To: R/V Clearance Officer
OES/OA Room 5805
U.S. Department of State
Washington DC 20520

PRELIMINARY CRUISE REPORT FORM

STATE DEPT. CRUISE NO: 2000-100

SHIP NAME: R/V MAURICE EWING (cruise EW0108)

OPERATING INSTITUTE: LDEO, Columbia University

PROJECT TITLE: Kolpos Korinthiakos: deep seismic imaging of active continental extension

CRUISE DATES (INCLUSIVE): 23 July - 1 August 2001

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DESCRIPTION OF SCIENTIFIC PROGRAM: Marine multichannel seismic profiling (with coincident swath bathymetry and free-air gravity) of the Gulf of Corinth, Greece. Marine airgun shots were also recorded by an array of land seismometers - see following detailed report.

SCHEDULE OF DATA DELIVERY: All marine data delivered at end of cruise (8/1/01) to designated Greek observer (Dr. Maria Sachpazi). Land seismic data delivered in September, 2001.

Data Description: Navigation, marine multichannel seismic, swath bathymetry, free-air gravity, land seismic - see following detailed report

Kolpos Korinthiakos
Deep Seismic Imaging of Active Continental Extension
Cruise Report for EW0108

R/V Maurice Ewing
Patras, Greece to Pireas, Greece
23rd July – 1st August, 2001

Cruise Participants

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Introduction

Scientists from the University of Hawaii, National Observatory of Athens, and Institut de Physique du Globe de Paris conducted a 10-day cruise in the Gulf of Corinth, leaving Patras on the 23rd July and arriving in Pireas on the 1st of August. The R/V *Maurice Ewing*, with a 6-km-long streamer and a 20-airgun sound source, was used for the experiment. The airgun blasts were also recorded on an array of 100 land seismometers surrounding the Gulf out to distances of 150 km.

The mechanics of continental extension and the controversial notion that low- and very-low-angle normal faults play a key role at some places/times in lithosphere rifting and break-up are the subject of much debate. Low-angle normal faults appear to be much more common in the geologic record than in earthquake focal mechanism catalogs. Many authors posit that normal faults that dip <30° are not seismically active, whereas others propose that parts of active normal faults could dip at very low angles (<15°), similar to the near-horizontal surfaces that separate basement from tilted sedimentary cover as seen in metamorphic core complexes.

The Gulf of Corinth is an active continental rift with high seismicity and extensional strain rate. The bounding faults are high-angle (40°-50°) where they crop out. In the center-west of the Gulf, earthquake studies reveal faults at 6-11- km depth with low (~30°), and perhaps very low (10-15°), dips whereas in the east the activity is on faults dipping ~45° at 4-13-km depth. New MCS data confirm this contrast and further suggest the exciting prospect that a very low-angle (15°) fault may be active in the center-west. Because the upper crust to 4-6 km depth is aseismic, and existing reflection seismic images don't penetrate >5km, the relation of the seismogenic structures to the shallow structures is unknown. A wide variety of deformation styles have been proposed based on outcrop and seismicity evidence. The deformation (measured by strain and seismicity) is focused beneath the Gulf. Therefore marine seismic reflection data are required to directly determine the fault geometry in the upper 15 km of crust and thereby to distinguish between the competing models of faulting and the extensional deformation of continental lithosphere. The new seismic observations sought to image the structures accommodating the deformation in this actively extending area and to provide a database essential for proposed ocean drilling.

A teleseismic tomographic study of the crustal structure suggests that the crustal thinning may not be coincident with the rift (Tiberi et al., 2000). Specifically, there is evidence for thinner crust north of the central-west part of the Gulf, which is consistent with the hypothesis of a low-angle normal detachment at 10-12 km depth above ductile lower crust. The result is at the limit of resolution of the teleseismic tomographic study, but can be tested readily by recording our marine shots onshore. Using the 100 land seismic stations, the shot-receiver distances should be sufficient to record Moho reflections (>80 km, given the 30-40 km thick crust). The results will allow us to derive a 3-D crustal velocity structure of the region and test the Tiberi et al (2000) model of asymmetric crustal thinning related to Corinth rifting on low-angle detachments.

Operations

The R/V Maurice Ewing left Patras at 1000 (0700 UTC) on the 23rd of July, 2001 and transited at full speed to the deployment site, arriving at 1300 (1000 UTC). After problems with the tail buoy and a bad digitizing cannister, the 6 km streamer was deployed and we began shooting at 0353 (0053 UTC) on the 24th of July. At 0930 (0630

UTC) on the 26th of July, a bad can caused us to pull in a significant portion of the streamer. Shooting recommenced at 1413 (1113 UTC) At 1700 (1400 UTC) on the 28th of July, the streamer was shortened to 3 km to allow increased maneuverability of the ship along short dip lines. Fishing line and nets tangles around the birds were removed. Shooting started again at 2226 (1926 UTC). Shooting stopped on July 31 at 1700 (1400 UTC).

Cruise Summary and Data Distribution

During eight days at sea we shot 54 individual multi-channel seismic lines and collected coincident navigation, swath bathymetry, and free-air gravity data (Fig. 1). Despite problems with the new UKOOA navigation files on the R/V Maurice Ewing, basic MCS processing sequences, including Dip Moveout, NMO-Stack and Migration were carried out onboard on selected dip lines (e.g. Fig. 2, 3, & 4). The data clearly show well developed asymmetric graben in the basin and their bounding normal faults.

Copies of ALL data (marine and land) collected on this program have been provided to both our Greek (Dr. Maria Sachpazi) and French (Dr. Alfred Hirn) colleagues, with whom we continue to collaborate post-cruise on the processing and analysis of same.

Seismic Acquisition Parameters

Streamer Configuration

The first half of the Gulf of Corinth seismic experiment was shot using the Ewing's 240 channel, 6-km-long streamer with a group interval of 25 m. The second half of the experiment was shot using a 3 km streamer configured with 240 channels and a 12.5 m group interval. The Ewing streamer is made up of active sections each of which is 150 m in length. At the front of the streamer there is a passive stretch section and an armored tow leader connecting the streamer to the ship. At the back of the streamer there is a small 4 m active section, which completes the last hydrophone group, a passive stretch section and a tail buoy section. Each active section has 11 complete 12.5 m receiver groups plus 2 half groups at either end. The half groups are completed by the adjoining active section. See appendix for exact streamer configuration

Compass Birds and Streamer Navigation

The streamer was instrumented with depth control birds (set to 10 m for this survey) of which odd numbered ones were compass birds. The birds at the front of the streamer, and at the end, were more closely spaced than in the middle. In the main part of the streamer, the spacing of the birds was 300 m (compass birds 600 m). The tail buoy was attached to the active part of the streamer by 150 m of stretch section and 25.3 m stick section. There was a functioning CA code GPS receiver on the tail buoy during acquisition. Locations from the receiver, a CA code receiver on the Ewing, and the Y-code receiver were recorded in the compass bird data files, cb1.d<julian day>, along with the compass bird headings.

Air Gun Array

A 20 air gun, 8445 cu. in. array was used during the entire experiment. Guns are numbered starting from the starboard side, thus gun 1 is the gun furthest out on the boom. The average airgun tow depth was 10 m. See appendix for the array configuration.

Acquisition and Recording

Data was acquired using "shoot-on-distance" plus randomization to reduce the coherence of water multiples. The mean shot spacing was set at 50 m. The 50 m shot spacing mean that full-fold CMP gathers are 60-fold.

For each shot, 16384 ms of data was recorded for all 240 channels at 4 ms sample interval. Each 3490E tape was set to record 182 shots, which corresponds to ~60 minutes of data. The original SEG-D format was converted to SEG-Y for archiving and subsequent processing. The size of each SEG-Y formatted file of 182 shots is 726139920 bytes.

The Spectra system was used to control data acquisition and streamer navigation. Real time streamer navigation proved informative to watchstanders and the bridge. Many problems were encountered when inputting the UKOOA navigation files into the MCS processing software (ProMAX). Though the UKOOA navigation was successfully used ashore, we chose to use more traditional methods at sea for most of the lines, generating simple geometry files from the R/V *Maurice Ewing* ts.n<jday> files.

Archival and SEG-D to SEG-Y Conversion

The SIOSEIS copy script reformatted the SEG-D 3490E tapes into SEG-Y and wrote them to disk in IEEE format, where the files could be input to ProMAX. The copy script utilizes *segdin* parameter offline, which rewinds and ejects the input SEG-D tape after it has been read. This signals the operator that a new tape should be mounted. After a new tape is inserted, a file named "in" must be created with the tape unit number in it. segdin waits for the creation of this file before reading the new tape. *segdin* deletes the file "in" so that it enters another wait state at the end of the tape. The SEG-Y files were stored on disk until ~30 GB was present, at which time the SEG-Y files were copied to DLT tape using *totape*, a program written by Mike Simpson at SOEST. Writing multiple SEG-Y files to a single tape violates the SEG-Y standard. In addition to converting SEG-D to SEG-Y for archival, direct copies of the 3490E SEG-D tapes were made using Jeff Turmelle's *copytapes* perl script. 3490E cartrudge were put in the stacker on *grampus* and copied to the DLT tape drive. The stacker was refilled until the DLT was filled (approx. 65 tapes). Jeff's script gives a running count of how full the DLT tape is. See the appendix for details of the scripts and programs used here.

Ewing SEG-D Tape Format

The Ewing Syntron seismic system may record in a SEG-D demultiplexed format – 20 bit binary, IBM floating point, or IEEE floating point, however IEEE is preferable. The SEG-D format specifies that the first tape record of each shot contain the SEG-D headers. The demultiplexed traces follow and are terminated by a file mark.

SEG-D allows the seismic channels to be grouped into channel sets. The Syntron system on the Ewing normally has the streamer data in channel set 1 and the 12-channel auxillary box in channel set 2. If the aux box is not used, channel set 2 need not be recorded. In contrast, the old Digicon system had the first channel set as the non-seismic "trace 0" and the second channel set had the seismic data.

LDEO uses the SEG-D extended general header to record many other recording variables much as they used "trace 0" on the old Digicon recording systems. For instance, the Hydrosweep center beam depth and streamer depth and streamer compasses are in the LDEO SEG-D extended trace header. SIOSEIS process *segdin* retains the extended general header, and extracts the Hydrosweep depth, compasses, shot number, and True Time clock for the trace header.

The shot time in the regular SEG-D location is the PC clock within the Syntron system. The LDEO true time (GPS) clock that all the Ewing real-time systems reference is extracted by SIOSEIS process *segdin* and is used in its SEG-Y headers. The true time clock is the time base used in the LDEO ts shot files.

The LDEO R/V Maurice Ewing gun firing system generates a shot number every time the guns are fired. Thus, the shot number is a count of shot triggers sent to the guns. The SEG-D file number is a count of files written to tape. If the system triggers but the guns do not fire, the shot is not recorded. As a result the shot number increments but the file number does not. Experience shows that files may be lost by the recording system, but triggers (and shot numbers) are rarely dropped and one can assume a constant distance between shots numbers when "shooting by distance". SIOSEIS puts the shot number in the SEG-Y trace header "shot number" position (the third 32 bit integer) and the file number in the "energy source number" (the fifth 32 bit integer).

Gravity Data

The Bell BGM-3 gravimeter was logged at one second intervals. There were no gaps in the gravimeter record for this cruise.

Logging

- Raw gravity data is logged to disk and broadcast to the network
- A real-time gravity process reads the sampled data and applies a 6 minute gaussian filter to the raw sample to provide a running display of the current gravity. This value is used is the gravity ties to determine the local gravity.

Gravity Post Processing

- Raw data is filtered using a 6-minute gaussian filter and mGals are output. The raw mGals are represented by:
  mGals = gravity_count * scale + bias
  bias = 852645.3 (Dec. 5, 1997), scale = 5.0940744 (July 9, 1992).
- A second filter is then applies; an 8 minute Gaussian filter using the GMT system.
  filter1D –G480 –R –E
- The filtered output is then reduced to 1 minute intervals by using the mean values of all data +/- 30 seconds from the 00 second mark of the minute output;
  98+254:00:07:00.000 980422.37
  98+254:00:08:00.000 980422.38
- The data is merged with the navigation. See Processed File Formats. At this point Eotvos corrections are determined by merging the daily navigation and raw gravity files and calculating the Eotvos correction as:
  Eotvos correction = 7.5038 * vel_east*cos(lat) + 0.004154*vel*vel
- The velocities used in the Eotvos calculation are smoothed to reduce jitter in the corrected gravity and FAA values. The smoothing is done using a 9 point moving average.

Gravity Ties

It is usual practice to have a gravity "tie" to a gravity reference base station during the port stay. A portable gravity meter, e.g. the LaCoste Model G#70, is used to make 1) a pier side reading; 2) a reading at the base station; 3) an additional pier side reading. The pier side gravity value, adjusted in value to correspond to the height of the BGM gravity meter, is compared to the real-time BGM gravity reading discussed previously.

The practice is not to adjust the BGM-3 so that its reading agrees with the pier-side gravity value, but to establish a “dc shift”, which represents a constant correction to be applied to all gravity values on the next cruise.

For example, suppose the pier-side value equaled 980274.7 mGal and the BGM reading was 980279.9, the dc shift would be 5.2 mGal. In other words, the BGM is 5.2 mGal high. This values is subtracted from observed values of gravity following the cruise as a constant correction. The “drift” of the Bell gravity meter is determined from the two in-port gravity stations. In the pre-cruise tie the BGM might have been found to be 5.3 mGal high. The drift during the cruise is therefore equal to 3.2 mGal (8.4-5.2).

The last gravity tie prior to this cruise was in San Juan, Puerto Rico. A gravity tie was made in Athens

Hydrosweep Data

Multibeam bathymetry was collected using the recently upgraded Hydrosweep DS multibeam sonar. This version of the Hydrosweep DS-2 calculates as many as 140 “soft” beams based on the 59 “hard” beams generated by the ATLAS GE-6012 hardware signal processor. The total swath can be as much as approximately 120 degrees. The “soft” beam spacing is approximately 0.85 degrees. The new sonar in addition to a wider swath, produces acoustic reflectivity data.

A beta release of MB-System (Version 5.0 beta 03) was installed in */usr/local/metadata/dev/mbsystem* on the R/V *Maurice Ewing* computer network. This was a symbolic link to the current version with binaries and man pages. This is the first release that supports the new file formats produced by the Hydrosweep DS-2.

XBT

Four XBTs were launched during the survey (Table 1) to determine the water velocity profile in the Gulf of Corinth. This information will be used during processing of the Hydrosweep multibeam bathymetry

Table 1: Location of XBTs

XBT Number	Latitude	Longitude
1	38.2889	022.1478
2	38.2914	22.2773
3	38.2806	22.4162
4	38.1198	23.0876

Land Seismic Stations

During the marine experiment, a number of land seismic stations recorded the shots from the R/V *Maurice Ewing*. Forty 4.5 Hz, 3 component geophones were installed in shallow holes in the far field under a contract with Landtech (Fig. 5; Table 2). Various other permanent seismic stations also recorded the shots in the far field, including the NOA (ATHNET), PATNET, and CRL (Corinth Rift Laboratory) stations (Tables 3, 4, and 5).

A French group, of the CNRS INSU, headed by Jean-Michel Marthelot and in cooperation with the NOA, installed ~75 geophone groups as an 8 km array perpendicular to the coast near Derveni, in the southern part of the gulf. A similar profile of ~25 groups was installed to the north of the gulf near Itea. The geophones comprised a string of six 10 Hz geophones which were coupled to the ground through spikes. The goal of these near field instruments was primarily to record wide-angle reflections, effectively extending selected north-south lines in the gulf.

Table 2. Proposed and actual location of the 40 far field 4.5 Hz geophones.

Station Number	Proposed Location		Actual Location	
	Latitude	Longitude	Latitude	Longitude
1	39.1219	21.9457	39.13266	21.87883
2	38.9604	22.0688	38.95646	22.05756
3	38.7931	22.184	38.74229	22.2155
4	38.643	22.2842	38.5895	22.3308
5	39.2014	22.5533	39.19943	22.52364
6	39.0297	22.5347	39.03718	22.52118
7	38.8637	22.5164	38.89987	22.49428
8	38.6633	22.5048	38.64679	22.48758
9	39.0169	23.3163	39.02174	23.31044
10	38.8709	23.157	38.85734	23.11659
11	38.7301	23.0205	38.73256	23.00938
12	38.5384	22.8246	38.53165	22.82115
13	38.6985	23.7319	38.71199	23.75239
14	38.6175	23.5087	38.62209	23.49897
15	38.5295	23.3299	38.54046	23.31164
16	38.3864	23.0109	38.37654	23.01378
17	38.0853	23.9709	38.07511	23.95336
18	38.1091	23.6951	38.11486	23.67767
19	38.1313	23.4628	Not determined	
20	38.1533	23.223	38.14848	23.22779
21	37.8851	23.4545	37.89365	23.43775
22	37.9655	23.1519	37.95526	23.16916
23	37.3689	23.1852	37.36843	23.17791
24	37.5544	23.0677	37.57124	23.0735
25	37.6993	22.9703	37.67827	22.95469
26	37.8732	22.8516	37.85962	22.85999
27	37.2621	22.2459	37.2638	22.24067
28	37.4566	22.278	37.43538	22.29499
29	37.68	22.2964	37.68738	22.29469
30	37.9317	22.3371	37.92776	22.339
31	37.6747	21.449	37.69866	21.45462
32	37.7712	21.6599	37.75583	21.61983
33	37.8616	21.8567	37.86826	21.89036
34	37.9915	22.0982	37.99054	22.13687
35	38.1421	21.9037	38.17484	22.03746
36	38.4837	21.1098	38.48797	21.11188
37	38.4775	21.3588	38.46745	21.36954
38	38.4362	21.6293	38.4558	21.6232
39	38.3831	21.8701	38.41666	21.8595
40	38.5598	21.9969	38.56416	21.98666

Table 3. Locations of seismic stations in the NOA network.

Station Name	Latitude	Longitude	Elevation (m)
ATH	37.9822	23.7167	95
ITM	37.1797	21.9267	400
JAN	39.6567	20.8508	540
KZN	40.3067	21.7708	900
PTL	38.0488	23.8647	500
RLS	38.0578	21.4667	100
VLS	38 10.50	20.5897	375
NEO	39.1750	23.2235	500
VLI	36.1750	22.9488	220
EVR	38.9167	21 .8087	1050

Table 4. PATnet seismic stations:

Latitude	Longitude
38.8179	20.9615
38.1407	20.7662
37.7232	20.8453
37.1635	21.6079
37.7091	21.4845
38.1842	21.4037
38.3505	21.5784
38.2791	21.7683
38.4016	21.8481

Table 5. Corinth Rift Laboratory (CRL) seismic stations

Latitude	Longitude
38.1937	22.0588
38.2605	22.1113
38.1977	22.1603
38.2348	22.0753
38.3320	22.1752
38.2317	22.1180
38.3658	22.0725
38.4102	22.0168
38.3735	22.2483
38.3910	22.1397
38.2648	22.0633
38.2467	22.0433

Seismicity During Survey

During the recording period of the land instruments, approximately 180 earthquakes occured in the vicinity of the study area. Most of these events are aftershocks from the Ms=5.8 Skyros left-lateral strike slip event located at approximately 39.06 N, 24.35 E (as determined by the Institute of Geodynamics, National Observatory of Athens). The Skyros event is located approximately 57 km northeast of land station 13 (Fig. 5)

Appendix

MCS lines shot during the Gulf of Corinth experiment

Line	Latitude Start	Longitude Start	FFID Start	Latitide End	Longitude End	FFID End	Comments
GOC1	38.3092	22.5011	5	38.3154	22.2025	546	Strike E-W
GOC2	38.3121	22.2022	554	38.2545	22.7505	1562	Strike W-E
GOC3	38.2470	22.7489	1510	38.2552	22.1577	2588	Strike E-W
GOC4	38.2410	22.1605	2613	38.1912	22.7973	3747	Strike W-E
GOC5	38.1893	22.7998	3762	37.9982	22.8110	4186	Dip N-S
GOC6	37.9985	22.8167	4191	38.2058	22.8400	4693	Dip S-N
GOC7	38.2101	22.8334	4699	38.2336	22.1957	5837	Strike E-W
GOC8	38.2197	22.1976	4770	38.1582	22.7603	7049	Strike W-E
GOC9	38.1486	38.1486	7082	38.1795	22.4359	7674	Strike E-W
GOC10	38.1847	22.4334	7104	38.3816	22.4812	7571	Dip S-N
GOC11	38.3801	22.4855	7587	38.1476	22.4389	8160	Dip N-S
GOC12	38.1478	22.4340	8165	38.3116	22.4250	8540	Dip S-N
GOC53	38.2665	22.1991	9001	38.2167	22.4222	9001	Strike W-E
GOC12A	38.2217	22.4254	9462	38.3827	22.4764	9854	Dip S-N
GOC13	38.3792	22.4827	9884	22.4827	22.4242	10453	Dip N-S
GOC14	38.1474	22.4180	10479	38.3932	22.4522	11050	Dip S-N
GOC15	38.3933	22.4583	11051	38.1542	22.4149	11662	Dip N-S
GOC16	38.1564	22.4090	11671	38.3877	22.4469	12226	Dip S-N
GOC17	38.3873	22.4512	12258	38.1788	22.4576	12734	Dip N-S
GOC18	38.1770	22.4624	12731	38.0952	23.1591	14036	Strike W-E
GOC19	38.0904	23.1578	14067	38.1126	22.5910	15074	Strike E-W
GOC20	38.1144	22.5880	15078	38.2955	22.6263	15078	Dip S-N
GOC21	38.2959	22.6323	15516	38.1431	22.6505	15872	Dip N-S
GOC22	38.1420	22.6546	15897	38.1249	23.1621	16800	Strike W-E
GOC23	38.1296	23.1632	16813	38.1795	22.6670	17707	Strike E-W
GOC24	38.3229	22.3665	17813	38.1849	22.3170	17813	Dip N-S
GOC25	38.1852	22.3113	18157	38.3261	22.2935	18505	Dip S-N
GOC26	38.3268	22.2908	18506	38.2009	22.2322	18840	Dip N-S
GOC27	38.2010	22.2286	18844	38.3383	22.2458	19195	Dip S-N
GOC28	38.3382	22.2486	19197	38.1909	22.2957	19605	Dip N-S
GOC29	38.1942	22.3082	19656	38.3266	22.3509	19980	Dip S-N
GOC30	38.3265	22.3540	19623	38.1665	22.3585	21378	Dip N-S
GOC31	38.1642	22.3615	21387	38.1521	22.4870	21614	Strike W-E
GOC32	38.1556	22.4895	21625	38.2782	22.5337	21933	Dip S-N
GOC33	38.2769	22.5389	21956	38.1183	22.5831	22373	Dip N-S
GOC34	38.1182	22.5908	224023	38.3443	22.6503	224565	Dip S-N
GOC35	38.3441	22.6564	22512	38.0715	22.7056	23182	Dip N-S
GOC36	38.0774	22.7116	23215	38.2907	22.7239	23722	Dip S-N
GOC37	38.2906	22.7260	23728	38.0353	22.7519	24330	Dip N-S
GOC38	38.0354	22.7543	24335	38.2163	22.8262	24818	Dip S-N
GOC39	38.2162	22.8286	24823	38.0440	22.8524	25259	Dip N-S
GOC40	38.0416	22.8489	25278	38.0599	22.6980	25554	Strike E-W
GOC41	38.0622	22.6942	25570	38.2820	22.7161	26076	Dip S-N
GOC42	38.2801	22.7213	26114	38.0781	22.7937	26653	Dip N-S
GOC42A	38.0855	22.7964	26667	38.1284	22.7759	26783	
GOC42B	38.1268	22.7693	26798	38.1172	22.7585	26828	
GOC42C	38.1165	22.7582	26830	38.0265	22.7548	27030	
GOC43	38.0243	22.7567	27033	37.9628	22.9151	27356	Strike W-E

Line	Latitude Start	Longitude Start	FFID Start	Latitide End	Longitude End	FFID End	Comments
GOC44	37.9609	22.9142	27360	37.9765	22.8184	27550	Strike E-W
GOC45	37.9780	37.9780	27553	38.2149	22.8178	28082	Dip S-N
GOC46	38.2159	22.8161	28085	38.2041	22.6527	28374	Strike E-W
GOC21a	38.2019	22.6499	28386	38.1060	22.6177	28618	Dip N-S
GOC47	38.1044	22.6136	28642	38.1390	22.5223	28828	Strike E-W
GOC48	38.1434	22.5209	28629	38.3044	22.5188	29005	Dip S-N
GOC49	38.3038	22.5140	29033	38.1454	22.4563	29426	Dip N-S
GOC49a	38.1459	22.4512	29452	38.1705	22.3857	29584	Strike E-W
GOC50	38.1726	22.3821	29631	38.3229	22.3982	29966	Dip S-N

SIOSEIS copy script:

```
/opt/sioseis/bin/sioseis << eof
procs segdin prout diskoa end

segdin
   ffilen 99999   # take all shots (this is the preset!)
   ftr 1 ltr 999  # skip the auxiliary channels - 161-172 and 161-180
   fcset 1 lcset 1
   offline yes  # eject after the rewind after EOT
   newfile yes  # start a new SEG-Y file on every SEG-D tape
   iunit 11 end
end

prout
      fno 1 lno 999999 end
end

diskoa
   opath /export/home/ew0108/ew0108_goc.258.segy end
end

end
eof
```

totape c program:

```
#include <stdio.h>
#include <fcntl.h>
#include <errno.h>
#include <malloc.h>
#include <sys/types.h>
#include <sys/ioctl.h>
#include <sys/mtio.h>
#include <strings.h>
#include "segyhead.h"
  char         scud[40*80];
  Reelhdr      rhdr;
char    *buf;
main(argc,argv)
     int       argc;
     char      **argv;
{
  char  *argptr;
  char  progname[30];
  int   fd_in,fd_out;
  struct       mtop    top;
  int   cc;
  int   sz;
  for (strcpy(progname,*argv); (--argc>0 && **++argv == '-');){
    for (argptr=(*argv+1); *argptr; argptr++)
      switch (*argptr){
```

```
      case  'f':
        break;
      default:
        break;
      }
  }
  fd_out=open("/dev/rst4",O_WRONLY,0644);
  top.mt_op=MTREW;
  top.mt_count=1;
  ioctl(fd_out,MTIOCTOP,&top);

  while (argc){
    printf("%s\n",*argv);
    fd_in=open(*argv++,O_RDONLY);
    if (fd_in<0){
      perror("totape open:");
      exit(1);
    }
    argc--;


    cc=read(fd_in,scud,sizeof(scud));
    write(fd_out,scud,sizeof(scud)); /* the useless tape header */

    cc=read(fd_in,(char *)&rhdr,sizeof(rhdr));
    cc=write(fd_out,(char *)&rhdr,sizeof(rhdr));
    if (buf !=NULL)
      free(buf);
    sz=rhdr.samp_per_trace*sizeof(float)+240;
    buf=malloc(sz);

    while (1){
      cc=read(fd_in,buf,sz);
      if (cc==0) break;
      write(fd_out,buf,sz);
    }

    close(fd_in);
    top.mt_op=MTWEOF;
    top.mt_count=1;
    ioctl(fd_out,MTIOCTOP,&top);
  }

  printf("Pau\n");
  top.mt_op=MTWEOF;
  top.mt_count=1;
  ioctl(fd_out,MTIOCTOP,&top);
  top.mt_op=MTOFFL;
  top.mt_count=1;
  ioctl(fd_out,MTIOCTOP,&top);
  exit(0);
}
```

makefile for totape:

```
#
CC=cc
CFLAGS +=
INSTALLDIR=/net/kahaloa/export/kahaloa/andrew/bin

all:    cor todisk totape
cor:    cor.o ibmiee.o
        $(LINK.c) -o cor cor.o ibmiee.o -lm
        install -m 755 $@ $(INSTALLDIR)
totape totape_grampus todisk todisk_makani:  $$@.o
        $(LINK.c) -o $@  $@.o
        install -m 755 $@ $(INSTALLDIR)

totape.o:      totape.c totape_grampus.c
        cc -c $(CFLAGS) totape.c
```

copytapes:

```
#!/bin/perl
#
# $Id: copytapes,v 1.1 2001/07/29 10:20:53 jefft Exp $
#
# This program is designed to copy tapes from the 3490 stacker to the
```

```
# DLT drive.  It copies all the files on each 3490 to the DLT until the
# DLT is full.
#
# This assumes that the MaxLength of the DLT drive is 38482906972160 bytes
# (2**40) * 35 (35 GB)
#
# It will output some statistics as well for each tape.  On error, it prompts
# for you to enter a new 3490.  It needs to be restarted for each DLT.
#
#
use Time::Local;

$From = "/dev/rmt/2";   # 3490 drive
$To   = "/dev/rmt/0";   # DLT drive

# Norewind drives
$FromNoRewind = $From . "n";
$ToNoRewind   = $To . "n";

$Length = 0;                   # Current amount of data put on DLT.
$MaxLength = 37482906972160;   # Maximum amount for DLT
$OneTape = 800000000;          # size of one 3490
$Current  = 1;                 # Current 3490 tape number

NEWTAPE:
#
#   While there is room on the DLT, add another 3490 tape.
while (($Length + $OneTape) < $MaxLength)
{
    $TapeLength = 0;   # Total size of 3490 tape
    $size = -1;                # size of one file on 3490 tape
    $Filenumber = 1;   # which filenumber of the tape

    #
    # Get the start time in seconds
    ($sec,$min,$hours,$mday,$mon,$year,@rest) = gmtime();
    $t1 = timegm($sec,$min,$hours,$mday,$mon,$year);

    #
    # While there is still data on the 3490 tape
    while ($size != 0)
    {
        # tcopy will copy one file from the 3490 to the DLT
      ONEFILE:
        unless (open TCOPY, " tcopy $FromNoRewind $ToNoRewind |")
        {
            # If we can't open the tape device...
            print STDERR "Error, Check Tapes.";

            # Wait a second, and try again
            sleep 60;
            next NEWTAPE;
        }

        # If we get here, we should be copying data
        # output of tcopy  is:
        #       file 1: record 1: size 7360
        #       file 1: records 2 to 241: size 16436
        #       file 1: eof after 241 records: 3952000 bytes
        #       eot
        #       total length: 3952000 bytes
        # or <end of tape>
        #       file 1: eof after 0 records: 0 bytes
        #       eot
        #       total length: 0 bytes
        # or <no tape in drive>
        #       Can't open /dev/rmt/**
        #
        print STDERR "Copying $Filenumber ... ";
        my $ok = 0;
        while (<TCOPY>)
        {
            # print STDERR $_;
            # If there is no tape in the drive, we get no output,
            # so $ok will be 0 if we don't get here.
            $ok = 1;
            if (/total length/)
            {
                ($a,$b,$size,$c) = split;
                $Length += $size;
                $TapeLength += $size;
                print "size: $size bytes \n";
```

```
            } elsif (/Can/)
            {
               # ERROR CASE... No tape in drive...
               print STDERR "Replace 3490 Cartridge!!!\n";
               sleep 60;
               close TCOPY;
               next NEWTAPE;
            }
            if ($size == 0)
            {
               print STDERR " ... removing last eot from DLT ... ";
               system "mt -f $ToNoRewind bs 2";
               print STDERR "\n";
            }
        }
        close TCOPY;

        if ($ok == 0)
        {
            print STDERR "Replace 3490 Cartridge!!!\n";
            sleep 120;
            next NEWTAPE;
        }

        # Next File on tape
        #
        $Filenumber++;
    } # END OF 3490 TAPE

    # Get end time of this tape.
    #
    ($sec,$min,$hours,$mday,$mon,$year,@rest) = gmtime();
    $t2 = timegm($sec,$min,$hours,$mday,$mon,$year);

    # rewind 3490
    #
    print STDERR " ... rewinding 3490 tape ... ";
    system "mt -f $From rewoff";
    print STDERR "\n";

    # Stats...
    #
    print "\n\tTape $Current completed: Tape Length = $TapeLength bytes\n";
    printf "\tDLT contents: $Length of $MaxLength [%f %%]\n",
    ($Length/$MaxLength)*100;

    printf "\tElapsed time for tape $Current: %f minutes\n\n", ($t2-$t1)/60.0;

    # Next Tape
    #
    $Current++;

    # Give cartridge time to reload
    #
    # sleep 60;
}

print "End of DLT Tape, Replace DLT.\n";
```

DLT SEG-Y TAPE CONTENTS

Reel Number	Shots	Line Number	DLT Tape Number	File Number on Tape
100	6-187	GOC1	1	1
101	188-369			
102	370-546			
103	567-607			1 on DLT 3
104	654-835	GOC2		2
105	836-1017			
106	1018-1199			3
107	1200-1381			
108	1382-1562			4
109	1510-1701	GOC3		5
110	1702-1797			
111	2310-2491			6
112	2492-2588			
113	2613-2799	GOC4		7
114	2800-2981			
115	2982-3163			8
116	3164-3345			
117	3346-3527			9
118	3528-3709			
119	3710-3747			10
120	3769-3862	GOC5		11
121	3864-4045			
122	4046-4173			12
123	4175-4186			
124	4202-4311	GOC6		13
125	4313-4494			
126	4495- 4676			14
127	4677-4693			
128	4708-4790	GOC7		15
129	4792-4973			
130	4794-5155			16
131	5156-5337			
132	5338-5439			17
133	5441-5622			
134	5623-5781			18
135	5783-5837			
136	Empty			
137	Empty			
138	6054-6235	GOC8		19
139	6236-6315			
140	6317-6498			20
141	6499-6588			
142	6590-6771			21
143	6772-6855			
144	6857-7043			22
145	7044-7049			
146	7082-7263	GOC9		23
147	7264-7372			24
148	7374-7571			25
149	Empty			
150	7578-7674			26

Reel Number	Shots	Line Number	DLT Tape Number	File Number on Tape
151	7104-7286	GOC10	1	27
152	7287-7469			28
153	7470-7554			29
154	7556-7571			30
155	Empty			
156	7588-7774	GOC11		31
157	7775-7956			32
158	7957-8143			33
159	8144-8160			34
160	8165-8347	GOC12		35
161	8348-8462			37
162	9001-9182	GOC53	2	1
163	9183-9312			2
164	9314-9417			3
165	9462-9540	GOC12A		4
166	9542-9723			5
167	9724-9803			6
168	9805-9854			7
169	Empty			
170	9919-9999	GOC13		8
171	10069-10165			9
172	10167-10348			10
173	10349-10432			11
174	10434-10453			12
175	Empty			
176	10484-10665	GOC14		13
177	10666-10847			14
178	10848-11031			15
179	11032-11050			16
180	11051-11236	GOC15		17
181	11237-11405			18
182	11407-11590			19
183	11591-11662			20
184	11673-11861	GOC16		21
185	11862-12043			22
186	12044-12225			23
186	12226-12226			24
188	12227-12441			25
189	12442-12623	GOC17		26
190	12624-12719			27
191	12721-12733			28
192	Empty			
193	12732-12921	GOC18		29
194	12922-13103			30
195	13104-13285			31
196	13286-13392			32
197	13394-13575			33
198	13576-13658			34
199	13660-13841			35
200	Empty			
201	13848-13928			36
202	13930-14036			37
203	14067-14134	GOC19	2	38

Reel Number	Shots	Line Number	DLT Tape Number	File Number on Tape
204	14136-14317			39
205	No tape			
206	14323-14399			40
207	14401-14582			41
208	14583-14647			42
209	14649-14830			43
210	No tape			
211	14836-14932			44
212	14934-15074			45
213	15078-15178	GOC20		46
214	15180-15361			47
215	15362-15456			48
216	15458-15510			49
217	15516-15602	GOC21		50
218	15516-15785			51
219	15786-15862			52
220	15864-15872			53
221	No tape			
222	15898-16079	GOC22		54
223	16080-16261			55
224	16262-16443			56
225	16444-16625			57
226	16626-16800			58
227	16814-16983	GOC23		59
228	16985-17166			60
229	17167-17348		3	2
230	17349-17530			3
231	17531-17672			4
232	17674-17707			5
233	17813-17994	GOC24		6
234	17995-18152			7
235	18157-18338	GOC25		8
236	18339-18505			9
237	18506-18691	GOC26		10
238	18692-18840			11
239	18844-19025	GOC27		12
240	19026-19195			13
241	19197-19388	GOC28		14
242	19389-19573			15
243	19574-19600			16
244	19660-19842	GOC29		17
245	19843-19980			18
246	19623-19630 20006-21188	GOC30		19
247	21189-21370			20
248	21371-21378			21
249	21387-21568	GOC31		22
250	21569-21614			23
251	21625-21807	GOC32		24
252	21808-21933			25
253	21956-22141	GOC33		26
254	22142-22323			27
255	22324-22373	GOC33	3	28
256	224023-224211	GOC34		29

Reel Number	Shots	Line Number	DLT Tape Number	File Number on Tape
257	224212-224393			30
258	224394-224565			31
259	22512-22693	GOC35		32
260	22694-22875			33
261	22876-23075			34
262	23058-23182			35
263	23215-23396	GOC36		36
264	23397-23578			37
265	23579-23722			38
266	23728-23913	GOC37		39
267	23914-24095			40
268	24096-24277			41
269	24278-24330			42
270	24335-24521	GOC38		43
271	24522-24703			44
272	24704-24818			45
273	24823-25005	GOC39		46
274	25006-25187			47
275	25188-25259			48
276	25278-25459	GOC40		49
277	25460-25554			50
278	25570-25751	GOC41		51
279	25752-25933			52
280	25934-26076			53
281	26114-26295	GOC42	4	1
282	26296-26477			2
283	26478-26673			3
284	26674-26878			4
285	26879-27030			5
286	27034-27215	GOC43		6
287	27216-27356			7
288	27360-27541	GOC44		8
289	27542-27550			9
290	27553-27734	GOC45		10
291	27735-27916			11
292	27917-28082			12
293	28085-28266	GOC46		13
294	28267-28378			14
295	28386-28567	GOC21A		15
296	28568-28618			16
297	28642-28827	GOC47		17
298	28828-28828			18
299	28631-28812	GOC48		19
300	28813-28998			20
301	28999-29005			21
302	29033-29218	GOC49		22
303	29219-29403			23
304	29404-29426			24
305	29452-29584	GOC49A		25
306	29631-29812	GOC50		26
307	29813-29966	GOC50	4	27

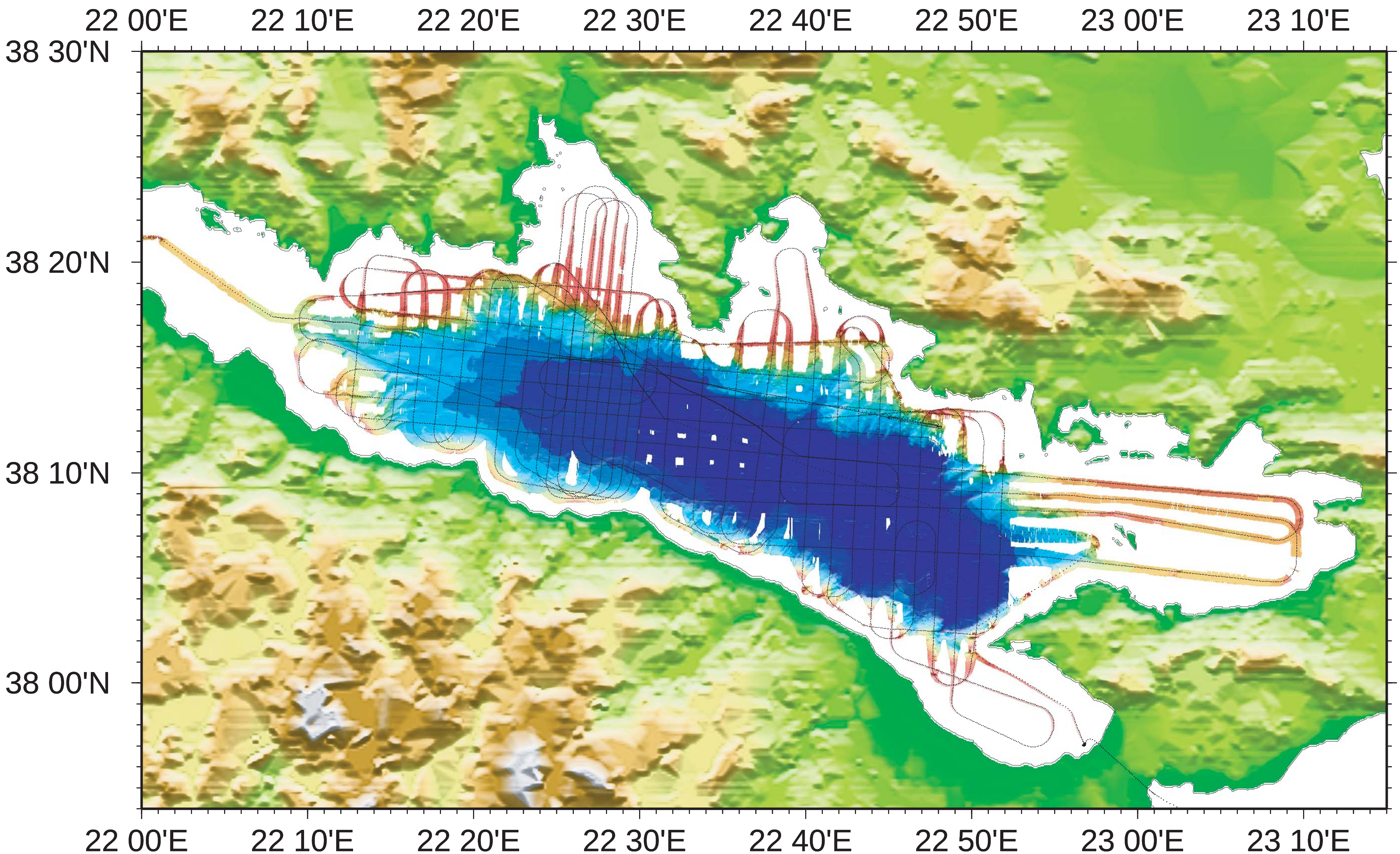


Figure 1. Topgraphy and bathymetry of the Gulf of Corinth. Track lines (black) overlay the newly collected Hydrosweep DS-2 bathymetry.

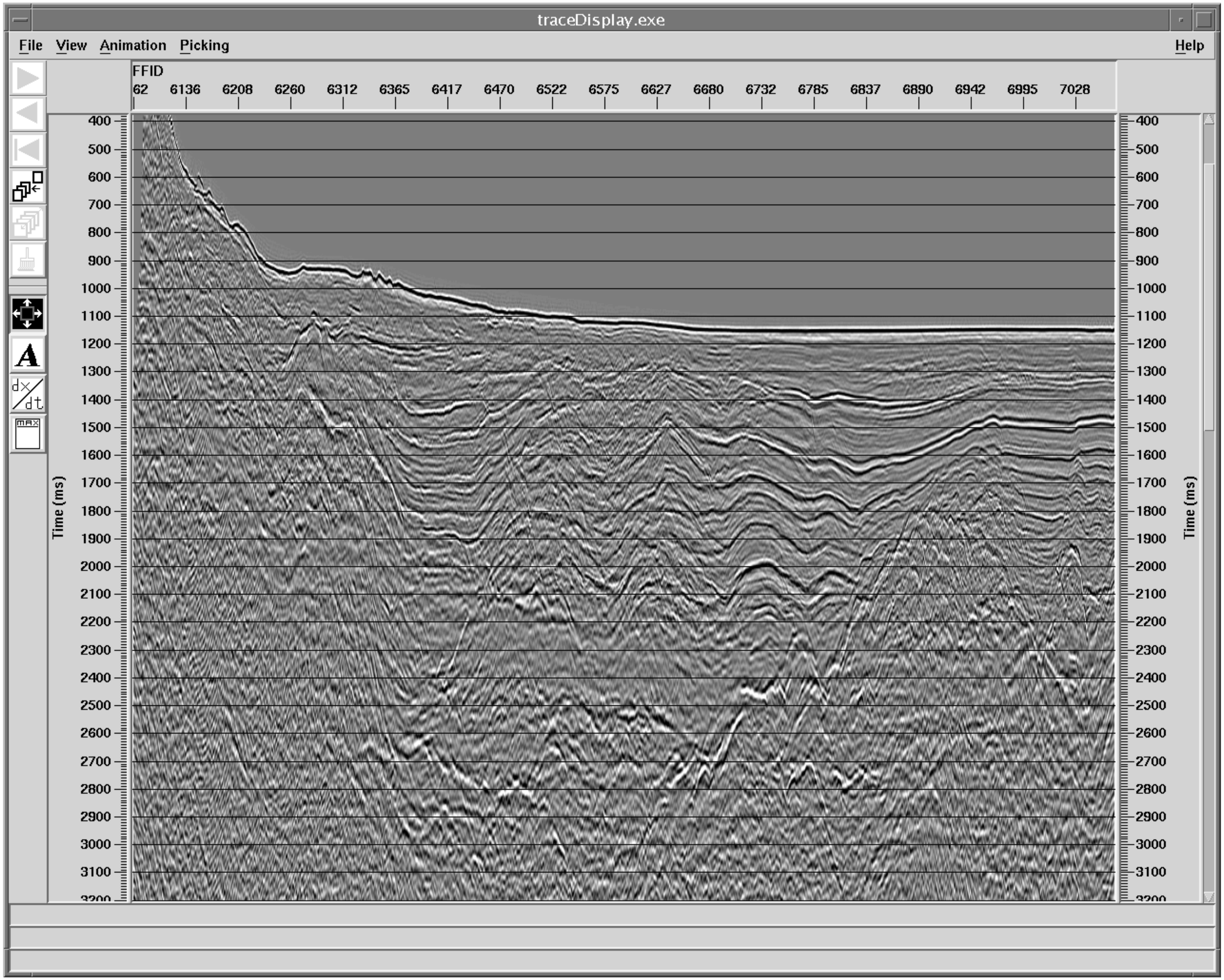


Figure 2. MCS Line GOC 8. Processing through migration has been performed on this E-W line.

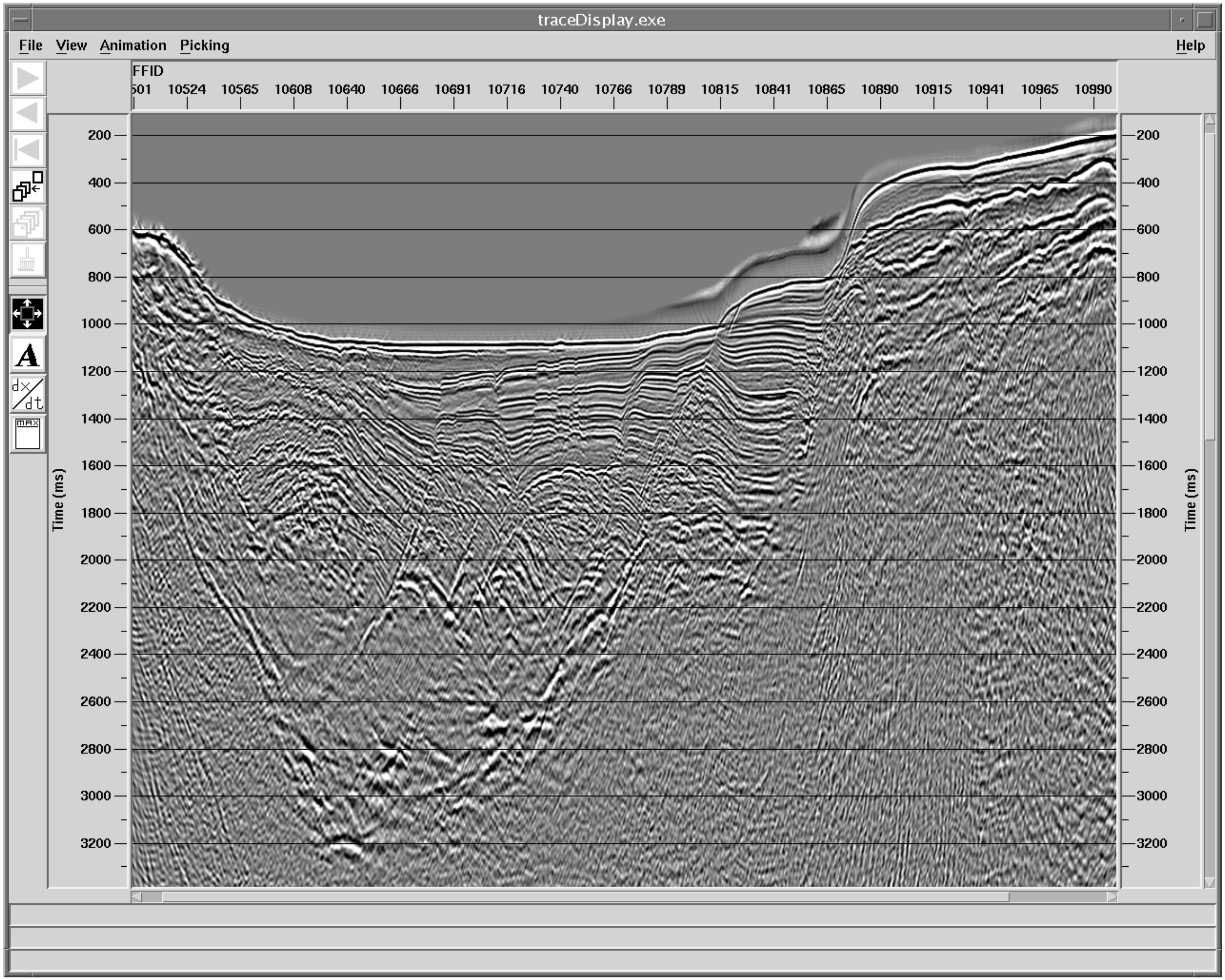


Figure 3. MCS Line GOC 14. Processing through migration has been performed on this N-S line.

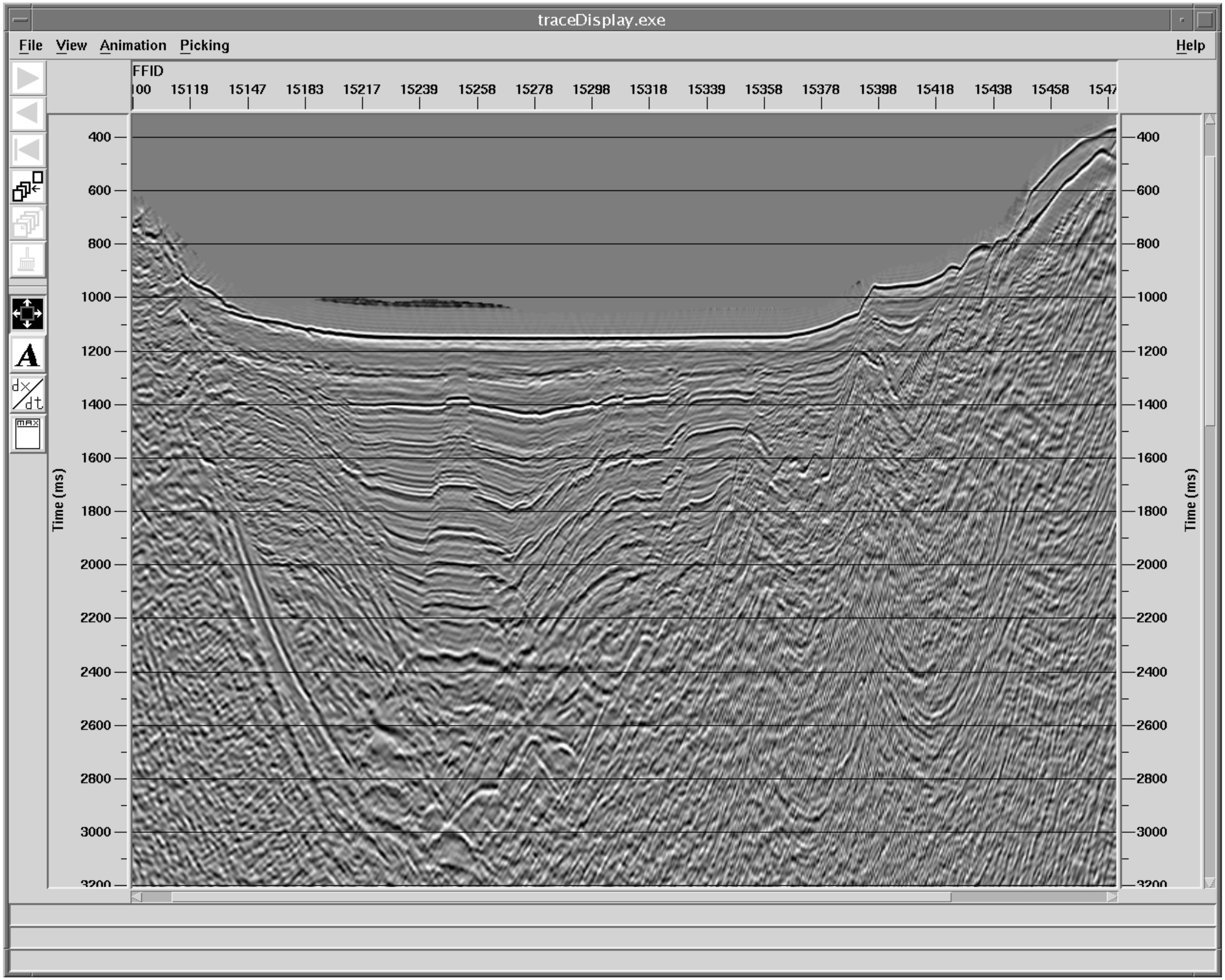


Figure 4. MCS Line GOC 20. Processing through migration has been performed on this N-S line.

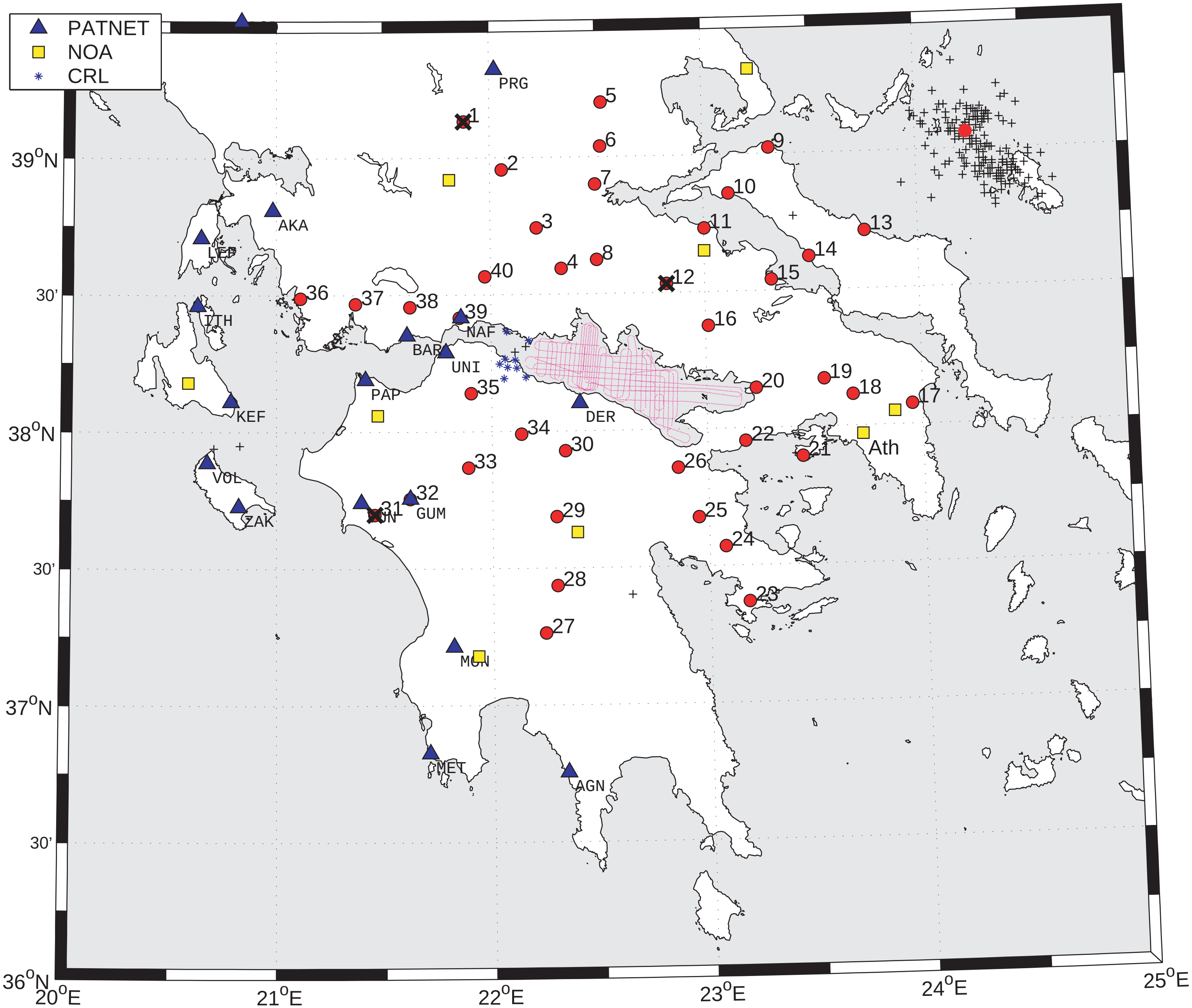
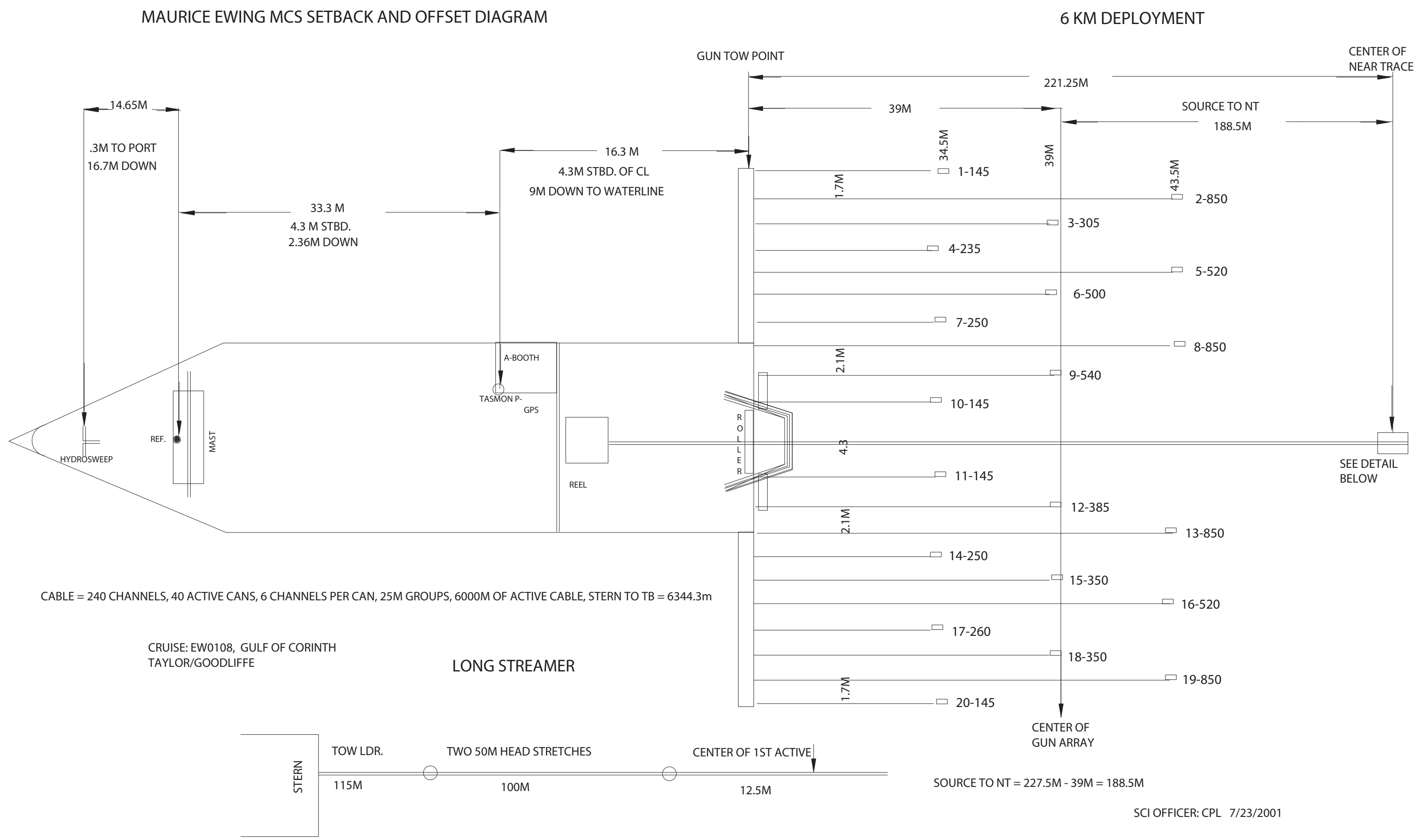


Figure 5. Location of temporary land geophones (red circles), PATNET sesimometers (blue triangles), NOA seismometers (yellow squares), and Corinth Rift Laboratory seismometers (blue stars). Black crosses mark earthquakes that occurred during the survey period, including the Skyros event in the NE corner. MCS track lines are indicated in purple.


MAURICE EWING MCS SETBACK AND OFFSET DIAGRAM
6 KM DEPLOYMENT
GUN TOW POINT
CENTER OF NEAR TRACE
221.25M
39M
SOURCE TO NT
188.5M
14.65M
.3M TO PORT
16.7M DOWN
16.3 M
4.3M STBD. OF CL
9M DOWN TO WATERLINE
33.3 M
4.3 M STBD.
2.36M DOWN
34.5M
39M
43.5M
1.7M
1-145
2-850
3-305
4-235
5-520
6-500
7-250
8-850
2.1M
9-540
10-145
4.3
11-145
12-385
2.1M
13-850
14-250
15-350
16-520
17-260
18-350
19-850
1.7M
20-145
A-BOOTH
TASMON P-GPS
REF.
MAST
HYDROSWEEP
REEL
ROLLER
SEE DETAIL BELOW
CENTER OF GUN ARRAY
CABLE = 240 CHANNELS, 40 ACTIVE CANS, 6 CHANNELS PER CAN, 25M GROUPS, 6000M OF ACTIVE CABLE, STERN TO TB = 6344.3m
CRUISE: EW0108, GULF OF CORINTH
TAYLOR/GOODLIFFE
LONG STREAMER
STERN
TOW LDR.
115M
TWO 50M HEAD STRETCHES
100M
CENTER OF 1ST ACTIVE
12.5M
SOURCE TO NT = 227.5M - 39M = 188.5M
SCI OFFICER: CPL 7/23/2001

MAURICE EWING MCS SETBACK AND OFFSET DIAGRAM

3 KM DEPLOYMENT