51268

DOE/NV/00410-67

DOE/NV/00410-67

#5

ENVIRONMENTAL SURVEILLANCE REPORT FOR THE NEVADA TEST SITE (JANUARY 1981 THROUGH DECEMBER 1981)

MAY 1982

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-AC08-76NV00410

Reynolds Electrical & Engineering Co., Inc.
P.O. Box 14400 ● Las Vegas, Nevada 89114-4400

IN REPLY REFER TO:

E R R A T A

ENVIRONMENTAL SURVEILLANCE REPORT
FOR THE NEVADA TEST SITE
(JANUARY 1981 THROUGH DECEMBER 1981)

DOE/NV/00410-67

Please make the following changes in the report(s) in your possession.

The following tables are amended as follows:

Page 4, Table 1

Change CaF^2:Dy to CaF_2:Dy

Pages 55-57, Table 16

Change heading 1981 ADJUSTED ANNUAL DOSE (mrem/h) to 1981 ADJUSTED ANNUAL DOSE (mrem/y)

Page 66, Table 21, Note *e*

Change 10 mrad/h to 10 μrad/h

DOE/NV/00410-67

ENVIRONMENTAL SURVEILLANCE REPORT
FOR THE
NEVADA TEST SITE
(JANUARY 1981 THROUGH DECEMBER 1981)

MAY 1982

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-AC08-76NV00410

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 1981 through December 1981. 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

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

Credit must be given to D. Douglass, D. Wilson and S. Pfeuffer 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 & Engineering Co., Inc. (REECo) during the calendar year of 1981. As part of its contract, DE-AC08-76NV00410, 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 (Figure 1). 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. For a detailed description of the location, background, and existing environment of the Nevada Test Site, see Reference 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

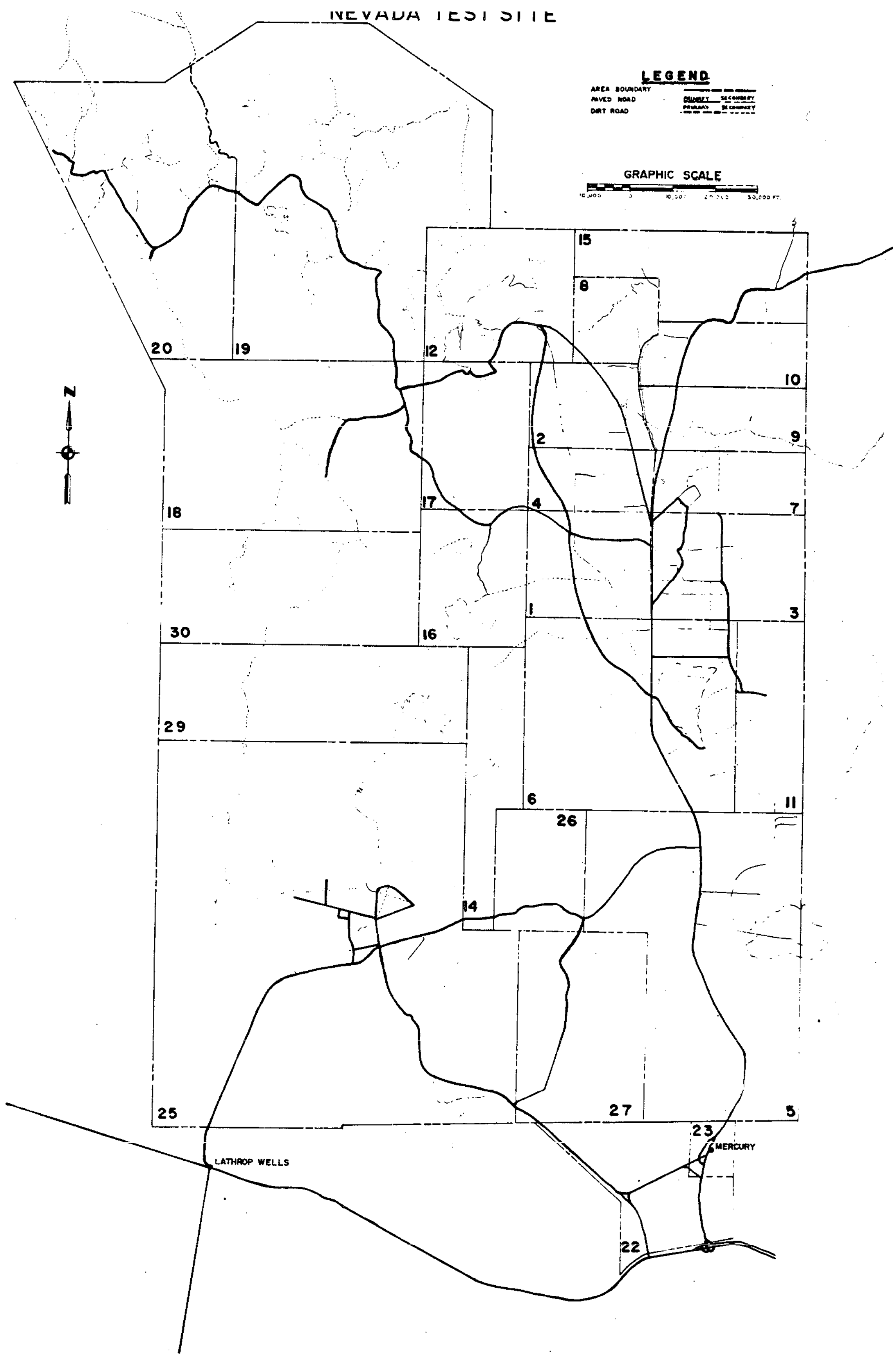

NEVADA TEST SITE
LEGEND
AREA BOUNDARY
PAVED ROAD
DIRT ROAD
GRAPHIC SCALE
30,000 FT.
N
15
8
12
20
19
10
9
2
7
17
4
18
3
1
30
16
29
6
11
26
14
25
27
5
23
MERCURY
LATHROP WELLS
22

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 survey the ambient NTS external gamma levels and are collected on a quarterly

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	Bimonthly Monthly	3 1	HT-HTO
Potable Water	1-liter grab sample.	Weekly	9	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)
Effluent Ponds	4-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.
Contaminated Ponds	1-liter grab sample.	Monthly	6**	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.

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 has proved its importance by indicating the arrival of fresh fission products in the air after foreign nuclear testing. The analysis of the timing of these fission products dismisses the Nevada Test Site as the source. 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 analvsis was used principally as a check of the water in the ponds below the Area 12 tunnels. Gross gamma analysis was used as a screening tool for elevated gamma activity in NTS water samples. It was found to be of minimal use to this program.

TABLE 2

DOE CONCENTRATION GUIDES (CGs) FOR CONTROLLED AREAS[1]

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}
^{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}
^{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}

[1] This table contains the concentration guides for the nuclides of major interest at the NTS (DOE Order 5480.1, 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	1×10^{-16} µCi/cc
	Water	Wide Beta II	100	Evaporate, transfer residue to a 12.7 cm stainless steel planchet	1000 ml	5×10^{-10} µCi/ml
Gross Gamma	Water	23 cm x 23 cm NaI Well crystal	20	Aliquot sample into Nalgene bottle	500 ml	6×10^{-8} µCi/ml
Gamma Spectroscopy	Air (particulate)	Ge(Li)	20	Same as 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	Count the planchet after beta analysis	500 ml	1×10^{-8} 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	4×10^{-7} µCi/ml
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
Direct Gamma Radiation	TLD	Harshaw 2000		Post-anneal at 115°C for 15 minutes. Readout to 270° for 25 seconds		5 mR/quarter

B. SUMMARY OF RESULTS

The results obtained from the environmental surveillance program for the reporting period of CY-1981 show that the radioactivity in air and water in the NTS environments was low compared to DOE guidelines. In general, ^{239}Pu concentrations in air were slightly higher in the first half than the second half of the year. 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-1981 average gross beta concentration in air was 1.9×10^{-13} μCi/cc at station 39, Area 5 RWMS #5. This average represents 0.019 percent of the applicable concentration guide of 1×10^{-9} μCi/cc as listed in DOE Order 5480.1, Chapter XI (assuming ^{90}Sr is the beta emitter present). The stations that were sampled over the entire report period demonstrated similar results. The site average for the forty-seven stations was 1.6×10^{-14} μCi/cc with one standard deviation being nine percent. The increase of gross beta concentrations in air during the first half of the year was attributed to fallout from the foreign nuclear atmospheric test of the previous year. The maximum weekly average for gross beta activity occurred in the week of May 11 of 4.9×10^{-13} μCi/cc. During the second half of the year there was a decreasing trend of gross beta activity. The average gross beta activity for the last two weeks of CY-1981 approached the baseline value of the first half of CY-1980.

^{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 5480.1, Chapter XI). The ^{239}Pu concentrations, generally, followed the same pattern as the gross beta concentrations in air. The first six months concentrations were greater than the second six months'. The highest average ^{239}Pu concentration occurred in Area 9 at the 9-300 Bunker #2. This ^{239}Pu concentration of 3.6 X 10^{-16} μCi/cc represents 0.018 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.

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 1.8 X 10^{-8} μCi/ml from the Area 15 EPA Farm and 1.6 x 10^{-8} μCi/ml from Area 6 Well C1. Gross beta analysis of the open reservoirs indicated slight excesses above their respective ^{40}K activities. Water from one open reservoir (A-5 resevoir) and three natural springs (White Rock, Captain Jack Springs, and the Reitmann Seep) 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 ^{239}Pu concentration in water was 9.9 x 10^{-10} μCi/ml at Well Ue5c Reservoir. This represents 0.0009 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 detection limit for tritium increased from the previous year because the sample size was decreased to 2-ml. This represented an increase in the detection limit from 1 X 10^{-7} μCi/ml in CY-1980 to 4 X 10^{-7} μCi/cc for CY-1981. The highest concentration of tritium in noncontaminated water occurred at Well J-13. This concentration of 3.6 x 10^{-5} μCi/ml represents 1.2 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 minimal changes throughout CY-1981. A nine station control network displayed a small increase over previous years, while the remaining 154 stations recorded only a few small changes related to known effects. Rates were recorded up to 3500 mrem/y at the 4-04 road station, but the majority of NTS locations measured in the range of approximately 100-160 mrem/y.

The maximum dose to an individual living at the NTS boundary was calculated for CY-1981. The maximum calculated dose to the total body, bone, and lung was 0.6 mrem, 21.0 mrem, and 1.2 mrem respectively. Using the values from Reference 17, these doses represent risks for radiation-induced cancers of 9.9×10^{-8} (total body), 1.0×10^{-7} (bone), and 2.4×10^{-8} (lung) to the individual.

C. SAMPLING AND ANALYSIS

1. Air Monitoring

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

The sampling units consist of a positive displacement pump drawing air at approximately 100 liters per minute through a 9-centimeter 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. A nominal minimum detection limit (MDL), defined as that value for which the relative two sigma counting error was 100 percent, for the typical parameters involved was 1 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. A nominal minimum detection limit (MDL) for this analysis was 1 X 10^{-17} µCi/cc for the parameters involved.

A separate sampler was designed for the collection of airborne tritium (HT) and tritiated water vapor (HTO) (Reference 4). It was portable and 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 a silica gel drying column. The dry air then passed through a catalytic converter containing platinum to generate HTO from HT according to the reaction $2HT + O_2 \xrightarrow{Pt} 2HTO$. The generated vapor was collected on another drying column to which a small volume of distilled water served as a trap for HTO and made a supplemental supply of hydrogen unnecessary. Appropriate aliquots of condensed moisture were obtained by heating the silica gel. Counting via liquid scintillation techniques allowed for the determination of the HT and HTO activities. A nominal MDL for this analysis was 3×10^{-13} μCi/cc.

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 and tritium concentrations, and were screened for gross gamma. 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 gross gamma activity in a NaI(Tl) well crystal. A 2-ml sample was aliquoted and subjected to tritium analysis via liquid scintillation. 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. Nominal MDL's were: (1) gross gamma, 6×10^{-8} μCi/ml; (2) tritium, 4×10^{-7} μCi/ml; and (3) gross beta, 5×10^{-10} 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 typical MDL for this procedure was 1×10^{-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 70 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 the 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. Of these forty-seven locations, forty-six stations (numbered 1-23 and 25-47) were sampled continuously over the entire report period. The one remaining location was installed in April, and sampled throughout the rest of the year. This new station was Area 5 Gate 200.

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 1981 gross beta and ^{239}Pu yearly locational averages, respectively. Tables 4 and 5 list these yearly averages along with the half-year averages. In previous years, the gross beta measurements have been the more important environmental indicators. The network average for the whole year for gross beta activity was 1.6 x 10^{-13} or 0.016 percent of the applicable concentration guide of 1 x 10^{-9} μCi/cc listed in DOE Order 5480.1, Chapter XI (assuming ^{90}Sr is the beta emitter present). The network average for CY-1981 was twenty-three percent higher than for CY-1980. All of the stations showed similiar increases in gross beta activity and therefore, this increase was attributed to the CY-1980 foreign nuclear atmospheric test and not a local event. The maximum average concentration for the whole network occurred during the week of May 11. The average gross beta concentration for this week was 4.9 X 10^{-13} μCi/cc or 0.05 percent of the concentration guide (assuming ^{90}Sr is the beta emitter present). After reaching this maximum the gross beta concentrations steadily declined to near baseline concentrations during the last two weeks of CY-1981. During the week of September 7 a slight leakage occurred. A special air sample was analyzed and no gross fission products were detected on it or the rest of the ambient air monitoring network.

Table 5 lists the ^{239}Pu concentrations for the year. All stations averaged below 10^{-15} μCi/cc for CY-1981, with the majority being on the order of 10^{-17} μCi/cc. The highest activity was found at 9-300 Bunker #2. The average concentration at this location was 3.6 X 10^{-16} μCi/cc, or 0.18 percent of the controlled area concentration guide of 2 X 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

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING STATIONS
(GROSS BETA YEARLY AVERAGES X10^{-14} µCi/cc)

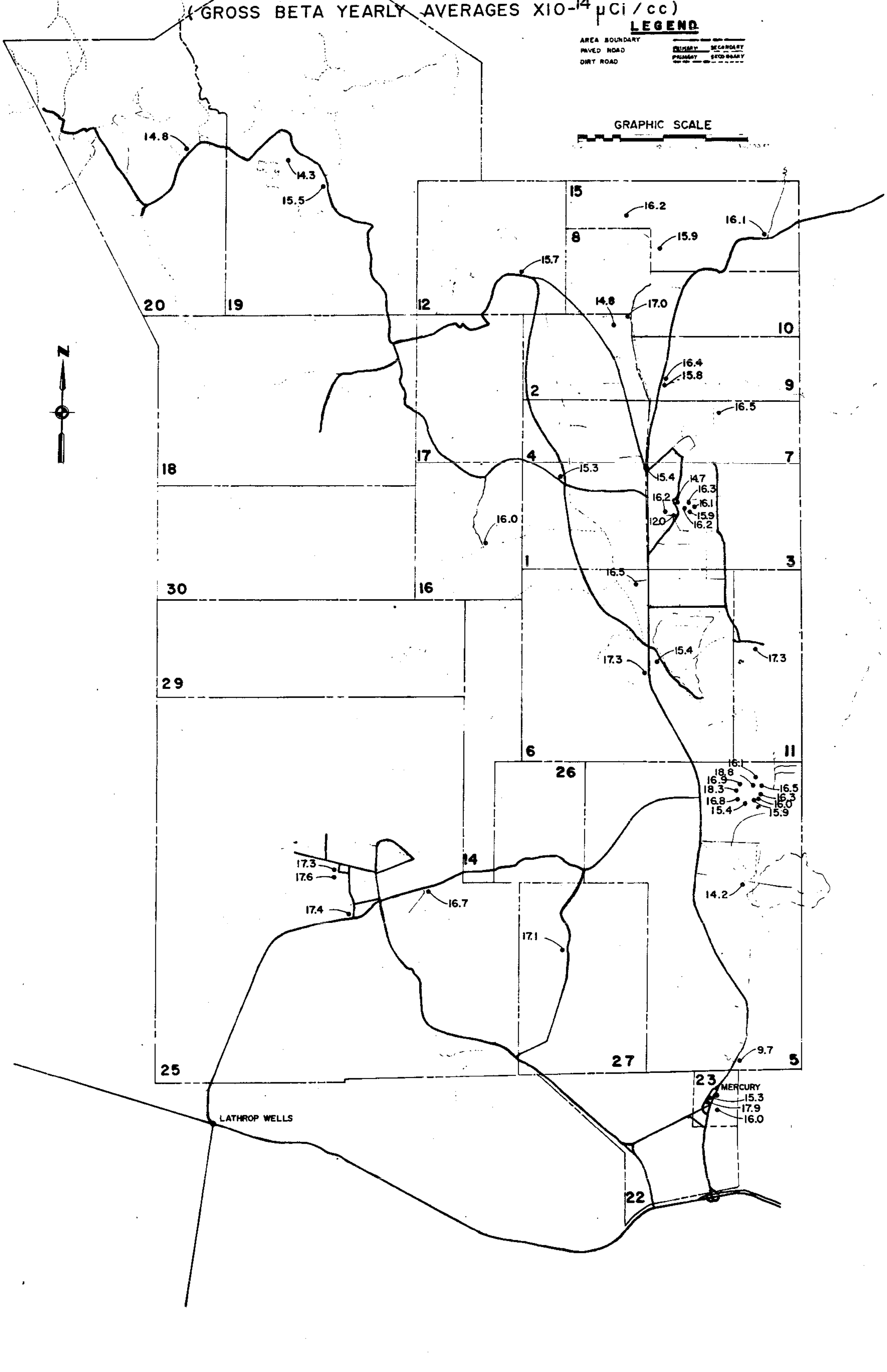


Figure 2

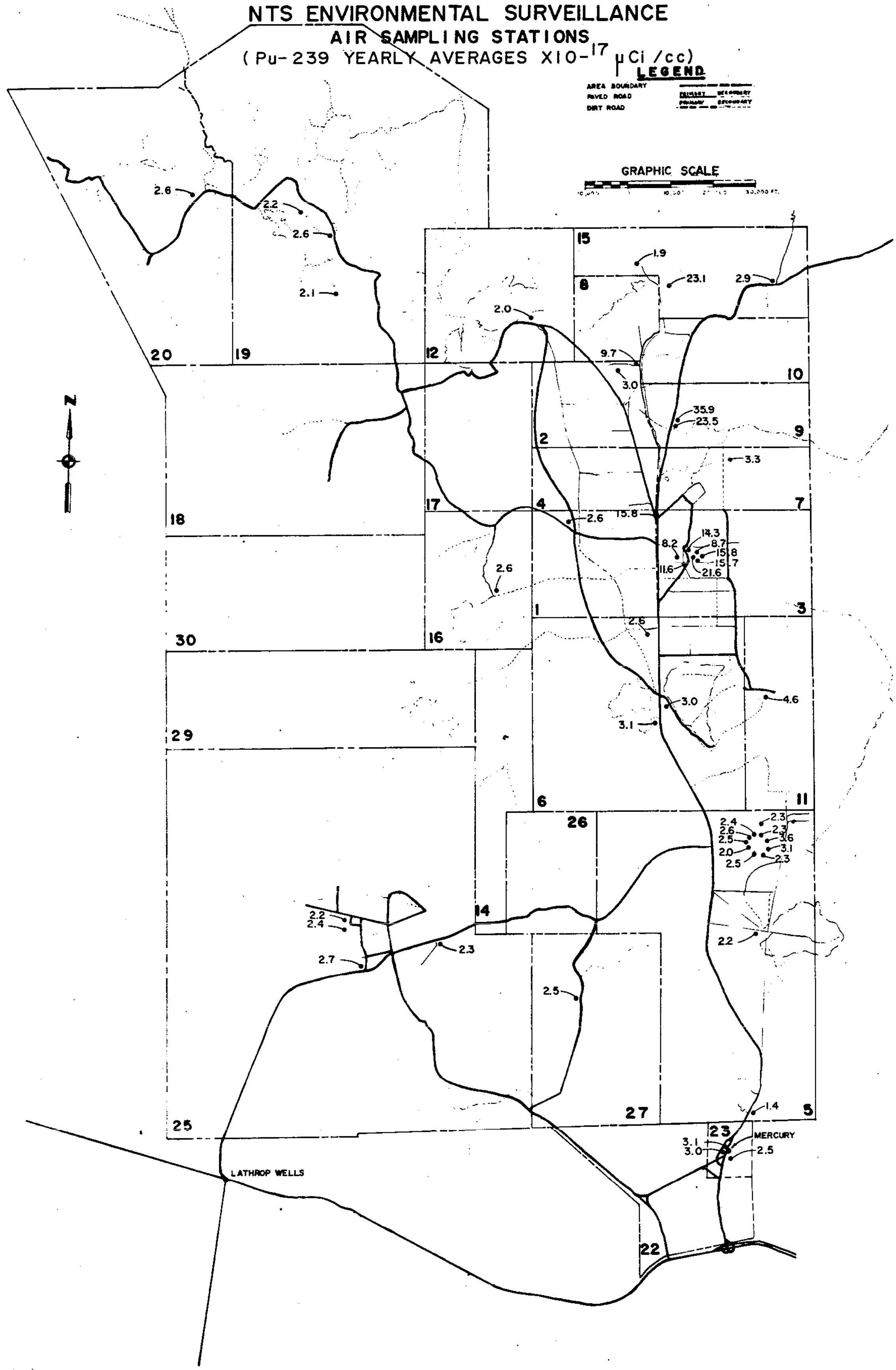

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING STATIONS
(Pu-239 YEARLY AVERAGES X10-17 μCi /cc)
LEGEND
AREA BOUNDARY
PAVED ROAD
DIRT ROAD
GRAPHIC SCALE
20
19
12
15
8
10
9
2
7
17
4
18
1
3
30
16
29
6
11
26
14
25
27
5
23
22
MERCURY
LATHROP WELLS
2.6
2.2
2.6
2.1
2.0
1.9
23.1
2.9
9.7
3.0
35.9
23.5
3.3
15.8
2.6
14.3
8.2
8.7
15.8
15.7
11.6
21.6
2.6
2.6
3.0
3.1
4.6
2.3
2.4
2.3
2.6
3.6
2.5
3.1
2.0
2.3
2.5
2.2
2.4
2.7
2.3
2.2
2.5
1.4
3.1
3.0
2.5

Figure 3

TABLE 4

AVERAGES OF AIR SURVEILLANCE DATA FOR GROSS BETA

(X 10^{-14} μCi/cc)

Station	1/1/81-6/30/81	7/1/81-12/31/81	1/1/81-12/31/81
Area 1 Gravel Pit	30.8	4.3	15.3
Area 2 Cable Yard	28.6	4.4	17.0
Area 2 Compound	25.1	4.2	14.8
Area 3 BJY	25.7	4.2	15.4
Area 3 Compound	27.6	4.3	16.2
Area 3 Complex #2	21.8	4.0	12.0
Area 3 3-300 Bunker	25.4	4.1	14.7
Area 3 U3ax South	27.4	4.3	15.9
Area 3 U3ax East	27.4	4.4	16.1
Area 3 U3ax North	27.7	4.4	16.3
Area 3 U3ax West	27.7	4.7	16.2
Area 5 DOD Yard	27.7	4.5	16.1
Area 5 Gate 200	20.7	4.2	9.7
Area 5 RWMS #1	27.7	4.7	15.9
Area 5 RWMS #2	27.4	4.5	16.0
Area 5 RWMS #3	28.7	4.4	16.3
Area 5 RWMS #4	27.6	4.3	16.5
Area 5 RWMS #5	30.7	4.6	18.9
Area 5 RWMS #6	28.5	4.3	16.9
Area 5 RWMS #7	27.5	4.4	18.3
Area 5 RWMS #8	28.2	4.4	16.8
Area 5 RWMS #9	26.4	4.4	15.4
Area 5 Well 5B	24.5	3.8	14.2
Area 6 CP Complex	29.0	4.6	17.3
Area 6 Well 3 Complex	26.5	4.4	16.5
Area 6 Yucca Complex	25.7	4.3	15.4
Area 7 UE7ns	28.2	4.3	16.5
Area 9 9-300 Bunker	24.7	4.6	15.8
Area 9 9-300 Bunker #2	28.0	4.2	16.4
Area 11 Gate 293	30.1	4.4	17.3
Area 12 Compound	26.5	4.0	15.7
Area 15 EPA Farm	27.5	4.4	15.9
Area 15 Gate 700	27.4	4.3	16.1
Area 15 Piledriver	27.3	4.1	16.2
Area 16 Substation	27.3	4.1	16.0
Area 19 Echo Peak	26.0	4.0	14.8
Area 19 Substation	26.2	4.0	15.5
Area 19 19-3 Substation	25.3	3.9	14.8
Area 20 Dispensary	24.4	3.7	14.8
Area 23 Bldg. 790	29.8	4.3	17.9
Area 23 Bldg. 790 #2	24.3	4.1	15.3
Area 23 H&S Roof	27.6	4.0	16.0
Area 25 E-MAD South	29.5	4.6	17.6
Area 25 E-MAD North	29.3	4.3	17.3
Area 25 NRDS Warehouse	29.3	4.3	17.4
Area 25 Henre Site	28.8	4.5	16.7
Area 27 Cafeteria	29.1	4.1	17.1

TABLE 5

AVERAGES OF AIR SURVEILLANCE DATA FOR PLUTONIUM

($\times 10^{-17}$ µCi/cc)

Station	1/1/81-6/30/81	7/1/81-12/31/81	1/1/81-12/31/81
Area 1 Gravel Pit	4.0	1.3	2.6
Area 2 Cable Yard	11.2	8.3	9.7
Area 2 Compound	3.8	2.1	3.0
Area 3 BJY	21.9	9.7	15.8
Area 3 Cafeteria	9.8	6.6	8.2
Area 3 Complex #2	8.2	14.4	11.6
Area 3 U3ax South	21.3	10.0	15.7
Area 3 U3ax East	12.9	18.7	15.8
Area 3 U3ax North	7.8	9.6	8.7
Area 3 U3ax West	31.7	11.5	21.6
Area 3 3-300 Bunker	12.2	16.4	14.3
Area 5 DOD Yard	3.7	0.8	2.3
Area 5 Gate 200	2.7	0.7	1.4
Area 5 RWMS #1	4.0	1.1	2.5
Area 5 RWMS #2	2.5	2.1	2.3
Area 5 RWMS #3	4.4	1.7	3.1
Area 5 RWMS #4	2.6	4.7	3.6
Area 5 RWMS #5	4.4	1.2	2.8
Area 5 RWMS #6	3.9	0.9	2.4
Area 5 RWMS #7	4.0	1.2	2.6
Area 5 RWMS #8	4.5	0.9	2.5
Area 5 RWMS #9	3.3	0.9	2.0
Area 5 Well 5B	3.0	1.4	2.2
Area 6 CP Complex	4.5	1.8	3.1
Area 6 Well 3 Complex	3.7	1.5	2.6
Area 6 Yucca Complex	3.9	2.1	3.0
Area 7 UE7ns	4.5	2.0	3.3
Area 9 9-300 Bunker	24.5	32.6	28.5
Area 9 9-300 Bunker #2	29.0	42.8	35.9
Area 11 Gate 293	6.5	2.6	4.6
Area 12 Compound	3.0	1.0	2.0
Area 15 EPA Farm	15.5	30.7	23.1
Area 15 Gate 700	4.5	1.3	2.9
Area 15 Piledriver	3.4	0.7	1.9
Area 16 Substation	4.3	0.8	2.6
Area 19 Echo Peak	3.2	1.1	2.1
Area 19 Substation	3.9	1.2	2.6
Area 19 19-3 Substation	3.7	0.9	2.2
Area 20 Dispensary	4.3	1.2	2.6
Area 23 Bldg. 790	4.3	1.8	3.0
Area 23 Bldg. 790 #2	4.0	2.2	3.1
Area 23 H&S Roof	3.8	1.2	2.5
Area 25 E-MAD South	3.7	1.1	2.4
Area 25 E-MAD North	3.6	0.8	2.2
Area 25 NRDS Warehouse	4.2	1.3	2.7
Area 27 Cafeteria	4.2	0.7	2.5
Area 28 Henre Site	3.8	0.9	2.3

of these tests are still demonstrated in increased plutonium concentrations in air in Areas 1, 2, 3, 7, 8, 9, 10, and 15.

The overall ^{239}Pu concentrations in the ambient air monitoring network followed a similar trend as the gross beta concentrations. The average network ^{239}Pu concentrations were greater in the first six month period of CY-1981. The individual exceptions were stations in areas of previous safety shots. A substantial increase in ^{239}Pu concentrations seen during the summer months at these stations may be explained by resuspension of ^{239}Pu from the soil (Reference 9). This increase during the summer months caused the second six month period to have higher ^{239}Pu concentrations at these stations.

The four tritium in air stations showed substantial fluctuations throughout the year. This may be due to the small volume of the samples collected. The three stations at RWMS were collected twice monthly and the Building 650 sample was collected on a monthly basis. The highest concentration of HTO occurred at Building 650 of 6.0×10^{-8} µCi/cc which represents 1.2 percent of the concentration guide. Area 5 #2 had the highest HT concentration of 1.3×10^{-7} µCi/cc or 0.07 percent of the concentration guide. Table 6 lists the average tritium concentrations at each location along with the lowest and highest values recorded. Appendix B has the actual measurements plotted for each location.

E. RADIOACTIVITY IN SURFACE AND GROUND WATER

The principal water distribution system on the NTS consists of twelve supply wells, nine potable water stations, and seventeen open reservoirs. The wells feed directly to many of the reservoirs, and the drinking water was pumped 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 sampled and evaluated as a special monitoring program. 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 non-routine schedules because of limitations in the amount of water at each location.

TABLE 6

Tritium In Air

Area 5 #1

HTO (highest) 1.1E-08 μCi/cc	HT (highest) 4.4E-09 μCi/cc
HTO (lowest) <6.4E-14 μCi/cc	HT (lowest) <4.0E-14 μCi/cc
HTO (average) 1.2E-09 μCi/cc	HT (average) 3.2E-10 μCi/cc

Area 5 #2

HTO (highest) 2.3E-10 μCi/cc	HT (highest) 1.3E-07 μCi/cc
HTO (lowest) <5.3E-14 μCi/cc	HT (lowest) <5.4E-14 μCi/cc
HTO (average) 5.4E-11 μCi/cc	HT (average) 9.5E-09 μCi/cc

Area 5 #3

HTO (highest) 2.1E-08 μCi/cc	HT (highest) 1.3E-08 μCi/cc
HTO (lowest) <7.7E-14 μCi/cc	HT (lowest) <4.4E-14 μCi/cc
HTO (average) 2.6E-09 μCi/cc	HT (average) 9.9E-10 μCi/cc

Bldg. 650, Mercury

HTO (highest) 6.0E-08 μCi/cc	HT (highest) 9.8E-10 μCi/cc
HTO (lowest) <1.9E-14 μCi/cc	HT (lowest) <3.3E-14 μCi/cc
HTO (average) 9.8E-09 μCi/cc	HT (average) 1.3E-10 μCi/cc

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 4. Appendix B consists of the plots of each station for measured gross beta activity with 2σ error bars. An averaging plot is included which shows the trend of the mean of the network throughout the reporting period. The range at each point is also given. Table 7 lists the 1981 averages for each location. The highest average recorded was 1.6×10^{-8} μCi/ml at Well C1. This was 5.3 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 1.7×10^{-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 ($\times 10^{-9}$ μCi/ml)
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

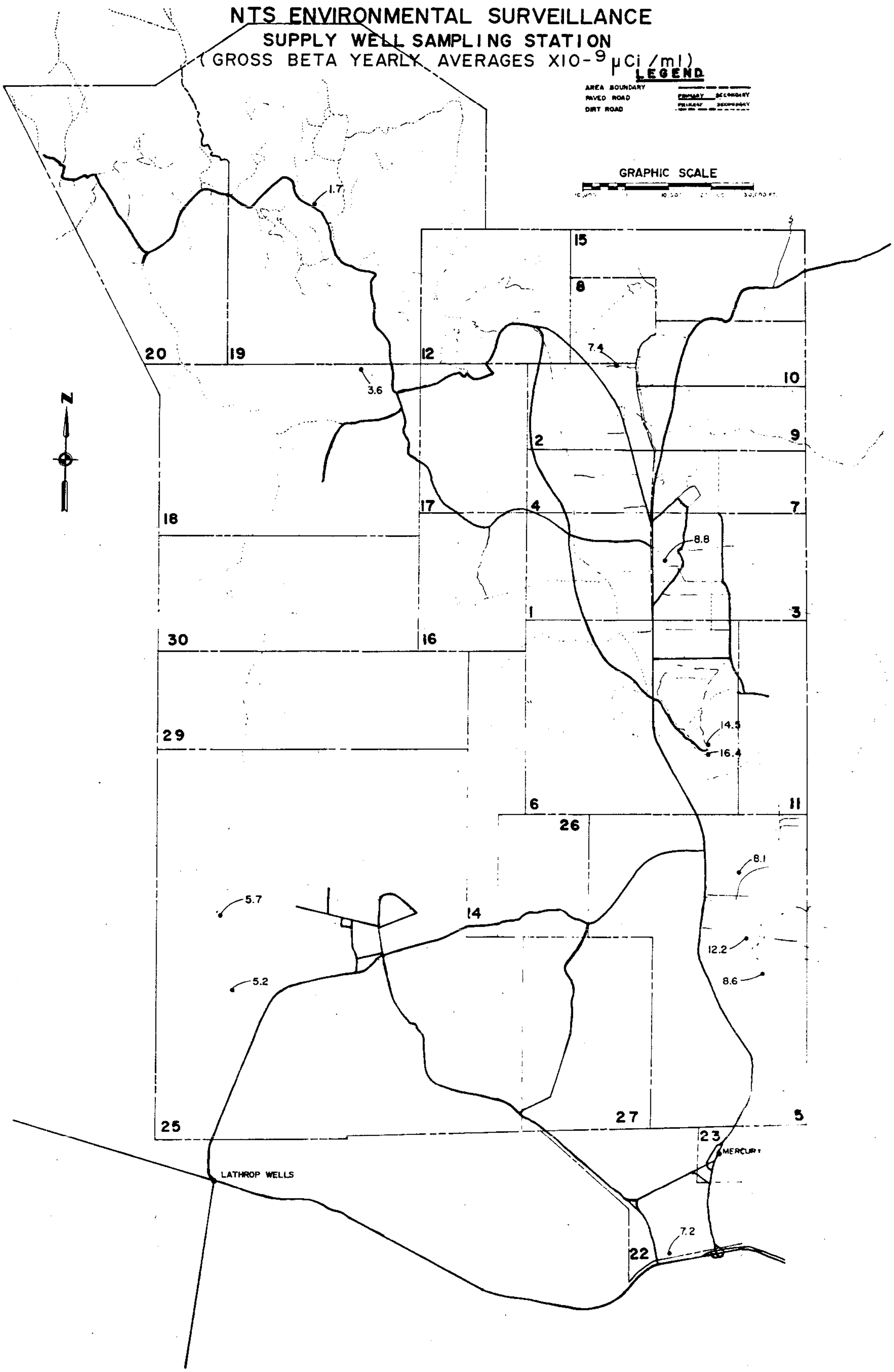

NTS ENVIRONMENTAL SURVEILLANCE
SUPPLY WELL SAMPLING STATION
(GROSS BETA YEARLY AVERAGES X10-9 μCi/ml)
LEGEND
AREA BOUNDARY
PAVED ROAD
DIRT ROAD
GRAPHIC SCALE
1.7
3.6
7.4
8.8
14.5
16.4
8.1
12.2
8.6
5.7
5.2
7.2
LATHROP WELLS
MERCURY
20
19
12
15
8
10
9
2
7
4
17
18
1
3
30
16
29
6
11
26
14
25
27
5
23
22
N

Figure 4

TABLE 7

AVERAGES OF SUPPLY WELL DATA FOR GROSS BETA

Station	Gross Beta Yearly Average (X 10^{-9} μCi/ml)
Area 2 Well 2	7.4
Area 3 Well A	8.8
Area 5 Well 5B	12.2
Area 5 Well 5C	8.6
Area 5 Well Ue5c	8.1
Area 6 Well C	14.5
Area 6 Well C1	16.4
Area 18 Well 8	3.6
Area 22 Army Well #1	7.2
Area 25 Well J12	5.2
Area 25 Well J13	5.7
Area 19 Well U19c	1.7

The most significant study accomplished with this network's data file, was an investigation of the correlation of gross beta results to a laboratory chemical analysis for cations. The naturally-occurring beta emitter, potassium, was found to be the cation of interest in this water system. 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 5 graphically displays the relationship for the primary waters onsite. A linear regression from the supply well data obtained the following equation: Gross Beta = [0.36 + 0.89 (potassium in mg/liter)] X 10^{-9} μCi/ml. The correlation coefficient was 0.94. Therefore, the variation of gross beta results in NTS water was principally dependent upon potassium, or more specifically, 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 5.

$$A = \lambda N$$

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

$$= \frac{(0.001g)\ (6.02 \times 10^{23})\ (1.18 \times 10^{-4})}{39.1}$$

$$= 1.82 \times 10^{15}\ {}^{40}K \text{ atoms/mg}$$

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

$$= 1.04 \times 10^{-15} \text{ minutes}^{-1}$$

Thus, $A(dpm/mg) = \lambda N$

$$= 1.82 \times 10^{15} \times 1.04 \times 10^{-15}$$

$$= 1.90$$

$$A(\mu Ci/mg) = \frac{1.90}{2.22 \times 10^{6}}$$

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

or

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

The calculated activity of 8.56×10^{-10} µCi/ml per mg/liter correlated well with 8.9×10^{-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 radio activity 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 to 2-ml for tritium, the detection limit has been increased. The positive tritium results are

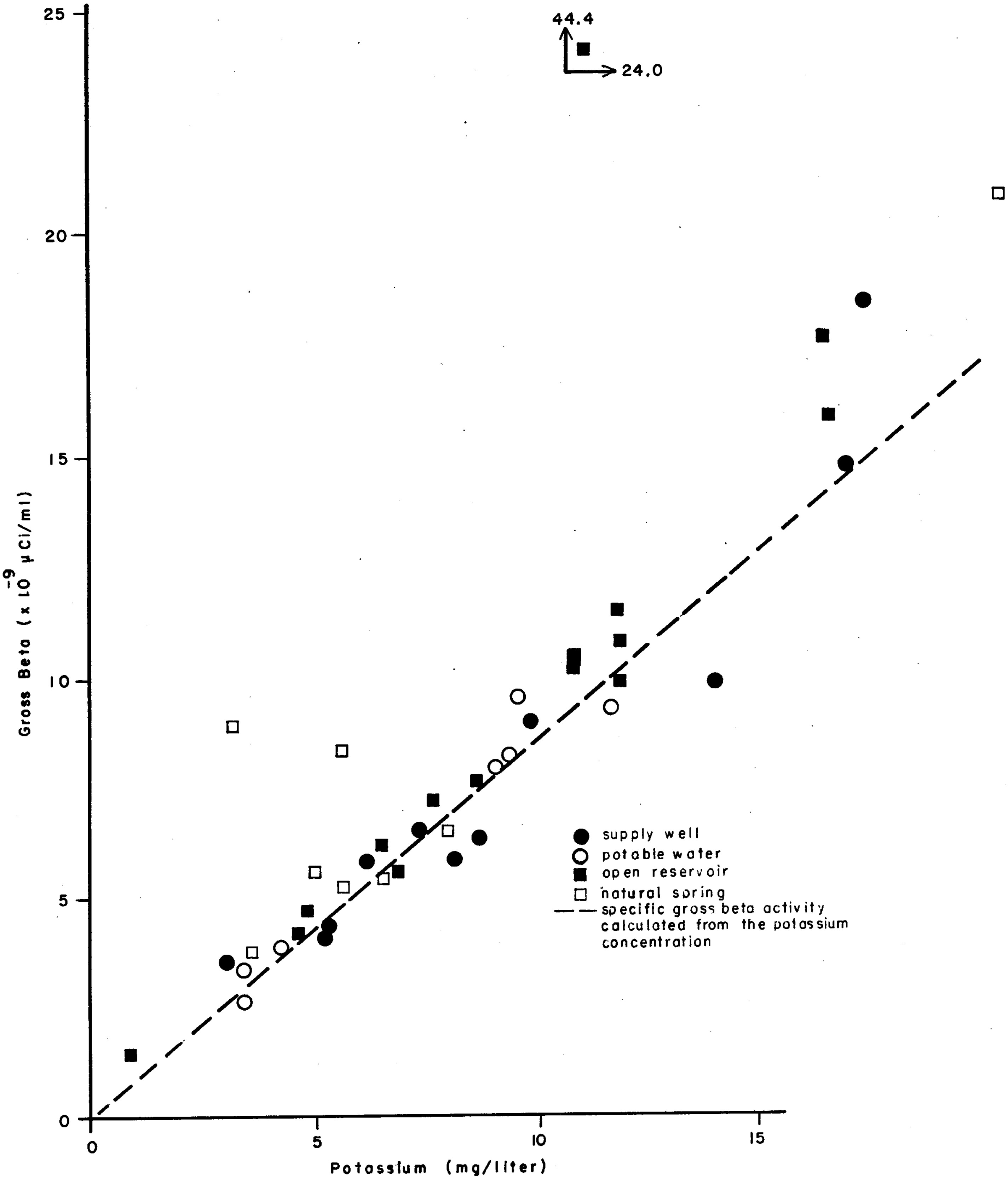


FIGURE 5 WATER RADIOACTIVITY vs. POTASSIUM CONCENTRATION

Figure 5

TABLE [illegible]

TRITIUM VALUES ABOVE DETECTION LIMITS FROM NONCONTAMINATED WATERS

WATER TYPE	STATION	DATE	µCi/ml
Potable Water	Area 2 Rest Room	04/21/81	4.1E-07 ± 93.3%
		06/16/81	1.2E-06 ± 37.5%
		08/11/81	9.2E-07 ± 50.9%
		09/28/81	4.5E-07 ± 98.5%
		10/25/81	6.9E-07 ± 74.7%
		11/16/81	5.7E-07 ± 88.2%
		12/03/81	1.3E-06 ± 39.0%
Potable Water	Area 3 Cafe	08/10/81	1.0E-06 ± 46.6%
		10/26/81	6.3E-07 ± 80.8%
		11/09/81	6.5E-07 ± 78.2%
		11/16/81	5.2E-07 ± 96.3%
Potable Water	Area 6 Cascade Water	02/23/81	1.6E-07 ± 82.6%
		09/22/81	7.8E-07 ± 57.4%
		10/26/81	8.5E-07 ± 59.9%
		11/02/81	8.0E-07 ± 64.1%
		11/23/81	5.7E-07 ± 88.9%
Potable Water	Area 6 Cafe	01/12/81	1.1E-06 ± 13.7%
		01/20/81	1.3E-07 ± 93.7%
		02/02/81	2.6E-07 ± 47.1%
		02/23/81	4.8E-07 ± 28.7%
		03/09/81	1.2E-06 ± 38.3%
		08/10/81	8.3E-07 ± 75.6%
		08/17/81	9.2E-07 ± 56.3%
		09/29/81	7.8E-07 ± 58.7%
		10/20/81	5.6E-07 ± 90.5%
		11/02/81	1.1E-06 ± 49.5%
		11/16/81	5.9E-07 ± 85.1%
Potable Water	Area 12 Cafe	08/11/81	5.9E-07 ± 77.1%
		10/25/81	1.0E-06 ± 52.4%
		12/03/81	6.0E-07 ± 84.6%
Potable Water	Area 15 EPA Farm	02/23/81	1.2E-06 ± 12.6%
		03/02/81	5.6E-07 ± 77.9%
		03/10/81	1.3E-06 ± 35.7%
		03/16/81	2.1E-07 ± 77.8%
Potable Water	Area 23 Cafe	01/20/81	6.3E-07 ± 21.4%
		02/02/81	4.4E-07 ± 93.4%
		02/23/81	9.3E-07 ± 15.9%
		03/09/81	6.4E-07 ± 68.6%
		08/10/81	1.0E-06 ± 46.0%
		09/22/81	7.5E-07 ± 60.4%
		10/05/81	7.9E-07 ± 56.6%

Table 8 (continued)

WATER TYPE	STATION	DATE	μCi/ml
Potable Water	Area 25 Service Station	08/10/81	1.5E-06 ± 43.3%
		08/17/81	7.8E-07 ± 65.7%
		11/23/81	5.6E-07 ± 91.3%
		11/30/81	7.8E-07 ± 65.0%
Potable Water	Area 27 Cafe	01/20/81	5.9E-07 ± 22.4%
		02/23/81	7.8E-07 ± 18.8%
		03/02/81	6.3E-07 ± 69.3%
		03/09/81	1.4E-06 ± 31.7%
		03/16/81	4.5E-07 ± 91.3%
		04/13/81	4.5E-07 ± 87.6%
		08/17/81	8.4E-07 ± 61.1%
		09/29/81	1.1E-06 ± 46.3%
		10/20/81	5.9E-07 ± 87.0%
		10/26/81	8.4E-07 ± 60.7%
		11/09/81	6.8E-07 ± 75.2%
Natural Springs	Area 5 Cane Springs	10/07/81	4.4E-07 ± 99.5%
		11/20/81	8.4E-07 ± 61.1%
Natural Springs	Area 7 Reitmann Seep	02/19/81	3.3E-07 ± 51.6%
		05/13/81	5.8E-07 ± 73.6%
		09/16/81	8.2E-07 ± 58.9%
		10/02/81	1.2E-06 ± 40.8%
		11/12/81	1.1E-06 ± 47.1%
Natural Springs	Area 12 White Rock Springs	08/20/81	5.5E-07 ± 87.7%
		09/17/81	4.6E-07 ± 96.9%
Natural Springs	Area 15 Tub Springs	10/30/81	5.6E-07 ± 90.7%
Natural Springs	Area 29 Tippipah Springs	10/29/81	6.1E-07 ± 83.9%
		11/20/81	1.1E-05 ± 49.0%
Open Reservoir	Well A Reservoir	12/02/81	5.7E-07 ± 91.1%
Open Reservoir	Well 5B Reservoir	01/06/81	3.4E-07 ± 37.5%
		09/17/81	7.8E-07 ± 59.5%
		12/10/81	2.8E-06 ± 16.7%
Open Reservoir	UE5c Reservoir	09/17/81	6.2E-07 ± 72.6%
		10/27/81	8.5E-07 ± 61.3%
Open Reservoir	Well 2 Reservoir	03/07/81	8.3E-07 ± 53.7%
Open Reservoir	Well 3 Reservoir	05/07/81	4.2E-07 ± 92.0%
		10/02/81	5.6E-07 ± 88.0%
Open Reservoir	Well C1 Reservoir	03/12/81	4.9E-07 ± 88.1%
		09/10/81	5.3E-07 ± 82.8%

WATER TYPE	STATION	DATE	µCi/ml
Open Reservoir	Area 5 Reservoir	01/06/81	1.9E-05 ± 3.0%
		02/19/81	1.1E-05 ± 3.2%
		03/26/81	7.3E-06 ± 7.9%
		04/15/81	9.5E-06 ± 6.7%
		09/09/81	9.7E-07 ± 48.1%
		10/27/81	1.1E-06 ± 45.4%
		11/02/81	2.3E-06 ± 23.9%
		12/17/81	2.3E-06 ± 20.3%
Open Reservoir	Camp 17 Reservoir	11/18/81	5.7E-07 ± 89.7%
Open Reservoir	Well 20A Reservoir	11/25/81	6.1E-07 ± 83.5%
Open Reservoir	Area 23 Swimming Pool	02/11/81	5.1E-07 ± 27.8%
		03/05/81	4.6E-07 ± 87.6%
		10/06/81	5.5E-06 ± 87.7%
Open Reservoir	Area 3 Mud Plant Reservoir	09/02/81	1.1E-06 ± 91.3%
		10/06/81	6.6E-07 ± 73.4%
Open Reservoir	Area 2 Mud Plant Reservoir	02/04/81	1.8E-05 ± 8.4%
Open Reservoir	Well J-11 Reservoir	09/03/81	4.9E-07 ± 91.9%
		10/07/81	6.2E-07 ± 79.4%
Open Reservoir	Well 8 Reservoir	11/18/80	6.8E-07 ± 75.8%
Supply Well	Well 2	09/08/81	5.0E-07 ± 88.9%
		11/04/81	6.2E-07 ± 82.3%
Supply Well	Well 5B	09/06/81	4.7E-07 ± 95.3%
Supply Well	Well 5C	11/08/81	7.3E-07 ± 70.0%
Supply Well	Well UE5C	10/04/81	5.3E-07 ± 91.6%
Supply Well	Well C	07/29/81	6.8E-07 ± 74.3%
		09/09/81	5.0E-07 ± 90.5%
		11/04/81	5.2E-07 ± 95.8%
Supply Well	Well C1	03/10/81	5.3E-07 ± 75.7%
Supply Well	Well 8	09/09/81	5.0E-07 ± 90.5%
Supply Well	Army Well #1	02/07/81	2.9E-07 ± 45.7%
		03/08/81	7.4E-07 ± 60.2%
Supply Well	Well J-13	10/04/81	7.7E-07 ± 63.3%
		11/08/81	3.6E-05 ± 2.9%
Supply Well	Well U19C	09/08/81	6.2E-07 ± 72.6%

TABLE 9

PLUTONIUM VALUES ABOVE DETECTION LIMITS
FROM NONCONTAMINATED WATERS

WATER TYPE	STATION	DATE	µCi/ml
Potable Water	Area 2 Rest Room	09/15/81	1.4E-11 ± 86.0%
		12/03/81	2.2E-11 ± 69.7%
Natural Springs	Tub Springs	06/11/81	1.9E-11 ± 94.7%
Natural Springs	Reitmann Seep	03/09/81	1.3E-10 ± 35.0%
		06/25/81	1.1E-10 ± 47.1%
		09/16/81	5.4E-11 ± 66.5%
		12/04/81	3.8E-11 ± 63.1%
Natural Springs	Tippipah Springs	06/12/81	2.4E-11 ± 86.2%
		12/04/81	1.8E-11 ± 94.7%
Open Reservoir	Well 2 Reservoir	09/11/81	1.4E-11 ± 86.0%
Open Reservoir	Well A Reservoir	03/04/81	1.5E-11 ± 86.0%
Open Reservoir	Well 5B Reservoir	06/19/81	1.8E-11 ± 94.7%
		09/17/81	1.2E-11 ± 94.5%
		12/10/81	2.5E-11 ± 94.9%
Open Reservoir	UE5C Reservoir	03/04/81	1.7E-10 ± 94.7%
		06/19/81	3.0E-10 ± 69.8%
Open Reservoir	Well C1 Reservoir	09/10/81	1.3E-11 ± 94.5%
Open Reservoir	Area 3 Mud Plant Reservoir	06/24/81	4.8E-11 ± 53.8%
		09/04/81	2.3E-11 ± 79.5%
Open Reservoir	Area 2 Mud Plant Reservoir	12/10/81	4.8E-11 ± 55.8%
Open Reservoir	Area 5 Reservoir	03/26/81	2.5E-11 ± 66.0%
		09/09/81	9.9E-10 ± 15.5%
		12/17/81	2.0E-10 ± 27.3%
Supply Well	Well A	03/10/81	2.1E-11 ± 86.1%
		06/17/81	2.6E-11 ± 69.7%
Supply Well	Well UE5C	06/20/81	2.7E-11 ± 94.9%
Supply Well	Well C	03/10/81	9.2E-12 ± 99.9%
		12/02/81	1.6E-11 ± 86.0%
Supply Well	Well J-12	12/05/81	3.8E-11 ± 66.4%
Supply Well	Well U19C	03/10/81	3.3E-11 ± 66.0%
		12/02/81	6.2E-11 ± 66.7%

given in Table 8. The highest value was 3.6×10^{-5} μCi/ml from well J-13. This is 1.2 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 are seven positive plutonium results given in Table 9 for supply wells. The highest value was 6.2×10^{-11} for Well U19c. This represents 0.001 percent of the concentration guide for ^{239}Pu. All of the Pu positives have a relatively high percentage error which indicates near background level or false positives that may be caused by statistical fluctuations of the counting system.

2. Potable Water

As a check of any effect the water distribution system might have on end use activity, nine consumption points were sampled during the reporting period. The locations of all stations are shown in Figure 6 with their gross beta yearly averages.

Appendix D contains the computer plots of the measured gross beta activity with the 2σ error bars included. An average plot is provided which shows the network mean trend throughout the reporting period along with the range at each point. Table 10 contains a list of the average gross beta activity measured at each sample location for CY-1981. The highest average recorded was 1.8 X 10^{-8} μCi/ml at the Area 15 EPA Farm. This was 6.0 percent of the concentration guide for drinking water (assuming ^{90}Sr is the beta emitter present). This sample was stopped in July due to the closing of the EPA Farm. The lowest average gross beta activity, excluding Cascade brand bottled water, was 4.1 X 10^{-9} μCi/ml at the Area 12 Cafeteria and Area 2 Restroom. 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-1980. 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-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

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 5 showed this graphically.

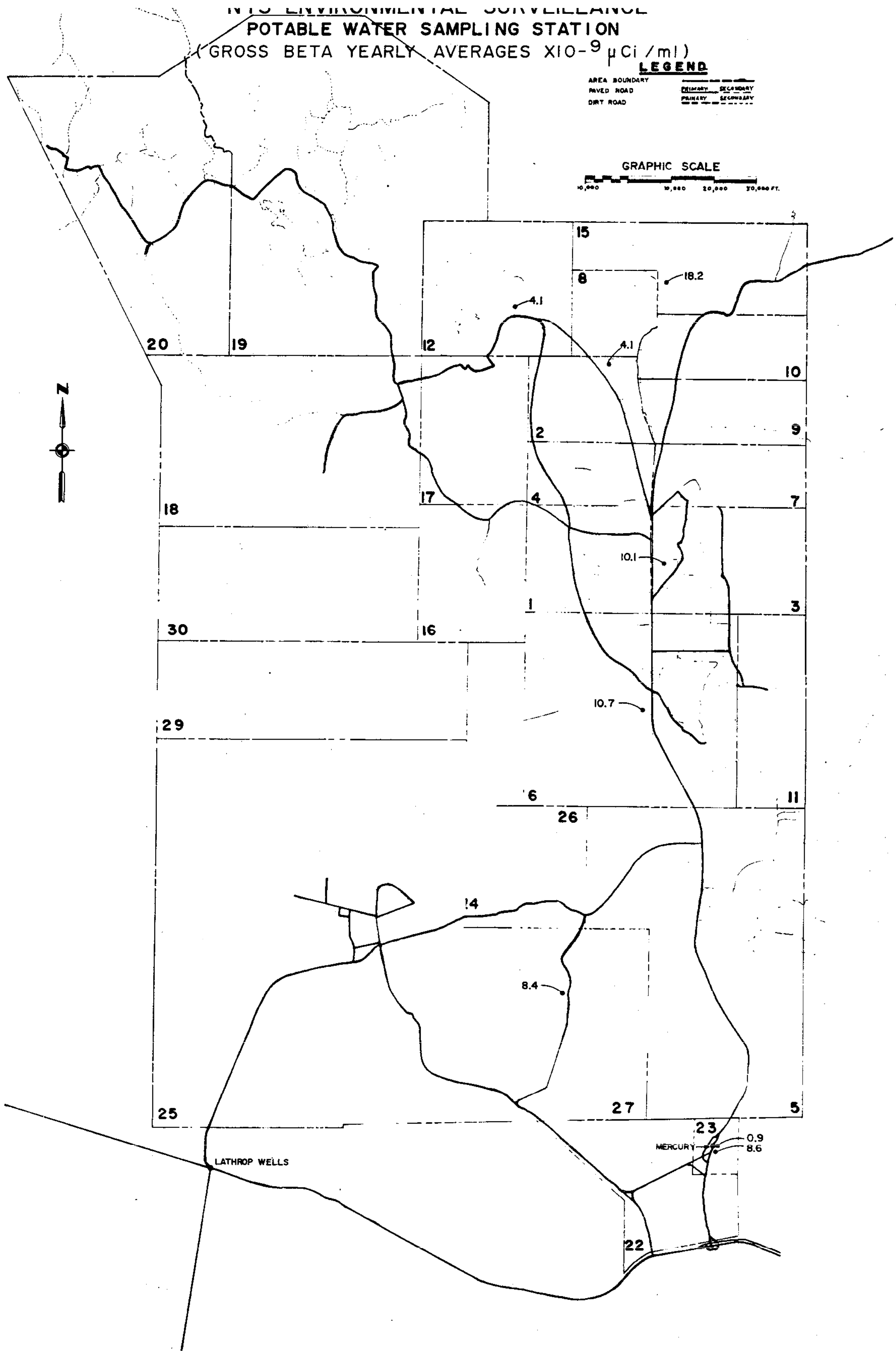

NTS ENVIRONMENTAL SURVEILLANCE
POTABLE WATER SAMPLING STATION
(GROSS BETA YEARLY AVERAGES X10-9 μCi/ml)
LEGEND
AREA BOUNDARY
PAVED ROAD
DIRT ROAD
PRIMARY
SECONDARY
GRAPHIC SCALE
N
15
8
18.2
4.1
4.1
20
19
12
10
9
2
17
4
7
18
10.1
1
3
30
16
10.7
29
6
11
26
14
8.4
25
27
5
23
MERCURY
0.9
8.6
LATHROP WELLS
22

Figure 6

TABLE 10

AVERAGES OF POTABLE WATER DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($X\ 10^{-9}\ \mu Ci/ml$)
Area 2 Restroom	4.1
Area 3 Cafeteria	10.1
Area 6 Cafeteria	10.7
Area 12 Cafeteria	4.1
Area 15 EPA Farm	18.2
Area 23 Cafeteria	8.6
Area 23 Cascade Water	0.9
Area 27 Cafeteria	8.4
Area 25 Service Station	6.0

The potable water results lie very 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 = [0.26 + 0.85 (potassium in mg/liter)] X 10^{-9} μCi/ml. The correlation coefficient was 0.97.

Appendix D also includes the plots of the network averages for tritium and plutonium. The positive tritium results were given in Table 8. The highest value was 1.5 x 10^{-6} μCi/ml for Area 25 Service Station. This is 0.05 percent of the concentration guide for tritium in drinking water. The majority of the fifty-two positive measurements are near the detection limit of the system and are believed to be caused by fluctuations in the counting system. There were two positive plutonium results for potable water in Table 9. The highest value was 2.2 x 10^{-11} μCi/ml from the Area 2 Restroom. This represents 0.0004 percent of the corcentration guide for ^{239}Pu. All of the plutonium positives have a high percentage error associated with them which indicates they may be caused by statistical fluctuations of the counter.

3. Open Reservoirs

Open reservoirs have been established at various locations on the NTS for industrial purposes. Sixteen of these impoundments were sampled during the report period. The locations are shown in Figure 7 along with their gross beta yearly averages.

TABLE 11

COMPARISON OF END USE AND SUPPLY WATER

FOR GROSS BETA AVERAGES

($X\ 10^{-9}\ \mu Ci/ml$)

Station (end use/supply)	CY-1979
Area 2 Restroom	4.1
Area 18 Well 8	3.6
Area 3 Cafeteria	10.1
Area 3 Well A	8.8
Area 6 Cascade Water	0.9
(Demineralized Bottled Water)	--
Area 6 Cafeteria	10.7
Area 6 Well C/C1	14.5/16.4
Area 12 Cafeteria	4.1
Area 18 Well 8	3.6
Area 23 Cafeteria	8.6
Area 5 Well 5B/5C	12.2/8.6
Area 22 Army Well #1	7.2
Area 27 Cafeteria	8.4
Area 5 Well 5B/5C	12.2/8.6
Area 22 Army Well #1	7.2

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-1981.

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.

Table 12 includes a list of the CY-1981 gross beta averages at each location. The highest beta content was 6.3 X 10^{-8} μCi/ml at Area 5 Reservoir. This result was 0.6 percent of the concentration guide (assuming ^{90}Sr is the beta emitter present). The lowest gross beta average was 2.2 X 10^{-9} μCi/ml at Well U19c 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.

Year	Mean (X 10^{-9} μCi/ml)
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

NTS ENVIRONMENTAL SURVEILLANCE
OPEN RESERVOIR SAMPLING STATION
(GROSS BETA YEARLY AVERAGES X10^{-9} μCi/ml)

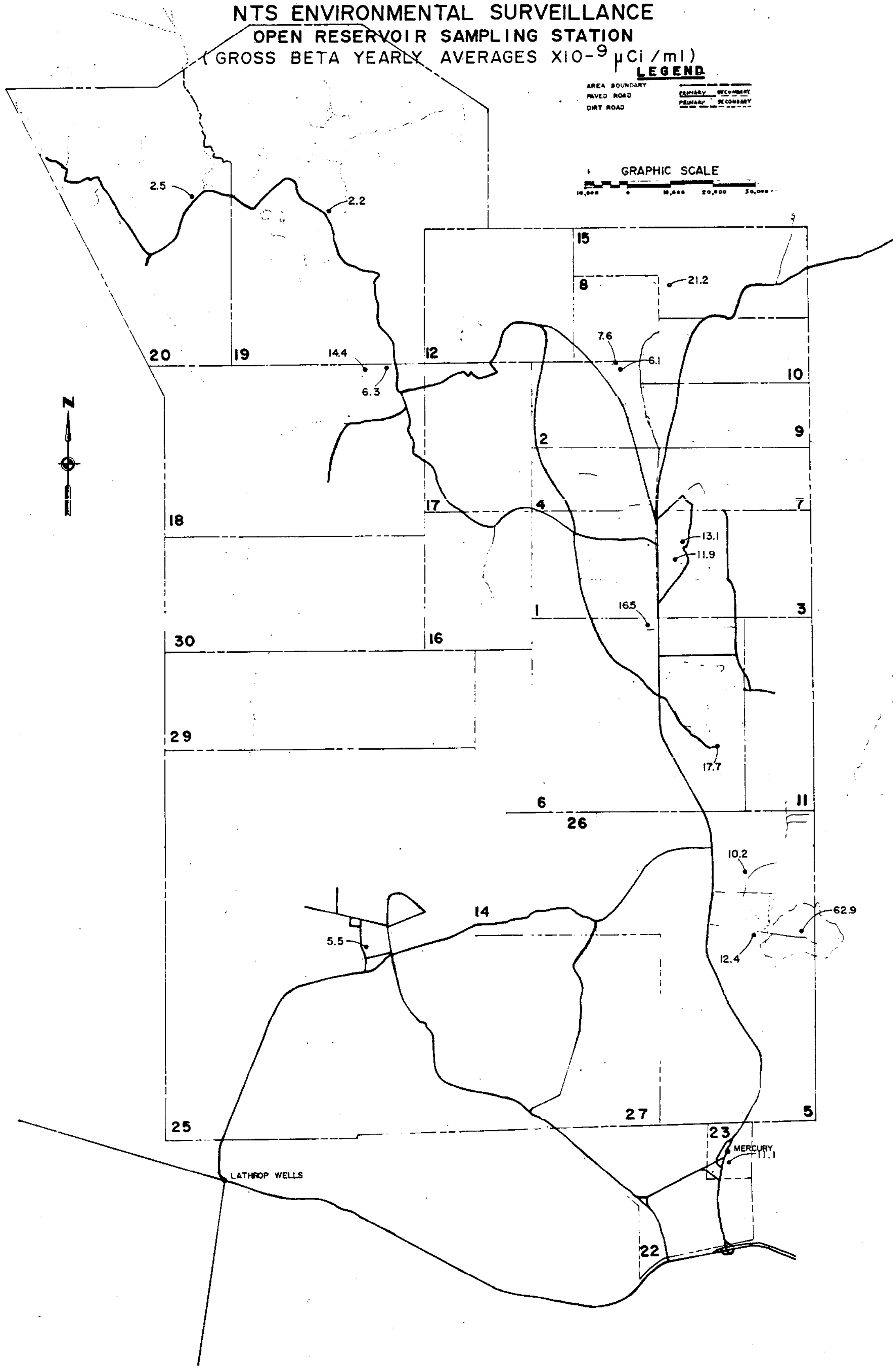


Figure 7

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 5, 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. As in the case of the supply well data, there are a relatively large number of positive tritium and plutonium results. There were thirty positive tritium values, the highest was 1.8×10^{-5} μCi/ml at Area 2 Mud Plant Reservoir. This is 0.02 percent of the tritium concentration guide. The highest of the eleven positive plutonium concentrations was 9.2×10^{-10} μCi/ml or 0.001 percent of the plutonium concentration guide. The positive tritium and plutonium results can be seen in Tables 8 and 9.

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 8 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

TABLE 12

AVERAGES OF OPEN RESERVOIR DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($\times 10^{-9}$ µCi/ml)
Area 2 Well 2 Reservoir	7.6
Area 3 Well A Reservoir	11.9
Area 5 Well 5B Reservoir	12.4
Area 5 Well Ue5c Reservoir	10.2
Area 6 Well 3 Reservoir	16.5
Area 6 Well C1 Reservoir	17.7
Area 15 Well Ue15d Reservoir	21.2
Area 18 Camp 17 Reservoir	6.3
Area 20 Well 20A Reservoir	2.5
Area 23 Swimming Pool	11.1
Area 19 Well U19c Reservoir	2.2
Area 3 Mud Plant Reservoir	13.1
Area 2 Mud Plant Reservoir	6.1
Area 25 Well J-11 Reservoir	5.5
Area 18 Well 8 Reservoir	11.4
Area 5 Reservoir	62.9

TABLE 13

COMPARISON OF OPEN RESERVOIRS AND SUPPLY WATER FOR GROSS BETA AVERAGES

($\times 10^{-9}$ µCi/ml)

Station (Reservoir/Supply)	CY-1980
Area 2 Well 2 Reservoir	7.6
Area 2 Well 2	7.4
Area 3 Well A Reservoir	11.9
Area 3 Well A	8.8
Area 5 Well 5B Reservoir	12.4
Area 5 Well 5B	12.2
Area 5 Well Ue5c Reservoir	10.2
Area 5 Well Ue5c	8.1
Area 6 Well C1 Reservoir	17.7
Area 6 Well C1	16.4
Area 19 Well U19c Reservoir	2.2
Area 19 Well U19c	1.7

shows the trend of the network mean throughout the reporting period. The range at each point is also given. Table 14 includes a list of the averages at each location. The highest average recorded was 2.4 X 10^{-8} μCi/ml at Gold Meadows Pond. This was 0.2 percent of the CG (assuming ^{90}Sr is the beta emitter present). The lowest beta concentration was 4.6 X 10^{-9} μCi/ml at Tippipah Spring.

Captain Jack Spring, Reitmann Seep, and White Rock Spring all had gross beta activities in excess of that calculated from their potassium concentrations as shown in Figure 5. Even though these three stations show an excess of radionuclides they all are within the applicable concentration guide (assuming ^{90}Sr is the beta emitter present).

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

Year	Mean (X 10^{-9} μCi/ml)
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 1.1 x 10^{-5} μCi/ml at Tippipah Springs. This represents 0.01 percent of the concentration guide for tritium. The highest plutonium value was 1.3 x 10^{-10} μCi/ml at

NTS ENVIRONMENTAL SURVEILLANCE
NATURAL SPRING SAMPLING STATION
(GROSS BETA YEARLY AVERAGES X10-9 μCi/ml)

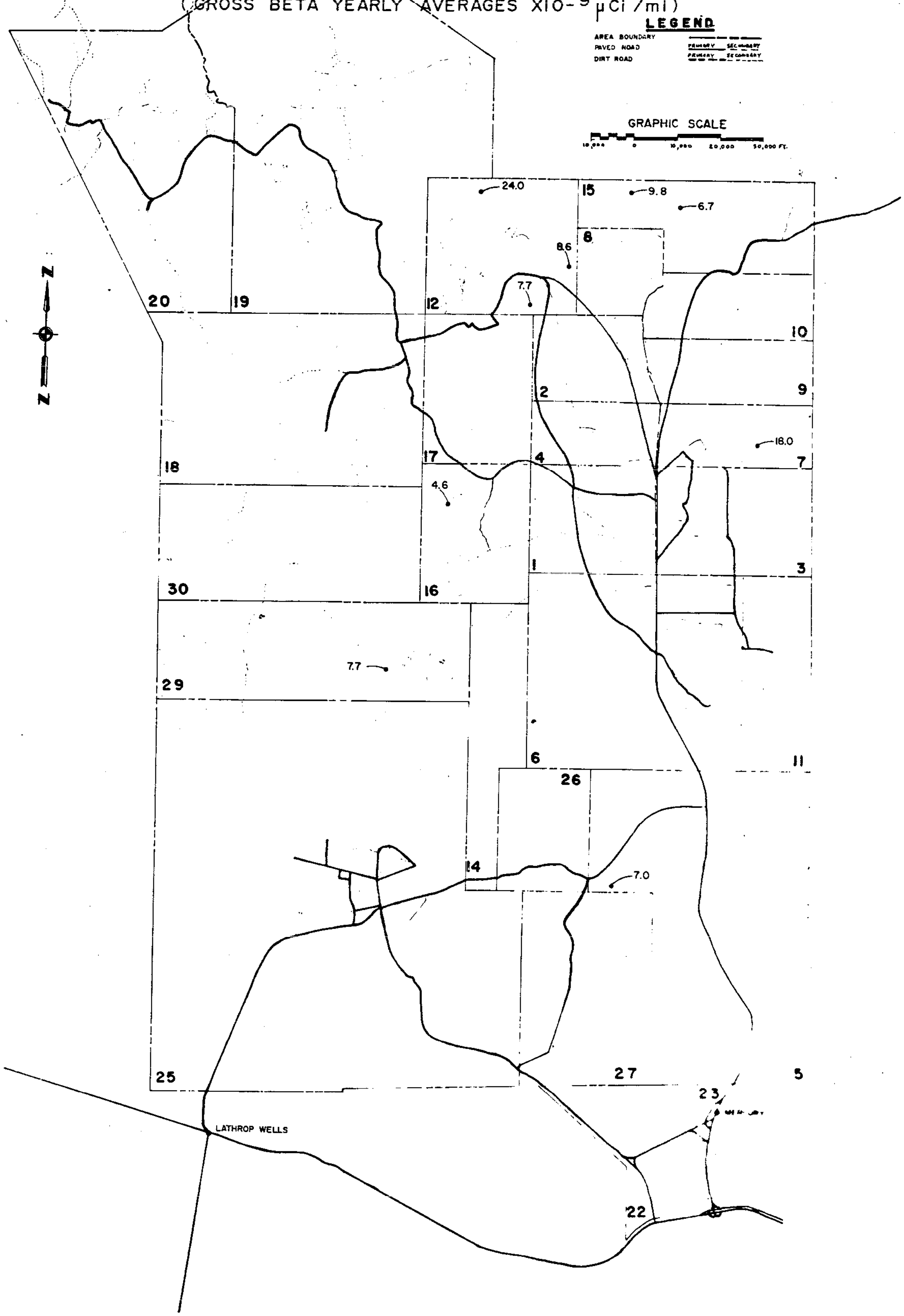


Figure 8

TABLE 14

AVERAGES OF NATURAL SPRINGS DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($\times 10^{-9}$ µCi/ml)
Area 5 Cane Spring	7.0
Area 12 White Rock Spring	8.6
Area 12 Captain Jack Spring	7.7
Area 12 Gold Meadows Pond	24.0
Area 15 Oak Butte Spring	9.8
Area 15 Tub Spring	6.7
Area 29 Topopah Spring	7.7
Area 7 Reitmann Seep	18.0
Area 16 Tippipah Spring	4.6

Reitmann Seep. This is 0.0001 percent of the concentration guide for plutonium. The positive results for tritium and plutonium are listed in Tables 8 and 9.

5. Contaminated Ponds

Five contaminated ponds were sampled on a special study basis. The locations are shown in Figure 9. These ponds were impound waters from tunnel test areas, a laboratory waste sump, 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.

Table 15 is a list of the gross beta averages at the five 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-1980 and CY-1981 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-1981. These ponds are closed systems which contain both sanitary and radioactive waste for evaporative treatment. Contact with the

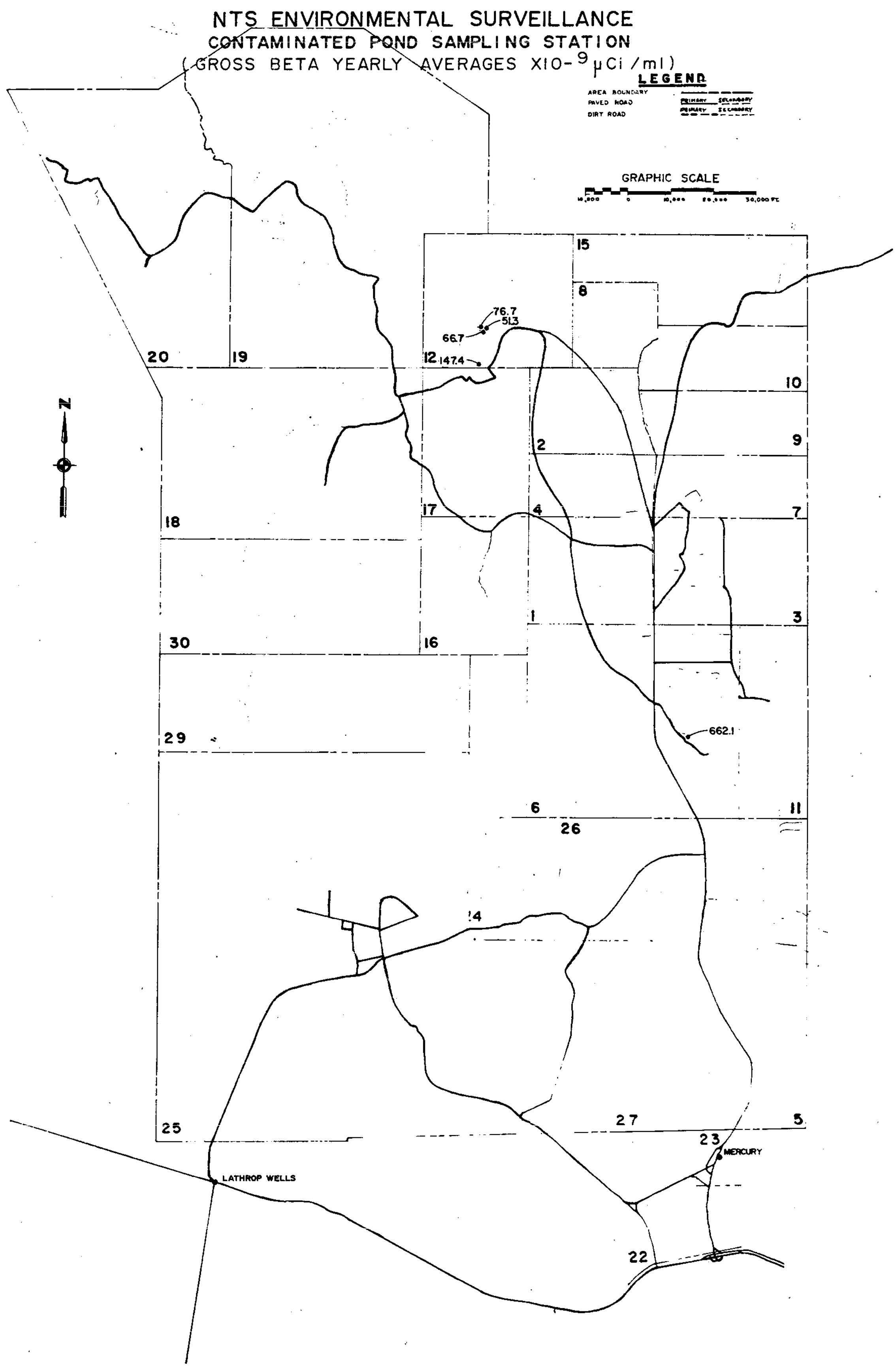

NTS ENVIRONMENTAL SURVEILLANCE
CONTAMINATED POND SAMPLING STATION
(GROSS BETA YEARLY AVERAGES X10-9 µCi/ml)
LEGEND
AREA BOUNDARY
PAVED ROAD
DIRT ROAD
PRIMARY
SECONDARY
GRAPHIC SCALE
N
76.7
51.3
66.7
147.4
662.1
1
2
3
4
5
6
7
8
9
10
11
12
14
15
16
17
18
19
20
22
23
25
26
27
29
30
LATHROP WELLS
MERCURY

Figure 9

TABLE 15

AVERAGES OF CONTAMINATED PONDS FOR GROSS BETA

Station	Gross Beta Yearly Average (X 10^{-9} µCi/ml)
Area 6 Yucca Waste Pond	662.1
Area 12 N Upper	77.7
Area 12 N Middle	51.3
Area 12 N Lower	66.7
Area 12 G Waste	147.4

working population was minimal. The highest tritium value was 6.7×10^{-6} $\mu Ci/ml$ and 2.3×10^{-11} $\mu Ci/ml$ 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 in CY-1981. The additional eleven stations were placed at 500-feet intervals around the Radioactive Waste Management Site. Table 16 lists the maximum, minimum, and average dose rates, and the adjusted annual dose for each monitoring station. The expansion was carried out for four aspects of the NTS environment: (1) additional measurement of dose rates in areas of elevated gamma activity; (2) coverage of the nuclear testing areas; (3) coverage of the RWMS locations; and (4) coverage of the mountainous borders of the NTS. Nine control-type stations from the 1977 network were retained for comparison to all new stations and for detection of any small variations in the general NTS background.

The nine locations that comprised the original control network demonstrated slightly more variable and higher dose rates than in previous years. Table 17 summarizes the nine locations average dose rates from 1977-1981. The largest

TABLE 16

GAMMA MONITORING RESULTS - SUMMARY OF 1981

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1980 ADJUSTED ANNUAL DOSE (mrem/y)	1981 ADJUSTED ANNUAL DOSE (mrem/y)
A-90 Road (18)	01/27/81 - 01/08/82	0.54	0.40	0.45	170	165
A-100 Road (18)	01/27/81 - 01/08/82	0.51	0.40	0.45	160	165
A-108 Road (18)	01/27/81 - 01/08/82	0.47	0.43	0.46	175	170
A-116 Road (20)	01/27/81 - 01/08/82	0.60	0.28	0.48	190	175
A-130 Road (20)	01/27/81 - 01/08/82	0.52	0.40	0.46	145	170
A-132 Road (20)	01/21/81 - 01/19/82	0.48	0.40	0.45	165	165
A-136 Road (20)	12/16/80 - 01/19/82	0.72	0.38	0.51	85	185
Angle Road (3)	01/21/81 - 01/13/82	1.96	1.76	1.83	685	670
Bldg. 190 (23)	12/16/80 - 01/05/82	0.26	0.20	0.24	75	90
Bldg. 610 Fence (23)	12/16/80 - 01/05/82	0.22	0.16	0.19	60	70
Bldg. 610 X-Ray Area (23)	12/16/80 - 01/06/82	7.62	2.93	5.18	1090	1890
Bldg. 650 Dosimetry Room (23)	12/16/80 - 01/05/82	0.22	0.17	0.21	65	75
Bldg. 650 Roof (23)	12/16/80 - 01/05/82	0.21	0.15	0.18	60	65
Bldg. 650 Sample Storage (23)	12/16/80 - 01/05/82	1.15	0.72	0.95	270	345
B.J.Y. (3)	01/27/81 - 01/13/82	0.45	0.41	0.43	140	155
C-16 Road (19)	01/21/81 - 01/19/82	0.49	0.28	0.40	160	145
C-25 Road (19)	01/21/81 - 01/19/82	0.50	0.40	0.45	195	165
C-27 Road (19)	01/21/81 - 01/19/82	0.47	0.42	0.45	205	165
C-31 Road (19)	01/21/81 - 01/19/82	0.48	0.42	0.46	200	170
Cable Yard (2)	01/28/81 - 01/13/82	0.50	0.34	0.42	160	155
Cafeteria (27)	12/16/80 - 01/05/82	0.45	0.38	0.41	135	150
Campsite (20)	01/21/81 - 01/19/82	0.46	0.38	0.42	165	155
Circle & L Road (10)	01/28/81 - 01/13/82	0.48	0.42	0.45	165	165
Complex (3)	01/21/81 - 01/13/82	0.42	0.31	0.38	130	140
Complex (12)	01/22/81 - 01/08/82	0.49	0.39	0.42	135	155
CP Complex (6)	01/27/81 - 01/13/82	0.29	0.22	0.25	85	90
CP-50 Calibration Bench (6)	01/27/81 - 01/13/82	5.31	0.43	2.02	140	740
CP-50 Instrument Calib. Door (6)	01/27/81 - 01/13/82	0.70	0.35	0.55	205	200
CA-14 (10)	01/28/81 - 01/13/82	0.49	0.43	0.47	185	170
Decon Pad Front Office (6)	01/27/81 - 01/13/82	0.39	0.21	0.30	105	110
Decon Pad Back Office (6)	01/27/81 - 01/13/82	0.50	0.30	0.39	130	140
Desert Rock Weather Stn. (22)	12/16/80 - 01/05/82	0.22	0.18	0.21	70	75
E-MAD East (25)	12/16/80 - 01/05/82	0.38	0.34	0.36	125	130
E-MAD North (25)	12/16/80 - 01/05/82	1.16	0.91	1.04	355	380
E-MAD Tile Bed (25)	12/16/80 - 01/05/82	0.46	0.32	0.37	125	135
E-MAD West (25)	12/16/80 - 01/05/82	0.38	0.29	0.34	130	125
EPA Farm (15)	01/28/81 - 01/13/82	0.45	0.33	0.39	130	140
F-2 Road (20)	01/21/81 - 01/19/82	0.69	0.40	0.50	180	185
F-8 Road (20)	01/21/81 - 01/19/82	0.71	0.42	0.52	160	190
F-12 Road (20)	01/21/81 - 01/19/82	0.67	0.28	0.44	125	160
Gate 100 (23)	12/16/80 - 01/05/82	0.25	0.18	0.21	65	75
Gate 700 (15)	01/28/81 - 01/13/82	0.40	0.32	0.36	110	130
Gravel Pit (1)	01/27/81 - 01/08/82	0.37	0.31	0.33	130	120
Groom Pass L43.5 (15)	11/28/81 - 01/13/82	0.47	0.34	0.40	145	145
Henre Site (28)	12/16/80 - 01/05/82	0.43	0.32	0.39	130	140
J-6 Road (20)	01/21/81 - 01/19/82	0.70	0.22	0.47	185	170

Table 16 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1980 ADJUSTED ANNUAL DOSE (mrem/y)	1981 ADJUSTED ANNUAL DOSE (mrem/h)
J-16 Road (20)	01/21/81 - 01/19/82	0.49	0.24	0.39	140	140
J-24 Road (20)	01/21/81 - 01/19/82	0.75	0.39	0.50	145	185
J-31 Road (20)	01/21/81 - 01/19/82	2.13	1.72	1.91	790	700
L-40 (15)	01/28/81 - 01/13/82	0.60	0.46	0.51	190	185
L-49 (15)	01/28/81 - 01/13/82	0.41	0.29	0.35	115	130
Lamp Shack (15)	01/28/81 - 01/13/82	0.43	0.39	0.41	140	150
LLL Trailer (15)	01/28/81 - 01/13/82	0.45	0.37	0.43	160	155
Logistics Desk (6)	01/27/81 - 01/13/82	0.30	0.19	0.25	90	90
Lower Mint Lake (12)	01/22/81 - 01/19/82	1.58	1.37	1.47	580	535
NRDS Warehouse (25)	12/16/80 - 01/05/82	0.42	0.37	0.40	130	155
Office (15)	01/28/81 - 01/13/82	0.37	0.29	0.32	105	115
Post Office (23)	12/16/80 - 01/05/82	0.21	0.18	0.20	60	75
R-3 Road (19)	01/21/81 - 01/19/82	0.53	0.44	0.48	215	175
R-9 Road (19)	01/21/81 - 01/19/82	0.58	0.45	0.51	215	185
R-20 Road (19)	01/21/81 - 01/19/82	0.71	0.40	0.53	190	195
R-27 Road (19)	01/21/81 - 01/19/82	0.55	0.44	0.48	215	175
R-31 Road (19)	01/21/81 - 01/19/82	0.52	0.40	0.47	190	170
Ramatrol (23)	12/16/80 - 01/05/82	0.47	0.37	0.43	130	155
RWMS East 500' (5)	04/06/81 - 01/05/82	0.42	0.20	0.33		120
RWMS East 1000' (5)	12/16/80 - 01/05/82	0.42	0.35	0.38	130	140
RWMS East 1500' (5)	04/06/81 - 01/05/82	0.45	0.30	0.38		140
RWMS East Gate (5)	04/06/81 - 01/05/82	0.43	0.32	0.37		135
RWMS North 500' (5)	04/06/81 - 01/05/82	0.47	0.34	0.40		145
RWMS North 1000' (5)	12/16/80 - 01/05/82	0.43	0.37	0.40	135	145
RWMS North 1500' (5)	04/06/81 - 01/05/82	0.45	0.31	0.38		140
RWMS Northeast Corner (5)	04/06/81 - 01/05/82	0.43	0.19	0.33		120
RWMS Northwest Corner (5)	04/06/81 - 01/05/82	0.45	0.32	0.38		140
RWMS Offices (5)	04/06/81 - 01/05/82	0.61	0.44	0.53		195
RWMS South Gate (5)	12/16/80 - 01/05/82	1.68	0.34	0.68	140	250
RWMS South 500' (5)	04/06/81 - 01/05/82	0.43	0.31	0.37		135
RWMS Southwest Corner (5)	04/06/81 - 01/05/82	0.44	0.29	0.36		130
RWMS West 500' (5)	12/16/80 - 01/05/82	0.45	0.35	0.40	140	145
RWMS West 1000' (5)	04/06/81 - 01/05/82	0.45	0.31	0.39		140
RWMS West 1500' (5)	12/16/80 - 01/05/82	0.45	0.36	0.41	125	150
Security Gate 293 (11)	01/27/81 - 01/13/82	0.51	0.40	0.44	165	160
Sedan Crater Visitor's Box (10)	01/28/81 - 01/13/82	0.68	0.45	0.56	225	205
Sedan Crater West Area (10)	01/28/81 - 01/13/82	3.31	2.68	2.95	1120	1075
Storage Shed (15)	01/28/81 - 01/13/82	0.41	0.33	0.37	135	135
Substation Bus (15)	01/28/81 - 01/13/82	0.33	0.29	0.31	115	115
TH-1 (6)	01/22/81 - 01/08/82	0.28	0.15	0.23	75	85
TH-9 (6)	01/22/81 - 01/08/82	0.36	0.30	0.32	100	115
TH-18 (1)	01/22/81 - 01/08/82	0.31	0.27	0.29	100	105
TH-27 (1)	01/22/81 - 01/08/82	0.34	0.29	0.31	115	115
TH-37 (1)	01/22/81 - 01/08/82	0.42	0.35	0.38	145	140
TH-47 (4)	01/22/81 - 01/08/82	0.51	0.42	0.46	170	170
TH-57 (2)	01/22/81 - 01/08/82	0.34	0.26	0.29	100	105
TH-67.5 (12)	01/22/81 - 01/08/82	0.34	0.27	0.30	105	110
Upper Haines Lake No. 1 (12)	01/22/81 - 01/08/82	0.45	0.32	0.37	145	135
Upper N Tunnel Pond (12)	01/22/81 - 01/08/82	0.50	0.36	0.41	160	150
U3ax Northeast (3)	01/27/81 - 01/13/82	1.30	0.99	1.12	430	410
U3ax Northwest (3)	01/27/81 - 01/13/82	0.84	0.80	0.83	305	305
U3ax South (3)	01/27/81 - 01/13/82	2.16	0.46	1.04	270	380
U3ax Southeast (3)	01/27/81 - 01/13/82	0.74	0.62	0.70	245	255
U3by North (3)	01/21/81 - 01/13/82	1.30	1.08	1.21	435	440

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1980 ADJUSTED ANNUAL DOSE (mrem/y)	1981 ADJUSTED ANNUAL DOSE (mrem/h)
U3by South (3)	01/21/81 - 01/13/82	0.60	0.52	0.56	205	205
U3bz North (3)	01/21/81 - 01/13/82	0.88	0.65	0.78	275	285
U3bz South (3)	01/21/81 - 01/13/82	0.59	0.42	0.49	160	180
U3cj North (3)	01/21/81 - 01/13/82	0.61	0.49	0.55	165	200
U3co North (3)	01/21/81 - 01/13/82	5.81	4.62	5.17	1960	1890
U3co South (3)	01/21/81 - 01/13/82	3.42	2.79	3.03	1010	1105
U3du North (3)	01/21/81 - 01/13/82	0.67	0.38	0.56	210	205
U3du South (3)	01/21/81 - 01/13/81	0.76	0.58	0.69	250	255
U3ey South (3)	01/21/81 - 01/13/82	0.48	0.35	0.42	90	155
Well 3 (6)	01/21/81 - 01/13/82	0.41	0.33	0.38	130	140
Well 5B (5)	12/16/80 - 01/05/82	0.43	0.31	0.37	125	135
Well 19C Reservoir (19)	01/21/81 - 01/19/82	0.47	0.39	0.43	195	155
Yucca Complex (6)	01/27/81 - 01/13/82	0.35	0.18	0.29	110	105
2-04 Road (2)	01/28/81 - 01/13/82	8.67	7.16	7.98	2890	2915
2-07 Road (2)	01/28/81 - 01/13/82	1.10	0.98	1.05	410	385
3-03, O.B. Roads (3)	01/27/81 - 01/13/82	0.40	0.26	0.32	110	115
4-04 Road (4)	01/27/81 - 01/13/82	11.00	7.85	9.40	3690	3435
6-09, O.B. Roads (6)	01/27/81 - 01/13/82	0.45	0.32	0.38	135	140
7-300 Bunker (7)	01/27/81 - 01/13/82	1.49	1.10	1.31	475	480
8K 25 (8)	01/28/81 - 01/13/82	0.39	0.28	0.34	135	125
9-300 Bunker (9)	01/28/81 - 01/13/82	0.47	0.36	0.41	145	150
10 A-24 (10)	01/28/81 - 01/13/82	1.13	0.93	1.02	385	375
18-1C Gate (18)	01/27/81 - 01/08/82	0.48	0.35	0.43	145	155
18P 35 (18)	01/22/81 - 01/08/82	0.57	0.42	0.49	170	180
18P 39 (18)	01/27/81 - 01/08/82	0.54	0.39	0.48	155	175
19P 41 (19)	01/27/81 - 01/08/82	0.55	0.38	0.44	180	160
19P 46 (19)	01/27/81 - 01/08/82	0.45	0.39	0.42	155	155
19P 54 (19)	01/27/81 - 01/08/82	0.50	0.39	0.46	135	170
19P 59 (19)	01/27/81 - 01/08/82	0.61	0.46	0.53	175	195
19P 66 (19)	01/27/81 - 01/08/82	0.52	0.45	0.50	195	185
19P 71 (19)	01/27/81 - 01/08/82	0.52	0.26	0.42	160	155
19P 77 (19)	01/27/81 - 01/08/82	0.51	0.45	0.49	175	180
19P 87 (19)	01/27/81 - 01/08/82	0.64	0.51	0.56	215	205
19P 88 (19)	01/27/81 - 01/08/82	0.57	0.29	0.46	180	170
19P 91 (19)	01/27/81 - 01/08/82	0.62	0.44	0.53	170	195
20-4C Gate (20)	01/27/81 - 01/08/82	0.51	0.42	0.47	170	170
25-4P Gate (25)	12/16/80 - 01/05/82	0.53	0.32	0.44	140	160
25-7P Gate (25)	12/16/80 - 01/05/82	0.44	0.33	0.39	135	140
30-1C Gate (30)	07/14/80 - 01/20/82	0.59	0.40	0.52	205	190
130 M (4)	01/27/81 - 01/13/82	0.38	0.32	0.36	140	130
140 M (2)	01/28/81 - 01/13/82	0.45	0.24	0.37	160	135
150 M (2)	01/28/81 - 01/13/82	0.46	0.42	0.44	160	160
168 M (12)	01/22/81 - 01/08/82	0.43	0.33	0.38	140	140
170 M (12)	01/22/81 - 01/08/82	0.38	0.29	0.34	135	125
175 M (12)	01/22/81 - 01/08/82	0.46	0.37	0.40	165	145
185 Holmes Road (17)	01/22/81 - 01/08/82	0.48	0.38	0.43	165	155
190 M (19)	01/22/81 - 01/08/82	0.56	0.43	0.50	185	185
196 M (19)	01/22/81 - 01/08/82	0.54	0.41	0.49	175	180

Table 16 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	ELEVATION (FT)	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1980 ADJUSTED ANNUAL DOSE (mrem/y)	1981 ADJUSTED ANNUAL DOSE (mrem/h)
N670,600 E667,300 (22)	01/23/81 - 01/07/82	4000	0.23	0.20	0.22	75	80
N731,300 E638,700 (28)	01/23/81 - 01/07/82	5750	0.34	0.27	0.32	105	115
N754,000 E557,800 (31)	01/23/81 - 01/07/82	4800	0.48	0.38	0.44	155	160
N849,500 E545,000 (30)	10/27/80 - 01/07/82	7100	0.57	0.45	0.49	160	180
N887,000 E558,000 (20)	01/23/81 - 01/07/82	6100	0.64	0.50	0.56	175	205
N948,800 E527,800 (20)	01/23/81 - 01/07/82	5650	0.60	0.48	0.54	190	195
N944,700 E563,300 (19)	01/23/81 - 01/12/82	6300	0.34	0.25	0.31	105	115
N955,500 E614,200 (19)	01/23/81 - 01/07/82	7200	0.53	0.44	0.48	170	175
N935,500 E639,750 (19)	01/23/81 - 01/08/82	6550	0.55	0.37	0.45	165	165
N903,800 E635,500 (12)	01/23/81 - 01/07/82	6900	0.41	0.32	0.37	115	135
N907,600 E686,200 (8)	01/23/81 - 01/07/82	5826	0.62	0.44	0.50	180	185
N874,600 E691,500 (10)	01/23/81 - 01/07/82	5000	0.31	0.22	0.26	85	95
N844,200 E704,900 (3)	01/23/81 - 01/07/82	5100	0.26	0.20	0.23	75	85
N788,800 E709,500 (11)	01/23/82 - 01/07/82	5200	0.45	0.39	0.42	145	155
N710,800 E720,000 (11)	01/23/81 - 01/07/82	4280	0.21	0.15	0.18	65	65

TABLE 17

TLD Control Station Comparison

Station	Dose Rate (mrem/d) 1977	1978	1979	1980	1981
Bldg. 650 Dosimetry Room	0.15	0.16	0.17	0.18	0.21
Bldg. 650 Roof	0.15	0.15	0.15	0.16	0.18
Area 27 Cafeteria	0.37	0.37	0.35	0.37	0.41
CP Complex	0.21	0.22	0.21	0.23	0.25
Henre Site	0.34	0.34	0.33	0.35	0.39
NRDS Warehouse	0.35	0.35	0.33	0.35	0.40
Post Office	0.15	0.15	0.15	0.16	0.20
Well 5B	0.32	0.32	0.31	0.34	0.38
Yucca Complex	0.29	0.31	0.30	0.30	0.32
Network Average	0.26	0.26	0.26	0.27	0.30

variance was 0.05 mrem/d. The overall network range of these stations was 0.18 mrem/d to 0.41 mrem/d, with an average NTS background of approximately 0.30 mrem/d (110 mrem/y). This corresponds favorably with rates measured at offsite Nevada locations by the Environmental Protection Agency (Reference 11).

The remaining 156 stations of the network yielded dose rates which ranged from 0.18 mrem/d to 9.4 mrem/d, about a factor of 50 variation. The majority of individual location measurements were consistent within a range of ± 10 percent between field cycles. This suggested that the elevated gamma dose rates were caused by the presence of long-lived radionuclides, a theory borne out by the fact that most of the soil-deposited NTS fission products were well over a decade old. Few stations displayed substantial variations, and fluctuations were related to known radioactive source movement or moderation. The greater variability of the results in the TLD control stations and to a lesser extent in the overall network may be attributed to 1) variability within the three different TLD batches used for ambient gamma monitoring, 2) temperature and pressure corrections beginning in the third quarter, 3) mechanical problems associated with the calibration source, 4) and a more accurate estimate of the storage background for each location starting in the third quarter.

The mean for the CY-1980 stations, excluding those that were in buildings, was 245 mrem/y compared to the mean of 240 mrem/y for CY-1981. This represents a difference of 2.0 percent for the whole network and verifies the accuracy of the ambient gamma monitoring system.

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-1981. This was done by calculating the fifty year cummulative dose for the individual receiving a one year intake from the maximum average measured radionuclide concentrations onsite. The dose conversion factors used for calculating the cummulative dose came from Reference 14 and are tabulated in Table 18. Basically, this report used models and parameters equivalent to those used in ICRP Publication 2 (Reference 16). The radionuclides considered for the dose calculations were tritium, ^{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, and lung.

1. Dose From Ingestion of Radionuclides

The dose from the ingestion pathways were calculated for an individual living at the NTS boundary during CY-1981. 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 due to the naturally occurring ^{40}K content. The Cascade bottled water brought onsite was assumed to have natural background levels of ^{239}Pu and tritium. These background concentrations were subtracted from the stations having the maximum ^{239}Pu and tritium concentrations to obtain the net concentrations used in the dose calculations. These values are listed in Table 19. The assumed fluid intake for the individual was 1.6 l/d 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 20.

2. Dose from Inhalation of Radionuclides

The dose from the inhalation of gross beta activity and ^{239}Pu was calculated for the individual living at the NTS boundary. The dose from tritium was not calculated because from the four stations sampled, the average tritium concentrations were considered to be of natural background concentrations. To obtain the radionuclide concentrations used for the dose calculations, average background station concentrations were subtracted from the highest average concentrations onsite. These values are listed in Table 19. All of the gross beta activity used in these calculations was assumed to be ^{90}Sr. This assumption is probably conservative and will over estimate the actual dose to the individual. 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 20.

3. Estimated Risk to Individual

The maximum estimated dose to the total body, bone, and lung from NTS operations during CY-1981 was 0.6 mrem, 21.0 mrem, and 1.2 mrem, respectively. Table 21 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 0.5 percent (total body), 13.7 percent (bone), and 0.5 percent (lung) over natural background. 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 1.0×10^{-7}, 1.0×10^{-7}, and 2.4×10^{-8}, respectively. Reference 17 estimates that an acceptable risk to any individual in the public is 10^{-6} to 10^{-5} per year. The maximum calculated risk to the individual at the NTS boundary is at least an order of magnitude below this acceptable risk. 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-1981 would have no observable ill effects from the operation of the NTS.

TABLE 18

DOSE CONVERSION FACTORS[a]

Organ	Inhalation (mrem/50 y per pCi inhaled) ^{239}Pu[d]	^{90}Sr[b]	Ingestion (mrem/50 y per pCi inhaled) ^{239}Pu[d]	^{3}H[c]
Total Body	1.55E-01	7.62E-04	3.82E-05	6.2E-08
Bone	6.38E+00	1.24E-02	1.57E-03	0.0
Lung	3.44E-01	1.20E-03	0.0	6.2E-08

a. Taken from Reference 14.

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

c. 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).

d. 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).

TABLE 19

RADIONUCLIDE CONCENTRATIONS USED FOR DOSE ASSESSMENT

	Air (μCi/cc)		Potable Water (μCi/ml)	
	^{239}Pu	Gross Beta	^{239}Pu	^{3}H
Maximum Onsite Concentration	35.9E-17	18.9E-14	1.85E-11	4.72E-07
Background Concentration	2.5E-17	16.0E-14	1.33E-11	3.95E-07
Net Concentration	33.4E-17	2.9E-14	0.52E-11	0.77E-07

TABLE 20

50 YEAR CUMMULATIVE DOSES[a]

Organ	Inhalation (mrem)		Ingestion (mrem)		Total (mrem)
	^{239}Pu	^{90}Sr[b]	^{239}Pu	^{3}H	
Total Body	4.3E-01	1.9E-01	1.2E-04	2.8E-03	6.2E-01
Bone	17.9E+00	3.0E+00	4.8E-03	0.0	2.1E+01
Lung	9.7E-01	2.9E-01	0.0	2.8E-03	1.2E+00

a. 50 year cummulative dose from inhalation and ingestion of radionuclides for one year.

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

TABLE 21

ESTIMATED NATURAL BACKGROUND DOSE AT THE NTS BOUNDARY[a]

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

a. These values were derived from References 13 and 18.

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

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

d. Variation throughout U.S. very minimal, usuallv less then 1 mrem/y.

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

f. Average values for the U.S.

H. RADIOACTIVE WASTE MANAGEMENT SITE (RWMS)

The radioactive Waste Management Site is located in Area 5 of the Nevada Test Site (Figure 10). 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 twelve air samplers, three for tritium and nine for gross fission products and plutonium, and sixteen TLD's, for gamma monitoring, placed strategically in and around the RWMS. Figures 11-13 show the locations of the stations and their yearly averages.

The tritium in air samplers are placed in areas known to contain tritium contaminated waste. Results for the RWMS surveillance are summarized in Table 6. The highest average for HTO was 2.6 x 10^{-9} µCi/cc at RWMS Station #3, which is 0.05 percent of the concentration guide. RWMS Station #2 had the highest concentration of HT, 9.5 10^{-9} µCi/cc, which is 0.0005 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 1.7 x 10^{-13} µCi/cc compared to the network average of 1.6 10^{-13} µCi/cc. This concentration represents

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

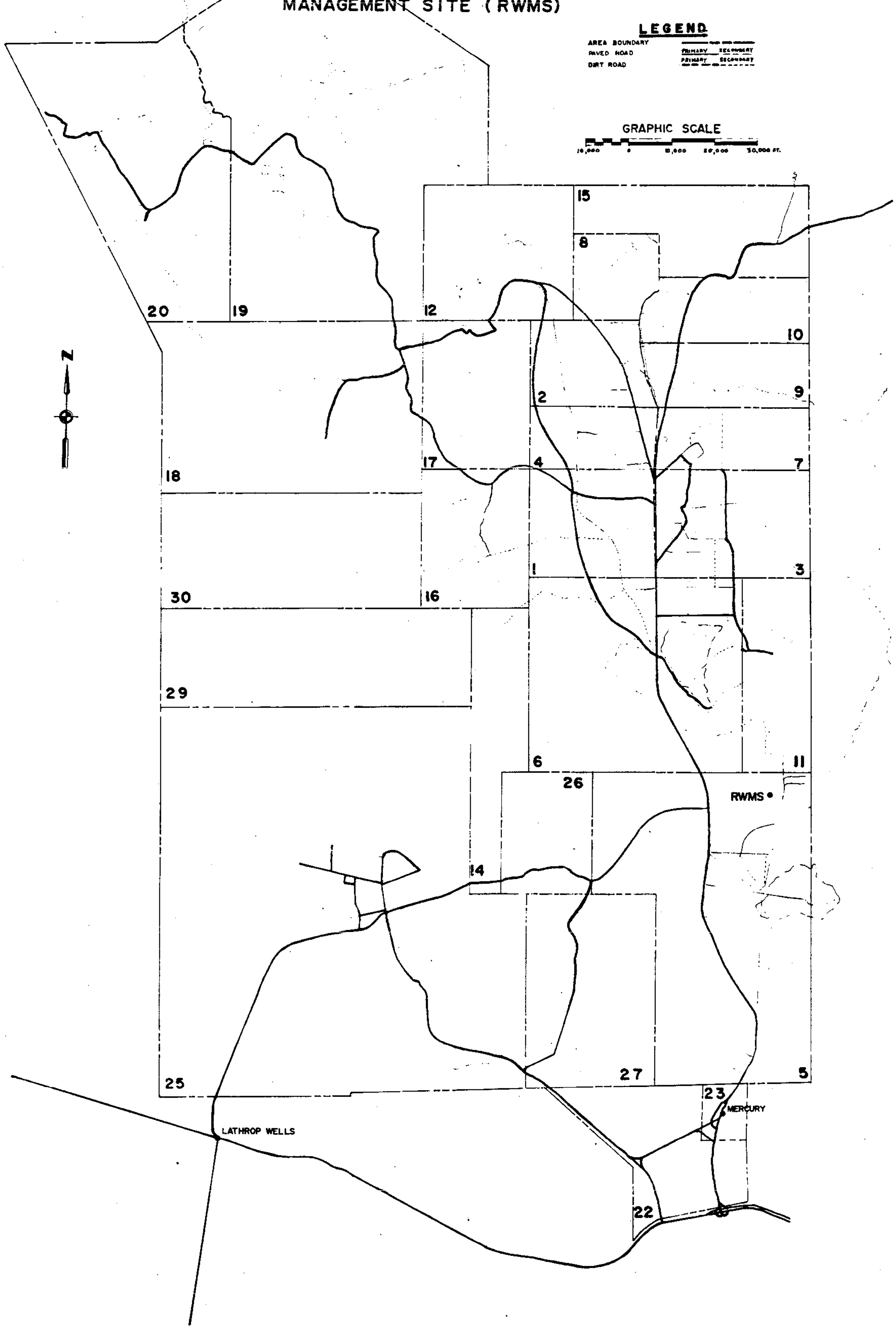


Figure 10

0.017 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 and areas not contaminated by previous safety shots was 2.6 10^{-17} μCi/cc. This is 0.0013 percent of the concentration guide for ^{239}Pu.

Table 16 gives a summary of the gamma monitoring results for 1981. The average annual dose was 148 mrem/y or 17 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 135 mrem/y or 15 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 1981.

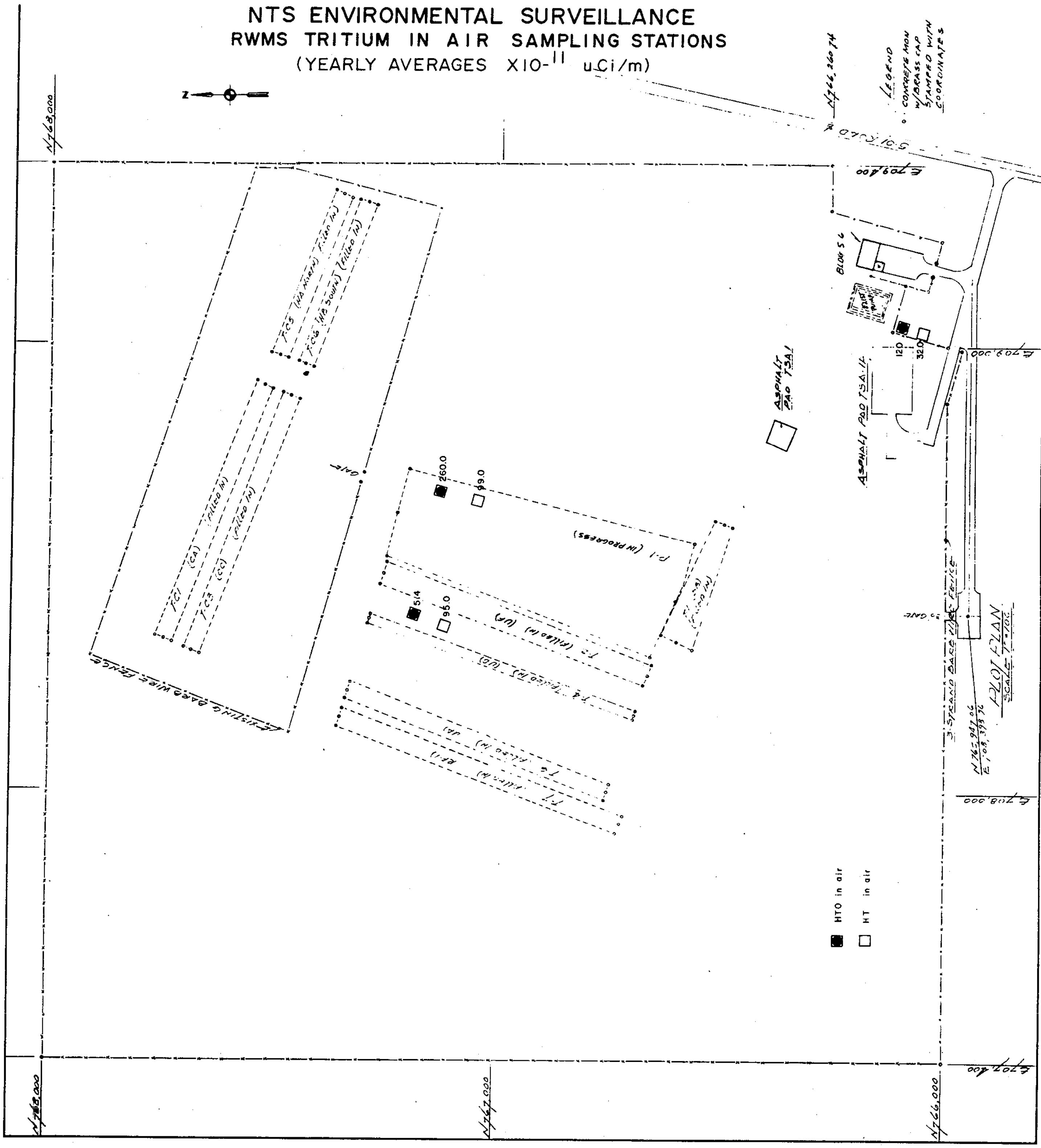

NTS ENVIRONMENTAL SURVEILLANCE
RWMS TRITIUM IN AIR SAMPLING STATIONS
(YEARLY AVERAGES X10-11 uCi/m)
260.0
99.0
514
95.0
120
32.0
HTO in air
HT in air

Figure 11

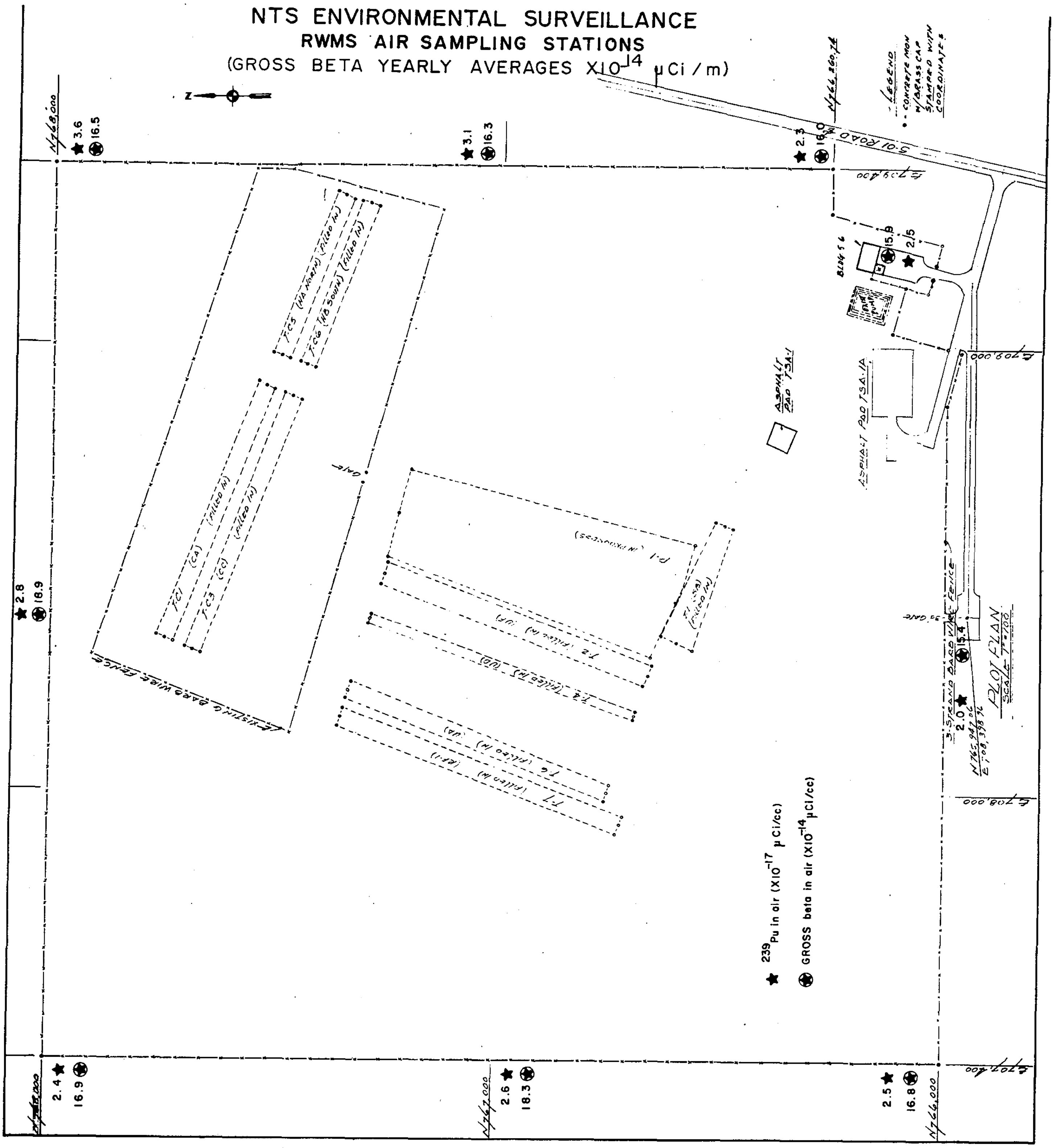

NTS ENVIRONMENTAL SURVEILLANCE
RWMS AIR SAMPLING STATIONS
(GROSS BETA YEARLY AVERAGES X10^-14 μCi/m)
3.6 16.5
3.1 16.3
2.3 16.0
15.9 2.5
2.8 18.9
15.4
2.0
2.4 16.9
2.6 18.3
2.5 16.8
239Pu in air (X10^-17 μCi/cc)
GROSS beta in air (X10^-14 μCi/cc)
PLOT PLAN

Figure 12

NTS ENVIRONMENTAL SURVEILLANCE
RWMS GAMMA MONITORING STATIONS
(YEARLY AVERAGES mrem/d)

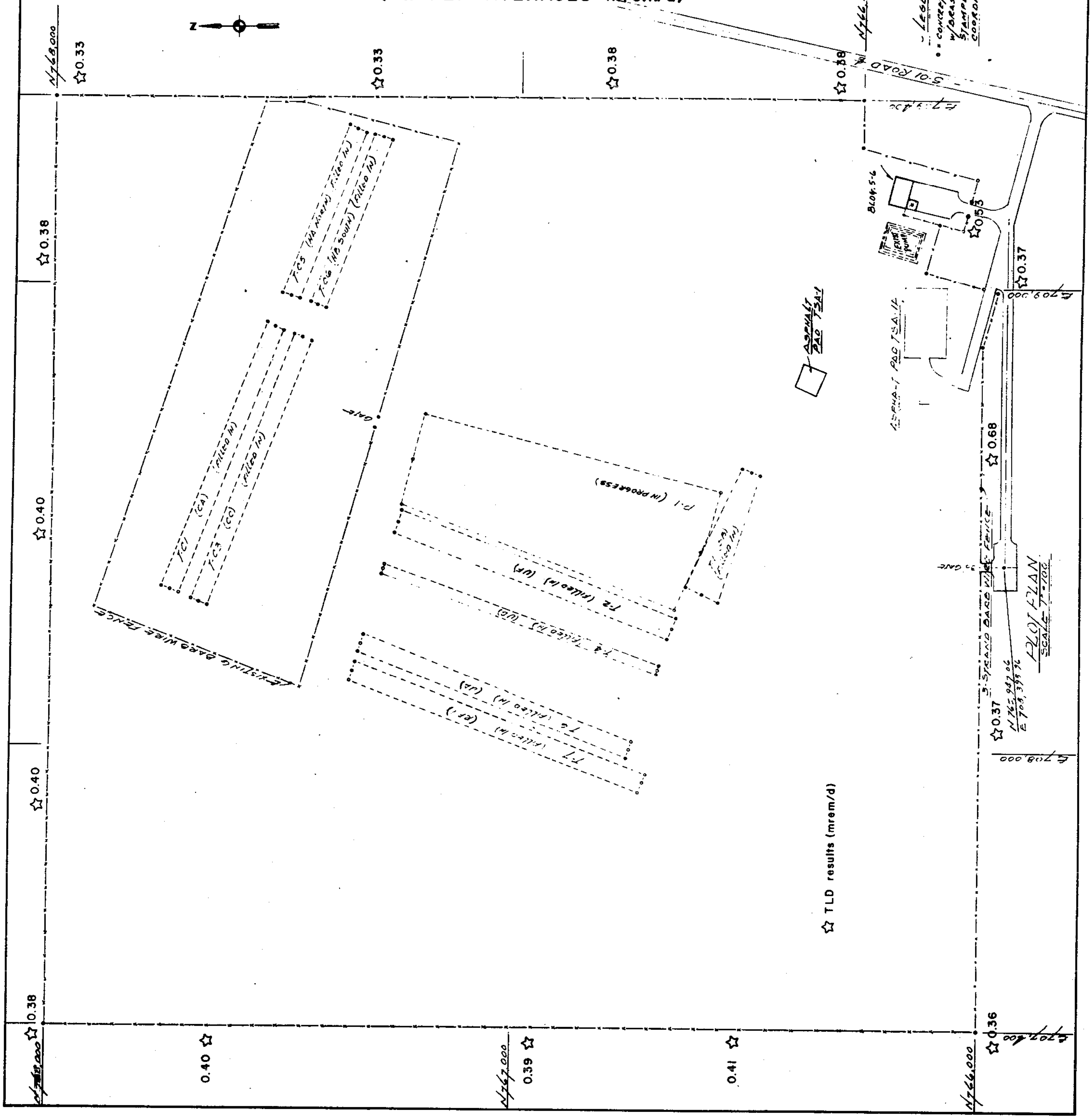


Figure 13

I. REFERENCES

(1) ERDA. "Final Environmental Impact Statement, Nye County Nevada." ERDA-1551. Nevada Operations Office, U.S. Energy Research and Development Administration, Las Vegas, Nevada. Available from U.S. Dept. of Commerce, NTIS, Springfield, VA, 22161. September 1977.

(2) DOE/EP-0023, "A Guide For Environmental Radiological Surveillance at U.S. Department of Energy Installations," Pacific Northwest Laboratories, Richland, Washington, 1981.

(3) DOE ORDER, 5840.1, Chapter XI, "Standards for Radiation Protection," Department of Energy, Washington, D.C. 1981.

(4) Straight, R. J., "HT-HTO Sampling at the Nevada Test Site," IAEA/NEA International Symposium on the Behavior of Tritium in the Environment, San Francisco, 1978.

(5) Beck, Harold L., "Environmental Radiation Fields", Health and Safety Laboratory, U.S. Atomic Energy Commission, New York, New York, 1972.

(6) Burke, Gail De Planque, Thomas F. Gesell. "Error Analysis of Environmental Radiation Measurements Made With Integrating Detector," NBS Special Publication 456, pp. 187-198, 1976.

(7) ANSI N545-1975, "American National Standard; Performance Testing And Procedural Specifications For Thermoluminescent Dosimetry (Environmental Applications)," American National Standards Institute, Inc., New York, New York, 1975.

(8) Scoggins, Wayne A., DOE/NV/00410-64, "Environmental Surveillance Report for the Nevada Test Site January 1980 Through December 1980, Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nevada, 1981.

(9) Lantz, Michael W., NVO/0410-60, "Environmental Surveillance Report for the Nevada Test Site January 1979 through December 1979, Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nevada, 1980.

(10) Bureau of Radiological Health, "Radiological Health Handbook," U.S. Department of Health, Education, and Welfare, Rockville, Maryland, 1970.

(11) EPA-600/4-81-047, "Offsite Environmental Monitoring Report for the Nevada Test Site and Other Test Areas Used for Underground Detonations," January through December 1980, Environmental Protection Agency, Las Vegas, Nevada, 1981.

(12) DOE-NV-00410-54, "Area 5 Radioactive Waste Management Site Safety Assessment Document," Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nevada, 1980.

(13) EG&G-1183-1552, "Radiological Survey of the Nevada Test Site (Survey Period: 1970-1971)," EG&G, Las Vegas, Nevada, 1972.

(14) Hoenes, G. R. and Soldat, J. K., NUREG-0172, "Age-Specific Radiation Dose Commitment Factor for a One-Year Chronic Intake," Battelle Pacific Northwest Laboratories, Richland, Washington, 1977.

(15) ICRP Publication 23, "Report of the Task Group on Reference Manual - A Report Prepared by a Task Group of Committee 2 of ICRP," Pergamon Press, Oxford 1977.

(16) ICRP Publication 2, "Recommendation of the International Commission on Radiological Protection - Report of Committee 2 on Permissible Dose for Internal Radiation (1959)," Pergamon Press, Oxford, 1960.

(17) ICRP Publication 26, "Radiation Protection - Recommendation of the International Commission on Radiological Protection," Pergamon Press, Oxford, 1977.

(18) NCRP Report No. 45, "National Background Radiation in the United States - Recommendation of the National Council on Radiation Protection and Measurements, Washington, D.C., 1975.

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

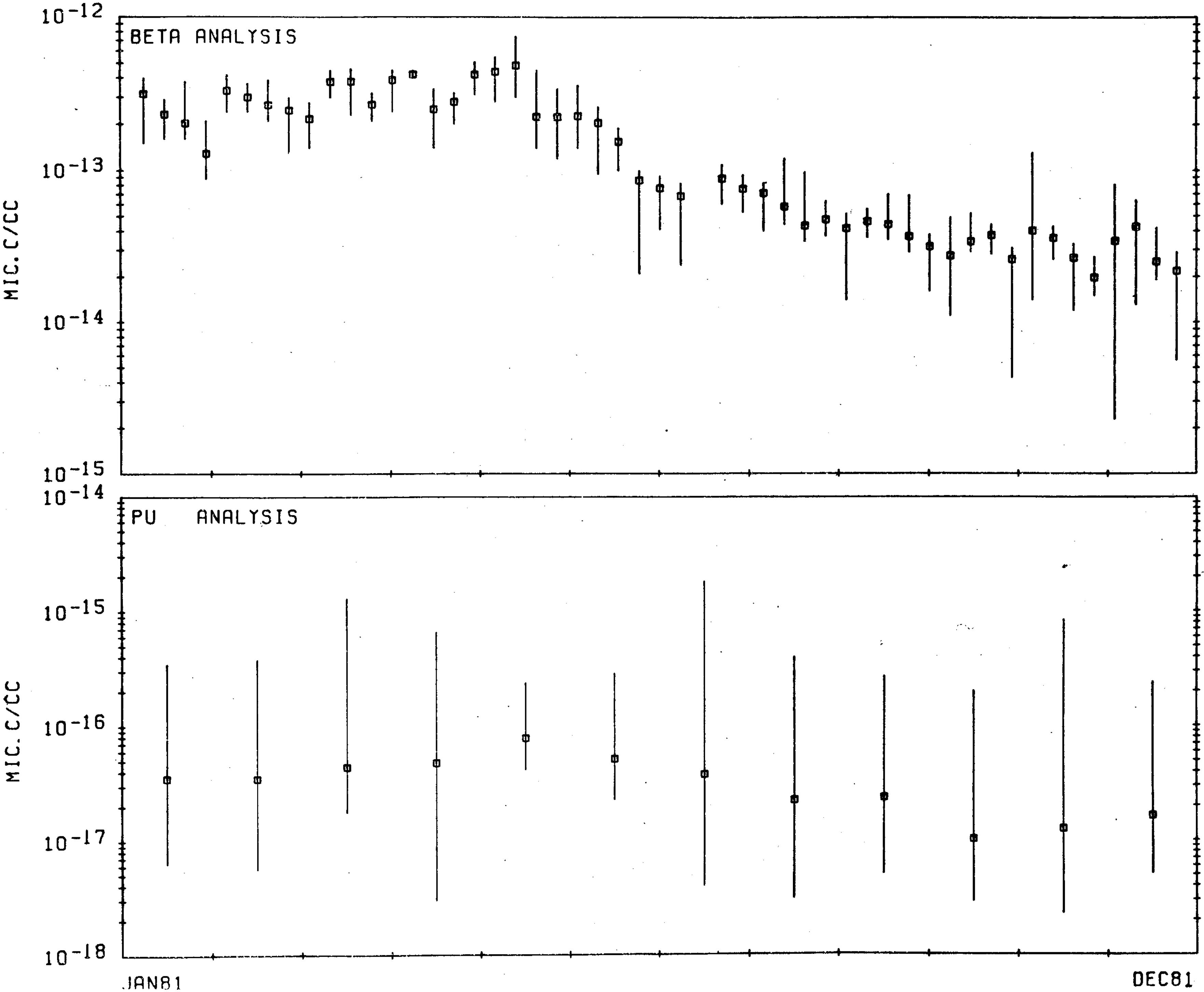
Station Number	Location
1	Area 11 Gate 293
2	Area 6 Well 3 Complex
3	Area 3 Cafeteria
4	Area 9 9-300 Bunker
5	Area 10 Gate 700
6	Area 2 Cable Yard
7	Area 2 Compound
8	Area 12 Changehouse
9	Area 19 Echo Peak
10	Area 19 Substation
11	Area 16 Substation
12	Area 9 9-300 Bunker #2
13	Area 23 H&S Roof
14	Area 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

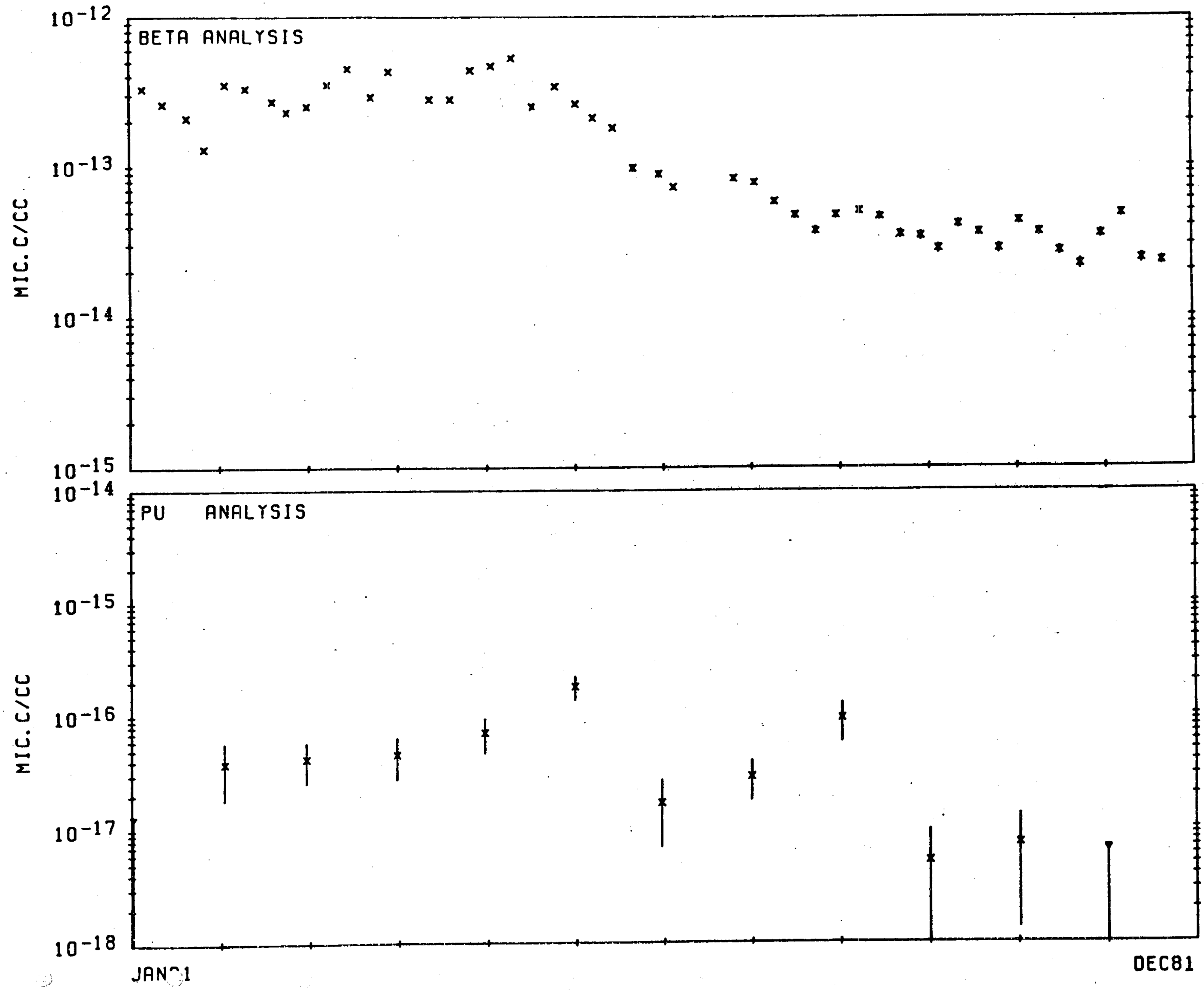
(Continued)

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
48	Area 5 Gate 200

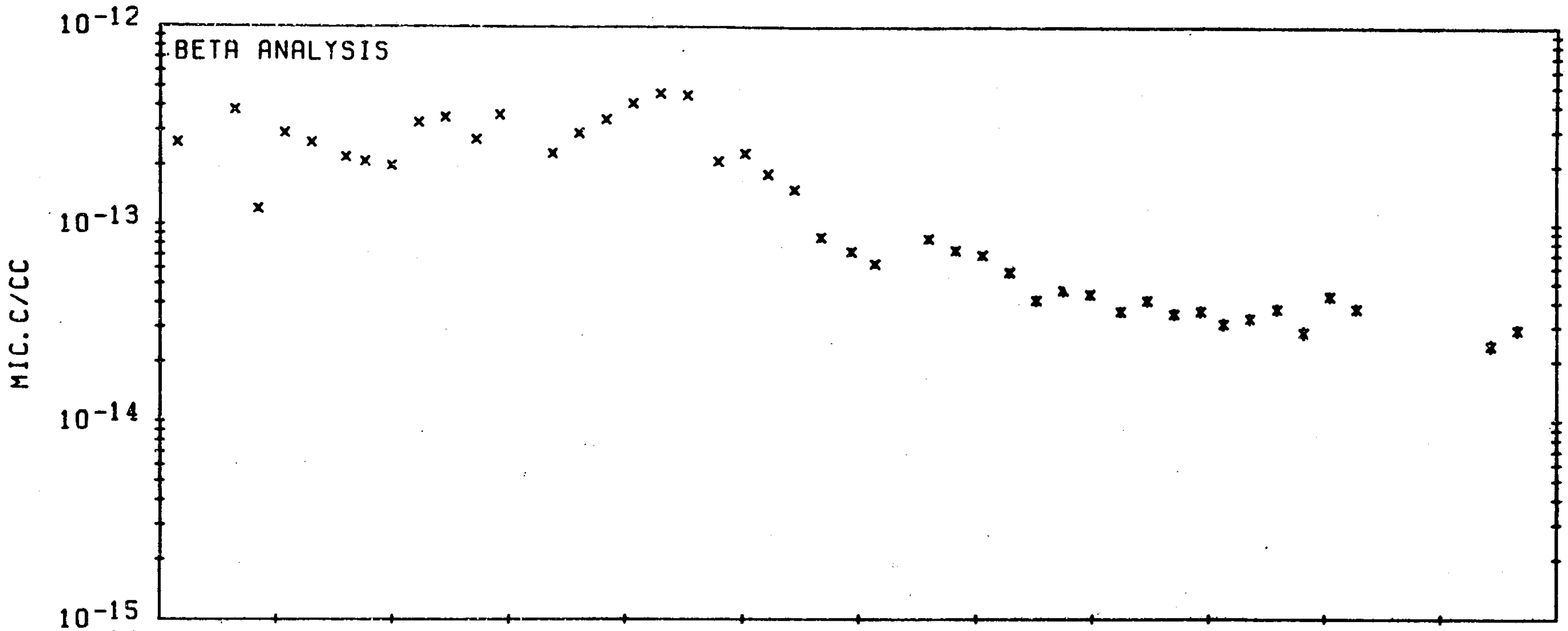
AIR NETWORK AVERAGES

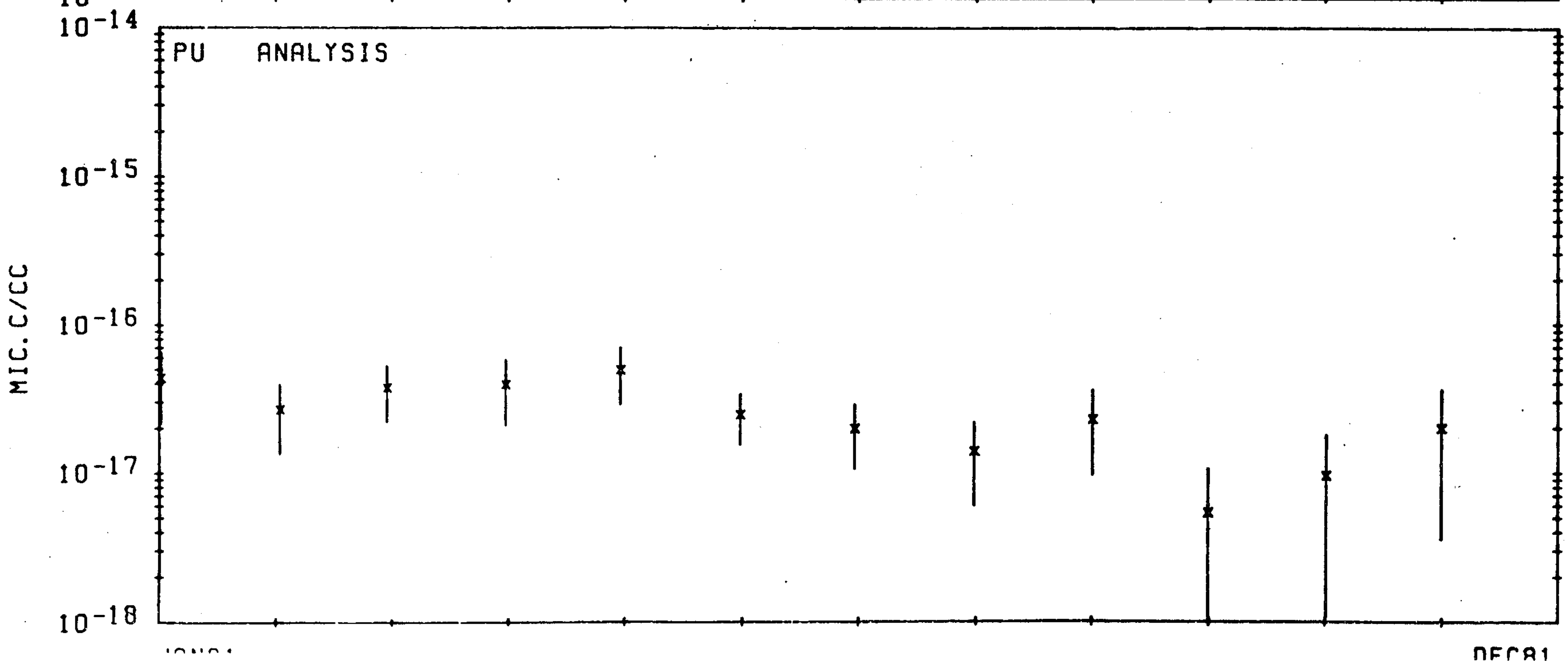


AIR SAMPLING STATION NUMBER 1

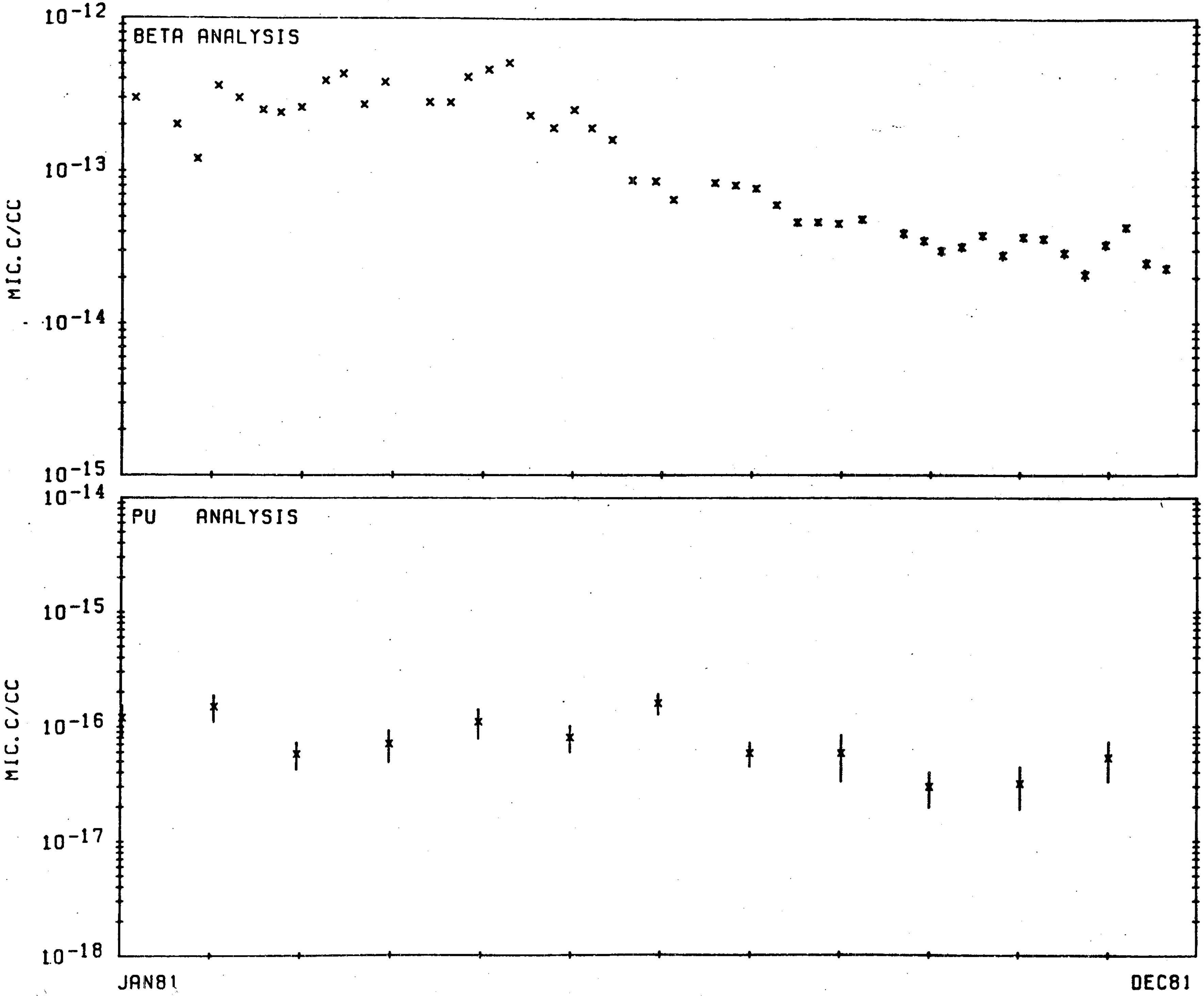


AIR SAMPLING STATION NUMBER 2

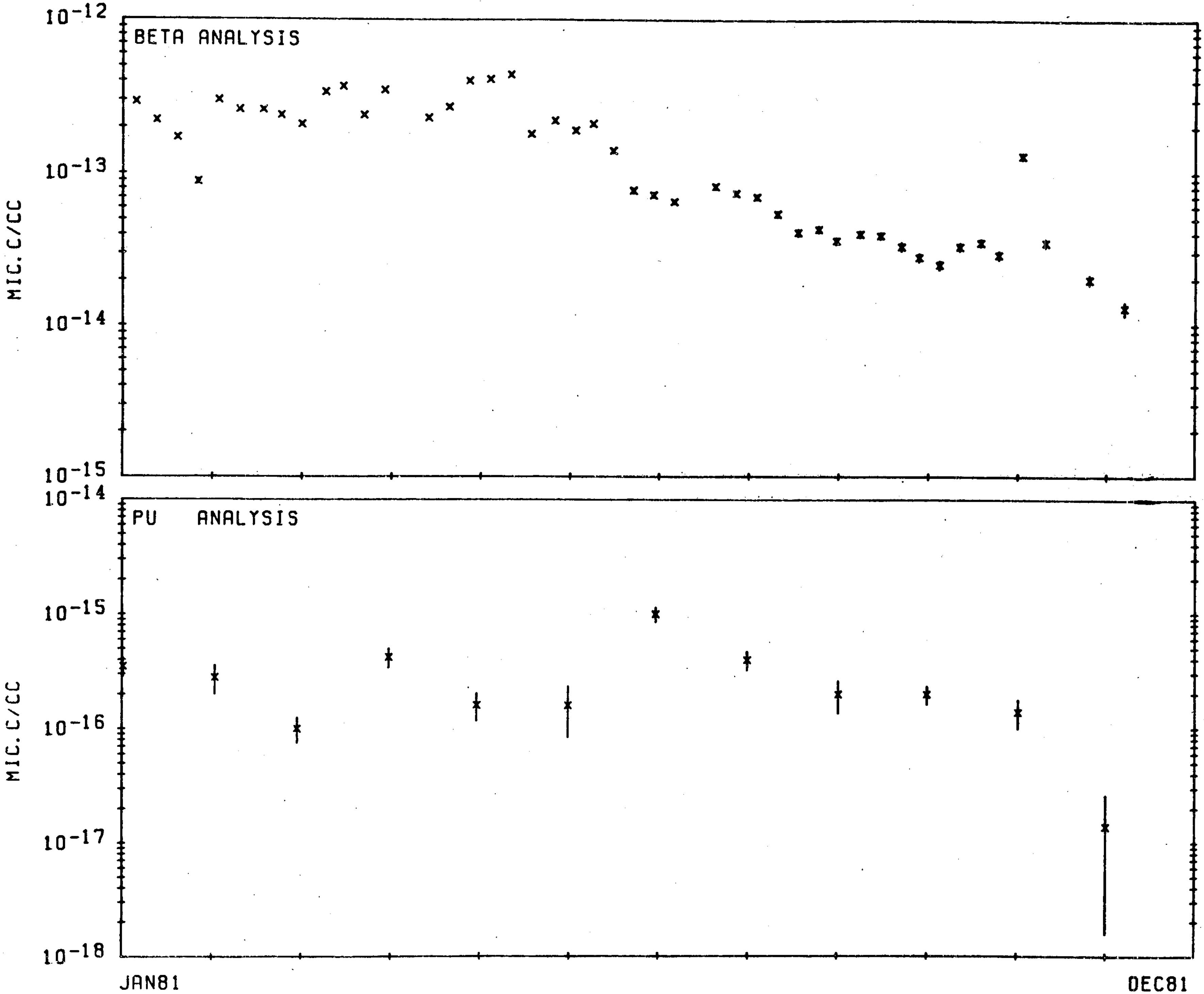




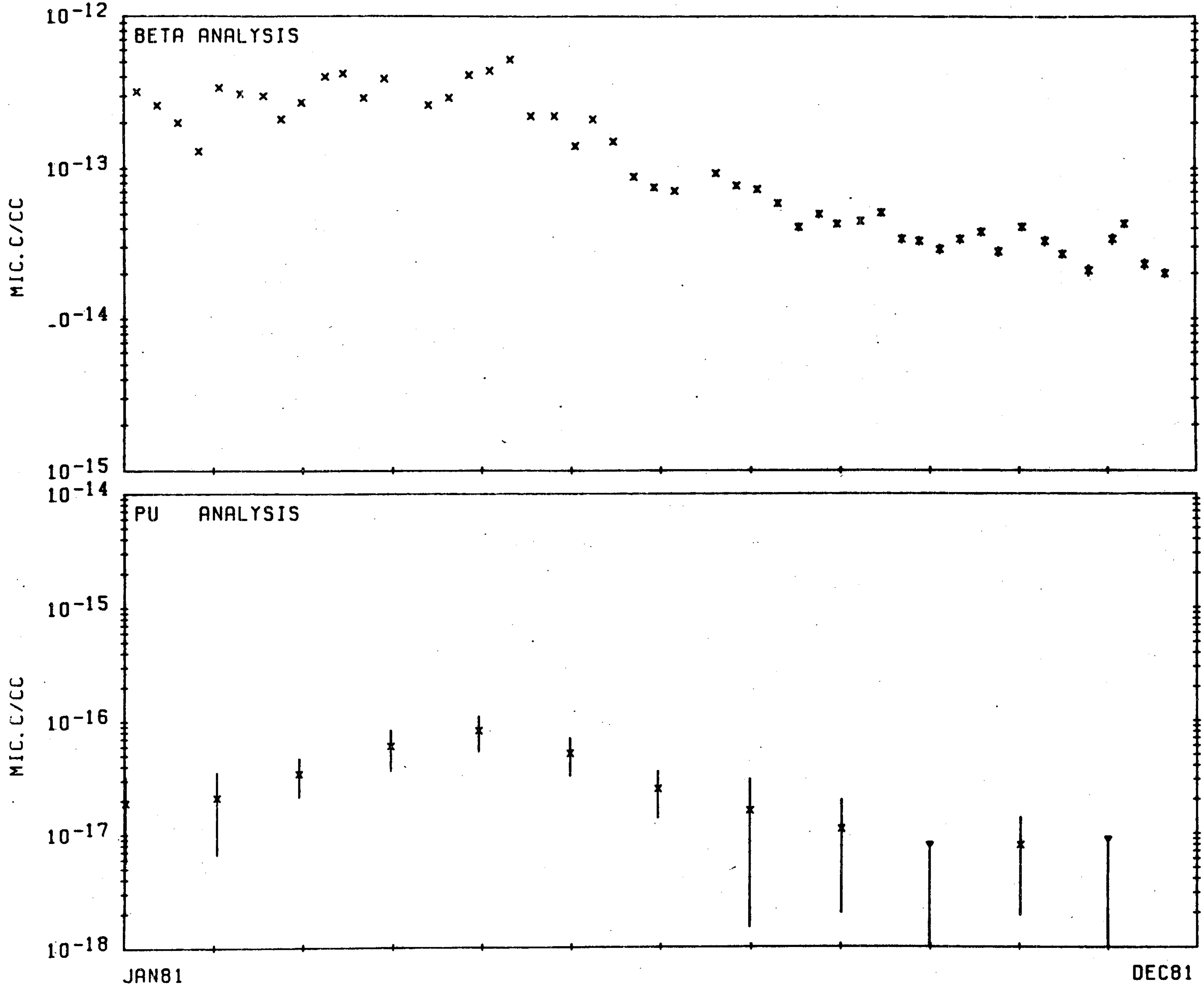
AIR SAMPLING STATION NUMBER 3



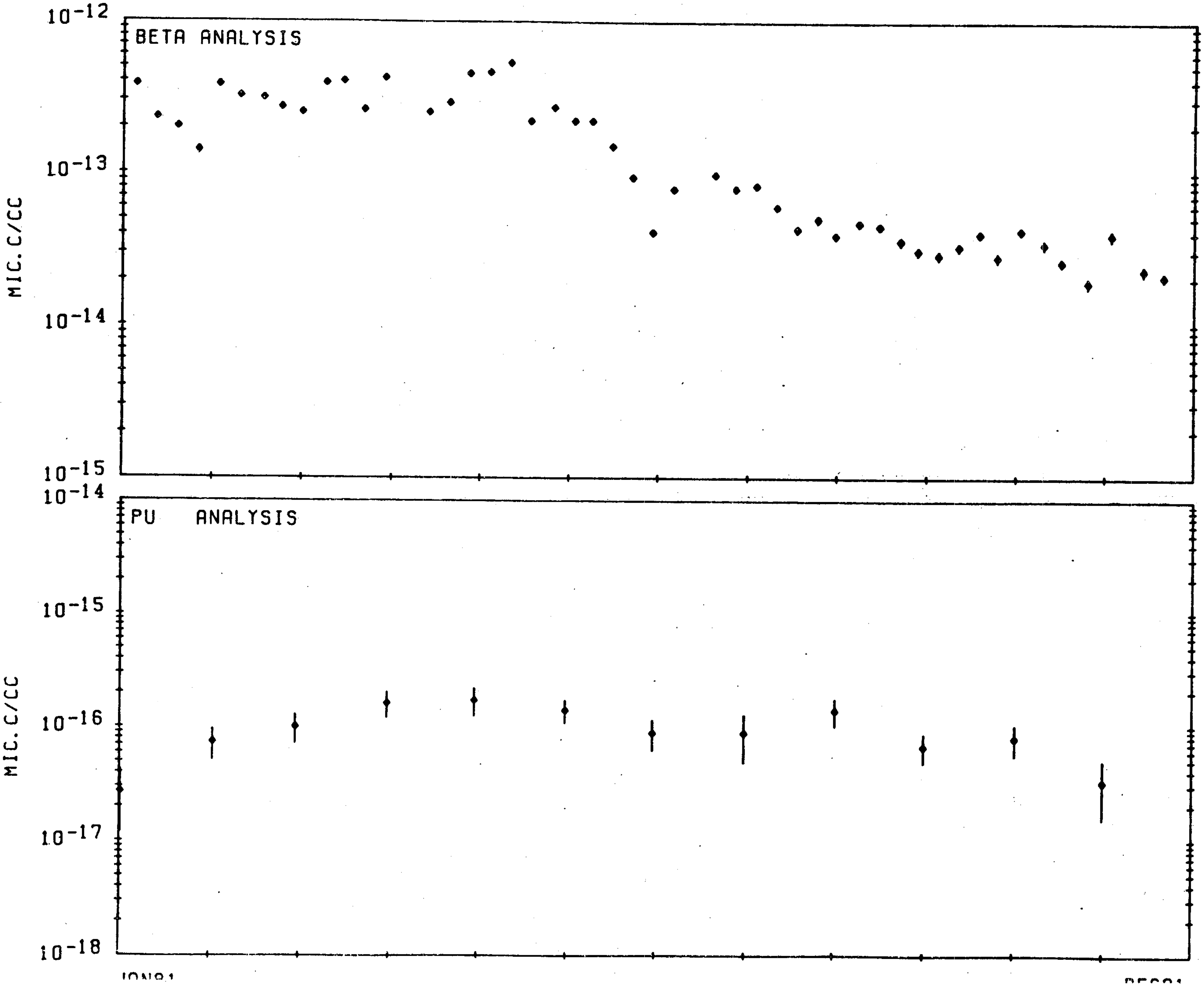
AIR SAMPLING STATION NUMBER 4



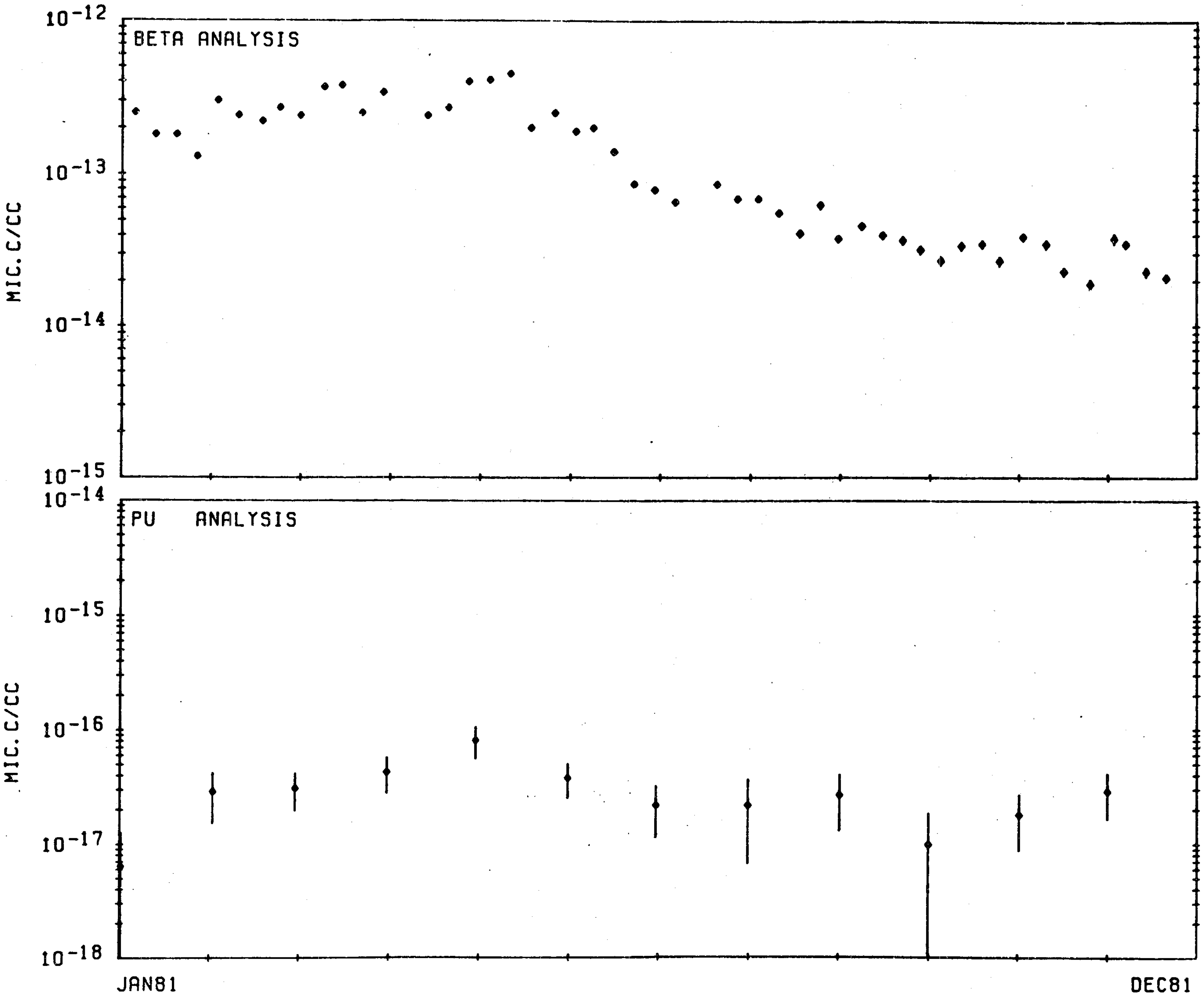
AIR SAMPLING STATION NUMBER 5



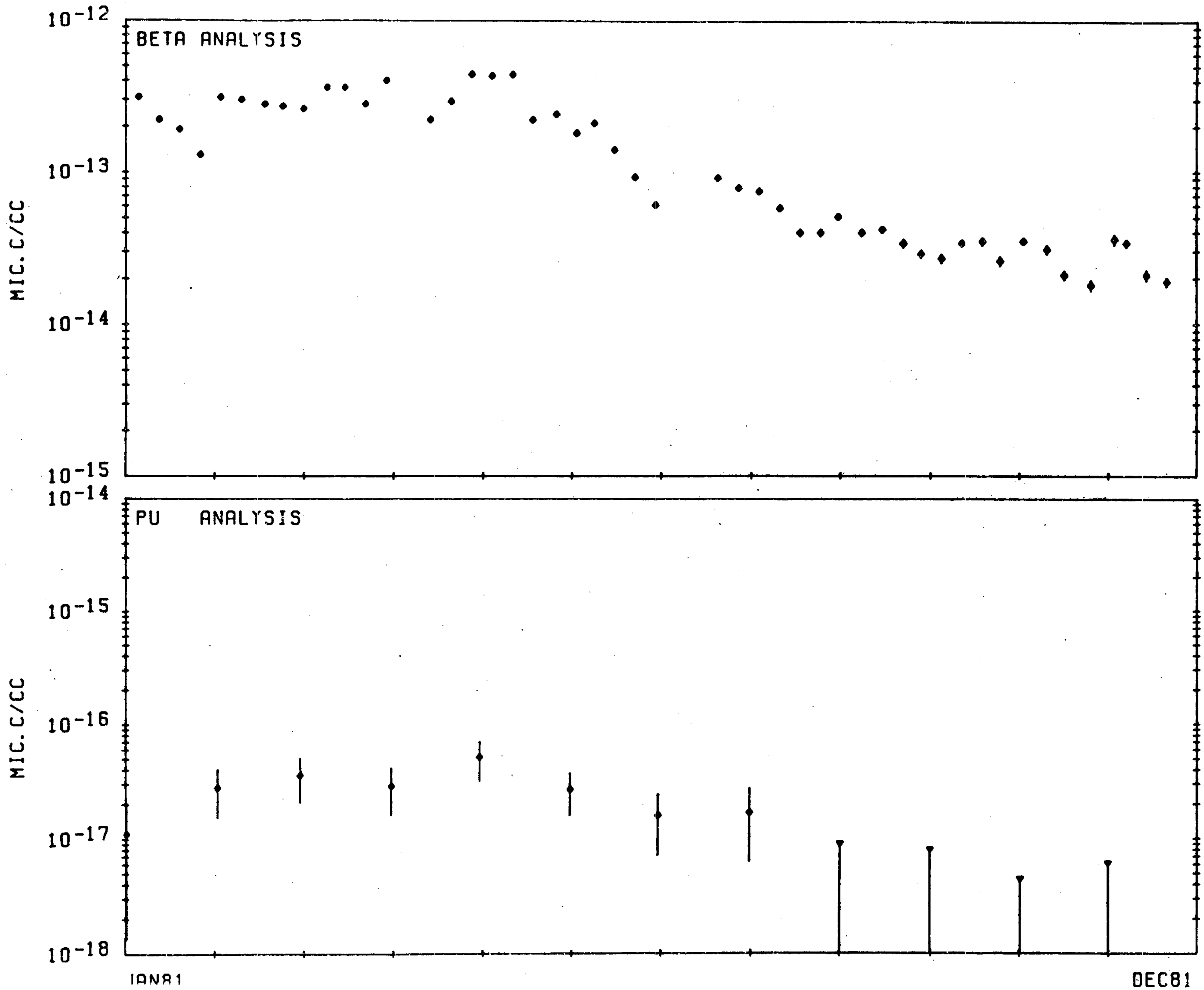
AIR SAMPLING STATION NUMBER 6



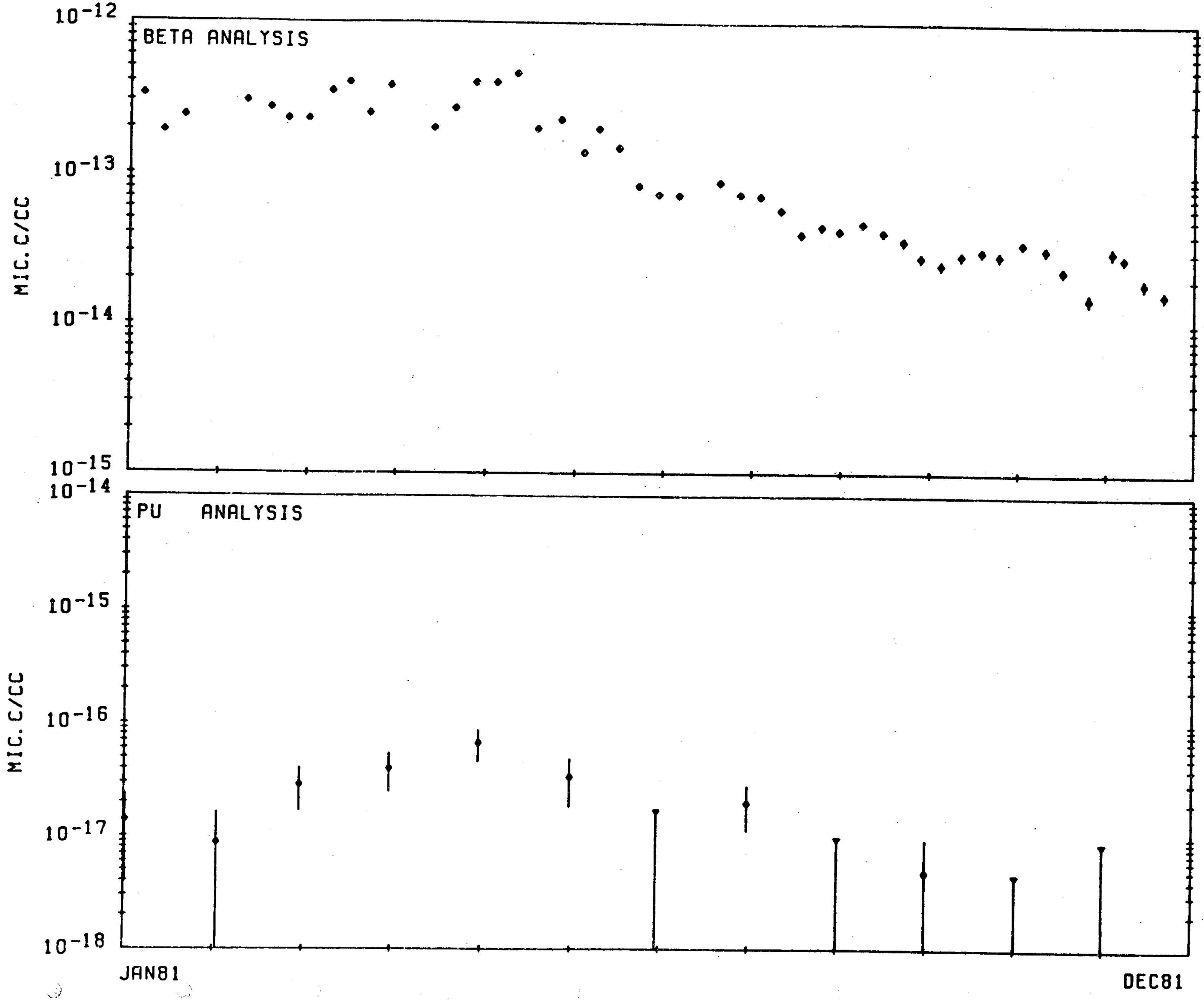
AIR SAMPLING STATION NUMBER 7



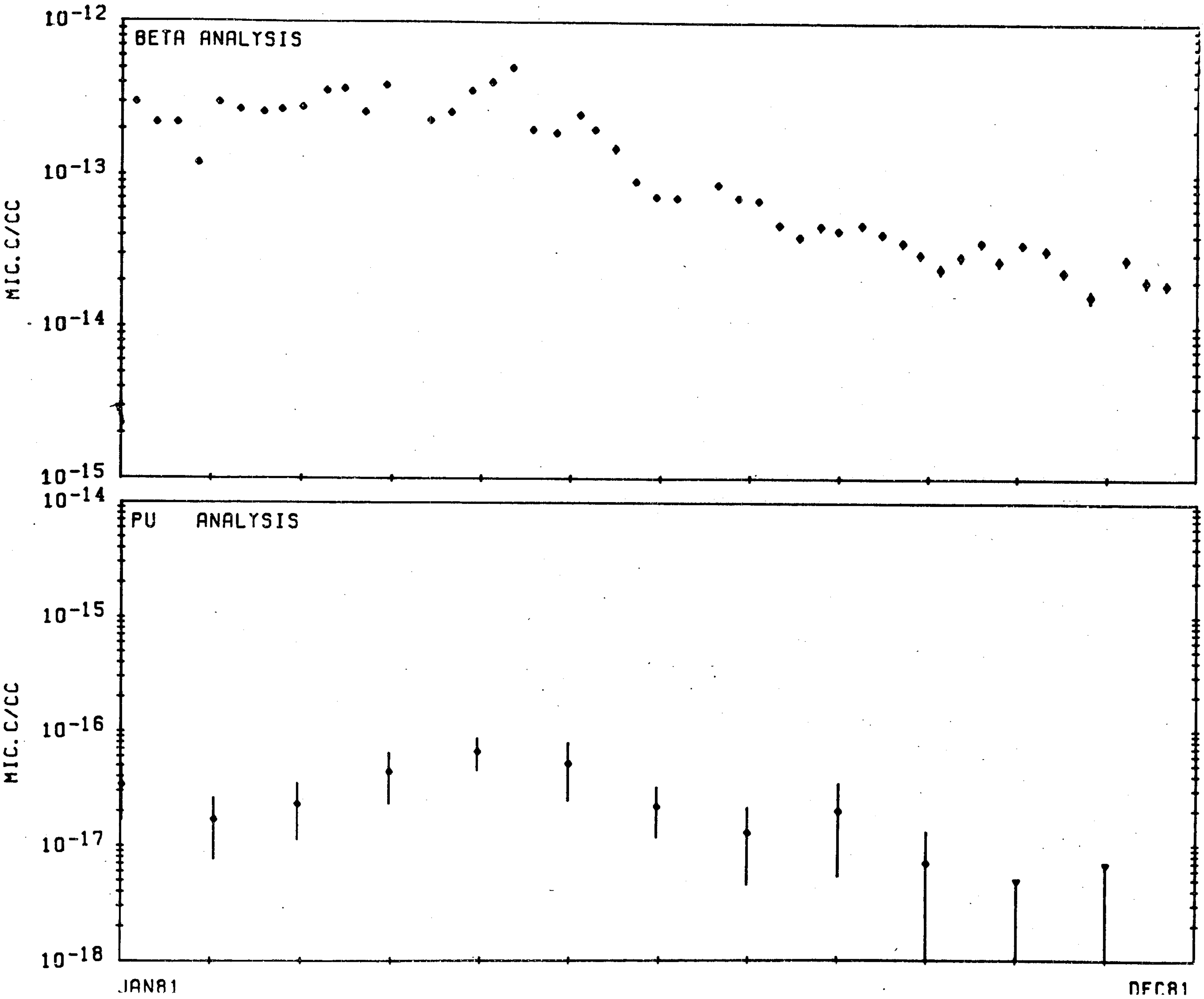
AIR SAMPLING STATION NUMBER 8



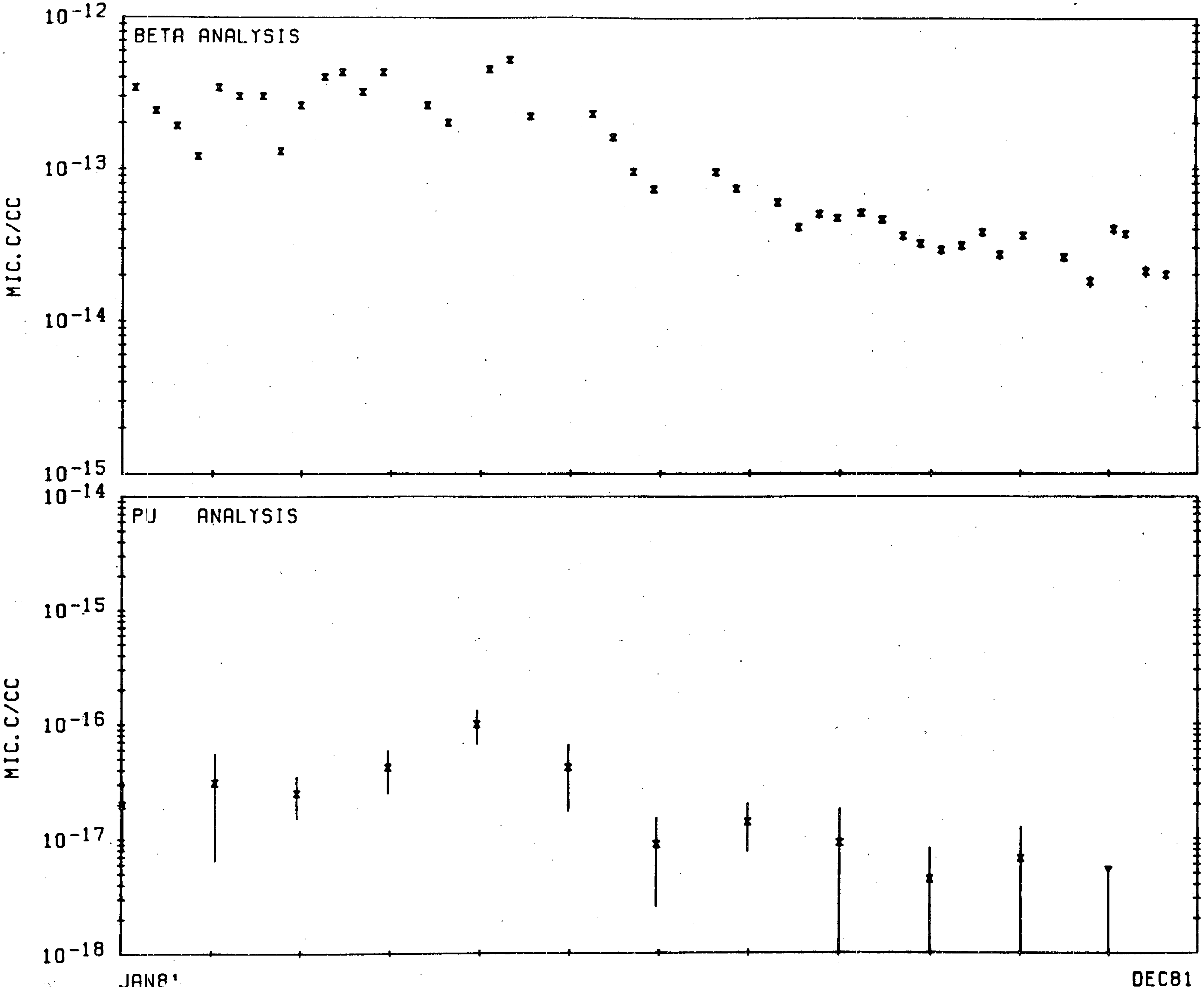
AIR SAMPLING STATION NUMBER 9



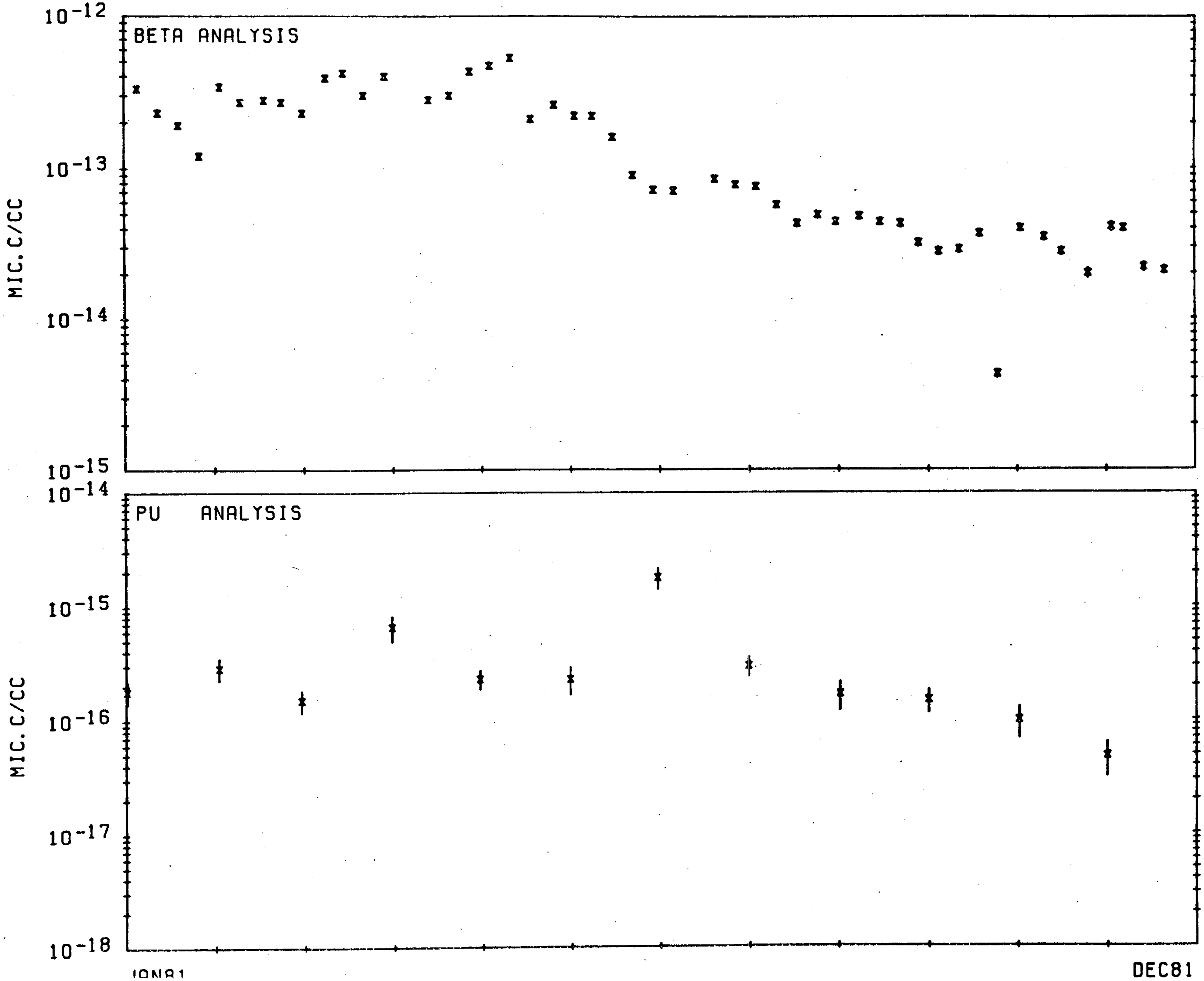
AIR SAMPLING STATION NUMBER 10



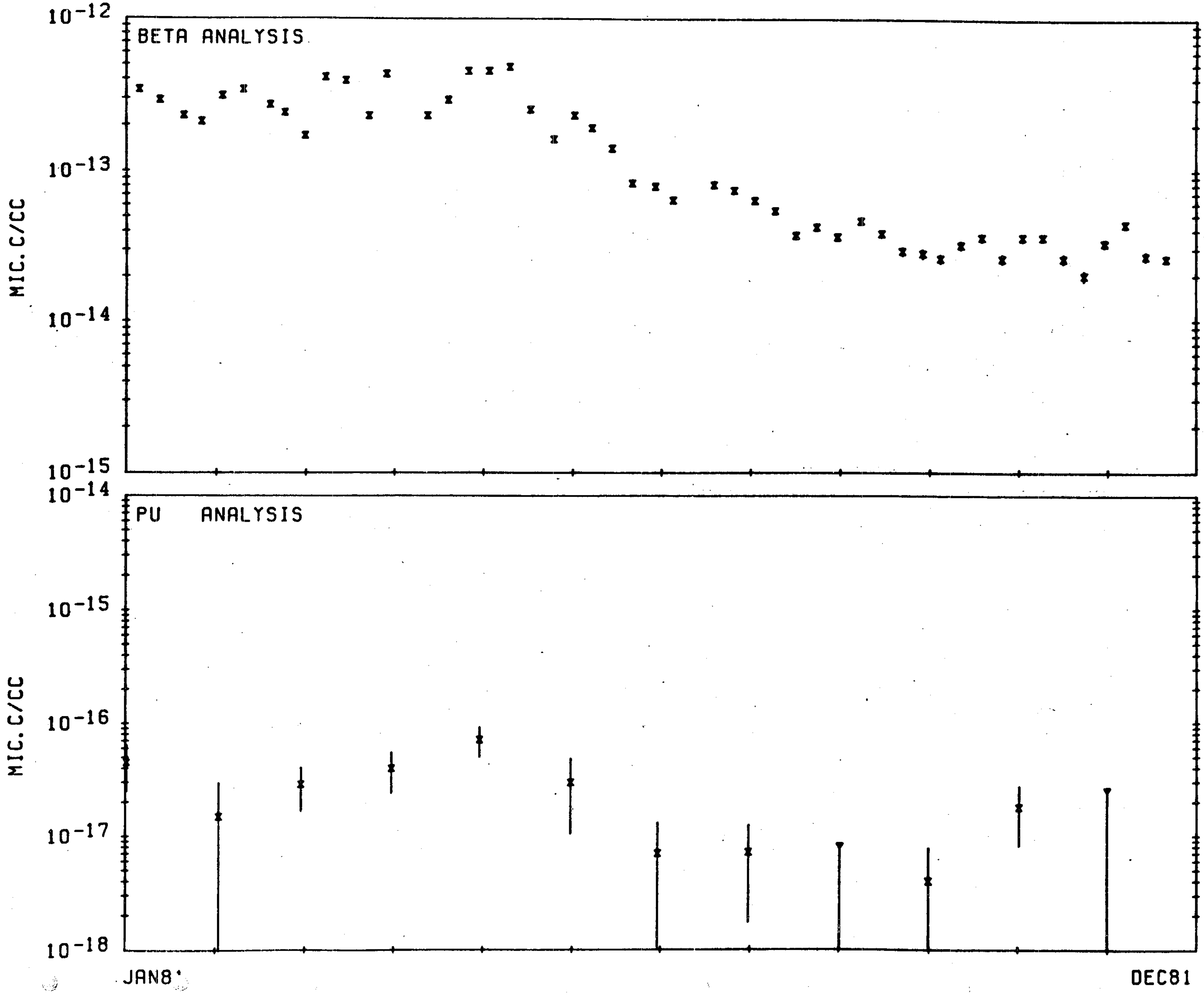
AIR SAMPLING STATION NUMBER 11



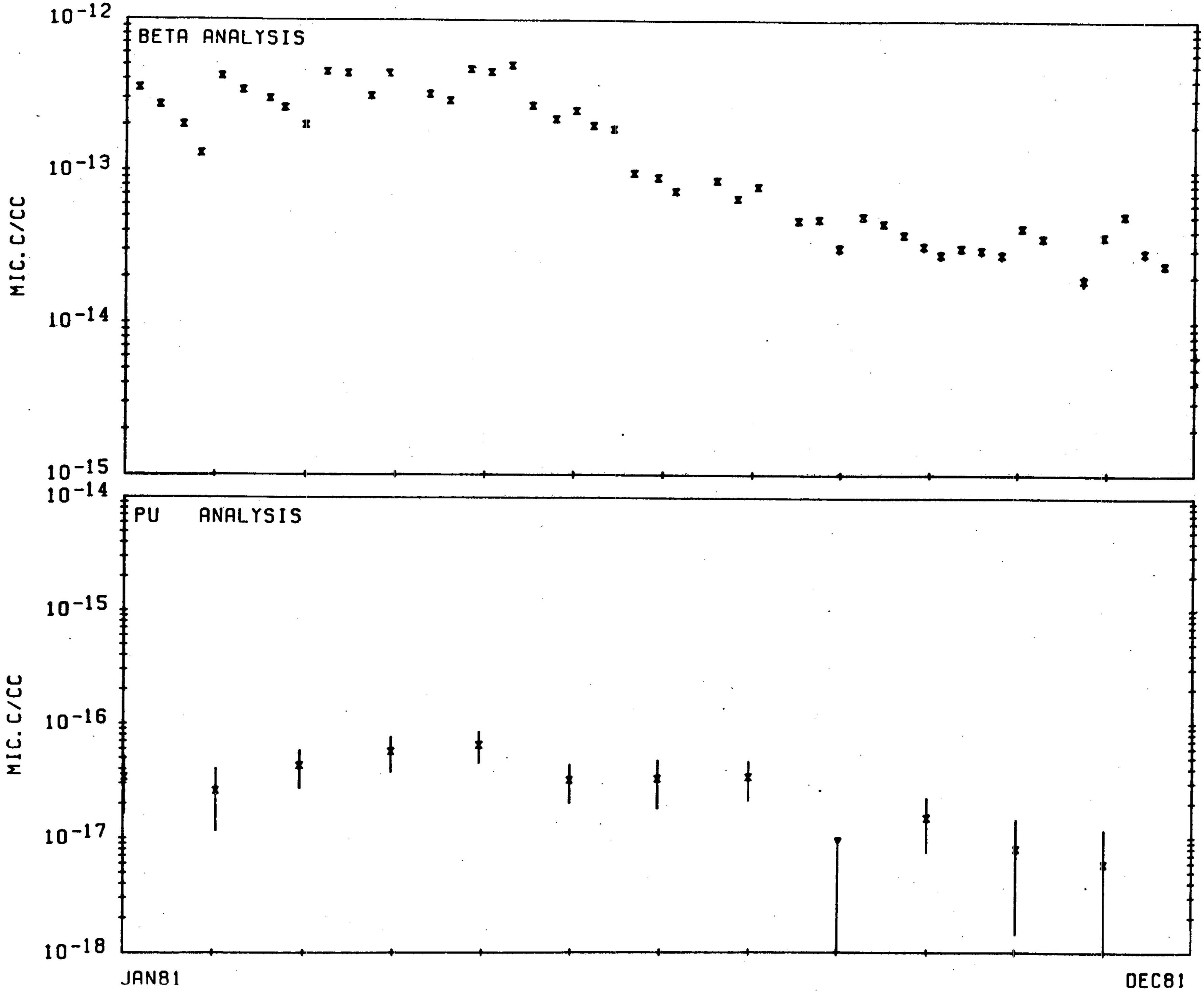
AIR SAMPLING STATION NUMBER 12



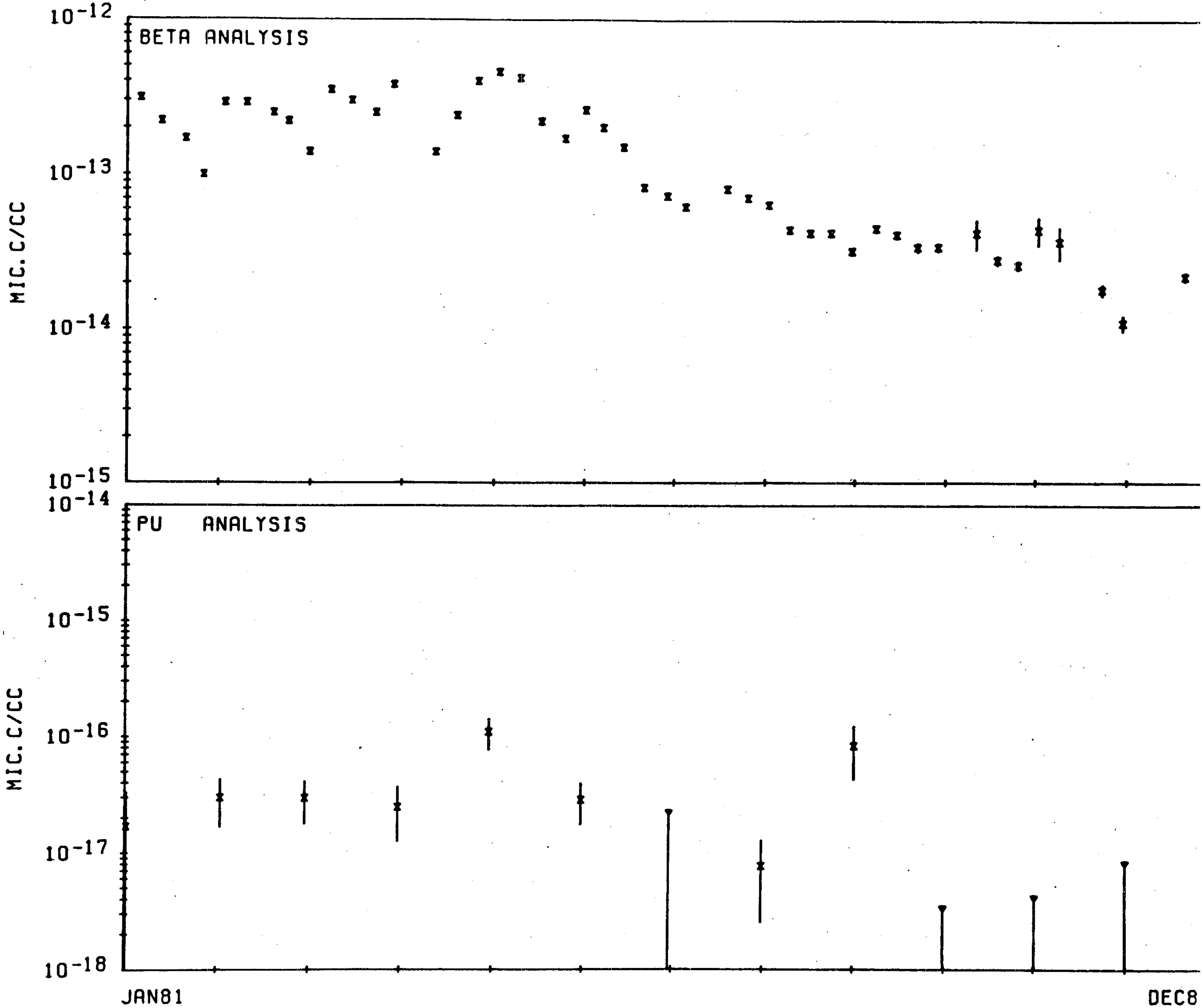
AIR SAMPLING STATION NUMBER 13



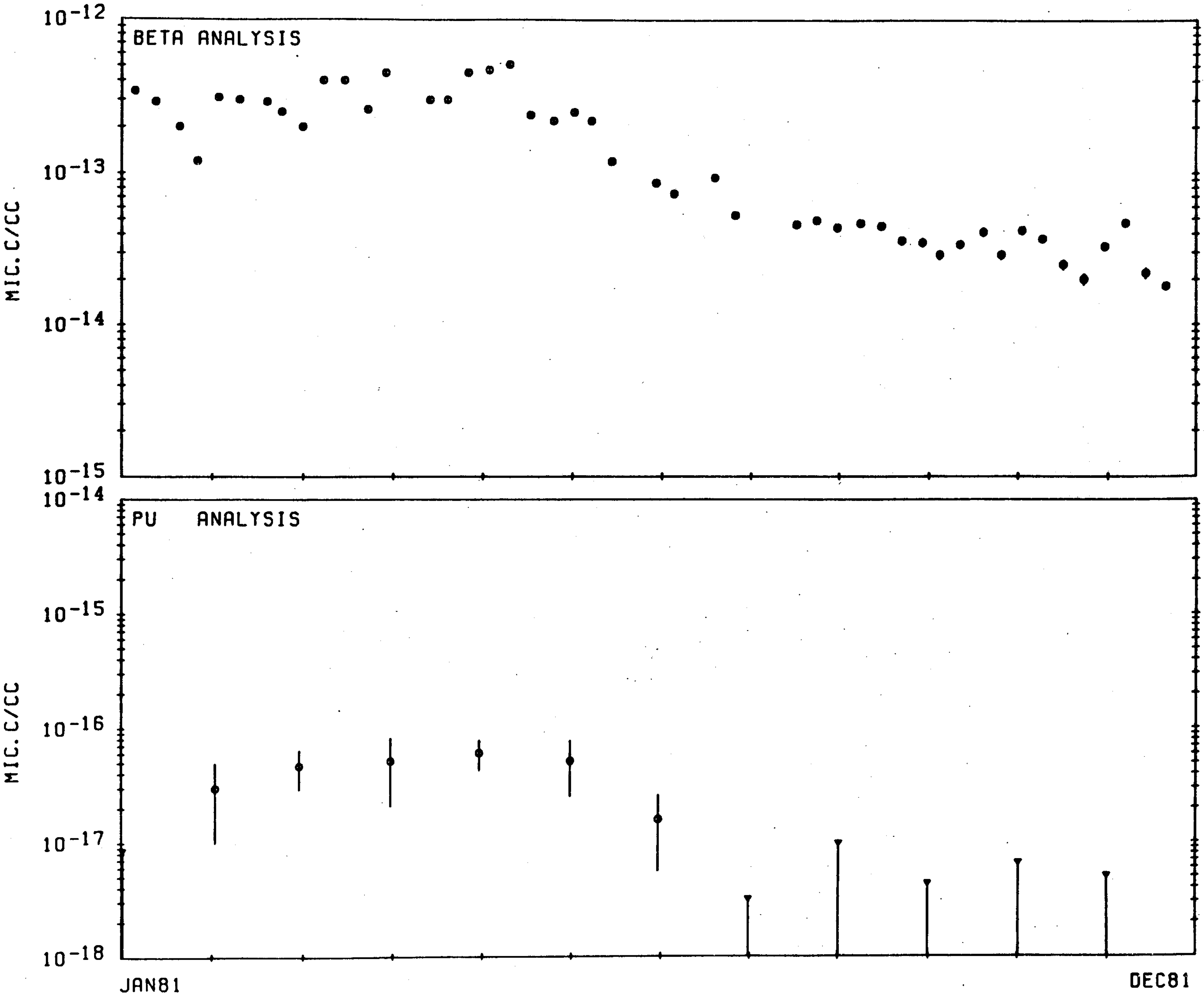
AIR SAMPLING STATION NUMBER 14



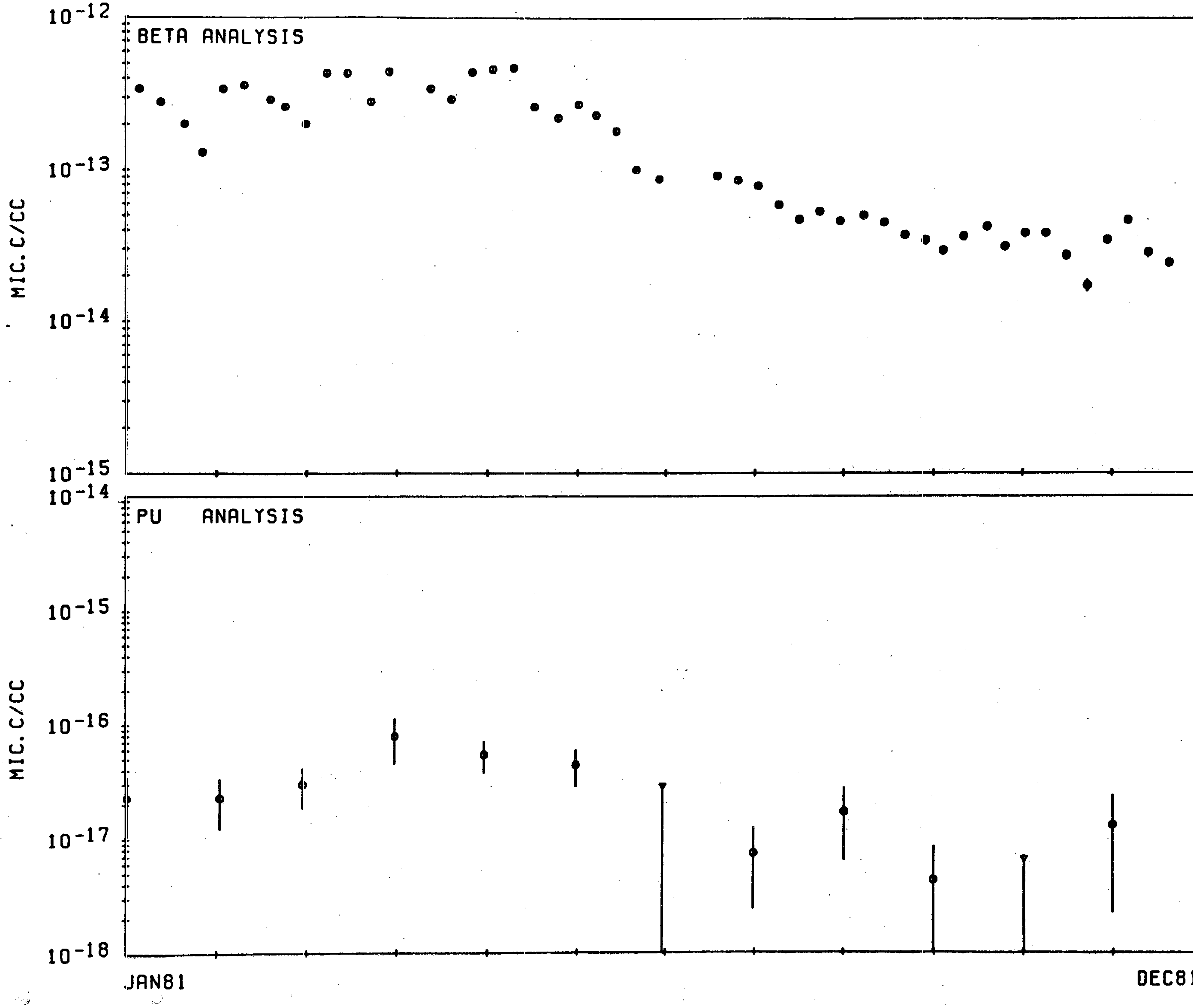
AIR SAMPLING STATION NUMBER 15

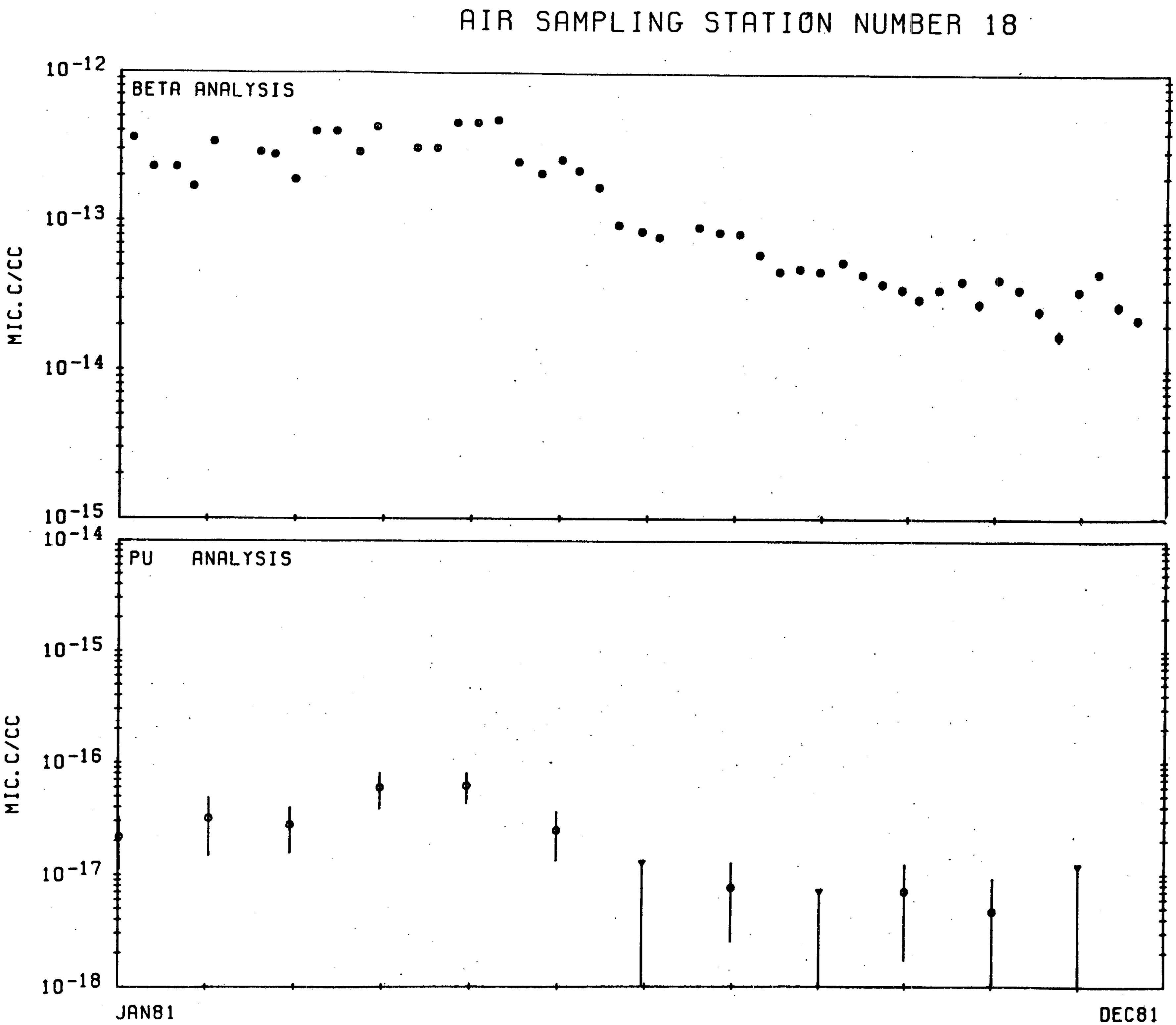


AIR SAMPLING STATION NUMBER 16



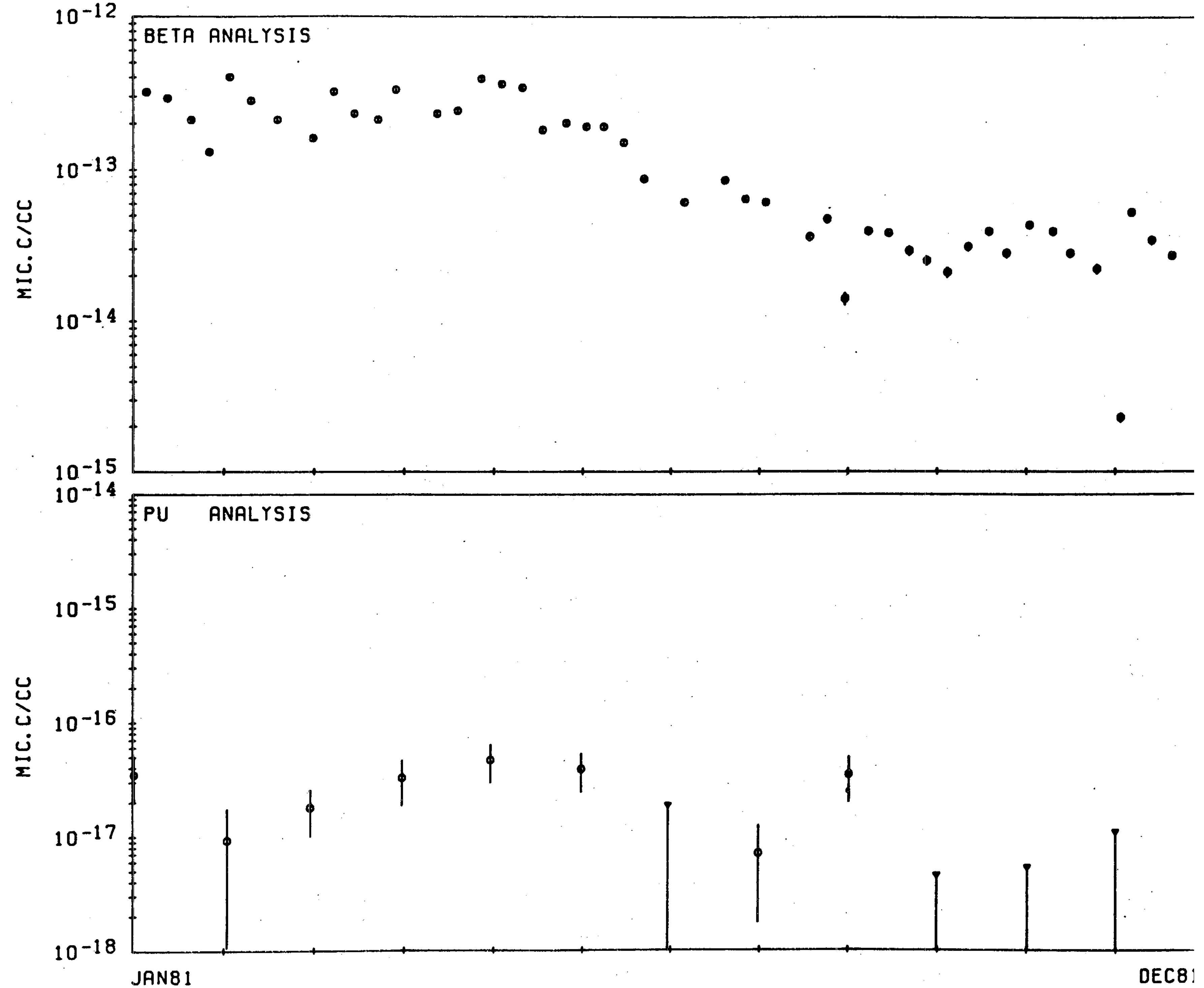
AIR SAMPLING STATION NUMBER 17



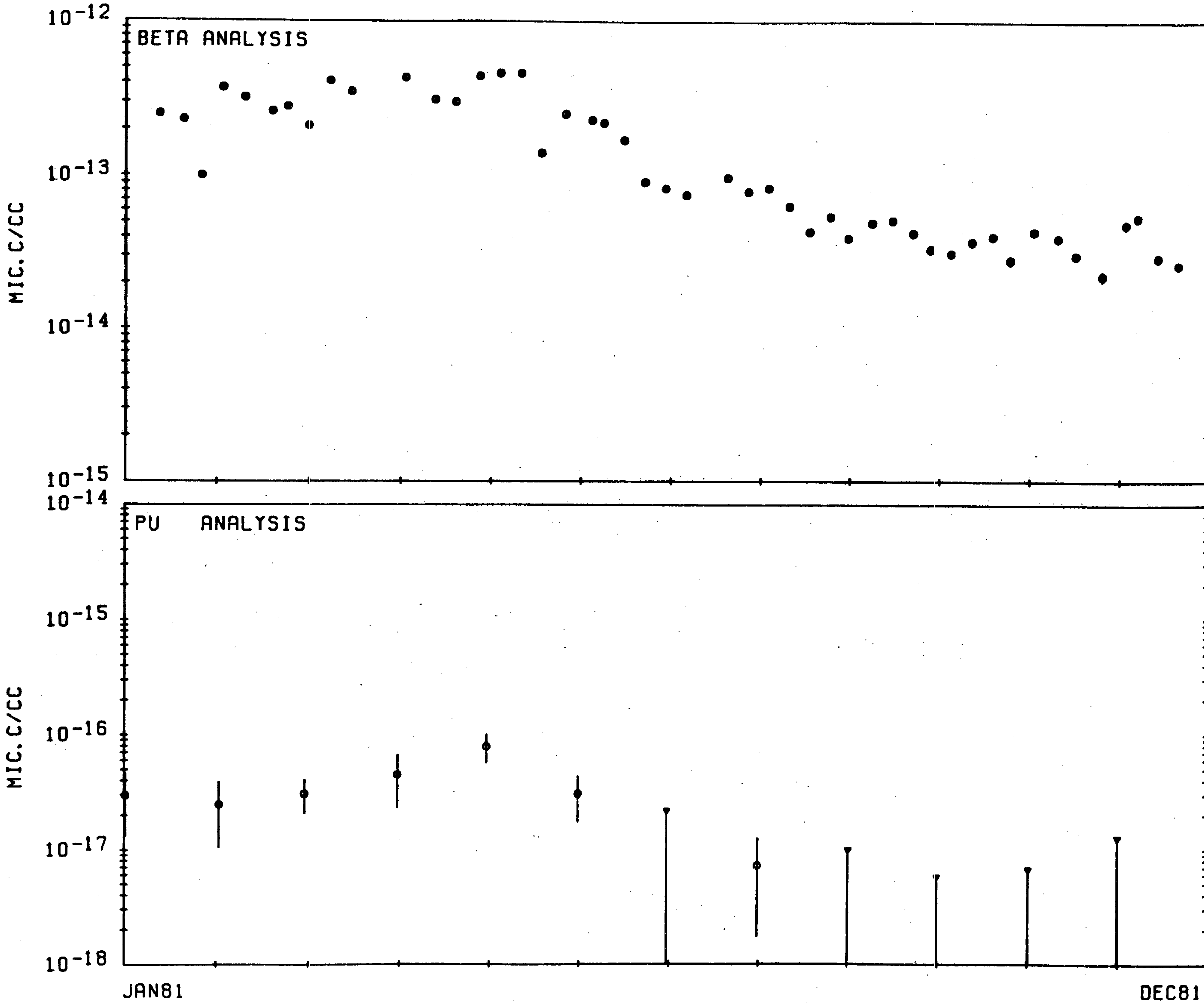


AIR SAMPLING STATION NUMBER 18
BETA ANALYSIS
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
PU ANALYSIS
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN81
DEC81

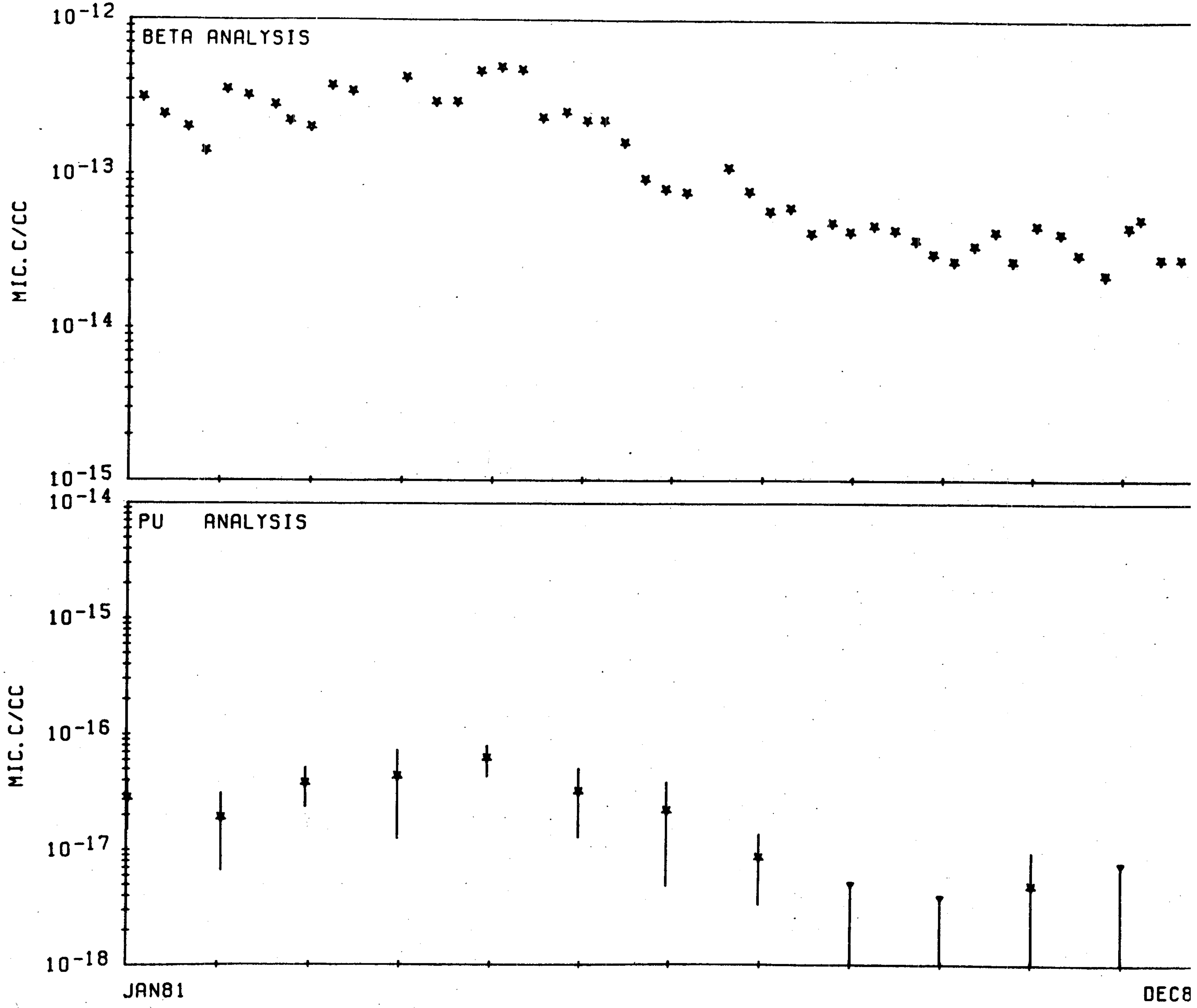
AIR SAMPLING STATION NUMBER 19



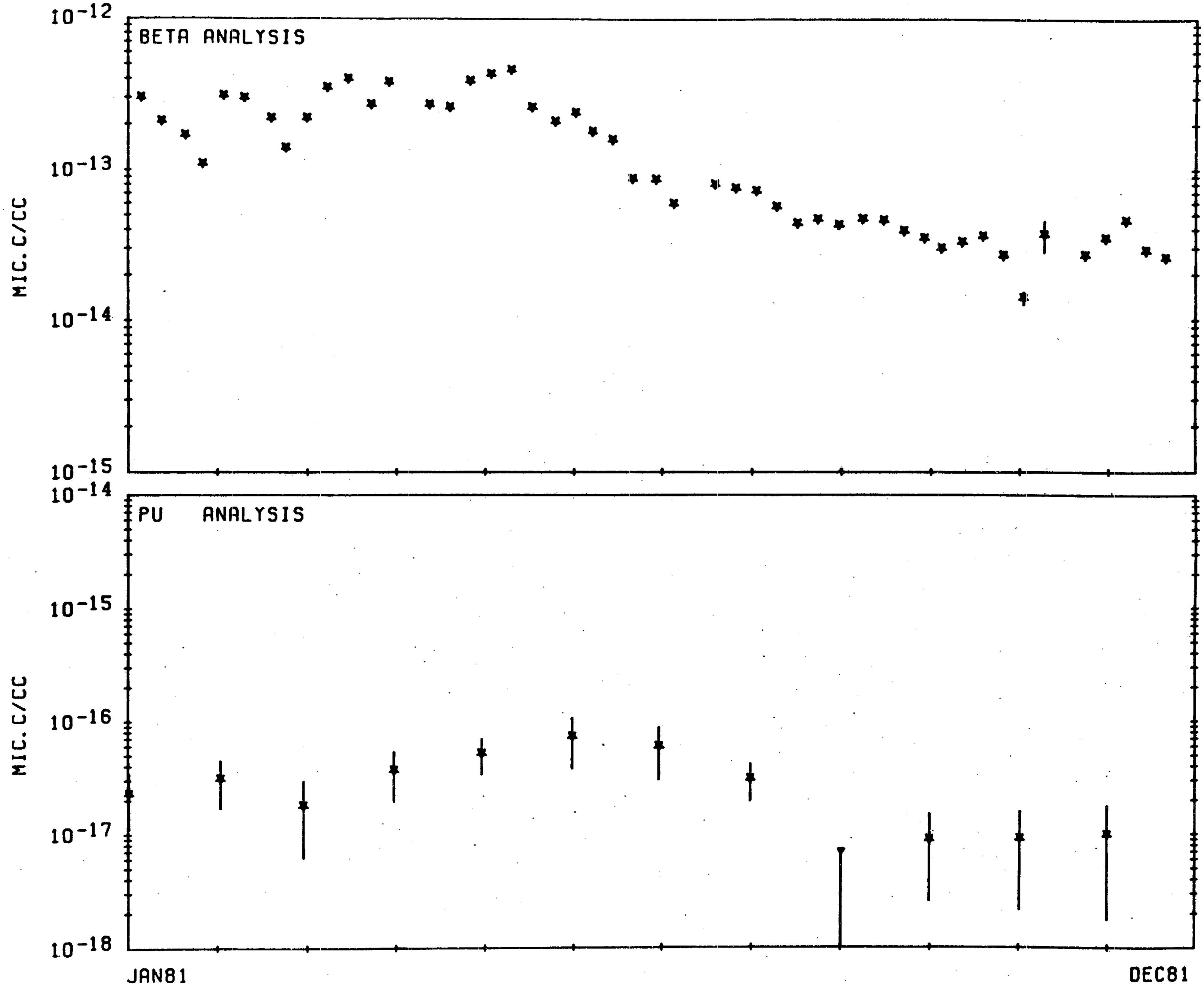
AIR SAMPLING STATION NUMBER 20



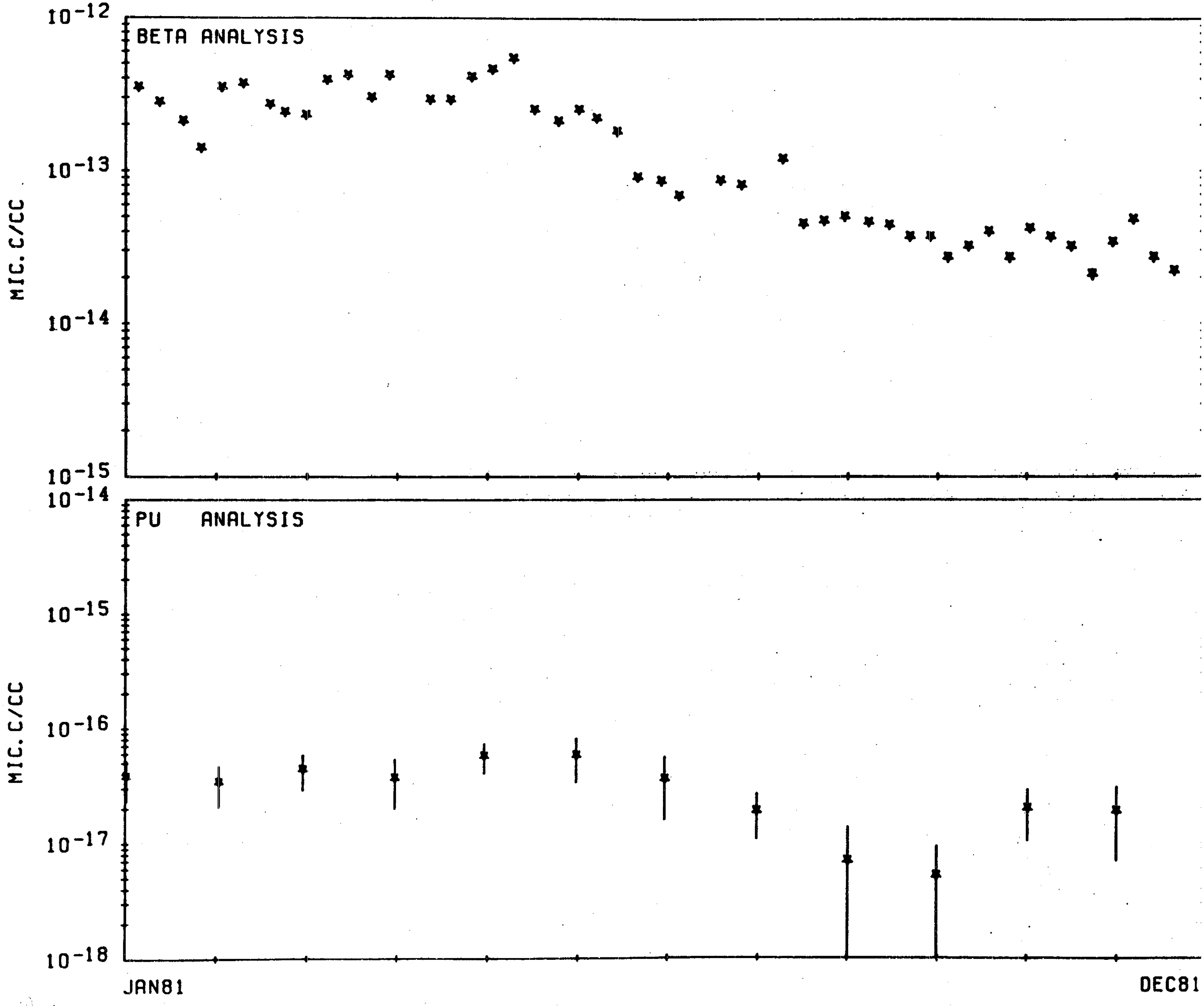
AIR SAMPLING STATION NUMBER 21



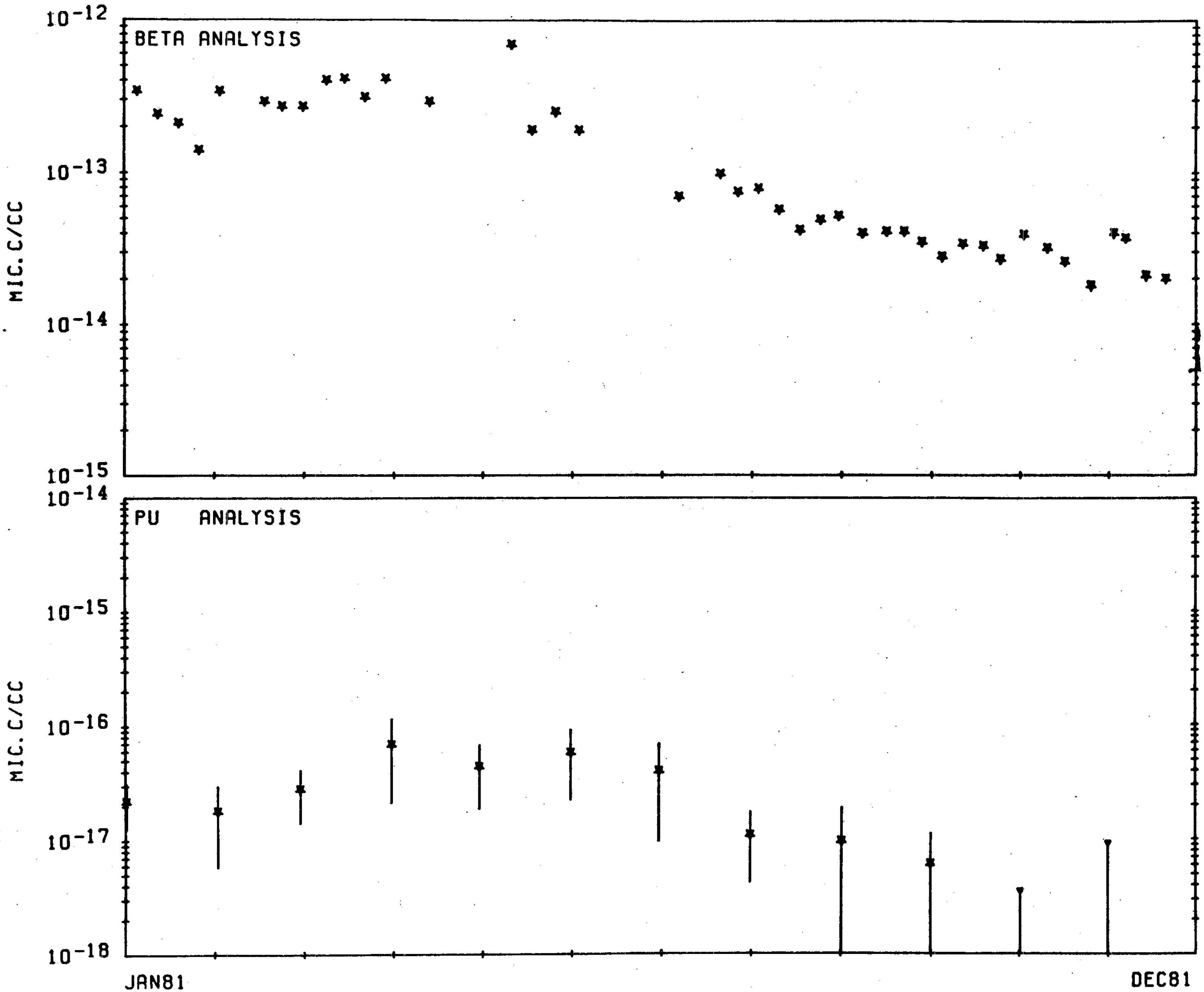
AIR SAMPLING STATION NUMBER 22



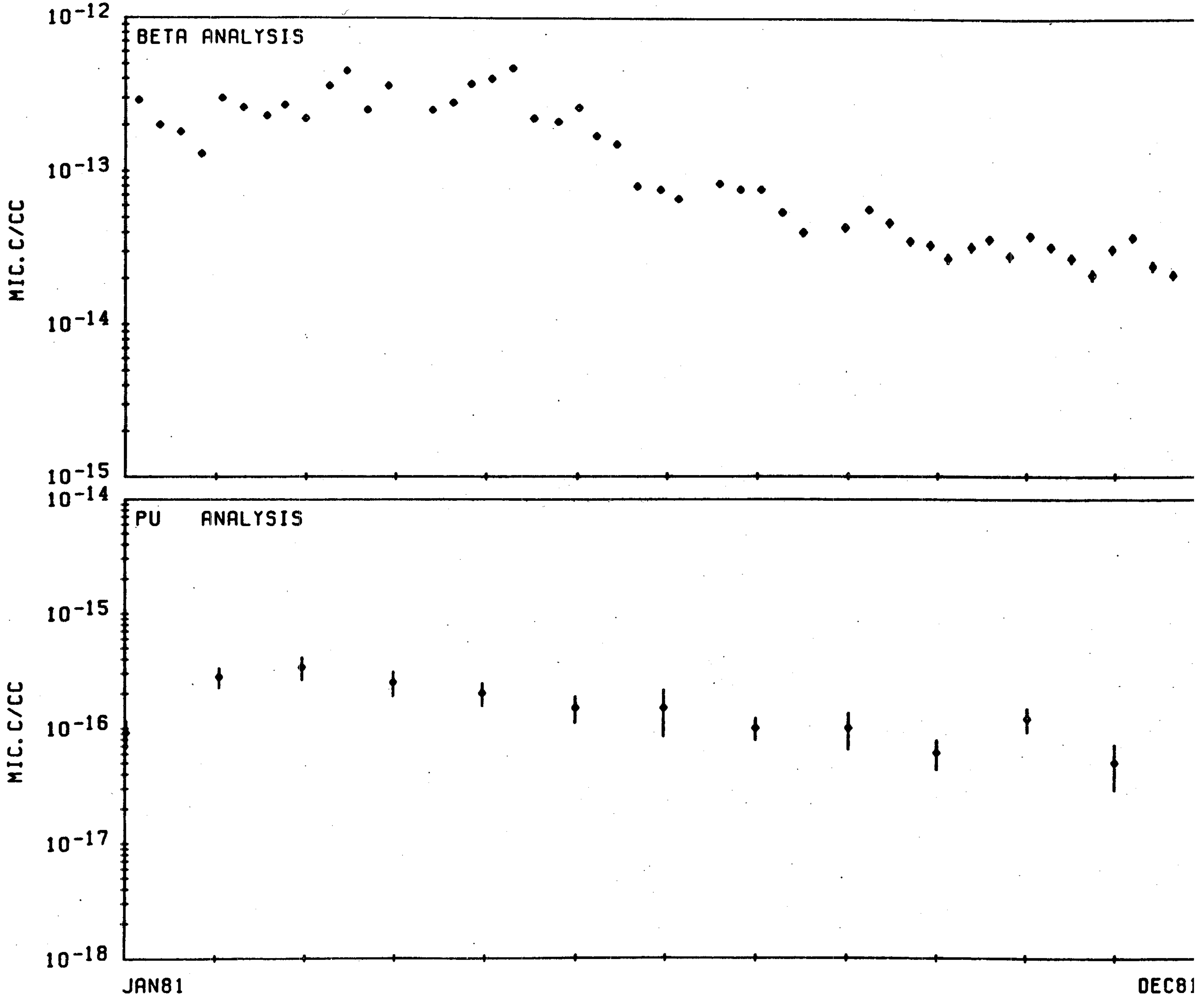
AIR SAMPLING STATION NUMBER 23

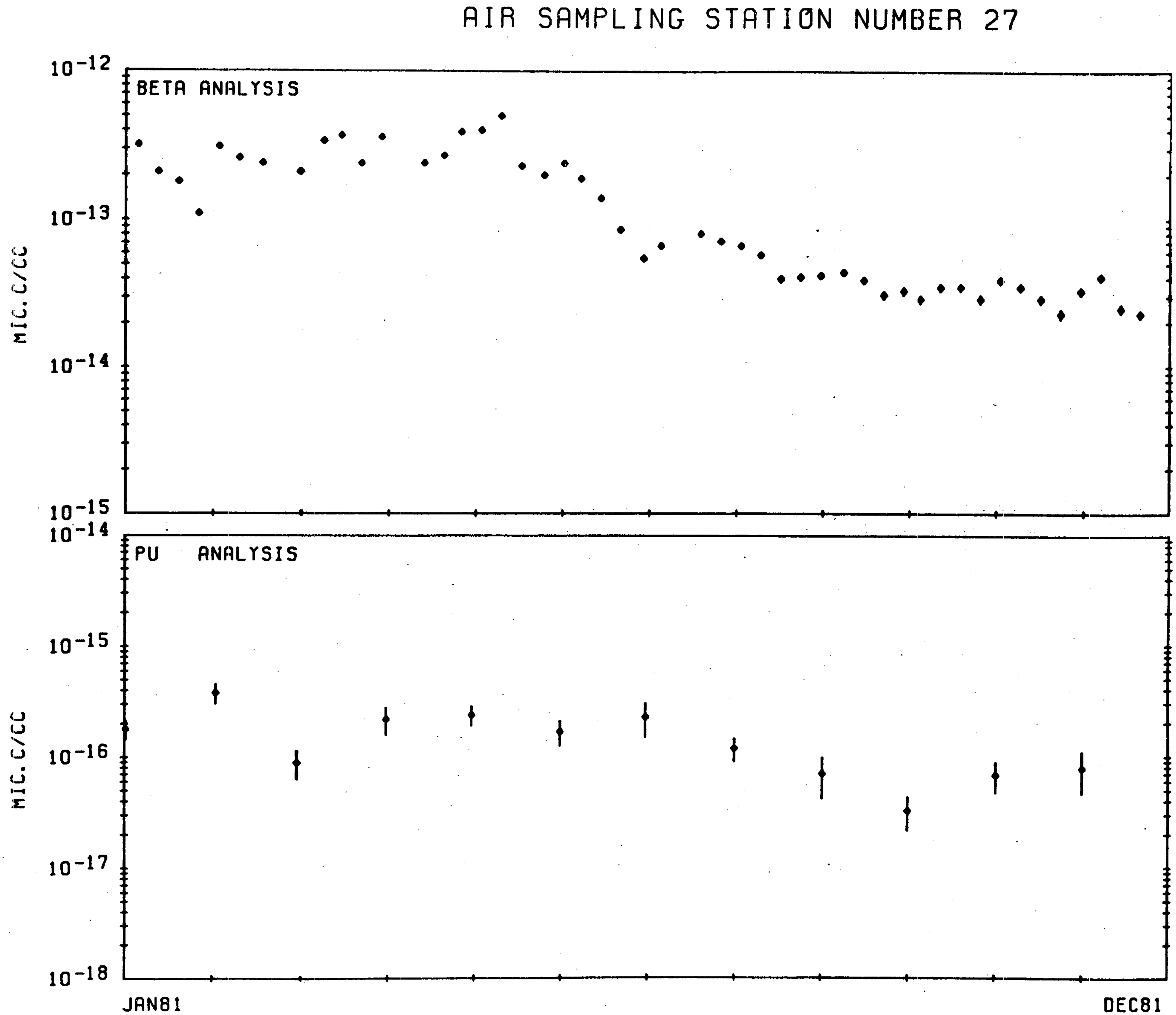


AIR SAMPLING STATION NUMBER 25

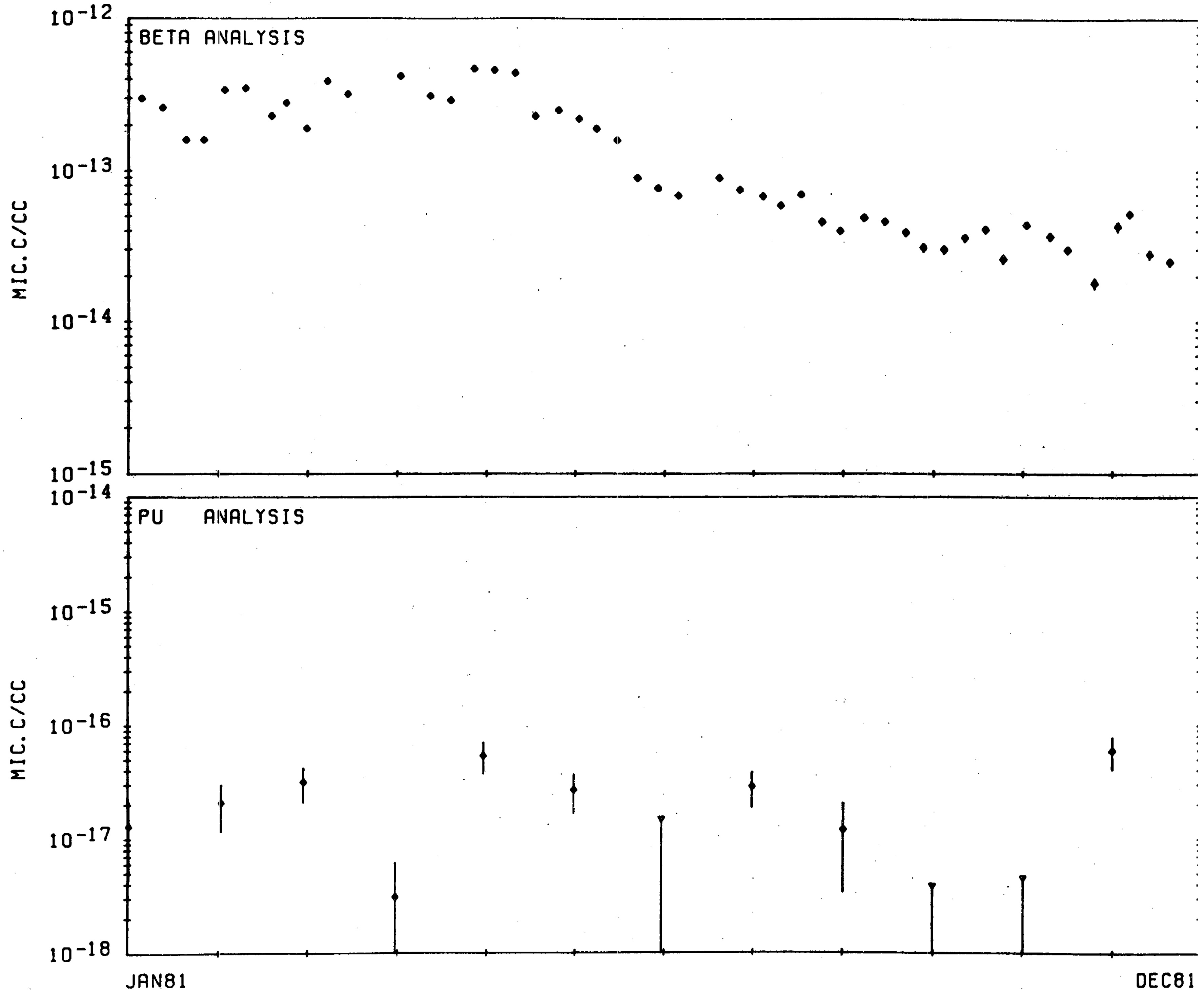


AIR SAMPLING STATION NUMBER 26

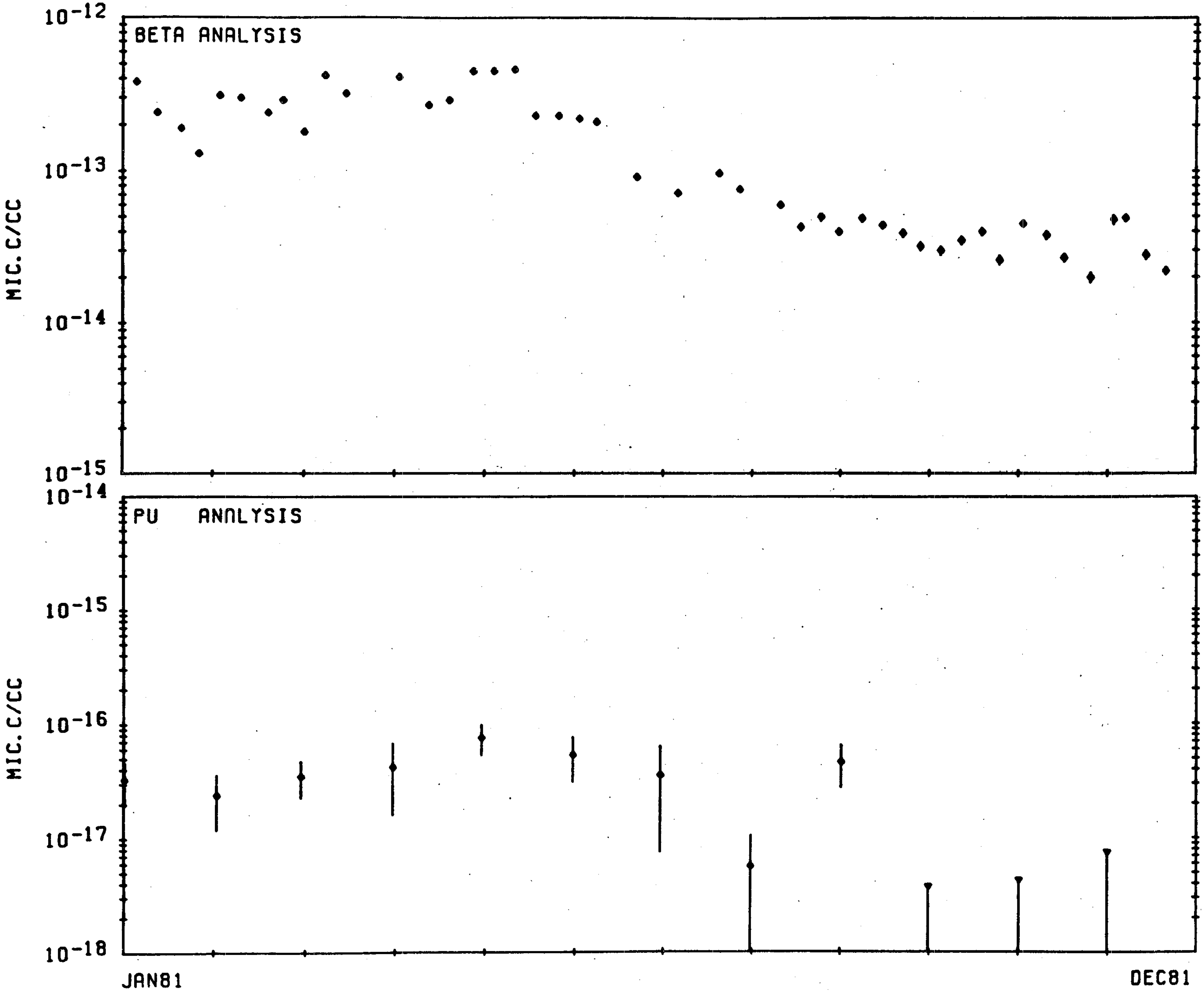


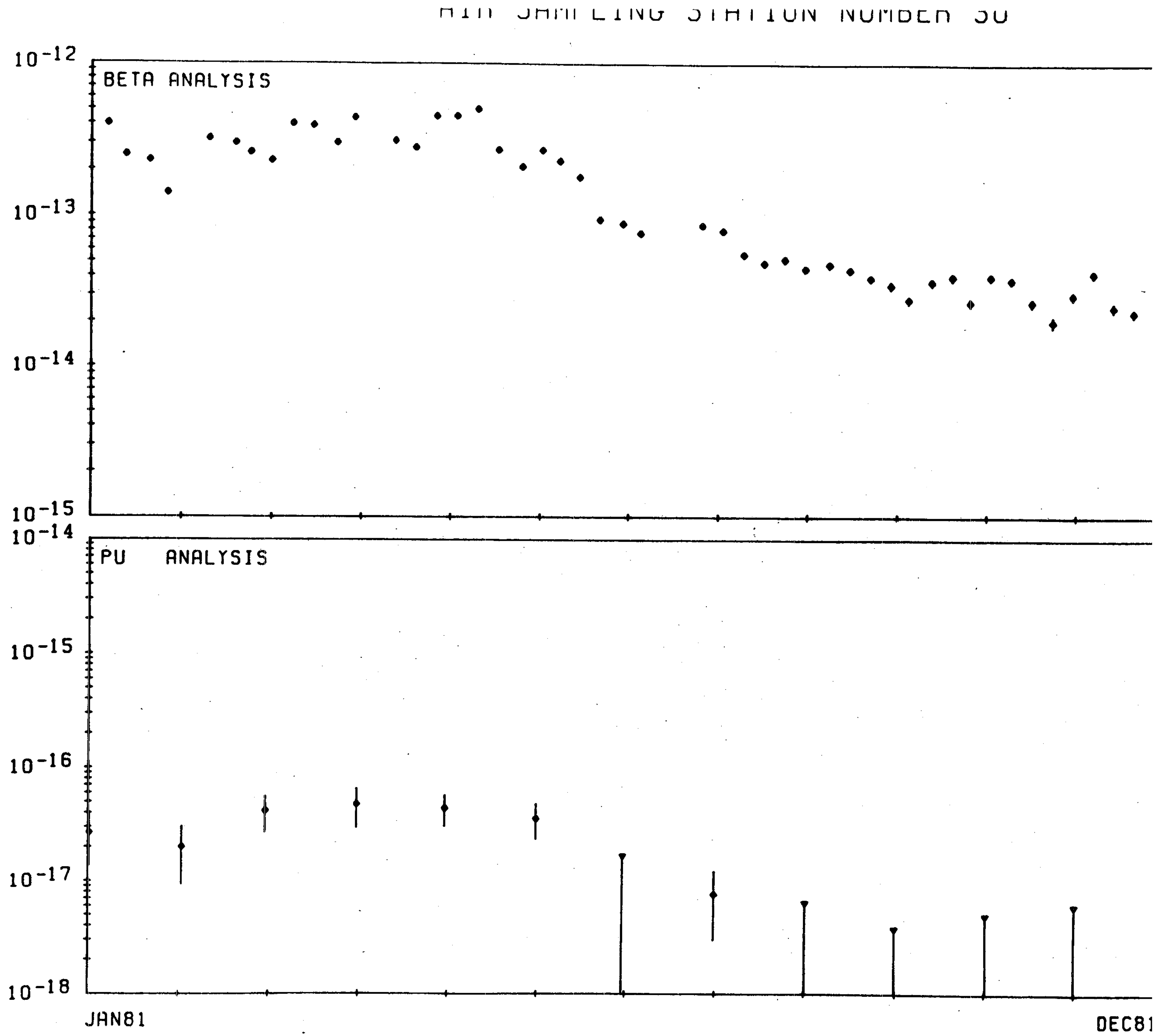

AIR SAMPLING STATION NUMBER 27
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN81
DEC81

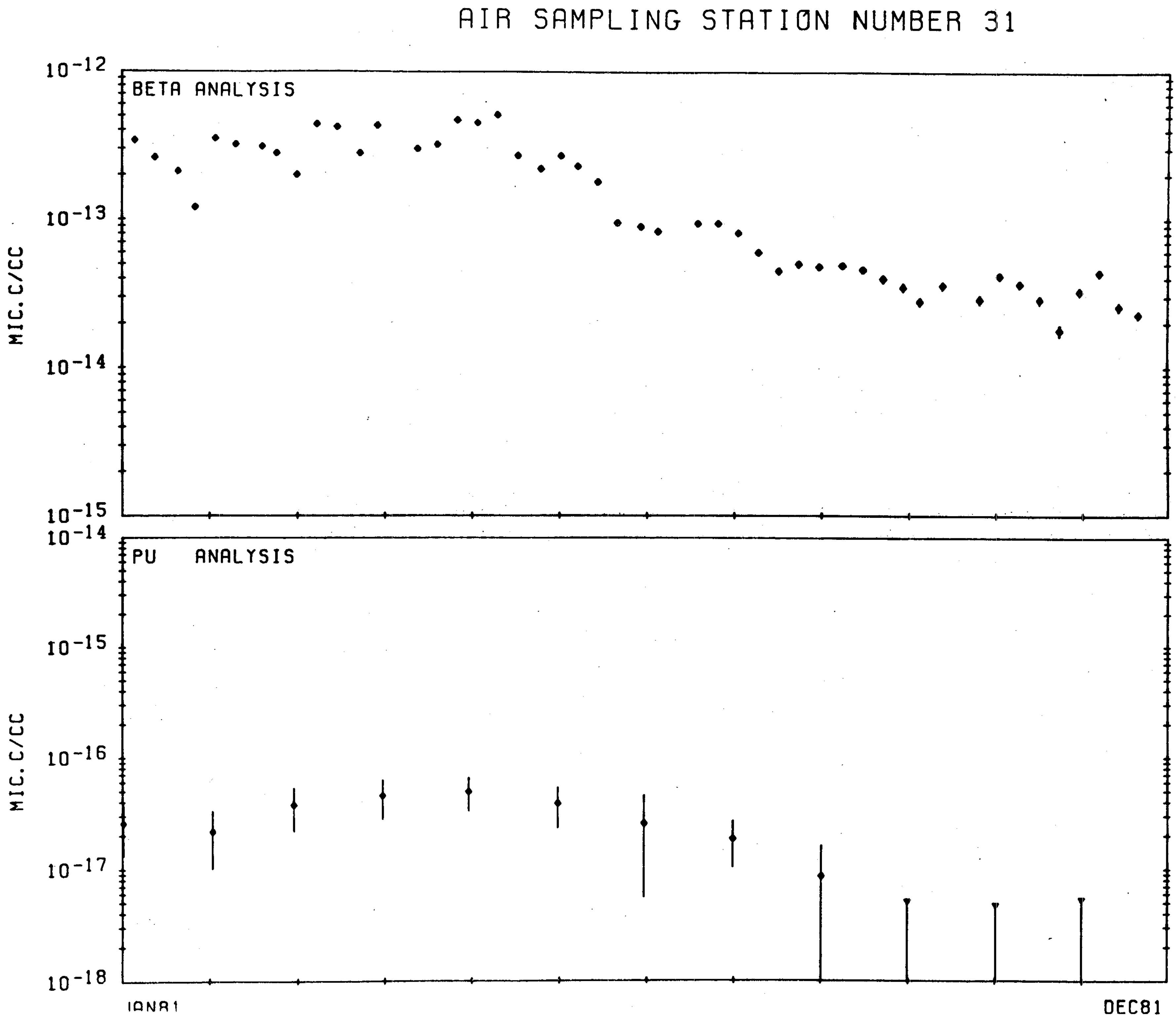
AIR SAMPLING STATION NUMBER 28



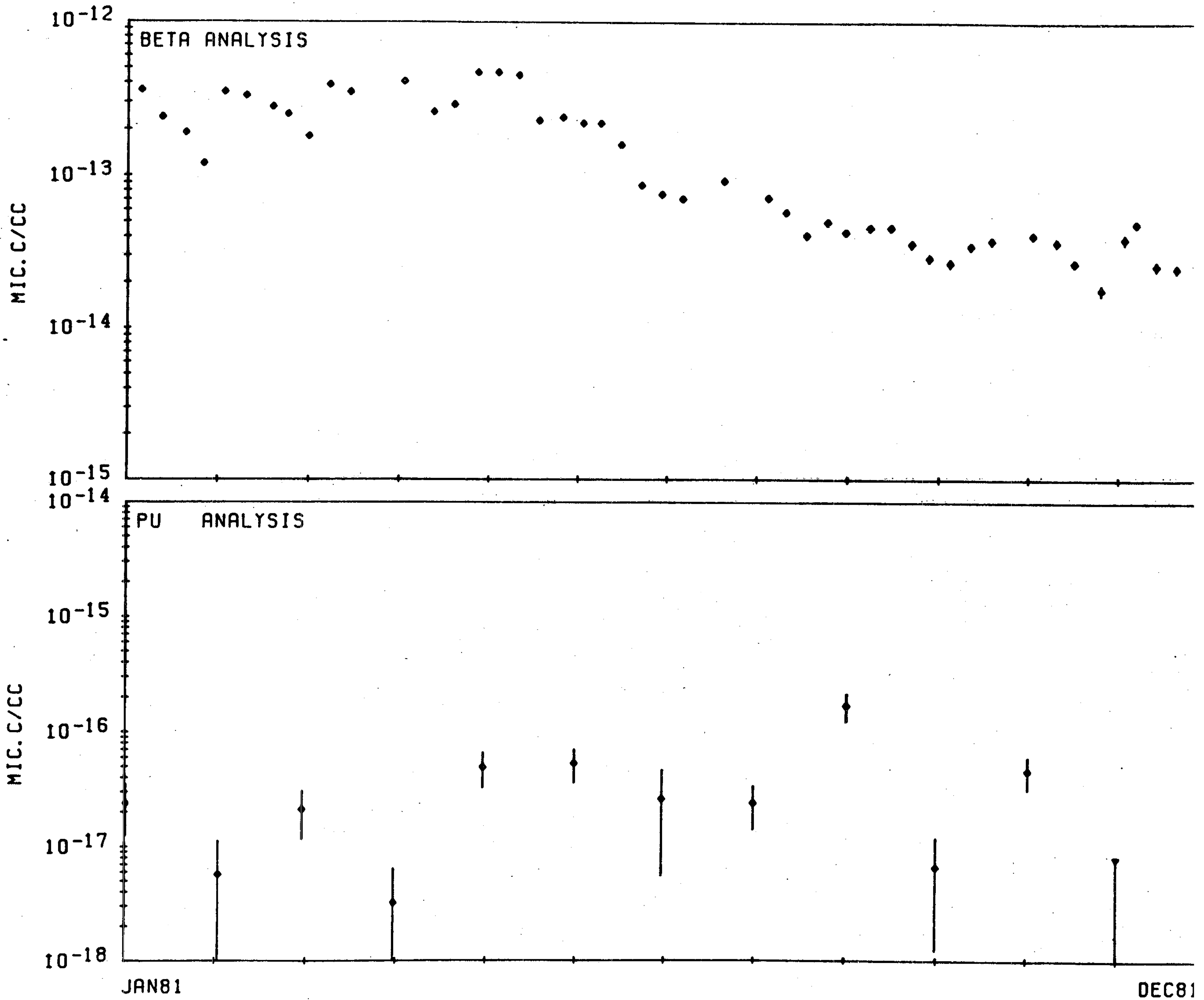
AIR SAMPLING STATION NUMBER 29



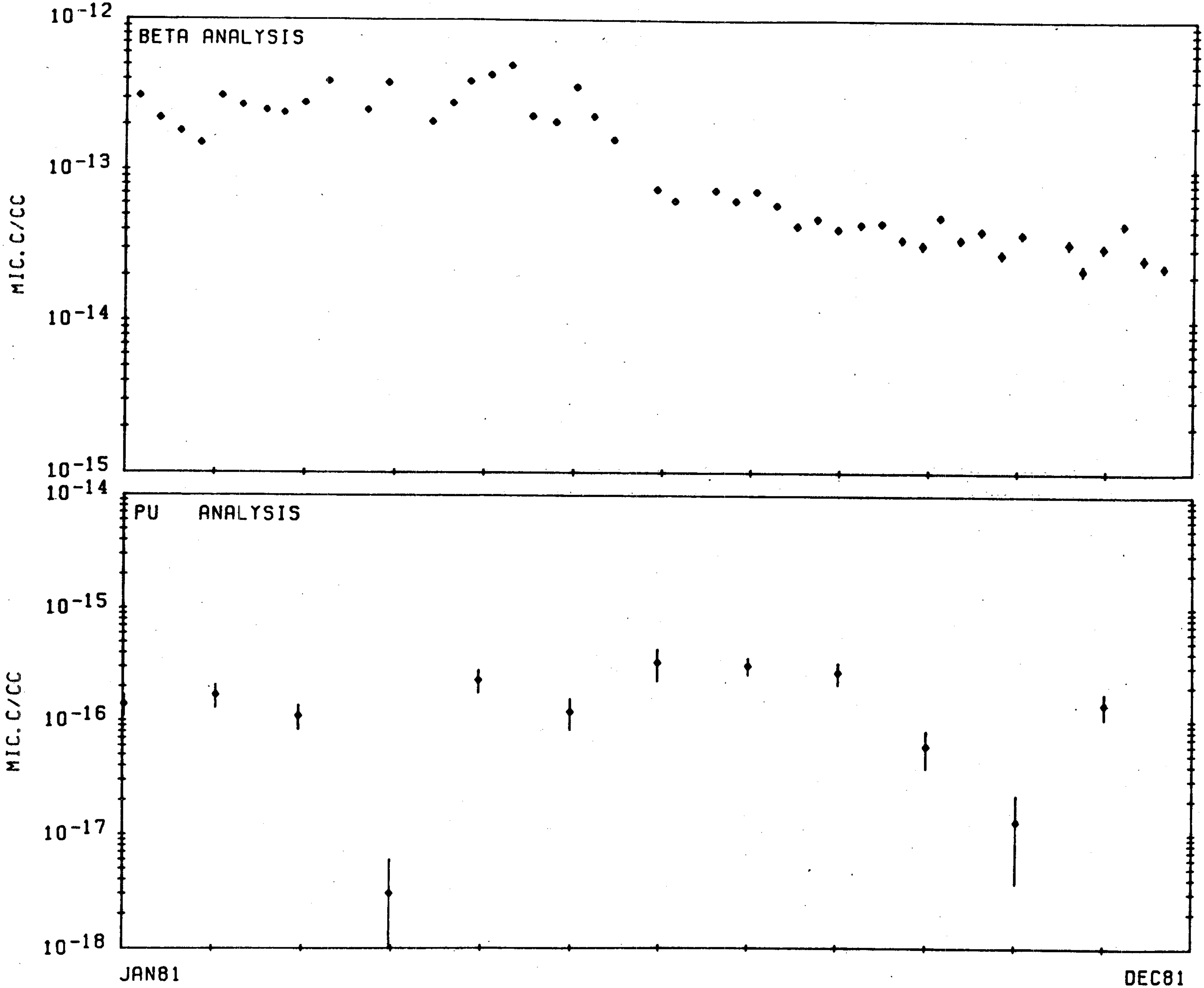

AIR SAMPLING STATION NUMBER 30
BETA ANALYSIS
MIC.C/CC
10^-12
10^-13
10^-14
10^-15
PU ANALYSIS
MIC.C/CC
10^-14
10^-15
10^-16
10^-17
10^-18
JAN81
DEC81


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}
JAN81
DEC81

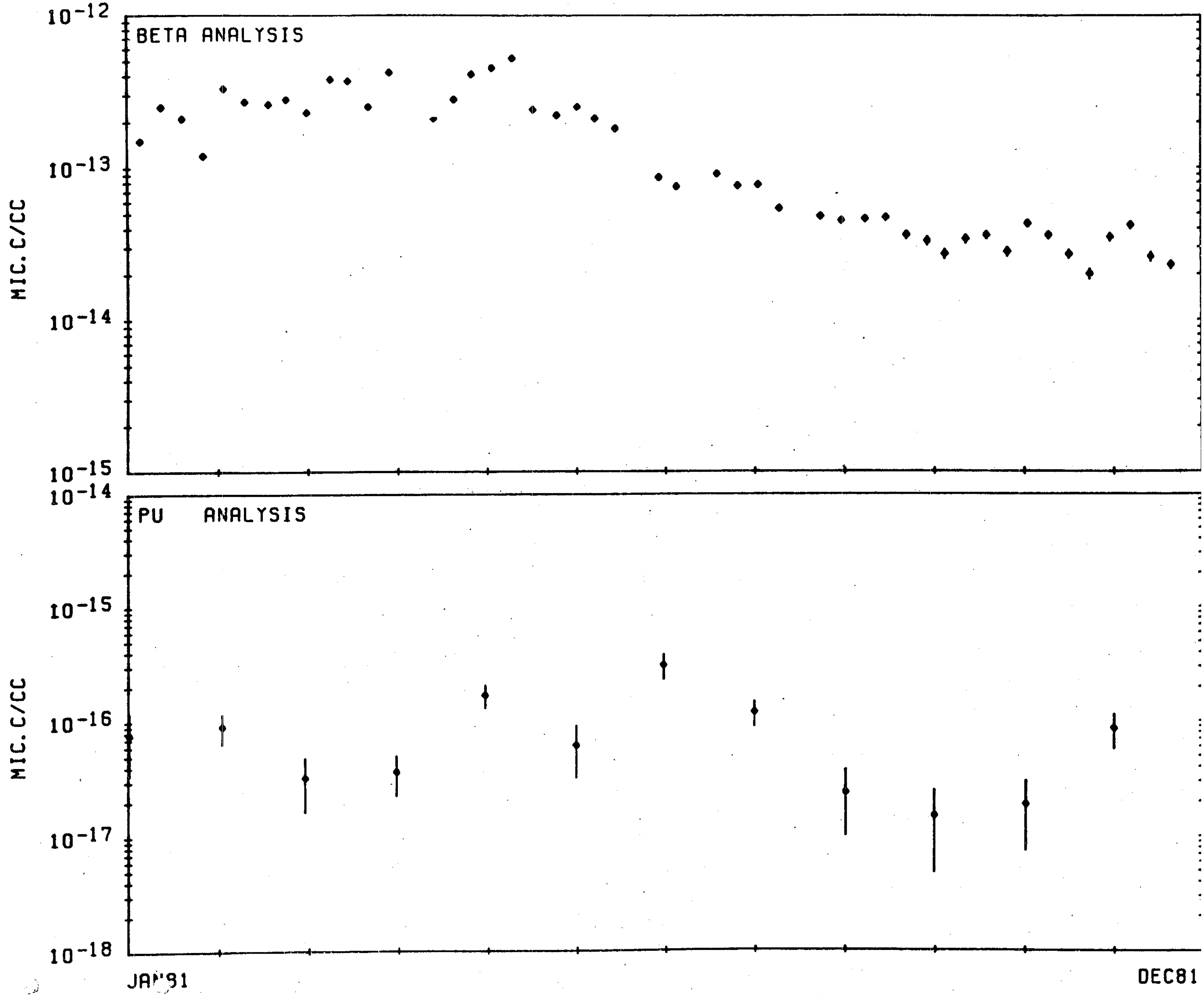
AIR SAMPLING STATION NUMBER 32



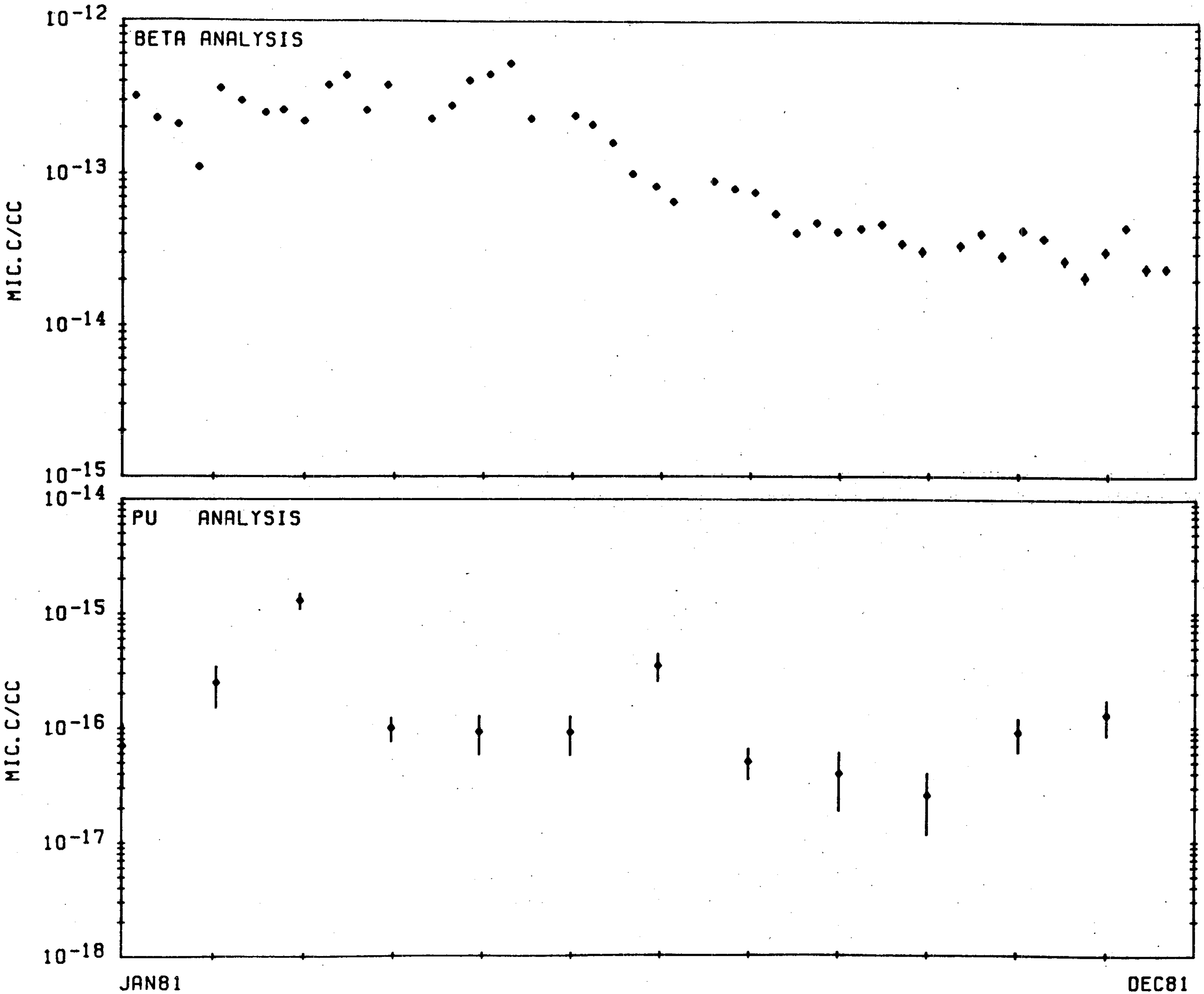
AIR SAMPLING STATION NUMBER 33



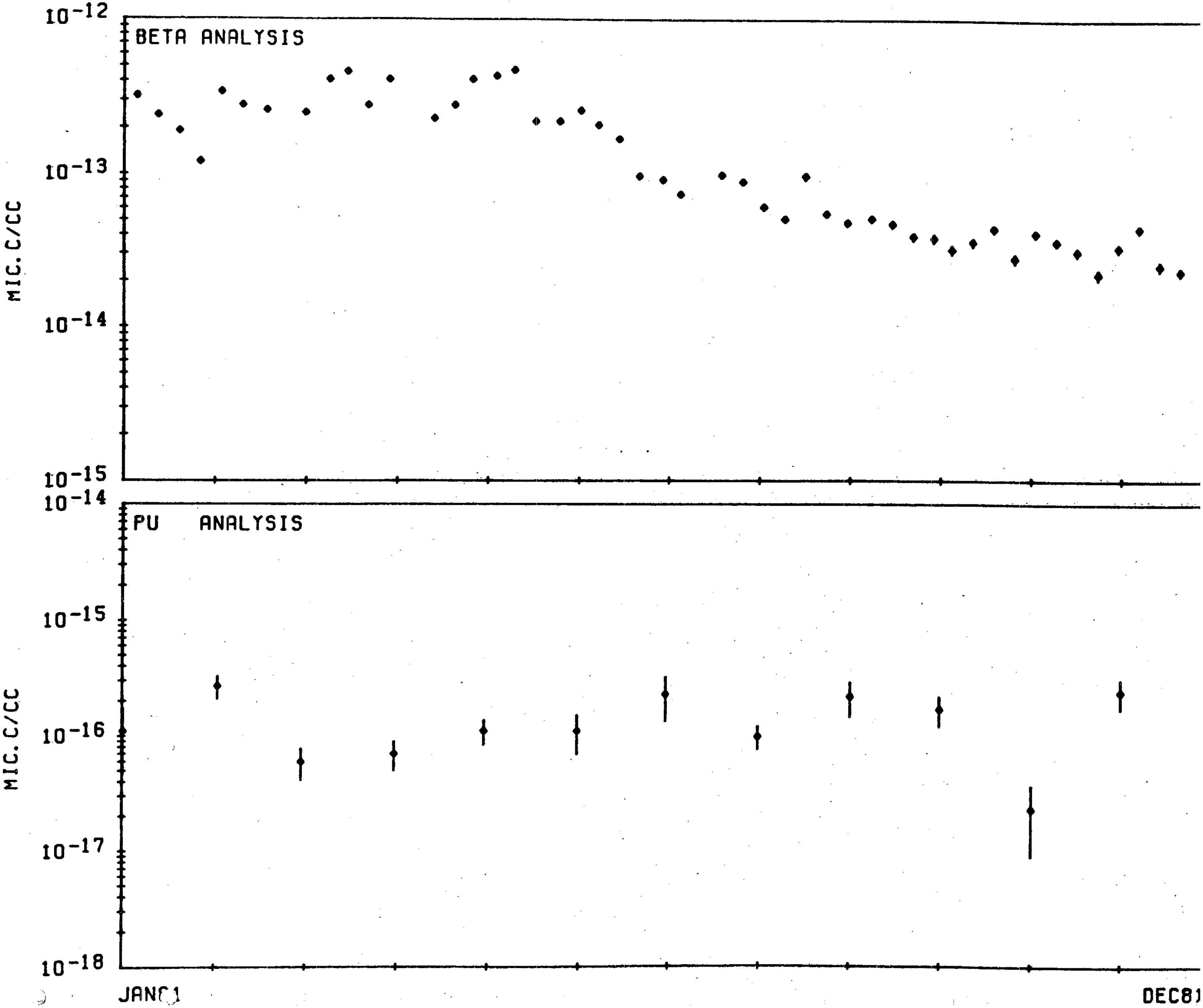
AIR SAMPLING STATION NUMBER 34



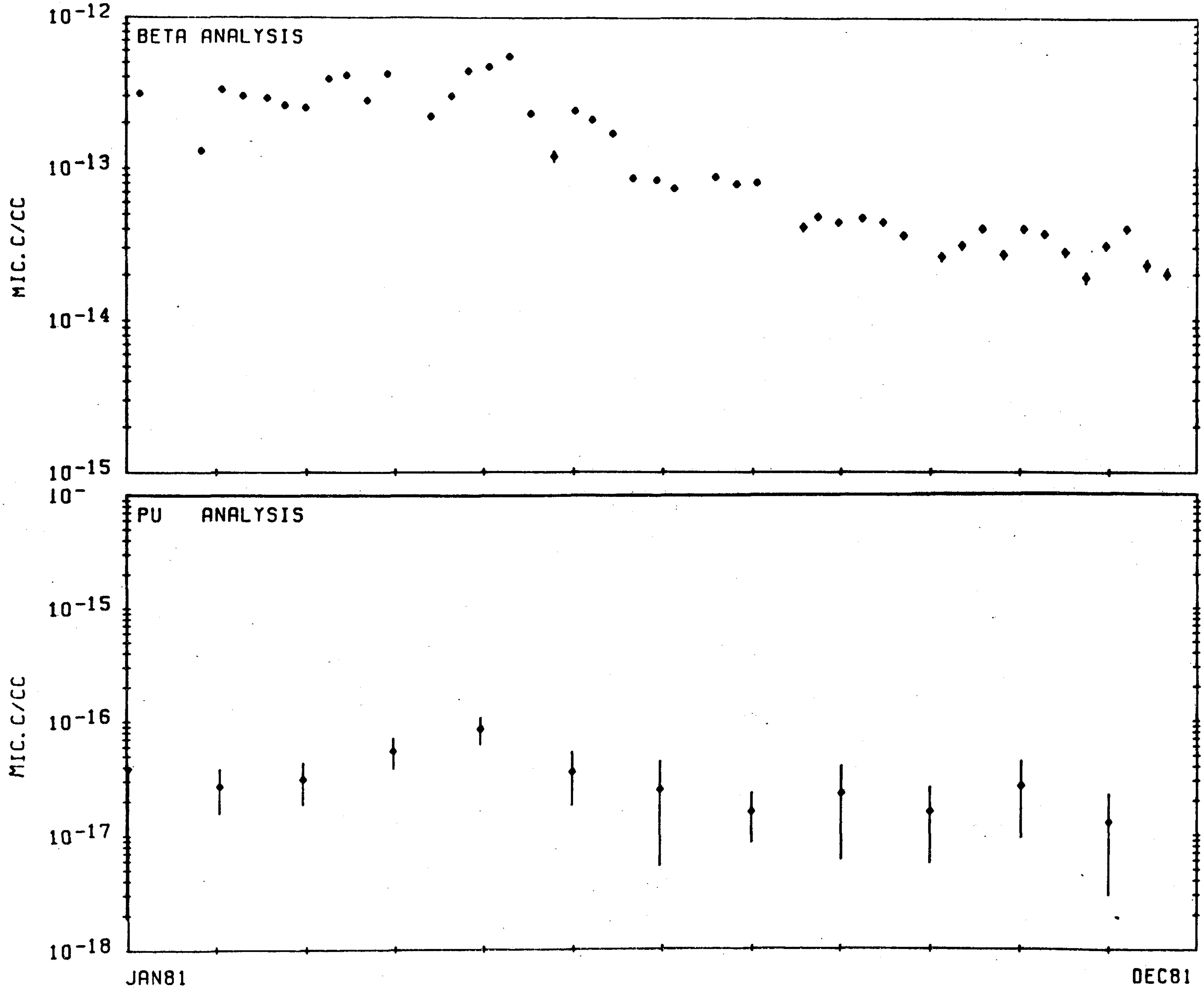
AIR SAMPLING STATION NUMBER 35



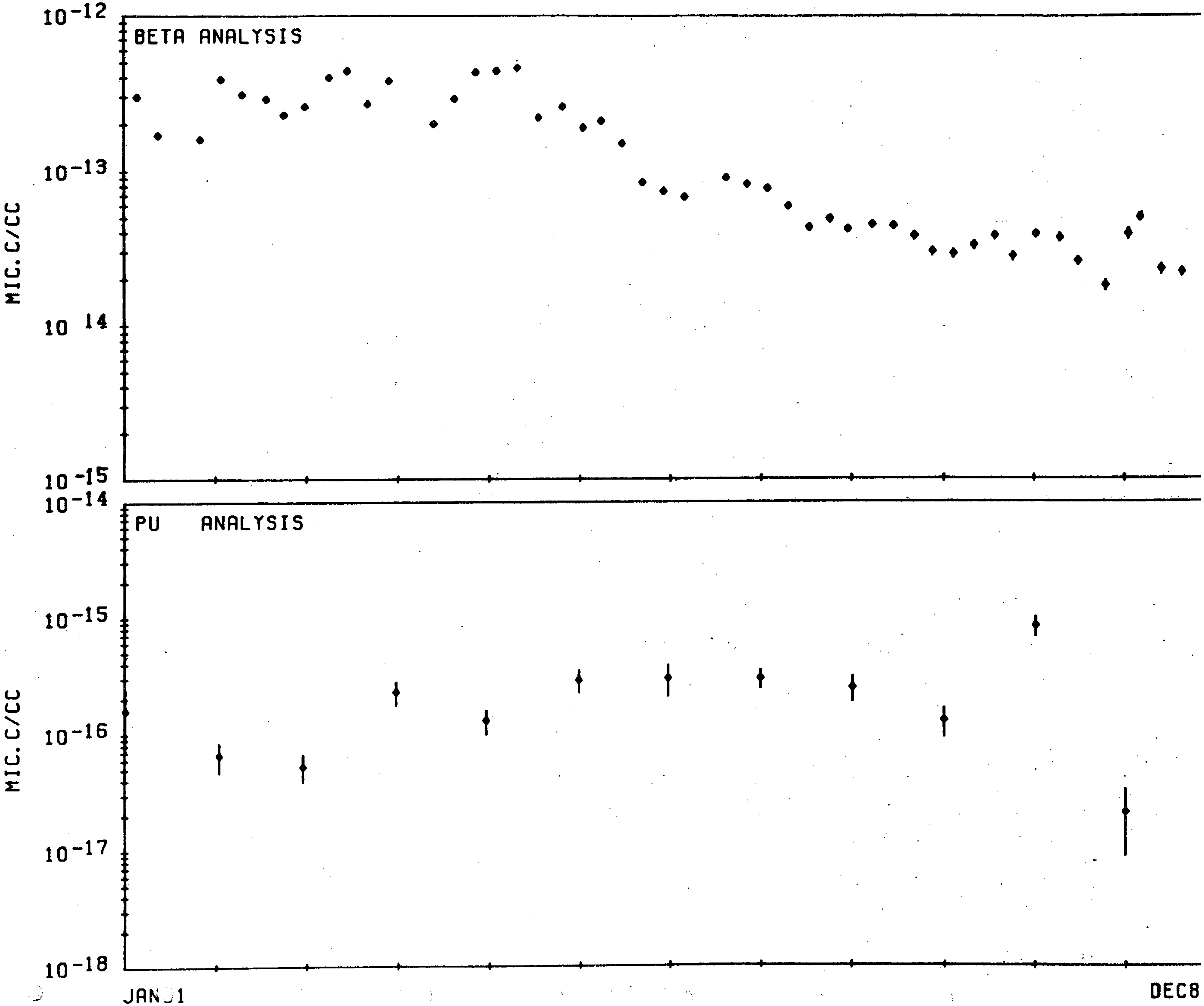
AIR SAMPLING STATION NUMBER 56



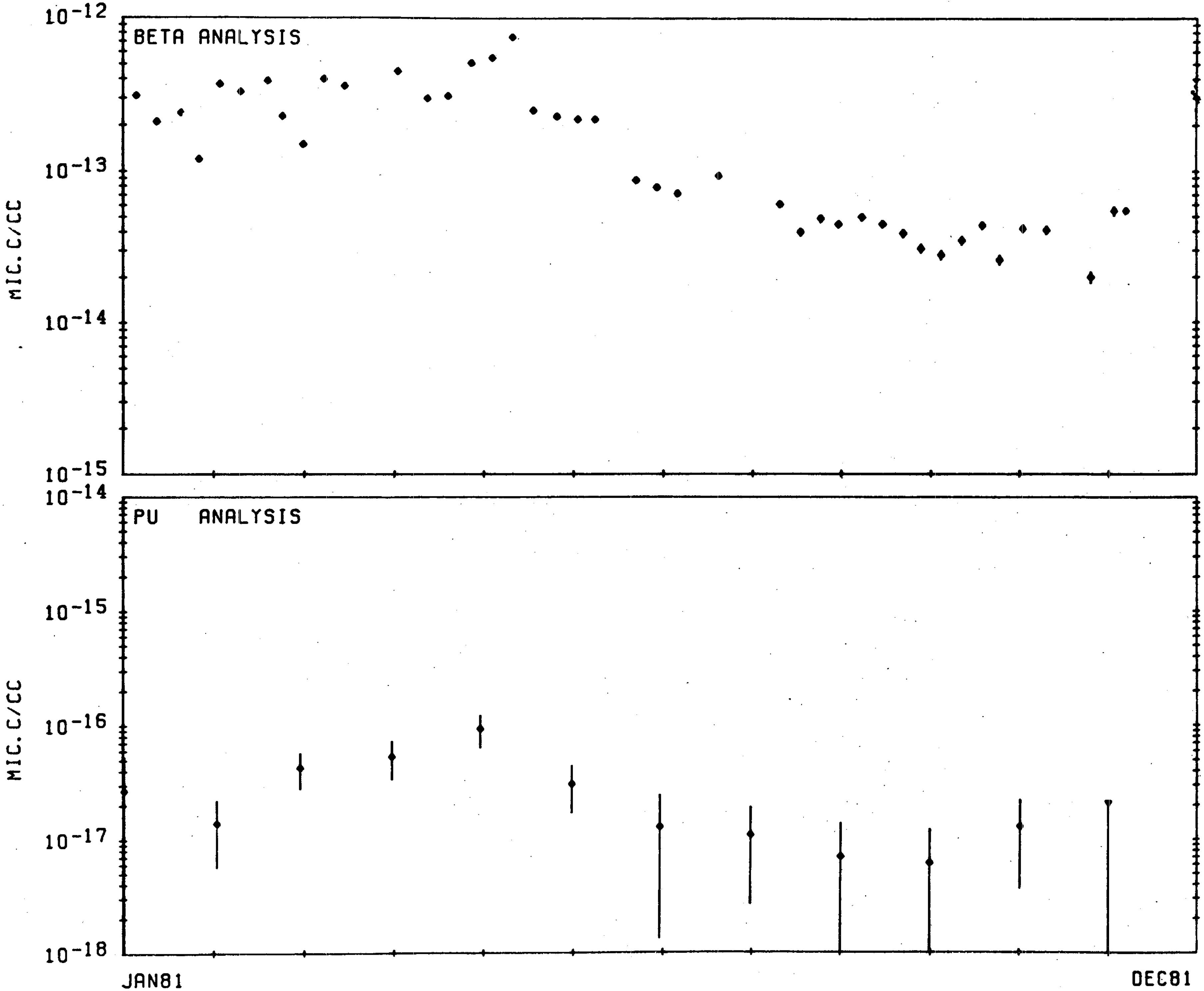
AIR SAMPLING STATION NUMBER 37



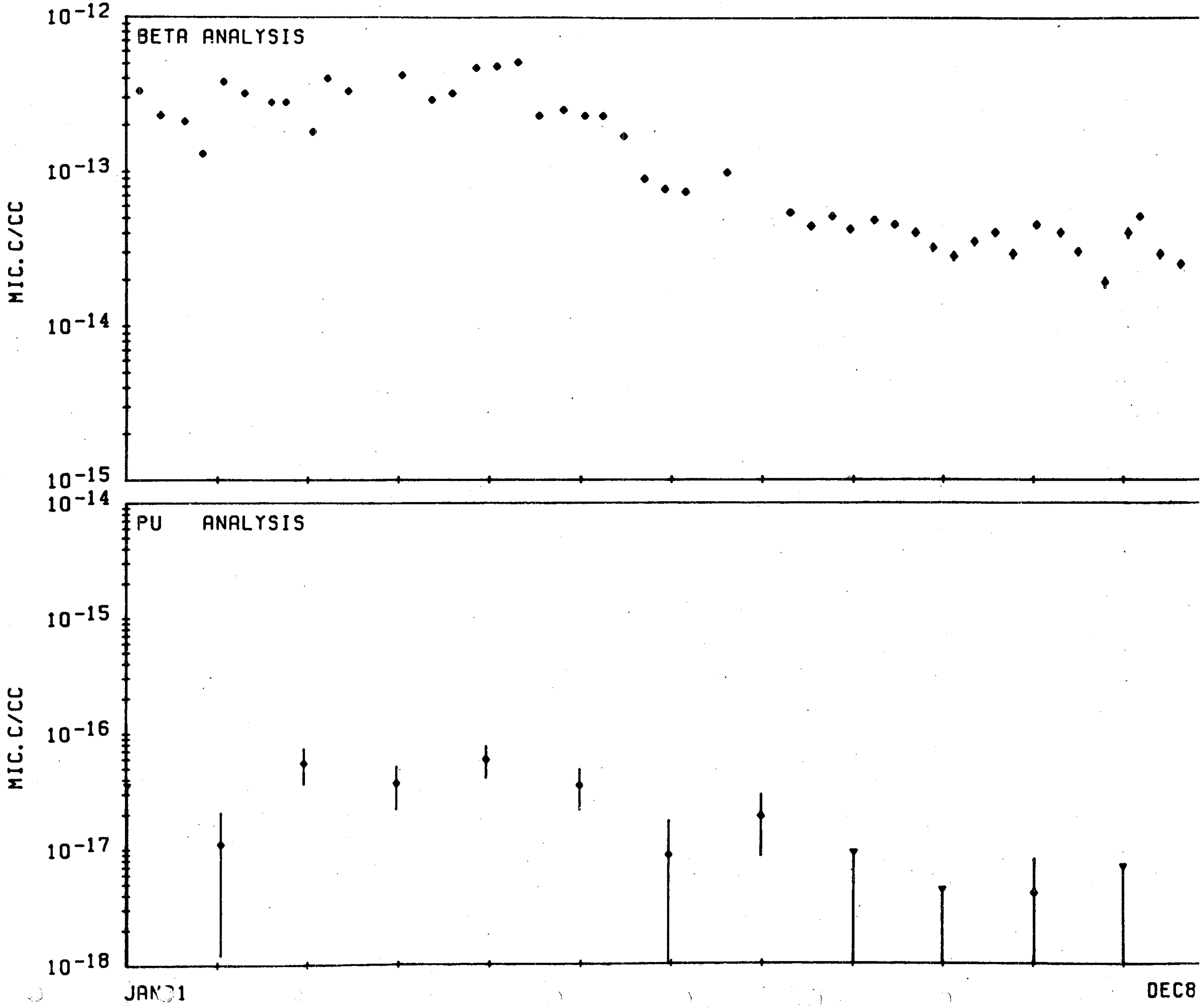
AIR SAMPLING STATION NUMBER 50



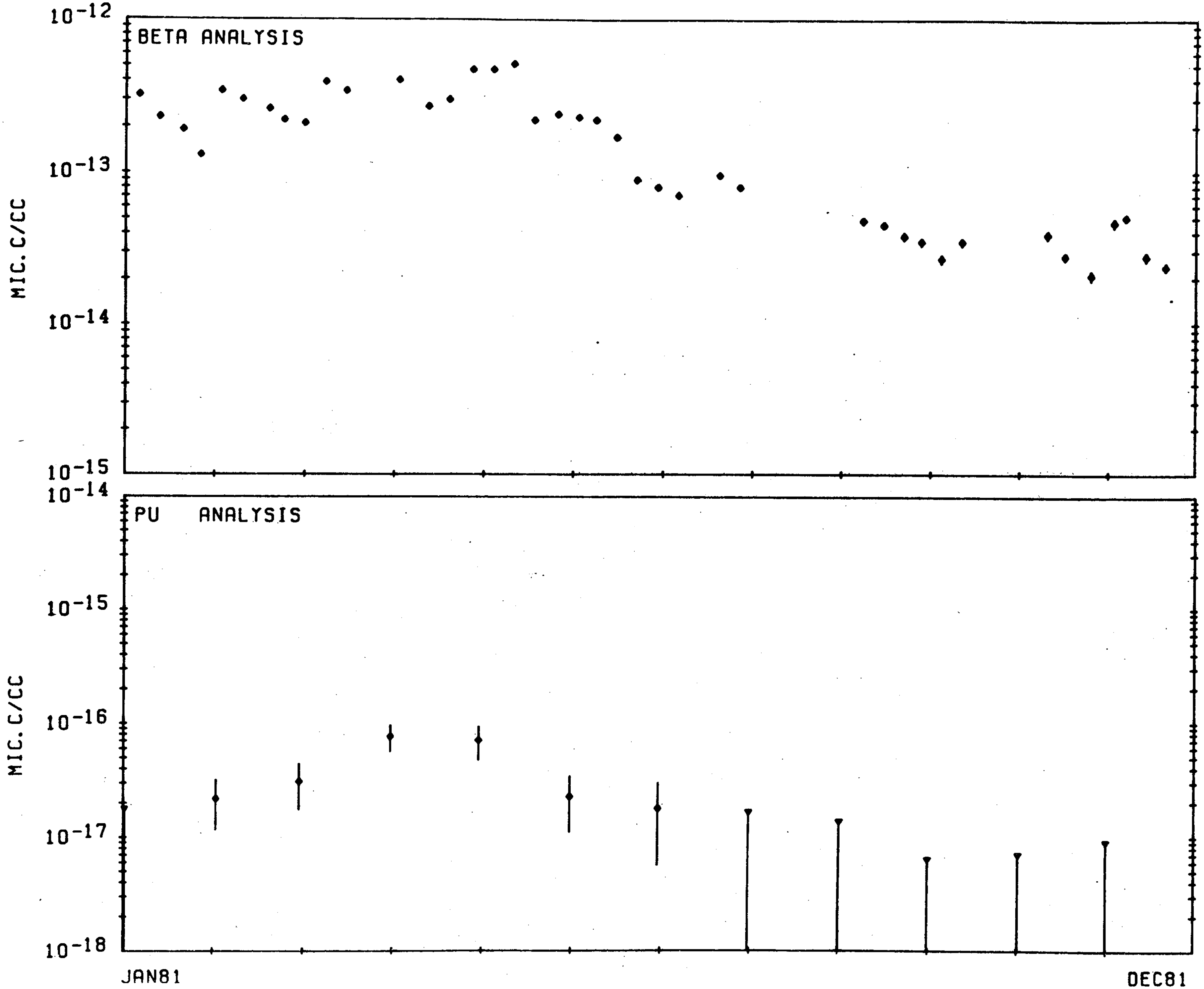
AIR SAMPLING STATION NUMBER 39



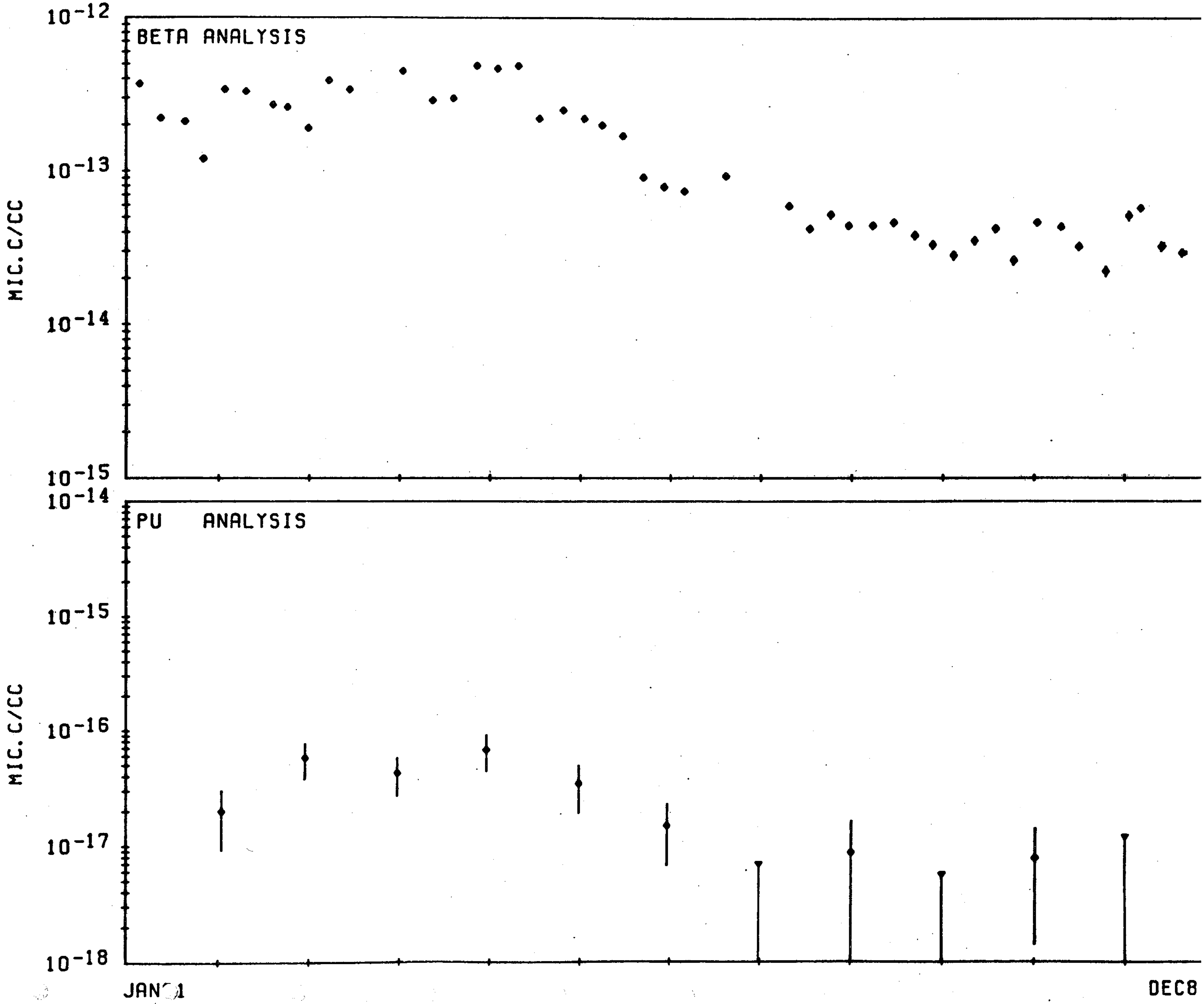
AIR SAMPLING STATION NUMBER 40



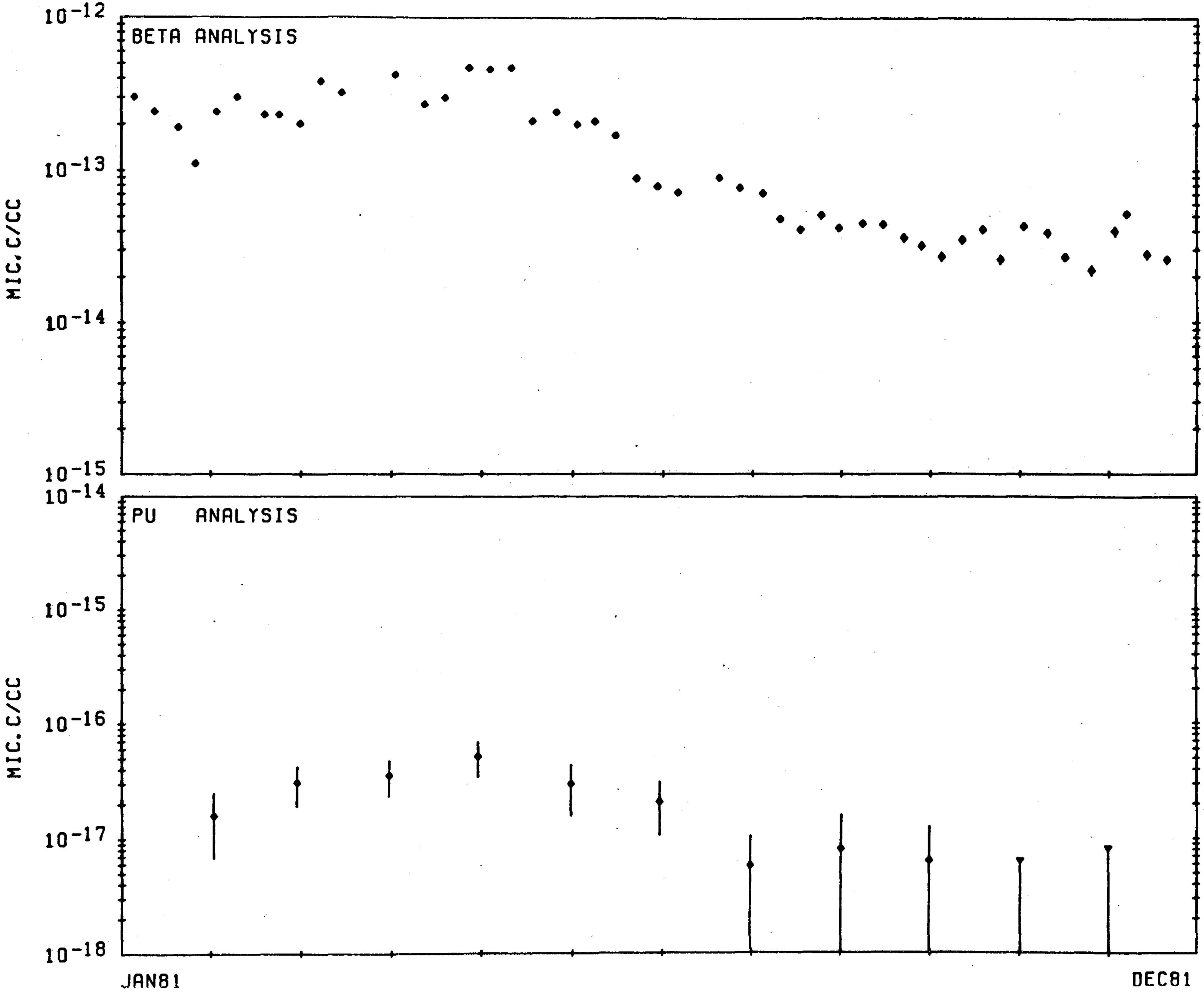
AIR SAMPLING STATION NUMBER 41



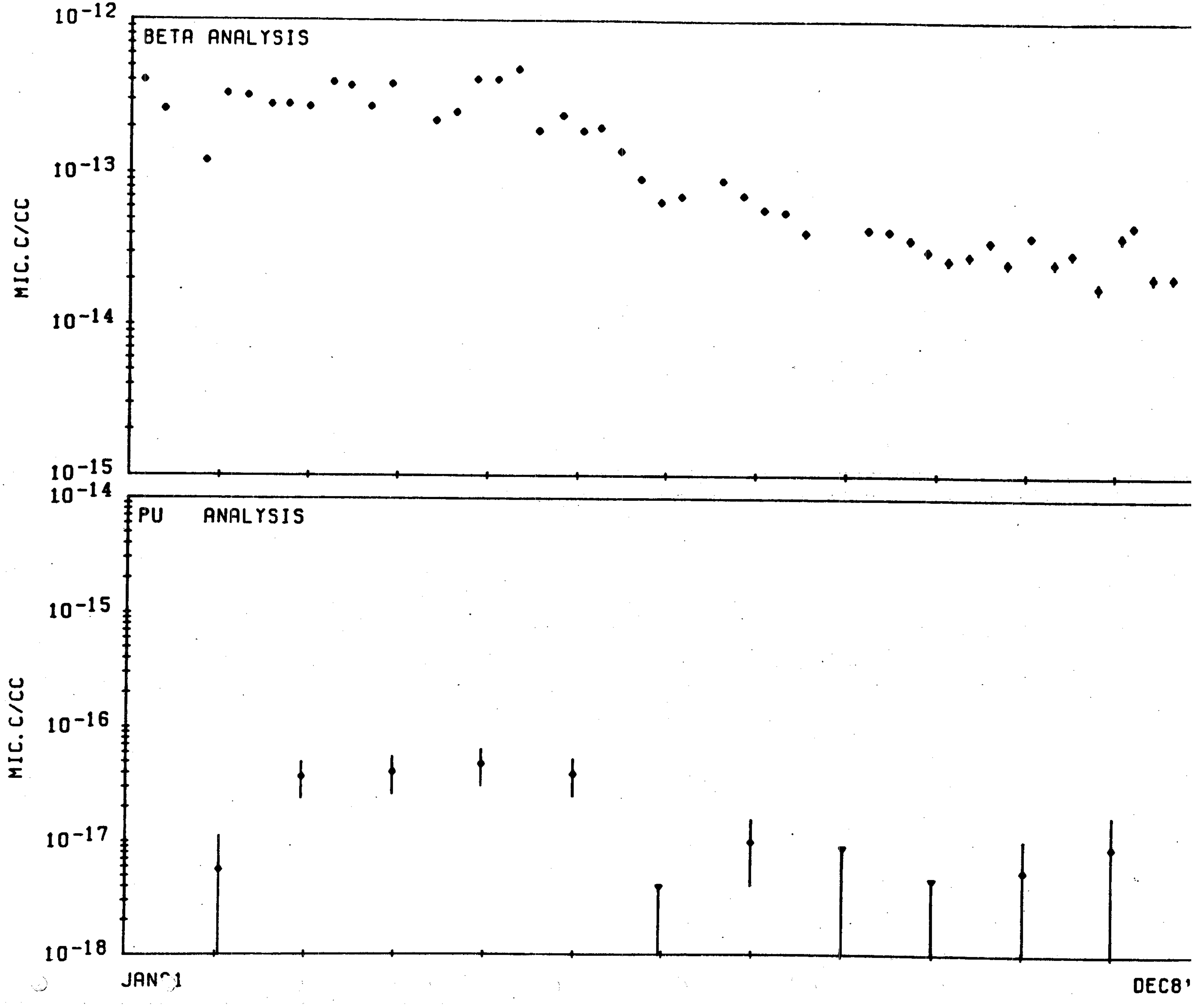
AIR SAMPLING STATION NUMBER 42



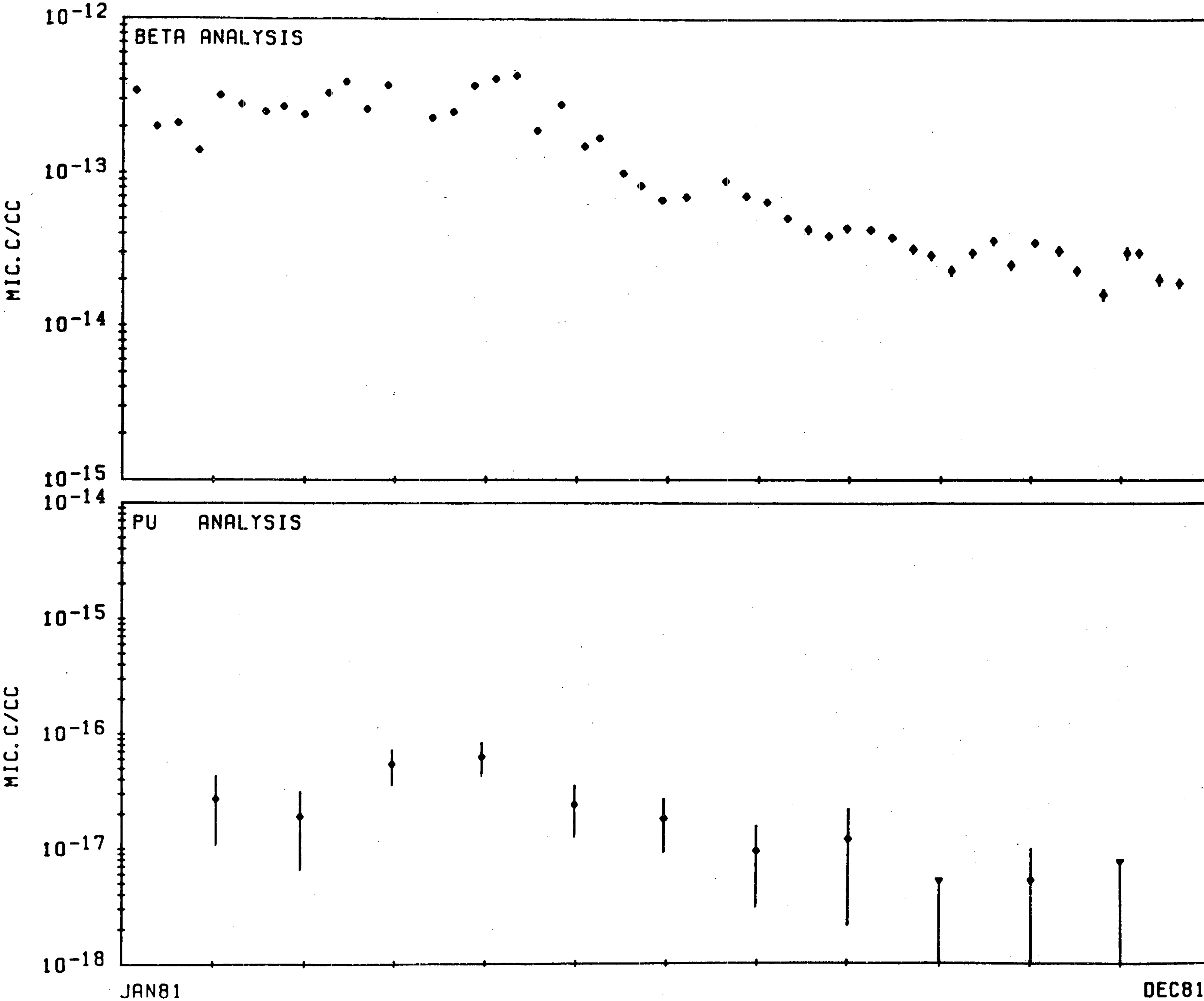
AIR SAMPLING STATION NUMBER 43



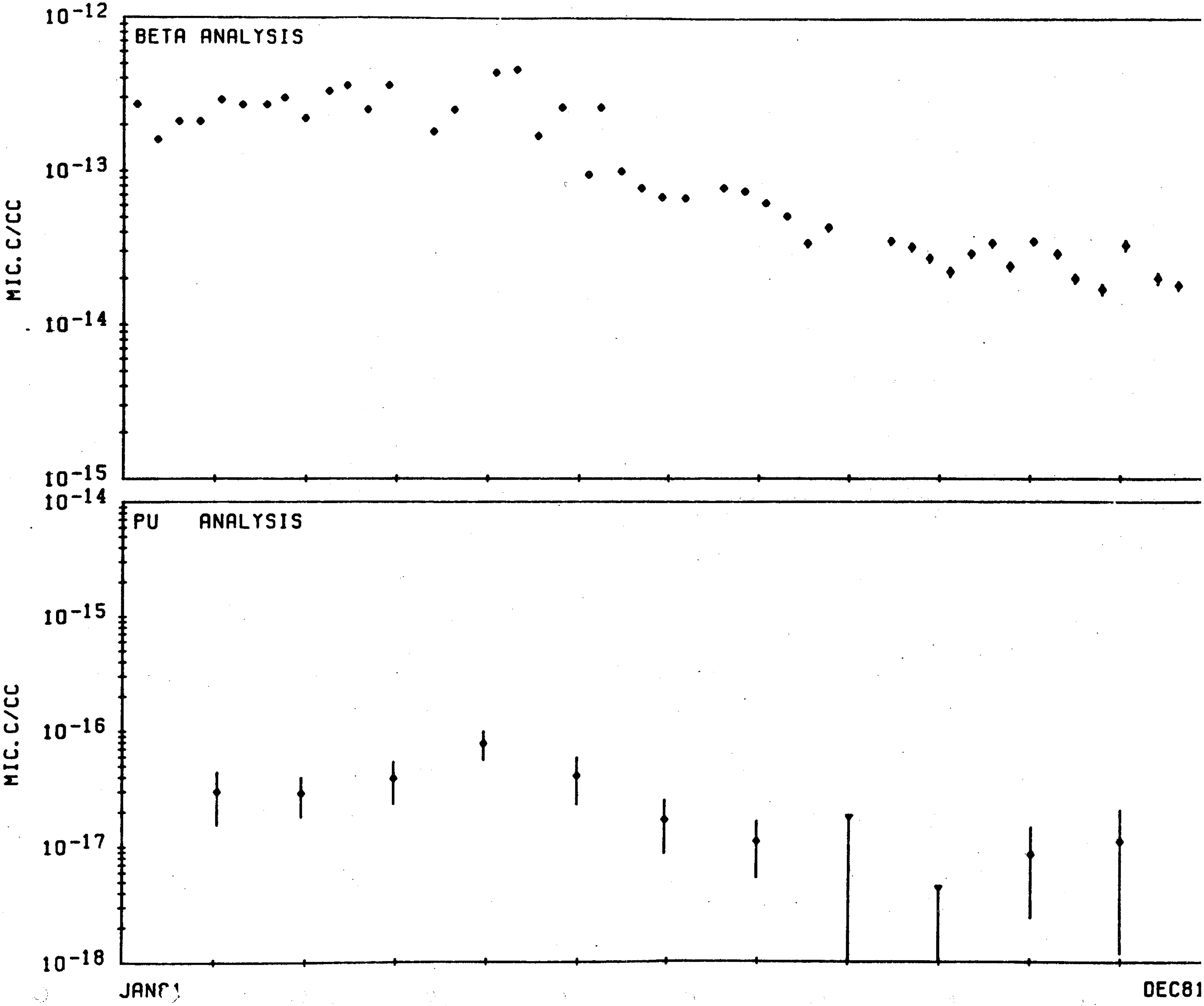
AIR SAMPLING STATION NUMBER 44

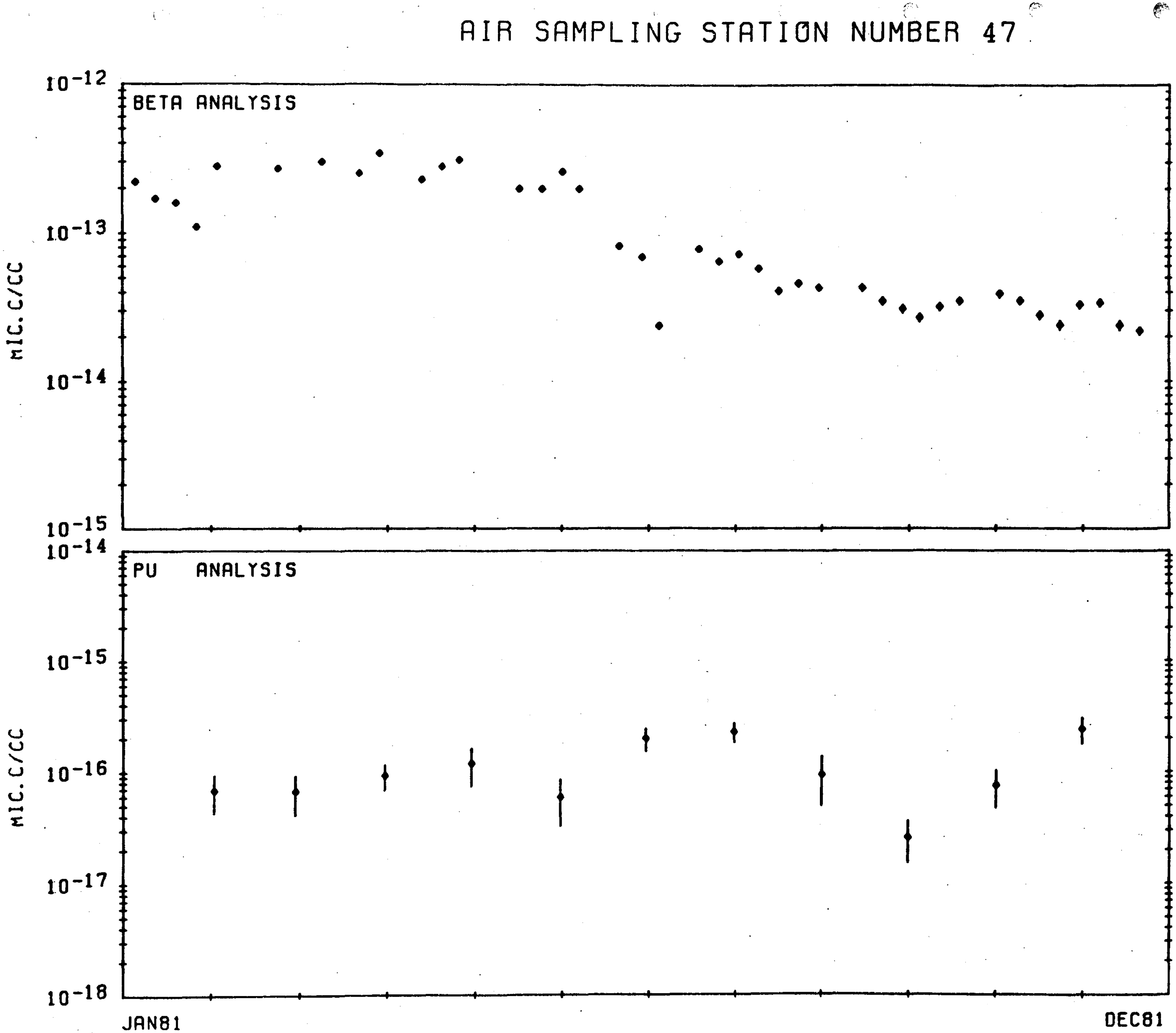


AIR SAMPLING STATION NUMBER 45

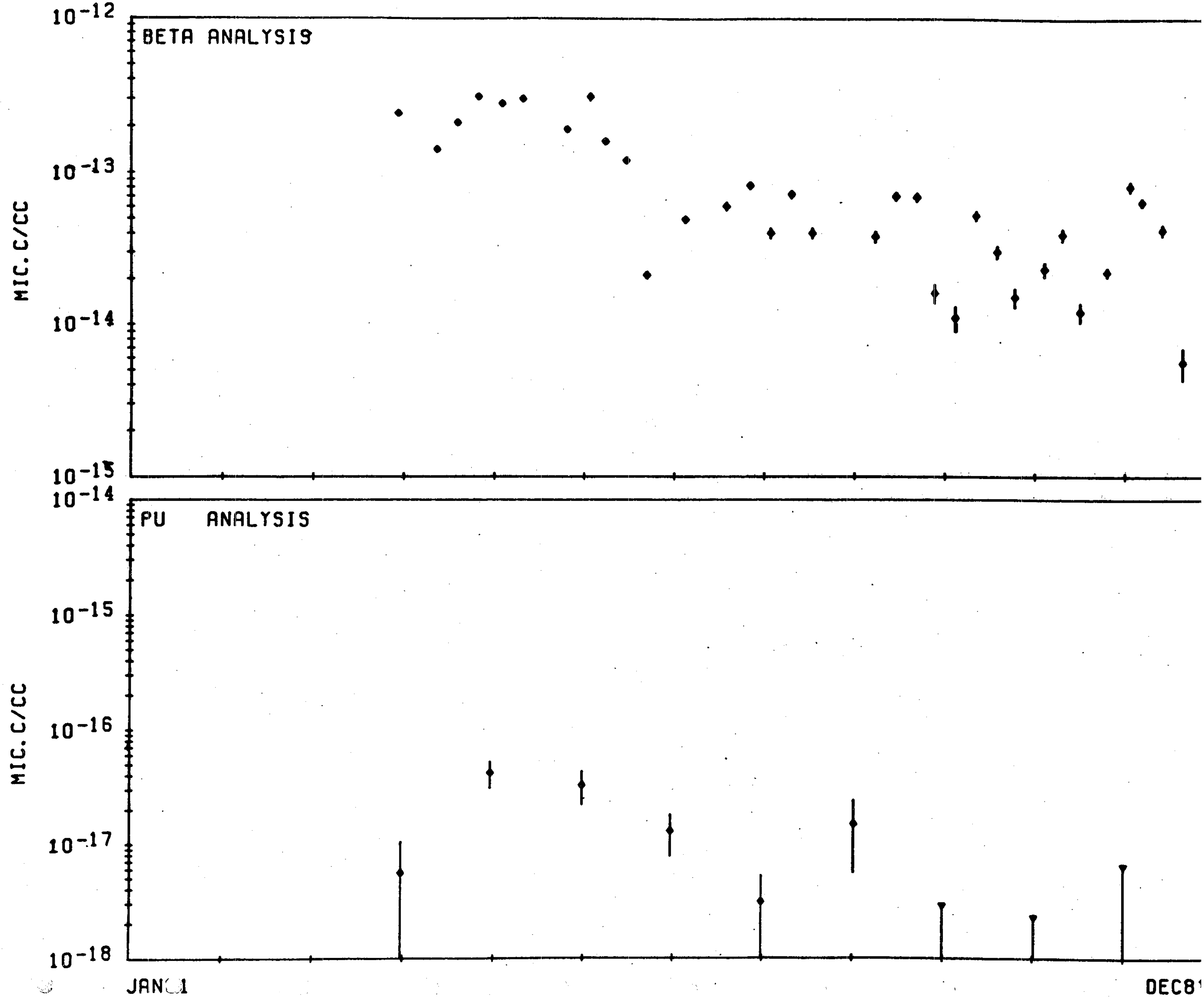


AIR SAMPLING STATION NUMBER 46




AIR SAMPLING STATION NUMBER 47
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
JAN81
DEC81

AIR SAMPLING STATION NUMBER 48



A P P E N D I X B

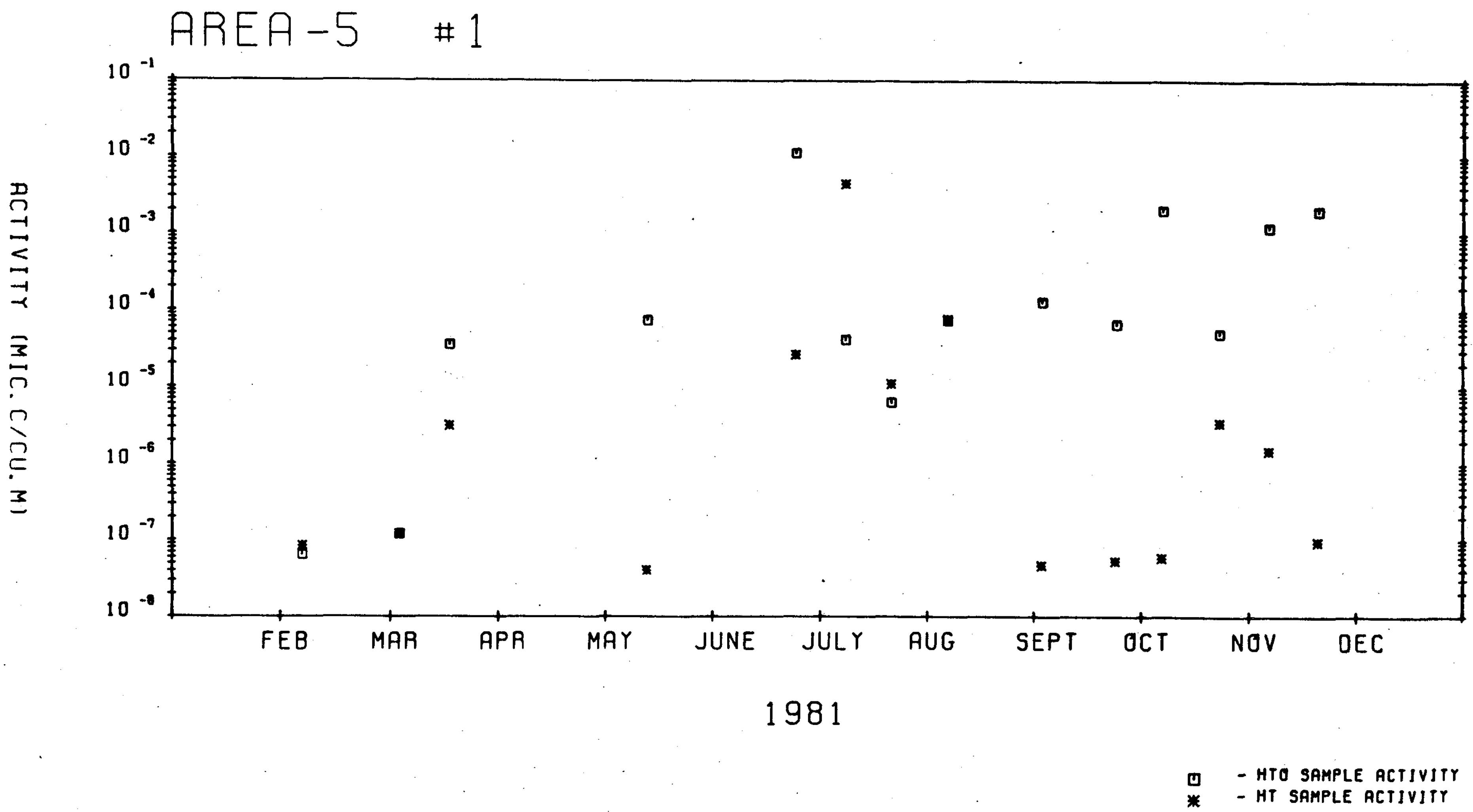
NTS Environmental Surveillance

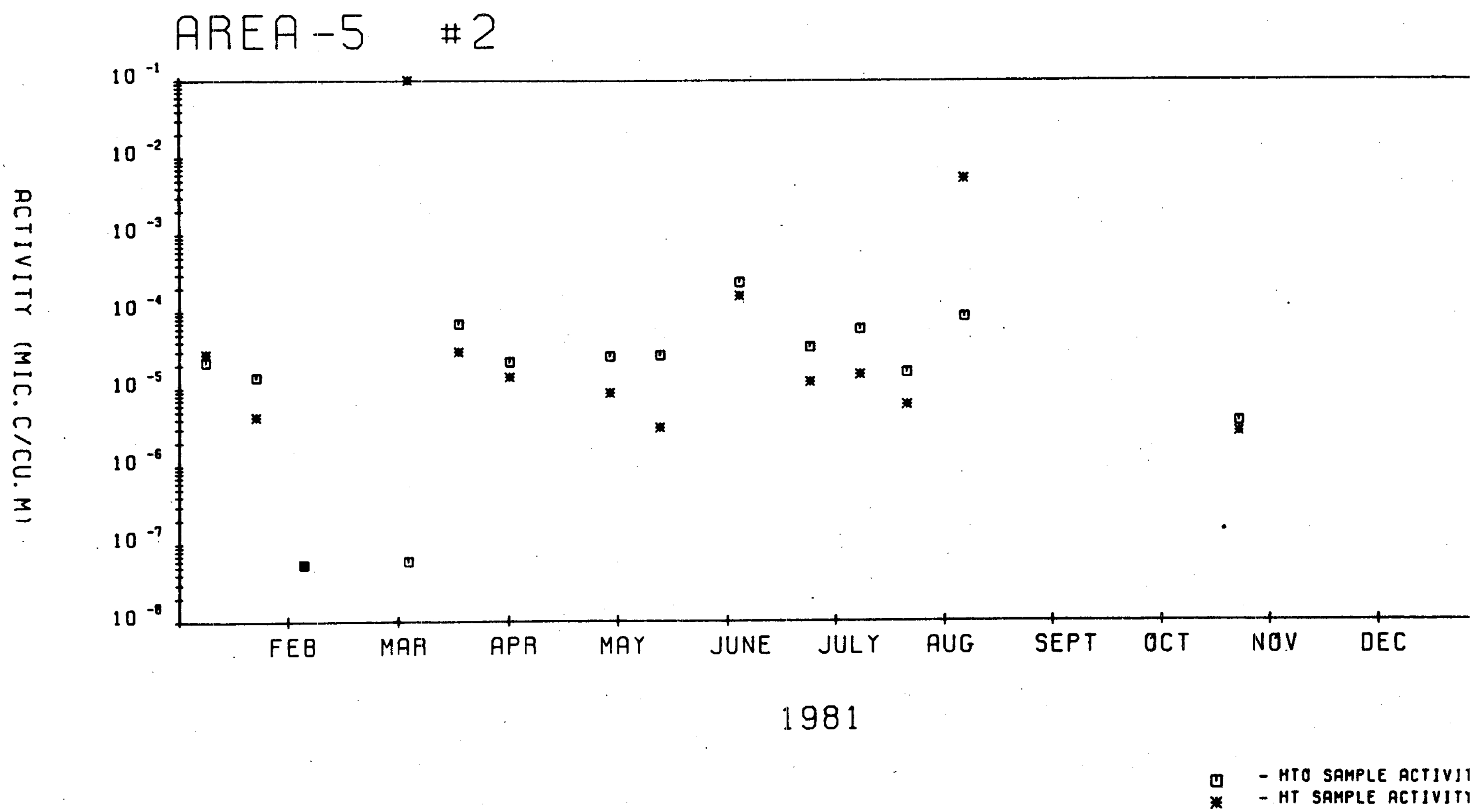
Tritium in Air Sampling Locations and Plots

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

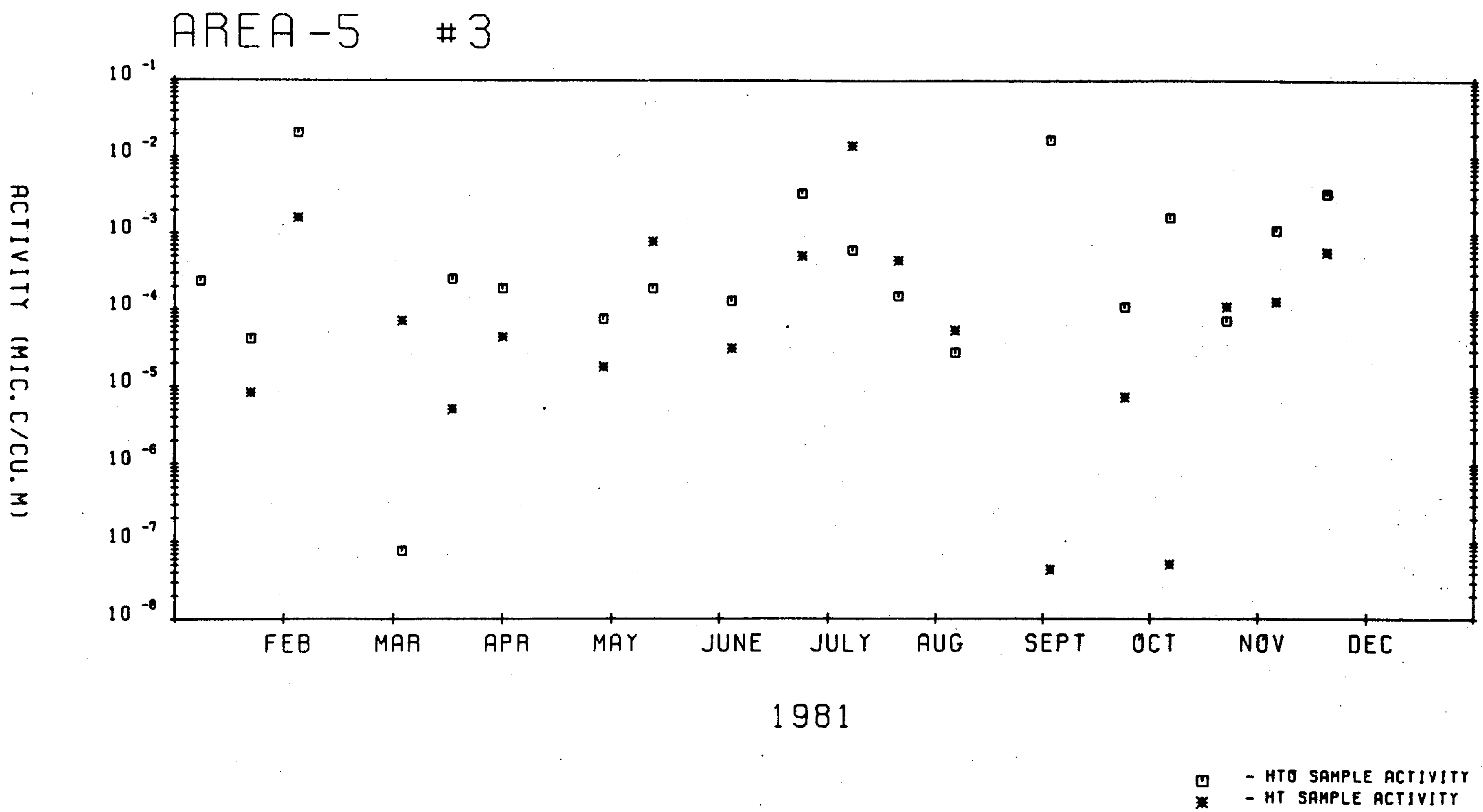
NTS ENVIRONMENTAL SURVEILLANCE
TRITIUM IN AIR SAMPLING LOCATIONS

Area	Location
5	RWMS #1
5	RWMS #2
5	RWMS #3
23	Building 650


AREA-5 #1
ACTIVITY (MIC.C/CU.M)
10 -1
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
1981
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

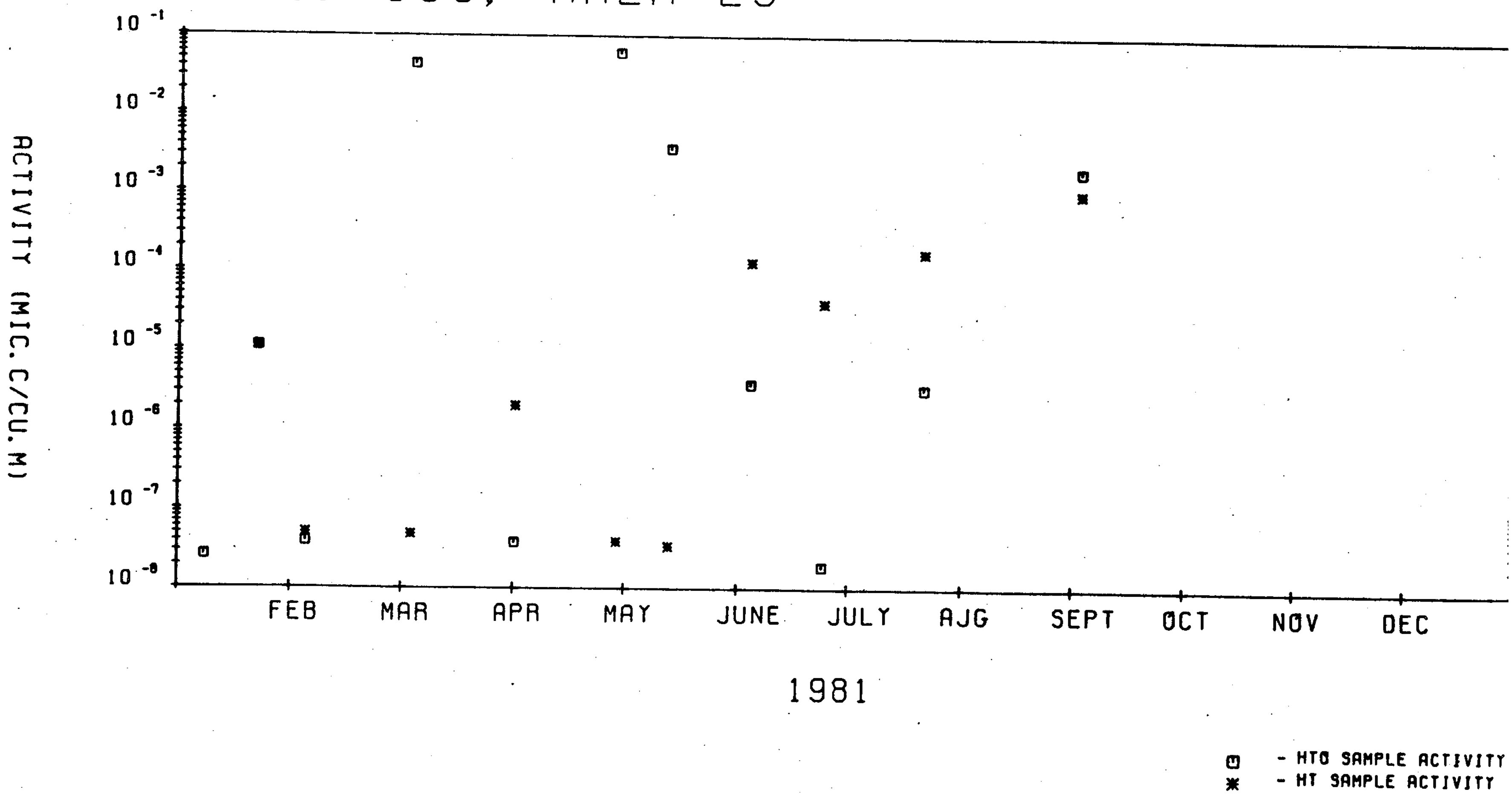


AREA-5 #2
ACTIVITY (MIC.C/CU.M)
10 -1
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1981
- HTO SAMPLE ACTIVIT
- HT SAMPLE ACTIVITY



AREA-5 #3
ACTIVITY (MIC.C/CU.M)
10^{-1}
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
1981
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

BLDG. 650, AREA 23



APPENDIX C

NTS Environmental Surveillance

Supply Wells Locations and Plots

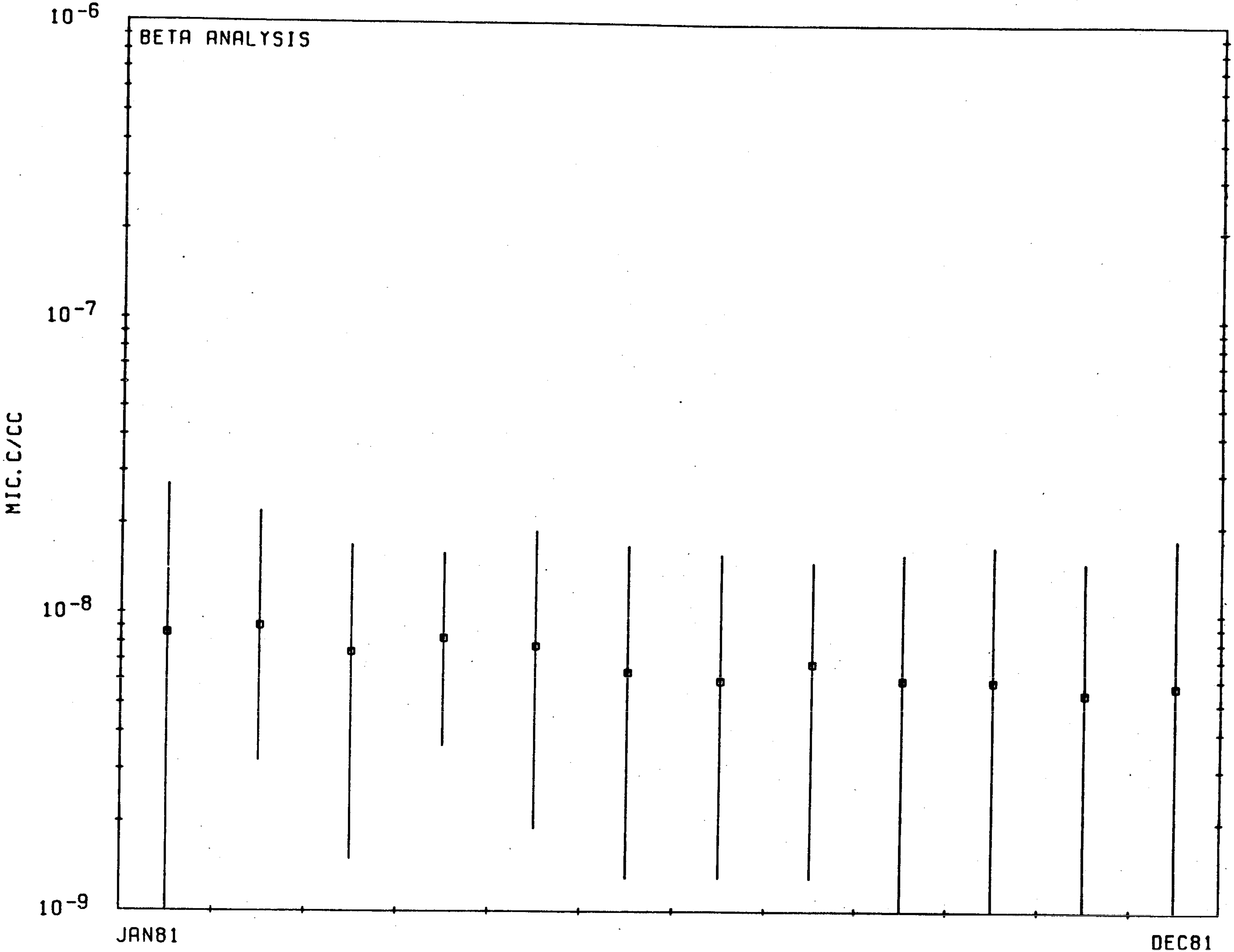
Several symbols are used in Appendix C to denote the data points. In the first two pages of plots, the supply well network averages, a square represents the arithmetic mean of all values at that point in time, and the vertical line is the range of the data.

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.

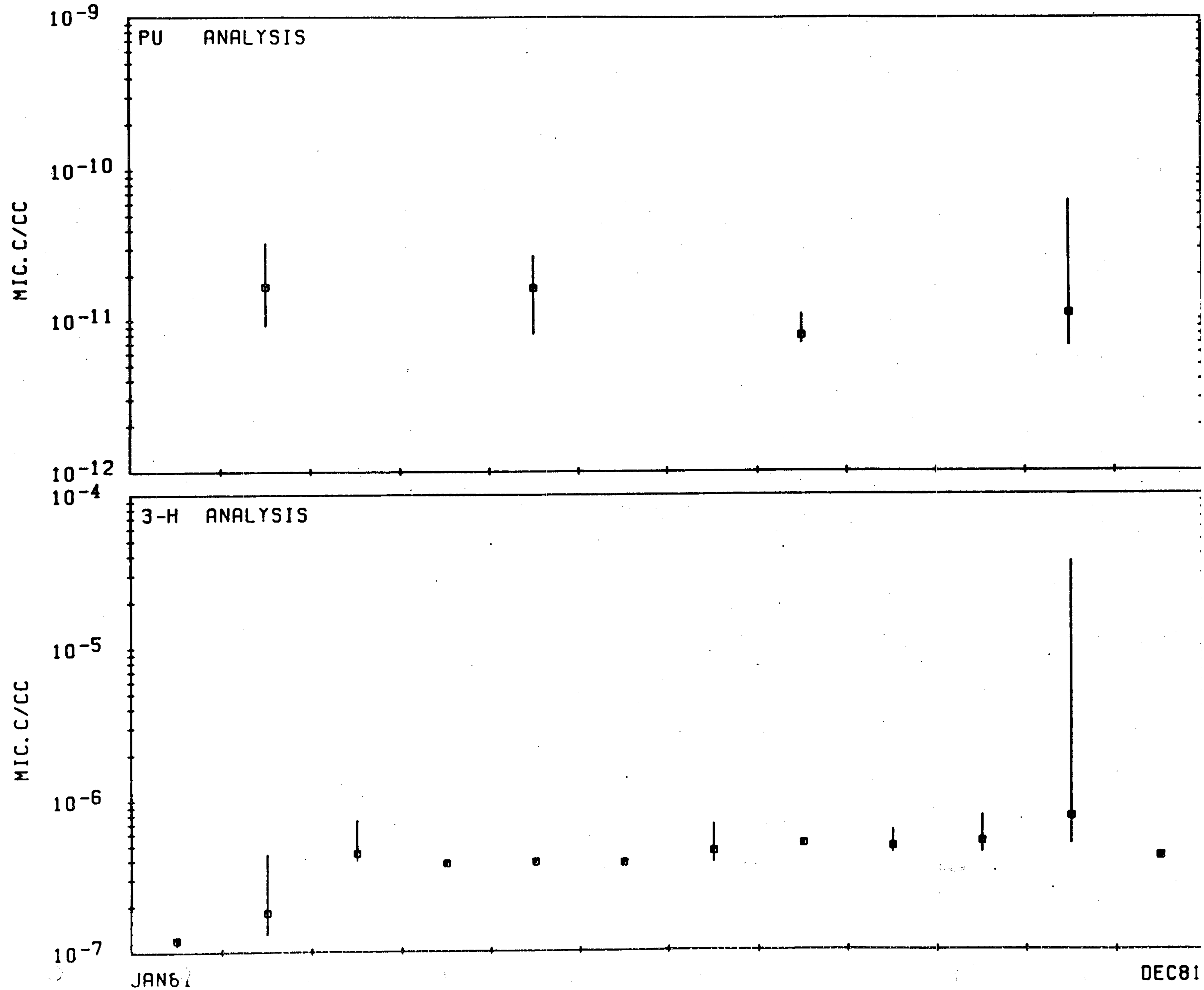
NTS ENVIRONMENTAL SURVEILLANCE
SUPPLY WELLS SAMPLING LOCATIONS

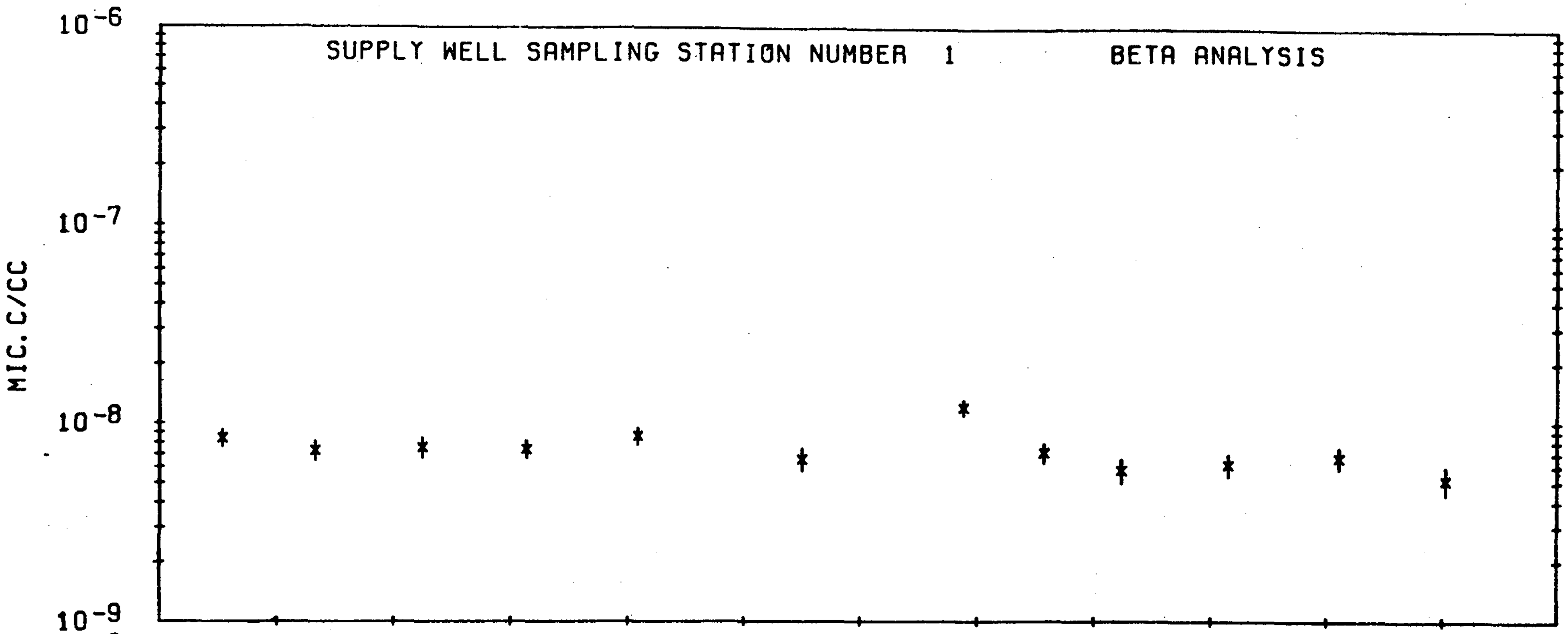
Station Number	Location
1	Area 2 Well 2
2	Area 3 Well A
3	Area 5 Well 5B
4	Area 5 Well 5C
5	Area 5 Well Ue5c
6	Area 6 Well C
7	Area 6 Well C1
9	Area 18 Well 8
13	Area 22 Army Well #1
14	Area 25 Well J12
15	Area 25 Well J13
18	Area 19 Well U19c

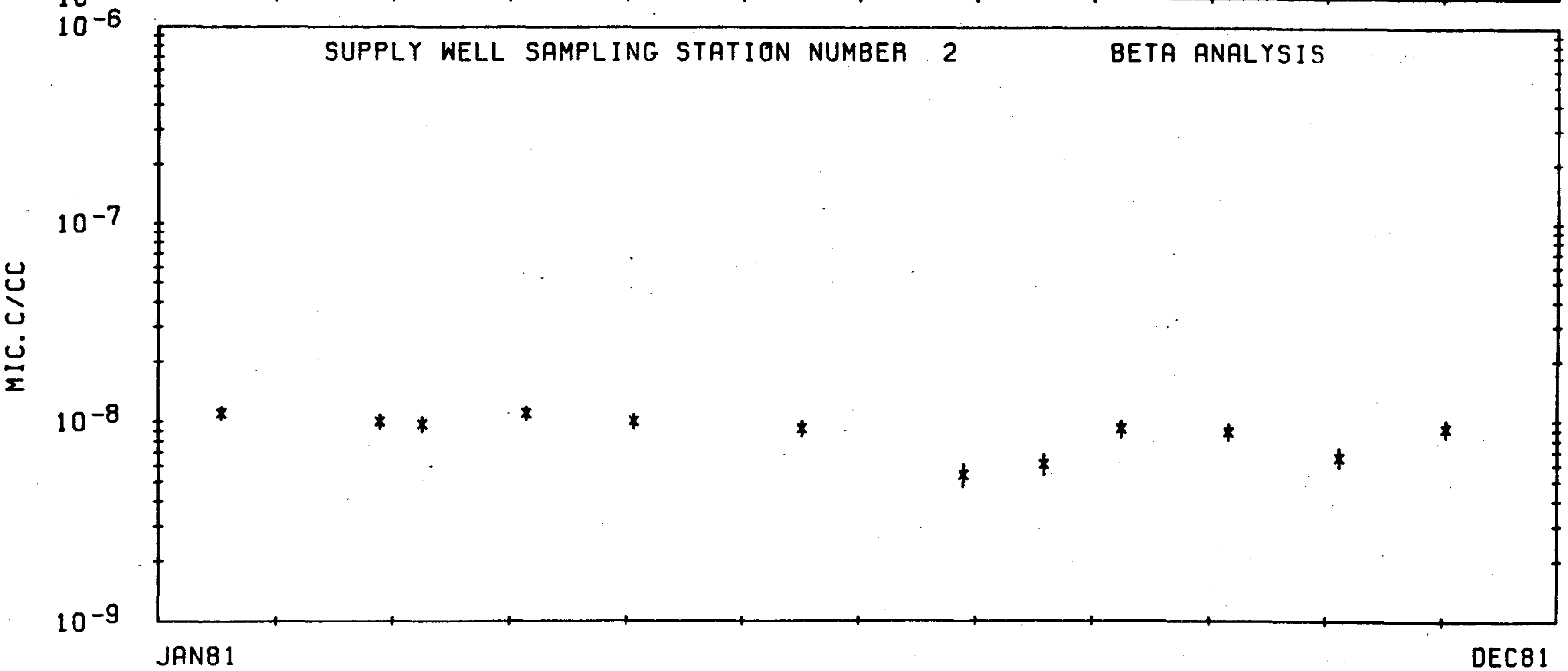
SUPPLY WELL NETWORK AVERAGES

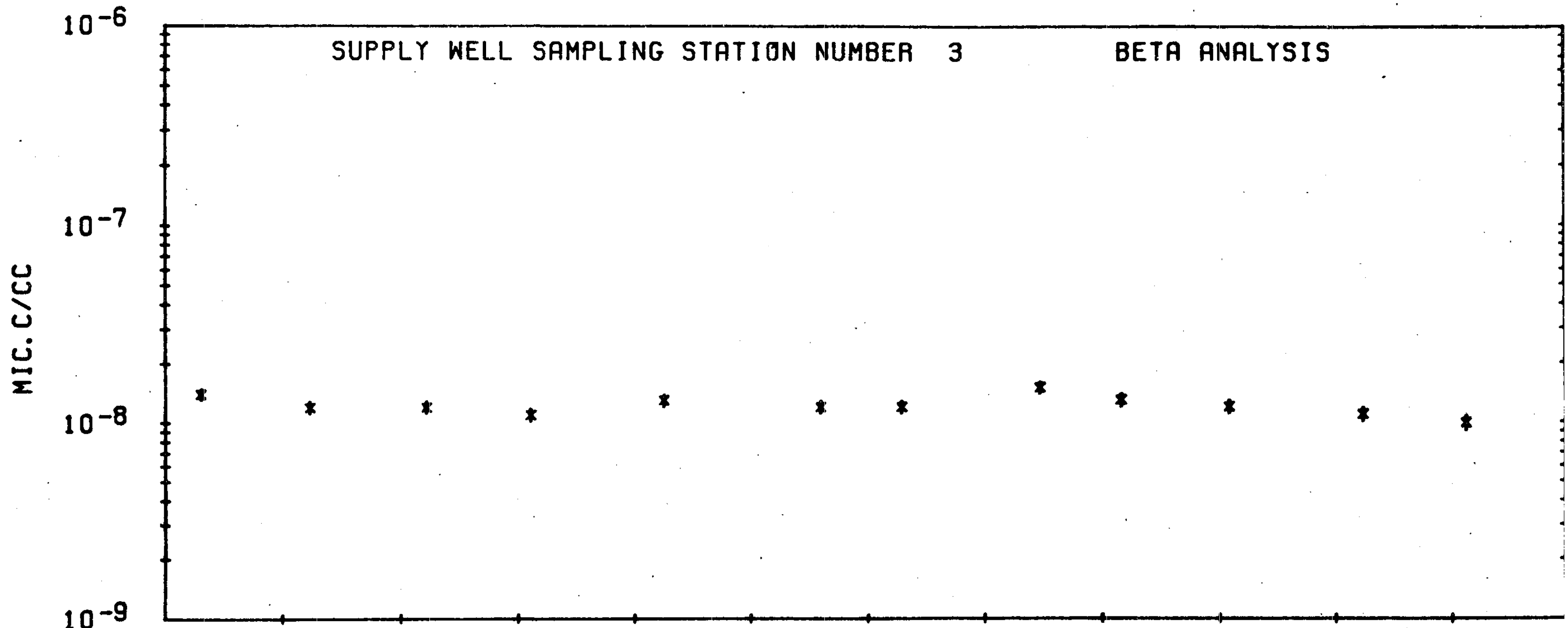


SUPPLY WELL NETWORK AVERAGES

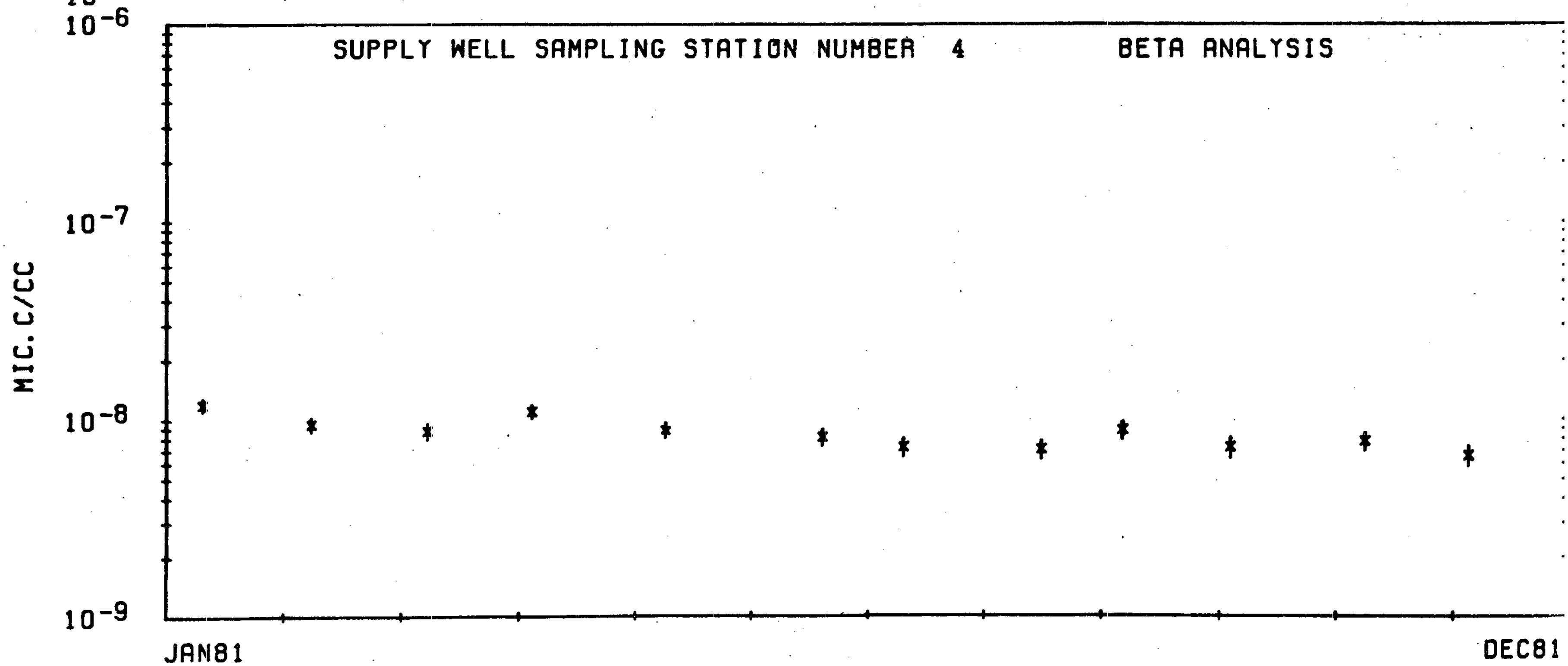



SUPPLY WELL SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

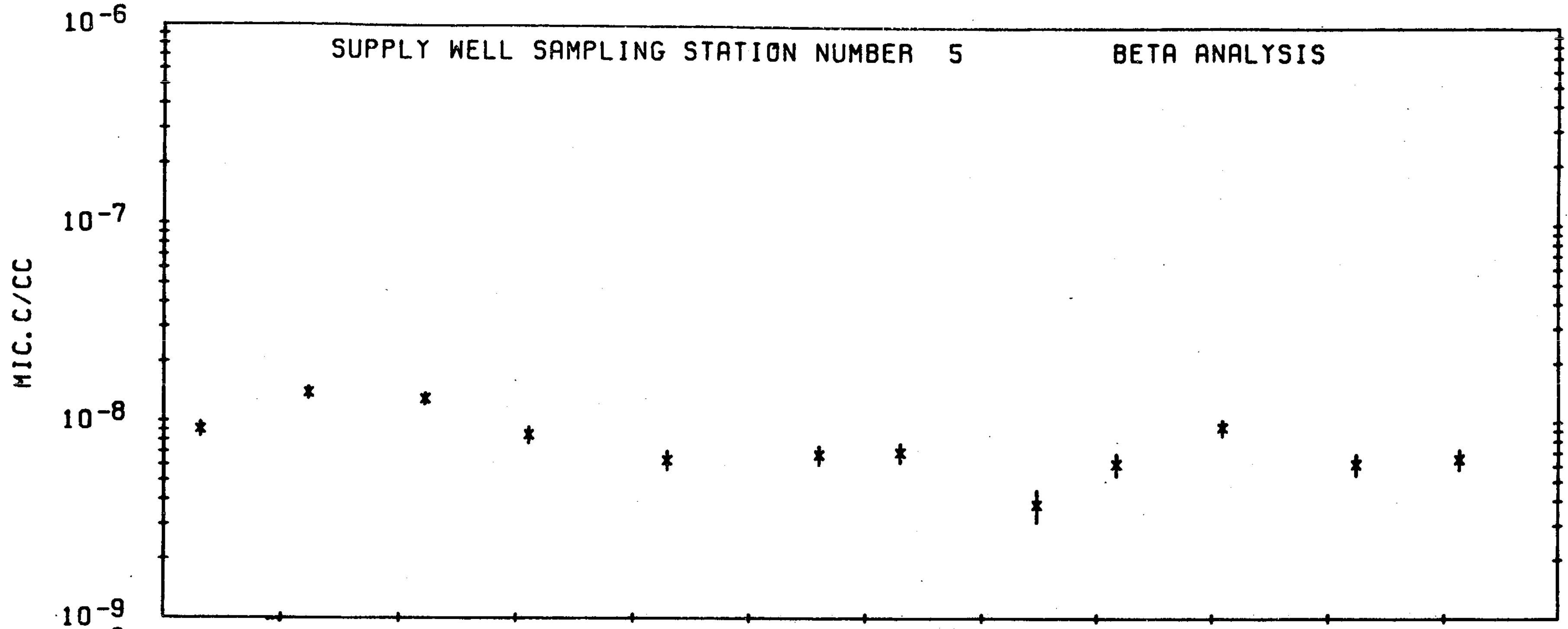

SUPPLY WELL SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81

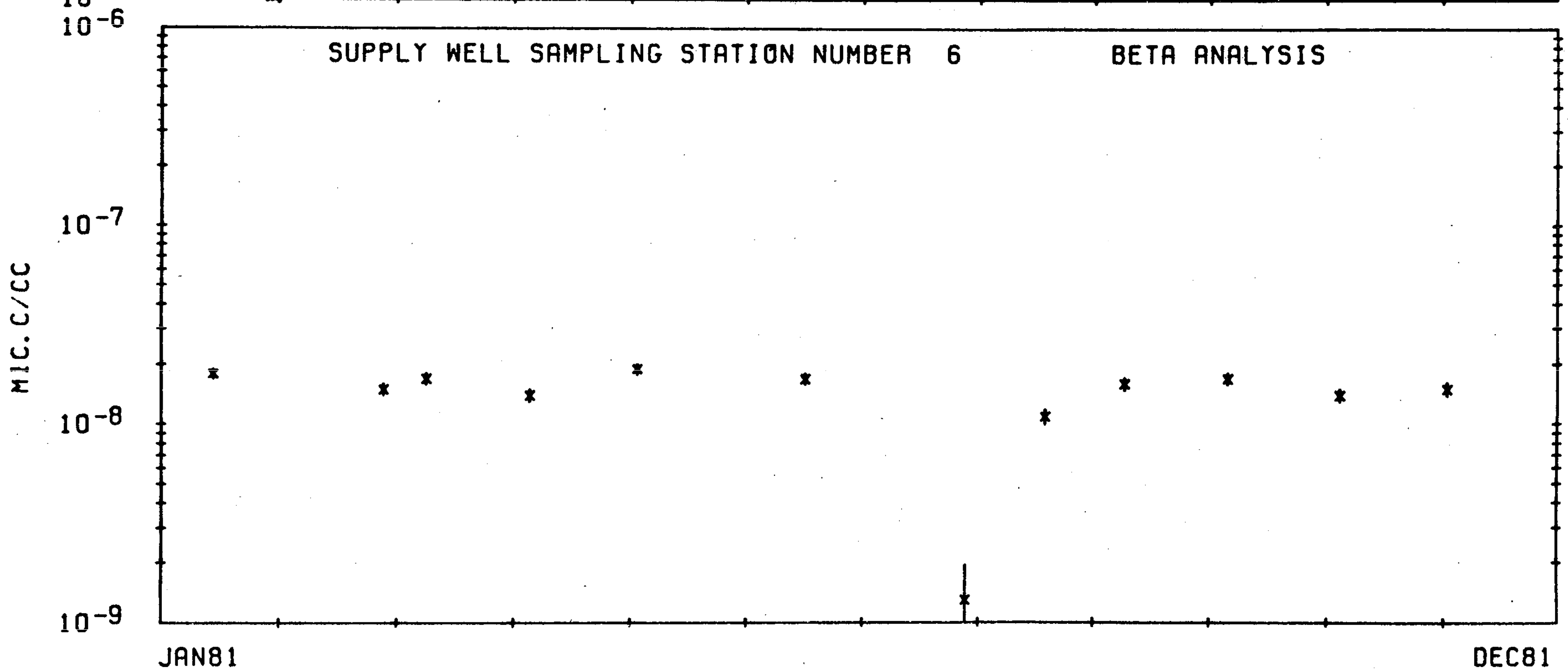


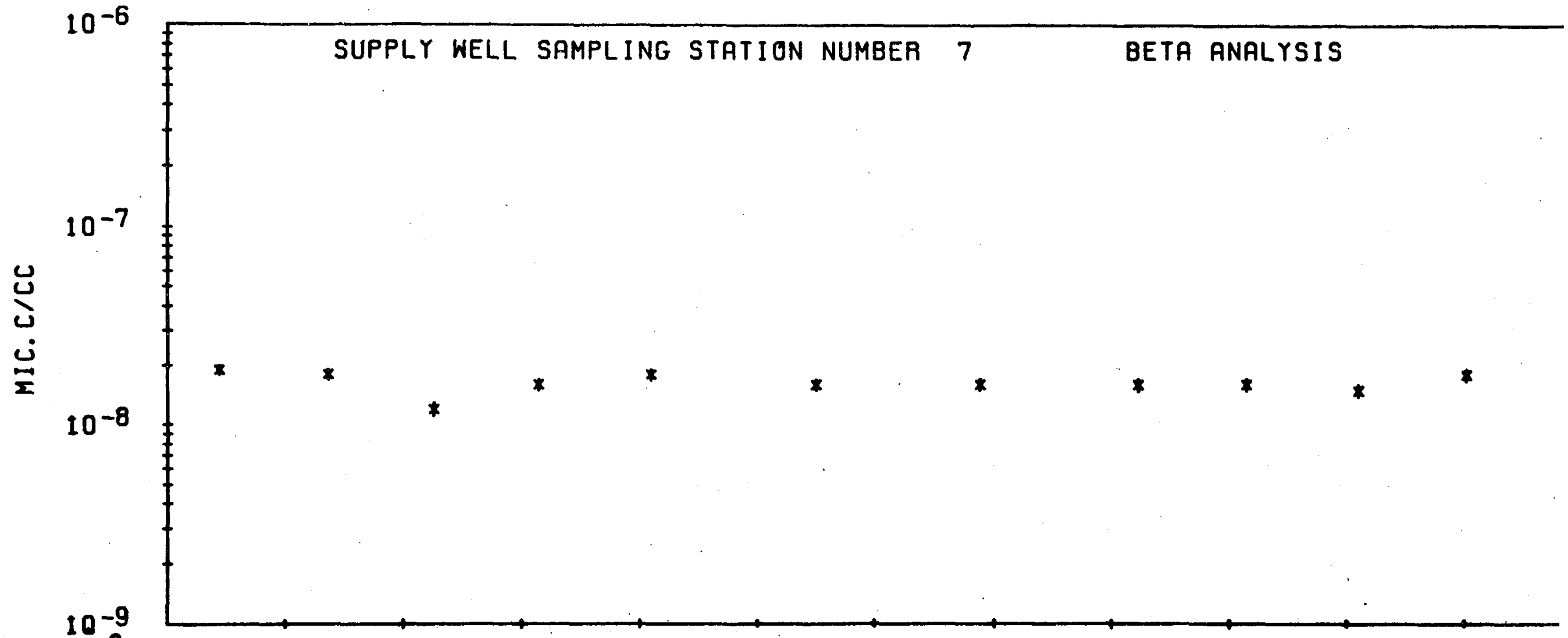
SUPPLY WELL SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9

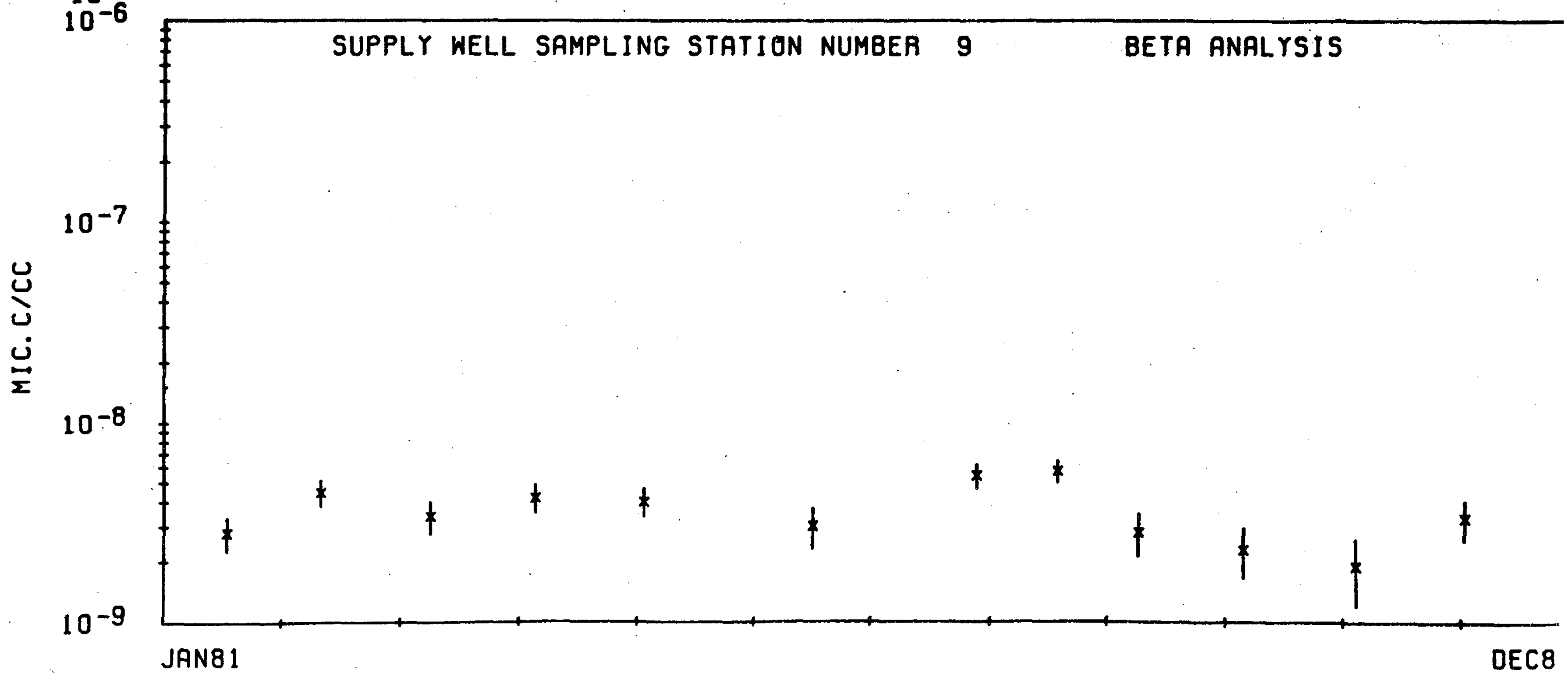


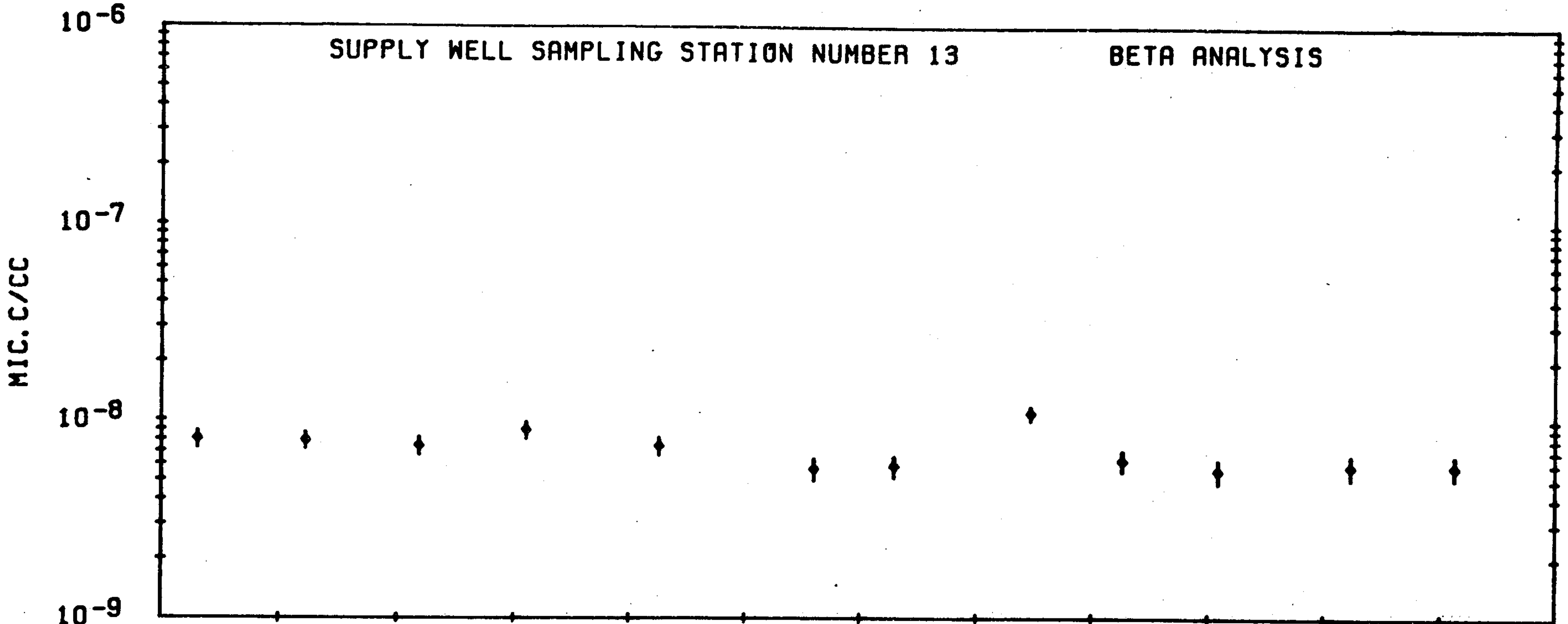
SUPPLY WELL SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN81
DEC81

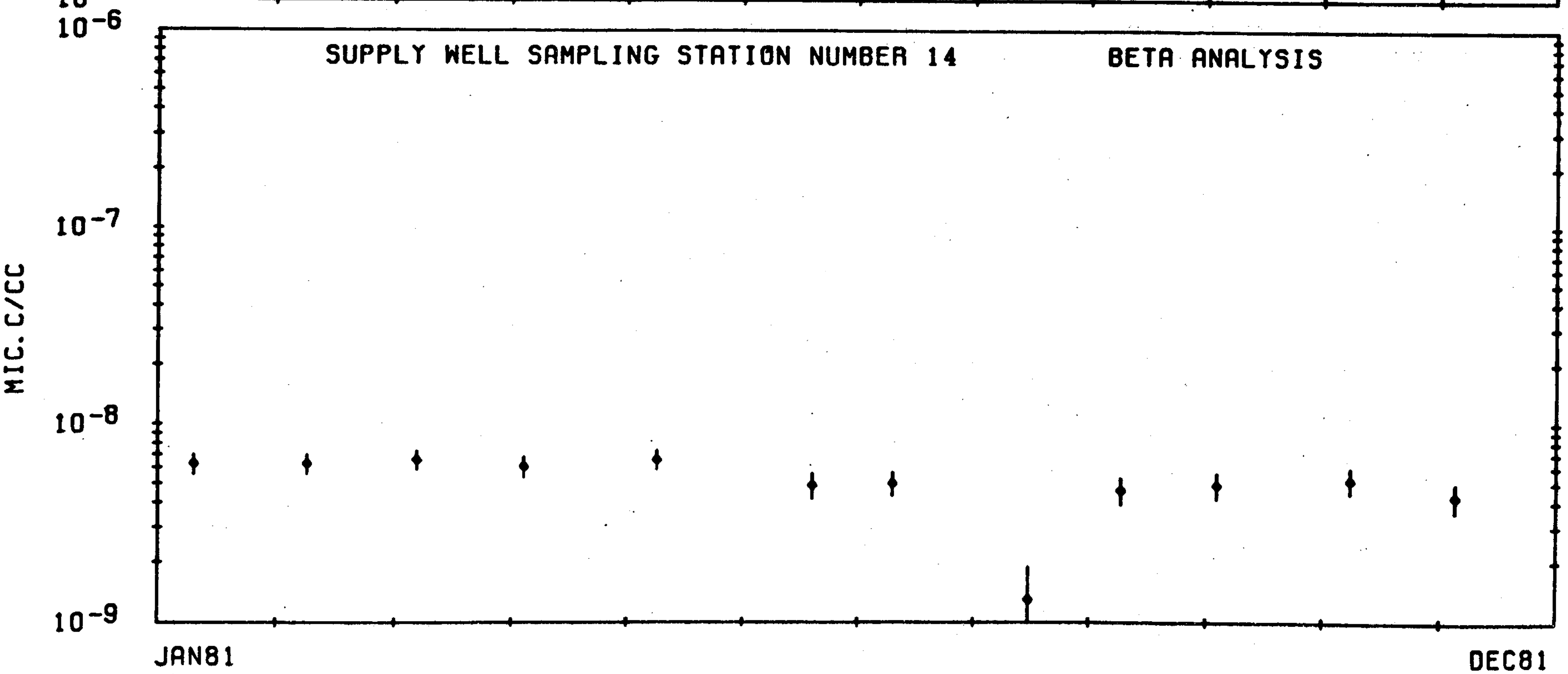

SUPPLY WELL SAMPLING STATION NUMBER 5
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

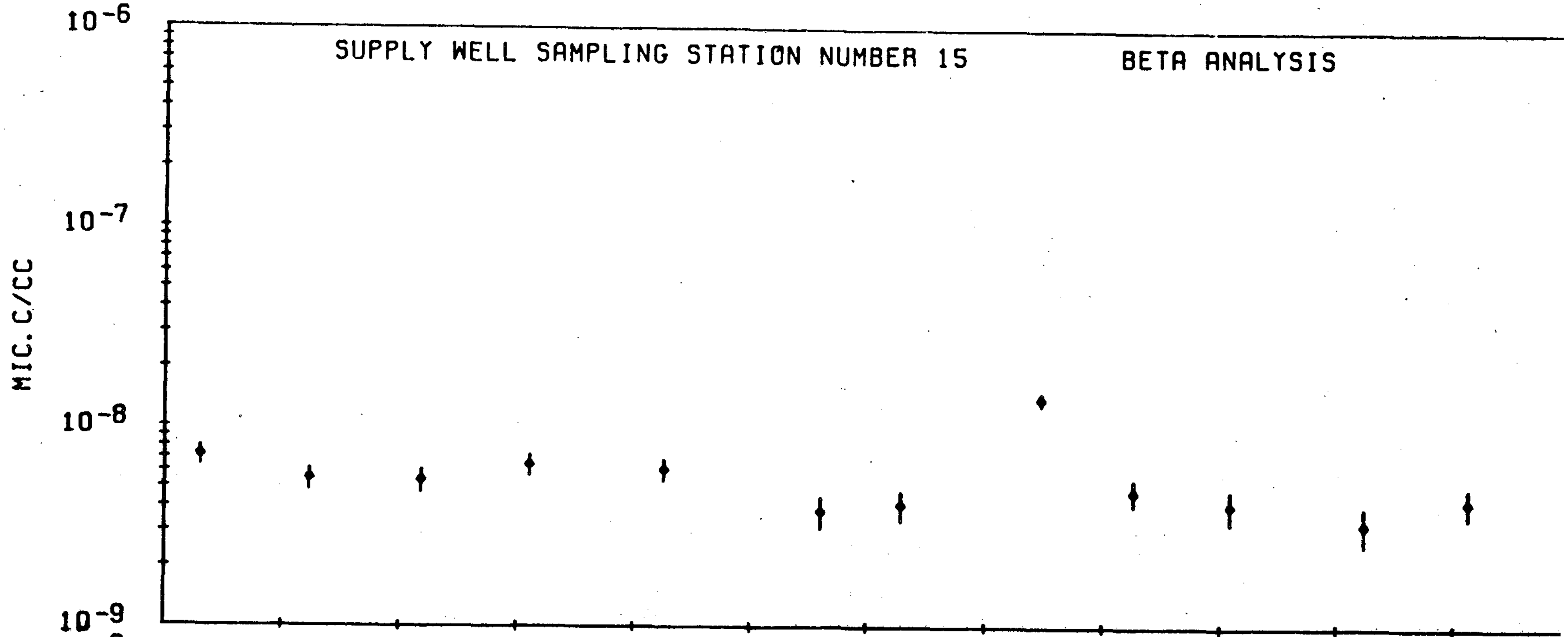

SUPPLY WELL SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81

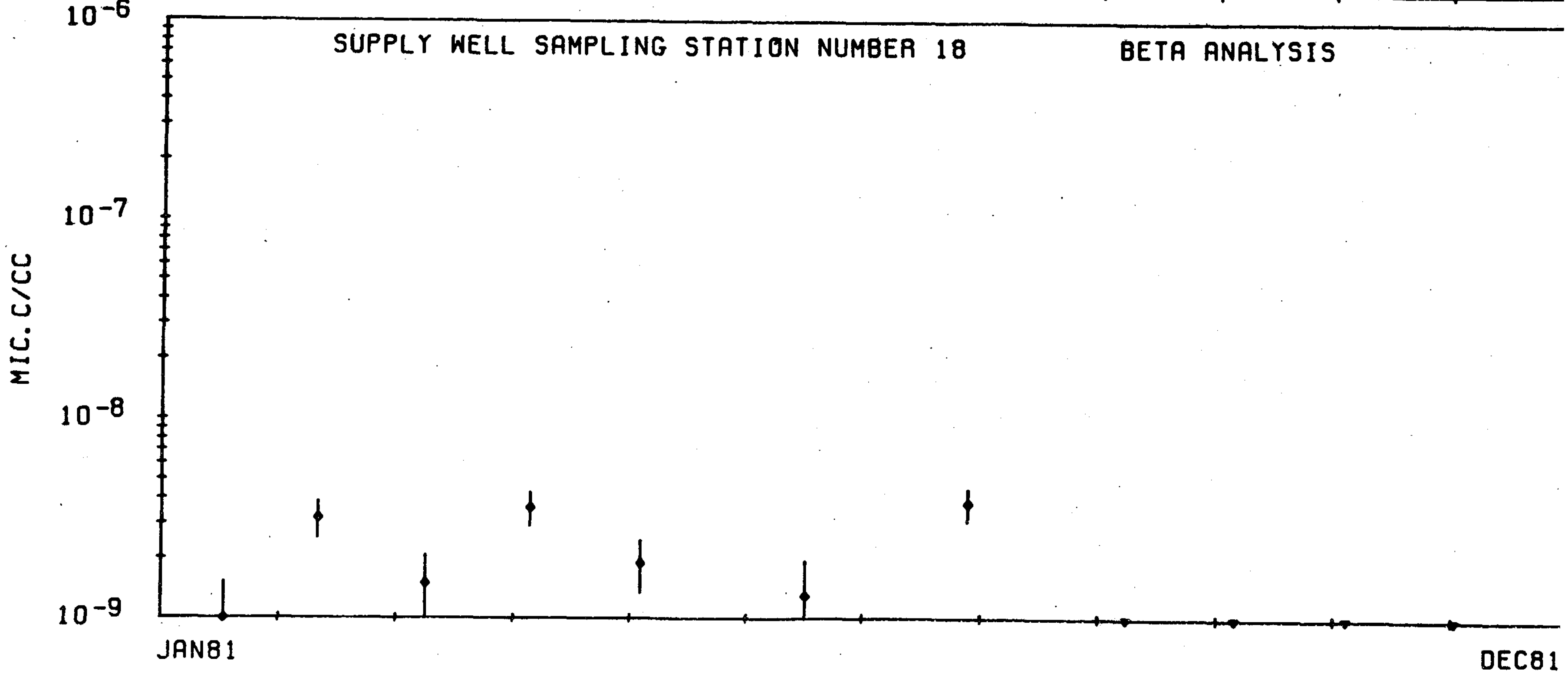

SUPPLY WELL SAMPLING STATION NUMBER 7
BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹


SUPPLY WELL SAMPLING STATION NUMBER 9
BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹
JAN81
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}
JAN81
DEC81


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}
JAN81
DEC81

APPENDIX D

NTS Environmental Surveillance

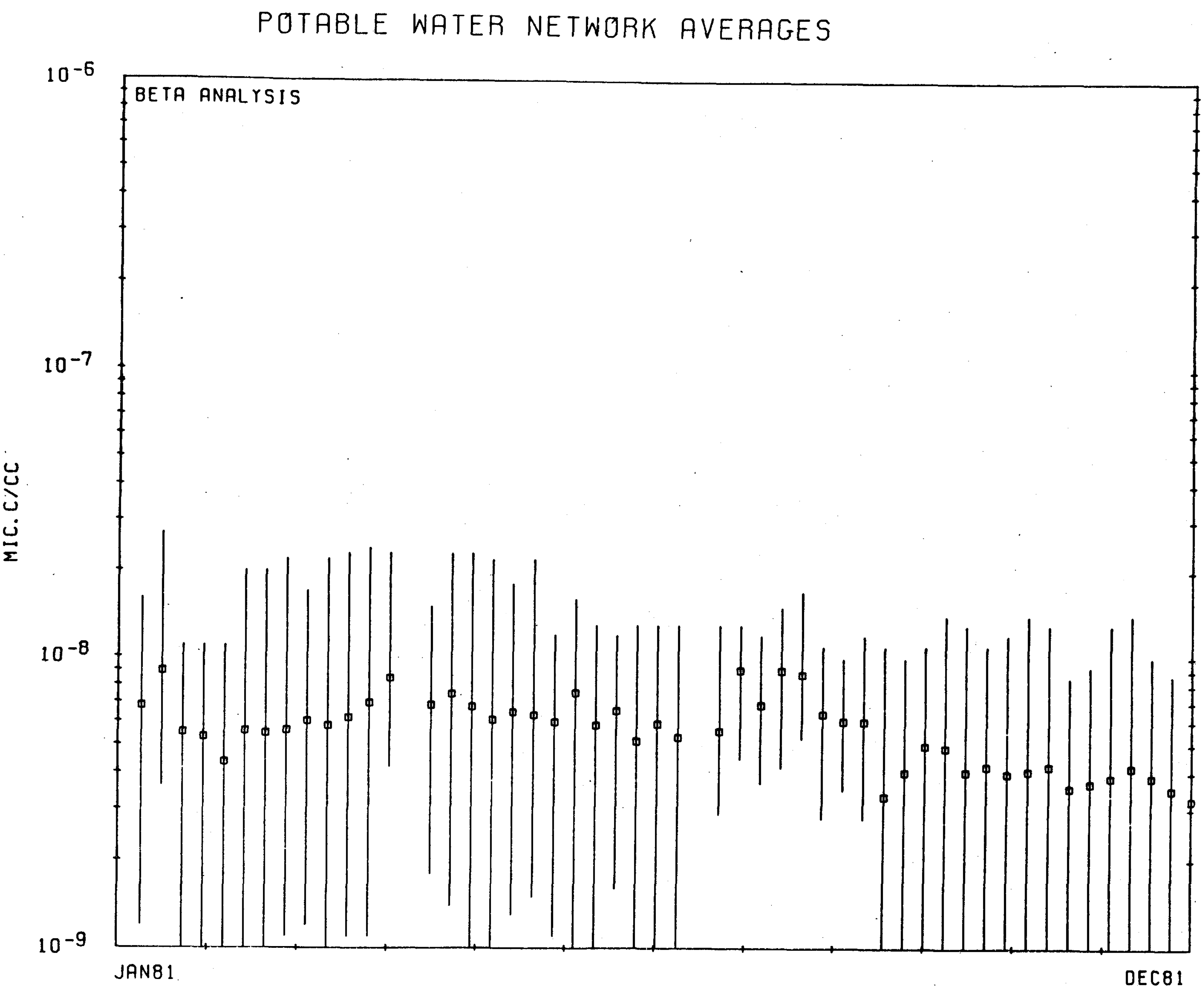
Potable Water Locations and Plots

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.

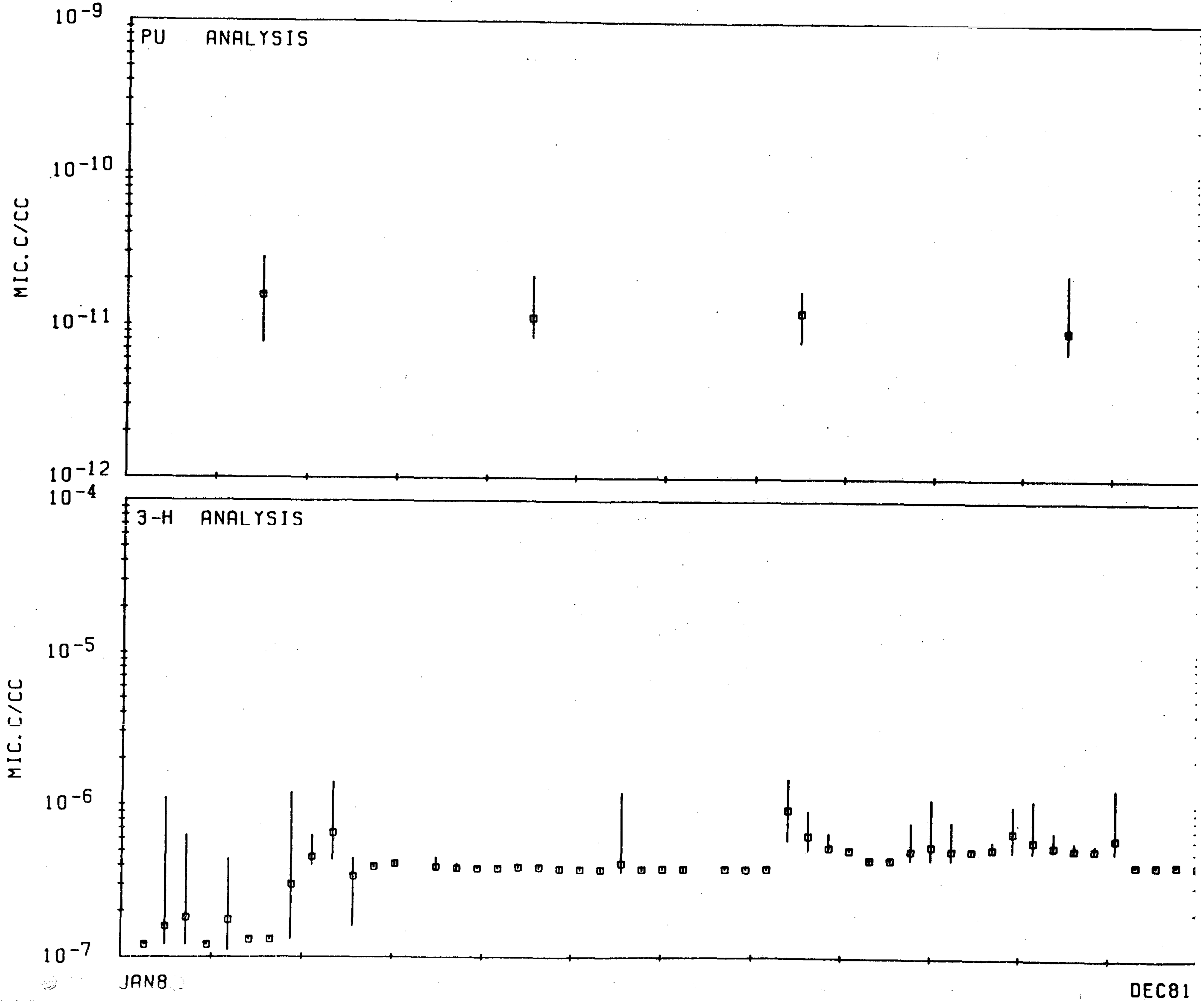
The remaining plots show the gross beta data of each station. A two-sigma error bar is also added to the data points, and, in all plots, a delta with a line to the bottom of the plot means below detection limit.

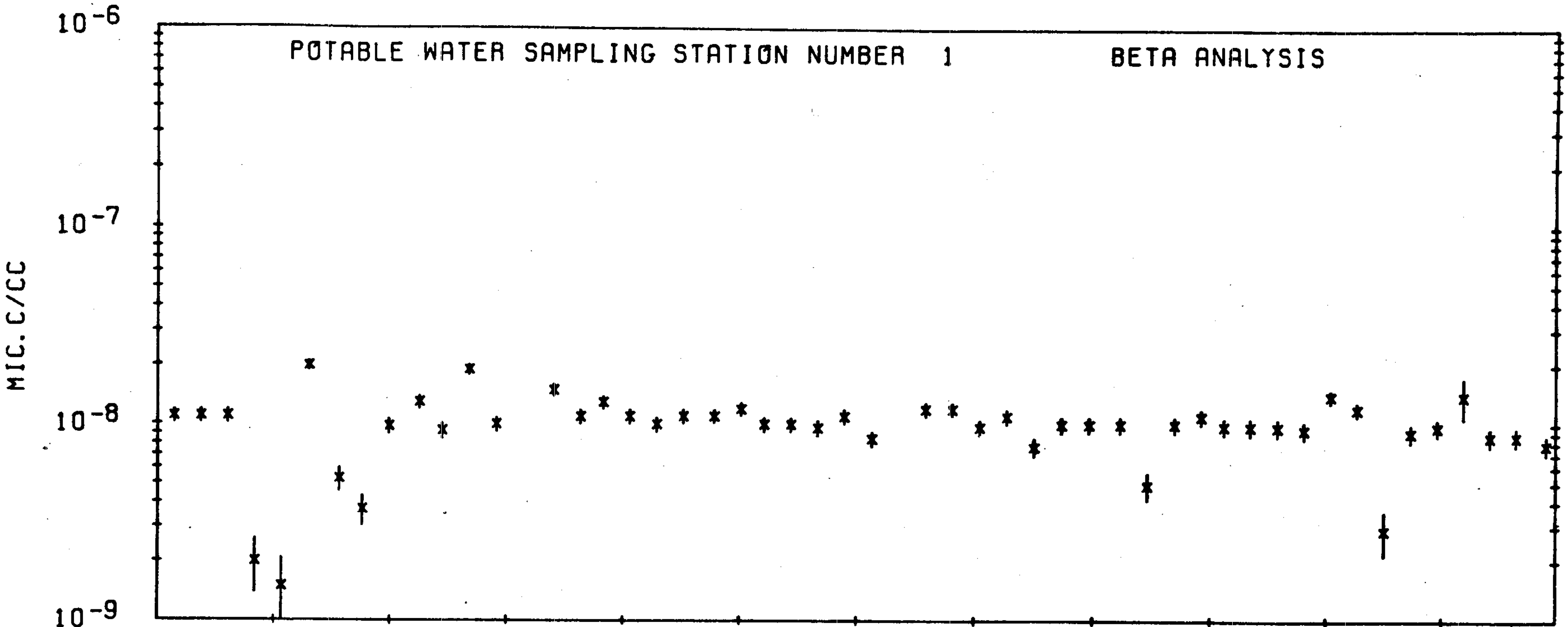
NTS ENVIRONMENTAL SURVEILLANCE
POTABLE WATER SAMPLING LOCATIONS

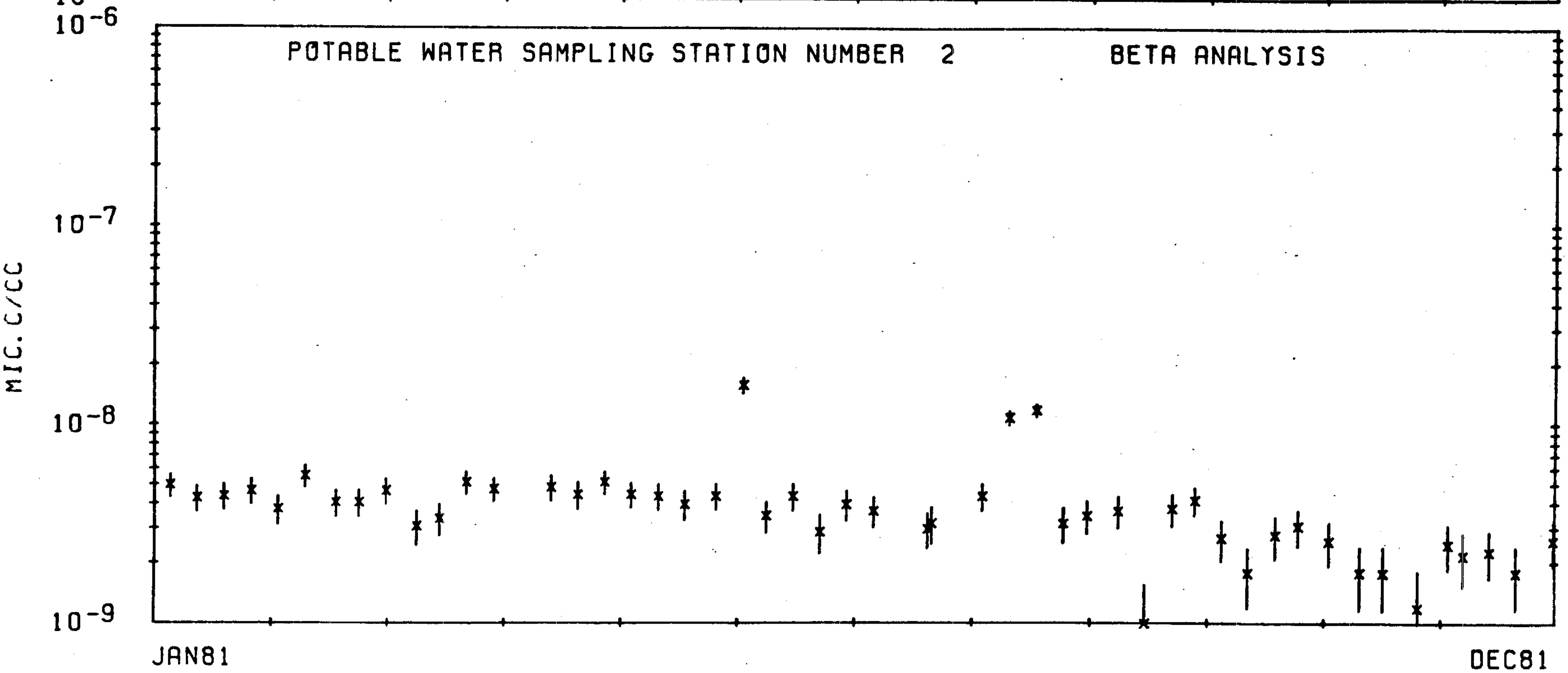
Station Number	Location
1	Area 3 Cafeteria
2	Area 2 Rest Room
3	Area 12 Cafeteria
4	Area 23 Cafeteria
5	Area 27 Cafeteria
6	Area 6 Cascade Water
7	Area 6 Cafeteria
8	Area 25 Service Station
9	EPA Farm

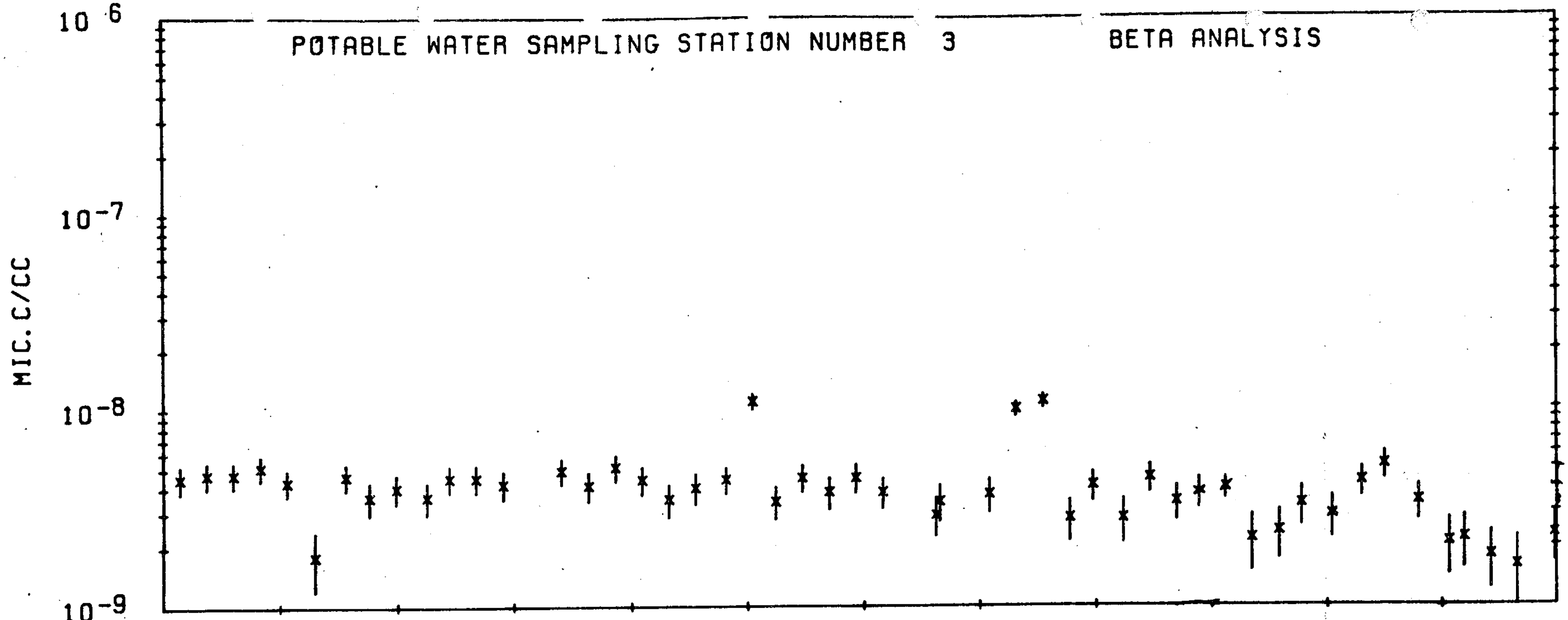

POTABLE WATER NETWORK AVERAGES
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN81
DEC81

POTABLE WATER NETWORK AVERAGES

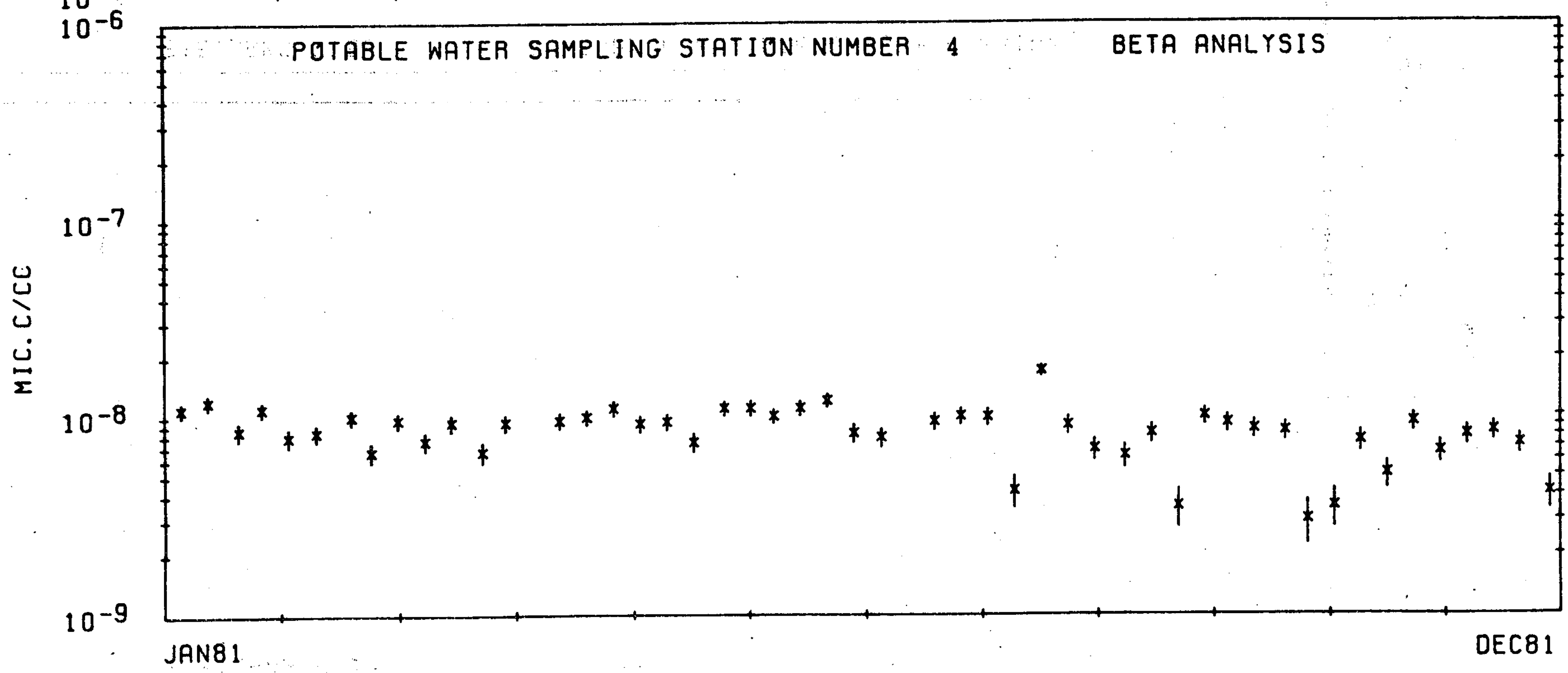



POTABLE WATER SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

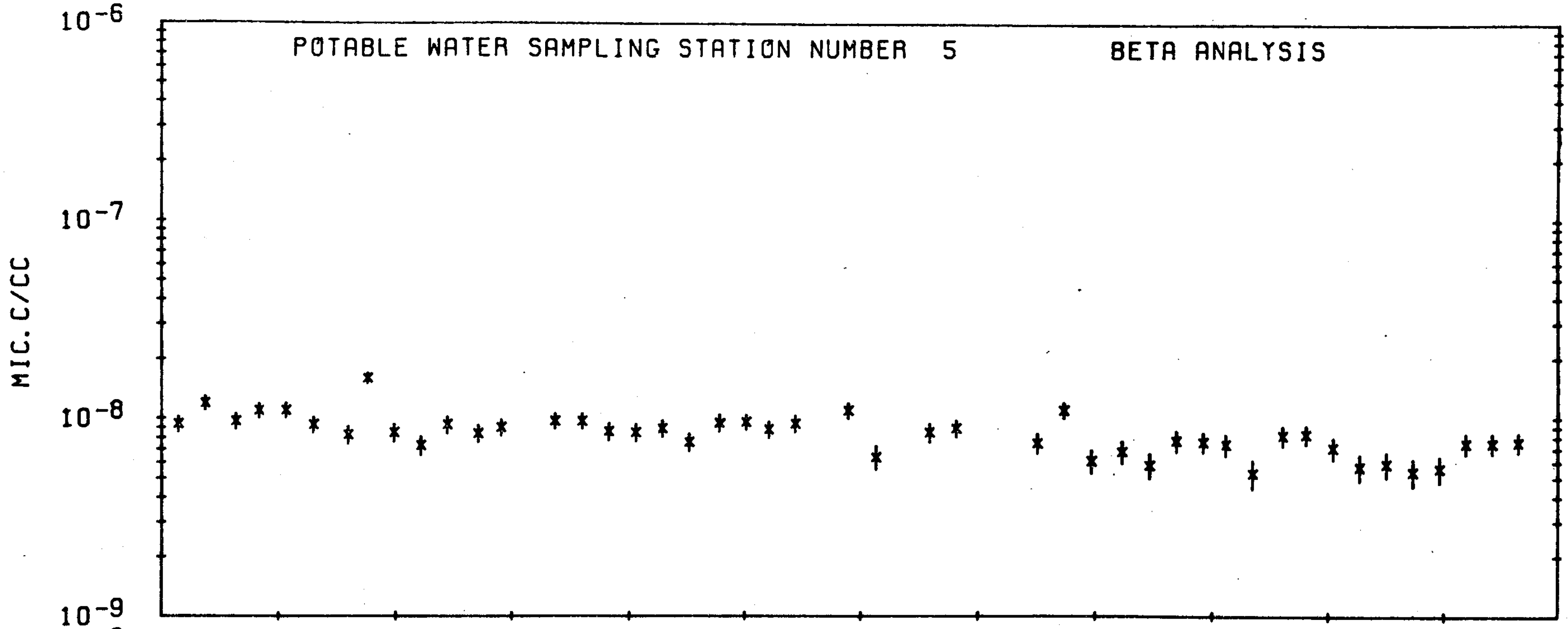

POTABLE WATER SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81

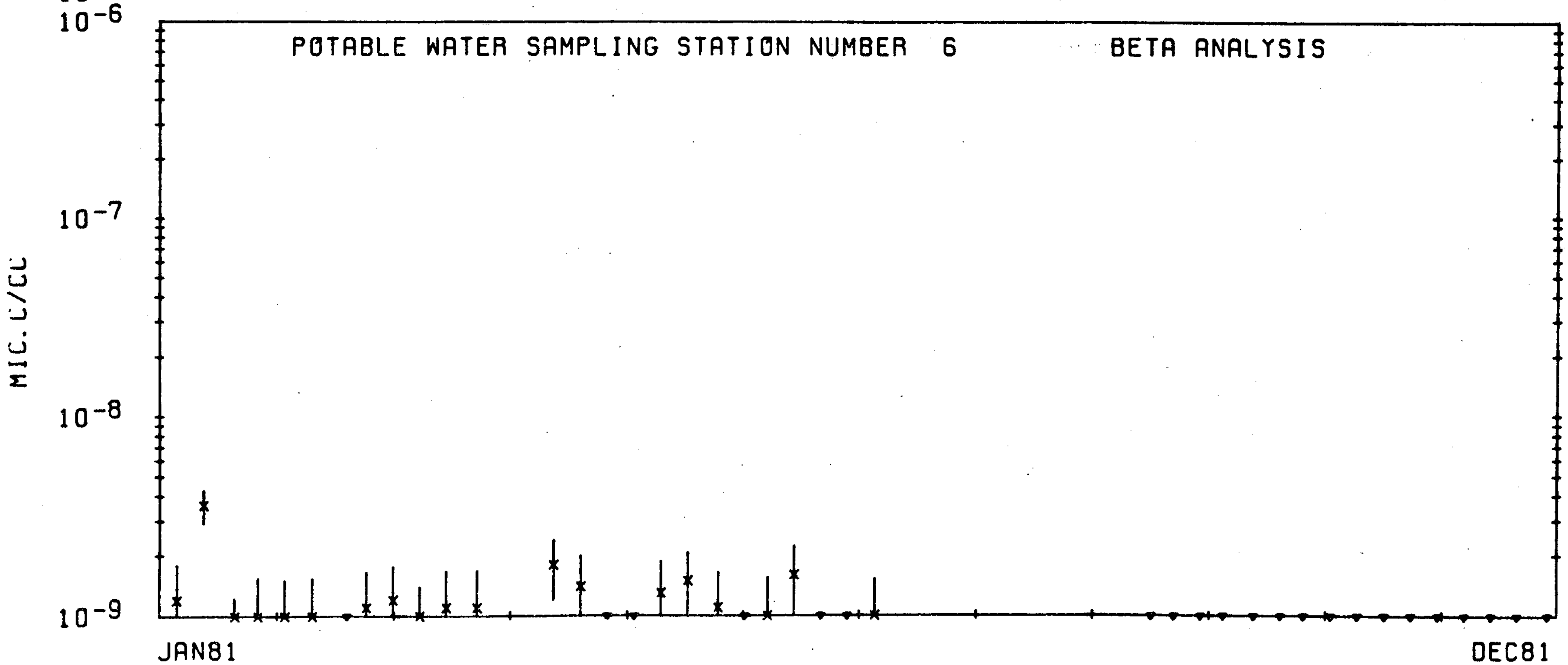


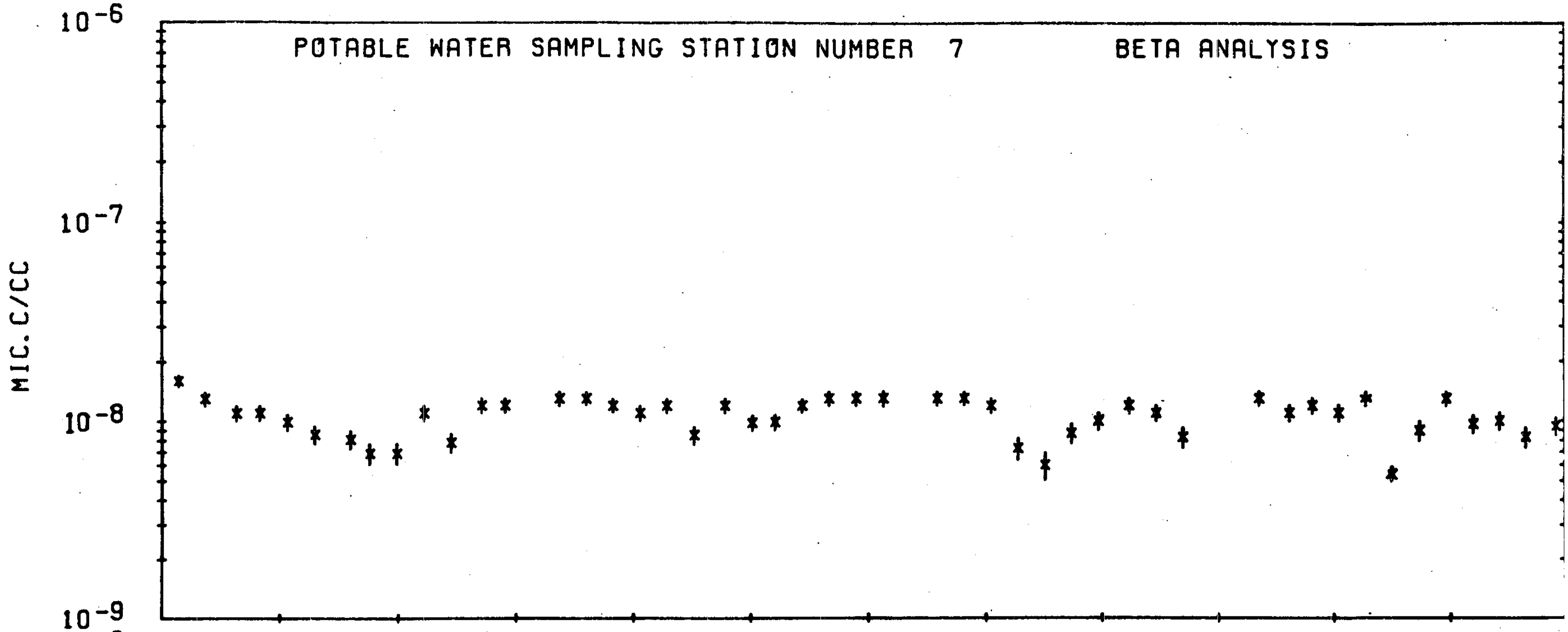
POTABLE WATER SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9

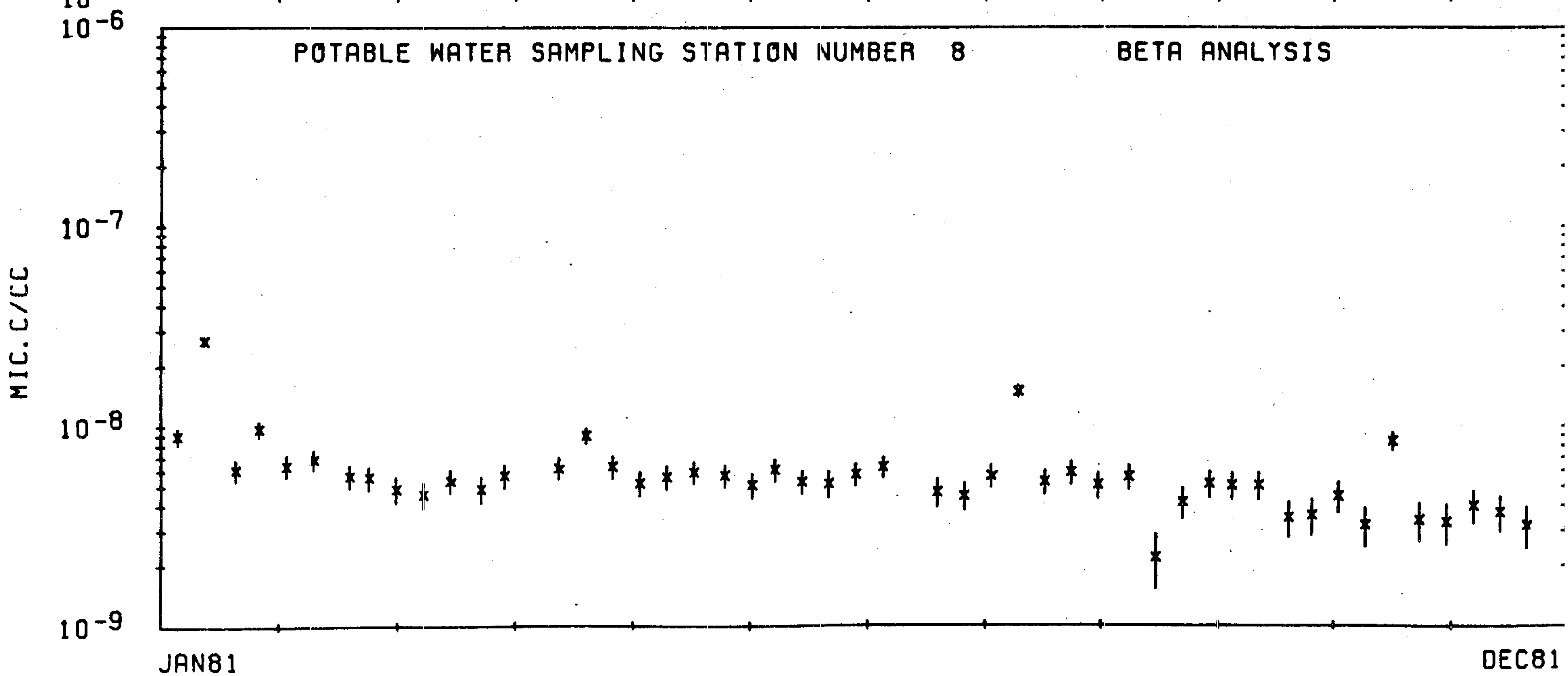


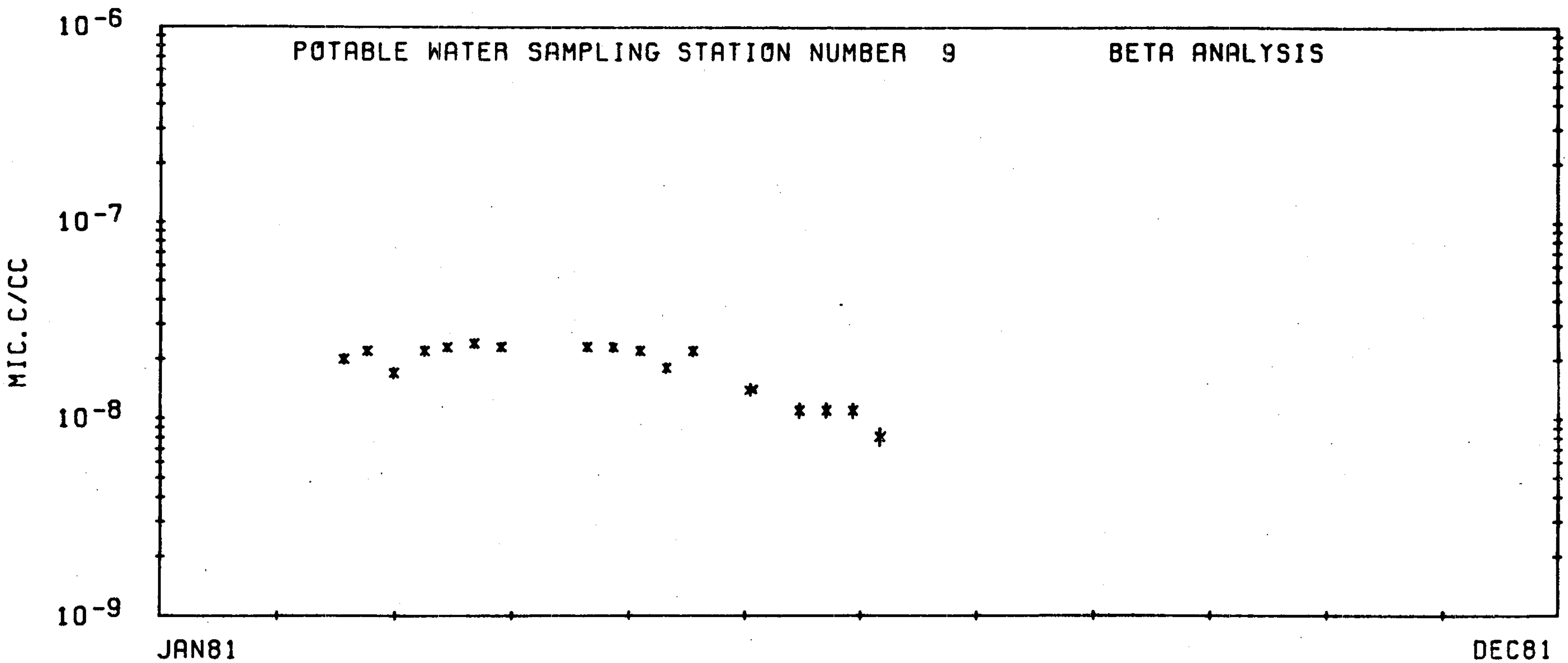
POTABLE WATER SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN81
DEC81


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
JAN81
DEC81


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


POTABLE WATER SAMPLING STATION NUMBER 8
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81


POTABLE WATER SAMPLING STATION NUMBER 9
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN81
DEC81

APPENDIX E

NTS Environmental Surveillance

Open Reservoirs Locations and Plots

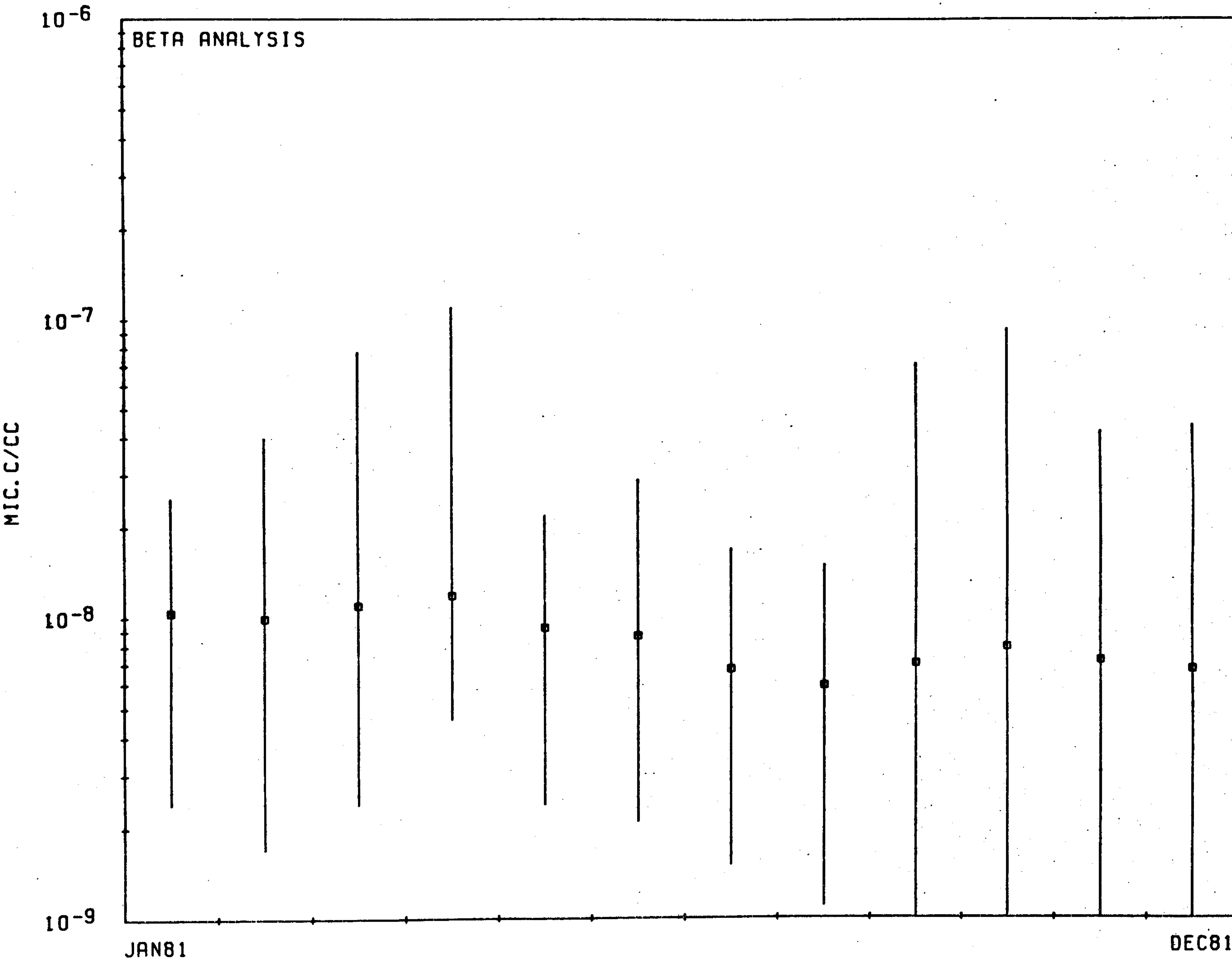
Several symbols are used in Appendix E to denote the data points. In the first two pages of plots, the open reservoir network averages, a square represents the arithmetic mean of all values at that point in time, and the vertical line is the range of the data. The remaining plots of Appendix E show the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

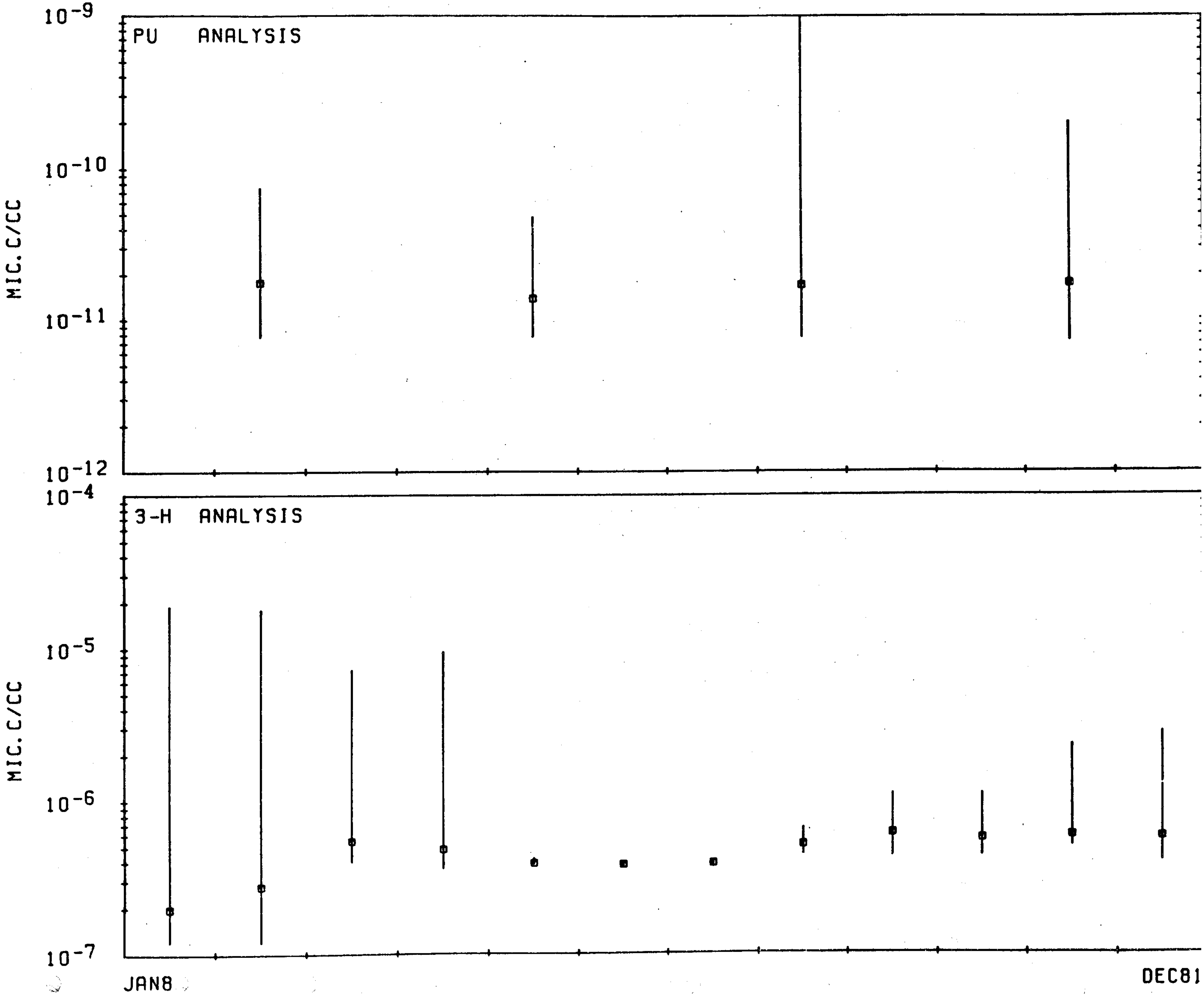
Station Number	Location
1	Area 2 Well 2 Reservoir
2	Area 3 Well A Reservoir
3	Area 5 Well 5B Reservoir
4	Area 5 Well Ue5c Reservoir
5	Area 6 Well 3 Reservoir
6	Area 6 Well C1 Reservoir
7	Area 15 Well Ue15d Reservoir
8	Area 18 Camp 17 Reservoir
11	Area 20 Well 20A Reservoir
12	Area 23 Swimming Pool
16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

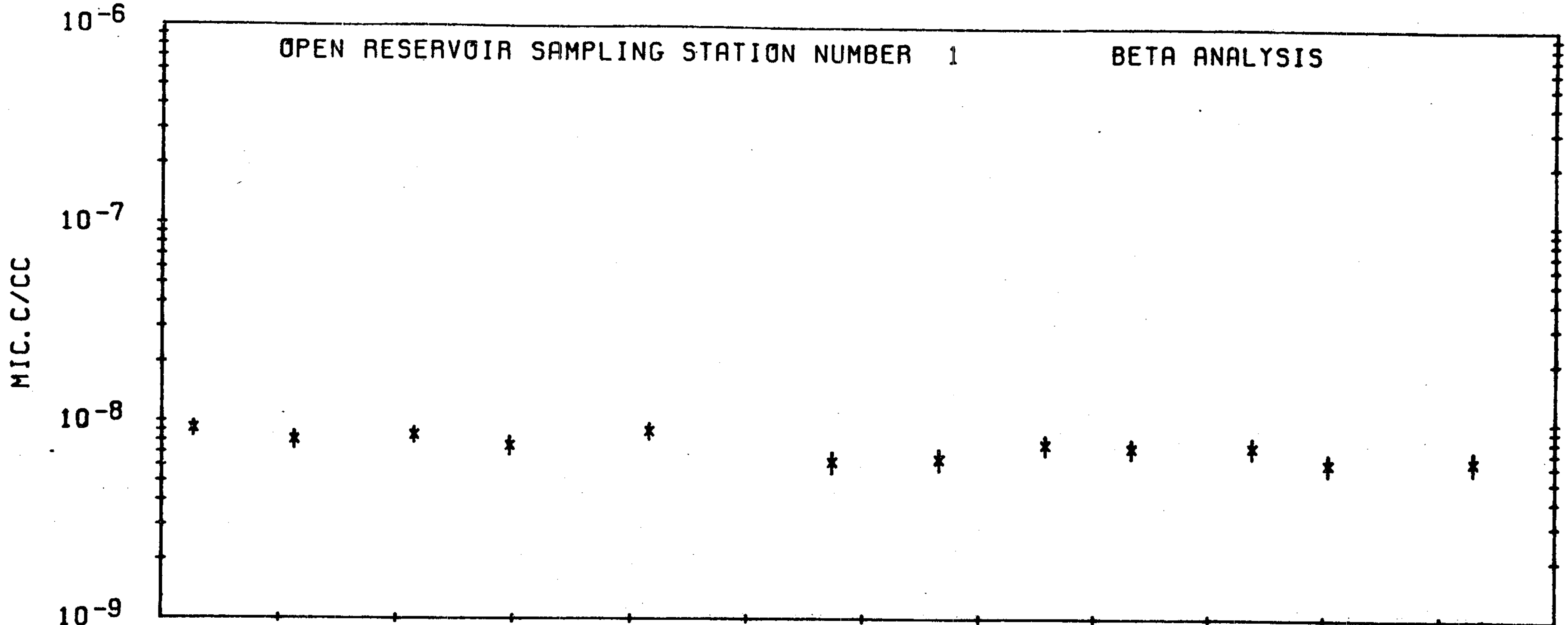
* Reservoir was dry.

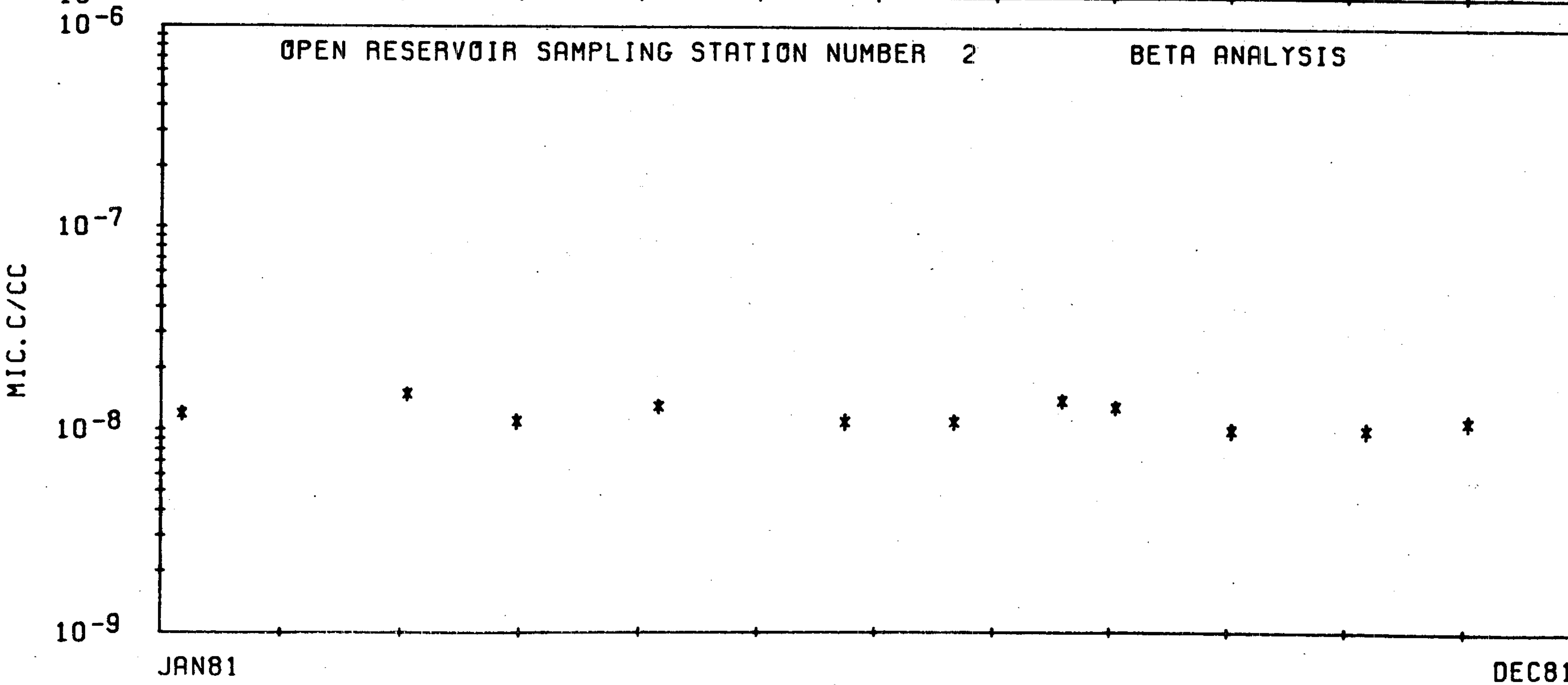
OPEN RESERVOIR NETWORK AVERAGES

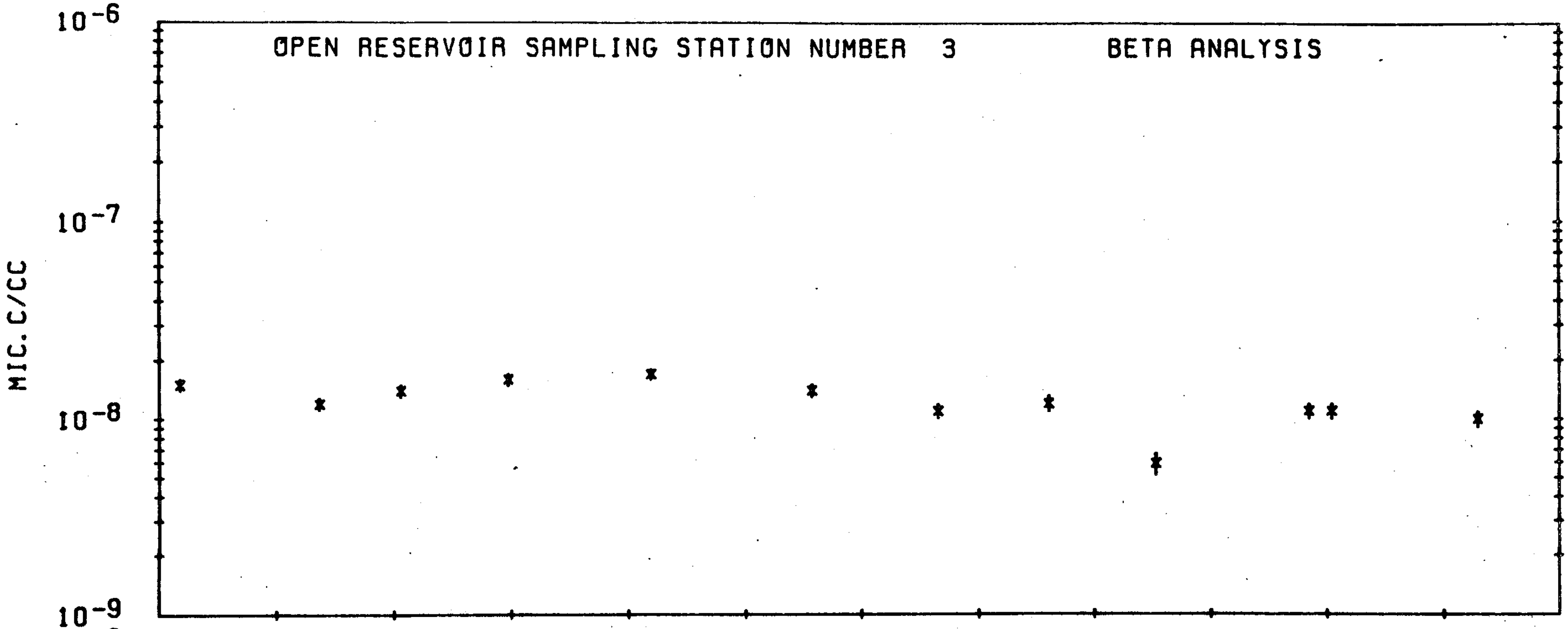


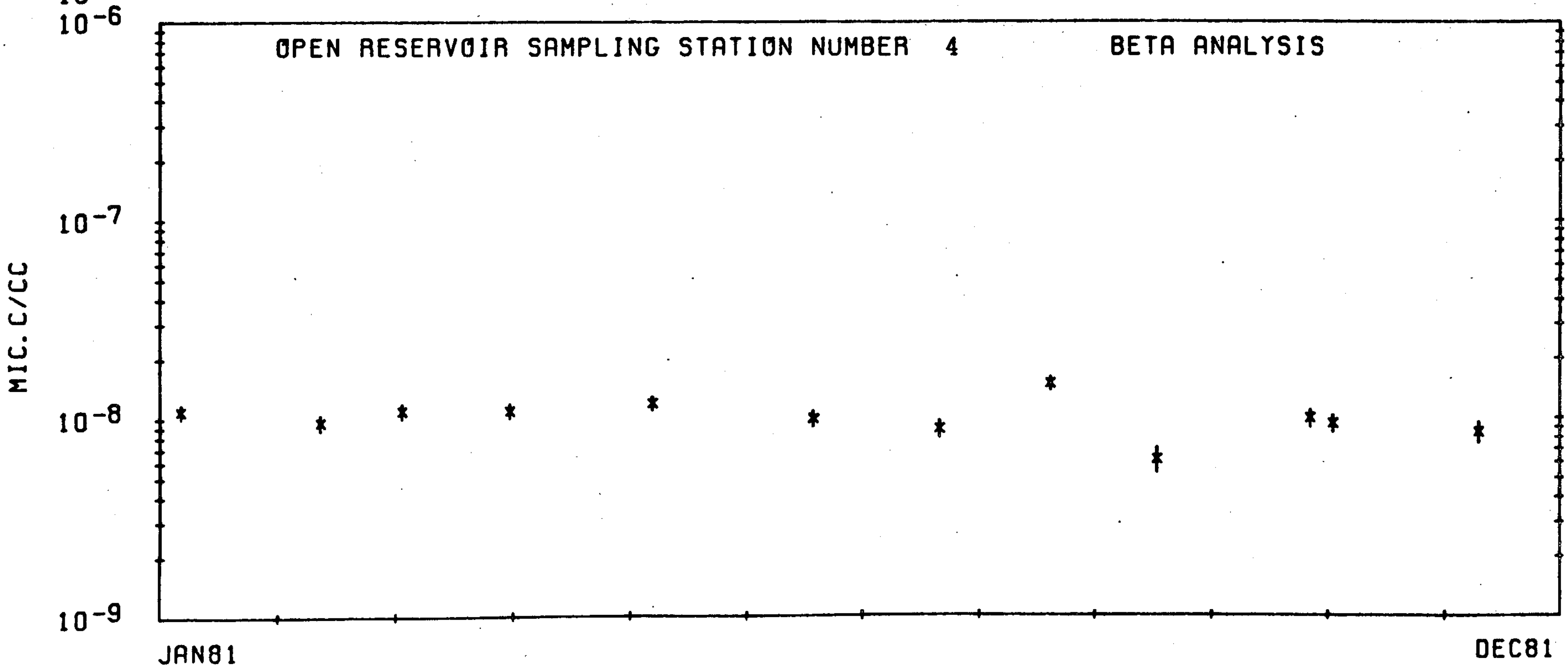
OPEN RESERVOIR NETWORK AVERAGES

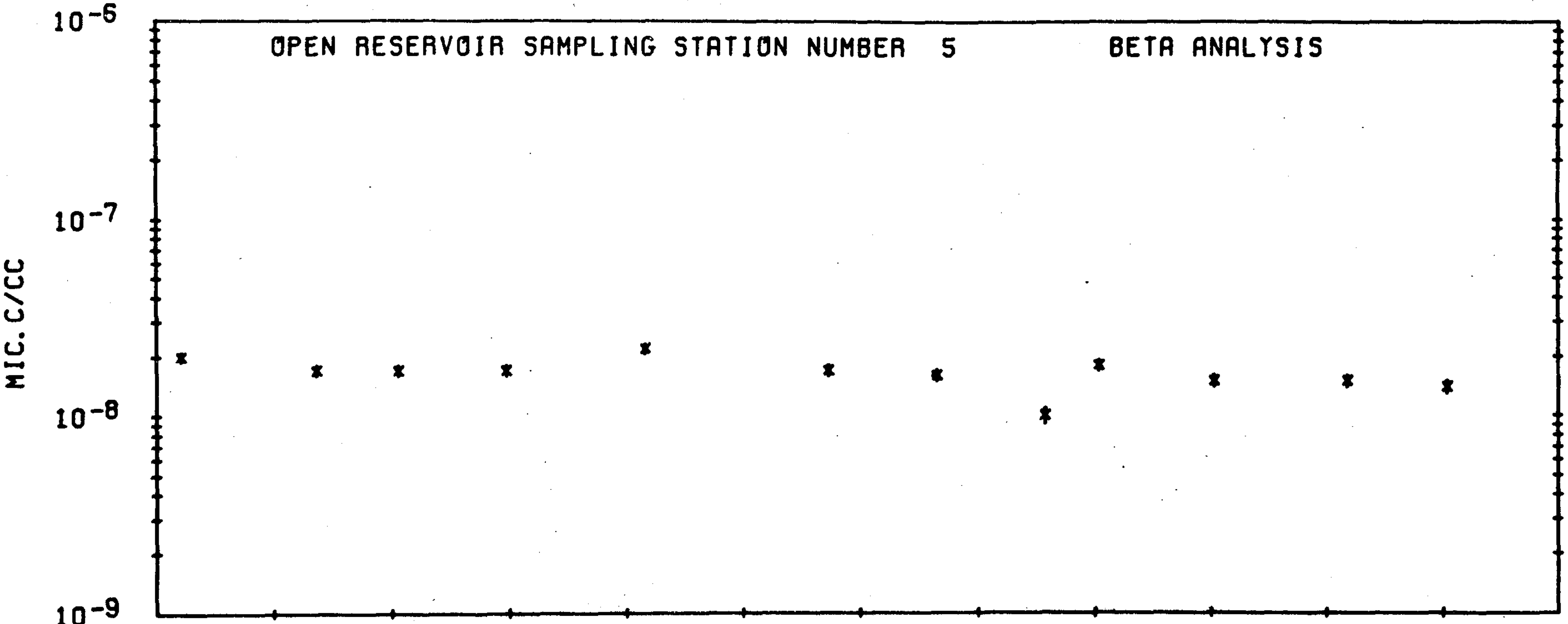


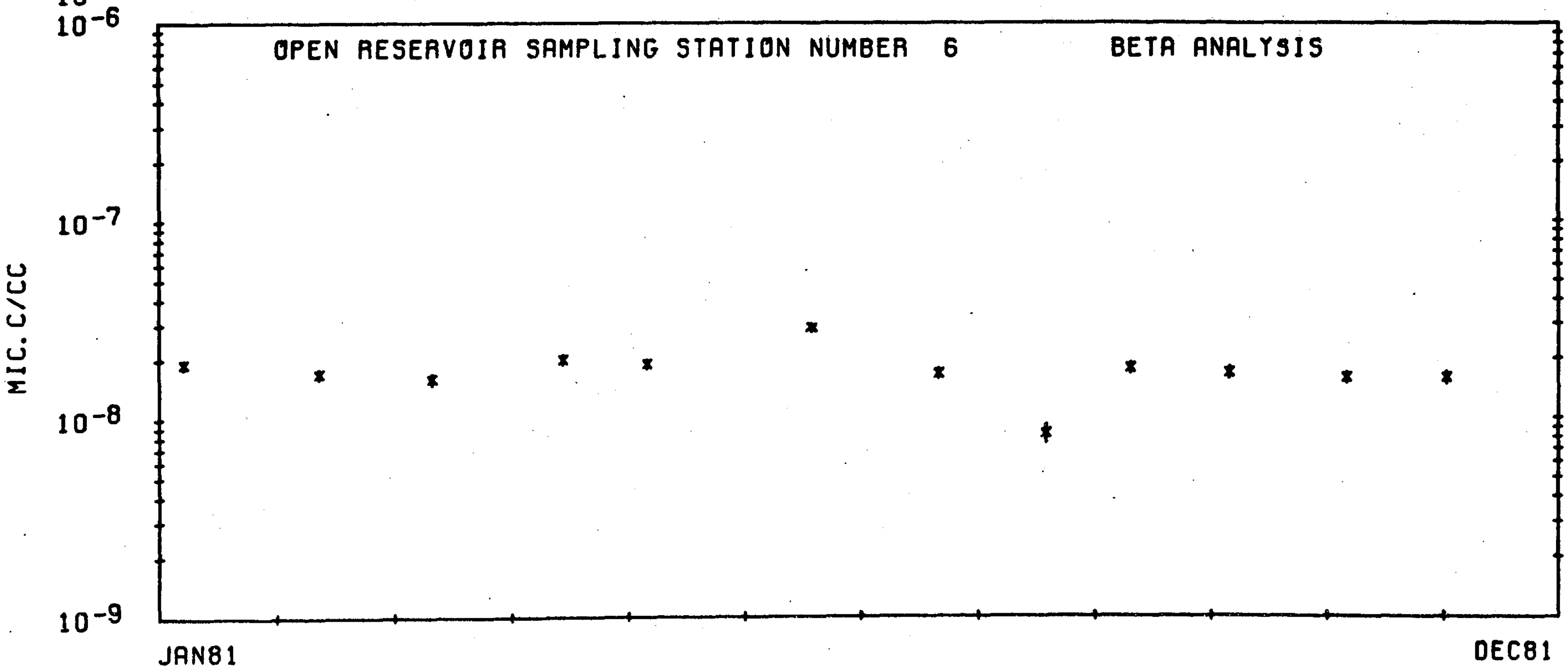

OPEN RESERVOIR SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9

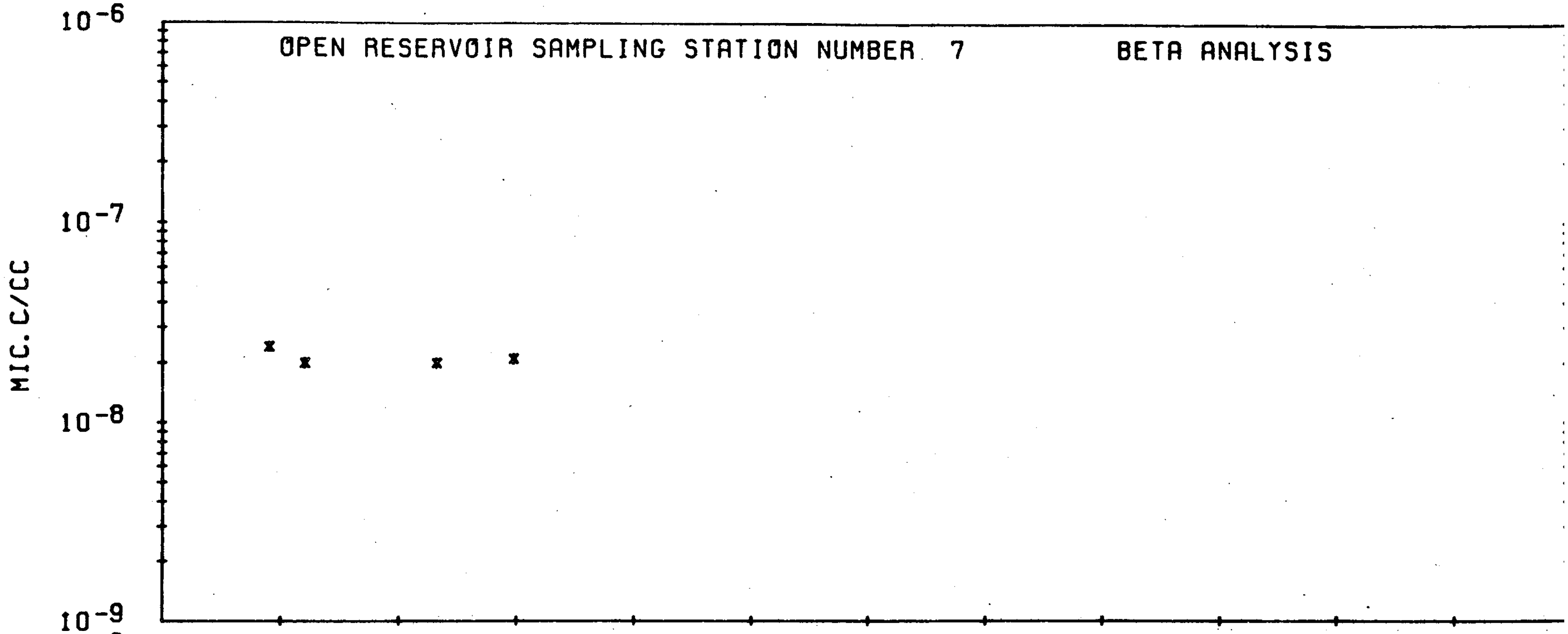

OPEN RESERVOIR SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN81
DEC81

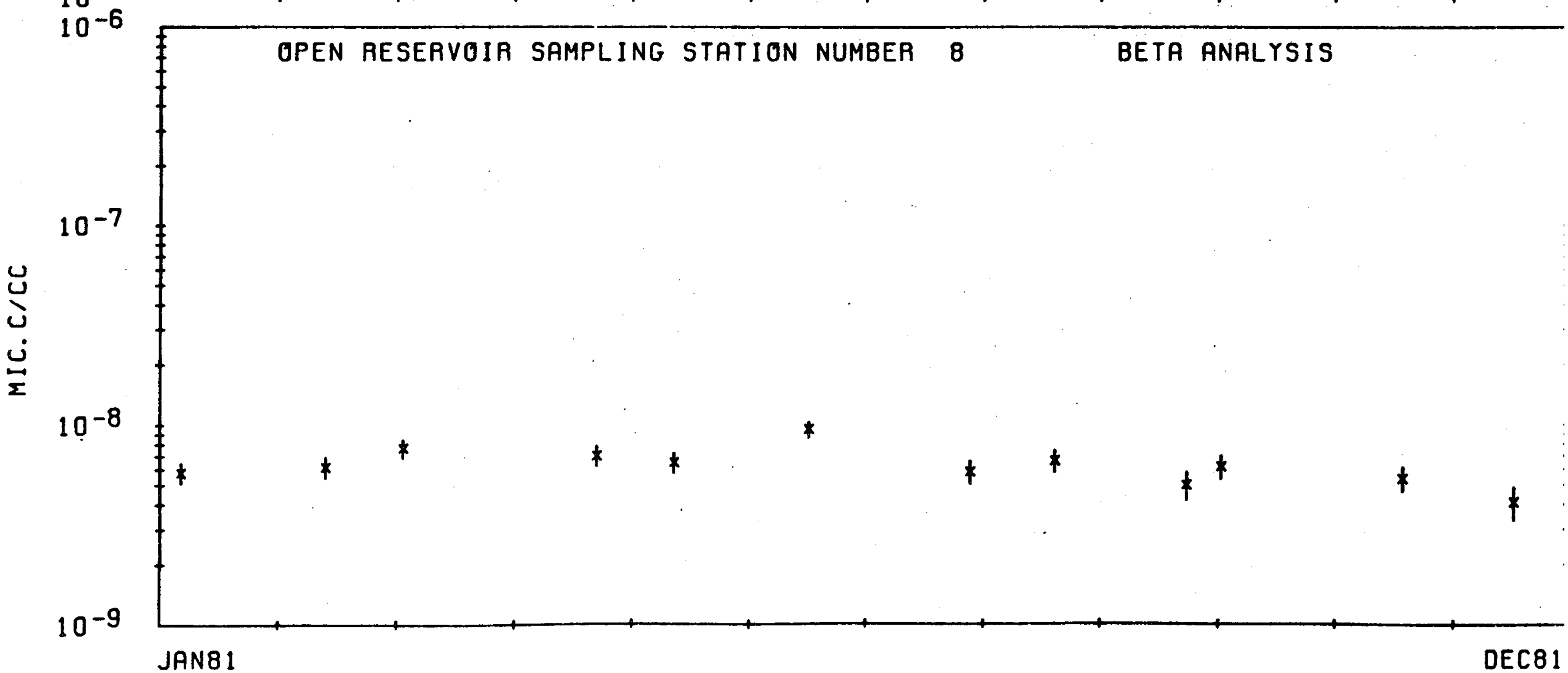

OPEN RESERVOIR SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9

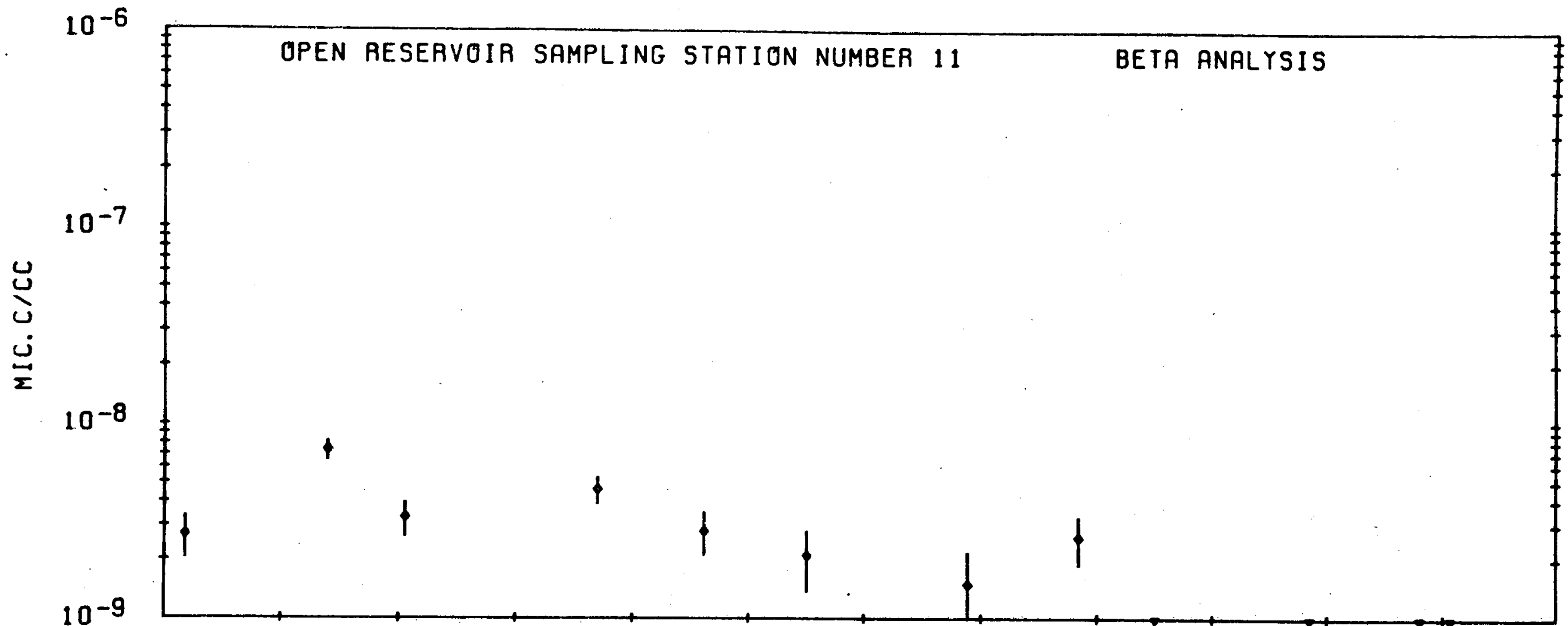

OPEN RESERVOIR SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN81
DEC81

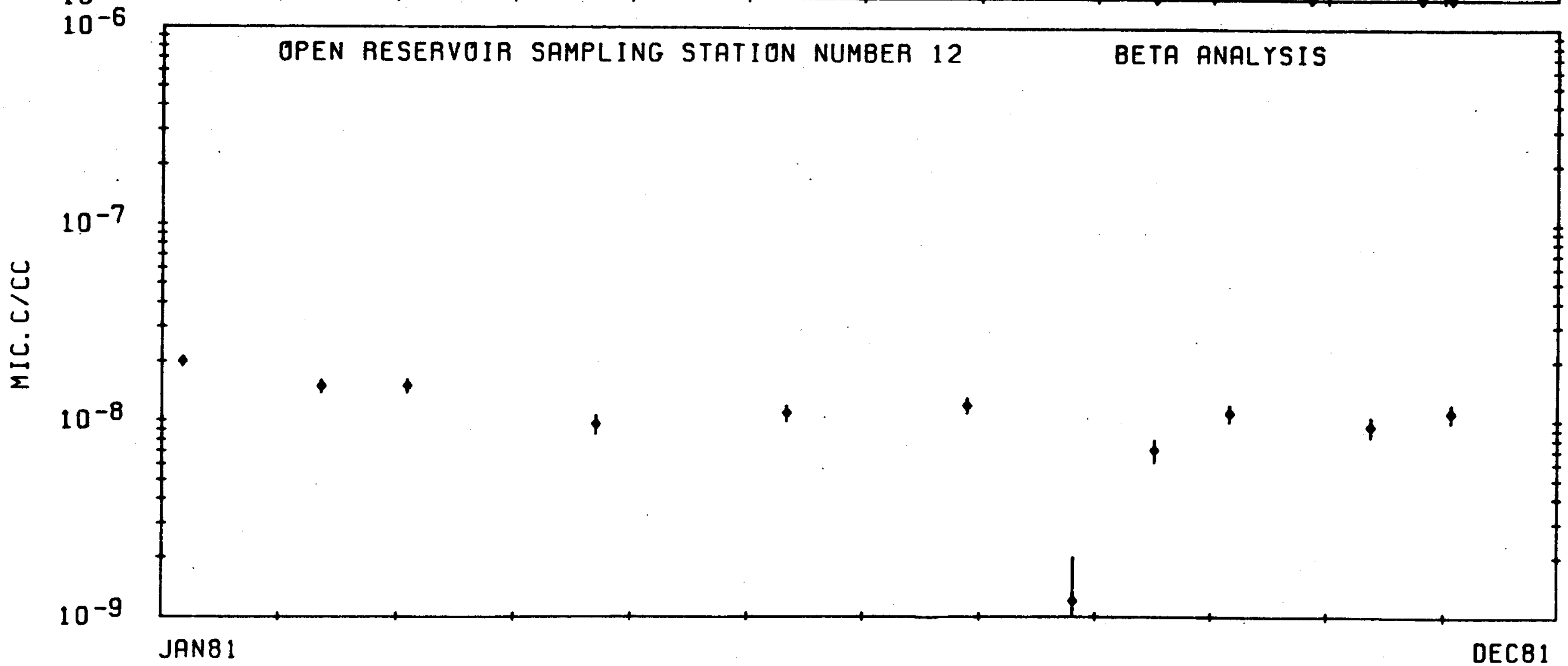

OPEN RESERVOIR SAMPLING STATION NUMBER 5
BETA ANALYSIS
MIC.C/CC
10-6
10-7
10-8
10-9

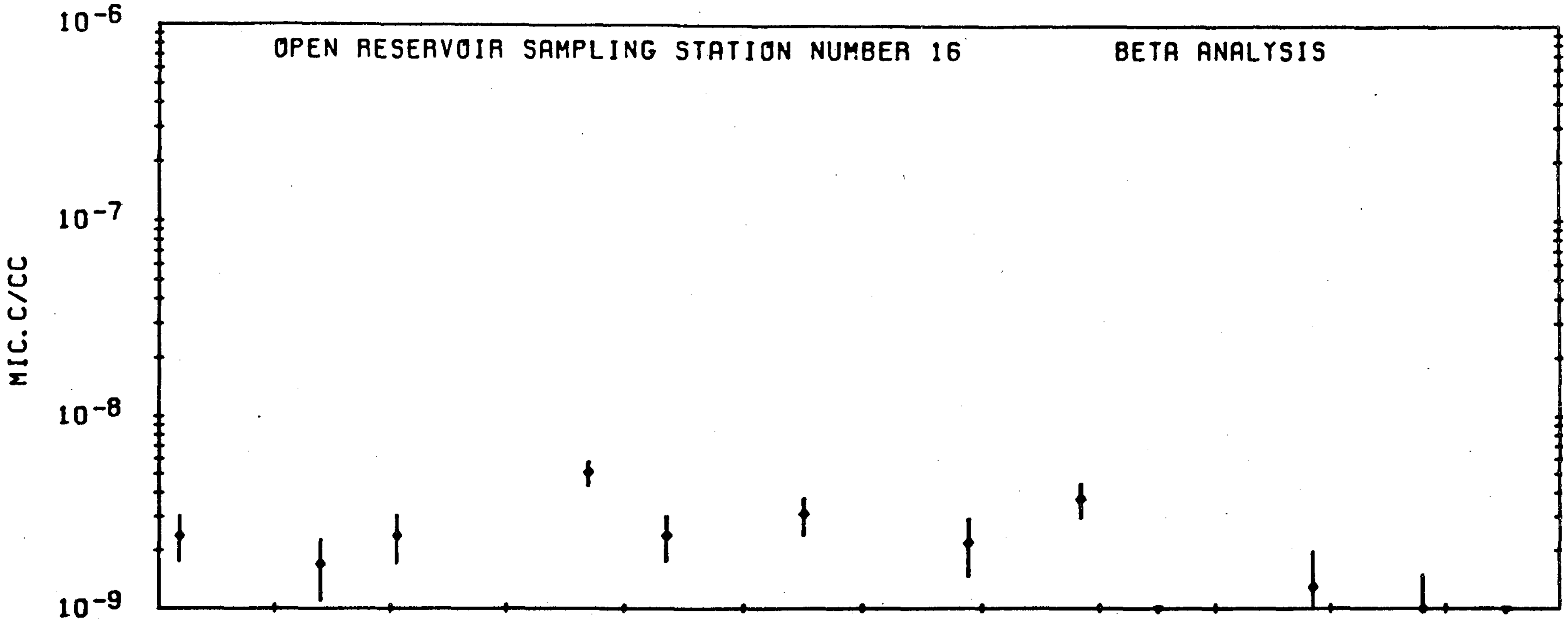

OPEN RESERVOIR SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10-6
10-7
10-8
10-9
JAN81
DEC81

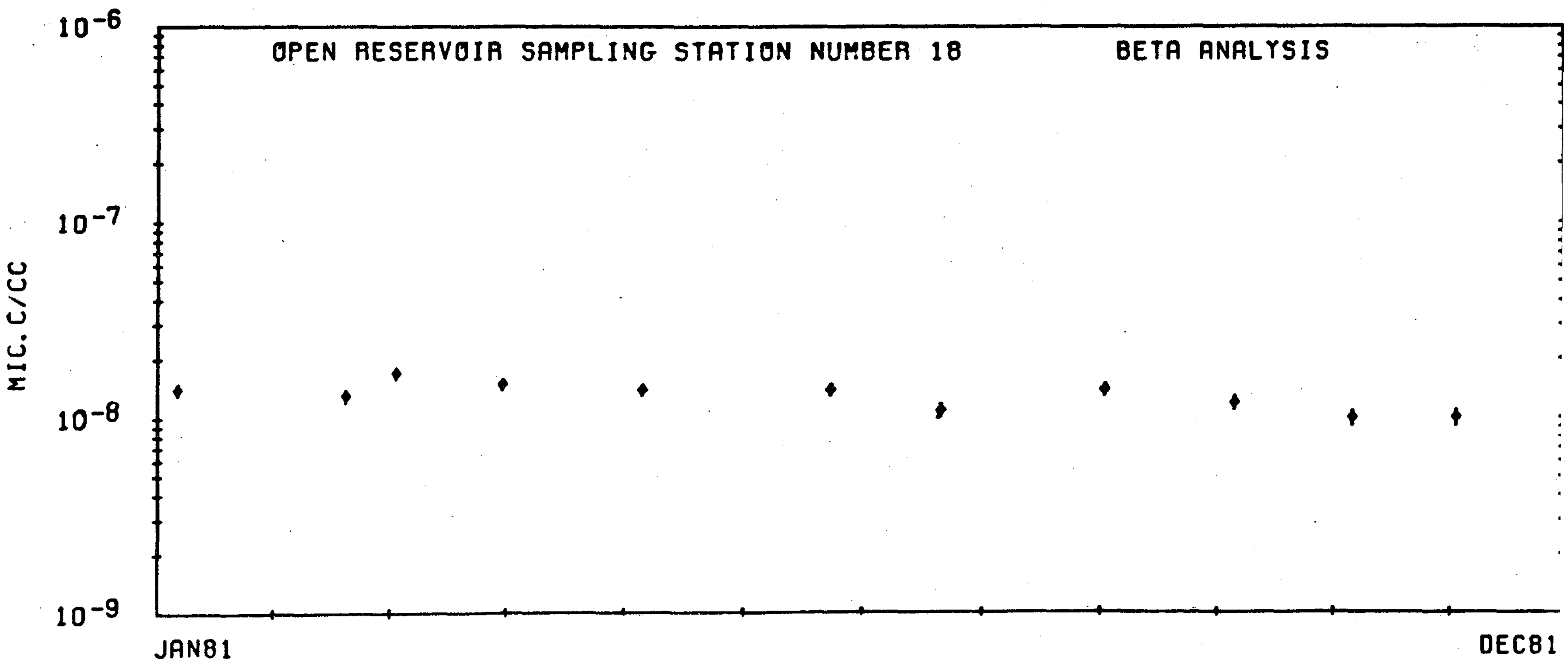

OPEN RESERVOIR SAMPLING STATION NUMBER 7
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9

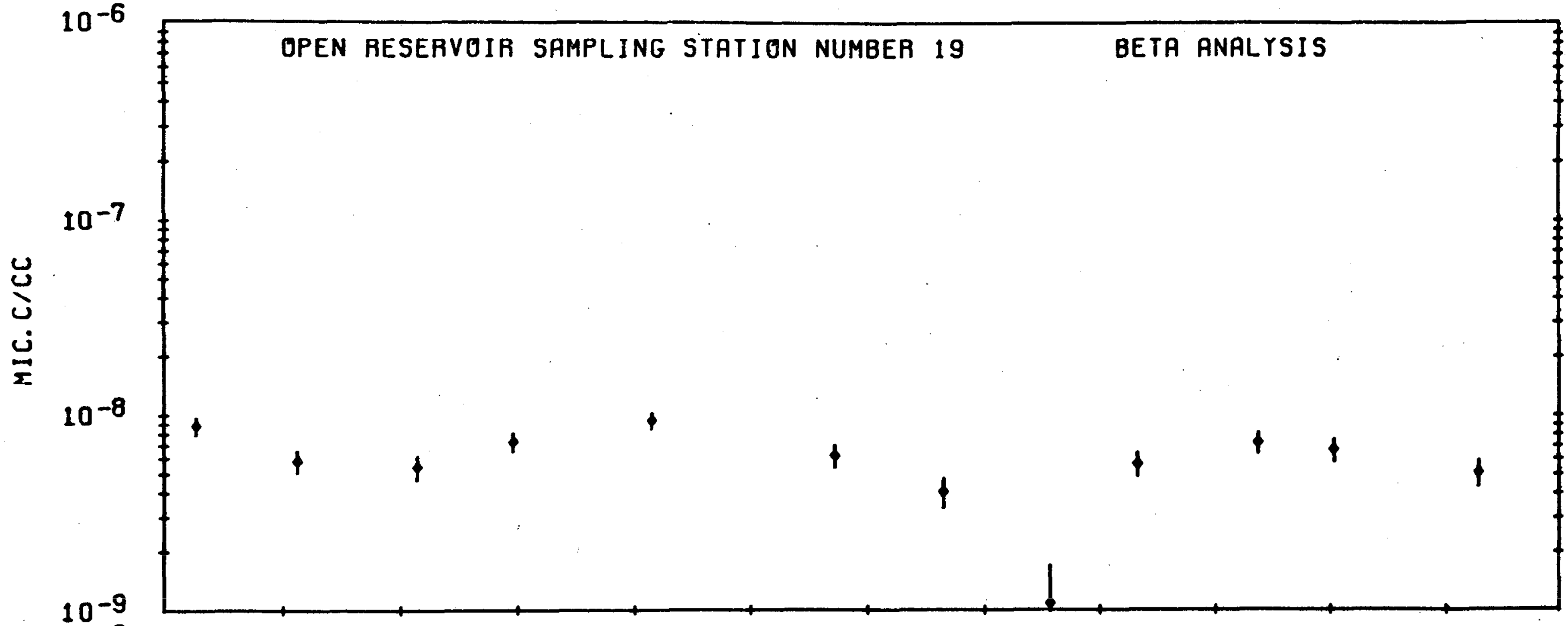

OPEN RESERVOIR SAMPLING STATION NUMBER 8
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN81
DEC81

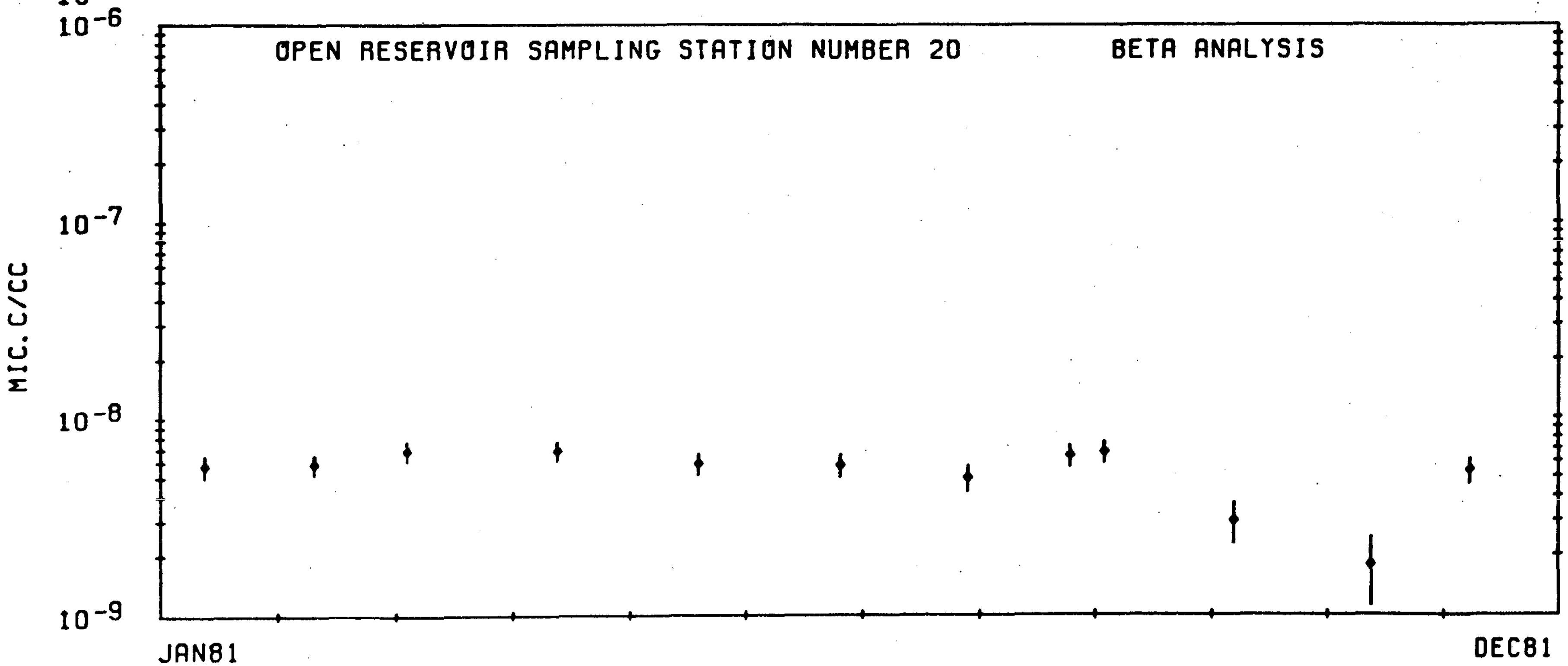

OPEN RESERVOIR SAMPLING STATION NUMBER 11
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

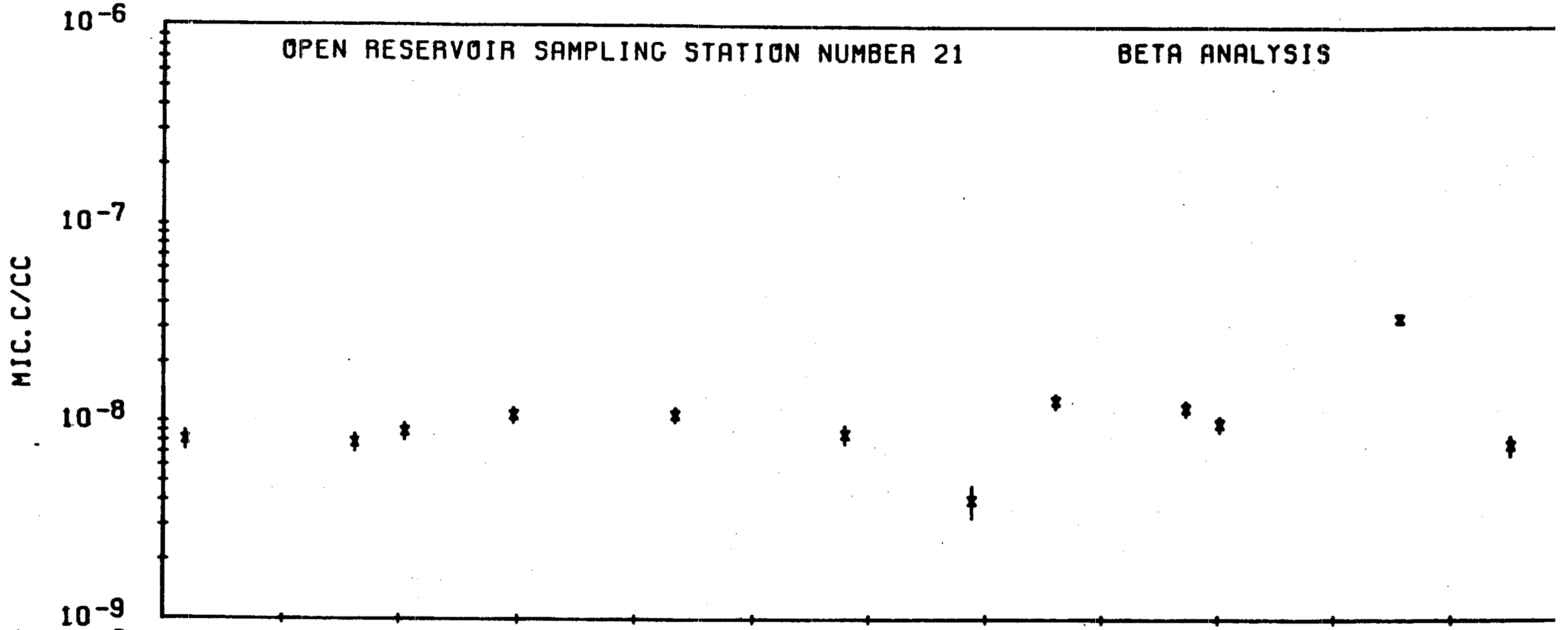

OPEN RESERVOIR SAMPLING STATION NUMBER 12
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81

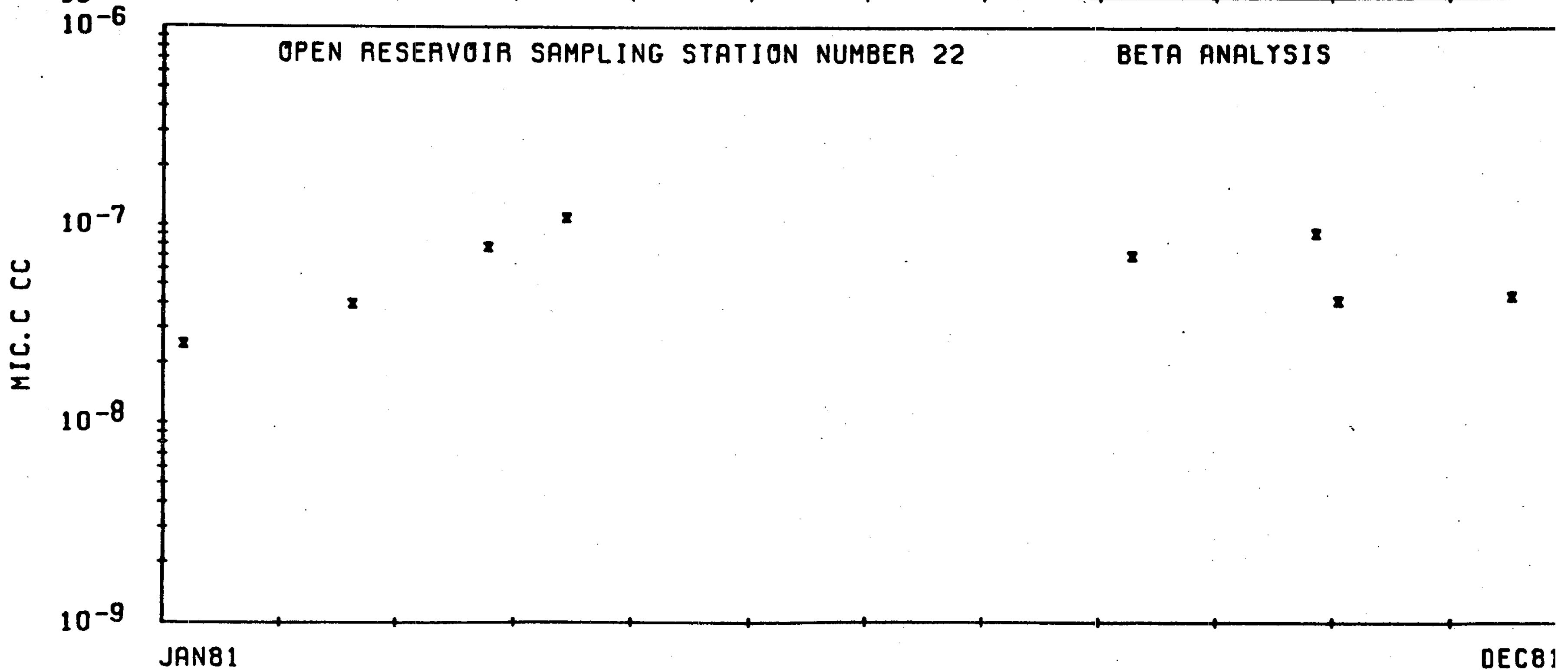

OPEN RESERVOIR SAMPLING STATION NUMBER 16
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


OPEN RESERVOIR SAMPLING STATION NUMBER 18
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81


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


OPEN RESERVOIR SAMPLING STATION NUMBER 20
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81


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


OPEN RESERVOIR SAMPLING STATION NUMBER 22
BETA ANALYSIS
MIC.C CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81

A P P E N D I X F

NTS Environmental Surveillance

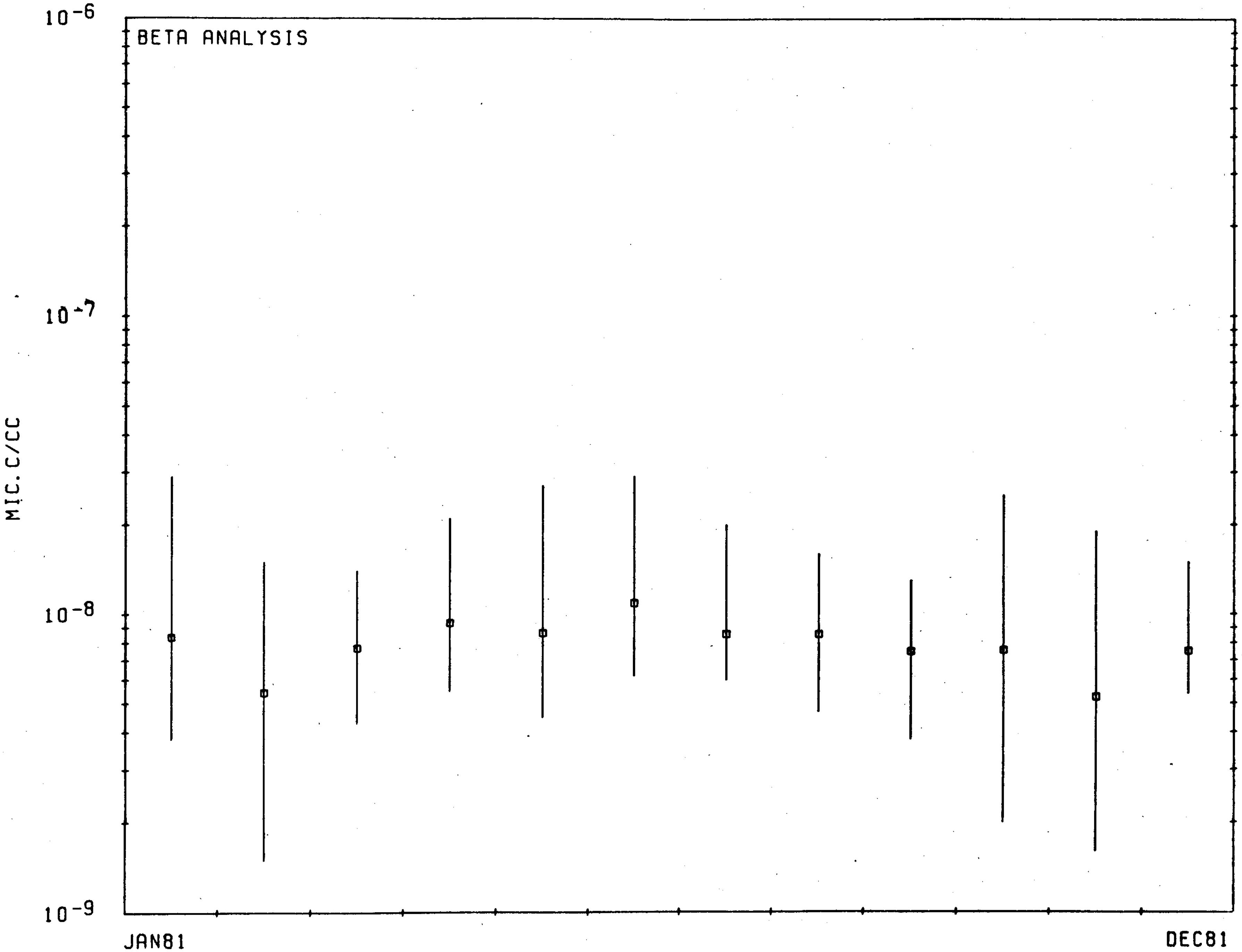
Natural Springs Locations and Plots

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.

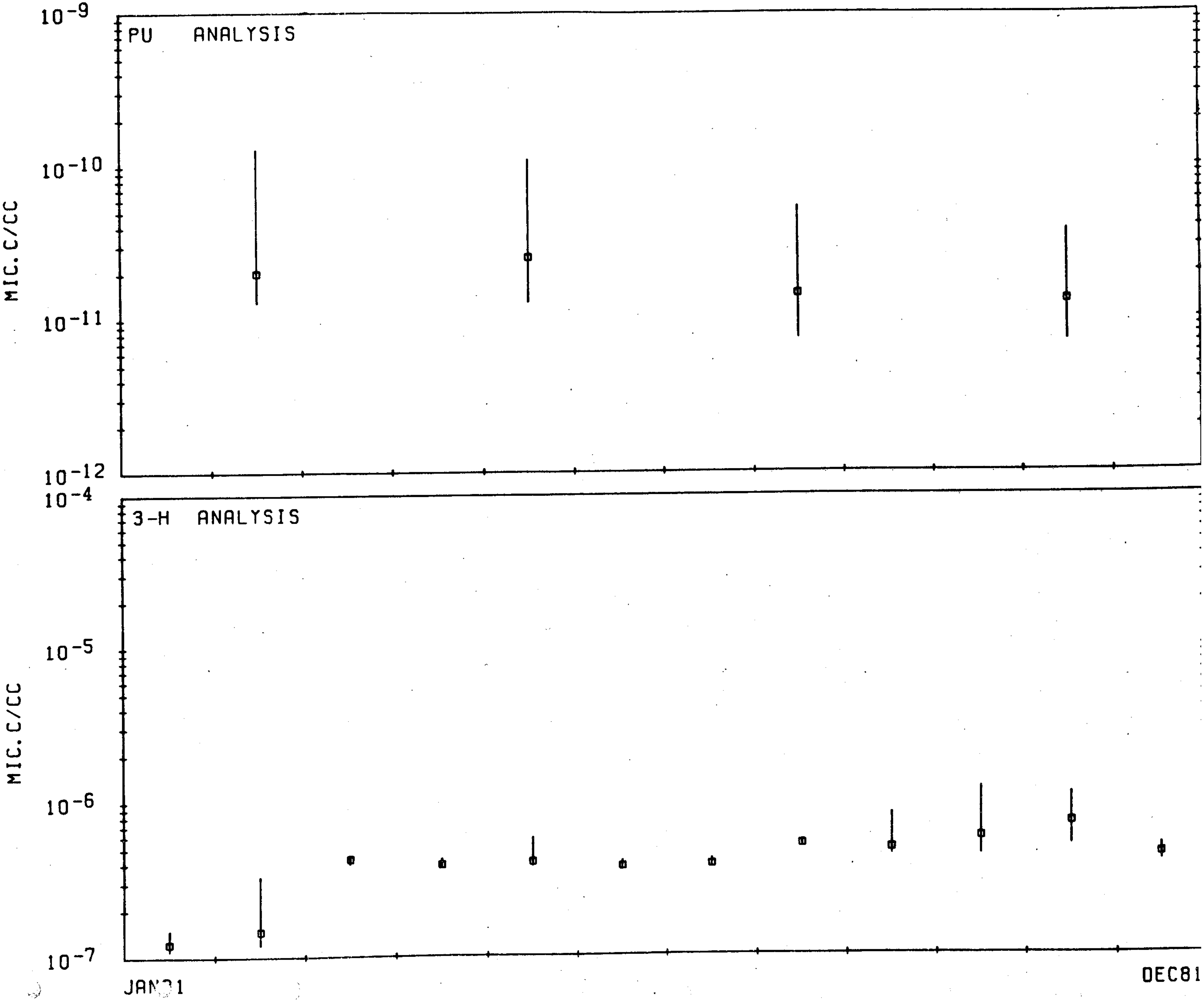
NTS ENVIRONMENTAL SURVEILLANCE
NATURAL SPRINGS SAMPLING LOCATIONS

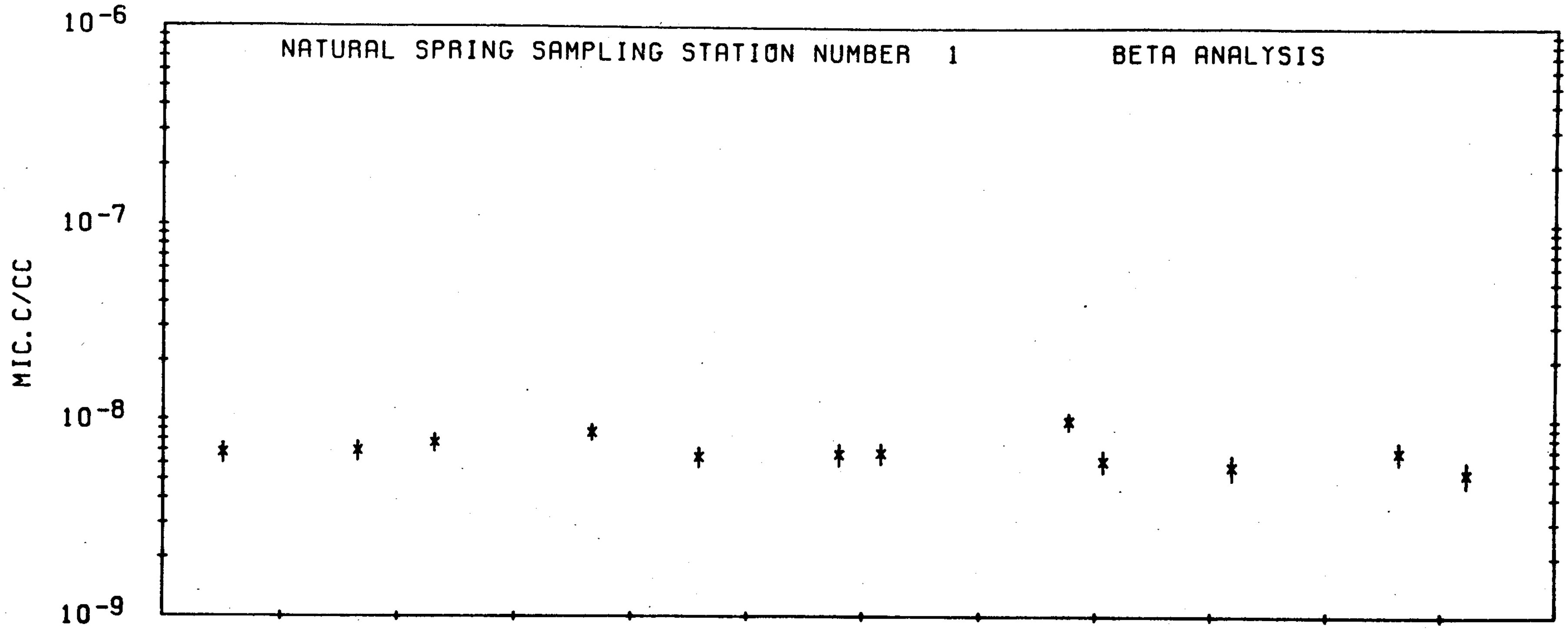
Station Number	Location
1	Area 5 Cane Springs
2	Area 12 White Rock Springs
3	Area 12 Captain Jack Spring
4	Area 12 Gold Meadows Pond
5	Area 15 Oak Butte Spring
6	Area 15 Tub Spring
7	Area 29 Topopah Spring
8	Area 7 Reitmann Seep
9	Area 16 Tippipah Spring

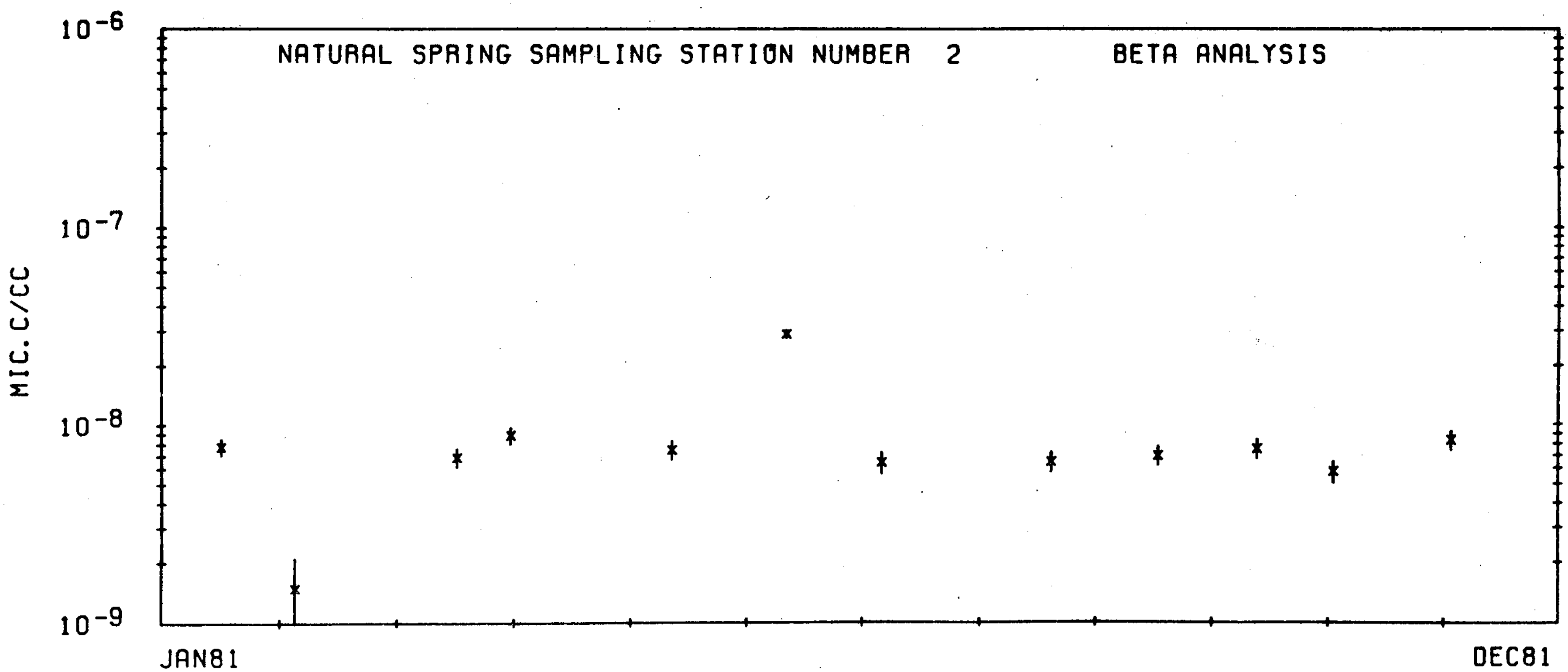
NATURAL SPRING NETWORK AVERAGES

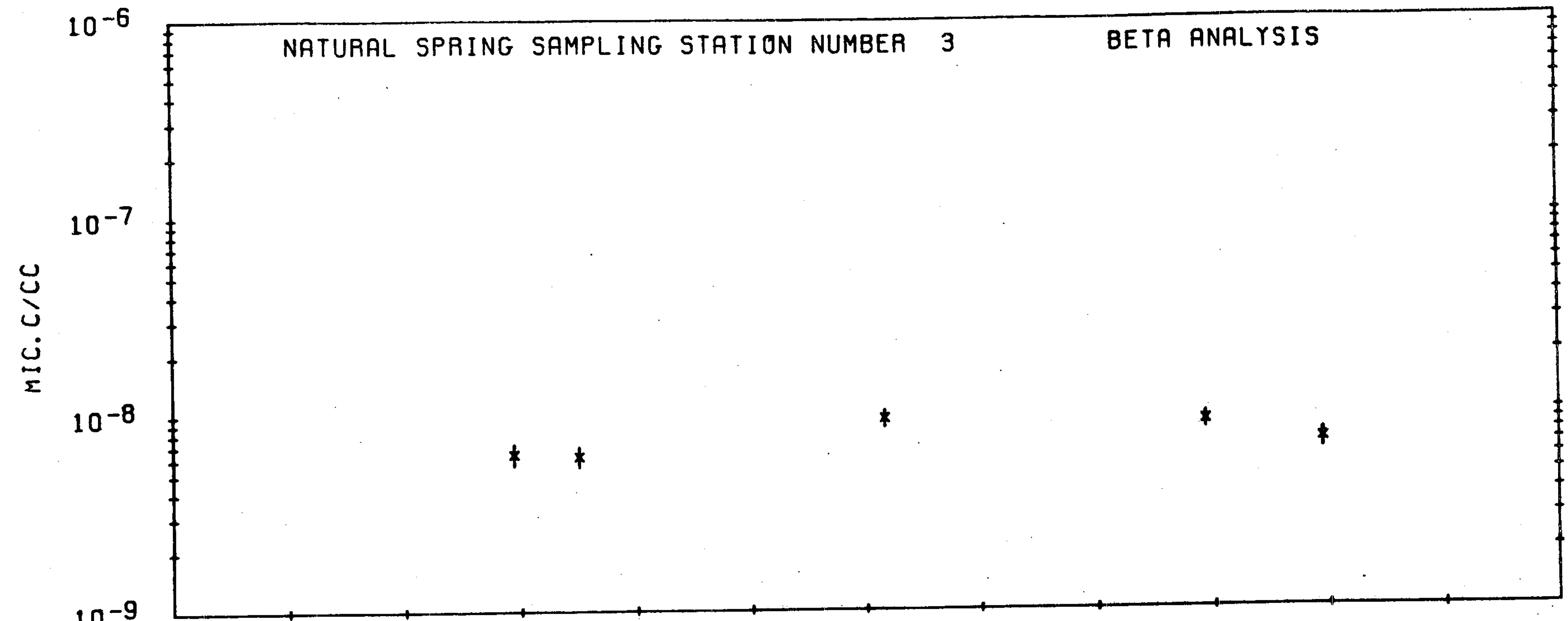


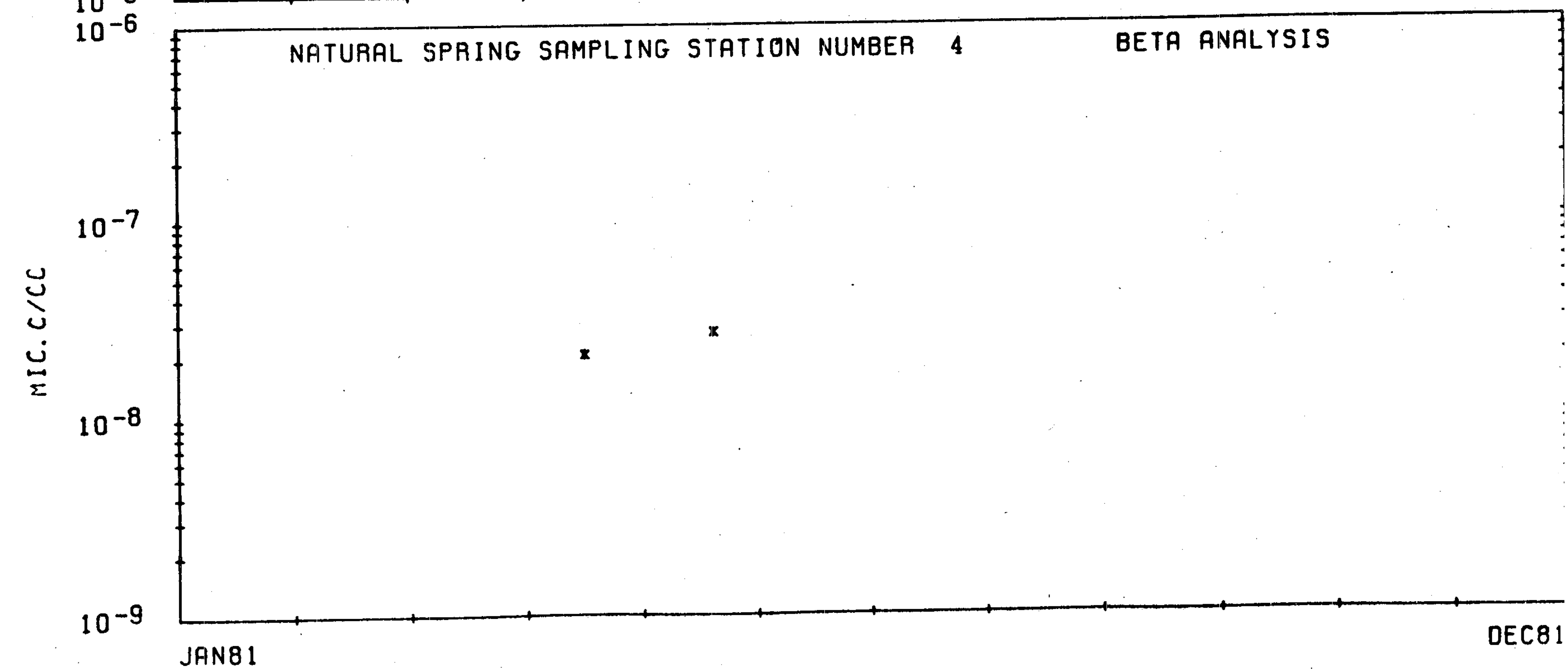
NATURAL SPRING NETWORK AVERAGES

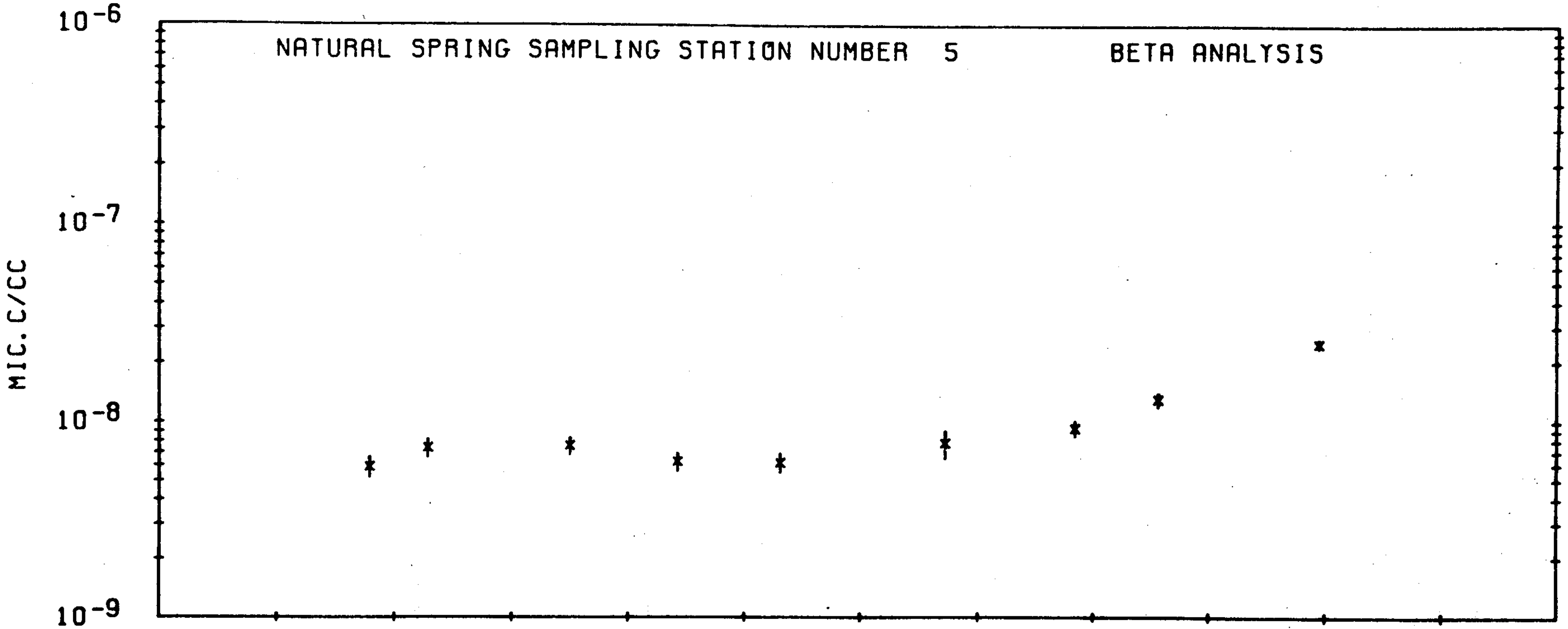


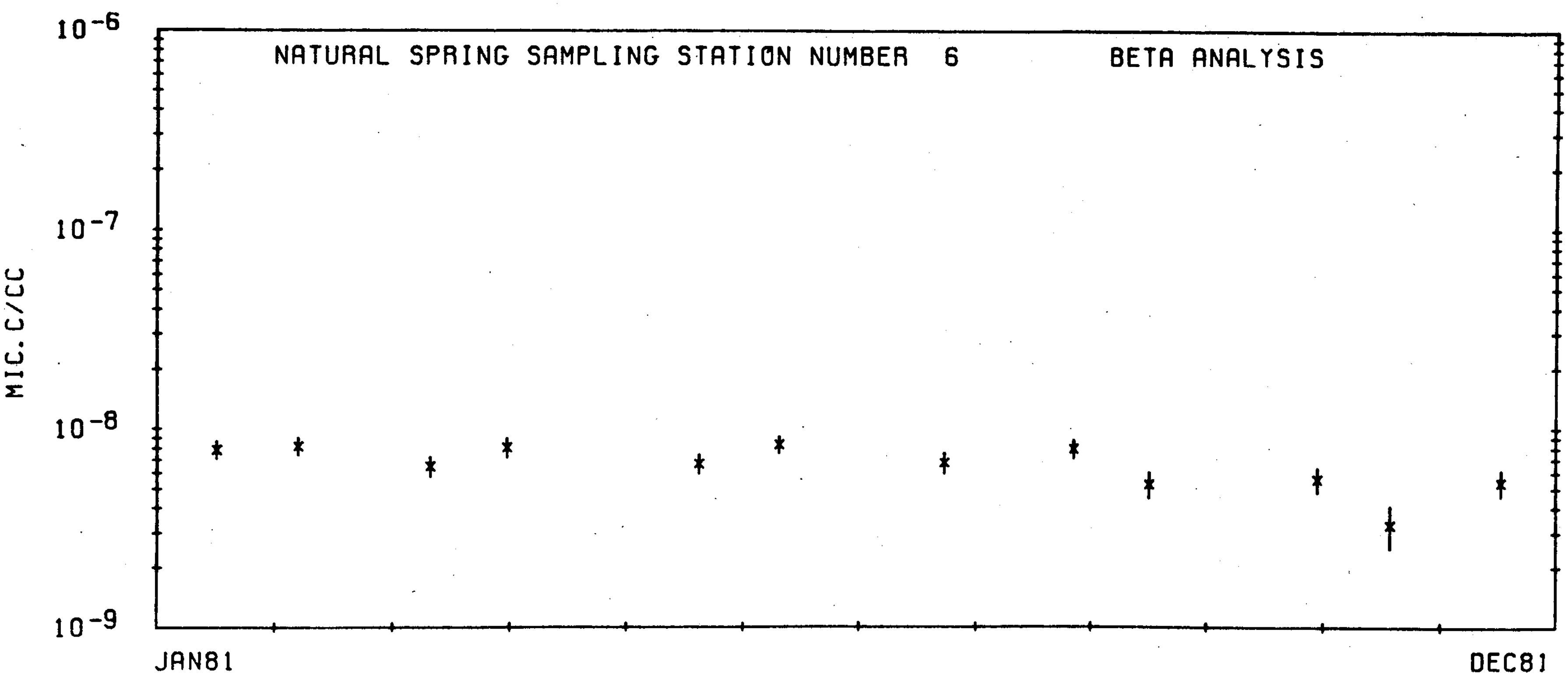

NATURAL SPRING SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

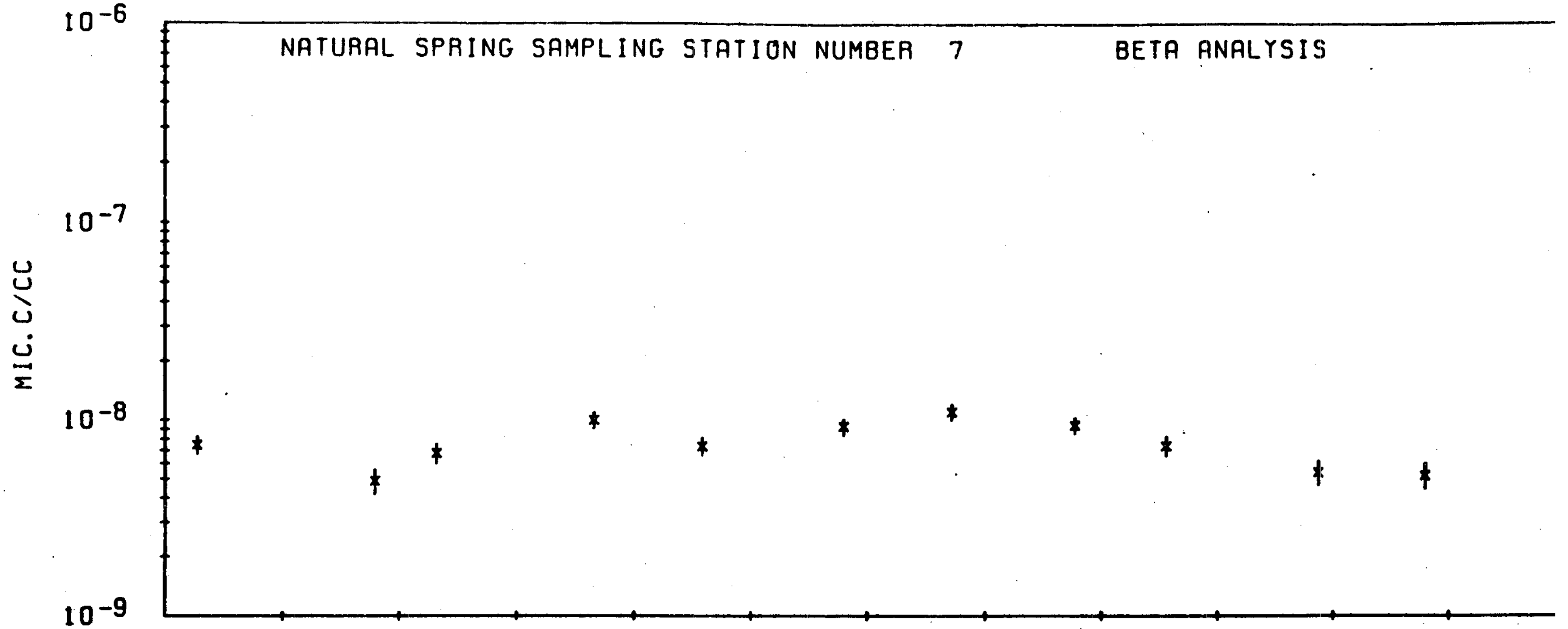

NATURAL SPRING SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81

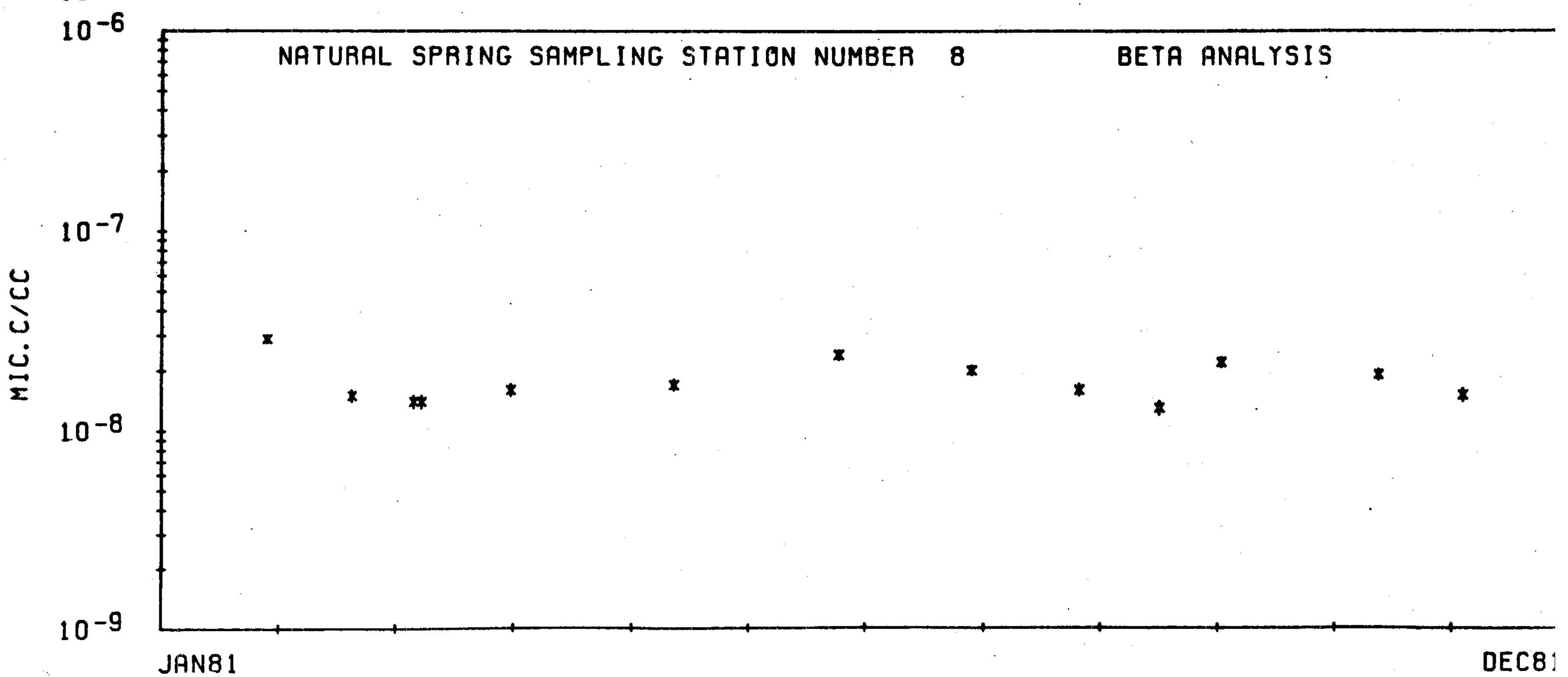

NATURAL SPRING SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9

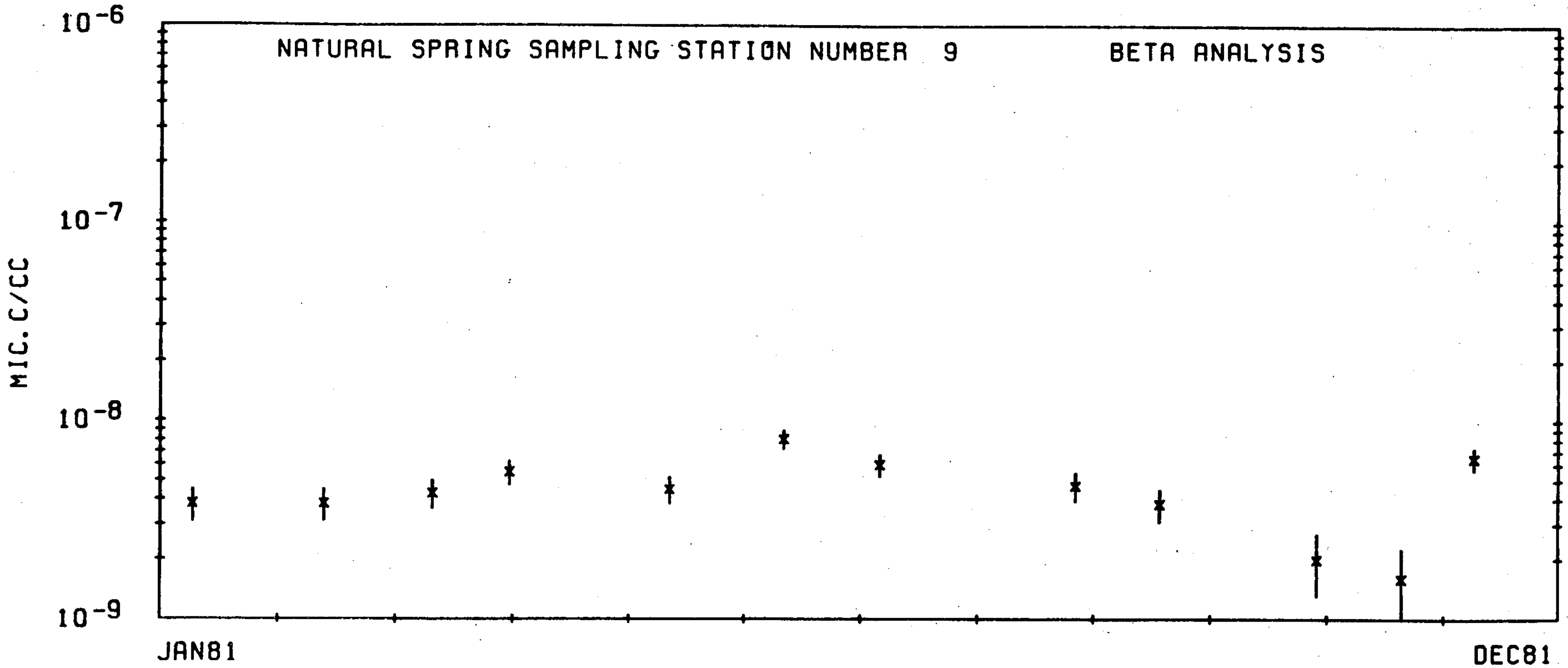

NATURAL SPRING SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN81
DEC81


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


NATURAL SPRING SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81


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


NATURAL SPRING SAMPLING STATION NUMBER 8
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN81
DEC81


NATURAL SPRING SAMPLING STATION NUMBER 9
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN81
DEC81

A P P E N D I X G

NTS Environmental Surveillance

Contaminated Ponds 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.

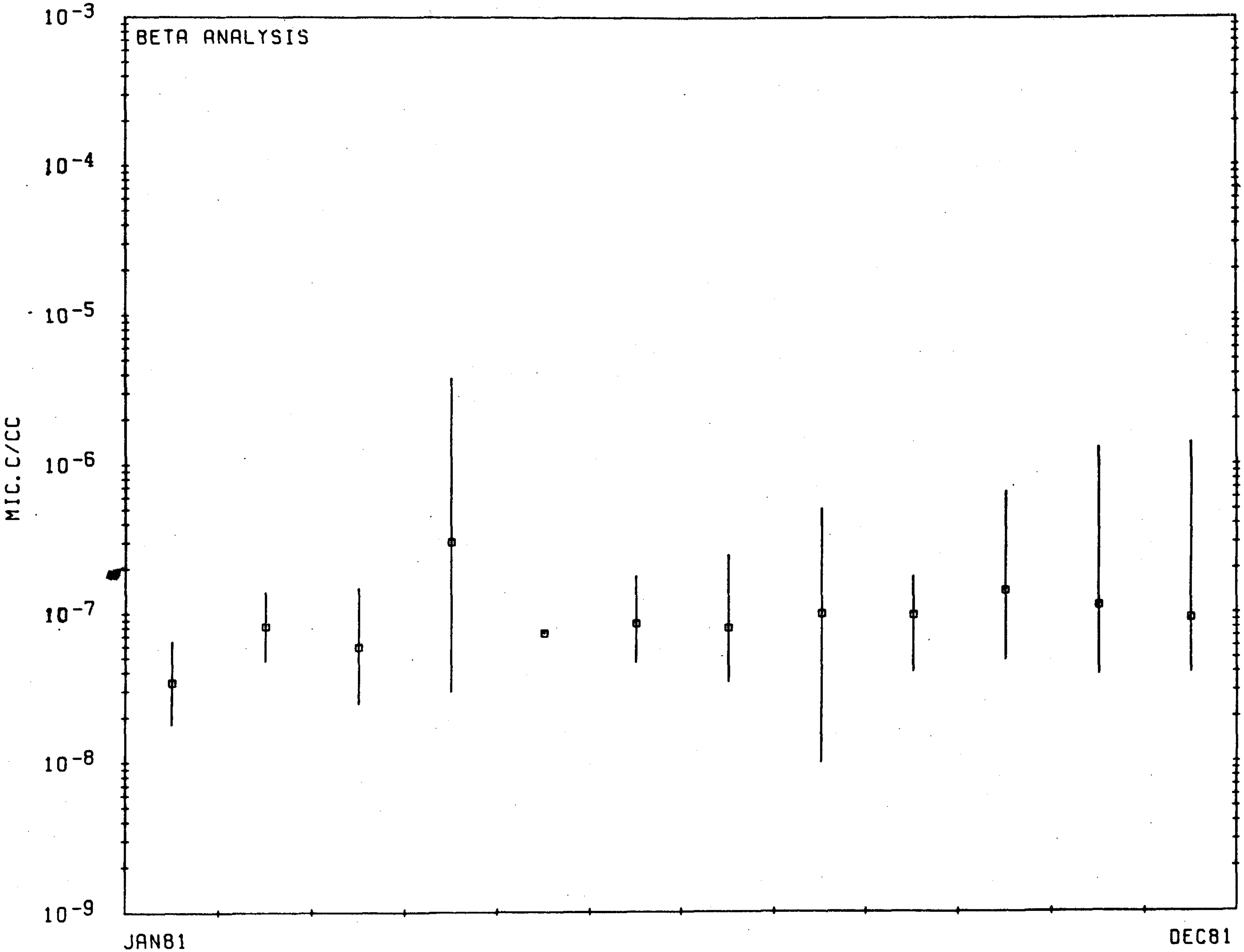
The remaining plots show the gross beta of each station. A two-sigma error bar is also added to the data points, and, in all plots, a delta with a line to the bottom of the plot means below detection limit.

NTS ENVIRONMENTAL SURVEILLANCE
CONTAMINATED PONDS SAMPLING LOCATIONS

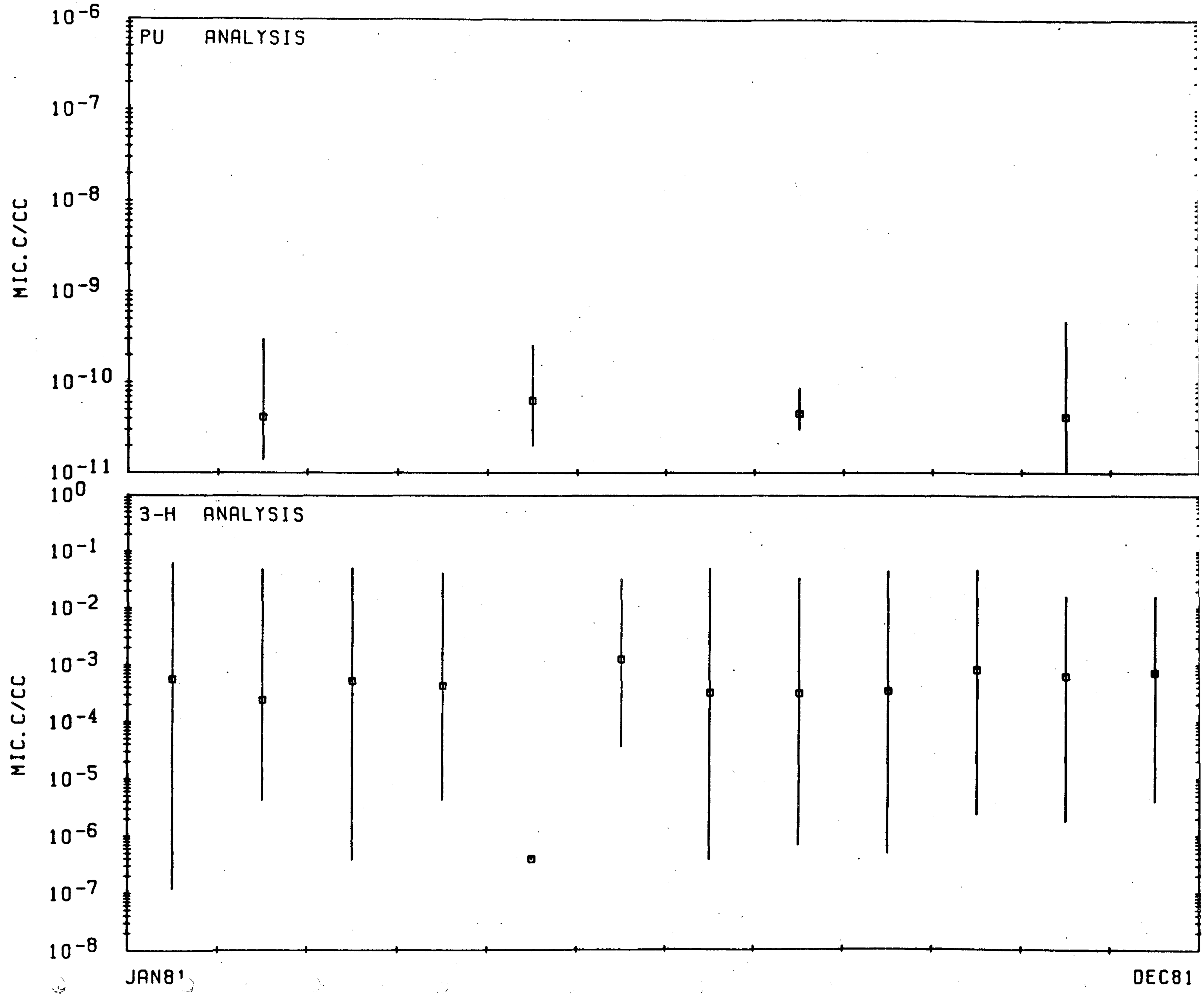
Station Number	Location
8	Area 12 N Upper
9	Area 12 N Mid
10	Area 12 N Lower
11	Area 12 G Tunnel
* 12	Area 12 H&S Sump
13	Area 6 Yucca Decontamination Pond

* Contaminated ponds were dry.

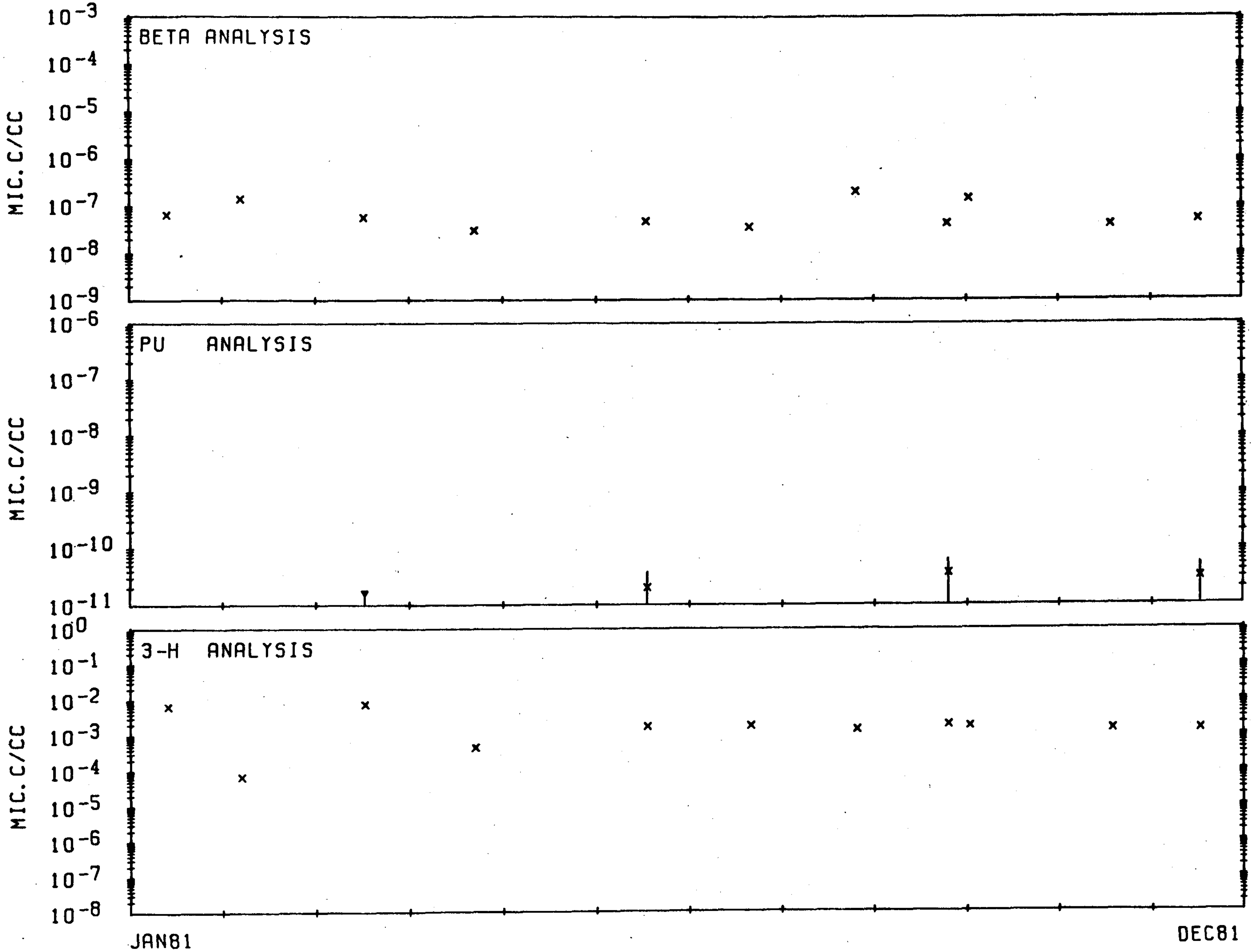
CONTAMINATED POND NETWORK AVERAGES



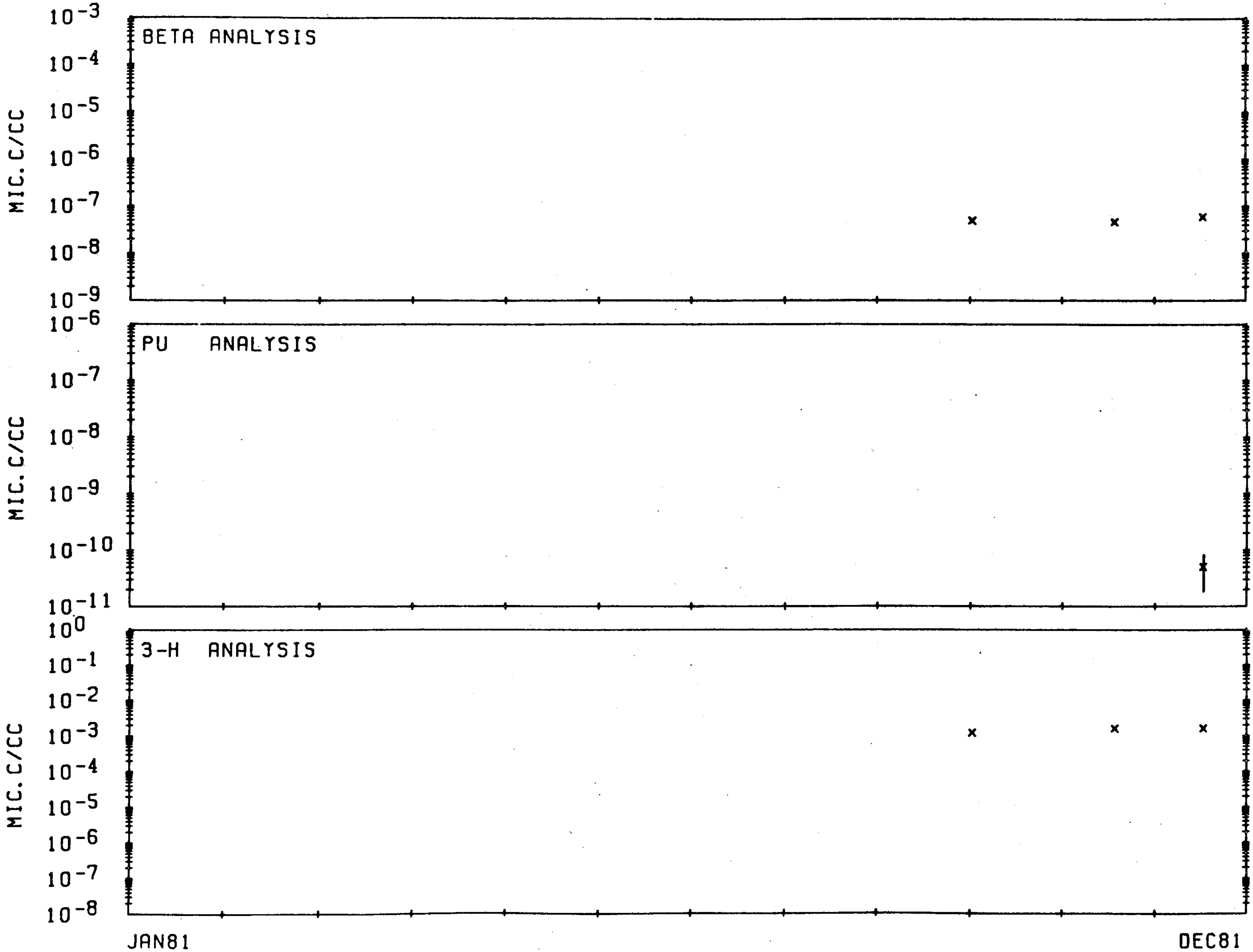
CONTAMINATED POND NETWORK AVERAGES



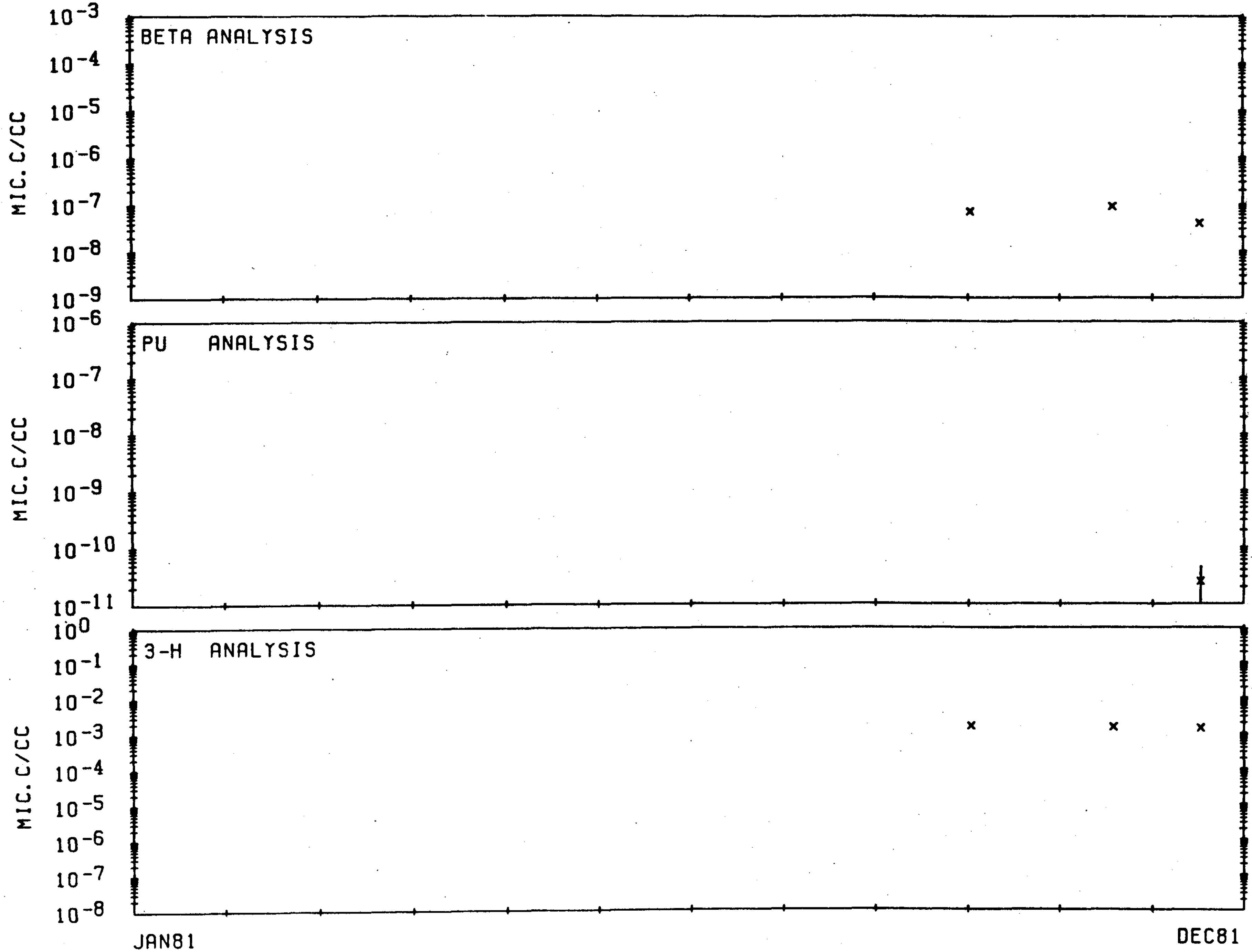
CONTAMINATED POND SAMPLING STATION NUMBER 8



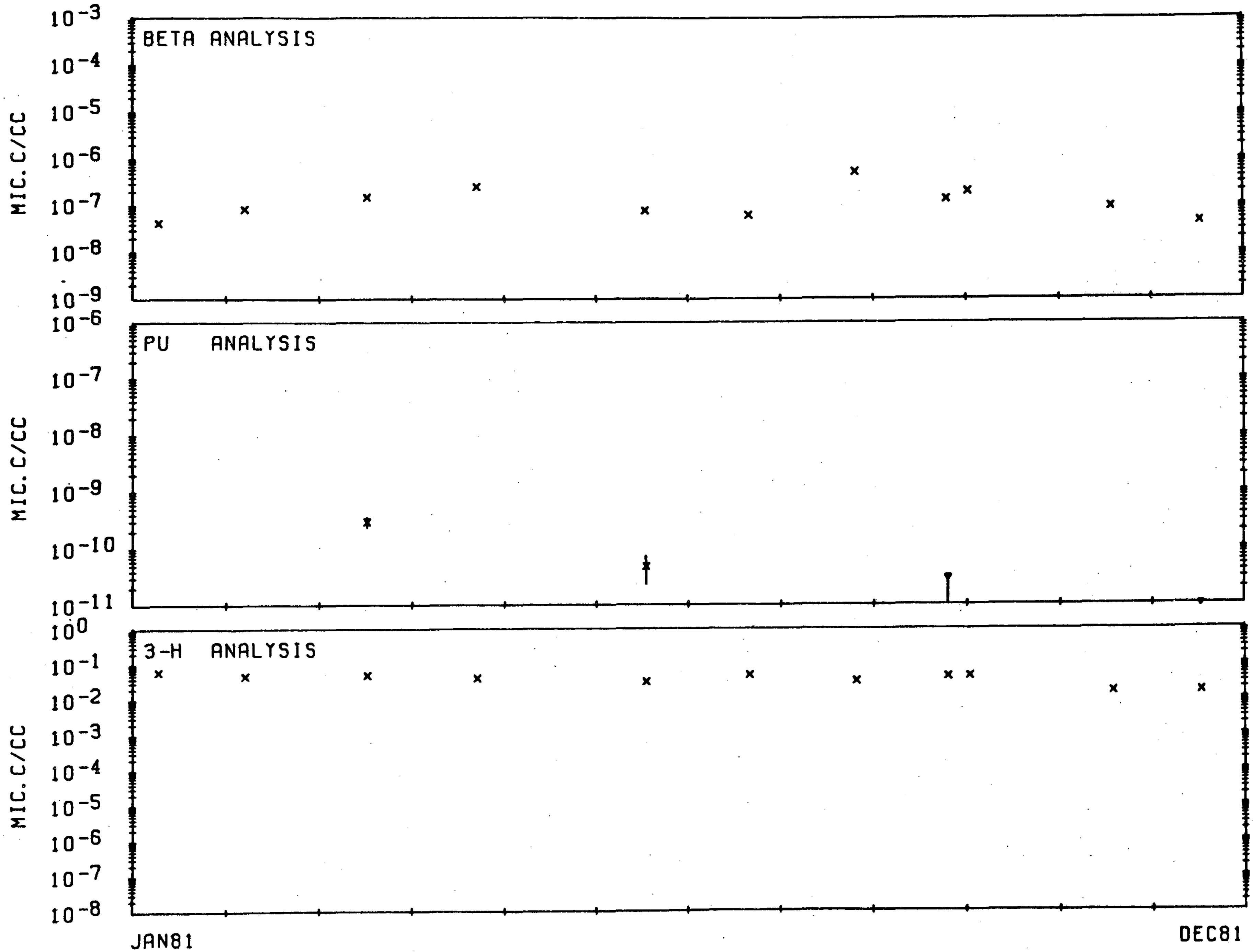
CONTAMINATED POND SAMPLING STATION NUMBER 9



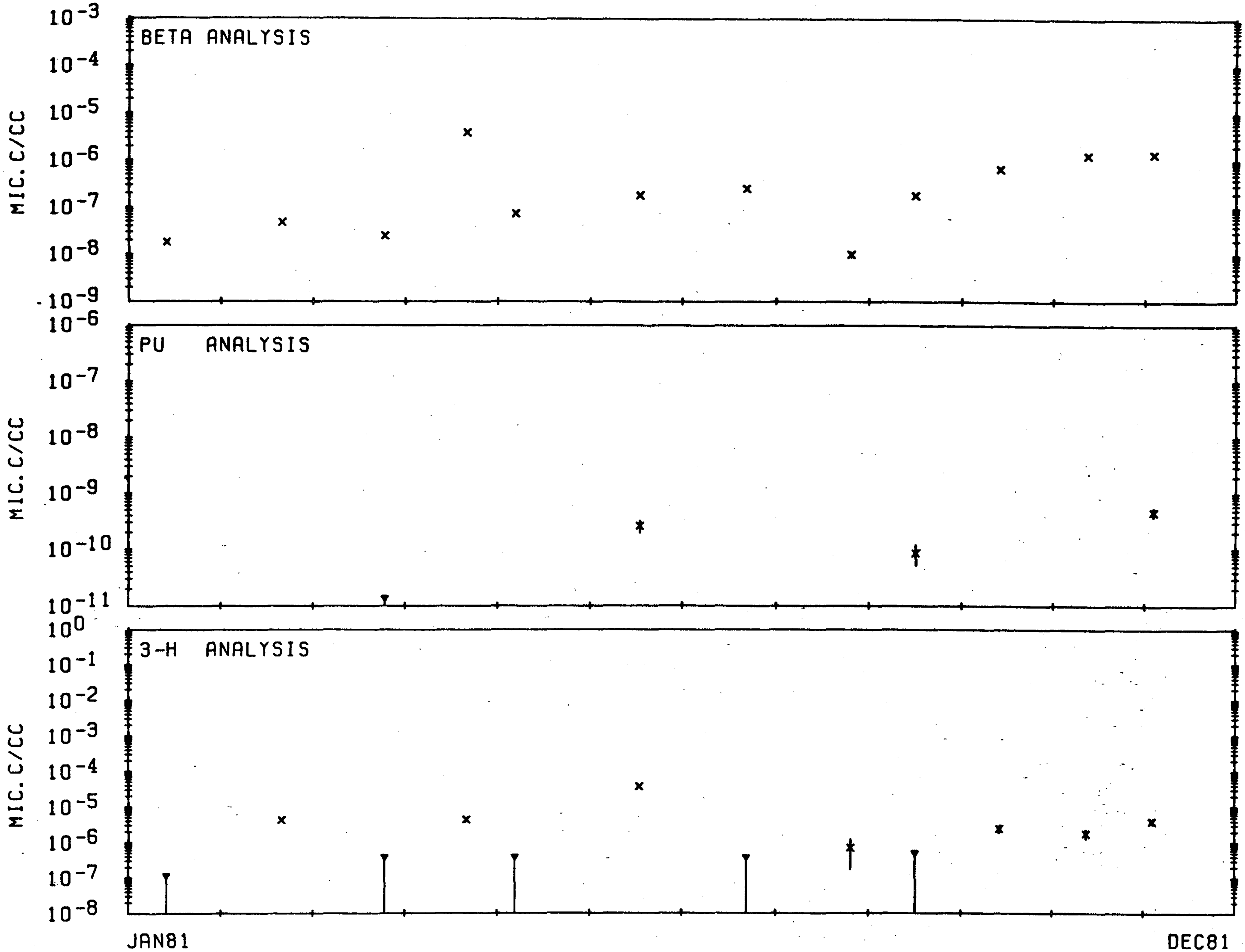
CONTAMINATED POND SAMPLING STATION NUMBER 10



CONTAMINATED POND SAMPLING STATION NUMBER 11



CONTAMINATED POND SAMPLING STATION NUMBER 13



DISTRIBUTION

T. H. Blankenship, DOE/NV
J. R. Boland, DOE/NV
C. D. Broyles, SL, Albuquerque, NM
E. D. Campbell, DOE/NV
B. W. Church, DOE/NV (2)
W. A. Vaughan, AS/EV, DOE/HQ
C. F. Costa, EPA/EMSL, Las Vegas, NV
J. F. Doyle, EG&G, Las Vegas, NV
J. E. Dummer, LASL, Los Alamos, NV
P. B. Dunaway, DOE/NV
P. K. Fitzsimmons, DOE/NV
M. E. Gates, Manager, DOE/NV
R. F. Crossman, EPA/EMSL, Las Vegas, NV
Major General William Hoover, MA, DOE/HQ (2)
J. C. Hopkins, LANL, Los Alamos, NM
D. F. Miller, DOE/NV
J. S. Kahn, LLNL, Livermore, CA
Librarian, EG&G, Las Vegas, NV
D. A. Nowack, DOE/NV
P. J. Mudra, DOE/NV
H. F. Mueller, NSNSO/NOAA, Las Vegas, NV
P. O. Murphy, EG&G, Las Vegas, NV
R. M. Nelson, AMD DOE/NV
G. Oertel, DOE/HQ (3)
K. M. Oswald, LLNL, Mercury, NV
E. Rippeon, Library, DOE/HQ (2)
G. E. Schweitzer, EPA/EMSL, Las Vegas, NV
T. P. Stuart, EG&G, Las Vegas, NV
Technical Information, REECo, Las Vegas, NV
Technical Library, DOE/NV (3)
Technical Library, REECo, Mercury, NV
J. Toman, LLNL, Livermore, CA
G. E. Tucker, SL, Albuquerque, NM
USDOE TIC, Oak Ridge, TN (27)
R. D. Duncan, Deputy Manager, DOE/NV
D. E. Patterson, DOE/HQ (2)
R. W. Newman, AST DOE/NV