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RADIOLOGICAL EFFLUENT AND ONSITE AREA MONITORING REPORT FOR THE NEVADA TEST SITE (JANUARY 1985 THROUGH DECEMBER 1985)

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(JANUARY 1985 THROUGH DECEMBER 1985)

by

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ABSTRACT

This report documents the environmental surveillance program at the Nevada Test Site as conducted by the Department of Energy (DOE) onsite radiological safety contractor from January 1985 through December 1985. The results and evaluations of measurements of radioactivity in air and water, and of direct gamma radiation exposure rates are presented. Relevancy to DOE concentration guides (CG'S) is established. This report was formerly titled "Environmental Surveillance Report for the Nevada Test Site."

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ACKNOWLEDGMENTS

Credit must be given to D. Wilson and B. White for their excellent work in the program. I would also like to thank D. Fauver, J. Morrison and the reviewers of this report for their cooperation and assistance.

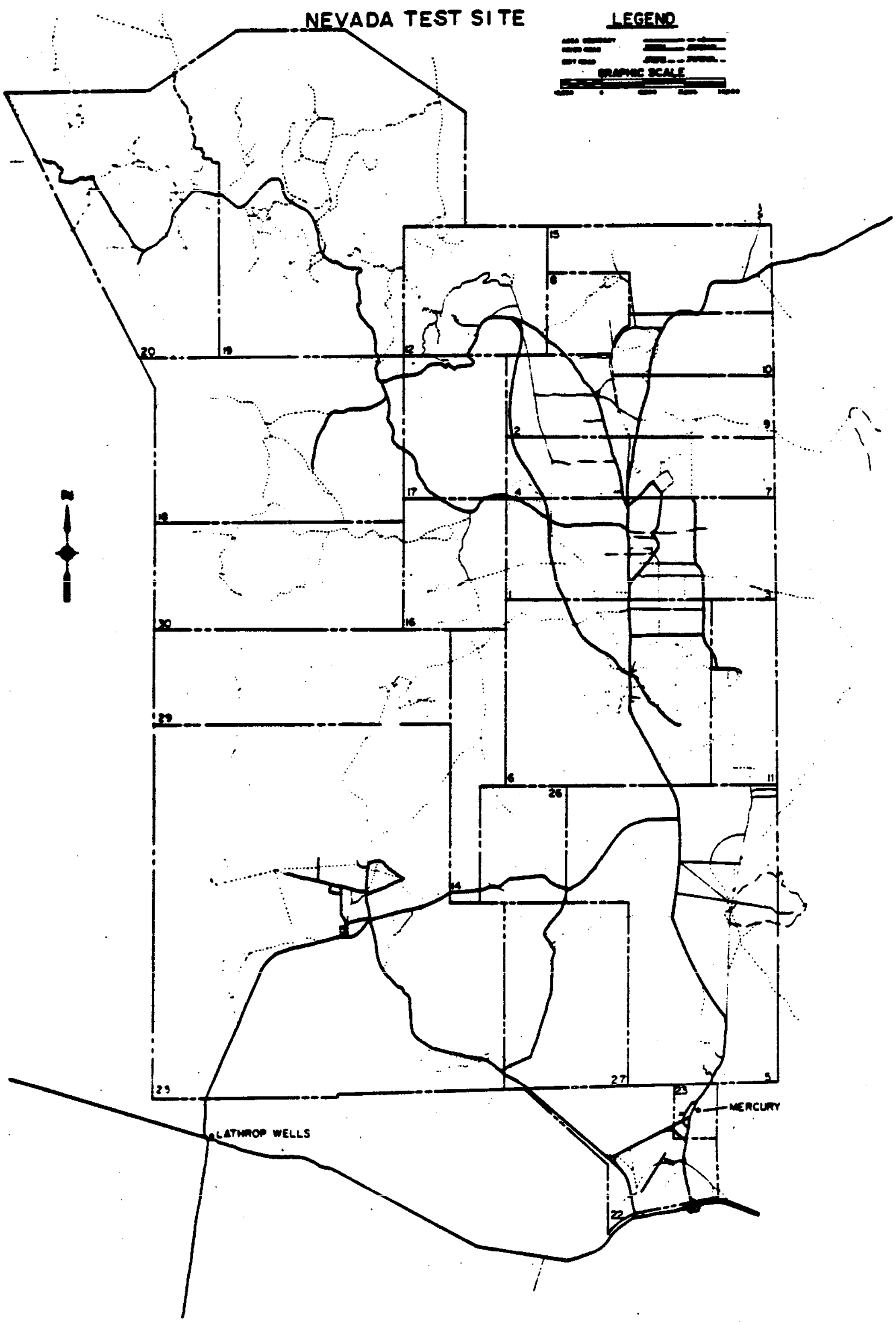
A. INTRODUCTION

This report documents the program conducted at the Nevada Test Site (NTS) for monitoring of radioactivity in the general onsite environment as performed by Reynolds Electrical and Engineering Co., Inc. (REECo) during the calendar year of 1985. As part of its contract, DE-AC08-84NV10327, REECo is responsible for providing radiological safety services within the confines of the test site. For a number of years, the effluent and onsite area monitoring program has been part of a Department of Energy (DOE) program designed to control, minimize, and document exposures to the NTS working population.

The NTS covers an area of 3,711 square kilometers, with terrain and climate conditions typical of the high southwest desert region and mountainous areas. Temperatures vary from -20°C to 50°C. The area is subject to high winds, dust-laden atmosphere, and low humidity. Elevations range from dry lake beds to rugged mountains as high as 2,300 meters. The NTS, since 1951, has been the primary location for testing the nation's nuclear devices (Figure 1).

The monitoring program originally was designed to examine the environment for levels of radioactivity that are of interest in documenting the radiation exposure to NTS workers; i.e., a backup for the onsite personnel dosimetry system. This program also could provide data concerning onsite releases or be a monitoring locale for the detection of worldwide fallout in Nevada from foreign sources. The program follows the standards presented in "A Guide For Environmental Radiological Surveillance at U.S. Department of Energy Installations," DOE/EP-0023 (Reference 2). The standards dictate the following objectives for the protection of the public:

FIGURE 1



NEVADA TEST SITE
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(1) Evaluation of containment of radioactivity onsite.

(2) Detection of rapid changes and evaluation of long-term trends.

(3) Assessment of doses-to-man from radioactive releases as a result of DOE operations.

(4) Collection of data bearing on the movement of contaminants released to the environment, with the intent of discovering unknown pathways of exposure.

(5) Maintenance of a data base.

(6) Detection and evaluation of radioactivity from offsite sources.

(7) Demonstration of compliance with applicable regulations and legal requirements concerning releases to the environment.

These objectives are met through the operation of the effluent and onsite area monitoring program. A summary of the environmental plan is shown in Table 1. Air and potable water samples are collected at specific areas where personnel spend significant amounts of time. Additional air sampling stations are located at sites throughout the NTS in support of the testing program and the radiological waste management program. Water sampling of supply wells, open reservoirs, natural springs, contaminated ponds, and sewage ponds is also done to evaluate the possibility of any movement of radioactive contaminants into the NTS water system. The rate of sampling for each of these surveillance networks is related to potential personnel exposure; i.e., weekly water samples at each cafeteria. Thermoluminescent dosimeters (TLD's) are used to survey the ambient NTS external gamma levels and are collected on a quarterly cycle. Except for removal of a station, inaccessibility of the location, or loss of data, sampling was continuous during this reporting period. A review of all analytical results from this sampling program relative to the DOE

TABLE 1

SUMMARY OF ENVIRONMENTAL PROGRAM

Sample Type	Description	Collection Frequency	Number of Samples	Analysis
Air	Continuous sampling through Whatman GF/A glass filter and a charcoal cartridge	Weekly	47	Gamma spectroscopy, gross beta, plutonium (monthly composite)
	Low-volume sampling through silica gel	Biweekly	17	HTO
	Continuous low volume sampling	Weekly	7	^{85}Kr and ^{133}Xe
Potable Water	1-liter grab sample	Weekly	8	Gross beta, tritium, plutonium (quarterly)
Supply Wells	1-liter grab sample	Monthly	12	Gamma spectroscopy, gross beta, tritium, plutonium (quarterly)
Open Reservoirs	1-liter grab sample	Monthly	17*	Gamma spectroscopy, gross beta, tritium, plutonium (quarterly)
Natural Springs	1-liter grab sample	Monthly	9*	Gamma spectroscopy, gross beta, tritium, plutonium (quarterly)
Contaminated Ponds	1-liter grab sample	Monthly	8*	Gamma spectroscopy, gross beta, tritium, plutonium (quarterly)
Effluent Ponds	3-liter grab sample	Quarterly	7	Gamma spectroscopy, gross beta, plutonium
External Gamma Radiation Levels	CaF_2:Dy Thermoluminescent Dosimeters	Quarterly	163	Total integrated exposure over field cycle

* All of these locations were not sampled due to inaccessibility or lack of water.

concentration guides was performed daily to insure that potential problems were noted in a timely fashion. Table 2 lists the CG's used in the evaluations of the results of this program (References 3 and 22).

All laboratory analyses appropriate to the environmental surveillance program are shown in Table 3. The analysis that provided the most information on the majority of test site samples has been the gross beta analysis. This analysis allowed for rapid determinations of trends in gross radioactivity, and because of counting system characteristics, had a low detection limit. This meant that positive measurements were obtained down to the lowest limits of ambient radioactivity. The remaining analyses show their worth to the program in more specific instances. Gamma spectroscopy and noble gas sampling have proved their importance by indicating whether increases of radioactivity in air were caused by the Nevada Test Site or other offsite sources. TLD analysis of direct gamma radiation onsite has shown: (1) elevated exposure rates at the coordinates of the NTS atmospheric tests; and (2) consistent exposure rates at all radiation levels when the TLD's are integrated over a three month period. Plutonium analysis was primarily an indicator of the small amounts of Pu-239 in the air near areas with histories of safety shots. Tritium analysis was used principally as a check of the water in the ponds below the Area 12 tunnels.

TABLE 2

CONCENTRATION GUIDES (CGs) FOR CONTROLLED AREAS

Nuclide	CG for Air* (μCi/cc)	CG for Major NTS Waters*+ (μCi/ml)	CG for Drinking Water** (μCi/ml)
^{3}H	5×10^{-6}	1×10^{-1}	2×10^{-5}
^{7}Be	6×10^{-6}	5×10^{-2}	6×10^{-6}
^{60}Co	3×10^{-7}	1×10^{-3}	1×10^{-7}
^{85}Kr	1×10^{-5}	--------	--------
^{89}Sr	3×10^{-8}	3×10^{-4}	8×10^{-8}
^{90}Sr	1×10^{-9}	1×10^{-5}	8×10^{-9}
^{95}Zr	1×10^{-7}	2×10^{-3}	2×10^{-7}
^{131}I	4×10^{-9}	3×10^{-5}	3×10^{-9}
^{132}Te	2×10^{-7}	9×10^{-4}	9×10^{-8}
^{133}Xe	1×10^{-5}	--------	--------
^{137}Cs	6×10^{-8}	4×10^{-4}	2×10^{-7}
^{140}Ba	1×10^{-7}	8×10^{-4}	9×10^{-8}
^{152}Eu	1×10^{-8}	2×10^{-3}	2×10^{-7}
^{238}Pu	2×10^{-12}	1×10^{-4}	5×10^{-6}
^{239}Pu	2×10^{-12}	1×10^{-4}	5×10^{-6}
gross β***	1×10^{-9}	1×10^{-5}	1.5×10^{-8}

*This column contains the concentration guides for the predominant nuclides detected at the NTS, as listed in DOE Order 5480.1A, Chapter XI, Table 1.

+These concentrations are applicable to the discharge of liquid effluents to sanitary sewage systems.

**Drinking water concentration guides are as required by the National Interim Primary Drinking Water Regulations.

***Concentration guides for gross β are derived according to DOE ORDER 5480.1A, attachment XI-1.3, page 14.

TABLE 3
LABORATORY ANALYTICAL PROCEDURES

Type of Analysis	Type of Sample	Analytical Equipment	Counting Period (Min.)	Analytical Procedures	Sample Size	Detection Limit
Gross Beta	Air	Gas-flow Proportional Counter	20	Place filter on a 12.7 cm stainless steel planchet.	10^9 cc	2×10^{-16} µCi/cc
	Water	Gas-flow Proportional Counter	100	Evaporate, transfer residue to a 12.7 cm stainless steel planchet.	1000 ml	1×10^{-9} µCi/ml
Gamma Spectroscopy	Air (particulate)	Germanium Semiconductor	20	Same as for gross beta.	10^9 cc	5×10^{-15} µCi/cc
	Air (gaseous)	Germanium Semiconductor	20	Place charcoal cartridge in plastic bag.	10^9 cc	5×10^{-15} µCi/cc
	Water	Germanium Semiconductor	20	Aliquot sample into Nalgene bottle.	500 ml	1×10^{-8} µCi/ml
Krypton-85	Air	Liquid Scintillation Counter	200	Cryogenic-gas chromatographic techniques used to collect krypton into liquid scintillation solution.	3×10^5 cc	4×10^{-12} µCi/cc
Plutonium-239	Air	Silicon Semiconductor	333	Filter is ashed and put in solution. Pu is purified by anion exchange resin column, then electrodeposited on a stainless steel disc.	4×10^9 cc	1×10^{-17} µCi/cc
	Water	Silicon Semiconductor	1000	Pu is concentrated with $Fe(OH)_3$ and purified with anion resin column. Electrodeposited on a stainless steel disc.	1000 ml	4×10^{-11} µCi/ml
Tritium	Air	Liquid Scintillation Counter	100	Distill the H_2O and aliquot 5 ml into a scintillation solution.	6×10^6 cc	3×10^{-13} µCi/cc
	Water	Liquid Scintillation Counter	100	Distill 20 ml of sample and aliquot 4 ml into a scintillation solution.	4 ml	4×10^{-7} µCi/ml
Xenon-133	Air	Liquid Scintillation Counter	200	Cryogenic-gas chromatographic techniques used to collect xenon into liquid scintillation solution.	3×10^5 cc	10×10^{-12} µCi/cc
Direct Gamma Radiation	TLD	Harshaw 2000 TLD Reader		Post-anneal at 115°C for 15 minutes. Readout to 270° for 25 seconds.		10 mR/quarter

B. SUMMARY OF RESULTS

The results obtained from the effluent and onsite area monitoring program for the reporting period of CY-1985 show that the radioactivity in air and water, and external gamma exposure levels in the NTS environments were low compared to DOE guidelines.

The highest CY-1985 average gross beta concentration in air was 1.9×10^{-14} µCi/cc at one of the forty-seven stations, excluding samples collected at Gate 200 and the Area 5 communications tower which were analyzed by a different procedure (see Section D). This average represents 0.002 percent of the applicable concentration guide of 1×10^{-9} µCi/cc as listed in Table 2. The site average for the forty-seven stations was 1.7×10^{-14} µCi/cc with one standard deviation being 28.0 percent. This gross beta concentration is considered to be normal background for the Nevada Test Site. Pu-239 concentrations in air were primarily on the order of 10^{-17} µCi/cc as compared with the concentration guide of 2×10^{-12} µCi/cc (DOE Order 5480.1A, Chapter XI, Table 1). The highest average Pu-239 concentration occurred in Area 9 at the 9-300 Bunker 2. This Pu-239 concentration of 1.5×10^{-15} µCi/cc represents 0.08 percent of the concentration guide. The majority of NTS air sampling stations measured plutonium concentrations similar to those found in the base camp (Mercury), and all were negligible in terms of exposure to NTS personnel. The maximum average tritium concentration in air occurred at the Area 23 Building 650 roof. This concentration, 8.0×10^{-9} µCi/cc, represents 0.16 percent of the concentration guide.

The average concentration of Kr-85 for CY-1985 was 33 pCi/m^3, which was slightly higher than the CY-1984 average of 28 pCi/m^3. This increase in Kr-85 concentration in ambient air was expected since nuclear technologies, predominantly nuclear power generation, continue to generate and release small quantities of Kr-85 (Reference 25). Xe-133 concentrations continue to be nondetectable except for instances related to specific events.

Measurements of radioactivity in the principal NTS water system showed that no release or movement of radionuclides occurred during the reporting period. One supply well sample was added in September, 1985, at Well 16D. The highest average gross beta concentration in potable waters and supply wells was 8.0×10^{-9} µCi/ml from the Area 23 Cafeteria and 10.5×10^{-9} µCi/ml from Area 6 Well C. Water from several of the open reservoirs showed gross beta activities believed to be associated with the occasional influx of radionuclides from surface contamination in the surrounding areas. There was no human consumption of this water, and the activity was still within the applicable concentration guides.

The highest average Pu-239 concentration from contaminated waters was 3.2×10^{-10} µCi/ml at Upper N Pond. This value represents 0.0003 percent of the concentration guide for Pu-239. For all other waters sampled, the highest average Pu-239 concentration was 1.8×10^{-10} µCi/ml at the Area 5 Reservoir. This value represents 0.0001 percent of the concentration guide for Pu-239. However, all of the positive plutonium results have a high percentage error associated with them and are possibly due to statistical fluctuations of the counting system.

The highest average concentration of tritium in noncontaminated water occurred at Well J-12. This concentration of 2.4 X 10^{-6} μCi/ml represents 12 percent of the limit allowed by Table 2, Column 2 of DOE Order 5480.1.

Measurable amounts of tritium were present in the contaminated waste ponds. The amounts of effluent released to the environment for the year were calculated and reported to DOE Headquarters in accordance with DOE Order 5484.1, Chapter IV.

TLD measurements of the NTS gamma radiation rates at the 163 locations showed some variation during CY-1985. A nine station control network displayed lower results than previous years. The remaining 154 stations recorded changes related to known effects. The maximum dose rate of 1817 mrem/y occurred at the 4-04 road station but the majority of NTS locations measured in the range of approximately 100-160 mrem/y.

The maximum dose to an individual working at the NTS was calculated for CY-1985. The maximum calculated dose to the total body, bone, and lung was 3.5 mrem, 34 mrem, and 4.5 mrem respectively. Using the risk estimate values from Reference 17, these doses represent risks for radiation-induced cancers of 1 X 10^{-7} (total body), 2 X 10^{-7} (bone), and 9 X 10^{-8} (lung) to the individual.

C. SAMPLING AND ANALYSIS

1. Air Monitoring

Air sampling units were located at 47 stations on the NTS to measure the radionuclides in the form of particulates and halogens. All placements were chosen primarily to provide monitoring of radioactivity at sites with high occupational factors. Geographical coverage, access, and availability of commercial power were also considered.

The sampling units consist of a positive displacement pump drawing air at approximately 100 liters per minute through a 9-centimeter diameter Whatman GF/A filter for particulates, followed by a charcoal cartridge for radioiodines mounted on a plastic sample holder. A dry-gas meter was utilized to measure the volume of air displaced over the sampling period (typically seven days). The total volume sampled was approximately 1000 cubic meters.

The samples were held for about seven days prior to analysis to allow naturally-occurring radon and its daughter products to decay. Gross beta counting was performed with a gas flow proportional counter for 20 minutes. The lower limit of detection for typical parameters involved was 2×10^{-16} μCi/cc. Gamma spectroscopy was accomplished using germanium detectors with an input to 2000 channels, calibrated at 1 keV per channel from 0 to 2 MeV.

The weekly air samples for a given sampling station were batched on a monthly basis and radiochemically analyzed for Pu-239. The procedure incorporated an acid dissolution and an ion exchange recovery on a resin bed. Plutonium was deposited by plating on a stainless steel disc. The chemical yield of the plutonium was determined with an internal Pu-236 tracer. Alpha spectroscopy was performed utilizing a solid state silicon surface barrier detector. The lower limit of detection for the parameters involved was 1×10^{-17} µCi/cc.

A separate sampler was designed for the collection of airborne tritiated water vapor (HTO) (Reference 4). The portable sampler was capable of unattended operation for up to two weeks in desert areas. A small electronic pump drew air into the apparatus at approximately 0.5 liters per minute, and the HTO was removed from the air stream by two silica gel drying columns. Appropriate aliquots of condensed moisture were obtained by heating the silica gel. Counting via liquid scintillation techniques allowed for the determination of the HTO activity. A lower limit of detection for this analysis was 3×10^{-13} µCi/cc.

Noble gas sampling units are housed in a metal tool box. Three metal air bottles are attached to the sampling units with short hoses. A vacuum is maintained on the first bottle which causes a steady flow of air to be collected in the other two bottles. The flow rate is approximately 0.5 cubic centimeters per minute. The two collection bottles are exchanged weekly which yield a sample volume of about 3×10^5 cubic centimeters.

The noble gases are separated and collected from the atmospheric sample by a series of cryogenic-gas chromatographic techniques. Water and carbon dioxide are removed at room temperature and the krypton and xenon are collected on charcoal at liquid nitrogen temperatures. These gases are transferred to a molecular sieve where they are separated from any remaining gases and each other. The krypton and xenon are transferred to separate scintillation vials and counted on a liquid scintillation counter. The lower limits of detection for krypton and xenon are 4 X 10^{-12} and 10 X 10^{-12} μCi/cc, respectively.

2. Water Monitoring

Water samples were collected at various frequencies from selected potable water consumption points, supply wells, natural springs, open reservoirs, final effluent ponds, and contaminated ponds. Frequency was determined on the basis of a preliminary radiological pathways analysis; i.e., potable water weekly, supply wells monthly, etc. Samples were collected in 1-liter glass containers. All samples were analyzed for gross beta, tritium, and gamma emitting isotopes. Plutonium analyses were performed on a quarterly basis.

A 500-ml aliquot was taken from the water sample and counted in a Nalgene bottle for gamma activity with a germanium detector. A 5-ml aliquot was used for tritium analysis via liquid scintillation counting. The remainder of the original sample was evaporated to 15-ml, transferred to a stainless steel counting planchet, and evaporated to dryness after the addition of a wetting agent. Beta counting was accomplished as described in Section 1 except that the water samples were counted for 100 minutes. Lower limits of detection were: (1) gamma spectroscopy, ≅1 X 10^{-8} µCi/ml; (2) tritium, 9 X 10^{-7} µCi/ml; and (3) gross beta, 1 X 10^{-9} µCi/ml.

For the quarterly plutonium analysis, an additional 1-liter sample was collected. The radiochemical procedure was similar to that described in Section 1. As mentioned, alpha spectroscopy was used to measure any Pu-239. The lower limits of detection for this procedure was 4 X 10^{-11} µCi/ml.

3. Gamma Monitoring (TLD)

TLD's were located at 163 stations on the NTS to measure the external gamma radiation from the environment. These locations were chosen to: (1) provide a low-level control type network; (2) measure the residual activity from the atmospheric testing program; and (3) document the radiological conditions at the radioactive waste management sites (RWMS).

The dosimeters used were CaF_2:Dy (TLD-200) 0.6 cm X 0.6 cm x 0.09 cm chips from Harshaw Chemical Company. Two badges consisting of two chips each, shielded by a 0.12 cm cadmium shield (1030 mg/cm^2) inside a 0.13 cm plastic (140 mg/cm^2) holder were placed about one meter above the ground at each location. The dosimeters detected gamma radiation above an energy cutoff of approximately 90 keV. The known systematic errors of the dosimeter in this application were the minimized detection of lower energy photons and fade of the phosphor's stored energy with time. Previous research indicated that only about 5-10% of the total exposure from natural background was from gamma emitters below 150 keV (Reference 5).

Fade in TLD-200 can be high when used in elevated temperatures such as those encountered at certain NTS locations. This loss of the phosphor's stored energy was minimized both physically and analytically by the REECo dosimetry group. Before readout, the chips were annealed at 115° C for 15 minutes to reduce the high-fade, low temperature traps.

In March, 1985, the responsibility for the issuance and analysis of environmental TLD's was transferred to the REECo group currently supplying calibration and readout services to the Nuclear Radiation Assessment Division, EMSL-LV. A detailed description of their facilities and methodology is presented in Reference 21.

4. Data Treatment

Each set of data obtained from this program underwent a thorough inspection as to its accuracy. Not only is the data analyzed automatically by computer, it is also verified by REECo Environmental Sciences Department (ESD) personnel prior to acceptance. If serious differences were found from the expected value, a review of the field handling, sample preparation, and processing was done. On the occasions when the problem could not be resolved by an environmental analyst, a recount or second sample was secured whenever possible.

All data were inspected on a daily basis and listed in tabular form. This treatment facilitated the data review process and revealed trends or periodicity. Each station's data were plotted against a logarithmic axis because of the possible magnitudes of variation in environmental data. The averaging plots in each section show arithmetic means and the range of data at each point. Arithmetic means, although severely affected by outliers (suspicious data), were those values compared to the CG's and listed in all tables. The plots provided reassurance to the means by graphically demonstrating the data file.

D. RADIOACTIVITY IN AIR

Ambient air monitoring was performed at the 47 locations shown in Figures 2 and 3. Samples collected at Gate 200 and the Area 5 communications tower were counted for gross β without allowing seven days for the decay of natural radioactivity, as were the other air samples. Although the results from these samples are higher and more variable due to the natural radioactivity, they serve as rapid indicators of unusual events, such as fallout from foreign sources. The computer plotted displays of the gross beta and Pu-239 activities for the entire air surveillance network are presented in Appendix A. In the first plot, weekly values were arithmetically averaged to show a smoothed presentation of the changes in airborne radioactivity over the surveillance period. The data ranges are included for each of these points. The remaining plots in Appendix A depict the actual measurements at each station.

Figures 2 and 3 summarize the 1985 gross beta and Pu-239 yearly locational averages, respectively. Tables 4 and 5 list these yearly averages along with half-year averages. The network average for the whole year for gross beta activity, excluding Gate 200 and the Area 5 communications tower, was 1.7×10^{-14} or 0.002 percent of the applicable concentration guide of 1×10^{-9} µCi/cc listed in DOE Order 5480.1A, Chapter XI.

Table 5 lists the Pu-239 concentrations for the year. All stations averaged below 10^{-14} µCi/cc for CY-1984, with the majority being on the order of 10^{-17} µCi/cc. The maximum average concentration was found at 9-300 Bunker 2. The

FIGURE 2

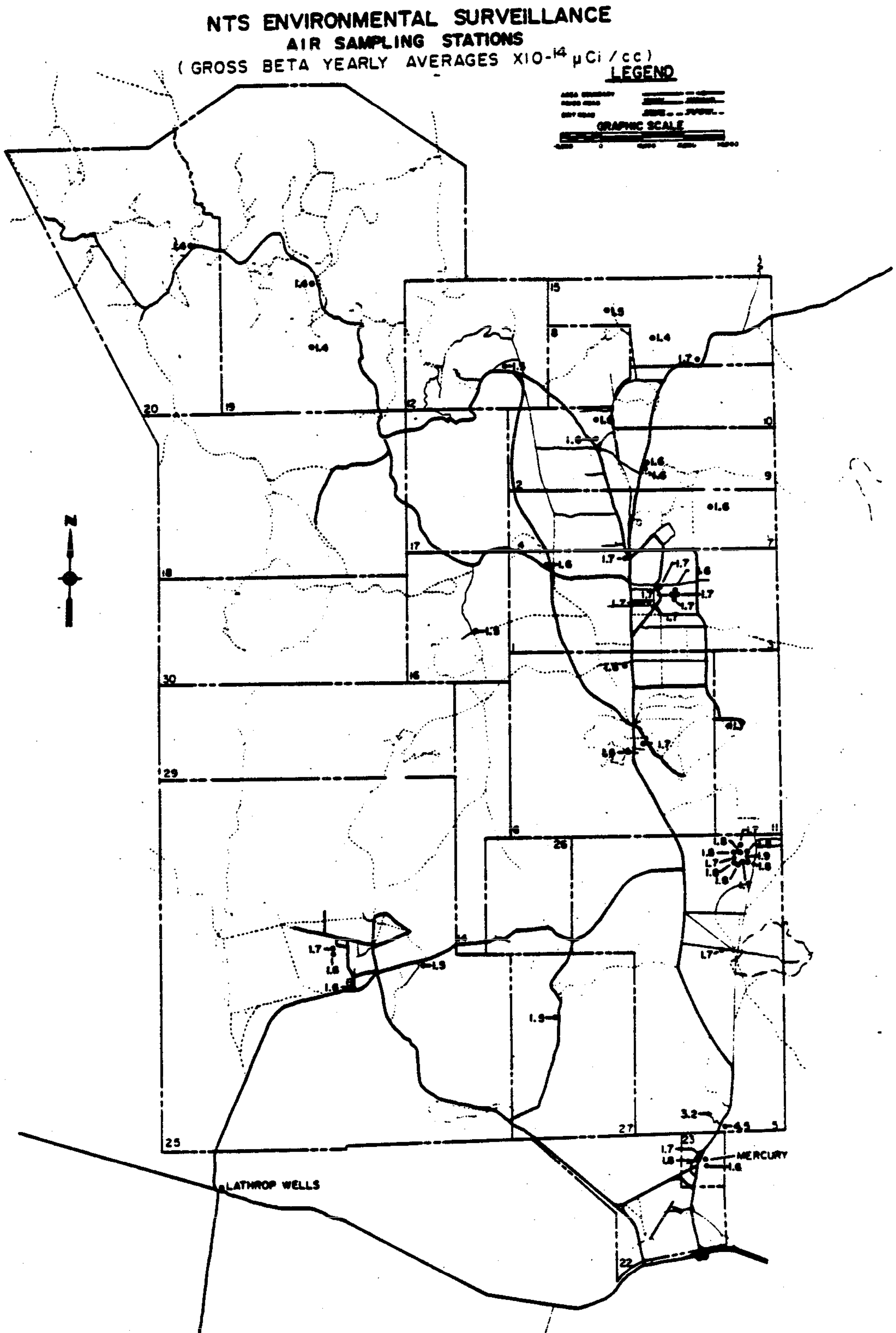

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING STATIONS
(GROSS BETA YEARLY AVERAGES X10-14 µCi / cc)
LEGEND
GRAPHIC SCALE
LATHROP WELLS
MERCURY
N

FIGURE 3

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING STATIONS
(Pu-239 YEARLY AVERAGES $\times 10^{-17}$ μCi/cc)

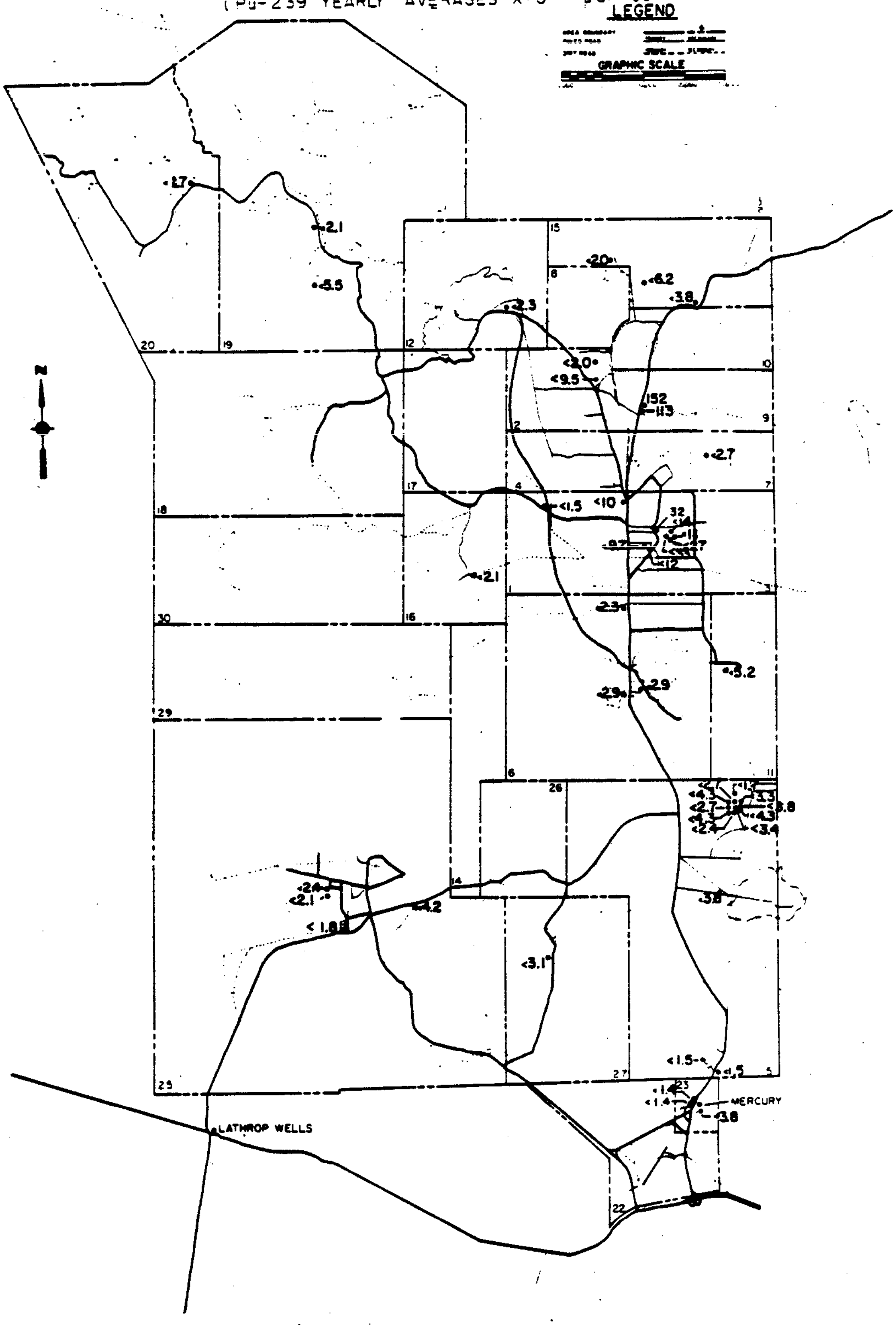


TABLE 4

AVERAGES OF AIR SURVEILLANCE DATA FOR GROSS BETA

($\times 10^{-14}$ µCi/cc)

Station	1/1/85-6/30/85	7/1/85-12/31/85	1/1/85-12/31/85
Area 1 BJY	1.6	1.9	1.7
Area 1 Gravel Pit	1.4	1.8	1.6
Area 2 Hydraulic Lift Yard	1.6	1.6	1.6
Area 2 Compound	1.5	1.7	1.6
Area 3 Compound	1.5	1.8	1.7
Area 3 Complex No. 2	1.5	1.8	1.7
Area 3 3-300 Bunker	1.6	1.9	1.7
Area 3 U3ax South	1.6	1.8	1.7
Area 3 U3ax East	1.7	1.8	1.7
Area 3 U3ax North	1.7	1.6	1.6
Area 3 U3ax West	1.8	1.7	1.7
Area 5 DOD Yard	1.6	1.8	1.7
Area 5 Gate 200	4.2	4.8	4.5*
Area 5 RWMS No. 1	1.6	1.8	1.7
Area 5 RWMS No. 2	1.6	1.9	1.8
Area 5 RWMS No. 3	1.7	2.1	1.9
Area 5 RWMS No. 4	1.7	2.0	1.8
Area 5 RWMS No. 5	1.6	2.0	1.8
Area 5 RWMS No. 6	1.7	1.9	1.8
Area 5 RWMS No. 7	1.6	1.8	1.7
Area 5 RWMS No. 8	1.7	1.9	1.8
Area 5 RWMS No. 9	1.7	1.8	1.8
Area 5 Well 5B	1.6	1.8	1.7
Area 5 Communications Tower	3.3	3.1	3.2*

*Samples collected at these locations are not held for decay of natural radon daughters, in order to obtain an immediate indicator.

TABLE 4 (Continued)

($\times 10^{-14}$ μCi/cc)

Station	1/1/85-6/30/85	7/1/85-12/31/85	1/1/85-12/31/85
Area 6 CP Complex	1.5	1.6	1.6
Area 6 Well 3 Complex	1.6	1.6	1.6
Area 6 Yucca Complex	1.6	1.9	1.7
Area 7 UE7ns	1.6	1.7	1.6
Area 9 9-300 Bunker	1.5	1.6	1.6
Area 9 9-300 Bunker No. 2	1.5	1.6	1.6
Area 11 Gate 293	1.6	1.8	1.7
Area 12 Compound	1.5	1.5	1.5
Area 15 EPA Farm	1.4	1.5	1.4
Area 15 Gate 700	1.7	1.6	1.7
Area 15 Piledriver	1.4	1.5	1.5
Area 16 Substation	1.5	1.5	1.5
Area 19 Echo Peak	1.4	1.3	1.4
Area 19 Substation	1.3	1.4	1.4
Area 20 Dispensary	1.3	1.5	1.4
Area 23 Bldg. 790	1.5	2.0	1.8
Area 23 Bldg. 790 No. 2	1.6	1.7	1.7
Area 23 H and S Roof	1.5	1.7	1.6
Area 25 E-MAD South	1.5	1.7	1.6
Area 25 E-MAD North	1.6	1.7	1.7
Area 25 NRDS Warehouse	1.5	1.7	1.6
Area 25 Henre Site	1.5	1.6	1.5
Area 27 Cafeteria	1.5	1.6	1.5

TABLE 5

AVERAGES OF AIR SURVEILLANCE DATA FOR PLUTONIUM

($\times 10^{-17}$ μCi/cc)

Station	1/1/85-6/30/85	7/1/85-12/31/85	1/1/85-12/31/85
Area 1 Gravel Pit	<1.6	<1.3	<1.5
Area 2 Hydraulic Lift Yard	<15	<3.3	<9.5
Area 2 Compound	<1.6	<2.4	<2.0
Area 3 BJY	<10	<10	<10
Area 3 Compound	<11	<7.6	<9.7
Area 3 Complex No. 2	<14	<10	<12
Area 3 U3ax South	<25	<29	<27
Area 3 U3ax East	<12	<10	<11
Area 3 U3ax North	<13	<15	<14
Area 3 U3ax West	<26	<39	<33
Area 3 3-300 Bunker	33	31	32
Area 5 DOD Yard	<1.7	<1.8	<1.7
Area 5 Gate 200	<1.4	<1.7	<1.5
Area 5 RWMS No. 1	<1.4	<6.3	<3.4
Area 5 RWMS No. 2	<4.6	<4.0	<4.3
Area 5 RWMS No. 3	<1.2	<6.4	<3.8
Area 5 RWMS No. 4	<1.3	<5.3	<3.3
Area 5 RWMS No. 5	<1.3	<4.2	<2.7
Area 5 RWMS No. 6	<1.7	<6.9	<4.3
Area 5 RWMS No. 7	<1.7	<3.7	<2.7
Area 5 RWMS No. 8	<1.4	<7.2	<4.3
Area 5 RWMS No. 9	<1.7	<3.2	<2.4
Area 5 Well 5B	<1.9	<5.8	<3.8
Area 5 Communications Tower	<1.2	<1.9	<1.5
Area 6 CP Complex	<2.3	<3.5	<2.9
Area 6 Well 3 Complex	<2.7	<1.9	<2.3
Area 6 Yucca Complex	<2.2	<3.6	<2.9
Area 7 UE7ns	<2.2	<3.1	<2.7

TABLE 5 (Continued)

(X 10^{-17} μCi/cc)

Station	1/1/85-6/30/85	7/1/85-12/31/85	1/1/85-12/31/85
Area 9 9-300 Bunker	85	141	113
Area 9 9-300 Bunker No. 2	115	188	152
Area 11 Gate 293	<3.9	<6.4	<5.2
Area 12 Compound	<2.2	<2.4	<2.3
Area 15 EPA Farm	<4.1	<8.3	<6.2
Area 15 Gate 700	<4.7	<3.0	<3.8
Area 15 Piledriver	<1.4	<2.6	<2.0
Area 16 Substation	<1.2	<2.8	<2.1
Area 19 Echo Peak	<1.6	<8.8	<5.5
Area 19 Substation	<1.6	<1.5	<1.5
Area 20 Dispensary	<1.1	<2.2	<1.7
Area 23 Bldg. 790	<1.3	<1.5	<1.4
Area 23 Bldg. 790 No. 2	<1.4	<1.5	<1.4
Area 23 H and S Roof	<1.3	<6.2	<3.8
Area 25 E-MAD South	<1.2	<3.0	<2.1
Area 25 E-MAD North	<1.6	<3.1	<2.4
Area 25 Henre Site	<1.3	<7.2	<4.2
Area 25 NRDS Warehouse	<1.3	<2.3	<1.8
Area 27 Cafeteria	<1.5	<4.7	<3.1

average concentration at this location was 152 X 10^{-17} µCi/cc, or 0.08 percent of the controlled area concentration guide of 2 X 10^{-12} µCi/cc. Figure 3 shows the Pu-239 yearly results at their respective locations. The presence of this radionuclide is primarily due to tests conducted before 1960 in which nuclear devices were detonated with high explosives (safety shots). These tests spread low-fired plutonium throughout the eastern and northeastern areas of the NTS. Two decades later, the effects of these tests are still demonstrated in increased plutonium concentrations in air in Areas 1, 2, 3, 7, 8, 9, 10, and 15.

The locations of all of the tritium samplers along with their yearly averages are shown in Figure 4. All of these stations were sampled for two week periods. Substantial fluctuations occurred throughout the year with most of the samplers. This may be due to the small volumes of air sampled or mechanical problems with the sampler.

The highest average concentration of HTO was 8.0 x 10^{-9} µCi/cc at Building 650 representing 0.16 percent of the concentration guide. Both Buildings 650 and 790 release small amounts of tritium from processing samples. Due to the close proximity of the two tritium in air samplers, elevated concentrations of HTO are detected. Table 6 lists the maximums, minimums, and averages for each sampling location. Appendix B has the actual measurements plotted for each location.

The average concentration of Kr-85 for the entire network was slightly higher in CY-1985, rising from an average of 28 pCi/m^3 in CY-1983 to an average of 33 pCi/m^3 in CY-1985. This increase was expected since all sources worldwide

FIGURE 4

NTS ENVIRONMENTAL SURVEILLANCE
TRITIUM IN AIR SAMPLING STATIONS
(→TO YEARLY AVERAGES x 10⁻¹¹ μCi/cc)

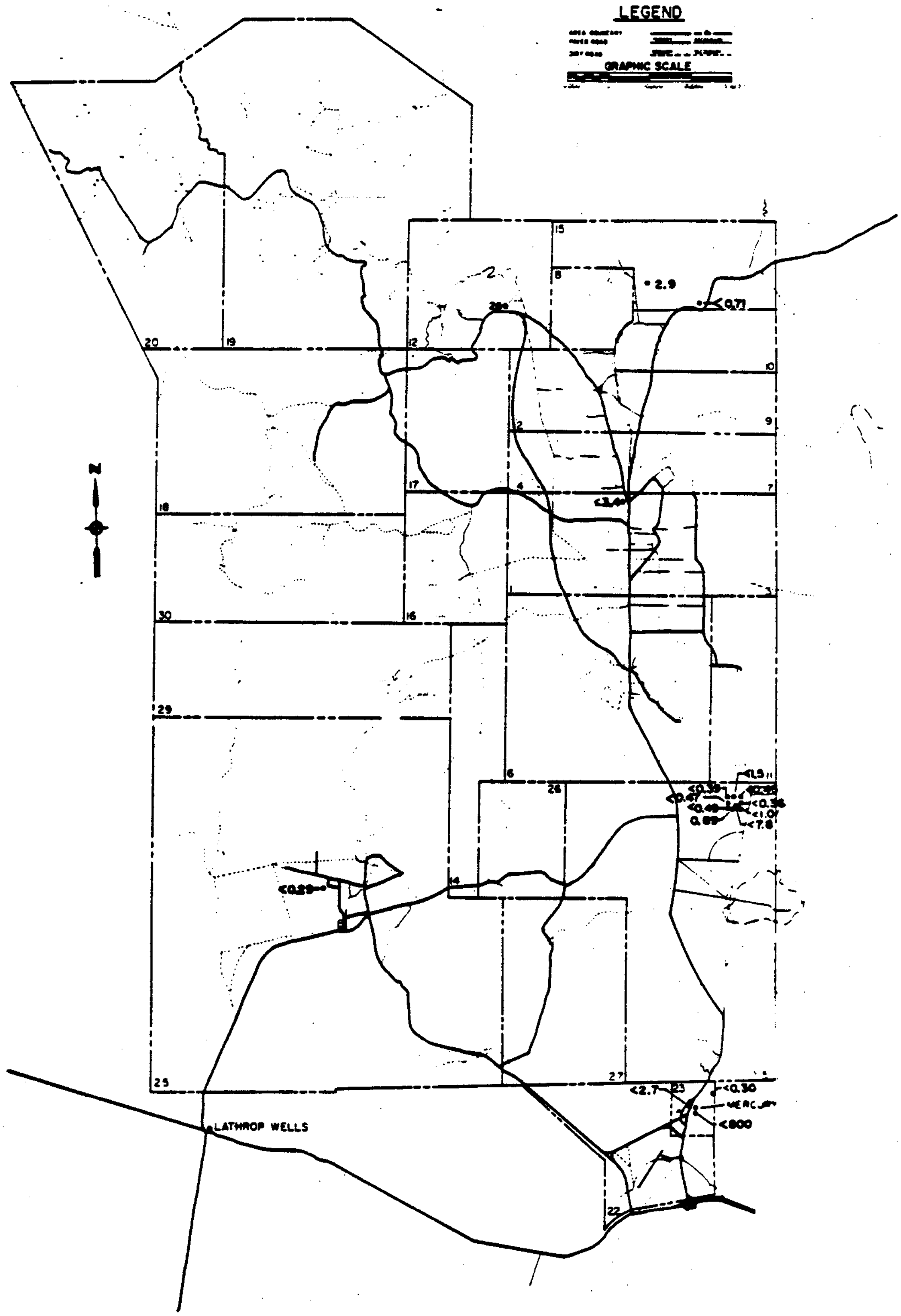


FIGURE 5

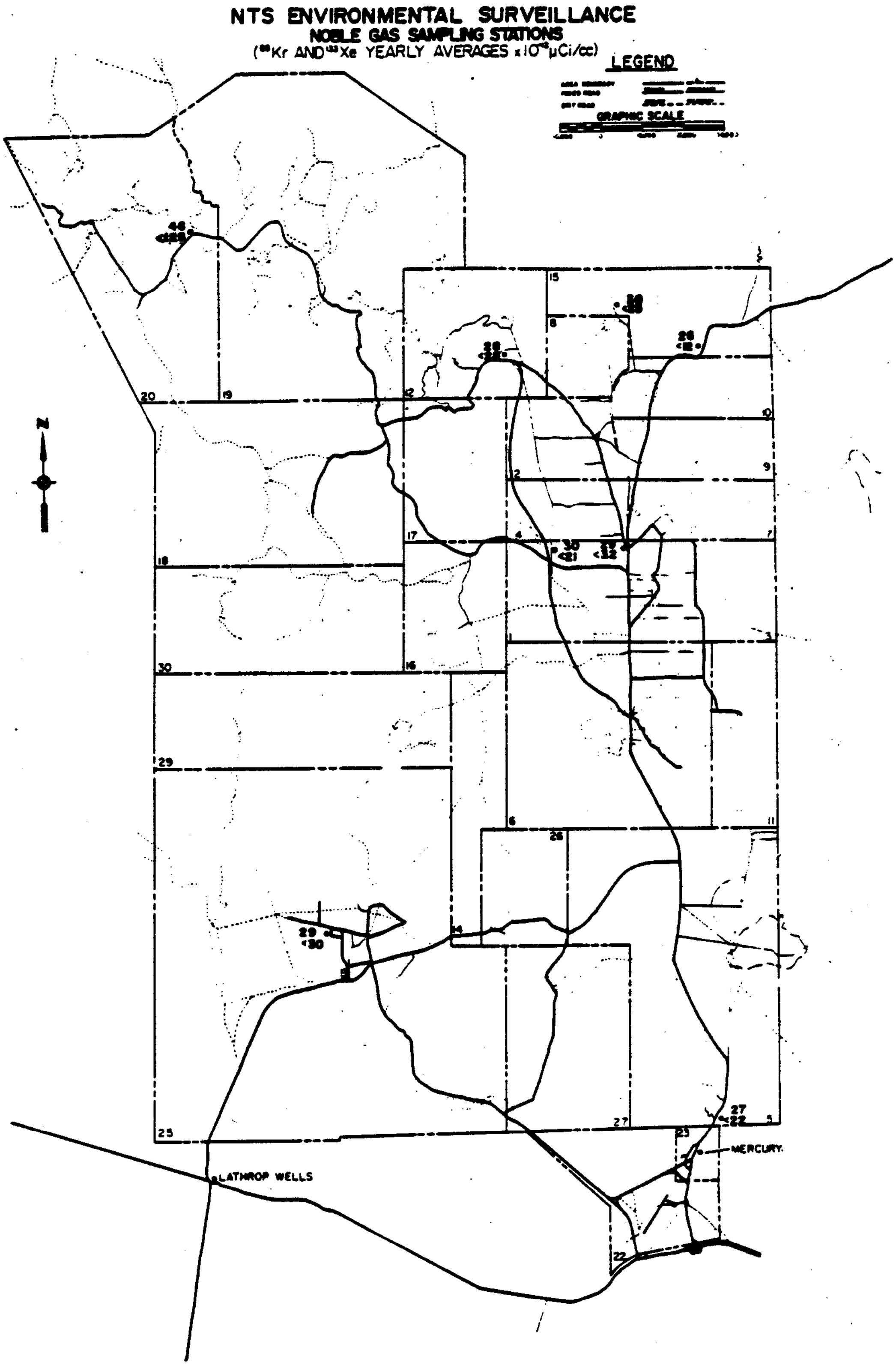

NTS ENVIRONMENTAL SURVEILLANCE
NOBLE GAS SAMPLING STATIONS
LEGEND
GRAPHIC SCALE
N
LATHROP WELLS
MERCURY

TABLE 6

TRITIUM IN AIR

Concentrations
(μCi/cc)

Stations	Maximum	Minimum	Average
Area 1 BJY	1.4×10^{-10}	$<1.1 \times 10^{-12}$	$<3.4 \times 10^{-11}$
Area 5 RWMS-1	3.6×10^{-10}	6.6×10^{-13}	$<7.8 \times 10^{-11}$
Area 5 RWMS-SE	3.7×10^{-11}	$<1.7 \times 10^{-12}$	$<1.0 \times 10^{-11}$
Area 5 RWMS-(SE-NE)	7.9×10^{-12}	$<1.5 \times 10^{-12}$	$<3.6 \times 10^{-12}$
Area 5 RWMS-NE	1.4×10^{-11}	$<2.6 \times 10^{-13}$	$<4.5 \times 10^{-12}$
Area 5 RWMS-(NE-NW)	7.0×10^{-11}	$<2.0 \times 10^{-12}$	$<1.5 \times 10^{-11}$
Area 5 RWMS-NW	7.5×10^{-12}	$<1.8 \times 10^{-12}$	$<3.9 \times 10^{-12}$
Area 5 RWMS-(NW-SW)	1.0×10^{-11}	$<7.2 \times 10^{-13}$	$<4.7 \times 10^{-12}$
Area 5 RWMS-SW	1.2×10^{-11}	$<1.9 \times 10^{-12}$	$<4.9 \times 10^{-12}$
Area 5 RWMS-(SW-SE)	2.0×10^{-11}	$<1.9 \times 10^{-12}$	$<8.9 \times 10^{-12}$
Area 12 Base Camp	4.7×10^{-9}	3.8×10^{-12}	2.6×10^{-10}
Area 15 EPA Farm	5.3×10^{-11}	7.8×10^{-12}	2.9×10^{-11}
Area 23 Bldg. 790	4.7×10^{-10}	$<1.7 \times 10^{-12}$	$<2.7 \times 10^{-11}$
Area 23 Bldg. 650	1.2×10^{-7}	$<1.7 \times 10^{-12}$	$<8.0 \times 10^{-9}$
Area 23 Site Boundary	1.0×10^{-11}	$<1.1 \times 10^{-12}$	$<3.0 \times 10^{-12}$
Area 25 EMAD	7.4×10^{-12}	$<1.0 \times 10^{-12}$	$<2.9 \times 10^{-12}$
Area 15 Gate 700	1.7×10^{-11}	$<1.5 \times 10^{-12}$	7.1×10^{-12}

(predominantly nuclear power generating facilities) continue to generate and release small quantities of Kr-85 (Reference 25). The network average of 33 pCi/m^3 includes elevated measurements taken at the Area 20 camp. These Kr-85 concentrations during CY-1985 ranged from 22 pCi/m^3 to 129 pCi/m^3. The elevated concentrations at Area 20 Camp continued from 1984, and have been determined to be related to slight seepage from Pahute Mesa events. The location and yearly average for each noble gas sampling station is shown in Figure 5. The Gate 700 Station was moved to the Area 1 gravel pit.

The maximum average Xe-133 concentration occured at Area 20 Camp. This concentration was 0.001 percent of the concentration guide. All positive Xe-133 results were directly related to slight seepage from Pahute Mesa and Rainier Mesa events.

Table 7 lists the average Kr-85 and Xe-133 concentrations at each location along with the lowest and highest values detected.

TABLE 7

NOBLE GASES IN AIR

Concentrations (X 10^{-12} µCi/cc)

Stations	^{85}Kr			^{133}Xe		
	Max	Min	Avg	Max	Min	Avg
Area 1 BJY	46	18	29	654	<3	<32
Area 12 Base Camp	39	19	28	<166	<5	<28
Area 15 EPA Farm	67	20	30	<78	<7	<25
Area 5 Gate 200	39	18	27	<35	<4	<22
Area 25 EMAD	48	18	29	555	<2	<30
Area 15 Gate 700*	28	22	26	<16	<6	<12
Area 20 Camp	129	22	46	1155	<6	<128
Gravel Pit*	59	22	30	34	<6	<21

*Gate 700 Sampling Station was moved on March 5, 1985 to Area 1, Gravel Pit.

E. RADIOACTIVITY IN SURFACE AND GROUND WATER

The principal water distribution system on the NTS consists of sixteen supply wells, eight potable water stations, and sixteen open reservoirs. Two supply wells were added to the sampling network in September 1985, at Well 16D and at the Area 20 water well. The wells feed directly to many of the reservoirs, and the drinking water was pumped from the wells to the points of consumption. This was the critical pathway for the ingestion of waterborne radionuclides, so the system was routinely sampled and evaluated. The supply wells and open reservoirs were sampled on a monthly basis. All drinking water was collected weekly to provide a constant check of the end use activity and to allow frequent comparisons to the radioactivity of the water in the wells. The identification of any radionuclides above natural background in the supply well system initiated a closer review of the drinking water. The surface and ground/water monitoring network creates a large data base to evaluate long-term trends or intermittent changes in activity.

Natural springs, contaminated ponds, and effluent ponds were also monitored. The springs and contaminated ponds were collected monthly when water was available for sampling. The effluent ponds were sampled quarterly.

1. Supply Wells

Water from sixteen supply wells was used for a variety of sanitary and industrial purposes. The criteria for collection was primarily based on potential for human consumption. The secondary purpose was to document the radiological characteristics of NTS ground water and analyze the data for trends or changes. The yearly gross beta averages are shown at their respective locations in Figure 6. Appendix C consists of the plots of each station for measured gross beta activity with 2σ error bars. An averaging plot is included which shows the trend of the mean of the network throughout the reporting period. The range at each point is also given. Table 8 lists the 1985 averages for each location. The highest average recorded was 10.5 X 10^{-9} μCi/ml at Well C. This was 0.3 percent of the concentration guide. The lowest average gross beta activity for the onsite supply wells was <1.6 X 10^{-9} μCi/ml at Well U19c.

The activities of each well and the entire network average appeared consistent over this reporting period. In previous reports (References 8 and 23) it was shown that the majority of gross beta activity was attributable to naturally occurring potassium-40. No trends in the plots were discernible, verifying that no movement of radionuclides occurred in this NTS water system. The average of the entire network, as compared to previous years was:

Year	Mean (X 10^{-9} μCi/ml)
CY-1985	5.8
CY-1984	6.4
CY-1983	6.6
CY-1982	7.0
CY-1981	8.3
CY-1980	8.8
CY-1979	9.4
CY-1978	9.1
July-December 1977	10.9
FY-1977	10.4

FIGURE 6

NTS ENVIRONMENTAL SURVEILLANCE
SUPPLY WELL SAMPLING STATIONS
(GROSS BETA YEARLY AVERAGES X10^{-9} μCi/ml)

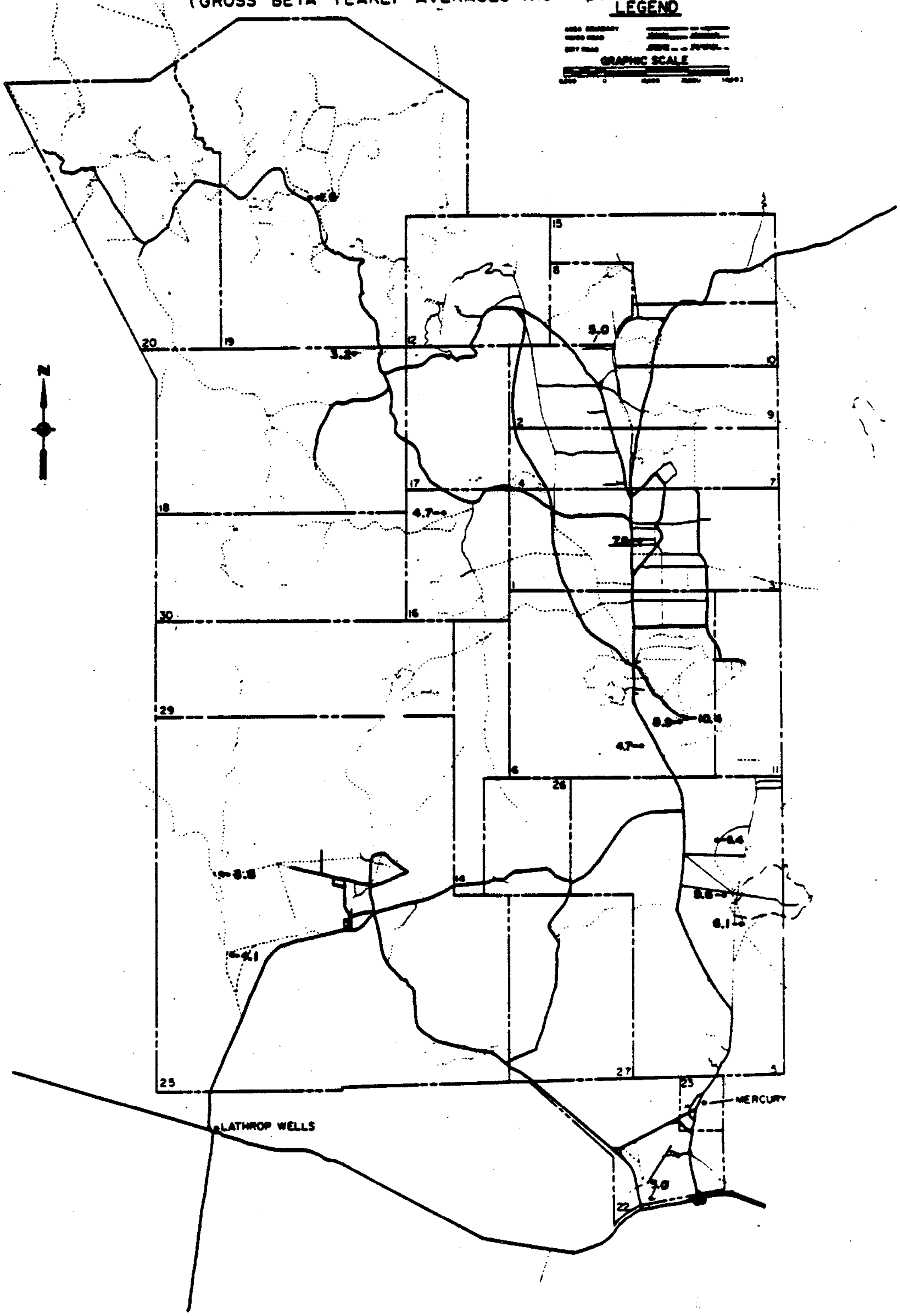


TABLE 8

AVERAGES OF SUPPLY WELL DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($X 10^{-9}$ µCi/ml)
Area 2 Well 2	5.0
Area 3 Well A	7.5
Area 5 Well 5B	9.6
Area 5 Well 5C	6.1
Area 5 Well Ue5c	5.4
Area 6 Well C	10.5
Area 6 Well C1	8.9
Area 6 Well 4	4.7
Area 16 Well 16D	4.7
Area 18 Well 8	3.2
Area 19 Well U19c	<1.6
Area 20 Area 20 Water Well	5.3
Area 22 Army Well No. 1	5.0
Area 25 Well J12	4.1
Area 25 Well J13	3.8

Appendix C includes plots of the network monthly averages for tritium and plutonium. The positive tritium results for all noncontaminated NTS waters are given in Table 9. There were no positive tritium or plutonium results for supply wells for CY-1985.

2. Potable Water

As a check of any effect the water distribution system might have on end use activity, eight consumption points were sampled during the reporting period. The locations of all stations are shown in Figure 7 with their gross beta yearly averages.

Appendix D contains the computer plots of the measured gross beta activity with the 2σ error bars included. An average plot is provided which shows the network mean trend throughout the reporting period along with the range at each point. Table 10 contains a list of the average gross beta activity measured at each sample location for CY-1985. The highest average recorded was 8.0 X 10^{-9} μCi/ml at the Area 23 Cafeteria. This was 53.0 percent of the screening level for drinking water as required by the National Interim Primary Drinking Water Regulations. This value was 3.0 percent of the concentration guide for uncontrolled areas (Reference 3). The lowest average gross beta activity, excluding Cascade brand bottled water, was 2.9 X 10^{-9} μCi/ml at the Area 2 Rest Room. The Cascade water was demineralized water brought in from offsite and was used as a check of the laboratory system. It was included in the results listing because the bottles were stored onsite and the water was consumed by NTS personnel.

TABLE 9

TRITIUM VALUES ABOVE DETECTION LIMITS
FROM NONCONTAMINATED WATERS

WATER TYPE	STATION	DATE	µCi/ml
Potable Water	Area 2 Rest Room	03/14/85	$5.0 \times 10^{-7} \pm 43\%$
Potable Water	Area 3 Cafe	03/14/85	$7.6 \times 10^{-7} \pm 29\%$
Natural Spring	Tub Springs	07/11/85	$9.7 \times 10^{-7} \pm 41\%$
Open Reservoir	Camp 17 Reservoir	03/06/85	$6.0 \times 10^{-7} \pm 36\%$
Open Reservoir	Well 20A Reservoir	03/06/85	$6.2 \times 10^{-7} \pm 35\%$
Open Reservoir	Area 2 Mud Plant Reservoir	03/06/85 07/11/85	$6.0 \times 10^{-7} \pm 36\%$ $1.1 \times 10^{-6} \pm 37\%$
Supply Well	Well J-12	12/07/85	$2.4 \times 10^{-6} \pm 14\%$

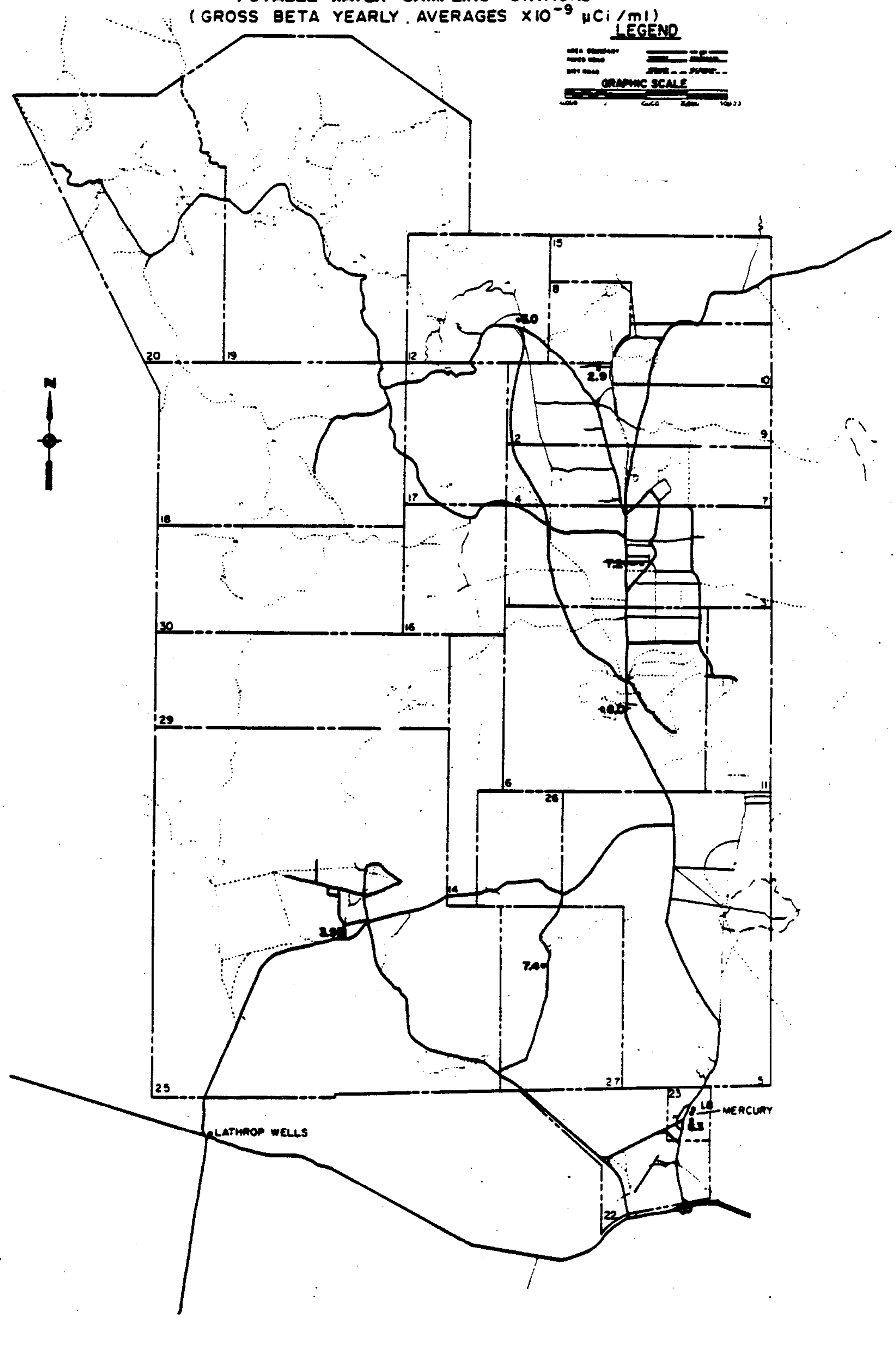
TABLE 10

AVERAGES OF POTABLE WATER DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($\times 10^{-9}$ $\mu Ci/ml$)
Area 2 Rest Room	2.9
Area 3 Cafeteria	7.2
Area 6 Cafeteria	8.0
Area 12 Cafeteria	3.0
Area 23 Cafeteria	6.3
Area 23 Cascade Water	<1.8
Area 25 Service Station	3.9
Area 27 Cafeteria	7.4

FIGURE 7

NTS ENVIRONMENTAL SURVEILLANCE
POTABLE WATER SAMPLING STATIONS
(GROSS BETA YEARLY AVERAGES $\times 10^{-9}$ µCi /ml)



Gross beta measurements at these potable water stations demonstrated that no release or movement of radionuclides occurred in the NTS water system throughout CY-1985. No discernible trends were identified on the plotted data.

The average of the entire network, as compared to averages reported in previous environmental reports, was:

Year	Mean (X 10^{-9} µCi/ml)
CY-1985	5.0
CY-1984	5.3
CY-1983	5.3
CY-1982	5.8
CY-1981	7.9
CY-1980	5.8
CY-1979	6.5
CY-1978	6.7
July-December 1977	7.8
FY-1977	7.3

All potable water, except Cascade bottled water, was obtained from the supply wells. A comparison of these waters and their suppliers is shown in Table 11. In previous reports (References 8 and 23) it was shown that the majority of the radioactivity in supply well and potable water was from naturally occurring Potassium-40.

Appendix D also includes the plots of the network averages for tritium and plutonium. The positive tritium results were given in Table 9. The highest average was <7.2 x 10^{-7} µCi/ml at the Area 27 Cafeteria. This is 3.6 percent of the concentration guide for tritium in drinking water. The majority of the seven positive measurements are near the detection limit of the system and are believed to be caused by the statistical fluctuation inherent in counting. There were no positive plutonium results for the CY-1985.

TABLE 11

COMPARISON OF END USE AND SUPPLY WATER

FOR GROSS BETA AVERAGES

(X 10^{-9} μCi/ml)

Station (end use/supply)	CY-1985
Area 2 Rest Room	2.9
Area 18 Well 8	3.2
Area 3 Cafeteria	7.2
Area 3 Well A	7.5
Area 6 Cafeteria	8.0
Area 6 Well C/C1	10.5/8.9
Area 12 Cafeteria	3.0
Area 18 Well 8	3.2
Area 23 Cafeteria	6.3
Area 5 Well 5B/5C	9.6/6.1
Area 22 Army Well No. 1	5.0
Area 23 Cascade Water (Demineralized Bottled Water)	<1.8
Area 27 Cafeteria	7.4
Area 5 Well 5B/5C	9.6/6.1
Area 22 Army Well No. 1	5.0

3. Safe Drinking Water Act Results

In accordance with the Safe Drinking Water Act of 1976, special water sampling was conducted during CY-1985 on all wells that supply potable water at the eight distribution points on the NTS.

The eight NTS potable water locations were sampled according to the stringent requirements for water systems near nuclear facilities, with the exception of iodine-131 which was excluded from the list of analyses since it is not seen as a potential contaminant to the NTS water supply. Potable water samples were collected and analyzed quarterly for tritium, gross alpha and gross beta. Strontium-90 analysis was performed on an annual basis. These results are listed in Table 12. All concentrations were below the prescribed screening levels.

4. Open Reservoirs

Open reservoirs have been established at various locations on the NTS for industrial purposes. Fifteen locations were sampled during the report period. The locations are shown in Figure 8 along with their gross beta yearly averages.

Appendix E consists of the plots of each station of the measured gross beta activity with 2σ error bars. An averaging plot is included which shows the entire network mean trend throughout the reporting period. The range at each point is also given. These plots demonstrate consistent concentrations of gross beta activity at all locations throughout CY-1985.

TABLE 12

NTS POTABLE WATERS

SAFE DRINKING WATER ACT RESULTS

Type of Analysis	Location				
	A-3 Cafe	A-2 Restroom	A-12 Cafe	Mercury Cafe	A-27 Cafe
Gross Alpha* ($\times 10^{-9}$ µCi/ml)					
Max	4.19	<0.90	<0.77	6.64	<5.7
Min	1.69	<0.56	<0.60	2.64	2.39
Avg	3.09	<0.73	<0.72	4.57	3.46
Gross Beta** ($\times 10^{-9}$ µCi/ml)					
Max	9.78	4.0	6.15	10.1	13.2
Min	3.01	<1.80	<1.6	<1.5	4.27
Avg	7.18	2.90	2.96	6.28	7.38
^{3}H*** ($\times 10^{-7}$ µCi/ml)					
Max	<8.9	<11	<11	<8.9	<11
Min	<4.9	<4.9	<4.9	<4.9	<4.9
Avg	<6.91	<7.14	<7.08	<6.95	<7.19
^{90}Sr*** ($\times 10^{-9}$ µCi/ml)					
Max****	<0.84	<0.91	<0.57	<0.73	<0.80

* Screening level for gross alpha activity is 5×10^{-9} µCi/ml.

** Screening level for gross beta activity near a nuclear facility is 1.5×10^{-8} µCi/ml.

*** Maximum contaminant levels for ^{3}H and ^{90}Sr are 2×10^{-5} µCi/ml and 8×10^{-9} µCi/ml, respectively.

**** Strontium-90 analysis is performed once a year.

Table 12 (Continued)

Type of Analysis	Location: Cascade Water	A-6 Cafe	A-25 Service Station
Gross Alpha* ($\times 10^{-9}$ µCi/ml)			
Max	<0.58	8.27	<0.84
Min	<0.52	<2.1	<0.62
Avg	<0.56	<5.93	<0.75
Gross Beta** ($\times 10^{-9}$ µCi/ml)			
Max	7.66	19.9	9.38
Min	<1.5	1.85	2.20
Avg	<1.84	8.00	3.88
^{3}H*** ($\times 10^{-7}$ µCi/ml)			
Max	<8.9	<8.7	<11
Min	<4.9	<4.9	<4.9
Avg	<6.98	<6.90	<9.85
^{90}Sr*** ($\times 10^{-9}$ µCi/ml)			
Max****	<0.59	<0.37	<0.82

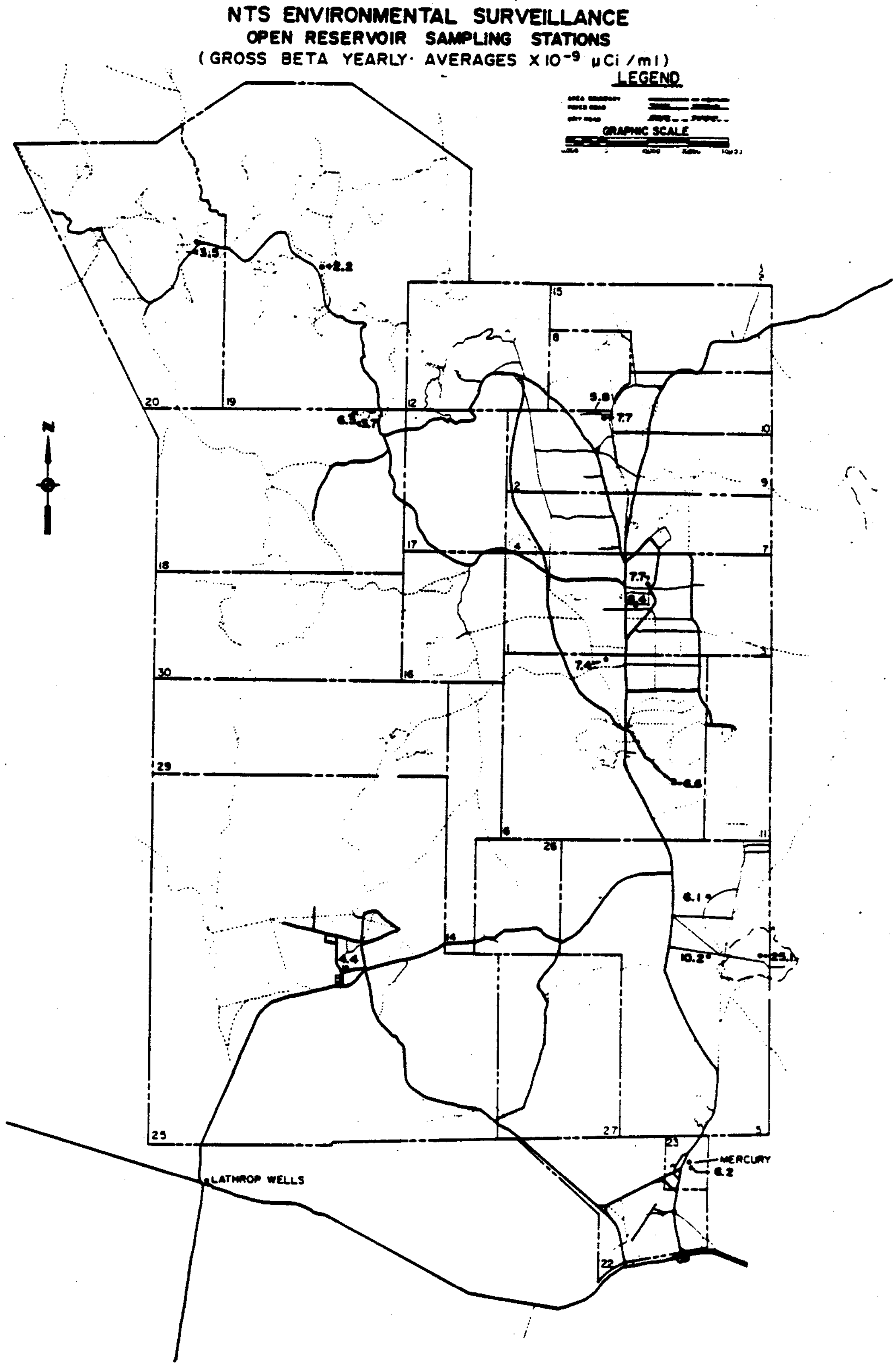
* Screening level for gross alpha activity is 5×10^{-9} µCi/ml.

** Screening level for gross beta activity near a nuclear facility is 1.5×10^{-8} µCi/ml.

*** Maximum contaminant levels for ^{3}H and ^{90}Sr are 2×10^{-5} µCi/ml and 8×10^{-9} µCi/ml, respectively.

**** Strontium-90 analysis is performed once a year.

FIGURE 8


NTS ENVIRONMENTAL SURVEILLANCE
OPEN RESERVOIR SAMPLING STATIONS
(GROSS BETA YEARLY AVERAGES X 10^-9 μCi/ml)
LEGEND
GRAPHIC SCALE
3.5
2.2
20
19
12
6.3
2.7
15
8
5.8
7.7
10
9
2
17
4
7
18
7.7
8.4
30
16
1
3
7.4
29
6.8
6
11
26
6.1
14
10.2
25.1
4.4
25
27
5
23
MERCURY
6.2
LATHROP WELLS
22

No trends were seen for the network, although the data were more variable than the supply well data. The large variation could have been caused by real activity fluctuations or variable sampling procedures since some of the open reservoirs are difficult to sample. The average gross beta results for the entire network, as compared to previous years were:

Year	Mean (X 10^{-9} µCi/ml)
CY-1985	7.3
CY-1984	6.8
CY-1983	8.1
CY-1982	9.7
CY-1981	13.6
CY-1980	8.1
CY-1979	10.9
CY-1978	13.1
July-December 1977	19.4
FY-1977	19.6

Table 13 includes a list of the CY-1985 gross beta averages at each location. The highest average beta concentration was 25.1 X 10^{-9} µCi/ml at Area 5 Reservoir. This result was 0.25 percent of the concentration guide. The lowest gross beta average was <2.2 X 10^{-9} µCi/ml at Well U19c.

Table 14 shows the gross beta activities of the open reservoirs that were supplied by wells, along with the activities of the associated wells. The values for the reservoirs were in most cases slightly higher. This is most likely caused by resuspended contaminated material settling into the open reservoirs and/or run-off into the reservoirs from contaminated areas.

The highest positive tritium value for all reservoirs was 1.1 X 10^{-6} µCi/ml at the Area 2 Mudplant Reservoir. This is 0.001 percent of the tritium concentration guide for controlled areas. There were two positive plutonium result at the Area 5 Reservoir with activity levels of 1.1 X

TABLE 13

AVERAGES OF OPEN RESERVOIR DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($X\ 10^{-9}\ \mu Ci/ml$)
Area 2 Well 2 Reservoir	5.8
Area 2 Mud Plant Reservoir	6.4
Area 3 Well A Reservoir	8.4
Area 3 Mud Plant Reservoir	7.7
Area 5 Well 5B Reservoir	10.3
Area 5 Well Ue5c Reservoir	6.1
Area 5 Reservoir	25.1
Area 6 Well 3 Reservoir	7.4
Area 6 Well C1 Reservoir	6.6
Area 18 Camp 17 Reservoir	<3.7
Area 18 Well 8 Reservoir	6.5
Area 19 Well 19c Reservoir	<2.2
Area 20 Well 20A Reservoir	<3.5
Area 23 Swimming Pool	6.2
Area 25 Well J-11 Reservoir	4.4

TABLE 14

COMPARISON OF OPEN RESERVOIRS AND SUPPLY WATER FOR GROSS BETA AVERAGES

($\times 10^{-9}$ µCi/ml)

Station (Reservoir/Supply)	CY-1983
Area 2 Well 2 Reservoir	5.8
Area 2 Well 2	5.0
Area 3 Well A Reservoir	8.4
Area 3 Well A	7.5
Area 5 Well 5B Reservoir	10.3
Area 5 Well 5B	9.6
Area 5 Well Ue5c Reservoir	6.1
Area 5 Well Ue5c	5.4
Area 6 Well C1 Reservoir	6.6
Area 6 Well C1	8.9
Area 19 Well U19c Reservoir	<2.2
Area 19 Well U19c	<1.6

10^{-10} and 9.7×10^{-11} μCi/ml. This is 0.0001 percent of the concentration guide. The positive tritium and plutonium results can be seen in Tables 9 and 15. Appendix E also includes the plots of the network averages for tritium and plutonium.

5. Natural Springs

The term "natural springs" was a label given to the spring supplied pools located within the NTS. There is no known human consumption from these springs. Nine locations sampled on a monthly basis (when accessible) are shown in Figure 9 along with their gross beta yearly averages.

Appendix F contains the plots of all the natural spring sampling stations of the measured gross beta activity is presented with 2σ error bars. An averaging plot is included which shows the trend of the network mean throughout the reporting period as well as the range for each point. Table 16 presents a list of the gross beta averages at each location. The highest average recorded was 25.5×10^{-9} μCi/ml at Reitmann Seep. This was 0.26 percent of the CG. The network average, as compared to those presented in previous reports, was:

Year	Mean ($\times 10^{-9}$ μCi/ml)
CY-1985	9.8
CY-1984	10.3
CY-1983	7.6
CY-1982	9.0
CY-1981	10.5
CY-1980	16.7
CY-1979	22.1
CY-1978	23.7
July-December 1977	24.4
FY-1977	15.2

FIGURE 9

NTS ENVIRONMENTAL SURVEILLANCE
NATURAL SPRING SAMPLING STATIONS
(GROSS BETA YEARLY AVERAGES X 10^{-9} µCi /ml)

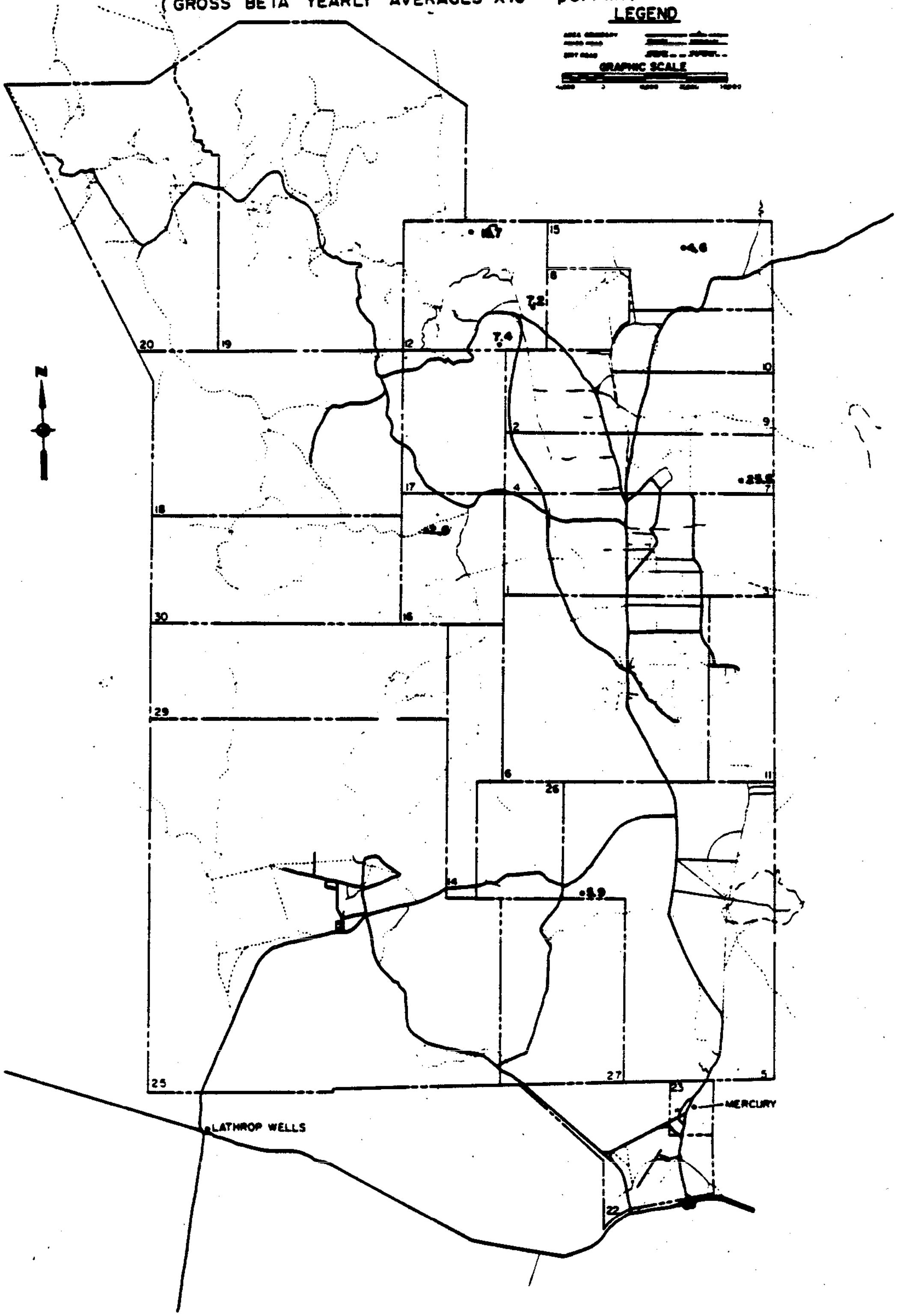


TABLE 15

PLUTONIUM VALUES ABOVE DETECTION LIMITS FROM NONCONTAMINATED WATERS

WATER TYPE	STATION	DATE	μCi/ml
Natural Spring	Reitmann Seep	12/11/85	$1.0 \times 10^{-10} \pm 42\%$
Open Reservoir	Area 5 Reservoir	03/04/85	$1.1 \times 10^{-10} \pm 38\%$
		09/06/85	$9.7 \times 10^{-11} \pm 43\%$

TABLE 16

AVERAGES OF NATURAL SPRINGS DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($X 10^{-9}$ µCi/ml)
Area 5 Cane Spring	5.9
Area 7 Reitmann Seep	25.5
Area 12 White Rock Spring	7.2
Area 12 Captain Jack Spring	7.4
Area 12 Gold Meadows Pond	15.7
Area 15 Tub Spring	4.6
Area 16 Tippipah Spring	2.6

Appendix F includes plots of the network averages for tritium and plutonium at the natural spring sampling stations. The only positive tritium result was 9.6×10^{-7} μCi/ml at Tub Springs. This represents 0.0001 percent of the concentration guide for tritium. The only positive plutonium result was 1.0×10^{-10} μCi/ml at Reitman Seep. This is 0.0001 percent of the concentration guide for plutonium. The positive results for tritium and plutonium are listed in Tables 9 and 15.

6. Contaminated Ponds

Seven contaminated ponds were sampled on a special study basis. The gross beta concentration for each location is shown in Figure 10. These ponds were impound waters from tunnel test areas and a contaminated laundry release point. They are monitored in accordance with DOE Order 5484.1, Chapter IV, to provide a data base for calculations of any offsite releases. Tritium results from these sites are reported to DOE Headquarters on an annual basis.

Table 17 is a list of the gross beta, tritium, and Pu-239 averages at the seven active stations. The first two pages of Appendix G contain the contaminated pond network averages. The remaining plots show the gross beta, Pu-239, and tritium concentrations at each station. The differences between CY-1984 and CY-1985 can be attributed to the decrease or increase in use of the ponds.

FIGURE 10

NTS ENVIRONMENTAL SURVEILLANCE
CONTAMINATED POND SAMPLING STATIONS
(GROSS BETA YEARLY AVERAGES X 10^{-6} µCi/ml)

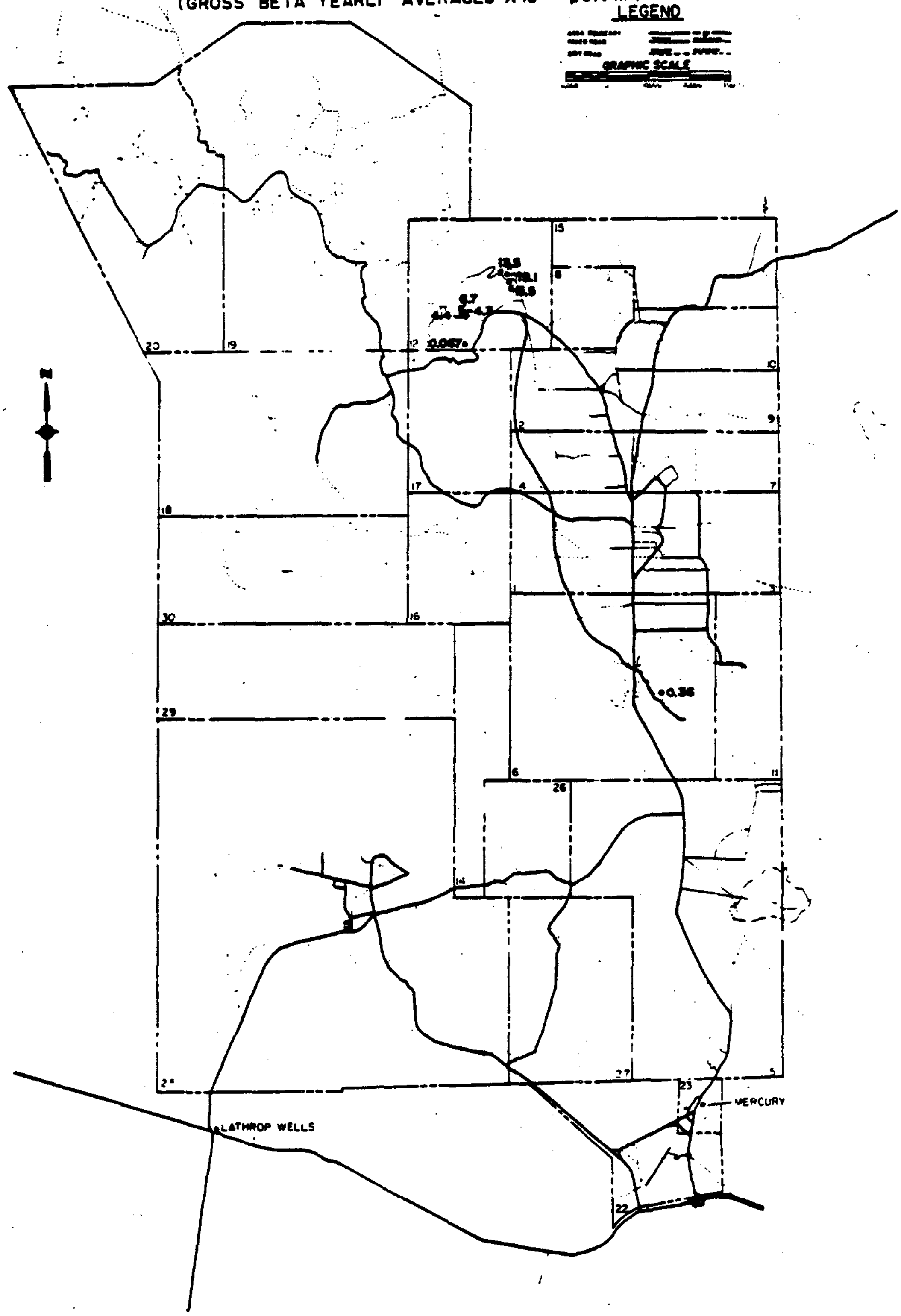


TABLE 17

CONTAMINATED POND YEARLY CONCENTRATION AVERAGES

(μCi/cc)

Station	Tritium Yearly Average	Gross Beta Yearly Average	^{239}Pu Yearly Average
Area 6 Yucca Waste Pond	3.6×10^{-6}	3.6×10^{-7}	$<8.8 \times 10^{-11}$
Area 12 N Upper	4.1×10^{-3}	6.7×10^{-6}	$<3.2 \times 10^{-10}$
Area 12 N Middle	2.9×10^{-3}	4.3×10^{-6}	$<2.2 \times 10^{-10}$
Area 12 N Lower	2.9×10^{-3}	4.4×10^{-6}	$<2.2 \times 10^{-10}$
Area 12 G Waste	5.9×10^{-3}	6.7×10^{-8}	$<6.6 \times 10^{-11}$
Area 12 Upper Mint Lake	1.3×10^{-2}	1.4×10^{-5}	$<5.0 \times 10^{-11}$
Area 12 Middle Mint Lake	1.3×10^{-2}	1.9×10^{-5}	$<5.9 \times 10^{-11}$
Area 12 Lower Mint Lake	1.2×10^{-2}	1.6×10^{-5}	$<5.7 \times 10^{-11}$

7. Effluent Ponds

Samples from six effluent pond locations were collected during CY-1985. These ponds are closed systems which contain both sanitary and radioactive waste for evaporative treatment. Contact with the working population was minimal. The highest average gross beta value was 3.8 x 10^{-8} μCi/ml. Plutonium and tritium concentrations were less than detectable concentrations at all locations.

F. AMBIENT GAMMA MONITORING

A program to measure the ambient gamma exposure rates on the NTS was established in 1977 with 21 stations. In CY-1978, the program was expanded to 86 locations, 139 stations in CY-1979, 152 stations in CY-1980, and 163 stations since CY-1981. The TLD's are changed on a quarterly basis. Several TLD's were not collected for the fourth quarter in Areas 18, 19, and 20, due to impassable roads. Table 18 lists the maximum, minimum, and average dose rates, along with the adjusted annual dose for each monitoring station.

Table 19 lists the results for the nine locations that comprised the original control network. The CY-1984 results indicate reduced dose rates from previous years. This reduction is also seen in most of the external gamma dose rates listed in Table 18. As noted in Section C.3, the responsibility for the calibration and readout of environmental TLD's was shifted to another group within the Environmental Sciences Department. It is assumed that the reduction in dose rates experienced in CY-1984 is attributable to differences in

TABLE 18

GAMMA MONITORING RESULTS - SUMMARY OF 1985

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1984 ADJUSTED ANNUAL DOSE (mrem/y)	1985 ADJUSTED ANNUAL DOSE (mrem/y)
10 A-24 (10)	01/16/85 - 01/28/86	0.69	0.48	0.62	253	225
130 M (4)	01/16/85 - 01/28/86	0.32	0.24	0.28	106	101
140 M (2)	01/16/85 - 01/28/86	0.36	0.28	0.32	121	116
150 M (2)	01/16/85 - 01/28/86	0.37	0.29	0.33	116	120
168 M (12)	01/17/85 - 01/24/86	0.33	0.29	0.31	117	112
170 M (12)	01/17/85 - 01/24/86	0.30	0.27	0.28	107	104
175 M (12)	01/17/85 - 01/24/86	0.32	0.29	0.31	117	113
18 P 35 (18)	01/17/85 - 01/24/86	0.39	0.30	0.35	128	127
18 P 39 (18)	01/17/85 - 01/24/86	0.36	0.31	0.34	116	125
18-1C Gate (18)	01/18/85 - 01/24/86	0.35	0.27	0.31	133	111
185 Holmes Road (17)	01/17/85 - 01/24/86	0.34	0.29	0.31	123	115
190 M (19)	01/17/85 - 01/24/86	0.39	0.34	0.36	129	132
196 M (19)	01/17/85 - 01/24/86	0.38	0.34	0.36	123	132
19P 41 (19)	01/17/85 - 01/24/86	0.41	0.35	0.38	124	140
19P 46 (19)	01/17/85 - 01/24/86	0.34	0.32	0.33*** ****	113	122
19P 54 (19)	01/17/85 - 01/24/86	0.34	0.31	0.33	110	119
19P 59 (19)	01/17/85 - 01/24/86	0.42	0.36	0.39	121	141
19P 66 (19)	01/17/85 - 01/24/86	0.43	0.36	0.38	121	140
19P 71 (19)	01/17/85 - 01/24/86	0.40	0.22	0.33	124	120
19P 77 (19)	01/18/85 - 01/24/86	0.42	0.25	0.34	138	126
19P 87 (19)	01/18/85 - 01/24/86	0.46	0.31	0.39	156	142
19P 88 (19)	01/18/85 - 01/24/86	0.45	0.29	0.36	142	132
19P 91 (19)	01/18/85 - 01/24/86	0.41	0.26	0.34	130	125
2-04 Road (2)	01/16/85 - 01/28/86	4.24	5.26	4.78	1868	1746
2-07 Road (2)	01/16/85 - 01/28/86	0.76	0.59	0.68	273	248
20-4C Gate (20)	01/18/85 - 01/24/86	0.40	0.36	0.37	139	133
25-4P Gate (25)	01/16/85 - 01/16/86	0.32	0.24	0.29	125	106
25-7P Gate (25)	01/16/85 - 01/16/86	0.30	0.24	0.27	121	100
3-03 O.B. Roads (3)	01/16/85 - 01/23/86	0.24	0.19	0.21	79	78
30-1C Gate (30)	01/18/85 - 01/24/86	0.46	0.38	0.42	173	153
4-04 Road (4)	01/16/85 - 01/28/86	6.75	3.97	4.98	2300	1817
6-09 O.B. Roads (6)	01/16/85 - 01/23/86	0.32	0.27	0.29	110	107
7-300 Bunker (7)	01/16/85 - 01/28/86	0.80	1.06	0.95	327	347
8K 25	01/16/85 - 01/28/86	0.29	0.22	0.26	125	94
9-300 Bunker (9)	01/16/85 - 01/28/86	0.36	0.27	0.31	102	114
A-100 Road (18)	01/18/85 - 01/24/86	0.39	0.29	0.34	119	124
A-108 Road (18)	01/18/85 - 01/24/86	0.39	0.31	0.35	136	128
A-116 Road (20)	01/18/85 - 01/24/86	0.43	0.37	0.39	148	143
A-130 Road (20)	01/18/85 - 01/24/86	0.39	0.33	0.36	124	130
A-132 Road (20)	01/18/85 - 01/24/86	0.38	0.23	0.32	128	115
A-136 Road (20)	01/18/85 - 01/24/86	0.35	0.25	0.31	128	114

* No sample collected 1st quarter
** No sample collected 2nd quarter
*** No sample collected 3rd quarter
**** No sample collected 4th quarter

TABLE 18 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1984 ADJUSTED ANNUAL DOSE (mrem/y)	1985 ADJUSTED ANNUAL DOSE (mrem/y)
A-90 Road (18)	01/18/85 - 01/24/86	0.38	0.30	0.34	114	124
Angle Road (3)	01/16/85 - 01/23/86	0.46	0.33	0.40	379	144
B.J.Y. (1)	01/16/85 - 01/28/86	0.32	0.25	0.29	102	105
Bldg. 190 (23)	01/16/85 - 01/16/86	0.18	0.15	0.16	68	60
Bldg. 610 Fence (23)	01/16/85 - 01/16/86	0.14	0.12	0.13	51	48
Bldg. 610 X-Ray Area (23)	01/16/85 - 01/16/86	2.41	0.77	1.50	817	547
Bldg. 650 Dosimetry Room (23)	01/16/85 - 01/16/86	0.15	0.11	0.13	53	49
Bldg. 650 Roof (23)	01/16/85 - 01/16/86	0.14	0.10	0.12	50	45
Bldg. 650 Sample Storage (23)	01/16/85 - 01/16/86	3.47	0.75	1.72	781	628
C-16 Road (19)	01/17/85 - 01/24/86	0.39	0.33	0.35	128	127
C-25 Road (19)	01/17/85 - 01/24/86	0.38	0.33	0.35	135	127
C-27 Road (19)	01/17/85 - 01/24/86	0.40	0.34	0.37	131	134
C-31 Road (19)	01/17/85 - 01/24/86	0.39	0.34	0.36	136	131
CA-14 (10)	01/16/85 - 01/28/86	0.38	0.28	0.33	130	120
Cable Yard (2)	01/16/85 - 01/28/86	0.37	0.29	0.32	132	122
Cafeteria (27)	01/16/85 - 01/16/86	0.32	0.27	0.29	118	106
Campsite (20)	01/18/85 - 01/24/86	0.37	0.23	0.30	123	111
Circle & L Road	01/16/85 - 01/28/86	0.35	0.26	0.32	123	115
Complex (12)	01/17/85 - 01/24/86	0.32	0.30	0.31	122	113
Complex (3)	01/16/85 - 01/23/86	0.32	0.25	0.28	118	103
CP Complex (6)	01/16/85 - 01/23/86	0.18	0.14	0.17	64	60
CP-50 Calibration Bench (6)	01/16/85 - 01/23/86	0.30	0.25	0.28	172	100
CP-50 Instrument Calib Door (6)	01/16/85 - 01/23/86	0.46	0.35	0.40	193	146
Decon Pad Back Office (6)	01/16/85 - 01/23/86	0.27	0.21	0.24	101	88
Decon Pad Front Office (6)	01/16/85 - 01/23/86	0.35	0.17	0.24	114	89
Desert Rock Weather Stn. (22)	01/16/85 - 01/16/86	0.16	0.12	0.14	58	53
E-Mad East (25)	01/16/85 - 01/16/86	0.30	0.24	0.27	113	99
E-Mad North (25)	01/16/85 - 01/16/86	0.53	0.40	0.48	231	174
E-Mad Tile Bed (25)	01/16/85 - 01/16/86	0.27	0.19	0.25	108	89
E-Mad West (25)	01/16/85 - 01/16/86	0.28	0.21	0.26	106	95
EPA Farm (15)	01/16/85 - 01/28/86	0.30	0.24	0.27	101	97
F-12 Road (20)	01/18/85 - 01/24/86	0.38	0.23	0.31	132	114
F-2 Road (20)	01/18/85 - 01/24/86	0.40	0.25	0.33	134	120
F-8 Road (20)	01/18/85 - 01/24/86	0.41	0.26	0.34	137	125
Gate 100 (23)	01/16/85 - 01/16/86	0.16	0.13	0.14	58	52
Gravel Pit (1)	01/18/85 - 01/24/86	0.30	0.23	0.26	101	97
Henre Site (25)	01/16/85 - 01/16/86	0.31	0.23	0.28	110	101
J-16 Road (20)	01/18/85 - 01/24/86	0.38	0.24	0.32	128	116
J-24 Road (20)	01/18/85 - 01/24/86	0.39	0.24	0.32	130	118
J-31 Road (20)	01/18/85 - 01/24/86	1.19	0.94	1.03	449	374
J-6 Road (20)	01/18/85 - 01/24/86	0.41	0.36	0.38****	142	138
Lamp shack (15)	01/16/85 - 01/28/86	0.32	0.26	0.29	120	106
LLL Trailer (15)	01/16/85 - 01/28/86	0.36	0.28	0.32	130	118

* No sample collected 1st quarter
** No sample collected 2nd quarter
*** No sample collected 3rd quarter
**** No sample collected 4th quarter

TABLE 18 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1984 ADJUSTED ANNUAL DOSE (mrem/y)	1985 ADJUSTED ANNUAL DOSE (mrem/y)
Logistics Desk (6)	01/16/85 - 01/23/86	0.17	0.15	0.16	74	58
Lower Mint Lake (12)	01/17/85 - 01/24/86	1.27	0.90	1.04	456	381
NRDS Warehouse (25)	01/16/85 - 01/16/86	0.31	0.23	0.28	116	101
Office (15)	01/16/85 - 01/28/86	0.27	0.21	0.24	91	86
Post Office (23)	01/16/85 - 01/16/86	0.15	0.11	0.13	50	47
R-20 Road (19)	01/18/85 - 01/24/86	0.39	0.32	0.35	135	126
R-27 Road (19)	01/18/85 - 01/24/86	0.42	0.25	0.35	142	127
R-3 Road (19)	01/18/85 - 01/24/86	0.45	0.34	0.38	158	140
R-31 Road (19)	01/18/85 - 01/24/86	0.38	0.31	0.35	129	127
R-9 Road (19)	01/18/85 - 01/24/86	0.44	0.35	0.38	150	139
Ramatrol (23)	01/16/85 - 01/16/86	0.31	0.20	0.26	123	94
RWMS East 1000' (5)	01/16/85 - 01/23/86	0.31	0.25	0.29	120	104
RWMS East 1500' (5)	01/16/85 - 01/23/86	0.30	0.24	0.28	122	100
RWMS East 500' (5)	01/16/85 - 01/23/86	0.32	0.23	0.28	98	102
RWMS East Gate (5)	01/16/85 - 01/23/86	0.34	0.26	0.29	114	107
RWMS North 1000' (5)	01/16/85 - 01/23/86	0.32	0.25	0.29	110	107
RWMS North 1500' (5)	01/16/85 - 01/23/86	0.31	0.24	0.28	99	103
RWMS North 500' (5)	01/16/85 - 01/23/86	0.33	0.25	0.30	110	108
RWMS Northeast Corner (5)	01/16/85 - 01/23/86	0.32	0.23	0.28	99	102
RWMS Northwest Corner (5)	01/16/85 - 01/23/86	0.34	0.24	0.30	112	109
RWMS Offices (5)	01/16/85 - 01/23/86	0.51	0.25	0.33	112	120
RWMS South 500' (5)	01/16/85 - 01/23/86	0.33	0.26	0.30	115	110
RWMS South Gate (5)	01/16/85 - 01/23/86	0.37	0.21	0.28	99	103
RWMS Southwest Corner (5)	01/16/85 - 01/23/86	0.30	0.23	0.28	100	102
RWMS West 1000' (5)	01/16/85 - 01/23/86	0.33	0.26	0.31	123	112
RWMS West 1500' (5)	01/16/85 - 01/23/86	0.34	0.29	0.29	115	107
RWMS West 500' (5)	01/16/85 - 01/23/86	0.33	0.24	0.29	115	106
Security Gate 293 (6)	01/16/85 - 01/23/86	0.33	0.27	0.30	112	110
Sedan Crater West Area (10)	01/16/85 - 01/28/86	1.71	1.34	1.54	665	563
Sedan Crater Visitor's Box (10)	01/16/85 - 01/28/86	0.42	0.26	0.36	156	132
Storage Shed (15)	01/16/85 - 01/28/86	0.31	0.22	0.28	110	104
Substation Base (15)	01/16/85 - 01/28/86	0.27	0.22	0.24	95	88
TH-1 (6)	01/17/85 - 01/24/86	0.18	0.15	0.16	67	59
TH-18 (1)	01/17/85 - 01/24/86	0.24	0.19	0.21	80	77
TH-27 (1)	01/17/85 - 01/24/86	0.26	0.22	0.24	94	88
TH-37 (1)	01/17/85 - 01/24/86	0.30	0.27	0.28	109	103
TH-47 (4)	01/17/85 - 01/24/86	0.35	0.30	0.32	126	117
TH-57 (2)	01/17/85 - 01/24/86	0.24	0.21	0.22	87	82
TH-67.5 (12)	01/17/85 - 01/24/86	0.26	0.23	0.24	91	87
TH-9 (6)	01/17/85 - 01/24/86	0.27	0.23	0.25	94	90
U3ax Northeast (3)	01/16/85 - 01/23/86	0.82	0.60	0.71	248	259
U3ax Northwest (3)	01/16/85 - 01/23/86	0.52	0.39	0.44	199	162
U3ax South (3)	01/16/85 - 01/23/86	0.41	0.32	0.36	131	131

* No sample collected 1st quarter
** No sample collected 2nd quarter
*** No sample collected 3rd quarter
**** No sample collected 4th quarter

TABLE 18 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1984 ADJUSTED ANNUAL DOSE (mrem/y)	1985 ADJUSTED ANNUAL DOSE (mrem/y)
U3ax Southeast (3)	01/16/85 - 01/23/86	0.48	0.39	0.43	182	157
U3by North (3)	01/16/85 - 01/23/86	0.87	0.67	0.77	287	280
U3by South (3)	01/16/85 - 01/23/86	0.46	0.36	0.40	142	146
U3bz North (3)	01/16/85 - 01/23/86	0.57	0.43	0.51	198	185
U3bz South (3)	01/16/85 - 01/23/86	0.39	0.31	0.34	113	124
U3cj North (3)	01/16/85 - 01/23/86	0.36	0.30	0.33	129	120
U3co North (3)	01/16/85 - 01/23/86	3.57	2.67	3.08	1248	1124
U3co South (3)	01/16/85 - 01/23/86	1.95	1.66	1.80	602	660
U3du North (3)	01/16/85 - 01/23/86	0.43	0.38	0.40**	154	147
U3du South (3)	01/16/85 - 01/23/86	0.50	0.37	0.45	172	165
U3ey South (3)	01/16/85 - 01/23/86	0.36	0.29	0.32	199	118
Upper Haines Lake No. 1 (12)	01/17/85 - 01/24/86	0.31	0.28	0.30***	102	109
Upper N Tunnel Pond (12)	01/17/85 - 01/24/86	0.34	0.31	0.32	125	117
Well 19c Reservoir (19)	01/17/85 - 01/24/86	0.39	0.34	0.35	132	129
Well 3 (6)	01/16/85 - 01/28/86	0.27	0.22	0.25	97	92
Well 5B (5)	01/16/85 - 01/23/86	0.28	0.23	0.26	98	93
Yucca Complex (6)	01/16/85 - 01/23/86	0.25	0.19	0.22	85	82

* No sample collected 1st quarter
** No sample collected 2nd quarter
*** No sample collected 3rd quarter
**** No sample collected 4th quarter

Table 18 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	ELEVATION (FT)	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1984 ADJUSTED ANNUAL DOSE (mrem/y)	1985 ADJUSTED ANNUAL DOSE (mrem/y)
N670,600 E667,300 (22)	02/04/85 - 01/14/86	4000	0.14	0.12	0.13**	60	47
N731,300 E638,700 (28)	02/04/85 - 01/14/86	5750	0.23	0.20	0.21	97	78
N849,500 E545,000 (30)	02/04/85 - 01/14/86	7100	0.37	0.31	0.33	139	121
N887,000 E558,000 (20)	02/04/85 - 01/14/86	6100	0.45	0.37	0.40	157	147
N948,800 E527,800 (20)	02/04/85 - 01/14/86	5650	0.37	0.33	0.35	144	129
N944,700 E563,300 (19)	02/04/85 - 01/14/86	6300	0.22	0.19	0.21	85	76
N955,500 E614,200 (19)	02/04/85 - 01/14/86	7200	0.36	0.32	0.35	136	126
N935,500 E639,750 (19)	02/04/85 - 01/14/86	6550	0.37	0.30	0.34	135	123
N903,800 E635,500 (12)	02/04/85 - 01/14/86	6900	0.27	0.23	0.25	100	89
N907,600 E686,200 (8)	02/04/85 - 01/14/86	5826	0.38	0.32	0.35	141	128
N874,600 E691,500 (10)	02/04/85 - 01/14/86	5000	0.17	0.15	0.16	71	59
N844,200 E704,900 (3)	02/04/85 - 01/14/86	5100	0.16	0.14	0.15	64	54
N788,800 E709,500 (11)	02/04/85 - 01/14/86	5200	0.34	0.26	0.31	131	111
N710,800 E720,000 (11)	02/04/85 - 01/14/86	4280	0.14	0.11	0.13	54	47

* No sample collected 1st quarter
** No sample collected 2nd quarter
*** No sample collected 3rd quarter
**** No sample collected 4th quarter

TABLE 19

TLD CONTROL STATION COMPARISON

Station	Dose Rate (mrem/d)						
	1979	1980	1981	1982	1983	1984	1985
Bldg. 650 Dosimetry Room	0.17	0.18	0.21	0.19	0.21	0.15	0.13
Bldg. 650 Roof	0.15	0.16	0.18	0.18	0.18	0.14	0.12
Area 27 Cafeteria	0.35	0.37	0.41	0.37	0.39	0.32	0.29
CP Complex	0.21	0.23	0.25	0.20	0.25	0.18	0.17
Henre Site	0.33	0.35	0.39	0.37	0.36	0.30	0.28
NRDS Warehouse	0.33	0.35	0.40	0.38	0.36	0.32	0.28
Post Office	0.15	0.16	0.20	0.18	0.18	0.14	0.13
Well 5B	0.31	0.34	0.38	0.33	0.33	0.27	0.26
Yucca Complex	0.30	0.30	0.32	0.29	0.29	0.23	0.22
Network Average	0.26	0.27	0.30	0.28	0.28	0.23	0.21

the methodologies used by the respective groups, not a change in ambient conditions. Further tests are being run at this time to confirm this assumption.

The overall network range of the control stations was 0.14 mrem/d to 0.32 mrem/d, with an average natural background on NTS of approximately 0.28 mrem/d (100 mrem/y). The lower values measured in CY-1984 correspond favorably with rates measured at surrounding offsite Nevada locations by the Environmental Protection Agency in CY-1983 (Reference 24). The remaining 154 stations of the network yielded dose rates which ranged from 0.15 mrem/d to 6.30 mrem/d.

G. RADIOACTIVE WASTE MANAGEMENT SITE (RWMS)

The Radioactive Waste Management Site is located in Area 5 of the Nevada Test Site (Figure 11). RWMS consists of approximately 37.2 hectares (92 acres) of land which is devoted to surface storage and disposal of defense low-level radioactive wastes. Waste facilities at the site include trenches, pits, and asphalt pads. The type of waste disposed of at RWMS includes tritium contaminated waste, low-level waste, and equipment that is activated or contaminated. The stored waste consists of transuranic (TRU) contaminated waste only. For a more detailed description of RWMS see Reference 12.

Surveillance of the RWMS is accomplished by using eighteen air samplers, nine for tritium and nine for fission products and plutonium, and sixteen TLD's, for gamma monitoring, placed around the RWMS. Figures 12-14 show the locations of the stations and their yearly averages.

FIGURE 11

NEVADA TEST SITE
LOCATION OF THE RADIOACTIVE WASTE
MANAGEMENT SITE (RWMS)

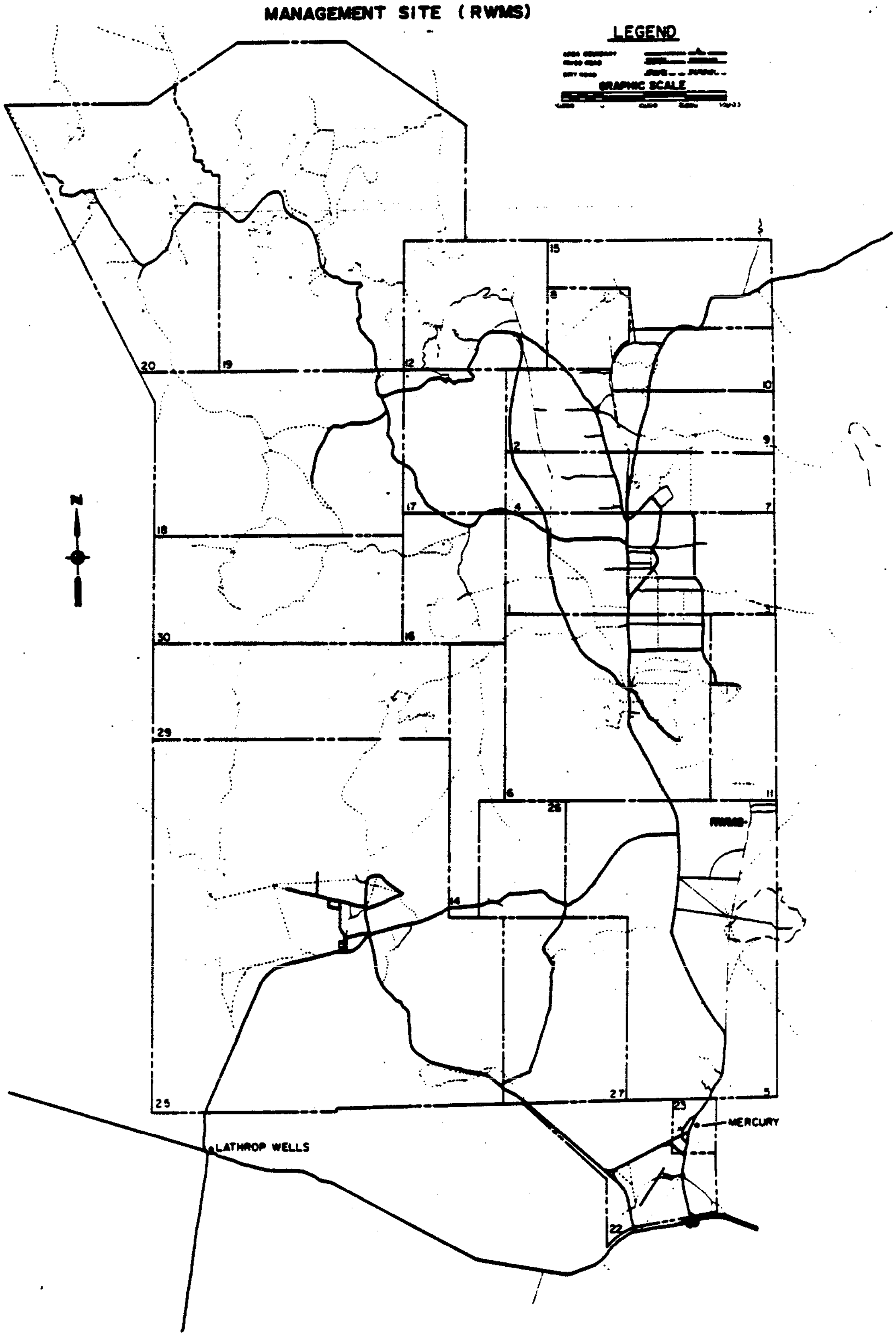


FIGURE 12

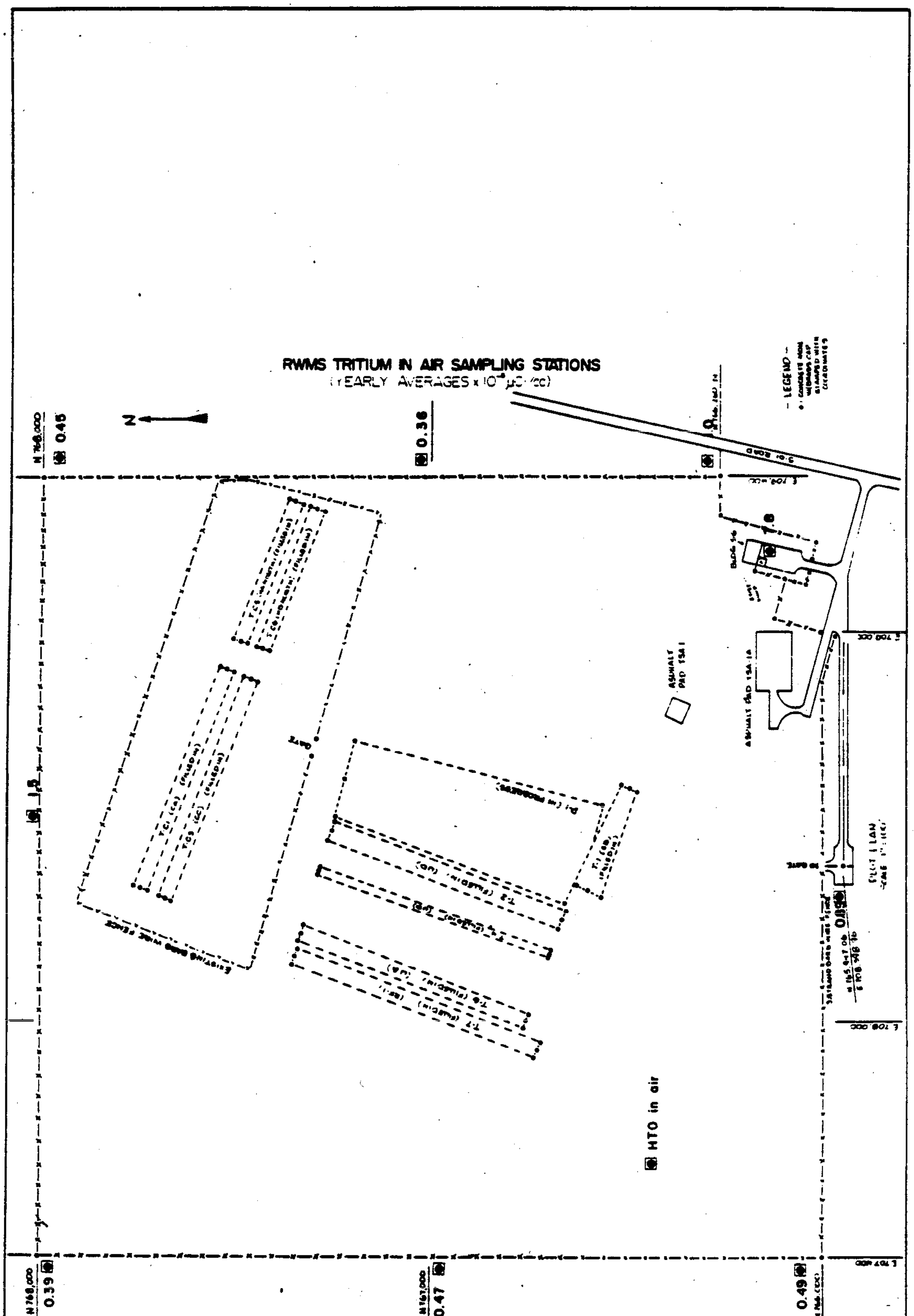

RWMS TRITIUM IN AIR SAMPLING STATIONS
N
0.45
0.36
1.5
0.39
0.47
0.49
HTO in air

FIGURE 13

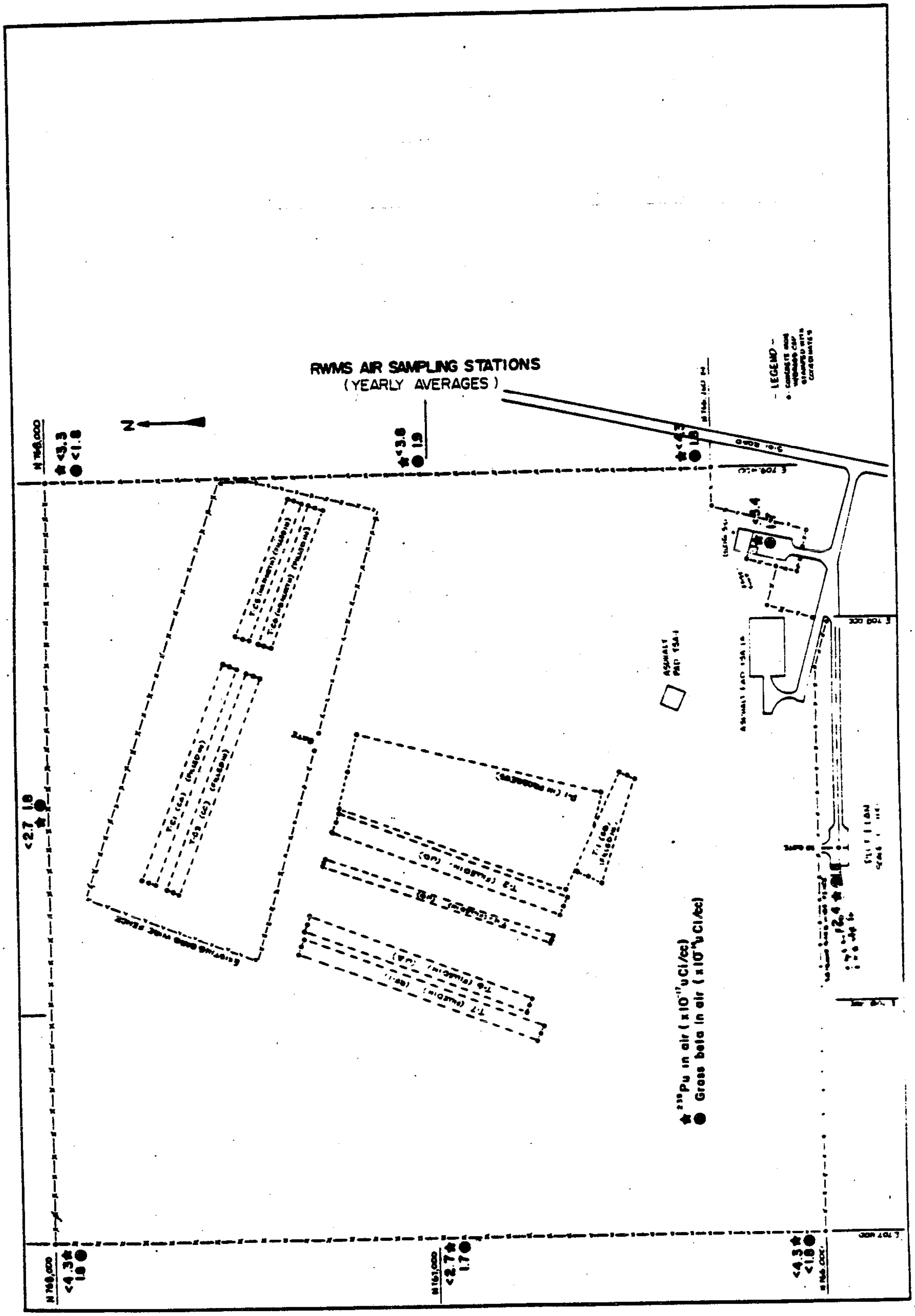
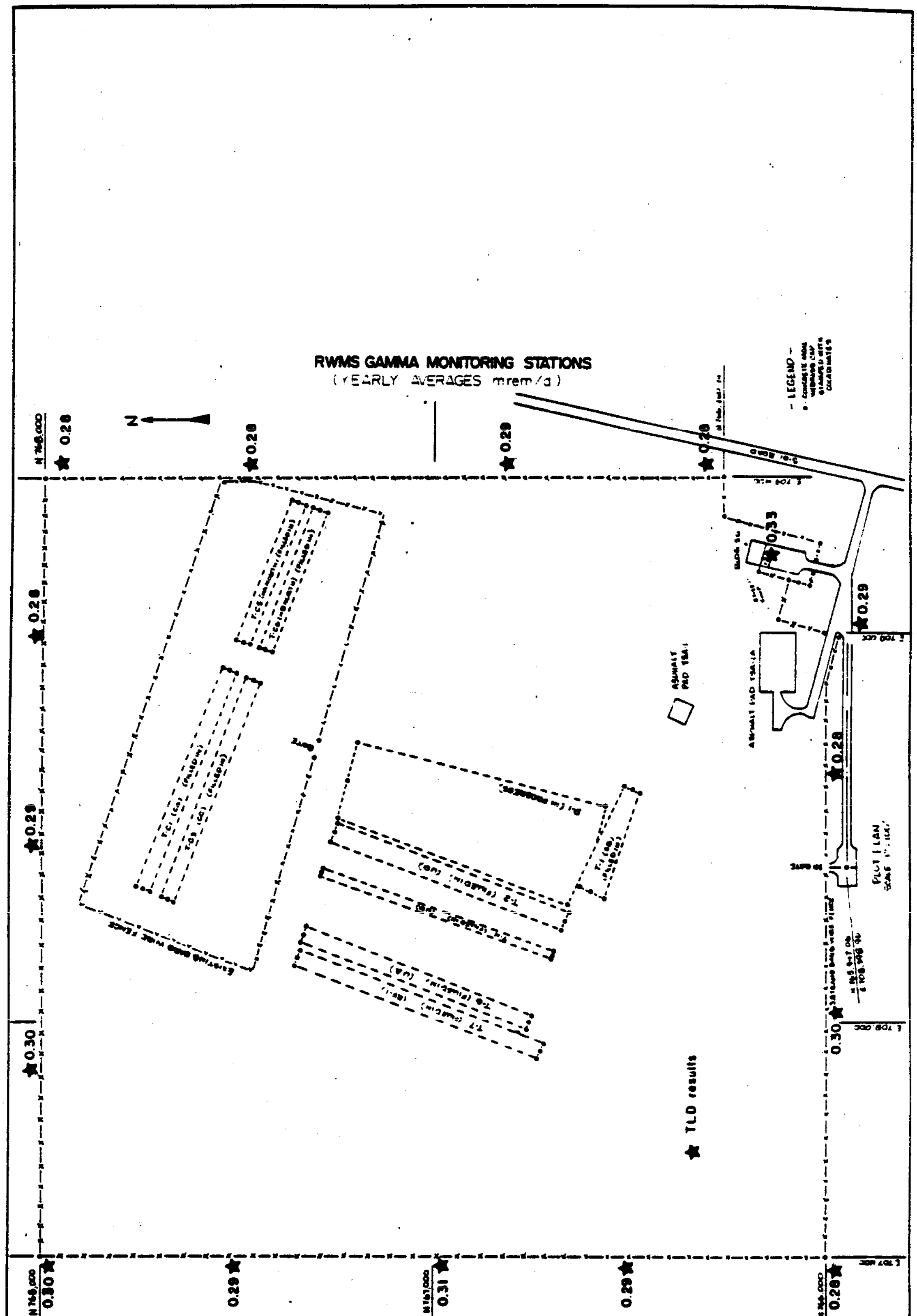


FIGURE 14



RWMS GAMMA MONITORING STATIONS
(YEARLY AVERAGES mrem/d)
N
0.28
0.28
0.29
0.28
0.33
0.29
0.28
0.29
0.28
0.30
0.30
0.30
0.29
0.31
0.29
0.28
TLD results

The tritium in air samplers are placed around the perimeter of RWMS. Results for the RWMS surveillance are summarized in Table 6. The highest average for HTO was 7.8×10^{-11} µCi/cc at RWMS-1 Station, which is 0.002 percent of the concentration guide.

Gross beta and Pu-239 in air results for the site are summarized in Tables 4 and 5. The average gross beta concentration was 1.8×10^{-14} µCi/cc which was slightly higher than the network average of 1.7×10^{-14} µCi/cc. These concentrations represent approximately 0.002 percent of the concentration guide. Results from the nine gross beta stations were grouped closely together and all were within two standard deviations from the average.

The average concentration of Pu-239 in air at RWMS was $<3.5 \times 10^{-17}$ µCi/cc. This is 0.002 percent of the concentration guide for Pu-239.

Table 18 gives a summary of the gamma monitoring results for 1985. The average annual dose for the control network was 77 mrem/y or 9 µrem/h. The natural background of Area 5 which averaged slightly higher at 106 mrem/y or 12 µrem/h compared favorably with the literature value of 11-20 µR/h (Reference 13). Another station, two miles south (Well 5B), had an annual dose rate of 93 mrem/y or 11 µrem/h.

In conclusion, the results from the surveillance network around the RWMS indicate that there were no detectable releases of radioactive materials as a result of operations during 1985.

H. PERIMETER DOSE ASSESSMENT

The maximum postulated dose from the NTS operations was calculated for an individual at work within the test site during the entire CY-1985. This was done by calculating the fifty year cumulative dose, except for the dose from air immersion, for the individual receiving a one year occupational intake from measured radionuclide concentrations onsite. The dose from air immersion was calculated for a one year occupational exposure to a semi-infinite cloud. In the calculation the air immersion dose was treated like an external exposure and, therefore, once the radioactive source was considered removed, for the purposes of this calculation the end of CY-1985, there was no further exposure. The dose conversion factors used for calculating the cumulative dose came from References 14 and 20, and are tabulated in Table 20. Basically, these reports used models and parameters equivalent to those used in ICRP Publication 2 (Reference 16). The radionuclides considered for the dose calculations were tritium, Xe-133, Pu-239, and Sr-90 (assuming the gross beta concentration in air consists entirely of Sr-90). The critical organs considered for tritium, Pu-239 and Sr-90 were the total body, bone, and lung. The critical organ considered for Xe-133 was total body.

1. Dose From Ingestion of Radionuclides

The dose from the ingestion pathways was calculated for an individual at work within the NTS boundary during CY-1985. The only pathway considered was the ingestion of water. Ingestion of foodstuffs was not considered because of the lack of locally grown food adjacent to the site boundary. The water was assumed to be similar to the potable

TABLE 20

DOSE CONVERSION FACTORS*

	Inhalation (mrem/50 y per pCi inhaled)			Ingestion (mrem/50 y per pCi ingested)		Air Immersion (mrem/y per $\mu Ci/m^3$)	
Organ	^{3}H***	^{239}Pu****	^{90}Sr**	^{239}Pu****	^{3}H***	^{133}Xe	^{85}Kr
Total Body	$9.35X10^{-8}$	$1.55X10^{-1}$	$7.62X\text{-}10^{-4}$	$3.82X\text{-}10^{-5}$	$6.18X\text{-}10^{-8}$	$2.19X10^{2}$	$1.9X10^{1}$
Bone	0.0	$6.38X10^{0}$	$1.24X\text{-}10^{-2}$	$1.57X\text{-}10^{-3}$	0.0	$2.19X10^{2}$	$1.9X10^{1}$
Lung	$9.35X10^{-8}$	$3.44X10^{-1}$	$1.20X\text{-}10^{-3}$	0.0	$6.18X\text{-}10^{-8}$	$2.37X10^{2}$	$3.6X10^{1}$
Skin	-----	-----	-----	-----	-----	$6.04X10^{2}$	$1.4X10^{3}$

* Taken from References 14 and 20.

** Gross beta activity was assumed to be ^{90}Sr.

*** The dose conversion factor was divided by 1.7 to take into account the change in Quality Factor for weak beta emitters (DOE Order 5840.1, Chapter XI).

**** The dose conversion factor was multiplied by two to take into account the change in Quality Factor for alpha emitters (DOE Order 5840.1, Chapter XI).

water sampled onsite. The radionuclides considered for the calculation were Pu-239 and tritium. The gross beta concentration was not used in the calculation because it was shown earlier (Reference 23) that the gross beta concentration was primarily due to the naturally occurring K-40 content. The Cascade bottled water brought onsite was assumed to have natural background levels of Pu-239 and H-3. These background concentrations were subtracted from the potable water stations having the maximum average Pu-239 and tritium concentrations to obtain the net concentrations used in the dose calculations. These values are listed in Table 21. The assumed fluid intake for the individual was 1.6 liters per day and was derived from ICRP Publications 23 (Reference 15). The resulting ingestion doses to the total body, lung, and bone for Pu-239 and tritium are given in Table 22.

2. Dose from Inhalation of Radionuclides

The doses from the inhalation of tritium, gross beta activity, and Pu-239 were calculated for the individual at work within the NTS boundary. The maximum average tritium in air and Pu-239 in air concentrations were used for the dose calculations after background concentrations were subtracted.

All of the gross beta activity was assumed to be Sr-90. The concentrations used for calculating the inhalation dose are listed in Table 21. The individual was assumed to breathe 3840 cubic meters of air in one year (Reference 15). The calculated fifty year cumulative doses to the whole body, lungs, and bone are given in Table 22.

TABLE 21

RADIONUCLIDE CONCENTRATIONS USED FOR DOSE ASSESSMENT

	Air (µCi/cc)					Potable Water (µCi/ml)	
	^{3}H	^{239}Pu	Gross Beta	^{133}Xe	^{85}Kr	^{239}Pu	^{3}H
Onsite Concentration	$<8.0X10^{-9}$	$1.5X10^{-15}$	$1.9X10^{-14}$	$<1.3X10^{-10}$	$4.6X10^{-11}$	$<5.7X10^{-11}$	$<9.8X10^{-7}$
Background Concentration	$2.6X10^{-12}$	$2.8X10^{-17}$	$1.4X10^{-14}$	0.0	$2.7X10^{-11}$	$<4.3X10^{-11}$	$<7.0X10^{-7}$
Net Concentration	$<8.0X10^{-9}$	$1.5X10^{-15}$	$5.0X10^{-15}$	$<1.3X10^{-10}$	$1.9X10^{-11}$	$<1.5X10^{-11}$	$<2.8X10^{-7}$

TABLE 22

50 YEAR CUMMULATIVE DOSES*

Organ	Inhalation (mrem)			Ingestion (mrem)		Air Immersion (mrem)		
	^{3}H	^{239}Pu	^{90}Sr**	^{239}Pu	^{3}H	^{133}Xe	^{85}Kr	Total (mrem)
Total Body	$<2.6X10^{0}$	$8.2X10^{-1}$	$1.3X10^{-2}$	$<1.4X10^{-4}$	$<4.3X10^{-3}$	$<2.8X10^{-2}$	$<3.6X10^{-4}$	$<3.5X10^{0}$
Bone	0.0	$3.4X10^{1}$	$2.2X10^{-1}$	$<5.9X10^{-3}$	0.0	$<2.8X10^{-2}$	$<3.6X10^{-4}$	$<3.4X10^{1}$
Lung	$<2.6X10^{0}$	$1.8X10^{0}$	$2.1X10^{-2}$	0.0	$<4.3X10^{-3}$	$<3.1X10^{-2}$	$<6.8X10^{-4}$	$<4.5X10^{0}$
Skin	----	----	----	----	----	$<7.9X10^{-2}$	$<2.7X10^{-2}$	$<1.1X10^{-1}$

* 50 year cummulative dose from inhalation and ingestion of radionuclides for one year. The air immersion dose rate was calculated for a one year exposure with no resulting exposure after CY-1985 ended.

** Assumed all of the gross beta activity was ^{90}Sr.

3. Dose from Air Immersion

The air immersion dose from Xe-133 was calculated for an individual working within the NTS boundary. The average Kr-85 concentration at the Area 20 dispensary was above the network average and was used in air immersion dose calculations, after subtraction of background. The highest average Xe-133 concentration was used to calculate the air immersion dose. These values are given in Table 22. The calculated doses to the whole body, lungs, bone, and skin are listed in Table 23.

4. Estimated Risk to Individual

The maximum estimated dose to the total body, bone, and lung from NTS operations during CY-1985 was 3.5 mrem, 3.4 mrem, and 4.5 mrem, respectively. Table 23 lists the estimated dose to an individual for one year from natural background radiation. ICRP Publication 26 (Reference 17) estimated the risk of fatal health effects per unit dose over the individual's lifetime. Using these values the risk for the total body, bone, and lung were 1×10^{-7}, 2×10^{-7}, and 9×10^{-8}, respectively.

Reference 17 estimates that an acceptable risk to any individual in the public is 10^{-6} to 10^{-5} per year. The maximum calculated risk to the individual at the NTS boundary is at least an order of magnitude below this acceptable risk.

TABLE 23

ESTIMATED NATURAL BACKGROUND DOSE AT THE NTS BOUNDARY*

Source	Total Body** (mrem/y)	Bone (mrem/y)	Lungs (mrem/y)
Cosmic Radiation***	36	36	36
Cosmic Radionuclides+	0.7	0.8	0.7
External Terrestrial++	56	56	56
Inhaled Radionuclides+++	---	---	100
Radionuclides in the Body+++	27	60	24
Total for One Year	120	153	217
U.S. Average Total	80	120	180

* These values were derived from References 13 and 20.

** The values for the total body are assumed to be the same as those for the gonads in Reference 18.

*** Assumed altitude of 1 km and a 10% reduction from structural shielding.

\+ Variation throughout U.S. very minimal, usually less than 1 mrem/y.

++ Value of 10 μrad/h assumed at the site boundary. Value reduced by 20% for shielding by housing and 20% for shielding by the body.

+++ Average values for the U.S.

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A P P E N D I X A

NTS Environmental Surveillance

Air Sampling Locations and Plots

Several symbols are used in Appendix A to denote the data points. In the first plot, the air network weekly averages, a square represents the arithmetic mean of all values at that point in time, and the vertical line is the range of the data.

The remaining plots of Appendix A show the gross beta and plutonium data of each station. A two-sigma error bar is also added to the data points, and, in all of the plots, a delta with the line to the bottom of the plot means below detection limit.

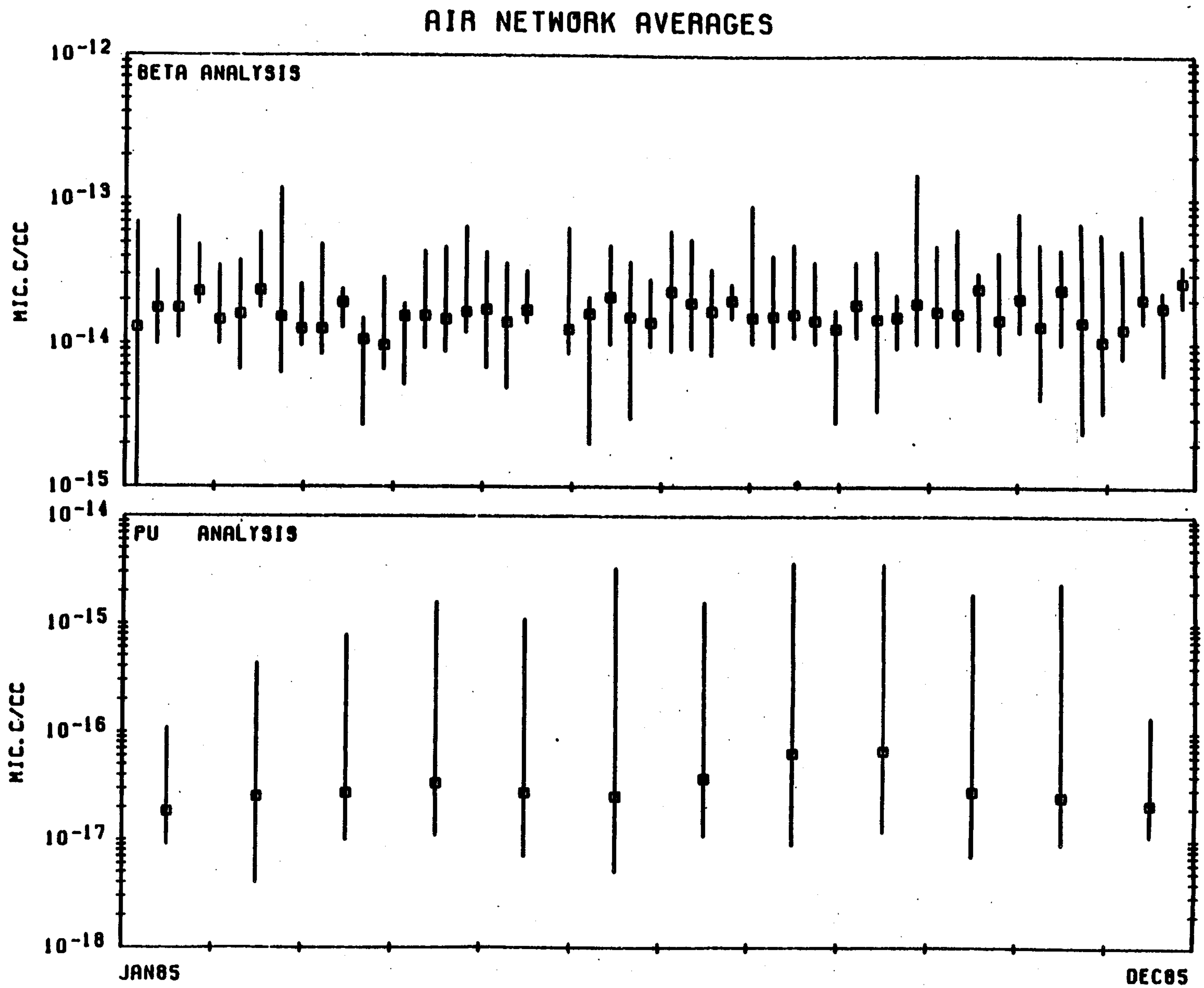
NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING LOCATIONS

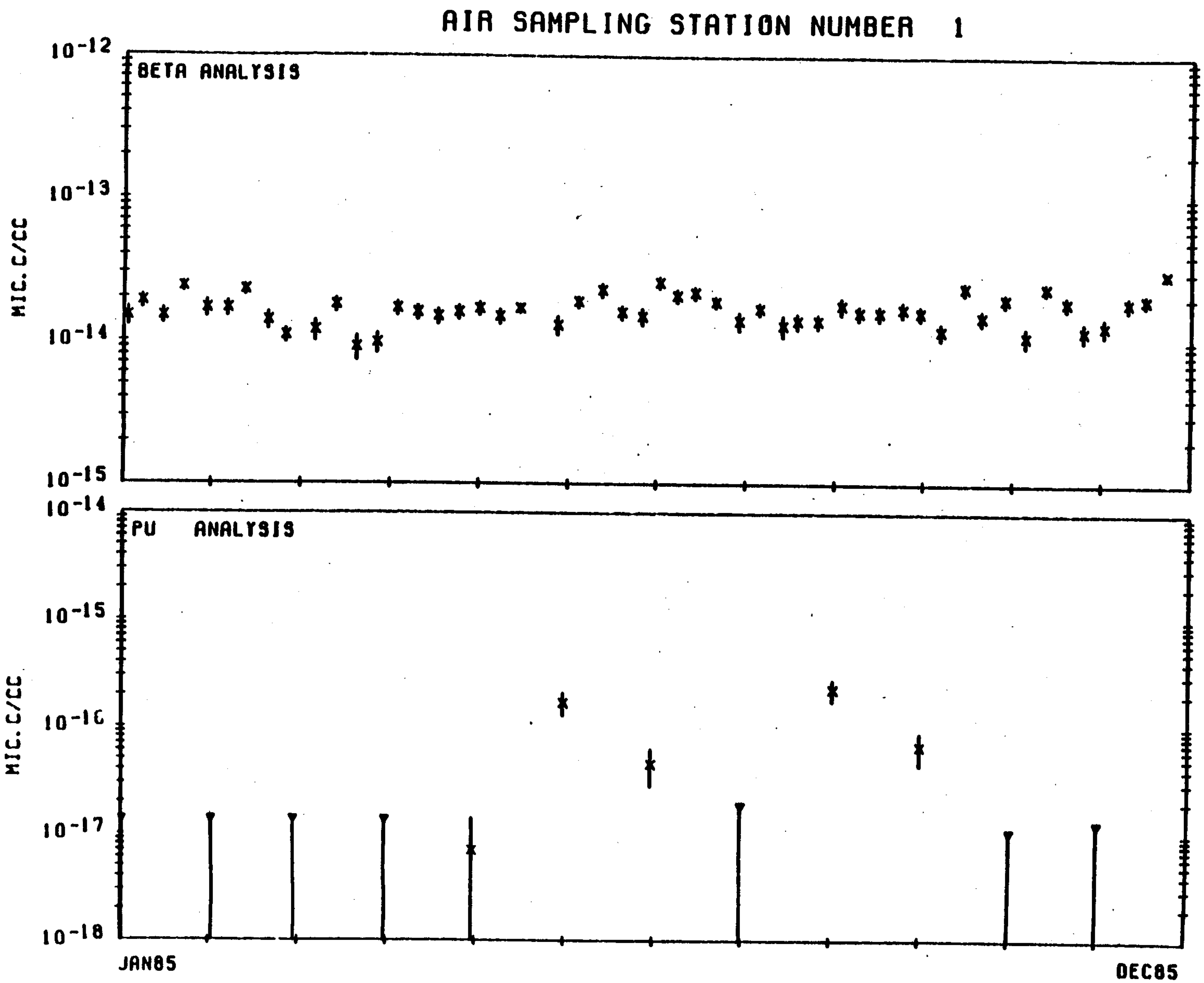
Station Number	Location
1	Area 11 Gate 293
2	Area 6 Well 3 Complex
3	Area 3 Cafeteria
4	Area 9 9-300 Bunker
5	Area 10 Gate 700
6	Area 2 Cable Yard
7	Area 2 Compound
8	Area 12 Changehouse
9	Area 19 Echo Peak
10	Area 19 Substation
11	Area 16 Substation
12	Area 9 9-300 Bunker No. 2
13	Area 23 H&S Roof
14	Area 23 Building 790
15	Area 23 Bldg. 790 No. 2
16	Area 27 Cafeteria
17	Area 25 NRDS Warehouse
18	Area 28 Henre Site
19	Area 5 Well 5B
20	Area 5 RWMS No. 1
21	Area 5 DOD Yard
22	Area 6 Yucca Complex
23	Area 6 CP Complex
25	Area 1 Gravel Pit
26	Area 3 BJY
27	Area 3 3-300 Bunker

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING LOCATIONS

(Continued)

Station Number	Location
28	Area 5 RWMS No. 2
29	Area 5 RWMS No. 3
30	Area 25 E-MAD North
31	Area 25 E-MAD South
32	Area 5 RWMS No. 4
33	Area 3 U3ax South
34	Area 3 U3ax East
35	Area 3 U3ax North
36	Area 3 U3ax West
37	Area 7 UE7ns
38	Area 15 EPA Farm
39	Area 5 RWMS No. 5
40	Area 5 RWMS No. 6
41	Area 5 RWMS No. 7
42	Area 5 RWMS No. 8
43	Area 5 RWMS No. 9
44	Area 15 Pile Driver
46	Area 20 Dispensary
47	Area 3 Complex No. 2
48	Area 5 Gate 200
49	Area 5 Communications Tower


AIR NETWORK AVERAGES
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85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PU ANALYSIS
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MIC.C/CC
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10-14
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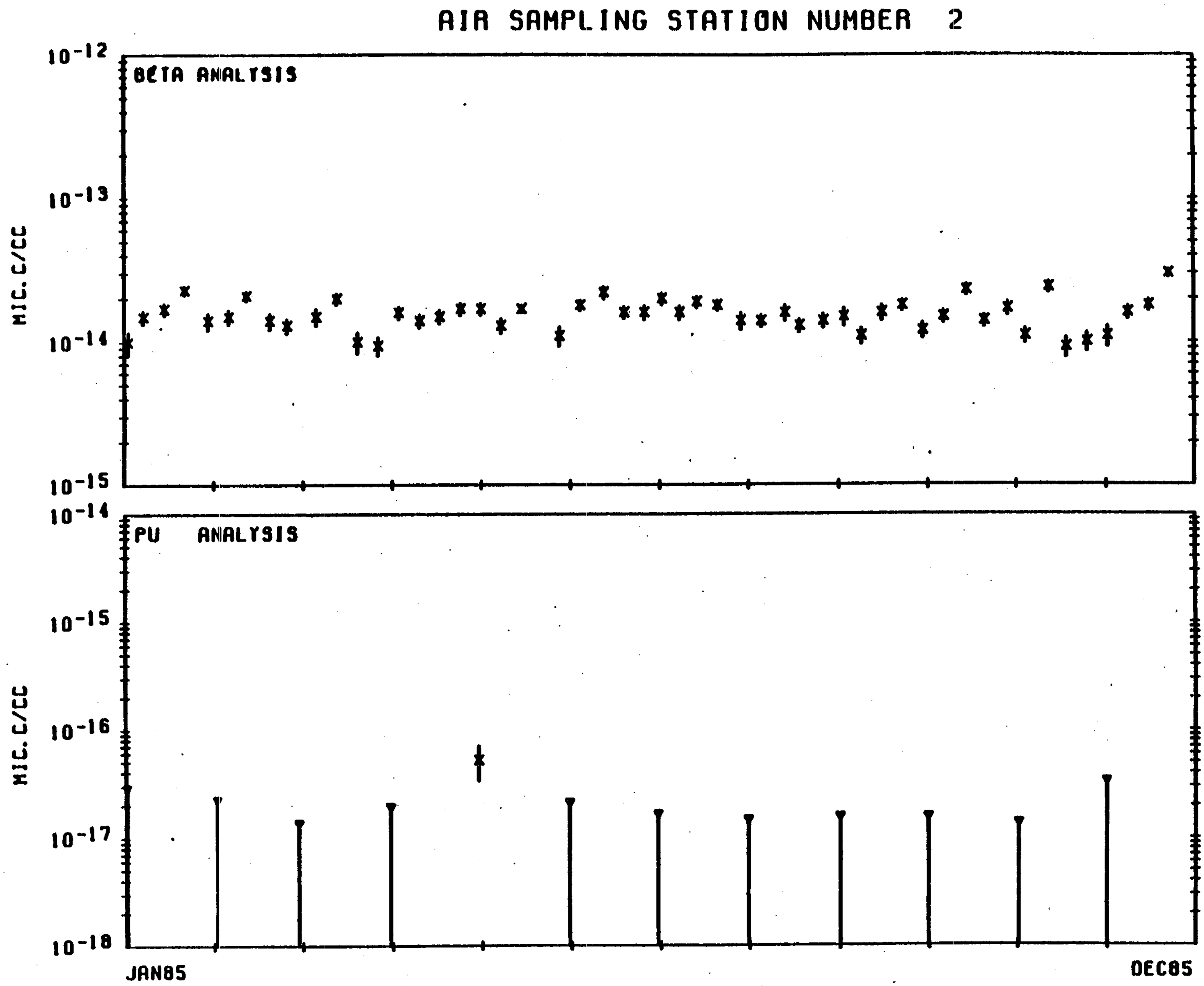
10-15
10-16
10-17
10-18
JAN85
DEC85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PU ANALYSIS
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MIC.C/CC
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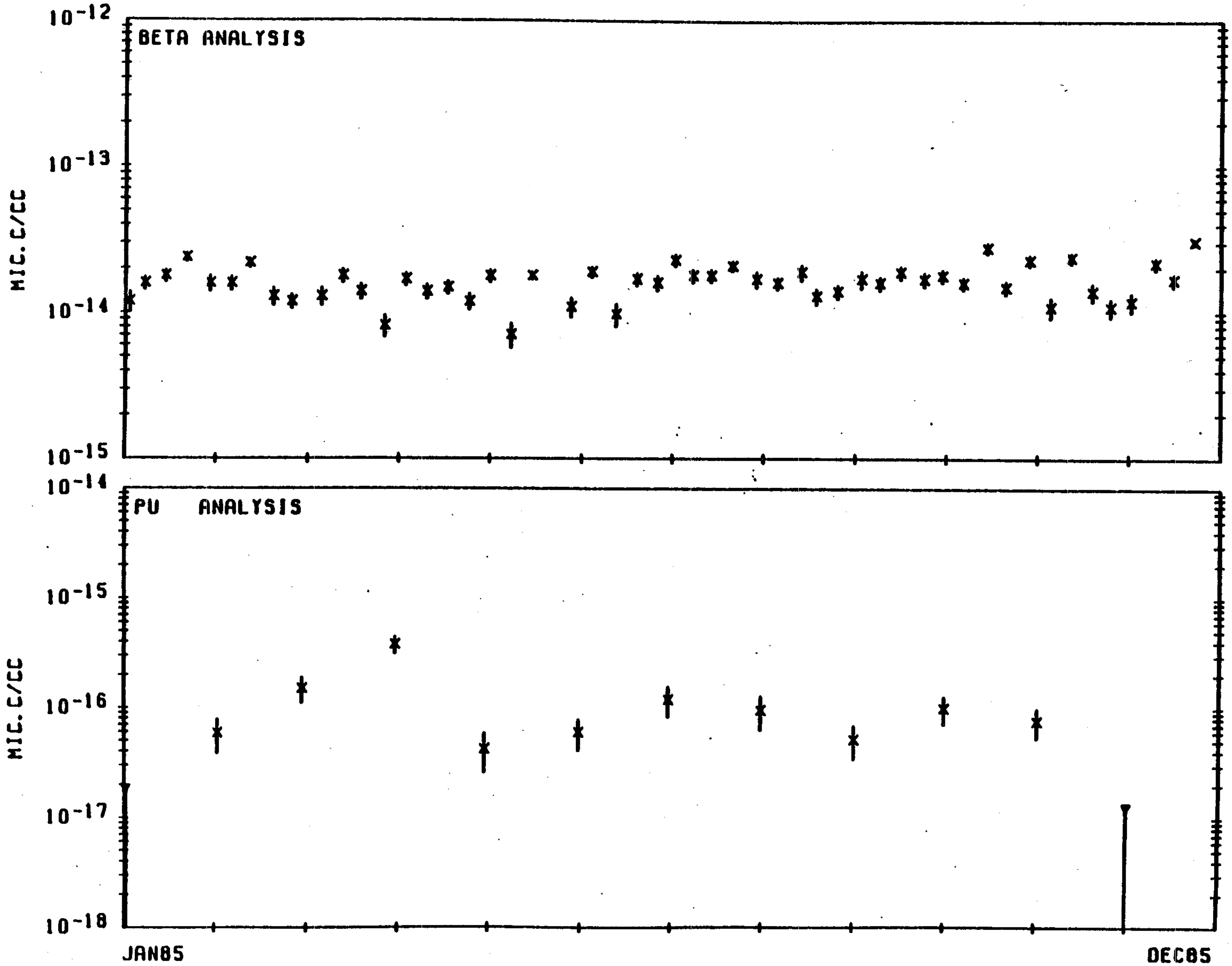
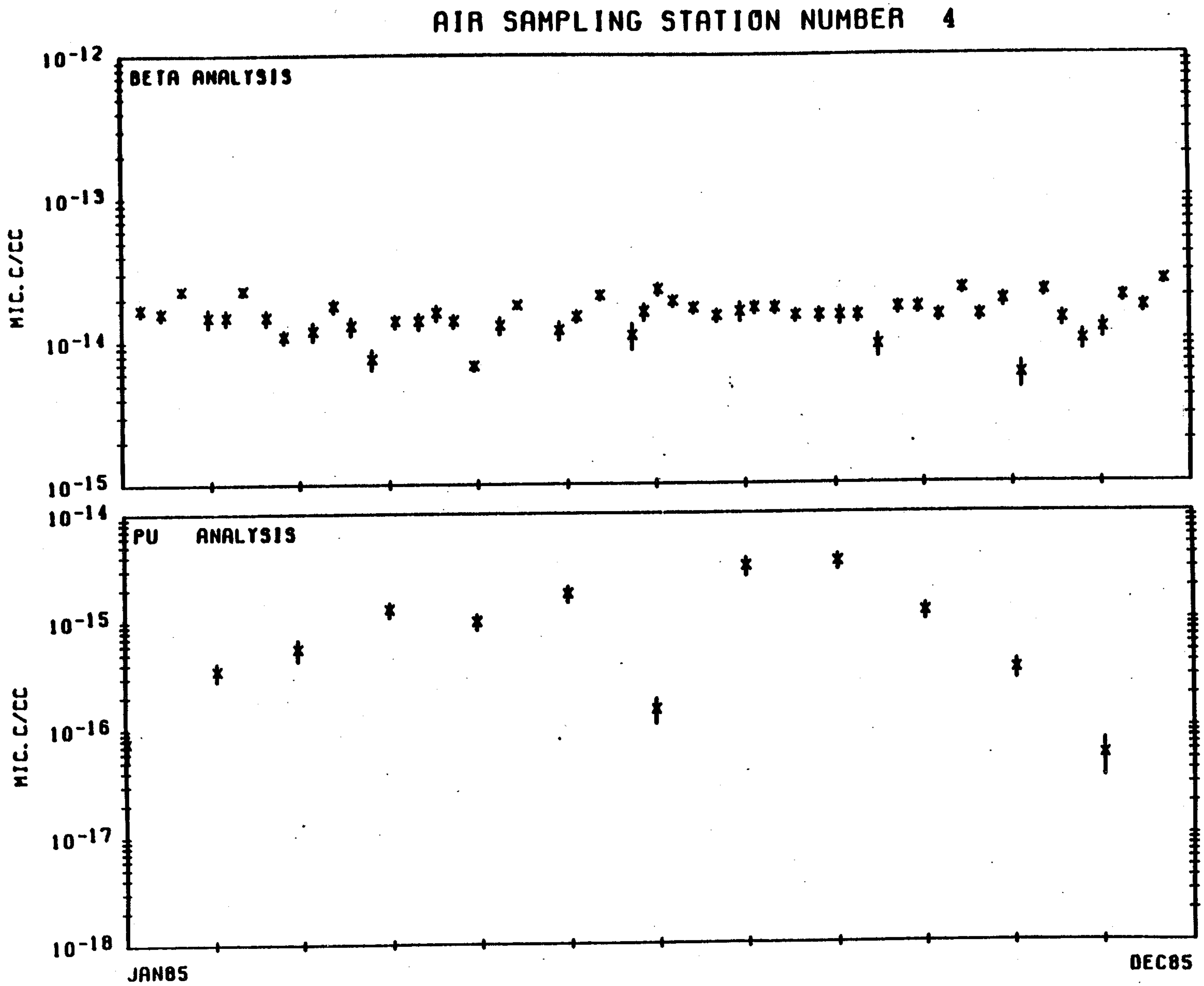
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85

AIR SAMPLING STATION NUMBER 3

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PU ANALYSIS
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MIC.C/CC
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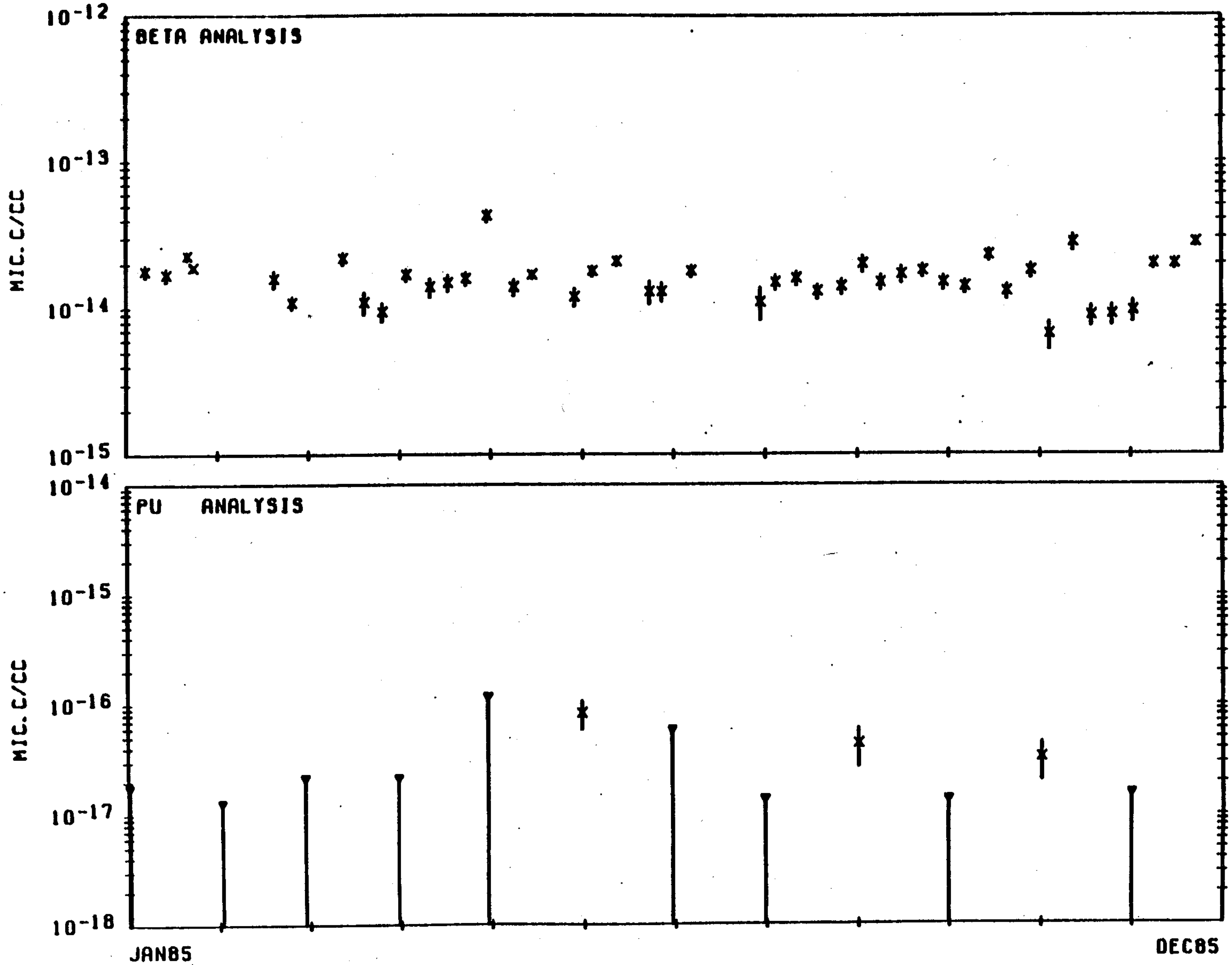
10-14
10-15
10-16
10-17
10-18
JAN85
DEC85

AIR SAMPLING STATION NUMBER 5



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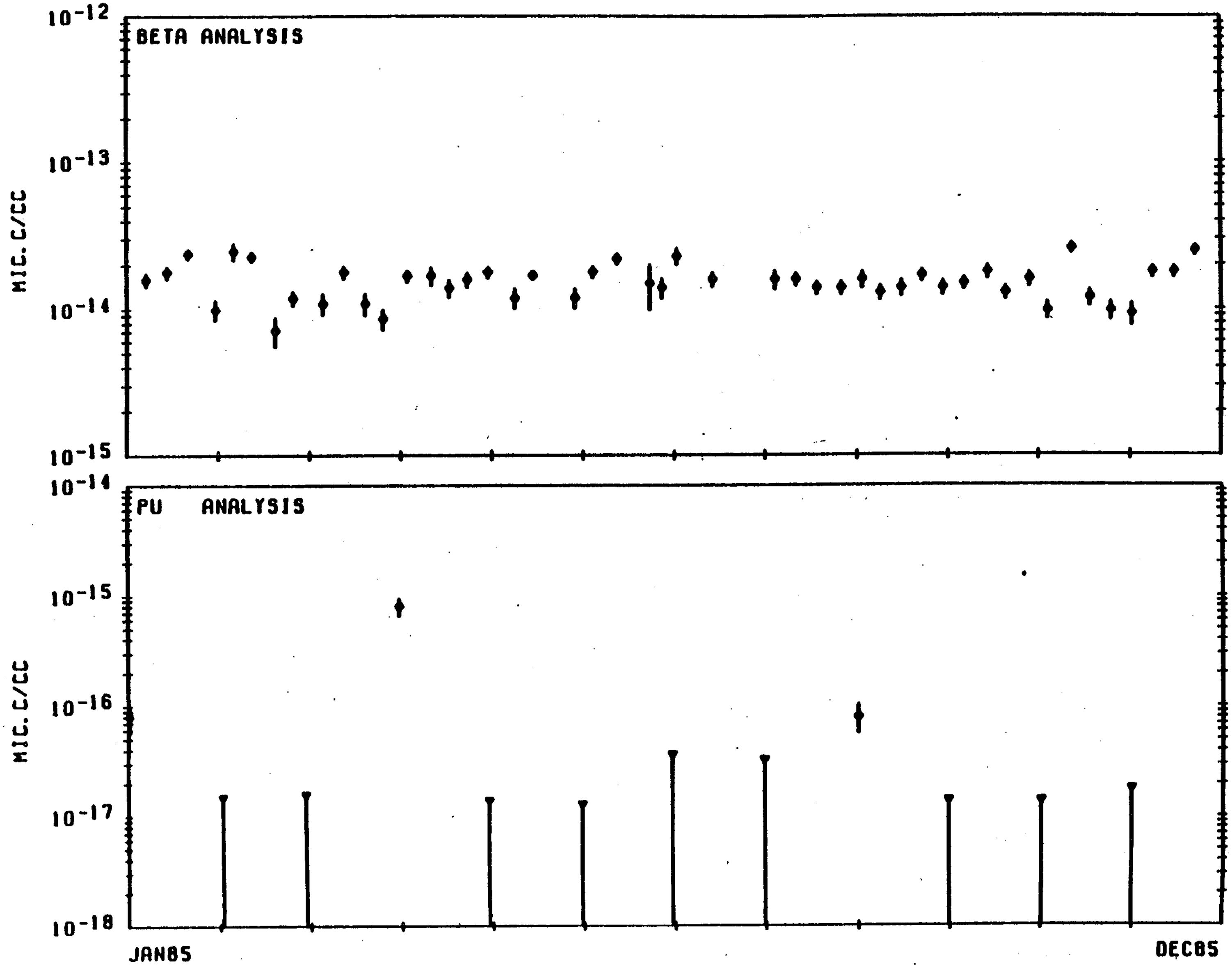

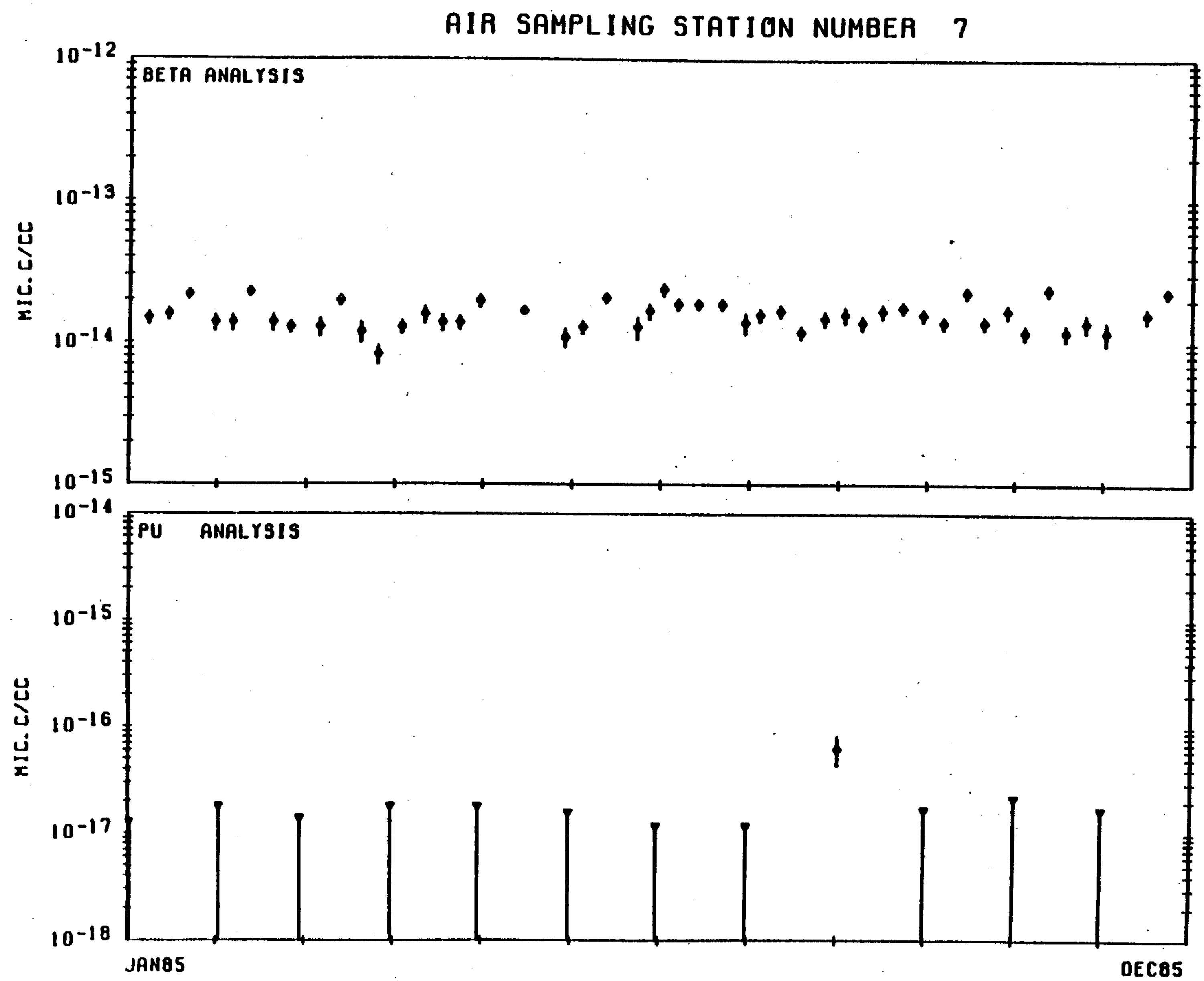
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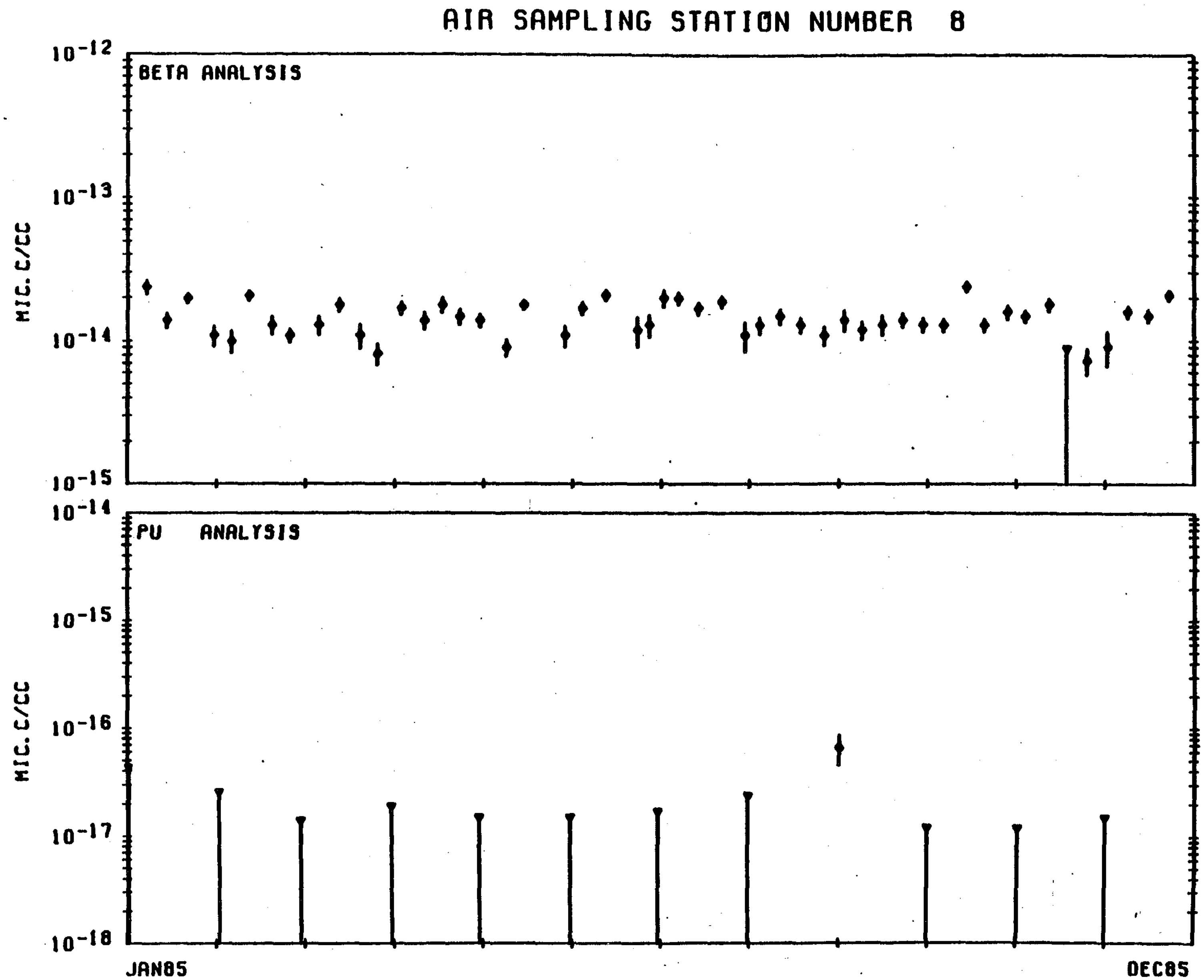
10^{-13}
10^{-14}
10^{-15}
PU ANALYSIS
MIC.C/CC
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85



AIR SAMPLING STATION NUMBER 8
BETA ANALYSIS
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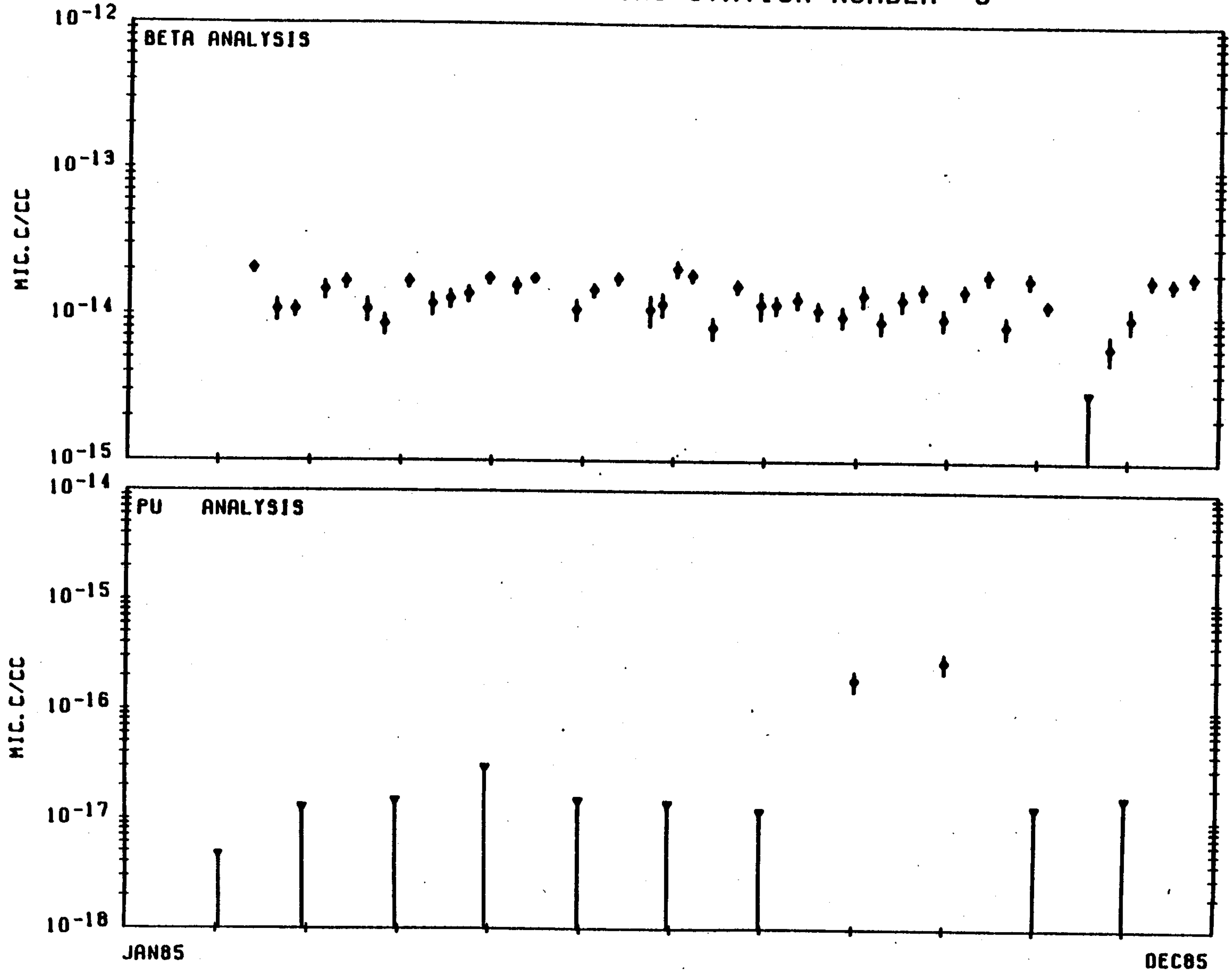
10^{-14}
10^{-15}
PU ANALYSIS
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85

AIR SAMPLING STATION NUMBER 9



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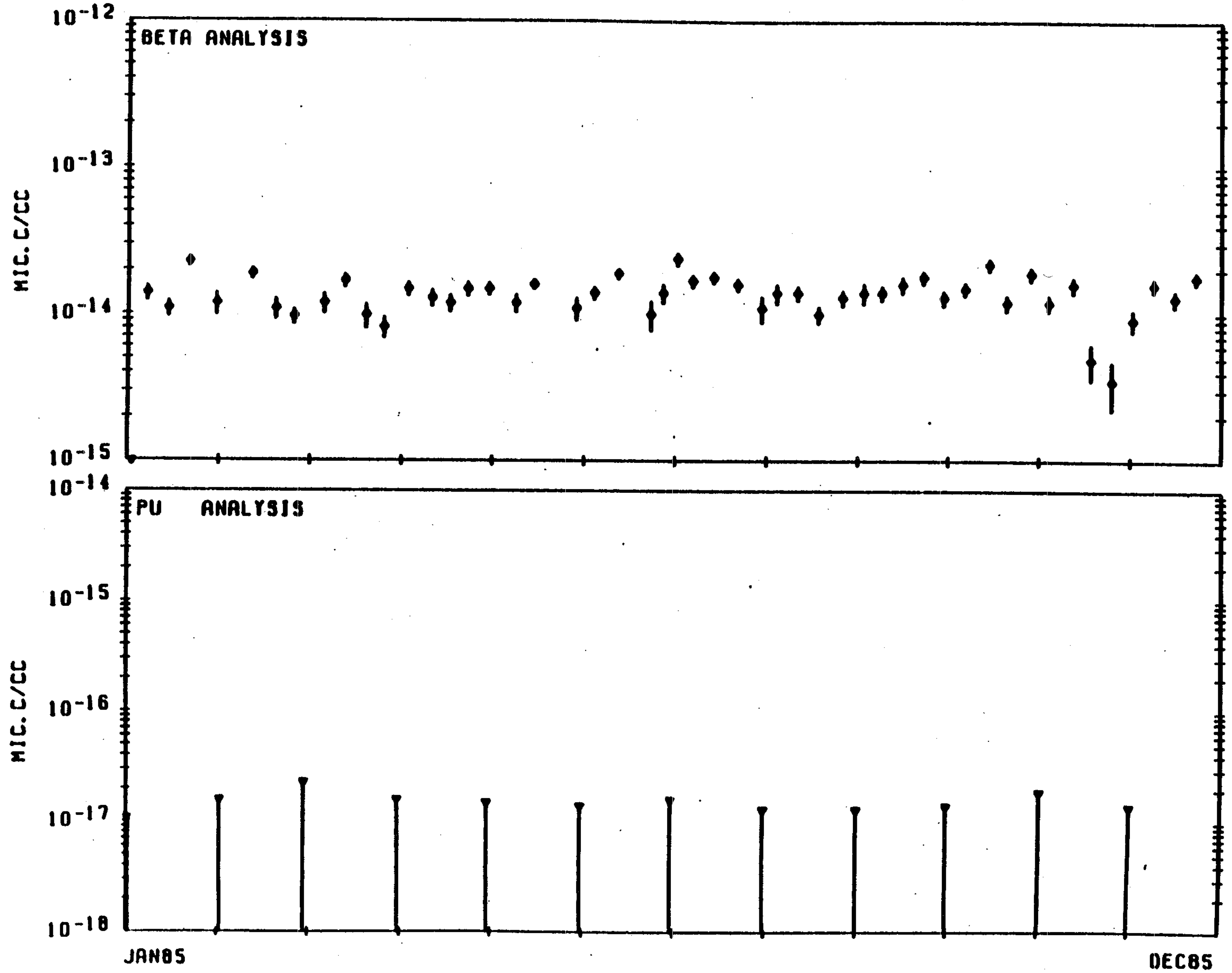

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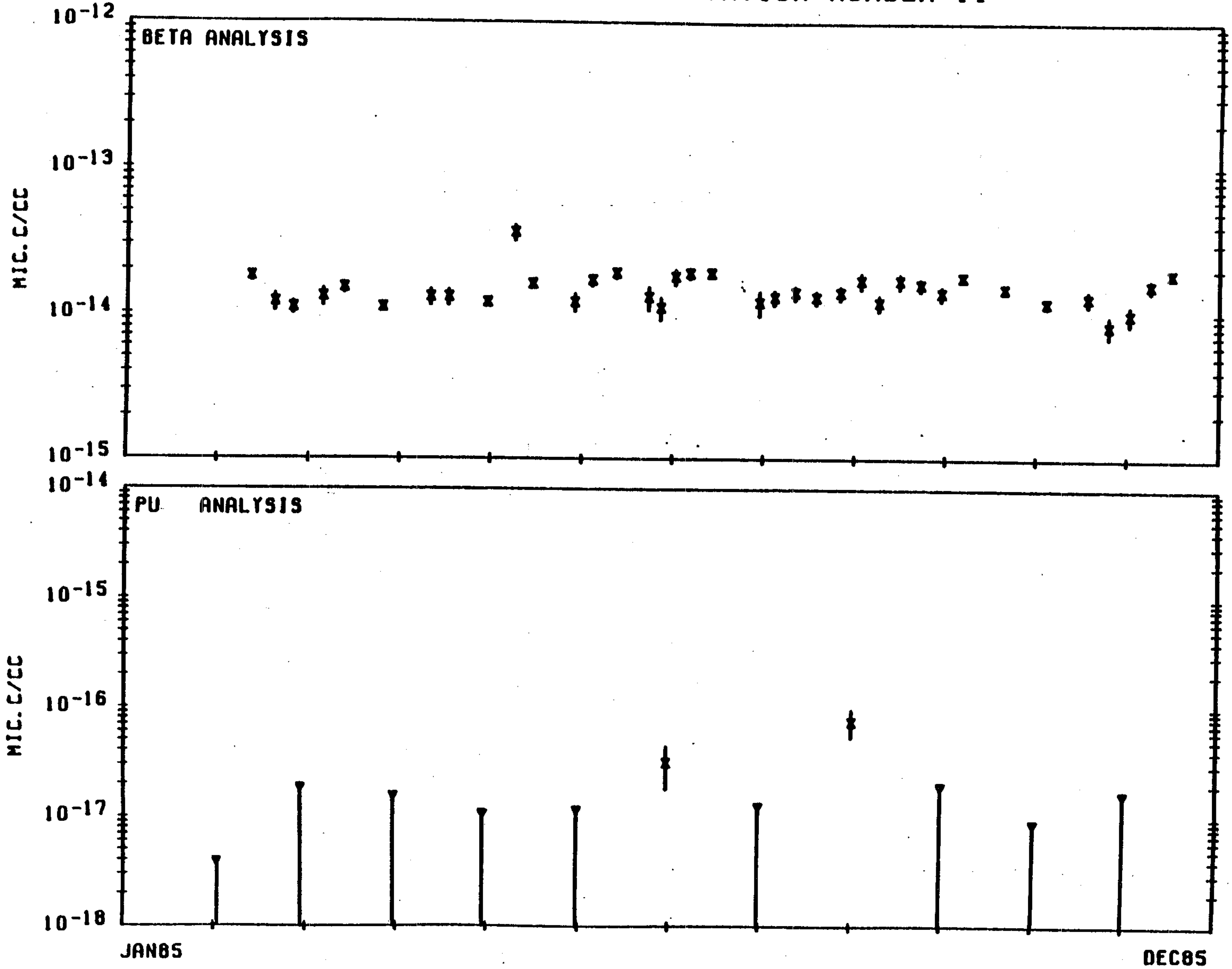

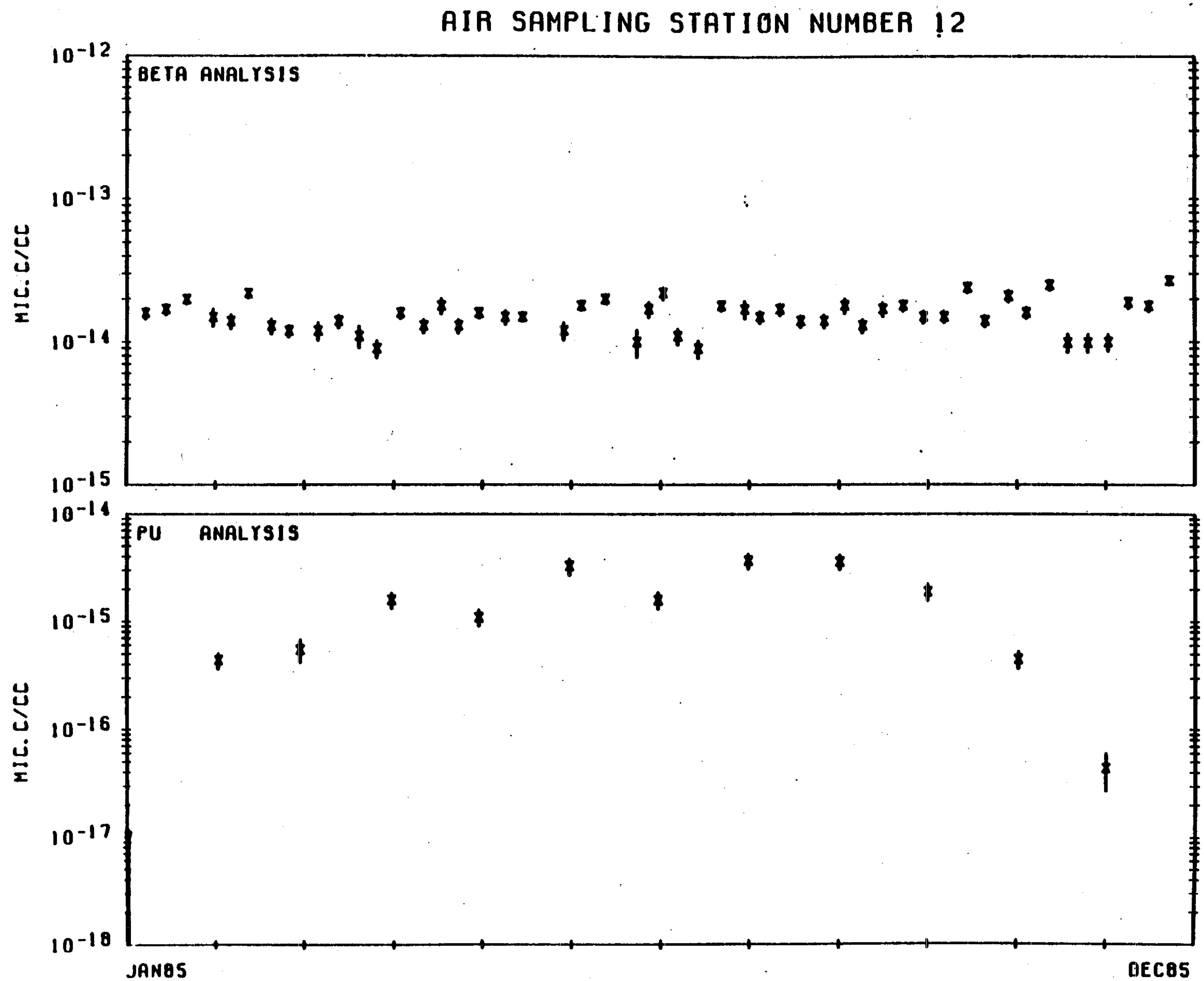
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MIC.C/CC
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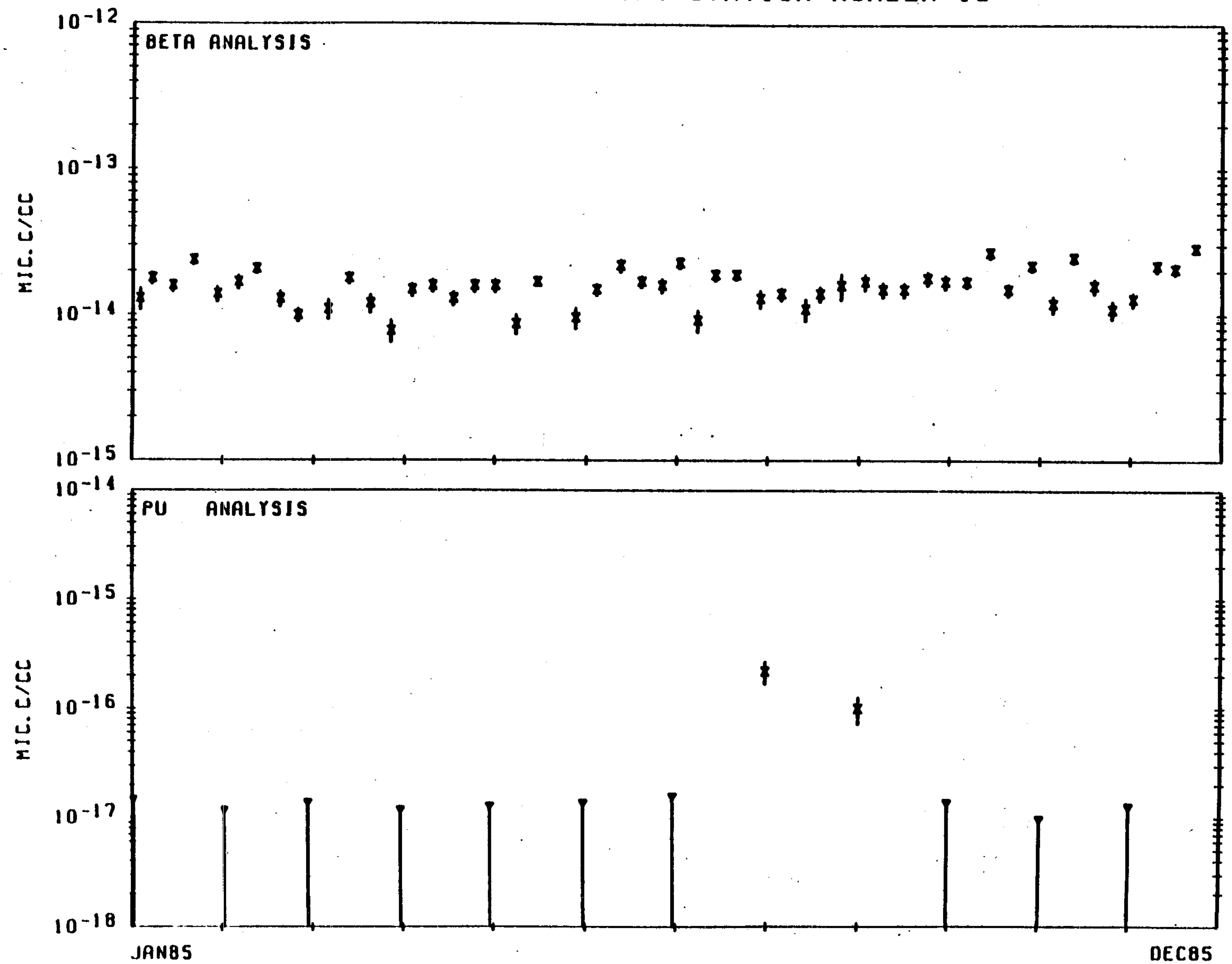
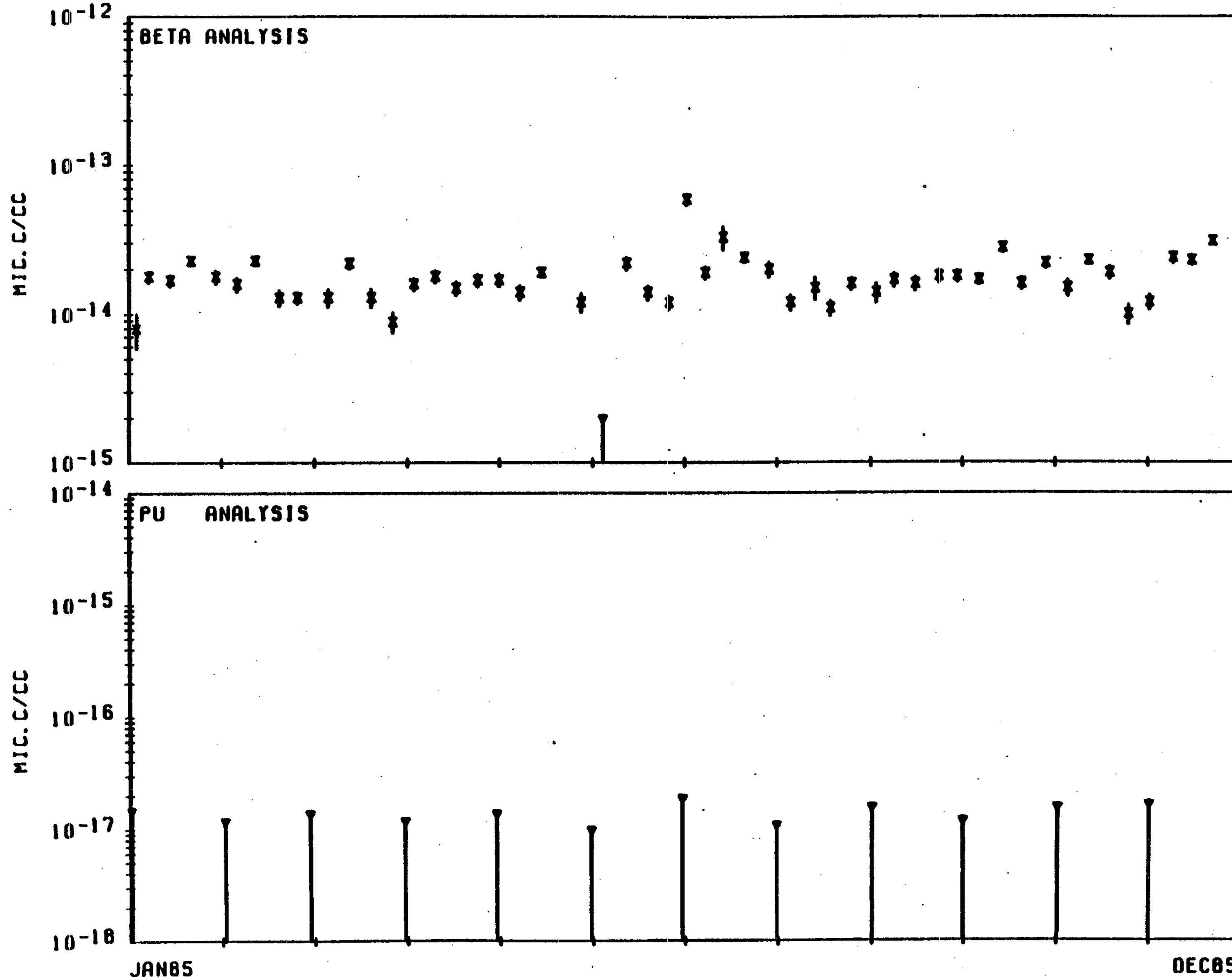
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85

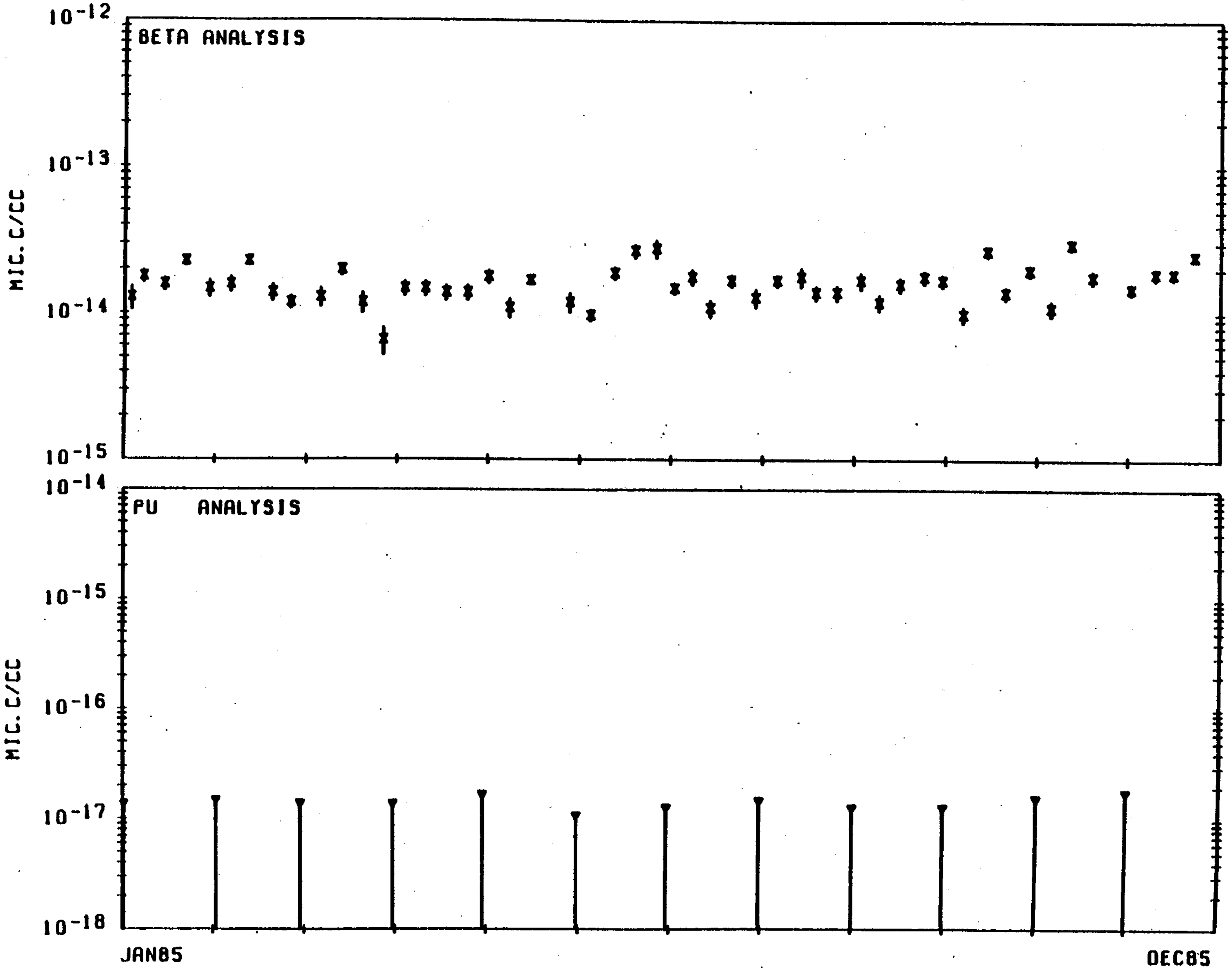
AIR SAMPLING STATION NUMBER 13

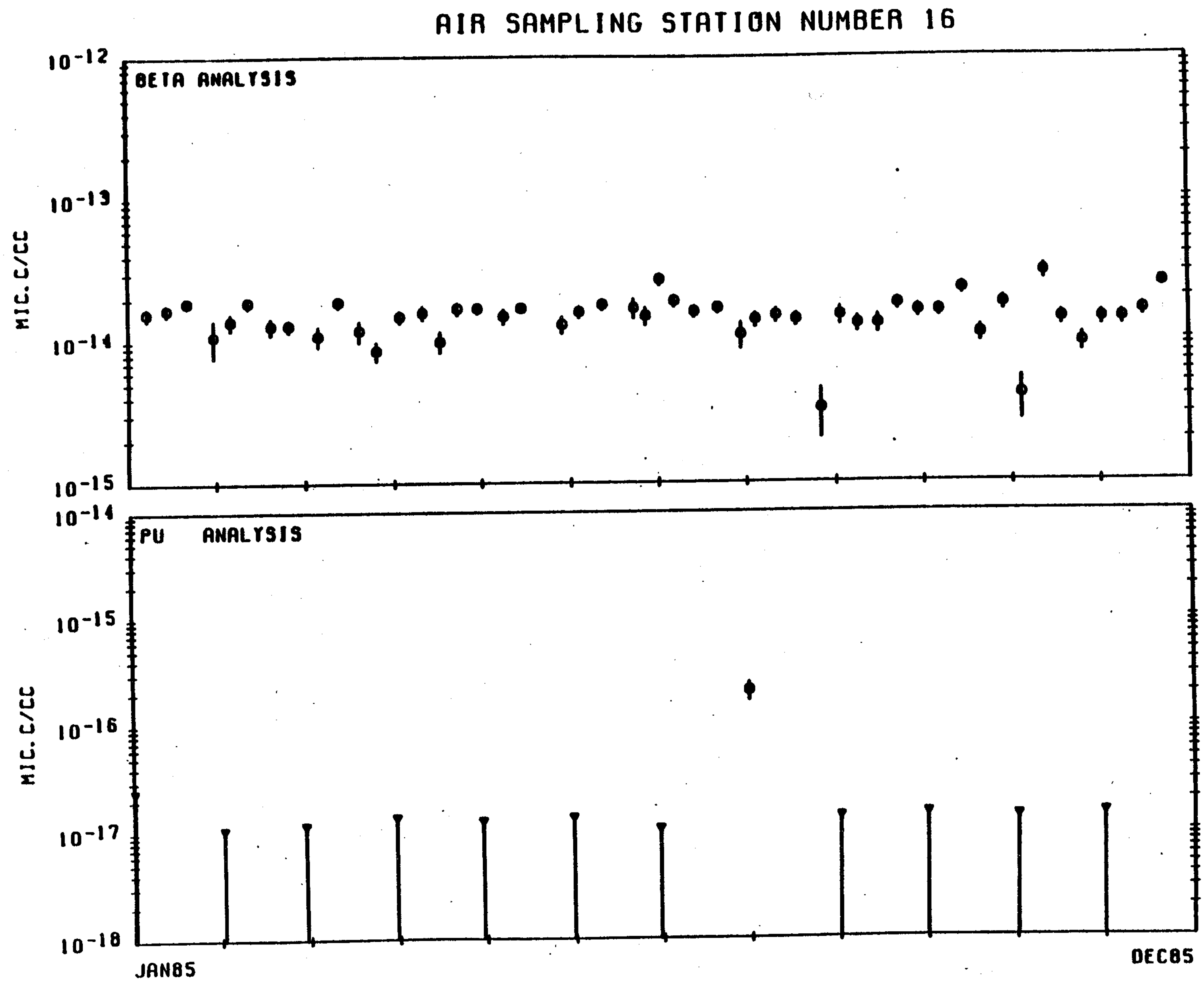


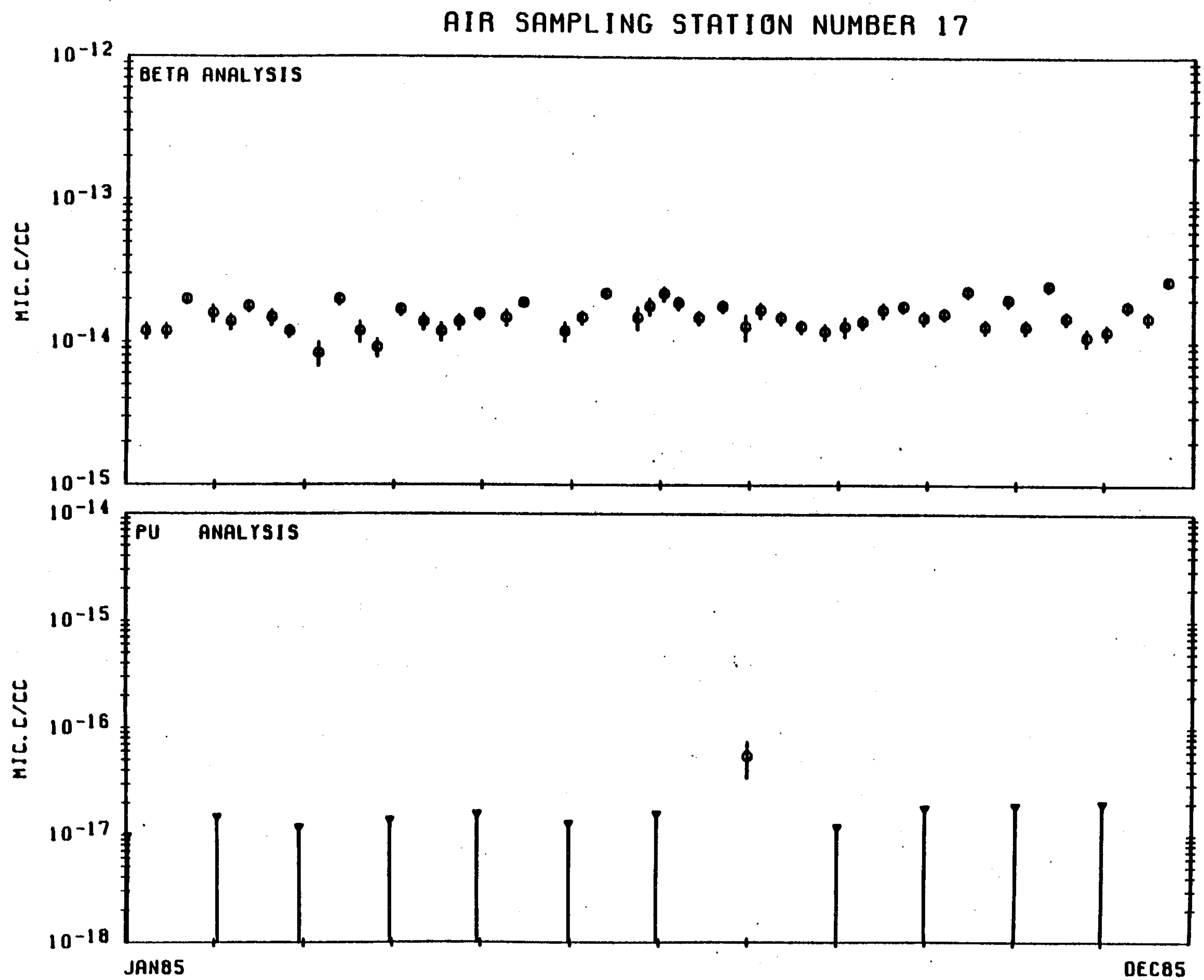
AIR SAMPLING STATION NUMBER 14



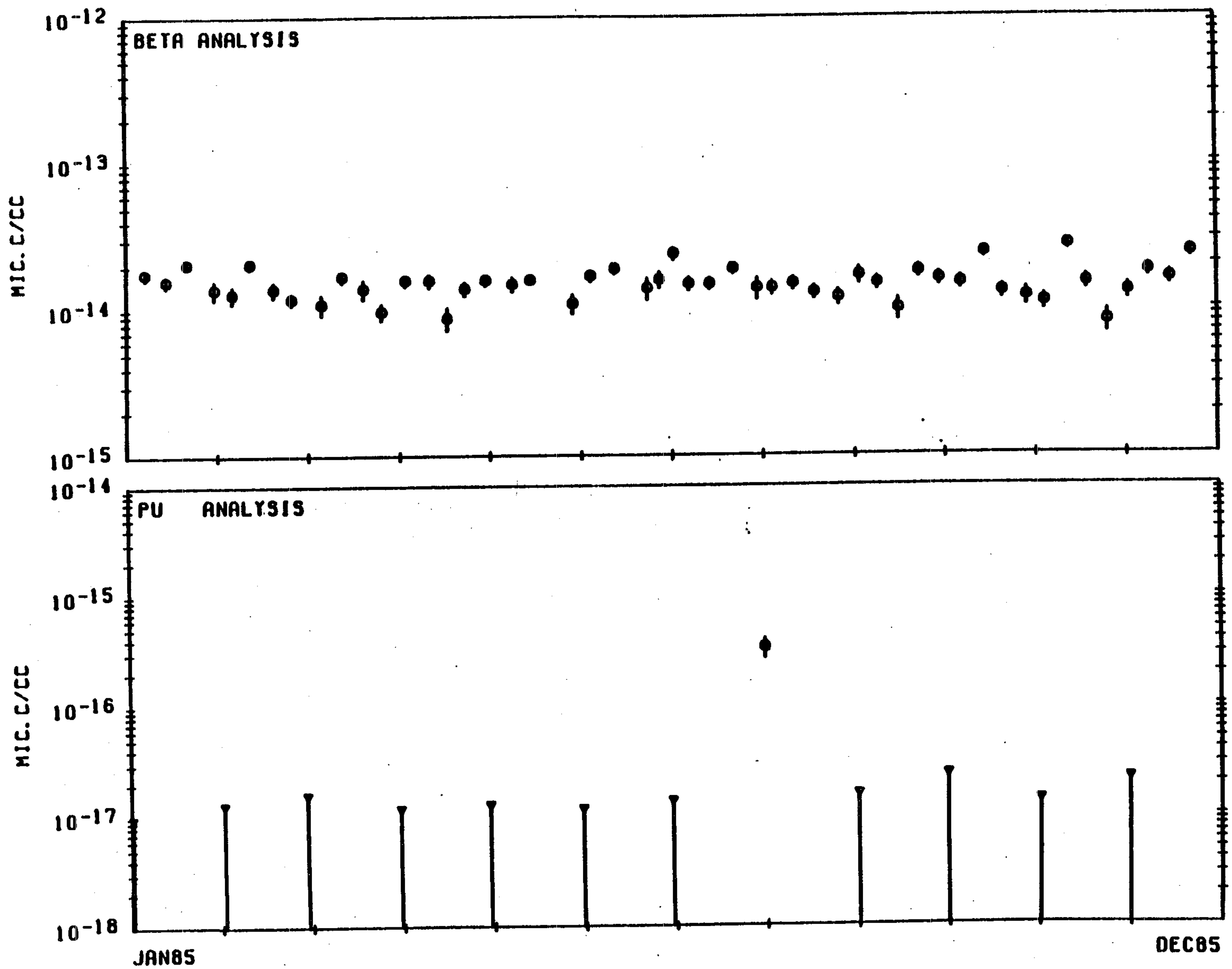
AIR SAMPLING STATION NUMBER 15



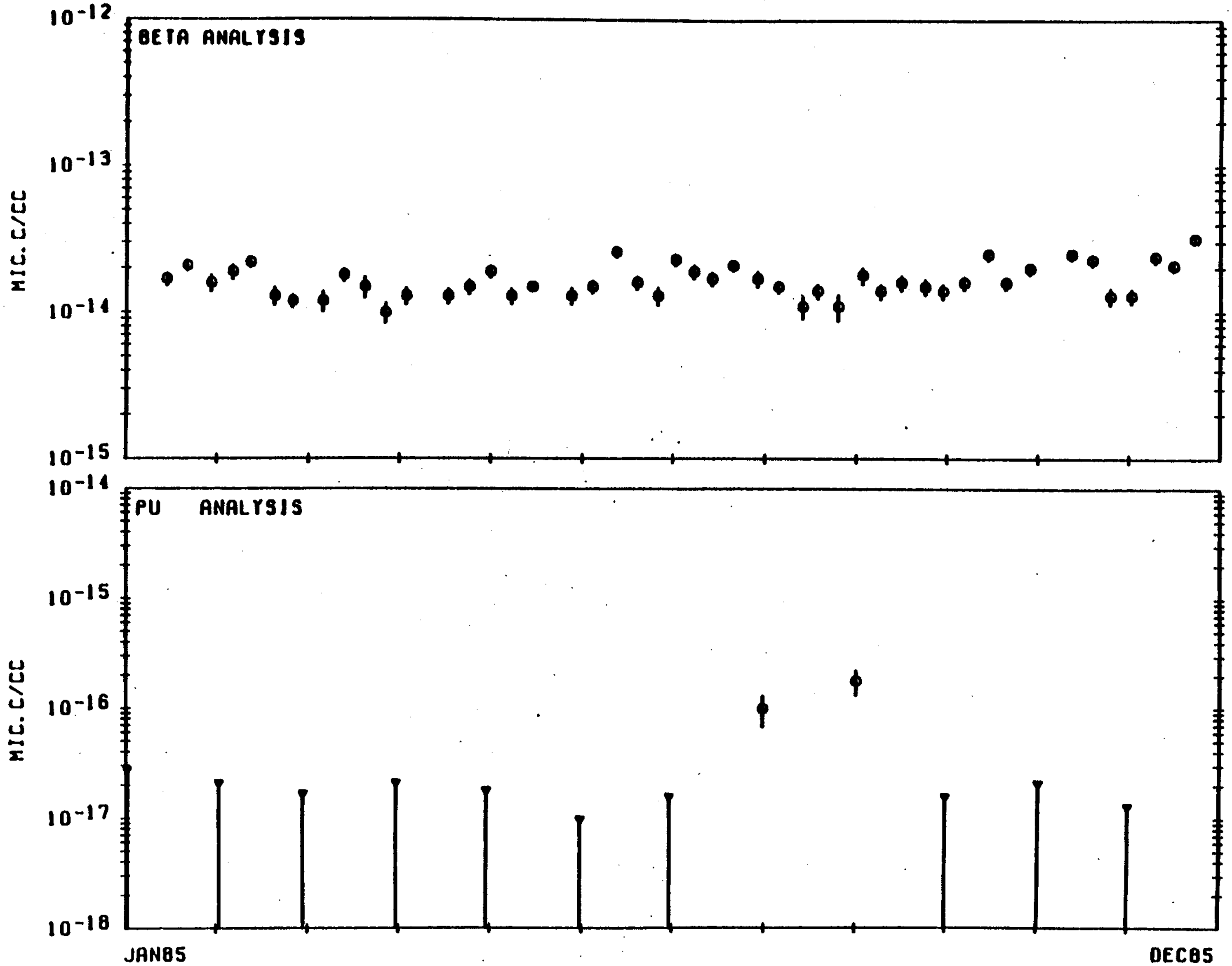

AIR SAMPLING STATION NUMBER 16
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85


AIR SAMPLING STATION NUMBER 17
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85

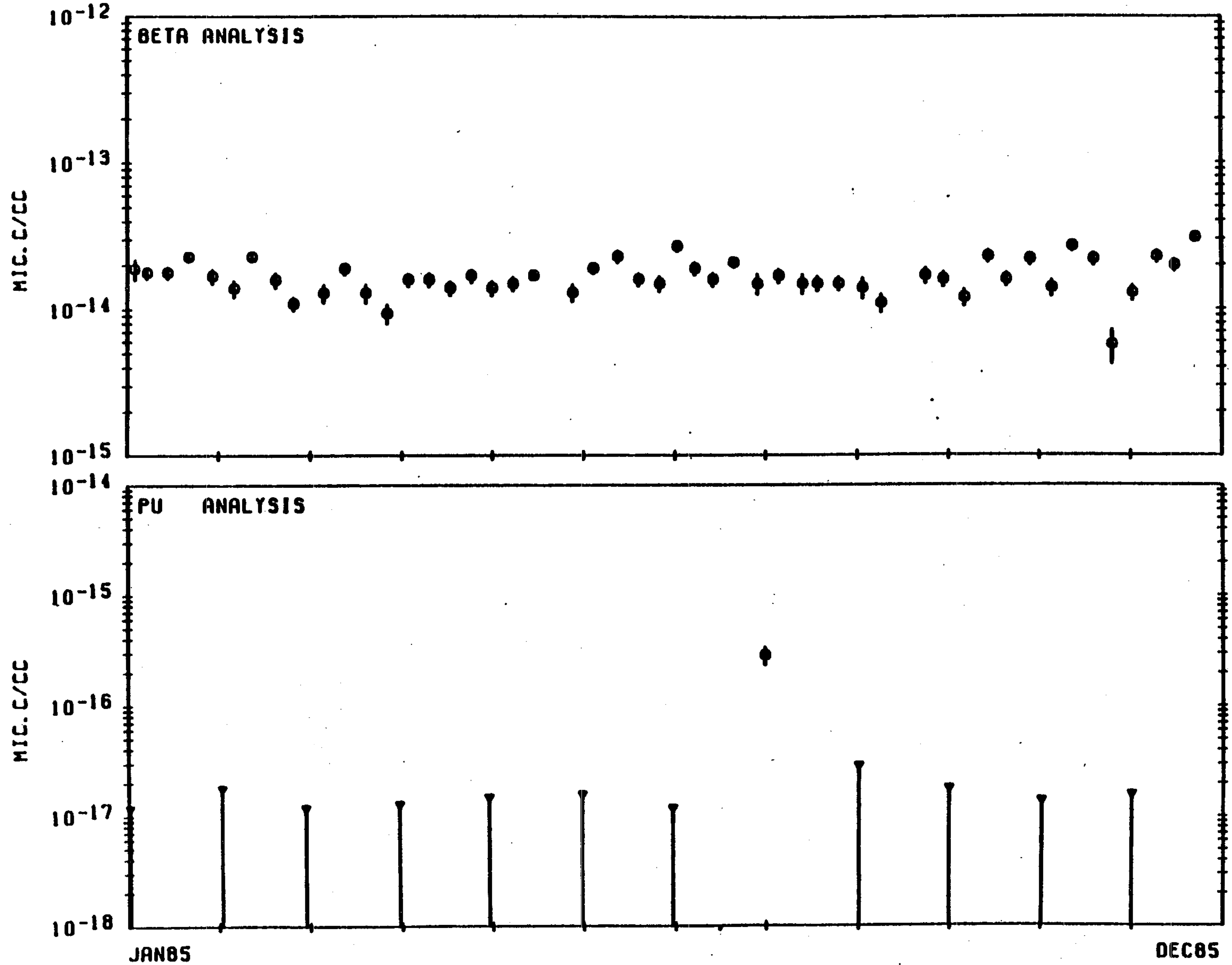
AIR SAMPLING STATION NUMBER 18

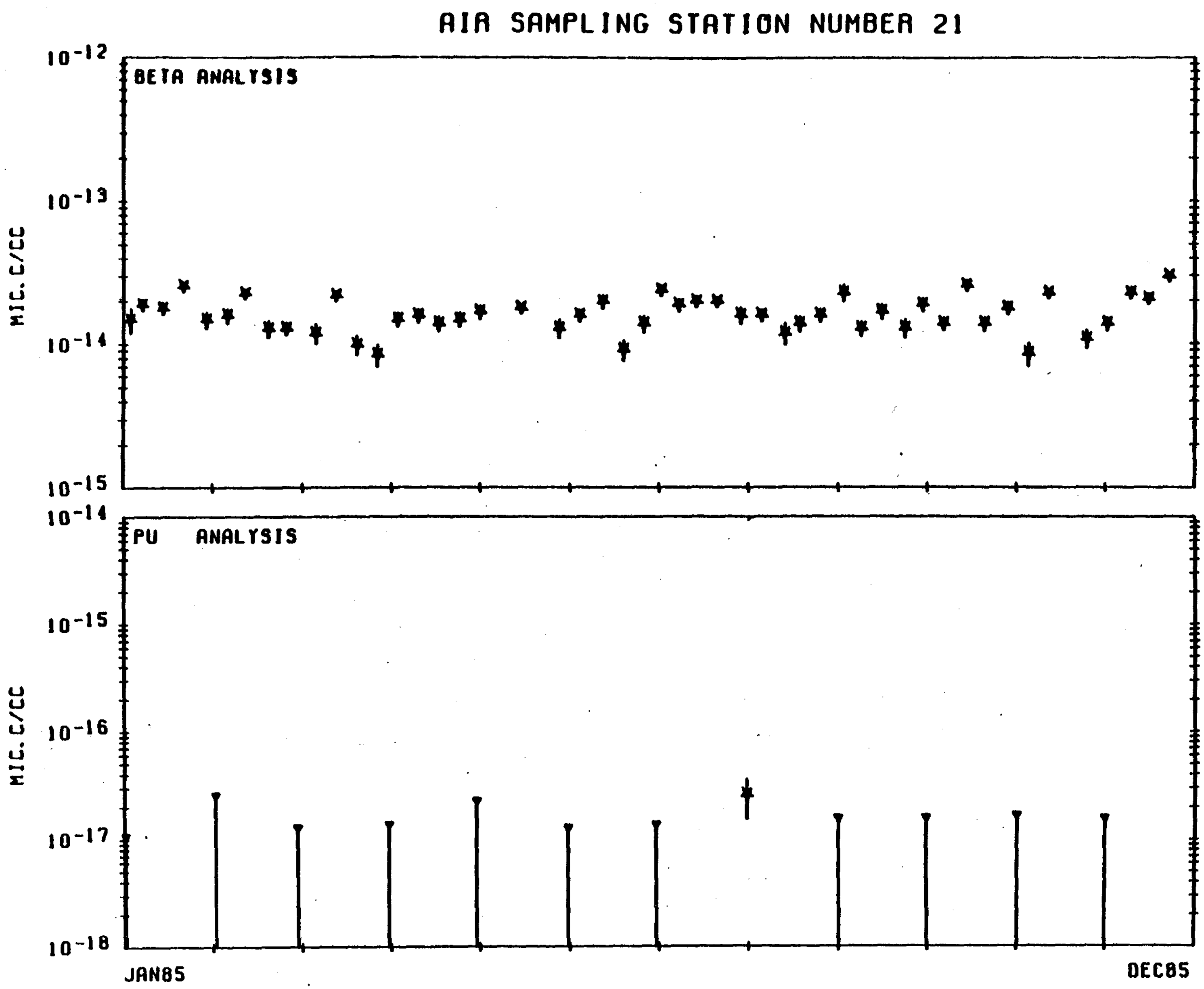


AIR SAMPLING STATION NUMBER 19

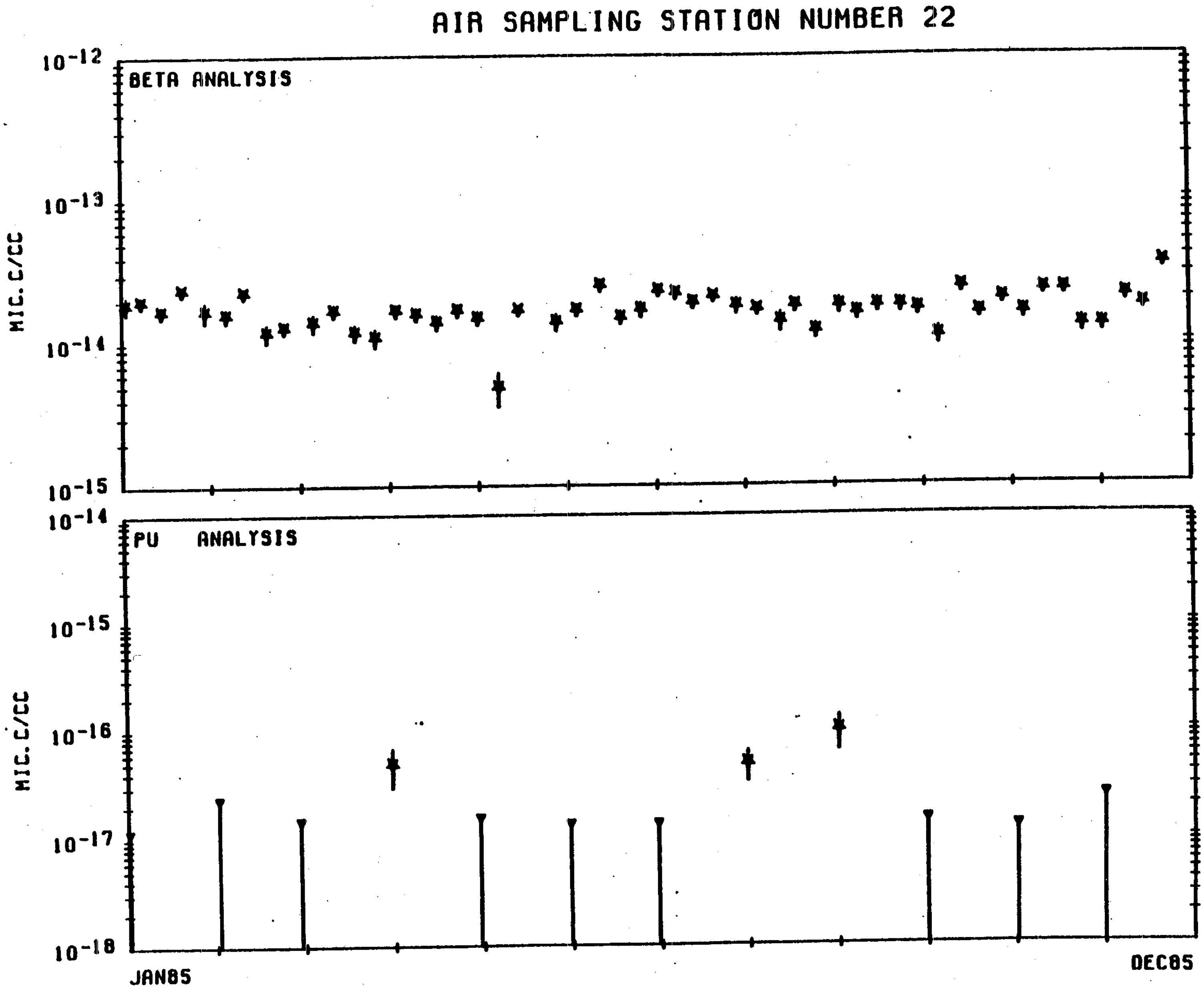


AIR SAMPLING STATION NUMBER 20



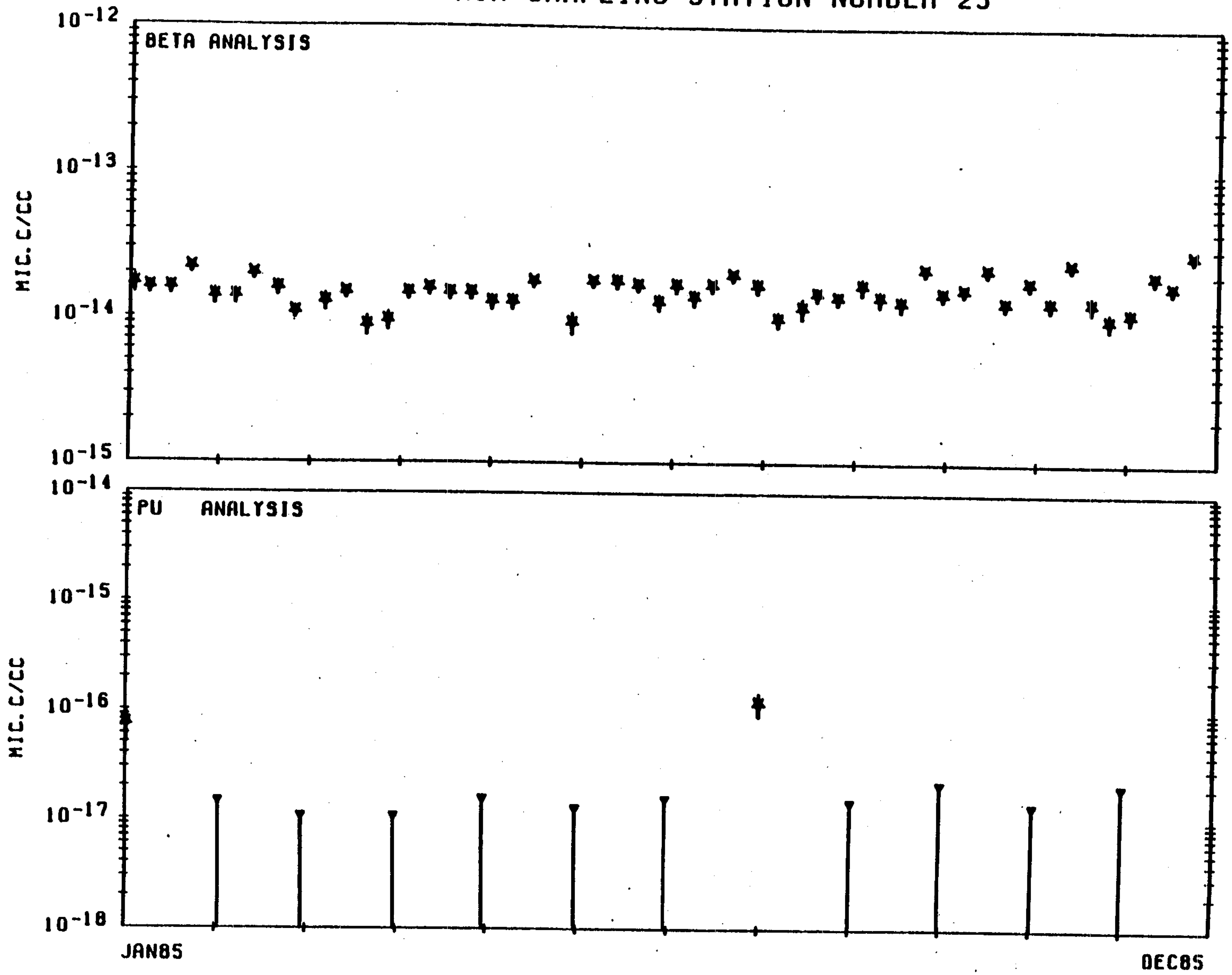


AIR SAMPLING STATION NUMBER 21
BETA ANALYSIS
PU ANALYSIS
MIC. C/CC
MIC. C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85

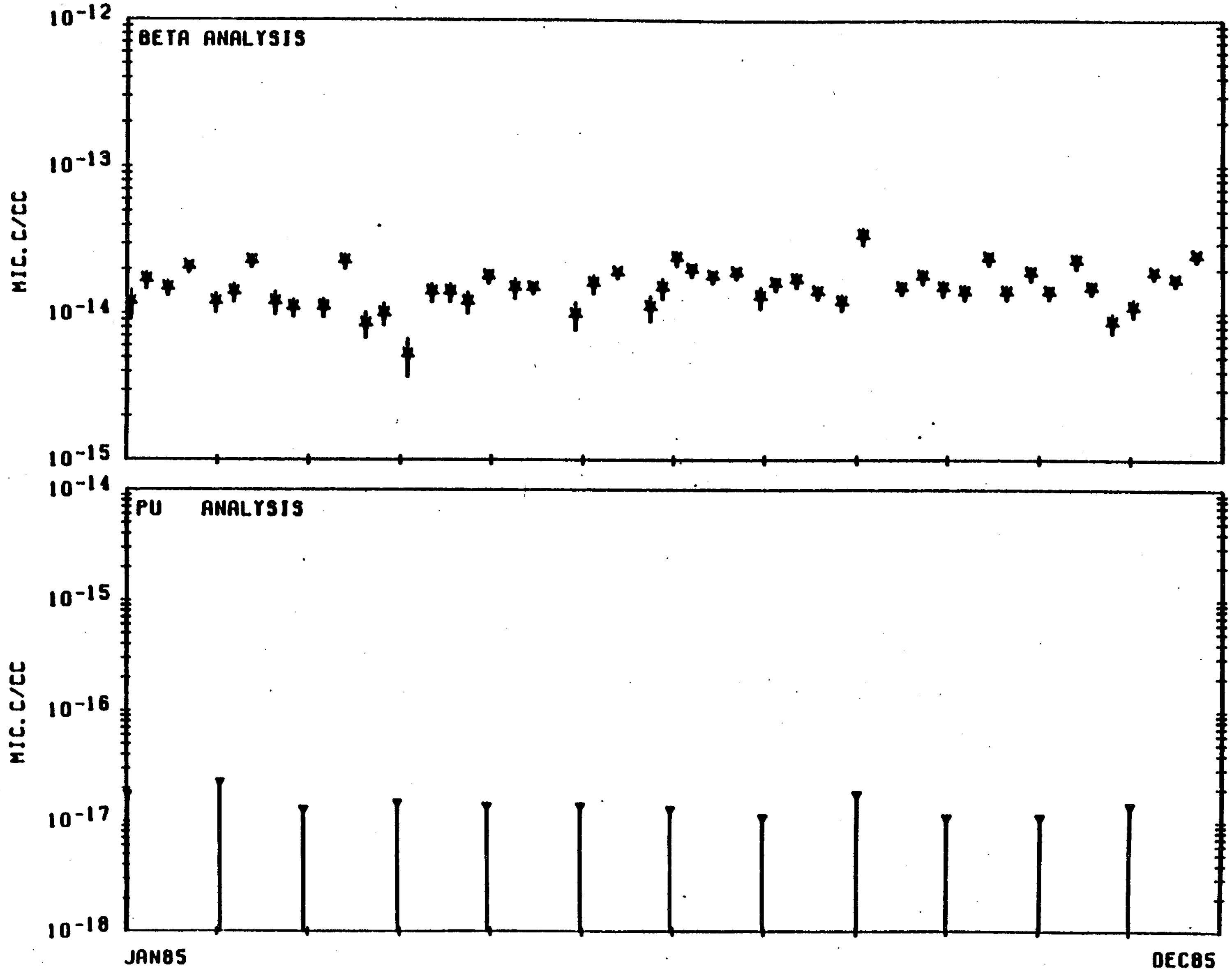


AIR SAMPLING STATION NUMBER 22
BETA ANALYSIS
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
PU ANALYSIS
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85

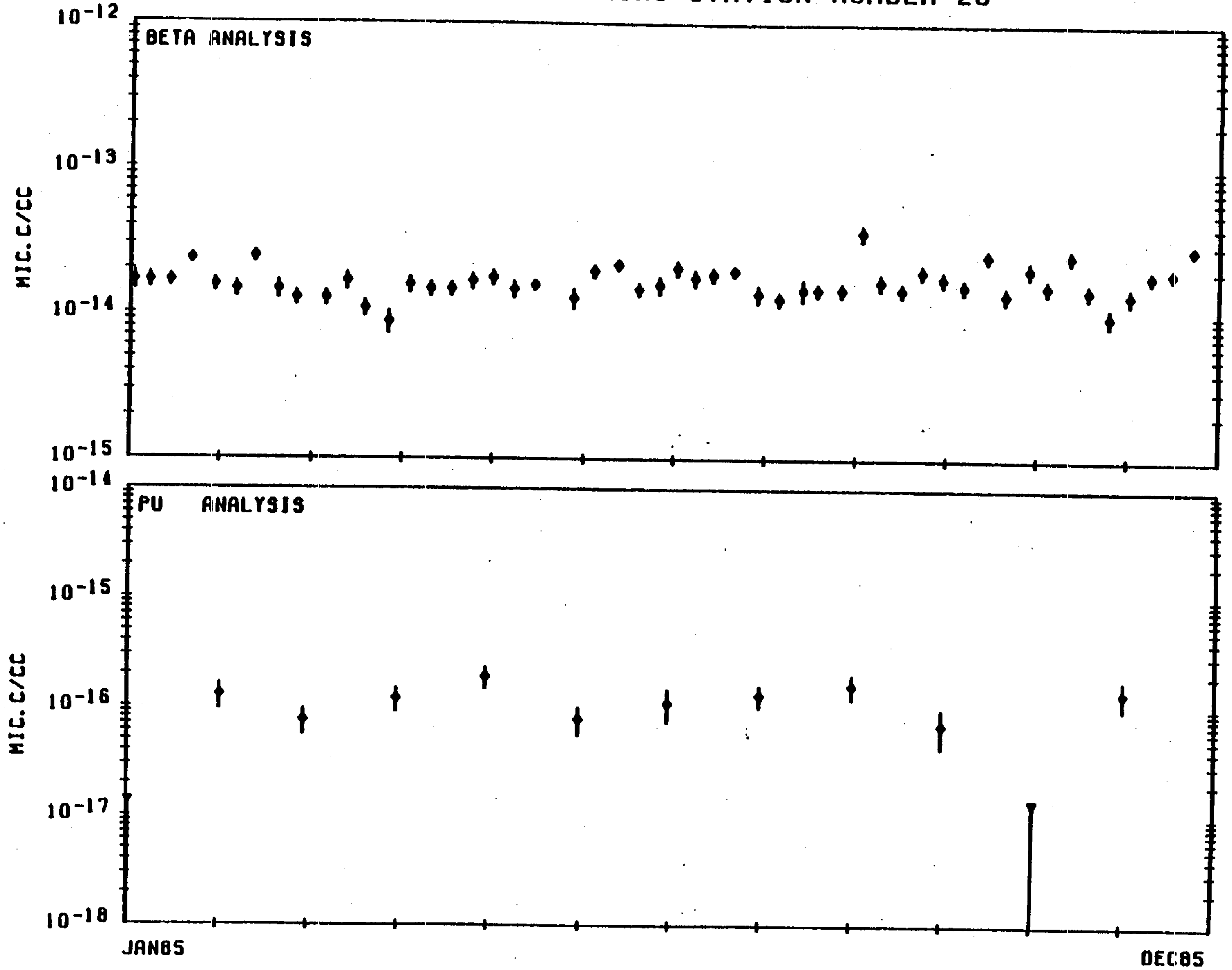
AIR SAMPLING STATION NUMBER 23



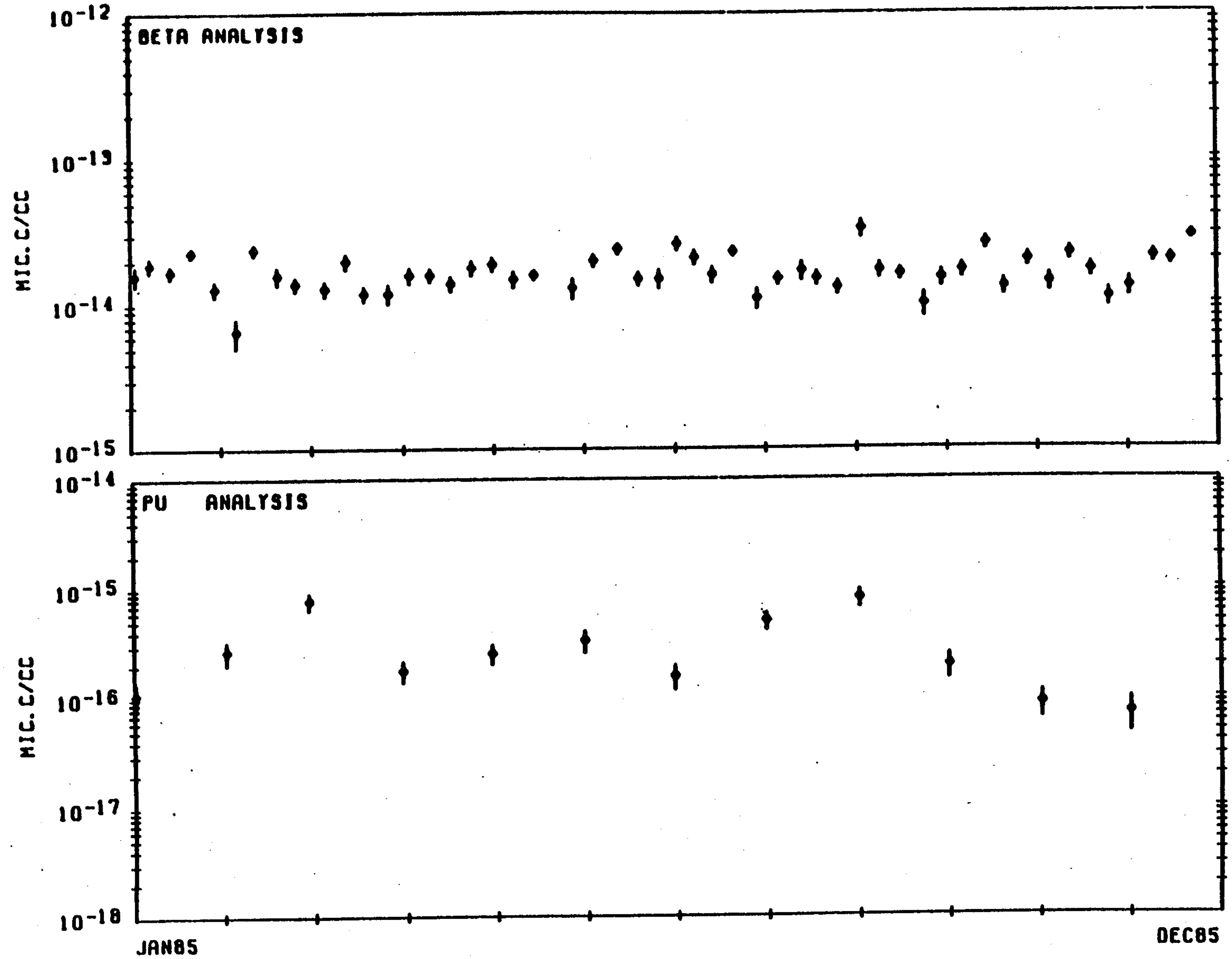
AIR SAMPLING STATION NUMBER 25



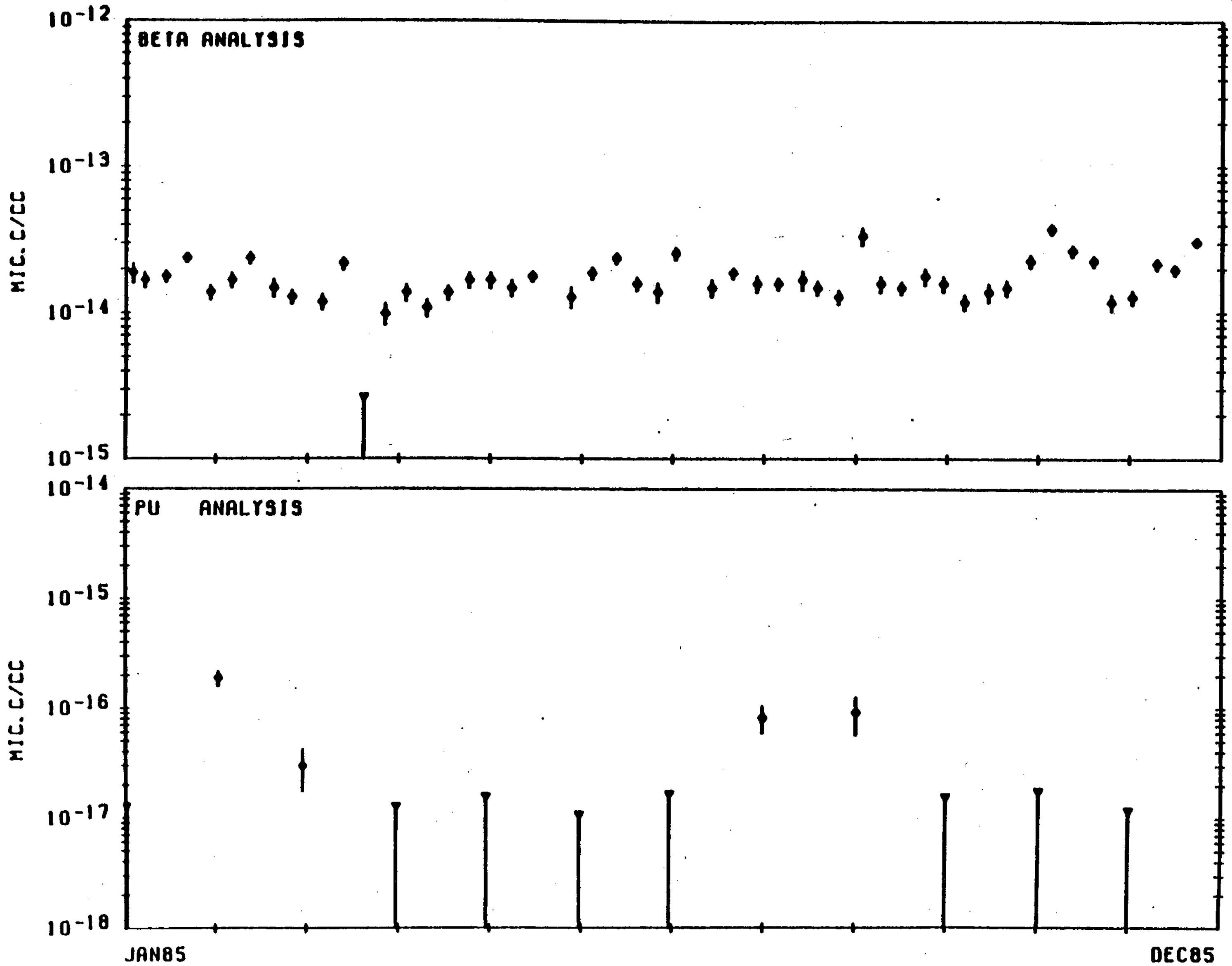
AIR SAMPLING STATION NUMBER 26

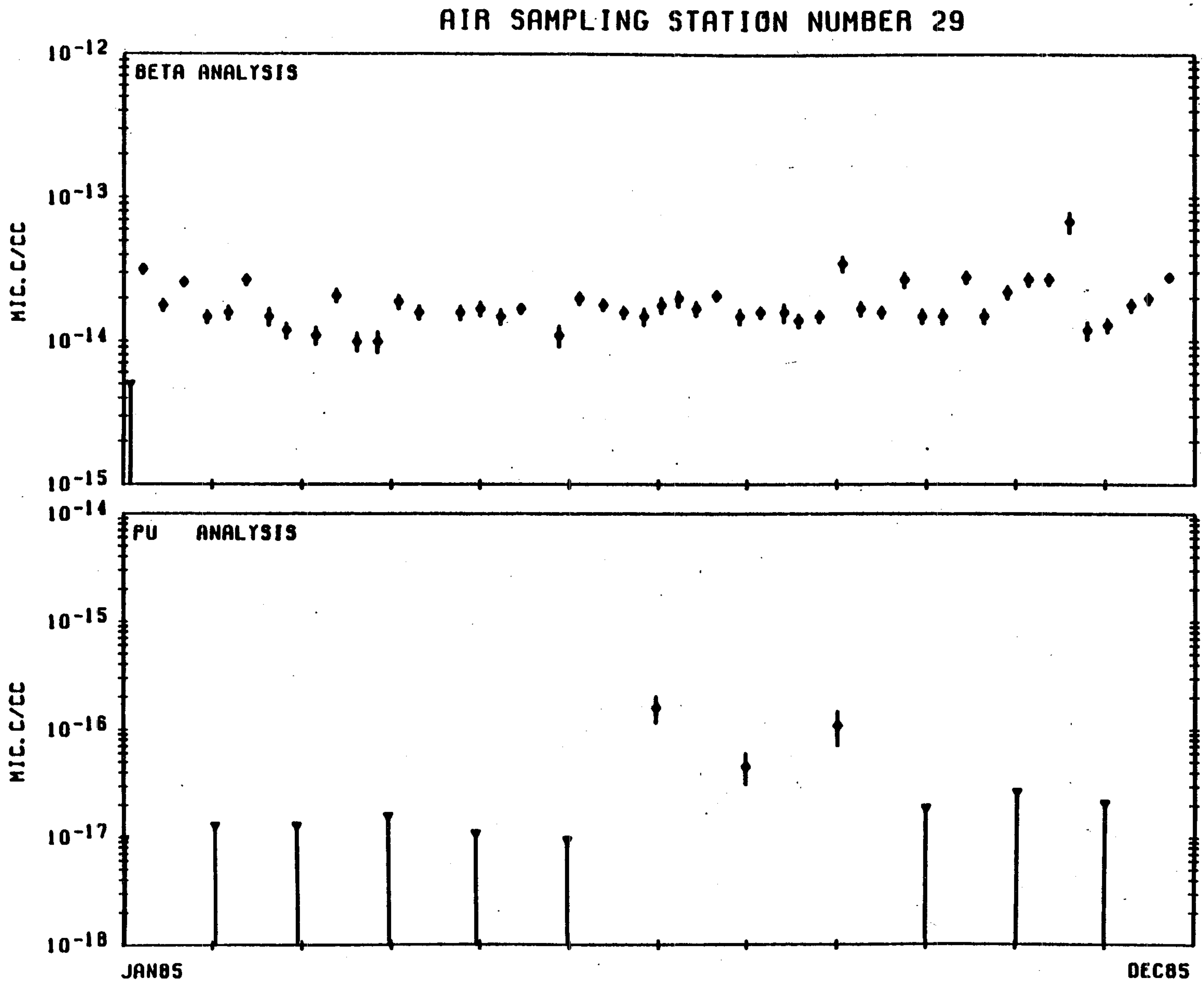


AIR SAMPLING STATION NUMBER 27

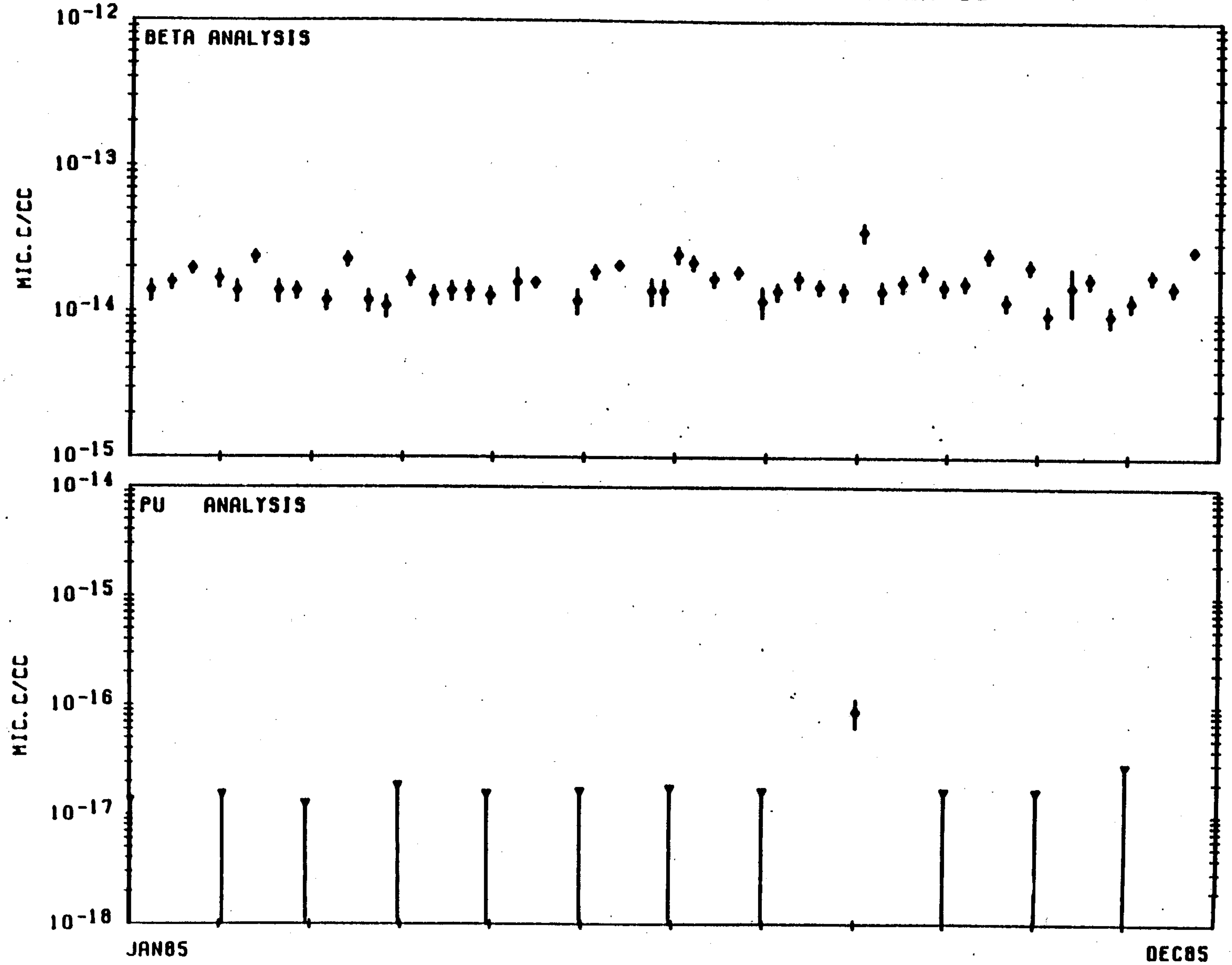


AIR SAMPLING STATION NUMBER 28

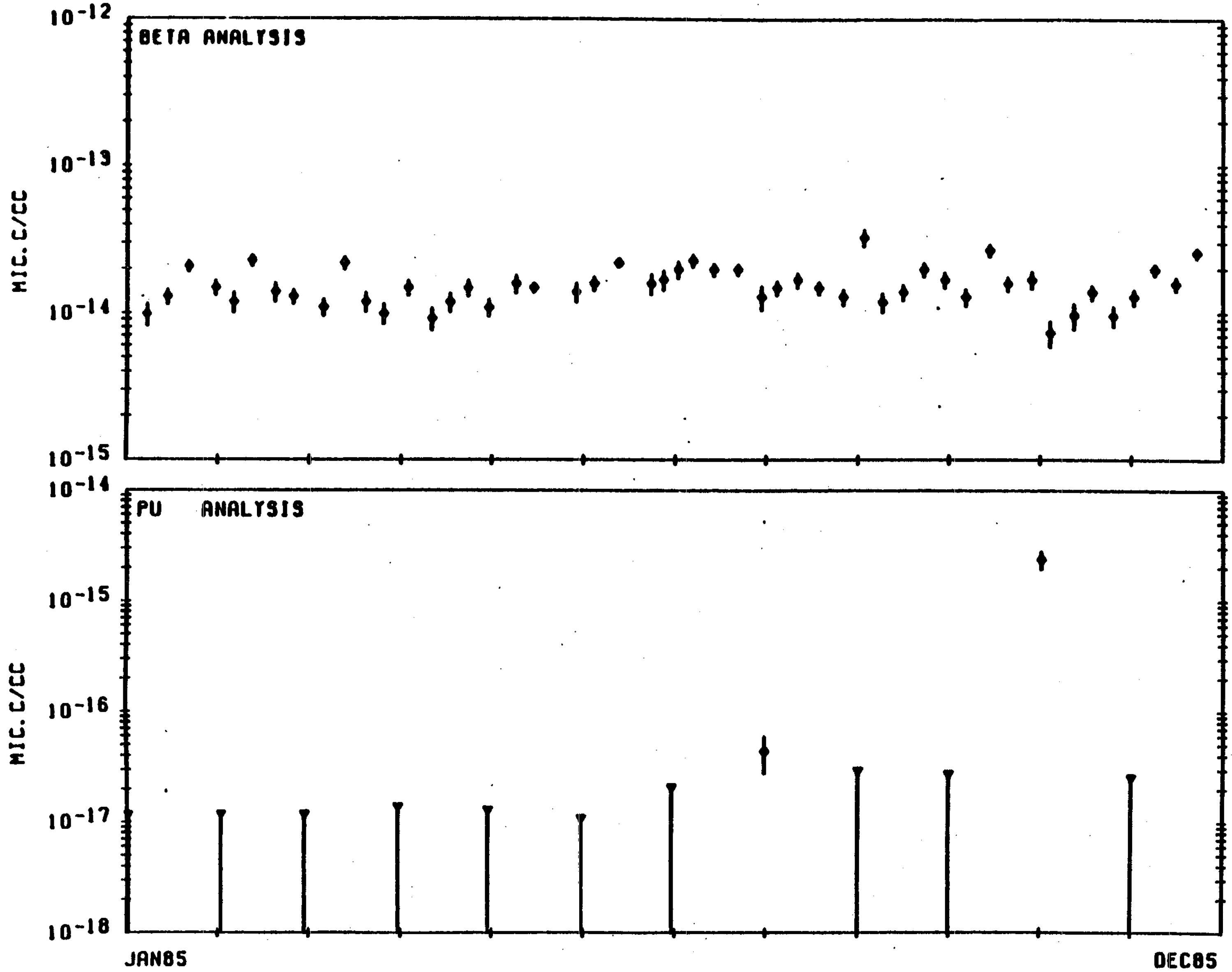



AIR SAMPLING STATION NUMBER 29
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85

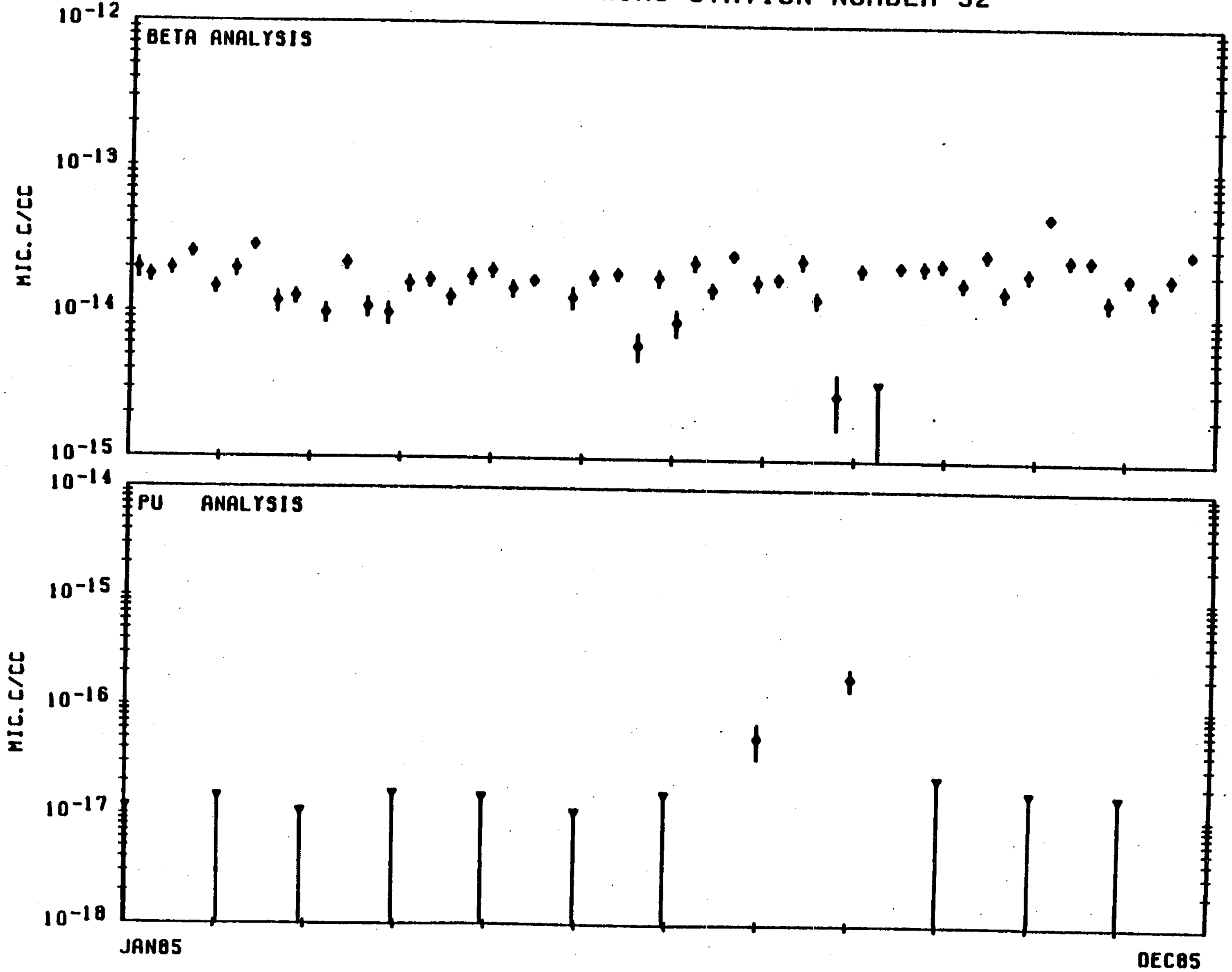
AIR SAMPLING STATION NUMBER 30



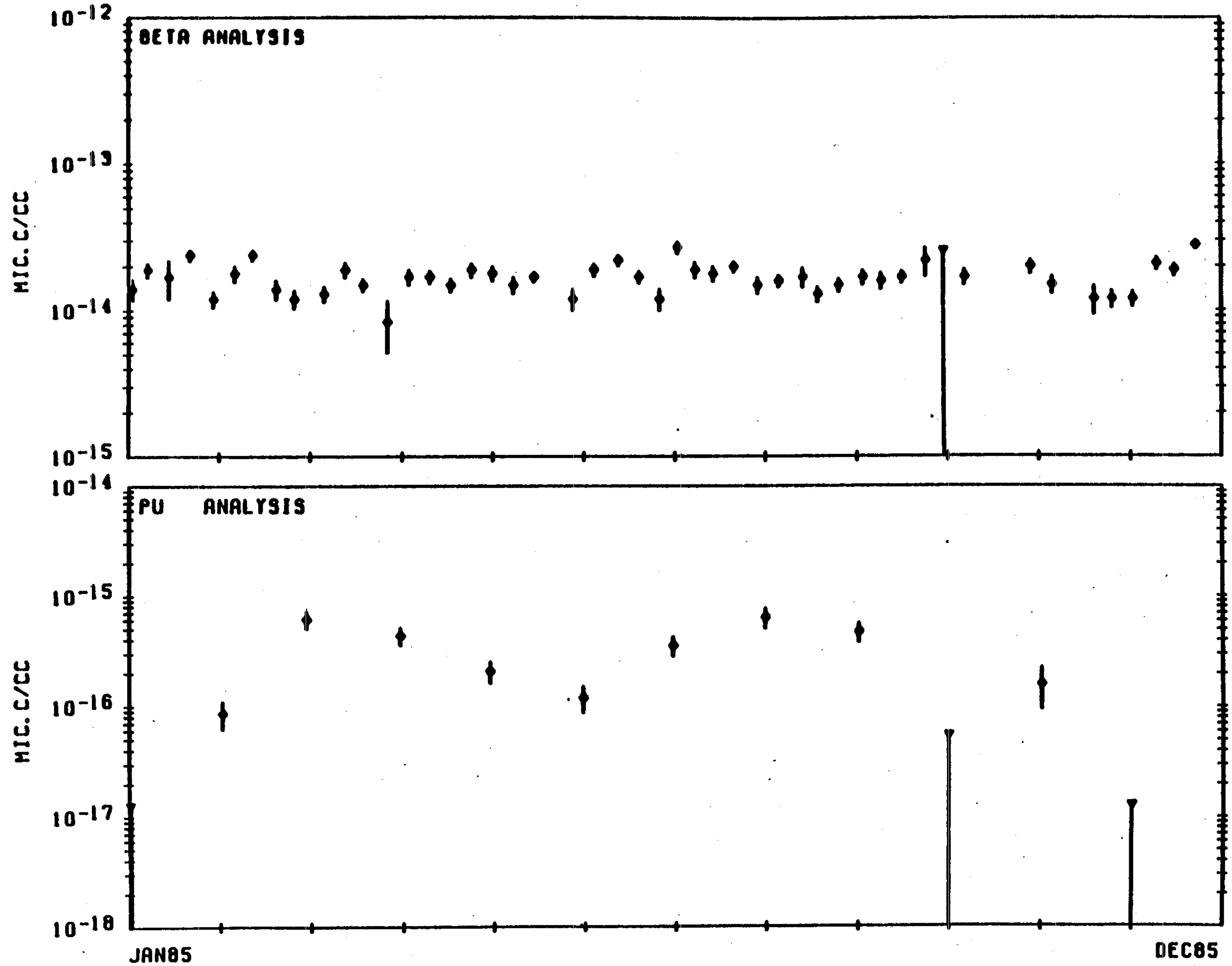
AIR SAMPLING STATION NUMBER 31



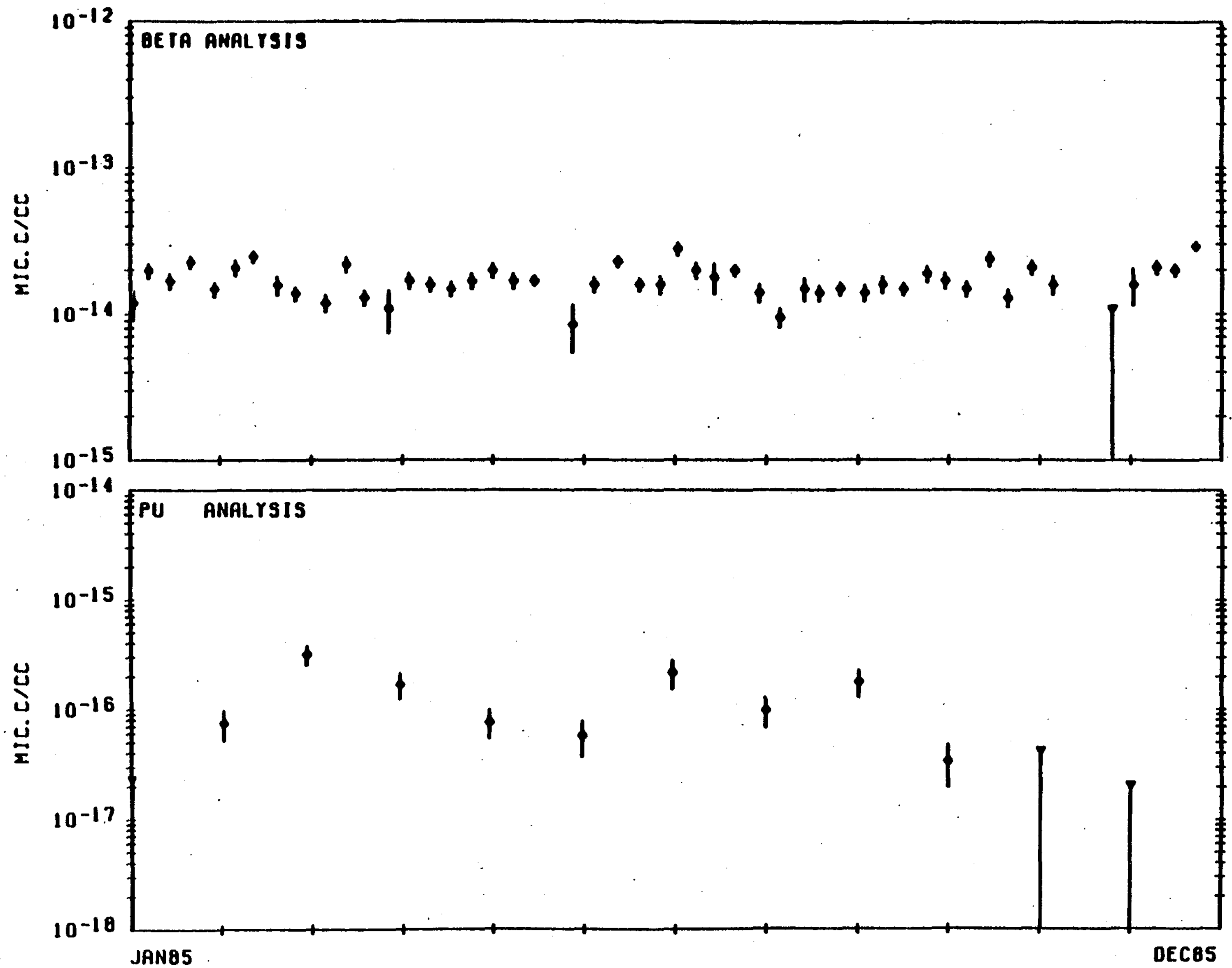
AIR SAMPLING STATION NUMBER 32

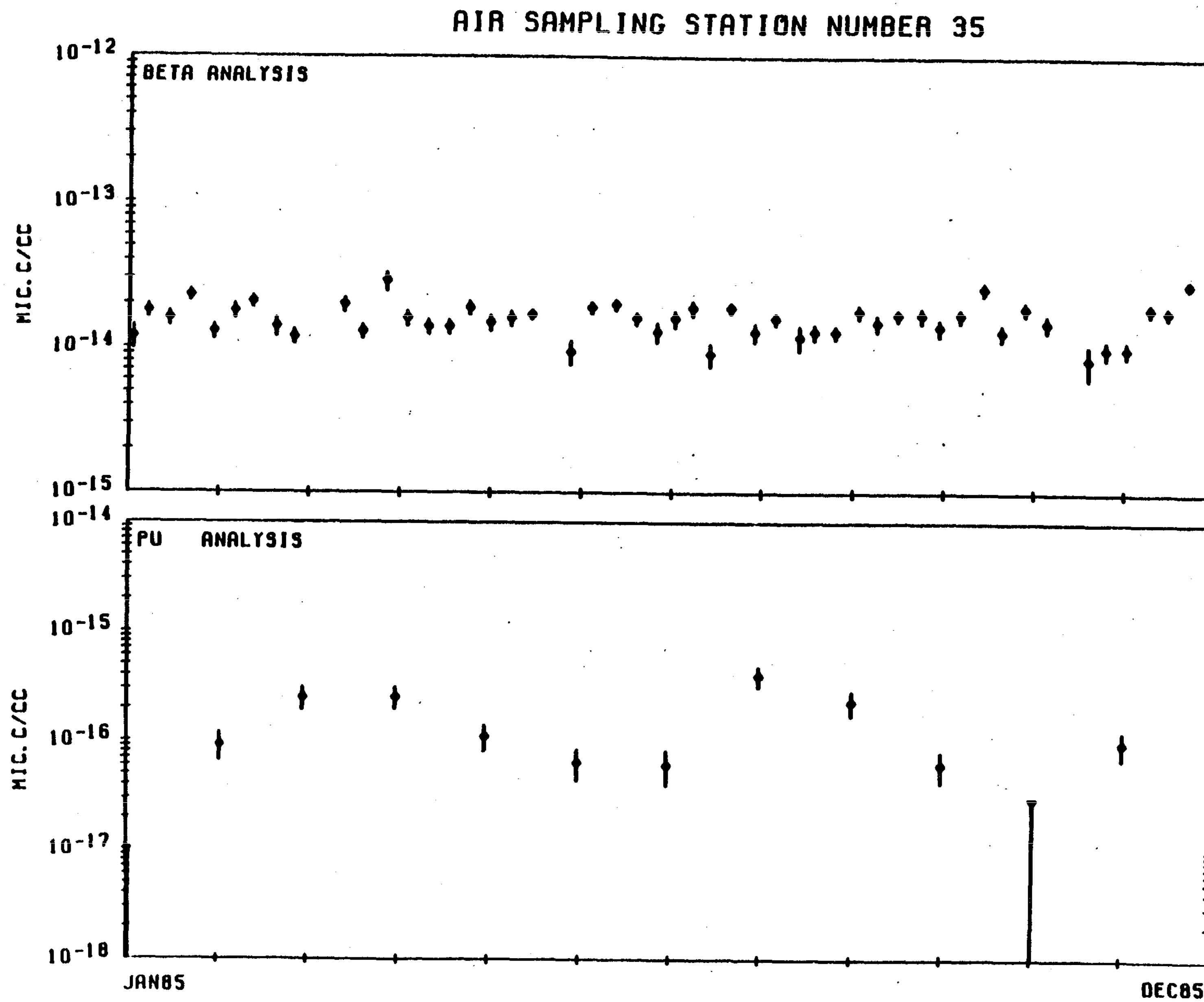


AIR SAMPLING STATION NUMBER 33

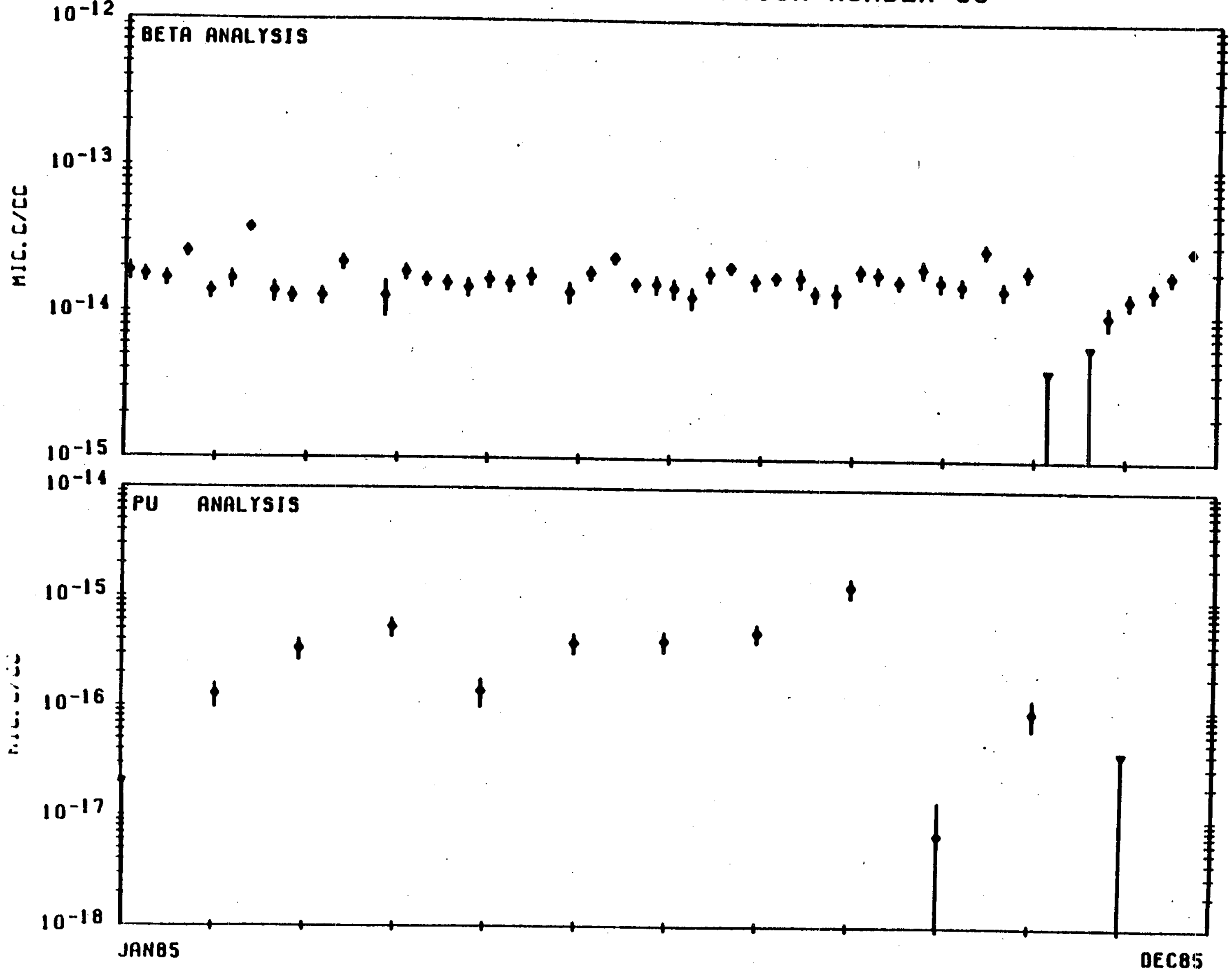


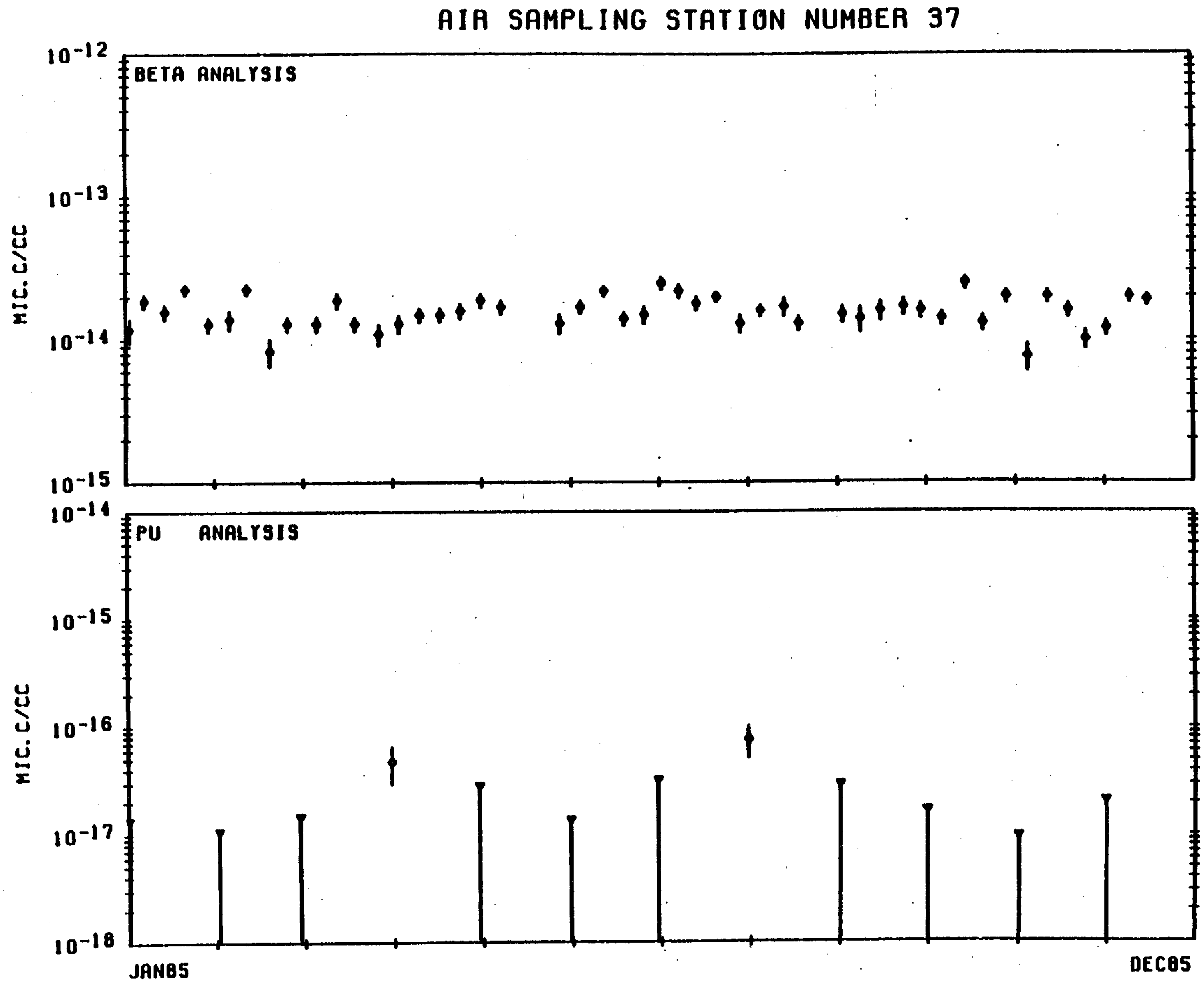
AIR SAMPLING STATION NUMBER 34



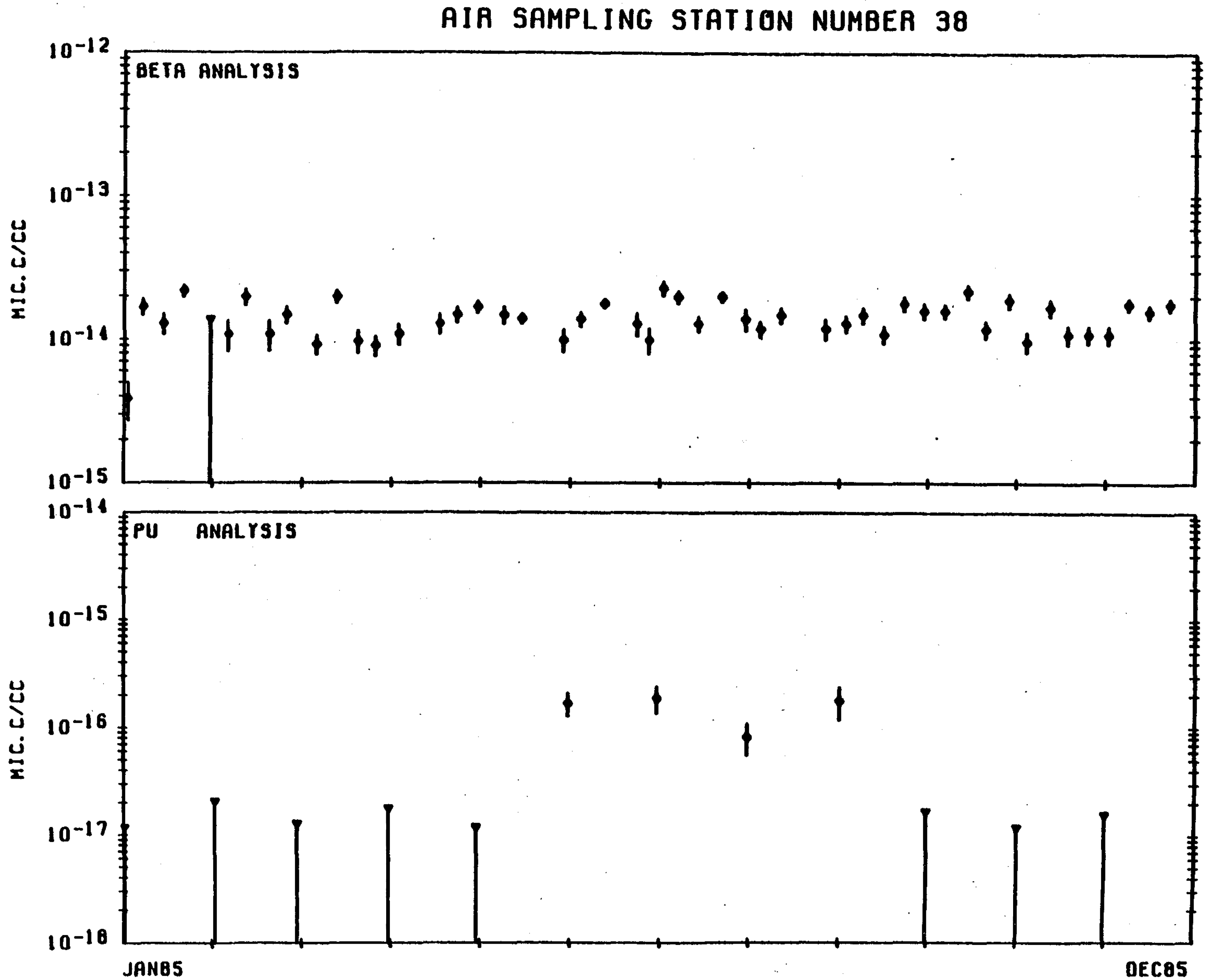

AIR SAMPLING STATION NUMBER 35
BETA ANALYSIS
10^{-12}
10^{-13}
10^{-14}
10^{-15}
MIC.C/CC
PU ANALYSIS
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
MIC.C/CC
JAN85
DEC85

AIR SAMPLING STATION NUMBER 36

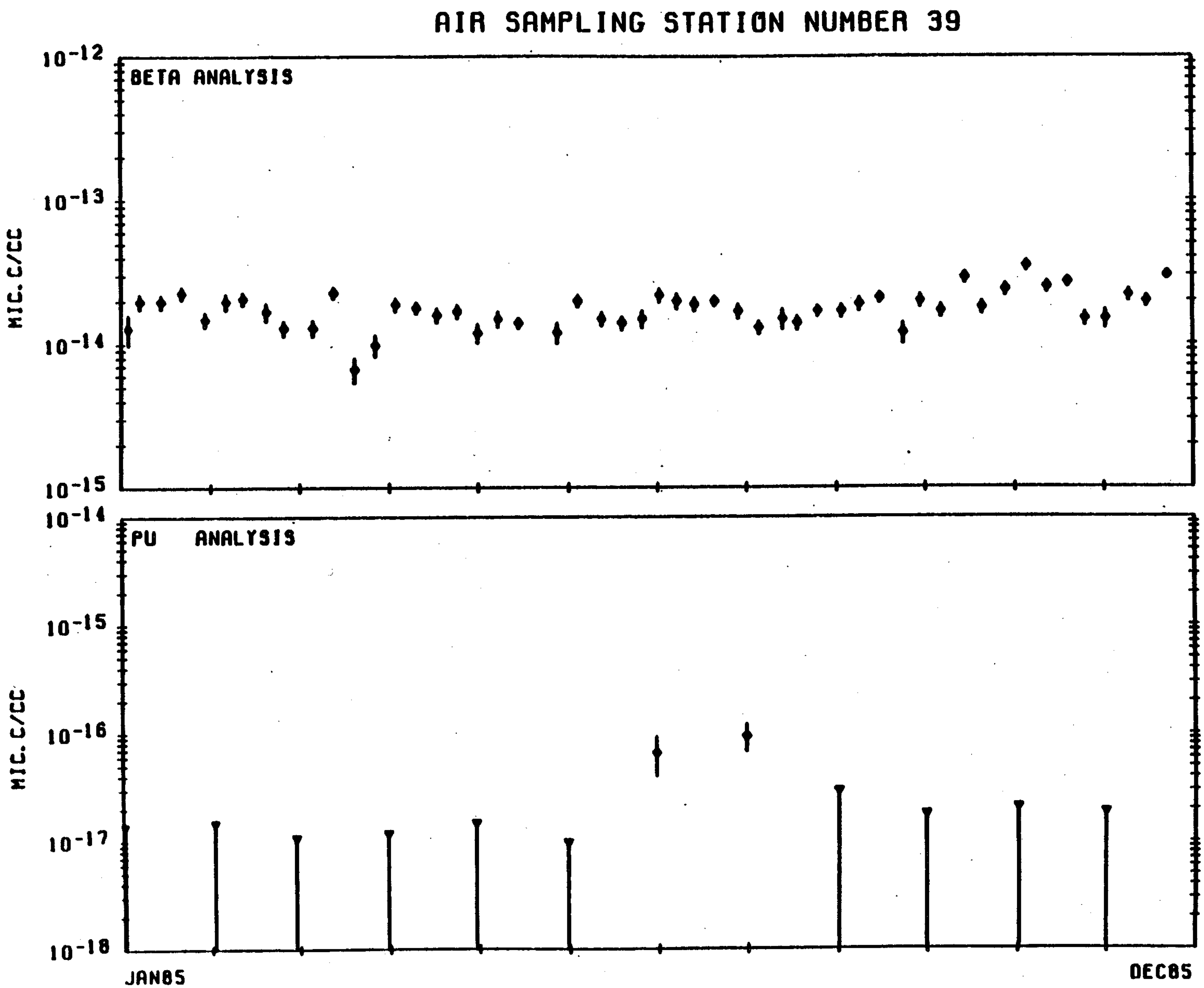




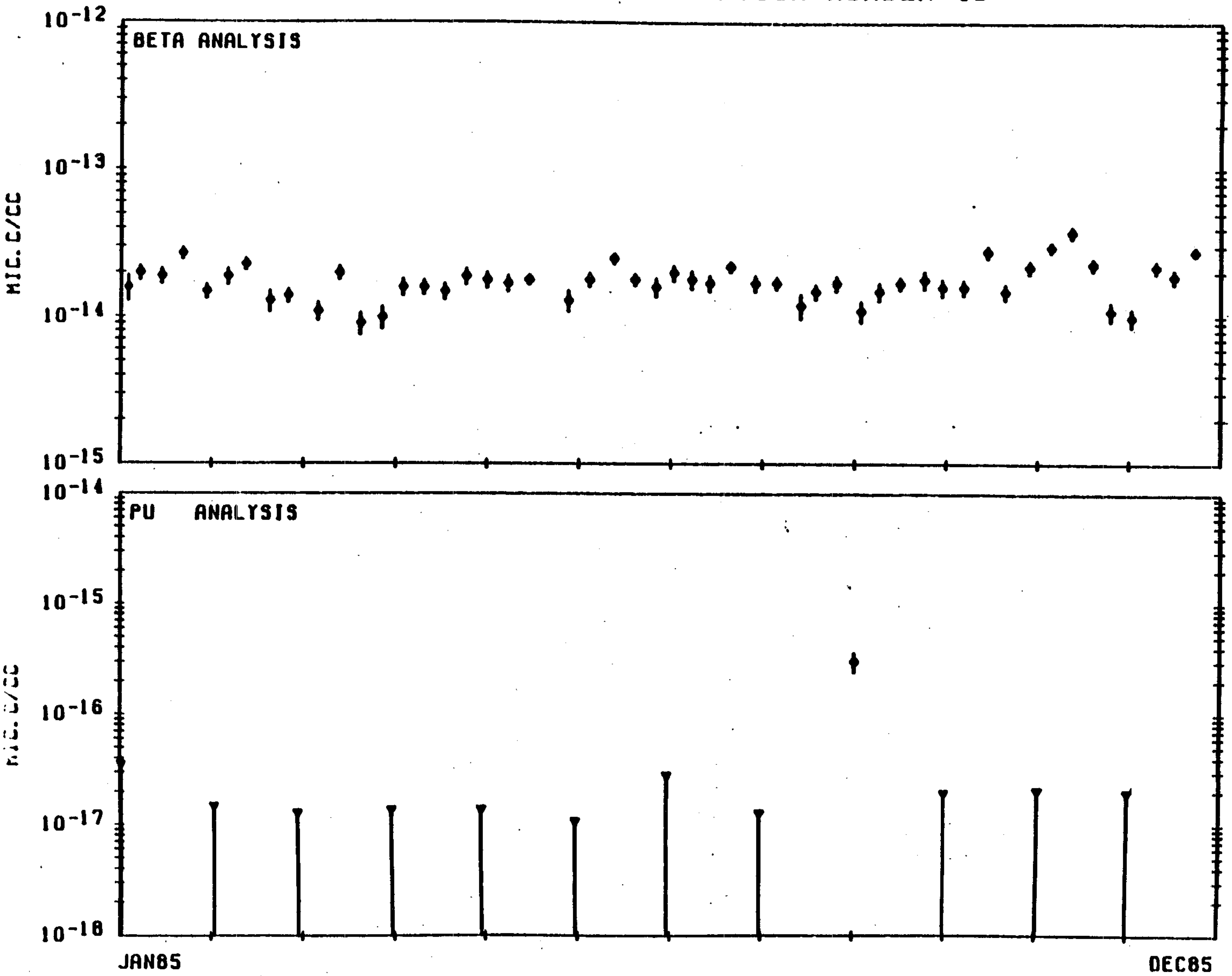
AIR SAMPLING STATION NUMBER 37
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85


AIR SAMPLING STATION NUMBER 38
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10-12
10-13
10-14
10-15
10-14
10-15
10-16
10-17
10-18
JAN85
DEC85

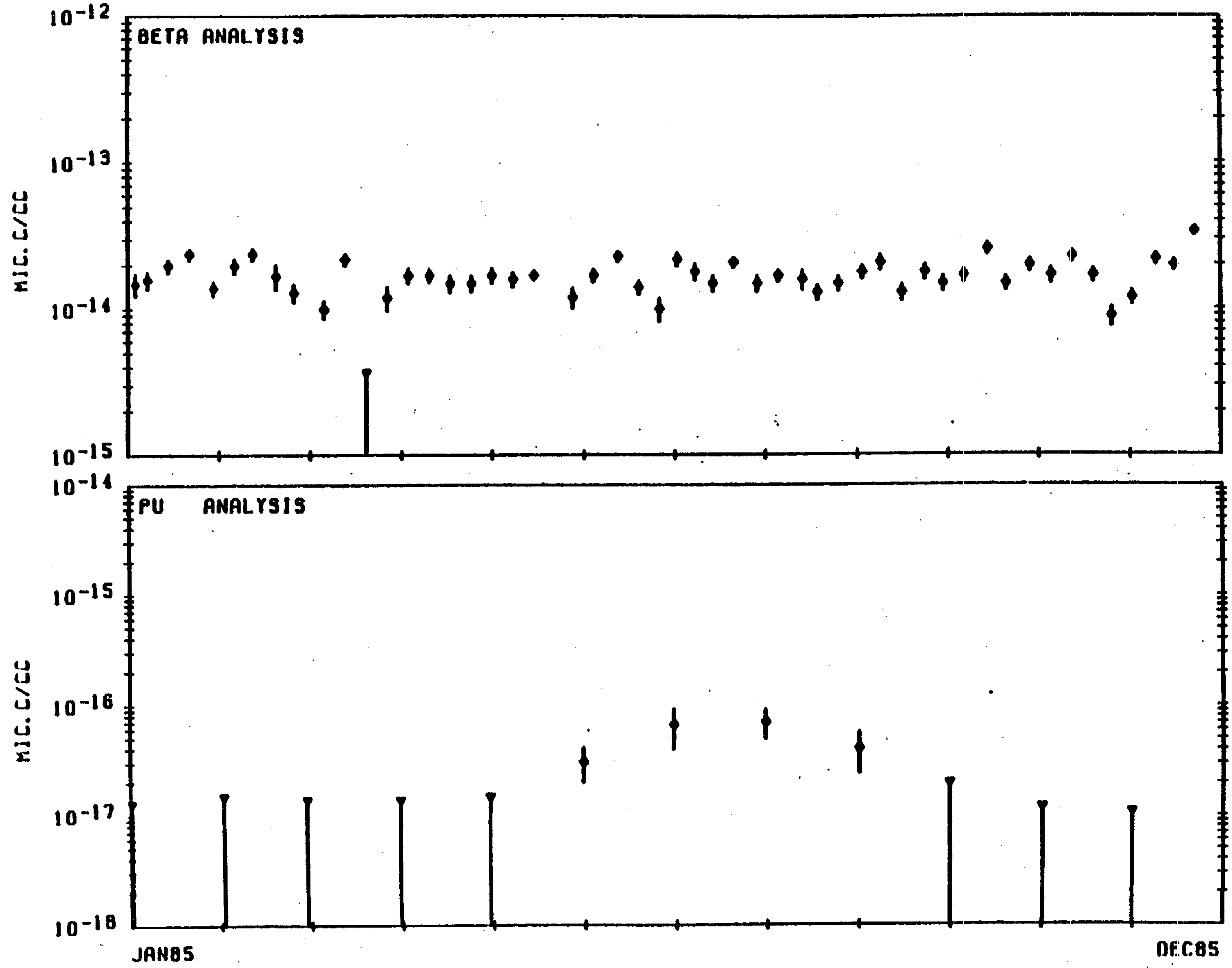
-119-

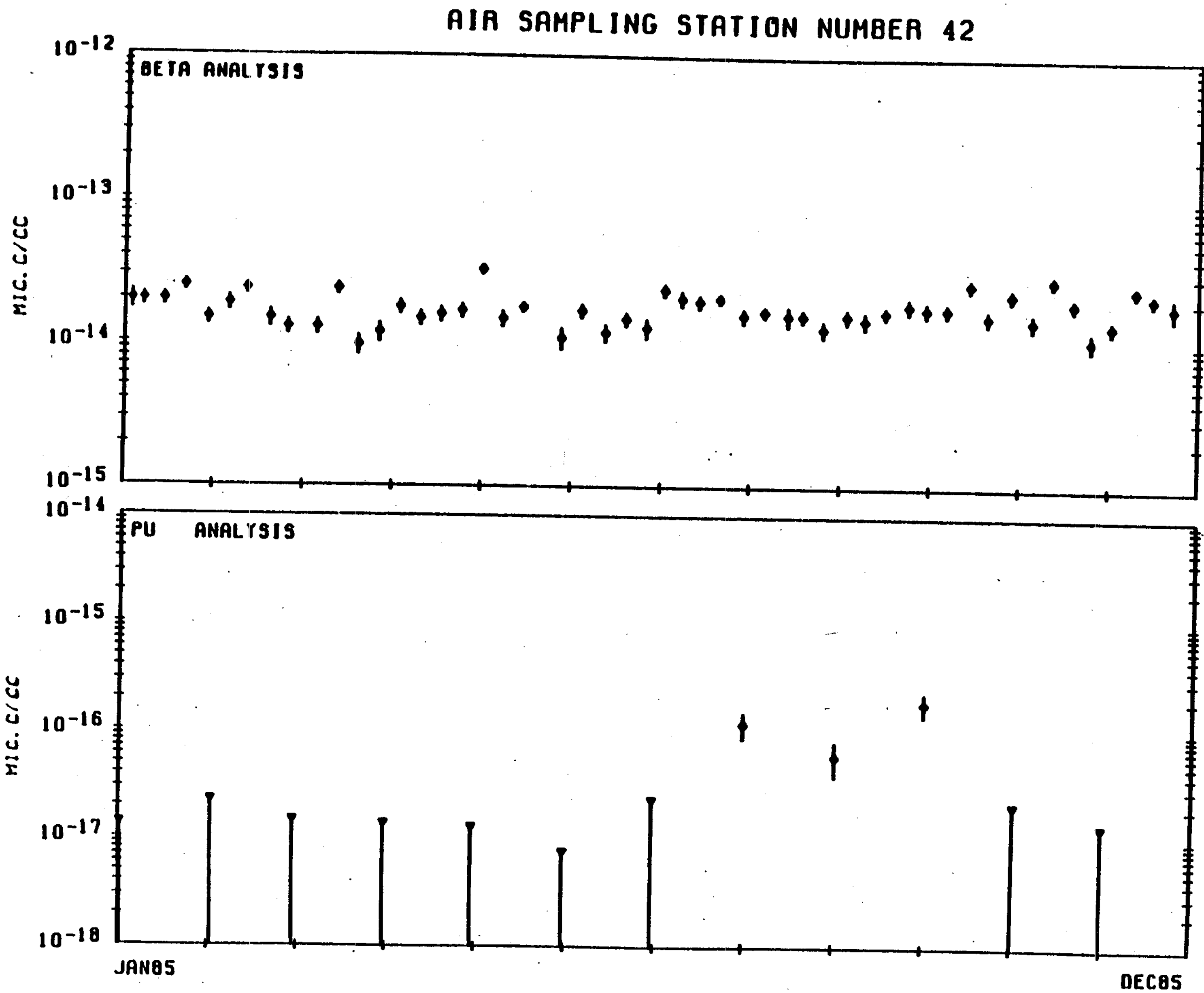

AIR SAMPLING STATION NUMBER 39
BETA ANALYSIS
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
PU ANALYSIS
MIC.C/CC
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85

AIR SAMPLING STATION NUMBER 40

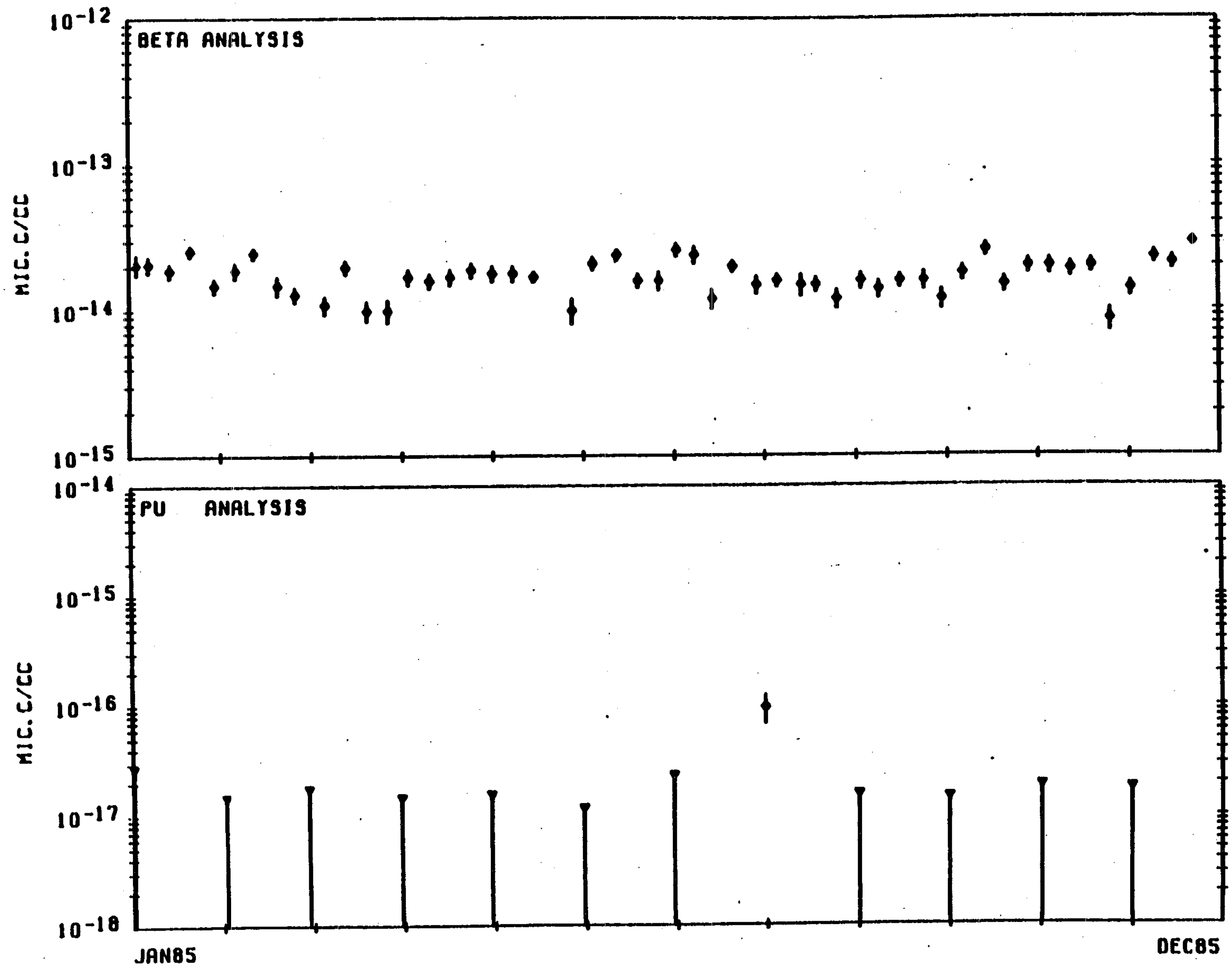


AIR SAMPLING STATION NUMBER 41

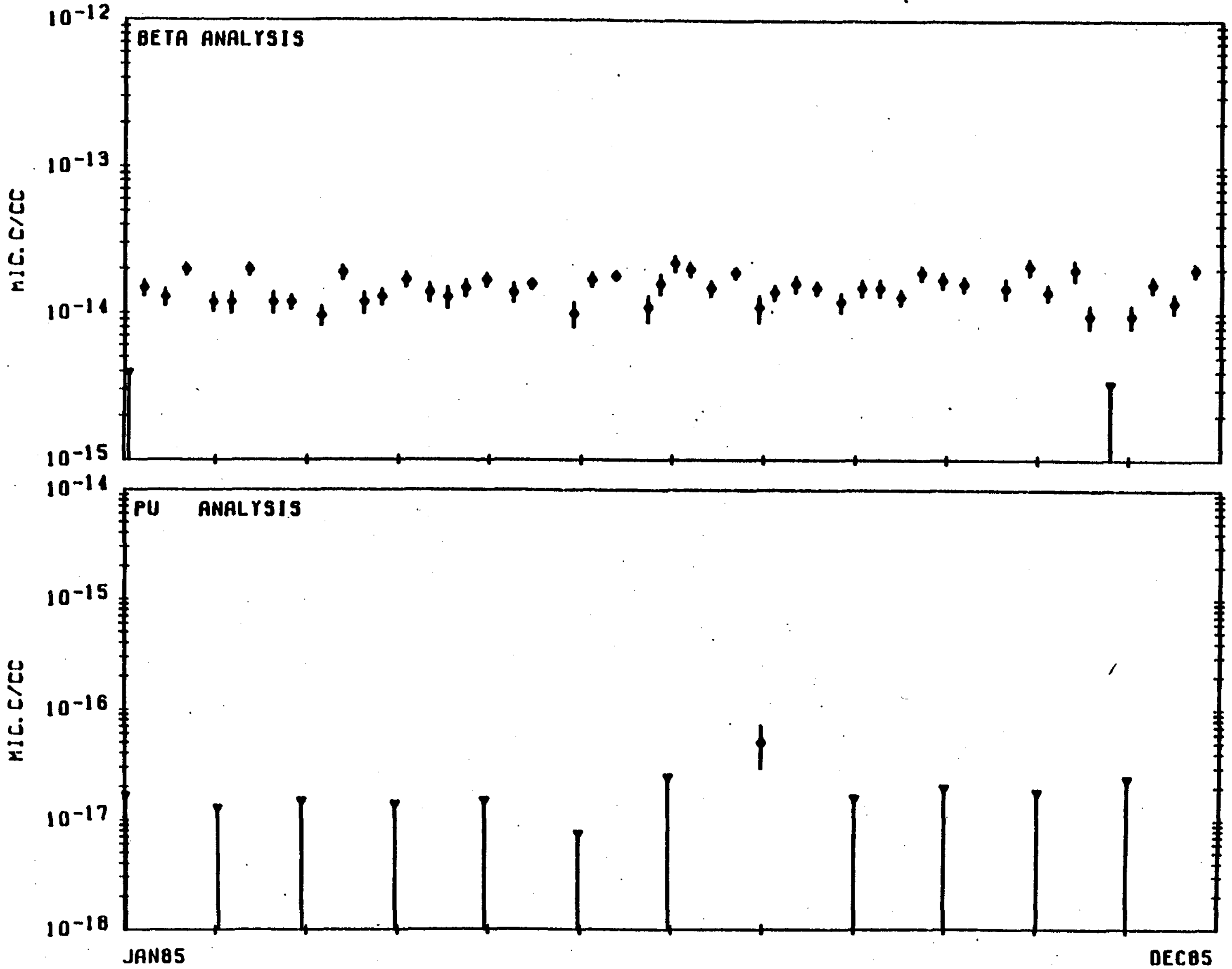


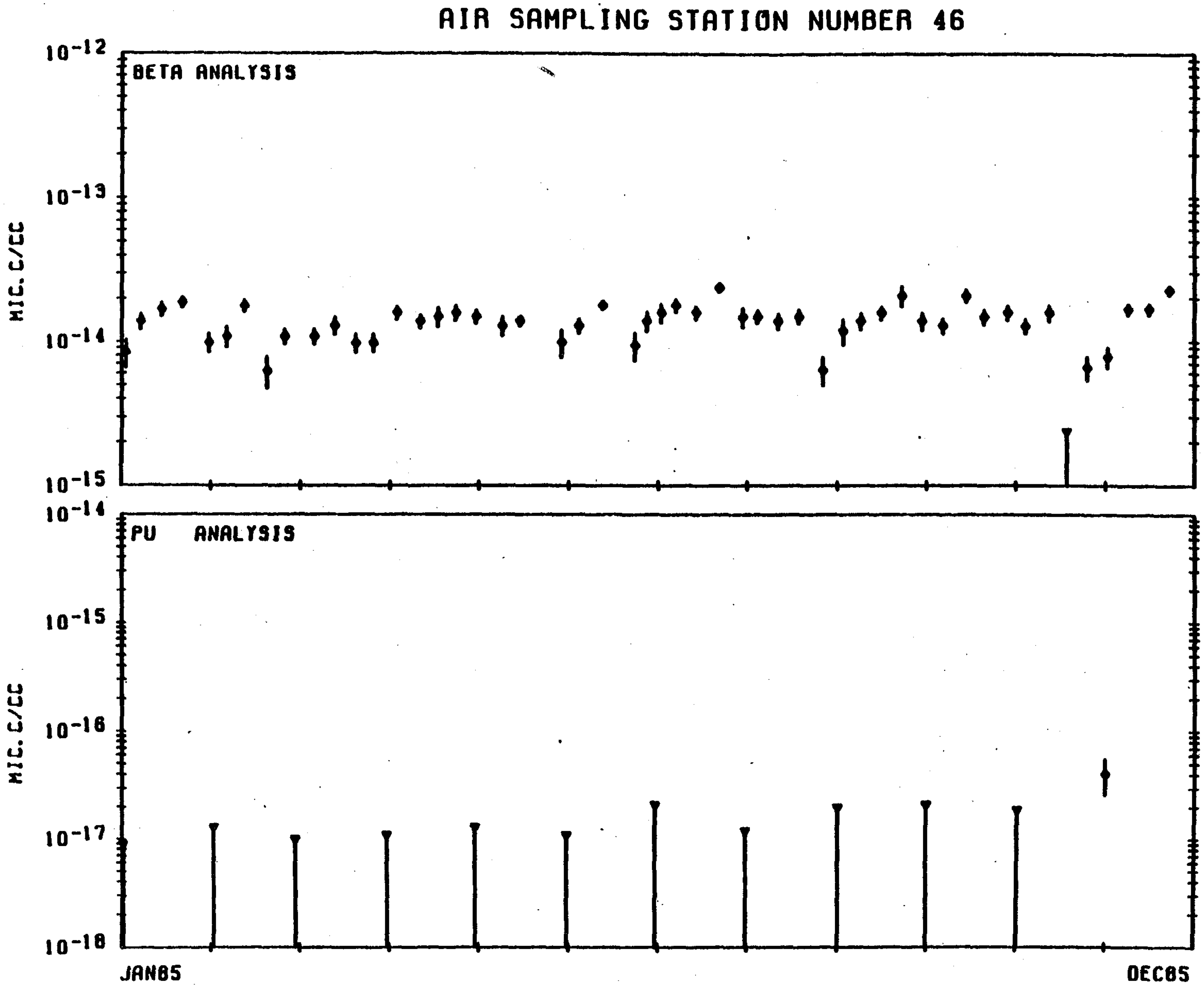

AIR SAMPLING STATION NUMBER 42
BETA ANALYSIS
PU ANALYSIS
MIC. C/CC
MIC. C/CC
10-12
10-13
10-14
10-15
10-14
10-15
10-16
10-17
10-18
JAN85
DEC85

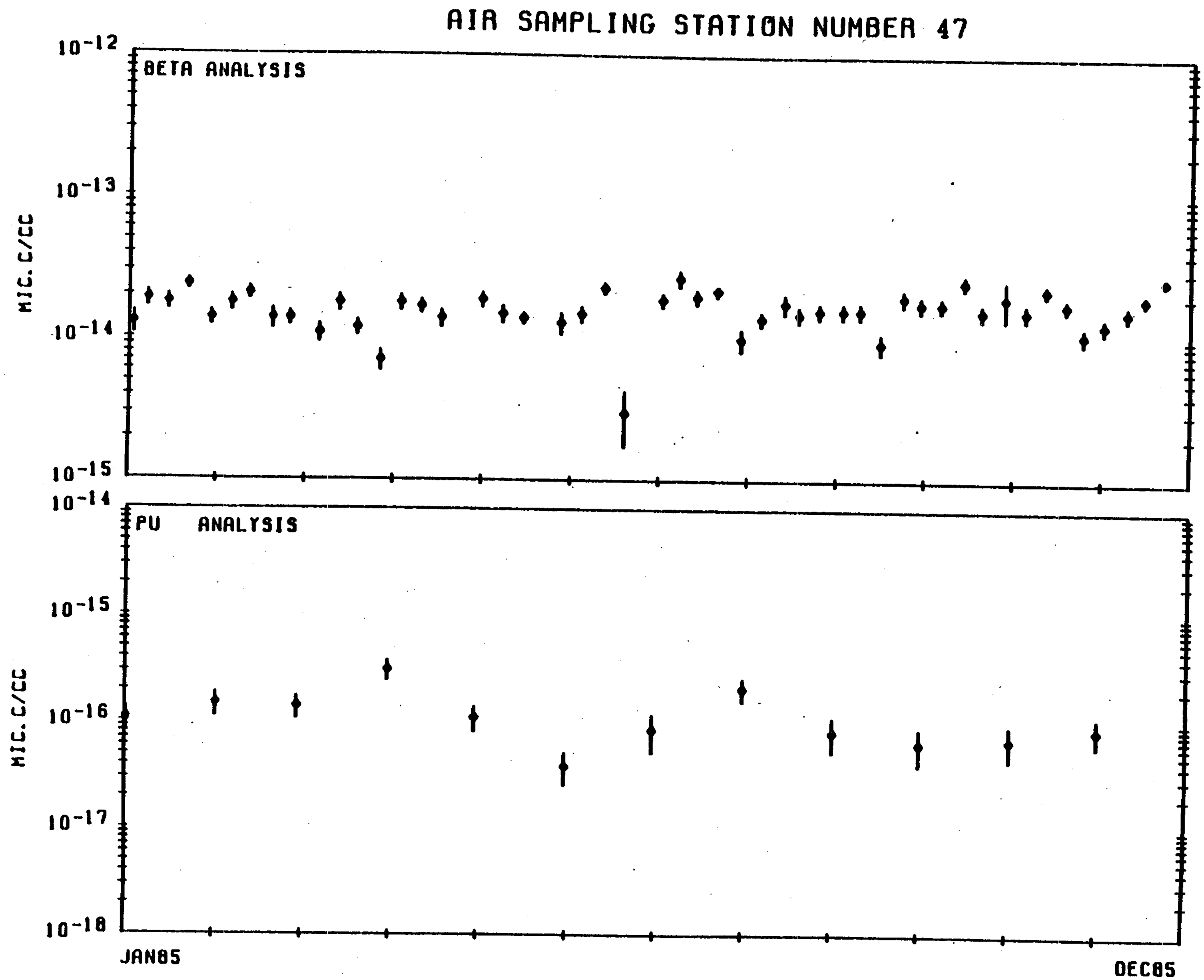
AIR SAMPLING STATION NUMBER 43



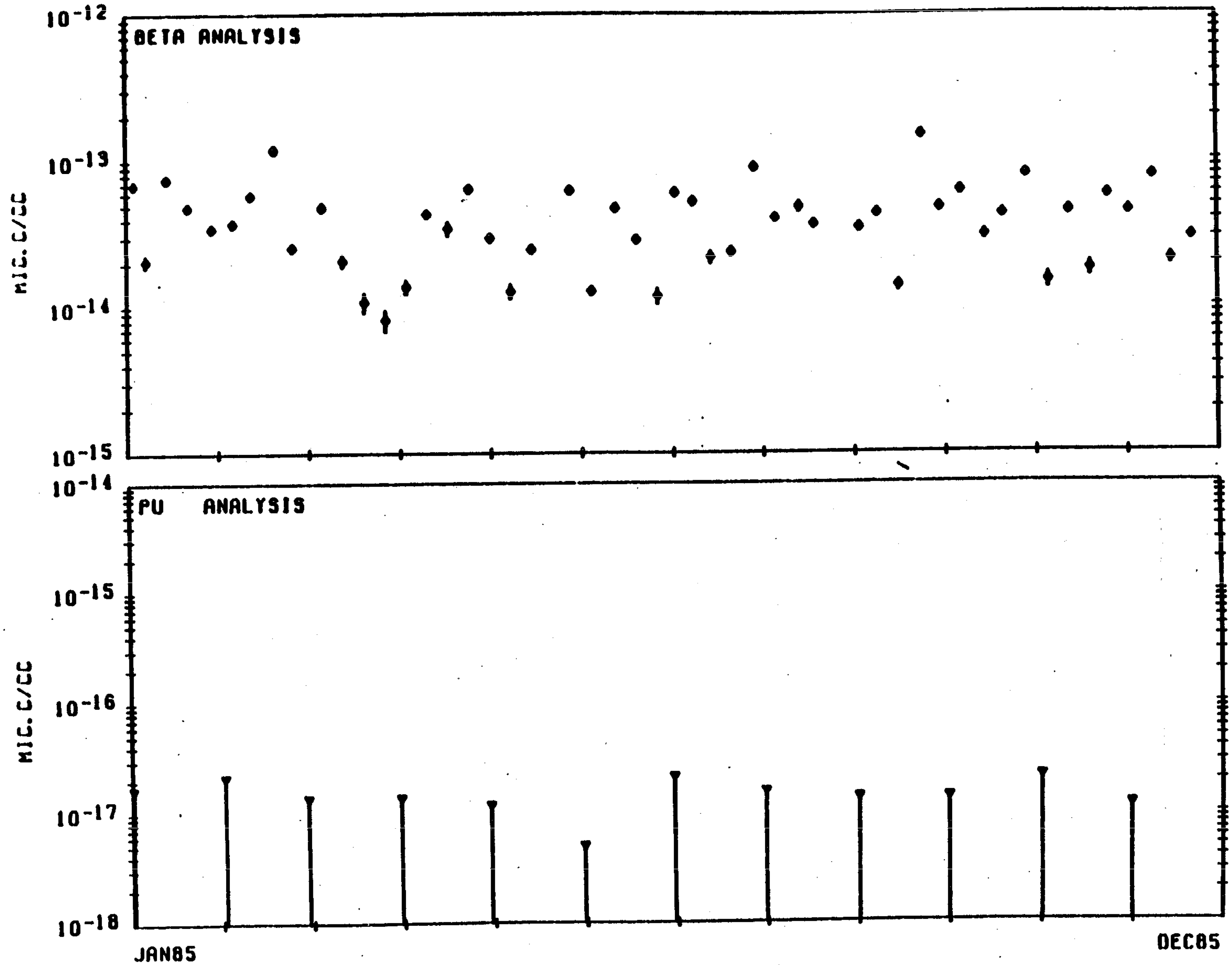
AIR SAMPLING STATION NUMBER 44



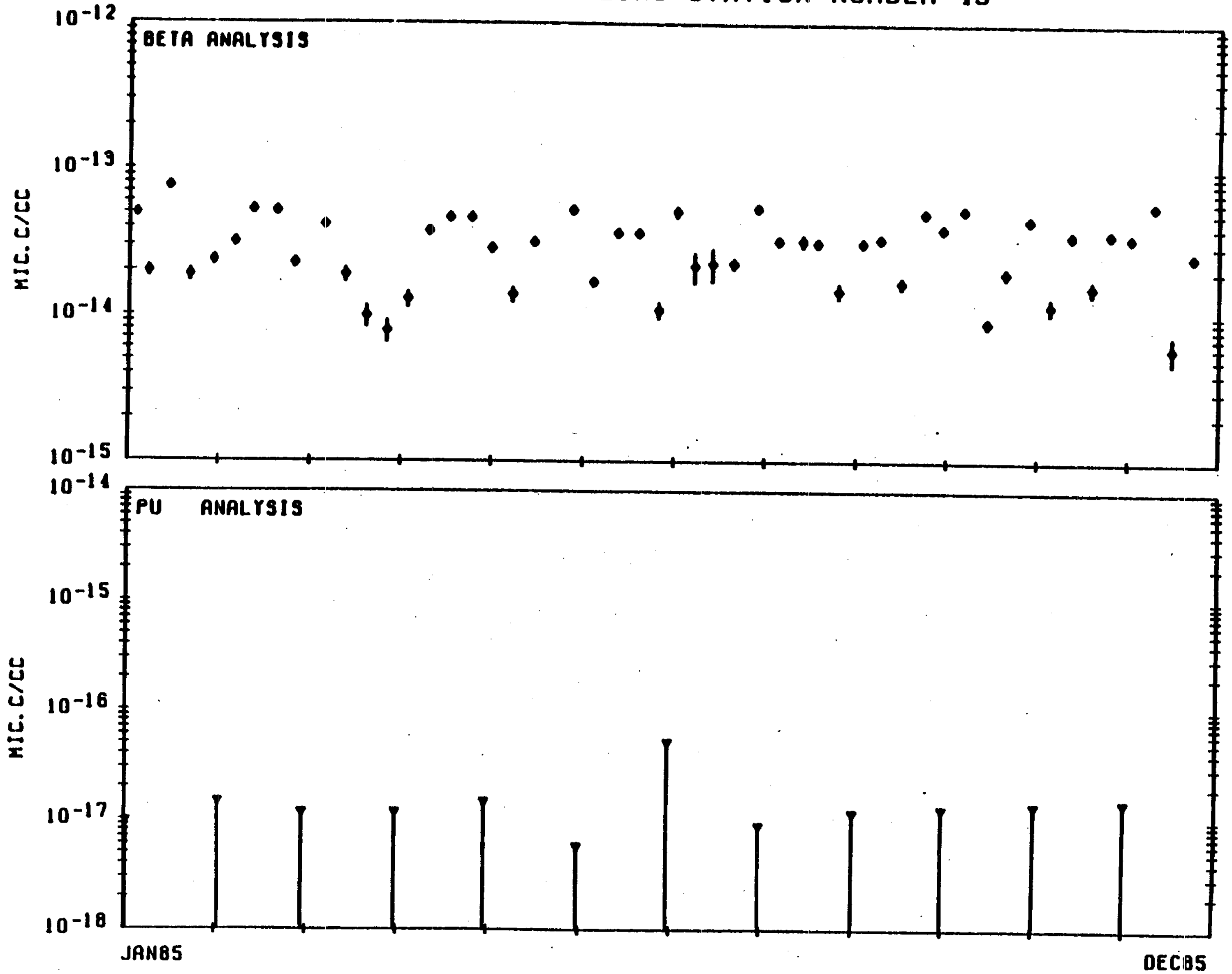

AIR SAMPLING STATION NUMBER 46
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN85
DEC85


AIR SAMPLING STATION NUMBER 47
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
10-12
10-13
10-14
10-15
10-16
10-17
10-18
JAN85
DEC85

AIR SAMPLING STATION NUMBER 48



AIR SAMPLING STATION NUMBER 49



APPENDIX B

NTS Environmental Surveillance

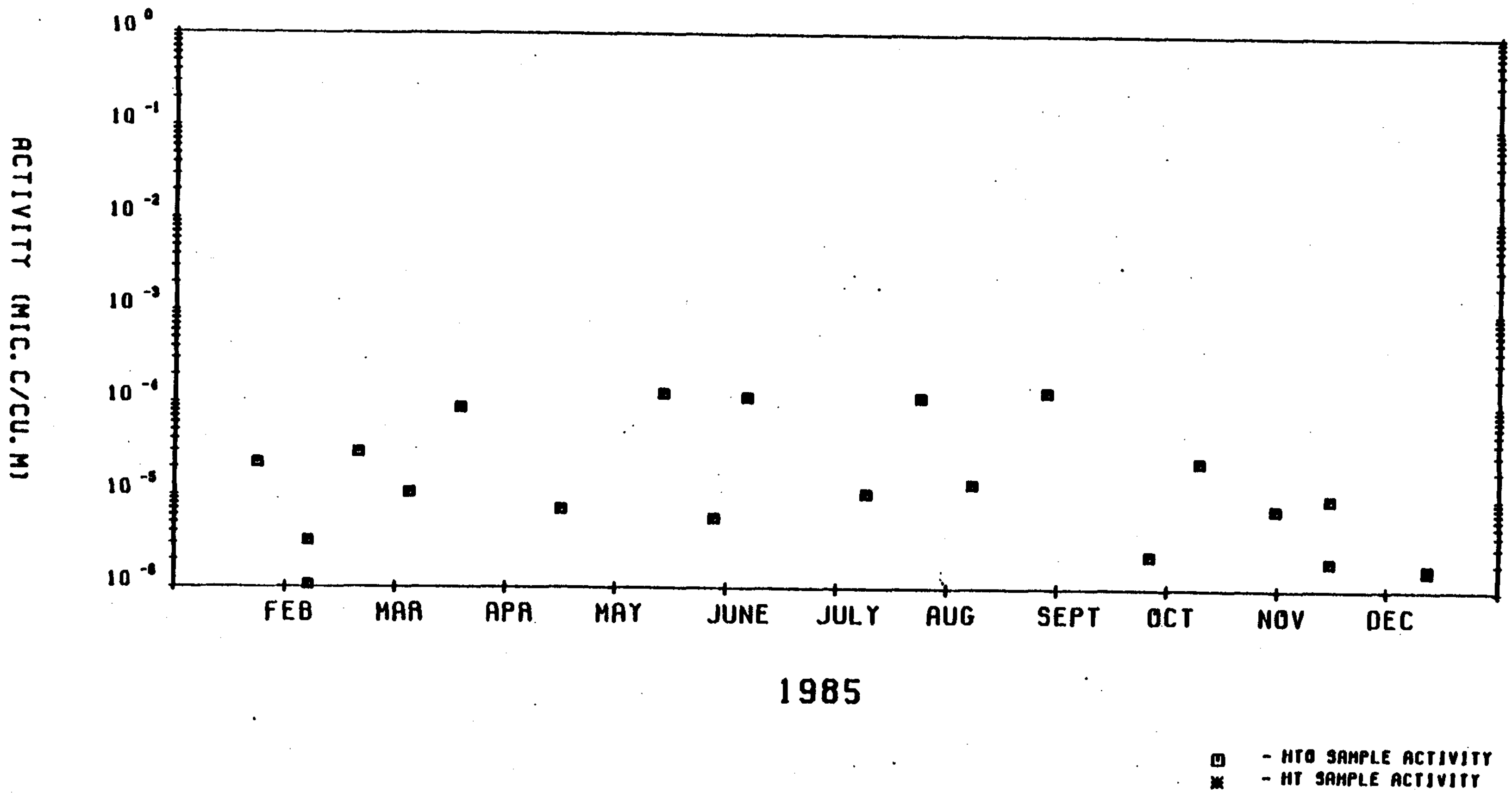
Tritium in Air Sampling Locations and Plots

The tritium in air data for each station is plotted in Appendix B for the entire year.

NTS ENVIRONMENTAL SURVEILLANCE
TRITIUM IN AIR SAMPLING LOCATIONS

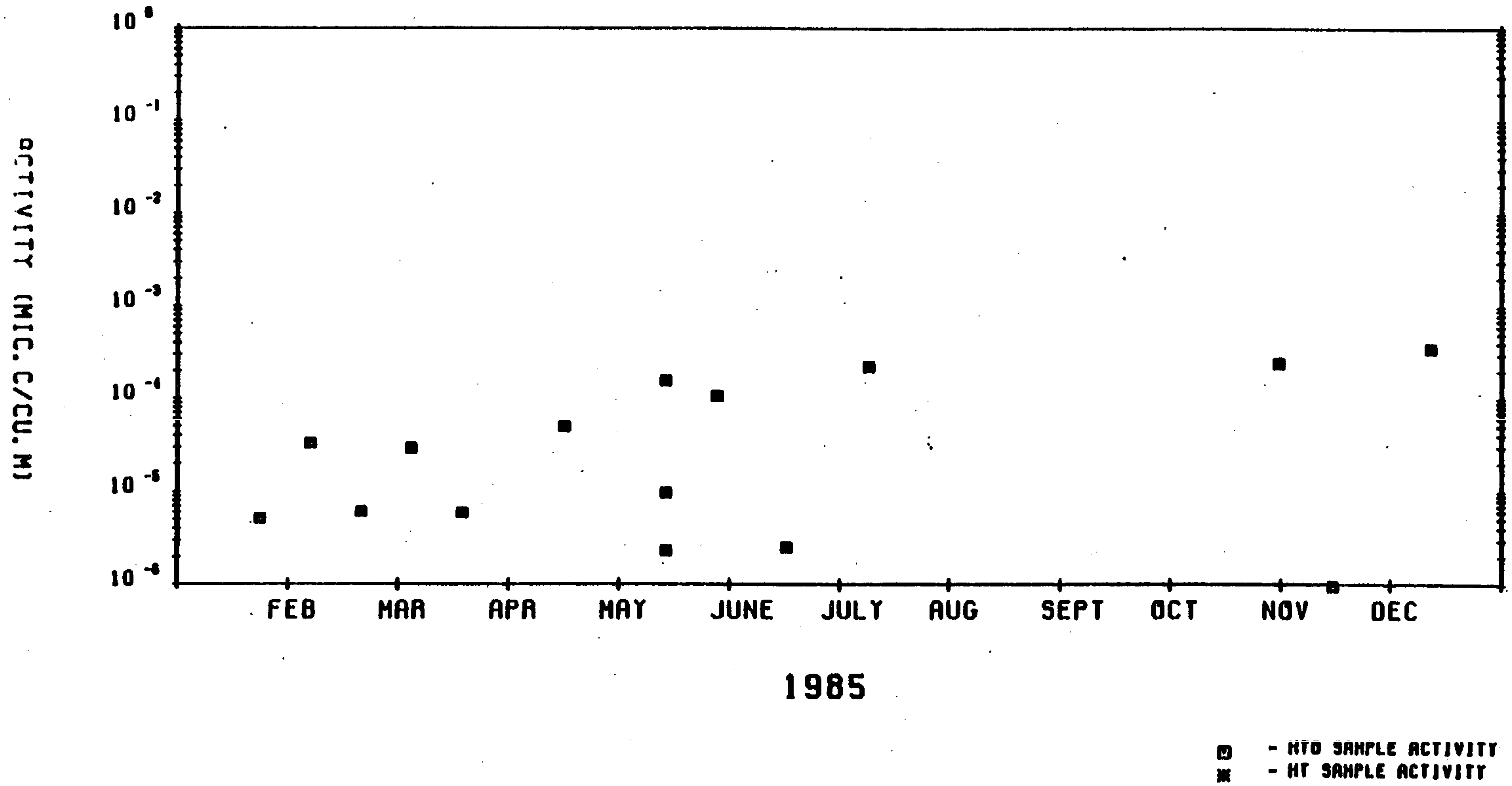
Area	Location
1	BJY
5	RWMS - 1
5	RWMS - SE
5	RWMS - (SE-NE)
5	RWMS - NE
5	RWMS - (NE-NW)
5	RWMS - NW
5	RWMS - (NW-SW)
5	RWMS - SW
5	RWMS - (SW-SE)
12	Base Camp
15	EPA Farm
15	Gate 700
23	Bldg. 790
23	Bldg. 650
23	Site Boundary
25	EMAD

BJY, AREA 1

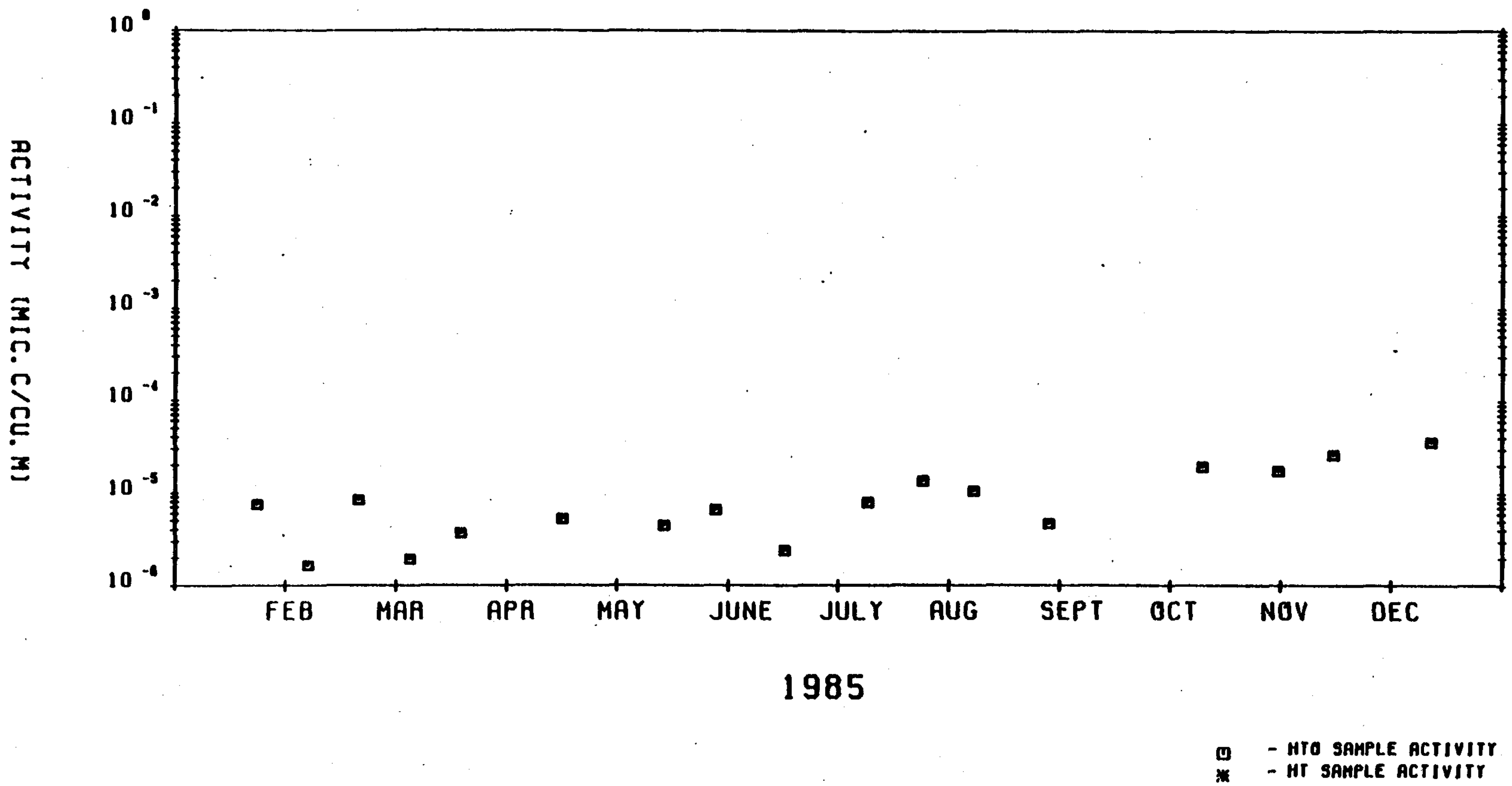


ACTIVITY (MIC.C/CU.M)
10⁰
10⁻¹
10⁻²
10⁻³
10⁻⁴
10⁻⁵
10⁻⁶
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1985
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

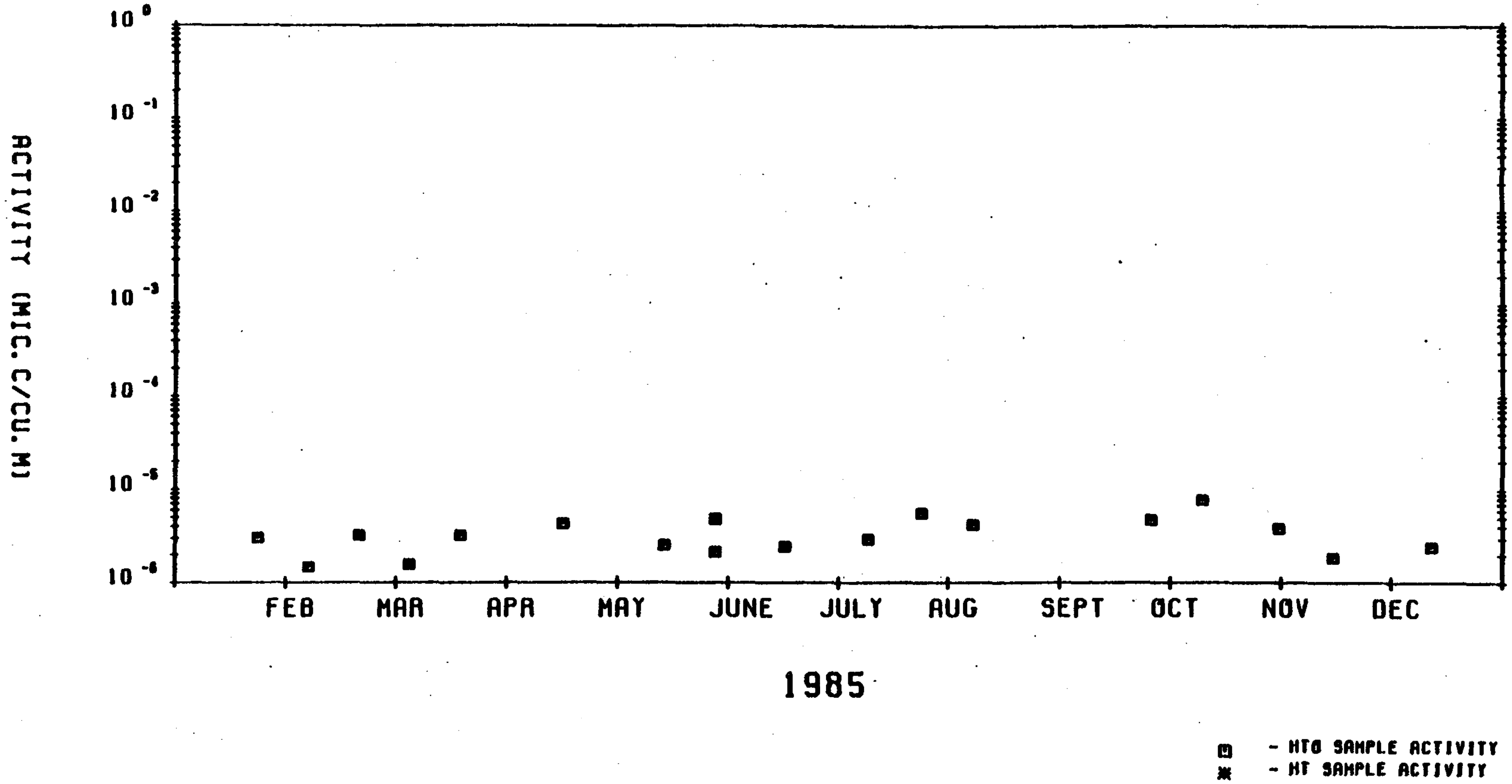
RWMS-1, AREA 5


ACTIVITY (MIC.C/CU.M)
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1985
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

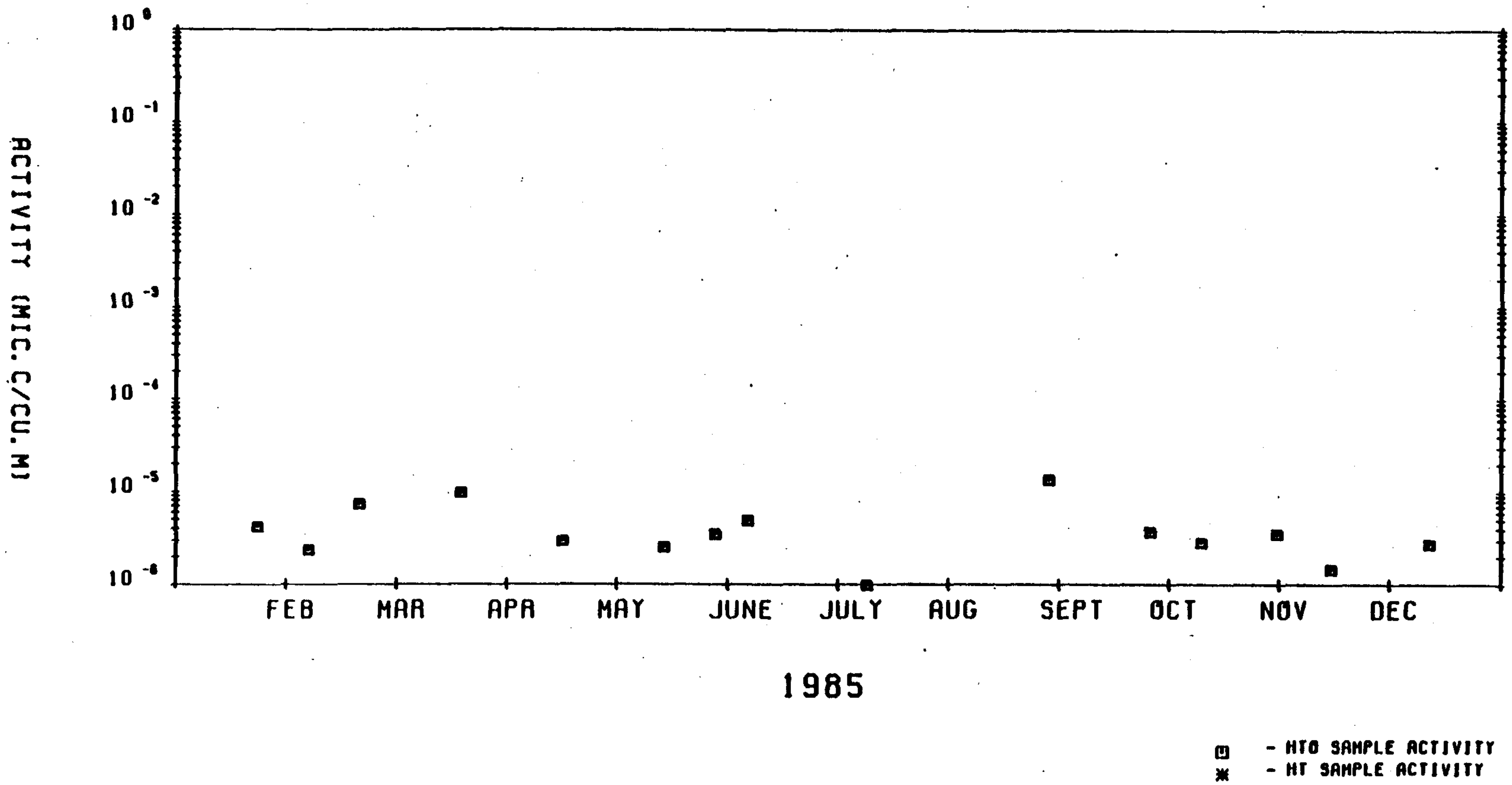
RWMS-SE, AREA 5

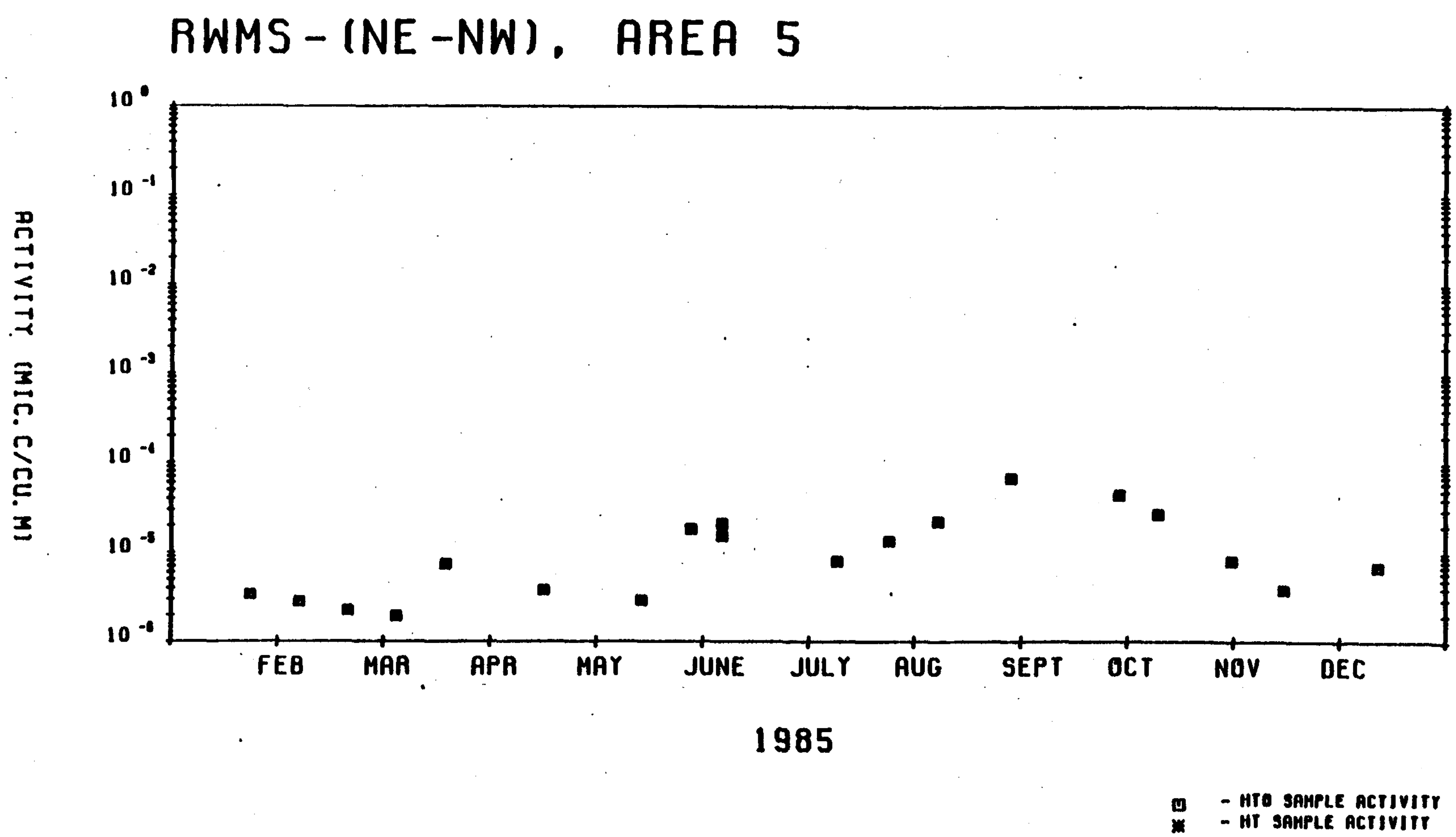


RWMS-(SE-NE), AREA 5

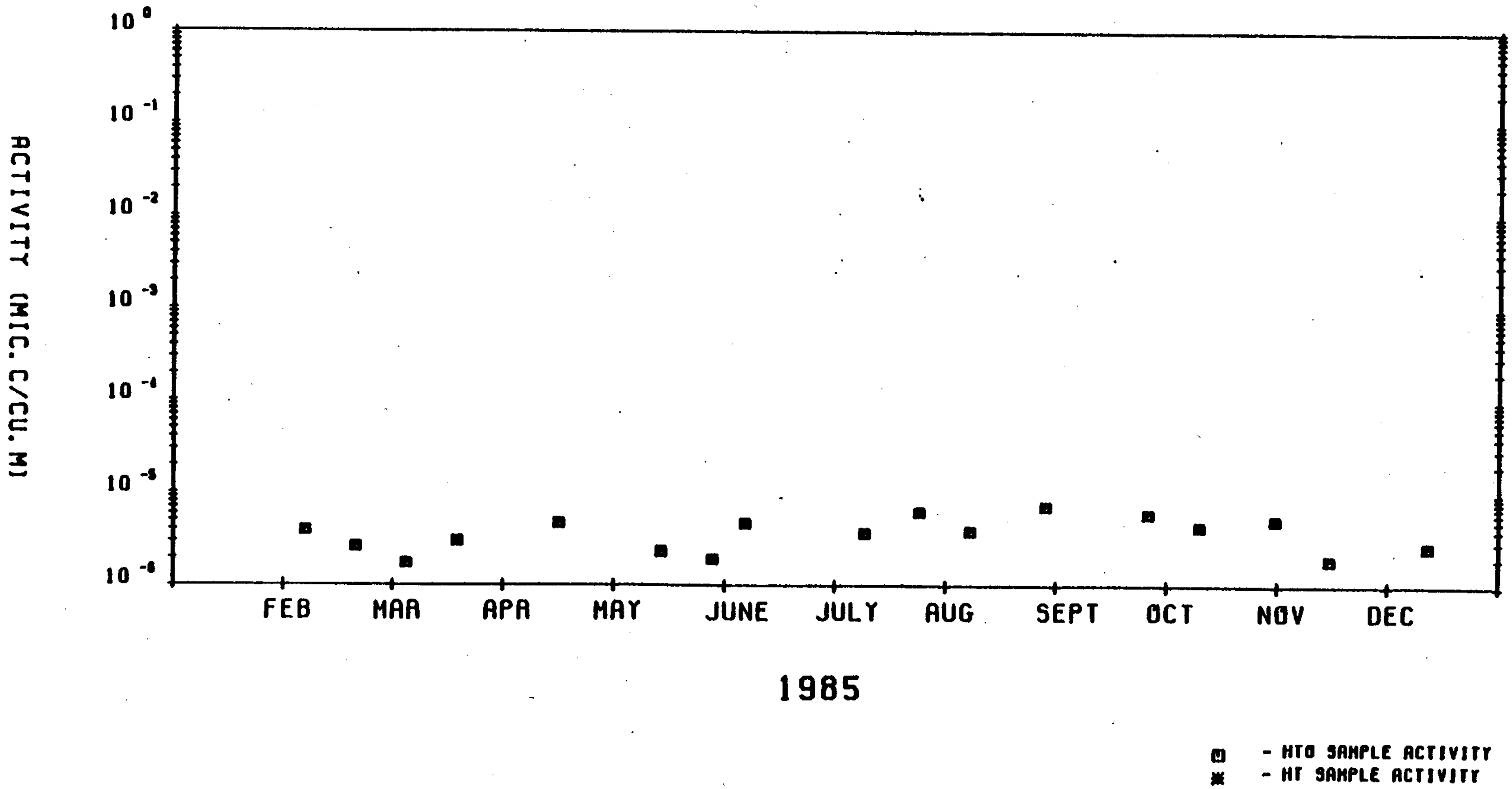


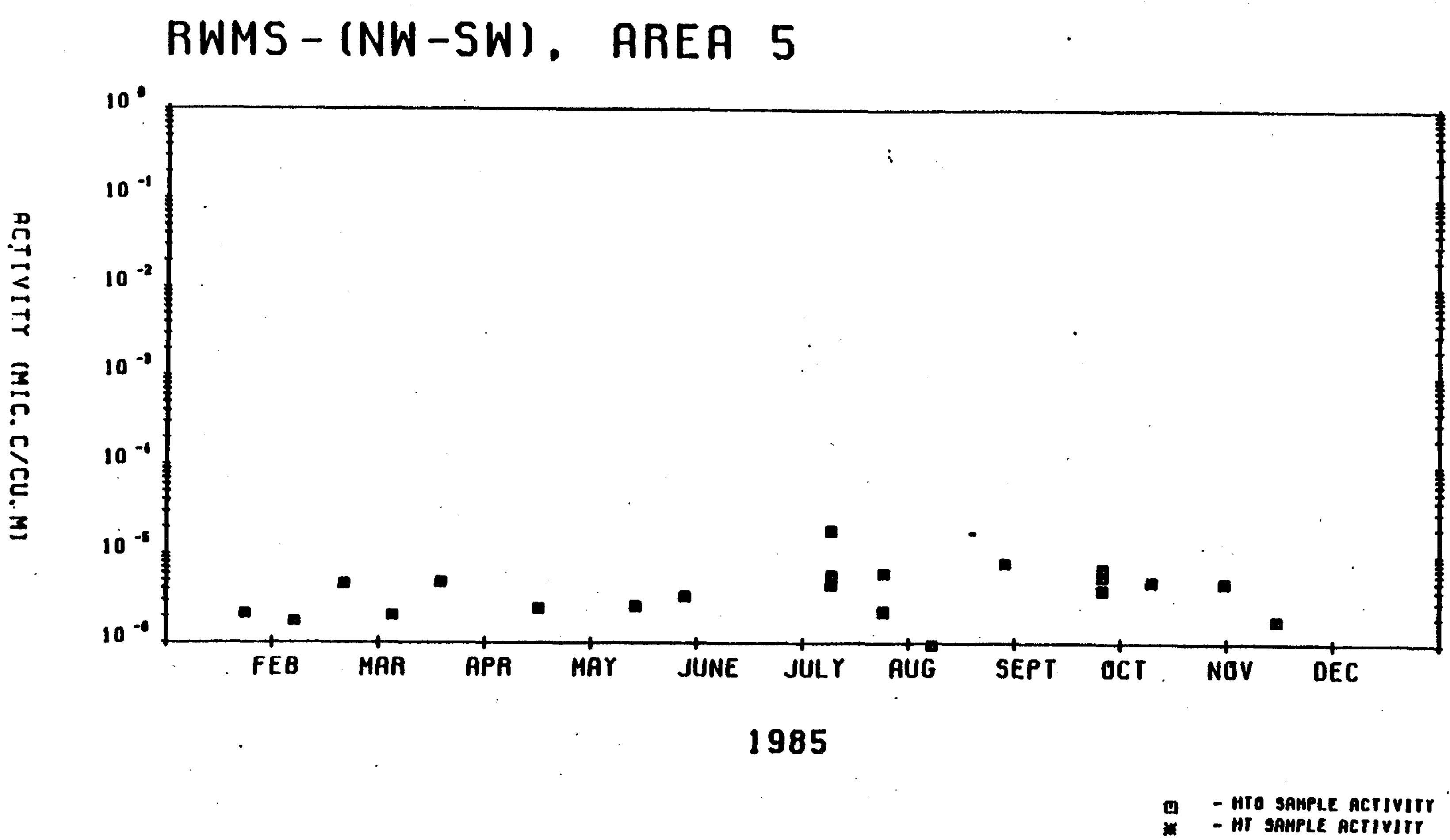
RWMS-NE, AREA 5



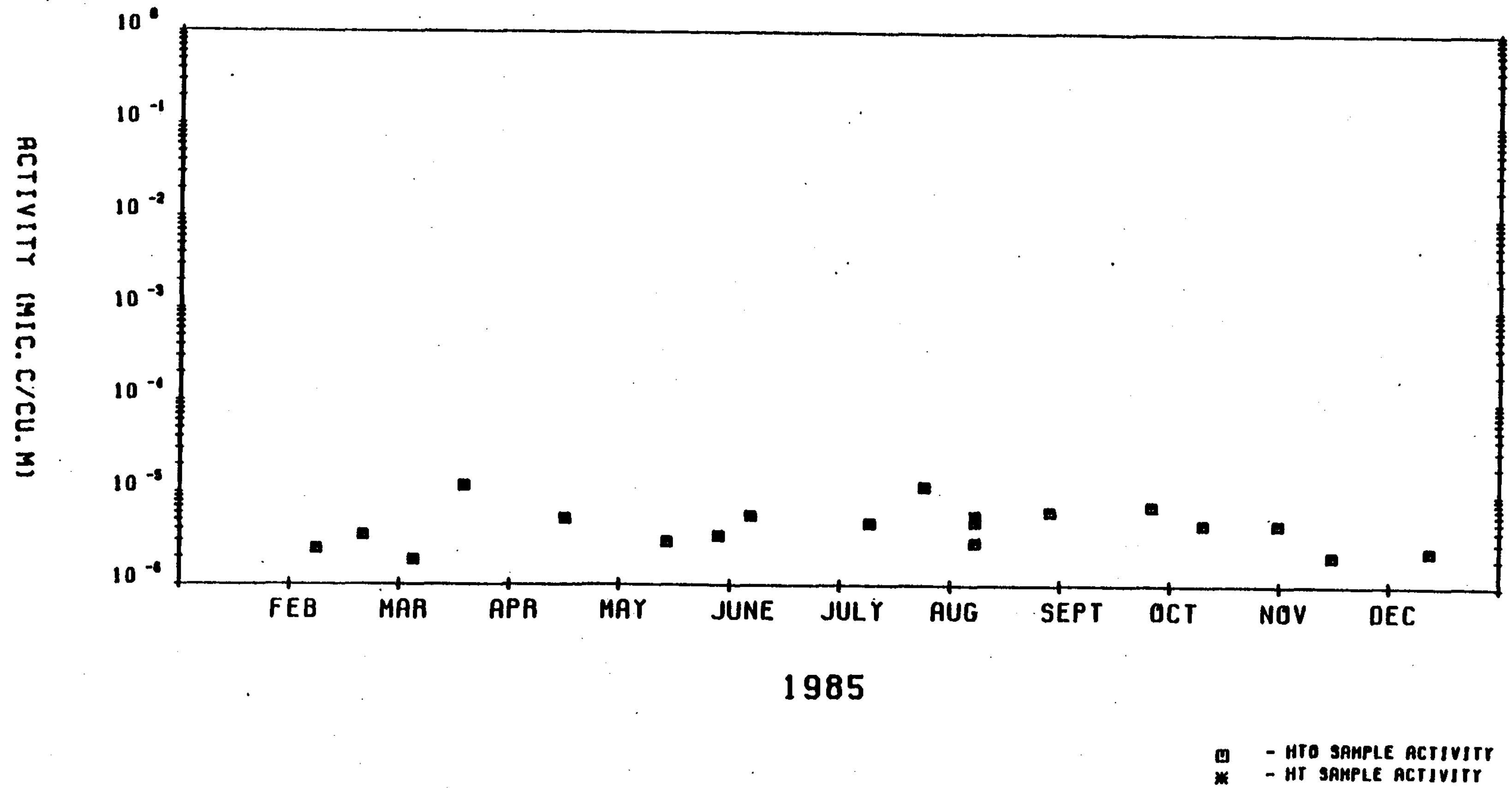

RWMS-(NE-NW), AREA 5
ACTIVITY (MIC.C/CU.M)
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1985
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

RWMS-NW, AREA 5

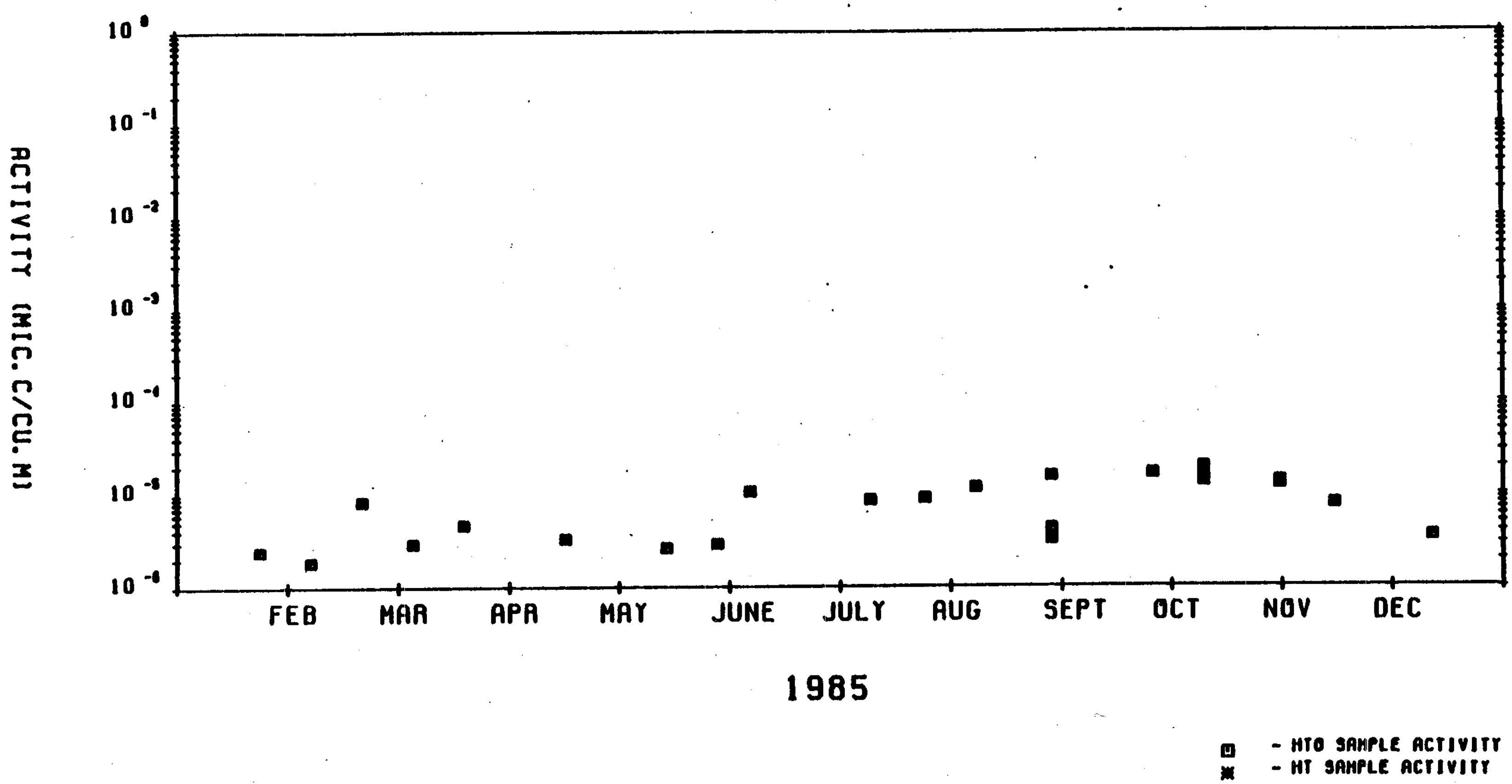


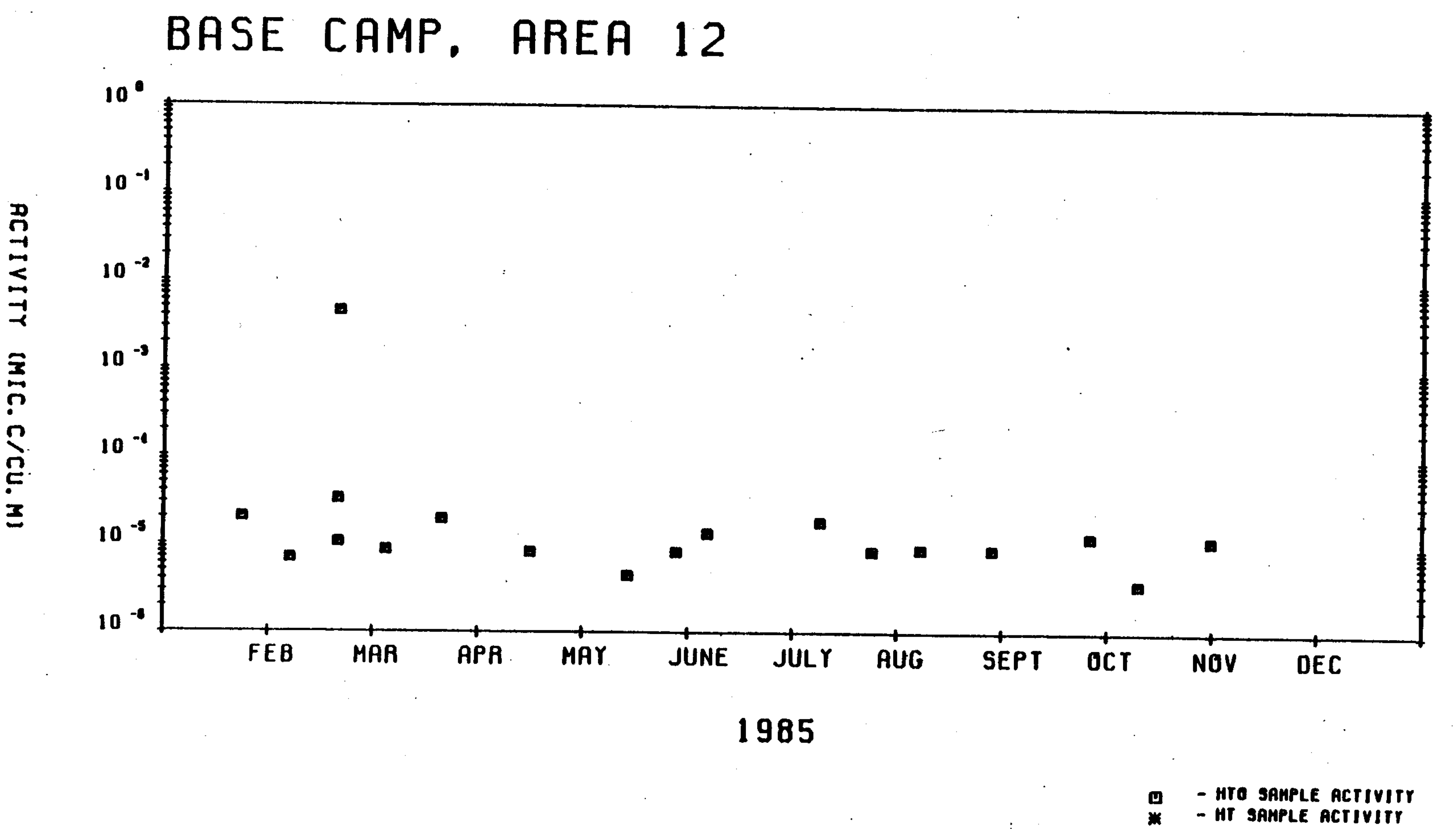

RWMS-(NW-SW), AREA 5
ACTIVITY (MIC.C/CU.M)
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
1985
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

RWMS-SW, AREA 5



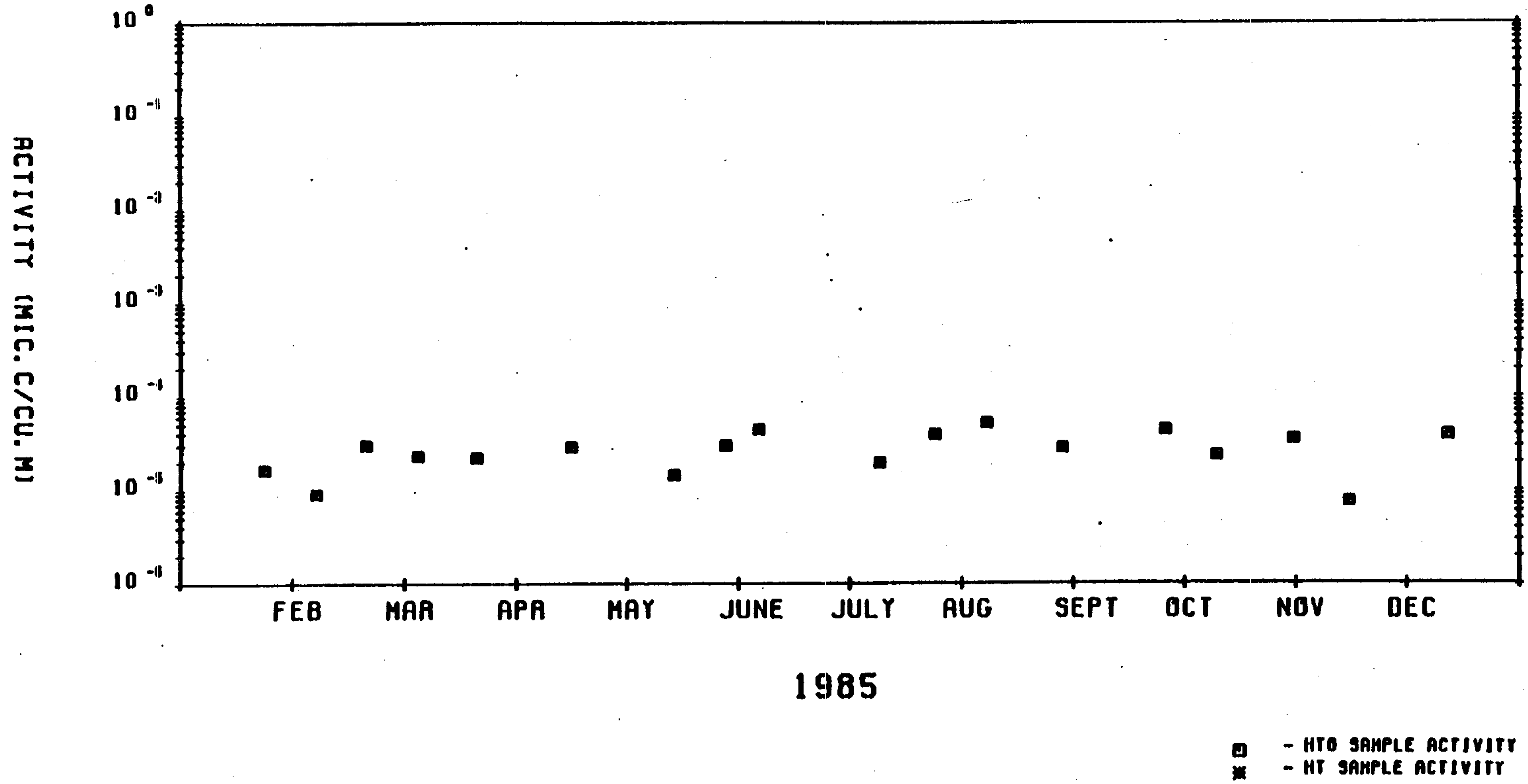
RWMS-(SW-SE), AREA 5



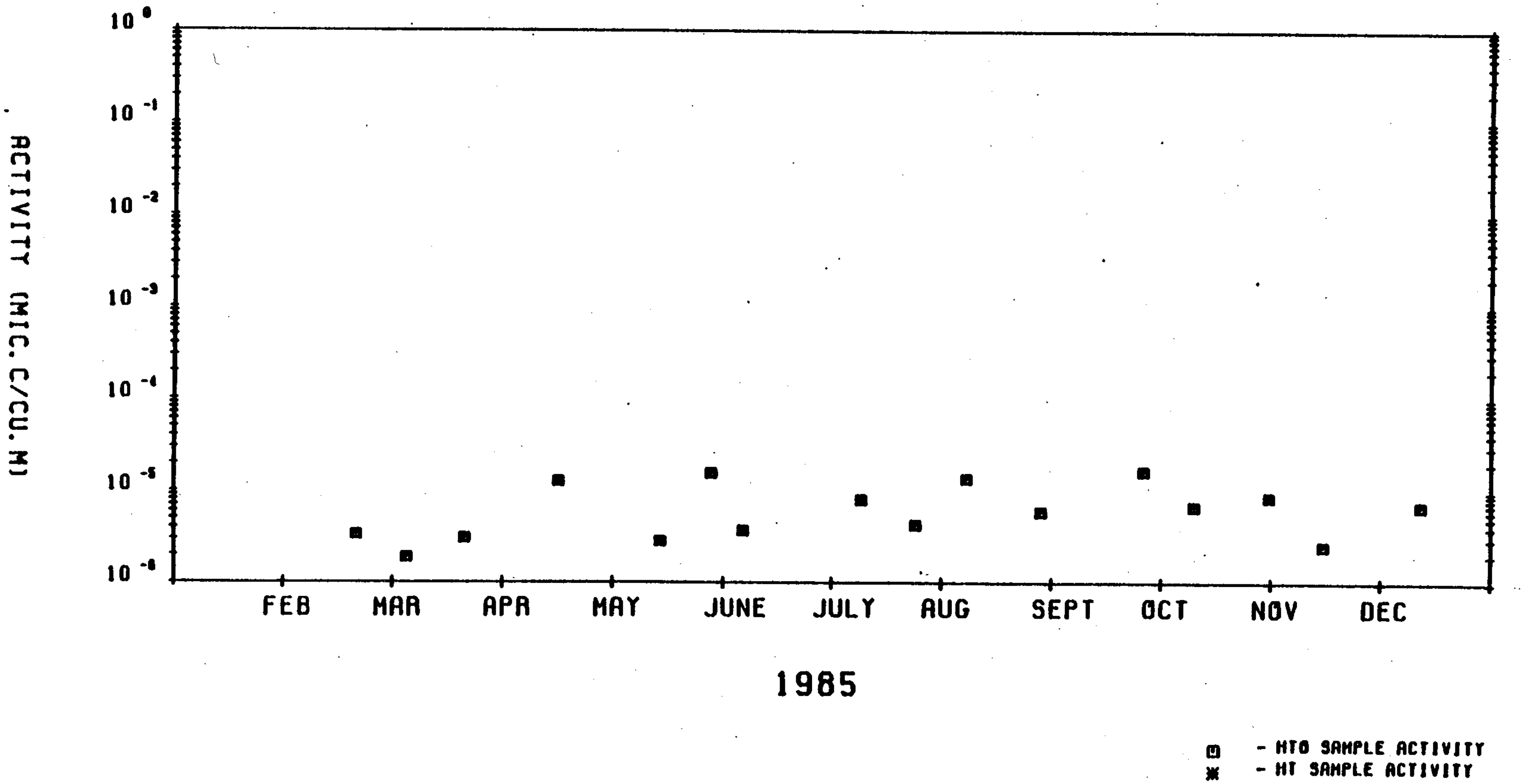


BASE CAMP, AREA 12
ACTIVITY (MIC.C/CU.M)
10 ⁰
10 ⁻¹
10 ⁻²
10 ⁻³
10 ⁻⁴
10 ⁻⁵
10 ⁻⁶
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1985
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

EPA FARM, AREA 15

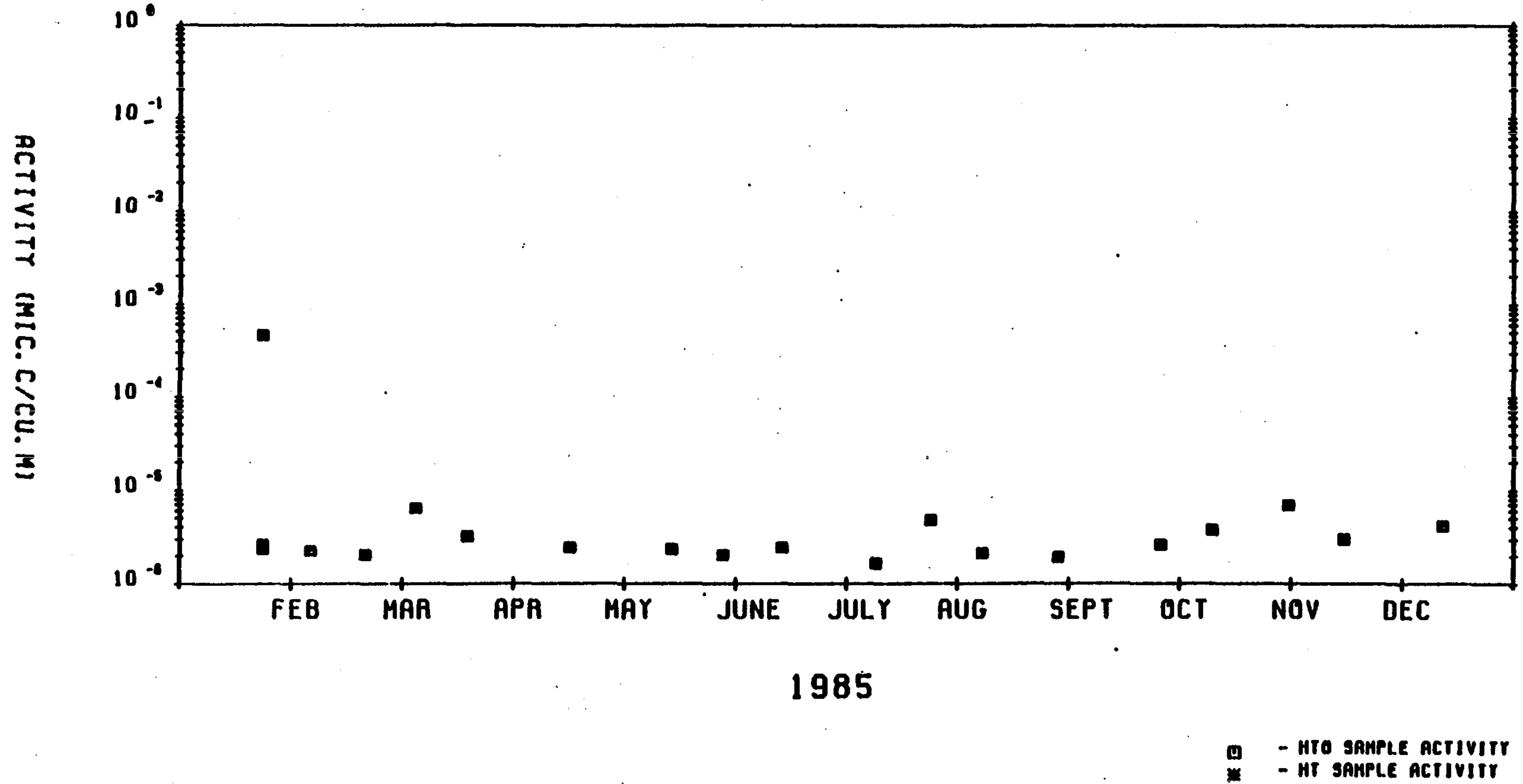


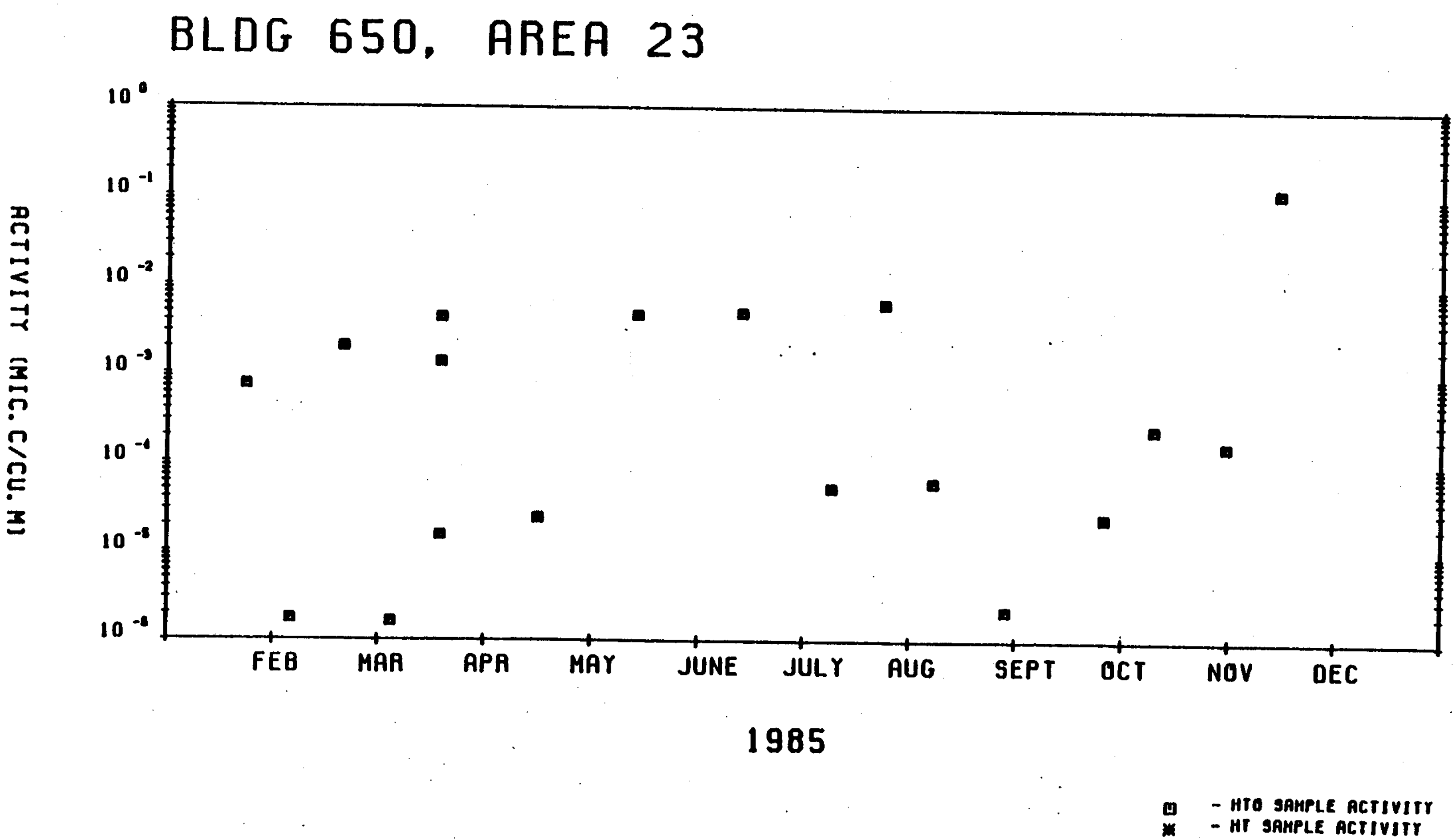
GATE 700



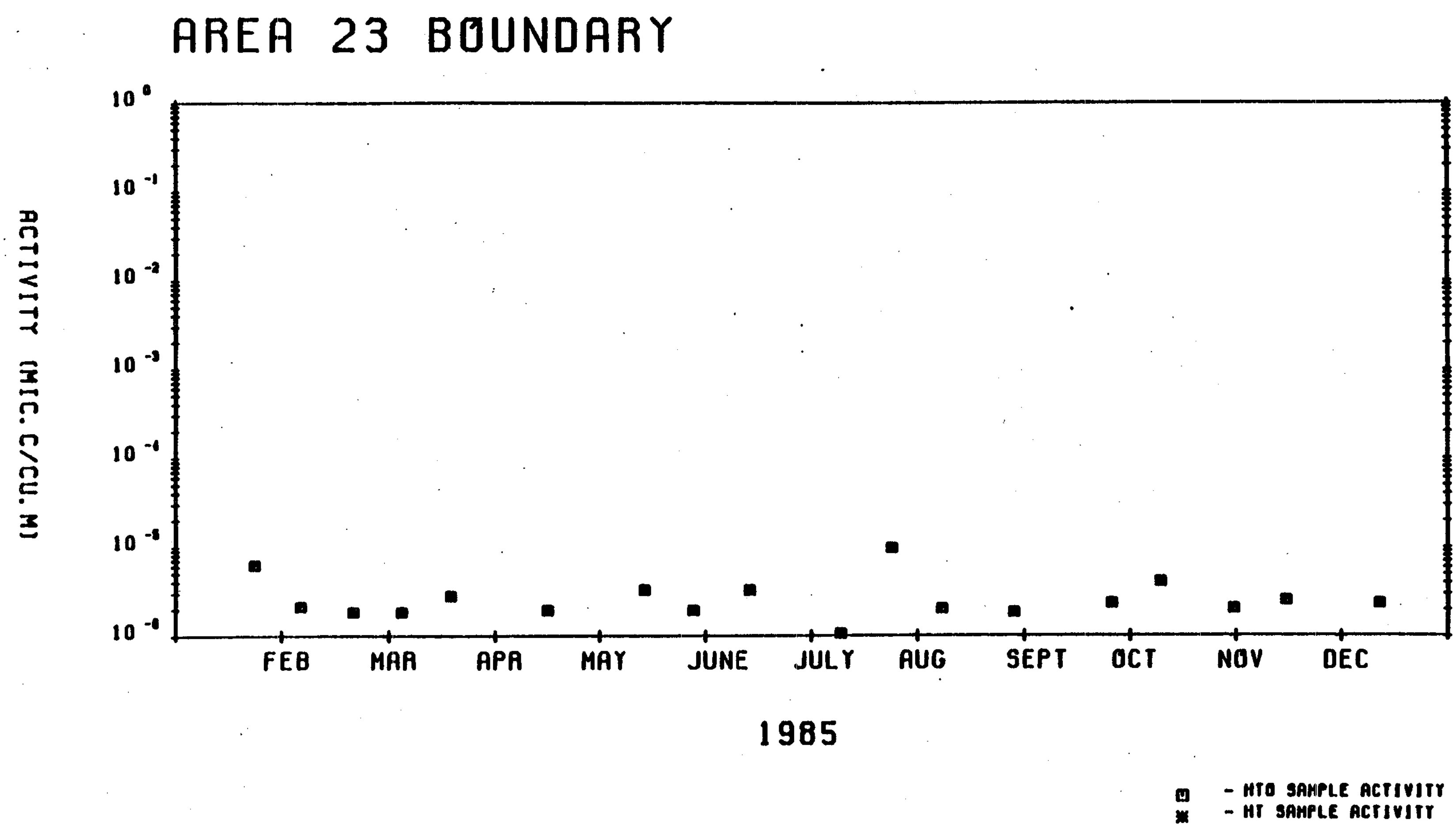
10⁰
10⁻¹
10⁻²
10⁻³
10⁻⁴
10⁻⁵
10⁻⁶
ACTIVITY (MIC.C/CU.M)
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1985
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

BLDG 790, AREA 23

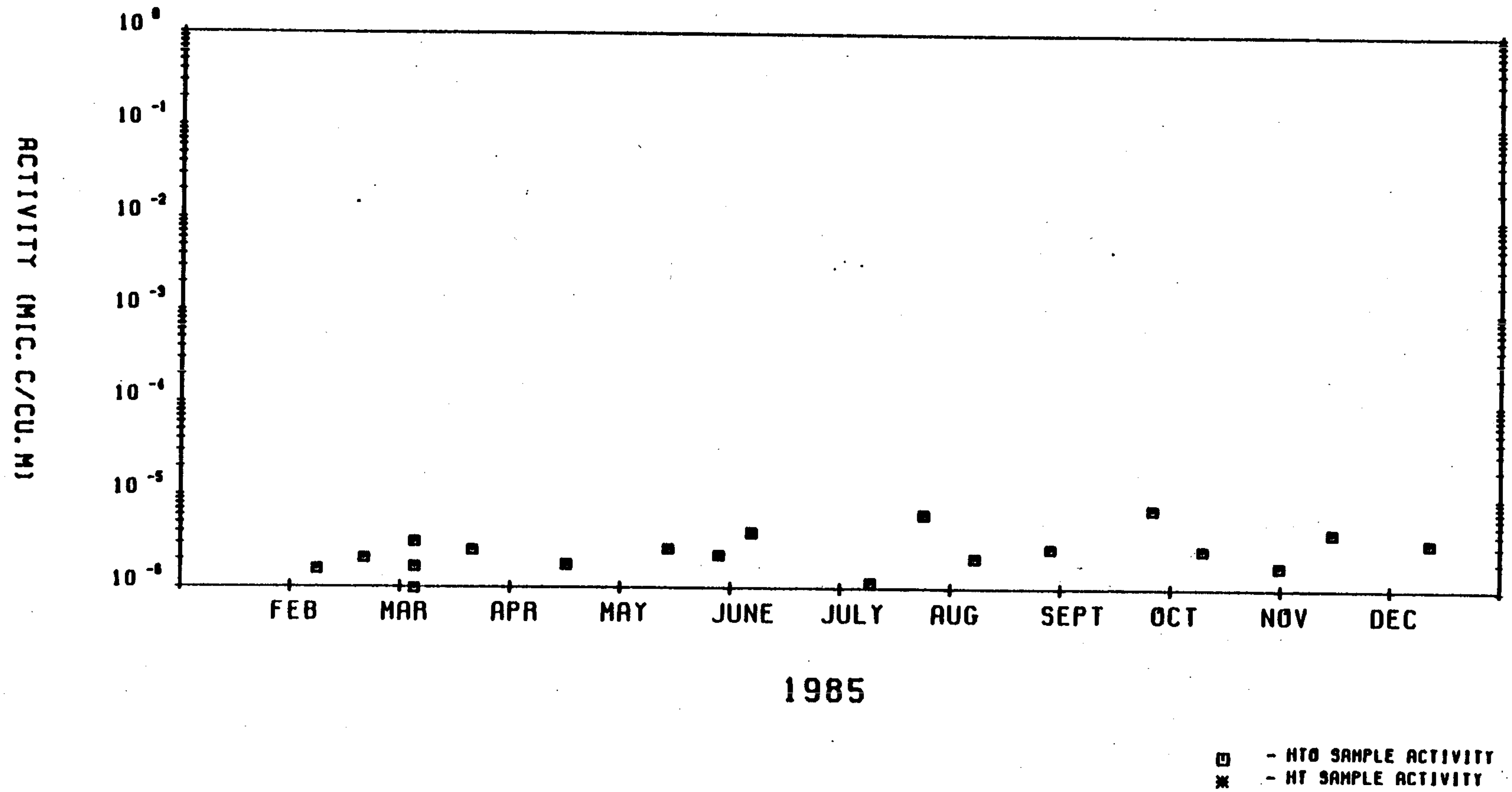




BLDG 650, AREA 23
ACTIVITY (MIC.C/CU.M)
10 ⁰
10 ⁻¹
10 ⁻²
10 ⁻³
10 ⁻⁴
10 ⁻⁵
10 ⁻⁶
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1985
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY


AREA 23 BØUNDARY
ACTIVITY (MIC.C/CU.M)
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1985
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

EMAD, AREA 25



EMAD, AREA 25

A P P E N D I X C

NTS Environmental Surveillance

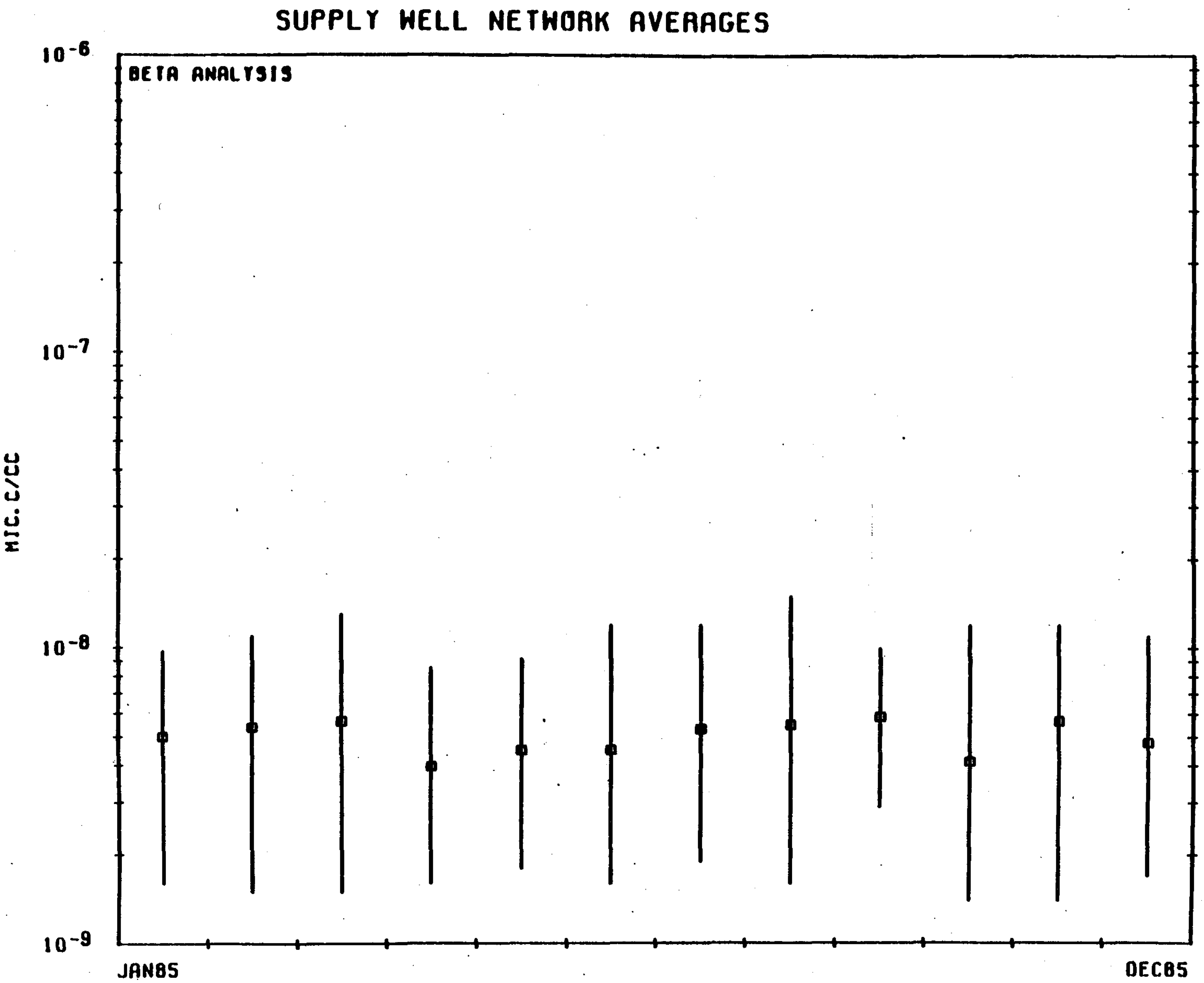
Supply Well Locations and Plots

Several symbols are used in Appendix C to denote the data points. In the first two pages of plots, the supply well network averages, a square represents the arithmetic mean of all values at that point in time, and the vertical line is the range of the data.

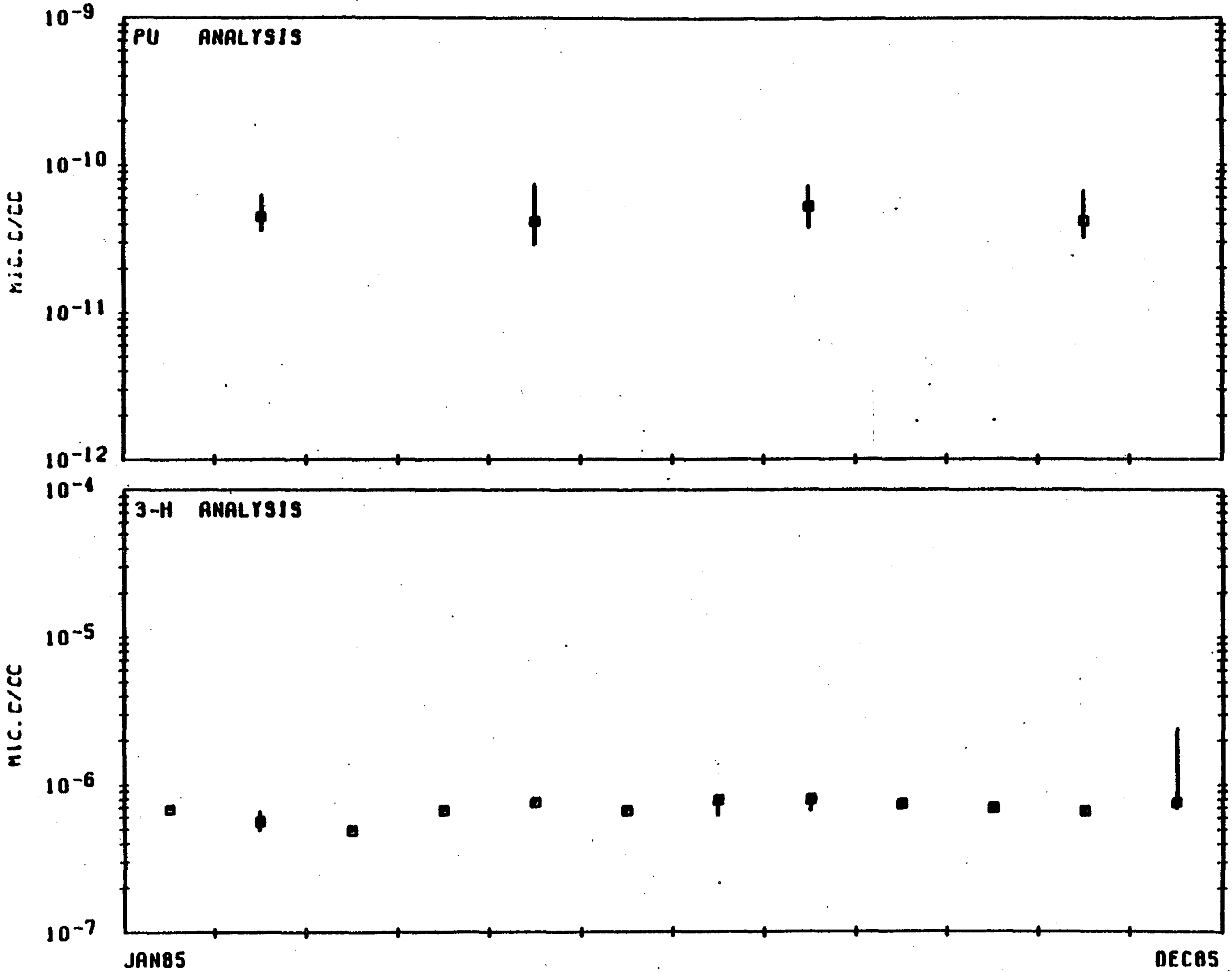
The remaining plots of Appendix B show the gross beta data of each station. A two-sigma error bar is also added to the data points, and, in all of the plots, a delta with the line to the bottom of the plot means below detection limit.

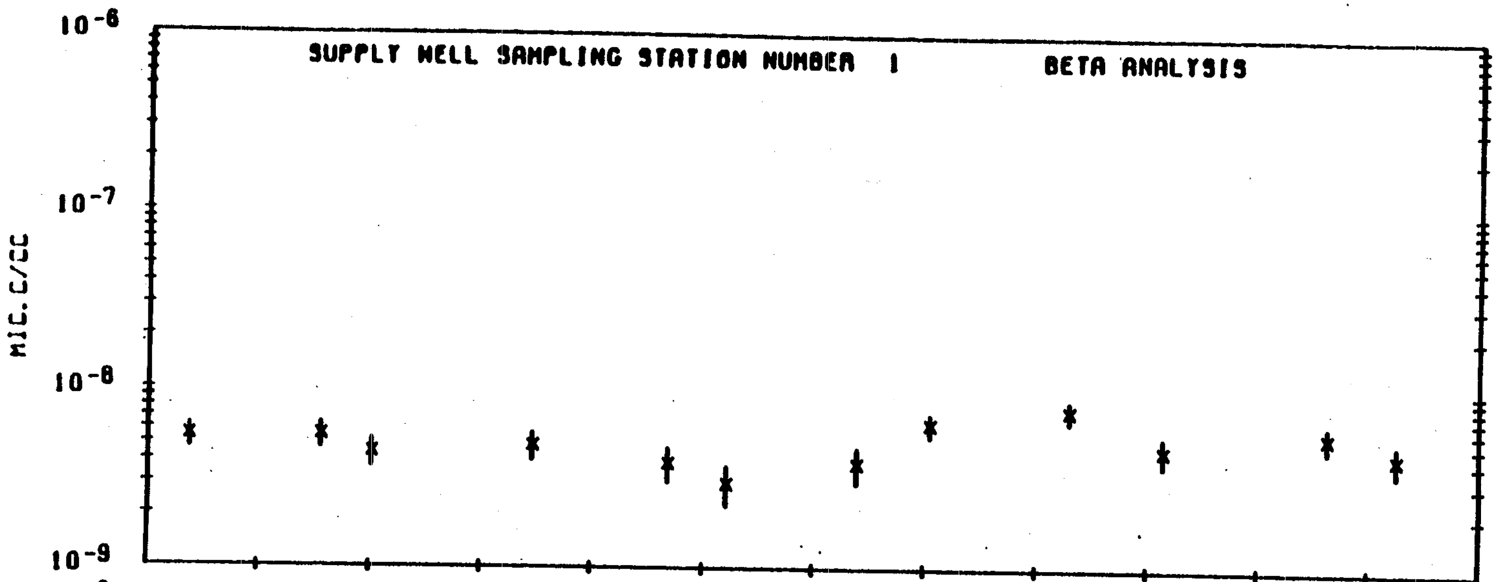
NTS ENVIRONMENTAL SURVEILLANCE
SUPPLY WELLS SAMPLING LOCATIONS

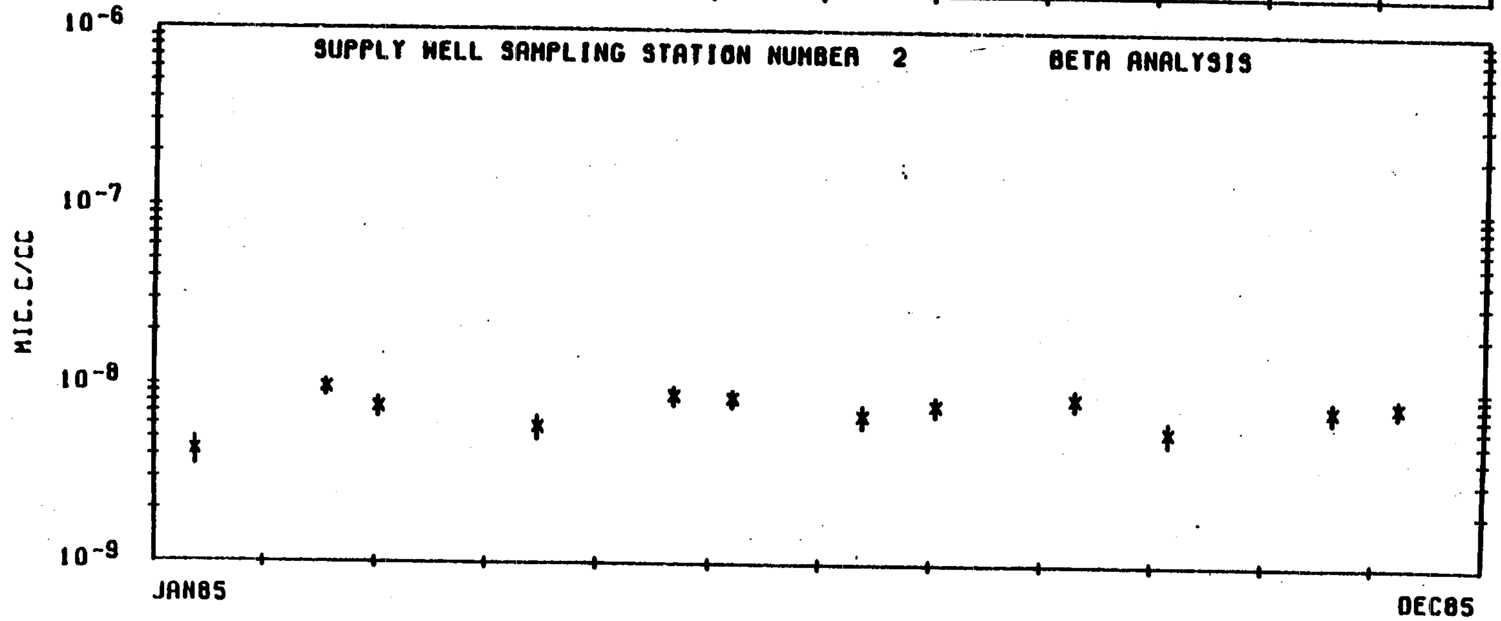
Station Number	Location
1	Area 2 Well 2
2	Area 3 Well A
3	Area 5 Well 5B
4	Area 5 Well 5C
5	Area 5 Well Ue5c
6	Area 6 Well C
7	Area 6 Well C1
9	Area 18 Well 8
13	Area 22 Army Well No. 1
14	Area 25 Well J12
15	Area 25 Well J13
18	Area 19 Well U19c
19	Area 6 Well 4
20	Area 20 Water Well
21	Area 16 Well 16d

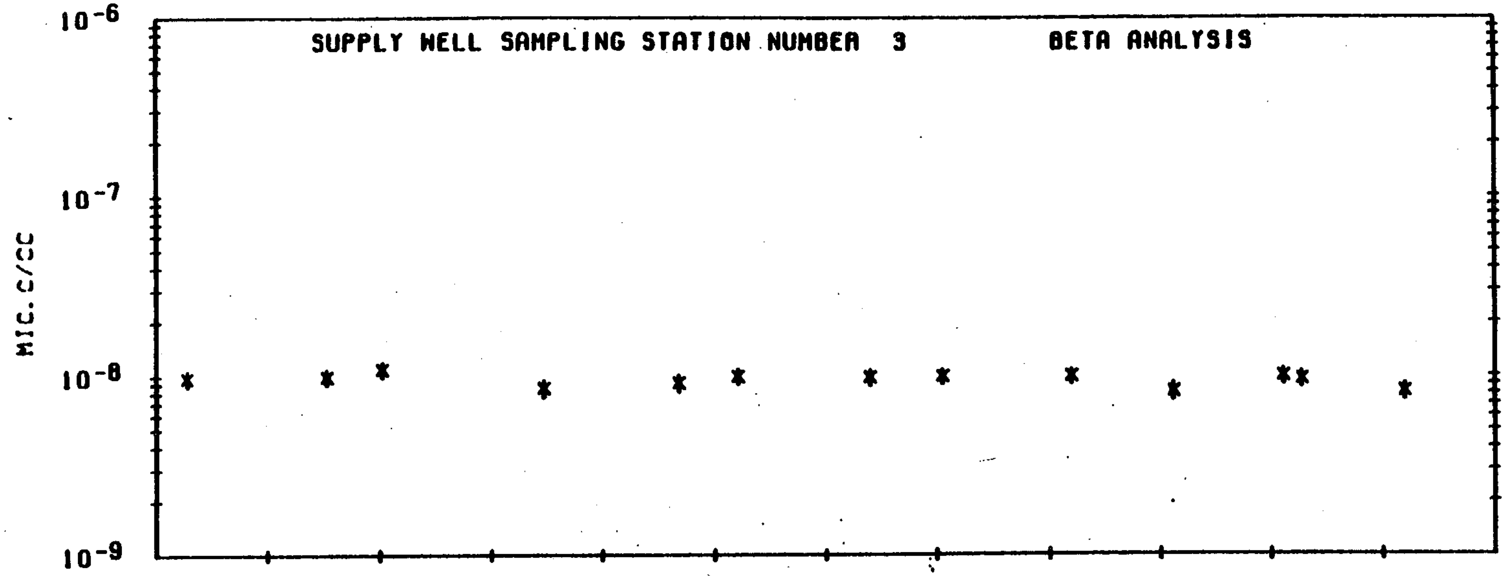

SUPPLY WELL NETWORK AVERAGES
BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹
JAN85
DEC85

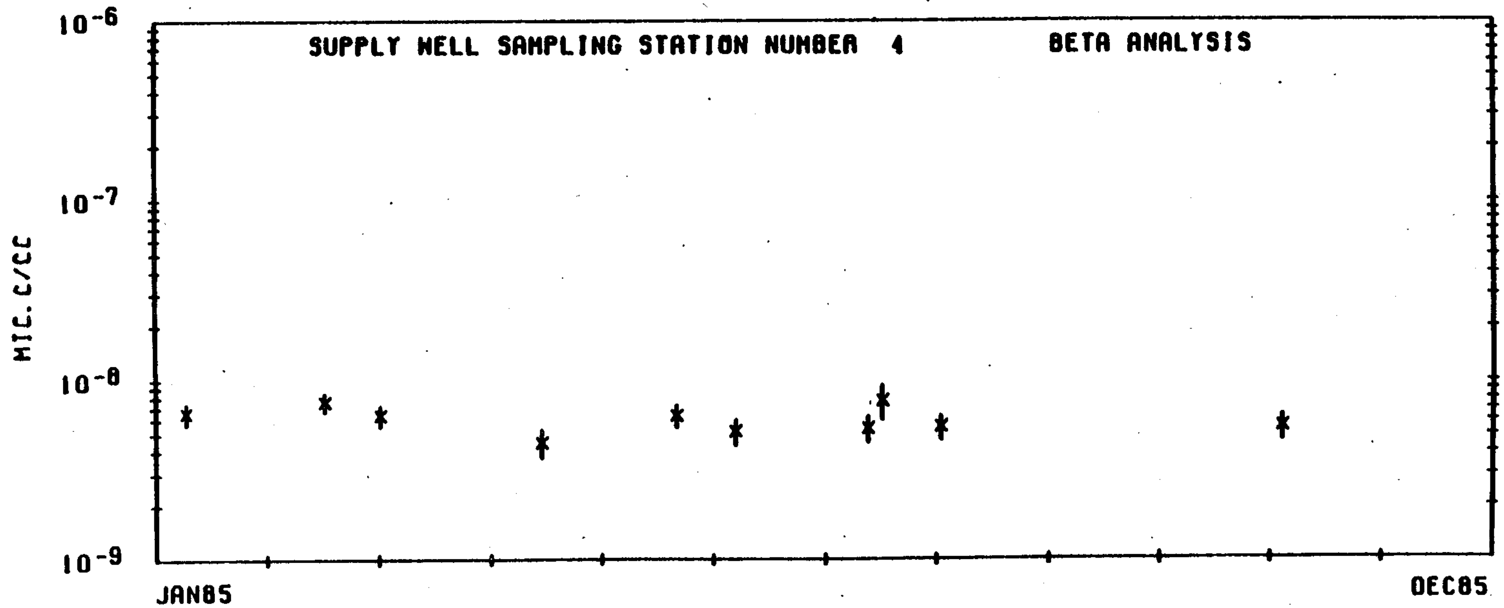
SUPPLY WELL NETWORK AVERAGES

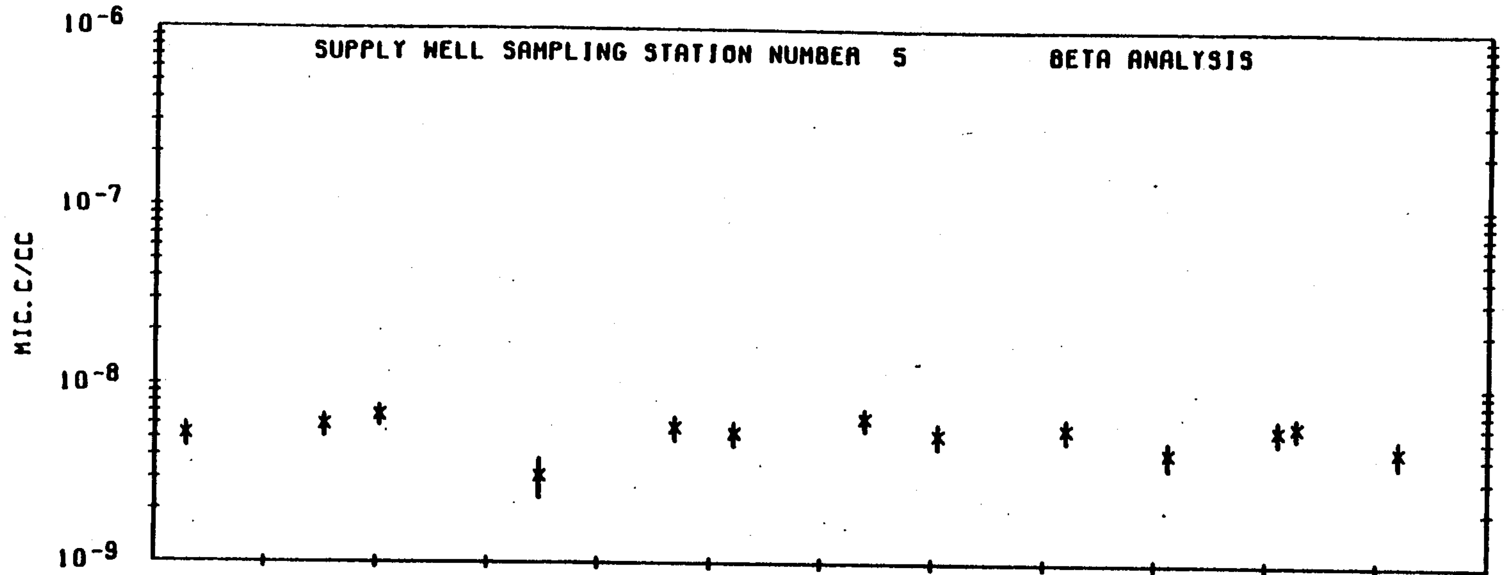


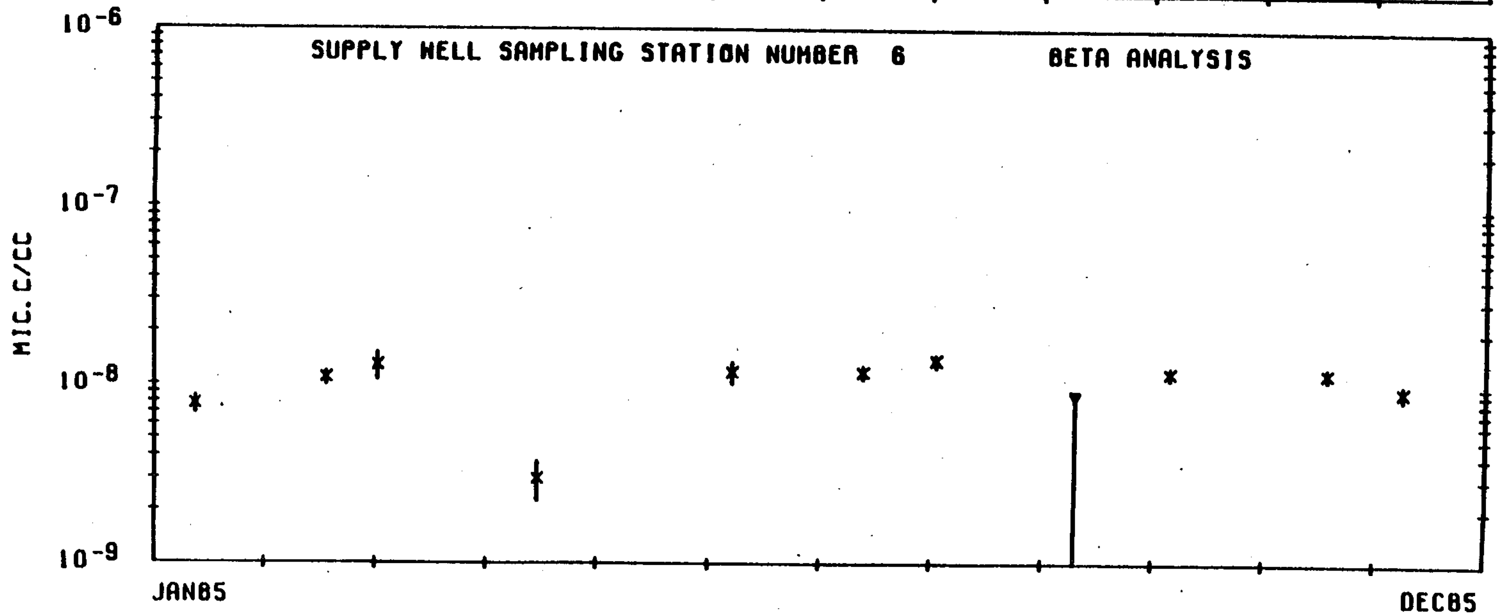

SUPPLY WELL SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC. C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

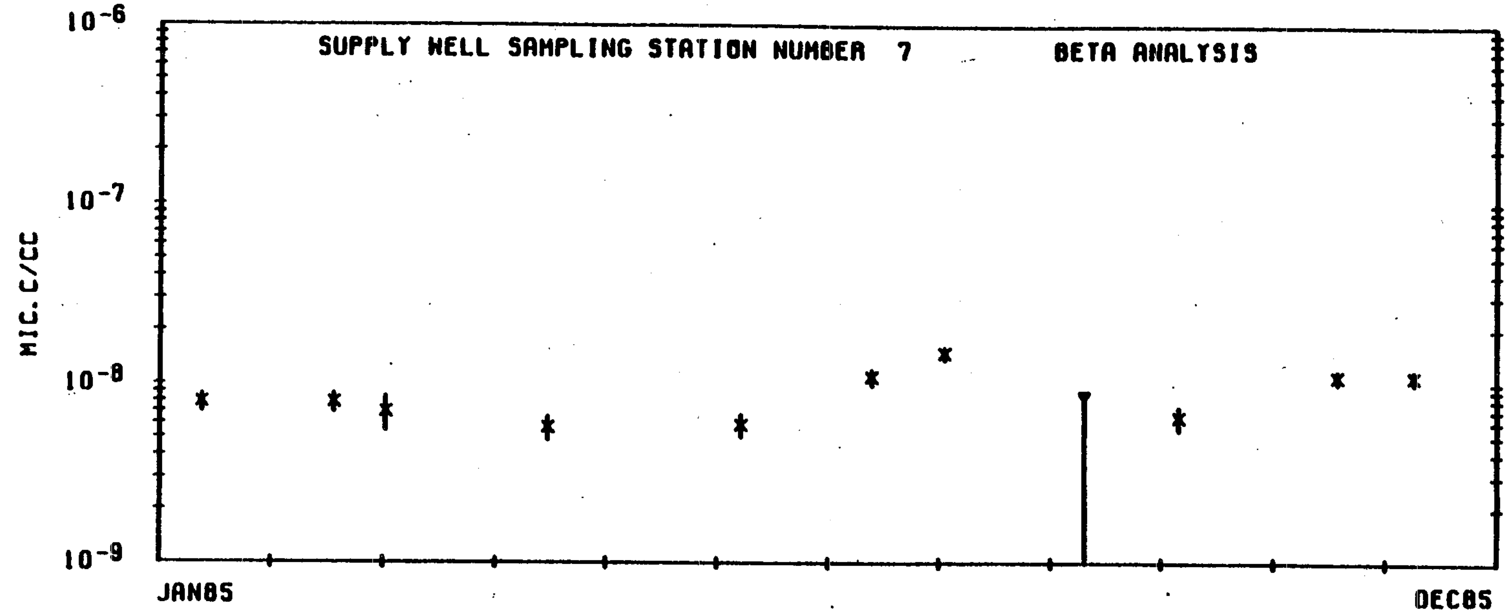

SUPPLY WELL SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC. C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

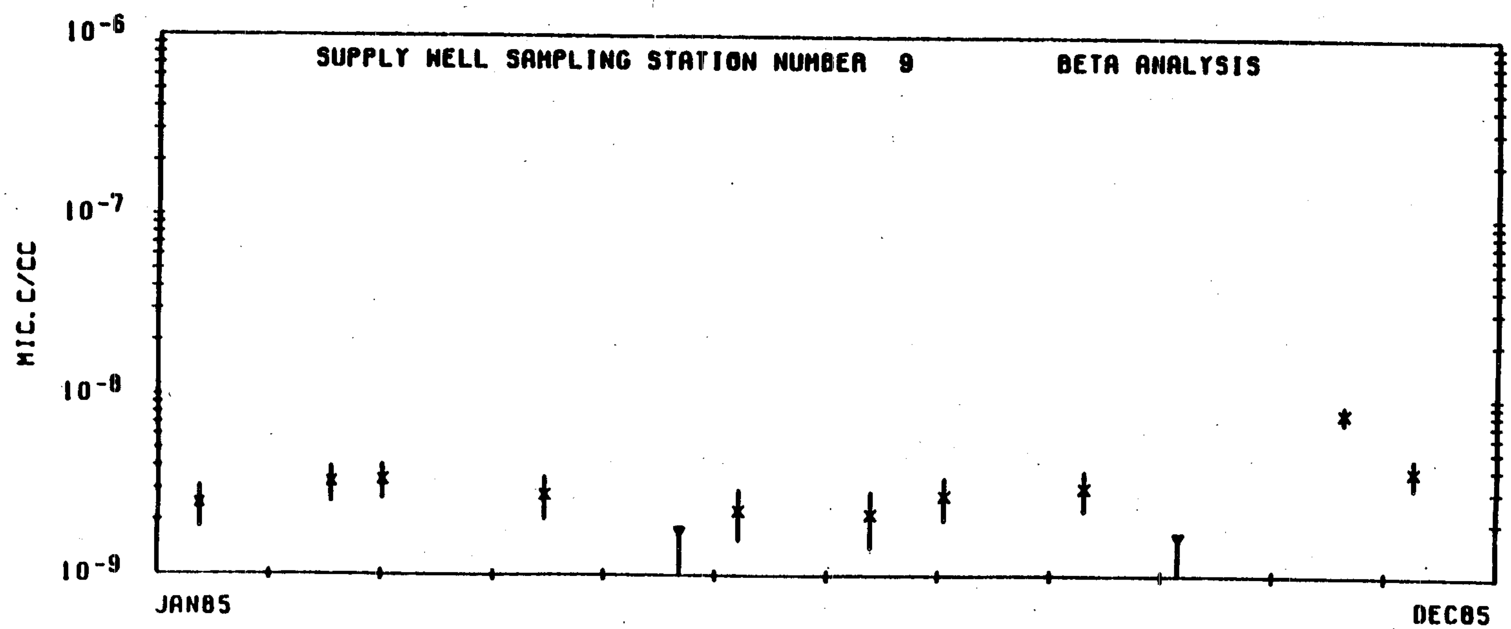

SUPPLY WELL SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC. C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

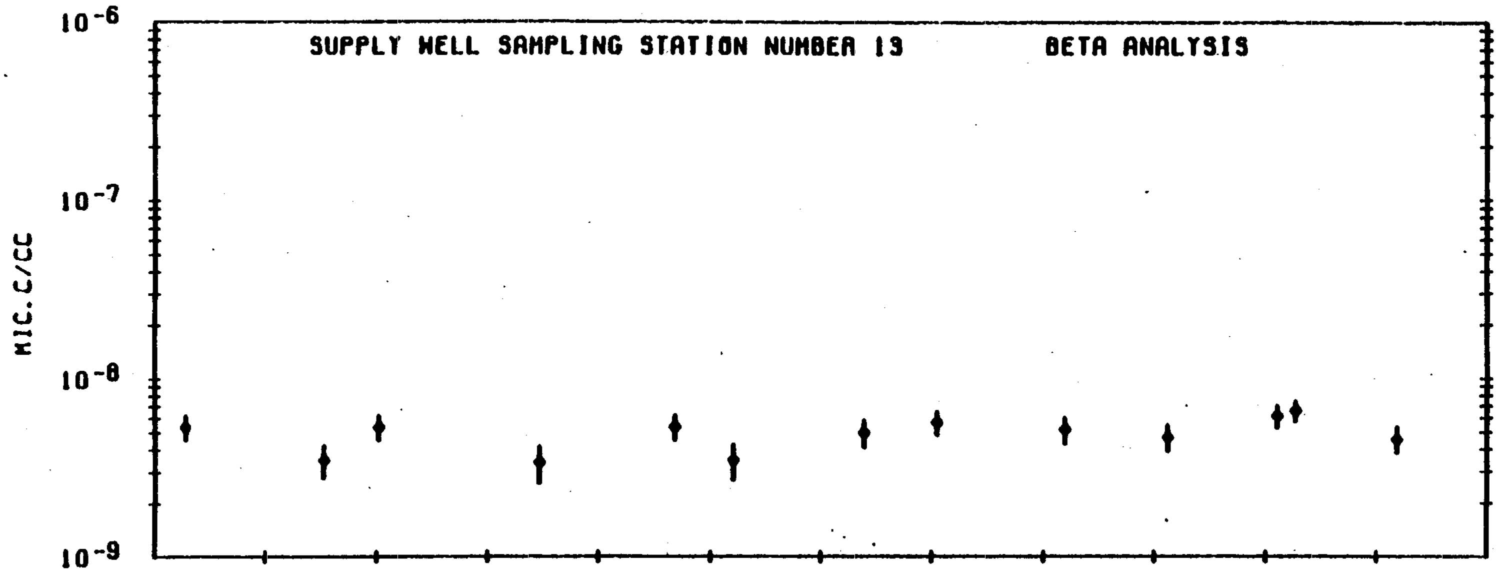

SUPPLY WELL SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC. C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

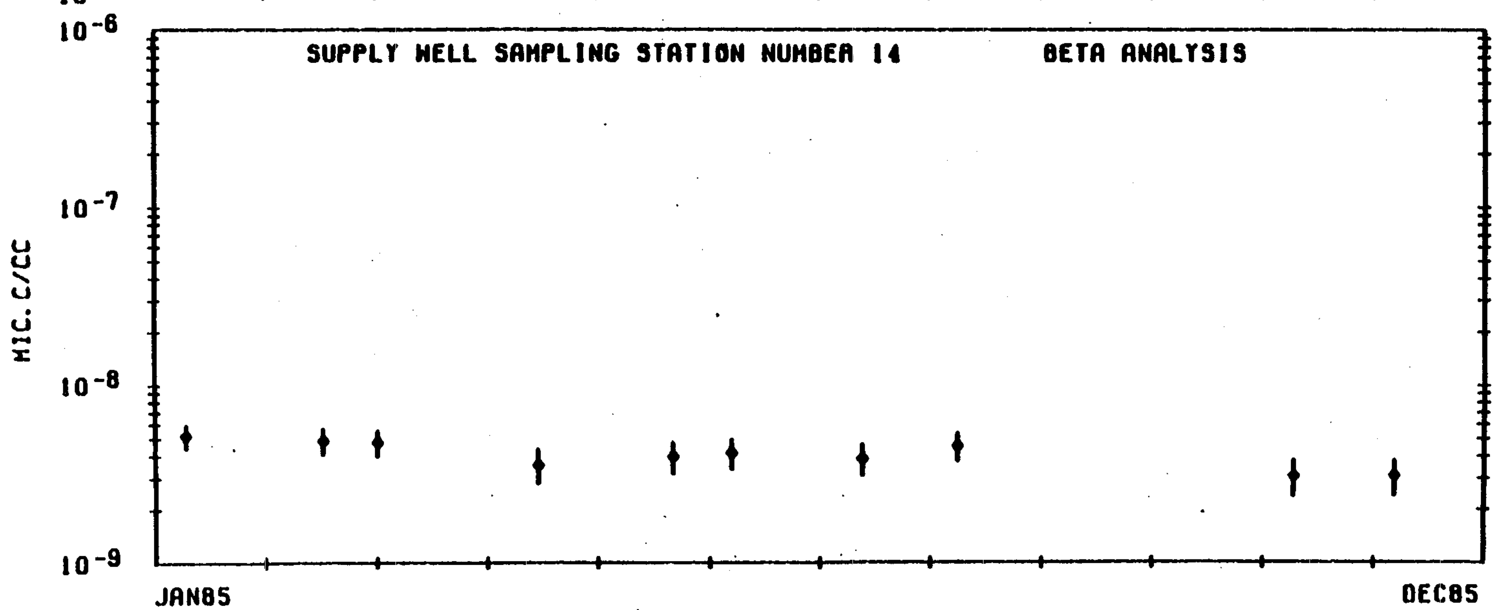

SUPPLY WELL SAMPLING STATION NUMBER 5
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

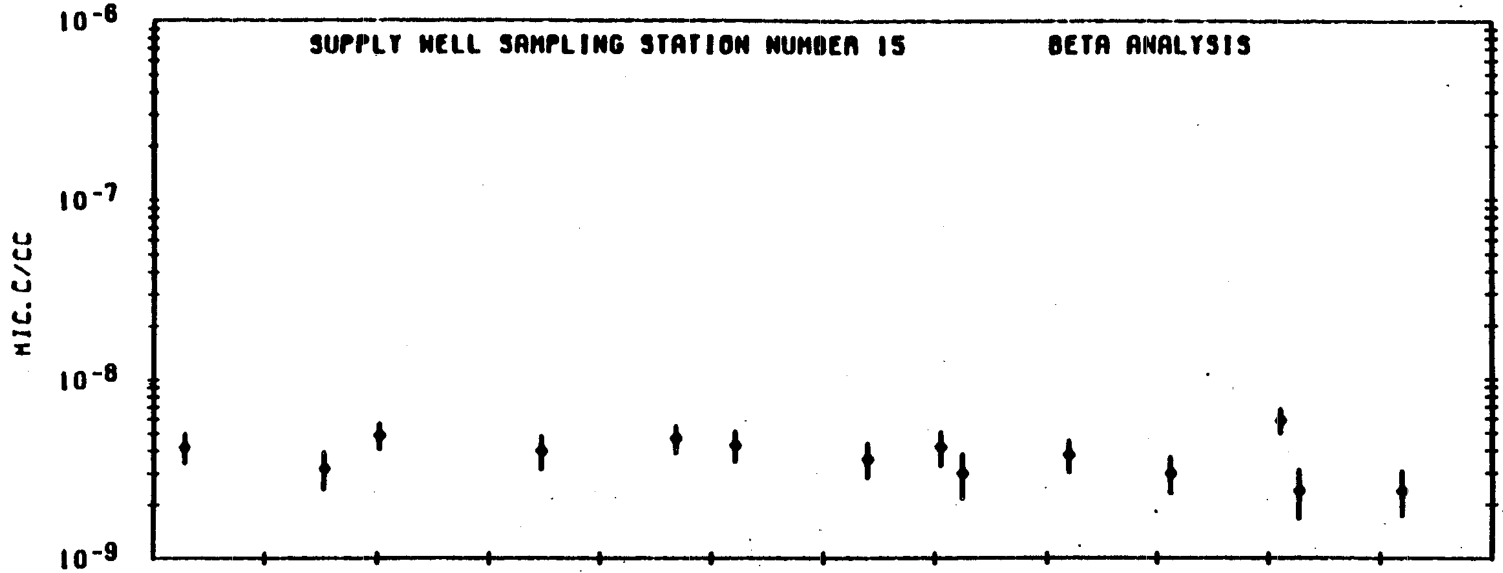

SUPPLY WELL SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

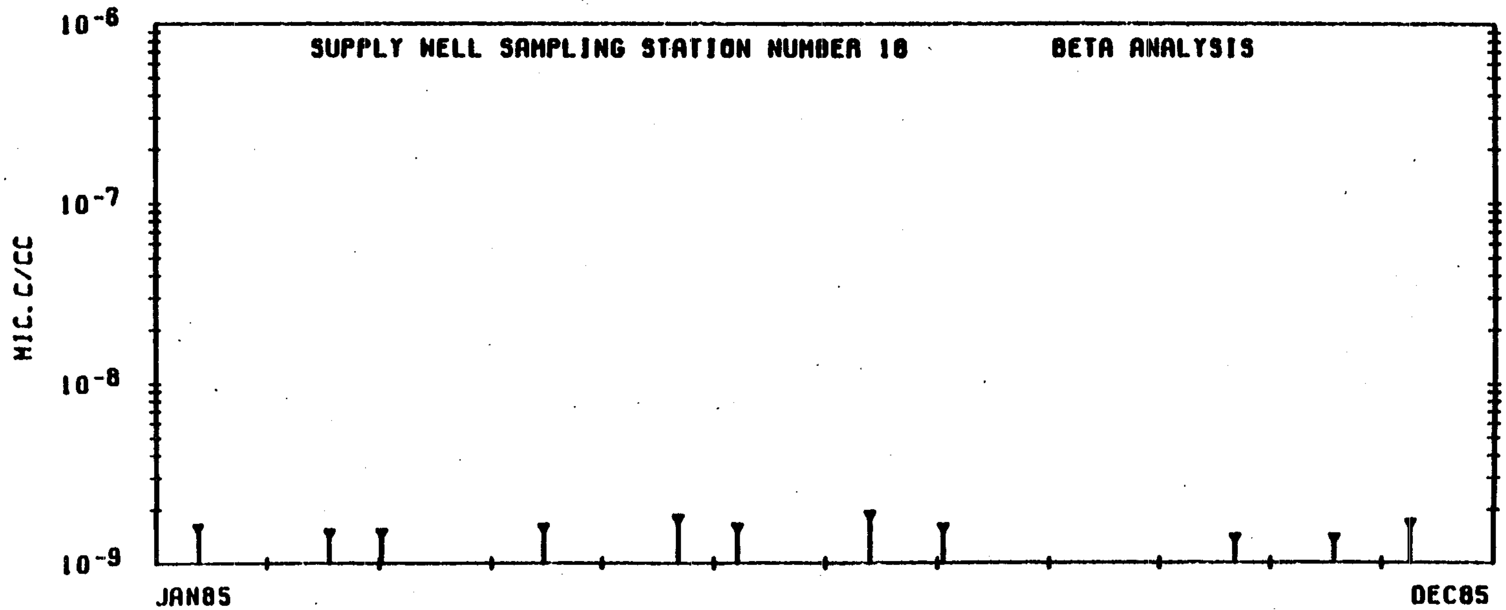

SUPPLY WELL SAMPLING STATION NUMBER 7
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

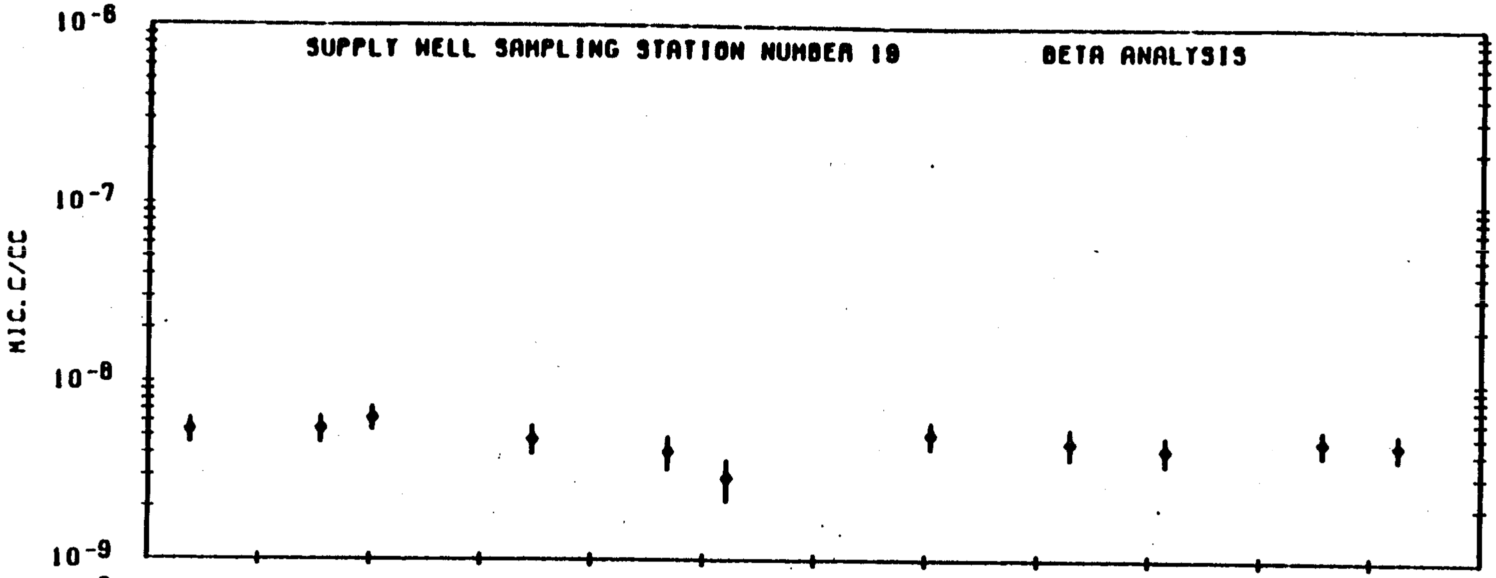

SUPPLY WELL SAMPLING STATION NUMBER 9
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

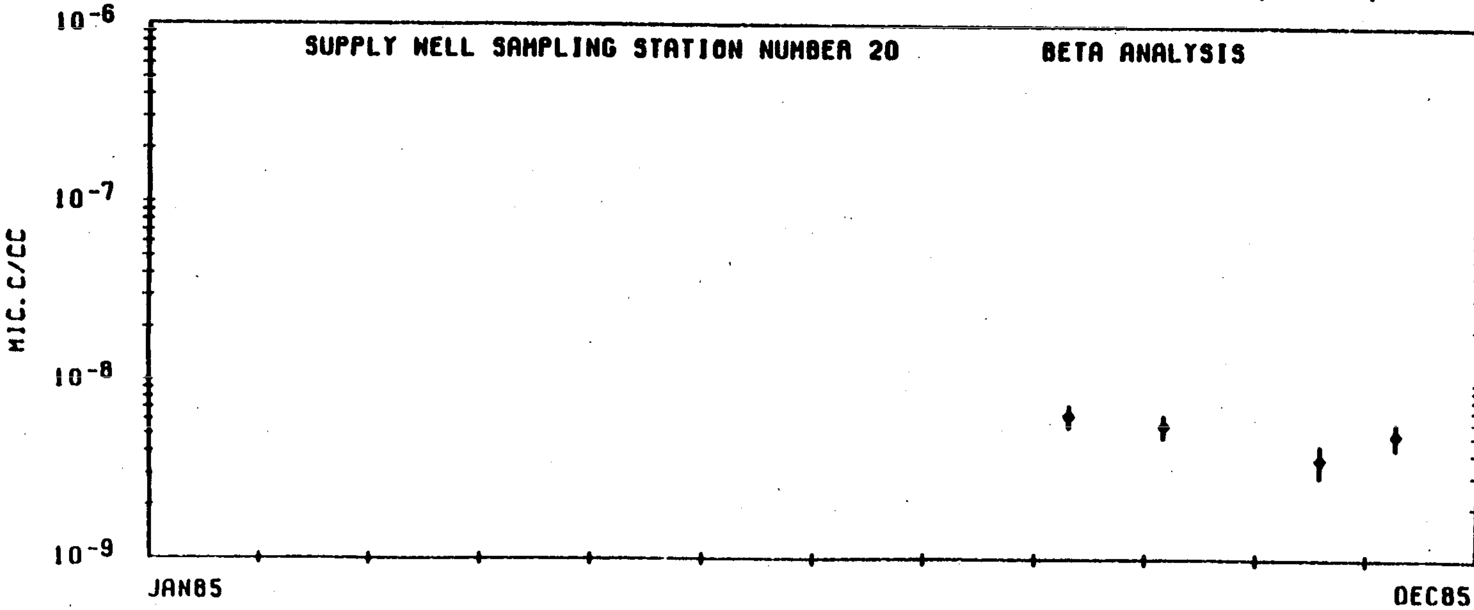

SUPPLY WELL SAMPLING STATION NUMBER 13
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

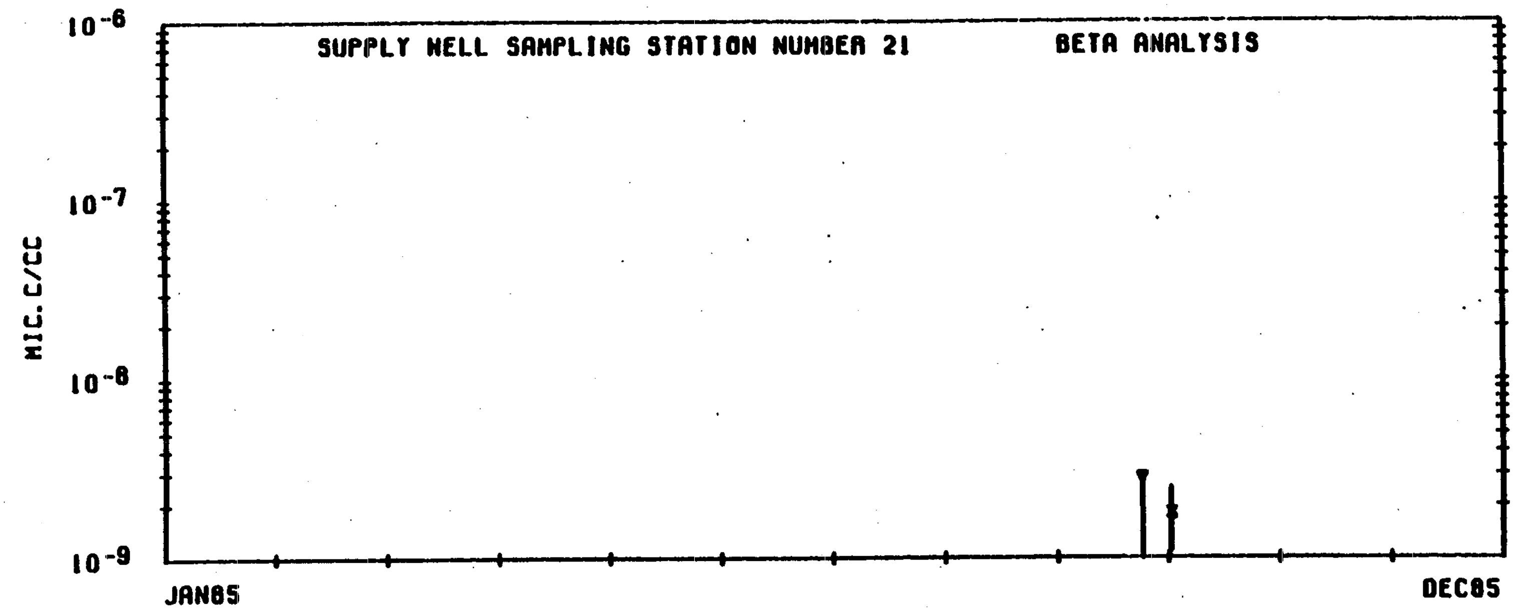

SUPPLY WELL SAMPLING STATION NUMBER 14
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85


SUPPLY WELL SAMPLING STATION NUMBER 15
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


SUPPLY WELL SAMPLING STATION NUMBER 18
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85


SUPPLY WELL SAMPLING STATION NUMBER 19
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


SUPPLY WELL SAMPLING STATION NUMBER 20
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85


SUPPLY WELL SAMPLING STATION NUMBER 21
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

A P P E N D I X D

NTS Environmental Surveillance

Potable Water Locations and Plots

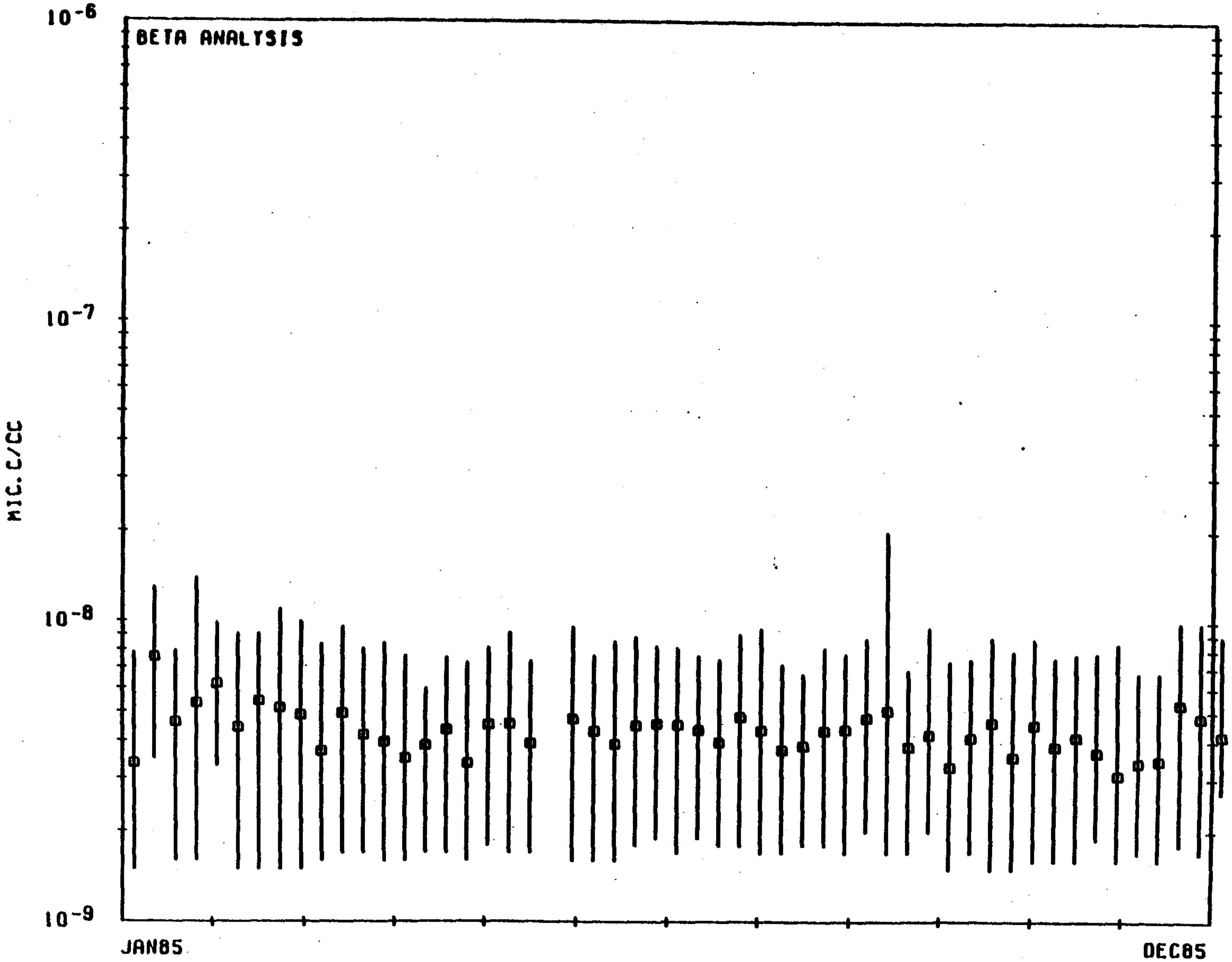
In the first two pages of plots in Appendix D, the potable water network averages, a square is used to represent the arithmetic mean of all values at that point in time, and the vertical line is the range of the data.

The remaining plots show the gross beta data of each station. A two-sigma error bar is also added to the data points, and, in all plots, a delta with a line to the bottom of the plot means below detection limit.

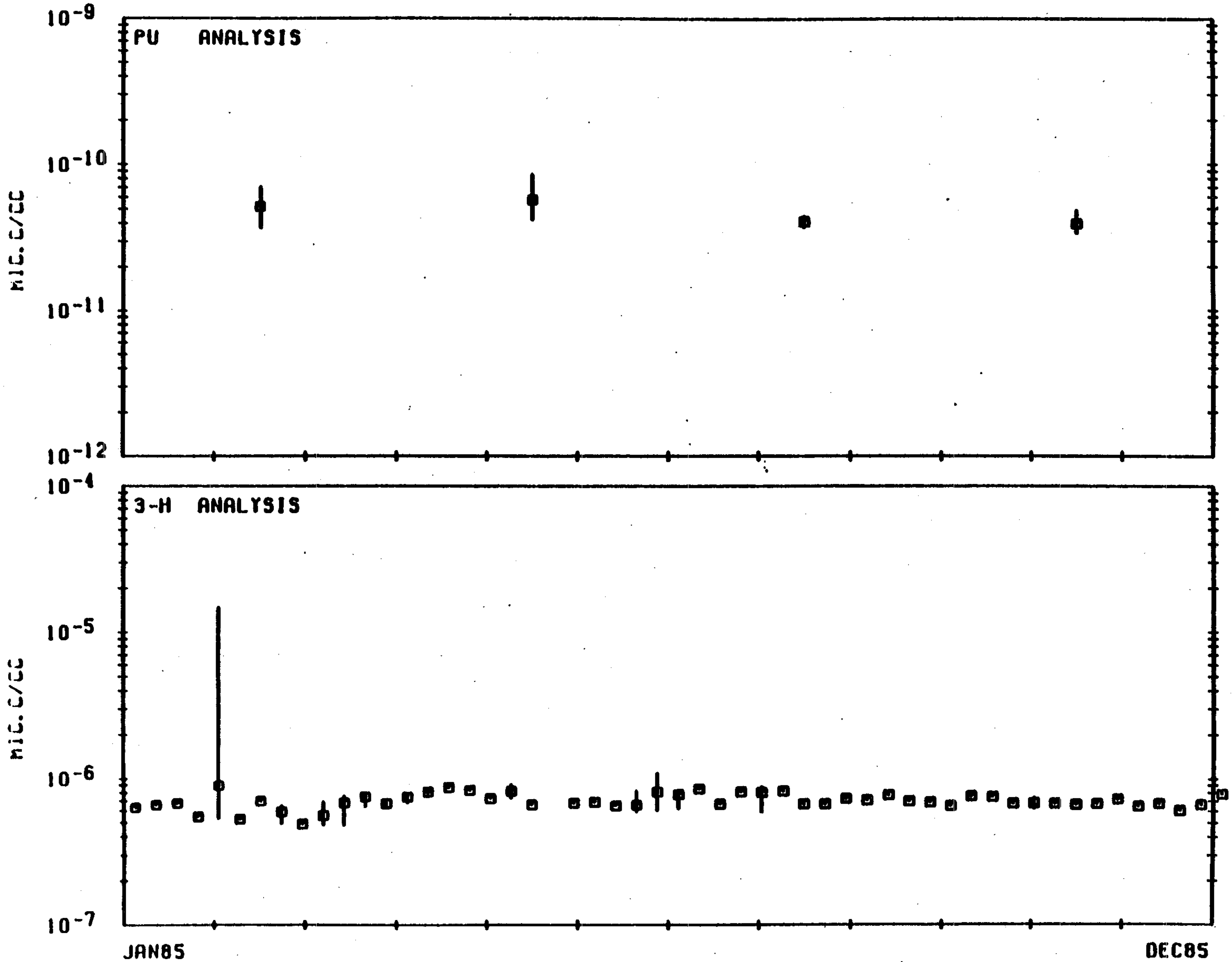
NTS ENVIRONMENTAL SURVEILLANCE
POTABLE WATER SAMPLING LOCATIONS

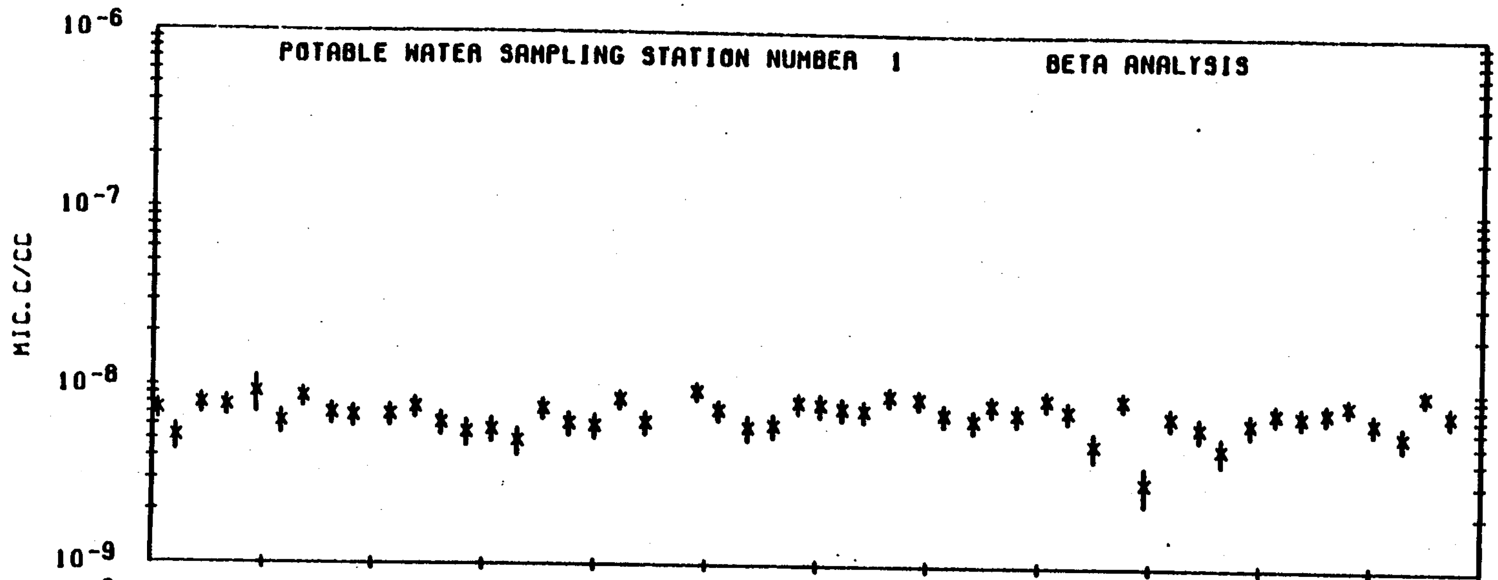
Station Number	Location
1	Area 3 Cafeteria
2	Area 2 Rest Room
3	Area 12 Cafeteria
4	Area 23 Cafeteria
5	Area 27 Cafeteria
6	Area 6 Cascade Water
7	Area 6 Cafeteria
10	Area 25 Service Station

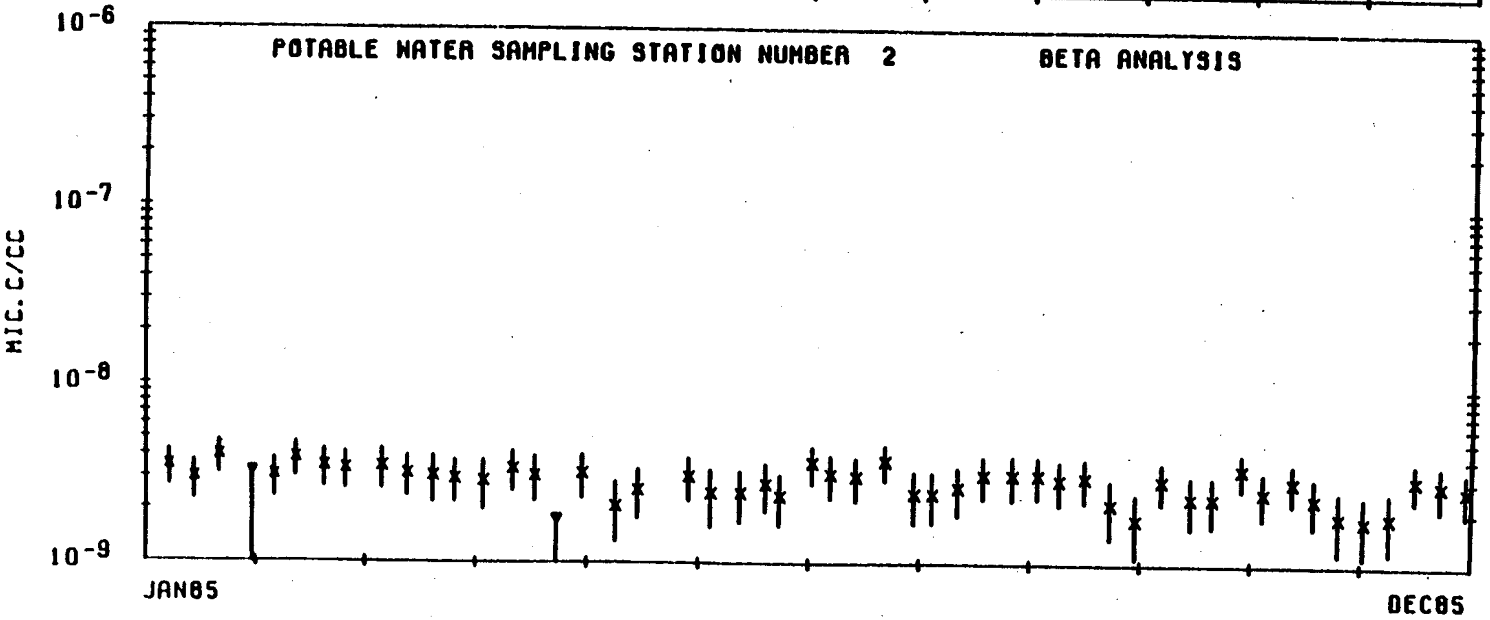
POTABLE WATER NETWORK AVERAGES

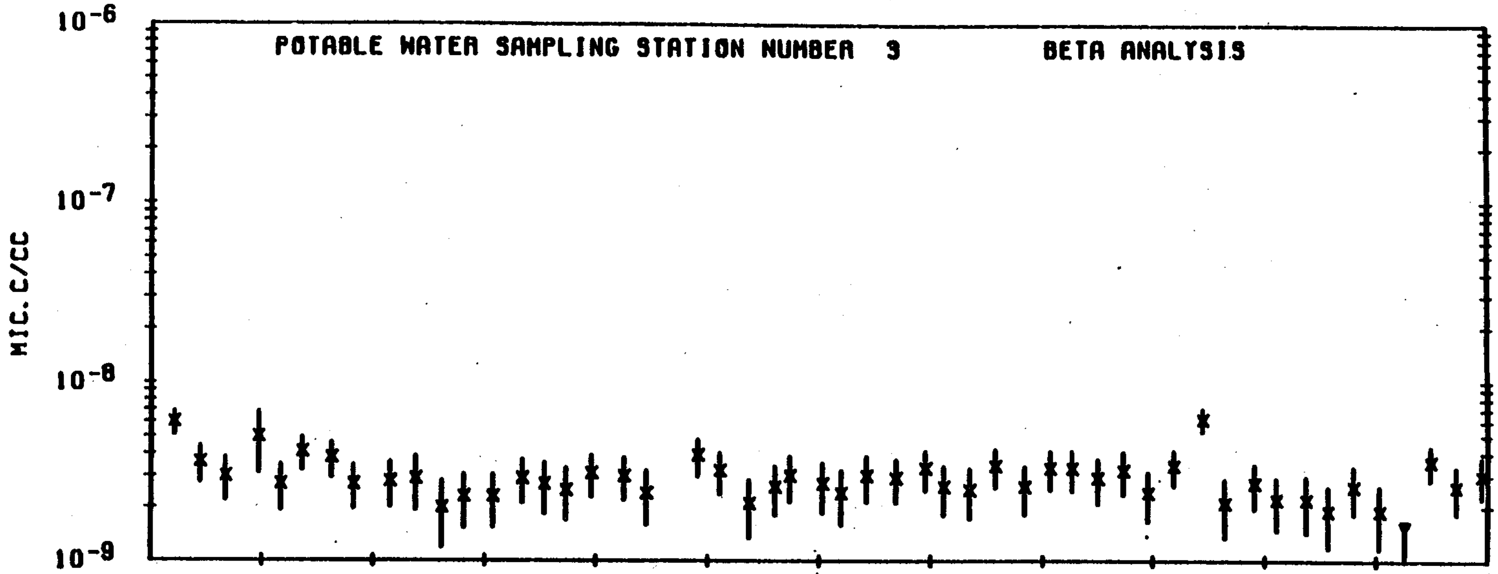


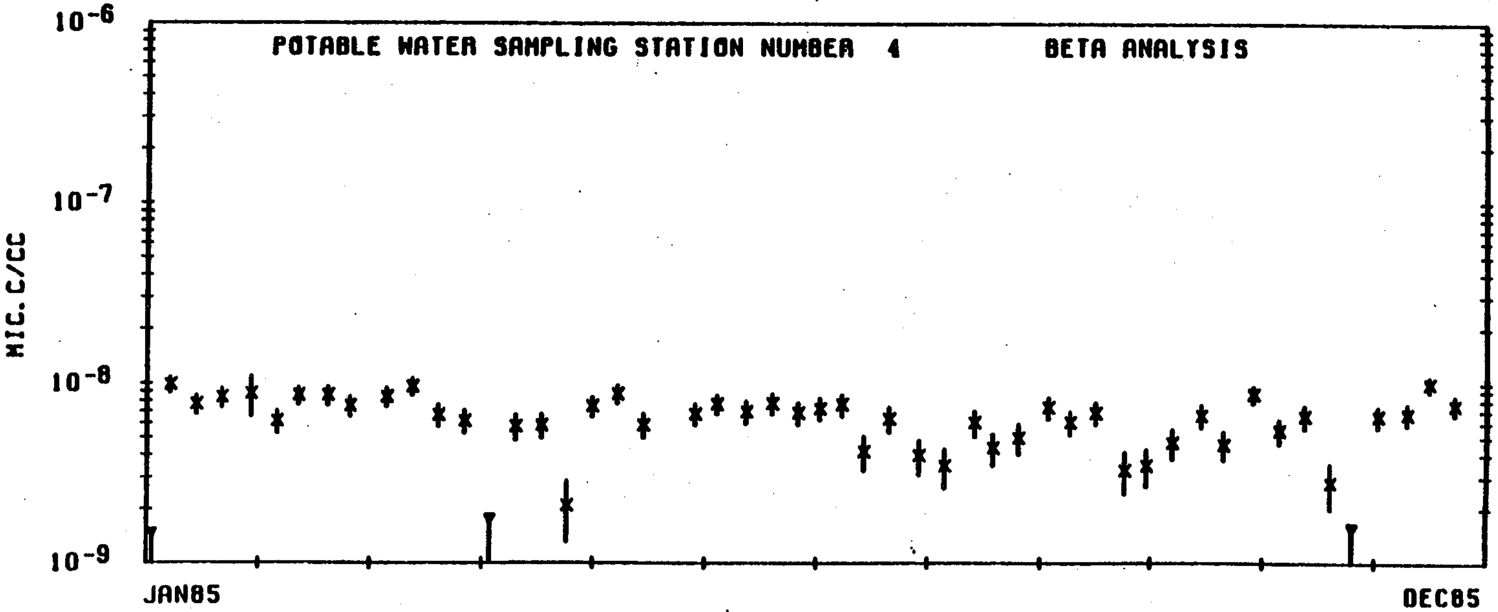
POTABLE WATER NETWORK AVERAGES

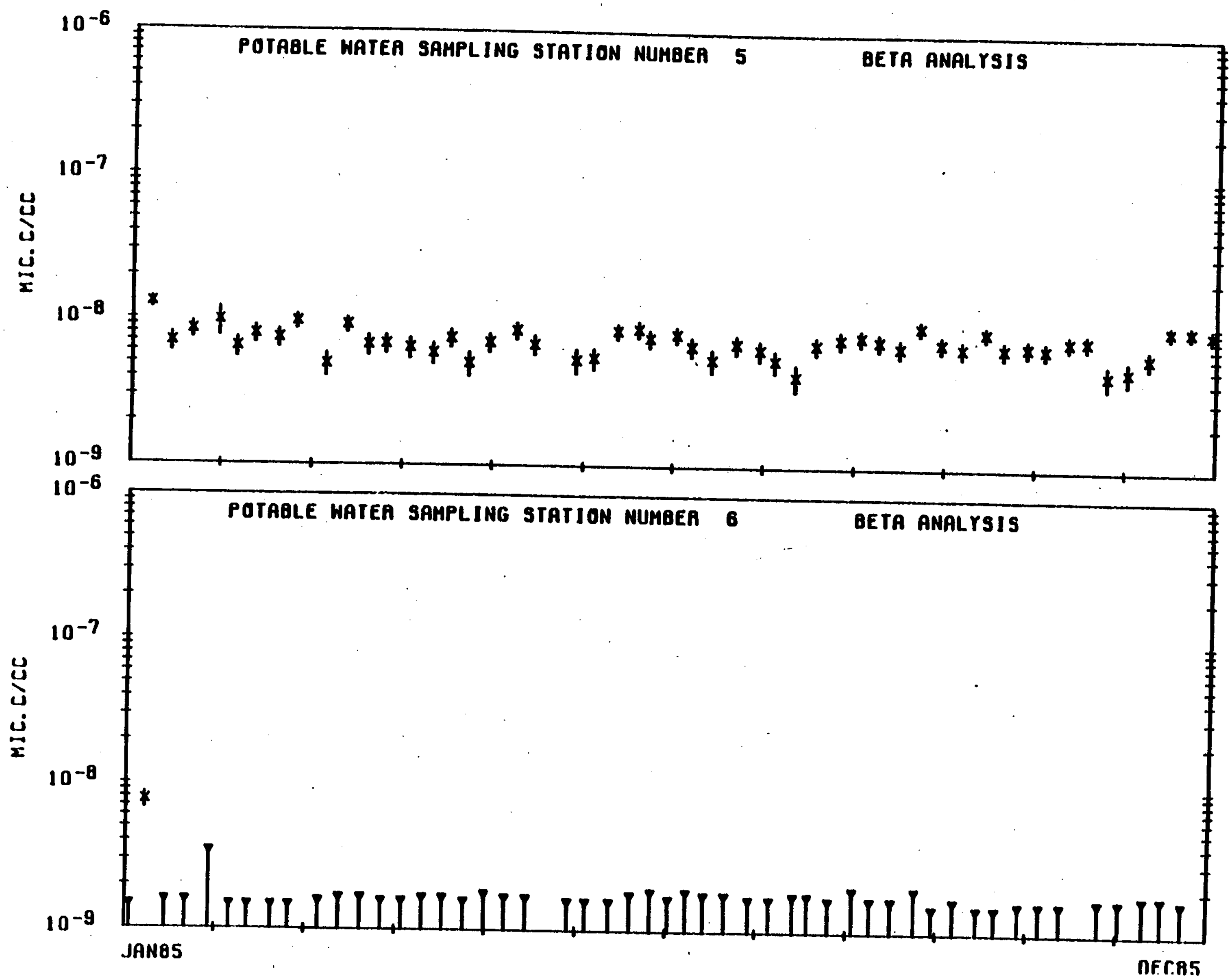


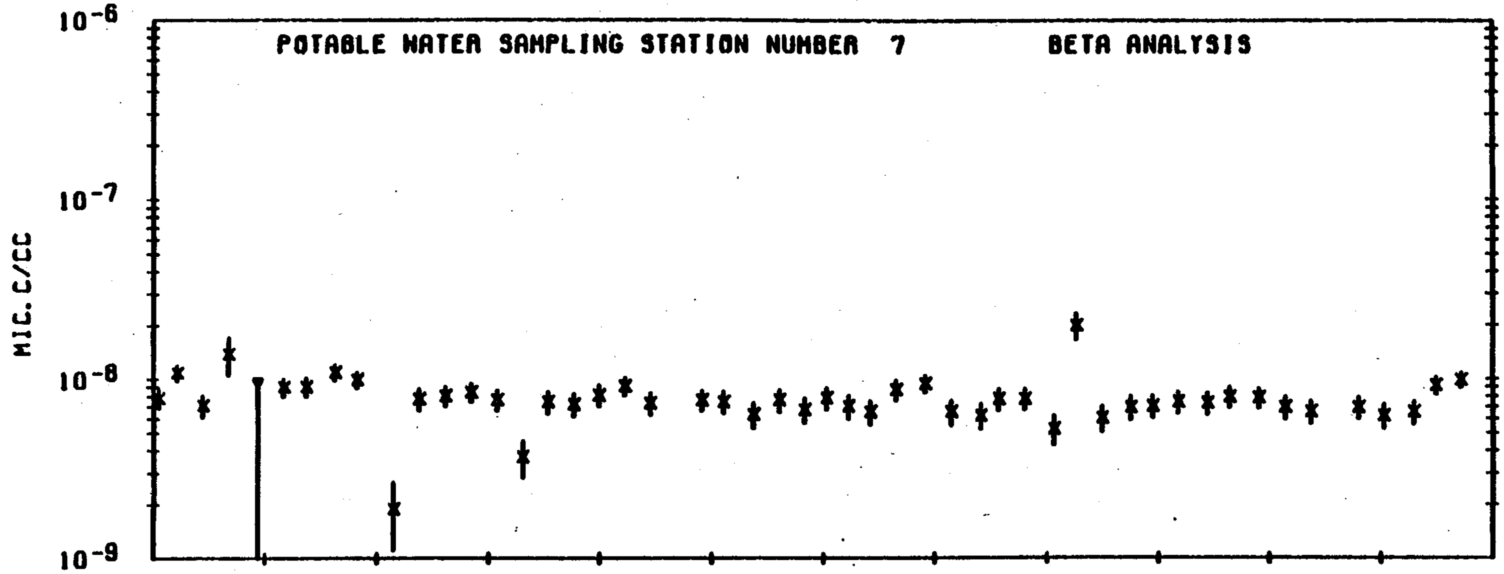

POTABLE WATER SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9

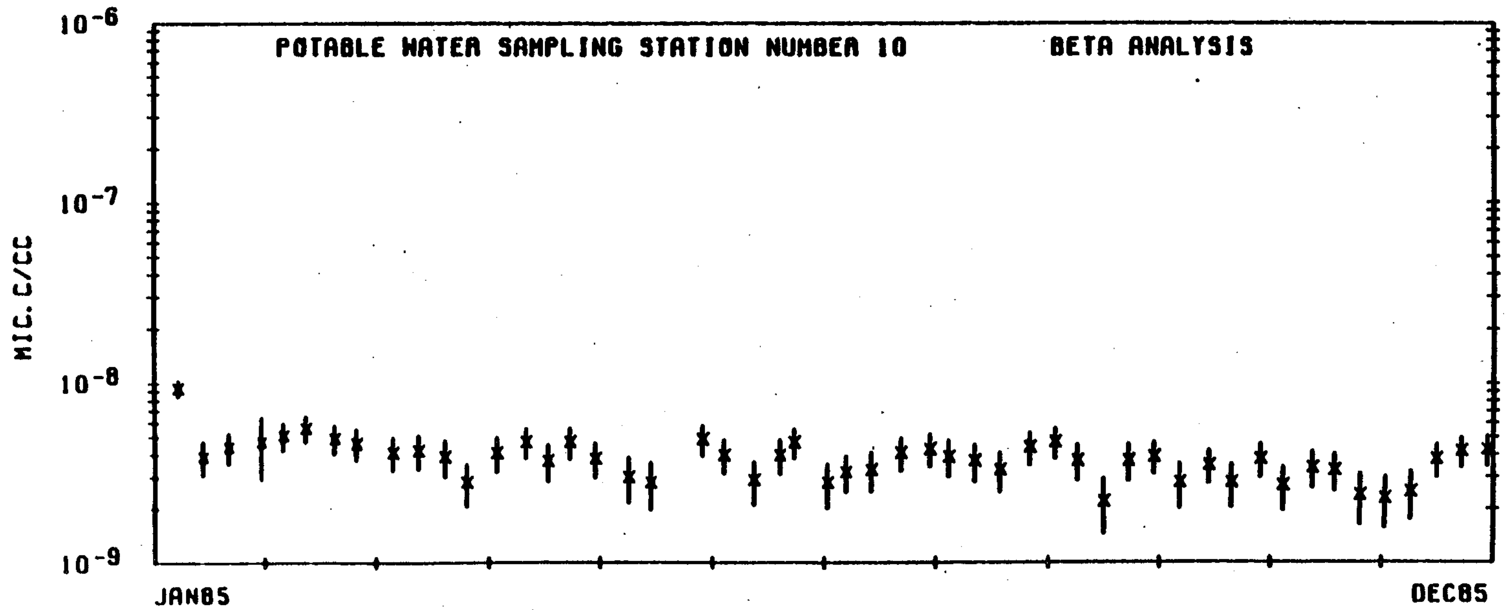

POTABLE WATER SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN85
DEC85


POTABLE WATER SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10-6
10-7
10-8
10-9


POTABLE WATER SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10-6
10-7
10-8
10-9
JAN85
DEC85


POTABLE WATER SAMPLING STATION NUMBER 5
BETA ANALYSIS
MIC.C/CC
10-6
10-7
10-8
10-9
POTABLE WATER SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10-6
10-7
10-8
10-9
JAN85
DEC85


POTABLE WATER SAMPLING STATION NUMBER 7
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


POTABLE WATER SAMPLING STATION NUMBER 10
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

A P P E N D I X   E

NTS Environmental Surveillance

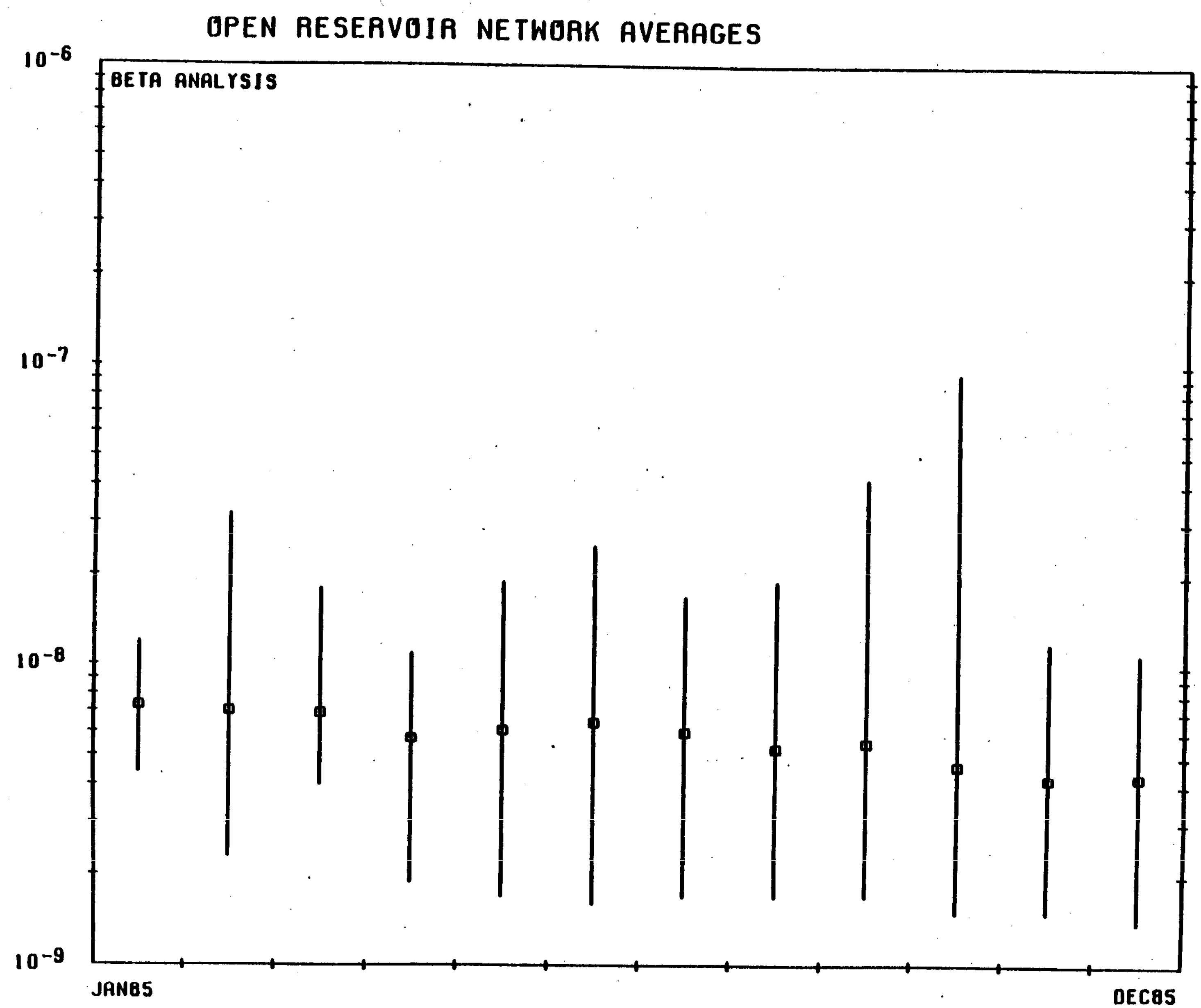
Open Reservoir Locations and Plots

Several symbols are used in Appendix E to denote the data points. In the first two pages of plots, the open reservoir network averages, a square represents the arithmetic mean of all values at that point in time, and the vertical line is the range of the data. The remaining plots of Appendix E show the gross beta data of each station. A two-sigma error is also added to the data points, and, in all plots, a delta with the line to the bottom of the plot means below detection limit.

NTS ENVIRONMENTAL SURVEILLANCE
OPEN RESERVOIRS SAMPLING LOCATIONS

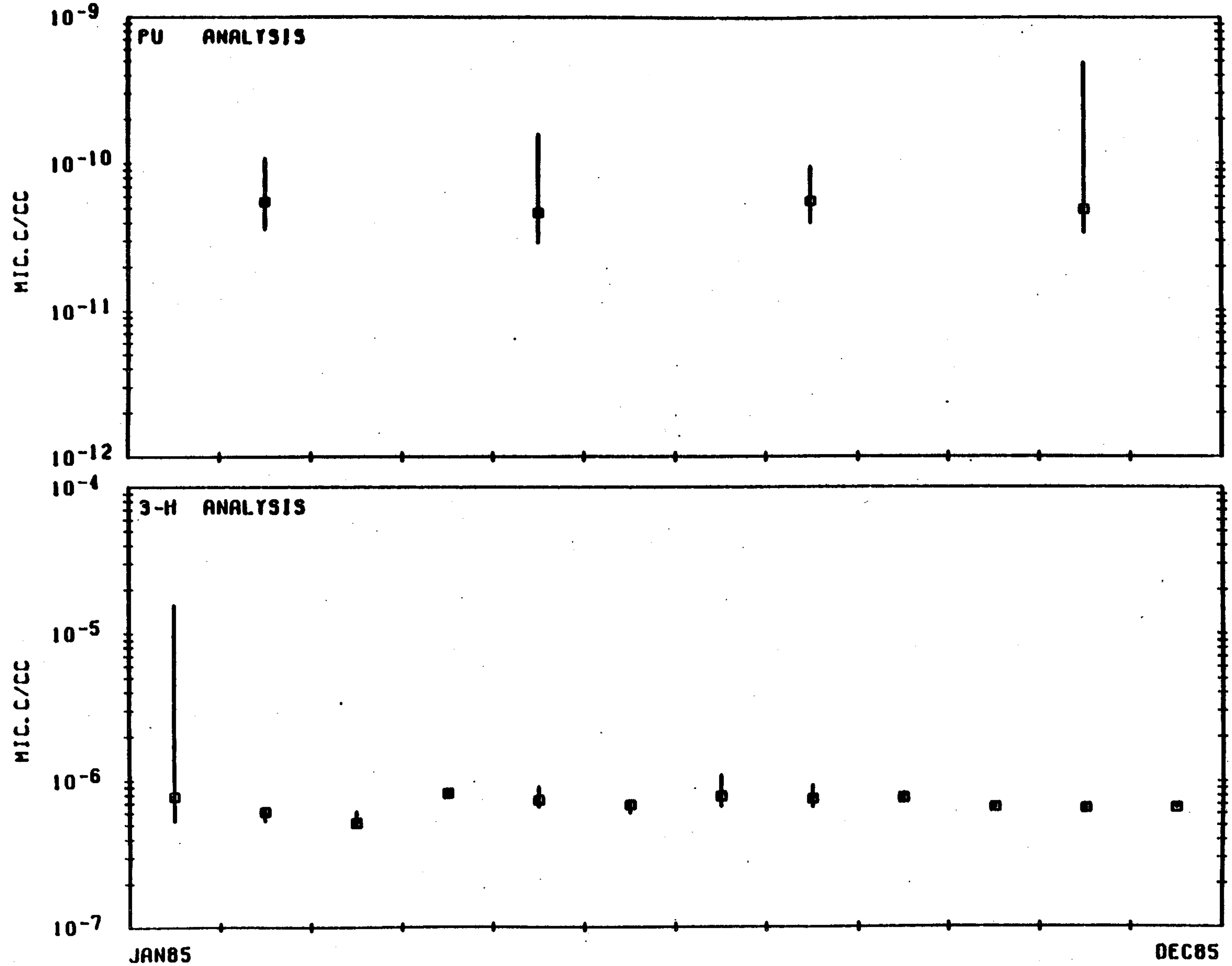
Station Number	Location
1	Area 2 Well 2 Reservoir
2	Area 3 Well A Reservoir
3	Area 5 Well 5B Reservoir
4	Area 5 Well Ue5c Reservoir
5	Area 6 Well 3 Reservoir
6	Area 6 Well C1 Reservoir
8	Area 18 Camp 17 Reservoir
11	Area 20 Well 20A Reservoir
12	Area 23 Swimming Pool
16	Area 19 Well U19c Reservoir
* 17	Area 25 Well J-12 Reservoir
18	Area 3 Mud Plant Reservoir
19	Area 2 Mud Plant Reservoir
20	Area 25 Well J-11 Reservoir
21	Area 18 Well 8 Reservoir
22	Area 5 Reservoir

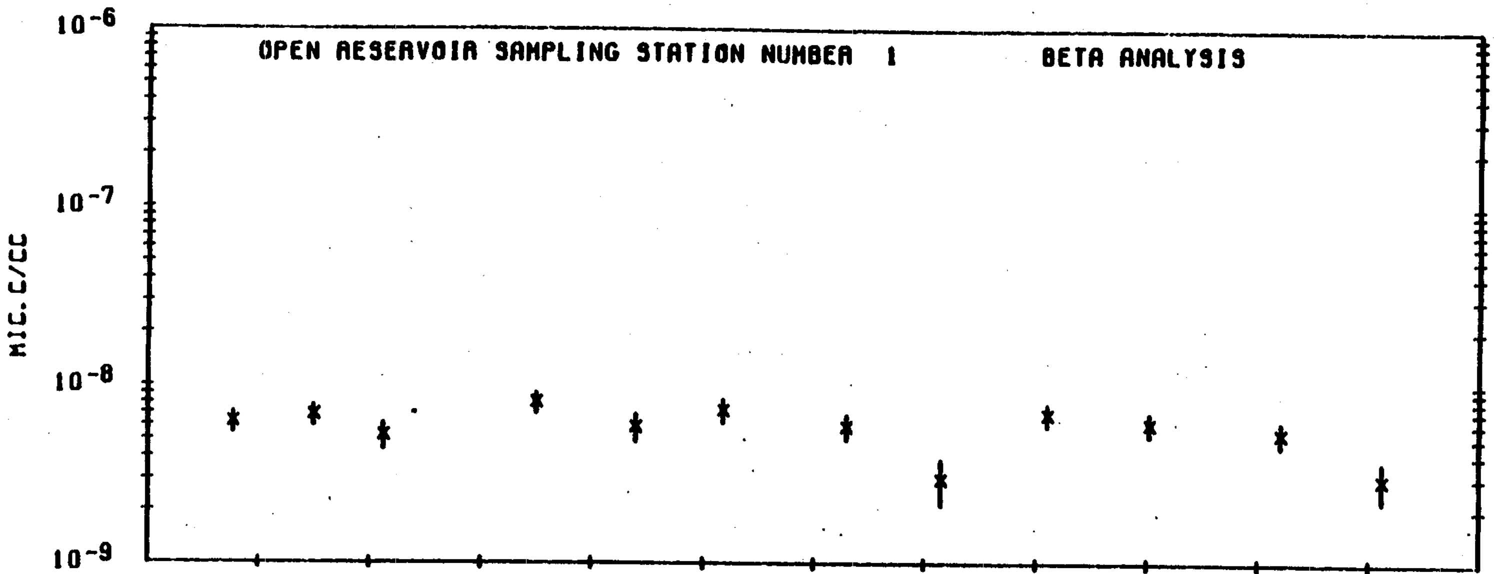
* Reservoir was dry.

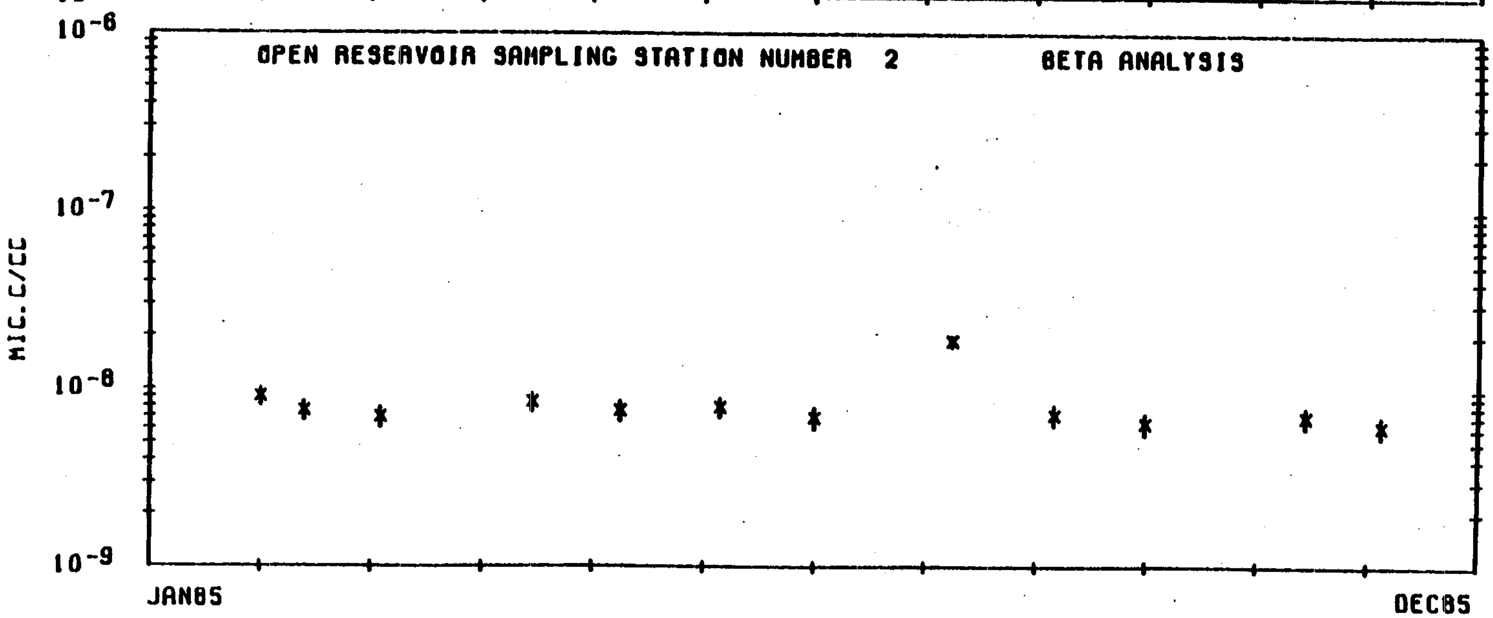


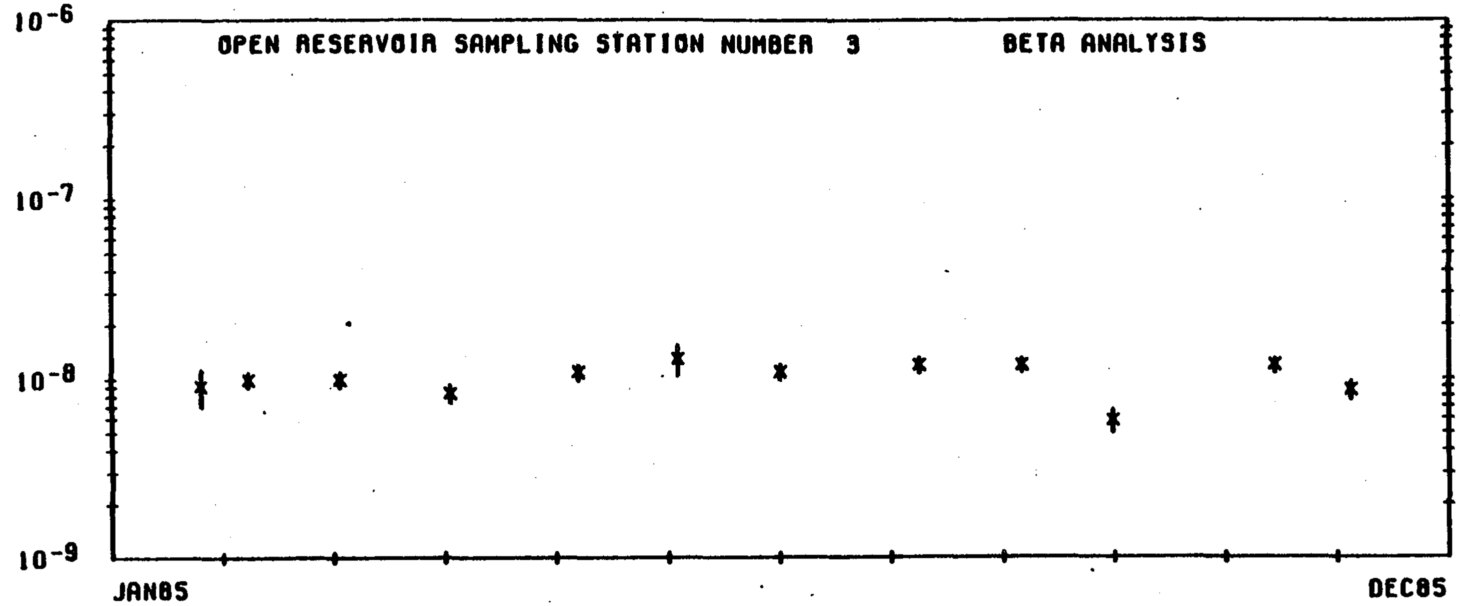
OPEN RESERVOIR NETWORK AVERAGES
BETA ANALYSIS
10-6
10-7
10-8
10-9
MIC.C/CC
JAN85
DEC85

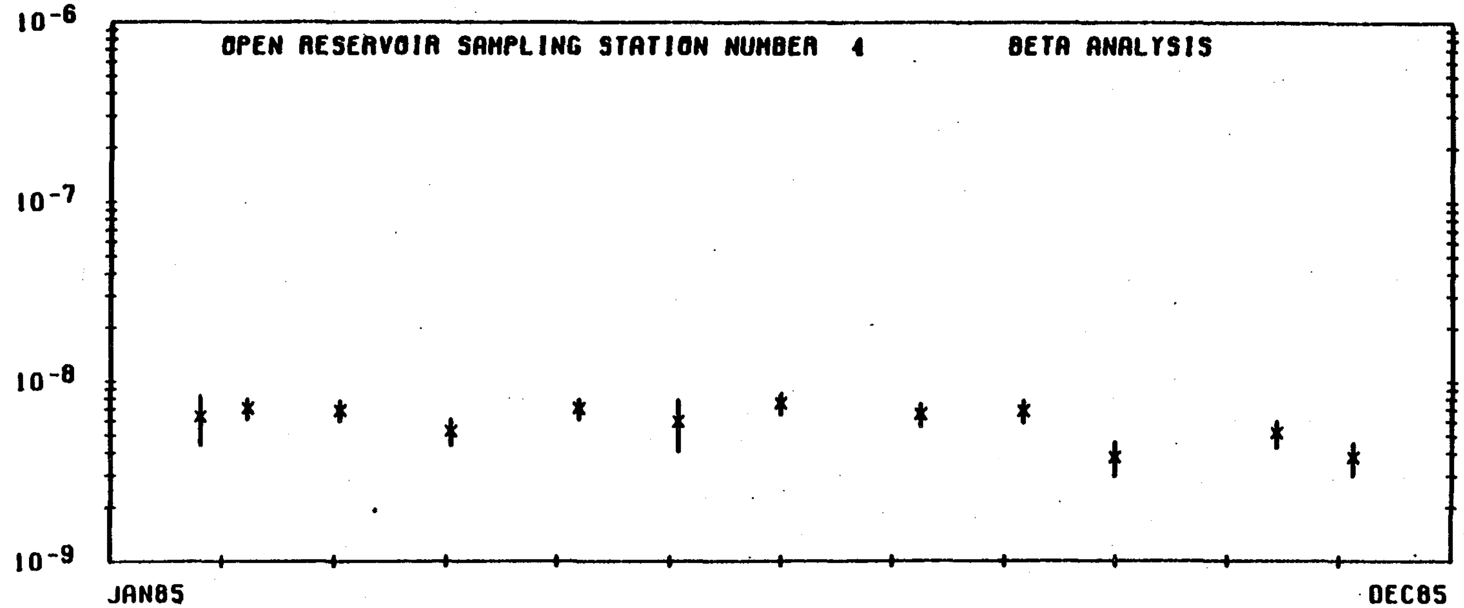
OPEN RESERVOIR NETWORK AVERAGES

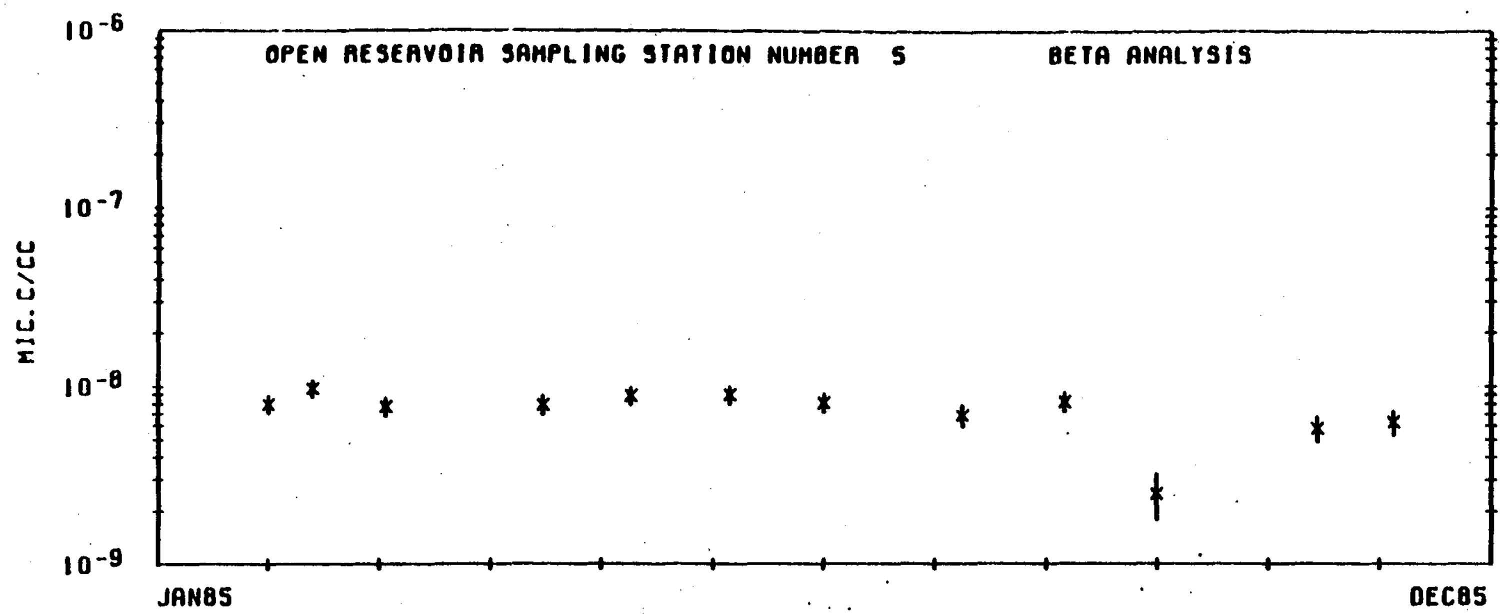


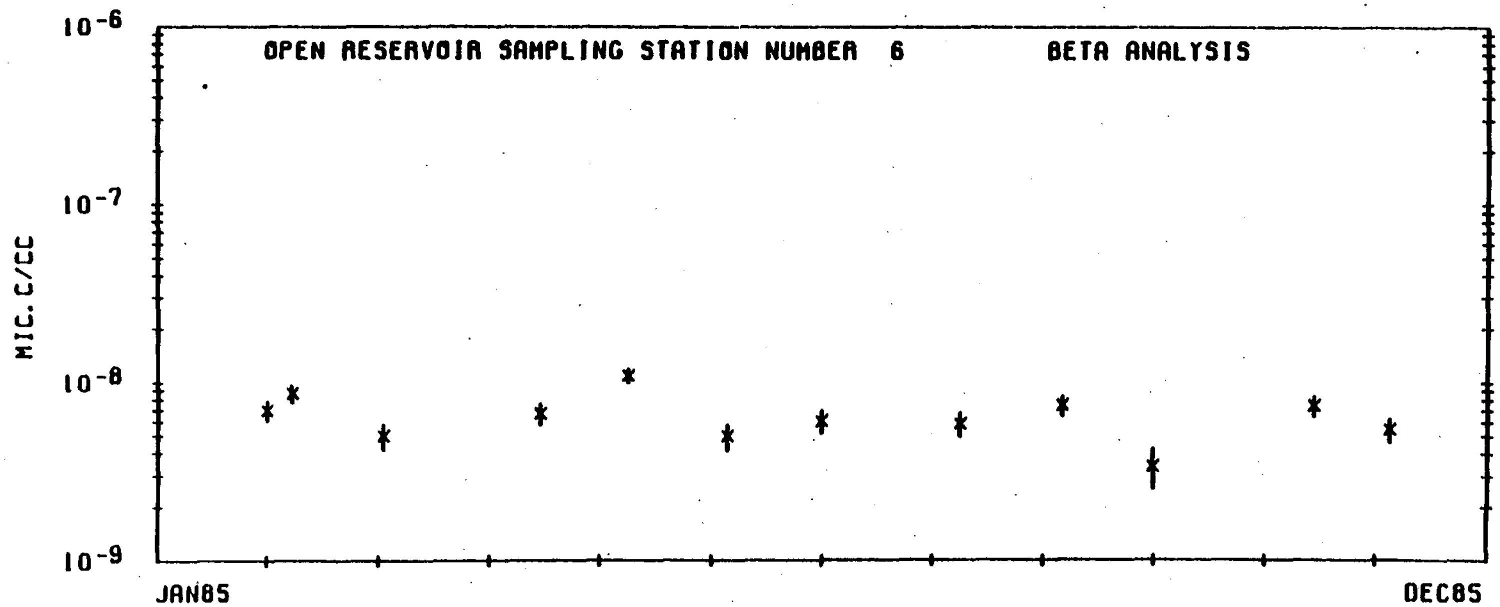

OPEN RESERVOIR SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹

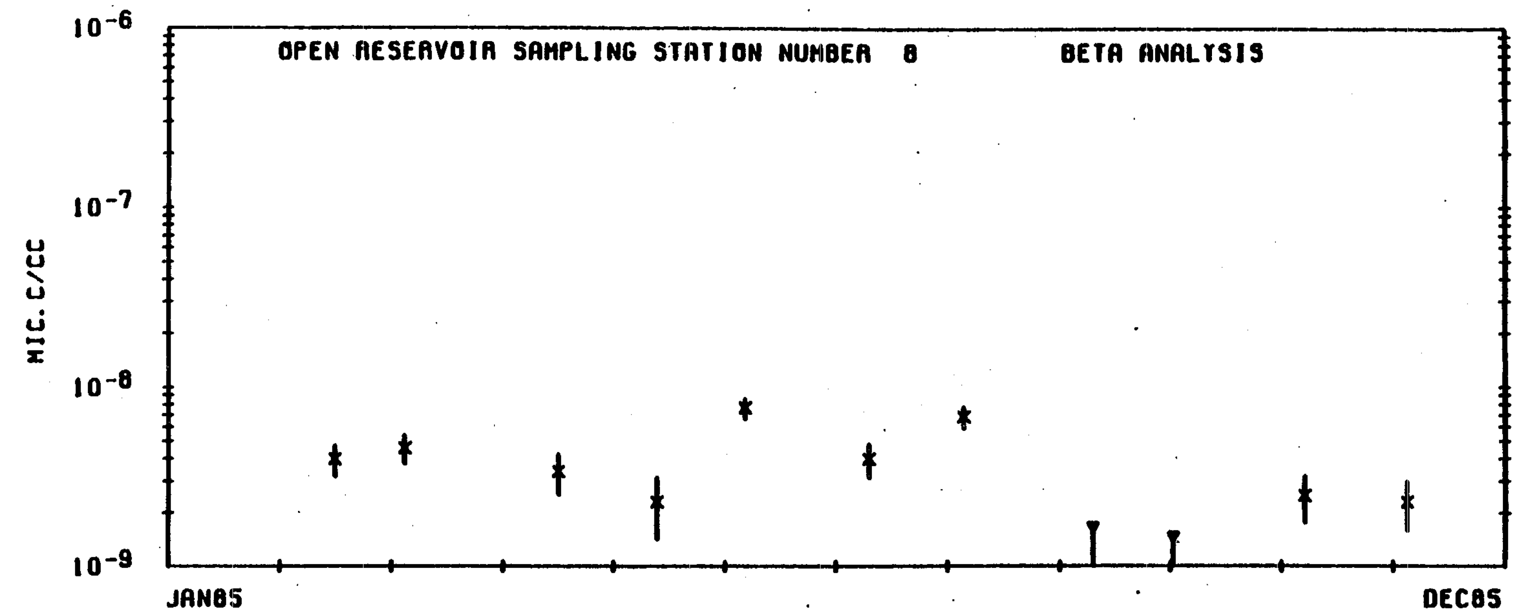

OPEN RESERVOIR SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹
JAN85
DEC85

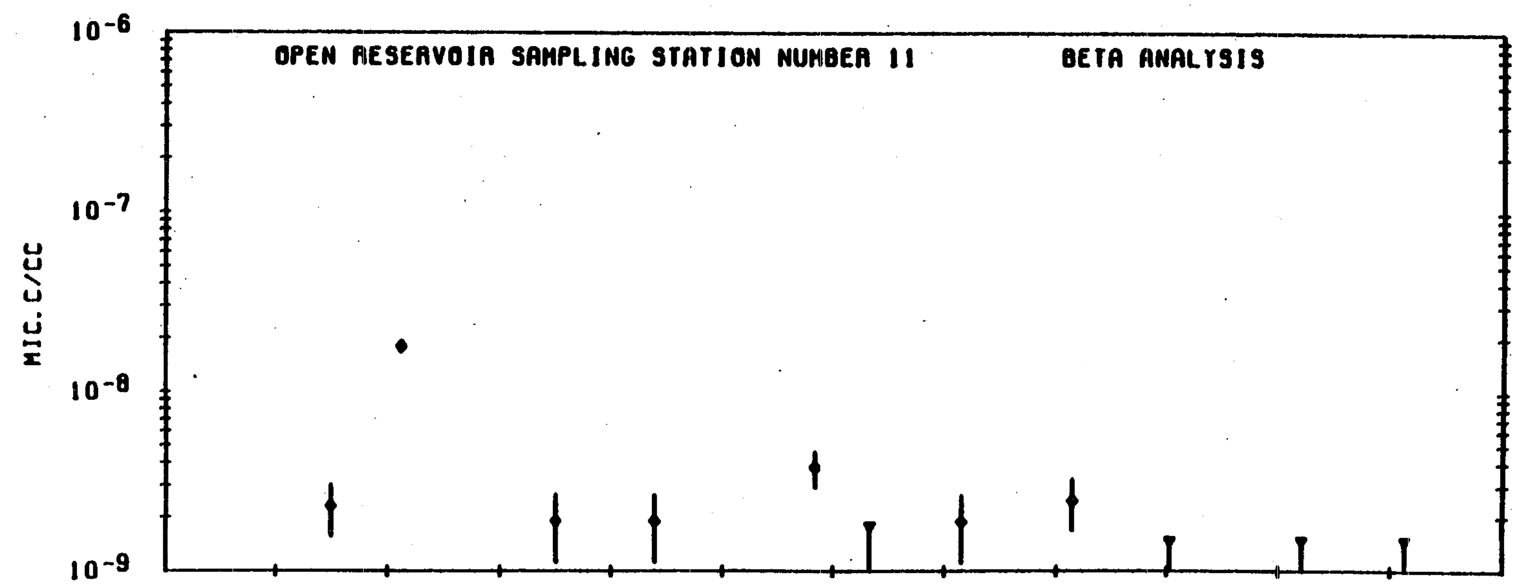

OPEN RESERVOIR SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

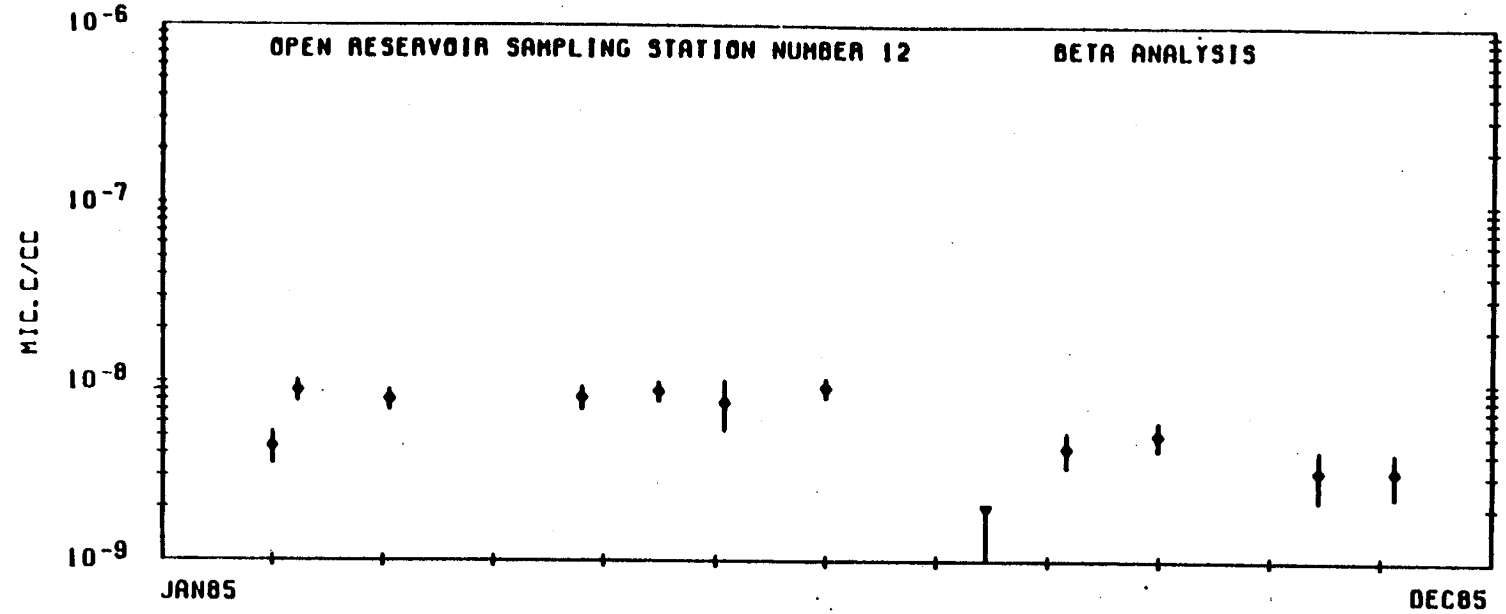

OPEN RESERVOIR SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

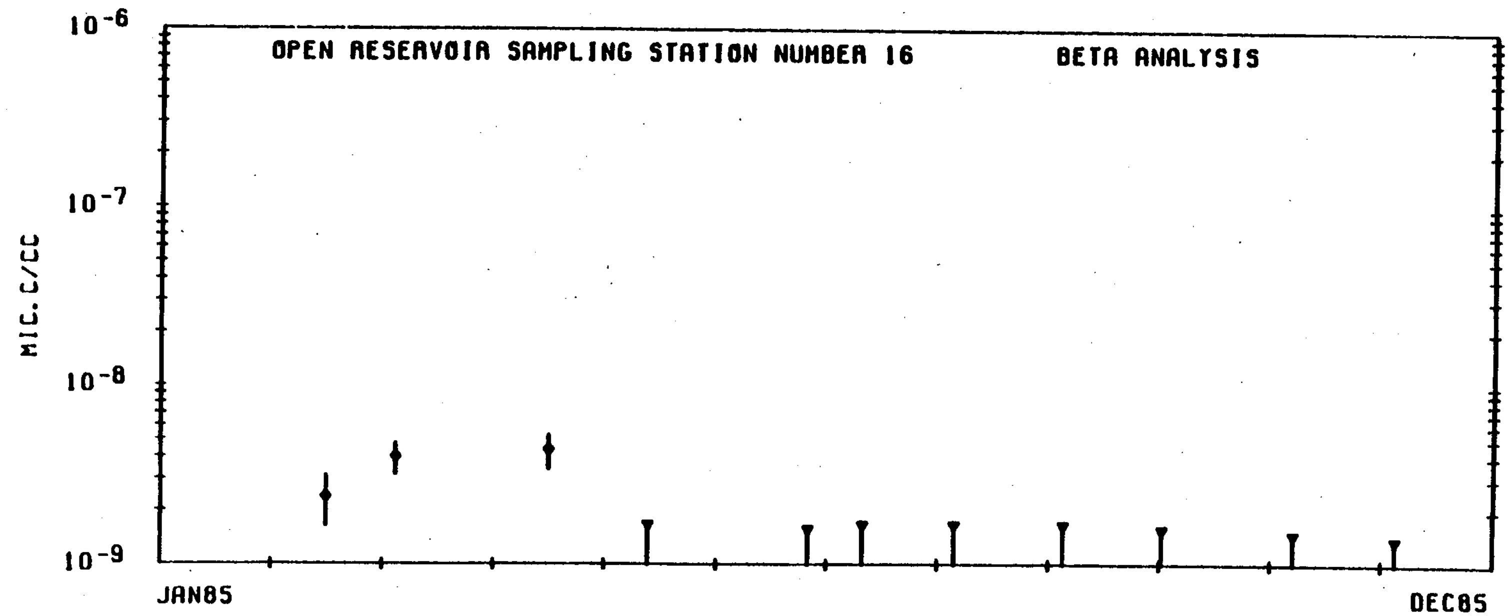

OPEN RESERVOIR SAMPLING STATION NUMBER 5
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

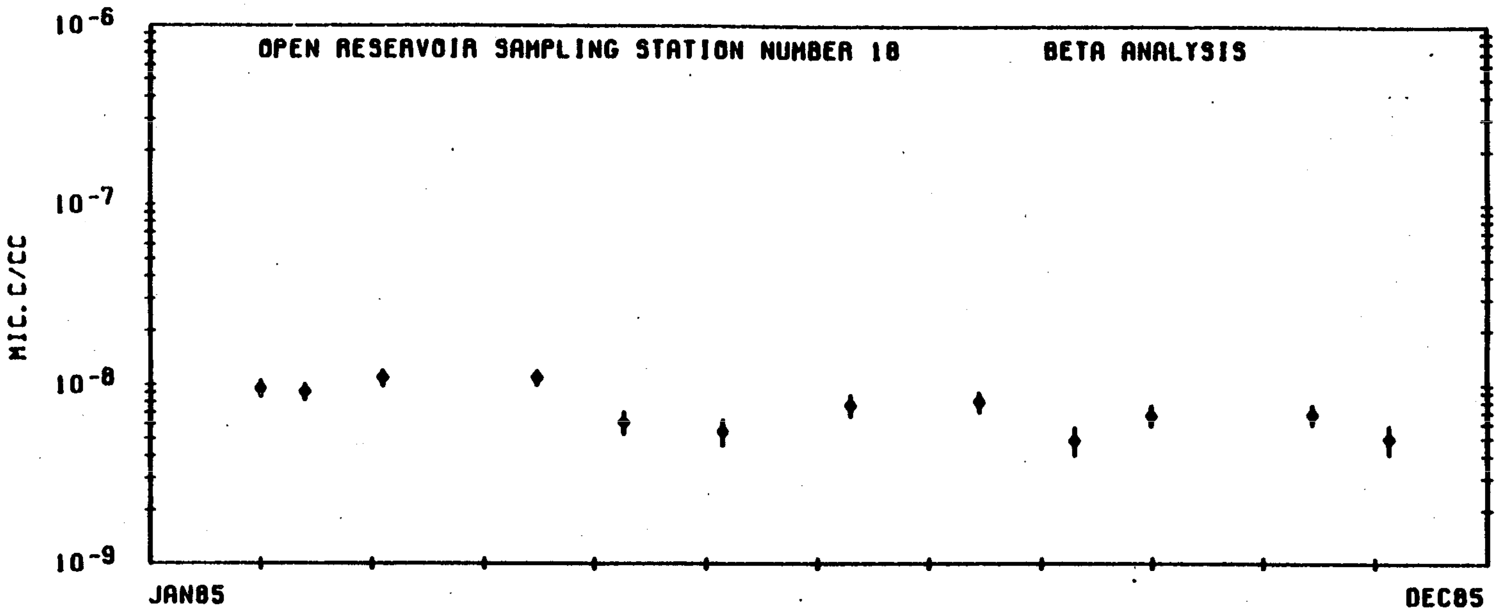

OPEN RESERVOIR SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

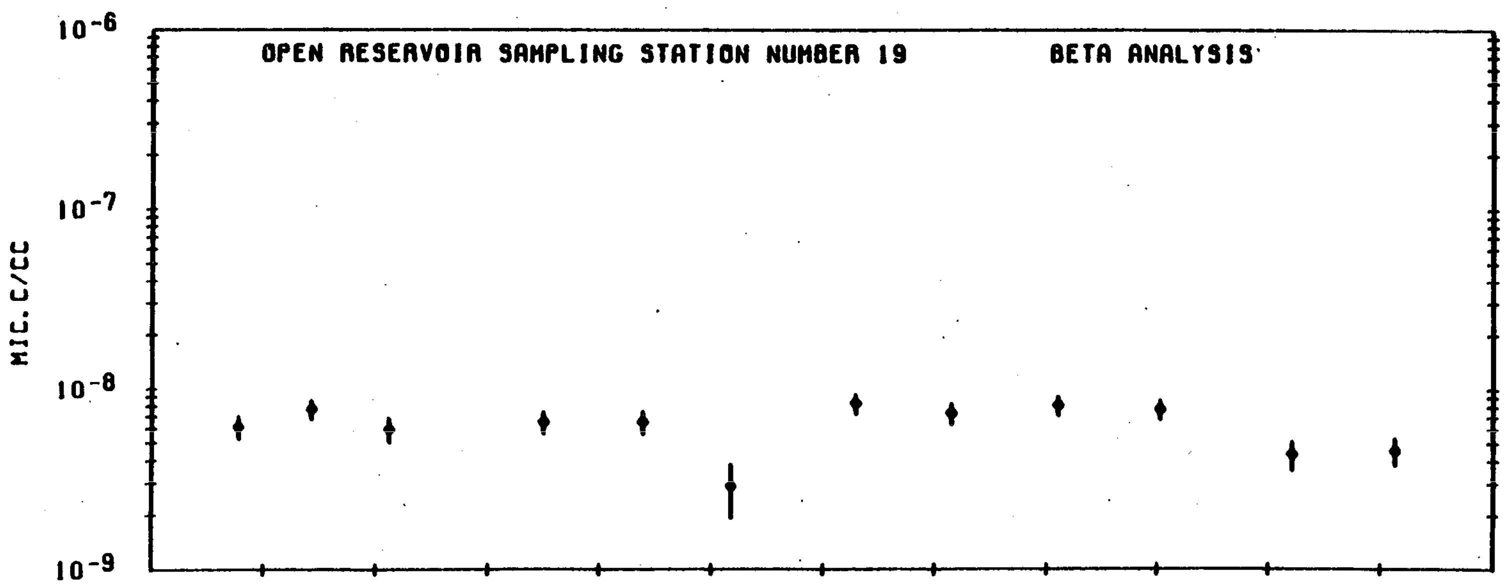

OPEN RESERVOIR SAMPLING STATION NUMBER 8
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

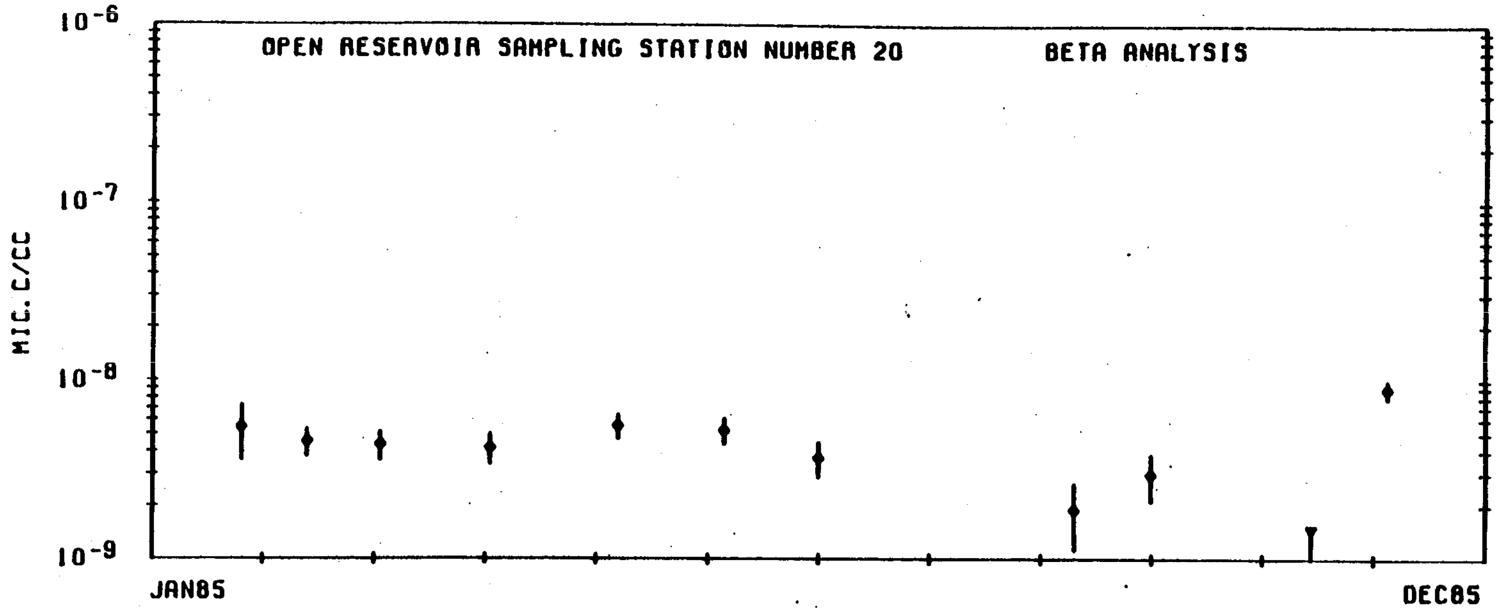

OPEN RESERVOIR SAMPLING STATION NUMBER 11
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

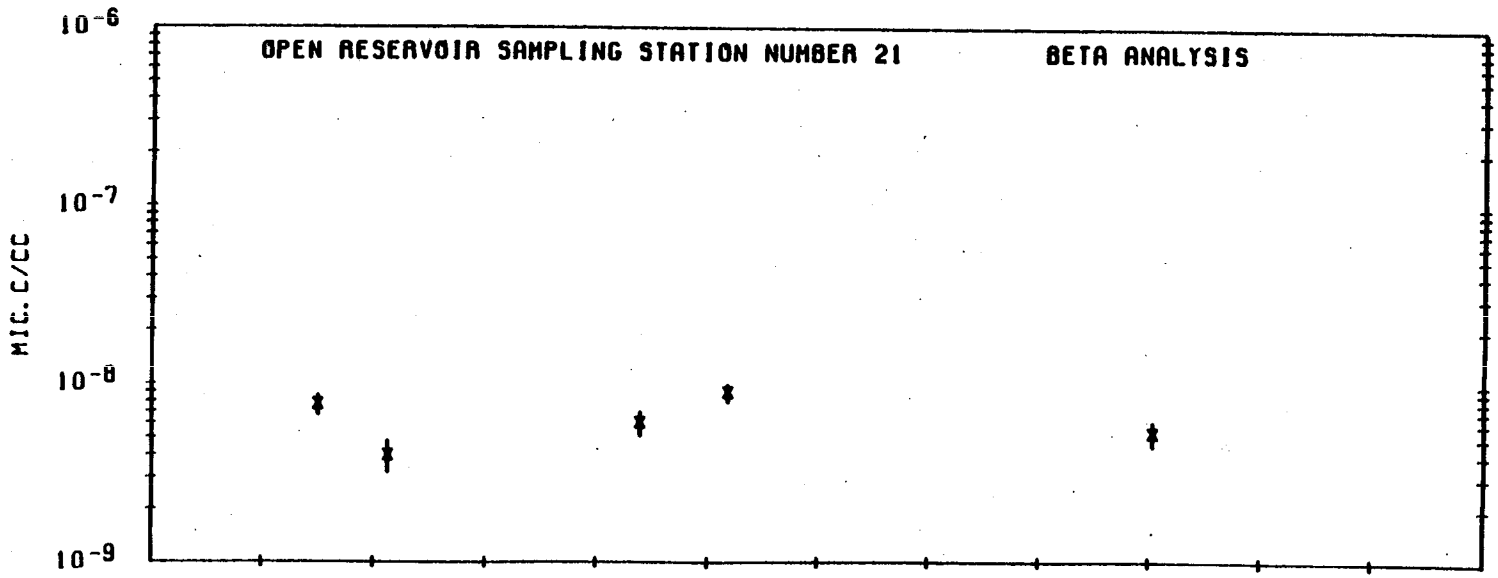

OPEN RESERVOIR SAMPLING STATION NUMBER 12
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

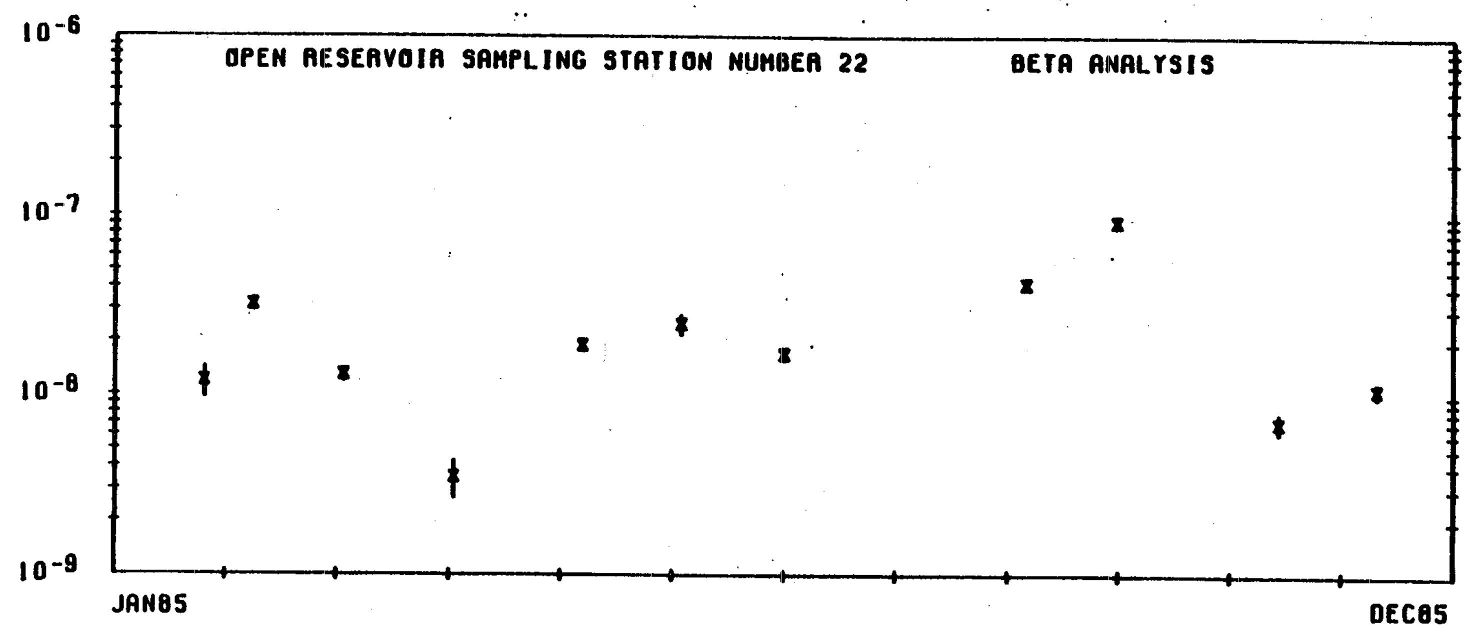

OPEN RESERVOIR SAMPLING STATION NUMBER 16
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85


OPEN RESERVOIR SAMPLING STATION NUMBER 18
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85


OPEN RESERVOIR SAMPLING STATION NUMBER 19
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


OPEN RESERVOIR SAMPLING STATION NUMBER 20
BETA ANALYSIS
MIC. C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85


OPEN RESERVOIR SAMPLING STATION NUMBER 21
BETA ANALYSIS
MIC. C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


OPEN RESERVOIR SAMPLING STATION NUMBER 22
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85

A P P E N D I X   F

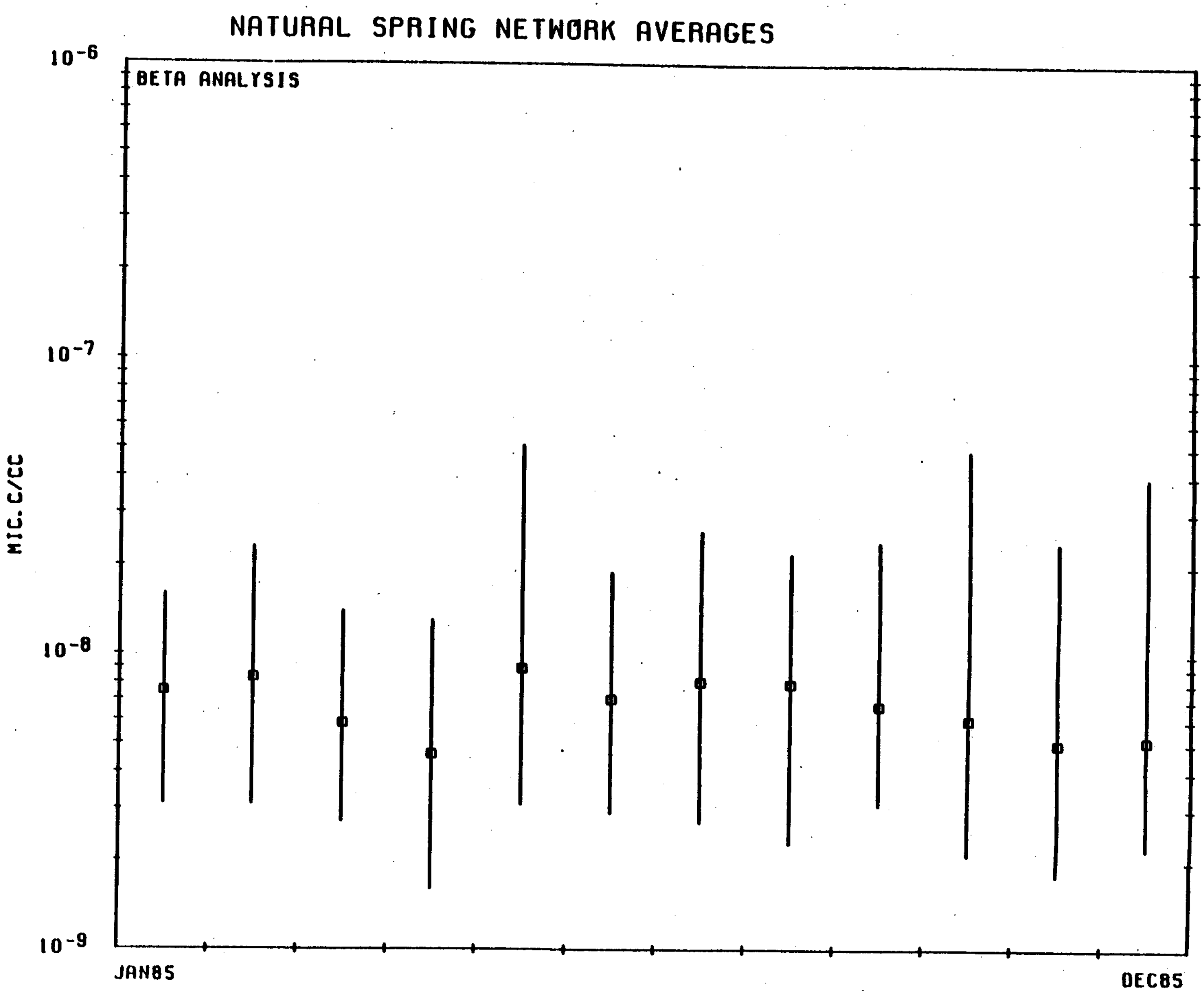
NTS Environmental Surveillance

Natural Spring Locations and Plots

In the first two pages of plots in Appendix F, the natural springs network averages, a square is used to represent the arithmetic mean of all values at that point in time, and the vertical line is the range of the data. The remaining plots show the gross beta data of each station. A two-sigma error bar is also added to the data points, and, in all plots, a delta with a line to the bottom of the plot means below detection limit.

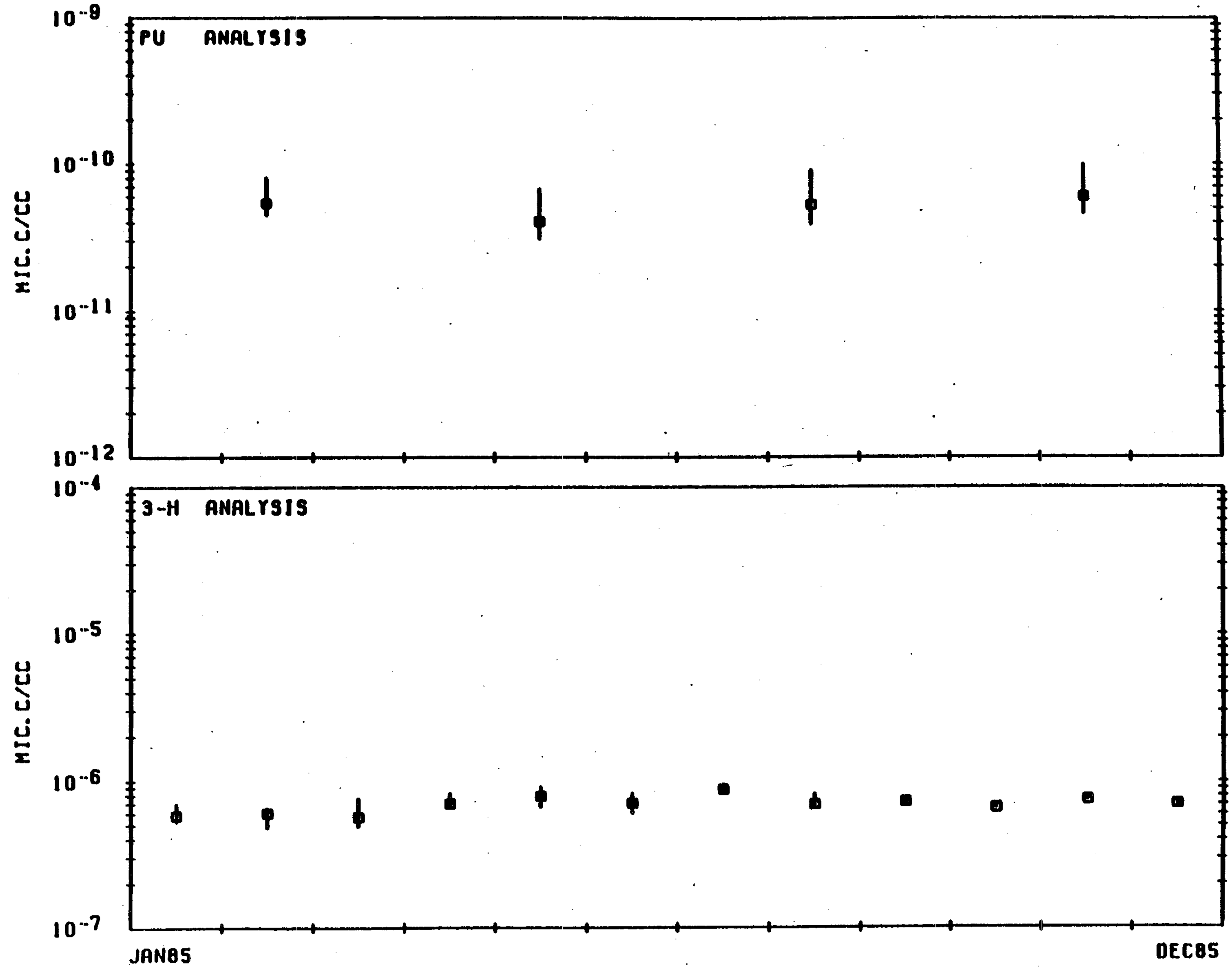
NTS ENVIRONMENTAL SURVEILLANCE
NATURAL SPRINGS SAMPLING LOCATIONS

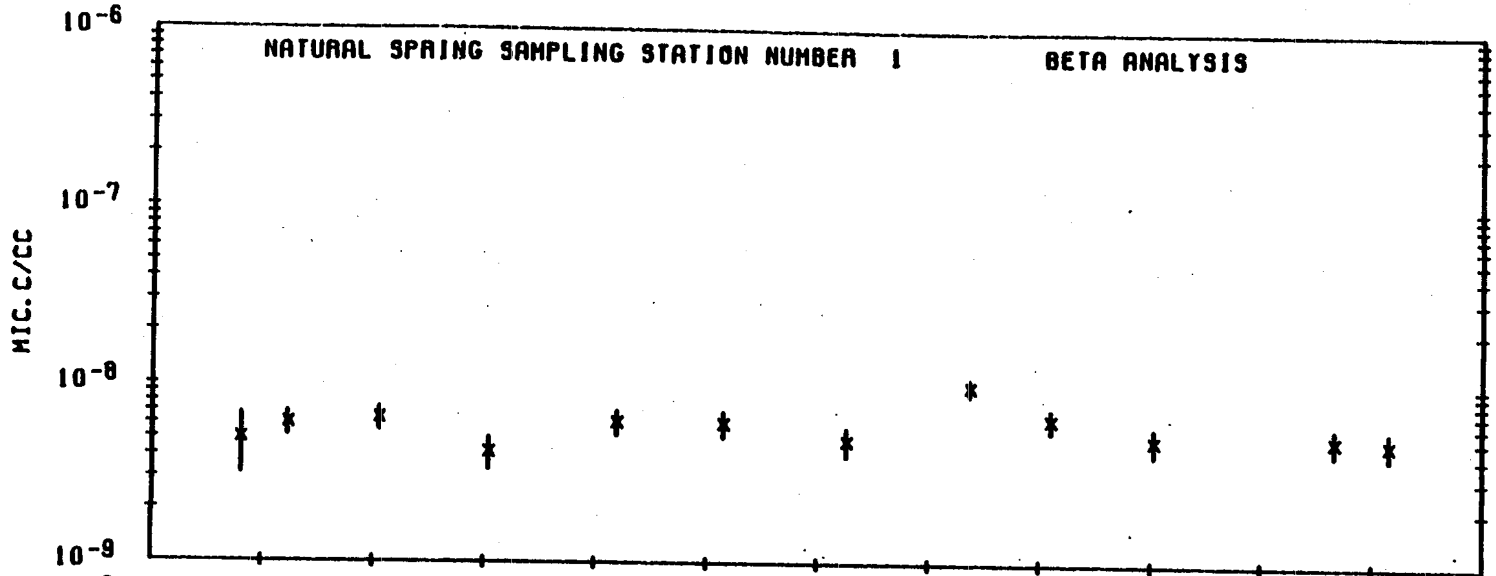
Station Number	Location
1	Area 5 Cane Springs
2	Area 12 White Rock Springs
3	Area 12 Captain Jack Spring
4	Area 12 Gold Meadows Pond
6	Area 15 Tub Spring
8	Area 7 Reitmann Seep
9	Area 16 Tippipah Spring



NATURAL SPRING NETWORK AVERAGES
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN85
DEC85

NATURAL SPRING NETWORK AVERAGES

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BETA ANALYSIS
MIC. C/CC
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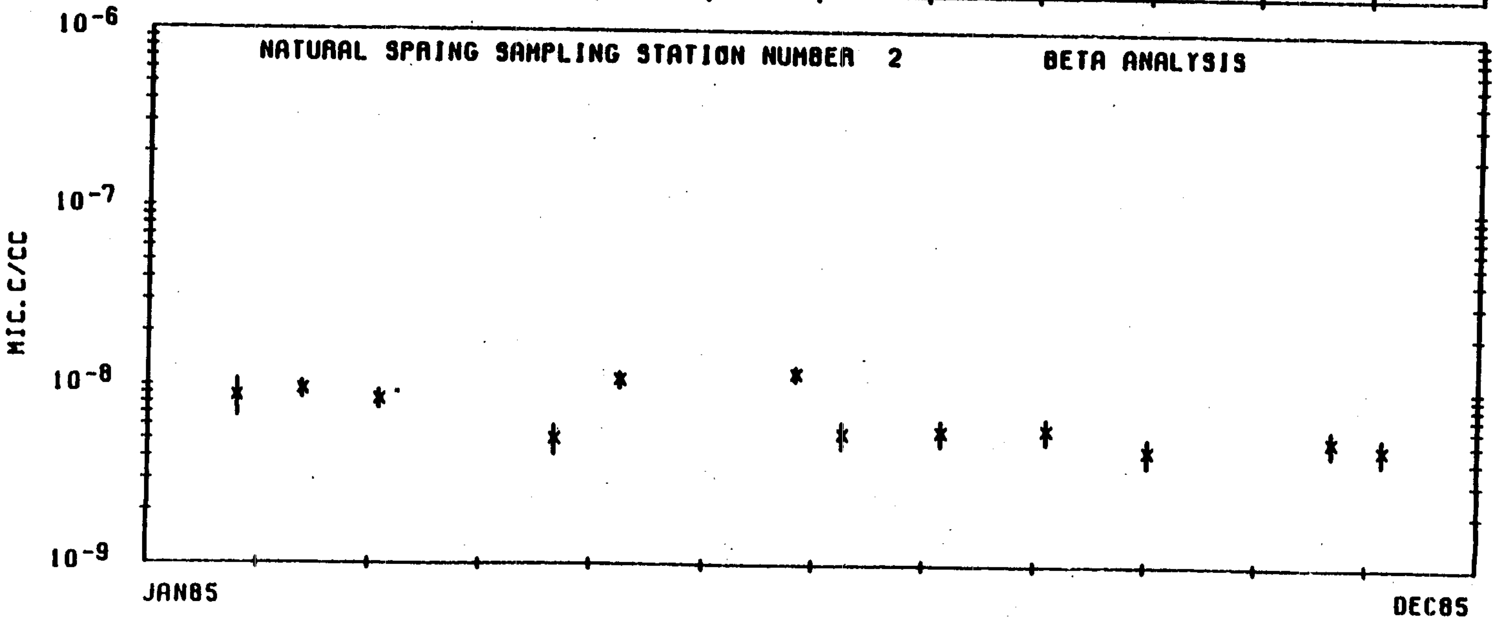
10^{-7}
10^{-8}
10^{-9}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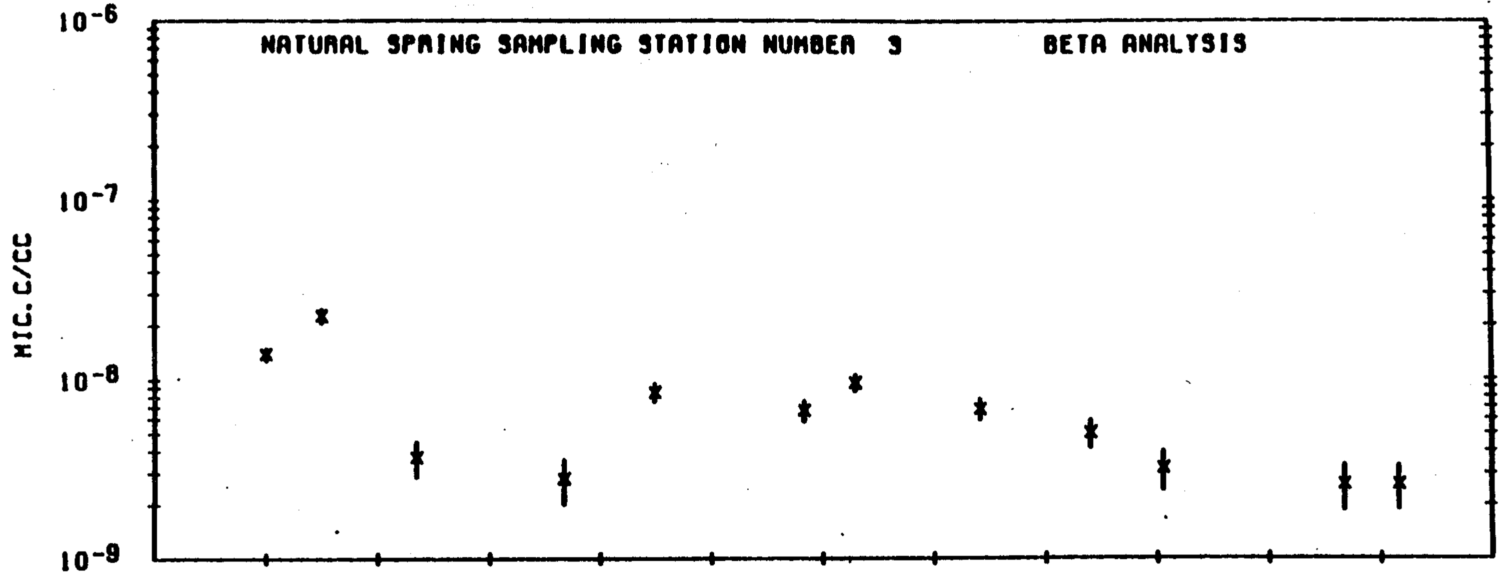
BETA ANALYSIS
MIC. C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85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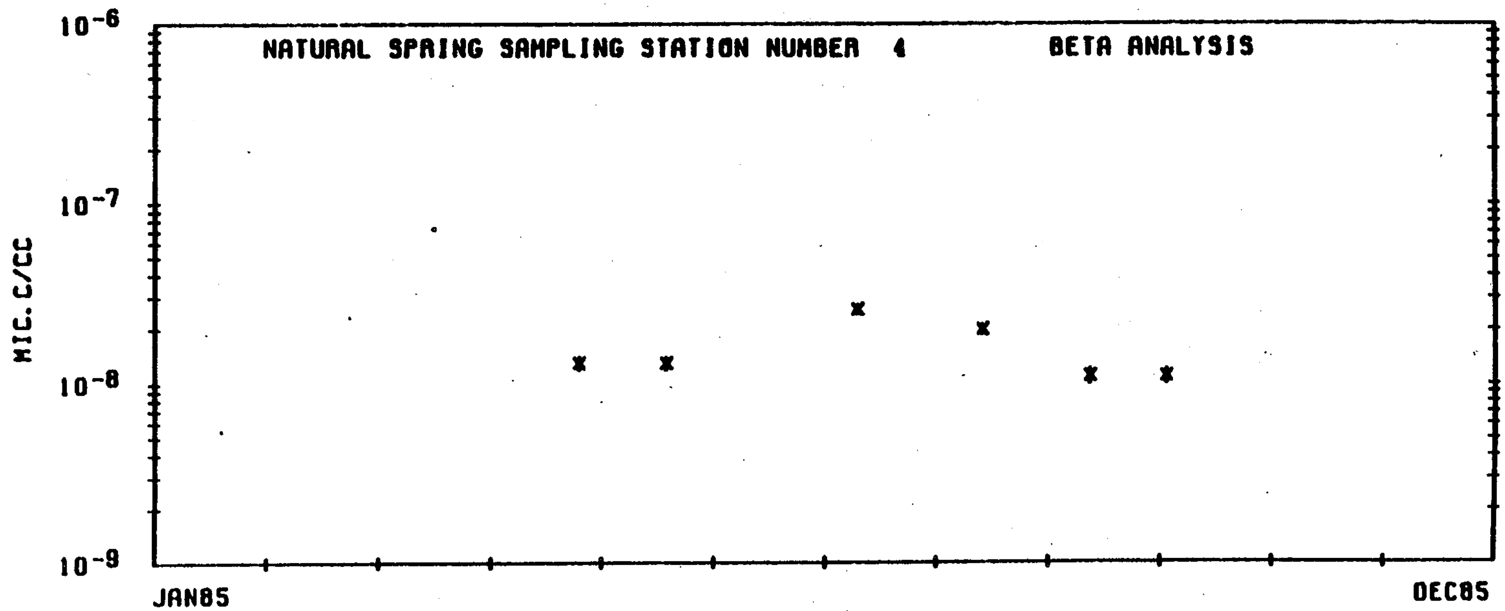
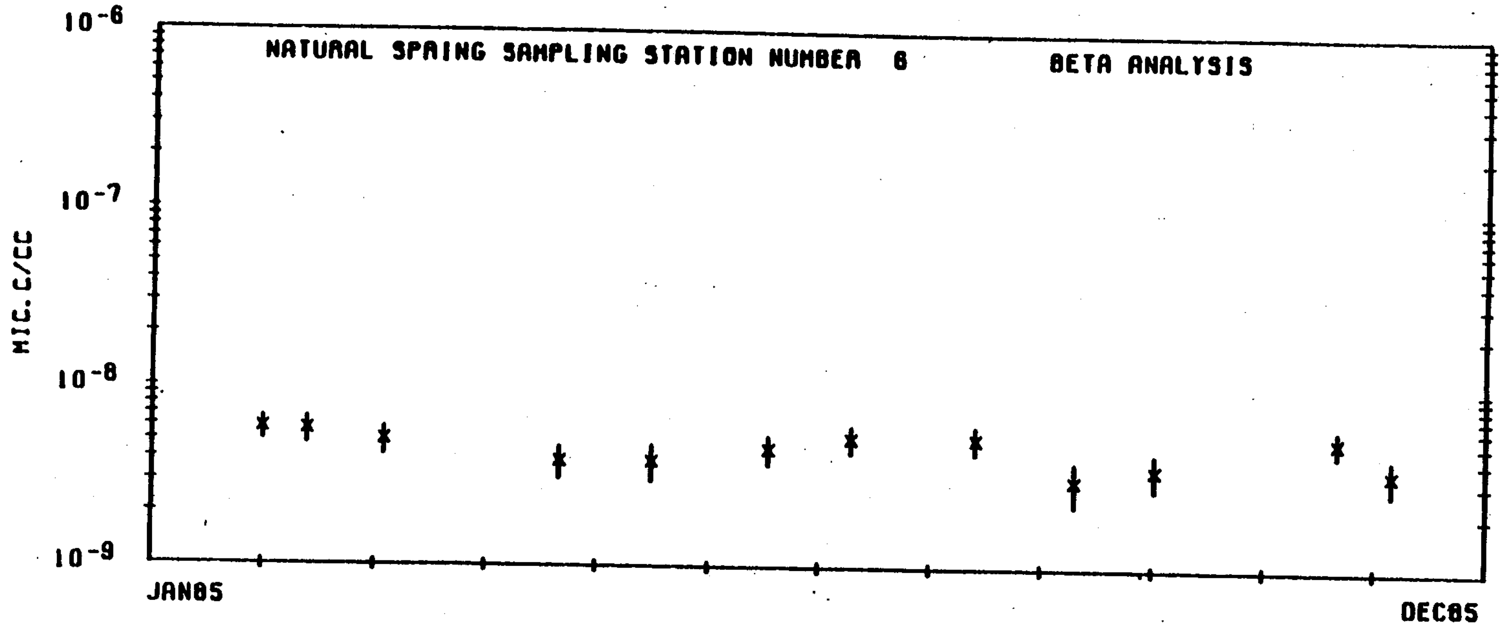
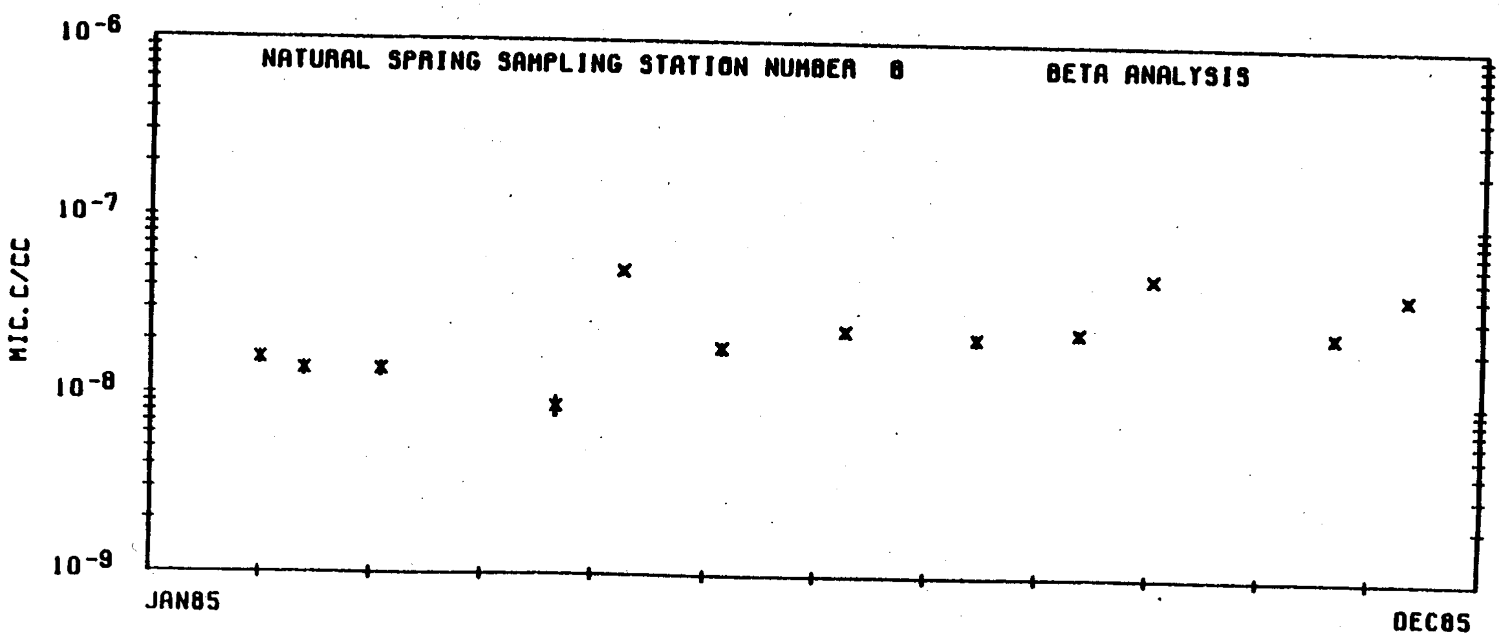
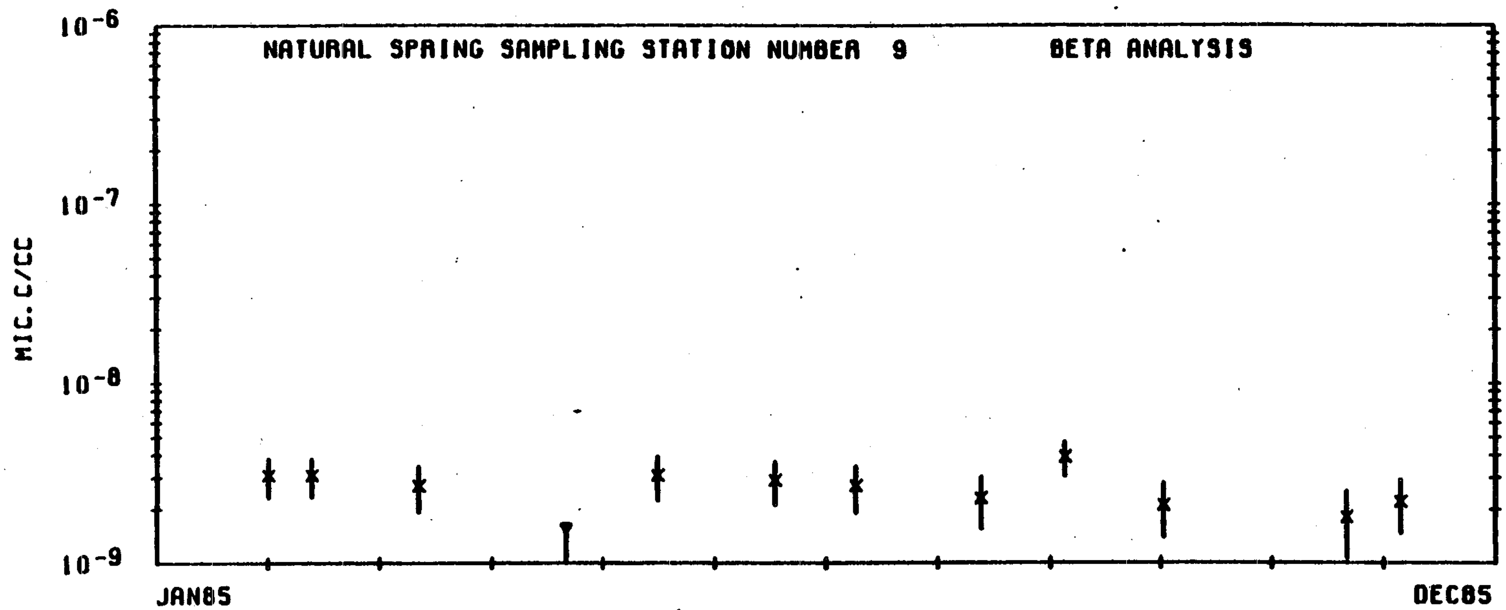
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


NATURAL SPRING SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85


NATURAL SPRING SAMPLING STATION NUMBER 8
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85


NATURAL SPRING SAMPLING STATION NUMBER 8
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN85
DEC85



NATURAL SPRING SAMPLING STATION NUMBER 9
BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹
JAN85
DEC85

APPENDIX G

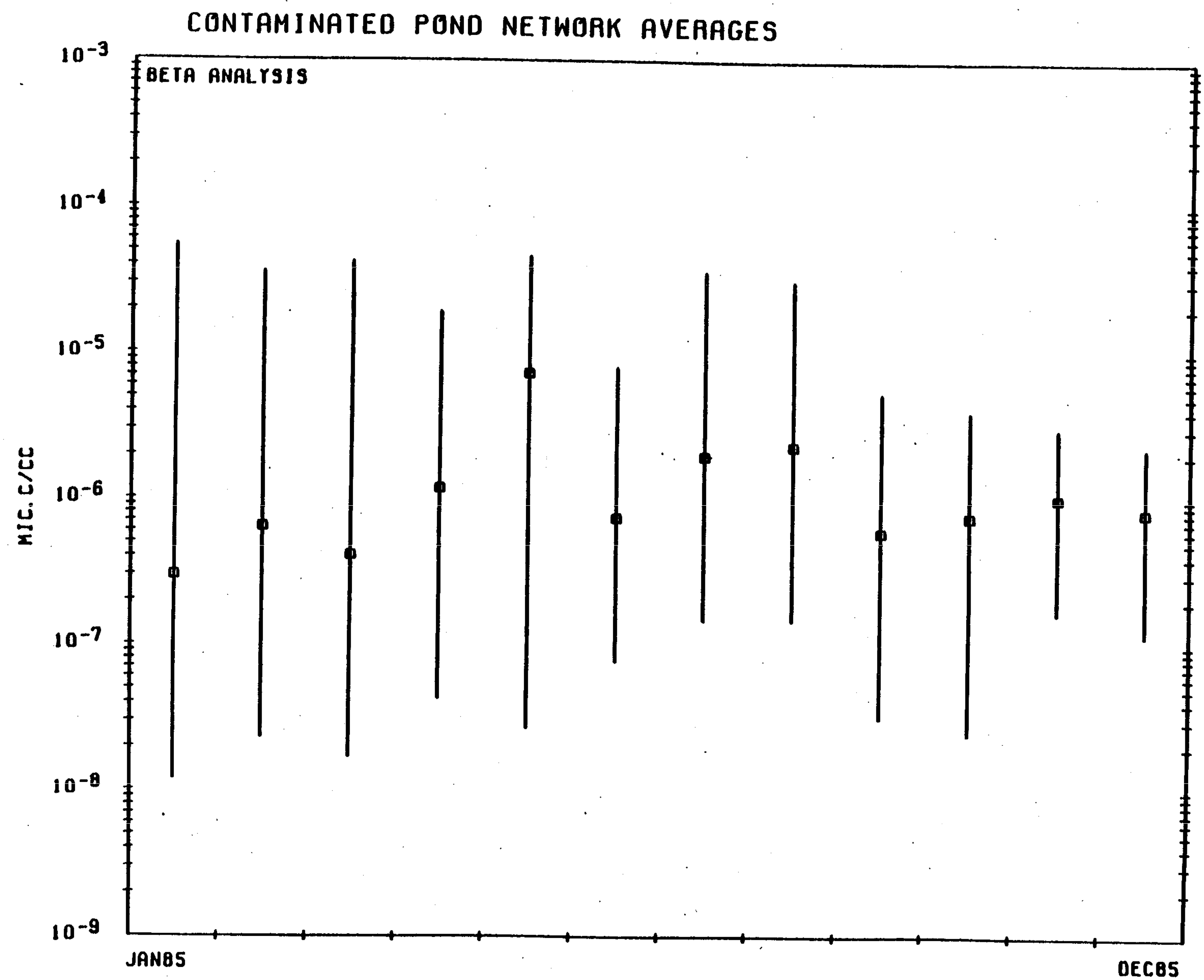
NTS Environmental Surveillance Contaminated Pond Locations and Plots

In the first two pages of plots in Appendix G, the contaminated pond network averages, a square is used to represent the arithmetic mean of all values at that point in time, and the vertical line is the range of the data.

The remaining plots show the gross beta of each station. A two-sigma error bar is also added to the data points, and, in all plots, a delta with a line to the bottom of the plot means below detection limit.

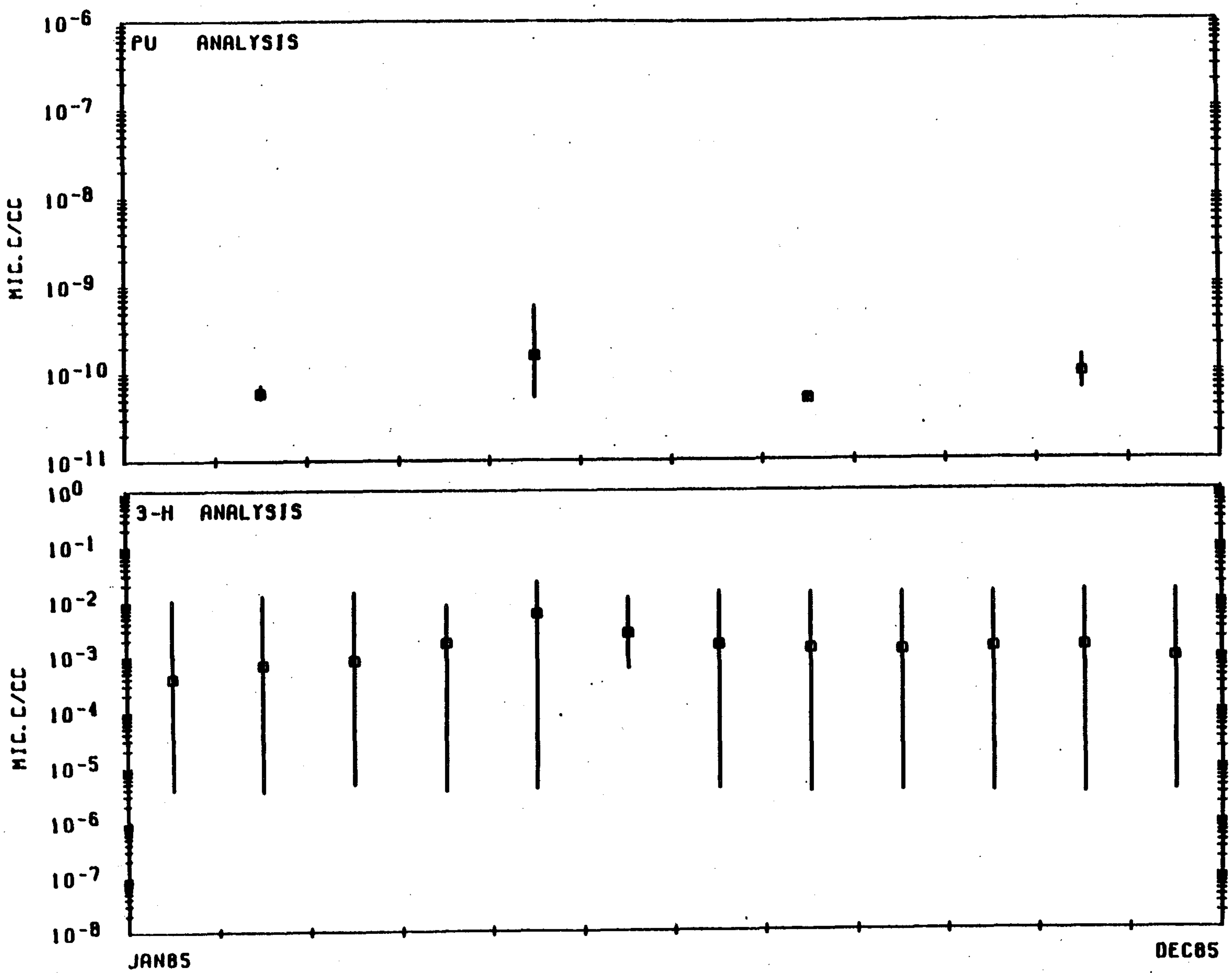
NTS ENVIRONMENTAL SURVEILLANCE
CONTAMINATED PONDS SAMPLING LOCATIONS

Station Number	Location
5	Area 12 Upper Mint Lake
6	Area 12 Middle Mint Lake
7	Area 12 Lower Mint Lake
8	Area 12 N Upper
9	Area 12 N Mid
10	Area 12 N Lower
11	Area 12 G Tunnel
13	Area 6 Yucca Decontamination Pond

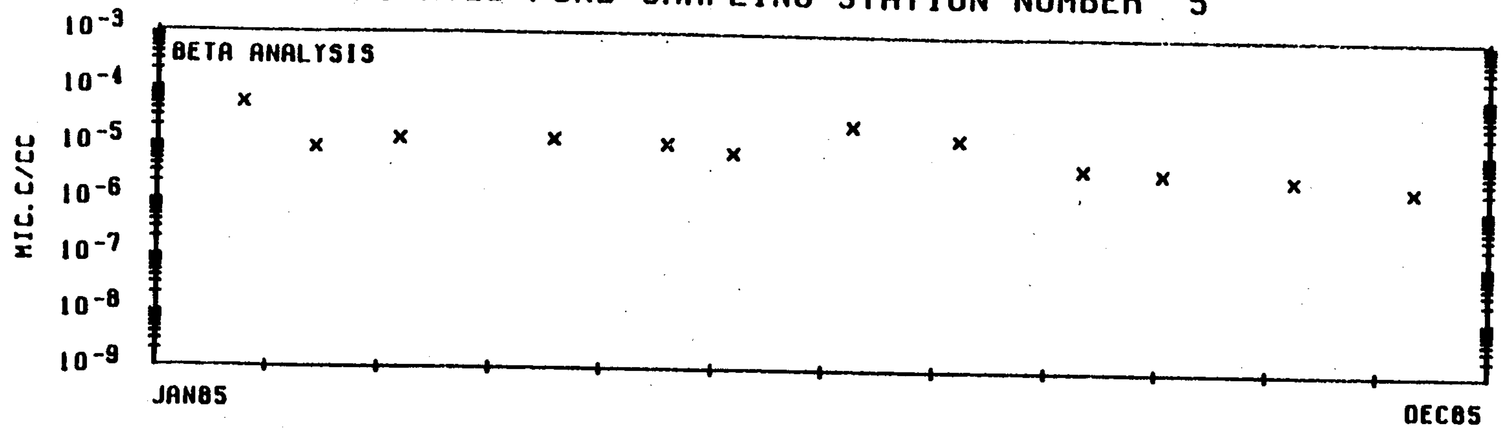


CONTAMINATED POND NETWORK AVERAGES
BETA ANALYSIS
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
MIC.C/CC
JAN85
DEC85

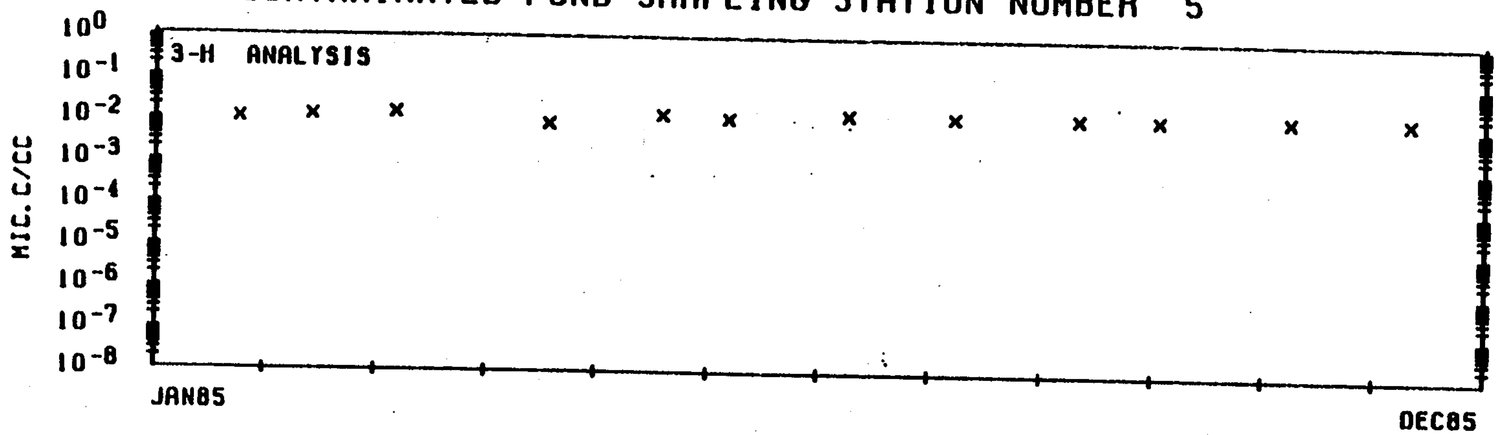
CONTAMINATED POND NETWORK AVERAGES

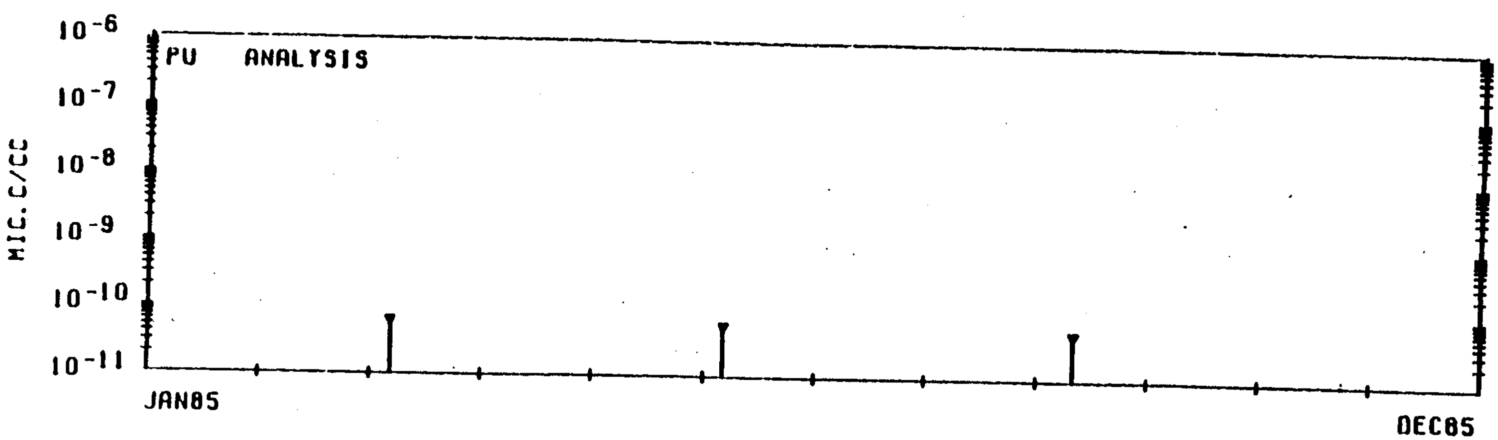


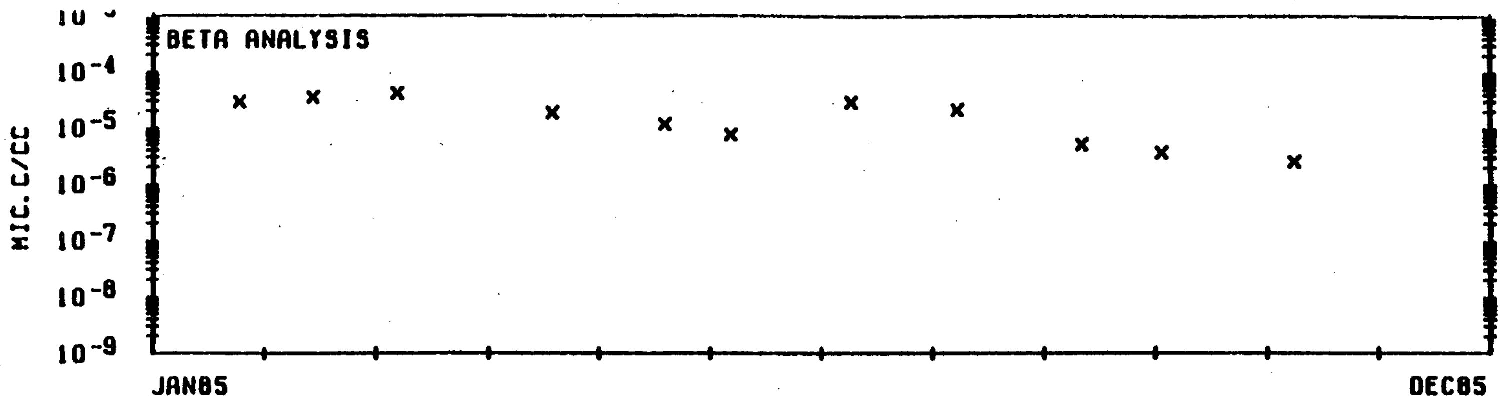
CONTAMINATED POND SAMPLING STATION NUMBER 5



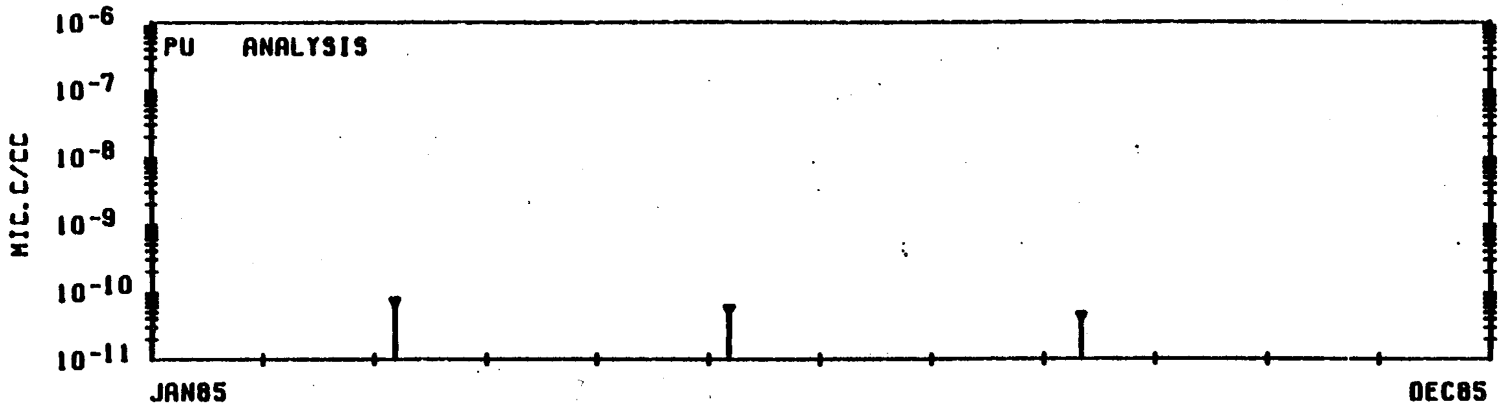
CONTAMINATED POND SAMPLING STATION NUMBER 5







CONTAMINATED POND SAMPLING STATION NUMBER 6



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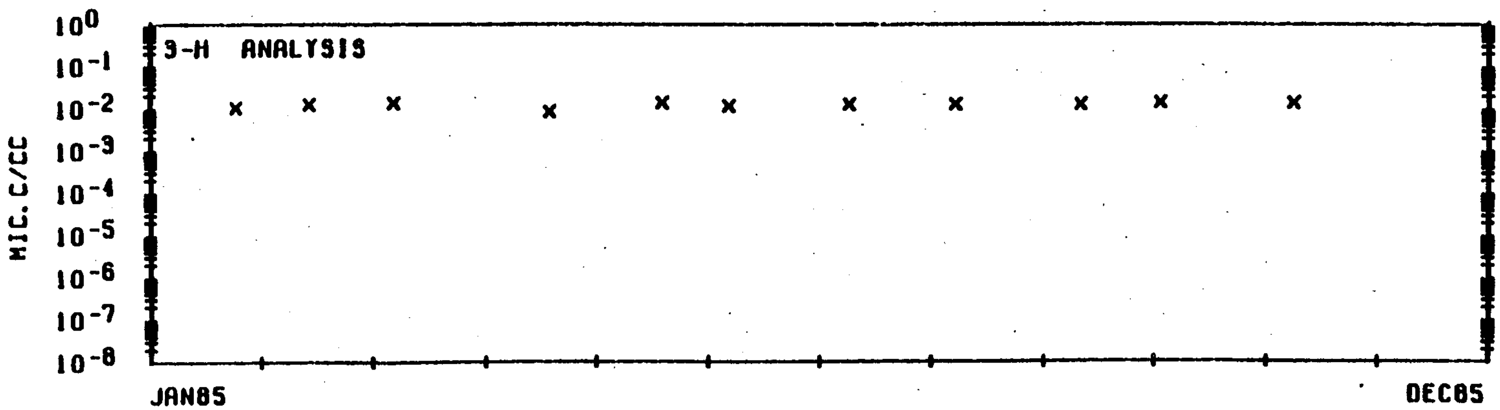

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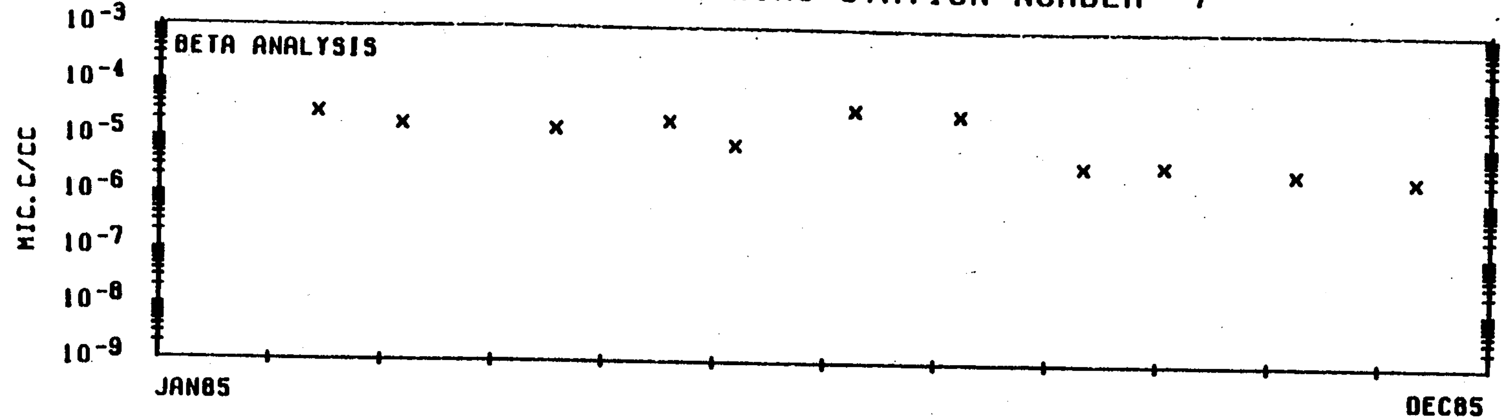

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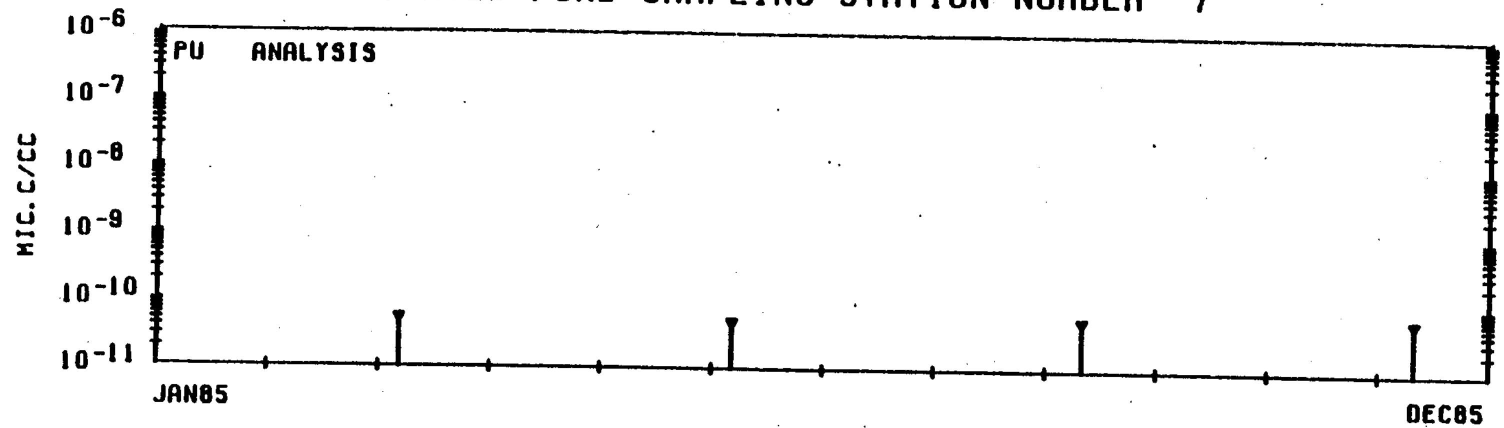

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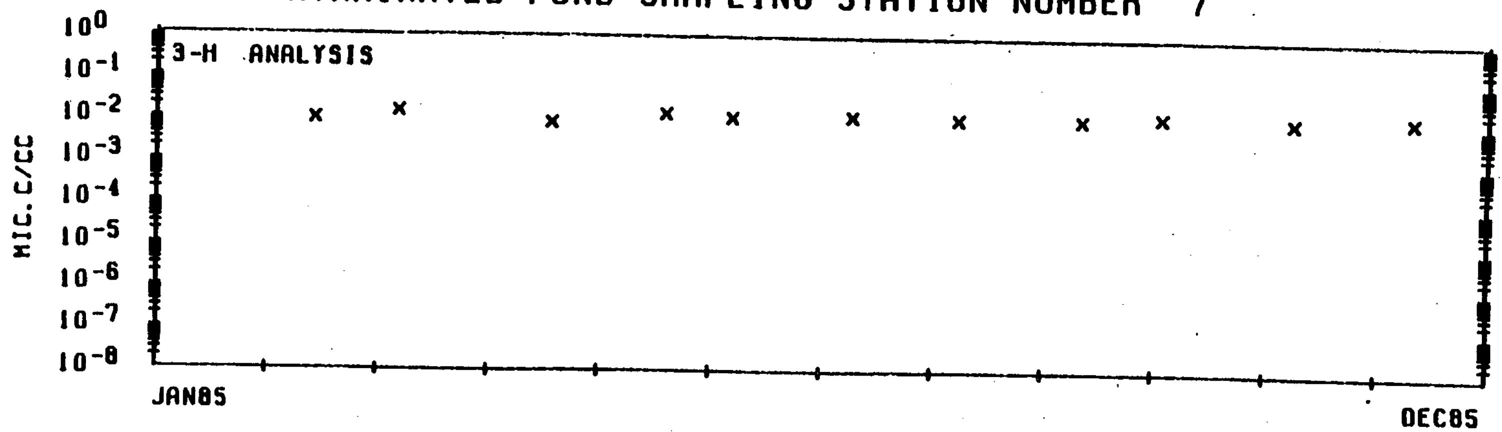
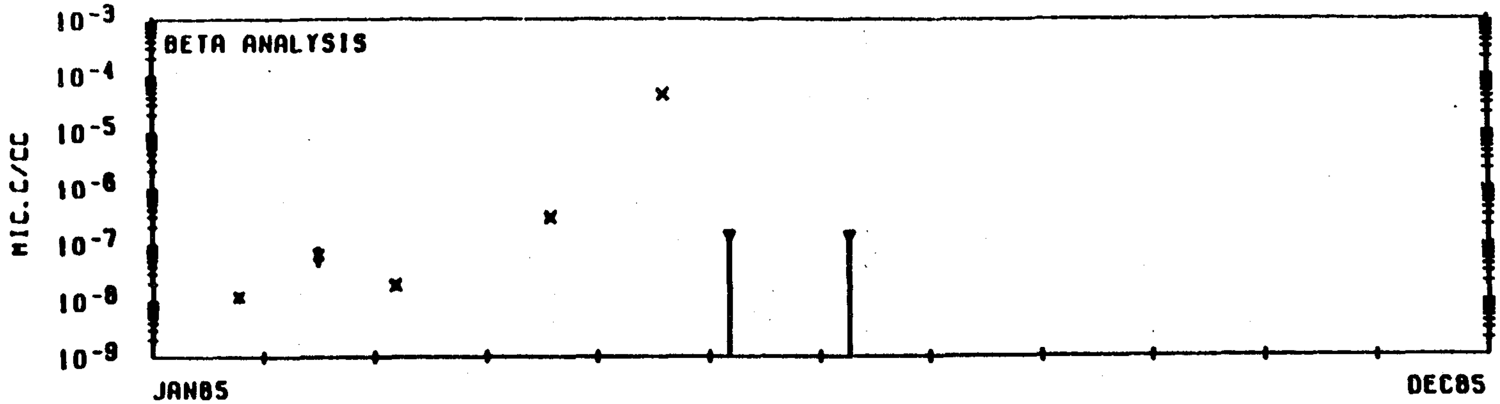
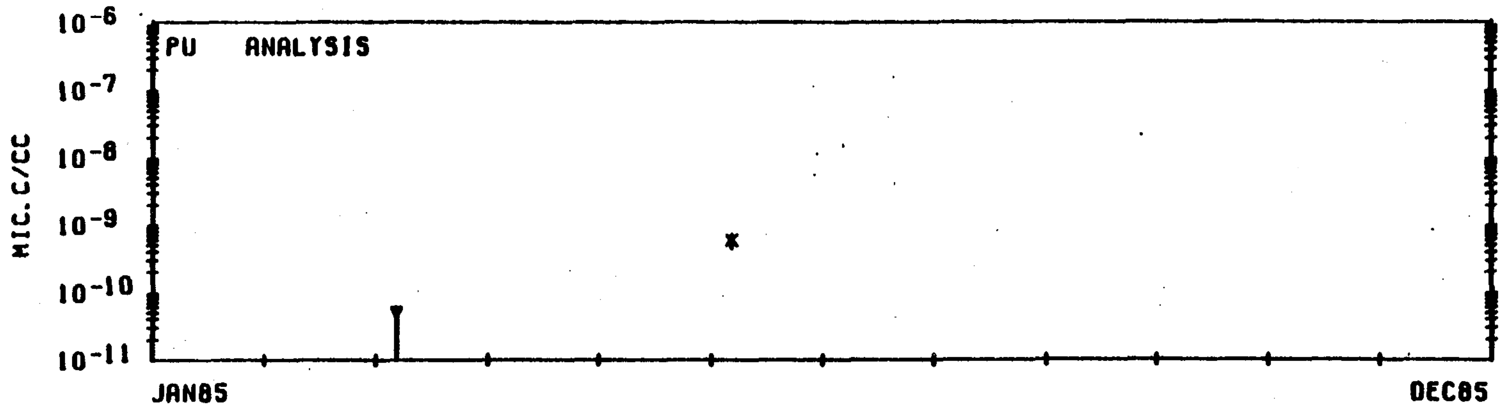
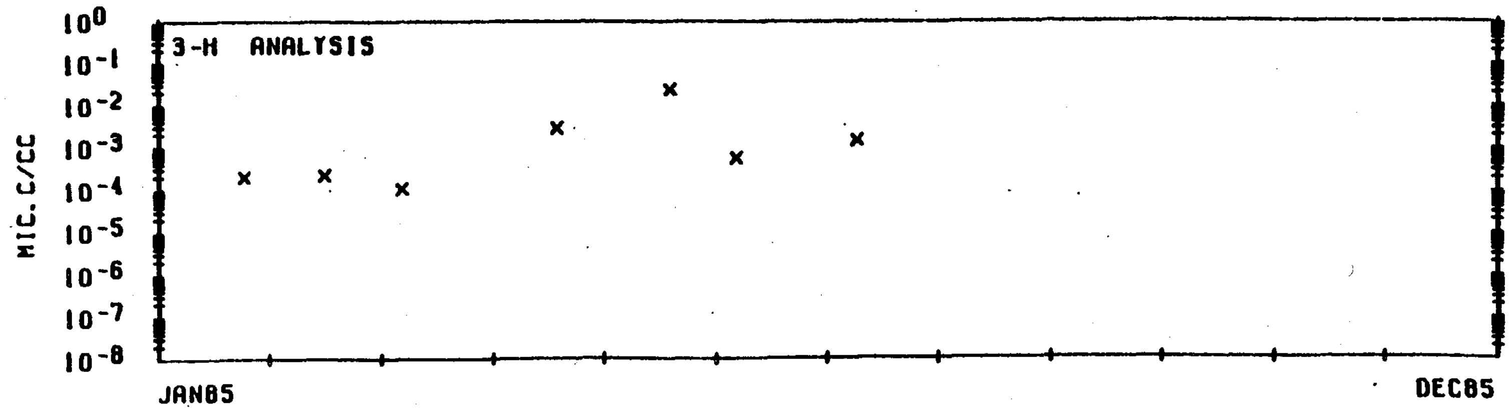




CONTAMINATED POND SAMPLING STATION NUMBER 8



CONTAMINATED POND SAMPLING STATION NUMBER 8



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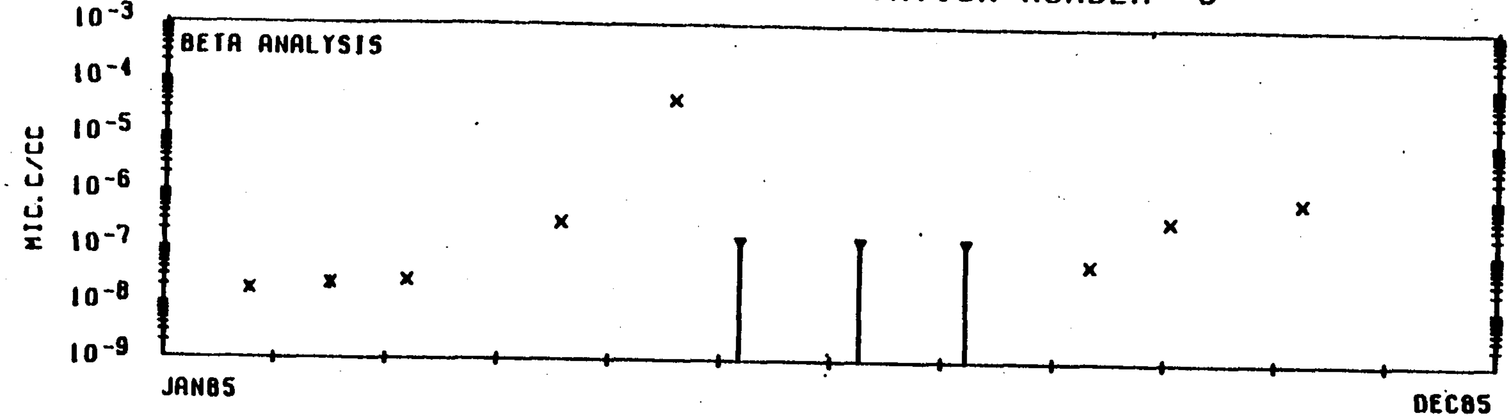

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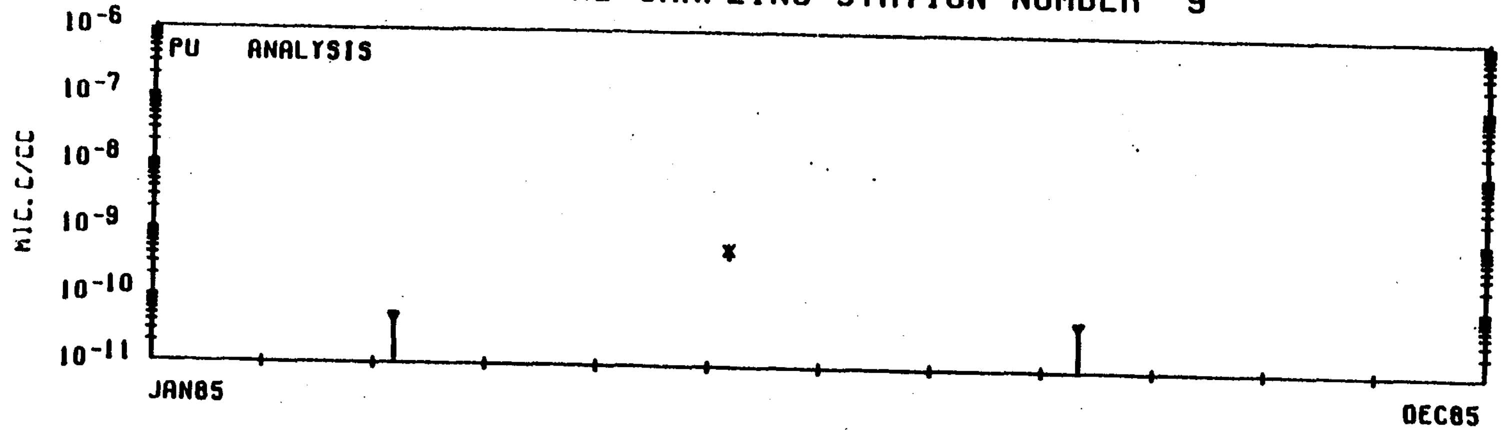

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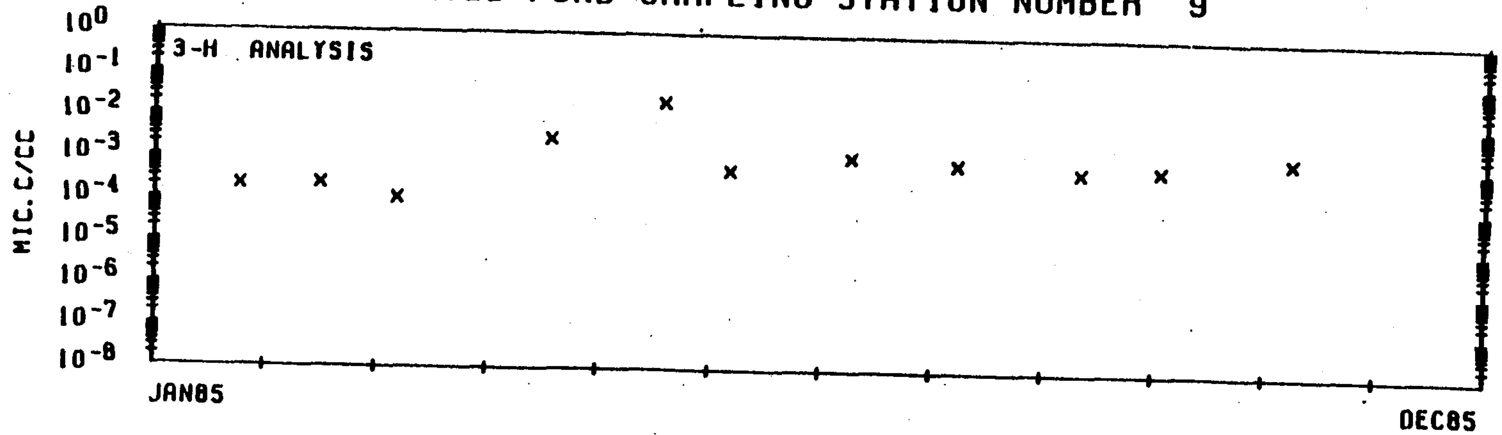

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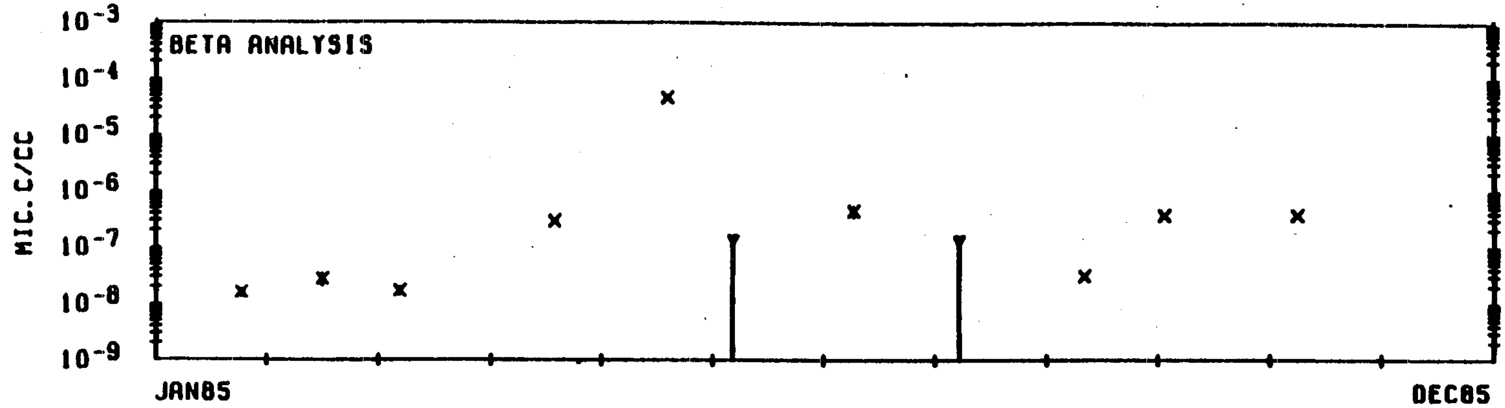

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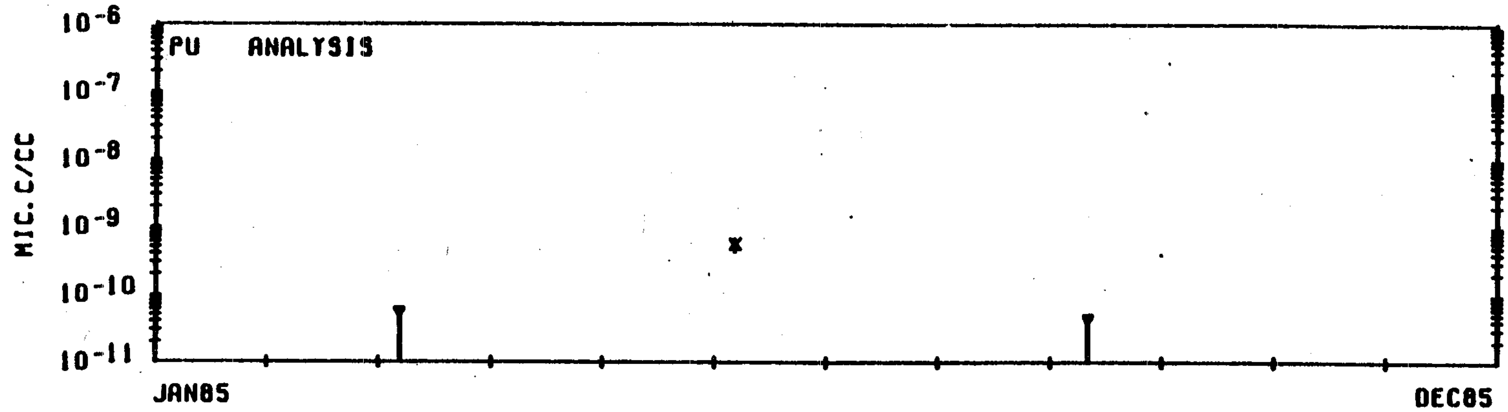

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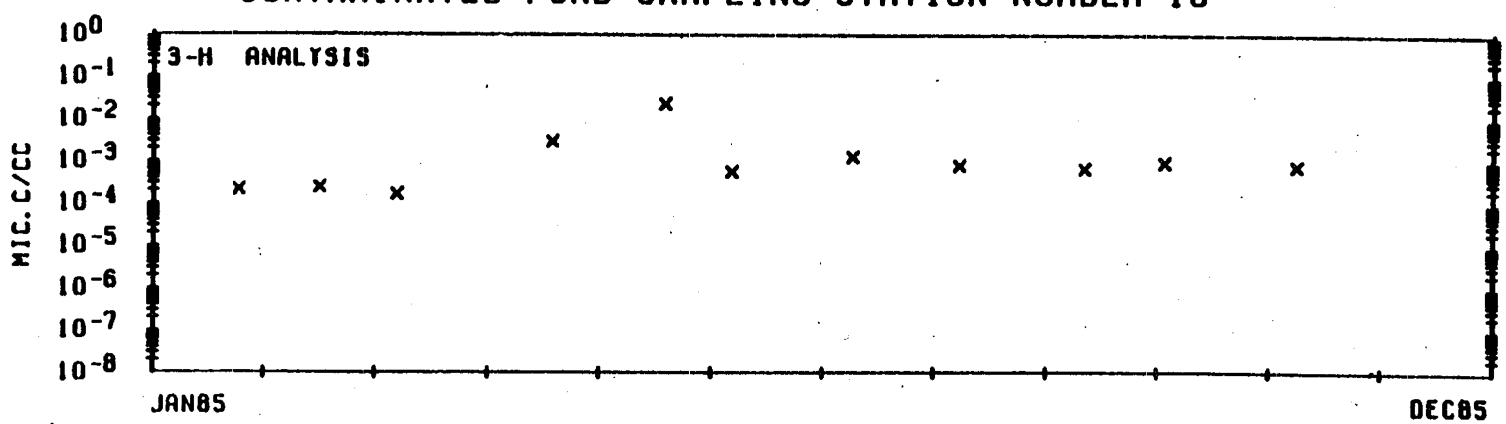

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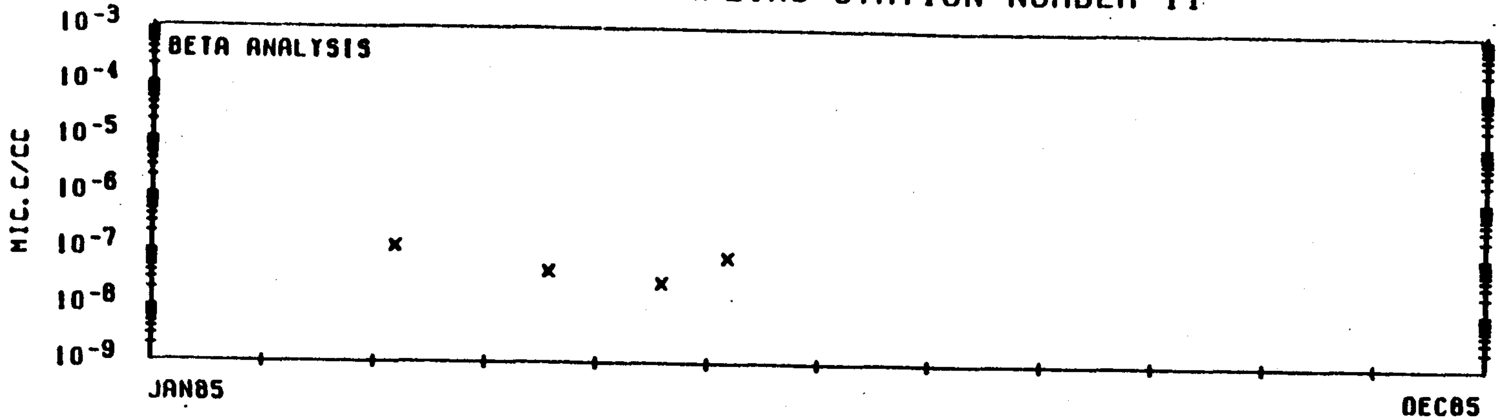

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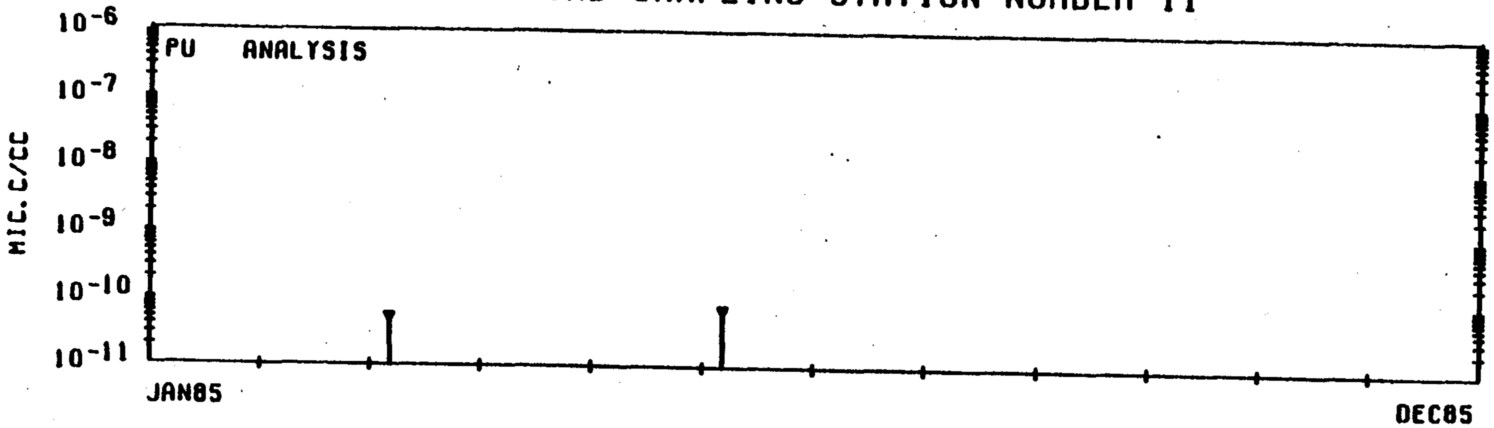

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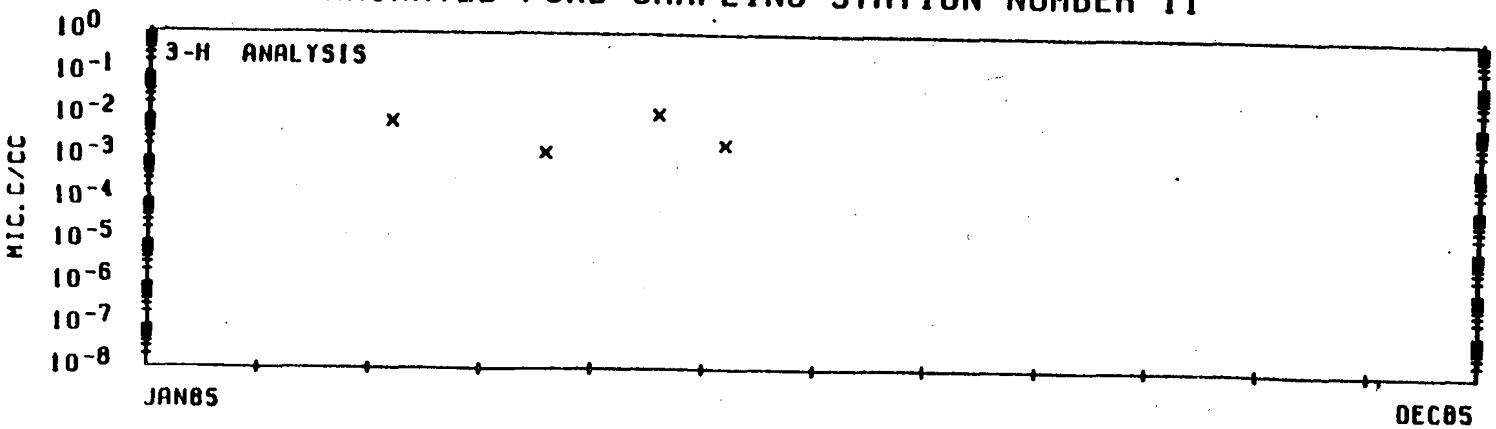

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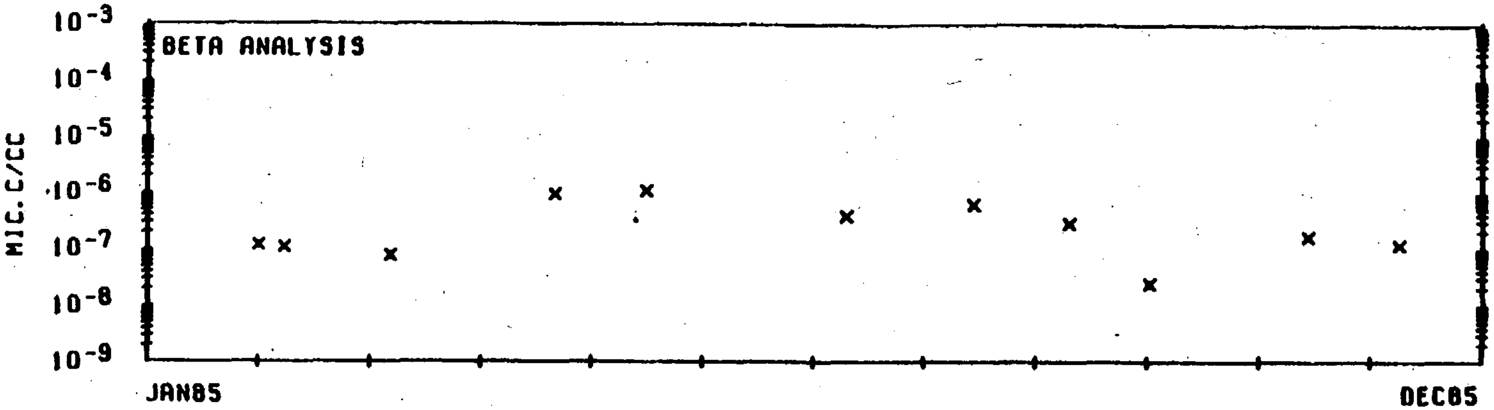

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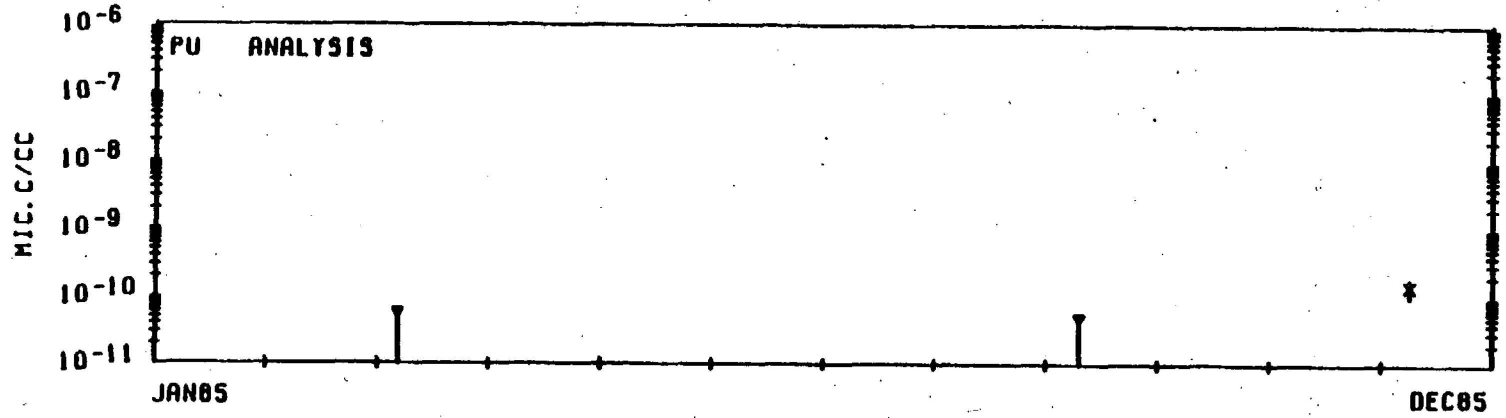

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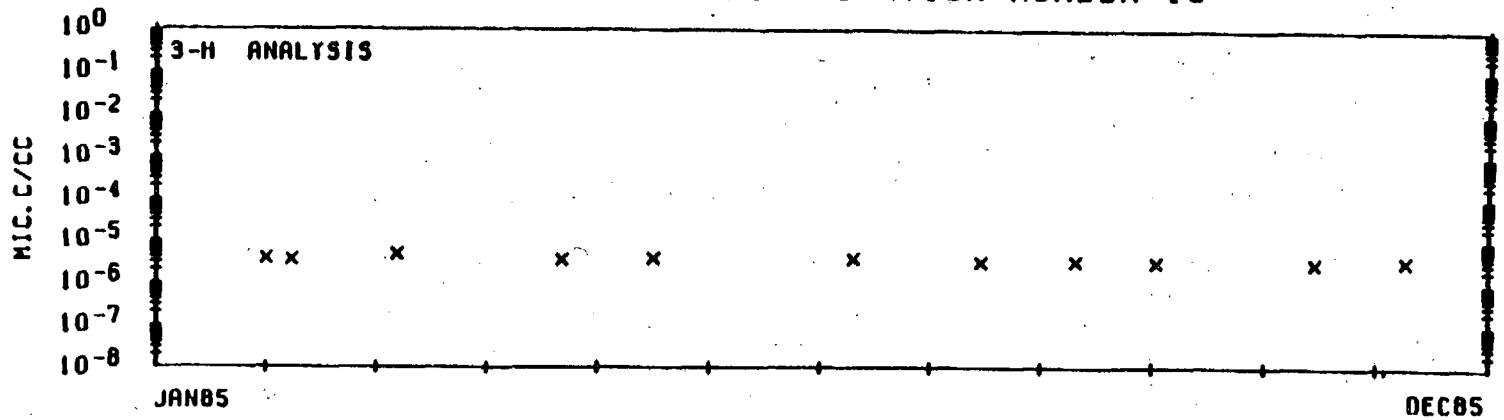

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