QUANTIFICATION OF POTENTIAL ARSENIC BIOAVAILABILITY IN SPATIALLY VARYING GEOLOGIC ENVIRONMENTS AT THE WATERSHED SCALE USING CHELATING RESINS

A Thesis

by

GRACIELA ESTHER LAKE

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2002

Major Subject: Geology

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Approved as to style and content by:

Bruce E. Herbert (Chair of Committee)	Richard Loeppert (Member)
Ethan Grossman (Member)	Andrew Hajash (Head of Department)

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ABSTRACT

Quantification of Potential Arsenic Bioavailability in Spatially Varying Geologic Environments at
the Watershed Scale Using Chelating Resins.
(December 2002)
Graciela Esther Lake, B.S., Texas A&M University
Chair of Advisory Committee: Dr. Bruce E. Herbert

Potential arsenic toxicity in different geologic environments is dependent on total arsenic concentration and arsenic bioavailability. It is important to identify the geologic environments that may sequester arsenic because these systems can act as long-term sources for arsenic as well as retard transport and limit toxicity.

Bioavailability is defined as the readiness of a compound or element to be taken up by organisms (Gregorich et al., 2001), while potential bioavailability is possible uptake of a compound or element by organisms. The objective of this research is to quantify the potential bioavailability of arsenic in laboratory microcosms and in different geologic environments in the Nueces and San Antonio River Watersheds, Texas, using a chelating resin as an infinite sink.

To assess the applicability of chelating resins to estimate potential arsenic bioavailability in the field, iron-loaded DOWEX M4195 resin was used to extract arsenic from solutions and sediments (pond sediment, river sediment, and ephemeral stream sediment). The average percentage of arsenic sorbed from solution was 66% ± 0.16. Competition studies between arsenate, phosphate, and vanadate suggest there is moderate competition, reducing overall arsenic sorption to the resin in the presence of competing ions. Iron-loaded resin was then exposed to sediment samples spiked with increasing amounts of arsenic over 15, 30, 60 and 90 days. Results of the sediment study showed 1) increased arsenic sorption to the resin over time,

2) small variations of potential bioavailable arsenic among geologically different sediments, and 3) evidence of arsenic sequestration.

Field devices that housed iron-loaded resin were used to extract potentially bioavailable arsenic from sediment in six different geologic environments (i.e. lake, river, perennial stream, ephemeral stream, pond, and wetland) in the watersheds over a twenty-eight day period. The wetland (15.7 mmol As/g wet resin) and perennial stream sediments (11.0 mmol As/g wet resin) represented the maximal and minimal calculated potential bioavailability, respectively. However, the potentially bioavailable index calculated from mmol As/g wet resin extracted from field environments and mmol As/ g sediment in digested samples showed sequestration would be high in the wetland environment and high bioavailability in the perennial stream and river environments.

To my parents –gracias por enseñarme como volar

and

In loving memory of Edith Mary Kruse Lake …Simple gifts.

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CHAPTER I

INTRODUCTION: LINKING BIOAVAILABILITY, SEQUESTRATION AND ECOLOGICAL RISK ASSESSMENTS

Introduction

Ecological risk assessment has been defined as an evaluation process of potential ecological effects that may occur or may be occurring due to exposure to stressors (Gregorich et al., 2001). Stressors can be a result of natural geologic processes and/or, most often, results of anthropogenic activities such as industry, urbanization, and agricultural practices. Risk evaluators must consider the industrial and agricultural patterns such as storage, use, and disposal of any wastes produced. Most importantly, risk evaluators must have an understanding of the fate of contaminants and the potential ecological hazards as a result of release and exposure to organisms (Calow, 1998).

The purpose of an ecological risk assessment is to provide a probability statement of possible risk. Ecological risk assessment is divided into two phases: (1) development of a conceptual understanding of the problem and (2) estimation of spatial and temporal exposure patterns, followed by quantification of the relationship between exposure and ecological effects (Graham et al., 1991).

A contaminant becomes a risk when it is bioavailable. Biological availability, or bioavailability is “the readiness of a chemical compound or element to be taken up by living organisms” (Gregorich et al., 2001). Through dissolution and desorption processes a

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contaminant can transfer from the solid phase to the free aqueous phase, threatening the ecology of a system because the contaminant becomes generally more accessible to organisms for uptake (Fig. 1). The objective of this chapter is to stress the importance in understanding bioavailability in relation to ecological risk assessment.

Bioavailability and sequestration

The ideas of bioavailability, sequestration, and bioaccumulation are fairly new. Bioavailability studies began through the evolution of population growth, observation, research, and the realization for the need to assess potential environmental problems. The development of these studies, as seen later in the section, is crucial to understanding the system as a whole.

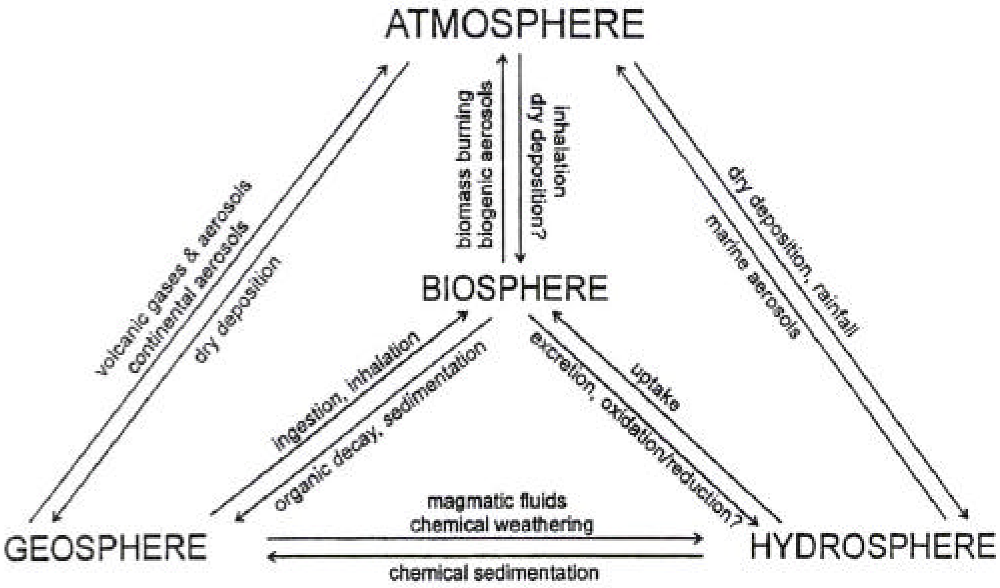


Fig. 1. Interactions between the Earth’s “reservoirs” (Larocque and Rasmussen, 1998).

Historical Review

In the late 1800s, the world was increasing in population and well on its way to advancing in industry, agriculture, and technology. In 1847, George Perkins Marsh gave a speech to the Agricultural Society of Rutland County, Vermont discussing the human impacts on the environment as a result of deforestation. He advocated a conservationist approach to saving the forests (Library of Congress, 1998). People slowly began to realize the overall environmental impacts of human society. Marsh later published the first discussion on modern ecological problems in a book titled *Man and Nature*. “We are not passive inhabitants of the Earth. We give Earth its shape and form. We are responsible for Earth,” (Marsh, 1864). Shortly after, the United States of America began to organize efforts to conserve their natural resources.

The increase in population in the late 1800’s and early 1900’s began to strain larger cities, forcing them to find alternative places to discard waste. An act "to prevent the dumping of refuse materials in Lake Michigan at or near Chicago" in 1910 brought about a movement to begin dealing with the pollution of urban water sources (Congress, 1998). As a result of the Congressional act, the U.S. government began to intervene in environmental problems that could potentially harm the health of U.S. citizens.

World War II led to the development of chemical warfare agents and synthetic insecticides containing compounds like arsenic, copper, lead, manganese, and zinc. Many were used to help deter diseases but others were meant for the purpose of entering a body to alter the reproductive and physiological processes and to cause death. When the war ended, these compounds were used for insect control in agriculture, industry and suburban areas (Burger, 1997).

The use of insecticides and pesticides became wide spread, and often times overused between the late 1940’s and early 1950’s. In 1954 Congress passed the Miller Pesticide Amendment which began to set safety limits for pesticide residues on raw agricultural commodities. Five years later, the Federal Food and Drug Administration (FDA), who supervised the uses and impacts of pesticides and insecticides, found that the weed killer aminotriazole caused cancer in laboratory animals (Library of Congress, 1998). Just before Thanksgiving, the FDA recalled a U.S. cranberry crop to check for traces of the aminotriazole because they feared the same effect in the U.S. human population exposed to the pesticide.

By the late 1950s the two main pesticides in use were chlorinated hydrocarbons (i.e. DDT, dieldrin, chlordane, and heptachlor) and organic phosphorus insecticides (i.e. malathion and parathion) (Burger, 1997). Problems as a result of the use of these pesticides began to appear; however, people were generally unconcerned. There was a lack of public knowledge of the few studies published on the relationship of pesticides and the health of the population and few federal regulations controlling their use.

Silent Spring by Rachel Carson (1962) introduced the general public to the hazards of DDT use. The objective of her book was to draw attention to the decline in the bird and insect populations. She introduced the idea of bioavailability based on a paper by Lichtenstien (1959); “we must wonder to what extent insecticides are absorbed from contaminated soils and introduced into plant tissues,” (Carson, 1962).

After the creation of the Environmental Protection Agency (EPA) in 1970 as a result of the National Environmental Policy Act of 1969, the National Center for Toxicological Research was established in the Pine Bluff Arsenal in Arkansas. The purpose of this center was to examine biological effects of chemicals in the environment (DOE,1969; FDA, 1999). Bioavailability studies became more prevalent by the 1970s as people began to understand the potential of environmental and human health impacts of contaminant release to the environment, and by the late 1980’s to early 1990’s the term bioavailability was in widespread use.

Bioavailability and Sequestration Defined

Bioavailability, sequestration, absorption, and adsorption are defined differently depending on research disciplines.

Environmental geochemistry and soil science describe the process of absorption and adsorption in terms of physical and chemical characteristics. Physically, the process of absorption is the energy of electromagnetic radiation taken up by a molecule and transformed into a different form of energy. Chemically, a substance taken up by another substance is the process of absorption (Gregorich et al., 2001). Adsorption is bonding of solutes to surfaces (Barber, 1984). These disciplines have combined the ideas of absorption and adsorption into a now commonly used word in environmental studies, sorption. Sorption is the removal of an ion or molecule from solution (Gregorich et al., 2001). Sequestration is a specific type of sorption reaction, where sequestration is the generally irreversible process of separation, isolation, or withdrawal from a system (Gregorich et al., 2001).

Chemically, bioavailability is defined by the free-ion activity model, as the potential for a contaminant to 1) diffuse from a bulk solution to a biological surface, 2) bind with a cell wall or membrane, 3) sorb or complex with the surface of a passive binding site within the cell's protective layer, and 4) be transported across the plasma membrane (Campbell, 1995; Morel, 1983). Similarly, bioavailability has also been defined as the readiness of a compound or element to be taken up by a living organism (Gregorich et al., 2001). In some cases the term is restricted to the supply of nutrients to biological organisms (i.e. plants) (Barber, 1984). On the other hand, toxicologists define bioavailability in terms of the potential risk where a bioavailable contaminant is an orally ingested compound that reaches systemic circulation in an organism (Zakrzewski, 1991).

It is interesting to find there is no set definition for either idea. A free molecule is always a potential candidate for uptake or ingestion by an organism; however, it is also a potential material easily sorbed or sequestered.

Quantification of Bioavailability

Biological or chemical assays are used to quantify bioavailability and potential bioavailability, respectively. Biological assays (i.e. plants and organisms) were used first in bioavailability studies because they are the most likely sinks for bioavailable contaminants. Chemical assays are now becoming the ideal techniques to be used in estimations of bioavailability because they

1) exhibit consistent and accurate results (Kenny et al., 1997), 2) are fairly inexpensive, and 3) assays such as chelating resin, are reusable (Chanda et al., 1986).

Biological Assays

Measurements obtained from biological assays have been considered the most accurate estimate of bioavailability in a system. Studies such as Geiszinger et al. (1998) and Campbell and Tessier (1996) evaluated bioavailability by collecting contaminated field samples of organisms and sediment. Figueira et al. (2000) and Chen and Chen (1999) collected *Sargassum* seaweed and grey mullet, *Liza macrolepis* and exposed the organisms to various amounts of heavy metals (cadmium, zinc, and copper). They analyzed the biomass to quantify the amount of metal uptake and compared these data to the initial injection amount. The studies were good estimates of metal bioaccumulation; however, applicability of these studies to other organisms requires assumptions to be made where uptake of metals by organisms may vary between kingdom, phylum, and even between species (Alexander, 2000).

Chemical Assays

Most studies concerning the fate and toxicity of metals in different geologic environments have been limited to laboratory studies because of the lack of control over natural processes and the system itself. In the same sense, scientists have searched for a method to consistently and accurately determine metal availability. Common chemical assays used to assess potential bioavailability are resins and gels which sorb available metals from the solid and solution phase. Kenny et al. (1997) compared the effectiveness between bioassays and chemical assays to quantify the amount of the antibiotic rifapentine in human plasma. They found greater accuracy and precision and fewer matrix interference problems using the chemical assays (chromatography resin). Resin methods are becoming more widely used to help estimate and quantify bioavailability. Resins and gels are fairly inexpensive and are looked at favorably because of their reusable characteristics.

Chelating resins have been used for removal of heavy metals in water, soils and sediment. Sengupta et al. (1991) and Zhao et al. (1998) tested the use of pre-treated resins, enhancing the ability of the resin to actively sorb the metal of choice. They concluded that the new resins had the capacity to remove trace amounts of metals in highly acidic conditions and in the presence of high amounts of competing ions (Ramana and Sengupta, 1992; Zhao et al., 1998). These studies provided a promising technique of tailoring chelating resins to selectively adsorb heavy metals in a controlled aqueous environment.

Lee and Zheng (1994) proposed a method to measure phytoavailability, "the availability of soil-borne metals to plant adsorption," using loaded or pre-treated resin in a laboratory setting. They transformed sodium-saturated chelating resin membrane sheets into calcium-saturated sheets. These sheets were placed in polypropylene bags and exposed to soil suspensions pretreated with cadmium, copper, and lead. They found weak correlations between the amounts of metal adsorbed by the resin sheet and the total metal concentration in soil samples spiked with individual metals. However, correlations were high in the soil containing all three metals. From the data gathered their method evaluate phytoavailability of cadmium, copper, and lead well.

A field study using anion exchange resins to evaluate nutrient bioavailability of phosphorus to *Eucalyptus saligna* and *Albizia falcataria* trees was conducted by Binkley et al. (2000). They placed resins in nylon stocking bags and buried them five centimeters below the forest floor. Lesser amounts of phosphorus were collected from under the *Albizia* compared to the *Eucalyptus*, indicating there was a low concentration of bioavailable phosphorus to the *Albizia* as a result of competition with plants and microbes. The use of resins in a field bioavailability study had not been tried up to this point. However, the study compared bioavailability of two different species of trees, which may vary in their phosphorus uptake.

Chelating resins are promising media to provide a good estimate of bioavailability. Though this media does not adapt to environmental stresses as do organisms, most resins can be considered infinite sinks in a natural environment.

Bioavailability, uptake and toxicity

Morel's (1983) free-ion activity model defines bioavailability as the potential of a contaminant to bind with a cell, where the actual process being described as uptake and the amount (activity) of contaminant sequestered by a cell is a function of toxicity (Campbell, 1995). If an organism ingests an excess amount of a nutrient or metal, the amount ingested, the chemical speciation, and the initial nutritional health and species of the organism all influence toxicity, the activity of a substance that is harmful to an organism and inhibits them from functioning in a normal manner (Langmuir, 1997; Larocque and Rasmussen, 1998; Speir et al., 1999).

Geology and Geochemistry

Contaminant bioavailability is a function of the geology, geochemistry, and system characteristics of the environment (Axtmann et al., 1997; Heiny and Tate, 1997; Salomons, 1995). A study by Williams (2001) confirmed that the mobilization of arsenic as a result of mine drainage could occur over a wide range of pH, Eh, geologic, and climatic settings. For example, if arsenic is present in a closed hydrologic semiarid environment, where evaporation exceeds precipitation rates, then evaporative concentrations can increase arsenic concentrations (Welch et al., 2000) in the pools easily accessible by animals such as cows and deer. In places such as West Bengal and Vietnam, human toxicity due to arsenic in the groundwater is at an alarming level. This water is of particular interest to scientists and the Indian government because it is a source of drinking water. The arsenic found in the water is a result of erosion and desorption from geologic formations containing the metal as a function of redox environment and kinetics (Acharyya et al., 2000; Berg et al., 2001). Arsenic introduced to the system is recycled in surface layers, allowing more arsenic to become bioavailable as it is dispersed in soils, sediment, and water by the erosion (Salomons, 1995).

A contaminant can also be introduced to a system via anthropogenic activities and geologic processes as a result of erosion. The construction of roads, buildings, waterways, and drinking wells (i.e. Bangladesh) results in the loss of native vegetation allowing the exposed soils to be weathered and eroded, or erosion of undisturbed sediments containing metals such as arsenic, sulfur, or iron. These eroded sediments can then be transported by wind, subjected to runoff, and/or anthropogenically relocated to areas of harsh climatic conditions where they have the potential to cause health problems.

Another possible source of geologic transport is through sorption processes. If the contaminate was released into a system in a "free state", it may associate with mobile colloidal particles. These particles can travel great distances allowing the contaminant to be transported miles from its source (Salbu and Steinnes, 1995). If the contaminant enters or is transported into certain geologic environments, such as reduced environments or ponds, the contaminants can accumulate by becoming sequestered, thus reducing bioavailability (Axtmann et al., 1997; Chung and Alexander, 1998). However, as long as a contaminant is sequestered in the system, there is always the potential of release to the environment.

Uptake and Toxicity

Metal uptake and toxicity are functions of free metal species, residence time, and environmental conditions. Trace metal uptake by organisms is achieved in two steps: 1) chemical binding to a membrane, and 2) cell membrane transfer to the inside of the cell (Morel and Hering, 1993). Despite the continuous metal depletion from the system, metal species bound to a cell and those in the system continue to maintain equilibrium with each other (Morel, 1983). Uptake of excess amounts of metals by a plant or ingestion by an animal interferes with functions at the cellular level leading to malnourishment or death. The increased amounts of arsenic accepted by the cell and the lowering of necessary phosphorus cause the cell to malfunction and eventually die. In animals, the arsenic becomes a carcinogen, interferes with DNA methyltransferases, and causes conjunctivitis, hyperkeratosis, gangrene, and liver enlargement (Gebel, 2000; Goering et al., 1999; Sarwar, 1999). Arsenic affects certain plants by altering the mineral balance, decreasing the ratio of chlorophyll a/b, and disrupts the uptake and transport of mineral elements within the plant and to its fruit (Koch et al., 2000; Päivöke and Simola, 2001).

Bioavailability, sequestration and ecological risk assessment

The EPA first began using ecological risk assessment as a standard practice in the early 1980s (EPA, 2001b). In 1990, William K. Reilly (1990) gave a summary speech of a report prepared by the EPA's Science Advisory Board to the National Press Club. This speech announced the EPA's decision to better define and standardize ecological risk assessments in order to increase the probability of preventing and fixing environmental problems. "Science can lend much-needed coherence, order, and integrity to the often costly and controversial decisions that must be made."

Application of Bioavailability to Ecological Risk Assessment

Ecological risk assessment is a series of steps designed to provide a basis for quantitatively balancing and comparing environmental risks and a way to improve estimations and understanding of potential risks (Graham et al., 1991). Most significant environmental studies have been focused in the laboratory where systems can be controlled. Few have actually been applied to the field; however, the information they have produced is important to refining the process of ecological risk assessment (Burger, 1997).

An ecological system is comprised of many different components. Understanding a system as a whole is important to assessing potential risks (Fig. 2). Therefore, field application of bioavailability studies is important because of the lack of information known about contaminants in natural systems. Many previous assessments have been based solely on studies of threatened species, thus ignoring the long term potential for contamination of other communities and ecosystems (Burger, 1997; Calow, 1998). Ecological risk assessment provides a flow chart to evaluate the potential effects of chemical, physical, and biological upsets to an ecological system (Burger and Gochfeld, 1997).

"Bioavailability is key to an accurate assessment of exposure in ecological risk assessment" (Cura, 1998). The use of bioavailability in ecological risk assessment should relate physical and chemical processes controlling availability, type and condition of the system, geochemical characteristics, relevant exposure, and uptake and tolerance levels of different species to the desired endpoints (Peijnenburg et al., 1997). The best way to implement such a bioavailability-focused ecological risk assessment is through changes in policy.

Public Policy

Public policy plays an important role in ecological risk assessment by setting guidelines. Ecological risk assessment is achieved in two phases: (1) understanding the problem by focusing on the endpoints and the mechanisms that could affect the endpoints and (2) estimation of the spatial and temporal patterns of contaminant exposure (Graham et al., 1991).

There are a number of issues in using ecological risk assessments to address a wider range of environmental issues. A common problem in the first phase of ecological risk assessment is poorly defined endpoints or ill-defined questions, which are often defined without relevance to ecological risk or are defined to support a predetermined policy position (Lackey, 1997; Merrell, 1995). Finkel (1997) described ecological risk assessment as being too “conservative” and often underestimating risk due to cost of assessment and treatment. The utility of ecological risk assessments are dependent on the level of detail and practicality of proposed prevention and/or remediation techniques (Hill et al., 2000). In the case of the new EPA arsenic standard of 10 ppb (EPA, 2001a) the need for the lower concentration is evident, yet the practicality of prevention in small towns is almost non-existent because of the use of non-regulated private drinking wells. Without government aid or funding, public water suppliers may be unable to comply.

The quality of ecological risk assessments is improved when different management options are assessed (Burger, 1997). The operational advantage of ecological risk assessment is to include uncertainty into a problem (Bartell, 1997).

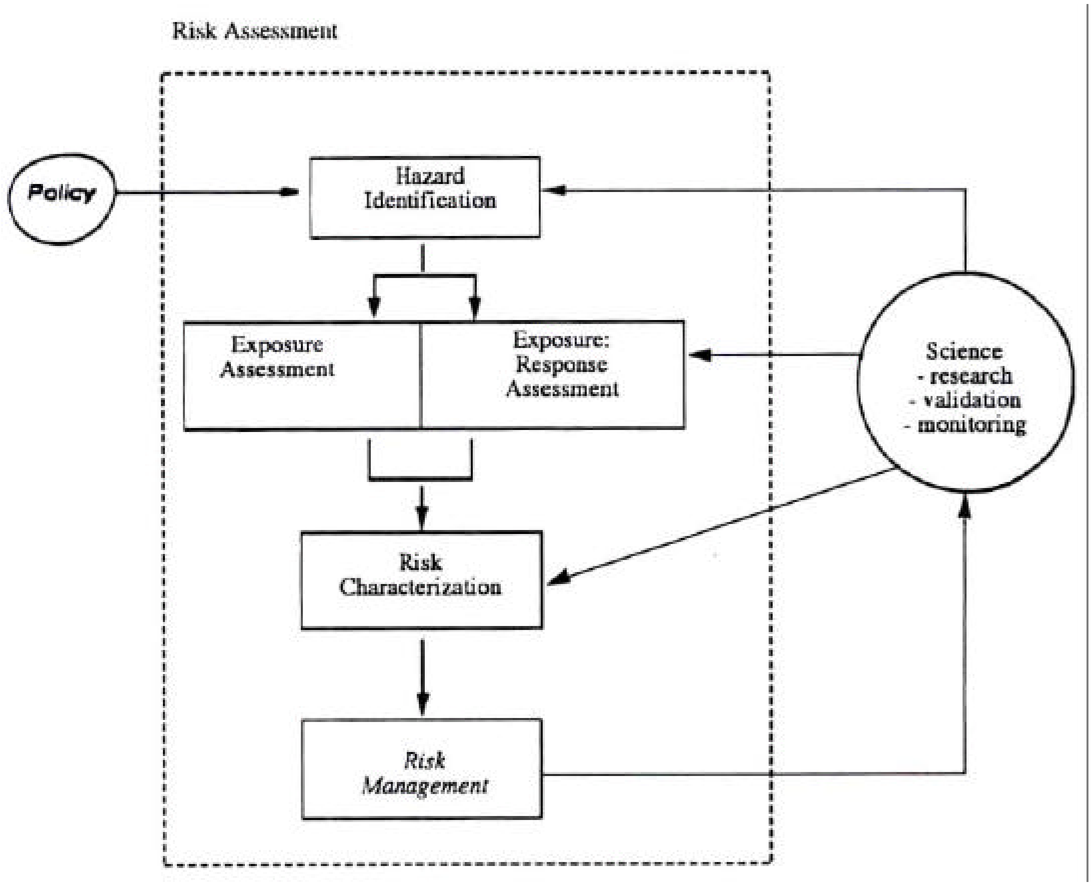


Fig. 2. Ecological risk assessment flow chart (Council, 1993).

Objectives

Science can provide information and rigorous procedures to better understand interactions between ecosystems (Calow and Forbes, 1997). With the use of information from scientific research, ecological risk assessments will be useful tools by including only the “best-available knowledge standard”; therefore, only improving with time (Suter and Efroymson, 1997).

The objective of this project is to develop a chelating resin that acts as a chemical assay to estimate potential bioavailability of arsenic in different geologic environments at the watershed scale. This study will:

(1) Design a technique to quantify potential bioavailable arsenic sorbed by a pre-treated chelating resin in solution and sediment samples in a laboratory setting.

(2) Use the laboratory technique to quantify potential bioavailable arsenic from various geologic environments over different intervals of time to link geomorphic processes to the environmental fate of arsenic.

(3) Examine the implications of assessing potential arsenic bioavailability for use in ecological risk assessments.

Project implications

This study is important because of the lack of information known about arsenic bioavailability in natural systems. Though only a small number of field sites will be studied, the information concerning quantification of potential arsenic bioavailability will be applicable to areas like West Bengal, Bangladesh, and the western United States to help assess potential risk.

CHAPTER II

QUANTIFYING POTENTIAL ARSENIC BIOAVAILABILITY IN A LABORATORY SETTING USING CHELATING RESINS

Introduction

Arsenic bioavailability is of scientific and political concern, particularly in places such as West Bengal, Bangladesh, and Vietnam, because of severe human health effects as a result of exposure to inorganic arsenic (Acharyya et al., 2000; Berg et al., 2001). Bioavailability is defined by the free-ion activity model, as the potential for a contaminant to 1) diffuse from a bulk solution to a biological surface, 2) bind with a cell wall or membrane, 3) sorb or complex with the surface of a passive binding site within the cell's outer layer, or 4) be transported across the plasma membrane (Campbell, 1995; Morel, 1983). Bioavailability is a function of the geology and the geochemistry of the environment (Heiny and Tate, 1997), metal speciation, and residence time (Alexander, 2000).

Arsenic bioavailability is often quantified using biological assays, which are considered the most accurate estimate of bioavailability. Bioassays of arsenic bioavailability can be used to quantify accumulation as a function of geology and geochemistry (Davis et al., 1996; Geiszinger et al., 1998), the individual characteristics of an organism (Päivöke and Simola, 2001), the type of organism (Koch et al., 2000; Martin et al., 2000), and bioaccumulation through the food chain (Kuroiwa et al., 1994; Pascoe et al., 1994). However, bioassays are highly variable as a result of individual and species variability.

Chemical assays, including resin extraction and selective dissolution, have been used to estimate potential metal bioavailability (Jing and Logan, 1991; Binkley et al., 2000). Potential bioavailability has also been quantified by combinations of chemical and biological assays (Lee et al., 1996; Lee and Zheng, 1993; Lee and Zheng, 1994). Potential arsenic bioavailability is the accessibility for arsenic uptake by an organism. The advantages of chemical assays to measure potential arsenic bioavailability are 1) results are more consistent between replicates, 2) materials are affordable, and 3) materials such as chromatography resins are reusable. The objective of this research is to design a technique to quantify potential arsenic bioavailability using pre-treated chelating resins in solution and sediment samples in a controlled laboratory environment. Chelating resins specific for metals have been used to quantify potential cadmium and copper bioavailability (Lee and Zheng, 1994). The studies by Ramana and Sengupta (1992) and Chanda et al. (1986) served as models for the development of a pre-treated resin for specific sorption of arsenic from solution.

Materials and methods

Loading of Resin

DOWEX liquid chromatography resin M4195 (Table 1), formerly XFS-4195 (Marston, personal communication) was loaded with copper and iron to test for optimum arsenic sorption. The resin was loaded with copper using a method modified from Ramana and Sengupta (1992). Resin was placed in a 250 mL Nalgene bottle, secured with teflon tape, and rinsed with double distilled water (DDW) for 10 minutes at 100 rpm on an automated shaker. The resin was then rinsed with 1 M HCl and 1 M NaOH, consecutively, for 20 minutes at 110 rpm to condition the resin, followed by a DDW rinse for 20 minutes at 110 rpm. Copper loading was completed by placing the resin in a 0.09 M $CuSO_4$ solution for 24 hours at 110 rpm followed by 3 rinses of DDW. The copper loaded resin will be later referred to as Cu-4195.

Table 1

DOWEX M4195 characteristics

Name		DOWEX Chelating Resin
Exchanger		M-4195
Cross Link	%	NA
Matrix		Styrene-DVB Macroporous
Mesh		16 – 50
Ionic Form		SO_4
Moisture	~%	62
Maximum Optimum Temperature	$(C^o)^2$	60
Total Exchange	$g\ Cu^{+2}\ L^{-1}$	35
Total Capacity	$Meq\ mL^{-1}$	NA
pH Range for Metal Sorption		0 – 7
Functional Group		Bis-picolylamine

Iron loading of the resin (referred to as Fe-4195) was completed using a method modified from Chanda et al. (1986). Resin was placed in a 250 mL Nalgene bottle with DDW, secured with teflon tape and capped. The resin underwent two DDW rinses for 10 minutes at 100 rpm on an automated shaker. DOWEX M4195 was then rinsed twice with 250 mL of 2 M HCl for 10 minutes at 100 rpm on an automated shaker. This was followed by several 250 mL DDW rinses at 100 rpm on an automated shaker until the pH of the effluent after shaking reached 2 or higher. The resin was then rinsed with a 0.09M $FeCl_3 \cdot 6H_2O$ (pH 2) solution for 10 minutes at 110 rpm on an automated shaker, then again for 20 hours at 110 rpm to prepare Fe-4195. The resins were then rinsed twice with a pH 2 DDW solution (adjusted with 1% HNO_3) for 10 minutes at 110 rpm on an automated shaker. Finally Fe-4195 was rinsed three times with a pH 8 DDW solution (adjusted with 1M NaOH) for 10 minutes at 110 rpm on an automated shaker. The pH of the solution after 10 minutes dropped to 2 after each DDW rinse.

Iron Oxide Precipitation Analysis

To insure there was no possibility of iron oxide precipitation on the surface of the resin, equilibrium modeling of iron loading on the resin and scanning electron microscopy photographs were taken of Fe-4195. Geochemical modeling of iron oxide (ferrihydite) precipitation was completed using the geochemical modeling program MINTEQ (version 3.11) using the modeling parameters in Table 2.

Scanning electron microscopy (SEM) pictures were taken of Fe-4195 at the Texas A&M University Microscopy and Imaging Center. Each sample was placed on a layer of double-stick carbon tape attached to the top of a 10 mm (height) by 9.5 mm (diameter) cylindrical stub. The samples were dried overnight in a desiccator jar (containing Drierite) and then coated with 400 angstroms of gold-palladium with a Hummer sputter coating device. The coated samples were examined at 5,000 to 15,000x magnification using a JEOL JSM 6400 scanning electron microscope at 15 KeV with working distances of 10 to 36 mm (M. Pendelton, personal communication).

Table 2

MINTEQ modeling parameters to estimate ferrihydrite precipitation

Parameter		**Input**
Temperature	°C	25.00
Concentration		Molal
Ionic Strength		To be computed by model
Inorganic Carbon		Not specified
Termination if charge imbalance exceeds 30%		No
Precipitation of oversaturated solids		Not allowed, exception: solids
Maximum number of iterations		200
Method used to calculate activity coefficient		Debye-Hückel equation
Output level		Full
pH		Fixed at 2.00
pe		Undefined
Eh		Undefined
Fe^{+3}	M	0.00 to 0.09
Cl^{-1}	M	0.00 to 0.27
Possible Solid		Ferrihydrite

Sorption Efficiency

To determine sorption efficiency, Fe-4195 was exposed to increasing concentrations of arsenate for 24 hours after completing one rinse in 50 mL of DDW for 10 minutes while shaking at 110 rpm. Initial concentrations were analyzed at time zero. Final solution concentrations were analyzed after 24 hours to insure mass balance. Percent sorption efficiency was calculated using the following equation:

$$\text{Total sorbed} = \text{concentration}_{\text{inital}} - \text{concentration}_{\text{final}} \qquad (1a)$$

$$\%\,\text{Sorption effciency} = \frac{(1a)}{\text{concentration}_{\text{inital}}} \times 100\,\% \qquad (1b)$$

The assumption that pH would remain constant throughout the experiment was based on MINTEQ modeling of the solution chemistry (Appendix I).

Resin Stripping

To remove arsenic from the resin for analysis, a stripping procedure was established. Resin was stripped of arsenate by first completing two rinses in 50 mL of DDW for 10 minutes while shaking at 110 rpm. The resin was then rinsed with 10 mL of 2 M NH_4OH (pH 11) for 24 hours while shaking at 100 rpm. This procedure was repeated to ensure maximum stripping.

To determine stripping efficiency, resin used in the sorption experiment was rinsed in 50 mL of DDW for 10 minutes at 110 rpm after the 24 hour period to remove any arsenate entrained in resin pores. Fe-4195 was then stripped using the method described above. Both stripping solutions were analyzed. Stripping efficiency was calculated using the following equations:

$$\text{Total strip concentration} = \text{concentration}_{\text{extraction1}} + \text{concentration}_{\text{extraction 2}} \qquad (2a)$$

$$\%\,\text{Stripping efficiency} = \frac{(2a)}{(1a)} \times 100\,\% \qquad (2b)$$

Resin was stored under refrigeration when not analyzed rapidly. A storage experiment over periods of one week and one month indicated no effects on stripping efficiency.

Anion Competition

A competition study was conducted to determine arsenic sorption interference in the presence of competing ions. Fe-4195 was rinsed with 50 mL of DDW for 10 minutes at 110 rpm and then rinsed with increasing concentrations of arsenate and an anion competitor over a 24 hour period. Phosphate and vanadate where chosen as competitors at 1:1 and 1:10 molar ratios (arsenate to competitor). Samples were analyzed at time zero and again after 24 hours. The assumption that pH would remain constant throughout the experiment was made based on MINTEQ modeling of the solution chemistry (Appendix I).

Sediment Microcosms

A series of soil microcosms were set up in a laboratory setting at 25°C to determine arsenic sorption by the resin from sediment. Containers for the sediment were 9.5-ounce polypropylene containers with lids. These containers were washed and rinsed with methanol and 1% HNO_3 and then allowed to air dry. The lids were then pierced with eleven 1-mm holes to ensure exposure of the samples to oxygen.

For ease of addition of sediment to the microcosms, each sample was oven dried at 70°C and sieved with a 2 mm sieve. Water content was measured using bulk and sieved samples. Three small portions of each of the original samples were weighed into small aluminum foil pans and oven dried overnight at 105-110°C. The sub-sample was then allowed to cool and was weighed for percent moisture determination. Percent moisture was important for characterization of the sediment and to better maintain water content in the microcosms. The following equations were used to calculate percent moisture (Dixon and White, 2000):

$$\text{amount of water lost} = \text{initial sample weight} - \text{oven dry weight} \qquad (3a)$$

$$\%\,\text{moisture}_{\text{dry weight bases}} = \frac{(3a)}{\text{oven dry weight}} \times 100\,\% \qquad (3b)$$

Each container was filled with approximately 100 grams of the oven-dried sediment. Double distilled water was then introduced to the systems to the point of saturation. To achieve a soil-water paste, the method described in Rhoades (1996) was followed. The soil was stirred with a glass rod, covered, and set aside overnight. Double distilled water was added again and stirred to achieve a uniformly saturated soil-water paste. The saturated soil-water paste was achieved when 1) the surface of the mixture glistened as it reflected light, 2) the mixture flowed easily when the container was tipped to one side, and 3) the sample consolidated easily by tapping the container after a trench was formed. The sediment was weighed every three weeks to correct for any water loss. Sediments were then spiked with varying concentrations of arsenate (0.00 mmol L^{-1}, 3.21×10^{-2} mmol L^{-1}, 1.6×10^{-1} mmol L^{-1}, 3.21×10^{-1} mmol L^{-1}), mixed with a glass rod, and allowed to equilibrate for 53 days (Alexander, 2000).

Resin containers were made to hold resin bags, for ease of removal after the designated exposure time. The containers were made using 5-cm clear high-density polyethylene canisters with low-density polyethylene lids. Three to five mm diameters holes were drilled around the circumference of the tube in a series of four vertical sets. The containers were washed and rinsed with 1% HNO_3 and then allowed to air dry. Polypropylene bags were then prepared to house the resin beads by sewing 5.5 by 2.5 cm polypropylene 75 mesh bags on two sides with rayon thread. The third side was melted using a hot plate after 0.6 grams of wet iron loaded resin was inserted. The polypropylene bags were then inserted into the containers.

After the spike to sediment equilibration time, resin containers were buried vertically in the center of the sediment microcosm. Some resin bags were placed outside of the container a day later because they were not able to interact with the sediment.

All results were corrected for background arsenic sorbed to resin placed in the control sediment samples.

Sediment Sample and Collection Site Descriptions

Grab samples were collected using a shovel with a fiberglass spade at depths ranging from 0 to 0.3 meters from three sites in Karnes and Live Oak Counties, Texas.

Nueces River (NR-59) sediment was collected from the bank off Interstate 59 in Live Oak County, Texas (N 28° 19’ 59.8”, W 098° 05’ 09.5”) near a boat dock under the interstate. The Atascosa River and adjoining creeks and streams feed the Nueces River near this site location. The banks of the river are stabilized by small trees and grasses.

Weedy Creek (WC-233) sediment was collected from the riverbank of Weedy Creek, Live Oak County, Texas (N 28° 36’ 10.3”, W 098° 10’ 58.5”). The sampling location was off Interstate 281 South, which could be reached by exiting on Texas Highway 2049 and traveling about one mile to Texas Farm Road 223.

Lyssy Pond (LP-791) sediment was collected from the property of Leo Lyssy, Jr., Karnes County, Texas (N 28° 54’ 38.9”, W 098° 06’ 43.3”). Lyssy Pond itself is a stock tank for cattle located on Texas Highway 791. The stock tank is filled mostly by runoff (Leo Lyssy Jr., personal communication). The soil in this area is overburden from a uranium strip mine, operational in the 1960’s. The sample was collected from the bank of the pond.

Sediment Characterization

Sediments were characterized to assist in the identification of geochemical factors affecting arsenic bioavailability. The Texas Agriculture Extension Service Soil, Water, and Forage Testing Laboratory at Texas A&M University analyzed bulk and sieved samples for plant available phosphorus, potassium, calcium, magnesium, sodium, sulfur using an NH_4Ac and EDTA extraction (Hons et al., 1990). Salinity (Rhoades, 1982) and pH (Schofield and Taylor, 1955) were analyzed using a conductivity meter and pH meter, respectively, in 2:1 water to sediment. Plant available zinc, iron, manganese, and copper were extracted using a DTPA solution (Lindsay and Norvell, 1978). Readily oxidizable organic matter was analyzed using Walkley (1947). These samples also underwent textural determination using a standard hydrometer method.

Nitrate was analyzed by the Texas Agriculture Extension Service using a method modified from Keeney and Nelson (1982) to reduce salting in analytical equipment. Two grams of soil and 20 mL of 1.0 M KCl were added to a 5 ounce cup and placed on a shaker for 10 minutes at 185 rpm. The solution is then filtered through Whatman No. 2 filter paper. The filtrate was analyzed using a Technicon 800 Autoanalyzer fitted with a cadmium reduction column. Results are expressed on a mg NO_3^- N kg^{-1} basis.

Cation exchange capacity (CEC) was analyzed on sieved samples using methods from Holmgren et al. (1977) and Soil Survey Staff (1996) (Table 3).

Sediments were digested using a method modified from Brandenburger (2001) where 0.2 grams of oven dried sample was digested using 2.5 mL of trace metal grade HCl and 1 mL of ultra-pure HNO_3 in a sealed digestion vessel under a fume hood. Hydrofluoric acid was not used because the extraction of arsenic from silicates was not expected to contribute appreciably to the total potentially bioavailable arsenic. The digestion vessels were placed in a 1200 watt microwave oven for 30 seconds (modified procedure from the recommendation of the Parr Instrument Company (2002). Buffalo River Sediment (8704) from the National Institute of Standards and Technology was analyzed as a standard (reported as total arsenic) (Table 4).

Arsenic Analysis

Sorption solutions, resin stripping solutions, and sediment digestions were analyzed using a Varian SpectraAA 200 FS graphite furnace atomic adsorption spectrometer (GFAAS). Universal graphite tubes (purchased from Varian Inc.) were used. The platform allowed for a better signal when sample was not burning off the wall of the tube. A 2.07×10^{-3} M nickel nitrate in 5% HNO_3 was used as a modifier (co-injected with the sample). The temperature program used for the water matrix samples can be found in Table 5. The temperature program used for the NH_4OH matrix samples can be found in Table 6. Both programs started with a hot inject step at 95ºC.

Available arsenic to the resin was calculated using the following equation:

$$\text{Available arsenic} = \frac{(2a)/(2b)}{(1b)} \qquad (4)$$

Table 3

Sediment characterization

Sample Description		NR-59	WC-233	LP-791
pH		7.7	7.6	6.7
Sand	**%**	55	55	51
Silt	**%**	23	20	19
Clay	**%**	22	25	30
Water Content	**%**	26	28	49
Organic Matter	**%**	0.20	1.0	3.6
Nitrate	**ppm**	4.0	4.0	3.0
Phosphorus[a]	**ppm**	1.2×10^{2}	44	52
Potassium[a]	**ppm**	6.0×10^{2}	7.4×10^{2}	5.1×10^{2}
Calcium[a]	**ppm**	2.4×10^{4}	3.2×10^{4}	3.5×10^{3}
Magnesium[a]	**ppm**	3.5×10^{2}	2.4×10^{2}	3.8×10^{2}
Salinity	**ppm**	4.4×10^{2}	4.4×10^{2}	4.2×10^{2}
Zinc[b]	**ppm**	29	0.45	2.7
Iron[b]	**ppm**	29	13	52
Manganese [b]	**ppm**	4.2	12	21
Copper[b]	**ppm**	8.7	0.65	0.48
Sodium[a]	**ppm**	2.9×10^{2}	3.0×10^{2}	2.8×10^{2}
Sulfur[a]	**ppm**	68	80	45

a extracted using a NH_4Ac and EDTA solution (Hons et al., 1990)

b extracted using a DTPA solution (Lindsay and Norvell, 1978)

Table 4

Bioavailable arsenic fraction in laboratory samples from digested sediment samples

Sample Name	**Mean As**	**Confidence Interval**	**NIST Reported As**
	mg/kg	***95%***	**mg/kg**
NIST 8704	4.8×10^{1}	2.1×10^{-2}	17[a]
NR-59	8.4	6.9×10^{-2}	
WC-233	1.5×10^{1}	9.8×10^{-2}	
LP-791	2.0×10^{1}	6.3×10^{-2}	

a Information value determined by spectrometric comparison to SRM 2704 using ICPMS after a downward adjustment of the certified arsenic value in SRM 2704 by 6% (NIST, 2000). Due to the approximate 6% loss of arsenic from SRM 2704, there is insufficient information to assign uncertainty.

Table 5

GFAAS water matrix temperature program

Step	Temperature °C	Time sec	Flow L/min	Gas Type	Read	Signal Storage
1	95	5.0	3.0	Normal	No	No
2	100	60.0	3.0	Normal	No	No
3	125	10.0	3.0	Normal	No	No
4	1200	5.0	3.0	Normal	No	No
5	1200	10.0	3.0	Normal	No	No
6	1200	2.0	3.0	Normal	No	Yes
7	2600	0.7	3.0	Normal	Yes	Yes
8	2600	2.0	3.0	Normal	Yes	Yes
9	2600	2.0	3.0	Normal	No	Yes
10	100	16.8	3.0	Normal	No	No

Table 6

GFAAS NH_4OH matrix temperature program

Step	Temperature °C	Time sec	Flow L/min	Gas Type	Read	Signal Storage
1	95	5.0	3.0	Normal	No	No
2	100	60.0	3.0	Normal	No	No
3	125	10.0	3.0	Normal	No	No
4	600	20.0	3.0	Normal	No	No
5	1300	5.0	3.0	Normal	No	No
6	1300	10.0	3.0	Normal	No	No
7	1300	2.0	3.0	Normal	No	Yes
8	2600	0.7	3.0	Normal	Yes	Yes
9	2600	2.0	3.0	Normal	Yes	Yes
10	2600	2.0	3.0	Normal	No	Yes
11	100	16.8	3.0	Normal	No	No

Results and discussion

Iron Versus Copper Loading

Chelating resin containing specific ionic and non-ionic groups designed for “capturing” certain ions from complex mixtures was originally created for use in industrial and mining waste remediation. DOWEX M4195 was created for the copper industry where the resin strongly sorbs metals in acid solutions.

To establish a loading procedure specific for arsenic sorption by M4195, copper and iron were both tested. Copper was the first choice for loading because it is a relatively soft metal (Langmuir, 1997). On the other hand, iron appeared to be a good choice because of the high affinity for arsenic adsorption to iron oxides. These metals were also picked because the loading methods were established (Chanda et al., 1986; Ramana and Sengupta, 1992).

Cu-4195 proved to be slightly less efficient for arsenic sorption (approximately 52% ± 0.08 sorption efficiency) compared to the copper loaded DOWEX 2N described in Ramana and Sengupta (1992). Calculated from arsenic remaining in solution after 24 hours, Fe-4195 had an average sorption efficiency of 66% ± 0.16 (Table 7). As a result of the higher sorption efficiency of the Fe-4195, it was used throughout the project (Fig. 3).

Loading the resin with iron brought about concerns of iron oxide precipitation on the surface or within the pores of the resin. Iron oxide precipitation may decrease the extraction efficiency from the new resin, as a result of excess arsenic sorption or coprecipitation to ferrihydrite. The presence of ferrihydrite may also possibly decrease the sorption of arsenic to the resin because of enhanced arsenic desorption from the resin back into the soil.

Table 7

Sorption efficiencies of copper (II) loaded DOWEX M4195 verses iron (III) loaded DOWEX M4195

Sample Name	**Average Initial Concentration**	**RSD**	**Average Concentration Left in Solution**	**RSD**	**Total As Sorbed to Resin**
	M	%	**M**	%	%
Cu-4195	6.87×10^{-7}	2.12	3.32×10^{-7}	4.0	51
Fe-4195	6.87×10^{-7}	2.12	8.63×10^{-8}	3.4	87

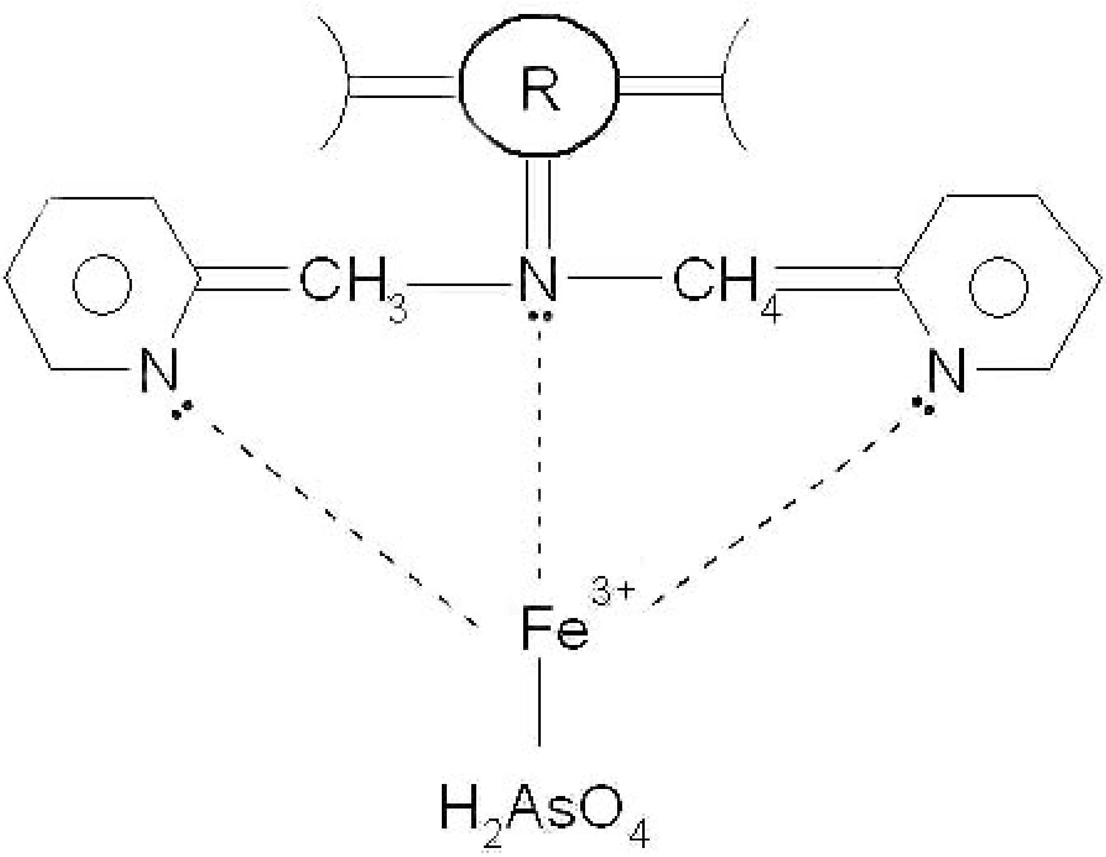


Fig. 3. Schematic of the iron loaded DOWEX M-4195. The notation R is the repeating monomer.

MINTEQ modeling suggested no ferrihydrite would precipitate on the surface of the resin at pH 2 (Fig. 4). However, goethite and $FeOH_{2.7}Cl_{0.3}$ were predicted to be oversaturated. These minerals are not expected to precipitate in the resin because of kinetic constraints.

To ensure that the model was correct and that there was no precipitation as a function of environmental factors, samples of a newly loaded Fe-4195 and two field exposed samples (NR151-4195 and LCC233-4195) were examined by SEM. For both the laboratory resin (Fig. 5) and the resin exposed to field conditions (Fig. 6), no mineral crystals were visible.

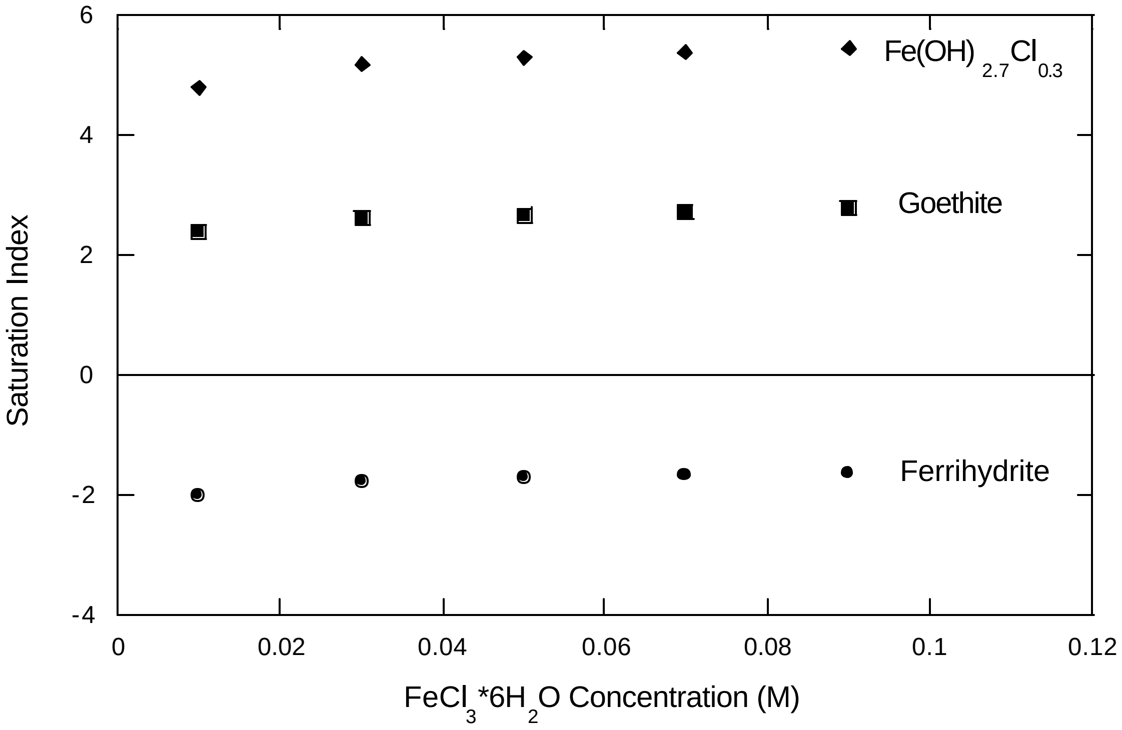


Fig. 4. Iron oxide modeling results (MINTEQ). The model expressed no possible iron mineral precipitates as a function of iron chloride concentrations and initial parameters.

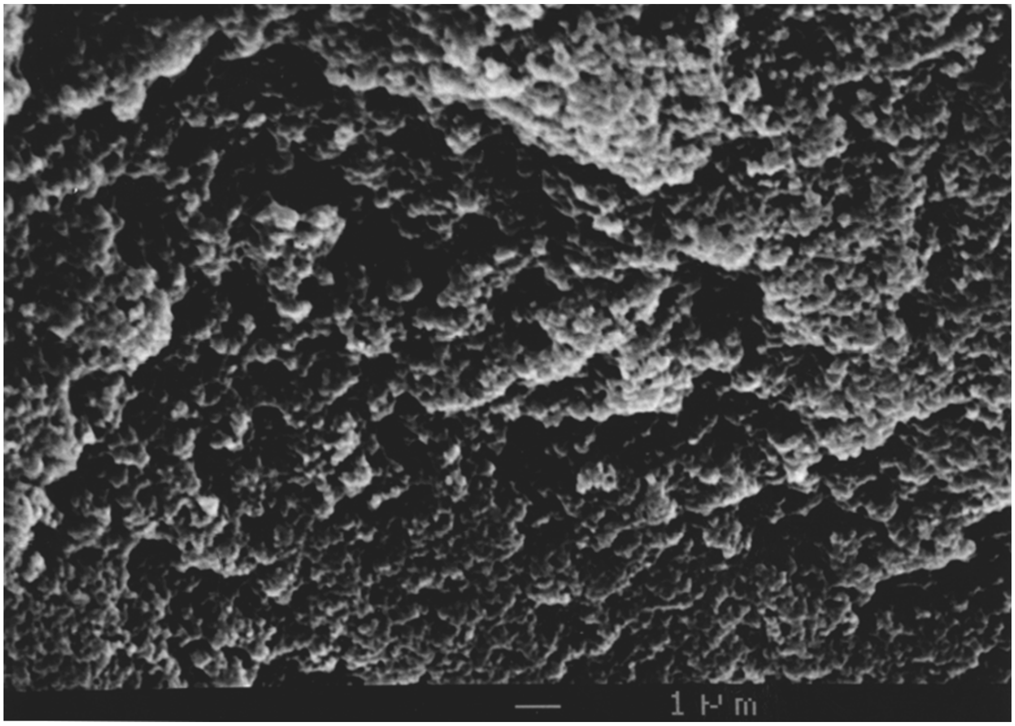


Fig. 5. SEM photograph of newly loaded Fe-4195 (5000x, working distance of 36mm).

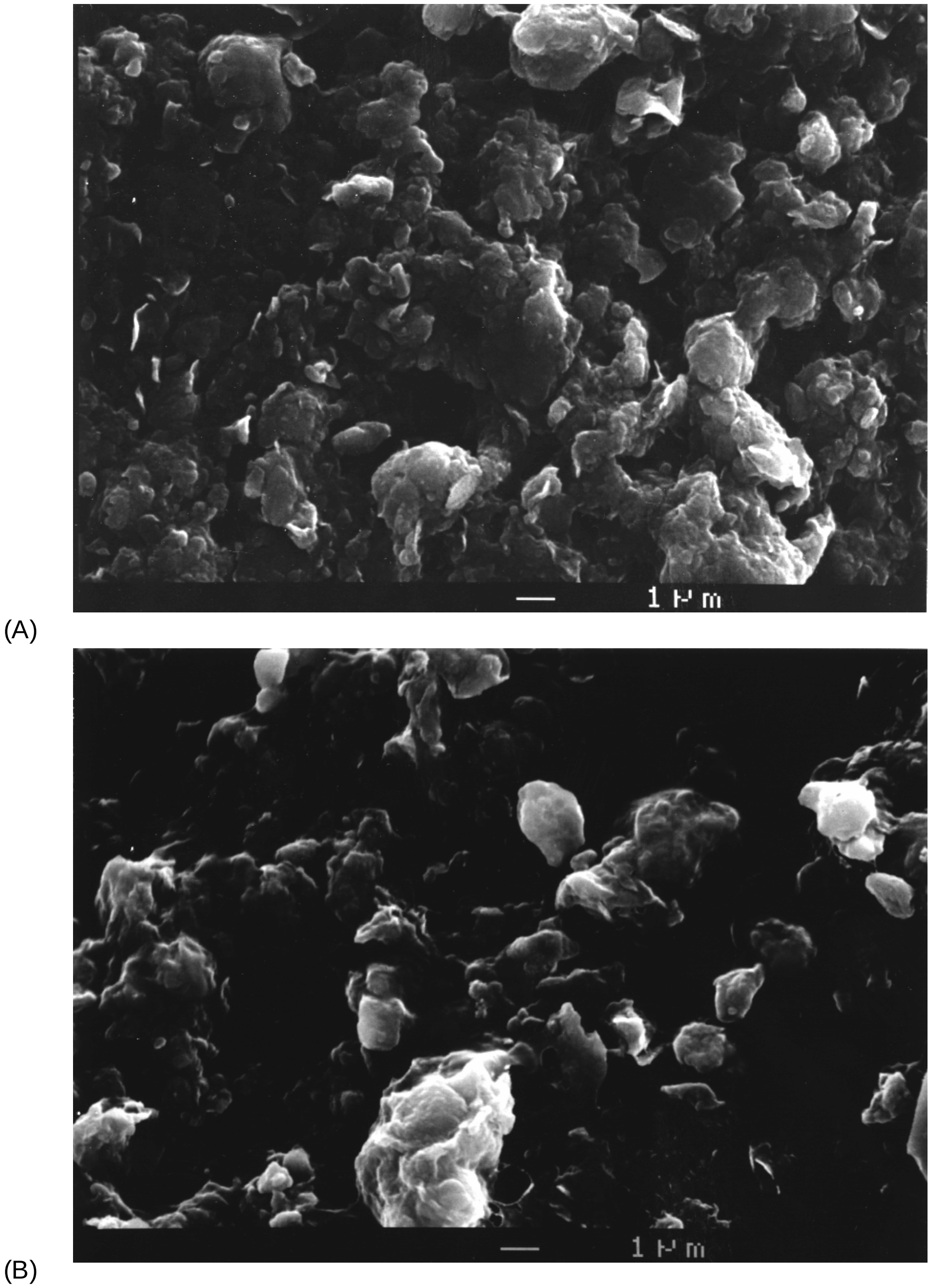


Fig. 6. SEM photographs of field exposed Fe-4195 resin. (A) Photograph of NR151-4195 (5000x, working distance of 10mm). This resin was exposed to a Nueces River (NR-151) field site over 28 days (site description in Chapter III). (B) Photograph of LCC233-4195 (5000x, working distance of 11mm). This resin was exposed to the Lake Corpus Christi field site over 28 days (site description in Chapter III).

Sorption and Extraction Efficiency

Sorption efficiency was calculated from loss from solution; arsenic not present in the solution after a 24 hour equilibration period was considered sorbed by the resin. Blank sample vials (i.e. no resin present) were also tested during this experiment to ensure no arsenic sorption to the sides of the tubes. A sorption isotherm was created for Fe-4195 (Fig. 7) as a function of initial arsenic concentration and amount sorbed to the resin. Fe-4195 obtained an average of 66% ± 0.16 sorption efficiency. Sorption isotherms seen in Chanda et al. (1986) display similar trends even though they were working at a much higher concentration range.

Fe-4195 was subjected to a competition study between arsenate, phosphate, and vanadate (1:1 and 1:10 molar ratios) because of their chemical similarities and the pronounced presence pf phosphate in Texas waters (Lee, 2001).

The results of the competition experiment between AsO_4^{3-} and PO_4^{3-} and AsO_4^{3-} and VO_4^{3-} can be seen in Fig. 8. Fig. 8A shows the competition at 1:1 molar ratios and Fig. 8B displays the competition at 1:10 molar ratios. The lower sorption of arsenic in the presence of phosphate and vanadate suggest there is competition for complexing sites on the resin, with greater competition at the 1:10 molar ratio. These results are consistent with other studies showing a decrease in arsenate sorption to ferrihydrite in the presence of phosphate (Jain and Loeppert, 2000). Chanda et al. (1986) found a 30-50% decrease in arsenate sorption to Fe-4195 in the presence of Cl^- and SO_4^{2-}. Although PO_4^{3-} and VO_4^{3-} sorption to the resin was not measured during this experiment, the data displayed moderate interference on arsenic sorption at low arsenic concentrations. The possibility remains that a change in pH may contribute to the reduced arsenic adsorption.

Samples used in the sorption isotherm experiment were stripped of iron and arsenate to calculate an average stripping efficiency of 24% ± 0.11, which is consistent with the low trends found by Chanda et al. (1986) when 1M NH_4OH was used as a stripping agent. Although 1 M NaOH is the suggested method of completely removing adsorbed arsenate (Chanda et al., 1986; Ramana and Sengupta, 1992), a 2 M NH_4OH solution was used because of sodium interferes

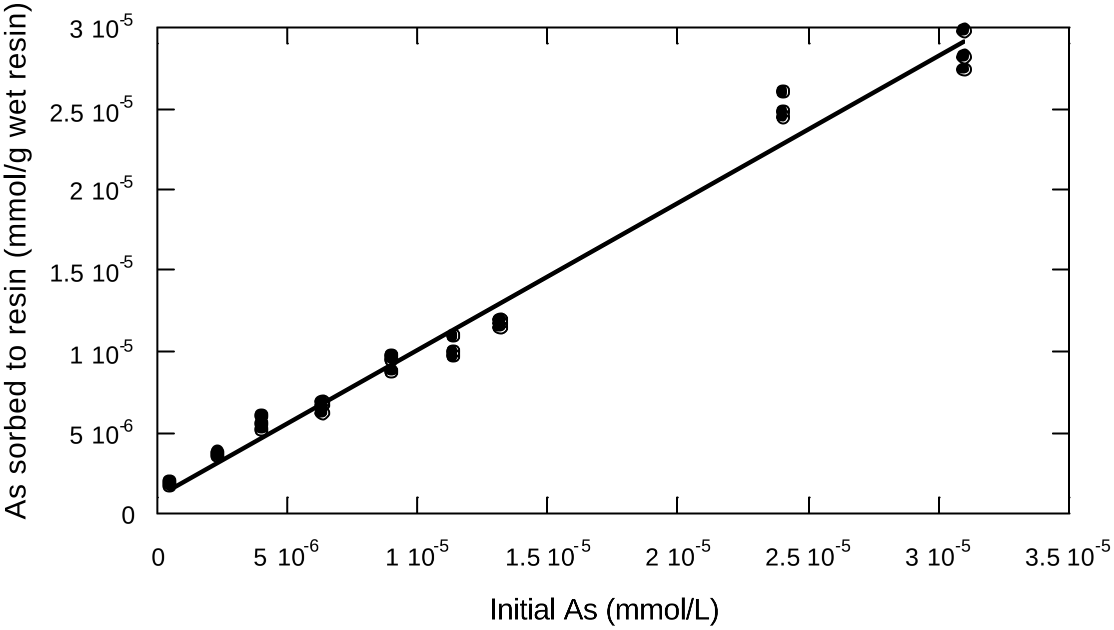


Fig. 7. Fe-4195 sorption of arsenic from solution. This graph displays arsenic sorbed to the resin from solution for increasing arsenic concentrations as a function of initial arsenic concentration. R is 0.99.

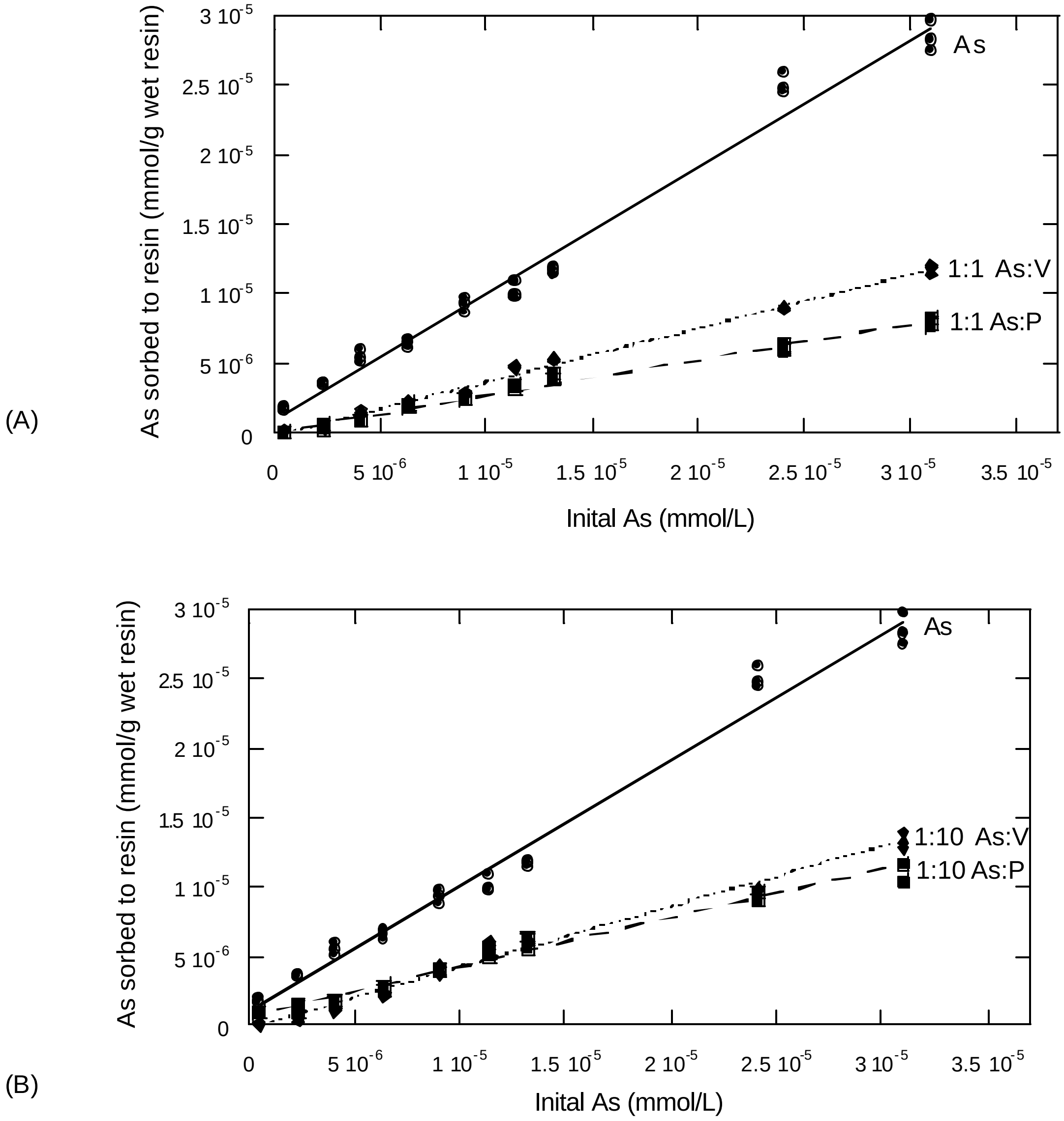


Fig. 8. Competition between AsO_4^{3-} and PO_4^{3-} and AsO_4^{3-} and VO_4^{3-} on Fe-4195 in solution. (A) 1:1 molar ratio competition of varying concentrations of AsO_4^{3-} and PO_4^{3-} and AsO_4^{-3} and VO_4^{3-}. (B) 1:10 molar ratio competition of varying concentrations of AsO_4^{3-} and PO_4^{3-} and AsO_4^{3-} and VO_4^{3-}.

with arsenic determination by GFAAS. When used, the NaOH caused visible flames inside the graphite tube and dilution of samples was not an option because of the low arsenic concentrations used in the experiments. Chanda et al. (1986) measured stripping efficiencies between 50 to 60% after 24 hours using 1 M NH_4OH. The higher extraction efficiency was likely due to the higher arsenic concentrations used in their experiments.

Alternative stripping solutions were tested in preliminary experiments including 1% HNO_3 and NH_4HPO_4. One percent HNO_3 exhibited limited ability to extract arsenic and might have degraded the resin. NH_4HPO_4 was used with the hypothesis that the arsenate would easily exchange with the PO_4^{-2}; however, limited arsenic was extracted with this technique.

Available Arsenic in Laboratory Sediments as a Function of Time

Sediment samples were spiked with increasing concentrations of arsenic and allowed to equilibrate for 52 days. Resin was added to each sample after sediment equilibration and arsenic was extracted at 15, 30, 60 and 90 days (Fig. 9). Resin in all three of the sediment microcosms displayed an increase in arsenic sorption between 15 and 30 days. After 30 days, the amount of arsenic sorbed by the resin remained constant. This trend suggests that either the resin became saturated or no more arsenic was available for sorption (Fig. 9). In some cases the trends drop in amount of arsenic extracted after reaching a maxima around 30 days, suggesting increased arsenic sequestration because of the longer equilibration time (Alexander, 2000). Fig. 9C and Fig. 10B show arsenic extraction increased throughout the experiment suggesting that perhaps the sample was not homogenous.

On average, extraction by the resin after 30 days appears to be an appropriate time to examine arsenic availability in sediment.

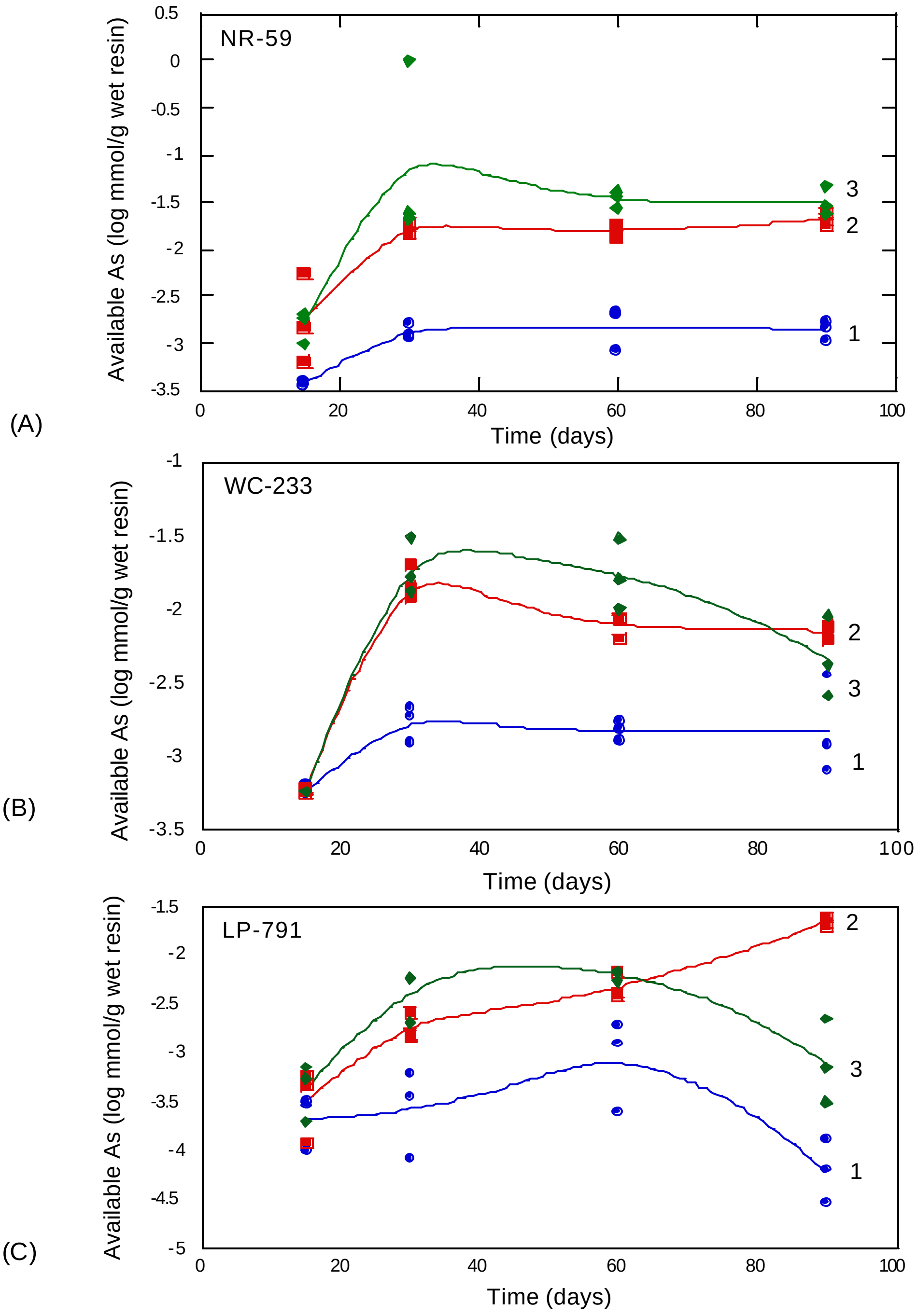


Fig. 9. Potential arsenic bioavailability to Fe-4195 from three sediments over time in a laboratory environment. Treatment 1,2, and 3 samples were spiked with 3.21×10^{-2} mmol arsenate L^{-1}, 1.6×10^{-1} mmol arsenate L^{-1}, 3.21×10^{-1} mmol arsenate L^{-1} respectively. (A) NR-59 sediment. (B) WC-233 sediment. (C) LP-791 sediment.

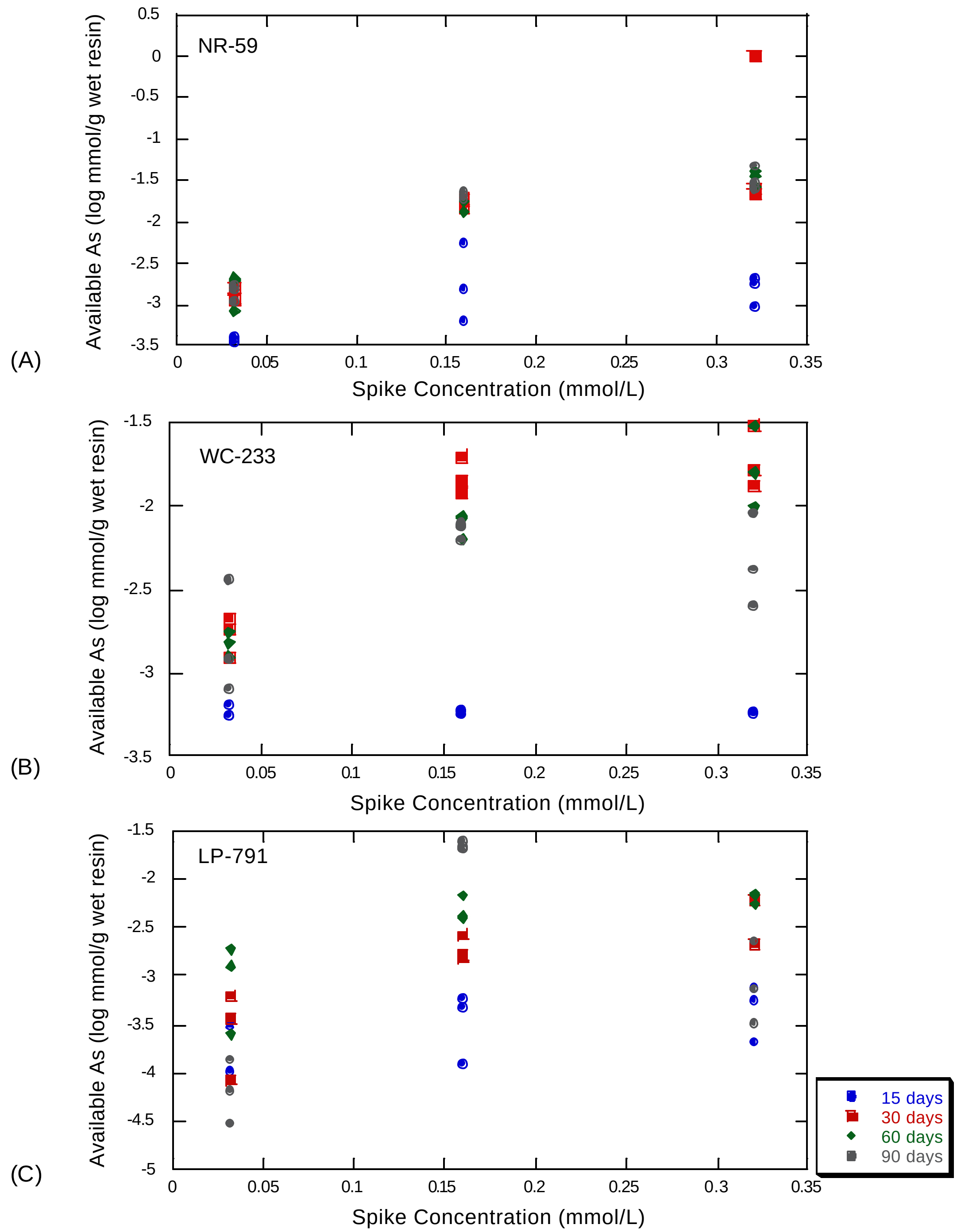


Fig. 10. Arsenic adsorption on Fe-4195 exposed to arsenic in a sediment microcosm as a function of initial arsenic spike concentration over time in a laboratory environment. (A) NR-59 sediment. (B) WC-233 sediment. (C) LP-791 sediment.

Potential Arsenic Bioavailability as a Function of Sediment Characteristics

Resin was exposed to characteristically different sediments to evaluate the possibility of measuring different potentials in arsenic bioavailability in different field environments (Chapter III). Sediment characteristics are an important factor when determining potential bioavailability as seen in studies such as Davis et al. (1996) and Lee et al. (1996). Similar results were seen where bioavailability and sequestration varied as a function of sediment characteristics.

The trends over time for a specific spike concentration appear to be consistent between the sediment samples (Fig. 11). Geologically, these sediments come from widely different environments. It was predicted that the Weedy Creek sample would have more available arsenic as a result of the lack of iron seen in the plant available fraction (see also Appendix IV). In Fig 11, this trend is evident compared to the other samples. This result leads to the hypothesis perhaps manganese oxide and iron oxide controlled the bioavailable arsenic. However, more data on the total iron and manganese contents would be needed to prove this hypothesis.

Arsenic availability from each sediment sample was expected to mirror plant available phosphate concentrations. However, lower plant available phosphate concentrations in WC-233 and LP-791 did not follow arsenic concentrations extracted from resin (Fig. 11). WC-233 was expected to have less available arsenic yet, high amounts of arsenic were extracted. Perhaps the NR-59 was extracting more phosphate compared to arsenic; however, an analysis of phosphorus adsorption by the resin is needed to support this hypothesis.

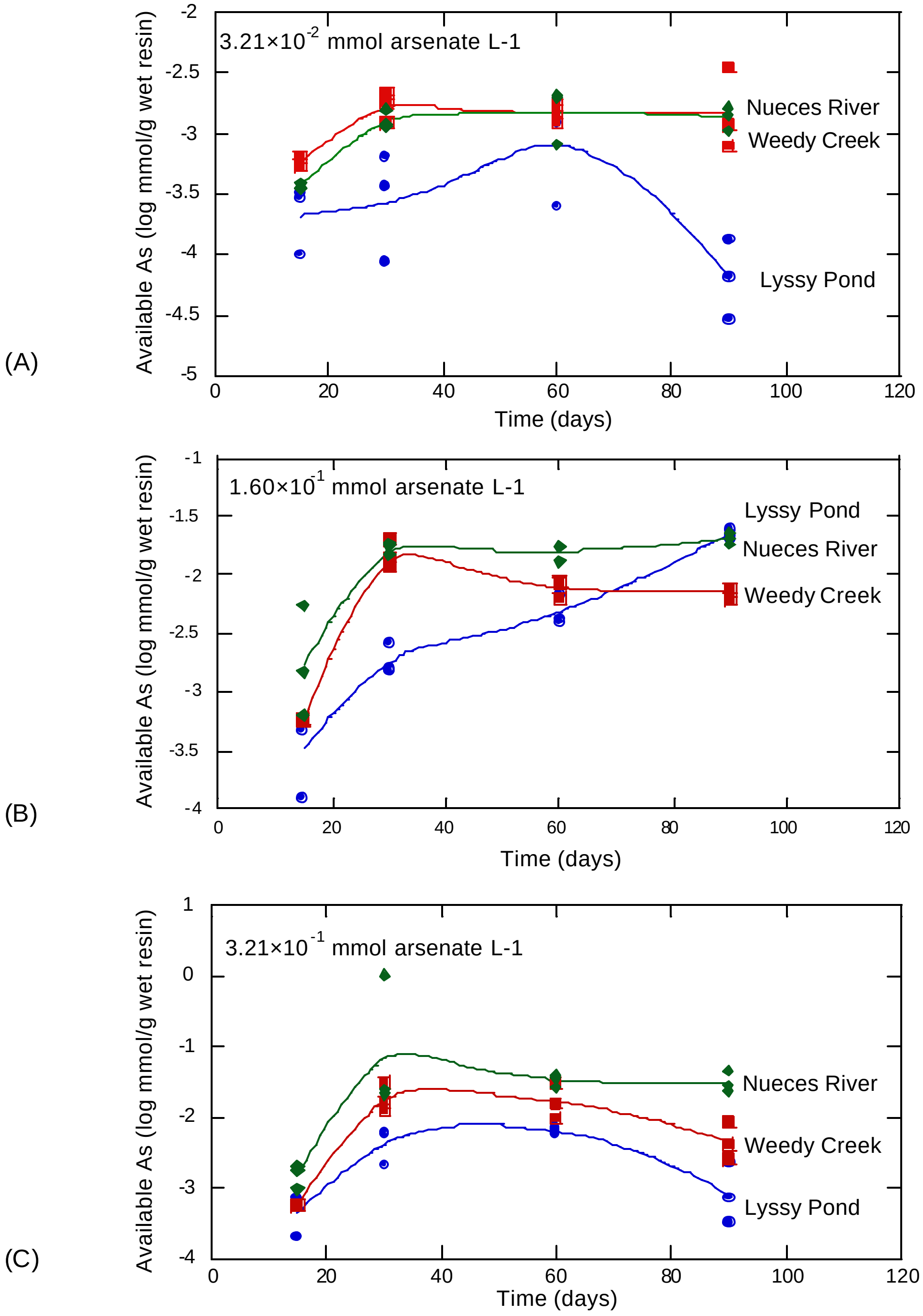


Fig. 11. Potential arsenic sorption as a function of sediment differences on Fe-4195 over time in a laboratory environment. (A) Samples spiked with 3.21×10^{-2} mmol arsenate L^{-1}. (B) Samples spiked with 1.60×10^{-1} mmol arsenate L^{-1}. (C) Samples spiked with 3.21×10^{-1} mmol arsenate L^{-1}.

CHAPTER III

LINKING GEOMORPHIC PROCESSES AND THE ENVIRONMENTAL FATE OF ARSENIC

Introduction

Humans are exposed to arsenic from drinking water, dust, or through food. Most of this contamination is a result of arsenic release from geologic materials, pesticides, or industrial waste (ATSDR, 1989). Weathered mine tailings are another important source of arsenic release to the environment. These sediments are exposed to seasonally varying oxidation and leaching, during which precipitation-dissolution, adsorption-desorption, and biological uptake processes control arsenic concentrations in solution (Larocque and Rasmussen, 1998).

Geology and geochemistry of an environment are major controlling factors of potential arsenic bioavailability (Williams, 2001). For example, in Bangladesh and West Bengal, arsenic in groundwater derives from dissolution of arsenic-rich iron oxyhydroxide coatings on sediments (Nickson et al., 2000). During the Holocene, arsenic was sequestered in fine grained, organic rich sediment; however, it has been mobilized as a result of anthropogenic interference (Acharyya et al., 2000). Geologically, environments ideal for arsenic sequestration tend to be geomorphically stable, water saturated, contain high organic matter, and fine texture (e.g. wetlands and surface water bodies) (Gambrell, 1994).

Arsenic bioavailability is strongly linked to speciation. The reduced form of arsenic, arsenite, found in reducing environments such as groundwater aquifers or wetlands, is considered the most toxic but less common form. Arsenate is found in oxidized environments and is more commonly found (Cullen and Reimer, 1989). These two forms of arsenic are generally mobile as aqueous species because they are free ions (Cullen and Reimer, 1989; Pantsar-Kallio and

Manninen, 1997). Fate of these arsenic species may also be affected by the presence of competing anions, such as phosphate (Kneebone and Hering, 2000).

To better understand arsenic speciation (Huang and Dasgupta, 1999), transport (Kneebone and Hering, 2000; Pantsar-Kallio and Manninen, 1997), and potential bioavailability (Davis et al., 1996; Geiszinger et al., 1998; Lee et al., 1996; Woo and Choi, 2001) in the environment, more field studies are needed. Most studies concerning the fate and toxicity of arsenics in different geologic environments have been limited to laboratory studies because of the lack of control over the natural system. Binkley et al. (2000) conducted a field study using anion exchange resins to evaluate bioavailability of phosphorus to *Eucalyptus saligna* and *Albizia falcataria* trees. This study used biological and chemical assays to evaluate field bioavailability of phosphorus, and presented the possibility for a measure of potential field-bioavailable arsenic. Lee and Zheng (1994) proposed a method to measure phytoavailability by transforming sodium-saturated chelating resin membrane sheets into calcium-saturated sheets and presented the idea that the transformation of resin specific for arsenic (Chanda et al., 1986; Ramana and Sengupta, 1992) could possibly be applied to field environments also. Though this media does not adapt to environmental stresses, as do organisms, the resin beads can be considered infinite sinks in a natural environment and provide a good estimate of potentially bioavailable arsenic.

This research is focused in South Texas, where open pit uranium mining during the 1960s and 1970s released uranium and other uranium-associated elements, including arsenic, to the Nueces and San Antonio River watersheds. Though the majority of the tailings piles and pits from this era have been remediated, there are concerns that erosion of the Catahoula Formation (Appendix V), exposed during mining, continues to contaminate the surface waters and surrounding environment (Eargle et al., 1975) (Fig. 12). The hypothesis for this study is that characteristics of different geologic environments and geomorphic processes control the potential bioavailability of arsenic within a watershed.

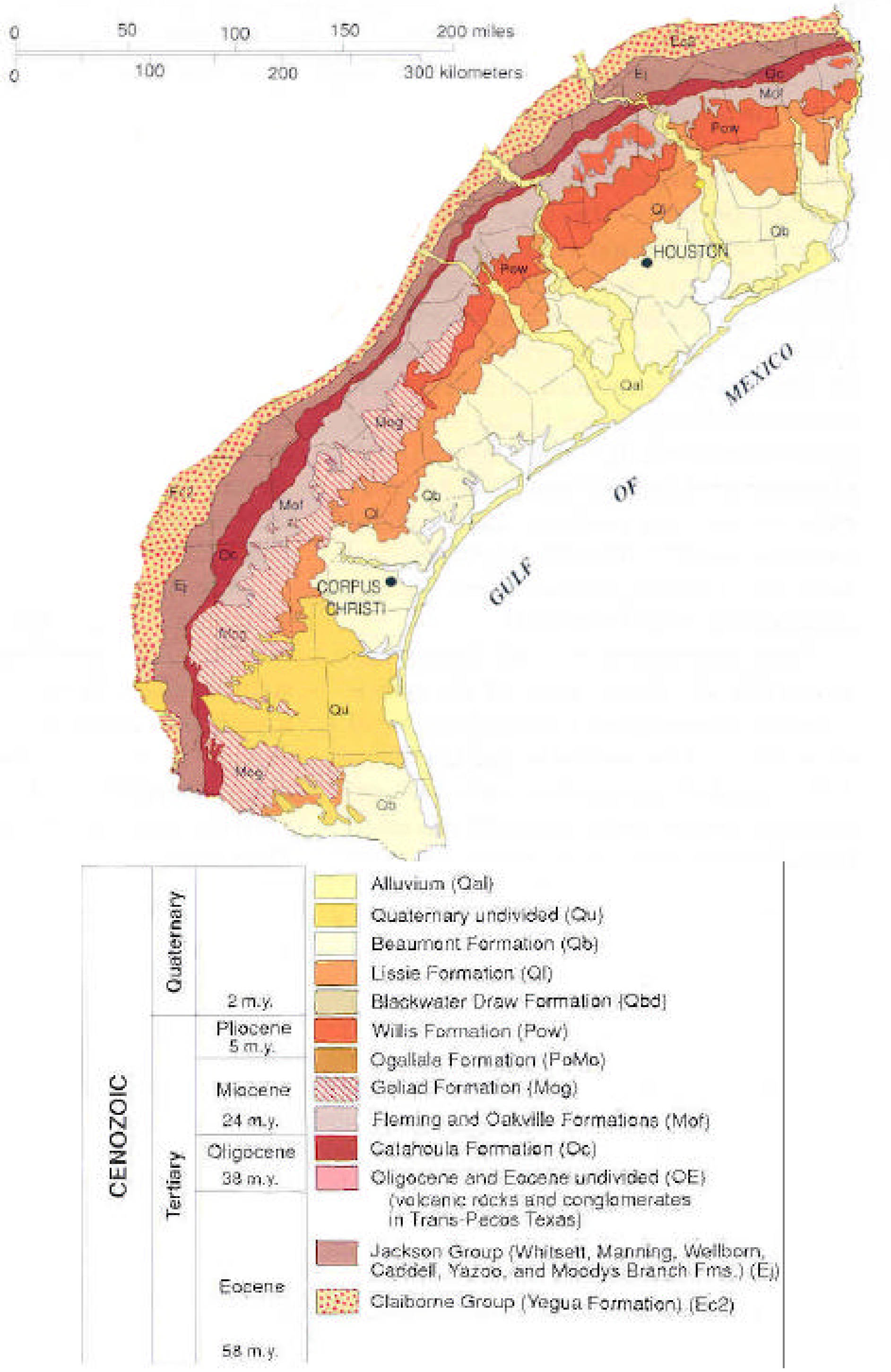


Fig. 12. Geologic map of South Texas. The dark red color displays the Catahoula Formation.

Materials and methodology

Site Descriptions

A total of six sites (Fig. 13) were chosen along the Nueces River and San Antonio River Watersheds. The sites were chosen on the basis of their geologic and hydrologic characteristics and ease of access. All samples used for sediment characterization and analysis were collected from 0 – 0.3 meter depths with a shovel (fiberglass spade) and placed in plastic bags for transport to the laboratory.

Two sites on the property of Leo Lyssy, Jr., Karnes County, Texas, once the site of a uranium strip mine operation were chosen: a small wetland area, Lyssy Wetland (LW-791) (Fig. 14A) (N 28° 54’ 38.9”, W 098° 06’ 43.3”) and Lyssy Pond (LP-791) (Fig. 14B), a stock tank for cattle (N 28° 54’ 38.0”, W 098° 06’ 40.8”) located on Texas Highway 791. Both sites lie near the edge of the watershed divide, lying more in the San Antonio River watershed. The stock tank is filled mostly by runoff (Leo Lyssy Jr., personal communication), and the wetland from groundwater seeps and runoff. LP-791 contains green algae and has a considerable amount of anthropogenically introduced gypsum. The vegetation around the area is mostly grassland and some small trees. The wetland contains tall grasses and marshy black sediment and is a ground water, surface water interaction point. The soil in this area is made up of overburden as a result of strip mining. The samples for analyses were collected from the bank of the pond and the edge of the wetland vegetation.

Tordillo Creek (TC-413) (Fig. 14C) is part of the head waters for the Atascosa River located in Atascosa County, Texas, on Texas Farm Road 413 off Texas Highway 791 (N 28° 51’ 34.2”, W 098° 10’ 49.8”). The site location is at a ponded area of the creek near an under road drainage pipe. Hydraulically, this site was characterized as a perennial stream. The banks contain a white soil, and the water is a dark brown to tan color. Samples were collected from the bank of the creek.

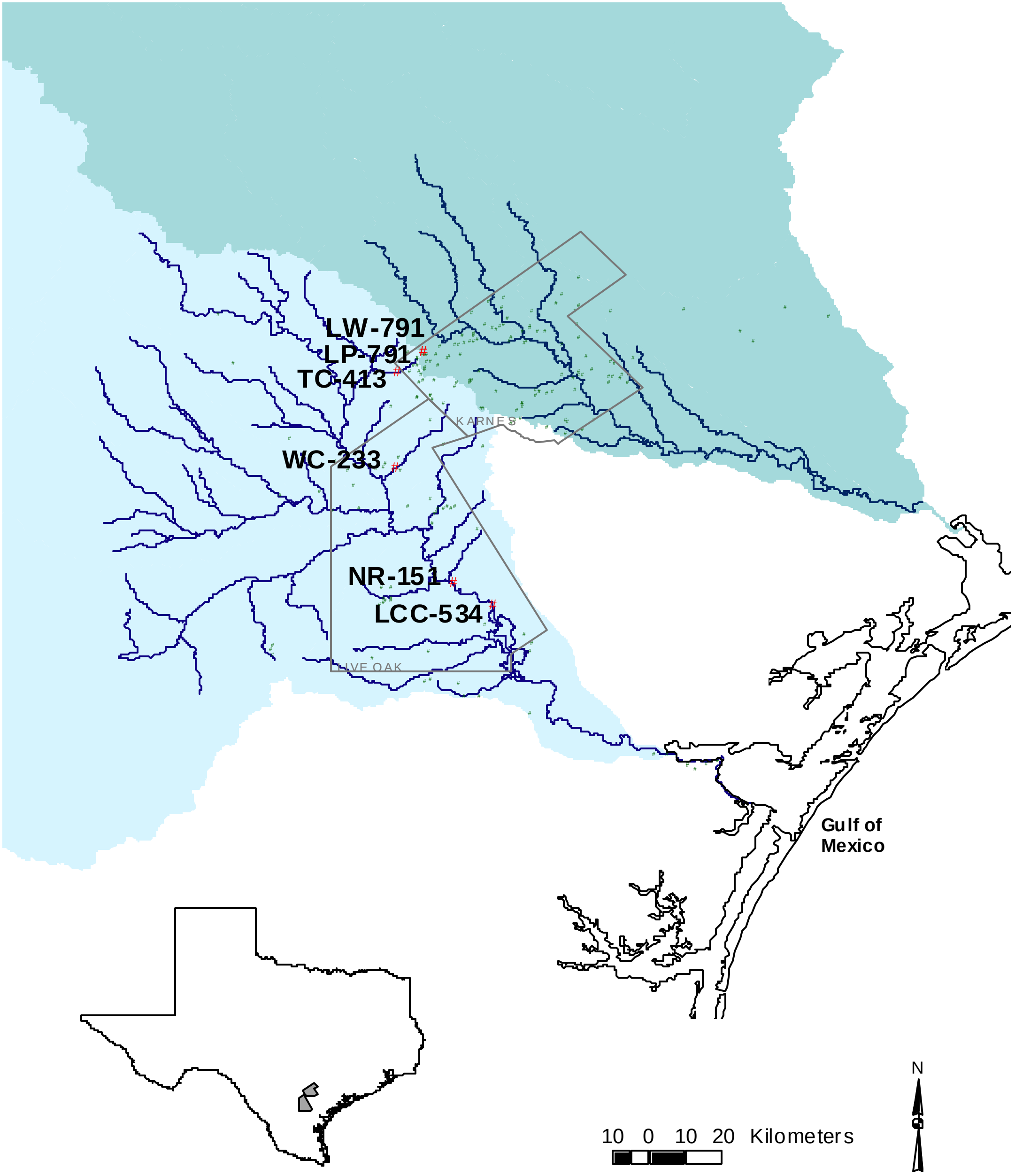


Fig. 13. Field sites in the Nueces and San Antonio River watersheds. The small map of Texas indicates where the two main counties of interest are located. Large dots indicated site locations. Uranium mine locations are indicated by small dots along the Nueces River Watershed (light shade) and San Antonio River Watershed (dark shade). Map and mine data were collected from the BASIN database.

(A)

(B)

Fig. 14. Photographs of field sites in South Texas. (A) Lyssy Wetland (LW-791). (B) Lyssy Pond (LP-791).

(C)

(D)

Fig. 14. (*continued*) (C) Tordilla Creek (TC-413). (D) Weedy Creek (WC-233).

(E)

(F)

Fig. 14. (*continued*) (E) Nueces River (NR-151). (F) Lake Corpus Christi (LCC-534).

Weedy Creek (WC-223) (Fig. 14D), Live Oak County, Texas is located off Interstate 281 South, exiting on Texas Highway 2049 and traveling about one mile, to Texas Farm Road 223 (N 28° 36’ 10.3”, W 098° 10’ 58.5”). The site is located where the creek intersects and, during flooding, runs over Farm Road 223. Weedy Creek is characterized as an ephemeral stream and contains white soils on its banks. When active, the stream flows into the Atascosa River. Sediment samples were collected from the bank of the creek.

Nueces River (NR-151) (Fig. 14E) sediment was collected from the bank under a bridge on the property of Aaron Morgan on Farm Road 151 off Texas Highway 799, Live Oak County, Texas (N 28° 17’ 56.6”, W 098° 02’ 32.7”). The Nueces River contains a very high sediment load making the water a brown color. The bank is stabilized by trees and some grasses. Samples were collected from a cut bank of the river.

The Lake Corpus Christi (LCC-543) (Fig. 14F) site is near the mouth of the Nueces River. The site is located near Swinney Switch, Live Oak County, Texas off Texas Highway 534 (N 28° 14’ 14.0”, W 097° 56’ 45.0”). LCC-543 is located in a marshy finger of the reservoir containing vegetation such as trees, grass, and wild water lilies. Sediment samples were collected at the edge of the water.

Sediment Characterization Methodology

For background information on sediment characteristics, grab samples collected from each field location were oven dried at 110°C (excluding easily removed organic matter and large rocks) for ease of storage.

Oven-dried samples were used in analysis of water content (Dixon and White, 2000) and digestion. Sediments were digested for arsenic using a method modified from Brandenburger (2001) where 0.2 grams of oven dried sample was digested using 2.5 mL of trace metal grade HCl and 1 mL of ultra-pure HNO_3 in a sealed digestion vessel under a fume hood. Hydrofluoric acid was not used because the extraction of arsenic from silicates was not expected to contribute appreciably to the total potentially bioavailable arsenic. The digestion vessels were placed in a 1200 watt microwave oven for 30 seconds (modified from recommendations by Parr Instrument Company (2002)). Buffalo River Sediment (8704) from the National Institute of Standards and Technology was used as a standard (reported as total arsenic) (Table 8).

The Texas Agriculture Extension Service Soil, Water, and Forage Testing Laboratory at Texas A&M University analyzed bulk and sieved samples for plant available phosphorus, potassium, calcium, magnesium, sodium, and sulfur using an NH_4Ac and EDTA extraction (Hons et al., 1990). Salinity (Rhoades, 1982) and pH (Schofield and Taylor, 1955) were analyzed using a conductivity meter and pH meter, respectively, in 2:1, water:sediment. Plant available zinc, iron, manganese, and copper were extracted using a DTPA solution (Lindsay and Norvell, 1978). Readily oxidizable organic matter was analyzed using Walkley (1947). These samples also underwent textural analysis using a standard hydrometer method.

Nitrate was analyzed by the Texas Agriculture Extension Service using a method modified from Keeney and Nelson (1982) to reduce salting in analytical equipment. Two grams of soil and 20 mL of 1.0 M KCl were added to a 5 ounce cup and placed on a shaker for 10 minutes at 185 opm. The solution was then filtered through Watman No. 2 filter paper. The filtrate was analyzed using a Technicon 800 Autoanalyzer fitted with a cadmium reduction column. Results are expressed on a mg NO_3^- N kg^{-1} basis (Table 9).

Cation exchange capacity (CEC) was also analyzed using methods from Holmgren et al. (1977) and Soil Survey Staff (1996) (Table 9).

Cores

Core samples were taken at each site using a 2.2-cm by 60.8-cm unslotted stainless steel probe with 1.9-cm butyrate plastic liners, and 1.9-cm polyethylene liner caps. These samples were placed in coolers for transport and described in the laboratory (Table 10).

Additional Field Sampling

Filtered (0.45µm) and unfiltered water samples were taken following methods described by the EPA (1996) at each field site in 15-mL polypropylene centrifuge tubes, acidified in the field with 16 M nitric acid and transported in a cooler. Temperature, pH, and dissolved oxygen of the water were also taken at each site using a portable unit.

Table 8

Potential bioavailable arsenic from digested sediment samples

Sample Name	**Mean As** **mg/kg**	**Confidence Interval** ***95%***	**NIST Reported As** **mg/kg**
NIST 8704	4.8×10^{1}	2.1×10^{-2}	17[a]
LW-791	7.3×10^{1}	9.3×10^{-2}	
LP-791	2.0×10^{1}	6.3×10^{-2}	
TC-413	3.0×10^{1}	1.3×10^{-1}	
WC-233	1.5×10^{1}	9.8×10^{-2}	
NR-151	6.6×10^{-5}	9.7×10^{-3}	
LCC-534	2.1×10^{1}	1.0×10^{-1}	

a Due to the approximate 6% loss of arsenic determined by spectrometric comparison to SRM 2704, there is insufficient information to assign uncertainty (NIST, 2000).

Field Deployable Resin Sampling Device and Iron Loaded M-4195

Sampling devices were made using a 25.4-cm piece of 1.9-cm 200 PSI PVC pipe (Fig. 15). The pipe was cut lengthwise leaving a 3-mm slit. Inserts with a 1.9-cm diameter and length and a 1.2-cm slit were placed at both ends of the pipe and then capped with 1.9-cm NIBCO schedule 40 (D-2466) caps. PVC (200 PSI) pipe was cut into 1.2-cm by 7-mm rings and capped with a plastic circle to form partitions. These partitions were placed every 2.5 cm beginning 5.1-cm below the cap depth. Eight 5-mm diameter holes were drilled around the circumference of the tube in a series of two vertical sets for each subsection. The containers were washed and allowed to air dry.

Table 9

Soil properties found at each field site

Sample Description		Lyssy Wetland	Lyssy Pond	Tordilla Creek	Weedy Creek	Nueces River	Lake Corpus Christi
pH		6.9	6.7	8.9	7.6	7.7	6.7
Sand	**%**	49	51	73	55	55	61
Silt	**%**	21	19	18	20	23	2.0
Clay	**%**	30	30	9.0	25	22	37
Water Content	**%**	52	49	27	28	26	48
Organic Matter	**%**	3.6	3.6	0.80	1.0	0.20	2.7
Nitrate	**ppm**	1.0	3.0	2.0	4.0	2.0	2.0
Phosphorus[a]	**ppm**	1.1×10^{2}	52	19	44	78	1.3×10^{2}
Potassium[a]	**ppm**	5.7×10^{2}	5.1×10^{2}	2.3×10^{2}	7.4×10^{2}	3.4×10^{2}	5.0×10^{2}
Calcium[a]	**ppm**	6.4×10^{4}	3.5×10^{3}	2.4×10^{3}	3.2×10^{4}	2.0×10^{4}	2.7×10^{4}
Magnesium[a]	**ppm**	8.5×10^{2}	3.8×10^{2}	53	2.4×10^{2}	4.1×10^{2}	4.7×10^{2}
Salinity	**ppm**	2.0×10^{3}	4.2×10^{2}	1.0×10^{3}	4.4×10^{2}	2.9×10^{2}	1.9×10^{3}
Zinc[b]	**ppm**	2.1	2.7	0.67	0.45	0.75	6.7
Iron[b]	**ppm**	1.1×10^{2}	52	14	13	28	64
Manganese [b]	**ppm**	67	21	17	12	3.3	39
Copper[b]	**ppm**	1.4	0.48	0.33	0.65	0.61	1.7
Sodium[a]	**ppm**	9.8×10^{2}	2.8×10^{2}	1.1×10^{3}	3.0×10^{2}	3.0×10^{2}	3.9×10^{2}
Sulfur[a]	**ppm**	2.1×10^{3}	45	63	80	83	4.4×10^{2}

a extracted using a NH_4Ac and EDTA solution (Hons et al., 1990)

b extracted using a DTPA solution (Lindsay and Norvell, 1978)

Table 10

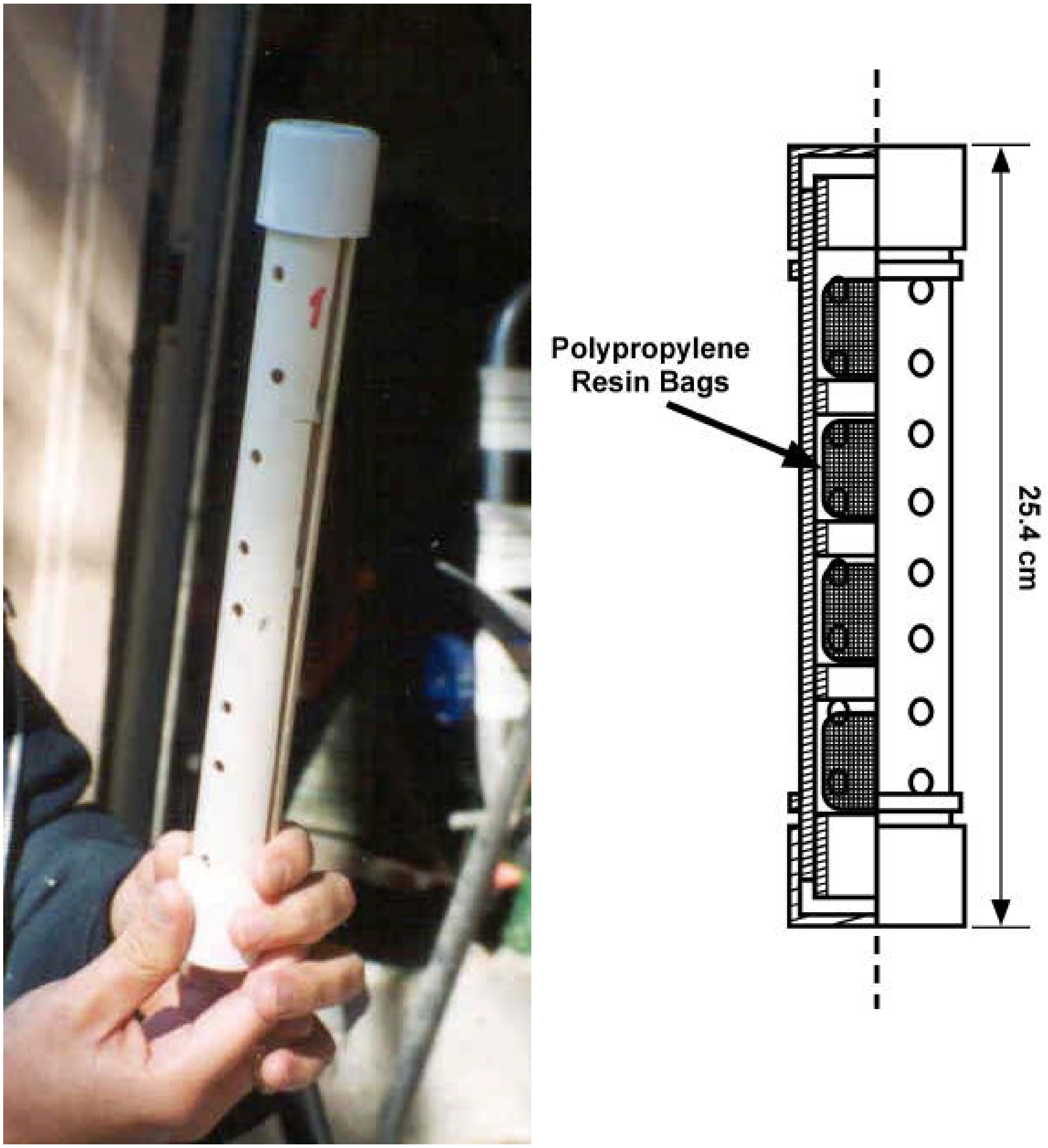
Core descriptions from each field site

Site Location	Depth inches	Description
LW-791	0.00 – 1.50	High organic matter, black and yellow color
	1.50 – 2.00	High organic matter and clay, 2.5Y/2/0
	2.00 – 6.00	Clay, areas of white splotches (2.5/7/2), high organic matter between 4.0 – 5.0”, 2.5Y/3/0
LP-791	0.00 – 1.50	Large sand to silt, saturated, high organic matter, 5Y/2.5/1 to 5Y/4/2
	1.50 – 4.25	Sand near top to silt/clay, GLEY 1/5/5GY to GLEY 1/3/10Y
	4.25 – 5.25	Clay, small pebbles at 5.0-5.3”, (reduced environment) GLEY 1/7/5G
TC-413	0.00	Very saturated, unconsolidated clay material
	0.00 - 3.00	Saturated but retains structure, silt to sand, small black particles, 5Y/3/1
	3.00 – 6.00	Sand, top retains water, large clast, small areas of black organic matter, 5Y/4/2 to 5Y/3/1
WC-233	0.00 – 2.50	Clay, some large leaves, 5Y/2.5/2
	2.50 – 3.75	Large sand to silt, saturated, no structure (very friable), 5Y/4/2
	3.75 – 5.25	Sand increasing grain size from top to bottom, root matter, 5Y/5/3
	5.25 – 6.00	Sand at top to silt/clay, large pebbles, 5Y/4/2
NR-151	0.00 – 3.75	Sand to silt, 5Y/4/2
	3.75 – 4.50	Sand, larger clasts, 5Y/3/2
	4.50 – 8.00	Clay/silt, roots, pieces of oxidized metal (?) at 7.5”, very bright yellow orange color
	8.00 – 8.50	Sand, 5Y/3/2
	8.50 – 10.0	Large clasts, clay to silt, 5Y/3/2
LCC-534	0.00 – 1.50	Silt to clay, high organic matter, saturated, (Mn oxides?), 5Y/2.5/1 to 2.5Y/2/0
	1.50 – 2.25	Silt to clay, visible organic matter, some saturation, 5Y/2.5/1
	2.25 – 3.50	Small pebbles and sand, 5Y/3/1

DOWEX M4195 resin was iron loaded using a method modified from Chanda et al. (1986). Resin was placed in a 250 mL Nalgen bottle with double distilled water (DDW), secured with virgin teflon tape and capped. The resin underwent two DDW rinses for 10 minutes at 100 rpm on an automated shaker. DOWEX M4195 was then rinsed twice with 250 mL of 2M HCl for 10 minutes at 100 rpm. This was followed by three 250 mL DDW rinses at 100 rpm until the pH of the effluent after shaking reached 2 or higher. The resin was then rinsed with a 0.09M $FeCl_3 \cdot 6H2O$ (pH 2) solution for 10 minutes at 110 rpm, then again for 20 hours at 110 rpm creating Fe-4195. The resin was then rinsed twice with a pH 2 DDW solution (adjusted with 1% HNO_3) for 10 minutes at 110 rpm to remove iron from resin pores. Finally Fe-4195 was rinsed three times with a pH 8 (average field water conditions) DDW solution (adjusted with 1M NaOH) for 10 minutes at 110 rpm. After shaking the pH of the solution continuously dropped to a pH of 2.

Polypropylene bags were prepared to house the resin beads. Polypropylene 75 mesh bags were cut into 5.5 by 2.5 cm squares and were sewn on two sides with rayon thread. The third side was melted using a hot plate after 0.6 gram of wet Fe-4195 was inserted into each subsection of the container (Fig. 15). Completed containers were placed in a bucket filled with DDW for transport to the field sites. This procedure used to insure the resin was hydrated when placed in the field.

Four devices were placed at each field site in a 15.2 cm deeps hole made with a 2.2 cm by 30 cm unslotted stainless steel probe. Devices were secured with plastic twist ties to discourage resin bag removal by people and animals such as raccoons. All sites were marked with flags, and each device was marked with flagging tape and a 3.8 cm diameter plastic round float (Airlite Plastics Co.). After 15, 28, 80 and 100 days, one device was collected from each site. The device was placed in a plastic bag and placed in a cooler for transport.



(A) (B)

Fig. 15. Field deployable resin sampling device. (A) Photograph of PVC container used to house resin bags placed at each field site. (B) Schematic of sampling device. Left section is a cut away portion displaying the inside of the device.

Estimation of Potential Arsenic Bioavailability

To remove arsenic and iron from Fe-4195 for analysis of sorbed arsenic, the resin was rinsed twice with 50 mL of DDW for 10 minutes at 110 rpm followed by two 10 mL rinses with 2M NH_4OH for 24 hours each at 100 rpm.

Resin stripping solutions, as well as sediment digestions and field water samples, were analyzed with the use of a Varian SpectraAA 200 FS graphite furnace atomic adsorption spectrometer (GFAAS). Universal graphite tubes (purchased from Varian Inc.) were used. The platform allowed for better signal when sample was not burning off of the wall of the tube. A 2.07×10^{-3} M nickel nitrate in 5% HNO_3 was used as a modifier (co-injected with the sample). The temperature program used for the water matrix samples (field water and soil digestions) can be found in Table 5, and the temperature program used for the resin stripping solution samples with a NH_4OH matrix can be found in Table 6. Both programs started with a hot inject step at 95ºC.

The estimation of potential arsenic bioavailability in a given system was calculated using equation 4 from Chapter II.

Results and discussion

Arsenic bioavailability studies which used biological assays (Davis et al., 1996; Päivöke and Simola, 2001; Pascoe et al., 1994) found geology and geochemistry of an environment to be the major controlling factors controlling transport of arsenic to the organisms. Field results from this study also suggested that the characteristics of the geologic environment, environmental conditions, and sediment characteristics were major controlling factors in the potential bioavailability of arsenic.

Influence of Environmental Factors on Potential Arsenic Bioavailability

In the San Antonio River Watershed, resin was placed at the sites during the summer months. The Lyssy property appeared to be an ideal location for sample collection because it was open to animals but closed to public access. One sample at the pond had to be repositioned as a result of animal interference. From the beginning of the experiment, the area began to dry out, lowering the water level in the pond and the wetland. In Fig. 16A-B, both graphs display decreasing trends of potential arsenic bioavailability after 28 days of exposure. There are two possible explanations for these trends: 1) the resin began to dry and was no longer activated, resulting in decreased uptake capabilities, or 2) arsenic was desorbed from the resin to a more active site, possibly organic matter.

In the Nueces River Watershed, a series of experiments had to be conducted as a result of anthropogenic interferences. For example, the experiment at WC-233 was started about a week later compared to the rest of the samples because samples were lost in the first week. The reason for their loss is unknown. At sample collection, there was some evidence of recent sediment deposition most likely due to road construction. The samples were most likely removed by road workers (S. Darby, personal communication). Despite these inferences, trends indicated an increase in arsenic available to the resin between 15 and 28 days (Fig. 16C-D). This trend is similar to that found in the laboratory experiment (Chapter II).

Approximately two months into the experiment, the area experienced massive flooding, which destroyed many homes, blocked roads, increased the amount of sediment load in the San Antonio, Nueces, and Atascosa rivers, and limited sampling. The increase in arsenic sorption to the resin at the sites that had initially begun to dry was due to the reactivation of the dried resin from the influx of water and the flushing and transport of bioavailable arsenic that might have been sequestered before the flood. Arsenic became more dilute in the water (as indicated by the decreasing concentration of arsenic in the filtered water sample) as a result of flushing of the arsenic from the sediments (Pantsar-Kallio and Manninen, 1997), increasing arsenic availability to the resin. Gambrell (1994) suggested that both iron oxides and organic matter can be important mobility mechanisms for metals in sediment. In the case of Lyssy Pond and Lyssy Wetland, the runoff from the Lyssy Pond dam could have easily transported material into the wetland area.

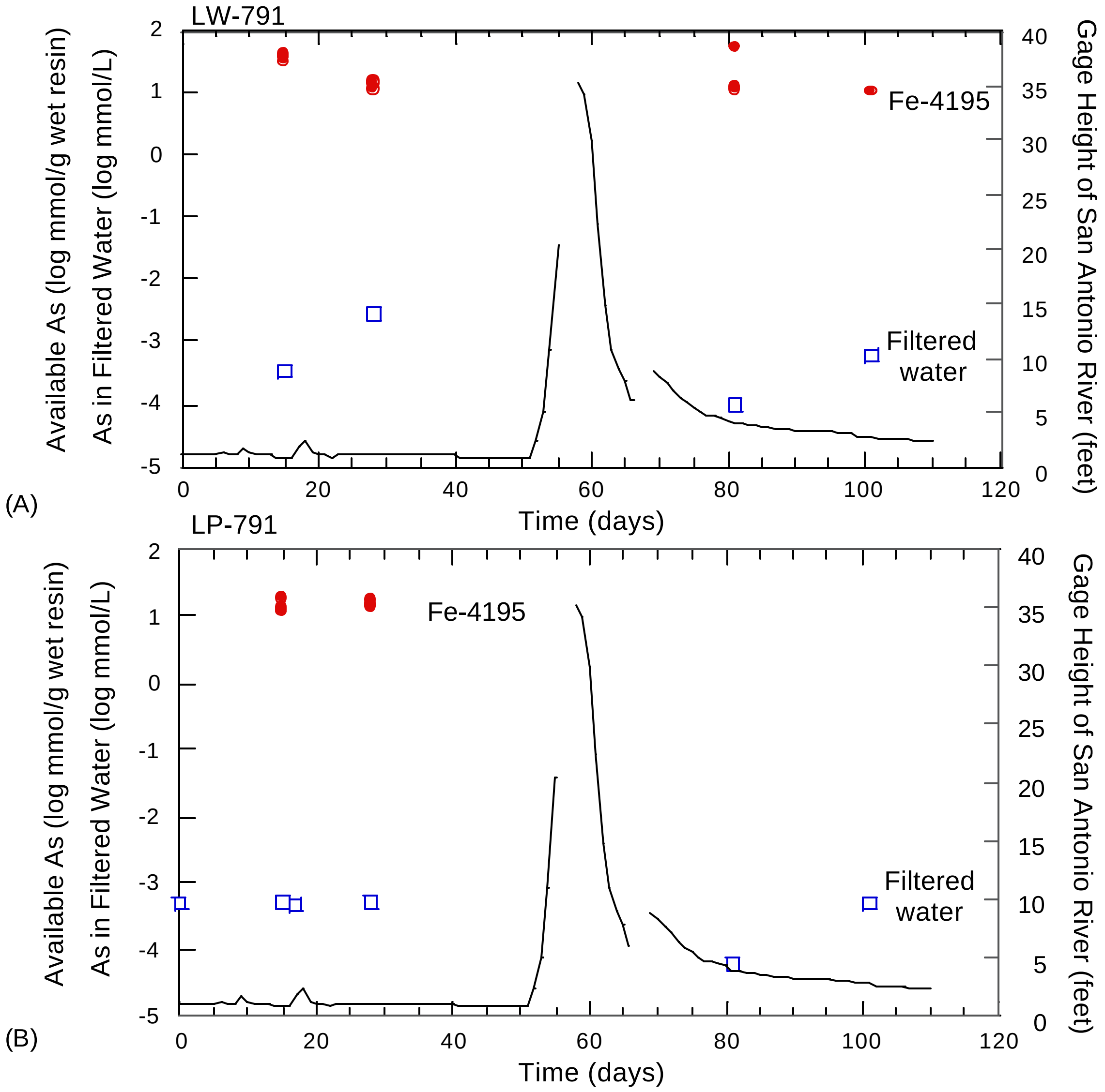
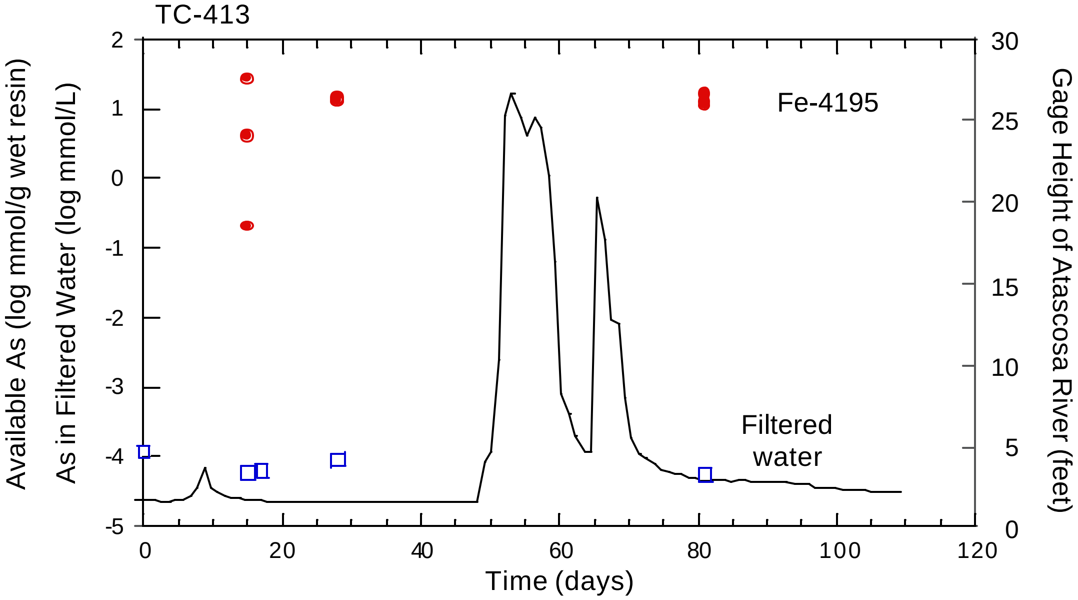


Fig. 16. Potential bioavailable arsenic from resin collected from field sites. These graphs show the log of estimated available arsenic to resins (mmol/g wet resin) against time of exposure in days (filled circles). These graphs also contain the log of arsenic concentrations (mmol L^{-1}) found in filtered water samples collected from the site. Filtered water samples were chosen because everything is dissolved and considered as a bioavailable fraction (unfilled squares). For reference, the hydrograph from the major river near the site location was also plotted (feet). The breaks in data are a result of no available data for that time (USGS, 2002). (A) LW-791. (B) LP-791.

(C)



(D)

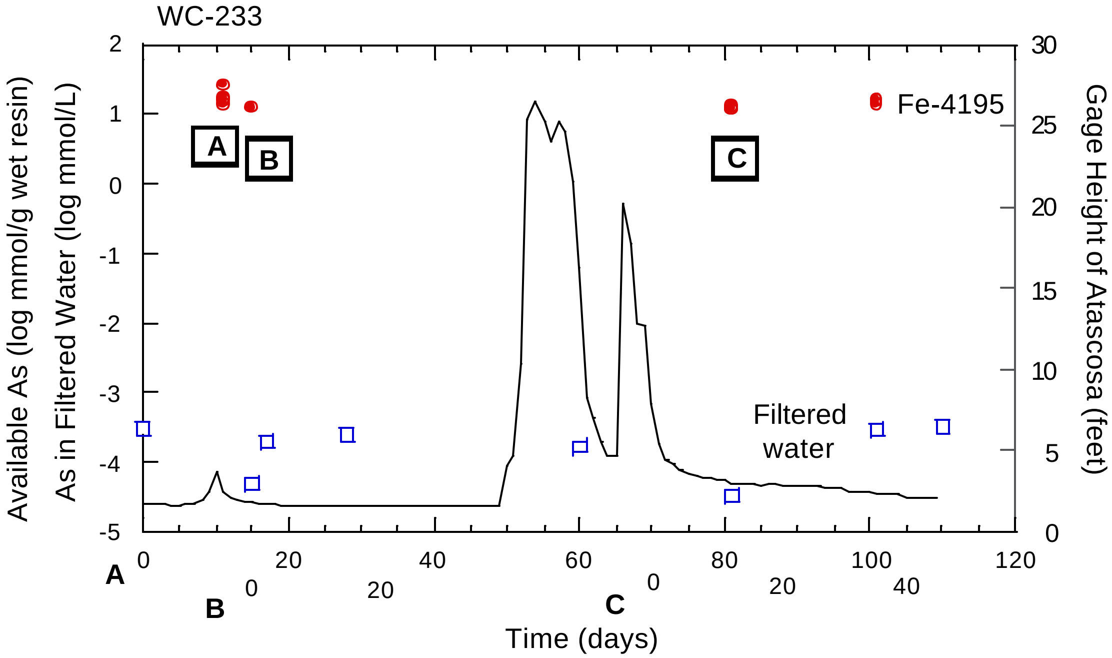


Fig. 16. (*continued*) (C) TC-413. (D) WC-233. One resin bag was found after 15 days from the beginning of the original field experiment, labeled A. The second experiment began 17 days after the original experiment. Available arsenic after 11 days of exposure is labeled B. Post-flood experiment labeled C.

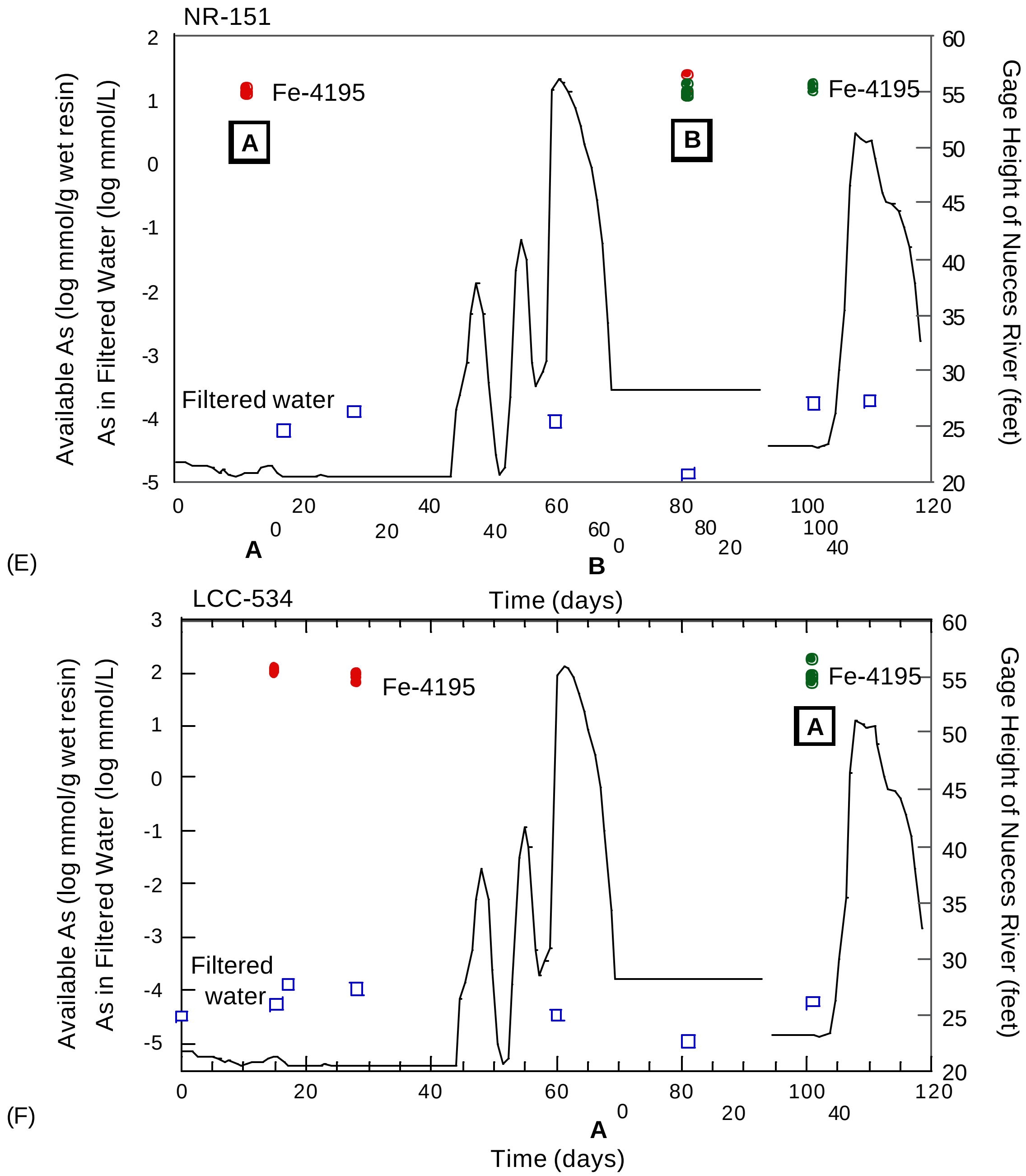


Fig. 16. (*continued*) (E) NR-151. This site was found 17 days after the original experiment began where data labeled A denotes 11 days of exposure. After 81 days, the water remained high so a second experiment was started. B denotes the first (20 days of exposure) and results from original samples exposed for 84 days. (F) LCC-534. Post-flood experiment labeled A.

Tordilla Creek experienced different environmental conditions compared to the other sites. Water levels remained constant throughout the sampling period and there was no evidence of deposition or high water during the flood event, which is reasonable given that the Tordilla Creek catchment basin is large and allows water to constantly flow. Fig. 16C shows a constant arsenic concentration in the filtered water samples and the leveling of the available arsenic to the resin after the flood event. This trend could be attributed to the fact that this area did not appear to be affected by the flood. As a result, the environmental conditions and concentrations were stable and allowed this site to be a field control.

The flood event detoured further sample device collection as a result of high water at several of the locations like LP-791, which was flooded well past the 100 day mark; however, the expected trend was a rise in the amount of potentially bioavailable arsenic in the area. As potentially bioavailable arsenic became sequestered by organic matter or iron oxides, the amount of arsenic sorbed by the resin would eventually become constant.

Post-flood experiments were started at WC-233, NR-151, and LCC-233. Trends in the WC-233 resin during this experiment are comparable to TC-413 where potentially bioavailable arsenic stayed constant. NR-151 showed a decrease in extracted arsenic concentrations, results similar to those found at the beginning at LP-791. Because of the high water level, the resin devices were placed at the current river level. As the flood waters receded, the sediments dried along with the resin and potentially bioavailable arsenic may have been sequestered. On the other hand, the LCC-233 resin devices were buried under approximately 3 feet of water. Because of the high water level, the sediment was saturated allowing the resin to remain active.

Potential Arsenic Bioavailability as a Function of Geology

Concentrations of arsenic extracted from resin exposed to sediment for 28 days was compared to arsenic concentrations extracted from sediment digests from each field location (Fig. 17). Resin in the small wetland area (LW-791) adsorbed the most available arsenic as expected from studies such as Cullen and Reimer (1989), Gambrell (1994), and Pascoe et al.

(1994). This was likely due to 1) the high arsenic concentration and 2) the area remained saturated as a result of groundwater seeps and runoff from the Lyssy Pond dam for the duration of the experiment, allowing the resin to remain hydrated and actively sorb arsenic.

The lake environment (LCC-534) was comparable to the wetland environment, such that the soils remained saturated during the 28 day experiment. This area is also geomorphically similar to the wetland because the site was located in a finger of the lake where conditions are stable, a perfect location for sequestration of nutrients and metals, evident by the many resident plants and animals. Bioavailability increases in these environments where available nutrients for uptake exist, allowing plants to be a prominent feature (Doyle and Otte, 1997; Kneebone and Hering, 2000).

The pond site (LP-791) and the ephemeral stream (WC-233) displayed less potentially bioavailable arsenic. Perhaps this is a result of occasional flushing of the systems. Both of these environments were greatly affected by the flood; however, during the 28 day collection time, water levels at both sites were approximately 2 feet below the original level. Another hypothesis for the low arsenic availability to the resin may be the organic matter content found in LP-791 (3.6%). In this case arsenic may have sorbed more readily to the organic matter compared to the resin. Further analysis of competition for arsenic adsorption between organic matter and resin would need to be conducted to confirm this hypothesis.

The perennial stream (TC-413) was the most consistent site and exhibited the lowest amounts of potentially bioavailable arsenic. The site always maintained small amounts of flowing water and a ponded area that changed only very slightly in water level over the course of the experiment. The area was well protected from the flood event and did not experience flushing.

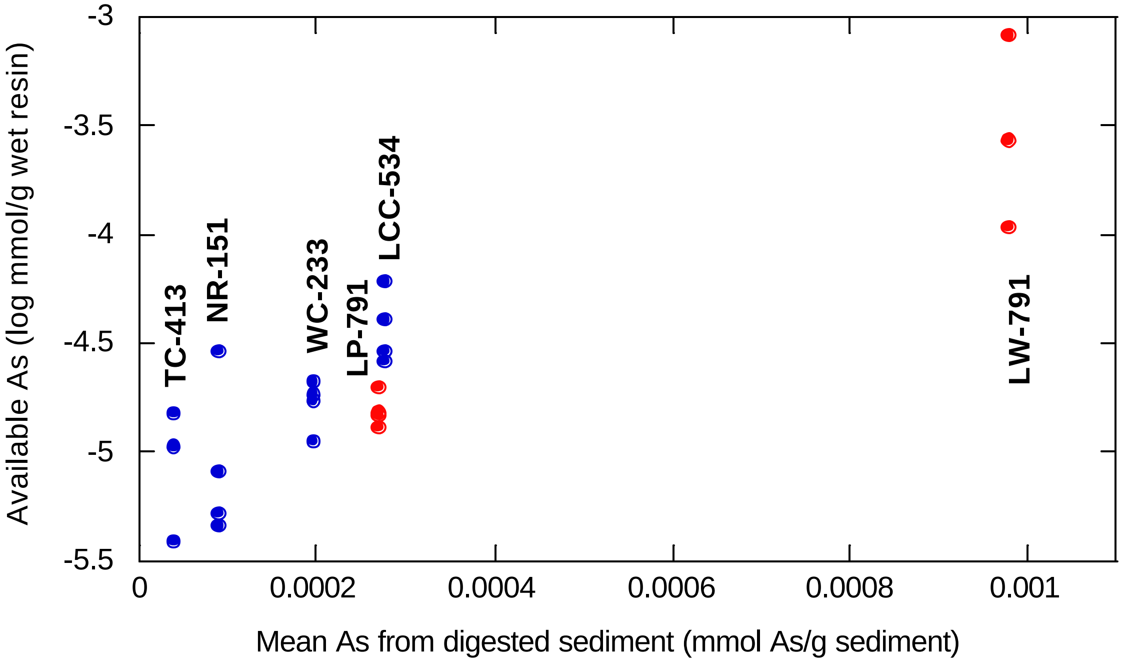


Fig. 17. Potential bioavailable arsenic measured from field resin exposed over 28 days as a function of available arsenic in digested sediment.

The trends seen in arsenic sorbed by the resins at WC-233 and TC-413 (Fig. 17) may be related to the lack of plant available iron (12.54 ppm and 13.94 ppm respectively) and low amounts of organic matter (1% and 0.8% respectively) in the environment. In the case of LW-719, the plant available iron and organic matter are high (114.40 ppm, 3.6%), which provides arsenic with many potential binding sites. Arsenic may then become sequestered and released as a result of kinetic, redox, or pH conditions.

The low resin-extractable arsenic seen in the river environment (NR-151) could have been influenced by the transport of arsenic by colloidal material. A likely explanation for the low concentration of resin-extractable arsenic seen in the pond, perennial stream, ephemeral stream, and the river, is the low water content of these sites. The resin most likely became drier compared to the wetland and lake environments and could not accept as much arsenic. Similarly, plants, when dry, slow in their ability to accept nutrients and/or metals in order to conserve energy to live.

It is also interesting to note that potential arsenic bioavailability in the Nueces River Watershed increased down the watershed and then dropped when it reached LCC-534, the mouth of the Nueces River (Fig. 17). These trends are different compared with trends reported in Helgen and Moore (1996) and Marcus et al. (2001) where metal concentrations decreased downstream.

To answer the hypothesis of whether geomorphic processes control the potential bioavailability of arsenic, a bioavailability index was needed (Fig. 18). This index was calculated by dividing mmol As/ g wet resin from resin exposed to field conditions over 28 days by mmol As/g sediment from the digested sediment samples. The trends seen in Fig. 18 show how bioavailability is influenced by the different geologic environments. LW-791 exhibits a very low potential arsenic bioavailablility ratio, suggesting that this environment sequesters arsenic well. This trend was expected based on observations of the geologic environment such as the strong hydrogen sulfide smell suggesting a reducing environment, the high organic matter content, and findings from other papers concerning the sequestration of metals by wetlands (Gambrell, 1994;

Kneebone and Hering, 2000). LP-791 also exhibits a high sequestration potential based on the ratio. A hypothesis concerning the sequestration of arsenic in the wetland and pond environment could also be made about the possible presence of iron oxide and manganese oxide phases which would control the bioavailability of arsenic (Kneebone and Hering, 2000); however, more data is needed. WC-233 is also predicted to be a sequestering environment. It makes sense that this area may be sequestering arsenic because it is an ephemeral stream in which arsenic is not being flushed as with the river and perennial stream. Two other hypotheses are 1) that arsenic is being coprecipitated with calcite or 2) sequestration is controlled by sulfide minerals (Appendix V).

A high potential arsenic bioavailability was predicted for the lake, river, and perennial stream environments (Fig. 18). These trends make sense hydrologically because these environments carry a high colloidal load by which arsenic can be transported downstream and deposited. TC-413, however, is part of the headwaters for the Atascosa River where bioavailable arsenic would have to already be present. The high ratio for LCC-534 is also expected because it is at the mouth of the Nueces River; arsenic not sequestered in small tributaries is transported downstream where it can accumulate but still be available for uptake.

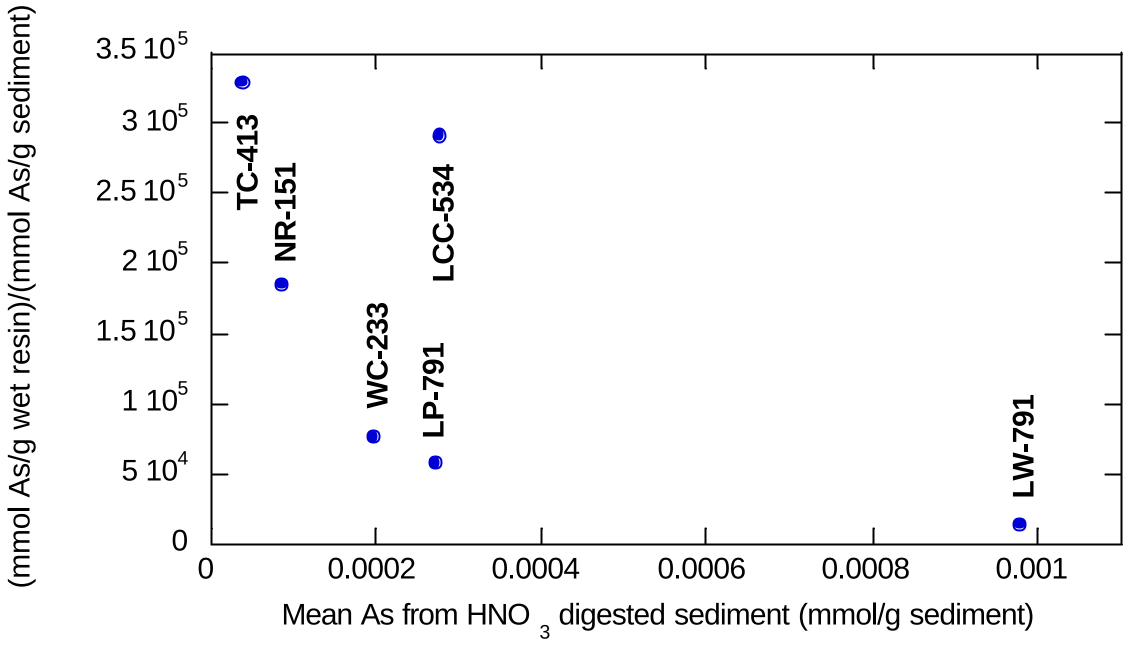


Fig. 18. Potential arsenic bioavailability normalized by total HNO_3-extractable arsenic.

CHAPTER IV

IMPLICATIONS AND SUMMARY

This study is important because of the lack of information known about arsenic availability and bioavailability in natural systems. Though only a small number of field sites were studied, the information concerning quantification of available arsenic could be applicable to areas with potential ecological risk like the Western United States. Areas such as West Bengal and Bangladesh have already experienced high toxic exposure so a technique such as this may be used after remediation to insure decreased availability.

Potential toxicity in different geologic environments along the watersheds is dependent on the total concentration and availability of arsenic. It is important to identify those geologic environments that sequester contaminants because these systems retard contaminant transport, limit toxicity, and can act as long-term sources for the contaminant.

Though the wetland and the lake environments were hydrologically unconnected, they both experience high concentrations of available arsenic as compared to the other environments. These two sites were similar only in the environmental conditions which allowed the arsenic to become sequestered and available to organisms and the resin. Interestingly, the amount of arsenic sequestered by the resin in these locations fell within the lower range of reported uptake by terrestrial grasses, emergent plants like *Carex sp.* and *Typha latifolia*, and some submergent plants (Koch et al., 2000).

The other field sites experienced drier conditions in which case the resin was inactive. This could be analogous to plant species that conserve energy during drying periods by lowering the amount of nutrients and metals available for uptake (Liang and Schoenau, 1995).

This technique proved to be a potentially useful tool for assessment of available arsenic and may prove to also be an efficient assessment method for other metals. In future studies, a collection and analysis of arsenic in several plant species from the field sites could provide a stronger argument for assessment of phytoavailablilty. It would also be interesting to study saturated environment along a transect to determine locations of metal sequestration and hypothesize about controlling factors as a function of hydrologic environments. However, this project proved to be successful in discovering differences in arsenic availability as a function of geologic environment.

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APPENDIX I

MINTEQ MODELING OF SOLUTION CHEMISTRY IN PHOSPHATE COMPETITION EXPERIMENT

```
________________________________________________________________________________
________________________________ PART 1 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


Comp As vs. P 1:1


--------------------------------------------------------------------------------
 Temperature (Celsius):  25.00
 Units of concentration: MOLAL
 Ionic strength to be computed.
 If specified, carbonate concentration represents total inorganic carbon.
 Do not automatically terminate if charge imbalance exceeds 30%
 Precipitation is allowed only for those solids specified as ALLOWED
   in the input file (if any).
 The maximum number of iterations is: 200
 The method used to compute activity coefficients is: Davies equation
 Full output file

--------------------------------------------------------------------------------
    330  0.000E-01   -7.00 y
     61  6.670E-08   -7.18 y
    580  1.610E-07   -6.79 y
    500  5.230E-07  -10.64

 H2O has been inserted as a COMPONENT
________________________________________________________________________________
________________________________ PART 1 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


--------------------------------------------------------------------------------

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
----------- THE INPUT DATA WILL BE USED IN A SERIES OF  8 SWEEPS ------------
  The input parameters for each sweep will be identical to this initial
  listing except that:
  --  The total dissolved concentration of  component number 500 in
      successive sweeps will be:
       5.230E-07  1.050E-06  2.090E-06  3.140E-06  4.180E-06  5.230E-06
       7.850E-06  1.050E-05
  --  After the first sweep, the initial component activity guesses
      for each successive sweep are the equilibrium activities computed at the
      end of the sweep which precedes it.

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

--------------------------------------------------------------------------------

INPUT DATA BEFORE TYPE MODIFICATIONS

   ID       NAME       ACTIVITY GUESS    LOG GUESS   ANAL TOTAL
    330  H+1              1.000E-07        -7.000   0.000E-01
     61  H3AsO4           6.607E-08        -7.180   6.670E-08
    580  PO4-3            1.622E-07        -6.790   1.610E-07
    500  Na+1             2.291E-11       -10.640   5.230E-07
      2  H2O              1.000E+00         0.000   0.000E-01
________________________________________________________________________________
________________________________ PART 2 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


 ALL SPECIES CONSIDERED IN THIS PROBLEM

--------------------------------------------------------------------------------
```

```
 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME         DH         LOGK    MIN LOGK  MAX LOGK    Z    DHA   DHB     GFW
    330  H+1            0.0000      0.0000     0.000     0.000   1.00  9.00  0.00    1.0080
     61  H3AsO4         0.0000      0.0000     0.000     0.000   0.00  0.00  0.00  141.9431
    580  PO4-3          0.0000      0.0000     0.000     0.000  -3.00  5.00  0.00   94.9714
    500  Na+1           0.0000      0.0000     0.000     0.000   1.00  4.00  0.08   22.9898

--------------------------------------------------------------------------------

 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME         DH         LOGK    MIN LOGK  MAX LOGK    Z    DHA   DHB     GFW
3305802  H3PO4          0.0000     21.7000     0.000     0.000   0.00  0.00  0.00   97.9950
3300020  OH-           13.3450    -13.9980     0.000     0.000  -1.00  3.50  0.00   17.0074
5005800  NaHPO4 -       0.0000     12.6360     0.000     0.000  -1.00  5.40  0.00  118.9690
3300611  H2AsO4 -      -1.6900     -2.2430     0.000     0.000  -1.00  0.00  0.00  140.9350
3300612  HAsO4 -2      -0.9200     -9.0010     0.000     0.000  -2.00  0.00  0.00  139.9270
3300613  AsO4 -3        3.4300    -20.5970     0.000     0.000  -3.00  0.00  0.00  138.9190
3305800  HPO4 -2       -3.5300     12.3460     0.000     0.000  -2.00  5.00  0.00   95.9790
3305801  H2PO4 -       -4.5200     19.5530     0.000     0.000  -1.00  5.40  0.00   96.9870

--------------------------------------------------------------------------------

 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME         DH         LOGK    MIN LOGK  MAX LOGK    Z    DHA   DHB     GFW
      2  H2O            0.0000      0.0000     0.000     0.000   0.00  0.00  0.00   18.0153


    Charge Balance: UNSPECIATED

      Sum of CATIONS=  5.230E-07 Sum of ANIONS =  4.830E-07

      PERCENT DIFFERENCE =  3.976E+00  (ANIONS - CATIONS)/(ANIONS + CATIONS)



             -------------------------------------------------------
             |  IMPROVED ACTIVITY GUESSES PRIOR TO FIRST ITERATION: |
             |      H3AsO4      Log activity guess:   -12.37        |
             |      PO4-3       Log activity guess:   -12.56        |
             |                                                      |
             -------------------------------------------------------
________________________________________________________________________________
______________________________ PART 3 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

    ITER     NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
      0   Na+1         5.230E-07  -5.230E-07   -10.64000    5.229E-07
      1   PO4-3        1.610E-07  -7.974E-08   -12.26369    7.972E-08
      2   Na+1         5.230E-07   5.122E-10    -6.28150    4.599E-10
      3   PO4-3        1.610E-07  -2.344E-09   -12.18077    2.328E-09
      4   H+1          0.000E-01   1.817E-11    -7.24649    4.298E-13

 ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1          0.000E-01  5.675E-08    -7.24649    0.999023  -1.323E-16
   61  H3AsO4       6.670E-08  1.617E-13   -12.79138    1.000000   5.686E-16
  580  PO4-3        1.610E-07  6.735E-13   -12.17552    0.991229   1.082E-15
  500  Na+1         5.230E-07  5.230E-07    -6.28192    0.999021   1.373E-15
    2  H2O          0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01
```

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-----------------------------------------------------------------------------

 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
   330  H+1          5.675E-08  5.669E-08    -7.24649   0.99902      0.000
    61  H3AsO4        1.617E-13  1.617E-13   -12.79138   1.00000      0.000
   580  PO4-3         6.735E-13  6.675E-13   -12.17552   0.99123      0.004
   500  Na+1          5.230E-07  5.225E-07    -6.28192   0.99902      0.000

-----------------------------------------------------------------------------

 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4         6.096E-13  6.096E-13   -12.21498   1.00000     21.700
3300020  OH-          1.774E-07  1.772E-07    -6.75151   0.99902    -13.998
5005800  NaHPO4 -      8.560E-14  8.552E-14   -13.06793   0.99902     12.636
3300611  H2AsO4 -      1.631E-08  1.630E-08    -7.78789   0.99902     -2.243
3300612  HAsO4 -2      5.038E-08  5.019E-08    -7.29940   0.99609     -8.999
3300613  AsO4 -3      2.264E-12  2.244E-12   -11.64892   0.99123    -20.593
3305800  HPO4 -2       8.427E-08  8.394E-08    -7.07601   0.99609     12.348
3305801  H2PO4 -       7.672E-08  7.665E-08    -7.11549   0.99902     19.553

-----------------------------------------------------------------------------

 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME       CALC MOL       LOG MOL   NEW LOGK     DH
     2  H2O          -1.774E-07      -6.751      0.000      0.000
_____________________________________________________________________________
______________________________ PART 4 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


              PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
             TYPE I and TYPE II (dissolved and adsorbed) species


H+1
         >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

         >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

         >1000.    PERCENT BOUND IN SPECIES #3300612   HA sO4 -2

         >1000.    PERCENT BOUND IN SPECIES #3300613   AsO4 -3


H3AsO4
           24.5    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

           75.5    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
           52.3    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

           47.7    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
          100.0    PERCENT BOUND IN SPECIES #    500   Na+1
```

```
H2O
        100.0    PERCENT BOUND IN SPECIES #3300020   OH-

______________________________________________________________________________
______________________________ PART 5 of OUTPUT FILE _________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



        ------------------------------------------------------
        ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX    NAME          DISSOLVED          SORBED          PRECIPITATED
             MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          -1.323E-16   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4         6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3         1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1          5.230E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O          1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


   Charge Balance: SPECIATED

    Sum of CATIONS =  5.797E-07 Sum of ANIONS   5.397E-07

    PERCENT DIFFERENCE =   3.573E+00  (ANIONS - CATIONS)/(ANIONS + CATIONS)

   EQUILIBRIUM IONIC STRENGTH (m) =   6.944E-07

   EQUILIBRIUM pH               =   7.246

   DATE ID NUMBER:          ******
   TIME ID NUMBER:        16561636
________________________________________________________________________________
______________________________ PART 6 of OUTPUT FILE ___________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


Saturation indices and stoichiometry of all minerals

  ID #    NAME     Sat. Index       Stoichiometry in [brackets]
 3006100 AS2O5        -32.282    [  2.000]  61  [ -3.000]   2
________________________________________________________________________________
______________________________ PART 1 of OUTPUT FILE ___________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  2 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
 1)  The total concentration of the component Na+1         is:   1.050E-06
 2)  The log activity guesses for all components are as computed at
     the point of FIRST convergence in the previous problem.

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______________________________ PART 3 of OUTPUT FILE ___________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

   ITER     NAME      TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
     0   Na+1         1.050E-06  -5.275E-07    -6.28192    5.274E-07
     2   Na+1         1.050E-06   1.208E-09    -5.97881    1.103E-09

 ID       NAME      ANAL MOL    CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1         0.000E-01  5.677E-08    -7.24641    0.998853  -2.882E-12
   61  H3AsO4      6.670E-08  1.616E-13   -12.79149    1.000000   4.759E-13
  580  PO4-3       1.610E-07  6.740E-13   -12.17582    0.989709  -1.065E-12
  500  Na+1        1.050E-06  1.050E-06    -5.97931    0.998851   1.575E-13
    2  H2O         0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME      CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
   330  H+1          5.677E-08  5.670E-08    -7.24641   0.99885      0.000
    61  H3AsO4       1.616E-13  1.616E-13   -12.79149   1.00000      0.000
   580  PO4-3        6.740E-13  6.671E-13   -12.17582   0.98971      0.004
   500  Na+1         1.050E-06  1.049E-06    -5.97931   0.99885      0.000

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME      CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4       6.094E-13  6.094E-13   -12.21506   1.00000     21.700
3300020  OH-         1.774E-07  1.772E-07    -6.75159   0.99885    -13.998
5005800  NaHPO4 -    1.718E-13  1.716E-13   -12.76554   0.99885     12.636
3300611  H2AsO4 -    1.631E-08  1.629E-08    -7.78807   0.99885     -2.243
3300612  HAsO4 -2    5.039E-08  5.016E-08    -7.29966   0.99541     -8.999
3300613  AsO4 -3     2.266E-12  2.243E-12   -11.64925   0.98970    -20.593
3305800  HPO4 -2     8.429E-08  8.390E-08    -7.07623   0.99541     12.348
3305801  H2PO4 -     7.671E-08  7.662E-08    -7.11565   0.99885     19.553

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME      CALC MOL      LOG MOL   NEW LOGK     DH
     2  H2O        -1.774E-07      -6.751      0.000     0.000
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______________________________ PART 4 of OUTPUT FILE _________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



           PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
         TYPE I and TYPE II (dissolved and adsorbed) species


H+1
         >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

         >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

         >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

          235.9    PERCENT BOUND IN SPECIES #3300613   AsO4 -3
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H3AsO4
          24.5    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

          75.5    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
          52.4    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

          47.6    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
         100.0    PERCENT BOUND IN SPECIES #    500   Na+1


H2O
         100.0    PERCENT BOUND IN SPECIES #3300020   OH-
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______________________________ PART 5 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



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         ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX     NAME          DISSOLVED          SORBED          PRECIPITATED
                  MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          -2.882E-12   100.0  0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4        6.670E-08   100.0  0.000E-01     0.0   0.000E-01     0.0
580  PO4-3         1.610E-07   100.0  0.000E-01     0.0   0.000E-01     0.0
500  Na+1          1.050E-06   100.0  0.000E-01     0.0   0.000E-01     0.0
  2  H2O           1.774E-07   100.0  0.000E-01     0.0   0.000E-01     0.0


    Charge Balance: SPECIATED

     Sum of CATIONS =  1.107E-06 Sum of ANIONS   5.398E-07

     PERCENT DIFFERENCE =   3.444E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

    EQUILIBRIUM IONIC STRENGTH (m) =   9.580E-07

    EQUILIBRIUM pH                =   7.246

    DATE ID NUMBER:          ******
    TIME ID NUMBER:        16561652
__________________________________________________________________________________
______________________________ PART 6 of OUTPUT FILE _____________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


Saturation indices and stoichiometry of all minerals

   ID #     NAME      Sat. Index       Stoichiometry in [brackets]
 3006100 AS2O5        -32.282    [  2.000]  61  [ -3.000]   2
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______________________________ PART 1 of OUTPUT FILE _____________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16
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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  3 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
  1)  The total concentration of the component Na+1        is:   2.090E-06
  2)  The log activity guesses for all components are as computed at
      the point of FIRST convergence in the previous problem.

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______________________________ PART 3 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

     ITER      NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
       0   Na+1          2.090E-06  -1.041E-06    -5.97931    1.041E-06
       2   Na+1          2.090E-06   2.985E-09    -5.67985    2.776E-09

 ID        NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1          0.000E-01  5.680E-08    -7.24630    0.998576  -4.439E-12
   61  H3AsO4       6.670E-08  1.616E-13   -12.79168    1.000000   7.160E-13
  580  PO4-3        1.610E-07  6.750E-13   -12.17630    0.987238  -1.676E-12
  500  Na+1         2.090E-06  2.090E-06    -5.68047    0.998574   3.130E-13
    2  H2O          0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID        NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
    330  H+1          5.680E-08  5.672E-08    -7.24630   0.99858      0.001
     61  H3AsO4       1.616E-13  1.616E-13   -12.79168   1.00000      0.000
    580  PO4-3        6.750E-13  6.663E-13   -12.17630   0.98724      0.006
    500  Na+1         2.090E-06  2.087E-06    -5.68047   0.99857      0.001

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID        NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4          6.093E-13  6.093E-13   -12.21520   1.00000     21.700
3300020  OH-            1.774E-07  1.771E-07    -6.75170   0.99857    -13.997
5005800  NaHPO4 -       3.416E-13  3.411E-13   -12.46707   0.99857     12.637
3300611  H2AsO4 -       1.630E-08  1.628E-08    -7.78838   0.99857     -2.242
3300612  HAsO4 -2       5.040E-08  5.011E-08    -7.30008   0.99430     -8.999
3300613  AsO4 -3        2.269E-12  2.240E-12   -11.64978   0.98723    -20.591
3305800  HPO4 -2        8.431E-08  8.383E-08    -7.07660   0.99431     12.348
3305801  H2PO4 -        7.669E-08  7.658E-08    -7.11590   0.99857     19.554

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID        NAME       CALC MOL       LOG MOL   NEW LOGK     DH
     2  H2O          -1.774E-07      -6.751      0.000      0.000
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______________________________ PART 4 of OUTPUT FILE ___________________________
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  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


              PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
            TYPE I and TYPE II (dissolved and adsorbed) species


H+1
        >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

        >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

        >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

         153.3    PERCENT BOUND IN SPECIES #3300613   AsO4 -3


H3AsO4
          24.4    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

          75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
          52.4    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

          47.6    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
         100.0    PERCENT BOUND IN SPECIES #    500   Na+1


H2O
         100.0    PERCENT BOUND IN SPECIES #3300020   OH-
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____________________________ PART 5 of OUTPUT FILE ________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



          -------------------------------------------------------
          ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX   NAME         DISSOLVED          SORBED          PRECIPITATED
                MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1        -4.439E-12   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4      6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3       1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1        2.090E-06   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O         1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


    Charge Balance: SPECIATED

     Sum of CATIONS =  2.147E-06 Sum of ANIONS   5.398E-07

     PERCENT DIFFERENCE =   5.982E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

    EQUILIBRIUM IONIC STRENGTH (m) =   1.478E-06

    EQUILIBRIUM pH                 =   7.246
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     DATE ID NUMBER:          ******
     TIME ID NUMBER:        16561657
_____________________________________________________________________
_______________________________ PART 6 of OUTPUT FILE _______________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


Saturation indices and stoichiometry of all minerals

   ID #     NAME      Sat. Index       Stoichiometry in [brackets]
  3006100 AS2O5        -32.282   [  2.000]  61  [ -3.000]   2
_____________________________________________________________________
_______________________________ PART 1 of OUTPUT FILE _______________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


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*** This is the beginning of SWEEP NUMBER  4 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
  1)  The total concentration of the component Na+1         is:   3.140E-06
  2)  The log activity guesses for all components are as computed at
      the point of FIRST convergence in the previous problem.

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_______________________________ PART 3 of OUTPUT FILE _______________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

     ITER      NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
       0   Na+1          3.140E-06  -1.053E-06    -5.68047    1.053E-06
       2   Na+1          3.140E-06   5.220E-09    -5.50307    4.906E-09

 ID       NAME       ANAL MOL    CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1         0.000E-01  5.682E-08    -7.24620    0.998344  -6.010E-12
   61  H3AsO4       6.670E-08  1.615E-13   -12.79183    1.000000   9.583E-13
  580  PO4-3        1.610E-07  6.757E-13   -12.17671    0.985163  -2.292E-12
  500  Na+1         3.140E-06  3.140E-06    -5.50379    0.998340   4.697E-13
    2  H2O         0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
    330  H+1         5.682E-08  5.673E-08   -7.24620   0.99834      0.001
     61  H3AsO4        1.615E-13  1.615E-13   -12.79183   1.00000      0.000
    580  PO4-3        6.757E-13  6.657E-13   -12.17671   0.98516      0.006
    500  Na+1         3.140E-06  3.135E-06    -5.50379   0.99834      0.001

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4         6.091E-13  6.091E-13   -12.21531   1.00000     21.700
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3300020  OH-           1.774E-07  1.771E-07    -6.75180   0.99834    -13.997
5005800  NaHPO4 -       5.129E-13  5.120E-13   -12.29070   0.99834     12.637
3300611  H2AsO4 -       1.630E-08  1.627E-08    -7.78864   0.99834     -2.242
3300612  HAsO4 -2       5.040E-08  5.007E-08    -7.30044   0.99337     -8.998
3300613  AsO4 -3        2.271E-12  2.237E-12   -11.65024   0.98515    -20.591
3305800  HPO4 -2        8.433E-08  8.377E-08    -7.07691   0.99338     12.349
3305801  H2PO4 -        7.667E-08  7.654E-08    -7.11611   0.99834     19.554

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME       CALC MOL      LOG MOL   NEW LOGK     DH
     2  H2O          -1.774E-07      -6.751      0.000      0.000
______________________________________________________________________________
______________________________ PART 4 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



              PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
            TYPE I and TYPE II (dissolved and adsorbed) species


H+1
            >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

            >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

            >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

             113.4    PERCENT BOUND IN SPECIES #3300613   AsO4 -3


H3AsO4
              24.4    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

              75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
              52.4    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

              47.6    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
             100.0    PERCENT BOUND IN SPECIES #    500   Na+1


H2O
             100.0    PERCENT BOUND IN SPECIES #3300020   OH-
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______________________________ PART 5 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



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             ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX    NAME          DISSOLVED           SORBED           PRECIPITATED
                  MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1         -6.010E-12   100.0   0.000E-01     0.0   0.000E-01     0.0
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 61  H3AsO4        6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3         1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1          3.140E-06   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O           1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


    Charge Balance: SPECIATED

      Sum of CATIONS =  3.197E-06 Sum of ANIONS   5.398E-07

      PERCENT DIFFERENCE =   7.111E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

    EQUILIBRIUM IONIC STRENGTH (m) =   2.003E-06

    EQUILIBRIUM pH                =   7.246

    DATE ID NUMBER:          ******
    TIME ID NUMBER:        16561663
______________________________________________________________________________
________________________________ PART 6 of OUTPUT FILE ____________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


Saturation indices and stoichiometry of all minerals

   ID #     NAME      Sat. Index       Stoichiometry in [brackets]
  3006100 AS2O5        -32.283    [  2.000]  61  [ -3.000]   2
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________________________________ PART 1 of OUTPUT FILE ____________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  5 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
  1)  The total concentration of the component Na+1         is:   4.180E-06
  2)  The log activity guesses for all components are as computed at
      the point of FIRST convergence in the previous problem.

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________________________________ PART 3 of OUTPUT FILE ____________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

    ITER      NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
     0   Na+1          4.180E-06  -1.045E-06    -5.50379    1.045E-06
     2   Na+1          4.180E-06   7.798E-09    -5.37882    7.380E-09

 ID        NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1         0.000E-01  5.685E-08    -7.24611    0.998142  -7.565E-12
   61  H3AsO4       6.670E-08  1.614E-13   -12.79197    1.000001   1.198E-12
  580  PO4-3        1.610E-07  6.764E-13   -12.17707    0.983368  -2.902E-12
  500  Na+1         4.180E-06  4.180E-06    -5.37963    0.998138   6.245E-13
    2  H2O         0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01
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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME      CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
    330  H+1          5.685E-08  5.674E-08    -7.24611   0.99814      0.001
     61  H3AsO4        1.614E-13  1.614E-13   -12.79197   1.00000      0.000
    580  PO4-3         6.764E-13  6.652E-13   -12.17707   0.98337      0.007
    500  Na+1          4.180E-06  4.172E-06    -5.37963   0.99814      0.001

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME      CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4         6.090E-13  6.090E-13   -12.21541   1.00000     21.700
3300020  OH-          1.774E-07  1.771E-07    -6.75189   0.99814    -13.997
5005800  NaHPO4 -      6.823E-13  6.811E-13   -12.16681   0.99814     12.637
3300611  H2AsO4 -      1.629E-08  1.626E-08    -7.78886   0.99814     -2.242
3300612  HAsO4 -2      5.041E-08  5.003E-08    -7.30074   0.99257     -8.998
3300613  AsO4 -3       2.273E-12  2.235E-12   -11.65063   0.98336    -20.590
3305800  HPO4 -2       8.434E-08  8.372E-08    -7.07718   0.99257     12.349
3305801  H2PO4 -       7.665E-08  7.651E-08    -7.11629   0.99814     19.554

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME      CALC MOL       LOG MOL   NEW LOGK     DH
     2  H2O         -1.774E-07      -6.751      0.000      0.000
_______________________________________________________________________________
______________________________ PART 4 of OUTPUT FILE __________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


          PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
        TYPE I and TYPE II (dissolved and adsorbed) species


H+1
       >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

       >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

       >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

         90.1    PERCENT BOUND IN SPECIES #3300613   AsO4 -3


H3AsO4
         24.4    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

         75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
         52.4    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

         47.6    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
        100.0    PERCENT BOUND IN SPECIES #    500   Na+1
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H2O
        100.0    PERCENT BOUND IN SPECIES #3300020   OH-
_______________________________________________________________________________
______________________________ PART 5 of OUTPUT FILE __________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



        ----------------------------------------------------
        ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX    NAME          DISSOLVED          SORBED          PRECIPITATED
               MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1         -7.565E-12   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4        6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3         1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1          4.180E-06   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O         1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


   Charge Balance: SPECIATED

    Sum of CATIONS =  4.237E-06 Sum of ANIONS   5.398E-07

    PERCENT DIFFERENCE =   7.740E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

   EQUILIBRIUM IONIC STRENGTH (m) =   2.523E-06

   EQUILIBRIUM pH              =   7.246

   DATE ID NUMBER:        ******
   TIME ID NUMBER:      16561674
_______________________________________________________________________________
______________________________ PART 6 of OUTPUT FILE __________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


Saturation indices and stoichiometry of all minerals

  ID #    NAME     Sat. Index       Stoichiometry in [brackets]
 3006100 AS2O5        -32.283    [  2.000]  61  [ -3.000]   2
_______________________________________________________________________________
______________________________ PART 1 of OUTPUT FILE __________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  6 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
 1)  The total concentration of the component Na+1         is:   5.230E-06
 2)  The log activity guesses for all components are as computed at
     the point of FIRST convergence in the previous problem.

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______________________________ PART 3 of OUTPUT FILE __________________________
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  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

    ITER     NAME      TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
      0   Na+1          5.230E-06  -1.058E-06    -5.37963    1.057E-06
      2   Na+1          5.230E-06   1.072E-08    -5.28150    1.020E-08

 ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1          0.000E-01  5.687E-08    -7.24604   0.997959  -9.134E-12
   61  H3AsO4       6.670E-08  1.614E-13   -12.79210   1.000001   1.440E-12
  580  PO4-3        1.610E-07  6.770E-13   -12.17739   0.981739  -3.518E-12
  500  Na+1         5.230E-06  5.230E-06    -5.28239   0.997954   7.806E-13
    2  H2O          0.000E-01 -1.774E-07     0.00000   1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
   330  H+1          5.687E-08  5.675E-08    -7.24604   0.99796      0.001
    61  H3AsO4       1.614E-13  1.614E-13   -12.79210   1.00000      0.000
   580  PO4-3        6.770E-13  6.647E-13   -12.17739   0.98174      0.008
   500  Na+1         5.230E-06  5.219E-06    -5.28239   0.99795      0.001

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4        6.088E-13  6.088E-13   -12.21550   1.00000     21.700
3300020  OH-          1.774E-07  1.770E-07    -6.75196   0.99795    -13.997
5005800  NaHPO4 -     8.533E-13  8.515E-13   -12.06981   0.99795     12.637
3300611  H2AsO4 -     1.629E-08  1.625E-08    -7.78906   0.99795     -2.242
3300612  HAsO4 -2     5.041E-08  5.000E-08    -7.30102   0.99184     -8.997
3300613  AsO4 -3      2.275E-12  2.234E-12   -11.65099   0.98173    -20.589
3305800  HPO4 -2      8.436E-08  8.367E-08    -7.07742   0.99184     12.350
3305801  H2PO4 -      7.664E-08  7.648E-08    -7.11646   0.99795     19.554

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME       CALC MOL       LOG MOL   NEW LOGK    DH
     2  H2O         -1.774E-07       -6.751     0.000     0.000
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________________________________ PART 4 of OUTPUT FILE __________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



           PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
         TYPE I and TYPE II (dissolved and adsorbed) species


H+1
         >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

         >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

         >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

           74.7    PERCENT BOUND IN SPECIES #3300613   AsO4 -3
```

```
H3AsO4
        24.4    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

        75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
        52.4    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

        47.6    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
       100.0    PERCENT BOUND IN SPECIES #    500   Na+1


H2O
       100.0    PERCENT BOUND IN SPECIES #3300020   OH-
________________________________________________________________________
____________________________ PART 5 of OUTPUT FILE ____________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



       -------------------------------------------------------
       ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX    NAME          DISSOLVED          SORBED          PRECIPITATED
                MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          -9.134E-12   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4        6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3         1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1          5.230E-06   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O           1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


  Charge Balance: SPECIATED

   Sum of CATIONS =  5.287E-06 Sum of ANIONS   5.399E-07

   PERCENT DIFFERENCE =   8.147E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

  EQUILIBRIUM IONIC STRENGTH (m) =   3.048E-06

  EQUILIBRIUM pH             =   7.246

  DATE ID NUMBER:        ******
  TIME ID NUMBER:      16561685
__________________________________________________________________________
____________________________ PART 6 of OUTPUT FILE ______________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


Saturation indices and stoichiometry of all minerals

  ID #    NAME     Sat. Index      Stoichiometry in [brackets]
 3006100 AS2O5        -32.283    [  2.000]  61  [ -3.000]   2
__________________________________________________________________________
____________________________ PART 1 of OUTPUT FILE ______________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16
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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  7 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
  1)  The total concentration of the component Na+1         is:   7.850E-06
  2)  The log activity guesses for all components are as computed at
      the point of FIRST convergence in the previous problem.

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______________________________ PART 3 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

     ITER      NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
      0   Na+1          7.850E-06  -2.631E-06    -5.28239    2.630E-06
      2   Na+1          7.850E-06   1.924E-08    -5.10513    1.845E-08

 ID        NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1          0.000E-01  5.691E-08    -7.24587    0.997562  -1.304E-11
   61  H3AsO4       6.670E-08  1.613E-13   -12.79236    1.000001   2.043E-12
  580  PO4-3        1.610E-07  6.784E-13   -12.17809    0.978216  -5.052E-12
  500  Na+1         7.850E-06  7.850E-06    -5.10619    0.997555   1.169E-12
    2  H2O          0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID        NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
    330  H+1          5.691E-08  5.677E-08    -7.24587   0.99756      0.001
     61  H3AsO4       1.613E-13  1.613E-13   -12.79236   1.00000      0.000
    580  PO4-3        6.784E-13  6.636E-13   -12.17809   0.97822      0.010
    500  Na+1         7.850E-06  7.831E-06    -5.10619   0.99755      0.001

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID        NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4        6.086E-13  6.086E-13   -12.21569   1.00000     21.700
3300020  OH-          1.774E-07  1.770E-07    -6.75213   0.99755    -13.997
5005800  NaHPO4 -     1.279E-12  1.276E-12   -11.89415   0.99756     12.637
3300611  H2AsO4 -     1.628E-08  1.624E-08    -7.78950   0.99755     -2.242
3300612  HAsO4 -2     5.042E-08  4.993E-08    -7.30163   0.99025     -8.997
3300613  AsO4 -3      2.279E-12  2.230E-12   -11.65176   0.97820    -20.587
3305800  HPO4 -2      8.439E-08  8.357E-08    -7.07796   0.99026     12.350
3305801  H2PO4 -      7.660E-08  7.641E-08    -7.11682   0.99756     19.554

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID        NAME       CALC MOL       LOG MOL   NEW LOGK     DH
     2  H2O          -1.774E-07      -6.751      0.000      0.000
_______________________________________________________________________________
______________________________ PART 4 of OUTPUT FILE __________________________
```

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  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


              PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
            TYPE I and TYPE II (dissolved and adsorbed) species


H+1
             >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

             >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

             >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

               52.4    PERCENT BOUND IN SPECIES #3300613   AsO4 -3


H3AsO4
               24.4    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

               75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
               52.4    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

               47.6    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
              100.0    PERCENT BOUND IN SPECIES #    500   Na+1


H2O
              100.0    PERCENT BOUND IN SPECIES #3300020   OH-
__________________________________________________________________________
_____________________________ PART 5 of OUTPUT FILE ______________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



            ------------------------------------------------------
            ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX     NAME           DISSOLVED           SORBED           PRECIPITATED
                  MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          -1.304E-11   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4         6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3          1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1           7.850E-06   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O          1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


    Charge Balance: SPECIATED

      Sum of CATIONS =  7.907E-06 Sum of ANIONS   5.399E-07

      PERCENT DIFFERENCE =   8.722E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

    EQUILIBRIUM IONIC STRENGTH (m) =   4.358E-06

    EQUILIBRIUM pH                =   7.246
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    DATE ID NUMBER:         ******
    TIME ID NUMBER:       16561690
________________________________________________________________________________
______________________________ PART 6 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


Saturation indices and stoichiometry of all minerals

   ID #     NAME      Sat. Index        Stoichiometry in [brackets]
  3006100 AS2O5        -32.284    [  2.000]  61  [ -3.000]   2
________________________________________________________________________________
______________________________ PART 1 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16




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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  8 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
  1)  The total concentration of the component Na+1         is:   1.050E-05
  2)  The log activity guesses for all components are as computed at
      the point of FIRST convergence in the previous problem.

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______________________________ PART 3 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

    ITER      NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
      0   Na+1          1.050E-05  -2.669E-06    -5.10619    2.668E-06
      2   Na+1          1.050E-05   2.938E-08    -4.97881    2.833E-08

 ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1         0.000E-01  5.695E-08    -7.24572    0.997219  -1.699E-11
   61  H3AsO4        6.670E-08  1.612E-13   -12.79260    1.000001   2.652E-12
  580  PO4-3         1.610E-07  6.796E-13   -12.17869    0.975174  -6.603E-12
  500  Na+1          1.050E-05  1.050E-05    -4.98002    0.997209   1.561E-12
    2  H2O         0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
    330  H+1          5.695E-08  5.679E-08    -7.24572   0.99722      0.001
     61  H3AsO4         1.612E-13  1.612E-13   -12.79260   1.00000      0.000
    580  PO4-3         6.796E-13  6.627E-13   -12.17869   0.97517      0.011
    500  Na+1          1.050E-05  1.047E-05    -4.98002   0.99721      0.001

-----------------------------------------------------------------------------

 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
```

```
3305802  H3PO4         6.083E-13  6.083E-13   -12.21586   1.00000     21.700
3300020  OH-          1.774E-07  1.769E-07    -6.75228   0.99721    -13.997
5005800  NaHPO4 -      1.709E-12  1.704E-12   -11.76844   0.99721     12.637
3300611  H2AsO4 -      1.627E-08  1.622E-08    -7.78987   0.99721     -2.242
3300612  HAsO4 -2      5.043E-08  4.987E-08    -7.30215   0.98888     -8.996
3300613  AsO4 -3       2.283E-12  2.226E-12   -11.65243   0.97515    -20.586
3305800  HPO4 -2       8.442E-08  8.348E-08    -7.07842   0.98889     12.351
3305801  H2PO4 -       7.657E-08  7.636E-08    -7.11714   0.99721     19.554

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID     NAME      CALC MOL      LOG MOL   NEW LOGK    DH
    2  H2O       -1.774E-07     -6.751     0.000     0.000
______________________________________________________________________________
______________________________ PART 4 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



            PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
          TYPE I and TYPE II (dissolved and adsorbed) species


H+1
          >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

          >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

          >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

            40.3    PERCENT BOUND IN SPECIES #3300613   AsO4 -3


H3AsO4
            24.4    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

            75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
            52.4    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

            47.6    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
           100.0    PERCENT BOUND IN SPECIES #    500   Na+1


H2O
           100.0    PERCENT BOUND IN SPECIES #3300020   OH-
```

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_______________________________________________________________________________
_______________________________ PART 5 of OUTPUT FILE _________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16



        ------------------------------------------------------
        ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX     NAME          DISSOLVED           SORBED          PRECIPITATED
                  MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          -1.699E-11   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4         6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3          1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1           1.050E-05   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O          1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


   Charge Balance: SPECIATED

    Sum of CATIONS =  1.056E-05 Sum of ANIONS   5.399E-07

    PERCENT DIFFERENCE =   9.027E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

   EQUILIBRIUM IONIC STRENGTH (m) =   5.683E-06

   EQUILIBRIUM pH               =   7.246

   DATE ID NUMBER:         ******
   TIME ID NUMBER:       16561696
_______________________________________________________________________________
_______________________________ PART 6 of OUTPUT FILE _________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 16:56:16


Saturation indices and stoichiometry of all minerals

  ID #     NAME      Sat. Index       Stoichiometry in [brackets]
                                 3006100 AS2O5        -32.284    [  2.000]  61  [ -3.000]   2
```

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______________________________ PART 1 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


Comp As:P 1:10


--------------------------------------------------------------------------------
 Temperature (Celsius):  25.00
 Units of concentration: MOLAL
 Ionic strength to be computed.
 If specified, carbonate concentration represents total inorganic carbon.
 Do not automatically terminate if charge imbalance exceeds 30%
 Precipitation is allowed only for those solids specified as ALLOWED
   in the input file (if any).
 The maximum number of iterations is: 200
 The method used to compute activity coefficients is: Davies equation
 Full output file

--------------------------------------------------------------------------------
   330  0.000E-01   -7.00 y
    61  6.670E-08   -7.18 y
   580  1.610E-07   -6.79 y
   500  3.430E-06   -5.46

 H2O has been inserted as a COMPONENT


______________________________ PART 1 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
----------- THE INPUT DATA WILL BE USED IN A SERIES OF  8 SWEEPS ------------
  The input parameters for each sweep will be identical to this initial
  listing except that:
 --  The total dissolved concentration of  component number 500 in
     successive sweeps will be:
      3.430E-06  3.430E-06  6.860E-06  1.370E-05  2.060E-05  2.740E-05
      3.430E-05  5.140E-05
 --  After the first sweep, the initial component activity guesses
     for each successive sweep are the equilibrium activities computed at the
     end of the sweep which precedes it.

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INPUT DATA BEFORE TYPE MODIFICATIONS

   ID       NAME       ACTIVITY GUESS    LOG GUESS   ANAL TOTAL
   330  H+1             1.000E-07        -7.000   0.000E-01
    61  H3AsO4           6.607E-08        -7.180   6.670E-08
   580  PO4-3            1.622E-07        -6.790   1.610E-07
   500  Na+1             3.467E-06        -5.460   3.430E-06
     2  H2O             1.000E+00         0.000   0.000E-01
```

```
_______________________________ PART 2 of OUTPUT FILE _______________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


 ALL SPECIES CONSIDERED IN THIS PROBLEM

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

  ID      NAME        DH        LOGK    MIN LOGK  MAX LOGK   Z    DHA   DHB    GFW
   330  H+1          0.0000     0.0000    0.000     0.000   1.00  9.00  0.00    1.0080
    61  H3AsO4        0.0000     0.0000    0.000     0.000   0.00  0.00  0.00  141.9431
   580  PO4-3         0.0000     0.0000    0.000     0.000  -3.00  5.00  0.00   94.9714
   500  Na+1          0.0000     0.0000    0.000     0.000   1.00  4.00  0.08   22.9898

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

  ID      NAME        DH        LOGK    MIN LOGK  MAX LOGK   Z    DHA   DHB    GFW
3305802  H3PO4         0.0000    21.7000    0.000     0.000   0.00  0.00  0.00   97.9950
3300020  OH-          13.3450   -13.9980    0.000     0.000  -1.00  3.50  0.00   17.0074
5005800  NaHPO4 -      0.0000    12.6360    0.000     0.000  -1.00  5.40  0.00  118.9690
3300611  H2AsO4 -     -1.6900    -2.2430    0.000     0.000  -1.00  0.00  0.00  140.9350
3300612  HAsO4 -2     -0.9200    -9.0010    0.000     0.000  -2.00  0.00  0.00  139.9270
3300613  AsO4 -3       3.4300   -20.5970    0.000     0.000  -3.00  0.00  0.00  138.9190
3305800  HPO4 -2      -3.5300    12.3460    0.000     0.000  -2.00  5.00  0.00   95.9790
3305801  H2PO4 -      -4.5200    19.5530    0.000     0.000  -1.00  5.40  0.00   96.9870

------------------------------------------------------------------------------

 Type III - SPECIES WITH FIXED ACTIVITY

  ID      NAME        DH        LOGK    MIN LOGK  MAX LOGK   Z    DHA   DHB    GFW
     2  H2O          0.0000     0.0000    0.000     0.000   0.00  0.00  0.00   18.0153


    Charge Balance: UNSPECIATED

     Sum of CATIONS=  3.430E-06 Sum of ANIONS =  4.830E-07

     PERCENT DIFFERENCE =  7.531E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)



          -------------------------------------------------------
         |  IMPROVED ACTIVITY GUESSES PRIOR TO FIRST ITERATION: |
         |      H3AsO4     Log activity guess:   -12.37        |
         |      PO4-3      Log activity guess:   -12.56        |
         |                                                      |
          -------------------------------------------------------
```

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_______________________________ PART 3 of OUTPUT FILE _______________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

    ITER     NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
     0   Na+1          3.430E-06   3.737E-08    -5.46000    3.702E-08
```

```
     1  PO4-3          1.610E-07  -7.974E-08   -12.26369    7.972E-08
     2  Na+1           3.430E-06   5.905E-09    -5.46471    5.562E-09
     3  PO4-3          1.610E-07  -2.414E-09   -12.18222    2.398E-09
     4  H+1            0.000E-01   1.931E-11    -7.24617    1.573E-12

 ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1         0.000E-01  5.683E-08    -7.24617    0.998285  -7.135E-17
   61  H3AsO4        6.670E-08  1.615E-13   -12.79188    1.000000   3.074E-16
  580  PO4-3         1.610E-07  6.759E-13   -12.17681    0.984641   5.719E-16
  500  Na+1          3.430E-06  3.430E-06    -5.46545    0.998281   4.637E-15
    2  H2O         0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

--------------------------------------------------------------------------------

 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
    330  H+1          5.683E-08  5.673E-08    -7.24617   0.99828      0.001
     61  H3AsO4         1.615E-13  1.615E-13   -12.79188   1.00000      0.000
    580  PO4-3          6.759E-13  6.656E-13   -12.17681   0.98464      0.007
    500  Na+1           3.430E-06  3.424E-06    -5.46545   0.99828      0.001

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4         6.091E-13  6.091E-13   -12.21533   1.00000     21.700
3300020  OH-           1.774E-07  1.771E-07    -6.75183   0.99828    -13.997
5005800  NaHPO4 -       5.602E-13  5.592E-13   -12.25244   0.99828     12.637
3300611  H2AsO4 -       1.629E-08  1.627E-08    -7.78871   0.99828     -2.242
3300612  HAsO4 -2       5.040E-08  5.006E-08    -7.30053   0.99314     -8.998
3300613  AsO4 -3        2.272E-12  2.237E-12   -11.65036   0.98463    -20.590
3305800  HPO4 -2        8.433E-08  8.376E-08    -7.07698   0.99314     12.349
3305801  H2PO4 -        7.666E-08  7.653E-08    -7.11616   0.99828     19.554

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME       CALC MOL       LOG MOL   NEW LOGK     DH
    2  H2O          -1.774E-07      -6.751      0.000      0.000


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_______________________________ PART 4 of OUTPUT FILE _________________________
 PC MINTEQA2 v3.10   DATE OF  CALCULATIONS: 29-OCT-**  TIME: 17:14:45



           PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
         TYPE I and TYPE II (dissolved and adsorbed) species


H+1
         >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

         >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

         >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

         >1000.    PERCENT BOUND IN SPECIES #3300613   AsO4 -3


H3AsO4
           24.4     PERCENT BOUND IN SPECIES #3300611   H2AsO4 -
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          75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
          52.4    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

          47.6    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
         100.0    PERCENT BOUND IN SPECIES #    500   Na+1


H2O
         100.0    PERCENT BOUND IN SPECIES #3300020   OH-


_______________________________________________________________________________
______________________________ PART 5 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



         -----------------------------------------------------
         ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX    NAME          DISSOLVED          SORBED          PRECIPITATED
                  MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          -7.135E-17   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4        6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3         1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1          3.430E-06   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O           1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


   Charge Balance: SPECIATED

     Sum of CATIONS =  3.487E-06 Sum of ANIONS   5.398E-07

     PERCENT DIFFERENCE =   7.319E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

   EQUILIBRIUM IONIC STRENGTH (m) =   2.148E-06

   EQUILIBRIUM pH               =   7.246

    DATE ID NUMBER:          ******
    TIME ID NUMBER:        17144558


_________________________________________________________________________________
______________________________ PART 6 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


Saturation indices and stoichiometry of all minerals

   ID #    NAME      Sat. Index       Stoichiometry in [brackets]
  3006100 AS2O5        -32.283    [  2.000]  61  [ -3.000]   2
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______________________________ PART 1 of OUTPUT FILE ________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  2 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
  1)  The total concentration of the component Na+1         is:   3.430E-06
  2)  The log activity guesses for all components are as computed at
      the point of FIRST convergence in the previous problem.

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______________________________ PART 3 of OUTPUT FILE ________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

     ITER      NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
       0   Na+1          3.430E-06  -5.895E-09    -5.46545    5.552E-09
       2   Na+1          3.430E-06   5.905E-09    -5.46471    5.561E-09

  ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1          0.000E-01  5.683E-08    -7.24617    0.998285  -6.444E-12
   61  H3AsO4       6.670E-08  1.615E-13   -12.79187    1.000000   1.025E-12
  580  PO4-3        1.610E-07  6.759E-13   -12.17682    0.984641  -2.462E-12
  500  Na+1         3.430E-06  3.430E-06    -5.46545    0.998281   5.129E-13
    2  H2O          0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
   330  H+1           5.683E-08  5.673E-08   -7.24617   0.99828      0.001
    61  H3AsO4        1.615E-13  1.615E-13  -12.79187   1.00000      0.000
   580  PO4-3         6.759E-13  6.656E-13  -12.17682   0.98464      0.007
   500  Na+1          3.430E-06  3.424E-06   -5.46545   0.99828      0.001

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4        6.091E-13  6.091E-13  -12.21534   1.00000     21.700
3300020  OH-          1.774E-07  1.771E-07   -6.75183   0.99828    -13.997
5005800  NaHPO4 -     5.602E-13  5.592E-13  -12.25244   0.99828     12.637
3300611  H2AsO4 -     1.629E-08  1.627E-08   -7.78870   0.99828     -2.242
3300612  HAsO4 -2     5.040E-08  5.006E-08   -7.30053   0.99314     -8.998
3300613  AsO4 -3      2.272E-12  2.237E-12  -11.65035   0.98463    -20.590
3305800  HPO4 -2      8.433E-08  8.375E-08   -7.07699   0.99314     12.349
3305801  H2PO4 -      7.666E-08  7.653E-08   -7.11616   0.99828     19.554
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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME       CALC MOL       LOG MOL   NEW LOGK     DH
     2  H2O          -1.774E-07      -6.751      0.000      0.000


______________________________________________________________________________
______________________________ PART 4 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



              PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
             TYPE I and TYPE II (dissolved and adsorbed) species


H+1
            >1000.     PERCENT BOUND IN SPECIES #3300020   OH-

            >1000.     PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

            >1000.     PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

             105.8     PERCENT BOUND IN SPECIES #3300613   AsO4 -3


H3AsO4
              24.4     PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

              75.6     PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
              52.4     PERCENT BOUND IN SPECIES #3305800   HPO4 -2

              47.6     PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
             100.0     PERCENT BOUND IN SPECIES #    500   Na+1


H2O
             100.0     PERCENT BOUND IN SPECIES #3300020   OH-


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______________________________ PART 5 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



             -------------------------------------------------------
             ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX     NAME          DISSOLVED          SORBED          PRECIPITATED
                   MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          -6.444E-12   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4        6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3         1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1          3.430E-06   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O           1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
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   Charge Balance: SPECIATED

    Sum of CATIONS =  3.487E-06 Sum of ANIONS   5.398E-07

    PERCENT DIFFERENCE =   7.319E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

   EQUILIBRIUM IONIC STRENGTH (m) =   2.148E-06

   EQUILIBRIUM pH              =   7.246

   DATE ID NUMBER:         ******
   TIME ID NUMBER:       17144569

______________________________________________________________________________
_____________________________ PART 6 of OUTPUT FILE __________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


Saturation indices and stoichiometry of all minerals

  ID #    NAME      Sat. Index       Stoichiometry in [brackets]
 3006100 AS2O5        -32.283    [  2.000]  61  [ -3.000]   2


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_____________________________ PART 1 of OUTPUT FILE __________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  3 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
 1)  The total concentration of the component Na+1         is:   6.860E-06
 2)  The log activity guesses for all components are as computed at
     the point of FIRST convergence in the previous problem.

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_____________________________ PART 3 of OUTPUT FILE __________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

   ITER     NAME      TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
    0   Na+1          6.860E-06  -3.436E-06    -5.46545    3.435E-06
    2   Na+1          6.860E-06   1.583E-08    -5.16368    1.514E-08

 ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1         0.000E-01  5.689E-08    -7.24593    0.997704  -1.157E-11
   61  H3AsO4       6.670E-08  1.613E-13   -12.79227    1.000001   1.815E-12
  580  PO4-3        1.610E-07  6.779E-13   -12.17784    0.979473  -4.473E-12
  500  Na+1         6.860E-06  6.860E-06    -5.16468    0.997697   1.022E-12
    2  H2O         0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01
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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME      CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
   330  H+1          5.689E-08  5.676E-08    -7.24593   0.99770      0.001
    61  H3AsO4        1.613E-13  1.613E-13   -12.79227   1.00000      0.000
   580  PO4-3         6.779E-13  6.640E-13  -12.17784   0.97947      0.009
   500  Na+1          6.860E-06  6.844E-06    -5.16468   0.99770      0.001

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME      CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4         6.087E-13  6.087E-13  -12.21562   1.00000     21.700
3300020  OH-          1.774E-07  1.770E-07    -6.75207   0.99770    -13.997
5005800  NaHPO4 -       1.118E-12  1.116E-12   -11.95244   0.99770     12.637
3300611  H2AsO4 -       1.628E-08  1.624E-08    -7.78934   0.99770     -2.242
3300612  HAsO4 -2       5.042E-08  4.996E-08    -7.30141   0.99082     -8.997
3300613  AsO4 -3       2.278E-12  2.231E-12   -11.65148   0.97946    -20.588
3305800  HPO4 -2        8.438E-08  8.361E-08    -7.07777   0.99082     12.350
3305801  H2PO4 -        7.661E-08  7.644E-08    -7.11669   0.99770     19.554

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME      CALC MOL      LOG MOL   NEW LOGK     DH
     2  H2O        -1.774E-07      -6.751      0.000      0.000


_____________________________________________________________________________
_______________________________ PART 4 of OUTPUT FILE ________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



                PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
             TYPE I and TYPE II (dissolved and adsorbed) species


H+1
          >1000.    PERCENT BOUND IN SPECIES #3300020   OH-

          >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

          >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

            59.1    PERCENT BOUND IN SPECIES #3300613   AsO4 -3


H3AsO4
            24.4    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

            75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
            52.4    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

            47.6    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
           100.0    PERCENT BOUND IN SPECIES #    500   Na+1
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H2O
          100.0    PERCENT BOUND IN SPECIES #3300020   OH-

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________________________________ PART 5 of OUTPUT FILE _______________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



          ------------------------------------------------------
          ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX    NAME          DISSOLVED           SORBED          PRECIPITATED
                 MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          -1.157E-11   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4        6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3         1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1          6.860E-06   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O           1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


   Charge Balance: SPECIATED

    Sum of CATIONS =  6.917E-06 Sum of ANIONS   5.399E-07

    PERCENT DIFFERENCE =   8.552E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

   EQUILIBRIUM IONIC STRENGTH (m) =   3.863E-06

   EQUILIBRIUM pH               =   7.246

   DATE ID NUMBER:         ******
   TIME ID NUMBER:       17144574

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________________________________ PART 6 of OUTPUT FILE _________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


Saturation indices and stoichiometry of all minerals

  ID #     NAME      Sat. Index       Stoichiometry in [brackets]
 3006100 AS2O5        -32.284    [  2.000]  61  [ -3.000]   2

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________________________________ PART 1 of OUTPUT FILE _________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  4 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
 1)  The total concentration of the component Na+1         is:   1.370E-05
 2)  The log activity guesses for all components are as computed at
     the point of FIRST convergence in the previous problem.

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______________________________ PART 3 of OUTPUT FILE ___________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

   ITER     NAME      TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
     0   Na+1          1.370E-05  -6.856E-06    -5.16468    6.854E-06
     2   Na+1          1.370E-05   4.339E-08    -4.86328    4.201E-08
     3   H+1           0.000E-01  -2.176E-11    -7.24557    4.019E-12

 ID       NAME      ANAL MOL    CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
 330  H+1          0.000E-01  5.699E-08    -7.24556    0.996856  -5.656E-18
  61  H3AsO4       6.670E-08  1.611E-13   -12.79286    1.000002   2.500E-16
 580  PO4-3        1.610E-07  6.808E-13   -12.17932    0.971957   4.614E-16
 500  Na+1         1.370E-05  1.370E-05    -4.86465    0.996843   1.171E-14
   2  H2O          0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME      CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
   330  H+1          5.699E-08  5.681E-08    -7.24556   0.99686      0.001
    61  H3AsO4       1.611E-13  1.611E-13   -12.79286   1.00000      0.000
   580  PO4-3        6.808E-13  6.617E-13   -12.17932   0.97196      0.012
   500  Na+1         1.370E-05  1.366E-05    -4.86465   0.99684      0.001

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME      CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4       6.081E-13  6.081E-13   -12.21601   1.00000     21.700
3300020  OH-         1.774E-07  1.768E-07    -6.75244   0.99684    -13.997
5005800  NaHPO4 -    2.228E-12  2.221E-12   -11.65354   0.99685     12.637
3300611  H2AsO4 -    1.626E-08  1.621E-08    -7.79029   0.99684     -2.242
3300612  HAsO4 -2    5.044E-08  4.980E-08    -7.30273   0.98742     -8.996
3300613  AsO4 -3     2.287E-12  2.222E-12   -11.65317   0.97193    -20.585
3305800  HPO4 -2     8.445E-08  8.339E-08    -7.07889   0.98744     12.351
3305801  H2PO4 -     7.655E-08  7.630E-08    -7.11745   0.99685     19.554

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME      CALC MOL      LOG MOL   NEW LOGK     DH
     2  H2O         -1.774E-07     -6.751      0.000      0.000


______________________________ PART 4 of OUTPUT FILE ___________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



          PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
        TYPE I and TYPE II (dissolved and adsorbed) species


H+1
        >1000.    PERCENT BOUND IN SPECIES #3300020   OH-
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          >1000.    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

          >1000.    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

          >1000.    PERCENT BOUND IN SPECIES #3300613   AsO4 -3


 H3AsO4
           24.4    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

           75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


 PO4-3
           52.5    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

           47.5    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


 Na+1
          100.0    PERCENT BOUND IN SPECIES #    500   Na+1


 H2O
          100.0    PERCENT BOUND IN SPECIES #3300020   OH-


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____________________________ PART 5 of OUTPUT FILE _______________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



          ------------------------------------------------------
          ----------- EQUILIBRATED MASS DISTRIBUTION -----------


 IDX    NAME         DISSOLVED          SORBED          PRECIPITATED
                 MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

 330  H+1         -5.656E-18   100.0   0.000E-01     0.0   0.000E-01     0.0
  61  H3AsO4        6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
 580  PO4-3         1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
 500  Na+1          1.370E-05   100.0   0.000E-01     0.0   0.000E-01     0.0
   2  H2O         1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


   Charge Balance: SPECIATED

    Sum of CATIONS =  1.376E-05 Sum of ANIONS   5.400E-07

    PERCENT DIFFERENCE =   9.245E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

   EQUILIBRIUM IONIC STRENGTH (m) =   7.283E-06

   EQUILIBRIUM pH              =   7.246

   DATE ID NUMBER:          ******
   TIME ID NUMBER:        17144585
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________________________________ PART 6 of OUTPUT FILE __________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


Saturation indices and stoichiometry of all minerals

    ID #     NAME      Sat. Index       Stoichiometry in [brackets]
  3006100 AS2O5         -32.285    [  2.000]  61  [ -3.000]   2



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________________________________ PART 1 of OUTPUT FILE __________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45


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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  5 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
  1)  The total concentration of the component Na+1         is:   2.060E-05
  2)  The log activity guesses for all components are as computed at
      the point of FIRST convergence in the previous problem.

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________________________________ PART 3 of OUTPUT FILE __________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

     ITER      NAME       TOTAL MOL    DIFF FXN    LOG ACTVTY    RESIDUAL
       0   Na+1           2.060E-05  -6.943E-06    -4.86465    6.941E-06
       1   H+1            0.000E-01  -2.169E-11    -7.24690    3.949E-12
       2   Na+1           2.060E-05   7.916E-08    -4.68613    7.709E-08
       3   H+1            0.000E-01  -3.201E-11    -7.24529    1.427E-11

 ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1          0.000E-01  5.707E-08    -7.24528    0.996191   3.156E-17
   61  H3AsO4       6.670E-08  1.609E-13   -12.79331    1.000002   3.621E-16
  580  PO4-3        1.610E-07  6.831E-13   -12.18050    0.966091   6.611E-16
  500  Na+1         2.060E-05  2.060E-05    -4.68780    0.996172   2.129E-14
    2  H2O          0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
   330  H+1           5.707E-08  5.685E-08    -7.24528   0.99619      0.002
    61  H3AsO4        1.609E-13  1.609E-13   -12.79331   1.00000      0.000
   580  PO4-3         6.831E-13  6.599E-13   -12.18050   0.96609      0.015
   500  Na+1          2.060E-05  2.052E-05    -4.68780   0.99617      0.002

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4         6.077E-13  6.077E-13  -12.21634   1.00000     21.700
3300020  OH-          1.774E-07  1.767E-07    -6.75272   0.99617    -13.996
5005800  NaHPO4 -      3.343E-12  3.330E-12  -11.47758   0.99618     12.638
3300611  H2AsO4 -      1.624E-08  1.618E-08    -7.79103   0.99617     -2.241
3300612  HAsO4 -2      5.046E-08  4.969E-08    -7.30376   0.98477     -8.994
3300613  AsO4 -3       2.294E-12  2.216E-12  -11.65448   0.96605    -20.582
3305800  HPO4 -2       8.450E-08  8.322E-08    -7.07978   0.98478     12.353
3305801  H2PO4 -       7.649E-08  7.620E-08    -7.11806   0.99618     19.555

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME       CALC MOL      LOG MOL   NEW LOGK     DH
    2  H2O        -1.774E-07     -6.751     0.000     0.000


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________________________________ PART 4 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



                PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
              TYPE I and TYPE II (dissolved and adsorbed) species


H+1
              >1000.    PERCENT BOUND IN SPECIES #    330   H+1

              >1000.    PERCENT BOUND IN SPECIES #3305802   H3PO4

              >1000.    PERCENT BOUND IN SPECIES #5005800   NaHPO4 -

              >1000.    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

              >1000.    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


H3AsO4
                24.4    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

                75.6    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2


PO4-3
                52.5    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

                47.5    PERCENT BOUND IN SPECIES #3305801   H2PO4 -


Na+1
               100.0    PERCENT BOUND IN SPECIES #    500   Na+1


H2O
               100.0    PERCENT BOUND IN SPECIES #3300020   OH-
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______________________________ PART 5 of OUTPUT FILE ______________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:45



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              ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX     NAME           DISSOLVED           SORBED           PRECIPITATED
                  MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1           3.156E-17   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4         6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3          1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1           2.060E-05   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O          1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


     Charge Balance: SPECIATED

       Sum of CATIONS =  2.066E-05 Sum of ANIONS   5.401E-07

       PERCENT DIFFERENCE =   9.490E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

     EQUILIBRIUM IONIC STRENGTH (m) =   1.073E-05

     EQUILIBRIUM pH                =   7.245

     DATE ID NUMBER:          ******
     TIME ID NUMBER:        17144596


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______________________________ PART 6 of OUTPUT FILE ______________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46


Saturation indices and stoichiometry of all minerals

   ID #     NAME      Sat. Index        Stoichiometry in [brackets]
  3006100 AS2O5         -32.286    [  2.000]  61  [ -3.000]   2


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______________________________ PART 1 of OUTPUT FILE ______________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46


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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  6 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
  1)  The total concentration of the component Na+1         is:   2.740E-05
  2)  The log activity guesses for all components are as computed at
      the point of FIRST convergence in the previous problem.

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________________________________ PART 3 of OUTPUT FILE ____________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

     ITER      NAME       TOTAL MOL    DIFF FXN    LOG ACTVTY    RESIDUAL
       0   Na+1           2.740E-05  -6.879E-06    -4.68780    6.876E-06
       1   H+1           0.000E-01  -3.191E-11    -7.24690    1.417E-11
       2   Na+1           2.740E-05   1.208E-07    -4.56225    1.180E-07
       3   PO4-3          1.610E-07  -1.646E-11   -12.18151    3.629E-13

 ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1          0.000E-01  5.713E-08    -7.24504    0.995636   8.742E-17
   61  H3AsO4        6.670E-08  1.608E-13   -12.79370    1.000003   4.935E-16
  580  PO4-3         1.610E-07  6.850E-13   -12.18148    0.961218   8.932E-16
  500  Na+1          2.740E-05  2.740E-05    -4.56416    0.995612   3.241E-14
    2  H2O          0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
    330  H+1          5.713E-08  5.688E-08    -7.24504   0.99564      0.002
     61  H3AsO4        1.608E-13  1.608E-13   -12.79370   1.00000      0.000
    580  PO4-3         6.850E-13  6.584E-13   -12.18148   0.96122      0.017
    500  Na+1          2.740E-05  2.728E-05    -4.56416   0.99561      0.002

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4         6.073E-13  6.073E-13   -12.21660   1.00000     21.700
3300020  OH-           1.774E-07  1.766E-07    -6.75296   0.99561    -13.996
5005800  NaHPO4 -      4.438E-12  4.419E-12   -11.35468   0.99562     12.638
3300611  H2AsO4 -      1.623E-08  1.616E-08    -7.79166   0.99561     -2.241
3300612  HAsO4 -2      5.047E-08  4.959E-08    -7.30461   0.98255     -8.993
3300613  AsO4 -3       2.299E-12  2.210E-12   -11.65557   0.96116    -20.580
3305800  HPO4 -2       8.455E-08  8.308E-08    -7.08052   0.98257     12.354
3305801  H2PO4 -       7.644E-08  7.611E-08    -7.11856   0.99562     19.555

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME       CALC MOL       LOG MOL   NEW LOGK     DH
     2  H2O          -1.774E-07      -6.751      0.000      0.000

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________________________________ PART 4 of OUTPUT FILE __________________________
  PC MINTEQA2 v3.10   DATE OF  CALCULATIONS: 29-OCT-**  TIME: 17:14:46



           PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
         TYPE I and TYPE II (dissolved and adsorbed) species


H+1
         >1000.    PERCENT BOUND IN SPECIES #    330   H+1
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```
          >1000.    PERCENT BOUND IN SPECIES #3305802   H3PO4

          >1000.    PERCENT BOUND IN SPECIES #5005800   NaHPO4 -

          >1000.    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

          >1000.    PERCENT BOUND IN SPECIES #3305801   H2PO4 -
H3AsO4
           24.3    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -

           75.7    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2
PO4-3
           52.5    PERCENT BOUND IN SPECIES #3305800   HPO4 -2

           47.5    PERCENT BOUND IN SPECIES #3305801   H2PO4 -
Na+1
          100.0    PERCENT BOUND IN SPECIES #    500   Na+1
H2O
          100.0    PERCENT BOUND IN SPECIES #3300020   OH-
______________________________________________________________________________
______________________________ PART 5 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46



          -------------------------------------------------------
          ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX     NAME            DISSOLVED            SORBED           PRECIPITATED
                MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          8.742E-17   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4       6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3        1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1         2.740E-05   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O          1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


    Charge Balance: SPECIATED

      Sum of CATIONS =  2.746E-05 Sum of ANIONS   5.401E-07

      PERCENT DIFFERENCE =   9.614E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

    EQUILIBRIUM IONIC STRENGTH (m) =   1.413E-05

    EQUILIBRIUM pH                =   7.245

    DATE ID NUMBER:         ******
    TIME ID NUMBER:       17144607
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______________________________ PART 6 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46


Saturation indices and stoichiometry of all minerals

   ID #     NAME      Sat. Index       Stoichiometry in [brackets]
  3006100 AS2O5        -32.286    [  2.000]  61  [ -3.000]   2

______________________________ PART 1 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46


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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  7 in the series of  8 ***
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The input for this sweep is identical to the initial sweep except:
  1)  The total concentration of the component Na+1         is:   3.430E-05
  2)  The log activity guesses for all components are as computed at
      the point of FIRST convergence in the previous problem.

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
______________________________ PART 3 of OUTPUT FILE ___________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

     ITER      NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
       0   Na+1          3.430E-05  -7.020E-06    -4.56416    7.017E-06
       1   PO4-3          1.610E-07  -1.638E-11   -12.17387    2.768E-13
       2   Na+1          3.430E-05   1.686E-07    -4.46471    1.651E-07
       3   PO4-3          1.610E-07  -2.048E-11   -12.18240    4.377E-12

  ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1         0.000E-01  5.719E-08    -7.24483    0.995140   1.630E-16
   61  H3AsO4        6.670E-08  1.607E-13   -12.79404    1.000004   6.497E-16
  580  PO4-3         1.610E-07  6.867E-13   -12.18236    0.956870   1.168E-15
  500  Na+1         3.430E-05  3.430E-05    -4.46683    0.995110   4.518E-14
    2  H2O         0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

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 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
    330  H+1          5.719E-08  5.691E-08   -7.24483   0.99514      0.002
     61  H3AsO4        1.607E-13  1.607E-13   -12.79404   1.00000      0.000
    580  PO4-3        6.867E-13  6.571E-13   -12.18236   0.95687      0.019
    500  Na+1         3.430E-05  3.413E-05   -4.46683   0.99511      0.002

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 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
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3305802  H3PO4          6.070E-13  6.070E-13   -12.21684   1.00000     21.700
3300020  OH-           1.774E-07  1.765E-07    -6.75317   0.99510    -13.996
5005800  NaHPO4 -       5.548E-12  5.520E-12   -11.25802   0.99512     12.638
3300611  H2AsO4 -       1.622E-08  1.614E-08    -7.79221   0.99511     -2.241
3300612  HAsO4 -2       5.048E-08  4.950E-08    -7.30538   0.98056     -8.992
3300613  AsO4 -3        2.305E-12  2.205E-12   -11.65656   0.95680    -20.578
3305800  HPO4 -2        8.459E-08  8.295E-08    -7.08119   0.98060     12.355
3305801  H2PO4 -        7.640E-08  7.603E-08    -7.11902   0.99512     19.555

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 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME       CALC MOL       LOG MOL   NEW LOGK     DH
     2  H2O         -1.774E-07      -6.751      0.000      0.000

_____________________________________________________________________________
______________________________ PART 4 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46



           PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
         TYPE I and TYPE II (dissolved and adsorbed) species

H+1
         >1000.    PERCENT BOUND IN SPECIES #    330   H+1
         >1000.    PERCENT BOUND IN SPECIES #3305802   H3PO4
         >1000.    PERCENT BOUND IN SPECIES #5005800   NaHPO4 -
         >1000.    PERCENT BOUND IN SPECIES #3305800   HPO4 -2
         >1000.    PERCENT BOUND IN SPECIES #3305801   H2PO4 -

H3AsO4
          24.3    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -
          75.7    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2

PO4-3
          52.5    PERCENT BOUND IN SPECIES #3305800   HPO4 -2
          47.5    PERCENT BOUND IN SPECIES #3305801   H2PO4 -

Na+1
         100.0    PERCENT BOUND IN SPECIES #    500   Na+1

H2O
         100.0    PERCENT BOUND IN SPECIES #3300020   OH-

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______________________________ PART 5 of OUTPUT FILE _________________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46




         -------------------------------------------------------
         ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX     NAME          DISSOLVED           SORBED          PRECIPITATED
              MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          1.630E-16   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4        6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3         1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1          3.430E-05   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O          1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
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   Charge Balance: SPECIATED

    Sum of CATIONS =  3.436E-05 Sum of ANIONS   5.402E-07

    PERCENT DIFFERENCE =   9.690E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

   EQUILIBRIUM IONIC STRENGTH (m) =   1.758E-05

   EQUILIBRIUM pH                =   7.245

   DATE ID NUMBER:          ******
   TIME ID NUMBER:        17144612

________________________________________________________________________________
______________________________ PART 6 of OUTPUT FILE ___________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46


Saturation indices and stoichiometry of all minerals

  ID #     NAME      Sat. Index        Stoichiometry in [brackets]
 3006100 AS2O5        -32.287    [  2.000]  61  [ -3.000]   2

________________________________________________________________________________
______________________________ PART 1 of OUTPUT FILE ___________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46


-------------------------------------------------------------------------------

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
*** This is the beginning of SWEEP NUMBER  8 in the series of  8 ***
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------

The input for this sweep is identical to the initial sweep except:
 1)  The total concentration of the component Na+1         is:   5.140E-05
 2)  The log activity guesses for all components are as computed at
     the point of FIRST convergence in the previous problem.

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

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______________________________ PART 3 of OUTPUT FILE _____________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46



PARAMETERS OF THE COMPONENT MOST OUT OF BALANCE:

     ITER      NAME       TOTAL MOL    DIFF FXN   LOG ACTVTY    RESIDUAL
       0   Na+1           5.140E-05  -1.727E-05    -4.46683    1.726E-05
       1   PO4-3          1.610E-07  -2.029E-11   -12.17389    4.191E-12
       2   Na+1           5.140E-05   3.077E-07    -4.28904    3.025E-07
       3   PO4-3          1.610E-07  -3.040E-11   -12.18428    1.430E-11

 ID       NAME       ANAL MOL   CALC MOL  LOG ACTVTY     GAMMA     DIFF FXN
  330  H+1          0.000E-01  5.731E-08    -7.24438    0.994094   4.306E-16
   61  H3AsO4       6.670E-08  1.604E-13   -12.79476    1.000006   1.142E-15
  580  PO4-3        1.610E-07  6.904E-13   -12.18423    0.947747   2.031E-15
  500  Na+1         5.140E-05  5.140E-05    -4.29163    0.994049   8.230E-14
    2  H2O          0.000E-01 -1.774E-07     0.00000    1.000000   0.000E-01

----------------------------------------------------------------------------

 Type I - COMPONENTS AS SPECIES IN SOLUTION

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
    330  H+1          5.731E-08  5.697E-08    -7.24438   0.99409      0.003
     61  H3AsO4       1.604E-13  1.604E-13   -12.79476   1.00001      0.000
    580  PO4-3        6.904E-13  6.543E-13   -12.18423   0.94775      0.023
    500  Na+1         5.140E-05  5.109E-05    -4.29163   0.99405      0.003

----------------------------------------------------------------------------

 Type II - OTHER SPECIES IN SOLUTION OR ADSORBED

   ID       NAME       CALC MOL   ACTIVITY   LOG ACTVTY    GAMMA     NEW LOGK
3305802  H3PO4        6.062E-13  6.062E-13   -12.21735   1.00001     21.700
3300020  OH-          1.774E-07  1.764E-07    -6.75362   0.99404    -13.995
5005800  NaHPO4 -     8.286E-12  8.237E-12   -11.08423   0.99406     12.639
3300611  H2AsO4 -     1.619E-08  1.609E-08    -7.79339   0.99404     -2.240
3300612  HAsO4 -2     5.051E-08  4.932E-08    -7.30701   0.97638     -8.991
3300613  AsO4 -3      2.316E-12  2.195E-12   -11.65864   0.94764    -20.574
3305800  HPO4 -2      8.468E-08  8.268E-08    -7.08260   0.97643     12.356
3305801  H2PO4 -      7.632E-08  7.586E-08    -7.11998   0.99406     19.556

----------------------------------------------------------------------------

 Type III - SPECIES WITH FIXED ACTIVITY

   ID       NAME       CALC MOL      LOG MOL   NEW LOGK     DH
     2  H2O         -1.774E-07      -6.751      0.000      0.000

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______________________________ PART 4 of OUTPUT FILE _____________________
  PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46



               PERCENTAGE DISTRIBUTION OF COMPONENTS AMONG
            TYPE I and TYPE II (dissolved and adsorbed) species

H+1
          >1000.    PERCENT BOUND IN SPECIES #    330   H+1
          >1000.    PERCENT BOUND IN SPECIES #3305802   H3PO4
          >1000.    PERCENT BOUND IN SPECIES #5005800   NaHPO4 -
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          >1000.    PERCENT BOUND IN SPECIES #3305800   HPO4 -2
          >1000.    PERCENT BOUND IN SPECIES #3305801   H2PO4 -

H3AsO4
           24.3    PERCENT BOUND IN SPECIES #3300611   H2AsO4 -
           75.7    PERCENT BOUND IN SPECIES #3300612   HAsO4 -2
PO4-3
           52.6    PERCENT BOUND IN SPECIES #3305800   HPO4 -2
           47.4    PERCENT BOUND IN SPECIES #3305801   H2PO4 -

Na+1
          100.0    PERCENT BOUND IN SPECIES #    500   Na+1
H2O
          100.0    PERCENT BOUND IN SPECIES #3300020   OH-
___________________________________________________________________________________
________________________________ PART 5 of OUTPUT FILE __________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46

          ------------------------------------------------------
          ----------- EQUILIBRATED MASS DISTRIBUTION -----------


IDX     NAME          DISSOLVED          SORBED          PRECIPITATED
                  MOL/KG   PERCENT    MOL/KG   PERCENT    MOL/KG   PERCENT

330  H+1          4.306E-16   100.0   0.000E-01     0.0   0.000E-01     0.0
 61  H3AsO4       6.670E-08   100.0   0.000E-01     0.0   0.000E-01     0.0
580  PO4-3        1.610E-07   100.0   0.000E-01     0.0   0.000E-01     0.0
500  Na+1         5.140E-05   100.0   0.000E-01     0.0   0.000E-01     0.0
  2  H2O          1.774E-07   100.0   0.000E-01     0.0   0.000E-01     0.0


   Charge Balance: SPECIATED

    Sum of CATIONS =  5.146E-05 Sum of ANIONS   5.403E-07

    PERCENT DIFFERENCE =   9.792E+01  (ANIONS - CATIONS)/(ANIONS + CATIONS)

   EQUILIBRIUM IONIC STRENGTH (m) =   2.613E-05

   EQUILIBRIUM pH                =   7.244

   DATE ID NUMBER:        ******
   TIME ID NUMBER:       17144623


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________________________________ PART 6 of OUTPUT FILE ____________________________
 PC MINTEQA2 v3.10   DATE OF CALCULATIONS: 29-OCT-**  TIME: 17:14:46


Saturation indices and stoichiometry of all minerals

  ID #    NAME     Sat. Index     Stoichiometry in [brackets]
                                3006100 AS2O5        -32.289    [  2.000]  61  [ -3.000]   2
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APPENDIX II

DATA FROM LABORATORY EXPERIMENTS

Resin Sorption Ability

Sample ID	wet resin weight	calc initial conc	calc initial conc	Mean Initial Conc	RSD	Mean Initial Conc	Mean Initial Conc	Mean Initial Conc
	g	ug/L	mmol	ug/L	%	M	mmol/L	mmol
NR-a	0.0000	0.0000	0.00E+00	1.887	8.9	2.52E-08	2.52E-05	5.04E-07
blank-a	0.6547	0.0000	0.00E+00	1.887	8.9	2.52E-08	2.52E-05	5.04E-07
blank-b	0.6206	0.0000	0.00E+00	1.887	8.9	2.52E-08	2.52E-05	5.04E-07
blank-c	0.6532	0.0000	0.00E+00	1.887	8.9	2.52E-08	2.52E-05	5.04E-07
blank-a	0.6050			-0.053	>100	-7.07E-10	-7.07E-07	-1.41E-08
blank-b	0.6398			-0.053	>100	-7.07E-10	-7.07E-07	-1.41E-08
blank-c	0.6214			-0.053	>100	-7.07E-10	-7.07E-07	-1.41E-08
blank-a	0.6665			-0.053	>100	-7.07E-10	-7.07E-07	-1.41E-08
blank-b	0.6136			-0.053	>100	-7.07E-10	-7.07E-07	-1.41E-08
blank-c	0.6147			-0.053	>100	-7.07E-10	-7.07E-07	-1.41E-08
5-a	0.6144	5.0000	1.33E-06	*8.924*	*0.3*	1.19E-07	1.19E-04	2.38E-06
5-b	0.6145	5.0000	1.33E-06	*8.924*	*0.3*	1.19E-07	1.19E-04	2.38E-06
5-c	0.6604	5.0000	1.33E-06	*8.924*	*0.3*	1.19E-07	1.19E-04	2.38E-06
10-a	0.6074	10.0000	2.67E-06	15.273	7.3	2.04E-07	2.04E-04	4.08E-06
10-b	0.6072	10.0000	2.67E-06	15.273	7.3	2.04E-07	2.04E-04	4.08E-06
10-c	0.6016	10.0000	2.67E-06	15.273	7.3	2.04E-07	2.04E-04	4.08E-06
10-a	0.6163			8.301	25.8	1.11E-07	1.11E-04	2.22E-06
10-b	0.6018			8.301	25.8	1.11E-07	1.11E-04	2.22E-06
10-c	0.6025			8.301	25.8	1.11E-07	1.11E-04	2.22E-06
10-a	0.6033			8.772	8.8	1.17E-07	1.17E-04	2.34E-06
10-b	0.6068			8.772	8.8	1.17E-07	1.17E-04	2.34E-06
10-c	0.6595			8.772	8.8	1.17E-07	1.17E-04	2.34E-06
20-a	0.6205	20.0000	5.34E-06	23.920	4.3	3.19E-07	3.19E-04	6.39E-06
20-b	0.6017	20.0000	5.34E-06	23.920	4.3	3.19E-07	3.19E-04	6.39E-06

20-c	0.6382	20.0000	5.34E-06	23.920	4.3	3.19E-07	3.19E-04	6.39E-06
30-a	0.6089	30.0000	8.01E-06	33.905	6.0	4.53E-07	4.53E-04	9.05E-06
30-b	0.6715	30.0000	8.01E-06	33.905	6.0	4.53E-07	4.53E-04	9.05E-06
30-c	0.6138	30.0000	8.01E-06	33.905	6.0	4.53E-07	4.53E-04	9.05E-06
30-a	0.6070			*25.488*	*0.3*	3.40E-07	3.40E-04	6.80E-06
30-b	0.6237			*25.488*	*0.3*	3.40E-07	3.40E-04	6.80E-06
30-c	0.6224			*25.488*	*0.3*	3.40E-07	3.40E-04	6.80E-06
30-a	0.6135			26.597	9.2	3.55E-07	3.55E-04	7.10E-06
30-b	0.6105			26.597	9.2	3.55E-07	3.55E-04	7.10E-06
30-c	0.6049			26.597	9.2	3.55E-07	3.55E-04	7.10E-06
40-a	0.6039	40.0000	1.07E-05	42.525	2.8	5.68E-07	5.68E-04	1.14E-05
40-b	0.6375	40.0000	1.07E-05	42.525	2.8	5.68E-07	5.68E-04	1.14E-05
40-c	0.6698	40.0000	1.07E-05	42.525	2.8	5.68E-07	5.68E-04	1.14E-05
50-a	0.6213	50.0000	1.33E-05	49.443	3.8	6.60E-07	6.60E-04	1.32E-05
50-b	0.6513	50.0000	1.33E-05	49.443	3.8	6.60E-07	6.60E-04	1.32E-05
50-c	0.6217	50.0000	1.33E-05	49.443	3.8	6.60E-07	6.60E-04	1.32E-05
50-a	0.6326			39.169	17.6	5.23E-07	5.23E-04	1.05E-05
50-b	0.6021			39.169	17.6	5.23E-07	5.23E-04	1.05E-05
50-c	0.6066			39.169	17.6	5.23E-07	5.23E-04	1.05E-05
50-a	0.6038			*45.480*	*0.1*	6.07E-07	6.07E-04	1.21E-05
50-b	0.6108			*45.480*	*0.1*	6.07E-07	6.07E-04	1.21E-05
50-c	0.6286			*45.480*	*0.1*	6.07E-07	6.07E-04	1.21E-05
75-a	0.6787	75.0000	2.00E-05	90.201	14.3	1.20E-06	1.20E-03	2.41E-05
75-b	0.6033	75.0000	2.00E-05	90.201	14.3	1.20E-06	1.20E-03	2.41E-05
75-c	0.6084	75.0000	2.00E-05	90.201	14.3	1.20E-06	1.20E-03	2.41E-05
75-a	0.6018			61.604	12.3	8.22E-07	8.22E-04	1.64E-05
75-b	0.6243			61.604	12.3	8.22E-07	8.22E-04	1.64E-05
75-c	0.6075			61.604	12.3	8.22E-07	8.22E-04	1.64E-05
75-a	0.6159			67.617	4.1	9.03E-07	9.03E-04	1.81E-05
75-b	0.6329			67.617	4.1	9.03E-07	9.03E-04	1.81E-05
75-c	0.6030			67.617	4.1	9.03E-07	9.03E-04	1.81E-05
100-a	0.6060	100.0000	2.67E-05	116.008	15.3	1.55E-06	1.55E-03	3.10E-05
100-b	0.6743	100.0000	2.67E-05	116.008	15.3	1.55E-06	1.55E-03	3.10E-05

100-c	0.6722	100.0000	2.67E-05	116.008	15.3	1.55E-06	1.55E-03	3.10E-05
100-a	0.6111			82.686	6.1	1.10E-06	1.10E-03	2.21E-05
100-b	0.6546			82.686	6.1	1.10E-06	1.10E-03	2.21E-05
100-c	0.6218			82.686	6.1	1.10E-06	1.10E-03	2.21E-05
100-a	0.6055			88.564	3.6	1.18E-06	1.18E-03	2.36E-05
100-b	0.6036			88.564	3.6	1.18E-06	1.18E-03	2.36E-05
100-c	0.6050			88.564	3.6	1.18E-06	1.18E-03	2.36E-05
200-a	0.6051			161.498	0.8	2.16E-06	2.16E-03	4.31E-05
200-b	0.6188			161.498	0.8	2.16E-06	2.16E-03	4.31E-05
200-c	0.6095			161.498	0.8	2.16E-06	2.16E-03	4.31E-05
200-a	0.6071			180.736	3.7	2.41E-06	2.41E-03	4.82E-05
200-b	0.6072			180.736	3.7	2.41E-06	2.41E-03	4.82E-05
200-c	0.6096			180.736	3.7	2.41E-06	2.41E-03	4.82E-05
250-a	0.6010			219.291	1.2	2.93E-06	2.93E-03	5.85E-05
250-b	0.6051			219.291	1.2	2.93E-06	2.93E-03	5.85E-05
250-c	0.6235			219.291	1.2	2.93E-06	2.93E-03	5.85E-05
250-a	0.6016			214.542	2.7	2.86E-06	2.86E-03	5.73E-05
250-b	0.6035			214.542	2.7	2.86E-06	2.86E-03	5.73E-05
250-c	0.6101			214.542	2.7	2.86E-06	2.86E-03	5.73E-05
300-a	0.6175			241.338	2.1	3.22E-06	3.22E-03	6.44E-05
300-b	0.6437			241.338	2.1	3.22E-06	3.22E-03	6.44E-05
300-c	0.6053			241.338	2.1	3.22E-06	3.22E-03	6.44E-05
300-a	0.6027			247.313	0.7	3.30E-06	3.30E-03	6.60E-05
300-b	0.6093			247.313	0.7	3.30E-06	3.30E-03	6.60E-05
300-c	0.6237			247.313	0.7	3.30E-06	3.30E-03	6.60E-05
s2-0-200-a	0.6027			*197.161*	*0.8*	2.63E-06	2.63E-03	5.26E-05
s2-7-200-a	0.6120			*197.161*	*0.8*	2.63E-06	2.63E-03	5.26E-05
s2-7-200-b	0.6644			*197.161*	*0.8*	2.63E-06	2.63E-03	5.26E-05
s2-7-200-c	0.6365			*197.161*	*0.8*	2.63E-06	2.63E-03	5.26E-05
s2-30-200-a	0.6195			*197.161*	*0.8*	2.63E-06	2.63E-03	5.26E-05
s2-30-200-b	0.6861			*197.161*	*0.8*	2.63E-06	2.63E-03	5.26E-05
s2-30-200-c	0.6373			*197.161*	*0.8*	2.63E-06	2.63E-03	5.26E-05
AsFe50_a	0.0187			*26.897*	*2.9*	3.59E-07	3.59E-04	7.18E-06

AsFe50_b	0.0244	*26.897*	*2.9*	3.59E-07	3.59E-04	7.18E-06
AsFe50_c	0.0273	*26.897*	*2.9*	3.59E-07	3.59E-04	7.18E-06

Resin Sorption Ability cont.

Mean Effluent Conc	RSD	Mean Effluent Conc	Mean Effluent Conc	Mean Effluent Conc	total sorbed	total sorbed / g resin	Sorption efficiency	Average Sorption efficiency	std dev
ug/L	%	M	mmol/L	mmol	mmol	mmol/g wet resin	%	%	
-2.623	15.0	-3.50E-08	-3.50E-05	-7.00E-07	1.20E-06	na	na	66%	0.16
-2.806	11.4	-3.75E-08	-3.75E-05	-7.49E-07	1.25E-06	1.91E-06	na		
-2.421	6.4	-3.23E-08	-3.23E-05	-6.46E-07	1.15E-06	1.85E-06	na		
-2.138	13.7	-2.85E-08	-2.85E-05	-5.71E-07	1.07E-06	1.64E-06	na		
-0.312	50.1	-4.16E-09	-4.16E-06	-8.33E-08	6.91E-08	1.14E-07	na		
-0.583	23.9	-7.78E-09	-7.78E-06	-1.56E-07	1.41E-07	2.21E-07	na		
-0.596	23.6	-7.95E-09	-7.95E-06	-1.59E-07	1.45E-07	2.33E-07	na		
-1.079	13.3	-1.44E-08	-1.44E-05	-2.88E-07	2.74E-07	4.11E-07	na		
-1.751	13.7	-2.34E-08	-2.34E-05	-4.67E-07	4.53E-07	7.39E-07	na		
-2.196	2.3	-2.93E-08	-2.93E-05	-5.86E-07	5.72E-07	9.31E-07	na		
0.483	84.8	6.45E-09	6.45E-06	1.29E-07	2.25E-06	3.67E-06	94.6%		
0.380	*0.2*	5.07E-09	5.07E-06	1.01E-07	2.28E-06	3.71E-06	95.7%		
0.276	31.2	3.68E-09	3.68E-06	7.37E-08	2.31E-06	3.50E-06	96.9%		
1.748	24.6	2.33E-08	2.33E-05	4.67E-07	3.61E-06	5.94E-06	88.6%		
2.746	12.7	3.67E-08	3.67E-05	7.33E-07	3.34E-06	5.51E-06	82.0%		
3.830	20.2	5.11E-08	5.11E-05	1.02E-06	3.05E-06	5.08E-06	74.9%		
0.366	75.1	4.89E-09	4.89E-06	9.77E-08	2.12E-06	3.44E-06	95.6%		
0.522	20.3	6.97E-09	6.97E-06	1.39E-07	2.08E-06	3.45E-06	93.7%		
0.726	12.3	9.69E-09	9.69E-06	1.94E-07	2.02E-06	3.36E-06	91.3%		

-1.116	29.1	-1.49E-08	-1.49E-05	-2.98E-07	2.64E-06	4.38E-06	112.7%
-0.502	48.2	-6.70E-09	-6.70E-06	-1.34E-07	2.48E-06	4.08E-06	105.7%
-0.804	43.1	-1.07E-08	-1.07E-05	-2.15E-07	2.56E-06	3.88E-06	109.2%
9.578	19.5	1.28E-07	1.28E-04	2.56E-06	3.83E-06	6.17E-06	60.0%
8.950	13.8	1.19E-07	1.19E-04	2.39E-06	4.00E-06	6.64E-06	62.6%
7.748	3.7	1.03E-07	1.03E-04	2.07E-06	4.32E-06	6.76E-06	67.6%
11.827	1.2	1.58E-07	1.58E-04	3.16E-06	5.89E-06	9.68E-06	65.1%
12.107	3.1	1.62E-07	1.62E-04	3.23E-06	5.82E-06	8.67E-06	64.3%
12.364	1.4	1.65E-07	1.65E-04	3.30E-06	5.75E-06	9.37E-06	63.5%
4.818	9.3	6.43E-08	6.43E-05	1.29E-06	5.52E-06	9.09E-06	81.1%
4.942	13.0	6.60E-08	6.60E-05	1.32E-06	5.48E-06	8.79E-06	80.6%
5.282	10.4	7.05E-08	7.05E-05	1.41E-06	5.39E-06	8.67E-06	79.3%
6.242	8.2	8.33E-08	8.33E-05	1.67E-06	5.43E-06	8.86E-06	76.5%
7.565	10.1	1.01E-07	1.01E-04	2.02E-06	5.08E-06	8.32E-06	71.6%
6.746	17.4	9.00E-08	9.00E-05	1.80E-06	5.30E-06	8.76E-06	74.6%
17.935	1.0	2.39E-07	2.39E-04	4.79E-06	6.56E-06	1.09E-05	57.8%
18.789	4.3	2.51E-07	2.51E-04	5.02E-06	6.34E-06	9.94E-06	55.8%
18.203	3.6	2.43E-07	2.43E-04	4.86E-06	6.49E-06	9.69E-06	57.2%
22.326	7.1	2.98E-07	2.98E-04	5.96E-06	7.24E-06	1.17E-05	54.8%
21.668	0.5	2.89E-07	2.89E-04	5.78E-06	7.41E-06	1.14E-05	56.2%
21.699	6.9	2.90E-07	2.90E-04	5.79E-06	7.41E-06	1.19E-05	56.1%
16.576	*0.2*	2.21E-07	2.21E-04	4.42E-06	6.03E-06	9.53E-06	57.7%
15.503	0.3	2.07E-07	2.07E-04	4.14E-06	6.32E-06	1.05E-05	60.4%
8.173	2.1	1.09E-07	1.09E-04	2.18E-06	8.27E-06	1.36E-05	79.1%
12.436	*0.7*	1.66E-07	1.66E-04	3.32E-06	8.82E-06	1.46E-05	72.7%
16.136	8.8	2.15E-07	2.15E-04	4.31E-06	7.83E-06	1.28E-05	64.5%
16.517	7.1	2.20E-07	2.20E-04	4.41E-06	7.73E-06	1.23E-05	63.7%
28.154	1.8	3.76E-07	3.76E-04	7.52E-06	1.66E-05	2.44E-05	68.8%
31.495	6.0	4.20E-07	4.20E-04	8.41E-06	1.57E-05	2.60E-05	65.1%
33.641	8.9	4.49E-07	4.49E-04	8.98E-06	1.51E-05	2.48E-05	62.7%
26.468	2.4	3.53E-07	3.53E-04	7.07E-06	9.38E-06	1.56E-05	57.0%
25.371	2.1	3.39E-07	3.39E-04	6.77E-06	9.67E-06	1.55E-05	58.8%
25.270	3.6	3.37E-07	3.37E-04	6.75E-06	9.70E-06	1.60E-05	59.0%

27.017	2.7	3.61E-07	3.61E-04	7.21E-06	1.08E-05	1.76E-05	60.0%
25.591	4.1	3.42E-07	3.42E-04	6.83E-06	1.12E-05	1.77E-05	62.2%
26.977	3.2	3.60E-07	3.60E-04	7.20E-06	1.08E-05	1.80E-05	60.1%
48.578	3.6	6.48E-07	6.48E-04	1.30E-05	1.80E-05	2.97E-05	58.1%
46.697	5.4	6.23E-07	6.23E-04	1.25E-05	1.85E-05	2.74E-05	59.7%
45.005	6.8	6.01E-07	6.01E-04	1.20E-05	1.90E-05	2.82E-05	61.2%
33.609	2.7	4.49E-07	4.49E-04	8.97E-06	1.31E-05	2.14E-05	59.4%
31.987	3.3	4.27E-07	4.27E-04	8.54E-06	1.35E-05	2.07E-05	61.3%
29.708	5.3	3.97E-07	3.97E-04	7.93E-06	1.41E-05	2.27E-05	64.1%
35.429	3.9	4.73E-07	4.73E-04	9.46E-06	1.42E-05	2.34E-05	60.0%
40.462	3.2	5.40E-07	5.40E-04	1.08E-05	1.28E-05	2.13E-05	54.3%
38.434	3.3	5.13E-07	5.13E-04	1.03E-05	1.34E-05	2.21E-05	56.6%
61.326	11.2	8.19E-07	8.19E-04	1.64E-05	2.67E-05	4.42E-05	62.0%
69.455	10.6	9.27E-07	9.27E-04	1.85E-05	2.46E-05	3.97E-05	57.0%
71.585	7.1	9.55E-07	9.55E-04	1.91E-05	2.40E-05	3.94E-05	55.7%
89.369	6.7	1.19E-06	1.19E-03	2.39E-05	2.44E-05	4.02E-05	50.6%
91.348	5.9	1.22E-06	1.22E-03	2.44E-05	2.39E-05	3.93E-05	49.5%
89.361	10.2	1.19E-06	1.19E-03	2.39E-05	2.44E-05	4.00E-05	50.6%
81.331	10.2	1.09E-06	1.09E-03	2.17E-05	3.68E-05	6.13E-05	62.9%
92.065	11.7	1.23E-06	1.23E-03	2.46E-05	3.40E-05	5.61E-05	58.0%
92.742	11.5	1.24E-06	1.24E-03	2.48E-05	3.38E-05	5.42E-05	57.7%
116.857	0.6	1.56E-06	1.56E-03	3.12E-05	2.61E-05	4.33E-05	45.5%
105.625	8.5	1.41E-06	1.41E-03	2.82E-05	2.91E-05	4.82E-05	50.8%
107.443	10.4	1.43E-06	1.43E-03	2.87E-05	2.86E-05	4.69E-05	49.9%
111.010	9.3	1.48E-06	1.48E-03	2.96E-05	3.48E-05	5.63E-05	54.0%
103.579	8.6	1.38E-06	1.38E-03	2.76E-05	3.68E-05	5.71E-05	57.1%
104.918	11.3	1.40E-06	1.40E-03	2.80E-05	3.64E-05	6.02E-05	56.5%
128.750	9.1	1.72E-06	1.72E-03	3.44E-05	3.16E-05	5.25E-05	47.9%
131.064	6.9	1.75E-06	1.75E-03	3.50E-05	3.10E-05	5.09E-05	47.0%
132.646	4.1	1.77E-06	1.77E-03	3.54E-05	3.06E-05	4.91E-05	46.4%
86.996	19.5	1.16E-06	1.16E-03	2.32E-05	2.94E-05	4.88E-05	55.9%
85.270	17.6	1.14E-06	1.14E-03	2.28E-05	2.99E-05	4.88E-05	56.8%
85.996	27.0	1.15E-06	1.15E-03	2.30E-05	2.97E-05	4.47E-05	56.4%

86.602	21.3	1.16E-06	1.16E-03	2.31E-05	2.95E-05	4.64E-05	56.1%
87.983	*3.6*	1.17E-06	1.17E-03	2.35E-05	2.91E-05	4.70E-05	55.4%
84.516	22.9	1.13E-06	1.13E-03	2.26E-05	3.01E-05	4.38E-05	57.1%
93.598	17.6	1.25E-06	1.25E-03	2.50E-05	2.76E-05	4.34E-05	52.5%
-0.196	*1.4*	-2.62E-09	-2.62E-06	-5.24E-08	7.23E-06	3.87E-04	100.7%
6.462	*3.4*	8.63E-08	8.63E-05	1.73E-06	5.45E-06	2.24E-04	76.0%
1.013	*2.4*	1.35E-08	1.35E-05	2.70E-07	6.91E-06	2.53E-04	96.2%

Solution Competition

Sample ID	**Ratio**	**Competitor**	**As Stock solution conc**	**Competitor stock solution conc**	**vol of solution**	**As conc**	**As Conc**	**log**	**As Conc**
			ppm	*ppm*	*mL*	*ppb*	*M*		*mmol*
A-0a	1:1	P	50	10	100	0	0.00E+00	#NUM!	0.00E+00
A-0b	1:1	P	50	10	100	0	0.00E+00	#NUM!	0.00E+00
A-0c	1:1	P	50	10	100	0	0.00E+00	#NUM!	0.00E+00
A-5a	1:1	P	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
A-5b	1:1	P	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
A-5c	1:1	P	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
A-10a	1:1	P	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
A-10b	1:1	P	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
A-10c	1:1	P	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
A-20a	1:1	P	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
A-20b	1:1	P	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
A-20c	1:1	P	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
A-30a	1:1	P	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06

A-30b	1:1	P	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
A-30c	1:1	P	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
A-40a	1:1	P	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
A-40b	1:1	P	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
A-40c	1:1	P	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
A-50a	1:1	P	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
A-50b	1:1	P	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
A-50c	1:1	P	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
A-75a	1:1	P	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
A-75b	1:1	P	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
A-75c	1:1	P	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
A-100a	1:1	P	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
A-100b	1:1	P	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
A-100c	1:1	P	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
B-0a	1:1	P	50	10	100	0	0.00E+00	#NUM!	0.00E+00
B-0b	1:1	P	50	10	100	0	0.00E+00	#NUM!	0.00E+00
B-0c	1:1	P	50	10	100	0	0.00E+00	#NUM!	0.00E+00
B-5a	1:10	P	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
B-5b	1:10	P	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
B-5c	1:10	P	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
B-10a	1:10	P	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
B-10b	1:10	P	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
B-10c	1:10	P	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
B-20a	1:10	P	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
B-20b	1:10	P	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
B-20c	1:10	P	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
B-30a	1:10	P	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
B-30b	1:10	P	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
B-30c	1:10	P	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
B-40a	1:10	P	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
B-40b	1:10	P	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
B-40c	1:10	P	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
B-50a	1:10	P	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05

B-50b	1:10	P	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
B-50c	1:10	P	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
B-75a	1:10	P	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
B-75b	1:10	P	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
B-75c	1:10	P	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
B-100a	1:10	P	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
B-100b	1:10	P	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
B-100c	1:10	P	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
C-0a	1:1	V	50	10	100	0	0.00E+00	#NUM!	0.00E+00
C-0b	1:1	V	50	10	100	0	0.00E+00	#NUM!	0.00E+00
C-0c	1:1	V	50	10	100	0	0.00E+00	#NUM!	0.00E+00
C-5a	1:1	V	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
C-5b	1:1	V	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
C-5c	1:1	V	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
C-10a	1:1	V	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
C-10b	1:1	V	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
C-10c	1:1	V	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
C-20a	1:1	V	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
C-20b	1:1	V	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
C-20c	1:1	V	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
C-30a	1:1	V	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
C-30b	1:1	V	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
C-30c	1:1	V	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
C-40a	1:1	V	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
C-40b	1:1	V	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
C-40c	1:1	V	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
C-50a	1:1	V	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
C-50b	1:1	V	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
C-50c	1:1	V	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
C-75a	1:1	V	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
C-75b	1:1	V	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
C-75c	1:1	V	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
C-100a	1:1	V	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05

C-100b	1:1	V	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
C-100c	1:1	V	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
D-0a	1:1	V	50	10	100	0	0.00E+00	#NUM!	0.00E+00
D-0b	1:1	V	50	10	100	0	0.00E+00	#NUM!	0.00E+00
D-0c	1:1	V	50	10	100	0	0.00E+00	#NUM!	0.00E+00
D-5a	1:10	V	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
D-5b	1:10	V	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
D-5c	1:10	V	50	10	100	5	6.67E-08	-7.18E+00	1.33E-06
D-10a	1:10	V	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
D-10b	1:10	V	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
D-10c	1:10	V	50	10	100	10	1.33E-07	-6.87E+00	2.67E-06
D-20a	1:10	V	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
D-20b	1:10	V	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
D-20c	1:10	V	50	10	100	20	2.67E-07	-6.57E+00	5.34E-06
D-30a	1:10	V	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
D-30b	1:10	V	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
D-30c	1:10	V	50	10	100	30	4.00E-07	-6.40E+00	8.01E-06
D-40a	1:10	V	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
D-40b	1:10	V	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
D-40c	1:10	V	50	10	100	40	5.34E-07	-6.27E+00	1.07E-05
D-50a	1:10	V	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
D-50b	1:10	V	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
D-50c	1:10	V	50	10	100	50	6.67E-07	-6.18E+00	1.33E-05
D-75a	1:10	V	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
D-75b	1:10	V	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
D-75c	1:10	V	50	10	100	75	1.00E-06	-6.00E+00	2.00E-05
D-100a	1:10	V	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
D-100b	1:10	V	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05
D-100c	1:10	V	50	10	100	100	1.33E-06	-5.87E+00	2.67E-05

Solution Competition continued

Competitor Conc *ppb*	**Competitor Conc** *M*	**Na** *M*	**Competitor Conc** *mmol*	**Spike vol As** *uL*	**Spike vol competitor** *uL*	**Resin weighed** *g*
0	0.00E+00	0.00E+00	0.00E+00	0	0	0.6497
0	0.00E+00	0.00E+00	0.00E+00	0	0	0.6253
0	0.00E+00	0.00E+00	0.00E+00	0	0	0.6058
5	1.61E-07	5.23E-07	3.23E-06	10	50	0.6036
5	1.61E-07	5.23E-07	3.23E-06	10	50	0.6104
5	1.61E-07	5.23E-07	3.23E-06	10	50	0.6144
10	3.23E-07	1.05E-06	6.46E-06	20	100	0.6102
10	3.23E-07	1.05E-06	6.46E-06	20	100	0.6322
10	3.23E-07	1.05E-06	6.46E-06	20	100	0.6155
20	6.46E-07	2.09E-06	1.29E-05	40	200	0.6089
20	6.46E-07	2.09E-06	1.29E-05	40	200	0.6026
20	6.46E-07	2.09E-06	1.29E-05	40	200	0.6052
30	9.69E-07	3.14E-06	1.94E-05	60	300	0.6045
30	9.69E-07	3.14E-06	1.94E-05	60	300	0.6097
30	9.69E-07	3.14E-06	1.94E-05	60	300	0.6600
40	1.29E-06	4.18E-06	2.58E-05	80	400	0.6115
40	1.29E-06	4.18E-06	2.58E-05	80	400	0.6038
40	1.29E-06	4.18E-06	2.58E-05	80	400	0.6204
50	1.61E-06	5.23E-06	3.23E-05	100	500	0.6445
50	1.61E-06	5.23E-06	3.23E-05	100	500	0.6014
50	1.61E-06	5.23E-06	3.23E-05	100	500	0.6687
75	2.42E-06	7.85E-06	4.84E-05	150	750	0.6146
75	2.42E-06	7.85E-06	4.84E-05	150	750	0.6190
75	2.42E-06	7.85E-06	4.84E-05	150	750	0.6100
100	3.23E-06	1.05E-05	6.46E-05	200	1000	0.6185
100	3.23E-06	1.05E-05	6.46E-05	200	1000	0.6431
100	3.23E-06	1.05E-05	6.46E-05	200	1000	0.6001
10	3.23E-07	6.46E-07	6.46E-06	0	100	0.6405

10	3.23E-07	6.46E-07	6.46E-06	0	100	0.6238
10	3.23E-07	6.46E-07	6.46E-06	0	100	0.6206
50	1.61E-06	3.43E-06	3.23E-05	10	500	0.6014
50	1.61E-06	3.43E-06	3.23E-05	10	500	0.6087
50	1.61E-06	3.43E-06	3.23E-05	10	500	0.6123
100	3.23E-06	6.86E-06	6.46E-05	20	1000	0.6052
100	3.23E-06	6.86E-06	6.46E-05	20	1000	0.6492
100	3.23E-06	6.86E-06	6.46E-05	20	1000	0.6087
200	6.46E-06	1.37E-05	1.29E-04	40	2000	0.6058
200	6.46E-06	1.37E-05	1.29E-04	40	2000	0.6123
200	6.46E-06	1.37E-05	1.29E-04	40	2000	0.6194
300	9.69E-06	2.06E-05	1.94E-04	60	3000	0.6168
300	9.69E-06	2.06E-05	1.94E-04	60	3000	0.5996
300	9.69E-06	2.06E-05	1.94E-04	60	3000	0.6043
400	1.29E-05	2.74E-05	2.58E-04	80	4000	0.6046
400	1.29E-05	2.74E-05	2.58E-04	80	4000	0.6085
400	1.29E-05	2.74E-05	2.58E-04	80	4000	0.6009
500	1.61E-05	3.43E-05	3.23E-04	100	5000	0.6781
500	1.61E-05	3.43E-05	3.23E-04	100	5000	0.6326
500	1.61E-05	3.43E-05	3.23E-04	100	5000	0.6074
750	2.42E-05	5.14E-05	4.84E-04	150	7500	0.6129
750	2.42E-05	5.14E-05	4.84E-04	150	7500	0.6045
750	2.42E-05	5.14E-05	4.84E-04	150	7500	0.6123
1000	3.23E-05	6.86E-05	6.46E-04	200	10000	0.6083
1000	3.23E-05	6.86E-05	6.46E-04	200	10000	0.6838
1000	3.23E-05	6.86E-05	6.46E-04	200	10000	0.6058
0	0.00E+00	0.00E+00	0.00E+00	0	0	0.6036
0	0.00E+00	0.00E+00	0.00E+00	0	0	0.6103
0	0.00E+00	0.00E+00	0.00E+00	0	0	0.6056
5	9.82E-08	2.98E-07	3.23E-06	10	50	0.6104
5	9.82E-08	2.98E-07	3.23E-06	10	50	0.6073
5	9.82E-08	2.98E-07	3.23E-06	10	50	0.6131
10	1.96E-07	5.97E-07	6.46E-06	20	100	0.6023

10	1.96E-07	5.97E-07	6.46E-06	20	100	0.6100
10	1.96E-07	5.97E-07	6.46E-06	20	100	0.6055
20	3.93E-07	1.19E-06	1.29E-05	40	200	0.6315
20	3.93E-07	1.19E-06	1.29E-05	40	200	0.6060
20	3.93E-07	1.19E-06	1.29E-05	40	200	0.6278
30	5.89E-07	1.79E-06	1.94E-05	60	300	0.6398
30	5.89E-07	1.79E-06	1.94E-05	60	300	0.6152
30	5.89E-07	1.79E-06	1.94E-05	60	300	0.6069
40	7.85E-07	2.39E-06	2.58E-05	80	400	0.6043
40	7.85E-07	2.39E-06	2.58E-05	80	400	0.6050
40	7.85E-07	2.39E-06	2.58E-05	80	400	0.6093
50	9.82E-07	2.98E-06	3.23E-05	100	500	0.6057
50	9.82E-07	2.98E-06	3.23E-05	100	500	0.6126
50	9.82E-07	2.98E-06	3.23E-05	100	500	0.6298
75	1.47E-06	4.48E-06	4.84E-05	150	750	0.6075
75	1.47E-06	4.48E-06	4.84E-05	150	750	0.6042
75	1.47E-06	4.48E-06	4.84E-05	150	750	0.6121
100	1.96E-06	5.97E-06	6.46E-05	200	1000	0.6264
100	1.96E-06	5.97E-06	6.46E-05	200	1000	0.6428
100	1.96E-06	5.97E-06	6.46E-05	200	1000	0.6057
10	1.96E-07	1.96E-07	6.46E-06	0	100	0.6112
10	1.96E-07	1.96E-07	6.46E-06	0	100	0.6034
10	1.96E-07	1.96E-07	6.46E-06	0	100	0.6025
50	9.82E-07	1.18E-06	3.23E-05	10	500	0.6173
50	9.82E-07	1.18E-06	3.23E-05	10	500	0.6274
50	9.82E-07	1.18E-06	3.23E-05	10	500	0.6027
100	1.96E-06	2.36E-06	6.46E-05	20	1000	0.6180
100	1.96E-06	2.36E-06	6.46E-05	20	1000	0.6216
100	1.96E-06	2.36E-06	6.46E-05	20	1000	0.6202
200	3.93E-06	4.73E-06	1.29E-04	40	2000	0.6060
200	3.93E-06	4.73E-06	1.29E-04	40	2000	0.6194
200	3.93E-06	4.73E-06	1.29E-04	40	2000	0.6115
300	5.89E-06	7.09E-06	1.94E-04	60	3000	0.6685

300	5.89E-06	7.09E-06	1.94E-04	60	3000	0.6454
300	5.89E-06	7.09E-06	1.94E-04	60	3000	0.6330
400	7.85E-06	9.45E-06	2.58E-04	80	4000	0.6075
400	7.85E-06	9.45E-06	2.58E-04	80	4000	0.6620
400	7.85E-06	9.45E-06	2.58E-04	80	4000	0.6222
500	9.82E-06	1.18E-05	3.23E-04	100	5000	0.6100
500	9.82E-06	1.18E-05	3.23E-04	100	5000	0.6197
500	9.82E-06	1.18E-05	3.23E-04	100	5000	0.6029
750	1.47E-05	1.77E-05	4.84E-04	150	7500	0.6031
750	1.47E-05	1.77E-05	4.84E-04	150	7500	0.6171
750	1.47E-05	1.77E-05	4.84E-04	150	7500	0.5999
1000	1.96E-05	2.36E-05	6.46E-04	200	10000	0.6314
1000	1.96E-05	2.36E-05	6.46E-04	200	10000	0.6004
1000	1.96E-05	2.36E-05	6.46E-04	200	10000	0.6485

Solution Competition continued

Mean Initial Conc	RSD	Initial Conc	Initial Conc	Initial Conc - background	Amount of As in Initial	Amount of As in Initial just DDW	Mean Effluent Conc	RSD
ug/L	%	M	mmol/L	mmol/L	mmol	mmol	ug/L	%
2.187	7.3	2.92E-08	2.92E-05	0.00E+00	5.84E-07	5.04E-07	1.727	3.2
2.187	7.3	2.92E-08	2.92E-05	0.00E+00	5.84E-07	5.04E-07	1.726	5.0
2.187	7.3	2.92E-08	2.92E-05	0.00E+00	5.84E-07	5.04E-07	1.867	10.2
2.631	7	3.51E-08	3.51E-05	5.93E-06	7.02E-07	2.38E-06	1.728	5.4
2.631	7	3.51E-08	3.51E-05	5.93E-06	7.02E-07	2.38E-06	1.508	9.7
2.631	7	3.51E-08	3.51E-05	5.93E-06	7.02E-07	2.38E-06	1.037	8.7
3.552	16.9	4.74E-08	4.74E-05	1.82E-05	9.48E-07	4.08E-06	1.399	8.8
3.552	16.9	4.74E-08	4.74E-05	1.82E-05	9.48E-07	4.08E-06	1.319	12.0
3.552	16.9	4.74E-08	4.74E-05	1.82E-05	9.48E-07	4.08E-06	1.405	7.0

5.925	13.6	7.91E-08	7.91E-05	4.99E-05	1.58E-06	6.39E-06	1.542	7.8
5.925	13.6	7.91E-08	7.91E-05	4.99E-05	1.58E-06	6.39E-06	*0.978*	*0.2*
5.925	13.6	7.91E-08	7.91E-05	4.99E-05	1.58E-06	6.39E-06	0.893	20.1
7.029	*0.7*	9.38E-08	9.38E-05	6.46E-05	1.88E-06	9.05E-06	1.381	6.4
7.029	*0.7*	9.38E-08	9.38E-05	6.46E-05	1.88E-06	9.05E-06	1.229	6.9
7.029	*0.7*	9.38E-08	9.38E-05	6.46E-05	1.88E-06	9.05E-06	1.148	13.7
8.597	19	1.15E-07	1.15E-04	8.56E-05	2.29E-06	1.14E-05	1.223	16.5
8.597	19	1.15E-07	1.15E-04	8.56E-05	2.29E-06	1.14E-05	0.892	17.6
8.597	19	1.15E-07	1.15E-04	8.56E-05	2.29E-06	1.14E-05	0.378	23.0
10.848	19.2	1.45E-07	1.45E-04	1.16E-04	2.90E-06	1.32E-05	1.320	5.7
10.848	19.2	1.45E-07	1.45E-04	1.16E-04	2.90E-06	1.32E-05	1.184	10.0
10.848	19.2	1.45E-07	1.45E-04	1.16E-04	2.90E-06	1.32E-05	0.953	9.9
14.945	15.8	1.99E-07	1.99E-04	1.70E-04	3.99E-06	2.41E-05	1.203	18.1
14.945	15.8	1.99E-07	1.99E-04	1.70E-04	3.99E-06	2.41E-05	0.569	12.8
14.945	15.8	1.99E-07	1.99E-04	1.70E-04	3.99E-06	2.41E-05	0.394	30.6
19.575	15.8	2.61E-07	2.61E-04	2.32E-04	5.23E-06	3.10E-05	1.286	25.1
19.575	15.8	2.61E-07	2.61E-04	2.32E-04	5.23E-06	3.10E-05	0.981	8.5
19.575	15.8	2.61E-07	2.61E-04	2.32E-04	5.23E-06	3.10E-05	0.823	1.7
2.702	4.2	3.61E-08	3.61E-05	0.00E+00	7.21E-07	5.04E-07	0.463	>100
2.702	4.2	3.61E-08	3.61E-05	0.00E+00	7.21E-07	5.04E-07	0.222	69.5
2.702	4.2	3.61E-08	3.61E-05	0.00E+00	7.21E-07	5.04E-07	0.575	76.6
2.757	20.6	3.68E-08	3.68E-05	7.34E-07	7.36E-07	2.38E-06	0.407	>100
2.757	20.6	3.68E-08	3.68E-05	7.34E-07	7.36E-07	2.38E-06	-0.649	22.0
2.757	20.6	3.68E-08	3.68E-05	7.34E-07	7.36E-07	2.38E-06	-0.155	33.1
4.282	24	5.72E-08	5.72E-05	2.11E-05	1.14E-06	4.08E-06	0.431	3.3
4.282	24	5.72E-08	5.72E-05	2.11E-05	1.14E-06	4.08E-06	0.156	95.8
4.282	24	5.72E-08	5.72E-05	2.11E-05	1.14E-06	4.08E-06	0.138	50.0
6.174	11.4	8.24E-08	8.24E-05	4.63E-05	1.65E-06	6.39E-06	0.535	85.7
6.174	11.4	8.24E-08	8.24E-05	4.63E-05	1.65E-06	6.39E-06	*-0.523*	*0.4*
6.174	11.4	8.24E-08	8.24E-05	4.63E-05	1.65E-06	6.39E-06	-0.245	53.6
9.118	*0.1*	1.22E-07	1.22E-04	8.56E-05	2.43E-06	9.05E-06	0.277	81.8
9.118	*0.1*	1.22E-07	1.22E-04	8.56E-05	2.43E-06	9.05E-06	0.305	27.4
9.118	*0.1*	1.22E-07	1.22E-04	8.56E-05	2.43E-06	9.05E-06	0.473	13.0

11.947	8.4	1.59E-07	1.59E-04	1.23E-04	3.19E-06	1.14E-05	0.777	37.5
11.947	8.4	1.59E-07	1.59E-04	1.23E-04	3.19E-06	1.14E-05	0.006	>100
11.947	8.4	1.59E-07	1.59E-04	1.23E-04	3.19E-06	1.14E-05	-0.634	37.2
14.771	7.3	1.97E-07	1.97E-04	1.61E-04	3.94E-06	1.32E-05	0.578	49.0
14.771	7.3	1.97E-07	1.97E-04	1.61E-04	3.94E-06	1.32E-05	0.212	35.3
14.771	7.3	1.97E-07	1.97E-04	1.61E-04	3.94E-06	1.32E-05	0.469	26.0
21.195	9.2	2.83E-07	2.83E-04	2.47E-04	5.66E-06	2.41E-05	0.483	56.9
21.195	9.2	2.83E-07	2.83E-04	2.47E-04	5.66E-06	2.41E-05	-0.440	51.3
21.195	9.2	2.83E-07	2.83E-04	2.47E-04	5.66E-06	2.41E-05	-0.803	37.1
26.785	1.5	3.58E-07	3.58E-04	3.21E-04	7.15E-06	3.10E-05	0.458	93.4
26.785	1.5	3.58E-07	3.58E-04	3.21E-04	7.15E-06	3.10E-05	0.117	75.4
26.785	1.5	3.58E-07	3.58E-04	3.21E-04	7.15E-06	3.10E-05	0.444	47.3
-0.269	>100	-3.59E-09	-3.59E-06	0.00E+00	-7.18E-08	5.04E-07	-0.599	63.1
-0.269	>100	-3.59E-09	-3.59E-06	0.00E+00	-7.18E-08	5.04E-07	-0.881	3.6
-0.269	>100	-3.59E-09	-3.59E-06	0.00E+00	-7.18E-08	5.04E-07	-1.179	21.7
0.149	>100	1.99E-09	1.99E-06	5.58E-06	3.98E-08	2.38E-06	-0.874	32.8
0.149	>100	1.99E-09	1.99E-06	5.58E-06	3.98E-08	2.38E-06	-0.533	11.8
0.149	>100	1.99E-09	1.99E-06	5.58E-06	3.98E-08	2.38E-06	-0.785	34.6
1.812	4.8	2.42E-08	2.42E-05	2.78E-05	4.84E-07	4.08E-06	-1.214	22.8
1.812	4.8	2.42E-08	2.42E-05	2.78E-05	4.84E-07	4.08E-06	-1.651	17.3
1.812	4.8	2.42E-08	2.42E-05	2.78E-05	4.84E-07	4.08E-06	-1.928	6.8
3.751	10.9	5.01E-08	5.01E-05	5.37E-05	1.00E-06	6.39E-06	*-1.300*	*0.0*
3.751	10.9	5.01E-08	5.01E-05	5.37E-05	1.00E-06	6.39E-06	-1.476	5.3
3.751	10.9	5.01E-08	5.01E-05	5.37E-05	1.00E-06	6.39E-06	-0.951	15.7
6.280	8.8	8.38E-08	8.38E-05	8.74E-05	1.68E-06	9.05E-06	-0.344	53.6
6.280	8.8	8.38E-08	8.38E-05	8.74E-05	1.68E-06	9.05E-06	-0.183	82.1
6.280	8.8	8.38E-08	8.38E-05	8.74E-05	1.68E-06	9.05E-06	-0.509	48.8
9.921	8.0	1.32E-07	1.32E-04	1.36E-04	2.65E-06	1.14E-05	-1.039	14.5
9.921	8.0	1.32E-07	1.32E-04	1.36E-04	2.65E-06	1.14E-05	-1.111	22.9
9.921	8.0	1.32E-07	1.32E-04	1.36E-04	2.65E-06	1.14E-05	-0.802	22.5
11.654	16.8	1.56E-07	1.56E-04	1.59E-04	3.11E-06	1.32E-05	-0.716	19.1
11.654	16.8	1.56E-07	1.56E-04	1.59E-04	3.11E-06	1.32E-05	-0.749	16.3
11.654	16.8	1.56E-07	1.56E-04	1.59E-04	3.11E-06	1.32E-05	-0.737	5.0

19.957	4.6	2.66E-07	2.66E-04	2.70E-04	5.33E-06	2.41E-05	*-0.325*	*0.1*
19.957	4.6	2.66E-07	2.66E-04	2.70E-04	5.33E-06	2.41E-05	-0.365	44.8
19.957	4.6	2.66E-07	2.66E-04	2.70E-04	5.33E-06	2.41E-05	-0.826	27.4
26.393	*0.5*	3.52E-07	3.52E-04	3.56E-04	7.05E-06	3.10E-05	-1.252	7.2
26.393	*0.5*	3.52E-07	3.52E-04	3.56E-04	7.05E-06	3.10E-05	-1.153	16.6
26.393	*0.5*	3.52E-07	3.52E-04	3.56E-04	7.05E-06	3.10E-05	-0.994	2.4
-0.286	10.7	-3.82E-09	-3.82E-06	0.00E+00	-7.63E-08	5.04E-07	-0.695	24.4
-0.286	10.7	-3.82E-09	-3.82E-06	0.00E+00	-7.63E-08	5.04E-07	-0.350	29.6
-0.286	10.7	-3.82E-09	-3.82E-06	0.00E+00	-7.63E-08	5.04E-07	-0.070	>100
0.568	4.4	7.58E-09	7.58E-06	1.14E-05	1.52E-07	2.38E-06	0.031	>100
0.568	4.4	7.58E-09	7.58E-06	1.14E-05	1.52E-07	2.38E-06	-0.675	64.3
0.568	4.4	7.58E-09	7.58E-06	1.14E-05	1.52E-07	2.38E-06	-1.120	18.7
1.697	27.2	2.27E-08	2.27E-05	2.65E-05	4.53E-07	4.08E-06	-1.103	17.9
1.697	27.2	2.27E-08	2.27E-05	2.65E-05	4.53E-07	4.08E-06	-0.820	18.2
1.697	27.2	2.27E-08	2.27E-05	2.65E-05	4.53E-07	4.08E-06	-0.764	17.4
4.473	*0.7*	5.97E-08	5.97E-05	6.35E-05	1.19E-06	6.39E-06	-0.886	13.8
4.473	*0.7*	5.97E-08	5.97E-05	6.35E-05	1.19E-06	6.39E-06	-0.508	41.7
4.473	*0.7*	5.97E-08	5.97E-05	6.35E-05	1.19E-06	6.39E-06	-0.154	>100
8.871	7.3	1.18E-07	1.18E-04	1.22E-04	2.37E-06	9.05E-06	-0.551	26.2
8.871	7.3	1.18E-07	1.18E-04	1.22E-04	2.37E-06	9.05E-06	-1.324	11.8
8.871	7.3	1.18E-07	1.18E-04	1.22E-04	2.37E-06	9.05E-06	-1.267	5.1
12.718	7.6	1.70E-07	1.70E-04	1.74E-04	3.40E-06	1.14E-05	-1.000	29.3
12.718	7.6	1.70E-07	1.70E-04	1.74E-04	3.40E-06	1.14E-05	-1.008	9.6
12.718	7.6	1.70E-07	1.70E-04	1.74E-04	3.40E-06	1.14E-05	-0.911	6.1
13.755	4.7	1.84E-07	1.84E-04	1.87E-04	3.67E-06	1.32E-05	-0.349	37.4
13.755	4.7	1.84E-07	1.84E-04	1.87E-04	3.67E-06	1.32E-05	-0.125	>100
13.755	4.7	1.84E-07	1.84E-04	1.87E-04	3.67E-06	1.32E-05	-0.134	38.5
21.477	2.5	2.87E-07	2.87E-04	2.90E-04	5.73E-06	2.41E-05	*-0.659*	*0.0*
21.477	2.5	2.87E-07	2.87E-04	2.90E-04	5.73E-06	2.41E-05	-1.114	32.8
21.477	2.5	2.87E-07	2.87E-04	2.90E-04	5.73E-06	2.41E-05	-0.999	15.1
30.203	2.3	4.03E-07	4.03E-04	4.07E-04	8.06E-06	3.10E-05	-0.638	50.0
30.203	2.3	4.03E-07	4.03E-04	4.07E-04	8.06E-06	3.10E-05	-0.862	12.6
30.203	2.3	4.03E-07	4.03E-04	4.07E-04	8.06E-06	3.10E-05	-0.572	43.5

Solution Competition continued

Effluent Conc M	Effluent Conc mmol/L	Amount of As in Effluent mmol	total sorbed mmol	total sorbed mmol/g wet resin	Sorption efficiency %	Average Sorption efficiency %	std dev
2.31E-08	2.31E-05	4.61E-07	1.23E-07	1.89E-07	21.0%	80%	0.17
2.30E-08	2.30E-05	4.61E-07	1.23E-07	1.97E-07	21.1%		
2.49E-08	2.49E-05	4.98E-07	8.54E-08	1.41E-07	14.6%		
2.31E-08	2.31E-05	4.61E-07	2.41E-07	3.99E-07	34.3%		
2.01E-08	2.01E-05	4.03E-07	3.00E-07	4.91E-07	42.7%		
1.38E-08	1.38E-05	2.77E-07	4.26E-07	6.93E-07	60.6%		
1.87E-08	1.87E-05	3.73E-07	5.75E-07	9.42E-07	60.6%		
1.76E-08	1.76E-05	3.52E-07	5.96E-07	9.43E-07	62.9%		
1.88E-08	1.88E-05	3.75E-07	5.73E-07	9.31E-07	60.4%		
2.06E-08	2.06E-05	4.12E-07	1.17E-06	1.92E-06	74.0%		
1.31E-08	1.31E-05	2.61E-07	1.32E-06	2.19E-06	83.5%		
1.19E-08	1.19E-05	2.38E-07	1.34E-06	2.22E-06	84.9%		
1.84E-08	1.84E-05	3.69E-07	1.51E-06	2.49E-06	80.4%		
1.64E-08	1.64E-05	3.28E-07	1.55E-06	2.54E-06	82.5%		
1.53E-08	1.53E-05	3.06E-07	1.57E-06	2.38E-06	83.7%		
1.63E-08	1.63E-05	3.26E-07	1.97E-06	3.22E-06	85.8%		
1.19E-08	1.19E-05	2.38E-07	2.06E-06	3.41E-06	89.6%		
5.05E-09	5.05E-06	1.01E-07	2.19E-06	3.54E-06	95.6%		
1.76E-08	1.76E-05	3.52E-07	2.54E-06	3.95E-06	87.8%		
1.58E-08	1.58E-05	3.16E-07	2.58E-06	4.29E-06	89.1%		
1.27E-08	1.27E-05	2.54E-07	2.64E-06	3.95E-06	91.2%		
1.61E-08	1.61E-05	3.21E-07	3.67E-06	5.97E-06	92.0%		
7.59E-09	7.59E-06	1.52E-07	3.84E-06	6.20E-06	96.2%		

5.26E-09	5.26E-06	1.05E-07	3.88E-06	6.37E-06	97.4%		
1.72E-08	1.72E-05	3.43E-07	4.88E-06	7.89E-06	93.4%		
1.31E-08	1.31E-05	2.62E-07	4.96E-06	7.72E-06	95.0%		
1.10E-08	1.10E-05	2.20E-07	5.01E-06	8.34E-06	95.8%		
6.18E-09	6.18E-06	1.24E-07	5.98E-07	9.33E-07	82.9%	99%	0.07
2.96E-09	2.96E-06	5.93E-08	6.62E-07	1.06E-06	91.8%		
7.67E-09	7.67E-06	1.53E-07	5.68E-07	9.15E-07	78.7%		
5.43E-09	5.43E-06	1.09E-07	6.27E-07	1.04E-06	85.2%		
-8.66E-09	-8.66E-06	-1.73E-07	9.09E-07	1.49E-06	123.5%		
-2.07E-09	-2.07E-06	-4.14E-08	7.77E-07	1.27E-06	105.6%		
5.75E-09	5.75E-06	1.15E-07	1.03E-06	1.70E-06	89.9%		
2.08E-09	2.08E-06	4.16E-08	1.10E-06	1.70E-06	96.4%		
1.84E-09	1.84E-06	3.68E-08	1.11E-06	1.82E-06	96.8%		
7.14E-09	7.14E-06	1.43E-07	1.51E-06	2.48E-06	91.3%		
-6.97E-09	-6.97E-06	-1.39E-07	1.79E-06	2.92E-06	108.5%		
-3.27E-09	-3.27E-06	-6.54E-08	1.71E-06	2.77E-06	104.0%		
3.70E-09	3.70E-06	7.39E-08	2.36E-06	3.83E-06	97.0%		
4.07E-09	4.07E-06	8.14E-08	2.35E-06	3.92E-06	96.7%		
6.31E-09	6.31E-06	1.26E-07	2.31E-06	3.82E-06	94.8%		
1.04E-08	1.04E-05	2.07E-07	2.98E-06	4.93E-06	93.5%		
8.01E-11	8.01E-08	1.60E-09	3.19E-06	5.24E-06	99.9%		
-8.46E-09	-8.46E-06	-1.69E-07	3.36E-06	5.59E-06	105.3%		
7.71E-09	7.71E-06	1.54E-07	3.79E-06	5.59E-06	96.1%		
2.83E-09	2.83E-06	5.66E-08	3.89E-06	6.14E-06	98.6%		
6.26E-09	6.26E-06	1.25E-07	3.82E-06	6.29E-06	96.8%		
6.45E-09	6.45E-06	1.29E-07	5.53E-06	9.02E-06	97.7%		
-5.87E-09	-5.87E-06	-1.17E-07	5.78E-06	9.55E-06	102.1%		
-1.07E-08	-1.07E-05	-2.14E-07	5.87E-06	9.59E-06	103.8%		
6.11E-09	6.11E-06	1.22E-07	7.03E-06	1.16E-05	98.3%		
1.56E-09	1.56E-06	3.12E-08	7.12E-06	1.04E-05	99.6%		
5.93E-09	5.93E-06	1.19E-07	7.03E-06	1.16E-05	98.3%		
-8.00E-09	-8.00E-06	-1.60E-07	8.81E-08	1.46E-07	-122.7%	180%	1.65
-1.18E-08	-1.18E-05	-2.35E-07	1.63E-07	2.68E-07	-227.5%		

-1.57E-08	-1.57E-05	-3.15E-07	2.43E-07	4.01E-07	-338.3%		
-1.17E-08	-1.17E-05	-2.33E-07	2.73E-07	4.47E-07	686.6%		
-7.11E-09	-7.11E-06	-1.42E-07	1.82E-07	3.00E-07	457.7%		
-1.05E-08	-1.05E-05	-2.10E-07	2.49E-07	4.07E-07	626.8%		
-1.62E-08	-1.62E-05	-3.24E-07	8.08E-07	1.34E-06	167.0%		
-2.20E-08	-2.20E-05	-4.41E-07	9.24E-07	1.52E-06	191.1%		
-2.57E-08	-2.57E-05	-5.15E-07	9.98E-07	1.65E-06	206.4%		
-1.74E-08	-1.74E-05	-3.47E-07	1.35E-06	2.14E-06	134.7%		
-1.97E-08	-1.97E-05	-3.94E-07	1.40E-06	2.30E-06	139.3%		
-1.27E-08	-1.27E-05	-2.54E-07	1.26E-06	2.00E-06	125.4%		
-4.59E-09	-4.59E-06	-9.18E-08	1.77E-06	2.76E-06	105.5%		
-2.44E-09	-2.44E-06	-4.89E-08	1.73E-06	2.80E-06	102.9%		
-6.79E-09	-6.79E-06	-1.36E-07	1.81E-06	2.99E-06	108.1%		
-1.39E-08	-1.39E-05	-2.77E-07	2.93E-06	4.84E-06	110.5%		
-1.48E-08	-1.48E-05	-2.97E-07	2.94E-06	4.87E-06	111.2%		
-1.07E-08	-1.07E-05	-2.14E-07	2.86E-06	4.70E-06	108.1%		
-9.56E-09	-9.56E-06	-1.91E-07	3.30E-06	5.45E-06	106.1%		
-1.00E-08	-1.00E-05	-2.00E-07	3.31E-06	5.40E-06	106.4%		
-9.84E-09	-9.84E-06	-1.97E-07	3.31E-06	5.25E-06	106.3%		
-4.34E-09	-4.34E-06	-8.68E-08	5.41E-06	8.91E-06	101.6%		
-4.87E-09	-4.87E-06	-9.74E-08	5.42E-06	8.98E-06	101.8%		
-1.10E-08	-1.10E-05	-2.20E-07	5.55E-06	9.06E-06	104.1%		
-1.67E-08	-1.67E-05	-3.34E-07	7.38E-06	1.18E-05	104.7%		
-1.54E-08	-1.54E-05	-3.08E-07	7.35E-06	1.14E-05	104.4%		
-1.33E-08	-1.33E-05	-2.65E-07	7.31E-06	1.21E-05	103.8%		
-9.28E-09	-9.28E-06	-1.86E-07	1.09E-07	1.79E-07	-143.0%	124%	0.46
-4.67E-09	-4.67E-06	-9.34E-08	1.71E-08	2.83E-08	-22.4%		
-9.34E-10	-9.34E-07	-1.87E-08	-5.77E-08	-9.57E-08	75.5%		
4.14E-10	4.14E-07	8.28E-09	1.43E-07	2.32E-07	94.5%		
-9.01E-09	-9.01E-06	-1.80E-07	3.32E-07	5.29E-07	218.8%		
-1.49E-08	-1.49E-05	-2.99E-07	4.51E-07	7.48E-07	297.2%		
-1.47E-08	-1.47E-05	-2.94E-07	7.47E-07	1.21E-06	165.0%		
-1.09E-08	-1.09E-05	-2.19E-07	6.72E-07	1.08E-06	148.3%		

-1.02E-08	-1.02E-05	-2.04E-07	6.57E-07	1.06E-06	145.0%
-1.18E-08	-1.18E-05	-2.37E-07	1.43E-06	2.36E-06	119.8%
-6.78E-09	-6.78E-06	-1.36E-07	1.33E-06	2.15E-06	111.4%
-2.06E-09	-2.06E-06	-4.11E-08	1.24E-06	2.02E-06	103.4%
-7.35E-09	-7.35E-06	-1.47E-07	2.52E-06	3.76E-06	106.2%
-1.77E-08	-1.77E-05	-3.53E-07	2.72E-06	4.22E-06	114.9%
-1.69E-08	-1.69E-05	-3.38E-07	2.71E-06	4.28E-06	114.3%
-1.33E-08	-1.33E-05	-2.67E-07	3.66E-06	6.03E-06	107.9%
-1.35E-08	-1.35E-05	-2.69E-07	3.66E-06	5.53E-06	107.9%
-1.22E-08	-1.22E-05	-2.43E-07	3.64E-06	5.85E-06	107.2%
-4.66E-09	-4.66E-06	-9.32E-08	3.77E-06	6.17E-06	102.5%
-1.67E-09	-1.67E-06	-3.34E-08	3.71E-06	5.98E-06	100.9%
-1.79E-09	-1.79E-06	-3.58E-08	3.71E-06	6.15E-06	101.0%
-8.80E-09	-8.80E-06	-1.76E-07	5.91E-06	9.80E-06	103.1%
-1.49E-08	-1.49E-05	-2.97E-07	6.03E-06	9.77E-06	105.2%
-8.80E-09	-8.80E-06	-1.76E-07	5.91E-06	9.85E-06	103.1%
-1.49E-08	-1.49E-05	-2.97E-07	8.36E-06	1.32E-05	103.7%
-1.33E-08	-1.33E-05	-2.67E-07	8.33E-06	1.39E-05	103.3%
-8.52E-09	-8.52E-06	-1.70E-07	8.23E-06	1.27E-05	102.1%

Resin Extration Ability assuming no resin loss

Sample ID	**wet resin weight** *g*	**final wet resin weight** *g*	**total sorbed** **mmol**	**Mean Conc (strip 1)** **ug/L**	**RSD** **%**	**Mean Conc (strip 1)** **M**	**Mean Conc (strip 1)** **mmol/L**	**Mean Conc (strip 1)** **mmol**	**Mean Conc (strip 2)** **ug/L**	**RSD** **%**
NR-a	0.0000	0.0000	1.20E-06	-3.081	36.7	-4.11E-08	-4.11E-05	-4.11E-07	-2.856	12.0
blank-a	0.6547	0.5583	1.25E-06	-4.297	10.0	-5.74E-08	-5.74E-05	-5.74E-07	-1.698	33.3
blank-b	0.6206	0.4665	1.15E-06	4.471	10.0	5.97E-08	5.97E-05	5.97E-07	-3.645	13.5
blank-c	0.6532	0.5436	1.07E-06	5.878	3.9	7.85E-08	7.85E-05	7.85E-07	-1.753	5.8

5-a	0.6144	0.4743	2.25E-06	-0.135	>100	-1.80E-09	-1.80E-06	-1.80E-08	0.658	79.5
5-b	0.6145	0.4937	2.28E-06	1.810	44.6	2.42E-08	2.42E-05	2.42E-07	0.798	>100
5-c	0.6604	0.5348	2.31E-06	3.082	8.2	4.11E-08	4.11E-05	4.11E-07	-2.894	41.0
10-a	0.6074	0.5120	3.61E-06	5.399	6.5	7.21E-08	7.21E-05	7.21E-07	-2.117	60.6
10-b	0.6072	0.4464	3.34E-06	*8.183*	*2.1*	1.09E-07	1.09E-04	1.09E-06	*0.272*	*0.3*
10-c	0.6016	0.4863	3.05E-06	7.257	37.7	9.69E-08	9.69E-05	9.69E-07	1.707	7.3
20-a	0.6205	0.5053	3.82E-06	0.737	87.8	9.84E-09	9.84E-06	9.84E-08	1.419	8.6
20-b	0.6017	0.5260	3.99E-06	2.807	35.6	3.75E-08	3.75E-05	3.75E-07	1.276	20.7
20-c	0.6382	0.5055	4.31E-06	4.764	8.4	6.36E-08	6.36E-05	6.36E-07	0.816	24.5
30-a	0.6089	0.5078	5.89E-06	7.856	1.5	1.05E-07	1.05E-04	1.05E-06	2.080	23.7
30-b	0.6715	0.5388	5.81E-06	7.543	6.2	1.01E-07	1.01E-04	1.01E-06	2.759	10.7
30-c	0.6138	0.5316	5.74E-06	3.355	46.1	4.48E-08	4.48E-05	4.48E-07	3.301	3.7
40-a	0.6039	0.4961	6.56E-06	4.886	8.8	6.52E-08	6.52E-05	6.52E-07	6.552	2.2
40-b	0.6375	0.5183	6.33E-06	5.042	14.3	6.73E-08	6.73E-05	6.73E-07	5.513	0.5
40-c	0.6698	0.5282	6.49E-06	6.360	5.0	8.49E-08	8.49E-05	8.49E-07	4.821	11.9
50-a	0.6213	0.4981	7.23E-06	9.500	3.3	1.27E-07	1.27E-04	1.27E-06	3.076	32.3
50-b	0.6513	0.5510	7.41E-06	8.685	5.5	1.16E-07	1.16E-04	1.16E-06	1.353	26.8
50-c	0.6217	0.4937	7.40E-06	11.816	2.4	1.58E-07	1.58E-04	1.58E-06	5.005	11.2
75-a	0.6787	0.5632	1.65E-05	12.504	1.8	1.67E-07	1.67E-04	1.67E-06	11.097	2.8
75-b	0.6033	0.4789	1.57E-05	17.072	7.3	2.28E-07	2.28E-04	2.28E-06	11.108	2.2
75-c	0.6084	0.4720	1.51E-05	15.084	61.4	2.01E-07	2.01E-04	2.01E-06	10.291	8.5
100-a	0.6060	0.4933	1.80E-05	22.211	2.0	2.96E-07	2.96E-04	2.96E-06	25.921	2.4
100-b	0.6743	0.5490	1.85E-05	17.780	1.6	2.37E-07	2.37E-04	2.37E-06	18.874	1.4
100-c	0.6722	0.5329	1.89E-05	20.396	1.3	2.72E-07	2.72E-04	2.72E-06	15.128	7.4
s2-0-200-a	0.6027		2.94E-05	39.531	2.0	5.28E-07	5.28E-04	5.28E-06	38.834	5.2
s2-7-200-a	0.6120		2.99E-05	*31.023*	*0.8*	4.14E-07	4.14E-04	4.14E-06	*36.820*	*1.1*
s2-7-200-b	0.6644		2.97E-05	28.737	2.0	3.84E-07	3.84E-04	3.84E-06	38.861	0.6
s2-7-200-c	0.6365		2.95E-05	30.261	6.7	4.04E-07	4.04E-04	4.04E-06	41.667	1.9
s2-30-200-a	0.6195		2.91E-05	16.635	5.4	2.22E-07	2.22E-04	2.22E-06	29.762	1.5
s2-30-200-b	0.6861		3.01E-05	*10.277*	*1.6*	1.37E-07	1.37E-04	1.37E-06	*31.807*	*1.0*
s2-30-200-c	0.6373		2.76E-05	14.882	1.7	1.99E-07	1.99E-04	1.99E-06	37.815	1.9
AsFe50_a	0.0187		7.23E-06	*8.725*	*2.2*	1.16E-07	1.16E-04	1.16E-06	*10.985*	*1.6*
AsFe50_b	0.0244		5.45E-06	*8.183*	*1.3*	1.09E-07	1.09E-04	1.09E-06	*7.737*	*2.1*

AsFe50_c	0.0273	6.91E-06	*10.019*	*4.7*	1.34E-07	1.34E-04	1.34E-06	*16.914*	*1.6*

Resin Extration Ability assuming no resin loss (continued)

Mean Conc (strip 2) M	Mean Conc (strip 2) mmol/L	Mean Conc (strip 2) mmol	total strip conc mmol	Extraction efficiency %	Ave Extraction efficiency %	std dev
-3.81E-08	-3.81E-05	-3.81E-07	na	na	24%	0.11
-2.27E-08	-2.27E-05	-2.27E-07	-8.00E-07	na		
-4.87E-08	-4.87E-05	-4.87E-07	1.10E-07	na		
-2.34E-08	-2.34E-05	-2.34E-07	5.51E-07	na		
8.78E-09	8.78E-06	8.78E-08	6.98E-08	3.1%		
1.07E-08	1.07E-05	1.07E-07	3.48E-07	15.3%		
-3.86E-08	-3.86E-05	-3.86E-07	2.51E-08	1.1%		
-2.83E-08	-2.83E-05	-2.83E-07	4.38E-07	12.1%		
3.62E-09	3.62E-06	3.62E-08	1.13E-06	33.8%		
2.28E-08	2.28E-05	2.28E-07	1.20E-06	39.2%		
1.89E-08	1.89E-05	1.89E-07	2.88E-07	7.5%		
1.70E-08	1.70E-05	1.70E-07	5.45E-07	13.7%		
1.09E-08	1.09E-05	1.09E-07	7.45E-07	17.3%		
2.78E-08	2.78E-05	2.78E-07	1.33E-06	22.5%		
3.68E-08	3.68E-05	3.68E-07	1.38E-06	23.7%		
4.41E-08	4.41E-05	4.41E-07	8.88E-07	15.5%		
8.75E-08	8.75E-05	8.75E-07	1.53E-06	23.3%		
7.36E-08	7.36E-05	7.36E-07	1.41E-06	22.3%		
6.43E-08	6.43E-05	6.43E-07	1.49E-06	23.0%		
4.11E-08	4.11E-05	4.11E-07	1.68E-06	23.2%		
1.81E-08	1.81E-05	1.81E-07	1.34E-06	18.1%		
6.68E-08	6.68E-05	6.68E-07	2.25E-06	30.3%		

1.48E-07	1.48E-04	1.48E-06	3.15E-06	19.0%
1.48E-07	1.48E-04	1.48E-06	3.76E-06	24.0%
1.37E-07	1.37E-04	1.37E-06	3.39E-06	22.5%
3.46E-07	3.46E-04	3.46E-06	6.42E-06	35.7%
2.52E-07	2.52E-04	2.52E-06	4.89E-06	26.5%
2.02E-07	2.02E-04	2.02E-06	4.74E-06	25.0%
5.18E-07	5.18E-04	5.18E-06	1.05E-05	35.6%
4.91E-07	4.91E-04	4.91E-06	9.06E-06	30.3%
5.19E-07	5.19E-04	5.19E-06	9.02E-06	30.4%
5.56E-07	5.56E-04	5.56E-06	9.60E-06	32.5%
3.97E-07	3.97E-04	3.97E-06	6.19E-06	21.2%
4.25E-07	4.25E-04	4.25E-06	5.62E-06	18.7%
5.05E-07	5.05E-04	5.05E-06	7.03E-06	25.4%
1.47E-07	1.47E-04	1.47E-06	2.63E-06	36.4%
1.03E-07	1.03E-04	1.03E-06	2.12E-06	39.0%
2.26E-07	2.26E-04	2.26E-06	3.59E-06	52.0%

Storage Experiment

start: 7-23-02

testing to see if there is any problem storing the resins in the refrigerator after bringing them from the field

Container ID	initial resin weight (wet)	final resin weight (wet)	original concentration	RSD	original concentration	original concentration	effluent after resin exposure	RSD
	g	g	ppb	%	M	mmol/L	ppb	%
second try								
NR-a	0.0000	0.0000	1.887	8.9	2.52E-08	2.52E-05	-2.623	15
blank-a	0.6547	0.5583	1.887	8.9	2.52E-08	2.52E-05	-2.806	11.4

blank-b	0.6206	0.4665	1.887	8.9	2.52E-08	2.52E-05	-2.421	6.4
blank-c	0.6532	0.5463	1.887	8.9	2.52E-08	2.52E-05	-2.138	13.7
s2-0-200-a	0.6027	0.4906	*197.16*	*0.8*	2.63E-06	2.63E-03	86.996	19.5
s2-0-200-b	0.6089	1.0275	*197.16*	*0.8*	2.63E-06	2.63E-03	76.473	11.3
s2-0-200-c	0.6502		*197.16*	*0.8*	2.63E-06	2.63E-03	na	na
s2-7-NR	0.0000		1.887	8.9	2.52E-08	2.52E-05	-2.187	2.5
s2-7-0-a	0.6557		1.887	8.9	2.52E-08	2.52E-05	-2.250	5.2
s2-7-0-b	0.6712		1.887	8.9	2.52E-08	2.52E-05	-2.327	5.5
s2-7-0-c	0.6783		1.887	8.9	2.52E-08	2.52E-05	-2.882	7.7
s2-7-200-a	0.6120		*197.16*	*0.8*	2.63E-06	2.63E-03	85.270	17.6
s2-7-200-b	0.6644		*197.16*	*0.8*	2.63E-06	2.63E-03	85.996	27
s2-7-200-c	0.6365		*197.16*	*0.8*	2.63E-06	2.63E-03	86.602	21.3
s2-30-NR	0.0000		1.887	8.9	2.52E-08	2.52E-05	-2.293	17
s2-30-0-a	0.6390		1.887	8.9	2.52E-08	2.52E-05	-2.541	8.9
s2-30-0-b	0.6749		1.887	8.9	2.52E-08	2.52E-05	-2.801	12.9
s2-30-0-c	0.6317		1.887	8.9	2.52E-08	2.52E-05	-3.370	5.2
s2-30-200-a	0.6195		*197.16*	*0.8*	2.63E-06	2.63E-03	*87.983*	*3.6*
s2-30-200-b	0.6861		*197.16*	*0.8*	2.63E-06	2.63E-03	84.516	22.9
s2-30-200-c	0.6373		*197.16*	*0.8*	2.63E-06	2.63E-03	93.598	17.6

Storage Experiment (continued)

effluent after resin exposure M	effluent after resin exposure mmol/L	amount sorbed mmol/L	amount sorbed mmol	date placed in refrigerator date	date removed from refrigerator date	storage time days	Mean conc (1) ppb	RSD %
-3.50E-08	-3.50E-05	6.02E-05	1.20E-06	8/14/2002	8/14/2002	0	-3.081	36.7
-3.75E-08	-3.75E-05	6.26E-05	1.25E-06	8/14/2002	8/14/2002	0	-4.297	10.0
-3.23E-08	-3.23E-05	5.75E-05	1.15E-06	8/14/2002	8/14/2002	0	4.471	10.0

-2.85E-08	-2.85E-05	5.37E-05	1.07E-06	8/14/2002	8/14/2002	0	5.878	3.9
1.16E-06	1.16E-03	1.47E-03	2.94E-05	8/14/2002	8/14/2002	0	39.531	2.0
1.02E-06	1.02E-03	1.61E-03	3.22E-05	8/14/2002	8/14/2002	0	*6.72*	*5.7*
#VALUE!	#VALUE!	na	#VALUE!	na	na	na	na	na
-2.92E-08	-2.92E-05	5.44E-05	1.09E-06	8/14/2002	8/21/2002	7	-5.61	1.1
-3.00E-08	-3.00E-05	5.52E-05	1.10E-06	8/14/2002	8/21/2002	7	-2.855	34
-3.11E-08	-3.11E-05	5.62E-05	1.12E-06	8/14/2002	8/21/2002	7	0.611	>100
-3.85E-08	-3.85E-05	6.37E-05	1.27E-06	8/14/2002	8/21/2002	7	0.377	>100
1.14E-06	1.14E-03	1.49E-03	2.99E-05	8/14/2002	8/21/2002	7	*31.023*	*0.8*
1.15E-06	1.15E-03	1.48E-03	2.97E-05	8/14/2002	8/21/2002	7	28.737	2
1.16E-06	1.16E-03	1.48E-03	2.95E-05	8/14/2002	8/21/2002	7	30.261	6.7
-3.06E-08	-3.06E-05	5.58E-05	1.12E-06	8/14/2002	9/12/2002	29	-16.229	5.3
-3.39E-08	-3.39E-05	5.91E-05	1.18E-06	8/14/2002	9/12/2002	29	-12.457	12.1
-3.74E-08	-3.74E-05	6.26E-05	1.25E-06	8/14/2002	9/12/2002	29	-9.570	12.6
-4.50E-08	-4.50E-05	7.02E-05	1.40E-06	8/14/2002	9/12/2002	29	-10.767	8.5
1.17E-06	1.17E-03	1.46E-03	2.91E-05	8/14/2002	9/12/2002	29	16.635	5.4
1.13E-06	1.13E-03	1.50E-03	3.01E-05	8/14/2002	9/12/2002	29	*10.277*	*1.6*
1.25E-06	1.25E-03	1.38E-03	2.76E-05	8/14/2002	9/12/2002	29	14.882	1.7

Storage Experiment (continued)

Conc (1)	Conc (1)	Conc (1)	Mean conc (2)	RSD	Conc (2)	Conc (2)	Conc (2)
M	mmol/L	mmol	ppb	%	M	mmol/L	mmol
-4.11E-08	-4.11E-05	-4.11E-07	-2.856	12.0	-3.81E-08	-3.81E-05	-3.81E-07
-5.74E-08	-5.74E-05	-5.74E-07	-1.698	33.3	-2.27E-08	-2.27E-05	-2.27E-07
5.97E-08	5.97E-05	5.97E-07	-3.645	13.5	-4.87E-08	-4.87E-05	-4.87E-07
7.85E-08	7.85E-05	7.85E-07	-1.753	5.8	-2.34E-08	-2.34E-05	-2.34E-07
5.28E-07	5.28E-04	5.28E-06	38.834	5.2	5.18E-07	5.18E-04	5.18E-06

8.96E-08	8.96E-05	8.96E-07	*21.075*	*4.9*	2.81E-07	2.81E-04	2.81E-06
#VALUE!	#VALUE!	#VALUE!	na	na	na	na	na
-7.49E-08	-7.49E-05	-7.49E-07	-4.852	32.4	-6.48E-08	-6.48E-05	-6.48E-07
-3.81E-08	-3.81E-05	-3.81E-07	-6.488	7.2	-8.66E-08	-8.66E-05	-8.66E-07
8.16E-09	8.16E-06	8.16E-08	-6.796	9.7	-9.07E-08	-9.07E-05	-9.07E-07
5.03E-09	5.03E-06	5.03E-08	-3.488	31.1	-4.66E-08	-4.66E-05	-4.66E-07
4.14E-07	4.14E-04	4.14E-06	*36.820*	*1.1*	4.91E-07	4.91E-04	4.91E-06
3.84E-07	3.84E-04	3.84E-06	38.86	0.6	5.19E-07	5.19E-04	5.19E-06
4.04E-07	4.04E-04	4.04E-06	41.67	1.9	5.56E-07	5.56E-04	5.56E-06
-2.17E-07	-2.17E-04	-2.17E-06	-0.296	>100	-3.95E-09	-3.95E-06	-3.95E-08
-1.66E-07	-1.66E-04	-1.66E-06	-5.516	16.5	-7.36E-08	-7.36E-05	-7.36E-07
-1.28E-07	-1.28E-04	-1.28E-06	-7.422	7.4	-9.91E-08	-9.91E-05	-9.91E-07
-1.44E-07	-1.44E-04	-1.44E-06	-7.077	15	-9.45E-08	-9.45E-05	-9.45E-07
2.22E-07	2.22E-04	2.22E-06	29.76	1.5	3.97E-07	3.97E-04	3.97E-06
1.37E-07	1.37E-04	1.37E-06	*31.807*	*1.0*	4.25E-07	4.25E-04	4.25E-06
1.99E-07	1.99E-04	1.99E-06	37.82	1.9	5.05E-07	5.05E-04	5.05E-06

Storage Experiment (continued)

total As from strip	total As strip	strip eff	ave strip eff	std dev	overall ave strip eff	std dev
mmol	mmol/g wet resin	%	%		%	
					25.5%	0.1
na	na	na				
-8.00E-07	-1.22E-06	na				
1.10E-07	1.78E-07	na				
5.51E-07	8.43E-07	na				

1.05E-05	1.74E-05	35.6%	23.5%	0.2
3.71E-06	6.09E-06	11.5%		
na	na	na		
na	na	na		
-1.25E-06	-1.90E-06	-112.9%		
-8.26E-07	-1.23E-06	-73.4%		
-4.15E-07	-6.12E-07	-32.6%		
9.06E-06	1.48E-05	30.3%	31.1%	0.0
9.02E-06	1.36E-05	30.4%		
9.60E-06	1.51E-05	32.5%		
na	na	na		
-2.40E-06	-3.75E-06	-202.9%		
-2.27E-06	-3.36E-06	-181.2%		
-2.38E-06	-3.77E-06	-169.7%		
6.19E-06	1.00E-05	21.2%	21.8%	0.0
5.62E-06	8.19E-06	18.7%		
7.03E-06	1.10E-05	25.4%		

```
Analyst        G Lake
Date Started     12:45PM 10/15/02
Worksheet        digest_10_15_02
Comment          1/100 dilution of digest
Methods          As

Method: As wtr_Ni_mod (Furnace)

                          Conc
Sample ID                 ug/L         RSD
                          ----------
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AsCAL ZERO                    0          78
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AsSTANDARD 1	25	10.2
AsSTANDARD 2	50	6
AsSTANDARD 3	75	12
AsSTANDARD 4	100	4.7

			my dilution	mg/kg	ave mg/kg soil	std dev	CI	mol/kg soil	ave mol/kg soil	std dev
Asblank_DDW	1.869	26.1								
As250ppb_check	272.324	6.7								
As500ppb_check	619.129	2.3	61912.9							
Asdigest_blank	2.449	36.5								
As8704-A	37.322	3.3	3732.2	46.653	4.8E+01	2.3E+00	2.1E-02	6.2E-04	6.4E-04	3.0E-05
As8704-b	40.622	1.6	4062.2	50.778				6.8E-04		
As8704-c	37.656	0.8	3765.6	47.07				6.3E-04		
AsDDW	-0.926	20.2								
AsLW-d	71.437	2.7	7143.7	89.296	7.3E+01	1.4E+01	9.3E-02	1.2E-03	9.8E-04	1.9E-04
AsLW-E	54.434	0.7	5443.4	68.043				9.1E-04		
AsLW-F	50.307	1.2	5030.7	62.884				8.4E-04		
AsLP-A	14.365	2.9	1436.5	17.956	2.0E+01	4.1E+00	6.3E-02	2.4E-04	2.7E-04	5.5E-05
AsLP-B	20.107	1.7	2010.7	25.134				3.4E-04		
AsLP-C	14.427	1.5	1442.7	18.034				2.4E-04		
AsDIGEST_BLANK	-0.059	>100								
AsWC-D	18.479	1.4	1847.9	23.099	1.5E+01	7.5E+00	9.8E-02	3.1E-04	2.0E-04	1.0E-04
AsWC-E	9.919	4.2	991.9	12.399				1.7E-04		
AsWC-F	6.998	2.1	699.8	8.7475				1.2E-04		
AsTC-A	1.475	14.3	147.5	1.8438	3.0E+00	2.1E+00	1.3E-01	2.5E-05	4.0E-05	2.8E-05
AsTC-B	4.282	13.1	428.2	5.3525				7.1E-05		
AsTC-C	1.375	5.2	137.5	1.7188				2.3E-05		
AsLCC-G	21.141	3.1	2114.1	26.426	2.1E+01	8.4E+00	1.0E-01	3.5E-04	2.8E-04	1.1E-04
AsLCC-H	8.936	6.2	893.6	11.17				1.5E-04		
AsLCC-I	19.998	1.6	1999.8	24.998				3.3E-04		
AsDDW_BLANK	-0.045	>100								
AsNR151-G-A	5.029	7.1	502.9	6.2863	6.6E+00	3.8E-01	9.7E-03	8.4E-05	8.7E-05	5.1E-06

AsNR151-G-B	5.469	9.2	546.9	6.8363				9.1E-05		
AsNR151-H	5.538	5	553.8	6.9225				9.2E-05		
AsNR-151-I	4.941	6.5	494.1	6.1763				8.2E-05		
AsNR-59-D	10.196	2.7	1019.6	12.745	8.4E+00	3.8E+00	6.9E-02	1.7E-04	1.1E-04	5.1E-05
AsNR59-E	5.289	5.2	528.9	6.6113				8.8E-05		
AsNR59-F	4.655	9.1	465.5	5.8188				7.8E-05		
As250CHECK	319.207	1.8								
AsDDW	1.155	32.8								

Worksheet digest_10_15_02 (continued)
Comment 1/100 dilution of digest

DF	Abs	Backgrnd	Readings		
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-	-	----	------		
1	0.0025	0.0248	0.0044	0.0026	0.0005
1	0.1876	0.0236	0.2089	0.172	0.1819
1	0.3591	0.024	0.3761	0.3348	0.3665
1	0.5604	0.0231	0.6311	0.497	0.5532
1	0.7239	0.0231	0.7525	0.6862	0.7331
1	0.014	0.0191	0.0176	0.0141	0.0103
4	0.5031	0.0198	0.5419	0.4831	0.4843
20	0.2298	0.018	0.2324	0.2333	0.2238
1	0.0184	0.0141	0.0116	0.025	0.0186
1	0.274	0.3728	0.2818	0.2764	0.2639
1	0.2965	0.3727	0.2911	0.3001	0.2984
1	0.2763	0.3579	0.2788	0.2759	0.2743
1	-0.0069	0.0175	-0.0062	-0.006	-0.0086
1	0.5308	0.3123	0.5427	0.5345	0.5151
1	0.3937	0.2908	0.397	0.3913	0.3928

1	0.3615	0.2462	0.3653	0.3625	0.3568
1	0.1078	0.1466	0.1042	0.1094	0.1098
1	0.1509	0.1763	0.1502	0.1488	0.1537
1	0.1083	0.1388	0.1096	0.1065	0.1087
1	-0.0004	0.0136	0.0002	0.0003	-0.0019
1	0.1387	0.3093	0.1407	0.1384	0.1369
1	0.0744	0.2217	0.0774	0.0747	0.0712
1	0.0525	0.192	0.0513	0.0533	0.053
1	0.0111	0.0336	0.0125	0.0094	0.0114
1	0.0321	0.0432	0.0299	0.037	0.0295
1	0.0103	0.0292	0.01	0.01	0.0109
1	0.1586	0.3617	0.1605	0.1624	0.153
1	0.0671	0.2408	0.0655	0.0718	0.0639
1	0.1501	0.3572	0.1526	0.1478	0.1498
1	-0.0003	0.0147	-0.0016	0.0006	0
1	0.0377	0.1866	0.0348	0.0401	0.0384
1	0.041	0.1817	0.0376	0.0451	0.0404
1	0.0416	0.1778	0.0427	0.0392	0.0428
1	0.0371	0.163	0.037	0.0395	0.0347
1	0.0765	0.234	0.0755	0.0789	0.0751
1	0.0397	0.1617	0.0379	0.0392	0.042
1	0.0349	0.1637	0.0323	0.0385	0.0341
4	0.5952	0.0156	0.5874	0.5908	0.6072
1	0.0087	0.0134	0.0054	0.0098	0.0108

22-Feb-02

MICROCOSM - LP

This sheet describes sample names and identifcations, dry weight, weight with water, and spike concentration.

Day1 Day1 Day1 Day2 Day2 Day2

Sample Description	Estimated Resin Exposure Time	Sample ID	Container Weight	Dry Weight (no container)	Sample + Water Weight (no cont)	Cont+Samp+Wtr	Initial Cont+Samp +Wtr	water added?	Final Cont+Samp +Wtr	Soil: Water
	days		*g*	*g*	*g*	*g*	*g*	*g*	*g*	
Lyssy Pond	15	LP-15-0-a	12.60	102.18	175.99	188.59	186.51	7.07	193.58	1.30
	15	LP-15-0-b	12.05	110.4	170.57	182.62	180.04	2.06	182.10	1.85
	15	LP-15-0-c	12.42	101.81	161.52	173.94	159.76	22.64	182.40	1.49
	15	LP-15-10-a	11.39	101.84	152.51	163.90	161.81	20.23	182.04	1.48
	15	LP-15-10-b	12.68	99.7	150.01	162.69	148.44	33.08	181.52	1.44
	15	LP-15-10-c	12.46	99.3	152.11	164.57	162.95	18.90	181.85	1.42
	15	LP-15-50-a	12.11	100.18	153.86	165.97	163.01	19.32	182.33	1.43
	15	LP-15-50-b	12.56	105.56	158.6	171.16	168.14	14.39	182.53	1.64
	15	LP-15-50-c	12.09	101.44	152.94	165.03	161.79	20.30	182.09	1.48
	15	LP-15-100-a	11.18	99.28	151.05	162.23	158.75	16.18	174.93	1.54
	15	LP-15-100-b	12.55	103.16	158.13	170.68	168.26	13.77	182.03	1.56
	15	LP-15-100-c	12.49	103.61	150.52	163.01	160.02	22.06	182.08	1.57
Lyssy Pond	30	LP-30-0-a	12.09	96.5	163.08	175.17	161.32	20.74	182.06	1.31
	30	LP-30-0-b	12.17	100.41	151.74	163.91	162.05	19.89	181.94	1.45
	30	LP-30-0-c	12.37	99.48	163.23	175.60	173.41	8.21	181.62	1.43
	30	LP-30-10-a	11.80	99.57	151.17	162.97	160.59	21.50	182.09	1.41
	30	LP-30-10-b	12.42	100.77	150.46	162.88	148.87	33.22	182.09	1.46
	30	LP-30-10-c	12.44	100.39	152.42	164.86	163.15	18.96	182.11	1.45
	30	LP-30-50-a	12.36	100.13	150.96	163.32	148.72	26.96	175.68	1.58
	30	LP-30-50-b	12.04	99.87	156.28	168.32	165.21	17.63	182.84	1.41
	30	LP-30-50-c	12.54	101.04	157.95	170.49	168.33	13.71	182.04	1.48
	30	LP-30-100-a	12.50	102.09	155.26	167.76	151.44	24.82	176.26	1.66
	30	LP-30-100-b	12.28	101.54	166.78	179.06	176.48	6.15	182.63	1.48
	30	LP-30-100-c	11.99	99.6	155.58	167.57	165.27	16.74	182.01	1.41
Lyssy Pond	60	LP-60-0-a	12.24	99.92	154.05	166.29	163.90	12.91	176.81	1.55
	60	LP-60-0-b	10.94	103.13	158.76	169.70	167.48	12.56	180.04	1.56

	60	LP-60-0-c	12.56	103.54	157.35	169.91	168.33	15.83	184.16	1.52
	60	LP-60-10-a	11.42	98.4	153.72	165.14	162.86	19.58	182.44	1.35
	60	LP-60-10-b	12.74	99.27	155.2	167.94	166.16	16.35	182.51	1.41
	60	LP-60-10-c	12.53	100.18	154.88	167.41	165.43	16.71	182.14	1.44
	60	LP-60-50-a	11.92	101.14	159.26	171.18	168.15	14.03	182.18	1.46
	60	LP-60-50-b	11.19	98.03	153.61	164.80	161.81	20.20	182.01	1.35
	60	LP-60-50-c	12.40	103.08	160.88	173.28	170.61	11.51	182.12	1.55
	60	LP-60-100-a	11.07	97.68	160.09	171.16	167.99	14.06	182.05	1.33
	60	LP-60-100-b	12.13	99.35	151.1	163.23	160.42	21.63	182.05	1.41
	60	LP-60-100-c	12.00	99.03	156.71	168.71	166.00	16.25	182.25	1.39
Lyssy Pond	90	LP-90-0-a	12.06	98.75	163.41	175.47	161.54	6.49	168.03	1.73
	90	LP-90-0-b	12.15	97.15	150.56	162.71	159.94	8.50	168.44	1.64
	90	LP-90-0-c	11.97	101.26	152.73	164.70	151.06	13.51	164.57	1.97
	90	LP-90-10-a	12.47	100.21	149.1	161.57	159.67	21.31	180.98	1.47
	90	LP-90-10-b	11.58	98.51	152.8	164.38	162.18	19.75	181.93	1.37
	90	LP-90-10-c	12.57	104.41	151.63	164.20	162.44	19.78	182.22	1.60
	90	LP-90-50-a	12.61	102.64	159	171.61	171.08	10.95	182.03	1.54
	90	LP-90-50-b	11.34	102.14	154.63	165.97	165.47	16.53	182.00	1.49
	90	LP-90-50-c	12.25	99.53	152.22	164.47	163.81	18.18	181.99	1.42
	90	LP-90-100-a	12.67	99.99	151.26	163.93	161.16	20.88	182.04	1.44
	90	LP-90-100-b	12.18	101.33	155.87	168.05	165.66	16.42	182.08	1.48
	90	LP-90-100-c	12.50	101.12	152.81	165.31	163.02	18.98	182.00	1.48

MICROCOSM - LP (continued)

Spike Conc (As)	Spike Conc (As)	Amount TO weigh for spike	Amount weighed and spiked	Conc spiked (As)	Conc spiked (As)	Conc spiked (As)	Spike date	Resin Introduction Date	Equilibration Time

ppm	*M*	*g Na_3AsO_4*	*g Na_3AsO_4*	*ppm*	*M*	*mmo/L*	*date*	*date*	*days*
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0047	11.09	3.56E-05	3.56E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0041	0.0043	10.37	3.32E-05	3.32E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0041	0.0047	11.38	3.65E-05	3.65E-02	3/25/2002	5/17/2002	53
50	1.60E-04	0.0208	0.0201	48.23	1.55E-04	1.55E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0220	0.0226	51.47	1.65E-04	1.65E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0211	0.0212	50.24	1.61E-04	1.61E-01	3/31/2002	5/17/2002	47
100	3.21E-04	0.0413	0.0412	99.76	3.20E-04	3.20E-01	4/2/2002	5/17/2002	45
100	3.21E-04	0.0429	0.0428	99.73	3.20E-04	3.20E-01	4/2/2002	5/17/2002	45
100	3.21E-04	0.0431	0.0432	100.23	3.21E-04	3.21E-01	4/2/2002	5/17/2002	45
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
10	3.21E-05	0.0041	0.0039	9.42	3.02E-05	3.02E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0046	10.97	3.52E-05	3.52E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0470	112.54	3.61E-04	3.61E-01	3/25/2002	5/17/2002	53
50	1.60E-04	0.0208	0.0205	49.21	1.58E-04	1.58E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0208	0.0203	48.86	1.57E-04	1.57E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0210	0.0211	50.20	1.61E-04	1.61E-01	3/31/2002	5/17/2002	47
100	3.21E-04	0.0425	0.0423	99.60	3.19E-04	3.19E-01	4/2/2002	5/17/2002	45
100	3.21E-04	0.0422	0.0422	99.90	3.20E-04	3.20E-01	4/2/2002	5/17/2002	45
100	3.21E-04	0.0414	0.0413	99.68	3.19E-04	3.19E-01	4/2/2002	5/17/2002	45
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
10	3.21E-05	0.0041	0.0044	10.75	3.45E-05	3.45E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0041	0.0041	9.93	3.18E-05	3.18E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0042	10.08	3.23E-05	3.23E-02	3/25/2002	5/17/2002	53
50	1.60E-04	0.0210	0.0211	50.15	1.61E-04	1.61E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0204	0.0203	49.78	1.60E-04	1.60E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0214	0.0217	50.60	1.62E-04	1.62E-01	3/31/2002	5/17/2002	47
100	3.21E-04	0.0406	0.0408	100.41	3.22E-04	3.22E-01	4/2/2002	5/17/2002	45
100	3.21E-04	0.0413	0.0412	99.69	3.20E-04	3.20E-01	4/2/2002	5/17/2002	45
100	3.21E-04	0.0412	0.0412	100.01	3.21E-04	3.21E-01	4/2/2002	5/17/2002	45
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53

0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0041	9.84	3.15E-05	3.15E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0041	0.0041	10.00	3.21E-05	3.21E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0043	0.0046	10.59	3.39E-05	3.39E-02	3/25/2002	5/17/2002	53
50	1.60E-04	0.0213	0.0216	50.59	1.62E-04	1.62E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0212	0.0213	50.13	1.61E-04	1.61E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0207	0.0207	49.99	1.60E-04	1.60E-01	3/31/2002	5/17/2002	47
100	3.21E-04	0.0416	0.0417	100.25	3.21E-04	3.21E-01	4/2/2002	5/17/2002	45
100	3.21E-04	0.0422	0.0424	100.59	3.22E-04	3.22E-01	4/2/2002	5/17/2002	45
100	3.21E-04	0.0421	0.0421	100.08	3.21E-04	3.21E-01	4/2/2002	5/17/2002	45

MICROCOSM - LP (continued)

Resin Introduction Amount	barried (b) or in film container (c)	Resin Removal Date	Resin Exposure Time	Final weight at Resin Removal (cnt + samp+ film cnt&lid)	Final weight at Resin Removal (cnt + samp)	Mean Conc (1)	RSD	Conc (1)	Conc (1)	Conc (1)
g wet resin		*date*	*days*	*g*	*g*	**ug/L**	**%**	**M**	**mmol/L**	**mmol**
0.6843		5/31/2002	14	193.84	192	6.2963	8.2	8.40E-08	8.40E-05	8.40E-07
0.6747		5/31/2002	14	187.89	186	*21.671*	*0.3*	2.89E-07	2.89E-04	2.89E-06
0.6038		5/31/2002	14	179.64	178	*33.035*	*4.1*	4.40E-07	4.40E-04	4.40E-06
0.6092		5/31/2002	14	186.80	185	*166.132*	*12.6*	2.22E-06	2.22E-03	2.22E-05
0.5993		5/31/2002	14	181.30	179	*29.817*	*23.1*	3.98E-07	3.98E-04	3.98E-06
0.6955		5/31/2002	14	185.92	184	*238.389*	*13.9*	3.18E-06	3.18E-03	3.18E-05
0.6963		5/31/2002	14	175.47	173	282.2593	3	3.76E-06	3.76E-03	3.76E-05
0.6868		5/31/2002	14	194.72	193	*26.579*	*6.2*	3.54E-07	3.54E-04	3.54E-06
0.6962		5/31/2002	14	183.84	182	373.9630	8.8	4.99E-06	4.99E-03	4.99E-05
0.6275		5/31/2002	14	176.63	175	419.4074	5.7	5.59E-06	5.59E-03	5.59E-05
0.6176		5/31/2002	14	185.80	184	280.6296	7.1	3.74E-06	3.74E-03	3.74E-05
0.6745		5/31/2002	14	183.29	181	*9.051*	*0.6*	1.21E-07	1.21E-04	1.21E-06
0.6596	b	6/14/2002	28	181.53	180	*116.930*	*27.5*	1.56E-06	1.56E-03	1.56E-05
0.6584	b	6/14/2002	28	181.56	180	75.45	12.6	1.01E-06	1.01E-03	1.01E-05
0.6630	b	6/14/2002	28	178.96	177	52.01	14	6.93E-07	6.93E-04	6.93E-06
0.6556	b	6/14/2002	28	179.00	177	159.118	6.3	2.12E-06	2.12E-03	2.12E-05
0.6290	b	6/14/2002	28	178.63	177	273.296	25.8	3.64E-06	3.64E-03	3.64E-05
0.6213	b	6/14/2002	28	179.19	177	22.386	18.1	2.98E-07	2.98E-04	2.98E-06

0.6152	c	6/14/2002	28	175.48	173	36.887	21.2	4.92E-07	4.92E-04	4.92E-06
0.6075	c	6/14/2002	28	182.21	180	33.182	10.6	4.42E-07	4.42E-04	4.42E-06
0.6544	c	6/14/2002	28	182.52	181	41.138	19.4	5.49E-07	5.49E-04	5.49E-06
0.6066	c	6/14/2002	28	176.57	175	50.369	9.5	6.72E-07	6.72E-04	6.72E-06
0.6104	b	6/14/2002	28	182.98	181	72.066	9.1	9.61E-07	9.61E-04	9.61E-06
0.6870	c	6/14/2002	28	185.18	183	55.479	25.5	7.40E-07	7.40E-04	7.40E-06
0.6724	b	7/16/2002	60	172.22	170	78.205	1.2	1.04E-06	1.04E-03	1.04E-05
0.6246	b	7/16/2002	60	180.66	179	98.526	9.7	1.31E-06	1.31E-03	1.31E-05
0.6156	b	7/16/2002	60	178.15	176	66.507	12.3	8.87E-07	8.87E-04	8.87E-06
0.6301	b	7/16/2002	60	173.73	172	161.097	6.5	2.15E-06	2.15E-03	2.15E-05
0.6066	b	7/16/2002	60	176.26	174	242.512	20.4	3.23E-06	3.23E-03	3.23E-05
0.6702	b	7/16/2002	60	174.19	172	156.969	5.0	2.09E-06	2.09E-03	2.09E-05
0.6934	c	7/16/2002	60	177.63	176	243.213	42.9	3.24E-06	3.24E-03	3.24E-05
0.6388	c	7/16/2002	60	176.71	175	108.186	26.7	1.44E-06	1.44E-03	1.44E-05
0.6032	c	7/16/2002	60	178.42	176	*227.421*	*14.2*	3.03E-06	3.03E-03	3.03E-05
0.6844	c	7/16/2002	60	177.05	175	112.307	20.5	1.50E-06	1.50E-03	1.50E-05
0.6389	c	7/16/2002	60	179.04	177	111.06	9.1	1.48E-06	1.48E-03	1.48E-05
0.6061	c	7/16/2002	60	175.46	173	111.348	21.1	1.48E-06	1.48E-03	1.48E-05
0.6933	b	8/15/2002	90	163.69	162	327.618	24.7	4.37E-06	4.37E-03	4.37E-05
0.6648	b	8/15/2002	90	163.40	161	88.114	30.4	1.17E-06	1.17E-03	1.17E-05
0.6022	c	8/15/2002	90	175.27	173	171.768	13.0	2.29E-06	2.29E-03	2.29E-05
0.6177	b	8/15/2002	90	178.11	176	195.584	9.8	2.61E-06	2.61E-03	2.61E-05
0.6801	b	8/15/2002	90	173.23	171	250.444	36.7	3.34E-06	3.34E-03	3.34E-05
0.6798	b	8/15/2002	90	177.86	176	152.620	6.1	2.03E-06	2.03E-03	2.03E-05
0.6376	c	8/15/2002	90	189.26	187	18621.6	60.8	2.48E-04	2.48E-01	2.48E-03
0.6580	b	8/15/2002	90	183.42	181	15847.0	61.0	2.11E-04	2.11E-01	2.11E-03
0.6570	c	8/15/2002	90	190.21	188	17008.260	3.3	2.27E-04	2.27E-01	2.27E-03
0.6312	b	8/15/2002	90	178.55	177	1688.7	34.7	2.25E-05	2.25E-02	2.25E-04
0.6168	c	8/15/2002	90	169.18	167	251.4	42.5	3.35E-06	3.35E-03	3.35E-05
0.6017	c	8/15/2002	90	179.14	177	*524.492*	*22.5*	6.99E-06	6.99E-03	6.99E-05

MICROCOSM - LP (continued)

Conc (1) / g resin mmol/g wet resin	Mean Conc (2) ug/L	RSD %	Conc (2) M	Conc (2) mmol/L	Conc (2) mmol	Conc (2) / g resin mmol/g wet resin	total strip conc mmol/g wet resin	Ave Background Conc mmol/g wet resin	Total Calc Conc - background mmol/g wet resin	Available As mmol/g wet resin	Log Available As mmol/g wet resin
1.23E-06	96.0741	2.6	1.28E-06	1.28E-03	1.28E-05	1.87E-05	1.99E-05	3.17E-05	-1.18E-05	-7.43E-05	#NUM!
4.28E-06	103.6667	0.6	1.38E-06	1.38E-03	1.38E-05	2.05E-05	2.48E-05		-6.95E-06	-4.39E-05	#NUM!
7.29E-06	195.4074	3.5	2.61E-06	2.61E-03	2.61E-05	4.32E-05	5.04E-05		1.87E-05	1.18E-04	-3.93E+00
3.64E-05	194.2593	1.8	2.59E-06	2.59E-03	2.59E-05	4.25E-05	7.89E-05		4.72E-05	2.98E-04	-3.53E+00
6.63E-06	184.0741	0.7	2.45E-06	2.45E-03	2.45E-05	4.10E-05	4.76E-05		1.59E-05	1.00E-04	-4.00E+00
4.57E-05	191.8889	0.4	2.56E-06	2.56E-03	2.56E-05	3.68E-05	8.25E-05		5.08E-05	3.21E-04	-3.49E+00
5.40E-05	281.0000	3	3.75E-06	3.75E-03	3.75E-05	5.38E-05	1.08E-04		7.61E-05	4.81E-04	-3.32E+00
5.16E-06	*237.074*	*4.2*	3.16E-06	3.16E-03	3.16E-05	4.60E-05	5.12E-05		1.95E-05	1.23E-04	-3.91E+00
7.16E-05	283.5185	1.4	3.78E-06	3.78E-03	3.78E-05	5.43E-05	1.26E-04		9.42E-05	5.95E-04	-3.23E+00
8.91E-05	280.2593	0.9	3.74E-06	3.74E-03	3.74E-05	5.96E-05	1.49E-04		1.17E-04	7.38E-04	-3.13E+00
6.06E-05	269.4815	0.8	3.59E-06	3.59E-03	3.59E-05	5.82E-05	1.19E-04		8.70E-05	5.50E-04	-3.26E+00
1.79E-06	313.2593	0.5	4.18E-06	4.18E-03	4.18E-05	6.19E-05	6.37E-05		3.20E-05	2.02E-04	-3.69E+00
2.36E-05	*115.984*	*6.4*	1.55E-06	1.55E-03	1.55E-05	2.34E-05	4.71E-05	3.43E-05	1.28E-05	8.05E-05	-4.09E+00
1.53E-05	99.588	5.4	1.33E-06	1.33E-03	1.33E-05	2.02E-05	3.54E-05		1.12E-06	7.08E-06	-5.15E+00
1.05E-05	49.664	6.7	6.62E-07	6.62E-04	6.62E-06	9.99E-06	2.04E-05		-1.39E-05	-8.76E-05	#NUM!
3.24E-05	505.793	1.3	6.74E-06	6.74E-03	6.74E-05	1.03E-04	1.35E-04		1.01E-04	6.37E-04	-3.20E+00
5.79E-05	158.069	6.1	2.11E-06	2.11E-03	2.11E-05	3.35E-05	9.14E-05		5.71E-05	3.61E-04	-3.44E+00
4.80E-06	200.092	0.3	2.67E-06	2.67E-03	2.67E-05	4.29E-05	4.77E-05		1.34E-05	8.47E-05	-4.07E+00
7.99E-06	1215.626	9.4	1.62E-05	1.62E-02	1.62E-04	2.63E-04	2.71E-04		2.37E-04	1.50E-03	-2.82E+00
7.28E-06	1290.926	3.4	1.72E-05	1.72E-02	1.72E-04	2.83E-04	2.91E-04		2.56E-04	1.62E-03	-2.79E+00
8.38E-06	2179.070	8.0	2.91E-05	2.91E-02	2.91E-04	4.44E-04	4.52E-04		4.18E-04	2.64E-03	-2.58E+00
1.11E-05	1625.676	1.9	2.17E-05	2.17E-02	2.17E-04	3.57E-04	3.68E-04		3.34E-04	2.11E-03	-2.68E+00
1.57E-05	4465.228	4.4	5.95E-05	5.95E-02	5.95E-04	9.75E-04	9.91E-04		9.57E-04	6.04E-03	-2.22E+00
1.08E-05	4904.838	3.2	6.54E-05	6.54E-02	6.54E-04	9.52E-04	9.63E-04		9.28E-04	5.86E-03	-2.23E+00
1.55E-05	156.146	0.6	2.08E-06	2.08E-03	2.08E-05	3.10E-05	4.65E-05	4.89E-05	-2.42E-06	-1.53E-05	#NUM!
2.10E-05	145.175	1.9	1.94E-06	1.94E-03	1.94E-05	3.10E-05	5.20E-05		3.14E-06	1.98E-05	-4.70E+00
1.44E-05	155.875	2.4	2.08E-06	2.08E-03	2.08E-05	3.38E-05	4.82E-05		-7.21E-07	-4.55E-06	#NUM!
3.41E-05	256.377	1.7	3.42E-06	3.42E-03	3.42E-05	5.43E-05	8.83E-05		3.95E-05	2.49E-04	-3.60E+00
5.33E-05	892.12	0.7	1.19E-05	1.19E-02	1.19E-04	1.96E-04	2.49E-04		2.01E-04	1.27E-03	-2.90E+00
3.12E-05	1598.192	2.6	2.13E-05	2.13E-02	2.13E-04	3.18E-04	3.49E-04		3.00E-04	1.90E-03	-2.72E+00
4.68E-05	3461.689	1.3	4.62E-05	4.62E-02	4.62E-04	6.66E-04	7.12E-04		6.64E-04	4.19E-03	-2.38E+00

2.26E-05	3146.102	4.2	4.19E-05	4.19E-02	4.19E-04	6.57E-04	6.79E-04		6.30E-04	3.98E-03	-2.40E+00
5.03E-05	*4791.130*	*217.0*	6.39E-05	6.39E-02	6.39E-04	1.06E-03	1.11E-03		1.06E-03	6.69E-03	-2.17E+00
2.19E-05	5958.914	1.2	7.95E-05	7.95E-02	7.95E-04	1.16E-03	1.18E-03		1.13E-03	7.16E-03	-2.15E+00
2.32E-05	5269.097	2.2	7.03E-05	7.03E-02	7.03E-04	1.10E-03	1.12E-03		1.07E-03	6.78E-03	-2.17E+00
2.45E-05	*4137.638*	*41.1*	5.52E-05	5.52E-02	5.52E-04	9.10E-04	9.35E-04		8.86E-04	5.59E-03	-2.25E+00
6.30E-05	113.520	73.1	1.51E-06	1.51E-03	1.51E-05	2.18E-05	8.48E-05	5.17E-05	3.31E-05	2.09E-04	-3.68E+00
1.77E-05	35.724	13.8	4.76E-07	4.76E-04	4.76E-06	7.16E-06	2.48E-05		-2.69E-05	-1.70E-04	#NUM!
3.80E-05	33.341	14.2	4.45E-07	4.45E-04	4.45E-06	7.38E-06	4.54E-05		-6.28E-06	-3.97E-05	#NUM!
4.22E-05	65.609	11.7	8.75E-07	8.75E-04	8.75E-06	1.42E-05	5.64E-05		4.68E-06	2.96E-05	-4.53E+00
4.91E-05	65.491	26.3	8.73E-07	8.73E-04	8.73E-06	1.28E-05	6.19E-05		1.02E-05	6.47E-05	-4.19E+00
2.99E-05	216.697	47.7	2.89E-06	2.89E-03	2.89E-05	4.25E-05	7.24E-05		2.07E-05	1.31E-04	-3.88E+00
3.89E-03	227.608	44.4	3.03E-06	3.03E-03	3.03E-05	4.76E-05	3.94E-03		3.89E-03	2.46E-02	-1.61E+00
3.21E-03	239.747	6.7	3.20E-06	3.20E-03	3.20E-05	4.86E-05	3.26E-03		3.21E-03	2.03E-02	-1.69E+00
3.45E-03	*145.410*	*0.1*	1.94E-06	1.94E-03	1.94E-05	2.95E-05	3.48E-03		3.43E-03	2.17E-02	-1.66E+00
3.57E-04	251.788	2.7	3.36E-06	3.36E-03	3.36E-05	5.32E-05	4.10E-04		3.58E-04	2.26E-03	-2.65E+00
5.43E-05	218.073	4.4	2.91E-06	2.91E-03	2.91E-05	4.71E-05	1.01E-04		4.98E-05	3.14E-04	-3.50E+00
1.16E-04	227.910	1.2	3.04E-06	3.04E-03	3.04E-05	5.05E-05	1.67E-04		1.15E-04	7.26E-04	-3.14E+00

22-Feb-02

MICROCOSM - WC

This sheet describes sample names and identifcations, dry weight, weight with water, and spike concentration.

				Day1	Day1	Day1	Day2	Day2	Day2	
Sample Description	**Estimated Resin Exposure Time**	**Sample ID**	**Container Weight**	**Dry Weight (no container)**	**Sample + Water Weight (no cont)**	**Cont+Samp +Wtr**	**Initial Cont+Samp +Wtr**	**water added?**	**Final Cont+Samp +Wtr**	**Soil: Water**
	days		*g*	*g*	*g*	*g*	*g*	*g*	*g*	
Weedy Creek	15	WC-15-0-a	12.31	100.04	172.31	184.62	183.15	6.95	190.10	1.29
	15	WC-15-0-b	12.22	100.99	160.89	173.11	171.62	18.39	190.01	1.31
	15	WC-15-0-c	11.61	100.75	166.37	177.98	176.67	18.33	195.00	1.22
	15	WC-15-10-a	12.69	100.47	168.37	181.06	179.19	10.82	190.01	1.31
	15	WC-15-10-b	12.15	100.11	166.70	178.85	177.34	12.71	190.05	1.29

	15	WC-15-10-c	12.18	100.10	162.24	174.42	173.16	17.45	190.61	1.28
	15	WC-15-50-a	12.64	100.37	163.95	176.59	174.60	10.87	185.47	1.39
	15	WC-15-50-b	11.21	100.31	167.95	179.16	176.85	8.29	185.14	1.36
	15	WC-15-50-c	11.50	100.66	166.77	178.27	176.00	9.32	185.32	1.38
	15	WC-15-100-a	11.80	99.56	160.79	172.59	169.79	15.54	185.33	1.35
	15	WC-15-100-b	11.08	100.41	162.62	173.70	171.08	14.04	185.12	1.36
	15	WC-15-100-c	11.54	100.90	163.18	174.72	172.29	12.85	185.14	1.39
Weedy Creek	30	WC-30-0-a	12.23	100.04	163.95	176.18	174.69	15.40	190.09	1.29
	30	WC-30-0-b	12.02	100.34	162.83	174.85	173.43	23.65	197.08	1.18
	30	WC-30-0-c	12.60	101.01	164.41	177.01	175.49	14.60	190.09	1.32
	30	WC-30-10-a	11.83	100.20	163.62	175.45	173.55	16.45	190.00	1.29
	30	WC-30-10-b	12.52	100.14	163.02	175.54	173.76	16.38	190.14	1.29
	30	WC-30-10-c	12.81	100.15	164.02	176.83	175.30	14.74	190.04	1.30
	30	WC-30-50-a	12.15	100.20	164.22	176.37	174.09	15.96	190.05	1.29
	30	WC-30-50-b	12.09	100.15	163.68	175.77	173.14	16.91	190.05	1.29
	30	WC-30-50-c	12.55	100.18	164.09	176.64	174.77	15.34	190.11	1.29
	30	WC-30-100-a	11.11	100.23	167.45	178.56	175.80	9.28	185.08	1.36
	30	WC-30-100-b	12.32	100.03	164.18	176.50	174.03	11.18	185.21	1.37
	30	WC-30-100-c	12.38	100.16	163.21	175.59	173.45	11.67	185.12	1.38
Weedy Creek	60	WC-60-0-a	11.42	100.22	163.08	174.50	172.87	17.18	190.05	1.28
	60	WC-60-0-b	12.34	100.21	164.39	176.73	176.26	14.82	191.08	1.28
	60	WC-60-0-c	11.91	100.68	163.09	175.00	173.56	21.66	195.22	1.22
	60	WC-60-10-a	12.34	100.50	163.43	175.77	174.14	15.94	190.08	1.30
	60	WC-60-10-b	12.38	100.68	164.28	176.66	175.11	14.92	190.03	1.31
	60	WC-60-10-c	12.21	100.76	163.82	176.03	174.77	15.35	190.12	1.31
	60	WC-60-50-a	11.64	100.38	164.93	176.57	175.15	14.91	190.06	1.29
	60	WC-60-50-b	11.66	100.13	164.46	176.12	173.78	16.49	190.27	1.28
	60	WC-60-50-c	12.36	100.10	166.04	178.40	176.34	13.81	190.15	1.29

	60	WC-60-100-a	12.37	100.45	164.57	176.94	174.44	10.63	185.07	1.39
	60	WC-60-100-b	12.62	100.15	165.14	177.76	175.59	9.60	185.19	1.38
	60	WC-60-100-c	12.48	100.16	168.54	181.02	179.03	6.04	185.07	1.38
Weedy Creek	90	WC-90-0-a	12.05	100.14	165.39	177.44	175.92	14.13	190.05	1.29
	90	WC-90-0-b	10.92	100.38	164.16	175.08	173.53	17.46	190.99	1.26
	90	WC-90-0-c	12.09	100.17	163.94	176.03	174.66	22.26	196.92	1.18
	90	WC-90-10-a	12.43	100.07	162.22	174.65	173.08	17.04	190.12	1.29
	90	WC-90-10-b	11.61	100.10	164.75	176.36	174.73	15.30	190.03	1.28
	90	WC-90-10-c	12.40	100.65	164.09	176.49	175.16	14.85	190.01	1.31
	90	WC-90-50-a	12.46	100.59	164.93	177.39	175.33	14.69	190.02	1.31
	90	WC-90-50-b	10.87	100.66	163.44	174.31	171.96	18.04	190.00	1.28
	90	WC-90-50-c	12.34	100.32	170.39	182.73	180.32	9.73	190.05	1.30
	90	WC-90-100-a	12.36	100.79	165.78	178.14	174.89	11.04	185.93	1.38
	90	WC-90-100-b	12.24	100.81	165.69	177.93	175.74	9.26	185.00	1.40
	90	WC-90-100-c	12.28	100.34	166.01	178.29	176.37	8.90	185.27	1.38

MICROCOSM - WC (continued)

Spike Concentration (As) ppm	Spike Concentration (As) M	Amount TO weigh for spike g Na_3AsO_4	Amount weighed and spiked g Na_3AsO_4	Concentration spiked (As) ppm	Concentration spiked (As) M	Concentration spiked (As) mmo/L	Spike date date	Resin Introduction Date date	Equilibration Time days
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
10	3.21E-05	0.0042	0.0042	10.05	3.22E-05	3.22E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0048	11.53	3.69E-05	3.69E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0046	11.05	3.54E-05	3.54E-02	3/25/2002	5/17/2002	53

50	1.60E-04	0.0209	0.0202	48.38	1.55E-04	1.55E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0209	0.0210	50.32	1.61E-04	1.61E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0209	0.0206	49.19	1.58E-04	1.58E-01	3/31/2002	5/17/2002	47
100	3.21E-04	0.0414	0.0412	99.48	3.19E-04	3.19E-01	4/1/2002	5/17/2002	46
100	3.21E-04	0.0418	0.0417	99.83	3.20E-04	3.20E-01	4/1/2002	5/17/2002	46
100	3.21E-04	0.0420	0.0418	99.58	3.19E-04	3.19E-01	4/1/2002	5/17/2002	46
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
10	3.21E-05	0.0042	0.0038	9.12	2.92E-05	2.92E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0043	10.32	3.31E-05	3.31E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0046	11.04	3.54E-05	3.54E-02	3/25/2002	5/17/2002	53
50	1.60E-04	0.0208	0.0206	49.42	1.58E-04	1.58E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0208	0.0205	49.21	1.58E-04	1.58E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0208	0.0204	48.95	1.57E-04	1.57E-01	3/31/2002	5/17/2002	47
100	3.21E-04	0.0417	0.0416	99.77	3.20E-04	3.20E-01	4/1/2002	5/17/2002	46
100	3.21E-04	0.0416	0.0415	99.73	3.20E-04	3.20E-01	4/1/2002	5/17/2002	46
100	3.21E-04	0.0417	0.0417	100.08	3.21E-04	3.21E-01	4/1/2002	5/17/2002	46
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
10	3.21E-05	0.0042	0.0039	9.33	2.99E-05	2.99E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0041	9.79	3.14E-05	3.14E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0043	10.26	3.29E-05	3.29E-02	3/25/2002	5/17/2002	53
50	1.60E-04	0.0209	0.0209	50.05	1.60E-04	1.60E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0208	0.0210	50.42	1.62E-04	1.62E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0208	0.0202	48.51	1.55E-04	1.55E-01	3/31/2002	5/17/2002	47
100	3.21E-04	0.0418	0.0418	100.03	3.21E-04	3.21E-01	4/1/2002	5/17/2002	46

100	3.21E-04	0.0417	0.0416	99.85	3.20E-04	3.20E-01	4/1/2002	5/17/2002	46
100	3.21E-04	0.0417	0.0416	99.84	3.20E-04	3.20E-01	4/1/2002	5/17/2002	46
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
0	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002	54
10	3.21E-05	0.0042	0.0044	10.57	3.39E-05	3.39E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0039	9.37	3.00E-05	3.00E-02	3/25/2002	5/17/2002	53
10	3.21E-05	0.0042	0.0045	10.75	3.44E-05	3.44E-02	3/25/2002	5/17/2002	53
50	1.60E-04	0.0209	0.0204	48.75	1.56E-04	1.56E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0209	0.0210	50.15	1.61E-04	1.61E-01	3/31/2002	5/17/2002	47
50	1.60E-04	0.0209	0.0199	47.68	1.53E-04	1.53E-01	3/31/2002	5/17/2002	47
100	3.21E-04	0.0419	0.0420	100.17	3.21E-04	3.21E-01	4/1/2002	5/17/2002	46
100	3.21E-04	0.0419	0.0419	99.91	3.20E-04	3.20E-01	4/1/2002	5/17/2002	46
100	3.21E-04	0.0417	0.0415	99.42	3.19E-04	3.19E-01	4/1/2002	5/17/2002	46

MICROCOSM - WC (continued)

Resin Introduction Amount	Resin Removal Date	Resin Exposure Time	barried (b) or in film container(c)	Final weight at Resin Removal (cnt + samp+ film cnt&lid)	Final weight at Resin Removal (cnt + samp)	Mean Conc (1)	RSD	Conc (1)	Conc (1)	Conc (1)
g	*date*	*days*		*g*	*g*	**ug/L**	**%**	**M**	**mmol/L**	**mmol**
0.6472	5/31/2002	14		194.15	192	*47.264*	*2.5*	6.30E-07	6.30E-04	6.30E-06
0.6509	5/31/2002	14		192.74	191	*-12.142*	*0.3*	-1.62E-07	-1.62E-04	-1.62E-06
0.6726	5/31/2002	14		194.58	193	*-9.902*	*0.8*	-1.32E-07	-1.32E-04	-1.32E-06
0.6578	5/31/2002	14		186.35	184	*168.154*	*8.0*	2.24E-06	2.24E-03	2.24E-05

0.6151	5/31/2002	14		189.35	187	*194.311*	*19.1*	2.59E-06	2.59E-03	2.59E-05
0.6588	5/31/2002	14		189.78	188	*172.290*	*5.7*	2.30E-06	2.30E-03	2.30E-05
0.6390	5/31/2002	14		191.75	190	*195.599*	*11.1*	2.61E-06	2.61E-03	2.61E-05
0.6255	5/31/2002	14		187.77	186	*177.056*	*7.1*	2.36E-06	2.36E-03	2.36E-05
0.6224	5/31/2002	14		186.76	185	*203.930*	*16.2*	2.72E-06	2.72E-03	2.72E-05
0.6713	5/31/2002	14		187.57	186	*177.678*	*3.9*	2.37E-06	2.37E-03	2.37E-05
0.6761	5/31/2002	14		185.61	184	*201.471*	*8.8*	2.69E-06	2.69E-03	2.69E-05
0.6149	5/31/2002	14		188.65	187	*165.981*	*2.8*	2.21E-06	2.21E-03	2.21E-05
0.6879	6/14/2002	28	b	188.15	186	51.177	6.1	6.82E-07	6.82E-04	6.82E-06
0.6115	6/14/2002	28	b	195.60	194	45.274	6.1	6.04E-07	6.04E-04	6.04E-06
0.6847	6/14/2002	28	b	187.42	185	98.593	3.0	1.31E-06	1.31E-03	1.31E-05
0.6050	6/14/2002	28	b	187.77	186	1304.271	2.5	1.74E-05	1.74E-02	1.74E-04
0.6577	6/14/2002	28	b	186.22	184	1052.485	19.8	1.40E-05	1.40E-02	1.40E-04
0.6380	6/14/2002	28	b	191.14	189	*798.692*	*28.4*	1.06E-05	1.06E-02	1.06E-04
0.6097	6/14/2002	28	b	193.38	191	9756.501	0.1	1.30E-04	1.30E-01	1.30E-03
0.6748	6/14/2002	28	b	188.38	186	8397.405	1.5	1.12E-04	1.12E-01	1.12E-03
0.6340	6/14/2002	28	b	189.33	187	*6386.496*	*113.9*	8.52E-05	8.52E-02	8.52E-04
0.6498	6/14/2002	28	c	184.29	182	6949.467	1.8	9.27E-05	9.27E-02	9.27E-04
0.6279	6/14/2002	28	b	182.45	180	15021.390	0.8	2.00E-04	2.00E-01	2.00E-03
0.6232	6/14/2002	28	c	185.85	184	8302.146	2.3	1.11E-04	1.11E-01	1.11E-03
0.6138	7/16/2002	60	b	182.31	180	127.624	3.5	1.70E-06	1.70E-03	1.70E-05
0.6937	7/16/2002	60	b	183.01	181	101.720	1.9	1.36E-06	1.36E-03	1.36E-05
0.6242	7/16/2002	60	c	192.83	191	59.342	2.8	7.91E-07	7.91E-04	7.91E-06
0.6814	7/16/2002	60	b	183.19	181	1114.959	15.5	1.49E-05	1.49E-02	1.49E-04
0.6670	7/16/2002	60	b	183.19	181	1213.147	7.5	1.62E-05	1.62E-02	1.62E-04
0.6090	7/16/2002	60	b	180.01	178	757.481	37.5	1.01E-05	1.01E-02	1.01E-04
0.6074	7/16/2002	60	b	181.12	179	2822.727	35.6	3.76E-05	3.76E-02	3.76E-04
0.6038	7/16/2002	60	b	181.76	180	1878.881	23.3	2.51E-05	2.51E-02	2.51E-04

0.6414	7/16/2002	60	c	178.23	176	616.721	9.5	8.22E-06	8.22E-03	8.22E-05
0.6120	7/16/2002	60	b	174.62	173	2245.206	15.0	2.99E-05	2.99E-02	2.99E-04
0.6544	7/16/2002	60	b	179.45	177	214.076	25.3	2.85E-06	2.85E-03	2.85E-05
0.6298	7/16/2002	60	b	176.56	175	15782.727	0.6	2.10E-04	2.10E-01	2.10E-03
0.6562	8/15/2002	90	b	184.91	183	179.846	2.2	2.40E-06	2.40E-03	2.40E-05
0.6436	8/15/2002	90	b	183.91	182	77.188	33.6	1.03E-06	1.03E-03	1.03E-05
0.6835	8/15/2002	90	b	186.95	185	501.312	17.6	6.68E-06	6.68E-03	6.68E-05
0.6209	8/15/2002	90	b	177.66	176	2178.035	3.0	2.90E-05	2.90E-02	2.90E-04
0.6160	8/15/2002	90	b	182.84	181	487.824	57.7	6.50E-06	6.50E-03	6.50E-05
0.6082	8/15/2002	90	b	185.60	184	739.936	46.5	9.87E-06	9.87E-03	9.87E-05
0.6033	8/15/2002	90	b	183.80	182	3846.562	43.8	5.13E-05	5.13E-02	5.13E-04
0.6422	8/15/2002	90	b	184.53	183	3353.749	38.8	4.47E-05	4.47E-02	4.47E-04
0.6076	8/15/2002	90	b	185.02	183	2578.018	20.4	3.44E-05	3.44E-02	3.44E-04
0.6003	8/15/2002	90	b	176.76	175	5724.970	8.0	7.63E-05	7.63E-02	7.63E-04
0.6949	8/15/2002	90	c	182.43	180			0.00E+00	0.00E+00	0.00E+00
0.6620	8/15/2002	90	c	180.58	179	3239.000	66.5	4.32E-05	4.32E-02	4.32E-04

MICROCOSM - WC (continued)

Conc (1) / g resin	Mean Conc (2)	RSD	Conc (2)	Conc (2)	Conc (2)	Conc (2) / g resin	total strip conc	Ave Background Conc	Total Calc Conc - background	Available As	Log Available As
mmol/g wet resin	ug/L	%	M	mmol/L	mmol	mmol/g wet resin	mmol/g wet resin	mmol/g wet resin	mmol/g wet resin	mmol/g wet resin	mmol/g wet resin
9.74E-06	*8.851*	*10.6*	1.18E-07	1.18E-04	1.18E-06	1.82E-06	1.16E-05	2.43E-07	1.13E-05	7.14E-05	-4.15E+00
-2.49E-06	*-19.123*	*1.5*	-2.55E-07	-2.55E-04	-2.55E-06	-3.92E-06	-6.40E-06		-6.65E-06	-4.20E-05	#NUM!
-1.96E-06	*-12.430*	*1.0*	-1.66E-07	-1.66E-04	-1.66E-06	-2.46E-06	-4.43E-06		-4.67E-06	-2.95E-05	#NUM!
3.41E-05	*259.193*	*3.3*	3.46E-06	3.46E-03	3.46E-05	5.25E-05	8.66E-05		8.64E-05	5.45E-04	-3.26E+00
4.21E-05	*264.456*	*11.4*	3.53E-06	3.53E-03	3.53E-05	5.73E-05	9.94E-05		9.92E-05	6.26E-04	-3.20E+00

3.49E-05	*263.851*	*21.3*	3.52E-06	3.52E-03	3.52E-05	5.34E-05	8.83E-05		8.80E-05	5.56E-04	-3.26E+00
4.08E-05	*251.579*	*21.8*	3.35E-06	3.35E-03	3.35E-05	5.25E-05	9.33E-05		9.31E-05	5.88E-04	-3.23E+00
3.77E-05	*246.465*	*4.9*	3.29E-06	3.29E-03	3.29E-05	5.25E-05	9.03E-05		9.00E-05	5.68E-04	-3.25E+00
4.37E-05	*244.544*	*19.0*	3.26E-06	3.26E-03	3.26E-05	5.24E-05	9.61E-05		9.58E-05	6.05E-04	-3.22E+00
3.53E-05	*285.526*	*9.4*	3.81E-06	3.81E-03	3.81E-05	5.67E-05	9.20E-05		9.18E-05	5.79E-04	-3.24E+00
3.97E-05	*266.904*	*7.3*	3.56E-06	3.56E-03	3.56E-05	5.26E-05	9.24E-05		9.21E-05	5.82E-04	-3.24E+00
3.60E-05	*259.763*	*10.1*	3.46E-06	3.46E-03	3.46E-05	5.63E-05	9.23E-05		9.21E-05	5.81E-04	-3.24E+00
9.92E-06	16.738	5.6	2.23E-07	2.23E-04	2.23E-06	3.24E-06	1.32E-05	1.64E-05	-3.24E-06	-2.05E-05	#NUM!
9.87E-06	16.327	4.9	2.18E-07	2.18E-04	2.18E-06	3.56E-06	1.34E-05		-2.97E-06	-1.88E-05	#NUM!
1.92E-05	17.56	3.3	2.34E-07	2.34E-04	2.34E-06	3.42E-06	2.26E-05		6.21E-06	3.92E-05	-4.41E+00
2.87E-04	290.264	2.7	3.87E-06	3.87E-03	3.87E-05	6.40E-05	3.51E-04		3.35E-04	2.11E-03	-2.67E+00
2.13E-04	492.939	0.6	6.57E-06	6.57E-03	6.57E-05	9.99E-05	3.13E-04		2.97E-04	1.87E-03	-2.73E+00
1.67E-04	*217.019*	*3.3*	2.89E-06	2.89E-03	2.89E-05	4.54E-05	2.12E-04		1.96E-04	1.24E-03	-2.91E+00
2.13E-03	4642.142	4.5	6.19E-05	6.19E-02	6.19E-04	1.02E-03	3.15E-03		3.13E-03	1.98E-02	-1.70E+00
1.66E-03	3118.818	7.4	4.16E-05	4.16E-02	4.16E-04	6.16E-04	2.28E-03		2.26E-03	1.43E-02	-1.85E+00
1.34E-03	2728.646	4.9	3.64E-05	3.64E-02	3.64E-04	5.74E-04	1.92E-03		1.90E-03	1.20E-02	-1.92E+00
1.43E-03	3360.476	2.3	4.48E-05	4.48E-02	4.48E-04	6.90E-04	2.12E-03		2.10E-03	1.33E-02	-1.88E+00
3.19E-03	8047.618	2.1	1.07E-04	1.07E-01	1.07E-03	1.71E-03	4.90E-03		4.88E-03	3.08E-02	-1.51E+00
1.78E-03	4065.748	5.4	5.42E-05	5.42E-02	5.42E-04	8.70E-04	2.65E-03		2.63E-03	1.66E-02	-1.78E+00
2.77E-05	35.828	1.8	4.78E-07	4.78E-04	4.78E-06	7.78E-06	3.55E-05	2.69E-05	8.57E-06	5.41E-05	-4.27E+00
1.96E-05	35.941	2.4	4.79E-07	4.79E-04	4.79E-06	6.91E-06	2.65E-05		-4.75E-07	-3.00E-06	#NUM!
1.27E-05	28.841	0.3	3.85E-07	3.85E-04	3.85E-06	6.16E-06	1.88E-05		-8.10E-06	-5.11E-05	#NUM!
2.18E-04	250.277	2.5	3.34E-06	3.34E-03	3.34E-05	4.90E-05	2.67E-04		2.40E-04	1.52E-03	-2.82E+00
2.43E-04	289.847	0.8	3.86E-06	3.86E-03	3.86E-05	5.79E-05	3.00E-04		2.74E-04	1.73E-03	-2.76E+00
1.66E-04	280.771	4.4	3.74E-06	3.74E-03	3.74E-05	6.15E-05	2.27E-04		2.00E-04	1.27E-03	-2.90E+00
6.20E-04	3594.940	5.2	4.79E-05	4.79E-02	4.79E-04	7.89E-04	1.41E-03		1.38E-03	8.72E-03	-2.06E+00
4.15E-04	4289.018	10.7	5.72E-05	5.72E-02	5.72E-04	9.47E-04	1.36E-03		1.34E-03	8.43E-03	-2.07E+00
1.28E-04	*4344.507*	*557.2*	5.79E-05	5.79E-02	5.79E-04	9.03E-04	1.03E-03		1.00E-03	6.34E-03	-2.20E+00

4.89E-04	9321.502	13.0	1.24E-04	1.24E-01	1.24E-03	2.03E-03	2.52E-03		2.49E-03	1.57E-02	-1.80E+00
4.36E-05	7607.552	32.7	1.01E-04	1.01E-01	1.01E-03	1.55E-03	1.59E-03		1.57E-03	9.89E-03	-2.00E+00
3.34E-03	6848.564	36.0	9.13E-05	9.13E-02	9.13E-04	1.45E-03	4.79E-03		4.76E-03	3.01E-02	-1.52E+00
3.65E-05	62.040	5.9	8.27E-07	8.27E-04	8.27E-06	1.26E-05	4.91E-05	6.39E-05	-1.48E-05	-9.31E-05	#NUM!
1.60E-05	72.779	11.4	9.70E-07	9.70E-04	9.70E-06	1.51E-05	3.11E-05		-3.28E-05	-2.07E-04	#NUM!
9.78E-05	70.190	10.7	9.36E-07	9.36E-04	9.36E-06	1.37E-05	1.11E-04		4.76E-05	3.00E-04	-3.52E+00
4.68E-04	*730.137*	*37.4*	9.74E-06	9.74E-03	9.74E-05	1.57E-04	6.25E-04		5.61E-04	3.54E-03	-2.45E+00
1.06E-04	392.845	37.4	5.24E-06	5.24E-03	5.24E-05	8.50E-05	1.91E-04		1.27E-04	8.00E-04	-3.10E+00
1.62E-04	400.438	19.9	5.34E-06	5.34E-03	5.34E-05	8.78E-05	2.50E-04		1.86E-04	1.17E-03	-2.93E+00
8.50E-04	2052.906	20.5	2.74E-05	2.74E-02	2.74E-04	4.54E-04	1.30E-03		1.24E-03	7.83E-03	-2.11E+00
6.96E-04	2803.673	17.7	3.74E-05	3.74E-02	3.74E-04	5.82E-04	1.28E-03		1.21E-03	7.67E-03	-2.12E+00
5.66E-04	2210.176	20.8	2.95E-05	2.95E-02	2.95E-04	4.85E-04	1.05E-03		9.87E-04	6.23E-03	-2.21E+00
1.27E-03	932.021	73.9	1.24E-05	1.24E-02	1.24E-04	2.07E-04	1.48E-03		1.41E-03	8.93E-03	-2.05E+00
0.00E+00	2479.542	20.1	3.31E-05	3.31E-02	3.31E-04	4.76E-04	4.76E-04		4.12E-04	2.60E-03	-2.59E+00
6.52E-04	369.902	12.3	4.93E-06	4.93E-03	4.93E-05	7.45E-05	7.27E-04		6.63E-04	4.19E-03	-2.38E+00

22-Feb-02

MICROCOSM - NR (continued)

This sheet describes sample names and identifcations, dry weight, weight with water, and spike concentration.

				Day1	Day1	Day1	Day2	Day2	Day2	
Sample Description	**Estimated Resin Exposure Time**	**Sample ID**	**Container Weight**	**Dry Weight (no container)**	**Sample + Water Weight (no cont)**	**Cont+Samp+ Wtr**	**Initial Cont+Samp+ Wtr**	**water added?**	**Final Cont+Samp +Wtr**	**Soil:Water**
	days		*g*	*g*	*g*	*g*	*g*	*g*	*g*	
Nueces River 59	15	NR-15-0-a	12.84	105.92	164.29	177.13	162.64	12.38	175.02	1.88

	15	NR-15-0-b	12.22	99.84	152.25	164.47	162.91	12.15	175.06	1.58
	15	NR-15-0-c	11.32	100.22	165.37	176.69	175.41	0.00	175.41	1.57
	15	NR-15-10-a	12.04	99.90	155.93	167.97	166.17	9.13	175.30	1.58
	15	NR-15-10-b	12.57	99.55	161.43	174.00	160.23	13.08	173.31	1.63
	15	NR-15-10-c	11.07	99.36	155.30	166.37	164.71	8.66	173.37	1.58
	15	NR-15-50-a	12.52	99.77	155.76	168.28	167.47	7.54	175.01	1.59
	15	NR-15-50-b	12.18	102.68	163.63	175.81	168.52	6.84	175.36	1.70
	15	NR-15-50-c	12.50	100.63	157.17	169.67	167.98	7.13	175.11	1.62
	15	NR-15-100-a	12.46	100.04	157.22	169.68	164.51	10.61	175.12	1.60
	15	NR-15-100-b	12.36	100.35	158.19	170.55	171.96	7.07	179.03	1.51
	15	NR-15-100-c	11.57	100.38	158.96	170.53	167.28	7.78	175.06	1.59
Nueces River 59	30	NR-30-0-a	12.59	100.12	159.83	172.42	171.04	4.07	175.11	1.60
	30	NR-30-0-b	12.39	100.35	157.24	169.63	167.96	7.11	175.07	1.61
	30	NR-30-0-c	12.41	100.61	158.67	171.08	169.64	5.44	175.08	1.62
	30	NR-30-10-a	12.46	100.92	157.23	169.69	167.86	7.17	175.03	1.64
	30	NR-30-10-b	12.38	100.58	158.61	170.99	169.14	5.89	175.03	1.62
	30	NR-30-10-c	11.29	100.96	159.09	170.38	168.63	6.44	175.07	1.61
	30	NR-30-50-a	12.10	100.34	158.81	170.91	168.03	7.33	175.36	1.59
	30	NR-30-50-b	12.16	101.36	159.09	171.25	168.72	6.31	175.03	1.65
	30	NR-30-50-c	11.35	100.90	159.26	170.61	168.00	7.11	175.11	1.61
	30	NR-30-100-a	12.08	100.41	157.44	169.52	167.23	8.30	175.53	1.59
	30	NR-30-100-b	12.57	100.53	162.45	175.02	160.05	14.94	174.99	1.62
	30	NR-30-100-c	11.89	100.22	157.09	168.98	166.32	8.75	175.07	1.59
Nueces River 59	60	NR-60-0-a	11.93	100.24	157.87	169.80	167.91	7.15	175.06	1.59
	60	NR-60-0-b	11.28	100.52	164.09	175.37	173.44	1.57	175.01	1.59
	60	NR-60-0-c	12.85	100.47	158.97	171.82	170.35	5.83	176.18	1.60
	60	NR-60-10-a	11.76	100.39	162.52	174.28	170.44	4.60	175.04	1.60
	60	NR-60-10-b	12.08	100.17	160.54	172.62	170.95	4.11	175.06	1.59
	60	NR-60-10-c	12.36	99.13	158.52	170.88	179.35	2.41	181.76	1.41
	60	NR-60-50-a	12.31	100.00	157.28	169.59	167.08	7.94	175.02	1.59
	60	NR-60-50-b	12.65	100.31	156.36	169.01	166.98	8.51	175.49	1.60
	60	NR-60-50-c	12.53	100.25	160.47	173.00	171.12	5.11	176.23	1.58

	60	NR-60-100-a	11.83	100.00	164.15	175.98	173.04	4.09	177.13	1.53
	60	NR-60-100-b	12.34	100.10	158.68	171.02	168.66	6.71	175.37	1.59
	60	NR-60-100-c	11.25	100.38	158.60	169.85	167.75	7.37	175.12	1.58
Nueces River 59	90	NR-90-0-a	11.59	100.19	156.18	167.77	165.84	9.17	175.01	1.58
	90	NR-90-0-b	11.14	100.33	158.17	169.31	167.62	7.88	175.50	1.57
	90	NR-90-0-c	11.01	100.42	160.06	171.07	158.34	18.67	177.01	1.53
	90	NR-90-10-a	11.55	100.03	156.40	167.95	165.95	9.26	175.21	1.57
	90	NR-90-10-b	11.45	100.01	158.54	169.99	168.19	6.90	175.09	1.57
	90	NR-90-10-c	11.64	100.03	157.89	169.53	167.92	7.14	175.06	1.58
	90	NR-90-50-a	11.45	100.12	159.11	170.56	167.90	7.23	175.13	1.58
	90	NR-90-50-b	11.27	100.60	157.73	169.00	166.45	8.80	175.25	1.59
	90	NR-90-50-c	11.60	100.15	157.52	169.12	166.73	8.37	175.10	1.58
	90	NR-90-100-a	11.58	100.38	157.34	168.92	166.16	9.03	175.19	1.59
	90	NR-90-100-b	11.63	100.01	159.83	171.46	168.96	7.38	176.34	1.55
	90	NR-90-100-c	12.12	100.55	157.94	170.06	168.08	7.02	175.10	1.61

MICROCOSM - NR (continued)

Spike Concentration (As)	Spike Concentration (As)	Spike Concentration (As)	Amount TO weigh for spike	Amount weighed and spiked	Concentration spiked (As)	Concentration spiked (As)	Concentration spiked (As)	Spike date	Resin Introduction Date
ppm	*M*	*mmol/L*	*g Na_3AsO_4*	*g Na_3AsO_4*	*ppm*	*M*	*mmo/L*	*date*	*date*
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0042	0.0043	10.35	3.32E-05	3.32E-02	3/25/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0041	0.0041	9.90	3.17E-05	3.17E-02	3/25/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0041	0.0040	9.68	3.10E-05	3.10E-02	3/25/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0208	0.0202	48.67	1.56E-04	1.56E-01	3/31/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0214	0.0215	50.33	1.61E-04	1.61E-01	3/31/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0209	0.0210	50.16	1.61E-04	1.61E-01	3/31/2002	5/17/2002

100	3.21E-04	3.21E-01	0.0416	0.0414	99.48	3.19E-04	3.19E-01	4/1/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0417	0.4180	1001.30	3.21E-03	3.21E+00	4/1/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0418	0.0418	100.10	3.21E-04	3.21E-01	4/1/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0042	0.0045	10.72	3.44E-05	3.44E-02	3/25/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0042	0.0043	10.28	3.29E-05	3.29E-02	3/25/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0042	0.0044	10.48	3.36E-05	3.36E-02	3/25/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0209	0.0204	48.87	1.57E-04	1.57E-01	3/31/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0211	0.0211	50.04	1.60E-04	1.60E-01	3/31/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0210	0.0212	50.51	1.62E-04	1.62E-01	3/31/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0418	0.0419	100.31	3.22E-04	3.22E-01	4/1/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0418	0.0416	99.47	3.19E-04	3.19E-01	4/1/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0417	0.0417	100.02	3.21E-04	3.21E-01	4/1/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0042	0.0039	9.34	2.99E-05	2.99E-02	3/25/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0042	0.0048	11.52	3.69E-05	3.69E-02	3/25/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0041	0.0044	10.67	3.42E-05	3.42E-02	3/25/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0208	0.0203	48.80	1.56E-04	1.56E-01	3/31/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0209	0.0206	49.37	1.58E-04	1.58E-01	3/31/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0209	0.0202	48.44	1.55E-04	1.55E-01	3/31/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0416	0.0416	100.00	3.21E-04	3.21E-01	4/1/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0416	0.0412	98.94	3.17E-04	3.17E-01	4/1/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0418	0.0419	100.34	3.22E-04	3.22E-01	4/1/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
0	0.00E+00	0.00E+00	0.0000	0.0000	0.00	0.00E+00	0.00E+00	3/24/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0042	0.0046	11.05	3.54E-05	3.54E-02	3/25/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0042	0.0043	10.34	3.31E-05	3.31E-02	3/25/2002	5/17/2002
10	3.21E-05	3.21E-02	0.0042	0.0044	10.57	3.39E-05	3.39E-02	3/25/2002	5/17/2002

50	1.60E-04	1.60E-01	0.0208	0.0208	49.94	1.60E-04	1.60E-01	3/31/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0209	0.0206	49.22	1.58E-04	1.58E-01	3/31/2002	5/17/2002
50	1.60E-04	1.60E-01	0.0208	0.0202	48.48	1.55E-04	1.55E-01	3/31/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0418	0.0417	99.86	3.20E-04	3.20E-01	4/1/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0416	0.0415	99.75	3.20E-04	3.20E-01	4/1/2002	5/17/2002
100	3.21E-04	3.21E-01	0.0418	0.0417	99.69	3.20E-04	3.20E-01	4/1/2002	5/17/2002

MICROCOSM - NR (continued)

Equilibration Time	Resin Introduction Amount	barried (b) or in film container(c)	Resin Removal Date	Resin Exposure Time	Final weight at Resin Removal (cnt + samp+ film cnt&lid)	Final weight at Resin Removal (cnt + samp)	Mean Conc (1)	RSD
days	*g*		*date*	*days*	*g*	*g*	**ug/L**	**%**
54	0.6726	b	5/31/2002	14	174.09	172	21.28	7.6
54	0.6542	b	5/31/2002	14	177.63	176	22.053	1.3
54	0.6985	b	5/31/2002	14	184.68	183	22.022	3.5
53	0.6212	b	5/31/2002	14	181.23	179	108.618	9.2
53	0.6203	c	5/31/2002	14	171.01	169	*132.2115*	*4.0*
53	0.6182	b	5/31/2002	14	177.31	175	100.682	9.6
47	0.6495	c	5/31/2002	14	182.92	181	*965.969*	*59.3*
47	0.6009	c	5/31/2002	14	175.65	174	*270.960*	*75.5*
47	0.6888	c	5/31/2002	14	178.82	177	4370.212	20.2
46	0.6190	b	5/31/2002	14	200.01	198	1319.561	31.8
46	0.6096	c	5/31/2002	14	182.82	181	1139.75	23.6
46	0.6287	b	5/31/2002	14	199.95	198	551.811	21.9
54	0.6404	b	6/14/2002	28	175.16	173	47.047	0.8
54	0.6073	b	6/14/2002	28	172.63	171	47.58	11.2
54	0.5998	b	6/14/2002	28	172.36	170	39.727	7.4
53	0.6191	c	6/14/2002	28	191.05	189	*708.622*	*162.7*
53	0.6822	c	6/14/2002	28	187.26	185	795.111	2.2

53	0.6373	b	6/14/2002	28	172.49	170	1050.676	1.8
47	0.6366	b	6/14/2002	28	169.84	168	9133.0400	5.3
47	0.6725	c	6/14/2002	28	175.73	174	11254.0050	2.9
47	0.6015	c	6/14/2002	28	175.30	173	10667.6950	5.1
46	0.5995	c	6/14/2002	28	175.80	174	12230.9400	4.2
46	0.6283	c	6/14/2002	28	175.47	173		
46	0.6749	c	6/14/2002	28	174.64	173	*12659.661*	*488.7*
54	0.6405	b	7/16/2002	60	165.04	163	138.303	0.7
54	0.6653	b	7/16/2002	60	168.78	167	96.854	1.1
54	0.6093	b	7/16/2002	60	166.16	164	111.919	2.4
53	0.6155	b	7/16/2002	60	169.62	168	*1203.720*	*15.4*
53	0.6551	c	7/16/2002	60	171.81	170	1291.156	0.4
53	0.6656	b	7/16/2002	60	177.08	175	285.272	0.6
47	0.6019	b	7/16/2002	60	165.98	164	8110.9	7.5
47	0.6031	c	7/16/2002	60	171.13	169	10426.0	3.2
47	0.6052	c	7/16/2002	60	172.16	170	12642.1	2.3
46	0.6620	c	7/16/2002	60	171.02	169	25801.8	4.4
46	0.6427	b	7/16/2002	60	166.42	169	23027.0	3.6
46	0.6056	b	7/16/2002	60	170.71	164	16711.4	2.6
54	0.6290	b	8/15/2002	90	172.63	169	118.298	1.7
54	0.6148	b	8/15/2002	90	167.92	166	144.204	4.2
54	0.6093	b	8/15/2002	90	167.81	166	95.824	1.3
53	0.6125	b	8/15/2002	90	167.23	165	*827.511*	*36.7*
53	0.6645	b	8/15/2002	90	168.01	166	734.339	2.2
53	0.6139	b	8/15/2002	90	167.09	165	685.477	3.0
47	0.6145	c	8/15/2002	90	173.77	172	11641.5	4.6
47	0.6424	c	8/15/2002	90	171.05	169	14199.7	5.6
47	0.6369	b	8/15/2002	90	165.93	164	8278.8	7.4
46	0.6182	c	8/15/2002	90	171.99	170	*28665.418*	*0.2*
46	0.6050	b	8/15/2002	90	167.16	165	15310.1	3.9
46	0.6040	b	8/15/2002	90	168.76	167	11723.6	24.7

MICROCOSM - NR (continued)

Conc (1)	Conc (1)	Conc (1)	Conc (1) / g resin	Mean Conc (2)	RSD	Conc (2)	Conc (2)	Conc (2)	Conc (2) / g resin
M	mmol/L	mmol	mmol/g wet resin	ug/L	%	M	mmol/L	mmol	mmol/g wet resin
2.84E-07	2.84E-04	2.84E-06	4.22E-06	*41.203*	*1.9*	5.49E-07	5.49E-04	5.49E-06	8.17E-06
2.94E-07	2.94E-04	2.94E-06	4.49E-06	*20.363*	*2.5*	2.72E-07	2.72E-04	2.72E-06	4.15E-06
2.94E-07	2.94E-04	2.94E-06	4.20E-06	*35.739*	*1.6*	4.77E-07	4.77E-04	4.77E-06	6.82E-06
1.45E-06	1.45E-03	1.45E-05	2.33E-05	*225.954*	*2.7*	3.01E-06	3.01E-03	3.01E-05	4.85E-05
1.76E-06	1.76E-03	1.76E-05	2.84E-05	*179.157*	*4.2*	2.39E-06	2.39E-03	2.39E-05	3.85E-05
1.34E-06	1.34E-03	1.34E-05	2.17E-05	*218.039*	*3.3*	2.91E-06	2.91E-03	2.91E-05	4.70E-05
1.29E-05	1.29E-02	1.29E-04	1.98E-04	*239.837*	*4.9*	3.20E-06	3.20E-03	3.20E-05	4.92E-05
3.61E-06	3.61E-03	3.61E-05	6.01E-05	*230.144*	*4.1*	3.07E-06	3.07E-03	3.07E-05	5.11E-05
5.83E-05	5.83E-02	5.83E-04	8.46E-04	*224.614*	*17.8*	2.99E-06	2.99E-03	2.99E-05	4.35E-05
1.76E-05	1.76E-02	1.76E-04	2.84E-04	*237.843*	*9.9*	3.17E-06	3.17E-03	3.17E-05	5.12E-05
1.52E-05	1.52E-02	1.52E-04	2.49E-04	*225.595*	*3.2*	3.01E-06	3.01E-03	3.01E-05	4.93E-05
7.36E-06	7.36E-03	7.36E-05	1.17E-04	*231.575*	*7.5*	3.09E-06	3.09E-03	3.09E-05	4.91E-05
6.27E-07	6.27E-04	6.27E-06	9.80E-06	13.755	4.4	1.83E-07	1.83E-04	1.83E-06	2.86E-06
6.34E-07	6.34E-04	6.34E-06	1.04E-05	17.758	2.9	2.37E-07	2.37E-04	2.37E-06	3.90E-06
5.30E-07	5.30E-04	5.30E-06	8.83E-06	16.205	7.3	2.16E-07	2.16E-04	2.16E-06	3.60E-06
9.45E-06	9.45E-03	9.45E-05	1.53E-04	*190.354*	*12.8*	2.54E-06	2.54E-03	2.54E-05	4.10E-05
1.06E-05	1.06E-02	1.06E-04	1.55E-04	257.200	3.6	3.43E-06	3.43E-03	3.43E-05	5.03E-05
1.40E-05	1.40E-02	1.40E-04	2.20E-04	216.865	1.3	2.89E-06	2.89E-03	2.89E-05	4.54E-05
1.22E-04	1.22E-01	1.22E-03	1.91E-03	2068.3	4.1	2.76E-05	2.76E-02	2.76E-04	4.33E-04
1.50E-04	1.50E-01	1.50E-03	2.23E-03	2883.6	3.2	3.84E-05	3.84E-02	3.84E-04	5.72E-04
1.42E-04	1.42E-01	1.42E-03	2.36E-03	2728.8	4.0	3.64E-05	3.64E-02	3.64E-04	6.05E-04
1.63E-04	1.63E-01	1.63E-03	2.72E-03	2906.6	2.4	3.88E-05	3.88E-02	3.88E-04	6.46E-04
0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.69E-04	1.69E-01	1.69E-03	2.50E-03	*7201.675*	*1.1*	9.60E-05	9.60E-02	9.60E-04	1.42E-03
1.84E-06	1.84E-03	1.84E-05	2.88E-05	38.688	2.2	5.16E-07	5.16E-04	5.16E-06	8.05E-06
1.29E-06	1.29E-03	1.29E-05	1.94E-05	40.755	2.8	5.43E-07	5.43E-04	5.43E-06	8.17E-06
1.49E-06	1.49E-03	1.49E-05	2.45E-05	41.749	1.4	5.57E-07	5.57E-04	5.57E-06	9.14E-06

1.60E-05	1.60E-02	1.60E-04	2.61E-04	*476.190*	*13.9*	6.35E-06	6.35E-03	6.35E-05	1.03E-04
1.72E-05	1.72E-02	1.72E-04	2.63E-04	421.686	2	5.62E-06	5.62E-03	5.62E-05	8.58E-05
3.80E-06	3.80E-03	3.80E-05	5.71E-05	532.189	1.4	7.10E-06	7.10E-03	7.10E-05	1.07E-04
1.08E-04	1.08E-01	1.08E-03	1.80E-03	1465.8	3.8	1.95E-05	1.95E-02	1.95E-04	3.25E-04
1.39E-04	1.39E-01	1.39E-03	2.30E-03	2302.1	2.9	3.07E-05	3.07E-02	3.07E-04	5.09E-04
1.69E-04	1.69E-01	1.69E-03	2.79E-03			0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.44E-04	3.44E-01	3.44E-03	5.20E-03	5812.5	2.6	7.75E-05	7.75E-02	7.75E-04	1.17E-03
3.07E-04	3.07E-01	3.07E-03	4.78E-03	5099.2	7.4	6.80E-05	6.80E-02	6.80E-04	1.06E-03
2.23E-04	2.23E-01	2.23E-03	3.68E-03	2937.1	1.1	3.92E-05	3.92E-02	3.92E-04	6.47E-04
1.58E-06	1.58E-03	1.58E-05	2.51E-05	55.138	3.5	7.35E-07	7.35E-04	7.35E-06	1.17E-05
1.92E-06	1.92E-03	1.92E-05	3.13E-05	68.410	1.1	9.12E-07	9.12E-04	9.12E-06	1.48E-05
1.28E-06	1.28E-03	1.28E-05	2.10E-05	66.529	2.3	8.87E-07	8.87E-04	8.87E-06	1.46E-05
1.10E-05	1.10E-02	1.10E-04	1.80E-04	*573.763*	*1.1*	7.65E-06	7.65E-03	7.65E-05	1.25E-04
9.79E-06	9.79E-03	9.79E-05	1.47E-04	294.284	0.9	3.92E-06	3.92E-03	3.92E-05	5.90E-05
9.14E-06	9.14E-03	9.14E-05	1.49E-04	543.146	2.2	7.24E-06	7.24E-03	7.24E-05	1.18E-04
1.55E-04	1.55E-01	1.55E-03	2.53E-03	3807.251	0.6	5.08E-05	5.08E-02	5.08E-04	8.26E-04
1.89E-04	1.89E-01	1.89E-03	2.95E-03	3643.279	2.9	4.86E-05	4.86E-02	4.86E-04	7.56E-04
1.10E-04	1.10E-01	1.10E-03	1.73E-03	5837.076	2.6	7.78E-05	7.78E-02	7.78E-04	1.22E-03
3.82E-04	3.82E-01	3.82E-03	6.18E-03	5398.2	33.1	7.20E-05	7.20E-02	7.20E-04	1.16E-03
2.04E-04	2.04E-01	2.04E-03	3.37E-03	5522.2	9.3	7.36E-05	7.36E-02	7.36E-04	1.22E-03
1.56E-04	1.56E-01	1.56E-03	2.59E-03	5696.6	33.2	7.60E-05	7.60E-02	7.60E-04	1.26E-03

MICROCOSM - NR (continued)

total strip conc	Ave Background Conc	Total Calc Conc - background	Available As	Log Available As
mmol/g wet resin	mmol/g wet resin	mmol/g wet resin	mmol/g wet resin	mmol/g wet resin
1.24E-05	1.07E-05	1.70E-06	1.07E-05	-4.97E+00
8.64E-06		-2.04E-06	-1.29E-05	#NUM!
1.10E-05		3.40E-07	2.15E-06	-5.67E+00

7.18E-05		6.11E-05	3.86E-04	-3.41E+00
6.69E-05		5.62E-05	3.55E-04	-3.45E+00
6.87E-05		5.81E-05	3.67E-04	-3.44E+00
2.48E-04		2.37E-04	1.50E-03	-2.83E+00
1.11E-04		1.01E-04	6.34E-04	-3.20E+00
8.89E-04		8.79E-04	5.55E-03	-2.26E+00
3.35E-04		3.25E-04	2.05E-03	-2.69E+00
2.99E-04		2.88E-04	1.82E-03	-2.74E+00
1.66E-04		1.55E-04	9.81E-04	-3.01E+00
1.27E-05	1.31E-05	-4.87E-07	-3.07E-06	#NUM!
1.43E-05		1.20E-06	7.57E-06	-5.12E+00
1.24E-05		-7.12E-07	-4.50E-06	#NUM!
1.94E-04		1.80E-04	1.14E-03	-2.94E+00
2.06E-04		1.93E-04	1.22E-03	-2.92E+00
2.65E-04		2.52E-04	1.59E-03	-2.80E+00
2.35E-03		2.33E-03	1.47E-02	-1.83E+00
2.80E-03		2.79E-03	1.76E-02	-1.75E+00
2.97E-03		2.96E-03	1.87E-02	-1.73E+00
3.37E-03		3.35E-03	2.12E-02	-1.67E+00
0.00E+00		-1.31E-05	-8.30E-05	#NUM!
3.92E-03		3.91E-03	2.47E-02	-1.61E+00
3.68E-05	3.27E-05	4.16E-06	2.63E-05	-4.58E+00
2.76E-05		-5.10E-06	-3.22E-05	#NUM!
3.36E-05		9.44E-07	5.96E-06	-5.22E+00
3.64E-04		3.31E-04	2.09E-03	-2.68E+00
3.49E-04		3.16E-04	1.99E-03	-2.70E+00
1.64E-04		1.31E-04	8.27E-04	-3.08E+00
2.12E-03		2.09E-03	1.32E-02	-1.88E+00
2.81E-03		2.78E-03	1.76E-02	-1.76E+00
2.79E-03		2.75E-03	1.74E-02	-1.76E+00
6.37E-03		6.33E-03	4.00E-02	-1.40E+00
5.84E-03		5.80E-03	3.66E-02	-1.44E+00
4.33E-03		4.29E-03	2.71E-02	-1.57E+00

3.68E-05	3.95E-05	-2.70E-06	-1.71E-05	#NUM!
4.61E-05		6.64E-06	4.19E-05	-4.38E+00
3.55E-05		-3.94E-06	-2.49E-05	#NUM!
3.05E-04		2.66E-04	1.68E-03	-2.78E+00
2.06E-04		1.67E-04	1.05E-03	-2.98E+00
2.67E-04		2.27E-04	1.44E-03	-2.84E+00
3.35E-03		3.31E-03	2.09E-02	-1.68E+00
3.70E-03		3.66E-03	2.31E-02	-1.64E+00
2.96E-03		2.92E-03	1.84E-02	-1.74E+00
7.35E-03		7.31E-03	4.61E-02	-1.34E+00
4.59E-03		4.55E-03	2.87E-02	-1.54E+00
3.85E-03		3.81E-03	2.40E-02	-1.62E+00

Bioavailability Index

	mmol/g soil	ave mmol/g soil	**mmol/g wet resin**	**ave mmol/g wet resin**	BI
AsLW-d	1.2E-03	9.80E-04	1.57E+01	1.37E+01	1.40E+04
AsLW-E	9.1E-04		1.11E+01		
AsLW-F	8.4E-04		1.43E+01		
AsLP-A	2.4E-04	2.72E-04	1.47E+01	1.55E+01	5.71E+04
AsLP-B	3.4E-04		1.79E+01		
AsLP-C	2.4E-04		1.45E+01		
			1.50E+01		
AsWC-D	3.1E-04	1.97E-04	1.48E+01	1.49E+01	7.57E+04
AsWC-E	1.7E-04		1.55E+01		
AsWC-F	1.2E-04		1.51E+01		
			1.41E+01		
AsTC-A	2.5E-05	3.97E-05	1.28E+01	1.30E+01	3.28E+05
AsTC-B	7.1E-05		1.42E+01		
AsTC-C	2.3E-05		1.26E+01		
			1.25E+01		
AsLCC-G	3.5E-04	2.78E-04	9.10E+01	8.10E+01	2.91E+05

AsLCC-H	1.5E-04		8.93E+01		
AsLCC-I	3.3E-04		7.91E+01		
			6.46E+01		
AsNR151-G-A	8.4E-05	8.75E-05	1.79E+01	1.61E+01	1.84E+05
AsNR151-G-B	9.1E-05		1.74E+01		
AsNR151-H	9.2E-05		1.54E+01		
AsNR-151-I	8.2E-05		1.36E+01		

APPENDIX III

DATA FROM FIELD EXPERIMENTS

Contents: **Field observations and geochemical characteristics.**

LW

Water and soil digestion results

Field ID	**Field ID description**	**Field description**	**Location**	**Location**	**Fe**	**Fe**	**Date field sample taken**	**Temp**	**pH**	**DO**
			latitude	*longitude*	*ppm*	*M*	*date*	*C*		*mg/L*
Lyssy wetland	LW-791	ground water/surface water interaction, cat tail and grass vegitation	N 28 54 38.9	W 098 06 43.3	114.40	0.0020	5/10/2002	na	na	na
							5/25/2002	34.00	na	4.66
							5/27/2002	na	na	na
							6/7/2002	na	na	na
							7/9/2002	na	na	na
							7/30/2002	na	na	na
							8/19/2002	na	na	na
							8/28/2002	na	na	na

LW (continued)

water sample label	**Water (As)**	**Water (As)**	**Water (As)**	**Resin Device ID**	**Resin Device slot ID**	**Resin amount**	**Date introduced**	**Date removed from field**	**Exposure Time**
	ppb	*M*	*mmol/L*		*from top*	*g*	*date*	*date*	*days*

LW791_F	na	na	na	26	1	0.6649	05/10/02	06/07/02	28
LW791_Un	na	na	na		2	0.6167	05/10/02	06/07/02	28
LW791_F	25.118	3.35E-07	3.35E-04		3	0.6350	05/10/02	06/07/02	28
LW791_Un	30.109	4.02E-07	4.02E-04		4	0.6078	05/10/02	06/07/02	28
LW791_F	na	na	na	37	1	0.6277	05/10/02	07/30/02	81
LW791_Un	na	na	na		2	0.6485	05/10/02	07/30/02	81
LW791_F	211.914	2.83E-06	2.83E-03		3	0.6133	05/10/02	07/30/02	81
LW791_Un	937.363	1.25E-05	1.25E-02		4	0.6849	05/10/02	07/30/02	81
LW791_F	na	na	na	34	1	0.6163	05/10/02	8/19/2002	101
LW791_Un	na	na	na		2	0.6778	05/10/02	8/19/2002	101
LW791_F	7.161	9.56E-08	9.56E-05		3	0.5916	05/10/02	8/19/2002	101
LW791_Un	10.939	1.46E-07	1.46E-04		4	0.6344	05/10/02	8/19/2002	101
LW791_F	45.050	6.01E-07	6.01E-04	31	1	0.6134	05/10/02	05/25/02	15
LW791_Un	48.151	6.43E-07	6.43E-04		2	0.6000	05/10/02	05/25/02	15
LW791_F	na	na	na		3	0.6752	05/10/02	05/25/02	15
LW791_Un	na	na	na		4	0.6391	05/10/02	05/25/02	15

LW (continued)

Mean Conc (1) ug/L	RSD %	Conc (1) M	Conc (1) mmol/L	amt As from strip (1) mmol	Mean Conc (2) ug/L	RSD %	Conc (2) M	Conc (2) mmol/L
1297.516	80.5	1.73E-05	1.73E-02	1.73E-04	734.700	2.0	9.81E-06	9.81E-03
7715.680	8.3	1.03E-04	1.03E-01	1.03E-03			0.00E+00	0.00E+00
5419.931	*109.2*	7.23E-05	7.23E-02	7.23E-04	613.995	20.4	8.20E-06	8.20E-03
563.797	82.5	7.53E-06	7.53E-03	7.53E-05	240.254	82.4	3.21E-06	3.21E-03
23321.344	1.1	3.11E-04	3.11E-01	3.11E-03	5414.957	3.6	7.23E-05	7.23E-02
na	na	#VALUE!	#VALUE!	#VALUE!	na	na	#VALUE!	#VALUE!
17491.008	1.1	2.33E-04	2.33E-01	2.33E-03	1879.939	5	2.51E-05	2.51E-02
258.410	87.1	3.45E-06	3.45E-03	3.45E-05	1137.988	2.1	1.52E-05	1.52E-02
		0.00E+00	0.00E+00	0.00E+00	886.229	8	1.18E-05	1.18E-02
24646.7	37.2	3.29E-04	3.29E-01	3.29E-03	1104.494	3.5	1.47E-05	1.47E-02

12099.036	2.9	1.61E-04	1.61E-01	1.61E-03	1001.853	28.5	1.34E-05	1.34E-02
16200.14	51.5	2.16E-04	2.16E-01	2.16E-03	1072.121	4.5	1.43E-05	1.43E-02
829.416	2.3	1.11E-05	1.11E-02	1.11E-04	1926.440	1.8	2.57E-05	2.57E-02
1745.09	9.5	2.33E-05	2.33E-02	2.33E-04	*4868.211*	*68.7*	6.50E-05	6.50E-02
1587.115	8.2	2.12E-05	2.12E-02	2.12E-04	5155.567	2.6	6.88E-05	6.88E-02
1050.201	10.4	1.40E-05	1.40E-02	1.40E-04	2935.068	0.3	3.92E-05	3.92E-02

LW (continued)

amt As from strip (2) mmol	total As in strips mmol	Available As mmol	Available As mmol/g wet resin	Log Available As mmol/g wet resin
9.81E-05	2.71E-04	1.71E-03	1.57E+01	1.19E+00
0.00E+00	1.03E-03	6.50E-03	1.00E+01	1.00E+00
8.20E-05	8.05E-04	5.08E-03	1.11E+01	1.05E+00
3.21E-05	1.07E-04	6.78E-04	1.43E+01	1.15E+00
7.23E-04	3.84E-03	2.42E-02	1.23E+01	1.09E+00
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
2.51E-04	2.59E-03	1.63E-02	1.11E+01	1.04E+00
1.52E-04	1.86E-04	1.18E-03	5.40E+01	1.73E+00
1.18E-04	1.18E-04	7.47E-04	#DIV/0!	#DIV/0!
1.47E-04	3.44E-03	2.17E-02	1.04E+01	1.02E+00
1.34E-04	1.75E-03	1.10E-02	1.08E+01	1.03E+00
1.43E-04	2.31E-03	1.46E-02	1.07E+01	1.03E+00
2.57E-04	3.68E-04	2.32E-03	3.32E+01	1.52E+00
6.50E-04	8.83E-04	5.57E-03	3.79E+01	1.58E+00
6.88E-04	9.00E-04	5.68E-03	4.25E+01	1.63E+00
3.92E-04	5.32E-04	3.36E-03	3.79E+01	1.58E+00

Contents: **LP**

Field ID	Field ID description	Field description	Location	Location	Fe	Fe	Date field sample taken	Temp	pH	DO

			latitude	*longitude*	*ppm*	*M*	*date*	*C*		*mg/L*
Lyssy stock tank	LP-791	stockpond, algae in water, grassland vegitation	N 28 54 38.0	W 098 06 40.8	42.85	0.0008	5/10/2002	27.1	8.74	7.38
					52.3	0.0009				
							5/25/2002	26.9	na	4.93
							5/27/2002	29.9	na	9.33
							6/7/2002	32.3	9.31	13.01
							7/9/2002	na	na	na
							7/30/2002	33.0	8.34	6.22
							8/19/2002	37.0	8.08	7.01
							8/28/2002	na	na	na

LP (continued)

water sample label	**Water (As)**	**Water (As)**	**Water (As)**	**Resin Device ID**	**Resin Device slot ID**	**Resin amount**	**Date introduced**	**Date removed from field**	**Exposure Time**
	ppb	*M*	*mmol/L*		*from top*	*g*	*date*	*date*	*days*
LP791_F	37.045	4.94E-07	4.94E-04	24	1	0.6208	05/10/02	flood	flood
LP791_Un	36.880	4.92E-07	4.92E-04		2	0.6803	05/10/02	flood	flood
LP791_F	39.091	5.22E-07	5.22E-04		3	0.6616	05/10/02	flood	flood
LP791_Un	*39.664*	5.29E-07	5.29E-04		4	0.6772	05/10/02	flood	flood
LP791_F	34.518	4.61E-07	4.61E-04	3	1	0.6768	05/10/02	5/25/2002	15

LP791_Un	37.188	4.96E-07	4.96E-04		2	0.6730	05/10/02	5/25/2002	15
LP791_F	39.333	5.25E-07	5.25E-04		3	0.6543	05/10/02	5/25/2002	15
LP791_Un	*39.940*	5.33E-07	5.33E-04		4	0.6190	05/10/02	5/25/2002	15
LP791_F	na	na	na		E1	0.6510	05/10/02	5/25/2002	15
LP791_Un	na	na	na		E2	0.6440	05/10/02	5/25/2002	15
LP791_F	4.543	6.06E-08	6.06E-05		E3	0.6220	05/10/02	5/25/2002	15
LP791_Un	4.744	6.33E-08	6.33E-05	19	1	0.6416	05/10/02	6/7/2002	28
LP791_F	37.087	4.95E-07	4.95E-04		2	0.6567	05/10/02	6/7/2002	28
LP791_Un	39.557	5.28E-07	5.28E-04		3	0.6551	05/10/02	6/7/2002	28
LP791_F	na	na	na		4	0.6297	05/10/02	6/7/2002	28
LP791_Un	na	na	na	7	1	0.6368	05/10/02	flood	flood
					2	0.6388	05/10/02	flood	flood
					3	0.6875	05/10/02	flood	flood
					4	0.5992	05/10/02	flood	flood

LP (continued)

Stripped Resin amount	Resin loss	Mean Conc (1)	RSD	Conc (1)	Conc (1)	Conc (1)	Mean Conc (2)	RSD
g	*g*	ug/L	%	M	mmol/L	mmol	ug/L	%
flood	flood	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
flood	flood	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
flood	flood	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
flood	flood	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
0.4817	0.20	*308.140*	*78.8*	4.11E-06	4.11E-03	4.11E-05	52.748	0.2
0.4352	0.24	*158.927*	*68.0*	2.12E-06	2.12E-03	2.12E-05	34.592	0.5
0.4349	0.22	*206.941*	*98.7*	2.76E-06	2.76E-03	2.76E-05	51.001	3.4
0.4584	0.16	*47.283*	*4.2*	6.31E-07	6.31E-04	6.31E-06	40.288	5.8
0.4013	0.25	*29.492*	*0.9*	3.94E-07	3.94E-04	3.94E-06	*44.880*	*1.6*
0.3895	0.25	*45.612*	*2.8*	6.09E-07	6.09E-04	6.09E-06	47.079	1.2
0.5590	0.06	*51.829*	*10.3*	6.92E-07	6.92E-04	6.92E-06	36.033	14.2
0.4063	0.24	73.409	71.5	9.80E-07	9.80E-04	9.80E-06	34.598	12.1

0.5453	0.11	82.354	15.6	1.10E-06	1.10E-03	1.10E-05	65.241	25.2
0.4412	0.21	66.529	4.4	8.88E-07	8.88E-04	8.88E-06	29.664	22.8
0.3951	0.23	74.979	22.4	1.00E-06	1.00E-03	1.00E-05	37.519	72.7
na	na	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
na	na	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
na	na	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
na	na	na	na	#VALUE!	#VALUE!	#VALUE!	na	na

LP (continued)

Conc (2) M	Conc (2) mmol/L	amt As from strip (2) mmol	total As in s trips mmol	Available As mmol	Available As mmol/g wet resin	Log Available As mmol/g wet resin
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
7.04E-07	7.04E-04	7.04E-06	4.82E-05	3.04E-04	1.17E+01	1.07E+00
4.62E-07	4.62E-04	4.62E-06	2.58E-05	1.63E-04	1.22E+01	1.09E+00
6.81E-07	6.81E-04	6.81E-06	3.44E-05	2.17E-04	1.25E+01	1.10E+00
5.38E-07	5.38E-04	5.38E-06	1.17E-05	7.38E-05	1.85E+01	1.27E+00
5.99E-07	5.99E-04	5.99E-06	9.93E-06	6.27E-05	2.52E+01	1.40E+00
6.28E-07	6.28E-04	6.28E-06	1.24E-05	7.81E-05	2.03E+01	1.31E+00
4.81E-07	4.81E-04	4.81E-06	1.17E-05	7.40E-05	1.70E+01	1.23E+00
4.62E-07	4.62E-04	4.62E-06	1.44E-05	9.10E-05	1.47E+01	1.17E+00
8.71E-07	8.71E-04	8.71E-06	1.97E-05	1.24E-04	1.79E+01	1.25E+00
3.96E-07	3.96E-04	3.96E-06	1.28E-05	8.11E-05	1.45E+01	1.16E+00
5.01E-07	5.01E-04	5.01E-06	1.50E-05	9.48E-05	1.50E+01	1.18E+00
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!

Contents: TC

Field ID	Field ID description	Field description	Location	Location	Fe	Fe	Date field sample taken	Temp	pH	DO
			latitude	*longitude*	*ppm*	*M*	*date*	*C*		*mg/L*
Tordilla Creek	TC-413	env: ponded creek, drainage pipe under road drains into pond, water is very brown, soil on backs is white	N 28 51 34.2	W 098 10 49.8	13.94	0.0002	5/10/2002	26.2	8.96	2.70
							5/25/2002	25.4	na	12.32
							5/27/2002	29.3	na	11.33
							6/7/2002	31.0	8.89	6.40
							7/9/2002	na	na	na
							7/30/2002	32.4	8.43	3.78
							8/19/2002	na	na	na
							8/28/2002	na	na	na

TC (continued)

water sample label	Water (As)	Water (As)	Water (As)	Resin Device ID	Resin Device slot ID	Resin amount	Date introduced	Date removed from field	Exposure Time
	ppb	*M*	*mmol/L*		*from top*	*g*	*date*	*date*	*days*
TC413_F	9.153	1.22E-07	1.22E-04	15	1	0.6636	05/10/02	07/30/02	81
TC413_Un	5.189	6.93E-08	6.93E-05		2	0.6624	05/10/02	07/30/02	81
TC413_F	4.496	6.00E-08	6.00E-05		3	0.6355	05/10/02	07/30/02	81
TC413_Un	4.401	5.87E-08	5.87E-05		4	0.6070	05/10/02	07/30/02	81
TC413_F	4.818	6.43E-08	6.43E-05	28	1	0.6452	05/10/02	06/07/02	28

TC413_Un	5.847	7.80E-08	7.80E-05		2	0.6528	05/10/02	06/07/02	28
TC413_F	7.000	9.34E-08	9.34E-05		3	0.6514	05/10/02	06/07/02	28
TC413_Un	9.186	1.23E-07	1.23E-04		4	0.6054	05/10/02	06/07/02	28
TC413_F	na	na	na		Extra	0.6955	05/10/02	06/07/02	28
TC413_Un	na	na	na	2	1	0.6327	05/10/02	07/30/02	81
TC413_F	4.253	5.68E-08	5.68E-05		2	0.6190	05/10/02	07/30/02	81
TC413_Un	1.630	2.18E-08	2.18E-05		3	0.6216	05/10/02	07/30/02	81
TC413_F	na	na	na		4	0.6246	05/10/02	07/30/02	81
TC413_Un	na	na	na		Extra	0.6455	05/10/02	07/30/02	81
TC413_F	na	na	na	27	1	0.6435	05/10/02	05/25/02	15
TC413_Un	na	na	na		2	0.6657	05/10/02	05/25/02	15
					3	0.6790	05/10/02	05/25/02	15
					4	0.6156	05/10/02	05/25/02	15

TC (continued)

Stripped Resin amount	Resin loss	Mean Conc (1)	RSD	Conc (1)	Conc (1)	Conc (1)	Mean Conc (2)	RSD
g	*g*	**ug/L**	**%**	**M**	**mmol/L**	**mmol**	**ug/L**	**%**
0.5625	0.10	*74.436*	*5.2*	9.94E-07	9.94E-04	9.94E-06	*8.733*	*2.0*
0.0000	0.66	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
0.0000	0.64	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
0.0000	0.61	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
0.4930	0.15	22.777	6.5	3.04E-07	3.04E-04	3.04E-06	6.372	6.3
0.5407	0.11	54.71	0.6	7.30E-07	7.30E-04	7.30E-06	22.997	1.7
0.4705	0.18	88.165	0.9	1.18E-06	1.18E-03	1.18E-05	23.169	4.5
0.4421	0.16	88.714	2.1	1.18E-06	1.18E-03	1.18E-05	21.767	3.4
0.5192	0.18	23.707	6.8	3.16E-07	3.16E-04	3.16E-06	2.458	42.7
0.4459	0.19	144.889	2.3	1.93E-06	1.93E-03	1.93E-05	27.562	14.2
0.0000	0.62	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
0.0000	0.62	na	na	#VALUE!	#VALUE!	#VALUE!	na	na
0.5850	0.04	46.798	3.4	6.25E-07	6.25E-04	6.25E-06	29.739	8
0.4671	0.18	25.798	7.7	3.44E-07	3.44E-04	3.44E-06	11.718	7.8
0.5295	0.11	7.647	6	1.02E-07	1.02E-04	1.02E-06	-7.490	17.7

0.2387	0.43	9.367	8.9	1.25E-07	1.25E-04	1.25E-06	-5.801	16.9
0.5680	0.11	19.21	6.3	2.56E-07	2.56E-04	2.56E-06	32.266	1.6
0.5071	0.11	14.83	7.5	1.98E-07	1.98E-04	1.98E-06	25.247	3.0

TC (continued)

Conc (2)	Conc (2)	amt As from strip (2)	total As in strips	Available As	Available As	Log Available As
M	mmol/L	mmol	mmol	mmol	mmol/g wet resin	mmol/g wet resin
1.17E-07	1.17E-04	1.17E-06	1.11E-05	7.01E-05	1.12E+01	1.05E+00
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
8.50E-08	8.50E-05	8.50E-07	3.89E-06	2.46E-05	1.28E+01	1.11E+00
3.07E-07	3.07E-04	3.07E-06	1.04E-05	6.55E-05	1.42E+01	1.15E+00
3.09E-07	3.09E-04	3.09E-06	1.49E-05	9.38E-05	1.26E+01	1.10E+00
2.91E-07	2.91E-04	2.91E-06	1.47E-05	9.31E-05	1.25E+01	1.10E+00
3.28E-08	3.28E-05	3.28E-07	3.49E-06	2.20E-05	1.10E+01	1.04E+00
3.68E-07	3.68E-04	3.68E-06	2.30E-05	1.45E-04	1.19E+01	1.08E+00
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
3.97E-07	3.97E-04	3.97E-06	1.02E-05	6.45E-05	1.64E+01	1.21E+00
1.56E-07	1.56E-04	1.56E-06	5.01E-06	3.16E-05	1.45E+01	1.16E+00
-1.00E-07	-1.00E-04	-1.00E-06	2.10E-08	1.32E-07	2.05E-01	-6.88E-01
-7.74E-08	-7.74E-05	-7.74E-07	4.76E-07	3.00E-06	3.81E+00	5.81E-01
4.31E-07	4.31E-04	4.31E-06	6.87E-06	4.34E-05	2.68E+01	1.43E+00
3.37E-07	3.37E-04	3.37E-06	5.35E-06	3.38E-05	2.70E+01	1.43E+00

WC

Field ID	Field ID description	Field description	Location	Location	Fe	Fe	Date field sample taken	Temp	pH	DO
			latitude	*longitude*	*ppm*	*M*	*date*	*C*		*mg/L*

Weedy Creek	WC-233	small river, occasionally dry (half wet, half dry) - road division, white soils on banks	N 28 36 11	W 098 10 58.8	7.3	###	5/10/2002	28.7	7.07	5.75
							5/25/2002	25.4	na	5.40
							5/27/2002	26.2	na	8.80
							6/7/2002	36.5	na	9.17
							7/9/2002	na	na	na
							7/30/2002	33.9	7.50	2.93
							8/19/2002	32.5	7.75	5.03
							8/28/2002	30.0	1.90	7.69

WC (continued)

water sample label	**Water (As)**	**Water (As)**	**Water (As)**	**Resin Device ID**	**Resin Device slot ID**	**Resin amount**	**Date introduced**	**Date removed from field**
	ppb	*M*	*mmol/L*		*from top*	*g*	*date*	*date*
WC233_F	22.8	3.04E-07	3.04E-04	36	1	0.6634	05/27/02	06/07/02
WC233_Un	23.5	3.13E-07	3.13E-04		2	0.6950	05/27/02	06/07/02
WC233_F	3.663	4.89E-08	4.89E-05		3	0.6949	05/27/02	06/07/02
WC233_Un	4.479	5.98E-08	5.98E-05		4	0.6650	05/27/02	06/07/02
WC233_F	14.829	1.98E-07	1.98E-04		Extra	0.6880	05/27/02	06/07/02
WC233_Un	16.994	2.27E-07	2.27E-04	207	1	0.6566	07/30/02	08/19/02

WC233_F	19.262	2.57E-07	2.57E-04		2	0.6531	07/30/02	08/19/02
WC233_Un	14.179	1.89E-07	1.89E-04		3	0.6708	07/30/02	08/19/02
WC233_F	12.731	na	na		4	0.6349	07/30/02	08/19/02
WC233_Un	*11.115*	na	na	206	1	0.6288	07/30/02	08/28/02
WC233_F	*2.466*	3.29E-08	3.29E-05		2	0.6014	07/30/02	08/28/02
WC233_Un	2.247	3.00E-08	3.00E-05		3	0.6088	07/30/02	08/28/02
WC233_F	21.879	na	na		4	0.6113	07/30/02	08/28/02
WC233_Un	20.686	na	na		Extra found	0.6416	05/10/02	05/25/02
WC233_F	24.021	na	na					
WC233_Un	23.561	na	na					

WC (continued)

water sample label	Water (As)	Water (As)	Water (As)	Resin Device ID	Resin Device slot ID	Resin amount	Date introduced	Date removed from field
	ppb	*M*	*mmol/L*		*from top*	*g*	*date*	*date*
WC233_F	22.8	3.04E-07	3.04E-04	36	1	0.6634	05/27/02	06/07/02
WC233_Un	23.5	3.13E-07	3.13E-04		2	0.6950	05/27/02	06/07/02
WC233_F	3.663	4.89E-08	4.89E-05		3	0.6949	05/27/02	06/07/02
WC233_Un	4.479	5.98E-08	5.98E-05		4	0.6650	05/27/02	06/07/02
WC233_F	14.829	1.98E-07	1.98E-04		Extra	0.6880	05/27/02	06/07/02
WC233_Un	16.994	2.27E-07	2.27E-04	207	1	0.6566	07/30/02	08/19/02
WC233_F	19.262	2.57E-07	2.57E-04		2	0.6531	07/30/02	08/19/02
WC233_Un	14.179	1.89E-07	1.89E-04		3	0.6708	07/30/02	08/19/02
WC233_F	12.731	na	na		4	0.6349	07/30/02	08/19/02
WC233_Un	*11.115*	na	na	206	1	0.6288	07/30/02	08/28/02
WC233_F	*2.466*	3.29E-08	3.29E-05		2	0.6014	07/30/02	08/28/02
WC233_Un	2.247	3.00E-08	3.00E-05		3	0.6088	07/30/02	08/28/02
WC233_F	21.879	na	na		4	0.6113	07/30/02	08/28/02
WC233_Un	20.686	na	na		Extra found	0.6416	05/10/02	05/25/02
WC233_F	24.021	na	na					
WC233_Un	23.561	na	na					

WC (continued)

Exposure Time		Stripped Resin amount	Resin loss	Mean Conc (1)	RSD	Conc (1)	Conc (1)	Conc (1)
days		*g*	*g*	ug/L	%	M	mmol/L	mmol
11		0.4522	0.21	11.868	3.4	1.58E-07	1.58E-04	1.58E-06
11		0.5286	0.17	19.975	4.7	2.66E-07	2.66E-04	2.66E-06
11		0.5590	0.14	38.847	54.9	5.18E-07	5.18E-04	5.18E-06
11		0.5769	0.09	36.291	3	4.84E-07	4.84E-04	4.84E-06
11		0.4556	0.23	21.6	5.1	2.88E-07	2.88E-04	2.88E-06
20	84		0.66	*41.585*	*1.8*	5.54E-07	5.54E-04	5.54E-06
20			0.65	70.944	19.8	9.46E-07	9.46E-04	9.46E-06
20			0.67	117.507	10.2	1.57E-06	1.57E-03	1.57E-05
20			0.63	21.515	19.4	2.87E-07	2.87E-04	2.87E-06
29			0.63	92.388	1.9	1.23E-06	1.23E-03	1.23E-05
29			0.60	82.578	1.7	1.10E-06	1.10E-03	1.10E-05
29			0.61	102.971	3.4	1.37E-06	1.37E-03	1.37E-05
29			0.61	58.567	5.5	7.81E-07	7.81E-04	7.81E-06
15		0.5342	0.11	17.53	20.8	2.34E-07	2.34E-04	2.34E-06

WC (continued)

Mean Conc (2)	RSD	Conc (2)	Conc (2)	amt As from strip (2)	total As in strips	Available As	Available As	Log Available As
ug/L	%	M	mmol/L	mmol	mmol	mmol	mmol/g wet resin	mmol/g wet resin
4.571	13.4	6.09E-08	6.09E-05	6.09E-07	2.19E-06	1.38E-05	1.39E+01	1.14E+00
30.719	6.8	4.10E-07	4.10E-04	4.10E-06	6.76E-06	4.27E-05	2.54E+01	1.40E+00
22.292	4.8	2.97E-07	2.97E-04	2.97E-06	8.15E-06	5.15E-05	1.57E+01	1.20E+00
19.046	3.1	2.54E-07	2.54E-04	2.54E-06	7.38E-06	4.66E-05	1.52E+01	1.18E+00
14.87	10.5	1.98E-07	1.98E-04	1.98E-06	4.86E-06	3.07E-05	1.69E+01	1.23E+00
5.668	*0.3*	7.56E-08	7.56E-05	7.56E-07	6.30E-06	3.98E-05	1.14E+01	1.06E+00
11.76	30.2	1.57E-07	1.57E-04	1.57E-06	1.10E-05	6.96E-05	1.17E+01	1.07E+00
37.8	20.1	5.04E-07	5.04E-04	5.04E-06	2.07E-05	1.31E-04	1.32E+01	1.12E+00
3.858	35	5.14E-08	5.14E-05	5.14E-07	3.38E-06	2.14E-05	1.18E+01	1.07E+00
44.790	1.1	5.97E-07	5.97E-04	5.97E-06	1.83E-05	1.15E-04	1.48E+01	1.17E+00
45.374	*0.2*	6.05E-07	6.05E-04	6.05E-06	1.71E-05	1.08E-04	1.55E+01	1.19E+00
52.730	2.4	7.03E-07	7.03E-04	7.03E-06	2.08E-05	1.31E-04	1.51E+01	1.18E+00
24.231	3.9	3.23E-07	3.23E-04	3.23E-06	1.10E-05	6.97E-05	1.41E+01	1.15E+00
4.118	3.6	5.49E-08	5.49E-05	5.49E-07	2.89E-06	1.82E-05	1.23E+01	1.09E+00

NR

Field ID	Field ID description	Field description	Location	Location	Fe	Fe	Date field sample taken	Temp	pH	DO
			latitude	*longitude*	*ppm*	*M*	*date*	*C*		*mg/L*
Nueces River	NR-151	river, bank stabalized by trees and grasses, near bend in river, steep slopling bank	N 28 17 56.6?	W 098 02 32.7	28.42	0.0005	5/10/2002	na	na	na
							5/25/2002	na	na	na
							5/27/2002	26.2	na	13.23
							6/7/2002	30.1	8.26	8.22
							7/9/2002	na	na	na
							7/30/2002	30.7	6.64	2.75
							8/19/2002	31.8	7.64	3.03
							8/28/2002	30.0	7.25	5.00

NR (continued)

water sample label	Water (As)	Water (As)	Water (As)	Resin Device ID	Resin Device slot ID	Resin amount	Date introduced
	ppb	*M*	*mmol/L*		*from top*	*g*	*date*
NR151_F	7.8	1.04E-07	1.04E-04	32	1	0.6321	05/27/02
NR151_Un	7.7	1.03E-07	1.03E-04		2	0.6562	05/27/02
NR151_F	3.272	4.37E-08	4.37E-05		3	0.6400	05/27/02

NR151_Un	2.443	3.26E-08	3.26E-05		4	0.6420	05/27/02
NR151_F	4.918	6.56E-08	6.56E-05		EXTRA 1	0.6655	05/27/02
NR151_Un	5.173	6.90E-08	6.90E-05	33	1	0.6201	05/27/02
NR151_F	*9.338*	1.25E-07	1.25E-04		2	0.6704	05/27/02
NR151_Un	5.662	7.56E-08	7.56E-05		3	0.6894	05/27/02
NR151_F	6.497	8.67E-08	8.67E-05		4	0.6358	05/27/02
NR151_Un	4.326	5.77E-08	5.77E-05		EXTRA 1	0.6581	05/27/02
NR151_F	0.991	1.32E-08	1.32E-05		EXTRA 2	0.6860	05/27/02
NR151_Un	0.903	1.21E-08	1.21E-05	4	1	0.6283	05/27/02
NR151_F	*12.833*	1.71E-07	1.71E-04		2	0.6495	05/27/02
NR151_Un	12.913	1.72E-07	1.72E-04		3	0.6444	05/27/02
NR151_F	14.283	1.91E-07	1.91E-04		4	0.6673	05/27/02
NR151_Un	13.432	1.79E-07	1.79E-04	212	1	0.6966	07/30/02
					2	0.6690	07/30/02
					3	0.6710	07/30/02
					4	0.6330	07/30/02
				210	1	0.6273	07/30/02
					2	0.6344	07/30/02
					3	0.6020	07/30/02
					4	0.6053	07/30/02

NR (continued)

Date removed from field	**Exposure Time**	**Stripped Resin amount**	**Resin loss**	**Mean Conc (1)**	**RSD**	**Conc (1)**	**Conc (1)**
date	*days*	*g*	*g*	**ug/L**	**%**	**M**	**mmol/L**
06/07/02	11	0.5456	0.09	28.573	4.9	3.81E-07	3.81E-04
06/07/02	11	0.4698	0.19	*21.386*	*2.2*	2.85E-07	2.85E-04
06/07/02	11	0.4938	0.15	17.395	1.4	2.32E-07	2.32E-04
06/07/02	11	0.4491	0.19	19.434	5.1	2.59E-07	2.59E-04
06/07/02	11	0.5120	0.15	40.035	10.8	5.34E-07	5.34E-04
08/19/02	84		0.62	*20.410*	*1.4*	2.72E-07	2.72E-04
08/19/02	84		0.67	283.336	39.0	3.78E-06	3.78E-03
08/19/02	84		0.69	187.856	10.8	2.51E-06	2.51E-03

08/19/02	84			0.64	267.687	0.6	3.57E-06	3.57E-03
08/19/02	84			0.66	29.607	14.3	3.95E-07	3.95E-04
08/19/02	84			0.69	52.838	26.1	7.05E-07	7.05E-04
08/19/02	84			0.63	127.594	8.8	1.70E-06	1.70E-03
08/19/02	84			0.65	238.862	10.8	3.19E-06	3.19E-03
08/19/02	84		0.0000	0.64	na	na	#VALUE!	#VALUE!
08/19/02	84			0.67	172.148	11.2	2.30E-06	2.30E-03
08/28/02	29	93		0.70	19.137	18.1	2.55E-07	2.55E-04
08/28/02	29			0.67	*21.941*	*2.0*	2.93E-07	2.93E-04
08/28/02	29			0.67	38.709	1.6	5.17E-07	5.17E-04
08/28/02	29			0.63	160.210	2.5	2.14E-06	2.14E-03
08/19/02	20	84		0.63	89.316	4.2	1.19E-06	1.19E-03
08/19/02	20			0.63	96.229	1.5	1.28E-06	1.28E-03
08/19/02	20			0.60	82.451	8.3	1.10E-06	1.10E-03
08/19/02	20			0.61	77.518	3.2	1.03E-06	1.03E-03

NR (continued)

Conc (1) mmol	Mean Conc (2) ug/L	RSD %	Conc (2) M	Conc (2) mmol/L	amt As from strip (2) mmol	total As in strips mmol	Available As mmol	Available As mmol/g wet resin	Log Available As mmol/g wet resin
3.81E-06	7.191	4.6	9.60E-08	9.60E-05	9.60E-07	4.77E-06	3.01E-05	1.25E+01	1.10E+00
2.85E-06	*7.159*	*1.0*	9.56E-08	9.56E-05	9.56E-07	3.81E-06	2.41E-05	1.33E+01	1.13E+00
2.32E-06	8.388	9	1.12E-07	1.12E-04	1.12E-06	3.44E-06	2.17E-05	1.48E+01	1.17E+00
2.59E-06	4.112	11.4	5.49E-08	5.49E-05	5.49E-07	3.14E-06	1.98E-05	1.21E+01	1.08E+00
5.34E-06	15.633	3.6	2.09E-07	2.09E-04	2.09E-06	7.43E-06	4.69E-05	1.39E+01	1.14E+00
2.72E-06	*29.735*	*14.6*	3.97E-07	3.97E-04	3.97E-06	6.69E-06	4.23E-05	2.46E+01	1.39E+00
3.78E-05	65.025	0.8	8.68E-07	8.68E-04	8.68E-06	4.65E-05	2.94E-04	1.23E+01	1.09E+00
2.51E-05	28.047	41	3.74E-07	3.74E-04	3.74E-06	2.88E-05	1.82E-04	1.15E+01	1.06E+00
3.57E-05	41.577	18.6	5.55E-07	5.55E-04	5.55E-06	4.13E-05	2.61E-04	1.16E+01	1.06E+00
3.95E-06	6.275	33.5	8.38E-08	8.38E-05	8.38E-07	4.79E-06	3.02E-05	1.21E+01	1.08E+00
7.05E-06	3.676	20.8	4.91E-08	4.91E-05	4.91E-07	7.54E-06	4.76E-05	1.07E+01	1.03E+00
1.70E-05	27.373	20	3.65E-07	3.65E-04	3.65E-06	2.07E-05	1.31E-04	1.21E+01	1.08E+00
3.19E-05	26.614	19.1	3.55E-07	3.55E-04	3.55E-06	3.54E-05	2.24E-04	1.11E+01	1.05E+00

#VALUE!	na	na	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
2.30E-05	20.717	23.7	2.77E-07	2.77E-04	2.77E-06	2.57E-05	1.63E-04	1.12E+01	1.05E+00
2.55E-06	15.102	6.2	2.02E-07	2.02E-04	2.02E-06	4.57E-06	2.89E-05	1.79E+01	1.25E+00
2.93E-06	16.157	2.1	2.16E-07	2.16E-04	2.16E-06	5.08E-06	3.21E-05	1.74E+01	1.24E+00
5.17E-06	20.741	5.4	2.77E-07	2.77E-04	2.77E-06	7.93E-06	5.01E-05	1.54E+01	1.19E+00
2.14E-05	58.013	6.6	7.74E-07	7.74E-04	7.74E-06	2.91E-05	1.84E-04	1.36E+01	1.13E+00
1.19E-05	14.259	8.9	1.90E-07	1.90E-04	1.90E-06	1.38E-05	8.73E-05	1.16E+01	1.06E+00
1.28E-05	40.795	72.2	5.45E-07	5.45E-04	5.45E-06	1.83E-05	1.15E-04	1.42E+01	1.15E+00
1.10E-05	20.186	6.4	2.69E-07	2.69E-04	2.69E-06	1.37E-05	8.65E-05	1.24E+01	1.10E+00
1.03E-05	11.359	15.3	1.52E-07	1.52E-04	1.52E-06	1.19E-05	7.49E-05	1.15E+01	1.06E+00

LCC

Field ID	Field ID description	Field description	Location	Location	Fe	Fe	Date field sample taken	Temp	pH	DO
			latitude	*longitude*	*ppm*	*M*	*date*	*C*		*mg/L*
Lake Corpus Christi reservoir	LCC-543	river meets lake/reservoir, marshy finger of lake, cement blocks covering bank, trees, wild water lillies	N 28 14 14.0	W 098 56 45.0	63.50	0.0011	5/10/2002	31.3	7.02	5.69
							5/25/2002	25.8	na	2.08
							5/27/2002	26.3	na	7.64
							6/7/2002	29.9	7.34	4.84
							7/9/2002	na	na	na
							7/30/2002	30.1	6.28	1.34

8/19/2002	30.6	6.91	3.30
8/28/2002	na	na	a

LCC (continued)

water sample label	Water (As)	Water (As)	Water (As)	Resin Device ID	Resin Device slot ID	Resin amount
	ppb	*M*	*mmol/L*		*from top*	*g*
LCC534_F		3.15E-08	3.15E-05	6	1	0.6932
	2.357					
LCC534_Un	3.330	4.45E-08	4.45E-05		2	0.6050
LCC534_F	4.135	5.52E-08	5.52E-05		3	0.6117
LCC534_Un	3.869	5.16E-08	5.16E-05		4	0.6360
LCC534_F	9.380	1.25E-07	1.25E-04		EXTRA 1	0.6302
LCC534_Un	9.298	1.24E-07	1.24E-04	18	1	0.6790
LCC534_F	8.067	1.08E-07	1.08E-04		2	0.5897
LCC534_Un	6.360	8.49E-08	8.49E-05		3	0.6266
LCC534_F	2.559	3.42E-08	3.42E-05		4	0.6051
LCC534_Un	3.027	4.04E-08	4.04E-05		EXTRA 1	0.6247
LCC534_F	0.797	1.06E-08	1.06E-05		EXTRA 2	0.6513
LCC534_Un	0.736	9.82E-09	9.82E-06	211	1	0.6555
LCC534_F	4.5	6.01E-08	6.01E-05		2	0.6142
LCC534_Un	3.1	4.14E-08	4.14E-05		3	0.6707
LCC534_F	na	#VALUE!	#VALUE!		4	0.6830
LCC534_Un	na	#VALUE!	#VALUE!	16	1	0.6812
					2	0.6599
					3	0.6559
					4	0.6707

LCC (continued)

water sample label	Water (As)	Water (As)	Water (As)	Resin Device ID	Resin Device slot ID	Resin amount
	ppb	*M*	*mmol/L*		*from top*	*g*
LCC534_F	2.357	3.15E-08	3.15E-05	6	1	0.6932
LCC534_Un	3.330	4.45E-08	4.45E-05		2	0.6050
LCC534_F	4.135	5.52E-08	5.52E-05		3	0.6117
LCC534_Un	3.869	5.16E-08	5.16E-05		4	0.6360
LCC534_F	9.380	1.25E-07	1.25E-04		EXTRA 1	0.6302
LCC534_Un	9.298	1.24E-07	1.24E-04	18	1	0.6790
LCC534_F	8.067	1.08E-07	1.08E-04		2	0.5897
LCC534_Un	6.360	8.49E-08	8.49E-05		3	0.6266
LCC534_F	2.559	3.42E-08	3.42E-05		4	0.6051
LCC534_Un	3.027	4.04E-08	4.04E-05		EXTRA 1	0.6247
LCC534_F	0.797	1.06E-08	1.06E-05		EXTRA 2	0.6513
LCC534_Un	0.736	9.82E-09	9.82E-06	211	1	0.6555
LCC534_F	4.5	6.01E-08	6.01E-05		2	0.6142
LCC534_Un	3.1	4.14E-08	4.14E-05		3	0.6707
LCC534_F	na	#VALUE!	#VALUE!		4	0.6830
LCC534_Un	na	#VALUE!	#VALUE!	16	1	0.6812
					2	0.6599
					3	0.6559
					4	0.6707
				12	1	0.6047
					2	0.6417
					3	0.6438
					4	0.6752

LCC (continued)

Date introduced	Date removed from field	Exposure Time		Stripped Resin amount	Resin loss	Mean Conc (1)	RSD	Conc (1)
date	*date*	*days*		*g*	*g*	**ug/L**	**%**	**M**
05/10/02	05/25/02	15		0.5651	0.13	34.547	92.5	4.61E-07
05/10/02	05/25/02	15		0.3121	0.29	11.961	3.6	1.60E-07
05/10/02	05/25/02	15		0.5027	0.11	13.318	4.3	1.78E-07
05/10/02	05/25/02	15		0.4369	0.20	18.392	26.5	2.46E-07
05/10/02	05/25/02	15		0.5239	0.11	18.132	30.3	2.42E-07
05/10/02	06/07/02	28		0.5057	0.17	21.15	32.3	2.82E-07
05/10/02	06/07/02	28		0.3870	0.20	24.283	51.6	3.24E-07
05/10/02	06/07/02	28		0.5330	0.09	37.587	6.2	5.02E-07
05/10/02	06/07/02	28		0.1557	0.45	69.499	5.1	9.28E-07
05/10/02	06/07/02	28		0.4834	0.14	52.412	15.6	7.00E-07
05/10/02	06/07/02	28		0.4500	0.20	70.875	11.3	9.46E-07
07/30/02	8/19/2002	20	101		0.66	23.031	5.0	3.07E-07
07/30/02	8/19/2002	20		0.0000	0.61	na	na	#VALUE!
07/30/02	8/19/2002	20			0.67	42.087	6.3	5.62E-07
07/30/02	8/19/2002	20			0.68	67.085	2.8	8.96E-07
07/30/02	8/19/2002	20			0.68	1.362	12.9	1.82E-08
07/30/02	8/19/2002	20			0.66	35.572	3.8	4.75E-07
07/30/02	8/19/2002	20			0.66	108.928	2.9	1.45E-06
07/30/02	8/19/2002	20		0.5342	0.14	48.186	3.2	6.43E-07
05/10/02	flood				0.60			
	flood				0.64			
	flood				0.64			
	flood				0.68			
05/10/02	flood				0.62			
	flood				0.64			
	flood				0.62			
	flood			0.5342	0.10			

LCC (continued)

Conc (1)	Conc (1)	Mean Conc (2)	RSD	Conc (2)	Conc (2)	amt As from strip (2)	total As in strips	Available As	Available As	Log Available As
mmol/L	mmol	ug/L	%	M	mmol/L	mmol	mmol	mmol	mmol/g wet resin	mmol/g wet resin
4.61E-04	4.61E-06	33.028	2.0	4.41E-07	4.41E-04	4.41E-06	9.02E-06	5.69E-05	1.23E+02	2.09E+00
1.60E-04	1.60E-06	8.325	9.8	1.11E-07	1.11E-04	1.11E-06	2.71E-06	1.71E-05	1.07E+02	2.03E+00
1.78E-04	1.78E-06	6.837	13.1	9.13E-08	9.13E-05	9.13E-07	2.69E-06	1.70E-05	9.55E+01	1.98E+00
2.46E-04	2.46E-06	8.84	7.7	1.18E-07	1.18E-04	1.18E-06	3.64E-06	2.29E-05	9.35E+01	1.97E+00
2.42E-04	2.42E-06	11.353	1.4	1.52E-07	1.52E-04	1.52E-06	3.94E-06	2.48E-05	1.03E+02	2.01E+00
2.82E-04	2.82E-06	9.346	29.4	1.25E-07	1.25E-04	1.25E-06	4.07E-06	2.57E-05	9.10E+01	1.96E+00
3.24E-04	3.24E-06	10.057	26.8	1.34E-07	1.34E-04	1.34E-06	4.58E-06	2.89E-05	8.93E+01	1.95E+00
5.02E-04	5.02E-06	*9.533*	*0.2*	1.27E-07	1.27E-04	1.27E-06	6.29E-06	3.97E-05	7.91E+01	1.90E+00
9.28E-04	9.28E-06	1.576	54	2.10E-08	2.10E-05	2.10E-07	9.49E-06	5.99E-05	6.46E+01	1.81E+00
7.00E-04	7.00E-06	19.386	36.9	2.59E-07	2.59E-04	2.59E-06	9.58E-06	6.05E-05	8.65E+01	1.94E+00
9.46E-04	9.46E-06	16.445	29	2.20E-07	2.20E-04	2.20E-06	1.17E-05	7.36E-05	7.78E+01	1.89E+00
3.07E-04	3.07E-06	9.05	7.1	1.21E-07	1.21E-04	1.21E-06	4.28E-06	2.70E-05	8.79E+01	1.94E+00
#VALUE!	#VALUE!	na	na	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
5.62E-04	5.62E-06	13.302	0.9	1.78E-07	1.78E-04	1.78E-06	7.39E-06	4.67E-05	8.31E+01	1.92E+00
8.96E-04	8.96E-06	14.876	8.2	1.99E-07	1.99E-04	1.99E-06	1.09E-05	6.91E-05	7.71E+01	1.89E+00
1.82E-05	1.82E-07	2.266	73.8	3.02E-08	3.02E-05	3.02E-07	4.84E-07	3.06E-06	1.68E+02	2.23E+00
4.75E-04	4.75E-06			0.00E+00	0.00E+00	0.00E+00	4.75E-06	3.00E-05	6.31E+01	1.80E+00
1.45E-03	1.45E-05	17.548	6.1	2.34E-07	2.34E-04	2.34E-06	1.69E-05	1.07E-04	7.33E+01	1.87E+00
6.43E-04	6.43E-06	7.962	9.5	1.06E-07	1.06E-04	1.06E-06	7.50E-06	4.73E-05	7.36E+01	1.87E+00

APPENDIX IV

WEEDY CREEK SEDIMENT REPORT (UNPUBLISHED DATA)

Weedy Creek Sediment Report

Graciela Lake

Texas A&M University, Geology and Geophysics Department, College Station, Texas

Submitted to Agronomy 626, December 5, 2000

Sediment from Weedy Creek, located in Live Oak County, Texas, was sampled as part of an investigation concerning the transport of contaminates (i.e. arsenic, As) as a function of iron (Fe) and organic matter content in varying geologic environments along the Nueces River watershed. The sample was made up of quartz, calcite, feldspars, mica, kaolinite, and smectite. Analysis of the sediment reviled a 117.6% moisture content, 0.03-0.04% Fe_2O_3, 17-19% mica in coarse and fine clay fractions, and cation exchange capacity of ~30 cmol/kg in the fine clay and ~60 cmol/kg in the coarse clay fractions. The sample was texturally classified as a clay.

Introduction

During the 1960s, South Texas was the site of many open pit uranium mines. Mining activities allowed processing wastes and sediment with "low" amounts of uranium (U) to run into nearby drainages, resulting in contamination of the surrounding environment, including the Nueces River watershed, by U and associated elements such as arsenic (As), molybdenum (Mo), selenium (Se), and vanadium (V).

Weedy Creek sediment was chosen because of its location along the Atasocsa River, which was once exposed to wastes from neighboring uranium mining operations. This sediment is part of a sample set in an investigation of how Fe and organic matter content in varying geologic environments affect the surface chemistry of colloidal particles in the Nueces River watershed. Identification of the mineral content and properties of this sediment, aids in the analysis of controlling factors of transport and bioavailabilty of contaminates to the environment.

Materials and Methods

Sample Description

The sample used for analyzes was composed of river sediment from Weedy Creek, Live Oak County, Texas (Figure 1). Sediment was collected from the riverbank of Weedy Creek where the creek crosses the road. The sampling location was off Interstate 281 South, exiting on Highway 2049 about one mile, down the first farm road on the left (Figure 2).

Weedy Creek flows into the Atascosa River through a soil area characterized as Monteola-Tordia-Zapata Soil. The Monteola soil has a 38-51 centimeters thick dark gray to dark grayish brown calcareous clay surface. 91-122 centimeters beneath the surface lie gray compacted massive calcareous clay containing large amounts of soft $CaCO_3$. The Tordia soil is very dark gray to dark gray. It is characterized as being very firm, subangular blocky to blocky alkaline clay. The soil tends to be 50 to 102 centimeters thick. It contains few $CaCO_3$ concretions and is moderately well drained. The Zapata soil has a 15 to 25 centimeter thick dark grayish brown to light brownish gray calcareous loam or clay loam surface. This loam surface covers a light gray or white caliche (Mills and Franki, 1969).

Sample Pretreatment

To prepare samples for analysis, methods from Dixon and White (2000) were followed. The sample was pre-sieved, removing large rocks, sticks, and coarse to medium sand; initial weight was not recorded.

A small portion of the bulk sample was weighed into a beaker and oven dried overnight at 105-110°C. This subsample was then placed in a desiccator to cool and was weighed for percent moisture determination.

(initial sample weight) – (oven dried weight) = amount of water lost (1a)
((amount of water lost) / (oven dried weight)) * 100 = % moisture $_{\text{dry weight bases}}$ (1b)

Sample treatment involved carbonate removal by pH 5 N NaOAc washes and organic matter and MnO_2 removal by H_2O_2, buffered with pH 5 N NaOAc. When H_2O_2 reactions became less violent, the majority of the organic matter and MnO_2 had been removed. The sample was then washed using pH 5 N NaOAc and N NaCl to remove residues from the system.

Size fractionation of sand, silt and coarse clays was achieved by washing the sample with pH 10 Na_2CO_3 solution. After the fractionation of sand, silt and coarse clay, the samples were oven dried overnight at 105-110°C and weighed. Fine clays were fractionated from the sample by flocculation with the addition of NaCl to the system.
The fine clays were then freeze-dried and weighed.

Sample Analysis

Samples were prepared for X-ray diffraction, free iron content, total potassium content, cation exchange capacity, and infrared spectroscopy analyses according to the methods found in Dixon and White (2000). These methods, along with theory, are summarized in Appendix A.

Results

Percent Moisture

50.5496 grams of bulk Weedy Creek sample was weighed into a beaker and oven-dried overnight for percent moisture determination. After drying, the mass of the sample was 23.231 grams, which was calculated to be 117.6% moisture on a dry weight bases using equations (1a,b).

Fractionation and Percent Yield

The first attempted treatment of soils reached the organic matter removal stage before exploding. The second attempt did not react as violently with the samples.

Fractionation achieved by saturation of the sample with pH 10 sodium carbonate (Na_2CO_3) yielded the weights seen in Table 1.

Table 1: Weights of each sample fraction

Fraction	Wet Weight	Dry Weight
	g	g
Bulk 1	47.8715	
Bulk 2	47.9585	
Sand		4.402
Silt		9.6127
Coarse Clay		15.5367
Fine Clay		10.7141
Total	95.83	40.2655

By analysis of the weights, the largest fraction of the sample was coarse clay (Table 2).

Table 2: Soil Size Fractions and Percent Yield

Fraction	Dry Weight	Size Fractions	Percent Yield
	g	dry weight / total dry weight	total wt of fractions / initial wt
Sand	4.402	10.93%	
Silt	9.6127	23.87%	
Coarse Clay	15.5367	38.59%	
Fine Clay	10.7141	26.61%	
Total	40.2655	100.00%	72.47%

Using the ternary diagram titled “Guide for Textural Classification” (Figure 3) from the U.S. Department of Agriculture, National Resources Conservation Service, this sample is texturally classified as a clay (Dixon and White, 2000).

X-ray Diffraction

Bulk Sample

The bulk XRD pattern (Figure 4) showed predominate minerals in the Weedy Creek sample to be low quartz (SiO_2) [3.35, 4.27, 1.82] and calcite ($CaCO_3$) [3.04, 2.29, 2.098]. The pattern also exhibited the possibility of elemental sulfur [3.87, 3.48, 3.22] existing in the bulk sample.

Sand and silt fractions

The sand and silt fractions of Weedy Creek produced peaks suggesting the presence of quartz (SiO_2), disordered albite $Na(Si_3Al)O_8$, and intermediate, sodian anorthite $(Ca,Na)(Si,Al)_4O_8$. Corresponding peaks are marked in Figure 5 and Figure 6.

Coarse clay fraction

In Figure 7, the peaks recorded from the Mg and K treatments were combined for analysis. The constant presence of the d spacings of 10.045, 10.019, 9.992, and 10.018 at ~9º 2 theta after all the treatments suggests the presence of a small amount of mica. Amorphous peaks at 20º 2 theta of intensities 4.452 and 4.487 in the Mg treatments are most likely caused by volcanic ash in the sediment. The lower order peaks are quartz, anorthite and albite.

Fine clay fraction

The peaks recorded from the Mg and K treatments were combined in Figure 8. The 15.581 (Mg, 25°C), 16.953 (Mg glycerol), 10.267 (K, 25°C), 10.045 (K, 300°C), and 10.124 (K, 500°C) peaks at 7º 2 theta suggest the presence of smectite. Mica can also been seen in this fraction, displayed by the shoulders at ~9º 2 theta of intensities 10.267 (Mg, 25°C) and 10.178 (Mg glycerol). The 7 peaks for Mg 25°C and glycerol and K 25°C and 300°C, disappearing after the K 500°C treatment at 12º 2 theta suggests the presence of kaolinite.

Scanning Electron Microscopy

A variety of particles were found in the silt fraction of the Weedy Creek sample. Four pictures, along with matching EDS patterns were taken for further analysis.

Figure 9 is a dog bone shaped silicon particle. It has undergone some weathering indicated by the rather jagged edges. This particle is interpreted to be a siliceous diatom because of its shape around the edges.

Figure 10 displays the presence of sodium, potassium, and silica rich particles. The letters marked on the particle pictures correspond to the lettered EDS patterns. The particle on the far left is a quartz (SiO_2) grain. Grains marked A and C are most likely the feldspar albite ($NaAlSi_3O_8$). B is an intermediate feldspar with an iron coating. Particle D was interpreted to be augite. Note the pits and rough edges of these particles.

A piece of volcanic ash (A) was also found in the silt fraction of the Weedy Creek sample seen in Figure 11. Its composition is similar to that of sanidine ($(K,Na)AlSi_3O_8$). Grain (B) in reveled an EDS pattern similar to orthoclase ($KAl\ Si_3O_8$); this particle is well rounded with some signs of weathering. (C) is a piece of anorthite ($CaAl2Si_2O_8$) and the grain in the far right corner is quartz (SiO_2).

Figure 12 is a siliceous particle, interpreted to be a small portion of a sponge spicule. The other grains see in this picture are quartz (SiO_2).

Transmission Electron Microscopy

The coarse clay fraction used for the Transmission Electron Microscopy (TEM) was not diluted enough for analysis of individual particles. The sample was packed with smectitic layers (Figure 13). For this reason, specimens dehydrated during the TEM session. It was extremely hard to find and measure lattice fringes, however, they did display moiré fringes. Overlapping platy crystals produces moiré patterns. These patterns correspond to alternations of fit and misfit crystal lattices, producing spacings much coarser than the lattice fringes (Gard, 1971).

Figure 14 shows turbostratically stacked layers of smectite, forming a ring like structure. Figures 15a and 15b are examples of parallel moiré patterns caused by the overlapping of smectite particles. In Figure 16a and 16b, the image displays this overlapping of particles. Notice the lighter and darker colors of the "single" particle highlighted by the green arrow. These figures also display more moiré fringes. Figure 16c is the diffraction pattern produced by Figure 16b. This ring pattern is characteristic of smectite.

Free Iron Oxides

Iron (Fe) oxides were determined using equations (A.3) in Appendix A.

Table 3: Free Iron Oxides.

Sample	Weight	Fe	Total Fe in solution	% Fe in sample	% Fe_2O_3
	g	ppm in solution	g	%	%
Sample1	2.1123	5.9	0.00059	0.03%	0.04%
Sample 2	2.2104	4.5	0.00045	0.02%	0.03%
Standard 1	2.3735	136.4	0.01364	0.57%	0.82%
Standard 2	2.0859	129.3	0.01293	0.62%	0.89%

Based on the results of these tests, Weedy Creek has 0.03 to 0.04% Fe_2O_3 content, a very low free Fe. The standard has a higher Fe content at 0.82 – 0.89%.

Total K Determination

Using equations (A.4) in Appendix A, the calculations shown in Table 4 were made.

Table 4: Total K Determination

Sample	Weight	K	Total K	K	Mica
	mg	ppm	mg	%	%
Standard (Brick Clay)	145.52	2.20	1.10	0.76	9.11
Standard (Brick Clay)	140.48	6.42	3.21	2.29	27.53
Coarse Clay (oven dry)	144.02	4.08	2.04	1.42	17.06
Coarse Clay (oven dry)	75.46	2.19	1.10	1.45	17.48
Fine Clay (freeze dry)	78.78	2.17	1.09	1.38	16.59
Fine Clay (freeze dry)	91.85	3.01	1.51	1.64	19.74

Percentages calculated for the first standard were not used because of their low mica content compared to the duplicate. Coarse and fine clays contained between 17 to 20% mica.

Cation Exchange Capacity

Cation exchange capacity (CEC) experiments were carried out twice for the fine clay fraction because of inconclusive data. The data found in the following tables were used in equations (A.5) in Appendix A to quantify CEC of Weedy Creek sediment.

Table 5: Trial 1 CEC Determination Weights.

Sample	W1	W2	W3	W3a	W4	Cal	CaS	OD weight
	mg	mg	mg	mg	mg	ppm Ca in 0.01 N $CaCl_2$	ppm Ca in supernate from sample	W3a-W1 (mg)
Coarse Clay 1	13548.12	13638.05	13897.00	13631.90	13631.69	190.40	2.91	83.78
Coarse Clay 2	13563.53	13655.96	13954.00	13632.10	13636.21	190.40	4.64	68.57
Fine Clay 1	13626.82	13708.19	14026.30	13707.40	13710.68	190.40	11.31	80.58
Fine Clay 2	13540.00	13627.50	13950.90	13627.30	13629.18	190.40	11.86	87.30
Standard 1	13684.84	13770.71	14143.10	13761.20	13763.09	190.40	15.50	76.36
Standard 2	9922.90	10018.31	10519.80	10007.90	10008.32	190.40	17.88	85.00

Table 6: Trial 1 CEC Calculations.

Sample	A	B	CEC
	mg	mg	cmol/kg
Coarse Clay 2	0.29	0.05	14.40
Coarse Clay 2	0.46	0.06	29.64
Fine Clay 1	1.13	0.06	66.29
Fine Clay 2	1.19	0.06	64.27
Standard 1	1.55	0.07	96.66
Standard 2	1.79	0.10	99.36

Table 8: Trial 2 CEC Calculations.

Sample	A	B	CEC
	mg	mg	cmol/kg
Coarse Clay 2	0.73	0.06	34.07
Coarse Clay 2	0.52	0.06	28.79
Standard 1	1.68	0.07	94.55
Standard 2	1.90	0.10	101.64

CEC for the coarse clays in Trial 1 (Table 6) were variable, whereas in Trial 2 (Table 8) CEC was calculated to be between 28.79 and 34.07 cmol/kg. Fine clay was determined to have a CEC between 64.27 and 66.29 cmol/kg (Table 6). The standard CEC varied between 94.55 and 101.64 cmol/kg.

Infrared Analysis

Infrared analysis of the coarse clay fraction of Weedy Creek sediment (Figure 17) displayed the presence of quartz (799, 780), and the possibility of montmorillonite (3622, 1102, 1042, 914, 519, 471). Peaks 3315 and 1625 are due to interlayer water. The peaks 1868, and 1520 are most likely the result of the sample not being washed well.

The fine clay fraction of the sample again shows a pattern for montmorillonite (3625, 3373, 1028, 916, 520, 467). As seen in the coarse clay fraction, peaks 3373 and 1626 were attributed to interlayer water (Dixon and White, 2000).

Table 7: Trial 2 CEC Determination Weights.

Sample	W1	W2	W3	W3a	W4	Cal	CaS	OD weight
	mg	mg	mg	mg	mg	ppm Ca in 0.01 N $CaCl_2$	ppm Ca in supernate from sample	W3a-W1 (mg)
Coarse Clay 1	13537.59	13638.05	13948.81	13635.56	13635.15	196.50	7.30	97.97
Coarse Clay 2	13541.20	13629.44	13938.95	13621.49	13621.27	196.50	5.24	80.29
Standard 1	13625.41	13734.30	14070.54	13710.32	13709.37	196.50	16.75	84.91
Standard 2	13683.46	13791.15	14287.69	13772.05	13772.67	196.50	19.02	88.59

NEWMOD

The fine clay fraction of Weedy Creek sediment was modeled using the computer program NEWMOD 2.02 © by R.C. Reynolds, Jr.

Figure 18a is the Mg saturated sample at 25ºC with peak intensities of 15.501, 5.011 and 3.264. The model for this analysis (Figure 18b) was made using the following parameters (MIC1): Most abundant clay = Dimica, 1.7 atoms of Fe, second mineral = Dimica, 0.21 atoms of Fe, decimal fraction of most abundant clay = 0.8; D001A = 10.045, D001B = 4.937, HIGHN = 30, LOWN = 2.

The Mg glycerol sample (Figure 19a) with peak intensities of 16.953 and 10.178 was modeled using a mixer file (Figure 19b). Files used to produce the mixed pattern were SMEC5 and SMC_K2, where files were multiplied by 0.5 and 1, respectively. SMEC5 contained the parameters: Most abundant clay = Dismectite-water1, 1.7 atoms of Fe, second mineral = Dismectite-water2, 0.7 atoms of Fe; D001A = 15.581, D001B = 10.267, HIGHN = 25, LOWN = 0. SMEC_K2 was made using the parameters: Most abundant clay = Dismectite-water2, 1.7 atoms of Fe, second mineral = Kaolinite, decimal fraction of most abundant clay = 0.8; D001A = 10.267, D001B = 4.937.

K saturated sample analysis at 25ºC seen in Figure 20a, was modeled using the SMC_K2 file (Figure 20b). Figure 21a shows K, 300ºC modeled by the file MIC1 (Figure 21b). The K, 550ºC sample (Figure 22a) was also modeled using the MIC1 file.

Discussion

Bulk sample interpretation

The purpose of analyzing the bulk sample was to better prepare for pretreatment of the soils. If the sample were made up of predominately carbonatious material, the pH 5 N NaOAc treatment might take a long time, so an alternative method may be required.

In the case of Weedy Creek, predominate minerals were quartz and calcite, two very common minerals. The possible presence of the elemental sulfur is not far fetched since the first attempted pretreatment of soils reached the organic matter removal stage before exploding. However, the second attempt did not react as violently with the samples. Analysis of the bulk sample was difficult since the sample still contained carbonates and organic matter, which can complicate a pattern.

Sand and silt fraction interpretation

Both sand and silt fractions contained the common minerals of quartz and plagioclase feldspars. It is common to see the presence of anorthite and albite together since they are both end members in the feldspar series (Klein and Hurlbut, 1993).

Coarse and fine clay fraction interpretations

The lower order peaks produced by the coarse clay fraction are due to quartz and feldspar, which is common in the coarse clay fractions of sediment.

The fine clay fraction of the Weedy Creek sample is unique compared to the rest of the fractions. XRD analysis produced peaks finally exhibiting the presence of the true clays smectite and kaolinite. Quartz and feldspars in this size fraction is not common, so these peaks may be higher order 00/XRD peaks (Dixon and White, 2000).

Transmission Electron Microscopy Interpretation

Based on the images and the dehydration of the specimens during TEM analyses prove the existence of smectite in the Weedy Creek sediment. The ring pattern produced by the diffraction of the particle in Figure 16b (Figure 16c) is caused by the interference of overlapping particles. A single crystal produces a characteristic spot pattern, however, in the case of smectite, the spot patterns overlap each other and produce a ring (Dixon and White, 2000).

Scanning Electron Microscopy Interpretation

The sample used for SEM was a silt size fraction, so the appearance of quartz was not unusual and the appearance of the feldspars added strength to the XRD interpretations. The appearance of the volcanic particle (Figure 11) raised some interesting questions (i.e. how far had this colloidal material traveled?). It was interpreted to be a volcanic particle because of its surface appearance and its EDS pattern. The surface of the particle appeared to have many vesicules, a characteristic of volcanic projecta, which is caused by gas bubbles. The EDS pattern lead to the mineral sanidine. Sanidine is characteristic of rocks that have cooled quickly from an initial high temperature eruption and is a common phenocryst in extrusive igneous rocks like rhyolites and trachytes (Klein and Hurlbut, 1993).

The sponge spicule (Figure 12) was an interesting surprise. Sponges are both marine and fresh water animals. They produce long spines on their backs for protection. In the case of this specimen, this was a very small piece. Over time, silica grows around the organic spicule, hence, the cylindrical shape. When the organic matter decays or is removed by other processes, a small hole is left where the spine use to be (Yancey, personal communication, 2000).

Project Implications

Discovering the mineralogical makeup of this sample allows for better analysis of factors controlling the fate and bioavailability of contaminates. The high amount of smectite found in the sample is significant because of its high surface area where contaminates can bind. Smectite was used as a liner for tailings piles in the area. Once the smectitic soil is exposed, erosion takes place and contaminates are exposed to the environment.

The project revolves around the idea that arsenic will sorb to the colloidal particles due to iron content, or lack of in the case of Weedy Creek, and/or organic matter content. If the arsenic can be transported as a result of these factors, the possibility that it can travel a long distance from the source over a long period of time has great implications. For example, high levels of arsenic have already been found in Lake Corpus Christi. This arsenic may or may not be new to the system. It is not entirely due to pesticide use since the area is mainly ranch land. Instead, it may have resulted from the mining activities of the 1960s.

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ABSTRACTS

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