5070	121.5679	-159.0900	-10.6083	288.6232	21.7385		14.3021	8.5	8.5
25	2507.8197	47.3127	-159.6000	-10.0000	294.1894	21.9704		5.5662	8.5	8.5
26	2636.8367	129.0170	-161.6720	-9.3280	309.3679	22.6028		15.1785	8.5	8.5
27	2878.6567	241.8200	-159.8600	-5.7200	337.8173	23.7882		28.4494	8.5	12.3
END SURVEY AT WYPT 27 @1630L May 23										
28	3222.5934	343.9367	-159.5000	0.0000	365.7796	24.9533		27.9623	12.3	12.3
equator										
29	3454.2328	231.6394	-159.2000	3.8500	384.6121	25.7380		18.8325	12.3	12.3
Fanning Atoll										
30	4503.5018	1049.2690	-157.8700	21.2900	469.9185	29.2924		85.3064	12.3	0
Honolulu 0700L May 29 = 29.292										
Total profile length in kilometers										
to wypt 27	5268									
Total seismics in kilometers										
to wypt 18	2900									
wypt 19 to 27	1426									
total seismics	4326									





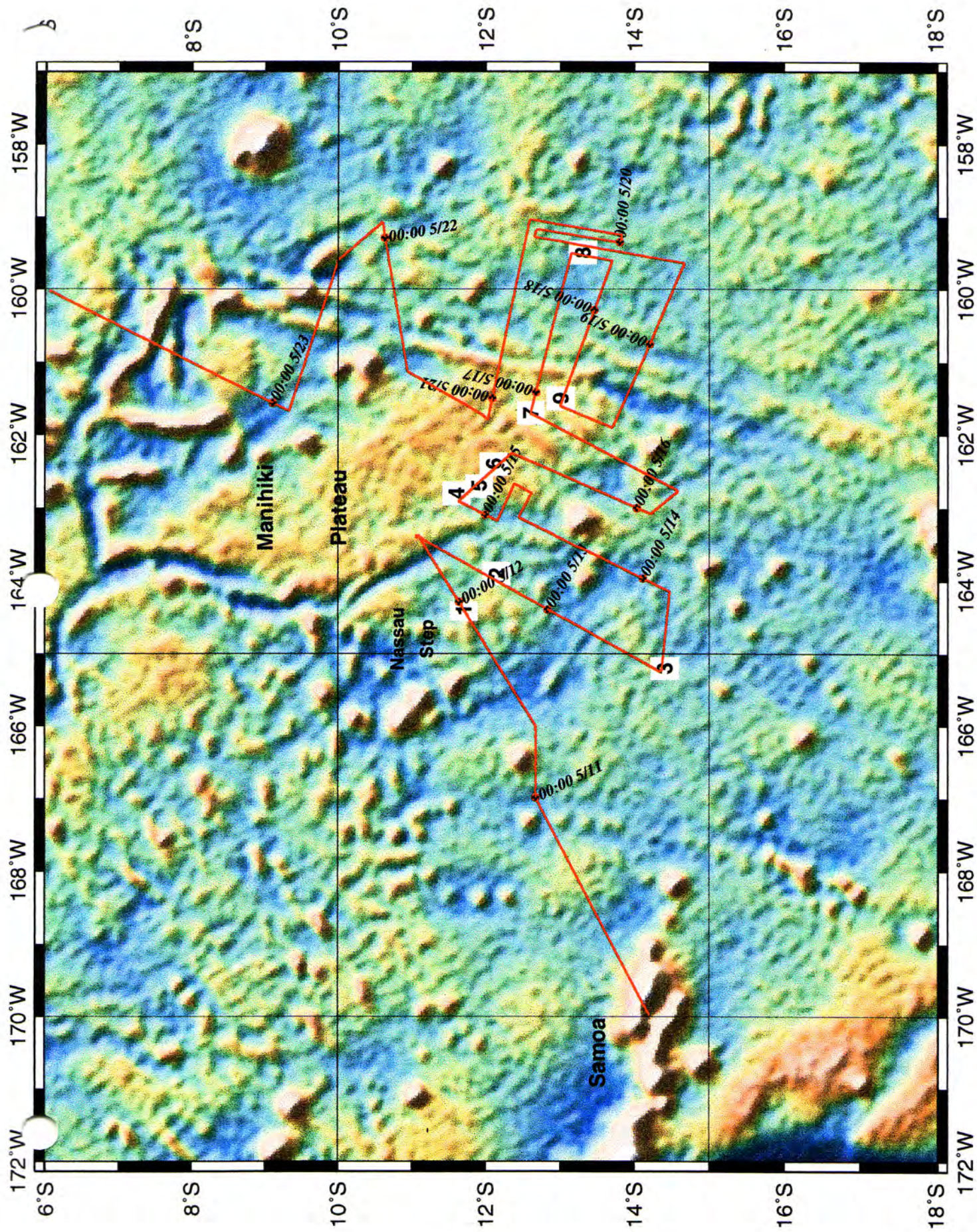


Figure 1: Sonobuoy locations along the Reville track

Sono Buoy Locations

Table 1

Sonobuoy Number	Location		Julian Day	Date	Time GMT	Depth to Ocean Floor, meters	Receiver Depth meters
1	11 43.82'	S, 164 26.33' W	130	11-May-98	2236	3482	27
2	12 8.67'	S, 163 59.78' W	132	12-May-98	1935	3727	27
3	14 21.85'	S, 165 12.12' W	134	14-May-98	1318	5425	27
4	11 38.64'	S, 162 53.13' W	136	16-May-98	314	2867	27
5	11 51.78'	S, 162 41.52' W	136	16-May-98	532	2707	27
6	12 3.79'	S, 162 30.66' W	136	16-May-98	730	2441	122
7	12 36.45'	S, 161 40.28' W	136	16-May-98	2155	2566	305
8	13 19.57'	S, 159 32.1' W	137	17-May-98	1600	5238	27
9	13 0.7'	S, 161 34.7' W	138	18-May-98	1000	2615	27

Source
Spectrum

Typical source
spectrum as recorded
by hydrophones

Max power: 2061.77

