MODIS Team Member - Semi-Annual Progress Report
Marine Optical Characterizations
December 1993

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NOAA/NESDIS

Significant progress has been made over this six-month reporting period. This progress has primarily been in the areas of completing preparations for the MOBY mooring deployment scheduled for October 4-8, from the University of Hawaii's R/V Mauna Wave and for the initial set up and construction of the operational facility in Hawaii, All shipments arrived at the University of Hawaii's Marine Center and the advance crew completed site preparations and laboratory setups. These activities took place during the period of September 23 through October 18. The following personnel was involved:

NOAA - Dennis Clark, Edward King, Phil Hovey, and Eric Stengel
MLML - William Broenkow, Mark Yarbrough, Michael Feinholz, and Todd Hunter
CHORS - Charles Trees
NASA - Stanford Hooker
Mooring Systems Inc. - Peter Clay and Technician

The operational facility is sited at the University of Hawaii's Marine Center at Snug Harbor, Honolulu, Hawaii. This facility will be used to refurbish MOBY during the quarterly buoy maintenance cruise. Work there required about one month of intensive labor by group from NOAA/NESDIS and from the MLML group funded under this contract, This facility is consist of the three mobile laboratories (Navy Met. Labs. from Desert Storm), an 85 x 40 foot Fabric Building Structure (FBS), services for power and water and space for the ship laboratories during the SeaWiFS Cal/Val cruises. A diagram depicting the general layout and services is shown in Figure 1. The Mobile laboratories and equipment were shipped to Hawaii. During the two weeks in September, shore power was brought in, the labs were sited and foundations were prepared for the FBS.

Because of the complexity of our at-sea operations, integrating into existing ship facilities has become too time consuming. E. King, P, Hovey, T. Hunter and M. Yarbrough worked at the MLML facility with completing the conversion of the Army surplus container into a data acquisition laboratory. This lab will significantly reduce the integration time and provide better control on our sources of power. However, placing three labs on some ships will present problems due to the lack of deck space. To enable stacking of two of the large labs, we have designed and constructed a steel stacking frame with aluminum walkways and stairs (Figures 2&3).

LANAI MOBY MOORING SITE

The preliminary operations schedule (16 months) for the MOBY system deployments and the SeaWiFS Cal/Val cruises was completed and is shown in Figures 4 & 5. This schedule is pending the concurrence of the University of Hawaii's ship schedulers.

The mooring site was selected based on four criteria:

1. The buoy must be located sufficiently distant from nearest land. That requirement is a consequence of SeaWiFS optical design where stray light enters the detectors from the adjacent pixels.
2. The buoy must be within line of sight distance from cellular phone relay stations.
3. The site was to be located in the wind shadow of the Island of Lanai. Relatively calm waters are desirable to insure good sea conditions for the scheduled buoy refurbishment work and close to shore for monthly cleaning and calibration by divers operating from a small boat.
4. The design depth of mooring was 1500 m based upon existing charts.

A map of the site with the mean wind speed isopleths and line-of-sight distances from the Maui GTE Mobilnet site are illustrated in Figure 6. In case of emergency, i.e. tropical storms, the small Port of Kaumalapau is available as a refuge (Figure 7). A small boat will be kept at the Mamki public facility. The boat will support diver calibration operations and will be capable of towing MOBY to Kaumalapau.

The Lanai relay station is estimated to be operational in the January-February time frame which allows the station to be located well within the wind shadow.

The buoy deployment cruise "Mooring 1" on the University of Hawaii ship, R/V Mauna Wave, departed Honolulu on 3 October (Figure 8). At the same time a bathymetric survey around a two mile grid centered on the intended mooring position was conducted. The bathymetric survey showed that the original site was on a steep ridge. The bathymetrical survey was shifted northward to locate a more level plateau. A good site in a valley between a small volcanic cone and rise of Island of Lanai was found about 1.5 miles north of the original position. The depth there was 1200 m. The Mooring Systems personnel shortened the mooring line, and the buoy was deployed at 2049.0' N and 15711.5' W on 4 October. The MOBY Prototype mooring is shown in Figure 9.

During the cruise, optics profiles using the Visibility Lab spectral transmissometer (VLST), a BioSpherical spectroradiometer, a NOAA 80-channel visible radiometer and the 38-channel surface irradiance radiometer were made at the mooring site to obtain an initial characterization. Water samples were collected for suspended material and pigment analysis, and long track profiling system was operated during the entire cruise. To determine local variability, a long-track transect was made around Lanai.

Following the completion of the cruise on 7 October, the FBS was erected, and cruise gear was stored in mobile laboratories and under the protective covering of the tent. The operational facility is shown in Figure 10.

SHIP OPERATION

The ship operations schedule is based on the following scenario presented to and approved by C. McClain.

Presently NOAA's Fleet Allocation Council has approved a total of twenty-five days or $300K for a UNOLS charter in Hawaiian waters for FY-94. The NOAA Fleet Allocation Plan has tentatively broken the twenty-five days into quarters with five days for three quarters and ten days for the fourth quarter Since I originally requested quarterly MOBY support plus additional support for the initialization cruise (total of 58 days), it appears that in reducing the request they have favored the MOBY option. This fits well with the scheduling scenario we discussed in which:

(a) According to this schedule, the MOBY mooring deployment planned on October 4-8 has been completed. We would proceed with the MOBY deployment and maintenance beginning in February 1994 under NOAA monies, and schedule an initialization cruise in August 1994 using NASA SeaWiFS dollars (according to this schedule, the MOBY mooring deployment has been completed in 'October 4-8).

(b) A fall initialization cruise in Hawaii could be covered by NOAA if the launch slips further (and NOAA supports the FY-95 58 day request).

(c) If NOAA support is not realized for an FY-95 initialization cruise we then take the Mexican option in the Gulf of California.

(d) Otherwise we schedule the Mexicans for January 1995 and the Canary Islands with the Spanish in May-June 1995.

I believe the above scheduling options can be negotiated at this time, howeve~ the University of Hawaii must be firmed up within the next month. (Note that this will commit NASA to the Hawaiian initialization cruise in FY-94.) If you concur with the above please let me know. ***The implementation of these at-sea experiments assumes that MODIS funding will be close to my present FY-94 profile.***

MARINE OPTICAL BUOY

The next major activity during this reporting period was the completion of system software in the prototype buoy (MOBY) and spectroradiometer (MOS), and the completion of the major electronics redesign of the MOS and the MOBY communications system.

MOS prototype was tested for a stray light and second order effects within the instrument. An optimal filter was chosen to reduce second order light in the red spectrograph.

Major refinements to the system included replacement of the Sutron controller by an Onset Tattletale micro-computer. The Sutron system has proved to be a bottleneck in serving as the communication link between the instruments (MOS) and serial (modem or hardware) communications. It is no longer a system requirement, because buoy telemetry will now be via cellular phone rather then GOES satellite. In addition to the Sutron computer having limited communication attributes, we determined that the data acquisition controller supplied with the SC spectrometers was also limited, and software errors in the SC system limited their application in MOBY. The decision was made to use a single controller to acquire data from the spectrometers and to act as the system controller. The assembly code was developed to implement FORTH on the Tattletale 7 CPU. That activity required six full months of work. Some 17000 lines of assembly code for 700 routines were the result. This work is described in a technical publication under preparation.

MOS was installed in MOBY for Monterey deployment. Because of the software problems, the first complete sea trial planned on 2 November was canceled. The prototype MOBY was deployed in 60 m depth in Monterey Bay on 30 November (Figure 11). The cellular phone contact was established. Data have been recorded as disk files on board MOBY and could be retrieved over cellular phone as required. The buoy has been deployed in Monterey Bay until 10 December and then it was recalibrated and packed for shipment to Hawaii.

We emphasize that considerable refinement, testing and debugging are required before we claim to have an operational instrument.

CALIBRATION

C. Cromer and C. Johnson, NIST provided a proposal for development of two single wavelength photodetectors for monitoring the stability of our calibration standards of spectral irradiance, radiance, and field reference lamps. The two calibrated radiometers will consist of filtered, temperature controlled, silicon photodiodes with required amplifier electronics, power supplies and precision apertures. NIST will provide absolute spectral irradiance response and calibration curves. Additionally, the NIST personnel will assist us with the development of proper procedures for calibrating the MOBY system in the field.

INSTRUMENTATION DEVELOPMENT

We have procured the EG&G-Gamma Scientific version of the 5000 Calibration System. The system is under construction and is scheduled for delivery early January 1994. In order to meet the Lanai MOBY deployment schedule a partial delivery of those components necessary for the MOBY calibrations as been approved.

Work on the Galai noise problem in the range of low concentrations and small particles has been completed, and the system will continue to be tested during the February buoy deployment. Due to the extremely low particle concentrations at the Hawaii site techniques for concentrating the particles using a series of plankton nets in line with the flow-thru system is being developed.

The lack of level winding capability on our vertical profiling buoys has presented a constant problem at depths greater than 30 meters. After considerable pondering , a level wind mechanism designed by G. Hurst was specified and brought. This system will be tested during the February deployment.

New flotation gear was designed and constructed for the vertical profiling buoys (Figure 12). These flotation buoys were made from molded translucent LEXAN with stainless steel grommets at the attachment points. The translucent buoys will reduce the potential of shading the downwelling irradiance collector during the near-surface measurements.

During the past MOCE cruises we have encountered contamination of the water samples utilized for the total suspended matter measurements. The source of this contamination is within the ships sea chest supply systems and is varying from ship to ship. We have initiated a solution to this problem with the procurement of a winch system which is capable of pumping sea water through a support cable which will be integrated into a paravane. The paravane system will house the pump and electronics and will be towed at a depth of approximately three meters at speed up to 12 knots. The present delivery schedule of these components should allow for initial testing during the February deployment.

SUPPORTING GRANTS AND INTERAGENCY ACTIONS

Funds were transferred to NIST for construction of the two calibrated photodetectors and field participation.

The CHORS SDSU grant renewal was initiated.

Renewal of RDC contract for 1994 was initiated.

PERSONNEL

The Ms. Marilyn Yuen was selected and approved for the GS-11 oceanographer position and reported to work in November. Her primary responsibility is to organize the MOCE Team data and maintain that data base.

DATA

Data processing of MOCE-1 and MOCE-2 Data sets continued. The data reduction programs (24 in number with 16000 lines of C and FORTRAN code) are now complete, but as we begin the work of applying them to data obtained during the MOCE-1 and MOCE-2 cruises, we anticipate bug corrections and refinements will be required.

Atmospheric data acquired during the MOCE-2 experiments (two stations) has been reduced and analyzed for the extraterrestrial flux with the Langley technique. Tabs and plots have been generated and best fit spectral intercept has been determined (Figure 13 & 14 and Table 1). CHORS performed a complete radiometric calibration of the instrument and provided a calibration report.

The along-track data for both cruises was completed and sent to C. Trees (CHORS) for the application of calibration coefficients and bias corrections. MOCE along-track data reduction is in progress.

S. Hooker and J. Brown began the upgrading (LabView's version 3) of the along-track data acquisition programs. W. I
ndest completed a utility for merging the one-hour VLST data records.

DOCUMENTATION

Moss Landing Marine Laboratories personnel are in the process of documenting several areas of their work, i.e. software modules, data reduction protocols, and hardware.

CHORS personnel have completed an interim data report for MOCE-1 and MOCE-2.

FINANCIAL REPORT

A financial summary statement for the past year is contained in the Appendix - MODIS Financial Summary January - December 1993.

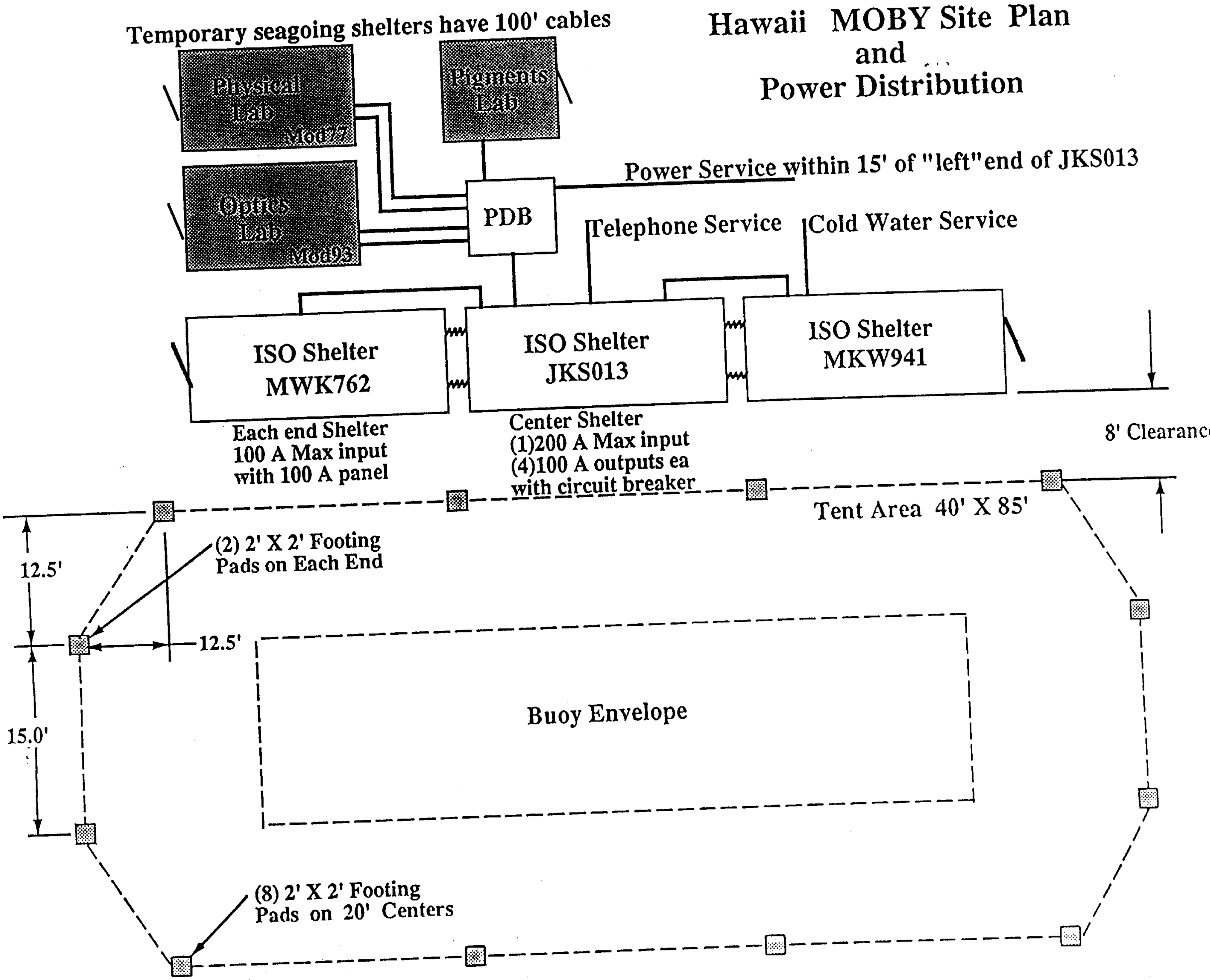

Temporary seagoing shelters have 100' cables
Hawaii MOBY Site Plan and Power Distribution
Physical Lab
Mod77
Pigments Lab
Optics Lab
Mod93
PDB
Power Service within 15' of "left" end of JKS013
Telephone Service
Cold Water Service
ISO Shelter MWK762
ISO Shelter JKS013
ISO Shelter MKW941
Each end Shelter
100 A Max input
with 100 A panel
Center Shelter
(1)200 A Max input
(4)100 A outputs ea
with circuit breaker
8' Clearance
Tent Area 40' X 85'
12.5'
(2) 2' X 2' Footing
Pads on Each End
12.5'
15.0'
Buoy Envelope
(8) 2' X 2' Footing
Pads on 20' Centers

FIGURE 1.

STACKING FRAME
for
OPTICAL AND PHYSICAL LABORATORIES

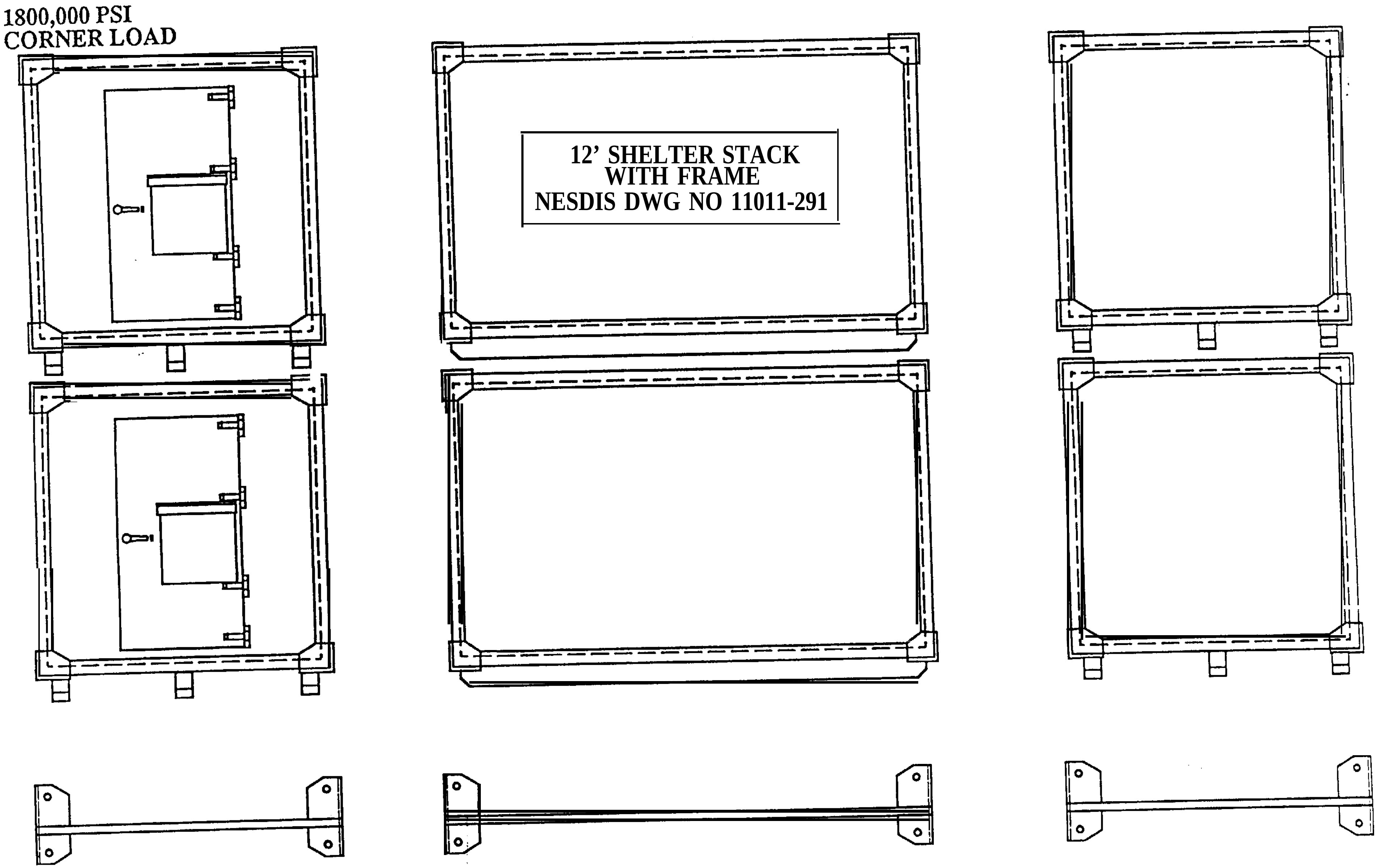
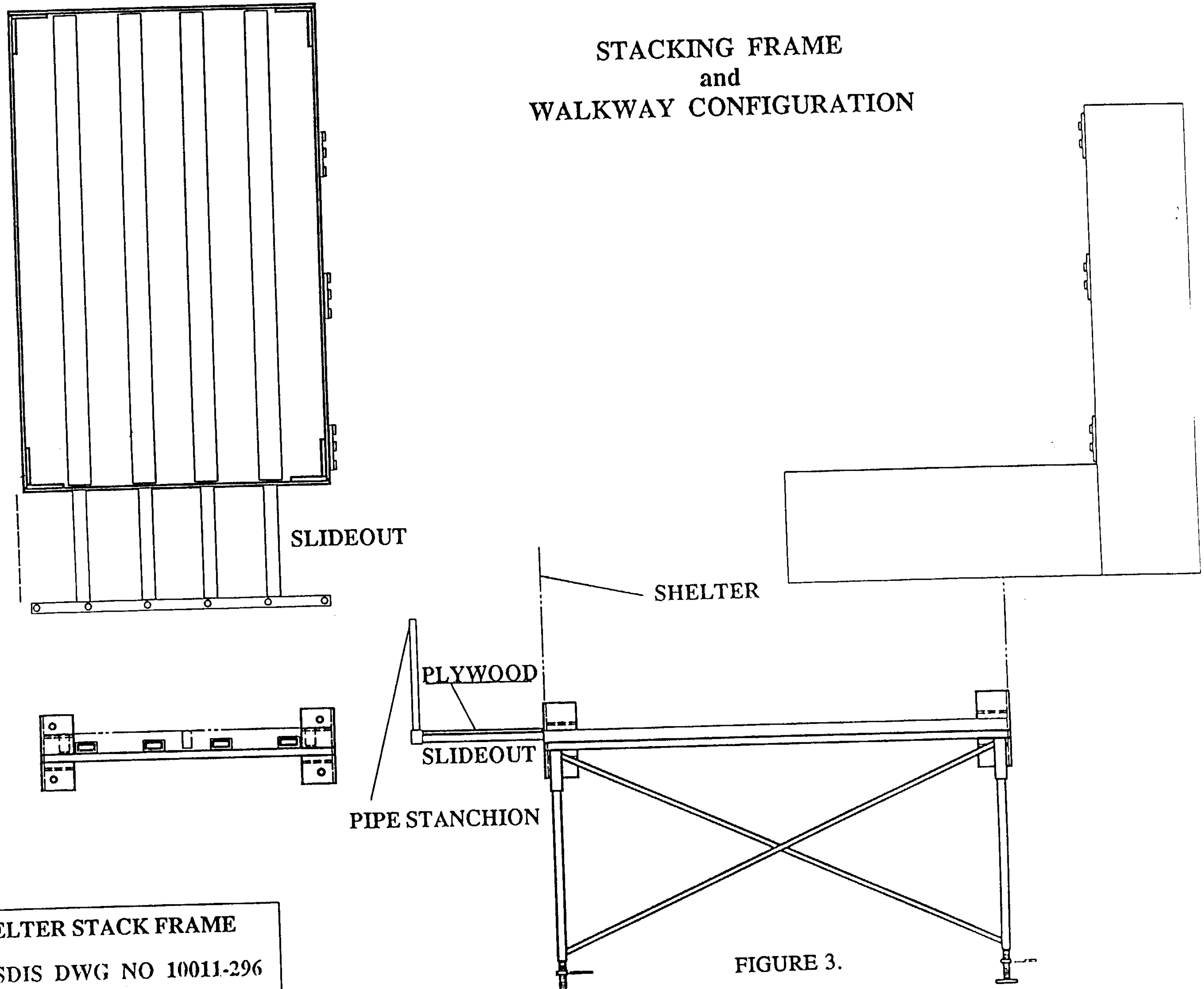


FIGURE 2.

STACKING FRAME
and
WALKWAY CONFIGURATION



SHELTER STACK FRAME

NESDIS DWG NO 10011-296

FIGURE 3.

FIGURE 4.

MOBY OPERATIONS SCHEDULE

Preliminary Draft - dkc

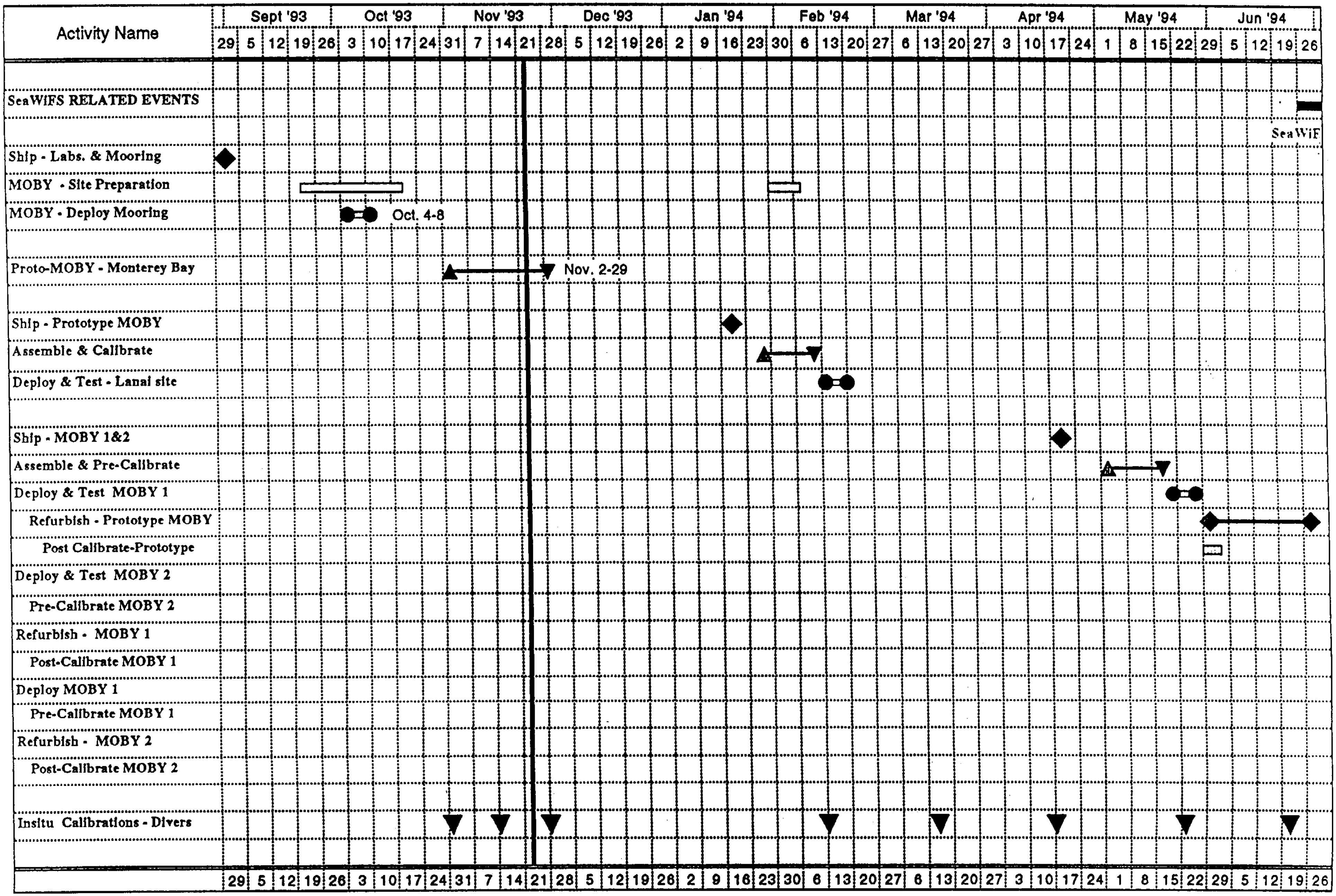
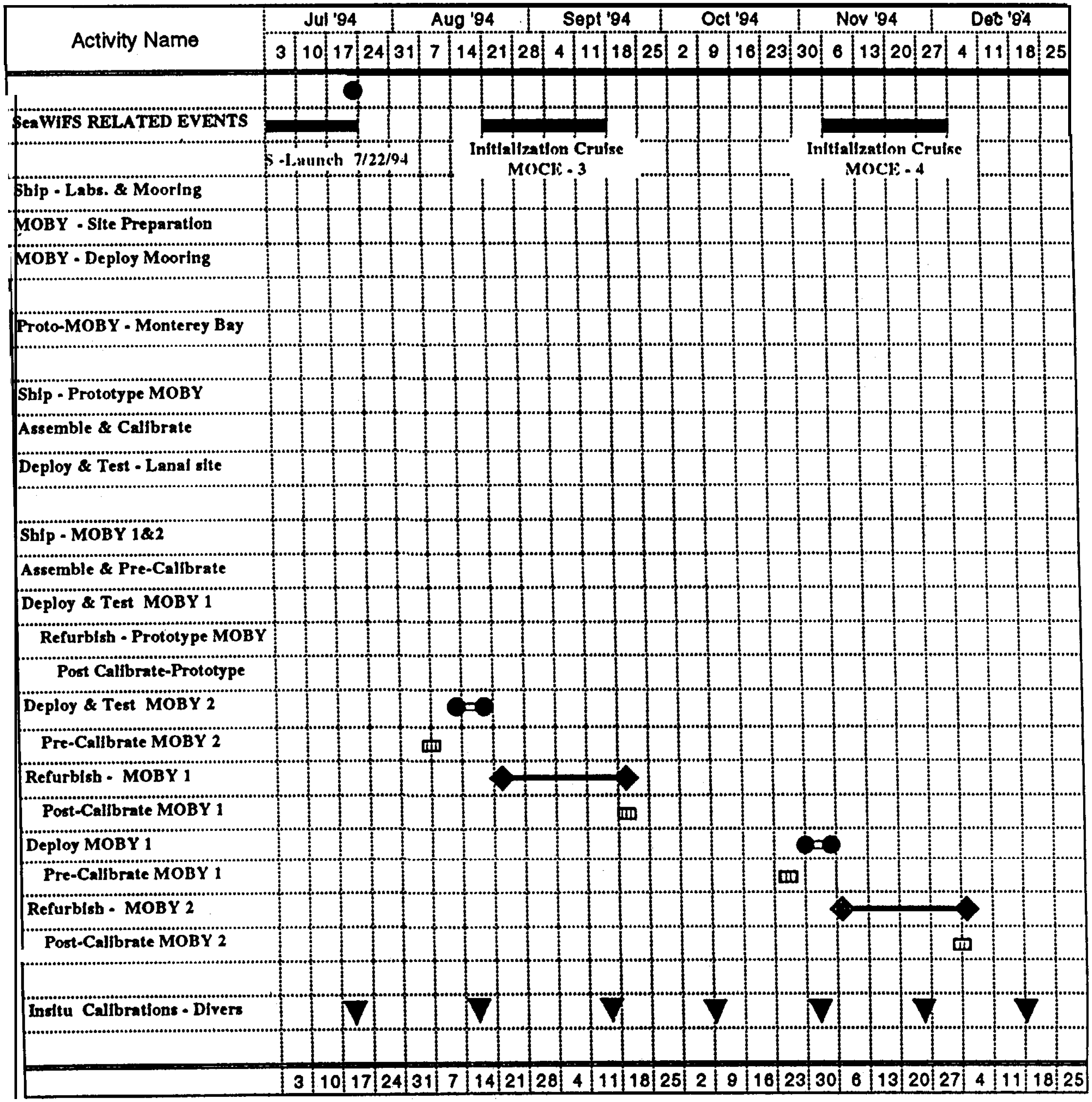
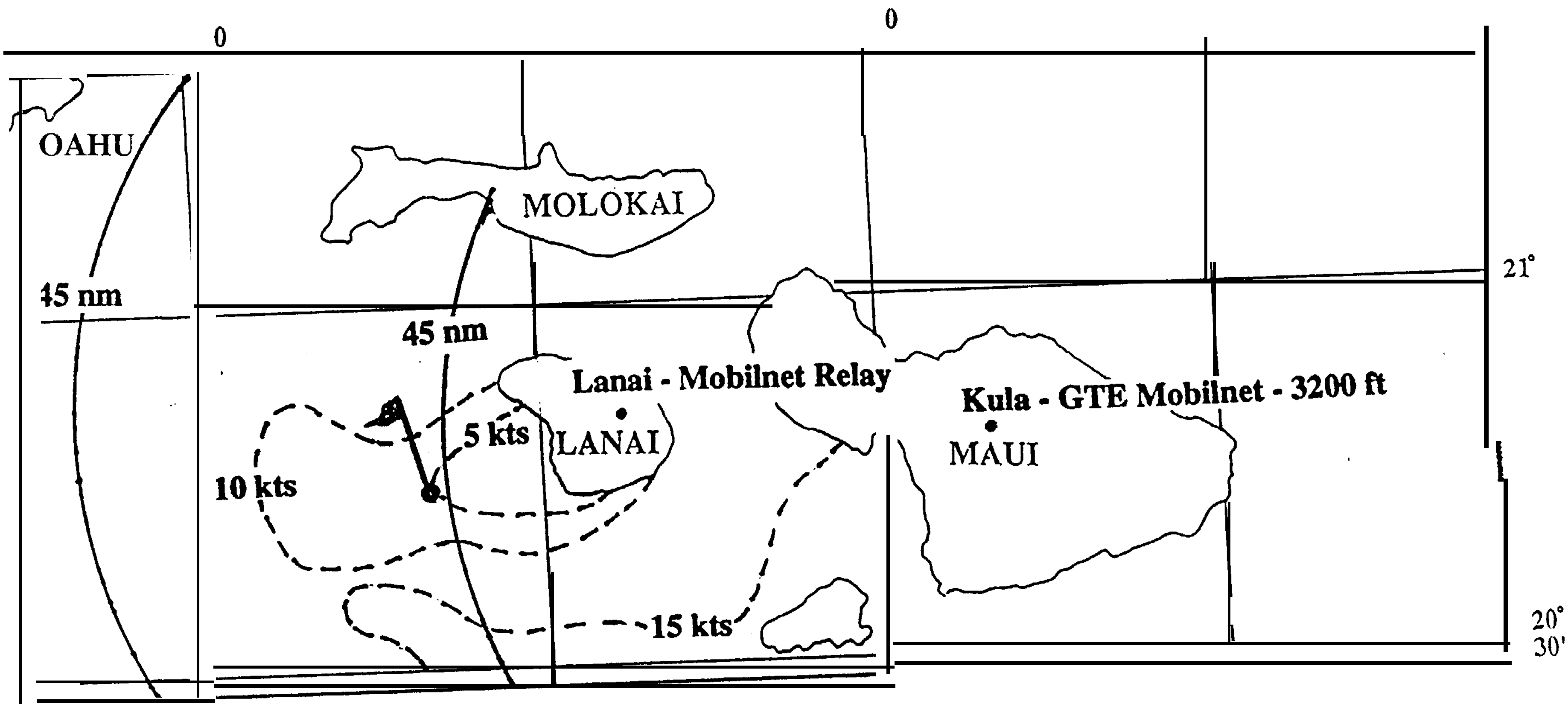


FIGURE 5.

MOBY OPERATIONS SCHEDULE

Preliminary Draft - dkc





Moby 1 Deployment Site - Lanai

FIGURE 6.

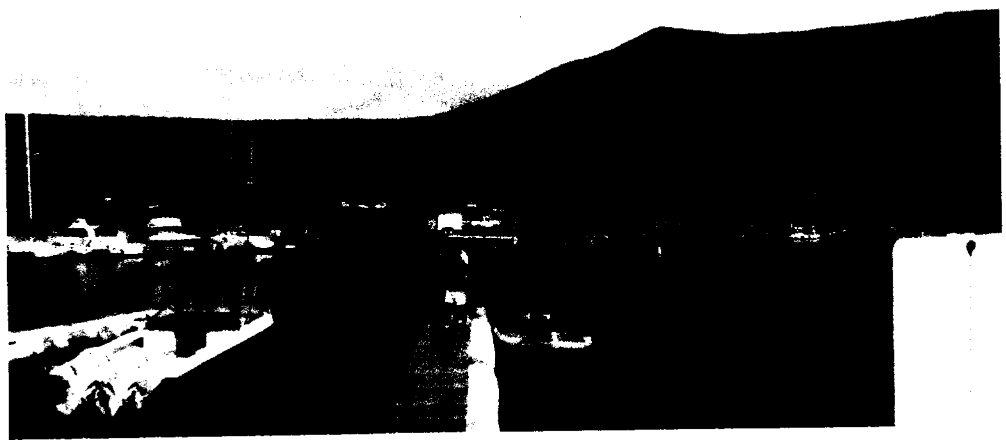


FIGURE 7.

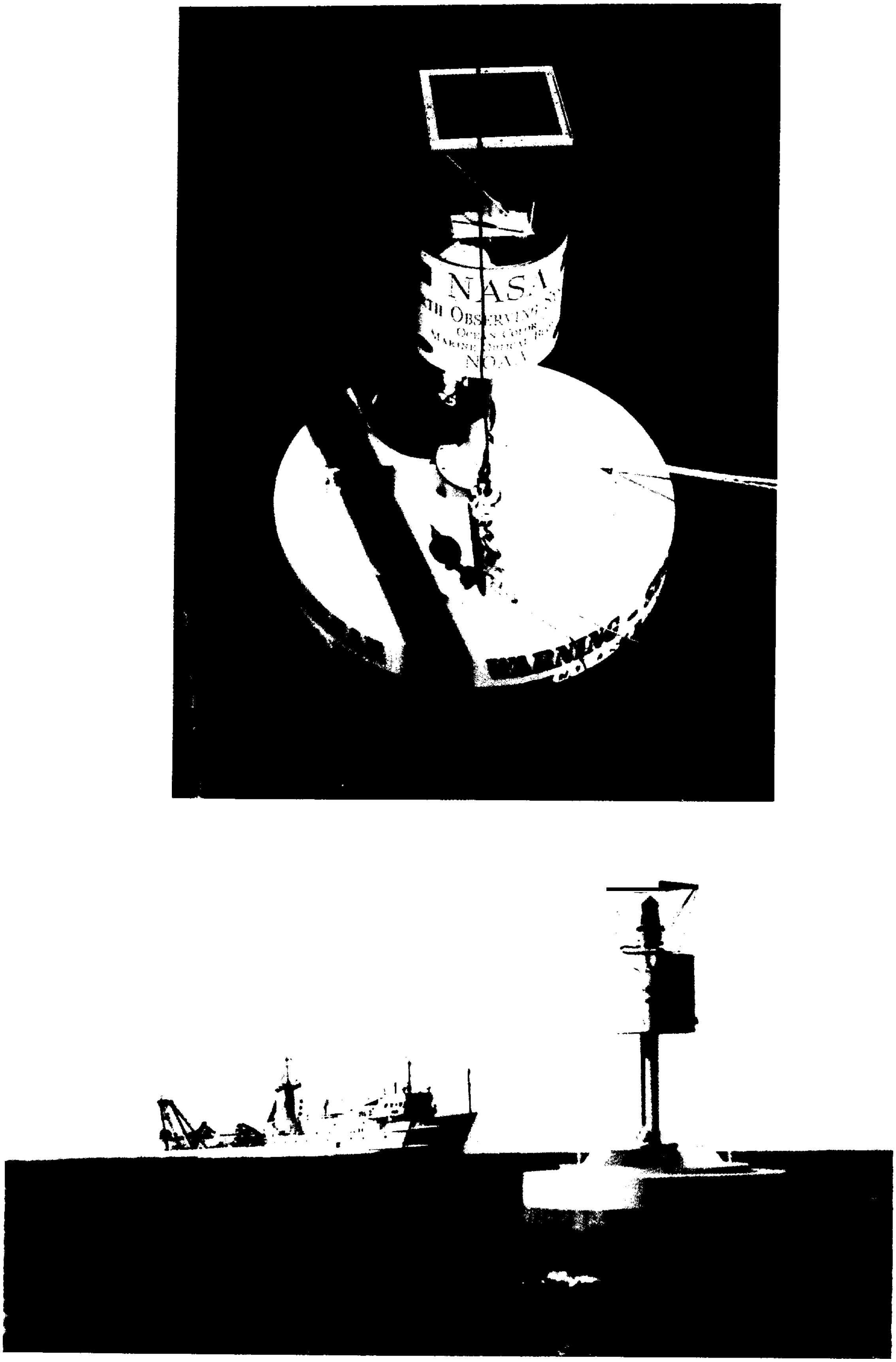


FIGURE 8.

MOBY PROTOTYPE MOORING
LANAI HAWAII - OCT. 1993

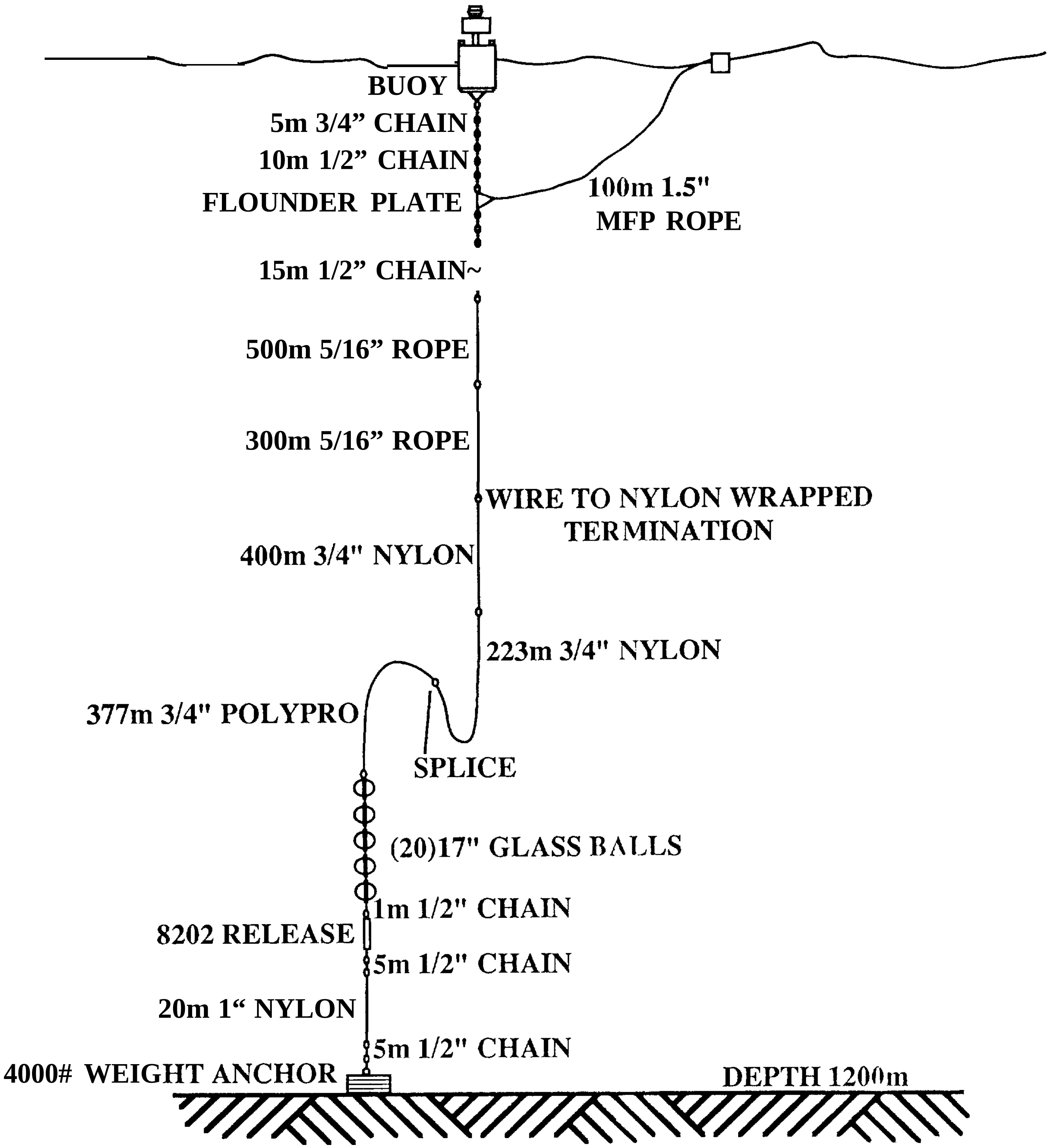


FIGURE 9.

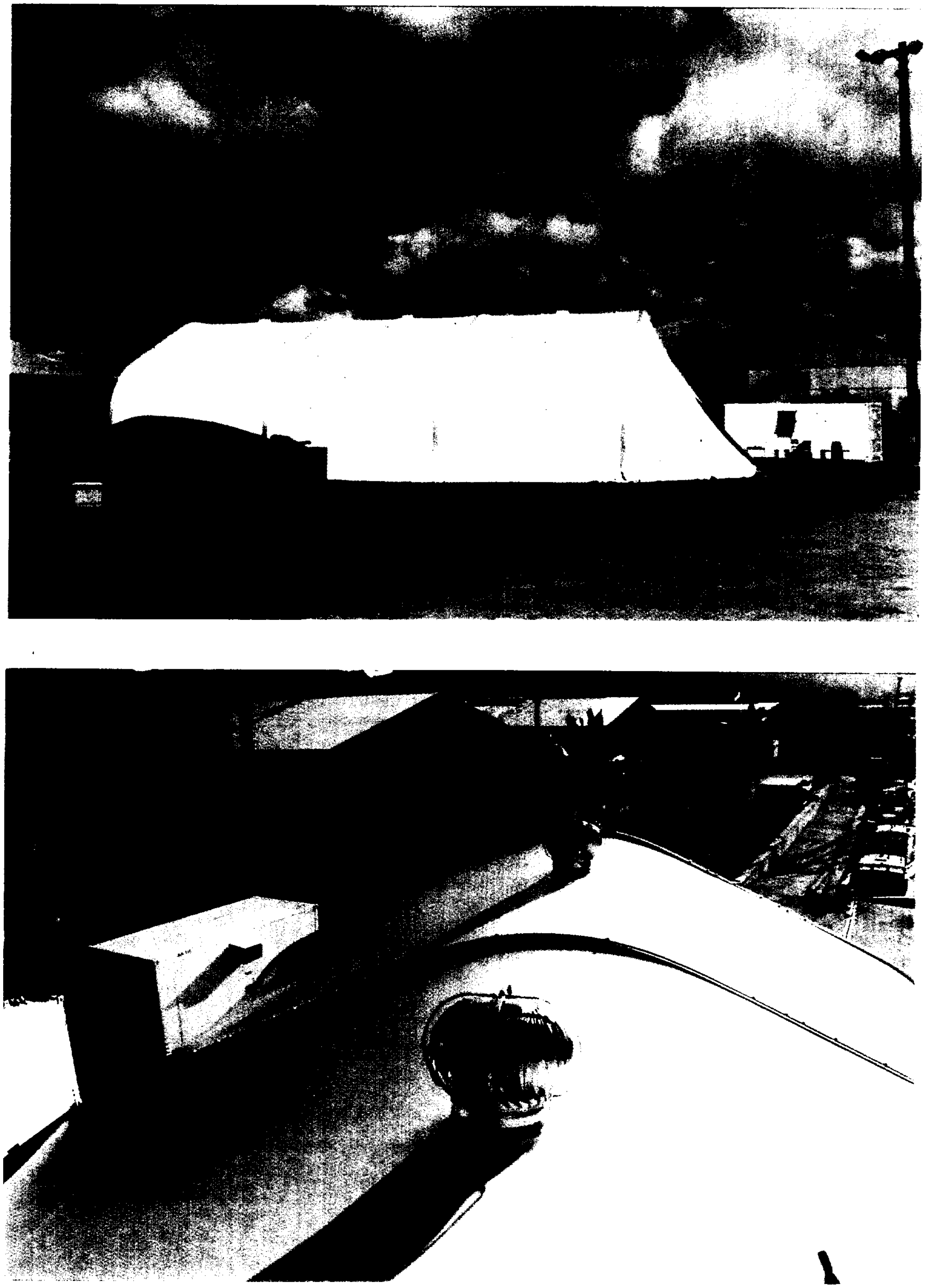


FIGURE 10.

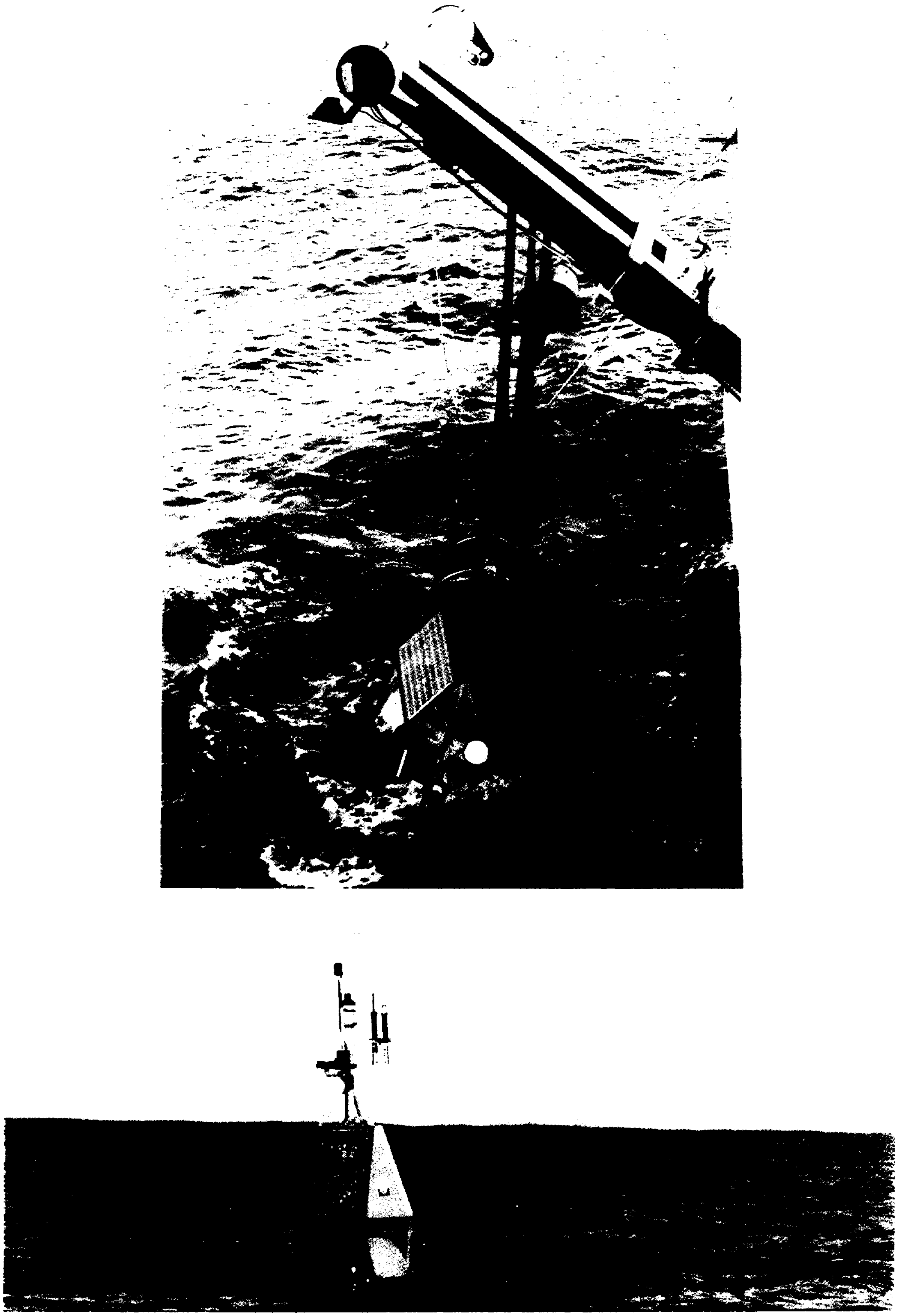


FIGURE 11.

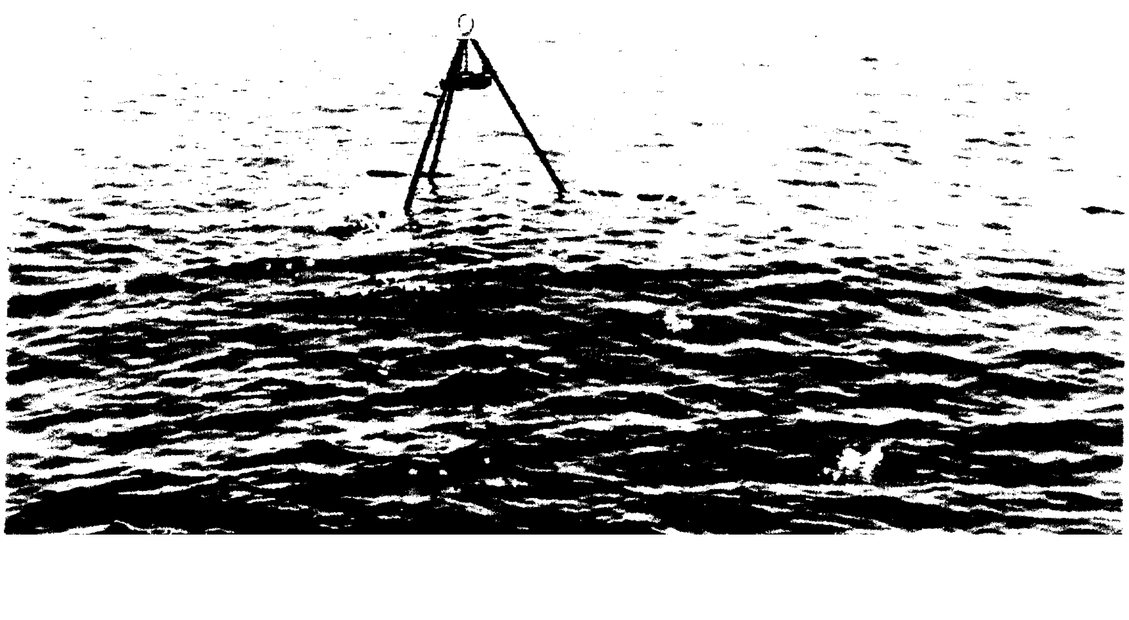


FIGURE 12.

STATION 6 LANGLEY

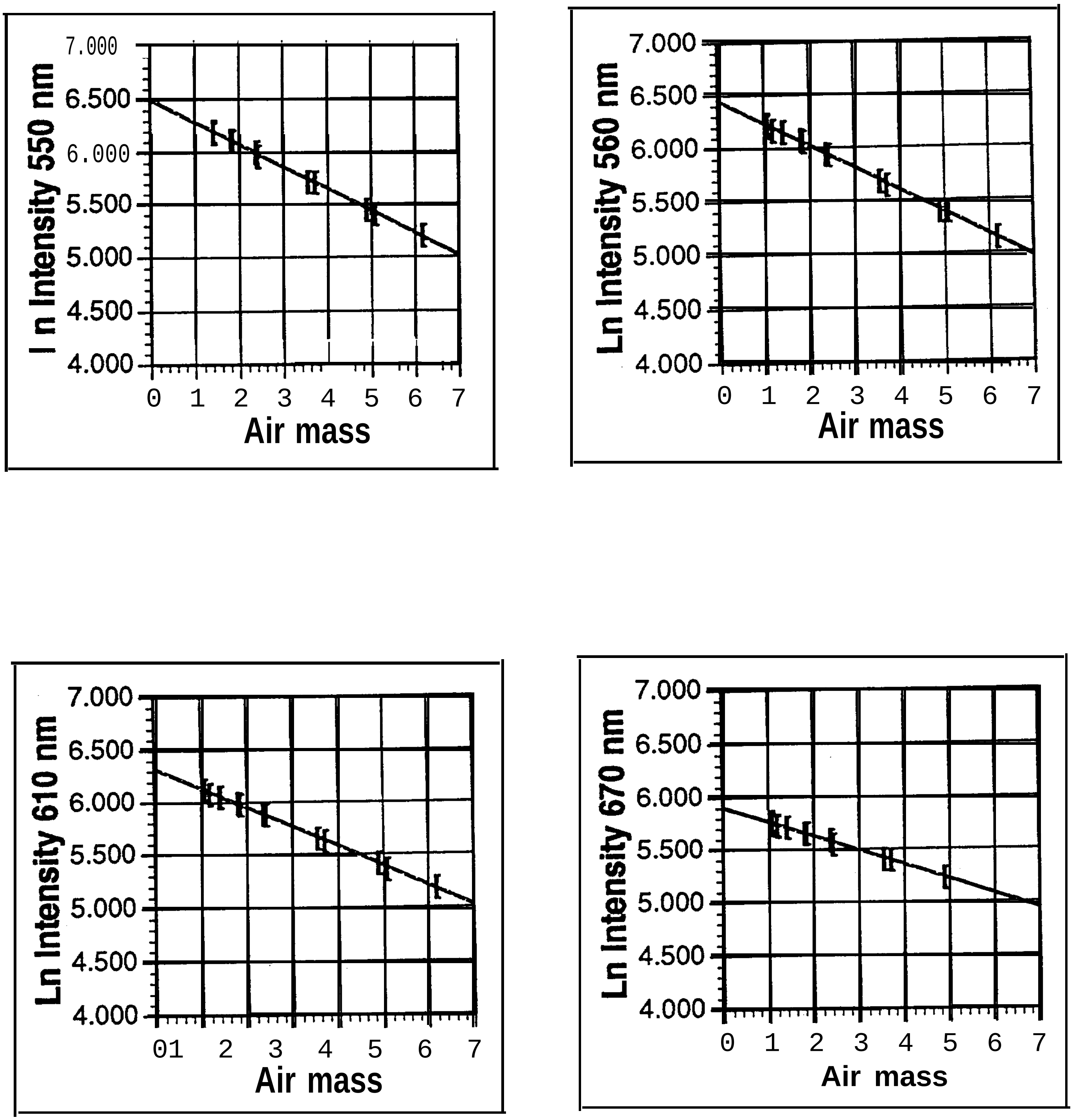
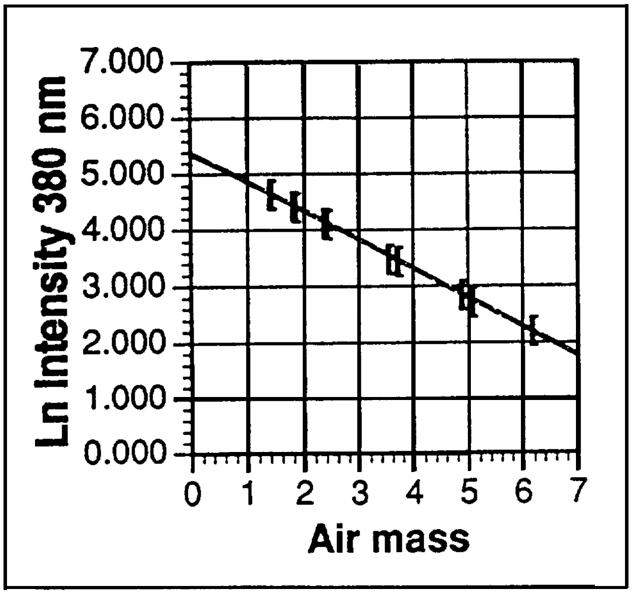
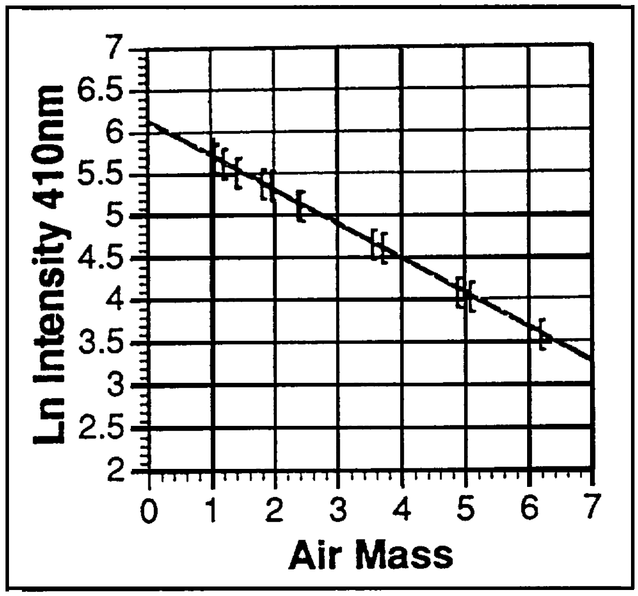
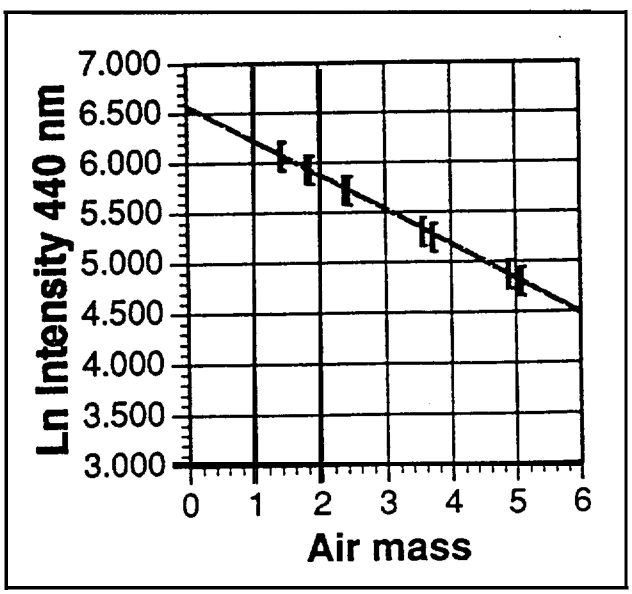


FIGURE 13.

STATION 6 LANGLEY







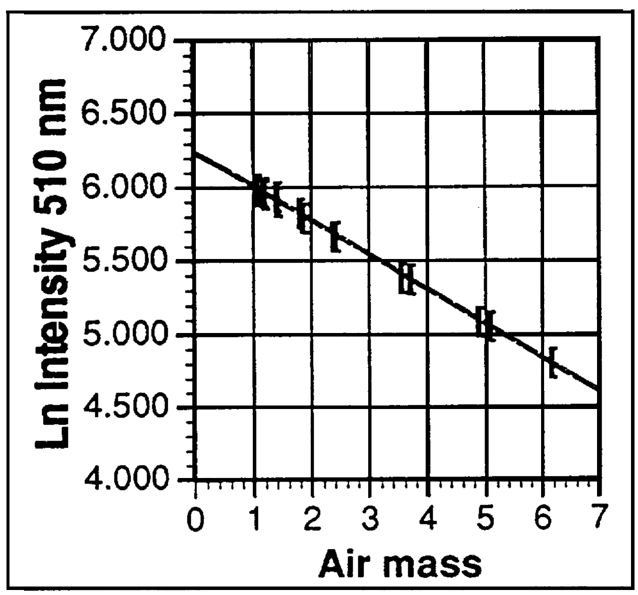


FIGURE 14.

DATA ANALYSIS

Station	Band nm	Slope	intercept	Variance
	380	0.5189	5.397	**0.9996**
	410	0.4118	6.142	**0.9996**
	440	0.3431	6.559	**0,9988**
6	510	0.2341	6.246	**0.9991**
	550	0.2098	6.491	**0.9983**
	560	0.2113	6.452	**0.9982**
	610	0.1830	6.321	**0.9988**
	670	0.1380	5.909	**0.9961**
	380	0.1482	1.752	**0.9969**
	410	0.4311	6.174	**9.9986**
	440	0.3551	6.578	**0.9987**
7	510	0.2261	6.511	**0.9970**
	550	0.2276	6.471	**0.9965**
	560	0.2276	6.471	**0.9965**
	610	0.2064	6.348	**0.9961**
	670	0.1574	5.919	**0.9942**

Table 1