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ENVIRONMENTAL SURVEILLANCE REPORT FOR THE NEVADA TEST SITE (JANUARY 1983 THROUGH DECEMBER 1983)

WAYNE A. SCOGGINS

REYNOLDS ELECTRICAL & ENGINEERING CO., INC.
POST OFFICE BOX 14400
LAS VEGAS, NV 89114

PREPARED FOR THE

U.S. DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE UNDER CONTRACT
DE-AC08-84NV10327

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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 1983 through December 1983. 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.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

Credit must be given to D. Wilson and B. White for their excellent work in the program. I would also like to thank 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 1983. 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 environmental surveillance 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

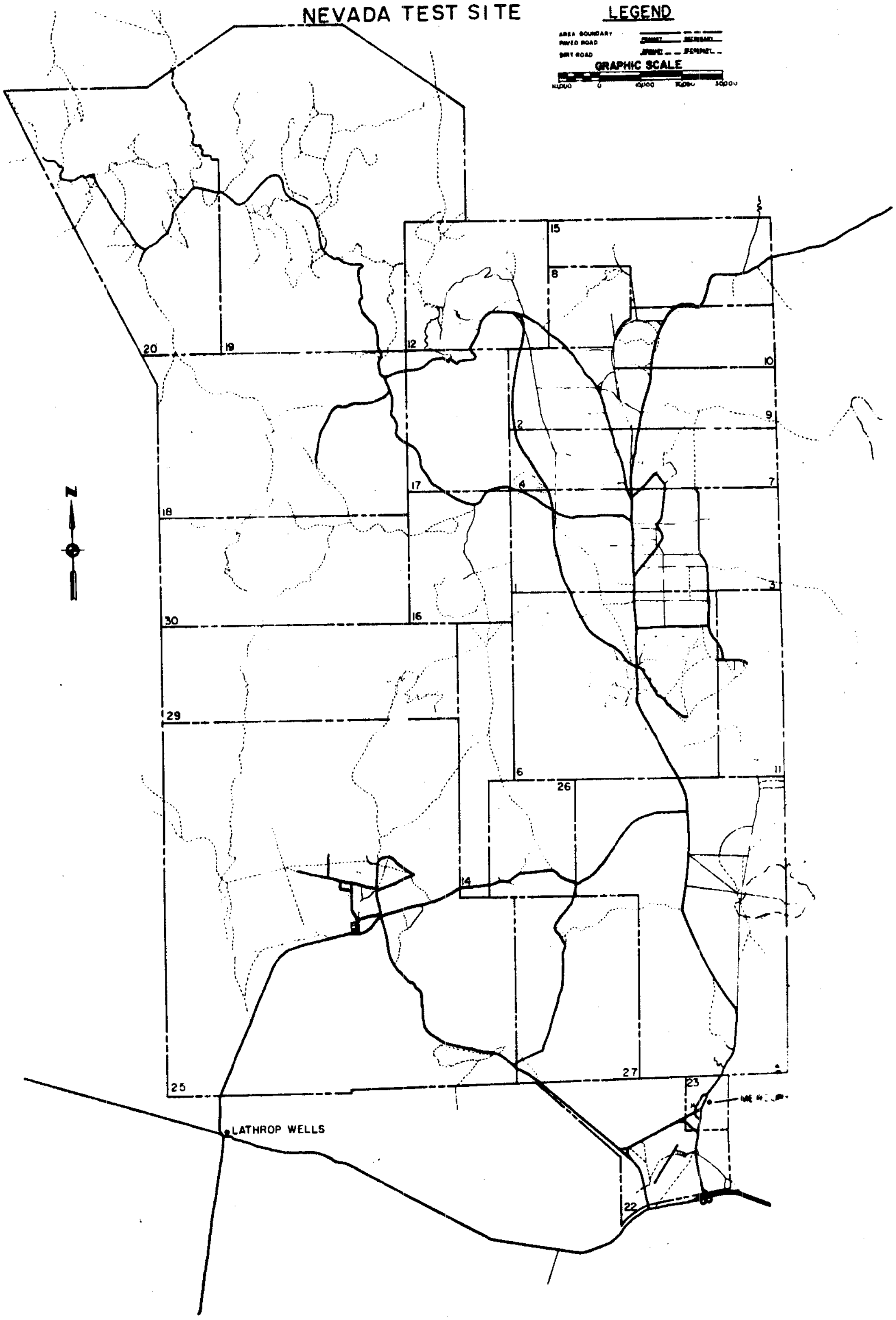

NEVADA TEST SITE
LEGEND
AREA BOUNDARY
PAVED ROAD
DIRT ROAD
GRAPHIC SCALE
0
N
15
8
12
20
19
10
9
2
17
4
7
18
3
30
16
29
6
11
26
14
27
25
23
22
LATHROP WELLS

FIGURE 1

Installations," DOE/EP-0023 (Reference 2). The standards dictate the following objectives for the protection of the public:

(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 environmental surveillance 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

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 gamma, gross beta, plutonium (quarterly)
Supply Wells	1-liter grab sample	Monthly	12	Gross gamma, gamma spectroscopy*, gross beta, plutonium (quarterly)
Open Reservoirs	1-liter grab sample	Monthly	17**	Gross gamma, gamma spectroscopy*, gross beta, plutonium (quarterly)
Natural Springs	1-liter grab sample	Monthly	9**	Gross gamma, gamma spectroscopy*, gross beta, plutonium (quarterly)
Contaminated Ponds	1-liter grab sample	Monthly	8**	Gross gamma, gamma spectroscopy*, gross beta, plutonium (quarterly)

* If the gross gamma measurement can be determined with a two sigma error of less than ten percent.

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

TABLE 1 (Continued)

SUMMARY OF ENVIRONMENTAL PROGRAM

Sample Type	Description	Collection Frequency	Number of Samples	Analysis
Effluent Ponds	3-liter grab sample	Quarterly	7	Gross gamma, gamma spectroscopy* gross beta, plutonium
External Gamma Radiation Levels	CaF_2:Dy Thermoluminescent Dosimeters	Quarterly	163	Total integrated exposure over field cycle

* If the gross gamma measurement can be determined with a two sigma error of less than ten percent.

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 analyses from this sampling program relative to the DOE concentration guides were performed daily to insure that potential problems were noted in a timely fashion. Table 2 lists the CG's used in the evaluations of this program (Reference 3).

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. It 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 plutonium-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

DOE 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}	3×10^{-3}
^{7}Be	6×10^{-6}	5×10^{-2}	2×10^{-3}
^{85}Kr	1×10^{-5}	--------	--------
^{89}Sr	3×10^{-8}	3×10^{-4}	3×10^{-6}
^{90}Sr	1×10^{-9}	1×10^{-5}	3×10^{-7}
^{95}Zr	1×10^{-7}	2×10^{-3}	6×10^{-5}
^{131}I	4×10^{-9}	3×10^{-5}	3×10^{-7}
^{132}Te	2×10^{-7}	9×10^{-4}	3×10^{-5}
^{133}Xe	1×10^{-5}	--------	--------
^{137}Cs	6×10^{-8}	4×10^{-4}	2×10^{-5}
^{140}Ba	1×10^{-7}	8×10^{-4}	3×10^{-5}
^{238}Pu	2×10^{-12}	1×10^{-4}	5×10^{-6}
^{239}Pu	2×10^{-12}	1×10^{-4}	5×10^{-6}

*This table contains the concentration guides for the nuclides of major interest at the NTS (DOE Order 5480.1A, Chapter XI).

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	Wide Beta II	20	Place filter on a 12.7 cm stainless steel planchet.	10^9 cc	2×10^{-16} µCi/cc
	Water	Wide Beta II	100	Evaporate, transfer residue to a 12.7 cm stainless steel planchet.	1000 ml	1×10^{-9} µCi/ml
Gamma Spectroscopy	Air (particulate)	Ge(Li)	20	Same as for gross beta.	10^9 cc	5×10^{-15} µCi/cc
	Air (gaseous)	Ge(Li)	20	Place charcoal cartridge in plastic bag.	10^9 cc	5×10^{-15} µCi/cc
	Water	Ge(Li)	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	333	Pu is concentrated with $Fe(OH)_3$ and purified with anion resin column. Electro-deposited on a stainless steel disc.	1000 ml	1×10^{-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	Aliquot 10 ml into a scintillation solution.	2 ml	9×10^{-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		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 environmental surveillance program for the reporting period of CY-1983 show that the radioactivity in air and water in the NTS environments was low compared to DOE guidelines. External gamma radiation at certain NTS sites approached the rate that could provide the annual dose commitment guide exposure for an individual in a controlled area (5 rem/y).

The maximum CY-1983 average gross beta concentration in air was 1.9 X 10^{-14} µCi/cc at seven of the forty-seven stations. This average represents 0.002 percent of the applicable concentration guide of 1 X 10^{-9} µCi/cc as listed in DOE Order 5480.1A, Chapter XI (assuming ^{90}Sr is the beta emitter present). The other stations during this report period demonstrated similar results. One of the air sampling stations, 19-3 Substation, was discontinued in August because the power was shut off at that substation. The site average for the forty-seven stations was 1.8 X 10^{-14} µCi/cc with one standard deviation being 4.7 percent. This gross beta concentration is considered to be normal background concentrations at the Nevada Test Site. ^{239}Pu concentrations in air were primarily on the order of 10^{-17} µCi/cc as compared with the concentration guide of 2 X 10^{-12} µCi/cc (DOE Order 5480.1A, Chapter XI). The highest average ^{239}Pu concentration occurred in Area 9 at the 9-300 Bunker. This ^{239}Pu concentration of 2.9 X 10^{-16} µCi/cc represents 0.014 percent of the concentration guide. The majority of NTS air sampling stations measured plutonium concentrations similar to those found in the basecamp (Mercury) and all were negligible in terms of exposure to NTS personnel.

One tritium in air sampler was added near the site boundary in Area 23 during CY-1983. The data showed large fluctuations throughout the year. The highest average tritium in air concentration occurred in Area 23, Bldg. 650 of 2.7 X 10^{-9} μCi/cc. This represents 0.05 percent of the concentration guide.

One noble gas sampler was added in October and placed at Area 20 Camp during CY-1983. Two minor releases, caused by drillback operations, were detected. The first occurred during the week of August 1, 1983, and was detected at the Area 1 BJY sampling location. The ^{133}Xe concentration was 154 x 10^{-12} μCi/cc or 0.0015 percent of the concentration guide. The other release occurred during the week of October 3, 1983. Prior to this drillback operation, the DOE asked that noble gas samplers be placed in about a two mile radius around the hole. To accomplish this the regular sampling units were borrowed and placed accordingly. The only sample location which had a positive result was at the 9-300 Bunker. The ^{133}Xe concentration was 16.1 x 10^{-12} μCi/cc which represents 0.0002 percent of the concentration guide.

Measurements of radioactivity in the principal NTS water system showed that no release or movement of radionuclides occurred during the reporting period. It was shown that the radioactivity in the closed water system (supply wells and potable waters) was determined by the specific activity of the associated potassium concentration (naturally occurring ^{40}K). The highest average gross beta concentration in potable waters and supply wells was 8.4 X 10^{-9} μCi/ml from the Area 6 Cafeteria and 11.9 x 10^{-9} μCi/ml from Area 6 Well C1. Water from one open reservoir (A-5 reservoir) 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 ^{239}Pu concentration from noncontaminated waters was 1.8 x 10^{-10} μCi/ml at A-5 Reservoir. This represents 0.004 percent of the concentration guide for ^{239}Pu. 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 the A-5 Reservoir. This concentration of 2.8 x 10^{-6} μCi/ml represents 0.1 percent of the concentration guide. Positive results close to the detection limit may have been caused by statistical fluctuations in the counter.

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-1983. A nine station control network displayed similar results to previous years, while the remaining 154 stations recorded changes related to known effects. The maximum dose rate of 3540 mrem/y occurred at Bldg. 610 in the X-Ray area, but the majority of NTS locations measured in the range of approximately 100-160 mrem/y.

The maximum dose to an individual living at the NTS boundary was calculated for CY-1983. The maximum calculated dose to the total body, bone, and lung was 0.20 mrem, 1.7 mrem, and 0.25 mrem respectively. Using the values from Reference 17, these doses represent risks for radiation-induced cancers of 3.3 X 10^{-8} (total body), 3.4 X 10^{-8} (bone), and 5.0 X 10^{-9} (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. One station was discontinued because of the lack of power. 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 Whatman GF/A filter for particulates, followed by a charcoal cartridge for radioiodines, and mounted on a plastic sample holder. A dry-gas meter was utilized to measure the volume of air displaced over the sampling period which was 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 the naturally-occurring radioactive noble gas products to decay to insignificant levels. Gross beta counting was performed with a gas flow proportional counter (Beckman WIDE BETA II) for 20 minutes. The lower limit of detection for typical parameters involved was 2 X 10^{-16} μCi/cc. Gamma spectroscopy was accomplished using a lithium-drifted germanium detector with an input to 2000 channels which were 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 ^{239}Pu. 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 ^{236}Pu tracer. Alpha spectroscopy was performed utilizing a solid state silicon surface barrier detector. The lower limit of detection for the parameters involved was 2 X 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 2 X 10^{-13} µCi/cc.

One noble gas sampling unit was added during CY-1983. The sampling units are housed in a metal tool box with three metal air bottles attached with quick disconnect 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 X 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 the krypton and zenon 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 original sample and counted in a Nalgene bottle for gamma activity in a Ge(Li) 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 ^{239}Pu. 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) provide an arc coverage for the nuclear testing program; (3) measure the residual activity from the atmospheric testing program; and (4) 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. A badge consisting of two chips shielded by 0.12 cm cadmium (1030 mg/cm^2) inside a 0.13 cm plastic (140 mg/cm^2) holder was 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. Calibration TLD's were stored in a lead pig to empirically determine the value of this minimized fade (usually less than 10 percent).

Random errors included dosimeter variance, source calibration, and transit exposure. One method of error analysis was contained in a paper by Burke and Gesell, "Error Analysis of Environmental Radiation Measurements Made with Integrating Detectors," NBS Special Publication 456, pp. 187-198, (1976), (Reference 6). For our purposes, a less rigid statistical evaluation was sufficient. All analyses are being evaluated as to their compliance with ANSI N545-1975, "American National Standard Performance, Testing, and Procedural Specification for Thermoluminescent Dosimetry (Environmental Applications)" (Reference 7).

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 plotted on a daily basis or 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.

In this program, the value used to check for inaccuracies, trends, or periodicity was the central tendency of the plots. This statistic showed the center of the data file with a strong resistance to outliers and allowed the judgement of the analyst to be imposed upon the system. Any suspected data were checked against the station's central tendency and prior measures of dispersion.

D. RADIOACTIVITY IN AIR

Ambient air monitoring was performed at the 47 locations shown in Figures 2 and 3. During the month of August one of the locations, 19-3 Substation, was discontinued because the power substation was taken out of service. The computer plotted displays of the gross beta and ^{239}Pu activities for the entire air surveillance network are presented in Appendix A. In the first plot, the forty-seven 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 1983 gross beta and ^{239}Pu yearly locational averages, respectively. Tables 4 and 5 list these yearly averages along with the half-year averages. The network average for the whole year for gross beta activity was 1.8×10^{-14} or 0.002 percent of the applicable concentration guide of 1×10^{-9} µCi/cc listed in DOE Order 5480.1A, Chapter XI (assuming ^{90}Sr is the beta emitter present).

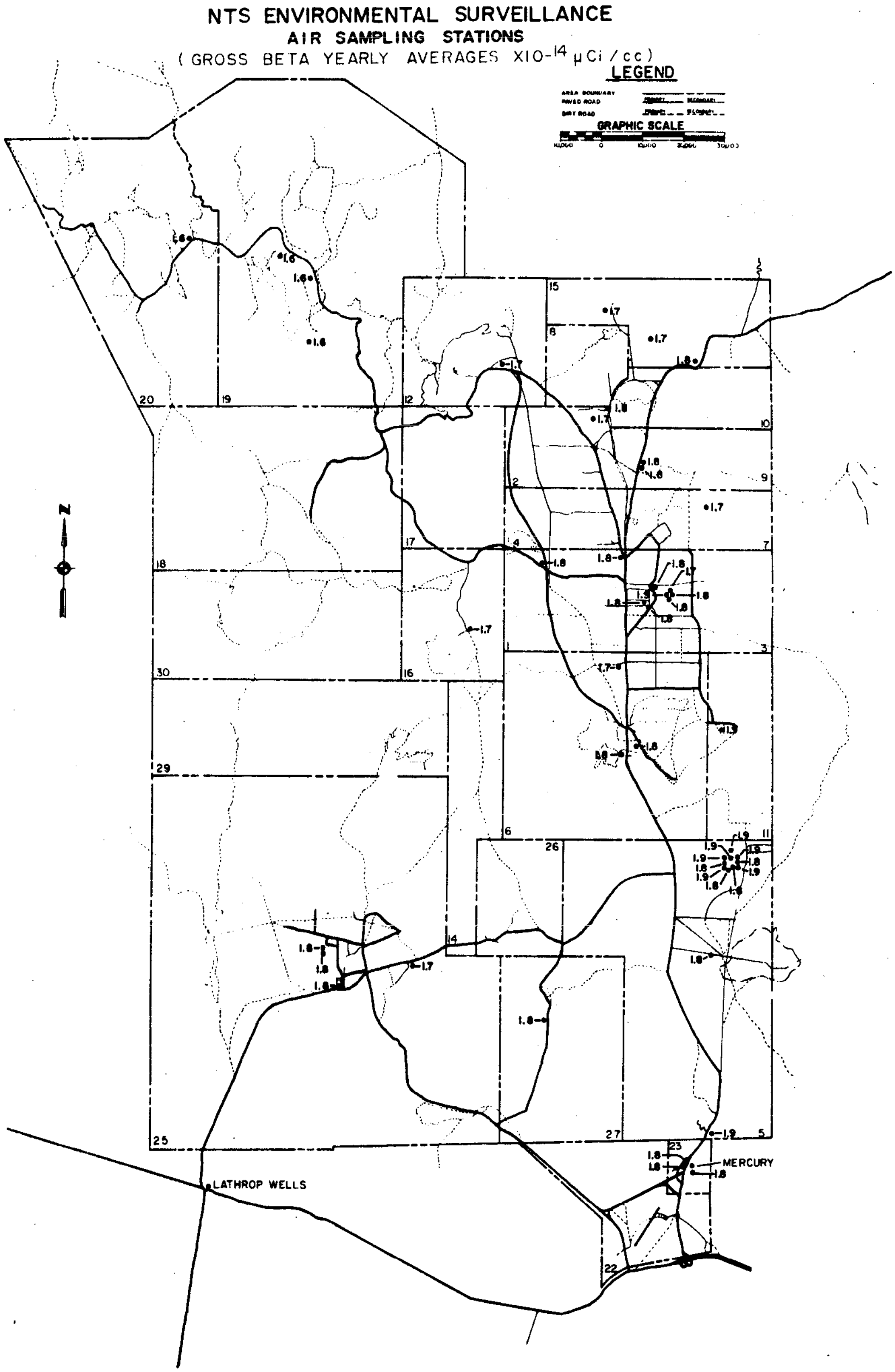

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING STATIONS
(GROSS BETA YEARLY AVERAGES X10-14 μCi / cc)
LEGEND
GRAPHIC SCALE
N
MERCURY
LATHROP WELLS

FIGURE 2

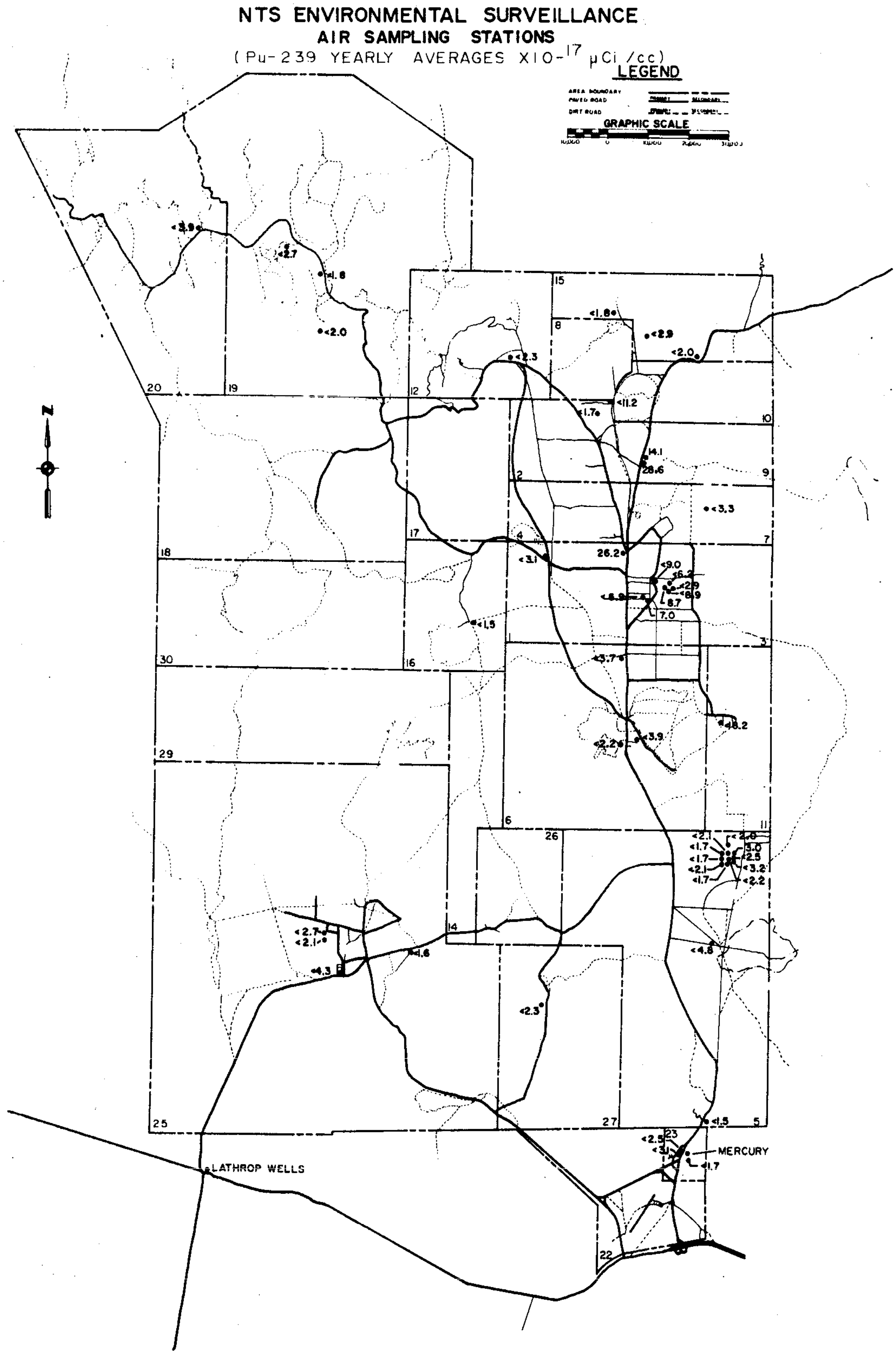

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING STATIONS
(Pu-239 YEARLY AVERAGES X10-17 μCi /cc)
LEGEND
GRAPHIC SCALE
LATHROP WELLS
MERCURY

FIGURE 3

TABLE 4

AVERAGES OF AIR SURVEILLANCE DATA FOR GROSS BETA

($\times 10^{-14}$ μCi/cc)

Station	1/1/83-6/30/83	7/1/83-12/31/83	1/1/83-12/31/83
Area 1 BJY	1.6	1.9	1.8
Area 1 Gravel Pit	1.6	1.9	1.8
Area 2 Cable Yard	1.7	1.9	1.8
Area 2 Compound	1.6	1.9	1.7
Area 3 Compound	1.8	1.9	1.8
Area 3 Complex #2	1.5	2.0	1.8
Area 3 3-300 Bunker	1.7	1.9	1.8
Area 3 U3ax South	1.7	1.9	1.8
Area 3 U3ax East	1.6	1.9	1.8
Area 3 U3ax North	1.6	1.9	1.7
Area 3 U3ax West	1.7	1.9	1.8
Area 5 DOD Yard	1.7	2.0	1.9
Area 5 Gate 200	1.5	2.2	1.9
Area 5 RWMS #1	1.8	1.8	1.8
Area 5 RWMS #2	1.8	2.0	1.9
Area 5 RWMS #3	1.7	1.9	1.8
Area 5 RWMS #4	1.7	2.1	1.9
Area 5 RWMS #5	1.8	2.0	1.9
Area 5 RWMS #6	1.7	2.1	1.9
Area 5 RWMS #7	1.7	1.9	1.8
Area 5 RWMS #8	1.7	1.9	1.8
Area 5 RWMS #9	1.7	2.0	1.8
Area 5 Well 5B	1.7	1.9	1.8
Area 6 CP Complex	1.7	1.9	1.8
Area 6 Well 3 Complex	1.6	1.8	1.7
Area 6 Yucca Complex	1.6	2.0	1.8
Area 7 UE7ns	1.6	1.8	1.7
Area 9 9-300 Bunker	1.7	1.9	1.8
Area 9 9-300 Bunker #2	1.7	1.8	1.8
Area 11 Gate 293	1.8	1.9	1.9
Area 12 Compound	1.5	1.7	1.6
Area 15 EPA Farm	1.6	1.8	1.7
Area 15 Gate 700	1.7	1.9	1.8
Area 15 Piledriver	1.6	1.8	1.7
Area 16 Substation	1.6	1.7	1.7
Area 19 Echo Peak	1.5	1.7	1.6
Area 19 Substation	1.4	1.8	1.6
Area 19 19-3 Substation	1.5	1.7	1.6
Area 20 Dispensary	1.5	1.6	1.6
Area 23 Bldg. 790	1.7	1.8	1.8
Area 23 Bldg. 790 #2	1.7	1.9	1.8
Area 23 H&S Roof	1.6	1.9	1.7
Area 25 E-MAD South	1.7	2.0	1.8
Area 25 E-MAD North	1.7	1.9	1.8
Area 25 NRDS Warehouse	1.6	1.9	1.8
Area 25 Henre Site	1.5	1.9	1.7
Area 27 Cafeteria	1.6	1.9	1.8

TABLE 5

AVERAGES OF AIR SURVEILLANCE DATA FOR PLUTONIUM

($\times 10^{-17}$ µCi/cc)

Station		1/1/83-6/30/83	7/1/83-12/31/83	1/1/83-12/31/83
Area 1	Gravel Pit	<2.2	<4.0	<3.1
Area 2	Cable Yard	<8.5	<13.9	<11.2
Area 2	Compound	<1.9	<1.5	<1.7
Area 3	BJY	<4.0	<48.3	<26.2
Area 3	Compound	<6.3	<7.4	<6.9
Area 3	Complex #2	<7.5	<6.5	<7.0
Area 3	U3ax South	<7.7	<10.0	<8.9
Area 3	U3ax East	<3.4	<2.3	<2.9
Area 3	U3ax North	<8.1	<4.4	<6.2
Area 3	U3ax West	<8.2	<5.3	<6.7
Area 3	3-300 Bunker	<5.8	<12.2	<9.0
Area 5	DOD Yard	<2.6	<1.3	<2.0
Area 5	Gate 200	<2.2	<0.9	<1.5
Area 5	RWMS #1	<3.0	<1.3	<2.2
Area 5	RWMS #2	<2.3	<3.9	<3.2
Area 5	RWMS #3	<2.2	<3.0	<1.2
Area 5	RWMS #4	<2.2	<3.8	<3.0
Area 5	RWMS #5	<2.6	<1.6	<2.1
Area 5	RWMS #6	<1.8	<1.6	<1.7
Area 5	RWMS #7	<1.7	<1.7	<1.7
Area 5	RWMS #8	<2.5	<1.6	<2.1
Area 5	RWMS #9	<1.5	<2.0	<1.7
Area 5	Well 5B	<7.2	<2.4	<4.8
Area 6	CP Complex	<3.1	<1.3	<2.2
Area 6	Well 3 Complex	<2.8	<4.6	<3.7
Area 6	Yucca Complex	<2.7	<5.0	<3.8
Area 7	UE7ns	<2.3	<4.3	<3.3
Area 9	9-300 Bunker	34.7	23.5	28.6
Area 9	9-300 Bunker #2	11.4	16.4	14.1
Area 11	Gate 293	<2.9	<33.4	<18.2
Area 12	Compound	<1.8	<2.8	<2.3
Area 15	EPA Farm	<4.0	<1.9	<2.9
Area 15	Gate 700	<2.2	<1.7	<2.0
Area 15	Piledriver	<2.1	<1.5	<1.8
Area 16	Substation	<1.8	<1.2	<1.5
Area 19	Echo Peak	<2.5	<1.5	<2.0
Area 19	Substation	<2.0	<1.5	<1.8
Area 19	19-3 Substation	<2.5	<3.3	<2.7
Area 20	Dispensary	<5.5	<2.5	<3.9
Area 23	Bldg. 790	<3.2	<3.0	<3.1
Area 23	Bldg. 790 #2	<2.3	<2.7	<2.5
Area 23	H&S Roof	<1.8	<1.6	<1.7
Area 25	E-MAD South	<2.7	<1.4	<2.0
Area 25	E-MAD North	<3.6	<1.8	<2.7
Area 25	Henre Site	<1.8	<1.3	<1.6
Area 25	NRDS Warehouse	<7.3	<1.2	<4.3
Area 27	Cafeteria	<2.8	<1.7	<2.2

Table 5 lists the ^{239}Pu concentrations for the year. All stations averaged below 10^{-15} µCi/cc for CY-1983, with the majority being on the order of 10^{-17} µCi/cc. The highest activity was found at 9-300 Bunker. The average concentration at this location was 2.9×10^{-16} µCi/cc, or 0.01 percent of the controlled area concentration guide of 2×10^{-12} µCi/cc. Figure 3 shows the ^{239}Pu yearly results at their respective locations. This map highlights the areas of plutonium contamination. The radioactivity 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.

An additional tritium in air sampler was added in CY-1983 near the site boundary in Area 23. 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 intervals. 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 occurred at Building 650 of 2.7×10^{-9} µCi/cc which represents 0.05 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,

NTS ENVIRONMENTAL SURVEILLANCE
TRITIUM IN AIR SAMPLING STATIONS
(HTO YEARLY AVERAGES x 10^{-11} µCi/cc)

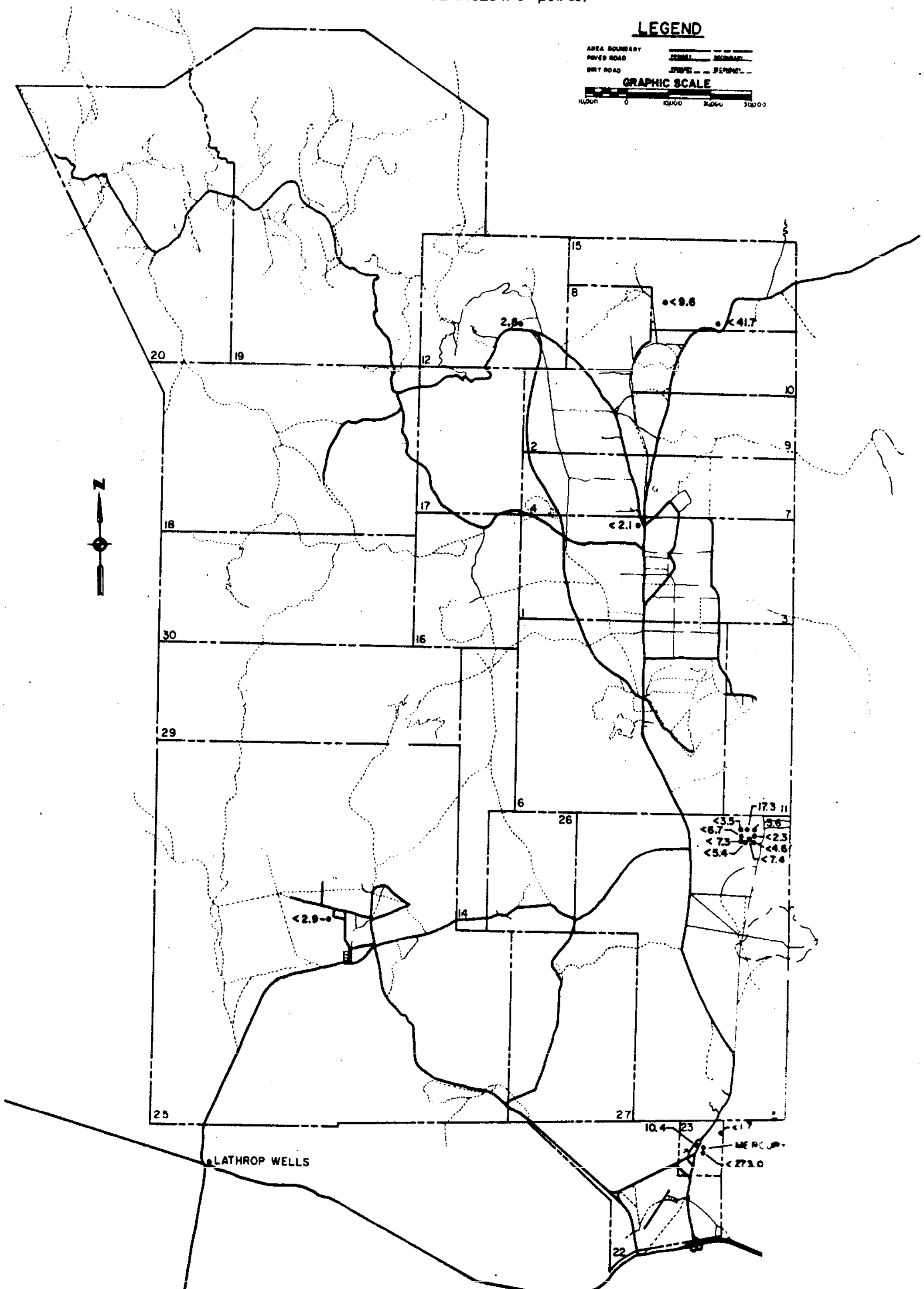


FIGURE 4

elevated concentrations of HTO are detected. Table 6 lists the maximums, minimums, and averages along with the percent of the concentration guide. Appendix B has the actual measurements plotted for each location.

An additional noble gas sampler was added during the month of October at the Area 20 Camp. The location and yearly average for each station is shown in Figure 5. Two minor releases occurred during CY-1983 from drillback operations. The first occurred during the week of August 1, 1983, and was detected at the Area 1 BJY sampling location. The ^{133}Xe concentration was 154 x 10^{-12} µCi/cc or 0.0015 percent of the concentration guide. The second release occurred during the week of October 3, 1983. Prior to the start of drillback, the DOE requested the hole be surrounded with noble gas samplers with a radius of about two miles. To do this the regular sampling units were borrowed and placed accordingly. The only positive result occurred at the 9-300 Bunker. The ^{133}Xe concentration was 16.1 x 10^{-12} µCi/cc and represents 0.0002 percent of the concentration guide.

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

E. RADIOACTIVITY IN SURFACE AND GROUND WATER

The principal water distribution system on the NTS consists of twelve supply wells, eight potable water stations, and seventeen open reservoirs. The wells feed directly to many of the reservoirs, and the drinking water was pumped

TABLE 6

TRITIUM IN AIR

Concentrations
(μCi/cc)

Stations	Maximum	Minimum	Average	% of CG
Area 1 BJY	8.2E-11	<1.4E-13	<2.1E-11	<0.0004
Area 5 RWMS-1	2.5E-10	5.6E-12	<7.4E-11	<0.0015
Area 5 RWMS-SE	2.7E-10	<1.0E-11	<4.6E-11	<0.0009
Area 5 RWMS-(SE-NE)	<9.3E-11	<3.3E-12	<2.3E-11	<0.0005
Area 5 RWMS-NE	9.5E-11	<1.2E-12	<3.6E-11	<0.0007
Area 5 RWMS-(NE-NW)	4.2E-10	1.0E-11	1.7E-10	0.0034
Area 5 RWMS-NW	1.0E-10	2.2E-12	<3.5E-11	<0.0007
Area 5 RWMS-(NW-SW)	6.2E-10	3.3E-12	<6.7E-11	<0.0013
Area 5 RWMS-SW	5.4E-11	3.7E-12	<7.3E-11	<0.0015
Area 5 RWMS-(SW-SE)	1.4E-10	1.5E-11	<5.4E-11	<0.0011
Area 12 Base Camp	8.9E-11	6.7E-12	2.8E-11	0.0006
Area 15 EPA Farm	5.3E-10	<1.3E-13	<9.6E-11	<0.0019
Area 23 Bldg. 790	1.3E-09	<1.3E-13	<1.0E-10	<0.0020
Area 23 Bldg. 650	1.3E-08	<1.5E-13	<2.7E-09	<0.0540
Area 23 Site Boundary	3.2E-11	<2.4E-12	<1.7E-11	<0.0003
Area 25 EMAD	2.1E-10	<1.4E-13	<2.9E-11	<0.0006
Area 15 Gate 700	7.2E-09	<8.0E-14	<4.2E-10	<0.0084

NTS ENVIRONMENTAL SURVEILLANCE

NOBLE GAS SAMPLING STATIONS

(^{85}Kr AND ^{133}Xe YEARLY AVERAGES x 10^{-12} μCi/cc)

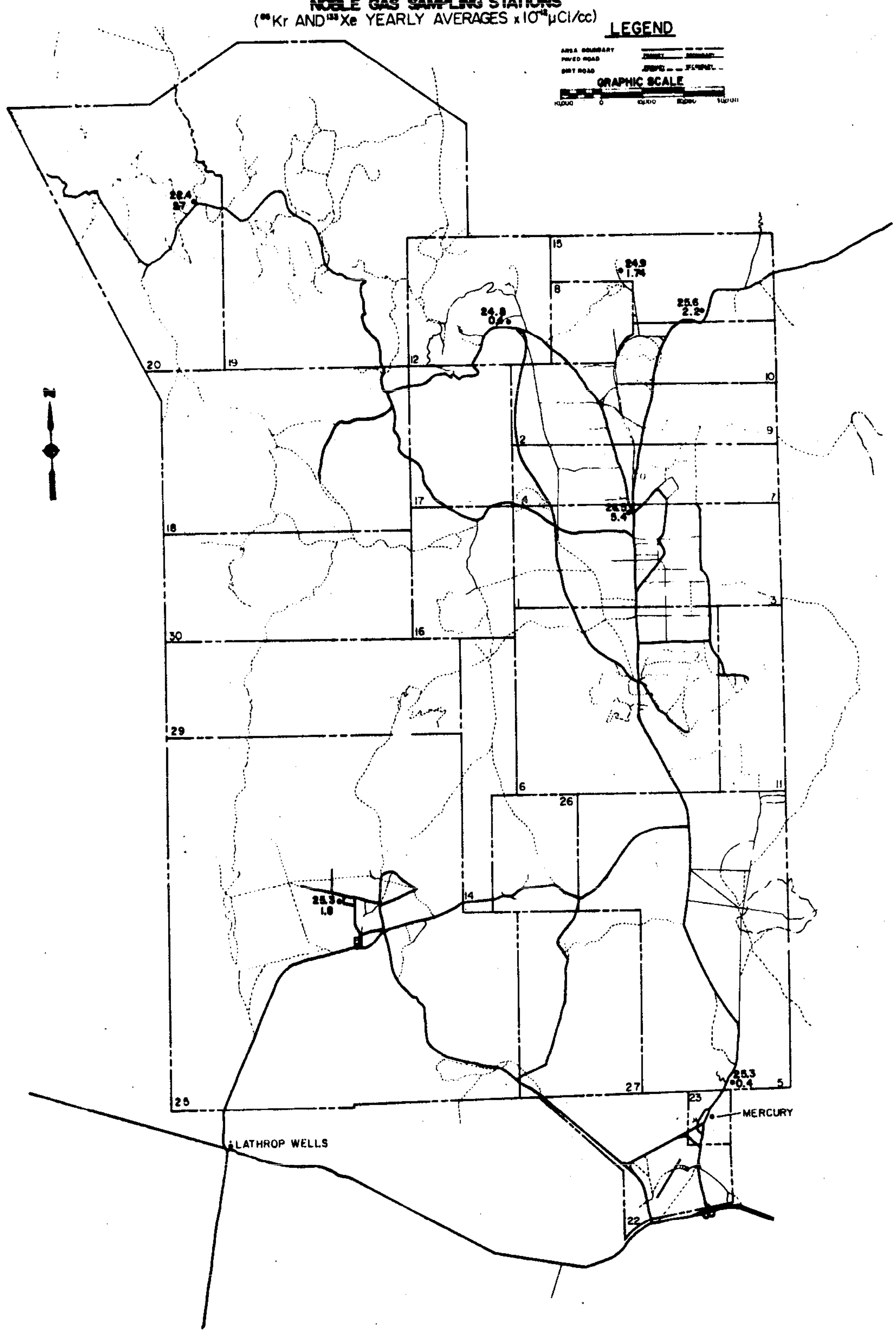


FIGURE 5

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	32.0	22.1	26.5	154.0	-4.0	5.4
Area 12 Base Camp	31.2	20.0	24.8	8.5	-5.5	0.4
Area 15 EPA Farm	29.7	19.9	24.9	12.5	-7.2	1.7
Area 5 Gate 200	29.8	19.6	25.3	8.8	-9.1	0.4
Area 25 EMAD	30.2	20.2	25.3	14.0	-5.7	1.8
Area 15 Gate 700	31.4	19.1	25.6	9.4	-4.3	2.2
Area 20 Dispensary	24.6	20.8	22.5	5.1	0.0	2.7

from the wells to the points of consumption. While the air surveillance network consisted of forty-seven stations measuring general atmospheric radioactivity, results from the water stations would only correspond where there was direct "communication" of fluid. This was the critical pathway for the ingestion of waterborne radionuclides, so the system was routinely sampled and evaluated. 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. This also created a large data base to evaluate long-term trends or intermittent changes in activity. The supply wells and open reservoirs were collected on a monthly schedule. The identification of any radionuclides above natural background in this system initiated a closer review of the drinking water.

The other water systems monitored onsite were the natural springs, contaminated ponds, and effluent ponds. The springs were collected monthly. The contaminated and effluent ponds were collected on nonroutine schedules because of limitations in the amount of water at each location.

1. Supply Wells

Water from twelve 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 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

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

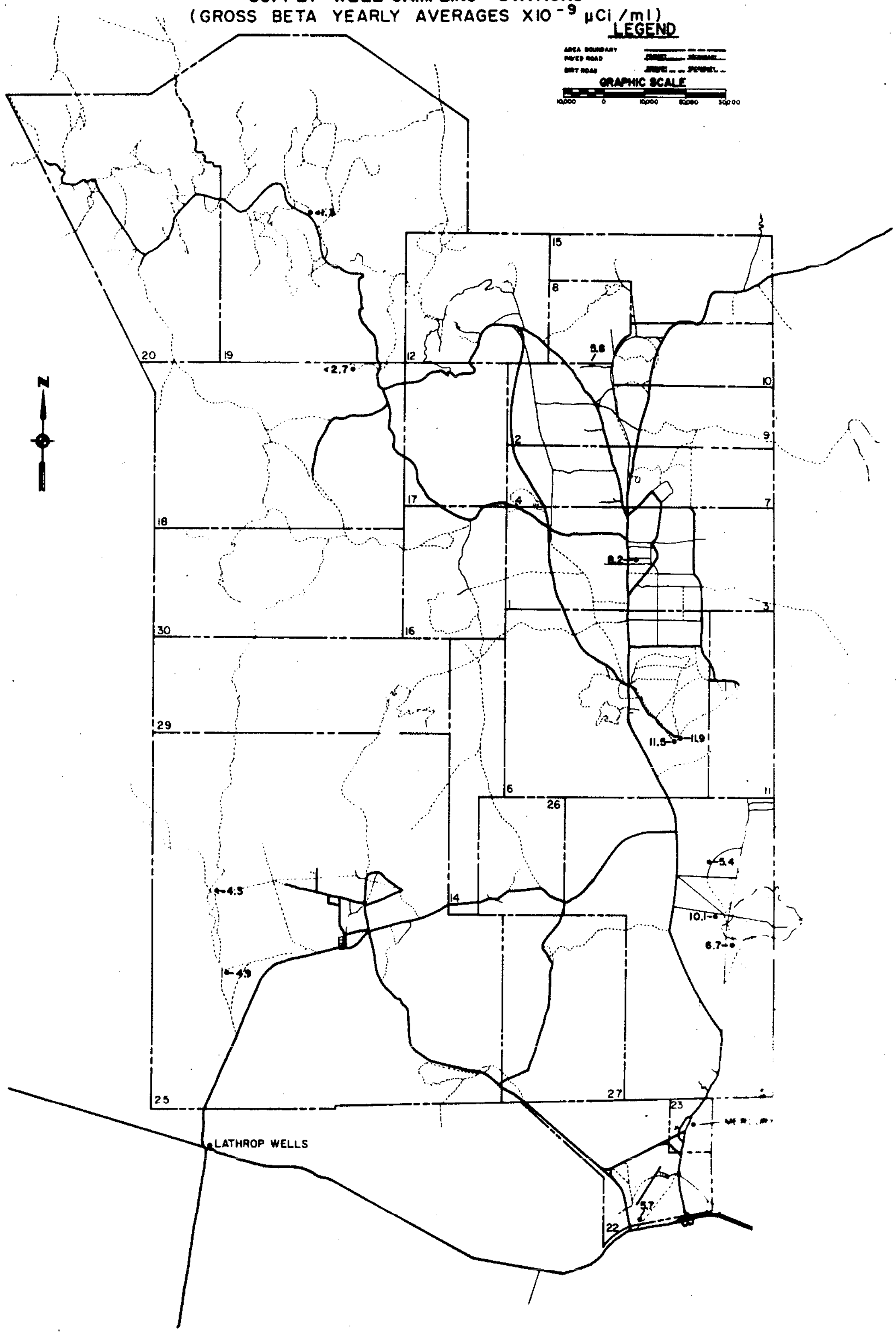


FIGURE 6

network throughout the reporting period. The range at each point is also given. Table 8 lists the 1983 averages for each location. The highest average recorded was 11.9 X 10^{-9} µCi/ml at Well C. This was 4.0 percent of the concentration guide (assuming ^{90}Sr is the beta emitter present). The lowest average gross beta activity for the onsite supply wells was <1.3 X 10^{-9} µCi/ml at Well U19c.

The activities of each well and the entire network average appeared consistent over this report period. 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-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
FY-1976	9.1

TABLE 8

AVERAGES OF SUPPLY WELL DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($\times 10^{-9}$ µCi/ml)
Area 2 Well 2	5.8
Area 3 Well A	8.2
Area 5 Well 5B	10.2
Area 5 Well 5C	6.7
Area 5 Well Ue5c	5.4
Area 6 Well C	11.9
Area 6 Well C1	11.6
Area 18 Well 8	<2.7
Area 19 Well U19c	<1.3
Area 22 Army Well #1	5.7
Area 25 Well J12	4.9
Area 25 Well J13	4.3

As in previous years the beta emitting isotope of potassium, ^{40}K, having a natural abundance of 0.012 percent, was shown to be the primary source of radioactivity in the NTS supply wells. Figure 7 graphically displays the relationship for the primary waters onsite. A linear regression from the supply well data obtained the following equation: Gross Beta = [-1.33 + 0.93 (potassium in mg/liter)] X 10^{-9} µCi/ml. The correlation coefficient was 0.97. Therefore, the variation of gross beta results in NTS water was principally dependent upon the beta emitter ^{40}K.

Calculations of the specific activity associated with the amount of ^{40}K in this water was determined using Reference 10. The results of these calculations were the basis for the solid line shown in Figure 7.

$$A = \lambda N$$

where: N = Number of radioactive atoms per unit mass (1mg)
λ = Decay constant
A = Activity

$$N = \frac{(0.001\ g)(N_o)(a)}{(\text{Atomic Mass})}$$

where: N_o = Avogadro's number
a = ^{40}K abundance

$$\lambda = \frac{\text{Ln } 2}{(1.26 \times 10^9)(365.25)(1440)}$$

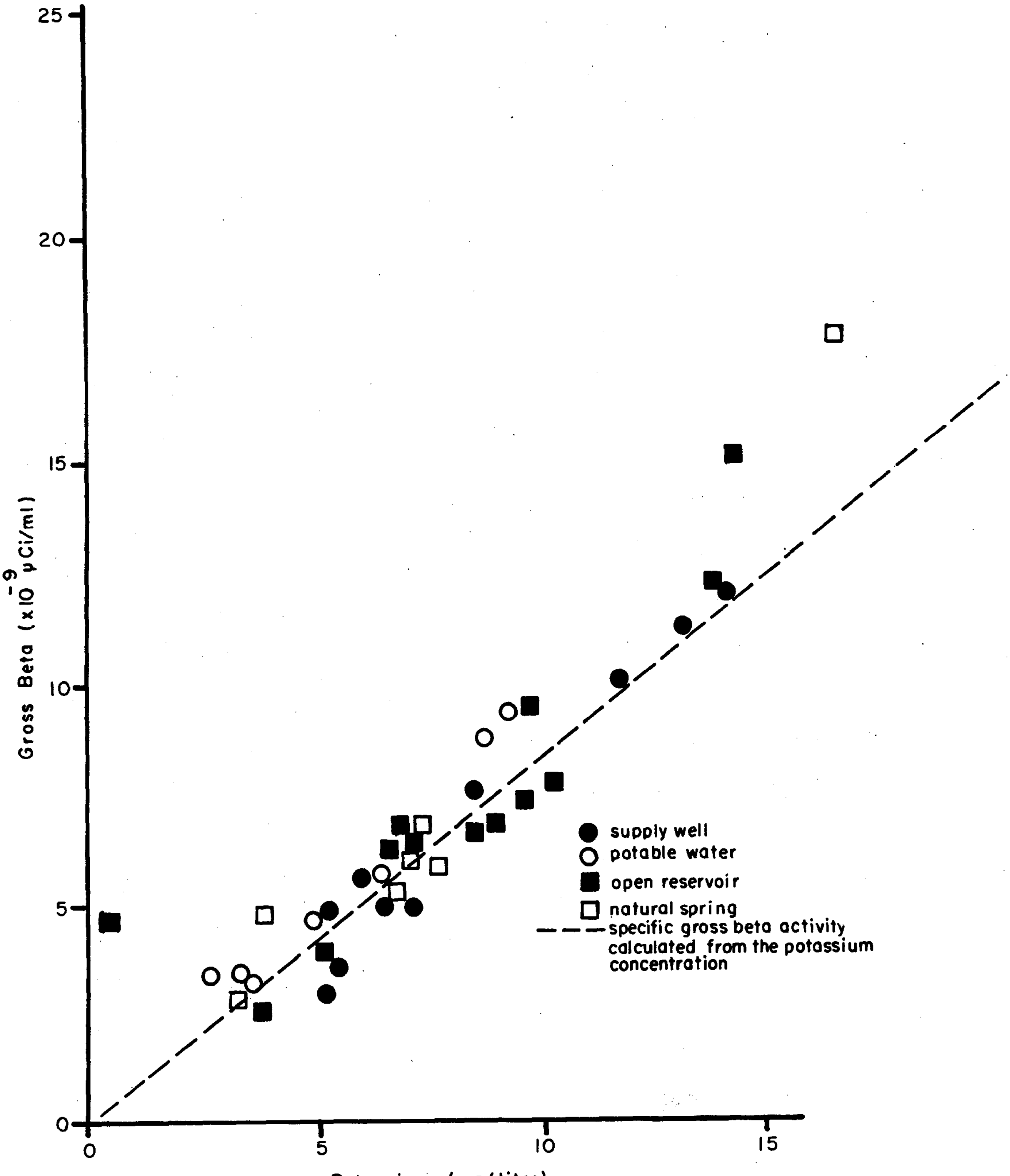
$$\text{Thus, } A(\text{dpm/mg}) = \frac{(0.001)(No)(a)(Ln2)}{(\text{Atomic Mass})(1.26 \times 10^9)(365.25)(1440)}$$

$$A(\mu Ci/mg) = \frac{(0.001)(6.022 \times 10^{23})(1.18 \times 10^{-4})(0.693)}{(39.1)(1.26 \times 10^9)(365.25)(1440)(2.22 \times 10^6)}$$

$$A = 8.56 \times 10^{-7}\ \mu Ci/mg(\text{potassium})$$

or

$$A = 8.56 \times 10^{-10}\ \mu Ci/ml \text{ per mg/liter}$$



WATER RADIOACTIVITY vs. POTASSIUM CONCENTRATION

Figure 7

The calculated activity of 8.56 X 10^{-10} μCi/ml per mg/liter correlated reasonably well with 9.3 X 10^{-10} μCi/ml per mg/liter from the linear regression analysis of the supply well data. This demonstrated conclusively that naturally-occurring potassium was the determining factor of the radioactivity in the NTS water. No other radionuclides could give rise to more than ten percent of the measured gross beta activity.

Appendix C includes plots of the network monthly averages for tritium and plutonium. Due to the change in sample size the lower limit of detection decreased slightly. The positive tritium results are given in Table 9. The highest value was 2.1 x 10^{-5} μCi/ml from Well A. This is 0.7 percent of the concentration guide for tritium in drinking water. The majority of the positive measurements are near the detection limits of the system. The positive values with a high percentage error are assumed to be caused by a fluctuation of the counter. There were no positive plutonium results for the supply wells for CY-1983.

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 8 with their gross beta yearly averages.

TABLE 9

TRITIUM VALUES ABOVE DETECTION LIMITS
FROM NONCONTAMINATED WATERS

WATER TYPE	STATION	DATE	μCi/ml
Potable Water	Area 23 Cafe	09/20/83	1.6E-06 ± 26.9%
Potable Water	Area 23 Cascade Water	10/03/83	1.0E-06 ± 34.5%
Potable Water	Area 6 Cafe	02/01/83	2.8E-06 ± 23.7%
	Area 6 Cafe	05/31/83	3.0E-05 ± 3.0%
Natural Spring	Captain Jack Springs	04/29/83	1.4E-06 ± 31.7%
Natural Spring	Topopah Springs	12/08/83	1.7E-06 ± 14.7%
Open Reservoir	Area 5 Reservoir	01/10/83	1.8E-06 ± 24.3%
		02/07/83	2.0E-06 ± 21.9%
		03/02/83	1.5E-06 ± 27.5%
		04/06/83	1.7E-05 ± 4.3%
		05/11/83	1.1E-06 ± 39.0%
		06/08/83	2.2E-06 ± 21.3%
Open Reservoir	Area 23 Swimming Pool	11/10/83	7.1E-07 ± 34.0%
Open Reservoir	Area 3 Mud Plant Reservoir	05/19/83	5.5E-05 ± 5.3%
		12/01/83	1.1E-06 ± 22.3%
Open Reservoir	Well J-11 Reservoir	04/06/83	1.2E-06 ± 36.6%
Supply Well	Well 2	01/09/83	3.2E-06 ± 14.5%
Supply Well	Well C1	02/08/83	1.4E-06 ± 31.3%
		11/09/83	8.7E-06 ± 4.5%
Supply Well	Well A	11/08/83	2.1E-05 ± 2.6%

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

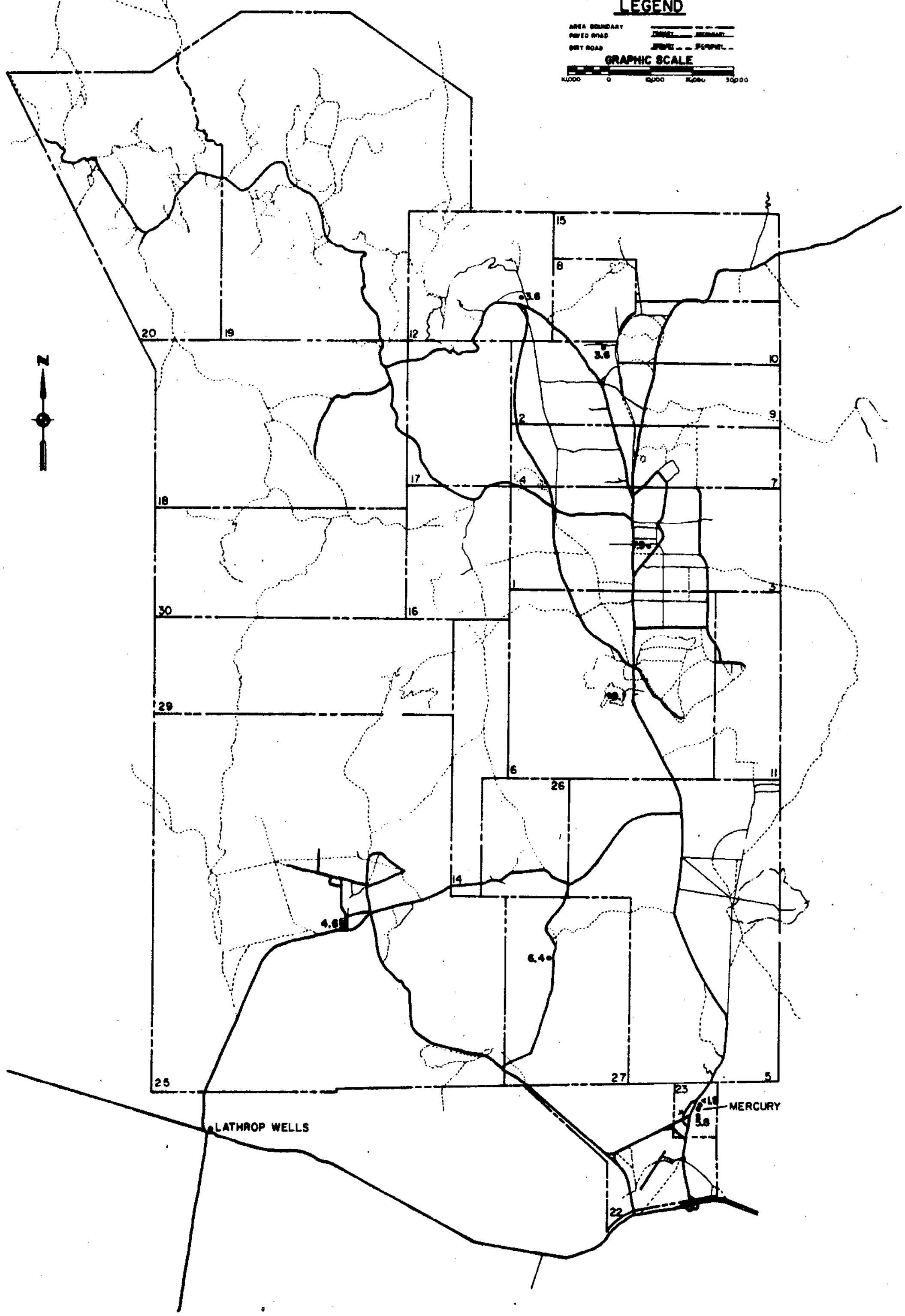


FIGURE 8

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-1983. The highest average recorded was 9.1 X 10^{-9} µCi/ml at the Area 6 Cafeteria. This was 3.0 percent of the concentration guide for drinking water (assuming ^{90}Sr is the beta emitter present). The lowest average gross beta activity, excluding Cascade brand bottled water, was 3.5 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.

Gross beta measurements at these potable water stations demonstrated that no release or movement of radionuclides occurred in the NTS water system throughout CY-1983. No discernible trends were seen 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-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
FY-1976	7.4

TABLE 10

AVERAGES OF POTABLE WATER DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($X\ 10^{-9}\ \mu Ci/ml$)
Area 2 Rest Room	3.5
Area 3 Cafeteria	7.9
Area 6 Cafeteria	9.1
Area 12 Cafeteria	3.6
Area 23 Cafeteria	5.8
Area 23 Cascade Water	<1.5
Area 25 Service Station	4.6
Area 27 Cafeteria	6.4

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. As shown in the previous section, the majority of radioactivity in supply well water and, therefore, in potable water was from the naturally occurring potassium. Figure 7 showed this graphically.

The potable water results lie close to the line calculated from the specific activity of the associated potassium results. The linear regression of the potable water data was: Gross Beta = [-0.34 + 0.99 (potassium in mg/liter)] X 10^{-9} μCi/ml. The correlation coefficient was 0.99.

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 value was 3.0×10^{-5} μCi/ml for Area 6 Cafe. This is 1.0 percent of the concentration guide for tritium in drinking water. The majority of the fourteen positive measurements are near the detection limit of the system and are believed to be caused by fluctuations in the counting system. There were no positive plutonium results for the CY-1983.

3. Open Reservoirs

Open reservoirs have been established at various locations on the NTS for industrial purposes. Fifteen of these impoundments were sampled during the report period. The locations are shown in Figure 9 along with their gross beta yearly averages.

TABLE 11

COMPARISON OF END USE AND SUPPLY WATER

FOR GROSS BETA AVERAGES

(X 10^{-9} µCi/ml)

Station (end use/supply)	CY-1983
Area 2 Rest Room	3.5
Area 18 Well 8	<2.7
Area 3 Cafeteria	7.9
Area 3 Well A	8.2
Area 6 Cafeteria	9.1
Area 6 Well C/C1	11.9/11.6
Area 12 Cafeteria	3.6
Area 18 Well 8	<2.7
Area 23 Cafeteria	5.8
Area 5 Well 5B/5C	10.2/6.7
Area 22 Army Well #1	5.7
Area 23 Cascade Water	<1.5
(Demineralized Bottled Water)	—
Area 27 Cafeteria	6.4
Area 5 Well 5B/5C	10.2/6.7
Area 22 Army Well #1	5.7

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

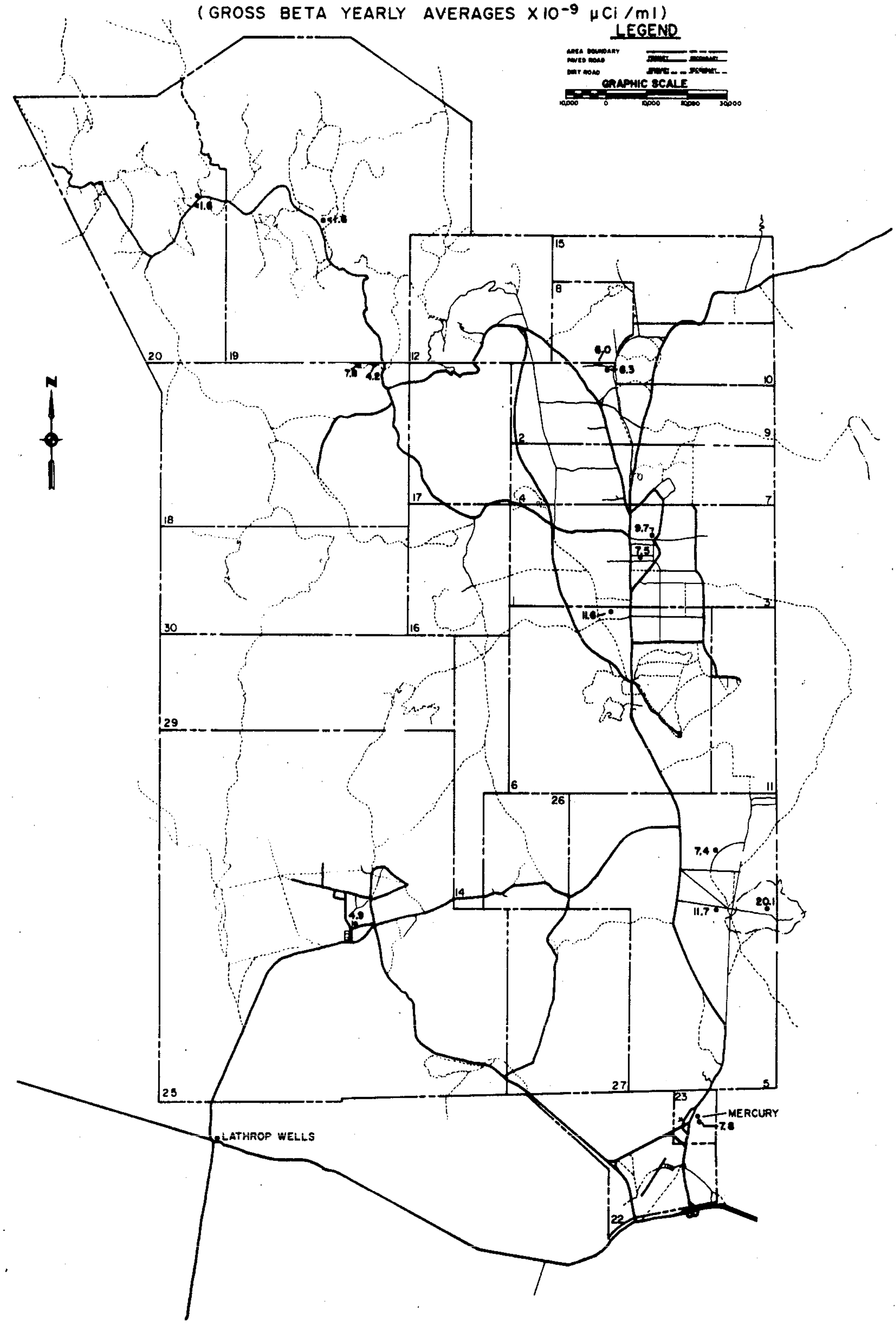


FIGURE 9

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-1983.

Flat 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, simply, more variable sampling procedures since some of the open reservoirs are difficult to sample. The average of the entire network, as compared to previous years was:

Year	Mean (X 10^{-9} μCi/ml)
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
FY-1976	22.0

Table 12 includes a list of the CY-1983 gross beta averages at each location. The highest average beta concentration was 20.1 X 10^{-9} μCi/ml at Area 5 Reservoir. This result was 0.2 percent of the concentration guide (assuming ^{90}Sr is the beta emitter present). The lowest gross beta average was <1.6 X 10^{-9} μCi/ml at Well U19c and Well 20a Reservoir.

Table 13 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 similar to those of the suppliers.

As shown in the supply well section, the majority of the radioactivity in the water of the supply wells and, therefore, in the open reservoirs was from the naturally occurring potassium. The results from the reservoirs lie above the calculated potassium line, as shown in Figure 7, in most instances. These cases may be caused by runoff from surface contamination in the surrounding areas.

Appendix E also includes the plots of the network averages for tritium and plutonium. There were ten positive tritium values, the highest was 5.5 x 10^{-5} μCi/ml at Area 2 Mud Plant Reservoir. This is 0.05 percent of the tritium concentration guide. There were three positive plutonium results. The highest plutonium concentration was 3.8 X 10^{-10} μCi/ml and occurred at A-5 Reservoir. This is 0.0004 percent of the concentration guide. The positive tritium and plutonium results can be seen in Tables 9 and 14.

TABLE 12

AVERAGES OF OPEN RESERVOIR DATA FOR GROSS BETA

Station	Gross Beta Yearly Average (X 10^{-9} μCi/ml)
Area 2 Well 2 Reservoir	6.0
Area 2 Mud Plant Reservoir	6.3
Area 3 Well A Reservoir	7.5
Area 3 Mud Plant Reservoir	9.7
Area 5 Well 5B Reservoir	11.7
Area 5 Well Ue5c Reservoir	7.4
Area 5 Reservoir	20.1
Area 6 Well 3 Reservoir	11.6
Area 6 Well C1 Reservoir	12.8
Area 18 Camp 17 Reservoir	4.2
Area 18 Well 8 Reservoir	7.7
Area 19 Well 19c Reservoir	<1.6
Area 20 Well 20A Reservoir	<1.6
Area 23 Swimming Pool	7.8
Area 25 Well J-11 Reservoir	4.9

TABLE 13

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	6.0
Area 2 Well 2	5.8
Area 3 Well A Reservoir	7.5
Area 3 Well A	8.2
Area 5 Well 5B Reservoir	11.7
Area 5 Well 5B	10.2
Area 5 Well Ue5c Reservoir	7.4
Area 5 Well Ue5c	5.4
Area 6 Well C1 Reservoir	12.8
Area 6 Well C1	11.6
Area 19 Well U19c Reservoir	<1.6
Area 19 Well U19c	<1.3

TABLE 14

PLUTONIUM VALUES ABOVE DETECTION LIMITS
FROM NONCONTAMINATED WATERS

WATER TYPE	STATION	DATE	μCi/ml
Natural Spring	Reitmann Seep	09/01/83	1.4E-10 ± 36.5%
Open Reservoir	Area 5 Reservoir	09/09/83	3.8E-10 ± 20.1%
		12/02/83	2.5E-10 ± 23.9%
Open Reservoir	A-2 Mud Plant	03/04/83	2.5E-10 ± 30.8%

4. Natural Springs

The term "natural springs" was a label given to the spring supplied pools located within the NTS. There was no known human consumption from these springs. Nine such locations were sampled on a monthly basis or when accessible, and are shown in Figure 10 along with their gross beta yearly averages.

Appendix F consists of the plots of all stations of the measured gross beta activity with 2σ error bars. An averaging plot is included which shows the trend of the network mean throughout the reporting period.

The range at each point is also given. Table 15 includes a list of the averages at each location. The highest average recorded was 14.0×10^{-9} μCi/ml at Reitmann Seep. This was 0.14 percent of the CG (assuming ^{90}Sr is the beta emitter present). The lowest beta concentration was 3.4×10^{-9} μCi/ml at Tippipah Spring.

Gold Meadows Spring's gross beta activity was in excess of that calculated from its potassium concentration as shown in Figure 7. Even though this station showed an excess of gross beta activity, it was still within the applicable concentration guide (assuming ^{90}Sr is the beta emitter present).

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

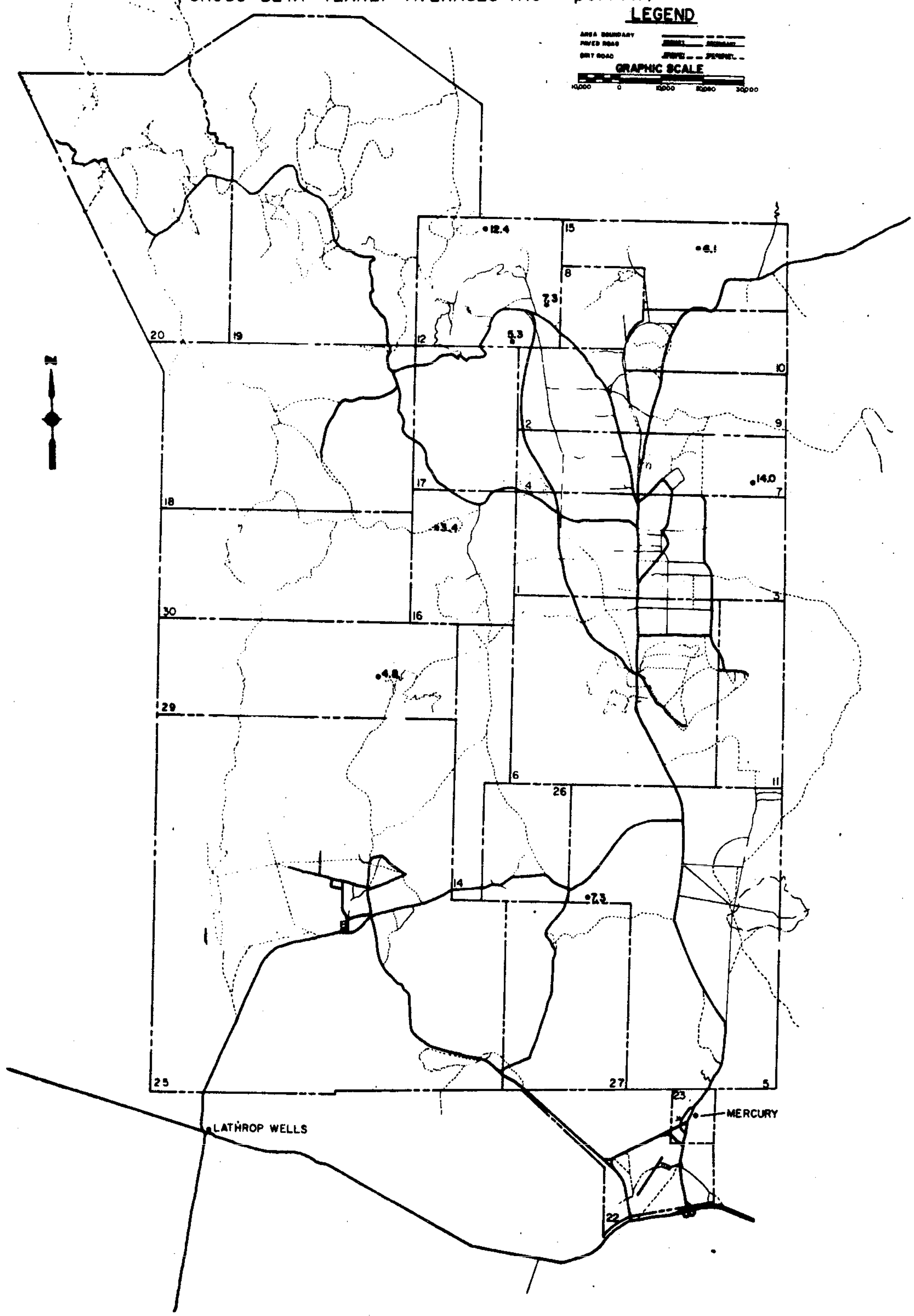


FIGURE 10

TABLE 15

AVERAGES OF NATURAL SPRINGS DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($\times 10^{-9}$ µCi/ml)
Area 5 Cane Spring	7.3
Area 7 Reitmann Seep	14.0
Area 12 White Rock Spring	7.3
Area 12 Captain Jack Spring	5.3
Area 12 Gold Meadows Pond	12.4
Area 15 Tub Spring	6.1
Area 16 Tippipah Spring	3.4
Area 29 Topopah Spring	4.8

The network average, as compared to those presented in previous reports, was:

Year	Mean ($X10^{-9}$ µCi/ml)
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
FY-1976	14.6

Appendix F includes plots of the network averages for tritium and plutonium. The highest value for tritium was 1.7×10^{-6} µCi/ml at Topopah Springs. This represents 0.002 percent of the concentration guide for tritium. The only positive plutonium value was 1.4×10^{-10} µCi/ml at Tub Springs. This is 0.0001 percent of the concentration guide for plutonium. The positive results for tritium and plutonium are listed in Tables 9 and 14.

5. Contaminated Ponds

Seven contaminated ponds were sampled on a special study basis. The locations are shown in Figure 11. 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. These calculations for tritium are reported to DOE Headquarters on an annual basis.

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

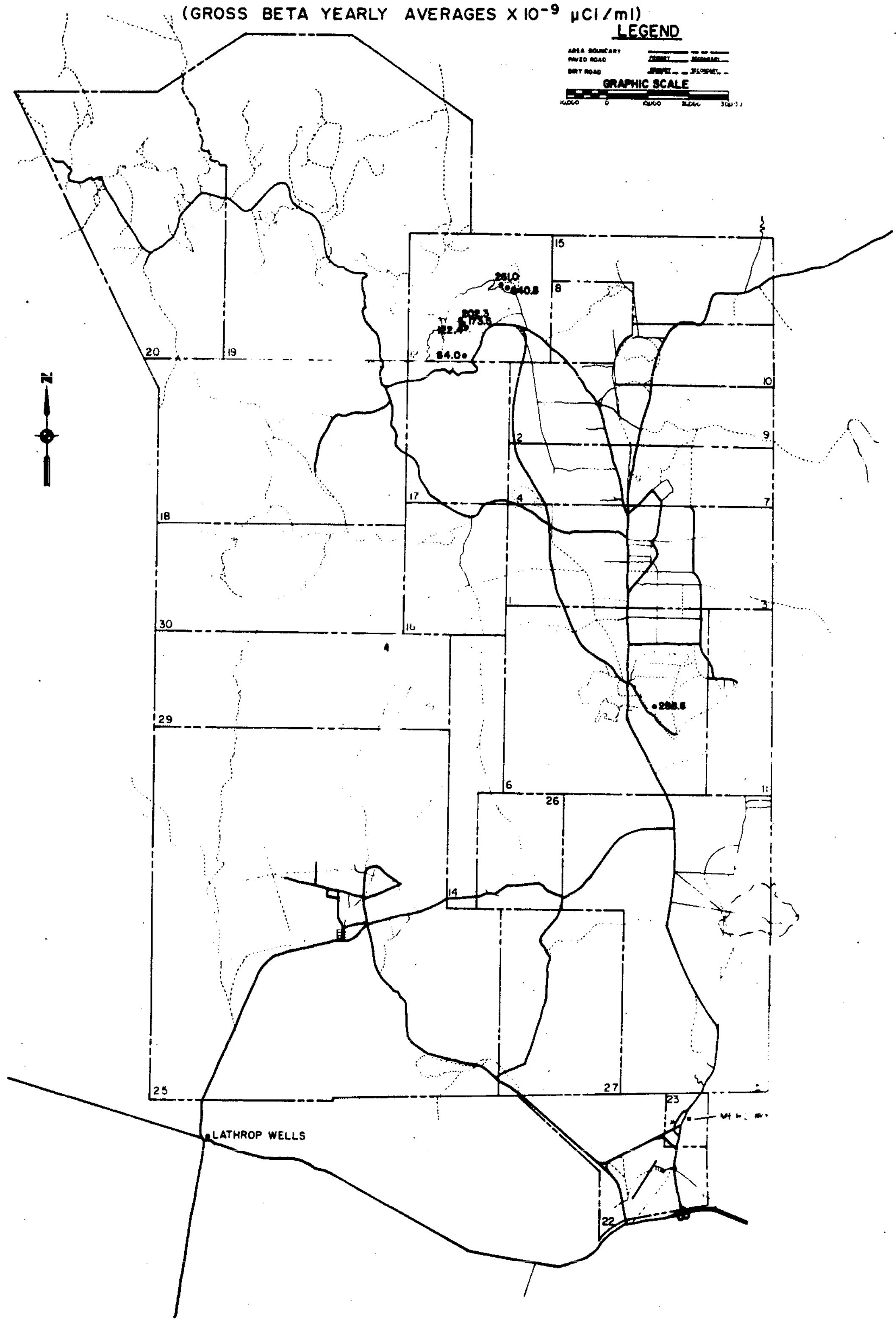


FIGURE 11

Table 16 is a list of the gross beta, tritium, and ^{239}Pu averages at the seven active stations. The first two pages of Appendix G contain the contaminated pond network averages and the remaining plots show the gross beta, ^{239}Pu, and tritium concentrations at each station. The differences between CY-1982 and CY-1983 can be attributed to the decrease or increase in use of the ponds.

6. Effluent Ponds

Samples from seven effluent pond locations were collected during CY-1983. 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 tritium value was 9.5×10^{-7} µCi/ml and 5.6×10^{-11} µCi/ml for plutonium. All results are within the applicable concentration guides.

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. Normally, the TLD's are changed on a quarterly basis. During CY-1983 the TLD's were changed on a semi-annual basis because of equipment problems and difficulty in obtaining replacement TLD's. Table 17 lists the maximum, minimum, and average dose rates, along with the adjusted annual dose for each monitoring station.

TABLE 16

CONTAMINATED POND YEARLY CONCENTRATION AVERAGES

Station	Tritium Yearly Average ($\times 10^{-6}$ µCi/ml)	Gross Beta Yearly Average ($\times 10^{-9}$ µCi/ml)	^{239}Pu Yearly Average ($\times 10^{-11}$ µCi/ml)
Area 6 Yucca Waste Pond	6.6	288.6	<68.0
Area 12 N Upper	2,077.0	202.3	<8.7
Area 12 N Middle	1,164.0	173.5	<8.7
Area 12 N Lower	1,628.0	122.4	<6.4
Area 12 G Waste	12,300.0	84.0	<3.8
Area 12 Upper Mint Lake	255.2	261.0	<14.0
Area 12 Middle Mint Lake	360.0	640.8	<5.9

TABLE 17
GAMMA MONITORING RESULTS - SUMMARY OF 1983

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.**	AVG.	1982 ADJUSTED ANNUAL DOSE (mrem/y)	1983 ADJUSTED ANNUAL DOSE (mrem/y)
-90 Road (18)	01/25/83 - 01/05/84	0.42	0.30	0.42	160	155
-100 Road (18)	01/25/83 - 01/05/84	0.42	0.28	0.42	155	155
-108 Road (18)	01/25/83 - 01/05/84	0.43	0.33	0.43	160	155
-116 Road (20)	01/25/83 - 01/05/84	0.49	0.33	0.49	175	180
-130 Road (20)	01/25/83 - 01/05/84	0.41	0.30	0.41	155	150
-132 Road (20)	01/25/83 - 01/05/84	0.54	0.45	0.45	155	165
-136 Road (20)	01/25/83 - 01/05/84	0.54	0.45	0.45	155	165
ngle Road (3)	01/20/83 - 01/05/84	1.49	1.46	1.46	625	535
ldg. 190 (23)	01/19/83 - 01/04/84	0.32	0.22	0.22	80	80
ldg. 610 Fence (23)	01/19/83 - 01/04/84	0.29*	0.18	0.18	75	65
ldg. 610 X-Ray Area (23)	01/19/83 - 01/04/84	9.69	1.43	9.69	2480	3540
ldg. 650 Dosimetry Room (23)	01/19/83 - 01/04/84	0.21	0.21	0.21	70	75
ldg. 650 Roof (23)	01/19/83 - 01/04/84	0.18	0.14	0.18	60	65
ldg. 650 Sample Storage (23)	01/19/83 - 01/04/84	2.02	0.84	2.02	205	740
.J.Y. (1)	01/20/83 - 01/05/84	0.35	0.28	0.35	135	130
-16 Road (19)	01/25/83 - 01/05/84	0.45	0.40	0.40	175	145
-25 Road (19)	01/25/83 - 01/05/84	0.59	0.40	0.40	165	145
-27 Road (19)	01/25/83 - 01/05/84	0.64	0.44	0.44	180	160
-31 Road (19)	01/25/83 - 01/05/84	0.61	0.43	0.43	175	155
able Yard (2)	01/20/83 - 01/05/84	0.54*	0.39	0.39	160	140
afeteria (27)	01/19/83 - 01/04/84	0.39	0.23*	0.39	135	140
ampsite (20)	01/25/83 - 01/05/84	0.42	0.40	0.40	155	145
ircle & L Road (10)	01/20/83 - 01/05/84	0.59*	0.39	0.39	155	140
omplex (3)	01/20/83 - 01/05/84	0.53	0.37	0.37	140	135
omplex (12)	01/21/83 - 01/04/84	0.39	0.36	0.39	155	140
P Complex (6)	01/21/83 - 01/04/84	0.25	0.18	0.25	75	90
P-50 Calibration Bench (6)	01/20/83 - 01/04/84	0.56	0.41	0.41	155	150
P-50 Instrument Calib. Door (6)	01/20/83 - 01/04/84	0.77	0.56	0.56	175	205
A-14 (10)	01/20/83 - 01/05/84	0.62	0.46	0.46	215	170
econ Pad Front Office (6)	01/20/83 - 01/04/84	0.27	0.27	0.27	135	100
econ Pad Back Office (6)	01/20/83 - 01/04/84	0.63	0.63	0.63	130	230
esert Rock Weather Stn. (22)	01/19/83 - 01/04/84	0.28*	0.19	0.19	75	70
-MAD East (25)	01/20/83 - 01/04/84	0.56*	0.34	0.34	130	125
E-MAD North (25)	01/20/83 - 01/04/84	0.98	0.73	0.73	255	265
-MAD Tile Bed (25)	01/19/83 - 01/04/84	0.46	0.33	0.33	120	120
E-MAD West (25)	01/19/83 - 01/04/84	0.58*	0.35	0.35	125	130
EPA Farm (15)	01/20/83 - 01/05/84	0.31	0.25	0.31	130	115
-2 Road (20)	01/25/83 - 01/05/84	0.57	0.47	0.47	170	170

*This result is suspect due to a reader malfunction during the readout of the TLD's.
**Due to a reader malfunction, the results from the second half of CY-1983 are being reported, but only the results from the first half of the year are being used in obtaining the average dose rate or the adjusted annual dose.

Table 17 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.**	AVG.	1982 ADJUSTED ANNUAL DOSE (mrem/y)	1983 ADJUSTED ANNUAL DOSE (mrem/y)
F-8 Road (20)	01/25/83 - 01/05/84	0.53	0.52	0.52	170	190
F-12 Road (20)	01/25/83 - 01/05/84	0.46	0.45	0.46	155	170
Gate 100 (23)	01/19/83 - 01/04/84	0.32*	0.18	0.18	65	65
Gate 700 (15)	01/20/83 - 01/05/84	0.32	0.27	0.32	120	115
Gravel Pit (1)	01/25/83 - 01/04/84	0.33	0.28	0.33	130	120
Groom Pass L43.5 (15)	01/20/83 - 01/05/84	0.36	0.27	0.36	145	130
Henre Site (25)	01/20/83 - 01/04/84	0.36	0.25	0.36	135	130
J-6 Road (20)	01/25/83 - 01/05/84	0.57	0.49	0.49	170	180
J-16 Road (20)	01/25/83 - 01/05/84	0.59	0.47	0.47	165	170
J-24 Road (20)	01/25/83 - 01/05/84	0.47	0.39	0.47	165	170
J-31 Road (20)	01/25/83 - 01/05/84	1.79	1.33	1.79	635	655
L-40 (15)	01/20/83 - 01/05/84	0.63*	0.42	0.42	180	155
L-49 (15)	01/20/83 - 01/05/84	0.41	0.32	0.32	125	115
Lamp Shack (15)	01/20/83 - 01/05/84	0.59	0.39	0.39	150	140
LLL Trailer (15)	01/20/83 - 01/05/84	0.61*	0.40	0.40	135	145
Logistics Desk (6)	01/20/83 - 01/04/84	0.37*	0.20	0.20	95	75
Lower Mint Lake (12)	01/21/83 - 01/04/84	1.29	0.53*	1.29	455	470
NRDS Warehouse (25)	01/20/83 - 01/04/84	0.36	0.29	0.36	140	130
Office (15)	01/20/83 - 01/05/84	0.55*	0.29	0.29	125	105
Post Office (23)	01/19/83 - 01/04/84	0.18	0.16	0.18	65	65
R-3 Road (19)	01/25/83 - 01/05/84	0.46	0.46	0.46	190	170
R-9 Road (19)	01/25/83 - 01/05/84	0.65	0.45	0.45	195	165
R-20 Road (19)	01/26/83 - 01/05/84	0.53	0.42	0.42	155	155
R-27 Road (19)	01/26/83 - 01/05/84	0.59	0.43	0.43	185	155
R-31 Road (19)	01/26/83 - 01/05/84	0.59	0.41	0.41	155	150
Ramatrol (23)	01/19/83 - 01/04/84	0.41	0.41	0.41	140	150
RWMS East 500' (5)	01/20/83 - 01/04/84	0.35	0.21	0.35	130	130
RWMS East 1000' (5)	01/20/83 - 01/04/84	0.70*	0.41	0.41	145	150
RWMS East 1500' (5)	01/20/83 - 01/04/84	0.36	0.31	0.36	130	130
RWMS East Gate (5)	01/20/83 - 01/04/84	0.50	0.33	0.50	155	185
RWMS North 500' (5)	01/20/83 - 01/04/84	0.37	0.32	0.37	140	135
RWMS North 1000' (5)	01/20/83 - 01/04/84	0.39	0.39	0.39	135	140
RWMS North 1500' (5)	01/20/83 - 01/04/84	0.34	0.26	0.34	130	125
RWMS Northeast Corner (5)	01/20/83 - 01/04/84	0.37	0.27	0.37	130	135
RWMS Northwest Corner (5)	01/20/83 - 01/04/84	0.37	0.29	0.37	135	135
RWMS Offices (5)	01/20/83 - 01/04/84	0.37	0.36	0.37	170	135
RWMS South Gate (5)	01/20/83 - 01/04/84	0.52	0.29	0.29	115	105
RWMS South 500' (5)	01/20/83 - 01/04/84	0.35	0.34	0.35	140	130
RWMS Southwest Corner (5)	01/20/83 - 01/04/84	0.34	0.28	0.34	125	125
RWMS West 500' (5)	01/20/83 - 01/04/84	0.59	0.43	0.43	140	155
RWMS West 1000' (5)	01/20/83 - 01/04/84	0.38	0.35	0.38	135	140
RWMS West 1500' (5)	01/20/83 - 01/04/84	0.54	0.35	0.35	140	130
Security Gate 293 (11)	01/20/83 - 01/05/84	0.39	0.25	0.39	140	140
Sedan Crater Visitor's Box (10)	01/20/83 - 01/05/84	0.66	0.51	0.51	210	185
Sedan Crater West Area (10)	01/20/83 - 01/05/84	2.31	2.28	2.28	995	835

*This result is suspect due to a reader malfunction during the readout of the TLD's.

**Due to a reader malfunction, the results from the second half of CY-1983 are being reported, but only the results from the first half of the year are being used in obtaining the average dose rate or the adjusted annual dose.

Table 17 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.**	AVG.	1982 ADJUSTED ANNUAL DOSE (mrem/y)	1983 ADJUSTED ANNUAL DOSE (mrem/y)
Storage Shed (15)	01/20/83 - 01/05/84	0.51*	0.34	0.34	130	125
Substation Bus (15)	01/20/83 - 01/05/84	0.48*	0.29	0.29	115	105
TH-1 (6)	01/21/83 - 01/04/84	0.21	0.18	0.21	75	75
TH-9 (6)	01/21/83 - 01/04/84	0.42	0.30	0.30	125	110
TH-18 (1)	01/21/83 - 01/04/84	0.49*	0.28	0.28	110	100
TH-27 (1)	01/21/83 - 01/04/84	0.49*	0.30	0.30	120	110
TH-37 (1)	01/21/83 - 01/04/84	0.53	0.36	0.36	145	130
TH-47 (4)	01/21/83 - 01/04/84	0.62*	0.41	0.41	160	150
TH-57 (2)	01/21/83 - 01/04/84	0.47*	0.29	0.29	115	105
TH-67.5 (12)	01/21/83 - 01/04/84	0.46	0.29	0.29	120	105
Upper Haines Lake No. 1 (12)	01/21/83 - 01/05/84	0.35	0.32	0.35	115	130
Upper N Tunnel Pond (12)	01/21/83 - 01/04/84	0.43	0.40	0.40	160	145
U3ax Northeast (3)	01/20/83 - 01/05/84	1.10	1.01	1.01	400	370
U3ax Northwest (3)	01/20/83 - 01/05/84	1.21	1.09	1.21	285	440
U3ax South (3)	01/20/83 - 01/05/84	0.69	0.51	0.51	195	185
U3ax Southeast (3)	01/20/83 - 01/05/84	0.80	0.59	0.59	225	215
U3by North (3)	01/20/83 - 01/05/84	1.00	0.56	1.00	405	365
U3by South (3)	01/20/83 - 01/05/84	0.49	0.31	0.49	195	180
U3bz North (3)	01/20/83 - 01/05/84	0.68	0.42*	0.68	255	250
U3bz South (3)	01/20/83 - 01/05/84	0.45	0.28	0.45	155	165
U3cj North (3)	01/20/83 - 01/05/84	0.47	0.29	0.47	180	170
U3co North (3)	01/20/83 - 01/05/84	4.27	1.81*	4.27	1690	1560
U3co South (3)	01/20/83 - 01/05/84	2.74	1.22	2.74	955	1000
U3du North (3)	01/20/83 - 01/05/84	0.66	0.50	0.50	195	185
U3du South (3)	01/20/83 - 01/05/84	0.64	0.35	0.64	235	235
U3ey South (3)	01/20/83 - 01/05/84	0.44	0.28	0.44	130	160
Well 3 (6)	01/20/83 - 01/05/84	0.32	0.30	0.32	130	115
Well 5B (5)	01/20/83 - 01/04/84	0.33	0.25	0.33	120	120
Well 19C Reservoir (19)	01/21/83 - 01/06/84	0.56	0.41	0.41	160	150
Yucca Complex (6)	01/20/83 - 01/05/84	0.29	0.19	0.29	105	105
2-04 Road (2)	01/20/83 - 01/05/84	6.45	3.60	6.45	2580	2355
2-07 Road (2)	01/20/83 - 01/05/84	1.11	0.64	1.11	365	405
3-03, O.B. Roads (3)	01/20/83 - 01/05/84	0.30	0.20	0.30	105	110
4-04 Road (4)	01/20/83 - 01/05/84	8.15	4.10	8.15	3180	2975
6-09, O.B. Roads (6)	01/20/83 - 01/05/84	0.34	0.24	0.34	140	125
7-300 Bunker (7)	01/20/83 - 01/05/84	0.99	0.52	0.99	420	360
8K 25 (8)	01/20/83 - 01/05/84	0.28	0.26	0.26	125	95
9-300 Bunker (9)	01/20/83 - 01/05/84	0.53	0.37	0.37	140	135
10 A-24 (10)	01/20/83 - 01/05/84	0.93	0.85	0.85	255	310
18-1C Gate (18)	01/25/83 - 01/05/84	0.45	0.41	0.41	235	150
18P 35 (18)	01/21/83 - 01/05/84	0.40	0.31	0.40	170	145
18P 39 (18)	01/25/83 - 01/05/84	0.40	0.30	0.40	155	145
19P 41 (19)	01/25/83 - 01/05/84	0.46	0.34	0.46	175	170
19P 46 (19)	01/25/83 - 01/05/84	0.40	0.25	0.40	155	145
19P 54 (19)	01/25/83 - 01/05/84	0.38	0.27	0.38	150	140

*This result is suspect due to a reader malfunction during the readout of the TLD's.
**Due to a reader malfunction, the results from the second half of CY-1983 are being reported, but only the results from the first half of the year are being used in obtaining the average dose rate or the adjusted annual dose.

Table 17 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.**	AVG.	1982 ADJUSTED ANNUAL DOSE (mrem/y)	1983 ADJUSTED ANNUAL DOSE (mrem/y)
19P 59 (19)	01/25/83 - 01/05/84	0.45	0.35	0.45	185	165
19P 66 (19)	01/25/83 - 01/05/84	0.45	0.27	0.45	185	165
19P 71 (19)	01/25/83 - 01/05/84	0.43	0.23	0.43	175	155
19P 77 (19)	01/25/83 - 01/05/84	0.47	0.31	0.47	185	170
19P 87 (19)	01/25/83 - 01/05/84	0.46	0.36	0.46	210	170
19P 88 (19)	01/25/83 - 01/05/84	0.49	0.35	0.49	200	180
19P 91 (19)	01/25/83 - 01/05/84	0.45	0.33	0.45	190	165
20-4C Gate (20)	01/25/83 - 01/05/84	0.45	0.44	0.45	170	165
25-4P Gate (25)	01/19/83 - 01/04/84	0.55*	0.36	0.36	145	130
25-7P Gate (25)	01/19/83 - 01/04/84	0.48	0.48	0.48	135	175
30-1C Gate (30)	01/25/83 - 01/05/84	0.59	0.50	0.50	140	185
130 M (4)	01/20/83 - 01/05/84	0.57*	0.37	0.37	130	135
140 M (2)	01/20/83 - 01/05/84	0.61*	0.39	0.39	140	140
150 M (2)	01/20/83 - 01/05/84	0.39	0.34	0.39	140	140
168 M (12)	01/21/83 - 01/04/84	0.53	0.38	0.38	155	140
170 M (12)	01/21/83 - 01/04/84	0.51*	0.32	0.32	130	115
175 M (12)	01/21/83 - 01/04/84	0.60	0.41	0.41	165	150
185 Holmes Road (17)	01/21/83 - 01/04/84	0.57	0.37	0.37	150	135
190 M (19)	01/21/83 - 01/04/84	0.43	0.31	0.43	180	155
196 M (19)	01/21/83 - 01/04/84	0.44	0.31	0.44	165	160

*This result is suspect due to a reader malfunction during the readout of the TLD's.
**Due to a reader malfunction, the results from the second half of CY-1983 are being reported, but only the results from the first half of the year are being used in obtaining the average dose rate or the adjusted annual dose.

Table 17 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	ELEVATION (FT)	DOSE RATE (mrem/d) MAX.	MIN.**	AVG.	1982 ADJUSTED ANNUAL DOSE (mrem/y)	1983 ADJUSTED ANNUAL DOSE (mrem/y)
N670,600 E667,300 (22)	02/01/83 - 01/06/84	4000	0.30*	0.17	0.17	80	60
N731,300 E638,700 (28)	02/01/83 - 01/06/84	5750	0.32	0.28	0.28	105	105
N754,000 E557,800 (31)	02/01/83 - 01/06/84	4800	0.49	0.41	0.41	140	150
N849,500 E545,000 (30)	02/01/83 - 01/06/84	7100	0.42	0.38	0.42	165	155
N887,000 E558,000 (20)	02/01/83 - 01/06/84	6100	0.51	0.47	0.51	190	185
N948,800 E527,800 (20)	01/31/83 - 01/06/84	5650	0.51	0.49	0.51	185	185
N944,700 E563,300 (19)	01/31/83 - 01/06/84	6300	0.27	0.26	0.27	100	100
N955,500 E614,200 (19)	01/31/83 - 01/06/84	7200	0.50	0.43	0.43	160	155
N935,500 E639,750 (19)	01/31/83 - 01/06/84	6550	0.49	0.43	0.43	160	155
N903,800 E635,500 (12)	01/31/83 - 01/06/84	6900	0.32	0.32	0.32	125	115
N907,600 E686,200 (8)	01/31/83 - 01/06/84	5826	0.59	0.43	0.43	165	155
N874,600 E691,500 (10)	01/31/83 - 01/06/84	5000	0.26	0.22	0.22	90	80
N844,200 E704,900 (3)	01/31/83 - 01/06/84	5100	0.33	0.21	0.21	75	75
N788,800 E709,500 (11)	01/31/83 - 01/06/84	5200	0.48	0.39	0.39	155	140
N710,800 E720,000 (11)	01/31/83 - 01/06/84	4280	0.23	0.18	0.18	65	65

*This result is suspect due to a reader malfunction during the readout of the TLD's.
**Due to a reader malfunction, the results from the second half of CY-1983 are being reported, but only the results from the first half of the year are being used in obtaining the average dose rate or the adjusted annual dose.

Substantial differences between stations from previous years occurred during the last half of CY-1983. The cause was attributed to the malfunction of the reader during the processing of the TLD's. This malfunction produced unreliable data and, therefore, the average dose rate and adjusted annual dose were taken from the first half of the year. The maximum and minimum values with an asterisk by them represent values that are highly suspect as a result of the reader malfunction.

The values used in Table 18 were taken from the first half of CY-1983. The nine locations that comprised the original control network demonstrated similar dose rates as in previous years. The largest variance was 0.05 mrem/d from the previous year. The overall network range of these stations was 0.18 mrem/d to 0.39 mrem/d, with an average natural background on NTS of approximately 0.28 mrem/d (100 mrem/y). This corresponds favorably with rates measured at offsite Nevada locations by the Environmental Protection Agency (Reference 11).

The remaining 154 stations of the network yielded dose rates which ranged from 0.17 mrem/d to 9.7 mrem/d, about a factor of 50 variation. The variations were more substantial than previous years because of the reader malfunction.

G. PERIMETER DOSE ASSESSMENT

The maximum postulated dose from the NTS operations was calculated for an individual residing at the site boundary during the entire CY-1983. This was done by calculating the fifty year cummulative dose, except for the dose from

TABLE 18

TLD CONTROL STATION COMPARISON

Station	Dose Rate (mrem/d) 1978	1979	1980	1981	1982	1983*
Bldg. 650 Dosimetry Room	0.16	0.17	0.18	0.21	0.19	0.21
Bldg. 650 roof	0.15	0.15	0.16	0.18	0.18	0.18
Area 27 Cafeteria	0.37	0.35	0.37	0.41	0.37	0.39
CP Complex	0.22	0.21	0.23	0.25	0.20	0.25
Henre Site	0.34	0.33	0.35	0.39	0.37	0.36
NRDS Warehouse	0.35	0.33	0.35	0.40	0.38	0.36
Post Office	0.15	0.15	0.16	0.20	0.18	0.18
Well 5B	0.32	0.31	0.34	0.38	0.33	0.33
Yucca Complex	0.31	0.30	0.30	0.32	0.29	0.29
Network Average	0.26	0.26	0.27	0.30	0.28	0.28

*Due to a reader malfunction, the results from the second half of CY-1983 are not being used in this table. Only the results from the first half of the year are being used.

air immersion, for the individual receiving a one year intake from measured radionuclide concentrations onsite. The dose from air immersion was calculated for a one year 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-1983, there was no further exposure. The dose conversion factors used for calculating the cummulative dose came from References 14 and 20, and are tabulated in Table 19. 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, ^{133}Xe, ^{239}Pu, and ^{90}Sr (assuming the gross beta concentration in air consists entirely of ^{90}Sr). The critical organs considered for these radionuclides were the total body, bone, lung, and skin for ^{133}Xe.

1. Dose From Ingestion of Radionuclides

The dose from the ingestion pathways were calculated for an individual living at the NTS boundary during CY-1983. 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 water sampled onsite. The radionuclides considered for the calculation were ^{239}Pu and tritium. The gross beta concentration was not used in the calculation because it was shown earlier (E.2.) that the gross beta concentration was primarily due to the naturally occurring ^{40}K content. The Cascade bottled water brought onsite was assumed to have natural background levels

TABLE 19

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
Total Body	9.35E-08	1.55E-01	7.62E-04	3.82E-05	6.18E-08	2.19E+02
Bone	0.0	6.38E+00	1.24E-02	1.57E-03	0.0	2.19E+02
Lung	9.35E-08	3.44E-01	1.20E-03	0.0	6.18E-08	2.37E+02
Skin	---	---	---	---	---	6.04E+02

* 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).

of ^{239}Pu and ^{3}H. These background concentrations were subtracted from the potable water stations having the maximum average ^{239}Pu and tritium concentrations to obtain the net concentrations used in the dose calculations. These values are listed in Table 20. 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 ^{239}Pu and tritium are given in Table 21.

2. Dose from Inhalation of Radionuclides

The doses from the inhalation of tritium, gross beta activity, and ^{239}Pu were calculated for the individual living at the NTS boundary. The average tritium in air and ^{239}Pu concentrations from samplers near the eastern site boundary were used for the dose calculations after background concentrations were subtracted.

The highest average gross beta concentration onsite was used in the dose calculation after the average background concentration was subtracted. All of the gross beta activity was assumed to be ^{90}Sr. The concentrations used for calculating the inhalation dose are listed in Table 20. The individual was assumed to breathe 8,400 cubic meters of air in one year (Reference 15). The calculated fifty year cummulative doses to the whole body, lungs, and bone are given in Table 21.

TABLE 20

RADIONUCLIDE CONCENTRATIONS USED FOR DOSE ASSESSMENT

	Air (μCi/cc)				Potable Water (μCi/ml)	
	^{3}H	^{239}Pu	Gross Beta	^{133}Xe	^{239}Pu	^{3}H
Onsite Concentration	2.9E-10	5.5E-17	1.9E-14	5.4E-12	<5.1E-11	<9.0E-07
Background Concentration	1.0E-10	2.5E-17	1.8E-14	1.5E-12	<4.2E-11	<8.7E-07
Net Concentration	1.9E-10	3.0E-17	0.1E-14	3.9E-12	<0.9E-11	<0.3E-07

TABLE 21

50 YEAR CUMMULATIVE DOSES*

Organ	Inhalation (mrem) ^{3}H	Inhalation (mrem) ^{239}Pu	Inhalation (mrem) ^{90}Sr**	Ingestion (mrem) ^{239}Pu	Ingestion (mrem) ^{3}H	Air Immersion (mrem) ^{133}Xe	Total (mrem)
Total Body	1.5E-01	3.9E-02	6.4E-03	<2.0E-04	<1.1E-03	8.5E-04	<2.0E-01
Bone	0.0	1.6E+00	1.0E-01	<8.2E-03	0.0	8.5E-04	<1.7E+00
Lung	1.5E-01	8.7E-02	1.0E-02	0.0	<1.1E-03	9.2E-04	<2.5E-01
Skin	---	---	---	---	---	2.4E-03	2.4E-03

* 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 the CY-1983 ended.

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

3. Dose from Air Immersion

The air immersion dose from ^{133}Xe was calculated for an individual at the NTS boundary. The ^{85}Kr concentrations at all six stations were considered to be at natural background levels and, therefore, were not used in the dose calculation. The ^{133}Xe concentration used in the calculation was obtained by subtracting the average of the stations that had background concentrations from the highest average concentration onsite. These values are given in Table 20. The calculated doses to the whole body, lungs, bone, and skin are listed in Table 21.

4. Estimated Risk to Individual

The maximum estimated dose to the total body, bone, and lung from NTS operations during CY-1983 was 0.20 mrem, 1.7 mrem, and 0.25 mrem, respectively. Table 22 lists the estimated dose to an individual living at the NTS boundary for one year from natural background radiation. The calculated doses to the individual represent increases of 0.17 percent (total body), 1.11 percent (bone), and 0.12 percent (lung) over natural background at the NTS. ICRP Publication 26 (Reference 17) estimated the risk of fatal health effects per unit dose over the individuals lifetime. Using these values the risk for the total body, bone, and lung were 3.3×10^{-8}, 3.4×10^{-8}, and 5.0×10^{-9}, respectively.

TABLE 22

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 then 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.

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. Due to the conservative assumptions used in the dose calculations and the comparison of risks, the postulated individual living at the NTS boundary during CY-1983 would have no observable ill effects from the operation of the NTS.

H. RADIOACTIVE WASTE MANAGEMENT SITE (RWMS)

The radioactive Waste Management Site is located in Area 5 of the Nevada Test Site (Figure 12). 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 strategically around the RWMS. Figures 13-15 show the locations of the stations and their yearly averages.

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

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

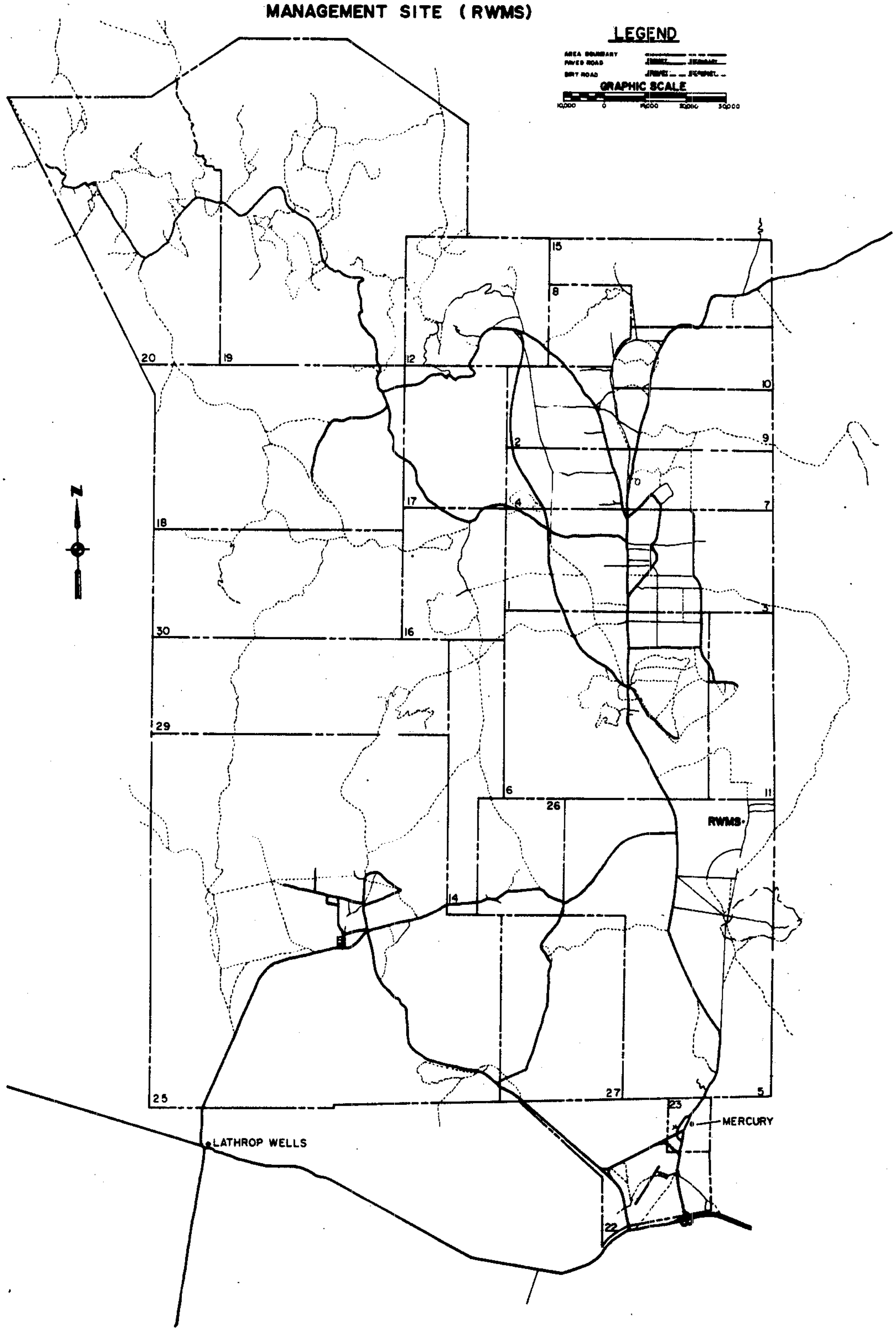


FIGURE 12

HTO was 1.7 x 10^{-10} μCi/cc at RWMS-(NE-NW) Station, which is 0.003 percent of the concentration guide.

Gross beta and ^{239}Pu in air results for the site are summarized in Tables 4 and 5. The average gross beta concentration was 1.8 x 10^{-14} μCi/cc which was the same as the network average of 1.8 10^{-14} μCi/cc. This concentration represents 0.002 percent of the concentration guide (assuming ^{90}Sr is the beta emitter present). 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 ^{239}Pu in air at RWMS was 2.1 x 10^{-17} μCi/cc. This is 0.001 percent of the concentration guide for ^{239}Pu.

Table 17 gives a summary of the gamma monitoring results for 1983. The average annual dose was 135 mrem/y or 16 μrem/h. This compared favorably with the natural background of Area 5 of 11-20 μR/h. (Reference 13). Another station, two miles south (Well 5B), had an annual dose rate of 120 mrem/y or 14 μrem/h.

In conclusion the results from this surveillance network around the RWMS indicate that there were no detectable releases of radioactive materials as a result of operations during 1983.

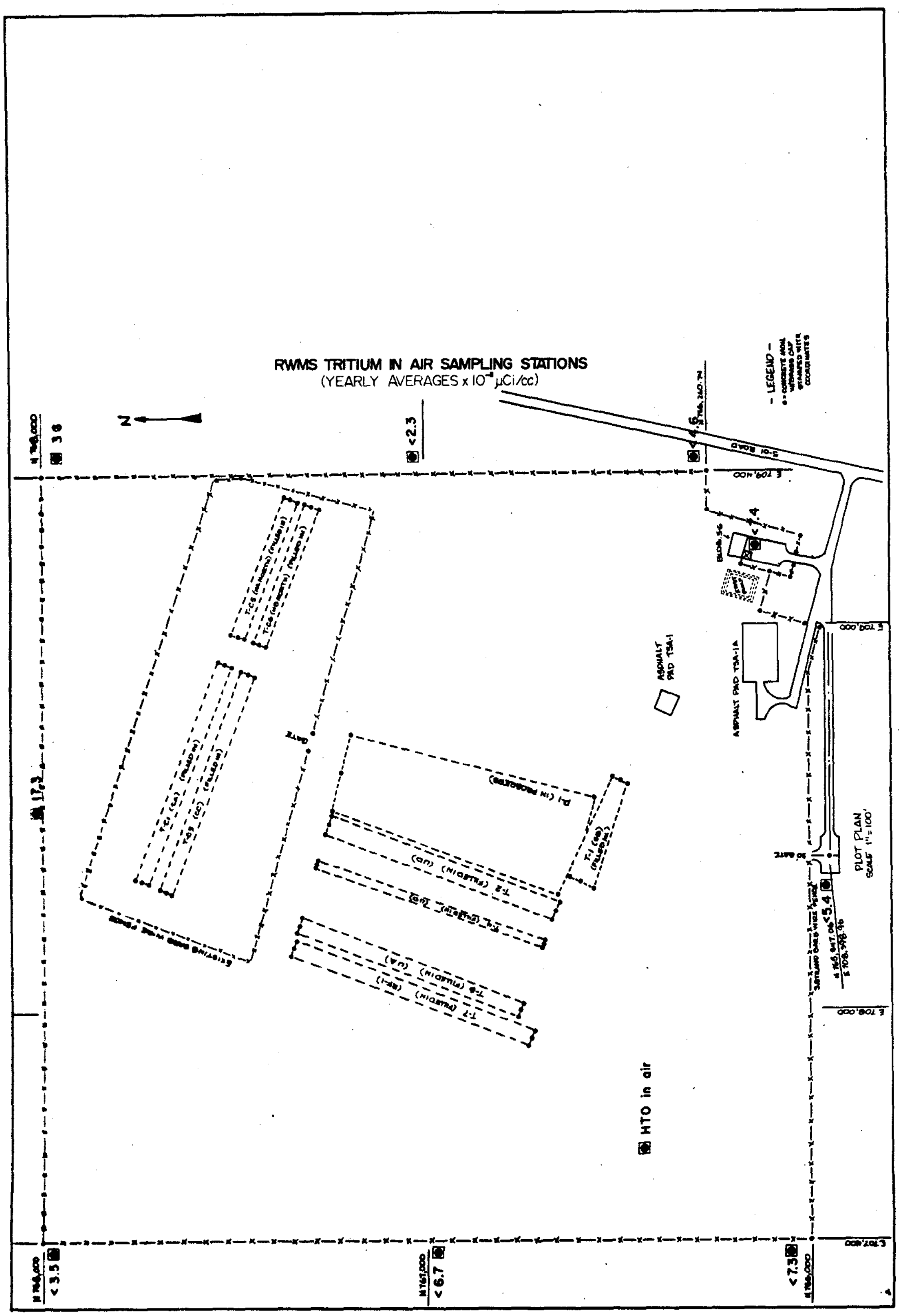
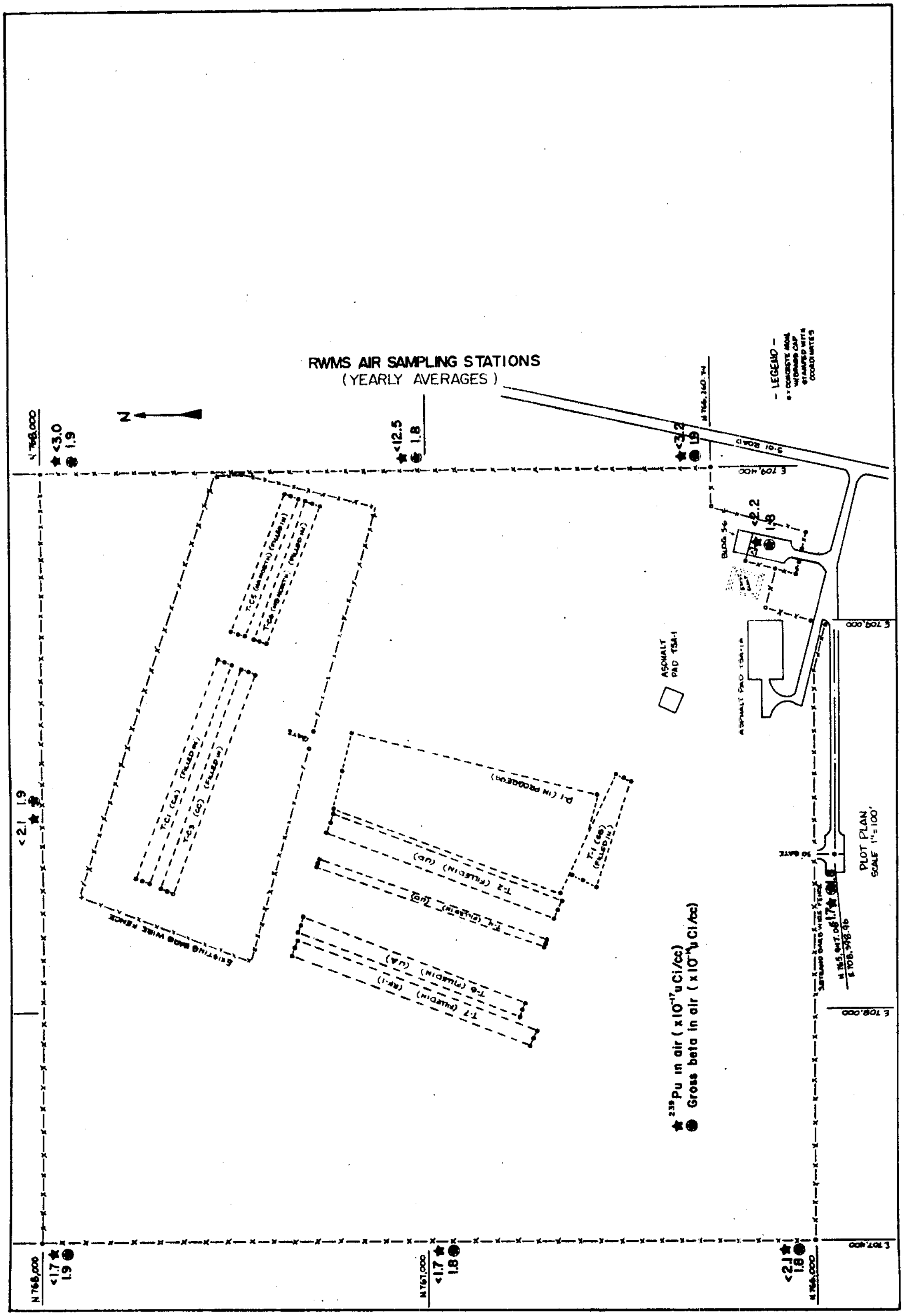

RWMS TRITIUM IN AIR SAMPLING STATIONS
(YEARLY AVERAGES x 10^-8 µCi/cc)
N
HTO in air
PLOT PLAN
SCALE 1"=100'

FIGURE 13



RWMS AIR SAMPLING STATIONS
(YEARLY AVERAGES)
N
Pu in air (x10^{-17} uCi/cc)
Gross beta in air (x10^{-14} uCi/cc)
PLOT PLAN
SCALE 1"=100'
<3.0
1.9
<12.5
1.8
<3.2
1.9
<2.2
1.8
<2.1
1.9
<1.7
1.9
<1.7
1.8
<2.1
1.8
ASPHALT PAD TSA-1
ASPHALT PAD TSA-1A
BLDG. 54
EXISTING BARB WIRE FENCE
N 768,000
N 767,000
N 766,000
E 709,000
E 708,000
E 707,000
- LEGEND -

FIGURE 14

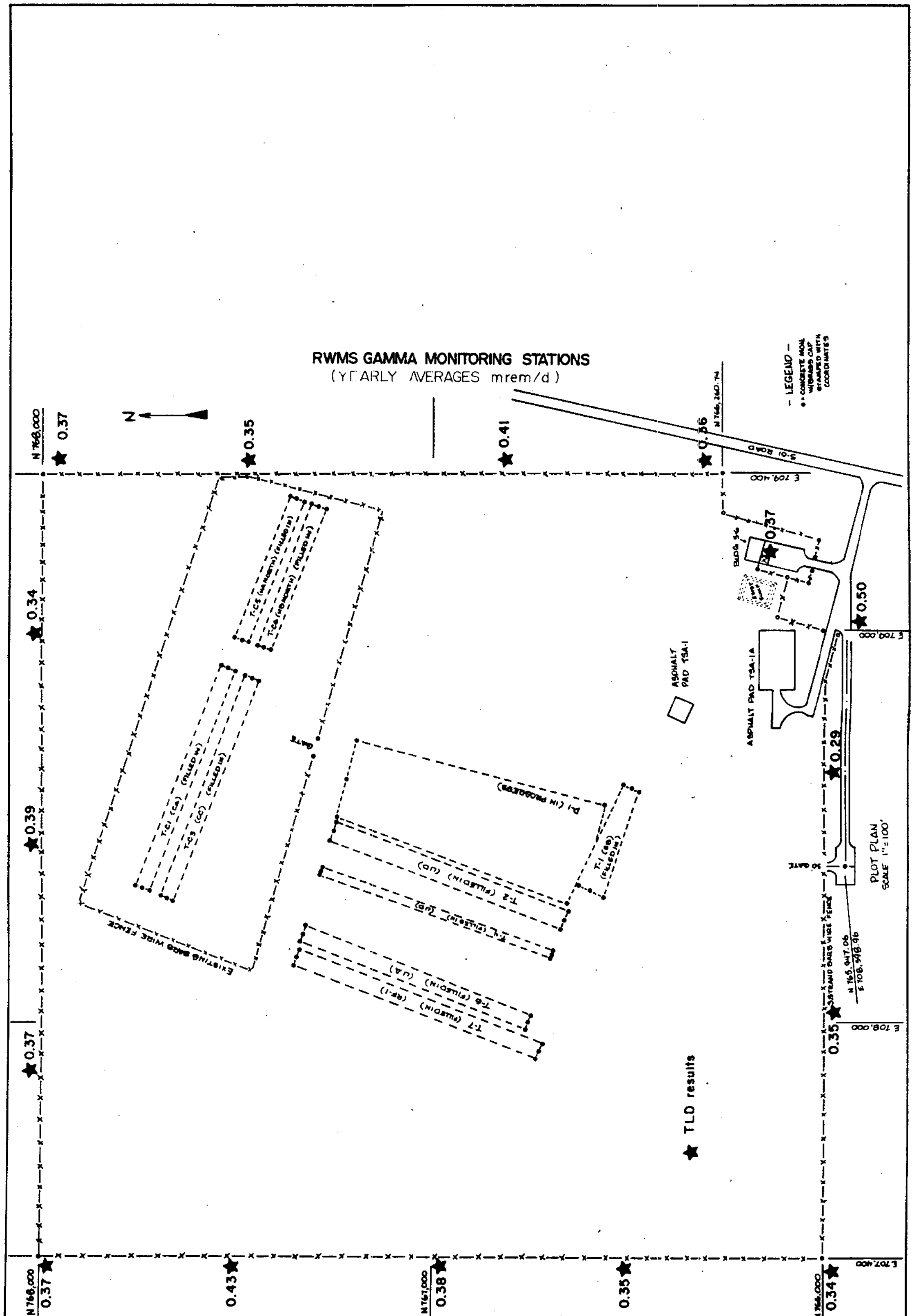

RWMS GAMMA MONITORING STATIONS
(YEARLY AVERAGES mrem/d)
N
0.37
0.35
0.41
0.36
0.37
0.50
0.34
0.39
0.37
0.29
0.35
0.37
0.43
0.38
0.35
0.34
- LEGEND -
ASPHALT PAD TSA-1
ASPHALT PAD TSA-1A
EXISTING BARB WIRE FENCE
GATE
PLOT PLAN
SCALE 1"=100'
TLD results

FIGURE 15

I. REFERENCES

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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 #2
13	Area 23 H&S Roof
14	Area 23 Building 790
15	Area 23 Bldg. 790 #2
16	Area 27 Cafeteria
17	Area 25 NRDS Warehouse
18	Area 28 Henre Site
19	Area 5 Well 5B
20	Area 5 RWMS #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
28	Area 5 RWMS #2
29	Area 5 RWMS #3
30	Area 25 E-MAD North
31	Area 25 E-MAD South
32	Area 5 RWMS #4

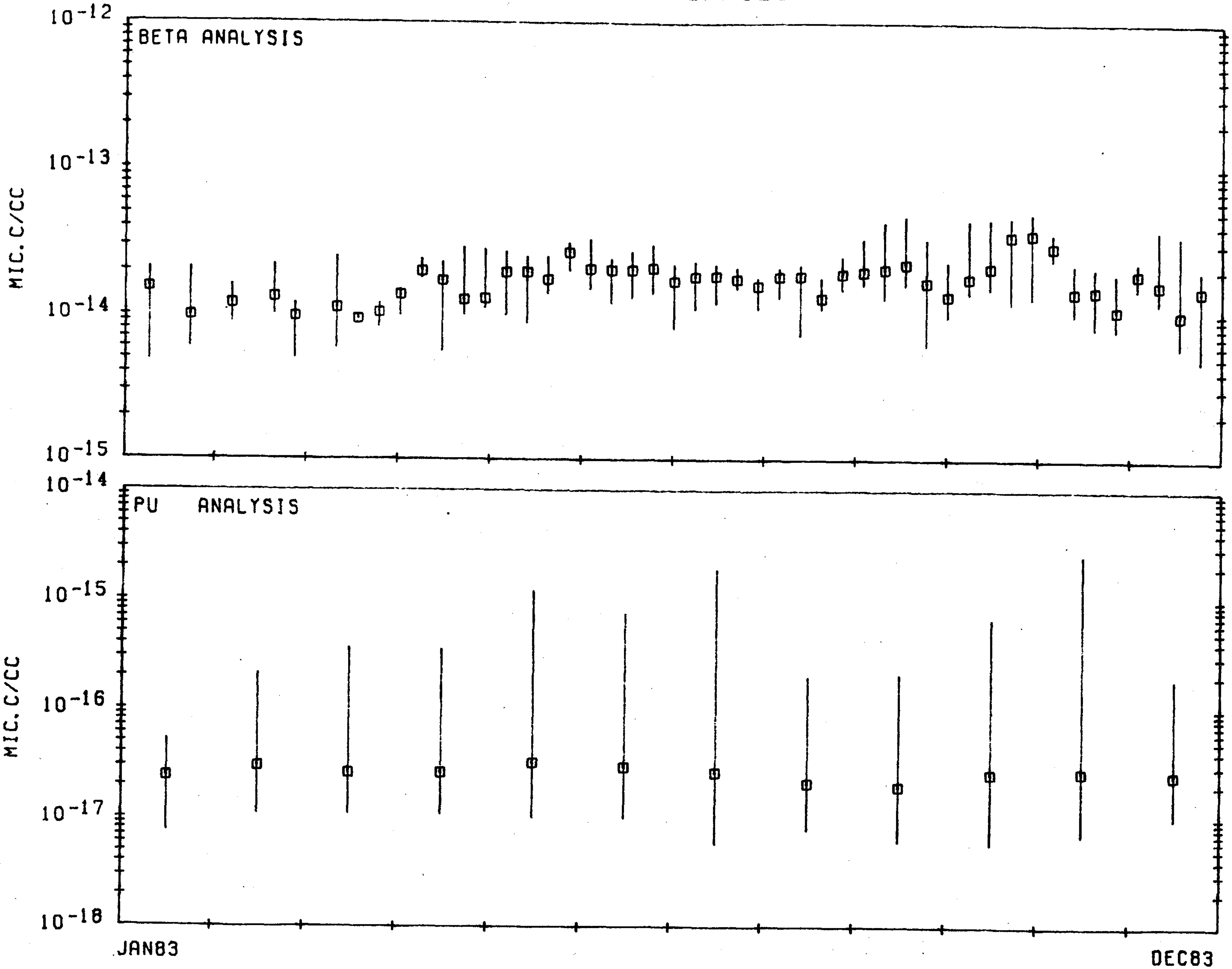
NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING LOCATIONS

(Continued)

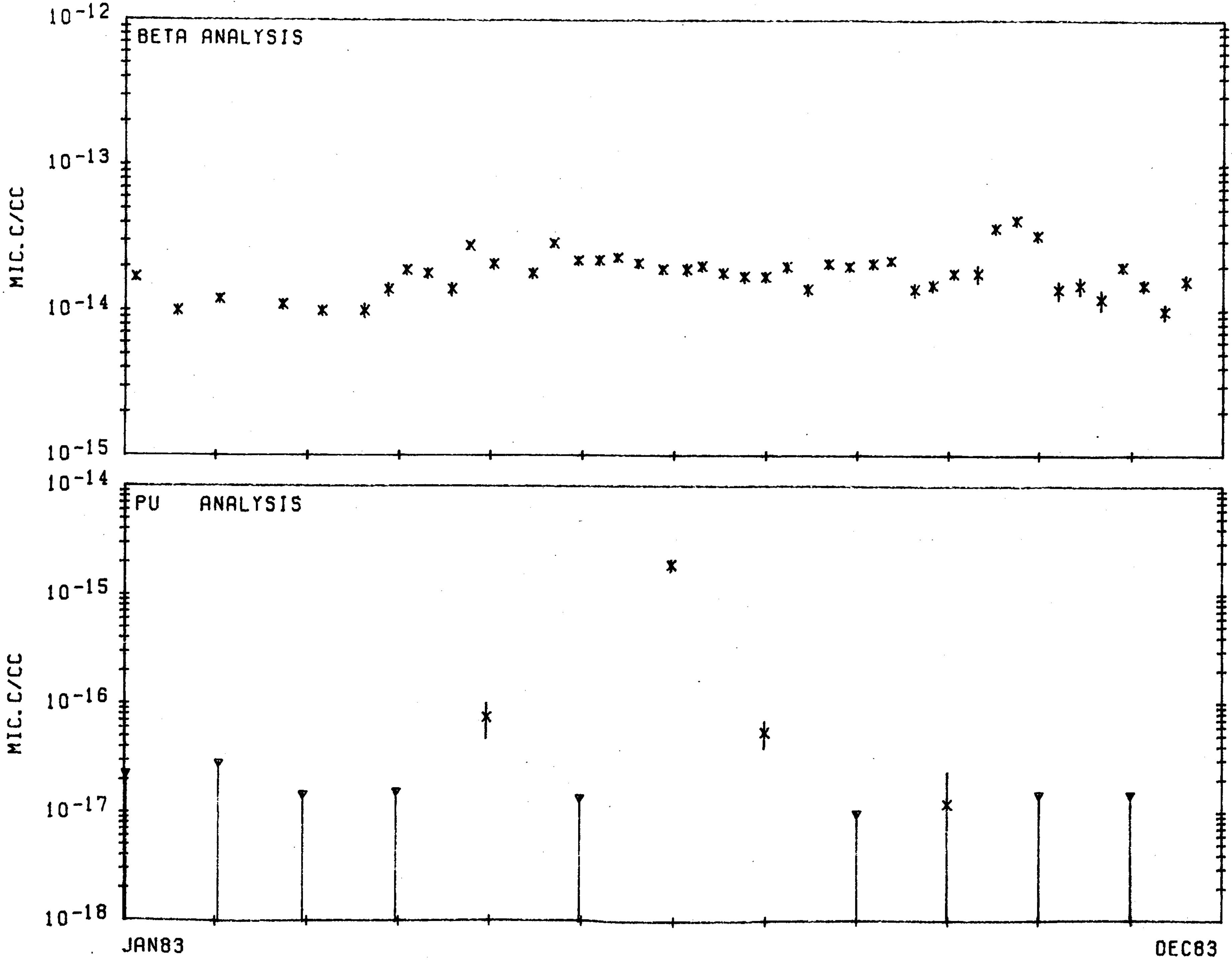
Station Number	Location
33	Area 3 U3ax South
34	Area 3 U3ax East
35	Area 3 U3ax North
36	Area 3 U3ax West
37	Area 7 UE7ns
38	Area 15 EPA Farm
39	Area 5 RWMS #5
40	Area 5 RWMS #6
41	Area 5 RWMS #7
42	Area 5 RWMS #8
43	Area 5 RWMS #9
44	Area 15 Pile Driver
*45	Area 19 19-3 Substation
46	Area 20 Dispensary
47	Area 3 Complex #2
50	Area 5 Gate 200

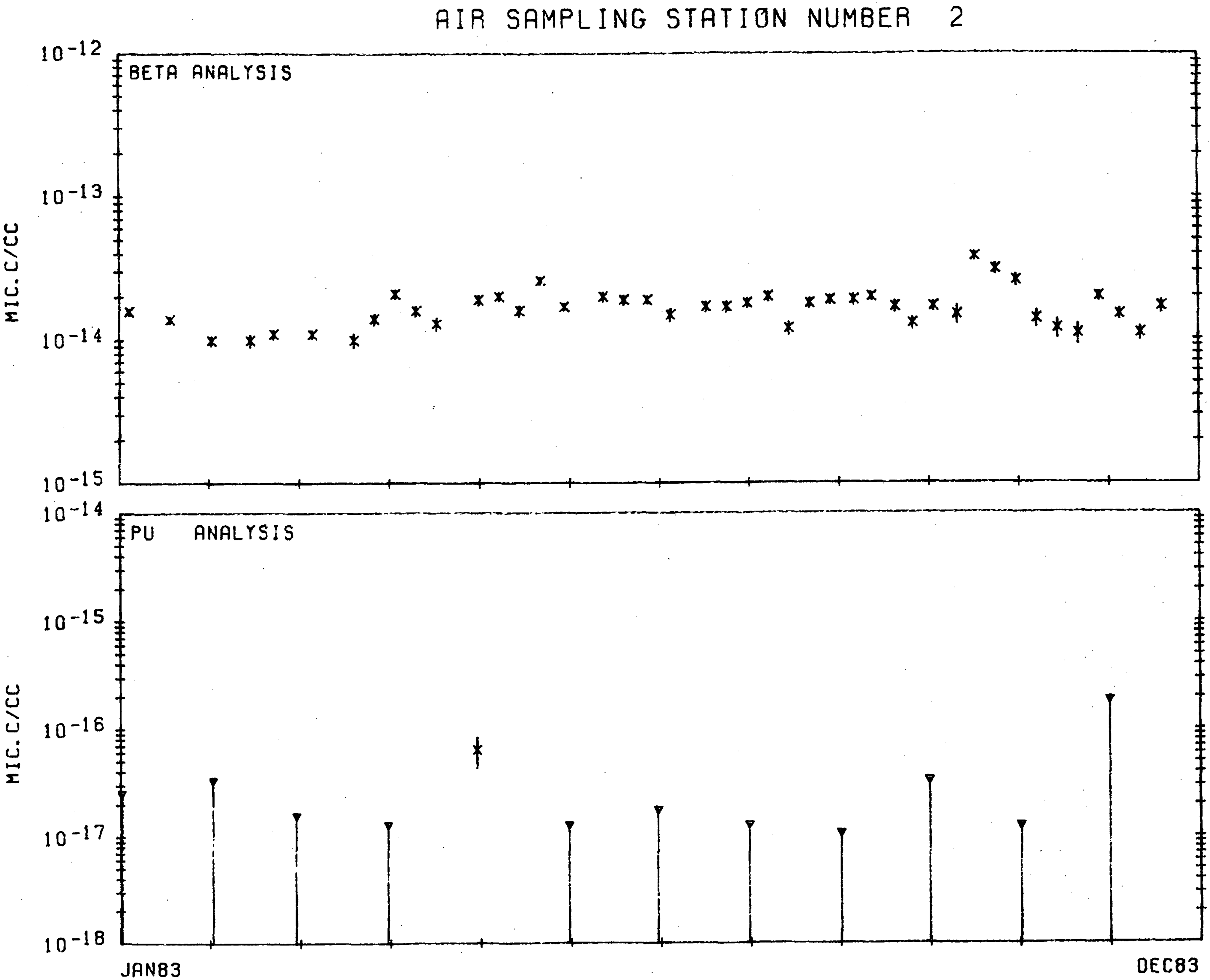
*Discontinued in August, 1983 because power substation was shutdown.

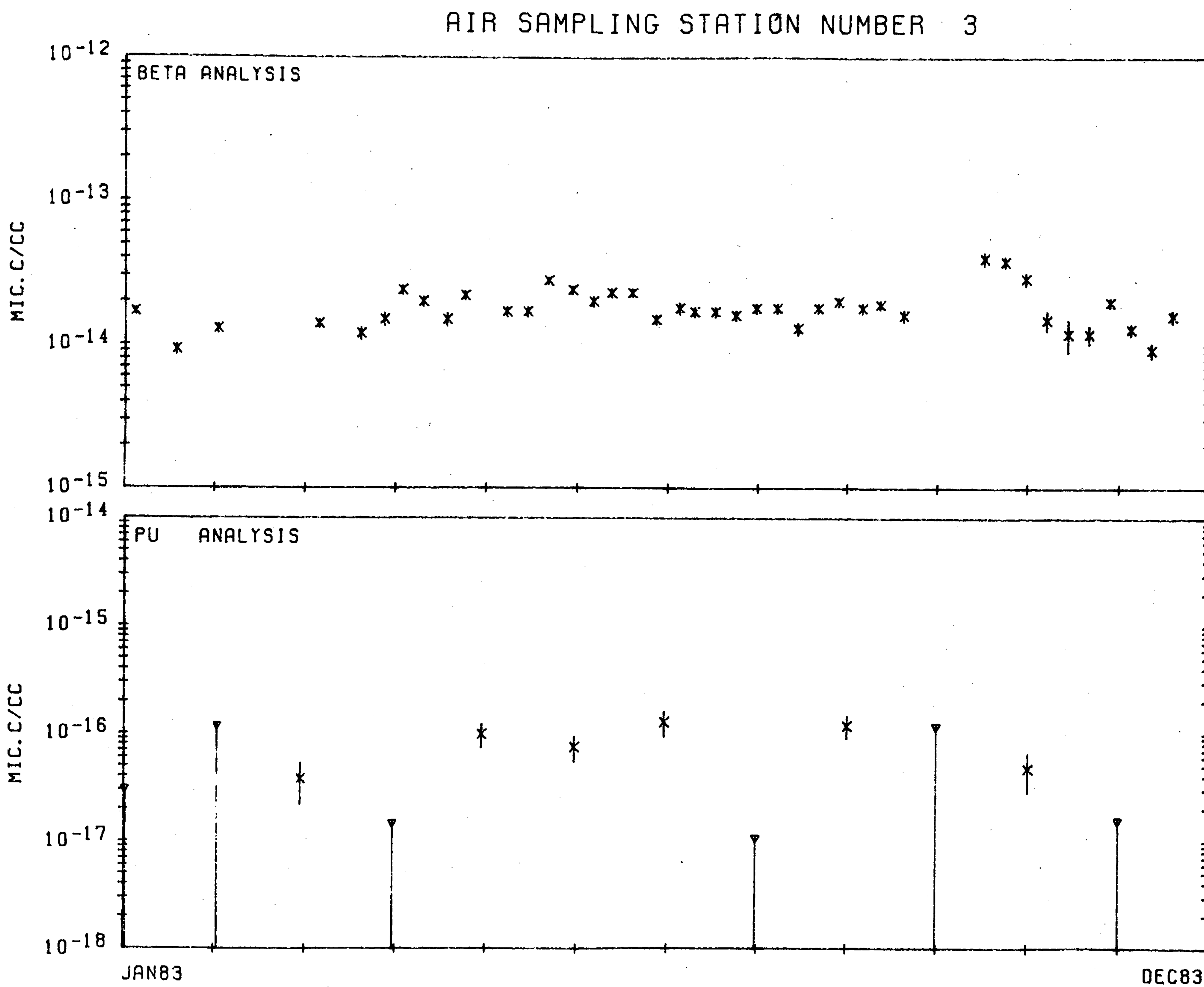
AIR NETWORK AVERAGES



AIR SAMPLING STATION NUMBER 1

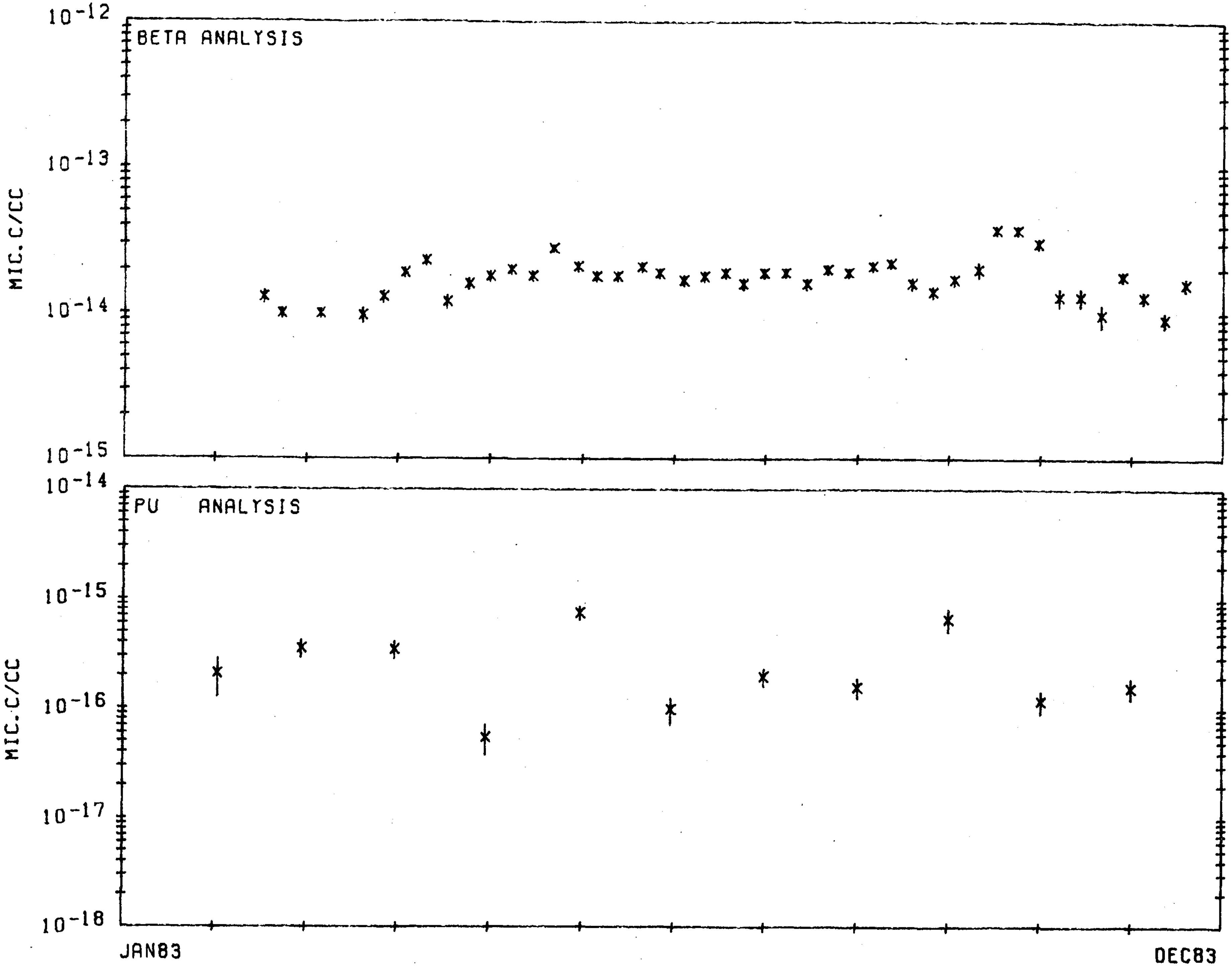


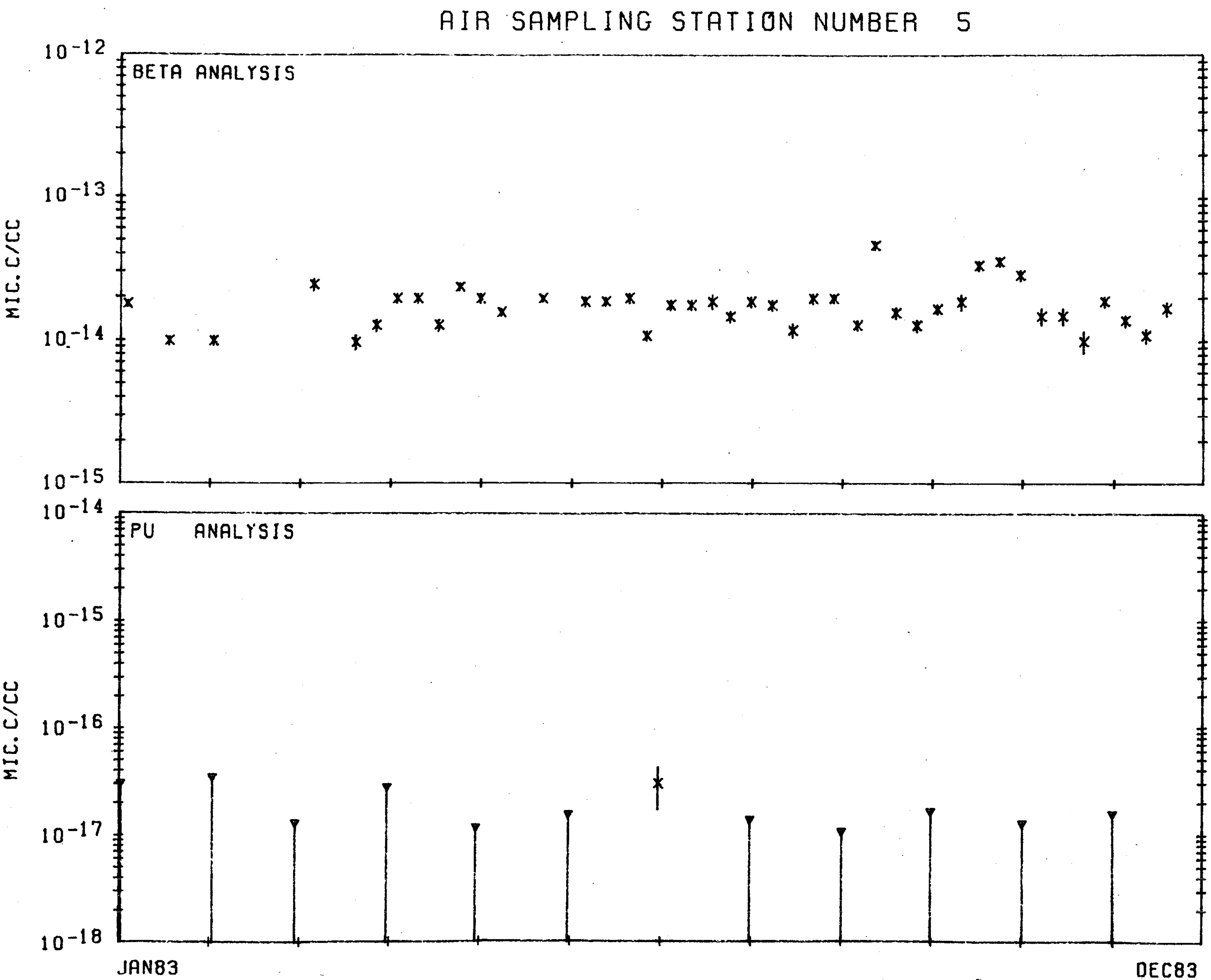

AIR SAMPLING STATION NUMBER 2
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83



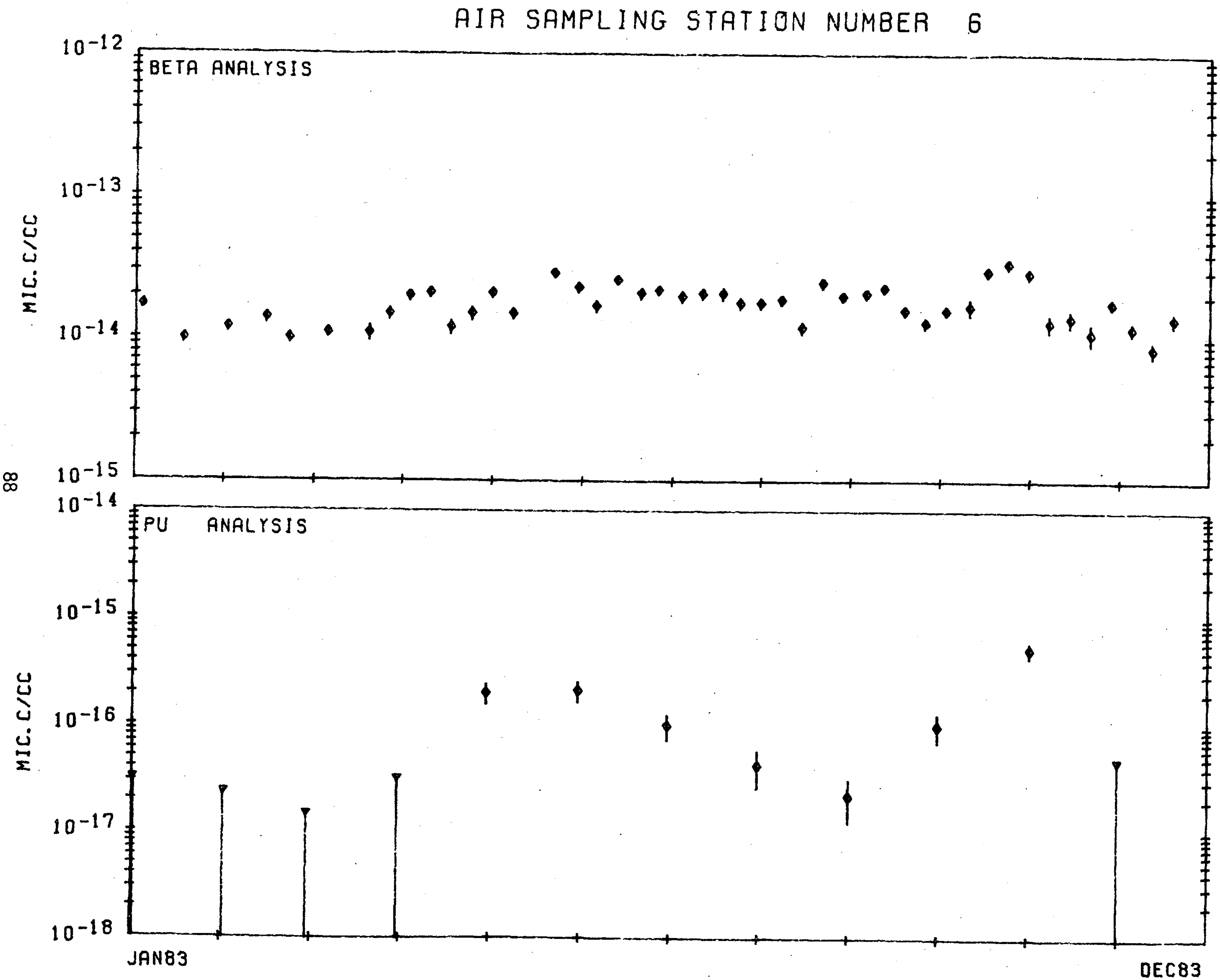
AIR SAMPLING STATION NUMBER 3
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

AIR SAMPLING STATION NUMBER 4



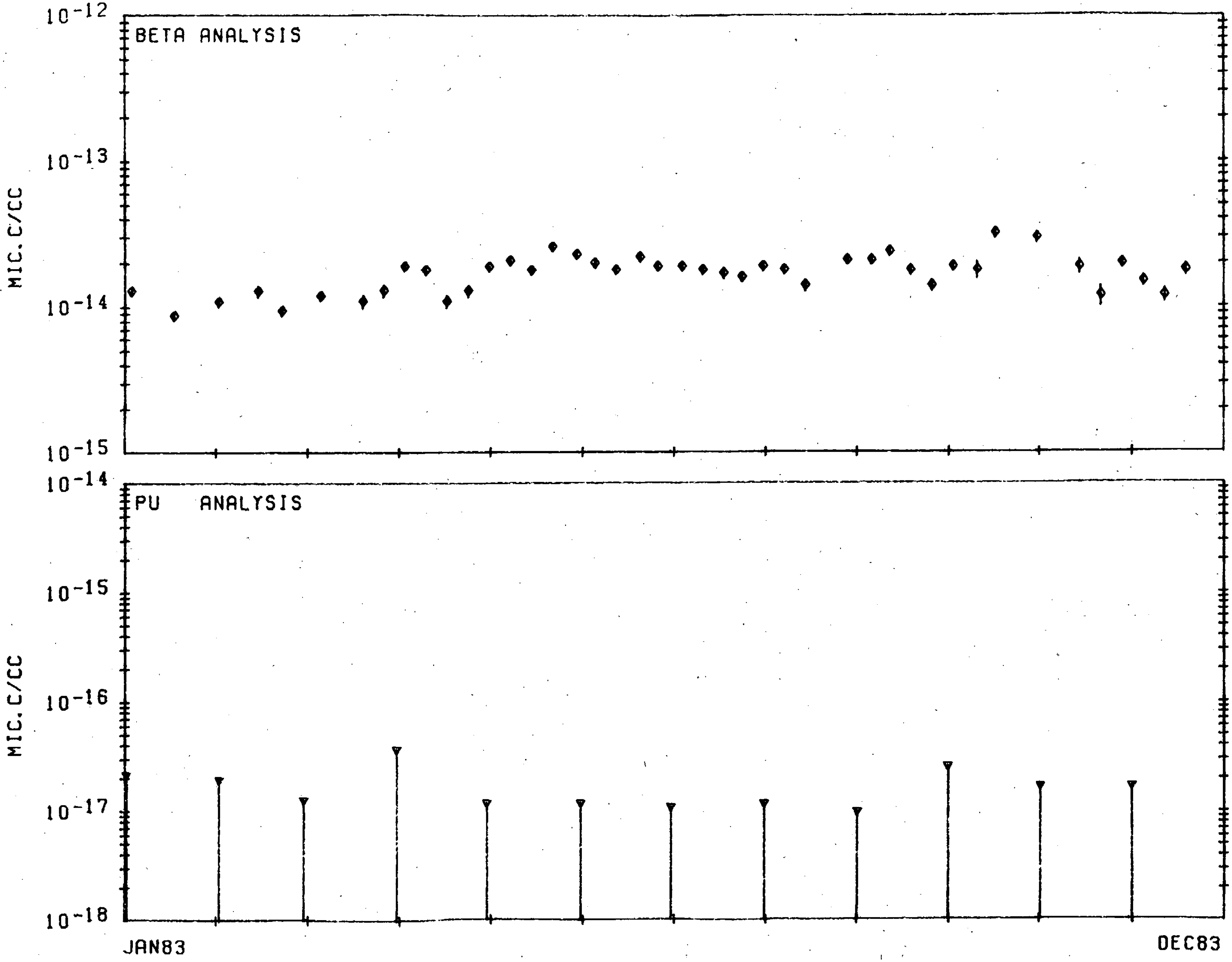


AIR SAMPLING STATION NUMBER 5
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10-12
10-13
10-14
10-15
10-14
10-15
10-16
10-17
10-18
JAN83
DEC83

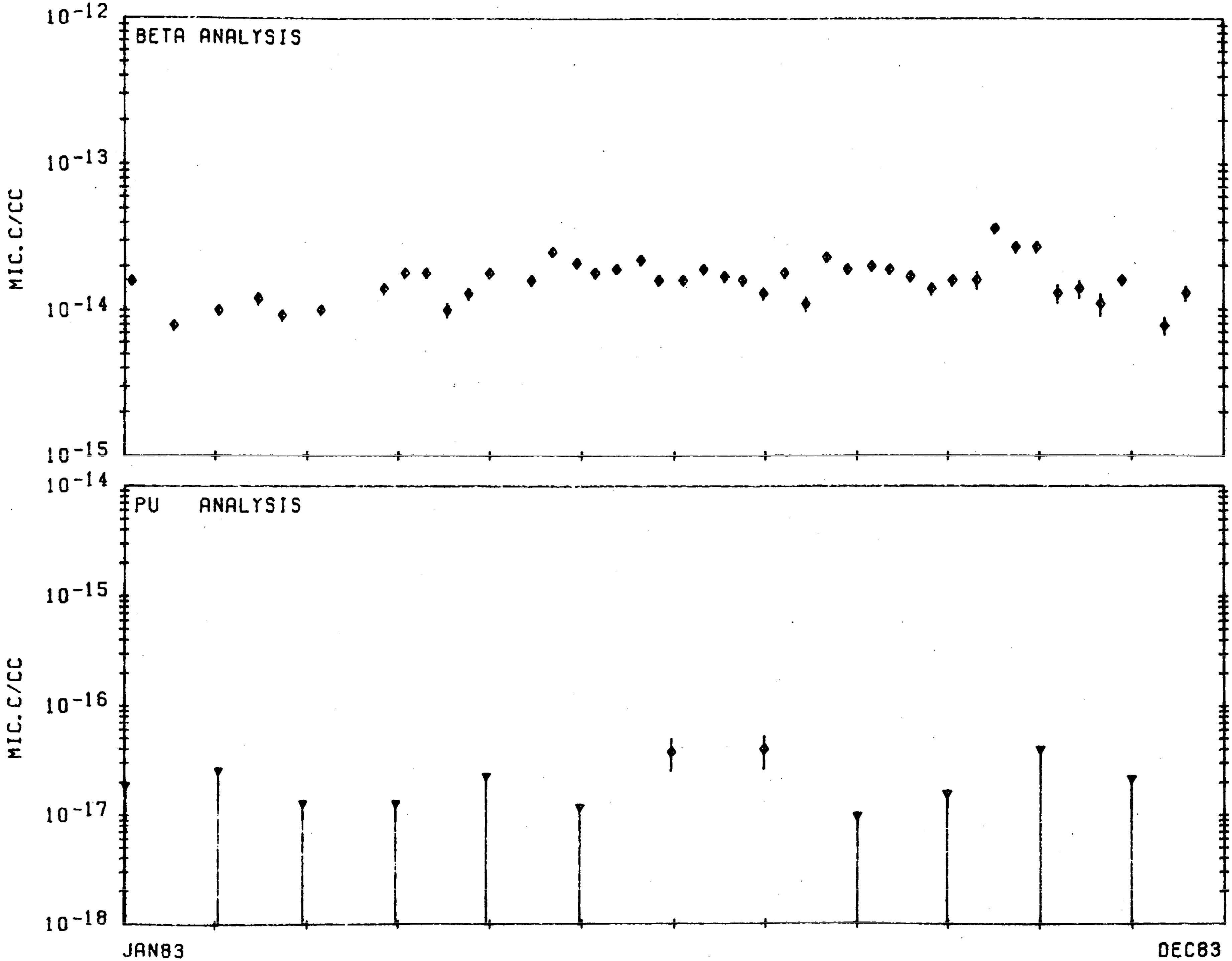


AIR SAMPLING STATION NUMBER 6
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

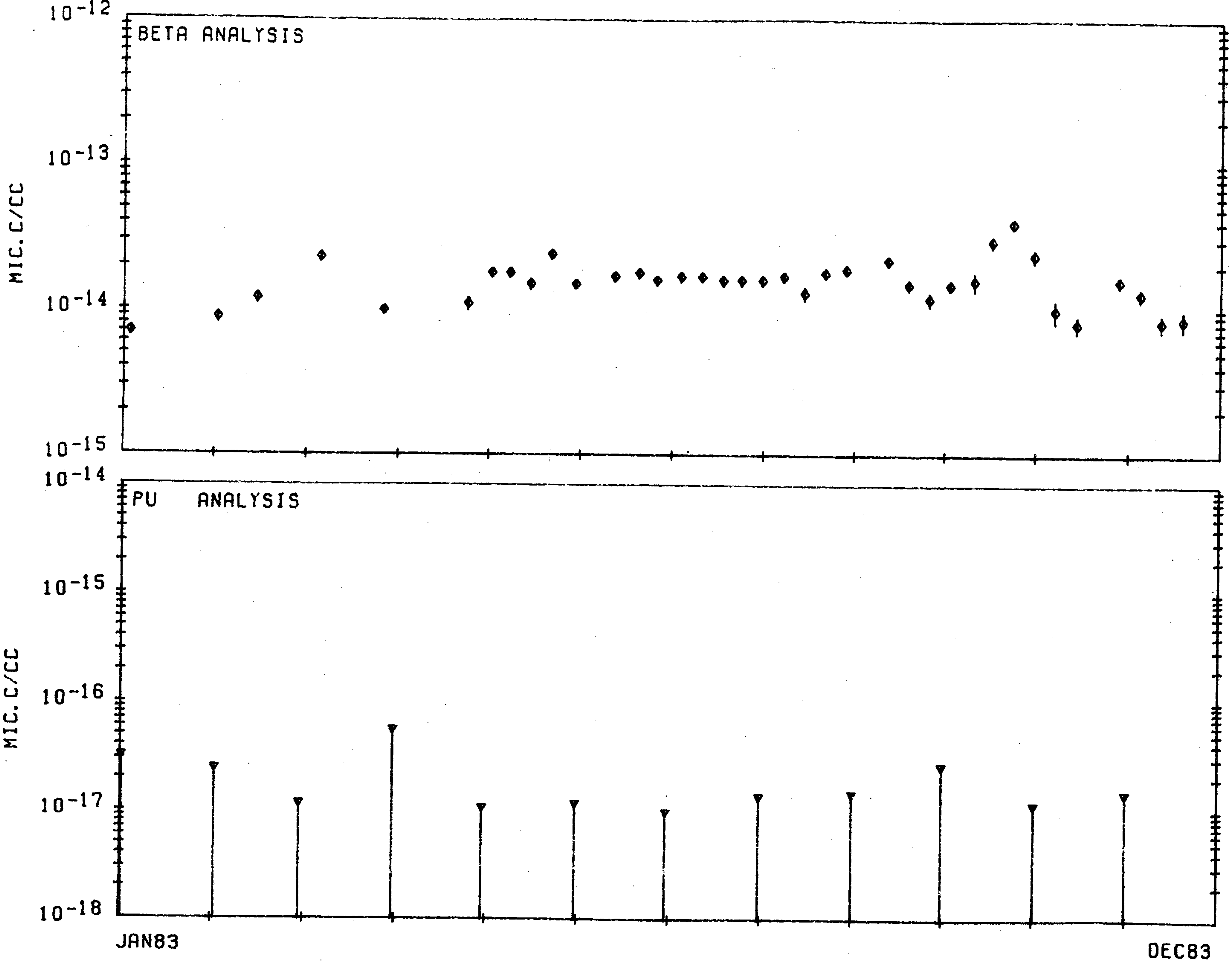
AIR SAMPLING STATION NUMBER 7



AIR SAMPLING STATION NUMBER 8



AIR SAMPLING STATION NUMBER 9



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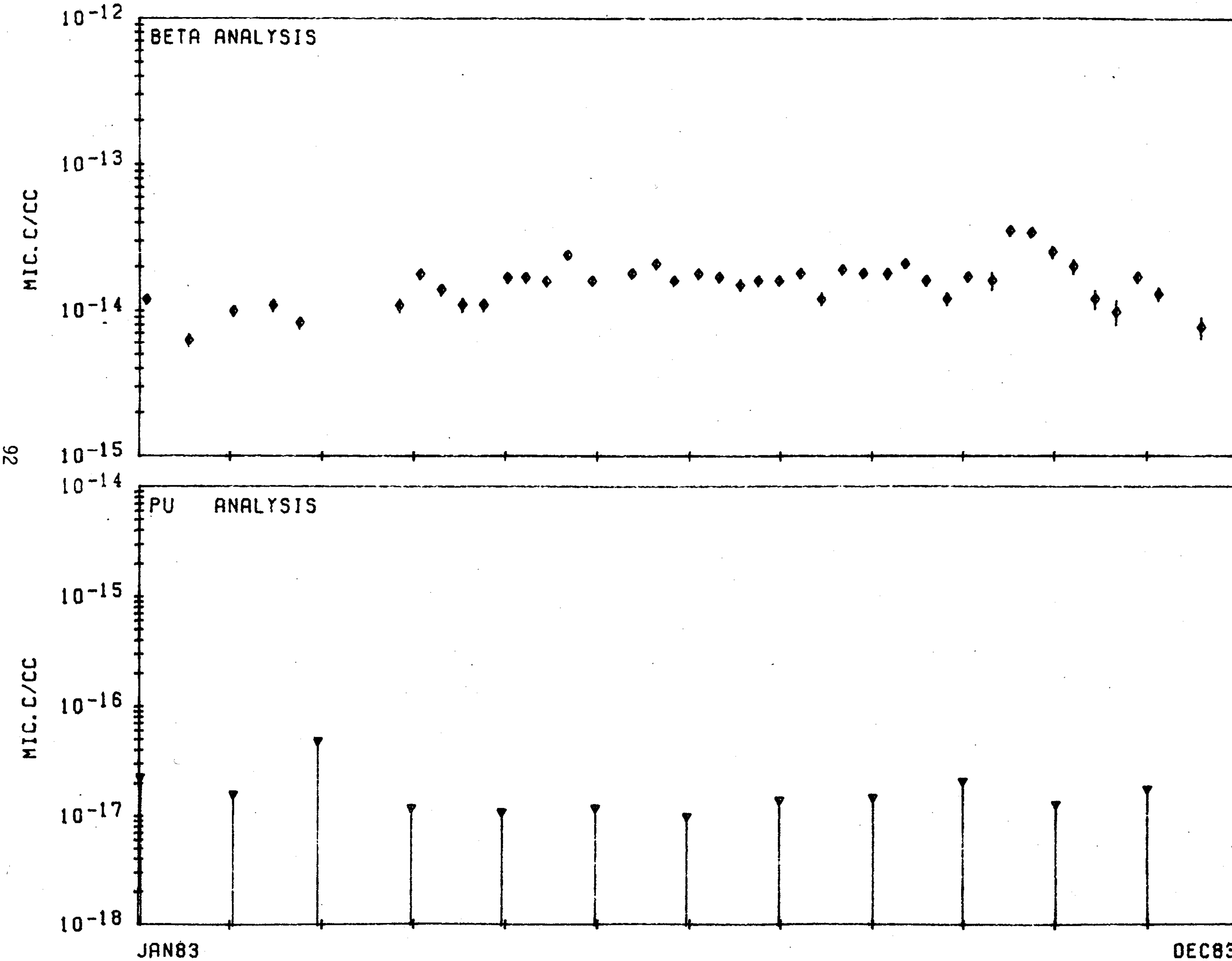
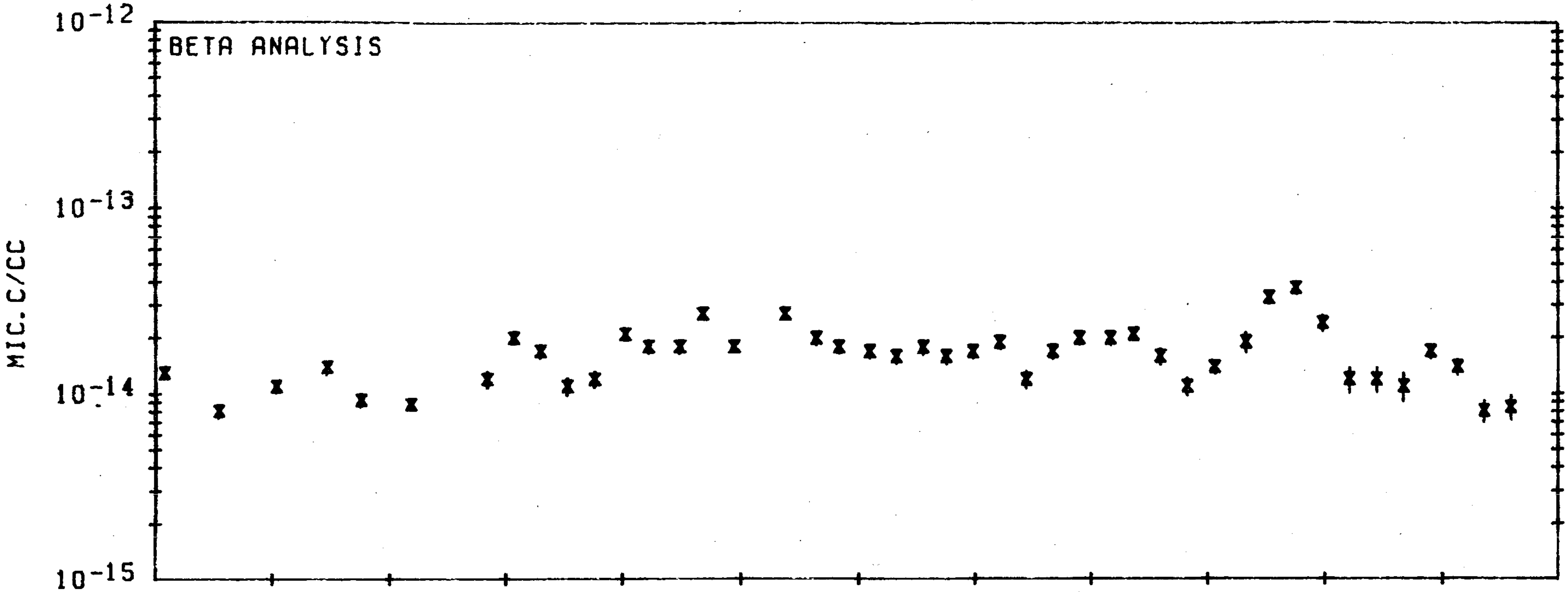
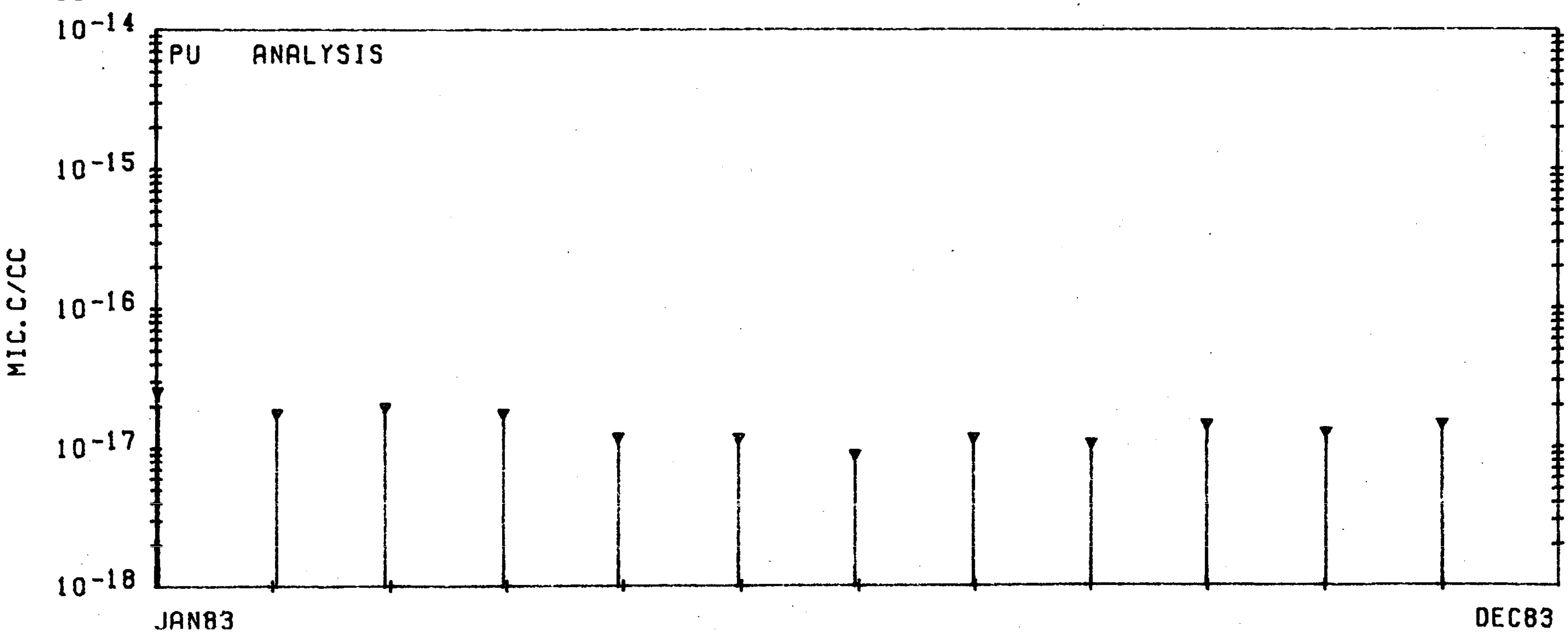
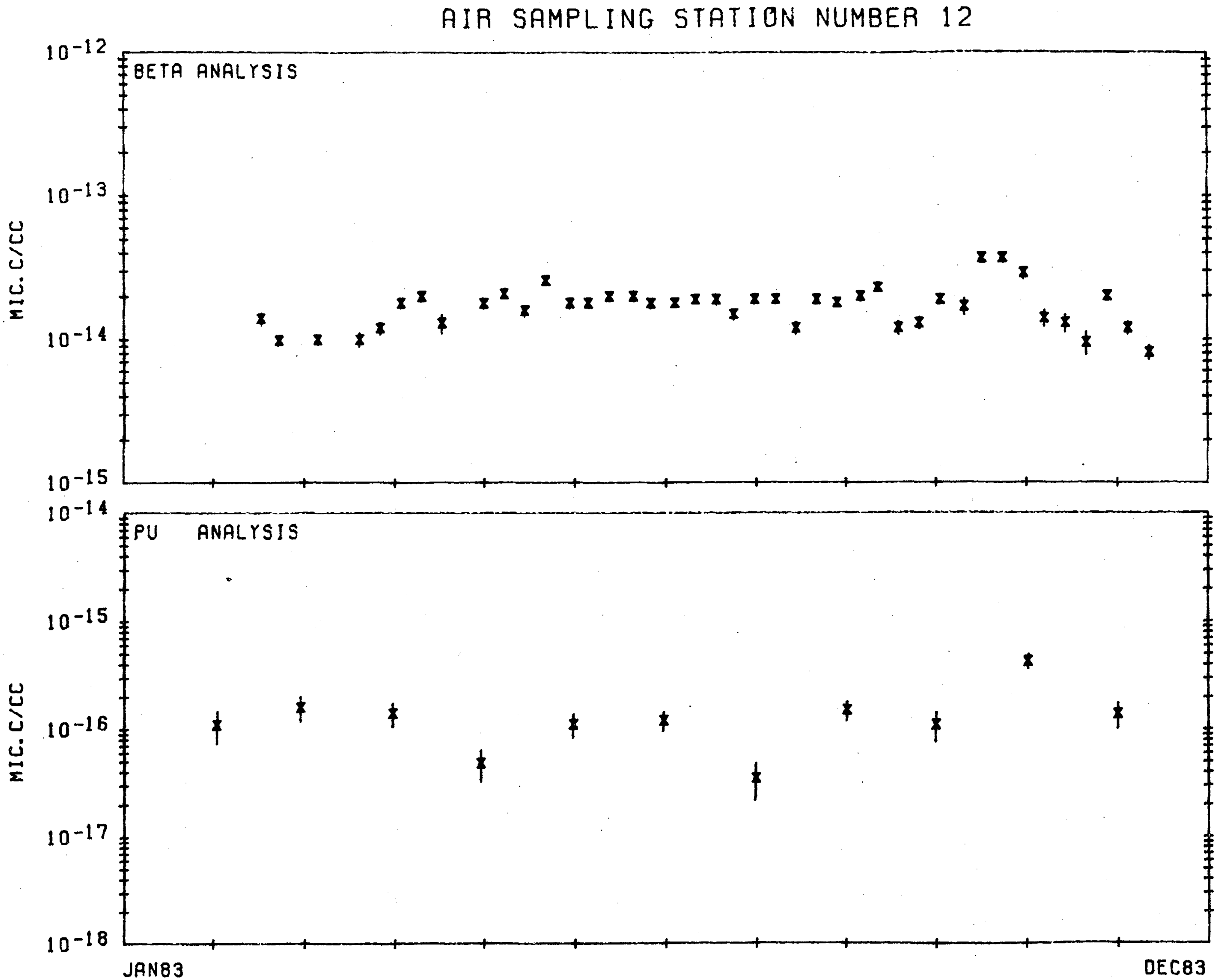
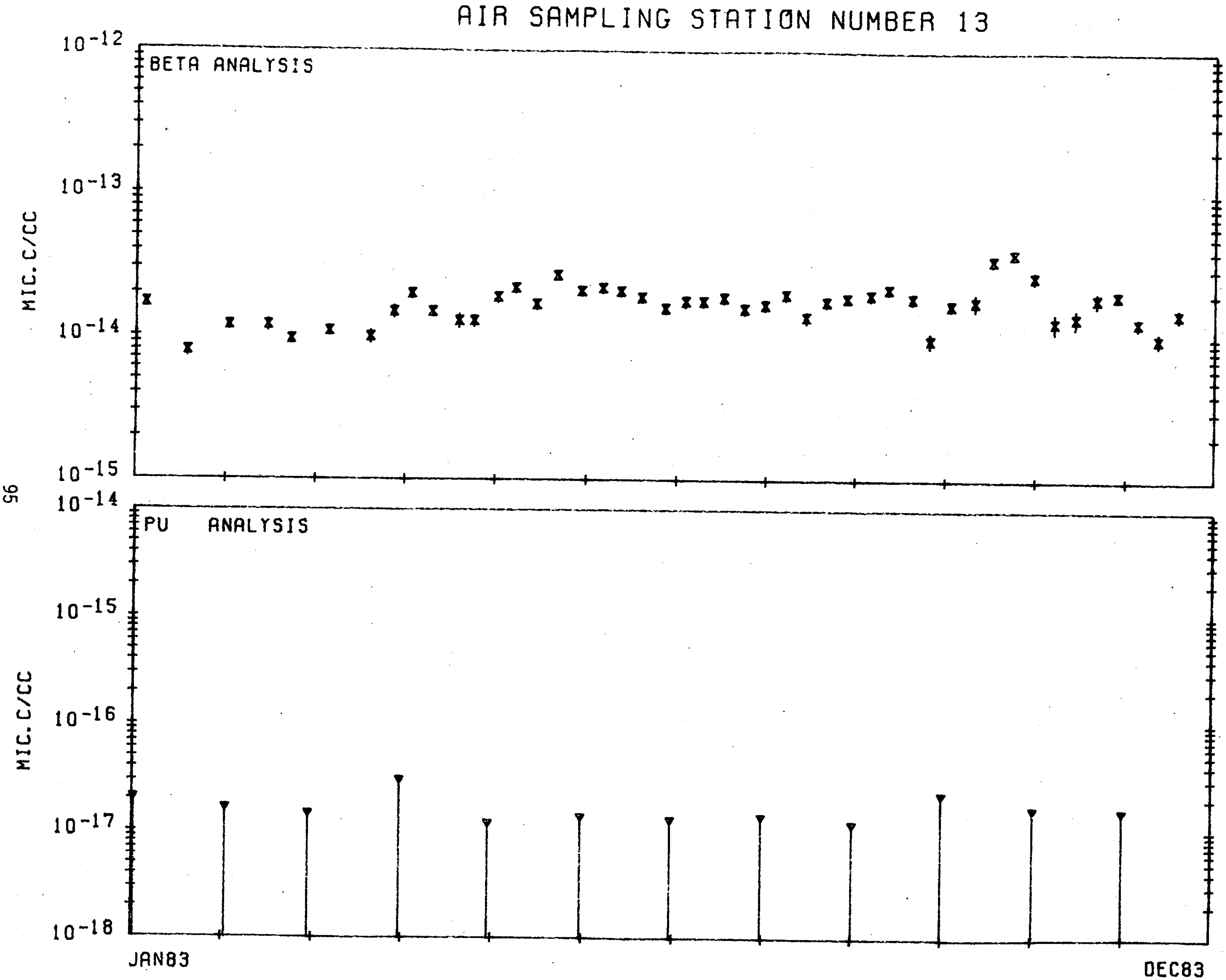


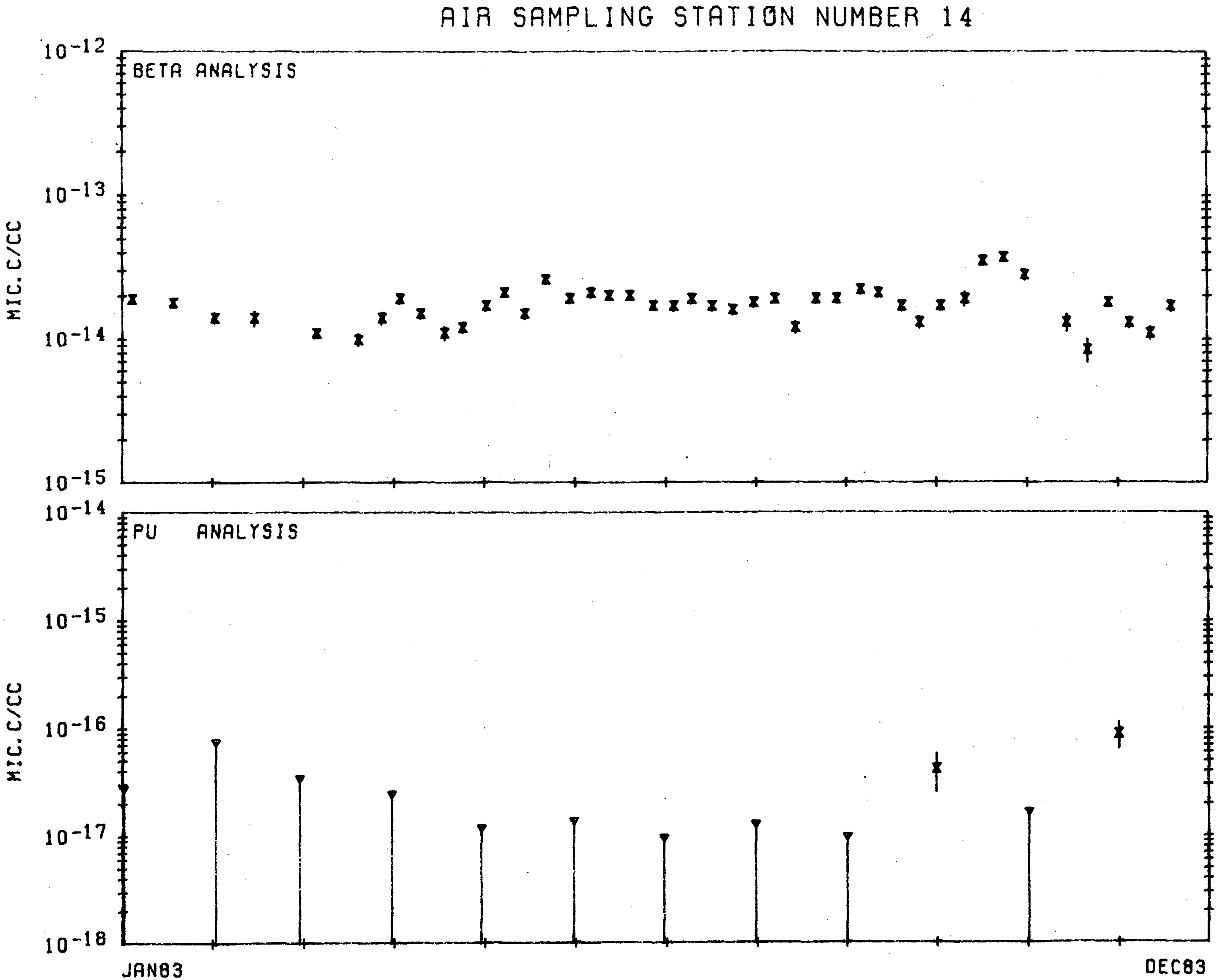
AIR SAMPLING STATION NUMBER 11



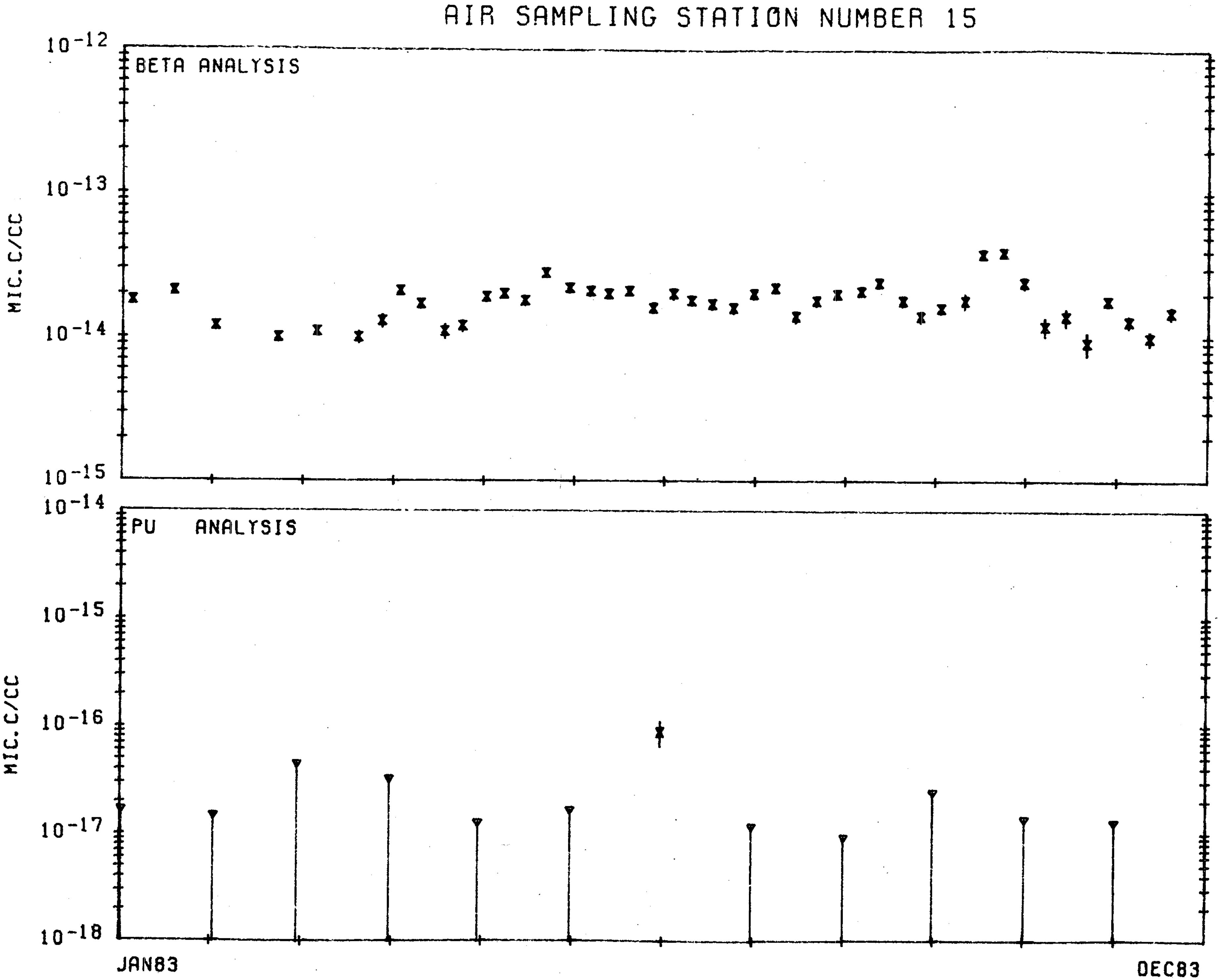



AIR SAMPLING STATION NUMBER 12
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10-12
10-13
10-14
10-15
10-14
10-15
10-16
10-17
10-18
JAN83
DEC83

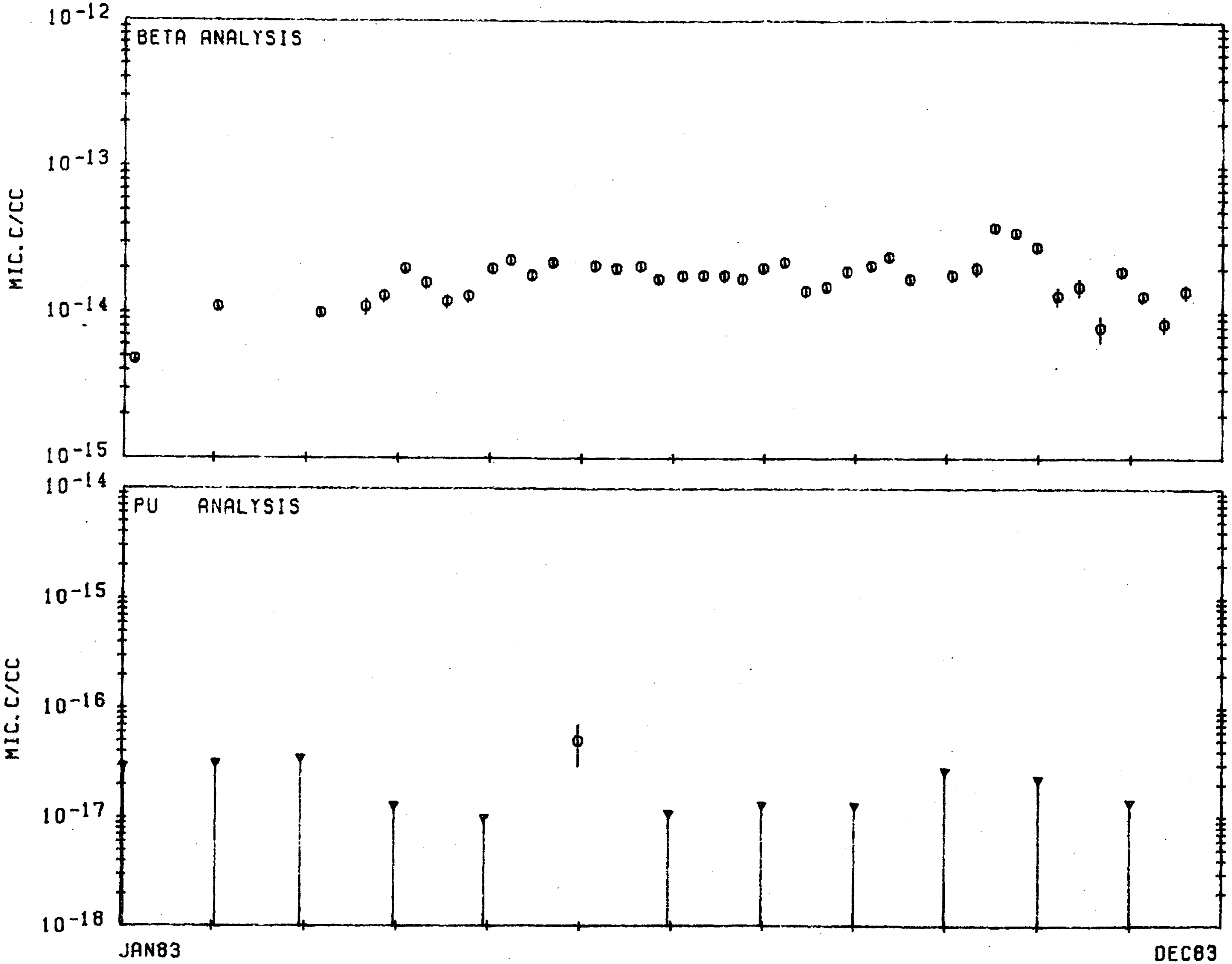

AIR SAMPLING STATION NUMBER 13
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

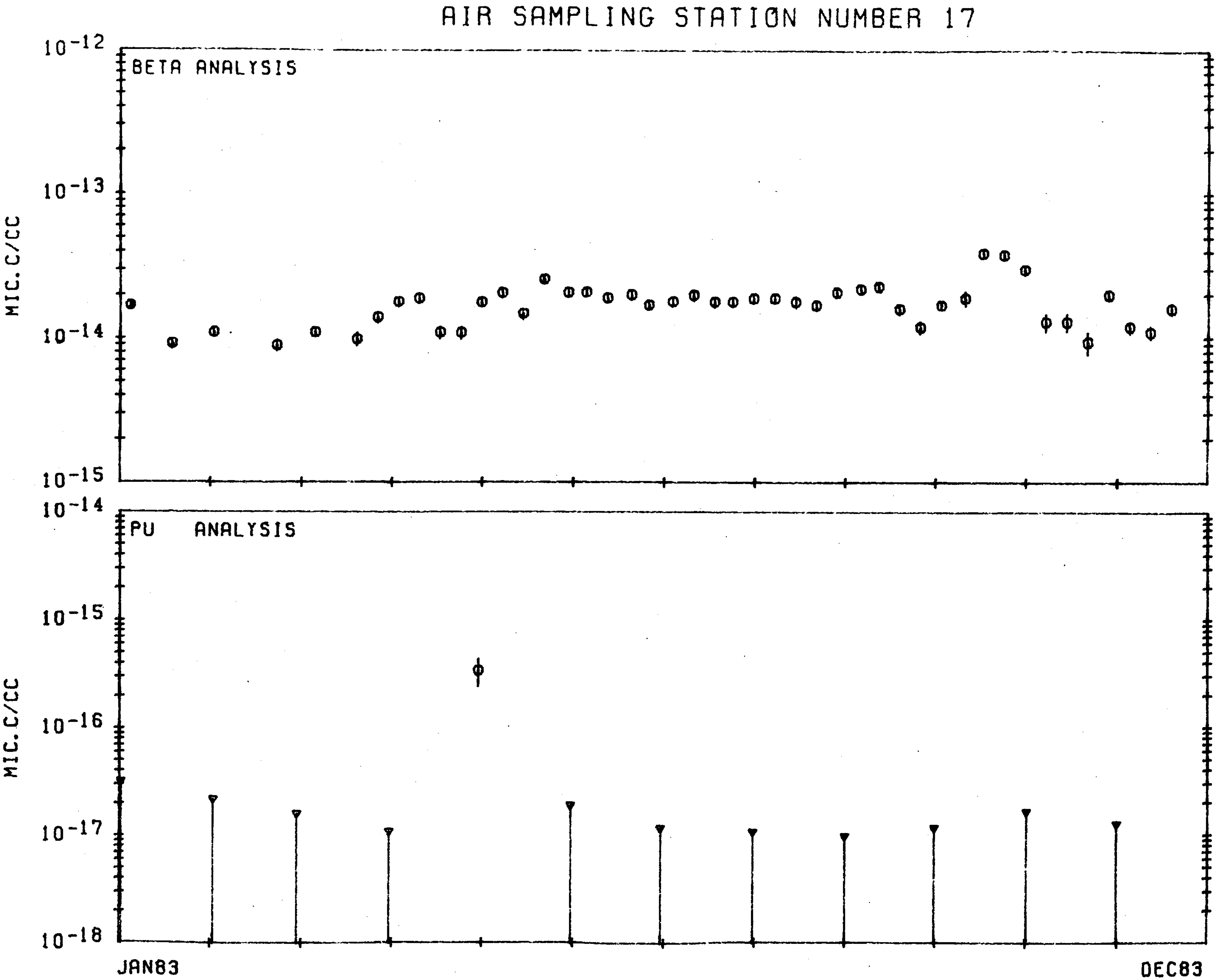


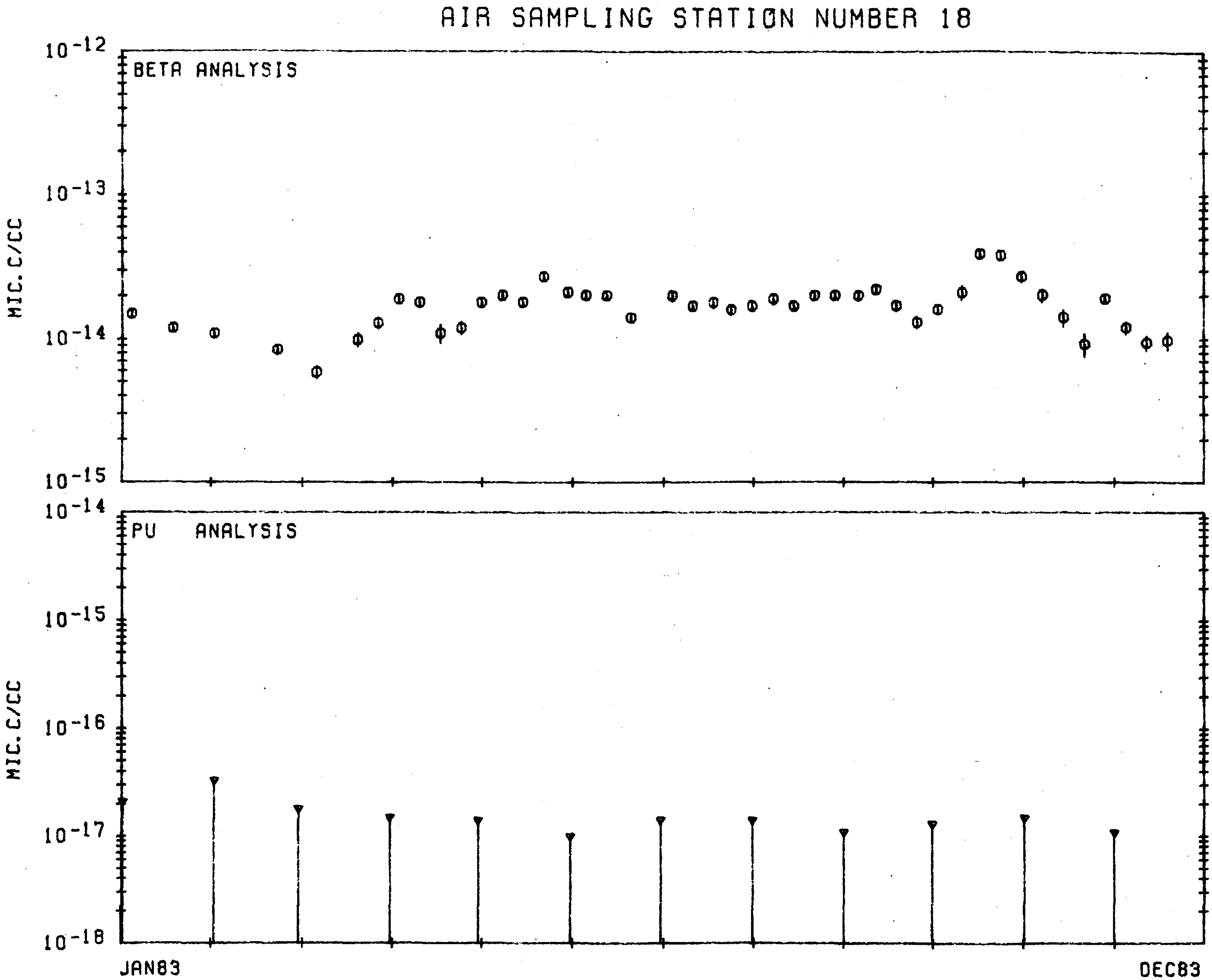
AIR SAMPLING STATION NUMBER 14
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83


AIR SAMPLING STATION NUMBER 15
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}
JAN83
DEC83

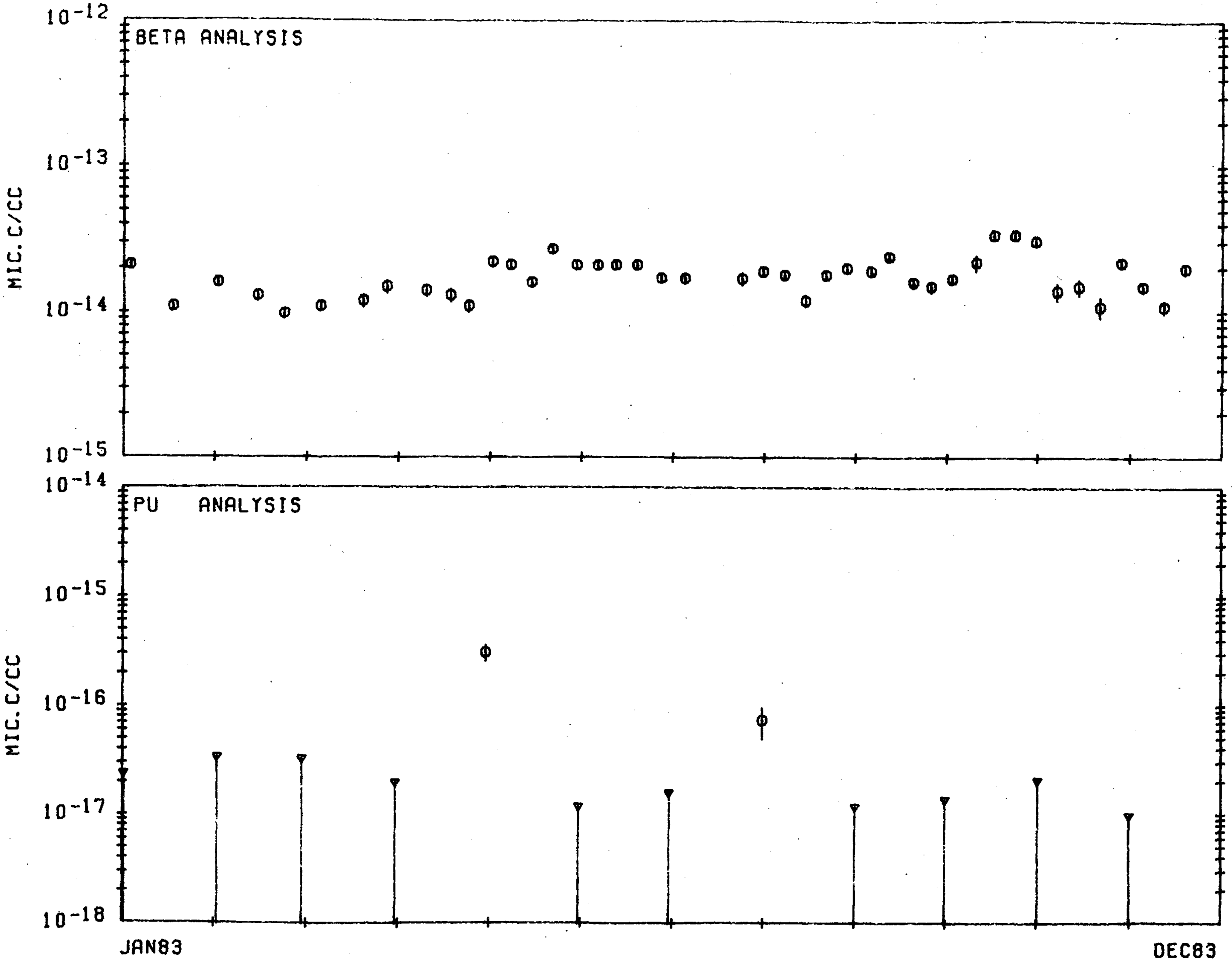
AIR SAMPLING STATION NUMBER 16

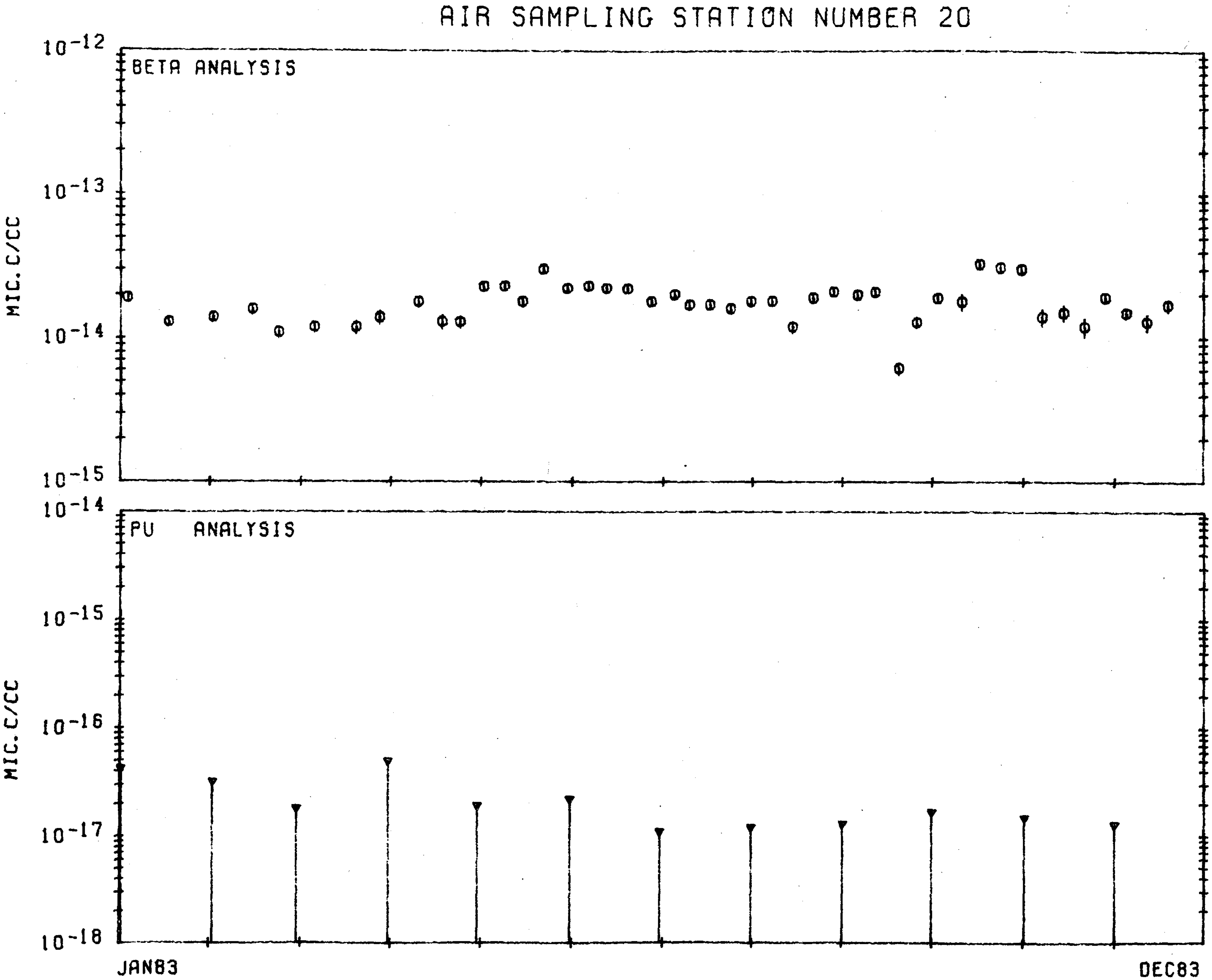



AIR SAMPLING STATION NUMBER 17
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

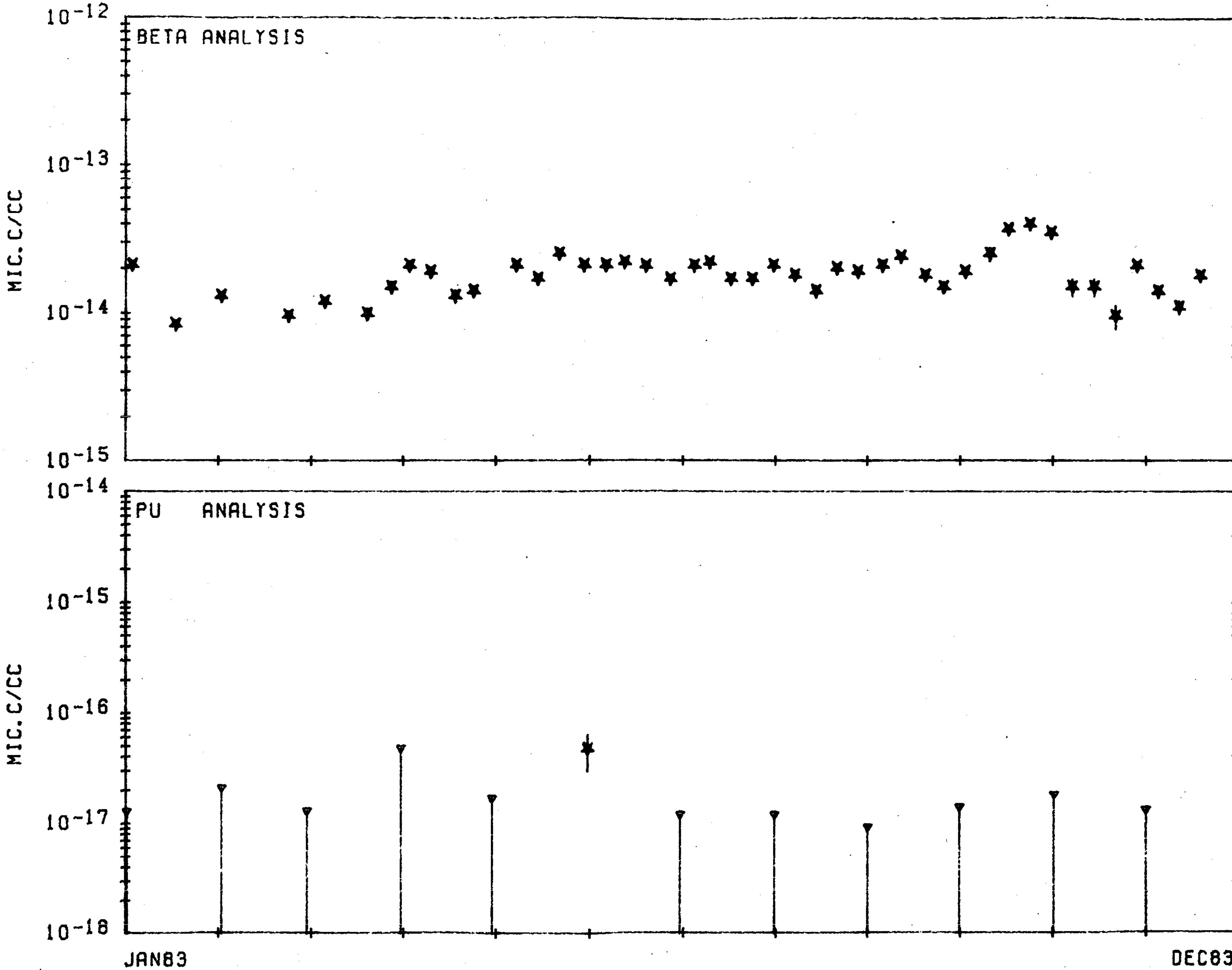

AIR SAMPLING STATION NUMBER 18
BETA ANALYSIS
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
PU ANALYSIS
MIC.C/CC
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

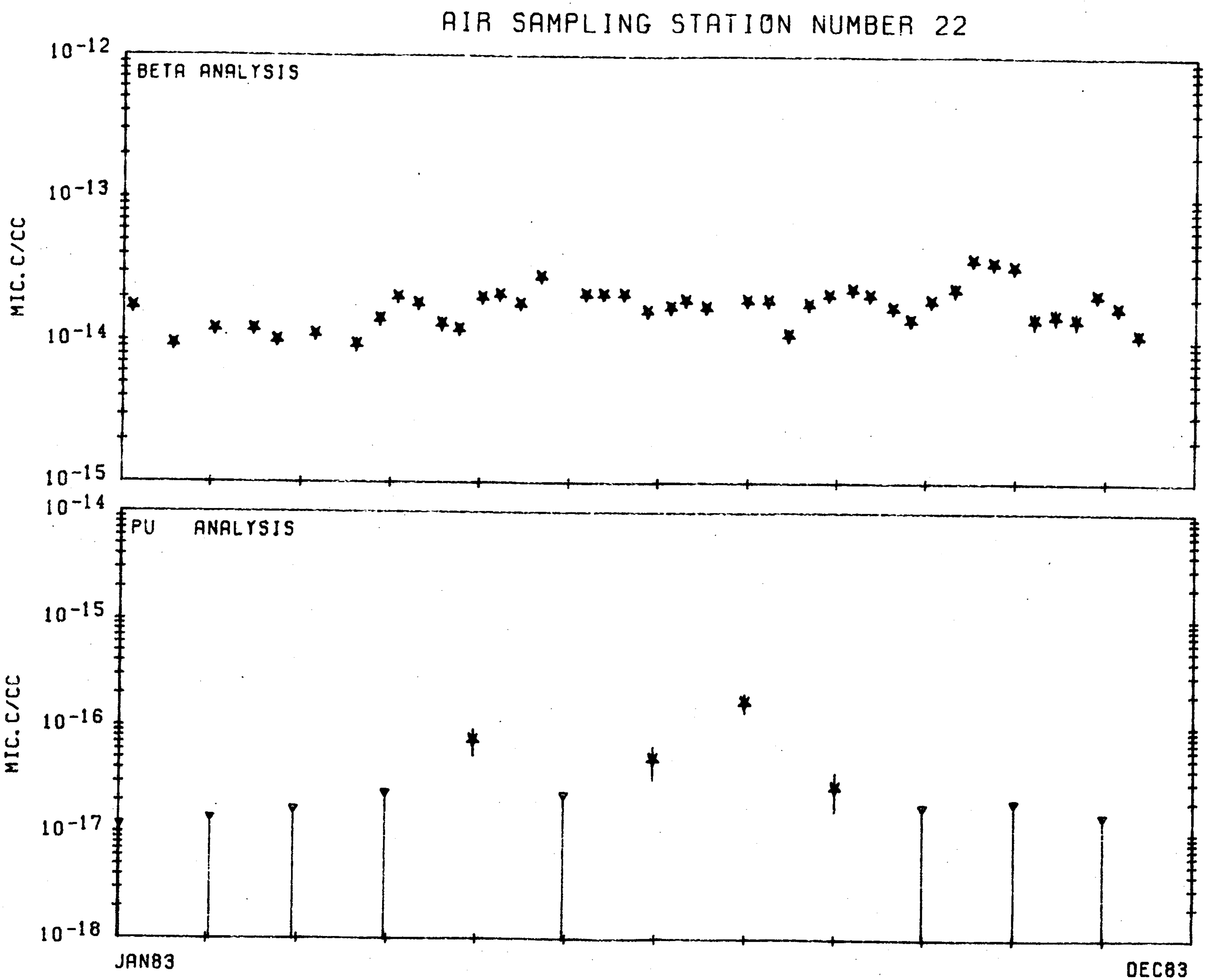
AIR SAMPLING STATION NUMBER 19




AIR SAMPLING STATION NUMBER 20
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}
JAN83
DEC83

AIR SAMPLING STATION NUMBER 21

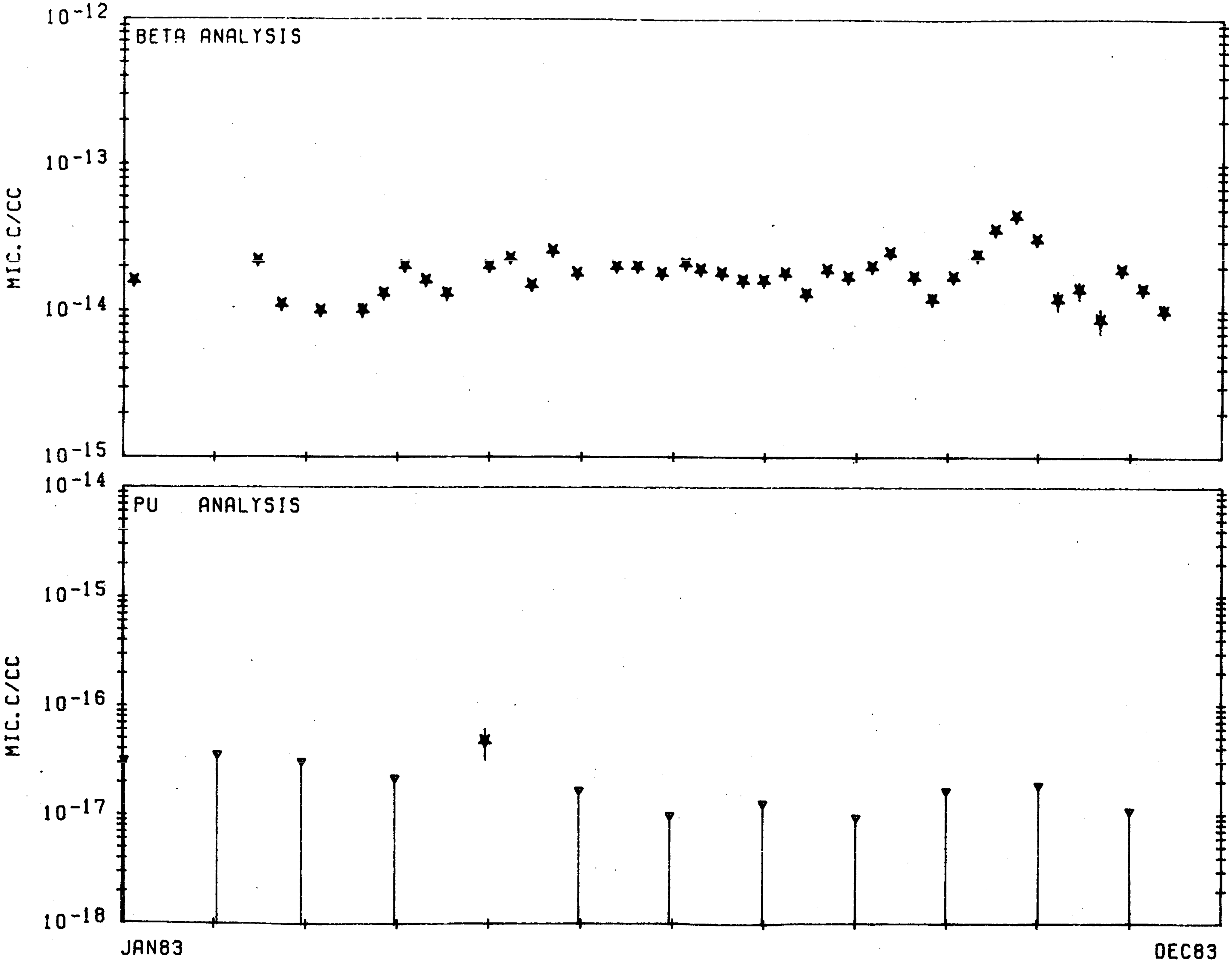




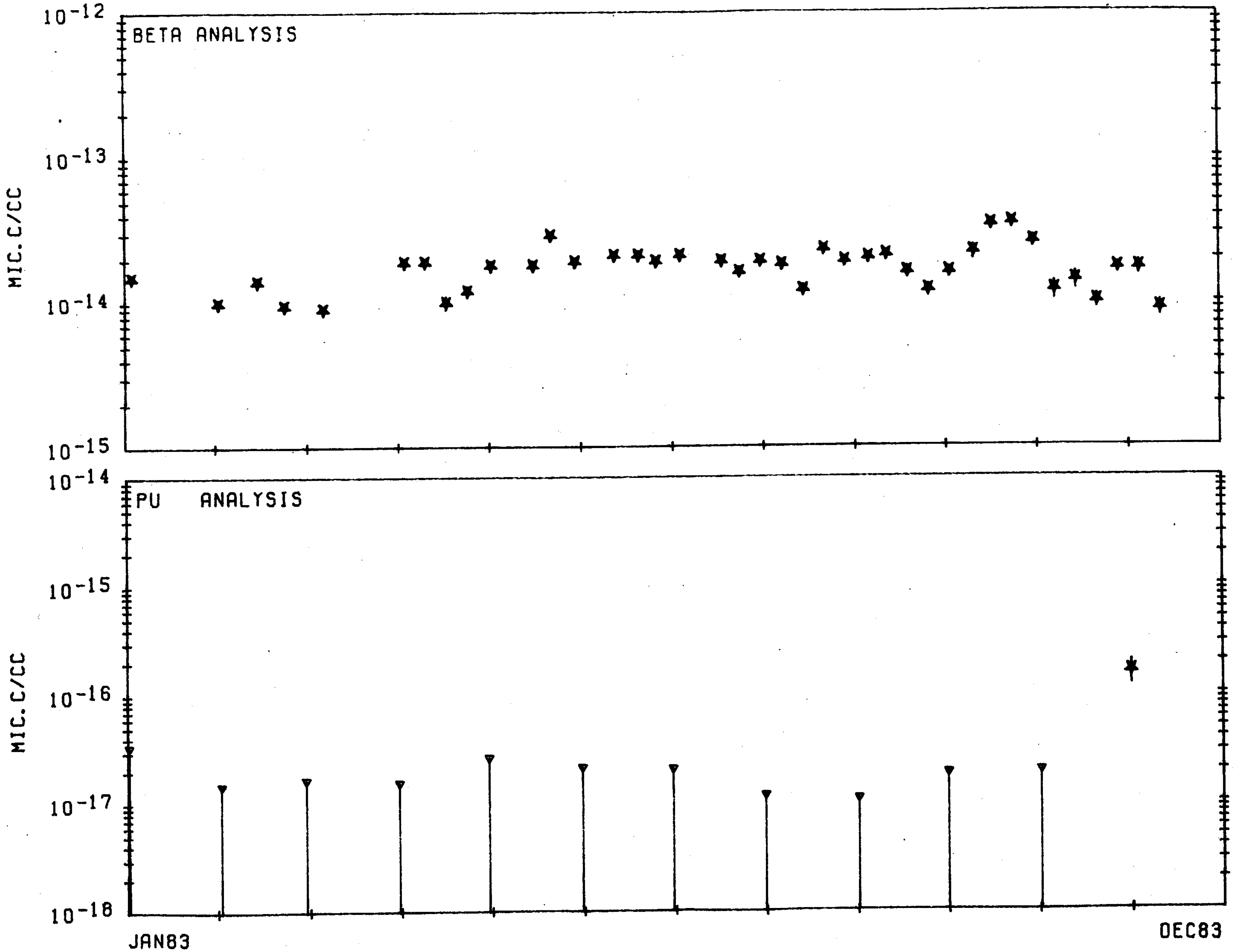
AIR SAMPLING STATION NUMBER 22
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

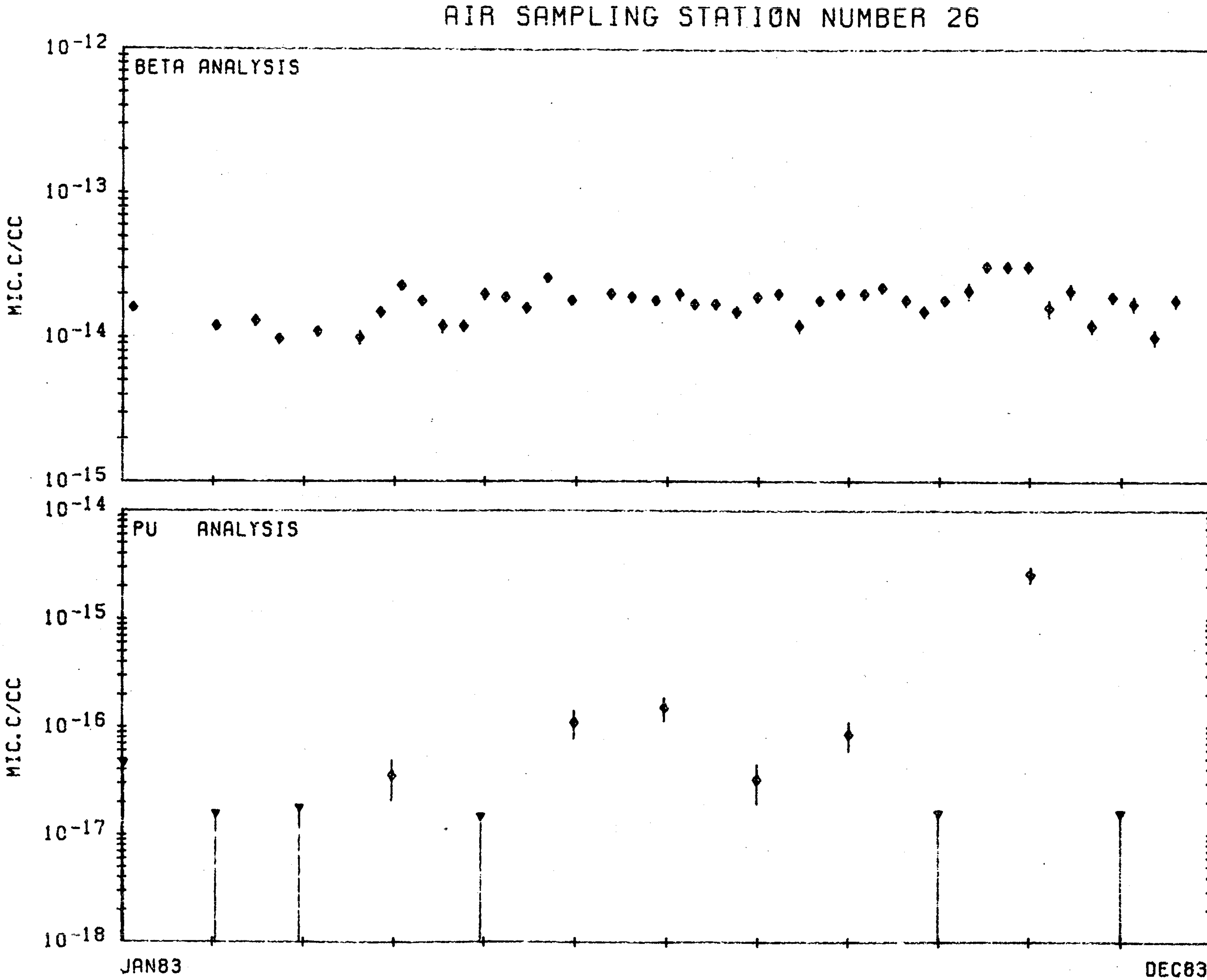
104

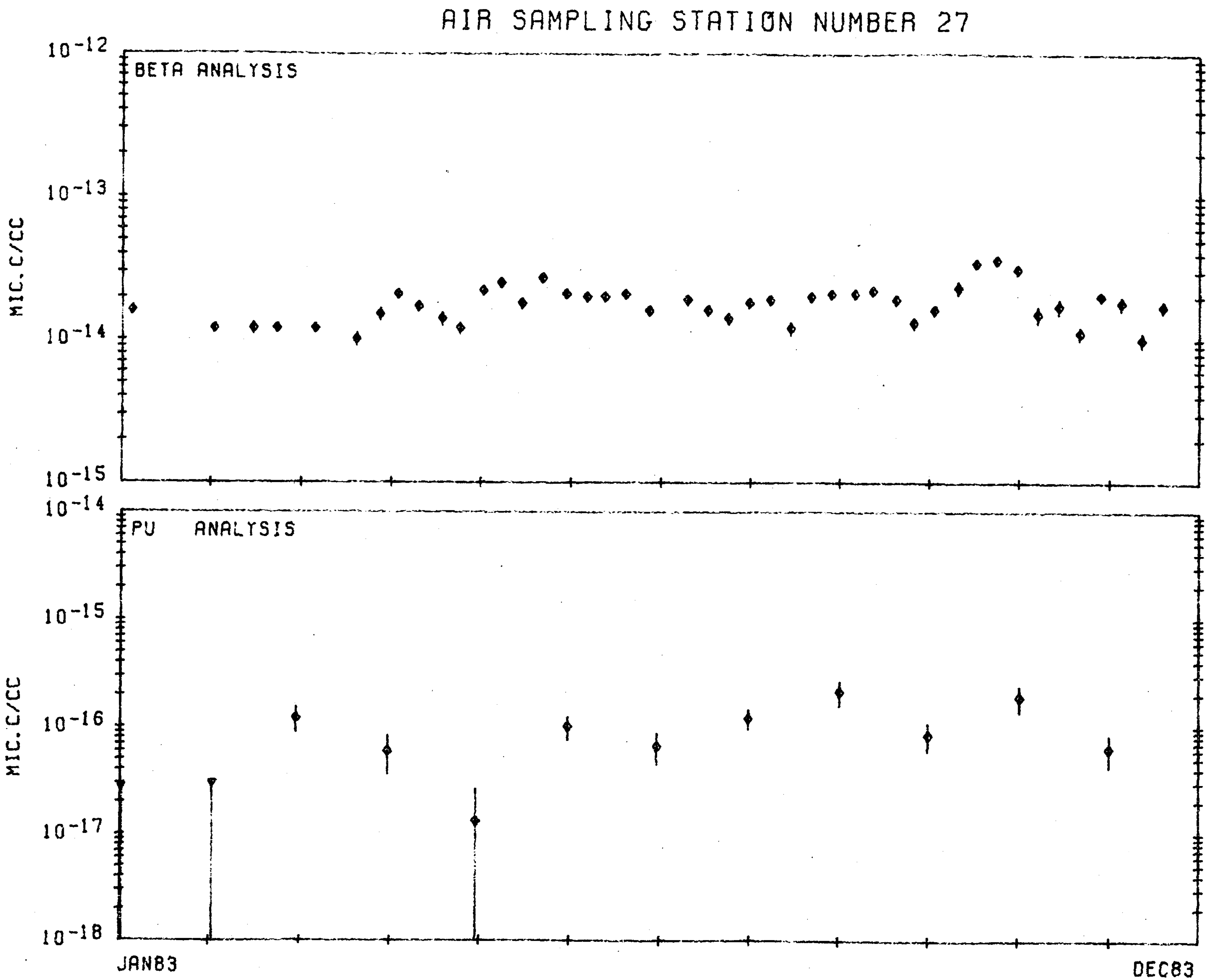
AIR SAMPLING STATION NUMBER 23



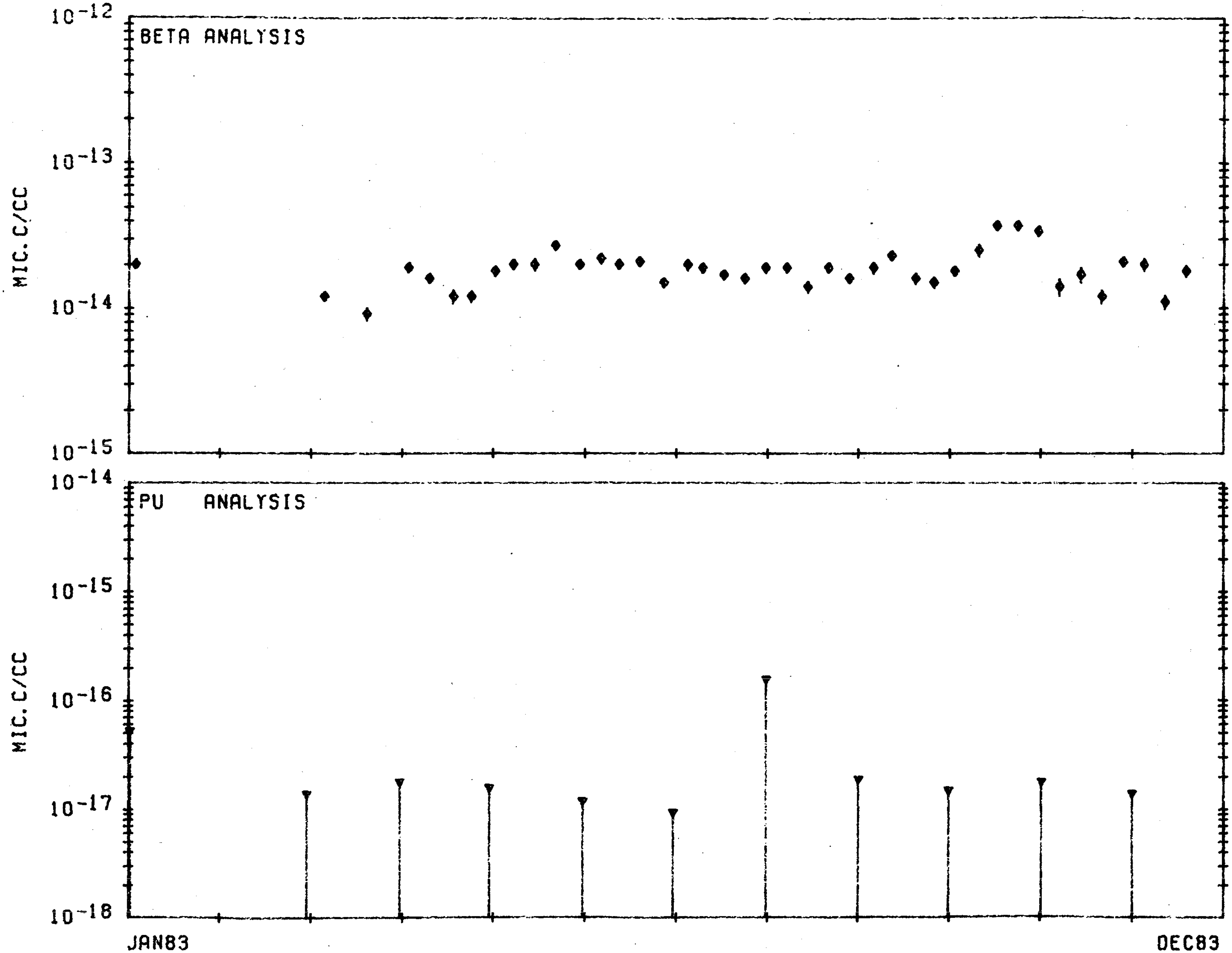
AIR SAMPLING STATION NUMBER 25

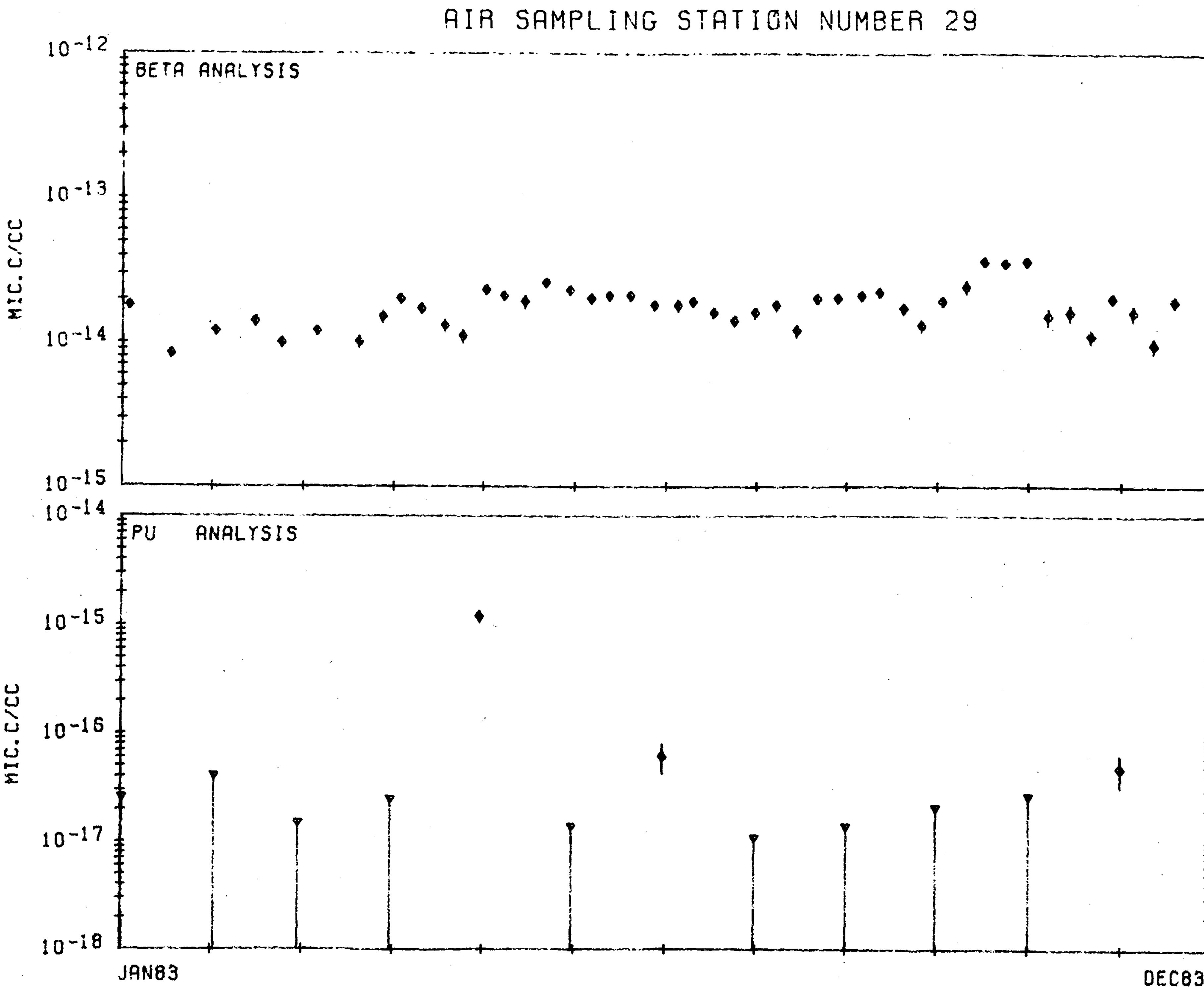



AIR SAMPLING STATION NUMBER 26
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

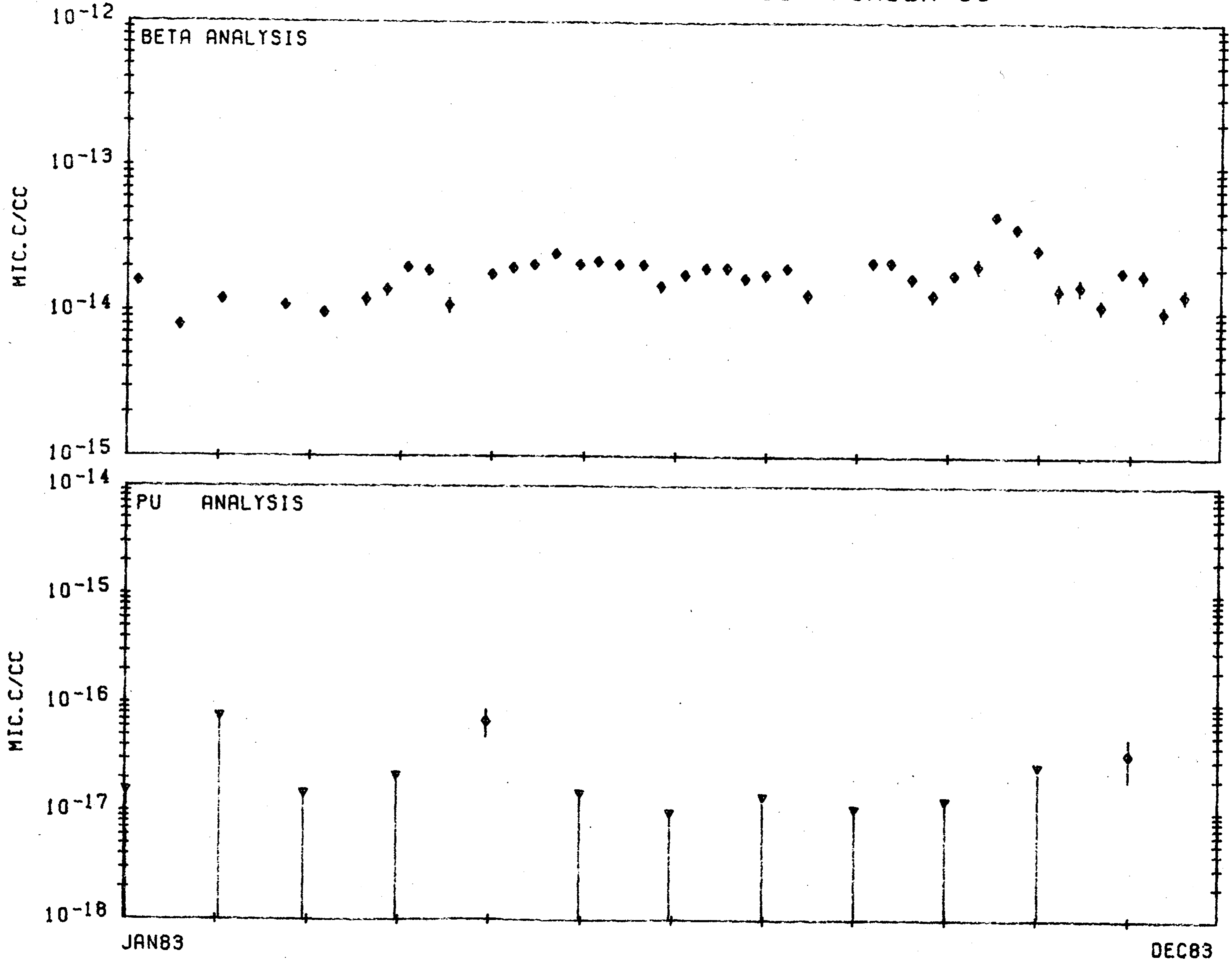

AIR SAMPLING STATION NUMBER 27
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

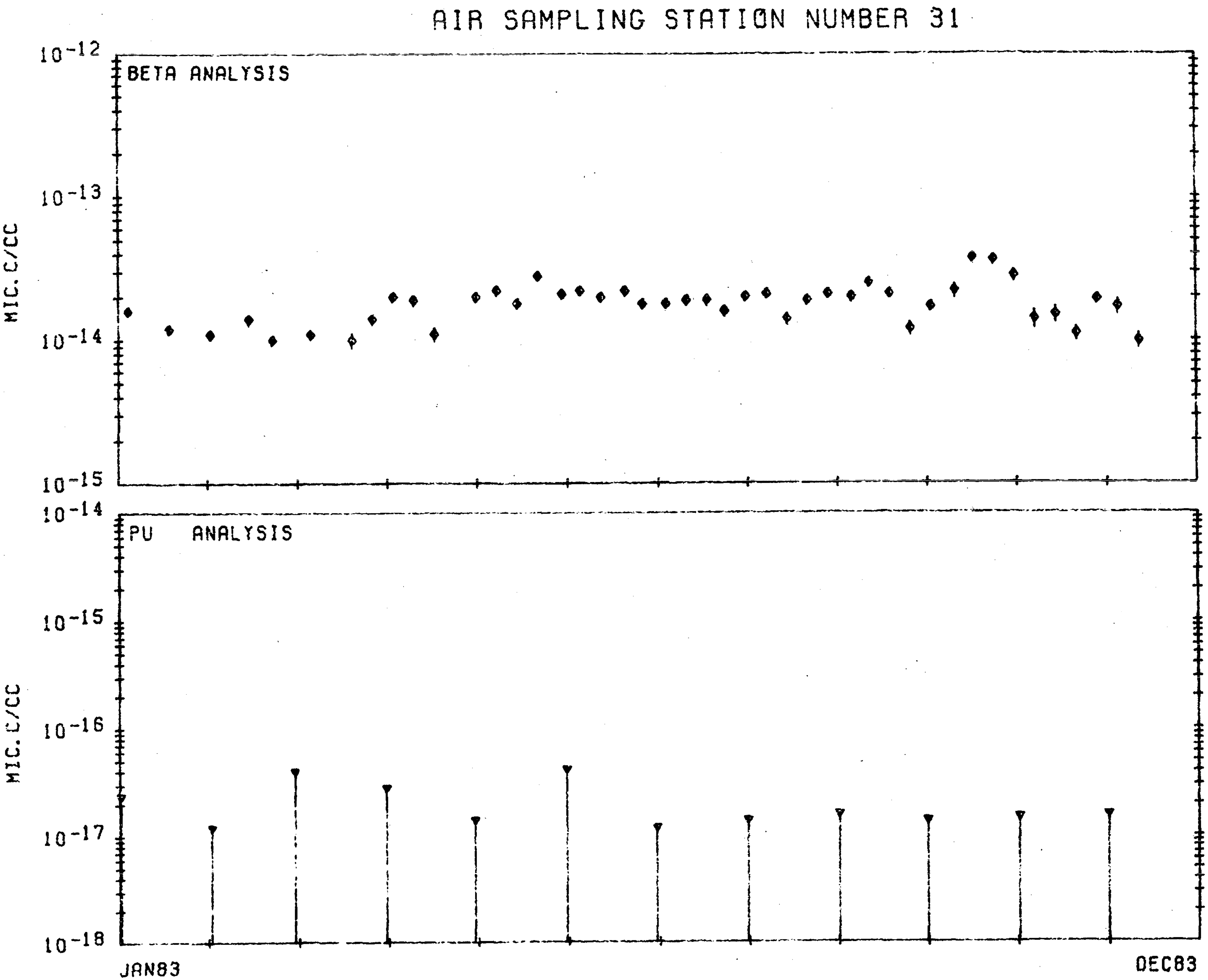
AIR SAMPLING STATION NUMBER 28

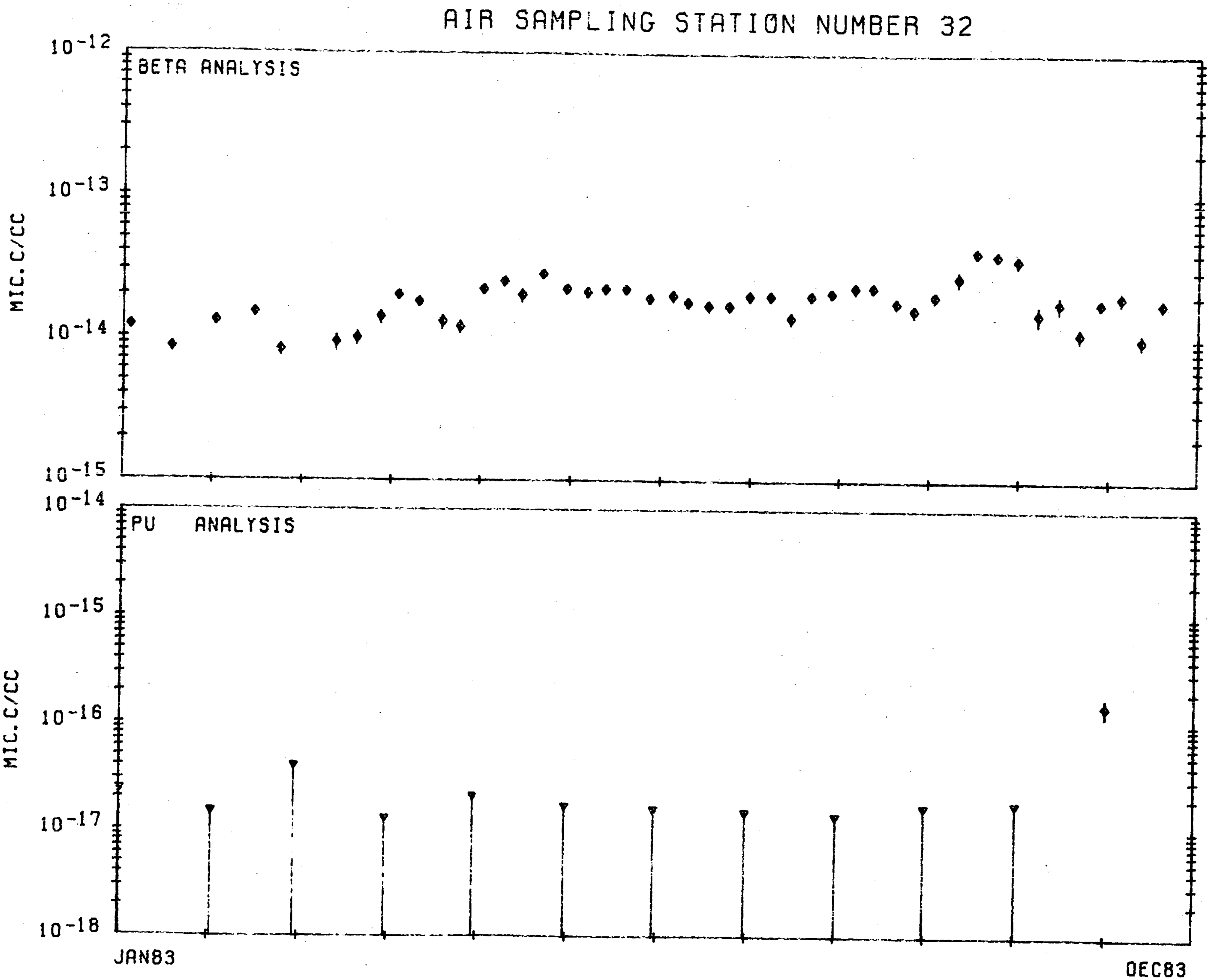


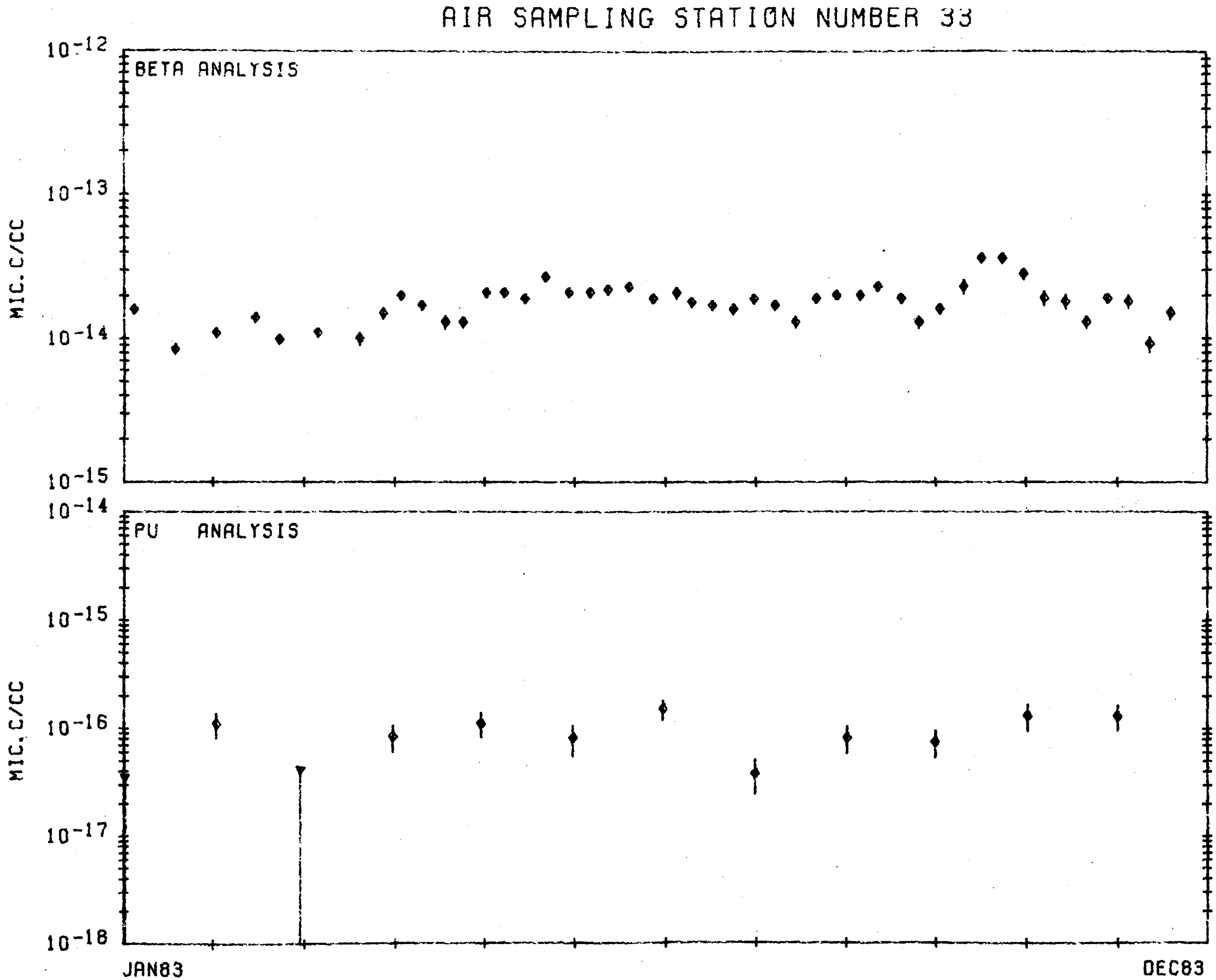

AIR SAMPLING STATION NUMBER 29
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

AIR SAMPLING STATION NUMBER 30




AIR SAMPLING STATION NUMBER 31
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}
JAN83
DEC83


AIR SAMPLING STATION NUMBER 32
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}
JAN83
DEC83


AIR SAMPLING STATION NUMBER 33
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10-12
10-13
10-14
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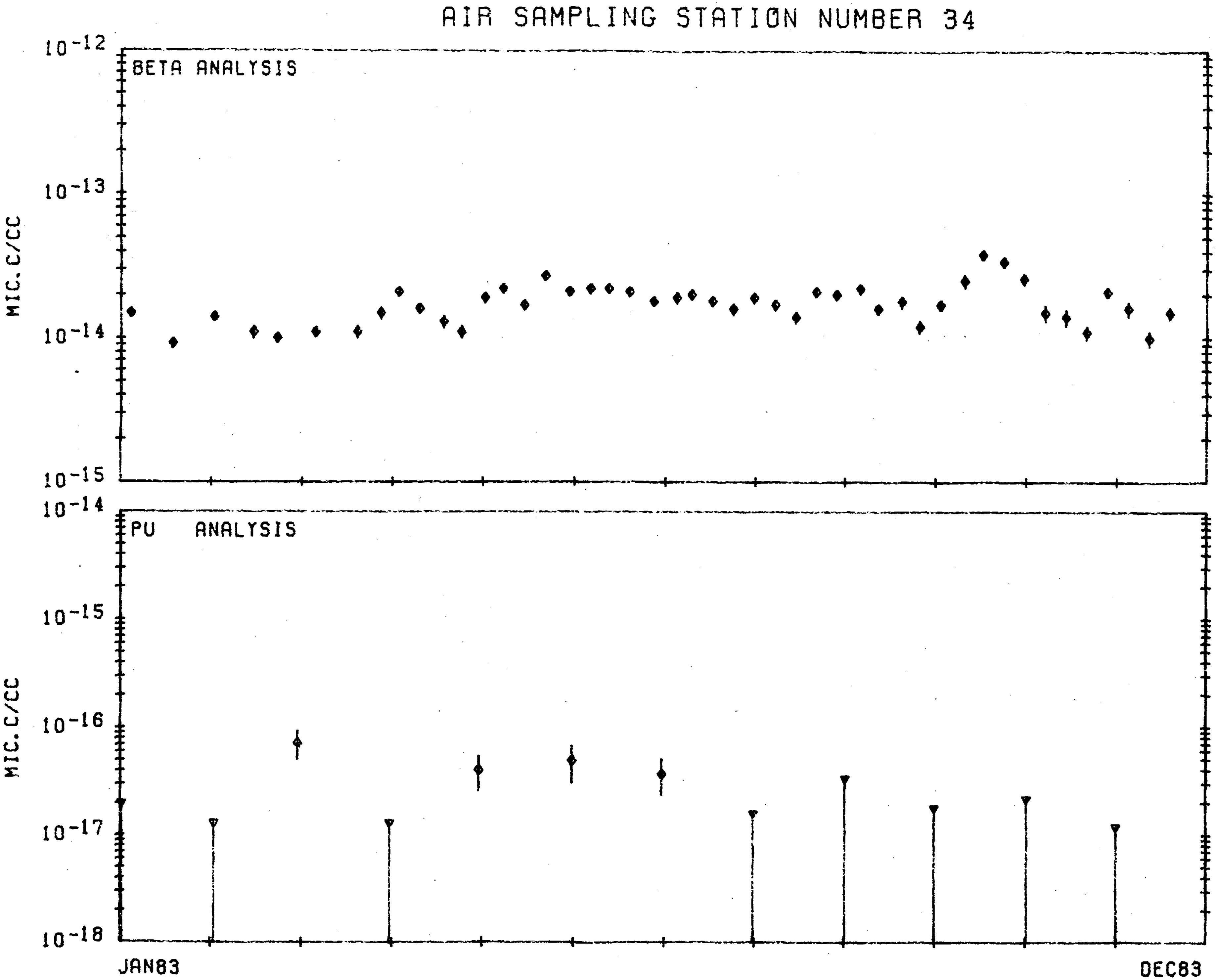
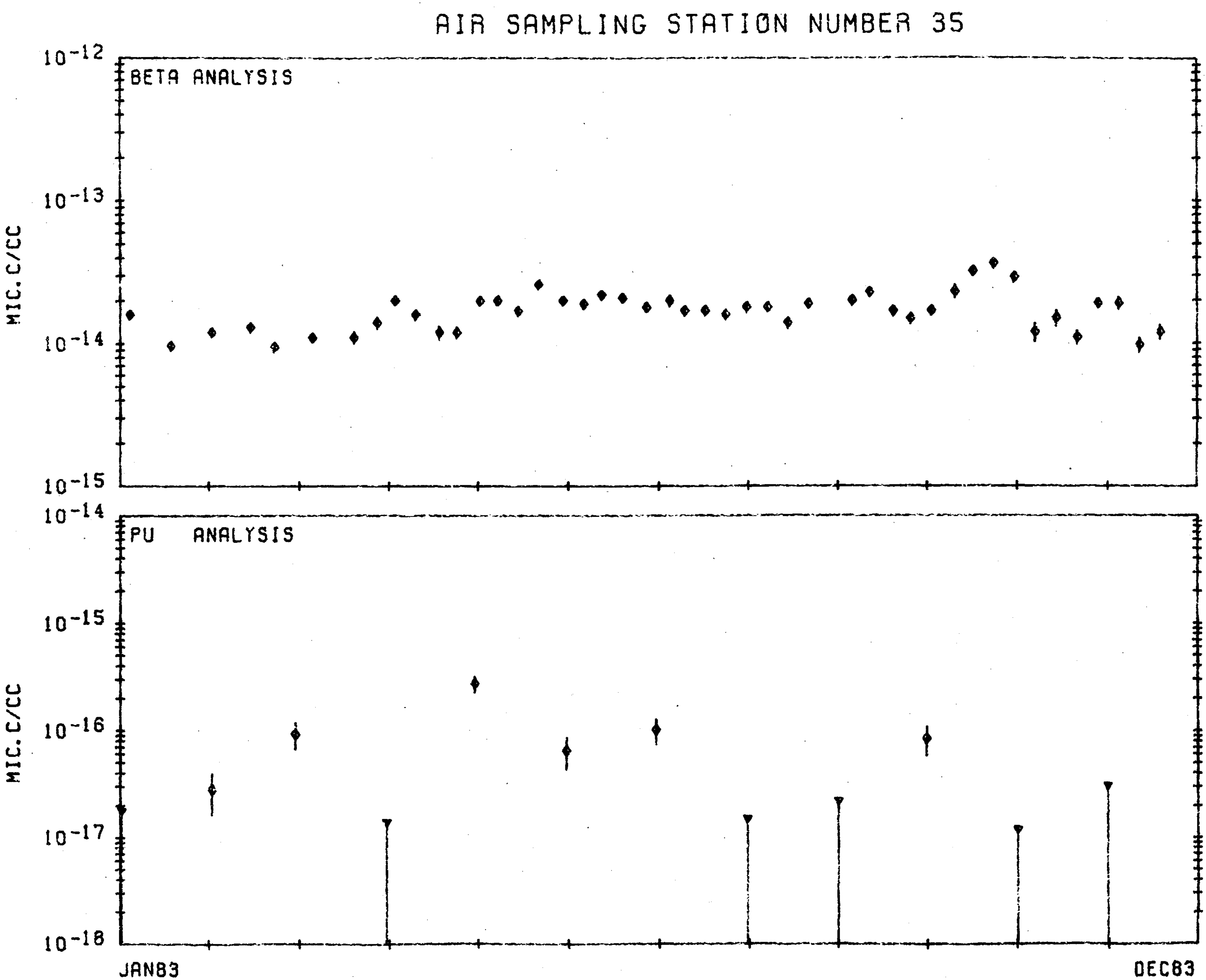
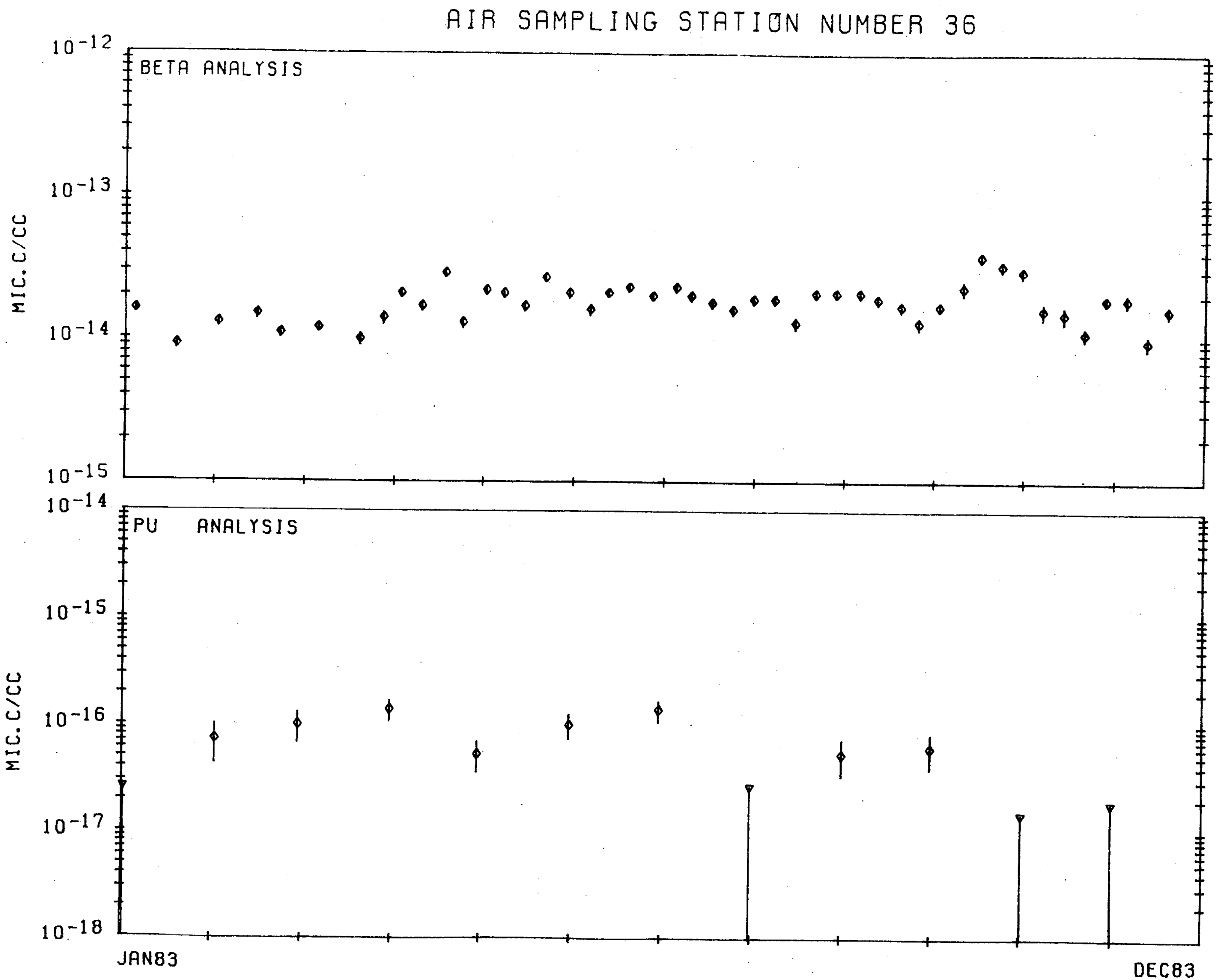
10-16
10-17
10-18
JAN83
DEC83



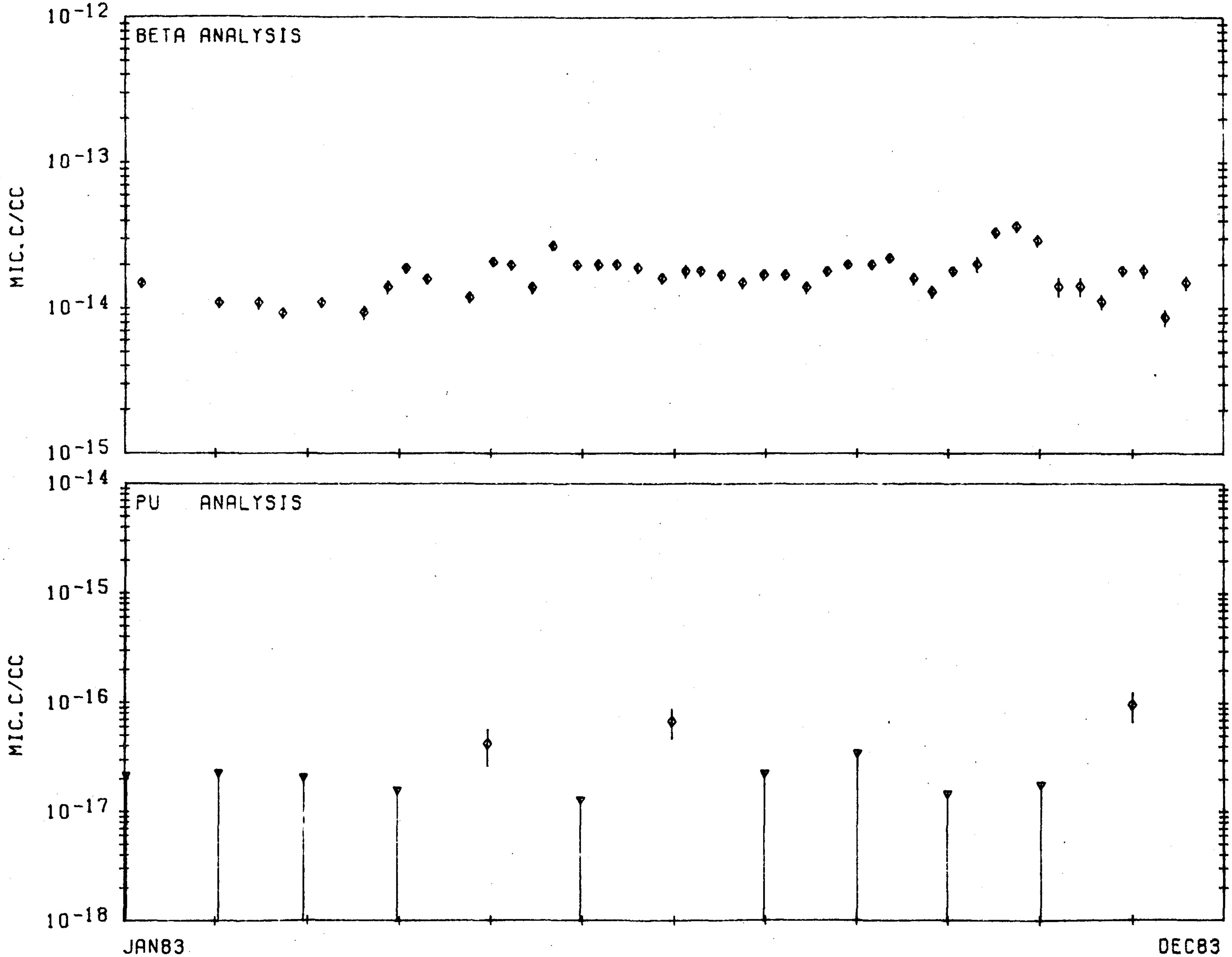
AIR SAMPLING STATION NUMBER 34
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

115

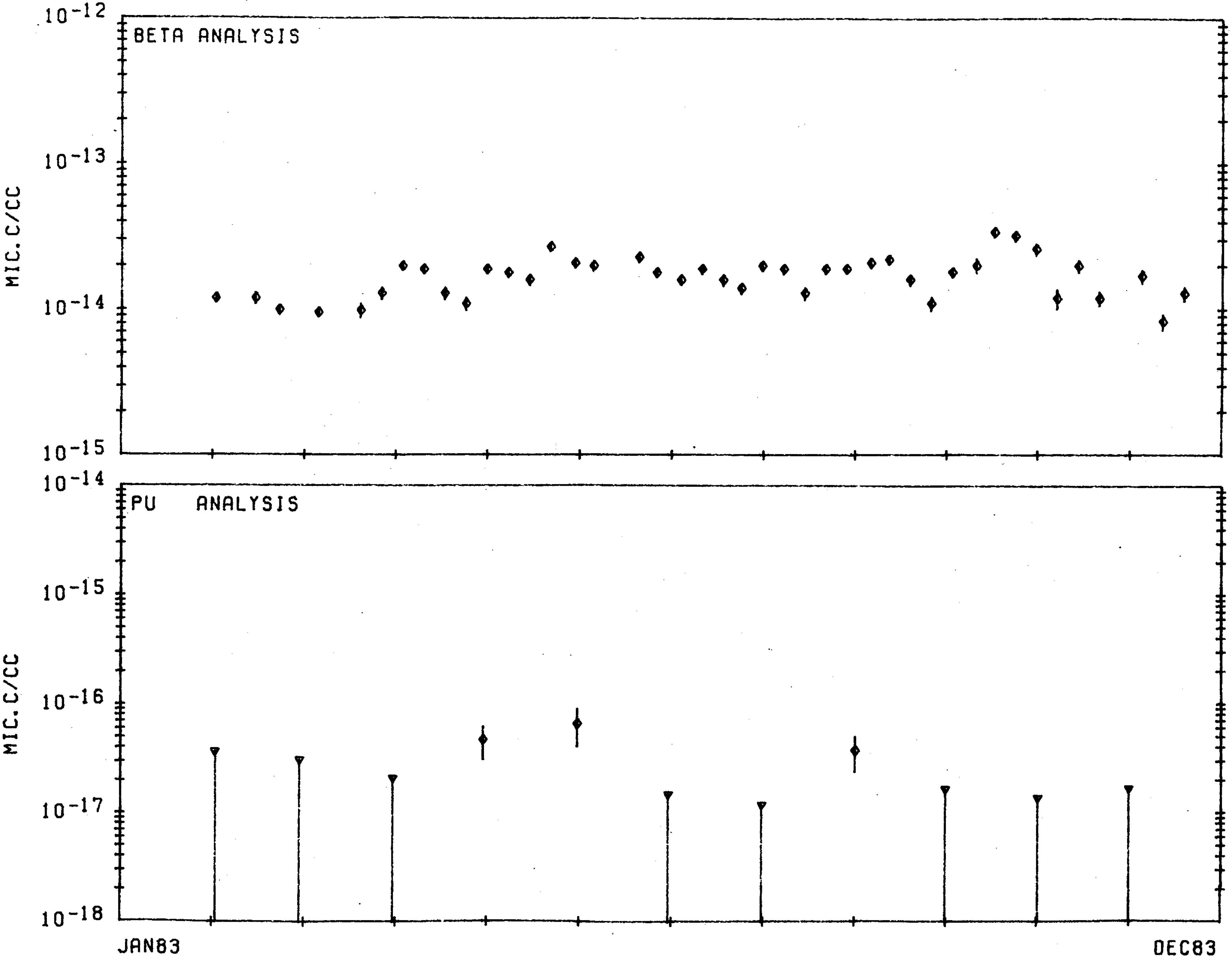

AIR SAMPLING STATION NUMBER 35
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10-12
10-13
10-14
10-15
10-14
10-15
10-16
10-17
10-18
JAN83
DEC83

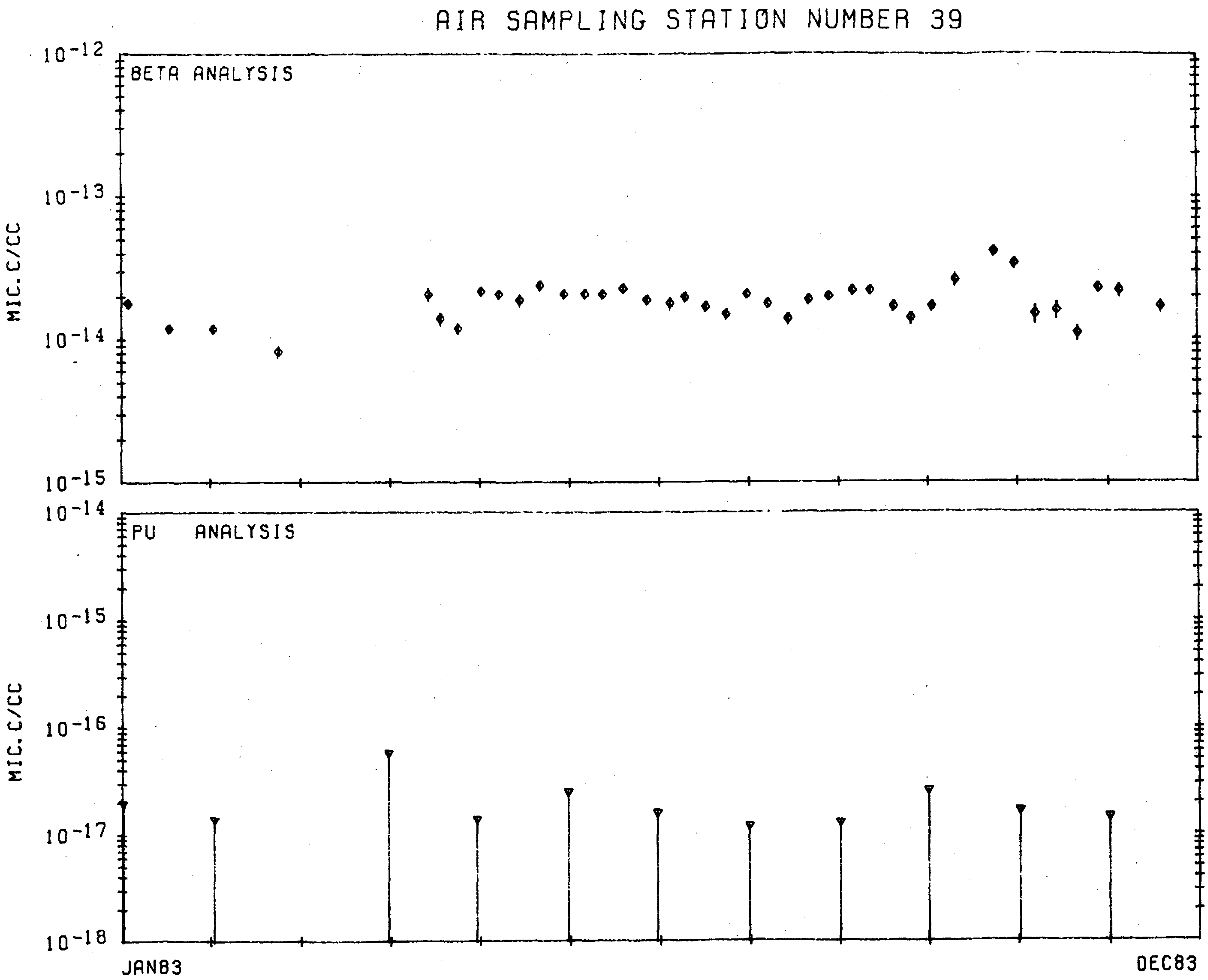

AIR SAMPLING STATION NUMBER 36
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

AIR SAMPLING STATION NUMBER 37



AIR SAMPLING STATION NUMBER 38





AIR SAMPLING STATION NUMBER 39
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
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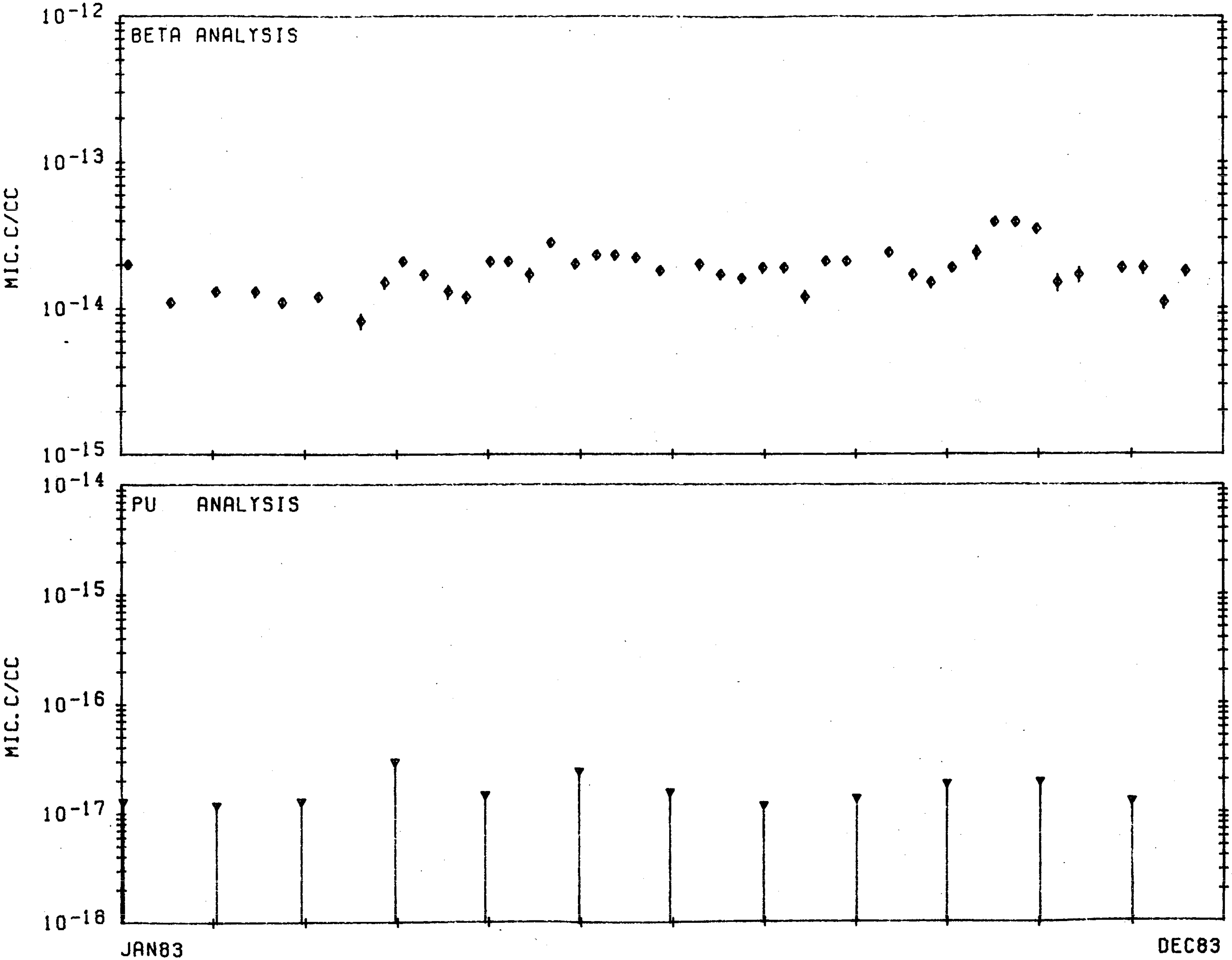
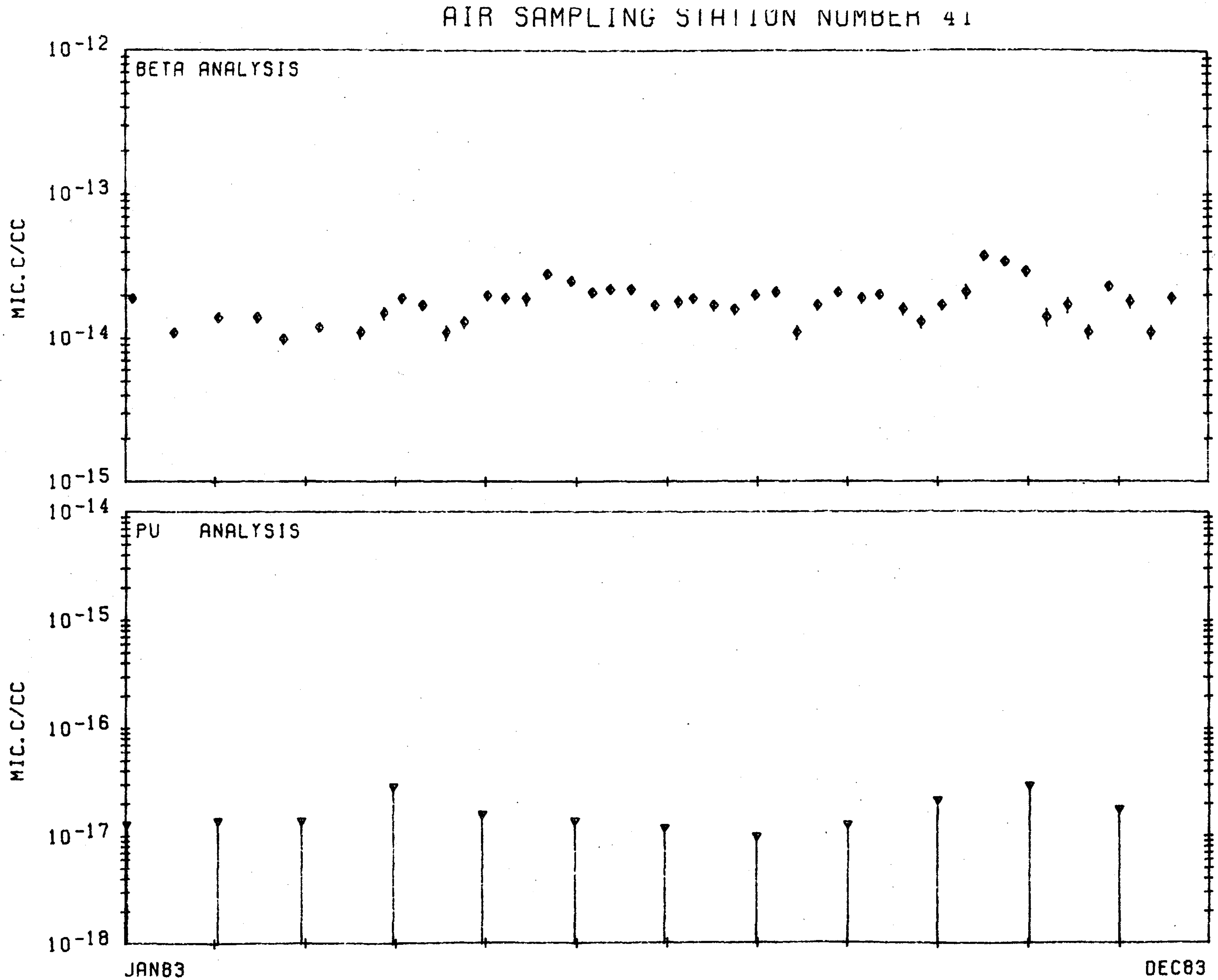
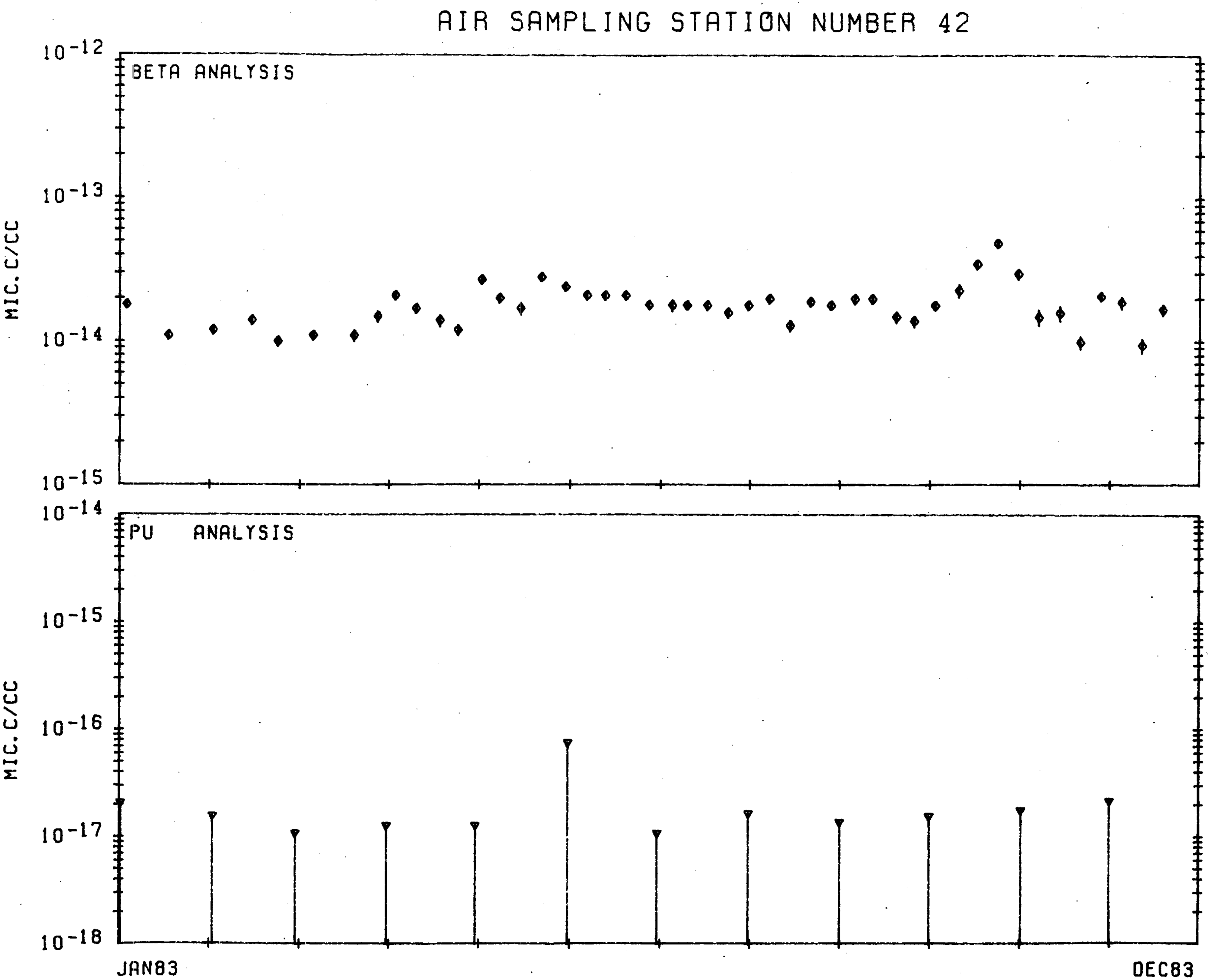
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

AIR SAMPLING STATION NUMBER 40

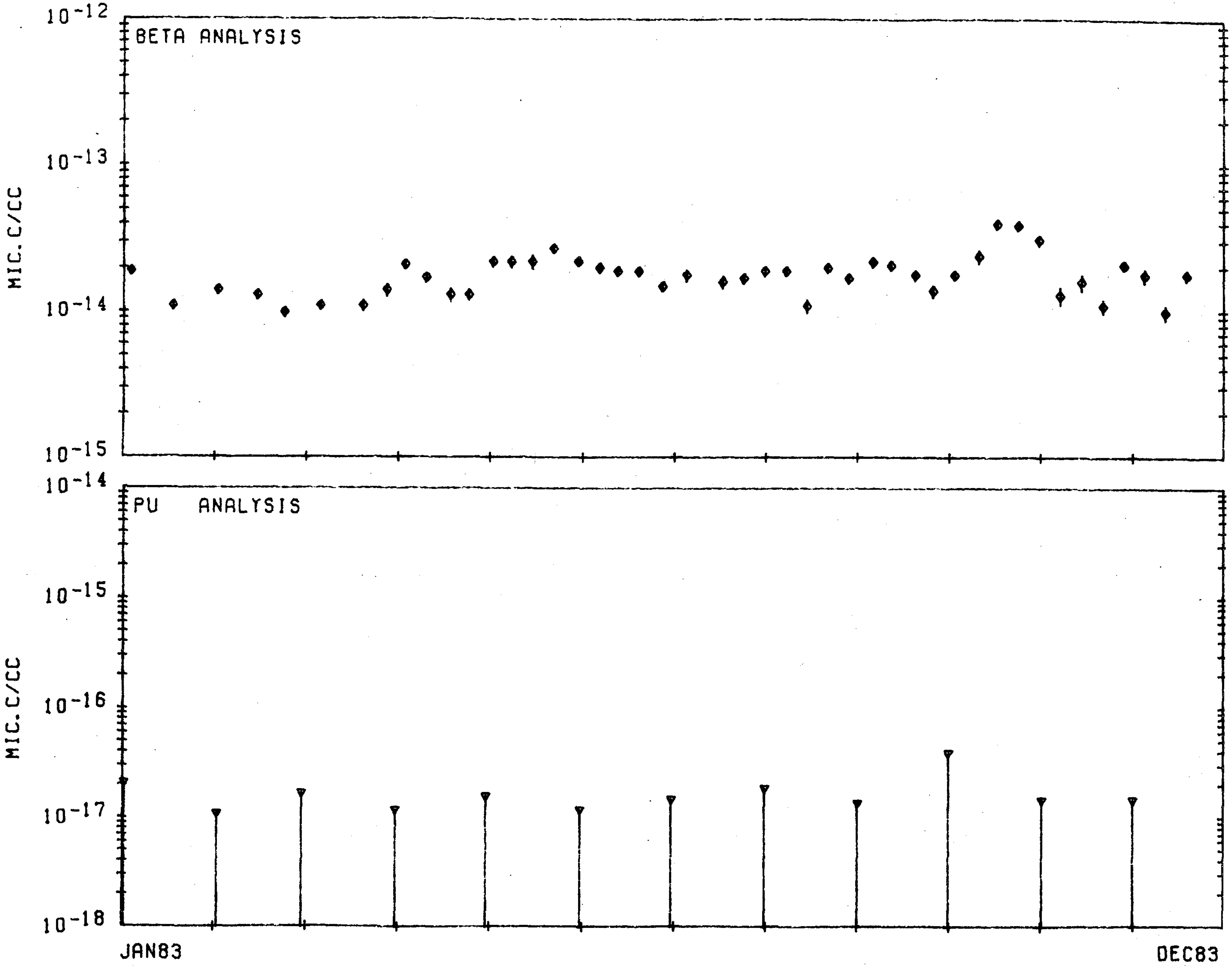



AIR SAMPLING STATION NUMBER 41
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN83
DEC83

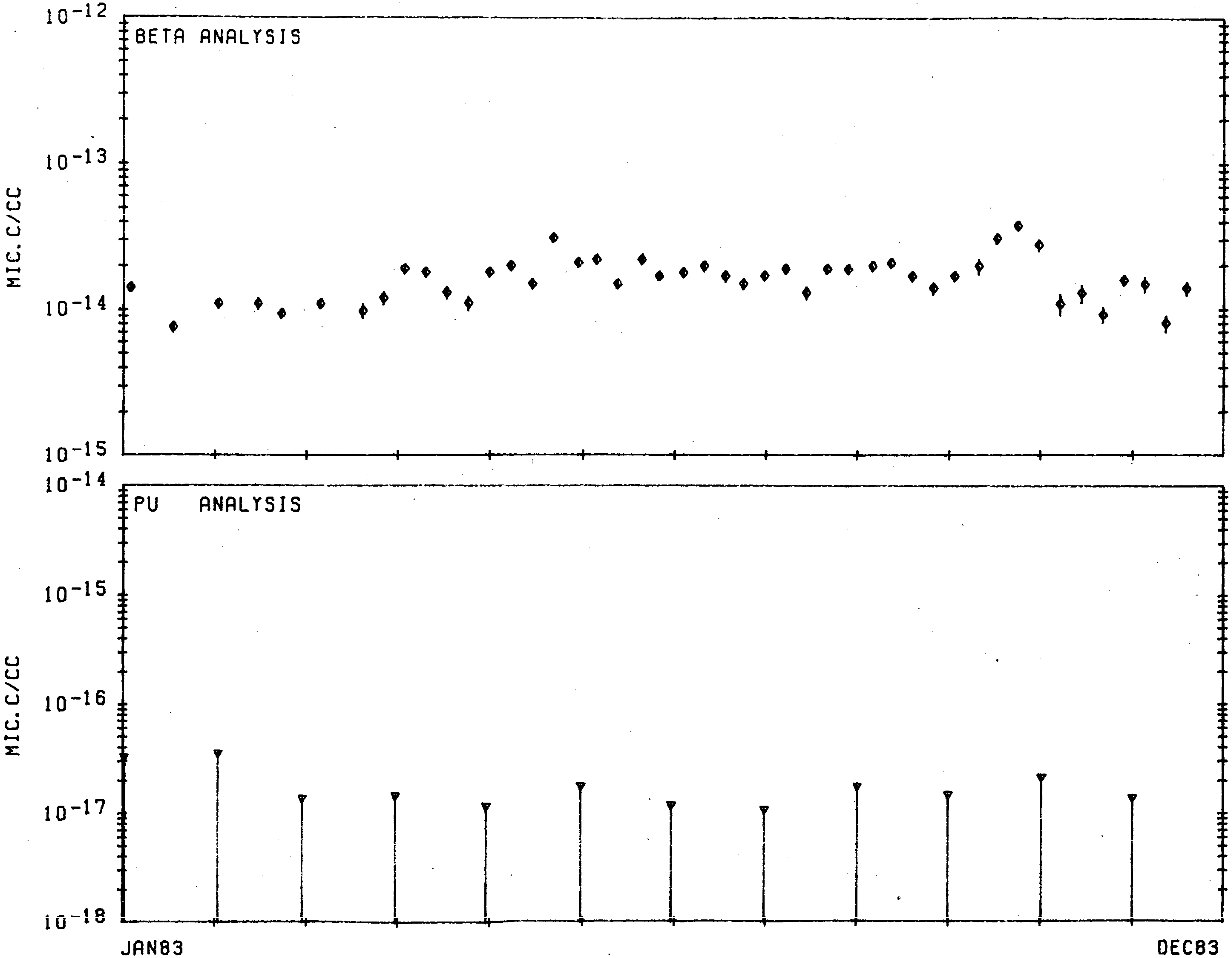
122


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}
JAN83
DEC83

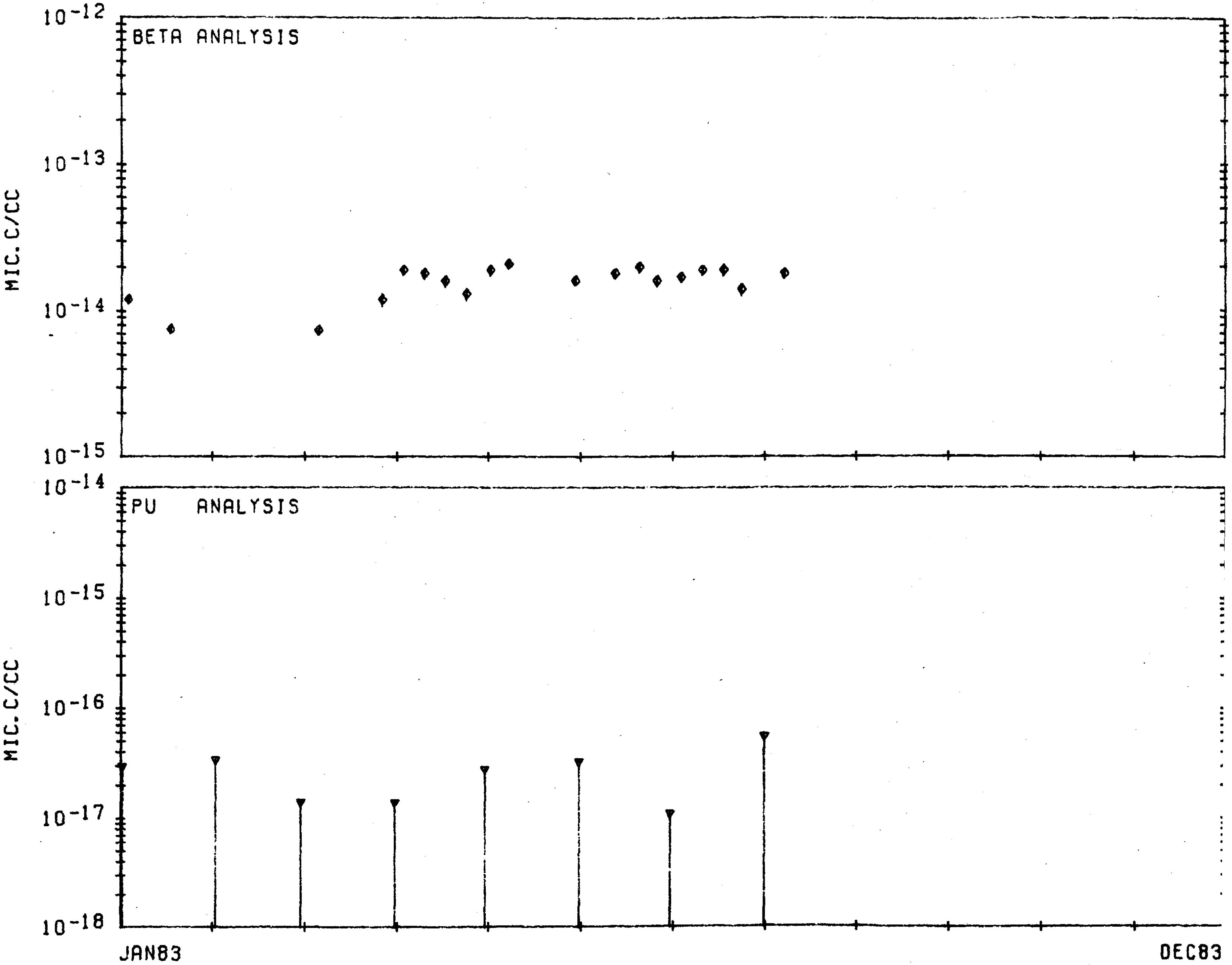
AIR SAMPLING STATION NUMBER 43



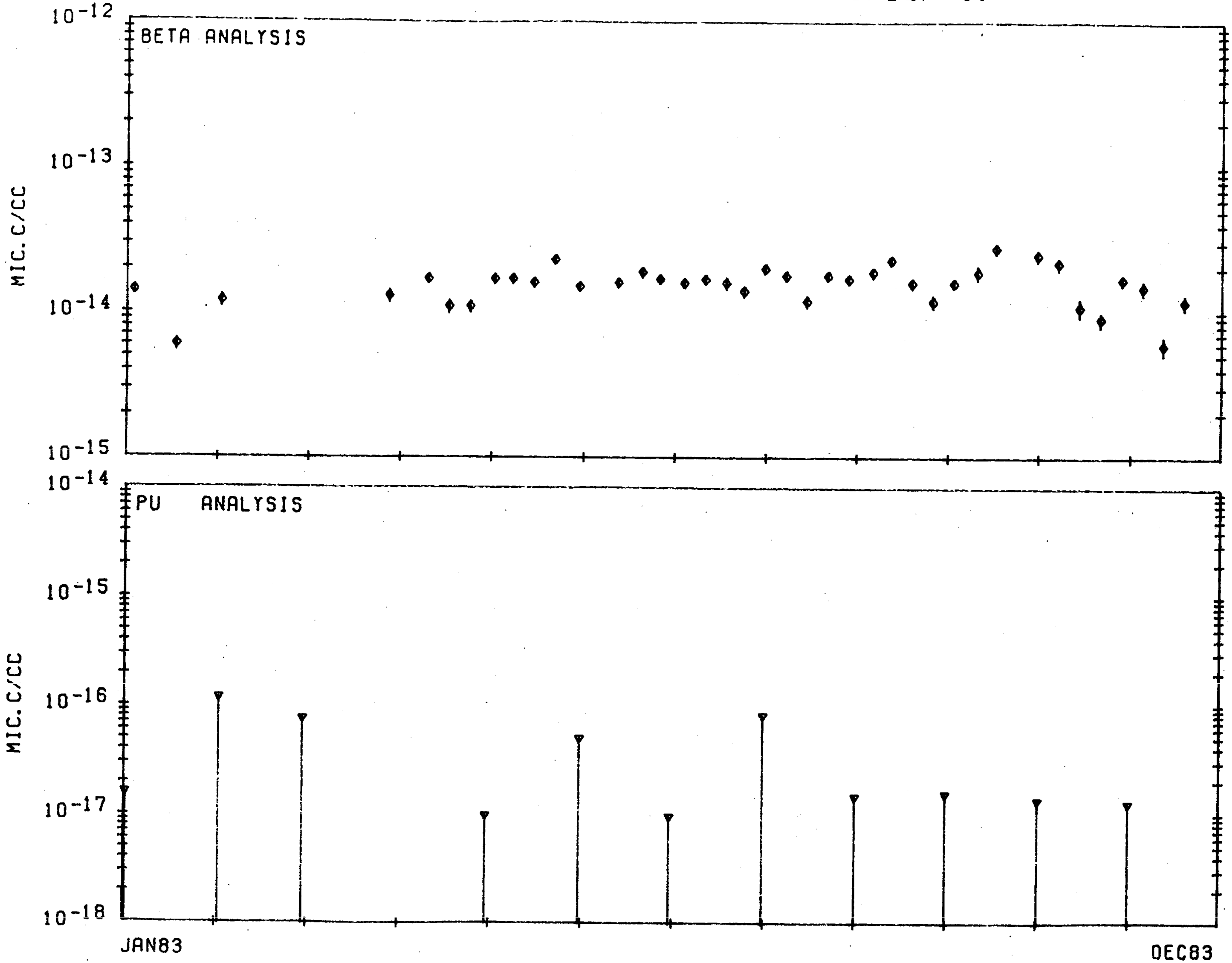
AIR SAMPLING STATION NUMBER 44



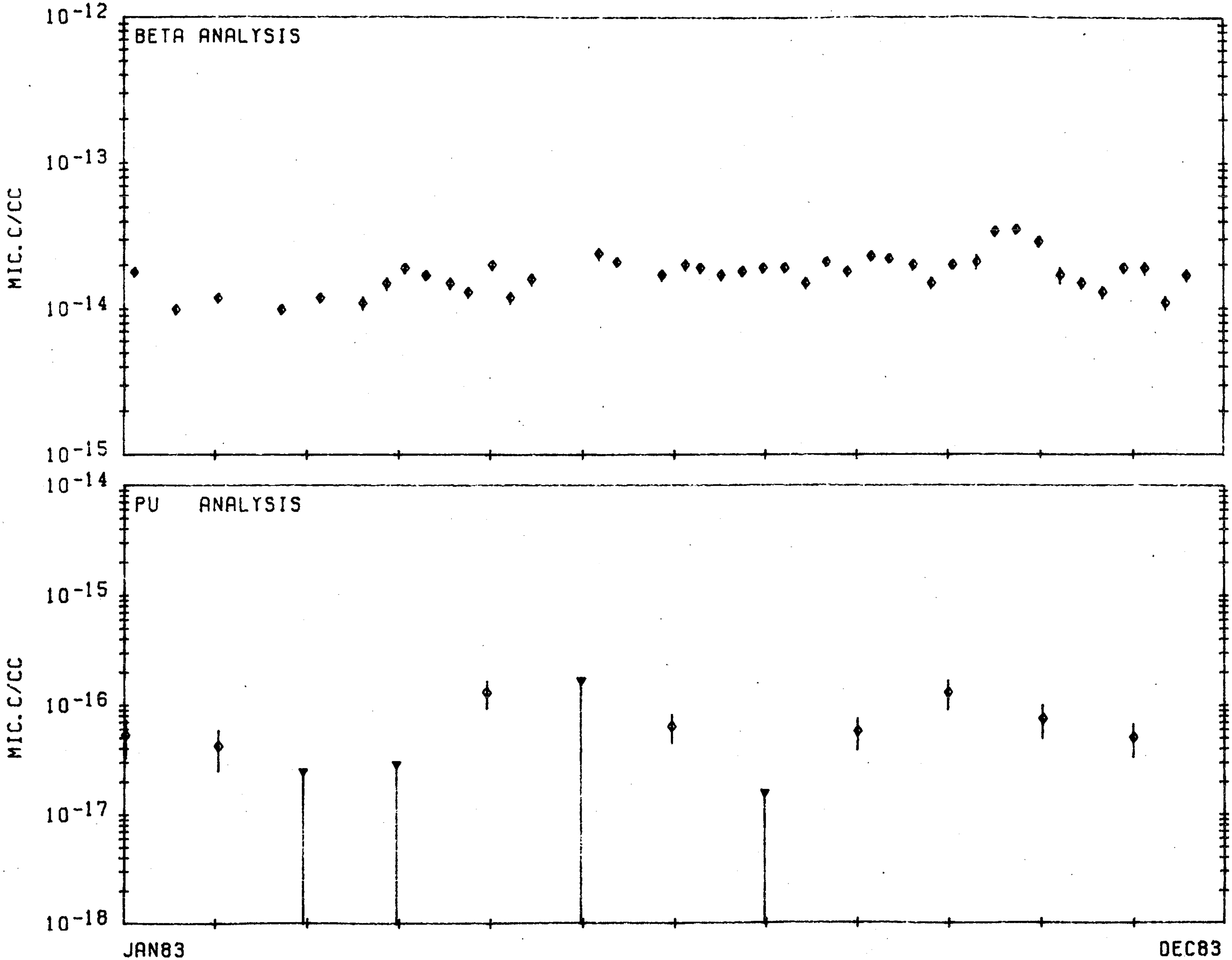
AIR SAMPLING STATION NUMBER 45

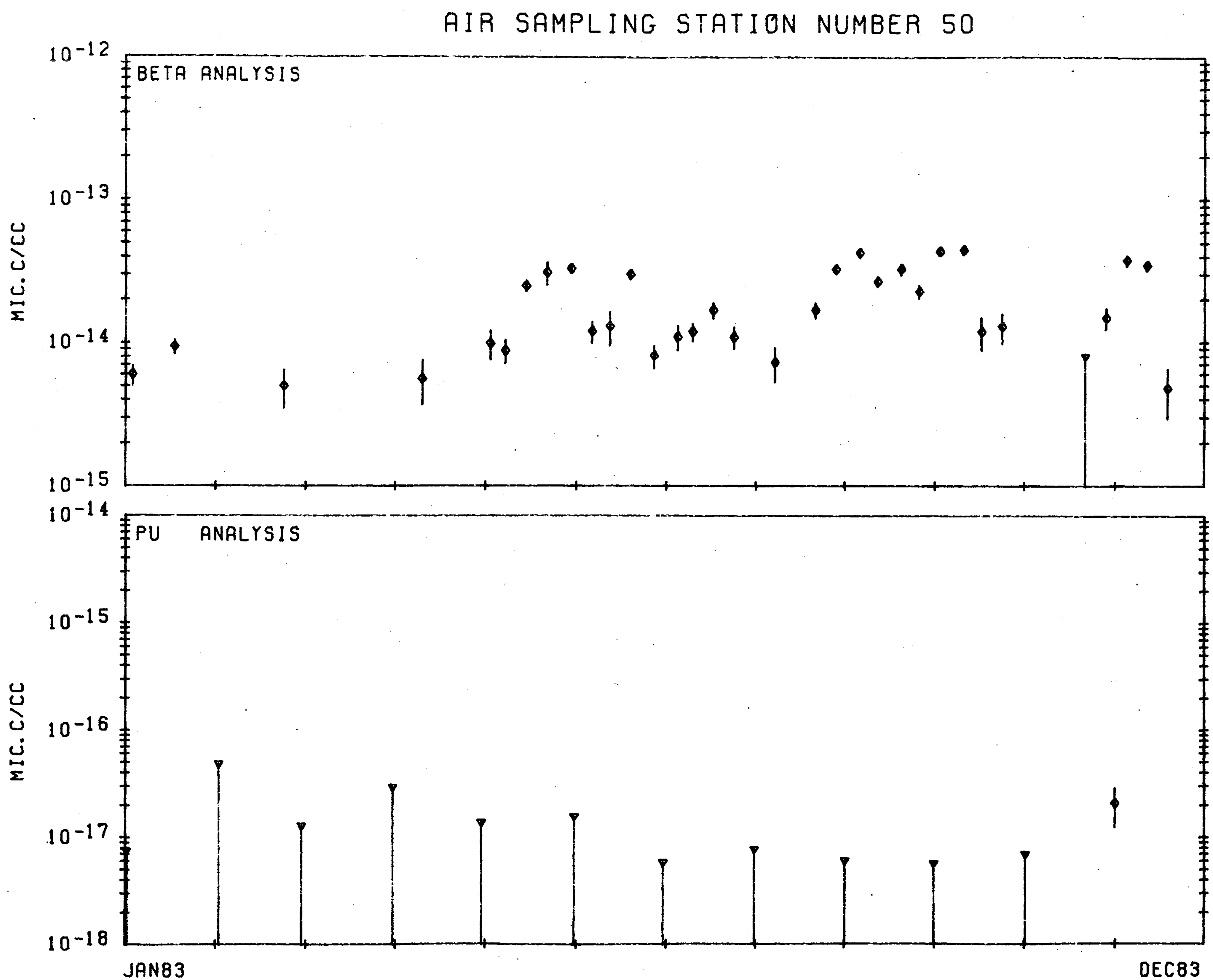


AIR SAMPLING STATION NUMBER 46



AIR SAMPLING STATION NUMBER 47




AIR SAMPLING STATION NUMBER 50
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}
JAN83
DEC83

A P P E N D I X B

NTS Environmental Surveillance

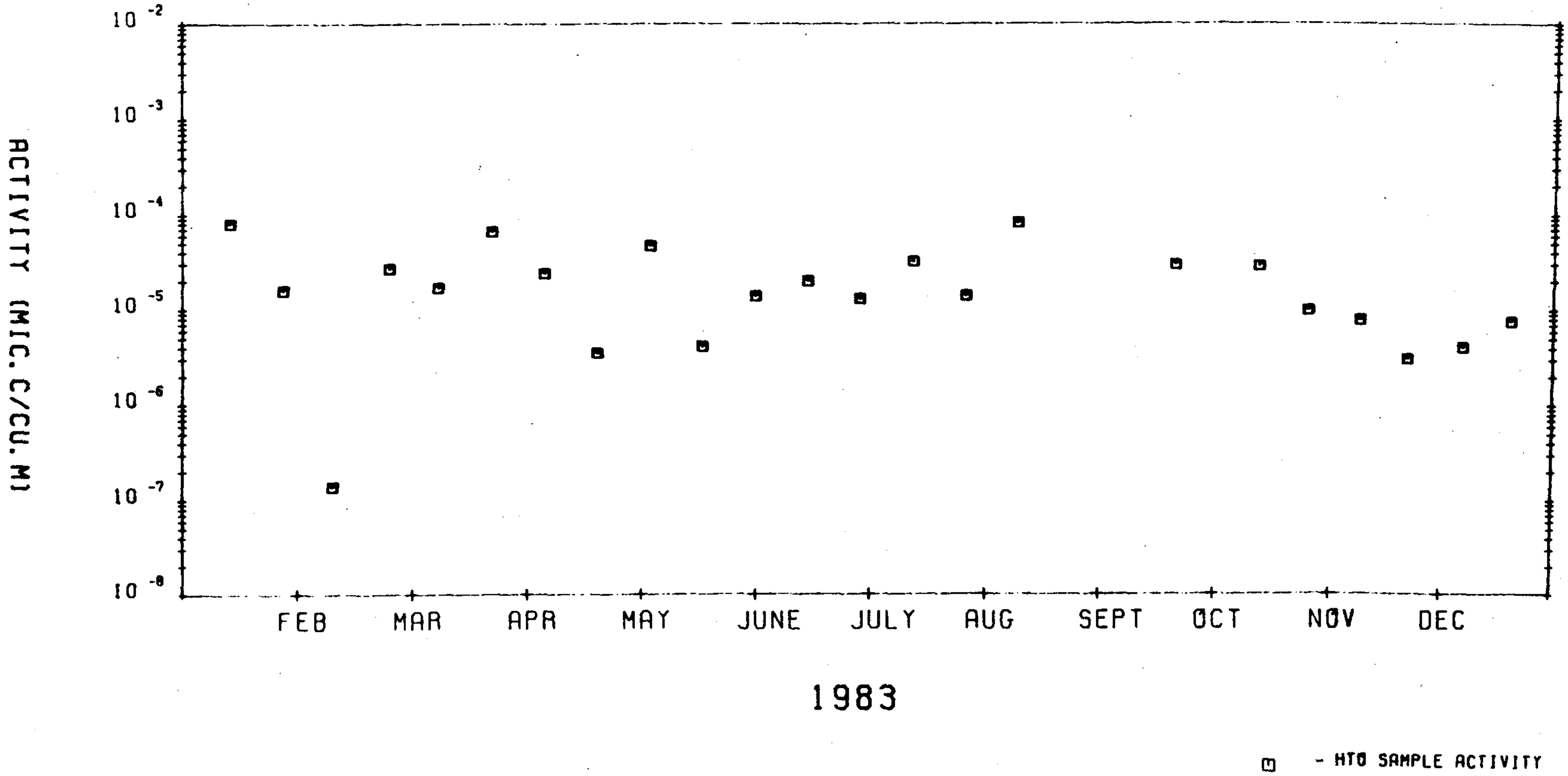
Tritium in Air Sampling Locations and Plots

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

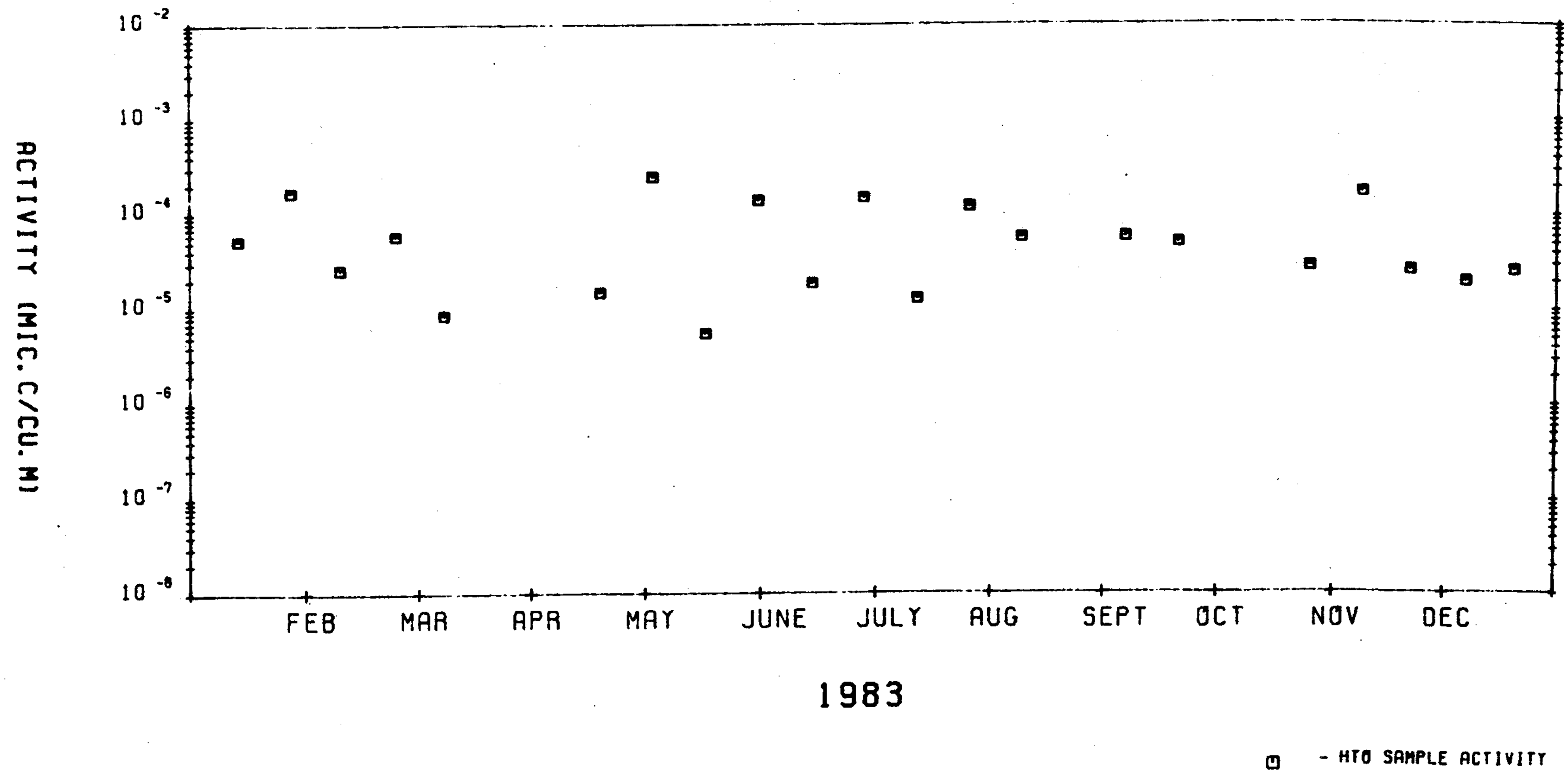
Area	Location
1	BJY
5	RWMS - 1
5	RWMS - SE
5	RWMS - (SE-NE)
5	RWMS - NE
5	RWMS - (NE-NW)
5	RWMS - NW
5	RWMS - (NW-SW)
5	RWMS - SW
5	RWMS - (SW-SE)
12	Base Camp
15	EPA Farm
15	Gate 700
23	Bldg. 790
23	Bldg. 650
23	Site Boundary
25	EMAD

BJY, AREA 1

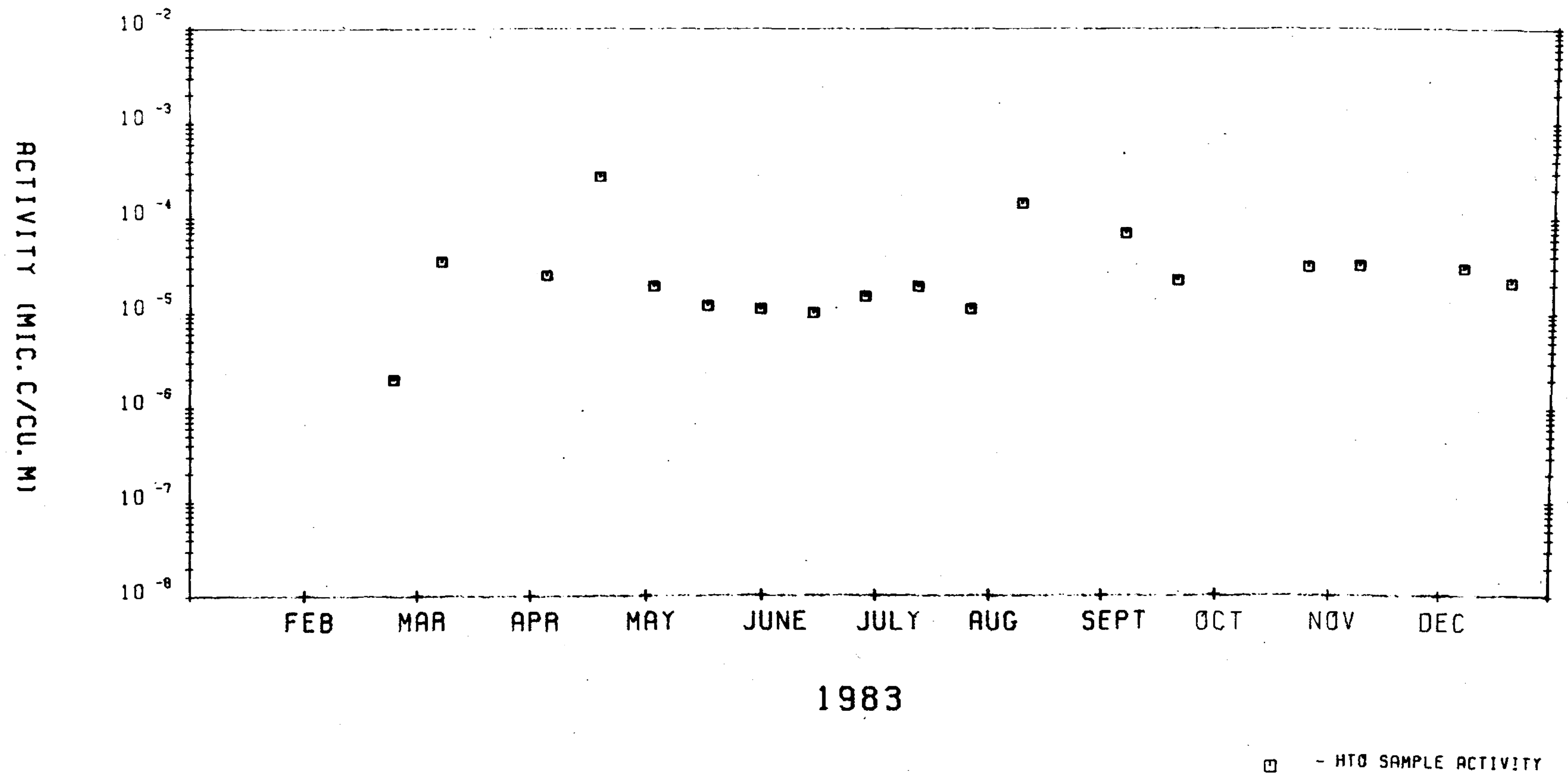


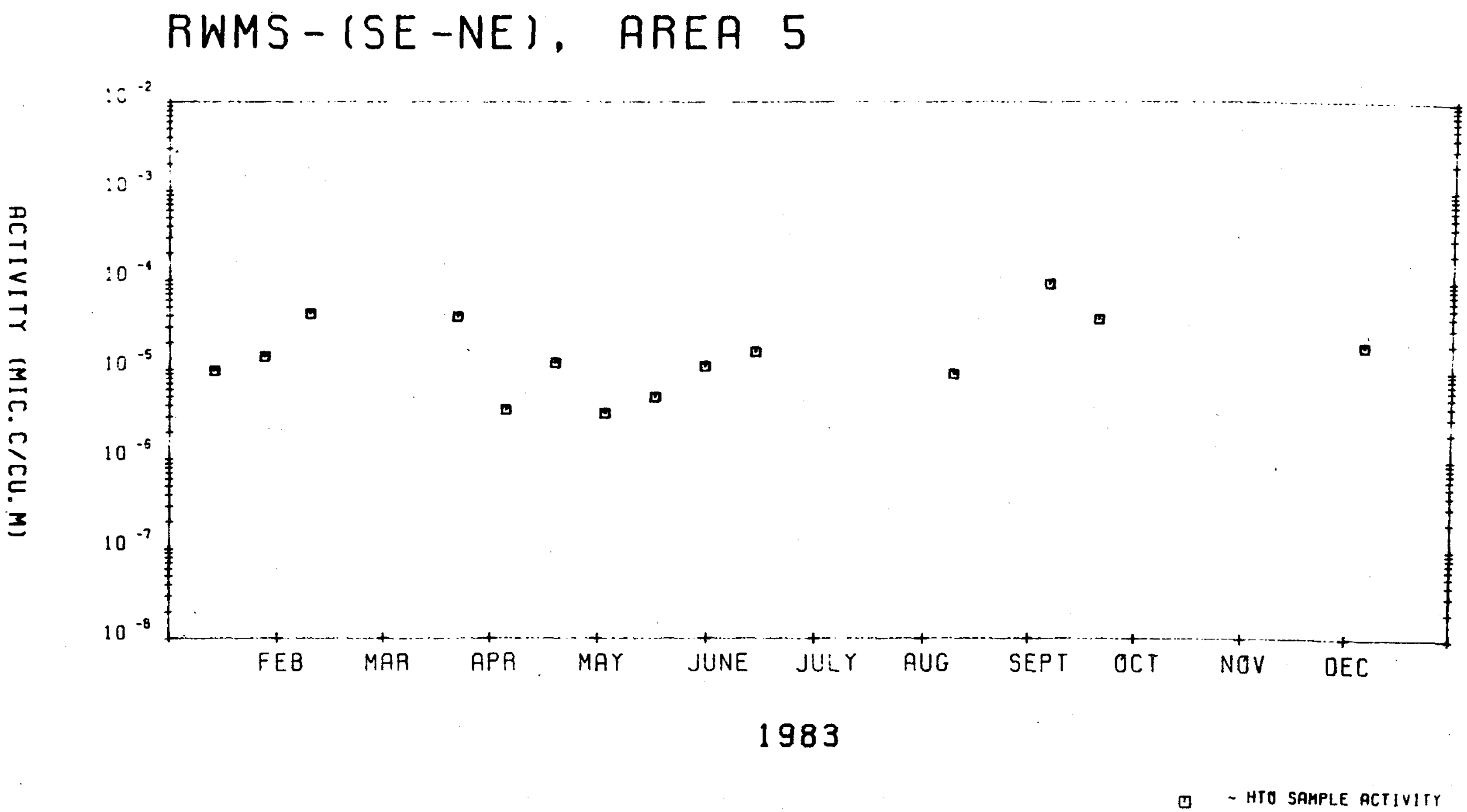
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
ACTIVITY (MIC.C/CU.M)
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1983
- HTO SAMPLE ACTIVITY

RWMS-1, AREA 5

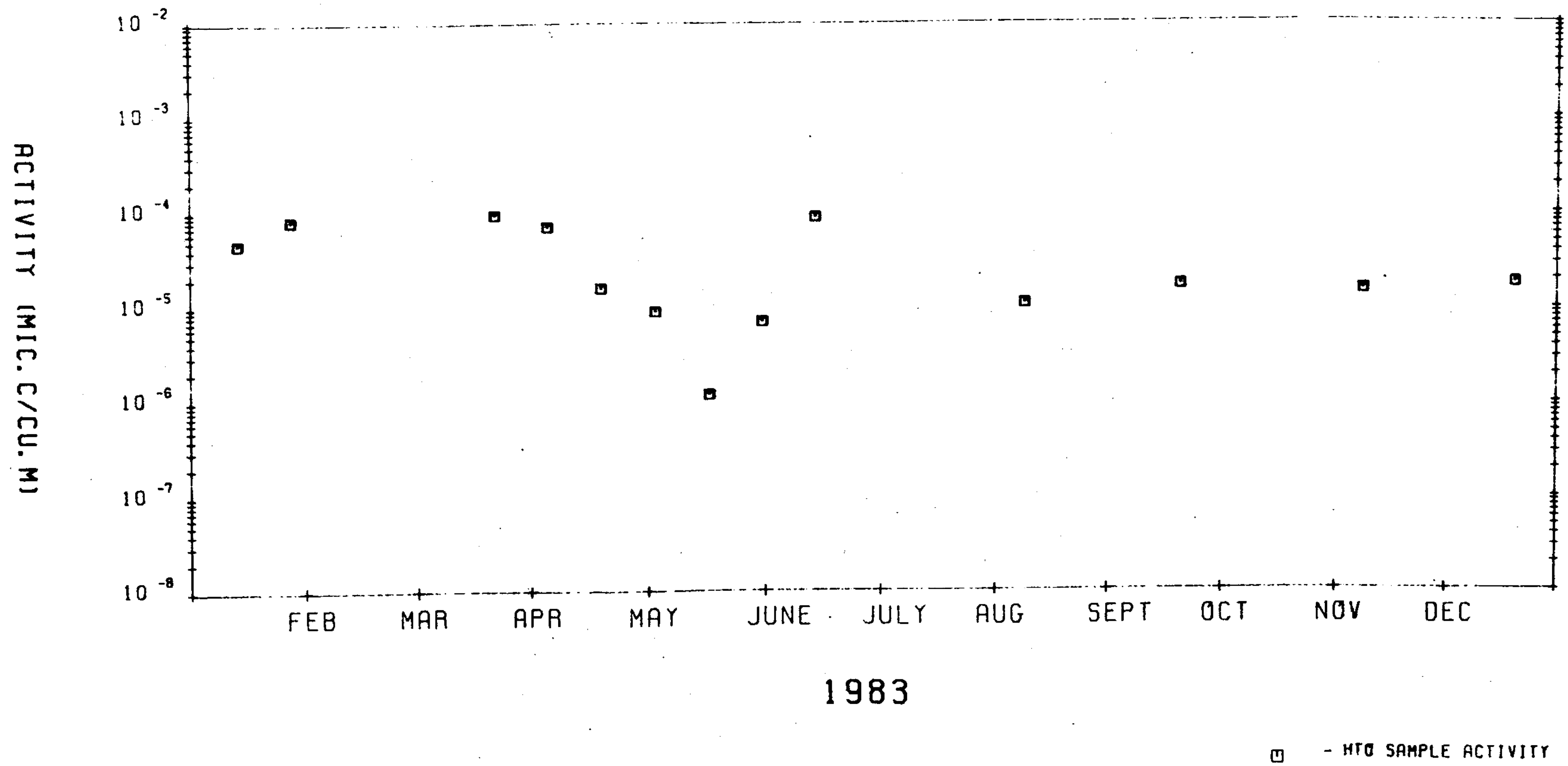

ACTIVITY (MIC.C/CU.M)
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1983
- HTO SAMPLE ACTIVITY

RWMS-SE, AREA 5

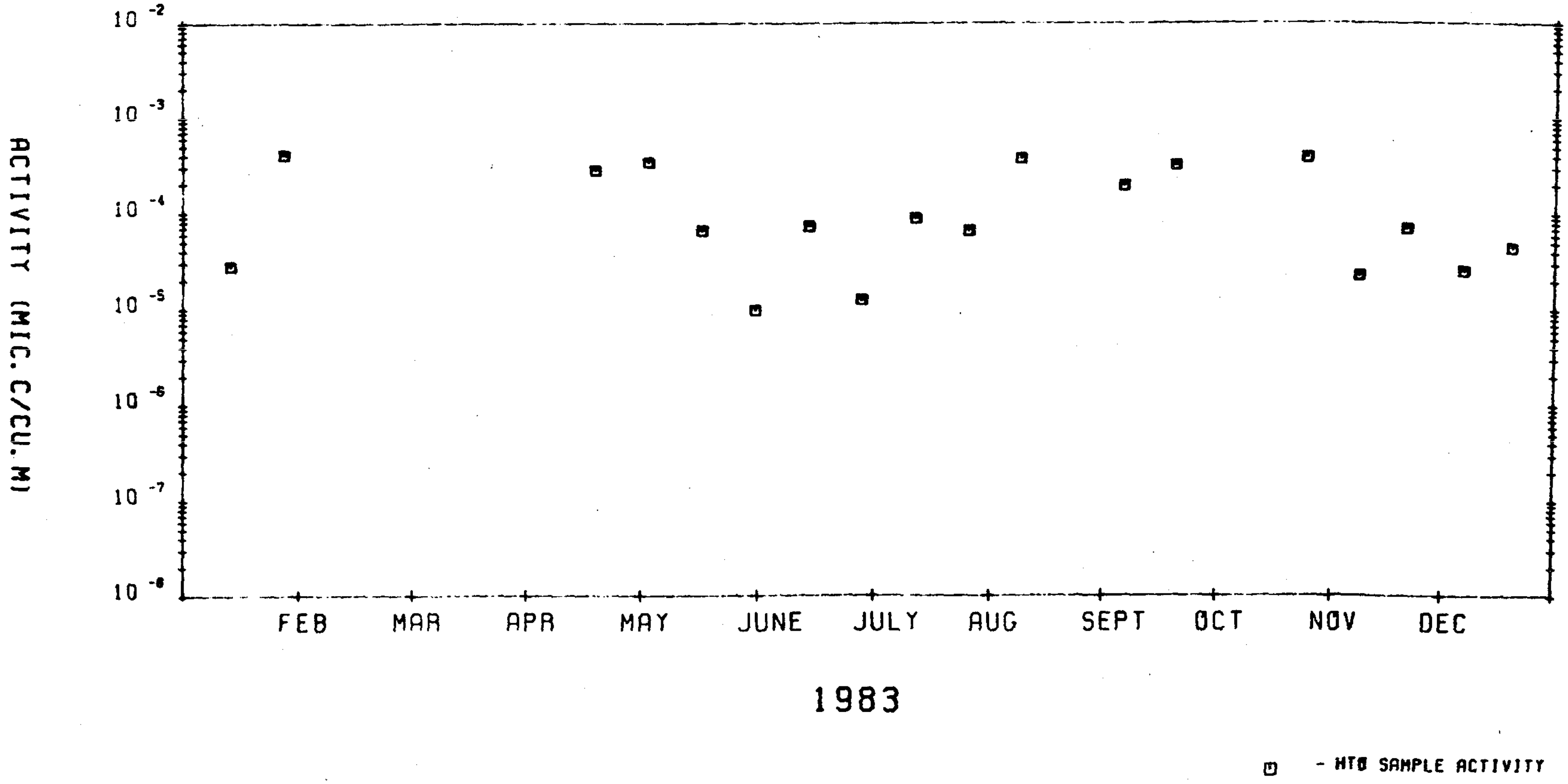



RWMS-(SE-NE), AREA 5
ACTIVITY (MIC.C/CU.M)
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1983
~ HTO SAMPLE ACTIVITY

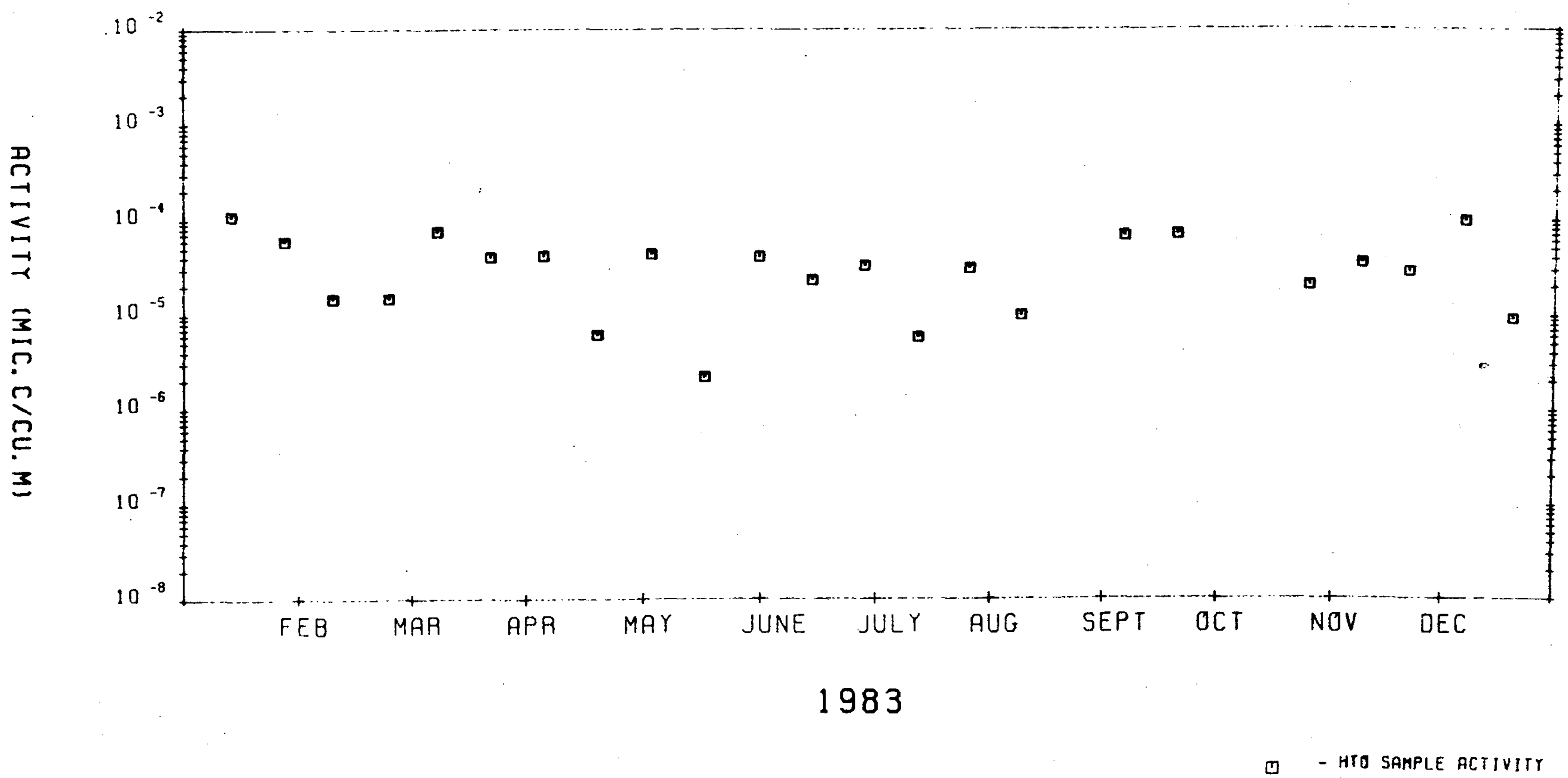
RWMS-NE, AREA 5

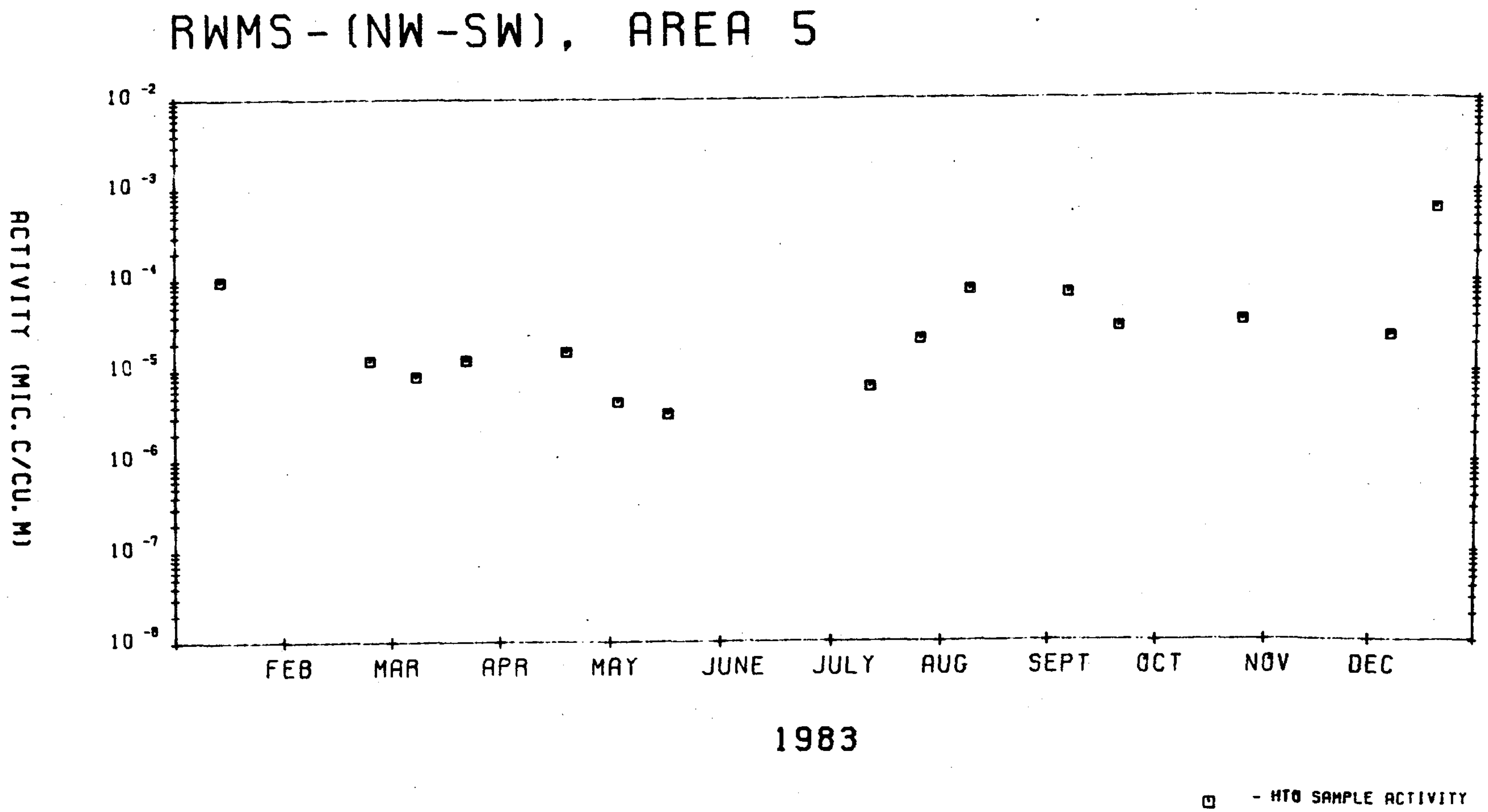


RWMS-(NE-NW), AREA 5

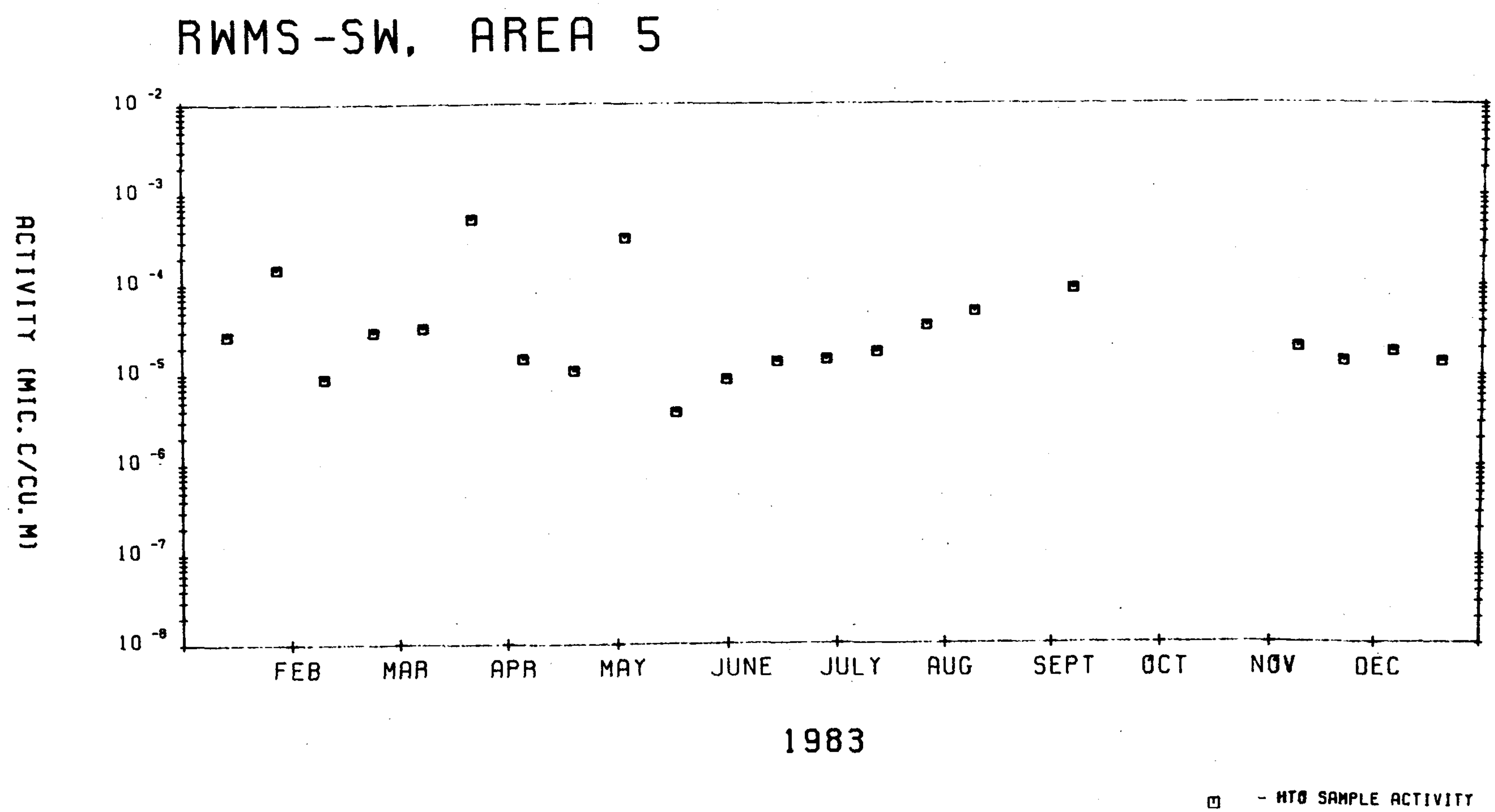


RWMS-NW, AREA 5

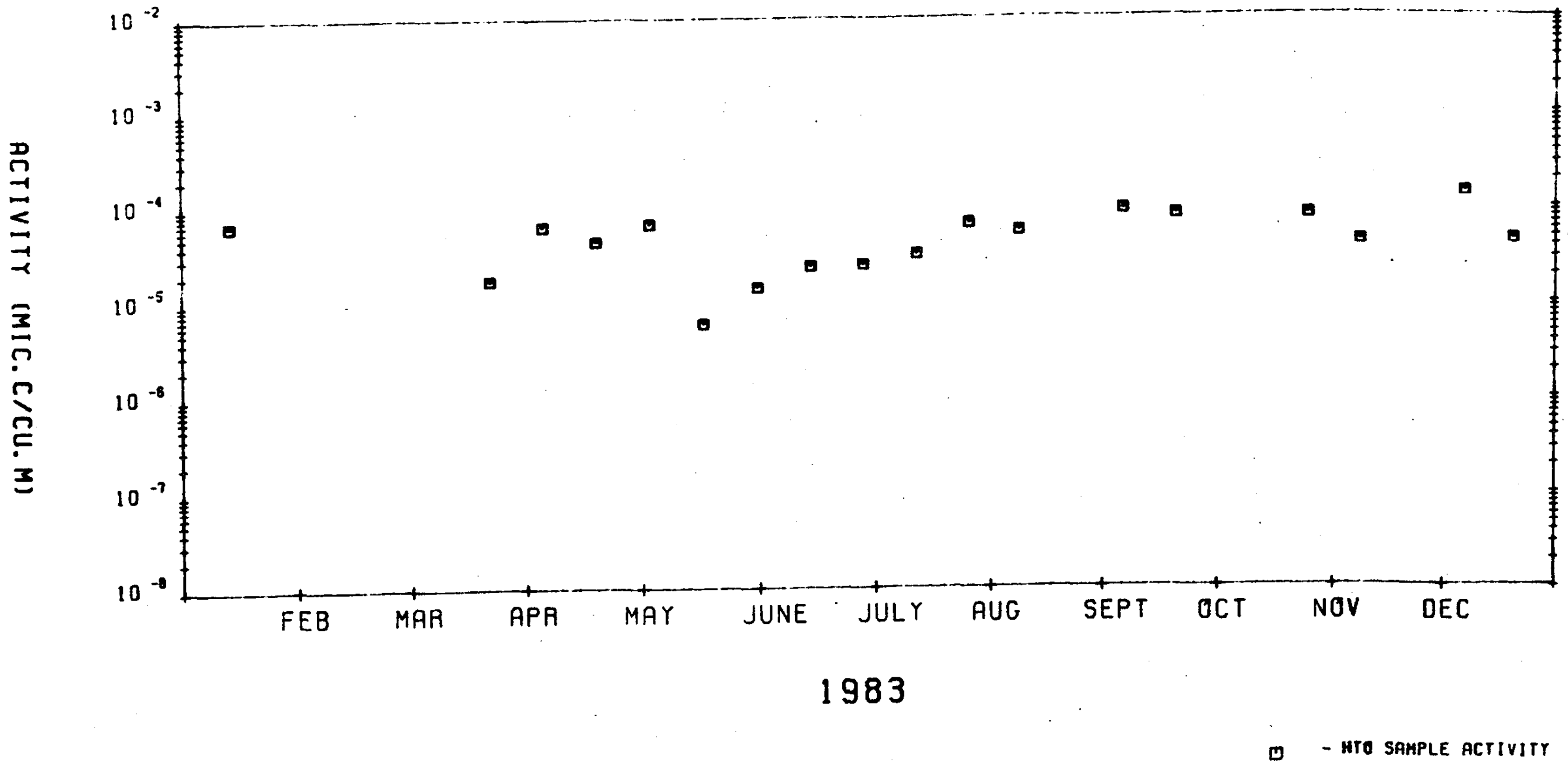




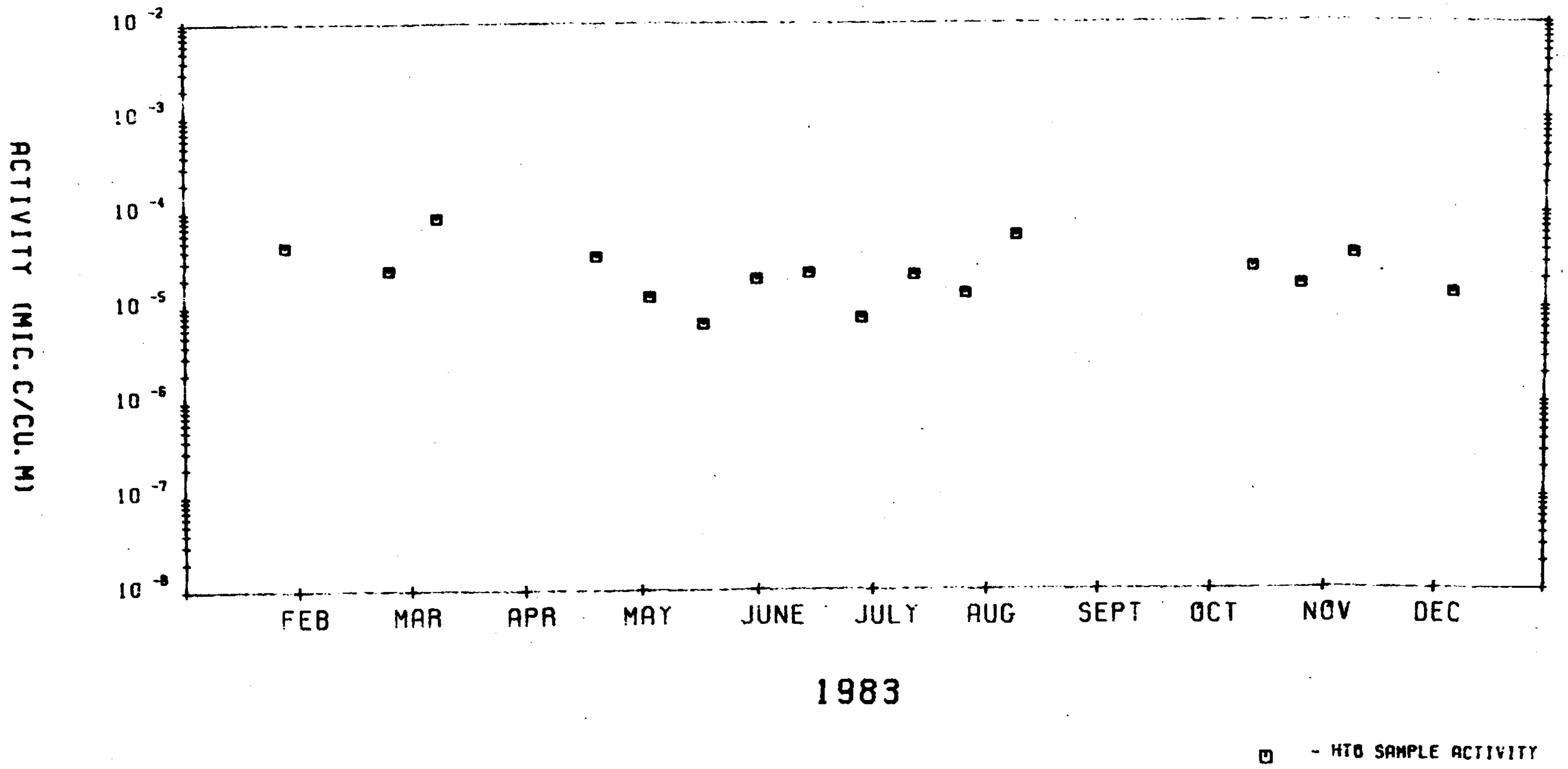
RWMS-(NW-SW), AREA 5
ACTIVITY (MIC.C/CU.M)
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1983
- HTO SAMPLE ACTIVITY


RWMS-SW, AREA 5
ACTIVITY (MIC.C/CU.M)
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1983
- HTO SAMPLE ACTIVITY

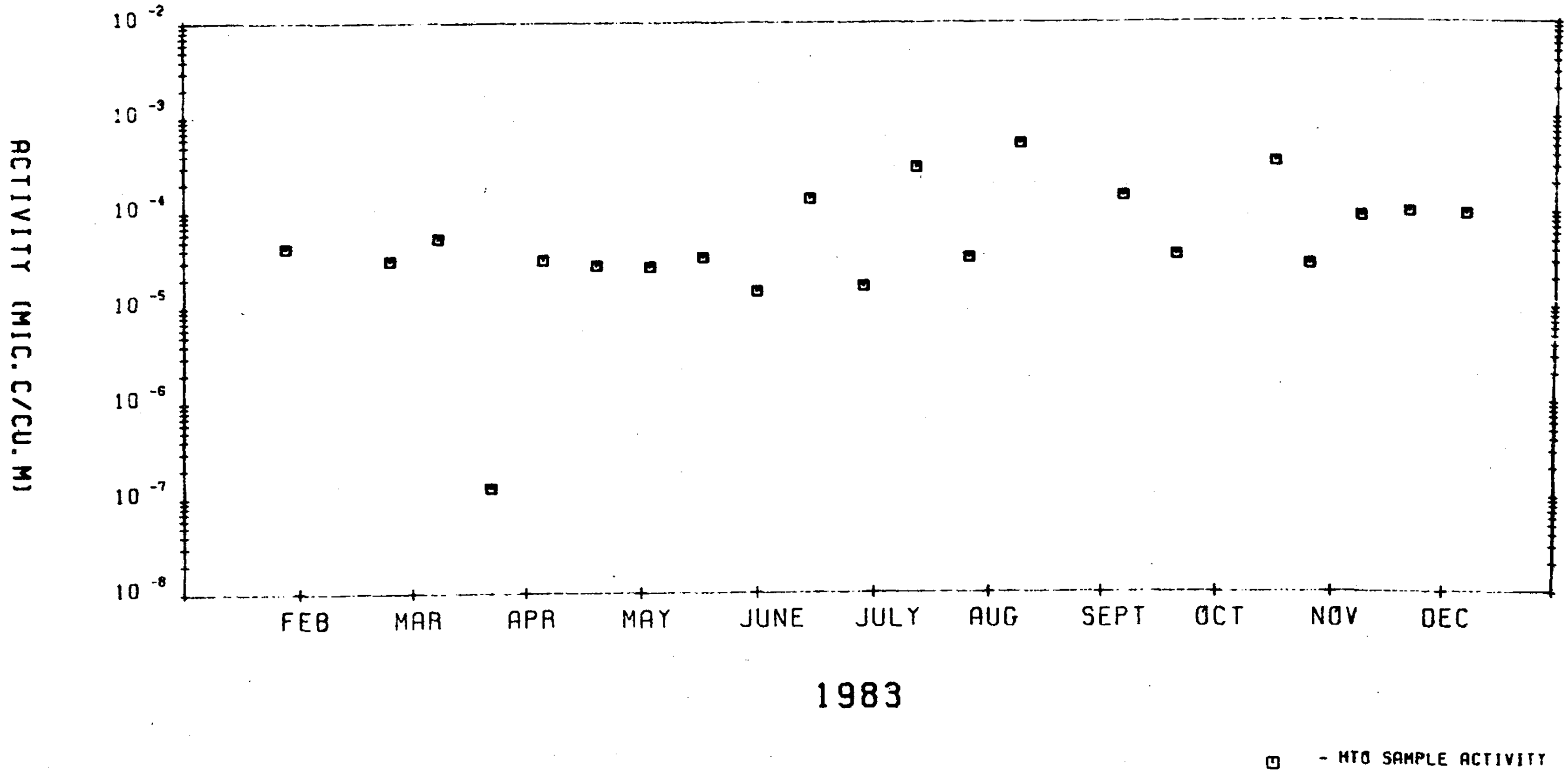
RWMS-(SW-SE), AREA 5



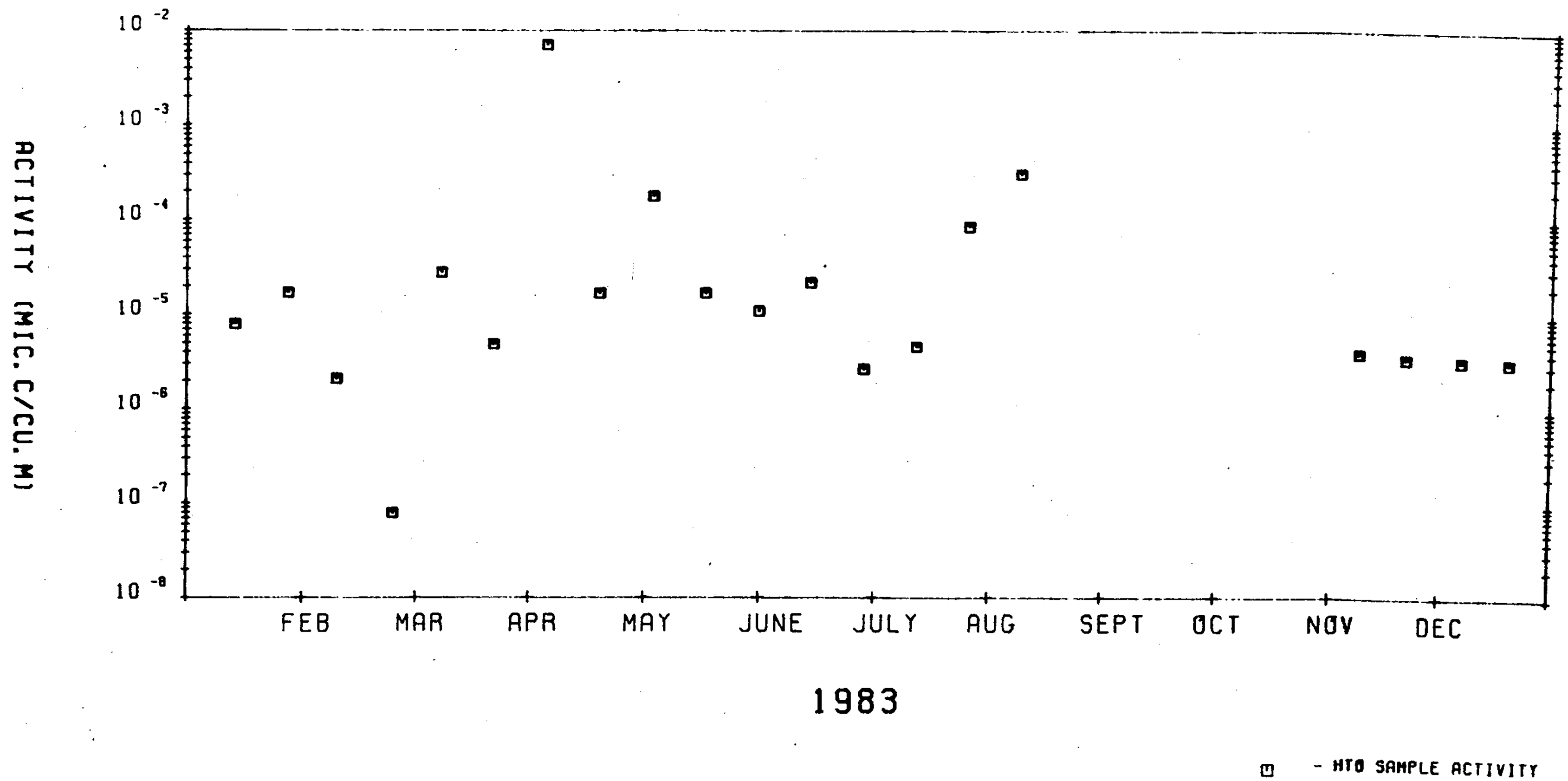
BASE CAMP, AREA 12



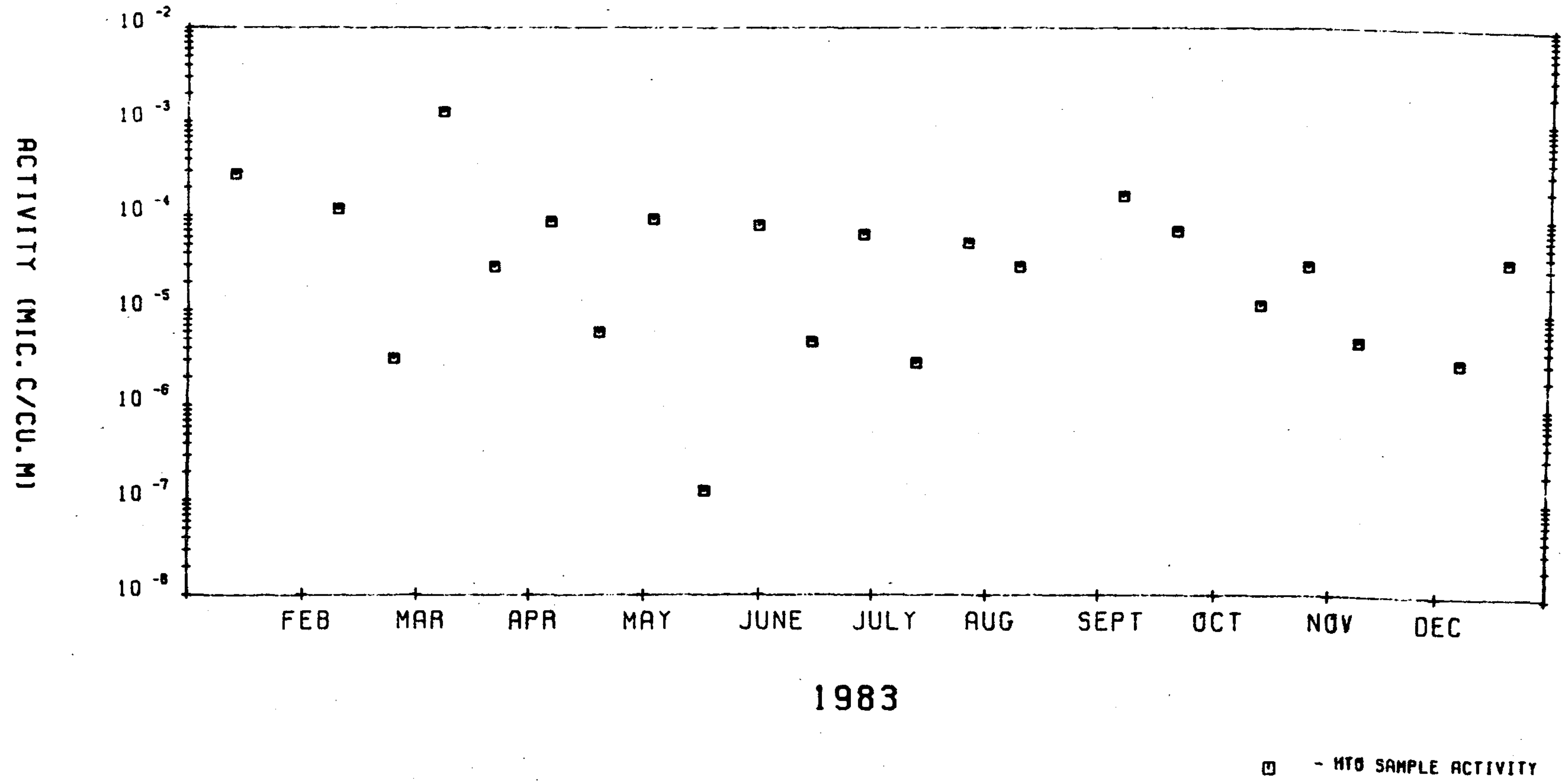
EPA FARM, AREA 15



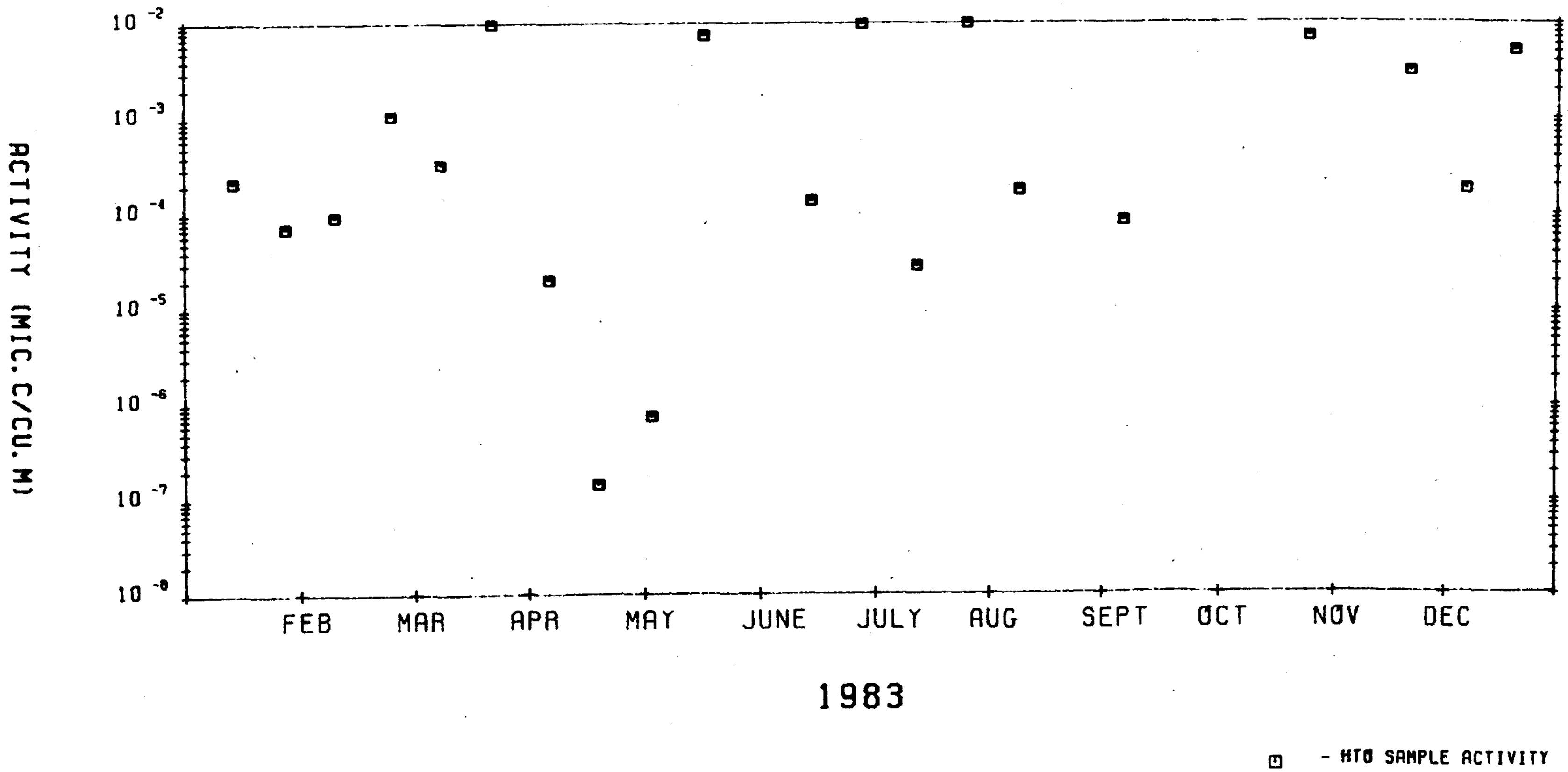
GATE 700


ACTIVITY (MIC.C/CU.M)
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1983
- HTO SAMPLE ACTIVITY

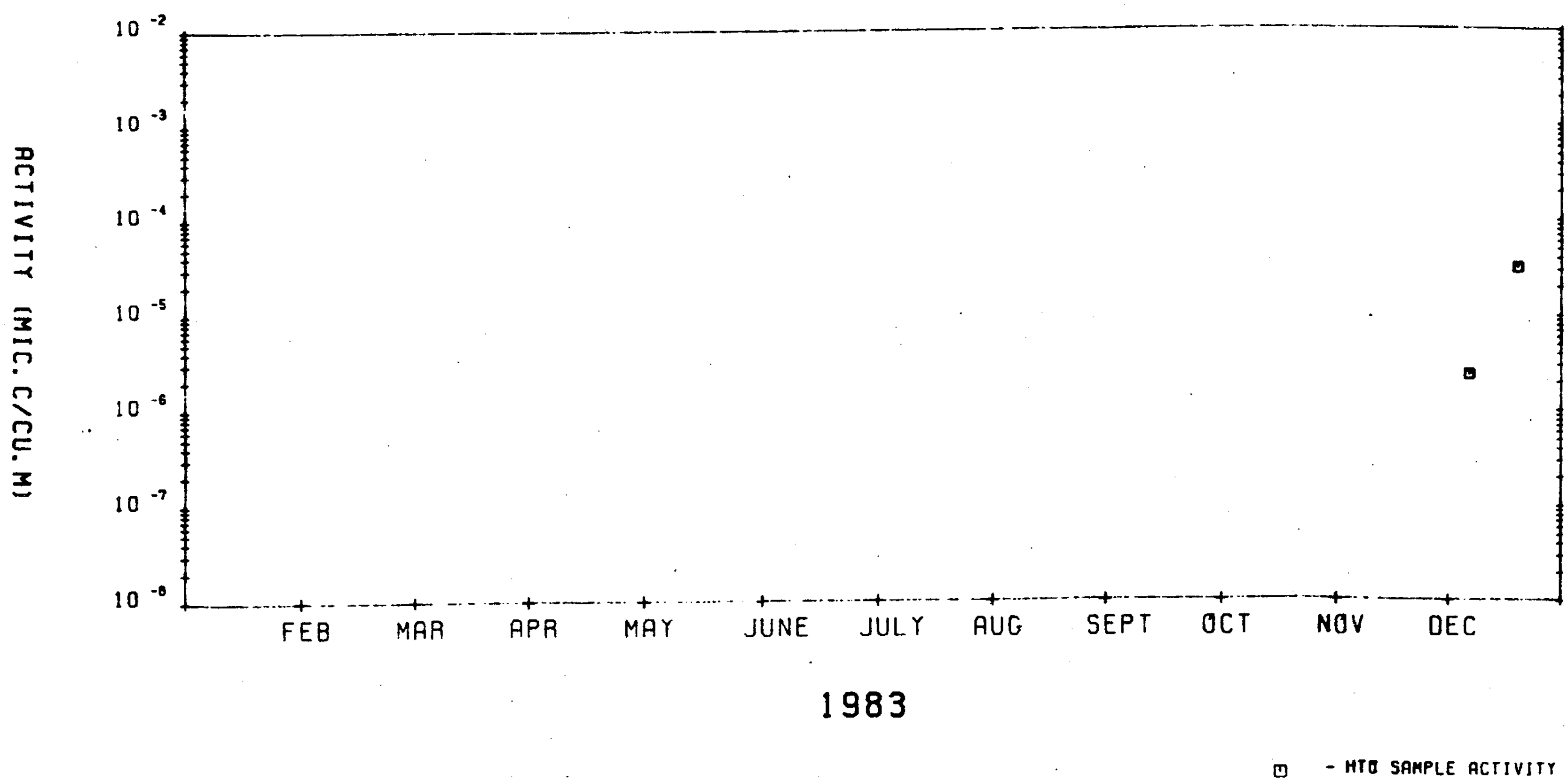
BLDG 790, AREA 23



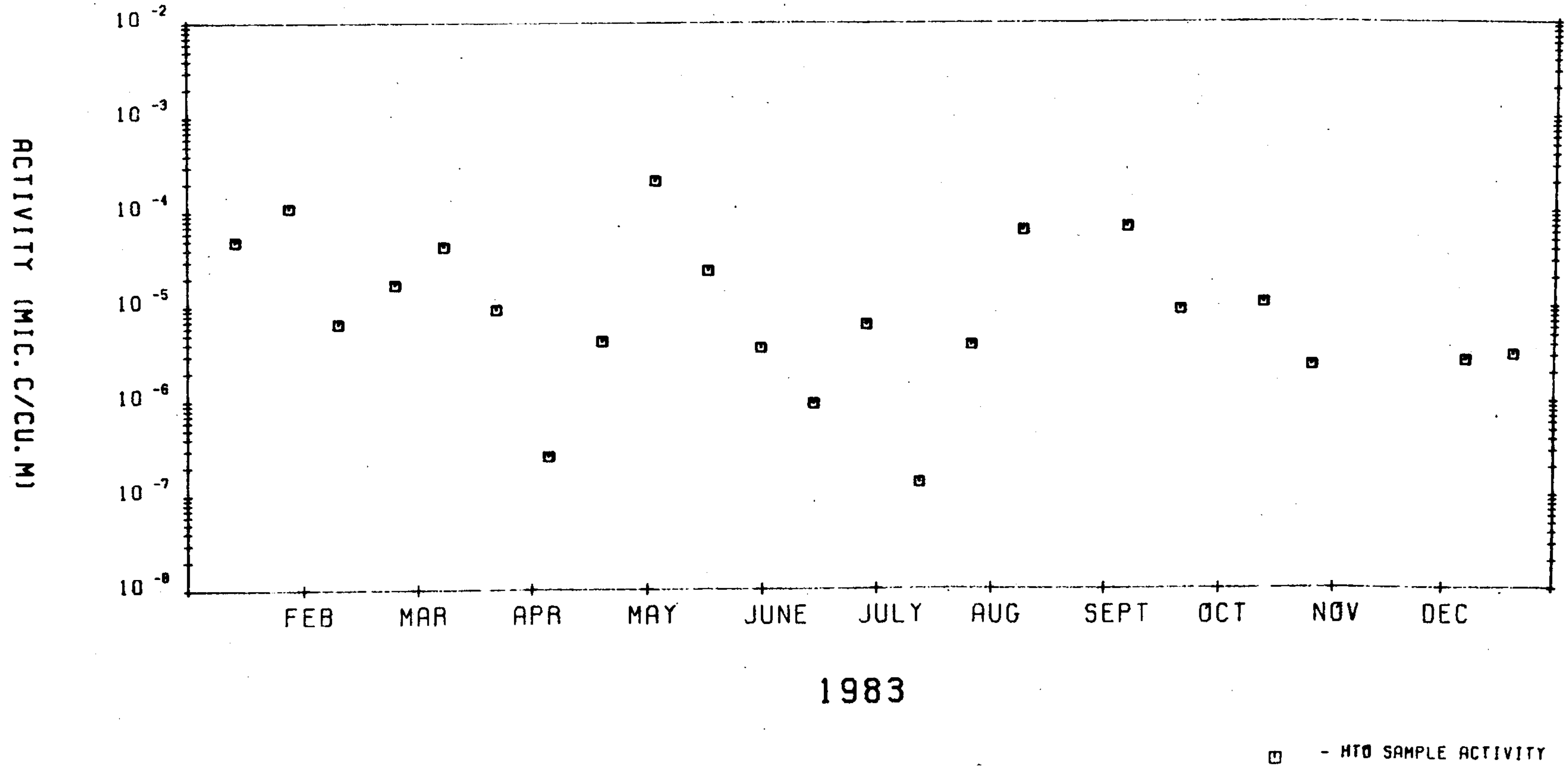
BLDG 650, AREA 23



SITE BOUNDARY, AREA 23



EMAD, AREA 25


10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
ACTIVITY (MIC.C/CU.M)
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1983
- HTO SAMPLE ACTIVITY

A P P E N D I X C

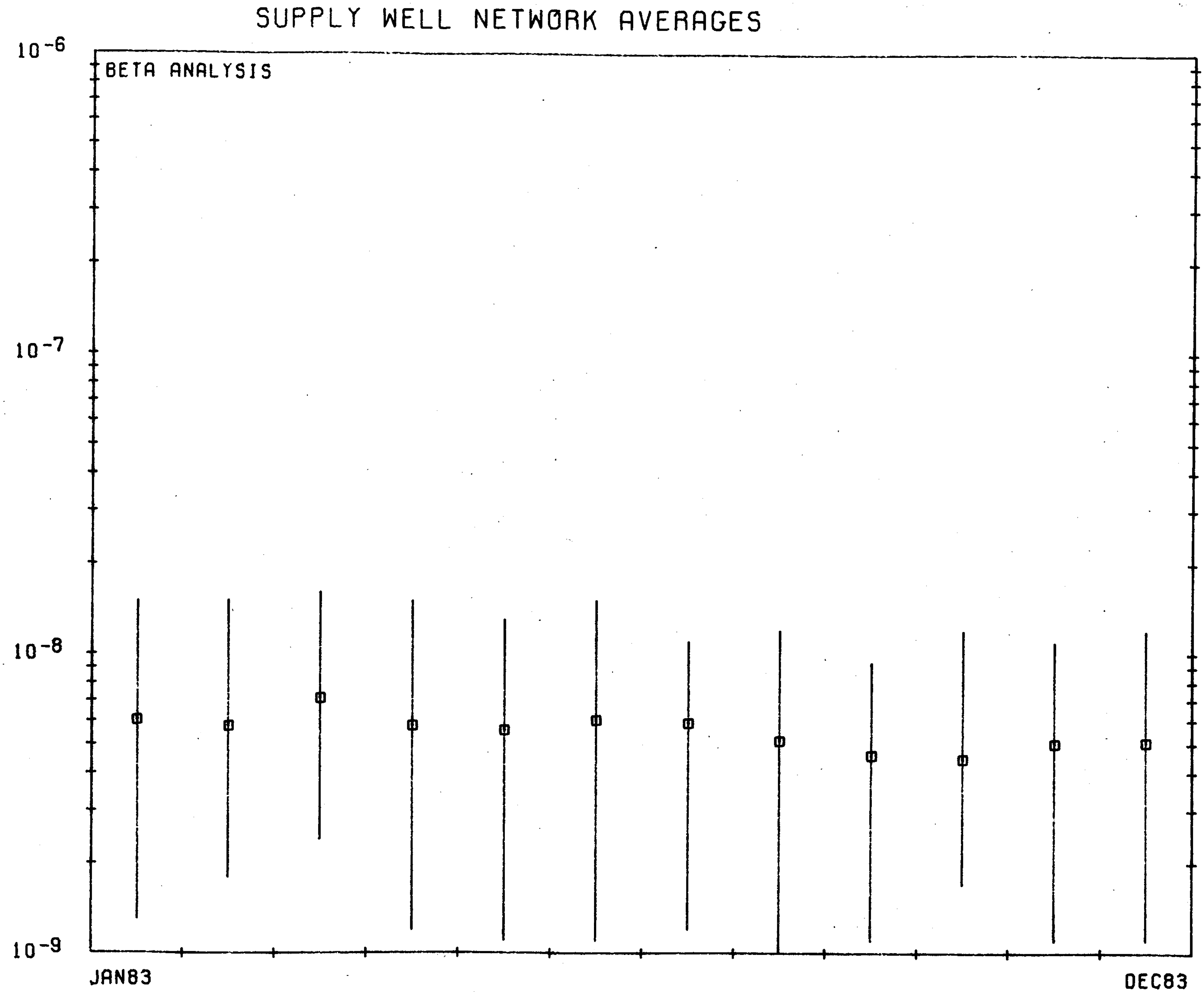
NTS Environmental Surveillance
Supply Well Locations and Plots

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.

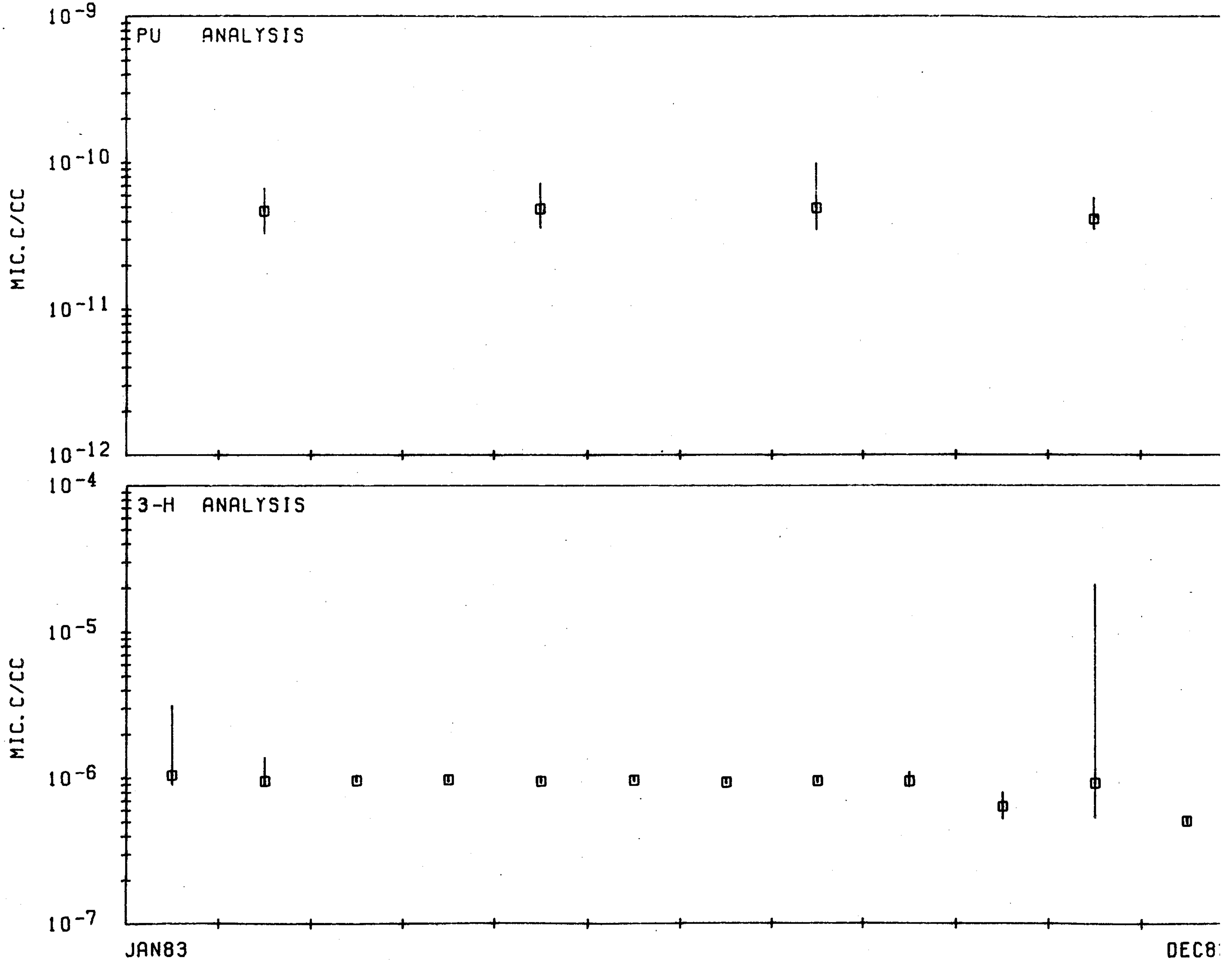
NTS ENVIRONMENTAL SURVEILLANCE
SUPPLY WELLS SAMPLING LOCATIONS

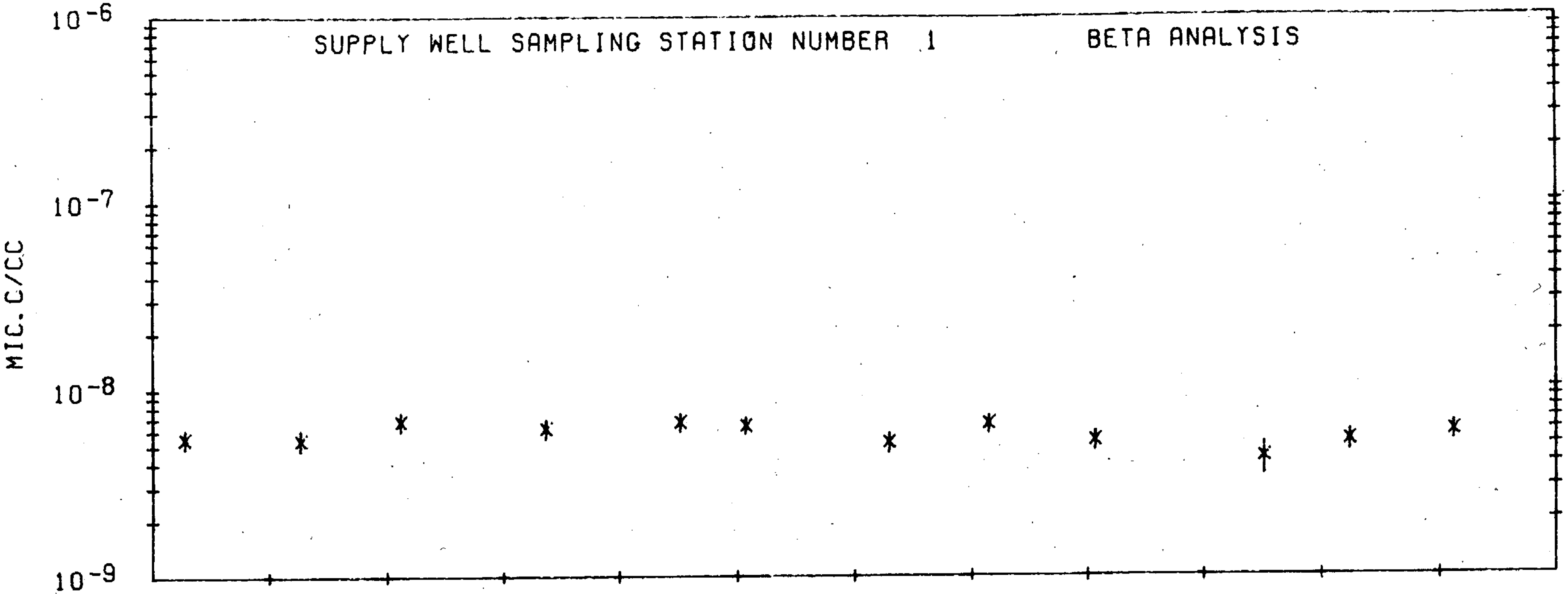
Station Number	Location
1	Area 2 Well 2
2	Area 3 Well A
3	Area 5 Well 5B
4	Area 5 Well 5C
5	Area 5 Well Ue5c
6	Area 6 Well C
7	Area 6 Well C1
9	Area 18 Well 8
13	Area 22 Army Well #1
14	Area 25 Well J12
15	Area 25 Well J13
18	Area 19 Well U19c



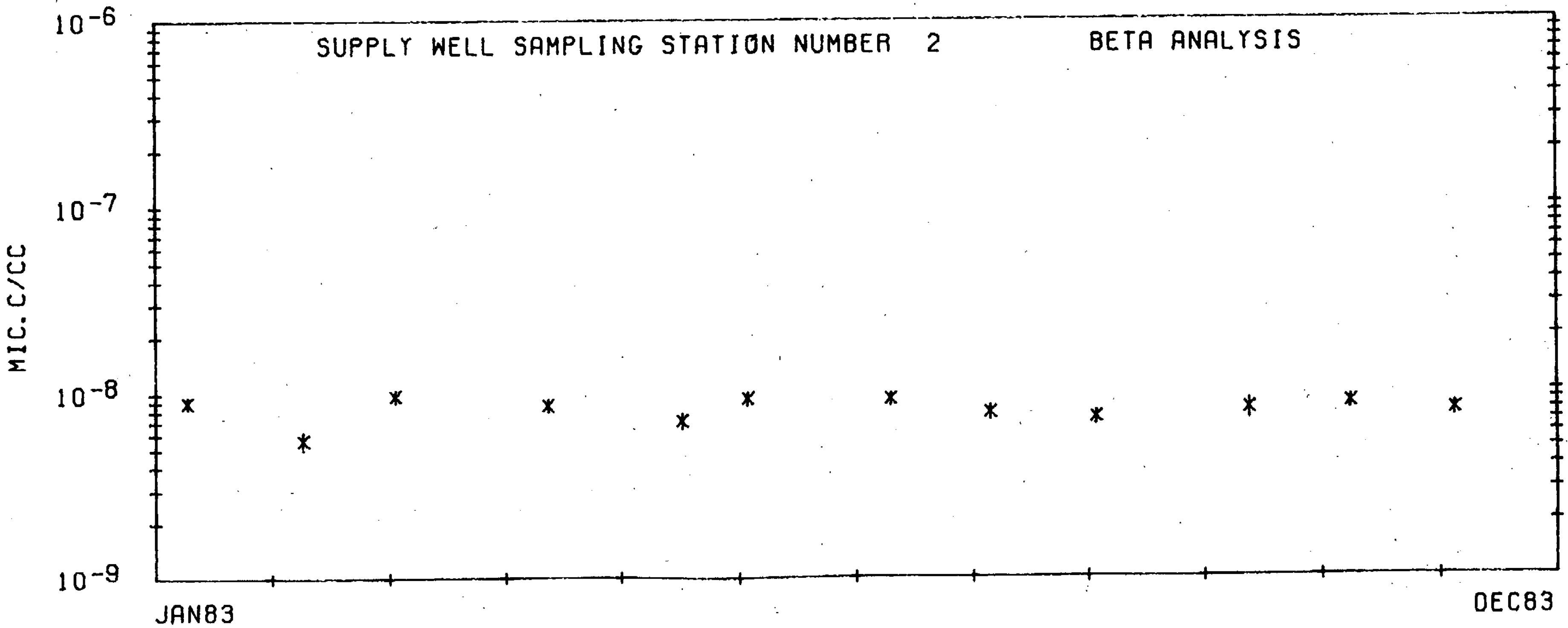
SUPPLY WELL NETWORK AVERAGES
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN83
DEC83

SUPPLY WELL NETWORK AVERAGES

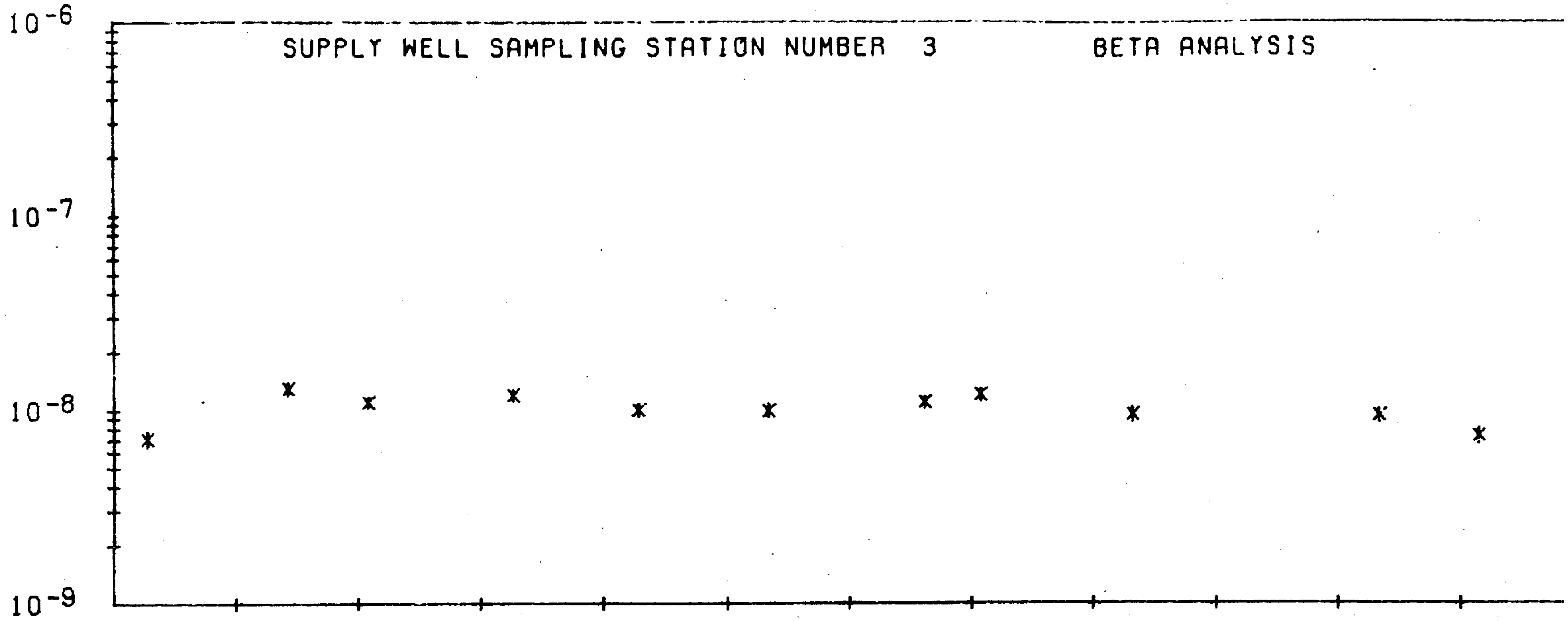


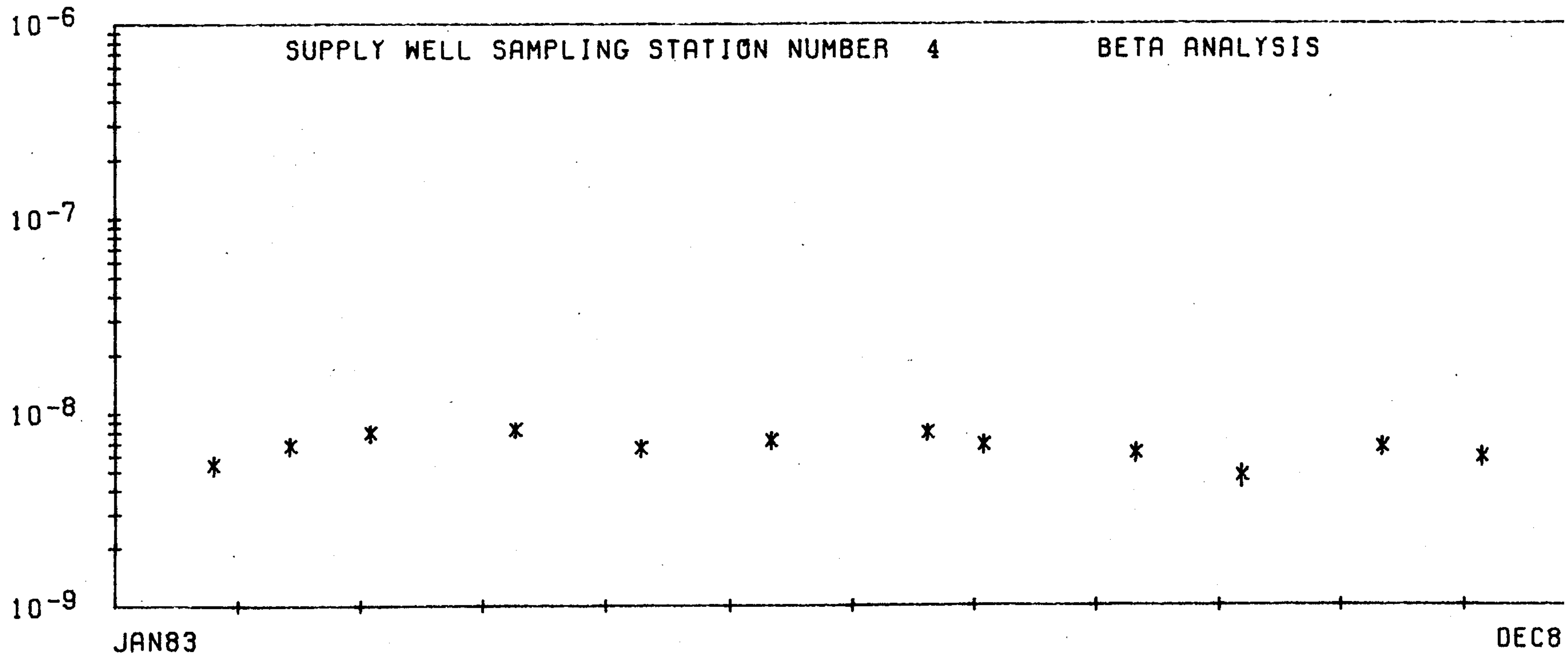


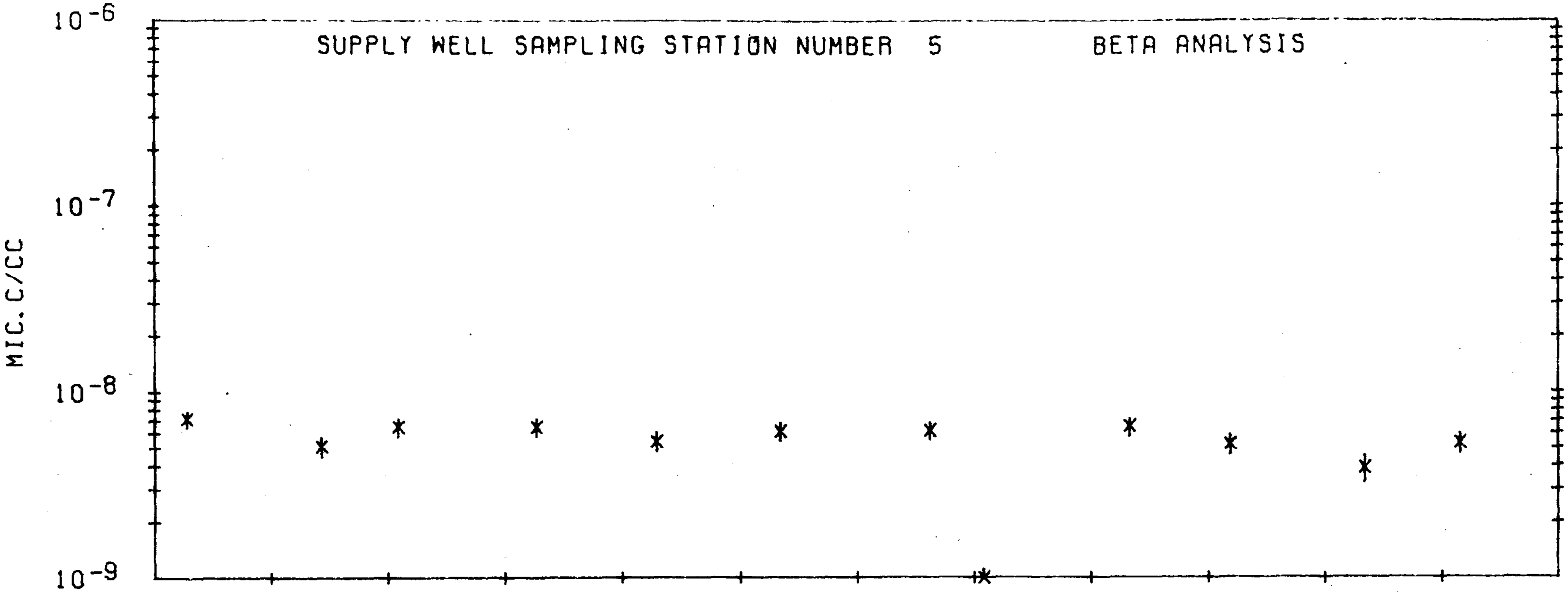
SUPPLY WELL SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

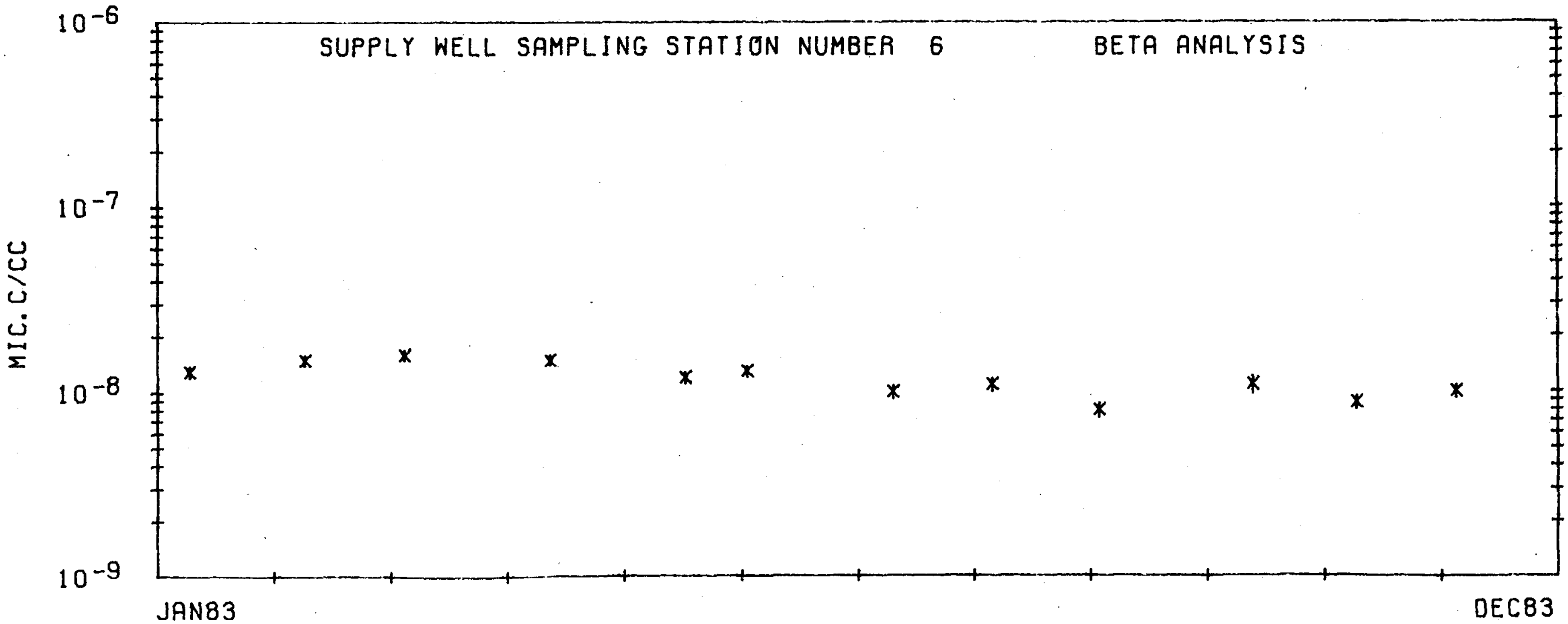


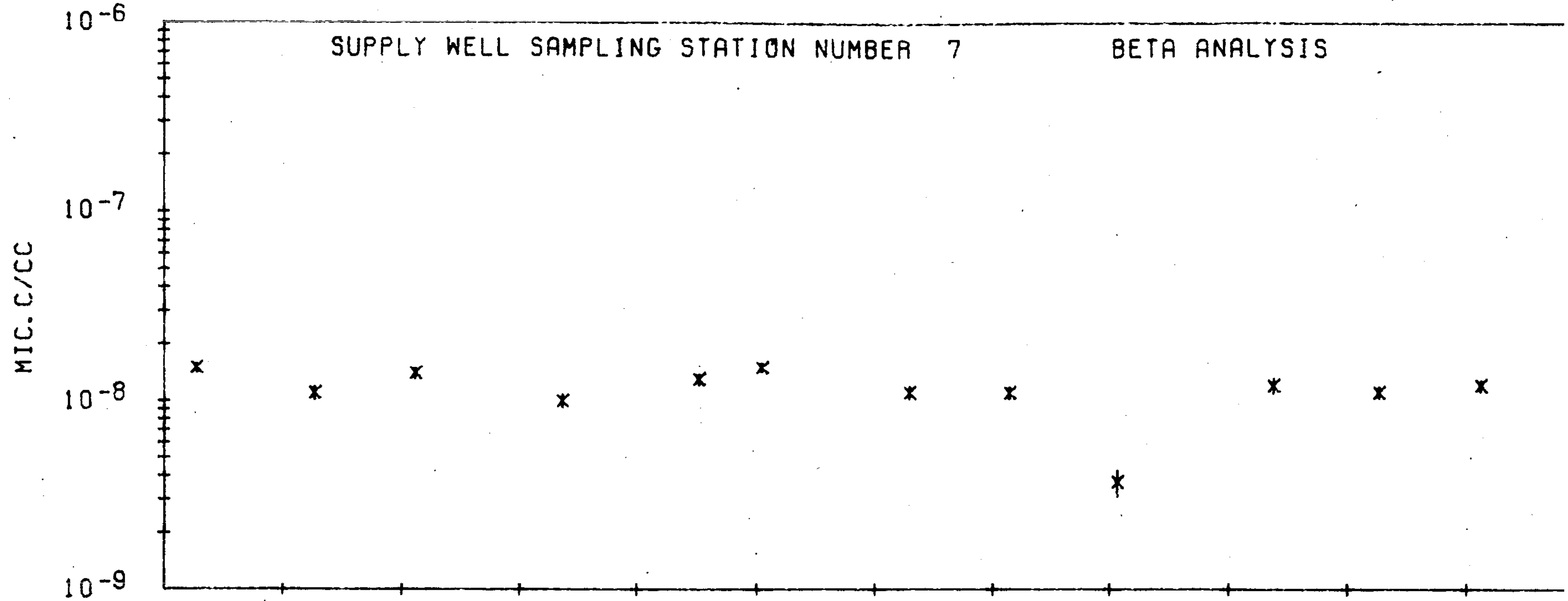
SUPPLY WELL SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC83

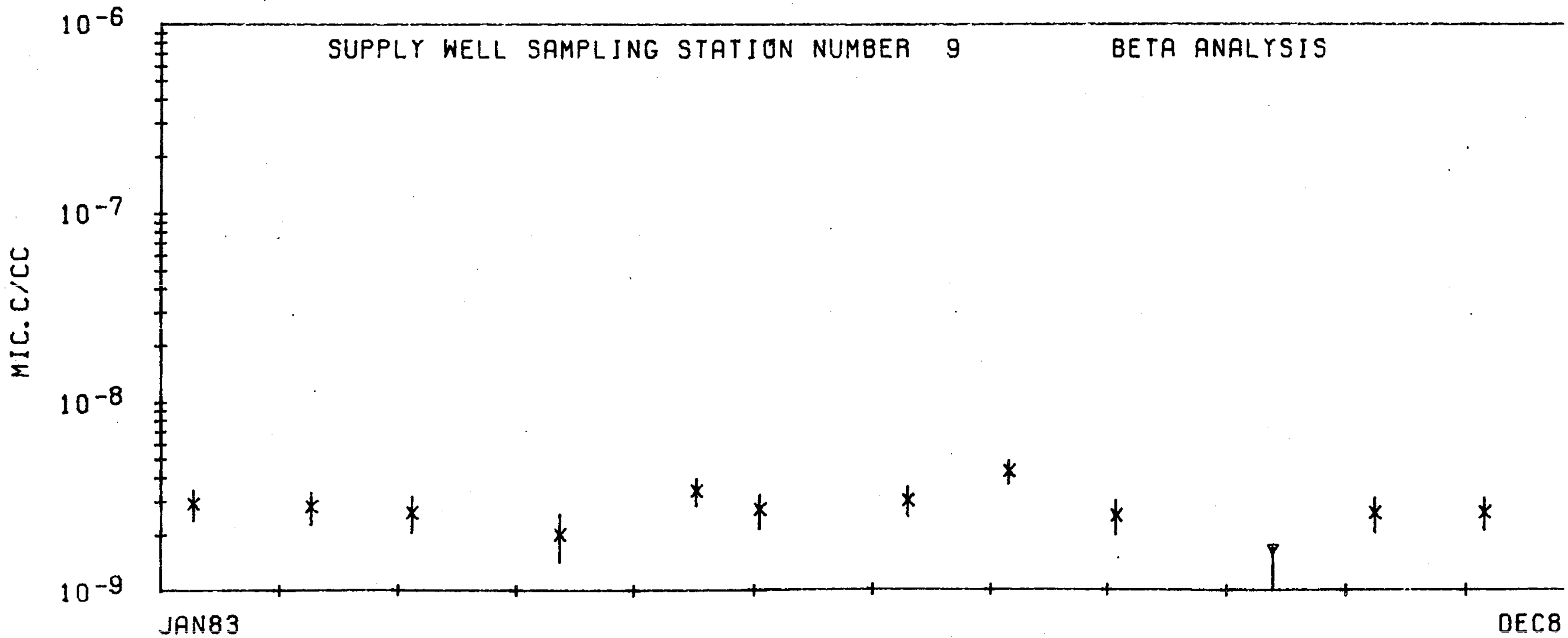

SUPPLY WELL SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

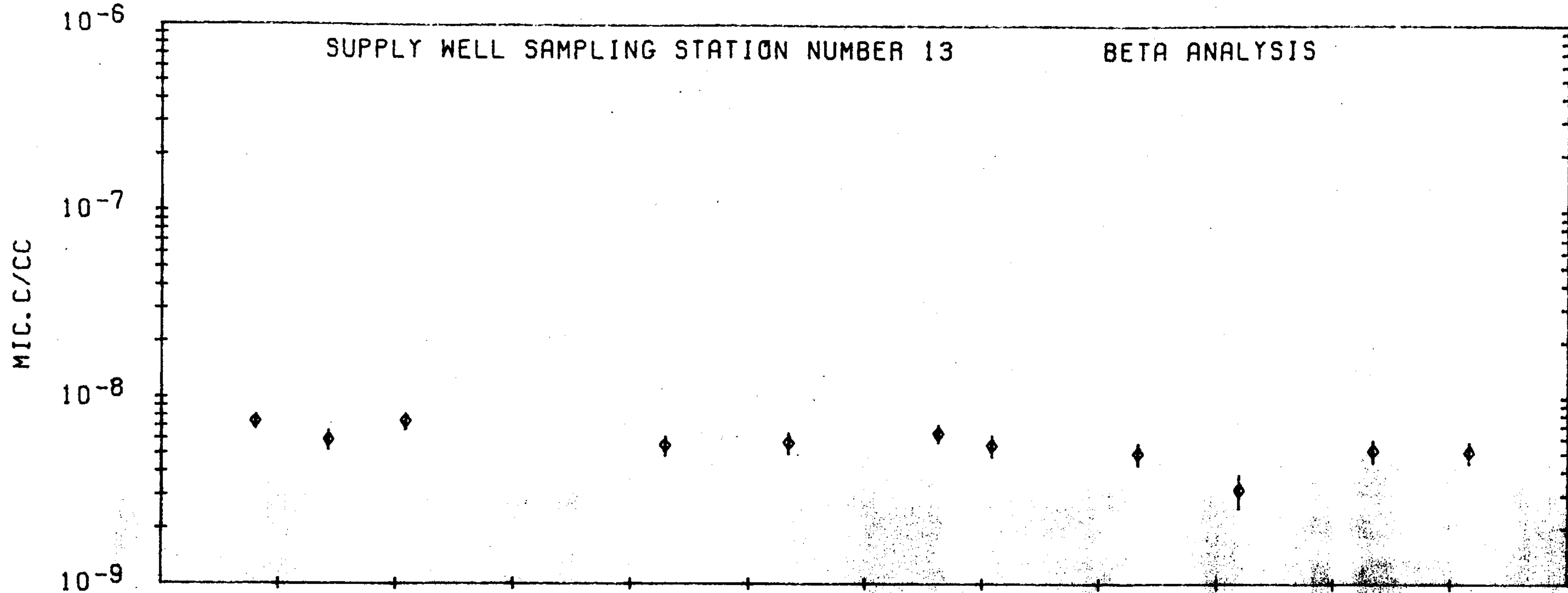

SUPPLY WELL SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC8

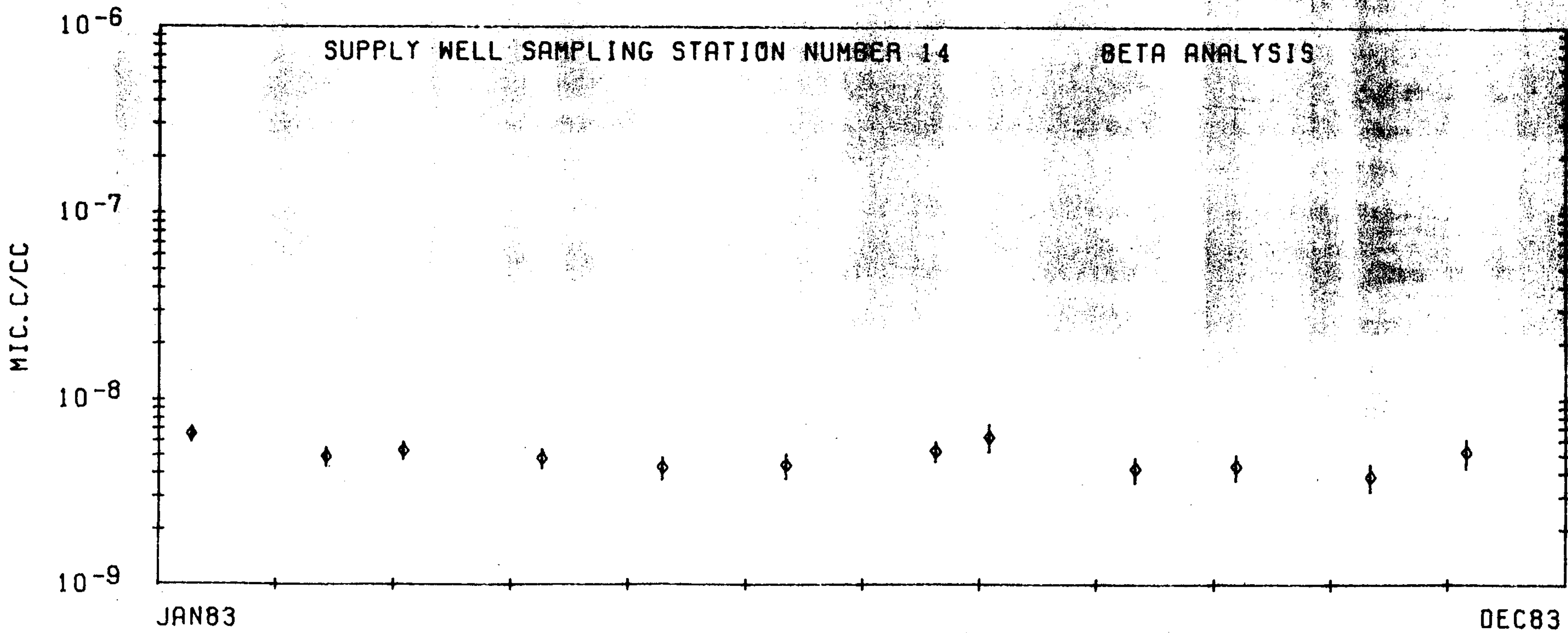

SUPPLY WELL SAMPLING STATION NUMBER 5
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9

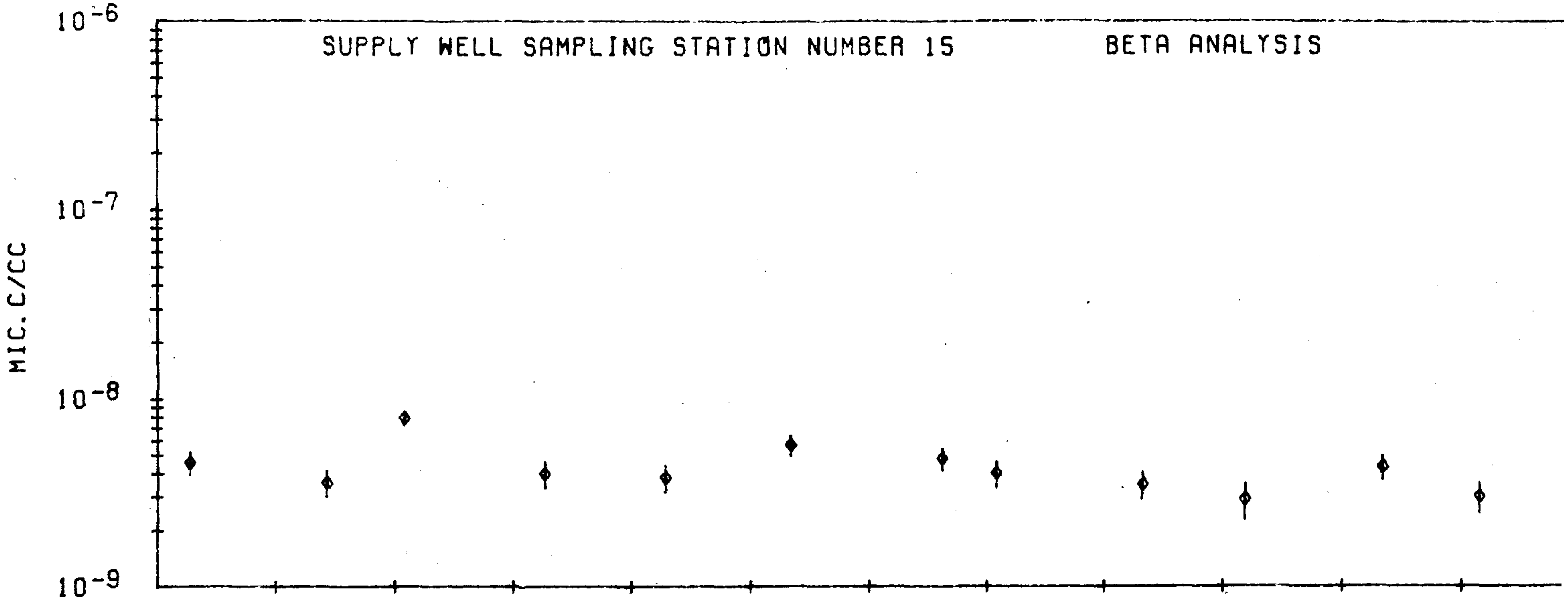

SUPPLY WELL SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN83
DEC83

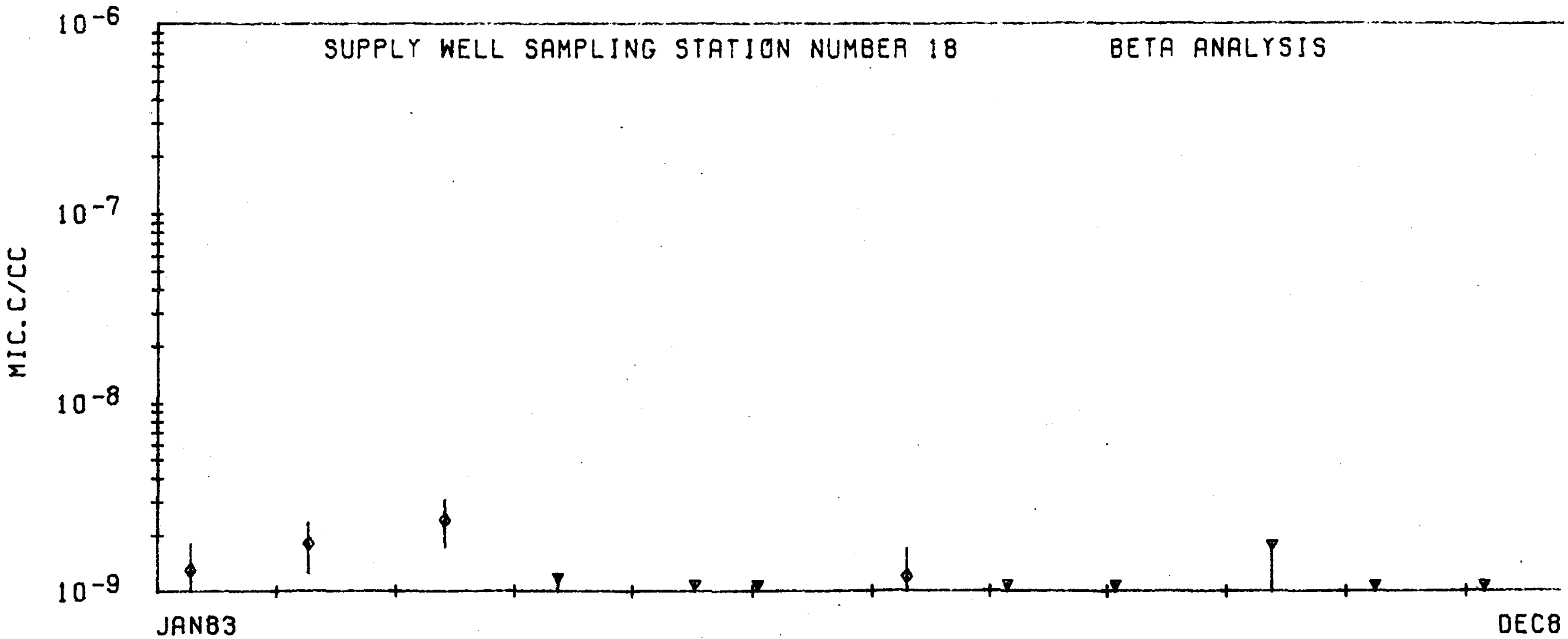

SUPPLY WELL SAMPLING STATION NUMBER 7
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


SUPPLY WELL SAMPLING STATION NUMBER 9
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC8


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}
JAN83
DEC83


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
JAN83
DEC8

A P P E N D I X D

NTS Environmental Surveillance

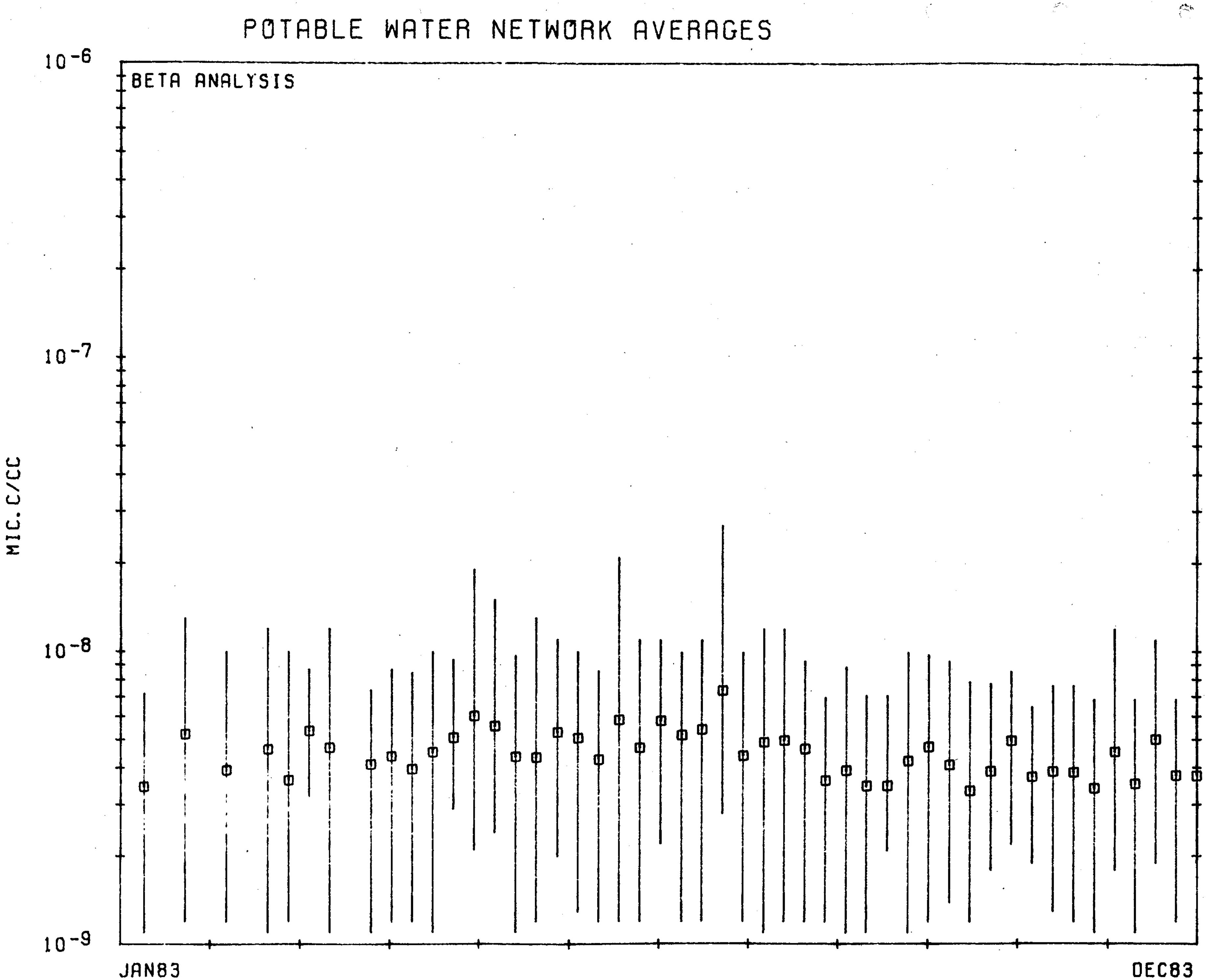
Potable Water Locations and Plots

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.

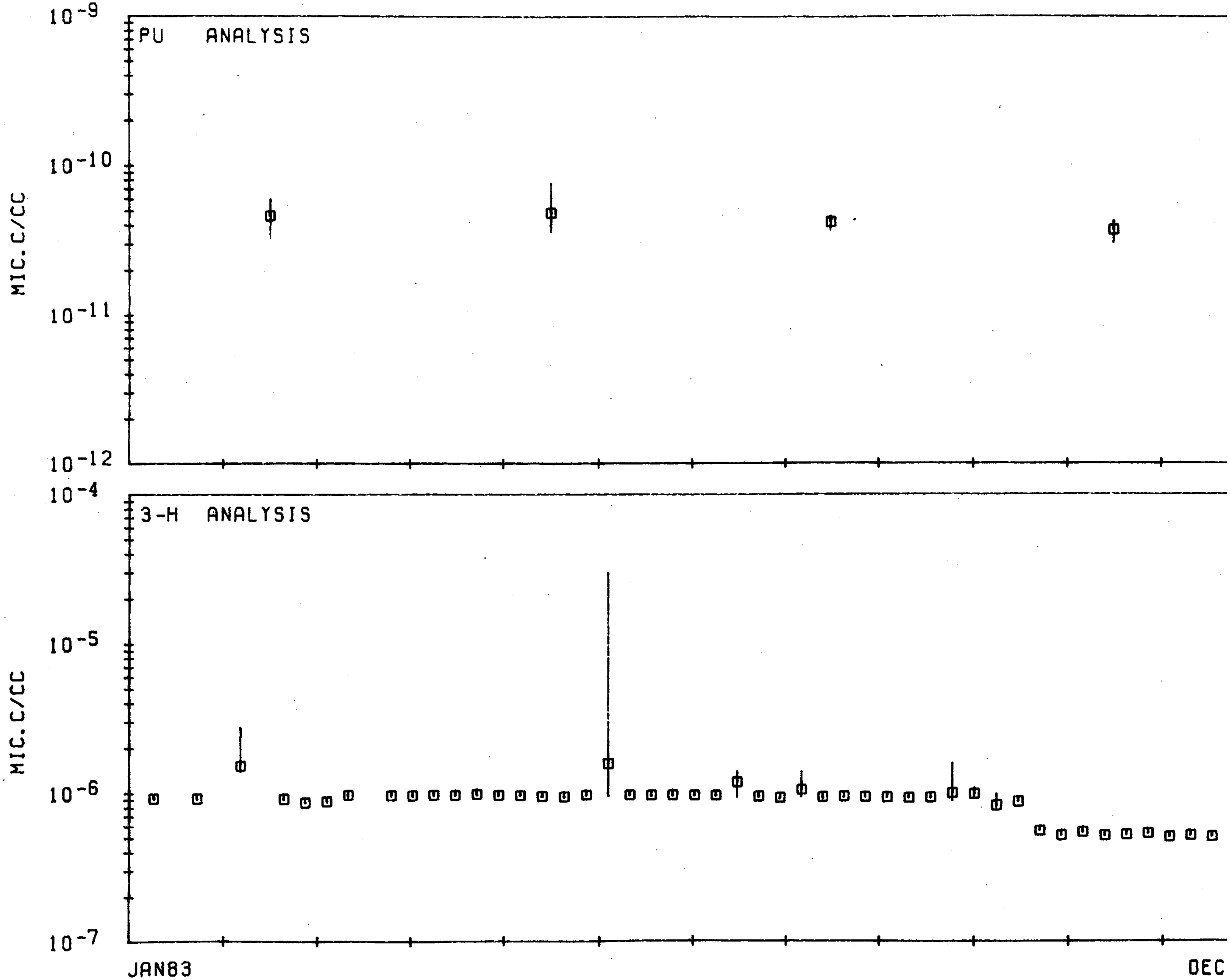
NTS ENVIRONMENTAL SURVEILLANCE
POTABLE WATER SAMPLING LOCATIONS

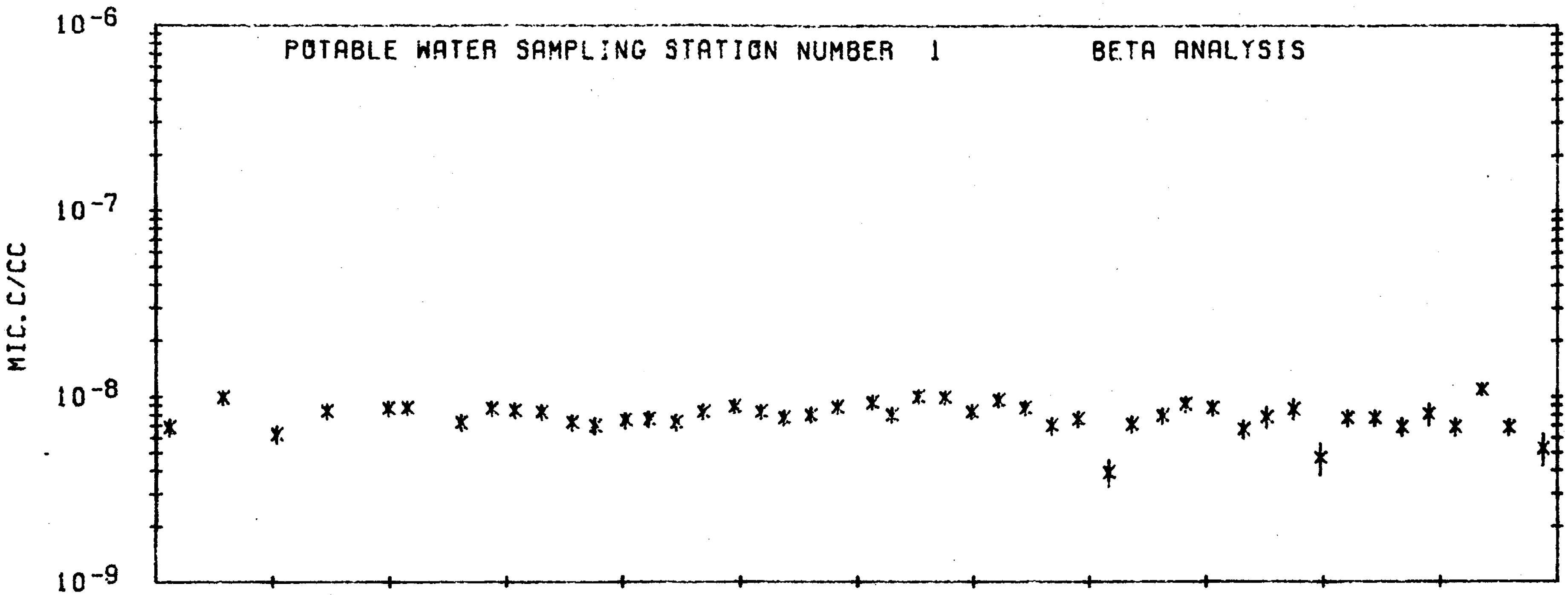
Station Number	Location
1	Area 3 Cafeteria
2	Area 2 Rest Room
3	Area 12 Cafeteria
4	Area 23 Cafeteria
5	Area 27 Cafeteria
6	Area 6 Cascade Water
7	Area 6 Cafeteria
10	Area 25 Service Station

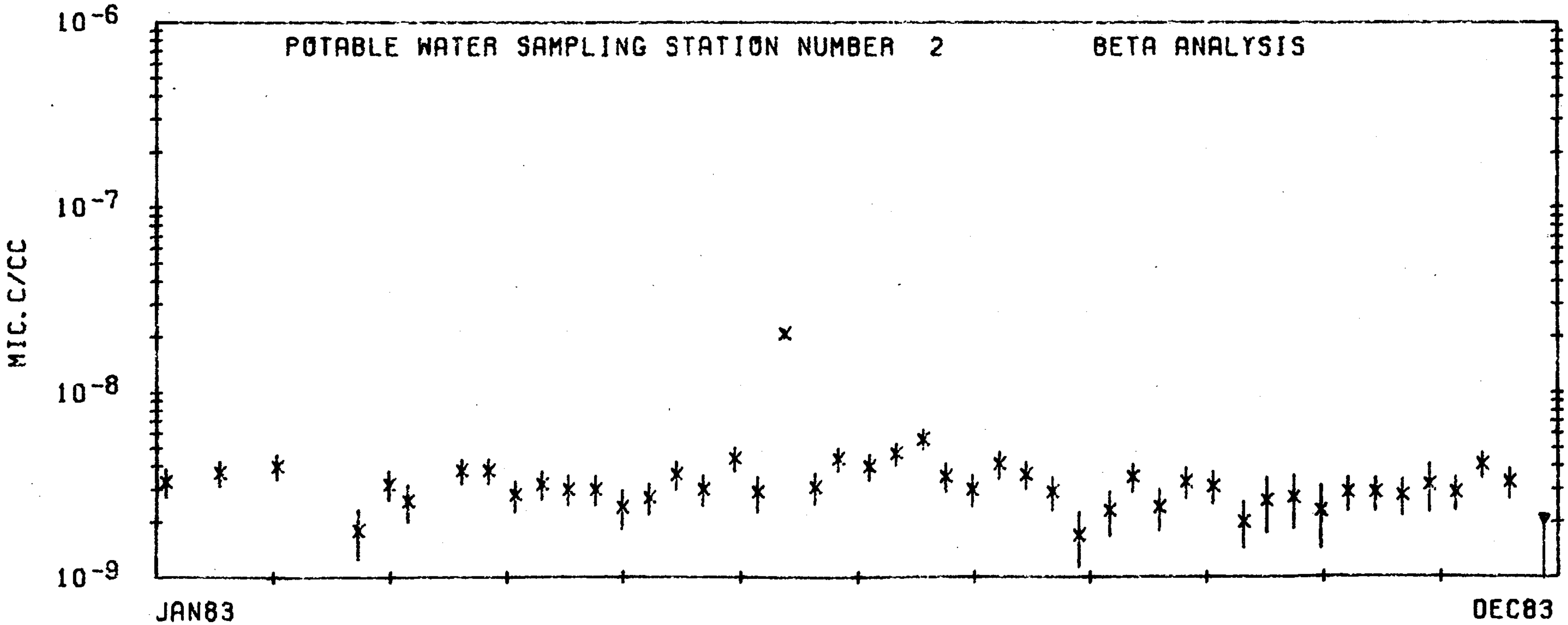


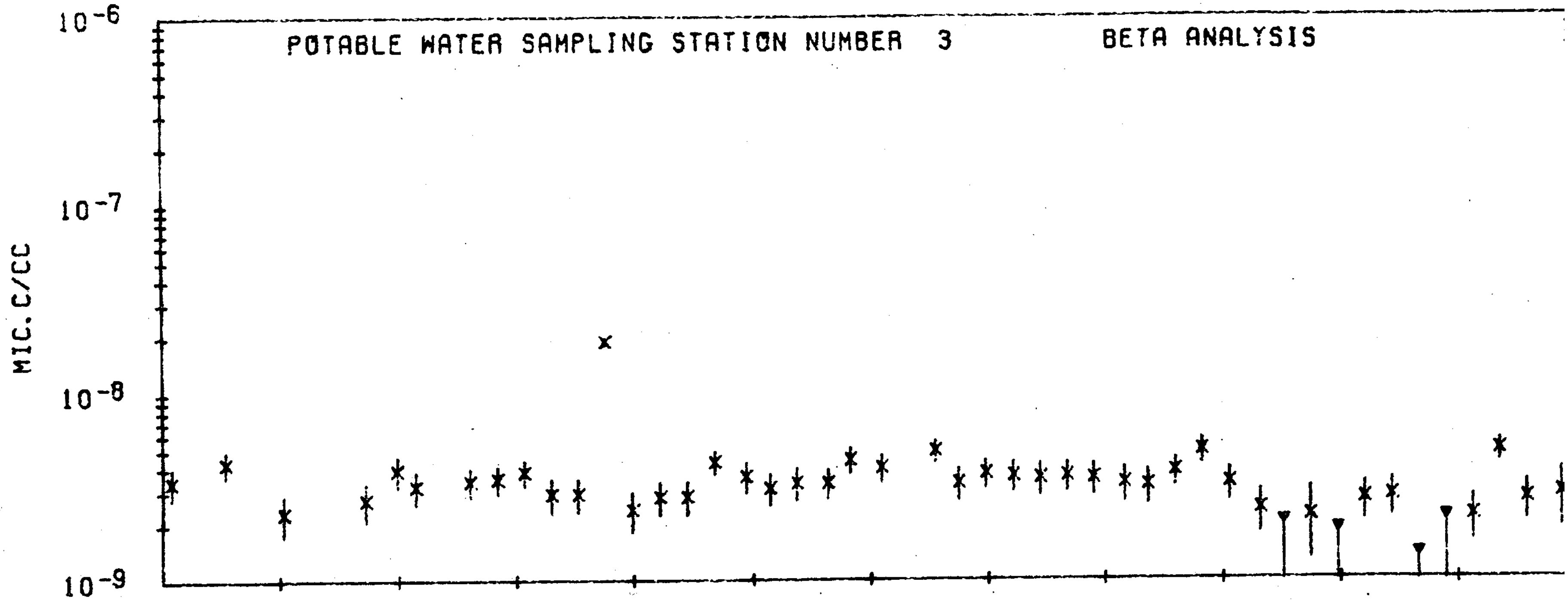
POTABLE WATER NETWORK AVERAGES
BETA ANALYSIS
MIC.C/CC
10 -6
10 -7
10 -8
10 -9
JAN83
DEC83

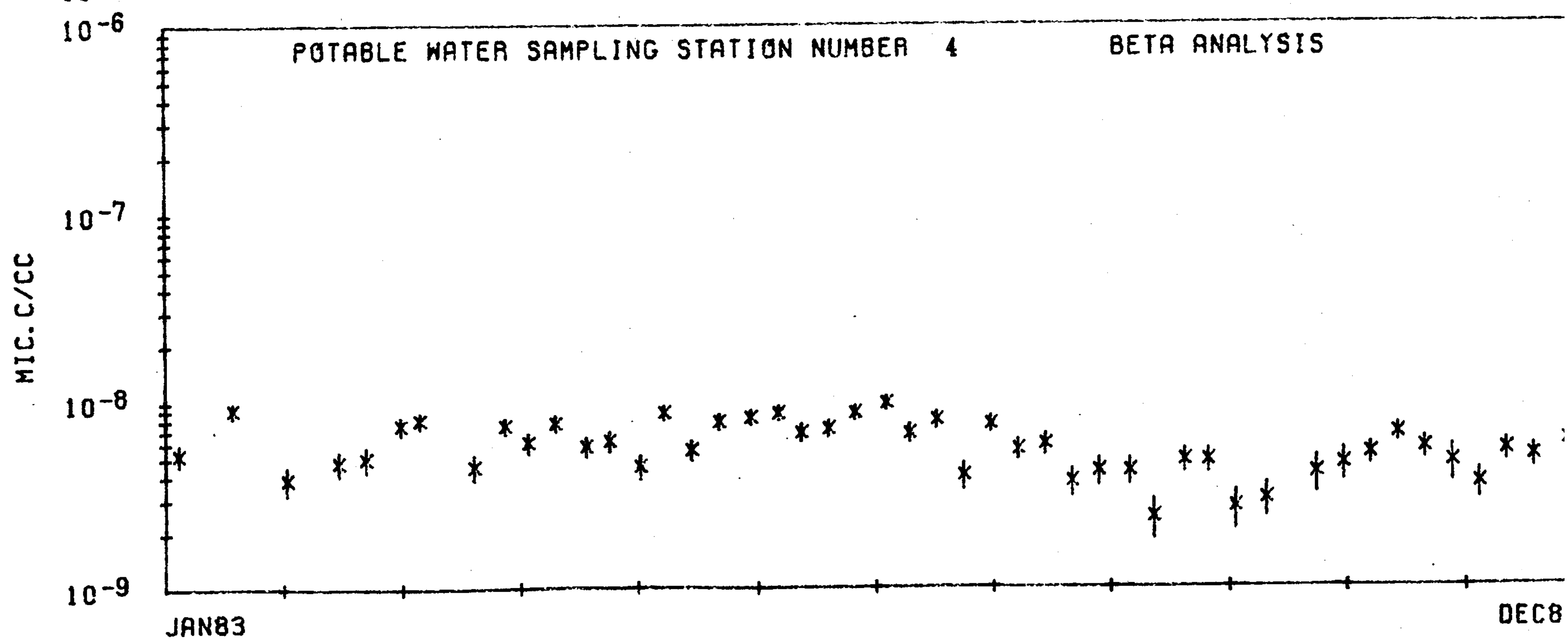
POTABLE WATER NETWORK AVERAGES

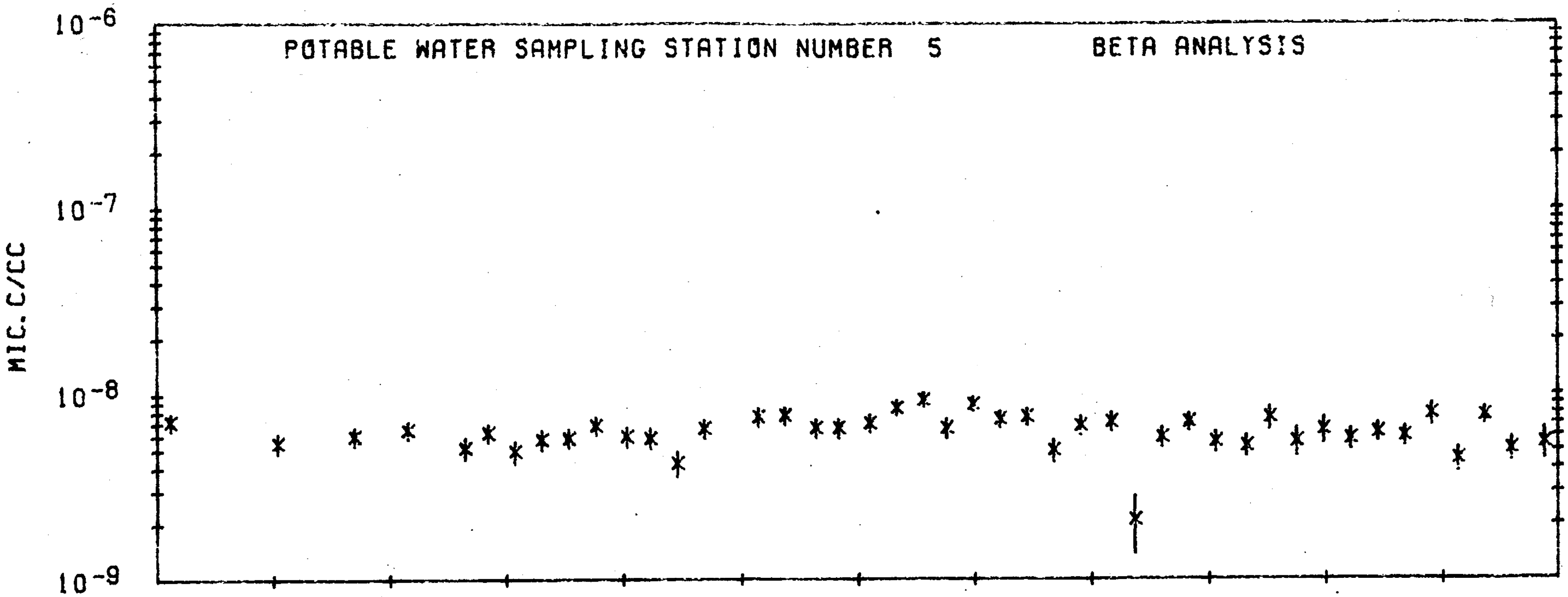


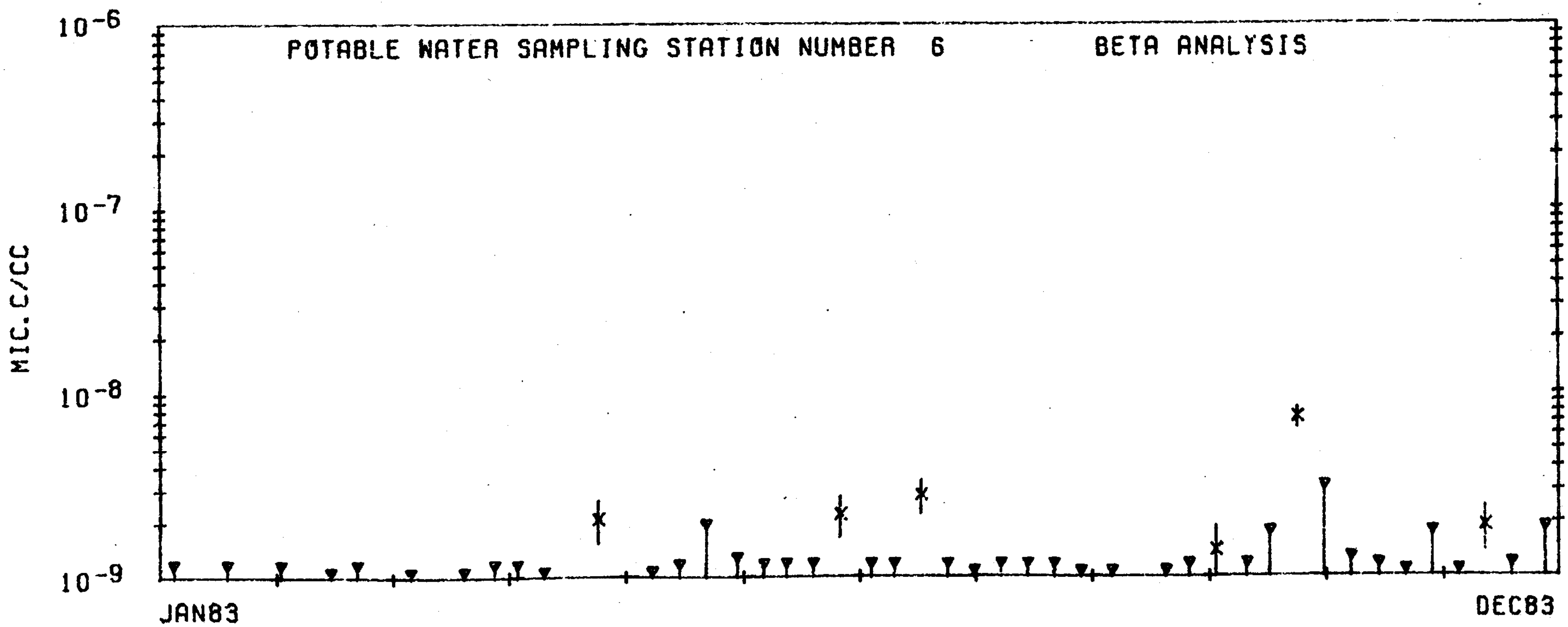

POTABLE WATER SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

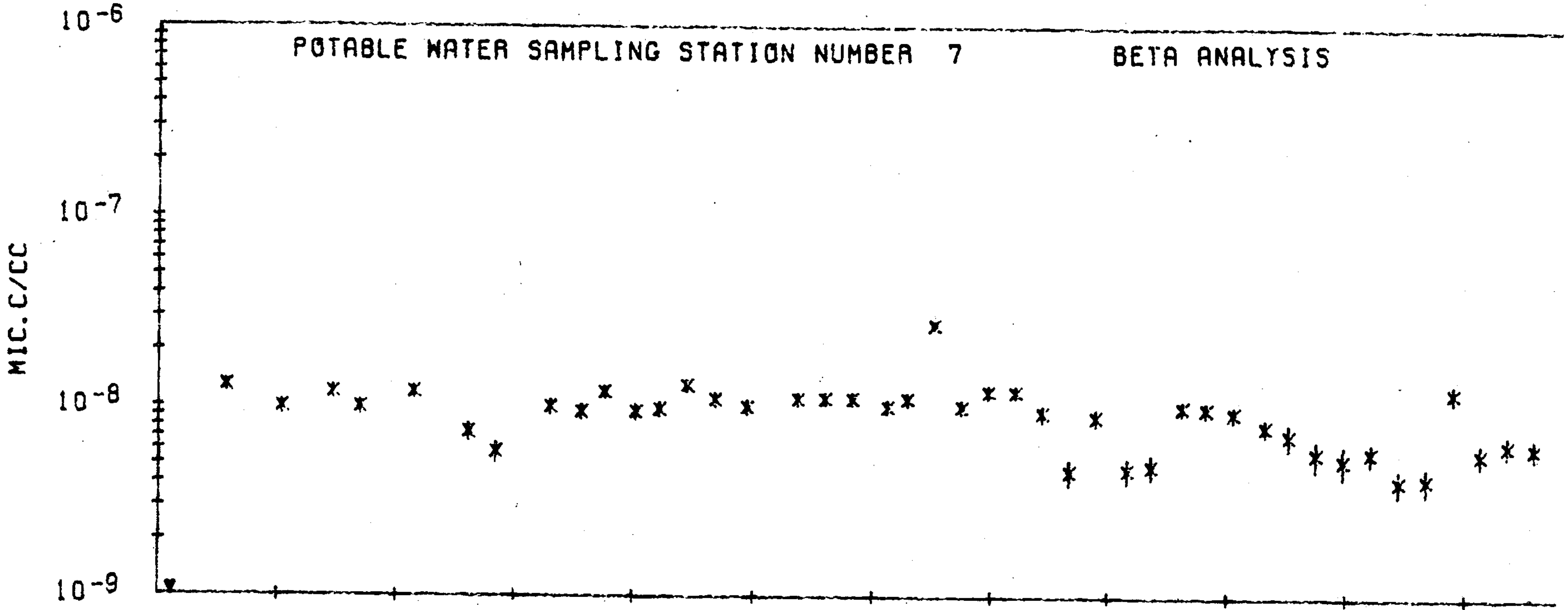

POTABLE WATER SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC83

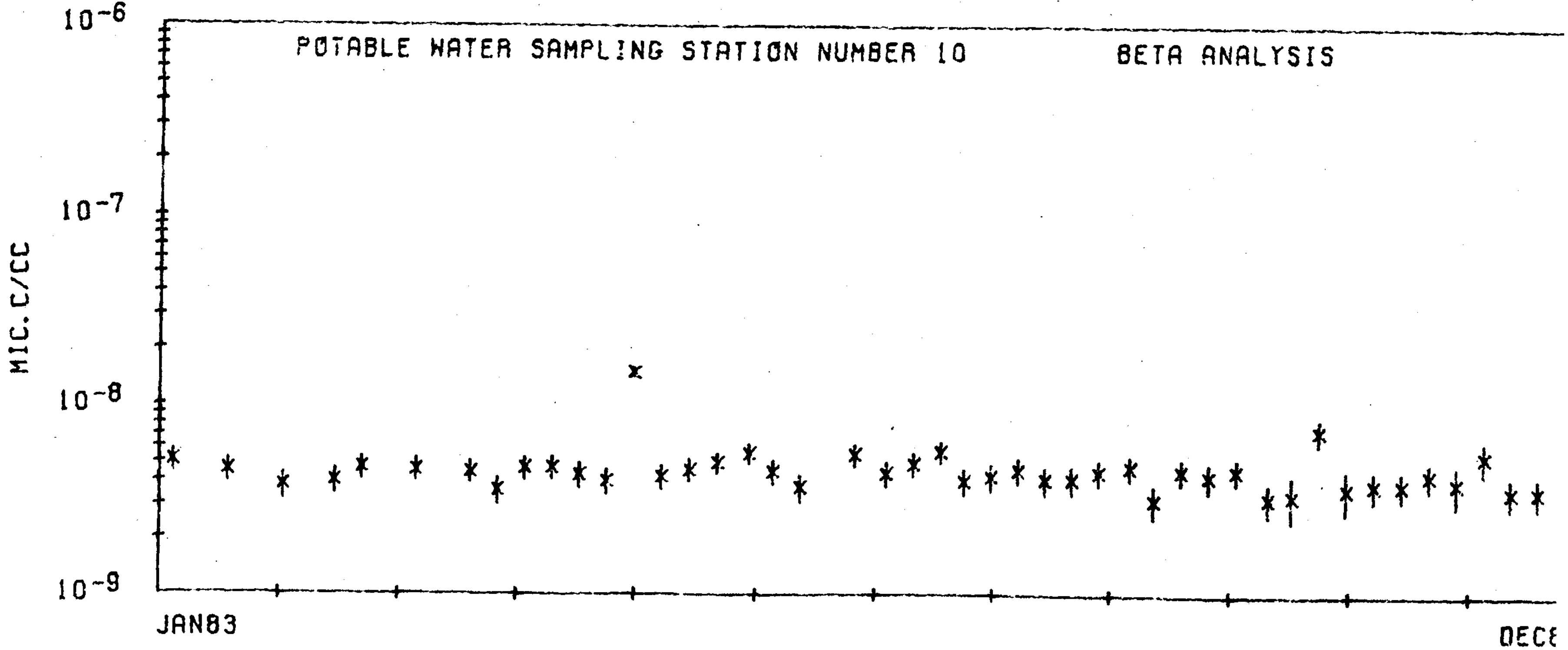

POTABLE WATER SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


POTABLE WATER SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC8


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}
JAN83
DEC83


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}
JAN83
DEC8

A P P E N D I X   E

NTS Environmental Surveillance

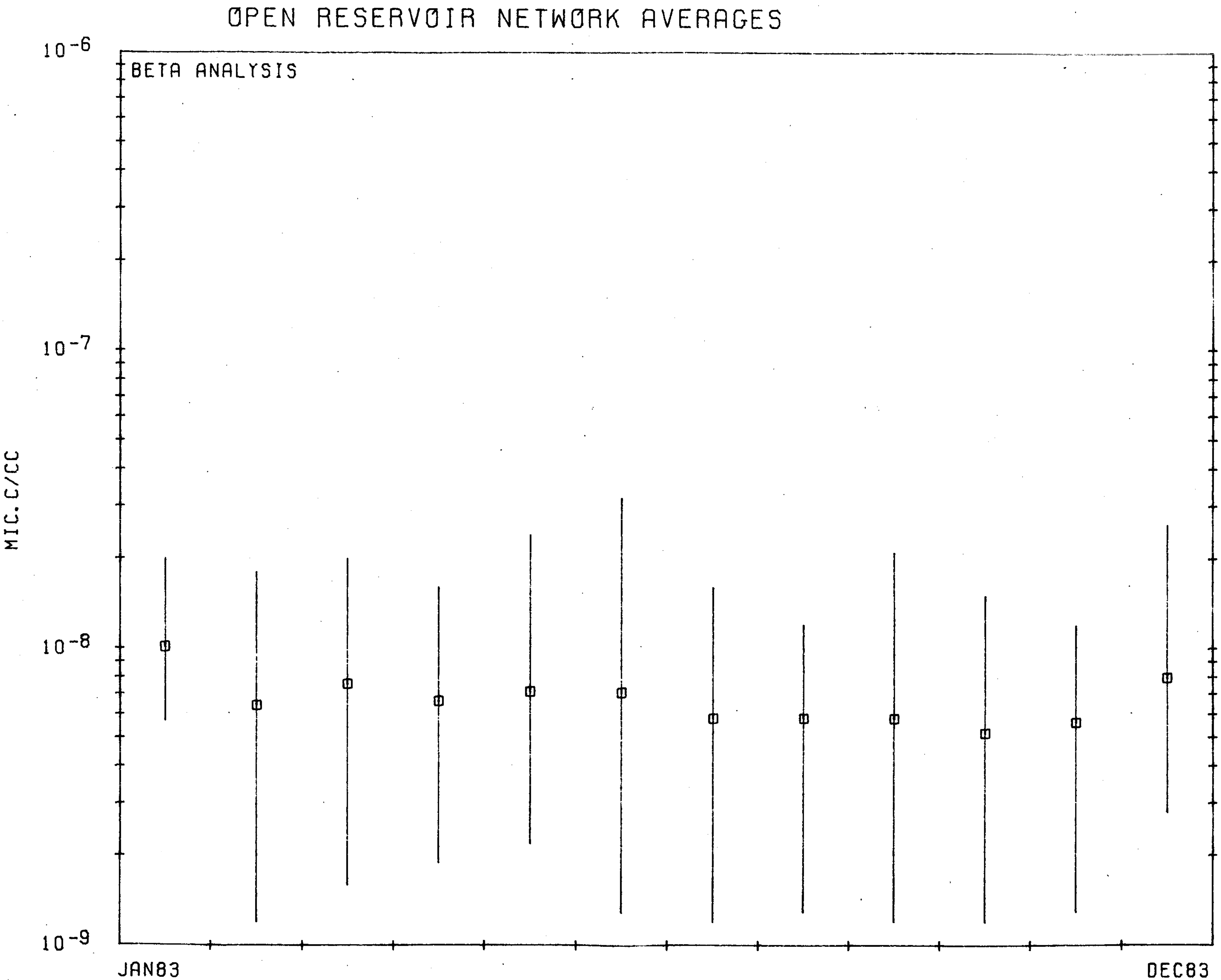
Open Reservoir Locations and Plots

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

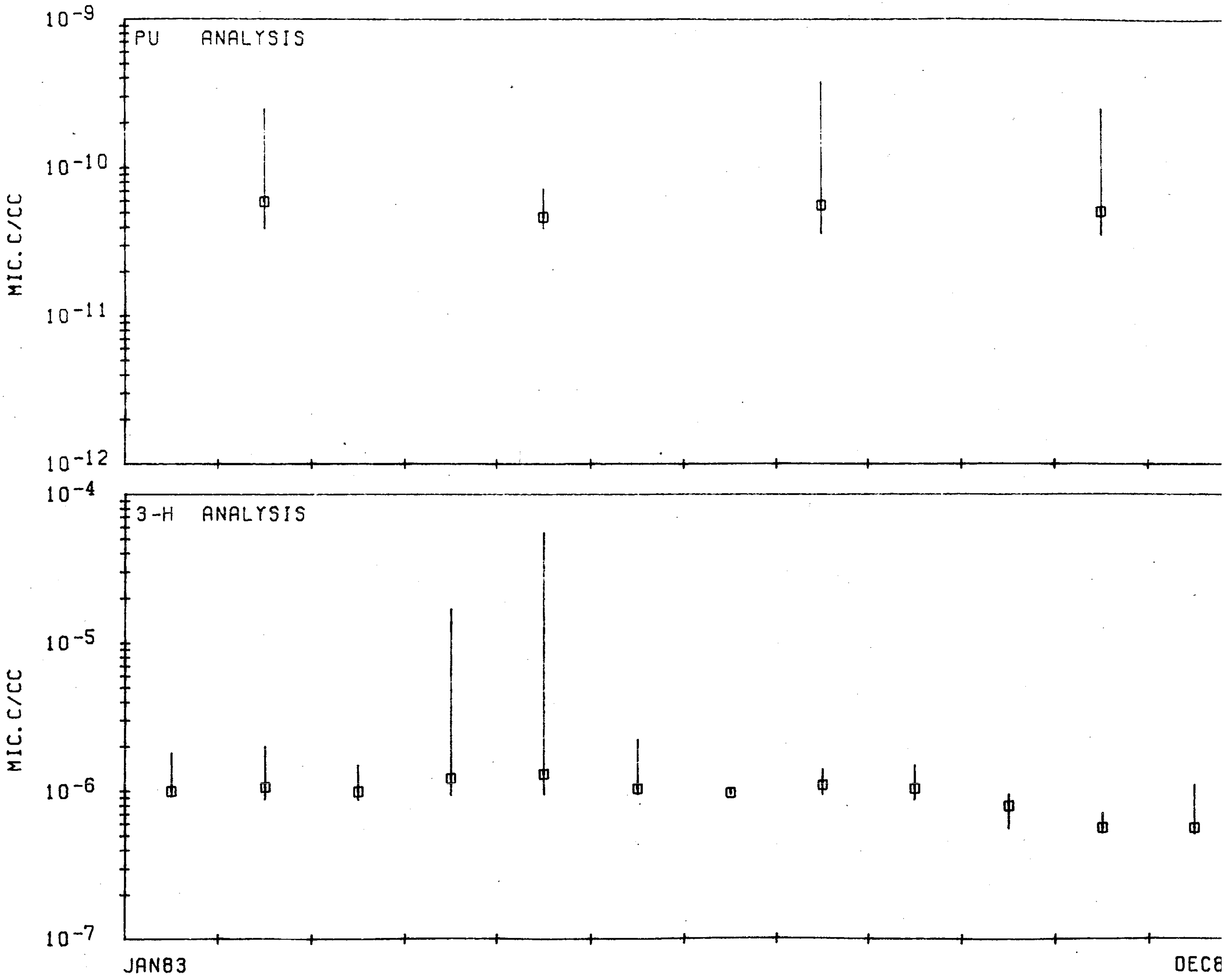
Station Number	Location
1	Area 2 Well 2 Reservoir
2	Area 3 Well A Reservoir
3	Area 5 Well 5B Reservoir
4	Area 5 Well Ue5c Reservoir
5	Area 6 Well 3 Reservoir
6	Area 6 Well C1 Reservoir
* 7	Area 15 Well Ue15d Reservoir
8	Area 18 Camp 17 Reservoir
11	Area 20 Well 20A Reservoir
12	Area 23 Swimming Pool
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

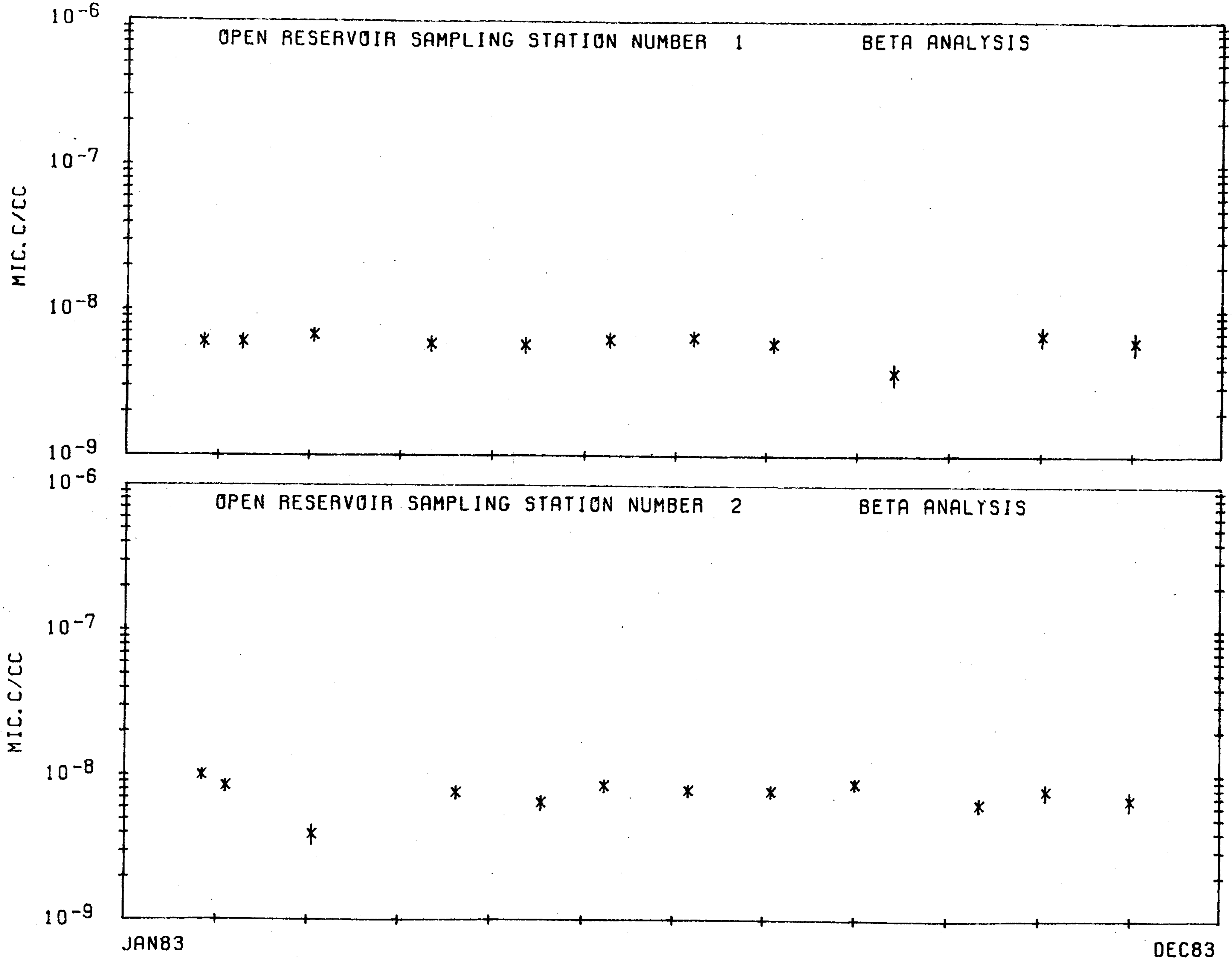
* Reservoirs were dry.

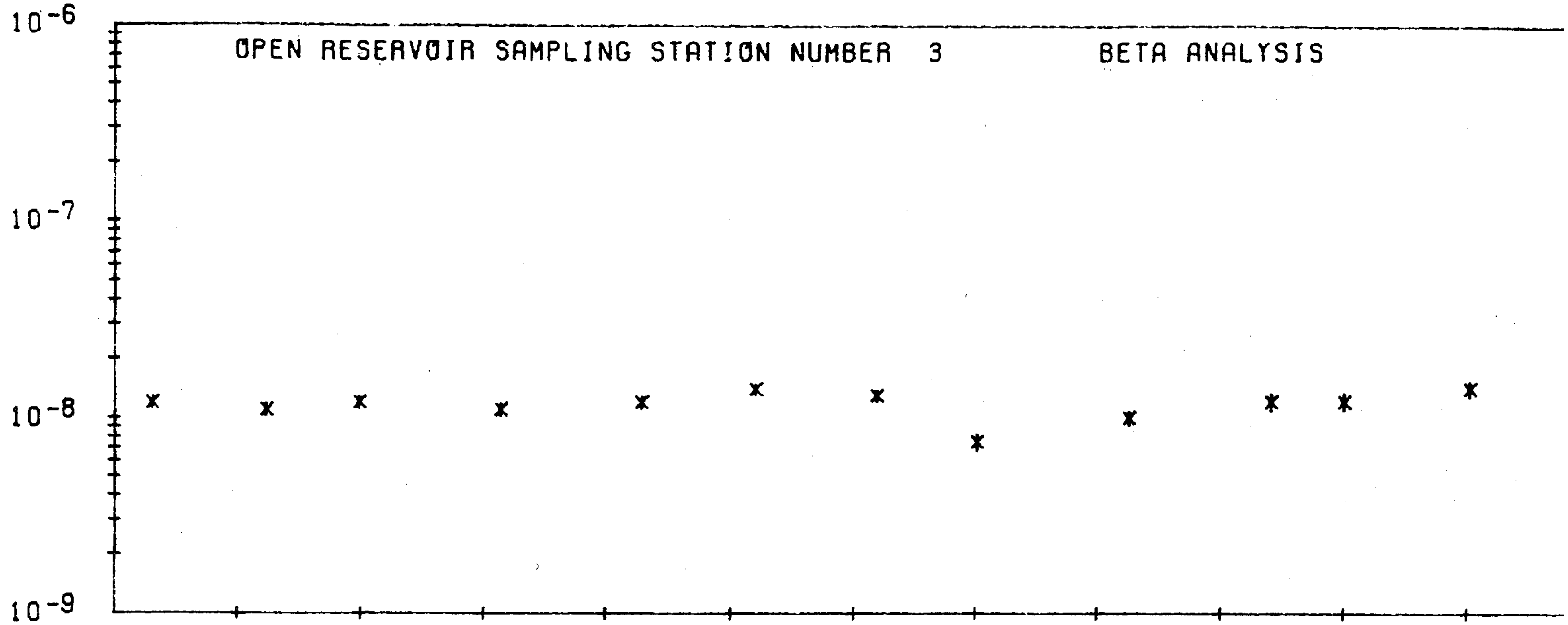


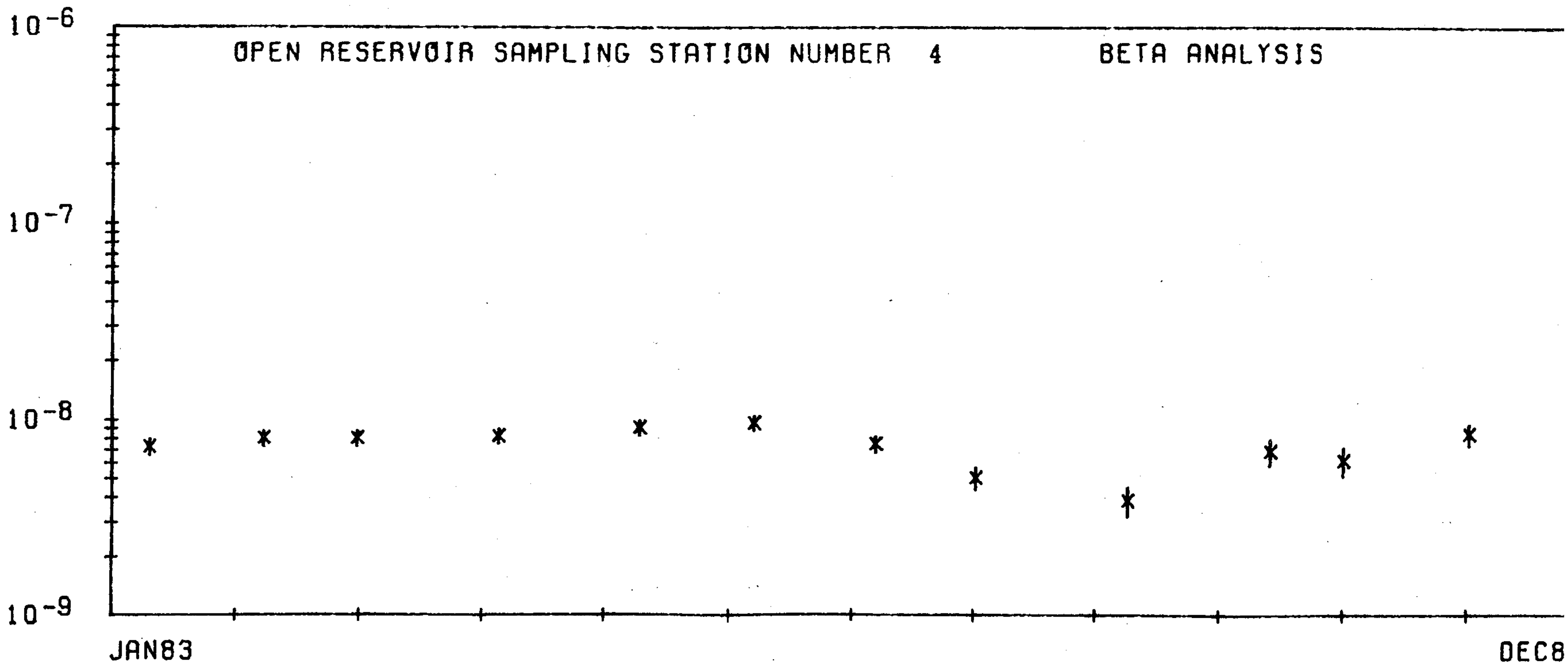
ØPEN RESERVØIR NETWØRK AVERAGES
BETA ANALYSIS
MIC.C/CC
10 -6
10 -7
10 -8
10 -9
JAN83
DEC83

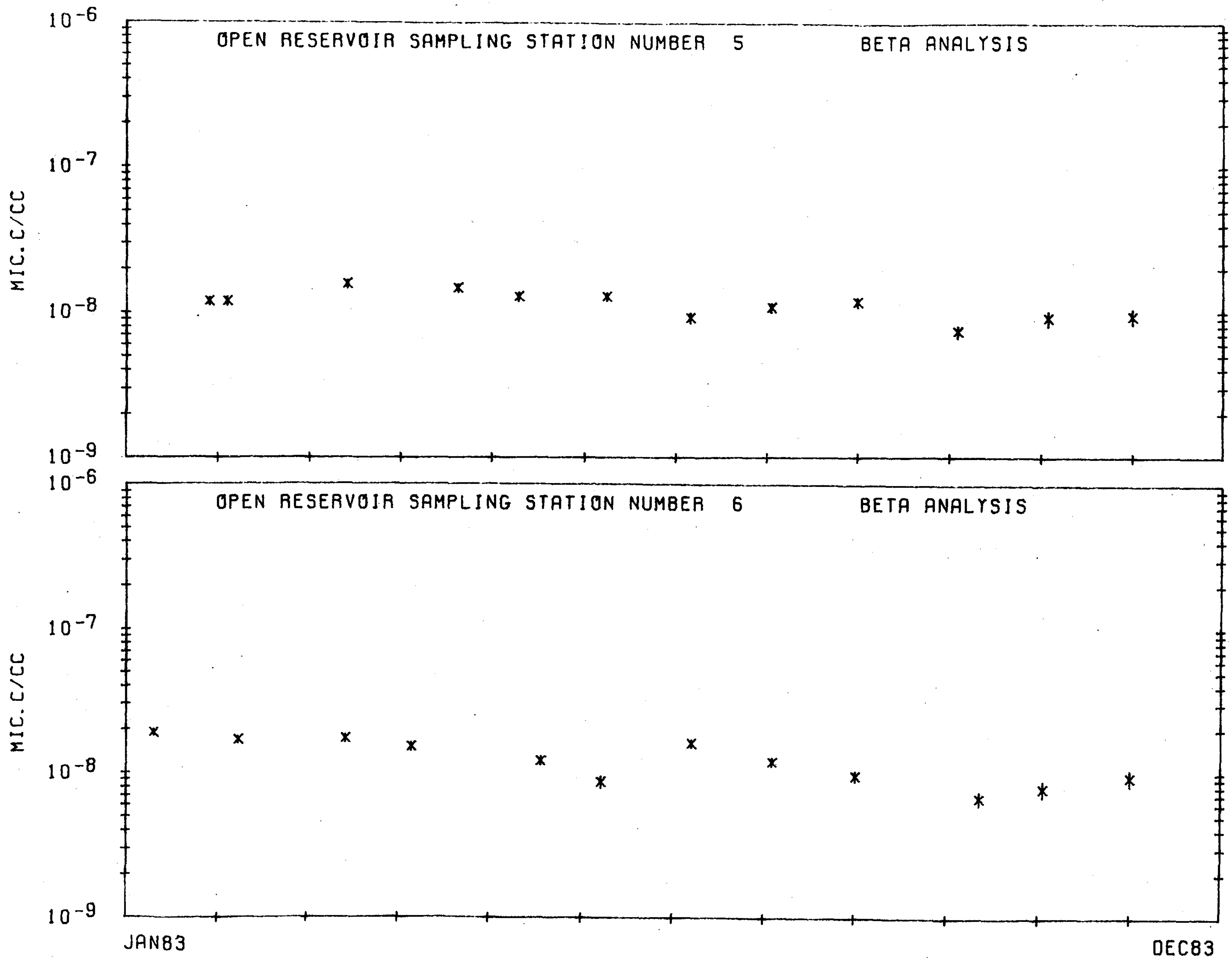
OPEN RESERVOIR NETWORK AVERAGES



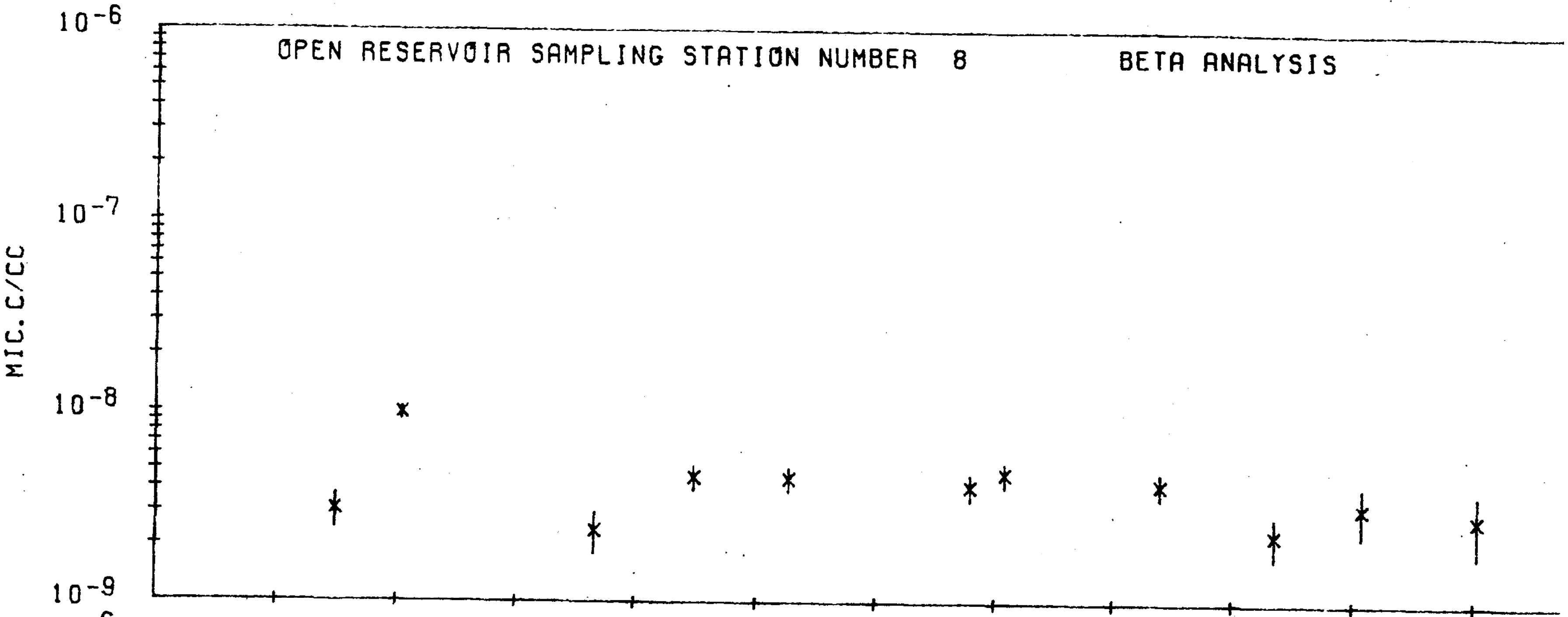

OPEN RESERVOIR SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
OPEN RESERVOIR SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC83

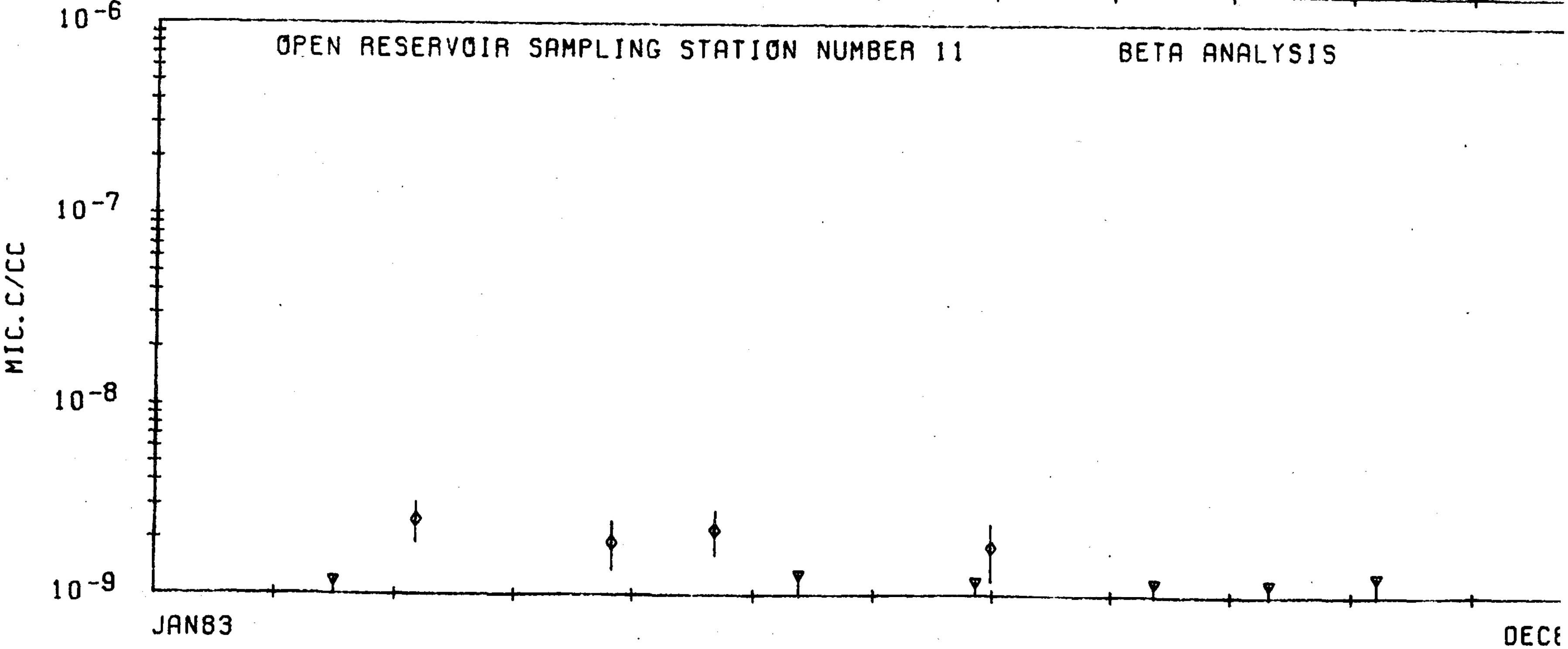

OPEN RESERVOIR SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹

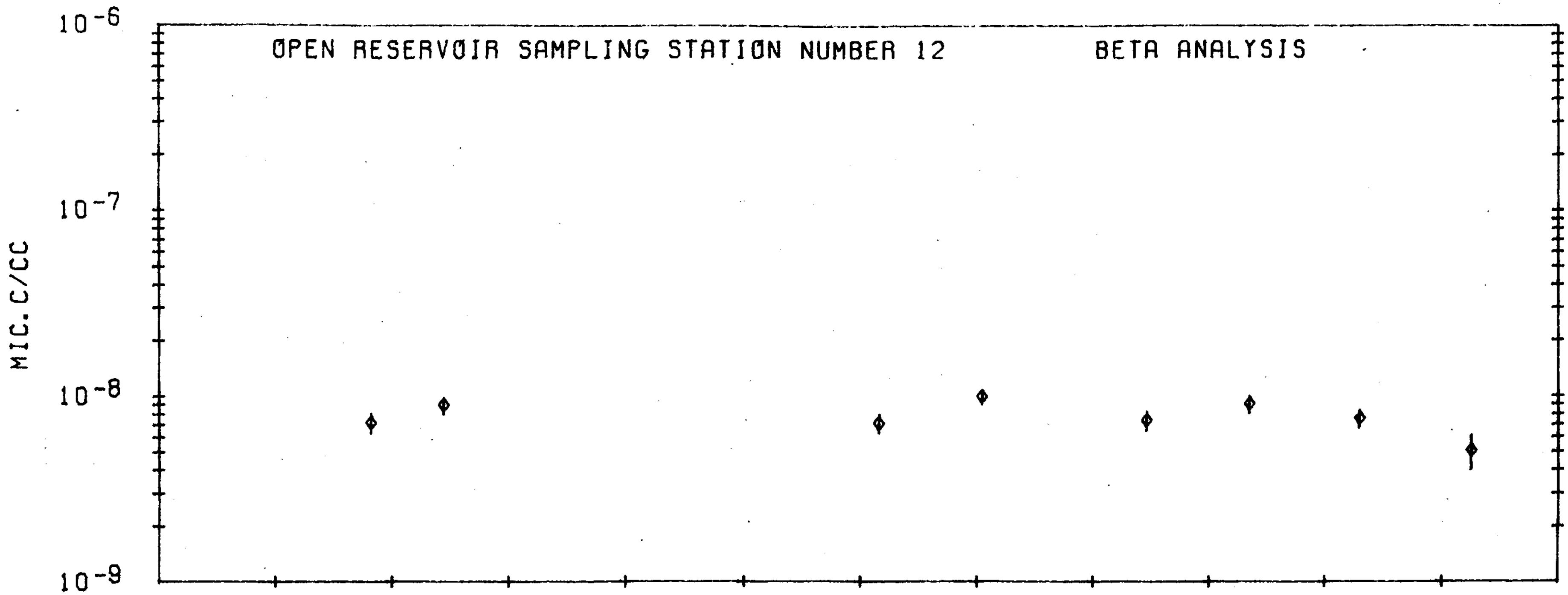

OPEN RESERVOIR SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹
JAN83
DEC8

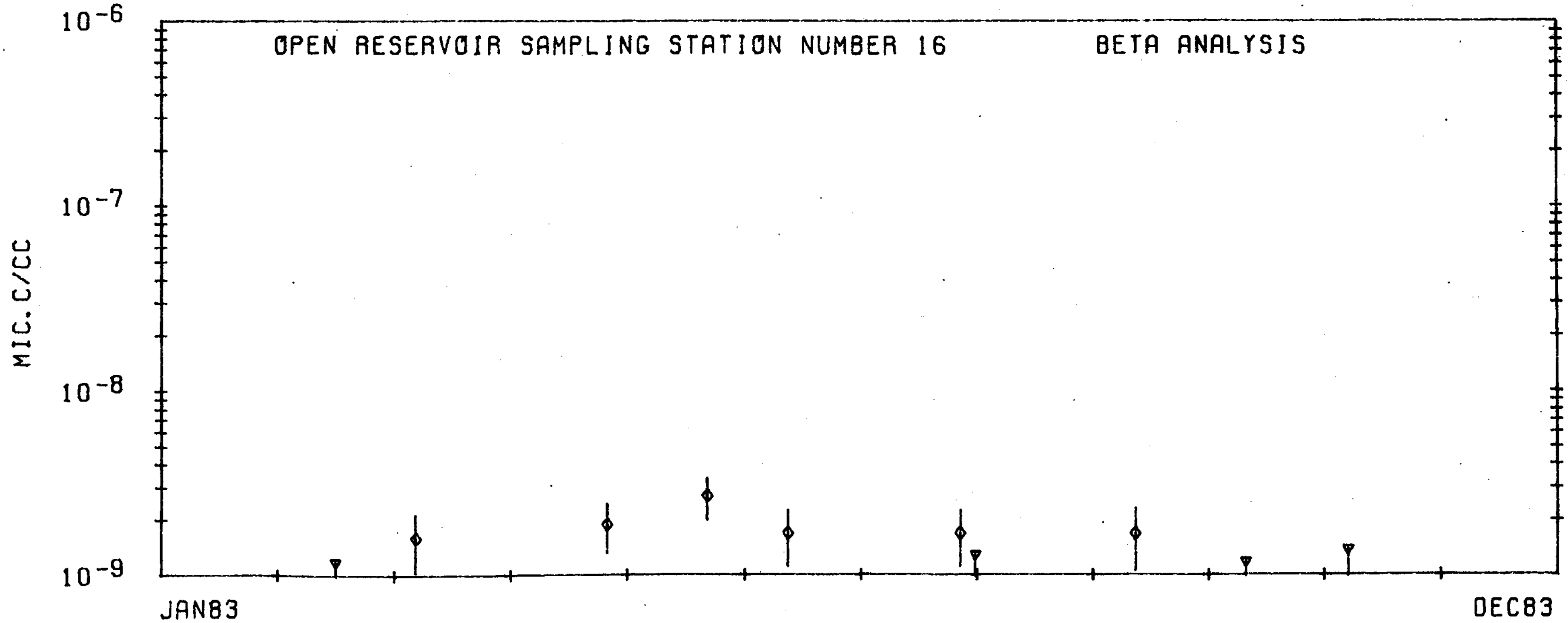


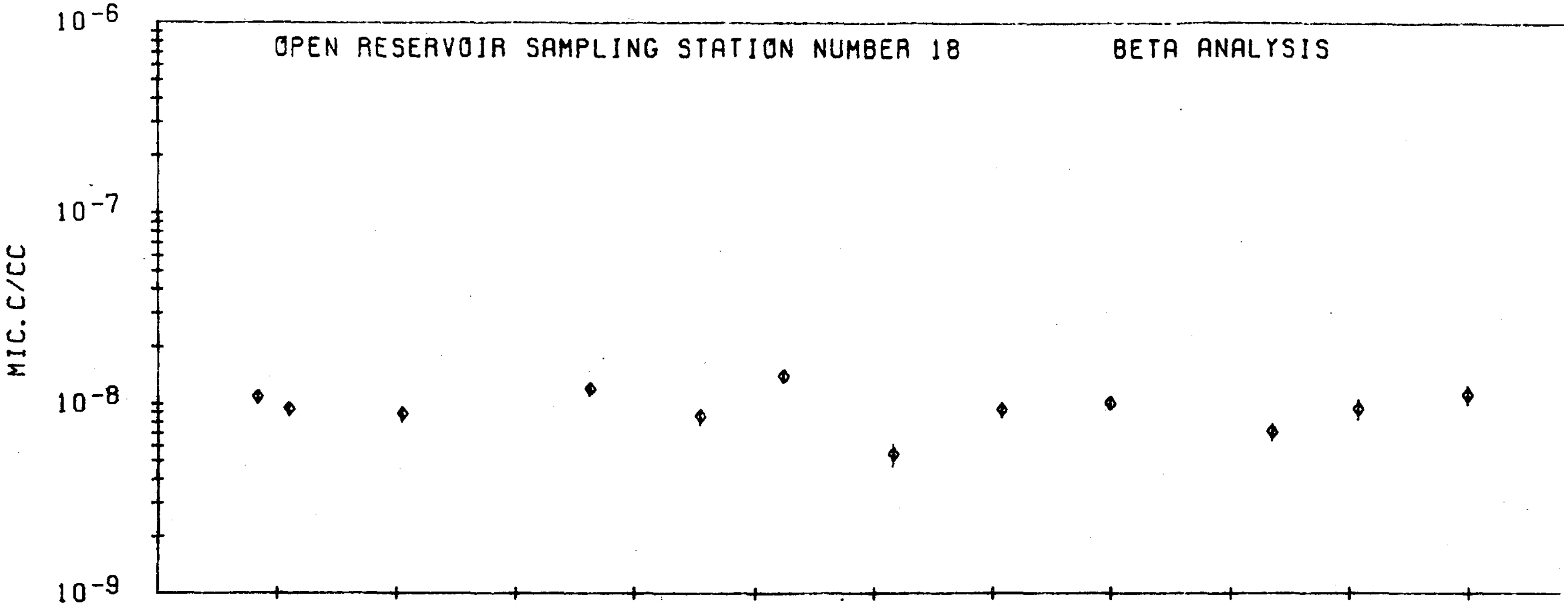
OPEN RESERVOIR SAMPLING STATION NUMBER 5
BETA ANALYSIS
MIC.C/CC
10-6
10-7
10-8
10-9
OPEN RESERVOIR SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10-6
10-7
10-8
10-9
JAN83
DEC83

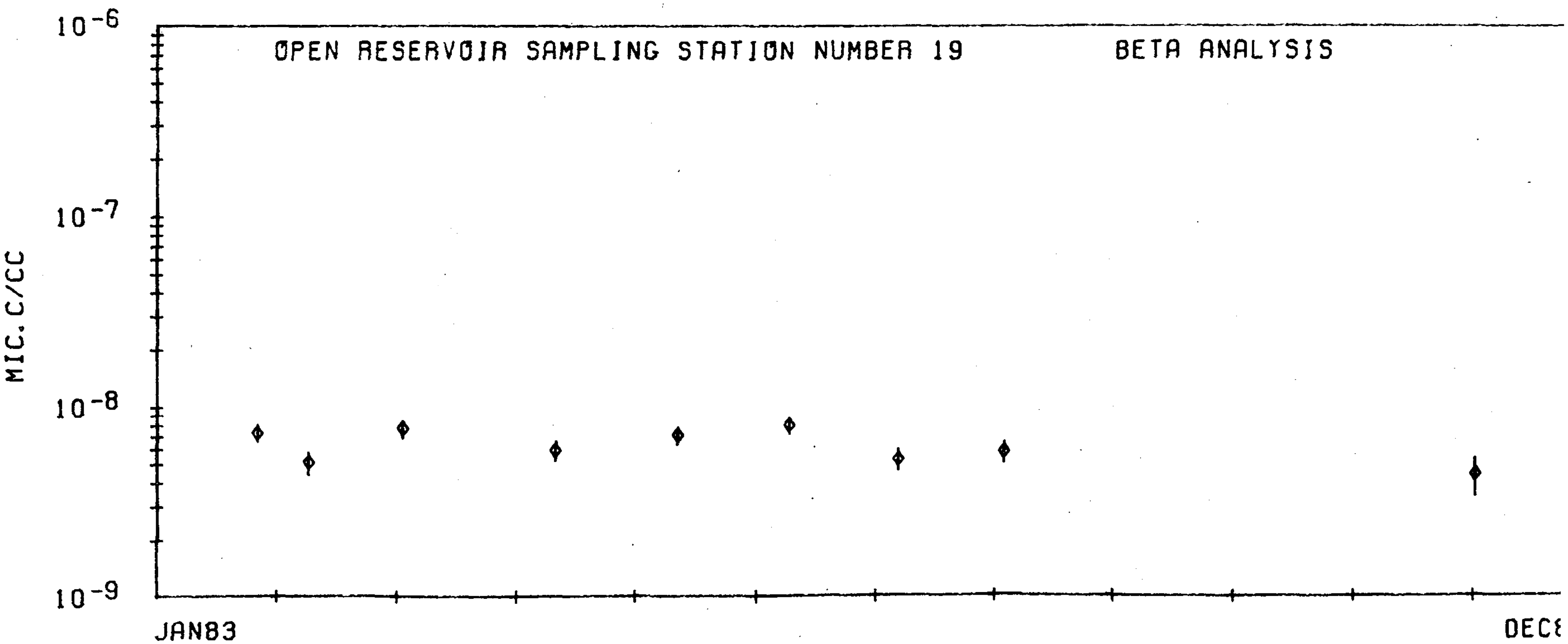

OPEN RESERVOIR SAMPLING STATION NUMBER 8
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9

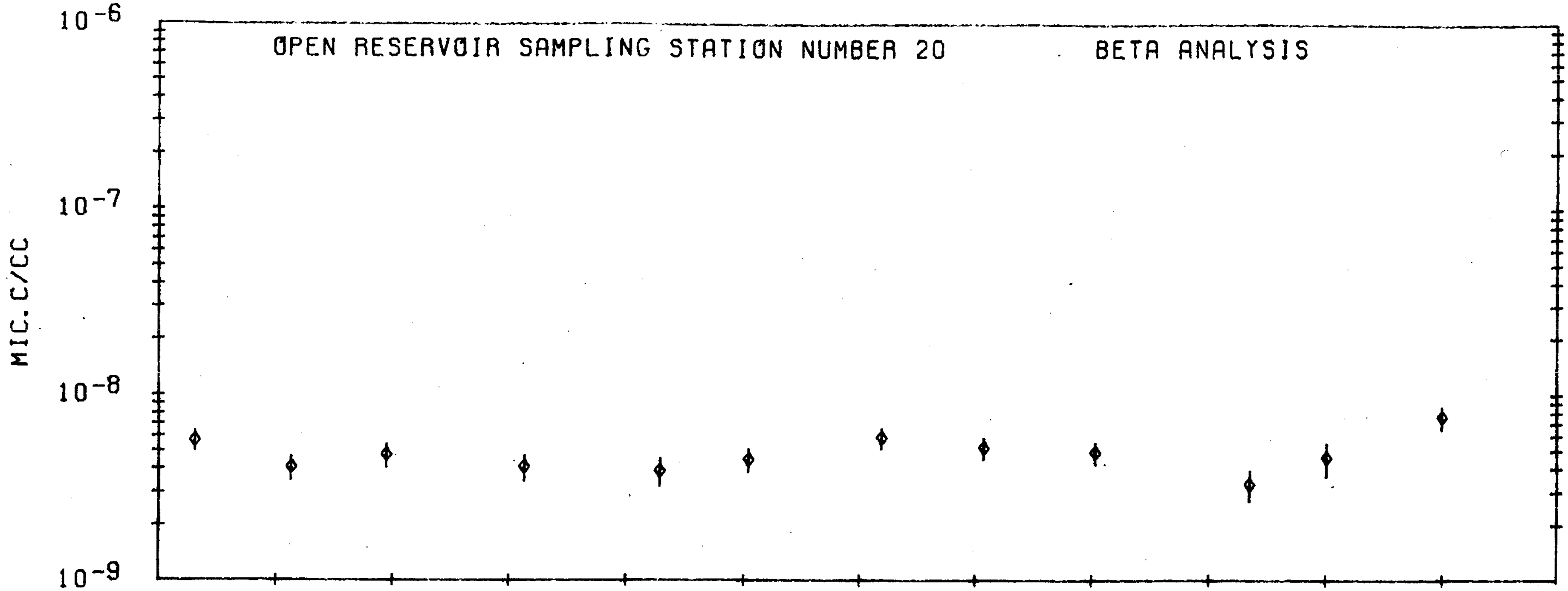

OPEN RESERVOIR SAMPLING STATION NUMBER 11
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN83

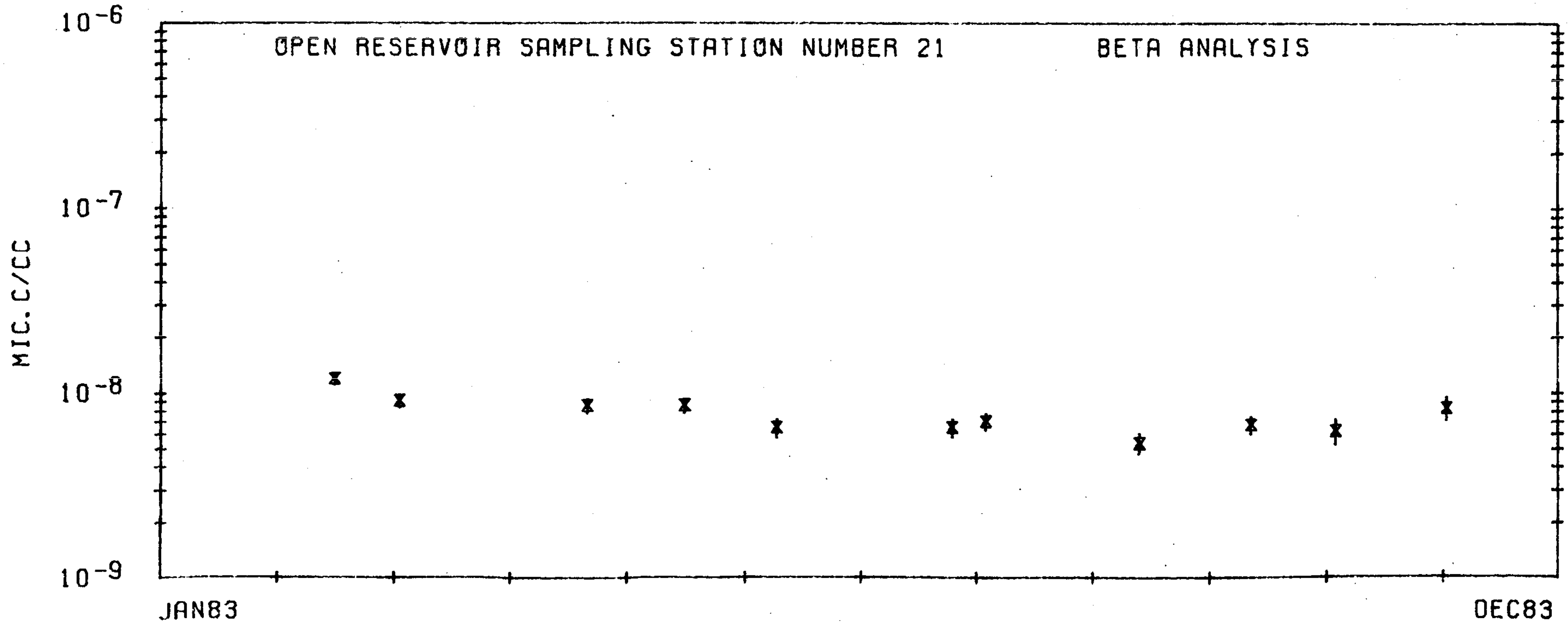

OPEN RESERVOIR SAMPLING STATION NUMBER 12
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

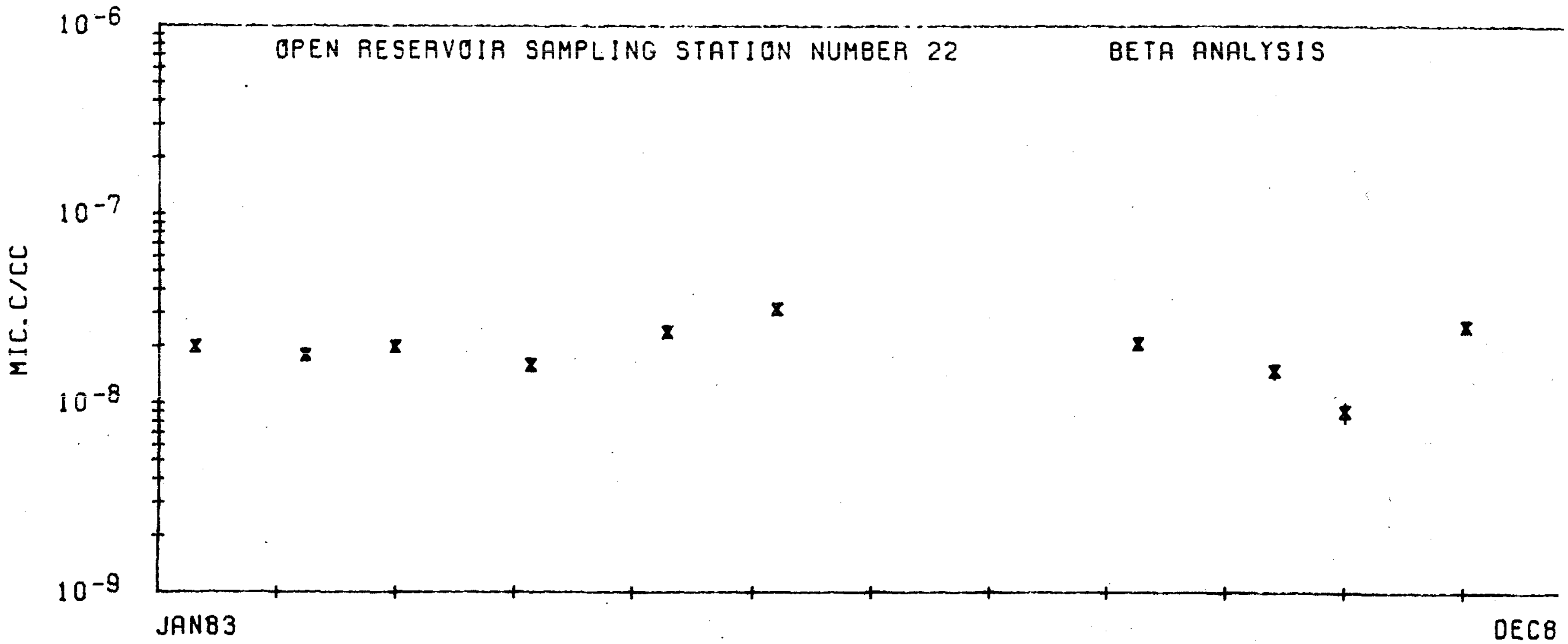

OPEN RESERVOIR SAMPLING STATION NUMBER 16
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC83


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


OPEN RESERVOIR SAMPLING STATION NUMBER 19
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC8


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


OPEN RESERVOIR SAMPLING STATION NUMBER 21
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC83


OPEN RESERVOIR SAMPLING STATION NUMBER 22
BETA ANALYSIS
10-6
10-7
10-8
10-9
MIC.C/CC
JAN83
DEC8

APPENDIX F

NTS Environmental Surveillance

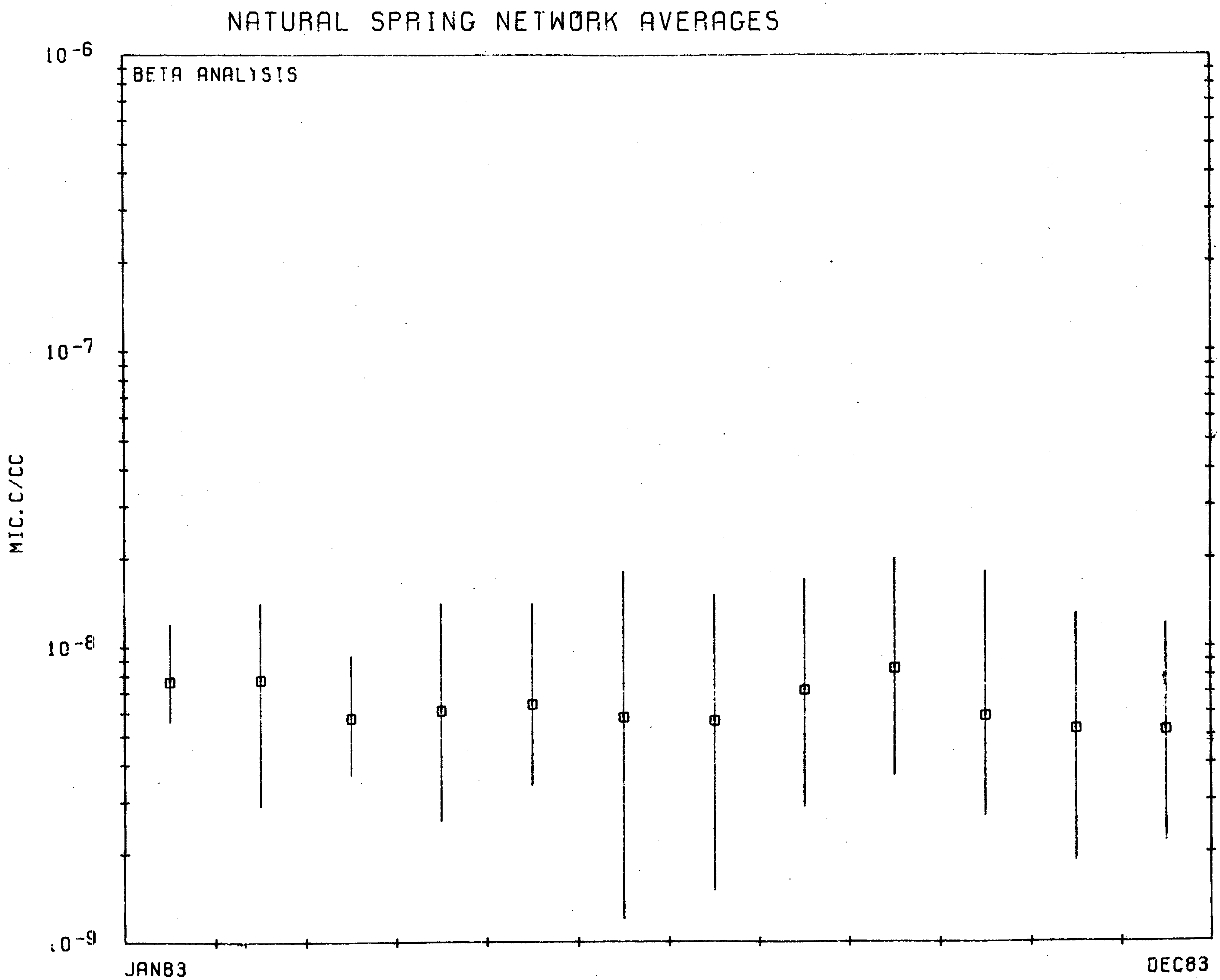
Natural Spring Locations and Plots

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.

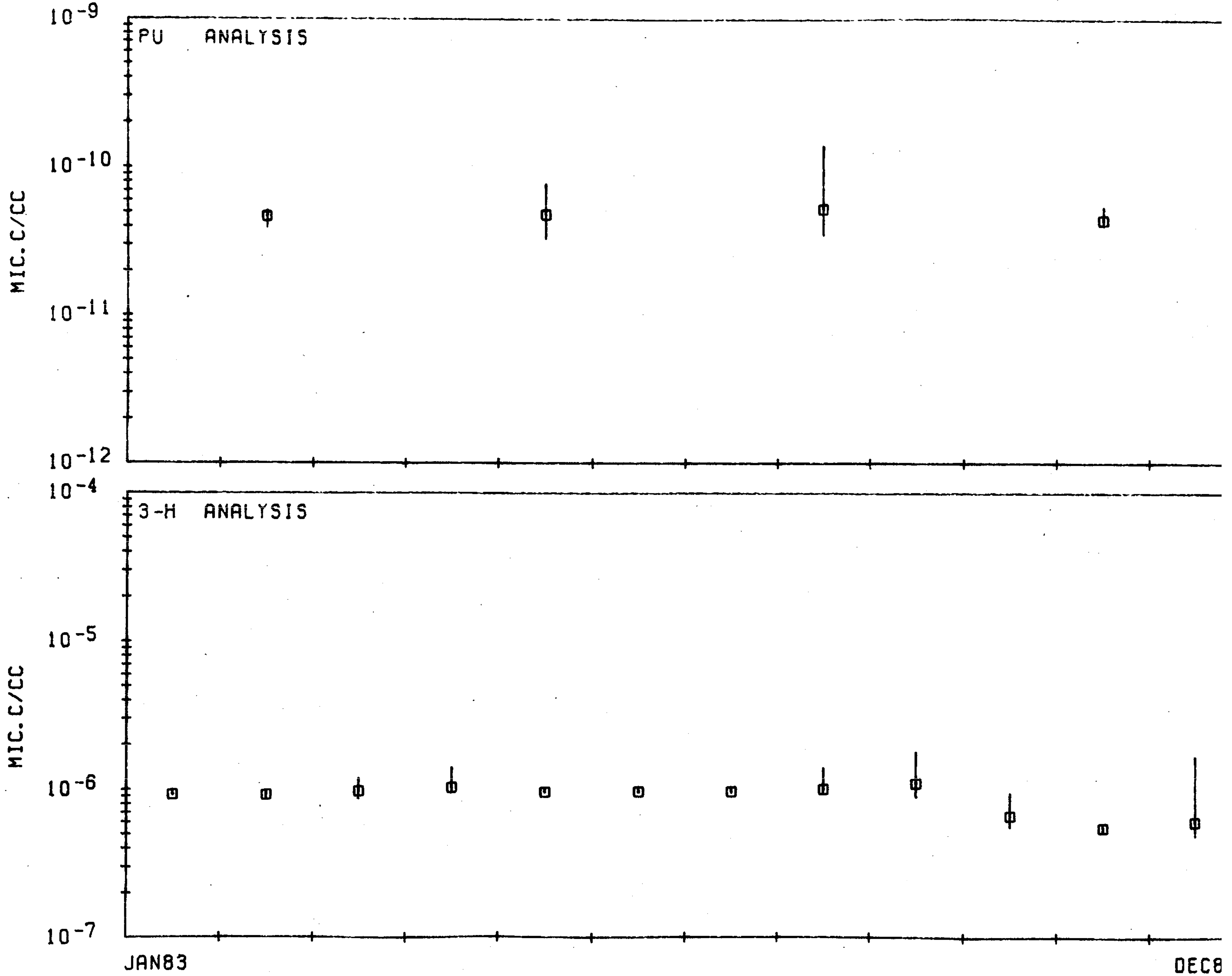
NTS ENVIRONMENTAL SURVEILLANCE
NATURAL SPRINGS SAMPLING LOCATIONS

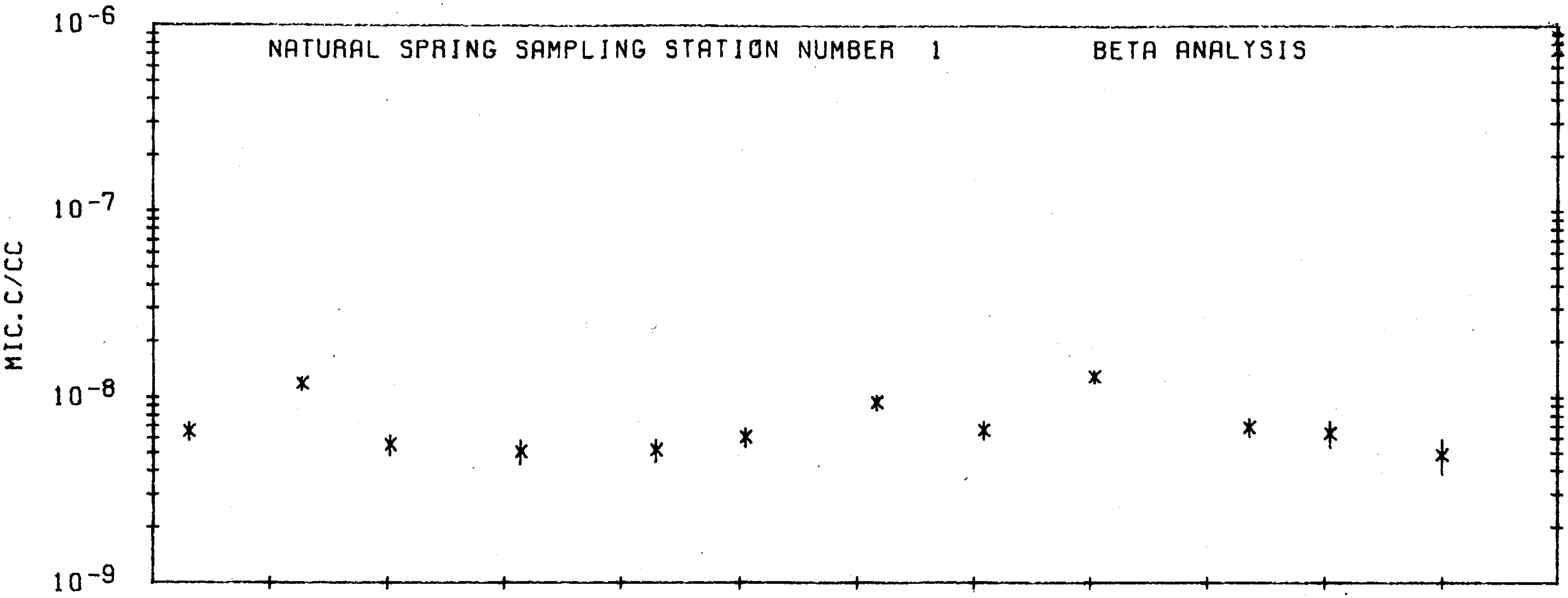
Station Number	Location
1	Area 5 Cane Springs
2	Area 12 White Rock Springs
3	Area 12 Captain Jack Spring
4	Area 12 Gold Meadows Pond
*5	Area 15 Oak Butte Spring
6	Area 15 Tub Spring
7	Area 29 Topopah Spring
8	Area 7 Reitmann Seep
9	Area 16 Tippipah Spring

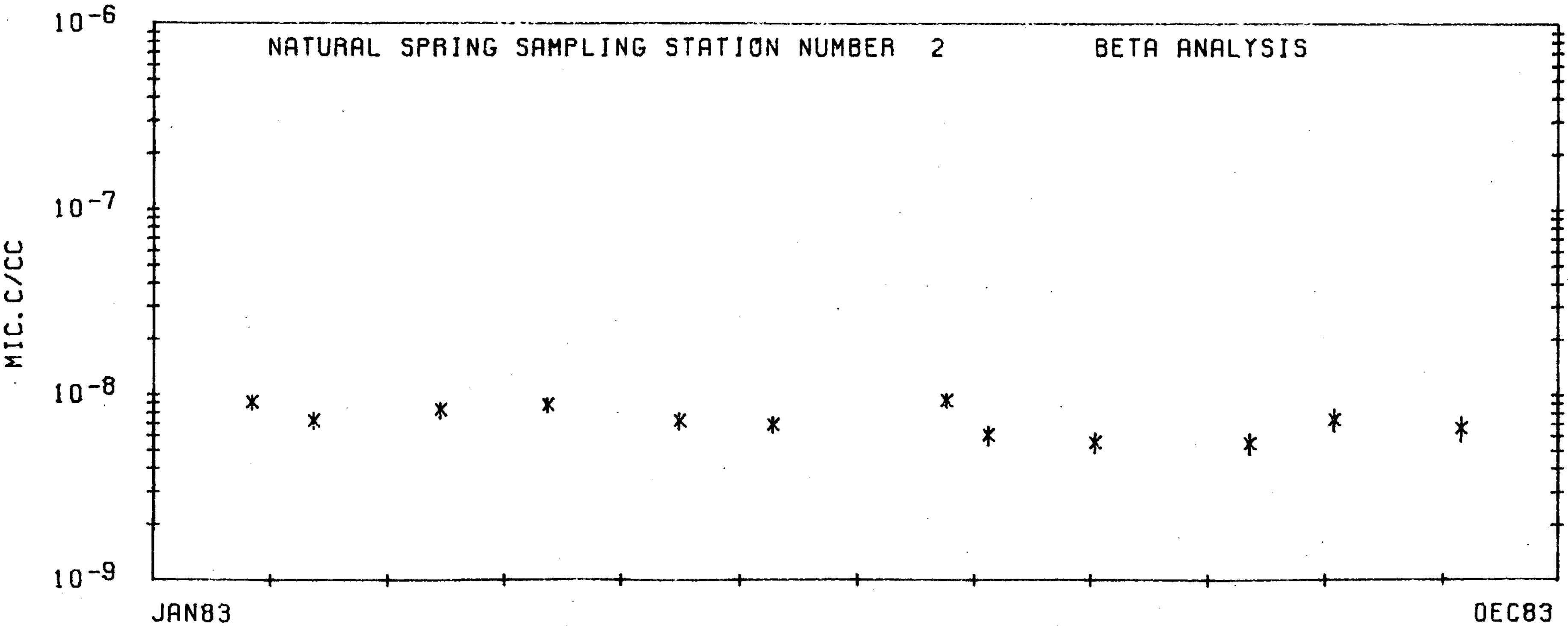
*Spring was dry.

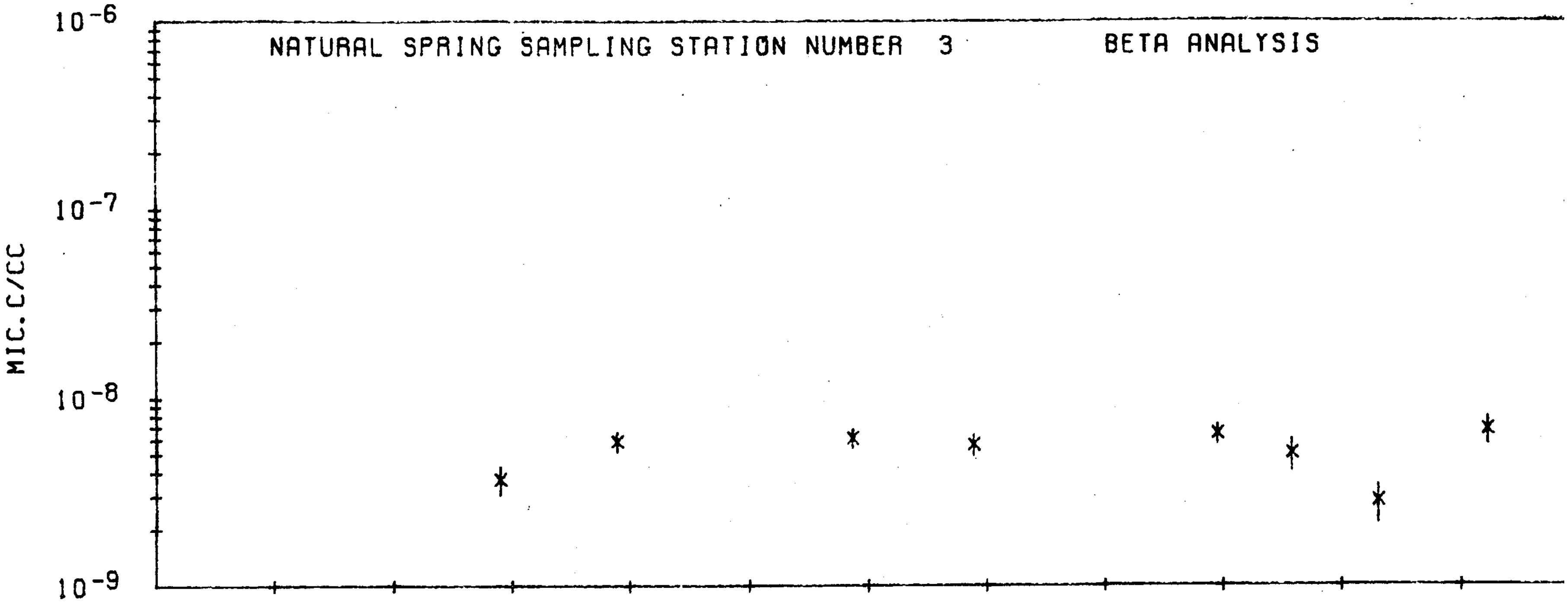

NATURAL SPRING NETWORK AVERAGES
BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹
JAN83
DEC83

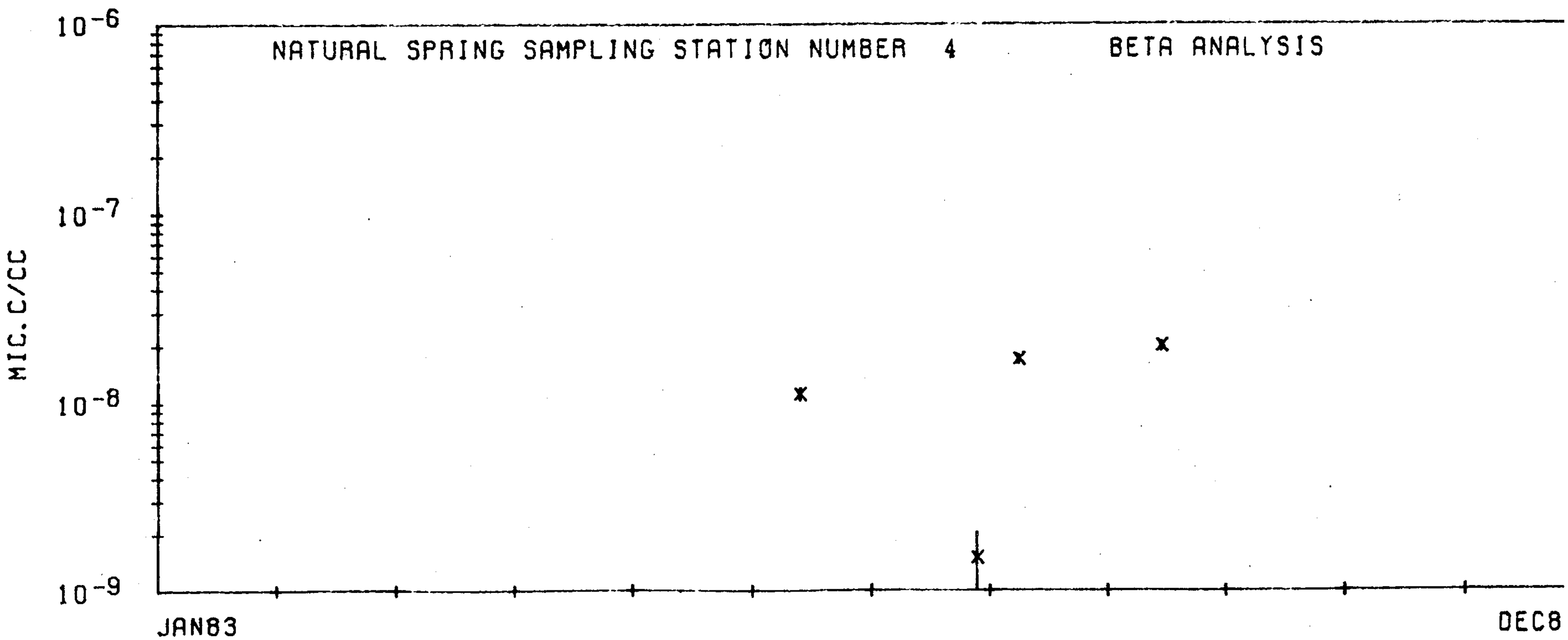
NATURAL SPRING NETWORK AVERAGES

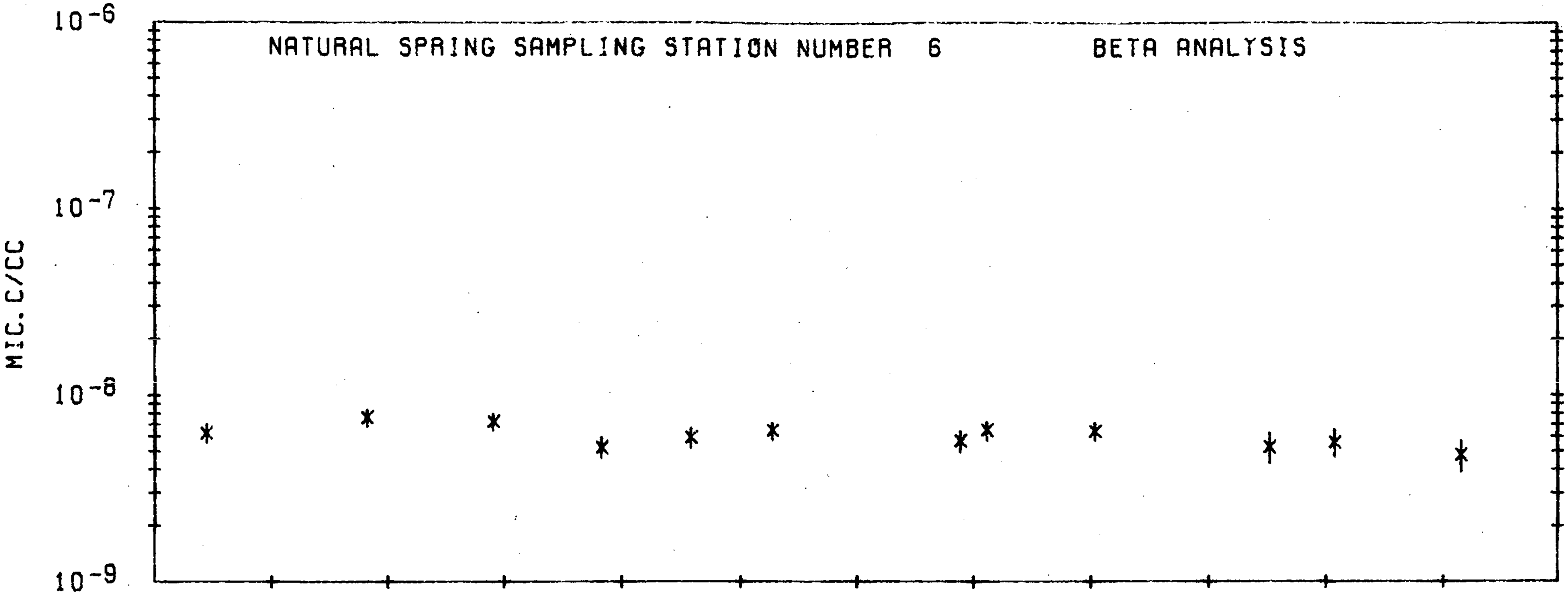


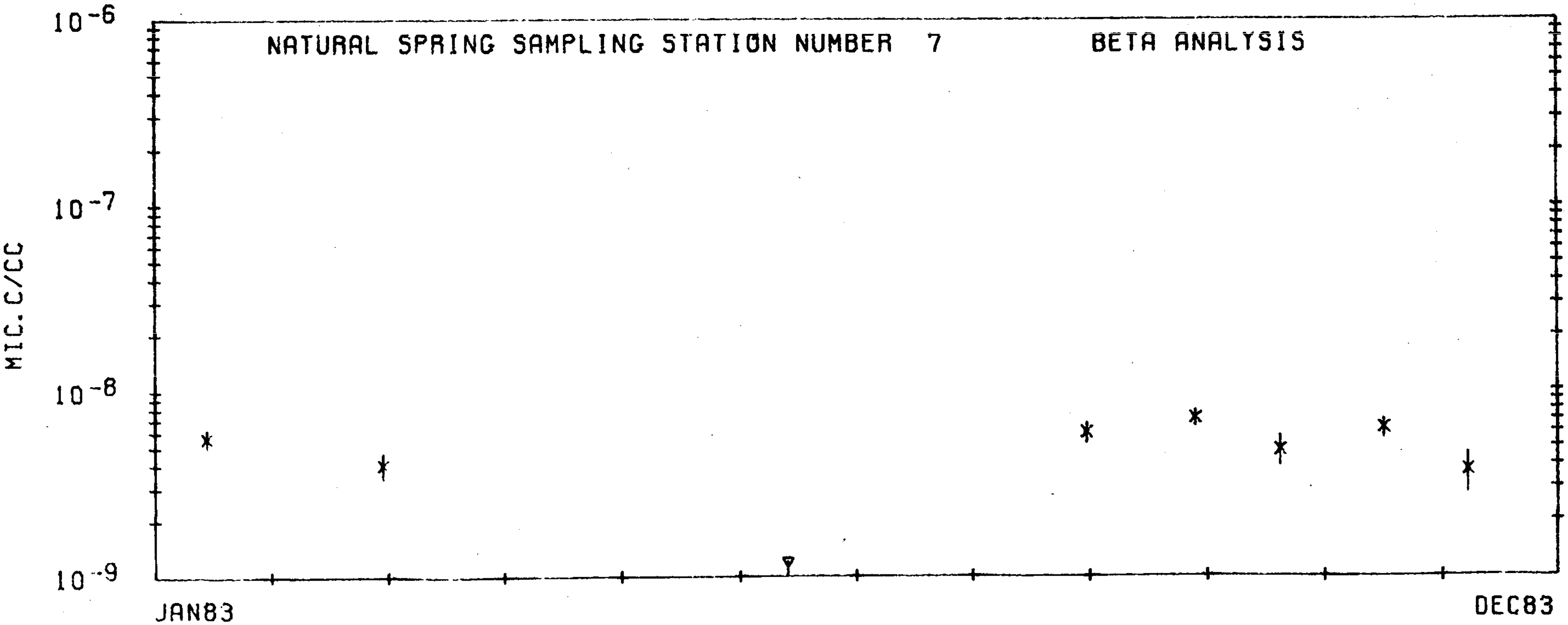

NATURAL SPRING SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

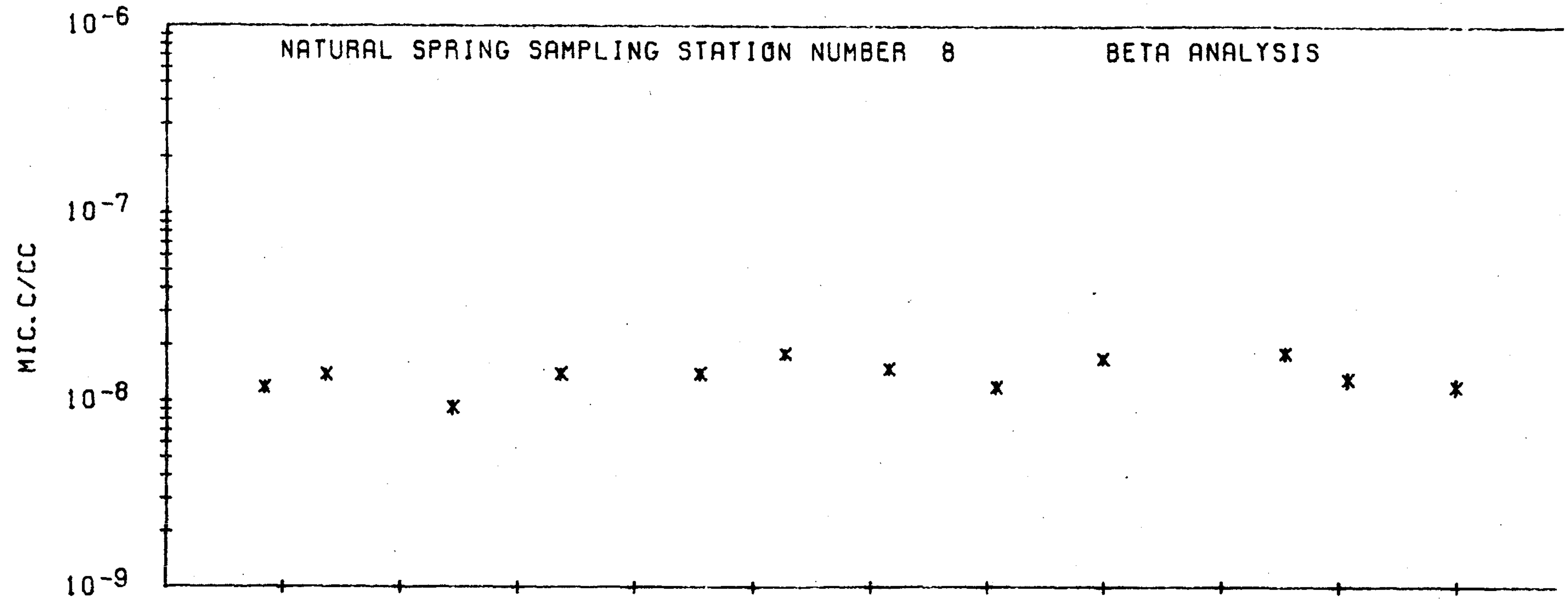

NATURAL SPRING SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC83

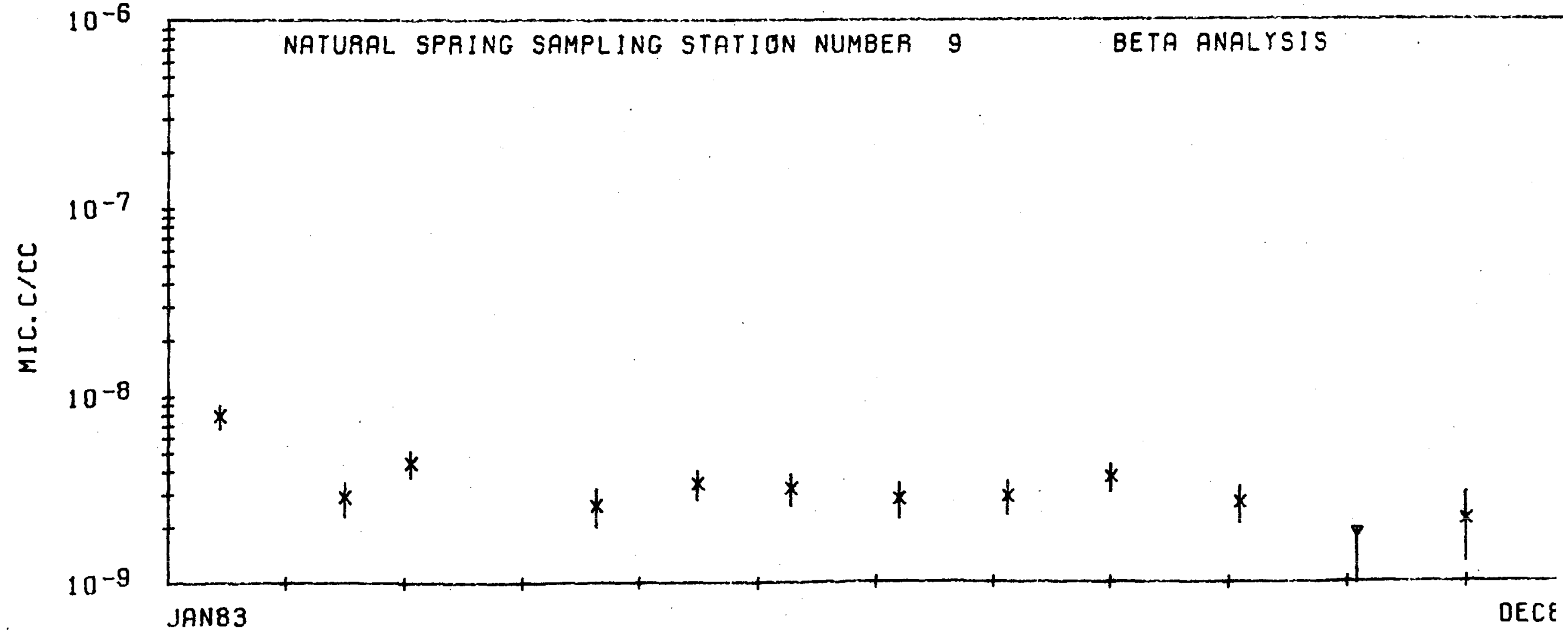

NATURAL SPRING SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


NATURAL SPRING SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC8


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


NATURAL SPRING SAMPLING STATION NUMBER 7
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DEC83


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


NATURAL SPRING SAMPLING STATION NUMBER 9
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN83
DECE

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.

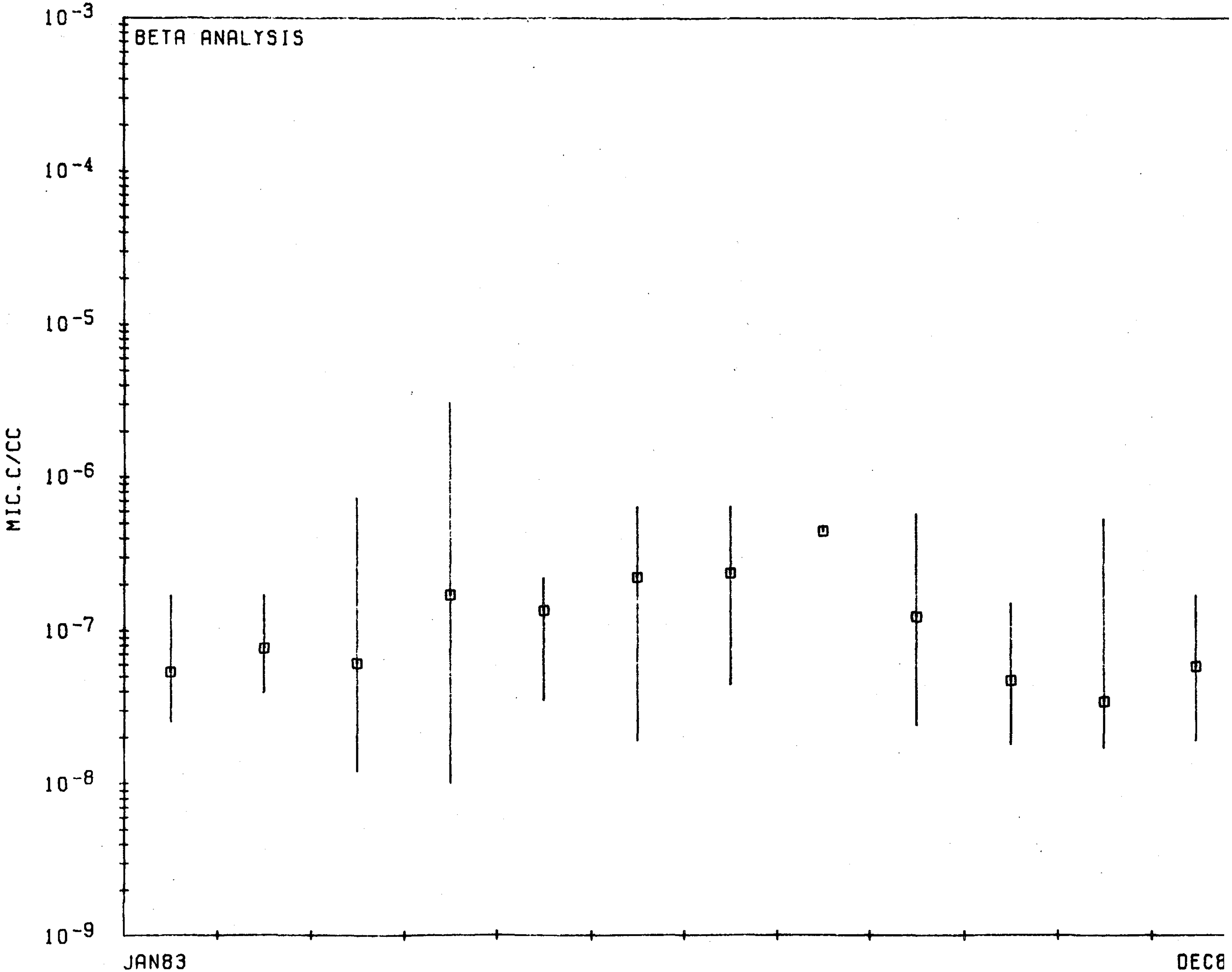
The remaining plots show the gross beta of each station. A two-sigma error bar is also added to the data points, and, in all plots, a delta with a line to the bottom of the plot means below detection limit.

NTS ENVIRONMENTAL SURVEILLANCE
CONTAMINATED PONDS SAMPLING LOCATIONS

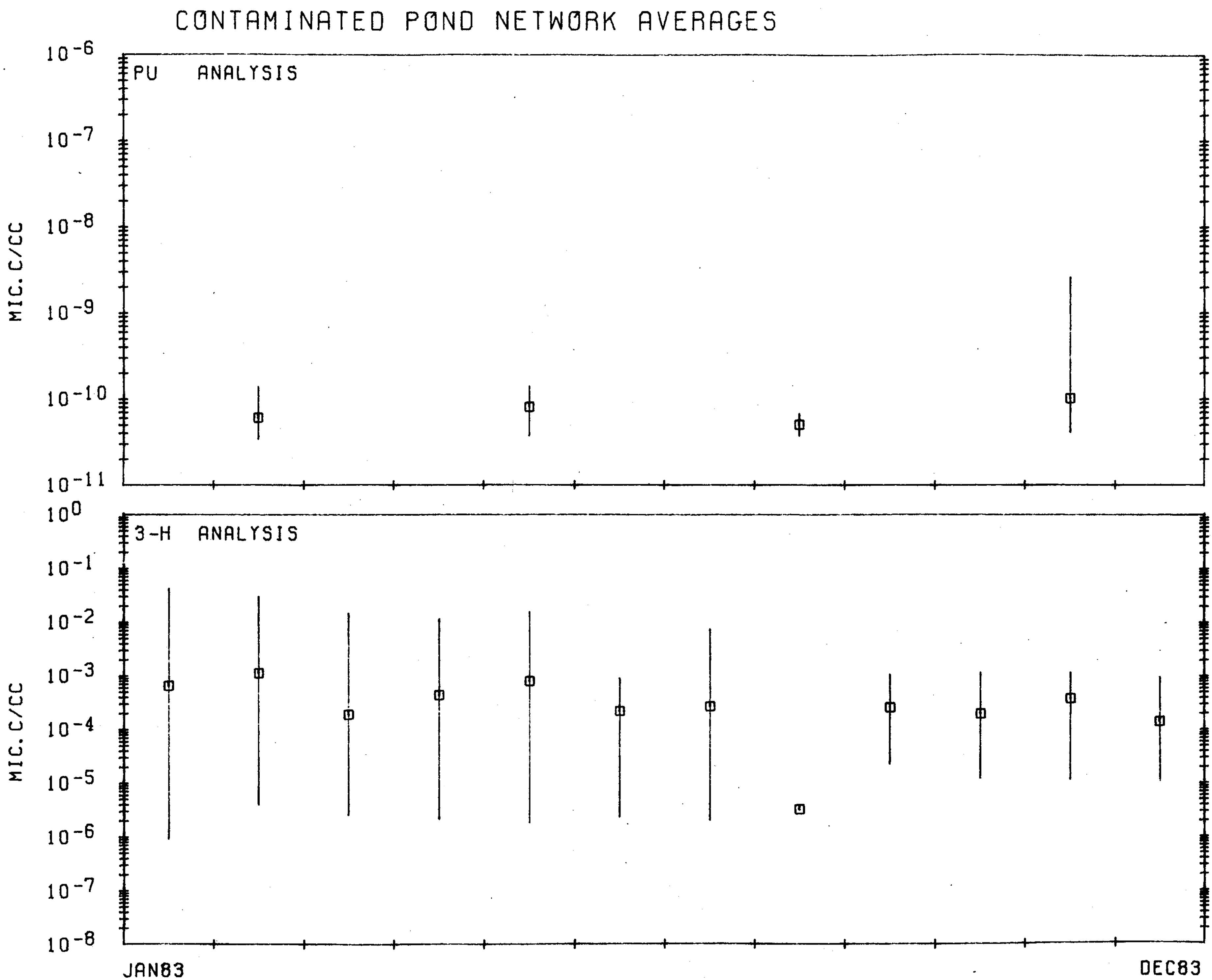
Station Number	Location
5	Area 12 Upper Mint Lake
6	Area 12 Middle Mint Lake
8	Area 12 N Upper
9	Area 12 N Mid
10	Area 12 N Lower
11	Area 12 G Tunnel
*12	Area 23 H&S Sump
13	Area 6 Yucca Decontamination Pond

*Pond was dry.

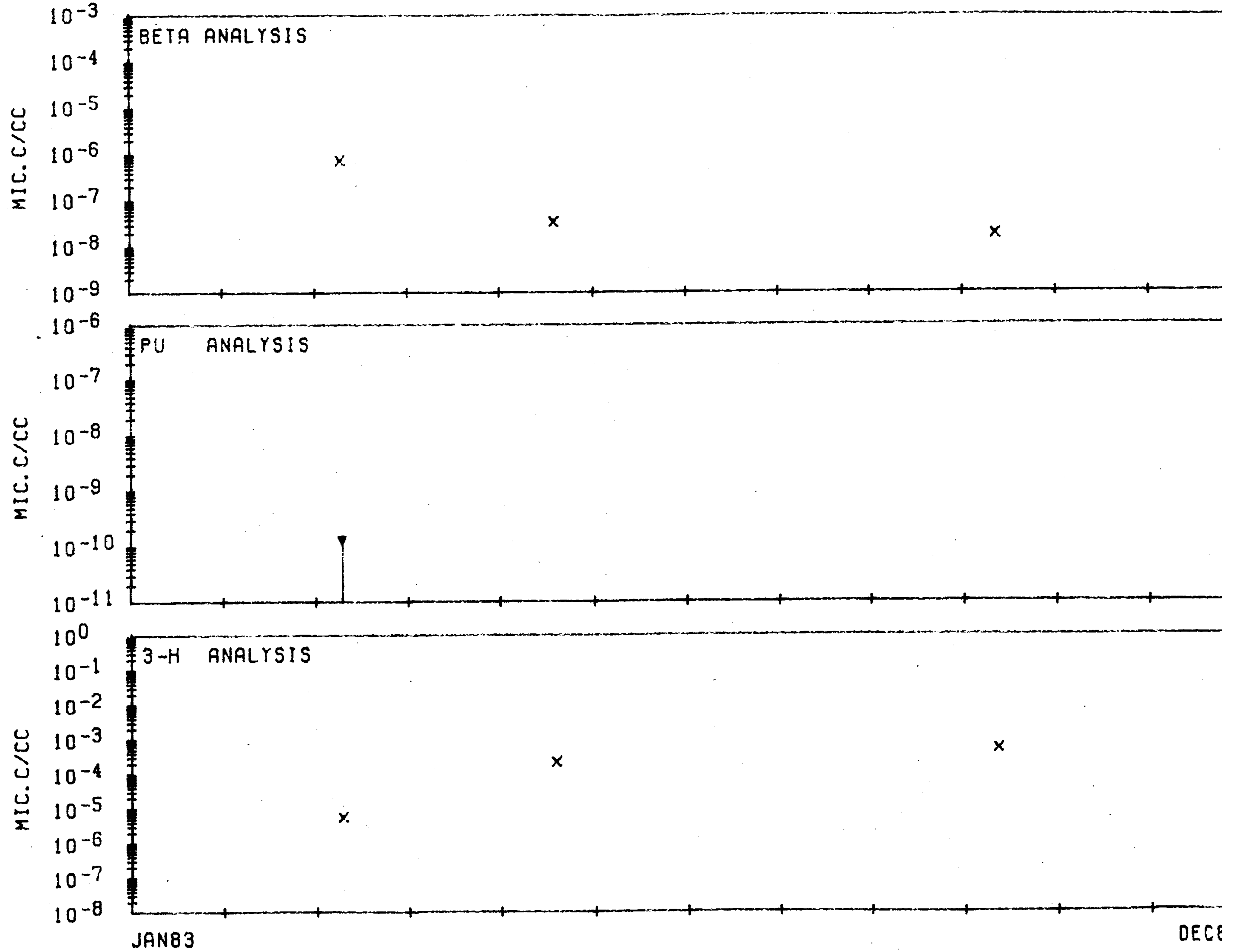
CONTAMINATED POND NETWORK AVERAGES



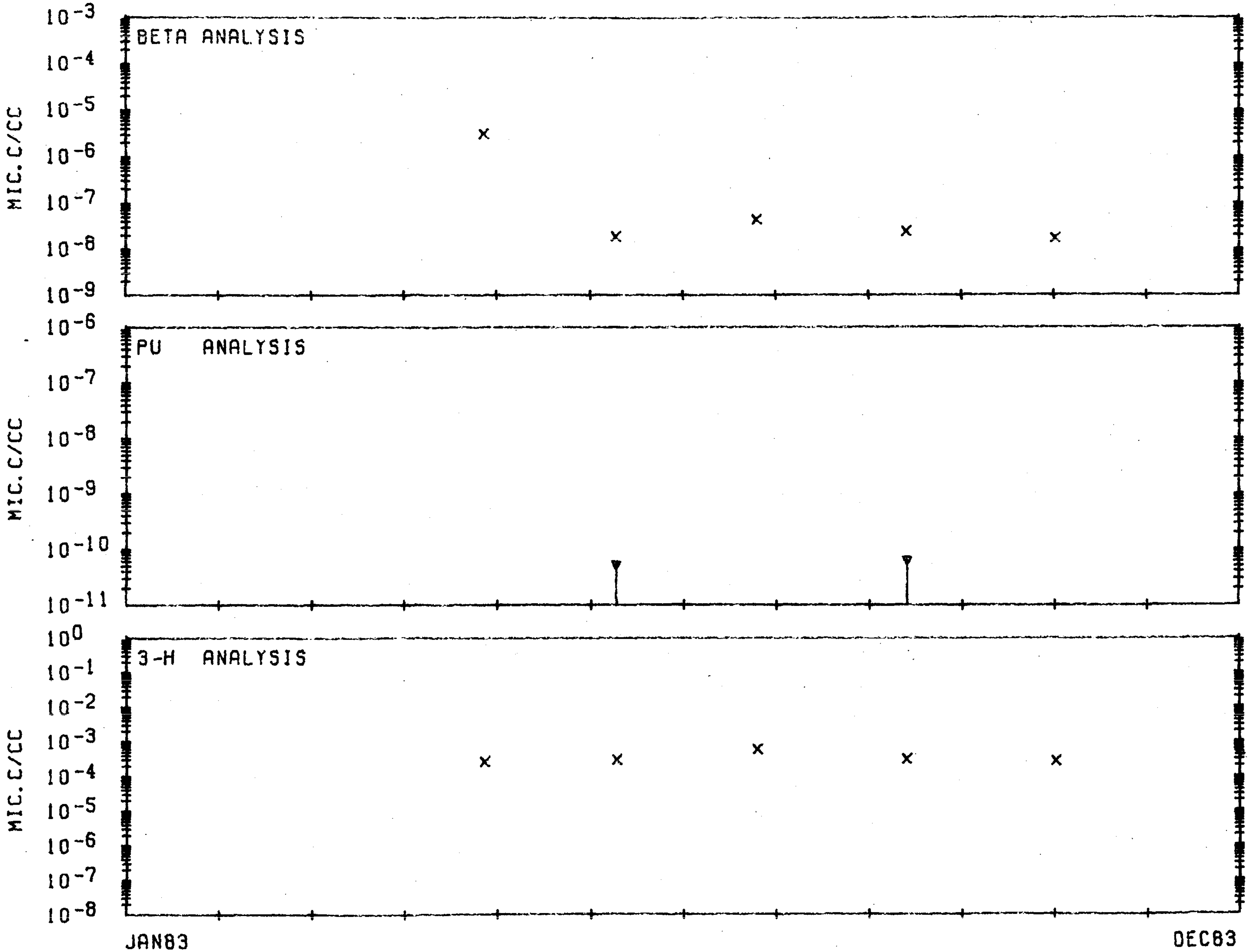
195

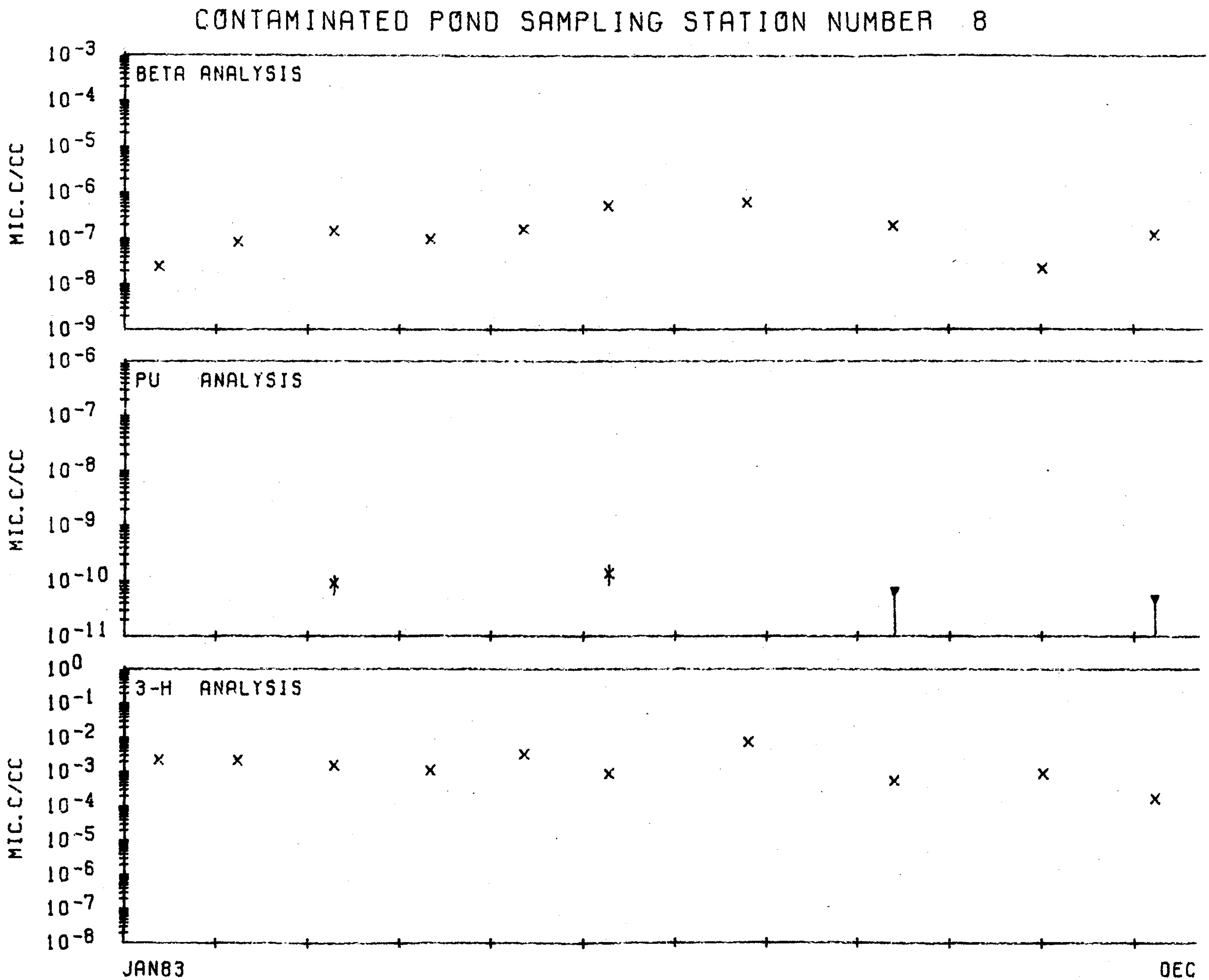

CONTAMINATED POND NETWORK AVERAGES
PU ANALYSIS
3-H ANALYSIS
MIC.C/CC
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
10^-10
10^-11
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
JAN83
DEC83

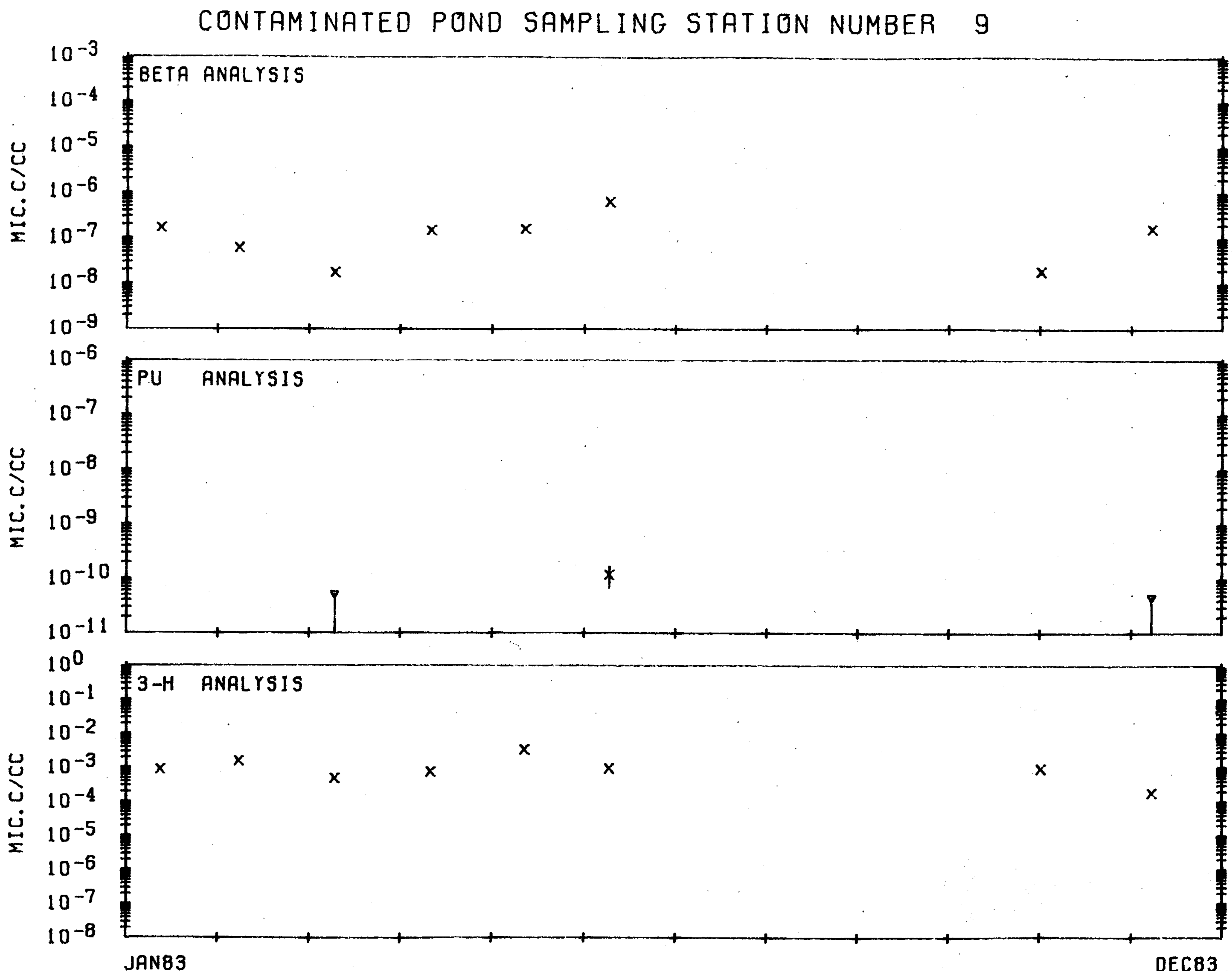
CONTAMINATED POND SAMPLING STATION NUMBER 5



CONTAMINATED POND SAMPLING STATION NUMBER 6

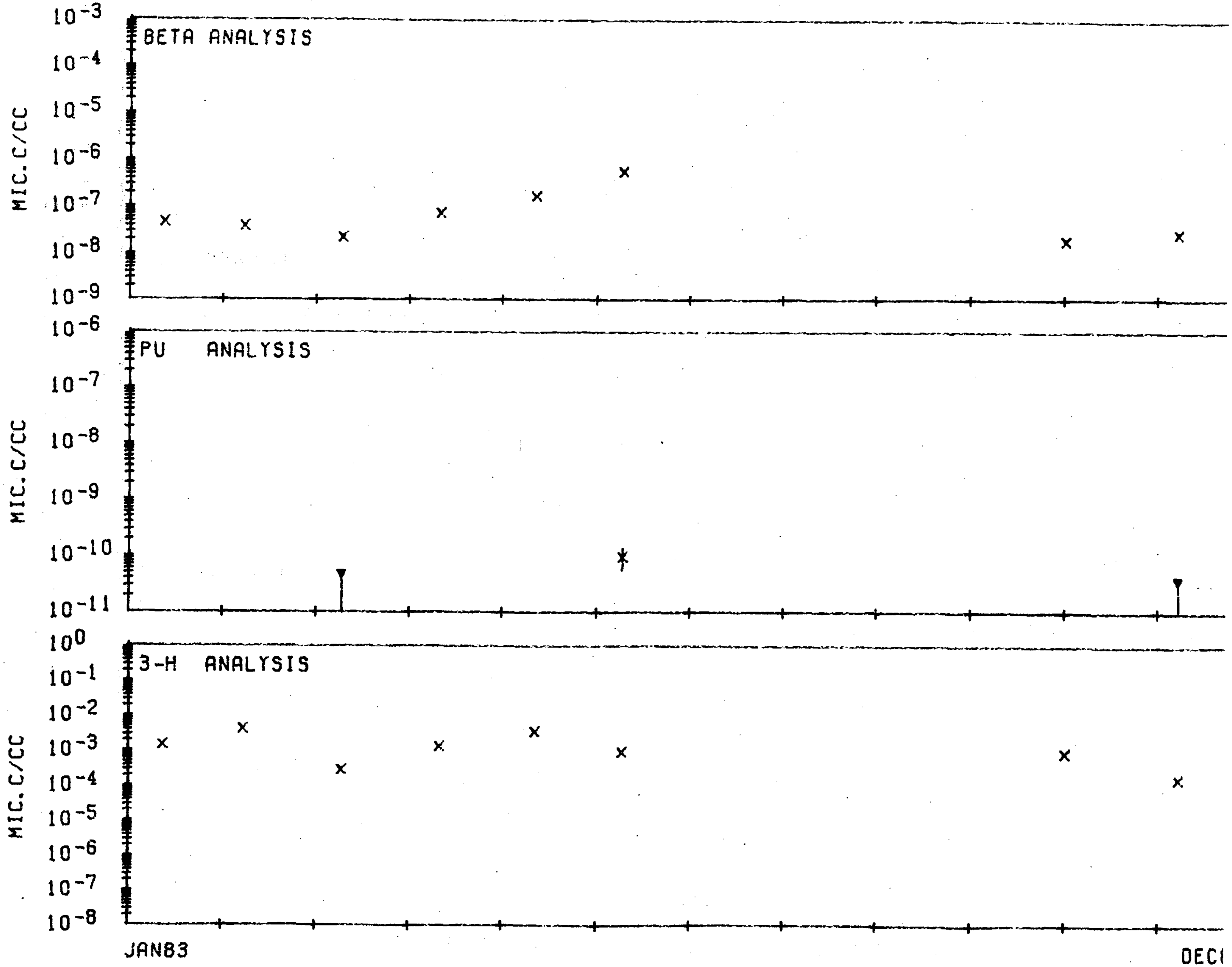


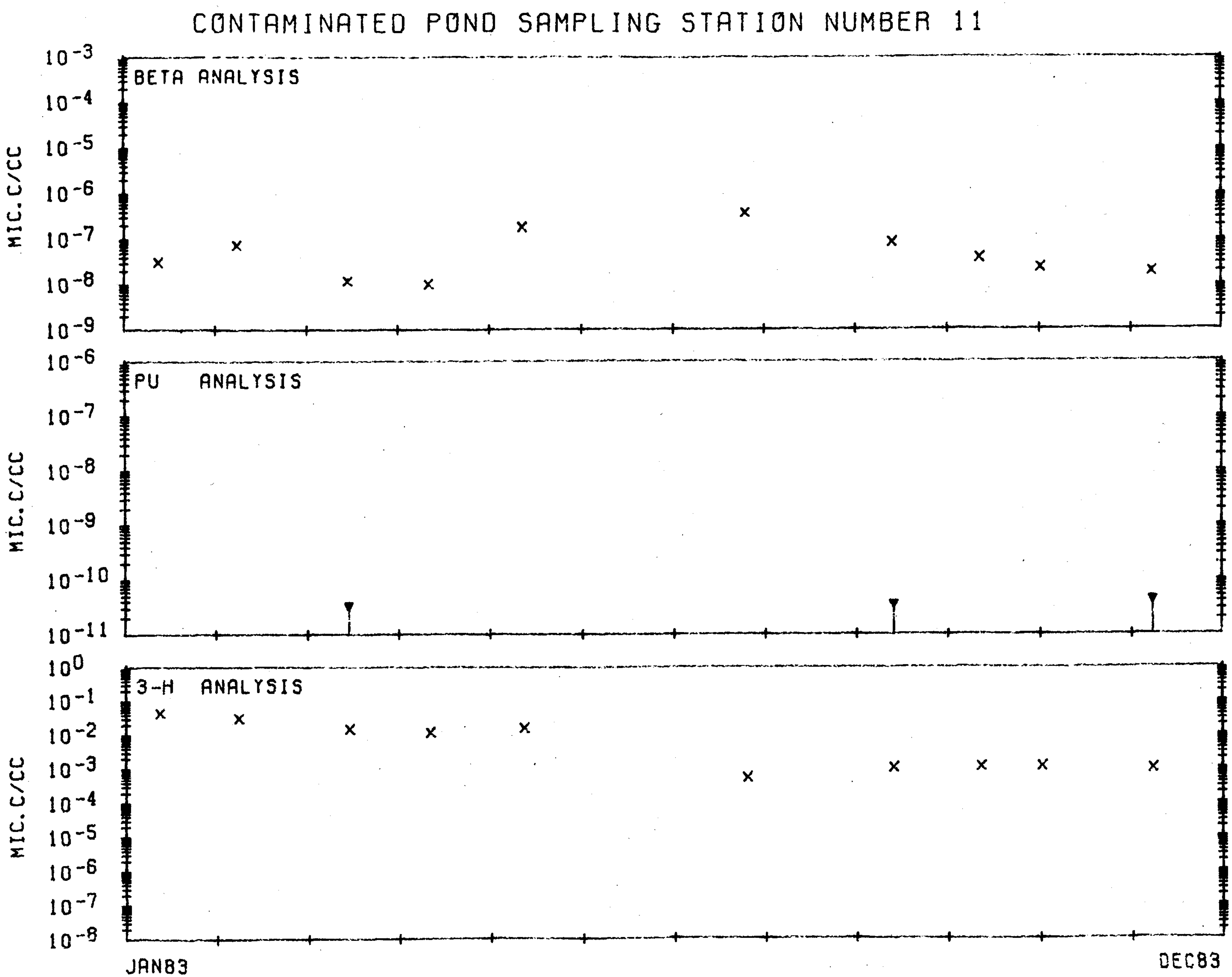

CONTAMINATED POND SAMPLING STATION NUMBER 8
BETA ANALYSIS
PU ANALYSIS
3-H ANALYSIS
MIC.C/CC
MIC.C/CC
MIC.C/CC
JAN83
DEC



CONTAMINATED POND SAMPLING STATION NUMBER 9
BETA ANALYSIS
PU ANALYSIS
3-H ANALYSIS
MIC.C/CC
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{0}
10^{-1}
10^{-2}
JAN83
DEC83

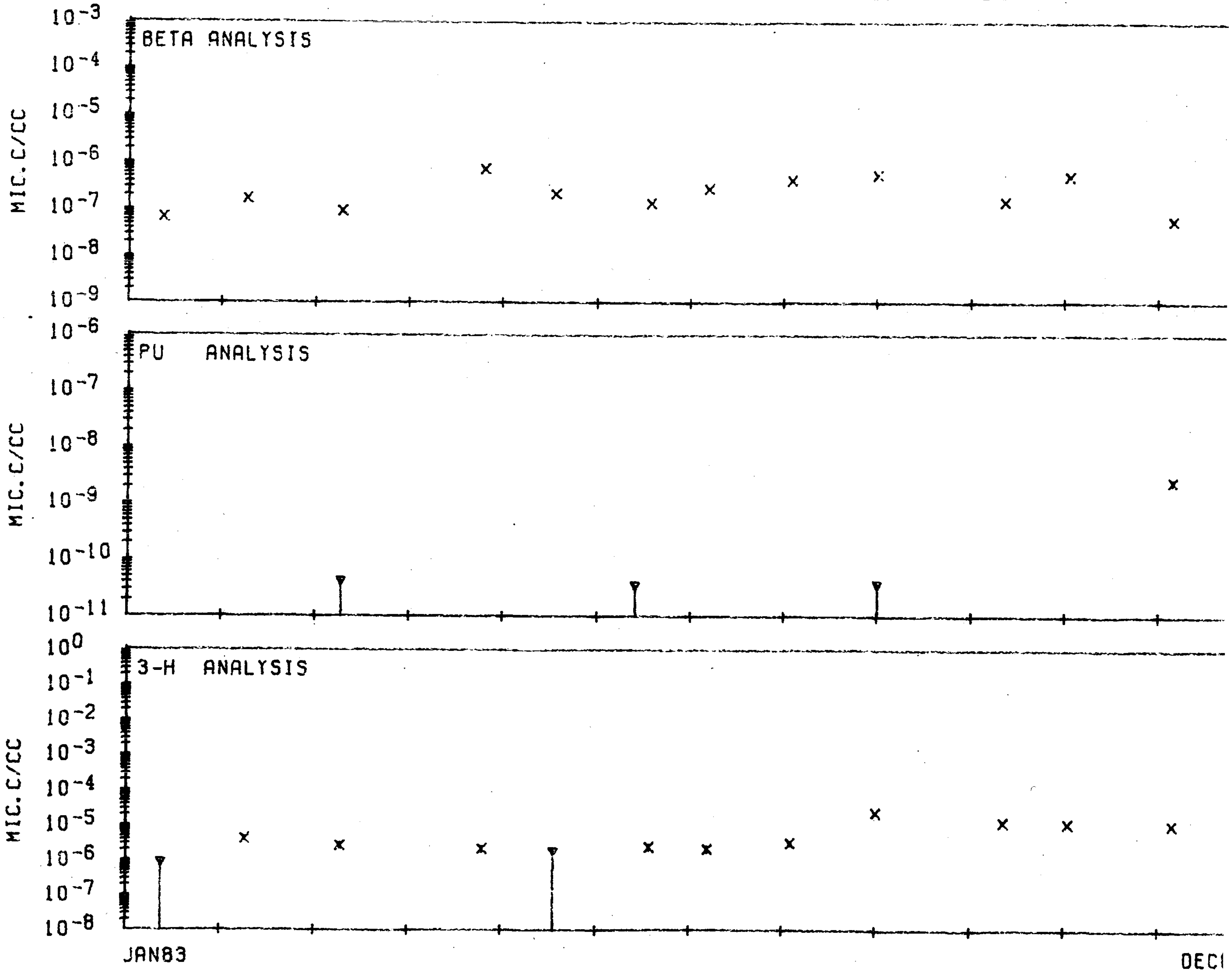
CONTAMINATED POND SAMPLING STATION NUMBER 10





CONTAMINATED POND SAMPLING STATION NUMBER 11
BETA ANALYSIS
PU ANALYSIS
3-H ANALYSIS
MIC.C/CC
JAN83
DEC83

CONTAMINATED POND SAMPLING STATION NUMBER 13



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