Final Report:

Use of Natural and Artificial Tracers to Detect Subsurface Flow of Contaminated Groundwater in the Florida Keys National Marine Sanctuary

(EPA Cooperative Agreement #X994871-96-0)

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Report of Activities during the period 1/1/96 - 12/31/97

INTRODUCTION

The Florida Keys are a low lying archipelago of Pleistocene limestone islands that extends off the southeastern tip of the Florida Peninsula in a southwest direction from Biscayne Bay to Key West. They stretch a total distance of 240 km (**Fig. 1**, Halley et al., 1995), enclosing Florida Bay to the north. They are typically divided into the Upper Keys, which are oriented parallel to the shelf edge and Lower Keys, which lie perpendicular to the shelf edge. The Upper Keys are considered to be those north of Bahia Honda and are composed of Key Largo Limestone. Key Largo Limestone consists of ancient hermatypic corals with intra- and interbedded calcarenites and thin beds of quartz sands (Halley et al., 1995). The formation is extremely porous and permeable due conduits and interconnected pore spaces created by ancient coral growth and meteoric diagenesis.

On the southern tip of Big Pine Key, Key Largo limestone grades into the Miami oolite facies that is characteristic of the Lower Keys. Miami oolite consists of well-sorted ooids with varying amounts of skeletal material (corals, echinoids, mollusks, and algae) and some quartz sand (Halley et al., 1995). On Big Pine Key, the oolite has a maximum thickness of approximately 6 m and is underlain by Key Largo Limestone. The Lower Keys are the remnants of a oolitic shoal or tidal bar system (Hoffmeister et al., 1967; Halley and Evans, 1983) deposited during the Pleistocene. The Miami oolite is much less permeable than the Key Largo limestone of the Upper Keys.

Florida Bay is a shallow lagoon bordered by the Keys and the Florida mainland. It covers an area of approximately 1800 km^2 and has an average depth of about one meter. Its western margin is open to the Gulf of Mexico. Shallow carbonate mud banks divide the bay into basins, restrict circulation, and attenuate tidal influences from the Gulf (Robblee et al., 1991). Most freshwater enters the bay from the north through Taylor Slough or as sheet flow from the Everglades generated by local precipitation. Salinity in the bay oscillates between brackish and hypersaline. Extensive seagrass beds can be found in the bay. In 1989, Zieman et al. estimated that seagrasses covered more than 80% of the bay. Many commercially important types of fish and crustaceans can be found in the bay. Some are year round residences, others depend on seagrass beds as a nursery ground (Robblee et al., 1991).

Around 1987, water quality in Florida Bay began deteriorating (Robblee et al. 1991). The clear and quiescent waters that once characterized the Bay began appearing green and turbid. Algae blooms and seagrass die-offs became commonplace. With seagrasses' death, the muddy bottom sediments of Florida Bay are more easily disturbed. Newly suspended sediments release nutrients to the water column which in turn fuels microalgae blooms. As turbidity and algal densities increase, light penetration to the bottom decreases and prevents seagrasses from recovering which in turn leads to a less stable bottom. The scenario could lead to a shift from a system dominated by benthic primary production to one dominated by water column photosynthesis. The scientific community generally agrees that this drastic change can be attributed to elevated salinity and/or increased nutrient loading resulting from the agricultural development and rapid urbanization of south Florida and the Florida Keys (EPA, 1991). Many facets of Florida Bay are now being studied to aid in the development of a model to characterize the physical, chemical, and biological conditions of the bay. This model will be used to predict what restoration steps could be most beneficial to the Bay. It is important that this model consider all significant nutrient sources for the bay.

Groundwater discharge has been documented as being highly significant for nutrient supply in some coastal areas. For example, Valiela et al. (1978), Valiela and Teal (1979), and Valiela et al. (1990) have shown that groundwater inputs of nitrogen are very important to the overall nitrogen economy of salt marshes in Massachusetts. In follow-up studies of Great South Bay, Capone and Bautista (1985) and Capone and Slater (1990) showed that SGD is a significant source (≥50%) of nitrate, as well as freshwater, to the bay. Nitrogen-rich groundwater is also suspected of nourishing *Cladophora* algal mats in Harrington Sound, Bermuda (Lapointe and O'Connell, 1989). SGD is particularly important in these cases because shallow groundwaters are often enriched in nitrogen, usually because of contamination from septic tanks.

In a more pristine environment, submarine springs were shown to cause measurable dilution of salinity and enrichment of nitrogen in Discovery Bay, Jamaica (D'Elia et al., 1981). Groundwater was also shown to be a significant component of terrestrial nutrient and freshwater loading to Tomales Bay, California (Oberdorfer et al. 1990). In an excellent review of the subject, Johannes (1980) points out that SGD delivers several times as much nitrate to coastal waters near Perth, Australia, than does river runoff. Johannes (1980) states that "it is ... clear that submarine groundwater discharge is widespread and, in some areas, of greater ecological significance than surface runoff." Indeed, there are some areas, such as the west coast of the island of Hawaii (Kay et al., 1977) and parts of the Yucatan Peninsula (Hanshaw and Back, 1980), where virtually all fresh water entering the sea is in the form of submarine discharge.

The above studies have addressed the case of a freshwater aquifer in contact with a coastal marine or lake environment. The situation in the Florida Keys is different in that most of the aquifer is saline to hyper-saline and the driving force is thought to be tidal rather than topographic. Therefore, the direction of groundwater flow beneath the Keys must oscillate as the fluctuating Atlantic tides create a differential head with respect to Florida Bay where tides are extremely damped. When the tide is high in the Atlantic, there is a negative hydraulic head associated with the wells on the Atlantic side and water is pushed into the Keys. Simultaneously, on the Bay side wells, there is a positive head as water is pushed from the Keys into the Bay. When the tide is low on the Atlantic the situation reverses and water is sucked from the Bay and transported into the Atlantic. Another study showed that sea level in Florida Bay is higher than on the Atlantic side of Keys more than 50% of the time (Halley et al., 1995). Higher water levels in the Bay suggests that net groundwater flow is toward the Atlantic.

The majority of the aquifer underlying the Keys is saline. Meteoric fresh water lenses do exist on some of the lower Keys due to the lower permeability of the Miami oolite compared to the Key Largo limestone of the upper Keys (Vacher et al., 1992). Approximately 600 sewage disposal (injection) wells ranging in depth from 10-30 m have been installed in the Florida Keys. In addition, there are also some 24,000 septic tanks and an estimated 5,000 illegal cess pools (Shinn et al., 1994) that can contribute to elevated nutrient levels in shallow groundwaters. The USEPA calculates that approximately 897 kg of nitrogen and 215 kg of phosphate are put into the subsurface groundwaters daily by these three methods of waste disposal (USEPA, 1996). Lapointe et al. (1990) have shown significant nutrient enrichment (up to 5000-fold) in groundwaters contiguous to septic tanks on Big Pine Key. In another study, Lapointe and Clark (1992) showed that phosphate and dissolved inorganic nitrogen levels were elevated in canals and some nearshore waters of the Keys.

Canals may be particularly impacted by sewage-derived nutrients due to their low flushing rates and their direct contact with contaminated groundwaters. Paul et al. (1995) conducted two tracer tests on Key Largo. They found that bacteriophages flushed into a toilet and injected into a simulated injection well all showed up in a nearby canal within 11 hours. Estimated rates of transport ranged from 0.57 to 24.2 m/h. Paul et al. (1997) repeated the simulated injection well portion of this experiment at this same location and found similar transport rates (2.5 to 35 m/hr). The greatest tracer concentrations in canals and wells corresponded with major stages of the tide. Some stations showed the greatest viral tracer concentration during high tide, while others showed a maximum at low tide. They speculated that the low tides enable drainage of the tracer and wastewater from the limestone, while high tides move the material back into the Keys, to be drained by another low tide.

In their 1997 study, Paul et al. also injected viral tracers into the class V injection well located at the Keys Marine Lab on Long Key (Middle Keys). They found slower rates of groundwater transport (0.12 to 2.0 m/hr) than those in Key Largo with the greatest movement being in the direction of the Atlantic Ocean. Some movement of the tracer was also observed toward Florida Bay. Movement of groundwater at this site seemed to be mostly along the north/south axis of Long Key with no indication of tidal pumping. Surface marine waters showed traces of the bacteriophages after 53 hours. They attributed this slower movement at the Long Key site to differences in geology, rate and force of tidal pumping, and/or the lack of numerous canals cut into the limestone.

This evidence suggests that significant quantities of sewage from on-site disposal systems may reach the surficial waters of the Florida Keys within hours to days. To date, there have been no studies examining bacterial utilization of this waste in situ (water polishing), adsorption of phosphate by the carbonate matrix, or the dilution of the sewage reaching the surface. Dilution, however, would not necessarily reduce the flux of nutrients to the surface waters. If the waste water plume reaches surface waters rapidly with a little dilution or polishing or if the flux into surface waters is high then human and ecosystem health could be at risk and different wastewater disposal methods would be needed.

The purpose of this study was two-fold: (1) perform a preliminary evaluation of the significance of groundwater discharge as a source of nutrients to Florida Bay and the reef tract using natural tracers; and (2) use artificial tracers obtain information on the fate of wastewater in the Florida Keys. As for the first objective, we have attempted to locate areas in the bay where groundwater seepage is more pronounced by reconnaissance surveys of the concentrations of radon and methane in the bay waters. These trace gases appear to function as natural indicators of submarine groundwater discharge into standing bodies of water due to higher concentrations in the groundwater (Cable et al., 1996; Bugna et al., 1996). Radon is typically elevated in groundwater because of production from dissolved radium and radium within the aquifer matrix, while methane is produced from the decay of organic matter. While both processes occur within the aquifer and result in elevated tracer concentrations within groundwaters, the production of each is completely independent of the other. Nutrient samples were collected and analyzed from surface and porewaters within the Bay, along the reef tract, and in some springs, wells, and canals.. In addition, the natural abundance of ^{15}N in algae collected at various sample sites will help serve as a potential indicator of nutriet inputs from groundwater (McClelland et al., 1997;

Fry, 1994; Sweeny et al., 1980). Algae with a groundwater input of nutrient N maybe enriched in the heavy isotope (+10-20‰) due to denitrification in the suboxic surface.

The second objective focuses on the determination of directions and rates of groundwater transport in the Florida Keys and determination of dilution of contaminated groundwaters prior to its input into surface waters. Also, it was our hope to determine how transport and dilution differ in the Keys due to varying locations and different waste disposal methods (i.e. septic tanks vs. injection wells). To examine the problem, we used two artificial tracers, sulfur hexafluoride (SF_6) and radio-iodine (I-131) to monitor groundwater movement in the Keys.

SF_6 is a very stable, slightly water soluble gas that has primarily been used since the 1960's as a gaseous electrical insulator (Wanninkhof et al., 1991). Due to its perfluorinated structure, SF_6 is an electrophilic compound that which reacts readily with free electrons, but virtually nothing else. Therefore, it can be measured at very low levels with a gas chromatograph equipped with an electron capture detector (GC-ECD). It has been successfully utilized to study gas exchange rates in lakes (Wanninkhof et al., 1985, 1987) and in the North Sea (Watson et al., 1991). It has also been used to examine vertical mixing rates in the Santa Monica Basin (Watson et al., 1991). It is well suited as a groundwater tracer because it is nontoxic, has extremely low background concentrations (0.05 fM, Watson and Liddicoat, 1985) and has been shown to be a conservative tracer in saturated sandy media with low organic content (Wilson and Mackay, 1993).

Radio-iodine is a water soluble isotope of iodine that has been used in hospitals for decades to treat thyroid cancer. All things considered, radio-iodine is an excellent groundwater tracer for several reasons: (1) the detection limits are extremely low, especially on an atomic (molar) basis; (2) the overall sensitivities are extremely high; (3) it has a relatively short half-life (8.04 days) so it will completely disappear from the system in a short time period and (4) it is considered conservative under the conditions present in the limestone matrix of the Keys. Due to the high cost of I-131; however, this tracer was only used in one experiment to confirm results obtained using SF_6 as a tracer.

METHODS

Natural Tracers

Radon and Methane Sampling

Samples for tracer analysis were collected at over 200 stations in Florida Bay and along the reef tract between August, 1995 and August, 1997. Radon samples were collected at each station using a peristaltic pump and 4-liter evacuated bottles. Standing water was purged from the hose at each depth prior to filling the sampling bottles, and the bottles were immediately sealed to prevent gas loss. Radon gas was extracted and counted using a modified emanation technique described by Mathieu et al. (1988). After radon stripping and transfer into alpha scintillation cells, counting was performed using Ludlum flask counters. After the initial radon analysis, the samples were sealed and stored for at least five days for ^{222}Rn ingrowth and then sparged again in order to determine the ^{226}Ra activity. "Excess" (unsupported) radon was determined as the difference between the "total" ^{222}Rn in samples and the supported ^{222}Rn, assumed to be equal to the ^{226}Ra activity. These values were decay-corrected back to the time of sampling in order to assess the in situ excess radon concentrations.

Methane samples were collected in Wheaton BOD bottles and stored on ice until analysis. Ethylene was also quantified to look for possible trends with other tracers. Both gases could be analyzed from the same sample. Upon return to the laboratory, water samples were transferred to 50-mL disposable syringes which were pre-flushed with nitrogen. An extraction volume of 10 mL of N_2 to 40 mL of water was added to each syringe, and the methane/ethylene extracted via headspace equilibration. Samples were run on a Shimadzu flame ionization gas chromatograph equipped with a 2-m stainless steel column packed with Poropack Q (McAuliffe, 1971).

Samples for ^{222}Rn, CH_4 and C_2H_4 in groundwater were also obtained from monitor wells at depths ranging from 5 to 60 meters. The locations of these sites were primarily within Florida Bay, onshore and offshore of Key Largo, and at the Key Marine Laboratory located on Long Key (**Figure 1**).

^{15}N

Algae samples collected from sites in Florida Bay and along the reef tract were sealed in plastic bags and frozen. Upon return to the University, samples were thawed, dried, and ground to a fine powder. Preweighed powdered samples, analysed by Isotope Services, Inc., were encapsulated in tin foil in duplicate and placed in a Carlo-Erba NA 1500 elemental analyzer. The elemental analyzer combusts the sample and yeilds a pulse of pure nitrogen using gas chromatograph column. This pulse of pure nitrogen gas is sampled by a VG-Isomass mass spectrometer for ^{15}N isotope analysis. The mass spectrometer admits a reference gas into the helium carrier stream and is measured along with every sample analysis.

Seepage

Direct measurements of groundwater seepage were made using an instrument design modified from Lee (1977). The "seepage meter" is simply a chamber implanted in the bottom sediments which has an open port where a plastic bag can be attached to collect seepage over measured time intervals. All seepage meters used in this study were either placed in areas which had sufficient sediment to provide a seal between the meter and surrounding sediment or directly cemented to the hard-bottom surface (cemented meters were placed by Gene Shinn et al.). Four liter plastic bag "collectors" were used and were prefilled with 1000 mL of bay water to prevent short-term artifacts (Shaw and Prepas, 1989). Addition of an initial 1000 mL of water allows for measurement of negative seepage, i.e., recharge into the underground aquifer. The lower reliable limit of measurement for seepage meters depends upon the length of deployment and the conditions under which the sampling occurs—based on our experience using these meters, we normally expect a lower useful limit of 3-5 $mL/m^2 \cdot min$ (Cable et al., 1997).

Artificial Tracers

Experimental Design and Sites

Three basic types of experiments were carried out using artificial tracers to evaluate different wastewater disposal methods at varying locations in the Keys. The different experiments examined were: (1) septic tanks in Miami oolite, Big Pine Key, (2) a simulated septic tank in Key Largo Limestone, and (3) a class V injection well in Key Largo Limestone. SF6 was used in all of these experiments while the I-131 was only used in one class V injection well experiment. The first type of experiments to be discussed were conducted with septic tanks on Big Pine Key. Residential units in this area obtain their tap water from individual wells that penetrate the underlying fresh water lens at a depth of about 2 meters. There is a potential problem as these residences have septic tanks in close proximity. Septic tanks in the Keys are typically placed less than a meter below the land's surface since the tank's leeching lines must be installed above the water table.

Two concerned residences allowed us to inject SF_6 saturated water into their toilets and then collected samples from their kitchen taps for approximately two months to ascertain the potential of well contamination. The approximate locations of the septic tanks in relation to these residential wells is shown in **Figure 2**. The first experiment was started on December 13, 1996 at site A (experiment A1). On June 12, 1997, we began two more experiments at site A and site B (experiments A2 and B). Background samples were collected from the kitchen faucet before each injection. In each case, sixty liters of tap water were sparged with 99.8% pure SF_6 (Scott Specialty Gases) for 20 minutes. A sample was collected from the SF_6 sparged water which was then poured into a toilet. Samples were collected from each well via a sink faucet within 20 minutes of injection and then once daily for a week or two. After this initial period, samples were collected at the leisure of the residents for approximately two months. Experiment A2 was only conducted for one week.

A simulated septic tank site was established at the Ranger Station on Key Largo. The well used for injection is eight inches in diameter with a depth of 10 meters. The well is screened from 0.66 m to the bottom. Due to the shallowness of the screened portion of this well, results from this study site may be comparable to results for septic tanks. Approximately 3 m to the south is a monitoring well that is 5 cm in diameter with depth of 6 m. It is screened from 1 meter to the bottom. Twenty six meters to the north of the injection well lies Florida Bay (**Fig. 3**). Three experiments were conducted at this site. For the first two experiments (July and August, 1996), SF_6 was bubbled directly into the injection well for ten or twenty minutes at a low Atlantic tide. For the third, 100 L of water was pumped from the injection well, sparged for 20 minutes with concentrated SF_6, then pumped back into the well at a rate of 10 L/minute during high tide.

The water level within the injection and monitor wells were determined as the distance from the top of the well which was then corrected to a relative tide. The tide modeling program, Tides and Currents for Windows (Version 2.0, Nautical Software), was used to plot the Atlantic tide. Observations from a nearby site on the Atlantic side of Key Largo have shown that this program is accurate for this location (**Fig. 4**). Water levels in Florida Bay were measured with a meter stick stuck into the sediment.

Sulfur Hexafluoride samples were collected from the well and the Bay periodically. Due to the large screened portion of the monitoring well, it was assumed to be an open system and therefore it was not purged before sampling. Tubing was inserted 2 m into the well and pumped to the surface for collection. Each piece of tubing was rinsed with a minimum of 3 times its volume prior to sampling. A second piece of tubing, looped at the end and weighted, was used to sample Florida Bay waters. Water was collected from just above the water/sediment interface. The tubing was put into position before injection and was not moved during the course of each experiment. Either a peristaltic pump or a glass syringe was used to collect the samples. During the August '97 experiment, samples were collected from 5 different locations in the Bay in an attempt to evaluate any spatial variability of seepage that could be occurring. Sample tubing was tied to the sides of cinder blocks which were placed in an X-formation in the boat basin (**Fig. 3**).

The third and largest study site was a class V injection well located at the Keys Marine Lab on Long Key. This type of injection well is currently used by multi-unit residences such as hotels, trailer parks, campgrounds, and small communities in the Keys (Paul et al., 1997). The class V injection well used for this study is drilled to 27.7 m and cased to 18.5 m. After treatment in a package plant, waste water is gravity fed into the injection well. There are seven monitor well clusters surrounding the injection well (**Fig. 5**). Each well cluster contains 4 wells drilled to depths of 4.6, 9.2, 13.8, and 18.5 m. Each well had a 1.2 m screened portion at the bottom. Two tracer experiments were conducted at this location, one in October 1996 and another in February 1997. In each case, two hundred liters of water was sparged with concentrated SF_6 gas for 20 minutes. For the February experiment, I-131 tablets were dissolved into the injection slug for a total activity of 150 mCi. The solution was siphoned into the injection well at a low Atlantic tide. Approximately 1000 L of waste water (salinity = 0 ppt) was then injected from the package plant's holding tank as a chaser to drive the solutions into the aquifer. The surrounding well clusters were then monitored for the presence of SF_6 (and I-131 for Feb exp.). Before each well was sampled, they were first purged to remove 3 well volumes. Purge water was stored in a large holding tank for the duration of the experiment. Water samples were collected using glass syringes or peristaltic pumps.

Atlantic tides for Long Key were obtained from the computer tide program described earlier. Measurements taken from the canal across US-1 confirm that this program is also accurate for this location (**Fig. 6**). Florida Bay tides were measured with a meter stick taped to the boat basin dock.

Groundwater transport rates for all experiments were determined for each sampling location by dividing the distance from the site of injection by the time of the peak concentration of the tracer at that sampling location. In some cases, well concentrations were still rising at the end of the experiment and no peak concentrations were observed. For these events, the last (and highest) concentration was used to estimate the transport rate. This method results in a minimum estimation of the transport time and thus a maximum estimate of the transport rate. These values are therefore presented as being less than the calculated maximum transport rate. In the injection well experiments, it was possible to sample multiple depths at each well location and vertical transport rates were also calculated. For these estimations, the wells' depths were subtracted from the injection depth (18.3 m) and then divided by the time of peak concentration.

Sampling methods

Sulfur Hexafluoride samples for all experiments were collected with two different variations of a head space extraction technique. Early in the study, samples were extracted on site. Water was collected from wells with syringes and $^1/_8$ inch copper tubing. Approximately 2 m of tubing was inserted into a well. A glass syringe was attached to the tubing with a 3-way stopcock and a small piece of tubing. After clearing the tubing and syringe of all air bubbles, three syringe volumes were drawn and discarded to act as a rinse. The sample was then pulled into the syringe. A headspace of argon or ultra-high purity nitrogen was then added to the syringe which was then shaken for two minutes to extract the SF_6 from solution into the headspace. Approximately 8 mLs of headspace was then injected into a 4 mL Vacutainer™. Standards stored in this fashion show no loss of SF_6 from the vacutainer for more than 500 days (**Fig. 7, Table 1**). Samples were analyzed within a month of collection.

Although the vacutainer method was adequate, it was too time intensive to allow the collection of a large number of samples. To reduce sampling time, extraction was delayed until the samples were to be analyzed. Therefore, samples were collected in 30 mL serum vials with a peristaltic pump. To prevent contamination, each well or water body being sampled had its own unique piece of tubing. After purging the tubing, a sample was pumped into a serum vial and allowed to overflow for three bottle volumes. The vial was then sealed with a rubber septa and a crimp cap. To prevent loss of SF_6 through the septa, the samples were stored on their sides until the samples could be extracted and analyzed. Samples were extracted in the lab by adding a small headspace (typically 4 mL) of argon or ultra-high purity nitrogen to the sample. Simultaneously, a volume of water from the sample had to be removed and discarded to allow room for the headspace. The serum vials were slightly over pressurized with 1 cc of nitrogen to allow several injection volumes (100 uL or less) for the gas chromatograph (GC) to be pulled from each sample.

A comparison of these methods showed that both extracted 95+% of the SF_6 from a water sample (**Table 2**). The latter method has the advantage of being able to change the water to gas ratio during extraction, which allows SF_6 to be extracted from a larger sample volume, resulting in a lower limit of detection which was, at best, 0.1 pM (10^{-13} moles/L). It is possible to reach sensitivities of 0.03 fM (3×10^{-17} moles/L) by concentrating the SF_6 from a 500 mL sample onto a cold trap (Wanninkhof et al., 1991). This extraction procedure is very time intensive and is unrealistic for the large numbers of samples generated for the majority of the experiments presented here.

I-131 samples were collected in one liter containers with a peristaltic pump. The water samples were returned to the laboratory and processed. In order to use this isotope in the field, it was necessary to develop a procedure that was simple, quick, and inexpensive. The majority of present procedures use an ion-exchange column and determine the I-131 yield gravimetrically or consider the recovery to be quantitative. However, increased ionic strength of a solution may inhibit accurate estimation of the yield using these methods. Since most of the water we would be analyzing would be saline, a different approach had to be taken. The procedure described below was originally designed to be used with geothermal waters of moderate salinity and allows for the measurement of I-131 using I-129 as a reference for the recovery.

Analytical methods

SF_6 samples were analyzed with a Shimadzu model 8A gas chromatograph equipped with an electron capture detector. Typically, the volume injected was 100 uL or less. The gas chromatograph contained a stainless steel column (180 cm x 0.1 cm I.D.) packed with molecular sieve 5A (80/100 mesh). Initially, a P5 mixture (95% argon, 5% methane) was used as a carrier gas with a flow rate of 25 mL/min. After having problems with carrier gas contamination, we switched to ultra-high purity nitrogen as a carrier at the same flow rate. Column and detector temperatures were set at 90°C and 220°C, respectively.

Headspace concentrations in ppmv (parts per million by volume, = μL/L) of SF_6 were determined by reference to a 1.04 ppm standard (Scott Specialty Gases). The standard was run at the beginning of each day, after every ten sample injections, and at the end of the day. Headspace concentrations were converted to dissolved concentrations in μM as shown below:

$$(\mu L/L)/\ (R((Latm)/(mol\ K))\ *\ T\ (K))\ *\ E \qquad (1)$$

where R is the gas constant from the ideal gas law, (PV = nRT), and T is temperature in degrees K. The parameter E is the extraction efficiency which is determined by repeated extractions of some of the water samples. All headspace gas is purged between extractions. The repeated extractions are continued until 99% of the gas of interest has been extracted. E is then calculated as:

Quantity of gas in first extraction/ Quantity of gas in summed extractions (2)

Extraction efficiency for SF_6 is at least 95%. Dilution of the standard show a linear relationship between SF_6 concentration and response of the GC (Fig. 8).

Replicates were collected for 10% of the samples. In addition, duplicate injections were run on the gas chromatograph every fifth injection. Precision between replicate samples and duplicate injection were usually less than 10%.

To test for radio-iodine, one liter water samples are spiked with a known amount of iodine-129 (I-129) and put through a series of oxidation/reduction steps to adjust the oxidation state of the radioactive (I-131) and stable area iodine carrier (I-129) (**Fig. 8**). Once in the correct oxidation step, the iodine is then precipitated as AgI in a slightly acidic solution. Depending on the matrix of the sample, other silver compounds may co-precipitate with the iodine. Many of these may be redissolved during the filtration process. In addition to the radiometric determination of the recovery, samples may be filtered through preweighed filters for a gravimetric yield determination. Filtered samples can then be counted on a NaI detector for the quantification of both I-131 and I-129. A simple equation may be used to estimate the number of I-131 counts in the I-129 counting region.

Taking the low energy I-131 counts into consideration, the radiometric yield can be determined and the I-131 sample activity may be estimated.

NATURAL TRACERS

Results and Discussion

Tracer concentrations

Results of the tracer analyses for groundwater samples collected on and offshore exhibited elevated tracer concentrations relative to surface waters, except for ethylene which had a limited data set (n = 15, measured only in offshore wells) and had similar concentrations as surface waters (**Table 3**). Both methane and radon appear to vary considerably spatially (82 - 1,124 dpm/L and 10 - 16,604 nM, respectively), however, radon did not vary over time in the same well measured over a year apart (April 1995 - 291 ± 58 dpm/L, June 1996 - 342 ± 118 dpm/L). Although the two gases are produced independently, there is a statistically significant correlation between the two in groundwater samples collected ($r = 0.46$, $n = 47$, $p < 0.01$). Ethylene did not correlate well with either radon ($r = 0.34$, $n = 15$, $p > 0.05$) or methane ($r = 0.25$, $n = 15$, $p > 0.05$) in groundwaters. Radon and methane concentrations in groundwater samples averaged approximately one to two orders of magnitude greater than that of surface waters. This large difference in concentrations should allow for the use of these gases as indicators for groundwater/surface water interaction in the Florida Keys.

Surface water radon and methane concentrations varied from <1 dpm/L to >20 dpm/L and 5 to 100 nM, respectively. Radon and methane samples collected from the reef-side of the Keys varied from <1 dpm/L to approximately 20 dpm/L and 4 to 40 nM, respectively (**Table 4**). As with the groundwaters, radon and methane were also statistically correlated on both the bay-side ($r = 0.51$, $n = 191$, $p < 0.01$) and the reef-side ($r = 0.81$, $n = 84$, $p <$

0.01) of the Keys. Ethylene concentration in bay waters were statistically correlated with both radon ($r = 0.27$, $n = 145$, $p < 0.01$) and methane ($r = 0.31$, $n = 151$, $p < 0.01$) if samples collected in canals and deep holes/springs are neglected, otherwise the correlation is not statistically significant (see below). Ethylene samples collected on the reef-side were statistically correlated with methane ($r = 0.62$, $n = 41$, $p < 0.01$), but not as well with radon ($r = 0.42$, $n = 41$, $p < 0.05$). Radon and methane are statistically correlated in all surface waters sampled throughout the Keys and since the production of the two gases is totally independent of each other, these findings are consistent with their being from a common source. As shown above, the two gases are also correlated in groundwaters, therefore it is probable that the common source of these gases in groundwater discharge into the overlying surface waters.

Tracer Distribution in Surficial Water

General trends in surface water concentration were established by contouring data from each tracer survey using a kriging method developed by Surfer, Jandel Scientific (**Fig. 9-20**). Concentration data were then grouped into four different categories according to region in order to evaluate spatial differences. Regions include samples taken near the North Coast (within ~2 miles of coast), Keys Bay-side (within ~2 miles of coast), Mid North East Bay (east of Black Betsy Keys), and Mid Bay (west of Black Betsy Keys). Samples from the Keys Bay-side were more elevated in groundwater tracer concentrations (e.g. radon, methane, and ethylene) than were samples from the other regions within the bay throughout the study period (**Table 5**). In particular, one of the narrowest areas of Key Largo (near the Sheraton and Rock Harbor) continually showed some of the highest tracer concentrations in surface waters on both the bay and reef side of the Keys, excluding canals and holes/springs. The tracer results suggest that the greatest groundwater seepage into Florida Bay occurs from and along the back-side of the Keys, and that groundwater input into the Mid-bay, North-East Bay and North Bay regions is of lesser importance.

Samples collected along the reef-side of the Keys showed very little variation throughout the study period. Surface water concentrations were relatively low on the reef-side (**Table 5 and 6**), except near Rock Harbor, Dove Key, and Rodriguez Key. Tracer concentrations in this area were typically 2-4 times higher in for both radon and methane. Samples were also collected along the reef tract and from cracks within some of the healthy (e.g. Molasses, French) and degraded reefs (Algae, Carysfort). There was not any significant difference between samples collected from cracks and surface waters or between degraded and healthy reefs. Sample concentrations along the reef tract are generally lower than samples collected near shore. These differences in concentration between the reef and near shore waters, as well as the lack of differences between surface water and water within the reef, are may be attributed to the highly energetic environment along the reef tract. Water within the reef is quickly exchanged with ambient surface water, therefore dilution of the tracers is probable. At any rate, with the exception of the reef-side areas near the Keys, Rock Harbor and Dove Key, our data do not provide any evidence for groundwater directly discharging along the reef tract. This is not to say that the phenomena does not occur. It is difficult in the study of nature to eliminate any possibility definitively. However, we see no evidence for the process.

Within the Keys, samples collected from artificial canals/trenches and submarine springs were extremely elevated in tracer concentrations and generally fully saline (e.g. more saline than surficial waters at the time of sampling; **Table 6**). Three submarine springs were identified and investigated during the study period: (1) Garden Cove Spring, located on the Atlantic-side of N. Key Largo (25° 10.22', 80° 22.02'); (2) Lois Key Spring on the Atlantic-side of Surgarloaf Key (24° 36.11', 81° 27.48'); and (3) a spring located on the bay side of Big Pine Key, "Four Corners" spring, in an open area equidistant from Big Pine Annette, Cutoe, and Howe Keys. Upon further investigation of these springs, it was determined that Four Corners spring was more dependent on rainfall than tidal influence. This particular spring did not appear to be moving water in or out of the solution hole, which measured about two feet in diameter. Samples taken from Four corners spring had similar concentration of tracers as that of the surface water. Samples were collected in May, 1997 during a relatively dry period for the area. The low rainfall and possible low water table may explain the lack of flow from the spring. However, elevated tracer concentrations were measured in the other two springs and in several canals, suggesting that subsurface fluids are actively seeping into these features, and from them may spill into Florida Bay/Atlantic Ocean. Submarine springs (Lois and Garden Cove) appear to be heavily influenced by the Atlantic tide. During high tide in the Atlantic, surface waters were sucked into the springs. Periods of low Atlantic tides showed the opposite, waters moving out of the springs at relatively high flow rates (**Table 7**). This is consistent with other observations of a tidally driven sloshing effect of groundwaters beneath the Keys. Water samples were collected during both high and low tides when ever possible. Not surprisingly, submarine springs appear to have a very similar composition, although slightly diluted, as that of the groundwater (**Fig. 21**). The natural tracer concentrations in groundwaters and samples collected from springs (Lois and Garden Cove) have a significant correlation ($r = 0.98$, $n = 9$, $p < 0.01$). Radon and methane ratios for the two water masses are almost identical (groundwater $Rn:CH_4 = 0.32$, spring water $Rn:CH_4 = 0.30$; ratios are based on averages for each water mass). The similarities in the water masses indicates groundwater as the source for the springs rather than recirculated surface water (reef-side surface water $Rn:CH_4 = 0.13$, bay-side surface water $Rn:CH_4 = 0.18$). Flow rates were measured from the Garden Cove spring, Key Largo with a hand-held mechanical flow meter manufactured by General Oceanics (**Table 7**). Flow from the spring was strong enough to produce a boil on the surface of the water on an outgoing tide.

Canals and trenches had a low tracer ratio (0.02) due to the high methane concentrations measured in these features. The higher methane contribution can probably be attributed to a higher organic content in the water masses and the sediments underlying them. Canals are typically a sink for particulate matter due to the low energy environment. Decaying organic matter would be a source for methane without radon production, leading to a lower Rn:CH_4 ratio. The high organic content and low energy of the canals tends to lead to eutrophic conditions (Lapointe and Clark, 1992; FDPC, 1973). In any case, the high radon concentrations in these features (springs and canals/trenches) are consistent with a significant influx of groundwater. It is likely that when these features were dredged, less permeable layers in the rock were cut and removed resulting in greater conductivity between surface water and the Key aquifer.

Nutrient samples were collected and analyzed from select surface waters, groundwaters, springs, and canals/trenches (**Table 7**). Nutrient concentrations in groundwater wells may have been biased due to the limited data set , because many of the wells were located in close proximity to a Class V sewage injection well (Keys Marine Laboratory). It is interesting to note that majority of the phosphate concentrations are below detection limit, except for samples collected in groundwater wells, springs, canals/trenches, and the interstitial fluid near Porjoe Key. All of these areas are suspected of being heavily influenced by groundwater based on the natural tracer concentrations. Surface waters were typically low in nutrient concentrations. Nitrate was the only parameter present in all waters sampled. On average nitrate and ammonia concentrations were equal within the Bay. Although the nutrient content of these various water masses may seem low, the total flux of groundwater carrying these constituents may be important. For instance, the garden cove spring has relatively low nitrogen concentration, contributing approximately 0.1 kg N day^{-1}. However, this was occurring over an extremely small area, only about one square meter. The seepage meter near Porjoe Key could be used to make a crude estimate of nutrient input from passive groundwater flow. This particular meter was flowing extremely rapidly [(7.35 ± 0.96) X 10^{-5} m^3 min^{-1}] (**Fig. 22a**), filling a four liter bag in less than an hour (**Table 7**), which is much faster than most measurements. Seepage meters in this area had an average flow of (3.35 ± 1.82) X 10^{-6} m^3 min^{-1}. More interesting was the composition of the interstitial water from the seepage meter near Porjoe Key. Salinity of the interstitial water taken from two seepage meters were significantly different ($p<0.01$) than the ambient seawater (28.5 ppt, n=6) measured by titration (**Fig. 22b**). Although the contribution from an average seepage meter is only 0.001 gN/day (based on nitrogen concentrations collected from the Porjoe Key seepage meter and the average seepage meter flow), this is only over a quarter of a square meter. This would be an extremely large source of nitrogen to surface waters if this flux occurred over all of Florida Bay.

^{15}N Enrichment in Algae

Algae was collected for ^{15}N analysis as a possible indicator of nitrogen derived from groundwater inputs. Samples were collected throughout the study period independent of season, The data presented is a compilation of all analyses performed up to June 1997. As with the other natural tracers, ^{15}N also is significantly higher near the Back-Keys than the other regions sampled (**Table 5**), although enriched nitrogen is also present near the North Coast in the Eastern Bay. The ^{15}N results exhibit somewhat similar trends as the other tracer data when contoured (**Fig. 23**). The elevated ^{15}N results are probably a signal for denitrification. Denitrification is a form of anaerobic respiration and takes place in a suboxic environment in the presence of organic matter. During denitrification the lighter nitrogen isotope (^{14}N) is converted to N_2 gas at a more rapid rate, leaving ^{15}N enriched nitrate behind to be taken up by algae and seagrasses. Along the North Coast these conditions are met in the muddy sediments of the bays and lagoons along the shore.

Along the Keys, however, and particularly along the bay-side of Key Largo, the bay floor is sediment poor, with only a thin veneer of sediment overlying rock. Denitrification is not as likely to occur in the sediments near the Keys. Therefore the enriched ^{15}N values near the Back-Key areas must be from a different source. We propose that the suboxic environment where denitrification occurs in this area is in the subsurface, within the carbonate framework of the Keys. ^{15}N of groundwater nitrate is enriched (J.K. Bohlke, pers. comm., 1996). Groundwater seepage can then bring these suboxic fluids to surface water where ^{15}N is taken up. The most pronounced enrichment with ^{15}N and other tracers occurs near Rock Harbor on either side of the island. Interestingly, this area is one of the thinnest points in the island and is near a large commercial Class V sewage injection well. The natural tracers (radon and methane) suggests that there is a significant amount of groundwater/surface water interaction around this area on both sides of the key, while the nitrogen data may suggest that groundwater entering the area is enriched in the heavier isotope, possibly due to waste disposal practices.

Tidal Experiment

An extensive twelve hour tidal experiment was conducted on both sides of Key Largo near Rock Harbor where high concentrations of radon and methane were previously observed. Groundwater wells (two wells at each site, 15 ft. and 60 ft.; installed by Gene Shinn, USGS) were monitored for pressure head relative to ambient water. Surface waters were collected hourly and analyzed for radon, methane, and nutrient concentrations. Groundwater seepage was monitored throughout the tidal cycle using seepage meters which were cemented directly to the hard-bottom (groundwater wells and seepage meters were installed by Gene Shinn et al., United States Geological Survey).

Results from the experiment verify the dependence of subsurface water movement beneath the Keys to the Atlantic tide stage. The pressure head within the well on the bay-side perfectly tracks the Atlantic tide with a very small lag time (**Fig. 24**). As the tide in the Atlantic increases, the well head becomes more positive and water begins to move rapidly out of the well. As the tide decreases in the Atlantic, the well head also decreases leading to a negative head which would cause water to be sucked into the well. This blowing and sucking of water to/from the well was observed on both sides of the Keys during the experiment. In contrast, the pressure head on the reef-side of the Keys exactly mirrored that of the Atlantic tide. As the tide increased, the pressure head decreased creating a sucking action within the well, and vice versa as the tide fell. Therefore, one would expect that groundwater entering the bay would be more pronounced during a high tide in the Atlantic and less pronounced on the reef-side during the same tide. The constituents associated with that groundwater should also follow those same patterns.

Seepage rates measured on both sides of the island showed a similar pattern to that expected based on the well information (**Fig. 25**). Consider first the reef-side (**Fig. 25a**), where seepage rates from one of two meters were low during the high tide compared to those rates measured during the low tide. This meter also showed recharge during the Atlantic high tide as expected. Seepage rates vary considerably between the two meters demonstrating the extensive spatial heterogeneity. On the bay-side with the exception of the first three measurements at the beginning of the period (circled), the seepage rates almost exactly mimic the Atlantic tide as was hypothesized based on the pressure head of the wells (**Fig. 25b**).

If elevated radon and methane concentrations in surface waters are due to groundwater inputs, then similar trends may be observed in seepage and tracer data. Although methane did not show a significant difference in concentration throughout the experiment, radon may show some correlation to the seepage data. Differences in radon concentrations are very small, but the trend is suggestive, e.g., on the reef-side there are somewhat higher concentrations during a low Atlantic tide and somewhat lower concentrations during a high Atlantic tide (**Fig. 26 a and b**). Nutrient trends were not as obvious during this experiment, however, results for some of the nutrient analyses are shown for completeness (**Fig. 27 and 28**). The nutrient data is not surprising due to the multiple sources/sinks and complicated dynamics of these parameters.

This tidal experiment, along with multiple observations of submarine springs blowing and sucking in response to the Atlantic tide, demonstrates the extreme dependency of groundwater movement below the Keys to the Atlantic tide. Current studies are examining the water level of both Florida Bay and the Atlantic on longer time scales so that a better understanding of the tidal induced flow beneath the Keys may be reached. The average water level in Florida Bay fluctuates very little on a daily basis, but may change by as much as 0.5 meters seasonally. This seasonal change may be important to the net groundwater movement in the northern Keys where the change in the height of the Bay is more pronounced. Assuming groundwater contributes to nutrient loading of surface waters, these seasonal changes may be important.

ARTIFICIAL TRACERS

Results

Septic Tank

The SF_6 concentrations of the 70 L injection slugs used in the septic tank experiments were 42.96 ± 2.65 μM, 199.93 ± 2.12 μM, and 210.46 ± 4.67 μM for experiments A1, A2, and B; respectively. SF_6 was detectable in tap water for each experiment within 20 minutes of injection and peak concentrations were observed within one day (**Table 8**). For experiment A1, the peak concentration, 9.62 ± 0.07 pM, (1 pM =

10^{-12} M) was seen 15 minutes after injection (**Fig. 29a**). This peak is suspicious as a flow rate of 80m/hr would have to exist for the SF_6 plume to travel to the well that rapidly. Lapointe et al. (1990) reported a maximum flow rate of 3.7 m/day (0.15 m/hr) on Big Pine Key. Contamination of this sample while sparging the water slug is likely. To test this, a second experiment was conducted at site A (exp. A2) for one week. Particular care was taken not to allow concentrated SF_6 gas come in contact with the sample vials. While sparging the injection slug, the vials were kept outside and brought in as needed after the injection. No initial peak was observed for experiment A2 (**Fig. 29b**), suggesting contamination may have been to blame for the initial peak observed in previous experiment. In fact, no significant changes in SF_6 concentration was observed for an entire week after the second injection. With the exception of the initial peak observed in experiment A1, all of the samples collected at site A showed very low SF_6 concentrations (less than 1.2 pM) for the duration of both experiments.

Experiment B showed much higher concentrations than either experiment at site A. Fifteen minutes after injection, duplicate samples were collected from the kitchen sink. These samples had relatively high SF_6 concentrations of 10 and 27.6 nM (1 nM = 10^{-9} M). The large discrepancy in these samples along with their rapid appearance suggests that these samples were also contaminated during the sparging process. For this reason, they were discarded and are not included in the data set. The rest of the data is included in Fig. 9c and Table 3. Values for experiment B ranged from 0 to 4.0 nM.

Before injection, background levels at site B were 0.48 ± 0.09 pM (1 pM = 10^{-12} M), presumably from the previous work done at site A. The first sample (0.18 days) revealed a concentration of 3.5 nM. By 0.44 days, the concentration fell to 0.41 nM then shot up to 4.0 nM again at 0.85 days. After this second peak, values began to tail off until day 10 when two elevated samples were observed with values of 0.49 and 0.48 nM (**Fig. 29c**). After this small rise, values fell to 39 pM and continued to fall, eventually becoming undetectable at 47 days. Values remained below detection for the remainder of the experiment which lasted for 68 days.

Transport rates were not calculated for either experiment at site A due to the lack of a reliable peak in SF_6 concentration. The one peak observed during experiment A1 was questionable enough to doubt its validity. As mentioned above, a transport rate of 80m/hr would have to exist for this peak to be a result of groundwater movement. In addition, a similar peak wasn't observed at all for experiment A2. The larger initial peak observed at 0.85 days during experiment B indicates a transport rate of 1.37 m/hr (32.9 m/day). This is considerably higher than previously published flow rates of groundwater through Miami oolite. The small peak observed at 10 days; however, corresponds to a flow rate of 0.11 m/hr, very close to the flow rate of 0.15 m/hr reported by Lapointe et al. (1990) on Big Pine Key.

Simulated Septic Tank

The results from the July '96 experiment at the Ranger Station are shown in **Fig. 30** and **Table 9**. The injection well was sparged for 10 minutes during a nearly low Atlantic tide. The rational for injecting at low tide was that if tidal pumping was occurring, groundwater would be moving toward the Bay during a rising tide. SF_6 samples for the monitor well and the Bay waters were collected for approximately 16 hours. The tides plotted from the monitor well water level data and the Atlantic indicate a 1.43 hour lag between their respective high tides. There is also a damping of 60% of the tidal amplitude as the pressure wave moves through the carbonate rock. The tidal levels in Florida Bay were not monitored during this experiment. It is well known that the tidal level in this region of the Bay is controlled primarily by local winds. The highest Bay tides occur when the winds blow from the west, piling water up in the Bay. Lowest tides are associated with easterly winds which force water out of the Bay. There was very little wind during this experiment and the water level in the Bay didn't visually appear to change by more that a couple of centimeters during the entire experiment.

SF_6 was detected in Florida Bay after 6.75 hours after injection at a concentration of 35.5 pM (**Fig. 30**). A peak concentration of 85.4 pM corresponding with a high Atlantic tide was observed after 7.93 hrs. This yields a transport rate of 3.28 m/hr. As the Atlantic tide turned and began to fall, the SF_6 quickly disappeared, presumably degassing from the surface waters and/or advecting from the sampling area. SF_6 was detected in the monitor well 5 hours after injection at a concentration of 0.223 nM. Values fluctuated slightly for 3 hours then dropped below detection. At just under 10 hours, the SF_6 concentrations began increasing again, reaching a peak concentration of 2.27 nM an hour later during a falling tide. A transport rate of 0.27 m/hr was calculated from the monitor well data. This is most likely an underestimate if the SF_6 plume moved first north toward the Bay on the rising Atlantic tide then turned south on the falling tide before reaching the monitor well, as the data suggests.

The second Key Largo experiment was conducted in August '96 at the same location. Due to background SF_6 levels from the previous experiment, both wells and the Bay were monitored for 6 hours before injection for SF_6 concentrations and water levels. Residual SF_6 was still present in the injection and monitor wells at concentrations of <14 nM and <3 nM, respectively and didn't fluctuate much with time. The elevated value in the injection well could represent SF_6 contamination of the well casing from the previous injections as SF_6 can bind to organic materials such as PVC. No residual SF_6 was detected in the Bay, although it was only sampled during a falling Atlantic tide. The injection well was sparged for 10 minutes with concentrated SF_6 during a low Atlantic tide. It was assumed that this would be sufficient to overcome the background concentrations already present in the wells.

The tidal levels for the Atlantic Ocean, the injection well and Florida Bay are plotted against time in **Fig. 31a**. Due to more intense monitoring, the tidal lag between the Atlantic and the injection well noted in the previous experiment is much more evident. A lag time of 1.78 hrs (±0.38) was calculated from three observed tidal cycles. This was simply done by taking the time difference from each low and high tide. A damping of 52% (± 6%) of the tidal amplitude was observed. The water level in Florida Bay was also monitored and didn't vary more than 4.6 cm.

The SF_6 results for the August '96 experiment are shown in **Fig. 31b** and **Table 10**. After a complete tidal cycle (0.71 days), no change in SF_6 had been observed in the monitor well. This raised concerns whether the well was sparged adequately enough to overcome background levels. The injection well was resparged with concentrated SF_6 gas for 20 more minutes at the next low tide (t=0.77 days) in hopes of resparging the same water mass as before. No more measurable changes in SF_6 were seen until 1.16 days when the monitor well's concentration started rising. A maximum concentration (24.6 nM) was reached at low tide (1.20 days) indicating a transport rate of 0.30 m/hr. As discussed previously, this could likely be an underestimation. Values returned to baseline after 1.26 days as the tide began to rise. A larger peak was observed at the next low tide (1.71 days) with a maximum SF_6 concentration of 72.2 nM. By 2 days, values were returning to baseline values. No further samples were collected until 2.64 days during a falling tide. The SF_6 concentration in the monitoring well at this time (70.4 nM) was similar to the previous maximum.

No SF_6 was detected in Florida Bay until 1.25 days, just as the first peak in the monitor well was declining, when a concentration of 70.8 pM was observed. This peak declined to 27.1 pM then increased slightly at 1.46 days to a concentration of 41.1 nM. This double peak may be the result of the multiple injections. After 1.5 days, SF_6 concentrations in the Bay were below our limit of detection. No further traces of SF_6 were detected in the Bay waters for the remainder of the experiment. The maximum concentration observed at 1.25 days correspond with a groundwater transport rate of 2.30 m/hr. This calculation assumes that this peak concentration was from the second injection. If the same is assumed for the second, smaller peak at 1.46 days, a transport rate of 1.59 m/hr can be inferred. If one were to assume that this double peak was due to the first injection alone then transport rates of 1.08 and 0.90 m/hr could be calculated.

It is interesting to note that for these two experiments (July and August '96), the injections occurred at a low tide and subsequent peaks in the monitor well were all detected at nearly the same tidal stage that existed during the injections. This suggests that net movement of the plumes may be small even though they are covering a distance of at least 29m during the courses of both experiments.

The third and final experiment at this location was during August, 1997. This time, 100 liters of water was pumped from the injection well, sparged for 20 minutes with concentrated SF_6 then pumped back into the well. Unlike the two previous experiments, injection was conducted during a high Atlantic tide rather than a low. The water level in the monitor well (approximately 3 m south of the injection well) was measured during the injection and had increased by more than 1 meter as the injected slug was pumped into the aquifer. The monitor well water level quickly returned to normal after the injection was completed. The monitor well was sampled for SF_6 and water levels every 30 minutes while the five Bay stations were sampled for SF_6 every hour. The water level in the Bay was also monitored hourly.

The tidal data are summarized in **Fig. 32a**. Once again, a time lag was observed between water levels in the Atlantic and in the monitor well. This lag was estimated to be 1.37±0.27 hrs during the course of this experiment. The amplitude of the Atlantic tide was dampened by 52% (± 4%) by the time it reached the monitor well, just as it was in the August '96 experiment. The Bay water levels were out of phase with the Atlantic tide but the amplitude was much smaller (<14 cm) and coincided with high northerly winds. It is unclear whether this small tidal change in the Bay affected groundwater movement during the course of this experiment.

Background concentrations for the injection well and the monitor well were 0.31 and 0.03 nM, respectively. As in the August '96 experiment, no increase in the monitor well's SF_6 concentration was observed during the first tidal cycle after injection (**Fig. 32b, Table 11**). During the next rising tide, monitor well SF_6 concentrations increased along with the tidal level of the monitor well, reaching a peak value of 1.56 nM at 14 hrs. This yields a transport rate of 0.21 m/hr. This may be an underestimation if the plume either moved through the monitor well undetected for the first tidal cycle or moved a little to the north before turning and heading south toward the monitor well. This peak coincided with the highest water level in the monitor well. As the tide fell, the SF_6 concentration followed suit, finally reaching background levels at low tide (18.5 hrs). A second, larger peak was observed with the next high tide. Once again, the maximum SF_6 concentration (4.63 nM) of this peak occurred during the highest monitor well tide. As the tide ebbed, SF_6 levels dropped returning to baseline at low tide then began rising with the next flooding tide. These results are similar to the two previous experiments in the respect that peak SF_6 concentrations were observed in the monitor well during the same tidal stage that existed at the time of injection.

Five sample sites were monitored in FL Bay to evaluate the spatial variability of groundwater seepage with time. Before injection, a background sample with a concentration of 2.54 pM was collected from site #3. SF_6 concentrations are plotted against time for each Bay site (1-5) in **Fig. 33**. The water level in the monitor well is also shown. All of the sites showed similar trends. The highest concentrations were observed shortly after Atlantic high tide as one would expect. The calculated time lag between these maximas and the highest monitor well water level is 2.19±1.62 hrs. Only one sample from the Bay had a higher concentration than the background sample during the entire experiment. This suggests that the SF_6 observed in the Bay for this experiment was left over from the two previous experiments. This residual plume seems to be sloshing back and forth between the monitor well and the Bay. Since this injection occurred at high tide (unlike the previous experiment where injection occurred at low tide), the newly injected SF_6 plume was probably transported to the south initially then turned with the tide and moved back to the north. We suggest that this tidal pumping movement kept the SF_6 plume in the southern vicinity of the injection well and most likely prevented the SF_6 plume from reaching the Bay waters over the timescale of this experiment. This is also supported by the low values observed in the Bay, which were significantly less than those observed in previous experiments.

Since the trends for each Bay sample site were so similar, the average Bay concentration and standard deviation were computed for each sampling round. Both the average and the standard deviation are plotted against time in **Fig. 34**. The highest variability between the Bay sites followed shortly after an Atlantic high tide when, according to the tidal pumping theory, one would expect seepage into the Bay to be the greatest. This suggests that when maximum seepage occurs, it is somewhat patchy. Conversely, the concentrations and variability are the lowest just after low Atlantic tide when water from Florida Bay is presumably being sucked into the bedrock of the Keys.

These simulated septic tank experiments show that substances injected into the upper portion of the water Table in Keys can be transported rapidly (0.21 to 3.28 m/hr) through Key Largo limestone and has the potential to reach surface waters within hours. The groundwaters seem to be driven through the subsurface matrix by tidal pumping, moving north (bayward) as the Atlantic tide rises and to the south (seaward) as the tide falls. Results from the five Bay stations in the last experiment indicate that residual SF_6 seems to be seeping into the Bay little by little with each tidal cycle. A year had passed between the last two experiments and SF_6 was still present in the Bay before the last experiment, suggesting a long resident time of substances injected into the aquifer. It is unclear how nutrients from septic tanks are affected by this long resident time. If given enough time, it is quite possible that the majority of the nutrients could be stripped from the water by indigenous microorganisms or in the case of phosphate, adsorbed onto the carbonate rock. Another possibility is that with each tidal cycle, a small portion of the wastewater plume could be introduced to surficial waters at a slow enough rate to be scavenged by benthic macroalgae or bacteria. On the other hand, if the nutrients aren't utilized in situ, this situation could lead to suspended algae blooms in the water column which could potentially be fueled by the anthropogenic nutrients pulsing out of the limestone with each passing tide for as long as one year.

Injection (sewage disposal) Well

During the October 1996 injection well experiment, there was heavy daily rainfall for the first two weeks of sampling. Results of the October 1996 experiment are shown in **Fig. 35-42** and **Appendix 1**. Note that **Fig. 35a and 35b** are the same data on different time scales. The 200 L injection slug had a SF_6 concentration of 46.25 ± 1.21 μM. Due to a spill of purge water in the first few hours of the experiment, the Bay waters were not sampled for SF_6. In addition, there was no lag observed between tidal levels in the wells and the Atlantic tide (Corbett, personal communication). This suggests that the aquifer's hydraulic conductivity is too high to be accurately measured with the 30 minute sampling regime conducted.

The first major flow path observed was southward. Two hours after injection, the first trace of SF_6 (58.06 nM) was seen at well 1 at 18.3 meters and increased to a maximum of 70.38 nM after 2.9 hours had passed (**Fig. 35**). Well 1 is located 5 m south of the injection well, resulting in a transport rate of 1.72 m/hr. The maximum SF_6

concentration observed at this well was 3 orders of magnitude (0.1%) of that injected. A much smaller peak (1.49 nM) was also observed at well 3, 18.3 m (5 m east of injection well) during the first hour of the experiment (**Fig. 37**). The SF_6 concentration at this well rapidly dropped to below 0.10 nM and remained there until 18 hrs.

Another small peak comparable to that of well 3, 18.3 m was also observed at well 5 at the shallowest depth, 4.6 m (**Fig. 39**). Well 5 is 10 m south of the injection well. SF_6 concentrations here rose to 0.80 nM, a dilution of 10,000 times the injected concentration, after 6.2 hrs had passed. This yields a horizontal transport rate of 1.61 m/hr, very close to that calculated for well 1, 18.6 m; and a vertical transport rate (VTR) of 2.2 m/hr. After 6 hours, SF_6 was also detected in well 1 at shallower depths (13.7 and 9.1 m) at concentrations of 0.74 and 0.30 nM (**Fig. 34**). By 10.6 hours, well 1 13.7 m reached a peak concentration of 27.0 nM. The 9.1 m well peaked out approximately 7 hours later with a concentration of 9.45 nM. The results of these two depths gives horizontal transport rates of 0.47 and 0.28 m/hr, respectively. Vertical transport rates for these two depths were calculated to be 0.43 and 0.51 m/hr, respectively. These shallow flow paths at wells 5 and 1 illustrate the buoyancy of the wastewater plume (salinity = 0 ppt) as it is injected into the saline aquifer. These data shows a portion of the waste has the potential to travel 15 meters upward over a horizontal distance of 10 m on timescale of a few hours.

The next traces of SF_6 were observed at wells 3 and 2 (**Fig. 37 and 36**), respectively. After about one day, SF_6 reached a maximum in well 3, 13.7 meters of 18.5 nM (horiz. transport rate (HTR) = 0.22 m/hr, vert. transport rate (VTR) = 0.20 m/hr). During this time, concentrations at 9.1 m were increasing much slower and finally reached a maximum concentration of 11.6 nM in 20 days (HTR = 0.01 m/hr, VTR = 0.02 m/hr). Well 3 19.3 m, which showed a small peak earlier in the experiment, slowly crept up to a value of 1.1 nM after 7.0 days then hovered between 1.0 and 0.2 nM for the remainder of the experiment.

Well 2 is 5 m north of the injection well and shows trends similar to well 3, 9.1 meters. Concentrations at all depths here began increasing slowly over a week or two period (**Fig. 36**). The two deeper wells (13.7 and 18.3 m) reached their maximas (2.96 and 4.65 nM) at 20 days and then began to decline. This yields transport rates of 0.01 m/hr for both horizontal and vertical transport. The shallower wells' (4.6 and 9.1 m) concentrations were still rising as of the last sampling period. This yields HTRs of less than 0.008 m/hr for both depths and VTRs of less than 0.005 and 0.008 m/hr, respectively. These are maximum estimations of transport rates since these SF_6 concentrations were still rising as of the last sampling round. In most cases, the time of peak concentration was used to calculate the transport rate; however, if no peak was observed the last and therefore highest value was used to estimate a transport rate. For this reason, these estimations are presented as maximums in **Table 12**, which summarizes the transport rates for this study. The remainder of the wells: 4, 6 and 7 took much longer than the others to show signs of SF_6 and were generally of lower concentrations (**Fig. 38, 40, 41**). As of the last sampling period (t = 77 days), some of the depth at these wells were still increasing in concentration.

A canal across US-1 was sampled 5 days after injection and showed a SF_6 concentration of 1.3 pM (**Fig. 42**). At 6 days, a maximum of 1.4 pM was reached (HTR = 0.74 m/hr) then levels declined. This maximum concentration is more than seven orders of magnitude less than the original injection slug. After 46 days, no SF_6 was detected in the canal. This shows that sewage has the potential to reach the surface waters in a few days, although it is greatly diluted within the surface waters. The flux of contaminants into surface waters has not been investigated.

These results suggest there are 2 types of movement for deep well injected sewage. The first is rapid advection through conduits presumably formed by the dissolution of or fractures within the calcium carbonate. The results presented here indicate that this rapid flow can be as much as 1.72 m/hr (41 m/day) horizontally and as great as 2.2 m/hr vertically. This suggests that buoyantly driven vertical flow can be greater than the horizontal flow. The next type of groundwater movement is slow diffusive transport through portions of the rock with lower permeability. Estimated horizontal flow rates for this diffusive transport can be less than 0.01 m/hr while vertical rates can be less than 0.002 m/hr.

In February 1997, we repeated the experiment using SF_6 as well as I-131 as tracers to determine if the major conduit pathways observed previously persist temporally and in association with different seasonal meteorological conditions. Due to the previous work done on site, a background concentration of less than 2 nM SF_6 was found at all the wells. This relatively low background was not expected to hinder our observations of major flowpaths although the resolution of the slow, diffusive type of transport would be lost. No background I-131 was detected. Due to the presence of residual SF_6 and the short half-life of the I-131, the February experiment was only monitored for nine days. There was no significant rainfall during the course of this experiment.

SF_6 results of the February '97 experiment are shown in **Fig. 43-51** and **Appendix 2**. Since I-131 results correlated so well with SF6, results for the radio-tracer are tabulated in **Appendix 3** rather than graphed (**Fig. 52**). Significant concentrations (defined as those I-131 values above the y-intercept of **Fig. 52**, 18319 dpm) of I-131 were only observed in wells associated with rapid flow (wells 1, 2, 3, and 4) therefore only these figures are shown in this report. Wells 5, 6, and 7 occasionally showed elevated values for I-131 but these peaks were relatively small (<7000 dpm) and are beleived to be contamination artifacts. Since the I-131 results support those obtained using SF_6, the transport rates and dilutions discussed below were calculated using the results from the SF_6 data.

The first flowpath observed in February was once again southward at well 1, 18.3 meters (**Fig. 43**) with a peak SF_6 concentration of 358 nM after 11 hours (HTR = 0.45 m/hr). This horizontal flow rate is an order of magnitude slower than the previous estimate at this location, although the SF_6 concentration is four times more concentrated than before. The 13.7 meter well climbed to 78 nM SF_6 in about 33 hours corresponding to flow rates of 0.14 m/hr both vertically and horizontally. The 9.1 and 4.6 meter wells at this location each took about 80 hours to top out with concentrations of 22.4 and 2.7 nM SF_6, respectively. The HTR for both depths was calculated to be 0.06 m/hr while the VTRs were 0.11 and 0.17 m/hr, respectively. With the exception of the shallowest well, which reached a peak SF_6 concentration of 2.68 nM after 79 hrs (HTR = 0.06 m/hr, VTR = 0.17 m/hr), the transport of the tracer to well 1 was slower and less diluted than in the previous experiment.

At well 3, the shallow well (4.6m) showed no increase in SF_6 concentration (**Fig. 45**). The deepest well (18.3m) showed a small peak of 1.52 nM at 19.2 hours then began to decrease slowly, yielding a flow rate of 0.26 m/hr. The intermediate depth wells (9.1 and 13.7 m) peaked out at 2.92 and 3.31 days, respectively, with much higher concentrations of 14.49 and 21.81 nM. These results suggest transport rates horizontally of 0.07 and 0.06 m/hr and vertically of 0.13 and 0.07 m/hr. Similar results were seen at well 4, 9.1m (Fig. 26) where concentrations began increasing at 1.08 days, reaching a maximum of 19.72 nM after 2.96 days (71 hrs). This yields a HTR of 0.07 m/hr and a VTR of 0.13m/hr. None of the other depths at well 4 showed any significant increase in SF_6 concentrations.

Well 3, 13.7m took much longer to reach a peak concentration during the February experiment than it did previously. In October, this well quickly reached a maximum after just 0.95 days (22.8 hrs). During this experiment, however it took 3.31 days. These results are similar to those observed at well 1, where higher concentrations were seen during the February experiment although the transport rates were slower. This could be due to the fact that there was no rainfall during the February experiment, whereas during the October '96 experiment there was daily heavy rainfall for the first two weeks of the experiment. Less recharge may result in less dilution of the SF_6 plume as well as slower movement away from the injection well.

Trends observed at well 3, 9.1 m and at well 4, 9.1 m (east and west of the injection well) support the idea that local recharge may alter flow paths for the waste water plume. At these intermediate depths, a maximum concentration of SF_6 was seen after approximately three days. This is in contrast to the previous experiment where slightly smaller peak values were seen in these wells after about three weeks. This seems to indicate that the plume moved more radially in February than the plume observed in October. Less recharge may allow the waste water plume to move outward in a more radial manner. It has been shown that the potentiometric surface at this site is sloped toward the Atlantic (Kump, 1996). Increased rainfall may increase this gradient, causing greater southward advection of the plume. At times of little or no recharge, this potentiometric gradient may be small enough to allow the waste water to move more east and west from the injection well . Local winds could also effect the hydraulic gradient in this area. Winds can act to force water in or out of the Bay thus steepening or lessening the hydraulic gradient in this area.

The remainder of the wells for the February experiment showed no signs of rapid conduit flow. For the first day of the experiment, we closely monitored SF_6 concentrations in most wells (1, 2, 3, 4, and 5) and tidal levels in the Atlantic. The SF_6 background fluctuations at wells 2, 4 and 5 (all depths, **Fig. 44, 46, 47**) did show fluctuations that may indicate tidal pumping. These results show that peak background SF_6 concentrations corresponded to a rising tide for the first day of the experiment (**Fig. 53**). After one day, the sampling intervals were increased and/or newly injected SF_6 was observed in the wells, thus the fine resolution was lost. Although wells 6 and 7 were only sampled every other sampling round due to time constraints, they also lend support to the idea that tides play an important part influencing groundwater flow in this region. The trends observed in background SF_6 concentrations in all depths at these two wells match up perfectly with one another (**Fig. 48, 49**). These two wells are approximately 40 m apart. The similarities in trends suggest that a common mechanism, tidal pumping, may be responsible for their observed fluctuations .

The concentrations measured in both the Bay and the canal across US-1 were near the limit of detection; however, results from the Bay may due to tidal action. **Fig. 50b** shows that for the first day of the experiment, SF_6 was only detectable in the Bay while the tide was high in the Atlantic. It is difficult to evaluate whether these peaks are residual background from the October experiment or from this injection. In either case, tidal pumping may explain these results. The canal concentrations were measured less frequently and showed no signs of tidal influences (**Fig. 51**). These concentrations in the canal are an order of magnitude less than observed during the October experiment.

Discussion

A summary of calculated transport rates is shown in **Table 12**. These results suggest that substances injected into the water Table beneath the Florida Keys has the potential to travel rapidly through the porous limestone matrix. The septic tank results from Big Pine Key suggest that during the time of these experiments the plumes from septic tanks in this neighborhood move in an eastward direction. The lack of any large SF_6 peaks for site A (**Fig. 29 a, b**) suggests that the tracer did not travel west toward the well at this site. Results from site B (**Fig. 29c**), however, indicate that the plume here did move toward that well, which lies approximately 27 m east of the septic tank's drainfield.

The rapid transport rate at this location (1.37 m/hr) is an order of magnitude higher than the flow rate of 0.15 m/hr (3.7 m/day) reported by Lapointe (1990). Two plausible explanations for this high transport rate are conduit / fracture flow or contamination during the initial sparging process carried out just before injection. Although no cores were available for examination from Big Pine Key, previous coring work done by Shinn et al. (1994) at the Saddlebunch Keys show that some portions of cores collected had unrecoverable portions in the upper 2 meters which could represent conduits, rubble, or sand layers that could have a much higher hydraulic conductivity than Miami oolite. The Saddlebunch Keys are located approximately 30 km west of Big Pine Key and are considered to be in the same geological formation of Miami oolite. It is possible that similar features could also be found at our site on Big Pine Key.

It is also possible that the SF_6 samples for this experiment could have been contaminated by concentrated SF_6 gas. At site A, the sparging and subsequent injections were conducted in a downstairs restroom that had a lot of windows and doors for ventilation. These were left open while sparging the injection slug with concentrated SF_6 gas. In addition, samples were collected from a sink on the second floor of the house so the chances of contamination were greatly reduced. The house at site B was one leveled so the sparging process had to be conducted down the hall from the sink that was to be used to collect samples from the well. In addition, the room where injection occurred had no windows and may not have been well ventilated. It is possible that residual SF_6 gas from the injection lingered in the house for several days and that the breakthrough curve observed after injection was actually sample contamination while the house degassed. A slower groundwater transport rate of 0.11 m/hr can be calculated from the small peak observed after 10 days at site B. This agrees remarkably well with Lapointe's (1990) estimate. This transport rate is most likely representative of the Miami oolite's primary porosity.

The most rapid transport rates found in this study were during the simulated septic tank experiments on Key Largo. Rates of groundwater transport were between 0.21 and 3.28 m/hr. The highest rate of transport was seen during the July '96 experiment when the tidal amplitude of the Atlantic was the highest of the three experiments (**Fig. 30**). The tidal amplitude in the Atlantic was 0.88 (± 0.03) m during the July '96 experiment. The next highest rates, 1.59 and 2.30 m/hr was observed during the August '96 experiment when the tidal amplitude was 0.56 (± 0.04) m (**Fig. 31a**). These observations indicate that the rate of groundwater flow is controlled by the amplitude of the Atlantic tide. We suggest that when the differences between high and low tides are largest, such as during a spring tide, groundwater moves more rapidly. When the tidal variations are smaller (neap tide), groundwater transport should be slower. It should be kept in mind that these maximum flow rates represent an average of the flow rate over a tidal cycle. Flow rates probably change dramatically over the course of a tidal cycle, responding to the changing pressure heads as the Atlantic and Florida Bay water levels oscillate.

Groundwater flow rates can typically be calculated with Darcy's law:

$$v = (-K / n) * dh/dl \qquad (3)$$

where v is the groundwater velocity, K is the hydraulic conductivity, n is the porosity, and dh/dl is the hydraulic gradient. If the velocity, porosity, and hydraulic gradient are known then one can estimate K. The data from the Key Largo experiments indicates that the hydraulic gradient varies over a tidal cycle. At high tide, we observed groundwater flow towards the bay, indicating the hydraulic gradient is sloped to the north. At low tide, flow was toward the Atlantic, suggesting the gradient was sloped toward the south. This indicates that the gradient undergoes a reversal at some point in the tidal cycle. The maximum Atlantic tidal amplitude observed on Key Largo was 0.88 m. If one assumes that the Atlantic's mean tidal level is equal to the bay's mean water level, then one can conclude that the greatest difference in the Atlantic and bay's water levels is 0.44 m at extreme high or low tide, which would establish maximum hydraulic gradients of $\pm 1.02 * 10^{-3}$ (0.44 m / 430 m). Using the highest and lowest rates of groundwater transport (3.28 and 0.27 m/hr), one can estimate two absolute values of K as 1602 and 131 m/hr, respectively.

The low end of these hydraulic conductivity estimates for Key Largo Limestone is twice the value of 60 m/hr (1440 m/d) reported by Vacher et al. (1992). This estimate was calculated by using equations of the Dupuit-Ghyben-Herzberg (DGH) analysis of the fresh water lens underlying Big Pine Key. Hydraulic conductivity is a property that is dependent on the permeability of the rock as well as the viscosity of the fluid moving through it. In a karstic matrix such as Key Largo limestone, K could vary tremendously depending on local geological features of the limestone (i.e. the presence or lack of conduits). Obviously, a much broader range could be calculated with different estimates of the hydraulic gradient. These estimates merely put a range on the possible values of K for this region of Key Largo. Other methods of estimating K, such as with a permeameter or a slug test, may give more precise estimates although these tests can also be affected by local geological features. The best estimation would be based on a large scale area. Such a calculation can be made for a confined aquifer using the tidal lag between a well and the ocean and the well's distance from the ocean but no such equations have been developed for an unconfined aquifer.

Numerous studies cite the large degree of secondary porosity in Key Largo limestone (Vacher et al., 1992; Shinn et al., 1994; Halley et al., 1995). The majority of the flow through this formation is believed to be via channel or conduit flow. These conduits were originally formed as ancient coral reefs developed vertically. More recently, meteoric diagenesis has contributed to the dissolution of calcium carbonate, resulting in further development of secondary porosity. This increase in secondary porosity increases the permeability of the Key Largo limestone and profoundly affects groundwater flow (Vacher et al., 1992).

The lowest groundwater transport rates for these simulated septic tank experiments were calculated from data obtained from the monitor well. As mentioned previously, these values are most likely underestimations due to the bi-directional advection of the SF_6 laden plume. During the July and August '96 experiments, injection occurred during a low Atlantic tide. As a result, the SF_6 injected into the well initially moved toward the Bay as the Atlantic tide rose. As the Atlantic tide fell, the plumes' movements turned to the south and were subsequently detected in the monitor well during low or falling tides. For the last experiment at this study site, injection was conducted close to high tide. This can be seen in **Fig. 32b** as the large spike for the water level of the monitor well. Subsequent SF_6 peaks in the monitor well were observed while the water level in the well was at its highest. This is consistent with the two previous experiment, where peak SF_6 concentrations in the monitor well were observed at the same tidal stage that existed when the injections occurred. This suggests that over a tidal cycle, the net movement of the plumes is small even though these plumes can travel a substantial distance in the course of a tidal cycle.

It is unclear why no SF_6 was detected in either the monitor well or the Bay after the first injection of the August '96 experiment (**Fig. 31b**). A plausible explanation is that the injected plume may have been so concentrated and narrow during the first tidal cycle that it passed through the monitor well undetected between sampling rounds. As the experiment continued, mechanical dispersion, along with diffusion, would tend to make the plume larger and less concentrated. As the plume moved through the porous limestone, some of it probably encountered pathways that were more or less hydraulically conductive. Dead end pore spaces could also trap some of the plume during it's movement. These differences in permeability would tend to disperse the plume more and more with each passing tidal cycle.

The dispersive behavior of the plume may also explain some of the other results from the August '96 and August '97 experiments. In each of these experiments, the SF_6 peaks observed for the monitor well were larger the second time they were observed. The results suggest that the SF_6 plumes did not completely travel across the monitor well during these experiments. If they had, then there would be a double peak for the monitor well each time the plume came in contact with the monitor well. One peak as the center of the plume crossed the monitor well in one direction, followed closely by a second peak observed after the tide turned and the most concentrated portion of the plume moved back across the monitor well. Instead, there is only one peak for each associated extreme tide. This suggests that the edge of both plumes came into contact with the monitor well, then turned with the tide before the center of the plume could make it to the monitor well. As the plume became more dispersed, a higher concentration of the edge of the plume may have came in contact with the monitor well, resulting in a larger peak concentration of the tracer.

Background samples collected from the injection and monitor wells suggest that the residence time of substances injected into the water Table can be quite long. No SF_6 experiments were conducted at this site between August '96 and August '97 yet there were still a residual concentration of 0.31 nM in the injection well. A background of 0.03 nM was detected in the monitor well. The elevated value in the injection well could represent SF_6 contamination of the well casing from the previous injections. In any event, these concentrations are several orders of magnitude less concentrated than the maximum concentration observed in the monitor well a year earlier. The concentrations of samples from the Bay all reflect background values of less than 4 pM, approximately 20 times more diluted than those collected a year earlier. Residual traces of SF6 were not detected in the Bay before the August '96 experiment yet it was detected in the Bay before the August '97 experiment. This was due to the fact the sampling technique was altered slightly between the August '96 and August '97 experiments, resulting in a lower limit of detection. Collecting samples in serum vials rather than glass syringes improved the lower limit of detection by an order of magnitude due to a change in the water to nitrogen ratios used during the extraction procedures for the two different sampling methods. In any case, the these lingering concentrations of SF_6 suggest that substances put into the water table and advected into marine surface water can persist for at least a year and can be continually pumped into the Bay with each passing tidal cycle.

Results from the deep well injection experiments on Long Key show that horizontal transport rates can range from less than 0.003 m/hr to as high as 1.72 m/hr. Vertical transport rates are similar (<0.002 - 2.2 m/hr) due to the buoyancy of the plume. Local recharge may partially control the dispersion of the plume. Heavy precipitation could steepen the hydraulic gradient in this area, causing higher rates of southward advection. During the second experiment, there was no significant precipitation. Lack of recharge could lessen the hydraulic gradient on Long Key. It is hypothesized that such a gradient could allow radial dispersion of the waste water plume away from the injection well. During dry periods, the Atlantic tide seems to be a driving mechanism for groundwater transport. This isn't evident from the October data set when heavy rainfall seems to have dominated the system. In February, however, the residual SF_6 from this first experiment did show signs of tidal pumping. This indicates that both recharge and/or tides may effect groundwater flow in this region, depending on local meteorological conditions. During the course of these experiments, the meteorological conditions were extreme (i.e. very wet or very dry) and may have allowed one or the other of these mechanisms to control groundwater flow. During periods of moderate rainfall, both of these forces could hypothetically influence the system simultaneously.

The deep well injection experiments conducted at KML had the best well coverage of the four sites used for this study with seven well clusters, each containing 4 wells of different depths. This provided a much more detail picture of the fate of substances injected into the aquifer underlying the Florida Keys than the experiments previously discussed. This relatively extensive coverage made it possible to roughly estimate what portion of the SF_6 injected could be accounted for by the results. The ease of which this can be estimated depends on the physical characteristics of the aquifer itself as well as the distribution of monitoring wells. In a homogeneous, isotropic aquifer that flows in only one direction this calculation would be quite simple. Many plotting programs are currently available for such applications. There are none; however, for a tidally driven, anisotropic aquifer with three dimensional flow that is riddled with innumerable holes and conduits. This structure is not only evident from the cores taken when these wells were drilled (Kump, personal communication, 1996) but can be seen in the many canals that have been cut into the Keys. One can see the remnants of ancient coral heads as well as cracks and cavities that formed as these reefs developed vertically. Due to the heterogeneity of this system, the buoyancy of the observed flow, and the limited distribution of monitoring wells, it became impractical to use any available programs to quantify the observed plume.

For these reasons, the author chose to use a simple interpolation of the data by essentially slicing up the study area into a stack of 8 pies and rings, each 2 m tall (**Fig. 54**). The volume represented in this method is cylindrical with a diameter of 20 m and a height of 20 m and is centered around the injection well. Although the injection well is screened from 20 to 30 meters, the data suggests that the plume rises vertically. The shallowest component (above 5 m) of the plume could not be assessed because no data was available above 5 m. Monitoring of the system was thus restricted to between 5 and 20 m. This same restriction was used in the mass balance of SF_6, thus the volume used for this estimation was limited between 4m and 20m. Porosity was assumed to be 50% (Kump, personal communication). Several other assumptions had to be made in order to use this technique. First, the system's matrix is heterogeneous and the plume spreads in a dispersive manner as it rises. Another assumption is that a well located in a particular slice is representative of the entire slice. This allows the known concentrations of individual wells to be used to estimate the concentration of a particular volume in each piece of the model that contains a well. The missing concentrations were then interpolated horizontally around the pies and rings and then vertically throughout the rest of the cylinder. None of these assumptions are completely correct but they do put some constraints on the problem which allow some crude quantifications to be made.

These interpolations are shown in **Appendixes 3 and 4**. The calculations were carried out for each sampling round of both experiments. Round 1 in the October '96 experiment isn't included. This round was conducted before injection as background and the SF_6 concentrations were below detection at all wells. The estimated SF_6 for the first experiment hovers between 19 and 34% of the injected amount for the first ten days (**Fig. 55**). After 17 and 20 days, this Fig. rises to 52 and 45%, respectively. After 46 days, 89% of the tracer could be accounted for by this method. After another month (t = 71 days), the estimation climbs to 144% of the injected amount. The values shown for the first 10 days may be underestimated due to the fact that the concentrations for each pie slice are based upon the outer edge of the pie, not the center. This is particularly true of the deeper depths, close to where the injection enters the aquifer. The most concentrated portion of the plume was probably located near the injection well and decreased with distance from the injection well.

As time continued, this plume probably dispersed in a more even fashion. This could lead to an overestimation in the later sampling rounds. This is due to the huge volumes in the outer rings of the finite model. Monitoring wells were only located in three of the eight outer rings. The remaining five rings had to be interpolated from these three.

These outer rings have a huge volume and consequently even a small overestimation of concentration can cause the estimated mass of SF_6 to increase drastically. Data from these experiments along with those conducted by Paul et al. (1997) indicate that tidal pumping sloshes the plume back and forth (north-south). Consequently, the plume may not ever reach the model's outer slices that are east and west of the injection well. This suggests the estimations of the outer rings located east and west of the injection well may be gross overestimates since the interpolations were made using data from wells 6 and 7, north and south of the injection well.

In February, there was a background of less than 2 nM at all wells. These values were used to obtain a total background which was then subtracted from the estimations for the second experiment. Due to this background, the sensitivity for the outer wells (wells 5, 6, and 7) which presumably represent diffusive transport, was lost. For this reason, the second trial was only monitored for 9 days. The first two sampling rounds were conducted one and 2.6 hours after injection. These estimates were virtually the same as the background estimate, indicating that a significant portion of the plume hadn't yet reached the monitoring wells. After six hours, the estimated amount of SF_6 began rising (54%) and continued to climb until 11 hours when a maximum of 164% of the injected mass was accountable (**Fig. 56**). Over the next 30 hours the estimate dropped to 74%, then fluctuated between 66 and 140% for the remainder of the experiment. Although crude and rather elementary, this method shows that a significant portion of tracer injected can be accounted for with the well coverage at this location.

SUMMARY

Surface waters in and around the Florida Keys have experienced rapid decline in the last decade. There is not a simple explanation to describe this change. The research performed over the last two years and described here may offer some insight into part of the problem. Groundwater in the Keys maybe a potential contributor of nutrients to surface waters. Although the ultimate detrimental impact of groundwater is difficult to assess, it has been shown through this research that groundwater moving into surface waters, especially near the Keys. Natural tracers are consistent with the hypothesis that waters closest to the Keys receive more groundwater than other locations within Florida Bay and along the reef tract. Wastewater disposal directly into subsurface waters can potentially increase nutrient concentrations within these waters. Nutrient analyses show elevated nutrient concentrations in groundwater and spring water relative to surface waters.

Artificial tracers were used to make a direct link between wastewater and surface waters and to provide information and transport rates, direction, and dilution rates. In general, it appears that transport rates and direction can differ throughout the Keys due to changes in local geology, rainfall and tidal levels. Transport direction at the study sites on Big Pine Key seems to be eastward in orientation and is probably dependent on the hydraulic gradient established by local recharge to the freshwater lens. Transport directions probably vary across Big Pine Key, depending on location. Conduit flow or contamination are the most likely explanations for the rapid transport, 1.37 m/hr observed at site B. The lower estimate of 0.11 m/hr is comparable to that presented by Lapointe et al. (1990) and most likely represents the primary porosity of Miami oolite.

The most rapid groundwater transport rates were observed during the simulated septic tank experiments on Key Largo. Rates were as high as 3.28 m/hr and were closely coupled to the Atlantic tide. Directions of groundwater transport were north/south in orientation. The observed plumes shifted directions as the Atlantic tide rose and fell. As this "sloshing" movement continued, the plume was dispersed more and more. The rate of transport is influenced by tidal amplitude with the highest rates corresponding to maximum tidal variations such as those observed during a spring tide. The high transport rates are an order of magnitude higher than the calculated hydraulic conductivity and are more indicative of a system that is dominated by conduit or fracture flow.

The deep well injection experiments conducted on Long Key illustrate the buoyancy of low salinity wastewaters injected into the saline aquifer. Vertical flow rates were comparable to horizontal rates. Due to the more extensive well coverage at this location, two types of transport were observed. The rapid flow rates (0.22 - 2.20 m/hr) represent conduit flow while the slower rates (< 0.03 m/hr) are representative of the diffusive flow associated with the limestone's primary porosity. Both precipitation and tides may be major mechanisms controlling groundwater transport at this location. Less recharge to the system may result in a more radial dispersion of the wastewater plume while high recharge rates may result in the plume being advected towards the south more rapidly. Obviously, more experiments need to be conducted at this or similar sites during the wet and dry seasons to accurately describe the effects of recharge on groundwater movement.

Determination of the amount of dilution that occurs before contaminated groundwaters reach nearby surface waters was also addressed . Results from Long Key indicate that by the time substances injected into the water table reach nearby surface waters they are diluted by six orders of magnitude or more. This dilution rate is representative of the processes that act to dilute SF_6 at this location only. Dilution must be factored by the input amount of nutrients. High dilution along with a high flux could still allow the delivery of significant quantities of nutrients to surface waters. The maximum SF_6 concentrations observed in the Bay during the Key Largo experiments (85 and 71 pM) were generally much higher than those concentrations observed in surface waters during the Long Key experiments, suggesting a lower dilution rate. However, dilution rates could not be calculated at this location due to the injection method. Dilution rates could be dramatically different at other locations. It is unclear how reactive substances, such as phosphates and dissolved nitrogenous compounds, are effected by subsurface processes of adsorption, dilution and/or degradation. Several other studies currently being conducted in the Keys are investigating the behavior of these reactive substances (FSU, Penn State, and USGS). However, it is clear from the results that no matter which disposal method is used, some contaminates have the ability to reach surficial waters on a short timescale of hours to days.

ACKNOWLEDGMENTS

We thank Bill Kruczynski for guidance and assistance with a boat. Gene Shinn and Chris Reich of the USGS were invaluable to our efforts. Paul Carlson and Chris Schrader also guided and supported our efforts. It was a pleasure working with Lee Kump and his group from Penn State University. The staff at the Keys Marine Lab on Long Key and the National Park Service on Key Largo also greatly facilitated our efforts. Christine Rutkowski assisted with sampling. NOAA-NURC of Key Largo was of major assistance in most of the offshore work as well, providing boat, lab and housing support on several occasions. Jim Fourqurean and Brian Fry provided some of the ^{15}N data.

This work is a compilation of four documents which we intend to submit for publication. The bulk of this work was supported by EPA. However to expedite the publication of the material and in the interest of compiling a coherent document, some of the results presented in this report were supported by funds from other agencies. Particularly the natural tracer (with the exception of the ^{15}N work which was supported by EPA) and seepage measurements collected within Florida Bay were supported by DEP, Seagrant and NOAA-NURC. The Porejoe Key work was obtained on a Seagrant mission

but we wished to compare it to other springs sampled on EPA missions. Additionally, Mr. Dillon was supported by Seagrant funds during part of his tenure at FSU to allow the enhancement of his work.

REFERENCES

Boesch, D., N. Armstrong, C. D'Elia, N. Maynard, H. Paerl and S. Williams, 1993. Deterioration of the Florida Bay Ecosystem: An evaluation of the scientific evidence. Interagency Working Group Report to National Fish and Wildlife Foundation.

Bokuniewicz, H., 1980. Groundwater seepage into Great South Bay, New York. Estuarine and Coastal Marine Science 10, 437-444.

Bokuniewicz, H. and B. Pavlik, 1990. Groundwater seepage along a Barrier Island. Biogeochemistry 10, 257-288.

Bugna, G.C., J.P. Chanton, J.E. Young, W.C. Burnett and P.H. Cable, 1996. Methane as a potential tracer of submarine groundwater discharge into the NE Gulf of Mexico. submited to Geochimical et Cosmochimica Acta.

Cable, J.E., G. Bugna, W.C. Burnett, J. Chanton. 1996. Application of ^{222}Rn and CH_4 for Assessment of Groundwater Discharge to the Coastal Ocean. Limnol. Oceanogr. 41(6), 1437-1444.

Cable J., W. Burnett, J. Chanton, D.R. Corbett, and P. Cable, 1997. Field evaluation of seepage meters for coastal marine work. Est. Coast. Shelf Sci. 45, 367-375.

Capone, D.G. and Bautista, M.F., 1985, A groundwater source of nitrate in nearshore marine sediments. Nature, 313, 214-216.

Capone, D.G. and Slater, J.M., 1990, Interannual patterns of water table height and groundwater derived nitrate in nearshore sediments. Biogeochemistry, 10, 277-288.

Carr, P. A. and Van Der Kamp, G. S. 1969. Determining Aquifer Characteristics by the Tidal Method. Water Resources Res., 5, 1023-1031.

D'Elia, C.F., Webb, K.L., and Porter, J.W., 1981, Nitrate-rich groundwater inputs to Discovery Bay, Jamaica: a significant source of N to local coral reefs Bulletin of Marine Science, 31, 903-910.

Florida Department of Pollution Control, 1973. Survey of water quality in waterways and canals of the Florida Keys with recommendations. Final Report.

Fry, B., 1994. Introductory address at stable isotope session at Second Coastal Wetland Ecology and Management Symposium. Key Largo, Florida.

Halley, R.B. and Evans, C.C., 1983, The Miami limestone: a guide to selected outcrops and their interpretation. Miami Geological Society.

Halley, R.B., Vacher, H.L., and Shinn, E.A., 1995, Geology and Hydrogeology of the Florida Keys. U.S. Geological Survey and Dept. of Geology, University of South Florida.

Hoffmeister, J.E. and Multer, H.G., 1968, Geology and origin of the Florida Keys. Geological Society of America Bulletin, 79, 1487-1502.

Kump, L.R., 1996, Quarterly progress report (EPA Cooperative Agreement #X994870-96-0).

Lapointe, B.E., O'Connell, J.D., and Garrett, G.S., 1990, Nutrient coupling between on-site sewage disposal systems, groundwaters, and nearshore surface waters of the Florida Keys. Biogeochemisrty, 10, 289-307.

Lapointe, B.E. and Clark, M.W., 1992, Nutrient inputs from the watershed and coastal eutrophication in the Florida Keys. Estuaries, 15, 465-476.

Lee, D.R. 1977. A device for measureing seepage flux in lakes and estuaries. Limnol. Oceanogr. 22, 140-147.

Mathieu, G., P. Biscayne, R. Lupton, and D. Hammond. 1988. System for measurements of 222Rn at low levels in natural waters. Health Physics 55, 989-992.

McAuliffe, C. 1971. Gas chromatographic determination of solutes by muliple phase equilibrium. Chem. Technol. 1, 46-51.

McClelland, J.W., I. Valiela, R.H. Michener, 1997. Nitrogen-stable isotope signatures in estuarine food webs: A record of increasing urbanization in coastal watersheds. Limnol. Oceanogr. 42(5), 930-937.

Oberdorfer, J.A., Valentino, M.A., and Smith, S.V., 1990, Groundwater contribution to the nutrient budget of Tomales Bay, California. Biogeochemisrty, 10, 199-216.

Paul, J.H., Rose, J.B., Brown, J., Shinn, E.A., Miller, S., and Farrah, S.R., 1995, Viral tracer studies indicate contamination of marine waters by sewage disposal practices in Key Largo, Florida. Applied and Environmental Microbiology, 61, 2230-2234.

Paul, J.H., Rose, J.B., Jiang, S.C., Zhou, X., Cochran, P., Kellogg, C., Kang, J.B., Griffin, D., Farrah, S., and Lukasik, J, 1997, Evidence for groundwater and surface water contamination by waste disposal wells in the Florida Keys. Water Research, 31, 1448-1454.

Robblee, M.B., Barber, T.R., Carlson, P.R., Durako, M.J., Fourqurean, J.W., Muehlstein, L.K., Porter, D., Yarbro, L.A., Zieman, R.T., and Zieman, J.C., 1991, Mass mortality of the tropical seagrass *Thalassia testudinum* in Florida Bay (USA). Marine Ecology Progress Series, 71, 297-299.

Shaw, R.D. and E.E. Prepas, 1989. Anomalous, short-term influx of water into seepage meters. Limnol. Oceanogr. 34. 1343-1351.

Shinn, E.A, Reese, R.S., and Reich, C.D., 1994, Fate and pathways of injection-well effluent in the Florida Keys. U.S. Geological Survey Open-file report. 94-276, St. Petersburg, Florida.

Sweeny, R.E., E. Kahil, and I.R. Kaplan, 1980. Characterization of domestic and industrial sewage in S. Cal. coastal sediments using N, C, S, and U tracers. Mar. Env. Res. 3, 225-248.

U.S. Environmental Protection Agency, 1991, Water quality protection program for the Florida Keys National Marine Sanctuary, phase 1, Report, Contract No. 68-C8-0105, prepared by Continental Shelf Associates and Batelle Ocean Sciences.

U.S. Environmental Protection Agency, 1996, Water quality protection program for the Florida Keys National Marine Sanctuary, First Biennial Report to Congress.

Vacher, L. H., Wrightman, M. J., and Stewart, M. T., 1992, Hydrology of meteoric diagenesis: effect of Pleistocene stratigraphy on freshwater lenses of Big Pine Key, Florida. In: Fletcher, C. W., III, and Wehmiller, J. F., (eds.), Quaternary Coasts of the United States: Marine and Lacustrine Systems, SEMP Special Publication no. 48, p213-219.

Valiela, I., Costa, J., Foreman, K., Teal, J.M., Howes, B., and Aubrey, D, 1990, Transport of water-borne nutrients from watersheds and theireffects on coastal waters. Biogeochemisrty, 10, 177-198.

Wanninkhof, R., Ledwell, J.R., and Broecker, W.S., 1985, Gas exchange-wind speed relationship measured with sulfur hexafluoride on a lake. Science, 227, 1224-1226.

Wanninkhof, R., Ledwell, J.R., Broecker, W.S., and Hamilton, M., 1987, Gas exchange on Mono Lake and Crowley Lake, California. Journal of Geophysical Research, 92, 14567-14580.

Wanninkhof, R., Ledwell, J.R., and Watson, A.J., 1991, Analysis of sulfur hexafluoride in seawater. Journal of Geophysical Research, 104, 8733-8740.

Watson, A.J. and Liddicoat, M.I., 1985, Recent history of atmospheric trace gas concentrations deduced from measurements in the deep sea: Application to sulfur hexafluoride and carbon tetrachloride. Atmosheric Environment, 19, 1477-1484.

Watson, A.J., Upstill-Goddard, R.C., and Liss, P.S., 1991, Air-sea gas exchange in rough and stormy seas measured by dual-tracer technique. Nature, 349, 145-147.

Watson, A.J., Ledwell, J.R., and Sutherland, S.C., 1991, The Santa Monica Basin tracer experiment: comparison of release methods and performances of perfluorodecalin and sulfur hexafluoride. Journal of Geophysical Research, 104, 8719-8725.

Wilson, R.D. and Mackay, D.M., 1993, SF_6 as a conservative tracer in a saturated sandy media. Groundwater, 31, 719-724.

Zieman, J.C., Fourqurean, J.W., and Iverson, R.L., 1989, Distribution, abundance, and productivity of seagrasses and macroalgaein Florida Bay. Bulletin of Marine Science, 44, 292-311.

Tables

Table 1. Comparison of peak heights between old standards stored in vacutainers and newly prepared standards. Results for each aged standard are given as percentage of fresh standard, averaged from 2 injections from the same vacutainer. Standard deviation of injections is also shown.

Age (days)	% of new standard	standard deviation (%)
7	100.0	0.31
71	94.1	0.52
118	98.7	--
281	97.5	3.75
281	100.3	1.84
281	97.4	0.81
489	96.4	2.24
489	100.9	0.05
489	99.2	2.65
511	100.8	1.88
511	99.8	1.72
511	99.4	2.32

Table 2. Comparison of SF_6 extraction efficiencies for samples collected in Vacutainers (Vac) and serum vials (SV).

sample container	1st extraction peak height	2nd extraction peak height	Extraction Efficiency (%)
Vac	1331959	10371	99.23
Vac	161575	0	100.00
Vac	158887	0	100.00
Vac	162762	0	100.00
SV	47404	2087	95.78
SV	2504586	43065	98.31
SV	87427	3601	96.04
SV	3041126	46909	98.48
SV	81539	2369	97.18

Table 3: Natural tracer concentrations in groundwater wells.

Date/Site	Rn-222 (dpm/L)	Methane (nM)	Ethylene (nM)
February 1995			
NURC, Key Largo	537 ± 6 (n = 2)	96 ± 110 (n = 2)	
April 1995			
Offshore Wells, Atlanic-Side	455 ± 124 (n = 12)	465 ± 498 (n = 11)	
Offshore Wells, Bay-Side	641 ± 293 (n = 3)	655 ± 212 (n = 3)	
Ranger Station, Key Largo	338 ± 67 (n = 2)	322 ± 244 (n = 2)	
May 1996			
Keys Marine Lab, Long Key	245 ± 69 (n = 28)	998 ± 712 (n = 2)	
Ranger Station, Key Largo	442 ± 141 (n = 2)		
December 1996			
Offshore Wells, Bay-Side	615 ± 237 (n = 16)	2520 ± 4756 (n = 16)	15 ± 23 (n = 15)
June 1997			
Offshore Wells, Bay-Side	294 ± 59 (n = 8)	545 ± 499 (n = 8)	
Total Average =	**398± 208 (n = 73)**	**1241 ± 2997 (n = 44)**	**15 ± 23 (n = 15)**

Table 4: Samples collected throughout the study period in Florida Bay and the Atlantic Ocean along the Florida Keys. Samples are arranged by geographic region. Concentrations and location are given for each sample.

SAMPLE ID	Date	Latitude	Longitude	Ra Activity dpm/L	EXCESS Rn Activity dpm/L	TOTAL Rn Activity dpm/L	Methane (nM)	Conc. Ethylene (nM)
Mid-Bay								
FB #1 10/24/95 (~8)	Oct. 95	24.89	-80.76	0.83 ± 0.05	0.23 ± 0.08	1.06 ± 0.09	7.78 ± 0.10	0.19
FB #2 10/24/95 (~7)	Oct. 95	24.92	-80.71	0.42 ± 0.03	1.24 ± 0.07	1.66 ± 0.08	6.62 ± 0.16	0.35
FB #3 10/24/95 (~6)	Oct. 95	24.95	-80.66	0.52 ± 0.03	0.69 ± 0.06	1.21 ± 0.07	7.64 ± 0.20	0.21
FB #4 10/24/95 (~7)	Oct. 95	25.03	-80.53	1.31 ± 0.05	3.68 ± 0.14	4.99 ± 0.15	29.74 ± 0.36	0.74
FB #5 10/25/95	Oct. 95	24.95	-80.78	1.41 ± 0.04	1.10 ± 0.09	2.51 ± 0.10	14.10 ± 0.50	0.46
FB #6 10/25/95	Oct. 95	25.00	-80.79	1.57 ± 0.04	0.00 ± 0.06	1.57 ± 0.08	15.48 ± 0.59	0.59
FB #7 10/24/95 (~6 ft)	Oct. 95	24.99	-80.88	1.64 ± 0.06	1.31 ± 0.12	2.95 ± 0.13	25.75 ± 1.23	0.62
FB #8 10/25/95	Oct. 95	25.02	-80.93	1.39 ± 0.06	2.06 ± 0.11	3.45 ± 0.13	16.18 ± 0.81	0.49
FB #9 10/25/95	Oct. 95	25.04	-89.07	1.43 ± 0.06	2.39 ± 0.12	3.82 ± 0.14	15.10 ± 0.77	1.03
FB #10 10/25/95 (~3)	Oct. 95	25.07	-80.94	1.49 ± 0.04	3.87 ± 0.14	5.36 ± 0.15	20.05 ± 1.21	0.63
FB #11 10/25/95 (~7)	Oct. 95	24.98	-80.93	1.40 ± 0.04	2.92 ± 0.12	4.32 ± 0.13	16.79 ± 0.05	0.41
FB #12 10/25/95 (~8)	Oct. 95	24.99	-80.98	1.31 ± 0.04	3.45 ± 0.12	4.76 ± 0.13	9.27 ± 0.19	0.37
FB #13 10/25/95 (~9)	Oct. 95	24.92	-80.93	1.03 ± 0.03	3.24 ± 0.12	4.27 ± 0.12	14.30 ± 0.39	0.35
FB #14 10/25/95 (~7)	Oct. 95	24.88	-80.85	1.06 ± 0.05	1.28 ± 0.10	2.34 ± 0.11	10.59 ± 0.61	0.43
FB #15 (N. Buch.) 10/25/95	Oct. 95	24.93	-80.77	1.21 ± 0.07	0.95 ± 0.11	2.16 ± 0.13	6.09 ± 0.44	0.42
FB #16 10/26/95 (~6)	Oct. 95	25.09	-80.58	1.52 ± 0.06	4.07 ± 0.16	5.59 ± 0.17	8.59 ± 0.22	0.25
FB #17 10/26/95 (~7)	Oct. 95	25.04	-80.61	1.40 ± 0.06	3.72 ± 0.14	5.12 ± 0.16	18.54 ± 0.28	0.42
FB #18 10/27/95	Oct. 95	25.01	-80.68	1.46 ± 0.06	1.42 ± 0.11	2.88 ± 0.12	10.66 ± 0.46	0.50
FB #19 10/27/95 (~7)	Oct. 95	25.01	-80.69	1.15 ± 0.05	1.41 ± 0.09	2.56 ± 0.10	17.42 ± 0.72	0.56
FB #20 10/27/95 (7)	Oct. 95	24.97	-80.70	1.10 ± 0.03	1.36 ± 0.08	2.46 ± 0.09	6.48 ± 0.20	0.31
FB #49 Green Mangrove Key	Oct. 95	24.92	-80.83	1.12 ± 0.05	1.50 ± 0.10	2.62 ± 0.11	11.90 ± 0.02	0.49
Arnsickers Seepage Site 11/2	Oct. 95	24.92	-80.83	1.22 ± 0.05	3.21 ± 0.14	4.43 ± 0.15	20.87 ± 0.64	0.85
FB #51 Twin Key Basin	Oct. 95	24.96	-80.79	1.39 ± 0.05	1.77 ± 0.11	3.16 ± 0.12	23.77 ± 0.71	0.54
FB #52 Steam Boat	Oct. 95	24.94	-80.68	0.40 ± 0.04	1.65 ± 0.09	2.05 ± 0.10	9.27 ± 0.17	0.41
FB #55 Rabbit Key Basin	Oct. 95	24.98	-80.85	1.47 ± 0.05	2.58 ± 0.14	4.05 ± 0.15	44.18 ± 5.03	1.01
FB #56 Rabbit Key West	Oct. 95	25.00	-80.89	1.43 ± 0.06	2.91 ± 0.14	4.34 ± 0.15	26.35 ± 0.62	0.52
FB #57 Johnson Key Basin	Oct. 95	25.06	-80.93	1.70 ± 0.05	0.72 ± 0.11	2.42 ± 0.12	31.22 ± 0.85	0.63
Lower Arsnicks 10/25/95	Oct. 95	25.00	-80.83	1.34 ± 0.04	2.16 ± 0.10	3.50 ± 0.11	20.52 ± 0.79	0.95
BS #47	26-Jun-97	25.07	-80.67	1.35 ± 0.07	1.19 ± 0.11	2.54 ± 0.13	16.58	1.82 ± 0.43
BS #49	26-Jun-97	25.08	-80.77	1.64 ± 0.08	1.32 ± 0.12	2.96 ± 0.15	18.14	2.25 ± 0.14
BS #50	26-Jun-97	25.10	-80.62	2.02 ± 0.09	0.69 ± 0.13	2.71 ± 0.15	5.43	1.75 ± 0.78
BS #51	26-Jun-97	25.10	-80.60	2.94 ± 0.12	0.00 ± 0.17	2.94 ± 0.21	4.58	1.52 ± 0.32
BS #62	27-Jun-97	25.04	-80.67	2.28 ± 0.07	3.98 ± 0.16	6.26 ± 0.17	27.35	6.30 ± 0.70

Table 4: Continued.

BS #71	30-Jun-97	25.06	-80.92	1.96	±	0.07	5.95	±	0.21	7.91	±	0.22	28.55			5.02	±	0.26
BS #72	30-Jun-97	25.01	-80.92	1.49	±	0.05	5.55	±	0.18	7.04	±	0.19	16.05			3.73	±	0.30
BS #73	30-Jun-97	24.99	-80.87	1.47	±	0.06	3.19	±	0.15	4.66	±	0.16	28.47			4.40	±	0.16
BS #74	30-Jun-97	24.98	-80.79	1.66	±	0.06	3.03	±	0.14	4.68	±	0.15	10.85			4.44	±	0.40
BS #75	30-Jun-97	24.97	-80.69	1.74	±	0.05	2.12	±	0.12	3.85	±	0.13	7.03			2.78	±	0.43
			Average:	**1.40**	±	**0.46**	**2.21**	±	**1.43**	**3.61**	±	**1.57**	**16.53**	±	**8.96**	**1.28**	±	**1.52**
Key-Bay-Side																		
Hammer Point Basin 7ft.	1-Mar-95	25.45	-80.52	1.31	±	0.05	4.17	±	0.20	5.48	±	0.21	21.25	±	0.09	2.10		
Tavernier Basin 7ft.	1-Mar-95	25.00	-80.54	1.05	±	0.04	6.36	±	0.22	7.42	±	0.22	43.43	±	0.65	2.98		
Little Buttonwood Sound	2-Mar-95	25.14	-80.35	1.09	±	0.04	4.08	±	0.19	5.16	±	0.19	28.64	±	0.60	1.04	±	0.03
Tarpon Basin 1.0m	2-Mar-95	25.12	-80.43	1.66	±	0.06	3.73	±	0.20	5.38	±	0.21	30.82	±	0.48	3.50		
Tarpon Basin 2.0m	2-Mar-95	25.12	-80.43	1.55	±	0.05	4.82	±	0.22	6.37	±	0.22	32.52	±	0.75	2.67		
Sheraton #1 10/23/95 (~2.5)	Oct. 95	25.07	-80.47	0.28	±	0.03	7.29	±	0.17	7.57	±	0.18	28.17	±	6.90	1.12		
Sheraton #2 10/23/95 (~3)	Oct. 95	25.07	-80.47	1.48	±	0.06	5.64	±	0.18	7.12	±	0.19	28.26	±	5.73	1.32		
Sheraton #3 10/23/95 (~4)	Oct. 95	25.07	-80.47	1.53	±	0.06	5.90	±	0.18	7.43	±	0.19	27.19	±	1.75	1.82		
Sheraton #4 10/23/95 (~5)	Oct. 95	25.07	-80.47	1.64	±	0.06	5.22	±	0.17	6.86	±	0.18	25.22	±	0.79	1.70		
FB #21 Hammer Pt. 10/30/95	Oct. 95	25.45	-80.52	1.75	±	0.06	2.51	±	0.13	4.26	±	0.15	24.50	±	0.84	0.91		
Hammer Point 10/23/95 (4)	Oct. 95	25.45	-80.52	0.37	±	0.03	5.05	±	0.14	5.42	±	0.14	39.78	±	5.91	0.80		
Hammer Point 10/24/95 (~3)	Oct. 95	25.45	-80.52	1.48	±	0.06	6.46	±	0.20	7.94	±	0.21	31.74	±	2.52	1.11		
Hammer Point 10/26/95 (3.5)	Oct. 95	25.45	-80.52	1.25	±	0.03	5.49	±	0.17	6.74	±	0.17	42.34	±	2.45	1.90		
Hammer Point #1 10/27/95	Oct. 95	25.45	-80.52	1.17	±	0.05	5.07	±	0.16	6.24	±	0.17	38.40	±	0.63	1.17		
Hammer Point #2 10/27/95	Oct. 95	25.45	-80.52	1.33	±	0.05	6.03	±	0.18	7.36	±	0.19	37.71	±		1.18		
Hammer Point #3 10/27/95	Oct. 95	25.45	-80.52	1.14	±	0.05	6.16	±	0.18	7.30	±	0.19	43.60	±	3.76	1.28		
Hammer Point #4 10/27/95	Oct. 95	25.45	-80.52	1.24	±	0.05	6.47	±	0.18	7.71	±	0.19	44.96	±	1.90	1.22		
FB #24 Buttonwood Sound	Oct. 95	25.12	-80.44	1.80	±	0.07	3.54	±	0.16	5.34	±	0.17	88.62	±	13.95	1.32		
FB#26 Tarpon Basin 10/30/95	Oct. 95	25.12	-80.42	3.08	±	0.09	2.21	±	0.18	5.29	±	0.20	65.45	±	0.53	1.21		
FB#27 Stellrich Point 10/30/95	Oct. 95	25.16	-80.40	1.42	±	0.06	5.70	±	0.18	7.12	±	0.19	77.02	±	4.93	4.14		
FB #28 Sexton Cove	Oct. 95	25.17	-80.39	1.40	±	0.05	1.21	±	0.10	2.61	±	0.11	80.72	±	4.26	1.24		
FB #30 Tavernier Basin (~6)	Oct. 95	25.00	-80.54	1.22	±	0.06	0.47	±	0.09	1.69	±	0.11	14.48	±	0.94	0.78		
FB #37A Tarpon Basin	Oct. 95	25.12	-80.43	1.42	±	0.06	1.32	±	0.11	2.74	±	0.13	47.17	±	8.28	0.51		
FB#37 Blackwater S. 10/31/95	Oct. 95	25.19	-80.42	1.33	±	0.05	3.44	±	0.13	4.77	±	0.14	53.89	±	0.25	1.15		
FB#38 B.water Sound SE	Oct. 95	25.15	-80.41	1.02	±	0.06	1.10	±	0.10	2.12	±	0.12	22.09	±	0.31	0.41		
FB #39 B.water Sound-Rowells	Oct. 95	25.15	-80.40	1.31	±	0.08	4.56	±	0.18	5.87	±	0.20	53.78	±	0.65	1.14		
Tavernier 10/24/95 (~4)	Oct. 95	25.01	-80.55	1.27	±	0.06	5.22	±	0.17	6.49	±	0.18	75.97	±		2.14		
FB #46 Rock Harbor	Oct. 95	25.08	-80.47	1.72	±	0.06	6.51	±	0.20	8.23	±	0.21	36.29	±	4.15	0.68	±	0.07
FB #47 Pigeon Key 11/1/95	Oct. 95	25.04	-80.51	1.32	±	0.06	2.58	±	0.12	3.90	±	0.14	16.82	±	5.10	0.56	±	0.07
FB #53 Mid. Matecumbe	Oct. 95	24.94	-80.64	0.62	±	0.04	1.96	±	0.11	2.58	±	0.11	22.68	±	1.17	0.50		
FB #54 Islamorada	Oct. 95	24.93	-80.63	0.61	±	0.04	3.71	±	0.15	4.32	±	0.16	45.44	±	0.91	0.83		
UMK #1 (8)	Oct. 95	24.94	-80.62	0.73	±	0.05	1.38	±	0.09	2.11	±	0.10	22.99	±	0.38	0.55	±	0.05
UMK #2 (~6)	Oct. 95	24.94	-80.62	0.83	±	0.05	1.85	±	0.09	2.68	±	0.10	35.55	±	1.93	0.56	±	0.05

Table 4: Continued.

UMK 10/24/95 (~3)	Oct. 95	24.94	-80.62	0.86	±	0.05	1.78	±	0.10	2.64	±	0.11	39.24	±	0.42	0.88		
UMK 10/27/95 (~3)	Oct. 95	24.94	-80.62	0.68	±	0.02	3.66	±	0.11	4.34	±	0.11	47.96	±	3.40	1.12		
BS#1	7-May-96	25.00	-80.55	1.26	±	0.07	1.33	±	0.09	2.59	±	0.11	13.05	±	0.18	1.91		
BS#3	7-May-96	25.08	-80.46	1.91	±	0.08	4.87	±	0.18	6.78	±	0.20	15.56	±	5.70	2.06	±	0.63
BS#4	8-May-96	25.09	-80.45	2.56	±	0.06	1.94	±	0.13	4.50	±	0.14	21.06	±	0.93			
BS#5	8-May-96	25.08	-80.47	1.91	±	0.08	3.87	±	0.16	5.78	±	0.18	23.88	±	0.87	2.26		
BS#6	8-May-96	25.07	-80.47	1.91	±	0.08	3.00	±	0.14	4.91	±	0.16	23.18	±	0.34			
BS#7	8-May-96	25.06	-80.48	1.91	±	0.08	3.67	±	0.15	5.58	±	0.17	17.75	±	0.20	2.11		
BS#8	8-May-96	25.07	-80.47	1.87	±	0.08	3.68	±	0.19	5.54	±	0.21	14.83	±	2.65	1.38	±	0.11
BS#9	8-May-96	25.04	-80.51	1.76	±	0.06	0.82	±	0.11	2.58	±	0.13	12.20	±	0.14			
BS#10	8-May-96	25.03	-80.51	1.59	±	0.07	2.21	±	0.15	3.80	±	0.17	14.36	±	2.39	1.56	±	0.28
BS#11	8-May-96	25.03	-80.51	1.65	±	0.08	5.35	±	0.22	7.01	±	0.23	106.29	±	18.40	1.91	±	0.49
BS#13	8-May-96	25.02	-80.51	1.69	±	0.07	5.19	±	0.17	6.88	±	0.18	29.10	±	2.18	2.08	±	0.52
BS#15	8-May-96	24.98	-80.56	0.73	±	0.05	1.21	±	0.08	1.93	±	0.09	15.24	±	1.90	1.22	±	0.14
BS#16	8-May-96	24.96	-80.57	0.73	±	0.05	1.23	±	0.08	1.96	±	0.09	17.04	±	0.84			
BS#18	9-May-96	25.07	-80.47	1.80	±	0.08	4.25	±	0.14	6.05	±	0.16	23.77	±	1.21	2.39	±	0.36
BS#19	10-May-96	25.07	-80.47	1.80	±	0.08	4.49	±	0.15	6.30	±	0.17	19.50	±	0.29			
BS#20	14-May-96	25.07	-80.47	2.04	±	0.07	8.90	±	0.25	10.94	±	0.26	40.21	±	5.45	3.33	±	0.49
BS#21	14-May-96	25.06	-80.48	2.07	±	0.07	6.58	±	0.27	8.65	±	0.28	36.58	±	5.92	3.35	±	0.40
BS#22	6-Aug-96	24.81	-80.84	0.58	±	0.04	1.82	±	0.10	2.39	±	0.11	15.70	±				
BS#23	6-Aug-96	24.82	-80.83	0.74	±	0.04	1.34	±	0.10	2.08	±	0.11	12.17	±				
BS#24	6-Aug-96	24.82	-80.82	0.63	±	0.04	1.14	±	0.10	1.77	±	0.11	13.17	±				
BS#25	6-Aug-96	24.83	-80.82	0.65	±	0.04	1.11	±	0.10	1.76	±	0.11	10.45	±				
BS#26	6-Aug-96	24.84	-80.80	0.62	±	0.03	1.56	±	0.10	2.17	±	0.11	20.94	±				
BS#27	6-Aug-96	24.84	-80.81	1.08	±	0.06	0.88	±	0.13	1.96	±	0.14	11.56	±				
BS #76	1-Jul-97	24.97	-80.56	1.37	±	0.05	2.30	±	0.13	3.67	±	0.14	36.36	±		14.20	±	0.59
BS #77	1-Jul-97	24.97	-80.56	1.28	±	0.05	3.41	±	0.14	4.69	±	0.14	38.49	±		15.48	±	0.77
BS #78	1-Jul-97	25.00	-80.54	1.75	±	0.06	4.08	±	0.17	5.83	±	0.18	35.54	±		17.60	±	0.35
BS #79	1-Jul-97	25.02	-80.52	1.76	±	0.06	7.38	±	0.22	9.14	±	0.23	52.04	±		15.30	±	0.10
BS #80	1-Jul-97	25.07	-80.47	2.45	±	0.05	9.43	±	0.27	11.87	±	0.27	41.52	±		18.34	±	0.38
BS #81	1-Jul-97	25.09	-80.46	2.84	±	0.06	9.44	±	0.28	12.28	±	0.28	53.90	±		19.13	±	1.21
BS #82	1-Jul-97	25.10	-80.44	2.90	±	0.06	4.53	±	0.19	7.43	±	0.20	45.89	±		16.15	±	0.51
BS #83	1-Jul-97	25.12	-80.43	2.50	±	0.05	4.33	±	0.18	6.83	±	0.19	81.55	±		14.87	±	0.64
BS #84	1-Jul-97	25.16	-80.40	1.98	±	0.04	2.34	±	0.13	4.32	±	0.13	40.63	±		15.43	±	0.35
			Average:	**1.44**	±	**0.61**	**3.89**	±	**2.21**	**5.32**	±	**2.49**	**35.35**	±	**20.45**	**3.92**	±	**5.55**
North Coast																		
FB #36 Long Sound 10/31/95	Oct. 95	25.23	-80.48	0.75	±	0.05	1.06	±	0.08	1.81	±	0.10	9.49	±	0.60			
FB #41 L. BWS	Oct. 95	25.21	-80.44	0.12	±	0.04	2.15	±	0.09	2.27	±	0.10	5.65	±	1.09			
FB #58 Bradley Key	Oct. 95	25.12	-80.95	0.91	±	0.04	0.63	±	0.06	1.54	±	0.07	13.86	±	0.62	0.45	±	0.23
FB #59 Flamingo Key	Oct. 95	25.13	-80.92	0.68	±	0.04	2.69	±	0.12	3.37	±	0.13	50.73	±	3.83	1.25	±	0.11

Table 4: Continued.

FB #60 Tin Can Channel	Oct. 95	25.13	-80.86	1.21	±	0.05	0.32	±	0.07	1.53	±	0.08	29.21	±	1.67	0.69	±	0.04
BS #34	24-Jun-97	25.18	-80.57	1.31	±	0.06	1.91	±	0.11	3.22	±	0.13	8.34			1.66		
BS #35	24-Jun-97	25.18	-80.59	1.43	±	0.07	3.66	±	0.15	5.09	±	0.16	13.87			2.35	±	0.66
BS #36	24-Jun-97	25.18	-80.61	1.38	±	0.06	2.43	±	0.12	3.80	±	0.14	15.37			1.66	±	0.09
BS #37	24-Jun-97	25.14	-80.64	1.83	±	0.08	1.59	±	0.14	3.42	±	0.16	8.01			2.24	±	0.63
BS #38	24-Jun-97	25.14	-80.62	2.15	±	0.08	1.27	±	0.13	3.42	±	0.15	6.43			1.58	±	0.66
BS #41	25-Jun-97	25.11	-81.03	1.78	±	0.07	1.05	±	0.12	2.83	±	0.14	11.64			2.91	±	0.15
BS #42	25-Jun-97	25.11	-81.09	1.81	±	0.07	1.12	±	0.12	2.93	±	0.14	10.22			1.86		
BS #44	25-Jun-97	25.09	-81.00	1.61	±	0.10	3.19	±	0.17	4.80	±	0.20	14.64			2.78	±	0.55
BS #44*	25-Jun-97	25.09	-81.00	1.61	±	0.10	2.56	±	0.15	4.17	±	0.18						
BS #46	25-Jun-97	25.12	-80.83	1.62	±	0.08	1.52	±	0.12	3.14	±	0.14	15.50			2.48	±	0.55
BS #46*	25-Jun-97	25.12	-80.83	1.62	±	0.08	1.56	±	0.12	3.18	±	0.15						
BS #48	26-Jun-97	25.11	-80.72	1.82	±	0.08	2.98	±	0.15	4.80	±	0.17	23.55			1.87	±	0.26
BS #64	30-Jun-97	25.11	-80.79	1.63	±	0.07	2.15	±	0.13	3.79	±	0.15	71.61			4.62	±	0.52
BS #65	30-Jun-97	25.14	-80.81	1.75	±	0.07	2.90	±	0.16	4.64	±	0.17	21.71			3.27	±	0.33
BS #66	30-Jun-97	25.13	-80.81	1.74	±	0.06	2.51	±	0.14	4.25	±	0.16	13.84			2.25	±	0.34
BS #67	30-Jun-97	25.11	-80.74	0.57	±	0.03	2.74	±	0.10	3.31	±	0.11	223.01			4.47	±	0.30
BS #68	30-Jun-97	25.12	-80.90	2.29	±	0.07	3.06	±	0.16	5.35	±	0.18	16.54			2.30	±	0.28
BS #69	30-Jun-97	25.12	-80.93	1.87	±	0.07	3.25	±	0.17	5.13	±	0.19	11.00			2.15	±	0.55
BS #70	30-Jun-97	25.11	-80.95	1.91	±	0.06	2.39	±	0.14	4.30	±	0.15	6.49			1.49	±	0.43
			Average:	**1.48**	±	**0.53**	**2.11**	±	**0.90**	**3.59**	±	**1.11**	**27.31**	±	**46.37**	**2.22**	±	**1.05**
Mid North East																		
FB #31 Elbow 10/31/95	Oct. 95	25.02	-80.51	1.62	±	0.06	1.15	±	0.10	2.77	±	0.12	21.84	±	1.02	0.51		
FB #32 East Bay 10/31/95	Oct. 95	25.18	-80.46	1.37	±	0.06	0.94	±	0.10	2.31	±	0.12	8.56	±	0.21	0.28	±	0.01
FB #33 Shell Key	Oct. 95	25.19	-80.45	1.54	±	0.06	4.16	±	0.16	5.70	±	0.17	16.76	±	3.64	0.30		
FB #34 Snipe Point 10/31/95	Oct. 95	25.20	-80.51	1.39	±	0.06	6.54	±	0.19	7.93	±	0.20	18.52	±	1.80	0.42	±	0.09
FB #35 Stump Pass 10/31/95	Oct. 95	25.20	-80.54	0.67	±	0.05	4.13	±	0.14	4.80	±	0.15	10.88	±	1.00	0.21		
FB #40 Mid BWS	Oct. 95	25.18	-80.42	1.34	±	0.06	0.43	±	0.09	1.77	±	0.11	21.14					
FB #42 Duck Key	Oct. 95	25.18	-80.50	1.55	±	0.05	1.45	±	0.10	3.00	±	0.11	7.25					
FB #43 Eagle Key	Oct. 95	25.15	-80.59	1.34	±	0.06	1.16	±	0.11	2.50	±	0.13	5.24	±	0.11			
FB #44 Nest Key	Oct. 95	25.14	-80.52	1.57	±	0.05	1.62	±	0.11	3.19	±	0.12	5.11	±	0.19	0.19		
FB #45 Porjoe Key	Oct. 95	25.14	-80.48	0.51	±	0.03	2.63	±	0.10	3.14	±	0.10	9.95	±	0.21	0.35		
BS#17	9-May-96	25.14	-80.47	2.22	±	0.11	0.23	±	0.10	2.46	±	0.11	6.97	±	0.23			
BS #28	24-Jun-97	25.18	-80.46	2.27	±	0.08	3.40	±	0.17	5.67	±	0.18	13.39			1.86	±	0.22
BS #29	24-Jun-97	25.18	-80.48	2.70	±	0.09	1.33	±	0.15	4.03	±	0.18	10.12			2.20	±	0.30
BS #30	24-Jun-97	25.18	-80.50	2.15	±	0.08	1.19	±	0.13	3.33	±	0.15	9.08			1.89	±	0.19
BS #31	24-Jun-97	25.18	-80.51	2.57	±	0.10	0.79	±	0.16	3.35	±	0.19	7.94			1.64	±	0.21
BS #31*	24-Jun-97	25.18	-80.51	2.60	±	0.09	0.70	±	0.14	3.30	±	0.16						
BS #32	24-Jun-97	25.18	-80.53	2.43	±	0.08	0.77	±	0.13	3.20	±	0.16	6.23			1.78	±	0.54

Table 4: Continued.

BS #33	24-Jun-97	25.17	-80.55	2.31	±	0.09	1.78	±	0.16	4.09	±	0.19	12.42			1.28	±	0.46
BS #39	24-Jun-97	25.14	-80.61	2.33	±	0.09	1.69	±	0.16	4.03	±	0.18	7.60			3.15	±	1.42
BS #40	24-Jun-97	25.14	-80.59	2.35	±	0.08	0.66	±	0.13	3.01	±	0.15	4.92			2.36	±	0.45
BS #52	26-Jun-97	25.10	-80.59	1.80	±	0.08	0.65	±	0.12	2.45	±	0.14	3.93			1.29	±	0.46
BS #53	26-Jun-97	25.10	-80.57	1.34	±	0.07	3.38	±	0.14	4.73	±	0.16	7.90			2.00	±	0.37
BS #54	26-Jun-97	25.10	-80.55	2.45	±	0.10	4.29	±	0.20	6.74	±	0.22	8.58			1.73	±	0.30
BS #55	26-Jun-97	25.14	-80.55	1.69	±	0.08	6.07	±	0.20	7.76	±	0.21	13.11			1.62	±	0.05
BS #56	26-Jun-97	25.14	-80.53	3.10	±	0.12	0.00	±	0.17	3.10	±	0.21	4.23			2.40	±	0.90
BS #57	26-Jun-97	25.10	-80.53	2.66	±	0.17	0.60	±	0.22	3.26	±	0.28	4.68			1.91	±	0.24
BS #57*	26-Jun-97	25.10	-80.53	2.66	±	0.11	0.86	±	0.16	3.52	±	0.20						
BS #59	27-Jun-97	25.14	-80.47	2.54	±	0.09	4.09	±	0.19	6.63	±	0.21	35.84			2.85	±	0.44
BS #86	1-Jul-97	25.21	-80.45	1.53	±	0.05	3.67	±	0.15	5.19	±	0.16	22.52			4.83	±	1.60
BS #87	1-Jul-97	25.18	-80.42	2.15	±	0.06	5.55	±	0.21	7.70	±	0.22	56.04			7.20	±	0.05
			Average:	**1.96**	±	**0.63**	**2.20**	±	**1.86**	**4.16**	±	**1.75**	**12.88**	±	**11.13**	**1.84**	±	**1.59**
Miscellaneous																		
Tavernier Hole 10/23/95	Oct. 95	25.00	-80.54	0.36	±	0.02	13.12	±	0.28	13.48	±	0.28	89.97	±	10.28	1.57	±	0.05
Tavernier Hole 10/24/95 (~12)	Oct. 95	25.01	-80.55	1.78	±	0.07	19.80	±	0.43	21.58	±	0.44	238.89	±	7.62	1.84	±	0.00
Tavernier Hole 10/26/95 (~15)	Oct. 95	25.01	-80.55	5.67	±	0.15	0.86	±	0.24	6.53	±	0.29	2029.21					
Tavernier Hole 10/26/95 (10)	Oct. 95	25.01	-80.55	1.86	±	0.06	21.29	±	0.08	23.15	±	0.10	466.42	±	59.60	2.25		
Tavernier Hole 10/26/95 (16)	Oct. 95	25.01	-80.55	7.58	±	0.14	120.86	±	2.36	128.44	±	2.36	2196.00	±	67.24	2.80		
Tavernier Hole10/26/95*(dup)	Oct. 95	25.01	-80.55	2.17	±	0.04	22.49	±	0.49	24.66	±	0.49						
Tavernier Hole10/26/95 (12)	Oct. 95	25.01	-80.55	1.75	±	0.06	21.54	±	0.46	23.29	±	0.47	456.62	±	42.08	2.47		
FB #29 Tavernier Hole (~3m)	Oct. 95	25.01	-80.55	2.75	±	0.09	18.81	±	0.46	21.56	±	0.47	959.55	±	45.95	3.41	±	0.21
FB #25 Tarpon Basin Canal	Oct. 95	25.11	-80.43	1.38	±	0.06	8.96	±	0.24	10.34	±	0.24	562.26	±	93.43	2.80		
FB #22 Hammer Pt. Canal	Oct. 95	25.03	-80.51	1.40	±	0.10	4.04	±	0.20	5.44	±	0.23	64.62	±	0.36	1.46		
FB #48 Hammer Point Canal	Oct. 95	25.03	-80.51	6.14	±	0.13	22.58	±	0.60	28.72	±	0.61	3849.67	±	110.96	1.56	±	0.36
Snake Creek #1 (~10)	Oct. 95	24.96	-80.59	0.63	±	0.04	1.41	±	0.08	2.04	±	0.09	13.36	±	1.05	0.40	±	0.02
Snake Creek #2	Oct. 95	24.96	-80.59	0.58	±	0.04	1.72	±	0.08	2.30	±	0.09	15.09	±	1.31	0.59	±	0.12
Snake Creek #3 10/23/95 (8)	Oct. 95	24.96	-80.59	0.15	±	0.02	3.56	±	0.10	3.71	±	0.10	25.06	±	1.71	0.44	±	0.05
Tavernier Basin 10/23/95	Oct. 95	25.00	-80.54	1.50	±	0.06	26.64	±	0.54	28.14	±	0.55	5568.22	±	371.00	2.75	±	0.08
BS#2	7-May-96	25.00	-80.54	1.41	±	0.06	4.72	±	0.14	6.12	±	0.15	57.07			3.05	±	0.09
BS#12	8-May-96	25.03	-80.51	2.18	±	0.08	16.44	±	0.38	18.62	±	0.39	466.87			6.40	±	0.25
BS#14	8-May-96	25.03	-80.51	1.76	±	0.09	18.27	±	0.41	20.03	±	0.42	742.40			4.03	±	0.09
Reef Side																		
RS#1	6-May-96	25 04.42	80 23.45	0.22	±	0.02	0.41	±	0.04	0.63	±	0.04	11.59	±	1.57			

Table 4: Continued.

RS#2	6-May-96	25 00.89	80 22.61	0.22	±	0.02	0.02	±	0.03	0.23	±	0.03	4.91	±	0.19			
RS#3	6-May-96	25 01.42	80 23.45	0.22	±	0.02	0.66	±	0.03	0.88	±	0.04	8.33	±	0.07			
RS#4	6-May-96	25 01.80	80 24.12	0.16	±	0.02	0.72	±	0.04	0.88	±	0.04	9.48	±	0.05			
RS#5	6-May-96	25 03.44	80 26.90	0.16	±	0.02	0.49	±	0.04	0.65	±	0.05	9.32	±	0.29			
RS#6	6-May-96	25 04.17	80 27.46	0.64	±	0.02	1.23	±	0.07	1.87	±	0.07	10.89	±	0.35			
RS#7	6-May-96	25 03.89	80 27.95	0.64	±	0.02	1.51	±	0.05	2.15	±	0.06	8.73	±	0.04			
RS#8	6-May-96	25 03.54	80 28.32	0.42	±	0.03	0.66	±	0.04	1.07	±	0.05	7.21	±	0.51			
RS#9	7-May-96	25 02.61	80 29.04	0.61	±	0.02	0.60	±	0.04	1.21	±	0.05	5.58	±	0.23	5.97		0.47
RS#10	7-May-96	25 00.84	80 30.25	0.94	±	0.05	0.74	±	0.07	1.68	±	0.09	9.41	±	0.76			
RS#11	7-May-96	25 00.55	80 30.76	1.04	±	0.06	1.98	±	0.11	3.02	±	0.13	14.74	±	0.37			
RS#12	7-May-96	25 00.30	80 30.95	0.86	±	0.05	1.04	±	0.09	1.90	±	0.10	8.27	±	0.03			
RS#13	7-May-96	24 59.56	80 29.77	0.31	±	0.04	0.29	±	0.06	0.60	±	0.07	6.36	±	0.35			
RS#14	9-May-96	25 04.17	80 27.65	0.59	±	0.04	0.57	±	0.06	1.17	±	0.08	8.30	±	0.51			
RS#14	9-May-96	25 04.17	80 27.65	0.58	±	0.05	0.76	±	0.08	1.34	±	0.09		±				
RS#15	10-May-96	25 04.17	80 27.65	0.61	±	0.05	0.87	±	0.07	1.48	±	0.08	8.59	±	0.31			
RS#16	10-May-96	25 04.17	80 27.65	0.61	±	0.05	1.01	±	0.07	1.61	±	0.08	8.30	±	0.13			
RS#17	10-May-96	25 06.65	80 20.50	0.42	±	0.04	0.23	±	0.05	0.65	±	0.06	9.82	±	0.03			
RS#18	10-May-96	25 06.72	80 18.32	0.24	±	0.04	0.00	±	0.04	0.24	±	0.05	4.83	±	1.63			
RS#19	10-May-96	25 07.46	80 18.00	0.18	±	0.03	0.10	±	0.04	0.27	±	0.05	4.47	±	0.53			
RS#20	10-May-96	25 08.11	80 19.22	0.27	±	0.03	0.25	±	0.04	0.52	±	0.06	9.96	±	0.17			
RS#21	10-May-96	25 08.23	80 22.07	0.45	±	0.04	0.00	±	0.05	0.45	±	0.06	4.13	±	0.23			
RS#22	12-May-96	25 12.99	80 17.33	0.25	±	0.02	0.47	±	0.05	0.71	±	0.05	13.90	±	0.96			
RS#23	12-May-96	25 13.27	80 15.82	0.23	±	0.02	0.75	±	0.05	0.97	±	0.06	11.93	±	0.23			
RS#24	12-May-96	25 13.42	80 13.01	0.27	±	0.02	0.28	±	0.04	0.54	±	0.05	6.16	±	0.25			
RS#25	12-May-96	25 16.41	80 12.51	0.29	±	0.03	0.19	±	0.04	0.48	±	0.05	5.67	±	0.09			
RS#26	12-May-96	25 16.28	80 13.91	0.31	±	0.02	0.22	±	0.05	0.53	±	0.05	10.54	±	0.35			
RS#27	12-May-96	25 16.81	80 16.76	0.65	±	0.03	2.14	±	0.09	2.79	±	0.10	10.28	±	0.35			
RS#28	13-May-96	25 04.71	80 25.36	0.41	±	0.02	0.57	±	0.06	0.98	±	0.06	12.12	±	0.27	1.92		0.04
RS#29	13-May-96	25 03.66	80 21.41	0.24	±	0.01	0.51	±	0.05	0.75	±	0.05	15.84	±	0.99	1.19		0.24
RS#30	13-May-96	25 01.99	80 20.95	0.23	±	0.01	0.21	±	0.04	0.44	±	0.04	5.17	±	0.15			
RS#31	13-May-96	25 09.03	80 17.65	0.19	±	0.01	0.77	±	0.05	0.96	±	0.05	7.55	±	0.41			
RS#32	13-May-96	25 13.29	80 19.37	0.55	±	0.02	1.80	±	0.08	2.35	±	0.08	7.25	±	0.20			
RS#33	13-May-96	25 11.49	80 20.51	0.40	±	0.02	1.96	±	0.08	2.35	±	0.08	16.04	±	0.02	1.67		0.09
RS#34	13-May-96	25 09.60	80 21.03	0.36	±	0.02	0.83	±	0.06	1.19	±	0.06	9.50	±	0.30	1.08		0.07
RS#35	13-May-96	25 06.18	80 23.94	0.53	±	0.02	0.70	±	0.06	1.23	±	0.06	10.58	±	0.18	2.98		0.51
RS#36	14-May-96	25 04.17	80 27.65	0.70	±	0.02	4.97	±	0.14	5.67	±	0.15	20.42	±	0.21			
RS#37	14-May-96	25 14.52	80 18.36	0.34	±	0.02	2.20	±	0.08	2.54	±	0.08	14.53	±	0.61			
RS#38	14-May-96	25 16.09	80 17.39	0.61	±	0.02	1.58	±	0.08	2.19	±	0.08	15.47	±	0.14			
RS#39	14-May-96	25 14.94	80 14.90	0.40	±	0.01	0.69	±	0.05	1.09	±	0.05	15.37	±	0.14			
RS#40	14-May-96	25 11.54	80 17.65	0.28	±	0.01	0.68	±	0.05	0.95	±	0.05	17.49	±	0.46	2.35		
RS#41	14-May-96	25 04.18	80 27.64	1.10	±	0.04	7.72	±	0.21	8.82	±	0.21	32.04	±	2.06			
RS#42	14-May-96	25 03.43	80 23.17	0.26	±	0.02	0.37	±	0.04	0.63	±	0.05	13.66	±	0.28			
RS#43	14-May-96	25 04.80	80 21.63	0.30	±	0.03	0.76	±	0.05	1.06	±	0.06	13.67	±	0.19			
RS#44	7-Aug-96	24 49.95	80 47.78	0.68	±	0.04	0.53	±	0.08	1.20	±	0.09	12.67					

Table 4: Continued.

RS#45	7-Aug-96	24 48.93	80 46.92	0.22	±	0.02	1.69	±	0.08	1.91	±	0.08	13.68					
RS#46	7-Aug-96	24 48.46	80 48.01	0.34	±	0.01	0.93	±	0.06	1.27	±	0.06	14.17					
RS#47	7-Aug-96	24 49.78	80 49.05	0.16	±	0.02	1.58	±	0.08	1.74	±	0.08	14.85					
RS#48	7-Aug-96	24 48.42	80 49.59	0.47	±	0.01	1.15	±	0.07	1.62	±	0.07	13.94					
RS#49	7-Aug-96	24 48.12	80 50.50	0.61	±	0.02	1.37	±	0.08	1.98	±	0.08	13.66					
RS #50	28-Jun-97	25.15	-80.30	0.24	±	0.03	0.79	±	0.05	1.04	±	0.06	10.08	±	1.76	3.28	±	0.99
RS #51	28-Jun-97	25.19	-80.29	0.49	±	0.04	0.39	±	0.06	0.88	±	0.07	11.37	±	0.31	3.91	±	0.45
RS #52	28-Jun-97	25.11	-80.38	0.51	±	0.04	0.41	±	0.06	0.92	±	0.07	9.77	±	0.63	5.19	±	1.06
RS #53	28-Jun-97	25.13	-80.39	1.06	±	0.05	4.37	±	0.12	5.43	±	0.13	36.37	±	0.14	26.52	±	5.89
RS #54	28-Jun-97	25.06	-80.45	0.46	±	0.03	0.69	±	0.04	1.15	±	0.05	16.31	±	0.56			
RS #55	28-Jun-97	25.00	-80.50	0.49	±	0.03	1.02	±	0.05	1.52	±	0.06	11.61	±	0.20	5.86		
RS #56	28-Jun-97	24.96	-80.53	0.46	±	0.04	1.10	±	0.05	1.56	±	0.07	13.52	±	0.64	3.23	±	0.89
RS #57	28-Jun-97			0.30	±	0.03	0.24	±	0.04	0.53	±	0.05	3.87	±	1.02	2.67	±	0.12
RS #58	2-Jul-97	25.14	-80.26	0.39	±	0.04	0.00	±	0.06	0.39	±	0.07	3.71	±	0.10	1.06	±	0.03
RS #59	2-Jul-97	25.14	-80.26	0.29	±	0.02	0.03	±	0.04	0.32	±	0.04	2.71	±	0.19	1.91	±	0.10
RS #60	2-Jul-97	25.12	-80.30	0.19	±	0.02	0.44	±	0.04	0.63	±	0.05	6.06	±	0.18	2.65	±	0.51
RS #61	2-Jul-97	25.12	-80.30	0.28	±	0.02	0.52	±	0.05	0.80	±	0.05	5.76	±	0.78	1.97	±	0.60
RS #62	2-Jul-97	25.11	-80.31	0.34	±	0.01	0.50	±	0.04	0.84	±	0.04	8.80	±	0.28	2.29	±	0.12
RS #63	2-Jul-97	25.11	-80.31	0.27	±	0.01	0.72	±	0.04	0.99	±	0.05	8.15	±	0.59	2.54	±	0.06
RS #64	2-Jul-97	25.11	-80.34	0.34	±	0.03	0.59	±	0.06	0.93	±	0.06	15.17	±	0.26	2.69	±	0.20
RS #65	2-Jul-97	25.07	-80.39	0.33	±	0.01	0.89	±	0.05	1.22	±	0.05	18.29	±	0.47	2.62	±	0.61
RS #66	2-Jul-97	25.03	-80.40	0.30	±	0.05	0.64	±	0.07	0.94	±	0.09	9.98	±	1.70	2.25	±	0.23
RS #67	2-Jul-97	25.07	-80.46	0.76	±	0.02	5.39	±	0.15	6.15	±	0.15	18.99	±	0.80	3.51	±	0.19
RS #68	3-Jul-97	25.15	-80.29	0.29	±	0.02	0.70	±	0.05	0.99	±	0.06						
RS #69	3-Jul-97	25.15	-80.29	0.23	±	0.02	1.34	±	0.06	1.58	±	0.07	15.95	±	0.39	2.28	±	0.51
RS #70	3-Jul-97	25.15	-80.29	0.28	±	0.03	0.83	±	0.06	1.11	±	0.07	17.08	±	0.33	2.68	±	0.34
RS #71	3-Jul-97	25.15	-80.30	0.30	±	0.02	0.90	±	0.05	1.20	±	0.06	17.89	±	0.24	2.48	±	0.23
RS #72	3-Jul-97	25.04	-80.35	0.22	±	0.02	0.38	±	0.05	0.59	±	0.05	6.98	±	0.15	1.53	±	0.11
RS #73	3-Jul-97	25.04	-80.35	0.18	±	0.01	0.40	±	0.04	0.57	±	0.04	6.26	±	0.09	1.90	±	0.22
RS #74	3-Jul-97	25.04	-80.35	0.29	±	0.02	0.22	±	0.04	0.51	±	0.04	9.74	±	6.11	1.90	±	0.30
RS #75	3-Jul-97	25.01	-80.37	0.48	±	0.04	0.18	±	0.06	0.66	±	0.07	4.21	±	0.35	2.02	±	0.52
RS #76	3-Jul-97	25.01	-80.37	0.23	±	0.02	0.08	±	0.04	0.31	±	0.04	3.81	±	0.11	2.30	±	0.73
RS #77	4-Jul-97	25.20	-80.34	0.82	±	0.02	2.13	±	0.11	2.94	±	0.11	8.71	±	0.08	3.44	±	0.38
RS #78	4-Jul-97	25.18	-80.35	0.52	±	0.02	3.40	±	0.12	3.91	±	0.12	19.36	±	0.11	3.06	±	0.46
RS #79	4-Jul-97	25.16	-80.35	0.47	±	0.03	1.57	±	0.20	2.04	±	0.20	9.68	±	0.22	2.55	±	0.12
RS #80	4-Jul-97	25.15	-80.37	0.71	±	0.03	2.20	±	0.12	2.91	±	0.12	7.25	±	0.12	2.69	±	0.26
RS #81	4-Jul-97	25.12	-80.38	0.79	±	0.03	1.16	±	0.10	1.95	±	0.10	13.06	±	0.41	2.75	±	0.85
RS #82	4-Jul-97	25.09	-80.43	0.89	±	0.03	3.26	±	0.15	4.15	±	0.16	21.40	±	1.26	5.07	±	0.14
RS #83	4-Jul-97	25.07	-80.44	0.78	±	0.03	2.84	±	0.13	3.63	±	0.14	14.43	±	0.30	2.88	±	0.57
RS #84	4-Jul-97	25.07	-80.46	1.16	±	0.04	10.48	±	0.28	11.64	±	0.28	31.14	±	0.47	4.42	±	1.40
RS #84-2	4-Jul-97	25.07	-80.46	0.49	±	0.05	8.04	±	0.69	8.53	±	0.69						

Table 4: Continued.

RS #85	4-Jul-97	25.06	-80.47	1.71	±	0.05	16.34	±	0.40	18.05	±	0.41	43.53	±	0.17	10.30	±	0.11
RS #85-2	4-Jul-97	25.06	-80.47	1.92	±	0.06	17.64	±	0.44	19.56	±	0.44						
			Average:	**0.48**	±	**0.31**	**1.64**	±	**2.94**	**2.12**	±	**3.19**	**11.93**	±	**7.00**	**3.55**	±	**4.03**

Table 5. Tracer concentrations by region, and significance (difference) relative to Keys Bay-side. Keys Bay-side was defined as sites located on the Florida Bay side of the upper Keys (Key Largo, Plantation Key and the Matecumbe Keys). North Coast Sties were along the Everglades Coast in muddy bottomed areas. Mid NE sites were in the Northeastern areas of the bay and typically had very little sediments overlying a rock bay floor. Mid Bay sites were typically basins within the mud-banked areas of the middle bay.

Natural Tracers	Florida Bay Region			
	Keys Bay-side (σ, n)	**Mid Bay (σ, n, p)**	**N. Coast (σ, n, p)**	**Mid N.E. (σ, n, p)**
^{222}Rn (dpm·L^{-1})	4.38 (3.24, 73)	2.23 (1.43, 40, 0.00)	2.89 (2.15, 33, 0.02)	2.40 (1.96, 32, 0.00)
^{226}Ra (dpm·L^{-1})	1.44 (0.59, 73)	1.42 (0.41, 40, 0.86)	1.49 (0.48, 33, 0.63)	1.95 (0.61, 32, 0.00)
CH_4 (nM)	38.2 (23.3, 73)	16.4 (8.8, 40, 0.00)	22.0 (19.3, 30, 0.00)	13.2 (10.8, 30, 0.00)
CH_2CH_2 (nM)	3.80 (5.40, 60)	1.28 (1.50, 39, 0.00)	1.87 (1.13, 26, 0.08)	1.80 (1.57, 25, 0.07)
^{15}N (‰)	7.89 (2.54, 23)	3.92 (1.98, 26, 0.00)	5.83 (2.26, 13, 0.02)	5.57 (2.46, 7, 0.04)

Table 6: Average tracer concentrations from samples collected in various surface waters.

Site	Rn-222 (dpm/L)	Methane (nM)	Ethylene (nM)
Canals/Trenches	19 ± 11 (n = 10)	830 ± 1140 (n = 10)	2.9 ± 1.5 (n = 10)
Garden Cove Spring, Key Largo	66 ± 19 (n = 4)	141 ± 176 (n = 4)	
Garden Cove Surface, Key Largo	4.3 ± 1.2 (n = 4)	41 ± 11 (n = 2)	
Lois Key Spring, Sugarloaf Key	122 ± 2 (n = 2)	493 ± 41 (n = 3)	
Porjoe Key Interstitial Fluid (seepage meter)	67 ± 1 (n = 1)	176 ± 11 (n = 3)	
Porjoe Key Surface	0.2 ± 0.1 (n = 1)	7.0 ± 0.2 (n = 3)	
Bay Average	4.8 ± 2.7 (n = 178)	27 ± 26 (n = 173)	2.5 ± 3.7 (n = 150)
Reef Average	1.5 ± 1.4 (n = 57)	11 ± 6 (n=57)	4.8 ± 6.4 (n = 14)

Table 7: Nutrient concentrations of of springs, goundwater, and surface waters.

Site	Flow Rate (m3/min)	NH4+ (uM)	NO3- (uM)	PO42- (uM)	Salinity (ppt)
KML Well (15' and 60')[1] (n = 2)		13.3 ± 0.04	0.62 ± 0.48	0.98 ± 0.18	
Canals/Trenches (n = 3)		6.2 ± 4.7	0.90 ± 0.33	0.07 ± 0.03	
Garden Cove Spring, Key Largo (n = 3)	7.10 ± 0.87[2]	0.53 ± 0.15	0.40 ± 0.16	0.08 ±0.04	31
Garden Cove Surface, Key Largo (n = 3)		BD[3]	1.24 ± 0.09	BD	29
Lois Key Spring, Sugarloaf Key		12.03	0.1	0.94	38
Porjoe Key Interstitial Fluid (seepage meter)[4]	(7.35±0.96) X 10^{-5}	15.17	0.68	0.03	24.9
Porjoe Key Surface		BD	1.14	BD	28.5
Bay Average (n = 27)		1.2 ± 1.5	1.1 ± 0.96	BD	
Reef Average (n = 49)		BD	0.30 ± 0.38	BD	

[1]KML refers to Key Marine Laboratory located on Long Key, wells were within 10 meters of Class V sewage injection well.
[2]Flow rate measured by a General Oceanics flow meter with low flow propeller.
[3]BD = Below Detection.
[4]Sample taken directly from seepage meter port. Seepage meter covers an area of 0.25 m^2.

Table 8a. Results from septic tank experiments at site A on Big Pine Key.
(*) indicates dates of injections.
B.D. = below detection

sampling date	time after injection (days)	tap water SF6 conc (pM)	SD (pM)
12/13/96 *	0.01	9.62	0.07
12/14/96	1	0.33	
12/15/96	2	0.31	0.01
12/16/96	3	0.69	0.03
12/17/96	4	0.93	0.00
12/18/96	5	0.58	0.01
12/19/96	6	0.09	
12/20/96	7	0.81	0.02
12/22/96	9	0.34	0.01
12/24/96	11	0.11	
12/26/96	13	0.34	0.00
12/30/96	17	0.55	
1/1/97	19	0.14	
1/3/97	21	0.64	0.11
1/5/97	23	1.15	
1/9/97	27	0.56	
1/11/97	29	0.39	0.00
1/13/97	31	0.18	
1/15/97	33	0.27	
1/17/97	35	0.60	
1/19/97	37	0.53	
1/21/97	39	0.13	
1/23/97	41	0.32	
1/25/97	43	0.32	0.02
1/29/97	47	0.44	
2/2/97	51	0.39	
2/6/97	55	0.53	
2/10/97	59	0.41	
2/14/97	63	0.32	0.01
6/12/97 *	181.48	0.33	0.03
6/12/97	181.50	0.37	0.03
6/12/97	181.71	B.D.	
6/12/97	181.96	0.10	0.00
6/13/97	182.33	0.04	0.06
6/14/97	183.33	0.04	0.00
6/15/97	184.33	0.12	0.02
6/16/97	185.83	0.06	0.08
6/17/97	186.33	0.14	0.01
6/18/97	187.33	0.16	0.01
6/18/97	187.33	0.13	0.00
6/19/97	188.33	0.10	0.01
6/20/97	189.33	0.11	0.01

Table 8b. Results from septic tank experiments at site B on Big Pine Key. (*) indicates date of injection.

B.D. = below detection

sampling date	time after injection (days)	tap water SF6 conc (pM)	SD (pM)
6/12/97	-0.01	0.38	0.07
6/12/97	-0.01	0.52	0.08
6/12/97 *	0.01	10002.07	140.19
6/12/97	0.01	27559.14	114.93
6/12/97	0.18	3537.98	70.72
6/12/97	0.44	410.40	18.74
6/13/97	0.85	4053.65	45.00
6/14/97	1.80	1099.73	1.78
6/14/97	2.43	880.79	16.05
6/15/97	2.76	692.27	
6/17/97	4.80	252.09	3.40
6/18/97	5.84	153.50	0.42
6/19/97	6.84	127.55	1.59
6/20/97	7.83	92.21	0.35
6/21/97	8.78	75.22	1.34
6/22/97	9.89	58.47	0.08
6/22/97	10.43	414.86	103.27
6/23/97	10.82	479.07	1.16
6/24/97	11.82	38.64	0.32
6/26/97	13.86	29.31	0.46
6/30/97	17.91	4.07	0.04
7/2/97	19.84	2.82	0.00
7/2/97	19.94	2.08	0.02
7/4/97	22.36	1.77	0.09
7/6/97	24.41	1.16	0.04
7/8/97	26.45	0.84	0.02
7/17/97	34.84	0.14	0.20
7/30/97	47.47	B.D.	0.00
8/12/97	60.47	B.D.	0.00
8/21/97	69.47	B.D.	0.00

Table 9. Results from July '96 simulated septic tank experiment on Key Largo.

Location	time after injection (hrs)	SF6 conc nmoles	well water level (m)
Monitor Well	0.00	B.D.	0.00
	0.17	B.D.	
	0.52	B.D.	-0.07
	0.83	B.D.	
	1.17	B.D.	-0.11
	2.05	B.D.	-0.19
	5.07	0.22	-0.03
	6.42	0.06	0.04
	7.83	0.19	0.21
	8.93	0.00	0.21
	9.92	0.85	0.16
	10.92	2.27	0.13
	16.67	0.34	0.01
	42.67	0.78	
Boat Basin	0.37	B.D.	
	1.05	B.D.	
	2.30	B.D.	
	5.33	B.D.	
	6.75	0.04	
	7.93	0.09	
	9.08	B.D.	
	10.08	B.D.	
	16.92	B.D.	
	42.67	B.D.	

Table 10. Results from August '96 simulated septic tank experiment on Key Largo.

Location	time after injection (hrs)	SF6 conc (nM)	St. Dev. (nM)
Monitor Well	0.00	1.94	0.12
	2.17	1.57	
	3.58	2.76	0.77
	4.75	2.39	0.01
	5.92	2.61	0.19
	6.75	2.89	0.03
	7.00	2.58	0.24
	7.17	2.33	0.29
	7.50	2.57	
	7.92	2.01	0.08
	8.33	2.49	0.22
	8.75	2.63	0.09
	10.17	2.22	0.09
	10.92	2.49	0.18
	11.93	2.45	0.18
	13.05	2.38	0.05
	14.07	2.30	0.23
	15.03	2.43	0.03
	15.98	2.42	0.00
	17.15	2.39	0.01
	18.57	2.64	0.06
	19.00	2.39	0.39
	19.67	2.33	0.06
	20.50	2.18	0.15
	21.67	2.29	0.25
	22.75	2.21	0.03
	23.52	1.99	0.23
	24.03	2.30	0.14
	24.77	2.36	0.04
	25.25	2.39	0.01
	26.12	2.59	0.19
	26.87	2.43	0.00
	27.73	7.35	0.45
	28.33	14.50	0.60
	28.68	24.59	1.67
	29.20	22.44	6.26
	29.70	5.49	1.26
	30.20	2.62	0.27
	30.70	2.43	0.05
	31.20	2.42	0.02
	31.75	2.74	0.07
	32.20	2.62	0.24
	32.75	2.85	0.02
	33.20	2.89	0.12
	34.13	2.83	
	34.87	3.00	0.09
	35.33	3.15	0.97
	35.75	2.73	0.41
	36.25	3.04	0.02
	37.22	5.46	0.86
	37.67	6.52	0.88
	39.20	40.23	4.12
	40.03	61.96	0.95
	41.00	72.17	0.62
	43.00	38.35	0.95
	44.12	13.80	0.84
	46.00	6.23	1.17
	47.87	4.05	0.02
	63.35	70.43	0.26

time after injection (hrs)	well water level (m)
-0.02	1.02
1.42	0.98
2.42	0.92
3.75	0.88
4.92	0.83
6.02	0.83
6.62	0.83
6.92	0.85
7.08	0.86
7.70	0.90
8.05	0.91
8.95	0.97
10.35	1.04
11.75	1.05
12.15	1.09
13.20	1.06
14.22	1.00
15.18	0.95
16.12	0.88
17.28	0.81
18.32	0.80
18.93	0.78
19.95	0.83
20.35	0.85
20.73	0.86
21.85	0.93
22.08	0.95
22.50	0.98
22.88	1.00
23.10	1.02
23.70	1.03
23.97	1.04
24.72	1.06
25.38	1.04
26.32	0.99
26.98	0.97
27.87	0.91
28.53	0.88
28.85	0.87
29.32	0.85
29.83	0.85
30.33	0.84
30.83	0.84
31.35	0.84
31.93	0.87
32.45	0.89
32.93	0.92
33.33	0.94
34.37	1.00
35.05	1.04
35.48	1.06
35.70	1.07
35.88	1.09
36.20	1.09
36.62	1.11
36.80	1.10
37.17	1.10
37.55	1.09
37.82	1.08
38.30	1.05
39.15	1.00
39.50	0.98
40.00	0.94
41.00	0.88
43.17	0.77
44.10	0.79
45.00	0.84
46.08	0.90
47.83	1.00
63.33	1.05

Location	time after injection (hrs)	SF6 conc (nM)	St. Dev. (nM)
Boat Basin	3.33	B.D.	
	4.50	B.D.	
	5.67	B.D.	
	7.17	B.D.	
	8.08	B.D.	
	9.00	B.D.	
	9.92	0.04	
	9.92	0.22	
	10.75	B.D.	
	11.75	B.D.	
	12.83	B.D.	
	13.88	B.D.	
	14.87	B.D.	
	15.83	B.D.	
	16.97	B.D.	
	18.70	B.D.	
	19.67	B.D.	
	20.75	B.D.	
	21.40	B.D.	
	21.88	B.D.	
	22.13	B.D.	
	22.50	B.D.	
	22.92	B.D.	
	23.33	B.D.	
	23.72	B.D.	
	24.20	B.D.	
	24.58	B.D.	
	24.95	B.D.	
	25.43	B.D.	
	26.13	B.D.	
	26.67	B.D.	
	27.70	B.D.	
	28.60	B.D.	
	29.92	0.07	0.03
	30.92	0.04	
	32.00	B.D.	
	33.00	0.03	0.00
	34.42	0.03	
	35.08	0.04	0.02
	35.52	0.01	
	36.02	B.D.	
	36.83	B.D.	
	37.37	B.D.	
	37.83	B.D.	
	38.33	B.D.	
	39.33	B.D.	
	40.18	B.D.	
	41.12	B.D.	
	43.20	B.D.	
	44.25	B.D.	
	45.17	B.D.	
	46.33	B.D.	
	48.00	B.D.	
	63.13	B.D.	

Table 11a. Monitor Well results for August '97 simulated septic tank experiment, Key Largo.

t (hrs)	ave conc (pM)	SD
0.25	33.46	
0.77	32.42	0.36
1.28	49.82	
	0.00	
1.88	43.69	3.91
2.25	0.00	
2.75	40.80	
3.30	28.01	
3.75	34.21	8.62
4.25	20.67	
4.75	13.31	0.30
5.15	13.38	
5.83	8.75	
6.30	8.22	
6.78	9.61	
7.25	11.72	0.16
7.75	13.10	
8.25	12.71	0.16
8.75	31.17	
9.25	44.56	
9.78	36.24	
10.28	43.50	0.80
10.78	47.69	
11.28	45.46	
11.80	136.59	
12.30	294.24	1.32
13.07	1067.97	
13.40	1334.63	
14.07	1554.83	
14.52	974.17	11.51
15.10	302.93	
15.57	83.83	
16.07	85.22	
16.53	80.05	1.70
17.10	44.18	
17.55	22.39	
18.15	11.17	
18.53	12.14	
19.03	11.56	
19.53	12.14	
20.00	11.48	
20.53	15.93	
21.02	16.18	
21.53	19.07	
22.02	48.67	1.23
23.25	214.71	
23.57	459.04	
24.17	752.45	
24.60	1403.01	47.47
25.08	2387.46	
25.55	3103.66	
26.08	3624.55	
26.52	4627.82	
27.08	4039.77	65.90
27.52	2526.60	
28.10	510.51	
28.58	754.17	
29.07	246.96	
29.52	164.54	
30.02	126.44	
30.55	52.68	0.24
31.12	36.75	
31.53	26.65	
32.00	18.96	
32.55	22.34	
33.02	34.63	
33.50	51.39	
34.02	88.47	0.56
34.53	222.40	
34.98	671.24	
35.53	1084.23	0.75

t (hrs)	Atlantic tide (cm)
-1.5	58
-0.5	73
0.5	82
1.5	79
2.5	67
3.5	49
4.5	30
5.5	15
6.5	6
7.5	6
8.5	15
9.5	34
10.5	52
11.5	67
12.5	76
13.5	76
14.5	70
15.5	52
16.5	34
17.5	15
18.5	3
19.5	0
20.5	6
21.5	18
22.5	37
23.5	55
24.5	70
25.5	76
26.5	76
27.5	67
28.5	52
29.5	34
30.5	18
31.5	12
32.5	12
33.5	21
34.5	34
35.5	49
36.5	64

t (hrs)	MW tide (cm)
-0.5	27.28
0.05	133.96
0.25	32.36
0.7	33.63
0.9	33.63
1.12	36.805
1.3	35.662
1.43	39.98
1.85	42.52
2.23	41.885
2.5	41.7326
2.75	39.345
3.25	38.71
3.73	34.9
4.25	33.63
4.75	30.455
5.12	26.645
5.8	23.47
6.27	19.66
6.72	15.85
7.23	13.31
7.75	9.5
8.25	8.23
8.75	6.96
9.25	8.865
9.77	13.31
10.27	13.945
10.77	19.025
11.27	22.835
11.78	29.185
12.27	34.265
13.07	39.345
13.4	39.98
14.05	44.425
14.48	42.52
15.08	40.615
15.55	38.075
16.05	36.17
16.5	35.535
17.08	32.36
17.53	26.01
18.08	22.835
18.5	21.438
19	17.12
19.5	13.31
19.97	11.405
20.5	6.96
21	6.96
21.5	6.96
21.98	9.5
23.25	17.12
23.55	19.66
24.13	22.835
24.58	28.55
25.07	31.09
25.53	32.995
26.07	36.17
26.5	38.71
27.07	39.345
27.5	38.71
28.08	37.44
28.53	35.535
29.05	32.995
29.5	31.725
30	27.28
30.53	24.74
31	20.93
31.5	18.39
32	15.215
32.55	12.04
33	10.77
33.48	8.865
34	13.31
34.5	13.31
34.97	14.58
35.52	22.2

time	Bay tide (cm)
6	11.5
7	9.5
8.98	7
9.85	6.5
10.85	6
11.85	5.5
12.95	4.5
13.95	2
14.98	3.5
15.95	7
17	7
17.97	8.5
19	8
19.93	9
20.95	7
21.98	6
24.03	6.75
24.97	6
26	4.5
26.95	4.3
28.07	4.5
28.98	5
29.88	10
30.93	1.3
32.02	5
32.85	3.5
34.05	1
34.95	0
35.7	0

Table 11b. Results from Bay stations for August '97 simulated septic tank experiment.

time (hrs)	Bay 1 SF6 conc. (pM)	SD	Bay 2 SF6 conc. (pM)	SD	Bay 3 SF6 conc. (pM)	SD	Bay 4 SF6 conc. (pM)	SD	Bay 5 SF6 conc. (pM)	SD
0.35	0.68	0.09	0.84	0.03	0.83	0.01	0.66	0.01	1.05	0.02
1.55	1.00	0.00	0.94	0.01	1.14	0.03	0.75	0.02	0.98	0.01
			0.00	0.00						
2.88	0.70	0.05	0.83	0.00	1.15	0.01	0.84	0.00	1.00	0.00
3.82	0.70	0.00	1.23	0.00	1.29	0.02	0.74	0.01	0.99	0.01
4.83	0.64	0.01	1.01	0.02	1.67	0.01	0.71	0.03	0.44	0.62
5.90	0.63	0.01	0.92	0.00	1.49	0.09	0.72	0.02	0.79	0.02
6.85	0.57	0.01	0.83	0.04	1.53	0.00	0.76	0.00	0.64	0.03
7.82	0.47	0.01	0.63	0.02	1.64	0.04	0.83	0.12	0.67	0.07
8.80	0.40	0.01	0.69	0.02	1.46	0.02	0.46	0.04	0.78	0.28
9.82	0.58	0.04	0.85	0.00	1.48	0.00	0.55	0.02	0.56	0.01
10.80	0.47	0.01	0.51	0.01	1.22	0.02	0.47	0.02	0.38	0.03
11.80	0.36	0.00	0.53	0.00	0.98	0.03	0.43	0.00	0.36	0.02
12.82	0.60	0.01	0.55	0.02	0.49	0.01	0.45	0.02	0.40	0.02
13.82	0.55	0.07	0.44	0.01	0.70	0.06	0.50	0.01	0.48	0.04
14.82	1.64	0.06	1.12	0.04	0.59	0.00	0.48	0.03		
15.80	1.57	0.04	1.01	0.01	0.87	0.01	0.36	0.04	0.83	0.10
16.82	0.89	0.01	0.39	0.02	1.54	0.04	0.63	0.01	0.95	0.02
17.83	0.85	0.04	0.17	0.01	1.15	0.11	0.95	0.01	1.12	0.00
18.78	0.89	0.02	0.15	0.03	0.99	0.00	1.02	0.01	0.93	0.04
19.77	0.98	0.08	0.40	0.04	0.91	0.03	0.93	0.03	1.00	0.05
20.80	0.84	0.04	0.27	0.01	0.69	0.03	0.77	0.01	0.69	0.05
21.80	0.88	0.01	0.65	0.04	0.85	0.04	0.85	0.02	0.76	0.04
					0.77	0.03				
23.90	0.64	0.03	0.61	0.03	0.68	0.02	0.72	0.03	0.71	0.03
24.83	0.66	0.08	0.63	0.04	0.68	0.01	0.59	0.01	0.68	0.02
25.83	0.74	0.02	0.56	0.10	0.65	0.02	0.53	0.03	0.61	0.02
26.82	0.54	0.23	0.62	0.09	0.68	0.37	0.51	0.01	0.58	0.06
27.85	0.65	0.02	1.34	0.00	1.07	0.03	0.54	0.02	0.19	0.00
28.82	1.04	0.02	1.69	0.00	3.54	0.05	0.50	0.00	0.50	0.03
29.88	0.51	0.00	0.51	0.03	1.73	0.00	0.85	0.01	0.61	0.02
30.82	0.77	0.02	0.53	0.09	0.77	0.03	0.62	0.03	0.57	0.02
31.90	0.48	0.01	0.64	0.06	1.84	0.08	0.61	0.03	0.65	0.01
32.85	0.49	0.01	0.85	0.00	1.41	0.05	0.67	0.01	0.52	0.04
33.88	0.63	0.01	0.77	0.04	0.75	0.06	0.48	0.02	0.61	0.03
34.83	0.67	0.02	0.57	0.04	0.50	0.02	0.42	0.05	0.55	0.02
35.57	0.54	0.04	0.53	0.01	0.52	0.02	0.45	0.01	0.55	0.02

Table 12a. Estimates of groundwater transport rates for septic tank experiments on Big Pine Key and simulated septic tank experiments on Key Largo.

Experiment / Date	Date	Horizontal Transport Rate (m/hr)
Septic A1	Dec-96	----
Septic A2	Jun-97	----
Septic B	Jun-97	1.37 & 0.11
simulated septic (RS-1)	Jun-96	
Bay		3.28
Monitor Well		0.27
simulated septic (RS-2)	Aug-96	
Bay		1.59 - 2.30
Monitor Well		0.3
simulated septic (RS-3)	Aug-97	
Bay		----
Monitor Well		0.21

Table 12b Estimated groundwater transport rates from injection well experiments on Long Key. Horizontal and verticle transport rates (HTR and VTR's) are shown.

		October '96		February '97	
sampling location	depth (m)	HTR (m/hr)	VTR (m/hr)	HTR (m/hr)	VTR (m/hr)
Well 1	4.6	< 0.003	< 0.008	0.06	0.17
	9.1	0.28	0.51	0.06	0.11
	13.7	0.47	0.43	0.15	0.14
	18.3	1.72	---	0.46	---
Well 2	4.6	< 0.003	< 0.008	---	---
	9.1	< 0.003	< 0.005	---	---
	13.7	0.01	0.01	0.03	0.02
	18.3	0.01	---	---	---
Well 3	4.6	< 0.003	< 0.008	---	---
	9.1	< 0.003	0.02	0.07	0.13
	13.7	0.22	0.2	0.06	0.06
	18.3	0.03	---	0.14	---
Well 4	4.6	< 0.003	< 0.008	---	---
	9.1	< 0.003	< 0.005	0.07	0.13
	13.7	< 0.003	< 0.002	---	---
	18.3	< 0.003	---	---	---
Well 5	4.6	1.61	2.2	---	---
	9.1	0.004	0.008	---	---
	13.7	< 0.003	< 0.005	---	---
	18.3	< 0.003	< 0.002	---	---
Well 6	4.6	< 0.01	< 0.008	---	---
	9.1	< 0.01	< 0.005	---	---
	13.7	< 0.01	< 0.002	---	---
	18.3	< 0.01	---	---	---
Well 7	4.6	< 0.01	< 0.008	---	---
	9.1	< 0.01	< 0.005	---	---
	13.7	< 0.01	< 0.002	---	---
	18.3	< 0.01	---	---	---
Canal		0.74	---	---	---

Figures

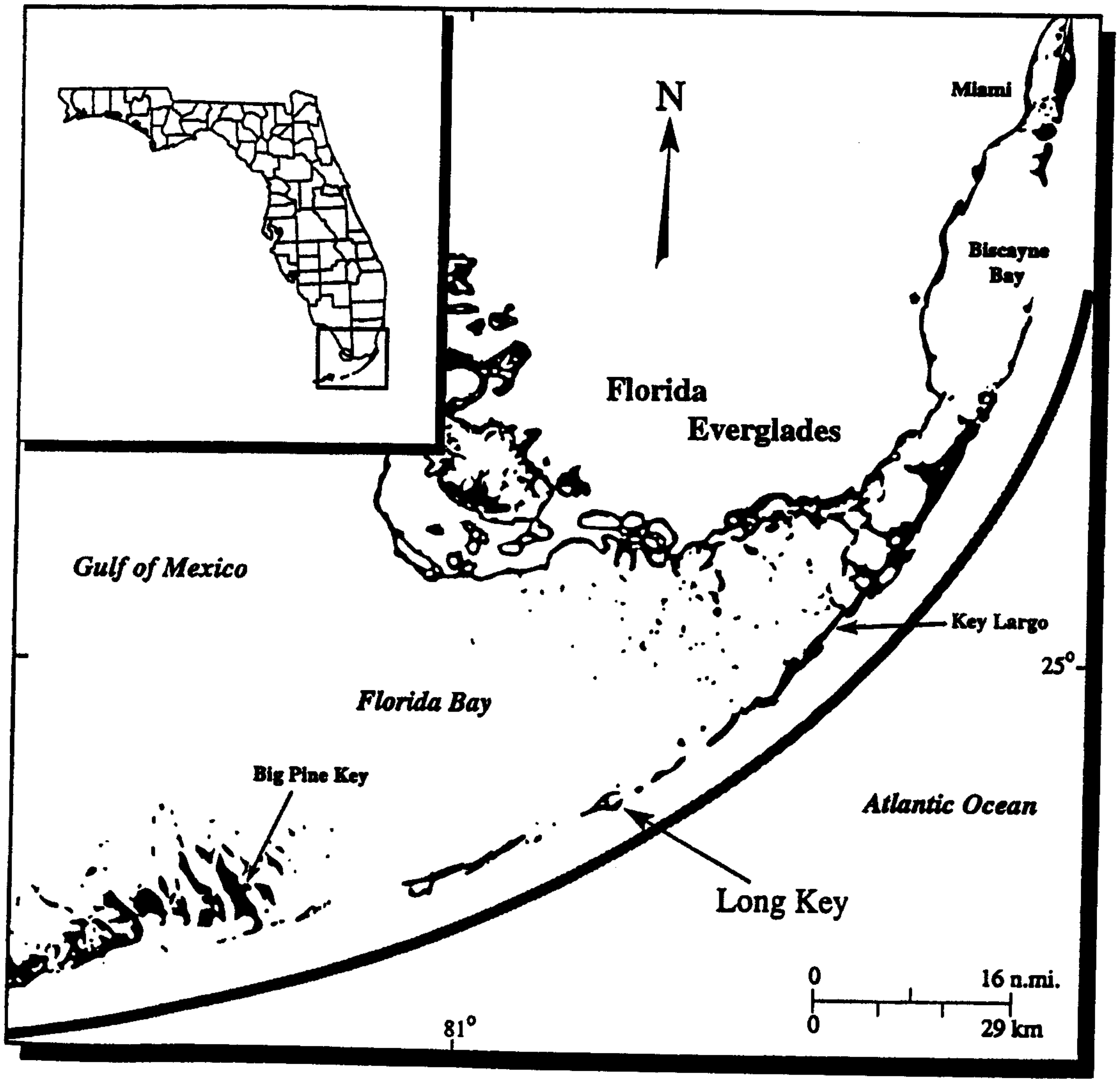

Figure 1: The Florida Keys are located off the southern tip of Florida. Florida Bay separates the Keys from the mainland.

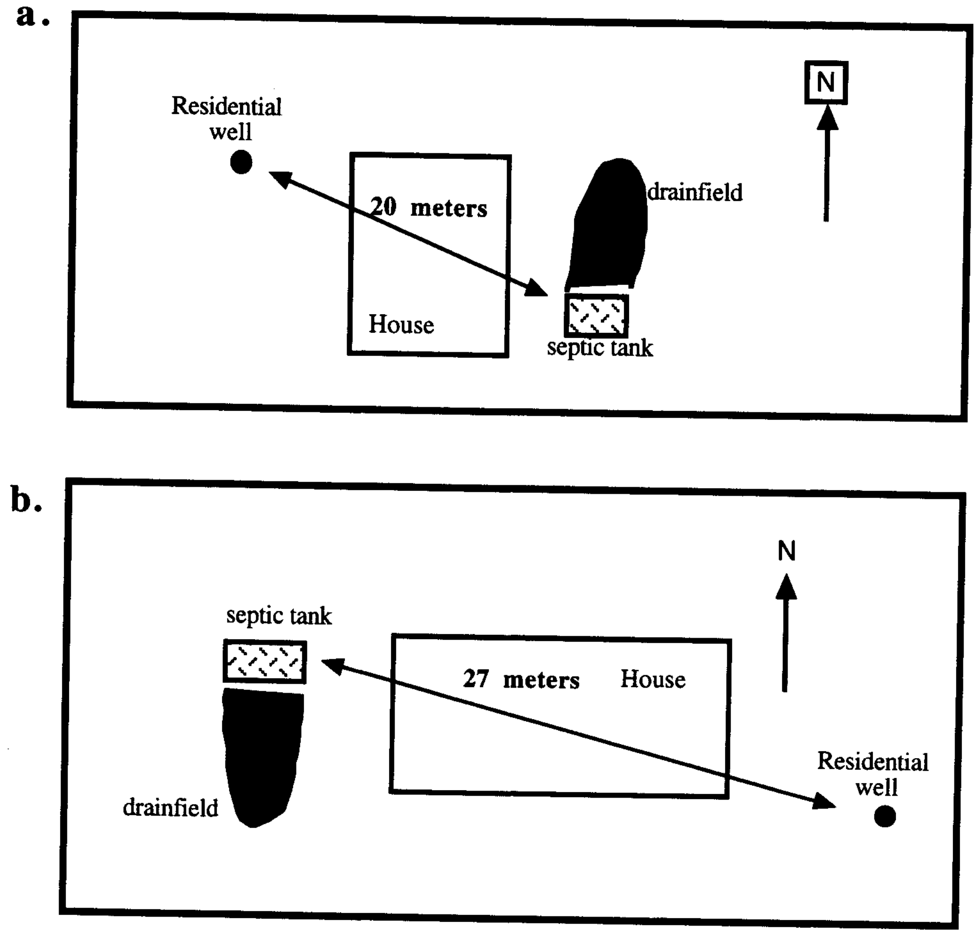

Figure 2. Study sites A and B for septic tank experiments on Big Pine Key. Figures are not drawn to scale.

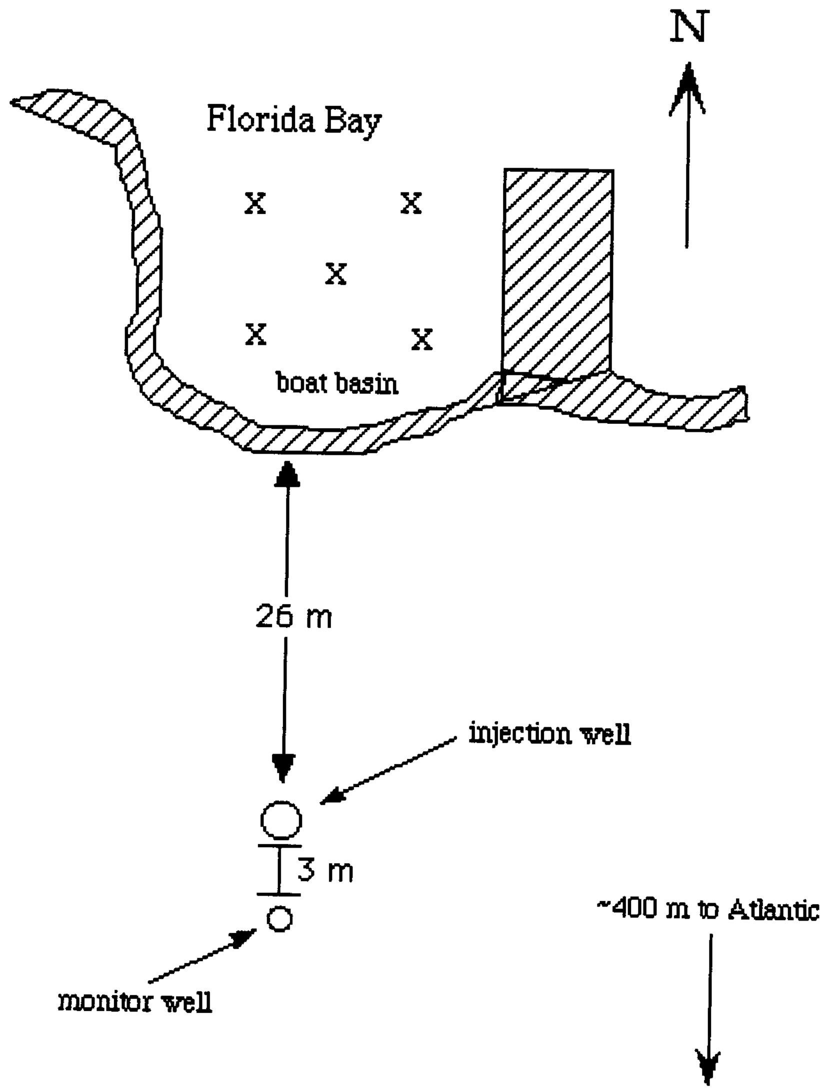

Figure 3. Study site at Ranger Station on Key Largo.

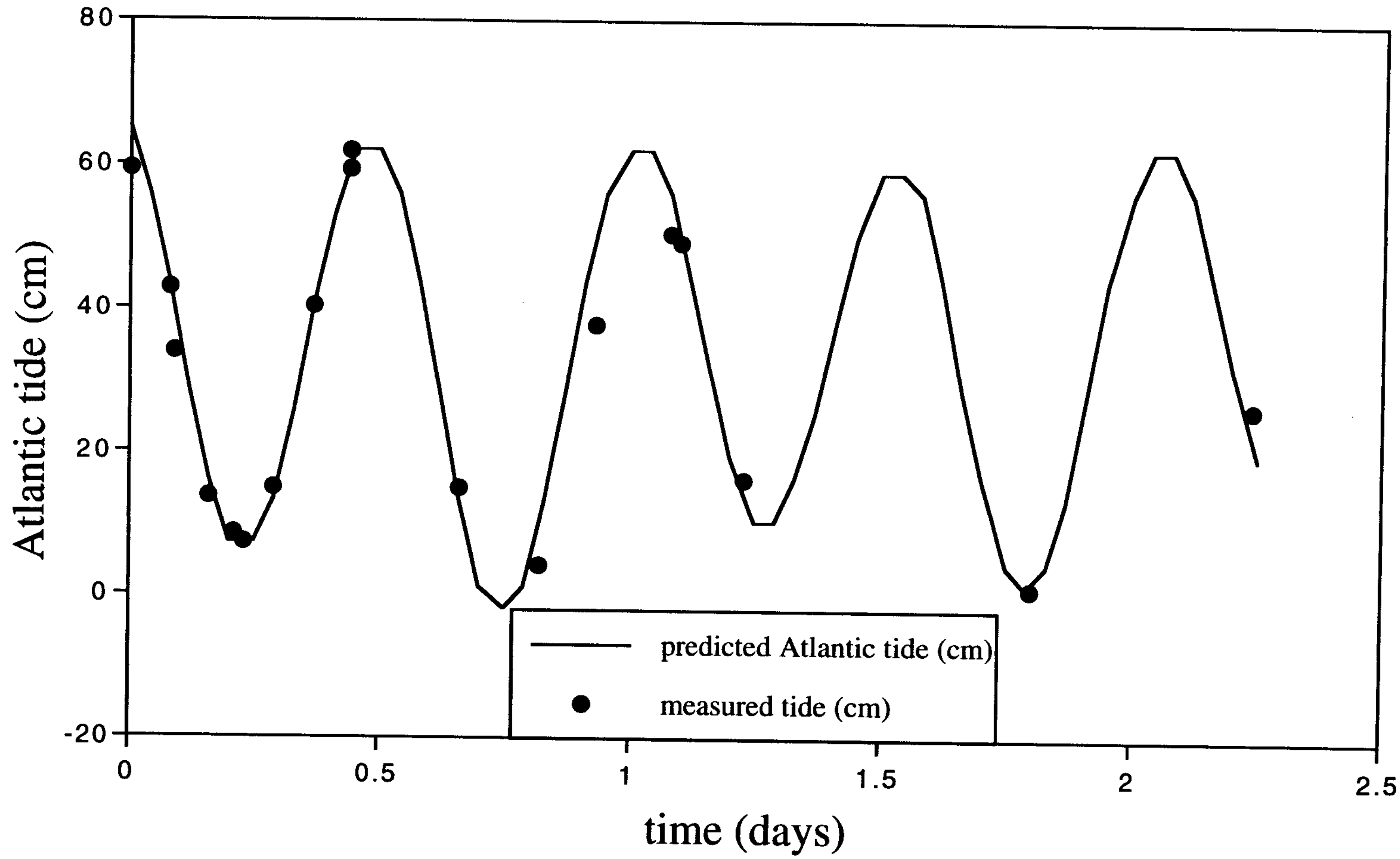

Figure 4. Comparison of tide program's predicted tide and actual tidal measurements for Atlantic Ocean side of Key Largo. Tide was measured in the Key Largo Canal.

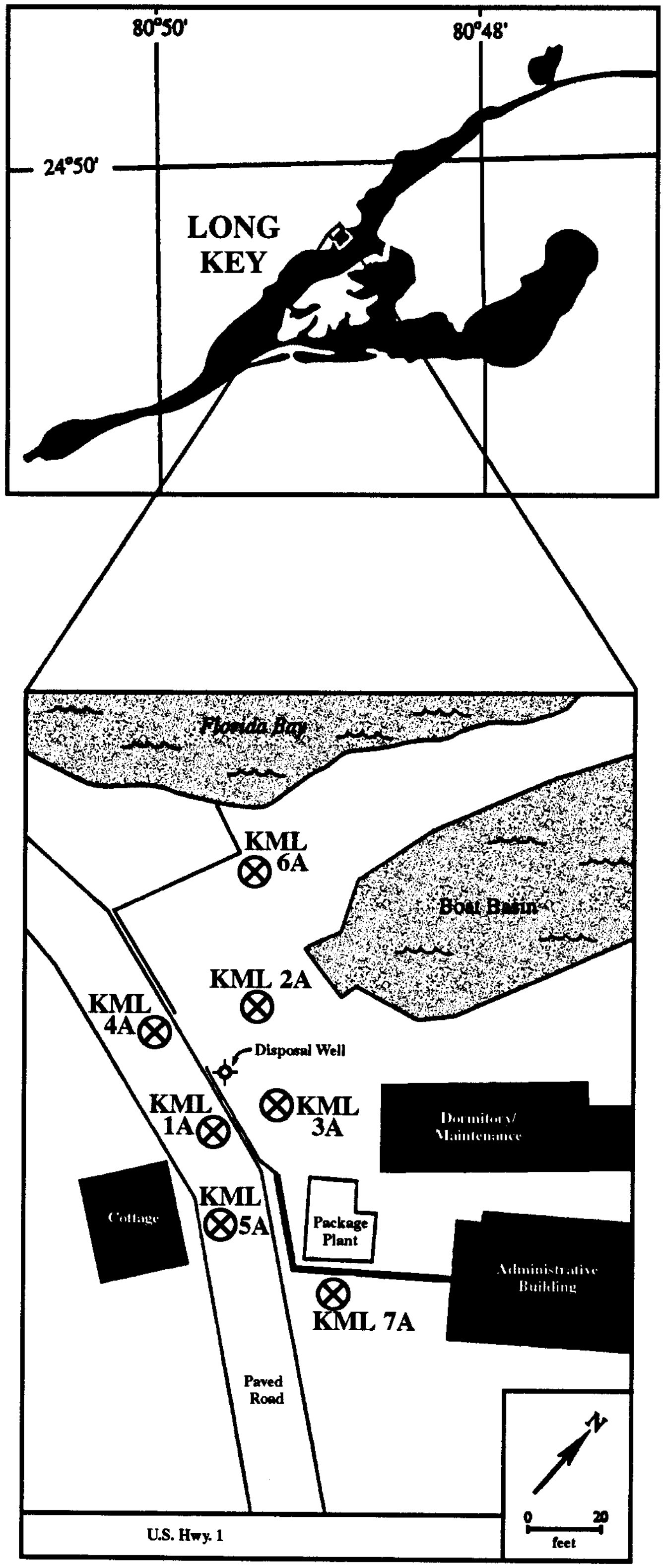

Figure 5: Sampling site located at the Keys Marine Laboratory. The canal that was used as an indicator of the Atlantic tide is located S.E. of Highway 1.

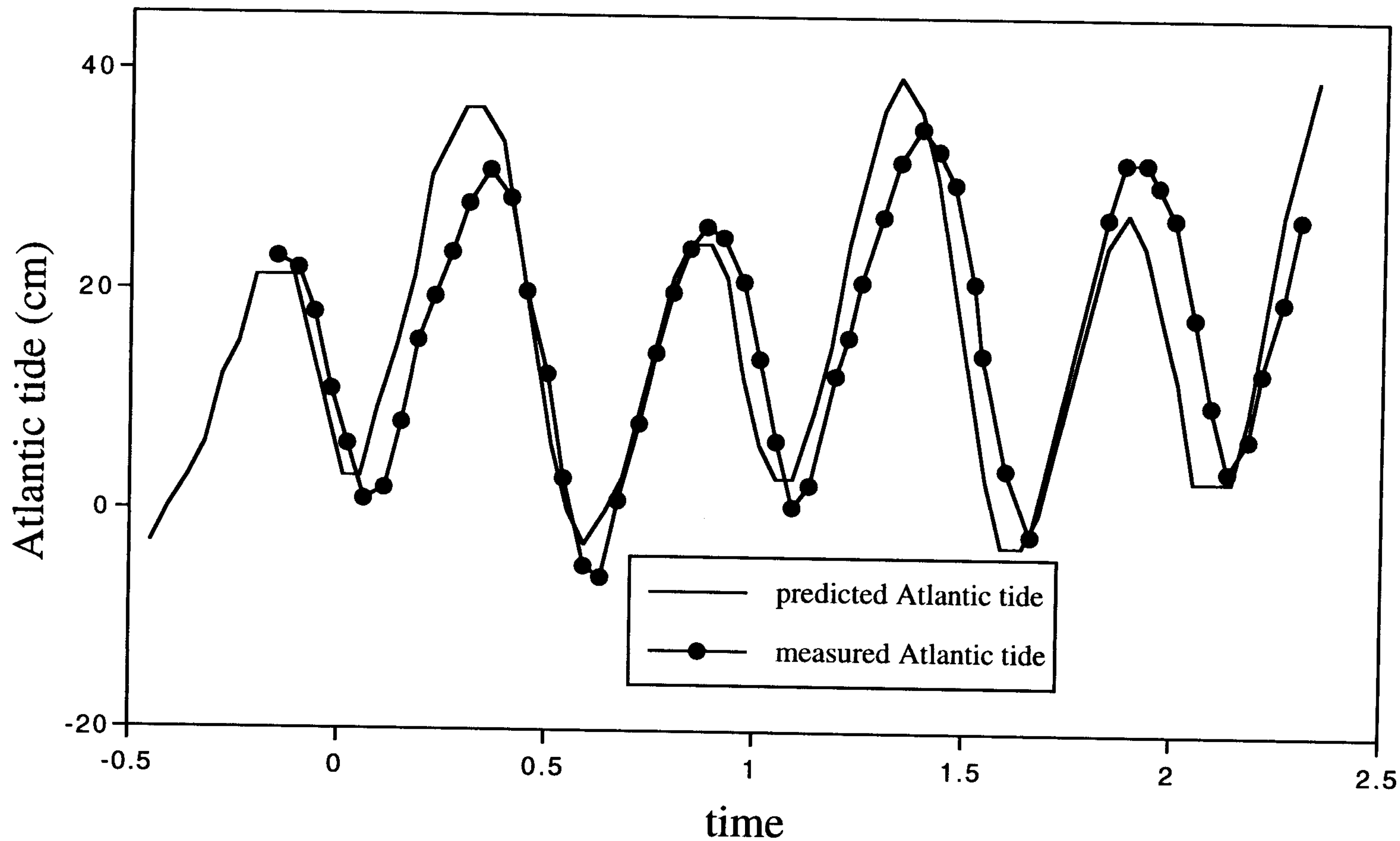

Figure 6. Comparison of tide program and actual tidal measurements from canal across US-1 from the Keys Marine Laboratory, Long Key.

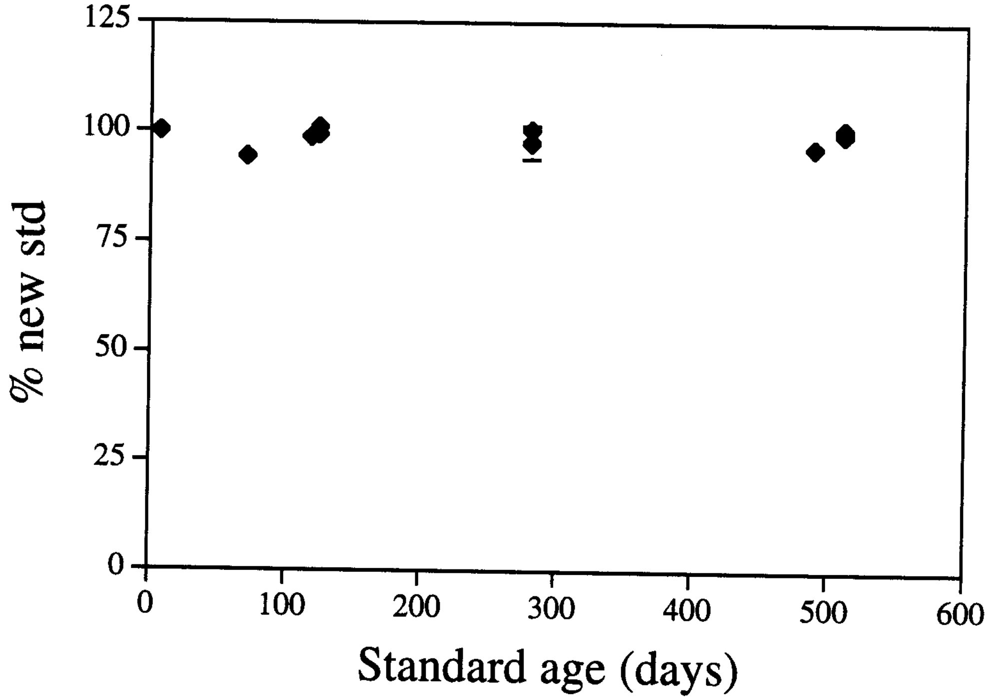

Figure 7. Results from 1.04 ppm standards stored in Vacutainers for differing time periods. Aged standards are compared with a newly prepared standard.

Flow Chart for I-131 Analysis

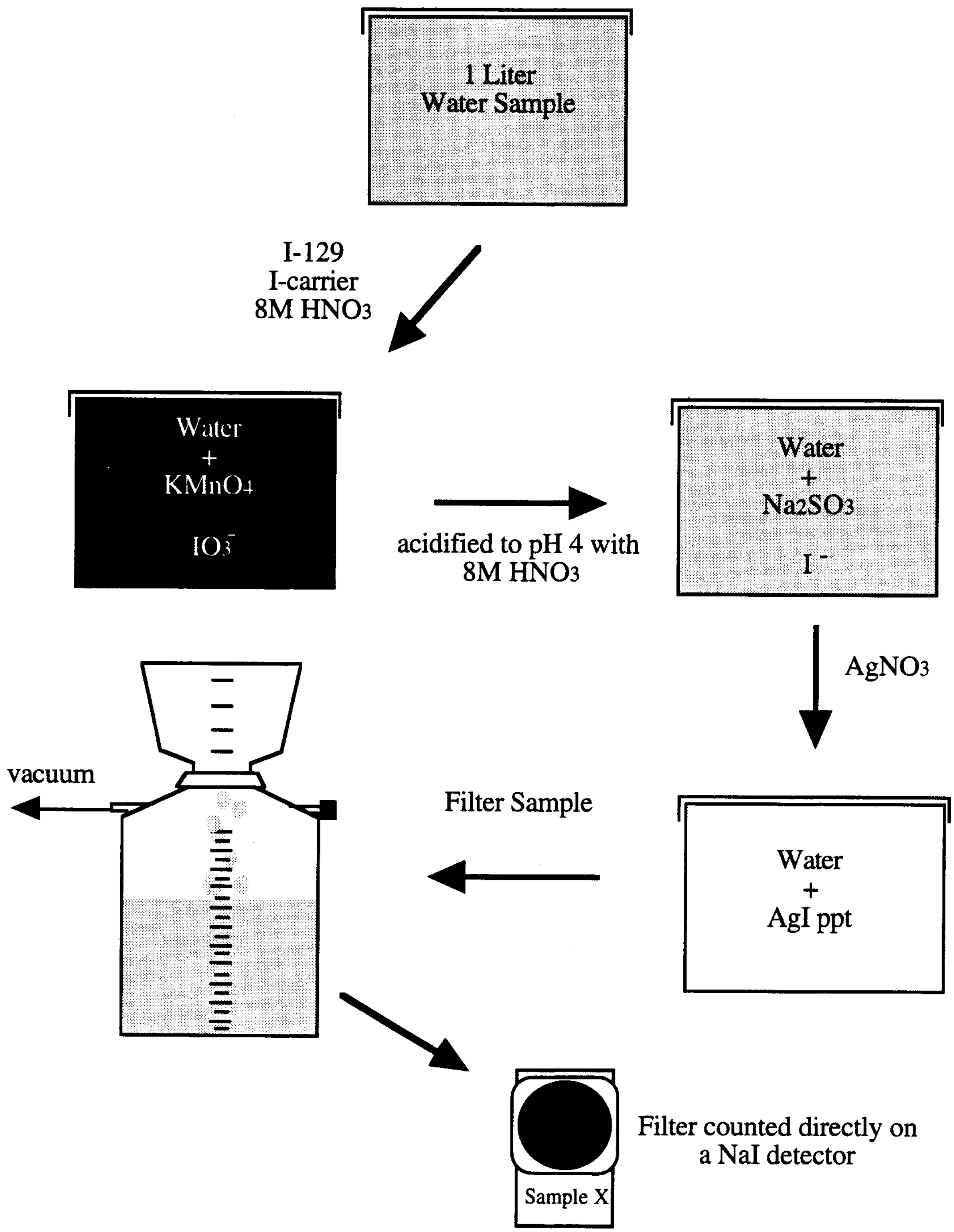

Figure 8: Schematic of iodine procedure used in field experiments used to concentrate I-131 from one liter saline water samples.

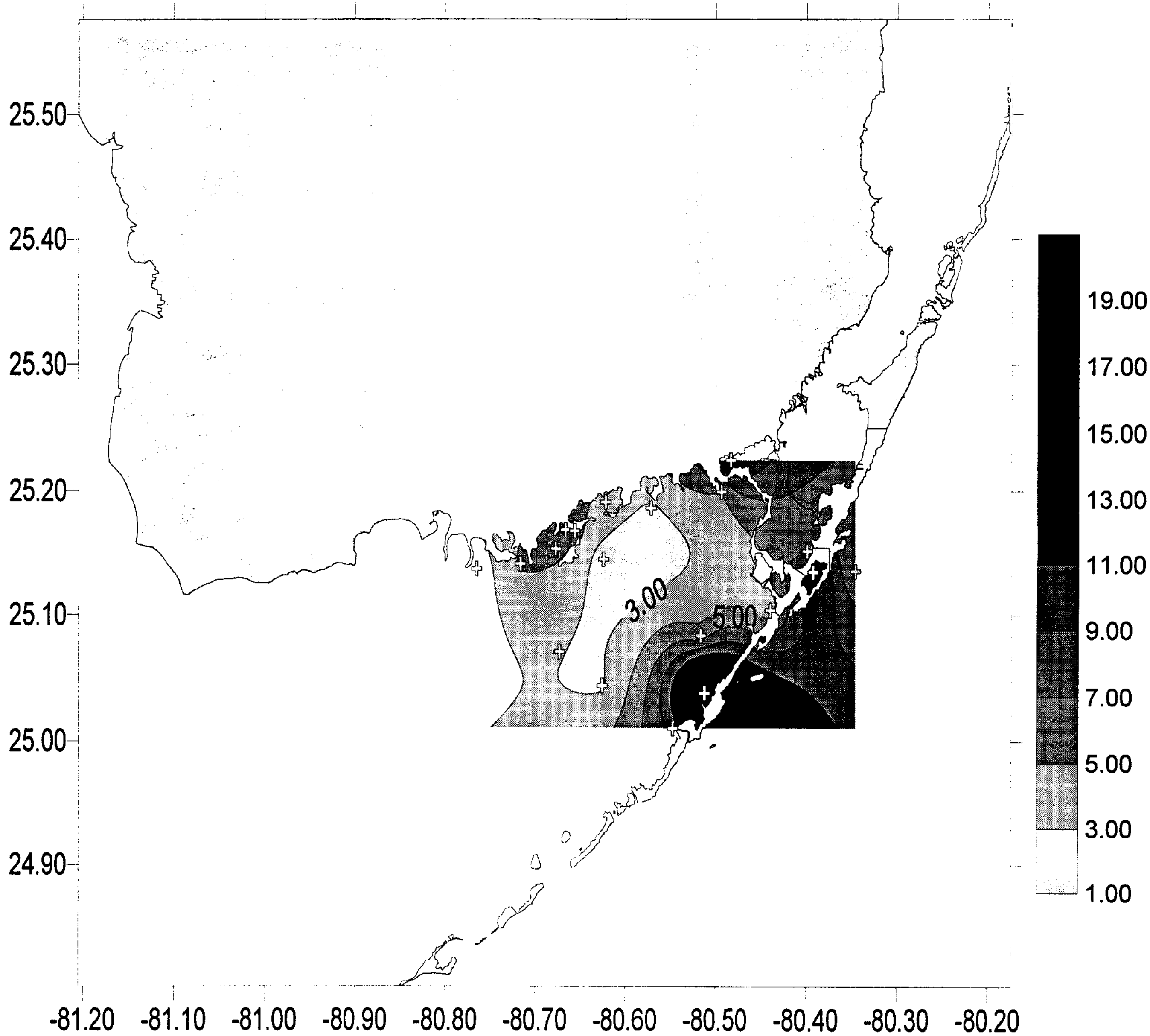

Figure 9: Contour of excess radon (dpm/L) in bottom water samples collected in December 1994.

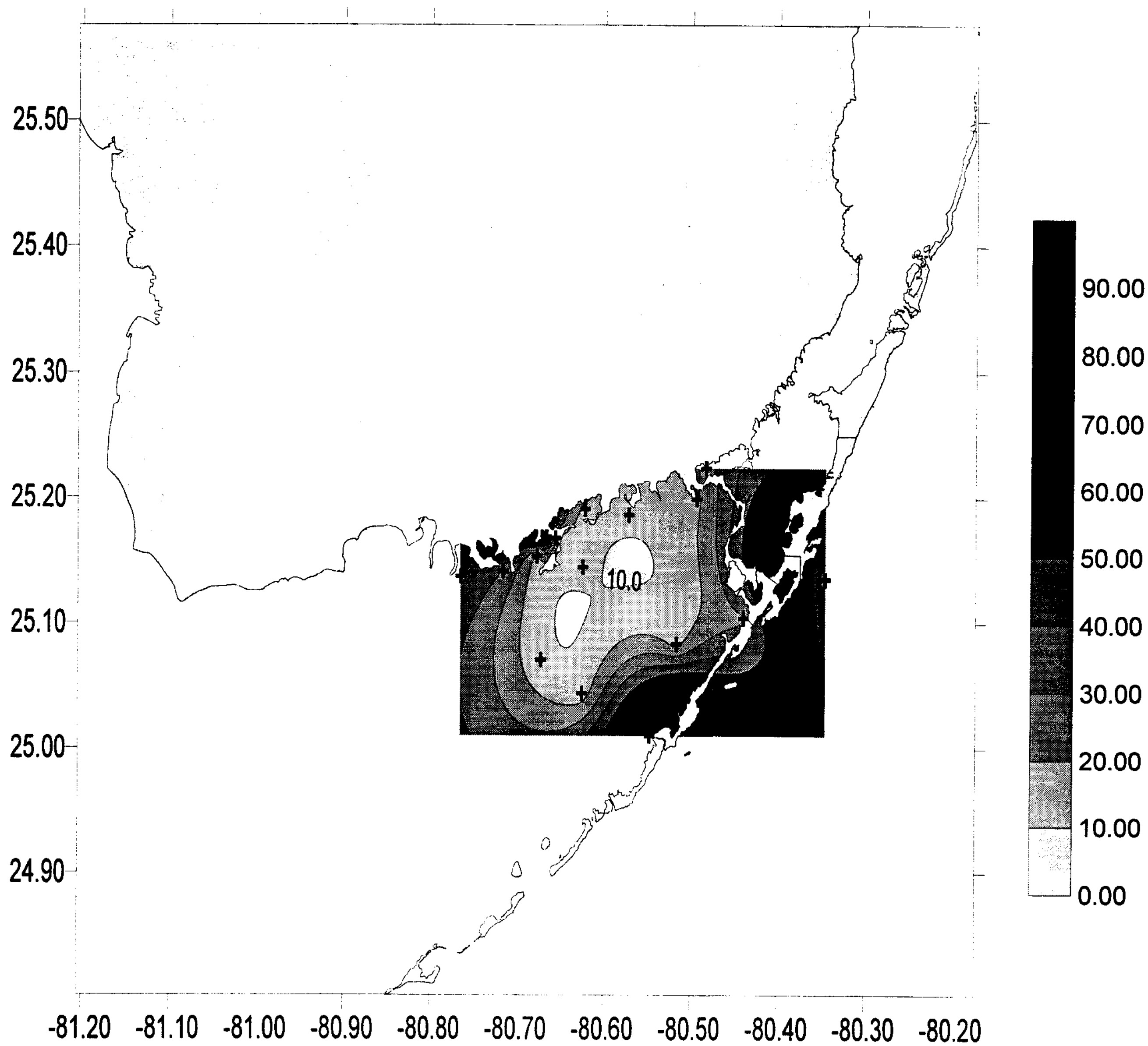

Figure 10: Contour of methane (nM) in bottom water samples collected in December 1994.

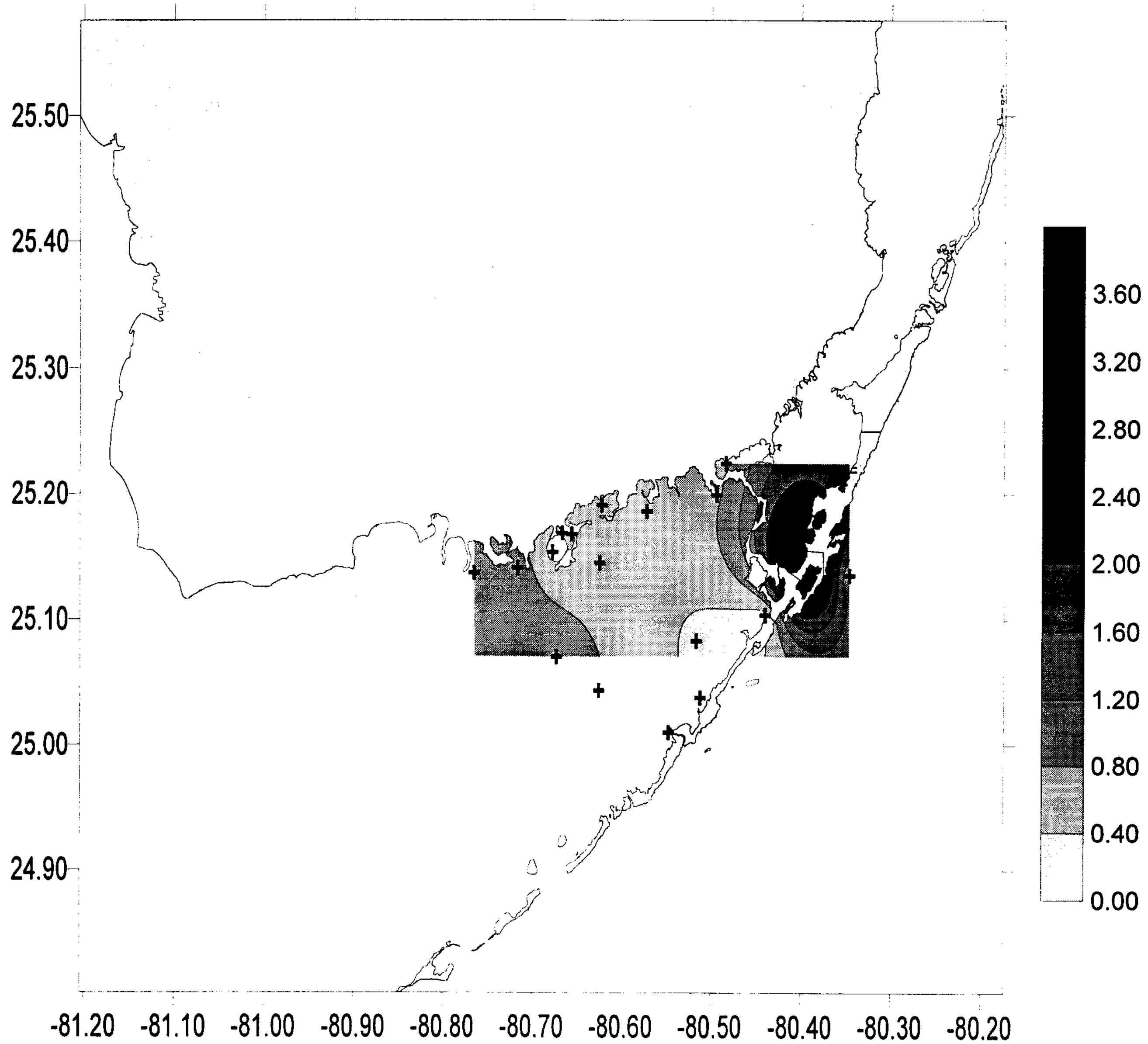

Figure 11: Contour of ethylene (nM) in bottom water samples collected in December 1994.

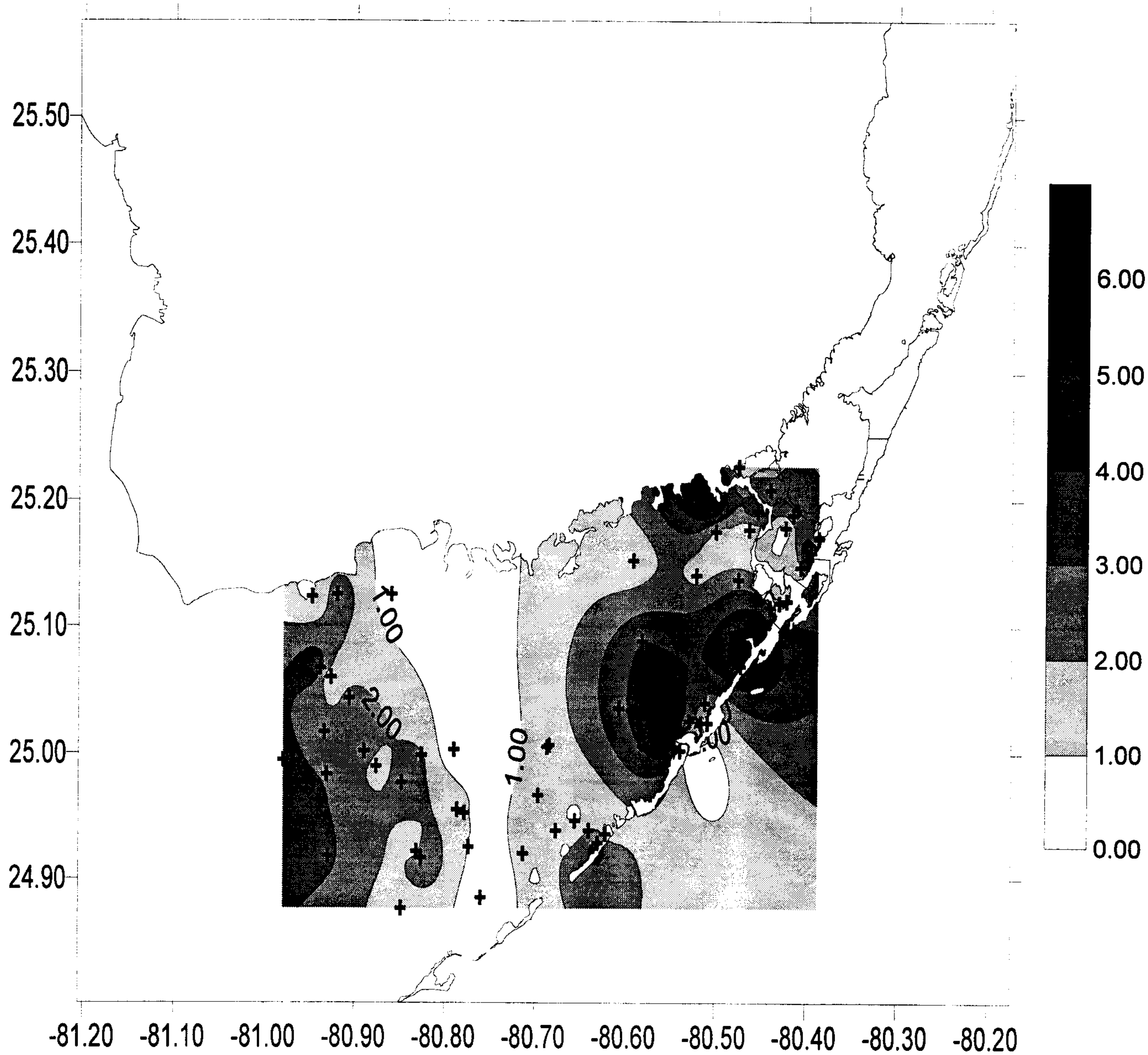

Figure 12: Contour of excess radon (dpm/L) in bottom water samples collected in October 1995.

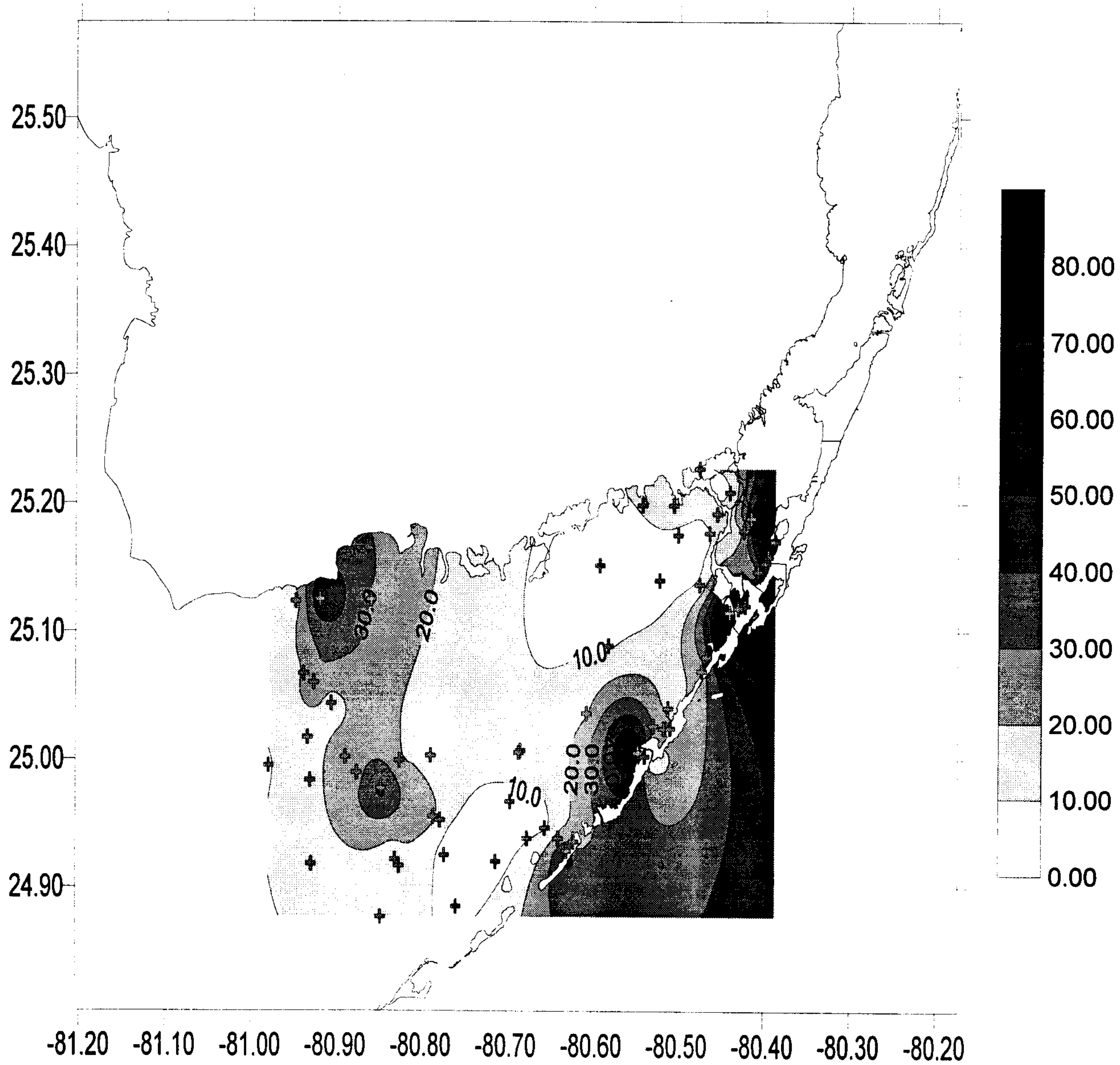

Figure 13: Contour of methane (nM) in bottom water samples collected in October 1995.

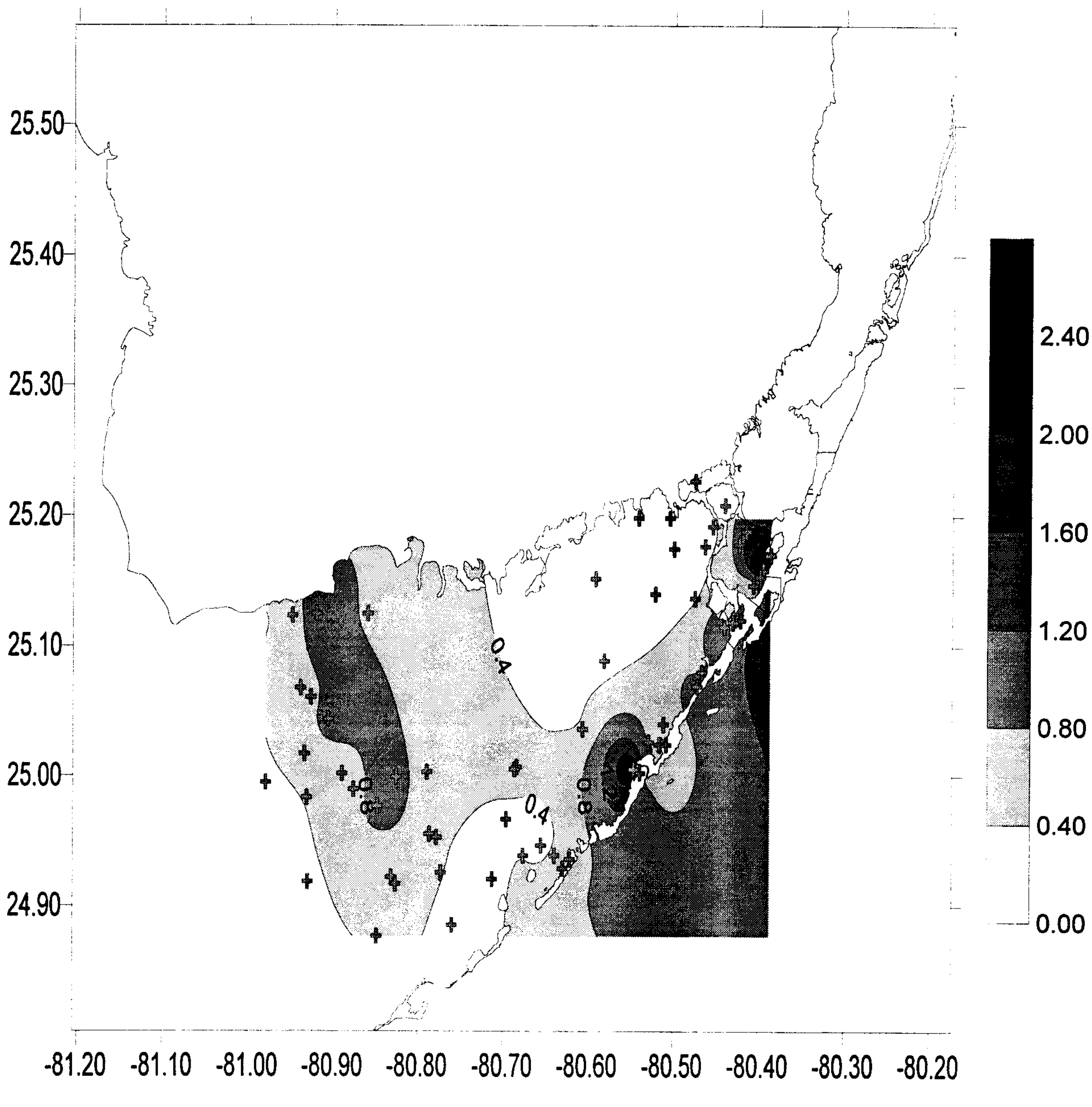

Figure 14: Contour of ethylene (nM) in bottom water samples collected in October 1995.

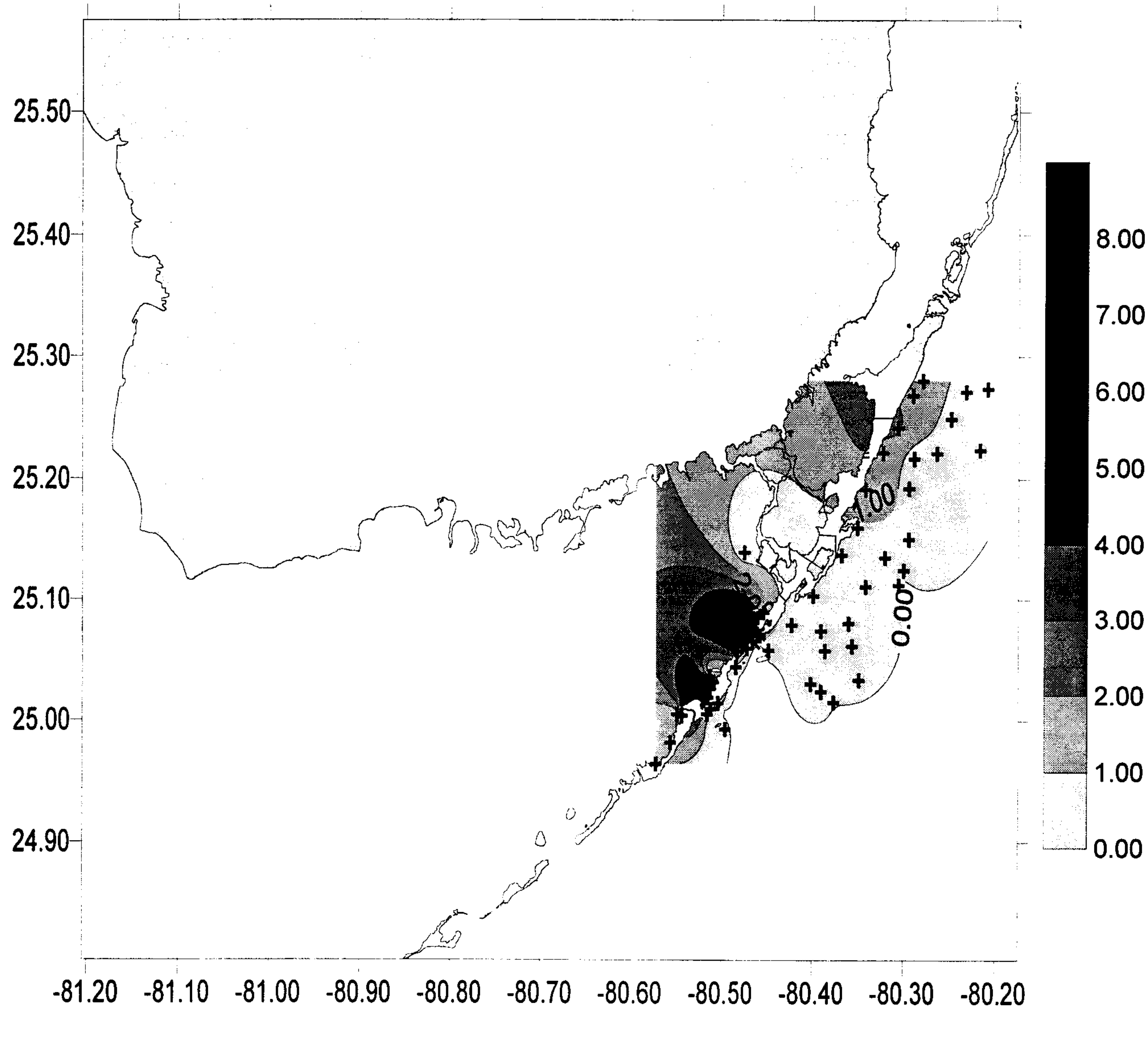

Figure 15: Contour of excess radon (dpm/L) in bottom water samples collected in May 1996.

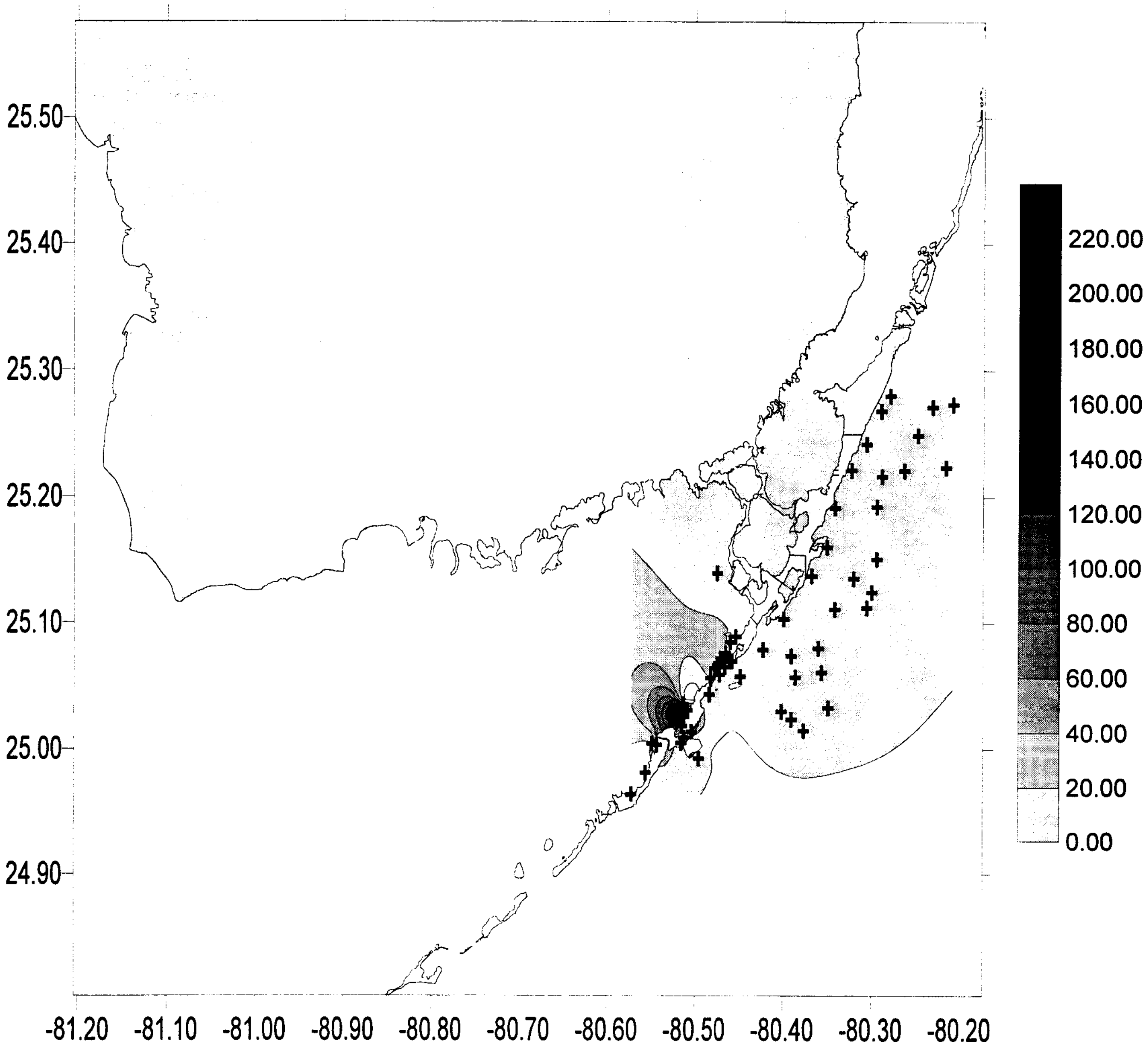

Figure 16: Contour of methane (nM) in bottom water samples collected in May 1996.

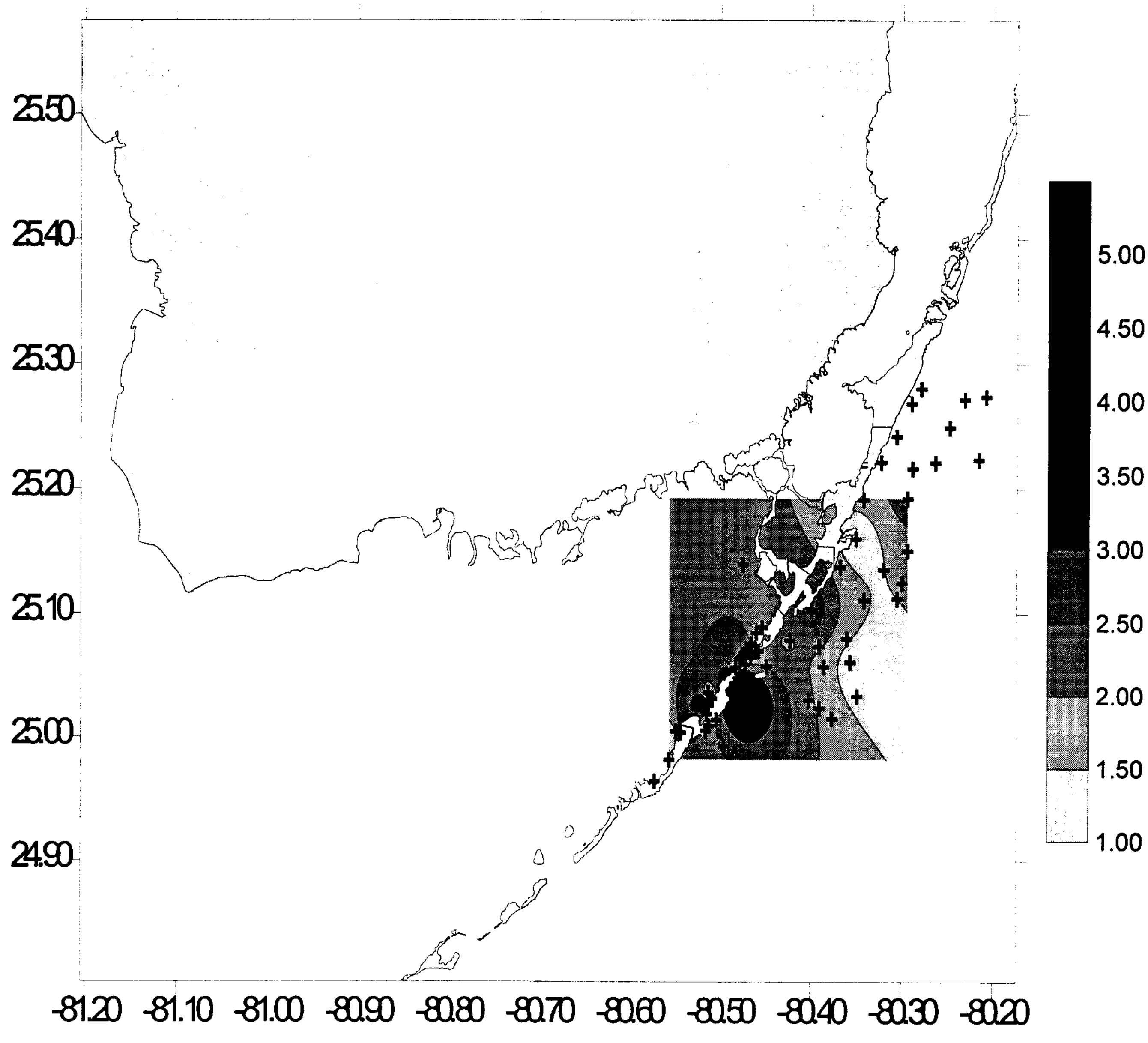

Figure 17: Contour of ethylene (nM) in bottom water samples collected in May 1996.

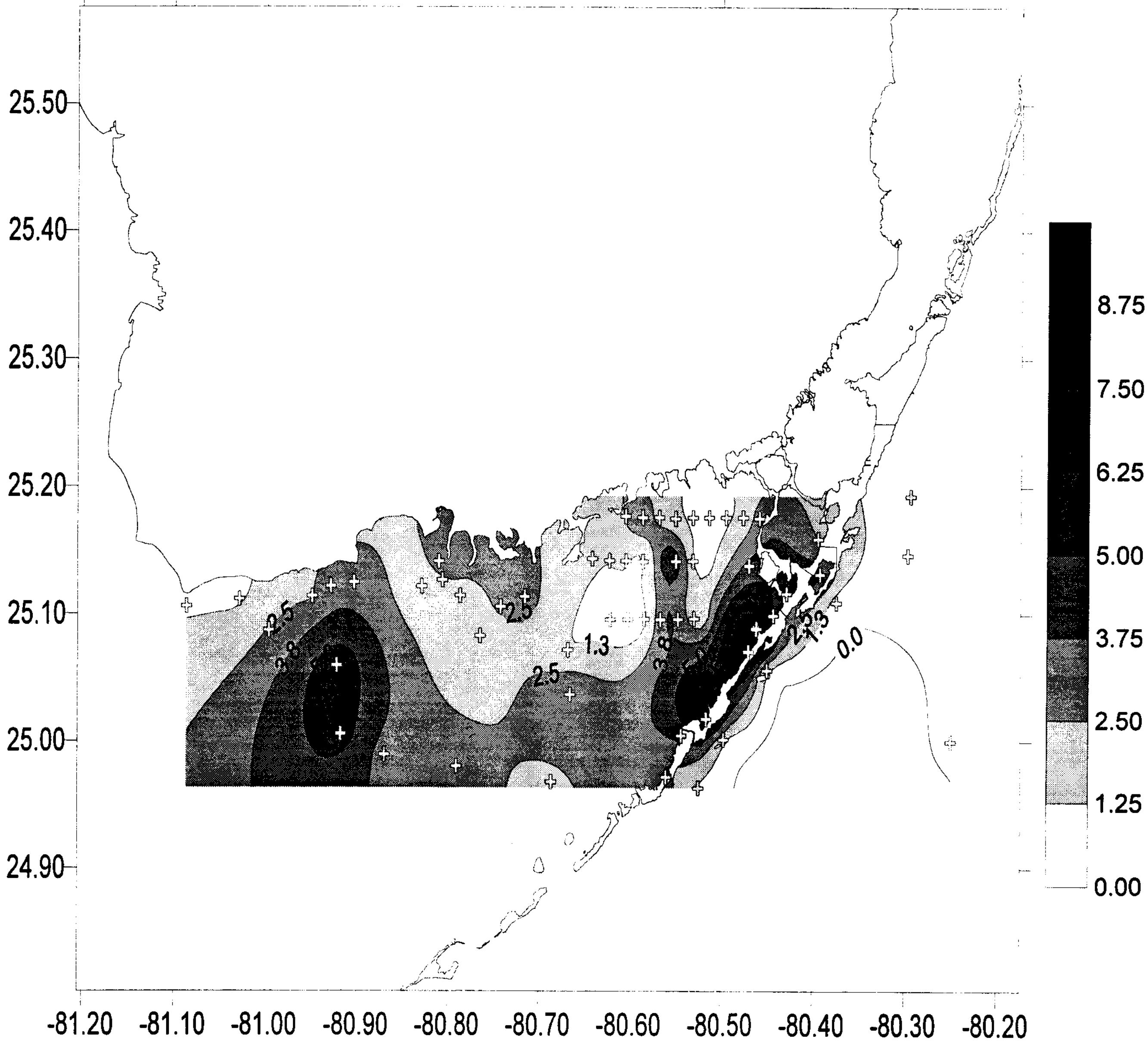

Figure 18: Contour of excess radon (dpm/L) in bottom water samples collected in June 1997.

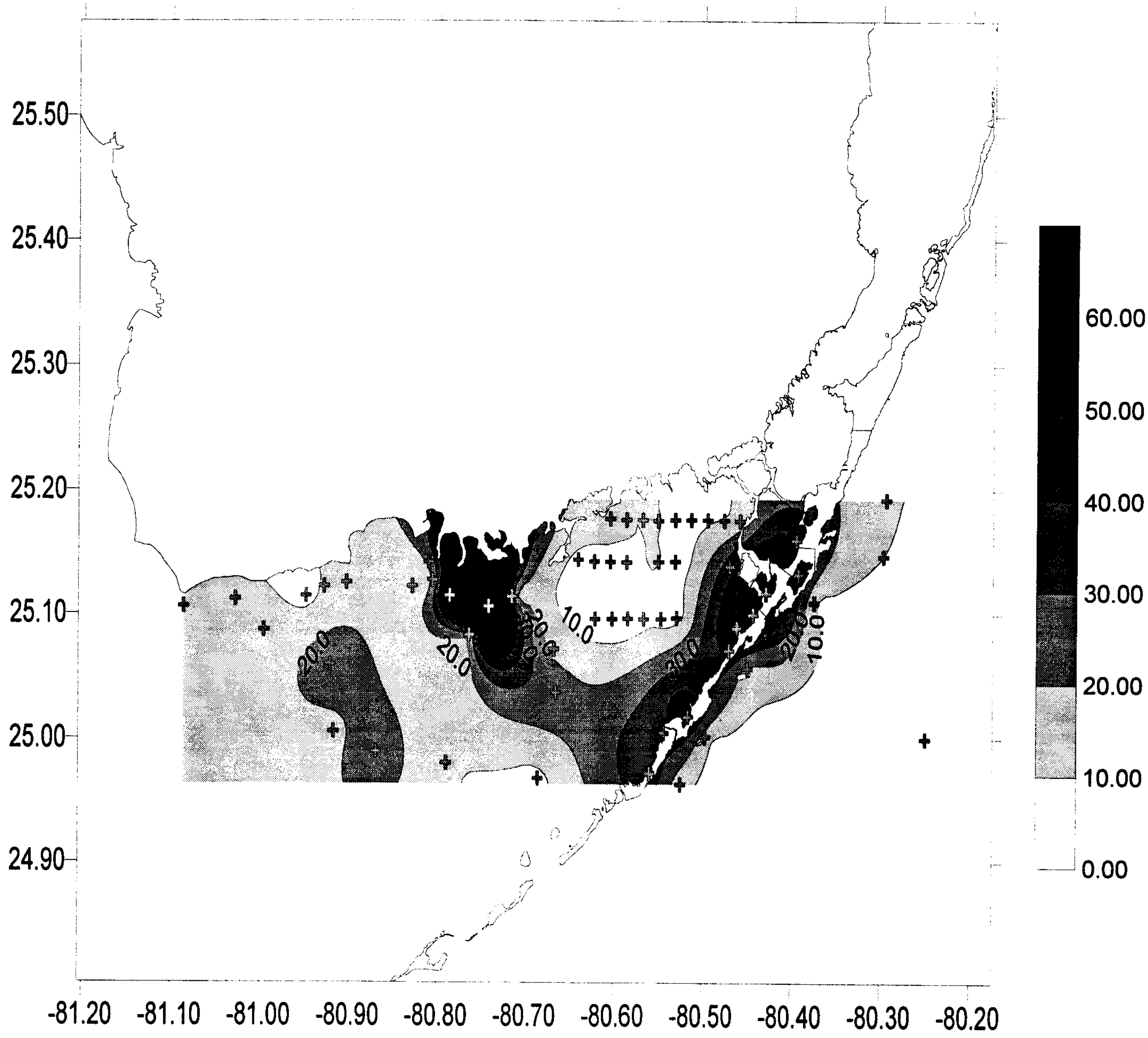

Figure 19: Contour of methane (nM) in bottom water samples collected in June 1997.

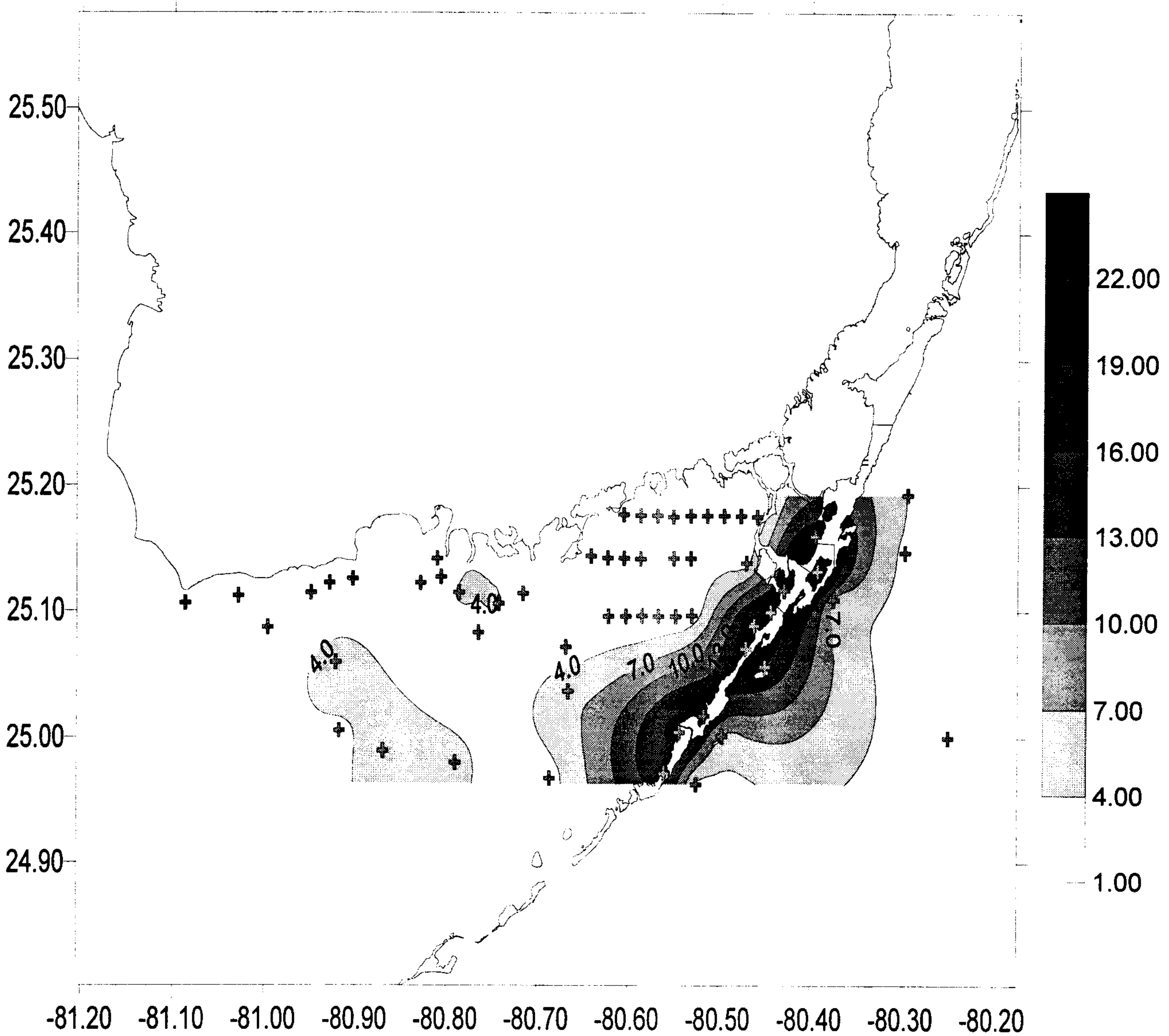

Figure 20: Contour of ethylene (nM) in bottom water samples collected in June 1997.

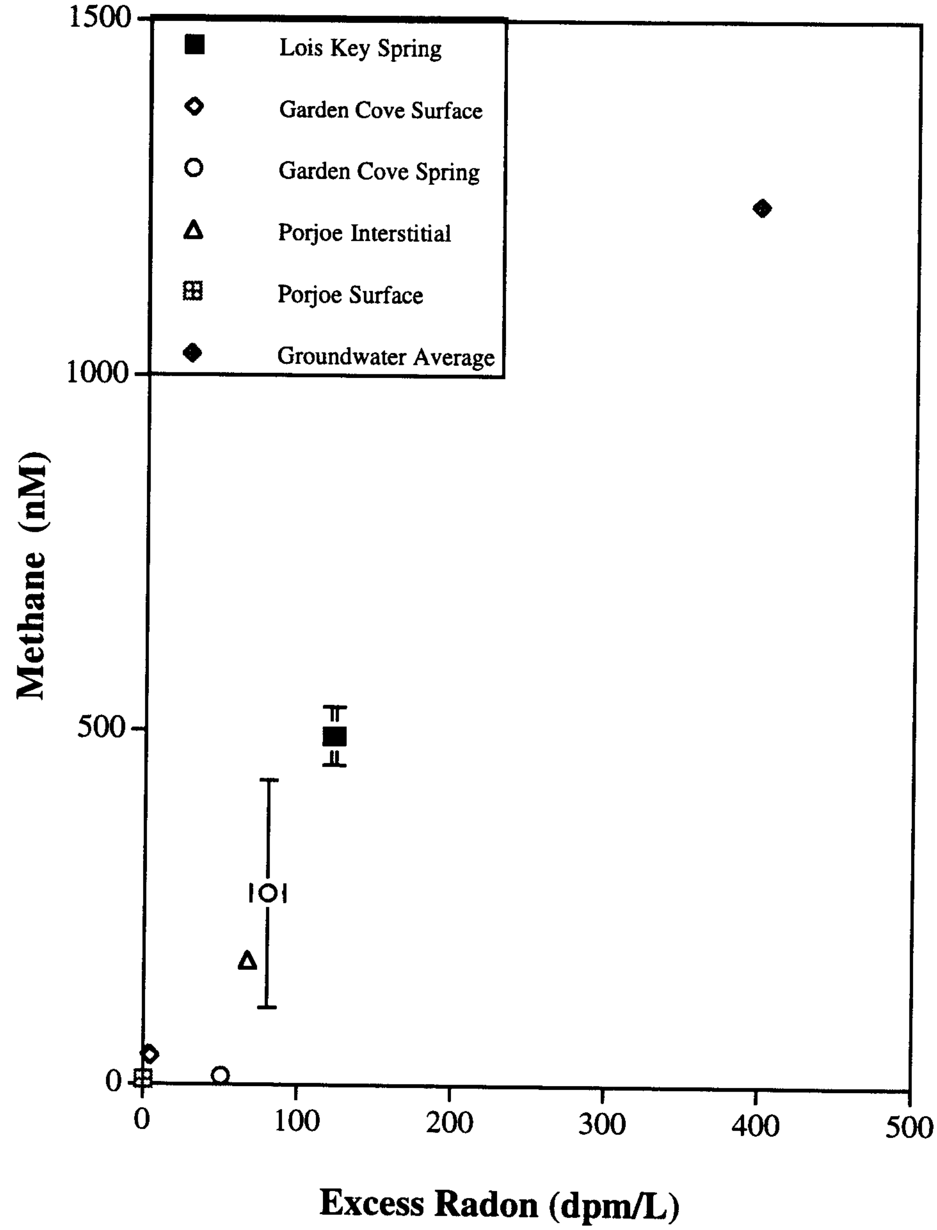

Figure 21: Radon and methane concentrations in springs sampled throughout the Keys. The groundwater tracer concentrations are based on the overall average of all the data collected.

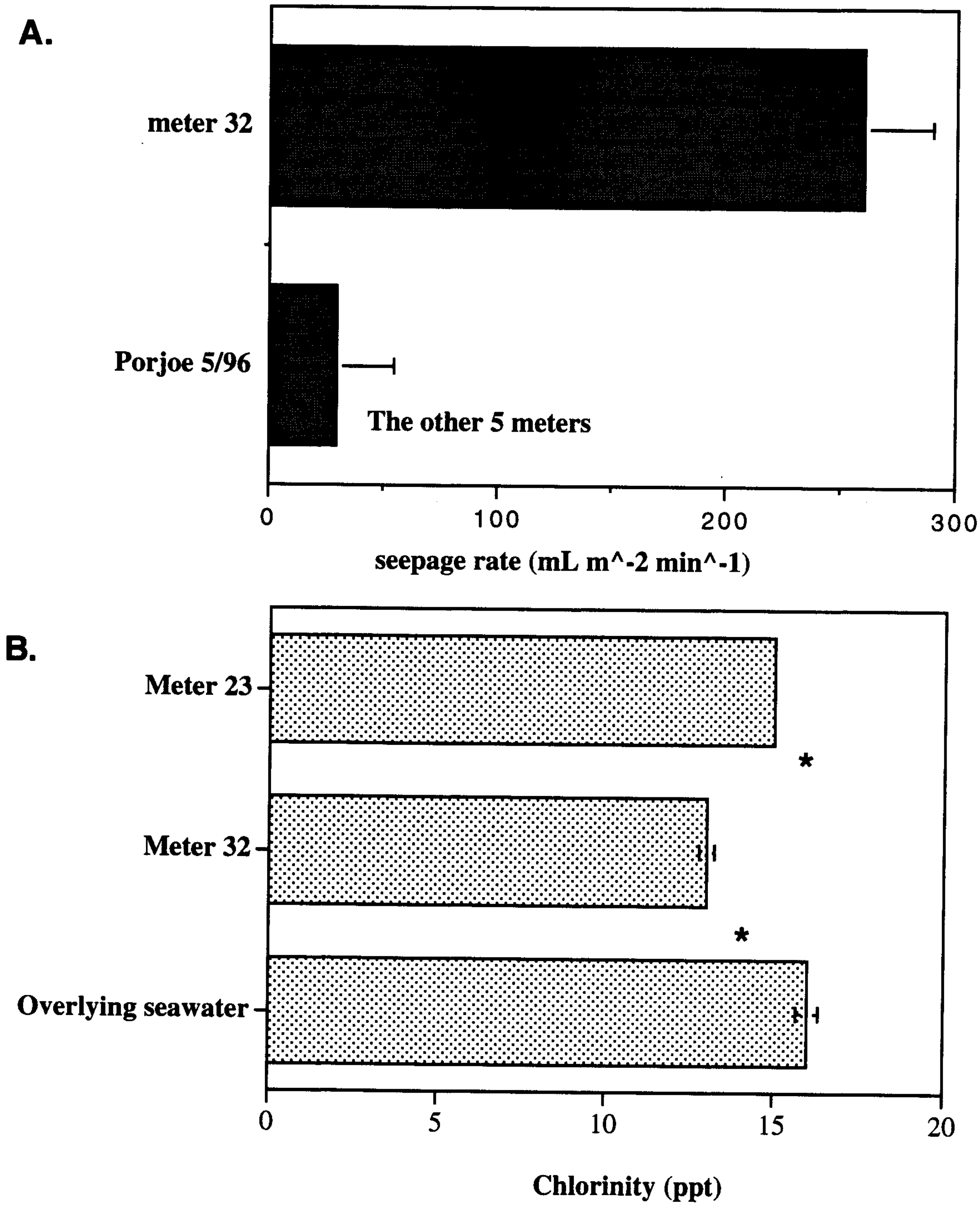

Figure 22: Seepage rates (A) and chlorinity (B) measured at Porjoe Key. Asterick (*) indicates a significant difference ($p<0.01$) between meter and overlying water.

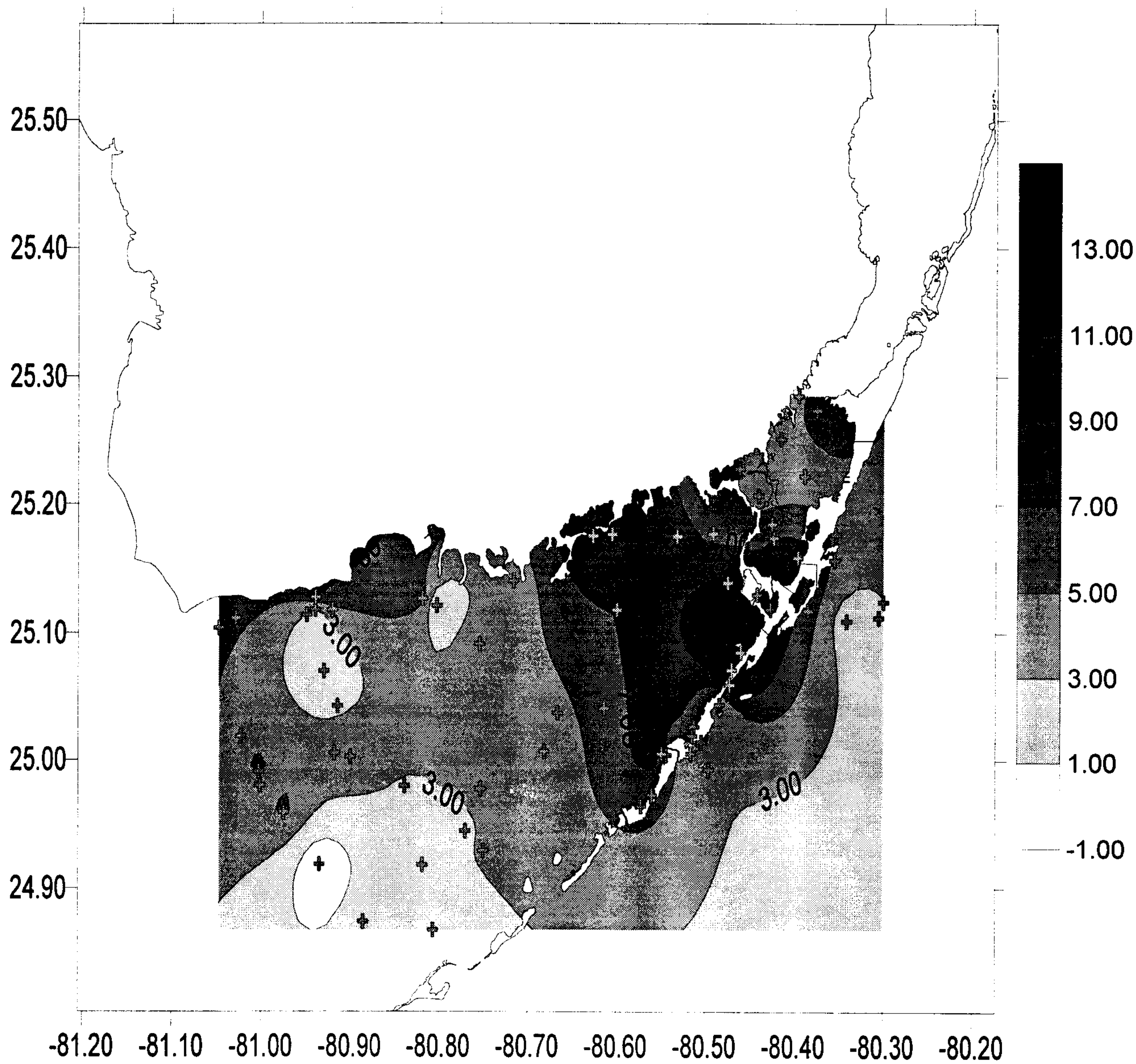

Figure 23: Contour of 15N (o/oo) in macroalgae collected in throughout the study period.

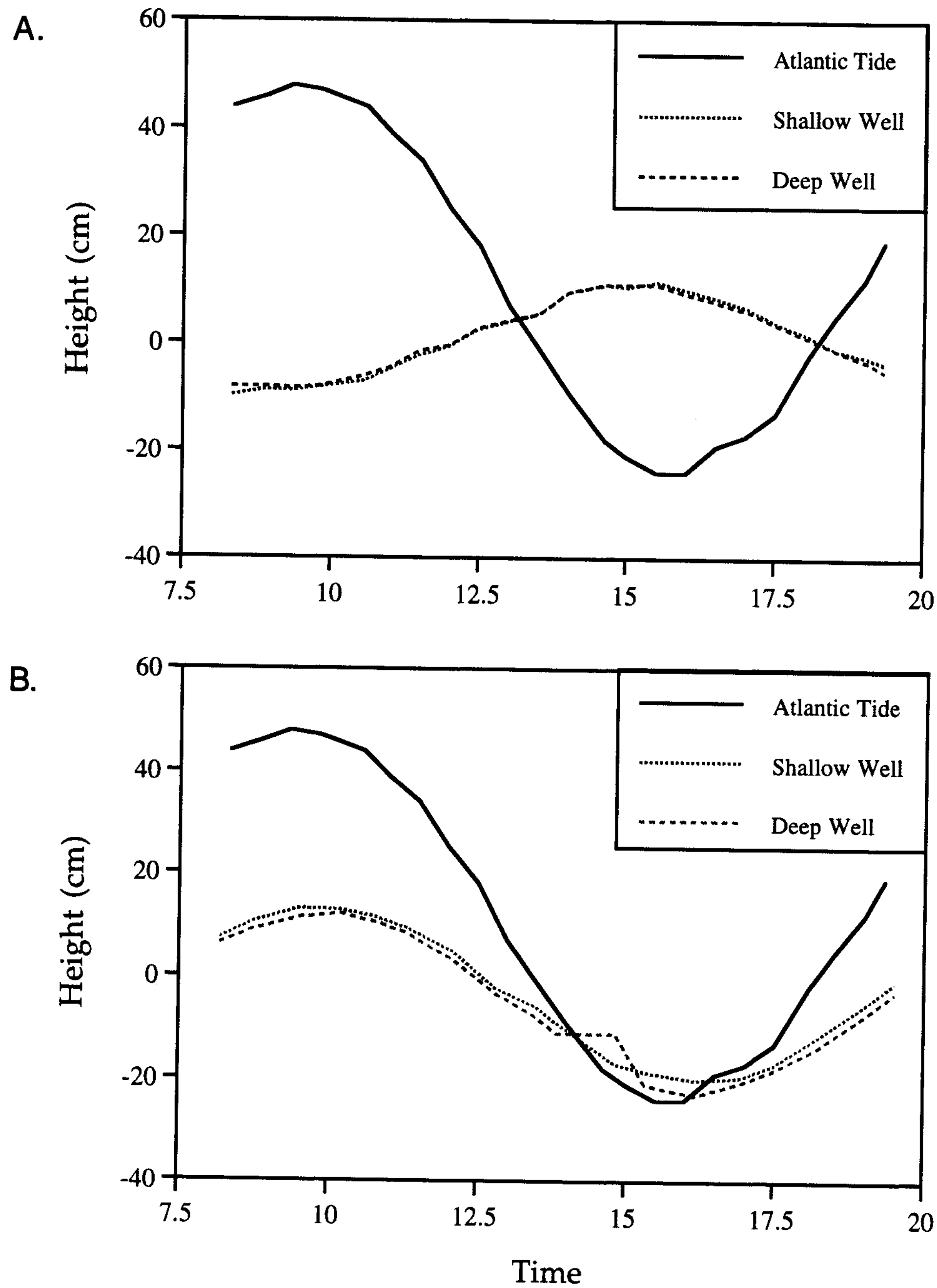

Figure 24: Well head shown relative to the Atlantic tide on the reef-side (A) and the bay-side (B).

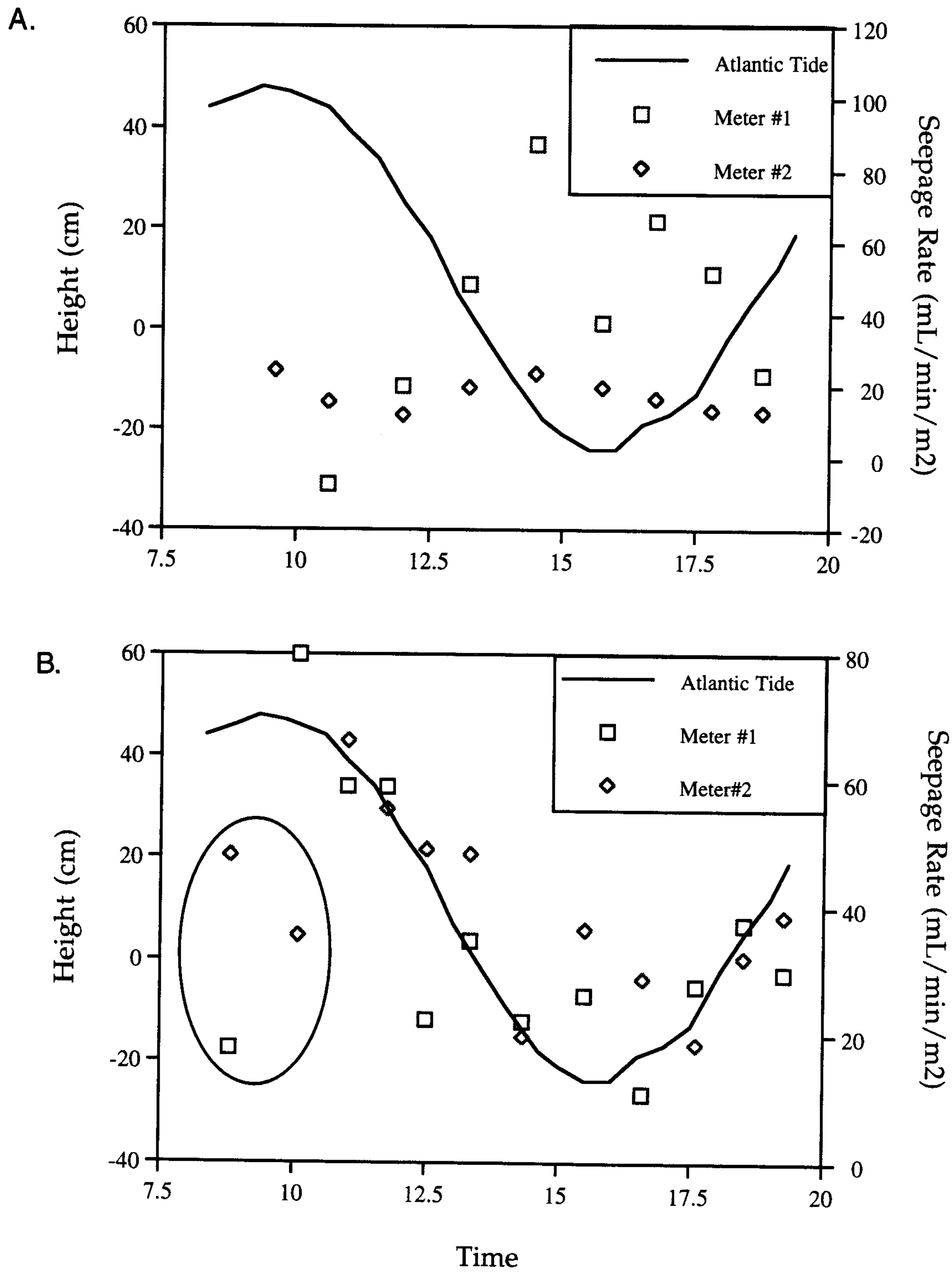

Figure 25: Seepage rates on the reef-side (A) and bay-side (B) relative to the Atlantic tide.

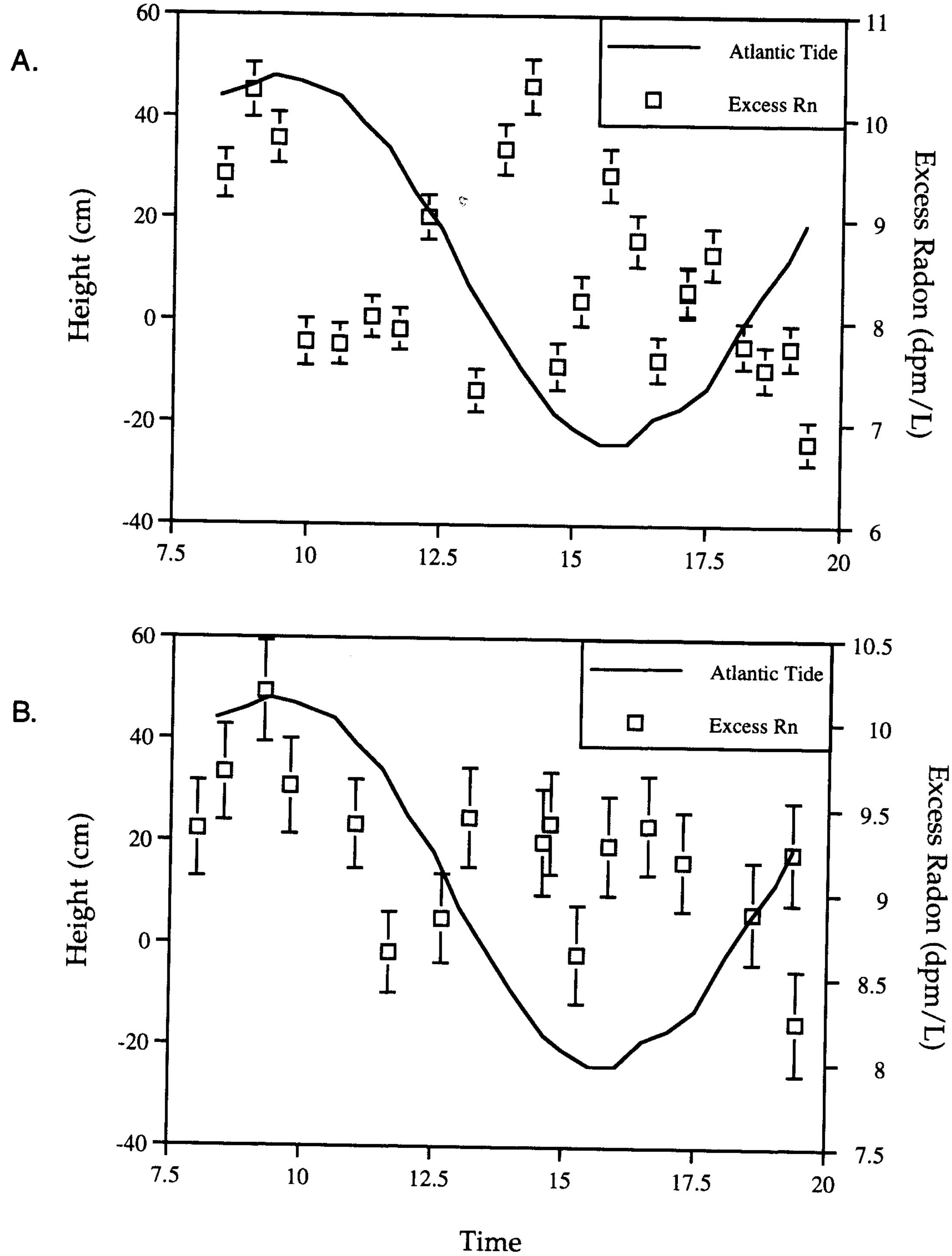

Figure 26: Excess radon on the reef-side (A) and bay-side (B) relative to the Atlantic tide.

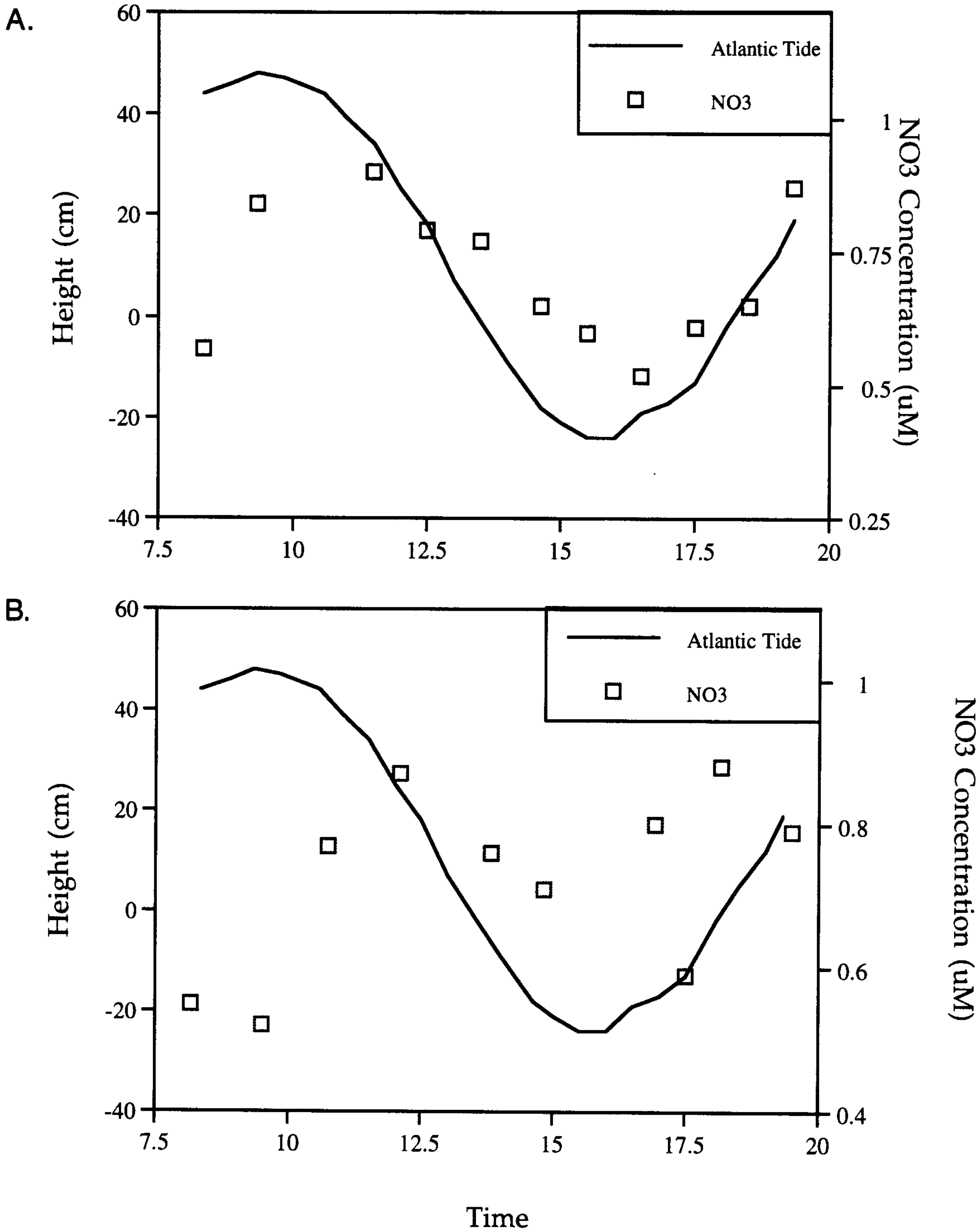

Figure 27: Nitrate concentration on the reef-side (A) and the bay-side (B) relative to the Atlantic tide.

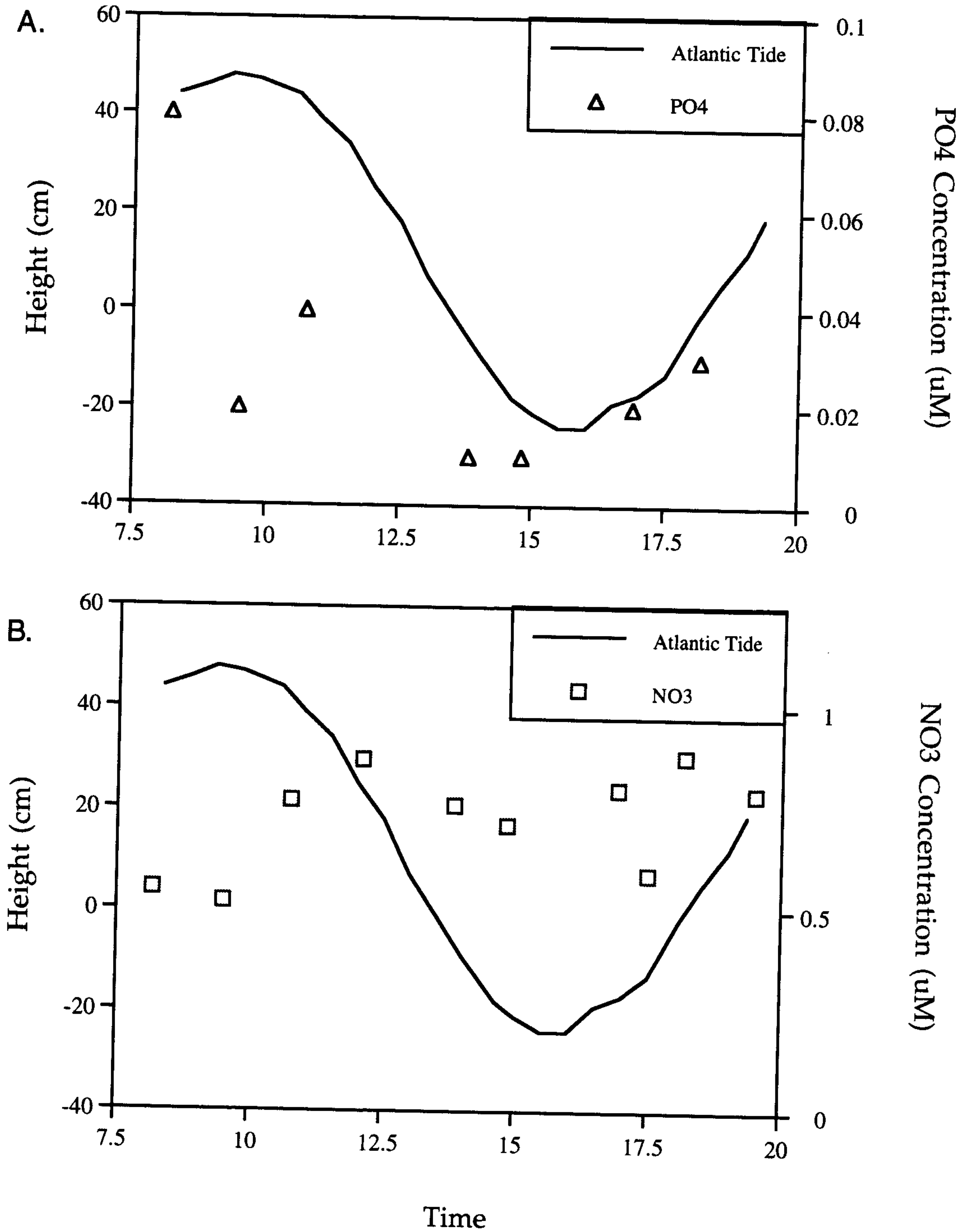

Figure 28: Phosphate (A) and ammonia (B) concentrations on the bay-side relative to the Atlantic tide.

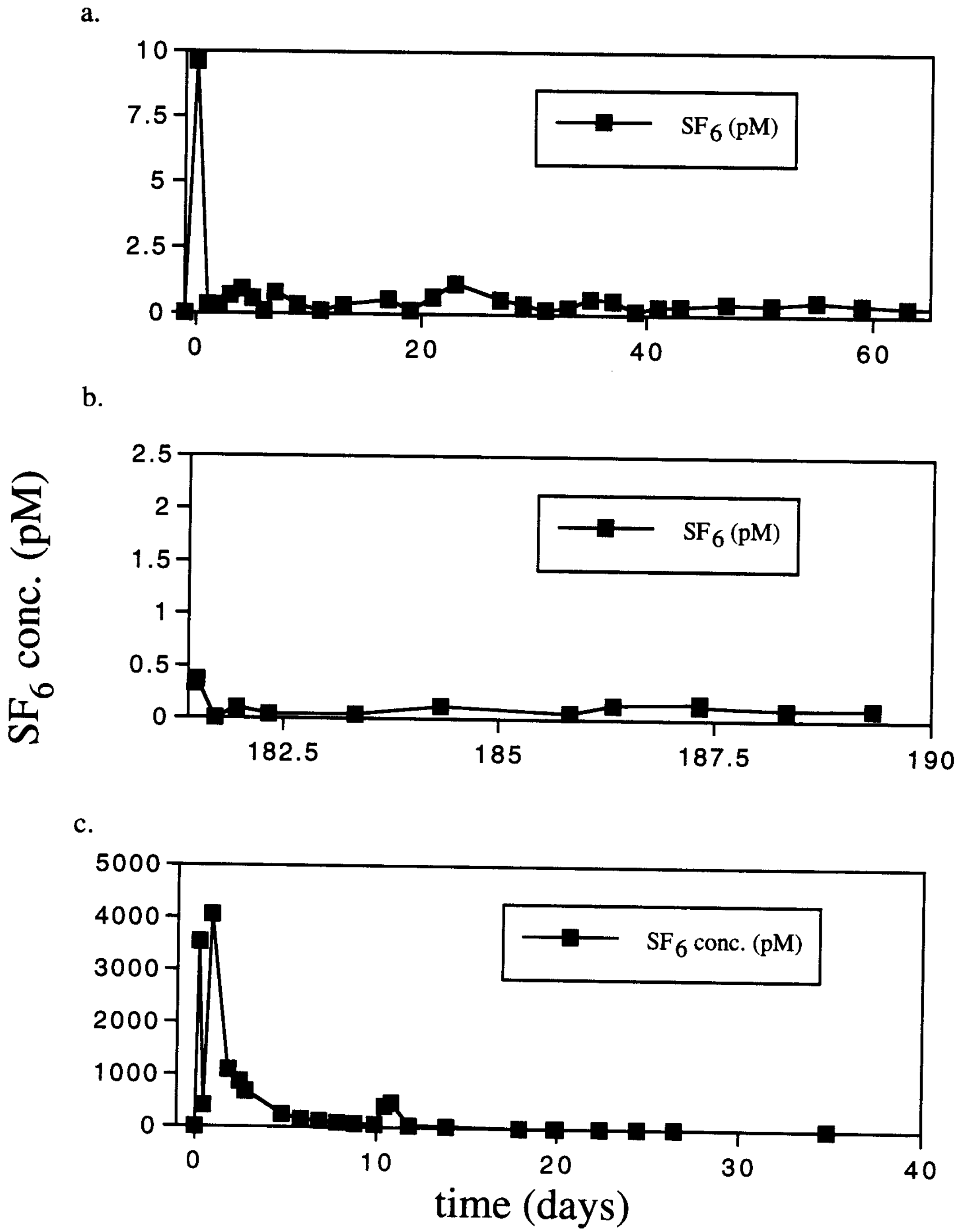

Figure 29. SF_6 concentrations vs. time for (a.) site A, December 96; (b.) site A, June 97; and (c.) site B, June 97. Note that the time scale for b. is continued from a. Also note difference in concentration scale for site B.

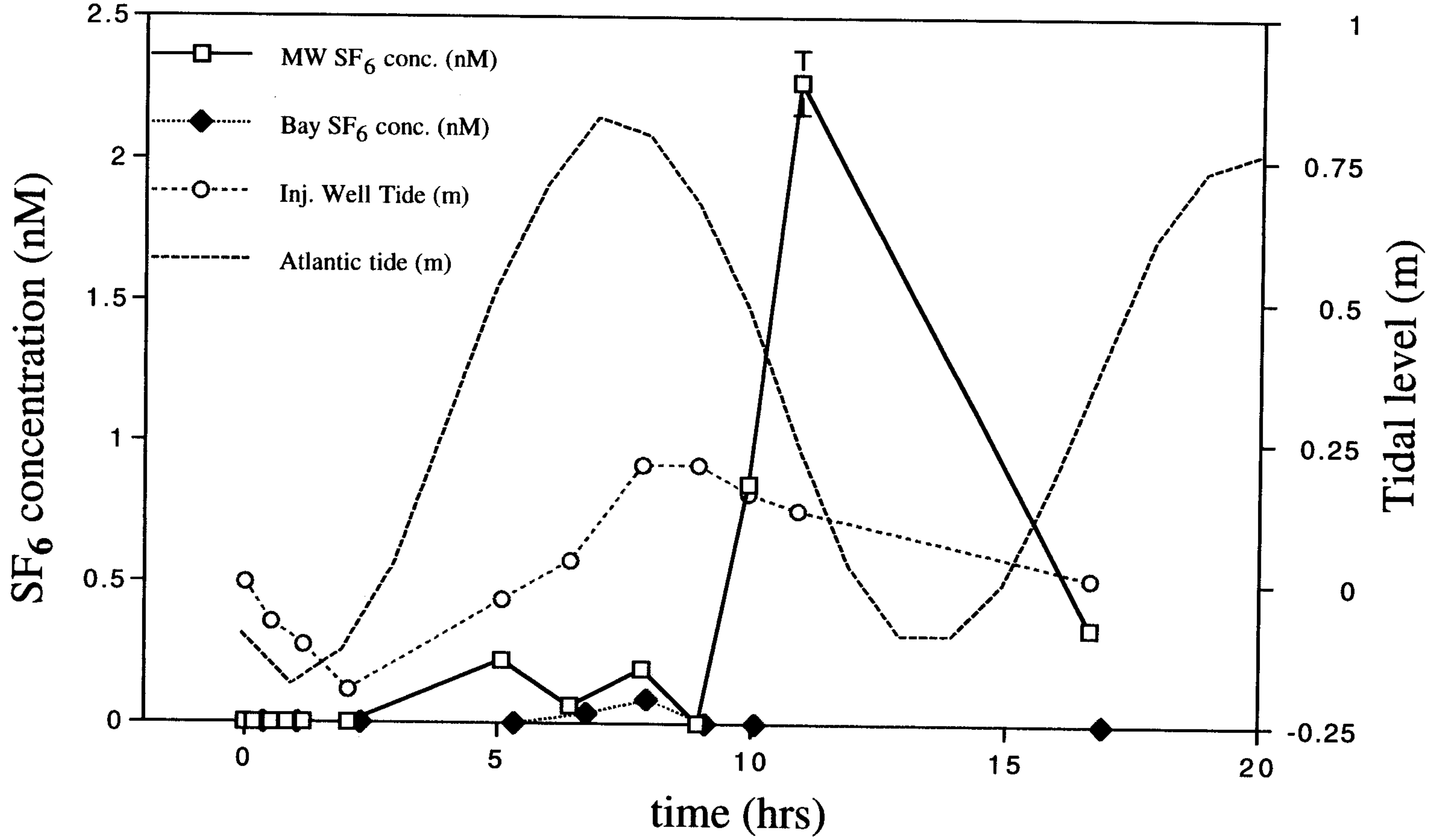

Figure 30. SF_6 concentrations and tidal levels vs. time for July '96 simulated septic tank experiment.

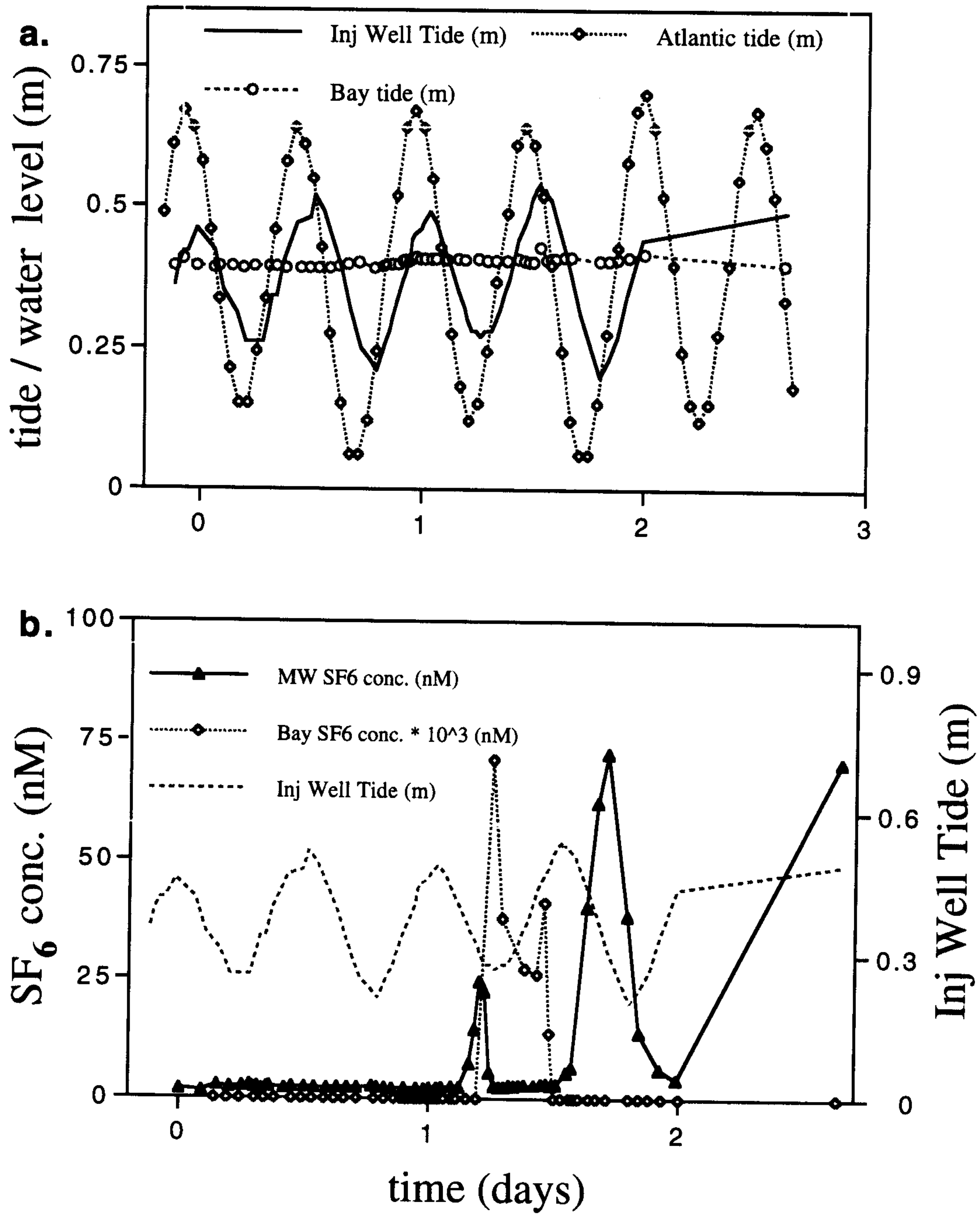

Figure 31. (a.) Tides and water levels for August '96 simulated septic tanks experiment. **(b.)** SF_6 concentrations plotted against time for monitor well and Florida Bay. Injection well water level shown for reference.

a.

b.

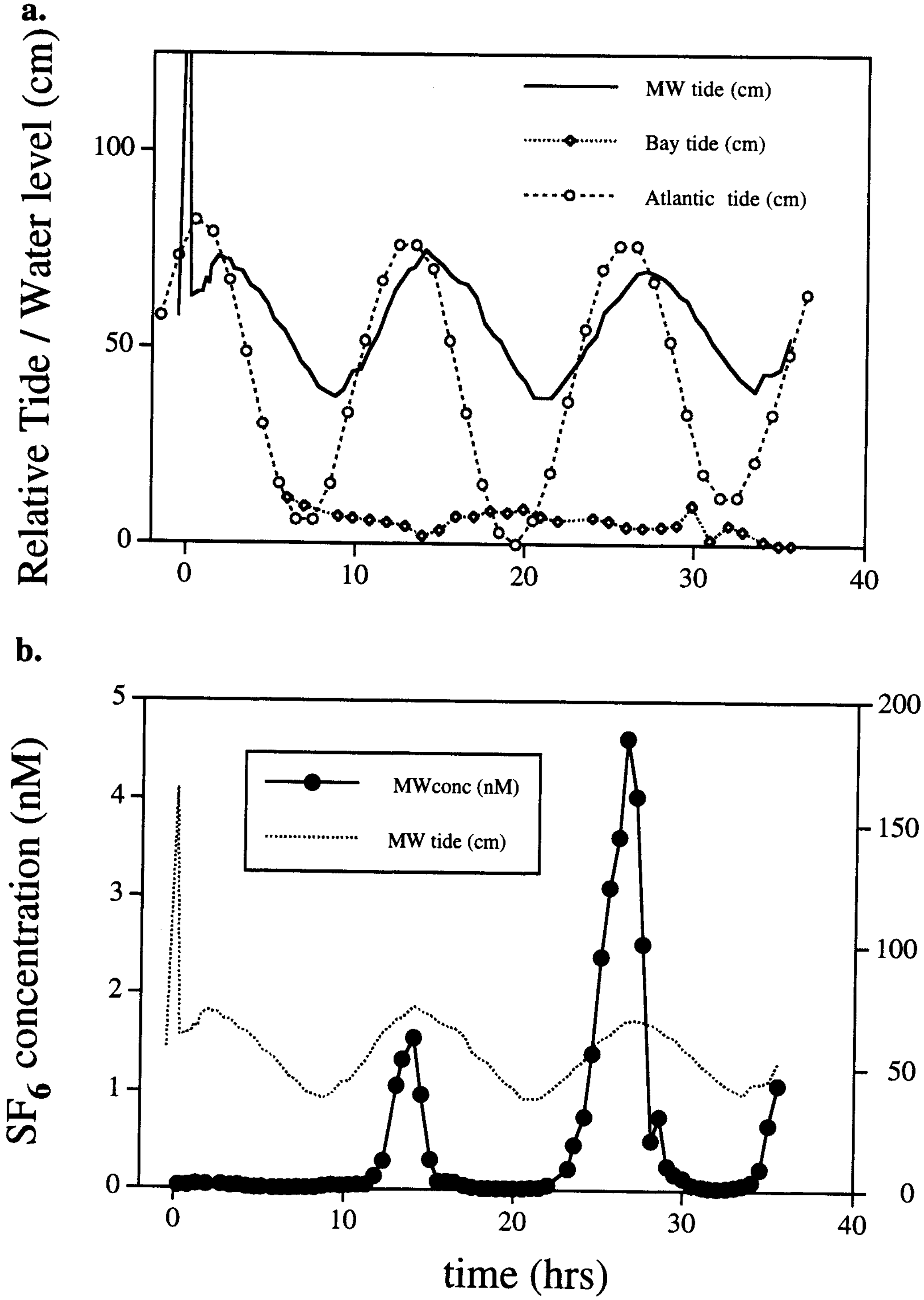

Figure 32. (a) Tidal / water levels for Atlantic Ocean, monitor well, and Florida Bay. **(b)** Monitor well SF_6 concentration plotted with monitor well water level.

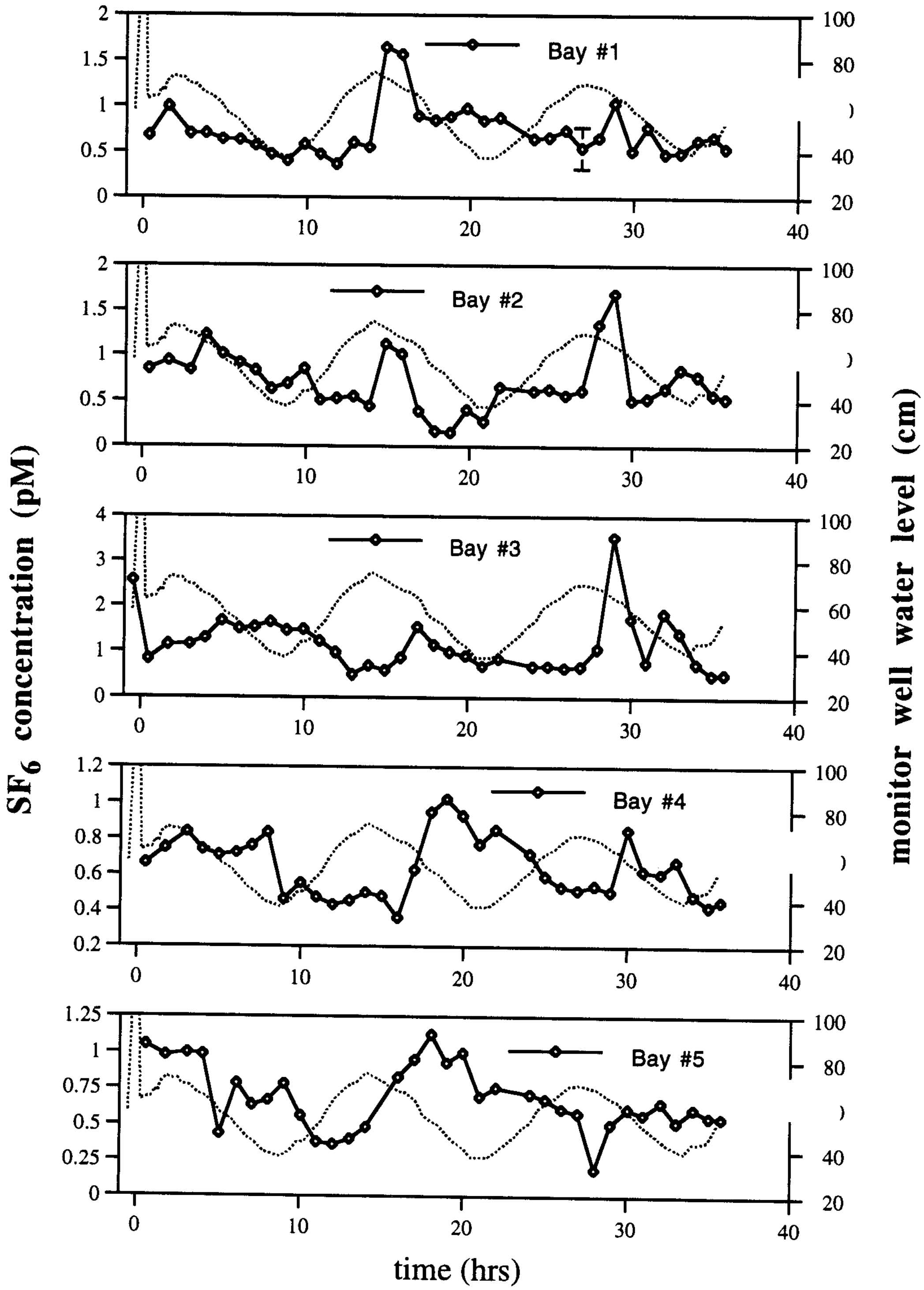

Figure 33. Results from the August '97 experiment's five bay sampling sites. SF_6 concentrations and monitor well water level plotted against time.

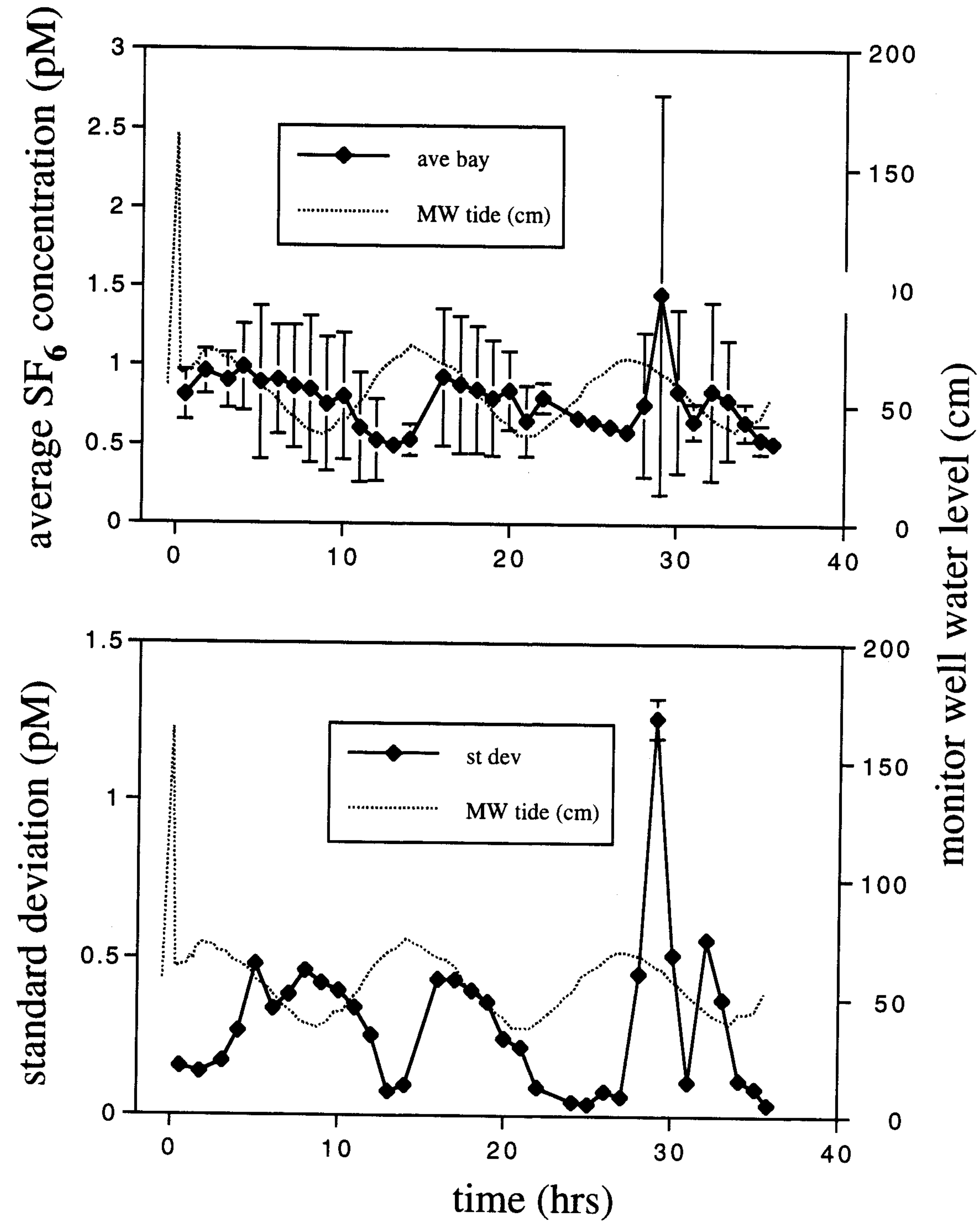

Figure 34. (a) Average SF_6 concentration of Bay stations 1-5 vs time. Standard deviationis shown by error bars. (b) Standard deviation values from (a) plotted against time. Monitor well tidal level is also shown for both plots.

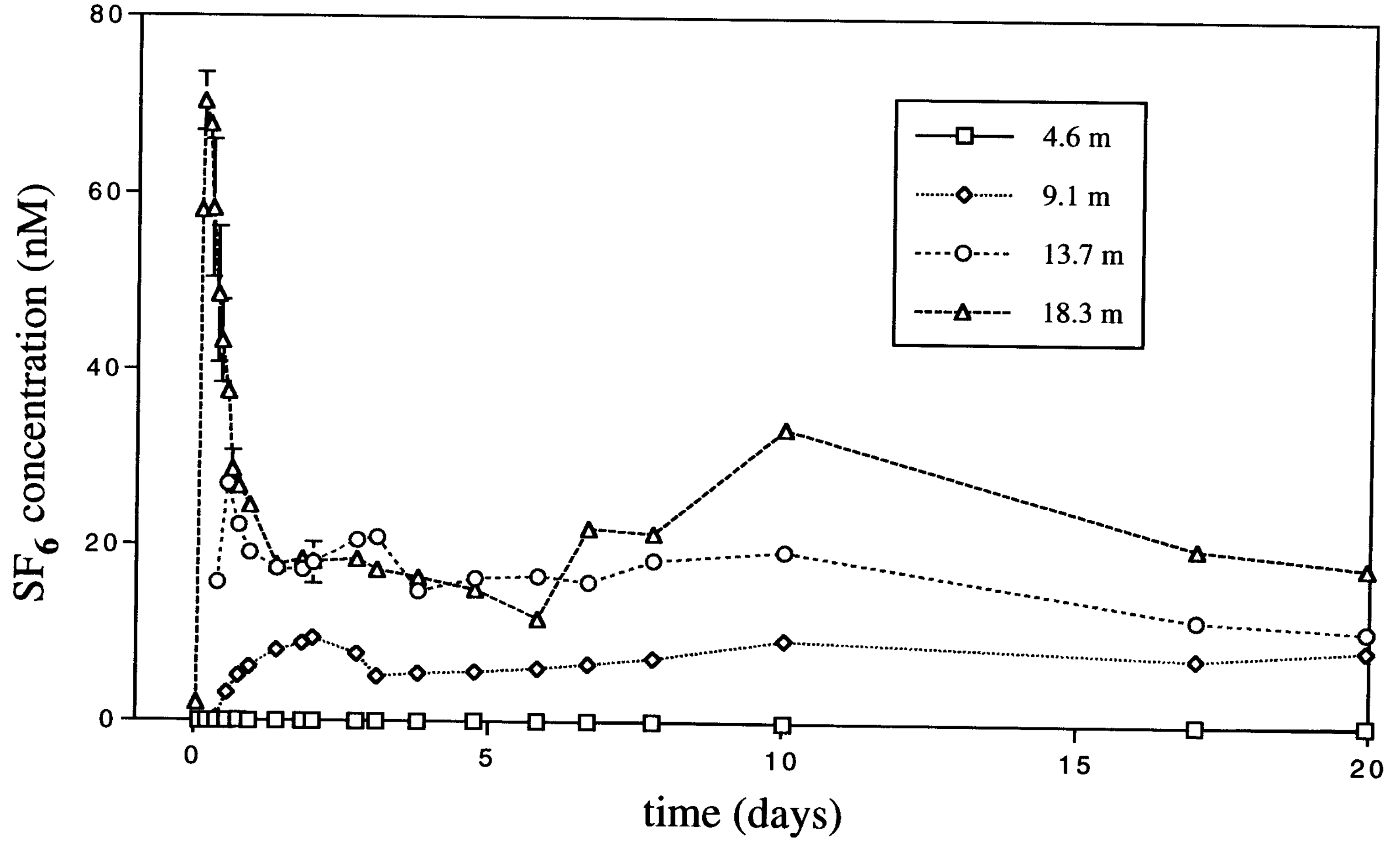

Figure 35a. Well 1 SF_6 concentrations vs. time for October '96 injection well experiment. Days 0-20.

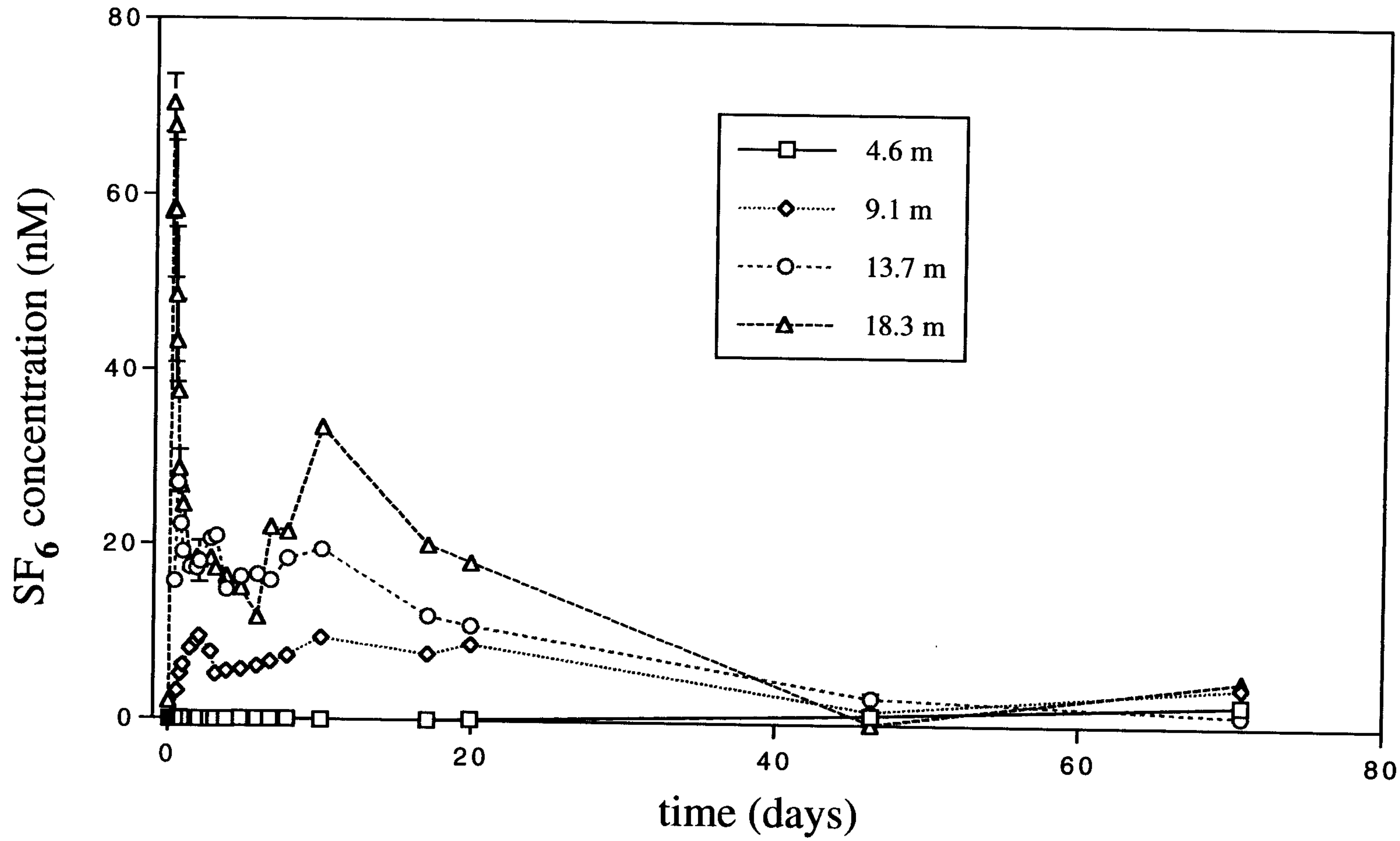

Figure 35b. Well 1 SF_6 concentrations vs. time for October '96 injection well experiment.

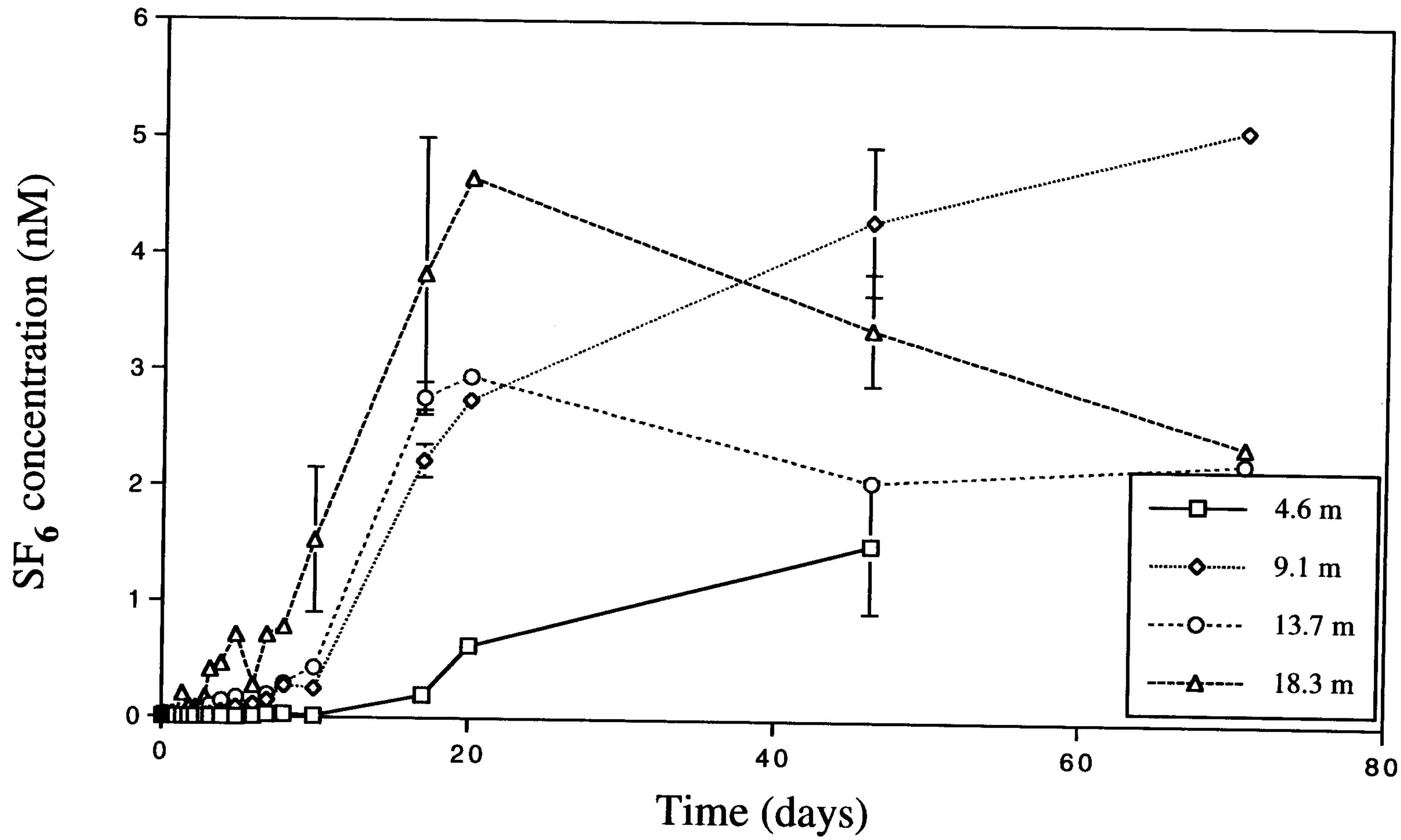

Figure 36. Well 2 SF_6 concentrations vs. time for October '96 injection well experiment.

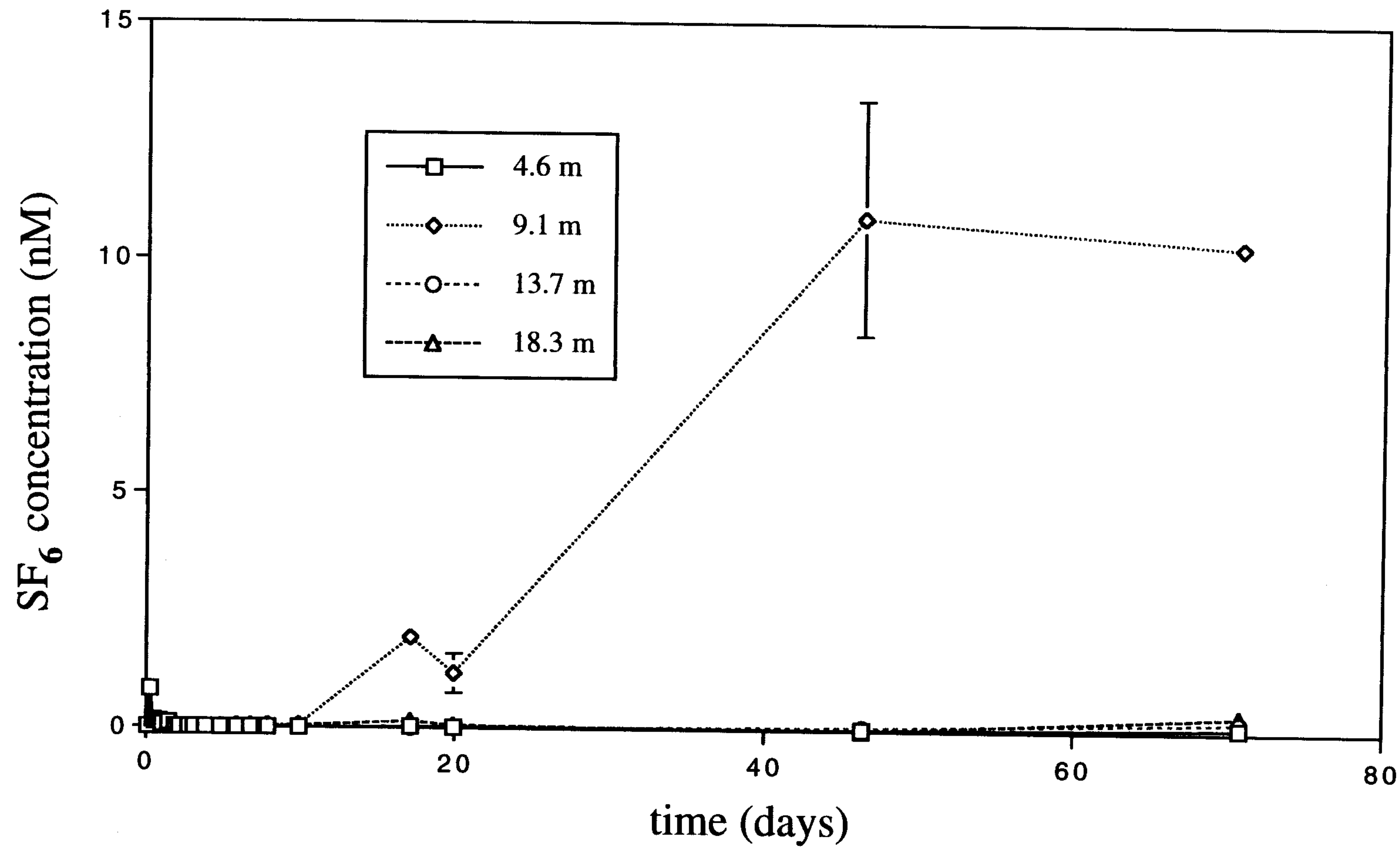

Figure 39. Well 5 SF_6 concentrations vs. time for October '96 injection well experiment.

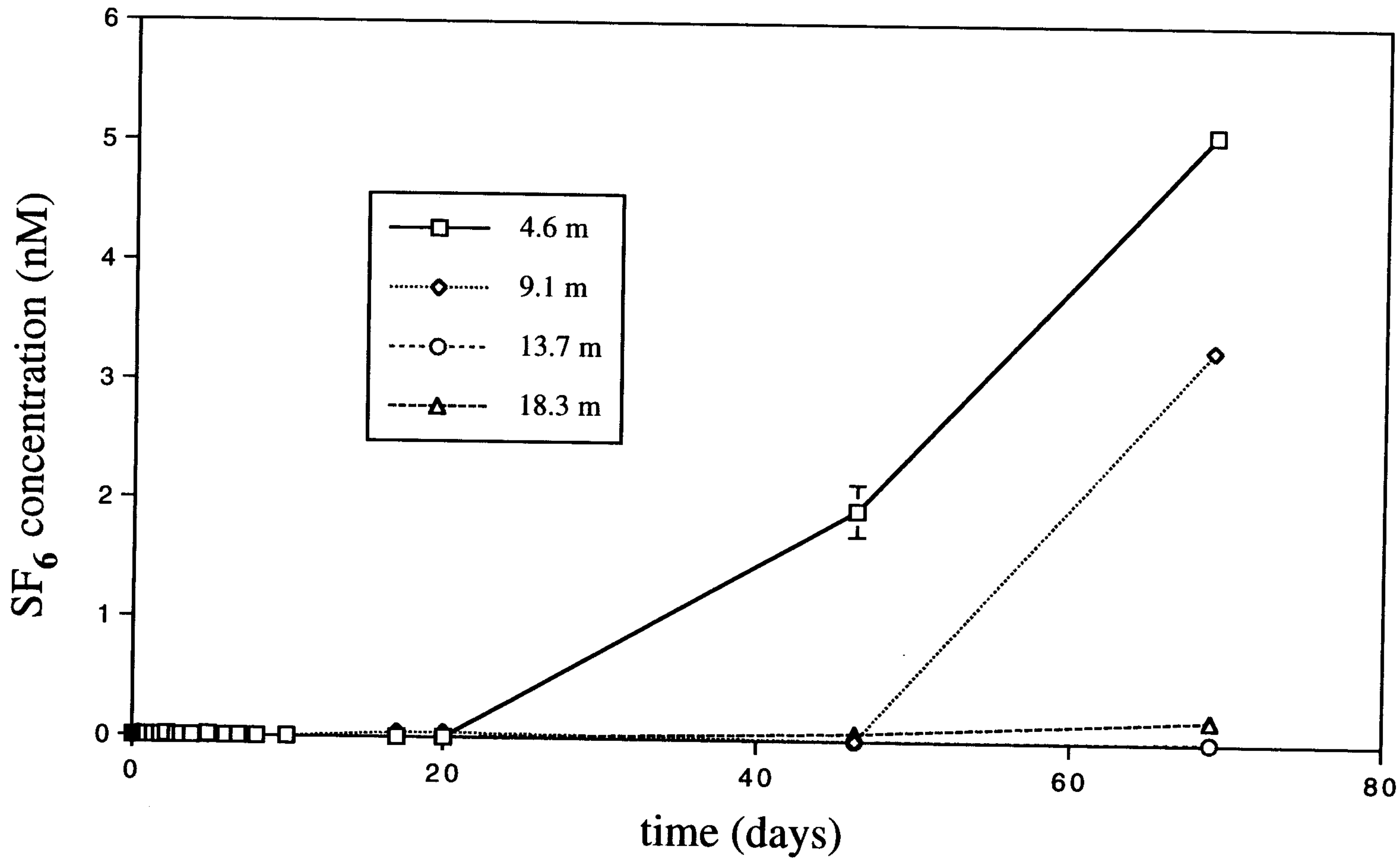

Figure 40. Well 6 SF_6 concentration vs. time for October '96 injection well experiment

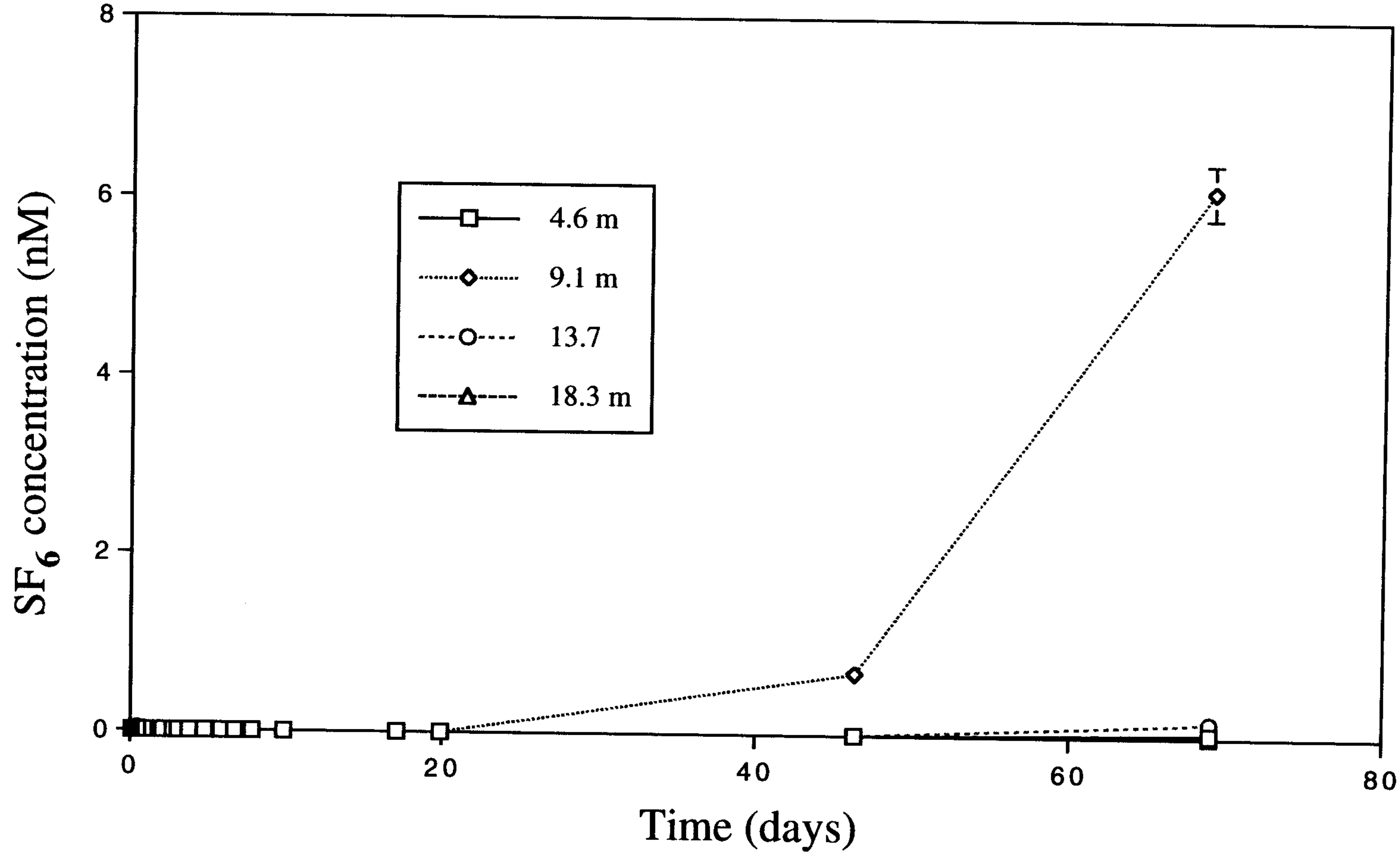

Figure 41. Well 7 SF_6 concentrations vs. time for October '96 injection well experiment.

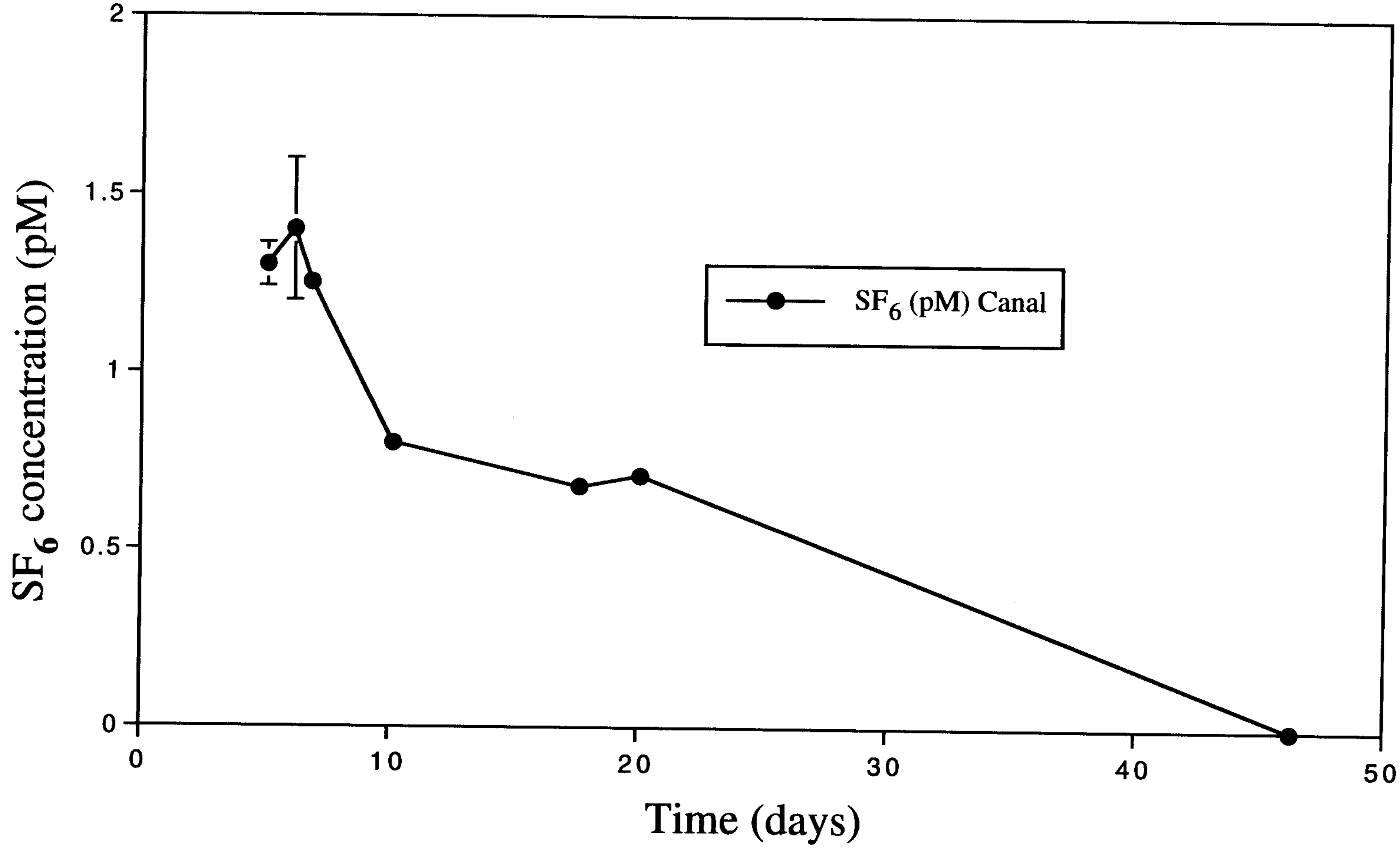

Figure 42. Canal SF_6 concentrations vs. time for October '96 injection well experiment.

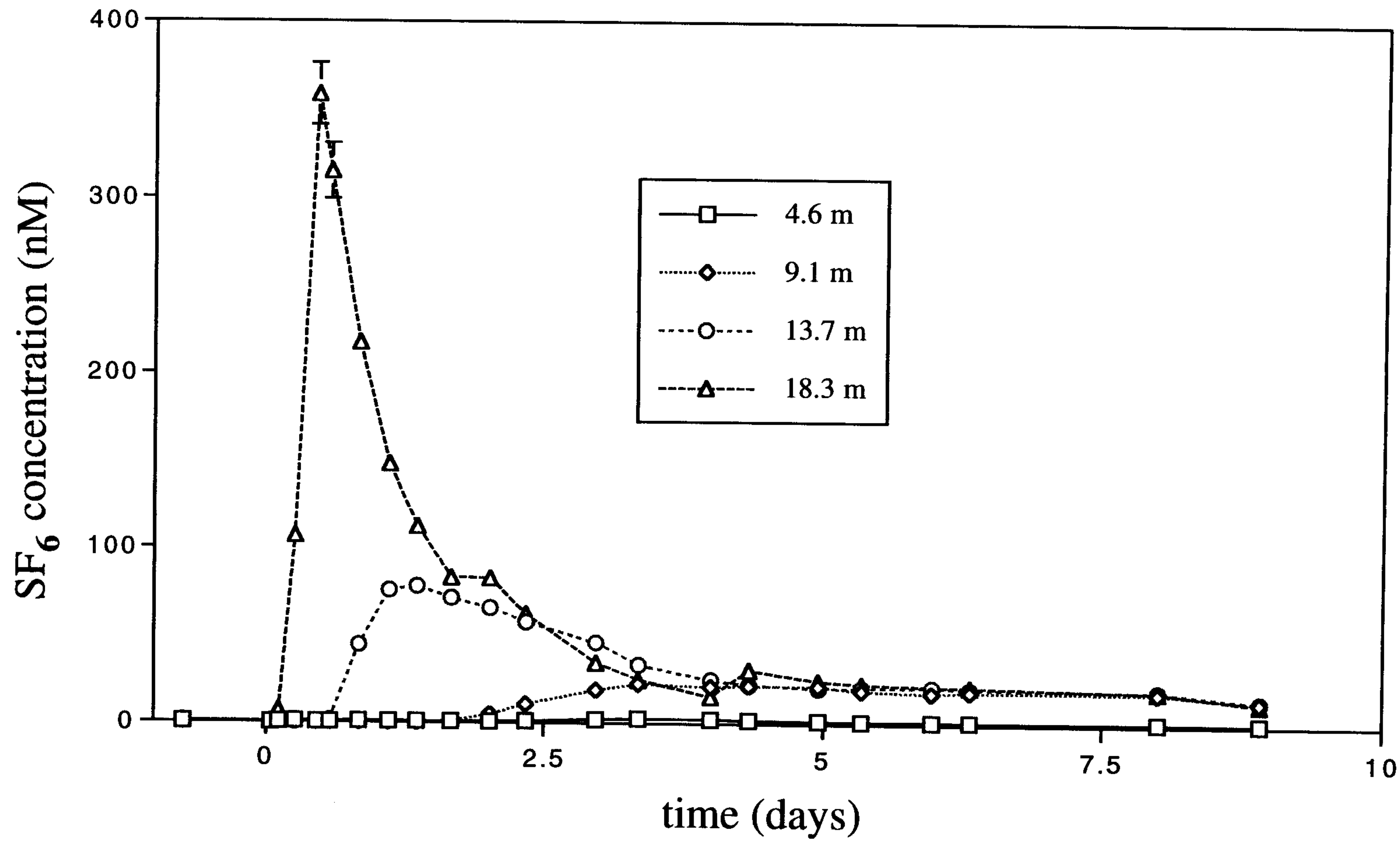

Figure 43. Well 1 SF_6 concentration vs. time for February '97 injection well experiment.

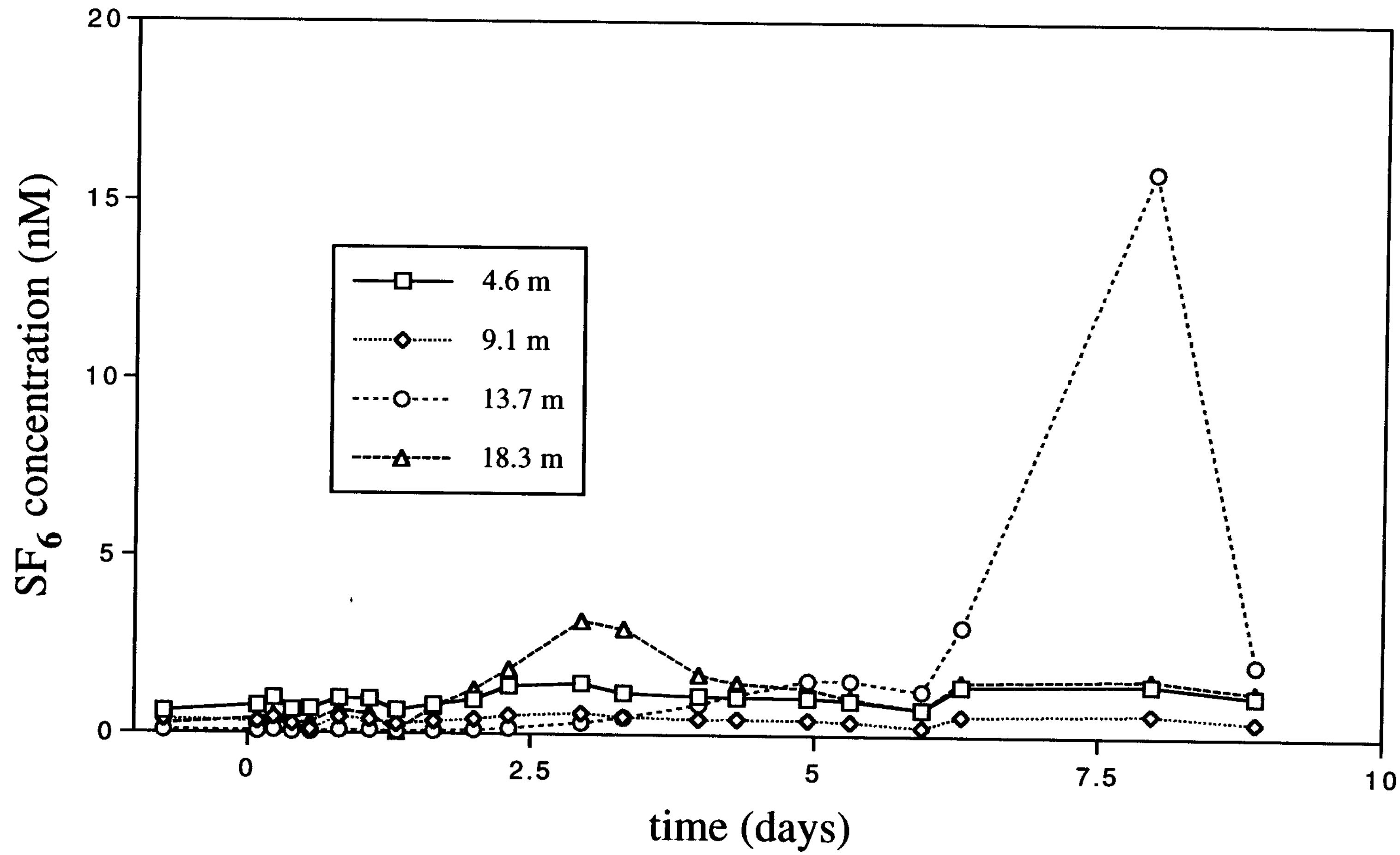

Figure 44. Well 2 SF_6 concentration vs. time for February '97 injection well experiment.

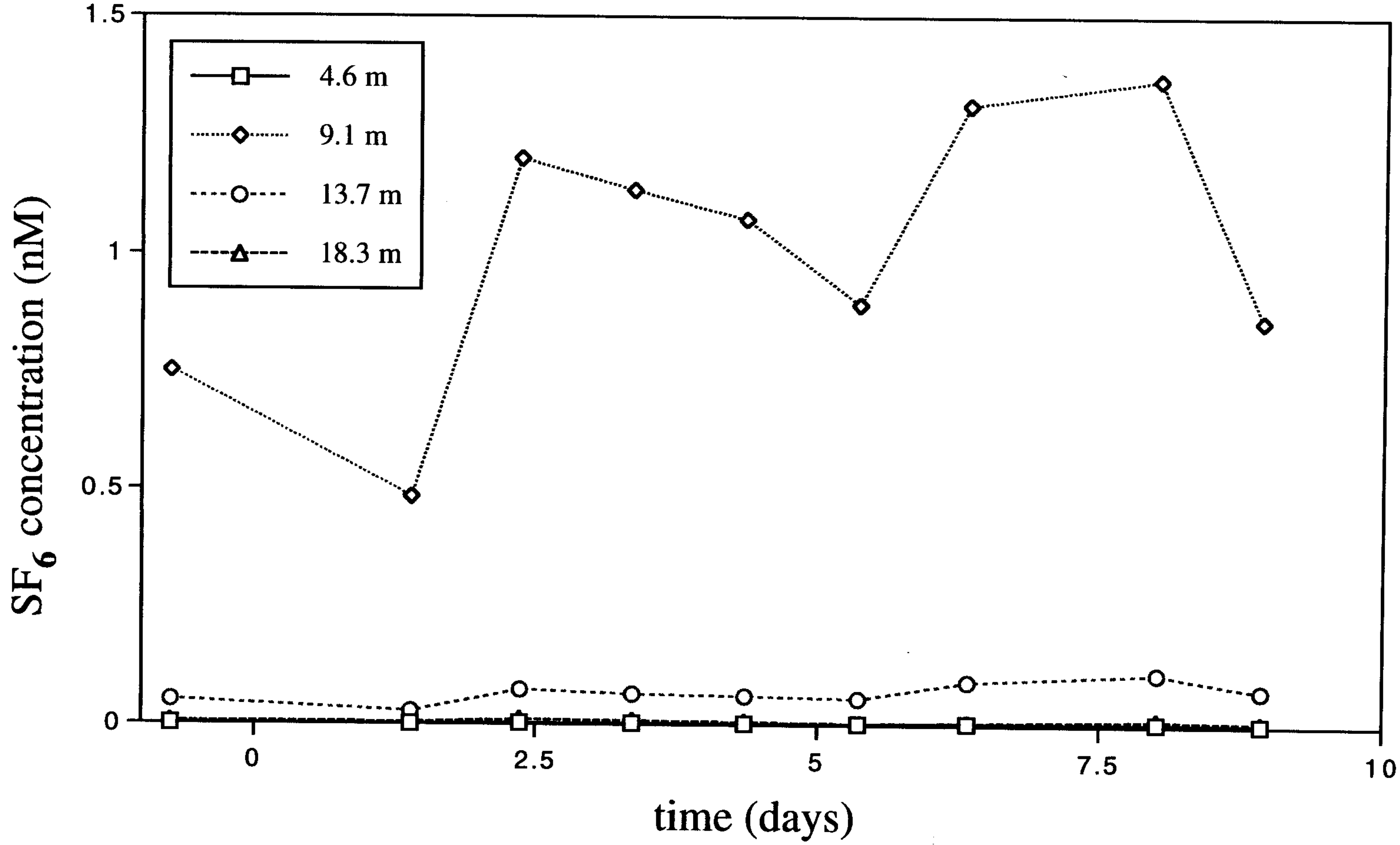

Figure 49. Well 7 SF_6 concentrations vs. time for February '97 injection well experiment.

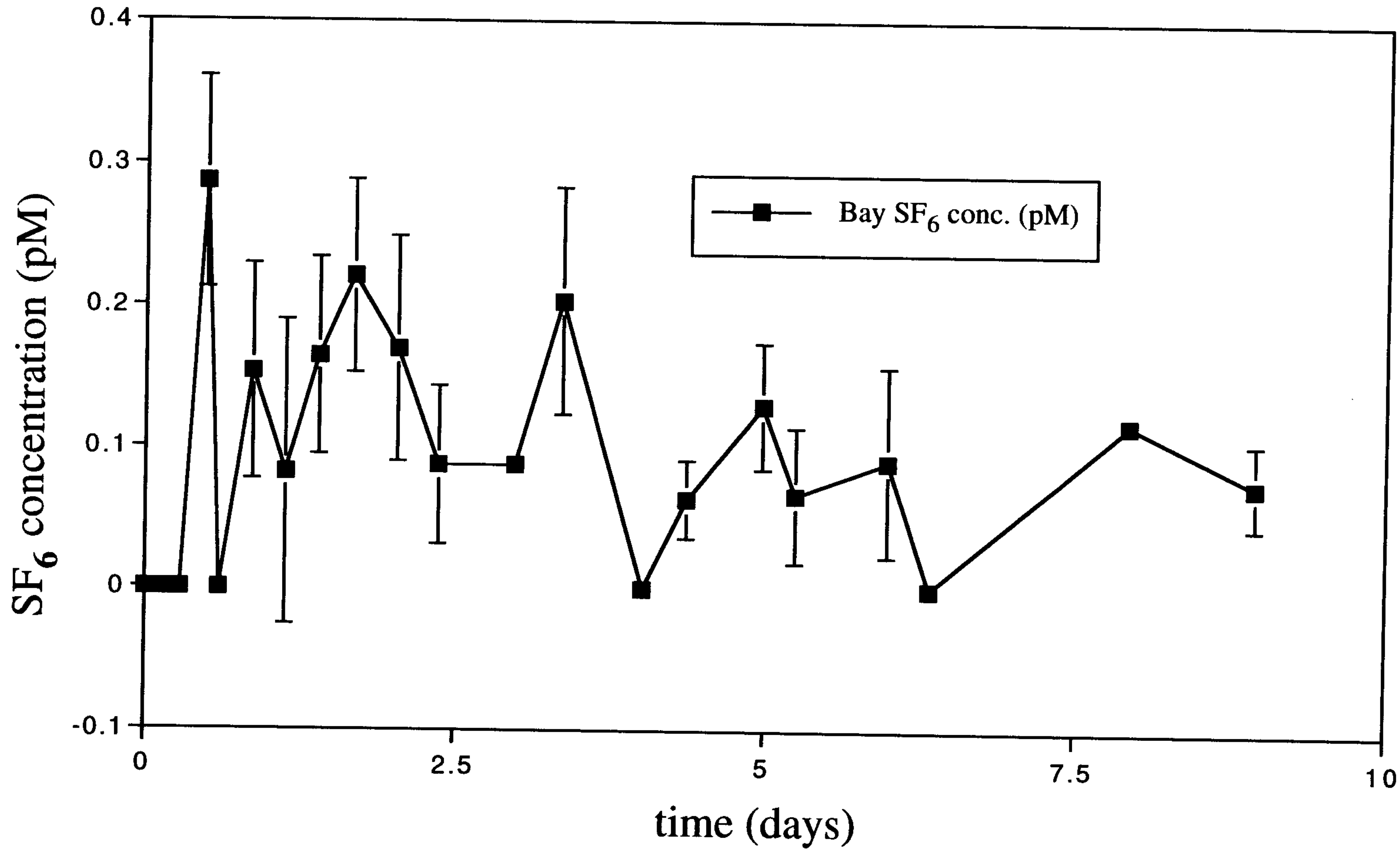

Figure 50a. Florida Bay SF_6 concentrations vs. time for February '97 injection well experiment.

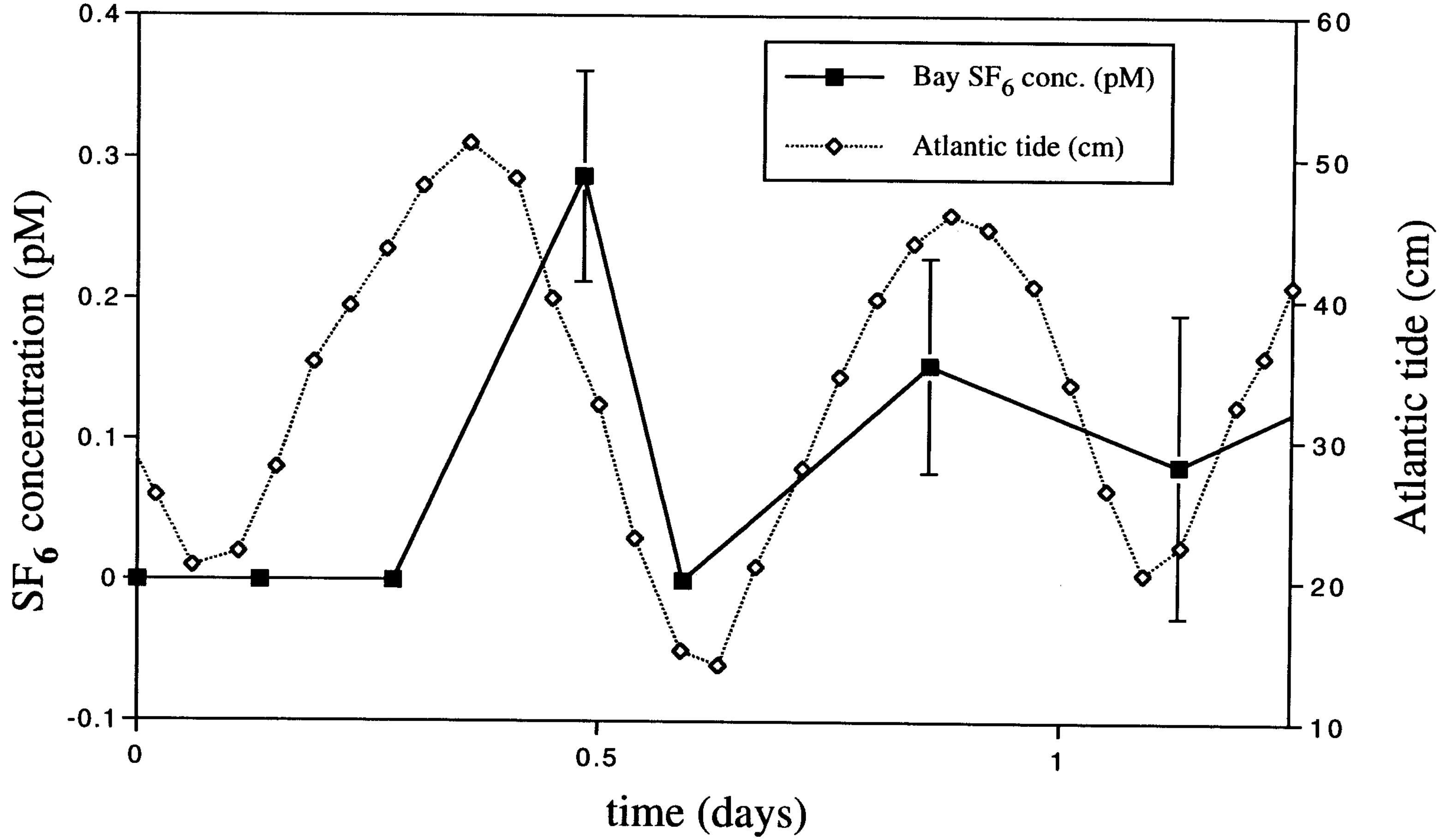

Figure 50b. Florida Bay SF_6 concentrations vs. time for February '97 injection well experiment.

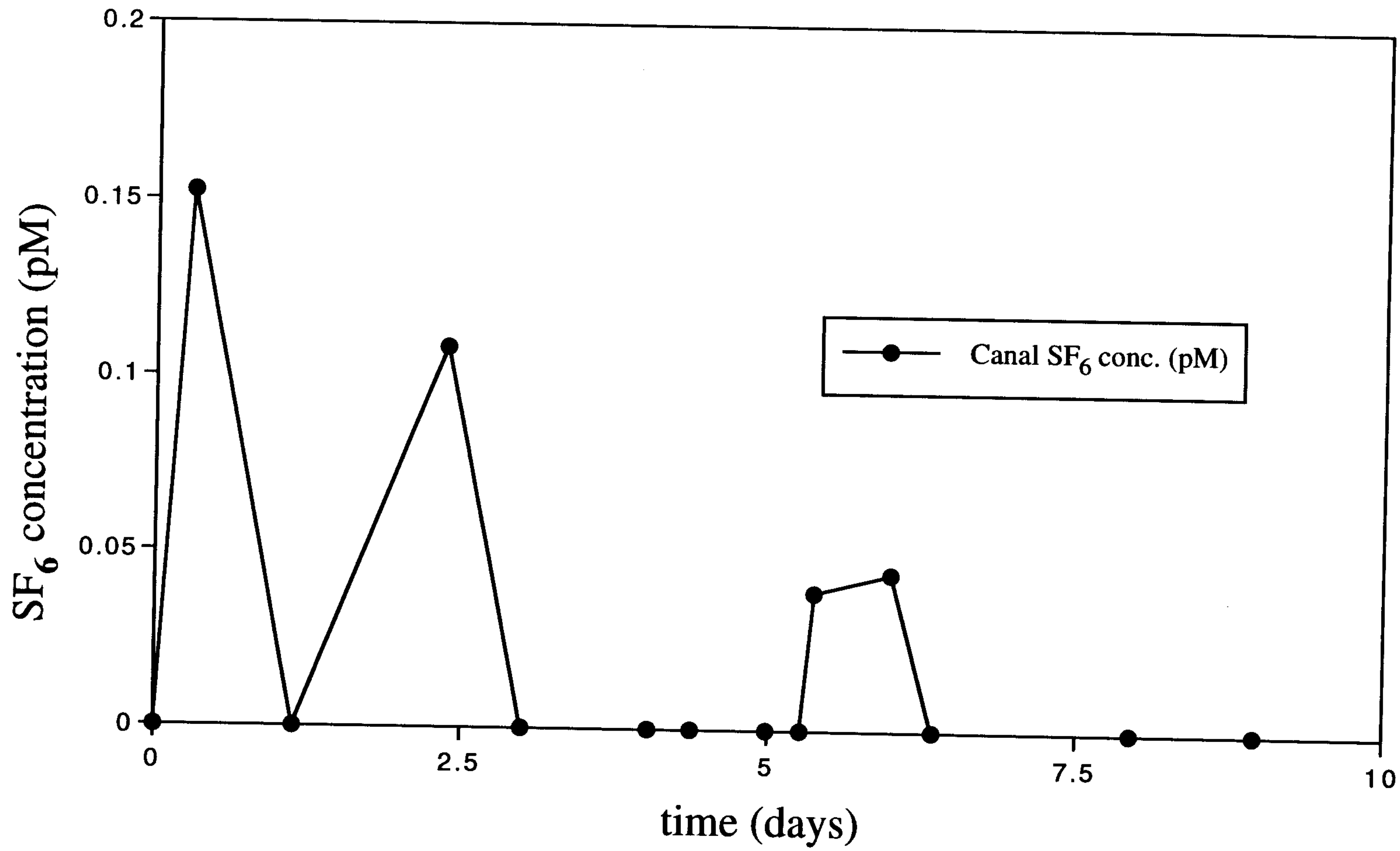

Figure 51. Canal SF_6 concentrations vs. time for February '97 injection well experiment.

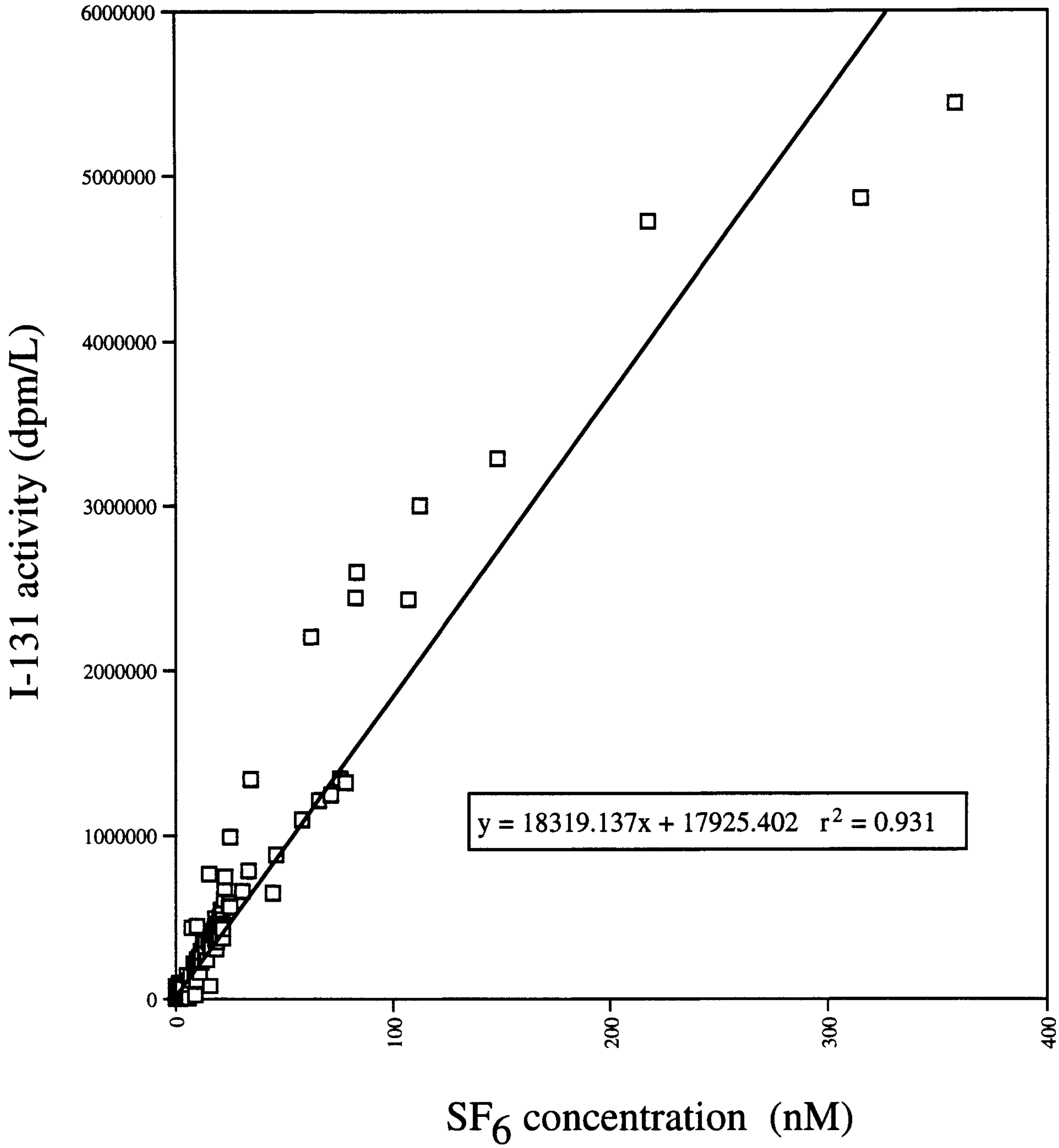

Figure 52 . All samples collected and analyzed for radio-iodine and SF6 during February '97 experiment. Note the excellent correlation between the two tracers.

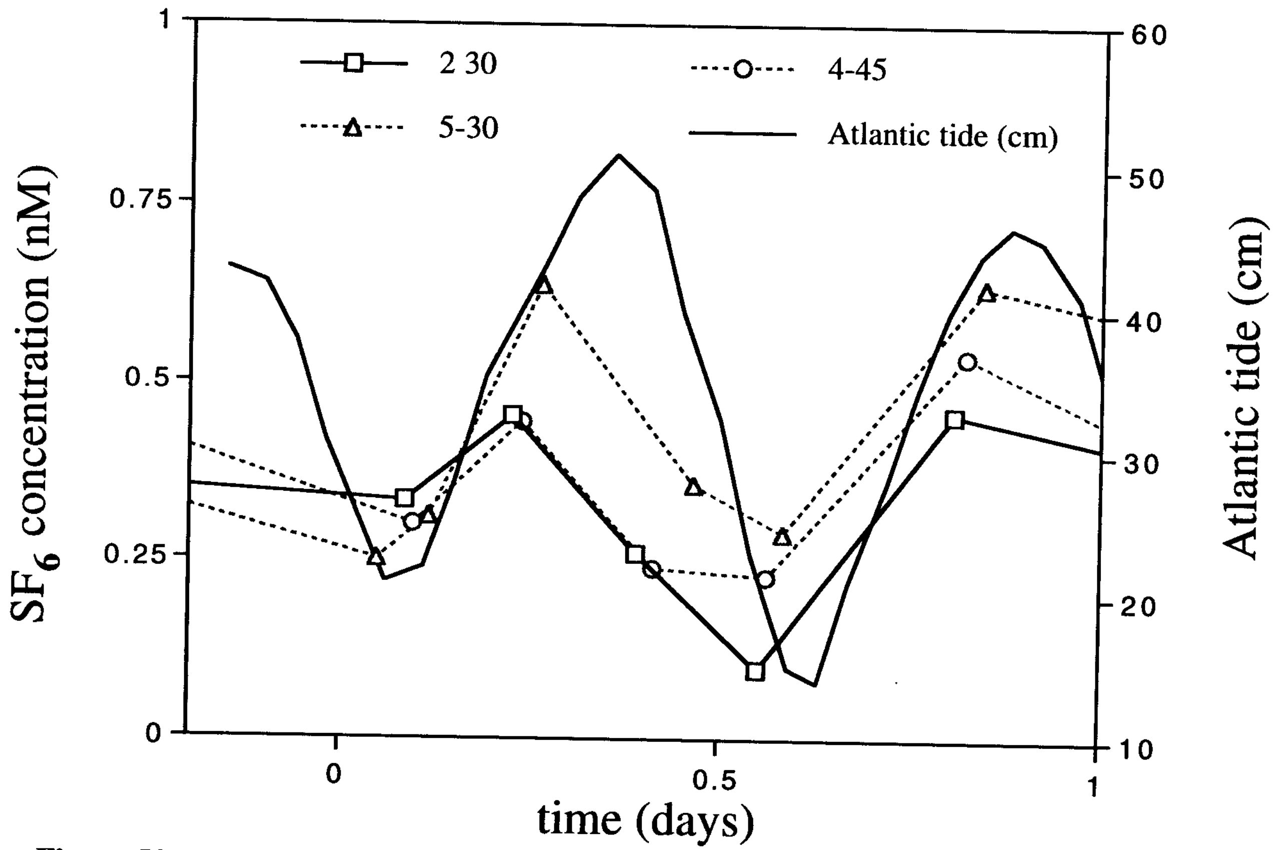

Figure 53. SF_6 concentrations (presumably residual fron 10/96 experiment) for wells 2, 4, and 5. Only 1 depth is shown for each well. Solid line is Atlantic tide. Note how SF_6 concentrations seem to follow tidal flucuations.

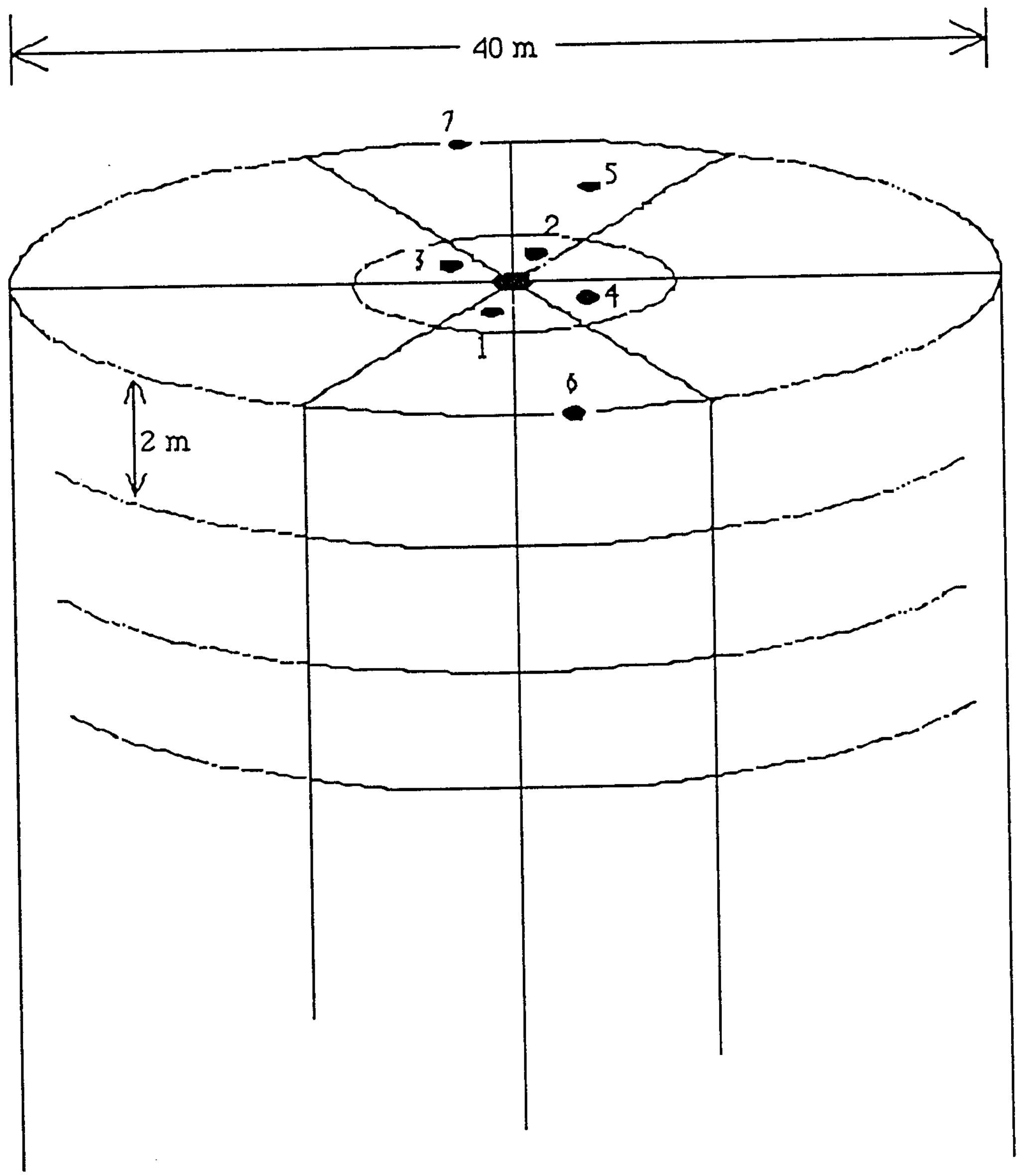

Figure 54. Schematic of finite model used to estimate the quantity of SF6 present at the sewage disposal well site on Long Key. Diagram is not drawn to scale.

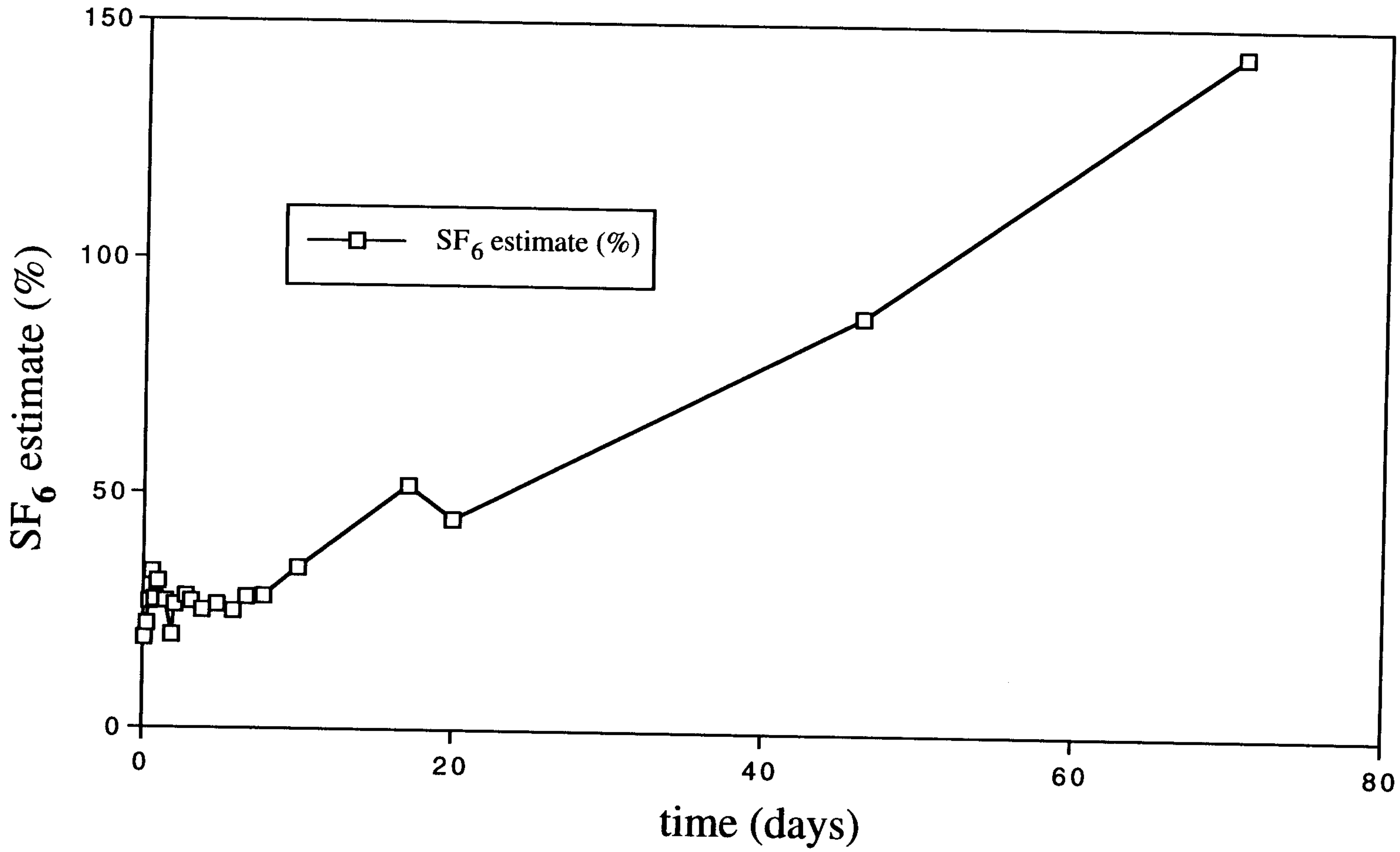

Figure 55. Estimated percent of SF_6 injected accounted for by finite model of study site, October 1996.

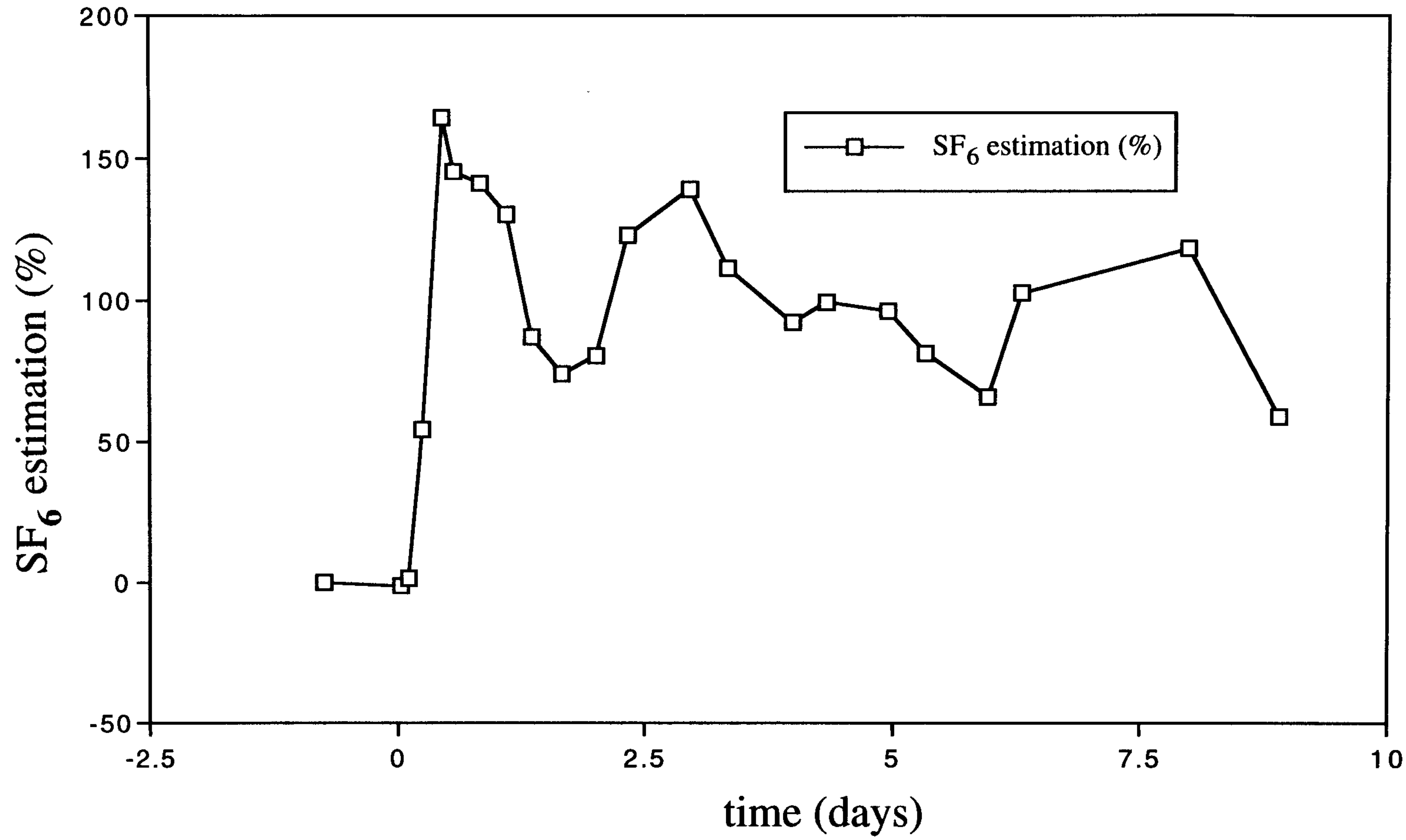

Figure 56. Estimated percent of SF_6 injected accounted for by finite model of study site, February 1997.

Appendix 1

time (days)	Well 1, 4.6m SF6 conc. (nM)	st dev	Well 1, 9.1m SF6 conc. (nM)	st dev	Well 1, 13.7 m SF6 conc. (nM)	st dev	Well 1, 18.3m SF6 conc. (nM)	st dev
0.09	0.000		0.000		0.000		21.979	
0.12							72.540	
0.22	0.000		0.035		0.738		77.655	
0.28							71.005	
0.38	0.000		0.229		19.389		46.990	
0.44							43.384	
0.55	0.002		2.352		30.993		35.999	
0.63							33.305	
0.74	0.028		4.812		21.259		23.324	
0.93	0.000		9.277		34.458		38.040	
1.40	0.000		13.974		26.994		14.049	
1.84	0.000		13.162		27.621		27.085	
2.02	0.000		9.798		21.387		16.753	
2.76	0.000		7.816		10.535		42.528	
3.10	0.000		5.403		21.917		8.902	
3.80	0.003		6.533		20.777		13.377	
4.77	0.029		6.356		19.967		4.098	
5.83	0.029		7.668		20.532		5.970	
6.70	0.039		7.288		16.820		15.835	
7.81	0.064	0.007	5.874	1.578	12.656	0.126	12.457	1.867
10.03	0.026	0.017	7.285	1.619	7.158	3.468	12.519	0.605
17.07	0.032	0.001	12.727	0.995	21.167	0.146	21.274	0.007
19.95	0.173		13.865		10.016		15.467	
46.31	1.082	0.187	6.680	1.774	4.994	0.499	0.160	0.022
70.77	2.495		6.459		2.560		7.525	

time (days)	Well 2, 4.6m SF6 conc. (nM)	st dev	Well 2, 9.1m SF6 conc. (nM)	st dev	Well 2, 13.7m SF6 conc. (nM)	st dev	Well 2, 18.3m SF6 conc. (nM)	st dev
0.05	0.000		0.000		0.000		0.000	
0.12							0.000	
0.21	0.012		0.003		0.023		0.000	
0.27							0.000	
0.37	0.000		0.000		0.000		0.000	
0.44							0.000	
0.54	0.000		0.000		0.000		0.000	
0.62								
0.73	0.000		0.000		0.000		0.026	
0.92	0.000		0.000		0.000		0.010	
1.33	0.000		0.000		0.000		0.200	
1.78	0.000		0.000		0.000		0.086	
2.19	0.000		0.000		0.022		0.076	
2.82	0.000		0.015		0.069		0.166	
3.15	0.000		0.017		0.096		0.407	
3.85	0.000		0.040		0.136		0.459	
4.82	0.000		0.084		0.166		0.708	
5.92	0.008		0.105		0.092		0.272	
6.81	0.023		0.143		0.192		0.707	

7.92	0.027	0.000	0.272	0.002	0.289	0.026	0.779	0.057
9.92	0.014	0.001	0.250	0.001	0.428	0.064	1.529	0.624
17.01	0.196	0.073	2.217	0.142	2.756	0.139	3.826	1.168
20.02	0.621		2.739		2.945		4.654	
46.31	1.510	0.581	4.304	0.635	2.059	0.017	3.373	0.481
70.77			5.105		2.243		2.387	

time (days)	Well 3, 4.6m SF6 conc. (nM)	st dev	Well 3, 9.1m SF6 conc. (nM)	st dev	Well 3, 13.7m SF6 conc. (nM)	st dev	Well 3, 18.3m SF6 conc. (nM)	st dev
0.04	0.000		0.000		0.000		1.493	
0.23	0.000		0.000		0.161		0.029	
0.41	0.000		0.170		4.442		0.068	
0.57	0.000		0.200		10.797		0.065	
0.75	0.000		0.065		8.276		0.217	
0.95	0.006		0.111		18.541		0.139	
1.35	0.024		0.315		14.677		0.159	
1.80	0.000		0.790		15.514		0.184	
2.18	0.000		0.656		11.354		0.111	
2.80	0.000		1.621		13.052		0.181	
3.13	0.000		2.789		12.390		0.199	
3.83	0.000		3.678		13.785		0.177	
4.80	0.004		4.826		13.245		0.128	
5.89	0.000		5.069		12.240		0.190	
6.75	0.000		3.654		12.587		0.550	
7.88	0.000		4.113	0.223	9.008	0.038	1.111	0.068
9.88	0.000		4.894	0.286	8.016	0.165	0.774	0.073
16.98	0.000		10.519	0.161	10.183	0.637	1.101	0.220
20.05	0.000		11.659		12.169		0.872	
46.31	0.008	0.003	5.961	0.330	4.249	1.085	0.204	0.042
70.77	0.040	0.001	3.470		1.834		0.793	

time (days)	Well 4, 4.6m SF6 conc. (nM)	st dev	Well 4, 9.1m SF6 conc. (nM)	st dev	Well 4, 13.7m SF6 conc. (nM)	st dev	Well 4, 18.3m SF6 conc. (nM)	st dev
0.08	0.000		0.000		0.000		0.000	
0.25	0.000		0.000		0.000		0.008	
0.41	0.014		0.000		0.000		0.000	
0.59	0.000		0.000		0.018		0.005	
0.78	0.000		0.000		0.017		0.060	
0.97	0.000		0.000		0.056		0.000	
1.38	0.000		0.000		0.082		0.000	
1.82	0.000		0.000		0.101		0.000	
2.16	0.000		0.000		0.058		0.000	

2.78	0.000		0.005		0.080		0.073	
3.12	0.000		0.013		0.096		0.000	
3.82	0.000		0.025		0.101		0.000	
4.78	0.000		0.055		0.117		0.009	
5.87	0.000		0.071		0.072		0.015	
6.73	0.000		0.131		0.086		0.000	
7.84	0.000		0.170	0.012	0.134	0.012	0.011	
9.84	0.000		0.623	0.005	0.458	0.046	0.000	
17.05	0.000		5.902	0.070	2.141	0.138	0.007	0.000
19.98	0.000		1.687	0.255	0.427	0.116	0.016	0.009
46.31	0.026	0.020	5.314	1.044	0.357	0.444	0.034	0.013
69.06	0.069		6.788		1.813		0.213	

time (days)	Well 5, 4.6m SF6 conc. (nM)	st dev	Well 5, 9.1m SF6 conc. (nM)	st dev	Well 5, 13.7m SF6 conc. (nM)	st dev	Well 5, 18.3m SF6 conc. (nM)	st dev
0.10	0.007		0.000		0.000		0.000	
0.26	0.798		0.000		0.000		0.000	
0.42	0.137		0.000		0.000		0.000	
0.60	0.097		0.000		0.000		0.000	
0.79	0.114		0.000		0.000		0.000	
0.99	0.057		0.000		0.000		0.000	
1.42	0.088		0.000		0.000		0.000	
1.85	0.000		0.000		0.010		0.056	
2.12	0.000		0.000		0.000		0.000	
2.74	0.000		0.000		0.000		0.000	
3.08	0.000		0.000		0.000		0.000	
3.79	0.000		0.000		0.000		0.000	
4.75	0.000		0.010		0.000		0.000	
5.81	0.000		0.025		0.000		0.000	
6.68	0.000		0.024		0.000		0.000	
7.79	0.000		0.034	0.004	0.000		0.007	0.002
9.80	0.000		0.048	0.003	0.000		0.037	0.000
17.11	0.024	0.001	1.924	0.114	0.000		0.141	0.004
19.94	0.019	0.005	1.159	0.416	0.007	0.002	0.055	0.007
46.31	0.022	0.004	10.887	2.484	0.069	0.037	0.000	
70.77	0.088		10.297		0.208		0.334	

time (days)	Well 6, 4.6m SF6 conc. (nM)	st dev	Well 6, 9.1m SF6 conc. (nM)	st dev	Well 6, 13.7m SF6 conc. (nM)	st dev	Well 6, 18.3m SF6 conc. (nM)	st dev
0.06	0.000		0.000		0.000		0.000	
0.24	0.000		0.000		0.000		0.000	
0.40	0.000		0.000		0.011		0.000	
0.58	0.000		0.000		0.000		0.000	

0.76	0.000		0.004		0.000		0.005	
0.96	0.000		0.000		0.000		0.000	
1.36	0.000		0.000		0.000		0.007	
1.81	0.000		0.000		0.000		0.000	
2.21	0.011		0.000		0.000		0.000	
2.83	0.000		0.000		0.000		0.000	
3.16	0.000		0.000		0.000		0.000	
3.82	0.000		0.000		0.000		0.000	
4.83	0.009		0.006		0.000		0.005	
5.94	0.000		0.000		0.000		0.000	
6.78	0.000		0.000		0.000		0.000	
7.95	0.000		0.000		0.000		0.000	
9.95	0.000		0.000		0.000		0.000	
17.03	0.000		0.039	0.006	0.000		0.000	
20.00	0.000		0.039	0.006	0.000		0.000	
46.31	1.931	0.220	0.000		0.000		0.063	0.004
69.06	5.095		3.296		0.006		0.191	

time (days)	Well 7, 4.6m SF6 conc. (nM)	st dev	Well 7, 9.1m SF6 conc. (nM)	st dev	Well 7, 13.7m SF6 conc. (nM)	st dev	Well 7, 18.3m SF6 conc. (nM)	st dev
0.11	0.000		0.000		0.000		0.000	
0.27	0.000		0.000		0.000		0.000	
0.44	0.008		0.020		0.019		0.000	
0.61	0.000		0.000		0.000		0.000	
0.80	0.000		0.000		0.000		0.000	
1.02	0.000		0.000		0.000		0.000	
1.43	0.000		0.000		0.000		0.000	
1.86	0.000		0.000		0.000		0.006	
2.11	0.000		0.000		0.000		0.000	
2.73	0.000		0.000		0.000		0.000	
3.07	0.000		0.000		0.000		0.000	
3.78	0.000		0.000		0.000		0.000	
4.74	0.000		0.000		0.000		0.000	
5.78	0.000		0.000		0.000		0.000	
6.65	0.000		0.000		0.000		0.000	
7.77	0.000		0.000		0.004	0.000	0.000	
9.78	0.000		0.000		0.000		0.000	
17.12	0.000		0.000		0.000		0.000	
19.90	0.000		0.000		0.000		0.000	
46.31	0.000		0.685	0.159	0.000		0.000	
69.06	0.036		6.102	0.302	0.161		0.007	

time (days)	FL Bay SF6 conc. (nM)	st dev	time (days)	Canal SF6 conc. (nM)	st dev
0.12		11.558	5.05	1.304	0.061
0.28	17.009		6.15	1.402	0.200
0.44	12.737		6.85	1.254	
0.61	12.588		10.13	0.802	
0.80	11.140		17.64	0.680	
0.99	6.242		20.08	0.711	0.030
1.42	5.762		46.31	0.000	0.000
1.84	5.971				
2.21	5.448				
2.84	3.474				
3.16	3.058				
3.86	2.557				
4.83	1.748				
5.94	1.151				
6.83	1.302	0.068			
7.96	1.044				
9.95	0.643	0.068			
17.63	0.000	0.000			
20.07	0.762	0.006			
46.31	0.000	0.000			

Appendix 2

time (days)	Well 1, 4.6m SF6 conc. (nM)	st dev	Well 1, 9.1m SF6 conc. (nM)	st dev	Well 1, 13.7 m SF6 conc. (nM)	st dev	Well 1, 18.3m SF6 conc. (nM)	st dev
-0.74	0.567		0.317		0.203		0.691	
0.04	0.051		0.366	0.263	0.141		0.574	
0.11	0.593	0.027	0.320		0.021		6.791	0.186
0.25	0.898		0.337		0.261		106.725	8.218
0.45	0.468		0.181		0.138		358.732	17.60
0.57	0.530		0.150		1.010		315.095	15.69
0.84	0.991		0.326	0.004	44.382	0.876	217.436	7.488
1.10	0.893		0.295	0.002	75.528	6.649	148.047	2.856
1.36	0.671		0.210		77.972	4.142	112.118	3.811
1.67	0.779	0.004	0.987	0.009	71.231	1.009	83.046	2.621
2.01	0.923	0.004	4.917	0.082	65.724	1.598	82.704	3.994
2.34	1.140	0.014	10.792	0.125	57.717	1.648	62.165	1.665
2.96	2.214		18.955		45.967	1.544	34.332	3.415
3.34	2.683	0.055	22.444	0.345	33.292	1.385	24.908	2.398
4.00	2.578	0.001	21.033	0.542	24.927	0.523	15.410	0.346
4.34	2.001		21.623		22.080		30.594	0.472
4.96	1.730	0.131	21.367	0.041	20.448		24.554	0.655
5.34	1.639		18.999	0.606	20.751	0.292	22.668	0.885
5.97	1.557	0.025	17.823		21.187			
6.32	1.407		18.694		20.204	0.154	21.374	
8.00	1.474		18.253		19.490		19.001	0.516
8.92	1.134	0.044	13.429		13.720		12.552	

time (days)	Well 2, 4.6m SF6 conc. (nM)	st dev	Well 2, 9.1m SF6 conc. (nM)	st dev	Well 2, 13.7m SF6 conc. (nM)	st dev	Well 2, 18.3m SF6 conc. (nM)	st dev
-0.74	0.615		0.384		0.088		0.249	
0.09	0.782		0.334		0.062		0.409	
0.23	0.989		0.453		0.100		0.499	
0.39	0.669		0.260		0.051	0.002	0.275	
0.55	0.692		0.098		0.045		0.300	
0.81	0.993		0.457		0.097		0.668	0.017
1.07	0.973		0.395		0.090	0.001	0.539	
1.31	0.658		0.268		0.058		0.040	0.004
1.64	0.818		0.347		0.086	0.003	0.766	
1.99	0.964		0.413		0.107	0.004	1.238	
2.31	1.353		0.521		0.169	0.003	1.830	0.054
2.95	1.435		0.603	0.007	0.328		3.195	
3.32	1.173	0.113	0.498		0.486	0.003	2.971	0.053
3.98	1.092		0.440		0.853		1.693	0.005
4.31	1.068	0.007	0.447		1.134		1.456	
4.94	1.045		0.429		1.545	0.040	1.321	0.003
5.32	0.979		0.393		1.546	0.009	1.041	
5.95	0.750		0.240	0.002	1.254		0.747	0.006
6.29	1.396		0.562	0.017	3.066		1.521	
7.98	1.464	0.002	0.636		15.868	0.009	1.615	0.010
8.89	1.159		0.427	0.001	2.047		1.279	0.030

time (days)	Well 3, 4.6m SF6 conc. (nM)	st dev	Well 3, 9.1m SF6 conc. (nM)	st dev	Well 3, 13.7m SF6 conc. (nM)	st dev	Well 3, 18.3m SF6 conc. (nM)	st dev

-0.74	0.001	0.000	0.134		0.096		0.078	
0.02	0.001	0.000	0.126		0.029		0.047	
0.08	0.000		0.069		0.042		0.068	0.002
0.22	0.001		0.119		0.084		0.218	
0.38	0.002	0.000	0.086		0.036		0.308	
0.04	0.001		0.059	0.001	0.039		0.684	
0.80	0.001		0.132		0.240		1.519	
1.06	0.001		0.124	0.002	0.905		1.342	
1.30	0.001	0.000	0.074		1.082		1.111	0.002
1.63	0.001	0.000	0.088	0.000	1.582		0.928	
1.99	0.005		0.179		6.065		0.859	
2.30	0.001	0.000	0.643		9.006	0.296	1.140	0.032
2.94	0.002		14.491	0.391	21.755		0.934	
3.31	0.001		13.715		21.811	0.193	0.742	
3.97	0.003	0.000	9.870	0.475	21.060	0.413	0.646	
4.31	0.001		11.078	0.020	20.872	0.694	0.463	
4.93	0.002		11.736	0.034	20.053		0.443	0.020
5.31	0.001		9.529		18.732	0.028	0.352	0.017
5.94	0.001	0.000	8.978	0.143	20.103	0.528	0.265	
6.29	0.002	0.000	8.826	0.041	16.758	0.573	0.505	0.009
7.97	0.002	0.000	9.713		16.395	1.318	0.433	
8.88	0.001	0.000	8.214	0.112	11.744	0.193	0.176	0.002

time (days)	Well 4, 4.6m SF6 conc. (nM)	st dev	Well 4, 9.1m SF6 conc. (nM)	st dev	Well 4, 13.7m SF6 conc. (nM)	st dev	Well 4, 18.3m SF6 conc. (nM)	st dev
-0.74	0.000		0.297		0.601		0.149	
0.10	0.574		0.074		0.301		0.123	
0.24	0.745	0.002	0.114		0.445		0.091	
0.41	0.421		0.059		0.239		0.034	0.034
0.56	0.489		0.000		0.228		0.061	
0.82	0.751		0.136		0.539		0.194	0.001
1.09	0.671		0.342	0.017	0.400		0.137	
1.34	0.856		1.125		0.340	0.001	0.112	
1.65	0.582		3.192	0.161	0.342	0.004	0.095	
2.00	0.569		5.979		0.310		0.137	
2.32	1.284		9.548	0.490	0.586		0.233	0.004
2.96	1.162		19.717	0.417	0.521		0.268	
3.33	1.164		18.259		0.531		0.232	0.001
3.99	0.992		9.870	0.475	0.434		0.229	
4.33	1.233	0.002	17.672		0.537	0.013	0.170	
4.95	0.890		15.829	0.126	0.398		0.162	0.021
5.33	0.987		15.120		0.438		0.159	0.001
5.96	0.439	0.006	7.221		0.247		0.091	
6.31	1.559	0.003	13.567	1.633	0.639	0.020	0.197	
8.00	1.639		15.877	0.170	0.715		0.277	0.000
8.91	0.936		11.702	0.468	0.719	0.003	0.202	

time (days)	Well 5, 4.6m SF6 conc. (nM)	st dev	Well 5, 9.1m SF6 conc. (nM)	st dev	Well 5, 13.7m SF6 conc. (nM)	st dev	Well 5, 18.3m SF6 conc. (nM)	st dev
-0.74	0.092	0.007	0.483		0.283		0.233	
0.05	0.037		0.252		0.498		0.193	
0.12	0.021		0.312		0.205		0.565	
0.26	0.041		0.637		0.357		0.345	
0.47	0.026		0.357		0.104		0.110	

0.58	0.020	0.001	0.289		0.163		0.122	
0.85	0.034		0.636		0.454	0.030	0.346	
1.12	0.022	0.001	0.571		0.360		0.339	
1.37	0.013		0.309		0.135		0.126	
1.67	0.027		0.422		0.152		0.278	0.026
2.02	0.019		0.438		0.313	0.064	0.205	0.005
2.35	0.043		0.438		0.738	0.007	0.449	
2.97	0.037	0.001	0.791		0.489		0.515	
3.35	0.034		0.652		0.402	0.004	0.437	
4.01	0.043	0.001	0.613		0.400		0.414	
4.35	0.038		0.686		0.412	0.013	0.412	
4.97	0.027		0.671		0.425	0.019	0.414	
5.35	0.038		0.588		0.366	0.001	0.361	0.008
5.98	0.021	0.001	0.321		0.178		0.179	
6.32	0.057		0.845	0.012			0.514	
8.01	0.042		0.903		0.412		0.582	0.007
8.93	0.031	0.001	0.420		0.403		0.371	

time (days)	Well 6, 4.6m SF6 conc. (nM)	st dev	Well 6, 9.1m SF6 conc. (nM)	st dev	Well 6, 13.7m SF6 conc. (nM)	st dev	Well 6, 18.3m SF6 conc. (nM)	st dev
-0.74	1.426		0.633		0.000		0.047	
1.32	0.756		0.292		0.001		0.029	
2.31	1.880		0.955		0.000	0.001	0.084	
3.32	1.716	0.035	0.770		0.002		0.023	
4.32	1.597		0.706	0.007	0.001		0.084	
5.32	1.382		0.597		0.001		0.068	0.001
6.30	1.955		0.798		0.004		0.106	0.001
7.99	2.093		0.905	0.004	0.003		0.119	
8.90	1.593	0.052	0.617		0.000	0.000	0.081	

time (days)	Well 7, 4.6m SF6 conc. (nM)	st dev	Well 7, 9.1m SF6 conc. (nM)	st dev	Well 7, 13.7m SF6 conc. (nM)	st dev	Well 7, 18.3m SF6 conc. (nM)	st dev
-0.74	0.001		0.751		0.051		0.005	0.000
1.39	0.001	0.000	0.484		0.028		0.005	0.001
2.36	0.003		1.201	0.001	0.073		0.010	
3.36	0.003		1.135		0.064	0.003	0.009	
4.35	0.003	0.000	1.073		0.061		0.007	
5.36	0.003		0.893		0.056		0.004	0.000
6.33	0.005	0.000	1.314		0.092	0.004	0.007	
8.02	0.006		1.369	0.004	0.109		0.012	
8.94	0.004		0.859		0.073	0.003	0.008	

time (days)	FL Bay SF6 conc. (nM)	st dev	time (days)	Canal SF6 conc. (nM)	st dev
0.13	0.000				
0.28	0.000		0.292		
0.48	0.287	0.074	0.292	0.152	
0.59	0.000				
0.86	0.153	0.076			
1.13	0.082	0.108			
1.40	0.164	0.070	1.135	0.000	
1.68	0.221	0.068			
2.03	0.169	0.080			

2.37	0.087	0.056		
2.98	0.087		2.375	0.108
3.37	0.203	0.080		
4.02	0.000		2.992	0.000
4.37	0.063	0.028		
4.98	0.130	0.045	4.026	0.000
5.24	0.066	0.048	4.375	0.000
			4.988	0.000
5.99	0.090	0.067	5.264	0.000
6.33	0.000		5.372	0.039
7.94	0.117		6.000	0.045
8.95	0.074	0.030	6.347	0.000
			7.948	0.000
			8.326	
			8.958	0.000

Appendix 3

Appendix 3: Radio-Iodine results from tracer experiment performed at the Keys Marine Laboratory in February 1997.

SAMPLE ID (round/well/depth)	Sample Time	SAMPLE TIME-INJECTION TIME	I-129 NET CPM	I-131 NET CPM	I-129 RECOVERY	I-129 recovery±	SAMPLE VOL. (L)	LLD (dpm/L)	I-131 ACTIVITY (dpm/L)			I-131 ACTIVITY (Bq/m3)		
0/1/15	2/18/1997 11:37	0.04	356.85	-4.34825	0.986466833	0.01995277	0.8	75.2012743	-30.516521	±	-16.477292	-508.60868	±	-274.62154
1/1/15	2/18/1997 13:21	0.11	354.93	1.11175	0.979305743	0.01983724	0.8	76.5031721	7.93746633	±	17.2374565	132.291105	±	287.290942
2/1/15	2/18/1997 16:45	0.25	365.85	-4.70825	1.011431562	0.02031998	0.8	75.6643601	-33.24652	±	-16.549073	-554.10867	±	-275.81789
3/1/15	2/18/1997 21:37	0.45	294.09	-45.74825	0.827349729	0.017709	0.8	94.458024	-403.28183	±	-18.496677	-6721.3639	±	-308.27795
3/1/15 RECOUNT	2/18/1997 21:37	0.45	282.45	-55.04825	0.798391377	0.01730891	0.8	181.294934	-931.37484	±	-35.896847	-15522.914	±	-598.28079
4/1/15	2/19/1997 0:27	0.57	359.43	7.41175	0.989578896	0.0199764	0.8	80.1876798	55.4656012	±	18.6935136	924.426686	±	311.558561
4/1/15 RECOUNT	2/19/1997 0:27	0.57	364.41	0.75175	1.005595377	0.02022419	0.8	122.895883	8.62196165	±	27.6381766	143.699361	±	460.636277
5/1/15	2/19/1997 6:47	0.83	1121.84	82.688	0.955510766	0.01208603	0.8	34.4746605	234.260105	±	14.29686	3904.33508	±	238.281
6/1/15	2/19/1997 13:15	1.10	326.79	37.23175	0.889318799	0.01843999	0.8	93.4598036	324.738387	±	25.982993	5412.30645	±	433.049883
6/1/15 RECOUNT	2/19/1997 13:15	1.10	346.89	14.97175	0.952388303	0.01941475	0.8	152.536394	213.128415	±	37.1179661	3552.14025	±	618.632769
7/1/15	2/19/1997 19:22	1.36	353.49	9.03175	0.972630876	0.01972407	0.8	89.7917773	75.6839501	±	21.1224507	1261.39917	±	352.040845
8/1/15	2/20/1997 2:42	1.66	1982.42	40.448	1.699870616	0.01858702	0.8	21.3227032	70.875341	±	8.21183914	1181.25568	±	136.863986
9/1/15	2/20/1997 11:05	2.01	1059.38	56.588	0.904624739	0.01166295	0.8	42.0128302	195.371914	±	16.6615146	3256.19857	±	277.691909
9/1/15 RECOUNT	2/20/1997 11:05	2.01	1059.38	30.968	0.90738198	0.0116985	0.8	67.1220085	170.818125	±	25.4860934	2846.96874	±	424.768223
10/1/15	2/20/1997 18:50	2.34	1124.72	55.688	0.96089237	0.01214398	0.8	40.0410746	183.241228	±	15.8480484	3054.02046	±	264.13414
10/1/15 RECOUNT	2/20/1997 18:50	2.34	1124.72	26.468	0.964037046	0.01218372	0.8	63.9460082	139.08824	±	24.0969124	2318.13734	±	401.615206
11/1/15	2/21/1997 9:50	2.96	414.07	1040.2952	0.909806193	0.01766592	0.8	53.5528707	9435.15535	±	204.271838	157252.589	±	3404.53063
11/1/15 RECOUNT	2/21/1997 9:50	2.96	384.01	729.1952	0.926164559	0.01828909	0.8	72.7939595	8989.77554	±	203.716628	149829.592	±	3395.27714
12/1/15	2/21/1997 18:57	3.34	848.35	4448.2352	1.053557361	0.01810976	0.8	49.2758157	37121.9917	±	680.804233	618699.861	±	11346.7372
13/1/15	2/22/1997 10:40	4.00	691.51	3175.6952	1.016251029	0.01796996	0.8	52.1040069	28023.3234	±	531.206013	467055.39	±	8853.43355
13/1/15 RECOUNT	2/22/1997 10:40	4.00	588.31	2280.8552	1.0118225	0.01835897	0.8	73.2638455	28300.6969	±	554.571175	471678.281	±	9242.85292
14/1/15	2/22/1997 18:52	4.34	581.35	2120.0552	1.046661855	0.01902962	0.8	53.5989218	19244.7789	±	378.859325	320746.316	±	6314.32208
14/1/15 RECOUNT	2/22/1997 18:52	4.34	510.49	1638.2552	0.997229227	0.01855876	0.8	74.4919008	20668.0887	±	419.924178	344468.144	±	6998.73629
15/1/15	2/23/1997 9:43	4.96	522.79	1625.4752	1.039535109	0.01926038	0.8	55.2280134	15203.7064	±	307.878664	253395.106	±	5131.31107
16/1/15	2/23/1997 18:56	5.34	474.13	1253.5952	1.019940153	0.01925428	0.8	59.9374486	12725.2193	±	265.732163	212086.989	±	4428.86939
17/1/15	2/24/1997 10:04	5.97	434.53	1050.3752	0.969216073	0.01862597	0.8	64.7966402	11526.7441	±	247.308195	192112.401	±	4121.80325
18/1/15	2/24/1997 18:18	6.31	634.15	594.9152	0.837902135	0.01189018	0.8	79.2001699	7979.77935	±	149.433806	132996.323	±	2490.56343
19/1/15	2/26/1997 10:46	8.00	405.09	535.11175	0.935703091	0.01830844	0.8	158.581888	7919.42019	±	212.381004	131990.337	±	3539.6834
20/1/15	2/27/1997 8:46	8.92	372.87	534.99175	0.846809661	0.01692655	0.8	189.116874	9442.18879	±	256.146645	157369.813	±	4269.11075
0-1-30	2/18/1997 11:37	0.04	1128.26	-7.792	0.970767358	0.01225628	0.8	31.105839	-19.918045	±	-11.10139	-331.96742	±	-185.02317
1/1/30	2/18/1997 13:21	0.11	1145.06	-7.552	0.985183969	0.01237927	0.8	30.9493694	-19.207447	±	-11.049552	-320.12411	±	-184.1592
2/1/30	2/18/1997 16:45	0.25	1118.06	-3.112	0.96149507	0.01217511	0.8	32.3930768	-8.2841439	±	-11.64385	-138.06907	±	-194.06417
3/1/30	2/18/1997 21:37	0.45	336.63	15.33175	0.923945696	0.01899507	0.8	84.5826989	121.023186	±	20.6276235	2017.0531	±	343.793725
3/1/30 recount	2/18/1997 21:37	0.45	357.75	8.55175	0.984553066	0.01990035	0.8	125.387276	100.069972	±	29.4164008	1667.83287	±	490.273347
4/1/30	2/19/1997 0:27	0.57	1118.66	16.388	0.959912268	0.01215294	0.8	33.6432488	45.3085047	±	12.4713147	755.141745	±	207.855245
5/1/30	2/19/1997 6:47	0.83	323.83	32.1752	0.984869136	0.02026926	0.8	41.6961677	227.209821	±	22.321356	3786.83035	±	372.0226
5/1/30 recount	2/19/1997 6:47	0.83	316.39	17.0552	0.9672724	0.02002686	0.8	65.6302957	189.570555	±	32.8796615	3159.50925	±	547.994359
6/1/30	2/19/1997 13:15	1.10	1142.96	134.108	0.968133121	0.01217217	0.8	34.9396585	385.060694	±	15.8449906	6417.67823	±	264.083177
7/1/30	2/19/1997 19:22	1.36	1233.92	317.828	1.026556545	0.01260376	0.8	34.6236732	904.317933	±	21.1007536	15071.9655	±	351.679227
8/1/30	2/20/1997 2:42	1.66	948.01	2724.1952	0.943982854	0.01222667	0.8	47.6693341	21993.1286	±	324.584222	366552.143	±	5409.73703
8/1/30 recount	2/20/1997 2:42	1.66	869.53	1882.5752	0.969464855	0.01278155	0.8	65.8553588	20996.8022	±	321.764337	349946.704	±	5362.73894

9/1/30	2/20/1997 11:05	2.01	1586.35	10464.6152	0.586202143	0.00696331	0.8	80.6406595	142918.036	±	1884.72835	2381967.26	±	31412.1391
9/1/30 recount	2/20/1997 11:05	2.01	1245.13	7712.6552	0.544388586	0.00670902	0.8	118.618996	154941.539	±	2117.60561	2582358.98	±	35293.4269
10/1/30	2/20/1997 18:50	2.34	3246.43	23940.2552	0.774998138	0.00853412	0.8	61.7121789	250212.706	±	3072.44994	4170211.77	±	51207.499
10/1/30 recount	2/20/1997 18:50	2.34	2419.87	17127.1352	0.69841285	0.00789233	0.8	95.8008221	277884.08	±	3495.50245	4631401.33	±	58258.3741
11/1/30	2/21/1997 9:50	2.96	5688.33	41822.4318	0.941	0.01407637	0.8	102.439998	399828.877	±	8284.31914	6663814.61	±	138071.986
12/1/30	2/21/1997 18:57	3.34	6701.41	54949.5152	0.669447044	0.00707243	0.8	77.89791	724935.512	±	8568.61001	12082258.5	±	142810.167
12/1/30 recount	2/21/1997 18:57	3.34	4772.17	37493.2352	0.752084926	0.00807453	0.8	99.9864711	634897.857	±	7615.46756	10581631	±	126924.459
13/1/30	2/22/1997 10:40	4.00	6881.73	51125.0718	0.973	0.01449431	0.8	107.668043	513707.687	±	10617.4612	8561794.79	±	176957.687
13/1/30 recount	2/22/1997 10:40	4.00	5065.65	36328.3518	0.973	0.01459809	0.8	150.733138	511033.947	±	10607.4647	8517232.45	±	176791.078
14/1/30	2/22/1997 18:52	4.34	6387.87	46276.2318	0.993	0.01481509	0.8	111.773987	482718.611	±	9986.41914	8045310.19	±	166440.319
14/1/30 recount	2/22/1997 18:52	4.34	4953.99	35598.8718	0.993	0.0149072	0.8	148.00703	491715.495	±	10210.1133	8195258.25	±	170168.554
15/1/30	2/23/1997 9:43	4.96	6105.75	44679.3918	0.99	0.014785	0.8	114.733681	478402.559	±	9902.7788	7973375.98	±	165046.313
16/1/30	2/23/1997 18:56	5.34	5322.15	38215.5318	0.969	0.01451921	0.8	124.817852	445155.686	±	9232.89575	7419261.44	±	153881.596
17/1/30	2/24/1997 10:04	5.97	4993.35	36871.2318	0.957	0.01436364	0.8	129.834077	446757.3	±	9274.90855	7445955	±	154581.809
18/1/30	2/24/1997 18:18	6.31	4468.77	31856.7318	0.927	0.01395795	0.8	141.6339	421079.161	±	8759.07594	7017986.01	±	145984.599
19/1/30	2/26/1997 10:46	8.00	3723.15	26390.5518	0.962	0.01457308	0.8	154.413257	380301.788	±	7939.67806	6338363.14	±	132327.968
20/1/30	2/27/1997 8:46	8.92	3416.13	23589.1518	0.968	0.0147117	0.8	165.004851	363248.936	±	7599.0301	6054148.93	±	126650.502
0/1/45	2/18/1997 11:37	0.04	332.29	4.2752	1.02065205	0.02086852	0.8	36.8911727	26.7109049	±	17.5154062	445.181749	±	291.923436
1/1/45	2/18/1997 13:21	0.11	313.15	4.7552	0.96160861	0.0199631	0.8	39.4386346	31.761453	±	18.7618239	529.35755	±	312.697065
2/1/45 recount	2/18/1997 16:45	0.25	341.65	116.1152	1.010321658	0.02051449	0.8	57.5748738	1132.22248	±	44.1319594	18870.3747	±	735.532656
3/1/45	2/18/1997 21:37	0.45	1182.26	99.368	1.005656854	0.01250966	0.8	31.6263857	258.256916	±	13.4904677	4304.28193	±	224.841128
4/1/45	2/19/1997 0:27	0.57	615.19	2425.5152	1.043903846	0.01880055	0.8	38.4786693	15806.4284	±	307.062334	263440.474	±	5117.70557
4/1/45 recount	2/19/1997 0:27	0.57	513.01	1580.7752	1.025087655	0.01905958	0.8	57.1033636	15287.6774	±	310.946537	254794.623	±	5182.44228
5/1/45 recount	2/19/1997 6:47	0.83	8255.97	62241.6318	1.003	0.0148915	0.8	115.464718	670695.796	±	13834.7798	11178263.3	±	230579.663
6/1/45	2/19/1997 13:15	1.10	22269.07	190281.435	1.005	0.01031376	0.8	41.8512798	1348698.47	±	15532.6894	22478307.9	±	258878.157
6/1/45 recount	2/19/1997 13:15	1.10	15238.39	125906.355	1.005	0.01037463	0.8	63.0720703	1344913.78	±	15571.1201	22415229.6	±	259518.669
7/1/45	2/19/1997 19:22	1.36	22107.97	198647.955	1.077	0.01616036	0.8	41.0528571	1381138.37	±	21944.6775	23018972.8	±	365744.625
7/1/45 recount	2/19/1997 19:22	1.36	17215.81	142190.535	1.077	0.0161881	0.8	55.0715203	1326195.22	±	21108.9523	22103253.7	±	351815.872
8/1/45	2/20/1997 2:42	1.66	18432.15	136768.172	0.912	0.01341534	0.8	97.6193455	1245994.85	±	25563.0514	20766580.9	±	426050.856
8/1/45 recount	2/20/1997 2:42	1.66	13158.99	97594.5318	0.912	0.01345603	0.8	137.716462	1254315.12	±	25779.2855	20905252	±	429654.758
9/1/45	2/20/1997 11:05	2.01	18897.69	143242.052	1.003	0.01475118	0.8	93.2455421	1246504.72	±	25570.457	20775078.6	±	426174.283
9/1/45 recount	2/20/1997 11:05	2.01	15235.83	115994.132	1.003	0.01477736	0.8	116.576055	1261945.76	±	25913.8638	21032429.3	±	431897.73
10/1/45	2/20/1997 18:50	2.34	17961.15	135949.892	1.037	0.01525709	0.8	91.2473628	1157695.92	±	23753.9933	19294932	±	395899.889
10/1/45 recount	2/20/1997 18:50	2.34	13562.79	102529.292	1.037	0.01529551	0.8	121.479209	1162372.24	±	23884.9197	19372870.6	±	398081.995
11/1/45	2/21/1997 9:50	2.96	42648.26	320340.428	0.948	0.00861636	0.8	41.3954154	1089732.35	±	10703.8701	18162205.9	±	178397.834
11/1/45 recount	2/21/1997 9:50	2.96	28695.62	207674.168	0.948	0.00865306	0.8	62.6058056	1068446.88	±	10538.5995	17807448	±	175643.325
12/1/45	2/21/1997 18:57	3.34	11541.01	92181.1952	0.975	0.01471066	0.8	53.3098424	832260.797	±	13297.917	13871013.3	±	221631.949
12/1/45 recount	2/21/1997 18:57	3.34	8254.45	63988.0952	0.975	0.01477777	0.8	74.6774233	809278.889	±	12990.5816	13487981.5	±	216509.694
13/1/45	2/22/1997 10:40	4.00	26253.44	195773.768	0.956	0.00873666	0.8	74.6328354	1200715.98	±	11856.5896	20011932.9	±	197609.827
14/1/45	2/22/1997 18:52	4.34	8418.31	66541.6952	1.006	0.0152429	0.8	55.8488814	629387.399	±	10099.4542	10489790	±	168324.237
14/1/45 recount	2/22/1997 18:52	4.34	6409.57	50598.0152	1.006	0.01531744	0.8	73.9574763	633760.647	±	10219.5881	10562677.5	±	170326.468
15/1/45	2/23/1997 9:43	4.96	21409.58	154298.168	0.971	0.0089024	0.8	47.5679334	603157.734	±	5974.94183	10052628.9	±	99582.3639
16/1/45	2/23/1997 18:56	5.34	6768.31	52182.1952	1.011	0.01537695	0.8	60.5761679	535345.117	±	8623.69651	8922418.61	±	143728.275
17/1/45	2/24/1997 10:04	5.97	6318.37	49754.4752	0.958	0.01459087	0.8	65.6731121	553387.635	±	8926.23316	9223127.25	±	148770.553
18/1/45	2/24/1997 18:18	6.31	5957.47	46169.6552	0.986	0.01503611	0.8	67.4010254	527026.969	±	8512.0448	8783782.81	±	141867.413
19/1/45	2/26/1997 10:46	8.00	4602.15	33205.7118	0.983	0.01478811	0.8	146.009778	452470.27	±	9406.87694	7541171.17	±	156781.282
20/1/45	2/27/1997 8:46	8.92	9781.64	73277.168	0.959	0.00897843	0.8	67.9624261	409254.438	±	4136.47926	6820907.3	±	68941.321

0/1/60	2/18/1997 11:37	0.04	357.45	0.09175	0.986609247	0.01994648	0.8	75.5061854	0.64652291	±	16.9221662	10.7753818	±	282.036104
1/1/60	2/18/1997 13:21	0.11	2977.47	22150.7118	1.04	0.01589752	0.8	72.1463581	149141.125	±	3130.11972	2485685.41	±	52168.662
1/1/60 recount	2/18/1997 13:21	0.11	2266.89	14737.5918	1.04	0.0161207	0.8	110.65903	152197.912	±	3223.09411	2536631.86	±	53718.2351
2/1/60	2/18/1997 16:45	0.25	47884.83	402928.232	1.253	0.01834553	0.8	63.8550205	2401143.2	±	49127.4369	40019053.3	±	818790.615
2/1/60 recount	2/18/1997 16:45	0.25	36334.89	278862.392	1.253	0.01836261	0.8	92.0129884	2394607.83	±	49020.9695	39910130.5	±	817016.159
3/1/60	2/18/1997 21:37	0.45	161204.29	1013972.3	1.538	0.02312912	0.8	86.1426721	4415042.9	±	70329.5381	73584048.3	±	1172158.97
3/1/60 recount	2/18/1997 21:37	0.45	95117.41	813460.215	1.538	0.02297049	0.8	37.9255893	5224904.53	±	82636.1547	87081742.2	±	1377269.24
4/1/60	2/19/1997 0:27	0.57	103841.49	857042.732	1.574	0.02328738	0.8	164.827424	4036511.18	±	83086.409	67275186.3	±	1384773.48
4/1/60 recount	2/19/1997 0:27	0.57	83597.37	646950.752	1.574	0.02301653	0.8	72.7933059	4394990.9	±	89857.9392	73249848.3	±	1497632.32
5/1/60	2/19/1997 6:47	0.83	257198.51	2342178.22	1.17	0.01058666	0.8	48.9878822	5437763.62	±	53177.1834	90629393.7	±	886286.39
6/1/60	2/19/1997 13:15	1.10	57981.75	472602.092	1.245	0.0182191	0.8	66.8394692	2947976.02	±	60298.3074	49132933.7	±	1004971.79
6/1/60 recount	2/19/1997 13:15	1.10	44711.07	341902.352	1.245	0.01823219	0.8	100.73058	3214095.22	±	65769.5432	53568253.7	±	1096159.05
7/1/60	2/19/1997 19:22	1.36	51437.43	431277.272	1.226	0.01794658	0.8	71.3503584	2871759.36	±	58749.4772	47862656	±	979157.954
7/1/60 recount	2/19/1997 19:22	1.36	42432.09	328589.012	1.226	0.01795697	0.8	95.7722832	2936893.46	±	60102.9021	48948224.3	±	1001715.03
8/1/60	2/20/1997 2:42	1.66	123061.58	946471.508	0.904	0.00816983	0.8	40.1718386	3124532.9	±	30521.7851	52075548.3	±	508696.419
9/1/60	2/20/1997 11:05	2.01	128058.80	923308.568	0.99	0.008946	0.8	38.4564521	2917910.24	±	28500.7778	48631837.3	±	475012.963
9/1/60 recount	2/20/1997 11:05	2.01	75005.18	559368.188	0.99	0.00896434	0.8	61.6532409	2834063.15	±	27736.5036	47234385.8	±	462275.061
10/1/60	2/20/1997 18:50	2.34	116287.70	860930.648	1.028	0.0092921	0.8	37.4720421	2651132.16	±	25902.1456	44185536	±	431702.427
10/1/60 recount	2/20/1997 18:50	2.34	72168.20	511399.928	1.028	0.00931023	0.8	61.893099	2601110.12	±	25462.2084	43351835.3	±	424370.14
11/1/60	2/21/1997 9:50	2.96	20207.53	181142.415	1.023	0.01535882	0.8	47.7129228	1463746.54	±	23270.3551	24395775.6	±	387839.251
11/1/60 recount	2/21/1997 9:50	2.96	14854.09	121073.895	1.023	0.01539535	0.8	68.8062855	1410874.33	±	22484.6783	23514572.2	±	374744.639
12/1/60	2/21/1997 18:57	3.34	15120.15	113314.112	1.014	0.01494047	0.8	101.414861	1072459.53	±	22023.9059	17874325.5	±	367065.098
12/1/60 recount	2/21/1997 18:57	3.34	11078.79	82681.5918	1.014	0.01499065	0.8	142.063832	1096194.62	±	22555.5218	18269910.4	±	375925.363
13/1/60	2/22/1997 10:40	4.00	10340.83	85328.2352	0.988	0.01492665	0.8	53.6902204	775885.533	±	12413.1364	12931425.5	±	206885.607
13/1/60 recount	2/22/1997 10:40	4.00	7300.45	60291.7952	0.988	0.01500596	0.8	76.5503557	781655.04	±	12571.8357	13027584	±	209530.595
14/1/60	2/22/1997 18:52	4.34	9173.97	68715.6918	0.987	0.01462943	0.8	112.621899	722227.604	±	14883.2462	12037126.7	±	248054.104
14/1/60 recount	2/22/1997 18:52	4.34	7135.41	52676.0718	0.987	0.01469242	0.8	149.138733	733160.646	±	15146.9724	12219344.1	±	252449.539
15/1/60	2/23/1997 9:43	4.96	7475.23	59971.6952	0.984	0.01493893	0.8	58.4813646	593982.332	±	9549.9037	9899705.53	±	159165.062
16/1/60	2/23/1997 18:56	5.34	64666.17	47247.0318	0.98	0.01433755	0.8	123.638696	545160.347	±	11164.6137	9086005.79	±	186076.894
17/1/60	2/24/1997 10:04	5.97	6309.09	47089.6518	0.957	0.01428182	0.8	130.067474	571596.42	±	11826.4513	9526607.01	±	197107.521
18/1/60	2/24/1997 18:18	6.31	5315.73	38818.4118	0.949	0.01421998	0.8	138.549431	501923.838	±	10410.1859	8365397.3	±	173503.098
19/1/60	2/26/1997 10:46	8.00	4084.65	29317.1118	0.926	0.01398274	0.8	154.997421	424073.338	±	8836.2473	7067888.97	±	147270.788
20/1/60	2/27/1997 8:46	8.92	3335.65	25007.4152	1.016	0.01575845	0.8	79.7654545	337826.22	±	5550.88417	5630436.99	±	92514.7362
1/2/15	2/18/1997 12:48	0.09	318.25	4.3952	0.977422378	0.02020625	0.8	38.9751649	29.0119091	±	18.5140875	483.531818	±	308.568124
2/2/15	2/18/1997 16:09	0.23	1185.08	-0.832	1.018864712	0.01266457	0.8	31.959575	-2.1851445	±	-11.528553	-36.419076	±	-192.14255
3/2/15	2/18/1997 20:06	0.39	336.75	0.39175	0.929370381	0.01910466	0.8	84.2149444	3.07888513	±	18.9035211	51.3147522	±	315.058684
4/2/15	2/18/1997 23:59	0.55	328.15	8.5952	1.006406059	0.02064261	0.8	39.9769179	58.1935699	±	19.3205397	969.892831	±	322.008996
4/2/15 recount	2/18/1997 23:59	0.55	319.21	4.9952	0.9801655	0.02024718	0.8	59.5954728	50.4168671	±	28.3784655	840.281119	±	472.974426
5/2/15	2/19/1997 6:08	0.81	295.63	18.1352	0.903035883	0.01903684	0.8	45.5264375	139.828507	±	22.9214522	2330.47512	±	382.024203
5/2/15 recount	2/19/1997 6:08	0.81	286.99	4.9952	0.881055277	0.01872482	0.8	71.2163865	60.247984	±	33.9135057	1004.13307	±	565.225096
6/2/15	2/19/1997 12:32	1.07	1124.90	12.788	0.965664037	0.01220365	0.8	35.0709623	36.8558268	±	12.9254704	614.263779	±	215.424506
7/2/15	2/19/1997 18:12	1.31	1170.68	28.268	1.003353716	0.01251948	0.8	35.4816626	82.4242288	±	13.4093197	1373.73715	±	223.488661
8/2/15	2/20/1997 2:02	1.64	501.43	303.8552	0.855	0.01596586	0.8	52.7755894	2715.87307	±	69.5296312	45264.5512	±	1158.82719
8/2/15 recount	2/20/1997 2:02	1.64	289.63	84.7352	0.861282592	0.0182585	0.8	85.3764962	1225.21383	±	58.0164479	20420.2305	±	966.940798
9/2/15	2/20/1997 10:37	1.99	311.59	67.1552	0.934982147	0.01943575	0.8	50.6528825	576.094217	±	31.7456779	9601.57029	±	529.094632
9/2/15 recount	2/20/1997 10:37	1.99	306.61	44.3552	0.927638988	0.01936523	0.8	63.7094352	478.583808	±	36.0552753	7976.3968	±	600.921255
10/2/15	2/20/1997 18:05	2.31	1138.82	25.028	0.976313353	0.01228931	0.8	39.5930781	81.433155	±	14.8844036	1357.21925	±	248.073394
10/2/15 recount	2/20/1997 18:05	2.31	1138.82	10.328	0.977895377	0.01230923	0.8	65.1695856	55.3117038	±	23.9240949	921.86173	±	398.734915
11/2/15	2/21/1997 9:26	2.95	348.39	11.13175	0.957837798	0.01950238	0.8	100.820123	104.738411	±	23.9996129	1745.64019	±	399.993548

12/2/15	2/21/1997 18:20	3.32	303.07	28.6952	0.922227729	0.01931183	0.8	56.4616868	274.392862	±	29.7809711	4573.21436	±	496.349518
12/2/15 recount	2/21/1997 18:20	3.32	311.11	37.7552	0.943789911	0.01962678	0.8	79.5530409	508.678363	±	43.6884276	8477.97271	±	728.14046
13/2/15	2/22/1997 10:10	3.98	368.79	156.33175	0.964643623	0.01933846	0.8	108.795961	1587.28633	±	55.5671603	26454.7722	±	926.119338
13/2/15 recount	2/22/1997 10:10	3.98	358.23	135.03175	0.942757442	0.01904858	0.8	140.413552	1769.45791	±	65.5576978	29490.9652	±	1092.6283
14/2/15	2/22/1997 18:17	4.31	313.87	38.9552	0.951860034	0.01974886	0.8	59.1846907	390.46717	±	32.6741836	6507.78617	±	544.569727
15/2/15	2/23/1997 9:16	4.94	350.37	8.49175	0.964203086	0.01960111	0.8	118.078715	93.5759258	±	27.6932605	1559.59876	±	461.554342
16/2/15	2/23/1997 18:19	5.32	1134.98	36.908	0.97173369	0.01224497	0.8	50.5795089	153.409046	±	19.3924058	2556.81743	±	323.206763
17/2/15	2/24/1997 9:34	5.95	314.89	14.4752	0.963560827	0.01997471	0.8	65.5486863	160.693485	±	32.4771767	2678.22475	±	541.286278
18/2/15	2/24/1997 17:46	6.29	305.77	29.5352	0.930239219	0.01943365	0.8	71.5396451	357.846193	±	37.8724726	5964.10322	±	631.207876
19/2/15	2/26/1997 10:11	7.98	342.93	2.01175	0.945876248	0.01934412	0.8	157.818301	29.6296613	±	35.7287987	493.827689	±	595.479979
20/2/15	2/27/1997 8:02	8.89	362.19	18.69175	0.993351443	0.02001096	0.8	161.411013	281.564853	±	40.1273517	4692.74756	±	668.789195
1/2/30	2/18/1997 12:48	0.09	344.73	-1.28825	0.951969708	0.01944014	0.8	79.1725529	-9.5185351	±	-17.61761	-158.64225	±	-293.62684
2/2/30	2/18/1997 16:09	0.23	332.77	3.9152	1.022254482	0.02089369	0.8	37.9525814	25.165466	±	17.9930571	419.424433	±	299.884285
3/2/30	2/18/1997 20:06	0.39	1163.72	84.668	0.991300615	0.01239232	0.8	32.1324629	223.572902	±	13.3646498	3726.21503	±	222.744163
4/2/30	2/18/1997 23:59	0.55	356.97	0.21175	0.98524343	0.01992619	0.8	80.3960136	1.58874153	±	18.0293352	26.4790255	±	300.48892
4/2/30 recount	2/18/1997 23:59	0.55	359.31	5.91175	0.989759061	0.01998186	0.8	116.764476	64.420206	±	26.99649	1073.6701	±	449.9415
5/2/30	2/19/1997 6:08	0.81	344.01	3.15175	0.94846863	0.01938001	0.8	85.7577232	25.2243694	±	19.5333617	420.406157	±	325.556029
6/2/30	2/19/1997 12:32	1.07	314.35	7.5752	0.964313416	0.01999926	0.8	43.7111878	56.0785036	±	21.0368386	934.641726	±	350.613977
7/2/30	2/19/1997 18:12	1.31	332.95	11.1752	1.020268586	0.02085026	0.8	43.4628892	82.2590332	±	21.2326598	1370.98389	±	353.877663
8/2/30	2/20/1997 2:02	1.64	488.13	328.11175	1.235483919	0.02314416	0.8	72.2586176	2212.61956	±	62.2450068	36876.9926	±	1037.41678
8/2/30 recount	2/20/1997 2:02	1.64	370.53	39.99175	1.009109933	0.02020449	0.8	144.169388	538.07	±	40.6510335	8967.83333	±	677.517225
9/2/30	2/20/1997 10:37	1.99	360.93	11.43175	0.992348699	0.02000965	0.8	94.4214613	100.73462	±	22.5129453	1678.91033	±	375.215754
10/2/30	2/20/1997 18:05	2.31	327.07	11.6552	1.002013525	0.02056975	0.8	47.9742269	94.6972613	±	23.4846535	1578.28769	±	391.410891
11/2/30	2/21/1997 9:26	2.95	1061.60	26.348	0.909787653	0.01172114	0.8	43.2116206	93.5629823	±	16.2819966	1559.38304	±	271.366611
11/2/30 recount	2/21/1997 9:26	2.95	1057.64	8.348	0.908320536	0.01171717	0.8	71.0788338	48.7616712	±	26.0118155	812.69452	±	433.530258
12/2/30	2/21/1997 18:20	3.32	357.87	2.67175	0.986888947	0.01994574	0.8	104.07616	25.9503007	±	23.6448515	432.505012	±	394.080858
13/2/30	2/22/1997 10:10	3.98	1189.40	174.728	1.003684598	0.0124618	0.8	42.7212379	613.426004	±	20.7477947	10223.7667	±	345.796578
14/2/30	2/22/1997 18:17	4.31	358.23	19.83175	0.982032308	0.01984214	0.8	113.496962	210.05866	±	28.406245	3500.97767	±	473.437417
15/2/30	2/23/1997 9:16	4.94	1112.78	23.888	0.954050259	0.01209955	0.8	48.4797383	95.1690875	±	18.1918067	1586.15146	±	303.196779
16/2/30	2/23/1997 18:19	5.32	1141.28	46.928	0.976071246	0.01227776	0.8	50.4331806	194.493124	±	19.66435	3241.55206	±	327.739166
17/2/30	2/24/1997 9:34	5.95	347.37	10.89175	0.955104195	0.0194626	0.8	130.833788	132.988134	±	31.1020537	2216.46891	±	518.367561
18/2/30	2/24/1997 17:46	6.29	364.83	36.45175	0.994583553	0.01999652	0.8	132.38162	450.340899	±	36.5594882	7505.68164	±	609.324803
19/2/30	2/26/1997 10:11	7.98	374.31	94.83175	1.000847098	0.01998513	0.8	149.337871	1321.65784	±	57.2476847	22027.6306	±	954.128078
20/2/30	2/27/1997 8:02	8.89	1289.78	914.348	1.010379777	0.01224446	0.8	64.5836881	4852.7756	±	76.6174909	80879.5934	±	1276.95818
1/2/45	2/18/1997 12:48	0.09	1115.24	-3.292	0.959090175	0.01215468	0.8	31.9823029	-8.6521772	±	-11.493011	-144.20295	±	-191.55019
2/2/45	2/18/1997 16:09	0.23	341.37	1.05175	0.941897593	0.01928752	0.8	81.4937299	7.99893248	±	18.3561325	133.315541	±	305.935542
3/2/45	2/18/1997 20:06	0.39	320.83	3.1352	0.985799333	0.02033697	0.8	40.1653856	21.3268589	±	18.9822981	355.447648	±	316.371635
4/2/45	2/18/1997 23:59	0.55	1089.50	5.588	0.936006623	0.01195396	0.8	34.610077	15.8933267	±	12.6105608	264.888778	±	210.176014
5/2/45	2/19/1997 6:08	0.81	1161.80	14.108	0.997243764	0.01247312	0.8	33.1945114	38.4846534	±	12.2596346	641.41089	±	204.327243
6/2/45	2/19/1997 12:32	1.07	341.49	13.41175	0.938014954	0.01920611	0.8	88.9054929	111.278012	±	21.4417451	1854.63353	±	357.362418
7/2/45	2/19/1997 18:12	1.31	367.65	22.17175	1.007235825	0.02020905	0.8	87.1022717	180.22904	±	22.0978492	3003.81733	±	368.297487
8/2/45	2/20/1997 2:02	1.64	2472.74	252.248	0.884	0.00929933	0.8	41.1446984	852.89872	±	22.0075444	14214.9787	±	366.792406
9/2/45	2/20/1997 10:37	1.99	1112.24	487.988	0.903639288	0.01146205	0.8	42.1973631	1692.1946	±	32.9283702	28203.2433	±	548.80617
9/2/45 recount	2/20/1997 10:37	1.99	1156.70	306.068	0.961438523	0.01204204	0.8	63.5684459	1598.87815	±	38.2666792	26647.9691	±	637.777986
10/2/45	2/20/1997 18:05	2.31	478.35	264.57175	0.996	0.01874092	0.8	95.4882136	2357.70005	±	69.4316405	39295.0009	±	1157.19401
10/2/45 recount	2/20/1997 18:05	2.31	408.21	211.23175	0.996	0.01945101	0.8	126.669304	2497.04228	±	78.9104825	41617.3713	±	1315.17471
11/2/45	2/21/1997 9:26	2.95	377.89	663.2552	0.930405294	0.01844098	0.8	52.6186256	5910.57684	±	135.760368	98509.614	±	2262.6728

11/2/45 recount	2/21/1997 9:26	2.95	373.33	483.4352	0.979280452	0.01946461	0.8	65.842477	5390.81135	±	129.680493	89846.8559	±	2161.34154
12/2/45	2/21/1997 18:20	3.32	492.33	1022.61175	1.010302592	0.01889074	0.8	102.121716	9745.95043	±	242.260526	162432.507	±	4037.67543
12/2/45 recount	2/21/1997 18:20	3.32	461.19	827.73175	0.990789273	0.01879606	0.8	129.139621	9975.72423	±	253.329182	166262.071	±	4222.15303
13/2/45	2/22/1997 10:10	3.98	629.05	2719.6352	0.983653213	0.01765142	0.8	54.0438312	24892.3837	±	480.175423	414873.061	±	8002.92371
13/2/45 recount	2/22/1997 10:10	3.98	549.97	1912.5752	1.022713048	0.01877518	0.8	72.5618342	23503.7131	±	468.588108	391728.551	±	7809.8018
14/2/45	2/22/1997 18:17	4.31	732.67	3399.7352	1.064490802	0.01866416	0.8	53.001794	30517.2479	±	573.147226	508620.799	±	9552.45376
14/2/45 recount	2/22/1997 18:17	4.31	625.27	2584.6352	1.019249428	0.018308	0.8	73.0485486	31975.7361	±	618.378102	532928.934	±	10306.3017
15/2/45	2/23/1997 9:16	4.94	912.37	4981.8752	1.06381594	0.01812211	0.8	54.1454676	45684.0561	±	829.319203	761400.935	±	13821.9867
16/2/45	2/23/1997 18:19	5.32	3060.50	15210.968	0.994009532	0.01014632	0.8	82.657086	103321.997	±	1140.78018	1722033.28	±	19013.003
17/2/45	2/24/1997 9:34	5.95	1097.83	6449.9552	1.120757862	0.01870237	0.8	56.4223721	61633.6295	±	1093.80626	1027227.16	±	18230.1044
18/2/45	2/24/1997 17:46	6.29	1161.73	7059.1352	1.104223047	0.01832181	0.8	60.3507438	72151.2453	±	1272.33169	1202520.75	±	21205.5282
19/2/45	2/26/1997 10:11	7.98	1182.63	6390.39175	1.085658922	0.01771933	0.8	137.828265	82197.9692	±	1800.88629	1369966.15	±	30014.7715
20/2/45	2/27/1997 8:02	8.89	1217.05	7373.1752	1.164537193	0.01923616	0.8	69.6747141	87004.0468	±	1527.24788	1450067.45	±	25454.1313
1/2/60	2/18/1997 12:48	0.09	323.53	3.7952	0.993873787	0.02045944	0.8	38.3874277	24.673649	±	18.1904746	411.227484	±	303.174577
1/2/60	2/18/1997 16:09	0.23	1137.92	-5.152	0.978787642	0.01232359	0.8	31.9161723	-13.512711	±	-11.436537	-225.21186	±	-190.60894
3/2/60	2/18/1997 20:06	0.39	332.89	5.0552	1.02222483	0.02089119	0.8	38.7921672	33.2117752	±	18.4765003	553.529587	±	307.941672
4/2/60	2/18/1997 23:59	0.55	312.55	8.1152	0.958587638	0.01991038	0.8	42.0415517	57.7813479	±	20.278793	963.022465	±	337.979883
5/2/60	2/19/1997 6:08	0.81	328.57	24.4952	1.002136099	0.02054836	0.8	41.5384263	172.322003	±	21.4913302	2872.03338	±	358.188837
5/2/60 recount	2/19/1997 6:08	0.81	314.71	12.3152	0.963762718	0.01998187	0.8	76.0108962	158.535683	±	37.3160261	2642.26138	±	621.933768
6/2/60	2/19/1997 12:32	1.07	1151.84	57.248	0.984038706	0.01234161	0.8	34.4903476	162.260847	±	13.685246	2704.34745	±	228.087433
7/2/60	2/19/1997 18:12	1.31	1241.12	490.988	1.014110568	0.01242928	0.8	35.208436	1420.6054	±	27.1866125	23676.7566	±	453.110209
8/2/60	2/20/1997 2:02	1.64	495.01	1542.5552	0.983088362	0.01840305	0.8	45.9626076	12007.5687	±	245.940158	200126.144	±	4099.00264
8/2/60 recount	2/20/1997 2:02	1.64	447.79	1041.0752	1.013257638	0.01935063	0.8	63.4634013	11189.6151	±	239.037908	186493.586	±	3983.96514
9/2/60	2/20/1997 10:37	1.99	625.69	2547.3752	1.033575101	0.0185633	0.8	45.9419537	19820.3847	±	383.461217	330339.745	±	6391.02028
9/2/60 recount	2/20/1997 10:37	1.99	544.51	1846.7552	1.028941997	0.01892327	0.8	62.8148557	19646.3285	±	392.901133	327438.808	±	6548.35222
10/2/60	2/20/1997 18:05	2.31	9086.42	9623.768	0.993	0.0093244	0.8	38.9673842	30817.8436	±	320.715254	513630.726	±	5345.25423
10/2/60 recount	2/20/1997 18:05	2.31	1880.48	5794.928	0.992934999	0.01097201	0.8	64.2555344	30599.5072	±	370.642296	509991.787	±	6177.37159
11/2/60	2/21/1997 9:26	2.95	1400.79	8194.17175	1.072870383	0.01722462	0.8	90.2800841	69038.6566	±	1495.54054	1150644.28	±	24925.6757
11/2/60 recount	2/21/1997 9:26	2.95	1162.23	6216.99175	1.088467257	0.01779782	0.8	117.199407	67998.7645	±	1491.73286	1133312.74	±	24862.2143
12/2/60	2/21/1997 18:20	3.32	1047.73	6224.7152	1.045437998	0.01753137	0.8	49.9656754	52674.5643	±	939.39762	877909.405	±	15656.627
12/2/60 recount	2/21/1997 18:20	3.32	815.23	4250.4752	1.020856128	0.01763843	0.8	73.8209444	53140.6409	±	979.968133	885677.348	±	16332.8022
13/2/60	2/22/1997 10:10	3.98	836.01	3706.95175	1.043769814	0.01777348	0.8	100.765288	34859.664	±	787.751025	580994.401	±	13129.1837
13/2/60 recount	2/22/1997 10:10	3.98	662.55	2680.83175	0.914814458	0.01615247	0.8	160.493175	40153.3183	±	932.242978	669221.971	±	15537.383
14/2/60	2/22/1997 18:17	4.31	693.21	2544.09175	1.046061301	0.01832995	0.8	106.709451	25335.587	±	586.353275	422259.783	±	9772.55458
14/2/60 recount	2/22/1997 18:17	4.31	606.51	1861.83175	1.039351389	0.01864134	0.8	141.728505	24625.9477	±	582.58384	410432.462	±	9709.73066
15/2/60	2/23/1997 9:16	4.94	619.95	2002.65175	1.028439335	0.01837213	0.8	110.809619	20709.91	±	487.725526	345165.166	±	8128.75877
16/2/60	2/23/1997 18:19	5.32	1788.86	4895.168	1.011004893	0.01128914	0.8	48.8131275	19636.3192	±	241.640198	327271.987	±	4027.33663
17/2/60	2/24/1997 9:34	5.95	548.13	1565.31175	0.97930152	0.01790768	0.8	127.753923	18662.5251	±	449.128694	311042.085	±	7485.47823
18/2/60	2/24/1997 17:46	6.29	575.49	1541.13175	1.063064814	0.01925539	0.8	124.024427	17837.842	±	427.192494	297297.366	±	7119.8749
19/2/60	2/26/1997 10:11	7.98	526.29	1339.83175	0.995890647	0.01836135	0.8	150.567089	18826.7621	±	458.08056	313779.368	±	7634.676
20/2/60	2/27/1997 8:02	8.89	338.37	1220.85175	0.962	0.01974844	0.8	166.87106	19012.5019	±	495.248528	316875.032	±	8254.14214
-1/3/15	2/17/1997 17:00	-0.74	317.37	4.38682996	0.974710797	0.0164133	0.8	20.0010761	27.7706219	±	16.2698831	462.843698	±	271.164718
0/3/15	2/18/1997 11:15	0.02	331.87	4.8152	1.019171215	0.02084489	0.8	36.6912903	29.921752	±	17.4587996	498.695866	±	290.979993
1/3/15	2/18/1997 12:38	0.08	315.91	2.4752	0.970896055	0.02010982	0.8	39.4964026	16.5568434	±	18.6166234	275.94739	±	310.277056
2/3/15	2/18/1997 15:55	0.22	317.35	4.2752	0.974695913	0.02016469	0.8	40.1923366	29.1010993	±	19.0829728	485.018322	±	318.049547
3/3/15	2/18/1997 19:50	0.38	360.43	61.9952	1.087021259	0.02178641	0.8	36.4797985	383.018896	±	22.2431433	6383.64827	±	370.719055
4/3/15	2/18/1997 11:45	0.04	339.87	3.75175	0.936836756	0.01920777	0.8	85.1087434	29.7991162	±	19.4482725	496.651937	±	324.137875

5/3/15	2/19/1997 5:58	0.80	339.27	40.41175	0.922682215	0.01892704	0.8	89.2590243	336.631776	±	25.2755901	5610.52959	±	421.259836
5/3/15 recount	2/19/1997 5:58	0.80	342.57	17.43175	0.939625464	0.01922197	0.8	154.414025	251.201973	±	38.1177695	4186.69955	±	635.296159
6/3/15	2/19/1997 12:17	1.06	317.17	8.8952	0.972526125	0.02012276	0.8	43.3991824	65.3803091	±	21.001439	1089.67182	±	350.023984
7/3/15	2/19/1997 17:59	1.30	312.49	8.4752	0.958277145	0.01990493	0.8	46.4160302	66.6235322	±	22.4223946	1110.3922	±	373.706576
8/3/15	2/20/1997 1:48	1.63	331.47	31.65175	0.904139013	0.0186703	0.8	98.8756939	292.067065	±	26.5719573	4867.78441	±	442.865955
9/3/15	2/20/1997 10:27	1.99	1707.39	10427.6718	1.157692411	0.01828535	0.8	81.1495004	78971.1599	±	1692.59015	1316186	±	28209.8358
9/3/15 recount	2/20/1997 10:27	1.99	1351.17	7776.15175	1.078422765	0.01737104	0.8	117.972755	85613.4039	±	1858.75622	1426890.06	±	30979.2703
10/3/15	2/20/1997 17:56	2.30	311.17	8.1152	0.954342693	0.01984523	0.8	50.4339778	69.3157864	±	24.3269888	1155.26311	±	405.449813
11/3/15 recount	2/21/1997 9:16	2.94	1105.64	11.588	0.949235957	0.01206398	0.8	68.1088039	64.8586027	±	25.0536433	1080.97671	±	417.560721
12/3/15	2/21/1997 18:11	3.31	353.25	6.81175	0.972725283	0.01972967	0.8	106.244725	67.5400524	±	24.6864021	1125.66754	±	411.440034
13/3/15	2/22/1997 9:59	3.97	1090.94	61.388	0.931239313	0.01188785	0.8	46.1136814	232.631825	±	18.4354959	3877.19708	±	307.258265
14/3/15	2/22/1997 18:09	4.31	189.85	28.5152	0.924	0.02234062	0.8	61.1263577	295.198839	±	32.4124186	4919.98064	±	540.206976
15/3/15	2/23/1997 9:09	4.93	1123.04	65.648	0.958376225	0.01211806	0.8	48.3621391	260.905269	±	19.4719332	4348.42115	±	324.53222
16/3/15	2/23/1997 18:08	5.31	1191.62	181.868	1.004824651	0.01246876	0.8	49.517836	740.071698	±	24.3394319	12334.5283	±	405.657198
17/3/15	2/24/1997 9:22	5.94	305.83	10.8152	0.936972131	0.01957328	0.8	67.5623065	123.751003	±	32.9602984	2062.51671	±	549.338307
18/3/15	2/24/1997 17:38	6.29	307.57	23.5952	0.937853945	0.01956227	0.8	71.7233025	286.611522	±	36.9786328	4776.8587	±	616.310547
19/3/15	2/26/1997 10:00	7.97	361.65	48.21175	0.981796739	0.01978619	0.8	152.938959	688.123424	±	45.2987821	11468.7237	±	754.979702
20/3/15	2/27/1997 7:52	8.88	1184.06	17.768	1.015986105	0.01263216	0.8	64.3735904	93.9944315	±	23.9150835	1566.57386	±	398.584724
(-1)-3-30	2/17/1997 17:00	-0.74	1167.54	-6.6497453	1.004415237	0.01022874	0.8	5.49057657	-15.709004	±	-8.4905354	-261.81673	±	-141.50892
0/3/30	2/18/1997 11:11	0.02	357.99	-6.38825	0.990308978	0.02001303	0.8	74.7079735	-44.539381	±	-16.206557	-742.32301	±	-270.10928
1/3/30	2/18/1997 12:32	0.07	409.65	-7.70825	1.133352051	0.02211404	0.8	66.941121	-48.155299	±	-14.428053	-802.58832	±	-240.46755
2/3/30	2/18/1997 15:55	0.22	356.79	0.93175	0.984501122	0.01991392	0.8	78.7270037	6.84570908	±	17.7217371	114.095151	±	295.362285
3/3/30	2/18/1997 19:48	0.38	1202.66	-6.412	1.034578216	0.01280155	0.8	30.8621426	-16.262055	±	-11.037504	-271.03426	±	-183.9584
4/3/30	2/18/1997 11:42	0.04	1109.66	13.628	0.95247228	0.01209067	0.8	34.0688247	38.1544435	±	12.5731344	635.907392	±	209.55224
5/3/30	2/19/1997 5:53	0.80	1168.16	0.128	1.004215796	0.01253872	0.8	33.3771025	0.35108676	±	12.0578352	5.85144598	±	200.96392
6/3/30	2/19/1997 12:14	1.06	343.65	7.17175	0.946104421	0.01933739	0.8	88.2614975	59.0733702	±	20.5492792	984.556171	±	342.487986
7/3/30	2/19/1997 17:55	1.30	372.99	19.35175	1.022936825	0.02044534	0.8	86.0276086	155.365079	±	21.4657967	2589.41798	±	357.763279
8/3/30 recount	2/20/1997 1:44	1.62	1030.82	14.948	0.884553916	0.01151223	0.8	66.8917593	82.1696724	±	24.7400494	1369.49454	±	412.334157
9/3/30 recount	2/20/1997 10:24	1.99	1158.86	181.328	0.97672001	0.01222621	0.8	62.6488401	933.541769	±	30.8039497	15559.0295	±	513.399161
10/3/30	2/20/1997 17:53	2.30	469.35	911.97175	0.984592935	0.01860475	0.8	96.7160161	8231.4264	±	207.240704	137190.44	±	3454.01174
11/3/30	2/21/1997 9:13	2.94	3651.13	30111.0752	0.924	0.0142844	0.8	53.0468632	270517.694	±	4428.51912	4508628.23	±	73808.652
11/3/30 recount	2/21/1997 9:13	2.94	2522.29	18774.0752	0.924	0.01450654	0.8	81.0722324	257774.759	±	4287.91897	4296245.98	±	71465.3162
12/3/30	2/21/1997 18:08	3.31	3821.65	30310.8152	0.95	0.01466346	0.8	55.0742317	282719.503	±	4621.72479	4711991.71	±	77028.7464
12/3/30 recount	2/21/1997 18:08	3.31	2835.43	21111.2552	0.95	0.01483338	0.8	77.7750715	278076.43	±	4600.14493	4634607.16	±	76669.0822
13/3/1930	2/22/1997 7:55	3.88	3288.73	25565.1152	0.908	0.01409098	0.8	58.6308652	253853.854	±	4172.72579	4230897.57	±	69545.4298
13/3/30 recount	2/22/1997 7:55	3.88	2415.37	17954.8952	0.908	0.01428645	0.8	83.4695978	253817.113	±	4231.4176	4230285.22	±	70523.6266
14/3/30	2/22/1997 18:06	4.31	2645.05	19210.6352	0.962	0.01506854	0.8	58.711803	191019.123	±	3170.57643	3183652.05	±	52842.9404
14/3/30 recount	2/22/1997 18:06	4.31	2645.05	17758.2752	0.962	0.01506854	0.8	69.7432853	209755.273	±	3483.19883	3495921.22	±	58053.3138
15/3/30	2/23/1997 9:05	4.93	3023.05	22663.6352	0.985	0.01533761	0.8	58.5445373	224711.683	±	3706.9052	3745194.72	±	61781.7533
16/3/30	2/23/1997 18:05	5.31	8231.60	56427.008	0.937	0.00883689	0.8	53.1817172	246606.902	±	2511.25109	4110115.03	±	41854.1849
17/3/30	2/24/1997 9:19	5.94	2795.49	19312.7118	0.982	0.01505473	0.8	127.540229	229871.836	±	4834.13555	3831197.27	±	80568.9258
18/3/30	2/24/1997 17:36	6.29	2621.25	17805.8718	0.965	0.0148409	0.8	137.909986	229168.155	±	4828.88868	3819469.26	±	80481.4779
19/3/30	2/26/1997 9:58	7.97	2354.73	15259.0518	1.001	0.01548263	0.8	150.004967	213613.403	±	4517.74026	3560223.39	±	75295.671
20/3/30	2/27/1997 7:46	8.88	2300.41	16437.4952	1.009	0.01591627	0.8	80.6319956	224467.129	±	3752.76632	3741118.81	±	62546.1054
(-1)-3-45	2/17/1997 17:00	-0.74	372.90	-3.4926648	1.030487922	0.01555056	0.8	13.1391432	-22.440422	±	-5.8264725	-374.00704	±	-97.107876
0/3/45	2/18/1997 11:11	0.02	1131.80	-9.292	0.973972018	0.01228429	0.8	30.9145258	-23.606285	±	-11.008049	-393.43808	±	-183.46749
1/3/45	2/18/1997 12:32	0.07	1181.48	-7.192	1.01645437	0.01264657	0.8	30.3767512	-17.953406	±	-10.851012	-299.22343	±	-180.8502
2/3/45	2/18/1997 15:55	0.22	1136.18	-5.332	0.97731119	0.01231106	0.8	32.2759076	-14.142443	±	-11.562256	-235.70739	±	-192.70426

3/3/45	2/18/1997 19:48	0.38	329.35	5.7752	1.011083752	0.02071936	0.8	65.4656631	64.031003	±	31.2729461	1067.18338	±	521.215768
4/3/45	2/18/1997 11:42	0.04	321.01	7.6952	0.98475791	0.02031255	0.8	40.997851	53.430681	±	19.7404747	890.511349	±	329.007911
5/3/45	2/19/1997 5:53	0.80	309.67	306.1352	0.845479745	0.01760383	0.8	49.3648195	2559.41391	±	69.5081807	42656.8985	±	1158.46968
5/3/45 recount	2/19/1997 5:53	0.80	315.49	202.6952	0.899566163	0.01863884	0.8	65.207807	2238.47765	±	68.5271187	37307.9609	±	1142.11864
6/3/45	2/19/1997 12:14	1.06	1905.32	6807.308	0.905336169	0.0099774	0.8	37.5380656	20999.2188	±	252.313793	349986.979	±	4205.22989
7/3/45	2/19/1997 17:55	1.30	2945.48	1024.868	0.978	0.01003243	0.8	36.620073	3084.20322	±	43.1621476	51403.387	±	719.369127
8/3/45	2/20/1997 1:44	1.62	1075.93	6386.2952	0.948	0.01585269	0.8	47.763802	51660.3784	±	918.652017	861006.307	±	15310.867
8/3/45 recount	2/20/1997 1:44	1.62	879.85	4644.9152	0.99	0.01693949	0.8	59.8215368	47059.2563	±	858.809148	784320.939	±	14313.4858
9/3/45	2/20/1997 10:24	1.99	668.29	472.5152	0.9605	0.01707246	0.8	49.4964596	3960.9524	±	88.9172659	66015.8734	±	1481.95443
9/3/45 recount	2/20/1997 10:24	1.99	639.55	324.3152	0.961	0.01719926	0.8	69.4448517	3814.31945	±	93.7829967	63571.9909	±	1563.04994
10/3/45	2/20/1997 17:53	2.30	10346.96	44948.168	0.921	0.00860442	0.8	42.0841811	155448.568	±	1572.33811	2590809.46	±	26205.6352
10/3/45 recount	2/20/1997 17:53	2.30	4757.30	27273.608	0.921	0.00898651	0.8	69.3489253	155431.192	±	1638.42026	2590519.86	±	27307.0044
11/3/45	2/21/1997 9:13	2.94	1716.75	42459.5718	0.927	0.01463563	0.8	104.611513	414524.695	±	8839.96385	6908744.92	±	147332.731
11/3/45 recount	2/21/1997 9:13	2.94	4506.81	32478.3318	0.927	0.01395437	0.8	137.819624	417734.253	±	8687.96472	6962237.55	±	144799.412
12/3/45	2/21/1997 18:08	3.31	483.03	44308.2318	0.969	0.01819385	0.8	106.825716	441728.629	±	10434.4103	7362143.82	±	173906.839
12/3/45 recount	2/21/1997 18:08	3.31	4799.85	37682.7918	0.969	0.01455975	0.8	148.883891	523583.673	±	10875.6734	8726394.56	±	181261.223
13/3/45	2/22/1997 7:55	3.88	6723.15	49897.5918	0.971	0.01447134	0.8	108.472702	505120.926	±	10442.8979	8418682.1	±	174048.298
13/3/45 recount	2/22/1997 7:55	3.88	5450.85	39559.6518	0.971	0.01454036	0.8	135.678096	500907.476	±	10385.3009	8348457.93	±	173088.348
14/3/45	2/22/1997 18:06	4.31	6222.25	48999.7952	0.995	0.01515924	0.8	56.8291834	471601.724	±	7609.44896	7860028.74	±	126824.149
14/3/45 recount	2/22/1997 18:06	4.31	4763.23	37413.9752	0.995	0.01525637	0.8	74.9498894	474913.543	±	7712.25517	7915225.72	±	128537.586
14/3/45 duplicate	2/22/1997 18:06	4.31	1928.31	41629.8318	0.96	0.01503196	0.8	116.533503	452741.987	±	9611.81965	7545699.78	±	160196.994
14/3/45 dup. recount	2/22/1997 18:06	4.31	4791.51	34383.6918	0.96	0.01442524	0.8	153.691689	493171.763	±	10246.0569	8219529.38	±	170767.616
15/3/45	2/23/1997 9:05	4.93	5669.97	41875.1118	1.01	0.01510972	0.8	112.961064	441448.522	±	9147.01623	7357475.37	±	152450.271
16/3/45	2/23/1997 18:05	5.31	15218.72	111950.108	0.901	0.00831977	0.8	54.8778529	504867.572	±	5035.70354	8414459.53	±	83928.3923
17/3/45	2/24/1997 9:19	5.94	14059.40	106014.308	0.99	0.00916027	0.8	51.6626764	450087.79	±	4497.85418	7501463.17	±	74964.2364
18/3/45	2/24/1997 17:36	6.29	732.01	34930.8752	0.979	0.01716743	0.8	67.8098402	401154.707	±	7355.77316	6685911.78	±	122596.219
19/3/45	2/26/1997 9:58	7.97	3552.39	24544.3518	0.96	0.0145681	0.8	157.134124	359929.457	±	7522.73399	5998824.28	±	125378.9
20/3/45	2/27/1997 7:46	8.88	3082.53	21211.9518	1.016	0.01550692	0.8	158.42817	313623.322	±	6577.78253	5227055.37	±	109629.709
(-1)-3-60	2/17/1997 17:00	-0.74	321.43	2.96040327	0.987685828	0.01501171	0.8	6.85891962	18.2027048	±	15.238169	303.378413	±	253.969484
0/3/60	2/18/1997 11:11	0.02	327.55	1.8152	1.006932109	0.02066301	0.8	37.2374522	11.4475921	±	17.5054471	190.793202	±	291.757452
1/3/60	2/18/1997 12:32	0.07	322.57	5.9552	0.990165204	0.02039864	0.8	38.7974004	39.129895	±	18.5473759	652.164917	±	309.122932
2/3/60	2/18/1997 15:55	0.22	366.55	288.4352	1.026636826	0.02049396	0.8	38.2870213	1870.29255	±	50.3521836	31171.5425	±	839.20306
2/3/60 recount	2/18/1997 15:55	0.22	353.83	192.4952	1.021069802	0.02055575	0.8	57.0712304	1860.57356	±	57.3145997	31009.5593	±	955.243328
3/3/60	2/18/1997 19:48	0.38	519.27	1383.39175	0.961663083	0.01777951	0.8	81.7043297	10548.3752	±	256.7171	175806.253	±	4278.61833
3/3/60 recount	2/18/1997 19:48	0.38	463.05	748.47175	1.022945211	0.01938838	0.8	141.684108	9896.73334	±	253.0506	164945.556	±	4217.51
4/3/60	2/18/1997 11:42	0.04	789.63	3797.85175	0.884760411	0.01519079	0.8	90.2801825	31998.2149	±	726.212684	533303.582	±	12103.5447
4/3/60 recount	2/18/1997 11:42	0.04	696.45	2608.77175	1.032953218	0.01808637	0.8	112.351685	27353.3794	±	632.401887	455889.656	±	10540.0314
5/3/60	2/19/1997 5:53	0.80	789.63	3797.85175	0.884760411	0.01519079	0.8	93.3302906	33079.2718	±	750.747716	551321.197	±	12512.4619
5/3/60 recount	2/19/1997 5:53	0.80	696.45	2608.77175	1.032953218	0.01808637	0.8	120.179385	29259.1277	±	676.462213	487652.128	±	11274.3702
6/3/60	2/19/1997 12:14	1.06	911.29	5105.2352	1.017341868	0.0173329	0.8	41.5345887	35911.6511	±	651.696635	598527.518	±	10861.6106
6/3/60 recount	2/19/1997 12:14	1.06	721.15	3308.8952	1.060831029	0.01864253	0.8	60.0215159	33635.6385	±	633.438982	560593.975	±	10557.3164
7/3/60	2/19/1997 17:55	1.30	891.19	4892.6552	1.029874872	0.017594	0.8	43.2357173	35825.8897	±	652.222479	597098.161	±	10870.3747
7/3/60 recount	2/19/1997 17:55	1.30	706.27	3249.7352	1.035753917	0.01825742	0.8	61.5668024	33884.7493	±	640.146455	564745.822	±	10669.1076
8/3/60	2/20/1997 1:44	1.62	800.61	3449.31175	1.03389457	0.01771525	0.8	86.6479936	27892.425	±	633.327478	464873.75	±	10555.458
8/3/60 recount	2/20/1997 1:44	1.62	697.95	2653.89175	1.021710895	0.0178832	0.8	114.681212	28403.4303	±	656.287883	473390.506	±	10938.1314
9/3/60	2/20/1997 10:24	1.99	717.57	2693.31175	1.062427075	0.01851242	0.8	88.5319264	22252.656	±	512.674507	370877.6	±	8544.57511
9/3/60 recount	2/20/1997 10:24	1.99	635.85	2047.05175	1.057189671	0.01880044	0.8	118.981049	22730.1305	±	533.568342	378835.509	±	8892.8057
10/3/60	2/20/1997 17:53	2.30	620.71	2801.1152	0.929496875	0.01671569	0.8	51.8565536	24600.5221	±	474.988097	410008.702	±	7916.46828
10/3/60 recount	2/20/1997 17:53	2.30	528.85	1916.7752	0.956277762	0.01768024	0.8	70.1606198	22775.8347	±	456.768477	379597.245	±	7612.80795

11/3/60	2/21/1997 9:13	2.94	6998.84	4540.088	0.921	0.00875719	0.8	42.8083983	15971.6247	±	173.676577	266193.745	±	2894.60962
11/3/60 recount	2/21/1997 9:13	2.94	1470.98	2755.868	0.921	0.01076833	0.8	70.2641521	15912.8537	±	210.327898	265214.228	±	3505.46497
12/3/60	2/21/1997 18:08	3.31	566.05	1561.8752	0.863	0.01576286	0.8	60.6916945	16054.0753	±	321.94283	267567.922	±	5365.71384
12/3/60 recount	2/21/1997 18:08	3.31	495.25	1054.1552	0.863	0.01615354	0.8	84.4954169	15085.0729	±	316.827682	251417.881	±	5280.46137
13/3/60	2/22/1997 7:55	3.88	1461.86	2775.368	0.958028942	0.01121924	0.8	75.4486162	17207.8932	±	227.607834	286798.221	±	3793.46391
14/3/60	2/22/1997 18:06	4.31	421.33	902.7152	0.98026446	0.0189625	0.8	58.43073	8933.09127	±	195.099624	148884.855	±	3251.6604
14/3/60 recount	2/22/1997 18:06	4.31	393.79	684.3152	0.971947543	0.01908375	0.8	78.5447904	9102.97344	±	206.863033	151716.224	±	3447.71722
15/3/60	2/23/1997 9:05	4.93	1411.82	2212.028	0.975636599	0.01153037	0.8	47.5378409	8641.43606	±	117.354532	144023.934	±	1955.90887
16/3/60	2/23/1997 18:05	5.31	1393.10	1998.248	0.982550741	0.01165373	0.8	50.473908	8288.42795	±	114.01452	138140.466	±	1900.242
17/3/60	2/24/1997 9:19	5.94	1380.80	2742.188	0.891913496	0.01060415	0.8	57.4231971	12940.1837	±	173.362982	215669.729	±	2889.38304
18/3/60	2/24/1997 17:36	6.29	449.37	626.37175	1.026812646	0.01959578	0.8	127.912133	7477.20383	±	194.80567	124620.064	±	3246.76117
19/3/60	2/26/1997 9:58	7.97	421.53	432.39175	1.016101223	0.01968768	0.8	148.645161	5998.23518	±	164.16918	99970.5863	±	2736.15301
20/3/60	2/27/1997 7:46	8.88	1258.10	772.868	0.998371635	0.01218711	0.8	65.6153238	4167.41212	±	68.8150455	69456.8686	±	1146.91742
1/4/15	2/18/1997 13:03	0.10	352.83	2.49175	0.973038797	0.01974251	0.8	78.1101855	18.1638309	±	17.7286936	302.730516	±	295.478227
2/4/15	2/18/1997 16:27	0.24	345.87	-0.38825	0.954809526	0.01948012	0.8	81.447773	-2.951114	±	-18.208278	-49.185234	±	-303.47129
3/4/15	2/18/1997 20:38	0.41	1113.92	-2.932	0.957916668	0.01214452	0.8	33.3819485	-8.0432487	±	-12.002633	-134.05414	±	-200.04388
4/4/15	2/19/1997 0:14	0.56	324.91	42.0752	0.984728197	0.0202491	0.8	41.3813115	294.876487	±	23.1544107	4914.60811	±	385.906845
4/4/15 recount	2/19/1997 0:14	0.56	321.43	19.1552	0.982041085	0.02024969	0.8	63.6906109	206.61974	±	32.1971698	3443.66233	±	536.619497
5/4/15	2/19/1997 6:30	0.82	1095.80	1.268	0.941887459	0.01200602	0.8	35.6796579	3.71788355	±	12.9125418	61.9647259	±	215.20903
6/4/15	2/19/1997 12:52	1.09	319.11	13.11175	0.876343472	0.01829808	0.8	95.3959669	116.730942	±	22.9724649	1945.5157	±	382.874416
7/4/15	2/19/1997 18:57	1.34	347.61	2.31175	0.958691807	0.01953195	0.8	91.8915662	19.8249379	±	20.8367009	330.415631	±	347.278348
8/4/15	2/20/1997 2:15	1.65	786.26	10.988	0.674739442	0.00975569	0.8	54.0408368	48.7973866	±	19.862583	813.289777	±	331.04305
8/4/15 recount	2/20/1997 2:15	1.65	816.26	4.688	0.701207522	0.00997891	0.8	84.5135551	32.5589073	±	30.7505149	542.648455	±	512.508581
9/4/15	2/20/1997 10:50	2.00	1172.00	50.888	1.0020541	0.01249884	0.8	38.208261	159.782239	±	14.9958072	2663.03732	±	249.93012
9/4/15 recount	2/20/1997 10:50	2.00	1172.00	145.088	0.991916234	0.01237239	0.8	61.8739924	737.726665	±	28.5767257	12295.4444	±	476.278762
10/4/15	2/20/1997 18:30	2.32	356.55	7.29175	0.981670369	0.01986032	0.8	97.1434315	66.1059461	±	22.6314172	1101.76577	±	377.190287
11/4/15	2/21/1997 9:40	2.95	299.71	18.3752	0.9155022	0.01922835	0.8	53.6033947	166.814606	±	27.0145948	2780.24343	±	450.243247
12/4/15	2/21/1997 18:45	3.33	350.01	8.31175	0.963270773	0.01958774	0.8	107.576947	83.4462838	±	25.2049753	1390.7714	±	420.082921
13/4/15	2/22/1997 10:26	3.99	299.65	8.2952	0.918843671	0.01929957	0.8	58.0257192	81.5186723	±	28.010894	1358.64454	±	466.848233
14/4/15	2/22/1997 18:39	4.33	308.05	29.2952	0.937336559	0.01954342	0.8	60.3938821	299.639537	±	31.9353079	4993.99229	±	532.255132
15/4/15	2/23/1997 9:29	4.95	308.83	6.6152	0.947669452	0.01974566	0.8	60.9418642	68.2760548	±	29.2136085	1137.93425	±	486.893475
16/4/15	2/23/1997 18:37	5.33	327.37	39.0752	0.993344687	0.02038704	0.8	61.7266895	408.492323	±	34.0733255	6808.20539	±	567.888759
17/4/15	2/24/1997 9:50	5.96	1028.48	40.988	0.879739849	0.01145867	0.8	58.2840666	196.31904	±	22.5089368	3271.984	±	375.148947
18/4/15	2/24/1997 18:05	6.31	368.79	10.59175	1.01433042	0.02033455	0.8	141.643945	140.010643	±	33.6108616	2333.51072	±	560.181027
19/4/15	2/26/1997 10:38	8.00	318.49	41.8352	0.965063931	0.01994687	0.8	79.1998089	561.145762	±	44.2831621	9352.42937	±	738.052702
20/4/15	2/27/1997 8:35	8.91	304.33	12.0152	0.931938295	0.0194936	0.8	87.3935584	177.836184	±	42.8524432	2963.9364	±	714.207386
1/4/30	2/18/1997 13:03	0.10	1151.12	-11.632	0.990832655	0.01242929	0.8	31.2182757	-29.841397	±	-11.077011	-497.35662	±	-184.61685
2/4/30	2/18/1997 16:27	0.24	1125.68	-5.092	0.968258837	0.01223369	0.8	32.6870618	-13.677922	±	-11.713855	-227.96537	±	-195.23091
3/4/30	2/18/1997 20:38	0.41	318.85	7.3952	0.978218591	0.02021286	0.8	40.6466326	50.9077848	±	19.5471748	848.46308	±	325.786246
4/4/30	2/19/1997 0:14	0.56	357.51	-1.34825	0.987265796	0.01995884	0.8	81.660883	-10.274952	±	-18.165697	-171.24921	±	-302.76161
5/4/30	2/19/1997 6:30	0.82	321.43	8.2352	0.985860955	0.02032846	0.8	42.4345018	59.1838159	±	20.4780163	986.396931	±	341.300272
6/4/30	2/19/1997 12:52	1.09	1256.96	1564.748	0.91216896	0.01113782	0.8	37.2992824	4796.23805	±	69.3398854	79937.3008	±	1155.66476
6/4/30 duplicate	2/19/1997 12:52	1.09	397.99	669.4952	0.990051048	0.01939294	0.8	44.3491666	5028.5484	±	114.364858	83809.14	±	1906.08097
6/4/30 dup. recount	2/19/1997 12:52	1.09	373.39	453.5552	0.989917187	0.01967529	0.8	64.2250278	4933.37531	±	119.958426	82222.9218	±	1999.3071
7/4/30	2/19/1997 18:57	1.34	2733.14	10379.828	0.947	0.00981434	0.8	37.8596057	32294.0187	±	364.00373	538233.644	±	6066.72883
8/4/30	2/20/1997 2:15	1.65	1354.69	8671.3352	1.001	0.01637571	0.8	45.3270193	66566.0581	±	1156.12813	1109434.3	±	19268.8021
8/4/30 recount	2/20/1997 2:15	1.65	1049.77	5936.4752	1.001	0.01678267	0.8	64.3367564	64684.0976	±	1154.24693	1078068.29	±	19237.4489

9/4/30	2/20/1997 10:50	2.00	2127.79	14721.9152	1.018	0.01612807	0.8	46.784688	116648.123	±	1959.242	1944135.38	±	32654.0333
9/4/30 recount	2/20/1997 10:50	2.00	1601.71	10373.8352	1.018	0.01643179	0.8	65.4114313	114921.874	±	1968.47992	1915364.57	±	32807.9987
10/4/30	2/20/1997 18:30	2.32	11572.52	55464.488	0.934	0.00869212	0.8	41.5605842	189431.632	±	1907.34122	3157193.86	±	31789.0203
10/4/30 recount	2/20/1997 18:30	2.32	5476.82	33657.968	0.934	0.009017	0.8	68.4656122	189372.205	±	1974.25929	3156203.42	±	32904.3215
11/4/30	2/21/1997 9:40	2.95	5097.99	44664.7518	0.937	0.01405558	0.8	103.619057	431916.578	±	8961.2124	7198609.63	±	149353.54
11/4/30 recount	2/21/1997 9:40	2.95	4708.41	34223.0118	0.937	0.01408669	0.8	135.981926	434304.899	±	9025.50177	7238414.98	±	150425.03
11/4/30 duplicate	2/21/1997 9:40	2.95	22099.52	119338.988	0.94	0.00861348	0.8	41.9984017	411880.244	±	4080.59927	6864670.73	±	68009.9879
11/4/30 dup. recount	2/21/1997 9:40	2.95	10277.84	71937.668	0.94	0.00878409	0.8	68.9263996	407472.024	±	4112.16706	6791200.4	±	68536.1177
12/4/30	2/21/1997 18:45	3.33	6526.81	54024.2552	0.965	0.01468779	0.8	54.478453	498451.903	±	8033.90241	8307531.72	±	133898.373
12/4/30 recount	2/21/1997 18:45	3.33	4626.43	36813.4352	0.965	0.01480823	0.8	78.1874106	487475.597	±	7922.30335	8124593.28	±	132038.389
13/4/30	2/22/1997 10:26	3.99	5694.63	41838.5118	0.947	0.01416575	0.8	111.388337	434921.886	±	9011.3036	7248698.1	±	150188.393
13/4/30 recount	2/22/1997 10:26	3.99	4980.63	35905.4118	0.947	0.01421454	0.8	139.968731	469014.48	±	9737.8308	7816908	±	162297.18
14/4/30	2/22/1997 18:39	4.33	5306.49	38442.6918	0.982	0.01471512	0.8	114.052433	409179.302	±	8486.95941	6819655.04	±	141449.324
14/4/30 recount	2/22/1997 18:39	4.33	4606.47	32886.9318	0.982	0.01477265	0.8	135.831204	416886.876	±	8667.1475	6948114.61	±	144452.458
15/4/30	2/23/1997 9:29	4.95	13952.60	101121.848	0.99	0.00916215	0.8	46.909883	389820.968	±	3896.81349	6497016.13	±	64946.8914
15/4/30 recount	2/23/1997 9:29	4.95	11323.88	78970.448	0.99	0.00921989	0.8	59.2681929	384629.097	±	3868.90056	6410484.95	±	64481.676
16/4/30	2/23/1997 18:37	5.33	4213.47	30229.9518	0.969	0.01461721	0.8	125.192041	353190.887	±	7354.85467	5886514.78	±	122580.911
17/4/30	2/24/1997 9:50	5.96	11836.76	87399.248	0.834	0.00775583	0.8	61.5948029	442392.356	±	4442.78714	7373205.93	±	74046.4524
18/4/30	2/24/1997 18:05	6.31	3586.15	27277.2752	0.965	0.01492766	0.8	75.252791	347642.85	±	5696.52408	5794047.5	±	94942.0679
19/4/30	2/26/1997 10:38	8.00	3165.27	21962.3718	0.974	0.01484903	0.8	155.256145	318216.982	±	6669.38031	5303616.37	±	111156.339
20/4/30	2/27/1997 8:35	8.91	2928.33	20233.4118	1.016	0.01554234	0.8	158.598988	299477.946	±	6289.68995	4991299.1	±	104828.166
1/4/45	2/18/1997 13:03	0.10	330.25	1.8152	1.015237435	0.02079011	0.8	37.9186334	11.6570018	±	17.8256659	194.283363	±	297.094432
2/4/45	2/18/1997 16:27	0.24	324.91	16.6352	0.993627236	0.02043209	0.8	39.6277068	111.64433	±	19.8150389	1860.73883	±	330.250648
2/4/45 recount	2/18/1997 16:27	0.24	322.03	4.2752	0.989091811	0.0203853	0.8	63.0853406	45.6766867	±	29.9522604	761.278111	±	499.204339
3/4/45	2/18/1997 20:38	0.41	350.01	-2.60825	0.966993703	0.01966344	0.8	81.3512774	-19.801993	±	-17.980975	-330.03322	±	-299.68292
4/4/45	2/19/1997 0:14	0.56	1085.48	-8.632	0.93408112	0.01194411	0.8	35.126507	-24.917373	±	-12.520465	-415.28954	±	-208.67442
5/4/45	2/19/1997 6:30	0.82	342.21	2.19175	0.943827522	0.01931365	0.8	87.6939588	17.937256	±	19.8722165	298.954267	±	331.203608
6/4/45	2/19/1997 12:52	1.09	295.59	-3.08825	0.816946088	0.01745861	0.8	106.335234	-30.646788	±	-23.447147	-510.77979	±	-390.78578
7/4/45	2/19/1997 18:57	1.34	324.49	13.1552	0.993552618	0.02043732	0.8	44.9049555	100.046392	±	22.1224585	1667.43986	±	368.707641
8/4/45	2/20/1997 2:15	1.65	312.45	6.63175	0.860169608	0.01807349	0.8	104.360147	64.5889381	±	24.2270547	1076.4823	±	403.784244
9/4/45	2/20/1997 10:50	2.00	366.33	20.61175	1.00412418	0.02016607	0.8	93.8407843	180.510226	±	23.5909718	3008.50377	±	393.182863
10/4/45	2/20/1997 18:30	2.32	318.55	17.0552	0.973916661	0.02012887	0.8	49.5507001	143.125269	±	24.8234346	2385.42115	±	413.723909
11/4/45	2/21/1997 9:40	2.95	464.29	1506.2552	0.901290129	0.01708585	0.8	54.5628546	13918.9139	±	288.479845	231981.898	±	4807.99742
11/4/45 recount	2/21/1997 9:40	2.95	401.65	951.4952	0.902664376	0.01764515	0.8	83.0879046	13389.1841	±	293.516156	223153.068	±	4891.93593
12/4/45	2/21/1997 18:45	3.33	352.35	13.05175	0.968113695	0.01964996	0.8	107.436847	130.863134	±	25.8551545	2181.05223	±	430.919242
13/4/45	2/22/1997 10:26	3.99	1138.46	43.388	0.974027957	0.01226179	0.8	44.5575943	158.871946	±	17.2701149	2647.86576	±	287.835248
14/4/45	2/22/1997 18:39	4.33	312.25	12.9152	0.95598576	0.01986134	0.8	58.8587514	128.742484	±	28.9697267	2145.70807	±	482.828779
15/4/45	2/23/1997 9:29	4.95	351.57	9.21175	0.967269884	0.01964485	0.8	118.127902	101.552343	±	27.8164392	1692.53905	±	463.60732
16/4/45	2/23/1997 18:37	5.33	310.63	6.6152	0.953206336	0.01983065	0.8	64.4608533	72.2185449	±	30.9003889	1203.64241	±	515.006482
17/4/45	2/24/1997 9:50	5.96	1011.80	40.568	0.865445771	0.01133752	0.8	59.4207689	198.096915	±	22.9332431	3301.61525	±	382.220718
18/4/45	2/24/1997 18:05	6.31	328.15	9.2552	1.006175188	0.02063788	0.8	72.2640552	113.270767	±	35.0207632	1887.84612	±	583.679386
19/4/45	2/26/1997 10:38	8.00	331.09	72.0752	0.993244016	0.02032667	0.8	77.068032	940.740474	±	49.2450117	15679.0079	±	820.750195
20/4/45	2/27/1997 8:35	8.91	1289.12	789.728	1.023224083	0.01240195	0.8	64.0906628	4159.37567	±	68.0333741	69322.9278	±	1133.88957
1/4/60	2/18/1997 13:03	0.10	358.29	-5.54825	0.990850665	0.0200194	0.8	76.8669471	-39.800724	±	-16.743052	-663.3454	±	-279.05087
2/4/60	2/18/1997 16:27	0.24	413.91	18.51175	1.136171472	0.02211248	0.8	68.5655693	118.453767	±	17.0166151	1974.22946	±	283.610252
2/4/60 recount	2/18/1997 16:27	0.24	424.59	5.19175	1.170191796	0.02263362	0.8	123.692811	59.9312787	±	28.4839848	998.854645	±	474.733081
3/4/60	2/18/1997 20:38	0.41	1148.18	-1.492	0.987213955	0.01239399	0.8	32.4300885	-3.976242	±	-11.686331	-66.270699	±	-194.77219

4/4/60	2/19/1997 0:14	0.56	319.81	2.5352	0.982871648	0.02029323	0.8	41.5663444	17.8469399	±	19.5969938	297.448999	±	326.616563
5/4/60	2/19/1997 6:30	0.82	1152.86	21.668	0.988744711	0.01239714	0.8	34.0682273	60.6630457	±	12.7370977	1011.05076	±	212.284961
6/4/60	2/19/1997 12:52	1.09	1127.06	51.188	0.963388289	0.01216732	0.8	36.6978502	154.370614	±	14.4135735	2572.84357	±	240.226225
7/4/60	2/19/1997 18:57	1.34	363.33	-7.04825	1.005273574	0.02023392	0.8	87.8068535	-57.757054	±	-18.987515	-962.61756	±	-316.45858
8/4/60	2/20/1997 2:15	1.65	8369.48	12.848	0.904	0.00851917	0.8	40.3888734	42.6435268	±	14.8824966	710.725446	±	248.041609
9/4/60	2/20/1997 10:50	2.00	957.62	226.868	0.798819174	0.01067531	0.8	48.0210854	895.284492	±	25.8251202	14921.4082	±	430.41867
9/4/60 recount	2/20/1997 10:50	2.00	1172.00	145.088	0.991916234	0.01237239	0.8	61.9852204	739.052842	±	28.6280968	12317.5474	±	477.134946
10/4/60	2/20/1997 18:30	2.32	358.71	16.23175	0.984584554	0.01988644	0.8	96.971946	146.894918	±	23.7663871	2448.24863	±	396.106452
11/4/60	2/21/1997 9:40	2.95	367.47	25.41175	1.00563438	0.02017957	0.8	96.7495881	229.44522	±	25.0190765	3824.08699	±	416.984609
11/4/60 recount	2/21/1997 9:40	2.95	311.43	9.63175	0.856331399	0.01801051	0.8	173.07318	155.57159	±	40.8598152	2592.85983	±	680.99692
12/4/60	2/21/1997 18:45	3.33	315.79	12.4952	0.967021883	0.02003156	0.8	54.4296804	115.183084	±	26.7413793	1919.71806	±	445.689655
13/4/60	2/22/1997 10:26	3.99	314.83	28.1552	0.958590932	0.01987267	0.8	56.1718723	267.847268	±	29.546124	4464.12113	±	492.435399
14/4/60	2/22/1997 18:39	4.33	356.19	15.39175	0.977915175	0.01978982	0.8	113.83841	163.520474	±	27.7657085	2725.34123	±	462.761809
15/4/60	2/23/1997 9:29	4.95	333.31	78.3152	0.997890057	0.02038739	0.8	57.9441943	768.538616	±	38.0313399	12808.9769	±	633.855664
16/4/60	2/23/1997 18:37	5.33	362.01	147.09175	0.949079492	0.01912168	0.8	128.087845	1758.29423	±	63.0104251	29304.9038	±	1050.17375
16/4/60 recount	2/23/1997 18:37	5.33	374.37	123.27175	0.991316728	0.01979399	0.8	145.750167	1676.74854	±	64.258512	27945.809	±	1070.9752
17/4/60	2/24/1997 9:50	5.96	1058.00	143.528	0.894081855	0.01153215	0.8	57.8768493	682.648849	±	26.7527834	11377.4808	±	445.879723
18/4/60	2/24/1997 18:05	6.31	382.29	117.27175	1.01522325	0.02016024	0.8	141.697411	1550.78159	±	60.6394924	25846.3599	±	1010.65821
19/4/60	2/26/1997 10:38	8.00	371.13	16.59175	1.018743773	0.0203886	0.8	148.659545	230.186743	±	36.5049512	3836.44572	±	608.415853
20/4/60	2/27/1997 8:35	8.91	373.81	493.6352	0.977188943	0.01941721	0.8	83.4414885	6975.86179	±	167.210239	116264.363	±	2786.83732
0/5/15	2/18/1997 11:55	0.05	329.35	3.5552	1.011860332	0.02073528	0.8	37.3567963	22.4927919	±	17.6848514	374.879866	±	294.747523
1/5/15	2/18/1997 13:34	0.12	321.13	3.9152	0.986449299	0.02034548	0.8	39.0836882	25.9154763	±	18.5294455	431.924606	±	308.824092
2/5/15	2/18/1997 17:05	0.26	1151.48	1.568	0.989721543	0.01241411	0.8	32.037627	4.12821442	±	11.5999036	68.8035737	±	193.331726
3/5/15	2/18/1997 21:55	0.47	306.43	5.4752	0.940685717	0.01964064	0.8	42.3570734	39.2767585	±	20.2097613	654.612641	±	336.829355
3/5/15 recount	2/18/1997 21:55	0.47	313.09	-2.8048	0.964068573	0.02001518	0.8	64.7925599	-30.777741	±	-29.910538	-512.96235	±	-498.50897
4/5/15	2/19/1997 0:45	0.58	344.97	5.19175	0.95042295	0.01940477	0.8	85.0450935	41.2057999	±	19.5860402	686.763332	±	326.434003
4/5/15 recount	2/19/1997 0:45	0.58	349.89	3.09175	0.964719189	0.01961906	0.8	128.271949	37.0110476	±	29.2074948	616.850794	±	486.791581
5/5/15	2/19/1997 7:05	0.85	302.41	8.9552	0.927102689	0.01942523	0.8	45.1725846	68.5109412	±	21.8662515	1141.84902	±	364.437525
6/5/15	2/19/1997 13:35	1.12	302.83	6.4952	0.929255149	0.01946311	0.8	47.3242875	52.0578606	±	22.6748195	867.631011	±	377.913658
7/5/15	2/19/1997 19:42	1.37	1181.36	2.708	1.015285766	0.01263243	0.8	35.3830919	7.87408843	±	12.8340193	131.234807	±	213.900321
8/5/15	2/20/1997 2:53	1.67	264.67	10.1552	0.810592923	0.01762654	0.8	56.4453901	97.0793062	±	27.4667056	1617.98844	±	457.778427
9/5/15	2/20/1997 11:20	2.02	304.87	12.8552	0.933305524	0.01951299	0.8	51.0913862	111.23366	±	25.1416366	1853.89434	±	419.027277
10/5/15	2/20/1997 19:04	2.35	1418.96	101.108	1.208953248	0.01426861	0.8	32.1507435	267.135981	±	13.7154925	4452.26636	±	228.591542
10/5/15 recount	2/20/1997 19:04	2.35	1173.26	57.968	1.002375329	0.01249863	0.8	63.9444736	304.612121	±	25.4000785	5076.86869	±	423.334641
11/5/15	2/21/1997 10:05	2.97	302.83	20.1752	0.924469816	0.01936288	0.8	53.2585047	181.977009	±	27.0513591	3032.95014	±	450.855985
12/5/15	2/21/1997 19:10	3.35	332.01	1.11175	0.916041463	0.01890723	0.8	113.680112	11.7947013	±	25.6140916	196.578355	±	426.901526
13/5/15	2/22/1997 10:55	4.01	345.15	10.53175	0.949099237	0.01937492	0.8	112.245291	110.322473	±	26.6292119	1838.70788	±	443.820198
14/5/15	2/22/1997 19:02	4.35	297.43	20.2952	0.907817188	0.01910622	0.8	62.4211991	214.553274	±	31.7250894	3575.88791	±	528.75149
15/5/15	2/23/1997 9:56	4.97	307.05	13.65175	0.842871099	0.01780337	0.8	135.724734	172.918971	±	32.7908105	2881.98284	±	546.513509
16/5/15	2/23/1997 19:10	5.35	317.05	62.0552	0.953561367	0.01973229	0.8	64.5256415	678.141332	±	39.5087138	11302.3555	±	658.478563
17/5/15	2/24/1997 10:16	5.98	1018.22	10.268	0.874225752	0.01142698	0.8	58.3644621	49.2481811	±	21.4245539	820.803018	±	357.075898
18/5/15	2/24/1997 18:28	6.32	1068.98	63.548	0.912128521	0.01172368	0.8	58.6027926	306.038487	±	23.5204799	5100.64145	±	392.007999
19/5/15	2/26/1997 10:57	8.01	1129.40	9.308	0.969907068	0.01224142	0.8	62.4313802	47.7545942	±	22.8817745	795.909903	±	381.362908
20/5/15	2/27/1997 9:00	8.93	351.09	5.73175	0.967131406	0.01964947	0.8	166.802532	89.2247201	±	38.5280831	1487.07867	±	642.134718
1/5/30	2/18/1997 13:34	0.12	353.19	-1.76825	0.975484829	0.01978657	0.8	78.1947017	-12.903761	±	-17.357261	-215.06268	±	-289.28768
2/5/30	2/18/1997 17:05	0.26	319.69	3.7352	0.982082757	0.02027891	0.8	40.1487798	25.3977893	±	19.0205404	423.296488	±	317.009007
3/5/30	2/18/1997 21:55	0.47	320.61	2.55175	0.884084001	0.01843418	0.8	89.1670715	21.2342997	±	20.2450124	353.904994	±	337.416874

4/5/30	2/19/1997 0:45	0.58	1079.48	-1.612	0.928167609	0.01189056	0.8	35.4414242	-4.6949617	±	-12.769115	-78.249361	±	-212.81859
5/5/30	2/19/1997 7:05	0.85	344.73	1.53175	0.951008292	0.01942051	0.8	87.1256469	12.4545838	±	19.6744403	207.576397	±	327.907338
6/5/30	2/19/1997 13:35	1.12	327.33	-1.58825	0.904044131	0.01873633	0.8	96.2402999	-14.264979	±	-21.382696	-237.74966	±	-356.37827
7/5/30	2/19/1997 19:42	1.37	322.21	6.0752	0.98901585	0.02038081	0.8	45.1893298	46.4949927	±	21.6137373	774.916546	±	360.228955
8/5/30	2/20/1997 2:53	1.67	354.03	6.15175	0.975103268	0.0197659	0.8	92.8342457	53.2969315	±	21.4921854	888.282192	±	358.203089
9/5/30	2/20/1997 11:20	2.02	350.67	-2.48825	0.968774538	0.01968937	0.8	97.3814743	-22.61339	±	-21.53719	-376.88983	±	-358.95317
10/5/30	2/20/1997 19:04	2.35	313.51	8.1152	0.961540643	0.0199557	0.8	50.2937428	69.1230493	±	24.2591791	1152.05082	±	404.319652
11/5/30	2/21/1997 10:05	2.97	366.27	108.09175	0.974134215	0.01956464	0.8	99.9978002	1008.73783	±	41.0455444	16812.2972	±	684.092407
11/5/30 recount	2/21/1997 10:05	2.97	320.13	83.55175	0.855143954	0.01783862	0.8	154.401584	1203.93383	±	56.2470828	20065.5638	±	937.451379
12/5/30	2/21/1997 19:10	3.35	313.51	8.5352	0.961393724	0.01995265	0.8	54.8467394	79.2819312	±	26.5015897	1321.36552	±	441.693162
13/5/30	2/22/1997 10:55	4.01	1151.30	20.408	0.98753923	0.01238736	0.8	44.0085246	73.8062436	±	16.4198181	1230.10406	±	273.663636
14/5/30	2/22/1997 19:02	4.35	454.41	289.05175	0.9606	0.01828508	0.8	116.711987	3148.37447	±	91.4094118	52472.9079	±	1523.4902
14/5/30 recount	2/22/1997 19:02	4.35	388.65	236.25175	0.9606	0.01899418	0.8	144.973527	3196.38477	±	98.6368402	53273.0795	±	1643.94734
15/5/30	2/23/1997 9:56	4.97	1144.76	22.448	0.981697448	0.01233649	0.8	47.3831459	87.4092498	±	17.7378325	1456.82083	±	295.630542
16/5/30	2/23/1997 19:10	5.35	365.91	14.91175	1.004908174	0.02018804	0.8	121.138485	168.580007	±	29.4616581	2809.66678	±	491.027635
17/5/30	2/24/1997 10:16	5.98	1009.16	6.608	0.866831042	0.01136619	0.8	58.9222921	31.996724	±	21.5037841	533.278733	±	358.396402
18/5/30	2/24/1997 18:28	6.32	1162.46	20.648	0.997107307	0.01246917	0.8	53.7015052	91.1213821	±	20.0439387	1518.6897	±	334.065644
19/5/30	2/26/1997 10:57	8.01	1249.16	12.608	1.07250588	0.01311974	0.8	56.5943912	58.6374992	±	20.8511295	977.291654	±	347.518826
20/5/30	2/27/1997 9:00	8.93	1168.76	12.728	1.003375577	0.01252621	0.8	65.4328741	68.4403168	±	24.1127192	1140.67195	±	401.878653
1/5/45	2/18/1997 13:34	0.12	1093.04	-5.752	0.94027027	0.01199545	0.8	33.0153981	-15.605988	±	-11.819612	-260.0998	±	-196.99353
2/5/45	2/18/1997 17:05	0.26	353.55	-1.58825	0.976417141	0.01979993	0.8	79.8937084	-11.842046	±	-17.750734	-197.36744	±	-295.84556
3/5/45	2/18/1997 21:55	0.47	1031.30	-6.232	0.887245963	0.01154539	0.8	36.1597483	-18.518623	±	-12.935906	-308.64372	±	-215.59843
4/5/45	2/19/1997 0:45	0.58	313.51	3.7952	0.9630518	0.01998706	0.8	42.4802437	27.3043204	±	20.1300475	455.072006	±	335.500791
5/5/45	2/19/1997 7:05	0.85	1107.14	-0.952	0.951875024	0.01209212	0.8	35.4259728	-2.7714981	±	-12.776589	-46.191635	±	-212.94315
6/5/45	2/19/1997 13:35	1.12	1070.66	0.368	0.920372239	0.01182335	0.8	38.4728611	1.16347793	±	13.9039174	19.3912989	±	231.731956
7/5/45	2/19/1997 19:42	1.37	276.31	0.7352	0.849693268	0.01825059	0.8	52.5989379	6.54925917	±	24.6207783	109.15432	±	410.346305
8/5/45	2/20/1997 2:53	1.67	1070.66	43.748	0.915703655	0.01176338	0.8	40.2443832	144.683607	±	15.6122093	2411.39345	±	260.203488
9/5/45	2/20/1997 11:20	2.02	996.74	1.028	0.856754476	0.01128379	0.8	44.8274543	3.78698024	±	16.2170886	63.1163374	±	270.284809
9/5/45 recount	2/20/1997 11:20	2.02	996.74	1.328	0.85672219	0.01128337	0.8	71.8527077	7.84146235	±	26.0060879	130.691039	±	433.434798
9/5/45 duplicate	2/20/1997 11:20	2.02	284.83	10.4552	0.872501081	0.01858183	0.8	54.7501809	96.9454895	±	26.6724183	1615.75816	±	444.540305
10/5/45	2/20/1997 19:04	2.35	354.51	15.99175	0.973073446	0.01971741	0.8	98.3249015	146.742133	±	24.0657068	2445.70221	±	401.095113
11/5/45	2/21/1997 10:05	2.97	1060.88	69.068	0.904571136	0.01165663	0.8	43.4738266	246.751952	±	17.6181045	4112.53253	±	293.635074
11/5/45 recount	2/21/1997 10:05	2.97	1060.88	35.048	0.908232391	0.01170381	0.8	71.4227334	205.710071	±	27.3045736	3428.50119	±	455.076227
12/5/45	2/21/1997 19:10	3.35	360.33	14.79175	0.989547049	0.01996218	0.8	105.424898	145.531853	±	25.6237177	2425.53089	±	427.061962
13/5/45	2/22/1997 10:55	4.01	304.15	28.6352	0.925570848	0.01936346	0.8	58.2280913	282.385556	±	30.7033539	4706.42594	±	511.722565
14/5/45	2/22/1997 19:02	4.35	339.31	232.2752	0.962490363	0.01957663	0.8	58.9353849	2318.40162	±	67.1848666	38640.027	±	1119.74778
14/5/45 recount	2/22/1997 19:02	4.35	327.85	174.9752	0.947282693	0.01943444	0.8	80.1184566	2374.20807	±	76.5242667	39570.1346	±	1275.40445
15/5/45	2/23/1997 9:56	4.97	380.11	597.3152	0.960300257	0.01900775	0.8	60.3025374	6100.26719	±	141.826063	101671.12	±	2363.76772
16/5/45	2/23/1997 19:10	5.35	302.17	14.2352	0.924517467	0.01937517	0.8	66.7402569	160.901892	±	33.0373525	2681.6982	±	550.622541
17/5/45	2/24/1997 10:16	5.98	988.04	40.688	0.84500712	0.01116423	0.8	60.2381603	201.415965	±	23.2560243	3356.93274	±	387.600405
18/5/45	2/24/1997 18:28	6.32	1155.44	336.188	0.957113806	0.01199202	0.8	56.0460213	1548.39886	±	35.3109634	25806.6477	±	588.516056
19/5/45	2/26/1997 10:57	8.01	1173.98	219.488	0.985611401	0.01228724	0.8	61.6540148	1112.05941	±	32.2967727	18534.3236	±	538.279546
20/5/45	2/27/1997 9:00	8.93	330.55	22.6952	1.008856321	0.02065469	0.8	80.9239876	311.043402	±	41.5385114	5184.0567	±	692.308523
1/5/60	2/18/1997 13:34	0.12	315.85	1.9952	0.970879398	0.02011047	0.8	39.8414413	13.4626694	±	18.7431247	224.377824	±	312.385412
2/5/60	2/18/1997 17:05	0.26	1157.00	-2.572	0.994912466	0.01246028	0.8	31.9105654	-6.7446794	±	-11.47995	-112.41132	±	-191.3325
3/5/60	2/18/1997 21:55	0.47	318.49	5.5352	0.977761852	0.02020933	0.8	40.8363972	38.2816317	±	19.4886689	638.027195	±	324.811148
4/5/60	2/19/1997 0:45	0.58	357.81	5.19175	0.985864196	0.01992594	0.8	82.1007437	39.7792122	±	18.907602	662.986869	±	315.126699

5/5/60	2/19/1997 7:05	0.85	316.75	23.1752	0.966238971	0.01999955	0.8	43.4780691	170.648881	±	22.3703139	2844.14801	±	372.838565
5/5/60 recount	2/19/1997 7:05	0.85	321.49	8.7752	0.985856623	0.02032739	0.8	74.3875445	110.552088	±	35.9786062	1842.5348	±	599.643436
6/5/60	2/19/1997 13:35	1.12	323.41	20.7752	0.987564973	0.0203315	0.8	44.6983409	157.270157	±	22.7551643	2621.16929	±	379.252739
7/5/60	2/19/1997 19:42	1.37	1193.84	9.908	1.025239566	0.01271477	0.8	35.1004536	28.5794966	±	12.8768014	476.324943	±	214.613357
8/5/60	2/20/1997 2:53	1.67	357.97	9.8552	1.097693016	0.02203642	0.8	41.7946219	69.7582452	±	20.3032909	1162.63742	±	338.388182
8/5/60 recount	2/20/1997 2:53	1.67	323.41	8.8952	0.991720656	0.02041706	0.8	59.2547755	89.2665557	±	28.6735755	1487.77593	±	477.892926
9/5/60	2/20/1997 11:20	2.02	369.39	3.87175	1.018277587	0.02040481	0.8	92.8138711	33.536328	±	21.2222202	558.9388	±	353.70367
10/5/60	2/20/1997 19:04	2.35	1108.64	5.048	0.952518803	0.01209492	0.8	40.891871	16.9633716	±	14.886715	282.72286	±	248.111916
10/5/60 recount	2/20/1997 19:04	2.35	1108.64	2.948	0.952744807	0.01209779	0.8	67.6551447	16.3901963	±	24.5488613	273.169938	±	409.147688
11/5/60	2/21/1997 10:05	2.97	315.13	13.2752	0.964718844	0.01999474	0.8	51.1129505	114.916325	±	25.1953544	1915.27208	±	419.922574
12/560	2/21/1997 19:10	3.35	318.37	21.6752	0.971746874	0.02008696	0.8	54.3274038	199.430588	±	27.7684151	3323.84313	±	462.806919
13/5/60	2/22/1997 10:55	4.01	306.21	71.67175	0.82077189	0.01735101	0.8	129.911407	868.941641	±	44.3905759	14482.3607	±	739.842932
14/5/60	2/22/1997 19:02	4.35	355.65	6.63175	0.979411181	0.01982834	0.8	114.586907	70.9183228	±	26.5981926	1181.97205	±	443.303211
15/5/60	2/23/1997 9:56	4.97	389.07	103.89175	1.038499164	0.02052879	0.8	110.322481	1069.6468	±	44.1828189	17827.4467	±	736.380314
16/5/60	2/23/1997 19:10	5.35	359.43	3.45175	0.990928969	0.02000366	0.8	123.193561	39.6846594	±	28.1052434	661.410989	±	468.420723
17/5/60	2/24/1997 10:16	5.98	985.70	17.708	0.845468618	0.0111799	0.8	60.27741	87.7162273	±	22.3946468	1461.93712	±	373.244114
18/5/60	2/24/1997 18:28	6.32	1154.78	15.068	0.991105572	0.01242017	0.8	54.178934	67.0875474	±	20.0406872	1118.12579	±	334.011454
19/5/60	2/26/1997 10:57	8.01	1224.20	57.848	1.046179782	0.01287532	0.8	58.1576387	276.471877	±	23.0900608	4607.86462	±	384.834347
20/5/60	2/27/1997 9:00	8.93	361.05	5.13175	0.99482777	0.02005783	0.8	162.362688	77.7583505	±	37.3793517	1295.97251	±	622.989196
3/6/15	2/18/1997 20:18	0.40	339.75	0.21175	0.937712413	0.01922765	0.8	84.243884	1.66478102	±	18.8922463	27.7463503	±	314.870772
7/6/15	2/19/1997 18:32	1.32	297.07	7.2152	0.91128526	0.01918549	0.8	49.1085164	60.0087931	±	23.600209	1000.14655	±	393.336816
10/6/15	2/20/1997 18:16	2.31	301.99	7.1552	0.926440398	0.01941857	0.8	52.2930687	63.3688185	±	25.1240546	1056.14698	±	418.734244
12/6/15	2/21/1997 18:32	3.32	1137.56	8.648	0.976992996	0.01230225	0.8	43.0504334	30.5949013	±	15.7618986	509.915022	±	262.69831
14/6/15	2/22/1997 18:27	4.32	318.25	23.4152	0.970769088	0.02006871	0.8	58.7133152	232.83281	±	30.2400881	3880.54683	±	504.001469
16/6/15	2/23/1997 18:27	5.32	312.01	2.3552	0.958941449	0.01992676	0.8	64.4793893	25.7192567	±	30.3777333	428.654278	±	506.295556
18/6/15	2/24/1997 17:55	6.30	1123.52	10.208	0.964755355	0.01219703	0.8	55.7354079	46.7549603	±	20.4569244	779.249339	±	340.948741
19/6/15	2/26/1997 10:23	7.98	325.93	25.2752	0.993742488	0.02041812	0.8	79.4032979	339.893489	±	41.2254388	5664.89149	±	687.090647
20/6/15	2/27/1997 8:18	8.90	1154.84	8.408	0.991873906	0.01242959	0.8	66.2748975	45.7928439	±	24.2556872	763.214065	±	404.261453
20/6/15 duplicate	2/27/1997 8:18	8.90	363.57	6.09175	1.001456238	0.02015349	0.8	161.461939	91.7925744	±	37.3673038	1529.87624	±	622.788396
3/6/30	2/18/1997 20:18	0.40	1097.60	-8.272	0.944461565	0.01203228	0.8	34.0404392	-23.139903	±	-12.139938	-385.66504	±	-202.33229
7/6/30	2/19/1997 18:32	1.32	335.43	-1.04825	0.926217825	0.01906119	0.8	95.5928839	-9.3515963	±	-21.297774	-155.85994	±	-354.9629
10/6/30	2/20/1997 18:16	2.31	350.97	15.33175	0.963527274	0.01957809	0.8	99.4775634	142.335156	±	24.2560242	2372.25261	±	404.267071
12/6/30	2/21/1997 18:32	3.32	1142.48	18.128	0.980202324	0.01232557	0.8	43.198164	64.3533307	±	16.0581026	1072.55551	±	267.635043
14/6/30	2/22/1997 18:27	4.32	351.15	23.49175	0.961242144	0.01952889	0.8	117.313307	257.1923	±	30.0058367	4286.53833	±	500.097279
16/6/30	2/23/1997 18:27	5.32	354.69	3.51175	0.977825063	0.01981092	0.8	125.106358	41.0013623	±	28.5509199	683.356038	±	475.848664
18/6/30	2/24/1997 17:55	6.30	1183.22	676.628	0.944357032	0.01174416	0.8	56.987049	3168.70626	±	54.8114041	52811.7709	±	913.523402
19/6/30	2/26/1997 10:23	7.98	361.29	1.05175	0.996881208	0.02009561	0.8	156.601721	15.3710794	±	35.2738597	256.184656	±	587.897662
20/6/30	2/27/1997 8:18	8.90	320.17	1.3952	0.984377803	0.02031843	0.8	83.0257464	19.6181911	±	38.9652843	326.969851	±	649.421405
3/6/45	2/18/1997 20:18	0.40	311.23	5.0552	0.955597659	0.01987032	0.8	41.8336191	35.8157033	±	19.9256008	596.928389	±	332.093347
7/6/45	2/19/1997 18:32	1.32	1270.22	45.728	1.087046113	0.01323222	0.8	33.1483662	124.56619	±	12.892616	2076.10317	±	214.876933
10/6/45	2/20/1997 18:16	2.31	1094.72	62.168	0.934404918	0.01191454	0.8	41.7795191	213.445096	±	16.7247652	3557.41826	±	278.746087
10/6/45 recount	2/20/1997 18:16	2.31	1135.64	31.088	0.972927424	0.01225772	0.8	66.0971843	168.861868	±	25.0977349	2814.36447	±	418.295582
12/6/45	2/21/1997 18:32	3.32	1143.44	9.008	0.982009107	0.01234497	0.8	43.1703439	31.9572745	±	15.8148172	532.621242	±	263.580287
14/6/45	2/22/1997 18:27	4.32	367.15	380.5952	0.996244427	0.01987958	0.8	57.2804793	3692.1527	±	93.0585975	61535.8783	±	1550.97662
14/6/45 recount	2/22/1997 18:27	4.32	354.85	286.8752	0.991192776	0.0199404	0.8	76.6471578	3723.90647	±	100.831386	62065.1079	±	1680.52309

16/6/45	2/23/1997 18:27	5.32	340.27	207.7352	0.974027582	0.01979739	0.8	63.5491517	2235.78251	±	67.2571776	37263.0418	±	1120.95296
18/6/45	2/24/1997 17:55	6.30	1133.48	19.988	0.972265129	0.01225689	0.8	55.4175962	91.0275539	±	20.6628227	1517.1259	±	344.380379
19/6/45	2/26/1997 10:23	7.98	325.57	17.8352	0.995237661	0.0204546	0.8	79.4836152	240.085151	±	39.9498905	4001.41918	±	665.831508
20/6/45	2/27/1997 8:18	8.90	1181.72	32.528	1.012385998	0.01259515	0.8	65.0021027	173.756322	±	24.7385137	2895.9387	±	412.308562
3/6/60	2/18/1997 20:18	0.40	342.87	-0.74825	0.946651595	0.01936093	0.8	83.548351	-5.8341813	±	-18.643107	-97.236355	±	-310.71846
7/6/60	2/19/1997 18:32	1.32	320.47	3.8552	0.984440096	0.02031481	0.8	45.5163966	29.7183361	±	21.5739325	495.305602	±	359.565541
10/6/60	2/20/1997 18:16	2.31	320.47	3.8552	0.984440096	0.02031481	0.8	49.4928372	32.3146137	±	23.458692	538.576895	±	390.9782
10/6/60 recount	2/20/1997 18:16	2.31	320.47	3.8552	0.984440096	0.02031481	0.8	75.1215837	49.0480056	±	35.6062451	817.46676	±	593.437419
12/6/60	2/21/1997 18:32	3.32	1131.50	3.908	0.972293524	0.01226417	0.8	43.6801017	14.0279446	±	15.8732987	233.799077	±	264.554978
14/6/60	2/22/1997 18:27	4.32	363.51	3.93175	1.002027028	0.02016588	0.8	112.673206	41.342988	±	25.7715749	689.0498	±	429.526248
16/6/60	2/23/1997 18:27	5.32	364.59	4.17175	1.004926245	0.02020805	0.8	121.863701	47.4447271	±	27.9098122	790.745451	±	465.163537
18/6/60	2/24/1997 17:55	6.30	1118.60	29.168	0.958485296	0.01213509	0.8	56.2917754	134.929666	±	21.3074356	2248.82777	±	355.123927
19/6/60	2/26/1997 10:23	7.98	371.37	0.39175	1.024929254	0.02050886	0.8	152.699658	5.58267549	±	34.2761059	93.0445915	±	571.268431
20/6/60	2/27/1997 8:18	8.90	335.11	9.4352	1.027521507	0.02096441	0.8	79.6826355	127.328172	±	38.6440495	2122.1362	±	644.067492
3/7/15	2/18/1997 22:09	0.48	316.03	4.3352	0.970614543	0.020102	0.8	41.2480792	30.2846509	±	19.5890296	504.744181	±	326.483827
7/7/15	2/19/1997 20:06	1.39	336.09	0.57175	0.927487268	0.01907661	0.8	95.5821398	5.10009466	±	21.4753063	85.0015777	±	357.921772
10/7/15	2/20/1997 19:20	2.36	360.75	-5.48825	0.997620355	0.02011867	0.8	146.661549	-75.118251	±	-31.954848	-1251.9708	±	-532.5808
12/7/15	2/21/1997 19:26	3.36	1156.46	24.728	0.9915102	0.0124195	0.8	42.8848459	87.1462481	±	16.113603	1452.43747	±	268.56005
14/7/15	2/22/1997 19:15	4.35	314.71	60.9752	0.946741208	0.01962896	0.8	60.3477767	623.195362	±	36.7818463	10386.5894	±	613.030772
14/7/15 recount	2/22/1997 19:15	4.35	317.41	39.9752	0.962392438	0.01990917	0.8	79.2249551	536.367372	±	43.9309261	8939.4562	±	732.182102
16/7/15	2/23/1997 19:22	5.36	306.85	9.8552	0.940445511	0.0196285	0.8	65.9248855	110.033399	±	32.0316259	1833.88999	±	533.860432
18/7/15	2/24/1997 18:37	6.33	1127.96	29.288	0.966518883	0.0122037	0.8	55.9008055	134.543781	±	21.1632748	2242.39636	±	352.721246
18/7/15 duplicate	2/24/1997 18:37	6.33	1155.86	21.128	0.991381833	0.01241994	0.8	50.1802685	87.1258879	±	18.7443776	1452.09813	±	312.406294
19/7/15	2/26/1997 11:06	8.01	319.99	55.1552	0.965018599	0.01992173	0.8	82.0855549	766.766105	±	48.7212519	12779.4351	±	812.020866
20/7/15	2/27/1997 9:20	8.94	343.11	6.15175	0.944961648	0.01932257	0.8	171.422556	98.4151502	±	39.687156	1640.2525	±	661.4526
3/7/30	2/18/1997 22:09	0.48	328.35	2.07175	0.905611761	0.01875188	0.8	87.4653439	16.9109759	±	19.8078411	281.849598	±	330.130686
7/7/30	2/19/1997 20:06	1.39	1101.32	10.988	0.945586759	0.01203314	0.8	38.1552866	34.4531725	±	14.0218925	574.219541	±	233.698208
10/7/30	2/20/1997 19:20	2.36	1122.68	35.288	0.961334107	0.01215673	0.8	40.8212436	118.377489	±	15.6092952	1972.95815	±	260.15492
10/7/30 recount	2/20/1997 19:20	2.36	1107.44	9.908	0.950964164	0.01207948	0.8	67.712876	55.133188	±	24.841316	918.886467	±	414.021934
12/7/30	2/21/1997 19:26	3.36	1110.68	6.608	0.95410464	0.01210774	0.8	44.6328934	24.237115	±	16.2886489	403.951917	±	271.477482
14/7/30	2/22/1997 19:15	4.35	357.09	33.63175	0.974180854	0.01970064	0.8	116.032728	364.187709	±	31.5204167	6069.79515	±	525.340278
16/7/30	2/23/1997 19:22	5.36	294.51	3.69175	0.811653559	0.0173653	0.8	151.126235	52.0675883	±	34.5242812	867.793138	±	575.404687
18/7/30	2/24/1997 18:37	6.33	1193.90	162.068	1.008915586	0.01251213	0.8	53.6929905	715.10648	±	25.5160106	11918.4413	±	425.266843
19/7/30	2/26/1997 11:06	8.01	364.71	6.69175	1.004398334	0.02019564	0.8	156.035701	97.4448743	±	36.2306316	1624.08124	±	603.843861
20/7/30	2/27/1997 9:20	8.94	1185.02	111.068	1.006770379	0.01251443	0.8	65.4821781	597.678889	±	28.5034532	9961.31482	±	475.057553
3/7/45	2/18/1997 22:09	0.48	1091.12	1.748	0.93781255	0.0119711	0.8	34.3742648	4.93776815	±	12.4494328	82.2961359	±	207.490547
7/7/45	2/19/1997 20:06	1.39	313.93	-5.2048	0.967491984	0.02007219	0.8	46.4303338	-40.927532	±	-21.237957	-682.12553	±	-353.96596
7/7/45 recount	2/19/1997 20:06	1.39	315.97	-0.6448	0.972172009	0.02013525	0.8	75.5295463	-8.2480562	±	-35.161952	-137.4676	±	-586.03253
10/7/45	2/20/1997 19:20	2.36	311.23	13.2752	0.952722263	0.01981053	0.8	51.067115	114.813274	±	25.1734957	1913.55456	±	419.558261
12/7/45	2/21/1997 19:26	3.36	1147.22	13.988	0.984722705	0.01236602	0.8	43.2917462	49.7641483	±	15.9858381	829.402471	±	266.430636
14/7/45	2/22/1997 19:15	4.35	323.71	9.7352	0.992349634	0.02042515	0.8	57.6431689	95.0391252	±	27.9916641	1583.98542	±	466.527734
16/7/45	2/23/1997 19:22	5.36	1176.56	96.848	1.001027945	0.01247087	0.8	49.8546594	396.782271	±	21.1748711	6613.03784	±	352.914518
18/7/45	2/24/1997 18:37	6.33	1185.08	164.948	1.001023358	0.0124428	0.8	54.1714198	734.299311	±	25.8776609	12238.3218	±	431.294349

19/7/45	2/26/1997 11:06	8.01	321.85	7.0352	0.987572661	0.02035692	0.8	80.2973789	95.672588	±	38.5577655	1594.54313	±	642.629425
20/7/45	2/27/1997 9:20	8.94	322.33	8.0552	0.988692362	0.02037219	0.8	83.1598037	113.448691	±	40.1011313	1890.81151	±	668.352189
3/7/60	2/18/1997 22:09	0.48	319.15	4.7552	0.98006489	0.02024608	0.8	40.9237763	32.957495	±	19.4682204	549.291583	±	324.470339
10/7/60	2/20/1997 19:20	2.36	288.75	2.91175	0.796020606	0.01713677	0.8	120.923544	32.8594481	±	27.5087105	547.657468	±	458.478508
12/7/60	2/21/1997 19:26	3.36	1167.38	32.768	1.000032516	0.01248911	0.8	42.697942	114.977464	±	16.2569285	1916.29107	±	270.948809
14/7/60	2/22/1997 19:15	4.35	370.59	5.37175	1.021078461	0.02044325	0.8	110.836036	55.5638196	±	25.5498709	926.063661	±	425.831182
16/7/60	2/23/1997 19:22	5.36	1167.14	24.788	1.000685008	0.01249807	0.8	49.9344843	101.718022	±	18.7640347	1695.30036	±	312.733912
18/7/60	2/24/1997 18:37	6.33	1245.80	6.848	1.070237287	0.01310248	0.8	50.6680689	28.5137247	±	18.4979379	475.228745	±	308.298965
19/7/60	2/26/1997 11:06	8.01	364.05	-2.66825	1.00576767	0.02023305	0.8	155.991271	-38.843837	±	-34.467905	-647.39729	±	-574.46509
20/7/60	2/27/1997 9:20	8.94	388.83	209.37175	1.001875662	0.01980797	0.8	162.363478	3172.50083	±	100.972729	52875.0139	±	1682.87882
1-Bay	2/18/1997 13:57	0.13	279.39	4.11175	0.769775819	0.01674713	1.725	70.0449578	26.8781203	±	16.0383885	447.968672	±	267.306475
2-Bay	2/18/1997 17:25	0.28	1134.62	16.808	0.973587385	0.01226958	1.62	18.7403748	25.8851186	±	6.95156815	431.418644	±	115.859469
3-Bay	2/18/1997 22:30	0.49	289.51	10.0352	0.887043898	0.01880676	1.595	26.0186947	44.220255	±	12.652616	737.004249	±	210.876933
4-Bay	2/19/1997 0:58	0.59	336.33	3.15175	0.927270128	0.01906826	1.6	49.0899503	14.4390849	±	11.1814541	240.651414	±	186.357569
7-Bay	2/19/1997 20:15	1.40	1134.62	11.408	0.974168536	0.01227691	1.62	18.7819694	17.6078564	±	6.90684979	293.464274	±	115.114163
9-Bay	2/20/1997 11:34	2.03	297.37	9.6152	0.911368542	0.01918201	1.7	24.3665753	39.6791647	±	11.827821	661.319411	±	197.13035
10-Bay	2/20/1997 19:31	2.37	350.25	9.09175	0.963667303	0.01959208	1.6	49.2722029	41.8065933	±	11.5947528	696.776555	±	193.24588
11-Bay	2/21/1997 10:18	2.98	327.51	16.47175	0.898383817	0.01861605	1.579	55.0180494	84.5746572	±	13.5085458	1409.57762	±	225.14243
12-Bay	2/21/1997 19:35	3.37	1021.04	86.948	0.868397666	0.01133976	1.6	25.0606615	179.063874	±	10.4863963	2984.3979	±	174.773272
12-Bay recount	2/21/1997 19:35	3.37	305.05	18.9752	0.931718406	0.01947675	1.6	39.1903631	125.943383	±	19.8009538	2099.05638	±	330.015896
13-Bay	2/22/1997 11:10	4.02	1056.74	55.028	0.902523101	0.01164577	1.6	32.5765111	147.314042	±	12.8847865	2455.23404	±	214.746442
13-Bay recount	2/22/1997 11:10	4.02	304.93	32.1152	0.926752843	0.01937497	1.6	29.1204651	158.386675	±	15.5958652	2639.77792	±	259.931086
14-Bay	2/22/1997 19:30	4.36	347.19	17.49175	0.952357232	0.01940943	1.75	55.0838433	89.9192779	±	13.6015197	1498.65463	±	226.691995
15-Bay	2/23/1997 10:12	4.98	1136.78	33.668	0.973629786	0.0122626	1.74	21.9921884	60.8473423	±	8.38645278	1014.12237	±	139.774213
15.5-Bay	2/23/1997 16:30	5.24	873.14	37.448	0.746579843	0.01033697	1.445	37.5730043	115.627304	±	14.4339143	1927.12173	±	240.565238
17-Bay	2/24/1997 10:30	5.99	908.12	5.468	0.780092773	0.01063618	1.6	32.586357	14.6426663	±	11.8711568	244.044438	±	197.852614
18-Bay	2/24/1997 18:45	6.33	1086.44	40.388	0.929630837	0.01188369	1.7	29.616887	98.2986614	±	11.4235685	1638.31102	±	190.392809
19-Bay	2/26/1997 9:15	7.94	1120.70	37.088	0.959438245	0.01213973	1.55	32.4477286	98.8948242	±	12.4448578	1648.24707	±	207.414296
20-Bay	2/27/1997 9:35	8.95	1088.72	18.908	0.933902574	0.01192994	1.5	37.3099485	57.9730422	±	13.887414	966.217371	±	231.4569
10-Canal	2/20/1997 19:45	2.38	727.64	22.508	0.623105855	0.00932236	1.55	32.4549564	60.0307521	±	12.1604405	1000.51254	±	202.674009
10-Canal recount	2/20/1997 19:45	2.38	643.22	8.288	0.552062963	0.00875493	1.55	60.2805347	41.0565721	±	22.0612481	684.276201	±	367.687468
11-Canal	2/21/1997 10:34	2.99	1106.96	66.488	0.944462346	0.0119986	1.55	32.1726282	175.786556	±	12.9741767	2929.77593	±	216.236278
13-Canal	2/22/1997 11:23	4.03	340.17	-14.72825	0.943965166	0.0193491	1.6	56.5631784	-77.746396	±	-11.819269	-1295.7733	±	-196.98781
14-Canal	2/22/1997 19:40	4.37	897.08	42.848	0.766579167	0.01050157	1.65	29.4963718	103.861598	±	11.4359096	1731.02664	±	190.598493
15-canal	2/23/1997 10:28	4.99	182.29	10.7552	0.556978317	0.01366124	1.75	47.6056271	86.7134541	±	23.2452813	1445.22423	±	387.421355
15.5-Canal	2/23/1997 17:05	5.26	919.88	10.808	0.789627786	0.01071317	1.56	32.8212407	29.1511826	±	12.0589698	485.853043	±	200.98283
16-Canal	2/23/1997 19:41	5.37	830.36	34.868	0.710080864	0.01003361	1.545	36.8965474	105.72279	±	14.1144308	1762.04649	±	235.240513
17-Canal	2/24/1997 10:38	6.00	671.42	39.188	0.57298015	0.0088995	1.6	44.0687214	141.918626	±	17.0096109	2365.31043	±	283.493514
18-Canal	2/24/1997 19:05	6.35	572.30	20.108	0.489823161	0.00824486	1.58	60.5729125	100.092879	±	22.6169917	1668.21465	±	376.949862
19-Canal	2/26/1997 9:30	7.95	1105.88	116.348	0.938167937	0.01192246	1.62	31.8161361	304.202099	±	13.9996685	5070.03498	±	233.327809
19.5-Canal	2/26/1997 18:35	8.33	245.61	11.49175	0.674019486	0.01531397	1.7	112.199964	120.330079	±	26.7906195	2005.50132	±	446.510324
20-canal	2/27/1997 9:45	8.96	304.63	9.1352	0.933868547	0.01952885	1.5	46.3884162	71.7690684	±	22.4715135	1196.15114	±	374.525225