R/V MAURICE EWING CRUISE EW 91-01

(Feb 1. - March 17, 1991)

A GEOPHYSICAL STUDY OF THE PACIFIC MARGIN OF THE ANTARCTIC PENINSULA

Cruise Report

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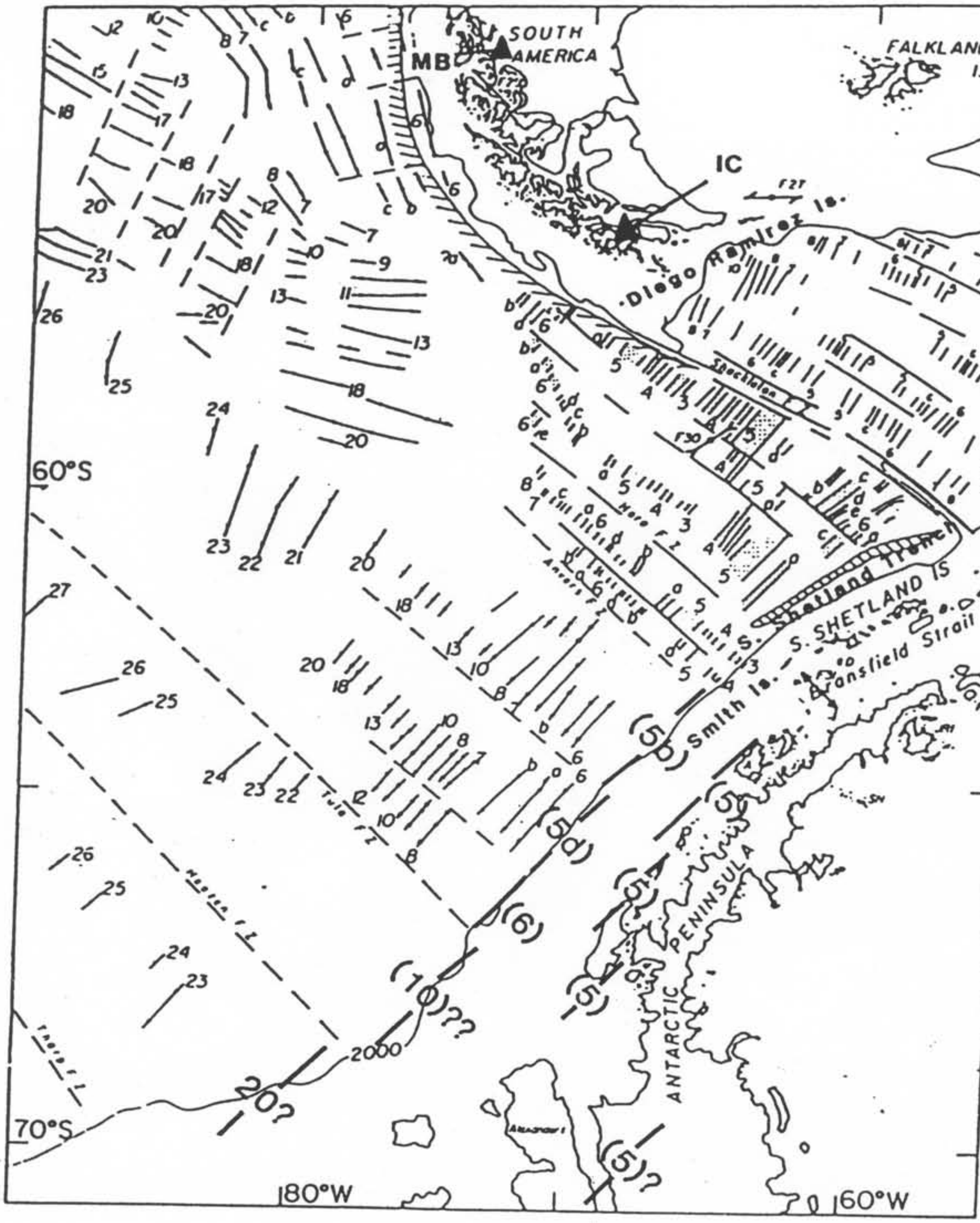
Objectives:

This report describes the operations carried out during cruise EW 9101, a geophysical study of the Pacific Margin of Antarctica including the Antarctic Peninsula and areas south to the intersection of the Heezen Fracture Zone with the margin at approximately 69° south (Figure 1). The objectives of the program were, broadly, to study an area which is believed to be the modern counterpart of the Andean orogenic belt. In its relatively recent development the tectonic events that have effected this margin include ridge subduction between the Hero and Heezen Fracture Zones, extension in the orogenically thickened continental crust to form the Bransfield Straits, and subduction along the South Shetland Trench. Events of this type are known to have been major components of the tectonic history that built the Andean orogenic belt over a period of perhaps 200 M yrs. The modern Pacific margin of Antarctica provides an environment in which to study these tectonic events in an active or recently inactive setting. Extension in the Bransfield Straits also provides an opportunity to study a tectonic phenomenon of general interest to Earth scientist; continental extension has apparently developed to a stage in which there is evidence in the form of active seismicity and active volcanic centers that seafloor spreading has commenced very recently. No evidence exists for unusual thermal conditions such as might be caused by the presence of a hot spot, and the extension may be caused by roll-back of the slab following relatively recent cessation of subduction along the South Shetland Trench. Thus it represents a relatively rare example in which the lithospheric response to purely stress-driven extension can be studied in a very young, well exposed environment .

The chief geophysical methodology involved the acquisition of approximately 6400 km of 120 channel MCS reflection data. Hydrosweep swath mapping was also carried out continuously together with the measurement of gravity and magnetic fields.

Cruise Narrative

The cruise began from Punta Arenas, Chile on Feb. 1st, 1991 at around noon. This date is two days later than the intended start date, the delay being caused by the failure of shipments of streamer sections, airgun parts and engineers supplies to arrive as scheduled. The vessel made the transit east into the Atlantic to conduct cable operations before moving south to begin science operations in the Bransfield Straits. Cable operations



SOUTH AMERICA
FALKLAND IS
MB
IC
Diego Ramirez Is.
Elephant Is.
Shetland Trench
S. SHETLAND IS
Smith Is.
Bransfield Strait
ANTARCTIC PENINSULA
60°S
70°S
80°W
60°W
2000

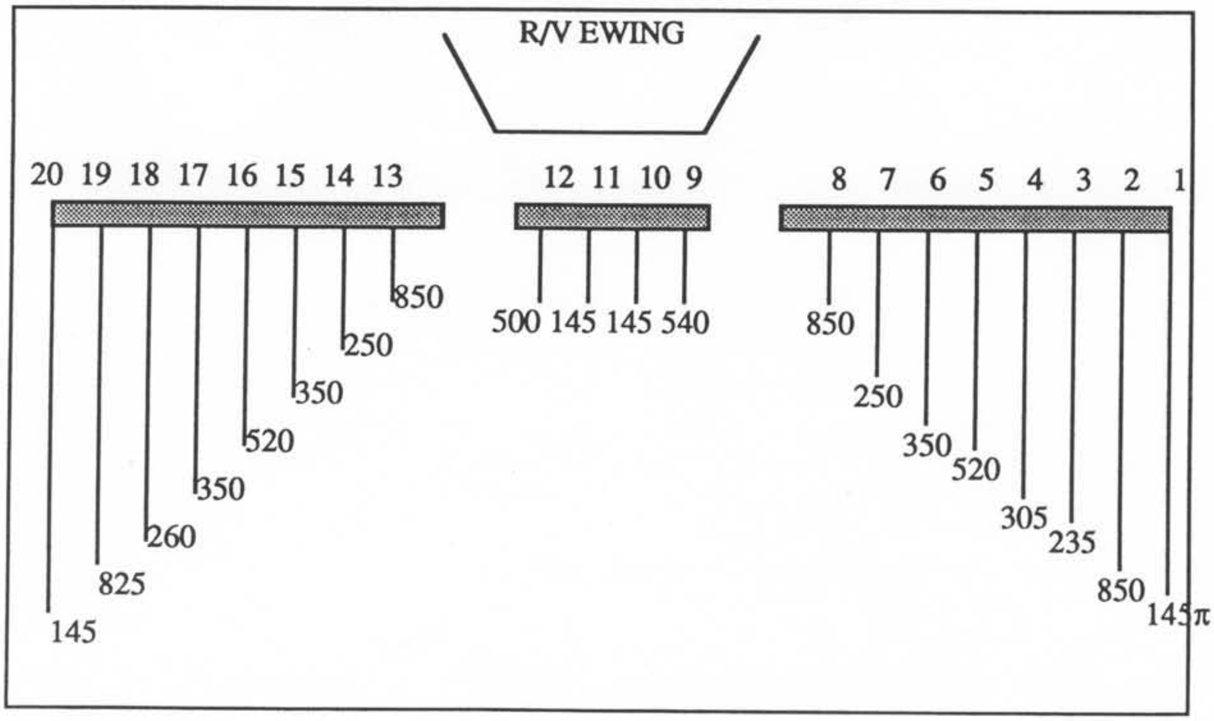
FIGURE 1

began at 0630 on the 2nd in fair weather off the Argentine coast north of the Straits of LaMaire. The required streamer work primarily consisted of re-configuring the streamer from the set-up used during the last MCS leg (Mountain/Miller, New Jersey margin) to that required for the present leg. This involved the addition of 4x100m sections, 4x50 meter sections, the addition and/or relocation of several depth transducers, and the addition of several bird collars. A new, active tailbuoy was also available.

The streamer was completely rebuilt by adding sections on to the drum by 0800 on the 3rd and we had begun to set and test the streamer when the weather deteriorated. Further work was prevented at 1400. The vessel hove to until around 0100 on the 4th when we made south for the Straits of La Maire, passing through around 1030. The intention was to find a lee south and west of the Straits to set all the DT's and birds, and have the streamer well balanced before making south. The purpose of conducting operations near port rather than at the end of the transit in the usual way was to avoid doing streamer work in what was anticipated to be the region where the poorest weather would occur, northeast of the South Shetland Islands. In fact, the weather did not subside significantly and streamer operations were conducted under very difficult conditions. Although continuously heading south the vessel was set consistently north and passed backwards through the Straits during streamer work. A second stretch section was included and several electrical and telemetry problems were encountered. The weather deteriorated through the day to the point where it was necessary to bring the streamer on board under very heavy conditions during which Dr Austin injured his hand. The back deck was continuously awash making the use of life lines mandatory. Waves breaking over the back of the vessel hit the gun winch control levers with sufficient force that all the guns on the starboard side boom were simultaneously raised several feet after being secured in place. It was not possible to bring the tailbuoy on board the vessel and it was allowed to tow from the tail rope. The vessel headed south to the work area at around 4 knots.

The weather gradually abated and an attempt was made to bring the tailbuoy on board early on the 5th during which it was found to have imploded and irreparably damaged. The magnetometer was deployed at this time and we continued south. The deployment site was reached at around 2100 on the 6th and final deployment was made in what turned out to be very fair conditions; much better than at any time during the initial work to the north. We made an initial deployment using the single hull passive tailbuoy and without birds to set the streamer electrically. During this deployment the central portion of the streamer sank deeply and the tailbuoy apparently sank also, but reappeared when the streamer was towed at 5 knots. When the streamer was brought on board to install depth control birds this tailbuoy was also lost. It seems likely that it had been holed either early in the operations or when it sank during deployment. After this time we ran with two Norwegian floats attached to the tail rope. Bird floats were installed on all the birds and each of the sections had been pumped full of oil as much as possible to compensate for the cold water. A depth control bird and DT were available every 200 meters; every second digitizing cannister.

Shooting commenced around 2100 on the 7th. Total gun array volume is 8385 cu inches. The configuration of gun sizes in the array is shown in the figure below. Shot interval is 20 sec and record length is 16 sec (the latter was varied during the survey). After this time the streamer remained in the water the entire period of the survey, being recovered on the morning of the 12th, an unprecedented period of over 32 days. The study then comprised operations in the areas; the Bransfield Straits, South Shetland Trench, and the Pacific margin of Antarctica between the Hero and Heezen Fracture Zones.



Bransfield Straits

Operations in this area occupied the period from the start of work until the morning of the 19th and approximately 2000 km of data were acquired under generally very mild conditions. The survey comprises sixteen lines run in a zigzag pattern approximately normal to the trend of the deeps that comprise the Straits (see Figure 2) and a pair of strike lines that tie through the central parts of the basin. The first line of the survey (AP-01) commenced north of the South Shetland Trench and was positioned to be an integral part of the survey of that region. The dip lines form a roughly equally spaced set throughout the Straits with their location governed by existing control including two recent Polish-Japanese refraction lines and several considerably older refraction experiments.

Operations during this part of the study proceeded very smoothly and were not impaired in any way by weather which proved to be very mild throughout. This allowed us to collect more lines in the western part of the Straits, in the region of Deception Island, than had been anticipated and to run an extra line east of line AP-01 after completing the northeast trending strike line. All lines to the south, toward the Antarctic Peninsula, were terminated at the point at which the density of icebergs made continuing inadvisable. Most lines reached to within 10 miles of the intended end points, but it was often necessary to turn to the outside and make an extended loop rather than a simple inside turn. These turns were invariably made at night, often in foggy conditions. It may have been possible to extend these lines somewhat closer to the coast if the approach had been made in daylight and good weather. The northern turn points were used to make extended loop turns during which airgun and compressor maintenance was carried out.

No major problems occurred during this part of the operations. The Telex tape drives showed numerous tape errors and short records. Only two operate reliably. Streamer remained in good operating conditions. Airguns performed with minor problems including tangling with associated line chaffing. Compressors have a persistent problem with the pumps for the fresh water cooling system. One failed and was later restored with improvised parts, and the others have similar problems. Hydrosweep failed during one of the dip lines: gravity and magnetics workedwithout problems.

South Shetland Trench

Operations in this area comprise thirteen lines (including line AP-01) of which nine are dip lines, three connect the dip lines along the shelf of the Islands, and one is a tie line on the mid-slope (Figure 2). The oceanward ends of the dip lines were not shot as they are relatively short and the time was used for system maintenance but all other systems remained in operation. Additionally, because conditions had allowed for a greater amount of acquisition than was anticipated, some concern was raised as to whether sufficient

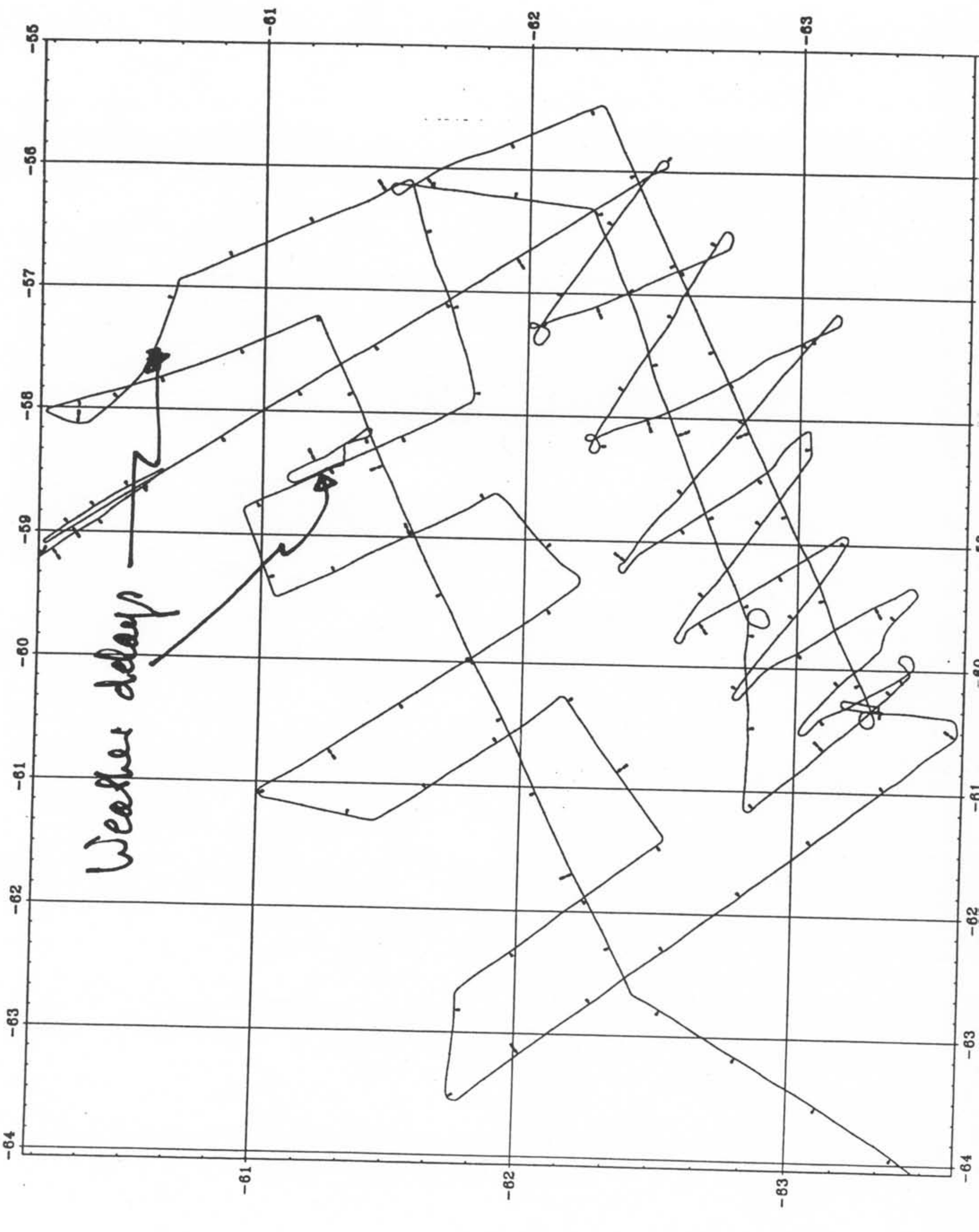


FIGURE 2

magnetic tape was available on the vessel, and this represented a way of economizing on tape usage. These lines were also shot with 12 sec record lengths rather than the 16 sec record length that was used for the Bransfield work.

Operations in this region were significantly hampered by poor weather at three locations indicated on Figure 2. The first occurred around midday on the 23rd when the weather deteriorated very rapidly and a series of events followed that only narrowly avoided the loss of the streamer. These were caused by the failure of the mounting of the steel cable that attaches to the tensiometer which is then attached to the streamer with a rope; Chinese Finger thus taking all the towing strain. Although this caused the tension alarm to sound the problem was not immediately recognized to be a failure of the towing arrangement. Following this failure the strain of the towing was taken on the chain that loops through the outer flange of the streamer winch, and this too failed. At this point the drum began to slowly unwind. This led to telemetry failures from the streamer as the slip ring was caused to rotate. The problem was still not recognized for what it was, and several attempts were made to re-boot the system from the lab. The situation was eventually recognized by Tim Nolan who was on the back deck and noticed the streamer slowly unwinding. The situation was not recovered until several turns on the old, inboard leader had come off the drum. The recovery caused the leader to be severely twisted and it was later removed and thrown overboard. The system was re-configured with a 100 meter inactive section on the drum followed by the new lead section. The streamer towed well in this configuration except in strong following seas (see below). While attempting to recover the situation and recommence operations Captain Haines became aware that the gun booms were dipping into the seas on strong rolls and called a halt to the work. The storm proved to be very short lived and work recommenced at around midnight .

The second weather-related delay occurred in the morning of the 25th, about an hour from the intended end of line AP-30 (see Figure 2). The vessel was heading north west with seas and winds out of the east experiencing a rolling motion which occasionally caused the gun booms to dip into the sea. When Captain Haines became aware of this he required that the ship be put on a westerly course to run down wind. This brought the streamer immediately to the surface. Several attempts were made to sink the streamer by slowing the ship to allow the head to drop under its own weight but even with no turns on the prop and steering with the bow thruster the vessel was moving sufficiently fast down wind that the streamer could not be controlled. The winds and motion of the vessel were such that the gun booms were slacking forward and the guns were being forced under the vessel. The captain would not allow the vessel to be turned onto a course that would have allowed the streamer to be controlled and the guns to be properly managed and this required that the guns be brought on board under very difficult and dangerous conditions. Even with the guns secured Captain Haines would not allow the vessel to turn on a course other than upwind or downwind. Since the latter would have put undue strain on the streamer we continued northwest. In the late evening the weather had moderated sufficiently in Captain Haines' opinion that we were granted permission to carry on. We made a slow turn into the trough and gained control of the streamer fairly readily and were able to recommence at the start of line AP-31 at around 0630 on the 26th. During either this or the previous storm the Norwegian floats were lost and the remainder of the work was conducted without any floatation on the end of the streamer.

Finally, on the last line of the South Shetland portion of the experiment we experienced heavy following seas and the streamer proved very difficult to manage. The streamer surfaced repeatedly and could only be controlled by slowing the ship to sink the head, allowing that deep point to propagate back then picking up speed to bring the tail down under the action of the birds. Some portion of the streamer was on the surface at most times along this line. Work on the South Shetland Trench portion of the study was completed around 0430 on the 28th and the vessel began the transit south to the third portion of the study.

Approximately 1800 km of data were obtained during this phase of the experiment which, excepting those times of poor weather conditions is of generally good quality. Recordings were made with a 12 sec record length. In deep water, and particularly in flat bottom conditions Hydrosweep showed many problems including numerous dropouts and bulls-eye "zits" that had been reported from previous legs. Adjusting gains and/or filter settings has little effect on these problems. They are dealt with in a particularly inefficient manner by the URI tech who simply edits out large potions of the recorded data and averages what's left until a smooth result is obtained. These problems did not arise in the shallower water and better weather conditions in Bransfield Straits The procedure by which these will be handled during post-processing at URI is not very clear at present nor is the service that the multibeam group will provide for these data given that they do not need to be adjusted and gridded as would be the case for a lawn mowing survey.

Pacific Antarctic Margin: Hero to Heezen Fracture Zones

In this part of the operations thirteen individual lines were obtained for a total of about 2600 km. They constitute one strike line on the shelf between the Hero and the Heezen Fracture Zones, five complete dip lines crossing the margin and a strike line at the base of the slope between latitudes 66° 40' and 69° 26' (see Figure 3). Most of the data is concentrated south of 66°. This part of the survey involves study of an area that is considerably less well known that the other two areas and hence the the work is considerably more reconnaissance in mode. The specific objectives that formed the framework in which the reconnaissance was carried out involved investigating the role that oceanic fracture zones (such as the Anvers, Adelaide, Tula and Heezen) intersecting the margin during its subduction phase played in the tectonic development of the margin, particularly the tectonic segmentation if it exists. We therefore aimed to locate lines in a pattern around the known fracture zone intersections. However the sparse nature of the data base on which these fracture zones have been located is such that their positions are often poorly known and this required that some effort be initially devoted to locating these in order to position lines appropriately.

The work commenced with a strike line along the shelf which is the continuation of the final line of the South Shetland Trench study and crosses the landward projection of the Hero Fracture Zone. This line continues to about 66° 40' south where a dip line (SAP -02) was shot across the margin and a strike line (SAP-03) was then shot south at the foot of the slope to about 68° south. The purpose of moving off the shelf at this point and shooting line 03 was to obtain definition of the location of the Tula Fracture Zone, one of the fracture zones considered most appropriate for investigating in the context of tectonic segmentation processes. SAP-03 first crosses the Adelaide Fracture which displayed the typical bipolar basement high and trough configuration. No similar signature could be recognized at the expected location of the Tula Fracture Zone, either in the near trace monitor or the stacked section that was generated using the Sun-based processing system running SIOSEIS that had been brought to the vessel for the study Tom Shipley (UTIG). This proved to be an extremely useful tool in providing basic processing of selected portions of the data that helped to locate tie lines in the northern areas and in attempts to locate features of interest in the southern area. Processing could not be achieved in real time, but the selected processing of key pieces of data, including a brute stack and constant velocity F-K migration was very helpful. Two almost equally plausible locations for the Tula FZ were identified from a combination of gravity, magnetic and seismic data.

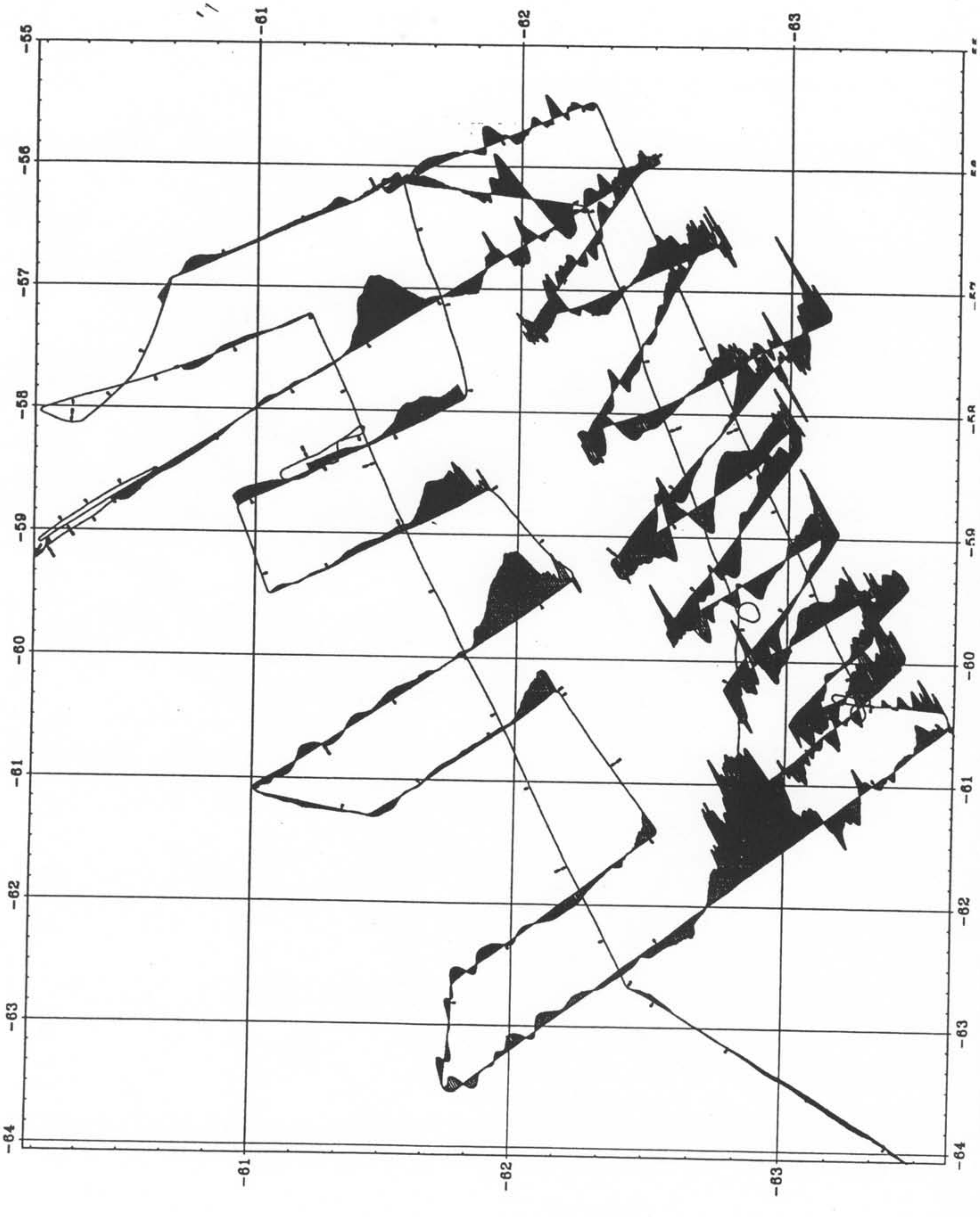


FIGURE 3

After progressing on line SAP-03 to about 68° we found it necessary to make a decision about whether to continue further south and attempt to study the segmentation problem by studying the intersection of the Heezen Fracture Zone with the margin or make the same type of study in the area of the Tula. Our best calculations at that point with a modest weather contingency factored in suggested that it would not have been possible to reach the Heezen, complete a survey in that area and still conduct any activity in the north (such as completing an oceanic strike line to compliment line SAP-01) in the available time. In view of this we made a dip line across the shelf toward the tip of Alexander Island. Heavy iceberg density in the region prevented us from approaching the margin as closely as we had hoped. Furthermore, the shallower parts of the line showed a very hard and deeply scoured bottom which will probably allow only a small degree of penetration. These factors suggested that the risk involved in making a close approach to the margin would not be adequately rewarded. We then ran dip line SAP-06 to the northwest across the margin and line SAP-07 to the northeast.

During this time the weather deteriorated considerably but did not cause termination of operations. After the turn to line SAP-08 we were advised by the captain that he would not permit operations any further south than that latitude in poor weather and sub-zero temperatures, and required that we move north and conduct operations only with about 50 miles of the coast, essentially the area in which we had already run SAP-01. The captain's concern involved the possibility of ice accumulations that might destabilize the vessel in the event of a storm combined with low temperatures that would cause spray coming over the bow and water on the back deck to freeze. At this point we were faced with a considerable dilemma since all objectives lay to the south. In fact, since lines SAP-04 and 05 has been shortened and we had not lost time for poor weather, it became apparent that the Heezen FZ **could** be reached in the time available if we simply traded the time involved for that required to shoot the oceanic strike line offshore from SAP-01. Since reaching the Heezen in what had proven to be an unusually good ice year seemed very clearly to be of higher priority than the northern strike line considerable effort was devoted to persuading the Master to allow operations to the south. Fortunately the weather cleared and although temperatures remained around 2 deg below zero the captain permitted a southerly line provided that he reserved the right to terminate the work at any point he chose. Under these restrictions we made the transit south on lines SAP-09 and 10.

Temperatures reached as low as 5 degrees below zero centigrade, but the weather remained very clear and calm allowing a shelf strike line to a position south of what is believed to be the point of intersection of the Heezen FZ with the margin, together with a dip line across the margin south of Heezen and an oceanic strike line north to join with line SAP-07 all to be completed in the remaining time. The work was completed with a short dip line across the margin between lines SAP-06 and 08 and the streamer and guns were brought on board in less than 3 hours beginning at 0600 on the 12 March. Transit to Punta Arenas was begun at 0900 having been advised that an ETA in Punta Arenas of the morning of the 17th required that we leave the area by noon on the 12th.

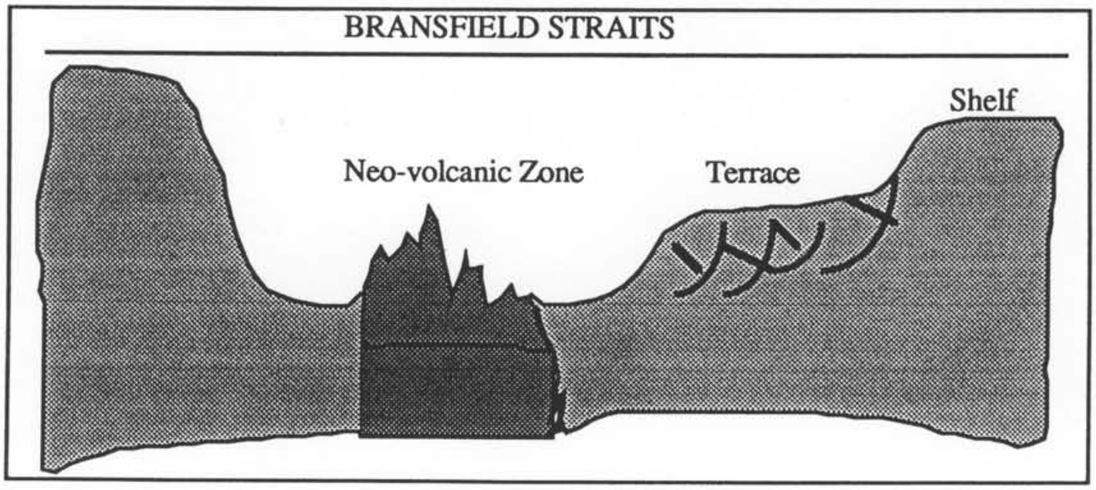
Although several fairly significant decision points were reached during the operations in this area which lead to changes in the conduct of the experiment, the net result was a survey that comprised a near-complete strike line down the shelf from the Hero to the Heezen Fracture Zones, an oceanic strike line that compliments the shelf line from north of the Tula to the Heezen FZ, and five dip lines, two of which straddle the Tula FZ and one that is located south of the Heezen FZ. We believe that the latter may be the farthest south that any research vessel has reached on the Pacific Margin of Antarctica. The highest latitude was 69° 26' south at the landward end of line SAP-11. The only significant problems encountered on this portion of the study were the failure of the BGM 3 gravimeter and the loss of one air gun due to an undiagnosed failure in the hose somewhere between the gun and the deck that will require the hose bundle to be rebuilt. The problem with the BGM 3 is presently not diagnosed.

*********comment on transit speed ************

Preliminary results

The availability of an on board processing capability allowed a number of key areas of the data to be examined and these, together with a preliminary study of the analog monitor records allow for a few comments to be made regarding the results of the investigation.

The extensional system in the Bransfield Straits comprises a strongly asymmetric depression within which the young volcanic center is located. The basin margin is much steeper and the basin is deepest to north, adjacent to the South Shetland Islands than to the south adjacent to the Antarctic Peninsula. A typical crossing of the basin is sketched in the illustration below. The most readily recognized expressions of extension are a region of rotated normal fault blocks beneath a terrace on the southern margin of the basin and the neo-volcanic zone itself which occupies the deepest part of the basin. The extent of magmatic activity varies along strike and, despite the existence of the recent volcanic center at Deception Island in the western part of the region, appears to be more prominently developed in the east.While there appears to be a dextral offset in the basin structure at around 59° west we cannot recognize any further evidence for structural segmentation of the basin at present. The basin south of Elephant Island is much smaller and more symmetric than the main Bransfield Basin, and may represent a less evolved equivalent of the regions to the east. In the eastern part of the region the faulted terrace that exists to the west either disappears or broadens into a wide shelf which shows evidence for normal faulting. The neo-volcanic zone is present throughout and can be identified on seismic records by a distinct volcanic edifice and in the magnetic signature (see figure 3).



There is nothing in the seismic record sections to suggest that the South Shetland Trench is presently or recently inactive. Most of the classic features associated with the toe of an accretionary prism can be recognized including the development of a frontal thrust which appears to be very young. In the southwestern lines the forearc region is distinctly concave in profile, possibly suggesting collapse under extension that may be associated with subduction zone roll-back, but this is hardly conclusive. There is no classic trench-slope basin although a small terrace is often present and was used to locate the tie line.

In the southern survey area records made on the shelf show extremely prominent multiples due to very hard bottom conditions. These prevented the recognition of anything but the shallowest structure and thus did not allow for any structure that might be associated with tectonic segmentation of the margin, which is presumably developed at depth, to be recognized prior to processing. The most prominent features of the margin are extensive erosion/constructional ridges in the lower portion of the continental slope that have built sediment accumulations up to 3 sec thick. Their internal reflector configuration is complex, attesting to several periods of growth and erosion that presumably relate to the oscillations of the ice cap. The processes involve seem to be the combination of down-slope and contour-current driven sedimentation; many of the feature are similar to, but much exaggerated forms of the depositional relationships seen in feature like the Blake Outer Ridge. Marked changes in reflection strength along individual reflectors are probably the response of facies changes. While the existing morphologic maps indicate the presence of several channels in the lower slope and continental, no canyons are known to head at the shelf break and the valleys may be an integral part of the complex depositional and erosional system that shaped the sediment accumulations. Perhaps the most remarkable aspect of these feature is that they seem to nucleate at the point of intersection of oceanic fracture zones with the margin. Apparently the topography of the fracture zone influenced the pattern of deposition such that they formed the locus of growth of the depositional structures. The fracture zones can be recognized as simple steps in the basement or as paired ridge and trough features. All those with significant relief seem to have sediment bodies associated with them.

At several locations along the oceanic strike lines the near-trace monitor showed low-angle dipping structures in the middle and upper oceanic basement that are very similar to those recognized in recent records from the western North Atlantic. Oceanic crust here was accreted at a similar spreading rate to that in the north Atlantic. The structures observed here are often more prominent in the vicinity of fracture zone offsets. The lower crust also occasionally showed evidence of structure on these records and in simple stacks made from the data. Moho could not be confidently identified. Several sonobuoys were deployed giving useful data up to offsets of more than 30 km. Preliminary analysis of these data are somewhat ambiguous but suggest that Moho may be located at around 9 seconds reflection time. These records provide the first example outside the Atlantic for this type of structure developed in oceanic crust at slow to moderate spreading rates and is a particularly valuable constraint on spreading processes.

Comments and recommendations

The cruise must be regarded as a considerable success. Cooperation between the members of the science party was excellent as was that between the ship's complement and the science party with the significant and unfortunate exception of the Master of the vessel, Captain Haines. The total amount of data collected considerably exceeded expectations due to a combination of unusually fair weather, very clear ice conditions and exceptionally good equipment performance Streamer and gun operations can be performed efficiently with the staff size currently available. Management of the 20-gun array would not be possible with the current staff if they were also required to provide service and maintenance for the compressors. The decision to include the latter as part of the ship's engineers' responsibilities is clearly a correct one.

Prior to the leg some concerns had been expressed about the possibility that the gun booms might dip into the seas in heavy weather, especially if the vessel was required to take a heading that put it in the trough, and cause a termination of operations. The gun booms were submerged for as much as one third of their length on several occasions during the leg with no apparent ill effects. Obviously it is not appropriate to have gun personnel on the booms at such times, but we learned that the arrays could be deployed and retrieved in heavy weather by using personnel on the booms to handle the hose bundles for only the inner four or five guns on the booms; the outer guns could be handled by bringing the booms in to the side of the vessel. Although the vessel takes a great deal of water over the back deck during moderate to heavy weather, there is no reason to believe that MCS operations will need to be terminated in lesser sea states than on CONRAD.

Hydrosweep performed vary variably. During all of the work in the Bransfield region the system performed flawlessly. Problems clearly arise in deep water, particularly when combined with flat bottom conditions and poor weather. These manifest themselves as dropouts of large portions of the data and single beam erroneous low values that must represent some form of near drop out. What data that does survive seems to be satisfactory and editing and smoothing produces a believable result. No amount of fiddling with windows and gains can solve the problem, although they can be reduced by careful attention to both. The problem seems to be one of low signal strength such that signal to noise ratios are very low in deep water and heavy seas push the system below its threshold for detecting (and making appropriate use of) returns. Since these problems are now well know I will not make the obvious recommendation that something needs to be done about these problems fairly quickly if the system is to be used in the manner in which it was intended.

The following are a few recommendations that would build upon an already solid base to improve the science operations for MCS/Hydrosweep and other cruises.

1) The onboard seismic processing system that was brought to the ship by Tom Shipley (UTIG) proved to be very useful and a similar system would be a valuable addition to the MCS system on the vessel. The ability to make a simple stack of a portion of the recorded data proved to be very beneficial in cruise planning. The system was too slow and not sufficiently robust to minor tape errors to produce an on-line stack, but could produce a stack using every other trace and an assumed velocity model a few hours after acquisition, and a constant-velocity F-K migration a few hours following that. While a truly on-line stack would be most useful, the ability to examine portions of the data that were critical to cruise planning was extremely beneficial.

The system made use of readily available SUN hardware with associated tape drives and disk storage devices and ran the SIOSEIS processing software. After the change is made to cartridge storage devices on the DSS-240 240, a similar system could be created with cartridge drive input since these are SCSI devices which can be provide relatively easy input to the SUNs. It seems most appropriate to use SUN hardware since we have extensive experience with these at Lamont, and probably install a basic version of SierraSEIS which is available through the IRIS consortium, and a SUN-based version of JDseis. The combination of these two software packages would be very valuable for QC of all data types, display of data following simple processing and the velocity analysis of sonobuoys and ESP data, all of which allow for informed decision making at sea to maximize the scientific return from an MCS study.

2) On legs where MCS and Hydrosweep data are being collected together navigation is available from two different sources; one derived by the URI tech associated with Hydrosweep data reduction, the other from the Lamont data reduction tech. On EW-9101 we had virtually 100% GPS coverage so the difference between the two was never significant. There is, however, a clear duplication of effort. Obviously the ship can only be in one place, yet we have the potential for the generation of two different navigation files. Using the crossing information from Hydrosweep improves the navigation but does not ensure absolute position accuracy since the crossing point itself is often free to move. The constraints from the other inputs including gravity data are important to achieving a "best" navigation. The current situation in which there is more than one navigation file is potentially very confusing and hazardous, especially for later synthesis or cruise planning. A decision has to be made at the appropriate level as to how this should be dealt with; I don't have a specific recommendation but I do wish to emphasize the need for a decision on this.

3) The UNOLS standard (or some suitable equivalent) meteorological station needs to be installed in the main lab. This lab is completely isolated from the outside and one has only the ship's motion to go by as an indication of weather conditions. The ship's officers are not required to provide any weather prognosis to the science party (although some volunteer this information). Weather conditions have a critical impact on science operations and reasonable forecasts that could be made based on the information available from the UNOLS standard station could avoid such hazardous situations as streamer retrieval in heavy weather and allow for operations to be modified to accommodate changing weather conditions.

4) Two personally-owned Macintosh computers were brought to the vessel and installed in the common space in the main lab where they saw extensive use to the benefit of the operations. This cruise report, for instance, would not be available at the end of the current leg were it not for the Mac SE that I lugged all the way from New York. Summaries of the log sheets for the entire leg are being made to allow an immediate start on processing. The availability of the Macs also provide the opportunity for scientists who are not in a position to let their shore-based projects drop completely while at sea to continue that work in some form. Students were also able to make progress on dissertations. A suitable system could be obtained for less than $2000 and easily linked into the Ethernet to allow access to printers and to make them useful as remote terminals.

5) The science library in the Chief Scientist room is a joke. It is embarrassing to think that scientists from other institutions come aboard the newest, and best equipped research vessel in the UNOLS fleet and find such a motley collection of out of date and generally useless texts. It includes material that I brought to the CONRAD for temporary use in 1978. I understood that Susan Klimley was putting a collection together for use on the vessel. I hope this didn't go away for financial reasons. It couldn't cost more than $1000 or so to put a modest, but good quality selection of recent texts on the vessel. The present collection should be disposed of.

EW 9101 Personnel

Austin, J	Co-Chief Scientist (UTIG)
Mutter, J.	Co-Chief Scientist (Lamont Doherty)
Shipley, T.	Co-Chief Scientist (UTIG)
Diebold, J	Scientist (Lamont-Doherty)
Smith, J.	Science Officer (Lamont-Doherty)
Stennet, J.	Science Officer (Lamont-Doherty)
Blaes, R.	Computer Tech (Lamont-Doherty)
Pittman, R.	Electronics Tech (A&M)
Dibernardo, J.	Senior airgun Tech (Lamont-Doherty)
Nolan, T.	Airgun (Lamont Doherty)
Smith, R.	Airgun (Lamont Doherty)
Maiwiriwiri, R	Airgun (Lamont Doherty)
Corey, S.	Hydrosweep (URI)
Bilir,S.	Student/watchstander (UTIG)
Tyburski,S.	Student/watchstander (UTIG)
Hoar, T	Student/watchstander (UTIG)
Saustrip,S	Computer Tech /watchstander (UTIG)
McGinnis, J	Student/watchstander (Lamont-Doherty)
Larter, R	Observer/watchstander (British Antarctic Survey)

Barnes, F	Film (UT Film School)
Zucal, J	Film (UT Film School)
St Clair, D	Freelance Writer (National Geographic)

	Line Number	Day/Date	Time	Latitude	Longitude	Reel #	File #	Shotpoint
Start	AP 1/1035	039/8 Feb. 91	0120:45	S 60° 20.9'	W 58° 1.3'	1	1	0
End		040/9 Feb. 91	0725:00	S 62° 29.07'	W 55° 59.3'	82	5390	2583
	AP 2/1036	040/9 Feb. 91	0958:50	S 62° 24.0731'	W 56°9.63'	83	1	3051
		040/9 Feb. 91	1808:50	S 62° 2.232'	W 57° 19.272'	119	1423	4519
	AP 3/1037	040/9 Feb. 91	2108:00	S 62° 1.9119'	W 57° 16.5431	120	1	1
		041/10 Feb. 91	0627:39	S 62° 44.214'	W 56° 35.3578'	144	1675	1679
	AP 4/1038	041/10 Feb. 91	0721:52	S 62° 42.7384'	W 56° 29.9722'	145	1	1
		041/10 Feb. 91	1914:54	S 62° 14.2431'	W 58° 15.1788'	176	2122	2140
	AP 5/1039	041/10 Feb. 91	2122:10	S 62° 15.318'	W 58° 13.087'	177	1	0(really 1)
		042/11 Feb. 91	0920:55	S 63° 8.2176	W 57° 13.435'	211	2140	2157
	AP 6/1040	042/11 Feb. 91	1028:54	S 63° 6.0217'	W 57° 11.2202	212	1	0
		042/11 Feb. 91	2359:37	S 62° 22.5427'	W 57° 9.7783'	248	2434	4794
	AP 7/1041	043/12 Feb. 91	0104:57	S 62° 23.3354'	W 59° 12.1738'	249	1	171
		043/12 Feb. 91	1112:00	S 62° 2.0674'	W 58° 5.4013'	277	1813	1820
	AP 8/1042	043/12 Feb. 91	1226:34	S 63° 2.1'	W 58° 18.5'	279	1	0(really 1)
		043/12 Feb. 91	2215:00	S 62° 33.9038'	W 59° 45.6897'	306	1767	1767
	AP 9/1043	043/12 Feb. 91	2309:00	S 62° 36.0189'	W 59° 44.5432'	307	1	1
		044/13 Feb. 91	1715:01	S 63° 9.4496'	W 58° 55.7248	328	1459	1459
	AP 10/1044	044/13 Feb. 91	0815:00	S 63° 9.6073'	W 58° 2.6151'	329	1	75
		044/13 Feb. 91	1612:00	S 62° 46.228'	W 58° 14.982'	350	1432	1506
	AP 11/1045	044/13 Feb. 91	1643:01	S 62° 47.7128'	W 60° 15.1358'	351	1	1
		045/14 Feb. 91	0140:03	S 63° 24.2213'	W 59° 20.6214'	375	1602	1602
	AP 12/1046	045/14 Feb. 91	0302:02	S 63° 24.358'	W 59° 28.146'	376	1	1
		045/14 Feb. 91	1045:23	S 63° 0.7963'	W 60° 30.5529'	397	1391	1391
	AP 13/1047	045/14 Feb. 91	1119:04	S 63° 2.9'	W 60° 30.2'	398	1	1
		045/14 Feb. 91	1633:48	S 63° 25.06'	W 60° 1.133'	411	939	941
	AP 14/1048	045/14 Feb. 91	1905:44	S 63° 23.924'	W 60° 4.7230'	413	1	0
		046/15 Feb. 91	0404:25	S 62° 50.647'	W 61° 11.283'	437	1617	1617
	AP 15/1049	046/15 Feb. 91	0440:30	S 62° 49.059'	W 61° 10.065'	438	1	1
		046/15 Feb. 91	1246:07	S 62° 49.3745'	W 59° 35.9088'	460	1457	1457
	AP 16/1050	046/15 Feb. 91	1536:09	S 62° 49.9'	W 59° 32.845'	461	1	1
		047/16 Feb. 91	1157:49	S 62° 15'	W 56° 21.8'	515	3665	3665
	AP 17/1051	047/16 Feb. 91	1243:09	S 62° 12.3739'	W 56° 18.0889'	516	1	999999(1)

	047/16 Feb. 91	2109:50	S 61° 31.6194'	W 56° 8.538'	538	1524	1524
AP 18/1052	047/16 Feb. 91	2319:10	S 61° 33.076'	W 56° 8.5975'	539	1	12
	048/17 Feb. 91	0825:11	S 62° 15.77'	W 55° 27.91'	563	1639	1638
AP 19/1053	048/17 Feb. 91	0907:11	S 62° 17.579'	W 55° 32.595'	564	1	7
	049/18 Feb. 91	1335:14	S 63° 17.2'	W 60° 23.7'	645	4882	5131
AP 20/1054	049/18 Feb. 91	1914:33	S 63° 14.67'	W 60° 19.94'	646	1	0(1)
	049/18 Feb. 91	2257:56	S 63° 34.2924'	W 60° 23.0643';	655	671	671
AP 21/1055	050/19 Feb. 91	0014:35	S 63° 34.5'	W 60° 34.1'	656	1	1
	051/20 Feb. 91	0323:00	S 61° 47.86'	W 63° 32.737'	730	4886	4884
AP 22/1056	051/20 Feb. 91	0950:19	S 61° 50.2832'	W 62° 32.9969'	731	1	1
	051/20 Feb. 91	2015:21	S 62° 31.9564'	W 61° 25.1768'	755	1876	1876
AP 23/1057	051/20 Feb. 91	2041:01	S 62° 31.6655'	W 61° 21.153'	756	1	1
	052/21 Feb. 91	0409:01	S 62° 9.889'	W 60° 16.939'	772	1345	1345
AP 24/1058	052/21 Feb. 91	0447:00	S 62° 7.455'	W 60° 17.77	773	1	1
	052/21 Feb. 91	1444:00	S 61° 26.47'	W 61° 17.05'	794	1791	1791
AP 25/1059	052/21 Feb. 91	2020:23	S 61° 0.9523'	W 61° 3.0912'	795	1	1
	053/22 Feb. 91	1341:25	S 62° 12.22'	W 59° 21.59'	833	3124	3124
AP 26/1060	053/22 Feb. 91	1401:25	S 62° 12.4'	W 59° 18.13'	834	1	3184
	053/22 Feb. 91	1918:26	S 61° 53.6023'	W 58° 38.2377'	845	952	4135

Line Number	Day/Date	Time	Latitude	Longitude	Reel #	File #	Shotpoint
AP 27/1061	053/22 Feb. 91	1945:26	S 61° 51.5354'	W 58° 39.6274'	846	1	1
	054/23 Feb.91	0700:09	S 61° 3.371'	W 59° 30.413'	869	2025	2025
AP 28A/1062A	054/23 Feb.91	1136:08	S 60° 56.94'	W 58° 45.77'	870	1	1
	054/23 Feb.91	1545:00	S 61° 14.304'	W 58° 27.409'	878	741	741
AP 28B/1062B	055/24 Feb. 91	0324:00	S 61° 13.05'	W 58° 29.9'	879	1	1
	055/24 Feb. 91	1137:00	S 61° 47.34'	W 57° 53.71'	898	1480	1480
AP 29/1063	055/24 Feb. 91	1200:00	S 61° 47.85'	W 57° 49.69'	899	1	1
	055/24 Feb. 91	2230:11	S 61° 32.9909'	W 56° 7.3322'	920	1891	1891
AP 30/1064	055/24 Feb. 91	2300:11	S 61° 30.9155'	W 56° 7.0907'	921	1	1
	056/25 Feb. 91	1041:53	S 60° 39.9769'	W 56° 56.6747'	946	2105	2105
AP 31/1065	057/26 Feb. 91	0914:55	S 60° 41.951'	W 57° 40.153'	947	1	1
	057/26 Feb. 91	1554:45	S 61° 11.435'	W 57° 14.323'	963	1200	1200
AP 32/1066	057/26 Feb. 91	1619:16	S 61° 12.849'	W 57° 14.801'	964	1	1
	059/28 Feb. 91	0630:40	S 62° 25.93'	W 62° 39.001'	1045	6872	6875

South Antarctic Peninsula Line Surveys

	Line Number	Day/Date	Time	Latitude	Longitude	Reel #	File #	Shotpoint #
Start	SAP 1A/1067	059/28 Feb. 91	0706:59	S 62° 28.4'	W 62° 43.9'	1046	1	1
End		059/28 Feb. 91	1157:21	S 62° 48.6'	W 63° 9.2'	1058	872	872
	SAP 1B/1068	059/28 Feb. 91	1444:40	S 63° 0.9'	W 63° 25.4'	1059	1	0(really 1)
		061/2 Mar. 91	2203:27	S 66° 44.9'	W 69° 19.1'	1214	9955	9957
	SAP 2/1069	061/2 Mar. 91	2357:54	S 66° 44.2'	W 69° 20.3'	1215	1	0
		062/3 Mar. 91	1613:37	S 65° 49'	W 71° 48.9'	1259	2927	2923
	SAP 3/1070	062/3 Mar. 91	1828:29	S 65° 46.8'	W 71° 52'	1260	1	1
		064/5 Mar. 91	0045:33	S 67° 46.1'	W 76° 3.6'	1326	5451	5452
	SAP 4/1071	064/5 Mar. 91	0320:32	S 67° 45.2'	W 76° 1.4'	1327	1	5915
		064/5 Mar. 91	1842:35	S 68° 40.3'	W 73° 33.6'	1370	2770	2768
	SAP 5/1072	064/5 Mar. 91	1851:55	S 68° 40.75'	W 73° 31.8'	1371	1	1
		064/5 Mar. 91	2340:15	S 68° 39.7'	W 72° 22.8'	1383	866	866
	SAP 6/1073	064/5 Mar. 91	2349:15	S 68° 39.4'	W 72° 21.2'	1384	1	1
		066/7 Mar. 91	0056:18	S 67° 6.3'	W 76° 8.1'	1452	4507	4522
	SAP 7/1074	066/7 Mar. 91	0106:58	S 67° 5.5'	W 76° 8.6'	1453	1	1
		066/7 Mar. 91	1457:00	S 66° 20'	W 74° 2.4'	1485	2539	2546
	SAP 8/1075	066/7 Mar. 91	1530:59	S 66° 20.5'	W 73° 56.2'	1486	1	1
		067/8 Mar. 91	1337:42	S 67° 43.2'	W 70° 46.6'	1547	4016	4018
	SAP 9/1076	067/8 Mar. 91	1545:02	S 67° 36.1'	W 70° 54.5'	1548	1	1
		068/9 Mar. 91	1108:44	S 68° 25.2'	W 74° 48.8'	1606	3489	3492
	SAP 10/1077	068/9 Mar. 91	1114:24	S 68° 25.44'	W 74° 49.78'	1607	1	0(really 1)
		069/10 Mar. 91	0737:06	S 69° 26.1231'	W 78° 34.4639'	1665	3660	3669
	SAP 11/1078	069/10 Mar. 91	0745:46	S 69° 25.8904'	W 78° 36.1425'	1666	1	0
		069/10 Mar. 91	1804:28	S 68° 42.3036'	W 79° 48.6421'	1693	1792+	1793+
	SAP 12/1079	069/10 Mar. 91	1808:08	S 68° 42.01'	W 79° 48.968'	1694	1	1
		070/11 Mar. 91	2250:00	S 67° 2.875'	W 75° 8.869'	1771	5167	5167
	SAP 13/1080	070/11 Mar. 91	2305:00	S 67° 3.025'	W 75° 5.74'	1773	1	1
		070/11 Mar. 91	0859:52	S 67° 40.2181'	W 73° 30.3924'	1799	1784	1786

Sonobuoy Logs for the Antarctic Peninsula MCS Cruise.

SB #	Line #	Start Date Julian	Start Date Calendar	GMT	End Date Julian	End Date Calendar	GMT	Reel #	File #
1	AP-1	040	9-Feb	3:20	040	9-Feb	5:42	analog only	4668
2	AP-2	040	9-Feb	10:13	040	9-Feb	unk	84	43
3	AP-3	041	10-Feb	0:38	041	10-Feb	unk	129	unk
4	AP-5	041	10-Feb	22:11	42	11-Feb	0:00	179	unk
5A	AP-6	042	11-Feb	18:40	42	11-Feb	18:52	233	1475
5	AP-6	042	11-Feb	18:53	42	11-Feb	20:10	234	unk
6A	AP-8	043	12-Feb	17:43	43	12-Feb	18:05	293	unk
6	AP-8	043	12-Feb	18:16	43	12-Feb	22:00	295	unk
7	AP-11	044	13-Feb	17:35	44	13-Feb	21:00	353	unk
8	AP-11	044	13-Feb	21:06	44	13-Feb	22:50	362	unk
9	AP-16	046	15-Feb	15:50	46	15-Feb	17:45	461	44
10	AP-16	046	15-Feb	17:51	46	15-Feb	19:50	467	unk
11	AP-16	046	15-Feb	19:51	46	15-Feb	21:50	472	unk
12A	AP-16	046	15-Feb	21:52	46	15-Feb	22:18	477	unk
12	AP-16	046	15-Feb	22:19	46	15-Feb	23:52	479	unk
13	AP-16	046	15-Feb	23:53	47	16-Feb	1:50	483	unk
14	AP-16	047	16-Feb	2:00	47	16-Feb	5:00	488	unk
15	AP-16	047	16-Feb	5:08	47	16-Feb	6:20	497	unk
16	AP-16	047	16-Feb	6:59	47	16-Feb	unk	502	2770
17	AP-16	047	16-Feb	9:05	47	16-Feb	11:57	508	3148
18	AP-18	047	16-Feb	23:23	48	17-Feb	8:75	539	unk
19	AP-19	048	17-Feb	9:40	48	17-Feb	14:30	565	unk
20	AP-19	048	17-Feb	12:02	48	17-Feb	unk	572	unk
21	AP-19	048	17-Feb	14:30	48	17-Feb	19:10	580	unk
22	AP-19	048	17-Feb	22:03	unk	unk	unk	601	2088
23	AP-19	049	18-Feb	1:54	49	18-Feb	5:00	612	2785
24	AP-19	049	18-Feb	7:19	49	18-Feb	9:18	627	3756
25	AP-23	051	20-Feb	22:40	52	21-Feb	2:21	761	361
26	AP-26	053	22-Feb	?	53	22-Feb	14:47	835	139
SB #	Line #	Start Date Julian	Start Date Calendar	GMT	End Date Julian	End Date Calendar	GMT	Reel #	File #
27A	AP-29	055	24-Feb	15:33	unk	unk	unk	906	unk
27	AP-29	055	24-Feb	15:44	55	24-Feb	18:00	906	unk
28	AP-32	057	26-Feb	17:43	57	26-Feb	19:55	966	253
29	AP-32	058	27-Feb	10:35	58	27-Feb	13:04	1003	3288
30	AP-32	058	27-Feb	20:02	58	27-Feb	22:15	1023	4990
31	AP-32	058	27-Feb	22:37	58	27-Feb	23:02	1029	5455
32	AP-32	059	28-Feb	2:57	59	28-Feb	5:27	1038	6231
33	SAP-1B	060	1-Mar	8:31	60	1-Mar	unk	1106	unk
34	SAP-1B	060	1-Mar	12:13	60	1-Mar	15:17	1117	3867
35	SAP-1B	061	2-Mar	3:54	61	2-Mar	unk	1164	6688
36A	SAP-1B	061	2-Mar	18:01	61	2-Mar	unk	1202	9228

36	SAP-1B	061	2-Mar	18:16	61	2-Mar	unk	1203	9273
37A	SAP-3	063	4-Mar	4:57	63	4-Mar	unk	1282	1888
37	SAP-3	063	4-Mar	5:18	63	4-Mar	unk	1282	1950
38	SAP-6	065	5-Mar	9:41	65	6-Mar	unk	1410	1777
39	SAP-8	067	8-Mar	3:12	67	8-Mar	unk	1519	2104
40	SAP-9	068	9-Mar	0:34	68	9-Mar	unk	1573	unk
41	SAP-9	068	9-Mar	8:45	68	9-Mar	unk	1599	3069
42	SAP-10	068	9-Mar	18:55	68	9-Mar	unk	1630	1385
43	SAP-11	069	10-Mar	8:05	69	10-Mar	unk	1666	59
44	SAP-12	070	11-Mar	2:00	70	11-Mar	unk	1715	1418
45	SAP-12	070	11-Mar	15:12	70	11-Mar	unk	1745	3433