Seismic Operations During Cruise IMAGES VIII, MONA/PAGE 2002, D-1-02-GM Cruise of the R/V Marion Dufresne in the Northern Gulf of Mexico

Patrick E. Hart and Thomas D. Lorenson

High-resolution chirp seismic refection profiles were collected at most of the 2002 core sites using a hull-mounted Thales Sea Falcon II chirp seismic system, using a 25 ms chirp source with a 1600 Hz bandwidth centered at 3.75 kHz. The system was operating almost continuously during the cruise, recording approximately 600 files in standard geophysical 16-bit SEG-Y format, which were later concatenated into 12 larger files. The 40 SEG-Y files available on the USGS website, http://walrus.wr.usgs.gov/infobank/d/d102gm/html/d-1-02-gm.meta.html were taken from these 12 files and comprise the tracklines designed to pass through and adjacent to the coring sites. The final SEG-Y data files each contain a SEG-Y EBCDIC file header (shown below) listing important information about the data and the data trace headers. The most important trace header information is longitude and latitude, given as 4 byte integers in trace header locations bytes 191-194 and 195-198, respectively. The values are decimal degrees, with five decimal places, multiplied by 100,000 to allow the values to remain integer. For example, a latitude of 27.29863 degrees will be recorded in the trace header as 2729863.

Table 1. SEG-Y EBCDIC header.

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                              **********************
                              * EBCDIC REEL HEADER *
                              **********************
   C 1 U. S.  GEOLOGICAL SURVEY                      COASTAL AND MARINE GEOLOGY
TEAM
   C 2 SURVEY_ID:  D1-02-GM                          YEAR:  2002
   C 3 AREA:   NORTHERN GULF OF MEXICO               VESSEL: R/V MARION DUFRESNE
   C 4
   C 5 INSTRUMENT: THALES UNDERWATER SYSTEMS SEAFALCON II CHIRP SEISMIC
   C 6             25 MS CHIRP LENGTH   1600 HZ BANDWIDTH CENTERED AT 3.75KHZ
   C 7             LINEAR FREQUENCY MODULATED CHIRP
   C 8 RECORDING PARAMETERS:                         CHANNELS PER SHOT:  1
   C 9        SAMPLE INTERVAL: 417  MICROSEC         SAMPLE FREQUENCY:  2.4KHZ
   C10        SAMPLES/TRACE: 2048                 DATA LENGTH:  850 MSEC
   C11         RECORD LENGTH VARIES WITH DEEP WATER DELAY PLUS DATA LENGTH
   C12              DATA TRACE IS AMPLITUDE ENVELOPE; POSITIVE VALUES ONLY
   C13
   C14
   C15 RECORDING FORMAT:
   C16        SEG-Y 16-BIT INTEGER
   C17 IMPORTANT TRACE HEADER VALUE LOCATIONS:
   C18    NAME    BYTES       TYPE       DESCRIPTION
   C19   FFID       9-12    INTEGER      FIELD FILE, SHOT OR PING NUMBER
   C20   CDP        21-24   INTEGER      SAME AS FFID
   C21
   C22   TYPE      29-30    INTEGER      TRACE IDENTIFFICATION CODE
   C23
   C24
   C25   DELAY    109-110   INTEGER      DELAY RECORDING TIME IN MILLISEC
   C26   NSAMPLES 115-116   INTEGER      NUMBER OF SAMPLES IN THIS TRACE
   C27   SRATE    117-118   INTEGER      SAMPLE INTERVAL IN MICROSEC FOR THIS
TRACE
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C28   YEAR     157-158   INTEGER      YEAR DATA RECORDED
C29   DAY      159-160   INTEGER      DAY OF YEAR
C30   HOUR     161-162   INTEGER      HOUR (24-HOUR CLOCK)
C31   MINUTE   163-164   INTEGER      MINUTE
C32   SECOND   165-166   INTEGER      SECOND
C33   LONGITUDE 191-194  INTEGER      DECIMAL DEGREES TIMES 100000
C34   LATITUDE  195-198  INTEGER      DECIMAL DEGREES TIMES 100000
C35
C36   FOR FURTHER INFORMATION CONCERNING THIS DATASET, CONTACT:
C37     PATRICK HART
C38     U. S. GEOLOGICAL SURVEY, M/S 999
C39     345 MIDDLEFIELD RD., MENLO PARK, CALIFORNIA  94025
C40     (650) 329-5160    INTERNET:  HART@USGS.GOV
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The SEG-Y data traces are the calculated amplitude envelope attribute showing positive values only, as opposed to a conventional wiggle trace with positive and negative values. The firing or chirp interval during data acquisition was 1.3 seconds for lines SP1b, SP2 and SP3 and 4.3 seconds for lines SP15 and SP16. For all other lines this interval was 3.5 seconds. Sample interval of the data is 417 microseconds with 2048 samples per trace, giving a data length of 850 milliseconds. The data were recorded with a variable deep-water delay calculated in real-time based on the water depth. In theory, this will give a constant record length below seafloor, but in practice the bottom-tracking feature occasionally loses the bottom and this causes skipped or blank traces in the final display. This is evident on some of the Tiff image files of the seismic lines, such as line SP15 or SP33a. The SEG-Y files are output with the deep-water delay applied.

In addition to the SEG-Y format files, a Tiff image file of each seismic line is available on the USGS website http://walrus.wr.usgs.gov/infobank/d/d102gm/html/d-1-02-gm.meta.html. These are grayscale Tiff format files with LZW compression. The display parameters of the data in these Tiff files are 15 inches/second and either 40 or 100 traces/inch. The horizontal scale is dependent on the chirp interval, ship speed and the traces/inch of the plot. To accurately determine horizontal distance along one of these seismic profiles, refer to the navigation file (D102GM_lines.xls) available on the USGS website http://walrus.wr.usgs.gov/infobank/d/d102gm/html/d-1-02-gm.meta.html. This spreadsheet lists position in decimal degrees versus time in GMT at 7 to 12 second intervals along each profile. A good estimate of horizontal scale for each line can be determined from the line summary table below, which lists line length and plotting parameters.

GMT is listed along the top of each seismic profile as hhmmss (hour,minute,second). Time is also in the standard SEG-Y trace header locations as described in the EBCDIC header. All of the profiles are plotted with north and west on the left. Two-way reflection time in 10 ms intervals is listed along the sides of the seismic profiles in the Tiff images. Using a seismic velocity of 1500 m/s, each 10 ms represents approximately 7.5 meters of sediment. A reduced image of line SP17, a west-to-east profile crossing Bush Hill, is shown below in Figure 2a.

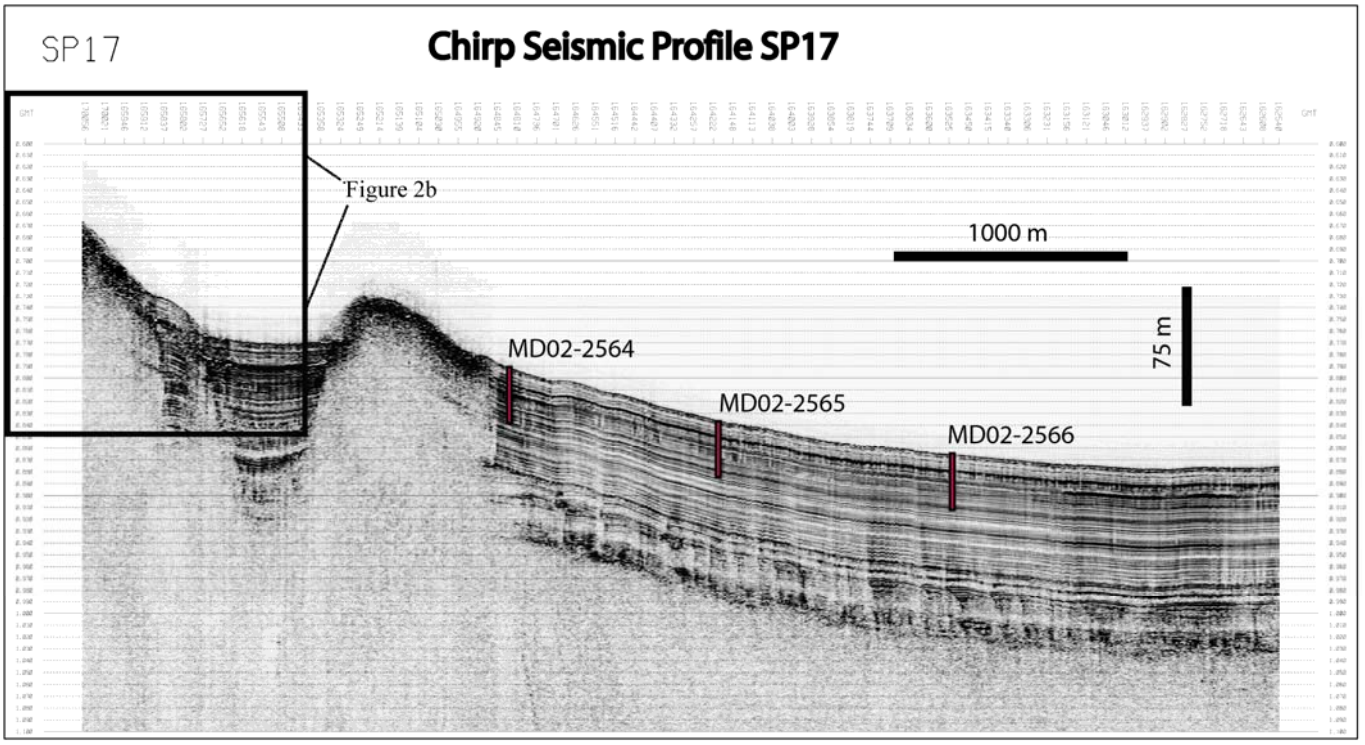


Fig. 2a. This image of seismic line SP17 was modified from the tiff image SP17.tif available on the USGS website http://walrus.wr.usgs.gov/infobank/d/d102gm/html/d-1-02-gm.meta.html. The size was reduced to fit on the page, and the title, scale bars, and the locations of cores MD02-2564, 2565, and 2566 were added. The data show good signal-to-noise ratio and approximately 100 to 150 m penetration into the soft sediments adjacent to the mound at the left-center of the figure. There is very little imaging beneath the hard carbonate and gas hydrate that occurs at the surface of this and similar mounds in the region. The location of this profile is shown on the Bush Hill map in Fig 4. At this reduced scale the GMT and two-way reflection time labels are not visible. The boxed area is expanded below in Figure 2b.

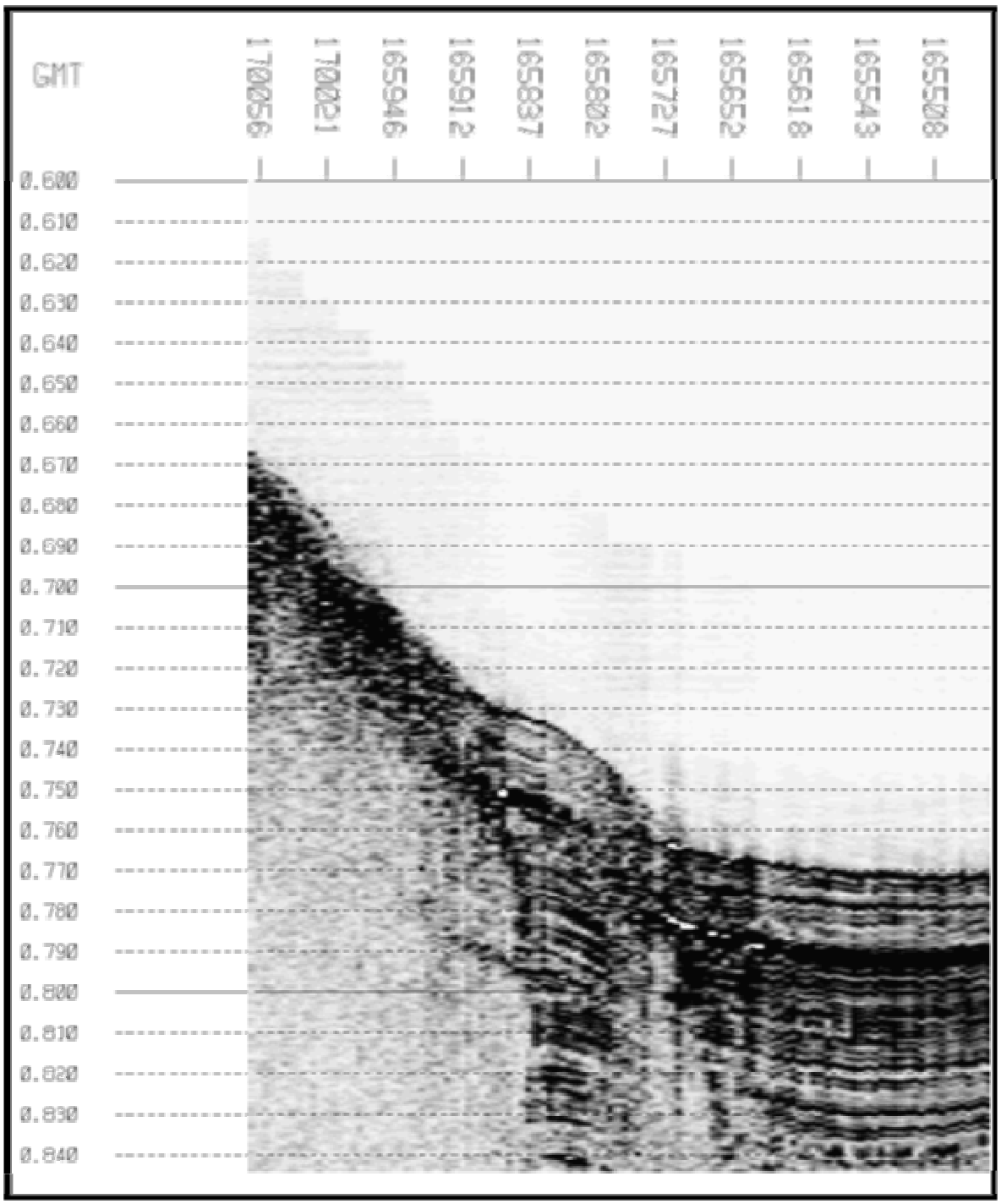


Figure 2b. This expanded view of a portion of line SP17 allows the GMT and reflection time labels to be read. Two-way reflection time from 600 ms to 840 ms in 10 ms intervals is labeled along the left and GMT from hour 16, minute 55, second 08 to hour 17, minute 00, second 56 is labeled along the top from right to left. The 35 second GMT label interval represents 10 traces at a 3.5 second chirp interval. This labeling is on all the Tiff image files.

Collecting geophysical data was not the highest cruise priority so the seismic coverage at each core site depends on the time available between coring operations. Trackline maps for the six areas where seismic data were acquired are shown in figures 3 through 8. The initial series of seismic lines at Tunica mound were poorly navigated and many lines were run in a fairly small area. As a result the lines are not straight and cross back and forth over each other. Figure 3a shows all the Tunica lines and figures 9b and 9c each plot a subset of the lines in order to be more legible. An additional problem with the Tunica lines is that the primary navigation recording system was not operating during the acquisition of lines SP1 to SP3, and lines SP6 through SP10. The navigation fixes for these lines were taken from the SEG-Y trace headers as described above. The precision of the fixes (approximately 10 m) in the trace headers is not as high as with the primary system (approximately 1 m) and therefore these lines appear to be choppier than the others when plotted at a large scale.

A table of information on all the chirp seismic lines is listed below and included on this CD in file "line_summary.xls". Three of the recovered cores do not have corresponding chirp seismic lines that pass near their locations. For these cores, MD02-2566, 2567 and 2567, files were made of the chirp data recorded while the ship was drifting during coring operations. These are listed as lines 24d, 25d, and 33d.

Table 2. Chirp seismic reflection line summary

Line no.	Area	Length km	JD	Start time hour-min	End time hour-min	Number traces	Tiff Scale inch/km	Line scale traces/km	Ave speed kts
1a	Tunica Mound	2.6	185	1812	1818	106	1.0	40.8	14.0
1b	Tunica Mound	7.3	185	1818	1838	916	1.3	125.5	11.8
2	Tunica Mound	10.7	185	1841	1921	1850	1.7	172.9	8.7
3	Tunica Mound	4.6	185	1937	1956	856	1.9	186.1	7.8
4	Tunica Mound	2.8	186	403	422	861	3.1	307.5	4.8
5	Tunica Mound	3.6	186	433	500	1227	3.4	340.8	4.3
6	Tunica Mound	4.1	187	910	938	483	2.9	117.8	4.7
7	Tunica Mound	3.0	187	941	959	311	2.6	103.7	5.4
8	Tunica Mound	2.5	187	1228	1246	309	3.1	123.6	4.5
9	Tunica Mound	2.1	187	1252	1304	207	2.5	98.6	5.7
10	Tunica Mound	2.2	187	1312	1328	274	3.1	124.5	4.5
11	Tunica Mound	2.2	187	1344	1358	241	2.7	109.5	5.1
12	Tunica Mound	1.0	187	1423	1431	138	3.5	138.0	4.0
13	Tunica Mound	1.2	187	1439	1446	121	2.5	100.8	5.6
14	Tunica Mound	2.1	187	1653	1731	656	7.8	312.4	1.8
15	Pigmy Basin	6.7	190	537	620	603	2.3	90.0	5.0
16	Pigmy Basin	5.4	190	644	716	449	2.1	83.1	5.5
17	Bush Hill	6.0	190	1625	1701	610	2.5	101.7	5.4
18	Bush Hill	3.0	190	1722	1739	293	2.4	97.7	5.7
19	Bush Hill	2.8	190	1746	1802	276	2.5	98.6	5.7

20	Bush Hill	2.2	190	1813	1828	259	2.9	117.7	4.8
21a	Kane Spur	21.0	192	444	646	2001	1.0	95.3	5.9
21b	Kane Spur	19.3	192	935	1120	1811	0.9	93.8	6.0
22a	Kane Spur	9.6	192	1224	1326	1070	1.1	111.5	5.0
22b	Kane Spur	26.4	192	1650	1919	2569	1.0	97.3	5.7
23a	Kane Spur	31.1	193	35	308	2639	0.8	84.9	6.6
23b	Kane Spur	5.5	193	530	604	580	1.1	105.5	5.2
24	Kane Spur	27.4	193	649	908	2398	0.9	87.5	6.4
24d	Kane Spur	drift	194	900	930	517	drift	drift	drift
25	Kane Spur	23.0	194	342	542	2067	0.9	89.9	6.2
25d	Kane Spur	drift	194	1457	1527	485	drift	drift	drift
26	West MC	10.8	195	622	722	1035	1.0	95.8	5.8
27	West MC	4.8	195	1220	1252	552	1.2	115.0	4.9
28	West MC	6.0	195	1303	1340	638	1.1	106.3	5.3
29	West MC	10.7	195	1925	2023	1000	0.9	93.5	6.0
30	West MC	11.1	195	2035	2143	1172	1.1	105.6	5.3
31	West MC	6.6	195	2149	2225	621	0.9	94.1	5.9
32	Central MC	6.4	195	219	242	396	0.6	61.9	9.0
32d	Central MC	drift	195	335	405	517	drift	drift	drift
33a	Central MC	9.5	196	37	105	483	0.5	50.8	11.0
33b	Central MC	0.9	196	212	250	655	7.3	727.8	0.8

The two tables below are a summary of all the *Marion Dufresne* cores and are combined in the spreadsheet file on this CD "core_seismic.xls". The one or two chirp seismic lines that pass over or near each core are listed with the core location along the line in time (GMT).

Table 3. Seismic reflection line ties with core locations.

CORE ID	Latitude	Longitude	Chirp Seismic Tie 1 distance from line to core	Chirp Seismic Tie 2 distance from line to core
MD02-2535	27.61983	-92.24100	SP2; 185 190955; 10 m N	SP11; 187 135555; on line
MD02-2536GHF-1	27.62268	-92.24378	SP12;187 142955; on line	SP8; 187 123210; 20 m NW
MD02-2536GHF-2	27.62530	-92.24600	SP12; 187 143100; 220 m NW	none
MD02-2536GHF-3	27.62700	-92.23750	SP7; 187 95640; 170 m N	none
MΔ02–2537	27.61600	-92.24867	SP1a; 185 181435; on line	SP2; 185 191310; 30 m NW
MD02-2538G	27.61667	-92.24717	SP1a; 185 181500; 20 m N	SP2; 185 191235; 30 m N
MD02-2539	27.63983	-92.19226	SP2; 185 184940; 80 m N	none
MD02-2540GHF-1	27.64008	-92.19201	SP2; 185 184935; 100 m N	none
MD02-2540GHF-2	27.64017	-92.19533	SP2; 185 185050; 190 m N	none
MD02-2541	27.63244	-92.21245	SP2; 185 185750; 160 m NW	none
MD02-2542GHF	27.63212	-92.21242	SP2; 185 185750; 140 m NW	none
MD02-2543G	27.61253	-92.25565	SP1a; 185 181250; 50 m SE	none
MD02-2544G	27.61315	-92.25336	SP10; 187 132425; 20 m N	SP2; 185 191520; 30 m N
MD02-2545G	27.61416	-92.25177	SP10 187 132255; on line	SP2; 185 191435; 20 m NW
MD02-2546	27.61567	-92.24697	SP11; 187 135125; 30 m SE	SP2; 185 191245; 80 m SE

MD02-2547GHF	27.61642	-92.24832	SP1a; 185 181445; 30 m NW	SP2; 185 191300; 60 m NW
MD02-2553C2	27.18340	-91.41694	SP15; 190 55650; on line	SP16; 190 65950; 40 m N
MD02-2554	27.78371	-91.49967	SP17; 190 164820; on line	SP18; 190 172810; 50 m E
MD02-2555	27.78320	-91.48901	SP17; 190 164210; 50 m S	SP19; 190 175540; on line
MD02-2556	27.78300	-91.47809	SP17; 190 163520;90 m S	SP20; 190 182010; 30 m W
MD02-2557GHF1	27.78304	-91.49862	SP17; 190 164740; 70 m S	SP18; 190 172830; 150 m E
MD02-2557GHF2	27.78310	-91.48904	SP17; 190 164210; 50 m S	SP19; 190 175540; on line
MD02-2557GHF3	27.78288	-91.47720	SP17; 190 163445; 100 m S	SP20; 190 182015; 50 m E
MD02-2559	28.22267	-89.08784	SP21a; 192 62815; on line	SP25; 194 53730; 60 m SE
MD02-2560	28.24361	-89.15503	SP21a; 192 54910; 40 m N	none
MD02-2561	28.20530	-89.02016	SP21b; 192 100640; 20 m N	SP23a; 193 13540; 20 m NW
MD02-2562	28.07997	-89.14030	SP23a; 193 30800; 170 m SW	none
MD02-2563C2	28.12354	-89.13651	SP24; 193 72140; 230 m N	none
MD02-2564GHFa	28.24347	-89.15464	SP21a; 192 54925; 40 m N	none
MD02-2564GHFb	28.22257	-89.08861	SP25; 194 53710; 10 m SE	SP21a; 192 62755; 50 m SW
MD02-2564GHFc	28.20545	-89.02014	SP21b; 192 100640; 30 m N	SP23a; 193 13535; 30 m NW
MD02-2564GHFd	28.20733	-89.02019	SP23a; 193 13450; 170 m NW	none
MD02-2565	28.12361	-89.13971	SP24; 193 72000; 130 m N	none
MD02-2566	28.11927	-89.10339	SP23a; 193 235 30; 660 m NW	SP24d; 194 91630; on line
MD02-2567	28.10037	-89.02007	SP24; 193 82700; 1750 m NE	SP25d; 194 151730; on line
MD02-2568GHFa	28.07992	-89.14030	SP23a; 193 30800; 170 m SW	none
MD02-2568GHFb	28.08107	-89.13717	SP23a; 193 30610; 100 m SE	none
MD02-2568GHFc	28.11936	-89.10331	SP23a; 193 235 30; 660 m NW	SP24d; 194 92850; on line
MD02-2568GHFd	28.12347	-89.13952	SP24; 193 72010; 120 m N	none
MD02-2568GHFe	28.12354	-89.13636	SP24; 193 72150; 240 m N	none
MD02-2569	28.15218	-89.47980	SP33b; 196 21200; 20 m SW	SP32d; 195 33800; on line
MD02-2570	28.07107	-89.68997	SP26; 195 65720; 20 m S	SP31; 195 222450; 60 m NW
MD02-2571C2	28.06681	-89.72007	SP26; 195 64020; 90 m S	SP28; 195 132315; 150 m W
MD02-2572GHF	28.07109	-89.69001	SP26; 195 65720; 20 m S	SP31; 195 222450; 60 m NW
MD02-2573GHF	28.15204	-89.48004	SP33b; 196 21200; 50 m SW	SP32d; 195 34200; on line

Table 4. Recovered core summary

CORE ID	Latitude	Longitude	Site Name	Core Length meters	Water Depth meters
MD02-2535	27.61983	-92.24100	Tunica Mound	37.84	605
MD02-2536GHF-1	27.62268	-92.24378	Tunica Mound	8.88	608
MD02-2536GHF-2	27.62530	-92.24600	Tunica Mound	none	564
MD02-2536GHF-3	27.62700	-92.23750	Tunica Mound	none	585
MΔ02–2537	27.61600	-92.24867	Tunica Mound	33.58	600
MD02-2538G	27.61667	-92.24717	Tunica Mound	7.76	599
MD02-2539	27.63983	-92.19226	Tunica Mound	31.10	622
MD02-2540GHF-1	27.64008	-92.19201	Tunica Mound	5.65	617
MD02-2540GHF-2	27.64017	-92.19533	Tunica Mound	none	620
MD02-2541	27.63244	-92.21245	Tunica Mound	35.34	615
MD02-2542GHF	27.63212	-92.21242	Tunica Mound	7.70	617
MD02-2543G	27.61253	-92.25565	Tunica Mound	0.15	579

MD02-2544G	27.61315	-92.25336	Tunica Mound	0.10	584
MD02-2545G	27.61416	-92.25177	Tunica Mound	9.27	588
MD02-2546	27.61567	-92.24697	Tunica Mound	31.21	595
MD02-2547GHF	27.61642	-92.24832	Tunica Mound	5.73	607
MD02-2553C2	27.18340	-91.41694	Pigmy Basin	10.32	2259
MD02-2554	27.78371	-91.49967	Bush Hill	31.05	602
MD02-2555	27.78320	-91.48901	Bush Hill	35.68	636
MD02-2556	27.78300	-91.47809	Bush Hill	34.25	654
MD02-2557GHF1	27.78304	-91.49862	Bush Hill	5.59	613
MD02-2557GHF2	27.78310	-91.48904	Bush Hill	none	639
MD02-2557GHF3	27.78288	-91.47720	Bush Hill	none	659
MD02-2559	28.22267	-89.08784	Kane Spur	33.39	1132
MD02-2560	28.24361	-89.15503	Kane Spur	28.24	1029
MD02-2561	28.20530	-89.02016	Kane Spur	28.80	1268
MD02-2562	28.07997	-89.14030	Kane Spur	26.09	1051
MD02-2563C2	28.12354	-89.13651	Kane Spur	3.86	1070
MD02-2564GHFa	28.24347	-89.15464	Kane Spur	7.63	1027
MD02-2564GHFb	28.22257	-89.08861	Kane Spur	none	1261
MD02-2564GHFc	28.20545	-89.02014	Kane Spur	none	1269
MD02-2564GHFd	28.20733	-89.02019	Kane Spur	none	1269
MD02-2565	28.12361	-89.13971	Kane Spur	22.50	1068
MD02-2566	28.11927	-89.10339	Kane Spur	26.05	1186
MD02-2567	28.10037	-89.02007	Kane Spur	26.65	1318
MD02-2568GHFa	28.07992	-89.14030	Kane Spur	6.96	1049
MD02-2568GHFb	28.08107	-89.13717	Kane Spur	none	1057
MD02-2568GHFc	28.11936	-89.10331	Kane Spur	none	1190
MD02-2568GHFd	28.12347	-89.13952	Kane Spur	none	1068
MD02-2568GHFe	28.12354	-89.13636	Kane Spur	none	1049
MD02-2569	28.15218	-89.47980	Central Miss	10.35	1032
MD02-2570	28.07107	-89.68997	West MC	28.35	631
MD02-2571C2	28.06681	-89.72007	West MC	10.38	664
MD02-2572GHF	28.07109	-89.69001	West MC	4.90	628
MD02-2573GHF	28.15204	-89.48004	Central MC	4.20	1027

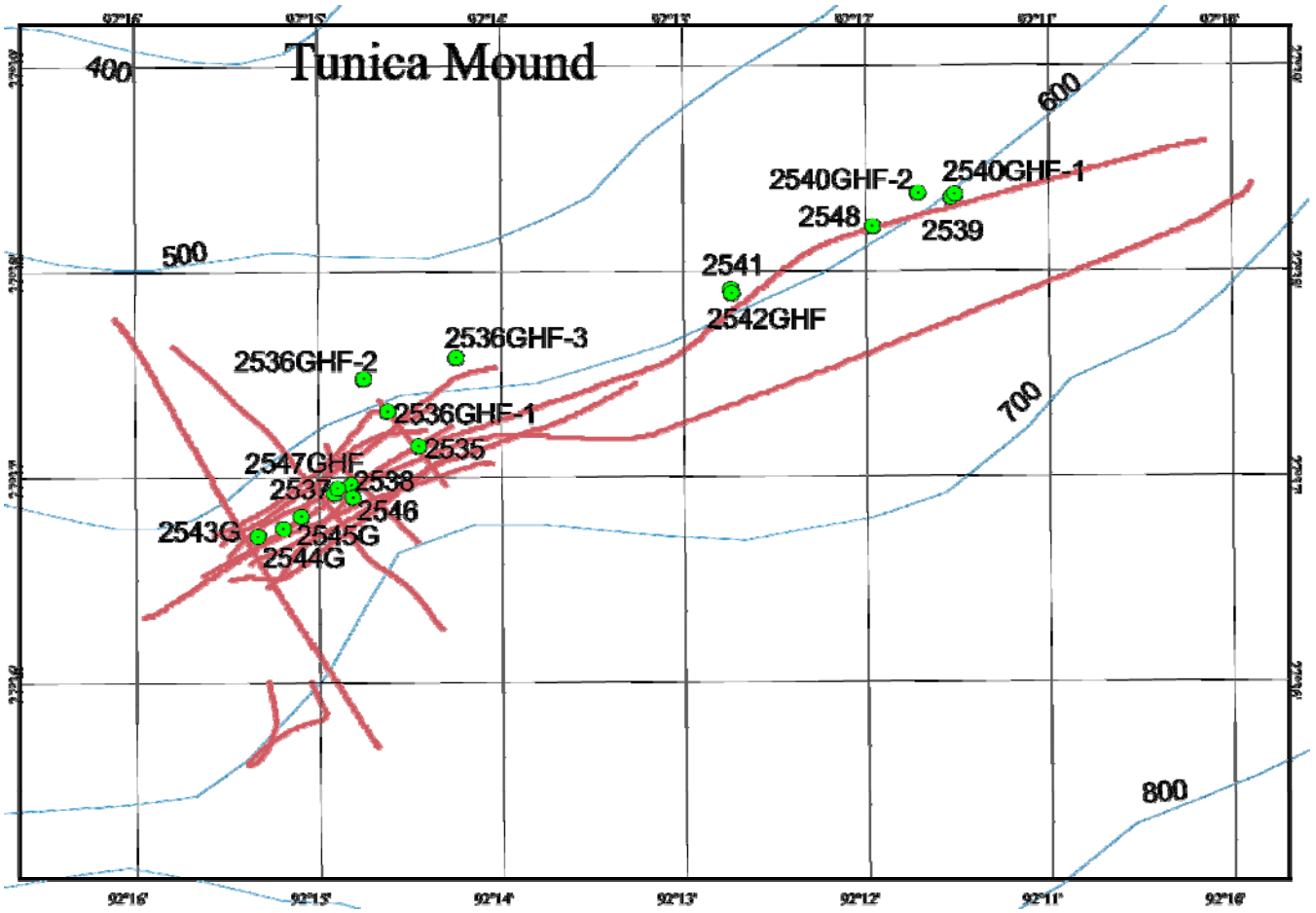


Figure 3a. Trackline map for seismic profiles at the Tunica Mound core sites. Core IDs are shown in this figure but line numbers are not, because the line spacing is too close to legibly show all line numbers in one page-size figure. Figures 3b and 3c show lines 1 through 7, and 8 through 14, respectively. Depth contours are in meters for this and all following maps.

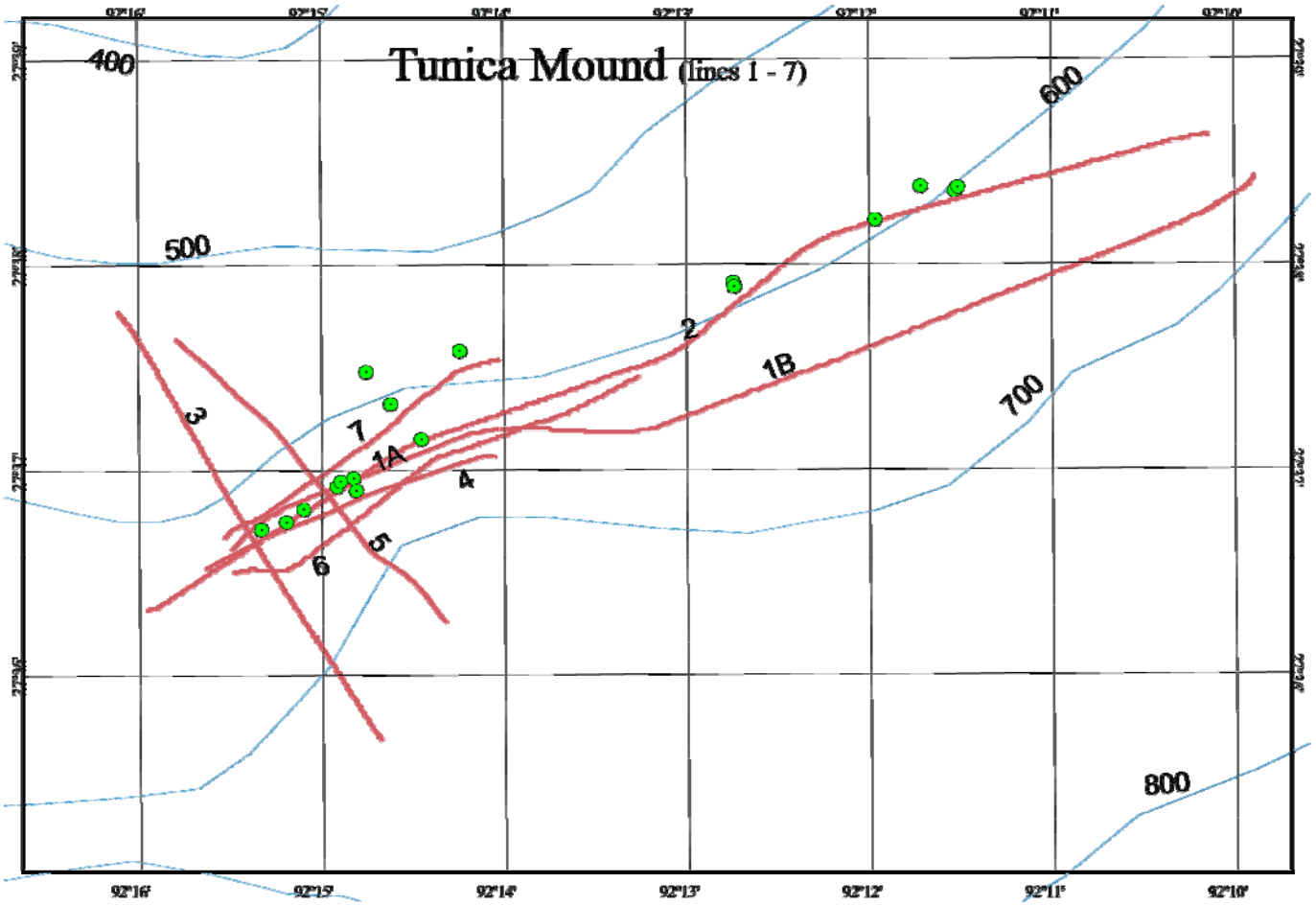


Figure 3b. Trackline map for seismic profiles 1 through 7 at the Tunica Mound core sites.

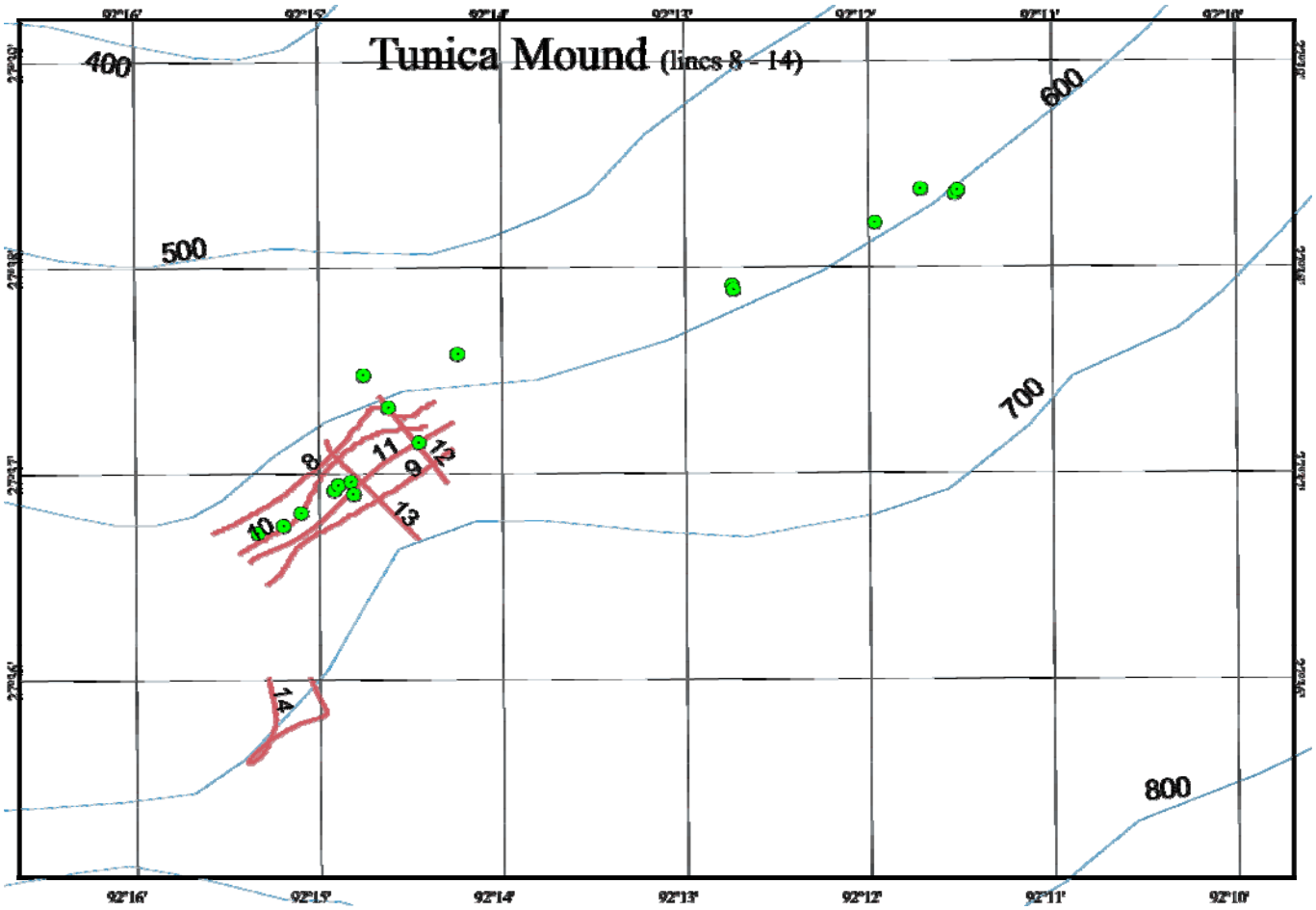


Figure 3c. Trackline map for seismic profiles 8 through 14 at the Tunica Mound core sites.

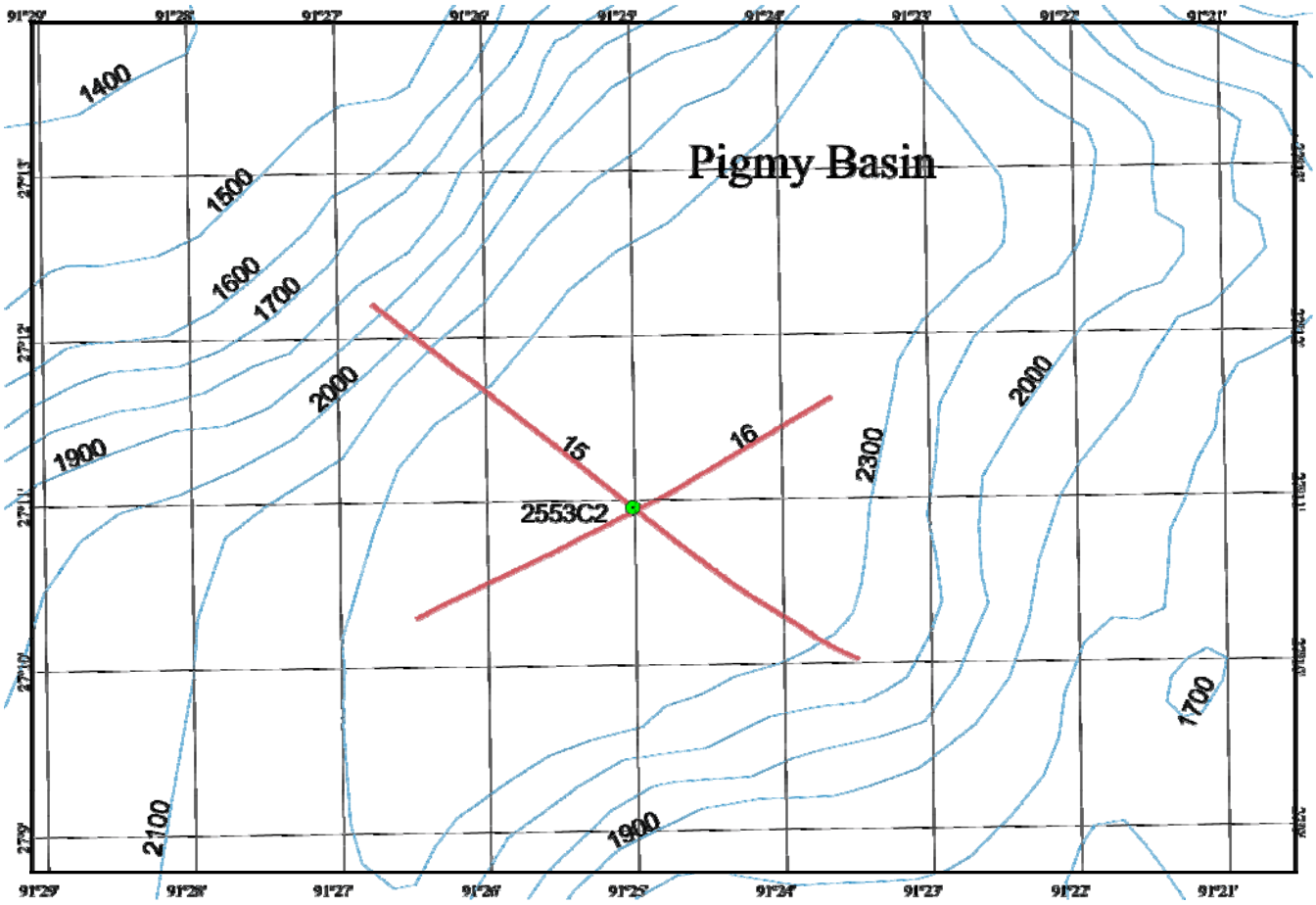


Figure 4. Trackline map for seismic profiles at the Pigmy Basin core site.

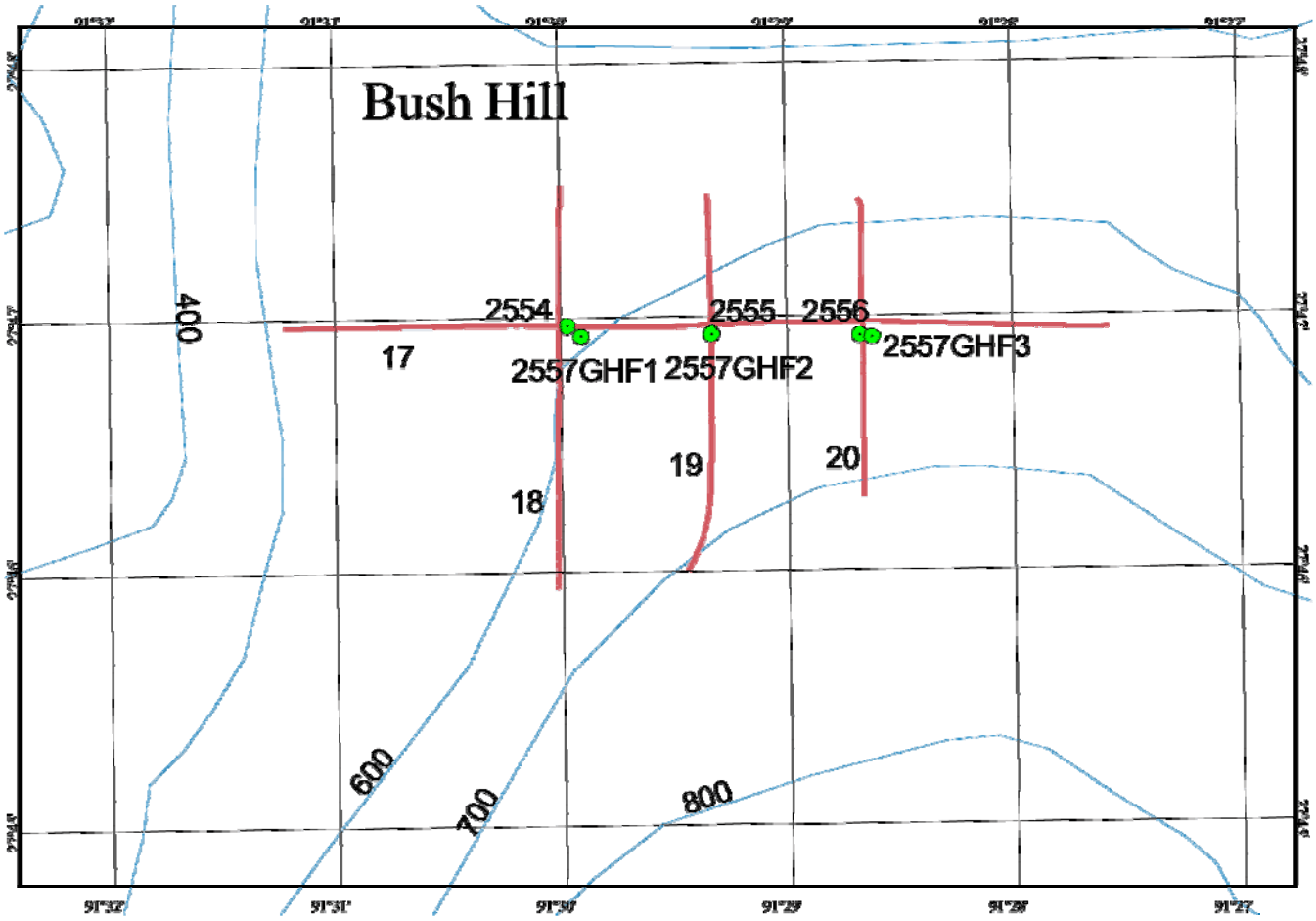


Figure 5. Trackline map for seismic profiles at the Bush Hill core sites.

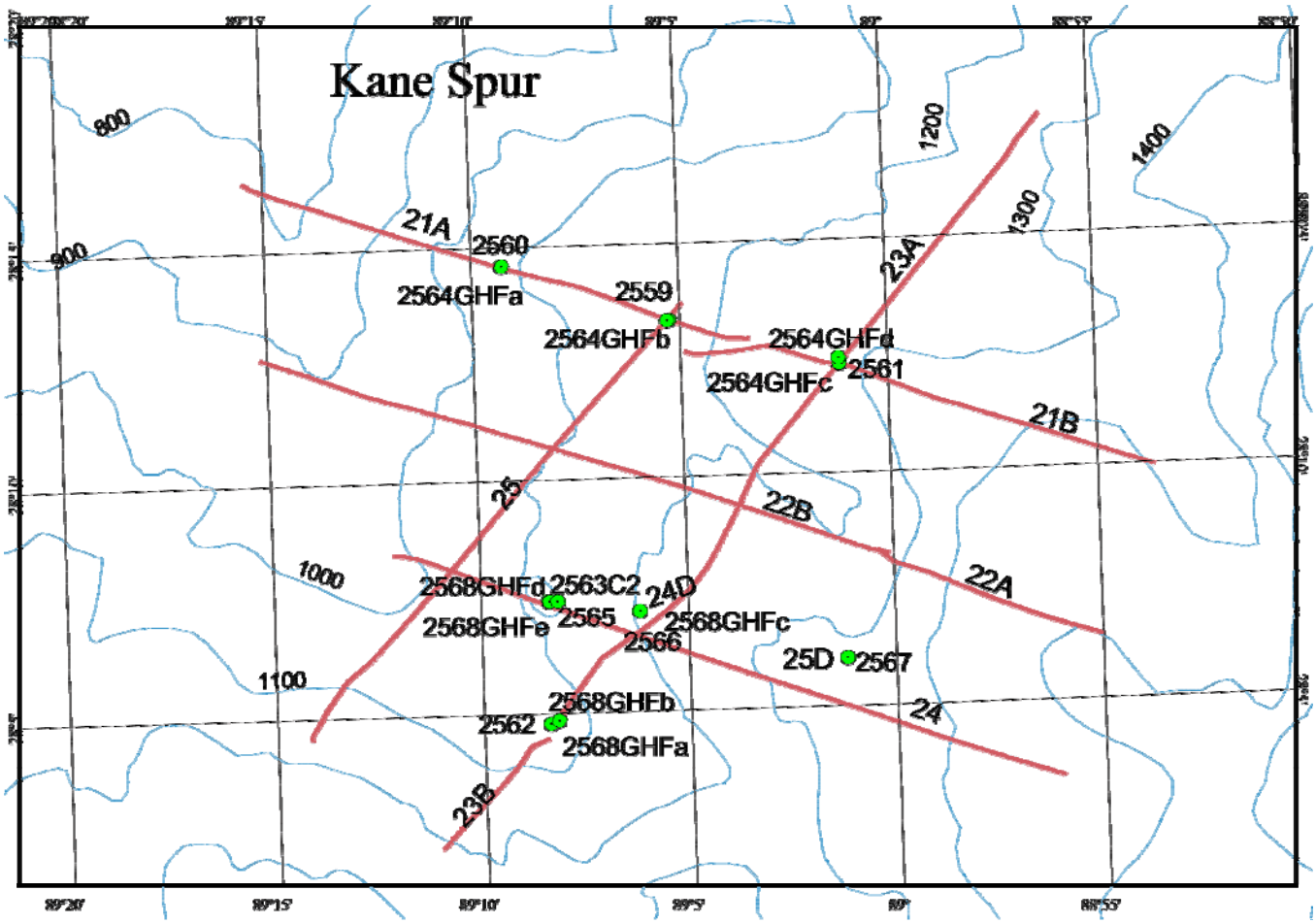


Figure 6. Trackline map for seismic profiles at the Kane Spur core sites in the eastern Mississipi Canyon.

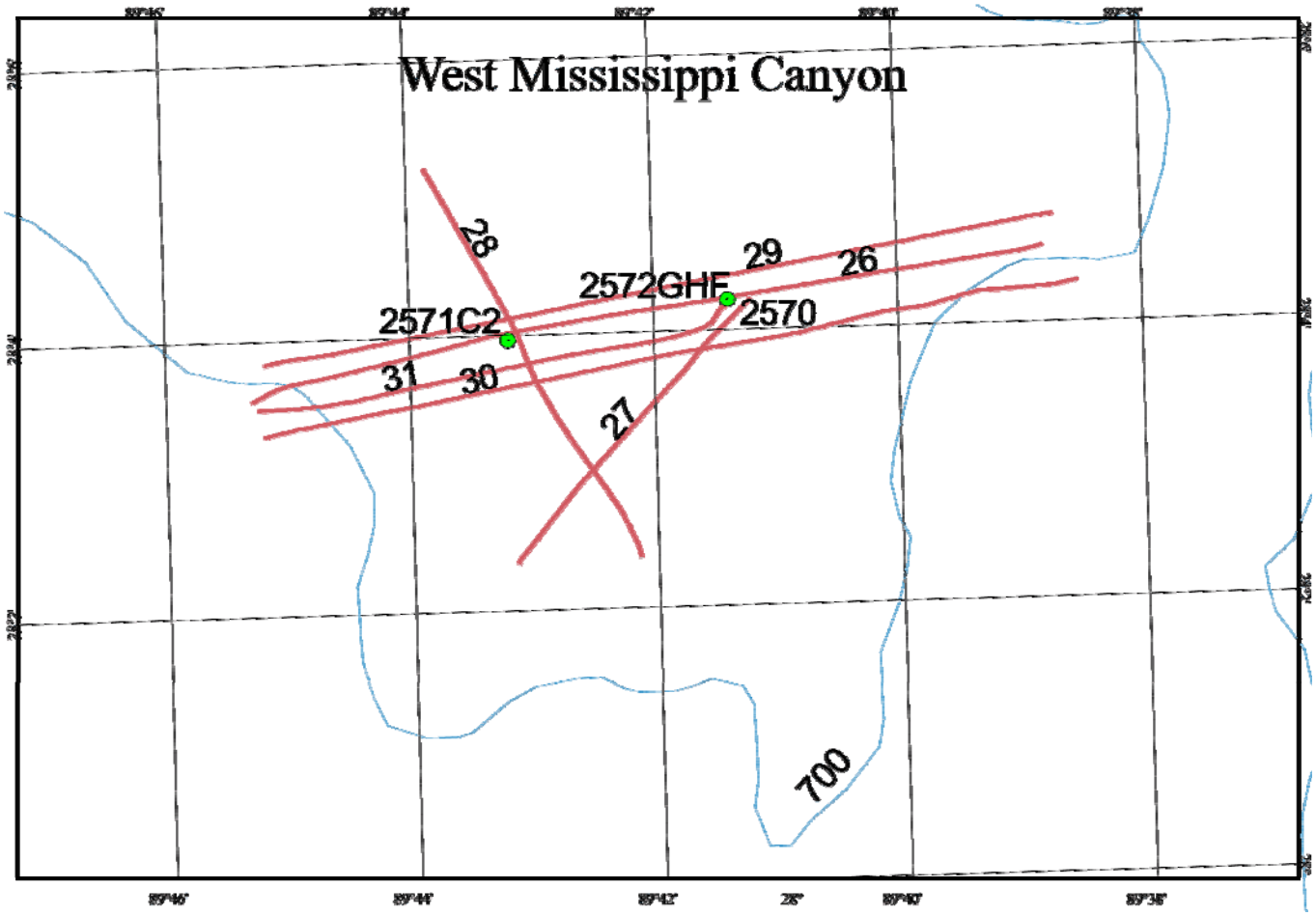
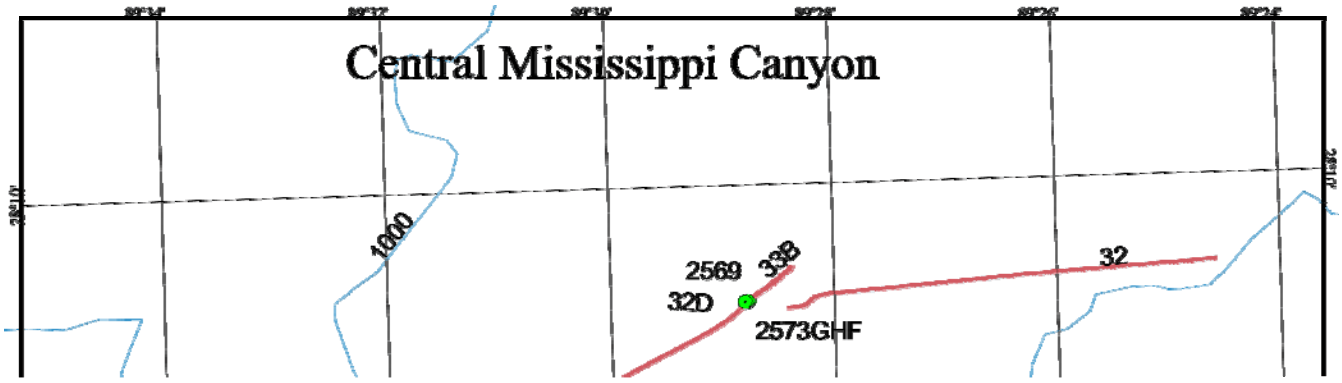


Figure 7. Trackline map for seismic profiles at the West Mississippi core sites.


Central Mississippi Canyon
1000
2569
33B
32D
2573GHF
32