Draft

A HIGH RESOLUTION GEOPHYSICAL SURVEY

of

SALE 68 AREA, OCS, SOUTHERN CALIFORNIA

for

UNITED STATES GEOLOGICAL SURVEY

by

Racal-Decca Survey, Inc.

Houston, Texas

Draft

INTRODUCTION

The U. S. Geological Survey required geophysical profiles of the marine environment in the Channel Islands, Southern California area for the Outer Continental Shelf Oil and Gas Lease Sale No. 68. These data were required so that an evaluation of potential geologic hazards to exploration and development of these tracks could be made. The survey area and grid requirements are shown in Figure 1.

The objective of this survey was to acquire high-resolution seismic profiles and bathymetry. Side Scan Sonar recordings were also acquired to complement the seismic and bathymetric profiles.

The acquired data were to be used for the analysis of shallow geologic structure, sedimentary environment, and seafloor morphology and features which might represent conditions hazardous to petroleum exploration and production in this area of potential leasing activity.

METHODS

1. Vessel

The 165 foot M/V MEDITERRANEAN SEAL (Figure 2) was utilized in these studies. Initial mobilization of the vessel occurred in Galveston, Texas and was completed when the field crew joined the vessel in San Pedro, California in late September 1980. Two Elder Houses located on the after deck contained the geophysical power and recording equipment. The typical configuration of the equipment streamed from the vessel is shown in Figure 3.

2. Navigation

The survey track was to be maintained to within 75 m and 10^{o} of the planned track with sequential location fixes at regular time or distance intervals fixed to 300 m along the track.

The shoreside group consisted of a chain commander and an assistant. Table 1 lists the type positioning equipment and the location of the shoreside stations used for each area of the study.

The Trisponder, a portable short range line of sight microwave system consisting of a master transceiver aboard the vessel and 2 -4 remote transponders, as indicated in Table 1, was the positioning device employed. The Trisponder system was calibrated on a measured range and is considered accurate to within 3 meters.

The Decca Range - Range Hi Fix Navigation System was employed to position the vessel in those areas or portions of areas beyond the range of the trisponders (this varied as a function of elevation of the transponders) and generally ranged between 25-30 km.) The Hi-Fix System in the range-range mode has a master transmitting station onboard the vessel with receiving gear and two slave transmitting stations on shore at the locations indicated in Table 1. The Hi-Fix System is considered accurate to within 8 - 10 m.

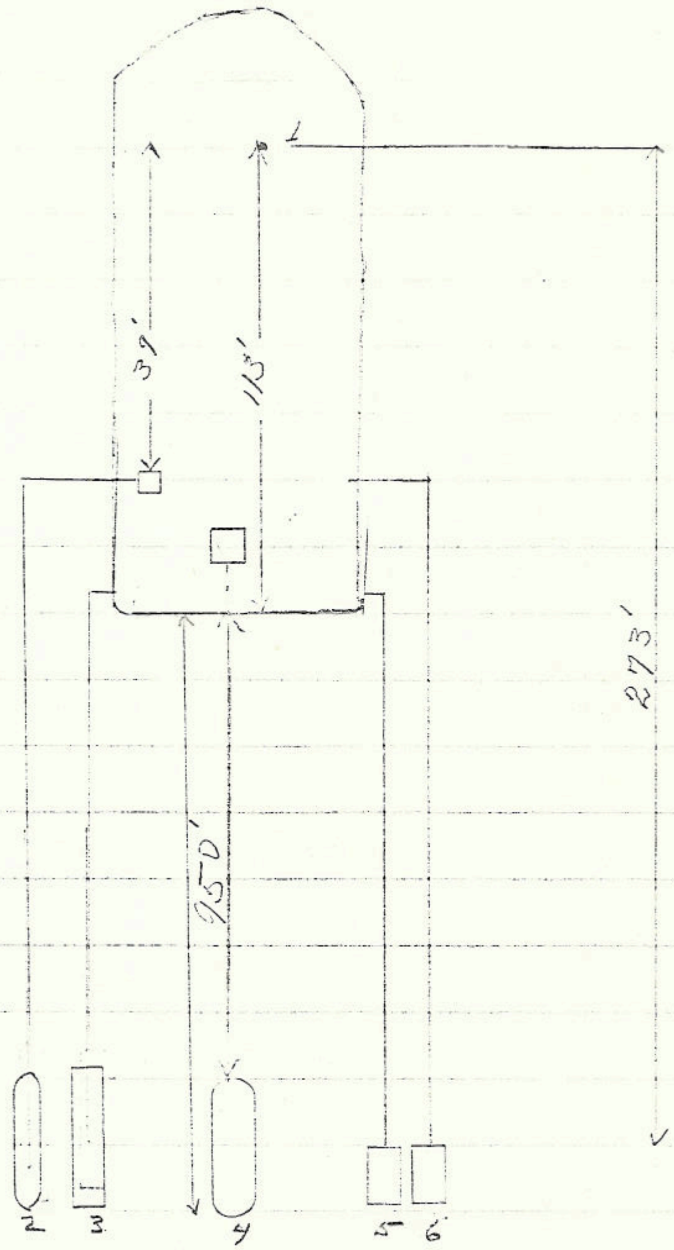
Both systems were integrated to the Autocarta, a computerized system which provides an on-line postplot.

TABLE 1

Shore-based Navigational Equipment used for
Positioning and Associated Station Information

AREA	POSITIONING	STATIONS USED
1	Trisponder *	Honda, Seacliff, Conception, Tresser, Arquello, Jalama, Manford
2	Trisponder *	Honda, Arquello, Conception, Jalma, Seacliff, Tressler
3	Trisponder *	Honda, Arquello, Conception, Tressler
4	Trisponder *	Manfred, Tressler, Seacliff, Honda, Arquello, Conception, Zuma Beach
5	Hi-Fix **	Manfred, Zuma Beach
6	Hi-Fix **	Manfred, Zuma Beach
7	Hi-Fix **	Manfred, Port Hueneme
8	Trisponder	Seacliff, Tressler
9	Trisponder *	Quay, Tressler
10	Hi-Fix **	Manfred, Zuma Beach
11	Trisponder *	D-1, Castro Peak, D-3, Reef
12	Trisponder *	Reef, D-3, Castro Peak, D-1, D-2
13	Hi-Fix **	Aires, Zuma Beach
14	Hi-Fix **	Aires, Zuma Beach
15	Trisponder *	San Pedro, Chica, Laguna Beach, Signal Hill
16	Trisponder *	Chica, Laguna Beach, Signal Hill
17	Trisponder *	Chica, Laguna Beach, Signal Hill

* Racal-Decca M 506 System
** Racal-Decca Range - Range Hi-Fix Navigation System



1 - Antenna

2 - Mini-sparker Source

3 - Sparker Sled

4 - Subbottom Profiler

5 - Hydrophone - Mini-sparker

6 - Hydrophone - Sparker

3. High Resolution Seismic Profiling

Seismic reflection profiling was required to clearly resolve geologic features down to a depth of at least 300 m (e.g. 400 ms reflection delay) below the ocean floor. Vertical resolution was 1 ms immediately below the seafloor and gradated to not more than 10 ms at maximum depth. Horizontal resolution was obtained by a short pulse interval and was never greater than 6 m.

Vertical profiling was accomplished with three systems (3.5 kHz Subbottom Profiler, 40-tip Mini-Sparker and 8.4 kJ Sparker). These systems achieved at least 1 ms vertical resolution and the systems were compensated from waveheave with a waveheave compensator. Table 1 lists the various seismic and accessory equipment used to acquire these data.

TABLE 2

Seismic and Accessory Equipment
Deployed from the Vessel

UNIT	DESCRIPTION	RECORDER
Subbottom Profiler	3.5 kHz, 10 kw, Edo 515	Edo, Model 614
Heave Compensator		Edo, Model 613
Sparker	8.4 kJ, EG&G	Edo, Model 614
Analog Tape Recorders for Analog Sparker		Uher 4400
Mini-Sparker	1 kJ, EG&G	Edo, Model 614
Digital Filtering System	DFS III with 12-trace cable	

With each of the above systems amplitude resolution was such that strong reflections were distinguishable from others. Records were presented in varying shades ranging from white (no reflection), intermediate tones for subbottom reflections not related to gas and dark tones for strong reflections. These varying intensity requirments were established for each line record by recording at least three different voltage levels from a step generator to show actual recorder amplitude.

The calibration of the acquired profiles was established such that the bottom reflection co-efficient could be determined and amplitude to subsequent reflections could be quantitatively compared to the bottom reflections amplitude.

4. Digital Processing of Seismic Data

It has been previously observed that in water depths shallower than 300 m the water column multiples may overwhelm or confuse seismic reflections within the required penetration depth. These were suppressed optimally by multi-channel time series computations including ? to be added by Exploration Processing

The data were digitized at 1 ms intervals from a 12-channel hydrophone for a one second total record length every 8.33 m wherever the bottom echo return was less than 0.5 seconds. A DFS III equipped with a 12-channel digital seismic recording systme and an automatic binary gain control and fillers to attenuate unwanted signals.

The towed detector cable was a multi-element, multi-channel, oil filled streamer with three depth control "birds" and three pressure sensitive depth meter read-outs. The channel spacing was 16.6 meters.

The energy source for this system was the 8.4 kJ Sparker.

5. Bathymetry

Where necessary water depths were determined from seismic profiles.

6. Side Scan Sonar

Plan views of seafloor textures were obtained in areas where such profiles could contribute to the interpretation of profiles and in water depths where successful recordings could be obtained without reducing vessel speed.

Side scan coverage was limited to water depths less than 200 m (600') due to cable length (1000 m) standard to the side scan system employed. In those instances where the depth was too great for complete coverage was left on until the ?

bottom coverage was reduced to 25 m at the final edge of the recording.

7. Compatibility

Cross talk and noise was reduced to levels where the required data were not obscured. In those instances where the signal to noise ratio was not within acceptable limits on any one system operations were suspended until the problem was rectified. There was no indication of cross talk on the acquired side scan data.

8. Data Quality Control

It was recognized that the planning of data acquisition strategy, experiments at start-up and during the course of the survey, labelling of recordings, logging of activities and conditions, and inspection and re-survey of rejected data were all part of the data quality control requirement. Accordingly each profile contained a calibration display of time and amplitude at the start of each recording and wherever amplitude presentation or time scale was altered. In those instances where data from any one system was missed for only one fix interval the data were accepted if not repeated within 20 fixes. Longer interruptions were cause to circle back and recommence with overlap. Data of poor quality were accepted only if the purpose of the survey was not jeopardized.

9. Bathymetry Work Sheets

Depths in meters were converted from analog and digital bathymetry recordings. All character points (maxima, minima, inflection and nick points) as well as the depths posted at each navigation fix were transferred from the profiles to work sheets. The basis for these conversions

EXECUTION OF PROGRAM

As a result of initial at sea experiments the Mini-sparker and Subbottom Profiler were operated at a pulse rate not less than 750 ms by using "wraparounds." The Mini-sparker was also set at 100 J until the water depth decreased the signal to noise ratio at which time the instrument was adjusted to 200 J. Data recorded from the Subbottom Profiler along with that from the Side Scan Sonar were displayed as split traces on an Edo, Model 606 Recorder. Subbottom data was recorded in this fashion to reduce vertical exaggeration with the 200 m scale. Depth references were obtained from the 1 second sparker data. On all records every 6th 50 m fix was marked.

A second series of at sea experiments resulted in the original sparker being replaced with a 9-element spark array. A streamed depth transducer was used at this time to check and ballast the single fold hydrophone and the 9-element spark array.

DATA PROCESSING

Acquired data commenced arriving at the Houston office of Racal-Decca Survey, Inc. in October, 1980. All analog records were immediately inventoried.

Postplotted shotpoints (navigation fix locations that represent the position of the antenna onboard the vessel at the time of the fix and which corresponds to the numbered fix marks on the appropriate seismic profiles) were generated from magnetic tape.

Each separately acquired segment of original seismic recording was annotated (i.e. line intersections, instrument settings, line identification, etc.) labelled and copied on a vellum transparency and fan-folded for use as a work copy in the interpretative mode. Mini-sparker and 8.4 kJ Sparker recordings were reduced to 50 percent of original size. Subbottom Profiler and Side Scan Sonar recordings were copies on vellum at 75 percent of original size.

All original geophysical recordings were microfilmed by continuous flow at the required reduction ratio. A negative and positive print of all data was prepared.

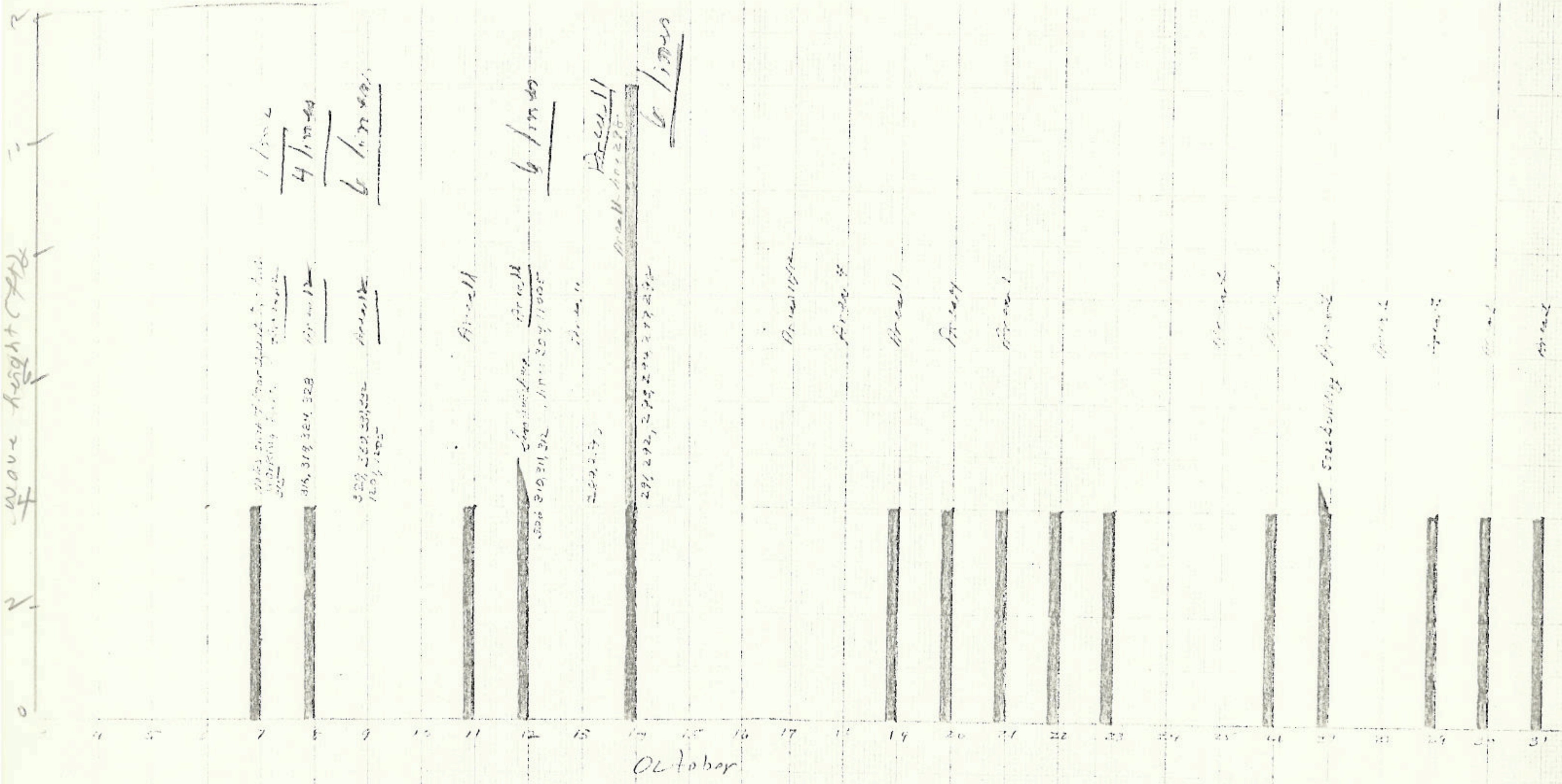
Original postplot maps were hand drawn at the required scale and size on the California Plane Coordinate System. Lease block boundaries and latitude-longitude coordinates were added to each of the eleven maps at a scale of 1:48,000.

OPERATING CONDITIONS

As anticipated a number of problems arose in the conduct of these studies. Prime among these were weather (heavy seas and fog), bottom topography and equipment malfunction.

Figure 3 depicts the effect rapidly changing bottom topography and weather in October, 1980. These difficulties were primarily encountered in Areas 11 and 12 and resulted in many of the lines being reshot. Sea conditions indicated in the figure were taken from the daily operators logs and indicate that the average wave heights encountered was four feet. A total of 11 and 12 lines had to be reshot in Areas 12 and 11, respectively. These problems were largely resolved in the first eight days of data acquisition. Further difficulties were experienced in January in Areas 13 and 14 where fog and skywaves compounded the problem.

Figure 4 depicts the shoot time, downtime, and mileage recorded per day from October, 1980 through January, 1981. In October as the seismic party gained experience with the rapidly changing bottom topography the number of miles recorded per day increased with time. The lack of acquired data in late November and December is attributable to scheduled holiday breaks. All original data were acquired by January 28 and the reshoot was completed in early February.



The impact of rapidly changing bottom topography and weather upon data acquisition.

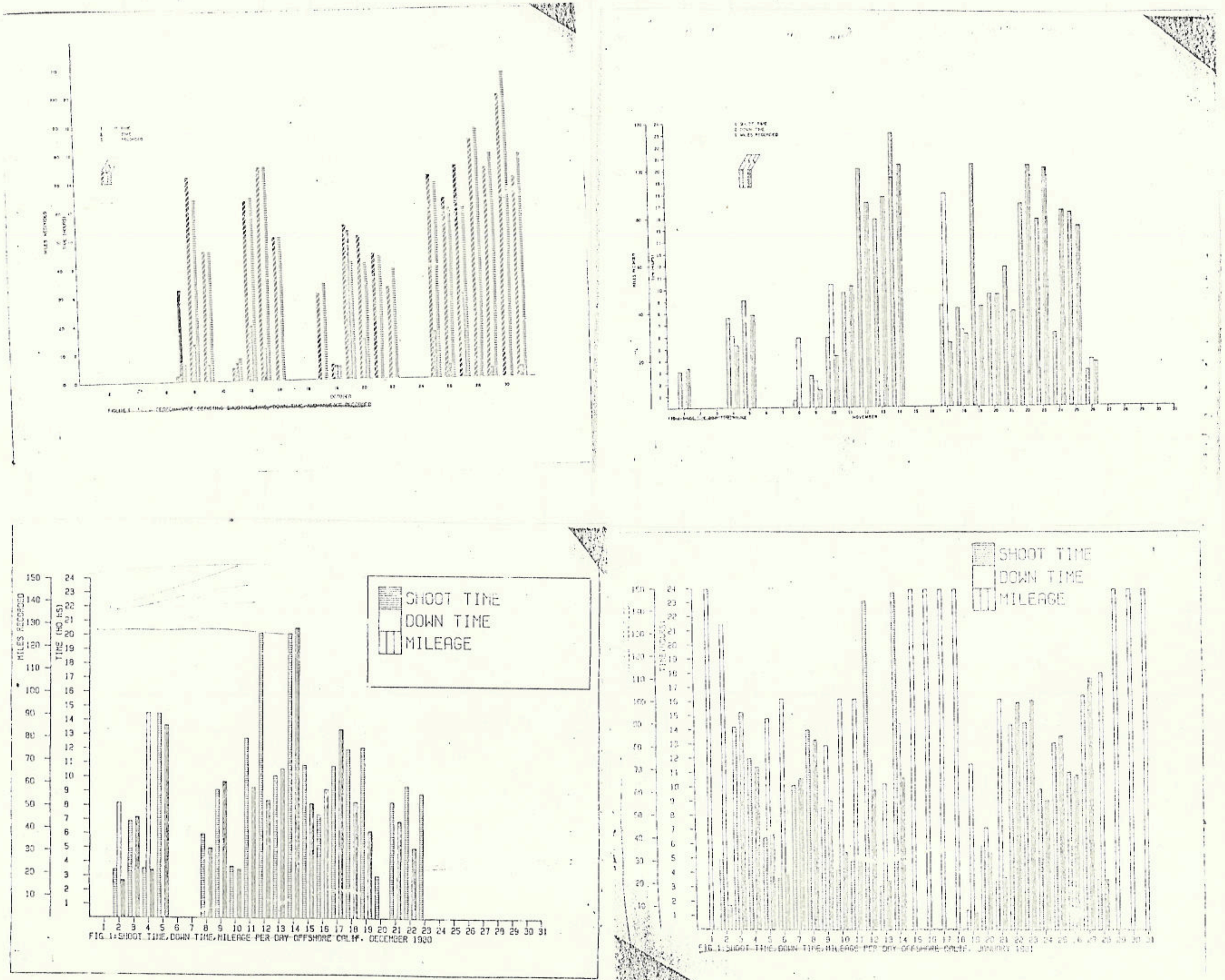


fig. 1. Shoot time, down time, mileage recorded per day, offshore California October 1980 – January 1981.

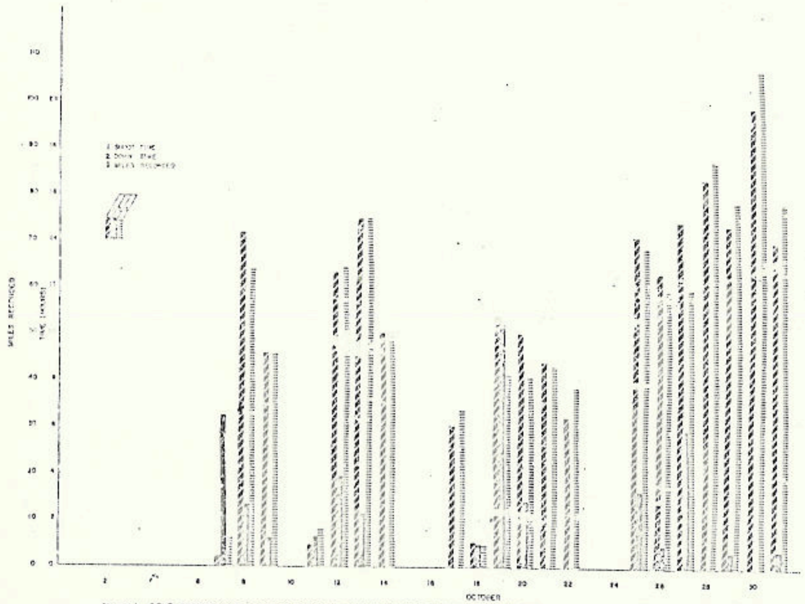


FIGURE 1 FIELD PERFORMANCE DEPICTING SHOOTING TIME, DOWN TIME, AND MILEAGE RECORDED

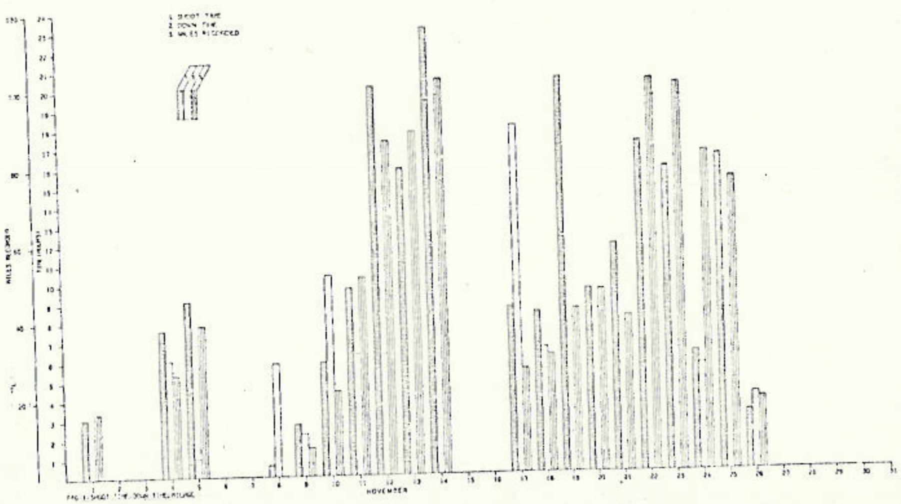


FIG 1 SHOOT TIME DOWN TIME MILEAGE

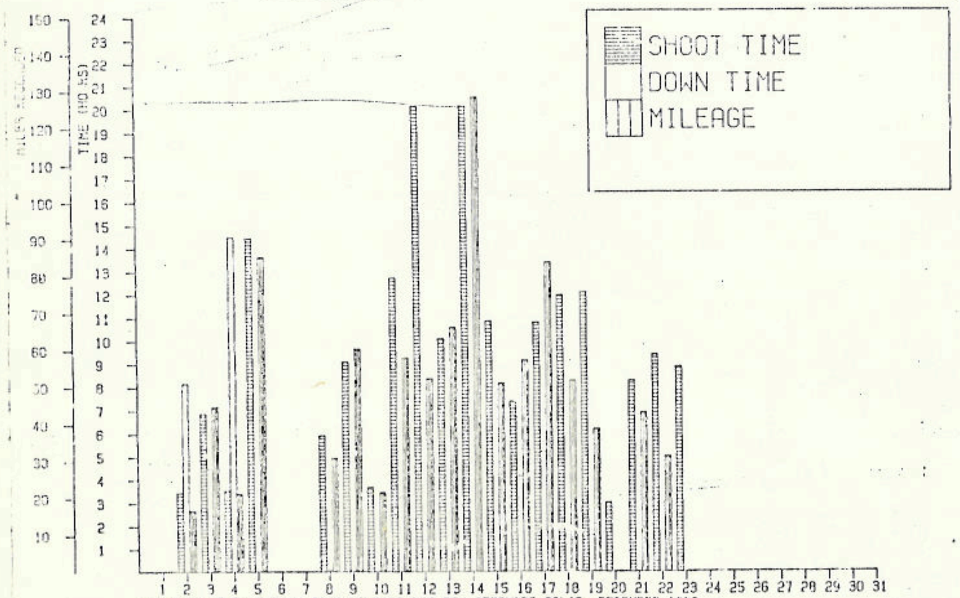


FIG 1:SHOOT TIME,DOWN TIME,MILEAGE PER DAY OFFSHORE CALIF. DECEMBER 1980

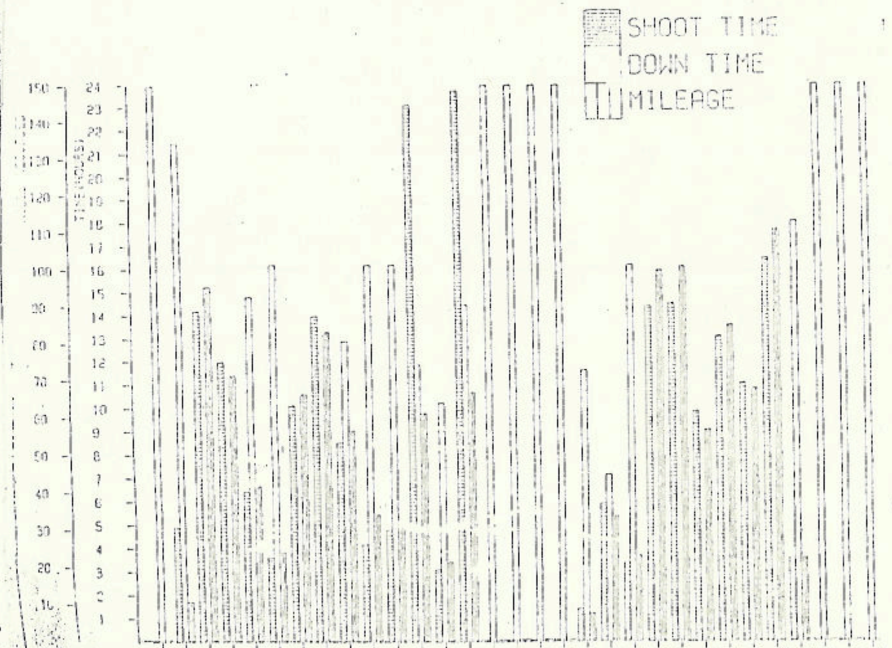


FIG 1:SHOOT TIME,DOWN TIME,MILEAGE PER DAY OFFSHORE CALIF. JANUARY 1981

Figure 4 Shoot time, down time, mileage recorded per day, offshore California