FINAL CRUISE REPORT

SIQUEIROS - ALVIN DIVING CRUISE
ATLANTIS-II 125-25

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OBJECTIVES

The goals of the Siqueiros Alvin Diving Cruise were to make observations on and take samples from various terrains within the Siqueiros Transform domain that had been identified as potential sites for intra-transform seafloor spreading based on a Sea MARC II sonar survey carried out in 1987. Once collected, these data could be used to interpret the recent spreading history of the Siqueiros-East Pacific Rise (EPR) plate boundary and provide further understanding of the petrologically diverse suite of rocks known to exist in this tectonically complex region. An additional objective was to be able to compare the petrologic and chemical compositons of rocks collected from the inferred spreading centers with those of mid-ocean ridge (MOR) basalts erupted on the adjacent EPR axis in an effort to better understand MOR petrologic segmentation and magmatic processes and mantle heterogeneity. Finally, because of the small size of the ridge-transform intersections (RTIs) at the inferred intra-transfomr spreading centers we hoped that additional tectonic data could be collected which would help to clarify the structural evolution of RTIs and their influence on accretionary processes at the ends of MOR segments.

DIVE LOCATIONS

Cruise All125-25 was dedicated to the investigation of the Siqueiros Transform Fault and its intersections with the East Pacific Rise (EPR). A generalized tectonic/location map of the region is presented in Figure 1. All references to transform faults and spreading centers in Siqueiros are based on the nomenclature used in Fornari et al. (1989) [Marine Geophysical Researches, v. 11, 263-299]. We completed 17 dives (2375-2391) in the Siqueiros transform domain in the locations listed below (Table 1) and shown in Figures 2a and 2b (individual dive tracks on SeaBeam base maps are shown in Annex 1. The last dive (2392) was located in the axial summit caldera (ASC) of the EPR near 9° 50.6'N at the request of numerous investigators involved in the Adventure cruise and the RIDGE Steering Committee.

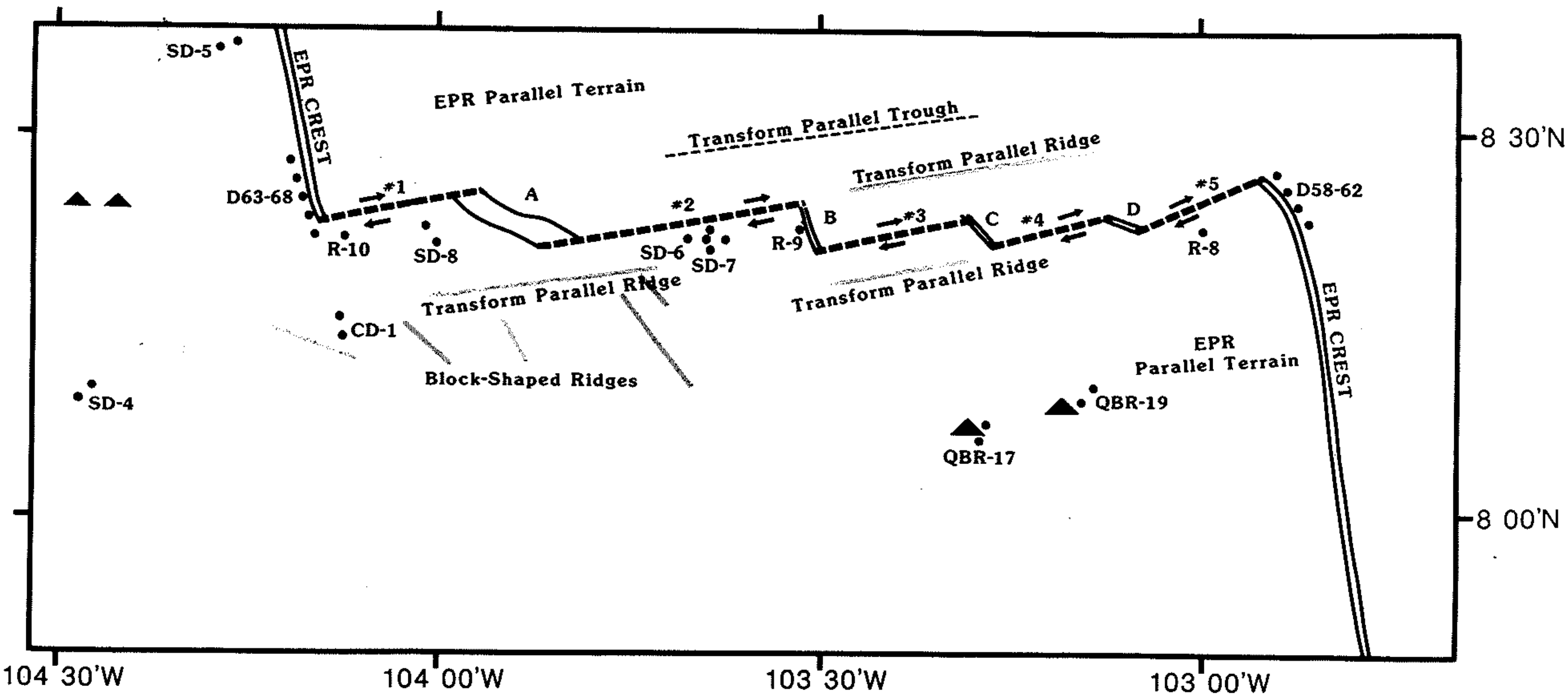

Fig. 1. Plate boundary geometry of the Siqueiros transform domain showing the locations of intra-transform spreading centers (A–D) and strike-slip faults (1–5). Major morphotectonic features discussed in the text are labeled and shown by a line pattern that follows the strike of the feature. Locations of dredges (dot symbols) in and around Siqueiros are also shown (see text for references to sampling programs). Large triangle symbols show locations of seamounts south of the eastern Siqueiros transform domain. Small triangles west of western RTI show position of the chain of small cones.

From Fornari et al., 1989

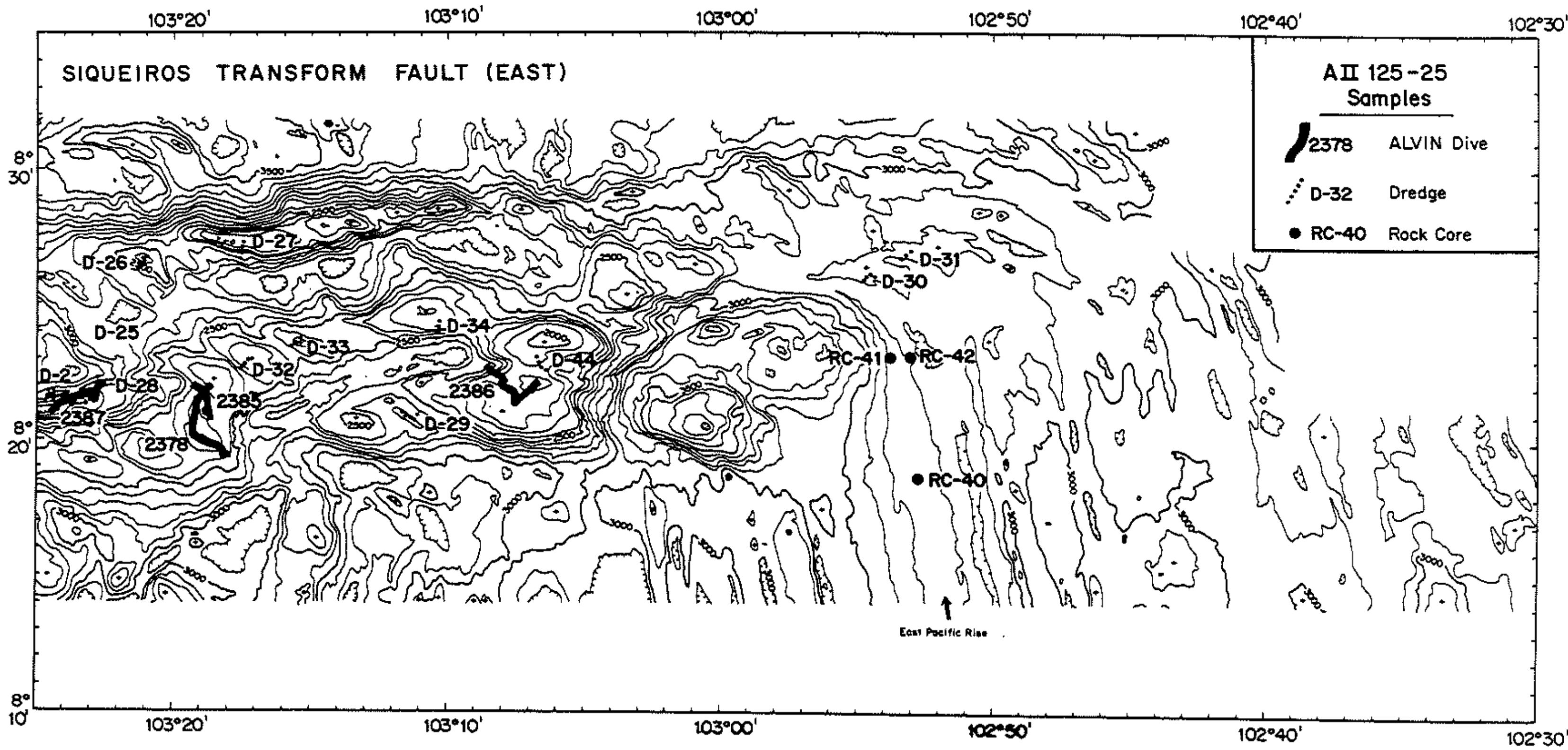

Figure 2a - SeaBeam bathymetry of the eastern Siqueiros Transform with ALVIN dives and dredges and rock cores plotted. Contour interval is 100 m.

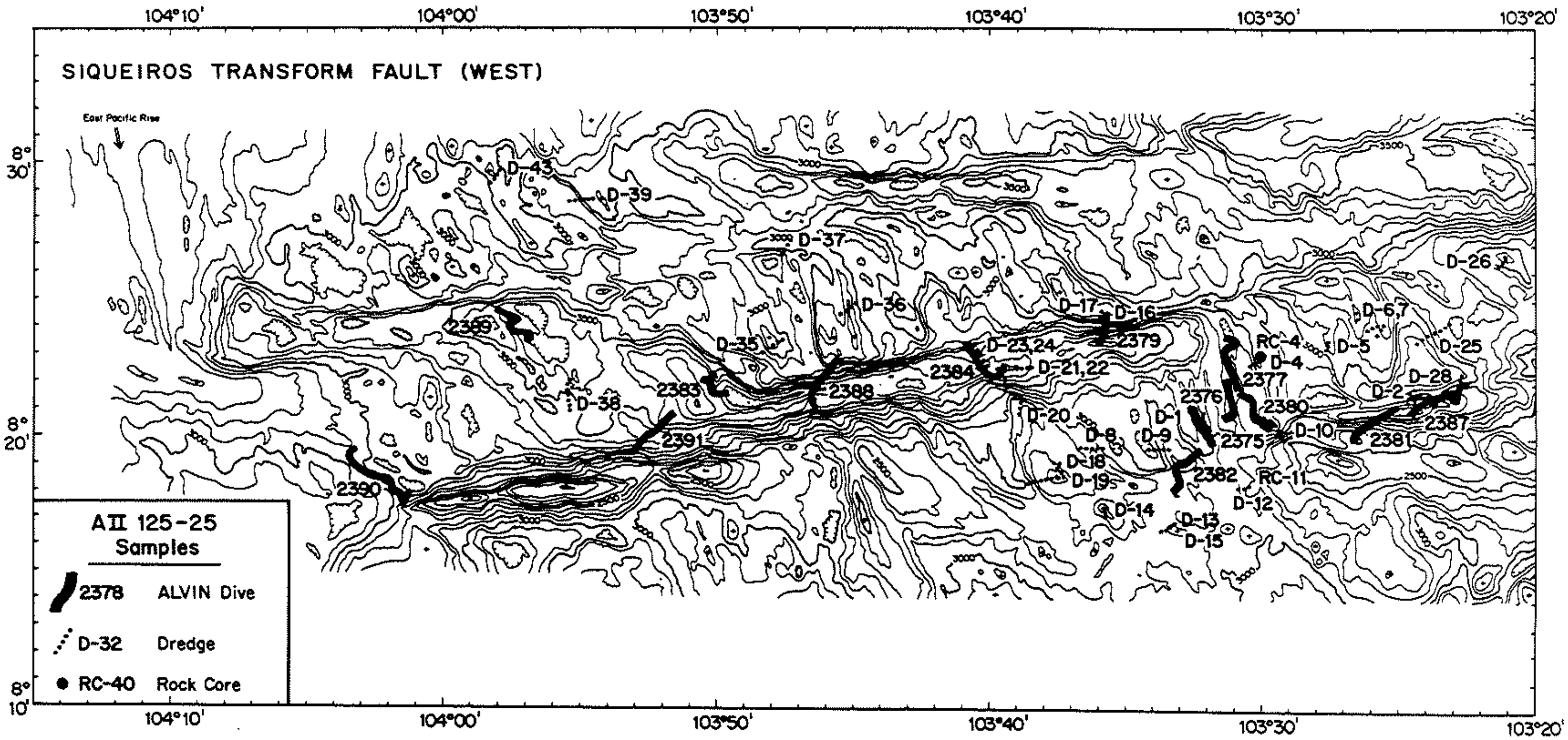

Figure 2b SeaBeam bathymetry of the western Siqueiros Transform with ALVIN dives and dredges and rock cores plotted. Contour interval is 100 m.

OPERATIONAL SUMMARY

ALVIN

ALVIN operations during the cruise were generally very satisfactory. Each days diving commenced at approximately 0730 hrs and the sub. was back on the surface between 1600-1700 hrs. On-bottom time varied between 4.5 to 6 hours and usually depended on the depth, which influenced the ascent and descent. Many dives were able to traverse over 3 km of seafloor, collecting on average 7-10 samples per dive.. There were some instances where dives were terminated 0.5 to 1 hour early in order to meet the established daily dive itinerary. With additional battery power and future objectives that include deep dives it is clear that adjustments need to be made to the current rules of diving between 0900-1700 hours.

Photographic equipment on the sub. consisted of the standard array of SIT video, color video mounted on the starbord arm, 35mm bow-camera transparencies and divers were equipped with hand-held 35 mm cameras. In addition, we were equpped with a Canon Xap-shot camera (digital video still camera) which records images on 2"x2" disk and was able to be replayed immediately on surfacing. These data plus hand-held video images taken with a Sony Hi-8, 8mm video camera permitted detailed documentation of specific features and provided important near- real-time data that was very useful during debriefing.

The ALVIN datalogger functioned very well and all dives except one have continuous digitally logged data at 1 minute intervals consisting primarily of: dive number, date, time, gyro heading, altitude, depth, temperature and, when in the ALNAV network, x/y and geographic coordinates. Datalogger files were imported into an Apple Macintosh environment via 3.5:" diskettes and the Apple File Exchange utility. Data have been stored on 3.5" diskettes in both raw (DOS format) and Macintosh Excel formats, as well as edited files that were used to plot different dive variables against one another. Data were then edited and graphically manipulated using primarily Excel and Kaliedagraph software. Final navigation data were exported back to the URI VAX for plotting as overlays on SeaBeam depth contours.

During this cruise we tested a pair of "Maxi-Lasers" fabricated by the Harbor Branch Oceanographic Institute (HBOI) (Mr. Bob Tusting was project manager) which were mounted on ALVIN for the purpose of providing an accurate scale measurement in the 35mm bow-camera frames and the video images. The lasers were tested during 43 dives (including previous Adventure dive program) to a maximum depth of 3920 m without any problems. The lasers produce two small red "dots" of light which, based on the geometry of the mounting bracket on the sub., are spaced 52 cm apart. Repeated tests showed that the dots were most visible when the subject matter in the frame was less than 3.56 m away from the lens while the maximum useable distance was calculated at 5.72 m. (D. Foster, pers. commun., 1991). The dots were visible in the SIT video at equivalent distances to those for the 35 mm camera and in the color video when it was pointed at the dots and the distance between image and lens was less than 3 m. We consider the test of the HBOI lasers to be an unqualified success and have strongly recommended to the ALVIN Group that they purchase a set as part of the standard equipment on the sub. These devices provide an unequivocal and accurate scale measurement in real-time permitting the divers to quantitatively measure geologic and biologic features. The laser dots also permit one to estimate, in a non-intrusive manner, fluid flux from hydrothermal vents by measuring elapsed time for particles exiting orifices of known dimensions to cross measured distances.

Navigation

The transponder navigation worked well in the net we established in spreading center B. There were some problems with the in-sub. navigation due to shadowing by the peaks along the axis of B; however the placement allowed us to dive off axis to the west (2375) on the A-B fault (2379) and on the axis of B and in the eastern trough using a combination of sub nav and ship-to-sub nav.

Trackpoint (short-baseline) navigation was quite good and when coupled with the SeaBeam maps left little doubt where the dive track went to, with only a 100-200 m uncertainty (we plotted at 480 inches per degree on the working-scale dive maps). Furthermore, a comparison between Trackpoint navigation and ship-sub transponder navigation carried out during dive 2380 confirmed that the Trackpoint navigation was accurate to within a few hundred meters when positioning the ship with GPS, which we had had on a 24 hour basis in undithered mode.

Dive tracks were plotted using edited navigation, either from ALNAV datalogger input (when in the transponder network), or smoothed navigation compiled based on Trackpoint, GPS and correlation between ALVIN pressure depth and SeaBeam depth contours on the survey maps (n.b. SeaBeam depths were generally 15-20 m shallower than ALVIN depths).

Data were output on the URI Calcomp plotter as overlays on the SeaBeam contours at a scale of 480 inches per degree. These maps served as the base maps for shipboard annotation of the geology along the dive tracks.

Atlantis-II

A-II operations were normal throughout the field program. We utilized the dredge winch heavily during the night-time sampling operations and the hydro-winch during several rock core stations. Dredging was conducted from the SeaBeam (gravity lab) after the winch controls were re-routed. All winch controls and tensiometers worked very well; no problems were encountered. Up to 3 dredges per night were possible with wire speeds of 70-80 m/min during ascent and 50-60 m/min during descent and short bottom dragging times. All dredging was conducted using SeaBeam and short wire scope (generally 300-400 m). Pingers were utilized during the first few dredges but poor pinger performance at depth rendered them ineffective in aiding to constrain the dredge depth.

GPS receivers worked well except for 2 instances of receiver problems which were traced to human error. Down time was less than 8 hours for the entire cruise.

Ship speed during SeaBeam surveys and transits usually varied between 10-12.5 knots depending on currents and winds. In general weather conditions were excellent (Seastate 1-2) throughout the cruise with maximum winds of 20 knots during sporadic squalls.

SCIENCE SUMMARY

Intra-Transform Spreading Centers

Observations made during the dives, shipboard analysis of the data collected and dredging confirm that three spreading centers (A, B and C, Figure 1) within the Siqueiros transform domain are actively accreting oceanic crust. Glassy, well-developed pillowed flows dominate the constructional volcanic terrain at each spreading axis, but sheet flows are common in flatter areas of rifting between volcanic highs. Volcanism at each axis is largely manifested in steep-sided pillow walls and coalesced edifices with both faulted and constructional slopes between 40-70°. The erupted lavas from the spreading centers fall into three broad categories based on hand-specimen description: aphyric basalt, plagioclase phyric basalt, and plagioclase/olivine phyric basalt; all with a significant degree of vesicularity (suggesting possibly different volatile contents than those of MORBs from the adjacent EPR. Based on the relative freshness of glassy crusts and Mn and sediment cover on volcanic flows, there appears to be a fairly systematic aging of the seafloor across the axis and flanks of each spreading center. The relative ages of volcanic flows along each spreading axis, however, do not show any overall aging pattern but there are areas of apparently younger and older flows along each axis. No areas of active hydrothermal activity were observed although there is some evidence of low-temperature alteration of lavas in the most recently rifted areas.

TABLE 1

DIVE #	GENERAL LOCATION
2375	2nd abyssal hill west of B axis
2376	southern portion of B axis
2377	northern portion of B axis
2378	southern crescent ridge at C and central graben
2379	north wall of A-B fault just west of B intersection
2380	southern RTI hole at B and trough east of B axis
2381	southern wall of transform connecting B and C
2382	southern wall west of C and plateau south of transform
2383	spreading center A, southern ridge
2384	young cones in axis of A-B transform trough
2385	northern RTI hole and central rift of C axis
2386	trough and northern peak of D
2387	cones in axis of B-C fault near C intersection
2388	A-B fault, cone on south side of axis and traverse up the north wall
2389	northern ridge in A
2390	western RTI, small ridge that connects EPR to south wall of A-B fault
2391	small cone built against south wall of A-B fault west of southern A ridge
2392	revisit to the BBQ Pit area on the EPR crest at 9° 50.6'N for time-series observations of a very young lava flow and sulfide sediment deposit which were discovered during the Adventure Cruise) Leg A-II/125-24

Spreading center A consists of two ridges (north and south) located near the west and east margins respectively of a deep pull-apart basin. At spreading center A, the lavas on the northern ridge were investigated during dive 2389 and are older to the north, towards the intersection with the fault that leads to the northern EPR axis. Well-formed, glassy pillows are present in the deep hole (3750 m) adjacent to the southern portion of the northern ridge and continue up the flank and on to the crest. The structures observed in the hole consist of E-W (transform parallel), and to a lesser extent NW-SE (ridge parallel) trending elongate constructional pillow ridges. These features suggest that transform tectonics are strongly influencing the loci of accretionary volcanism in this intra-transform spreading center. At the southern A ridge, along the eastern margin of the pull-apart basin, the pillow lava flows along the southern segment of this ridge also appear younger than those on the northern crest. At this locale the northern crest and eastern flank of the A spreading ridge are faulted and fissured indicating a tectonic overprinting on the volcanic terrrain. The terrain east of the southern A axial ridge was traversed during dive 2383 and found to be a much older volcanic terrain based on extensive weathering of the basalts and heavy Mn coating on the rocks.

Dive 2390 ,west of spreading center A (Figure 2, and Annex 1), was selected to investigate the intersection of the EPR axis with the westward termination of the A-B fault. We discovered that the ridge-transform intersection (RTI) is characterized by a distinct fault boundary which separates well-formed pillowed ridges and haystacks to the north from a faulted and tectonized escarpment to the south. Lavas appear to increase in age to the north, toward the EPR, and constructional ridges there are more faulted.

At spreading center B the volcanic terrain along the crest of the ridge consists largely of bulbous pillow walls, and constructional pillow escarpments. The terrain in the northern portion of B is tentatively considered to be slightly younger based on the fresher appearance of the samples returned from dive 2377 versus dive 2376 which traversed the southern B axial ridge (Figure 2). However, a small 100 m high cone just east of the central portion of the axis is believed to be the youngest volcanic center along this accretionary zone based on the extreme freshness of the lavas and delicate glassy character of the exterior crusts. The seafloor in the RTI hole at the northern end of B consists of a fresh, untectonized volcanic terrain with small haystacks of pillows and tubes up to 10 m high scattered in the bottom of the bathymetric depression. The southern RTI at B was investigated during dives 2376 and 2380 where the southern margin of the RTI was found to consist of a rather uniform talus slope cut by transform parallel (070-080°) faults that create small backslopes 1-3 m deep which are separated from the upward continuation of the slope by 5-15 m. Throughout the transform domain, on both the spreading axes as well as the strike-slip faults that link them, fault scarps that cut through expansive scree slopes have a similar morphologic expression. Faults are expressed as knife-edge ridges that cut across-slope, paralleled by relatively shallow linear depressions (3-15 m deep) that are, inturn, bordered by the upslope continuation of the talus covered slope. Throughout Siqueiros we observed many instances of talus slopes that are nearly free of sediment cover suggesting recent tectonic activity.

Spreading center C (Figure 1) consists of a narrow (~200 m wide), shallow (8 m-30 m deep) graben-like valley that runs between two shallow peaks with summit depths of 2220-2230 m. During dives 2378 and 2385 observations were made along the length of the graben as well as on the flanking peaks and the northern RTI hole where C intersects the B-C strike-slip fault (Figure 1). Young, glassy volcanic flows are restricted to the floor and occasionally are found draping the walls of the graben, possibly indicative of syntectonic volcanism. Many of the lavas that floor the graben are sheet flows cut by numerous gjas and deep fissures. Although hydrothermal staining on the surfaces of lavas was evident, no hydrothermal venting or deposits were found. The graben walls are formed by en echelon steps interpreted to be fault scarps that cut the northeast and southwest slopes of the flanking peaks. Faults and fissures within the graben and along the walls are rift parallel whereas those approaching the RTIs become more transform parallel. Samples collected at the northern RTI of C include a plagioclase porphyritic lava with thin glassy margins similar to plagioclase porphyries recovered from small volcanic edifices within deep areas of the B-C fault.

The trough picked as the developing spreading axis at D by Fornari et al. (1989) (Figure 1)was found to consist of older volcanic terrain that has been strongly tectonized. Only one well-developed lava flow with some glassy crust remaining was recognized in the trough separating the two flanking peaks; the other samples recovered are largely older, Mn covered basalts. A dredge (D44) subsequently taken in the trough immediately north of D (Figure 2), recovered much fresher, glassy basalt suggesting that any incipient spreading occurring at D is probably focussing along a transform-parallel lineament. These data further confirm the unstable and disorganized nature of accretion at D.

Strike-Slip Faults

Within the Siqueiros transform domain, six individual stike-slip faults have previously been suggested to link intra-transform spreading centers and the EPR (Figure 1). Prior mapping using Sea MARC II data indicated that faults in the western portion of Siqueiros are well-defined (where the intra-transform spreading centers appear best organized), but are poorly-defined, morphologically, in the region from the south end of spreading center C to the southern EPR axis.

Fault offsets between intra-transform spreading centers within Siqueiros vary in length (N.EPR-A = 20 km, A-B = 35 km, B-C =18 km, and C - S. EPR = 39 km). Two of the linking faults between spreading centers A and B and spreading centers B and C were chosen for detailed studies using ALVIN and the rock dredge. These faults were chosen because: 1) they link the most morphologically distinct and best organized (tectonically) intra-transform spreading centers, 2) they represent very clear relay zones between spreading centers, 3) relief is between ~1000 m and ~1500 m, facilitating dredge transects and exposing a maximum amount of the oceanic crustal section, and 4) transform axial deeps and RTI nodal deeps are well-defined in both faults. Both faults also exhibit morphologic linearity (azimuths 078° [A-B], and 075° [B-C]) that is slightly oblique to, but in the approximate relative motion direction between the Pacific and Cocos plates (082°). Both are throughgoing bathymetric structures uninterrupted by morphological highs or deviations in linearity. The trend, continuity, and distinctive topographic expression along these two transforms suggest that they are the locus of recent strike-slip deformation and serve to define the present plate configuration within the Siqueiros transform domain. The fault linking spreading center A and the northern EPR axis is also well-defined (azimuth 082°) but relief is not as well-developed and the fault trough axis is broader suggesting a more diffuse zone of deformation. For this reason, this transform was not selected for dive studies.

The faults linking C with the southern EPR (Figures 1 and 2) crest are less well-defined morphologically and the linearity of fault strands may not be continuous to the southern EPR. The several linear troughs which cut through the shallow topography at the eastern end of Siqueiros are also slightly more oblique (O73 -075°) to the O82° relative motion direction, have slightly different azimuths, and are interrupted by morphologic highs (e.g., in the vicinity of D ; Figure 1) suggesting that the locus of transform deformation has been unstable in this region. These facts, and in particular the lack of lateral morphologic continuity and well-defined spreading centers made it difficult to target these features for Alvin dives; however we did sample several of them with the dredge.

Three dives were located in the A-B fault (2379, 2384, and 2388). One dive investigated the western aseismic extension of the A-B fault and south wall of the A-B fracture zone west of the A RTI (2391) (Figure 2). Two dives were placed in the B-C transform (2381- south wall of the B-C transform; and 2387 -north wall of the B-C transform). In addition, many of the dives along the ridge axes recovered samples from nodal deeps at ridge-transform intersections.

The overall objectives of these dives were: 1] to locate regions of active strike-slip faulting between spreading centers, 2] to examine whether intrusive rocks are exposed along the transform walls, 3] to extensively and systematically sample the transforms because of the known compositional diversity in the region, and 4] to examine the possibility that the faults may contain discrete loci of extension and volcanism which would support the model of "leaky" transforms. Data concerning the latter observation would have important implications for the tectonic configuration and evolution of the Siqueiros transform domain.

One of the most remarkable results of the field program was the recovery of young glassy picritic basalts through dredging operations along the walls of the A-B fault, approximately 7 km west of spreading center B (Figures 1 and 2). During dive 2384, in the same area (Figure 2), we recovered similar young olivine-phyric basalts . We documented that these young lavas floor parts of the transform valley axis and that distinct and very young volcanic centers are nested along the lower parts of the south and north walls of the transform. These basalts are glassy, devoid of pelagic sediments, have hand-specimen aspects similar to Age-1 lavas recovered on the northern EPR near 9° 40-54'N, and are thus considered to be very young. They overlie and are sharply contrasted with a much older highly-sedimented terrain consisting of talus and pelagic sediment on the north wall of the transform and older manganese encrusted basalt, talus and pelagic sediment on the south wall. The older terrain exhibits extensive evidence of prolonged tectonic activity including older degraded transform-parallel fault scarps as well as fresh fault scarps that have offset bedrock and previously-deposited breccias and pebbly mudstones. The young volcanics, on the other hand, show no indication of recent faulting even along the transform axis and are considered post-kinematic with respect to structures observed along strike in the older terrane.

These results, to our knowledge, represent the first definitive documentation of young volcanic activity within an active transform far from an RTI. These lavas have important implications for the generation of MORBs because of their inferred, chemically primitive nature and unusual tectonic setting The transform tectonic setting in which these lavas were erupted may have allowed the parental magmas to by-pass the more usual fractionation and mixing processes believed to be common in longer-lived, open-system sub-axial magma chambers at MOR spreading centers and consequently the chemistry of the samples will bear directly on the generation of primary melts in the mantle. These picritic basalts also have implications for plate kinematics as transform faults are usually amagmatic. They suggest that faults within Siqueiros may be in a general state of tension and leaking along their length.

Other dives in the A-B fault did not encounter very young basalts, but did document extensive areas of recent faulting and exposure of both older volcanic and plutonic rocks. Dive 2379 and dredge 17D were conducted on the north wall of the A-B transform (4.5 km west of the B RTI, Figure 2). Both recovered microgabbroic and gabbroic rocks, as well as basaltic rocks with gabbroic xenoliths. With the exception of dive 2384, each of the dives along the A-B fault and its aseismic extension to the west, recovered fine-grained gabbroic rocks and/or basalts with gabbroic xenoliths indicating that samples of plutonic rocks are frequently exposed along the walls of this fault. Some of the xenoliths in these samples indicate that the rocks have been subjected to high temperature deformation and metamorphism prior to their inclusion in the basalt. One of the gabbroic samples from this fault shows cumulate layering. Much of the recent deformation along the A-B fault appears to be concentrated near the valley-axis and along the lower walls where recent faults scarps and features with short wavelength relief are present. Scarps along the higher parts of the wall are quite steep (40°-60°) but morphologically much older, more eroded, and incised in comparison.

Dives conducted on the B-C transform primarily recovered basalt samples. Dive 2387 (Figure 2), however, recovered a gabbroic sample from high on the north wall along a narrow transform-parallel ridge. The lack of extensive plutonic samples from this transform may reflect its shorter offset length and the less significant relief within the B-C fault. Zones of young strike-slip deformation appear to be more restricted to the north wall of the B-C fault where recent fault scarps and significant fine-scale (5-20 m) relief was encountered. The south wall was characterized by more significant talus cover and more continuous slopes inclined generally toward the transform axis.

Hydrothermal Activity and Deep Sea Biology

Despite the abundance of glassy, young lava flows suggesting recent eruptive activity no active hydrothermal venting or extinct chimney deposits were encountered. Some lavas recovered by the dredge and by ALVIN were stained with yellow to reddish-orange, low-temperature alteration products and in very few cases small veins of pyrite were found in dredged lava samples.

A low concentration of Galatheid crabs wwas sometimes observed near areas of fresh lava and deep sea shrimp were also in evidence. Otherwise the usual cast of deep sea benthic characters was present (e.g. brittle stars, holothurians, and gorgonians [especially in shallow areas and along steep cliffs where current activity may be more pronounced]. Water clarity at the bottom-water interface was very clear due to the scarcity of particulate matter.

It is unrealistic to assume that because we did not see any hydrothermal activity that none exists. Rather we interpret the paucity of hydrothermal evidence to reflect the general lack of sustained magmatic activity (similar to that seen on the adjacent EPR crest) that could supply the heat energy needed to drive a hydrothermal system within the Siqueiros transform domain.

SEABEAM DATA

Acquistion, General Operations and Shipboard Analysis

In order to map as much area as possible within the transform domain as well as add to the prior SeaBeam and Sea MARC II survey data along the southern EPR, 11 SeaBeam surveys were conducted during the course of the cruise. The total amount of survey time equaled approximately 8.5 days; an additional 5 days of transit data were collected from Acapulco, Mexico to the field area and from there to San

Diego. All data were collected outside the 200 n.m. territorial limit of Mexico.

Navigation merged with the SeaBeam data consisted of undithered GPS data from the Magnavox 1107 reciever. Navigation data are of excellent quality, however a consistent 90 m offset in the direction of ship movement was observed and attributed to time-stamping of the data which is done during the return of the signal. This error was corrected using the URI NAVOFFSET program which applies a constant shift to the data. Corrected data produced negligible crossover errors which were usually less than 50 m horizontal. Reproducibility of absolute depth contour data during different tracks at different angles to the seafloor terrain was also found to be excellent. Additional information concerning SeaBeam operations may be found in the SeaBeam summary report for this cruise compiled by E. Halter and J. Miller of URI.

SeaBeam mapping of each intra-transform spreading center in Siqueiros was carried out prior to diving on each axis. We mapped a 6000 km2, nearly rectangular area over the Siqueiros transform domain covering all the intra-transform spreading centers and adjacent EPR axes. The coverage is nearly 100% with only small, narrow gaps in the shallowest regions of the survey area. In addition, we have collected tie lines oriented parallel to each of the four spreading center axes.

While the previously collected Sea MARC II data allowed us to map Siqueiros at a 50 m (working-scale) contour interval, the newly collected SeaBeam survey data permits us to distinguish small-scale (10-50 m) morphological features that have important implications for interpreting transform and ridge structures, and the evolution of swaths of seafloor in and around the transform domain. Features such as the small (400-600 m diameter, 80-100 m high) young volcanic cones in the A-B and B-C fault axes had previously been undetected. The recovery of extremely fresh and glassy pillow basalts from these edifices indicates that accretion is taking place within the linking faults in Siqueiros as well as at the intra-transform spreading center axes.

Variable Depths of the Intra-Transform Spreading Centers

Minimum depths for the EPR axes at either end of Siqueiros are 2510 m (northern EPR crest) and 2720 m. (southern EPR crest). Interestingly, the 2510 m minimum depth for the northern EPR crest occurs within 6 km of the western RTI and is as shallow as the ridge crest near 9° 45-50'N where recent volcanic activity has been documented during the Adventure cruise (All-125-24). In contrast, the axes at spreading centers A and B are at 3600 m and 3100 m depth, respectively. Spreading center C and the area around D are shallower than the EPR axes having respective depths of 2400 m and 2100 m. The shoaling of the intra-transform spreading centers from west to east suggests a complex thermal regime and isostatic history for the seafloor within and adjacent to the transform domain.

Symmetry of Morphological Features about the Spreading Centers

Based on the mapping we find a remarkable symmetry of highs and lows on either side of spreading centers B and C, and the area around D, which was hinted at in the Sea MARCII data but is now well-documented. For example, to the south and west of spreading center B there are a series of three arcuate highs the summits of which decrease in depth from 3000 m to 2600 m to 2400 m away from the B axis. These three features have morphological counterparts with similar summit depths located north and east of spreading center B (Figure 2). Transform-parallel ridges that are shallower than 2100 m are adjacent to the outermost arcuate highs bounding B (Figure 2)

There are several aspects of this morphological symmetry that should be emphasized. First, the symmetry extends 30-40 km from spreading center B, 20 km from spreading center C and only 10 km from D. Second, there is a rotation of features within the swaths of symmetry. Shallow features that are located close to intra-transform spreading center B strike parallel to the ridge, while features that are further away become progressively more transform-parallel. At spreading center C and at D the symmetric features nearest to the ridge axes do not attain ridge-parallel orientations; we interpret this as evidence that spreading center B has been active longer than the two spreading centers to the east. Third, despite the correlation of features about the individual intra-transform spreading centers, in general the length of the eastern swaths of symmetric terrain are longer than the lengths of the western swaths of symmetric terrain. This suggests either that seafloor spreading may have been asymmetric at each intra transform spreading center or that volcanic overprinting consistently obscures some of the early-formed terrain that spreads to the east from each axis. Finally, it is important to note that the symmetry of seafloor fabric (i.e. packets of structures that strike at high angles to the transform trend) is only seen on the east side of spreading center A. It is possible that the morphological analogs of the structures observed east of A did exist to the west but have since been either volcanically overprinted by the EPR axis, located to the west of A, or disrupted by pull-apart tectonics associated with the most recent phase of opening at A.

East Pacific Rise Crest

The northern EPR crest has been mapped using SeaBeam by Macdonald et al (1984) with partial coverage in the western Siqueiros RTI. North of the western RTI the ridge crest has a triangular cross-section and a minimum depth of 2510 m. That crestal depth is about 200 m shallower than the minimum depth of the southern EPR (minimum depth mapped is 2720 m). Further mapping of the northern EPR-Siqueiros RTI shows that the ridge crest in the RTI is characterized by a wide (2-3.5 km) crestal area, dotted with small closed-contour peaks and cones, and that it bends eastward into the transform domain, gradually tapering into a narrow, low ridge that intersects the western tip of the A-B fault. The terrain at the EPR- A/B fault intersection was traversed during dive 2390, where steep-sided, well-formed, pillow-wall ridges and haystacks were observed to dominate the constructional volcanic terrain. The lava flows appear older to the north (heavier sediment cover and Mn coating) and somewhat younger (glassier pillow rinds) proximal to the south wall of the A-B fault. At the end of the dive the terrain was found to be dissected by transform sub-parallel (SW-NE) scarps that cut through the volcanic terrain as well as similarly oriented constructional flow fronts with steep (60°) faces composed of intact tubes and pillows.

With the additional survey time we were able to map a large area across the southern EPR crest out to 44 km on either side of the axis (equivalent to an age of ~700,000 years at 12 cm/yr, full-rate). Those data indicate that the southern EPR crest is triangular in cross-section and narrows from a 600 m wide axial block to a 200 m wide low ridge at approximately 3-4 km from where the ridge tip curves dramatically to the west and trends 270-275° into the eastern transform domain. Just prior to curving into the RTI the ridge axis bifurcates into a short (2.5 km long) double crested peak which is flanked to the east by three small cones (50-110 m high, 200-600 m diameter). The RTI hole which flanks the ridge tip is actually a double basin with two closed contour lows at 3970 and 3530 m depth, with the deeper basin being the farther west.

Wavelengths of EPR Parallel Features

The distance between morphological highs adjacent to the EPR axes is, on average, ~1.5 km. In contrast, the spacing of features bounding the intra-transform spreading centers is less than 1.0 km, especially where the intra-transform axes are believed to be better developed (e.g., at spreading center B). Continued analysis of the SeaBeam, Sea MARC II and geochemical data will permit us to better understand whether this difference results from a fundamental change in the crustal structure at the intra-transform spreading centers versus that at the EPR axis, or whether the frequency and/or nature of volcanism within Siqueiros differs from magmatic and volcanic processes at the rise axis.

DREDGING AND ROCK CORING

A total of 39 dredges and 5 rock cores were completed during the cruise (Figure 2 and Annex 2). Rock coring in the transform domain was limited because sediment and Mn cover on the rocks in older terrains made recovery of glass difficult. Rock cores 40, 41 and 42 were taken on the axis of the southern EPR just south of and within the RTI (Figure 2). We did not get recovery in 6 of the dredges in the older areas because thick sediment coupled with Mn pavement made it difficult for the dredge to dig in. The poor performance of the pingers onboard forced us to use a scope of wire between 300-400 m (greater than bottom depth) to insure that the dredge would be on the bottom. We also put a cylindrical, lead depressor weight 100 m up the wire from the dredge mouth. S.I.O.-type dredges (loaned to us from the Scripps Marine Tech. Group) were used and consisted of a 50 cm x 1 m mouth frame, 2 m chain bag with fishnet liner, and chain harness, with a 15,000 lb weaklink system.

The attempt to recover rocks from fault scarps and abyssal hills on the flanks of the intra-transform spreading centers, meant that at times we were dredging constructional slopes with little vertical relief. In addition the generally westerly current-set meant that we were principally restricted to dredging west- and north facing slopes, although other dredge traverses were tried with varying success.

Most of the dredges recovered a substantial amount of what appeared to be talus but also a few larger fragments of basalt that had obviously been broken off of outcrops. Younger areas provided better targets for obtaining *in situ* samples. In most dredge hauls, the samples were relatively homogeneous populations and we separated them into petrographically different rock types, based on hand specimen description, for later chemical analysis. Most of the rocks recovered within the transform domain were fine-grained plagioclase ± olivine phyric basalts that appear to have been parts of pillows. Many of these samples have a greater degree of vesicularity than typical EPR basalts; in a few samples vesicles make up to 5% by volume of the lavas and in some cases are present as prominent pipe vesicles.

In a general way, we have been able to estimate the age of ridge-parallel features using the amount of sediment and Mn-coating on samples and the extents to which the lavas have been weathered. There is a clear progression in the "relative age" of the basalts away from the central axes of spreading centers A, B, and C. A dredge up the southern wall of the A-B transform (RD 20, Fig 2) recovered a variety of fresh, glassy picritic basalts; many containing greater than 10 vol% olivine phenocrysts with spinel and melt(?) inclusions. These pillow basalts are remarkably fresh and many have thick glass selvages. As a result of that dredge, another 4 dredges in the same general area were carried out. They were taken in the deep areas of the A-B fault, on small, closed-contour peaks (up to 100m high) and saddles in the axis of the trough. These dredges recovered remarkably young-looking volcanic glasses having a spectrum of compositions from picritic-basalt through olivine basalt to olivine plagioclase basalt.

The primitive nature of the samples is quite distinct from other samples recovered during the cruise and clearly different from volcanics recovered at the EPR. The position of the dredges and the nature of the volcanics are consistent with recent volcanism within the A/B and B/C faults in the transform domain. We believe we have discovered a petrogenetically important group of lavas that may have profound implications for the nature of primitive melts ascending from the mantle. We also have unequivocally documented a transform fault that has leaked within the very recent past based upon the freshness of the lavas. The eruption of these lavas at 3800 m depth is also likely to be the deepest know recently erupted lavas from a plate boundary. The dredge data, and the important implications that this suite of rocks has for MOR magmagenesis and mantle petrochemistry resulted in our decision to locate dive 2384 in the axis of the A-B fault trough. At this dive location additional samples of the picritic and plagioclase phyric lavas were recovered and we substantiated the youthfulness of the volcanic terrain.

SAMPLE PREPARATION

A great deal of time and effort was expended during the cruise in preparing glass and whole-rock samples for land-based analyses. All individual Alvin samples were petrographically described and cataloged (see Annex 2). Representative dredge samples were selected after inspection of all of the rocks recovered and these were slabbed with a rock saw for thin-section chips and in order to remove surface alteration . On all samples with glass rinds or crusts, the glass was separated and picked for further cleaning. The glass (and whole-rocks when no glass was present) was crushed in a hardened steel mortar and then sequentially cleaned in acetone, 2N HCl, and distilled water in a heated ultrasonic bath. After chemical treatment, each sample was inspected under a binocular microscope, "dirty" fragments were discarded and a decision was made whether or not a sample should be cleaned again before being powdered. Generally, most samples were free of alteration and weathering after picking and two cleanings but heavily Mn-encrusted glasses were difficult to completely clean. These were futher processed but labeled as "dirty" samples.

After cleaning, 7-10 grams of glass or rock chips were ground to fine powder in either Alumina-Ceramic or Agate vials in a SPEX shaker mill. The remainder of the clean sample was saved for a variety of other analyses that require high purity natural glass fragments. Over 150 samples were processed at sea and are currently being analyzed by electron microprobe , XRF and ICP for major and trace elements.

DIVE SUMMARIES

Dive 2375

We looked at narrow ridge to the west of the inferred B axis to determine the relative age of lavas with respect to B axis. The lavas are heavily Mn coated and definitely older than samples recovered from B axis on subsequent dives (2376-2377). The seafloor is primarily pillowed constructional terrain and lavas are generally phyric with small laths/microphenocrysts of plagioclase. Definite N-S trending tectonic scarps (east facing) are present along the southern end of the ridge on east flank creating a very rubbly/tectonized area at southermost extension of this off-axis ridge

Dive 2376

This dive looked at the ridge axis of B from approximately the mid-point down to the southern end. The terrain is dominanted by large, well-developed pillows forming a young constructional terrain. There is a fresh appearance to lavas. Tectonic fissures several meters wide are common in the south. Basalt lavas range from aphyric to plag/olivine phyric. Some are strongly plag. phyric with large plag. phenocrysts. Flow forms along the ridge are fresh looking with good crusts but lavas sampled on the east flank in the southern portion of the ridge are the freshest. These are present either as lobate flows or pillowed flows.The terrain is definitely younger than that traversed on dive 2375.

Dive 2377

We investigated the spreading center B ridge axis on this dive from the ridge-transform intersection (RTI) hole at the north end of B down to the mid-point of the ridge, ending at the small cone that lies just east of the main B ridge. Terrain in the hole is fresh constructional terrain with 5-10 m relief made up of small pillow mounds and haystacks. There is a dusting of sediment on the forms but samples show abundant glass. No tectonic features were observed in hole, either transform or ridge parallel. The south slope of hole going up to ridge axis of B is a series of constructional escarpments forming 40-50° slopes with very little talus and almost no sediment in the interstices between lava forms. The lavas that form this slope are plag. phyric, somewhat vesicular (5%), and generally fine-grained.

The terrain along the B axis, noted while traversing from peak to peak along B, is dominantly pillows ranging in size from 0.5-1.5 meters. It is largely a young constructional terrain comprised of 350 deg trending pillow ridges. Some ridge parallel fissures (0.5-2 m wide) are present and cut through the terrain but one fissure seems to have uncut buds sticking out into the fissure; this may be the trace of an eruptive fissure. As young as the terrain looks on the northern portion of the ridge (it appears to be younger than the southern portion and the lavas seem fresher- they have more glass and are better preserved), the small cone just east of the axis has the youngest looking, and freshest lavas anywhere on B. The flows are largely budded pillows and larger bolster-shaped forms with small tubes snaking in between. These features form a purely constructional slope of 30-40 degrees that continues up to the summit. The lavas from this cone are all heavily plag. phyric (large glomerocrysts) basalts with 10-15% plag and up to 5% vesicles (one clear difference between these lavas and the lavas sampled on the Adventure cruise from the EPR at 9deg 30'-50' N is that these lavas are definitely vesicular, we are unsure if this is because of higher gas content of lavas or greater viscosity, the planned chemical analyses should answer this question).

Dive 2378

We investigated the southwestern crescent-shaped peak of spreading center C on this dive, starting from the SE slope of the ridge and traversing up the ridge to the crest and then down to the NE ending up in the narrow, sigmoid-shaped trough that runs between the two crescent peaks. The slope of the peak is mainly comprised of pillow talus that seems relatively old and has moderate amounts of sediment cover, Mn-coating and only small amounts of fresh glass. The top of the peak is made of mostly intact pillows but with some talus present. The crest of the peak also appears to be an older area with pillows generally <1 m in diameter. Some of the flatter areas or saddles on the crest had more lobate or jumbled sheet flows with noticeably more sediment cover presumably due to the flatter relief. Samples from these largely constructional areas confirm that lavas are older and more weathered than the youngest rocks we have recovered from spreading center B.

The end of the dive proceeded on a northeastward traverse along east side of the peak, north of the summit, and found a series of large east-and-west facing scarps that drop down to the east (relief of 10-15 m on each scarp except for one with 37m of relief), ending in a narrow (100 m wide) scarp-bounded graben. This low relief area is the trough which separates the two crescent peaks. The floor of graben has ropy to jumbled sheet flows and lobate flows that are much fresher (and younger) in appearance than lavas on ridge. In a few exposures in the walls of the graben a more massive (possibly ponded) sheet flow underlies the ropy sheets. The graben trends 330-350 deg ., with well-defined gja fissures (1-2 m across and 2-3 m deep) cutting the lavas in the floor of the graben. Samples recovered from the floor have abundant glass with only a thin Mn coating and confirm the younger nature of these lavas compared to those recovered from the SW peak. Most of the lavas from this dive are fine-grained and either sparsely phyric or aphyric. Based on our observations on this dive it appears that the most recent volcanic and tectonic activity in C has taken place in the graben between the cresent-shaped peaks that form the shallow relief at this intra-transform spreading center.

Dive 2379

This dive traversed the north wall of the A-B strike-slip fault about 9 km west of the northern B axis RTI. The dive was somewhat shortened due to the penetrator repair on Alvin the previous day and the long descent time to reach 3800 meters which was the starting depth. The floor of trough is sediment covered with no structures. Talus starts at about the 3650 m contour level and then the slope continues up in a series of 080 deg trending vertical to near-vertical fault faces with talus benches separating the vertical sections. The benches are very steep talus slopes (40-60 deg.). Only two samples were recovered as the hydraulic lines to the manipulators ruptured, thereby preventing sampling. The recovered samples are from talus at base of the slope between 3650-3550 m. They are intrusive rocks (diabase to micro-gabbro). We confirmed that intrusive rocks are the major rock types along the north wall of this section of the A-B strike slip fault with dredge A25-17D which sampled up the dive traverse and recovered a wide range of plutonic rocks.

Dive 2380 · end spec crafts

This dive traversed the trough east of the B ridge axis, from the RTI hole at the south end of B to approximately the mid-point of the ridge, to look for transform parallel structures in the RTI and to see whether the small constructional ridges in the trough are older or younger than the B axis terrain. The dive started in the center of the RTI hole in the eastern closed contour low. We traversed up to the south to see whether transform parallel structures exist and found 070-080 trending ridges in a steep 60 deg talus slope with occasional outcrops. The percentage of talus is about 98%. Only the tops of the fault scarps are exposed along narrow ridges in the talus. The ridges have well-defined backslopes that have 2-3 m of relief and are separated from the southern continuation of the slope by 10-20 m horizontal distance separating the crest in the talus from the slope. As we proceeded south, the next talus ramp would start and the sequence would continue. We presume that the faults are active otherwise we would not see the small backslopes as the rate of mass wasting appears to be high and would quickly cover up the trace of the fault. Rocks from this slope are fine grained, aphanitic to sparsely phyric (plag. and minor olivine) basalts.

We then traversed over to the western margin of the RTI hole and traveled up slope heading 045. Here we crossed over a series of constructional volcanic slopes cut by N-S trending fissures and cracks. The low ridges in the trough are characterized by older constructional pillow lava slopes. Although the forms are well preserved they do not appear very glassy. The samples confirm that while there is some glass on these lavas it has largely been spalled- off and weathered. After completing the traverse up the ridge within the trough and sampling the small peaks, we decided that the terrain was much older than what we had observed on the crest of B and especially on the small cone to the east of B axis. As we were at the same latitude as the cone we decided to head 270 deg. and go to the base of the cone and traverse up it to again confirm its relative age compared to the terrain in the trough. We landed at the base of the cone and found the terrain to be very young pillow- and tube-fed flows; some with buds clearly younger than any flow we had seen in the trough. There were also some more lobate lava flows as we continued up the slope. These flows appear to form on the small benches in the slope and may be more related to slope angle than to differences in lava type, but we sampled both to be sure. The samples collected on this dive from the cone are equivalent to those sampled from the NE side of the cone during dive 2377 and are plag. phyric with many buds and pristine glassy surfaces.

Dive 2381

This dive was located on the south wall of the transform connecting spreading centers B and C. The purpose of the dive was to document rock types exposed along the transform wall and to identify the PTDZ and associated strike-slip structures. The dive started in the axis of the transform valley at a depth of 3380m and extended up the southwall to a depth of 2570m. In the transform valley axis and on the lower part of the south wall large blocks, boulders, and cobbles of basalt pillow fragments and more massive blocks that may be diabasic were observed. Nearly continuous talus fields were found on steep slopes all the way to the middle of the wall where the first outcrops of pillow basalt were encountered along a degraded and older scarp. The talus on the slopes below was continuous and young as the interstitial areas between blocks lacked sediment ponds and there was only a thin dusting of pelagic sediment over the blocks and talus. At higher elevations on the scarp, few basaltic outcrops were encountered and more, young talus-covered slopes were found. As found along the lower part of the wall, the higher elevations are not characterized by extensive areas of smooth pelagic cover and the steep slopes are covered with talus blocks of basalt dusted with pelagic sediment. This terrain continues until the uppermost part of the wall (~2500m) where another extensive scarp of pillow lava is exposed. This scarp is also highly degraded by mass wasting and incised by erosional channels or chutes that cut through the outcrop, along which both fine and course talus was passing downslope.

At the top of the slope where relief is lower, more continuous pelagic sediment cover was encountered and only small islands of basaltic pillow outcrop are present. There is a distinct absence of fresh tectonic scarps in the axis of the transform valley and along the southern wall. This suggests that at the present time much of the strike-slip deformation may be taken up on the northern wall of the transform or on the northern boundary of the transform's bathymetric axis. This is very different from the situation on the northern wall dive (2379) on the A-B transform, where fresh tectonic scarps were encountered continuously throughout the dive. 15 samples were collected on the dive and all appeared to be basaltic or diabasic. They are older and somewhat weathered when compared to fresh material sampled at spreading center B. No plutonic rocks were sampled in contrast to Dive 2379 on the A-B transform where deep-crustal level rocks were collected.

DIVE 2382

This dive traversed the area south and west of spreading center "B" starting in the deep section just west of the dive 2375 track. The traverse started up a north facing wall to a high on the border of the spreading terrain and then south onto the plateau which is dotted with small seamounts. After traversing the boundary zone at the edge of the transform extension we headed south towards a group of seamounts that we had attempted to dredge during the previous nights (dredge recovered mostly Mn crusts and very small fragment of weathered pillow rind). The transform/plateau boundary is characterized by very fractured, faulted and steep talus covered walls that have dips from 15 to 90 deg but mostly in the 35 to 65 deg range. These walls were largely mass wasted with a modest amount of sediment cover; individual pillow fragments did not have much sediment. Near the top of each "step" there are exposures of fractured pillows and more massive and thicker (>1m) lobate or sheet flows with well developed columnar jointing. Over each major step in the wall (there are at least 5) there is a small bench (back-tilted block?) that is partially filled with talus and sediment. These appear to be inward facing scarps with only a few meters relief. At the very top of the wall there are some volcanic constructional features but most of the morphology seems more related to tectonism than volcanism. Pillows are truncated along the north-facing slope. All of the basalts are petrographically similar; slightly vesicular, aphyric, holocrystalline with thin glassy top surfaces coated with a thin Mn- crust. They are slightly weathered.

To the south, there is little evidence of tectonism aside from a few EPR parallel faults/ low ridges that are expressed in the sediment as offsets in basalt rubble. The morphology is flat to rolling and only a few pillow tops are exposed through the thick sedimentary cover. The sediments here appear to be much thicker and more pelagic and bioturbated; noticeably lacking the darker areas of volcanic debris that characterize the sediment in the transform/spreading center areas. In addition, the Mn-coatings on rock surfaces are thicker in this southern area.

The seamount flanks rise quite abruptly and the slopes are primarily covered with sediment and basalt talus. This talus is covered with more sediment than the talus on the wall of the transform area to the north. The thick sedimentary cover continues to the top of the seamount. The sediment is very bioturbated and there is a significant amount of life in/on it. The basalts have a very thick Mn-crust (~1cm) which has a botrioidal texture. The basalts are vesicular with plagioclase + clinopyroxene phenocrysts and rare olivine; similar to alkali olivine basalts from eastern Pacific seamounts. In general the two small seamounts investigated during this dive appear to be more related to EPR or off-ridge processes and crust than to anything happening in the transform domain. The transition from the tectonized region along the south wall of the transform to the clearly older and less fractured area to the south is striking.

Dive 2383

This dive traversed the terrain on the western margin of the RTI hole to the south and up along the ridge crest in the southern portion of spreading center A. The western margin of the RTI hole is a steep 40-50 deg talus slope with only a dusting of sediment. Well-formed, budded pillow flows form the steep eastern slope. In addition, the top of the ridge is largely unfissured in the south and heavily fissured in the mid-north portion. Large 2-3 m wide gja fissures are present on top in the mid-north portion. The last part of the dive traversed the seafloor to the east of the ridge to investigate the "nose" feature that protrudes into the pull-apart basin from the eastern margin wall. This feature is definitely older. The slope is all talus with abundant sediment cover and with only very occasional outcrops of older, Mn-coated pillows. At the summit there are ponds of sediment that have nearly covered the few outcrops of pillows. A pillow bud recovered from the top is heavily Mn coated, again attesting to the relative older age of this feature.

The samples from the RTI and main ridge.consist of very fresh pillow buds and fragments with thick glassy crusts which are slightly vesicular and plagioclase phyric. Samples from the eastern margin are slightly weathered with thin to moderate Mn coatings and contain.scarce plag microphenocrysts.The freshness of the basalts from top of the ridge also confirmed that the southern A ridge is a young constructional volcanic feature and a recently active spreading locus within Siqueiros.

Dive 2384

This dive was carried out in order to investigate a deep section of the A-B transform where we recovered very mafic and fresh lavas (including picrites) by dredging, and to document more fully the tectonic and age relationships of these fresh-looking basaltic rocks. The dive began along the axis of the transform in a roughly circular depression at a maximum depth of 3850 m. Unlike most axial deeps along transform axes, this depression is devoid of pelagic sediment and only fresh glassy pillow lavas and some fresh basalt talus are exposed. There is virtually no sediment cover on the basalts and they appear to be remarkably young. There is no evidence of cross-cutting faults in the transform axis where these fresh basalts are exposed. All structures are volcanic and constructional in origin. These facts suggest that the basalts here are very young and have not yet been exposed to strike-slip tectonics. Recovered samples are similar to primitive olivine phyric glassy basalts collected in the dredge hauls. The dive continued up the south wall of the transform where a steep flow front with fresh glassy basalt talus at the base is present at 3830m. The top of this feature is a roughly flat circular plateau less than 200 meters across (i.e., haystack structure) with steep (up to 70°) slopes on all sides. Elongate pillows characterize the steep flow fronts and bulbous and collapsed pillows dominate the top of the haystack. Prominant white to yellow staining that may be of hydrothermal origin is present along fractures in the basalts. Highly olivine phyric basalts with thick glass rinds were also sampled here.

At a depth of ~3730 m on the south wall, an older terrain was encountered which consists of alternating areas of smooth pelagic muddy bottom and slopes with talus blocks with a thick partial cover of pelagic sediment and sediment ponding between blocks. Degraded or active strike-slip fault scarps are also exposed in this terrain and indicate prolonged and recent tectonic activity. The transect turned westward within this older highly sedimented terrain along the wall parallel to the transform and then north to cross the transform axis in a different area. The transform was crossed at a saddle point (~3615 m) between two adjacent lows and was within the older highly sedimented terrain. This area is characterized by steep and very fresh strike-slip tectonic scarps, one uplifting older partially consolidated pebbly sediments (5 meters of vertical offset). All samples collected from talus in this older terrain are heavily manganese encrusted and the basalts are plagioclase + olivine phyric lavas, more typical of the surrounding ridge terrain.

The dive transect continued up the north wall of the transform and a sharp flow-front boundary was crossed at a depth of ~ 3650 m where young lavas with only a thin dusting of pelagic sediments (or none at all) were again encountered. There is no evidence of recent strike-slip faulting crosscutting this very young volcanic constructional terrain. Within this flow area there are a number of haystack-type volcanic constructional features up to 10 m high, superimposed on a platform of young glassy pillow lavas. These features are randomly distributed and characterized by the same steep slopes and flat tops as previously recognized in the first volcanic edifice we traversed. Three of these roughly circular features were investigated and all are comprised of glassy olivine phyric basalts and picritic basalts similar to those recovered in the nearby dredge hauls. These haystacks are apparently roughly circular point sources (possibly primary conduits) of recent volcanics erupted on the lower walls and floor of the transform valley. At shallower depths (~3570m) on the north wall, older, highly sedimented terrain was again encountered and basaltic samples collected there are plagioclase phyric and heavily manganese encrusted.

The dive demonstrates that the concept of a leaky transform origin for these young primitive basalts is very likely as they appear to be significantly younger than basalts identified on both the north and south walls of the transform, are virtually sediment free, and are not cut by very young strike-slip scarps identified along strike within the older terrain. The volcanics are thus post-kinematic with respect to the youngest tectonic activity along the transform and this constrains the eruptive position to be within the transform at a significant distance from either RTI. Because it is unlikely that large magma chambers exist in this relatively cold environment, the timing of eruptive sequences here also suggests that it is possible that the picritic liquid may be little modified by magma chamber processes before eruption. It may represent more closely the parental melts being tapped from the mantle in ridge environments prior to their modification by crustal mixing and fractionation processes. Thus the dredge and ALVIN collections from this area represent a very important suite of samples in terms of deciphering the petrogenesis of MORB in general.

Dive 2385

On this dive we continued our exploration of the graben at spreading center C (see Dive 2378). The dive started in the western extension of the B-C transform where it intersects the northernmost extension of the graben. The RTI is characterized by constructional pillows that have flowed down slope into the depression. The pillows have remarkably little sediment cover and ponding of sediment between pillows is minimal. Some small fractures heading ~ 200 -240°and another set at ~ 120° cut this terrain. The lavas did not appear particularly glassy and this was substantiated with the recovered sample which is extremely plagioclase porphrytic with only thin glassy margins. This rock type has only been recovered in two other dredges during this leg proximal to the eastern end of the B-C fault, and is quite unusual relative to typical EPR basalts.

Traversing upslope out of the RTI to the southeast, we started to encounter areas of sheet flows bounded by steep pillowed walls that trend subparallel to the graben (120-150°). Continuing in a eastward direction we began to intersect steeply dipping walls of rubble and pillows (some lobate). These slopes face WSW (strike ~155-175°) and are arranged in a step-like fashion with relatively narrow (8-25 m) benches at the top of each wall (~10-30 m high). Most of the steps are backfaulted at low angles with narrow troughs at the base of the next slope. In at least one case, there is a small rift between two of the walls. In a few places there appears to be younger pillow mounds/flows coming down slope. We followed one of these flows upslope but it terminates at a fault that bounded the steep slope it flowed on. Lobate pillows dominate the upper parts of the NE high. The series of 3-5 steps/walls that we traversed were clearly delineated by the CTFM sonar as we headed back to the graben to the SW. The NE-facing walls on the other side of the graben were also imaged as a series of en echelon NW-SE trending reflectors on the CTFM.

On the floor of the graben we again found a variety of sheet flows (ropy,jumbled,hackly,flat), the most massive of which seemed to form the floor. A small constructional pillow mound (haystack?) exists in one area The walls of the graben are characterized by slopes of rubble that overly the sheets,but in one place some relatively young looking pillows descend the slope onto the floor and are possible indicators of fault-related volcanism. The trough is fairly narrow (40-60 m wide) at the northern and southern ends and widens to ~150 m in the central part. Prominent fissures or gjas following a SSE(~165°-175°) trend cut through the sheets; most are 1-3 m wide and a few meters deep and filled with talus. Individual fissures may be as long as 100m but many are much shorter and step southwestward in an en echelon fashion. Near the southern end of the central trough we flew west and encountered steep talus covered walls (trending ~150-170°) that stepped up the hill in a manner similar to that noted on our earlier dive (2378) to the north, along the NW slope across the trough. Another constructional pillow mound exists along one of the steps on this NE-facing slope. There is a massive sheet flow in the graben as it narrows to the south. Here the fissure gets quite irregular and deep (5-6 m) exposing 3-5 m of the massive sheet flow. Low power and a ground prevented us from continuing our dive at this point.

Dive 2386

This dive traversed the northern portion of the trough which separates the two shallow peaks which were inferred to be the nascent spreading axis at spreading center D. Based on the similar morphology to spreading center C and the presence of the youngest volcanics at C in the central graben between the two crescent peaks we decided to concentrate our traverse in the trough. The dive traversed the northern trough from the RTI to the midpoint, finding only old pillow and lobate lava terrain with considerable sediment and a marked lack of glassy crusts. The only young-looking flow was a very small hackly lava flow of restricted areal extent (<500 m2) which was, on sampling, determined to be glassy, but nonetheless covered with a heavy Mn coating. The dive concluded with a traverse up the southwest facing slop of the NE peak at D and found only old outcrops of pillow and lobate lava on a mostly talus covered slope. The slope of the peak is heavily tectonized by 130-140 trending faults that cut through the talus forming razorback ridges in the talus with backslopes facing to the NE. The relief of the backslopes varies from 2-3 m to 20 m for one scarp, with the distance on between the razorback crest and the next slope up being on the order of 20-50 m. The summit of the peak is completely covered by 0.25-0.5 m sized, angular basaltic talus, no outcrops are present.

We therefore consider that while D has had volcanic activity this area of D has not been recently active, despite its extremely shallow depth (2000-2100 m) when compared to the axes of: A (3600-3700 m); B (2900 m); or C (2200-2300). It is likely that spreading center D is now experiencing a tectonic phase, possibly associated with the propagation of the C-D fault through D in an attempt to connect to the southern EPR axis along a trend that is closer to the 080 deg azimuth of the other strike-slip faults. In light of the relatively fresh, glassy lava recovered in D44 in the trough north of the northern peak investigated during this dive we suspect that a younger volcanic zone may lie north of this peak.

DIVE 2387

This was a PIT dive that traversed and climbed the inner deep and north wall of the eastern section of the B-C transform fault in an area where we see two small, closed-contour highs built against the north wall just above the axis of the trough. The dive started in the deep hole between the north and south walls and headed east, upslope toward a relatively high area that protruded into the transform. This feature is similar to those we dredged and dived on in the A-B transform where young mafic lavas were recovered. This dive was largely to see if the small cones and protrusions that exist deep along the N wall are recent volcanic constructs.

The deepest part of the transform was sediment filled but upslope became covered with heterogeneous mixtures of basalt talus and pelagic sediment. The western cone (it is really more like a delta) is definitely a volcanic construct although somewhat old in appearance and the lavas, while still glassy, are Mn covered. The north slope of the trough was traversed between the two cones and was found to be largely covered by talus with variable sediment cover. In some places along steep walls, it appeared that shearing and transform parallel faulting had occured within semiconsolidated slope deposits (breccias). Similar features were noted by Casey on earlier transform dives. The more easterly second cone is definitely older and appears constructional near the north wall but is extremely tectonized as you move towards the axis of the trough. It is fairly linear ridge and has more of a N-S linear fabric than cone-shape. The north slope of the trough was traversed up to the top of the valley at 2900 m and is largely talus covered with some large blocks near the base of the slope (possible intrusive rocks) and considerable sediment cover. The south-facing walls are steep and have shallow back-faults and benches toward the top. The top of the ridge is characterized by extensive sediment cover and only a few exposures of slabby-looking basalt.

The samples from the volcanic features in the trough are plag. rich lavas (similar in general to some of the other plag rich lavas from the spreading centers and the cones in the A-B fault). Samples from the walls of the transform (mostly talus but possibly some exposed outcrop) are fine-grained pillow basalts. The slabby rock collected from the 2900 m peak on the north wall is an olivine micro-gabbro.

The dive results provide further evidence for volcanic construction within the deep axes of the strike-slip faults in Siqueiros. It is interesting to note that the lavas here are definitely older than those recovered from the cones in the middle of the A-B fault. Also interesting is the fact that plag rich lavas have now been recovered in varying quantities from the axis at A, B and C and in the A-B and B-C fault. The magmatic and petrologic significance of this lava type and the microgabbro are likely to be important to our understanding of the evolution of Siqueiros.

Dive 2388

One purpose of this dive was to examine a small circular cone-shaped feature on the south wall of the A-B Transform to determine if it was a young volcano akin to the young volcanics along the transform axis located on dive 2384. The second purpose was to conduct a traverse and sample along the north wall of the transform The dive began at the cone-shaped feature on the south wall and it became clear the feature was old as it was partially covered with pelagic sediment and composed of massive and orthogonally-jointed outcrop that looked plutonic in character. A sample of medium-grained gabbro was taken from the top of the feature. Another sample from the south wall consisted of medium-grained and weathered plagioclase-phyric basalt.

The dive transect then proceeded to the axis of the transform at a depth of 3910 m where two blocks of plagioclase phyric basalt were sampled both from talus along a highly sedimented valley floor and the lowest part of the north wall. The valley floor and north wall were characterized by a series of transform-parallel ridges several meters high thate were covered with talus and pelagic sediment and troughs with extensive pelagic sediment fill. The lower part of the north wall consisted of a series of step-like scarps (50° to 90° slopes) with massive outcrop of basalts, gabbro, and cataclastic breccias) and terraces (15° to 40°) with slopes covered with talus and pelagic sediment. In general slopes steepened near the top of the wall and more massive outcrop of pillow basalt and microgabbro was encountered. Gabbros and micrograbbros were collected both high (3008 m) and low (3608m) on the north wall and alternated with plagioclase-phyric to aphyric basaltic outcrop suggesting fault bounded contacts between plutonic and basaltic rocks exist at all levels on the wall. There were abundant transform-parallel scarps along the wall. The lowest scarps appeared fresh with smooth planar faces that were not incised significantly and were probably due to recent faulting. Scarps often exposed what appeared to be fault gouge and cataclasites. A fault-related rather than sedimentary origin for the recovered breccias is tenatively inferred because the matrix of these poorly consolidated breccias is devoid of pelagic carbonate-rich material, and is more likely to consist of rock flour created by cataclasis along faults. Further detailed SEM, XRD and petrographic work is required to verify this. In the upper portion of the wall, steep scarps tended to be deeply incised by talus-laden gullies and channels that degraded scarps at frequent intervals along strike. These features were often steep-sided, up to several tens of meters wide and several meters deep.

The overall conclusions from the dive were that 1) there is no young volcanism attributable to leaky transform phenomenon in the areas traversed, 2) conical morphologies along the transform axis cannot necessarily be attributed to young volcanism, 3) medium-grained gabbroic rocks can be sampled along both on the south and north walls of the transform and appear to outcrop between basalt exposures along the walls suggesting exposure due to extensive faulting along the walls, 4) plutonic rocks have now been sampled in two localities along the north wall of transform A-B, 5) fresh tectonic scarps were generally restricted to the lower walls and axis of the transform, 6) steep but highly incised scarps characterize the higher parts of the northern transform wall.

Dive 2389

The NW part of spreading center "A" has a series of NW-SE trending ridges lying between prominent lows. The overall morphologic similarity to the environment of Dive 2383, prompted a visit to this area.

The dive began in a well developed low area to the SE and encountered very fresh pillow lavas at approx. 3750 m. ,based upon the presence of abundant surface glass and light covering of pelagic sediment. Similar lavas covered the northern wall of the depression but it was not determined if these were pillows draped across a pre-existing structure or a true constructional feature. However, the north wall of the depression is formed by a series of ridges trending E-W, as well as NW-SE, suggesting that the constructional features here have been strongly influenced by transform-parallel structures and spreading ridge-parallel structures. Similar fresh pillow lavas were encountered on a traverse to the north, west and north-east and sampled at 5 sample stations. To the north and west of the depression the pillows occur as a series of hummocky, lozange-shaped constructional mounds up to 60 m high arranged in linear NW-SE sets. The lavas are characteristically feldspar-phyric with very large feldspars being visible on fresh surfaces from the Alvin. A white alteration product also coats fracture surfaces when exposed on talus slopes.

Further traverses to the NE, to the top of a prominent NE-SW ridge, northwestward to another ridge, and then on a more northerly course toward the northern wall of the transform revealed more NW trending constructional pillow mounds. These mounds lacked lustrous surface glass, pillow buds were less common, sediment cover was thicker, and talus more abundant. We consider this terrain to be older than that to the south.

At the northernmost extremity of the traverse, continuous ridges with a pronounced E-W elongation were observed on the CTFM implying the influence of the northern transform on the topography. The transform wall was not reached during the dive.

Dive 2390

This dive was planned to examine the western RTI where the eastward curving portion of the western EPR appears to intersect the western extension of the A-B transform. At this point the transform is expressed as a steep northward-facing ridge that terminates at the juncture with a small closed contour high that appears to be either the southernmost extension of the EPR (propagating tip?) or another transform-related volcanic construct.

The dive began in a deep (3100 m) slightly east of the high and to the north of the transform wall. The slopes of the hole consist of constructional pillow lavas and tubes that are elongate in a down-slope direction. They are covered with a moderate amount of sediment and MnO and have a significant amount of sediment accumulated in the interstices between pillows; however, they have very well defined structures and show no expression of fracturing or faulting. This constructional terrain continues on to the flanks of the high to the SW where some haystack cones and fields of lobate flows exist. In one locale, the lobate flows and tubes are in contact with and overlain by a contorted and folded sheet flow. The sheetflow seem to merge with more lobates toward the transform wall and are covered by sediment and talus at the boundary of the wall and the small volcanic high. Climbing up (20-30°) along the wall we saw nothing but well-sorted talus (mostly cobble-sized fragments of pillows) mixed with pelagic sediment. There were no visible faults or fractures save for the major expression of the north-facing wall itself.

Traversing to the north and west, we continued to see well-formed pillows, lobes, tubes and the occasional or haystack. The moderate sediment cover and Mn coating on the lavas suggests the terrain is relatively "old". Even the deeper areas off the high to the N consist of constructional pillows that are intact and show no evidence of fracturing or faulting. The NNW-trending ridge is also constructional and has more pillow haystacks and lobate flows (often with meter deep collapse) covering the upper portions of numerous small (10-15 m relief) highs The most elevated portions of this ridge towards the NW are markedly different in that they are covered with rubble and talus and even areas with exposed outcrops appear to have been tectonized. The crest of the ridge is a series of knife-edge ridges and shallow sediment-filled valleys that parallel the ridge direction. Further north, the fractured terrain gives way to one of steep SW-facing constructional pillowed walls with slopes up to 60° and fantastic pillow tube forms. In general the lavas appear to be somewhat older than those to the south based on the amounts of sediment cover. Continuing N, the ridge steps down to a well sedimented saddle area and then changes it's trend to NE (30-40°) with SE-facing walls composed of even older-looking basalts that are significantly more fractured but still coherent enough to recognize as constructional flows.

Pillow lavas from the southern portion of the ridge have thick glassy crusts and significant MnO oxide coatings (up to 0.5 cm). These basalts are somewhat vesicular with substantial amounts of plagioclase microphenocrysts in the glass. The pillow basalts to the north have thick (furry, sooty and botryoidal) MnO coatings, are more weathered, less phyric and have thinner glass crusts than the lavas in the south. The southern lavas have the characteristics of some of the transform lavas recovered further to the east but it is difficult to say if they (or the lavas to the north) have more affinities with those in the transform or the EPR at this point. Perhaps the most significant aspects of this dive were the documentation of constuctional volcanism at the RTI and the apparent age progression to the north.

Dive 2391

The purposes of this dive were: 1) to assess whether the presumed aseismic extension of the A-B Transform has in the recent past undergone linking of Spreading Center B directly with the East Pacific Rise when the ridge tip periodically propagated to the south, 2) to examine the rock types and structures exposed within the axis and on the south wall of fracture zone, 3) to evaluate whether a circular peak nested on the south wall near the axis of the fracture zone is a young volcanic feature associated with leaky transform activity, and 4) to determine if the crust in the A swath is characterized by diffuse extension and volcanism or if it is highly organized to the east along an axis of recent volcanism documented on Dive 2383. The dive began in a fossil RTI nodal deep to the west of the present RTI between Spreading Center A and the A-B Transform. The dive then progressed up the south wall with the circular peak as a target along the way. The nodal depression was characterized by a pelagic sediment cover with isolated exposures of pillow basalt and some talus. There was little evidence of recent tectonic activity. There did not appear to be any fresh talus. Blocks to cobble size fragments on slopes have a thick coating of sediment or in some cases are almost completely buried. As we progressed up the south wall there was a considerable amount of talus on the slopes and a series of linear ridges striking 110° with 20 to 50 meter deeps separating them. These may have been old fault bounded ridges, but slopes were covered in talus and pelagic sediment and this was difficult to evaluate. Collections made along these ridges where there was exposure recovered mostly basalt, but also one microgabbro. The microgabbro suggests that uplift of plutonic levels along faults probably occurred in this region of the lower part of the south wall. The circular peak and a ridge extending east from it were composed of infrequent pillow basalt exposures that appeared old on the basis of heavy manganese coatings, as well as almost complete pelagic sediment cover.

The outcrops encountered during this dive do not seem to provide evidence for either a leaky transform volcanic episode or young volcanism in this region. Further up on the south wall, sedimented slopes with small pebble-size fragments predominated the slopes with some isolated areas where larger boulder-sized fragments to large blocks of talus lay upon the sedimented slopes. Some areas of continuous pelagic sediment cover, without talus blocks, were also present. All talus had a thick sediment coating and none of the talus looked young. No young fault scarps were found and little sign of any recent tectonic activity was obvious. Three samples of talus taken from these slopes included two microgabbros and one basalt. This suggests that a significant part of the south wall may be underlain by plutonic levels of the crust exposed during its transit along the A-B Transform. Based on the results presented above, it would appear that there is no evidence of very recent tectonic or volcanic activity in the region of the dive and it is probable that the extension of the A-B Fracture Zone past the A RTI has been aseismic in the recent past and is not now linked to the western EPR segment. It would also suggest that spreading within the A segment is now organized to the east of the dive traverse and not diffuse within the A swath of crust.

Dive 2392

The purpose of this dive was to revisit the axial summit caldera (ASC) on the EPR crest near 9° 50.6'N where an area of recent volcanism and a curious deposit of sulfide sediment were discovered during several dives carried out during the Adventure Program (A-II125-24) . The dive took place 35 days after the last visit to this site (D2372). The digital data collection during the dive was hindered by a major ground in the sub's main power system which required shutdown of all systems in order to trace it. After determining that the ground was related to moisture in the bottom window sensor and powering up the sub., the in-ball data-logging computer would not log altimeter, time, depth and heading data, nor would it display video data . We were finally able to turn the video camera on but without overlays, however, the 35 mm bow camera only operated at a default rate of 8 seconds so it had to be manually turned on and off during the dive. The 35 mm data frame was functional (based on a test strip developed on board) so some data will be recovered post cruise. Navigation for the dive was based on iterative ranging on a transponder placed in the ASC just 80 m south of the marker position at the BBQ Pit (GPS surveyed position was 9° 50.559'N; 104° 17.541'W; depth= 2495.2 m with a tether of 25 m). At one point during the dive we encountered the tether wire along a pillar and verified the xponder position with respect to the ASC walls (it was in the middle) and the sub. position.

Despite these setbacks were were able to make significant observations regarding the geology and biology around the several areas visited during the dive, to record rudimentary video and 35 mm data to document the traverse, and to collect rock, sediment and biological samples.

We commenced the traverse by landing approximately 150-200 meters outside the eastern wall of the ASC near 9° 50. The bottom approach was made on an extensive sheet flow with prominent striations in the lava surface that trended NW-SE caused by narrow bands (20-40 cm) of ropy/curtain folded lava. The texture is likely to be flow induced and oriented generally parallel to the direction of flow. The flow is glassy beneath a dusting of sediment and abundant brittle stars are present on the surface. We headed west from the landing site and within about 50 meters encountered a flow contact between a younger (little sediment dusting, more obvious glass reflections) lobate lava flow that overlies the sheet flow. Samples were taken from each unit. We then continued east and after traversing about 100 m more we came upon collapse terrain that heralded the approach of the ASC. However, within the collapse area we noted a prominent fissure about 2-7 m wide and 4-5 m deep and an area of approximately 20x30 m where a dense biological community of principally mussels, and lesser amounts of barnacles, serpulids, Galatheid crabs, and mostly dead clams was present. No tube worms were apparent. A 4-5 m high inactive sulfide chimney lies directly in the fissure and a sample of one of the spires was recovered (#3). It is primarily composed of oxidized sulfides and sphalerite but the innermost portions are comprised of pyrite and chalcopyrite. The chimney had a central spire about 0.5 m in diameter with two smaller spires on either flank and a small (1-2 m diameter) mound at the base. This fissure lies approximately 10-20 meters from the eastern rim of the ASC. The depth level of the ASC rim at this latitude is 2514-15 meters.

After descending into the collapse terrain of the ASC we traversed to the west wall and then came back to the approximate middle and traversed to the north to try to find Pat's "Hole to Hell"; a large collapse pit in the ASC that was found on the last leg to be vigorously venting fluids and bacterial mat material, and rimmed by high-temperature black smokers. The central floor of the ASC here is covered by a hackly sheet flow that appears to fracture and drop down into a deep linear collapse pit on the east. We were not able to locate the marker left by Pat Shanks on his last dive due to poor visibility caused by the large volume of cloudy warm water emanating from this hole. We did however, measure a temperature of 343°C at a small, 0.5 m high smoker that lies on fractured basalt on a small peninsula of the western collapse margin of the hole at 2521 m depth. The "smoke" was dark grey to translucent, and the highest temperature measured was in an orifice that was venting the clearest fluid. We left a marker (#7) at this site.

We proceeded northward through heavily collapsed terrain along the ASC and noted the abundance of bacterial mats and vents along the walls. Approximately 600 meters to the north we climbed up the eastern wall (similar to the traverse taken by Perfit and Edmond on Dive 2351) until we arrived at a distinctive community of serpulid worms and mussels in age 2 lobate flows with a characteristic "sooty" appearance. In the ARGO sonar data, the eastern margin of the ASC has several linear reentrants and we suspect that in traversing up the ASC floor we mistook one of these for a pillar/archway and ascended it not realizing that we were exiting the ASC until we noted the distinctive age-2 lobate terrain of the seafloor outside the ASC. Haymon previously noted on dive 2372 that this area was directly east of the BBQ site. On finding this "biological signpost" we dropped into the ASC, descending the 4-5 m high wall and across a large fissure, and almost immediately located the round plastic marker labelled #1 left on dive 2372, at a depth of 2525 meters. We then proceeded to carry out a series of east-west and north-south traverses across and along, respectively, the ASC floor to study: 1) the distribution of the sulfide sediment, 2) the contact relationships between the sulfide sediment and the new lava flow that floors part of the ASC in this area, 3) whether any discernable changes (geological or biological or both) had taken place since dive 2372, and 4) the geological features that comprise the ASC in this area.

One of the principal observations we made is that the ASC comprises at least two principal collapse levels and possibly a third as recorded in the west rim of the ASC. The collapse levels represent the trace of the shallowest depth that each of the most recent lava flooding events reached. We noted that one level lies at a depth of between 2520-2522 m and a second principal level lies between 2524-2526 m. These depth levels appear to correlate well across the ASC in the BBQ Pit area. The east wall of the ASC appears sharper and steeper than the western wall. And just 1-2 m below the rim of the western wall we sometimes saw a small bench suggestive of possibly a 3rd collapse level from a flooding event that did not succeed in overflowing the ASC in this area. Abundant collapse talus is present at the base of both ASC walls.

The sulfide sediment covers an area of approximately 2400 square meters (80x30 m) and clearly lies on the lava surfaces and on the tube-worm and clam/mussel debris that is incorporated in the new flow. The biological material is distributed over an area that is somewhat smaller than the area covered by the sulfide sediment (~40x30 m); and the tubeworm and shell debris is strewn on the surface of the flow as well as along the talus covered walls of the second level of drainback. Many of the tubeworms are shredded and the shells of mussels are broken into small angular fragments. Only a few tube worms appeared to be alive (just two observed during the entire dive to have the red tip of the worm sticking out of the sheath). We had a general sense that most of the dead tubeworms and clam/mussel shells lie on the flow rather than in it. However, there are also examples of lava encasing tubeworm and clam/mussel shells and evidence of blackening of the flesh and shells presumably by high temperature. We collected a number of decaying tubeworms and mussels from two separate areas within the flow and some pieces of lava in contact with them. A few of the tubeworms seem to have scorched outer surfaces and firm "cooked" innards. Another striking feature of the area is the abundance of Galatheid crabs which we estimate to be as great as one crab every 50 cm. A more precise count of crabs needs to be carried out using the bow camera film and should be compared with the previous dives to see if there has been any change in the resident crab popluation during the 35 days since the last visit.

The ASC in this area is 50-60 m wide (based on the ARGO sonar data and confirmation using the Alvin's CTFM sonar) and the sulfide sediment was found to cover an area from about 3-7 m from the east wall across the middle of the ASC to about 20 m from the west wall. There may be a dusting of sediment on the talus of the eastern wall in some areas near the Pit, however, given the chaotic nature of the collapse surface we found it difficult to determine whether a fine dusting of the sulfide sediment is present. In other areas the sediment forms a characteristic dull grey-colored deposit that sparkels under the sub's lights due to reflections off individual mineral grains. The sediment lies on the collapse talus and lavas of the 1st and 2nd collapse levels. There was no evidence of sediment or bacterial mats on the marker. We found the sediment to thin noticeably at about 30 m north of the marker and about 40-60 meters south of the marker although we had difficulty in tracing the limit of the deposit to the south possibly due to the chaotic nature of the collapsed terrain and the difficulty in navigating the sub. through the many lava pillars and archways that are found in the ASC floor. There appears to be a great deal of variation in the thickness of the deposit south of the marker perhaps as a consequence of local relief and accumulation at the base of steep walls. The sediment does appear to have collected in some of the low-points in the collapse terrain, ponding in some of the smoother and less-hackly areas a few meters to as much as 5 m across. It was obvious that the sulfide sediment had also been deposited along the base of the eastern and to a much lesser extent western walls but not within the deep, narrow fissure that runs along the E wall between 3-10 m from the base. This fissure was followed for at least 100 m south of the marker until it narrowed at a bridging obstruction. Our observations suggest that this feature may mark a surface fissure or collapse channel over a primary drainback zone, now modified through collapse, that must have opened following the eruption that produced the new lava flow in the BBQ Pit site. Extensive bacterial mat growth is present to the south of the Pit area on the east side of this fissure especially where it grades into the east wall of the 2nd collapse level.

In determining the sequence of events that resulted in the deposition of the sulfide sediment it will be important to account for the following geological observations:

1] The area has undergone at least 2 and possibly three caldera flooding events, each of which has failed to breach the present caldera walls in the area surveyed.

2] The new lava flow that floors the ASC in this area has been cut by a deep fissure and there is very little apparent sulfide sediment either on the steep walls or in the floor of the fissure where we were able to make observations.

3] There is a biological community comprising principally mussels, and serpulid worms in a 10-20 m swath adjacent to the east rim of the ASC proximal to the area covered by the sulfide sediment. Dead tubeworms and shell debris were observed on the talus at the base and along the face of the eastern wall of the ASC.

4] The sulfide sediment is sand- to fine-sand-sized and no large fragments were observed. It appears to have draped both the new flow and the tubeworm bodies as if it was a deposit that came out of suspension. The shell debris is rather finely fragmented and widely dispersed through the collapse talus and present along with intact shells that have been blackened.

5] It will be important to compare the geochemical analyses of rocks from the new flow described during dive 2372 around the BBQ Pit area to lavas north and south of the Pit. If the flow is chemically distinct it will help to establish that the flow is indeed a different and possibly younger eruptive unit than the flows surrounding it. If the chemistry is indistinguishable from the more extensive flows that floor the ASC in this region then it is possible that the latest eruption was of higher volume than previously suspected. The timing of the deposition of the sulfide sediment must have post-dated the implacement of the young flow, however, at this time it is difficult to place any meaningful constraints on the possible causal associations between these events.

6] Microbiological analyses and examinations of the burned tissues of vent animals should be carried out to try to determine if the burning agent was hot water or hot lava. This would help to constrain the relationship between the sulfide sediment deposition, and the disruption of the biological community.

7] Further analysis of the ARGO sonar and photographic data from this area will help to establish the relationships of the old versus the new features we have observed. However, it is imperative that during the next visit with Alvin to this site that a wide area electronic still imaging system be mounted on the sub so that a detailed digital photomosaic can be made of the BBQ Site and surrounding seafloor to establish the baseline morphology of the area for future studies so that changes can be accurately documented.

SCIENTIFIC PERSONNEL

Dan Fornari	Lamont-Doherty Geological Observatory
Mike Perfit	Dept of Geology, University of Florida
Jack Casey	Dept of Geoscience, University of Houston
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ALVIN LOGISTICS

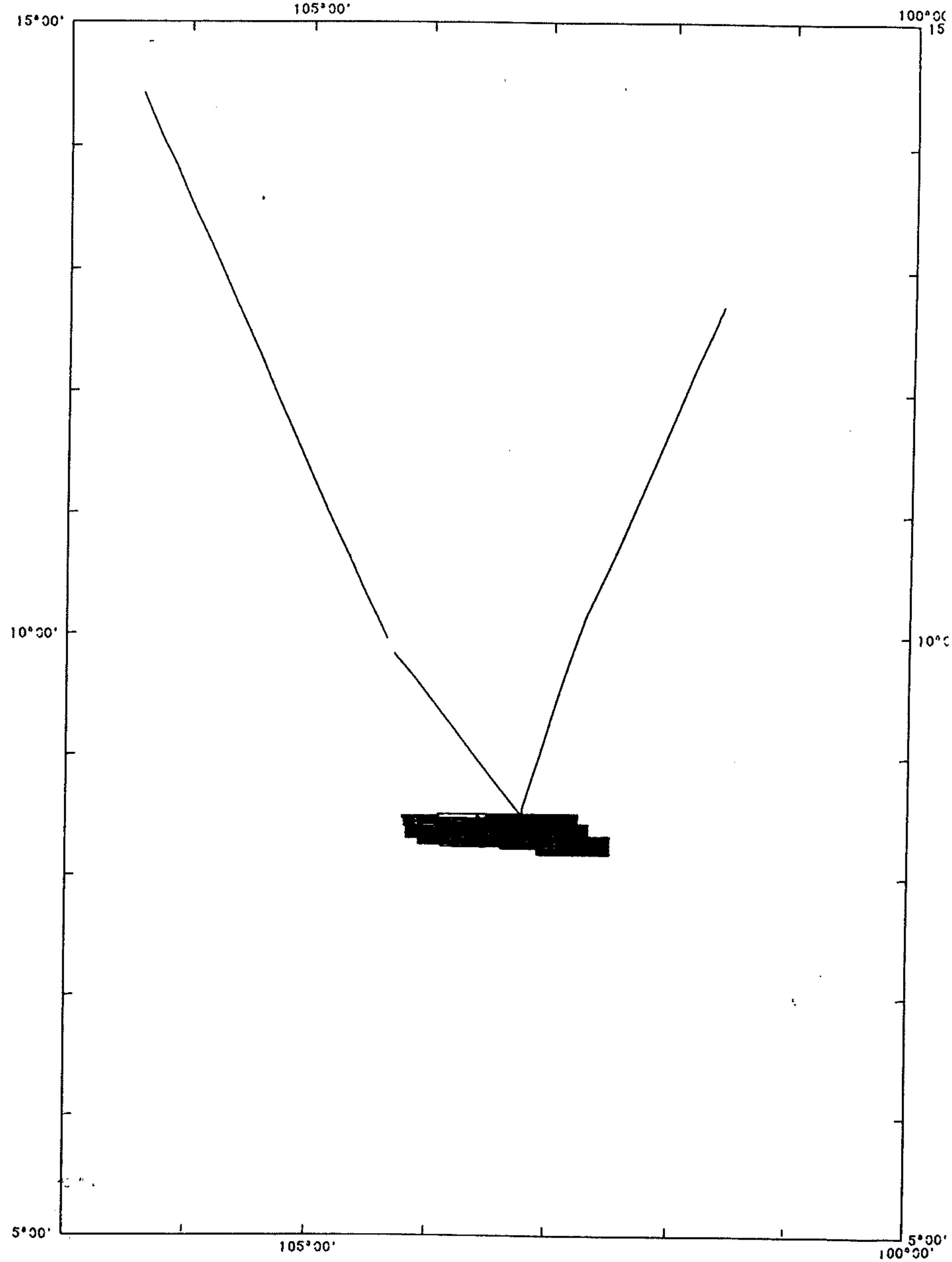
May 1991

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		in port acapulco 1	depart acapulco 1100 hrs transit to spreading center "B" Siqueiros 2	transit to Siqueiros 3	arrive spreading center B at 1000 hrs local commence Seabeam survey of B and C 4	1000 END 1st Cbeam survey lay in Xponders and survey-in rock core&dredge at night 5
DIVE 2375 FOSTER PERFIT RIDLEY 1ST SCARP W. OF "B" 6	DIVE 2376 HICKEY CASEY EDWARDS "B" SOUTH 7	DIVE 2377 VAN DOVER FORNARI DESONIE "B" NORTH 8	DIVE 2378 FOSTER PERFIT REYNOLDS "C" W. CRESENT 9	REPAIR DAY 10	DIVE 2379 HICKEY CASEY PIT A-B FAULT NEAR "B" 11	DIVE 2380 VAN DOVER FORNARI RIDLEY "B" TROUGH 12
DIVE 2381 FOSTER CASEY SCHUSTER "B"-"C" FAULT NEAR "B" 13	DIVE 2382 HICKEY PERFIT KIRK SMALL CONES SOUTH OF "B" 14	DIVE 2383 VAN DOVER FORNARI REYNOLDS SOUTH "A" RIDGE&RTI 15	DIVE 2384 FOSTER CASEY XIA FAULT DIVE IN A -B 16	DIVE 2385 HICKEY PERFIT MCCOY "C" TROUGH & N RIDGE 17	DIVE 2386 VAN DOVER FORNARI EDWARDS "D" AXIS 18	HAT DAY FORMAL B/S DAY CBEAM DAY 19
CBEAM & DREDGING DAY 20	DIVE 2387 FOSTER PERFIT P.I.T. "B"-"C" FAULT CONES 21	DIVE 2388 HICKEY CASEY ERNST "A"-"B" FAULT 22	DIVE 2389 VAN DOVER RIDLEY KIRK "A" N. RIDGE 23	DIVE 2390 FOSTER PERFIT PARADIS W. EPR & "A" RTI 24	DIVE 2391 HICKEY CASEY P.I.T. "A" 25	CBEAM & DREDGING DAY E. EPR AND RTI 26
DIVE 2392 VANDOVER PERFIT FORNARI EPR-ASC 9° 50-51'N START TRANSIT 27	TRANSIT TO SAN DIEGO 28	TRANSIT TO SAN DIEGO 29	TRANSIT TO SAN DIEGO 30	TRANSIT TO SAN DIEGO 31		

May 1991 NIGHT PROGRAM LOGISTICS

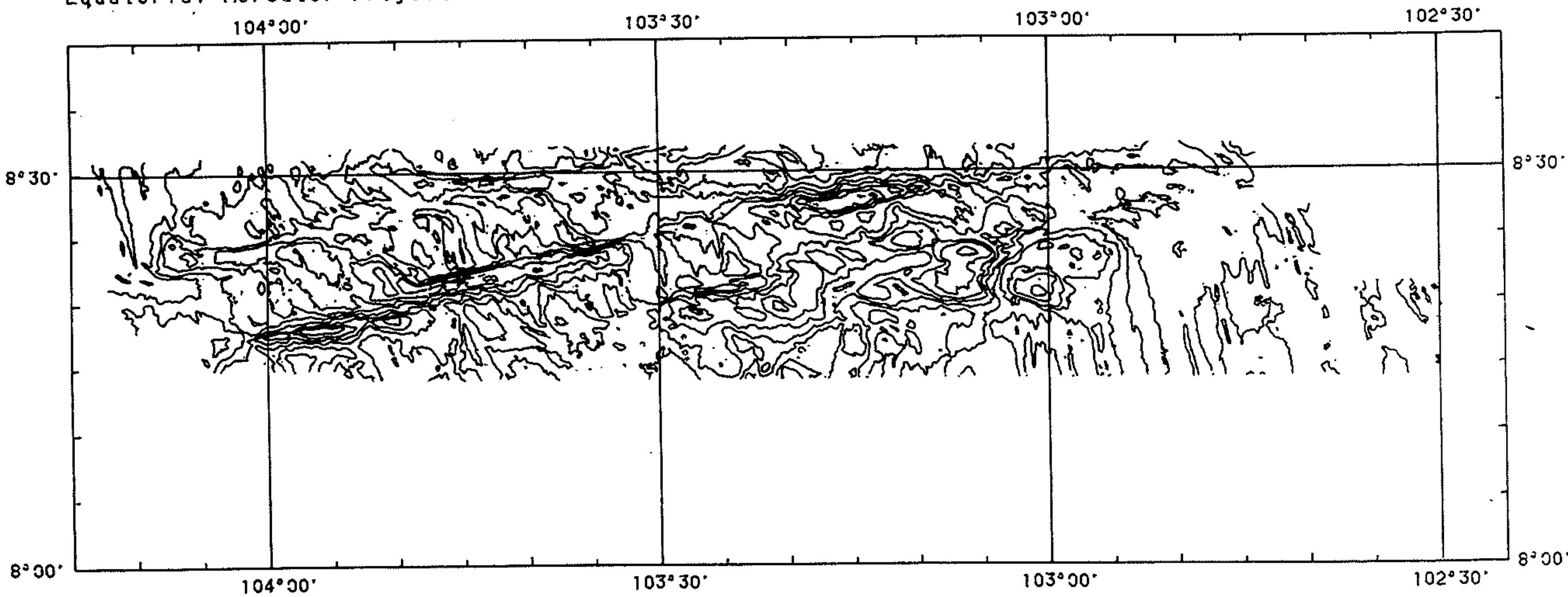
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		in port acapulco **1**	**depart acapulco 1100 hrs transit to spreading center B in Siqueiros** **2**	**transit to Siqueiros** **3**	arrive spreading center B at 1000 hrs local commence Seabeam survey of B and C **4**	1000 END 1st Cbeam survey lay in Xponders and survey-in A25-1D, A25-2D A25-3RC **5**
CBEAMING "A" **6**	DREDGE A25-4D DREDGE A25-5D DREDGE A25-6D DREDGE A25-7D ALL WEST OF SC "B" **7**	DREDGE A25-8D DREDGE A25-9D DREDGE A25-10D ALL EAST OF SC "B" 9D +10D NO RECOV. **8**	CBEAMING "D" **9**	DREDGING SOUTH OF "B" A25-11RC A25-12D A25-13D A25-14D A24-15D **10**	DREDGING SOUTH & WEST OF "B" **11**	CBEAMING NORTH & EAST OF "D" **12**
PULL 2 XPONDERS (B+D) DREDGING W & E OF "B" **13**	PULL 2 XPONDERS (A+C) DREDGE FOR PICRITE IN "A"-"B" TROUGH CBEAMING **14**	DREDGING FOR PICRITES... IN A-B TRANSFORM **15**	CBEAMING EAST OF "D" **16**	DREDGING NORTH & WEST OF "C" **17**	CBEAMING EAST OF "D" **18**	CBEAM DAY CBEAMING E. R/T INTERSECT A25-28D A25-29D **19**
CBEAM E. SIQUEIROS AND EPR & DREDGING RTI A25-30D A25-31D **20**	FINISH DREDGING AROUND "C" A25-32D A25-33D A25-34D **21**	CBEAM SW. OF "A" & A25-35 **22**	DREDGING EAST OF "A" A25-36 A25-37 A25-38 **23**	CBEAM WEST OF "A" TO EPR AXIS & 1 DREDGE ON EPR ABSSAL HILL A25-39 **24**	CBEAMING AROUND "A" AND OVER TO EASTERN RTI AREA **25**	CEBEAMING DREDGE E. RTI A25-40RC A25-41RC A25-42RC A25-43D A25-44D **26**
START TRANSIT TO SAN DIEGO AFTER DIVE 2392 **27**	**TRANSIT TO SAN DIEGO** **28**	**TRANSIT TO SAN DIEGO** **29**	**TRANSIT TO SAN DIEGO** **30**	**TRANSIT TO SAN DIEGO** **31**		

Equatorial Mercator Projection * Scale = 0.90 in/deg NECOR/SeaBeam 1-Jun-91 06:03



A125L25 Siqueiros Transform Fault Survey

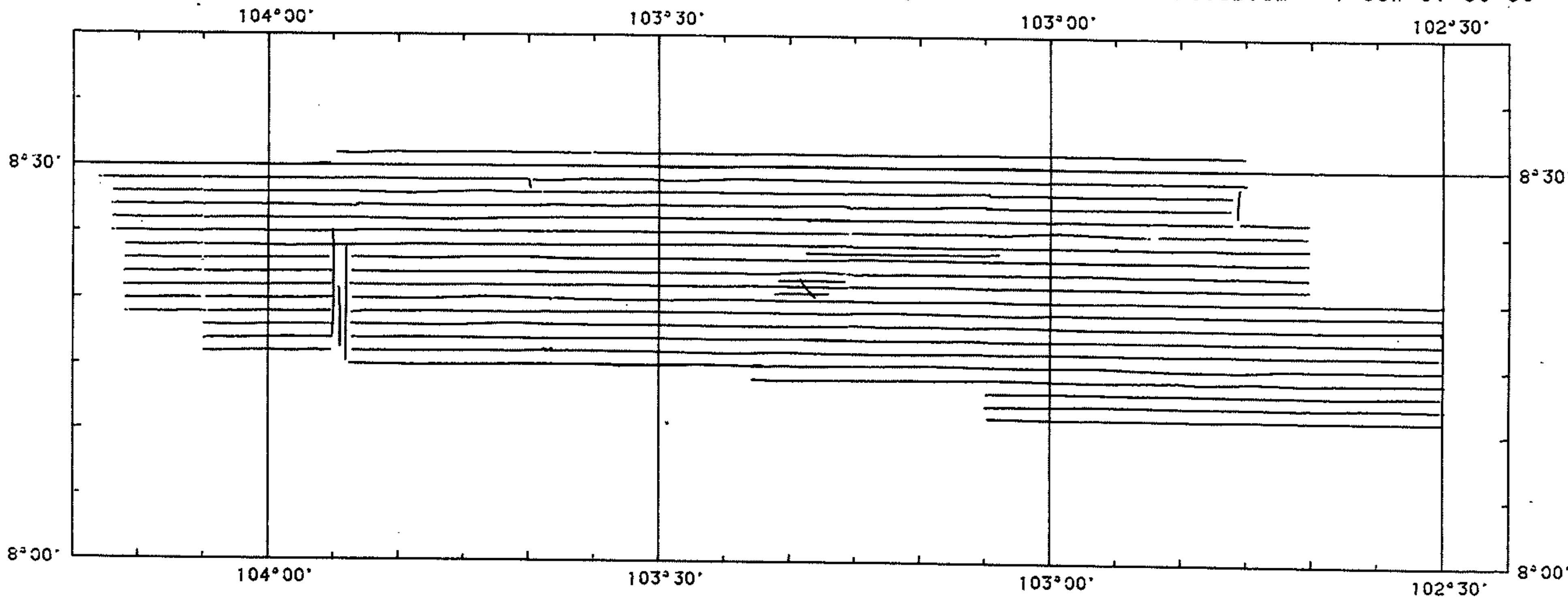
Equatorial Mercator Projection * Scale = 5.00 inches/degree NAVOCEANO/SeaBeam 1-Jun-91 06:18



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 200.0 meters COLOR CHANGE =5000.0 meters

A125L25 Siqueiros Transform Fault Survey

Equatorial Mercator Projection * Scale = 5.00 inches/degree NECOR/SeaBeam 1-Jun-91 05:39

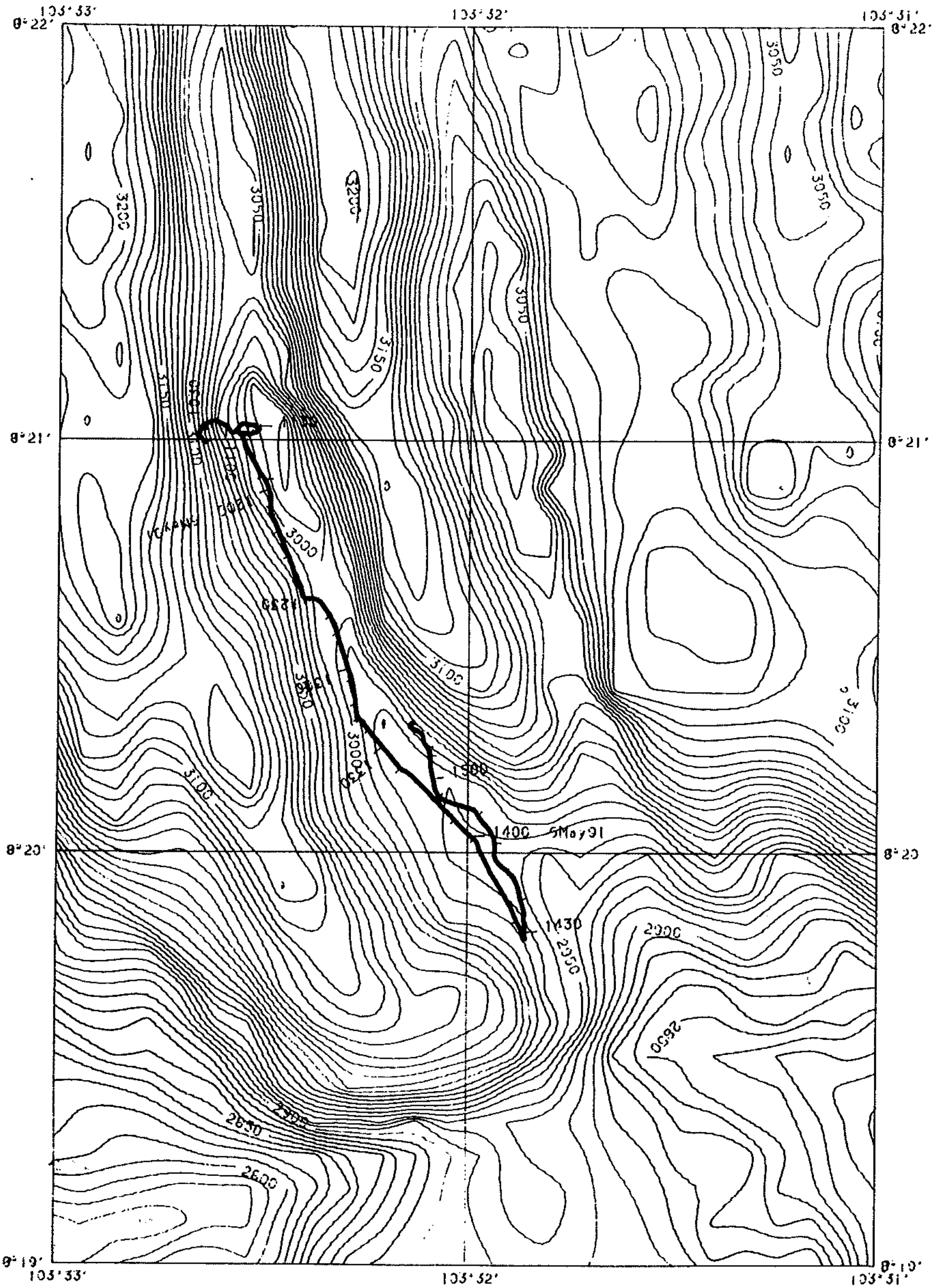


A125L25 Siqueiros Transform Fault Survey

ANNEX 1

DIVE TRACKS ON 10 M SEABEAM CONTOURS

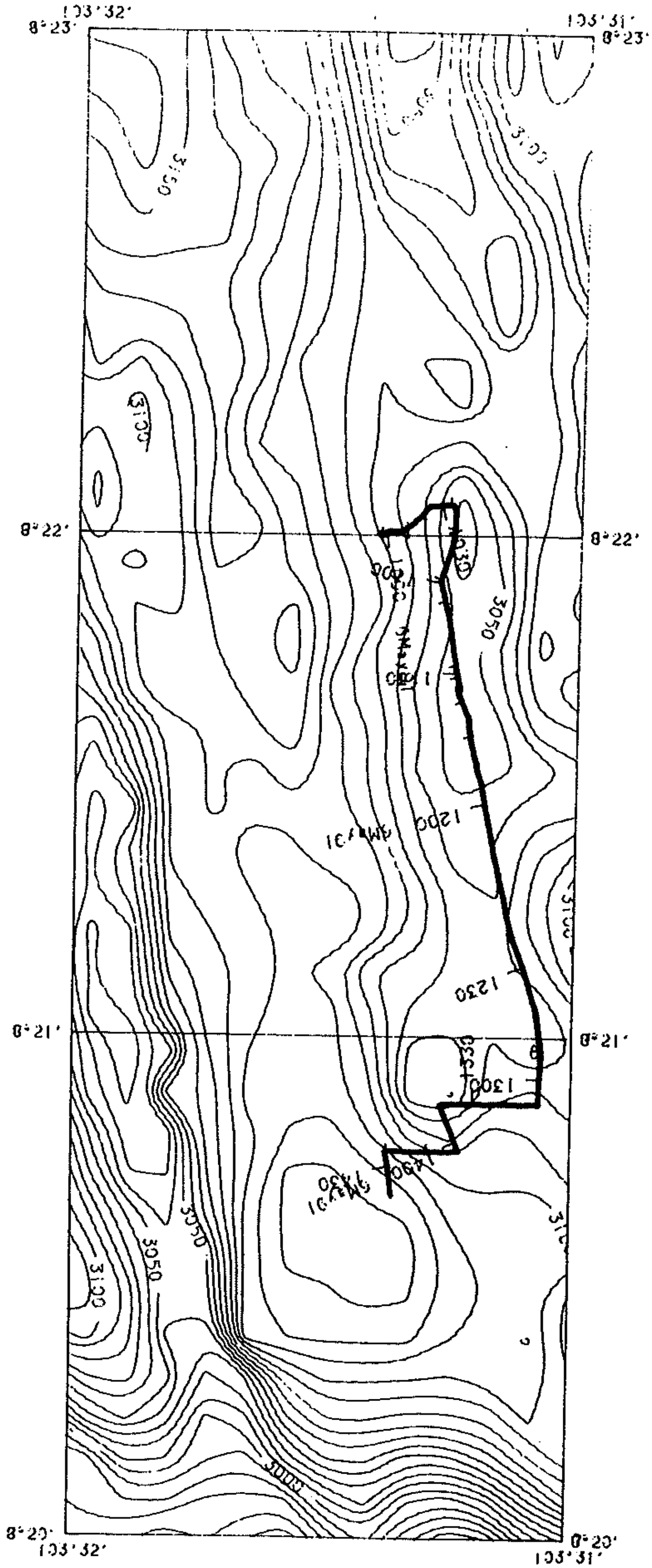
Equatorial Mercator Projection * Scale = 1:6000 DANO/SeaBeam 30-May-91 23:07



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2375

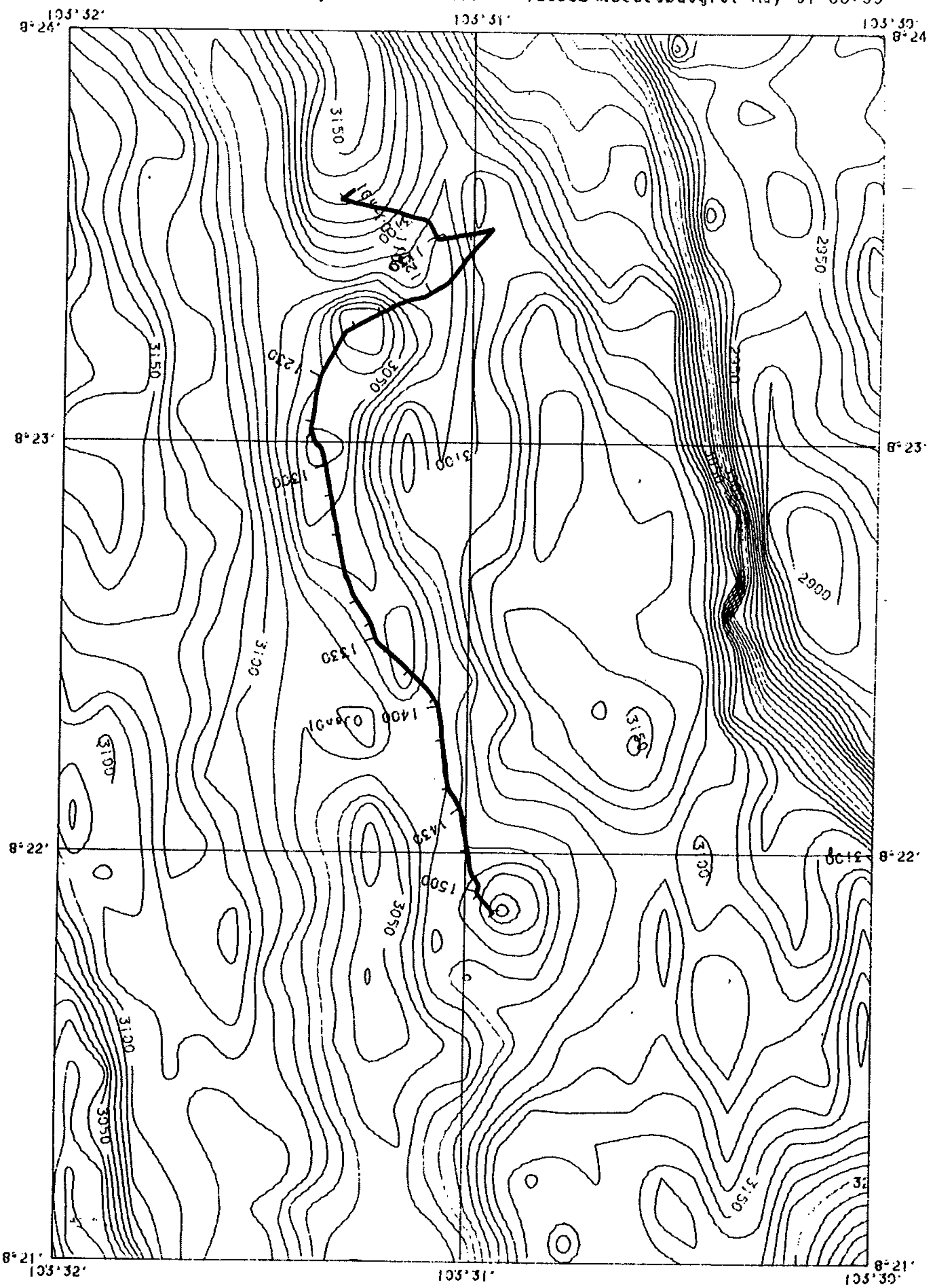
180.00 inches/deg



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters CO

A125L25 Dive 2376

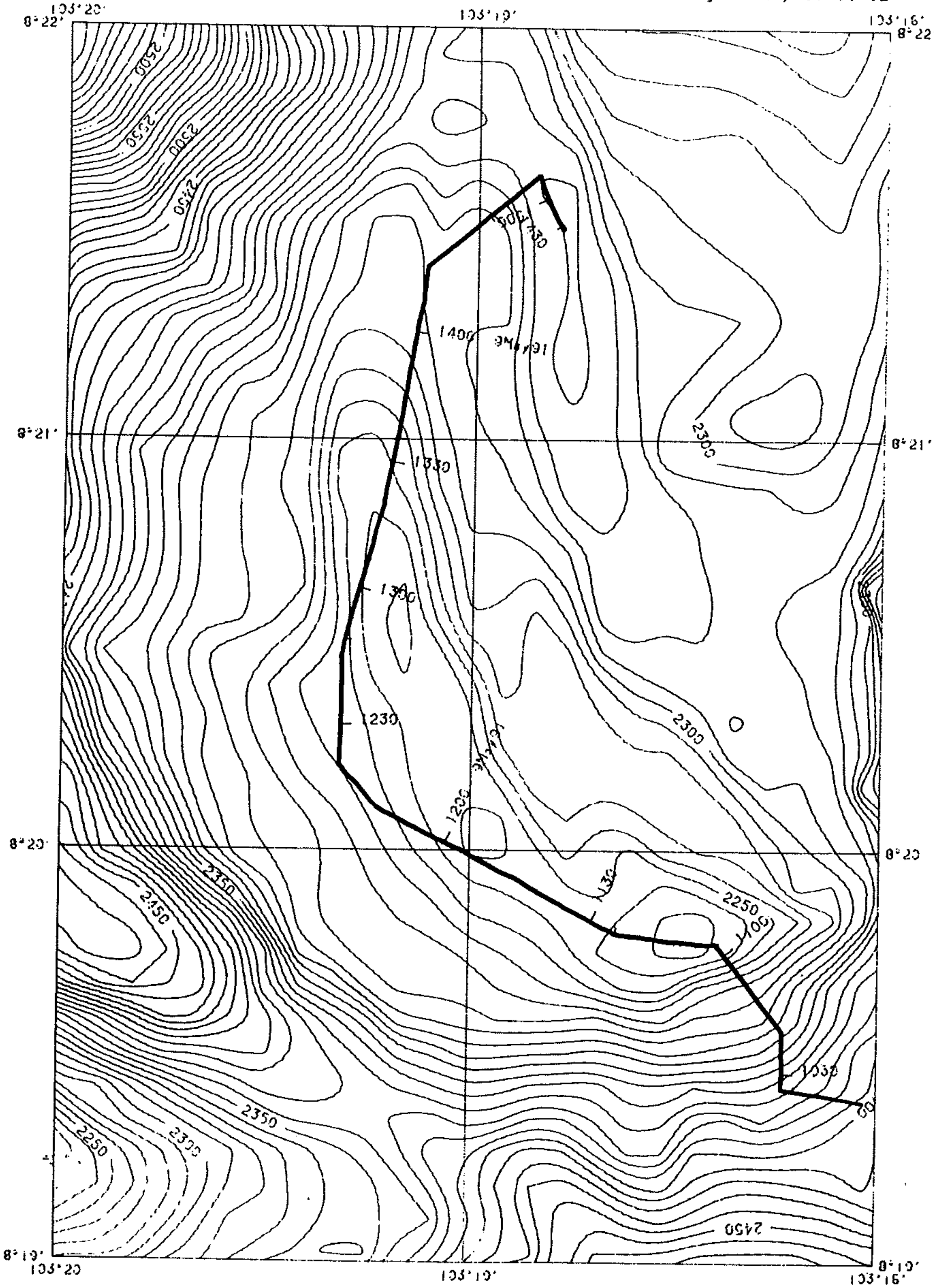
Equatorial Mercator Projection * Scale = 1600ODANO/SeaØdegr31-May-91 00:33



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2377

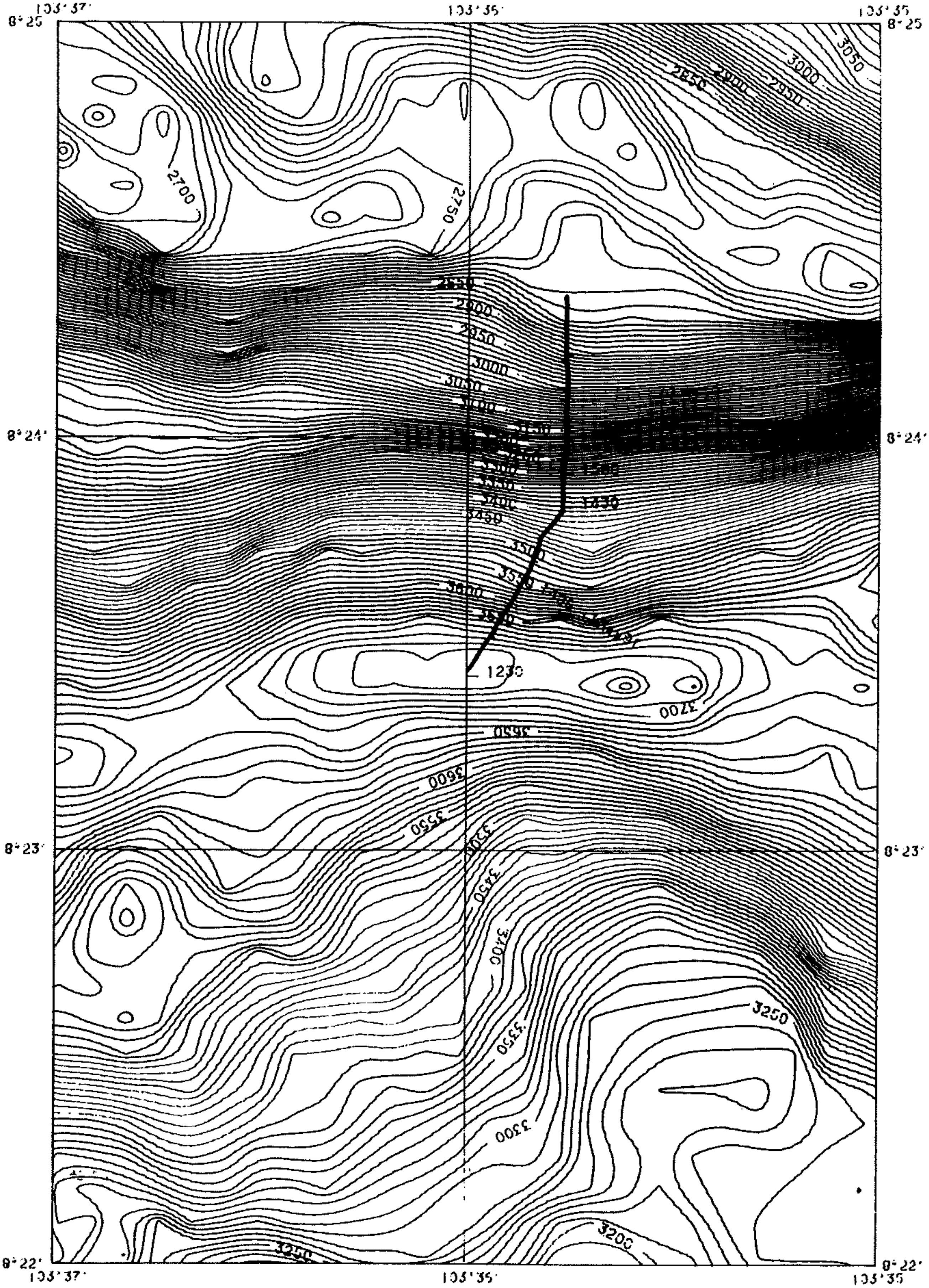
Equatorial Mercator Projection * Scale = N6VOCDANO/SeaBdagr31-May-91 00:52



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2378

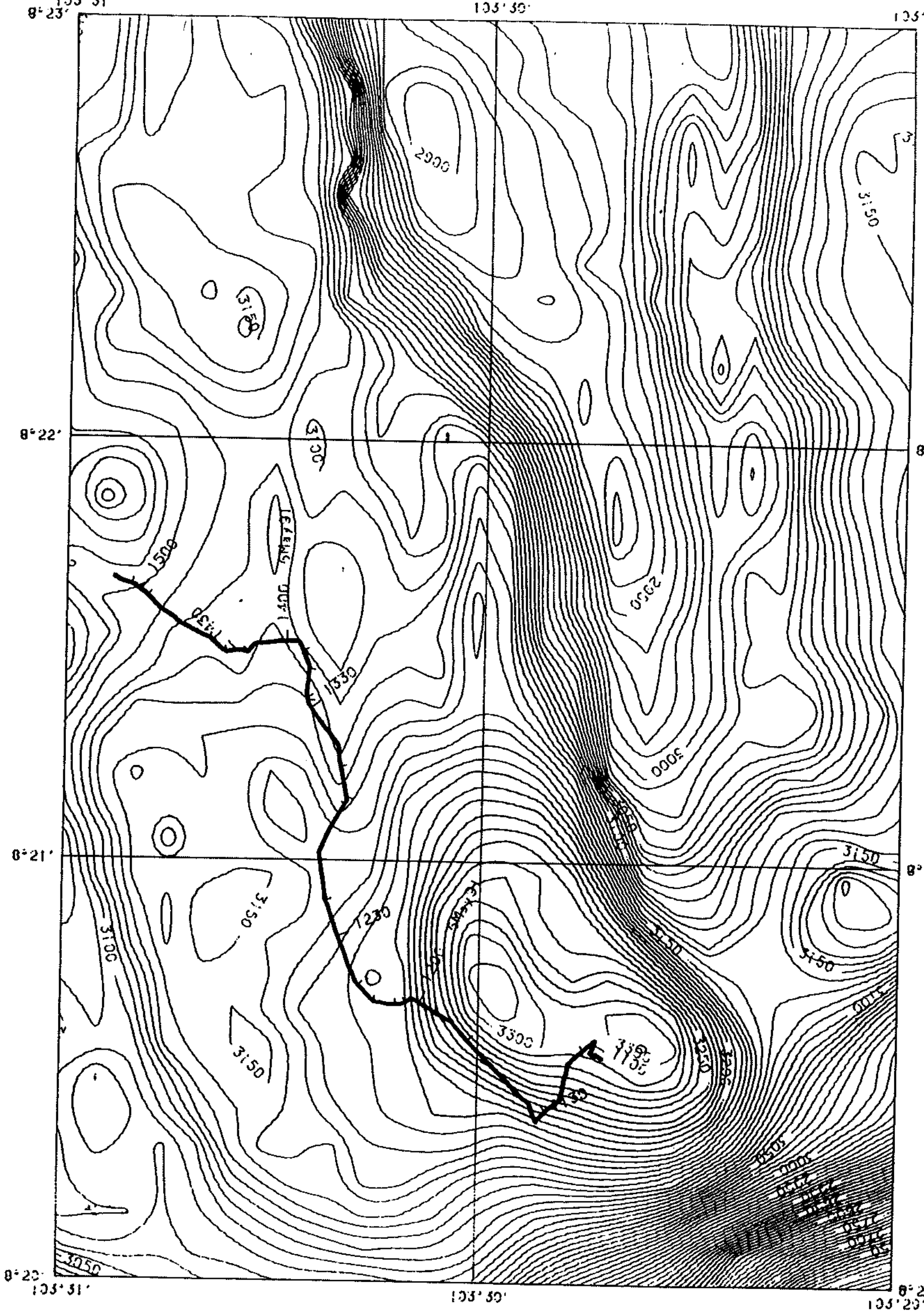
Equatorial Mercator Projection * Scale = N8VOCDANO/SeaBdegr3t-May-91 01:08



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2379

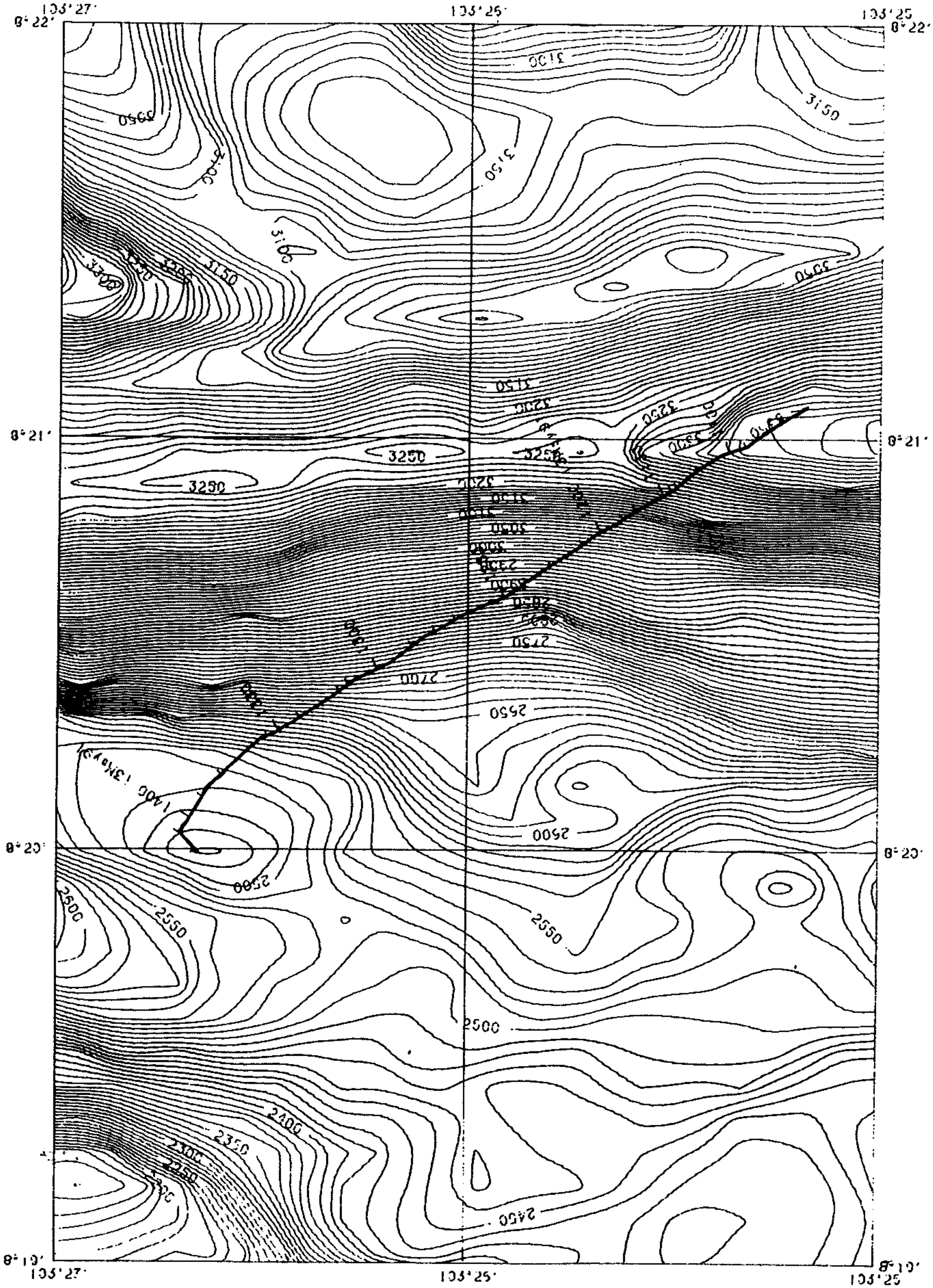
Equatorial Mercator Projection * Scale = N6000DAN0/SeaØdegr31-May-01 01:27



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2380

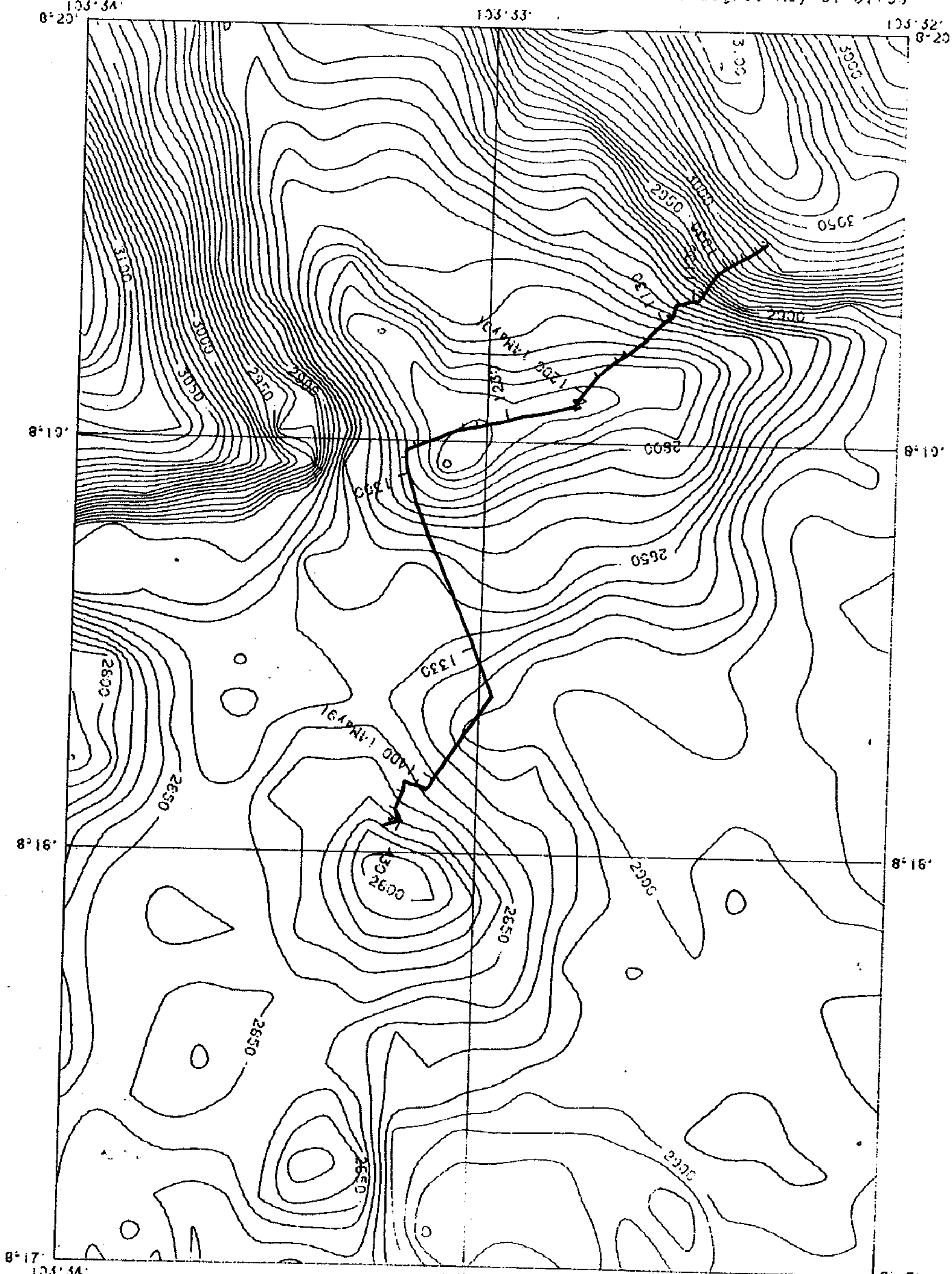
Equatorial Mercator Projection * Scale = N6000DAN0/SeaBdegr31-May-91 01:47



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2381

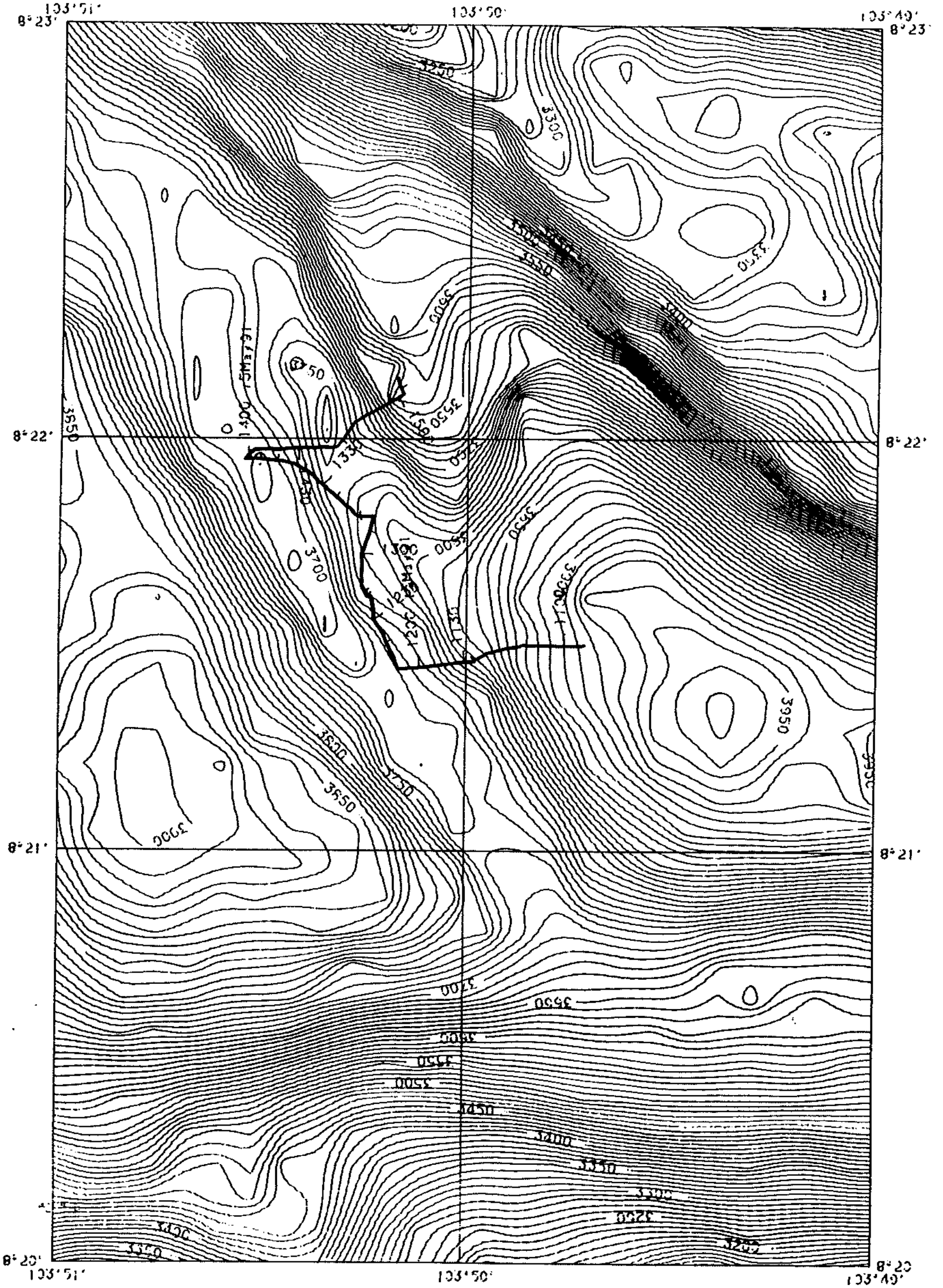
Equatorial Mercator Projection * Scale = N8000DAN8/SeaBdagr31-May-91 01:59



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2382

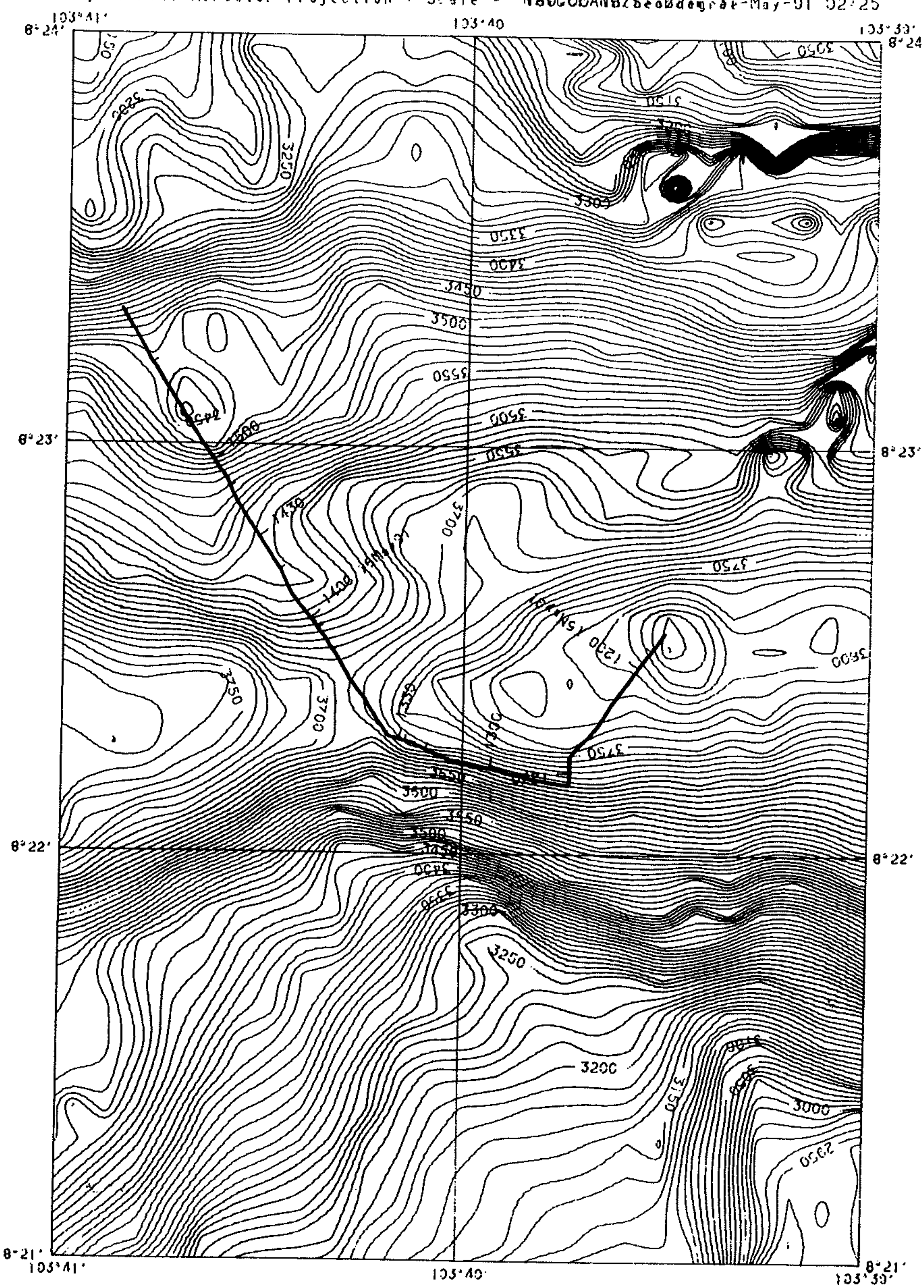
Equatorial Mercator Projection * Scale = N&VOCDANG/SeaØdemr31-May-91 02:09



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2383

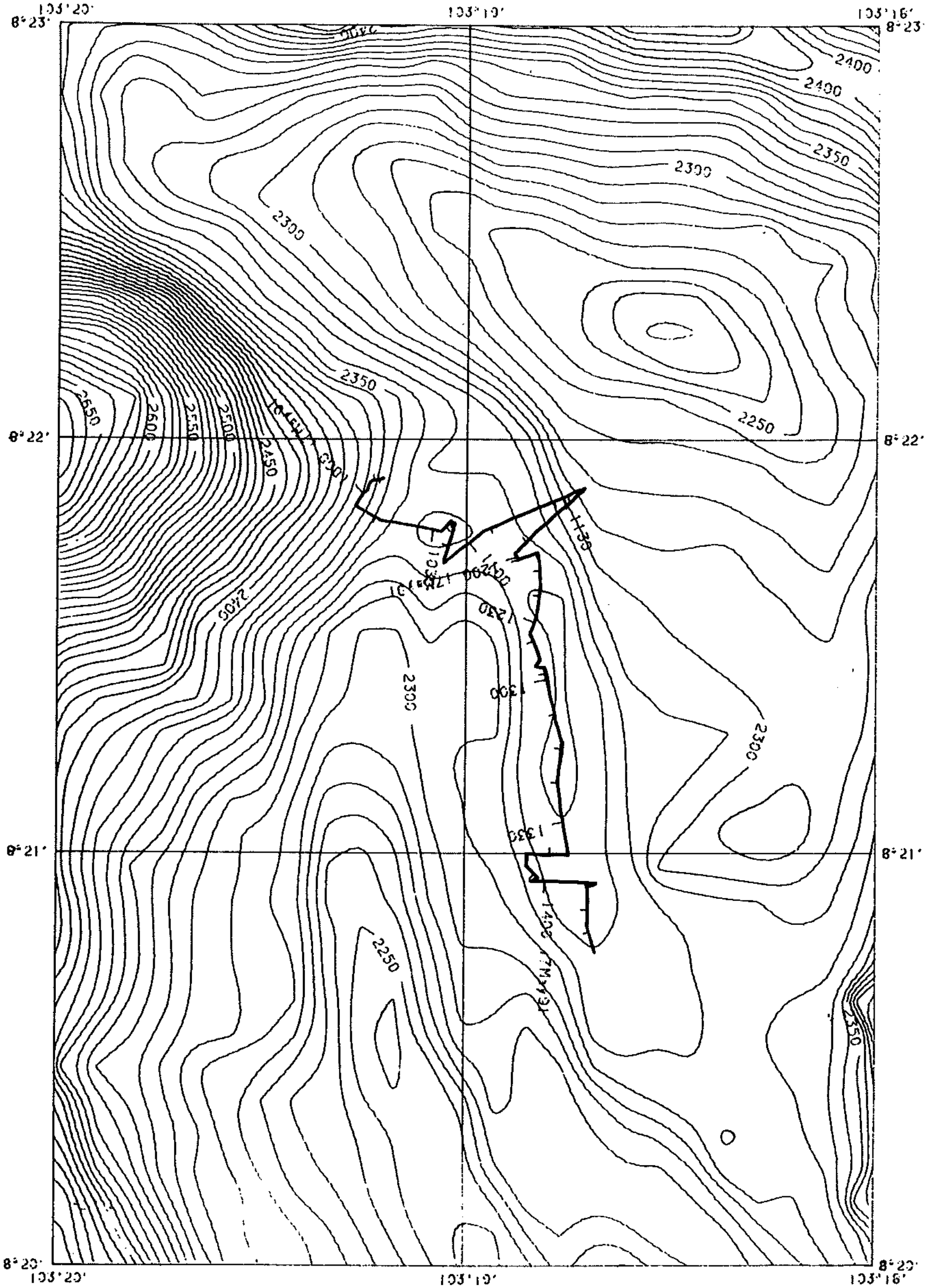
Equatorial Mercator Projection * Scale = NSVOODAN87SeoØdege3i-May-01 02:25



ORID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2384

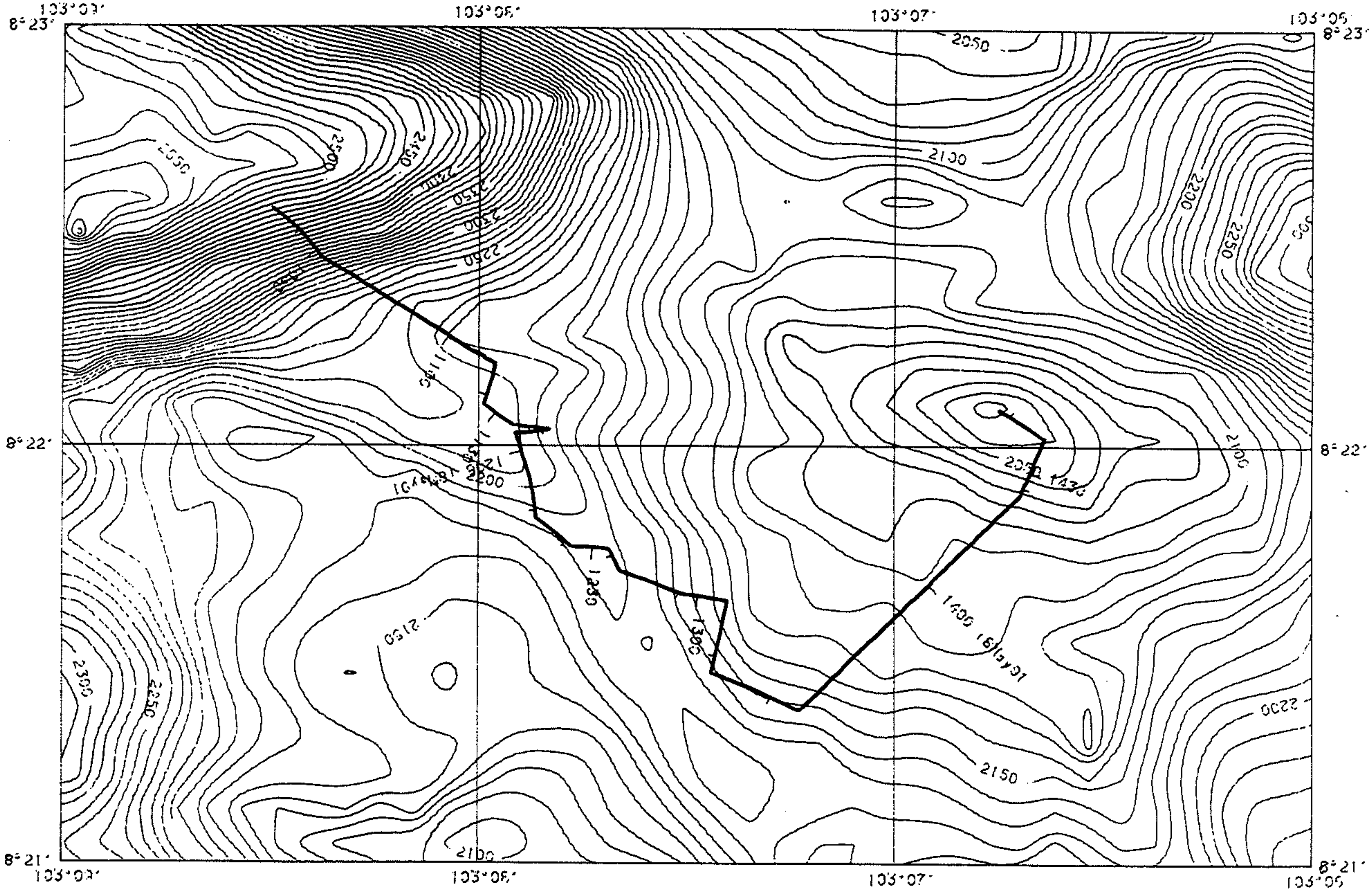
Equatorial Mercator Projection + Scale = NAVOCEAN0/Sea0degr31-May-01 02:39



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

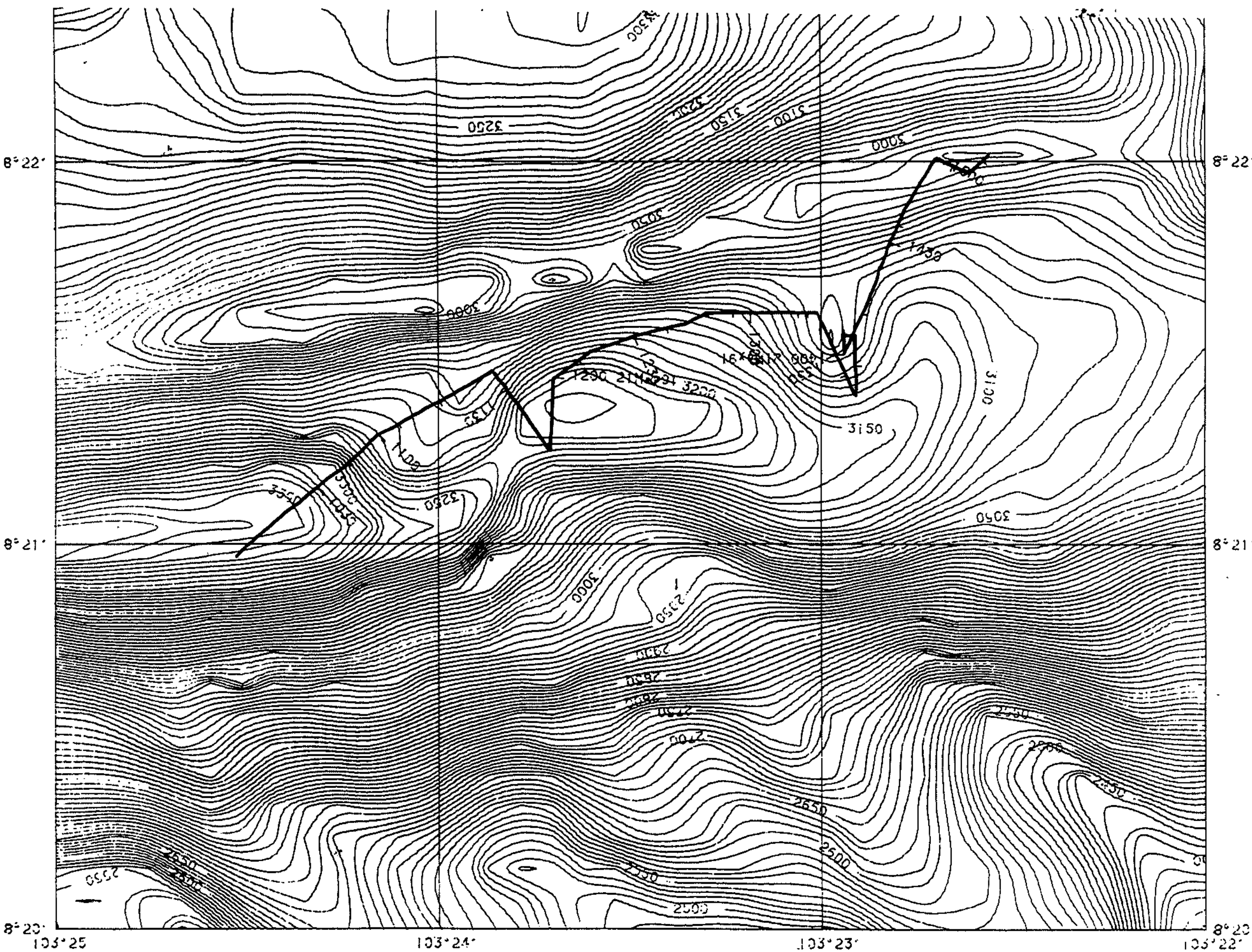
A125L25 Dive 2385

Equatorial Mercator Projection * Scale = 180.00 inches/degree   NAVOCEANO/SeaBeam 31-May-91 07:31



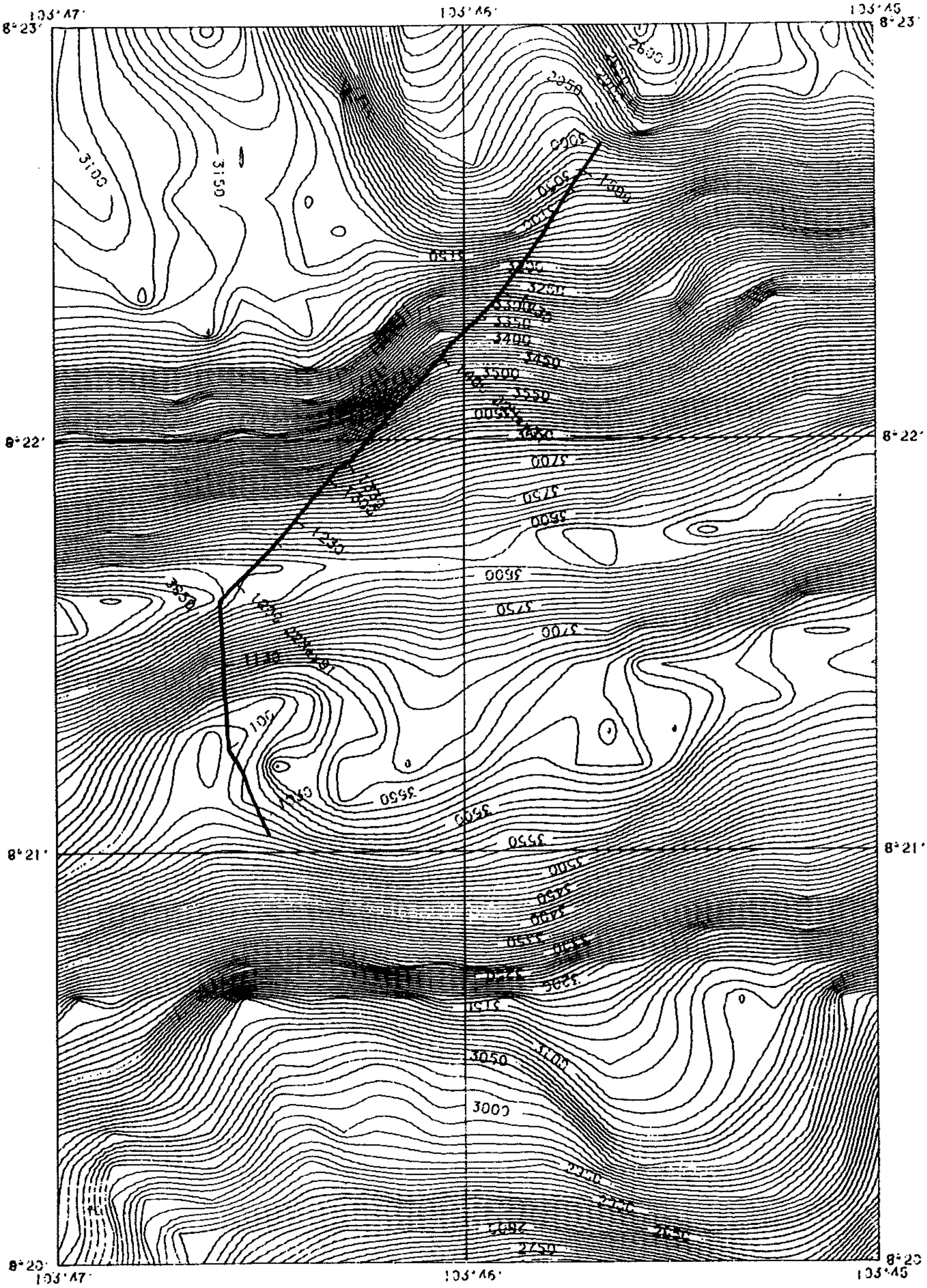
GRID INTERVAL - 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A1251.25   Dive 2386



GRID INTERVAL - 150 meters CONTOUR INTERVAL - 10.0 meters COLOR CHANGE - 100.0 meters

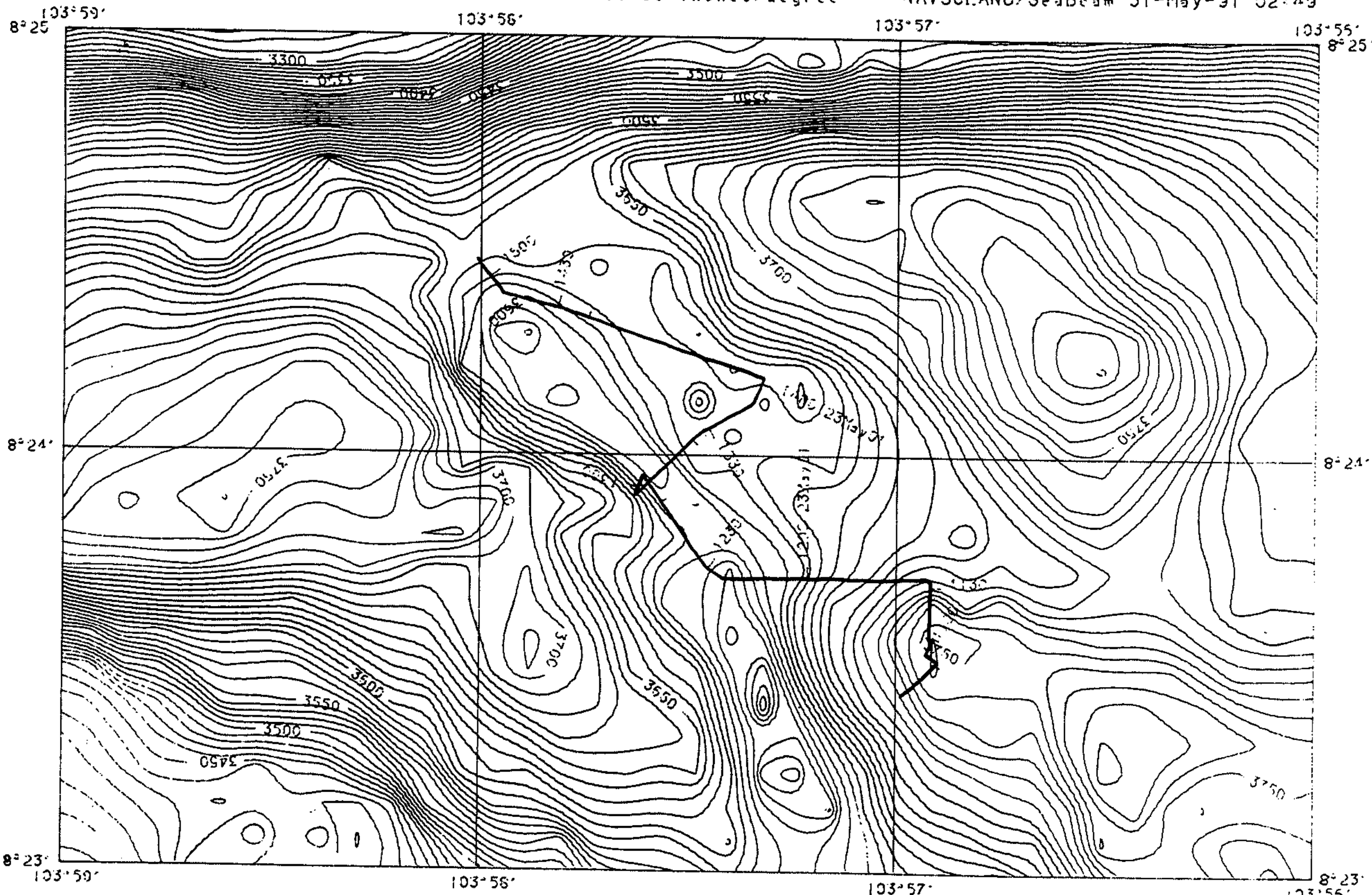
Equatorial Mercator Projection + Scale = N6000DANGZ6eaØdeg-31-May-01 07:55



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

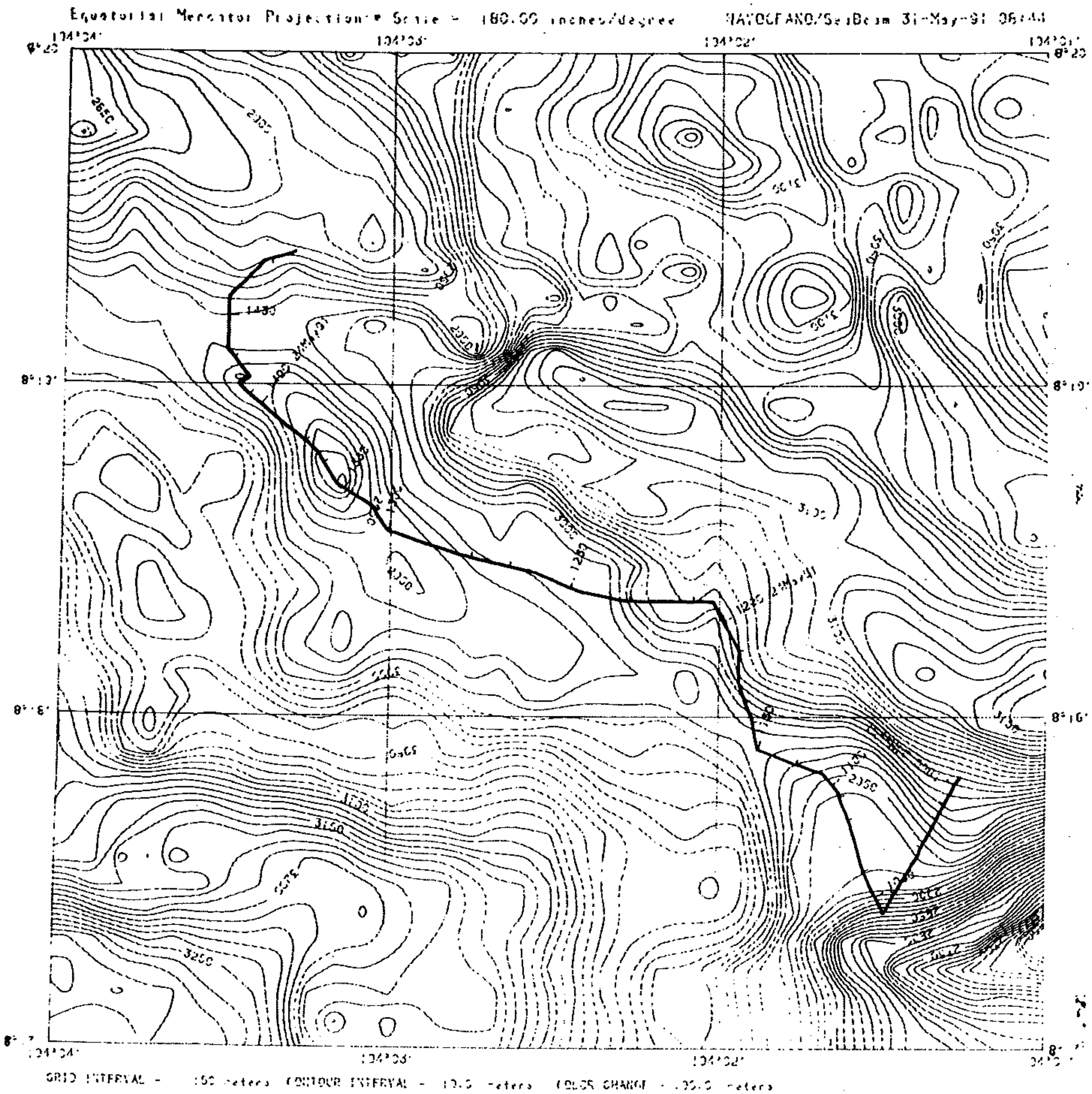
A125L25 Dive 2388

Equatorial Mercator Projection * Scale = 180.00 inches/degree NAVOCEANO/SeaBeam 31-May-91 02:49



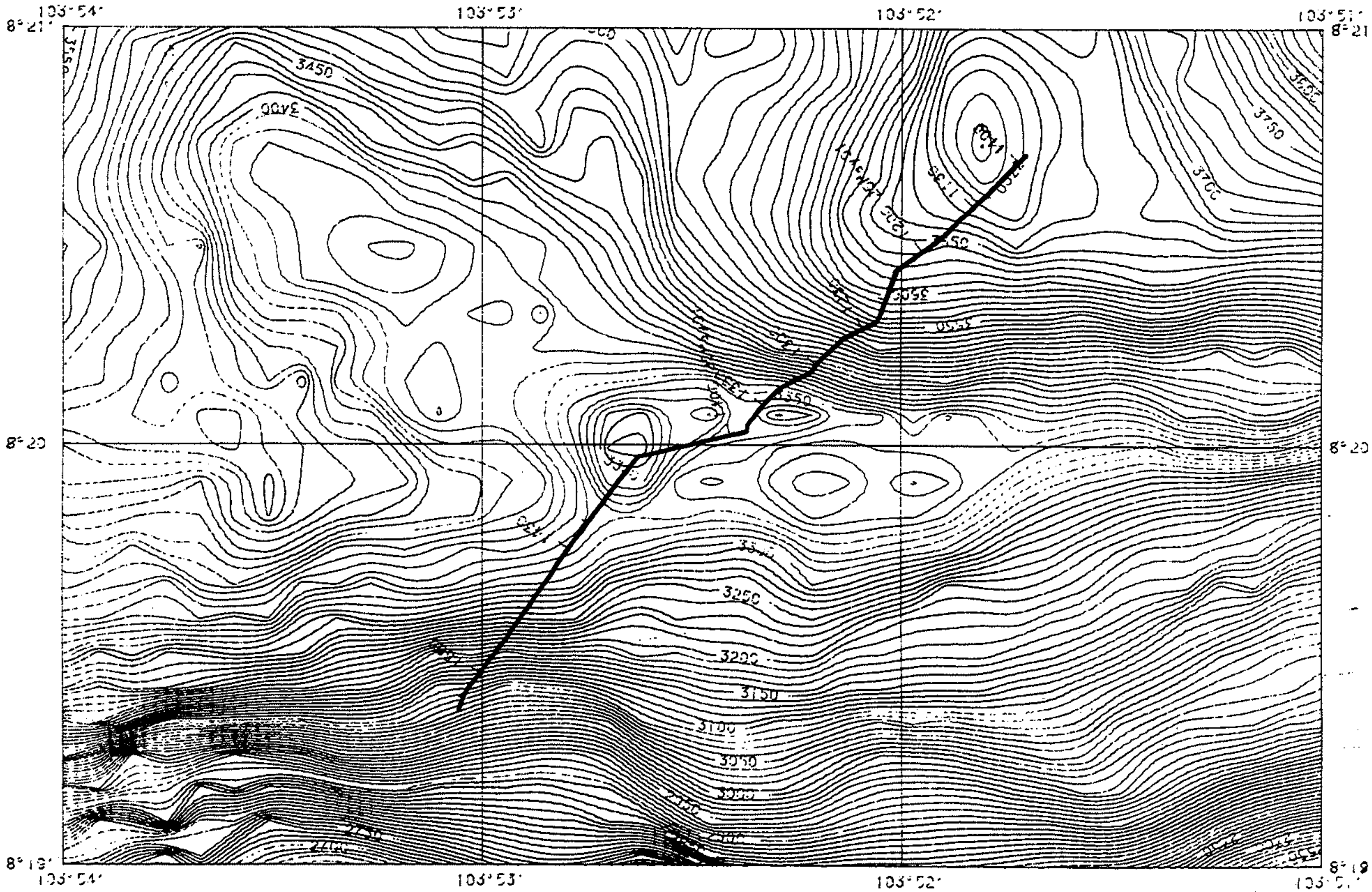
GRID INTERVAL - 150 meters CONTOUR INTERVAL - 10.0 meters COLOR CHANGE - 100.0 meters

A125L25 Dive 2389



A125E25 Dive 2390

Equatorial Mercator Projection * Scale = 180.00 inches/degree NAVOCEANO/SeaBeam 31-May-91 09:04



GRID INTERVAL = 150 meters CONTOUR INTERVAL = 10.0 meters COLOR CHANGE = 100.0 meters

A125L25 Dive 2391

ANNEX 2

SAMPLE INVENTORY SHEETS

SIQUEIROS ALVIN SAMPLES

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2375-1	basalt	4 mm	5 lb	F	plag.-micropheno	no		1-2 mm	mild		no	Mn on all surfaces. pillow frag.
2375-2	basalt	5 mm	1.5 lb	F	plag.	no		1-2 mm	mild		no	Mn on all surfaces. pillow frag.
2375-4	basalt	no	1 lb	F	plag.	1%		1-2 mm	light		no	Mn on all surfaces. pillow frag.
2375-5	basalt	yes	5 lb	F	plag.	5%		5 mm	mild		no	Mn on all surfaces. pillow frag. pg-phenocrysts
2375-6	basalt	yes	7 lb	F	plag.-micropheno	1%		2 mm	mild		no	2 mm thick Mn coating. lots of glass.
2375-7	basalt	yes	20 lb	F	plag.-micropheno	1%		1-2 mm	mild		no	Thick Mn coating
2375-8	basalt	yes	20 lb	F	1% plag.-micropheno	1%		1 mm	mild		no	Mn coating on all surfaces. More coarse grained.
2375-9	basalt	5 mm	8 lb	F	trace plag.	no		trace	light		no	Mn coating on all surfaces. pillow frag.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2376-1	basalt	yes	7 lb	F	aphyric	<1%	no	no	v. minor	no	no	ropy structure. thick glass
2376-2	basalt	yes	3 lb	F	aphyric	<1%	no	no	minor	discoloration	no	pillow lava
2376-3	basalt	yes	2 lb	F	ol+plag. phyric	<1%	no	no	slight	along fracture	no	pillow bud. glassy
2376-4	basalt	yes	4 lb	F	ol+plag.	<1%	no	minor	moderate	weathered	no	pillow frag
2376-5	basalt	yes	2 lb	F	plag. phyric	<1%	no	thin	moderate	weathered rind	no	two glass surfaces. pillow frag
2376-6A	basalt	yes	1 lb	F	plag. phyric	<1%	no	no	slight	whitish staining	no	some large vesicules, pillow frag
2376-6B	basalt	yes	3 lb	F	plag. phyric	<1%	no	thin	minor	palagnite	no	Mn coating on most surfaces, pillow frag
2376-7	basalt	yes	5 lb	F	aphyric	no	no	no	no	whitish stain	no	v. fresh glass. hollow tubes. sheet flows.
2376-8	basalt	yes	20 lb	F	plag. megacryst	<1%	no	thin	slight	whitish stain	no	fractured glass crust, hollow pillow.
2376-9	basalt	yes	20 lb	F	plag. megacryst	<1%	no	thin	moderate	palag.	no	hollow pillow, corrugated surface
2376-10	basalt	yes	15 lb	F	large plag., small ol	<1%	no	thin	slight	discoloration	no	glomeromorphic, pillow frag
2376-11	basalt	yes	15 lb	F	?	<1%	no	thin	slight		no	series of glass surf., lots of hollow struct. Mn coated. stretch marks on pillow surf.
2376-12	basalt	yes	20 lb	F	?	<1%	no	thin	minor	greenschist	no	Mn coating. corrugated pillow surface

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2377-1	pillow basalt	yes		F	aphyric glass, plag., ol	yes		1 mm	yes	whitish stain		tube or bud of pillow
2377-2	pillow basalt	yes	10 kg	F	10% plag.	yes		yes		whitish stain, Fe-oxides	yes	Mn coating on all sides, sediments inside tubes
2377-3	pillow bud	yes		F	10% plag.			yes	yes			Mn coating on glass
2377-4	pillow basalt	yes		F	plag.	yes		thin	yes			
2377-5	pillow basalt	yes		F	1% plag.	yes		yes				
2377-6	pillow basalt	yes		F	plag., ol	yes		mod		Mod. FeO coated		elephant skin texture. glass
2377-7	pillow basalt	yes		F	plag.	yes		thin	yes			bread crust text. flow banding
2377-8	pillow basalt	yes		F	5% plag.	yes				FeO stringee		linear flow texture
2377-9	pillow basalt	yes		F	5% plag., trace ol	1%						glass is weathered, drip texture
2377-10	pillow bud	yes		F	plag.	1%		yes	yes			Mn oxidites on glass, whitish staining
2377-11	pillow basalt	yes		F	1-2% plag.			yes	yes			Mn on surface pale yellow mat/interior.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2378-1	basalt	yes	25 lb	F	plag. phyric	<1%	no	yes	along joi	none	no	Mn coating
2378-2	basalt	yes	25 lb	F	plag. phyric	<1%	no	yes	strong	banding	no	weathering rind, Mn coated
2378-3	basalt	yes	25 lb	F	aphyric	no	no	yes	minor		yes	Mn-coated, jumbled sheet flow
2378-4	basalt	no	4 lb	F	plag., poorly phyric	<1%	no	yes	strong		no	heavily weathered and Mn coated
2378-5	basalt	yes	10 lb	F	plag., poorly phyric	<1%	no	yes	along frac.		no	Mn coating
2378-6	basalt	yes	20 lb	F	plag. megacrysts	<1%	no	yes	along frac.		no	Mn coating. some ol pheno.
2378-7	basalt	yes	15 lb	F	aphyric	<1%	no	yes	minor		no	curviplanar sheet flow
2378-8	basalt	yes	13 lb	F	plag. (ol) highly phyric	<1%	no	yes	along frac.		no	Mn coated
2378-9	basalt	yes	8 lb	F	aphyric	<1%	no	yes	no		no	jumbled sheet flow
2378-10	basalt	yes	10 lb	F	aphyric	<1%	no	thin	along frac.		no	jumbled sheet flow
2378-11	basalt	yes	15 lb	F	aphyric	<1%	no	thin	no		no	jumbled sheet flow, lots of glass

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2379-1	sediment core											
2379-2	microgabbro	no	20 lb	F	pl, cpx, ol, & hbl	no	no	thin	no	chlorite, zeolite	no	olivine gabbro
2379-3	microgabbro	no	10 lb	F	pl, cpx	no	no	thin	no	chlorite, zeolite	no	diabasic texture in places

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2381-1	basalt	no	15 lb	M	plag., cpx? phyric	>1%	some	thin	mild			crystalline
2381-2	basalt	no	5 kg	M	plag., rare ol	>1%	no	no	no			
2381-3	basalt	no	2 lb	M	plag., cpx?	>1%	no	no	no			form covered with mud
2381-4	basalt	no	4 kg	M	aphyric	>1%	no	no	no			thin
2381-5	basalt	no	3 kg	M	aphyric	>1%	no	no	no			thin
2381-6	basalt	no	2.5 kg	M	?	>1%	no	no	no			sl sar silica sand on surface
2381-7	basalt	no	7 kg	M	aphyric	>3%	no	no	no			Mn coating

SIQUEIROS ALVIN SAMPLES

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2381-8	basalt	no	2 kg	M	aphyric	>1%	no	slight	yes, w/sulf.			Mn in crack
2381-9	basalt		8 kg	M	plag.	>1%	no	thin	no		no	columnar jointing
2381-10	basalt		7 kg	M	plag. ± ol	5%	3%	slight	no		brnre(	has two glasses
2381-11	basalt		2.5 kg	M	aphyric	layered	no	yes	no		no	bx glass on surface
2381-12	basalt		5 kg	M	aphyric	pipe	no	thick	along jnts		no	sulfides in pipe vesicules
2381-13	basalt		6.5 kg	M	aphyric	micro	no	no	no		no	columnar jointing
2381-14A	basalt		.5 kg	M	plag.	no	no	thick	no			glassy surface
2381-14B	basalt		5 kg	M		micro	no	thick	no			outside surface

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2382-1	basalt	2mm		F	plag. microlites	yes		1 mm				pillow frag. Mn coating on all surfaces.
2382-2	basalt	2 mm		F	aphyric	micro		1 mm	yes			pillow frag. thin weathering rind along all surfaces. Mn coating on entire sample.
2382-3	basalt			F-M	aphyric	mod. vesi.		<.5 mm				Mn coating on all faces. pillow/massive flow.
2382-4	basalt	2 mm		F	aphyric	yes		thick	thin rind		yes	Mn coating on all surfaces. rare pg microphenocrysts.
2382-5	basalt	1 mm		F	aphyric	yes		thick				Mn coating on all surfaces. rare pg microphenocrysts. Similar to above sample.
2382-6	basalt	small		F	sparsely plag. phyric	yes		thin	thin			pillow frag.
2382-7	basalt	small		F	aphyric	yes		thin		palag.		one surface is MN-coated. Glass is palag. or devetrified.
2382-8	basalt	no		F. G.	equigr.	yes		hvy.				pillow frag. looks very old.
2382-9	basalt	yes		F	plag.. phyric			yes				pillow frag., hi- plag. phyric. Glom. plag, may contain incl.+some maybe resorbed.
2382-10	basalt			F	ol, plag.., & cpx phyric	yes	zeo.-filled	hvy.				pillow frag. old-looking.
2382-11	basalt	some		F	ol. plag.. cpx phyric			yes				highly phyric. pillow frag. bottroidal surface up to 1 cm thick.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2383-1	basalt	0.25cm	5kg	F	plag 3%	5%			light		light	weathering and sediment on joint surfaces
2383-2	basalt	0.5cm	2kg	F	plag 1%	1%		light	light			
2383-3	basalt	1cm	1kg	F	plag?	sm.+pipe	yes	no	light			very light weathering in vesicles
2383-4	basalt	<3cm	7kg	F	plag 1%	1%		yes	light		mud	Mn on underside
2383-5	basalt	<8cm	2.5kg	F	plag 3%	2%		no	light			beautiful flow drip
2383-6	basalt	<1cm	2.5kg	F	plag <1%	<1%		und/side	light			
2383-7	basalt	v. thin	3kg	F	plag <10%	2%		light	some			
2383-8	basalt	<1cm	5kg	F	plag 5%	1%		yes	yes			old bud, heavy Mn

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2385-1	basalt	0.25cm	<0.5kg	F	plag porphyry	2%		slight	slight	plag slightly alt		plag porphyry
2385-2	basalt	1+cm	2.5kg	F	aphanitic	1%		slight	slight	no		
2385-3A	basalt	<1cm	2kg	F	aphyric	3%			rind			
2385-3B	basalt	?		F	aphyric	1%		yes				thin sheet, thin ropes
2385-4	basalt	0.5cm	4kg	F	plag	3%			Fe oxides			
2385-5	basalt	2+cm	6kg	F	aphyric	2%					brown on top	
2385-6 top	basalt	1cm	10kg	F	aphyric	pipe		sooty	little			2 layers flow, top+bottom glassy
2385-6 bot.	basalt	4+cm	-	F	aphyric			sooty	little			bud w/2 lobes

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2385-7A	basalt	3+cm	2kg	F	plag v. slight	1%			slight			
2385-7B	basalt	thin	0.5kg	F	plag v. slight	2%			slight			glass top+bottom
2385-8	basalt	thin	0.5kg	F	aphyric			yes				

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2386-1	basalt	1 mm		F	aphyric	2% microv		yes				pillow frag. Mn-coating on all surfaces.
2386-2	basalt	1 mm		F	aphyric	1-2% microv		v. little		yellow-orange alteration		pillow frag.
2386-3	basalt	1 mm		F	aphyric	4% microv				palag.		pillow frag. Mn-coating?
2386-4	basalt	1 mm		F	aphyric	2% microv		thin				pillow frag. Mn-coating on sides.
2386-5	basalt	1-2 mm		F	aphyric	pipe		1 mm				ropy flow and contorted mass of channels.
2386-6	basalt	1 mm		F	aphyric	2% microv				palag.		pillow frag.
2386-7	basalt	3-4 mm		F	aphyric	2%		mod.				pillow frag. Mn-coating on all sides.
2386-8	basalt	1 mm		F	aphyric	2%		yes				pillow frag. brown Mn coating.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2387-1	basalt	some	2.5 kg	F	5-10% plag., <1% ol	yes		mod.		Fe, Mn oxides		pillow frag.
2387-2	basalt	1 mm	4 kg	F	5%plag.	slightly		mod.		Feoxides staining		pillow frag.
2387-3	basalt	thin rinc	5 kg	F	5-10%plag.	5%		mod.- hvy.				massive outcrop. Mn coating on three sides.
2387-4	basalt		5 kg	F	possible plag., ol, cpx?	slightly		thin			moder	Fe oxides staining on all sides.
2387-5	basalt	5 mm	5 kg	F	2% plag.			mod.				Fe-Mn staining. pillow frag.
2387-6	basalt	v little		F	5-10% plag., 2-3% ol.			hvy.				pillow frag. w/ Mn-Fe coating on three sides.
2387-7	basalt	v little	8 kg	F	10-15% plag., 2% ol	microv		hvy.				pillow frag. w/ Mn-Fe coating on three sides.

SIQUEIROS ALVIN SAMPLES

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2387-8A	ol. microgab.	no			very ol. plag. rich			mod.			yes	odd texture-nonequigranular.
2387-8B	basalt			f	aphyric			mod.				
2387-9	basalt		5 kg	F	some plag.			mod.	yes			weathered on all sides. fresh interior.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2388-1	diabase	no	2.5 kg	F-M	rare ol pheno	tiny		mod.	thick			medium grey color.
2388-2	basalt w/gabbroic xenolith		1.5 kg	F	15% pheno (plag., ol)			mod.	rind			gabb. xeno. ~ 5 cm in dia. in one corner. No chilled margin. 5 mm weath. rind.
2388-3	basalt	yes	1 kg	F	10-15%plag., 3% ol	1%		mod.				ol-pg-cpx bearing xeno. up to 5 mm. surf. has breccia w/whole rock+ glass chips
2388-4	basalt	no	2 kg	F	20% pheno & xeno ol. plag.	<5%						xenoliths are up to 4-5 mm. weathered out surface, lack Mn coating.
2388-5	basalt	yes	5 kg	F	plag.-ol clot 5-7%, cpx?						partly	more pg in devitrified glass. blue weathered surface.
2388-6A	basalt	no	2.5 kg	F	20% plag., 3% ol,	2-5 %, 1mm			yes			many large 4-6 mm pg-cpx clots of xenoliths
2388-6B	basalt	no	1 kg	F								6A and 6B are the same.
2388-7	microgabbro	no	7 kg	M	3% pheno. plag., rare ol up to 3 mm			some	yes			contains xenoliths with cpx inclusions in pg?. has blue weathered surfaces.
2388-8	breccia	no	3 kg	F-M	cataclastics							Fault gauge
2388-9A	basalt		.5 kg	F-M	some plag.	no			5 mm rind			
2388-9B	basalt	no	.5 kg	F	aphyric				yes	yes		alteration along fractures
2388-10	basalt	yes	2 kg	F	aphyric	no		yes	hvy			roppy glass on top.
2388-11	basalt		6 kg	F	5% plag., 1% ol				3 mm rind			Xenoliths 1-5% containing pg-ol-cpx? up to 1 cm.
2388-12	basalt		6 kg	F	ol, plag., px	2%		no				odd, lumpy fracture pattern. weathering along pervasive fractures.
2388-13	basalt	thin		F	plag., rare ol	2%		mod.	yes			interior is fractured, pillow frag.
2388-14	gabbro			M	2%plag., px, hbl	2%						

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2389-1	basalt	1 cm	1 kg	F	plag 10% ol 1%	<1%		v. light	no			pillow bud
2389-2	basalt	yes	0.75 kg	F	1% plag	<1%		v. light	no			pillow bud
2389-3	basalt	1 cm	0.5 kg	F	1% plag	<1%		v. light	no	white along fractures		pillow bud
2389-4	basalt	1 cm	1.5 kg	F	1% plag	<1%		v. light	no			pillow bud
2389-5	basalt	1 cm	1.5 kg	F	2% plag, <1% ol	<<1%		v. light	no			pillow bud
2389-6	basalt	thin	1 kg	F	2% plag	<<1%		mod.	mod.	FeO staining	light	pillow frag.-talus
2389-7	basalt	1 cm	25 kg	F	25% plag, 2% ol			mod.	mod.			pillow tube
2389-8	basalt	1 cm	8 kg	F	25% plag.	<<1%		mod.	mod.		light	slabby lava

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2390-1	basalt	5 mm	3 kg	F	1% plag., <1% ol.	microv		mod.				bulbous tube
2390-2	basalt	no		F	aphyric	small pip part. zeo. fil		mod.				pillow frag. rubby flow or flow breccia
2390-3A	basalt	5 mm	2 kg	F	1% plag.	yes		yes				Crust of pillow. 'crumbly' Mn. underside has glassy to mesocrystalline rind.
2390-3B	basalt	1 cm		F	few% plag..	3%		yes				contorted sheet flow. crumbly Mn coating on surface.
2390-4	basalt	7 mm	6 kg	F	rare plag.	yes		yes				crust of large lobate. has at least 3 layers of glass.
2390-5	basalt	thick		F	3% plag.,	microv		5 mm				pilloe frag.
2390-6	basalt	no		F	plag. microlites			sooty	5 mm rind			pillow frag. Moderate Mn coating on top.
2390-7	basalt	no	8 kg	F	aphyric			1 cm				pillow frag.
2390-8	basalt	15 mm		F	rare plag..							pillow tube. outer surface has 'aa' appearance
2390-9	basalt	5 mm		F	rare plag.	rare microv		yes			yes	glass maybe devitrified.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2391-1	basalt	2 mm		F	3%plag.,	no	no	yes	hvy			pillow frag. pg glomeromorphic texture.
2391-2	basalt	thin		F-M	5%plag., <1%px	no		yes	hvy			old pillow frag.
2391-3	basalt	thin		F	2%plag.	microv		yes	hvy			old pillow frag.
2391-4	basalt			F-M	5%plag., <1%ol	scarce		yes	hvy			old pillow frag. Possible pyroxene present
2391-5	microgabbro			F-M	plag., px ±ol	4%		yes	yes			granular and pg glomeromorphic textured.
2391-6	basalt			F	5-8%plag.	no		yes	yes			old pillow frag. pg glomeromorphic.
2391-7	basalt	thin & palag.		F	10%plag.	no		yes	hvy			old pillow frag. pg pheno up to 8 mm
2391-8	basalt	no		F	4%plag.	microv		hvy.	hvy			pg pheno up to 5 mm. old pillow frag.
2391-9	basalt			F	few plag. + ol	no		hvy.				old pillow frag.
2391-10	microgabbro			F	plag., px	no				chlorite		equigranular texture.
2391-11	microgabbro	no		F	plag., px	no				chlorite		equigranular with some phenocrysts.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
2392-1A	basalt	thick		G+F	some plag. microlites	some						flat to ropy sheet flow. some pg + ol phenocrysts and a few clots of ol+pg.
2392-1B	basalt	yes		F	some plag.±ol phenos	no						pillow bud 5 cm in diameter. some pg micropheno. microvesicular at center.
2392-2	sulfides et .				sulfides							pieces of a upper chimney from a large sulfide mound. sulfides look fairly old.
2392-3	tubeworms-biology sample											
2392-4	basalt	yes		G+F	rare plag.+ol clots and pherno							ropy flow. whitish and orange staining.
2392-5	glasses +sulfides	y										wax core. has most abund.t sulph (pyrite, chalpyr. and sphal.). blue looking.
2392-6,	sulfide sed. core	some										wax core. very small amount of sulfides in wax. just pyrite. some clean glass chips
2392-7,8	sulfide sed. core	some										
2392-9	basalt	lots		G+F	aphyric							ropy to hackley sheet flow. has rare pg micropheno. and a few ol.

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SAMPLE #	BULK GLASS	GL CLEANED	PROBE CHIPS	GL POWDER	WR POWDER	COMMENTS	SAMPLE DISTRIBUTION: U. F.	U. H.	LDGO
2375-1	X		XX			probe only	X	X	
2375-2	X	XX	X	XX A		altered glass, slightly "dirty"	X	X	
2375-4	X	X	XX	XX		extra	X	X	
2375-5							X	X	X
2375-6	X	XX	XX	XX		extra, <7g powder	X	X	
2375-7	X	XX	XX(IR)	XX(JC)		extra	X	X	
2375-8	X					altered glass	X	X	X
2375-9	X	X	XX(IR)	XX(JC)		extra, no glass left on sample	X	X	
2375-2 WR					XX	thin section block	X	X	
2375-8 WR					XX				
2376-1	X	XX	XX	XX A		extra sample not cleaned	X	X	
2376-2	X	XX	XX	XX A		extra	X	X	
2376-3	X	XX	XX(IR)	XX(JC)		extra	X	X	
2376-4	X	XX	XX	XX A		extra	X	X	
2376-5	X	XX	XX	XX		extra	X	X	
2376-6A	X	XX	XX	XX A		extra	X		
2376-6B	X	XX	XX	XX		extra	X	X	
2376-7	X	XX	XX(IR)	XXA(JC)		extra	X	X	
2376-8	X	XX	XX	XXA(JC)		extra	X	X	
2376-9	X	XX	XX	XX A		extra	X	X	
2376-10	X	XX	X	XX			X	X	
2376-11	X	XX	XX	XX		extra	X (70%)	X (30%)	
2376-12	X	XX	XX	XX		extra, slightly dirty	X (70%)	X (30%)	
2377-1	X	XX	XX(IR)	XX A		extra glass	X	X	
2377-2	X	XX	XX	XX A		extra glass, has plag	X (wrapped)	X	X
2377-3	X	XX	XX(IR)	XXA(JC)		extra glass, has plag	X	X	
2377-4	X	XX	XX			dirty, cleaned 2X in HCl	X	X	
2377-5	X	XX	XX	XX A		dirty, cleaned 2X in HCl	X	X	
2377-6	X	XX	XX	XX A		small amount extra	X	X	
2377-7	X	XX	XX	XX A		extra glass	X (wrapped)	X	
2377-8	X	XX	XX	XX A			X	X	
2377-9	X	XX	XX	XX A		small amount glass	X (WR)	X (WR)	
2377-10	X	XX	XX	XX A		extra glass	X (wrapped)		
2377-11	X	XX	XX(IR)	XXA(JC)		3 whirlpacks extra glass!	X	X	
2378-1	X	XX	XX	XX A		small amount extra	X	X	
2378-2	X	XX	XX(IR)	XXA(JC)		extra	X	X	
2378-3	X	XX	XX	XX A		extra	X	X	
2378-4 WR					XX A	no glass	X	X	
2378-5			XX			very small amt glass	X	X	
2378-6	X	XX	XX(IR)	XXA(JC)		extra glass (2 splits), very dirty	X	X	
2378-7	X	XX	XX(IR)	XX(JC)		extra, slightly dirty (Mn), washed 2x	X	X	

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2378-8	X	XX	XX	XX A		washed 2X HCl, white coat & Mn coat	X	X	
2378-9	X	XX	XX	XX		extra	X	X	
2378-10	X	XX	XX	XX A		extra, washed 2X	X	X	
2378-11	X	XX	XX	XX A		extra	X	X	
2379-2 WR					XX(JC)	no glass			
2379-3 WR					XX	no glass			
2380-2			XX			small amt, not cleaned	0.5kg		
2380-3	X	XX	XX	XX		ol, plag; cleaned 30min	1kg		
2380-4	X	XX(IR, all)	X(IR, all)	XXA(JC)		split is mostly rock, powder is mix of gl+rock	0.5kg		
2380-5	X	XX	XX	XX			0.1kg		
2380-6	X	XX				cleaned 30min; not enough to powder	2kg	2kg	5kg
2380-7	X	XX	X	XX		powder is mix of glass+rock	0.25kg		
2380-8	X	XX				not enough to powder	1kg		
2380-9	X	XX		XX					
2380-10	X	XX	XX	XX		dirty sample, cleaned 30min; also plag phyric	3kg	2kg	10kg
2380-11	X	XX	XX(IR)	XX(JC)		plag, sparse ol	0.75kg		
2380-12	X	XX	XX	XX		rare ol; cleaned 30min	0.1kg		
2381-2 WR					XX		X	X	
2381-3A WR					XX(JC)		X	X	
2381-10B	X	XX	X	XX			X	X	
2381-11	X	XX	XX(IR)	XX(JC)			X		
2381-11 WR					XX			X	
2381-14A			XX(IR)			probe only	X		
2381-14B			XX			probe only	X	X	
2382-1	X		XX				1kg	X	1kg
2382-2	X		XX				1kg	X	2kg
2382-4	X		XX		XX	thin section block	0.5kg	X	1kg
2382-5	X		XX				0.5kg	X	
2382-7	X	XX	XX(IR)	XX(JC)		washed 2x	0.3kg	X	
2382-9					XX	thin section block			
2382-10					XX(JC)				
2382-11					XX				
2382-3						thin section block, no sample processed	0.5kg	X	2kg
2382-6						no sample processed	1kg		
2382-8						no sample processed	2kg	X	
2383-1	X	XX	XX	XX		sparse plag phenocrysts	3kg	0.5kg (2)	
2383-2	X	XX(IR)	X (IR)	XX(JC)			0.5kg	0.3kg (2)	
2383-3	X	XX	XX	XX		sparse plag, dirty			
2383-4	X	XX	X	XX		picked for powder but still dirty, plag pheno.	3kg	1kg	
2383-5	X	XX	XX	XX			3kg	0.5kg	
2383-6	X	XX	XX(IR)	XX(JC)			1.5kg	0.5kg	
2383-7			XX(IR)			very small amt, for probe	2kg		
2383-8	X	XX	XX	XX		heavy Mn, white coating, washed 2x	0.2kg		

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SAMPLE #	BULK GLASS	GL CLEANED	PROBE CHIPS	GL POWDER	WR POWDER	COMMENTS	SAMPLE DISTRIBUTION: U. F.	U. H.	LDGO
2383-ski							0.5kg		
2384-1	X	XX	XX(IR)	XX(JC)			X	X	
2384-2	X	XX	XX(IR)	XX			X	X	
2384-3	X	XX	XX(IR)	XX		picked clean & free of ol phenocrysts	X	X	
2384-4						0.5kg to USGS	6kg	1kg	0.5kg
2384-5						breccia	2kg	2kg	2kg
2384-6	X	XX	XX	XX			2kg	2kg	
2384-7A	X	XX	XX	XX		top glass flow	X		
2384-7B	X	XX	XX	XX		bottom glass flow	X		
2384-8	X	XX	XX	XX		glass picked free of ol.; 0.5kg to USGS	3kg	5kg	
2384-9	X	XX	XX(IR)	XX(JC)			X	X	
2384-10	X	XX	XX	XX			5kg	2kg	
2384-11	X	XX	XX(IR)	XX(JC)		0.5kg to USGS	2kg	2kg	
2384-12	X		XX			probe only	1kg	1kg	0.5kg
2384-13						WR chip cut	4kg	4kg	3kg
2384-14						WR chip cut	8kg	5kg	5kg
2385-1	X	XX	XX	XX			1lb	0.3lb	
2385-2	X	XX	XX(IR)	XX(JC)			6lb	1lb	0.5lb
2385-3A	X	XX	X(IR)	X			3lb	0.3lb	0.3lb
2385-3B	X	XX	XX	XX			4lb	0.3lb	3lb
2385-4	X	XX	XX	XX			10lb	2lb	3lb
2385-5	X	XX	XX	XX			X	glass	3lb
2385-6T	X	XX	XX(IR)	XX(JC)		T=top	15lb	3lb	
2385-6B	X	XX	XX	XX		B=bottom	"	"	
2385-7A	X	XX	XX	XX			X	glass	
2385-7B	X	XX	XX	XX			X		
2385-8	X		XX				0.5lb	0.2lb	
2385-9	X	XX	XX	XX			1.5lb	0.5lb	0.6lb
2386-1			XX			not enough	1kg	0.2kg	
2386-2			XX			not enough	0.7kg	0.3kg	
2386-3			XX	XX			1kg	0.5kg	
2386-4			XX				1kg	1kg	
2386-5	X	XX	XX(IR)	XX(JC)		more glass on sample	2kg		
2386-6			XX		XX		1kg	0.3kg	
2386-7	X	XX	XX(IR)	XX		WR too, thin section block	1kg	0.25kg	
2386-8			XX				3kg	0.25kg	
2387-1	X	XX	XX(IR)	XX(JC)		no glass (?? written on orig. sheet)	0.5kg	0.5kg	0.5kg
2387-2	X		XX			very dirty, probe only	2kg	2kg	3kg
2387-3						no glass, sample bagged for WR	5kg		
2387-4						no glass, sample bagged for WR	5kg		
2387-5	X	XX	XX	XX			2kg	2kg	4kg
2387-6	X	XX	XX(IR)	XX(JC)		dirty glass, cleaned 30min	0.5kg	0.5kg	1kg
2387-7						no glass	2kg	1kg	6kg
2387-8A						microgabbro, no glass	ts chip	X	
2387-8B						no glass	8kg		

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2387-9						no glass	5kg		
2388-1						no glass, WR chips			
2388-2	X		XX	XX					
2388-3A			XX(IR)			3A=glass from rock; plag phyric			
2388-3B			XX			3B=glass from breccia on surface			
2388-4						no glass			
2388-5			XX			thin, devitrified glass; WR chip			
2388-6						no glass			
2388-7						no glass; WR chip			
2388-8						breccia			
2388-9A						no glass	0.3kg	0.2kg	
2388-9B						no glass	0.3kg	0.2kg	
2388-10	X	XX	XX(IR)	XX		extra bag of glass	1.5kg	1kg	
2388-11						no glass			
2388-12						no glass			
2388-13			XX			glass is dirty and only thin crust, small amt	1kg	0.5kg	1.5kg
2389-1	X	XX	XX(IR)	XX(JC)			X		
2389-2	X	XX	XX	XX			X		
2389-3	X	XX	XX	XX		sparse ol	X		
2389-4	X	XX	XX	XX			X		
2389-5	X	XX	XX	XX			X		
2389-6	X	XX	X	XX		mix of glass & mesocrystalline stuff	X		
2389-7	X	XX	XX	XX		pillow tube	2kg	2kg	20kg
2389-8	X	XX	XX	XX		slabby lava; 1kg to USGS, 1kg to R. Schuster	4kg	1kg	
2390-1	X	XX	XX(IR)	XX(JC)		glass full of plagioclase			all
2390-2						no glass	2kg	1kg	3kg
2390-3A	X		XX	XX			2kg	0.5kg	
2390-3B	X	XX	XX	XX			X	X	
2390-4	X	XX	XX	XX			2kg	2kg	4kg
2390-5	X	XX	X	XX		glass full of small plag	all		
2390-6	X	XX	X			very little glass	2kg	1kg	5kg
2390-7	X	X		XX		still dirty, do on probe	2kg	1kg	4kg
2390-8	X	XX		XX		lots of plag, small amt ol; cleaned 30min	all (2kg)		
2390-9	X	XX	XX(IR)	XX(JC)		extra glass	1kg	0.5kg	
2391-1	X	XX	XX(IR)	XX			5kg	2kg	2kg
2391-2	X	XX	XX			5.5g of glass cleaned	2kg	2kg	15kg
2391-3	X	XX	XX	XX			2kg	1kg	
2391-4						thin section chip	1.5kg	0.5kg	
2391-5						thin section chip	5kg	5kg	
2391-6							2kg	2kg	
2391-7						thin section chip	2kg	2.5kg	10kg
2391-8							5kg	3kg	
2391-9							4kg	2kg	0.2kg
2391-10							5kg	15kg	2kg
2391-11							3kg	8kg	

AII 125/LBG 25 ALVIN SAMPLE PROCESSING: **SAMPLE DISTRIBUTION:**

X=checked on original processing form; XX=verified during transit to San Diego; A=powdered in agate ball mill (otherwise done in alumina ball mill).
glass cleaned=there is cleaned, unpowdered glass; probe chips=there is dirty, unpowdered glass for probe, etc.
JC=Jack Casey has part of the powder. IR=Ian Ridley (has glass samples only).

SAMPLE #	BULK GLASS	GL CLEANED	PROBE CHIPS	GL POWDER	WR POWDER	COMMENTS	U. F.	U. H.	LDGO
2392-1A	X	XX		XX					
2392-2						sulfide split between Suzanne Paradis and			
2392-4	X	XX		XX					
2392-9	X	XX		XX		bag of 0.5kg of glass			
2392-10	X	XX	XX	XX					

SIQUEIROS DREDGE SAMPLES

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D1-1	Basalt	Yes		9 F.G.	aphyric	<1%	No	thin	mild	joint discol.	no	pillow, joints, large pipe vesc
A25D1-2	Basalt	Yes		4.5 F.G.	aphyric	<1%	No	thin	mild	joint discol.	no	pillow, thick Mn crust
A25D1-3	Basalt	Yes		7 F.G.	aphyric	<1%	No	thin	mild	joint discol.	no	pillow, joints, pipe vesc.
A25D1-4	Basalt	Yes		5.5 F.G.	aphyric	3%	No	trace	mild	joint discol.	no	pillow frag.
A25D1-5	Basalt	Yes		20 F.G.	aphyric	<1%	No	thin	mild	joint discol.	no	pillow, pipe vesicules
A25D1-6	Basalt	Yes		4 F.G.	plag. microphyric	<1%	No	no	mild	joint discol.	no	pillow, glass rust weathering
A25D1-7	Basalt	Yes		6 F.G.	plag. phyric	>1%	No	thin	mild	joint discol.	no	pillow, tube vesicules
A25D1-8	Basalt	Yes		2 F.G.	aphyric	<1%	No	thin	mild	joint discol.	no	fresh glass, rust weathering, pillow
A25D1-9	Basalt	Yes		1.5 F.G.	aphyric	<1%	No	no	mild	joint discol.	no	fresh glass, minor weathering, pillow
A25D1-10	Basalt	Yes		1.5 F.G.	aphyric	~1%	No	no	no	joint discol.	no	fresh glass, minor weathering, pillow
A25D1-11	Basalt	Yes		1.5 F.G.	aphyric, plag.	<1%	No	trace	mild	joint discol.	no	fresh glass, pillow
A25D1-12	Basalt	Yes		1.5 F.G.	aphyric	<1%	No	thin	mild	partially palag.	no	fresh glass, pillow
A25D1-13	Basalt	Yes		1 F.G.	aphyric	<1%	No	no	mild	partially palag.	no	thick rim of fresh glass, pillow
A25D1-14	Basalt	Yes		1 F.G.	plag. phyric	<1%	No	no	v. mild	partially palag.	no	fresh glass, pillow
A25D1-15	Basalt	Yes		1 F.G.	aphyric	<1%	No	no	mild	thick rusty palag. rim	no	fresh glass, pillow
A25D1-16	Basalt	Yes		1 F.G.	aphyric	<1%	No	no	v. mild	joint discol.	no	fresh glass, pillow
A25D1-17	Basalt	Yes		0.75 F.G.	aphyric	<1%	No	no	v. mild		no	fresh glass, pillow
A25D1-18	Basalt	Yes		0.5 F.G.	aphyric	<1%	No	no	v. mild		no	fresh glass, pillow
A25D1-19	Basalt	Yes		0.5 F.G.	aphyric	<1%	No	no	v. mild		no	thick rim of fresh glass, pillow
A25D1-21	pillow basalt	5mm		3 aphyric	<1%plag.	Yes	no	trace	no	light	no	pillow frag. pg pheno
A25D1-22	pillow basalt	4 mm		10 aphyric	trace plag.	Yes	no	trace	light	light palagn.	no	pillow frag. pg pheno
A25D1-23	pillow basalt	6 mm		15 aphyric	trace plag.	Yes	no	trace	light	light palag.	no	pillow frag. pg pheno
A25D1-24	pillow basalt	3 mm		2 aphyric	trace plag.	Yes	no	trace	light	light palag.	no	pillow frag. pg pheno
A25D1-25	pillow basalt	2 mm		1 aphyric	trace plag.	Yes	no	trace	light	Light	no	pillow frag. pg pheno
A25D1-26	pillow basalt	10 mm		8 aphyric	trace plag.	Yes	no	.1 mm	light	light	no	pillow frag. pg pheno
A25D1-27	pillow basalt	5 mm		2 aphyric	trace plag.	Yes	no	trace	light	light	trace	pillow frag. pg pheno
A25D1-28	pillow basalt	5 mm		0.5 aphyric	1% plag.	Yes	no	trace	light	light	no	pillow frag. pg pheno
A25D1-29	pillow basalt	no		0.5 aphyric	1% plag.	Yes	no	no	light	light	no	pillow interior
A25D1-30	pillow basalt	8 mm		2 aphyric	1% plag.	Yes	no	trace	light	light	no	pillow frag. pg pheno
A25D1-31	pillow basalt	5 mm		0.5 aphyric	1% plag.	Yes	no	no	light	light	trace no	pillow frag. pg pheno
A25D1-32	pillow basalt	4 mm		0.8 aphyric	1% plag.	Yes	no	trace	light	light	no	pillow frag. pg pheno
A25D1-33	pillow basalt	3 mm		1 aphyric	trace plag.	Yes	no	trace	light	light	no	pillow frag. pg pheno
A25D1-34	pillow basalt	6 mm		0.2 aphyric	trace plag.	Yes	no	trace	light		Yes	pillow frag. pg pheno
A25D1-35	pillow basalt	5 mm		3 aphyric		Yes	no	Yes	yes		no	
A25D1-36	pillow basalt	.25 mm		3 aphyric	plag.	Yes	no	Yes	yes		no	
A25D1-37	pillow basalt	5 mm		3 aphyric	plag.	Yes	no	Yes	yes		no	
A25D1-38	pillow basalt	5 mm		2 aphyric	plag. pheno. to 3 mm	Yes	no	Yes	yes		yes	
A25D1-39	pillow basalt	.3 mm		2 aphyric	plag. pheno. to 3 mm	Yes	no	Yes	yes		yes	
A25D1-40	pillow basalt	.2 mm		1.5 aphyric	plag. pheno. to 4 mm	Yes	no	Yes	yes		no	
A25D1-41	pillow basalt	.5 mm		2 aphyric	plag. pheno. to 3 mm	Yes	no	Yes	yes		no	
A25D1-42	pillow basalt	.3 mm		0.5 aphyric	plag. pheno. to 3 mm	Yes	no	no	yes		no	
A25D1-43	pillow basalt	.2 mm		0.3 aphyric		Yes	no	Yes	yes		no	internal glass layer?
A25D1-44	pillow basalt	.2 mm		0.3 aphyric	plag. pheno. to 3 mm	Yes	no	no	yes		no	
A25D1-45	pillow basalt	10 mm		0.5 aphyric	plag. pheno. to 3 mm	Yes	no	minor	yes		no	
A25D1-46	pillow basalt	10 mm		3 aphyric	plag. pheno. to 3 mm	Yes	no	Yes	yes		no	
A25D1-47	pillow basalt	5 mm		2 aphyric		Yes	no	Yes	yes		no	
A25D1-48	pillow basalt	.2 mm		0.5 aphyric	plag.		no	no	yes		yes	palag.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D2-1	basalt	no		3 F.G.	plag.	<1%	No	no	minor	along cracks	no	massive vesicular
A25D2-2	basalt	no		0.3 M-F	plag.	<2%	No	no	mild	rind	some	massive vesicular
A25D2-3	basalt	some		0.5 M-F	plag.+px	2%	No	no	mild	rind+cracks	some	massive vesicular
A25D2-4	basalt	no		0.5 M-F	plag.	<2%	No	no	mild	rind+cracks	some	massive vesicular
A25D2-5	basalt	no		1 M-F	plag.+px	2%	No	no	mild	rind+cracks	some	massive vesicular
A25D2-6	basalt	no		0.5 F	aphyric	<2%	yes	no	mild	irregular	some	weird pipe vesicules clastic morphology?
A25D2-7	basalt	yes		4 F	aphyric	1%	No	no	some	slt. discol.	some	pillow, thin glass
A25D2-8	basalt	not much		4 F	aphyric	1%	No	no	some	discol.	some	pillow
A25D2-9	basalt	yes		1 F	plag.	1%	No	no	mild	slt. discol.	some	pillow, thin glass
A25D2-10	basalt	yes		0.5 F	aphyric	1%	No	no	some	slt. discol.	some	pillow, thin glass
A25D2-11	basalt	yes		2 F	aphyric	1%	No	no	mild	part. palag.	some	pillow, thin glass, not too fresh
A25D2-12	basalt	yes		0.5 F	plag.<1%	1%	No	no	some	slt. discol.	some	pillow, thin glass
A25D2-13	basalt	yes		0.5 F	plag.<1%	1%	No	no	some	slt. discol.	slight	pillow
A25D2-14	basalt	yes		1 F	plag.<1%	1%	No	no	mild	slt. discol.	some	v. thin glass
A25D2-15	basalt	yes		0.25 F	plag.<1%	1%	No	slight	mild	Fe oxide?	some	v. thin glass
A25D2-16	basalt	yes		0.25 F	plag.<1%	1%	No	no	mild	slt. discol.	some	
A25D2-17	basalt	v. small		0.25 F	plag.<1%	1%	No	no	mild	blue	some	

SIQUEIROS DREDGE SAMPLES

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D2-18	basalt	yes	0.25	F	aphyric	1%	No	no	some	slt. discol.	slight	pillow, thin glass
A25D2-19	basalt	yes	0.25	F	plag.<1%	1%	No	no	some	blue	slight	
A25D2-20	basalt	v. little	0.25	F	aphyric	1%	No	no	some	blue	slight	v. little glass
A25D2-21	basalt			F		1%	No	no				
A25D2-22	basalt	v. little	0.25	F	plag.<1%	1%	No	no	slight	Fe staining	slight	
A25D2-23	2 small frag.	no	0.1	F	plag, px, minor ol.	1%	No	no	minor	minor	no	unusual-may be fractionated
A25D2-24	1 small diabase	no	0.1		pl+ px.		No	no	minor	minor	no	diabase
		other small pieces divided evenly among UF, UH, LDGO										

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25-3RC	rock-core sm. amt of glas. & Mn		< 1g									

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D4-1	basalt	yes	8	F	aphyric	5%	no	yes	yes	Fe & Mn oxides	no	
A25D4-2	basalt	yes	0.1	F	aphyric/glass	no	no	no	no	some clay		for probe
A25D4-3	basalt	yes	0.5	F	aphyric/glass	no	no	no	yes	fine dust of Fe-oxides	no	glass
A25D4-4	Andesitic basalt	yes	1.5	F	aphyric	1%	no	no	yes	Fe-oxides & clay	no	white coating(clays?)
A25D4-5	basalt	no	3		aphyric	few	no	yes		Fe-oxides & clay	no	whole rock analysis
A25D4-6	basalt	yes	5	F	aphyric	yes	yes	yes	yes	Fe-oxide	no	
A25D4-7	basalt	1 mm	8	F	aphyric	no	no	minor	yes	Fe-oxide	no	
A25D4-8	basalt	yes	3	V.F	aphyric	5%	no	yes		Fe-oxide	no	
A25D4-9	basalt	yes	1.5		aphyric	3%	no	yes			no	
A25D4-10	basalt	no	1		aphyric	few	no	yes	yes	Fe-oxide	no	whole rock analysis
A25D4-11	basalt	yes	1	V. F	aphyric	no	no	yes	yes		no	whitish coating
A25D4-12	basalt	yes	1	F	plag.	3%	no			Fe-oxide	no	

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D5-1	basalt	Yes	10 kg	F	?		no	trace	mild			pillow frag.
A25D5-2	basalt	Yes	10 kg	F		1%	no	trace	mild	Fe-oxides	clays along cracks	
A25D5-3	basalt	Yes	7 kg	F		rare	no	trace	mild	Fe-oxides	no	
A25D5-4	basalt	Yes	7 kg	F		centerno			mild	Fe-oxides	no	flow banding
A25D5-5	basalt	Yes	7 kg	F		centerno		trace	mild	Fe-oxides	no	flow banding

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D6-1	basaltic glass	yes	25 grams	G	?	no	no	Mn on t	slight a	clays & 5mm Mn crust	yes	sed. in fractures, fresh glass
A25D6-2	basalt	yes	5 lb	F		no	no	yes	slight a	Mn and Fe oxides and clays		

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D7-1	glass bud	Yes	15 grams	G	glass	no	no	yes		75% of the glass is alte	no	5 * 2.5 * 2 cm
A25D7-2	glass	yes	25 grams	G	glass	no	no	yes		some glass altered	minor cla	flat crust 3*3*1 cm
A25D7-3	glass	yes	30 grams	G	glass	no	no	yes		some glass altered	minor cla	ropy crust 4*3*1 cm

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D8-1	basalt	very thin	1 kg	F	aphyric	no	no	heavy	heavy	along fracture		old pillow frag.

A25D9	no recovery
A25D10	no recovery

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25-11RC	rock-core Mn crusts and biogenic ooze, and one small piece of glass											

A25D12	no recovery

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D13-1	plag. phyric basalt	slight	20 grams	glassy	plag. +ol±spl	no	no	heavy	some	slight oxidation	slt.	unusual texture and mineralogy

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D14-1	plag. phyric basalt	no		F	plag.±ol	no	no	heavy				
A25D14-2	plag. phyric basalt	no		F	plag.±ol	no	no	heavy				
A25D14-3	plag. phyric basalt	no		F	plag.±ol	no	no	heavy				
A25D14-4	plag. phyric basalt	no		F	plag.±ol	no	no	heavy				
A25D14-5	plag. phyric basalt	no		F	less plag.	no	no	heavy				
A25D14-6	plag. phyric basalt	no		F	less plag.	no	no	heavy				

SIQUEIROS DREDGE SAMPLES

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D15-1	plag. ol glass	matrix	81 grams	G	plag.+ ol in glass		no	2 mm		glass slight altered		same sort as D13 and similar sample but D15 has glass matrix

assorted fragments of single rock recovered and Mn crusts

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D16	no recovery											

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D17-13	layered gabbro	no	60 lb	M	plag.-cpx gab/cpx	no	no	no	moderate		no	sample shows layering
A25D17-14	basalt/diabase	no	6 lb	M	plag.-cpx/aphyric	no	<1%	no	modera'	zeolite/chlorite	no	no chilled surface or glass
A25D17-15	basalt/diabase	no	9 lb	M	plag.-cpx/aphyric	no	<1%	no	no	zeolite/chlorite	no	no chilled surface or glass
A25D17-16	basalt	no	6 lb	F	plag.-ol.phyric or aphyric	<1%	no	no	along fr	minor	no	xenogabbro co/gabbro
A25D17-17	microgabbro	no	10 lb	M	plag.-cpx	vugs	no	no	modera'	along fracture	no	
A25D17-18	microgabbro	no	15 lb	M	plag.-cpx	no	no	no	modera'	chlorite	no	thick weathering rind
A25D17-19	microgabbro	no	2 lb	M	plag.-cpx	no	no	no	modera'	amphibolite	no	
A25D17-20	basalt	no		8 F	plag.-ol phyric	<1%	no	no	no	in xenoliths	no	xenoliths of gabbro/amphibolite
A25D17-21	glass breccia	no										
A25D17-22	glass breccia	no										
A25D17-23	microgabbro	no										

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D18-1	basalt											
A25D18-2	glass											
A25D18-3	basalt											
A25D18-4	flat glass											roppy flow, Mn coated
A25D18-5	glass											roppy flow
A25D18-6	glass											

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D19-1	glass											
A25D19-2	basalt	Yes		F	aphyric							glassy fragment
A25D19-3	basalt	yes		F	aphyric			thin				pillow frag.
A25D19-4	basalt	no		F	aphyric			yes				Mn coating on all surfaces, pillow frag.
A25D19-5	basalt	palag.		F	aphyric			yes				Mn coating on top. weathered zones in interior. bottom is slight vesicuar.
A25D19-6	basalt	Yes	5 kg	F	aphyric			yes				sooty Mn coating. pillow frag. weathering halos.
A25D19-7	basalt	thin	7 kg	F	aphyric			1 mm				pillow frag. Mn coating on all surfaces
A25D19-8	basalt	palag.	5 kg	F	aphyric			2 mm				pillow frag. Mn coating on top.
A25D19-9	basalt	<1mm	7 kg	F	aphyric			1 mm				pillow frag.
A25D19-10	pumice frag.											rounded, dirty light brown color.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D20-1	picrite	yes	3 lb	F	8% Ol, 1% plag.	yes	no	no	no	no	no	pillow bud
A25D20-2	picrite	yes	3 lb	F	8% Ol, 1% plag.	no	no	yes	yes	no	no	pillow frag. Mn & white mat.
A25D20-3	picrite	yes	8 lb	F	8% Ol, 1% plag.	no	no	no	no	no	no	pillow frag.
A25D20-4	picrite	yes	5 lb	F	8% Ol, 1% plag.	no	no	no	no	no	no	pillow frag.
A25D20-5	picrite	yes	5 lb	F	8% Ol, 1% plag.	no	no	no	no	no	no	pillow frag.
A25D20-6	picrite	yes	5 lb	F	5% Ol, 1% plag.	no	no	yes	yes	no	no	pillow frag. MnO, FeO, & white mat.
A25D20-7	picrite	yes	3 lb	F	5% Ol, 1% plag.	no	no	no	no	no	no	pillow frag.
A25D20-8	picrite	yes	3 lb	F	5% Ol, 1% plag.	no	no	no	no	no	no	pillow frag.
A25D20-9	picrite	no	8 lb	F	micro-plag.	no	no	yes	yes	no	no	old pillow frag. MnO, FeO staining
A25D20-10	picrite	no	8 lb	F	micro-plag.	no	no	yes	yes	no	no	Gypsum, oxides on fracture
A25D20-11	picrite	no	4 lb	F	micro-plag.	no	no	yes	yes	no	no	old pillow frag. MnO coating
A25D20-12	picrite	dirty glass	15 lb	F	micro-plag.	no	no	yes	yes	no	no	old pillow frag.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D21-1	Alvin ski dredge											

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D22-1	basalt	15mm	20 kg	F	ol. plag.	1%	no	no	light	no	bm	very fresh , little sediment cover.
A25D22-2	basalt	8 mm	13 kg	F	ol± plag.	pipe	no	no	slight	no	no	
A25D22-3	basalt	4 mm	1 kg	F	ol. plag.	pipe	maybe	no	slight	no	no	
A25D22-4	basalt	thin	.25 kg	F	ol. , plag.	yes	no	no	some	no	no	
A25D22-5	basalt	3 mm	.25 kg	F	ol+plag.	pipe	no	no	some	no	no	

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D23-1	basalt	yes	70 kg	F	2% Ol. & rare plag.	yes	NO	no	yes	no	no	pillow frag. big pipe vesicules.
A25D23-2	basalt	yes	1 kg	F	3% ol	yes	NO	no	yes	no	no	pillow fragment.

SIQUEIROS DREDGE SAMPLES

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D24-1	glass	yes	?	glass	1% ol	yes	NO	no	no	no	no	pipe vesicule glass flow
A25D24-2	basalt	yes	.5 lb	F	1% ol	no	NO	no	no	no	no	pillow buds
A25D24-3	basalt	no	.5 lb	M	aphyric	5%	NO	yes	yes	no	no	old pillow fragment

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D25-1	basalt	no	5 kg	F	plag. + ol	yes		yes				
A25D25-2	basalt	no	10 kg	F	trace plag.			yes?				thick Mn coating
A25D25-3	basalt	no	2 kg	F	trace plag.	yes		thick				
A25D25-4	basalt	no	7 kg	F		yes		thick				weathering rind
A25D25-5	basalt	no	.5 kg	F	plag.	yes		yes?				old pillow more vesicular than others
A25D25-6	glass	yes		G		yes						
A25D25-7	glass	yes		G								

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D26-1	basalt	yes		F	aphyric	no	no	yes	yes	no	no	old ol-phyric frag.
A25D26-2												
A25D26-3												
A25D26-4	basalt	yes	.5 lb	F	aphyric	yes	?	no	yes	no	no	relatively fresh
A25D26-5	basalt	yes	.5 lb	F	aphyric	no	no	yes	yes	no	no	pillow frag
A25D26-6	basalt	yes	.8 lb	F	aphyric	no	no	yes	yes	no	no	pillow frag
A25D26-7	basalt	no	1 lb	F	aphyric	yes	no	yes	yes	no	yes	microvesicules 5-10%
A25D26-8	basalt	yes	.8 lb	F	aphyric	no	no	yes	yes	no	yes	glassy pillow frag. "breccia"
A25D26-9	basalt	yes	.8 lb	F	aphyric	no	no	yes	yes	no	yes	pillow frag
A25D26A25D:	basalt	no	.3 lb	F	aphyric	no	no	yes	yes	no	no	

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D27-1	basalt	v. thin		F	aphyric			thin				Mn coating on all surfaces
A25D27-2	basalt			F	aphyric			thin				Mn coating on all surfaces
A25D27-3	basalt			F	aphyric			thin				Mn coating on all surfaces
A25D27-4	basalt			F	aphyric	yes		thin				Mn coating on all surfaces, vesicular.
A25D27-5	glass			glassy				thin				

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D28-1	pg phyric basalt	thin			plag. 15%, ol <1%			thin	mild			pg up to 8 mm.
A25D28-2	pg +ol phyric basalt	no			15%plag., <1%ol			yes	mild			pg up to 5 mm, ol 0.5 mm
A25D28-3	pg ol phyric basalt	5 mm			plag. 10%, ol <1%	5%		yes	yes			pg zoned.
A25D28-4	pg ol phyric basalt	v. little			plag. 10%, ol <1%	yes		yes	yes			relatively fresh. All surface is weathered.
A25D28-5	pg ol phyric basalt	thin			plag. 10-15%, ol <1%			yes	yes			pg up to 8 mm, ol up to 1.5 mm.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D29-1	pg phyric basalt		walnut siz	F	5% plag., <1% ol	2%		yes	yes			total sample is walnut size.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D30-1	pg+ol phyric basalt	few mm		F-M	plag. <1%, ol<1%	no		heavy	yes			pillow frag. all surfaces are weathered. pg & ol pheno. < 1 mm.
A25D30-2	ol phyric basalt	yes		F	ol<1%	no		light	yes			pillow frag. fresh glasses(several mm thick)
A25D30-3	ol & pg phyric basalt			F-M	<1% ol, <1% plag.			yes	yes			pillow frag. ol & pg pheno < 1 mm.
A25D30-4	basalt	no		F	aphyric	no		yes	yes			
A25D30-5	basalt	yes		F	aphyric	no						Heavily Mn coated pillow frag.
A25D30-6	basalt	thin		F-M	sparse Ol & plag.	yes						pillow frag.
A25D30-7	basalt	thin		F-M	<1% plag.	yes		yes				pillow frag.
A25D30-8	basalt			F	sparse plag.	no		heavy				

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D31-1	basalt	yes		F	plag. <1%			heavy	yes	discol.		pillow frag.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D32-1	basalt	yes	.5 kg	F	aphyric	pipe						pillow frag.
A25D32-2	basalt	yes		F	aphyric			heavy	heavy			pillow frag. Platy Mn coating
A25D32-3	basalt	yes		F	aphyric			heavy				Some pg-microlites
A25D32-4	basalt	yes			aphyric							pillow frag. completely coated with Mn.
A25D32-5	basalt	yes			aphyric							pillow frag.
A25D32-6	basalt	thin		F-M	some plag.							large pillow frag.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	V e	A m	M n	W e	Alteration	Sed.	Remarks
A25D33-1	basalt	thin		F	aphyric							pillow frag. Mn coating on all surfaces
A25D33-2	basalt	no		F-M	some plag. (cpx?)	2%		heavy	heavy			large pillow frag.

SIQUEIROS DREDGE SAMPLES

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25D33-3	basalt	thin		F	rare plag.			heavy	heavy			D33-4,5 similar samples takenas extras for University of Florida.
A25D33-4	basalt											
A25D33-5	basalt											

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25D34-1	basalt	thin	10 kg	F	plag.	1%	no	yes	yes	no	no	
A25D34-2	basalt	thin	15 kg	F	plag.	1%	no	yes	yes	no	no	
A25D34-3	basalt	thin	1.5 kg	F	plag.	1%	no	yes	yes	no	no	
A25D34-4	basalt	thin	2 kg	F	aphyric	1%	no	yes	yes	no	no	glass surface brecciated.
A25D34-5	basalt	thin		F	aphyric	1%	no	yes	yes	no	no	

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25D35-1	pg phyric basalt	yes	1.5 lb	F-M	plag.<2%	4%		thin	yes			pillow frag.
A25D35-2	basalt	yes	15 kg	M		<1%		yes	yes			Mn coating on all surfaces. pillow frag.
A25D35-3	basalt	yes	30 kg	M	scarce ol and some plag.	few		yes	yes			pillow frag.
A25D35-4	ol-pg phyric basalt	yes	20 kg	F-M	ol 1%, plag. 10%	2%		yes	yes			pillow frag. Mn coating on all surfaces
A25D35-5	pg phyric basalt	yes	1 lb	F	plag. <2%	4%						small pillow frag. same as sample 1.
A25D35-6	basalt	3 mm	5 kg	F-M	aphyric	5%		yes				old pillow frag.
A25D35-7	basalt	no		M	<1%plag., some px and ol?	3%		heavy				old pillow frag.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25D36-1	Mn plates and 1 fragment composed of agglomeration of Mn pebbles and pelagic sediments between the pebbles.											
A25D36-2	basalt	yes		F	?							frag. of pillow bud. Mn coated.
A25D36-3	chips of glass											
A25D36-4	chips of glass											
A25D36-5	chips of glass											
A25D36-6	pg phyric basalt	thin		F	<1% plag.	5%		yes	yes			old pillow frag.
A25D36-7	pg phyric	same as sample #6										
A25D36-8	basalt	no		M	aphyric			heavy				old pillow frag.
A25D36-9	basalt				some plag.	4%		heavy				old pillow frag. All surfaces are Mn coated.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25D37-1	basalt	no	.5 kg	F	aphyric	rare	no	thin	yes	palag.	no	
A25D37-2	glass	yes	few gr	glassy		no	no	thick	no	no	no	glass budlet
A25D37-3	basalt	no	few gr	med	plag.	no	no	thick	yes	palag.	no	medium grained

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25D38-1	basalt	thin	5 kg?	F	aphyric?			yes	yes			old pillow frag.
A25D38-2	basalt	1 mm			plag. <2%			yes	yes			pillow frag
A25D38-3	basalt	1 mm			plag. < 5% in glass	micro-		yes	yes			pillow frag. pg < 1 mm
A25D38-4	basalt	3 mm			ol +plag. < 3%	yes		yes	yes		yes	pg <5 % in glass. pillow frag. more vesicular, weathered and sedimented.
A25D38-5	basalt	yes		M	plag. 2% in rock, 5% in glass							pillow frag.

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25D39-1	basalt	yes			aphyric	no		heavy				Mn coated pillow bud
A25D39-2	basalt				3% plag.	rare						
A25D39-3	basalt				holocrystalline	no						1% micropheno
A25D39-4	similar basalt goes to Univ. Houston											

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25RC40	rock-core small pieces of glasses, a few pieces with Fe-oxides coating. total weight ~ 2.5 grams.											

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25RC41	rock-core small pieces of pg microlites-bearing glasses. total weight 4 grams.											

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25RC42	rock-core small pieces of glass, some Mn and sediments.											

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25D43-1	basalt	no						heavy			yes	small pillow frag.
A25D43-2	Mn-coated glass	yes	4.5 grams	glassy								thin flat piece
A25D43-3	Mn-coated glass	yes	2.5 grams									thin flat piece
A25D43-4	Mn-coated glass	yes	1.0 grams									thin flat piece
A25D43-5	Mn-coated glass	yes	8.5 grams									basalt &glass, bud-shaped piece

Sample #	Lithology	Glass	Wt	G. S.	Mineralogy	Ve	Am	Mn	We	Alteration	Sed.	Remarks
A25D44-1	basalt	yes	20 kg	F	aphyric	5%		v light	heavy			large piece of pillow frag. 1% xenolith severely weathered
A25D44-2	basalt	yes	4 kg	F	aphyric	5%		yes	yes			pillow frag. <1% xenocrysts of pg.

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SAMPLE #	BULK GLASS	GL CLEANED	PROBE CHIPS	GL POWDER	WR POWDER	COMMENTS	U. F.	U. H.	LDGO
D1-1	X	XX	X	XX A		some to Floyd McCoy	4kg		
D1-2	X	XX	X	XX			2kg		
D1-3	X	XX	X (IR)	XX A			3.5kg		
D1-4	X	XX	X	XX			2.5kg		
D1-5	X	XX	X (IR)	XX (JC)			8kg		
D1 bulk samples						extra bulk samples	06-19	21-34	35-48
D2-3	X	X	X				X		
D2-3 WR					XX				
D2-6					XX				
D2-7	X	XX	X				X		
D2-8	X	XX	X				X		
D2-8 WR					XX		"		
D2-9	X	XX	X				X		
D2-10	X	XX	X				X		
D2-11	X	X	X				X		
D2-12	X	XX	X				X		
D2-14	X	XX	X			dropped during cleaning	X		
D2-15	X	XX	X				X		
D2-16	X	XX	X			dropped - thrown away			
D2-17	X	XX	X			small amount	X		
D2-18	X	XX	X				X		
D2-19	X	XX	X						
D2-20	X	XX	X				X		
D2-21	X					dropped/discarded			
D2-22	X	XX	X				X		
RC-3	X	XX					X		
D4-1	X	XX	X	XX					
D4-2	X	X	XX (IR)			small amt, not powdered			
D4-3	X	XX	XX	XX A					
D4-4	X	XX (IR)	X (IR)			small amt, not powdered; mesocrystalline			
D4-5 WR					XX A				
D4-6	X	XX	XX (IR)	XX A (JC)					
D4-7	X	XX	X			small amt, not powdered			
D4-8	X	XX	XX	XX A					
D4-9	X	XX	X			small amt, not powdered			
D4-10 WR					XX				
D4-11	X	XX	X			small amt, not powdered			
D4-12	X	XX	XX	XX					
D5-1									
D5-2	X	XX	X			small amt, not powdered			
D5-3	X	XX	X			small amt, not powdered			
D5-4	X	XX	X	XX					
D5-5	X	XX	X	XX A					

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SAMPLE #	BULK GLASS	GL CLEANED	PROBE CHIPS	GL POWDER	WR POWDER	COMMENTS	U. F.	U. H.	LDGO
D6-1	X	XX	X (IR)	XX (JC)					
D6-2	X	XX	X (IR)			small amt, not powdered			
D7-1	X	X	XX	XX A					
D7-2	X	X	X			small amt, not powdered			
D7-3	X	X	XX	XX		extra			
D8-1 WR					XX (JC)	WR only, thin section chip			
D13-1			XX (IR)			Mn, Fe stained, gl slightly altered; all to USGS			
D14-1			XX (IR)			Mn, Fe stained, gl slightly altered; all to USGS			
D14-2			XX			Mn, Fe stained, gl slightly altered; all to USGS			
D14-3			XX (IR)			Mn, Fe stained, gl slightly altered; all to USGS			
D14-4			XX			Mn, Fe stained, gl slightly altered; all to USGS			
D14-5			XX			Mn, Fe stained, gl slightly altered; all to USGS			
D14-6			XX			Mn, Fe stained, gl slightly altered; all to USGS			
D14 assorted						Mn, Fe stained, gl slightly altered; all to USGS			
D15-1			XX (IR)			Mn, Fe stained, gl slightly altered; to USGS			
D15 bulk samples			XX			small Mn coated pebbles; all to USGS			
D17-1 WR					XX (JC)		0.5kg	3kg	10kg
D17-2							0.5kg	0.2kg	
D17-3							2kg	0.5kg	
D17-4	X	XX	X			not enough to powder	0.25kg		
D17-5	X		XX			not enough to powder	0.1kg	0.2kg	
D17-6	X	XX	X			not enough to powder	0.5kg	0.5kg	
D17-7	X		XX			not enough to powder	chip	chip	
D17-8	X	XX	XX			very dirty glass & WR	0.2 kg	0.1kg	
D17-9	X	XX		XX		cleaned 30min	0.2kg		
D17-10			XX (IR)				1kg		
D17-11			XX (IR)				1kg	0.5kg	
D17-12							0.4kg		
D17-13									
D17-14							0.5kg		
D17-15							1kg	0.5kg	
D17-16							0.5kg	0.5kg	
D17-17							0.5kg	X	
D17-18							0.5kg	X	
D17-19							X	X	
D17-20							X	X	
D17-21			XX			glass breccia; some to USGS	1kg		
D17-22			XX			small glass breccia; to USGS			

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SAMPLE #	BULK GLASS	GL CLEANED	PROBE CHIPS	GL POWDER	WR POWDER	COMMENTS	SAMPLE DISTRIBUTION U. F.	U. H.	LDGO
D18-1 WR		WR chips?			(JC)	WR chips cleaned but not powdered?			
D18-2	X	XX	XX	XX					
D18-3	X	XX	XX (IR)	XX		cleaned 30min			
D18-4	X	XX	XX (IR)	XX		lots of glass altered, must be picked			
D18-5	X	XX	XX	XX					
D18-6	X		XX			very little fresh glass, save for probe			
D19-1	X	XX	X (IR)	XX (JC)		dirty, cleaned 2x			
D19-2	X	XX (IR)	X (IR)	XX (JC)		dirty, cleaned 2x			
D19-3			XX			very little glass, probe only			
D19-4 WR									
D19-5 WR					XX				
D19-6	X		XX			very dirty, washed 2x, still dirty: probe it			
D19-7	X	X	XX			very dirty, washed 2x, still dirty: probe it			
D19-8			XX			very little fresh glass; probe only			
D19-9	X	XX	XX			dirty, washed 2x			
D19-10						pumice fragments, not processed			
D20-1	X	X	XX (IR)	(JC)	XX ??	picrite; is the powder WR or glass?	X	X	X
D20-2	X		XX			picrite	X	X	X
D20-3	X		XX			picrite	X	X	X
D20-4	X		XX			picrite	X	X	X
D20-5	X		XX			picrite	X	X	X
D20-6	X		XX			picrite	X	X	X
D20-7	X		XX			picrite	X	X	X
D20-8	X		XX (IR)			picrite	X	X	X
D20-9			XX			old pillow			
D20-10						old pillow			
D20-11 WR					XX	old pillow			
D20-12	X		XX			old pillow; not enough to powder; dirty glass			
D20-13	X		XX			picrite	X	X	X
D20-14	X	X	XX			picrite	X	X	X
D20-15	X	XX	XX (IR)	XX(JC)		picrite	X	X	X
D20-16	X		XX			picrite	X	X	X
D20-17	X		XX			picrite	X	X	X
D20-18	X		XX			picrite	X	X	X
D20-19	X		XX			picrite	X	X	X
D20-20	X		XX			picrite	X	X	X
D20-21	X		XX			picrite	X	X	X
D20-30	X		XX (IR)						
D20-31	X		XX						
D20-33	X		XX						
D20-40	X		XX						
D21-1		XX	XX (IR)			"ski dredge" ?? processing log says "WR"			

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SAMPLE #	BULK GLASS	GL CLEANED	PROBE CHIPS	GL POWDER	WR POWDER	COMMENTS	SAMPLE DISTRIBUTION U. F.	U. H.	LDGO
D22-1	X	XX	XX (IR)	XX (JC)			X	X	X
D22-2	X		XX (IR)			dirty - probe only			
D22-3	X	X	XX (IR)	XX (JC)					
D22-4			XX (IR)			probe chips only			
D22-5			XX (IR)			probe chips only			
D22 bulk			XX			3 small bags	X		
D23-1	X	XX	XX	XX		huge piece of pillow	X	25kg	45kg
D23-2	X	XX	XX (IR)	XX (JC)			X		
D24-1	X	XX	XX	XX		U.F. sample wrapped	2 samp.		
D24-2	X	XX	X	XX			0.3kg		
D24-3 WR	X ??				XX ??	vial not labeled "WR", but notes say WR; ts chip	0.5kg		
D24 bulk						many small glass fragments in bulk bag	3kg	1kg	
D25-1							X	X	X
D25-2							X	X	X
D25-3			XX			probe only	X	X	
D25-4							X	X	
D25-5							X		
D25-6	X	XX	XX (IR)	XX (JC)		GLASS ONLY; dirty; cleaned 2x	X		
D25-7			XX (IR)			probe only	X		
D25-8	X	XX	X	XX					
D26-1	X		XX			from assorted glass bag			
D26-2	X		XX			dirty glass, probe only			
D26-3						relatively young basalt, weathered, no glass			
D26-4	X		XX (IR)			dirty, small, probe only			
D26-5	X		XX			dirty glass, very little, probe only			
D26-6	X	XX	XX (IR)	XX		dirty glass, not completely clean when powdered			
D26-7						no glass			
D26-8	X		XX			dirty, probe only			
D26-9						no glass			
D26-10						no glass			
D27-1						no glass; old, Mn coated basalt			
D27-2						no glass; old, Mn coated basalt			
D27-3						no glass; old, Mn coated basalt			
D27-4						no glass; old, Mn coated basalt			
D27-5	X	XX	XX (IR)	XX (JC)					
D28-1						no glass; old, Mn-coated basalt	3kg	2kg	
D28-2						no glass	2kg	2kg	
D28-3	X		XX			small amt of glass, probe only	1kg		
D28-3 WR					XX	WR and thin section chip	"		
D28-4	X		XX			very little glass, probe only	2kg		
D28-5	X		XX			very little glass, probe only	2kg		

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SAMPLE #	BULK GLASS	GL CLEANED	PROBE CHIPS	GL POWDER	WR POWDER	COMMENTS	SAMPLE DISTRIBUTION U. F.	SAMPLE DISTRIBUTION U. H.	SAMPLE DISTRIBUTION LDGO
D29-1 WR					XX				
D30-1	X	XX	XX (IR)	XX (JC)			X	X	X
D30-2	X	XX	XX	XX		extra glass	X	X	X
D30-3							X	X	X
D30-4							X	X	
D30-5			XX				X	X	
D30-6							X	X	
D30-7							X	X	
D30-8							X	X	
D31-1	X		XX	XX			X	X	X
D32-1	X	X	XX (IR)	XX (JC)		cleaned 40min	0.5kg		
D32-2	X	XX	X	XX		cleaned 30min	2 pc	2pc	
D32-3	X	XX	X (IR)	XX (JC)		cleaned 30min	0.5kg	0.5kg	3kg
D32-4	X	XX	X	XX			1kg	1kg	2kg
D32-5							0.5kg	0.5kg	0.25kg
D32-6							2 pc	0.5kg	1kg
D32			IR			Misc. glass			
D33-1	X	XX	XX (IR)	XX (JC)			0.5kg	0.5kg	
D33-2							1kg	0.5kg	
D33-3	X		XX			probe only	1kg	0.5kg	2kg
D33-4							0.5kg		
D33-5							0.5kg		
D34-1	X	XX	XX	XX			5kg	0.5kg	
D34-2	X	XX	XX (IR)	XX (JC)		cleaned 2x	2kg	2kg	12kg
D34-3	X	XX	XX	XX		cleaned 2x	0.5kg		
D34-4	X		XX			probe only; dirty dirty; cleaned 2x	1kg	0.5kg	
D34-5	X		XX			probe only	3kg	1kg	10kg
D35-1	X	XX	XX	XX		dirty; cleaned 2x	X	X	
D35-2	X	XX	XX	XX		dirty; cleaned 2x	X	X	
D35-3	X	XX (IR)	X (IR)	XX			X	X	
D35-4	X	XX	XX (IR)	XX (JC)		dirty; powdered anyway	X	X	
D35-5	X	XX	X			not enough to powder	X	X	
D36-1						Mn crust	X		
D36-2			XX				X		
D36-3	X	XX	XX (IR, all)	XX (JC)			X		
D36-4			XX (IR)			very little glass	X		
D36-5	X	XX	X	XX		very little glass	X		
D36-6			XX				X		
D36-7			XX				X		
D36-8							X		
D36-9							X		

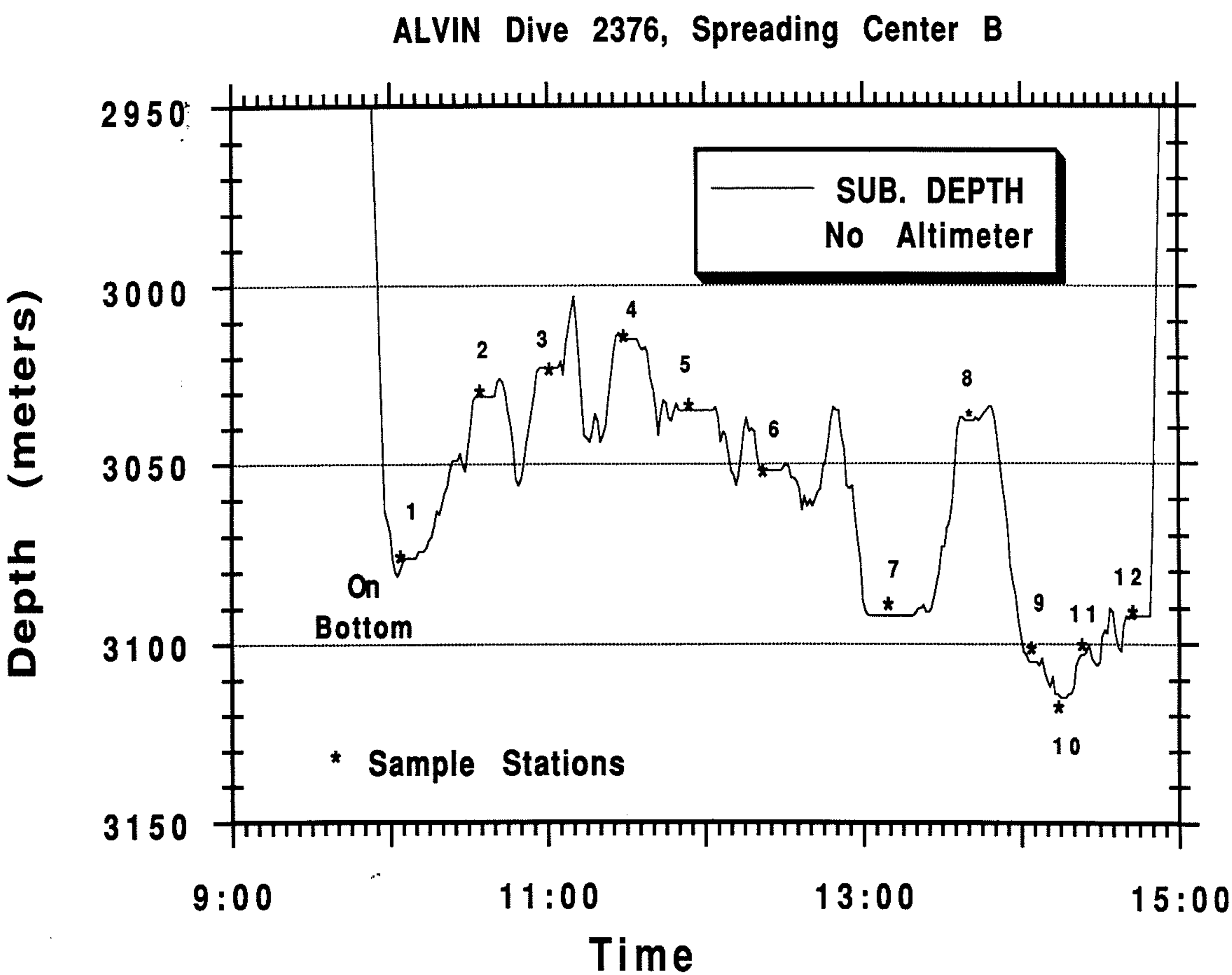
AII 125/LBG 25 DREDGE SAMPLE PROCESSING:

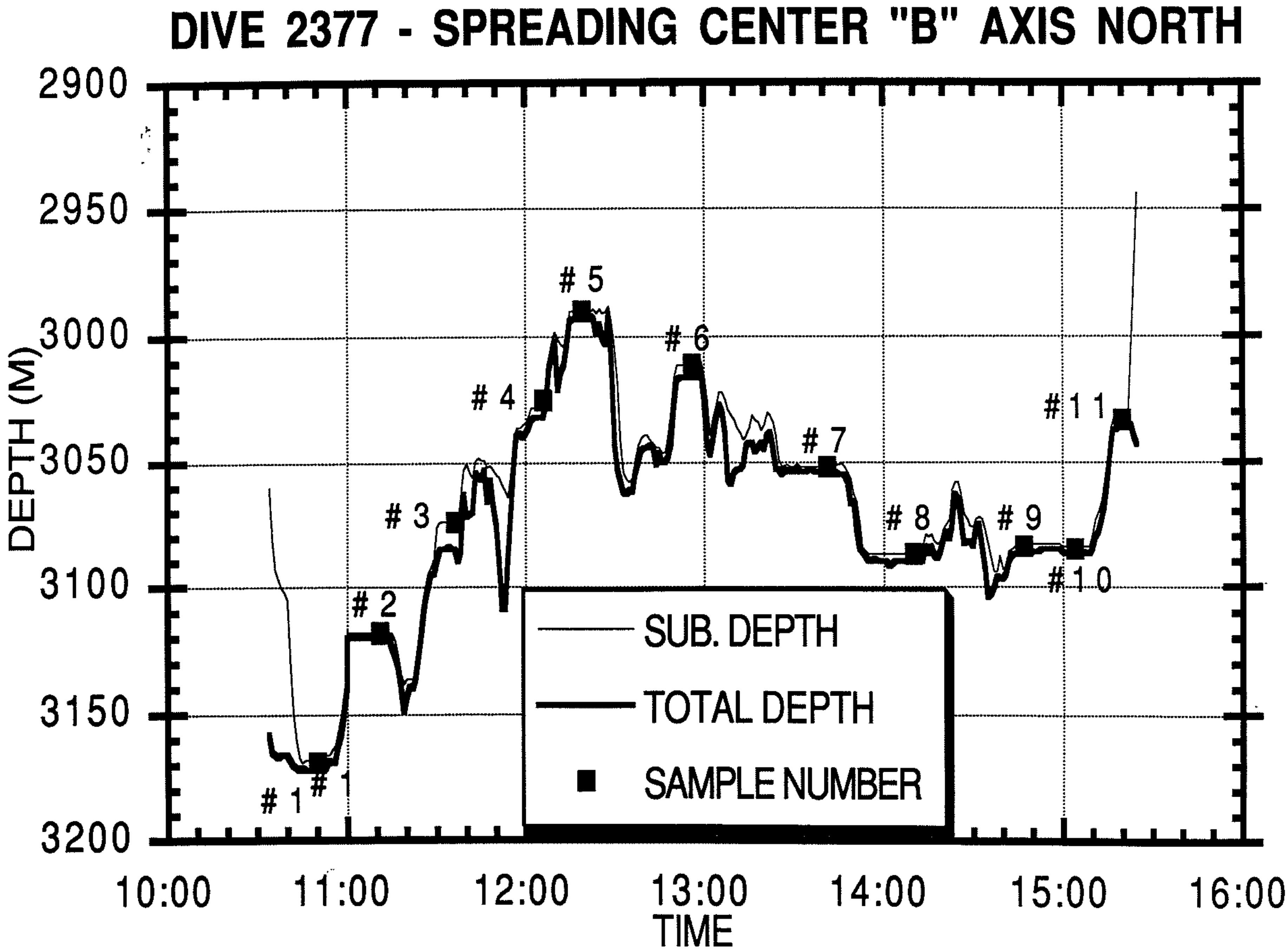
X=checked on original processing form; XX=verified during transit to San Diego; A=powdered in agate ball mill (otherwise done in alumina ball mill)
glass cleaned=there is cleaned, unpowdered glass; probe chips=there is dirty, unpowdered glass for probe, etc. [(MP) = Mike Perfit has all samples and powders. (JC) = Jack Casey has part of the powder. (IR) = Ian Ridley has part of the glass.]

SAMPLE #	BULK GLASS	GL CLEANED	PROBE CHIPS	GL POWDER	WR POWDER	COMMENTS	SAMPLE DISTRIBUTION U. F.	U. H.	LDGO
D36 bulk							5kg	5kg	
D37-2	X		XX (IR)			probe only			
D37-3			XX						
D38-1	X	XX	XX (IR)	XX					
D38-2	X	XX	XX (IR)	XX (JC)					
D38-3	X		XX			small, dirty; probe only			
D38-4	X		XX			small, dirty; probe only			
D38-5	X		XX			small, dirty; probe only			
D38 bulk, old			XX			5 samples mixed together (old pillow type)			
D38 bulk, fresh gl			XX			150g fresh glass, separate sample type, for probe			
D39-1	X (20g)	XX	XX (IR)			cleaned 38min, needs major picking job			
D39-2	X					found in dredge later			
D39 bulk(Misc.)	X		XX (IR)			Mn coated; for probe only			
RC-40	X	XX	XX			approx. 2.5g			
RC-41	X	XX							
RC-42	X	XX							
D43-1		WR cleaned				WR only			
D43-2	X		XX			dirty dirty dirty, cleaned 30min, not powdered			
D43-3	X		XX (IR)			probe only			
D43-4	X		XX			probe only			
D43-5	X		XX			probe only			
D44-1	X	XX	XX (IR)	XX (JC)		plag microphenocrysts	X	2kg	5kg
D44-2	X	X	XX	XX			X	X	X

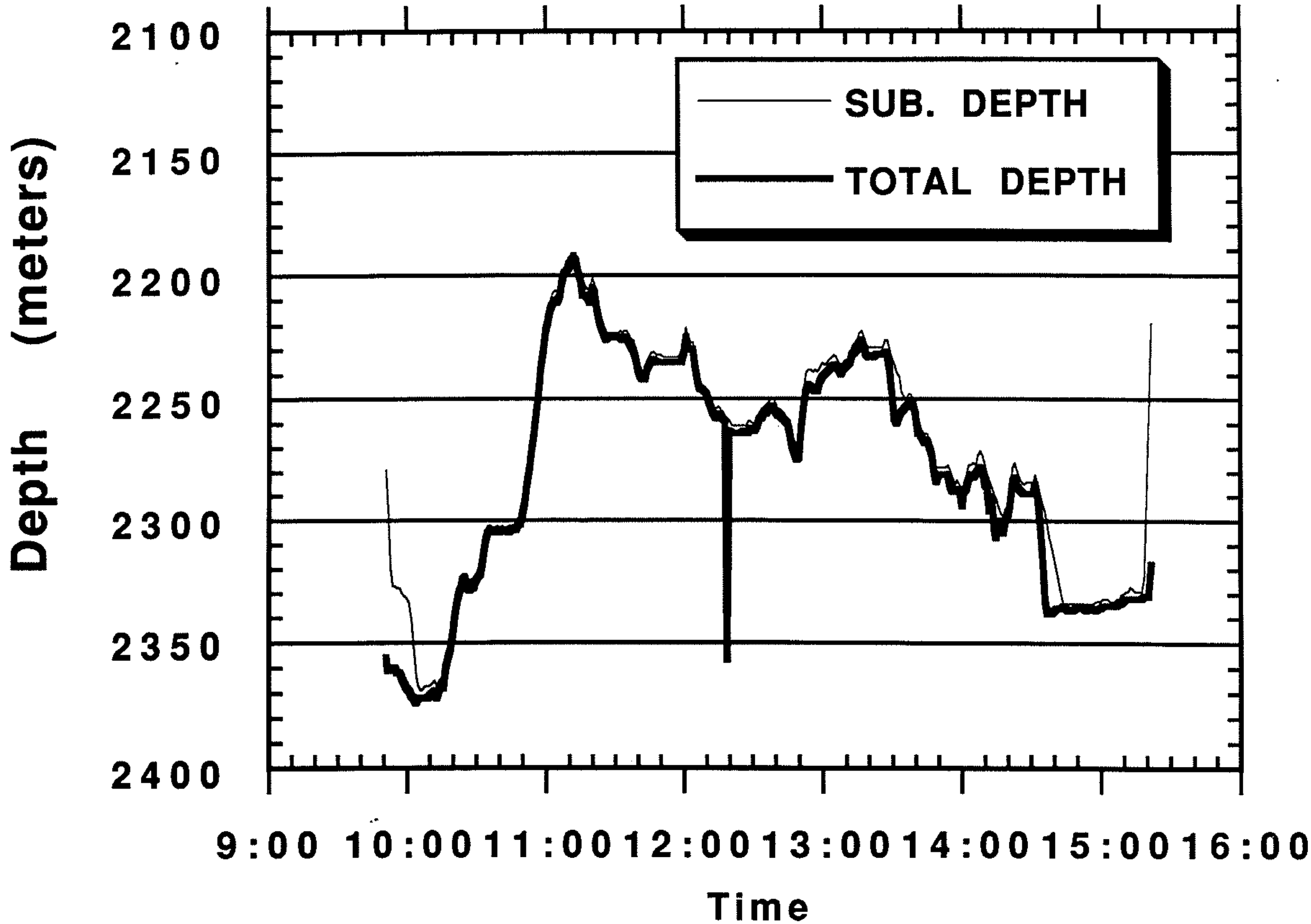
ANNEX 3

PRELIMINARY DIVE TIME/DEPTH/SAMPLE PLOTS

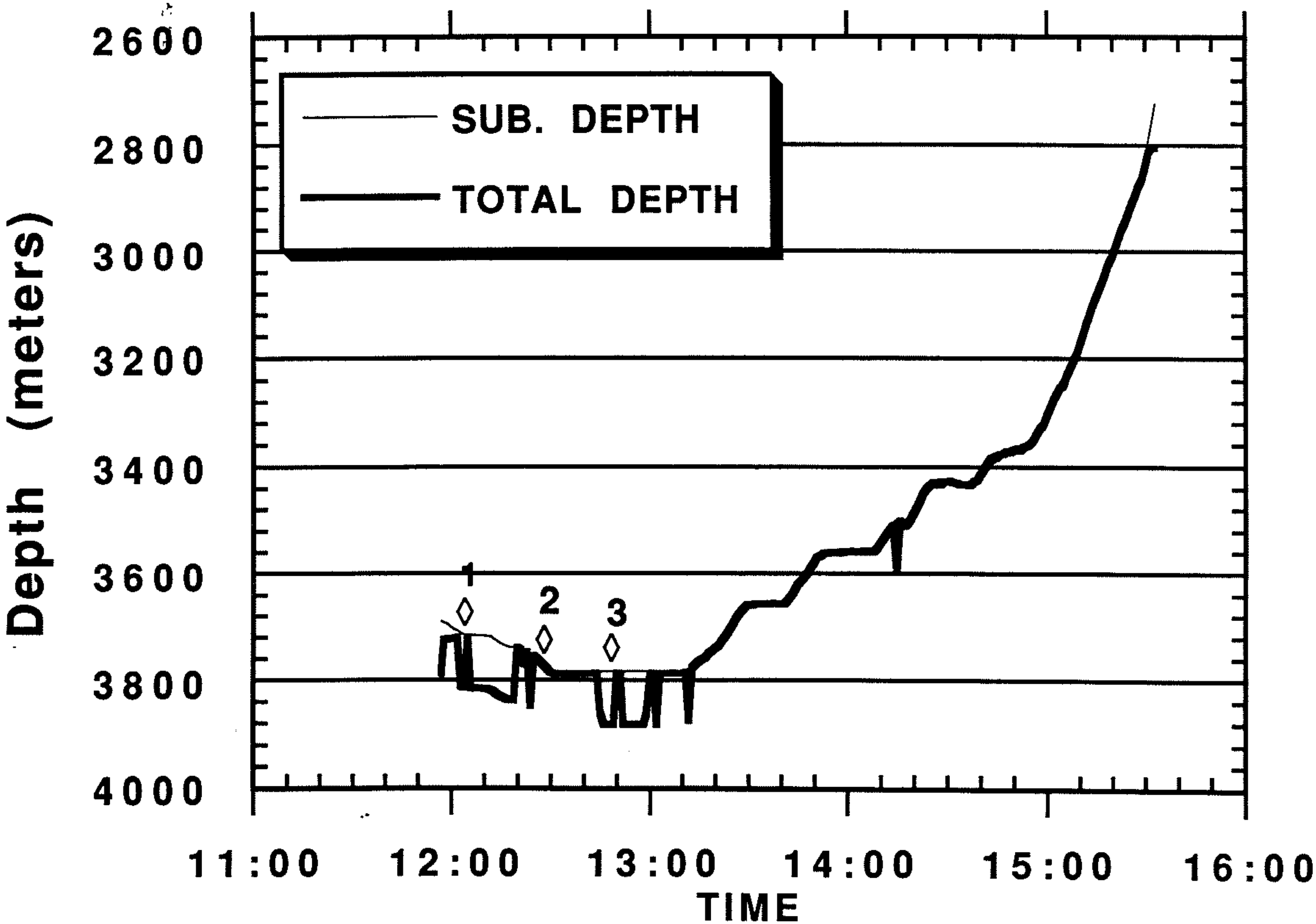

ALVIN Dive 2376, Spreading Center B
SUB. DEPTH
No Altimeter
Depth (meters)
2950
3000
3050
3100
3150
On
Bottom
1
2
3
4
5
6
7
8
9
10
11
12
* Sample Stations
9:00
11:00
13:00
15:00
Time


DIVE 2377 - SPREADING CENTER "B" AXIS NORTH
DEPTH (M)
2900
2950
3000
3050
3100
3150
3200
10:00
11:00
12:00
13:00
14:00
15:00
16:00
TIME
1
1
2
3
4
5
6
7
8
9
1 0
1 1
SUB. DEPTH
TOTAL DEPTH
SAMPLE NUMBER

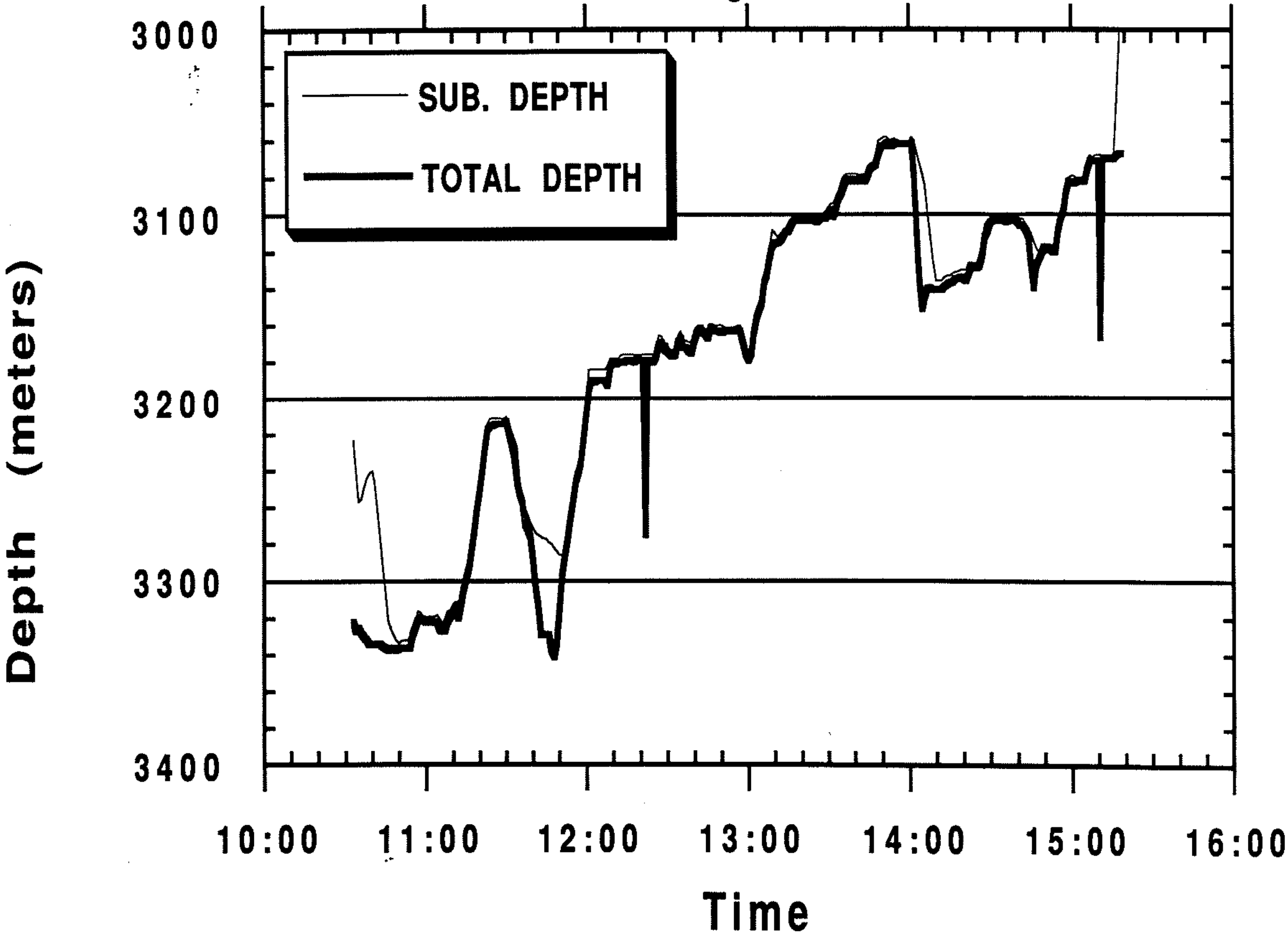
ALVIN Dive 2378, Southern Crescent Ridge at Spreading Center C and Central Graben

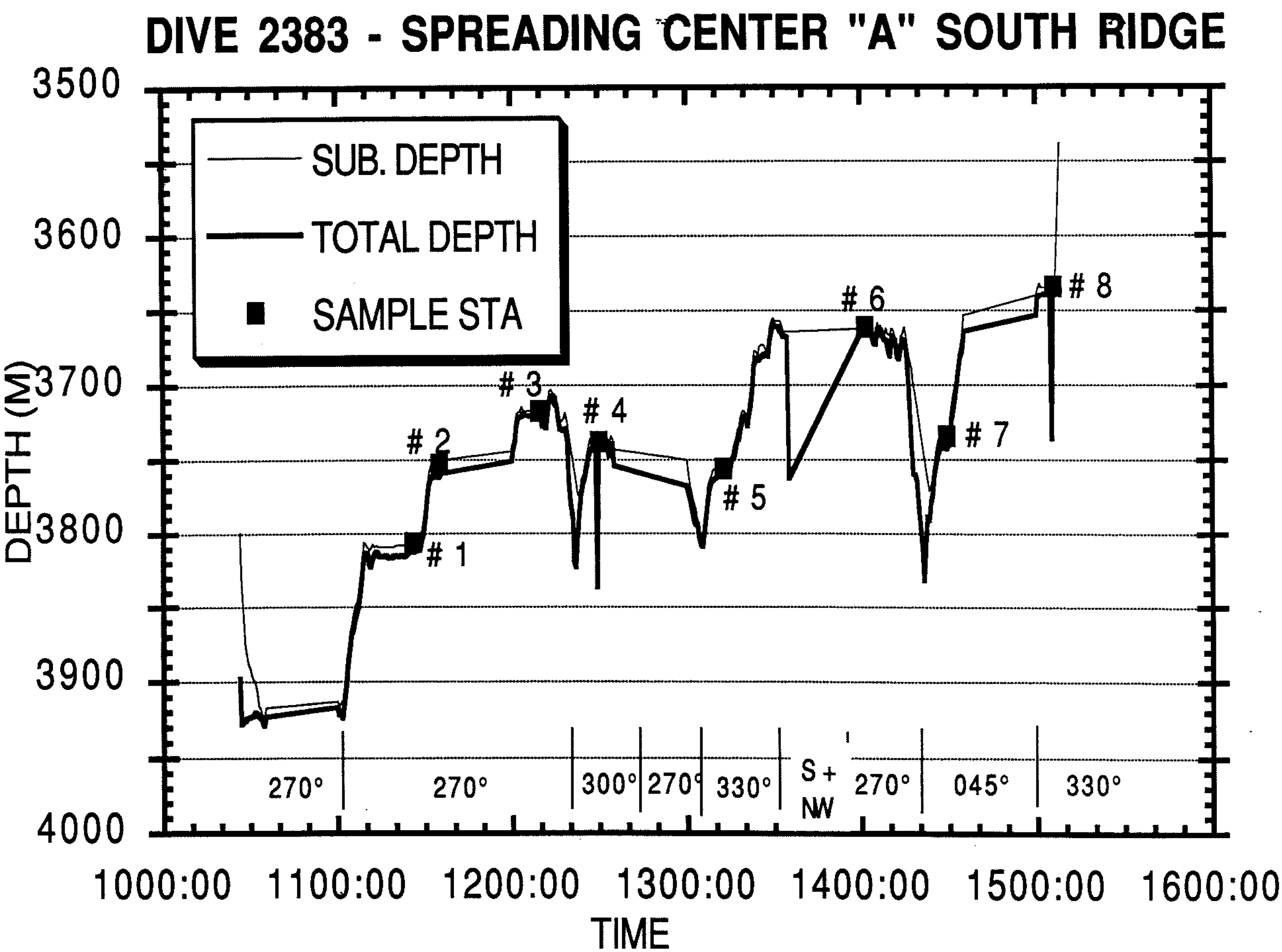


ALVIN 2379, north wall of A-B Transform west of intersection w/spreading center B

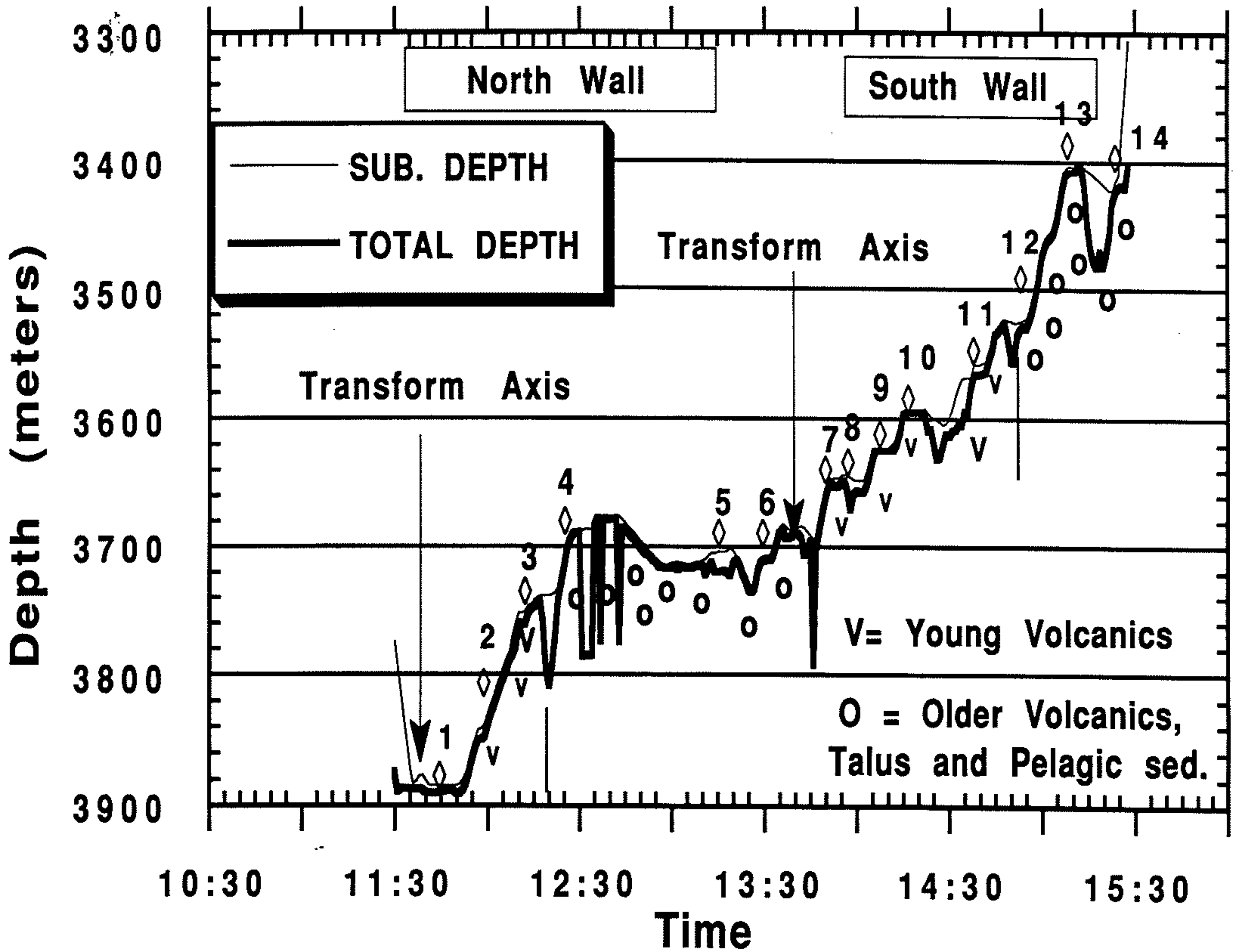


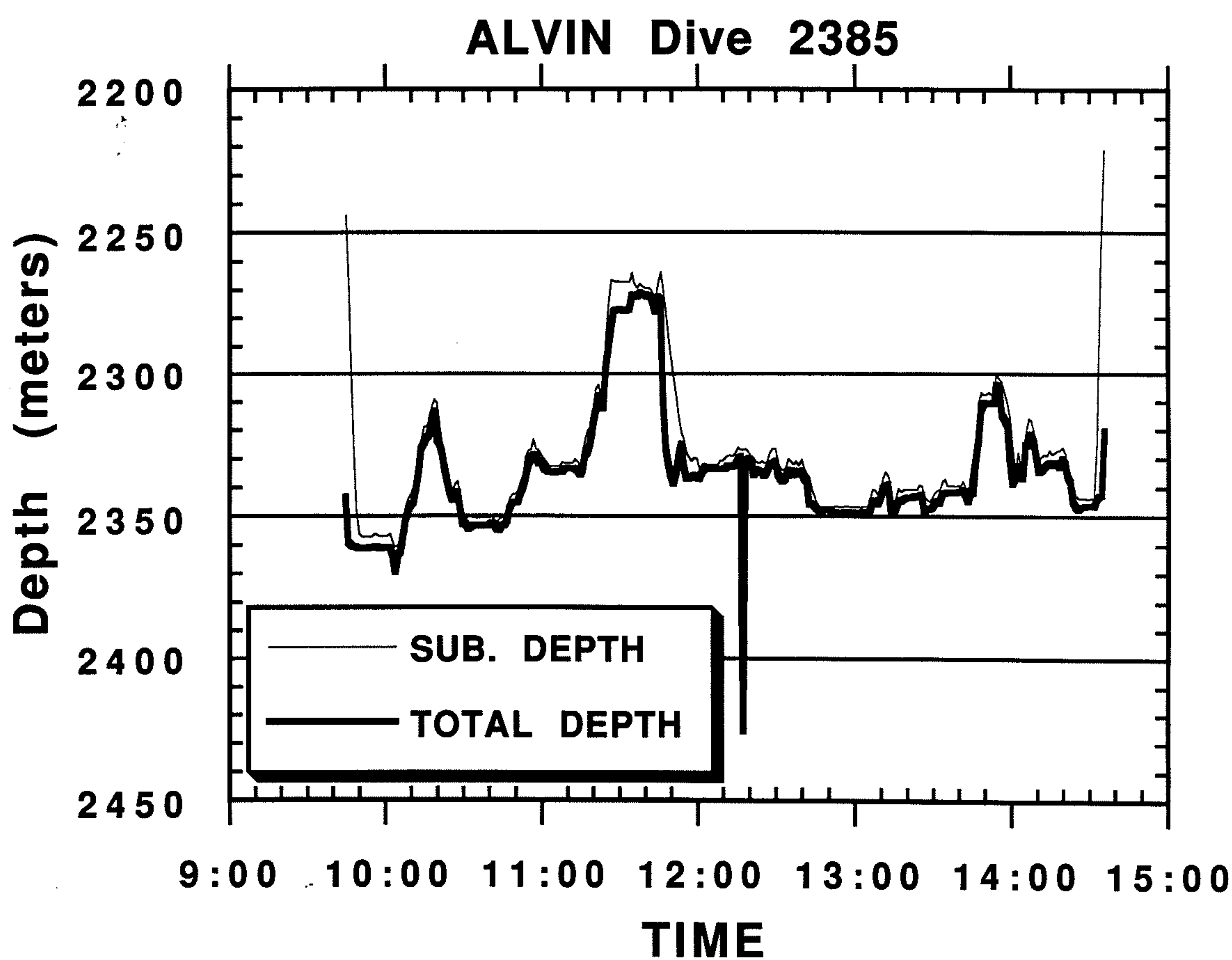
ALVIN Dive 2380, Southern RTI of Spreading Center B and trough east of B axis.

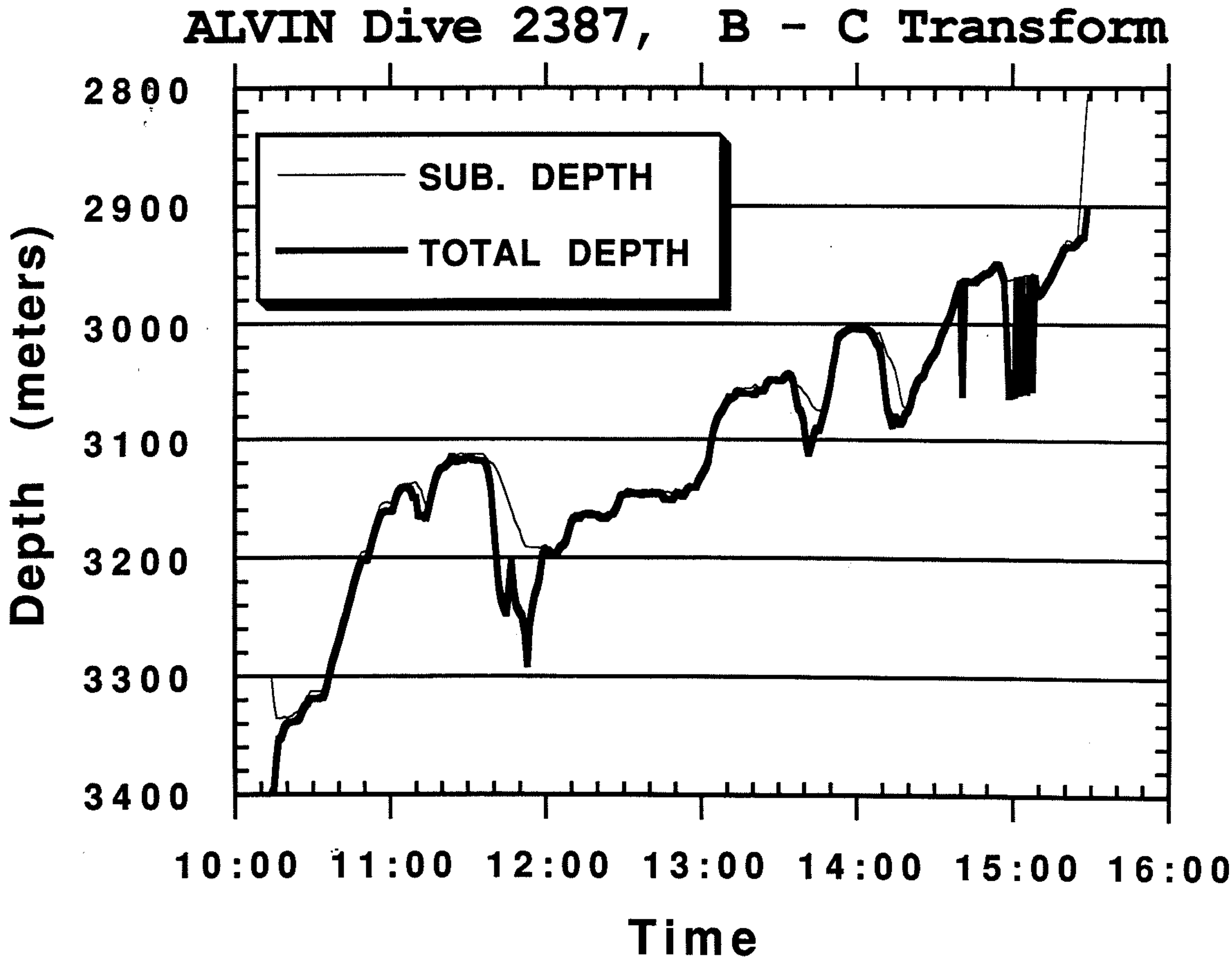


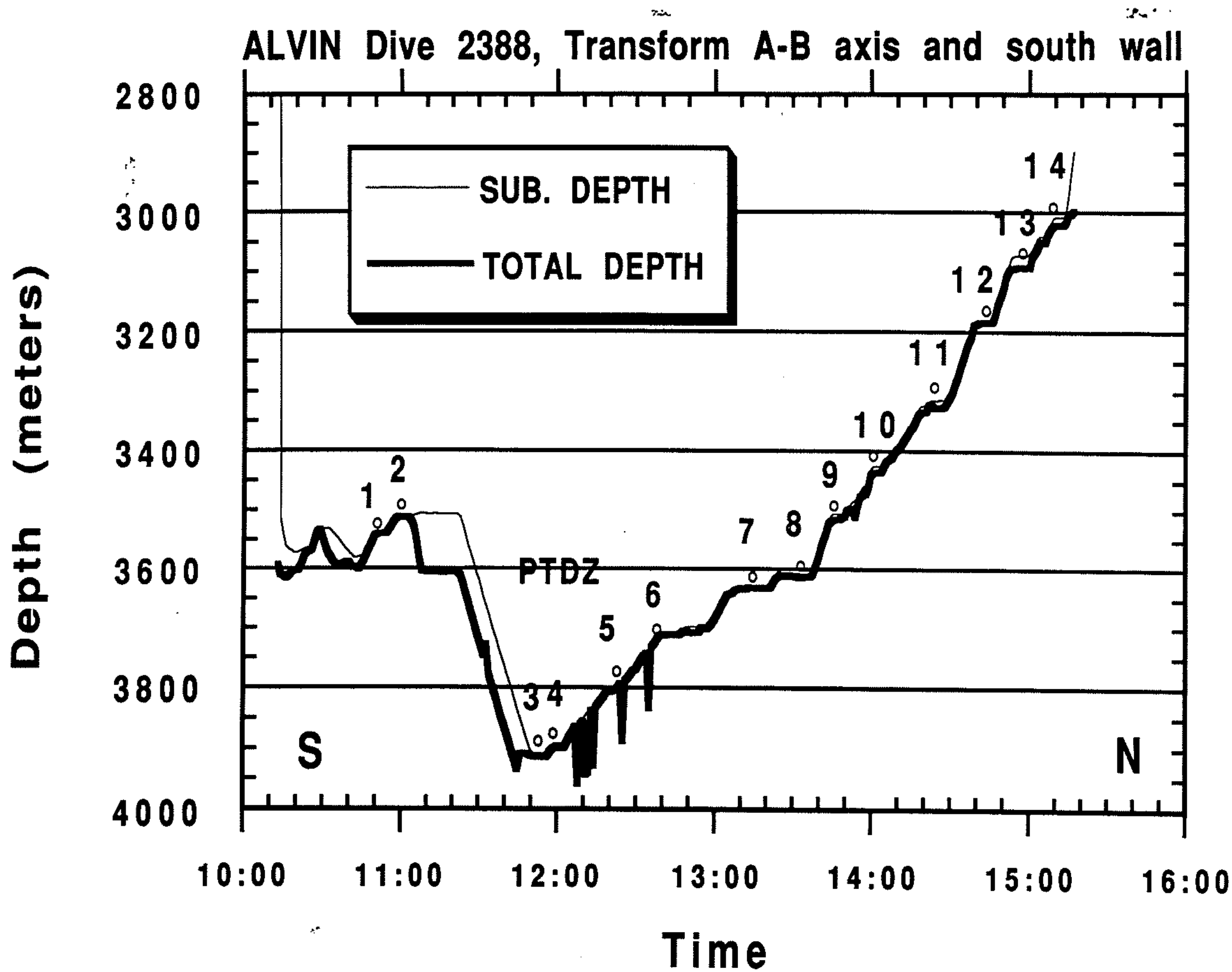

DIVE 2383 - SPREADING CENTER "A" SOUTH RIDGE
SUB. DEPTH
TOTAL DEPTH
SAMPLE STA
DEPTH (M)
3500
3600
3700
3800
3900
4000
1
2
3
4
5
6
7
8
270°
270°
300°
270°
330°
S + NW
270°
045°
330°
1000:00
1100:00
1200:00
1300:00
1400:00
1500:00
1600:00
TIME

ALVIN Dive 2384, Axis and South Wall of Transform A-B

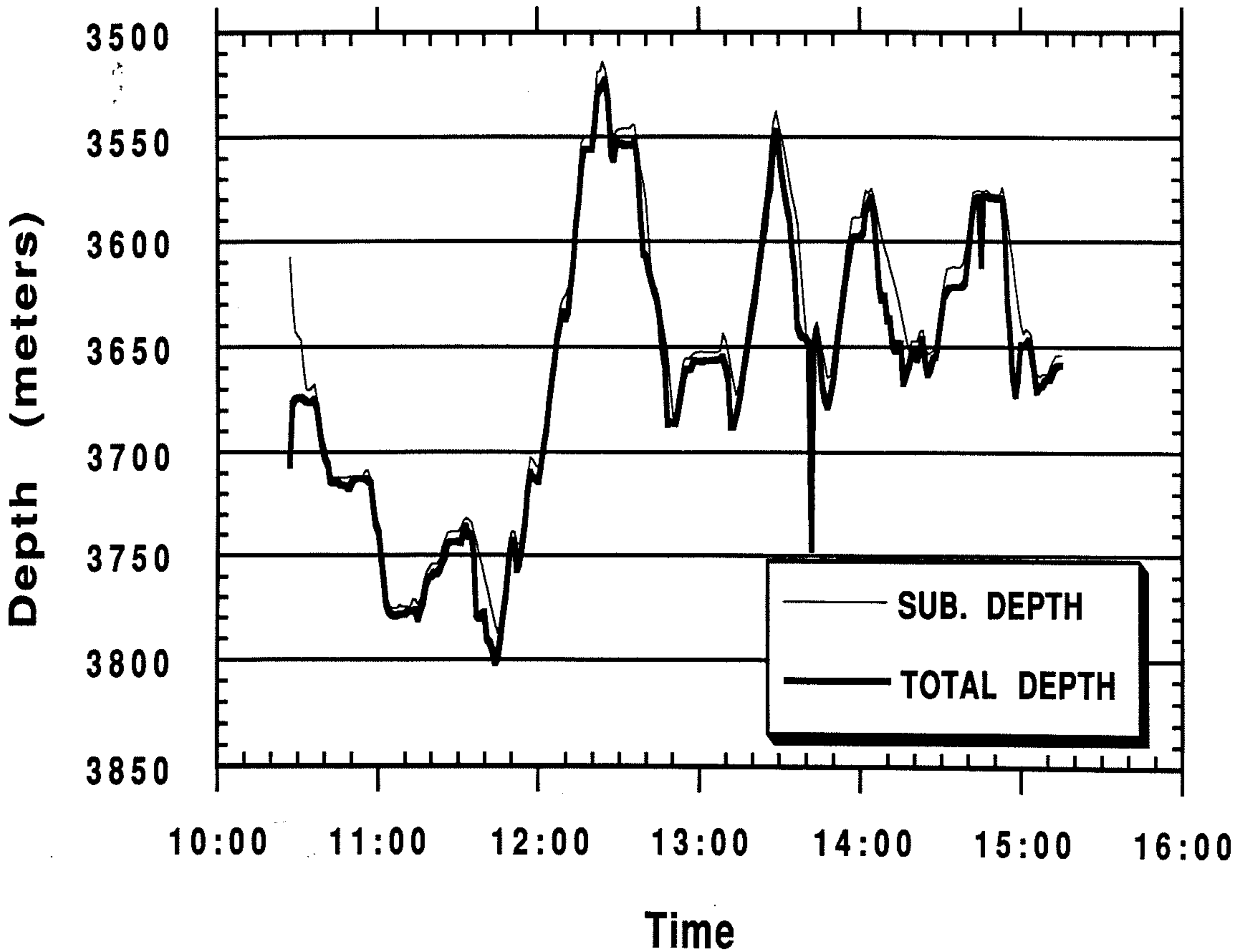


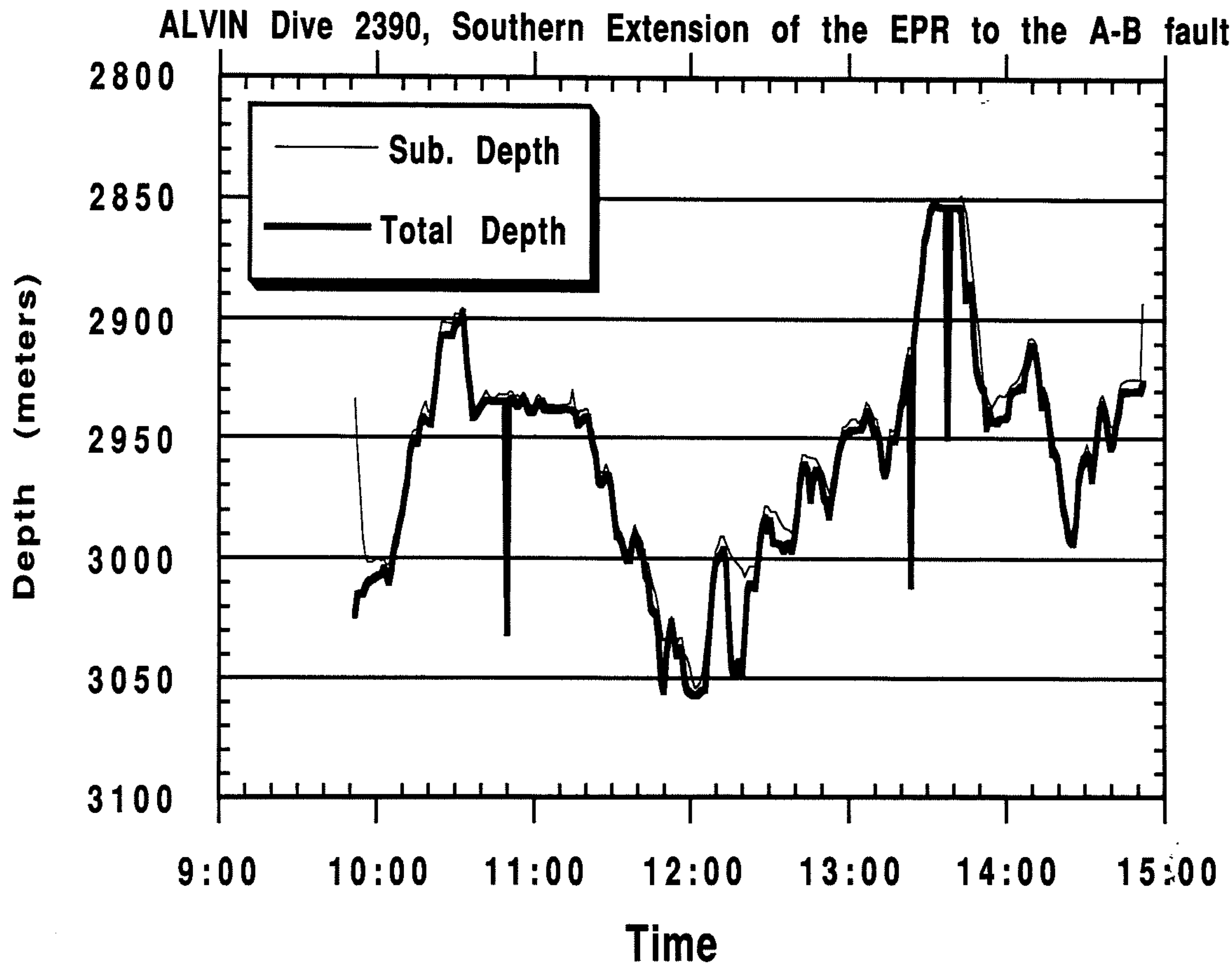

ALVIN Dive 2385
Depth (meters)
2200
2250
2300
2350
2400
2450
SUB. DEPTH
TOTAL DEPTH
9:00
10:00
11:00
12:00
13:00
14:00
15:00
TIME


ALVIN Dive 2387, B - C Transform
SUB. DEPTH
TOTAL DEPTH
Depth (meters)
2800
2900
3000
3100
3200
3300
3400
10:00
11:00
12:00
13:00
14:00
15:00
16:00
Time


ALVIN Dive 2388, Transform A-B axis and south wall
SUB. DEPTH
TOTAL DEPTH
Depth (meters)
2800
3000
3200
3400
3600
3800
4000
10:00
11:00
12:00
13:00
14:00
15:00
16:00
Time
S
N
PTDZ
1
2
3 4
5
6
7
8
9
1 0
1 1
1 2
1 3
1 4

ALVIN Dive 2389, Northern Ridge Segment of Spreading Center A





ALVIN Dive 2390, Southern Extension of the EPR to the A-B fault
Depth (meters)
2800
2850
2900
2950
3000
3050
3100
Sub. Depth
Total Depth
9:00
10:00
11:00
12:00
13:00
14:00
15:00
Time

Dive 2391, A-B Fault, West of The Spreading Center A RTI