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ENVIRONMENTAL SURVEILLANCE REPORT FOR THE NEVADA TEST SITE

(JANUARY 1980 THROUGH DECEMBER 1980)

1981

WORK PERFORMED UNDER CONTRACT NO. DE-AC08-76NV00410

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

DOE/NV/00410-64

ENVIRONMENTAL SURVEILLANCE REPORT

FOR THE

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(JANUARY 1980 THROUGH DECEMBER 1980)

WAYNE A. SCOGGINS

REYNOLDS ELECTRICAL & ENGINEERING CO., INC.
2501 WYANDOTTE
LAS VEGAS, NV 89114

PREPARED FOR THE

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ABSTRACT

This report documents the environmental surveillance program at the Nevada Test Site as conducted by the Department of Energy (DOE) onsite radiological safety contractor from January 1980 through December 1980. 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.

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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 1980. 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 ERDA Installations," ERDA 77-24

NEVADA TEST SITE

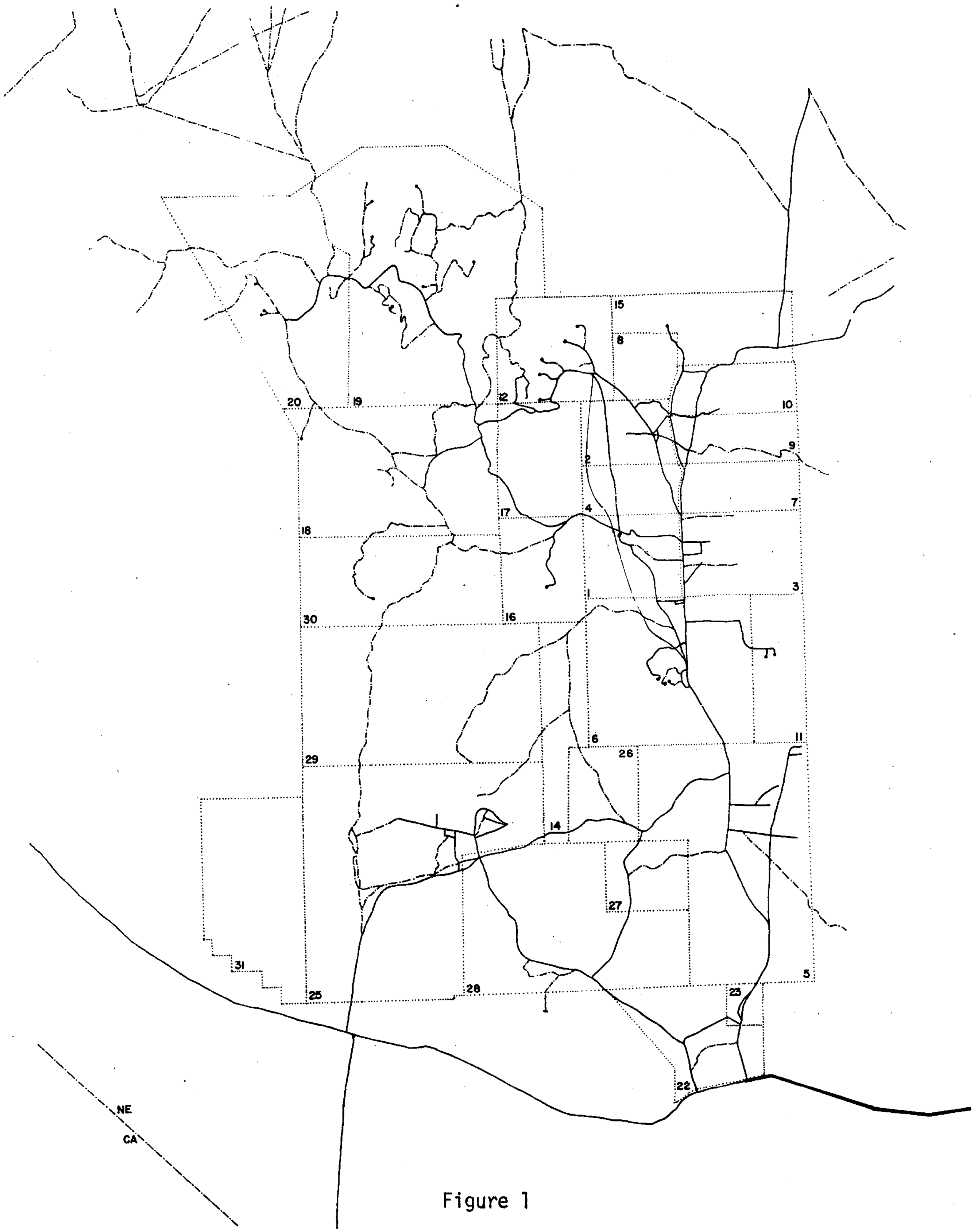


Figure 1

(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 three

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	46	Gamma spectroscopy, gross beta, plutonium (monthly composite)
	Low-volume sampling through a desiccant.	Bimonthly	10	HT-HTO
Potable Water	1-liter grab sample.	Weekly	8	Gross gamma, gross beta, plutonium (quarterly)
Supply Wells	1-liter grab sample.	Monthly	13	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	8**	Gross gamma, gamma spectroscopy* gross beta, plutonium
External Gamma Radiation Levels	CaF_2:Dy and LiF Thermoluminescent Dosimeters	Quarterly	152	Total integrated exposure over field cycle.
Contaminated Ponds	1-liter grab sample.	Monthly	13**	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 in the pond.

month 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 analysis 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	9×10^{-9}	6×10^{-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 CGs for the nuclides of major interest at the NTS (Manual Chapter 0524, Annex A).

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	10 ml	1×10^{-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-1980 show that the radioactivity in air and water in the NTS environments was low compared to DOE guidelines. ^{239}Pu concentrations in air decreased over the previous year and 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-1980 average gross beta concentration in air was 4.9×10^{-14} μCi/cc at station 36, U3ax west. This average represents 0.005 percent of the applicable concentration guide of 1×10^{-9} μCi/cc as listed in Manual Chapter 0524, Annex A (assuming ^{90}Sr to be the beta emitter present). The stations that were sampled over the entire report period demonstrated similar average results. The site average of these forty-three stations was 3.7×10^{-14} μCi/cc with one standard deviation being seventeen percent. The remaining three stations averaged 6.3×10^{-14} μCi/cc with one standard deviation being twelve percent. The measurements for gross beta activity for the first six months of CY-1980 were at the baseline value of previous years. The approximately fifty percent increase in the second six months for gross beta activity was attributed to a slight seepage of radioactive gas at U2eq during the week of September 29 and a foreign nuclear atmospheric test in October. The maximum gross beta concentration for the week of September 29 was 21.2×10^{-9} μCi/cc. Nineteen out of forty-six air sample stations showed a noticable increase in the gross beta activity. Starting the week of November 3 the gross beta activity for all stations increased due to the foreign nuclear atmospheric test. This increase continued with the maximum values for gross beta activity for the CY-1980 occurring during the week of December 22. Values up to 28.5 x 10^{-14} μCi/cc were recorded during this week.

^{239}Pu concentrations in air were primarily on the order of 10^{-16} μCi/cc or below, as compared with a CG of 2 X 10^{-12} μCi/cc (Manual Chapter 0524, Annex A). The four highest ^{239}Pu concentrations were recorded in the northeast region of the test site; Areas 2 and 9. These locations were:

Area	2	Complex	1.2 x 10^{-15} μCi/cc
Area	2	Cable Run	1.3 X 10^{-15} μCi/cc
Area	9	9-300 Bunker	1.3 X 10^{-15} μCi/cc
Area	9	9-300 Bunker #2	3.2 X 10^{-15} μCi/cc

The majority of NTS air sampling stations measured plutonium concentrations above those found in the basecamp (Mercury), although 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 were 8.98 X 10^{-9} μCi/ml from the Area 6 Cafeteria and 17.05 x 10^{-9} 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 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 9.2×10^{-11} μCi/ml at Well UE5c Reservoir. This represents 0.00009 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.

More positive tritium results occurred compared to last year. This is largely due to the increase of a 10 ml verses a 5 ml sample. The actual detection limit as seen in the results decreased from approximately 4×10^{-7} μCi/ml in CY-1979 to 1×10^{-7} μCi/ml in CY-1980. Many of these positive results came from the Cascade water and may be due to the tritium air concentration in the area where the water is stored. During the month of March there were twenty-seven positive tritium in water results. These results were observed in potable water, supply wells, reservoirs, and natural springs. They are believed to have been caused by a malfunction of the scintillation counter. The highest concentration of tritium in noncontaminated water occurred during March from Supply Well 2. This concentration of 3.5×10^{-4} μCi/ml represented 11.7 percent of the concentration guide for tritium in drinking water. Positive results close to the detection limit may have been caused by statistical fluctuation 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 Manual Chapter 0513.

TLD measurements of the NTS gamma radiation rates at the 152 locations showed minimal changes throughout CY-1980. A nine station control network displayed almost no change, while the remaining 143 stations recorded only a few small changes related to known effects. Rates were recorded up to 3700 mrem/y at the 4-04 road station, but the majority of NTS locations measured in the range of approximately 100-160 mrem/y.

C. SAMPLING AND ANALYSIS

1. Air Monitoring

Air sampling units were located at 46 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 $2H_2 + O_2 \xrightarrow{Pt} 2H_2O$. 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 10-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 X 10^{-8} μCi/ml; (2) tritium, 1 X 10^{-7} μCi/ml; and (3) gross beta, 5 X 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 X 10^{-11} μCi/ml.

3. Gamma Monitoring (TLD)

TLD's were located at 152 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 at least 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). For this system, a five percent increase in the measured value has been appropriate in field determinations. In locations where the spectrum differed appreciably in the lower energy range, LiF TLD's were used in conjunction with the CaF_2:Dy TLD's. These dosimeters, although not preferable for environmental applications because of their low sensitivity, provided a secondary system that detected the lower energy photons (the energy response curve was flat to about 10 keV).

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.

Dispersion of the laboratory results was evaluated continuously. Samples were recounted and the percent differences between the original and the second count described the variance of the counting system. When these checks indicated a problem, the systems were reviewed. The Median Absolute Deviation (MAD) was the statistic used to evaluate new data relative to prior measurements. The MAD was highly resistant to the outliers of environmental data, and was valuable in the measurement of station-to-station variations and laboratory quality.

D. RADIOACTIVITY IN AIR

Ambient air monitoring was performed at the 46 locations shown in Figures 2 and 3. Of these 46 locations, forty-three stations (numbered 1-23 and 25-44) were sampled continuously over the entire report period. Nine of these stations were started during January and the three remaining locations were installed in August and October, and were sampled until the end of the year. These new stations were:

Area 5	RWMS #2	Area 5	RWMS #8
Area 5	RWMS #3	Area 5	RWMS #9
Area 5	RWMS #4	Area 15	Piledriver
Area 5	RWMS #5	Area 19	19-3 Sub Station
Area 5	RWMS #6	Area 29	Dispensary
Area 5	RWMS #7	Area 3	Complex #2

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-six 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 1980 gross beta and ^{239}Pu yearly locational averages. Tables 4 and 5 list those 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 3.7 x 10^{-14} or 0.004 percent of the applicable concentration guide of 1 x 10^{-9} μCi/cc listed in Manual Chapter 0524 Annex A (assuming ^{90}Sr to the beta emitter present). The maximum average value 4.9 x 10^{-14} μCi/cc at the U3ax west station represents 0.005 percent of the concentration guide (assuming ^{90}Sr to be the beta emitter). One air sampler, U3ax north, showed an increase of beta activity during the week of April 7, 1980. The air activity was 6.0 x 10^{-13} μCi/cc which is 0.06 percent of the concentration guide for strontium-90. The most probably cause was from the placement of contaminated tunnel debris in the U3ax crater on April 10, 1980. During the second six months the gross beta activity increased by approximately fifty percent. This was caused by a slight seepage of radioactive gas

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

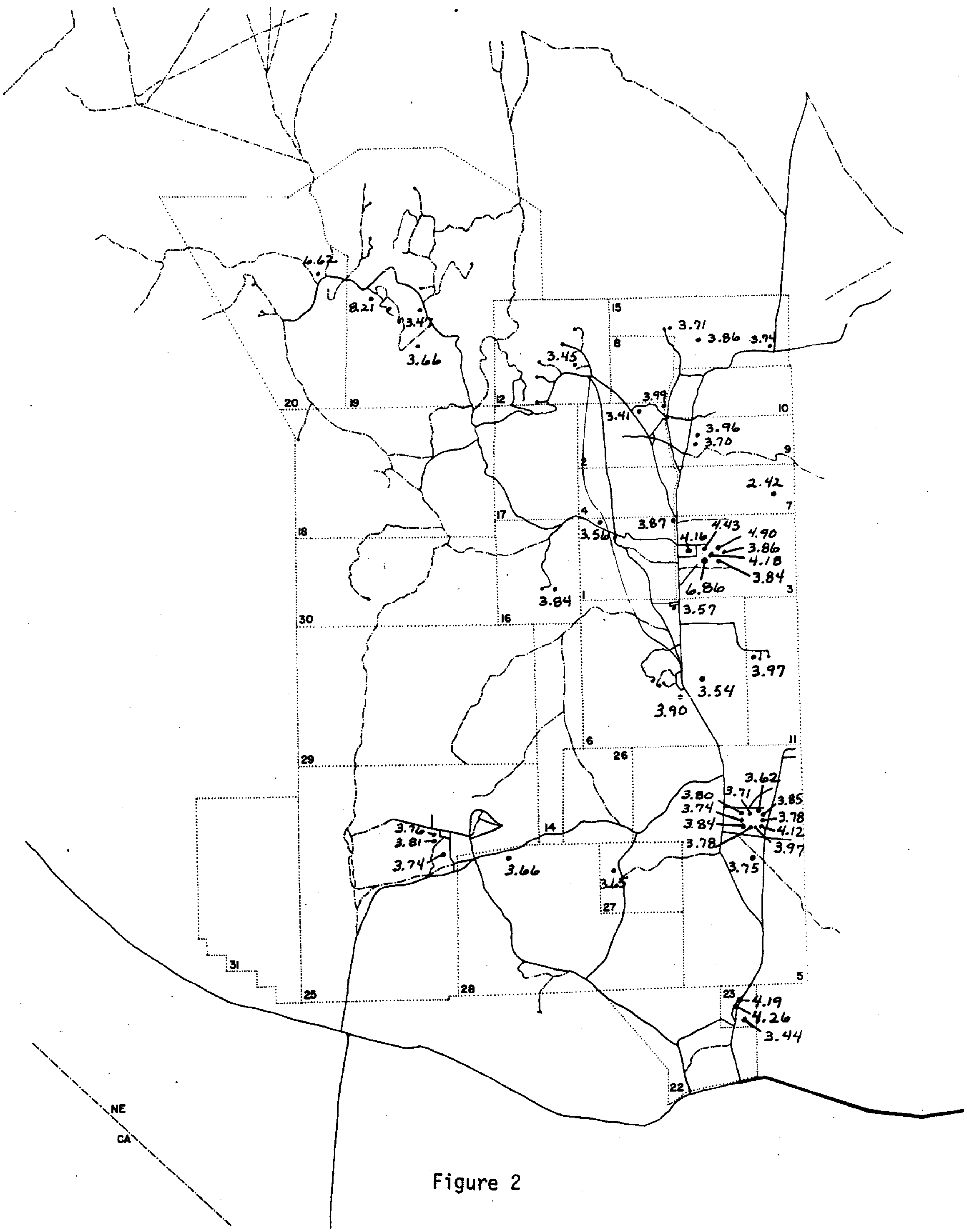


Figure 2

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING STATIONS
(Pu-239 YEARLY AVERAGES X10^{-17} μ Ci/cc)

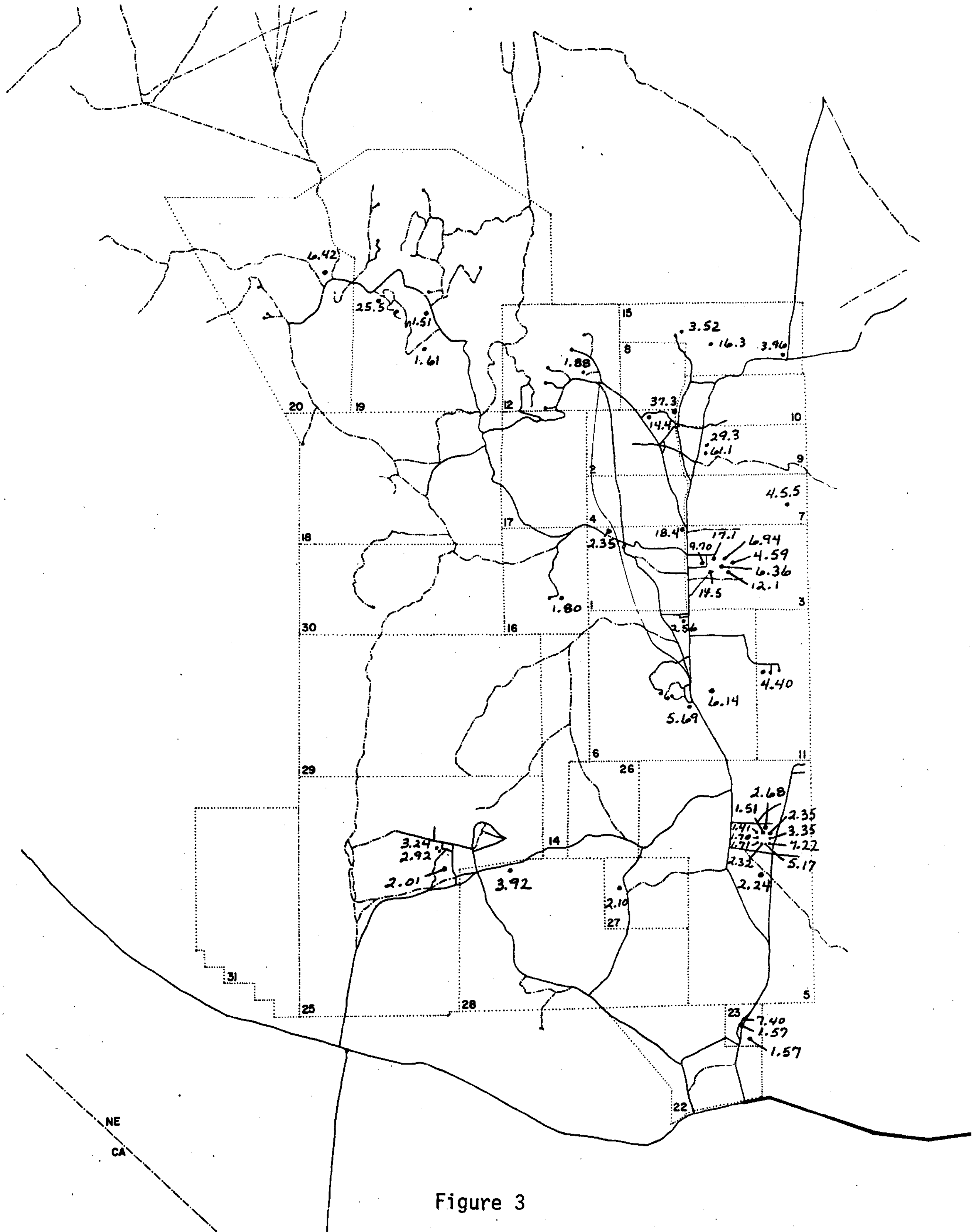


Figure 3

TABLE 4

AVERAGES OF AIR SURVEILLANCE DATA FOR GROSS BETA

($X\ 10^{-14}\ \mu Ci/cc$)

Station	1/1/80-6/30/80	7/1/80-12/31/80	1/1/80-12/31/80
Area 1 Gravel Pit	2.3	4.8	3.6
Area 2 Cable Yard	2.6	5.5	4.0
Area 2 Compound	2.3	4.7	3.4
Area 3 BJY	2.4	5.5	3.9
Area 3 Cafeteria	2.5	5.9	4.2
Area 3 Complex #2	--	6.9	6.9
Area 3 3-300 Bunker	2.3	6.8	4.4
Area 3 U3ax South	2.4	5.2	3.8
Area 3 U3ax East	2.3	5.4	3.9
Area 3 U3ax North	2.4	5.1	3.9
Area 3 U3ax West	2.4	6.2	4.2
Area 5 DOD Yard	2.2	5.6	3.6
Area 5 RWMS #1	2.6	5.8	4.0
Area 5 RWMS #2	2.4	6.1	4.1
Area 5 RWMS #3	2.4	5.4	3.9
Area 5 RWMS #4	2.3	5.5	3.8
Area 5 RWMS #5	2.4	5.2	3.7
Area 5 RWMS #6	2.5	5.2	3.8
Area 5 RWMS #7	2.4	5.3	3.7
Area 5 RWMS #8	2.3	5.5	3.8
Area 5 RWMS #9	2.4	5.3	3.8
Area 5 Well 5B	2.6	5.1	3.7
Area 6 CP Complex	2.6	5.3	3.9
Area 6 Well 3 Complex	2.3	4.9	3.6
Area 6 Yucca Complex	2.6	5.7	3.5
Area 7 UE7ns	2.3	2.4	2.4
Area 9 9-300 Bunker	2.4	5.2	3.7
Area 9 9-300 Bunker #2	2.4	5.7	3.9
Area 11 Gate 293	2.6	5.5	3.9
Area 12 Changehouse	2.3	5.2	3.4
Area 15 EPA Farm	2.2	5.6	3.9
Area 15 Gate 700	2.4	4.9	3.7
Area 15 Piledriver	2.3	5.1	3.7
Area 16 Substation	2.3	4.4	3.8
Area 19 Echo Peak	2.2	5.0	3.7
Area 19 Substation	2.1	5.1	3.5
Area 19 Substation	--	8.2	8.2
Area 20 Dispensary	--	6.6	6.6
Area 23 Bldg. 790	2.5	6.1	4.2
Area 23 Bldg. 790 #2	2.4	6.6	4.3
Area 23 H&S Roof	2.2	4.8	3.4
Area 25 E-MAD South	2.4	5.5	3.8
Area 25 E-MAD North	2.4	5.3	3.8
Area 25 NRDS Warehouse	2.4	5.3	3.7
Area 27 Cafeteria	2.4	5.3	3.6
Area 28 Henre Site	2.3	5.3	3.7

TABLE 5

AVERAGES OF AIR SURVEILLANCE DATA FOR PLUTONIUM

($X\ 10^{-17}\ \mu Ci/cc$)

Station			1/1/80-6/30/80	7/1/80-12/31/80	1/1/80-12/31/80
Area	1	Gravel Pit	2.6	2.1	2.3
Area	2	Cable Yard	11.1	43.5	37.3
Area	2	Compound	6.5	21.4	14.4
Area	3	BJY	16.1	20.6	18.4
Area	3	Cafeteria	9.4	10.0	9.7
Area	3	Complex #2		14.5	14.5
Area	3	U3ax South	14.6	9.7	12.1
Area	3	U3ax East	2.9	6.0	4.6
Area	3	U3ax North	4.4	9.5	6.9
Area	3	U3ax West	5.0	7.7	6.4
Area	3	3-300 Bunker	13.2	20.4	17.1
Area	5	DOD Yard	3.8	1.6	2.7
Area	5	RWMS #1	8.7	1.7	5.2
Area	5	RWMS #2	12.9	1.4	7.2
Area	5	RWMS #3	4.4	2.3	3.3
Area	5	RWMS #4	3.1	1.6	2.3
Area	5	RWMS #5	1.9	1.1	1.5
Area	5	RWMS #6	1.2	1.6	1.4
Area	5	RWMS #7	1.7	1.7	1.7
Area	5	RWMS #8	2.2	1.2	1.7
Area	5	RWMS #9	2.7	1.9	2.3
Area	5	Well 5B	3.5	1.0	2.2
Area	6	CP Complex	5.5	6.0	5.7
Area	6	Well 3 Complex	2.6	2.6	2.6
Area	6	Yucca Complex	4.4	3.3	6.1
Area	7	UE7ns	4.5	4.7	4.5
Area	9	9-300 Bunker	7.0	47.6	29.3
Area	9	9-300 Bunker #2	29.2	93.4	61.1
Area	11	Gate 293	2.9	5.6	4.4
Area	12	Changehouse	2.6	1.3	1.9
Area	15	EPA Farm	5.2	27.4	16.3
Area	15	Gate 700	6.5	1.8	3.9
Area	15	Piledriver	2.6	4.5	3.5
Area	16	Substation	2.2	1.2	1.8
Area	19	Echo Peak	2.1	1.1	1.6
Area	19	Substation	2.1	0.9	1.5
Area	19	19-3 Substation		25.5	25.5
Area	20	Dispensary		6.4	6.4
Area	23	Bldg. 790	11.9	2.9	7.4
Area	23	Bldg. 790 #2	2.1	1.0	1.6
Area	23	H&S Roof	2.1	1.1	1.6
Area	25	E-MAD South	4.2	1.6	2.9
Area	25	E-MAD North	4.9	1.7	3.2
Area	25	NRDS Warehouse	3.0	1.1	2.0
Area	27	Cafeteria	2.7	1.6	2.1
Area	28	Henre Site	5.8	2.1	3.9

at U2eq and a foreign nuclear atmospheric test. U2eq seeped during the week of September 29. The average of the forty-five air stations increased to 5.3 x 10^{-14} μCi/cc as compared to the first six months baseline average of 2.4 x 10^{-14} μCi/cc. One standard deviation for the week was eight-two percent and considerably larger than the yearly one standard deviation of seventeen percent. Ce-144 and some short-lived activation products were observed in the gamma spectroscopy system. The gross beta activity decreased the following weeks. During the week of November 3, the gross beta activity for all stations started to increase again. Fission products identified on the gamma spectroscopy system were ^{103}Ru, ^{95}Zr, ^{106}Rh, and ^{95}Nb. The highest value of 17.4 x 10^{-14} μCi/cc occurred during the week of December 22. This was 0.017 percent of the concentration guide for controlled areas (assuming ^{90}Sr to be the beta emitter).

Table 5 lists the ^{239}Pu concentrations for the year. All stations averaged below 10^{-15} μCi/cc for CY-1980, with the majority being on the order of 10^{-17} μCi/cc. The highest activity was found at the 9-300 Bunker #2; the average activity at this location was 6.1 X 10^{-16} μCi/cc, or 0.03 percent of the controlled area CG 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 of these tests were demonstrated in increased plutonium concentrations in air in Areas 1, 2, 3, 7, 8, 9, 10, and 15.

The overall network average plutonium concentration in air was shown to increase during the mid-year months of CY-1980 (see Appendix A, Plot of the Network Averages). This effect was also seen in CY-1978, and CY-1979 and explained by the resuspension of plutonium from the soil (Reference 9).

The tritium in air data collected during 1980 has been evaluated from four of the ten stations at this time. The four stations completed are three at the RWMS in Area 5 and one at Building 650 in Area 23. The highest semi-monthly value was 1.42×10^{-28} μCi/cc for HTO and 3.58×10^{-10} μCi/cc for HT. This represents 0.28 and 0.000018 percent of their respective concentration guides. Table 6 lists the average tritium concentrations at each location along with the highest and lowest 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 thirteen supply wells, eight potable water stations, and seventeen open reservoirs. The wells feed directly to many of the reservoirs and the drinking water was pumped from the wells to the points of consumption. While the air surveillance network consisted of forty-six stations measuring one 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

TABLE 6

Tritium In Air

Area 5 #1

HTO (highest)	1.42E-08 μCi/cc	HT (highest)	3.58E-10 μCi/cc
HTO (lowest)	<2.61E-13 μCi/cc	HT (lowest)	<5.15E-14 μCi/cc
HTO (average)	1.29E-09 μCi/cc	HT (average)	4.17E-11 μCi/cc

Area 5 #2

HTO (highest)	9.64E-11 μCi/cc	HT (highest)	2.96E-10 μCi/cc
HTO (lowest)	<6.01E-14 μCi/cc	HT (lowest)	<4.38E-14 μCi/cc
HTO (average)	2.07E-11 μCi/cc	HT (average)	4.15E-11 μCi/cc

Area 5 #3

HTO (highest)	3.19E-10 μCi/cc	HT (highest)	1.42E-10 μCi/cc
HTO (lowest)	<9.05E-14 μCi/cc	HT (lowest)	1.35E-11 μCi/cc
HTO (average)	1.28E-10 μCi/cc	HT (average)	4.49E-11 μCi/cc

Bldg. 650, Mercury

HTO (highest)	5.25E-11 μCi/cc	HT (highest)	7.09E-11 μCi/cc
HTO (lowest)	<2.02E-14 μCi/cc	HT (lowest)	1.11E-13 μCi/cc
HTO (average)	9.12E-12 μCi/cc	HT (average)	1.00E-11 μCi/cc

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.

1. <u>Supply Wells</u>

Water from thirteen 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 1980 averages for each location. The highest average recorded was 1.70×10^{-8} μCi/ml at Well C1. This was 0.2 percent of the CG assuming ^{90}Sr to be the most radiotoxic beta emitter present. The lowest average gross beta activity for the onsite supply wells was 2.7×10^{-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

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

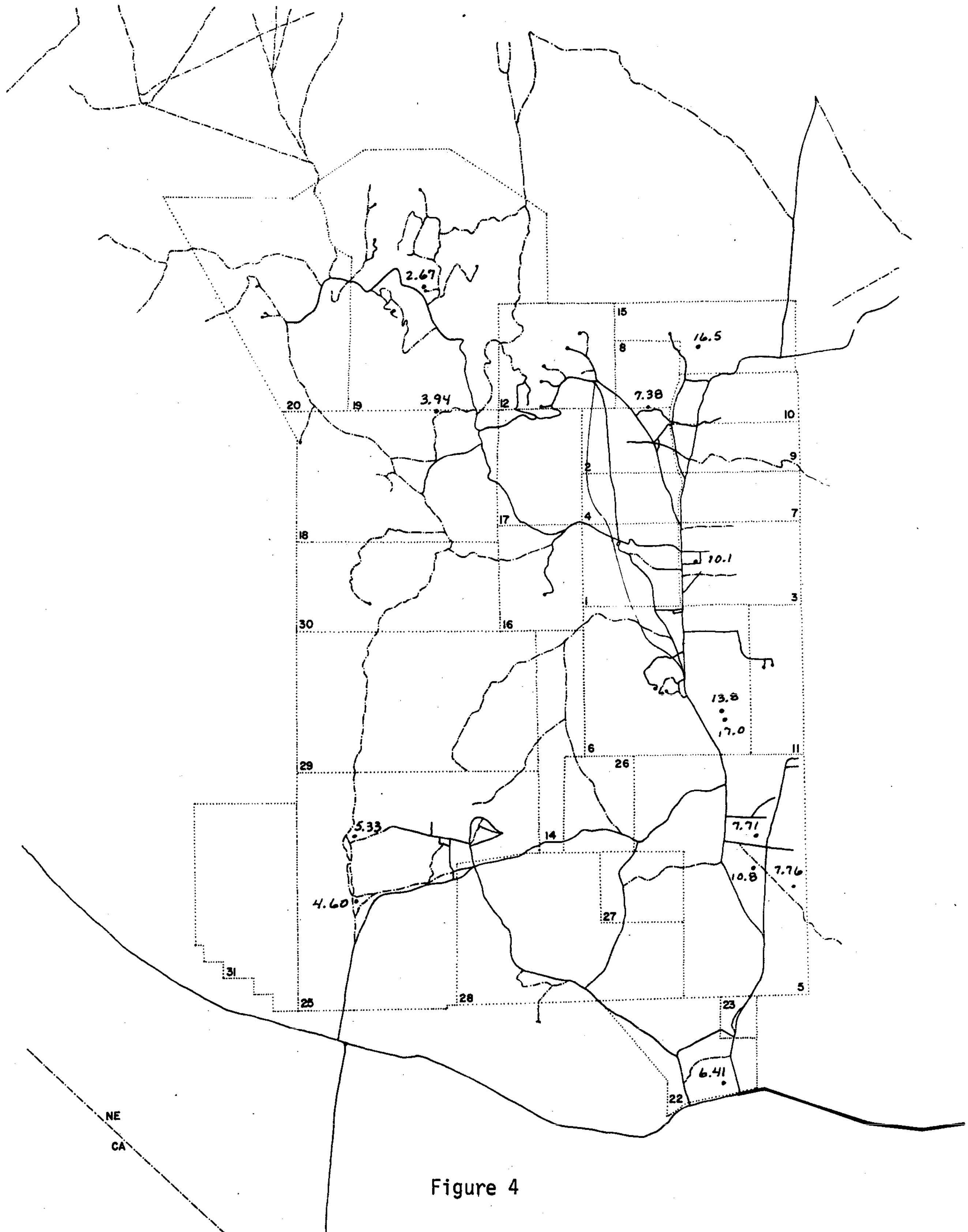


Figure 4

TABLE 7

AVERAGES OF SUPPLY WELL DATA FOR GROSS BETA

Station	Gross Beta Yearly Average (X 10^{-9} μCi/ml)
Area 2 Well 2	7.38
Area 3 Well A	10.12
Area 5 Well 5B	10.87
Area 5 Well 5C	7.76
Area 5 Well Ue5c	7.71
Area 6 Well C	13.83
Area 6 Well C1	17.05
Area 15 Well Ue15d	16.55
Area 18 Well 8	3.94
Area 22 Army Well #1	6.41
Area 25 Well J12	4.60
Area 25 Well J13	5.33
Area 19 Well U19c	2.67

discernible, verifying that no movement of radionuclides occurred in this NTS water system. The average of the entire network, as compared to averages from a previous report (Reference 9), was:

Year	Mean (X 10^{-9} μCi/ml)
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

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=[0.66 + 1.24 (potassium in mg/liter)] X 10^{-9} μCi/ml. The correlation coefficient was 0.96. 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.

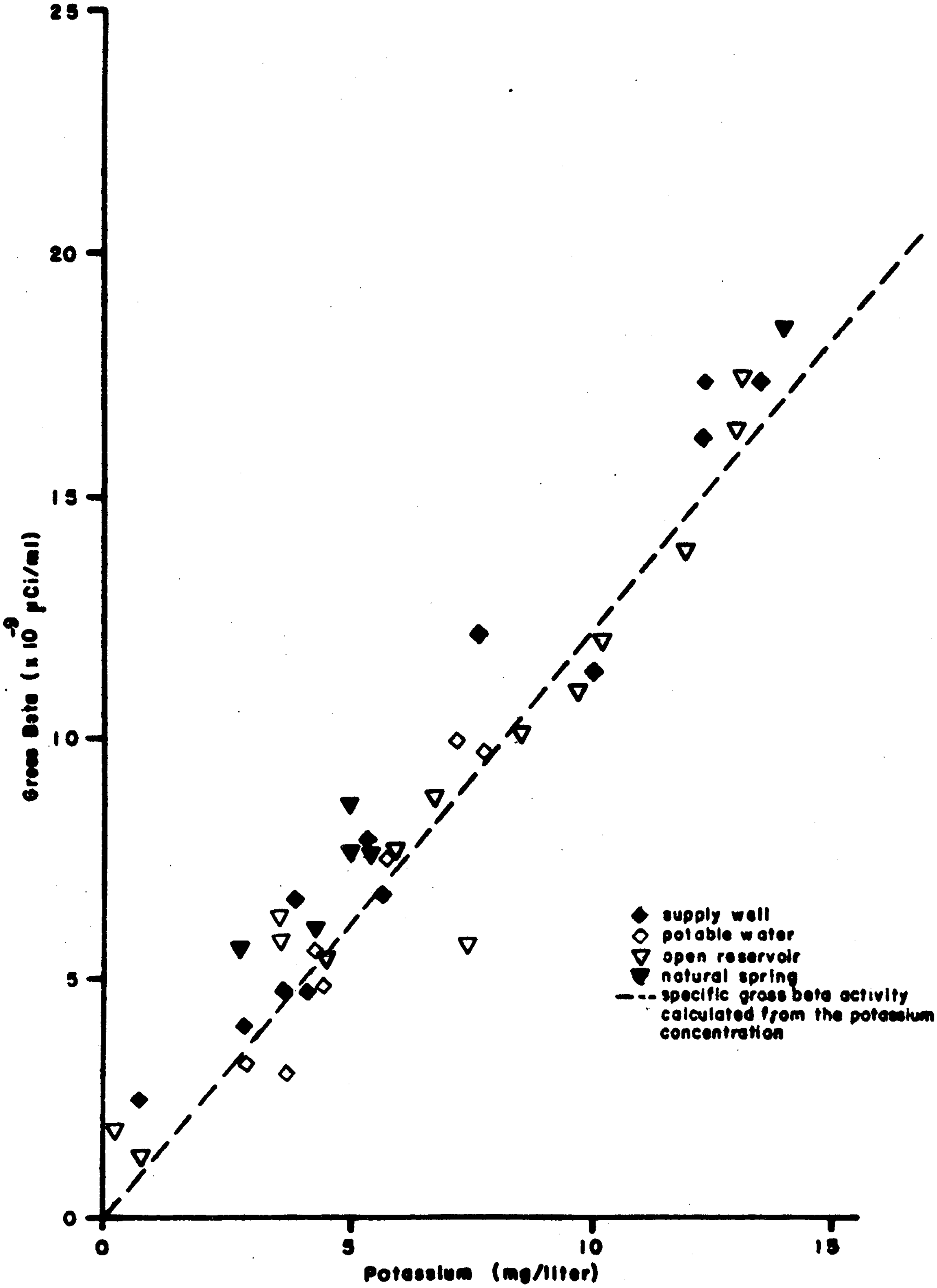


FIGURE 5 WATER RADIOACTIVITY vs. POTASSIUM CONCENTRATION

Figure 5

$$N\lambda = A$$

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

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

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

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

$$\text{Thus, } A(\text{dpm}) = \frac{(0.001)\ (N_o)(a)(\text{Ln } 2)}{(1.26 \times 10^9)(365.25)(1440)(\text{Atomic Mass})}$$

$$A(\mu Ci) = \frac{(0.001)(6.0225 \times 10^{23})(1.18 \times 10^{-4})(0.69315)}{(1.26 \times 10^9)(365.25)(1440)(39.1)(2.22 \times 10^6)}$$

$$A = 1.23 \times 10^{-6}\ \mu Ci/mg(\text{potassium})$$

$$A = 1.23 \times 10^{-9}\ \mu Ci/ml \text{ per mg/liter}$$

The calculated activity of 1.23×10^{-9} μCi/ml per mg/liter correlated well with 1.24×10^{-9} μCi/ml per mg/liter from the linear regression analysis of the supply well data. This demonstrated conclusively that naturally-occurring potassium was the determining factor of the radioactivity in the NTS water. No other radionuclides could give rise to more than ten percent of the measured gross beta activity.

Appendix C includes plots of the network monthly averages for tritium and plutonium. Due to the use of 10-ml for tritium samples the detection

TABLE 8

TRITIUM VALUES ABOVE DETECTION LIMITS FROM WATER SUPPLY DATA

WATER TYPE	STATION	DATE	μCi/ml
Potable Water	Area 2 Rest Room	01/21/80	.17E-06 ± 71.9%
		03/10/80	.23E-06 ± 53.8%
		04/22/80	.20E-06 ± 78.7%
		01/28/80	.17E-06 ± 88.6%
		01/07/80	.23E-06 ± 71.0%
Potable Water	Area 3 Cafe	01/21/80	.26E-06 ± 47.6%
		04/22/80	.28E-06 ± 57.1%
		03/17/80	.11E-04 ± 3.0%
		07/21/80	.12E-06 ± 98.4%
		01/28/80	.19E-06 ± 75.0%
		01/02/80	.15E-06 ± 79.4%
Potable Water	Area 6 Cascade Water	09/29/80	.21E-06 ± 58.8%
		02/25/80	.16E-06 ± 80.3%
		07/21/80	.30E-06 ± 42.7%
		01/20/80	.14E-06 ± 90.7%
		02/05/80	.33E-06 ± 38.3%
		11/24/80	.54E-06 ± 26.8%
		07/15/80	.29E-06 ± 41.5%
		11/17/80	.28E-06 ± 49.6%
		02/19/80	.15E-06 ± 86.7%
		10/14/80	.31E-06 ± 41.6%
		07/28/80	.18E-06 ± 66.6%
		03/10/80	.59E-06 ± 26.9%
		11/01/80	.40E-06 ± 35.4%
		04/07/80	.33E-06 ± 48.7%
		12/02/80	.42E-06 ± 33.6%
		08/18/80	.17E-06 ± 74.3%
		08/27/80	.35E-06 ± 36.4%
		04/29/80	.23E-06 ± 75.6%
		09/03/80	.32E-06 ± 41.1%
		08/04/80	.32E-06 ± 37.3%
		03/24/80	.11E-04 ± 2.8%
		09/08/80	.26E-06 ± 47.6%
		03/03/80	.22E-06 ± 67.8%
		05/19/80	.15E-06 ± 87.0%
		03/17/80	.17E-05 ± 11.1%
		08/11/80	.26E-06 ± 46.2%
		01/28/80	.26E-06 ± 60.5%
		06/30/80	.45E-06 ± 28.5%
		01/02/80	.23E-06 ± 67.8%
		09/15/80	.17E-06 ± 73.2%
		02/11/80	.32E-06 ± 43.7%
		05/27/80	.18E-06 ± 74.2%
		01/14/80	.23E-06 ± 67.8%
		04/14/80	.27E-06 ± 82.2%
		01/21/80	.40E-06 ± 32.1%

Table 8 (continued)

WATER TYPE	STATION	DATE	μCi/ml
Potable Water	Area 6 Cafe	03/24/80	.23E-05 ± 84.0%
		10/14/80	.21E-06 ± 58.6%
		12/02/80	.22E-06 ± 63.2%
		03/31/80	.33E-04 ± 2.2%
		11/24/80	.14E-06 ± 97.4%
		12/29/80	.13E-06 ± 91.7%
		08/04/80	.13E-06 ± 91.0%
		07/15/80	.15E-06 ± 80.6%
		07/21/80	.17E-06 ± 68.3%
		03/17/80	.13E-05 ± 14.0%
Potable Water	Area 12 Cafe	12/01/80	.15E-06 ± 88.2%
		04/22/80	.18E-06 ± 88.7%
		01/02/80	.15E-06 ± 83.8%
		03/25/80	.11E-05 ± 23.4%
		03/17/80	.52E-05 ± 4.8%
Potable Water	Area 23 Cafe	11/24/80	.14E-06 ± 97.2%
		12/02/80	.15E-06 ± 89.4%
		04/07/80	.19E-06 ± 84.1%
		03/24/80	.64E-06 ± 24.3%
		03/31/80	.10E-05 ± 24.3%
		03/10/80	.40E-06 ± 38.0%
		01/21/80	.13E-06 ± 93.2%
Potable Water	Area 27 Cafe	12/02/80	.18E-06 ± 75.7%
		03/10/80	.23E-06 ± 67.0%
		03/24/80	.10E-05 ± 16.0%
		01/07/80	.24E-06 ± 71.0%
Potable Water	Area 25 Service Station	11/24/80	.14E-06 ± 96.2%
		03/24/80	.40E-05 ± 5.7%
		02/05/80	.39E-06 ± 38.9%
Natural Springs	Area 5 Cane Springs	03/25/80	.73E-06 ± 22.8%
Natural Springs	Area 12 Captain Jack Springs	11/21/80	.21E-06 ± 66.3%
Natural Springs	Area 12 Gold Meadows	10/30/80	.34E-06 ± 44.8%
		07/30/80	.25E-06 ± 49.2%
		09/19/80	.19E-06 ± 67.4%
Natural Springs	Area 15 Oak Springs	11/21/80	.32E-06 ± 42.5%
		06/27/80	.15E-06 ± 77.8%
		03/26/80	.44E-06 ± 54.8%
Natural Springs	Area 15 Tub Springs	06/27/80	.23E-06 ± 55.4%
		02/21/80	.23E-06 ± 54.6%
		01/18/80	.57E-06 ± 24.8%
		08/05/80	.15E-06 ± 80.1%
		09/18/80	.16E-06 ± 77.5%
		03/11/80	.13E-05 ± 13.1%
		07/22/80	.16E-06 ± 76.3%

WATER TYPE	STATION	DATE	µCi/ml
Natural Springs	Area 29 Tippipah Springs	07/22/80	.21E-06 ± 59.9%
		08/13/80	.23E-06 ± 55.1%
		09/17/80	.15E-06 ± 86.3%
Natural Springs	Area 7 Reitmann Seep	09/11/80	.29E-06 ± 52.0%
		06/17/80	.16E-06 ± 89.3%
		08/14/80	.27E-06 ± 52.2%
		07/23/80	.49E-06 ± 32.9%
Open Reservoir	Well A Reservoir	03/25/80	.11E-04 ± 3.0%
Open Reservoir	Well 5B Reservoir	11/03/80	.71E-05 ± 3.7%
		12/10/80	.40E-06 ± 36.4%
		09/10/80	.25E-06 ± 54.0%
		03/25/80	.23E-06 ± 24.1%
		07/02/80	.27E-06 ± 46.9%
		01/03/80	.20E-06 ± 65.2%
		10/02/80	.44E-06 ± 32.7%
		08/13/80	.24E-06 ± 52.7%
Open Reservoir	UE5c Reservoir	12/10/80	.27E-06 ± 51.0%
		11/18/80	.33E-06 ± 43.6%
		06/05/80	.13E-06 ± 94.9%
		03/25/80	.19E-05 ± 10.1%
		09/10/80	.13E-06 ± 92.1%
		02/06/80	.22E-06 ± 67.8%
		01/03/80	.33E-06 ± 41.7%
Open Reservoir	Well 3 Reservoir	01/16/80	.16E-06 ± 76.2%
		07/02/80	.15E-06 ± 80.2%
		08/13/80	.17E-06 ± 73.1%
Open Reservoir	Well C1 Reservoir	12/10/80	.23E-06 ± 58.9%
		11/18/80	.19E-06 ± 72.9%
		08/14/80	.17E-06 ± 69.1%
		07/02/80	.15E-06 ± 83.2%
Open Reservoir	Well UE15D Reservoir	12/23/80	.17E-06 ± 71.3%
		11/18/80	.37E-06 ± 38.3%
		03/04/80	.45E-05 ± 5.2%
		01/18/80	.44E-06 ± 30.3%
		02/12/80	.25E-06 ± 50.4%
Open Reservoir	Camp 17 Reservoir	04/04/80	.10E-05 ± 24.3%
		08/07/80	.14E-06 ± 86.9%
Open Reservoir	Well 20A Reservoir	07/22/80	.15E-06 ± 83.5%
		08/07/80	.13E-06 ± 93.7%
Open Reservoir	Area 23 Swimming Pool	10/03/80	.14E-06 ± 83.9%
Open Reservoir	Well U19C Reservoir	03/11/80	.22E-06 ± 67.8%
		08/07/80	.18E-06 ± 68.5%

Table 8 (continued)

WATER TYPE	STATION	DATE	µCi/ml
Open Reservoir	Area 3 Mud Plant Reservoir	08/13/80	.16E-06 ± 72.5%
		07/02/80	.17E-06 ± 70.3%
		10/03/80	.14E-06 ± 88.3%
Open Reservoir	Area 2 Mud Plant Reservoir	10/03/80	.15E-06 ± 82.1%
		04/04/80	.32E-05 ± 9.3%
Open Reservoir	Well J-11 Reservoir	01/17/80	.16E-06 ± 76.2%
Open Reservoir	Well 8 Reservoir	11/18/80	.84E-06 ± 18.6%
		07/22/80	.16E-06 ± 76.6%
Open Reservoir	Area 5 Swimming Pool	11/18/80	.98E-05 ± 3.1%
Supply Well	Well 2	03/04/80	.35E-03 ± 0.4%
Supply Well	Well 5B	10/05/80	.13E-05 ± 18.9%
Supply Well	Well 5C	10/05/80	.12E-05 ± 19.3%
Supply Well	Well UE5C	10/05/80	.10E-05 ± 21.2%
		07/02/80	.26E-06 ± 48.9%
Supply Well	Well C1	03/04/80	.20E-06 ± 80.8%
		04/15/80	.78E-06 ± 30.7%
		10/03/80	.13E-06 ± 93.9%
		01/16/80	.21E-06 ± 58.7%
Supply Well	Army Well #1	10/05/80	.24E-05 ± 14.3%
Supply Well	Well J-13	10/05/80	.27E-05 ± 13.2%
Supply Well	Well U19C	08/09/80	.12E-06 ± 97.5%
Contaminated Pond	Middle Haines #3	02/28/80	.32E-02 ± 1.0%
Contaminated Pond	Lower Haines #4	02/28/80	.27E-01 ± 0.9%
Contaminated Pond	Upper Mint Lake	09/15/80	.61E-03 ± 1.0%
		05/14/80	.11E-02 ± 1.0%
		04/15/80	.48E-03 ± 1.0%
		06/25/80	.13E-02 ± 1.0%
Contaminated Pond	Upper N Pond	05/16/80	.43E-02 ± 0.9%
		11/20/80	.48E-02 ± 0.9%
		06/25/80	.47E-02 ± 0.9%
		10/30/80	.17E-02 ± 1.0%
Contaminated Pond	Hand S Sump	04/18/80	.20E-03 ± 1.0%
		08/20/80	.19E-05 ± 9.6%
Contaminated Pond	Yucca Waste Pond	09/15/80	.18E-06 ± 75.9%
		11/20/80	.50E-06 ± 28.4%
		02/28/80	.51E-05 ± 5.7%

Table 8 (continued)

WATER TYPE	STATION	DATE	μCi/ml
Contaminated Pond	Yucca Waste Pond (Cont)	08/20/80	.11E-05 ± 15.5%
		05/14/80	.67E-06 ± 23.8%
		10/27/80	.18E-06 ± 76.3%
		04/15/80	.63E-06 ± 27.0%
		06/30/80	.35E-06 ± 39.9%
Effluent Pond	Yucca Steam #2	10/27/80	.58E-06 ± 26.0%
		07/29/80	.13E-06 ± 93.5%
		09/18/80	.16E-06 ± 91.4%
		11/18/80	.63E-06 ± 27.2%
		08/19/80	.16E-06 ± 84.2%

TABLE 9

PLUTONIUM VALUES ABOVE DETECTION LIMITS FROM WATER SUPPLY DATA

WATER TYPE	STATION	DATE	µCi/ml
Potable Water	Area 2 Rest Room	09/16/80	.31E-10 ± 65.9%
Potable Water	Area 3 Cafe	09/15/80	.60E-10 ± 42.1%
Potable Water	Area 6 Cascade Water	09/15/80	.58E-10 ± 74.6%
Potable Water	Area 6 Cafe	12/02/80	.23E-10 ± 94.6%
		09/15/80	.21E-10 ± 94.6%
Potable Water	Area 12 Cafe	09/16/80	.41E-10 ± 74.3%
Potable Water	Area 23 Cafe	09/15/80	.29E-10 ± 65.9%
Potable Water	Area 27 Cafe	06/16/80	.45E-10 ± 96.4%
		09/15/80	.32E-10 ± 79.5%
Potable Water	Area 25 Service Station	09/15/80	.21E-10 ± 79.3%
		12/02/80	.24E-10 ± 94.7%
Natural Springs	Area 5 Cane Springs	06/18/80	.14E-10 ± 94.9%
		09/17/80	.26E-10 ± 93.9%
Natural Springs	Area 12 Captain Jack Springs	09/19/80	.65E-10 ± 60.4%
Natural Springs	Area 12 Gold Meadows	09/19/80	.26E-10 ± 79.4%
Natural Springs	Area 15 Oak Springs	06/19/80	.27E-10 ± 74.1%
		09/19/80	.40E-10 ± 65.8%
Natural Springs	Area 29 Topopah Springs	06/17/80	.33E-10 ± 69.7%
		09/17/80	.37E-10 ± 74.2%
Natural Springs	Area 7 Reitmann Seep	09/11/80	.42E-10 ± 59.8%
		06/11/80	.63E-10 ± 48.9%
Open Reservoir	Well 2 Reservoir	09/12/80	.46E-10 ± 66.2%
Open Reservoir	Well A Reservoir	09/11/80	.30E-10 ± 69.7%
		12/11/80	.30E-10 ± 69.7%
Open Reservoir	Well 5B Reservoir	09/10/80	.31E-10 ± 79.5%
Open Reservoir	UE5C Reservoir	09/10/80	.92E-10 ± 95.9%
Open Reservoir	Well 3 Reservoir	09/12/80	.32E-10 ± 69.7%
Open Reservoir	Well C1 Reservoir	09/10/80	.22E-10 ± 86.0%

Table 9 (continued)

WATER TYPE	STATION	DATE	µCi/ml
Open Reservoir	Well UE15D Reservoir	09/12/80 12/23/80	.43E-10 ± 51.7% .20E-10 ± 94.6%
Open Reservoir	Well 20A Reservoir	12/11/80	.22E-10 ± 94.6%
Open Reservoir	Area 23 Swimming Pool	03/25/80 09/12/80 12/23/80	.15E-10 ± 94.9% .21E-10 ± 79.4% .16E-10 ± 94.5%
Open Reservoir	Well U19C Reservoir	09/10/80	.22E-10 ± 85.4%
Open Reservoir	Area 3 Mud Plant Reservoir	06/13/80 09/11/80 12/11/80	.17E-10 ± 95.0% .32E-10 ± 60.0% .32E-10 ± 60.0%
Open Reservoir	Area 2 Mud Plant Reservoir	09/12/80	.15E-10 ± 94.5%
Open Reservoir	Well 8 Reservoir	09/12/80 12/23/80	.43E-10 ± 57.6% .43E-10 ± 57.6%
Supply Well	Well 2	09/11/80	.13E-10 ± 94.5%
Supply Well	Well A	03/04/80	.26E-10 ± 86.8%
Supply Well	Well 5B	12/06/80	.26E-10 ± 86.1%
Supply Well	Well 5C	12/06/80	.26E-10 ± 79.4%
Supply Well	Well UE5C	09/13/80	.15E-10 ± 94.5%
Supply Well	Well C1	12/09/80	.25E-10 ± 94.7%
Supply Well	Well UE15D	09/12/80	.20E-10 ± 86.0%
Supply Well	Well 8	12/08/80	.26E-10 ± 94.7%
Supply Well	Army Well #1	09/13/80 12/06/80	.19E-10 ± 79.3% .32E-10 ± 79.5%
Supply Well	Well J-13	09/15/80 12/06/80 06/14/80	.17E-10 ± 94.5% .25E-10 ± 86.1% .71E-10 ± 86.0%
Supply Well	Well U19C	12/08/80	.36E-10 ± 69.8%
Contaminated Pond	Upper N Pond	09/15/80	.17E-10 ± 94.5%
Contaminated Pond	Yucca Waste Pond	09/15/80 03/27/80	.30E-10 ± 79.5% .56E-09 ± 18.2%
Effluent Pond	Area 6 Final Effluent Pond	10/23/80	.29E-10 ± 74.1%
Effluent Pond	Area 23 Final Effluent Pond	07/24/80	.99E-10 ± 69.9%

Table 9 (continued)

WATER TYPE	STATION	DATE	µCi/ml
Effluent Pond	Area 6 Yucca #1	07/24/80	.41E-10 ± 62.9%
Effluent Pond	Yucca Steam #1	09/18/80	.30E-10 ± 65.9%
Effluent Pond	Yucca Steam #2	09/18/80	.65E-10 ± 62.5%

limit has been decreased, therefore giving rise to more positive tritium sample results as compared to CY-1979. These positive tritium results are given in Table 8. The highest value was 3.5×10^{-4} μCi/ml from Well 2. This is 11.7 percent of the concentration guide for tritium in drinking water. The majority of the positive measurements are near the detection limits of the system. The positive values with the high percentage error are assumed to be caused by a fluctuation of the counter.

There are 14 plutonium positive results given in Table 9. The highest value was 3.6×10^{-11} for Well U19c. This represents 0.0007 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. <u>Potable Water</u>

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

NTS ENVIRONMENTAL SURVEILLANCE
POTABLE WATER SAMPLING STATION
(GROSS BETA YEARLY AVERAGES X10^{-9} μ Ci/ml)

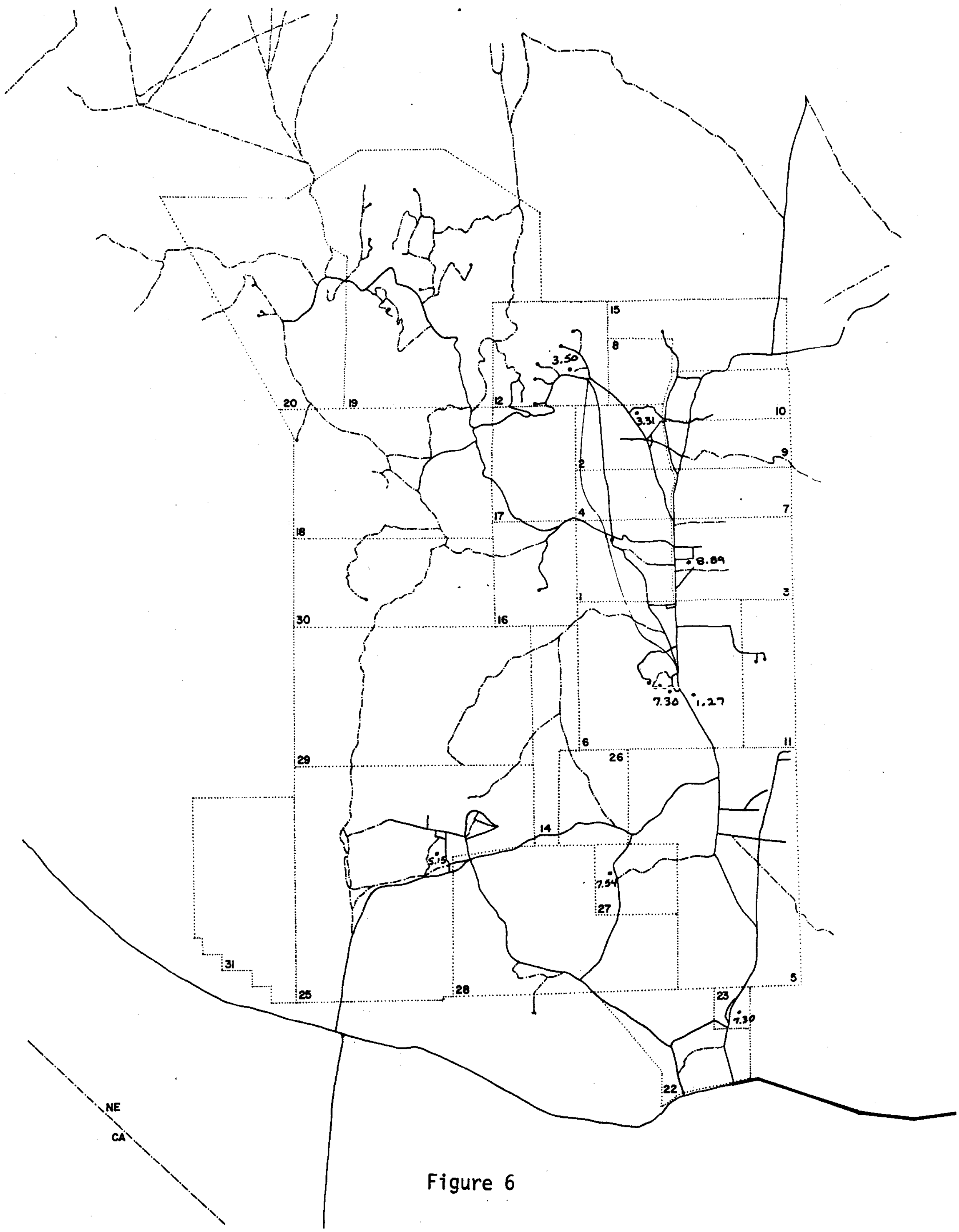


Figure 6

TABLE 10

AVERAGES OF POTABLE WATER DATA FOR GROSS BETA

Station	Gross Beta Yearly Average ($X 10^{-9}$ μCi/ml)
Area 2 Restroom	3.31
Area 3 Cafeteria	8.89
Area 6 Cascade Water	1.75
Area 6 Cafeteria	8.98
Area 12 Cafeteria	3.50
Area 23 Cafeteria	7.30
Area 27 Cafeteria	7.29
Area 25 Service Station	5.15

gross beta activity measured at each sample location for the calendar year 1980. The highest average recorded was 8.98 X 10^{-9} μCi/ml at the Area 6 Cafeteria. This was 3.0 percent of the CG for drinking water assuming ^{90}Sr to be the most radiotoxic beta emitter present. The lowest gross beta activity, excluding Cascade bottled water, was 3.31 X 10^{-9} μCi/ml at the Area 12 Cafeteria. 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-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. The potable water results lie very close to the line calculated from the

TABLE 11

COMPARISON OF END USE AND SUPPLY WATER

FOR GROSS BETA AVERAGES

(X 10^{-9} µCi/ml)

Station (end use/supply)	CY-1979
Area 2 Restroom	3.31
Area 18 Well 8	3.94
Area 3 Cafeteria	8.89
Area 3 Well A	10.12
Area 6 Cascade Water	1.75
(Demineralized Bottled Water)	--
Area 6 Cafeteria	8.98
Area 6 Well C/C1	13.83/17.05
Area 12 Cafeteria	3.50
Area 18 Well 8	3.94
Area 23 Cafeteria	7.30
Area 5 Well 5B/5C	10.87/7.76
Area 22 Army Well #1	6.41
Area 27 Cafeteria	7.29
Area 5 Well 5B/5C	10.87/7.76
Area 22 Army Well #1	6.41

specific activity of the associated potassium results. The linear regression of the potable water data was: Gross Beta=[-0.05 + 1.28 (potassium in mg/liter)] X 10^{-9} μCi/ml. The correlation coefficient was 0.970.

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 3.3 x 10^{-5} μCi/ml for Area 6 Cafeteria. This is 1.1 percent of the concentration guide for tritium in drinking water. The majority of the positive measurements are near the detection limit of the system. The positive values with a high percentage error are believed to be caused by fluctuations in the counting system. There were 35 positive tritium samples in the Cascade water. It is believed that the large number of tritium positives in the Cascade water may be due to tritium present in the air near the Cascade water storage area (Reference 9). There are eleven positive plutonium results for potable water in Table 9. The highest value was 6.0 x 10^{-11} μCi/ml from the Area 3 Cafeteria. This represents 0.001 percent of the concentration guide for ^{239}Pu. All of the plutonium positives have a relatively high percentage error associated with them which indicates they may be caused by fluctuation of the counter.

3. Open Reservoirs

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

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

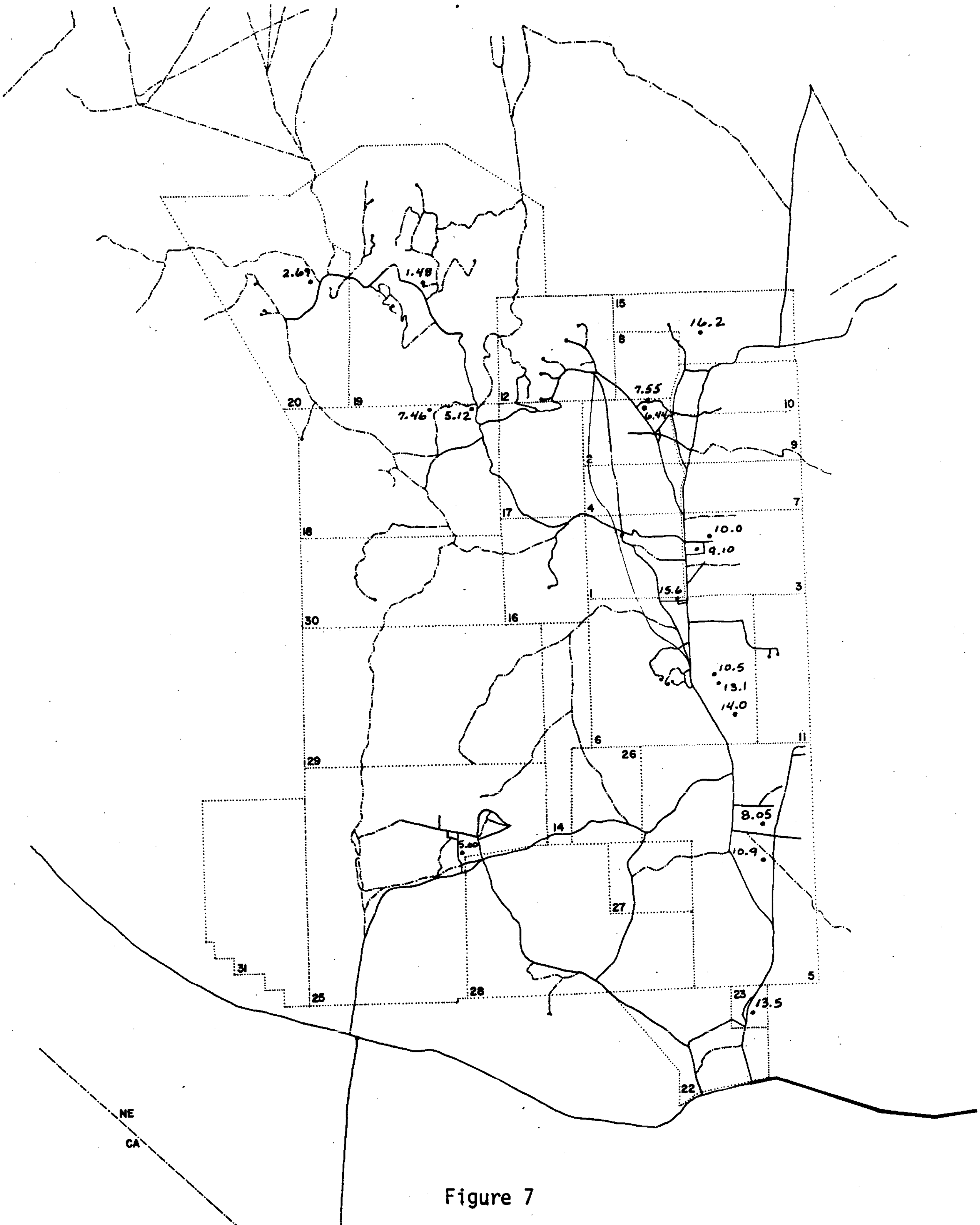


Figure 7

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-1980.

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-1980 gross beta averages at each location. The highest beta content was 1.61×10^{-8} µCi/ml at Well Ue15d Reservoir. This result was 0.16 percent of the concentration guide (Table 2). The lowest gross beta average was 1.48×10^{-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 ($\times 10^{-9}$ µCi/ml)
CY-1980	8.1
CY-1979	10.9
CY-1978	13.1
July-December 1977	19.4
FY-1977	19.6
FY-1976	22.0

TABLE 12

AVERAGES OF OPEN RESERVOIR DATA FOR GROSS BETA

Station	Gross Beta Yearly Average (X 10^{-9} μCi/ml)
Area 2 Well 2 Reservoir	7.55
Area 3 Well A Reservoir	9.10
Area 5 Well 5B Reservoir	10.90
Area 5 Well Ue5c Reservoir	8.05
Area 6 Well 3 Reservoir	15.56
Area 6 Well C1 Reservoir	14.00
Area 15 Well Ue15d Reservoir	16.17
Area 18 Camp 17 Reservoir	5.12
Area 20 Well 20A Reservoir	2.69
Area 23 Swimming Pool	13.46
Area 19 Well U19c Reservoir	1.48
Area 3 Mud Plant Reservoir	10.01
Area 2 Mud Plant Reservoir	6.44
Area 25 Well J-11 Reservoir	5.00
Area 18 Well 8 Reservoir	7.46
Area 5 Swimming Pool	3.80

TABLE 13

COMPARISON OF OPEN RESERVOIRS AND SUPPLY WATER FOR GROSS BETA AVERAGES

($X\ 10^{-9}$ μCi/ml)

Station (Reservoir/Supply)	CY-1980
Area 2 Well 2 Reservoir	7.55
Area 2 Well 2	7.38
Area 3 Well A Reservoir	8.38
Area 3 Well A	10.12
Area 5 Well 5B Reservoir	10.90
Area 5 Well 5B	10.87
Area 5 Well Ue5c Reservoir	8.05
Area 5 Well Ue5c	7.71
Area 6 Well C1 Reservoir	14.00
Area 6 Well C1	17.05
Area 15 Well Ue15d Reservoir	12.78
Area 15 Well Ue15d	15.41
Area 19 Well U19c Reservoir	1.48
Area 19 Well U19c	2.67

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 seem to be evidence for the theory of increased dissolved solids and worldwide fallout for open bodies of water.

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. The highest tritium concentration was 1.1×10^{-5} μCi/ml or 0.011 percent of the tritium concentration guide. The highest plutonium concentration was 9.2×10^{-11} μCi/ml or 0.00009 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. Human consumption was insignificant. 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 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

NTS ENVIRONMENTAL SURVEILLANCE
NATURAL SPRING SAMPLING STATION
(GROSS BETA YEARLY AVERAGES X10^{-9} μ Ci/ml)

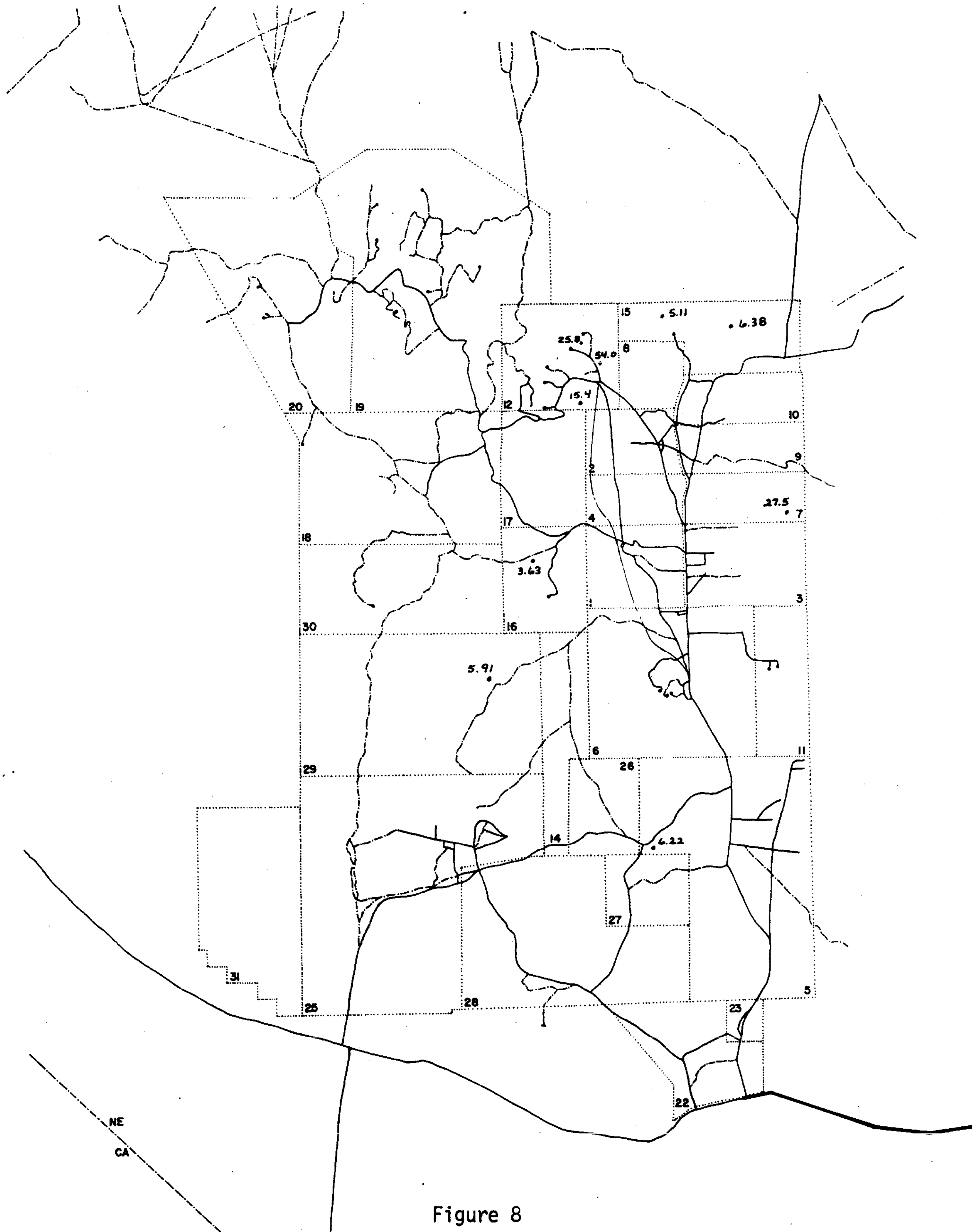


Figure 8

TABLE 14

AVERAGES OF NATURAL SPRINGS DATA FOR GROSS BETA

Station		Gross Beta Yearly Average (X 10^{-9} μCi/ml)
Area 5	Cane Spring	6.22
Area 12	White Rock Spring	53.97
Area 12	Captain Jack Spring	15.45
Area 12	Gold Meadows Pond	25.78
Area 15	Oak Butte Spring	5.11
Area 15	Tub Spring	6.38
Area 29	Topopah Spring	5.91
Area 7	Reitmann Seep	27.53
Area 16	Tippipah Spring	3.63

averages at each location. The highest average recorded was 5.40 X 10^{-8} $\mu Ci/ml$ at White Rock Spring. This was 0.5 percent of the CG (assuming ^{90}Sr to be the most radiotoxic beta emitter present). The lowest beta activity was 3.6 X 10^{-9} $\mu Ci/ml$ at Tippipah Spring.

The most significant gross beta results were found at the White Rock Spring. Highly variable, it has been demonstrated for several years that the substantial increases were due to surface runoff of contaminated soils after rains. This was shown by the cyclic nature of activity that was related to the rainy seasons. The region, Area 12, was exposed to fallout from atmospheric tests and the Baneberry release in 1970. The other locations showed no significant trends in their plots. White Rock Spring, and Reitmann Seep were all above the gross beta results calculated from their potassium concentrations as shown in Figure 5. This indicated that there were excess radionuclides in these waters.

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

Year	Mean (X 10^{-9} $\mu Ci/ml$)
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 1.3 x 10^{-6} $\mu Ci/ml$ at Tub

Springs. This represents 0.001 percent of the concentration guide for tritium. The highest plutonium value was 6.5×10^{-11} μCi/ml at Captain Jack Springs. This is 0.00006 percent of the concentration guide for plutonium. The positive results for tritium and plutonium are listed in Tables 8 and 9.

5. Contaminated Ponds

Four 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 Manual Chapter 0513 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 four active stations. The first two pages of Appendix G contain the contaminated pond network averages and the remaining plots show the gross beta for each station. The differences between CY-1979 and CY-1980 can be attributed to the decrease or increase in use of the ponds respectively.

6. Effluent Ponds

Samples from eight effluent pond locations were collected during CY-1980. These ponds are closed systems which contain both sanitary and radioactive waste for evaporative treatment. Contact with the working

NTS ENVIRONMENTAL SURVEILLANCE
CONTAMINATED POND SAMPLING STATION
(GROSS BETA YEARLY AVERAGES X10^{-9} μ Ci/ml)

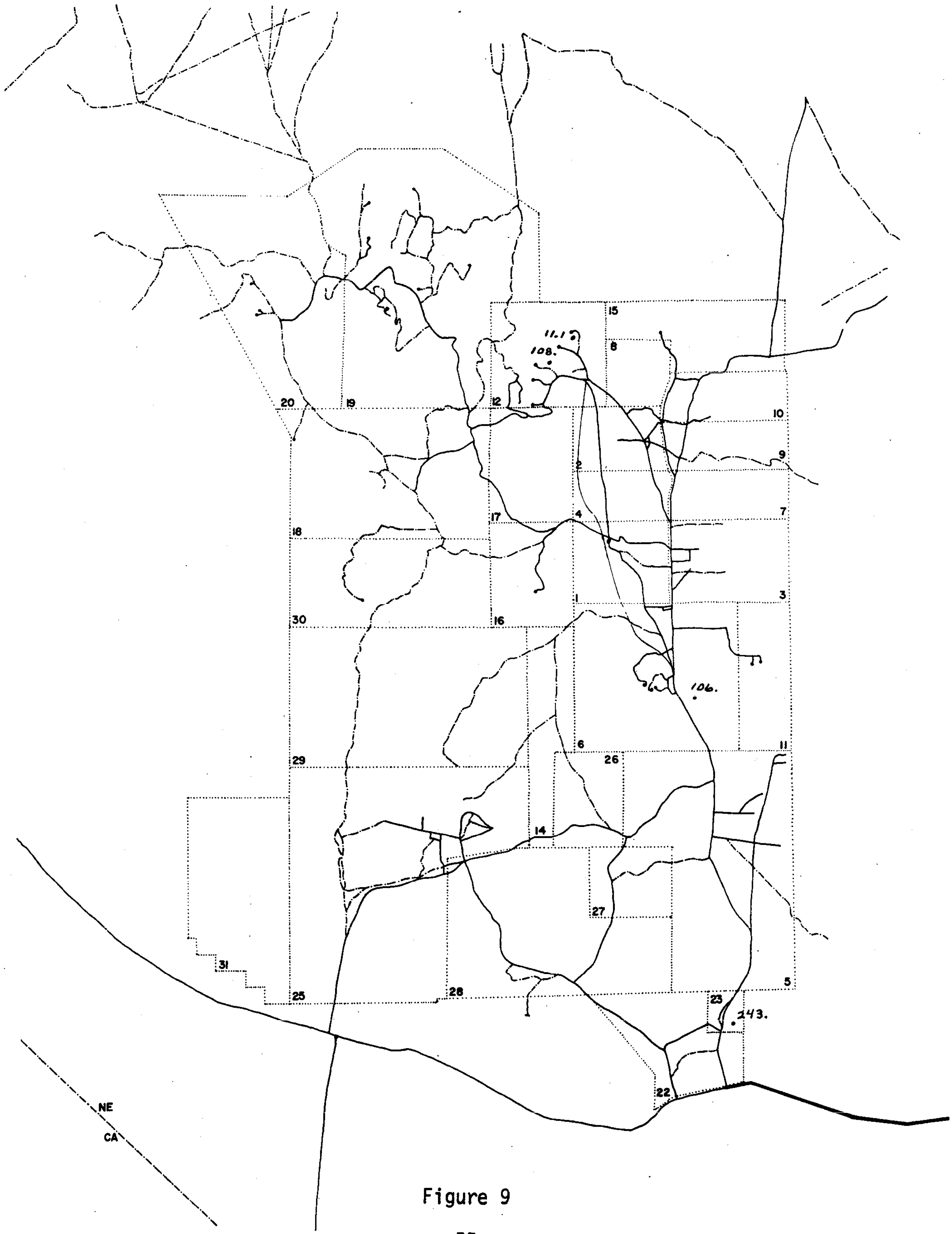


Figure 9

TABLE 15

AVERAGES OF CONTAMINATED PONDS FOR GROSS BETA

Station	Gross Beta Yearly Average ($X\ 10^{-9}\ \mu Ci/ml$)
Area 12 Mint Upper	11
Area 12 N Upper	108
Area 23 H&S Sump	243
Area 6 Yucca Decontamination Pond	106

population was minimal. The five positive tritium and four positive plutonium results were given in Table 8 and 9. The highest tritium value was 5.8×10^{-7} μCi/ml and 9.9×10^{-11} μCi/ml for plutonium. All results are within the applicable concentration guides.

F. AMBIENT GAMMA MONITORING

A program to measure the ambient gamma exposure rates on the NTS was established in 1977 with 21 stations. In CY-1978, the program was expanded to 86 locations, 139 stations in CY-1979, and 152 stations in CY-1980. 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 consistent data throughout the year and compared well to the 1977, 1978, and 1979 data. Table 17 summarizes the nine locations average dose rates for the four years. The largest variance was only 0.03 mrem/d. The overall network range of these stations was 0.16 mrem/d to 0.37 mrem/d, with an average NTS background of approximately 0.27 mrem/d (99 mrem/y). This corresponds favorably with rates measured at offsite Nevada locations by the Environmental Protection Agency (Reference 11).

TABLE 16
GAMMA MONITORING RESULTS - SUMMARY OF 1980

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1979 ADJUSTED ANNUAL DOSE (mrem/y)	1980 ADJUSTE ANNUAL DOSE (mrem/y)
A-90 Road (18)	08/01/80 - 01/27/81	0.47	0.47	0.47		170
A-100 Road (18)	08/01/80 - 01/27/81	0.54	0.33	0.44		160
A-108 Road (18)	08/01/80 - 01/27/81	0.49	0.47	0.48		175
A-116 Road (20)	08/01/80 - 01/27/81	0.58	0.46	0.52		190
A-130 Road (20)	08/01/80 - 01/27/81	0.48	0.33	0.40		145
A-132 Road (20)	07/03/80 - 01/21/81	0.50	0.40	0.45		165
A-136 Road (20)	07/08/80 - 12/16/80	0.24	0.22	0.23		85
Angle Road (3)	01/10/80 - 01/21/81	1.96	1.80	1.87	730	685
Bldg. 190 (23)	01/09/80 - 12/16/80	0.24	0.17	0.21	55	75
Bldg. 610 Fence (23)	01/09/80 - 12/16/80	0.19	0.14	0.17	58	60
Bldg. 610 X-Ray Area (23)	01/09/80 - 12/16/80	4.07	1.47	2.99	2800	1090
Bldg. 650 Dosimetry Room (23)	01/09/80 - 12/16/80	0.20	0.15	0.18	62	65
Bldg. 650 Roof (23)	01/09/80 - 12/16/80	0.17	0.14	0.16	55	60
Bldg. 650 Sample Storage (23)	01/09/80 - 12/16/80	1.21	0.41	.74	440	270
B.J.Y. (3)	01/11/80 - 01/27/81	0.41	0.36	0.39	130	140
C-16 Road (19)	07/03/80 - 01/21/81	0.53	0.34	0.44		160
C-25 Road (19)	07/03/80 - 01/21/81	0.58	0.47	0.53		195
C-27 Road (19)	07/03/80 - 01/21/81	0.58	0.53	0.56		205
C-31 Road (19)	07/03/80 - 01/21/81	0.55		0.55		200
Cable Yard (2)	01/11/80 - 01/28/81	0.47	0.41	0.44	155	160
Cafeteria (3)	01/10/80 - 01/21/81	0.37	0.28	0.35	130	130
Cafeteria (27)	01/09/80 - 12/16/80	0.39	0.29	0.37	130	135
Campsite	07/03/80 - 01/21/81	0.47	0.44	0.45		165
Circle & L Road (10)	01/11/80 - 01/28/81	0.46	0.44	0.45	155	165
Complex (12)	01/10/80 - 01/22/81	0.38	0.37	0.37	145	135
CP Complex (6)	01/11/80 - 01/27/81	0.25	0.19	0.23	77	85
CP-50 Calibration Bench (6)	01/11/80 - 01/27/81	0.46	0.33	0.38	145	140
CP-50 Instrument Calib. Door (6)	01/11/80 - 01/27/81	0.60	0.53	0.56	265	205
CA-14 (10)	01/11/80 - 01/28/81	0.53	0.50	0.51	195	185
Decon Pad Front Office (6)	01/11/80 - 01/27/81	0.31	0.25	0.29	100	105
Decon Pad Back Office (6)	01/11/80 - 01/27/81	0.43	0.29	0.35	185	130
Desert Rock Weather Stn. (22)	01/09/80 - 12/16/80	0.21	0.17	0.19	60	70
E-MAD East (25)	01/09/80 - 12/16/80	0.36	0.30	0.34	115	125
E-MAD North (25)	01/09/80 - 12/16/80	1.14	0.81	0.97	260	355
E-MAD Tile Bed (25)	01/09/80 - 12/16/80	0.37	0.31	0.34	120	125
E-MAD West (25)	01/09/80 - 12/16/80	0.37	0.32	0.35	120	130
EPA Farm (15)	01/11/80 - 01/28/81	0.38	0.35	0.36	115	130
F-2 Road (20)	07/03/80 - 01/21/81	0.50	0.47	0.49		180
F-8 Road (20)	07/03/80 - 01/21/81	0.60	0.27	0.44		160
F-12 Road (20)	07/03/80 - 01/21/81	0.47	0.21	0.34		125
Gate 100 (23)	01/09/80 - 12/16/80	0.19	0.16	0.18	60	65
Gate 700 (15)	01/11/80 - 01/28/81	0.35	0.22	0.30	100	110
Gravel Pit (1)	01/10/80 - 01/27/81	0.38	0.32	0.35	115	130
Groom Pass L43.5 (15)	01/11/80 - 11/28/81	0.43	0.37	0.40	130	145
Henre Site (28)	01/09/80 - 12/16/80	0.39	0.30	0.35	120	130
J-6 Road (20)	07/03/80 - 01/21/81	0.53	0.48	0.51		185

Table 16 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1979 ADJUSTED ANNUAL DOSE (mrem/y)	1980 ADJUSTED ANNUAL DOSE (mrem/y)
J-16 Road (20)	07/03/80 - 01/21/81	0.50	0.25	0.38		140
J-24 Road (20)	07/03/80 - 01/21/81	0.52	0.27	0.40		145
J-31 Road (20)	07/03/80 - 01/21/81	2.32	1.99	2.16		790
Lamp Shack (15)	01/11/80 - 01/28/81	0.41	0.32	0.39	130	140
LLL Trailer (15)	01/11/80 - 01/28/81	0.47	0.42	0.44	155	160
Logistics Desk (6)	01/11/80 - 01/27/81	0.29	0.23	0.25	70	90
Lower Mint Lake (12)	01/10/80 - 01/22/81	1.69	1.39	1.59	540	580
L-40 (15)	01/11/80 - 01/28/81	0.54	0.51	0.52	175	190
L-49 (15)	01/11/80 - 01/28/81	0.35	0.24	0.32	110	115
NRDS Warehouse (25)	01/09/80 - 12/16/80	0.39	0.31	0.35	120	130
Office (15)	01/11/80 - 01/28/81	0.31	0.28	0.29	100	105
Post Office (23)	01/09/80 - 12/16/80	0.18	0.12	0.16	55	60
R-3 Road (19)	07/03/80 - 01/21/81	0.60	0.58	0.59		215
R-9 Road (19)	07/03/80 - 01/21/81	0.60	0.58	0.59		215
R-20 Road (19)	07/03/80 - 01/21/81	0.53	0.50	0.52		190
R-27 Road (19)	07/03/80 - 01/21/81	0.59	0.58	0.59		215
R-31 Road (19)	07/03/80 - 01/21/81	0.53	0.50	0.52		190
RADEX North (3)	01/10/80 - 10/17/80	0.57	0.47	0.53	175	195
RADEX South (3)	01/10/80 - 10/17/80	0.49	0.41	0.45	145	165
Rainier Mesa Road-M150 (2)	01/11/80 - 01/28/81	0.47	0.40	0.44	140	160
Ramatrol (23)	01/09/80 - 12/16/80	0.37	0.33	0.35	110	130
RWMS East (5)	01/09/80 - 12/16/80	0.39	0.26	0.35	130	130
RWMS Gate (5)	01/09/80 - 12/16/80	0.39	0.35	0.38	170	140
RWMS North (5)	01/09/80 - 12/16/80	0.43	0.28	0.37	120	135
RWMS Southwest (5)	01/09/80 - 12/16/80	0.38	0.25	0.34	130	125
RWMS West (5)	01/09/80 - 12/16/80	0.41	0.36	0.38	130	140
Security Gate 293 (11)	01/11/80 - 01/27/81	0.57	0.34	0.45	155	165
Sedan Crater Visitor's Box (10)	01/11/80 - 01/28/81	0.69	0.57	0.62	250	225
Sedan Crater West Area (10)	01/11/80 - 01/28/81	3.42	2.30	3.07	1390	1120
Storage Shed (15)	01/11/80 - 01/28/81	0.40	0.35	0.37	125	135
Substation Bus (15)	01/11/80 - 01/28/81	0.33	0.30	0.31	120	115
TH-1 (6)	01/10/80 - 01/22/81	0.25	0.19	0.21	75	75
TH-9 (6)	01/10/80 - 01/22/81	0.32	0.21	0.28	115	100
TH-18 (1)	01/10/80 - 01/22/81	0.32	0.24	0.28	95	100
TH-27 (1)	01/10/80 - 01/22/81	0.33	0.28	0.31	110	115
TH-37 (1)	01/10/80 - 01/22/81	0.44	0.35	0.40	130	145
TH-47 (4)	01/10/80 - 01/22/81	0.50	0.44	0.47	155	170
TH-57 (2)	01/10/80 - 01/22/81	0.31	0.22	0.27	105	100
TH-67.5 (12)	01/10/80 - 01/22/81	0.32	0.28	0.29	115	105
Upper Haines Lake No. 1 (12)	01/10/80 - 01/22/81	0.44	0.35	0.40	150	145
Upper N Tunnel Pond (12)	01/10/80 - 01/22/81	0.45	0.41	0.44	155	160
U3ax Northeast (3)	01/11/80 - 01/27/81	1.23	1.13	1.18	550	430
U3ax Northwest (3)	01/11/80 - 01/27/81	0.89	0.78	0.83	290	305
U3ax South (3)	01/11/80 - 01/27/81	1.03	0.60	0.74	200	270
U3ax Southeast (3)	01/11/80 - 01/27/81	0.76	0.60	0.67	240	245
U3by North (3)	01/10/80 - 01/21/81	1.38	0.92	1.19	430	435
U3by South (3)	01/10/80 - 01/21/81	0.61	0.50	0.56	195	205
U3bz North (3)	01/10/80 - 01/21/81	0.89	0.41	0.75	280	275
U3bz South (3)	01/10/80 - 01/21/81	0.52	0.37	0.44	145	160
U3cj North (3)	10/17/80 - 01/21/81	0.45		0.45		165
U3co North (3)	01/10/80 - 01/21/81	5.93	4.7	5.37	1900	1960
U3co South (3)	01/10/80 - 01/21/81	3.35	1.47	2.77	1110	1010
U3ey South (3)	10/17/80 - 01/21/81	0.24		0.24		90
U3du North (3)	01/10/80 - 01/21/81	0.59	0.52	0.57	200	210

Table 13 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1979 ADJUSTED ANNUAL DOSE (mrem/y)	1980 ADJUSTED ANNUAL DOSE (mrem/h)
U3du South (3)	01/10/80 - 01/21/81	0.76	0.65	0.70	250	255
Well 3 (6)	01/10/80 - 01/21/81	0.36	0.31	0.35	115	130
Well 5B (5)	01/09/80 - 12/16/80	0.37	0.28	0.34	115	125
Well 19C Reservoir (19)	07/03/80 - 01/21/81	0.54	0.52	0.53		195
Yucca Complex (6)	01/11/80 - 01/27/81	0.32	0.28	0.30	110	110
2-04 Road (2)	01/11/80 - 01/28/81	9.34	5.40	7.91	2950	2890
2-07 Road (2)	01/11/80 - 01/28/81	1.22	1.07	1.12	385	410
3-03, O.B. Roads (3)	01/11/80 - 01/27/81	0.33	0.26	0.30	88	110
4-04 Road (4)	01/11/80 - 01/27/81	11.60	7.15	10.10	3580	3690
6-09, O.B. Roads (6)	01/11/80 - 01/27/81	0.43	0.27	0.37	130	135
7R 6 (7)	01/11/80 - 07/18/80	0.36	0.36	0.36	125	130
7-300 Bunker (7) ***	01/11/80 - 01/27/81	1.38	1.23	1.30	460	475
8K 25 (8)	01/11/80 - 01/28/81	0.40	0.34	0.37	115	135
9-300 Bunker (9)	01/11/80 - 01/28/81	0.45	0.36	0.40	140	145
10 A-24 (10)	01/11/80 - 01/28/81	1.19	0.72	1.05	420	385
18-1C Gate (18)	01/10/80 - 01/27/81	0.46	0.29	0.40	150	145
18P 35 (18)	01/10/80 - 01/22/81	0.51	0.41	0.47	145	170
18P 39 (18)	01/10/80 - 01/27/81	0.47	0.39	0.42	140	155
19P 41 (19)	01/10/80 - 01/27/81	0.54	0.45	0.49	160	180
19P 46 (19)	01/10/80 - 01/27/81	0.48	0.39	0.42	140	155
19P 54 (19)	01/10/80 - 01/27/81	0.43	0.28	0.37	135	135
19P 59 (19)	01/10/80 - 01/27/81	0.50	0.46	0.48	155	175
19P 66 (19)	01/10/80 - 01/27/81	0.58	0.48	0.53	170	195
19P 71 (19)	01/10/80 - 01/27/81	0.53	0.32	0.44	155	160
19P 77 (19)	01/10/80 - 01/27/81	0.58	0.35	0.48	160	175
19P 87 (19)	01/10/80 - 01/27/81	0.66	0.53	0.59	190	215
19P 88 (19)	01/10/80 - 01/27/81	0.58	0.37	0.49	180	180
19P 91 (19)	01/10/80 - 01/27/81	0.55	0.31	0.46	155	170
20-4C Gate (20)	01/10/80 - 01/27/81	0.54	0.34	0.46	160	170
25-4P Gate (25)	01/09/80 - 12/16/80	0.41	0.36	0.38	120	140
25-7P Gate (25)	01/09/80 - 12/16/80	0.40	0.35	0.37	160	135
30-1C Gate (30)	01/10/80 - 07/14/80	0.62	0.51	0.56	170	205
130 M (4)	01/11/80 - 01/27/81	0.40	0.37	0.39	125	140
140 M (2)	01/11/80 - 01/28/81	0.51	0.39	0.44	140	160
168 M (12)	01/10/80 - 01/22/81	0.43	0.27	0.38	145	140
170 M (12)	01/10/80 - 01/22/81	0.43	0.34	0.37	120	135
175 M (12)	01/10/80 - 01/22/81	0.47	0.42	0.45	155	165
185 Holmes Road (17)	01/10/80 - 01/22/81	0.47	0.43	0.45	150	165
190 M (19)	01/10/80 - 01/22/81	0.59	0.44	0.50	155	185
196 M (19)	01/10/80 - 01/22/81	0.52	0.42	0.48	150	175

* Moved to U3cj North
** Moved to U3ey South
*** Removed from service

Table 16 (Continued)

STATION (AREA)	MEASUREMENT PERIOD	ELEVATION (FT)	DOSE RATE (mrem/d) MAX.	MIN.	AVG.	1979 ADJUSTED ANNUAL DOSE (mrem/y)	1980 ADJUSTED ANNUAL DOSE (mrem/y)
N670,600 E667,300 (22)	01/03/80 - 01/23/81	4000	0.23	0.18	0.20	60	7[illegible]
N731,300 E638,700 (28)	01/08/80 - 01238/81	5750	0.31	0.27	0.29	90	10[illegible]
N754,000 E557,800 (31)	01/08/80 - 01/23/81	4800	0.46	0.39	0.43	135	155
N849,500 E545,000 (30)	01/23/80 - 10/27/80	7100	0.49	0.40	0.44	140	160
N887,000 E558,000 (20)	01/08/80 - 01/23/81	6100	0.54	0.38	0.48	185	175
N948,800 E527,800 (20)	01/23/80 - 01/23/81	5650	0.59	0.46	0.52	165	190
N944,700 E563,300 (19)	01/08/80 - 01/23/81	6300	0.33	0.26	0.29	90	105
N955,500 E614,200 (19)	01/08/80 - 01/23/81	7200	0.51	0.44	0.47	155	170
N935,500 E639,750 (19)	01/08/80 - 01/23/81	6550	0.47	0.43	0.45	150	165
N903,800 E635,500 (12)	01/08/80 - 01/23/81	6900	0.34	0.25	0.31	110	115
N907,600 E686,200 (8)	01/08/80 - 01/23/81	5826	0.53	0.46	0.49	155	180
N874,600 E691,500 (10)	01/08/80 - 01/23/81	5000	0.23	0.22	0.23	75	85
N844,200 E704,900 (3)	01/08/80 - 01/23/81	5100	0.21	0.20	0.21	75	75
N788,800 E709,500 (11)	01/08/80 - 01/23/81	5200	0.45	0.34	0.40	140	145
N710,800 E720,000 (11)	01/08/80 - 01/23/81	4280	0.21	0.17	0.18	58	65

TABLE 17

TLD Control Station Comparison

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

The remaining 143 tations of the network yielded dose rates which ranged from 0.16 mrem/d to 10.1 mrem/d, a factor of 60 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 following six stations showed decreases at the end of CY-1980 because of fewer radioactive sources being used in their vicinity:

Bldg. 600, X-Ray Area
Bldg. 650, Sample Storage
CP-50, Calibration Bench
CP-50, Instrument Calibration Door
Decon Pad, Back Office

The dose rates for the two stations, Area 3 radex north and south, changed because they were moved to U3cj north and U3ey south respectively.

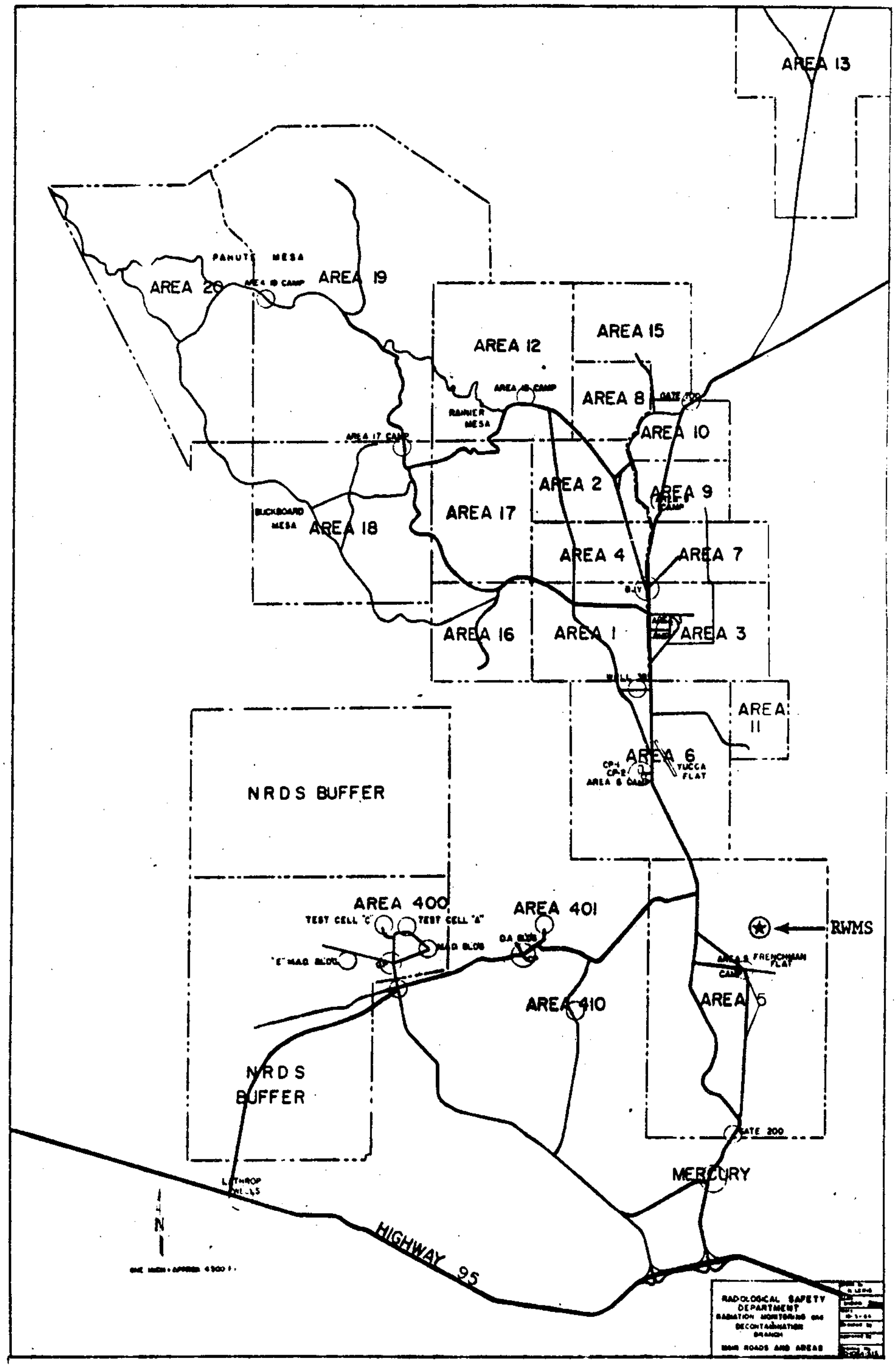
The mean for the CY-1979 stations, excluding those that were in buildings, was 240 mrem/year compared to the mean of 245 mrem/year for CY-1980. This represents a difference of 2.2 percent which is an excellent correlation and verifys the accuracy of the ambient gamma monitoring system.

G. 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

FIGURE 10

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



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 GFP and plutonium, and five TLD's, for gamma monitoring, placed stratigically 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 1.29×10^{-9} μCi/cc at RWMS Station #1, which is 0.016 percent of the concentration guides. RWMS Station #3 had the highest concentration of HT, $4.49\ 10^{-11}$ μCi/cc, which is 0.000002 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 3.8×10^{-14} μCi/cc compared to the network average of $3.7\ 10^{-14}$ μCi/cc. This concentration represents 0.0038 percent of the concentration guide assuming ^{90}Sr to be 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 was $2.96\ 10^{-17}$ μCi/cc as compared to $3.4\ 10^{-17}$ μCi/cc in areas not contaminated by previous safety shots. This is 0.0015 percent of the concentration guide for ^{239}Pu.

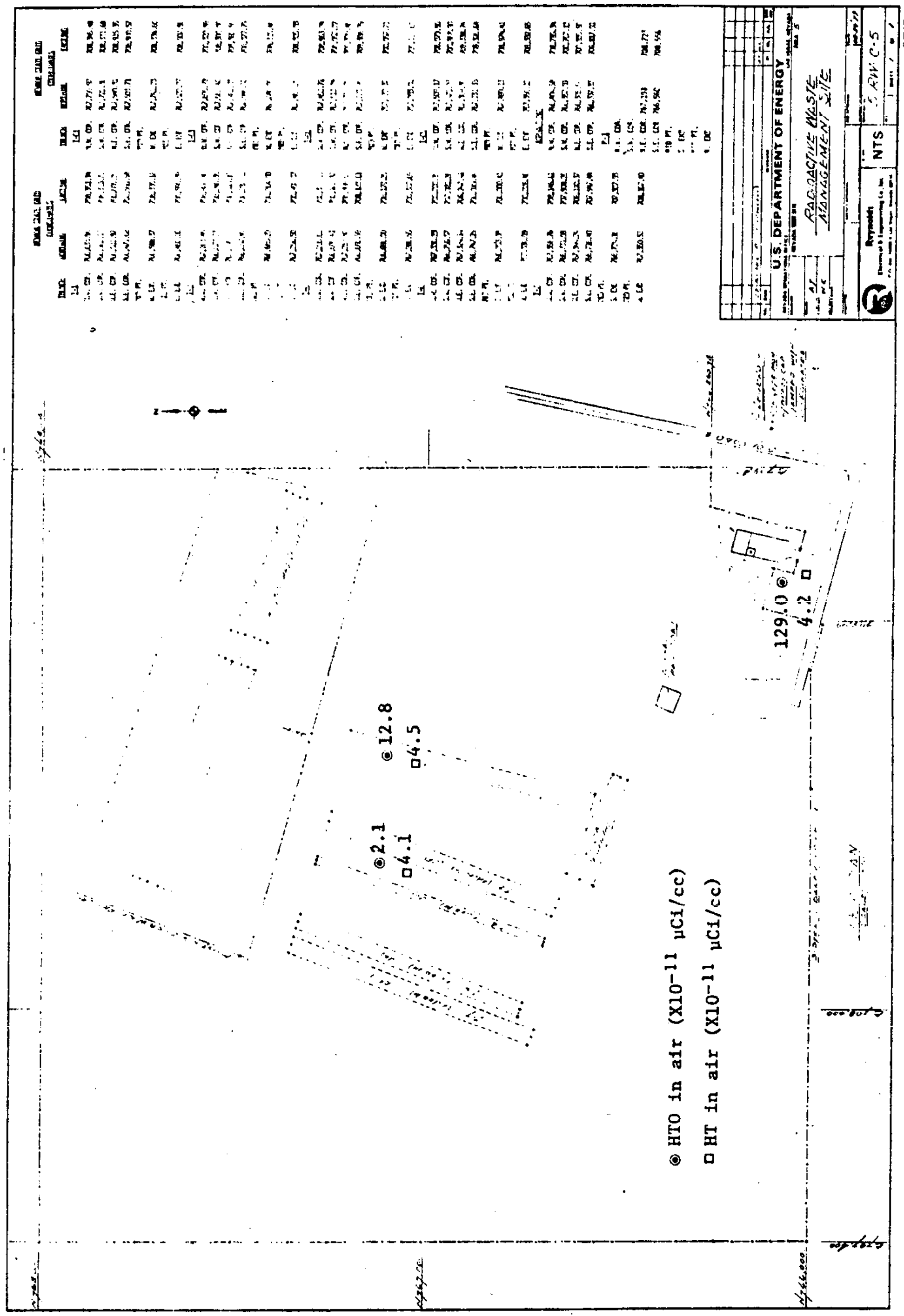


Figure 11. RWMS TRITIUM IN AIR SAMPLING STATIONS

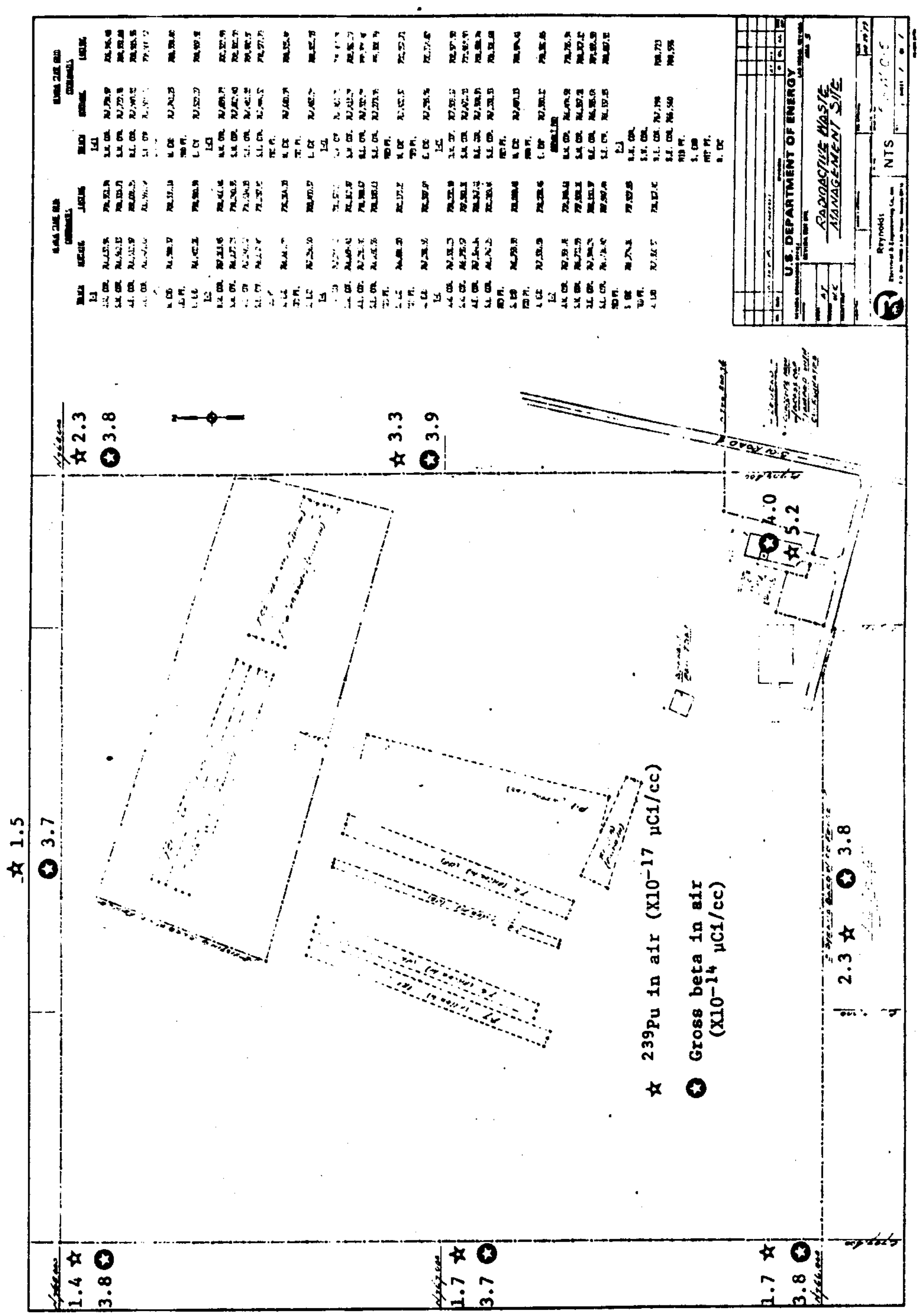


Figure 12. RWMS AIR SAMPLING STATIONS

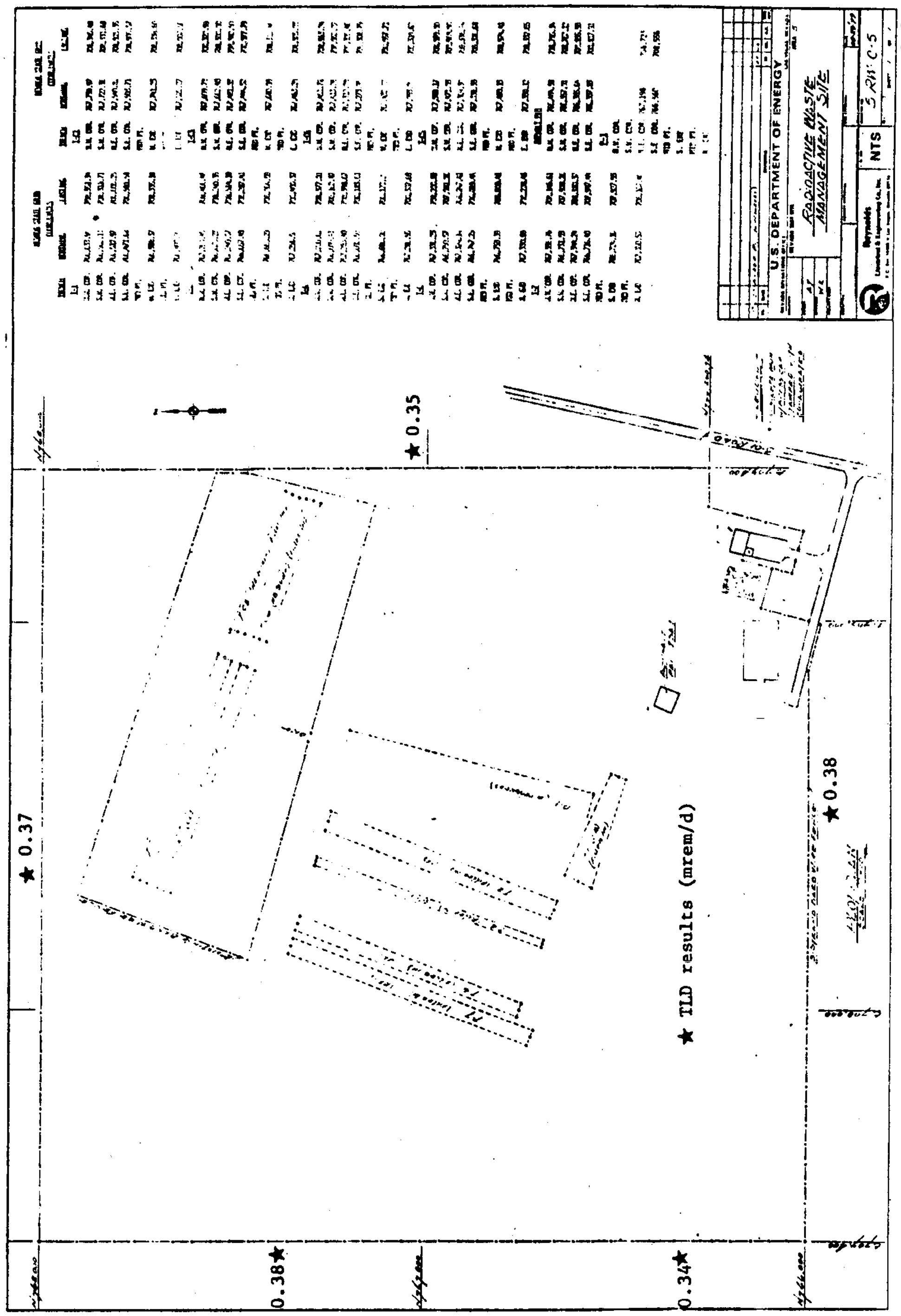


Figure 13. RWMS GAMMA MONITORING RESULTS

Table 16 gives a summary of the gamma monitoring results for 1980. The average annual dose was 134 mrem/y or 15 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 125 mrem/y or 14 μrem/h.

In conclusion the results from this surveillance network around the RWMS indicate that there were no detectable releases of radioactive materials as a result of operations during 1980.

H. REFERENCES

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APPENDIX 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. The data symbols for the plots are as follows:

Plot #	Symbol
1-5	×
7-10	◊
11-14	⧗
16-20	○
21-25	✱
26-49	◊

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

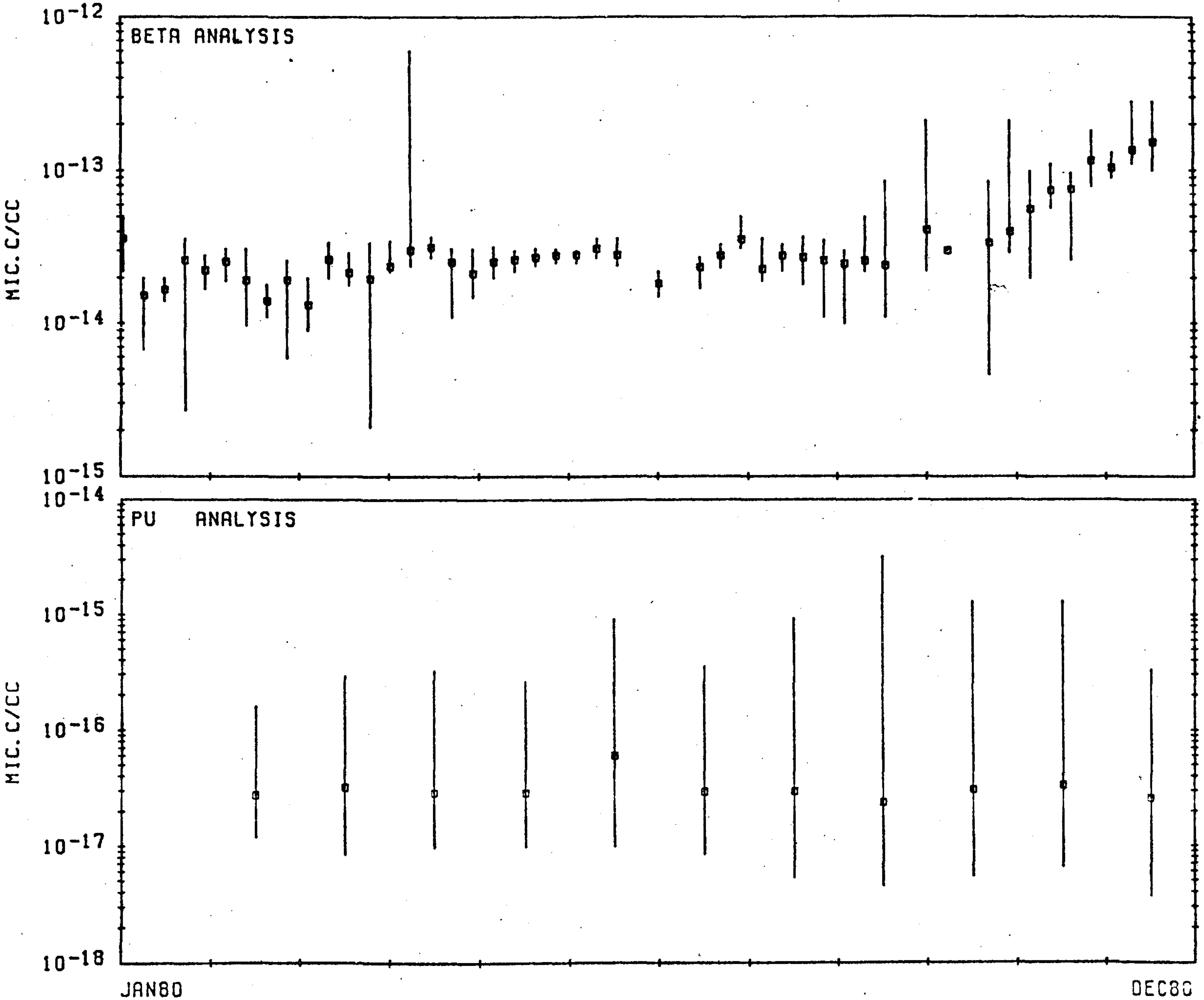
Station Number	Location
1	Area 1 Gravel Pit
2	Area 2 Compound
3	Area 3 Cafeteria
4	Area 5 Maintenance Complex
5	Area 5 Well 5B
7	Area 6 Yucca Complex
8	Area 6 CP Complex
9	Area 6 Well 3 Complex
10	Area 9 9-300 Bunker
11	Area 10 Gate 700
12	Area 11 Gate 293
13	Area 12 Changehouse
14	Area 16 Substation
16	Area 19 Echo Peak
17	Area 19 Substation
18	Area 20 Dispensary
19	Area 23 Building 790
20	Area 23 H&S Roof
21	Area 25 NRDS Warehouse
22	Area 27 Cafeteria
23	Area 28 Henre Site
25	Area 2 Cable Yard
26	Area 3 BJY
27	Area 3 3-300 Bunker
28	Area 5 RWMS #1
29	Area 23 Bldg. 790 #2
30	Area 25 E-MAD South
31	Area 25 E-MAD North
32	Area 5 RWMS #4
33	Area 3 U3ax South
34	Area 3 U3ax East

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING LOCATIONS

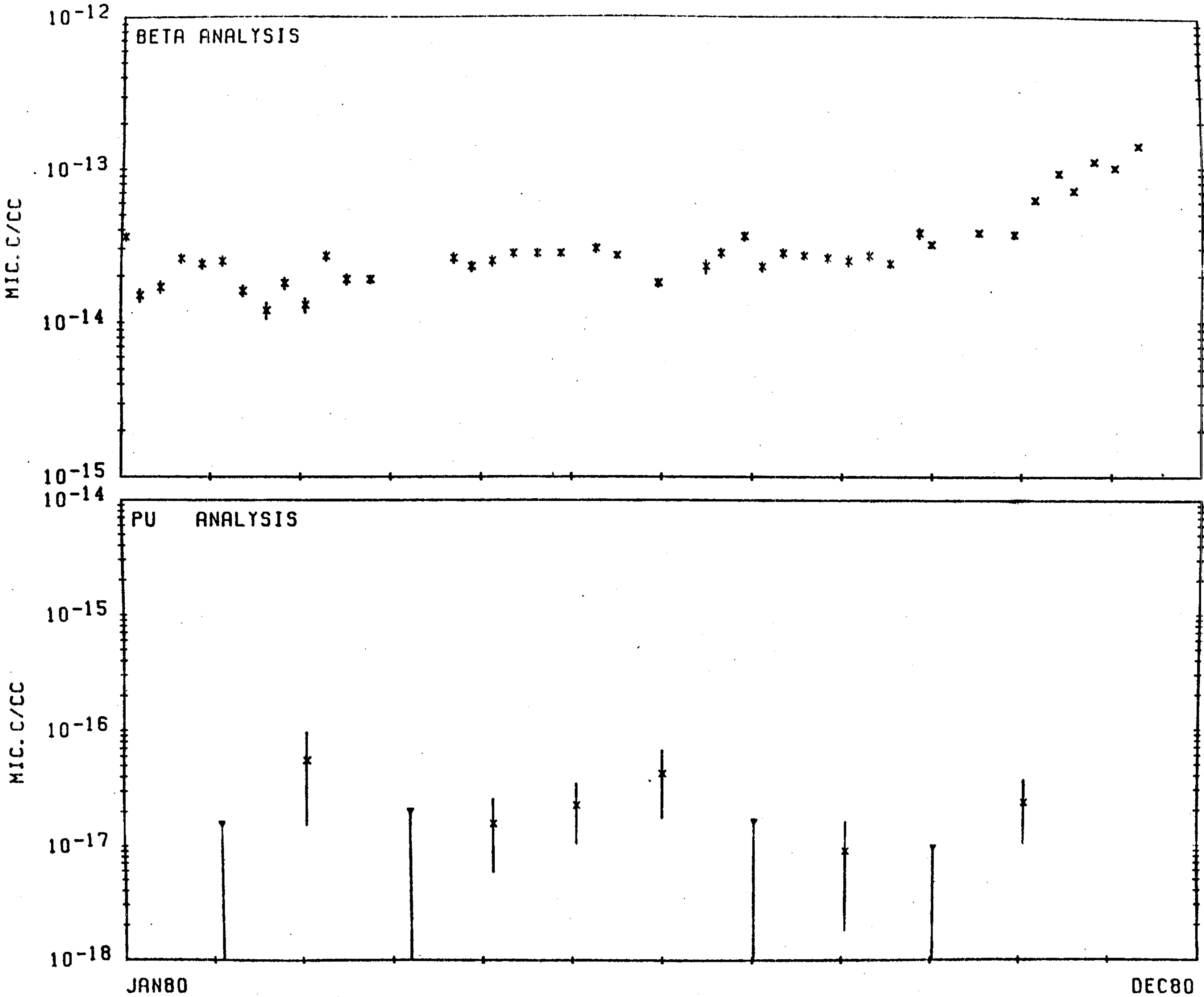
(Continued)

Station Number	Location
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 5 RWMS #2
46	Area 5 RWMS #3
47	Area 19 19-3 Substation
48	Area 3 Complex #2
49	Area 9 9-300 Bunker #2

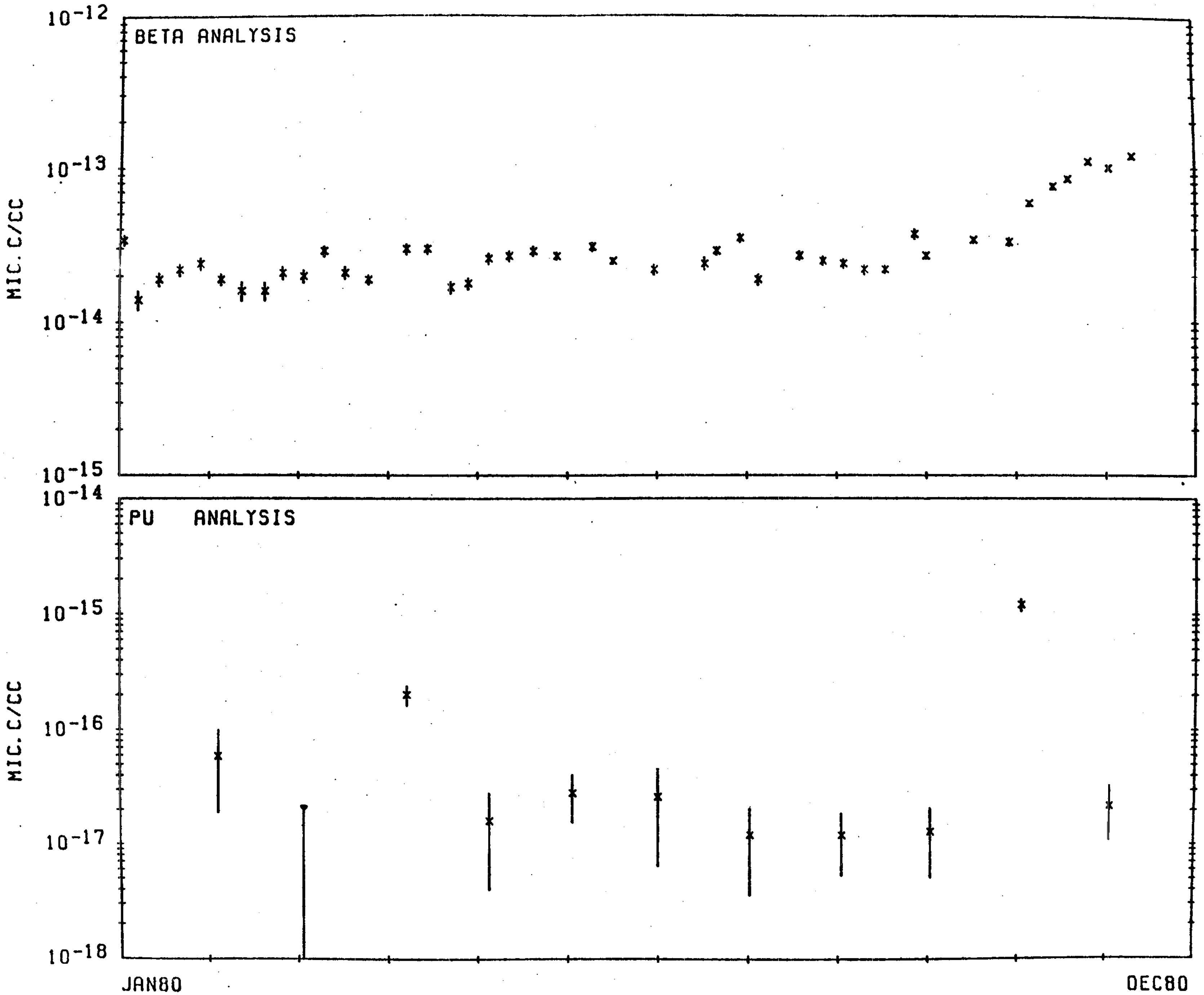
AIR NETWORK AVERAGES



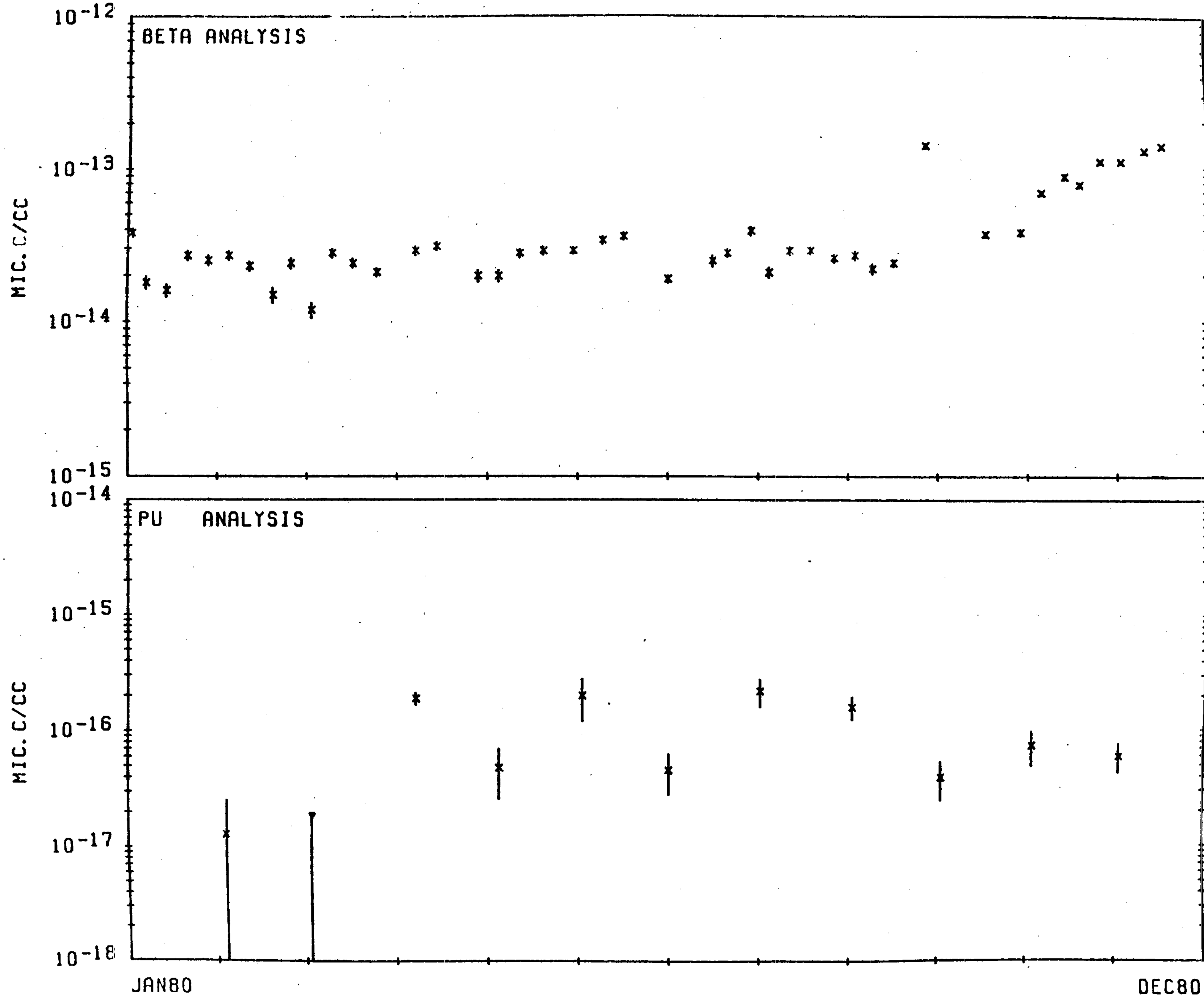
AIR SAMPLING STATION NUMBER 1



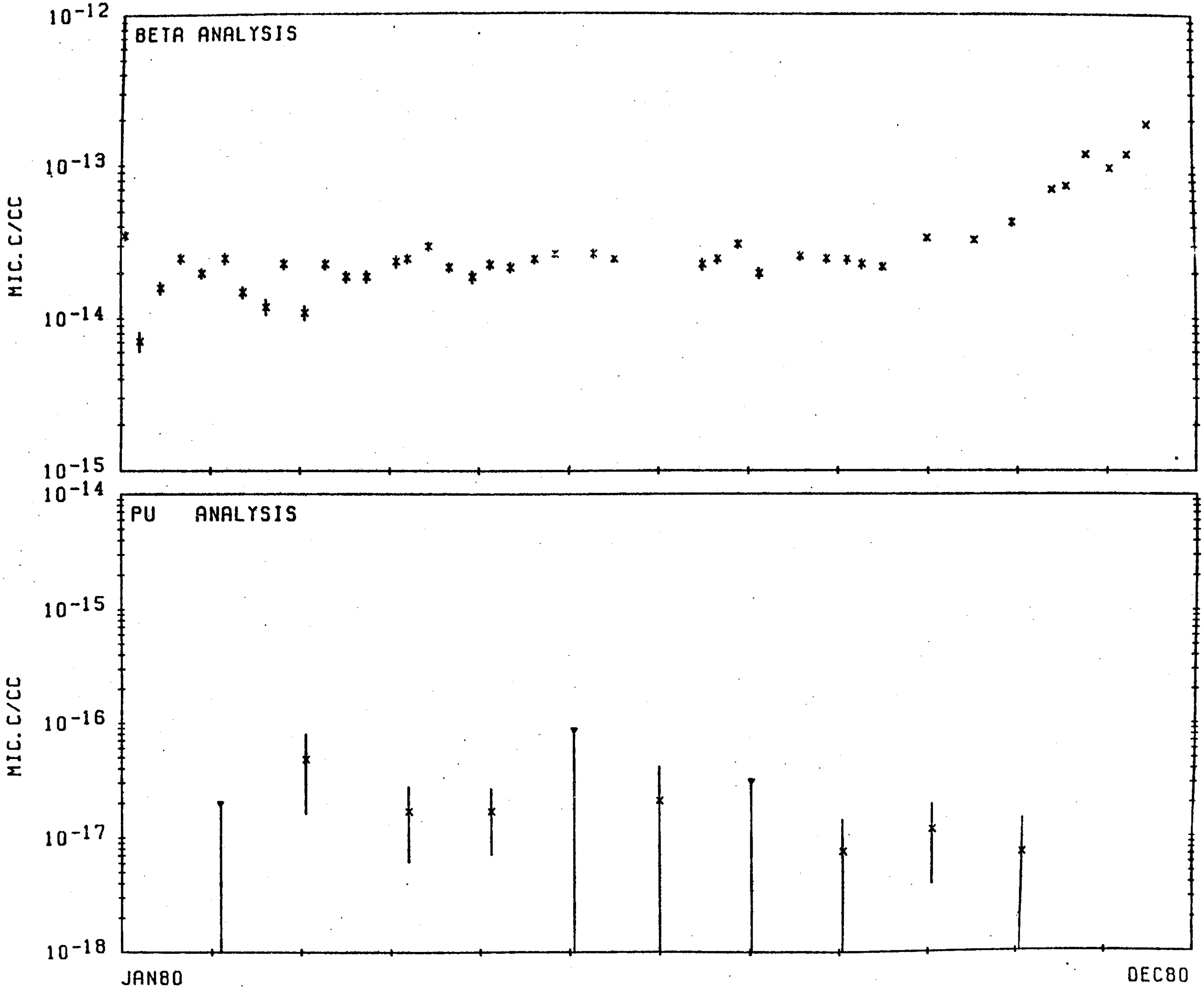
AIR SAMPLING STATION NUMBER 2



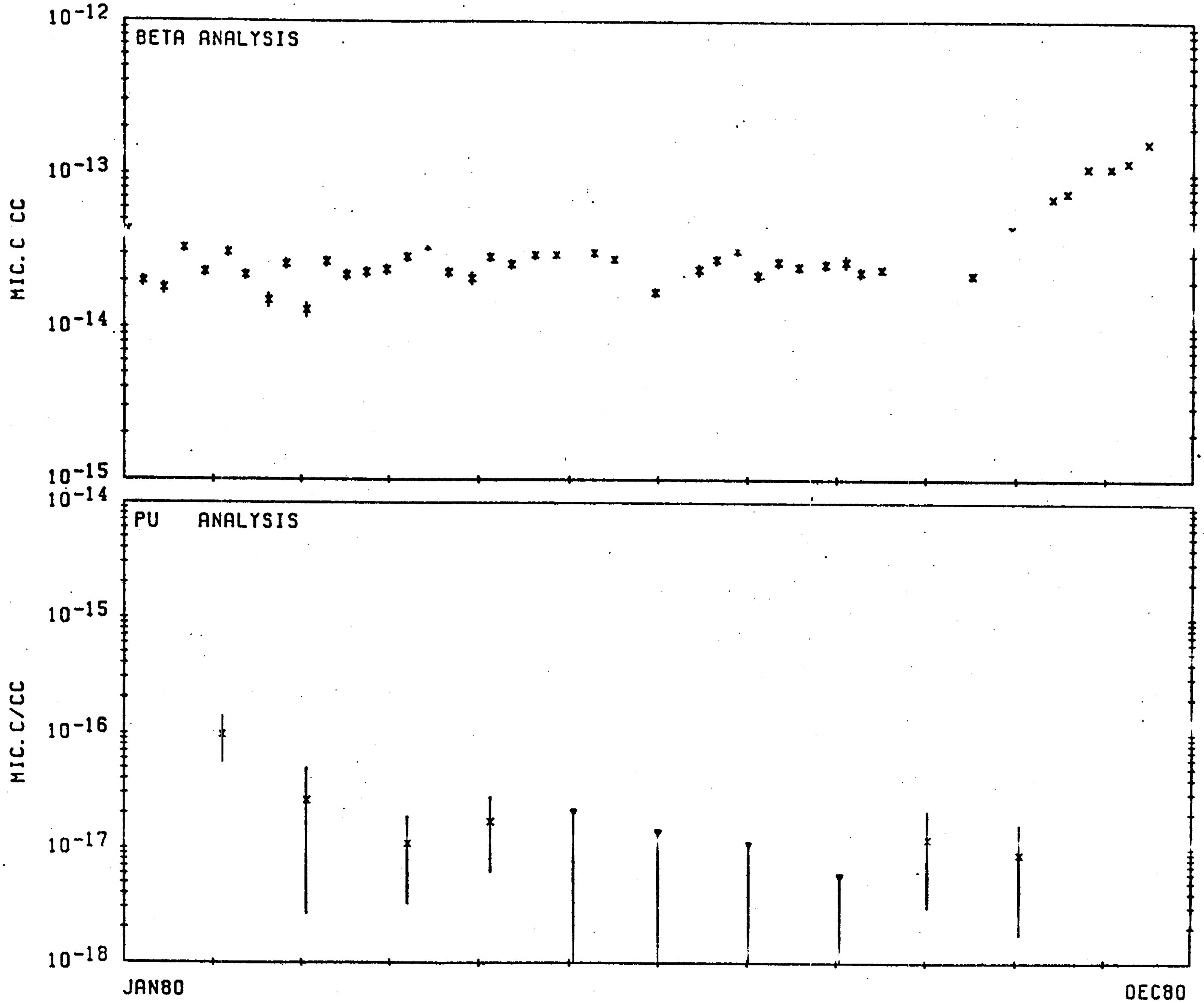
AIR SAMPLING STATION NUMBER 3



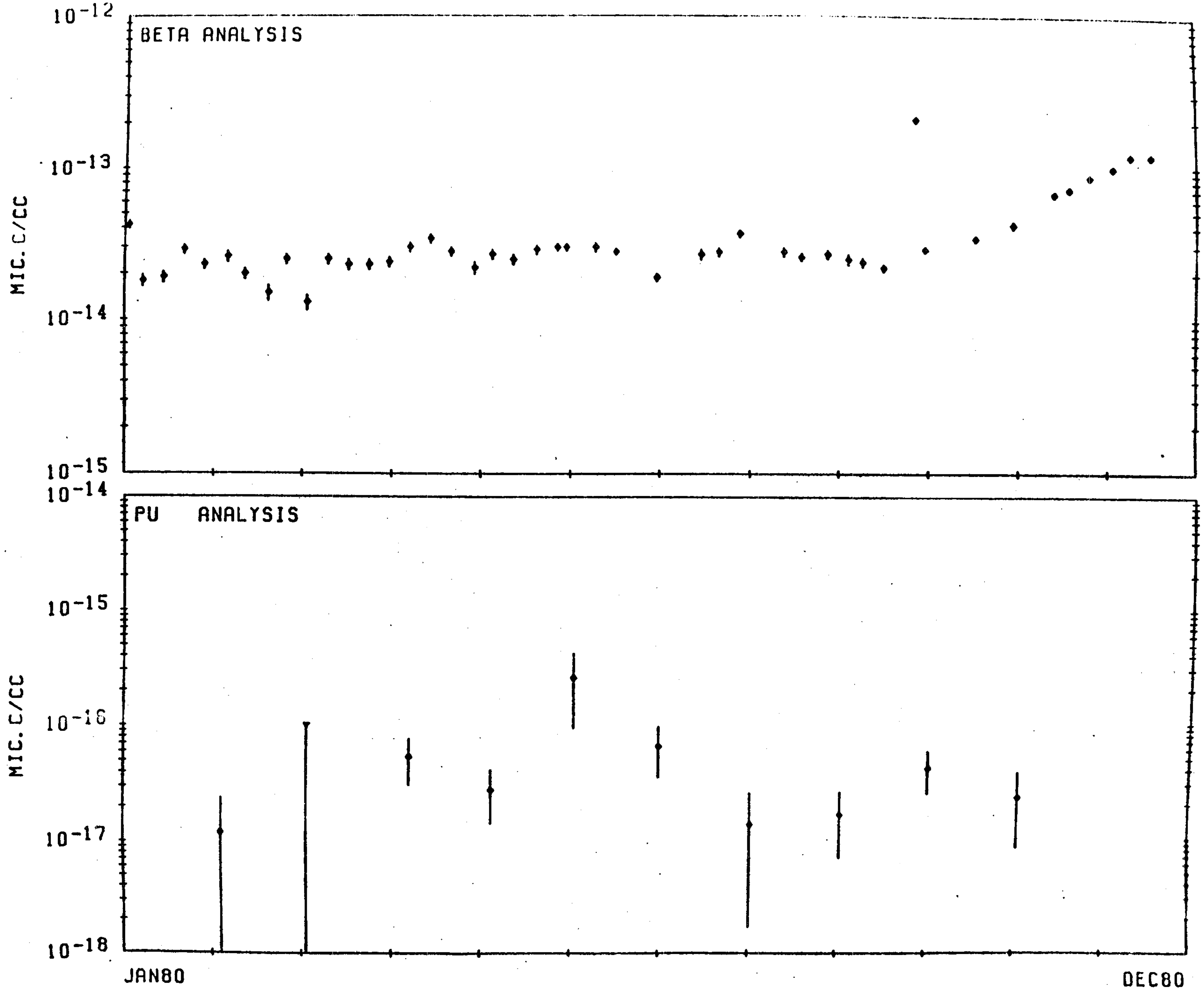
AIR SAMPLING STATION NUMBER 4



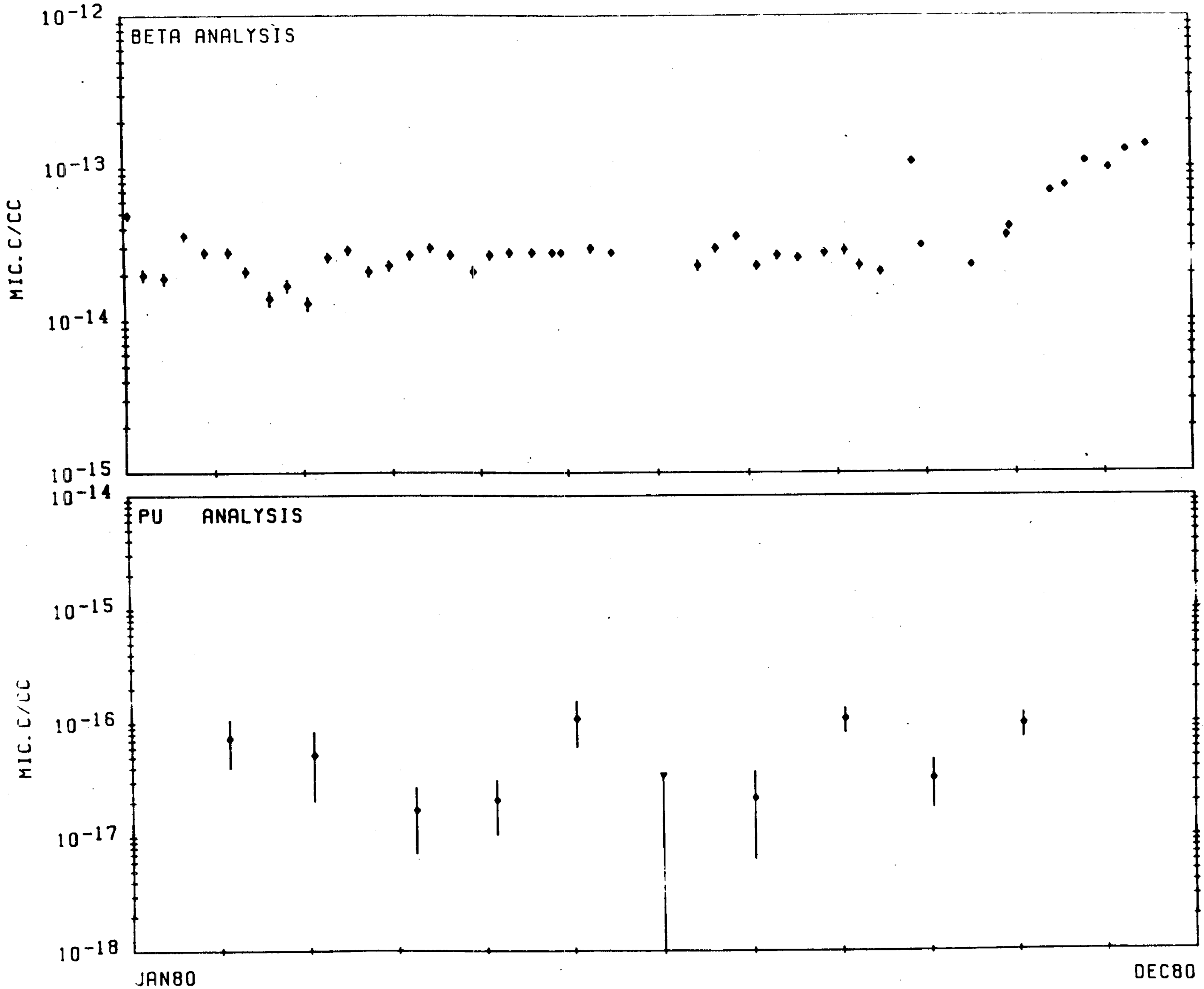
AIR SAMPLING STATION NUMBER 5



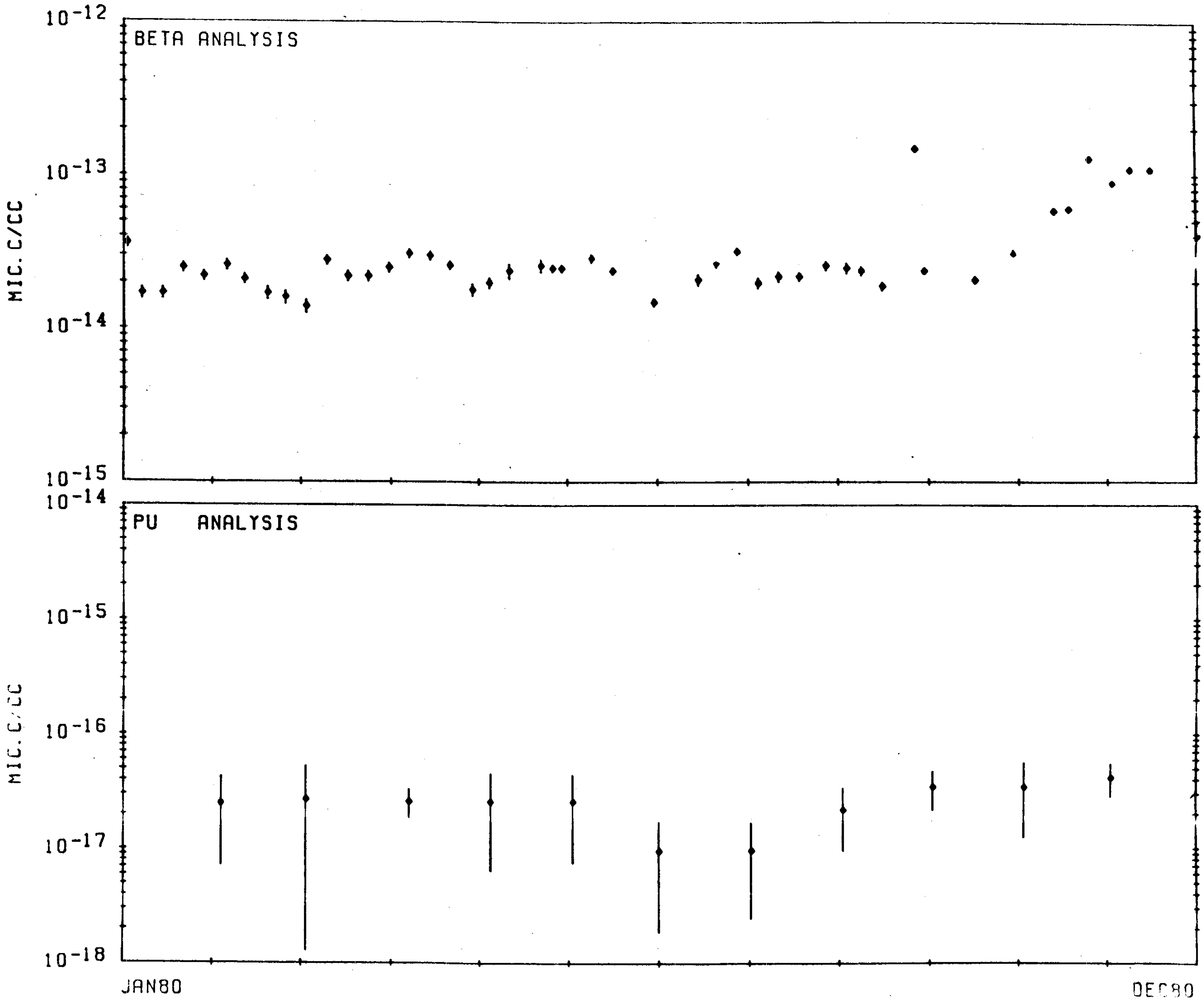
AIR SAMPLING STATION NUMBER 7



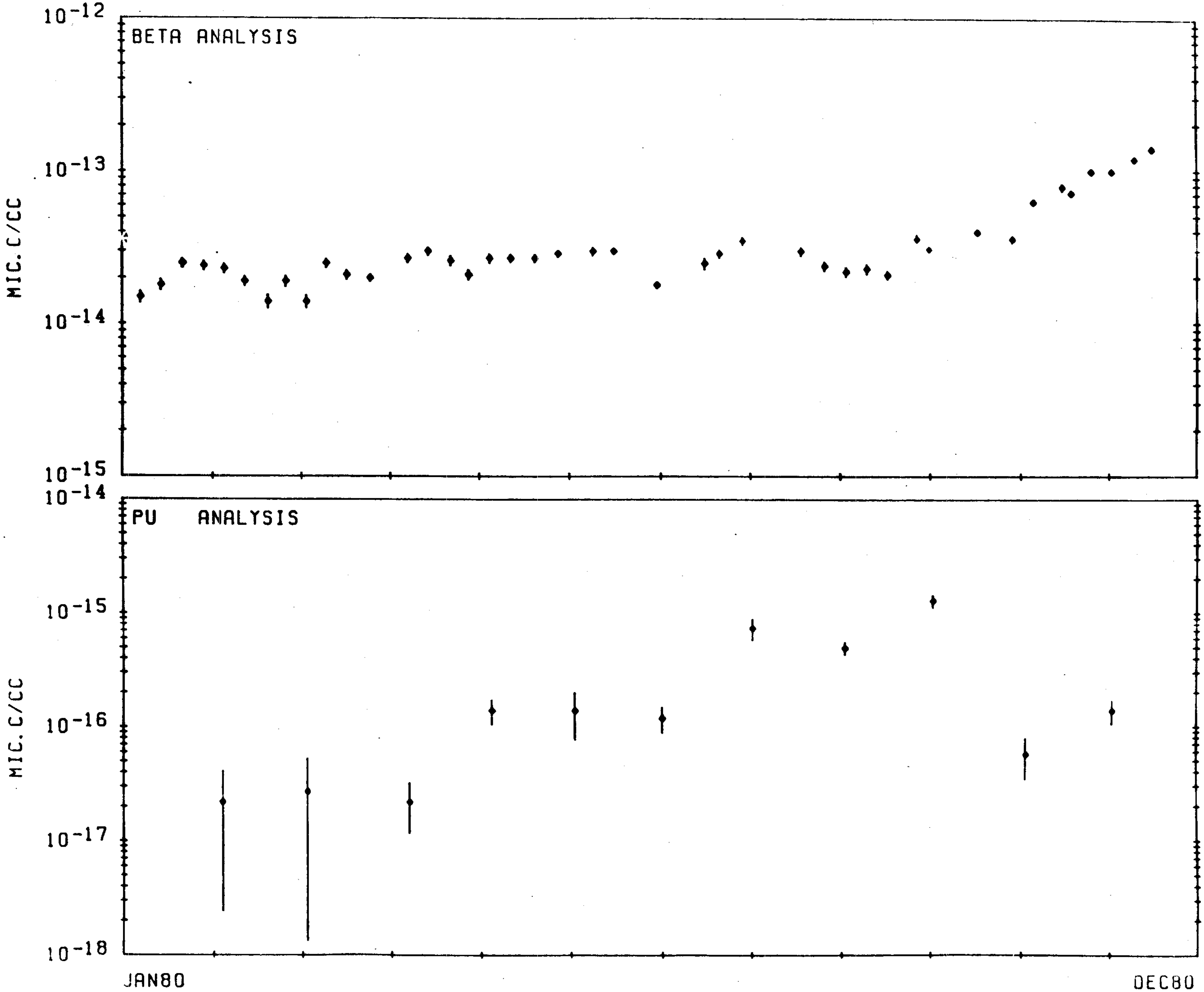
AIR SAMPLING STATION NUMBER 8



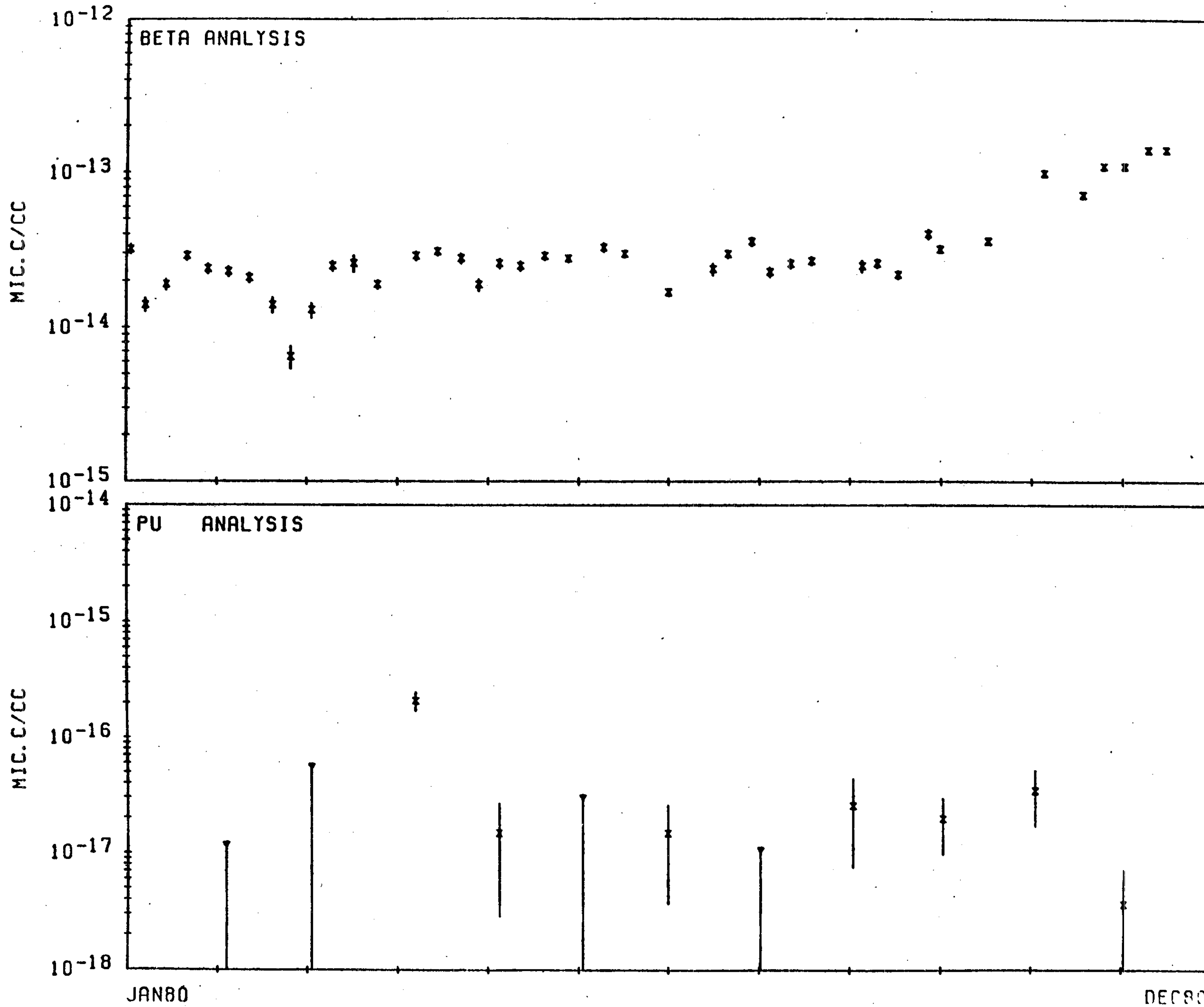
AIR SAMPLING STATION NUMBER 9

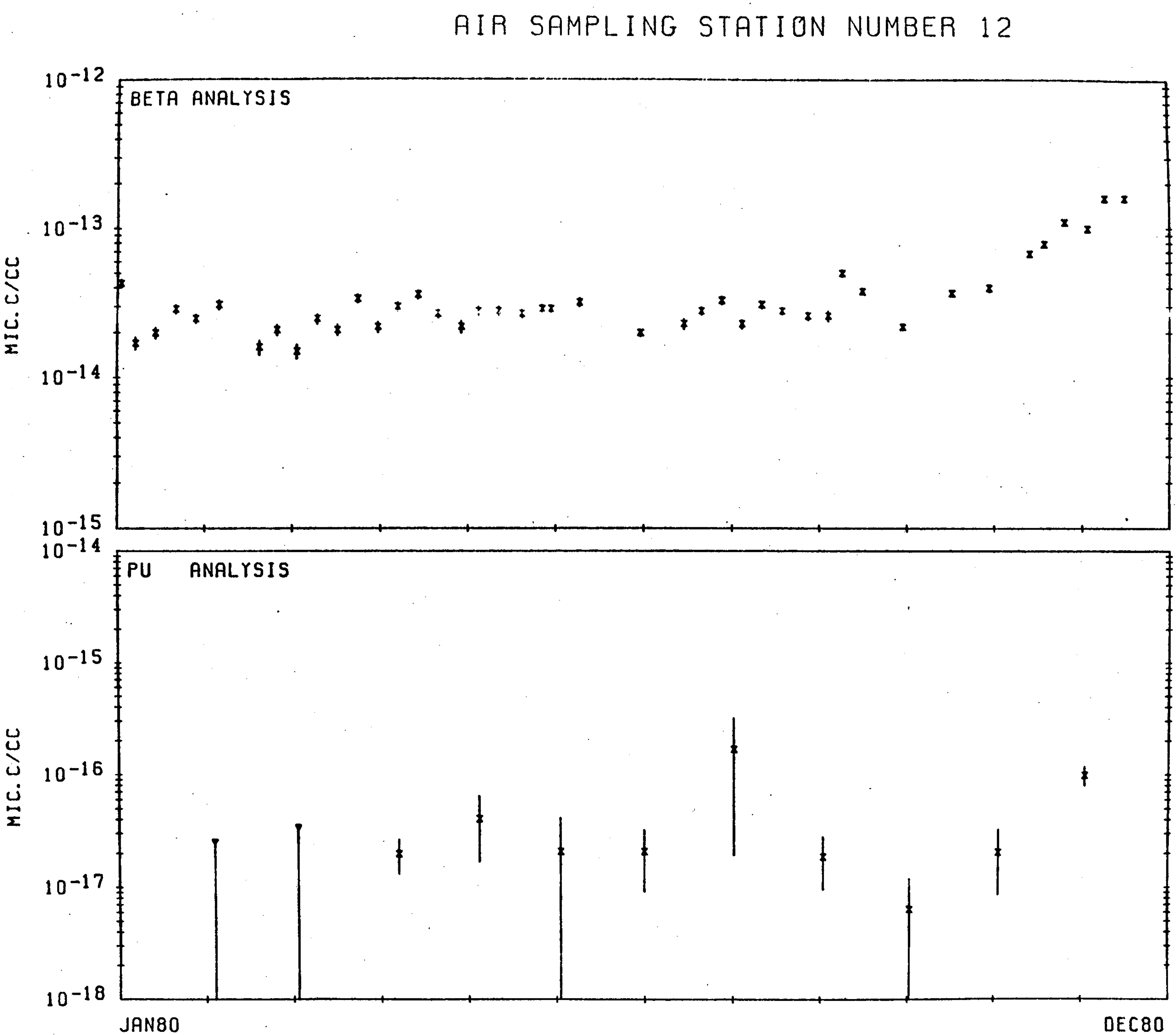


AIR SAMPLING STATION NUMBER 10

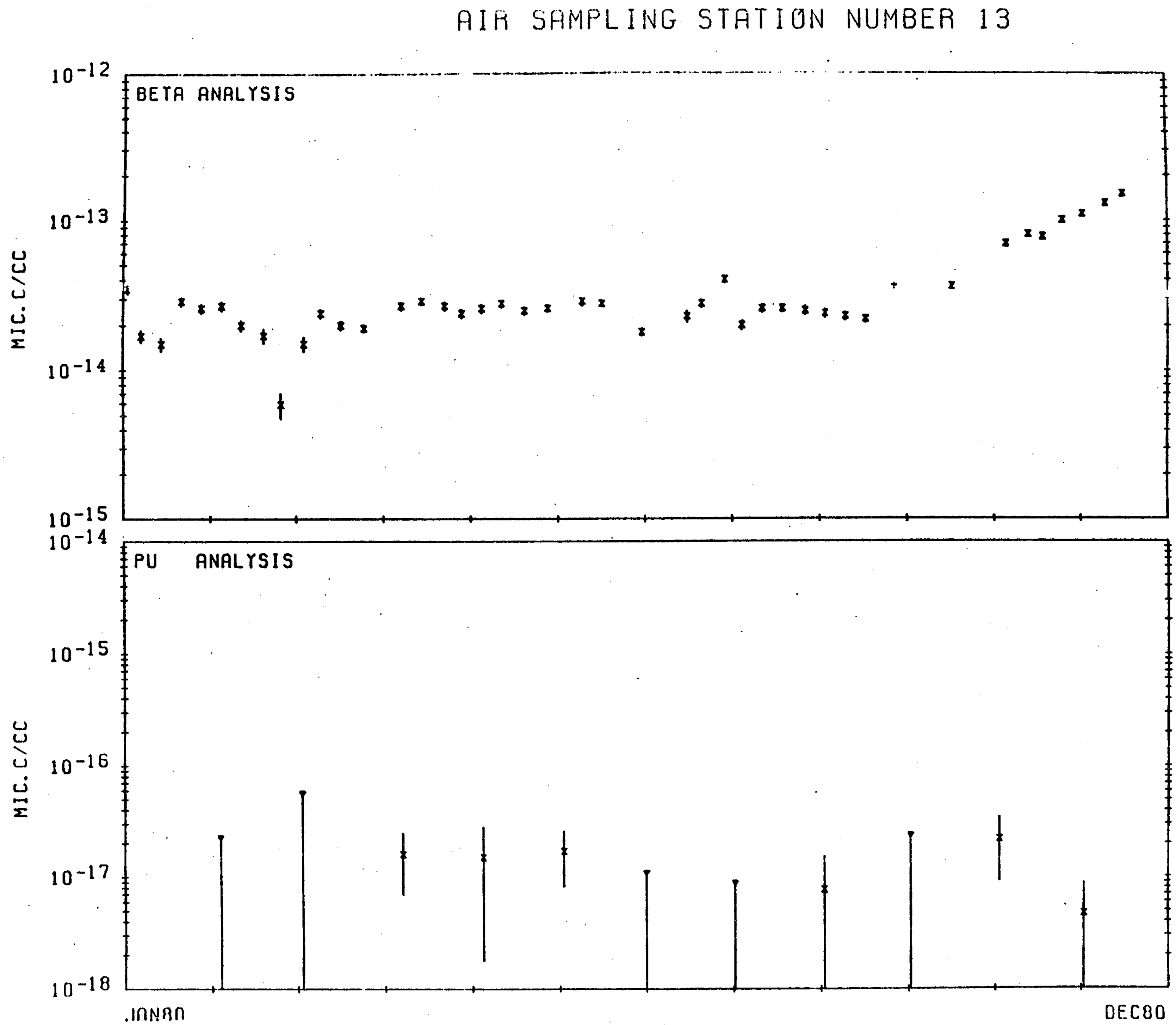


AIR SAMPLING STATION NUMBER 11



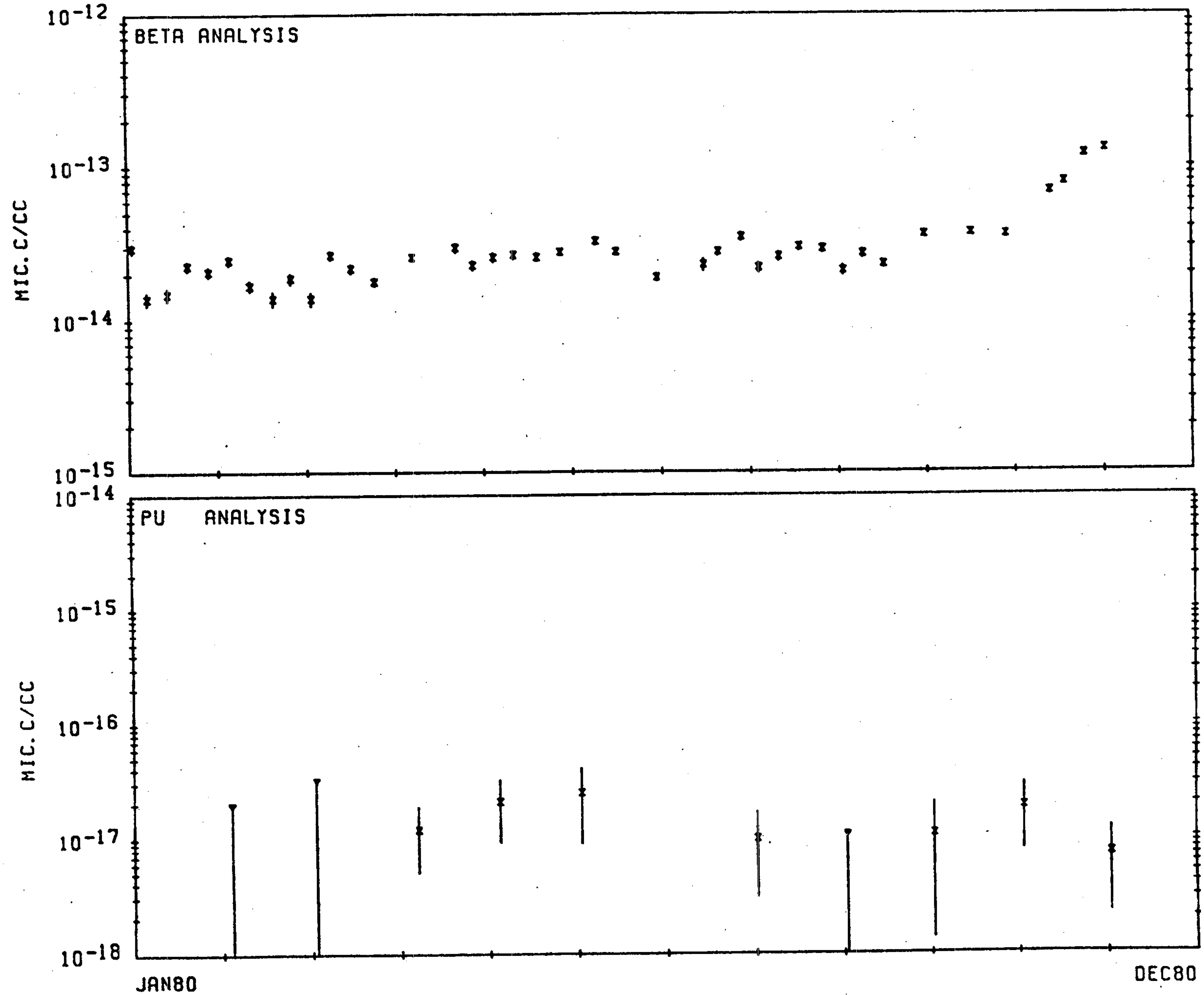


AIR SAMPLING STATION NUMBER 12
BETA ANALYSIS
PU ANALYSIS
MIC. C/CC
MIC. C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN80
DEC80

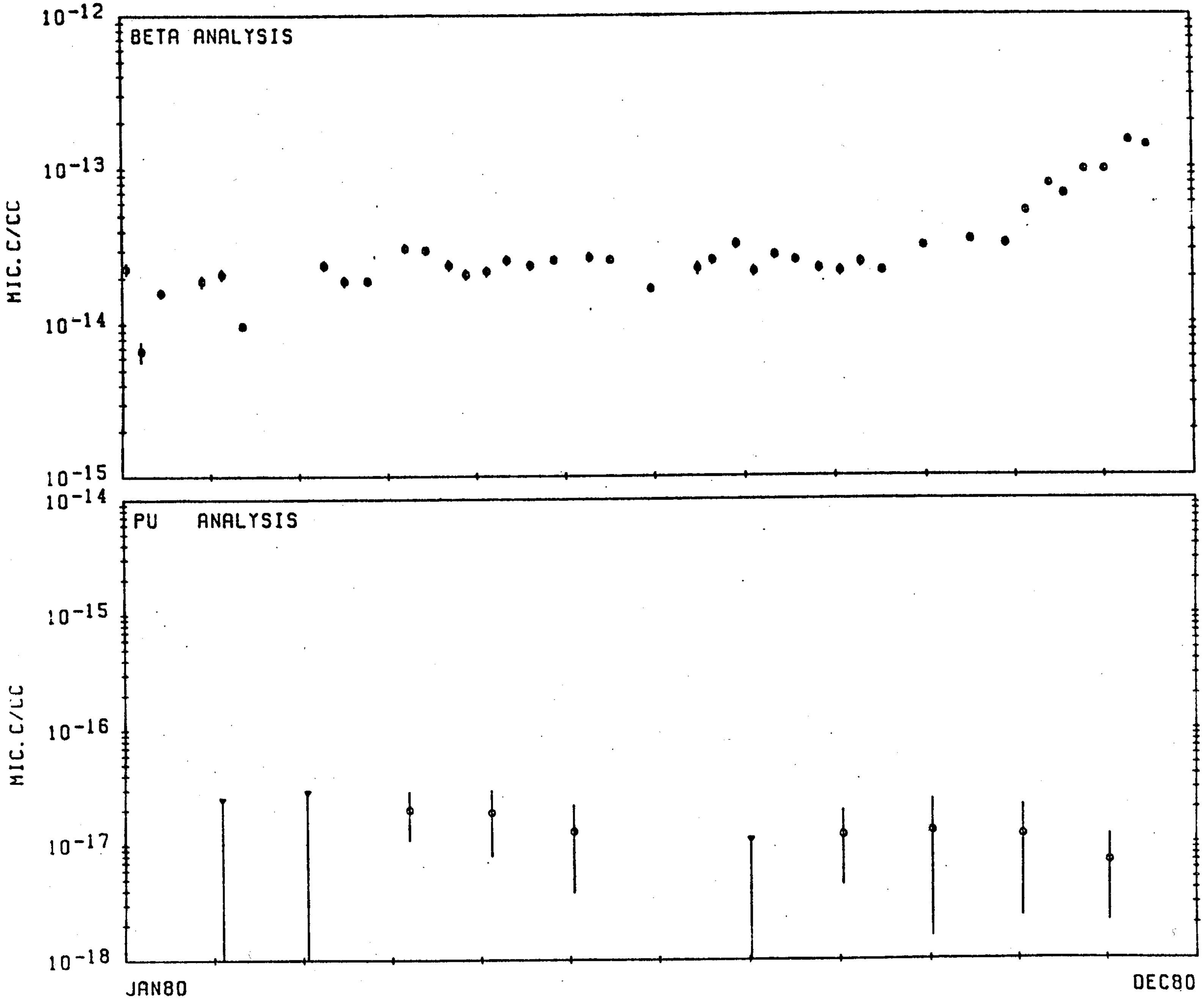


AIR SAMPLING STATION NUMBER 13
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN80
DEC80

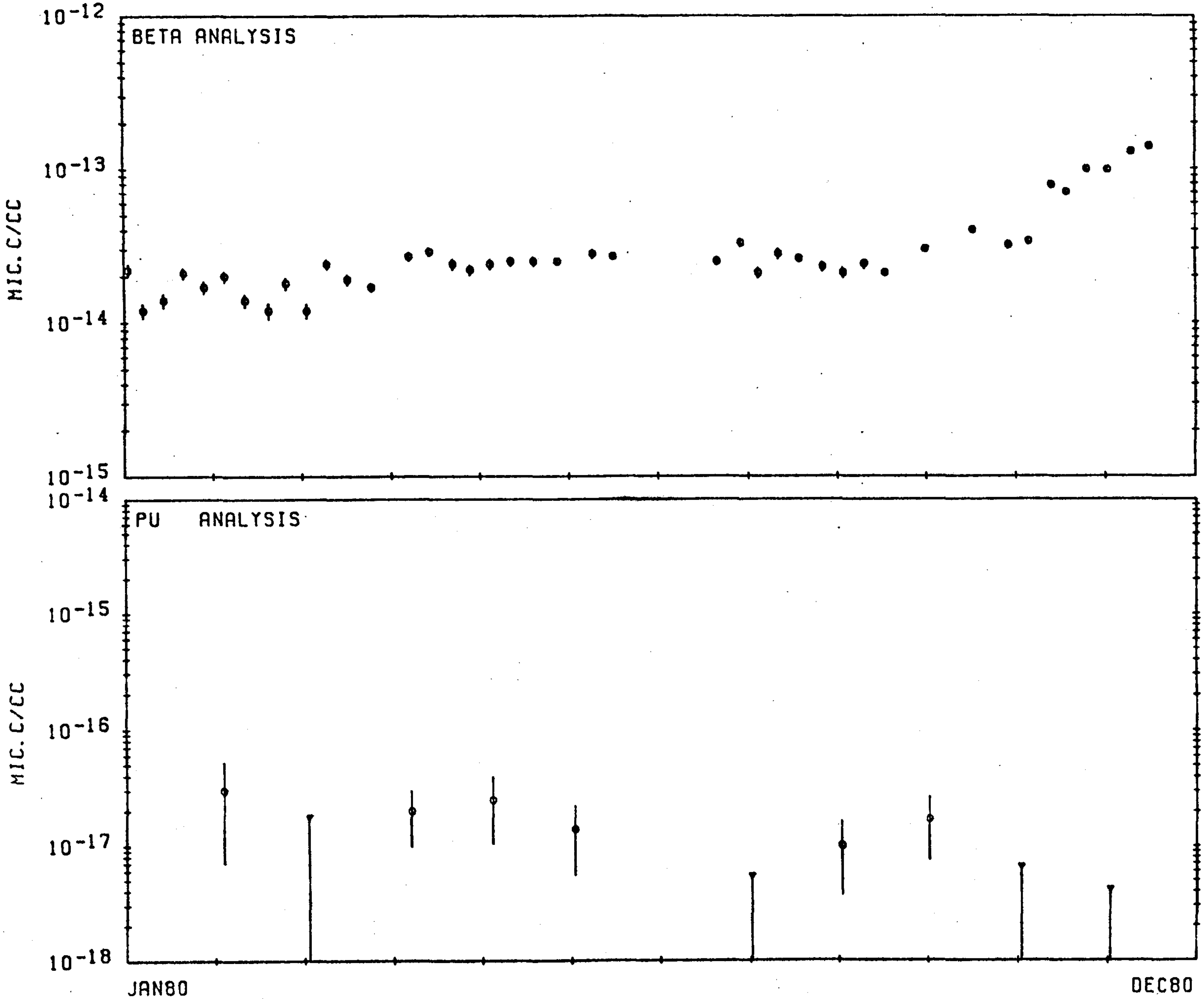
AIR SAMPLING STATION NUMBER 14



AIR SAMPLING STATION NUMBER 16

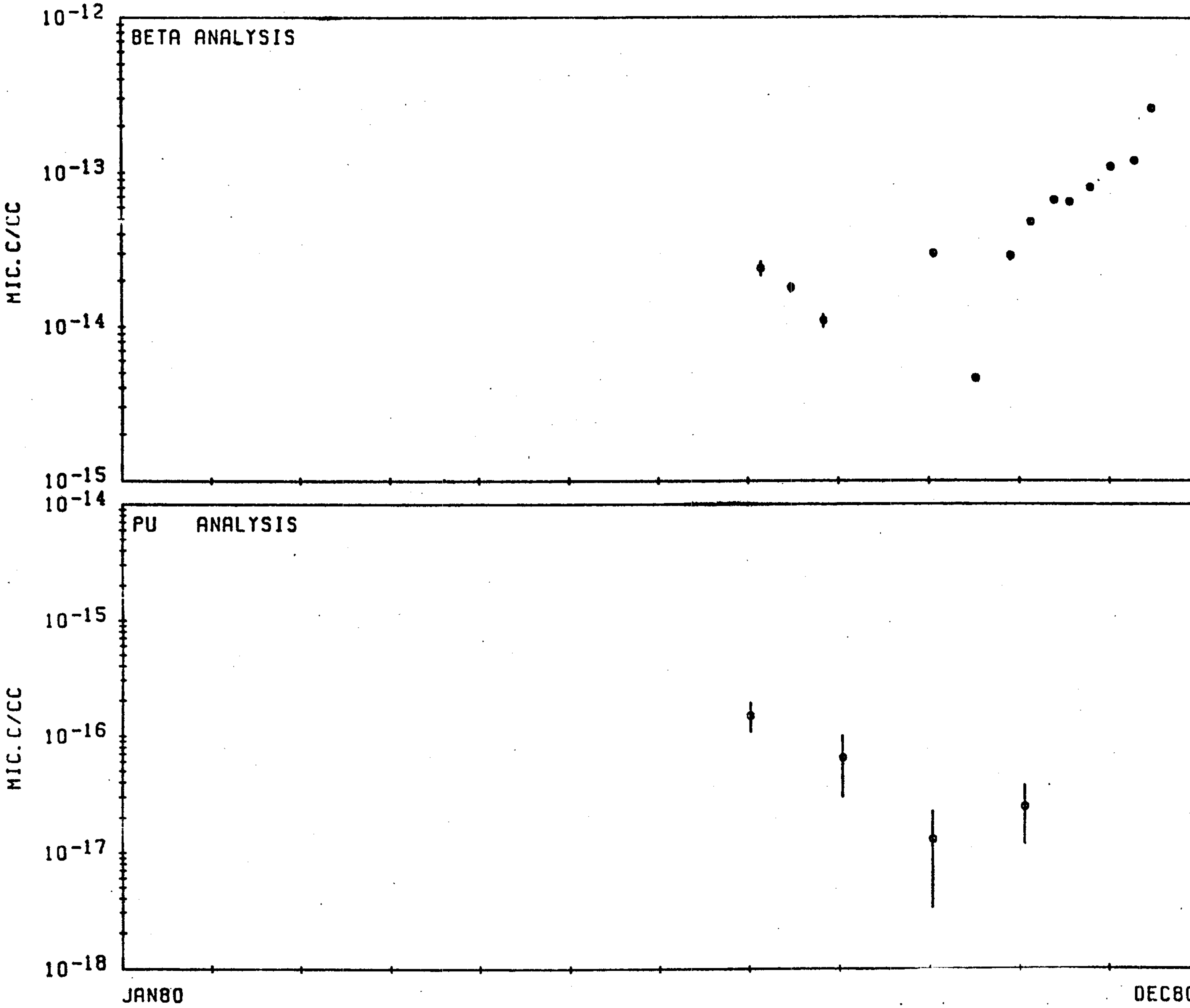


AIR SAMPLING STATION NUMBER 17

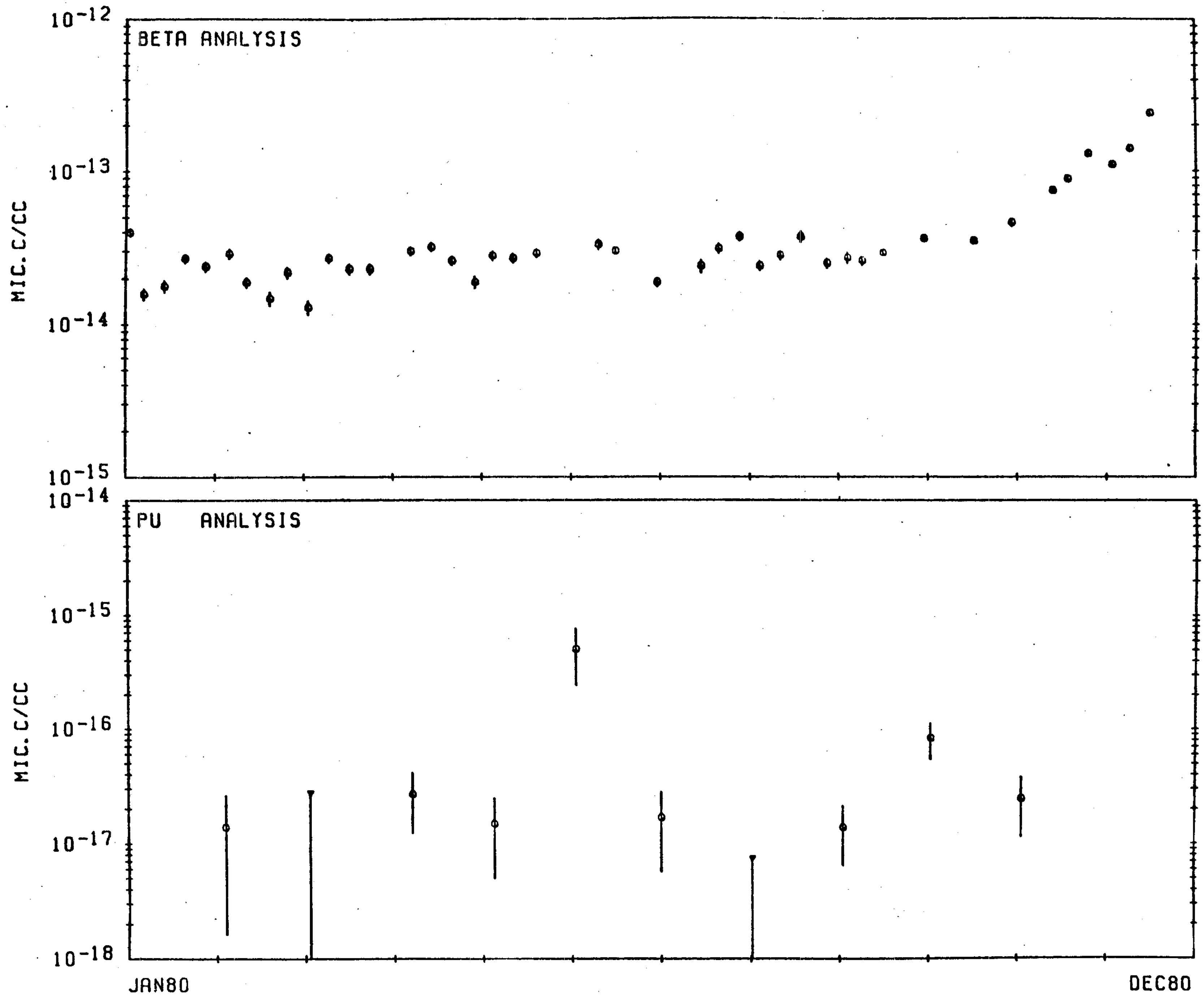


-90-

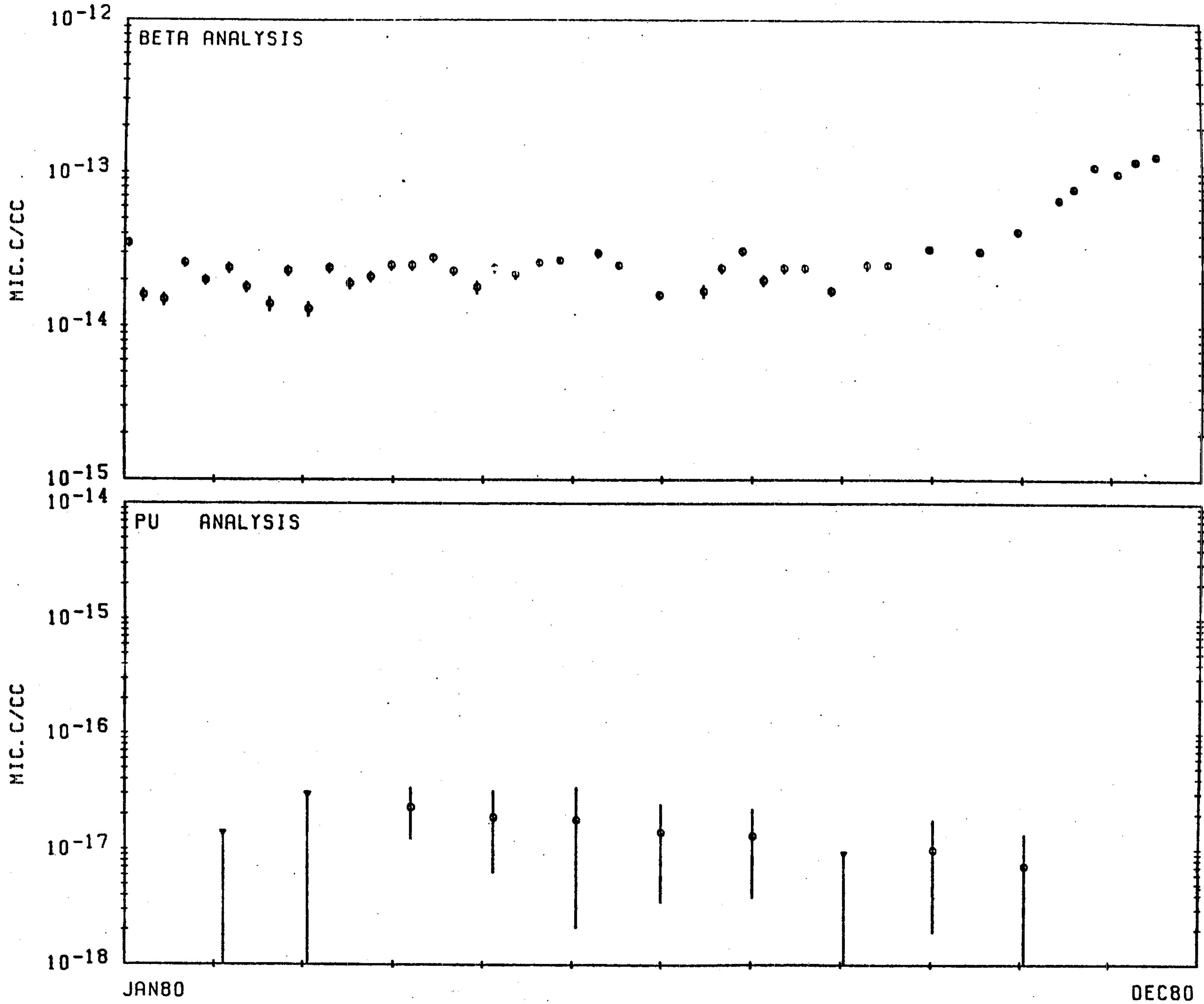
AIR SAMPLING STATION NUMBER 18



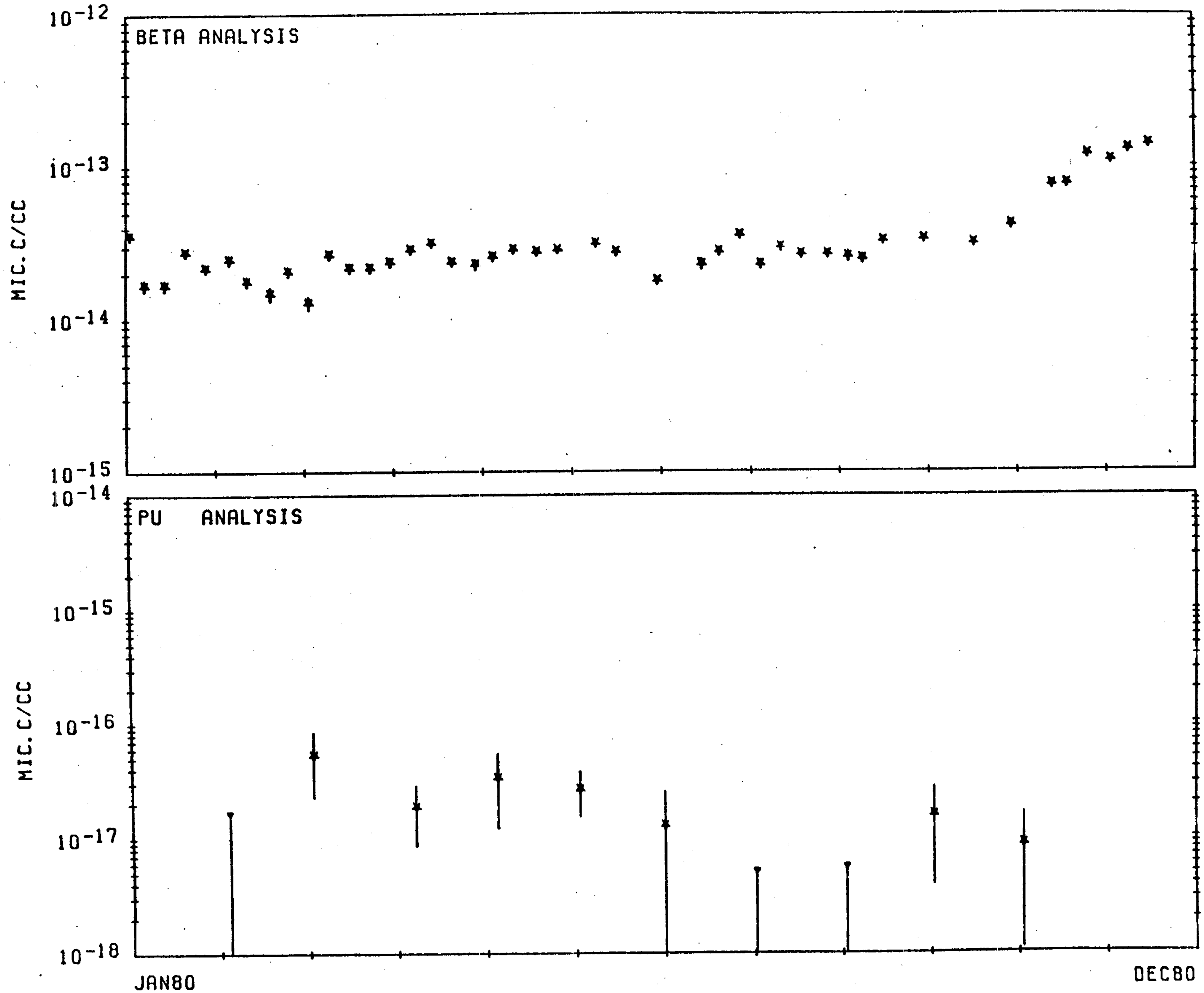
AIR SAMPLING STATION NUMBER 19



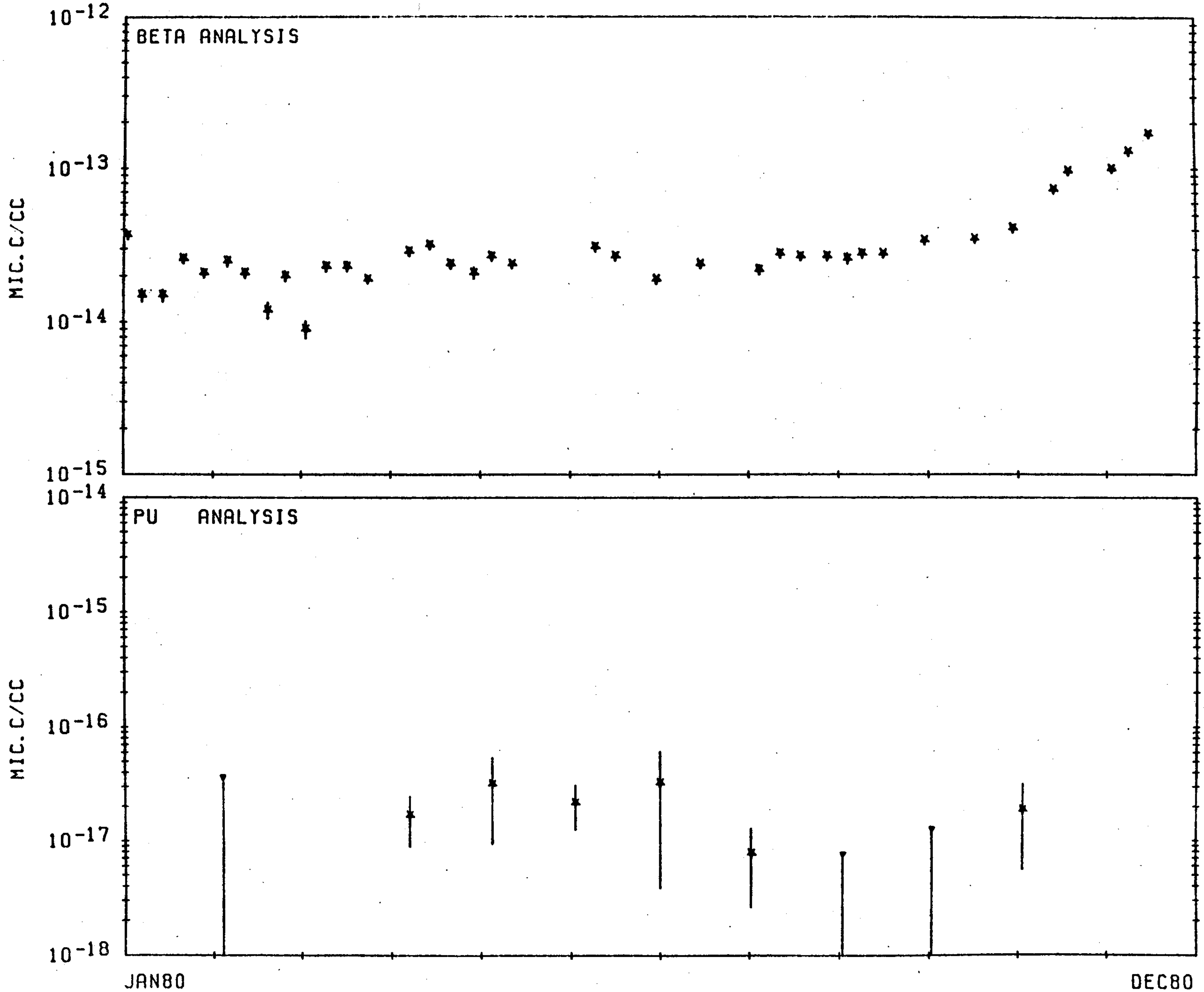
AIR SAMPLING STATION NUMBER 20

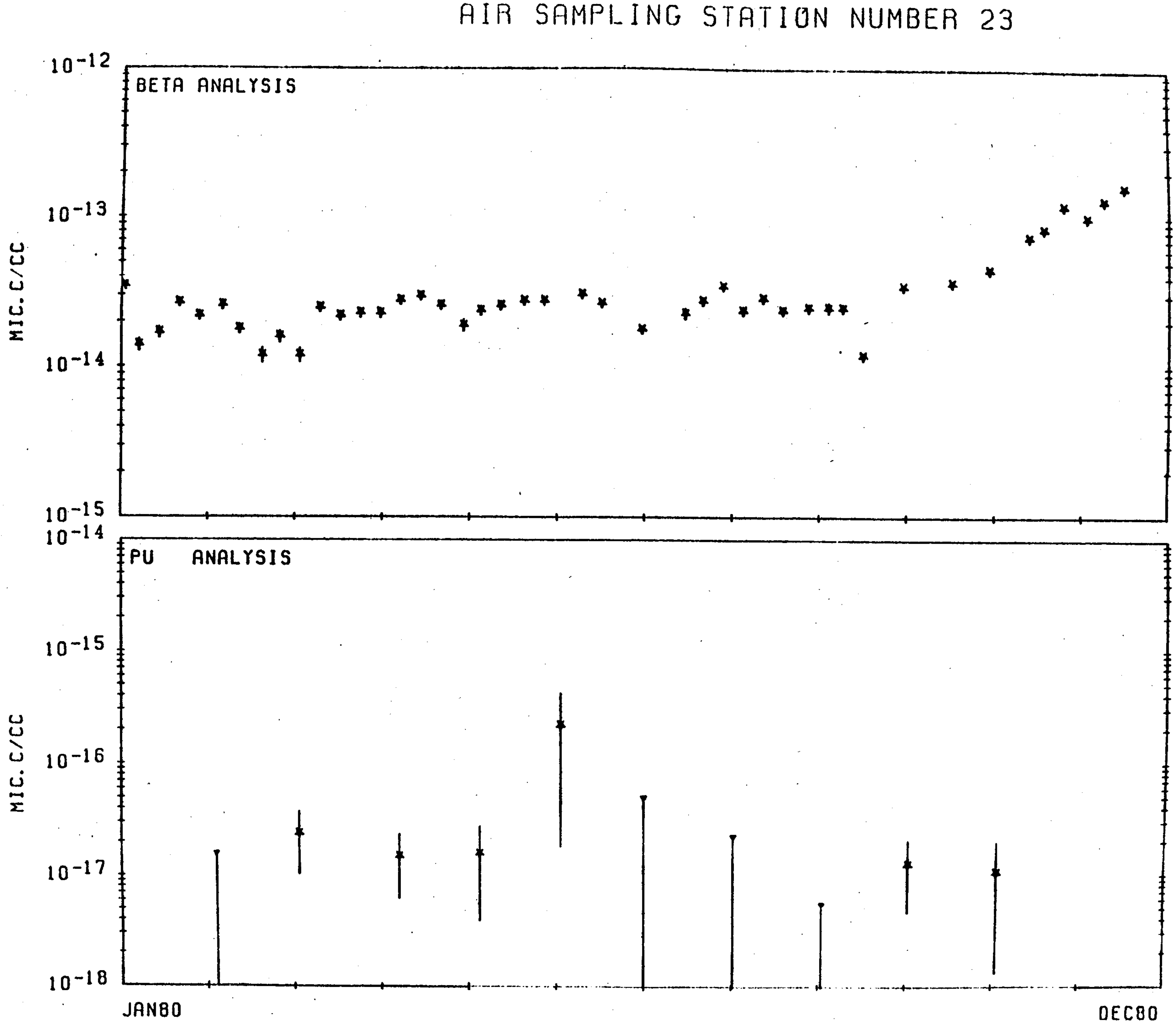


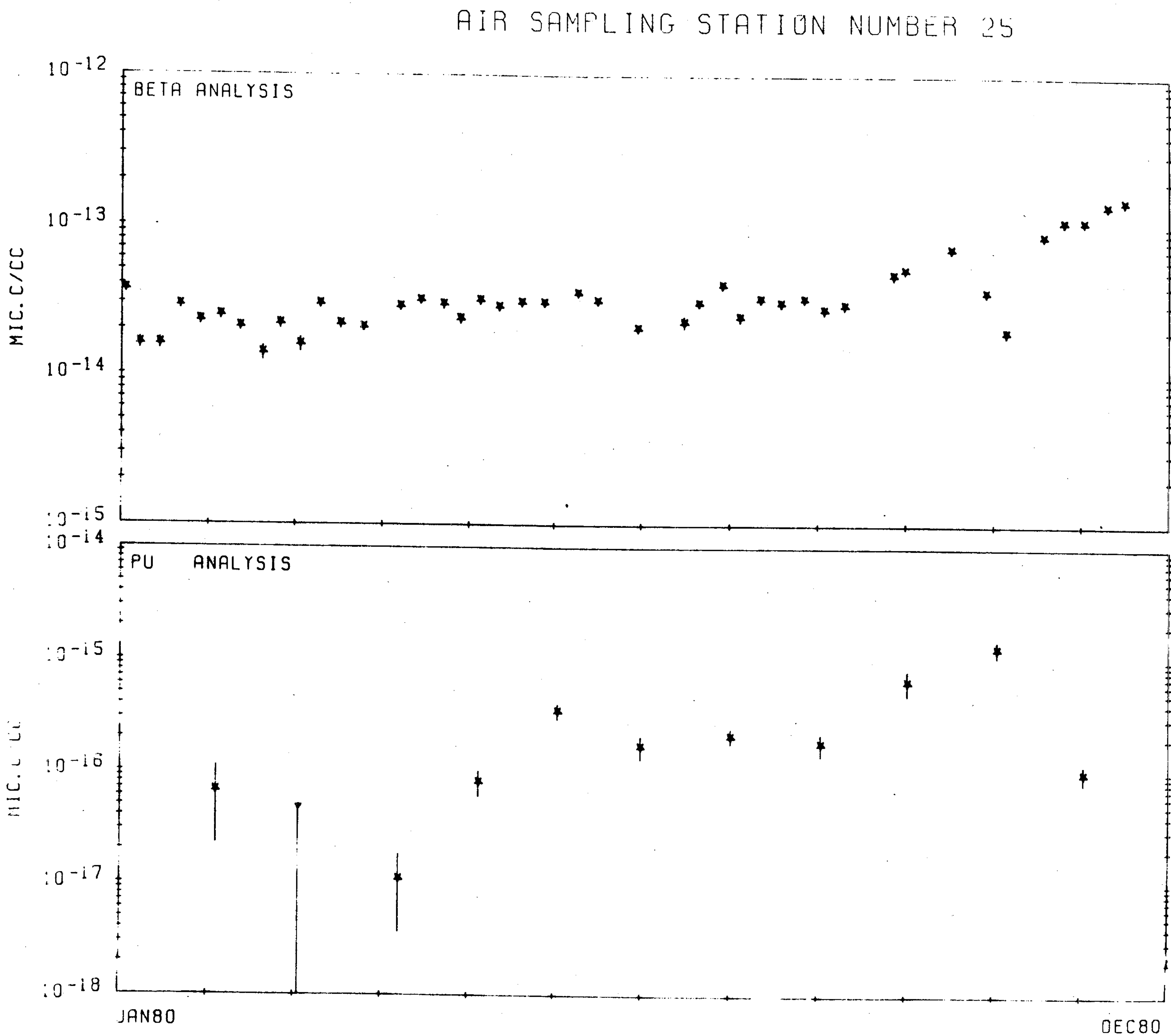
AIR SAMPLING STATION NUMBER 21



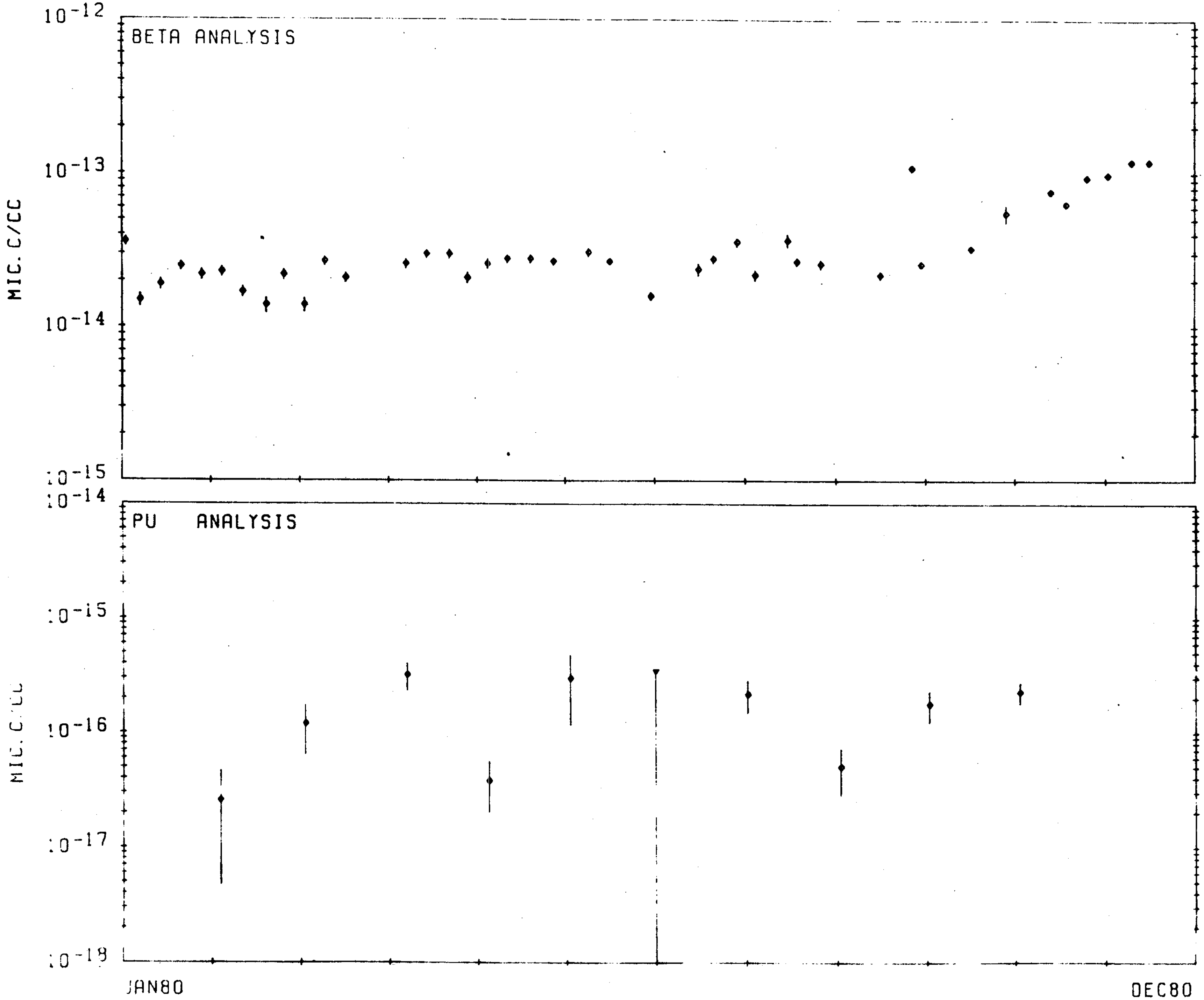
AIR SAMPLING STATION NUMBER 22



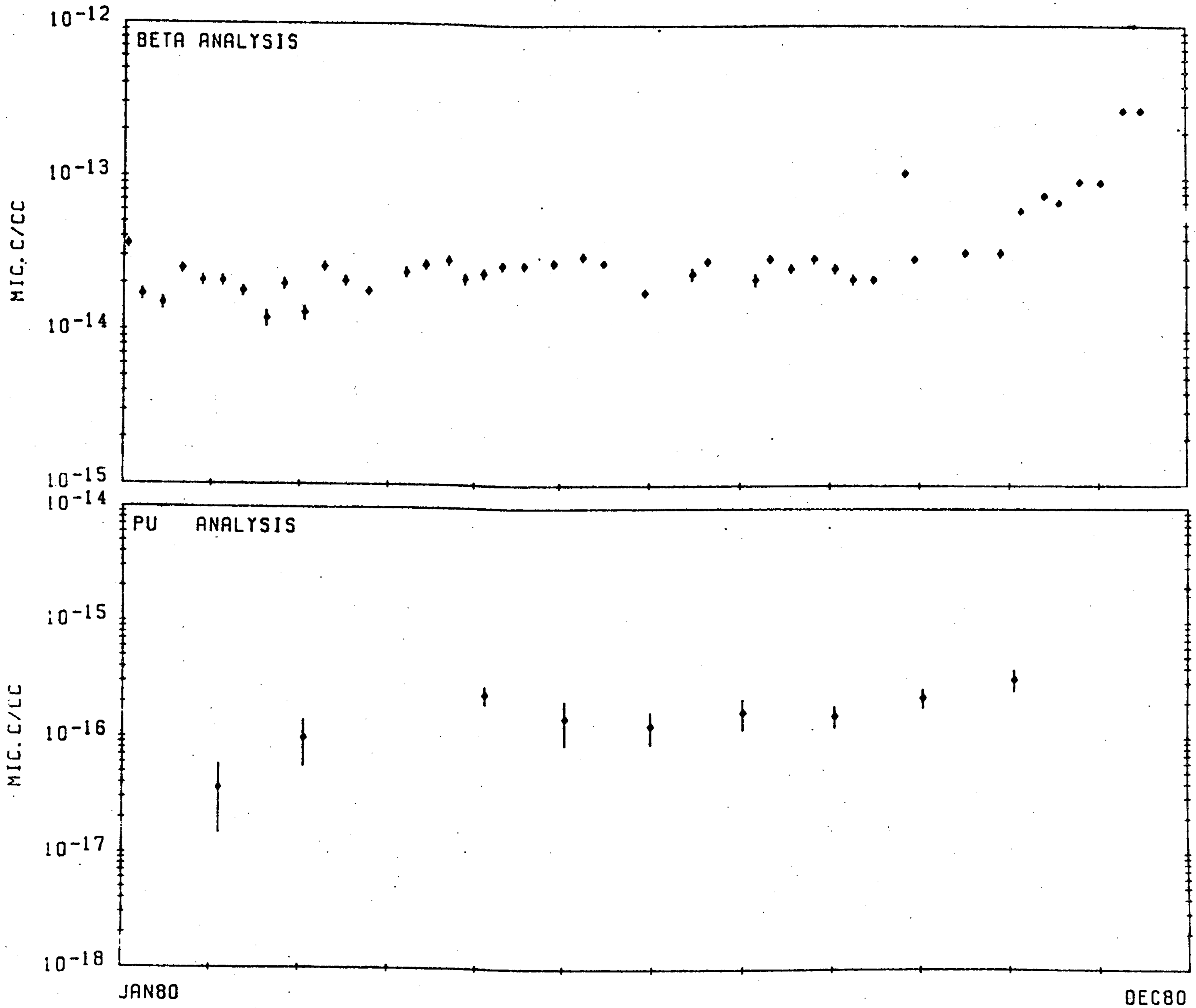

AIR SAMPLING STATION NUMBER 23
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10-12
10-13
10-14
10-15
10-14
10-15
10-16
10-17
10-18
JAN80
DEC80


AIR SAMPLING STATION NUMBER 25
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
10^-12
10^-13
10^-14
10^-15
10^-16
10^-17
10^-18
JAN80
DEC80

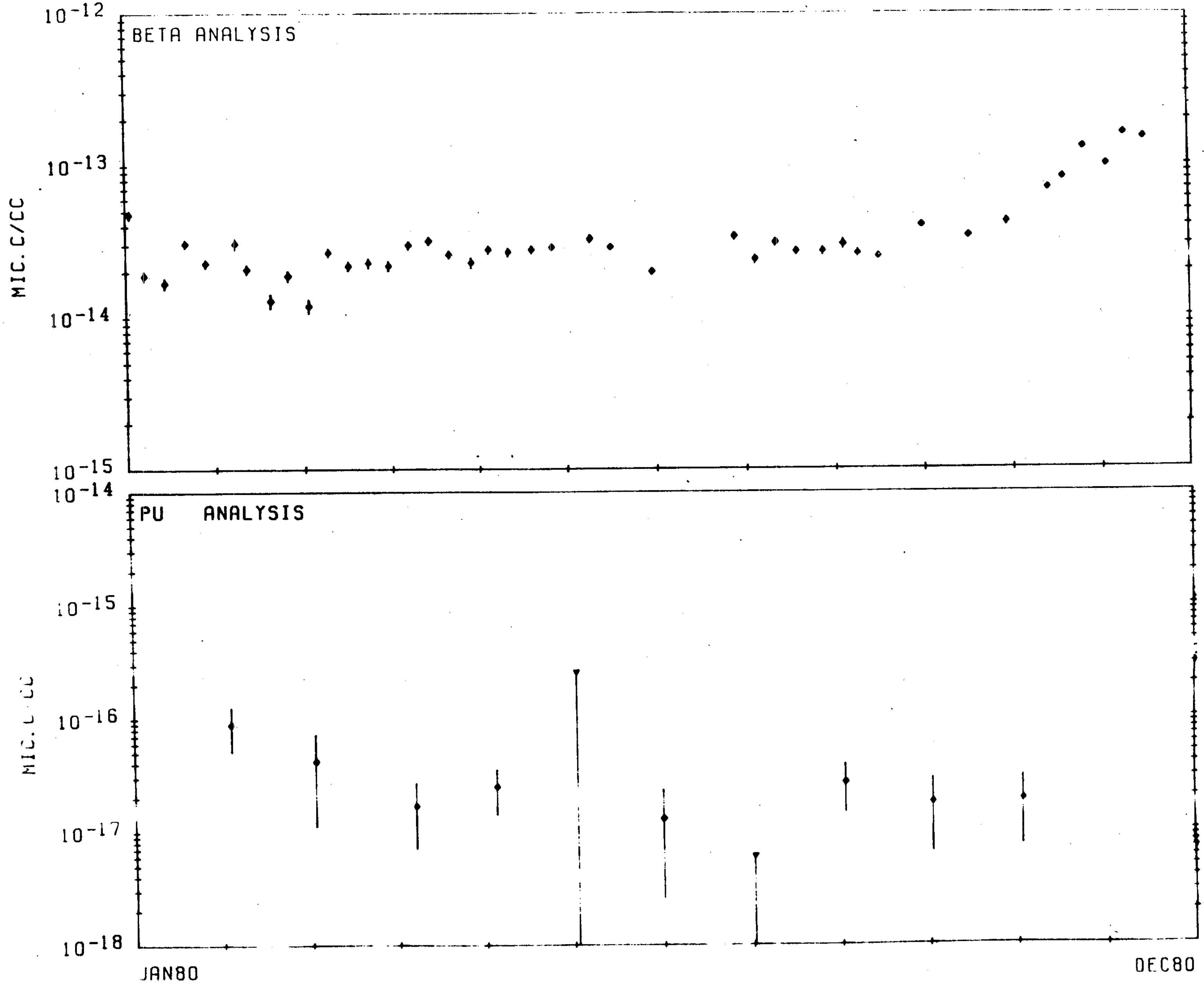
AIR SAMPLING STATION NUMBER 26



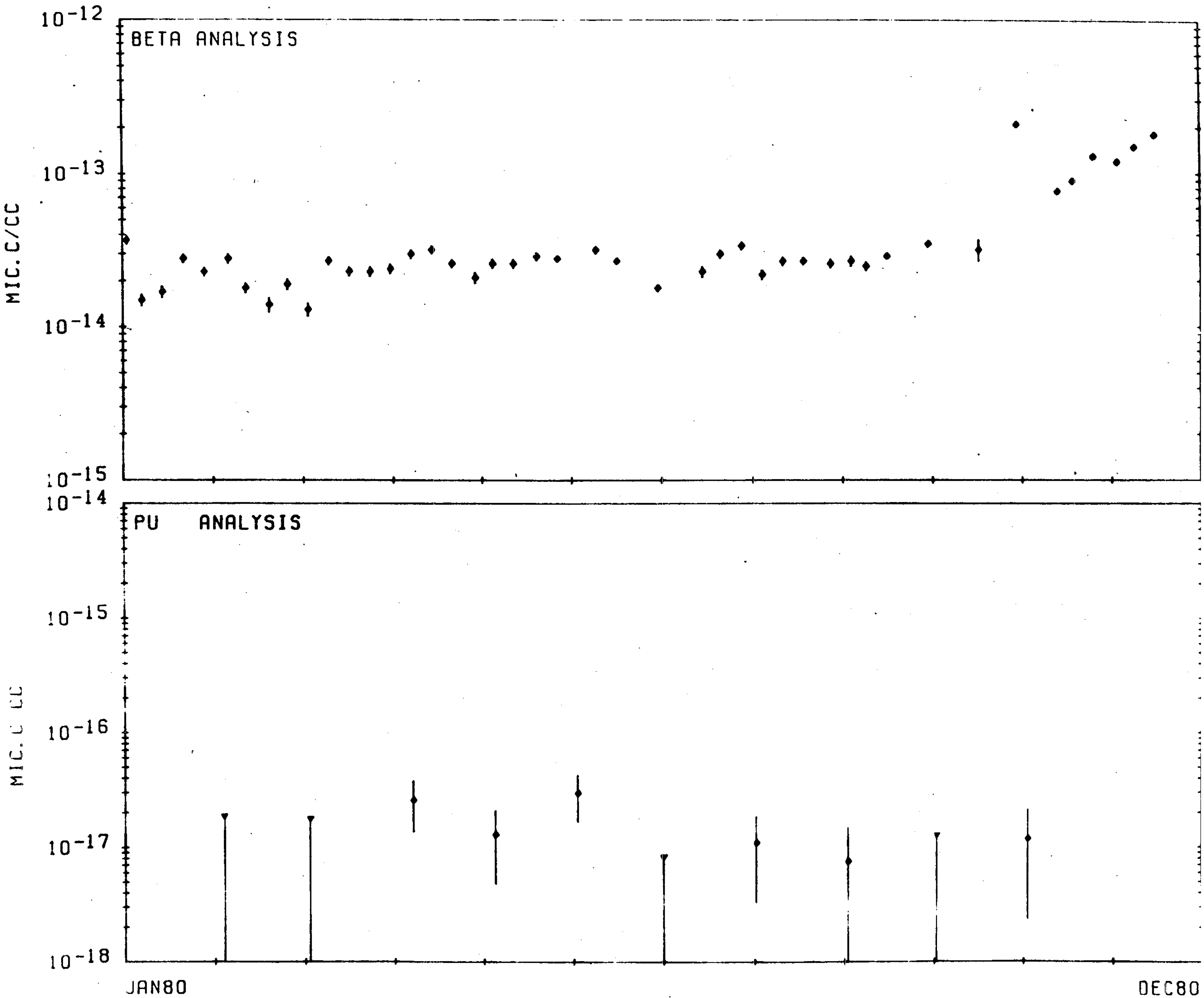
AIR SAMPLING STATION NUMBER 27



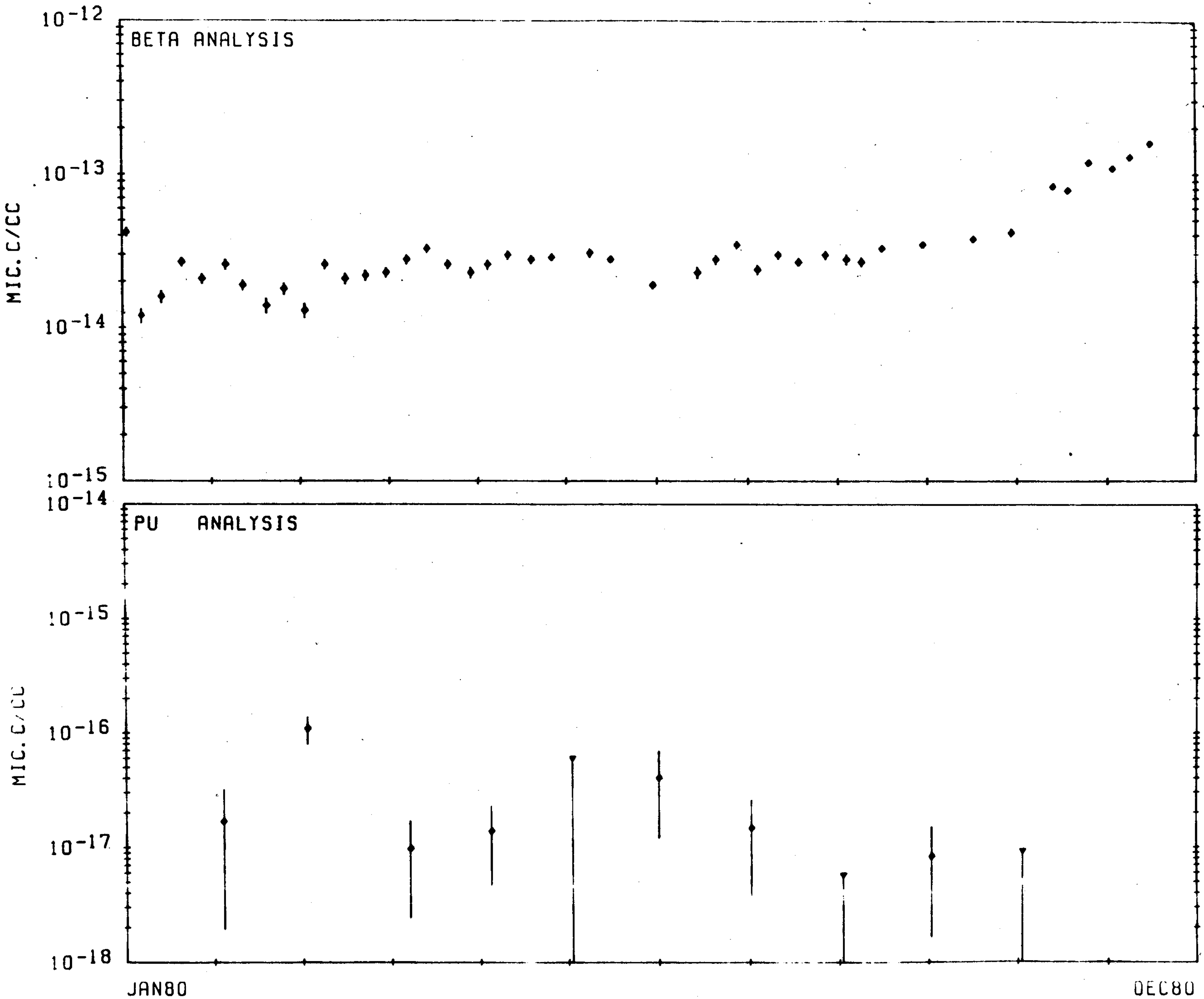
AIR SAMPLING STATION NUMBER 28



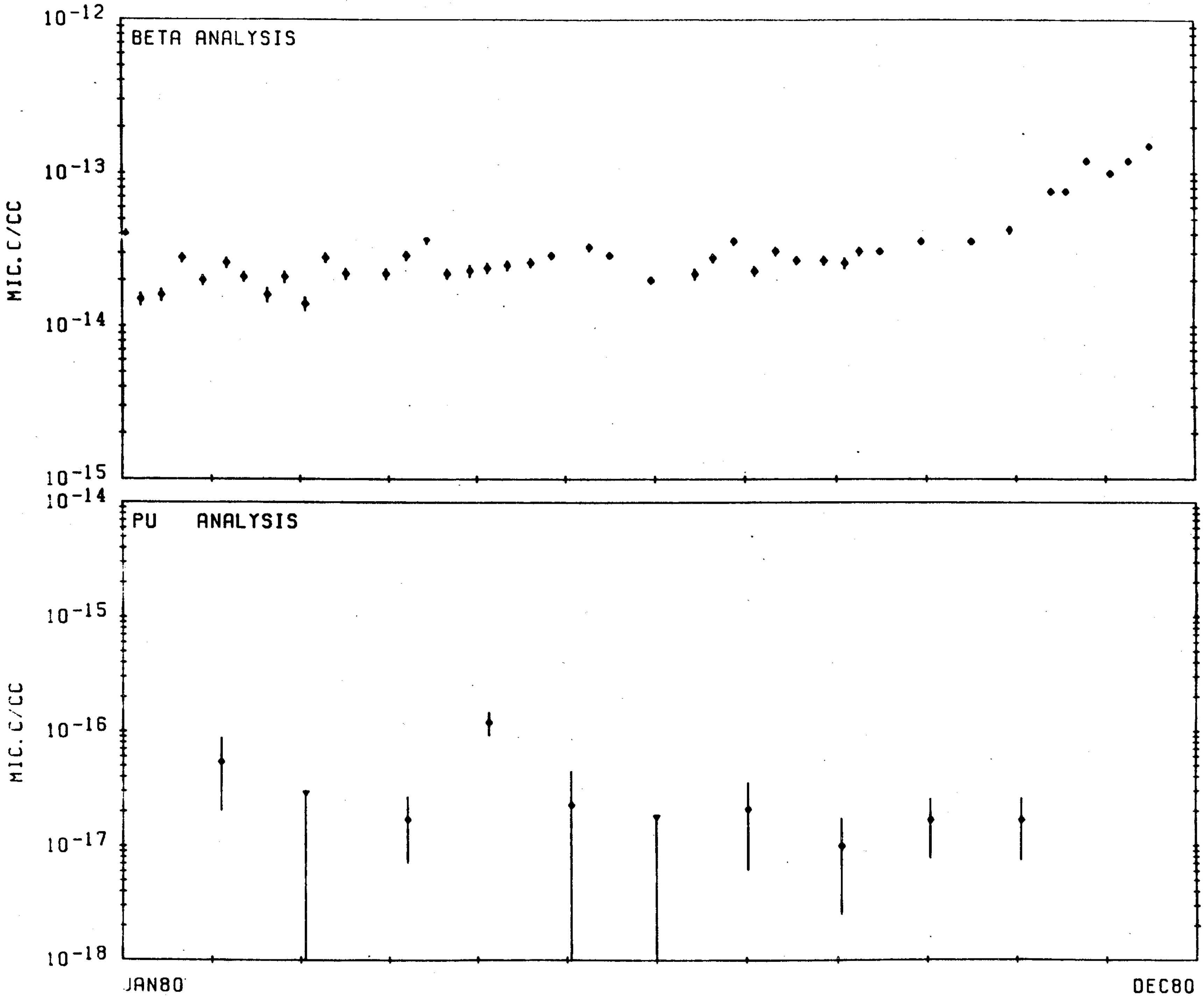
AIR SAMPLING STATION NUMBER 29



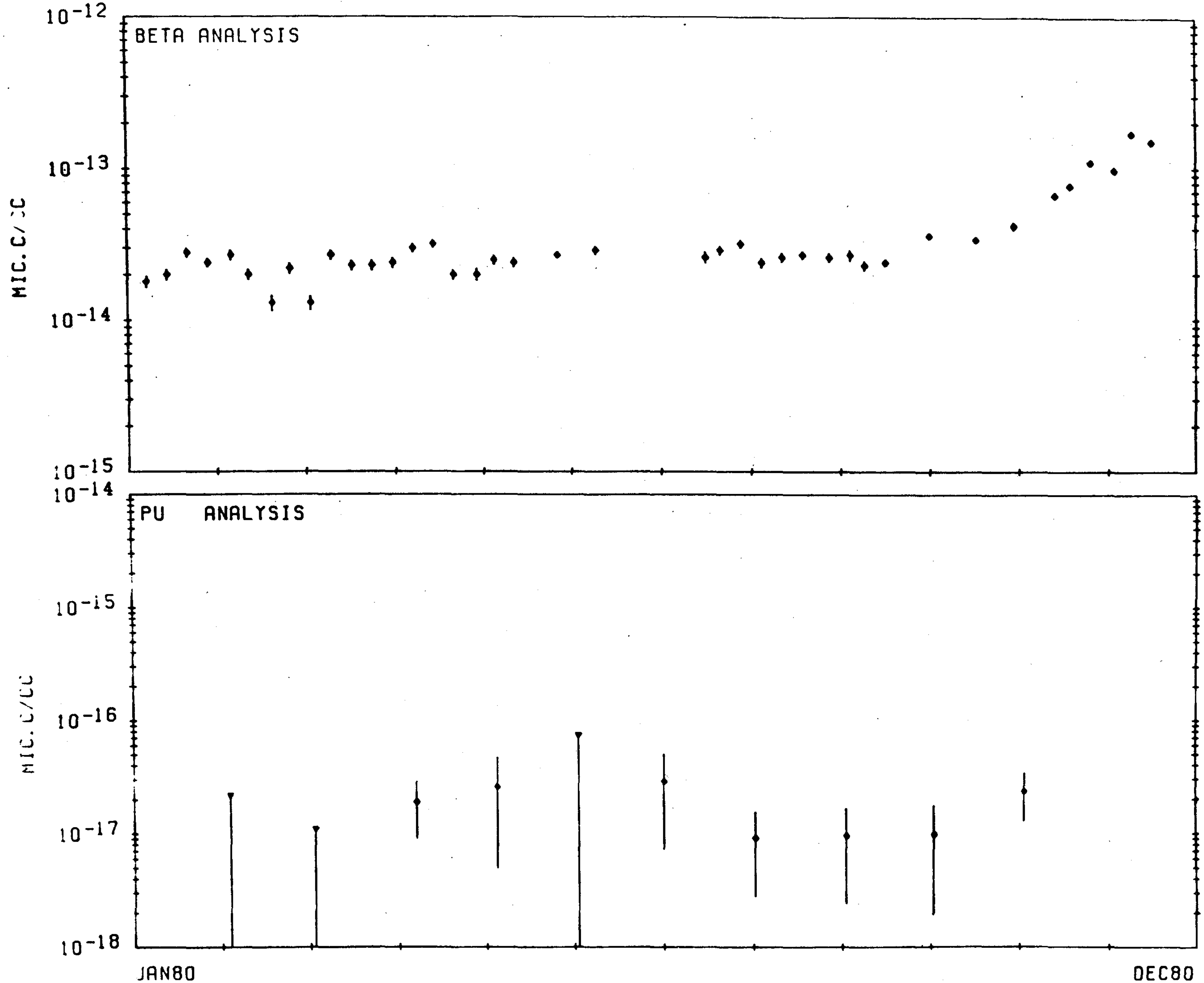
AIR SAMPLING STATION NUMBER 30



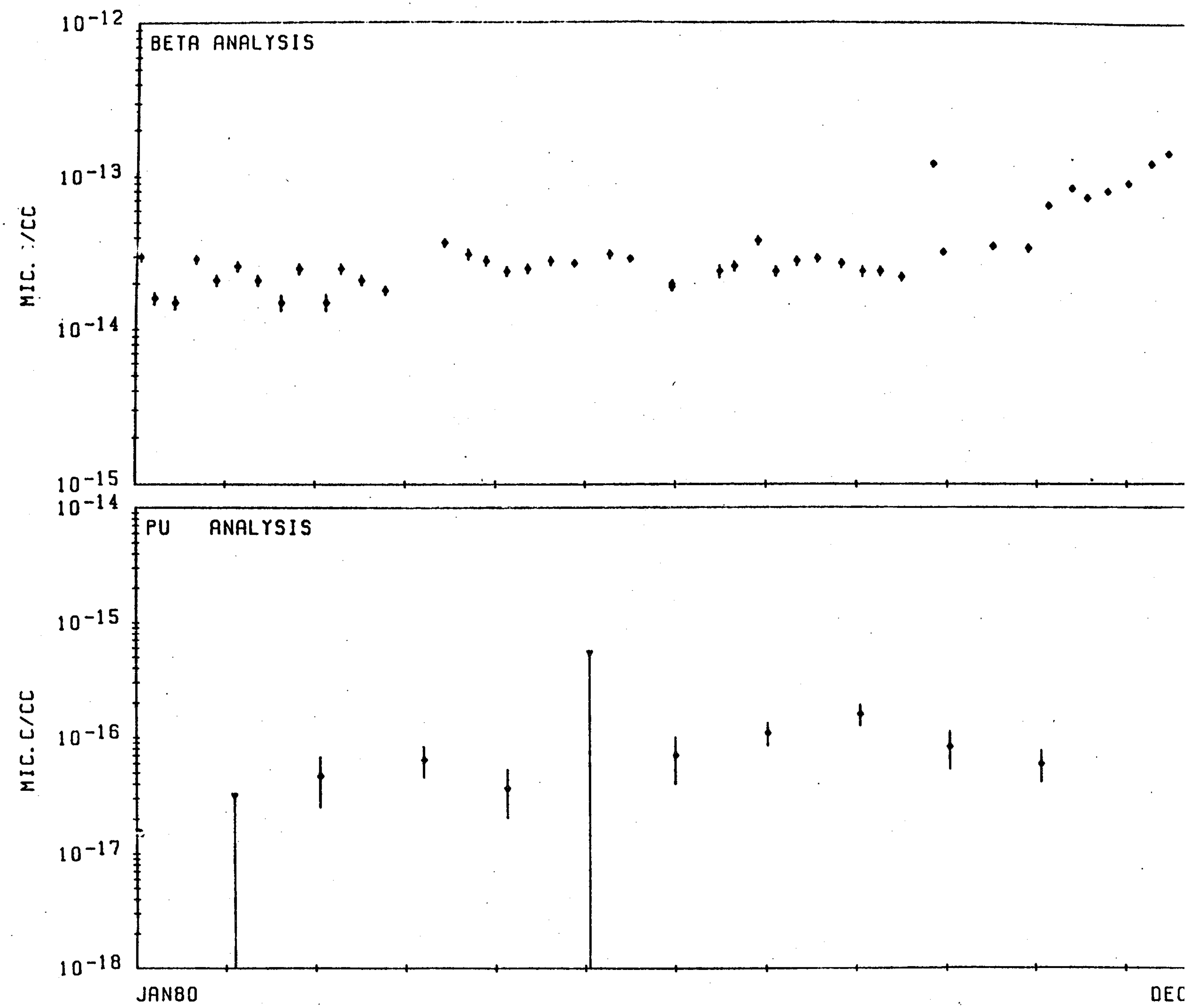
AIR SAMPLING STATION NUMBER 31



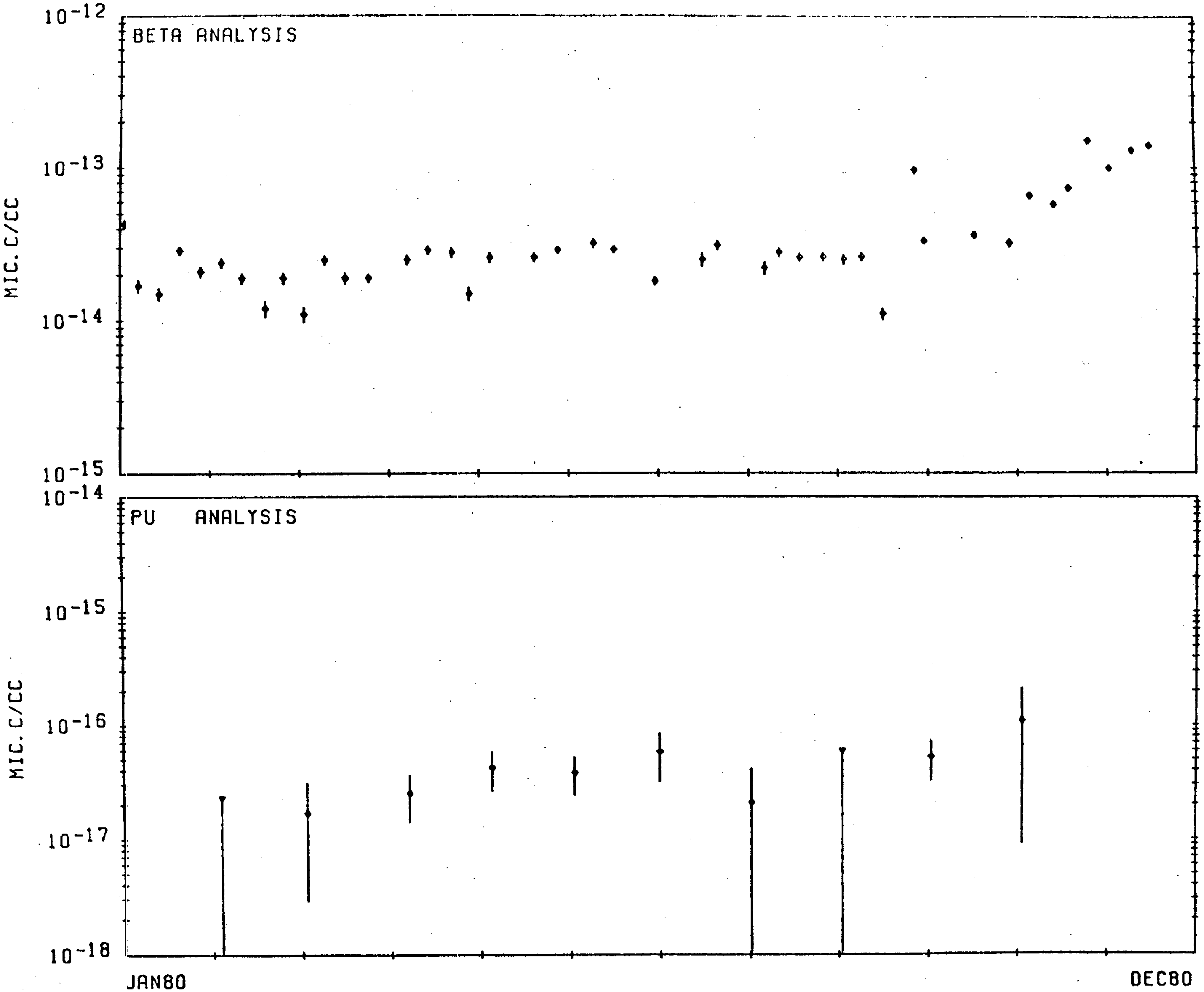
AIR SAMPLING STATION NUMBER 32



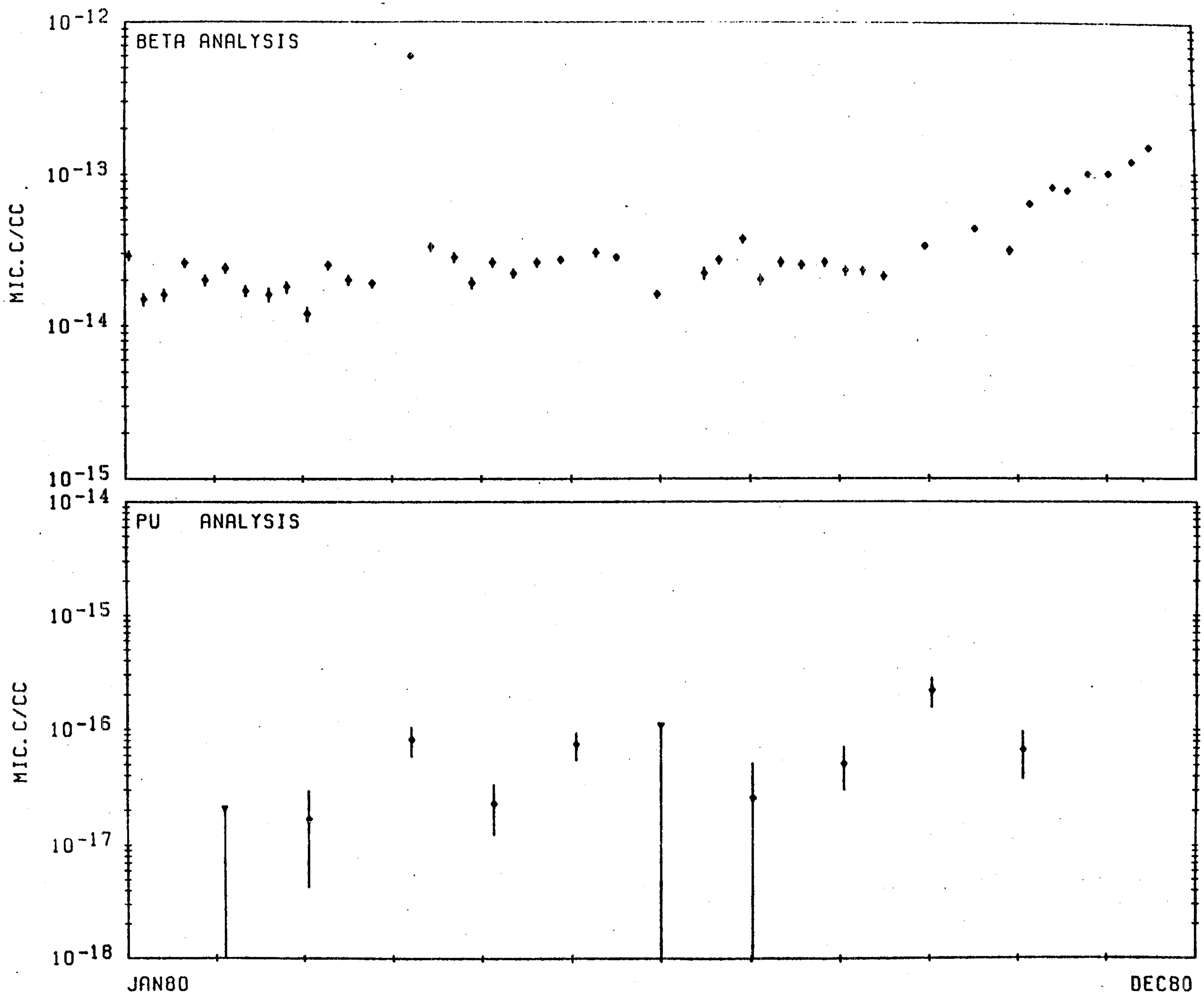
AIR SAMPLING STATION NUMBER 33



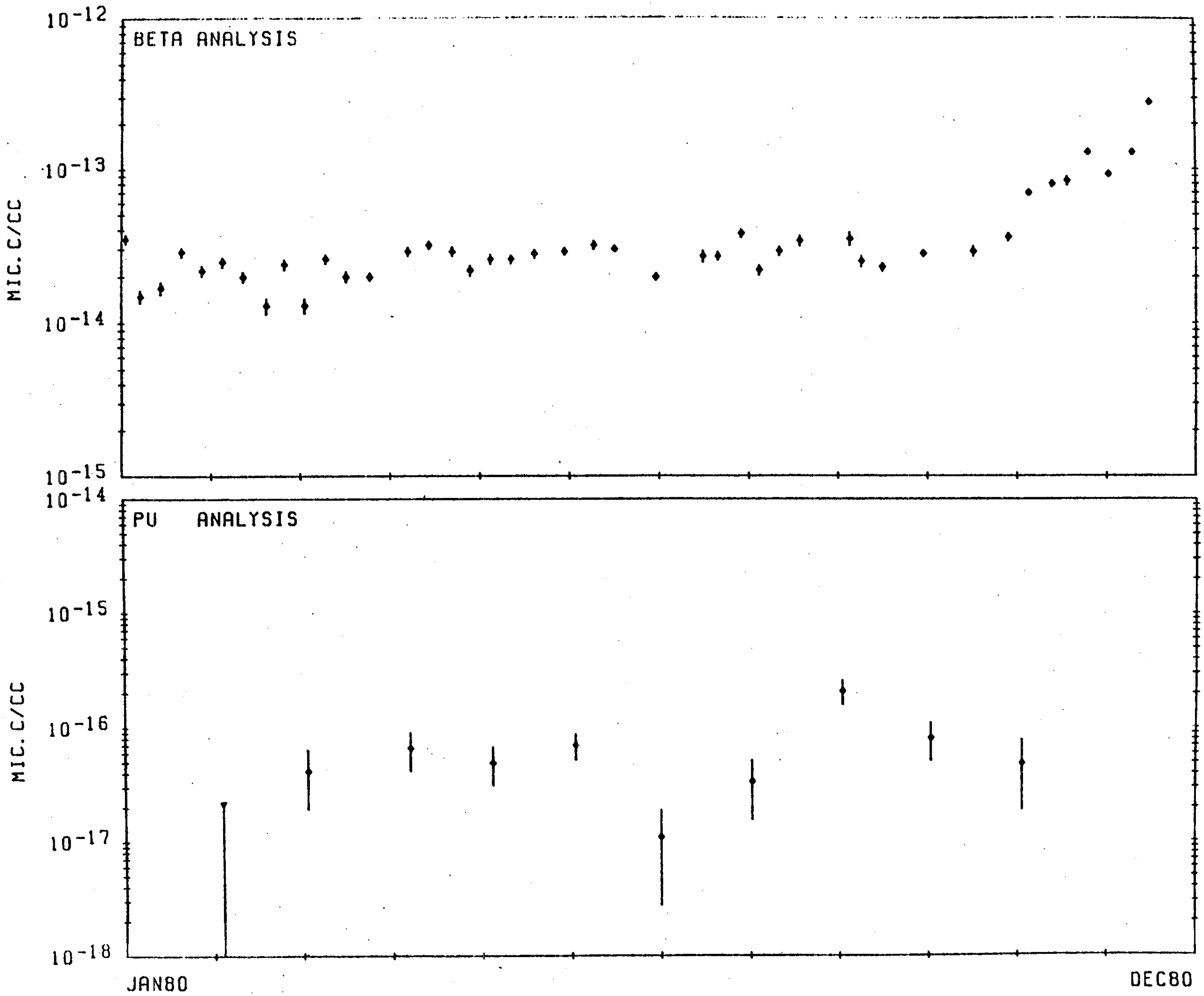
AIR SAMPLING STATION NUMBER 34



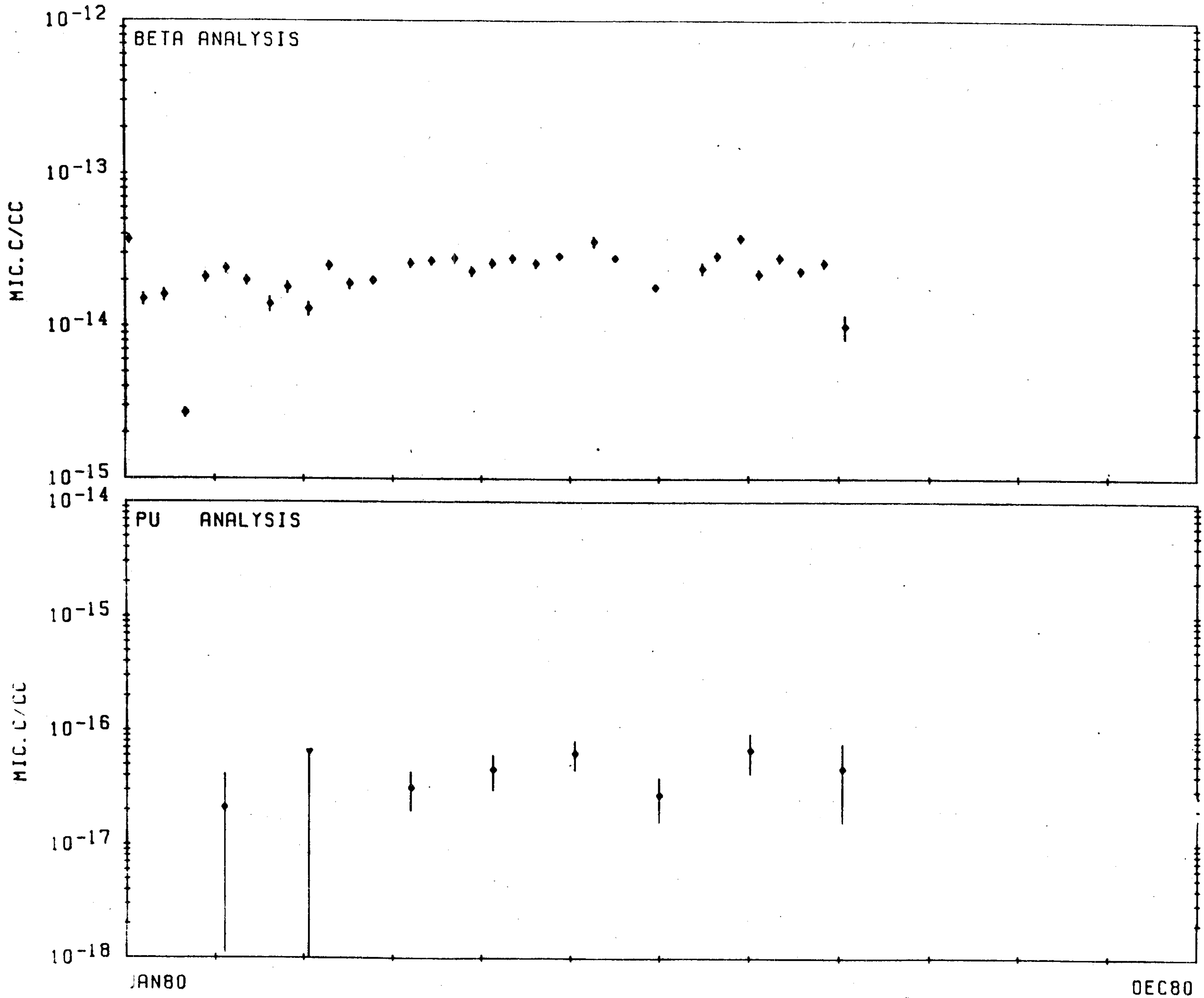
AIR SAMPLING STATION NUMBER 35



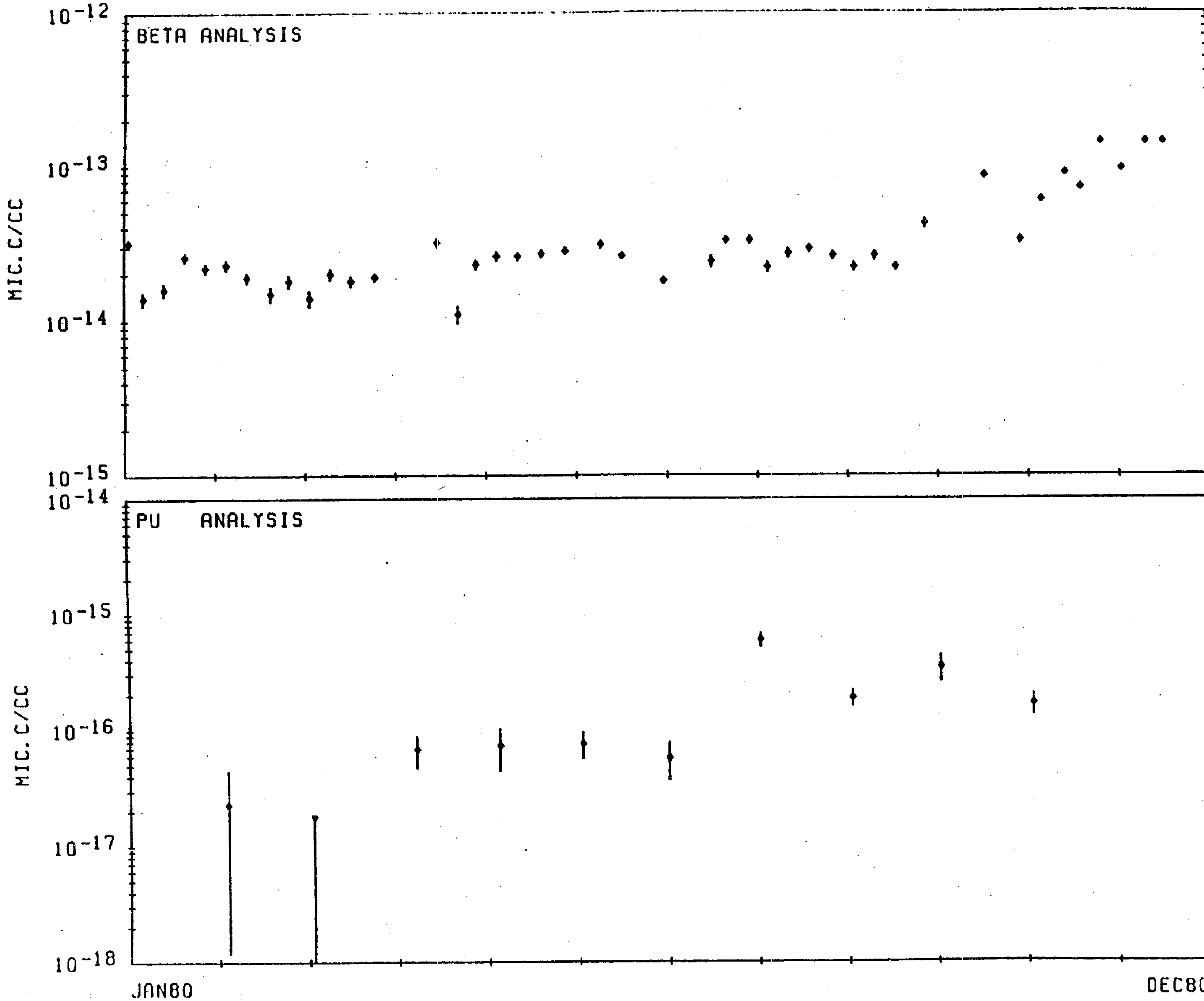
AIR SAMPLING STATION NUMBER 36



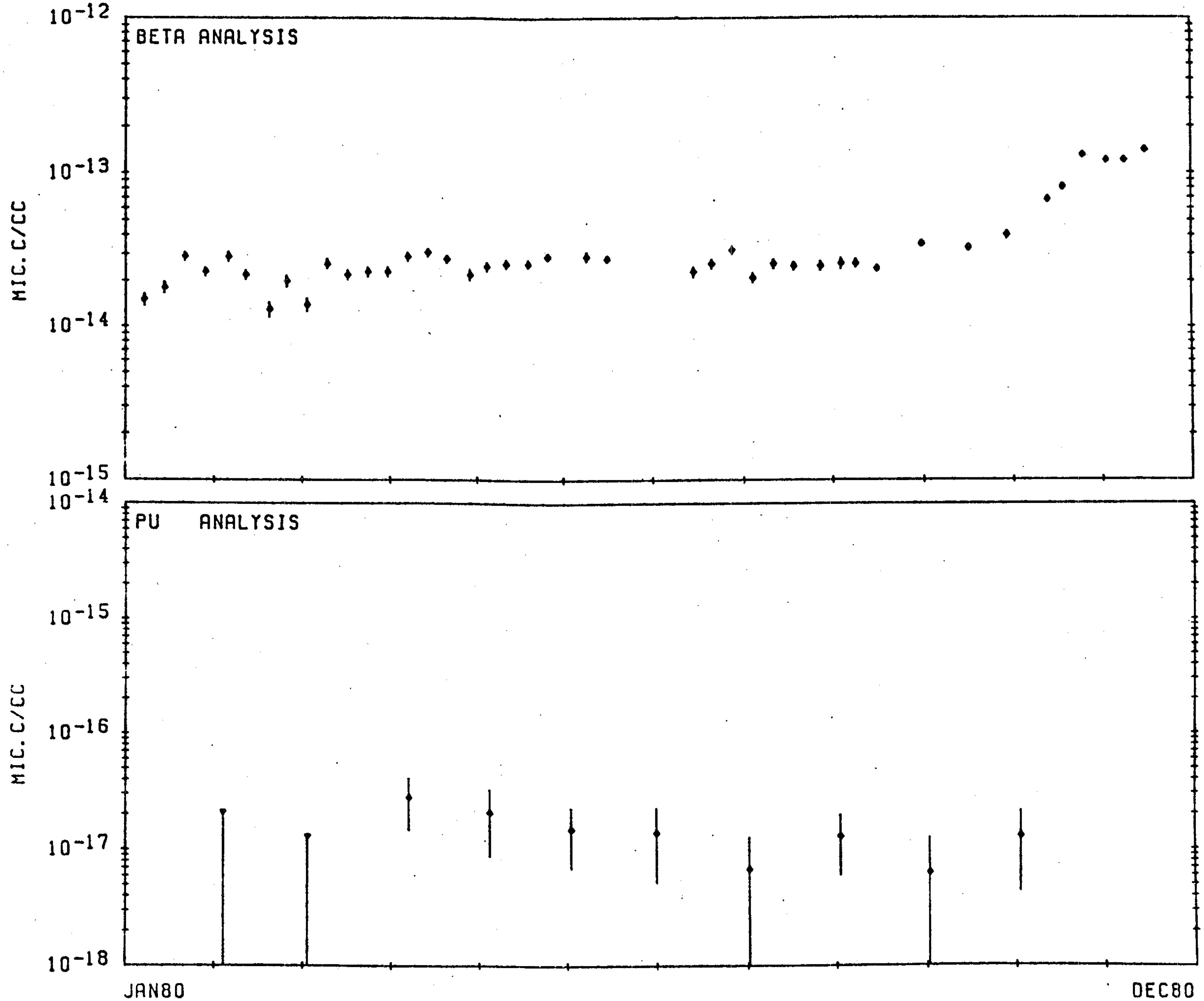
AIR SAMPLING STATION NUMBER 37



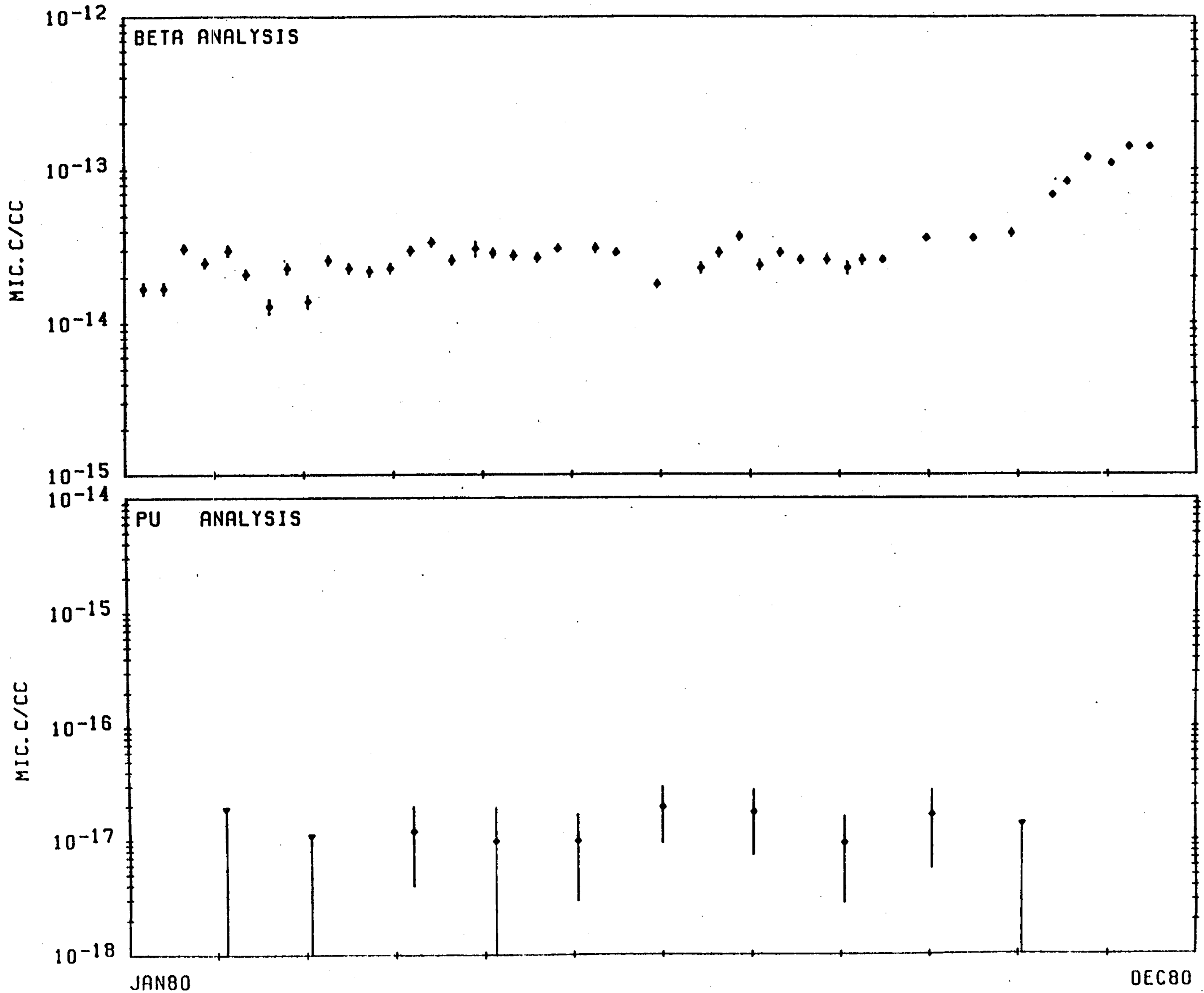
AIR SAMPLING STATION NUMBER 38



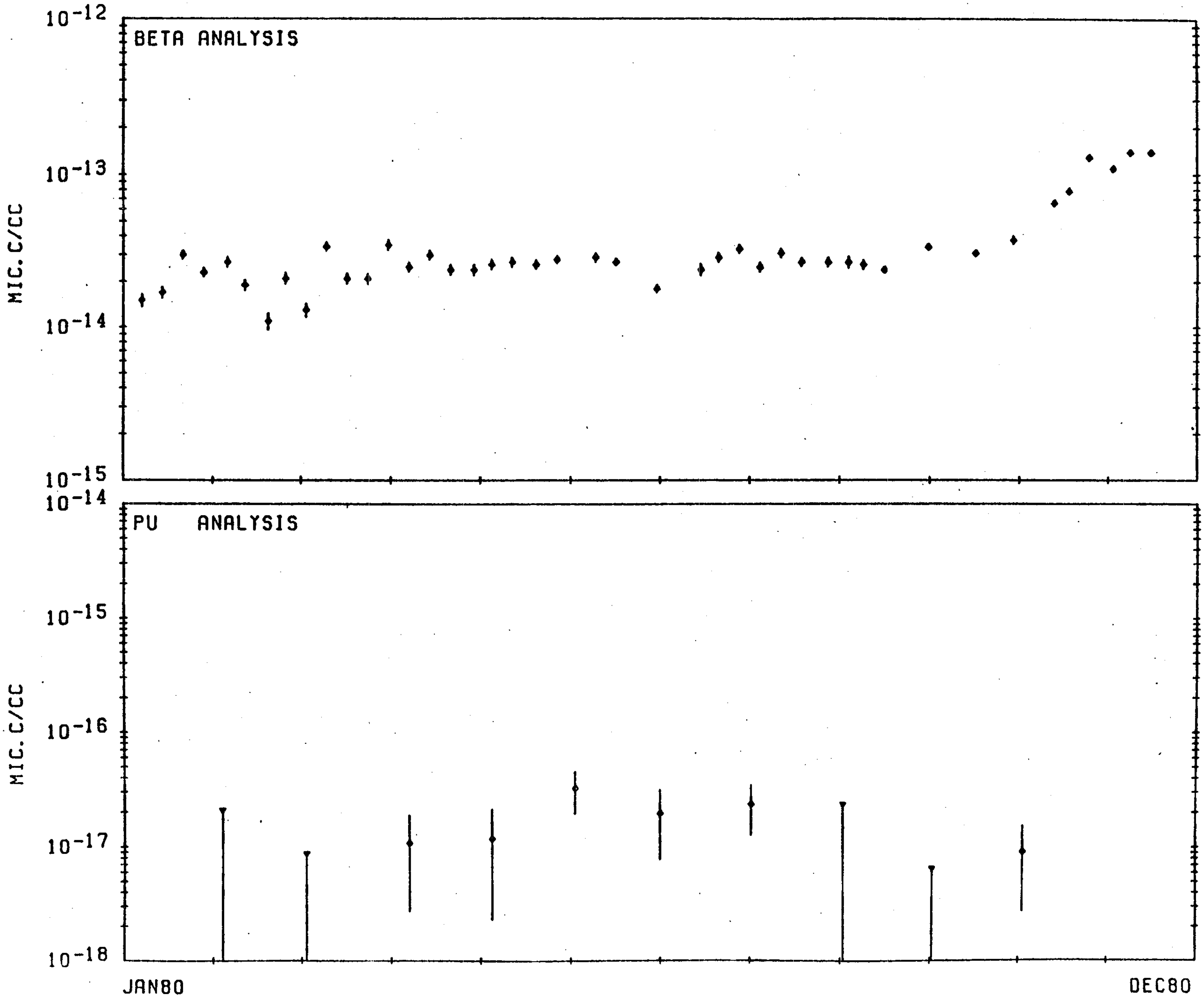
AIR SAMPLING STATION NUMBER 39



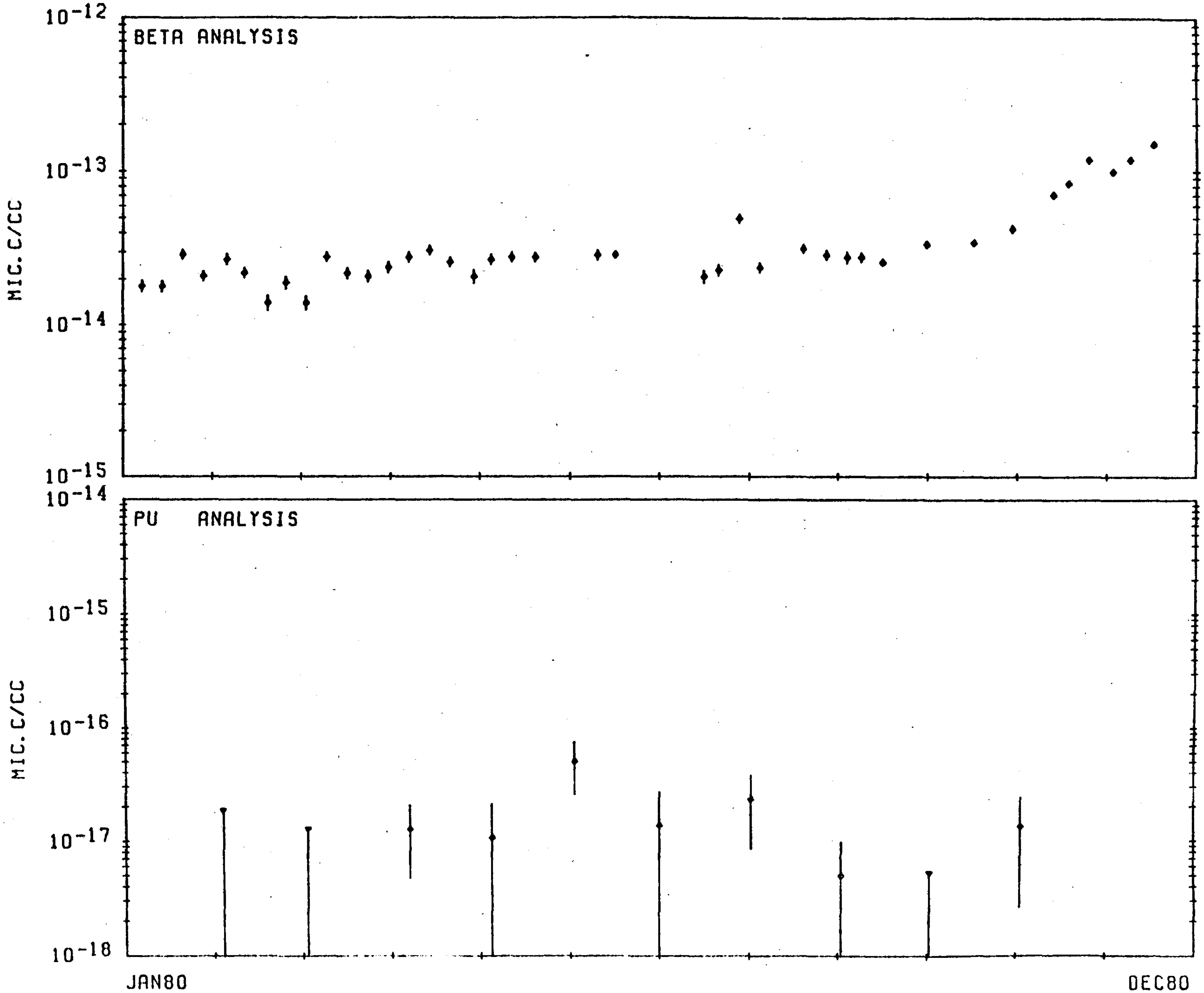
AIR SAMPLING STATION NUMBER 40



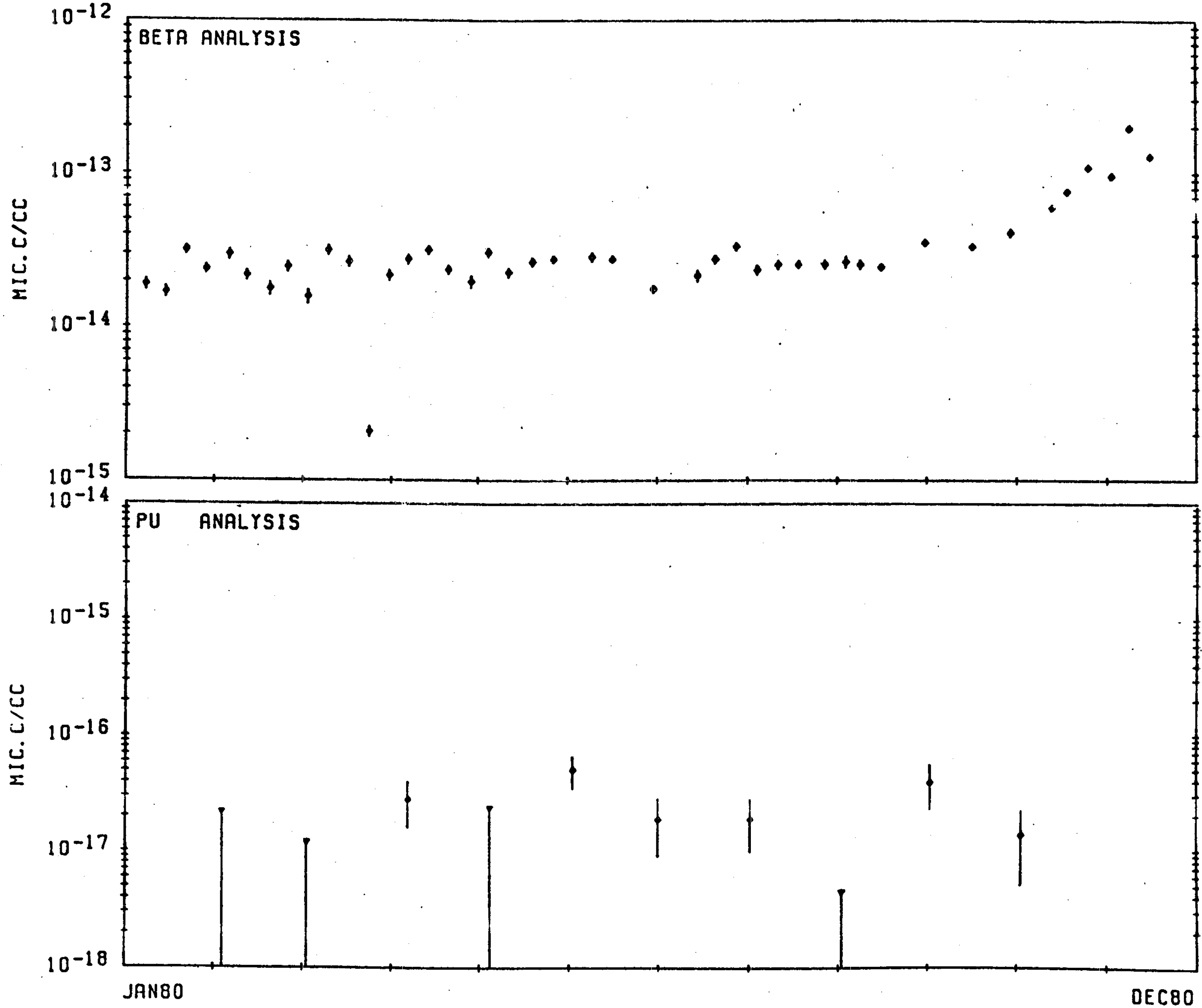
AIR SAMPLING STATION NUMBER 41

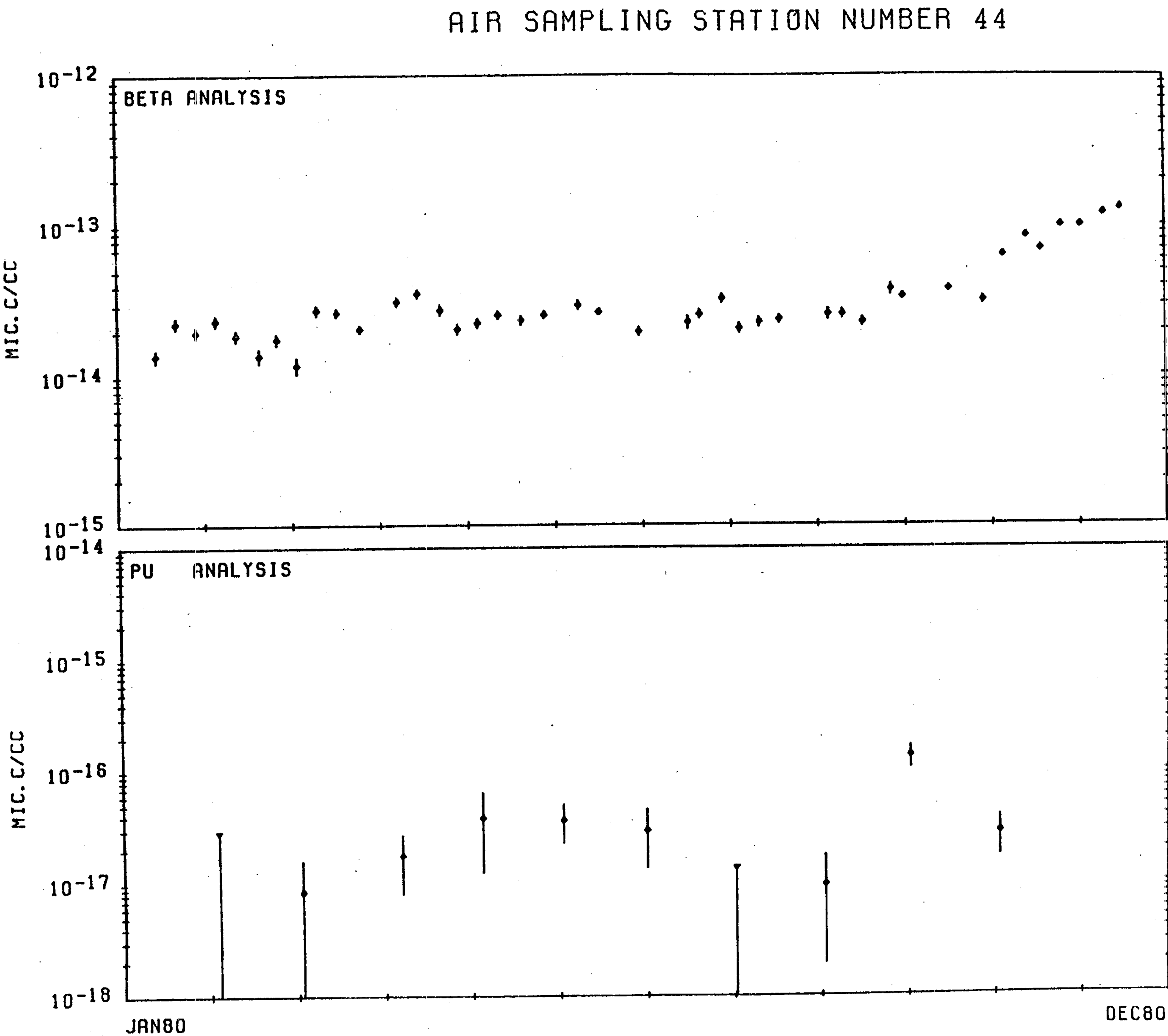


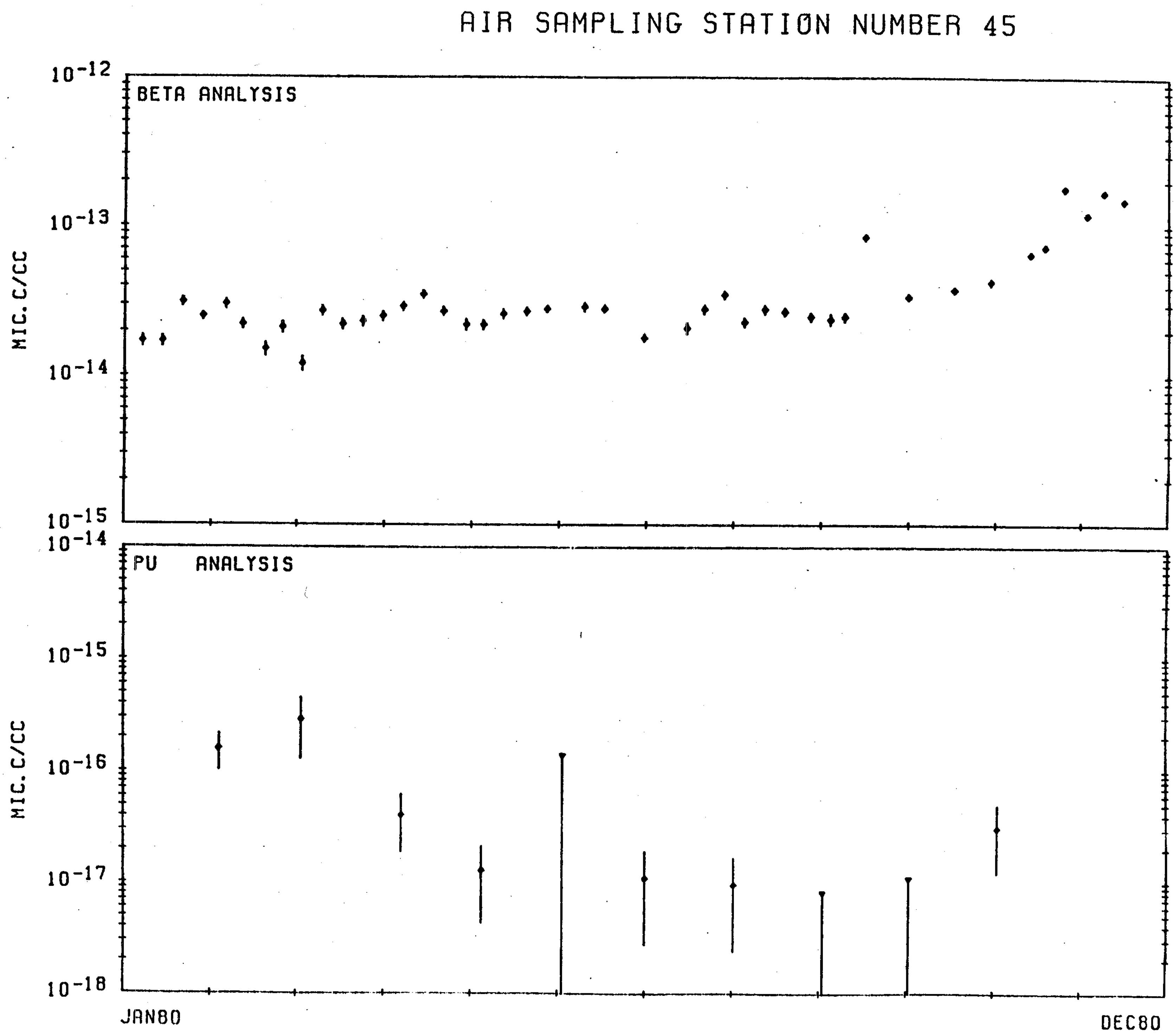
AIR SAMPLING STATION NUMBER 42

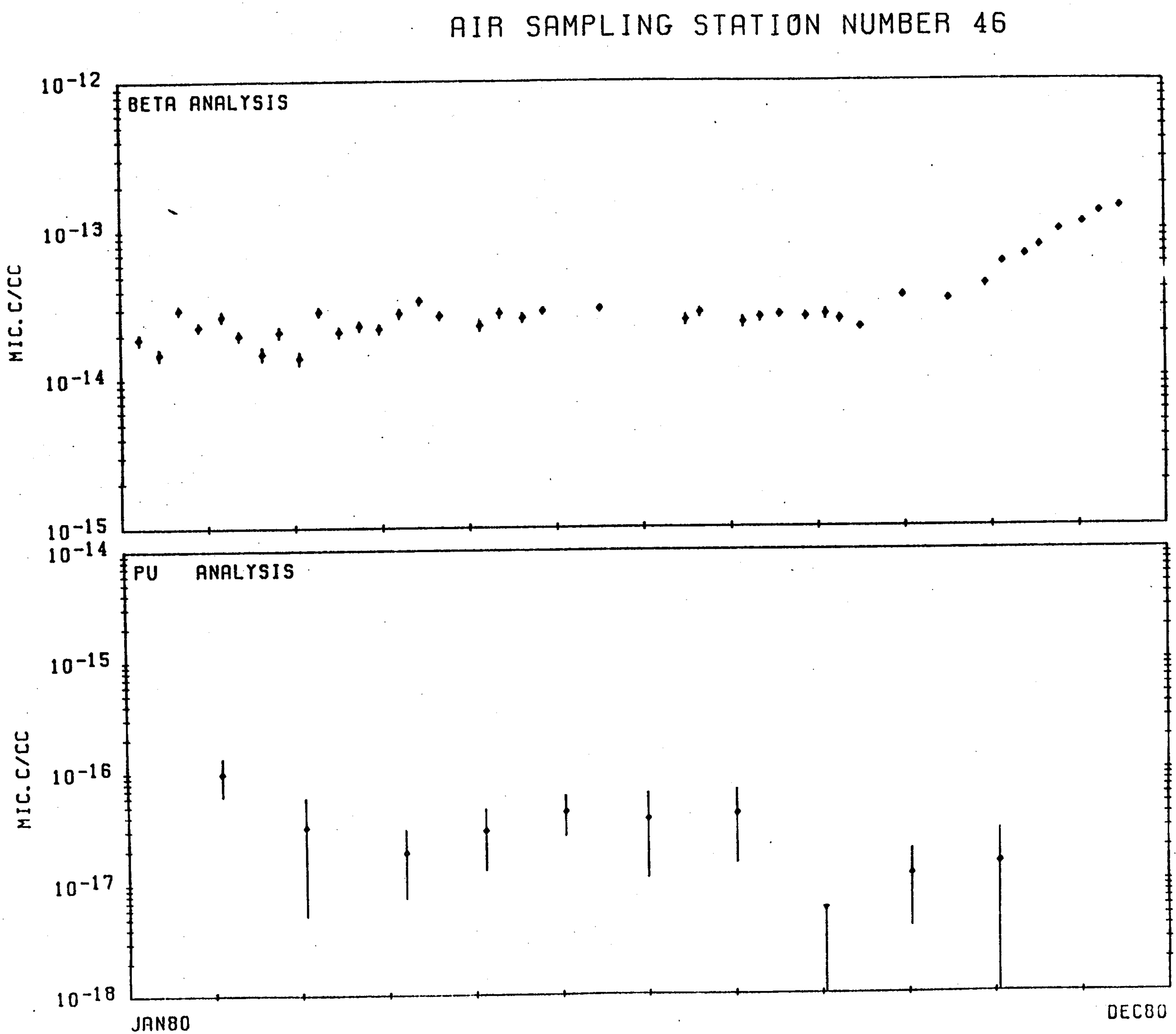


AIR SAMPLING STATION NUMBER 43

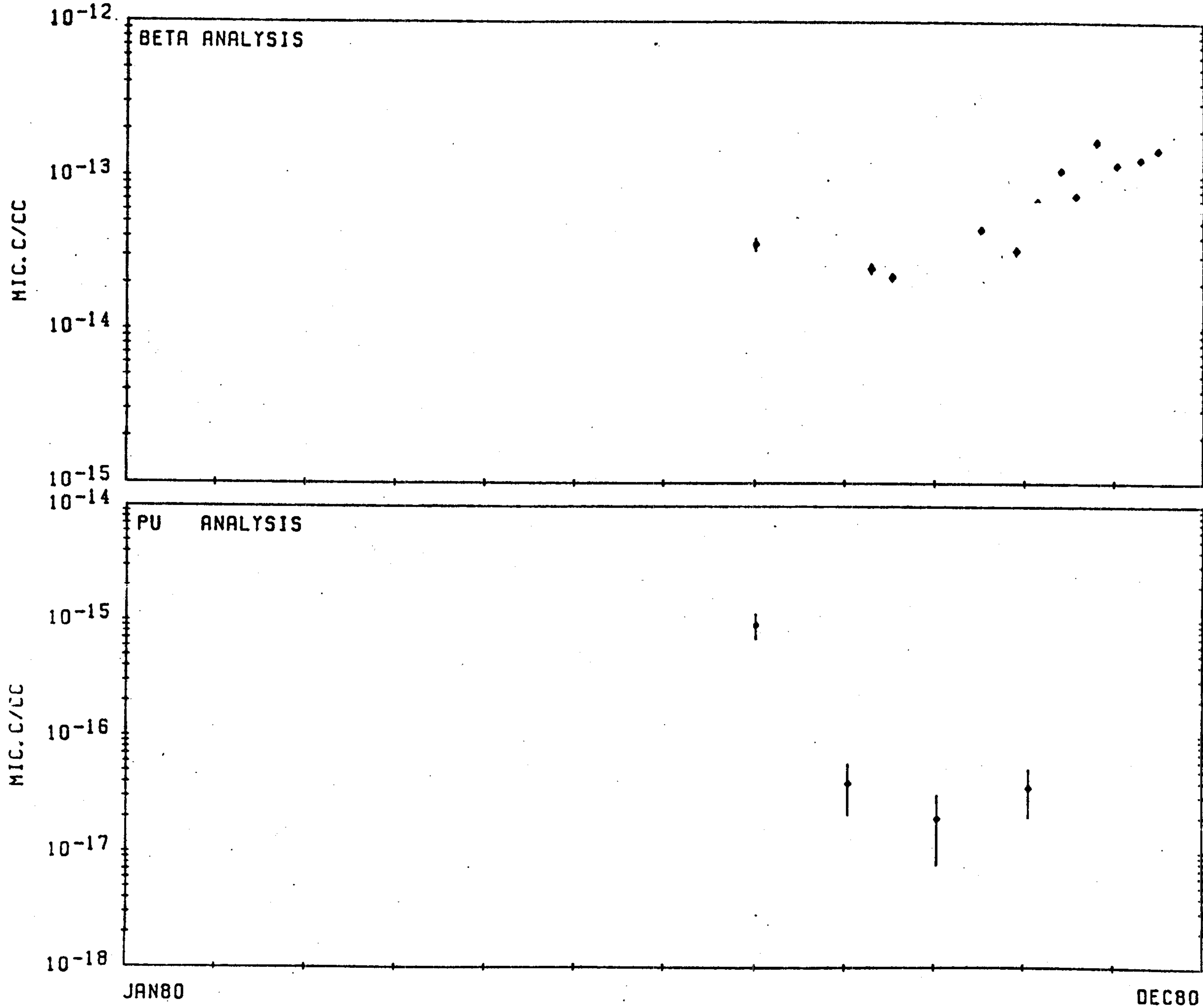



AIR SAMPLING STATION NUMBER 44
BETA ANALYSIS
MIC.C/CC
10^{-12}
10^{-13}
10^{-14}
10^{-15}
PU ANALYSIS
MIC.C/CC
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
JAN80
DEC80

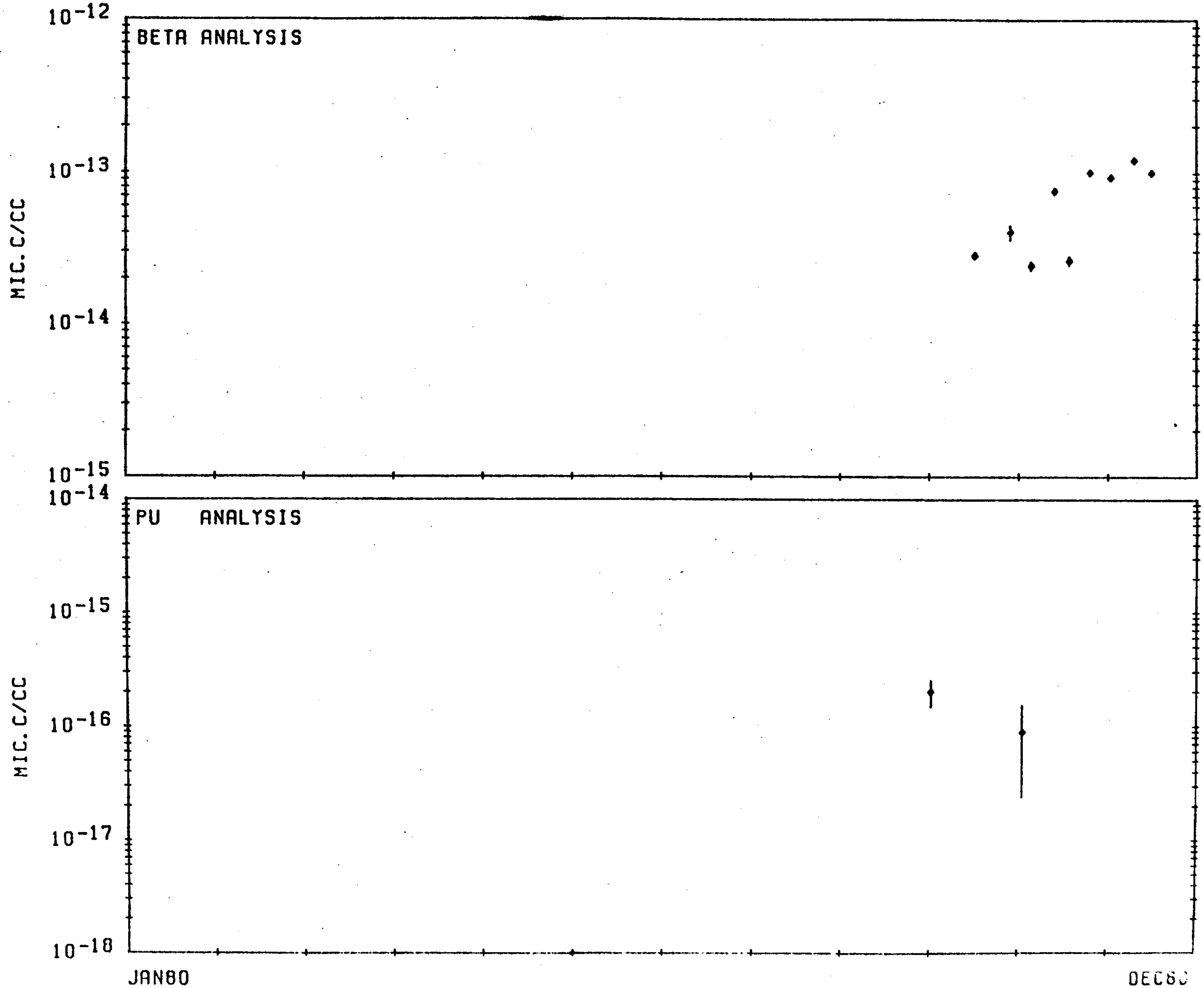

AIR SAMPLING STATION NUMBER 45
BETA ANALYSIS
PU ANALYSIS
MIC.C/CC
MIC.C/CC
10-12
10-13
10-14
10-15
10-14
10-15
10-16
10-17
10-18
JAN80
DEC80


AIR SAMPLING STATION NUMBER 46
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}
JAN80
DEC80

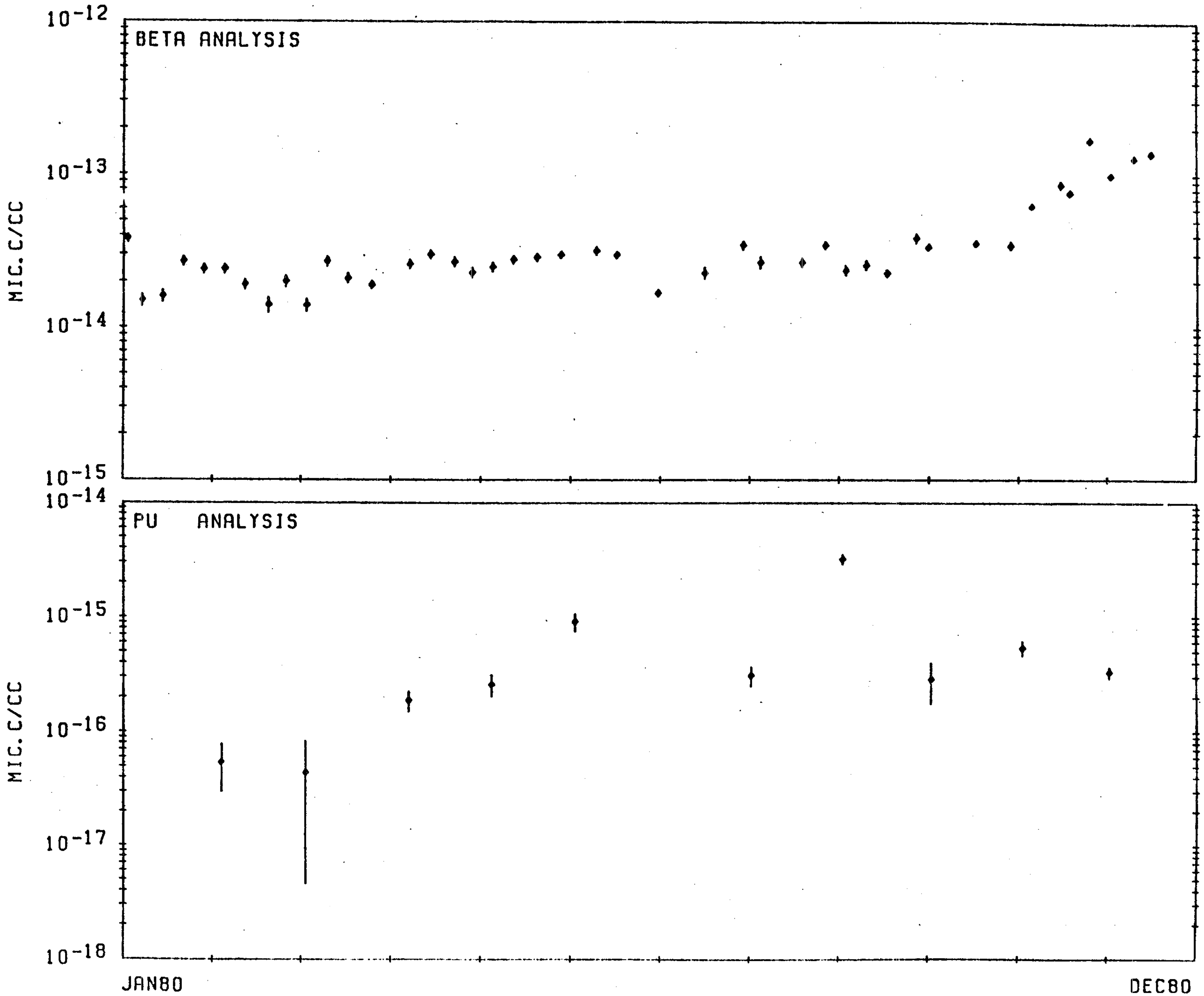
AIR SAMPLING STATION NUMBER 47



AIR SAMPLING STATION NUMBER 48



AIR SAMPLING STATION NUMBER 49



A P P E N D I X B

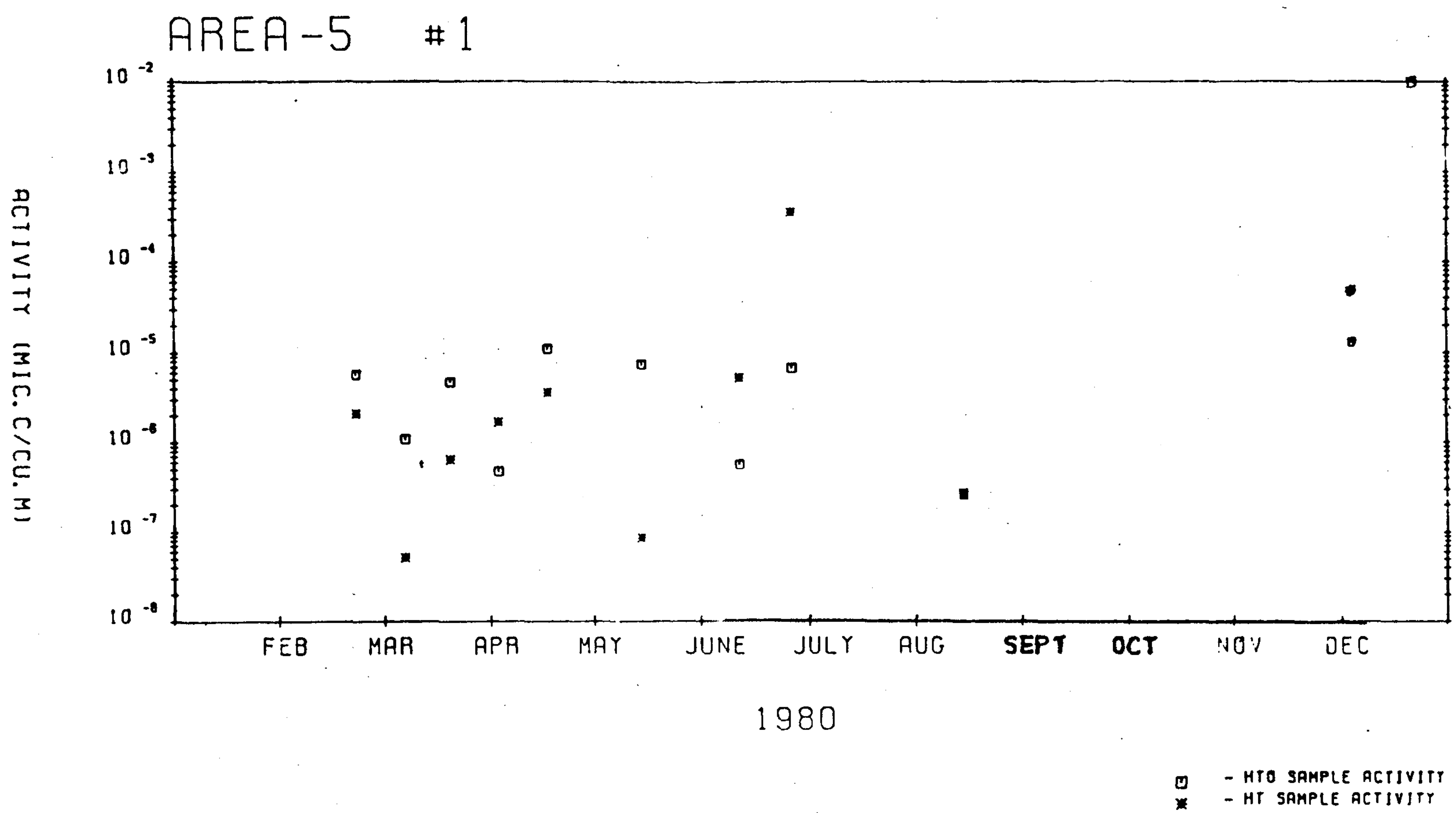
NTS Environmental Surveillance

Tritium in Air Sampling Locations and Plots

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

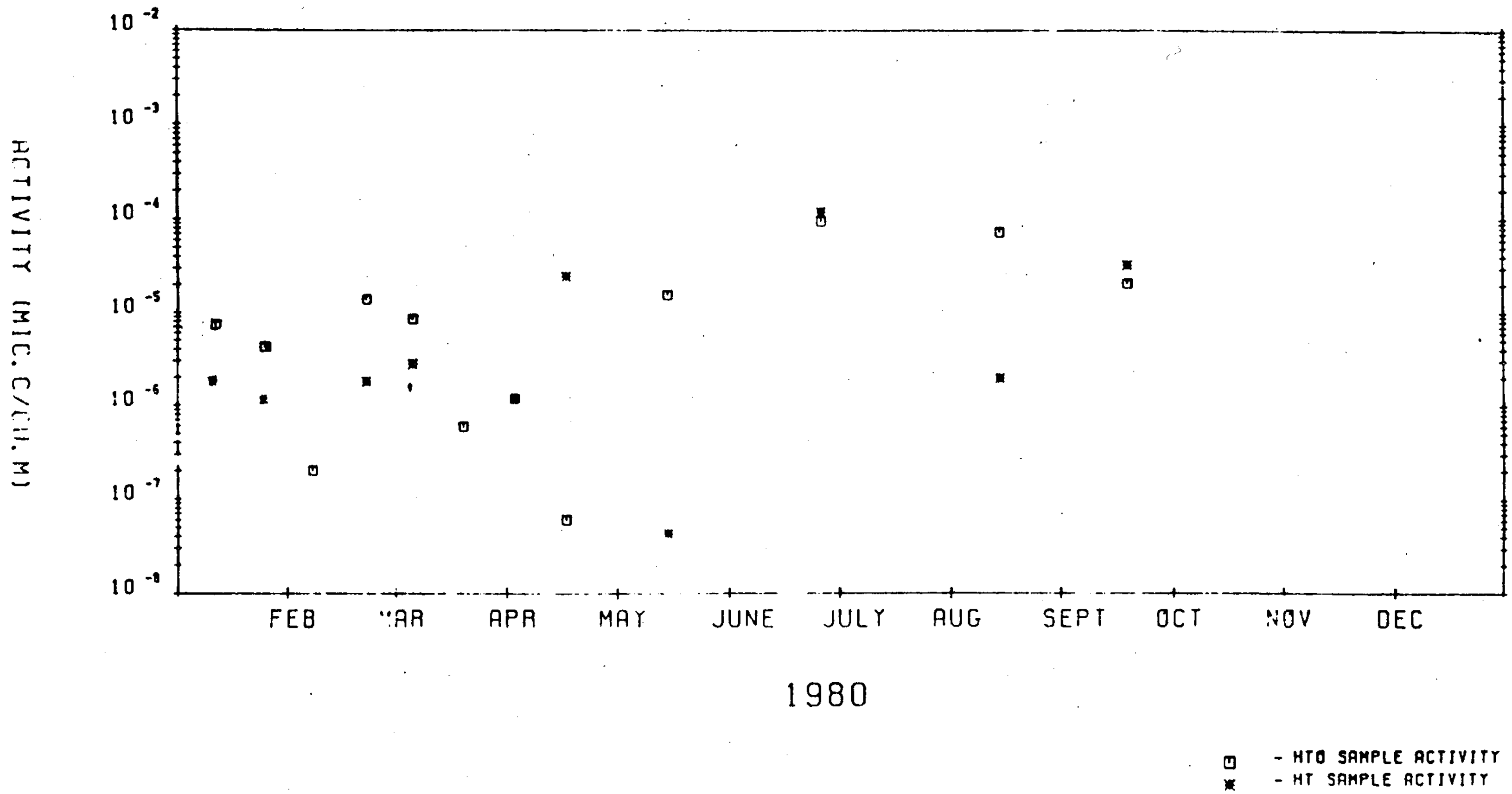
NTS ENVIRONMENTAL SURVEILLANCE
TRITIUM IN AIR SAMPLING LOCATIONS

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

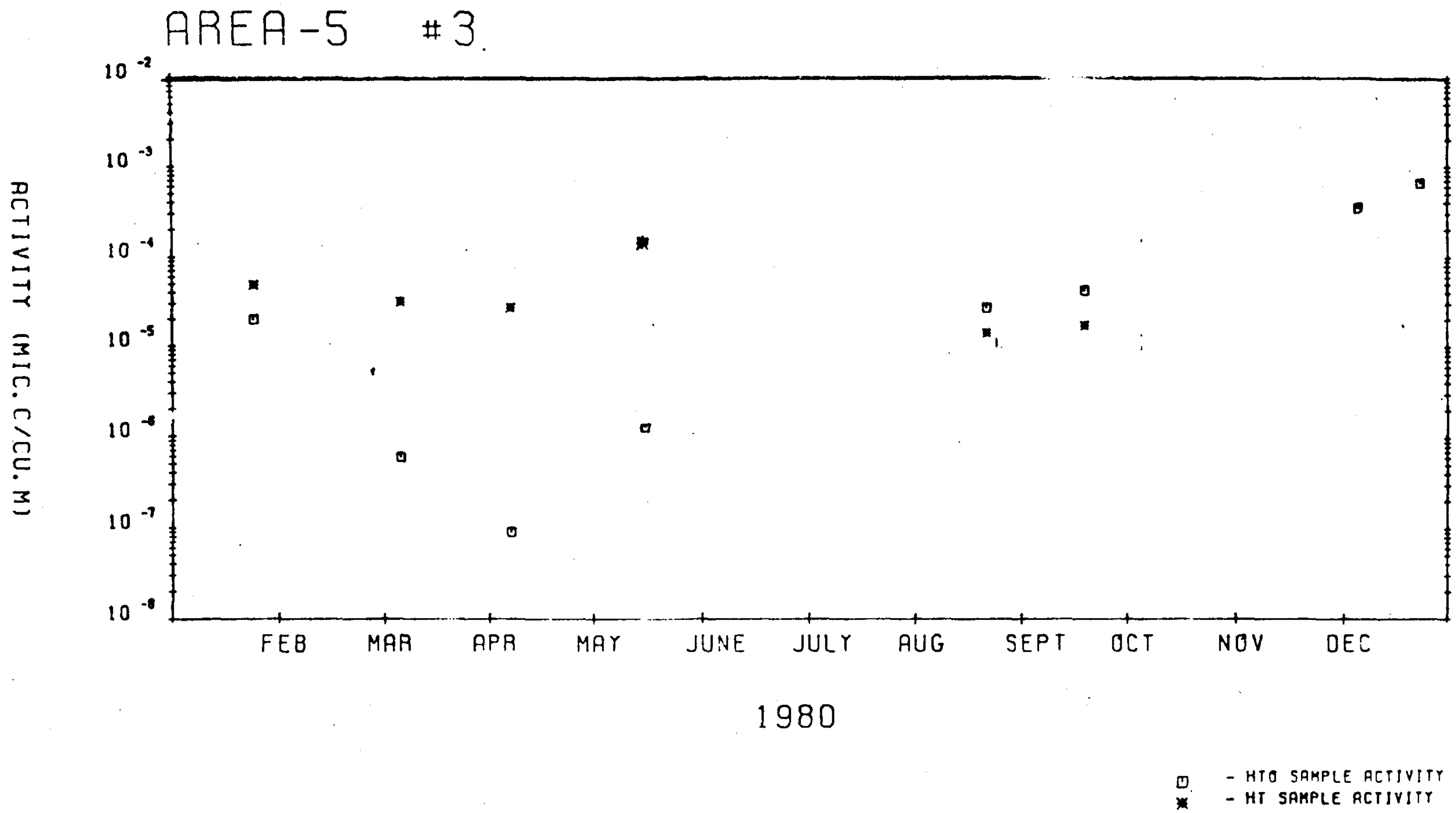


AREA-5 #1
ACTIVITY (MIC.C/CU.M)
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1980
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

AREA-5 #2

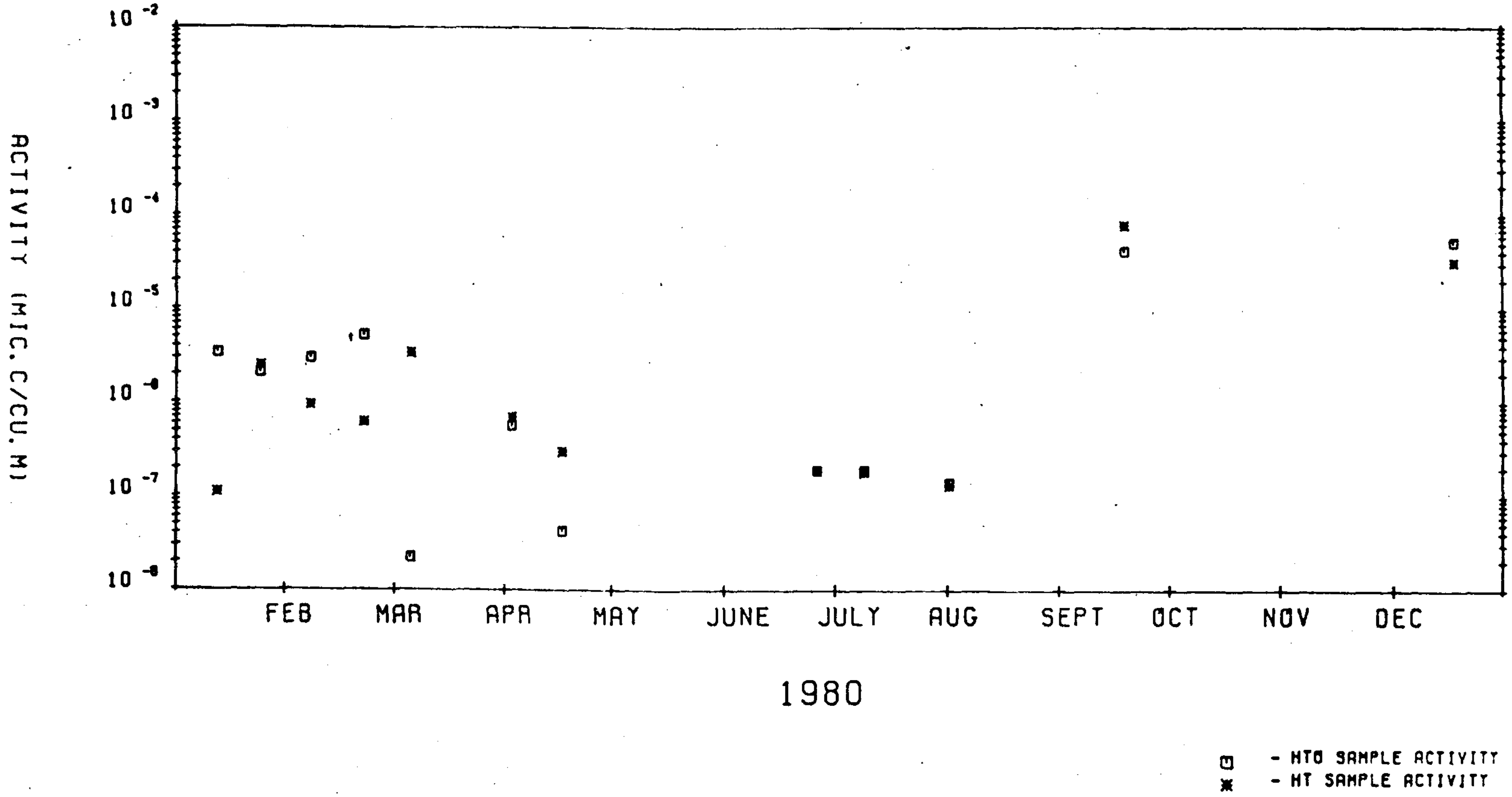


10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
ACTIVITY (MIC.C/CU.M)
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1980
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY



AREA-5 #3
ACTIVITY (MIC.C/CU.M)
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1980
- HTO SAMPLE ACTIVITY
- HT SAMPLE ACTIVITY

BLDG. 650, AREA 23



A P P E N D I X C

NTS Environmental Surveillance

Supply Wells Locations and Plots

Several symbols are used in Appendix B 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. The data symbols for the plots are as follows:

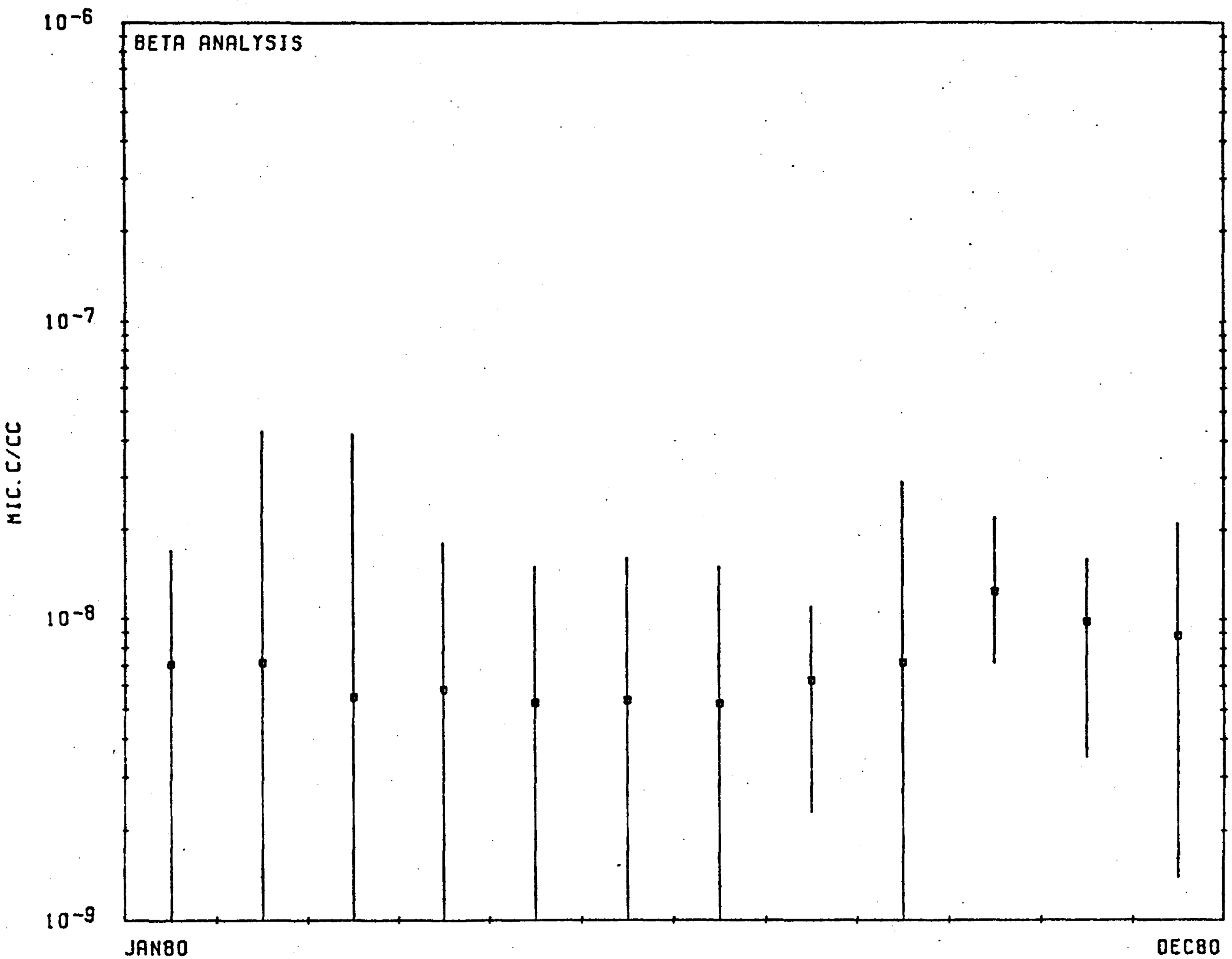
Plot #	Symbol
1-9	×
13-18	◊

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.

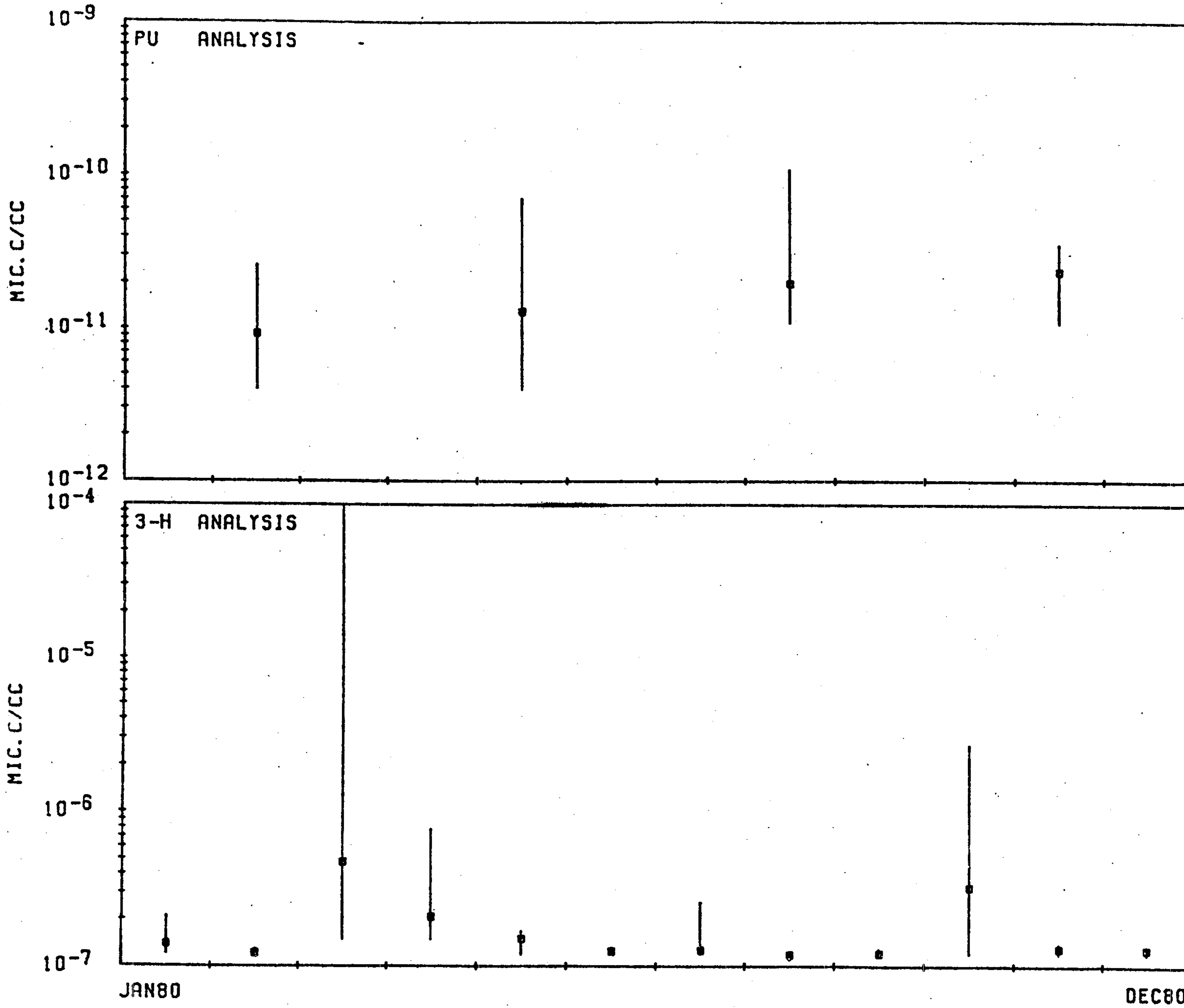
NTS ENVIRONMENTAL SURVEILLANCE
SUPPLY WELLS SAMPLING LOCATIONS

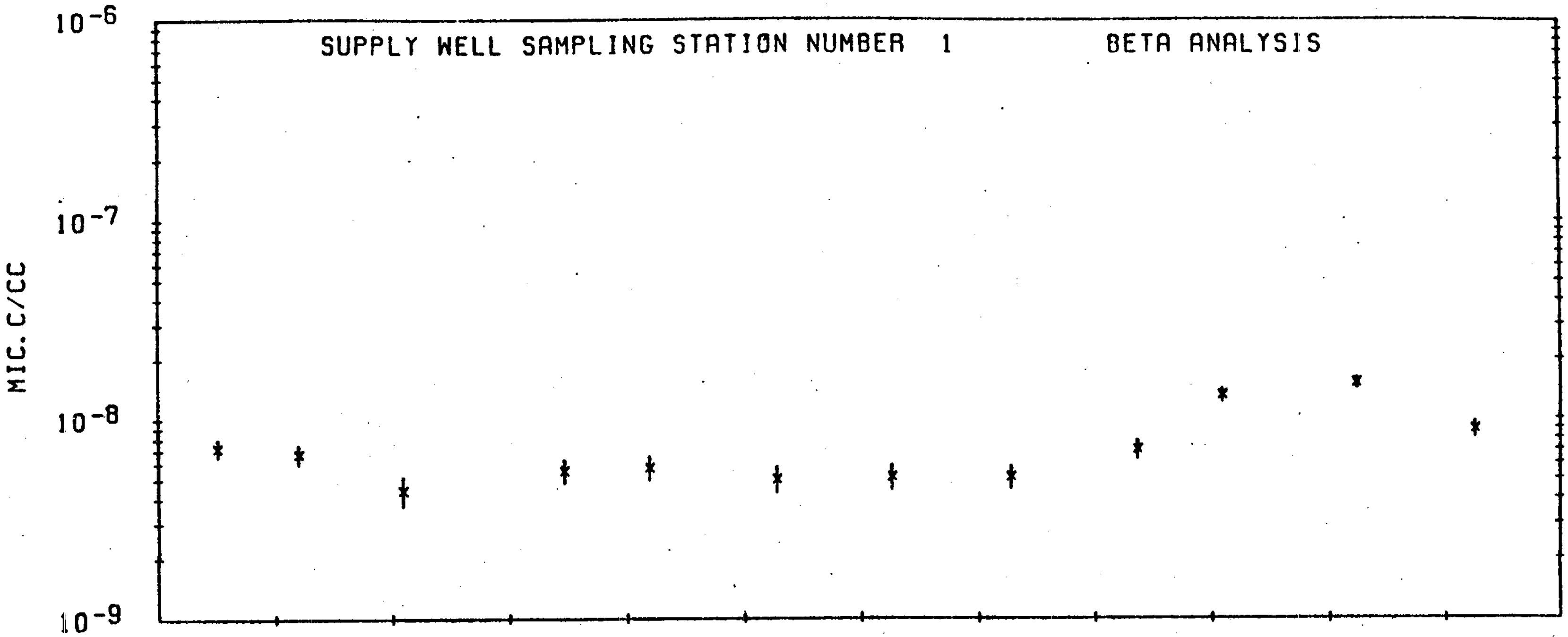
Station Number	Location
1	Area 2 Well 2
2	Area 3 Well A
3	Area 5 Well 5B
4	Area 5 Well 5C
5	Area 5 Well Ue5c
6	Area 6 Well C
7	Area 6 Well C1
8	Area 15 Well Ue15d
9	Area 18 Well 8
13	Area 22 Army Well #1
14	Area 25 Well J12
15	Area 25 Well J13
18	Area 19 Well U19c

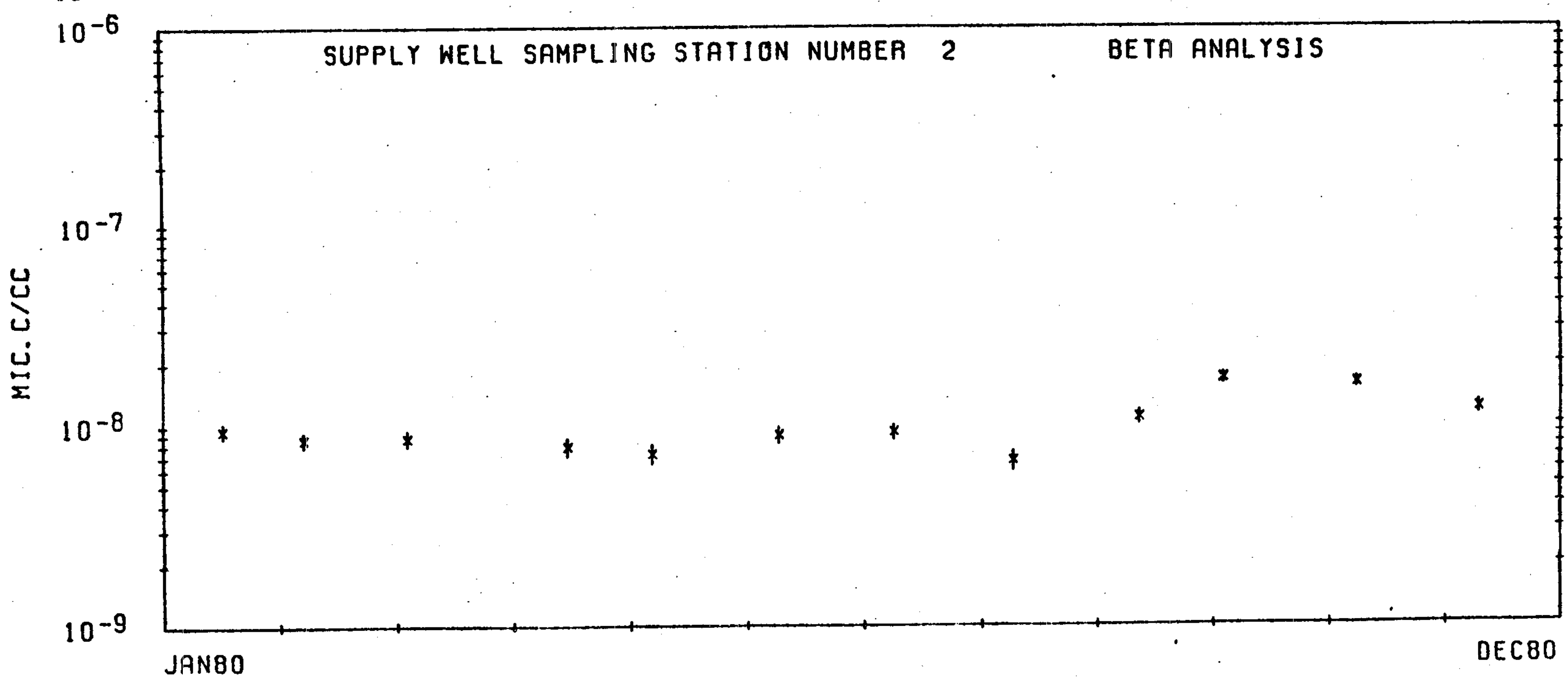
SUPPLY WELL NETWORK AVERAGES

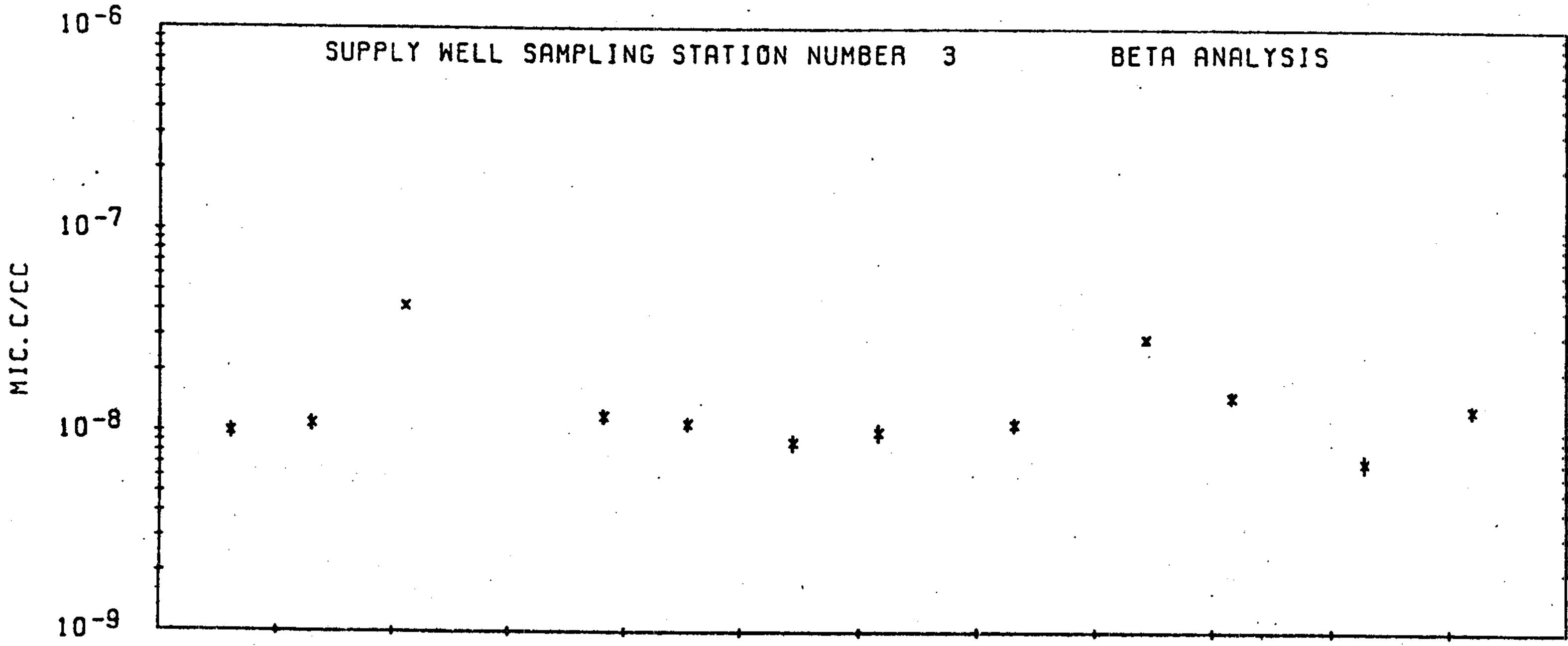


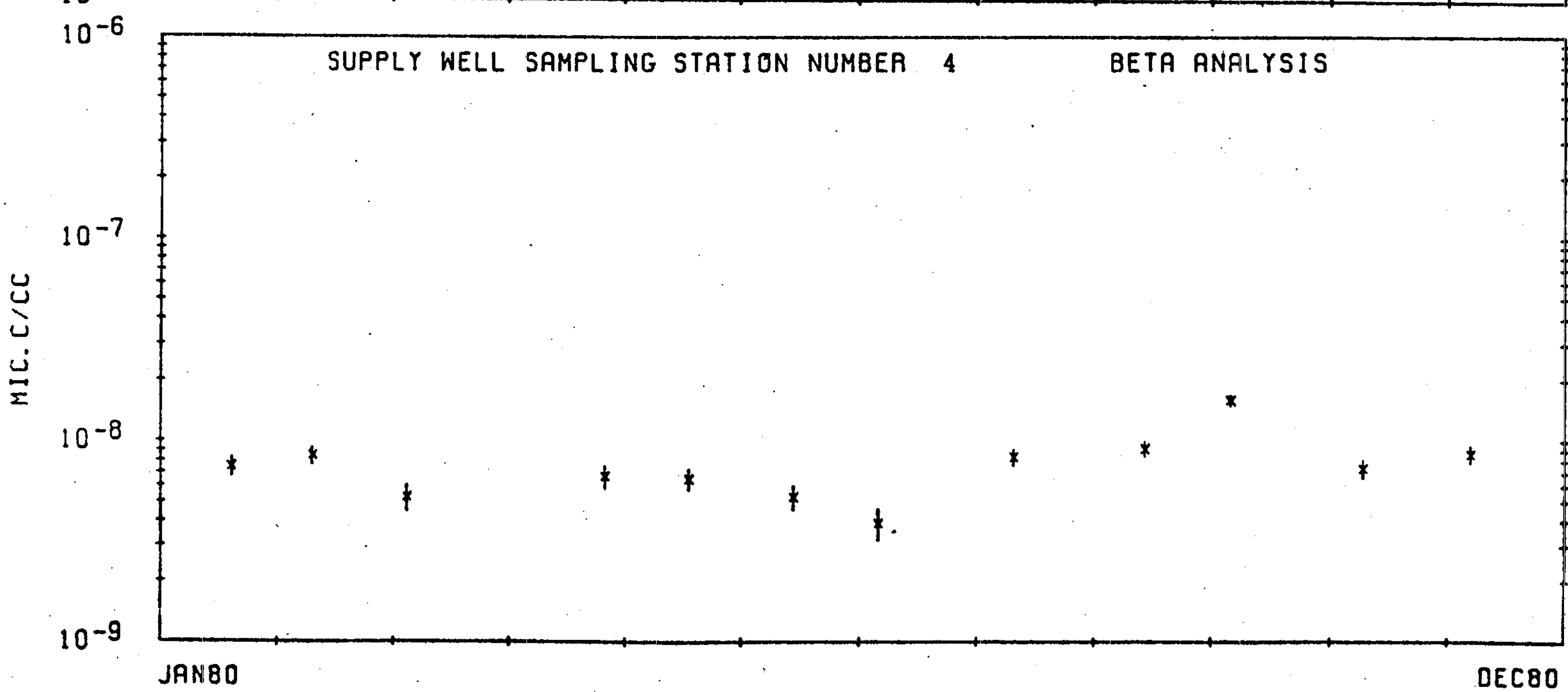
SUPPLY WELL NETWORK AVERAGES

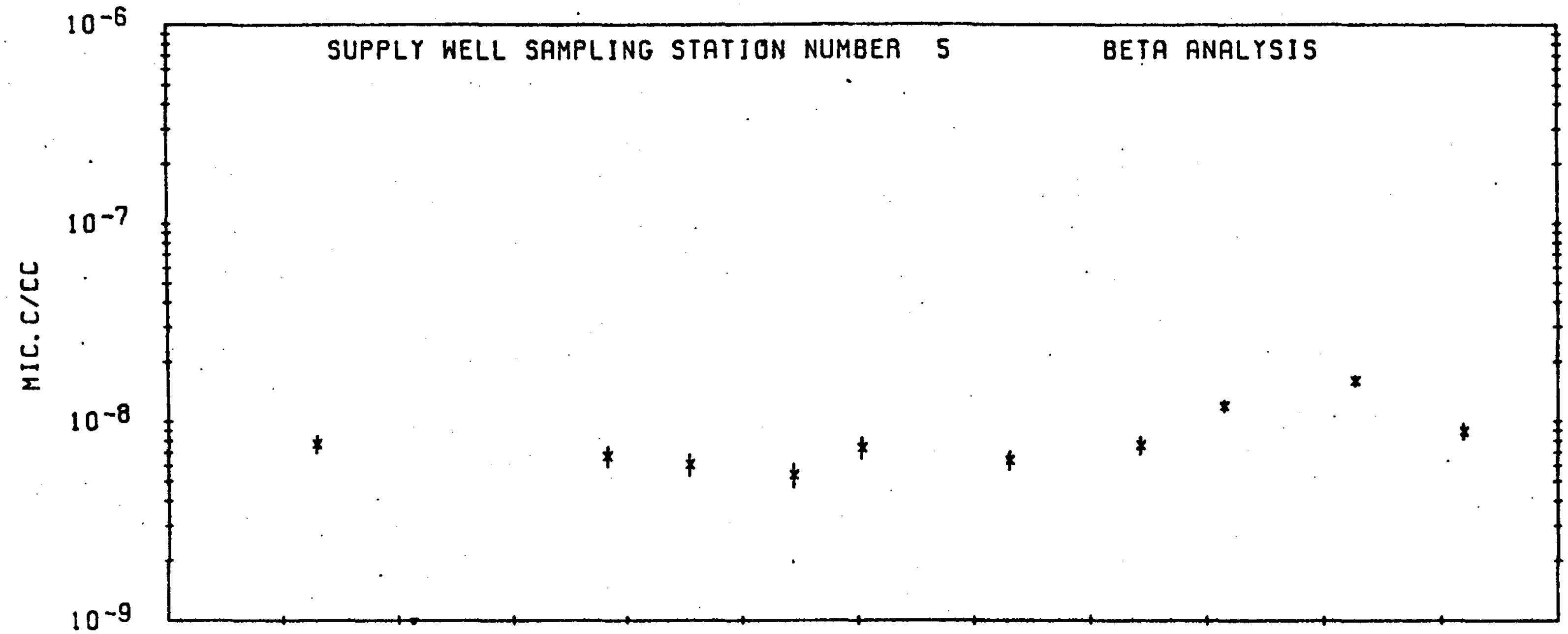


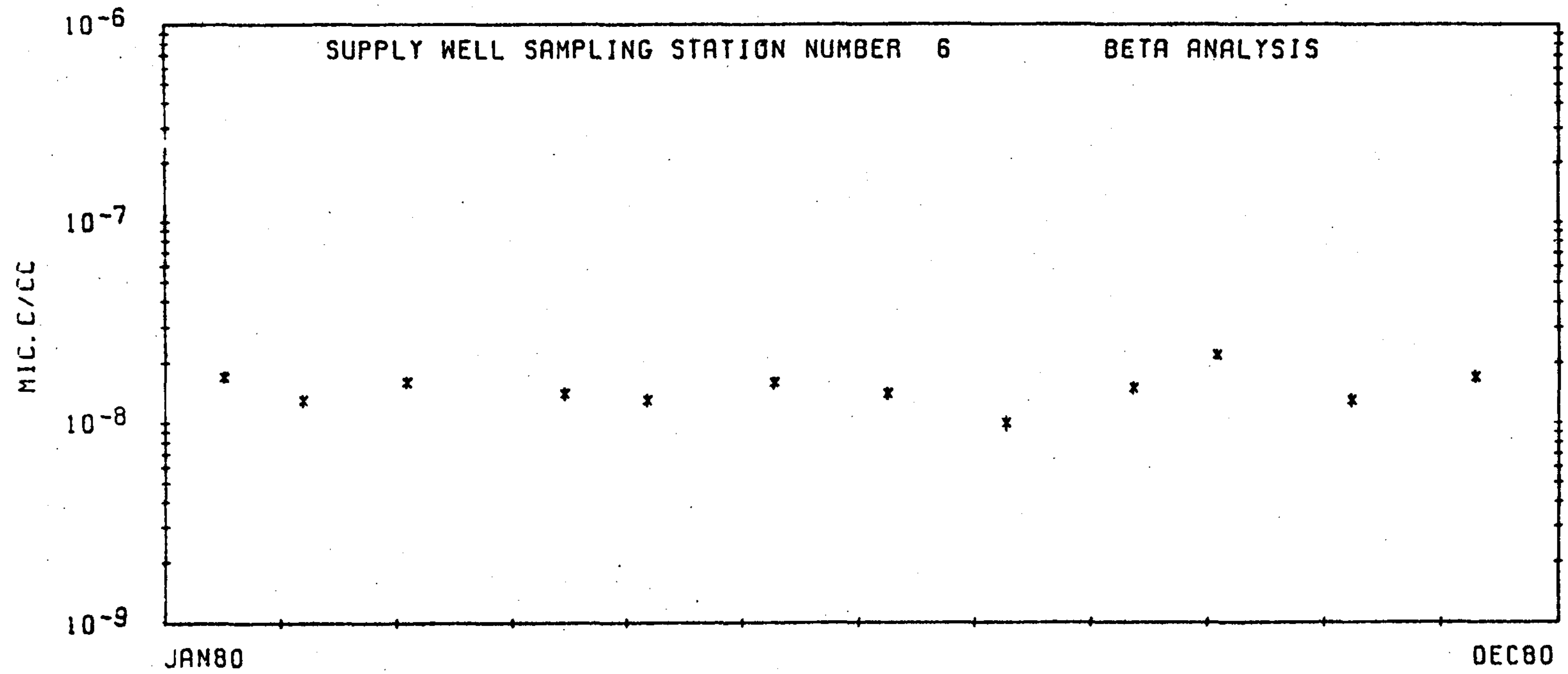

SUPPLY WELL SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

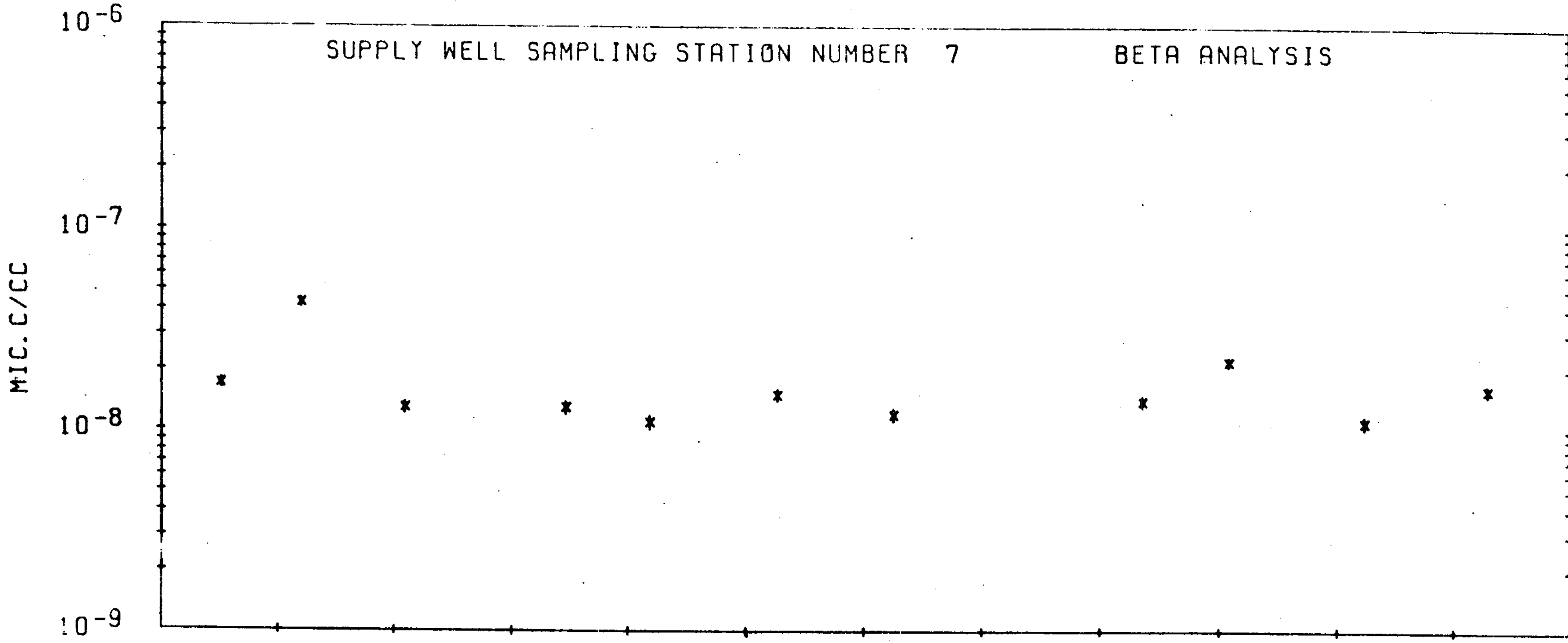

SUPPLY WELL SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80

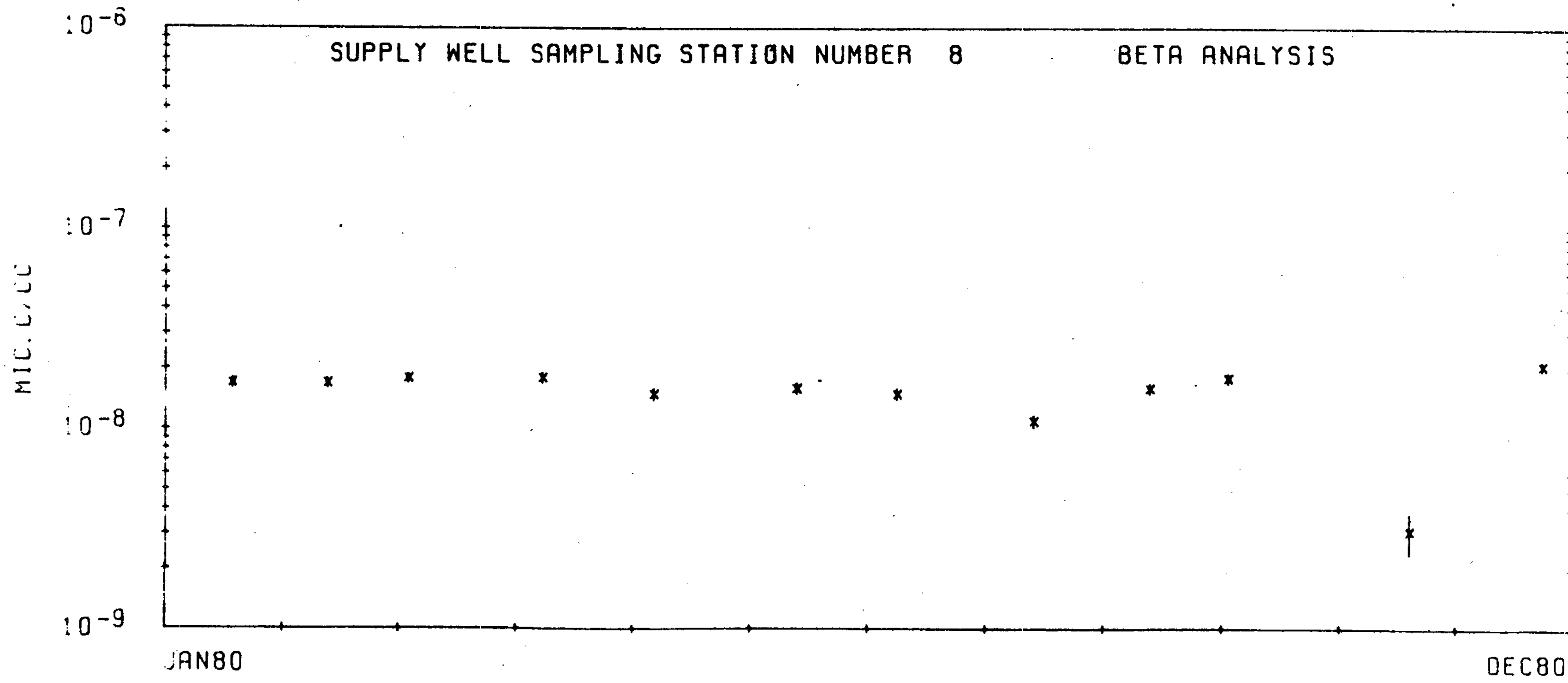

SUPPLY WELL SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

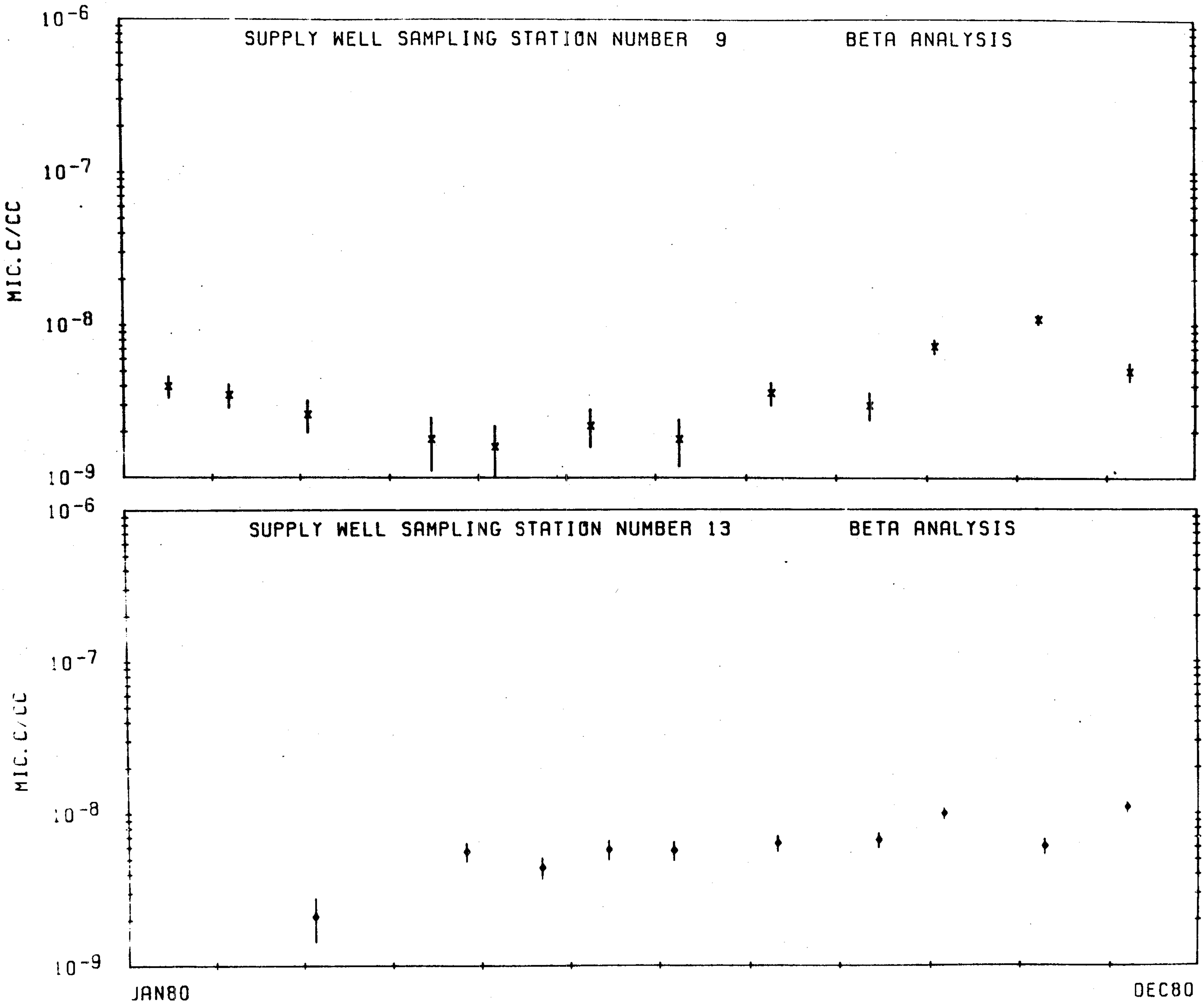

SUPPLY WELL SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80

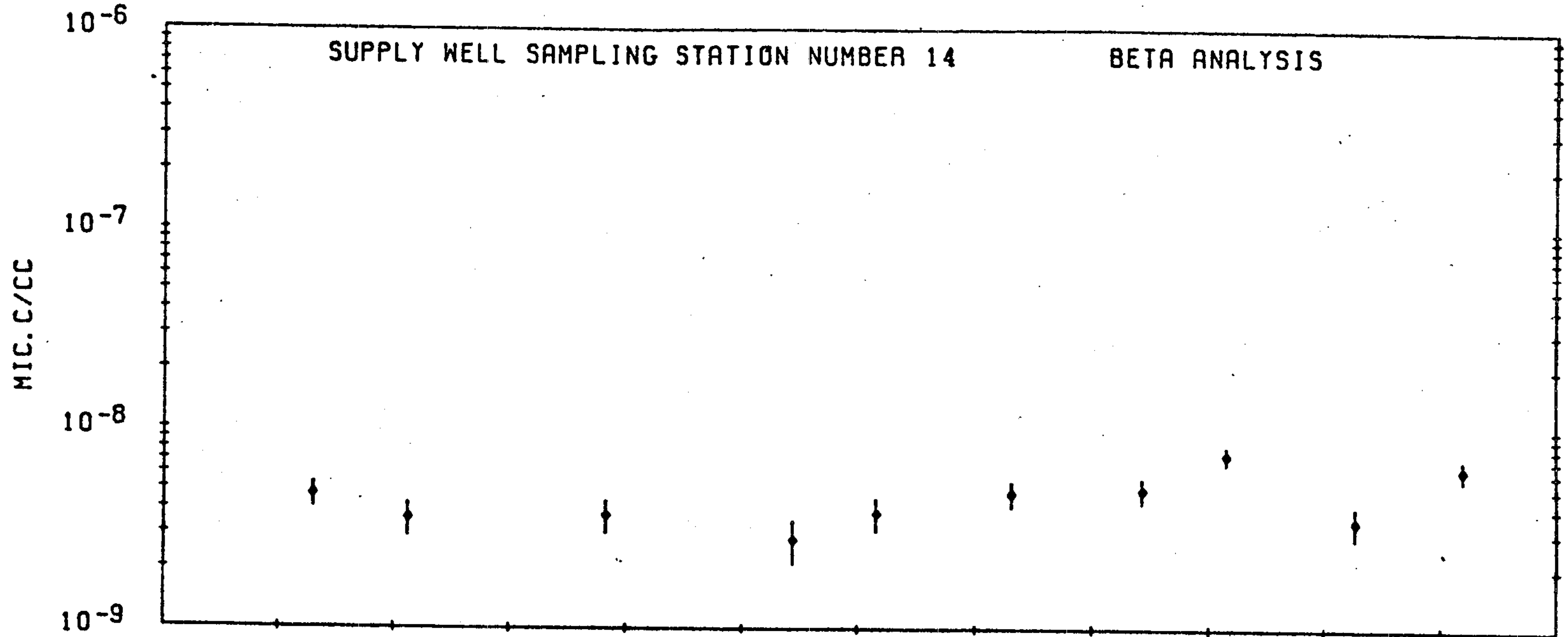

SUPPLY WELL SAMPLING STATION NUMBER 5 BETA ANALYSIS
10-6
10-7
10-8
10-9
MIC.C/CC

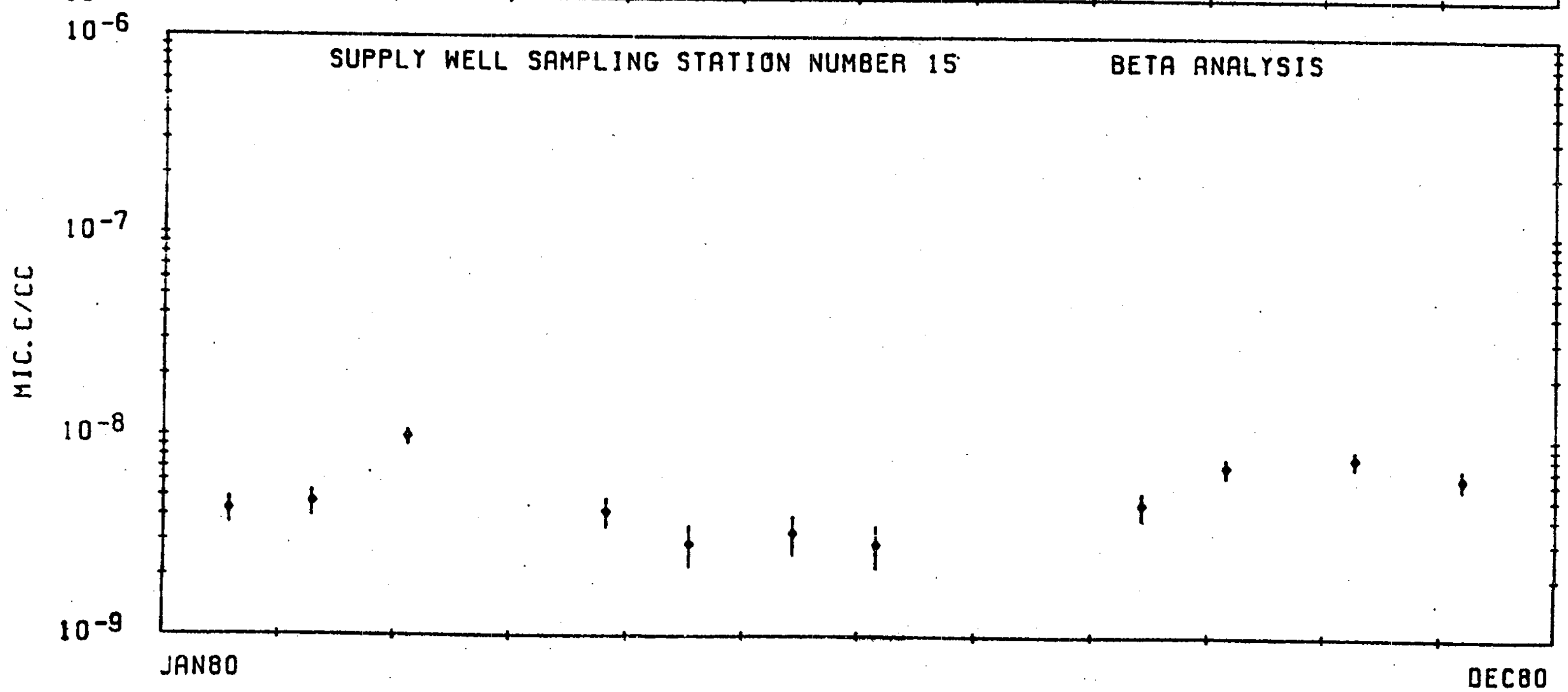

SUPPLY WELL SAMPLING STATION NUMBER 6 BETA ANALYSIS
10-6
10-7
10-8
10-9
MIC.C/CC
JAN80
DEC80

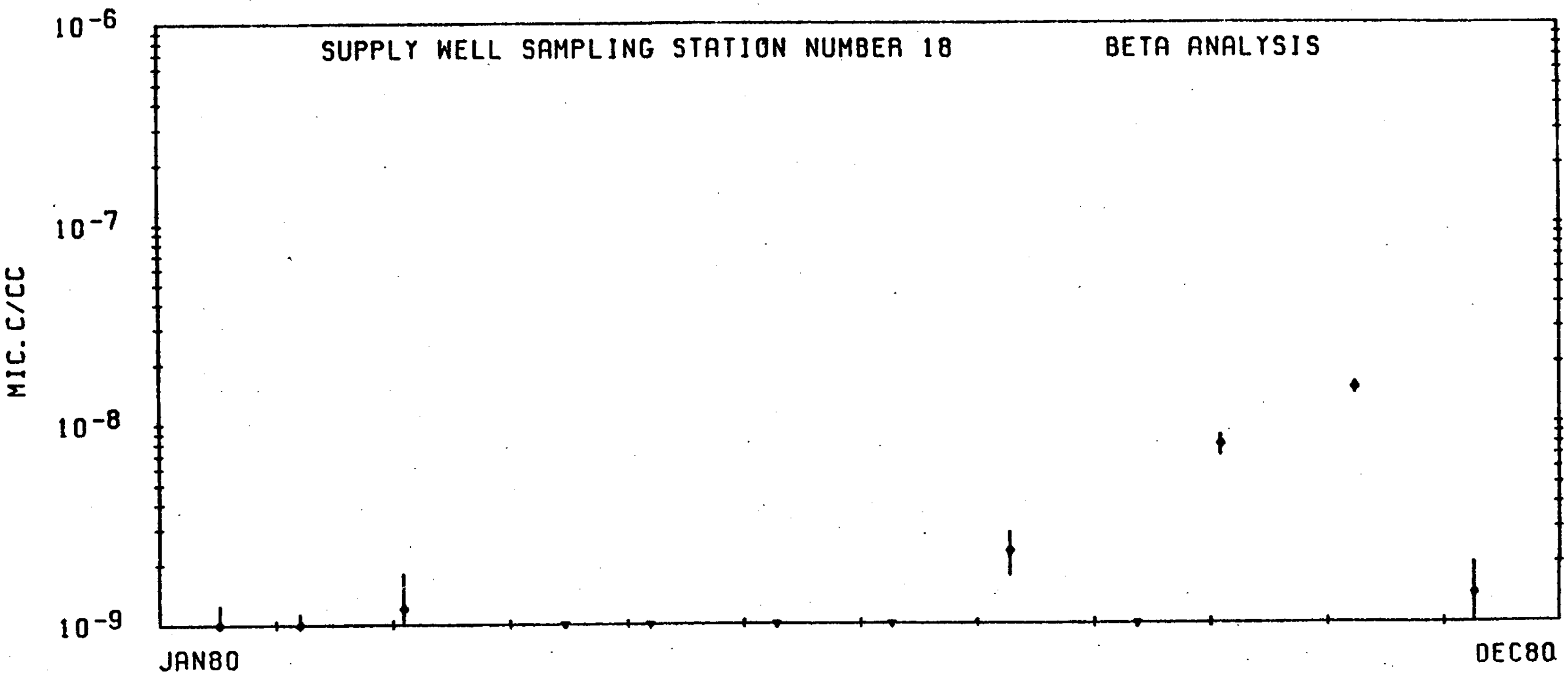

SUPPLY WELL SAMPLING STATION NUMBER 7
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9


SUPPLY WELL SAMPLING STATION NUMBER 8
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN80
DEC80


SUPPLY WELL SAMPLING STATION NUMBER 9
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
SUPPLY WELL SAMPLING STATION NUMBER 13
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80


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


SUPPLY WELL SAMPLING STATION NUMBER 15
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80


SUPPLY WELL SAMPLING STATION NUMBER 18
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80

APPENDIX D

NTS Environmental Surveillance

Potable Water Locations and Plots

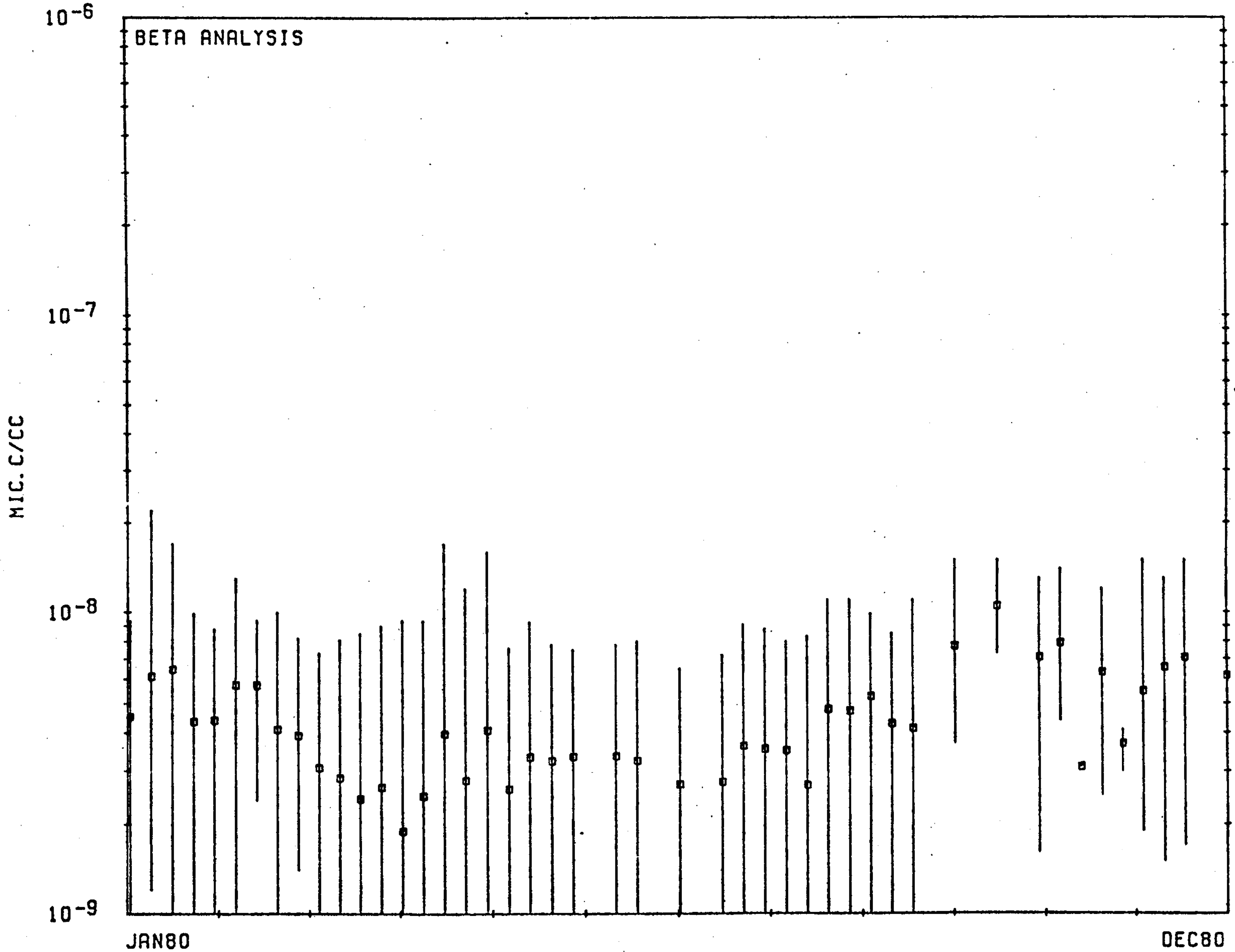
In the first two pages of plots in Appendix D, the potable water network averages, a square is used to represent the arithmetic mean of all values at that point in time, and the vertical line is the range of the data.

The remaining plots show the gross beta data of each station utilizing the symbol, X, as the data point. 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.

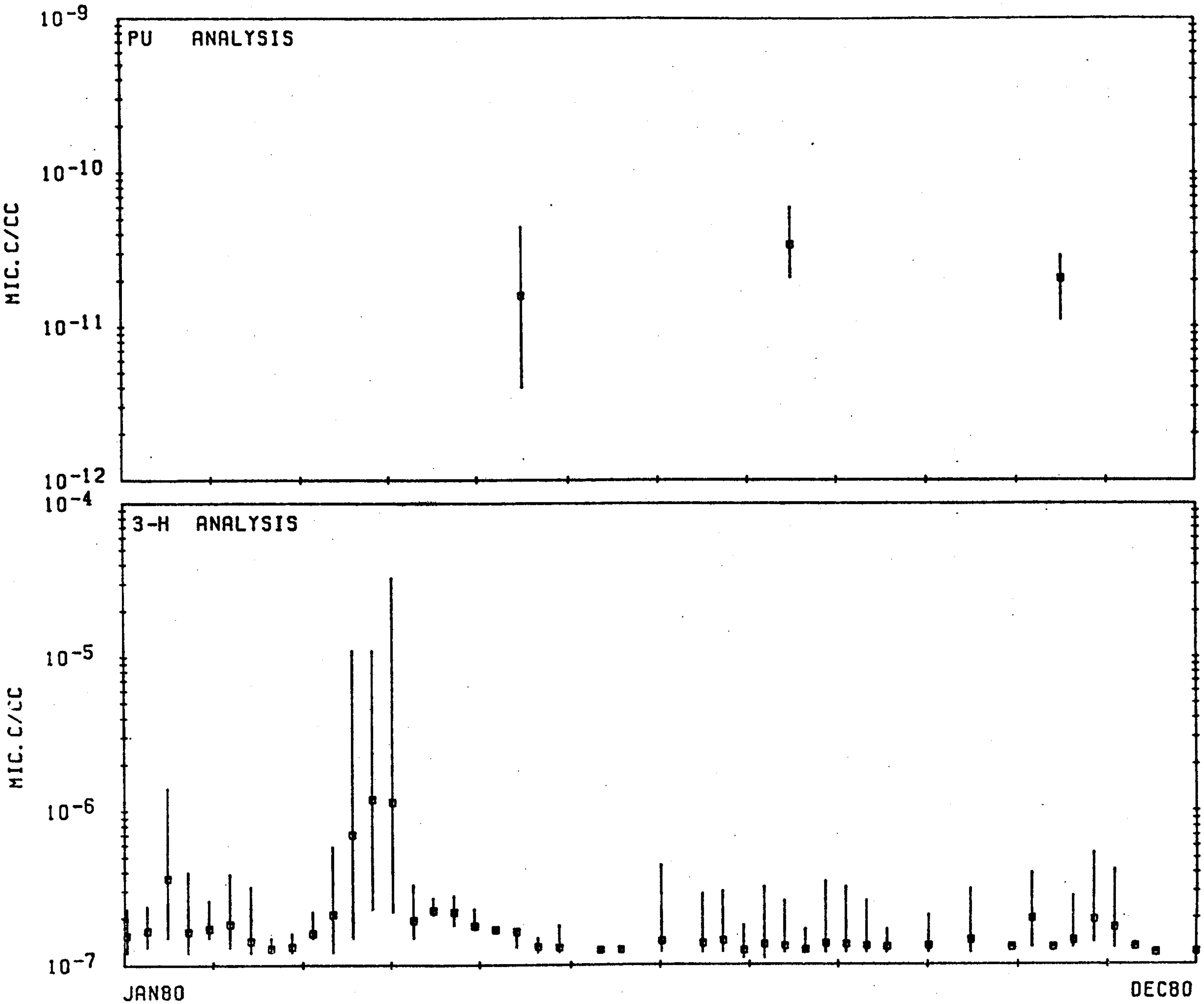
NTS ENVIRONMENTAL SURVEILLANCE
POTABLE WATER SAMPLING LOCATIONS

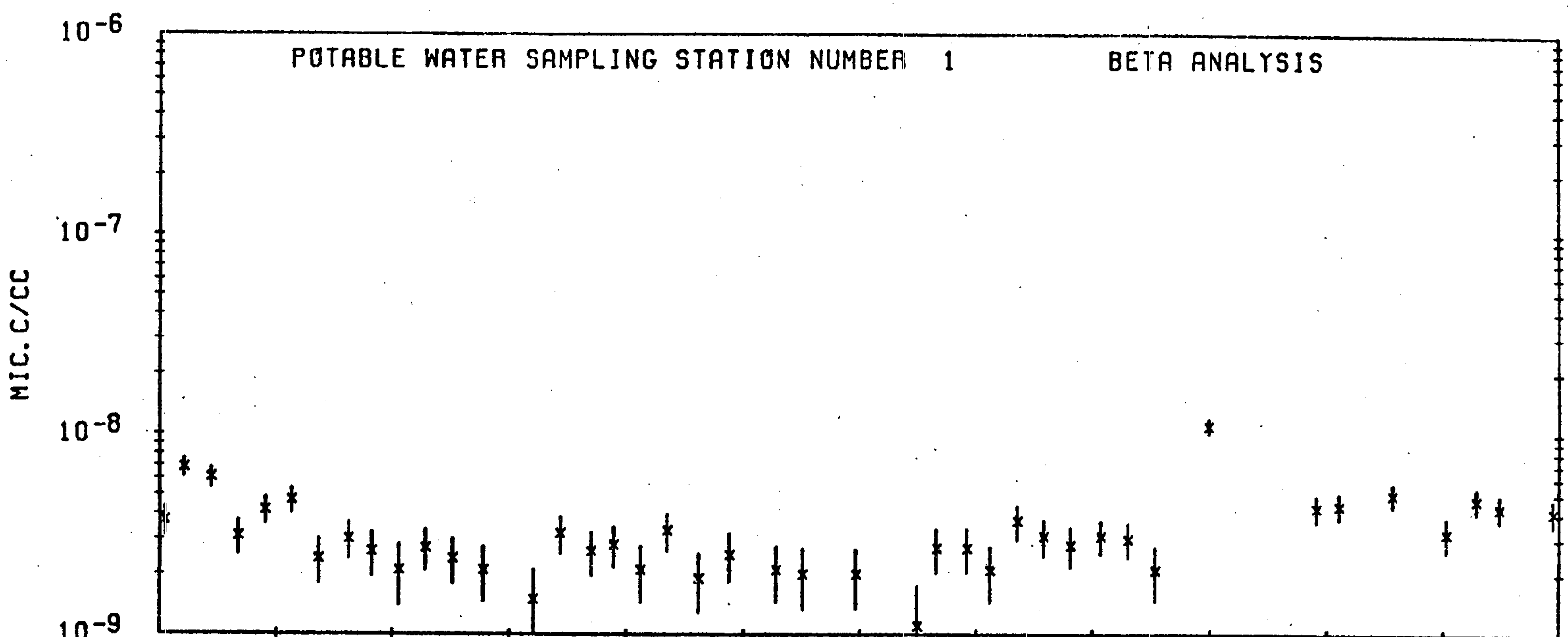
Station Number	Location
1	Area 2 Rest Room
2	Area 3 Cafeteria
3	Area 6 Cascade Water
4	Area 6 Cafeteria
5	Area 12 Cafeteria
7	Area 23 Cafeteria
8	Area 27 Cafeteria
10	Area 25 Service Station

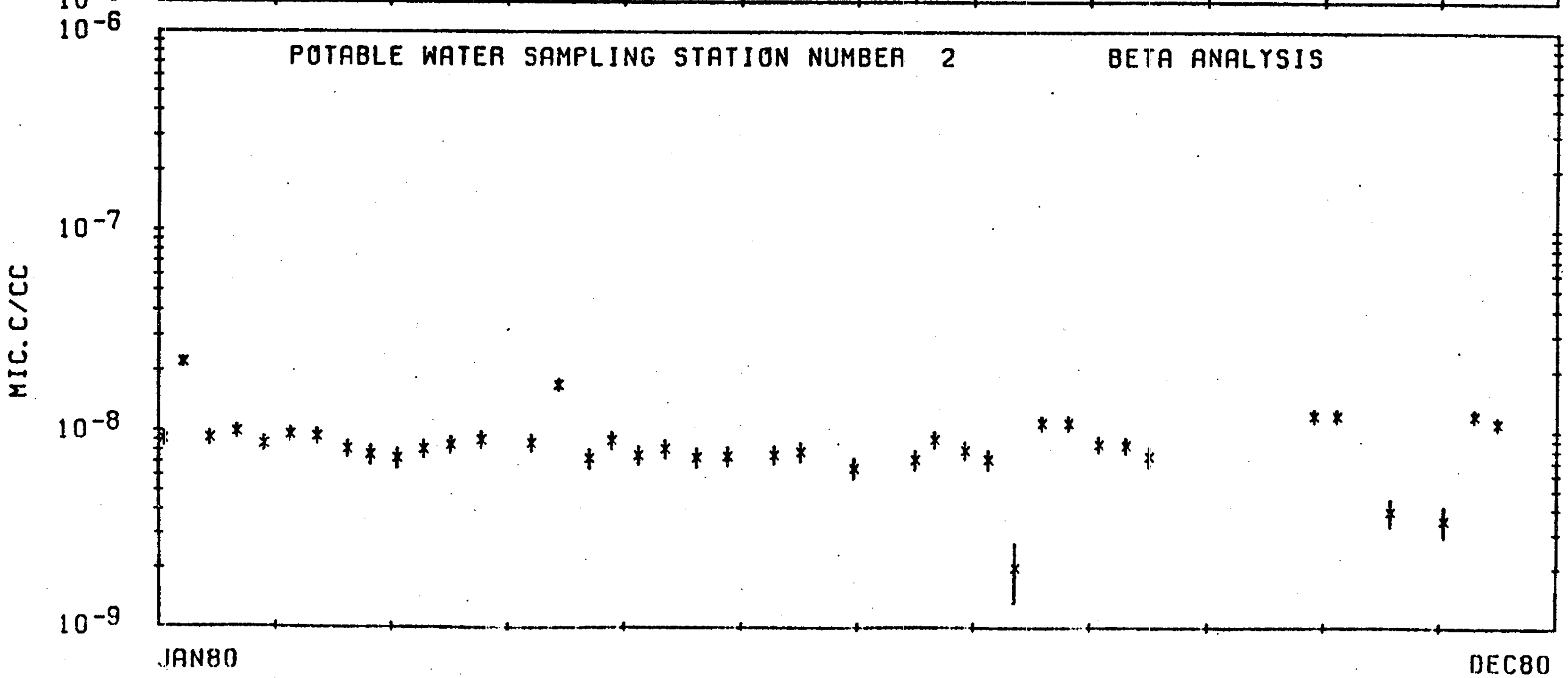
PØTABLE WATER NETWØRK AVERAGES

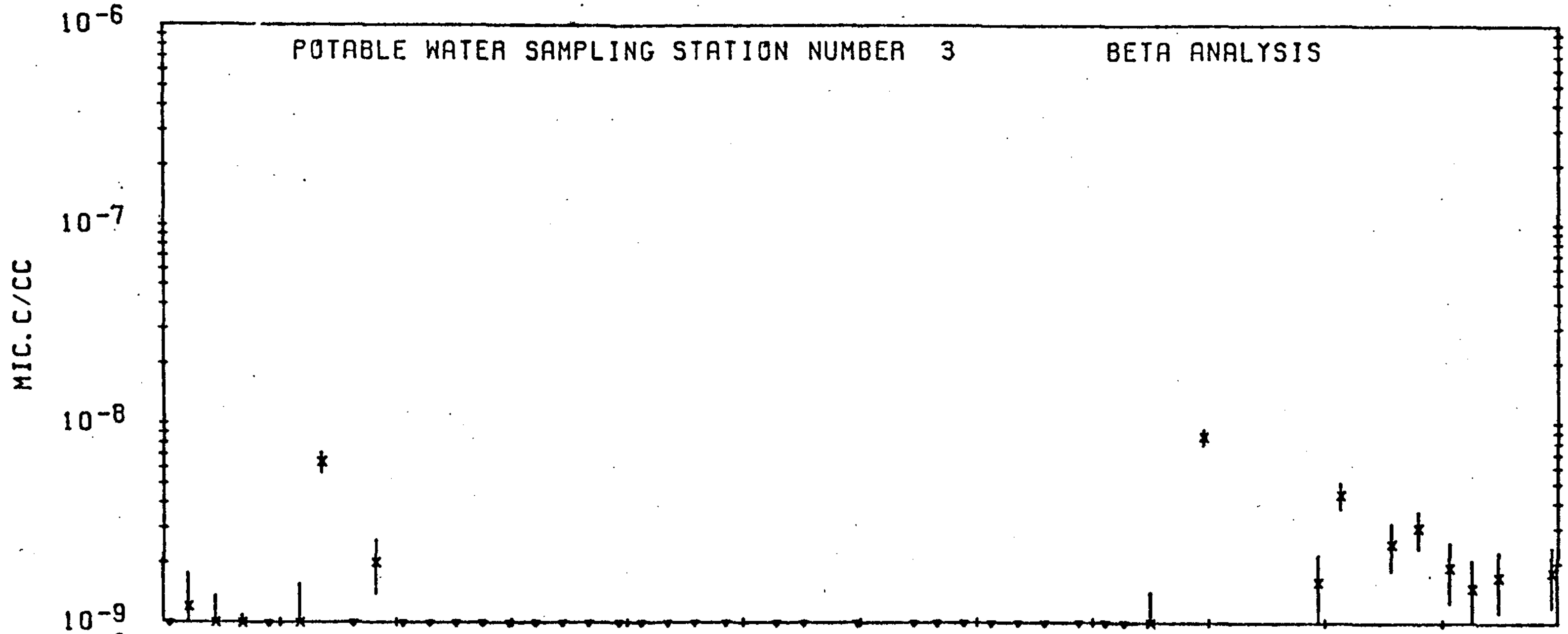


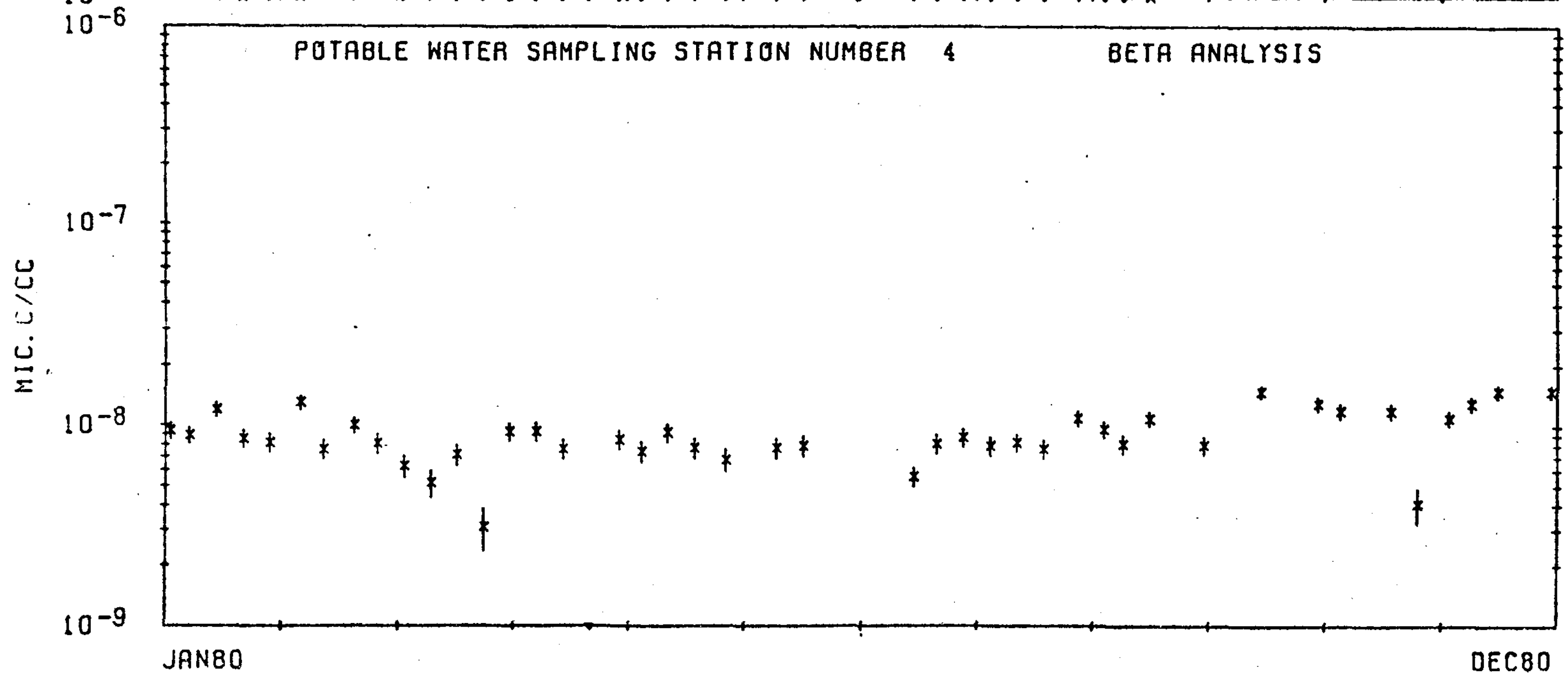
POTABLE WATER NETWORK AVERAGES

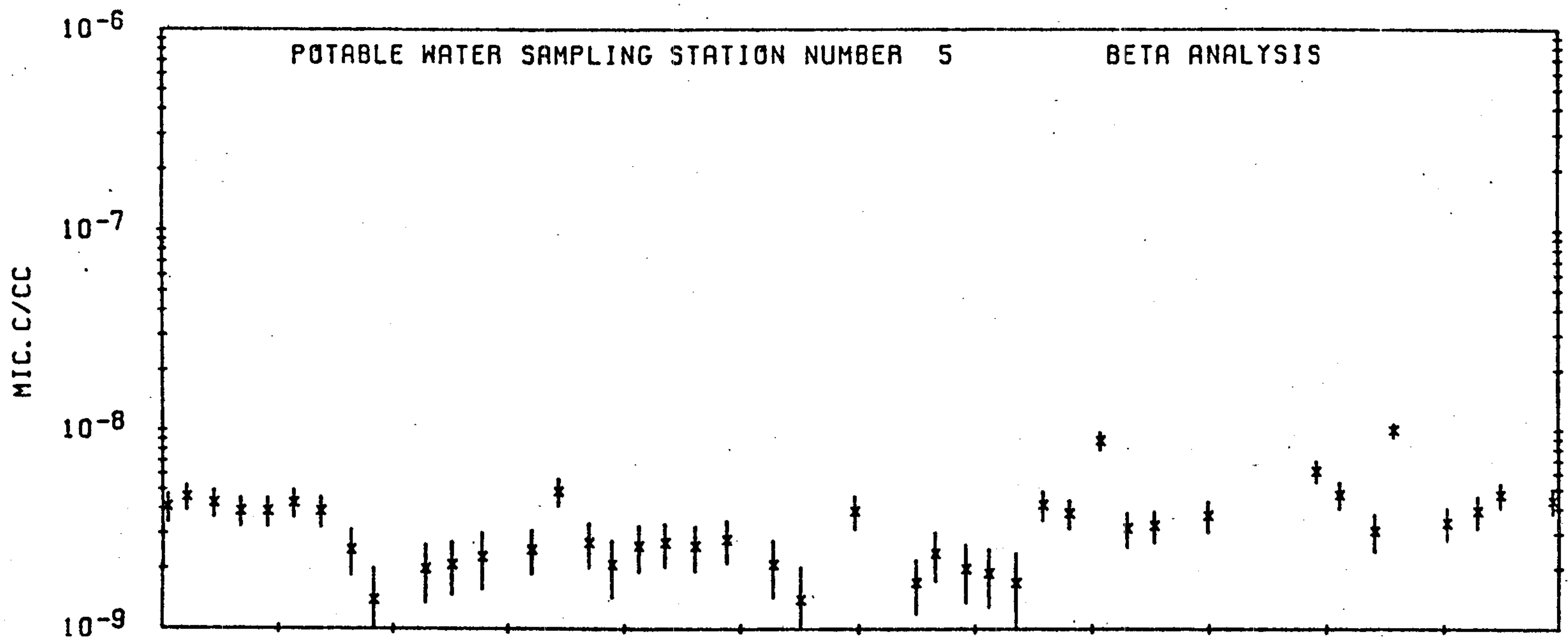


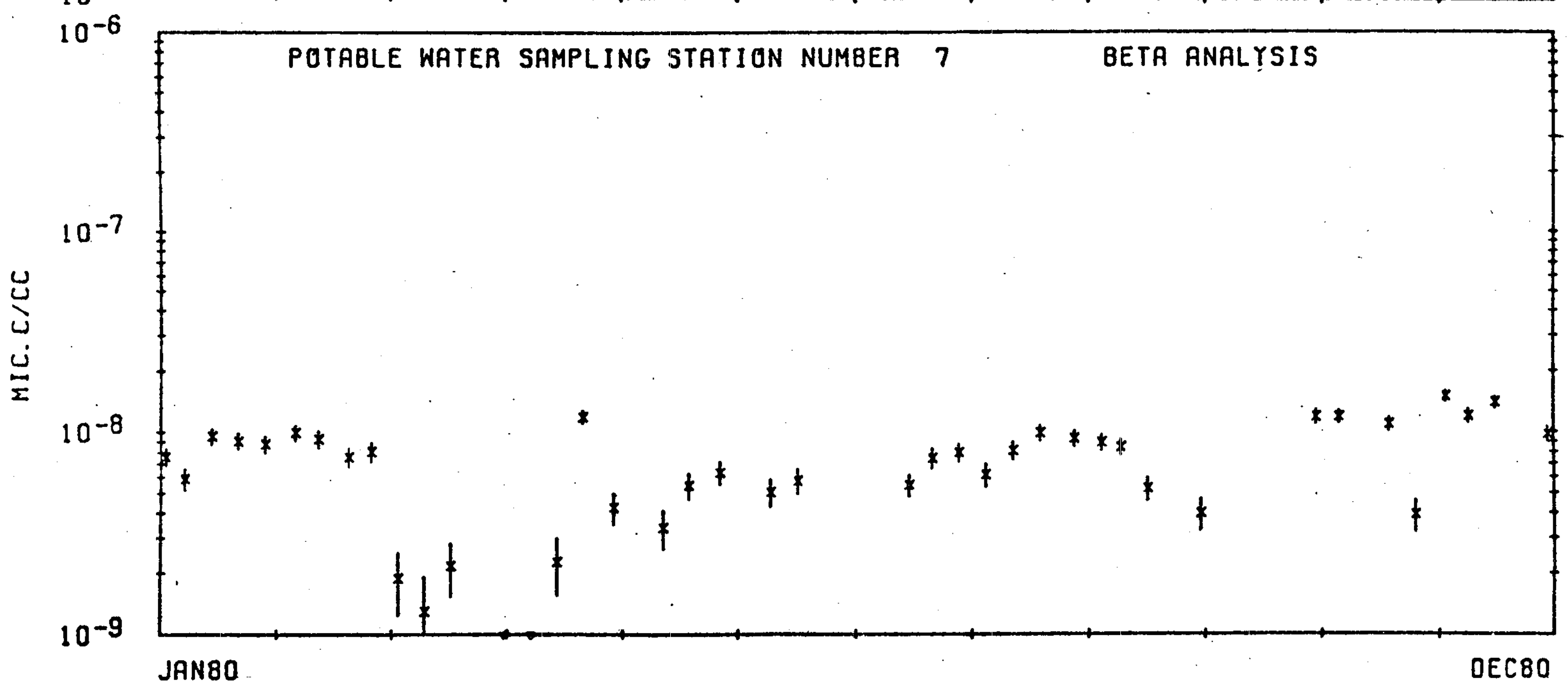

POTABLE WATER SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

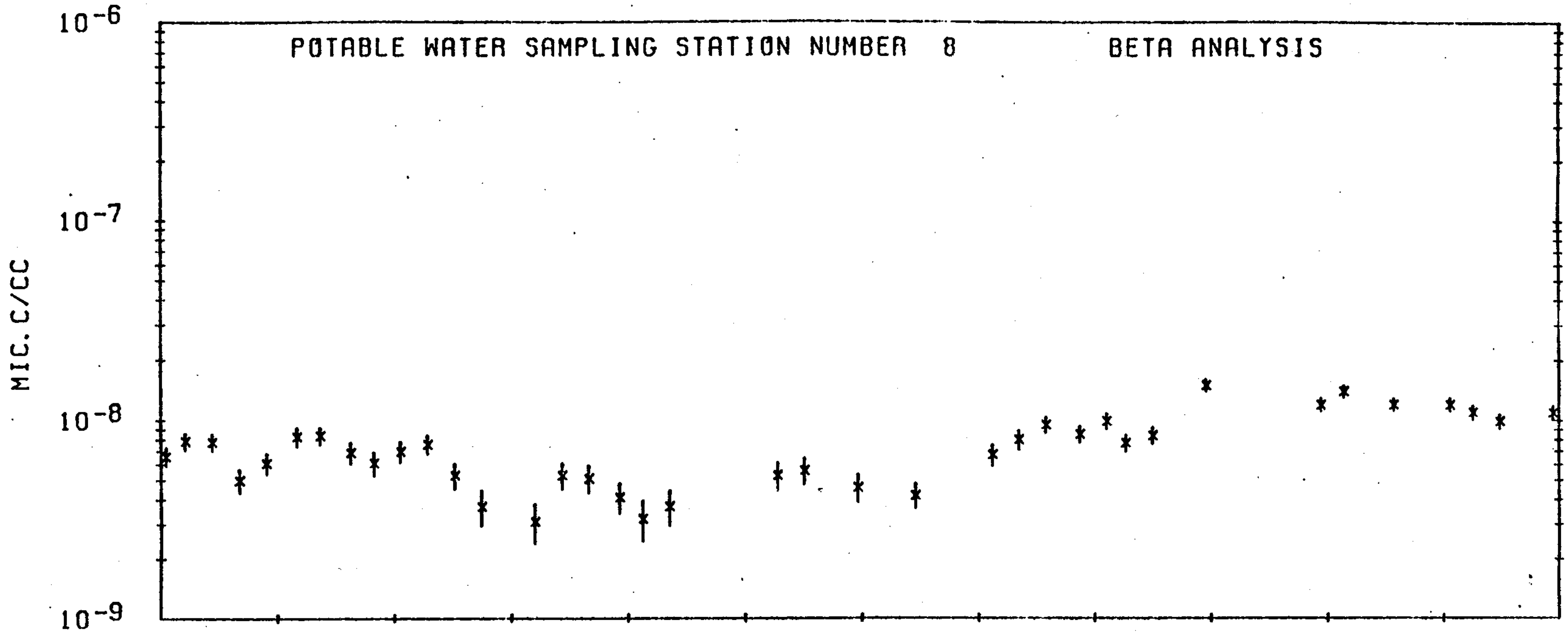

POTABLE WATER SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80

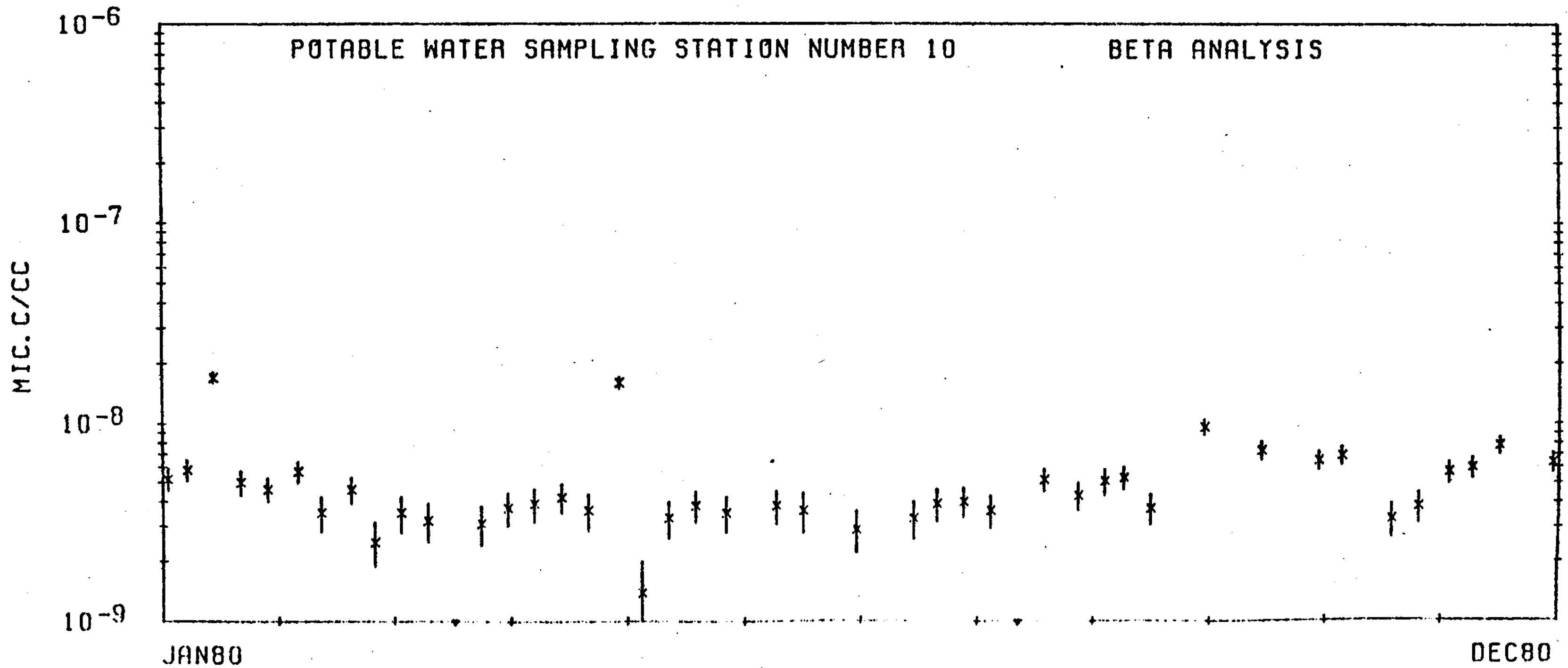

POTABLE WATER SAMPLING STATION NUMBER 3 BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹


POTABLE WATER SAMPLING STATION NUMBER 4 BETA ANALYSIS
MIC.C/CC
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹
JAN80
DEC80


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


POTABLE WATER SAMPLING STATION NUMBER 7
BETA ANALYSIS
MIC. C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80


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


POTABLE WATER SAMPLING STATION NUMBER 10
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80

APPENDIX E

NTS Environmental Surveillance

Open Reservoirs Locations and Plots

Several symbols are used in Appendix D 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. The data symbols for the plots are as follows:

Plot #	Symbol
1-8	×
11-20	◊
21-22	×

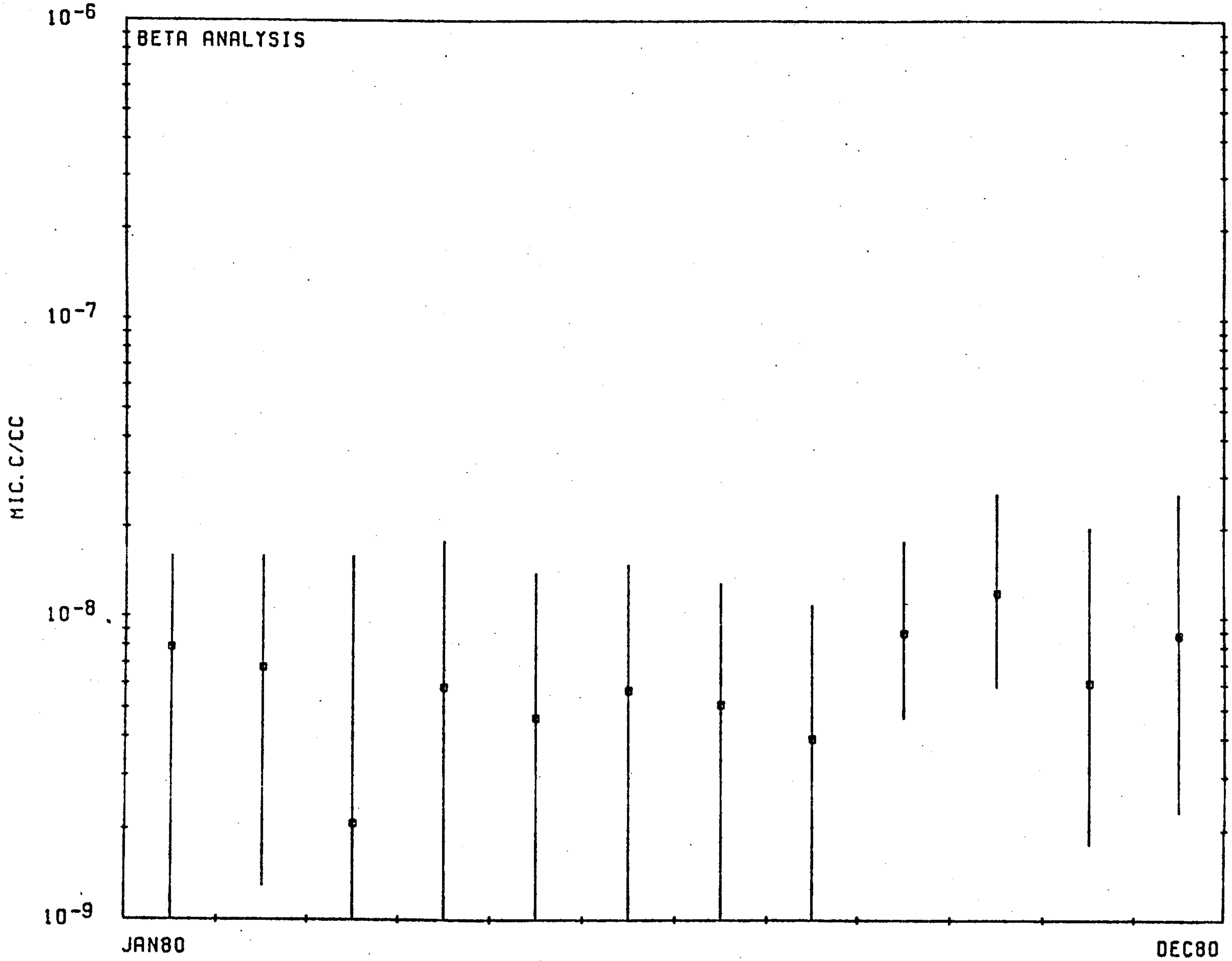
A two-sigma error is also added to the data points, and, in all plots, a delta with the line to the bottom of the plot means below detection limit.

NTS ENVIRONMENTAL SURVEILLANCE
OPEN RESERVOIRS SAMPLING LOCATIONS

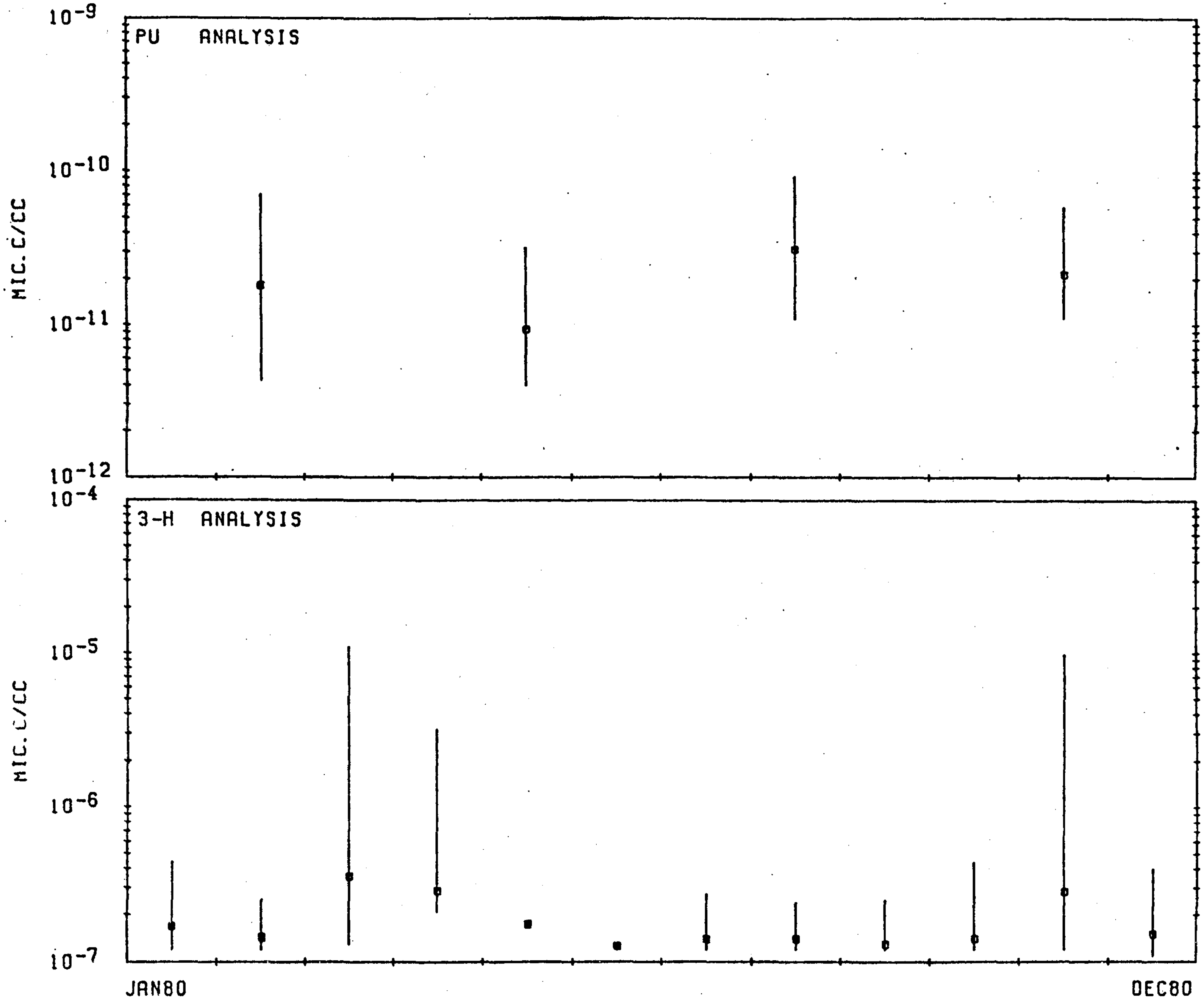
Station Number	Location
1	Area 2 Well 2 Reservoir
2	Area 3 Well A Reservoir
3	Area 5 Well 5B Reservoir
4	Area 5 Well Ue5c Reservoir
5	Area 6 Well 3 Reservoir
6	Area 6 Well C1 Reservoir
7	Area 15 Well Ue15d Reservoir
8	Area 18 Camp 17 Reservoir
11	Area 20 Well 20A Reservoir
12	Area 23 Swimming Pool
16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

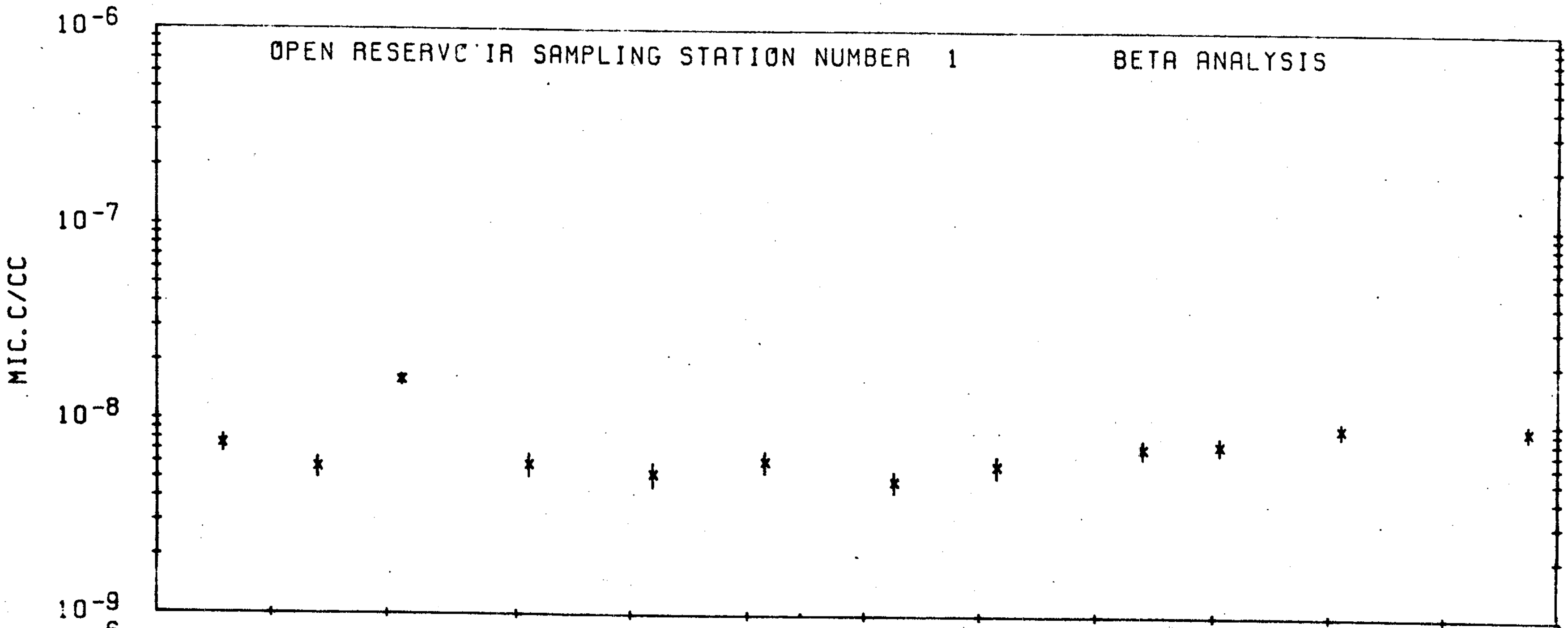
* Reservoir was dry.

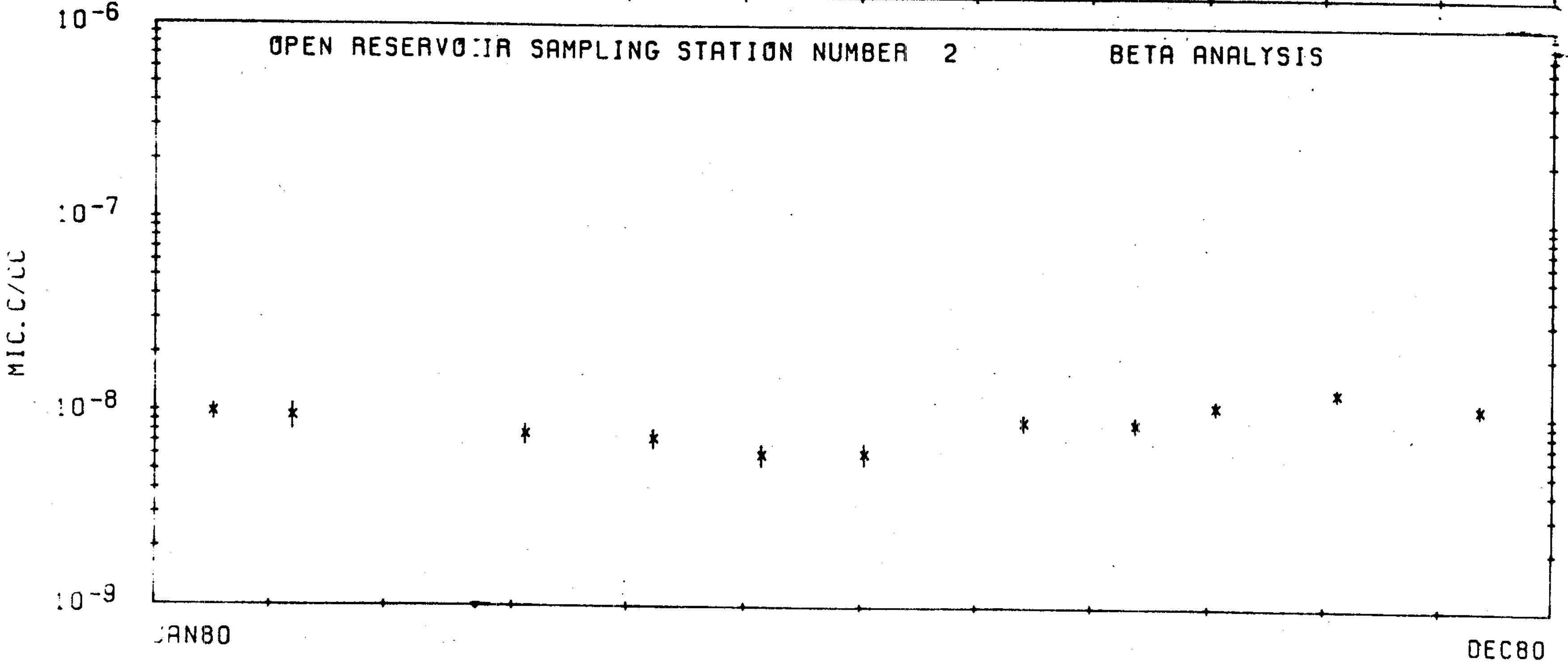
OPEN RESERVOIR NETWORK AVERAGES

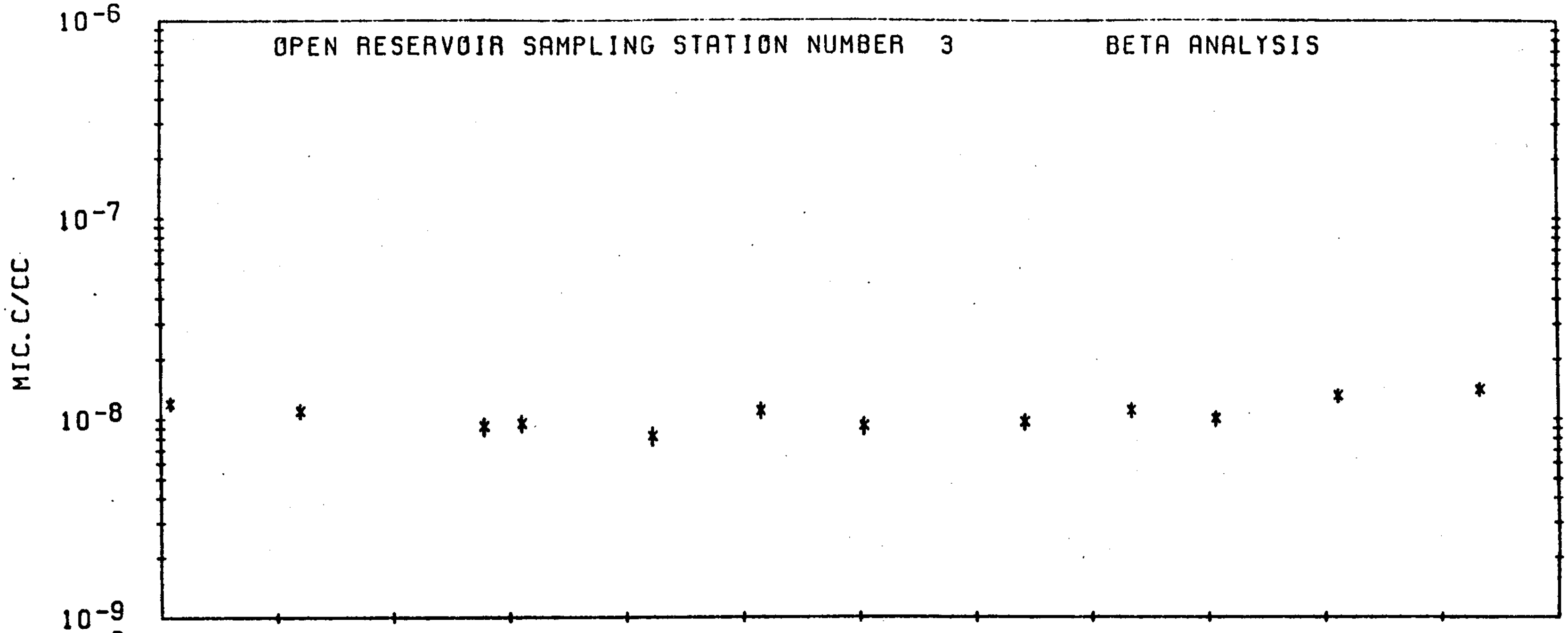


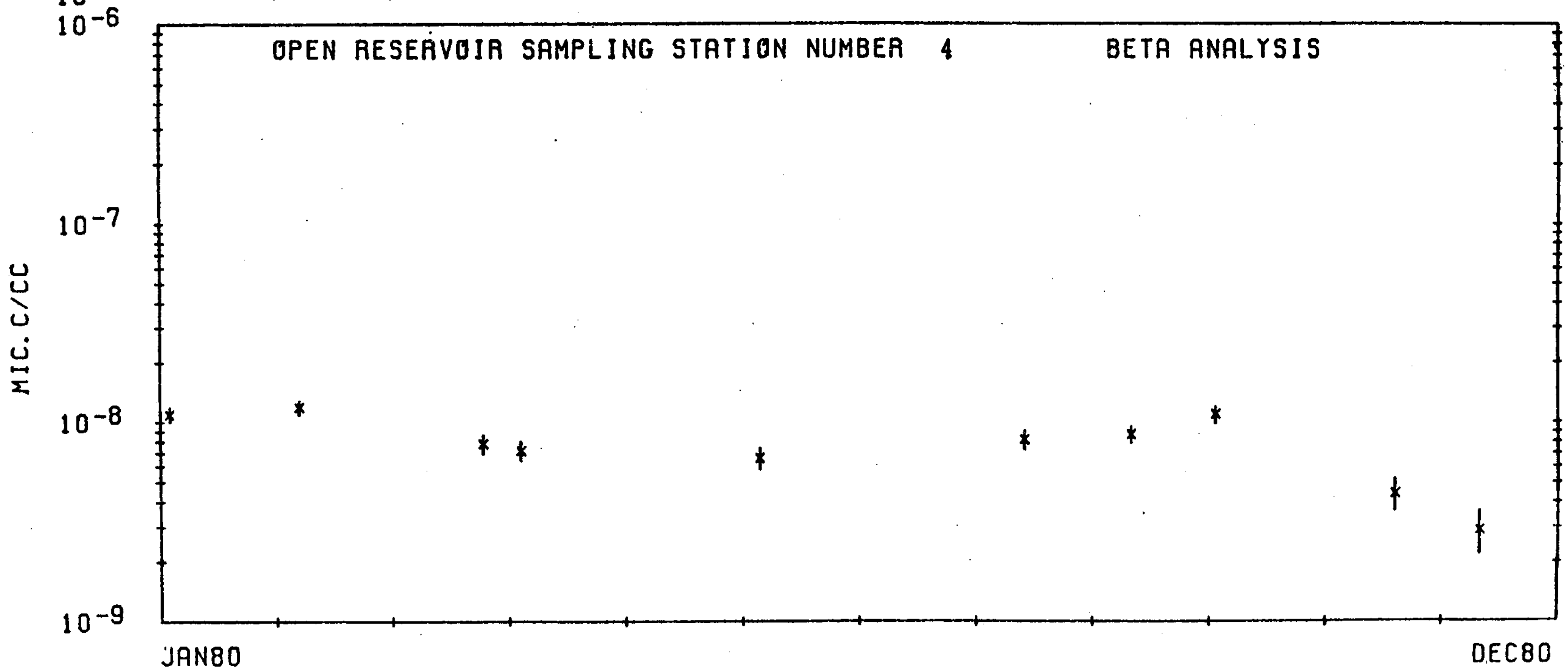
ØPEN RESERVØIR NETWØRK AVERAGES

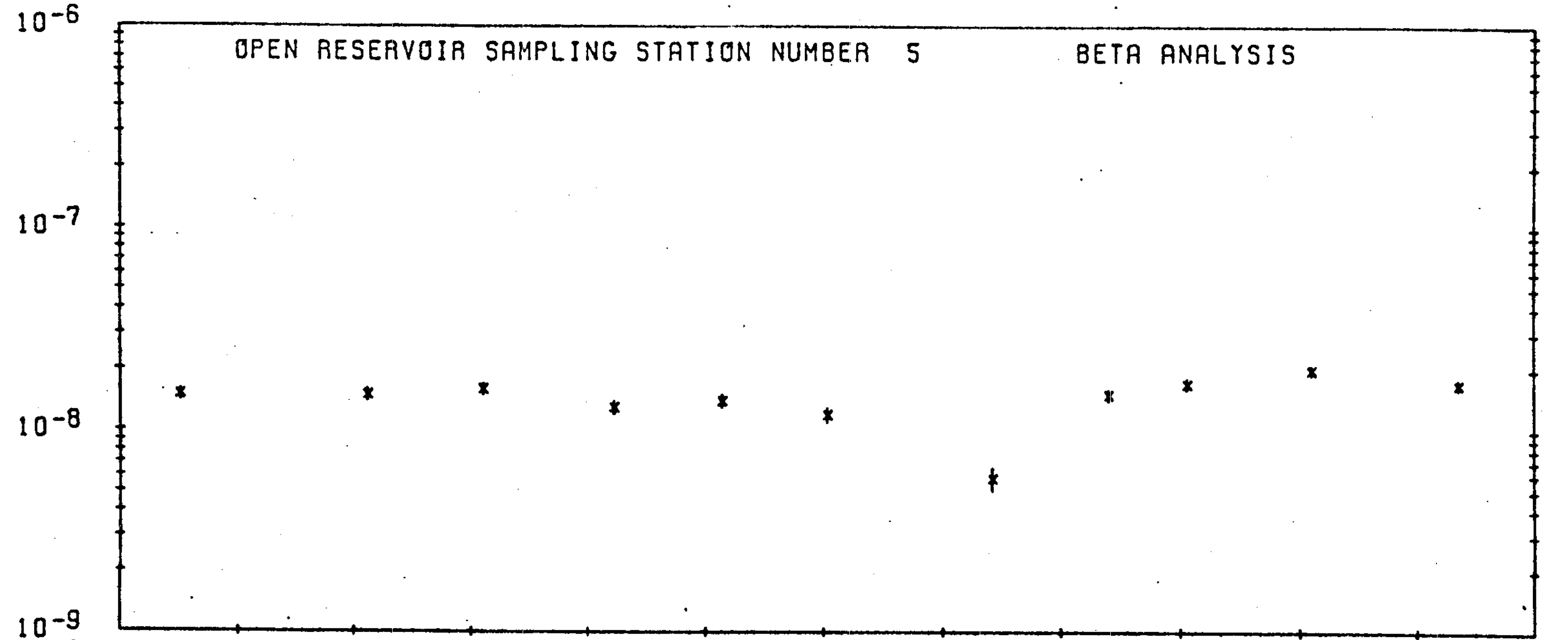


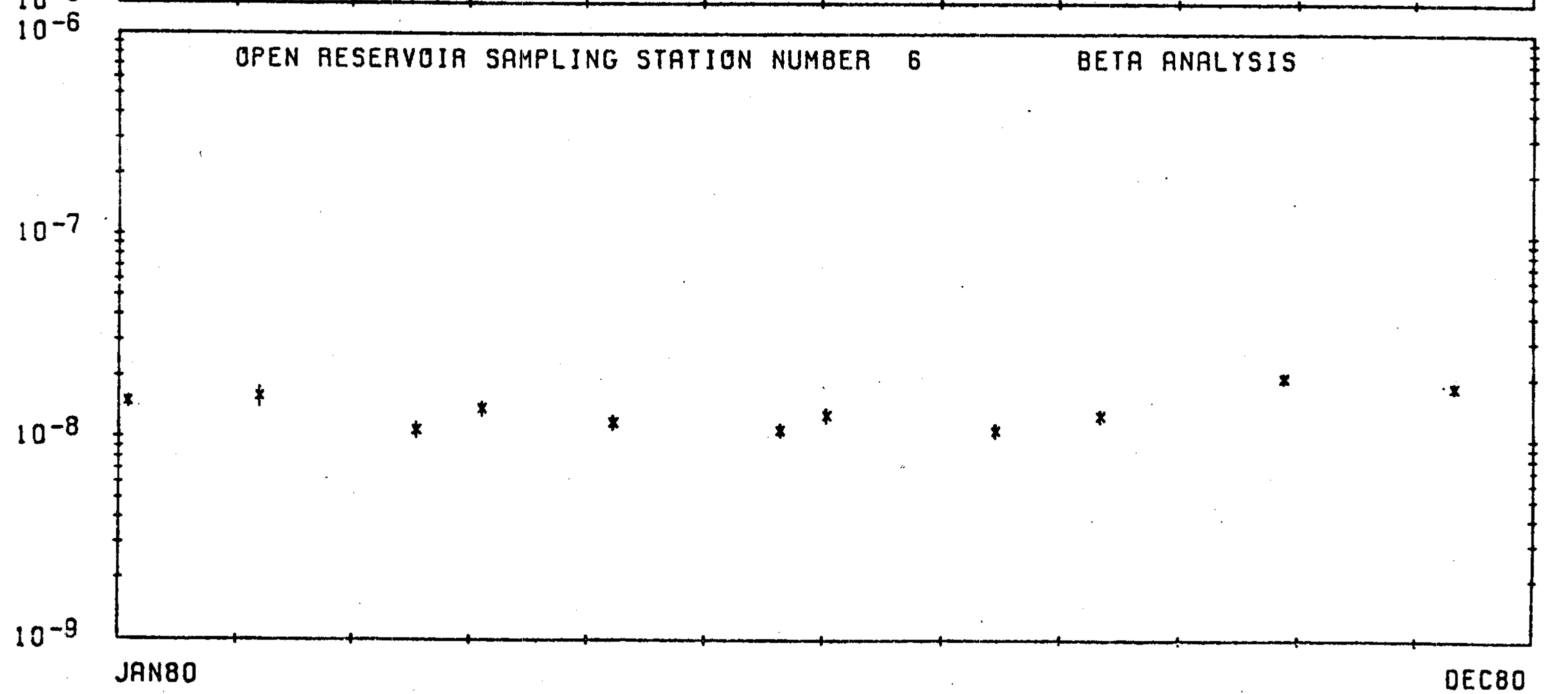

OPEN RESERVOIR SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

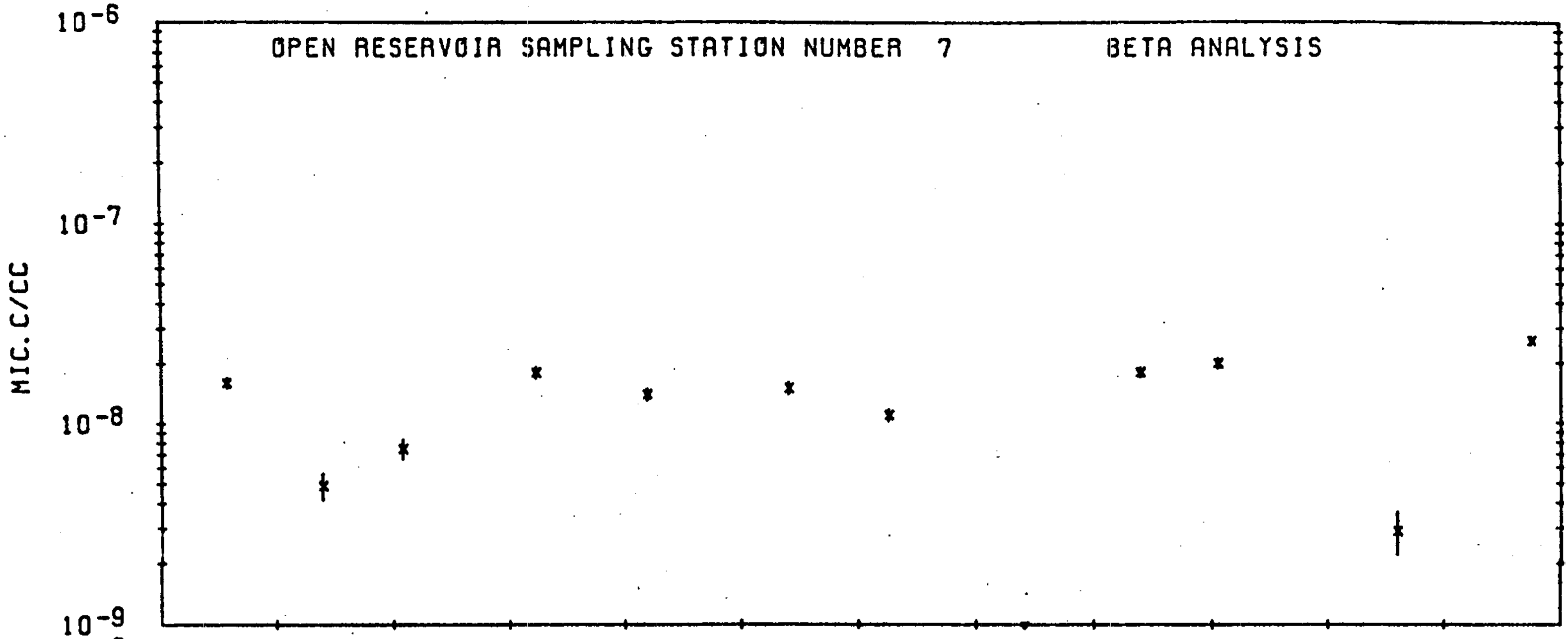

OPEN RESERVOIR SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80

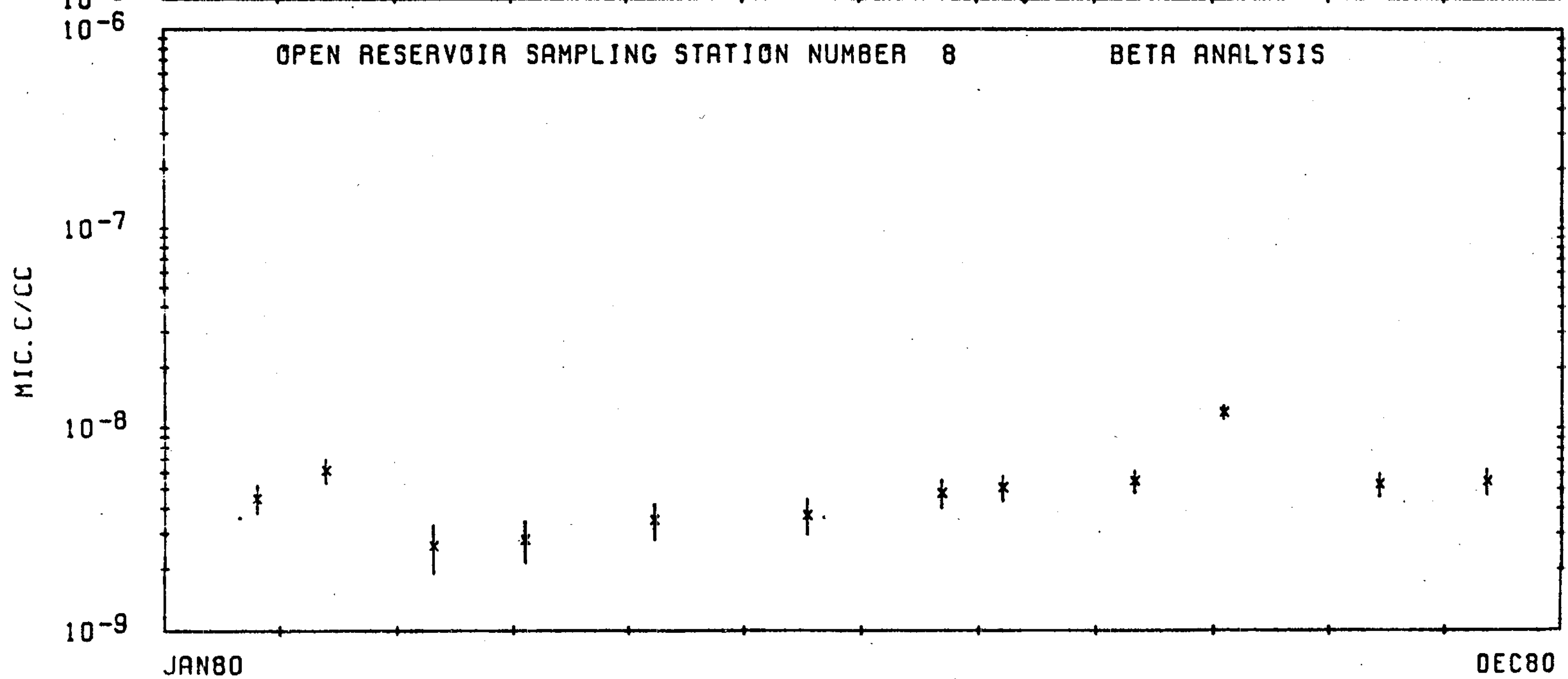

OPEN RESERVOIR SAMPLING STATION NUMBER 3
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

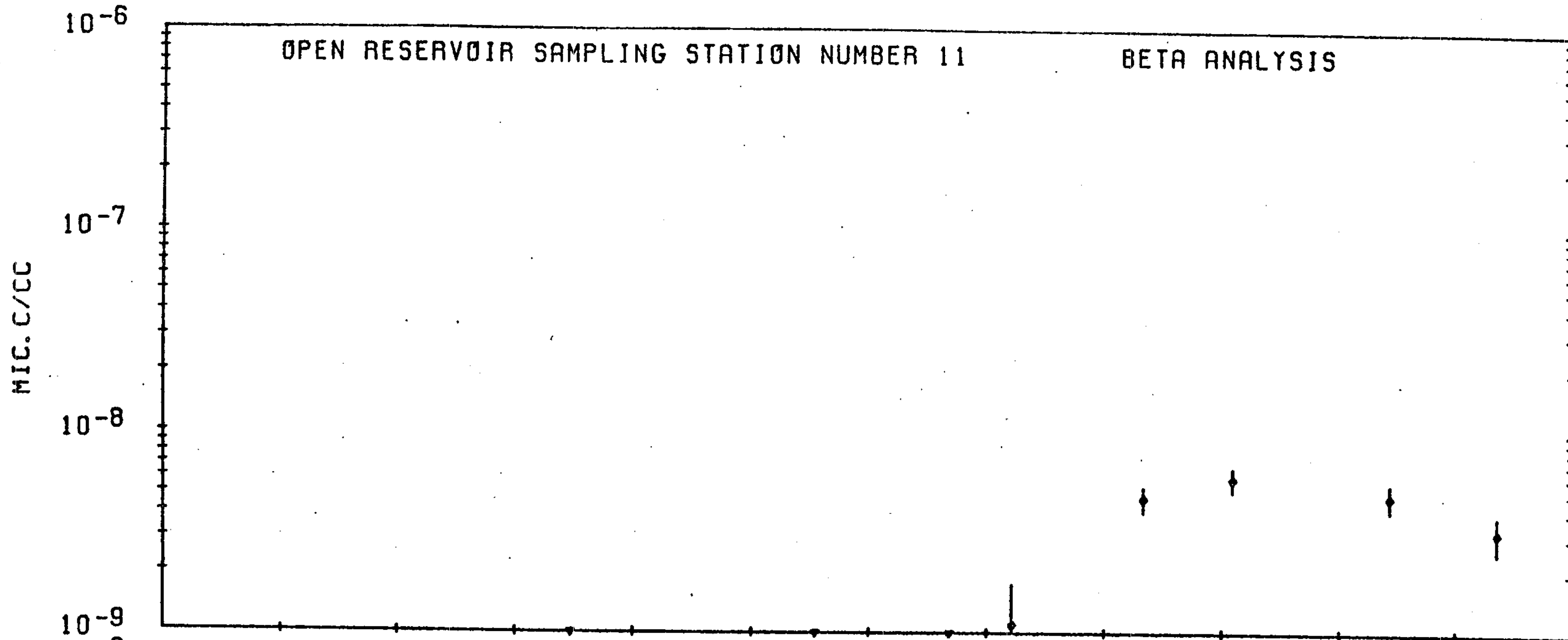

OPEN RESERVOIR SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80


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

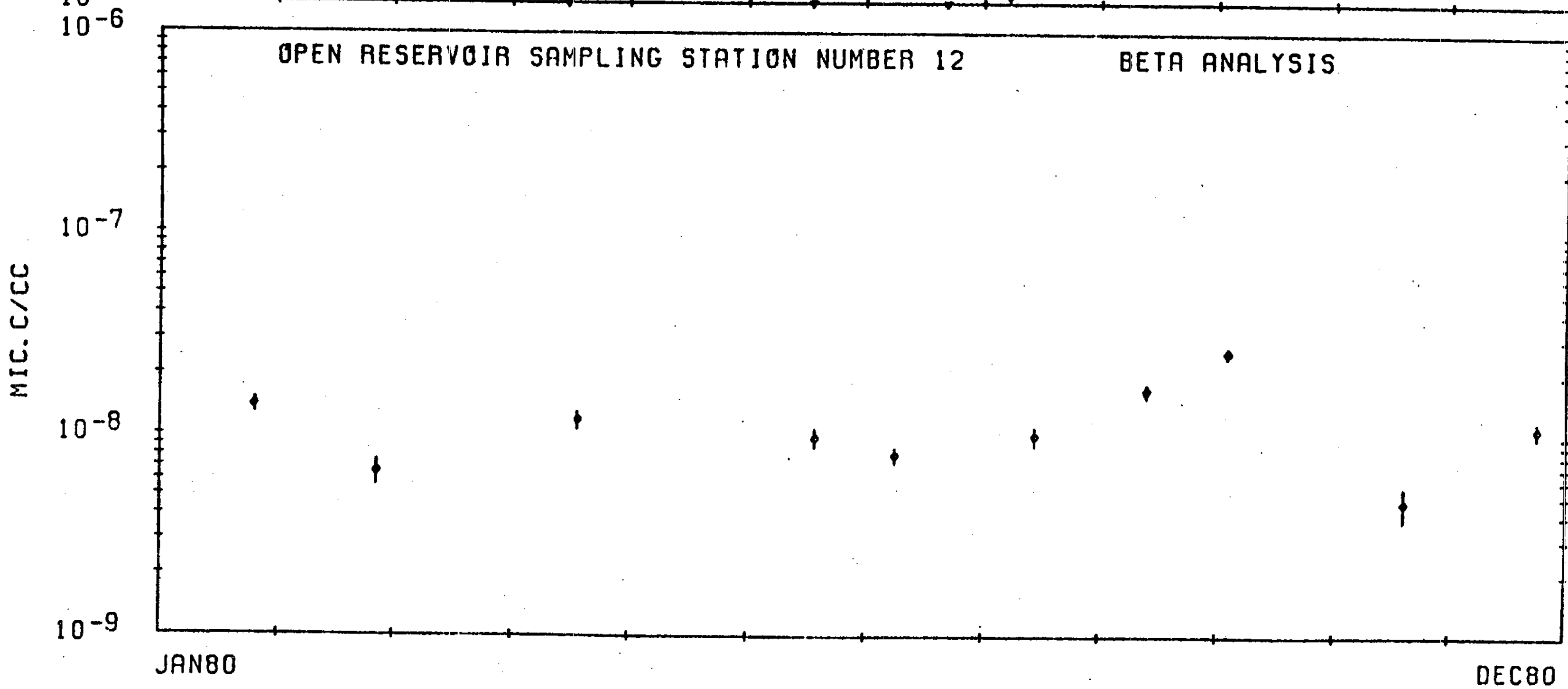

OPEN RESERVOIR SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80


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

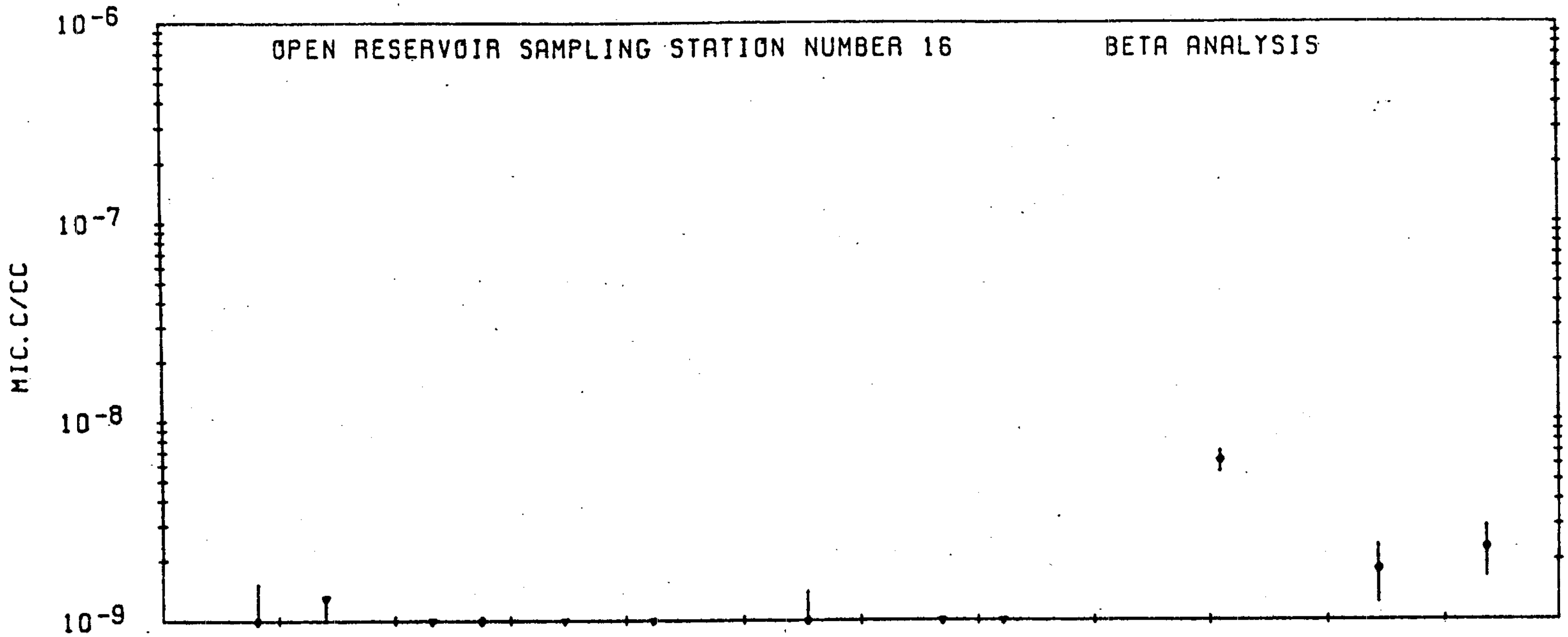

OPEN RESERVOIR SAMPLING STATION NUMBER 8
BETA ANALYSIS
MIC.C/CC
10-6
10-7
10-8
10-9
JAN80
DEC80

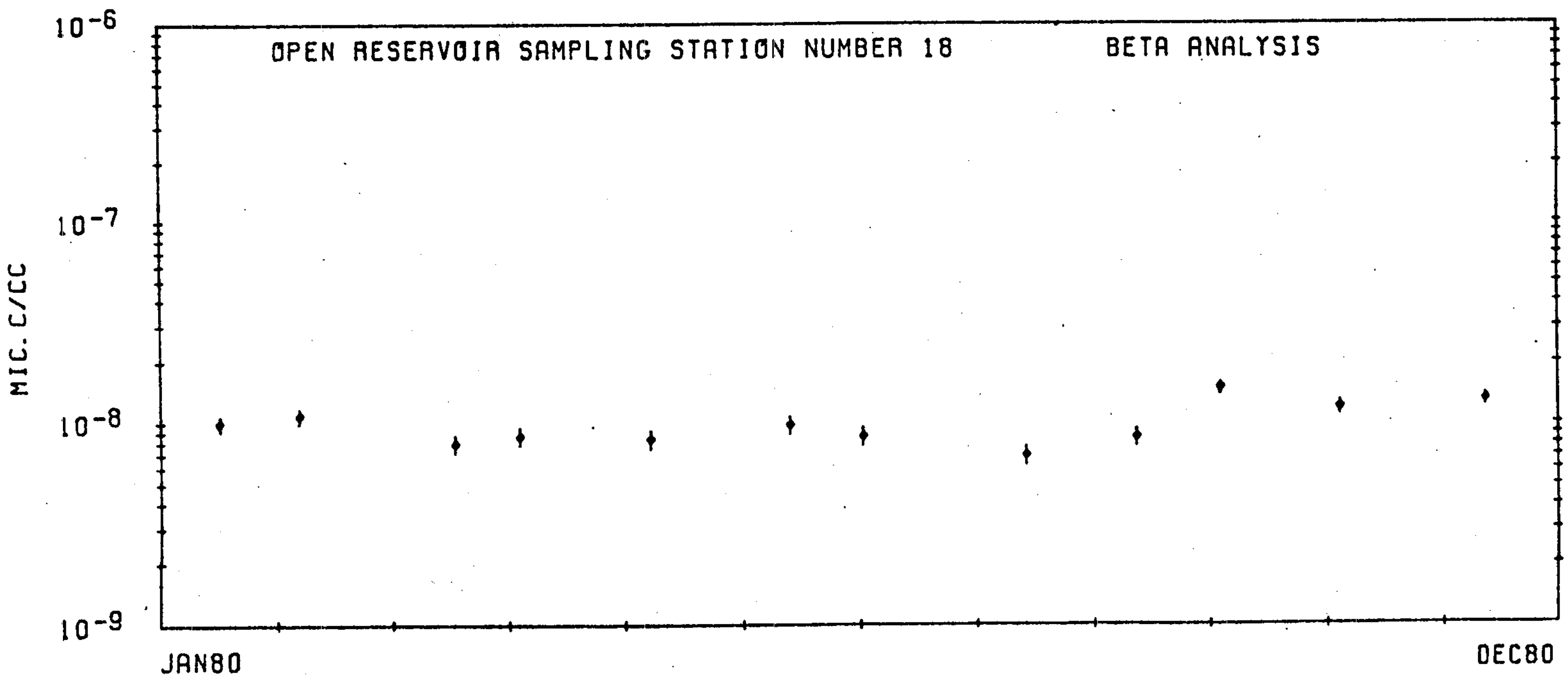


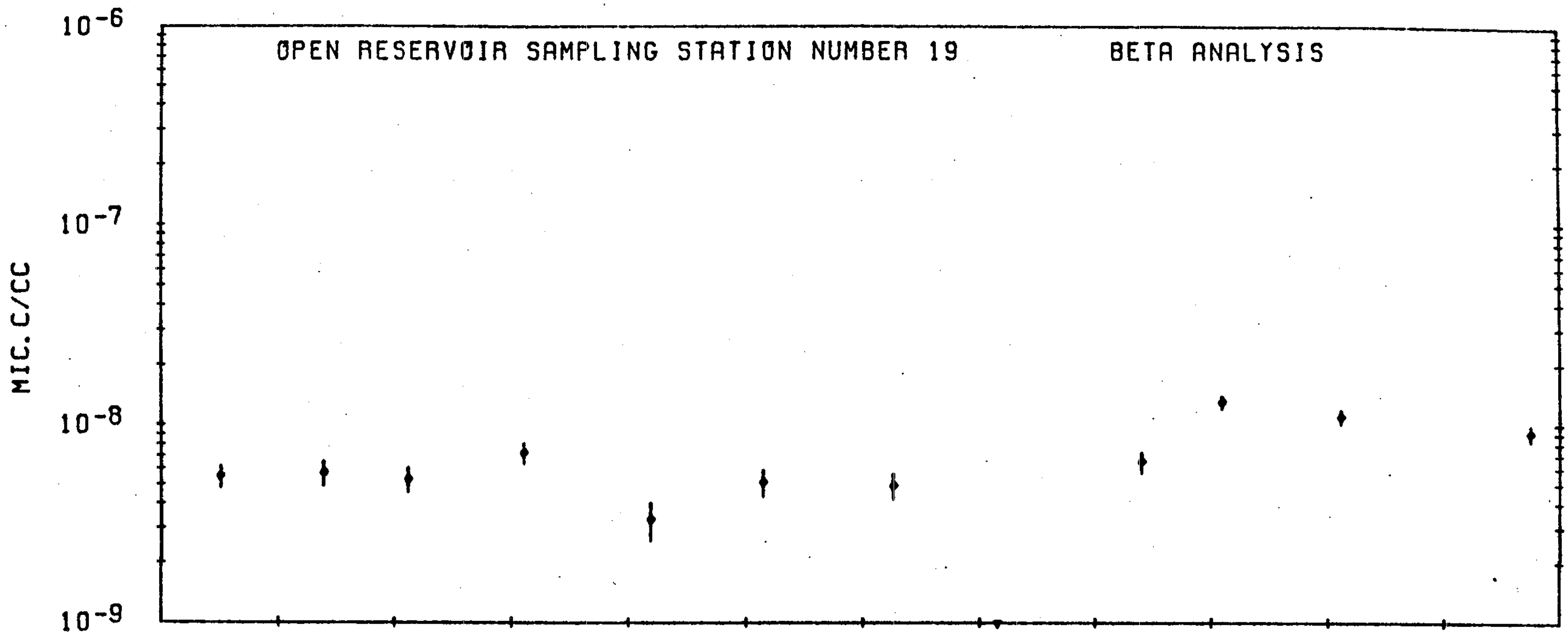
10^-6
10^-7
10^-8
10^-9
MIC.C/CC
OPEN RESERVOIR SAMPLING STATION NUMBER 11
BETA ANALYSIS

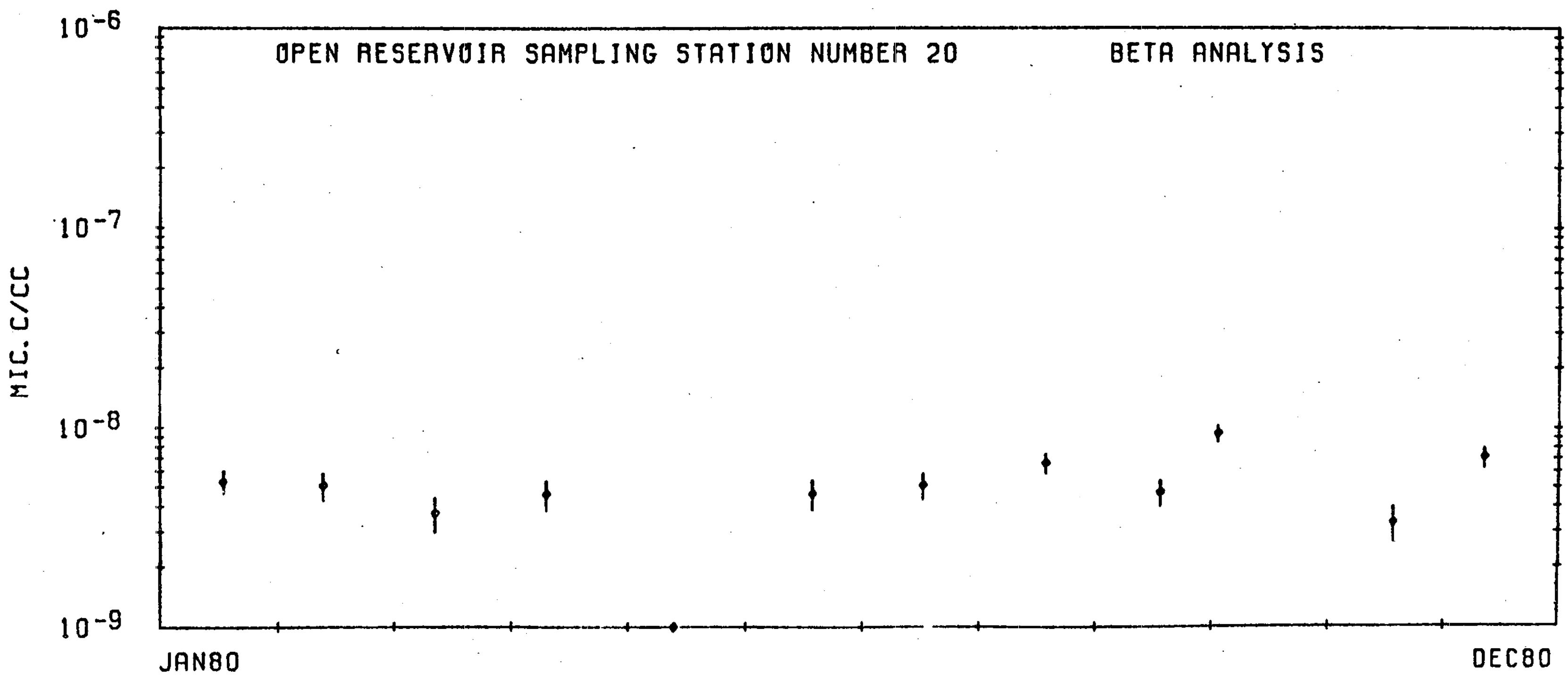


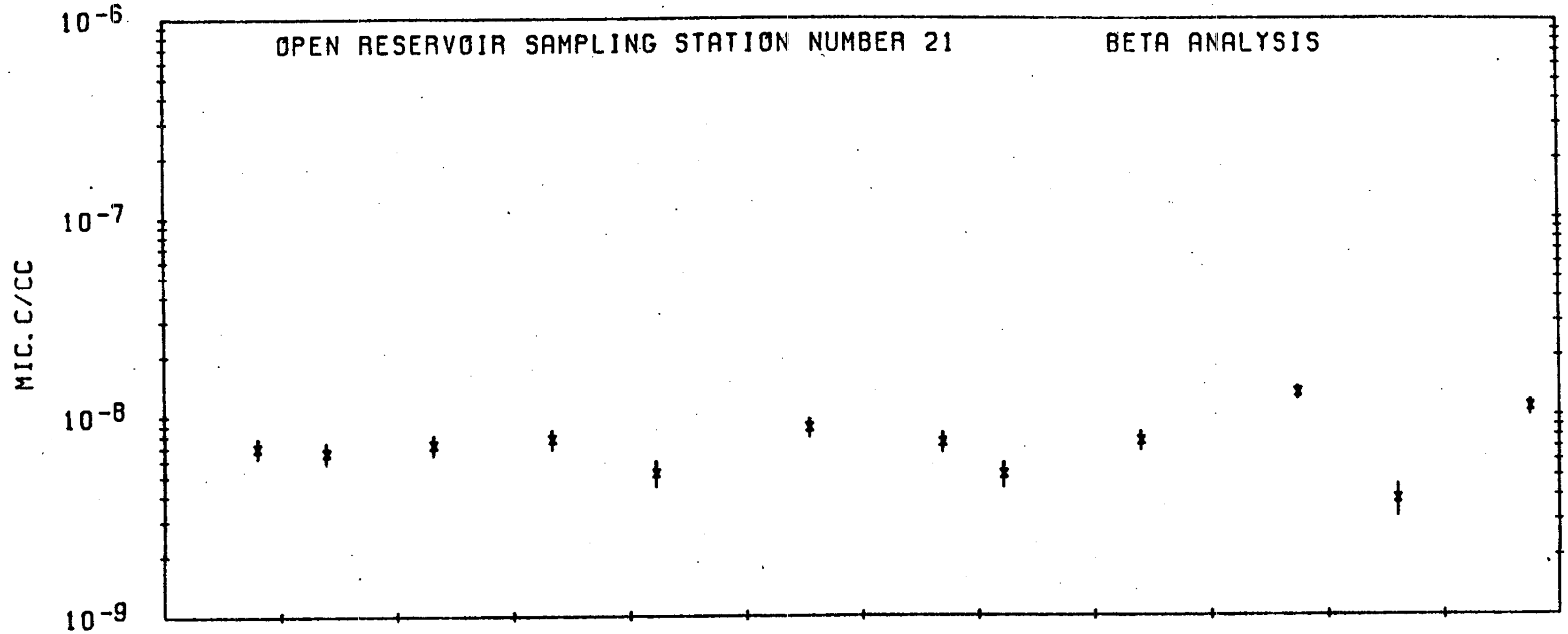
10^-6
10^-7
10^-8
10^-9
MIC.C/CC
OPEN RESERVOIR SAMPLING STATION NUMBER 12
BETA ANALYSIS
JAN80
DEC80

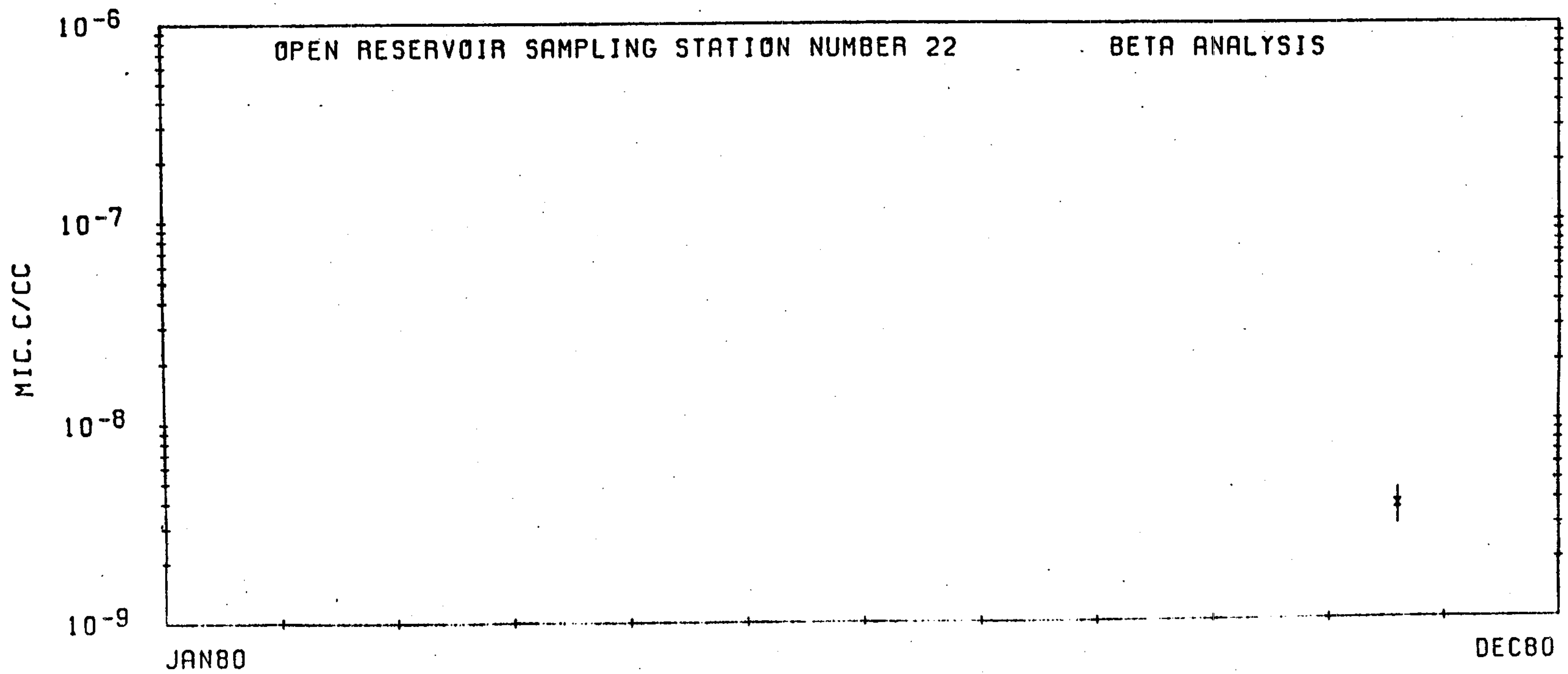

OPEN RESERVOIR SAMPLING STATION NUMBER 16
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}


OPEN RESERVOIR SAMPLING STATION NUMBER 18
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80


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}
JAN80
DEC80


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}
JAN80
DEC80

APPENDIX F

NTS Environmental Surveillance

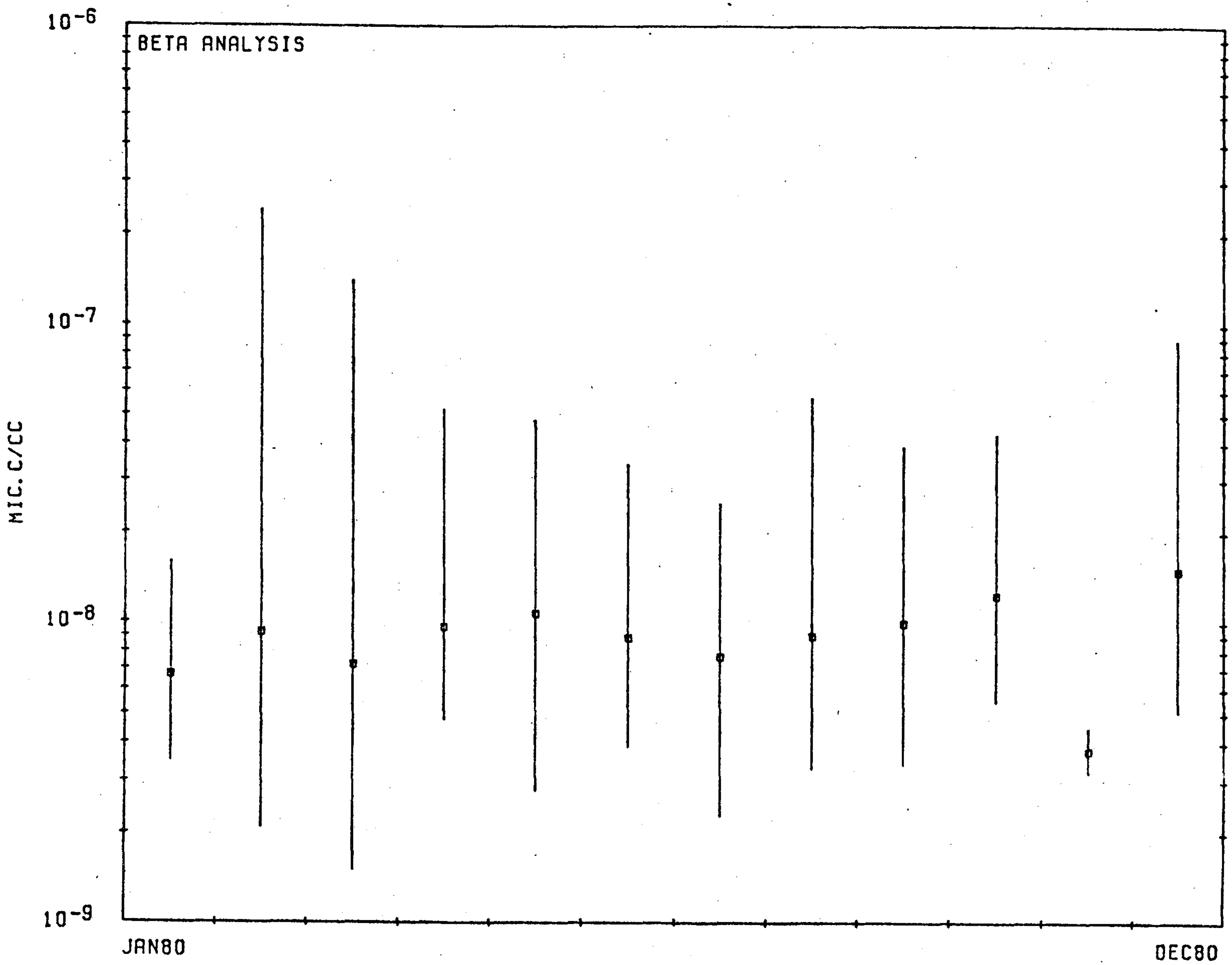
Natural Springs Locations and Plots

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 utilizing the symbol, X, as the data point. 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.

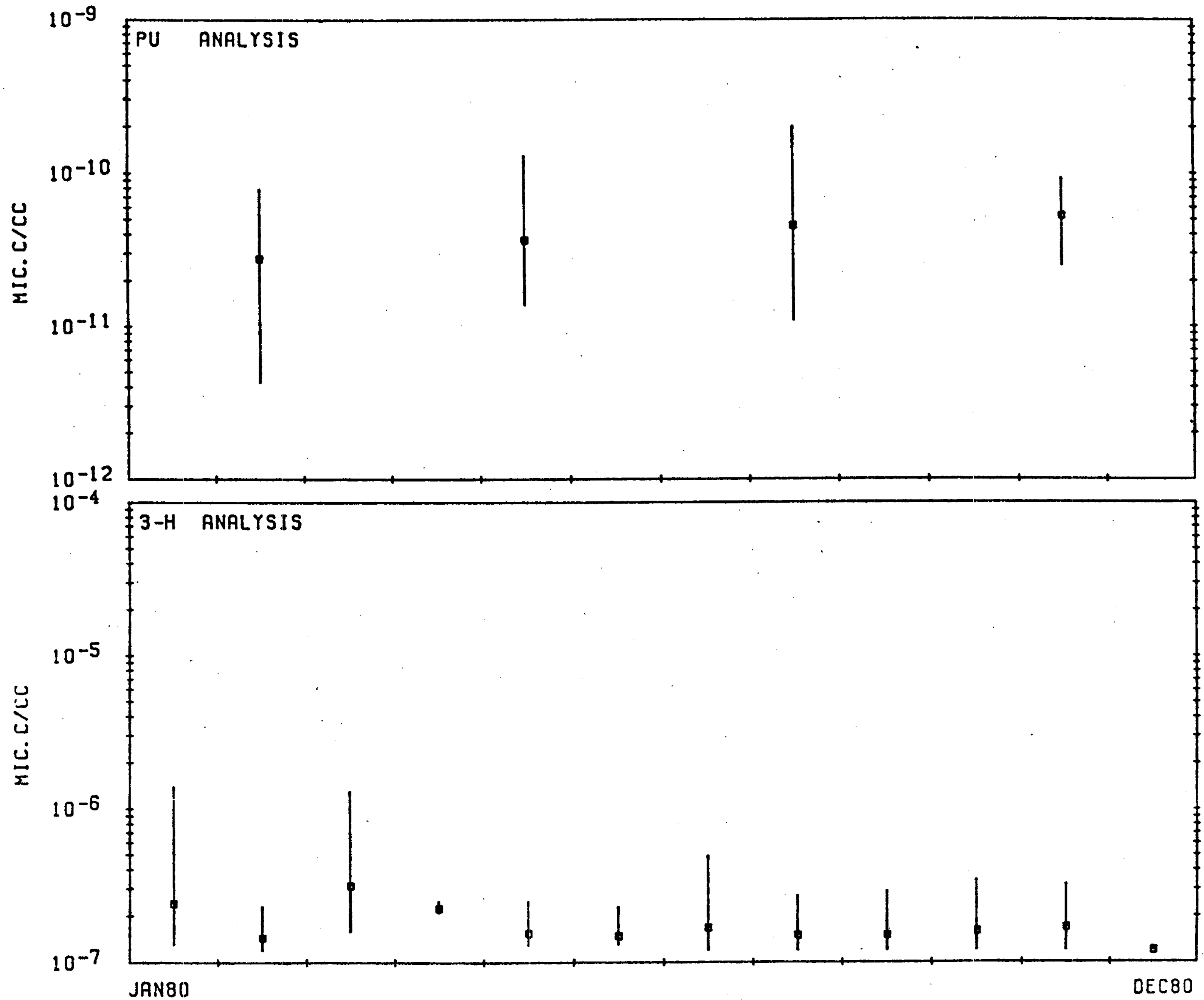
NTS ENVIRONMENTAL SURVEILLANCE
NATURAL SPRINGS SAMPLING LOCATIONS

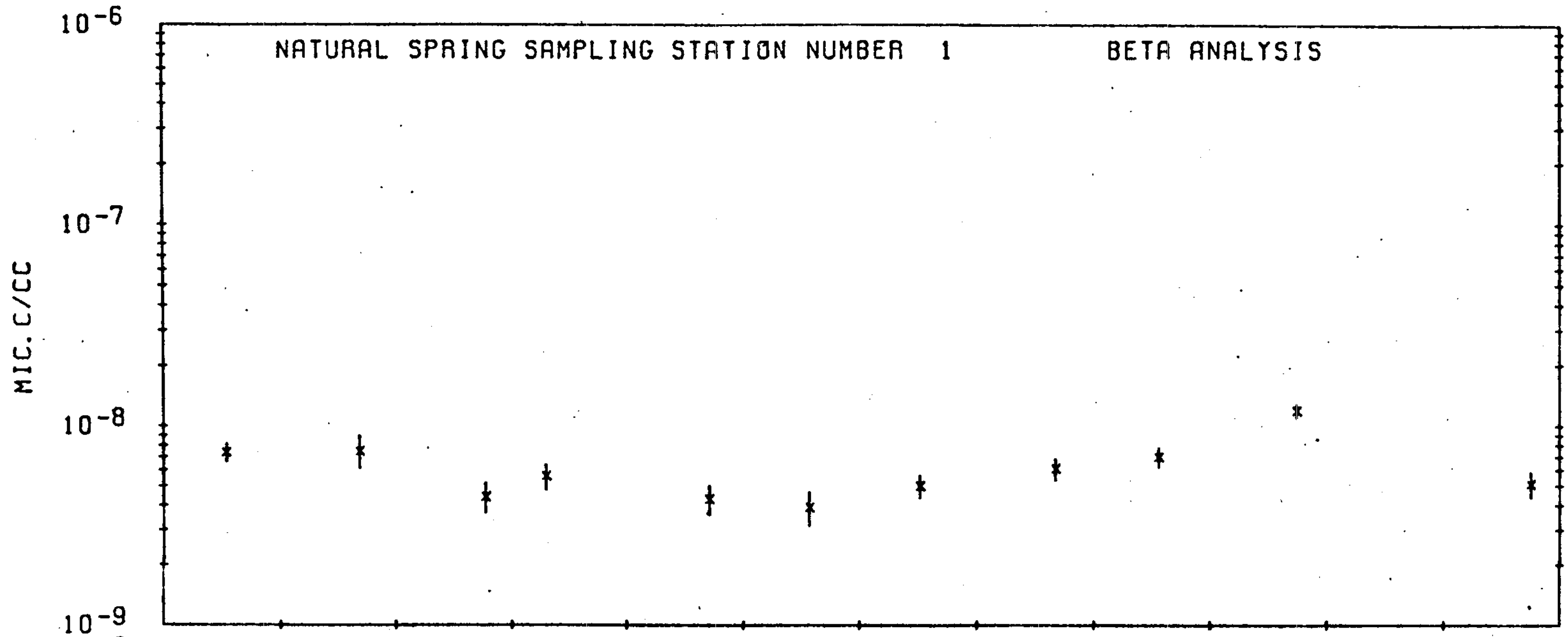
Station Number	Location
1	Area 5 Cane Springs
2	Area 12 White Rock Springs
3	Area 12 Captain Jack Spring
4	Area 12 Gold Meadows Pond
5	Area 15 Oak Butte Spring
6	Area 15 Tub Spring
7	Area 29 Topopah Spring
8	Area 7 Reitmann Seep
9	Area 16 Tippipah Spring

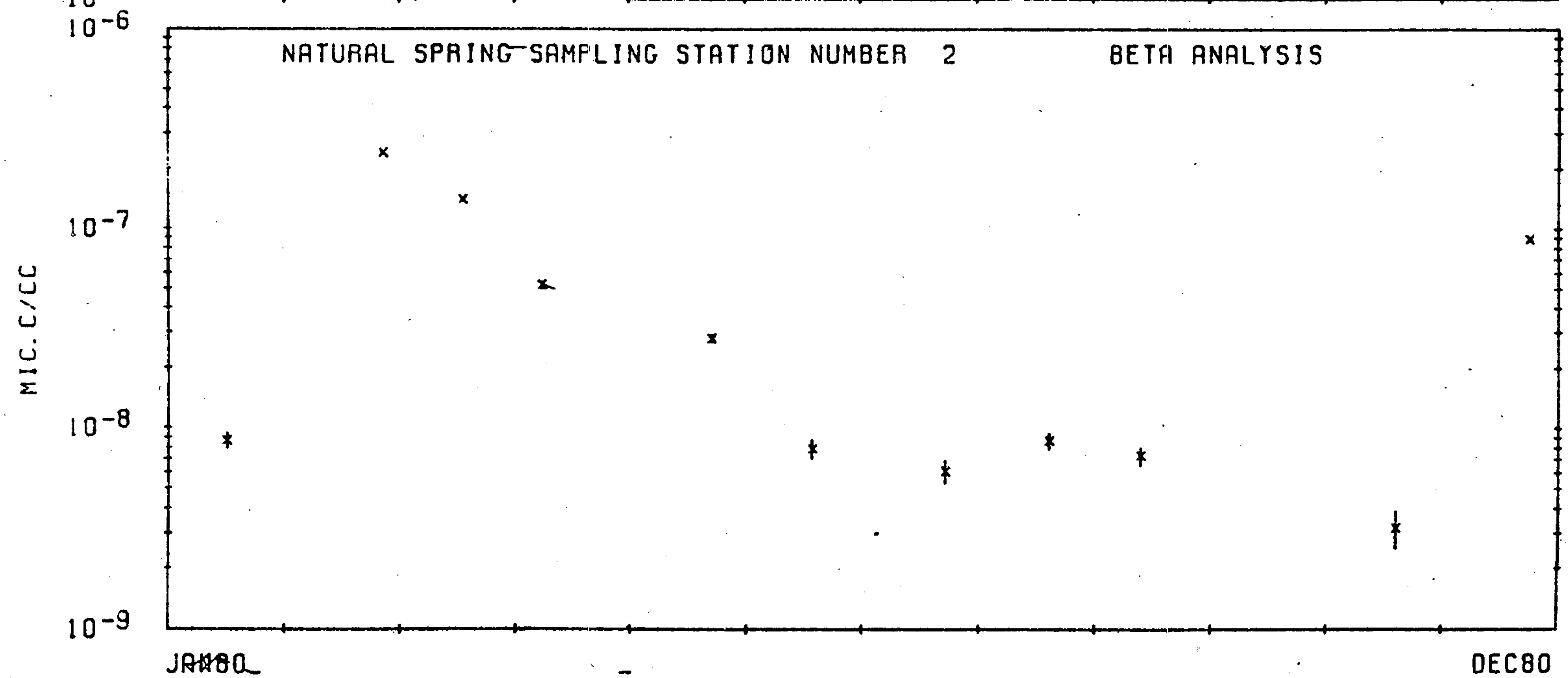
NATURAL SPRING NETWORK AVERAGES

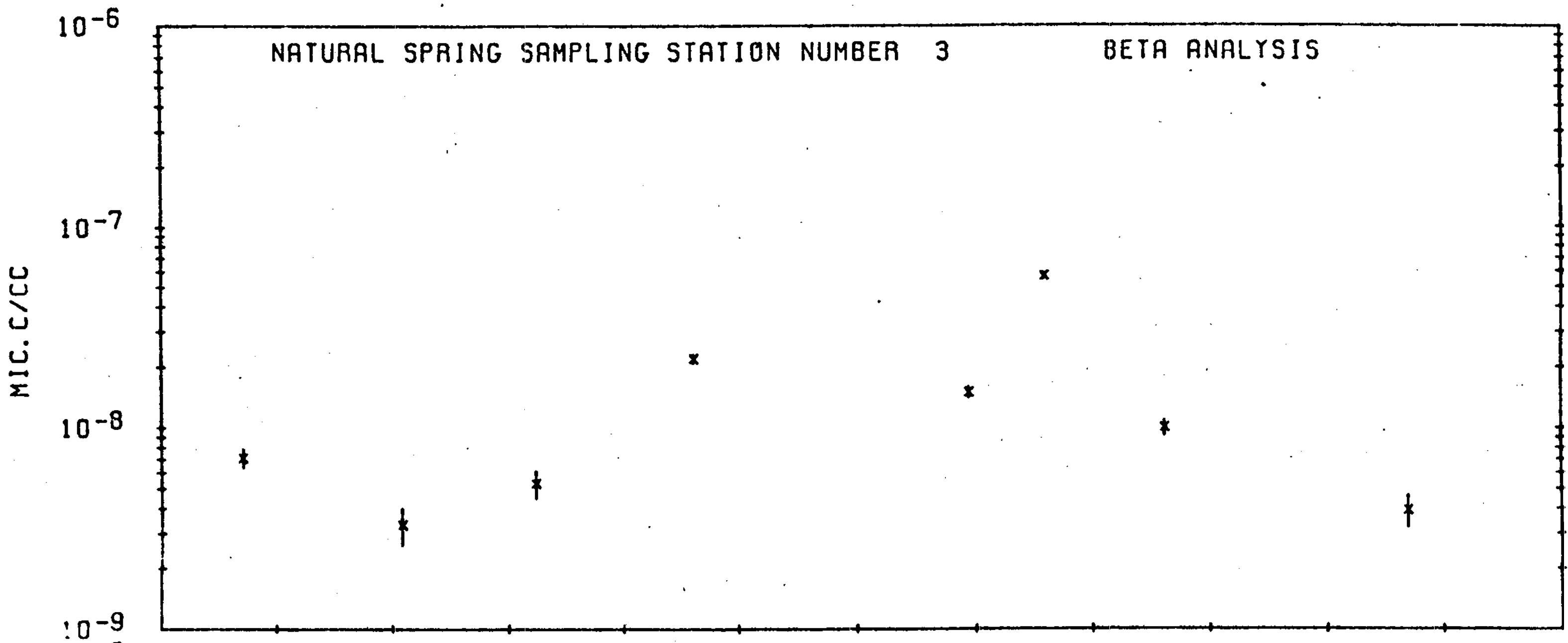


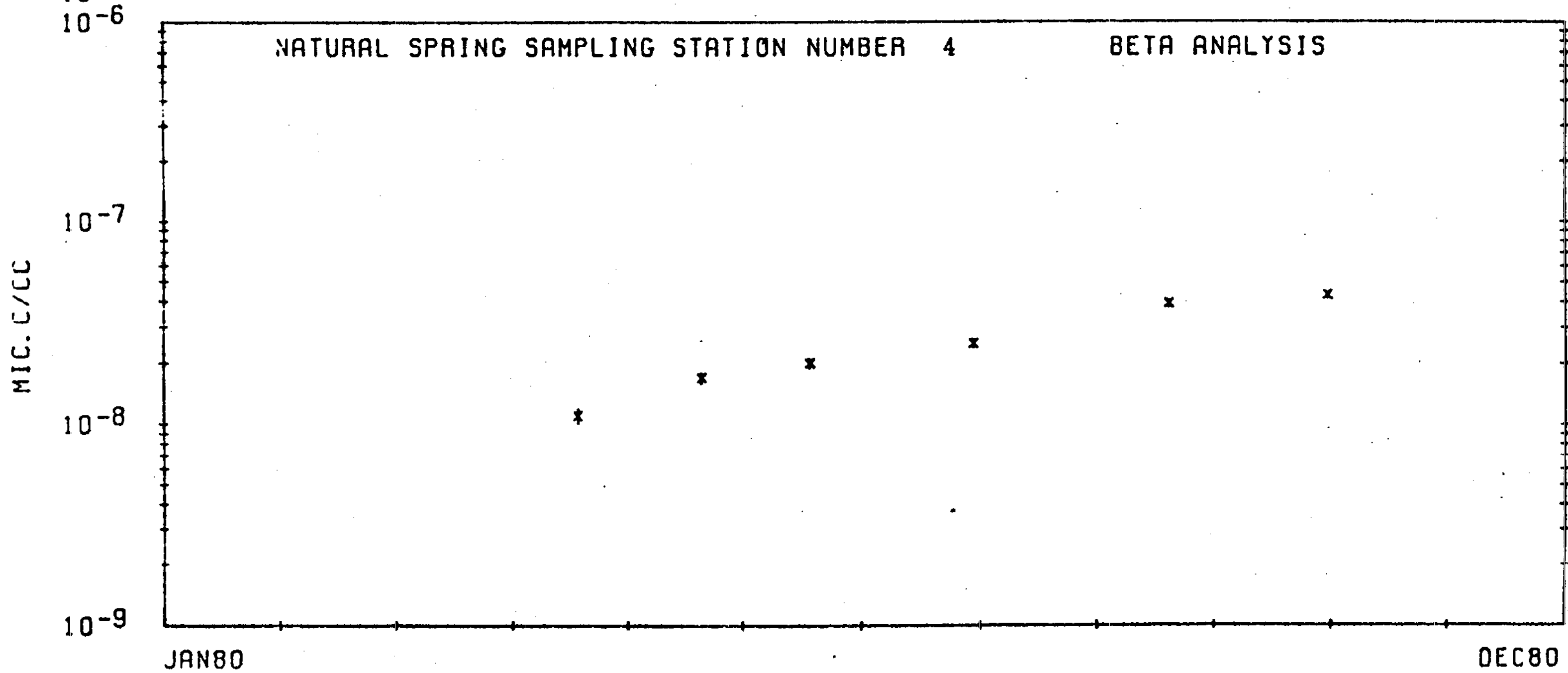
NATURAL SPRING NETWORK AVERAGES

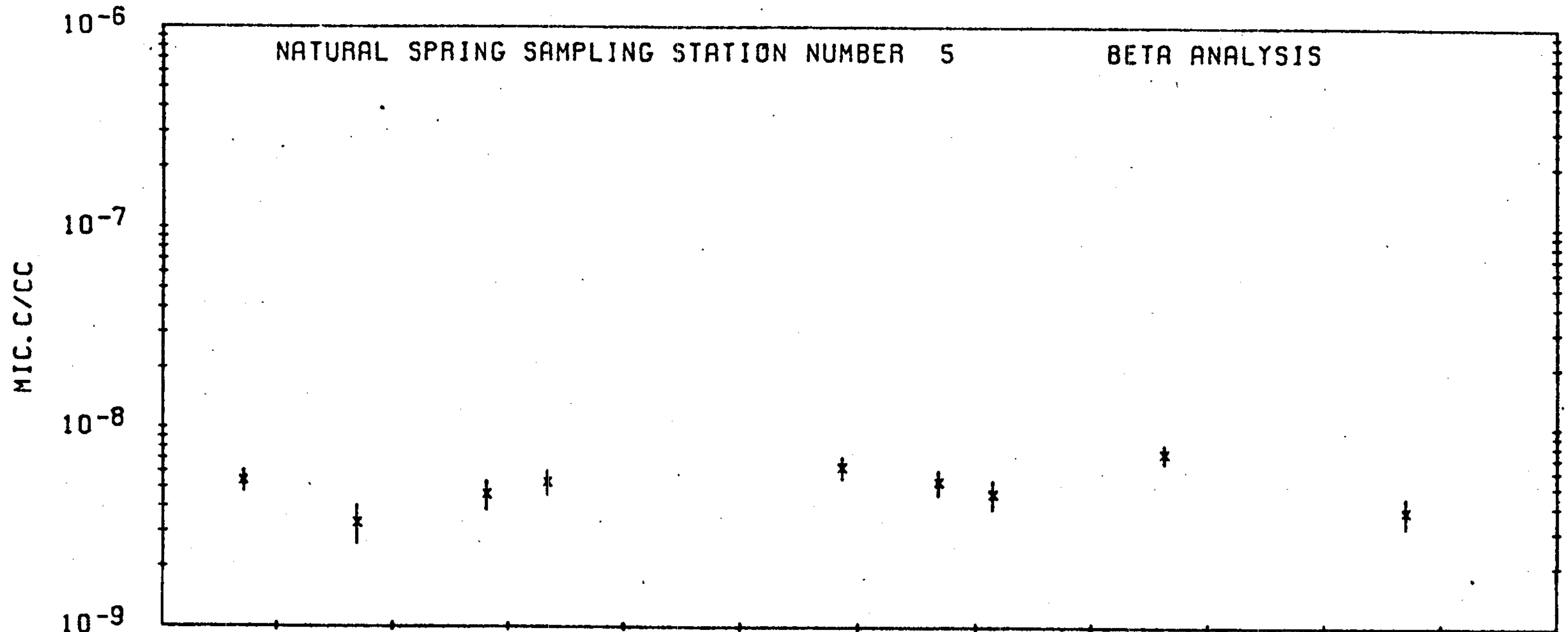



NATURAL SPRING SAMPLING STATION NUMBER 1
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}

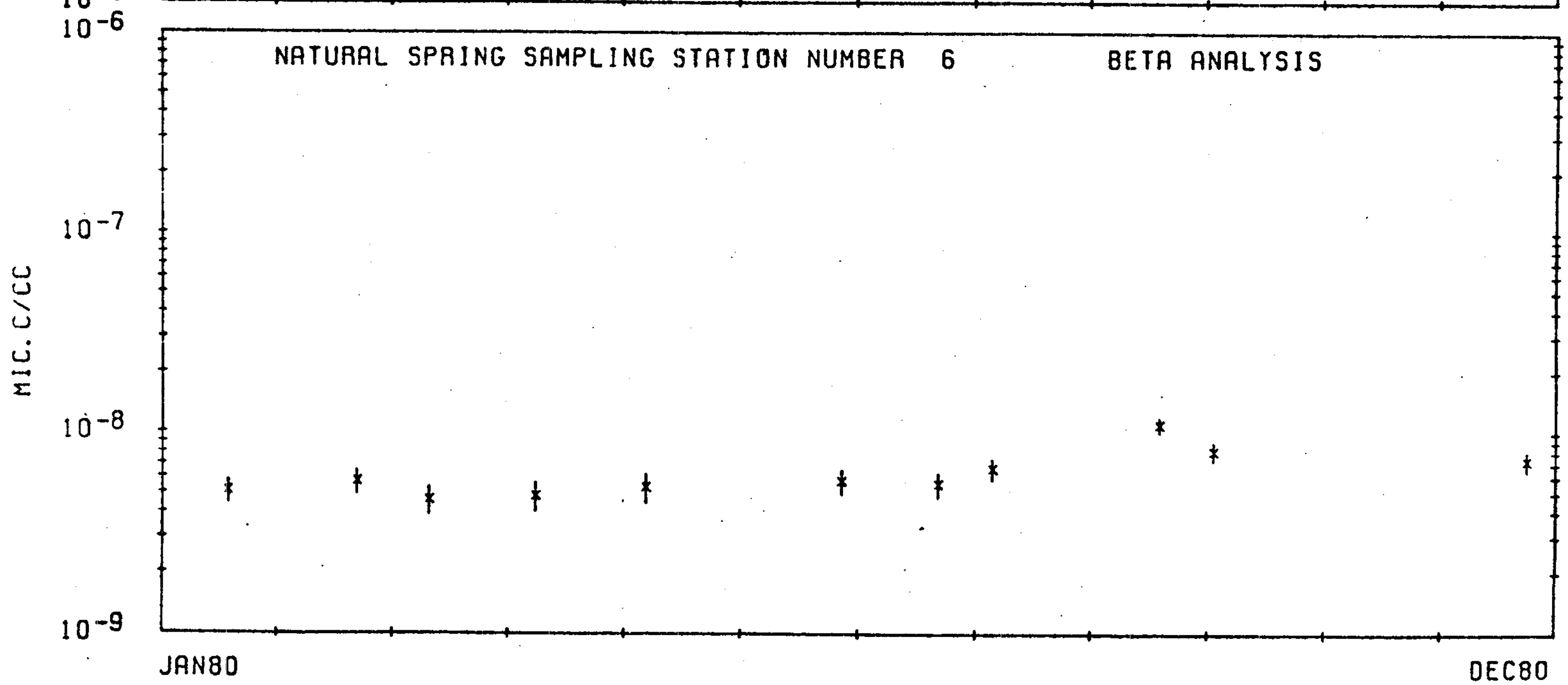

NATURAL SPRING SAMPLING STATION NUMBER 2
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80


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

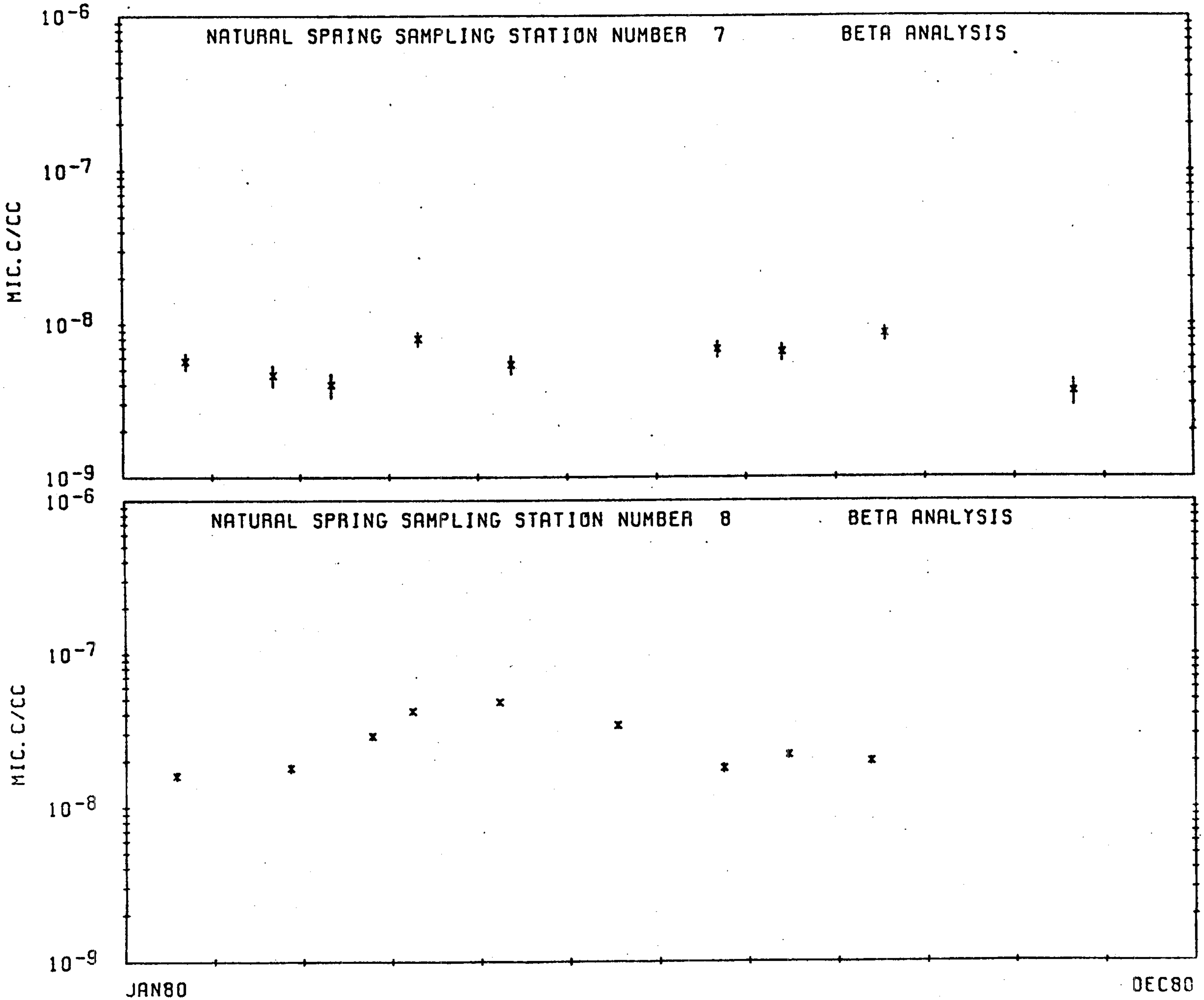

NATURAL SPRING SAMPLING STATION NUMBER 4
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80



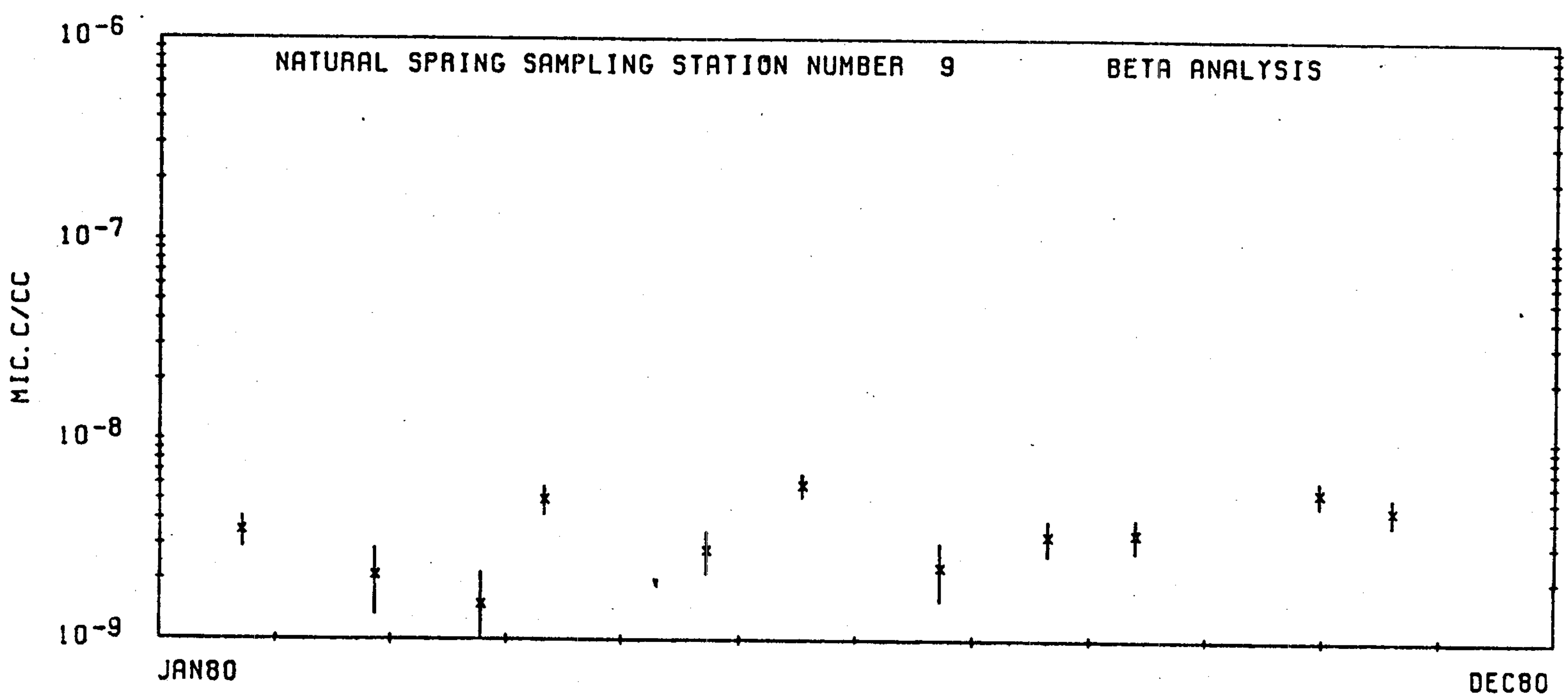
NATURAL SPRING SAMPLING STATION NUMBER 5
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9



NATURAL SPRING SAMPLING STATION NUMBER 6
BETA ANALYSIS
MIC.C/CC
10^-6
10^-7
10^-8
10^-9
JAN80
DEC80



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
JAN80
DEC80



NATURAL SPRING SAMPLING STATION NUMBER 9
BETA ANALYSIS
MIC.C/CC
10^{-6}
10^{-7}
10^{-8}
10^{-9}
JAN80
DEC80

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 utilizing the symbol, X, as the data point. 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.

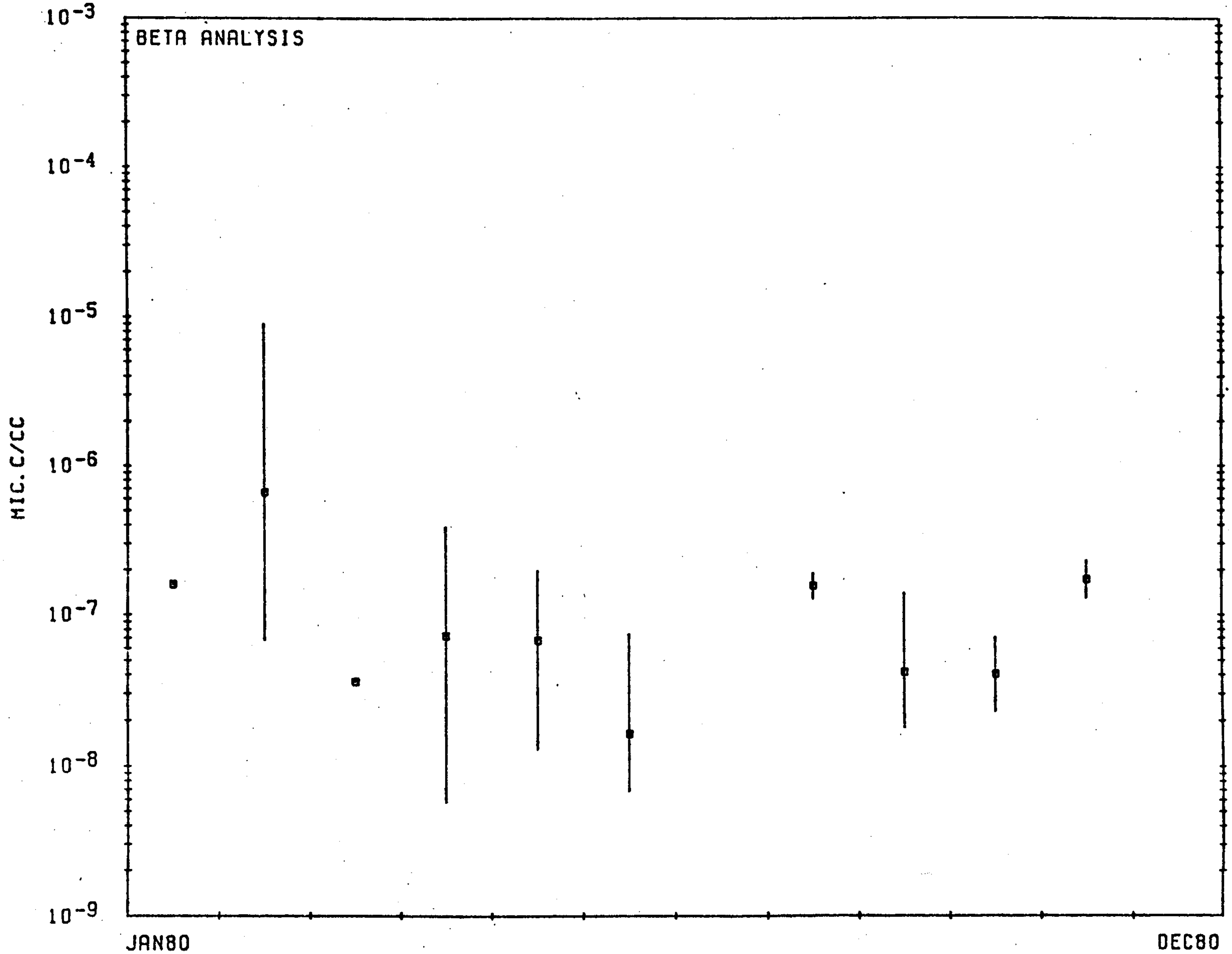
NTS ENVIRONMENTAL SURVEILLANCE
CONTAMINATED PONDS SAMPLING LOCATIONS

Station Number	Location
* 1	Area 12 Haines Upper
* 2	Area 12 Haines #2
** 3	Area 12 Haines #3
** 4	Area 12 Haines Lower
5	Area 12 Mint Upper
* 6	Area 12 Mint Mid
* 7	Area 12 Mint Lower
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

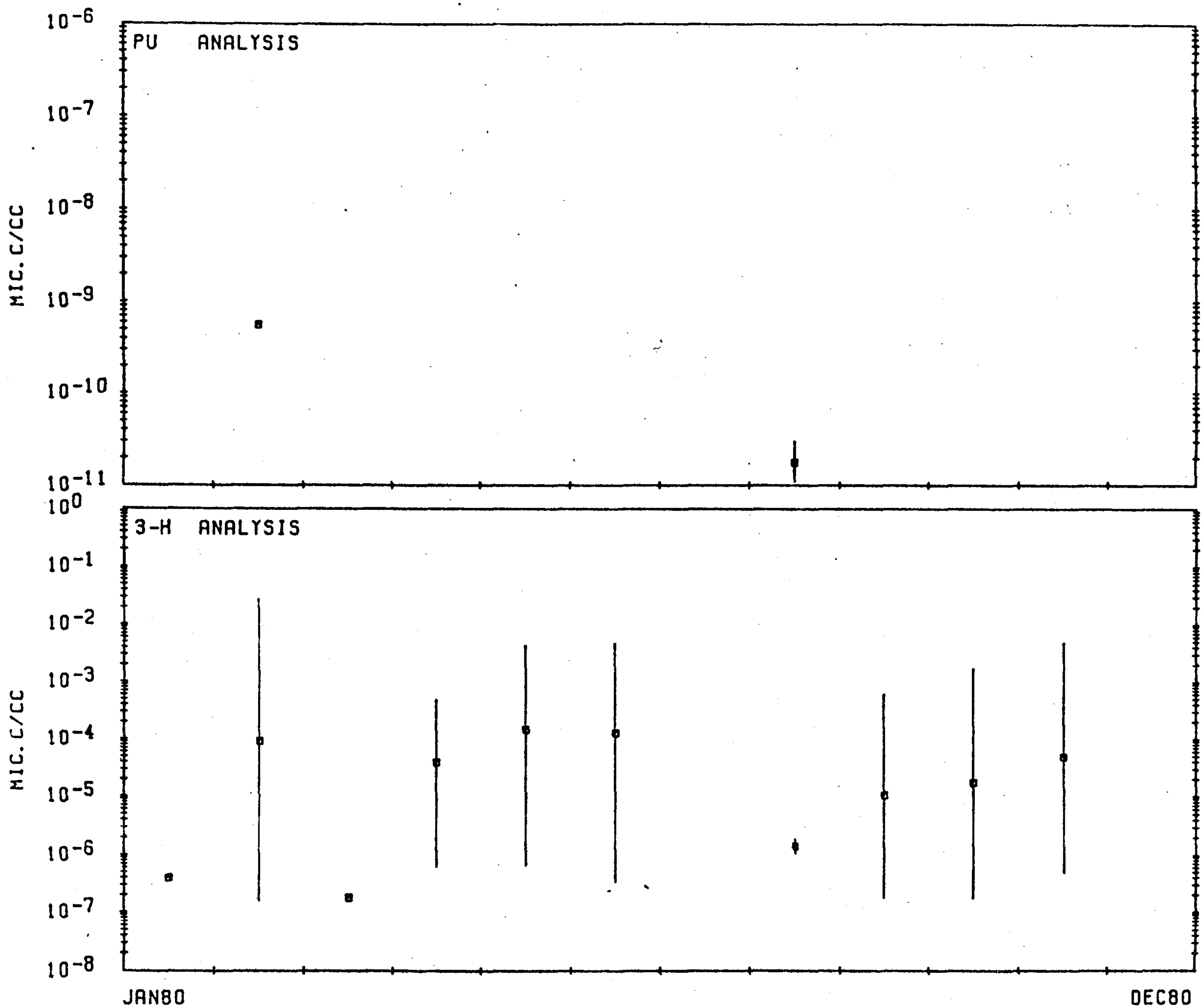
* Contaminated ponds were dry.

** No plots - insufficient data points.

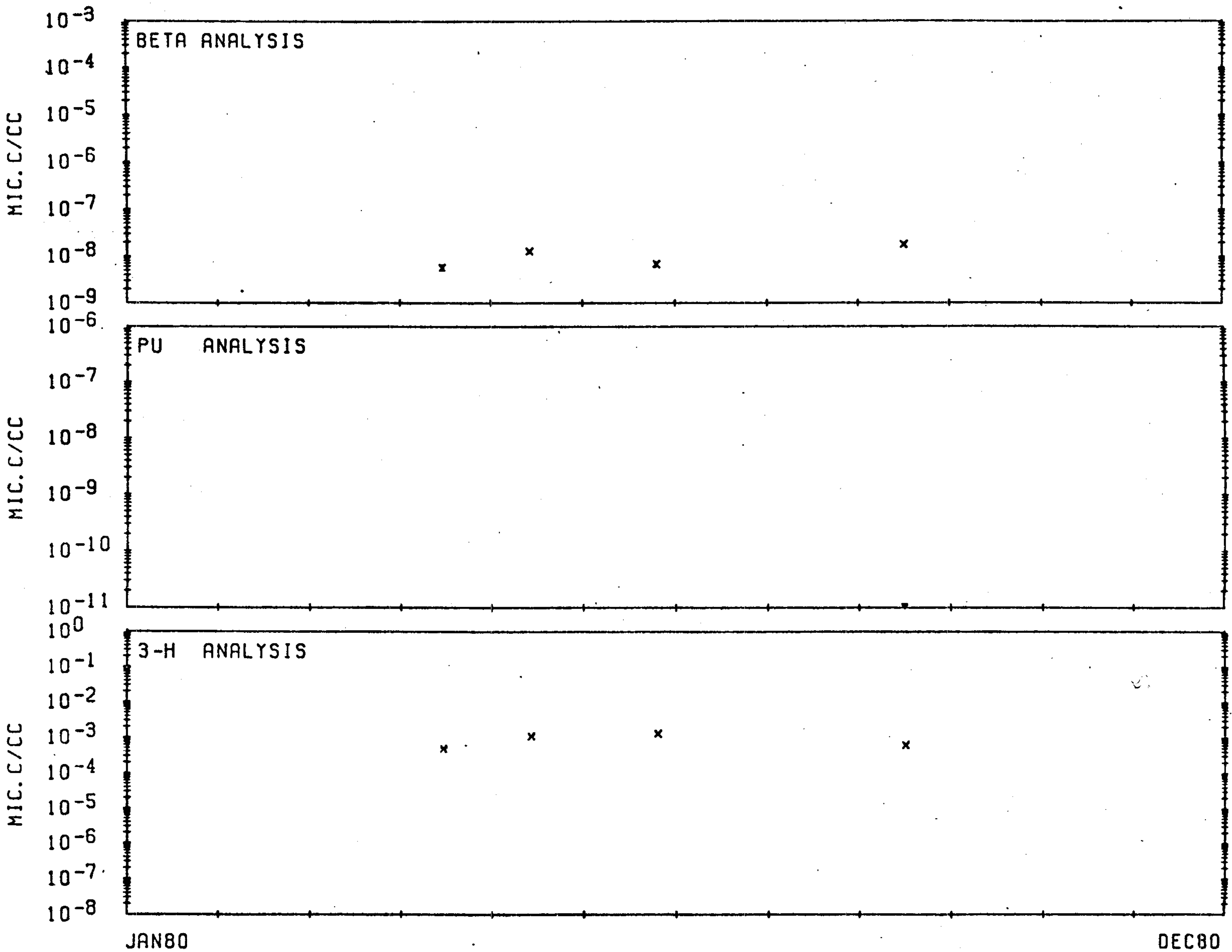
CONTAMINATED POND NETWORK AVERAGES



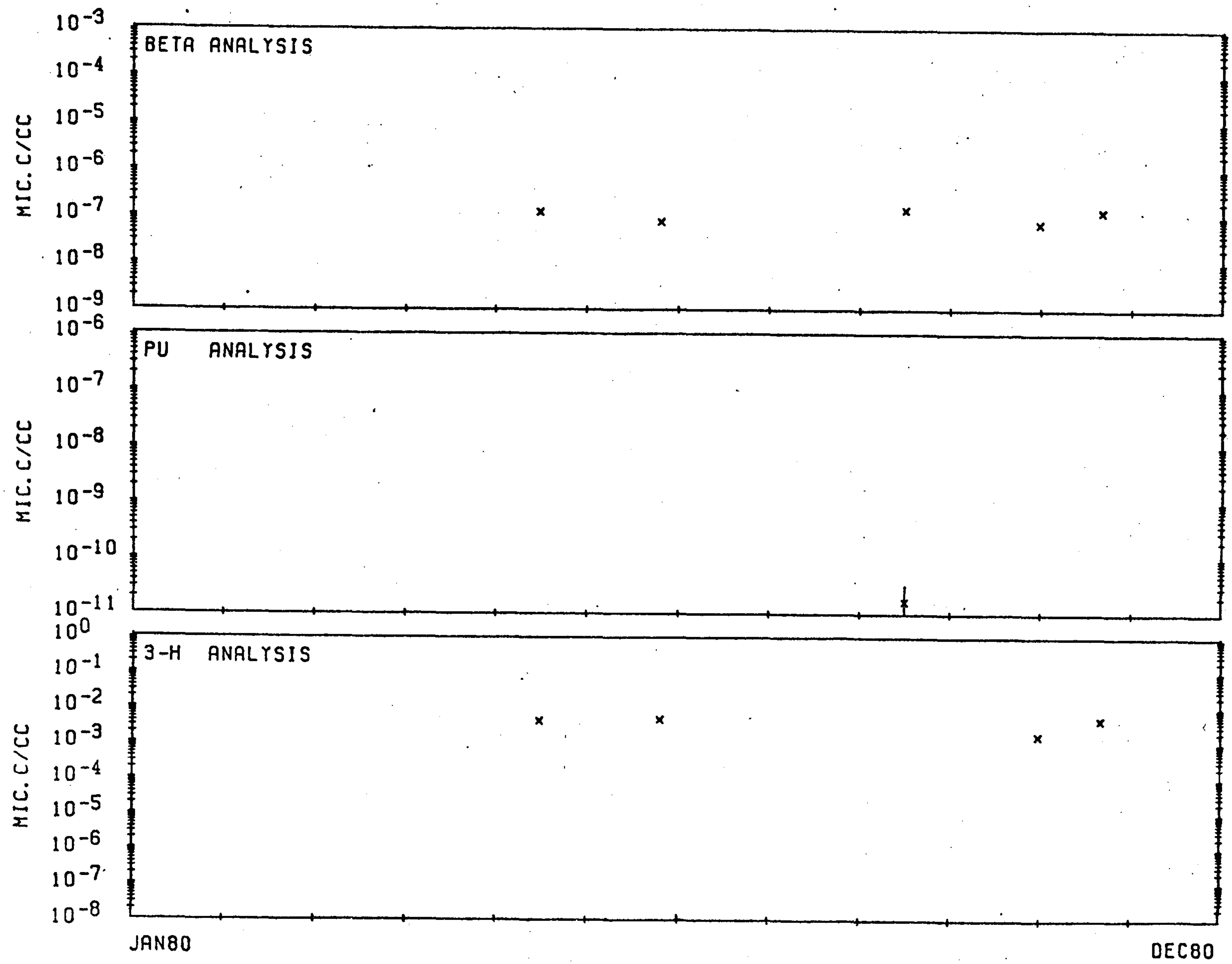
CONTAMINATED POND NETWORK AVERAGES



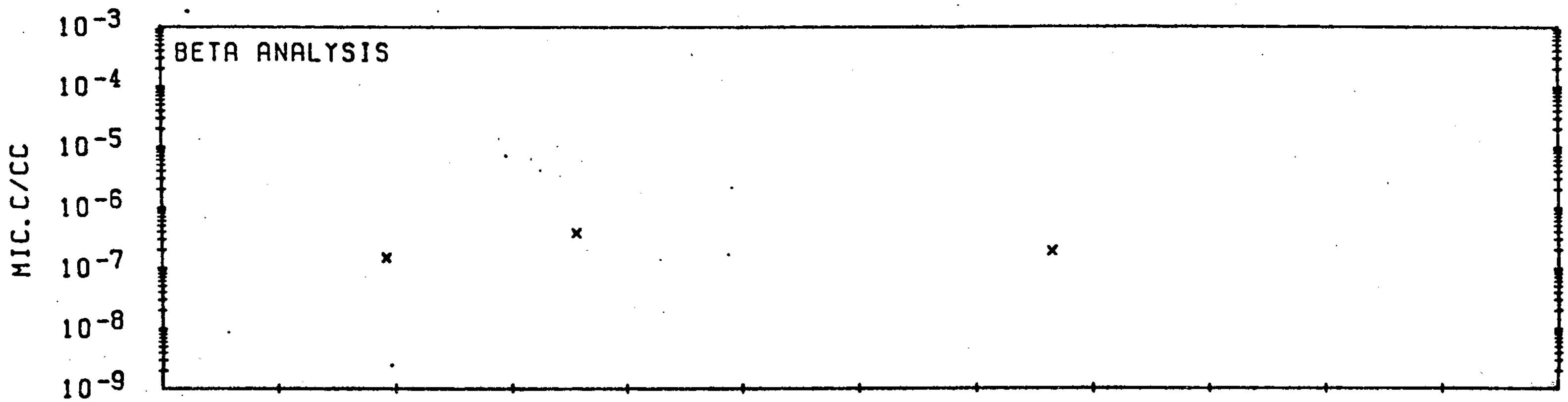
CONTAMINATED POND SAMPLING STATION NUMBER 5

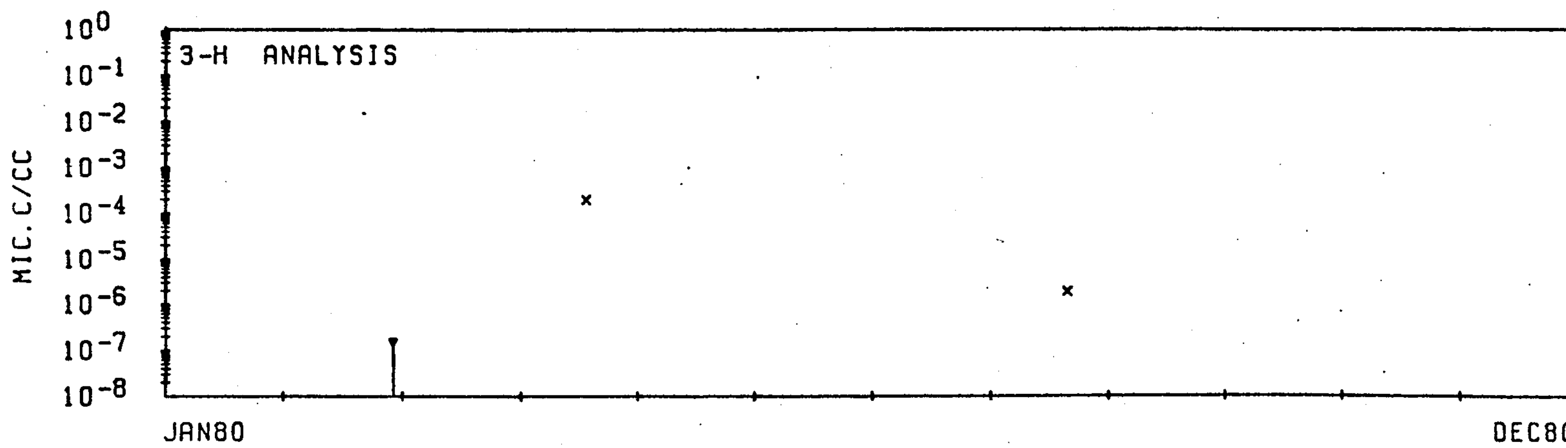


CONTAMINATED POND SAMPLING STATION NUMBER 8

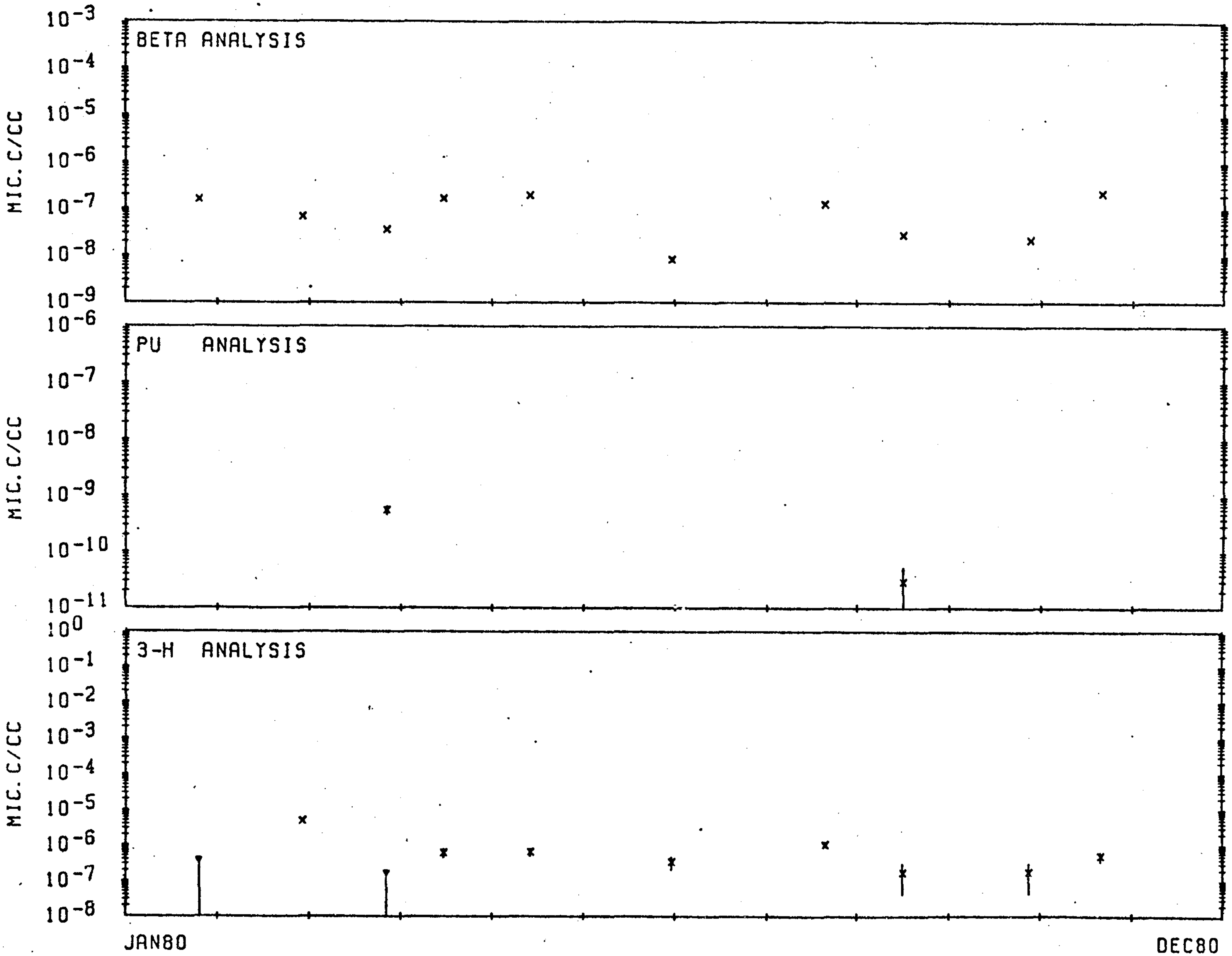


CONTAMINATED POND SAMPLING STATION NUMBER 12





CONTAMINATED POND SAMPLING STATION NUMBER 13



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