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LABORATORY DRAINAGE QUALITY FROM SILTITE-ARGILLITE AND DULUTH COMPLEX ROCK

Progress Report on Contract BLM J910P62009
to the
U.S. Bureau of Land Management
Salt Lake City Office

11 February 1998

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LIST OF APPENDICES

1. INTRODUCTION

Tailings and waste rock, as well as the mine itself, are components of metal mining operations which remain long after mining has ceased. These remnants may be, relatively speaking, chemically inert and therefore environmentally innocuous. On the other hand, mining wastes may adversely affect water quality long after mining has ceased. For example, acidic drainage was observed in 1977 at a Norwegian mine which had been abandoned in 1833 (Iversen and Johannessen, 1987). In the United States acidic drainage from mining areas has impacted thousand of miles of streams (U.S. Bureau of Mines 1985). Remediation of these problems can range from tens to hundreds of millions of dollars (Biggs 1989).

As discussed by Lapakko (1990), governmental agencies have, in recent years, developed regulations to reduce the potential for problematic mine waste drainage, and the associated financial liability. Plans for closure and post-closure care of mine wastes are an important aspect of these rules and must be submitted prior to mine development. This approach allows the costs of mine waste reclamation to be considered along with other mining costs in the assessment of mineral recovery economics.

In order to develop effective, efficient, and economical pre-development waste rock management plans it is necessary to estimate the quality of drainage generated by the lithologies excavated in order to access the ore. Mitgation techniques can then be scaled to the estimated potential for adverse impact. Existing data on a waste rock of similar composition, generated by similar mining methods, and exposed to environmental conditions for an extended time provide the best indicator of drainage quality. Since these data are rarely available, it is necessary to use other means of drainage quality prediction, such as compositional characterization and/or dissolution testing. Dissolution testing, however, can be expensive and may take several years to complete. In order to provide less expensive and time consuming method of predicting waste rock drainage quality, the U.S. Bureau of Mines Salt Lake City Research Center (USBM) initiated a program to develop a mathematical model to predict the quality of drainage from discrete rock types (individual lithologies; White and Jeffers 1994; White and others 1994; Lin 1996; Guard 1997; Lin and others 1997). Such a tool will assist regulatory agencies, mining companies, and the public in assessing potential water quality impacts of waste rock drainage.

Whereas literature values can provide dissolution rates for modeling individual isolated minerals present a given lithology, empirical data are needed to provide rates describing their dissolution within the specific rock matrix. Distinct to each lithology is the grain size, surface morphology, and extent of liberation of the individual mineral. Within each rock type the interaction with other minerals and their dissolution products will also be unique. Thus, dissolution testing on individual lithologies is a necessary step in developing the mathematical model for predicting the quality of drainage from individual lithologies. This dissolution testing will also provide, on a primary level, empirical data on drainage quality and dissolution rates for the lithologies tested.

As the number of lithologies subjected to dissolution testing increases, the integrity of the mathematical modeling output will increase, as will the catalogue of empirical data available to assist prediction of drainage quality from similar lithologies. The Duluth Complex is one lithology which has been subjected to several dissolution studies in both laboratory and field (Lapakko 1988, 1994; Lapakko and Antonson 1994). In this rock type virtually all of the sulfur minerals occur as sulfides.

The present study examines the dissolution of a siltite-argillite lithology, in which sulfur occurs in both sulfide and sulfate minerals. All samples tested were subjected to accelerated weathering in "modified" humidity cells according to the protocol described in ASTM Standard Method 5744-96 (White and Sorini 1996). In addition, some samples were tested using modifications of this method to assess the feasibility of obtaining comparable results with a simplified protocol.

2. OBJECTIVES

The objectives addressed in the present report are as follows.

1. Describe the variation of drainage quality, particularly pH, as a function of the sulfur content of siltite-argillite rocks.
2. Determine the rates of sulfate, calcium, and magnesium release as a function of the sulfur content of siltite-argillite rocks.
3. Relate the drainage pH and rates of release to the solid-phase composition of the siltite-argillite samples.

The objectives of the present study also include examining, for Duluth Complex rock, the effects of protocol variations on drainage quality and interlaboratory comparison of ASTM Modified Humidity Cell results. These objectives are not discussed in the present report.

3. BACKGROUND

3.1. Mine Waste Dissolution

3.1.1. Sources of Acid

The dissolution of iron sulfide minerals such as pyrite and pyrrhotite is responsible for the majority of mine-waste acid production (Stumm and Morgan 1981). Equations 1 and 2 are commonly published reactions representing pyrite and pyrrhotite oxidation by oxygen (after Stumm and Morgan 1981; Nelson 1978):

$$FeS_2(s) + (7/2)H_2O + (15/4)O_2(g) = Fe(OH)_3(s) + 4H^+(aq) + 2SO_4^{2-}(aq) \qquad \textbf{(1)}$$

$$FeS(s) + (5/2)H_2O + (9/4)O_2(g) = Fe(OH)_3(s) + 2H^+(aq) + SO_4^{2-}(aq) \qquad \textbf{(2)}$$

The rate of oxidation and attendant acid production is dependent on solid-phase compositional variables. Oxidation rates vary among sulfide minerals, reportedly decreasing in the order marcasite > pyrrhotite > pyrite. For a given sulfide mineral, the oxidation rate increases with the reactive surface area available. It also varies with the crystal form of the mineral. For example, the oxidation of framboidal pyrite is reported to be much more rapid than that of euhedral pyrite.

The rate of sulfide mineral oxidation also increases as pH decreases into a range conducive to bacterial catalysis of ferrous iron oxidation. Nordstrom (1982) reported that as "pH decreases to 4.5, ferric iron becomes more soluble and begins to act as an oxidizing agent." As pH further decreases bacterial oxidation of ferrous iron becomes the rate limiting step in the oxidation of pyrite by ferric iron (Singer and Stumm 1970), which is the only significant oxidizing agent in this pH range (Nordstrom 1982; Singer and Stumm 1970; Kleinmann et al. 1981).

These weathering reactions produce acidic, iron- and sulfate-rich aqueous water which can 1) contact sulfide minerals and accelerate their oxidation, 2) evaporate partially or totally to precipitate hydrated iron-sulfate and other minerals and/or 3) contact host rock minerals which react to neutralize some or all of the acid. Acidic flow which migrates through the mine waste will exit as acid mine drainage (AMD).

Hydrated iron-sulfate minerals precipitate during the evaporation of acidic, iron- and sulfate-rich water within mine-waste materials and store (for potential subsequent release) acid generated by iron sulfide mineral oxidation. The more common hydrated iron-sulfate minerals that occur as efflorescent salts on the surfaces of weathering pyrite include melanterite, rozenite, szomolnokite, romerite and copiapite ($FeSO_4 \cdot 7H_2O$, $FeSO_4 \cdot 4H_2O$, $FeSO_4 \cdot H_2O$, $Fe^{2+}Fe_2^{3+}(SO_4)_4 \cdot 14H_2O$, and $Fe^{2+}Fe_4^{3+}(SO_4)_6(OH)_2 \cdot 20H_2O$, respectively) (Alpers et al., 1994). According to Nordstrom (1982) and Cravotta (1994), these sulfate salts are highly soluble and provide an instantaneous source of acidic water upon dissolution and hydrolysis. They are partially responsible for increased acidity and metals loadings in the receiving environment during rainstorm events.

As an example, equations 3, 4 and 5 summarize the step-wise dissolution of melanterite.

$$FeSO_4 \cdot 7H_2O(s) = Fe^{2+}(aq) + SO_4^{2-}(aq) + 7H_2O \tag{3}$$

$$Fe^{2+}(aq) + (1/4)O_2(g) + H^+(aq) = Fe^{3+}(aq) + (1/2)H_2O \tag{4}$$

$$Fe^{3+}(aq) + 3H_2O = Fe(OH)_3(s) + 3H^+(aq) \tag{5}$$

The net result of equations 3 through 5 is summarized in equation 6, which shows a net production of two moles of acid produced for each mole of melanterite dissolved.

$$FeSO_4{\cdot}7H_2O(s) + (1/4)O_2(g) = Fe(OH)_3(s) + SO_4^{2-}(aq) + (9/2)H_2O + 2H^+(aq) \qquad \textbf{(6)}$$

Cravotta (1994) showed that a similar aqueous dissolution of romerite produced six moles of acid for each mole of romerite dissolved. Their cumulative storage and incremental release may help explain the lag from mine-waste placement to AMD-formation particularly in arid climates.

According to Nordstrom (1982), the formation of hydrated iron sulfates is an important intermediate step that precedes the precipitation of the more common iron minerals such as goethite and jarosite. Jarosite is slightly soluble (Alpers et al. 1994) and can, therefore, contribute acid according to equation 7. For example, recent preliminary leach studies

$$KFe_3(SO_4)_2(OH)_6(s) = K^+ + 3FeOOH(s) + 2SO_4^{2-}(aq) + 3H^+(aq) \qquad (7)$$

on natural and synthetic jarosites conducted by USBM showed a drop in pH from 6 in the deionized water leachant to 3 or 4 after contact with the jarosites. Because of its relatively low solubility, the acid contributed by jarosite dissolution is probably small relative to that by dissolution of more soluble hydrated iron sulfates.

3.1.2. Sources of Neutralization

The balance between the rates of acid production by iron-sulfide mineral oxidation and host rock buffering will determine the acidity of mine-waste drainage. The most effective minerals for neutralizing acid are those containing calcium carbonate and magnesium carbonate. Examples include calcite, magnesite, dolomite, and ankerite ($CaCO_3$, $MgCO_3$, $CaMg(CO_3)_2$, and $CaFe(CO_3)_2$, respectively). Equation 8 represents the dominant dissolution reaction of calcite ($CaCO_3$) with iron-sulfide-generated acid (H^+) above pH 6.4, while equation 9 is the dominant reaction below pH 6.4 (Drever, 1988):

$$CaCO_3(s) + H^+(aq) = HCO_3^-(aq) + Ca^{2+}(aq) \qquad \textbf{(8)}$$

$$CaCO_3(s) + 2H^+(aq) = H_2CO_3(aq) + Ca^{2+}(aq) \qquad \textbf{(9)}$$

The dissolution rates for the calcite reactions shown in equations 8 and 9 are relatively rapid. However, dissolution rates are not the same for all carbonates; for example, Rauch and White

(1977) and Busenberg and Plummer (1986) have reported that the rates of magnesium carbonate and calcium-magnesium carbonate (i.e., magnesite and dolomite) dissolution are substantially slower than that of calcium carbonate. Additionally, iron carbonates do not provide for net acid neutralization under oxidizing conditions, due to oxidation of the ferrous iron released, subsequent precipitation of ferric hydroxide, and the consequent acid production (reactions 4, 5).

Dissolution of silicates such as plagioclase-feldspar minerals (e.g., anorthite in equation 10, Busenberg and Clemency, 1976) and olivine minerals (e.g., forsterite in equation 11, Hem, 1970) can also neutralize acid under acidic conditions, but their dissolution rates (and subsequent acid neutralization) are slow relative to the carbonate minerals.

$$CaAl_2Si_2O_8(s) + 2H^+(aq) + H_2O = Ca^{2+}(aq) + Al_2Si_2O_5(OH)_4(s) \qquad \textbf{(10)}$$

$$Mg_2SiO_4(s) + 4H^+(aq) = 2Mg^{2+}(aq) + H_4SiO_4(aq) \qquad \textbf{(11)}$$

The effectiveness of silicate-mineral neutralization is thought to be optimized by these factors: 1) the acid-production rate is relatively slow, 2) feldspar minerals comprise a significant percentage of the overall mineralogy, and 3) the available silicate-mineral surface area is large (Morin and Hutt, 1994).

3.2. Previous Dissolution Studies on Siltite-Argillite Rock

From August 1991 through October 1995, USBM conducted dissolution studies on duplicates of three siltite-argillite samples containing total sulfur contents of 1.6, 2.8, and 13.3% (White and Jeffers 1994). Dissolution studies were mainly accelerated weathering in modified humidity cells, and conducted according to the protocol described in ASTM Standard Method 5744-96 (White and Sorini 1996). The periods of record for these accelerated-weathering tests ranged from 89 to 218 weeks (1.7 to 4.2 years). The rates observed over time for the various samples are presented in table 1.

Sulfate release rates were also calculated from data presented by Guard (1997) for humidity cell tests on four +2-inch samples of syenite porphyry rock. The major host rock minerals were potassium feldspar (41% to 82%) and quartz (10% to 40%). Pyrite was the only sulfide mineral reported (1.1% to 10% based on reported total sulfur content) and the samples were devoid of carbonate minerals. Sulfate release rates were calculated as the product of the average drainage volume and average sulfate concentration over the period from week 26 to 35 inclusive. The calculated sulfate release ranged from 540 to 9070 μmoles/kg/wk, and the typical pH values for the period of calculation ranged from 2.6 to 3.4 (table 1a).

4. METHODS

4.1. Materials

Two metal-sulfide bearing waste-rock types (siltite-argillite and gabbro) have been subjected to accelerated weathering tests (ASTM Standard Method 5744-96). The sulfur content of the siltite-argillite samples ranges from 0.12 to 5.7% (table 1), while that of the gabbro sample is 1.4%. The present report addresses only results from the siltite-argillite rock.

The siltite-argillite samples were provided by a western U.S. metal mine. Samples were initially collected by USBM SLRC during 1991 as part of its AMD predictive modelling project; and had sulfur contents of 1.5% (sample 100.4), 2.2% (99.4), 2.7% (100.5), 3.1% (99.1), 5.7% (99.6), and 13.0% (100.2). Subsamples of all but the 13% sulfide sample were sent to the Minnesota Department of Natural Resources Division of Minerals (MN DNR). Based on USBM kinetic-testing results for those 1991 samples, additional siltite-argillite samples were provided by the mine in 1996 so that average cation/anion release rates and an AMD-producing sulfide-content cutoff value could be determined for this rock type. Total sulfur contents of the 10 siltite-argillite samples presented in this report range from 0.12 to 5.7% (table 1).

FY91 Samples. Three blast-hole drill-cuttings samples from sulfide-bearing siltite-argillite outcrops classified as waste rock contain 2.2, 3.1, and 5.7% sulfide. A bulk sample containing 1.5% sulfide was also collected and crushed to 100% passing 1/4 inch. Additional size reduction prior to blending and splitting was not necessary for the blast hole samples because the resulting cuttings from the blast-hole drilling were minus 1/4 inch. Sample preparation was initially performed during 1991 by USBM SLRC. The minus 1/4-inch samples were blended in a "V" blender and split through a Jones Splitter (comprised of 3/4-inch chutes) into 1-kg humidity-cell charges. Bagged 1-kg charges from the original USBM sample preparation were reblended and split by MDNR through a Jones Splitter (comprised of 1/2-inch chutes) into 0.25-kg aliquots.

Four aliquots from the 0.25-kg aliquot population were used for the humidity-cell charge. An additional aliquot from the 0.25-kg population was ultimately split into 50-g aliquots for mineral characterization. One 50-g aliquot was randomly selected from the population and pulverized to 90% passing 140 mesh (100 um) for chemical characterization.

FY96 Samples. Six samples estimated to contain from 0.2 to 1.5% sulfide were collected from the surface of a 600-foot-wide bench cut into a final 2 to 1 pit-wall exposure of siltite-argillite. This bench traversed an oxidation zone approximately 300-ft thick that began at the pit-wall surface and extended to a "redox" boundary situated in the wall rock. The 300-ft distance was measured perpendicular to the final 2 to 1 pit-wall surface. Sulfide content of siltite-argillite in the oxidation zone was estimated to be near zero at the pit-wall surface and about 1-2% at the "redox" boundary.

The six samples were crushed at the mine site to 100% passing 1/4 inch and shipped to MDNR in plastic 5-gal buckets. As received sample masses ranged from 12 to 18 kg. Upon receipt at MDNR, each sample was reblended by being passed three times through a Jones Splitter comprised of 3/4-inch chutes. After reblending, each of the six samples was then ultimately split into aliquots of about 0.25-kg; four of these 0.25-kg aliquots were randomly selected from each sample's aliquot population to make up the sample's 1-kg. humidity-cell charge. For each of the six samples, another 0.25-kg aliquot was selected randomly from the remaining aliquot population and further split through a Jones Splitter comprised of 1/2-inch chutes to produce 50-g aliquots for mineral characterization. A 50-g aliquot was randomly selected from the 50-g aliquot population and pulverized by ring and puck to 90% passing 140 mesh (106 um) for chemical characterization.

4.2. Accelerated Weathering "Modified Humidity Cell" (ASTM Standard Method 5744-96).

Siltite-argillite and gabbro samples have currently been subjected to at least 20 weeks of accelerated-weathering tests conducted according to ASTM Standard Method 5744-96. A 16-cell array identical to that illustrated by figure 1 in the standard method is being used in this study. Four 0.25-kg aliquots (each in "zip-lock bags) comprising each sample were used to load individual humidity cells; this "4-bag" loading method was used to minimize sample stratification and consequent fluid "channeling" in the cell. The final 16-cell-array composition included 13 siltite-argillite samples and three replicates of Duluth Complex sample FL-6B (designated as sample MN-6.1).

The only departure from the standard-method protocol was the volume of de-ionized water used for the initial leach (week 0); instead of a single 500-ml leach, three 500-ml rinses totaling 1.5 L were performed on each sample to flush it of residual sulfate salts produced by natural weathering prior to sample collection. The 3-rinse procedure was comprised of an initial 500-ml drip-trickle leach to wet the 1-kg sample, a 500-ml flooded leach to saturate the sample (after sample was flooded, leachant was in contact with sample for 5 minutes prior to being drained), and a final 500-ml drip-trickle leach to complete the rinse. Recovered volumes from each of the three rises were weighed, and composited. Aliquot samples (approximately 60 ml) from the composite were preserved and submitted for analyses so that selected cation/anion loads could be calculated.

Following the initial 1.5-L week 0 rinse (Monday, July 1, 1996), the subsequent weekly accelerated-weathering cycles were comprised of the following:

- Tuesday - previous week's leachant collected and weighed; each humidity cell weighed to determine amount of interstitial water present in the waste-rock sample after the leach; three-day dry-air period initiated (same time each cycle) - NOTE: start of dry-air period begins the new week (i.e., week 1).

- Friday - dry-air period ends; each humidity cell weighed to determine evaporation rate of interstitial water; three-day wet-air period initiated (same time each cycle).
- Monday - wet-air period ends; each humidity cell weighed to determine gain/loss of interstitial water; 500-mL drip-trickle leach initiated.
- Tuesday - previous week's leachant collected and weighed; each humidity cell weighed to determine amount of interstitial water present in the waste-rock sample after the leach; three-day dry-air period initiated; start of new week (i.e., week 2).

Air-flow rates (L/min) and relative-humidity readings were taken once daily for each cell during the three-day dry-air period; these readings were also taken once daily for each cell on Friday and the following Monday during the wet-air period.

4.3. Modifications of the ASTM Protocol

All samples tested were subjected to humidity cell testing using the "Modified Humidity Cell" designated as ASTM Standard Method 5744-96 (White and Jeffers 1994). In addition, some samples were tested using modifications of this method. One of the modifications involved only an alteration of the drip rinse to a rinse in which the cell was flooded with the same volume of deionized water used in the drip leach. For the other two modifications the same two rinse methods were used. However, with these modifications the humidity cell apparatus was not subjected to the humid or dry air flow into the cell. Instead, the cells were simply stored in a controlled temperature and humidity room between rinses. The initial discussions which follow address results from the cells employing the ASTM Standard Method. Subsequent discussion addresses results from modifications of this method.

4.4. Analyses

The mine waste samples were analyzed for sulfur, sulfide, and sulfate by LERCH Brothers, Inc. (Hibbing, MN), Chemex Labs, Inc. (Sparks, NV), and/or ACTLABS, Inc. (Denver, CO). Evolved carbon dioxide, as well as whole rock and trace constituents concentrations were determined by ACTLABS, Inc. Mineralogic analyses using x-ray diffraction, optical microscopy, and SEM were conducted by Barry Frey of Midland Research of Nashwauk, MN (Appendix 1).

Water samples were analyzed for specific conductance, pH, alkalinity, acidity, and Eh at the MN DNR in Hibbing. Specific conductance was analyzed using a Myron L conductivity meter, and an Orion SA720 meter, equipped with a Ross combination pH electrode (8165), was used for pH analyses. Alkalinity (for pH $\geq$ 6.3) and acidity were determined using standard titration techniques for endpoints of 4.5 and 8.3, respectively (APHA et al., 1992). Eh readings were taken using a Beckman model 11 meter with an Orion electrode (9678BN).

Metal and sulfate determinations were conducted at the Minnesota Department of Agriculture (MN DA). Metals were determined with a Varian 400 SPECTRAA; a Zeeman GFAA furnace was attached for low concentrations. Sulfate concentrations were determined using a Technicon AA2 automated colorimeter or, for $[SO_4] < 5$ mg/L, a Dionex ion chromatograph.

5. RESULTS

5.1. Solid-Phase Analysis

Sulfur analyses revealed that the 21 siltite-argillite samples subjected to humidity cell testing could be divided into two general groups:

1) nine "sulfate rock" samples in which sulfide was essentially absent and sulfur was virtually totally present as sulfate and
2) twelve "sulfide rock" samples in which substantial sulfide was present.

An arbitrary cutoff for "substantial sulfide" was established at 0.1% sulfide (based on chemical analysis) to distinguish the two groups.

5.1.1. Sulfate Rock Samples

Sulfate was the primary form of sulfur in nine of the samples. Concentrations of all whole rock constituents were fairly constant among the samples. Silica (~70%), alumina (~12%), potassium (K_2O ~ 7%), and iron (Fe_2O_3 ~ 4%) were the major constituents of all samples, with sodium typically less than 0.5% (table 2).

The total sulfur content of these samples ranged from 0.12 to 1.93 percent, and chemical analysis indicated that the sulfide content of the all but one of the samples did not exceed 0.01 percent (table 2). The evolved carbon dioxide was reported as less than 0.06% for the nine sulfate-bearing rock samples analyzed to date. This is consistent with uniformly low solid-phase concentrations of calcium ($0.09 \leq [CaO] \leq 0.18\%$) and magnesium ($0.41 \leq [MgO] \leq 0.86\%$). The lack of calcium and magnesium carbonate minerals indicates that these samples will not neutralize substantial amounts of acid.

Mineralogic analyses were conducted on the samples with sulfur contents 0.38% S (71196) and 0.96% S (20696). X-ray diffraction analyses indicated that these rocks were predominantly quartz, with orthoclase, anorthoclase, and sericite typically contributing minor amounts to the host rock mineralogy. Alunite was the predominant sulfate minerals in the 0.38% S sample, while jarosite was predominant in the 0.96% S sample (table 3). XRD and microscopic analyses indicated trace amounts of pyrite in both samples. Thus, it is possible that trace amounts of pyrite are present in some or all of the samples despite the fact that chemical analysis indicated little or no sulfide. Microscopic examination indicated that half the sulfides present in each solid were liberated. XRD analyses did report possible traces of calcite, ankerite, and dolomite. Based on the evolved carbon dioxide determinations the maximum carbonate mineral neutralization potential is 1.4 mg/g $CaCO_3$ (assuming reported CO_2 is present solely as calcite).

5.1.2. Sulfide Rock Samples

Substantial sulfide ($S^{2-} > 0.1\%$) was present in 12 of the samples. In comparison with the sulfate samples, silica (~73%), alumina (~13%), and sodium (Na_2O~2.4%) contents were slightly higher; iron (Fe_2O_3~3%) was slightly lower; and potassium was lower (K_2O~5%). Total sulfur contents ranged from 0.16 to 5.82% and sulfide contents from 0.14 to 5.75% (table 4). Evolved carbon dioxide values from six of the samples did not exceed 0.02% and for the remaining four samples ranged from 0.94 to 2.52%. Thus, there appeared to be a bimodal distribution of carbonate mineral content of the samples.

X-ray diffraction (XRD) analysis of samples containing 1.69 (sample 11196), 2.30 (99.4), and 3.24 (99.1) percent sulfur indicated that the host rock mineralogy of the sulfide rocks was similar to that of the sulfate rocks (table 3). The sulfide rocks did contain more albite and less sulfate minerals. Quartz and albite were the major minerals, indicating that the potassium, which is present in masses twice those of sodium, is not present predominantly as a feldspar. Orthoclase was, however, reported to be present in minor quantities in all three samples. Sericite may be the predominant form of potassium.

XRD verified the presence of iron sulfide minerals in the three samples. Light microscopy indicated the predominant iron sulfide in 1.69-percent-S sample was pyrite, comprising virtually 100% of the sulfides present. In contrast, marcasite was reported to comprise 55% and 68% of the iron sulfide in samples 99.4 and 99.1, respectively. It was also noted that sample 99.1 contained more liberated fragments and grains (5.0 vs 1.4% of sample) and finer liberated marcasite grains (3.0 vs 0.7% minus 200 mesh) than sample 99.4 (table 5). XRD indicated that the predominant carbonate in the 3.24-percent-S sample was calcite (although the calcium oxide content of the sample indicated that, at most, 0.38% carbon dioxide could be associated with calcium carbonate), and that ankerite and dolomite were also present in this sample. No carbonates were detected by XRD in sample 99.1, despite an evolved carbon dioxide determination of 2.52%. This exemplifies the boundaries of XRD resolution.

5.2. Humidity Cell Results

5.2.1. Sulfate Rock Samples

The longest periods of record for the nine sulfate rock samples (that is, the reactor with the longest period among all replicates of a given sample) subjected to the ASTM Standard Method ranged from 28 to 68 weeks. Testing of three of the samples continues (0.16, 0.38, 0.96 percent total sulfur), with present records of 49, 52, and 70 weeks.

Sulfate release from the sulfate rocks was not strongly dependent on the sulfur content of the rocks (figure 1). Based on the rates of sulfate release, the sulfate samples were divided into two categories: low- sulfate-release and high-sulfate-release samples. The rates of sulfate release were calculated for periods of approximately linear release, as determined by visual examination of the cumulative release versus time plots. Rates of calcium and magnesium release were calculated for these same periods. The rates at the end of the period of record were used to compare chemical release among the samples. It must be noted, however, that rates varied over time and, therefore, the rates for a given sample are dependent on its period of record. Concentrations of sulfate, calcium, and magnesium generally declined or declined and plateaued over the period of record (appendix 3). Consequently, samples with a shorter period of record tend to have higher rates of release.

Low sulfate release was observed for the six samples with total sulfur contents of 0.12, 0.16, 0.24, 0.29, 0.30, and 0.96. The drainage pH from four of the samples was above six, while minimum values from the remaining two were 4.1 and 5.1 (0.16% and 0.96% S, respectively). Drainage pH typically decreased slightly over time or remained constant. Sulfate concentrations tended to decrease with time.

Sulfate release rates were in the approximate range of 10 to 40 micromoles/kg·wk (table 6), and did not vary strongly with solid-phase sulfur content (figure 2). The rates of calcium release typically ranged from 15 to 25 micromoles/kg·wk, with the 0.30-percent-S sample at 60 micromoles/kg·wk. Magnesium release rates ranged from 3 to 12 micromoles/kg·wk.

High sulfate release was observed for the samples with sulfur contents of 0.38, 0.42, and 1.93 percent (table 7). Minimum pH of drainage from these samples ranged from 2.7 to 3.5, markedly lower than from the low-sulfate-release samples. Drainage pH values tended to increase over time. In contrast, concentrations of sulfate, calcium, and magnesium decreased over time. Sulfate concentrations decreased to a greater than with the low-sulfate-release samples.

Sulfate release rates were approximately an order of magnitude higher (180 to 540 μmoles/kg/wk) than the previous group. Relative to the low-sulfate-release sample, rates of calcium release were similar and those for magnesium were roughly 2 to 4 times higher. Drainage pH decreased with increasing sulfate release, indicating that the drainage pH was largely controlled by the dissolution of sulfur-bearing minerals as opposed to acid-neutralizing minerals.

5.2.2. Sulfide Rock Samples

As was the case for the samples in which sulfur is present primarily as sulfate, the rates of sulfate release from the sulfide samples fell into two distinct groups.

Low sulfate release was observed for six of the twelve sulfide solids. The minimum drainage pH for these solids ranged from 3.9 to 6.5 (table 8). Drainage pH from these samples tended to increase over time, while concentrations of sulfate, calcium, and magnesium decreased.

The rates of sulfate release ranged from 140 to 400 micromoles/kg·wk (table 8). This range, as well as that for calcium release rates (15 to 50 micromoles/kg·wk), is roughly the same as for the sulfate solids with high sulfate release rates. In contrast, the magnesium release rates (40 to 280 micromoles/kg·wk) were an order of magnitude higher than those observed for the sulfate solids. This release apparently reflected dissolution of acid neutralizing minerals, since the observed minimum drainage pH values for these sulfide solids were roughly 1 to 3 units higher than the corresponding values for the sulfate solids (table 8).

High sulfate release was observed for six of the twelve sulfide solids. Minimum drainage pH values ranged from 2.2 to 4.6, with five of the values below 3. In contrast to the low-sulfate-release rocks, pH values tended to decrease over time. As was the case for the low-sulfate-release rocks, concentrations of sulfate, calcium, and magnesium tended to decrease with time. Sulfate concentrations decreased to a lesser extent than was observed for the low-sulfate-release rocks.

Sulfate release rates (1000 to 5000 micromoles/kg·wk) were about an order of magnitude higher than those from the sulfide solids exhibiting low sulfate release (table 9). In contrast, rates of calcium and magnesium release were generally almost an order of magnitude lower than the previous group. The sole exception was the sample containing 3.24% S, which had calcium and magnesium release rates of 200 and 1100 micromoles/kg·wk, respectively. As would be expected, this sample also had a minimum pH (4.6) considerably higher than the range observed for the other five solids (2.2 - 2.9).

6. DISCUSSION

6.1. Introduction

Drainage pH is controlled by the balance of rates of acid production and acid neutralization. The rate of sulfate release provides an indication of the rate of acid production. Similarly the rates of calcium and magnesium release can be used to approximate the rate of acid neutralization.

The samples were separated into four groups. First, the 21 samples subjected to dissolution testing were divided into nine in which the predominant form of sulfur was sulfate (sulfide content less than 0.1%) and 12 in which the predominant form of sulfur was sulfide (sulfide content greater than 0.1%). This division was made since the dissolution of sulfate minerals would be expected to affect drainage quality differently than that of sulfide minerals. The 0.1% boundary was chosen to represent an arbitrary "minimal" sulfide content and considered the distribution of sulfide values reported. Since only one value occurred between 0.01 and 0.14 percent sulfide, this natural gap was deemed a reasonable point to make the division. Second, both the sulfate and sulfide rock samples were divided into groups of low and high sulfate release rates.

6.2. Sulfate Rock Samples

Only two of the three high-sulfate release samples have been analyzed for chemical composition. The remaining high-sulfate-release rock sample has been submitted for chemical analysis, and additional examination of solid-phase chemistry will be presented in the final report. The sulfate content (as S) of the samples ranged from 0.12 to 1.85%, and the average sulfate content of the high-sulfate-release solids was about three times that of the low-sulfate-release solids. Otherwise, there is no clear difference in the major element chemistry between the low-sulfate release and high-sulfate-release samples. The low-sulfate release samples appear to have slightly lower iron and slightly higher aluminum, potassium, and titanium than the high-sulfate-release samples (table 2). Mineralogical examination of a low-sulfate-release and a high-sulfate-release rock sample revealed no substantial differences in mineralogy (table 3).

Slow dissolution of sulfate minerals, as well as oxidation of the trace amounts of iron sulfides present, would release sulfate and acid from the sulfate rock samples. Alunite and jarosite were identified in the two sulfate rock samples subjected to XRD analysis. Whereas dissolution of these minerals can produce acid, they produce less acid per mole sulfur present than pyrite (see section 3). In addition, these minerals are less reactive than pyrite and, therefore, produce acid at a slower rate. XRD and optical microscopy also identified trace amounts of pyrite, about half of which was liberated, in the two sulfate rock samples analyzed. Chemical analyses of these two samples indicated sulfide contents less than 0.02 percent, which implies iron disulfide contents no greater than 0.04%.

The evolved carbon dioxide determinations indicated neutralization potentials did not exceed 1.8 mg/g $CaCO_3$ and were typically no more than 0.45 mg/g $CaCO_3$. Thus the samples containing a predominance of sulfate minerals would be expected to have a slow rate of acid production and limited potential for acid neutralization.

The low sulfate release observed for six of the sulfate rock samples was consistent with the slow dissolution of alunite and jarosite. Despite a total sulfur contents ranging from 0.12% to 0.96%, the sulfate release rates were typically between 20 and 30 micromoles/kg/wk. It must be noted, however, that trace amounts of pyrite were reported in the 0.96% S rock sample. Apparently the sulfate release from the pyrite was low due to either the small amount of pyrite present or a slow oxidation rate. As indicated by the release of calcium and magnesium, the dissolution of acid neutralizing minerals in these samples was slow. Nonetheless, it was adequate to maintain drainage pH from four of the samples above 6.0, and that of a fifth above 5.0. The lowest minimum pH (4.10) was observed for the sample with the highest sulfate release rate and a sulfide content at least twice that of the other samples in the group.

The second group of sulfate rocks consisted of three samples which exhibited sulfate release rates an order of magnitude higher. The average sulfate content of these rocks was three times that of rocks from the previous group. If the sulfate mineral reactivity was similar to that for the previous sample, the difference in sulfate content is unlikely to account for the order of magnitude increase in sulfate release. Although solid-phase analyses conducted to date are inadequate to determine the cause of the elevated release rates several possibilities come to mind. First, there may be subtle differences in the sulfate mineralogy which were not detected by the analyses conducted. For example, there may be variations in sulfate mineral reactivities due to variability of mineral morphology or availability. It is also possible that other acid-producing sulfate minerals are present. For example, it was informally suggested that hydronium jarosite, a more soluble sulfate mineral, may be responsible for the accelerated sulfate release from these samples (Smith 1998).

Three possible variations in the trace amounts of iron sulfide minerals may have also contributed to elevated sulfate release. First, higher pyrite content in these rock samples is possible, since their total sulfur content was generally higher than that of the rocks with low sulfate release. It is conceivable that the resolution of chemical analysis was inadequate to detect subtle variations in sulfide content which may have been influential. For example, the reported sulfide content of sample 7-1196 was zero, yet pyrite was observed in this sample in the microscopic examination. The XRD analysis lacked resolution to determine relative amounts of pyrite in the low-sulfate-release and high-sulfate-release samples examined.

Second, the reactivity of the iron sulfide minerals present in this group may have been higher. For example the presence of marcasite or finer grained pyrite in these samples would tend to produce elevated sulfate release. Third, bacterial acceleration of pyrite oxidation may be active in the high sulfate release samples. This seems reasonable since the three high-sulfate-release samples had drainage pH values which were always below 3.9, which is below the 4.5 value cited as the approximate upper pH bound for bacterial catalysis (Nordstrom 1982; Singer and Stumm 1970; Kleinmann et al. 1981).

It should be noted that drainage pH from the high-sulfate-release sulfate solids tended to increase over time. In addition, relative to the low-sulfate-release samples there was a greater range of variability in the concentrations of hydrogen ion and sulfate in the drainage. This is consistent with the initial rapid oxidation of a small amount of reactive iron sulfide and its subsequent depletion.

Since the rate of acid neutralization (as indicated by calcium and magnesium release) was similar to that observed for the previous group, the accelerated acid production resulted in lower minimum drainage pH values. The range of values observed was 1.5 to 3 units lower than for the sample with low sulfate release.

6.3. Sulfide Rock Samples

The total sulfur content of the sulfide rock samples ranged from 0.16% to 5.82%, with sulfide contents ranging from 0.14% to 5.75%. The maximum sulfate content was 0.36%, near the middle of the values observed for the sulfate rocks. The average sulfur content for the six low-sulfate-release samples was 0.94 as compared to 2.0 for the six high-sulfate-release samples.

However, if the 5.75% S sample is excluded from the latter group the average sulfur content is reduced to 1.2%. Thus, the sulfur content of the high-sulfate-release solids was slightly higher than that of the low-sulfate release solids. Other possibly important differences in solid-phase chemistry include generally higher levels of calcium, magnesium, and evolved carbon dioxide in the low-sulfate-release solids. These values imply a higher calcium and magnesium carbonate content, and therefore a greater acid neutralization potential, in the low sulfate release solids.

XRD analysis revealed a few differences among the one low-sulfate-release and two high-sulfate-release sample analyzed. The pyrite content of the three samples ranged from 1.9 to 2.6%, and marcasite was present in the low-sulfate-release sample and one of the high-sulfate-release samples (2.3% and 4.0%, respectively; table 5). The percentages of liberated sulfide minerals present in the high-sulfate-release solids were 1.2 and 5.0%, with the low-sulfate release solid at 1.4%.

Oxidation of the exposed iron sulfide surfaces present would be expected to release most of the sulfate from these samples, with a small release from the sulfate minerals present. Assuming similar reactivity for the iron sulfide minerals present, sulfate release would be expected to increase with increasing available sulfide mineral surface area. This trend was not observed.

Sulfate release rates for the six low-sulfate-release samples were in the same range as those for the sulfate rock samples with high sulfate release (table 10). In contrast, the calcium and magnesium release from these samples was the most rapid of the four groups, indicating a relatively high rate of acid neutralization. As a result of this neutralization, the range of minimum drainage pH values observed (3.9-6.6, table 10) was two to three units higher than that for the high-sulfate-release sulfate group, despite similar sulfate release rates. The rates of sulfate release from the six high-sulfate-release samples were about ten times those from the previous group. Since acid neutralization rates (as indicated by calcium and magnesium release) were less than or equal to those from the other groups, the rapid acid production (as indicated by sulfate release) resulted in low pH values.

The lack of correlation between iron sulfide content and sulfate release indicated reactivity among the iron sulfide minerals must be variable. Mineralogic analyses of the three samples did not reveal any consistent distinction between low-sulfate-release and high-sulfate-release solids. The presence of marcasite would be expected to produce elevated sulfate release, as would higher sulfide mineral surface areas available for oxidation. However, both the presence of marcasite and a relatively high liberated sulfide mineral content were observed for the low-sulfate-release sample. Thus, neither the chemical analyses nor mineralogic analyses of the sulfide minerals revealed compositional factors which might be controlling the rate of sulfate release.

6.4 Comparison with Reported Rates

Three siltite-argillite samples were subjected to humidity cell testing at the USBM SLRC, one of which was also tested in the present study. The 2.30-percent-sulfur sample was also tested in the present study and the USBM and MN DNR release rates for sulfate (130 vs 140 μmoles/kg/wk, respectively), calcium (15 vs 14μmoles/kg/wk), and magnesium (170 vs 170 μmoles/kg/wk) were in good agreement (tables 1, 8). The 2.82-percent-sulfur sample exhibited release rates similar to those of the sulfide rock samples with low sulfate release. The pH values observed in the USBM study were higher most likely due to the use of glass wool, which contributed alkalinity, in the earlier experiment. The release rates from a 13.3-percent-sulfur sample were higher, and drainage pH lower, that the values observed for the sulfide rock samples with high sulfate release in the present study (table 1, 10). This highly reactive rock had a much higher sulfur content, some of which was present as framboidal pyrite, than the rocks tested in the present study.

Rates and attendant pH values calculated for syenite porphyry rocks (Guard 1997) fell into two classes. Samples with sulfur contents of 0.6 and 1.6 exhibited values intermediate to the sulfide rocks with low sulfate release and those with high sulfate release in the present study (tables 1a, 10). Samples with sulfur contents of 3.5 and 5.4 percent were generally consistent with the sulfide rocks with high sulfate release. Thus despite differences in rock type and particle size (+2-inch rock was used by Guard 1997) there were some similarities in the drainage quality observed.

7. CONCLUSIONS

Rocks in which sulfur was present as sulfate exhibited sulfate release which was less than or equal to that from rocks in which sulfur was present largely as sulfide. The sulfate release from the former group was the result of slow dissolution of alunite and jarosite and oxidation of trace amounts of iron sulfide. Pyrite was the only iron sulfide identified in the two sulfate rock samples analyzed. Iron sulfide oxidation released the majority of sulfate from the latter group. For both the sulfate-dominated solids and the sulfide dominated solids, there was a bimodal distribution of sulfate release rates.

Based on solid-phase sulfur speciation and sulfate release rates, four groups of rocks were identified: 1) sulfate rock with low sulfate release; 2) sulfate rock with high sulfate release; 3) sulfide rock with low sulfate release; and 4) sulfide rock with high sulfate release. In addition to sulfate release, characteristic ranges of calcium and magnesium release and drainage pH were associated with each group. Extensive chemical analysis was conducted on all samples, and one or two samples from each of the four groups was subjected to intensive mineralogic analysis. Other than solid-phase sulfur speciation (sulfate rock vs sulfide rock), no solid-phase variables were identified as strongly influencing the rate of sulfate release.

Additional examination of the drainage quality data in conjunction with subtleties of the solid-phase chemistry, suggests that the weathering history of the rock in the field may have played a dominant role in the leaching behavior of the rocks. Within both the sulfate and sulfide rocks, low sulfate release was associated with sample for which initial drainage pH was relatively high. Equivalently, high sulfate release was associated with rock samples for which initial drainage pH was low. The initial pH conditions are the result of leaching which occurred in the field.

The low pH conditions are more conducive to dissolution of alunite and jarosite. Consequently, rapid sulfate release was observed for sulfate rocks in (or on) which low pH conditions developed due to reaction in the environment. Quantitatively, the minimum pH range for the high-sulfate-release rocks (typically observed at the beginning of the experiment) was roughly 1.4 to 3 units lower than that for the low-sulfate-release rocks. Correspondingly, sulfate release from the low pH environment was roughly ten times that at high pH (table 10).

Low pH conditions are also more conducive to oxidation of iron sulfide minerals. As pH decreases below 4.5, bacterial oxidation of ferrous iron becomes the rate limiting step in the oxidation of pyrite by ferric iron (Singer and Stumm 1970), which is the only significant oxidizing agent in this pH range (Nordstrom 1982; Singer and Stumm 1970; Kleinmann et al. 1981). The oxidation by ferric iron is far more rapid than the oxidation by oxygen at higher pH values. The minimum pH values for the high-sulfate-release sulfide samples were about three units lower than those for the low-sulfate-release samples. The low pH was exhibited at the beginning of the experiment and was, therefore, the result of weathering that occurred in the field. The low calcium, magnesium, and carbonate contents of the low pH rocks is consistent with exposure to acidic conditions in the field. This field "conditioning" was conducive for bacterial catalysis of the iron sulfide oxidation, which resulted in the rapid rates observed in the laboratory.

8. ADDITIONAL WORK

Additional solid-phase chemical analyses will be included in the final report. Future work, beyond the time frame of the final report, should include additional solid-phase analyses on the samples tested to try to identify potential subtle compositional variables which may be influential. Testing drainages for the presence of bacteria would also be helpful in the interpretation of results.

9. ACKNOWLEDGMENTS

Bill White of the U.S. BLM Salt Lake City Office was largely responsible for splitting rock samples, loading humidity cells, and drafting the methods section of this report. John Folman conducted laboratory dissolution tests, with assistance from Anne Jagunich and supervision from David Antonson. Mr. Folman was also responsible for data entry, calculations, as well as tabular and graphical output. Gregory Walsh assisted with data entry, and Diane Melchert assisted with table production.

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Table 1. Release rates for siltite-argillite samples tested at the USBM Salt Lake City Research Center.

Sulfur Species, %			pH			Release Rates, µmole/kg/wk			Period, Weeks	Analysis per Period	Cell #	Sample #
S^{Tot}	S^{2-}	SO_4^{2-}	min	med	max	Ca	Mg	SO_4^{2-}				
2.30	2.21	0.27	8.1	9.0	9.3	70	200	193	5-24	20	4-A	99.4
			7.1	7.5	8.4	15	170	134	24-75	52	4-A	99.4
2.82	2.74	0.23	8.4	8.9	9.4	110	170	178	5-24	20	9-A	100.5
			6.4	7.5	8.5	92	230	162	24-218	195	9-A	100.5
			8.5	8.8	9.4	130	170	246	5-24	20	11-A	100.5
			7.8	8.5	9.0	120	200	202	24-75	52	11-A	100.5
13.3	13.0	0.73	2.7	3.4	4.4	260	3609	4581	6-28		5-A	100.2
			1.9	2.2	2.7	673	1835	19914	28-65		5-A	100.2
			2.0	2.2	2.3	343	648	15803	65-87		5-A	100.2
			2.0	2.1	2.3	130	691	30059	87-136		5-A	100.2
			1.8	2.2	2.4	18	152	9325	136-218	15	5-A	100.2

Table 1a. Sulfate release rates and typical pH values during weeks 26-35 for humidity cell testing of syenite-porphyry samples (calculated from data presented by Guard 1997).

Sample	Percent S	Sulfate release, μmole/wk	Typical pH	Calculated FeS_2 = 1.87 x %S
ZM-3	0.6	540	3.3	1.1
ZM-1A	1.6	570	3.4	3.0
ZM-2A	3.5	1250	3.0	6.5
ZM-4	5.4	9070	2.6	10

Table 2. Whole rock chemistry (percent) of siltite-argillite samples in which most **sulfur is present as sulfate**.
Sulfur analyses as indicated in footnotes; evolved CO_2 by ACTLABS, Inc.; metals and LOI for 0696 samples by CHEMEX; metals and LOI for 1196 samples by ACTLABS, Inc.

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Parameter	1-0696	3-0696	6-0696	4-0696	4-0696 DUP	5-0696	7-1196	2-1196	2-0696	8-1196
S	0.12[1]	0.16[1]	0.24[1]	0.29[1]	0.29[1]	0.30[1]	0.38[2]	0.42[2]	0.96[1]	1.93[2]
S^{2-}	<0.01[1]	0.04[1]	0.02[1]	0.01[1]	0.01[1]	0.02[1]	0[2,3]	0[2,3]	0.02[1]	0.08[3]
SO_4^{2-}-S	0.12[1]	0.12[1]	0.22[1]	0.28[1]	0.28[1]	0.26[1]	0.44[2]	0.43[2]	0.94[1]	1.85[2]
CO_2	0.03[2]	0.02[2]	0.03[2]	0.02[2]	0.02[2]	0.06[2]	<0.01	<0.01	<0.01	
Al_2O_3	12.94	10.66	13.29	12.32	12.16	12.38	11.11	11.04	12.86	
CaO	0.16	0.13	0.09	0.10	0.11	0.18	0.17	0.11	0.16	
Cr_2O_3	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.03	0.01	
Fe_2O_3	2.03	5.01	1.51	2.18	2.28	5.90	10.48	4.39	4.00	
K_2O	6.92	7.14	7.30	9.51	9.45	6.00	6.45	6.34	6.85	
MgO	0.72	0.50	0.52	0.42	0.41	0.78	0.59	0.62	0.86	
MnO	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Na_2O	0.89	0.41	1.26	0.39	0.37	0.26	0.38	1.29	0.25	
P_2O_5	0.09	0.16	0.12	0.12	0.12	0.13	0.16	0.13	0.17	
SiO_2	71.14	69.86	73.09	72.23	71.21	68.71	65.79	74.24	69.55	
TiO_2	0.51	0.53	0.58	0.53	0.52	0.51	0.46	0.44	0.57	
LOI	3.09	5.08	2.48	1.94	2.08	4.09	4.23	3.08	3.70	
TOTAL[4]	98.51	99.49	100.25	99.76	98.73	98.95	99.84	101.71	98.98	

[1]Good agreement between Lerch and Chemex analyses; average of two values used.
[2]Analysis by Lerch.
[3]Determined by difference.
[4]For parameters from Al_2O_3 through LOI.

Table 3. X-Ray Diffraction Mineralogy

SAMPLE	71196R	20696	11196R	99.4	99.1
S_T	0.38	0.96	1.69	2.30	3.24
S^{2-}	0	0.02	1.37	2.25	3.16
SO_4-S	0.44	0.94	0.32	0.05	0.08
CO_2	<0.01	<0.01	<0.01	1.15	2.52
QUARTZ	MAJOR	MAJOR	MAJOR	MAJOR	MAJOR
ALBITE	TRACE	TRACE	MAJOR	MAJOR	MAJOR
ORTHOCLASE	MINOR+	MINOR-	MAJOR+	MINOR+	MINOR
SERICITE	MINOR-	MINOR+	MINOR	MINOR	MINOR-
ANORTHOCLASE	MINOR	TRACE	TRACE	TRACE	TRACE
DIASPORE	TRACE	TRACE	TRACE	TRACE?	TRACE?
ILLITE	TRACE	TRACE	TRACE	TRACE	TRACE
MONTMORILL.	TRACE	TRACE	TRACE	TRACE	TRACE
KAOLINITE	TRACE?	TRACE?	TRACE	TRACE?	TRACE?
HEMATITE	TRACE	NONE	NONE	NONE	NONE
CHLORITE	NONE	NONE	NONE	NONE	TRACE
PYRITE	TRACE	TRACE	MINOR-	MINOR-	MINOR
PYRRHOTITE	TRACE?	TRACE?	TRACE?	TRACE?	TRACE?
MARCASITE	TRACE?	TRACE?	TRACE?	MINOR	MINOR+
ALUNITE	MINOR-	MINOR-	MINOR-	TRACE	TRACE?
JAROSITE	TRACE	MINOR+	TRACE?	TRACE	TRACE
BARITE	TRACE?	TRACE?	NONE	TRACE?	TRACE?
CALCITE	TRACE?	TRACE?	TRACE?	MINOR	TRACE
ANKERITE	TRACE	TRACE	TRACE	MINOR-	TRACE
DOLOMITE	TRACE?	TRACE?	TRACE	TRACE?	TRACE

NOTES:

1) 71196R had minor hematite, orthoclase as most major feldspar, trace pyrite.
2) 20696 had orthoclase as most major feldspar, trace pyrite, but the most jarosite.
3) 11196R had major albite and lesser orthoclase, with increased pyrite.
4) 99.4 had albite as most major feldspar; had the second most sulfide, with marcasite predominating; had the most carbonate with calcite and lesser ankerite (and dolomite).
5) 99.1 had albite as most major feldspar; had the most sulfide, with marcasite predominating; trace chlorite.

Table 4. Whole rock chemistry (percent) of siltite-argillite samples in which most **sulfur is present as sulfide**. Sulfur analyses as indicated in footnotes; evolved CO_2 by ACTLABS, Inc.; metals and LOI for 1196 samples, 99.1, and 99.4 by ACTLABS, Inc.

Parameter	7-0597	3-0597	6-0597	8-0597	2-0597	10-0597	1-0597	1-1196	100.4	99.4	99.1	99.6
S	0.16[1]	0.28[1]	0.36[1]	0.47[1]	0.47[1]	0.64[1]	0.99[1]	1.69[3]	1.60[5]	2.30[3]	3.24[3]	5.82[3]
S^{2-}	0.14[1]	0.26[1]	0.34[1]	0.44[1]	0.14[2]	0.56[2]	0.76[1]	1.37[4]	1.53[5]	2.25[4]	3.16[4]	5.75[4]
SO_4^{2-}-S	0.07[1]	0.04[1]	0.03[1]	0.10[1]	0.36[2]	0.12[2]	0.26[1]	0.32[3]	0.20[5]	0.05[3]	0.08[3]	0.07[3]
CO_2	0.01	-0.01	0.01	1.45	0.02	0.94	-0.01	<0.01		1.15	2.52	
Al_2O_3	14.28	13.56	12.75	13.16	10.64	14.13	12.29	12.73	12.32[5]	12.42	11.86	
CaO	0.16	0.16	0.11	0.22	0.11	0.26	0.07	0.11	0.62[5]	0.19	0.48	
Cr_2O_3								0.03		0.02	0.02	
Fe_2O_3	0.75	1.47	1.09	2.76	3.38	2.80	2.36	2.14	6.61[5]	4.48	9.53	
K_2O	4.48	4.64	4.16	4.36	6.56	4.01	6.00	5.51		5.88	4.53	
MgO	0.37	0.43	0.32	1.13	0.54	1.31	0.55	0.64	1.29[5]	1.55	1.54	
MnO	-0.01	-0.01	0.00	0.04	-0.01	0.02	-0.01	<0.01	<0.030[5]	0.01	0.04	
Na_2O	3.33	3.24	3.95	3.22	0.40	2.84	1.44	1.50		2.04	1.99	
P_2O_5	0.15	0.11	0.08	0.13	0.17	0.18	0.23	0.20	<1.75[5]	0.14	0.21	
SiO_2	75.72	75.00	74.98	70.56	72.90	72.62	73.71	72.10		68.96	62.96	
TiO_2	0.50	0.46	0.39	0.47	0.46	0.55	0.52	0.44	0.46[5]	0.44	0.50	
LOI								3.47		3.67	6.43	
TOTAL[6]	99.74	99.07	97.83	96.05	95.16	98.72	97.17	98.87		99.80	100.09	

[1]Good agreement between Lerch and ACTLAB analyses; average of two values used.
[2]Disagreement between Lerch and ACTLAB on sulfide/sulfate distribution; average used.
[3]Analysis by Lerch.
[4]Determined by difference.
[5]Analysis by USBM Salt Lake City Research Center.
[6]For parameters from Al_2O_3 through LOI.

Table 5. Sulfide mineral liberation for samples 1-1169, 99.4, 99.1.

Sample	1-1169	99.4	99.1
%S	1.69	2.30	3.24
% S^{2-}	1.37	2.25	3.16
% FeS_2 (1.87 x % S^{2-})	2.56	4.21	5.91
% Pyrite	2.56	1.89	1.89
Composite disseminate grains w/gangue size, μm	0.67 >60-200	0.97 0-200	0.53 10-200
Composite coarse euhedral intergrown w/gangue size, μm	0.61 >200	0.32 >200	0.024 >200
Nearly lib. grains w/gangue size, μm		0.38 >200	
Liberated fragments, % size, μm	0.051 10-60	0.13 10-200	1.0 0-200
Liberated grains, % size, μm	1.2 60-200	0.10 60-200	0.012 60-200
% Marcasite	0	2.32	4.02
Composite dissem. gr. w/gangue size, μm	NA_p NA_p	1.1 10-60	0.24[1] 0-200
Composite disseminated grains often colloform size, μm	NA_p NA_p	0.084 0-60	
Composite fine grains disseminated w/gangue size, μm	Na_p Na_p	0.17 >200	
Liberated fragments, % size, μm	NA_p NA_p	0.72 10-200	3.0 0-200
Liberated grains, % size, μm	NA_p NA_p	0.17 >200	0.83 >200
Total Liberated FeS_2, %	1.25	1.4	4.95

[1]minor colloform Na_p: not applicable

Table 6. Drainage pH and release rates for sulfate rocks with low sulfate release.

S Total	% S^{-2}	% SO_4 as S	pH			Release Rates (μmole)/kg•wk			Period Wks	Analysis Per Period	Reactor	Sample #
			min	med	max	Ca	Mg	SO_4				
0.12[1]	<0.01	0.12	6.39	6.85	7.07	19.0	7.6	16.7	18-28	4	17	1-0696
0.12	<0.01	0.12	6.33	6.59	6.96	14.4	0.53	30.6	20-28	3	7	1-0696
0.12	<0.01	0.12	6.53	6.64	6.76	18.2	6.5	31.1	12-20	5	8	1-0696
0.12	<0.01	0.12	6.33	6.56	6.76	13.5	4.46	16.5	12-20	5	20	1-0696
0.16	0.04	0.12	4.10	4.14	4.26	38.3	10.5	77.8	10-24	6	3(2)	3-0696
0.16	0.04	0.12	4.15	4.20	4.32	22.0	3.23	39.3	30-44	4	5	3-0696
0.24	0.02	0.22	6.55	6.90	7.15	23.5	3.78	8.87	20-44	7	1	6-0696
0.29[1]	0.01	0.28	6.54	6.79	7.01	18.7	4.78	23.8	10-28	8	18	4-0696
0.29[1]	0.01	0.28	6.25	6.55	6.72	14.1	3.25	20.0	12-20	5	21	4-0696
0.29	0.01	0.28	6.50	6.64	6.82	17.4	5.24	32.2	12-20	5	3	4-0696
0.29	0.01	0.28	6.51	6.62	6.67	16.7	4.89	29.6	12-20	5	4	4-0696
0.30	0.02	0.26	6.67	6.95	7.22	61.3	11.7	33.2	30-44	4	2	5-0696
0.96	0.02	0.94	5.06	5.16	5.57	20.6[2]	3.55[2]	43.4	36-68	7	6	2-0696

[1] DNR modified protocol.
[2] 36 - 72 week period of record; 8 analysis per period.

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Table 7. Drainage pH and release rates for sulfate rocks with high sulfate release.

S Total	% S^{-2}	% SO_4 as S	pH			Release Rates (μmole)/kg•wk			Period Wks	Analysis Per Period	Reactor	Sample #
			min	med	max	Ca	Mg	SO_4				
0.38	0.0	0.44	3.10	3.32	3.54	7.15	7.27	238.8	18-48	7	4(2)	7-1196
0.38[1]	0.0	0.44	3.08	3.32	3.61	9.82	16.4	282.5	12-48	10	23	7-1196
0.38[1]	0.0	0.44	3.09	3.33	3.54	13.9[3]	16.8[3]	292.8	12-48	10	25	7-1196
0.42	0.0	0.43	2.71	2.84	3.05	46.8[2]	21.7[2]	540.3	10-24	7	8(2)	2-1196
1.93	0.08	1.85	3.47	3.62	3.87	39.2	11.4	178.5	10-48	11	11(2)	8-1196

[1] DNR modified protocol.
[2] 10 - 24 week period of record; 7 analysis per period.
[3] 12 - 24 week period of record; 6 analysis per period.

Table 8. Drainage pH and release rates for sulfide rocks with low sulfate release.

S Total	% S^{-2}	$\%SO_4$ as S	pH min	pH med	pH max	Release Rates (μmole)/kg•wk Ca	Mg	SO_4	Period Wks	Analysis Per Period	Reactor	Sample #
0.16	0.14	0.07	4.29	4.37	4.44	9.12[2]	40.9[2]	187.2	7-16	5	1(2)	70597
0.47	0.44	0.10	5.31	5.40	5.47	19.8	141.1	230.7	7-14	4	7(2)	80597
0.47[1]	0.44	0.10	5.48	5.71	6.01			212.3	7-14	4	28	80597
0.47	0.14	0.36	3.88	3.97	4.04	139.4[2]	46.7[2]	294.7	7-16	5	3(3)	20597
0.64	0.56	0.12	4.24	4.55	4.80	21.5[2]	276.6[2]	400.5	7-14	4	8(3)	100597
1.60	1.53	0.20	6.25	6.69	7.13	9.69	226.9[3]	230.2	30-68	8	15	100.4
1.60	1.53	0.20	5.26	5.90	6.74	11.8	286.1	299.4	3-20	9	16	100.4
2.30	2.25	0.05	6.65	7.12	7.54	14.2	169.2	142.3	32-68	8	9	99.4

[1] DNR modified protocol.
[2] 7 - 14 week period of record; 4 analysis per period.
[3] 30 - 44 week period of record; 4 analysis per period.

Table 9. Drainage pH and release rates for sulfide rocks with high sulfate release.

S Total	% S^{-2}	$\%SO_4$ as S	pH			Release Rates (μmole)/kg•wk			Period Wks	Analysis Per Period	Reactor	Sample #
			min	med	max	Ca	Mg	SO_4				
0.28	0.26	0.04	2.66	2.73	2.80	7.20[2]	19.2[2]	1502	7-16	5	2(2)	30597
0.36	0.34	0.03	2.75	2.85	2.95	4.44[2]	4.69[2]	1276.5	7-16	5	5(2)	60597
0.99	0.76	0.26	2.25	2.35	2.42	14.8	51.6	4660	7-14	4	14(3)	10597
0.99[1]	0.76	0.26	2.23	2.26	2.33			5417	7-14	4	27	10597
1.69	1.37	0.32	2.22	2.31	2.41	6.71	18.9	2692	10-24	7	14(2)	1-1196
1.69	1.37	0.32	2.18	2.27	2.34	7.18	6.41	2739	10-48	11	16(2)	1-1196
1.69[1]	1.37	0.32	2.15	2.35	2.48	8.91[3]	22.5[3]	2953	12-44	9	24	1-1196
1.69[1]	1.37	0.32	2.17	2.34	2.44	7.58[3]	17.1[3]	2877	12-44	9	26	1-1196
3.24	3.16	0.08	4.60	5.01	6.34	199.3	1142.1	1265.4	32-68	8	10	99.1
5.82	5.75	0.07	2.90	3.04	3.16	3.00	4.29	1035.8	10-20	6	11	99.6

[1] DNR modified protocol.
[2] 7 - 14 week period of record; 4 analysis per period.
[3] 12 - 24 week period of record; 6 analysis per period.

Table 10. Summary of minimum pH and rate of sulfate, calcium, and magnesium release for four categories of siltite-argillite rock.

Dominant Sulfur Solid Phase	Relating Sulfate Release	Total Sulfur Content of Samples	pH min	Release Rates micromoles/kg·wk		
				SO_4	Ca	Mg
sulfate	low	0.12, 0.16, 0.24 0.29, 0.30, 0.96	4.1-6.5	20-40	15-60	3-12
sulfate	high	0.38, 0.42, 1.93	2.7-3.5	180-540	15-50	10-20
sulfide	low	0.16, **0.47**, 0.47 **0.64**, 1.60, **2.30**	3.9-6.6	140-400	10-140	40-280
sulfide	high	0.28, 0.36, 0.99 1.69, **3.24**, 5.82	2.2-2.9[1]	1000- 5000	3-15[1]	5-50[1]

[1] 3.24% S sample pH min = 4.6; release rates for calcium and magnesium of 200 and 400 micromoles/kg·wk.

Bold sulfur content implies high carbonate content.

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Figure 1. Sulfate rocks: Sulfate release rates were not strongly dependent on solid-phase sulfur content.

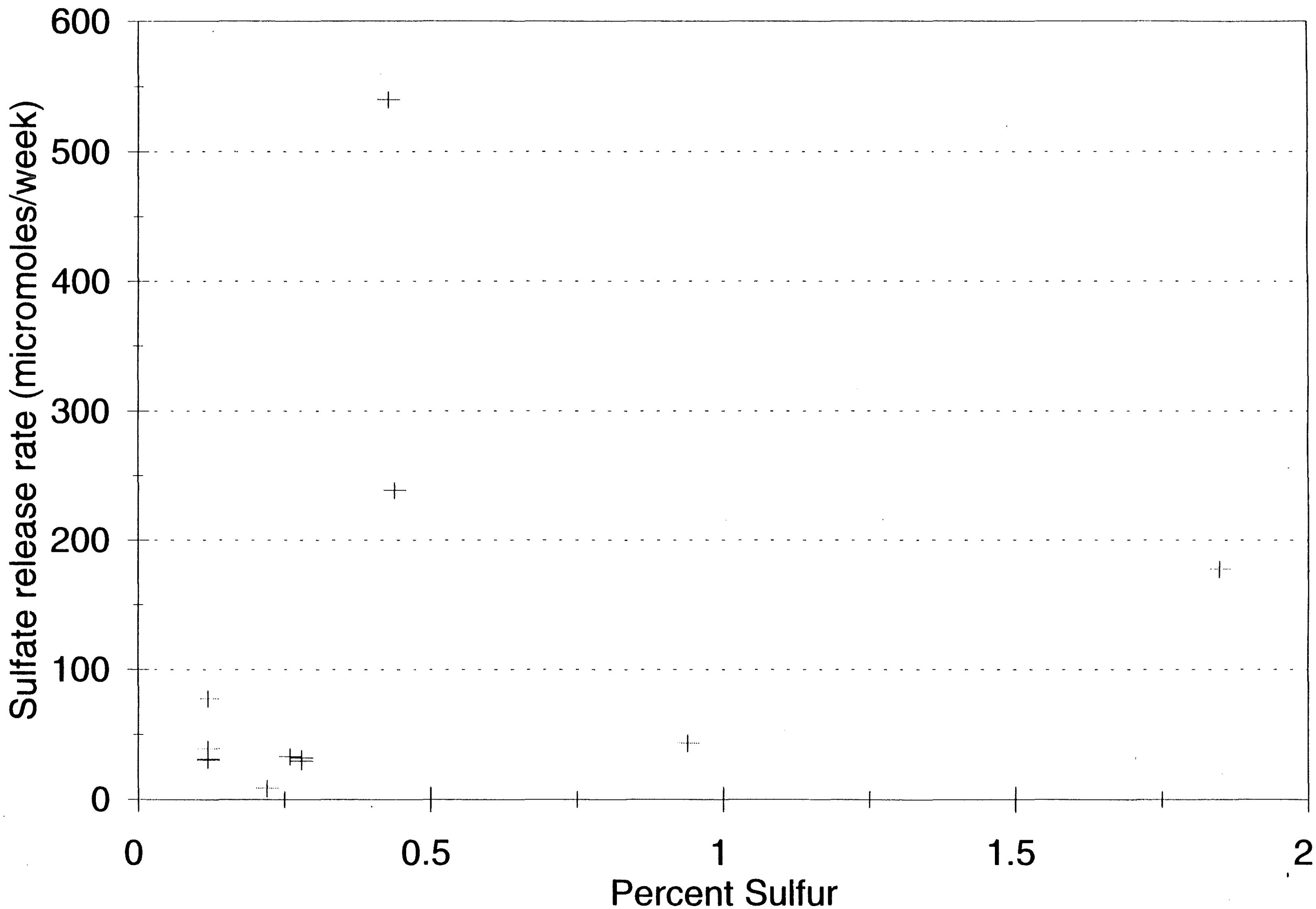


Figure 2. Sulfate rocks, low sulfate release: Sulfate release rates were not strongly dependent on solid-phase sulfur content.

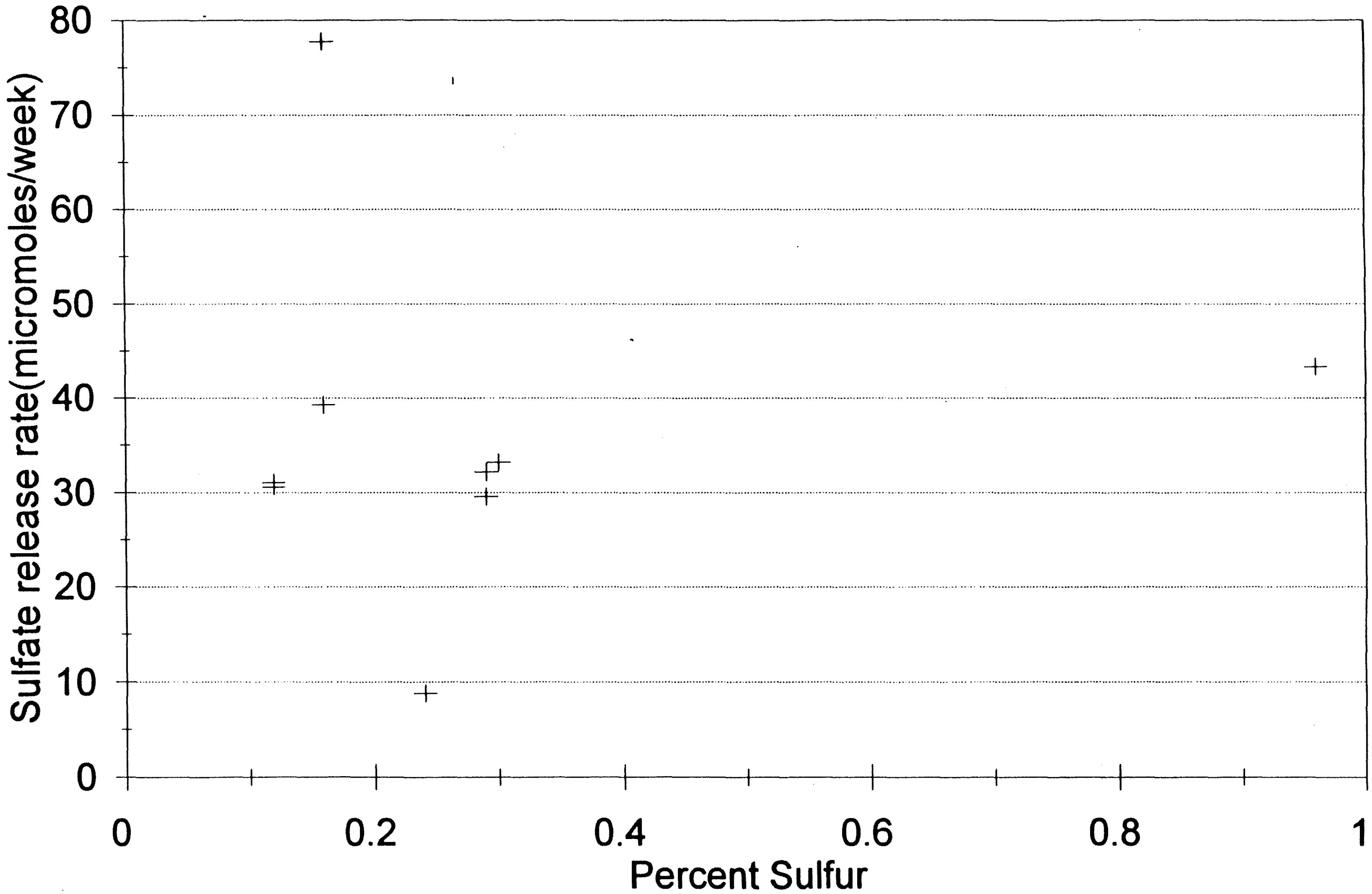


Figure 3. Sulfate rocks, low sulfate release: Calcium and magnesium release rates were not strongly influenced by the sulfate release rate, consequently pH decreased as the rate of sulfate release increased.

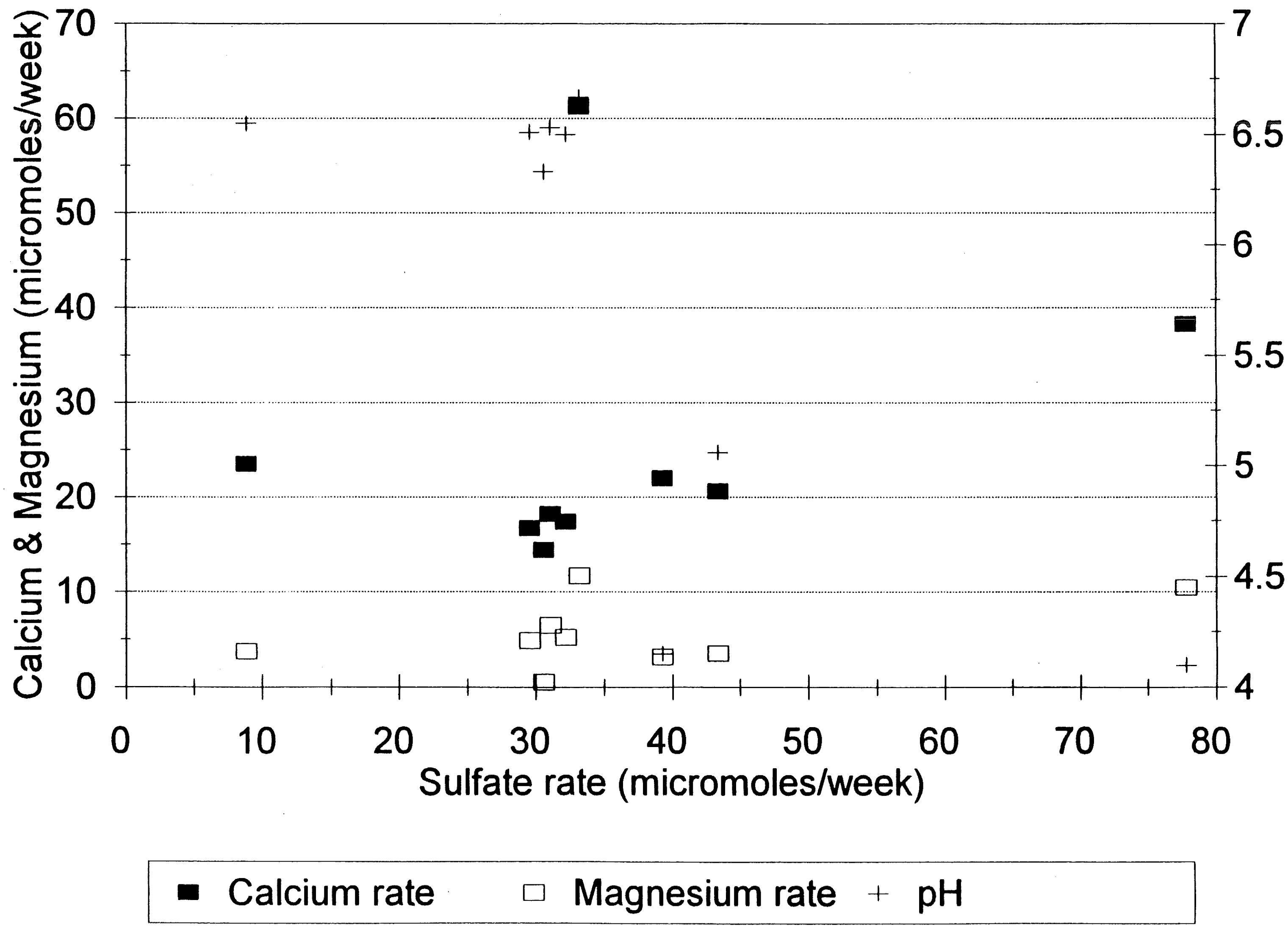


Figure 4. Sulfate rocks, high sulfate release: Sulfate release was not strongly dependent on solid-phase sulfur content.

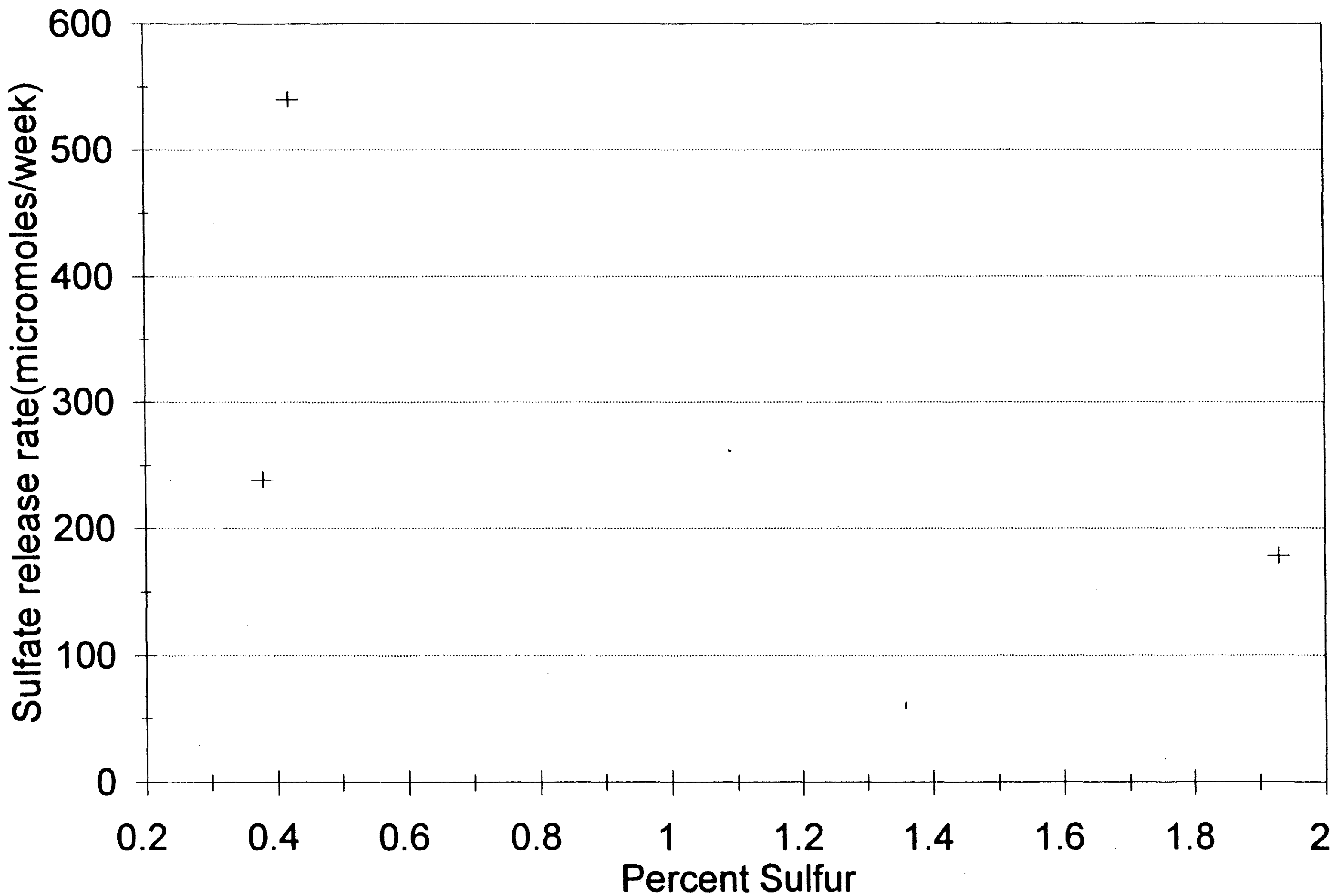


Figure 5. Sulfate rocks, high sulfate release: Calcium and magnesium release rates were not strongly influenced by the sulfate release rate, consequently pH decreased as the rate of sulfate release increased.

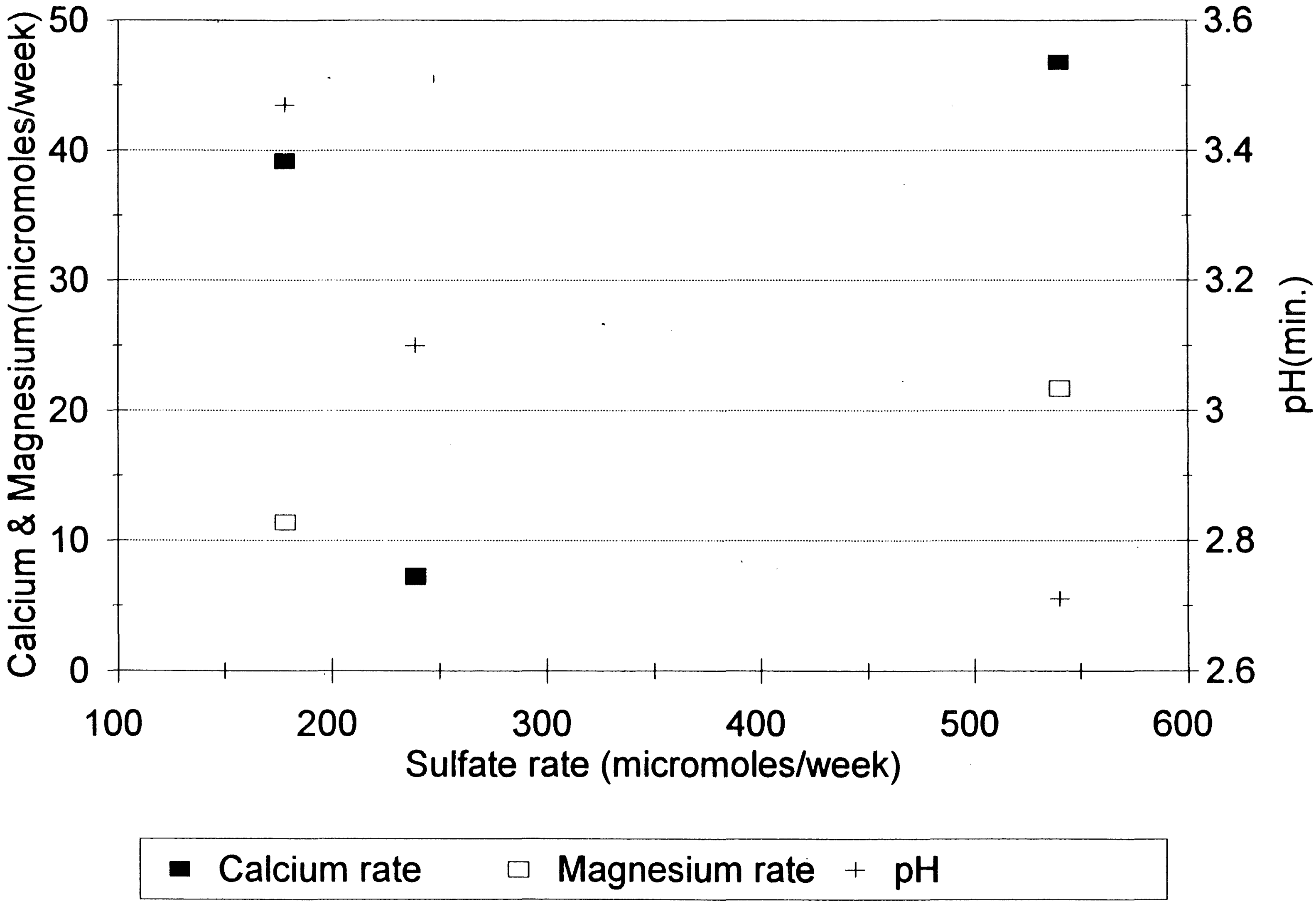


Figure 6. Sulfide rocks: Sulfate release rates were not strongly dependent on the solid-phase sulfur content.

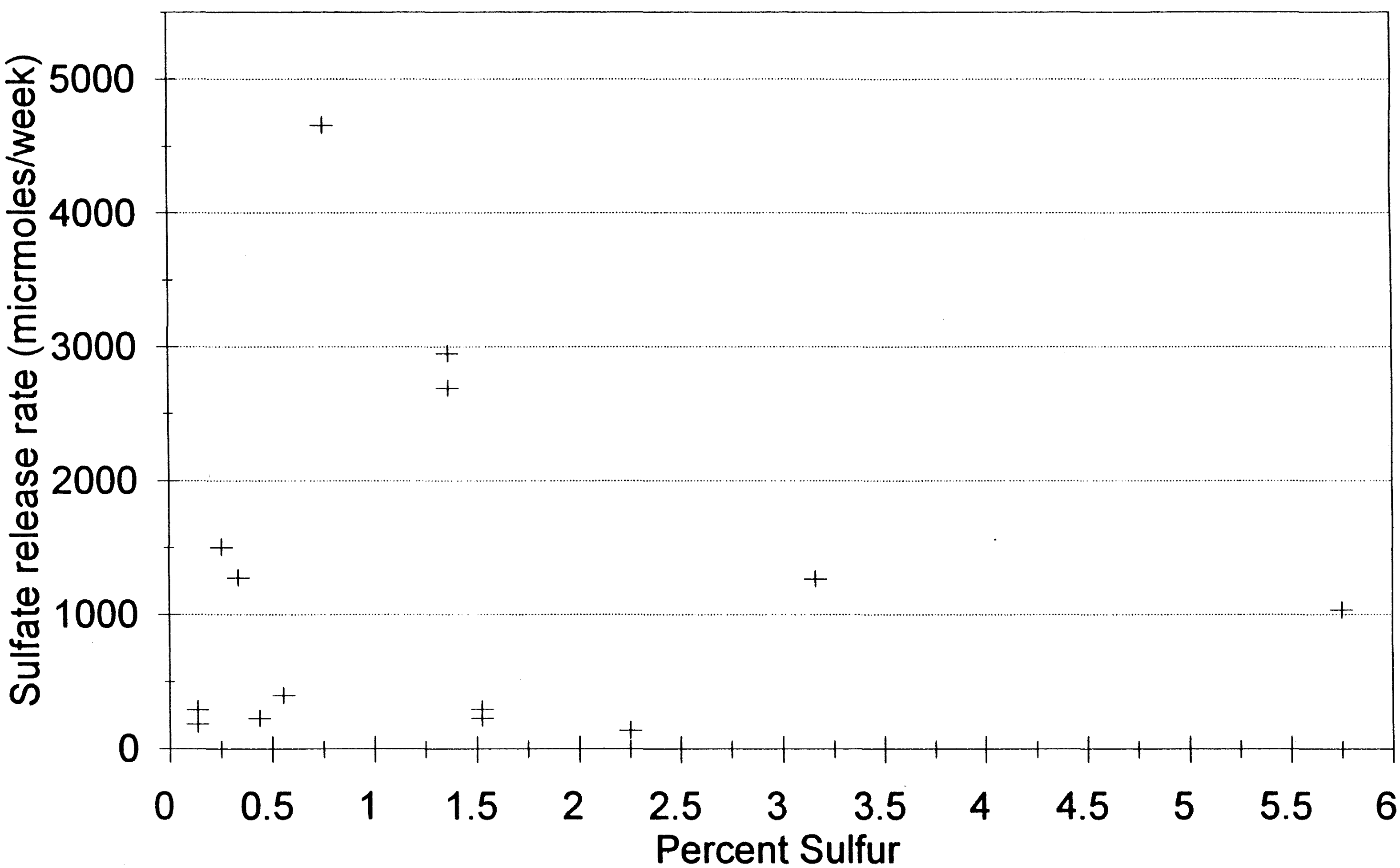


Figure 7. Sulfide rocks, low sulfate release: Sulfate release rates were not strongly dependent on solid-phase sulfur content.

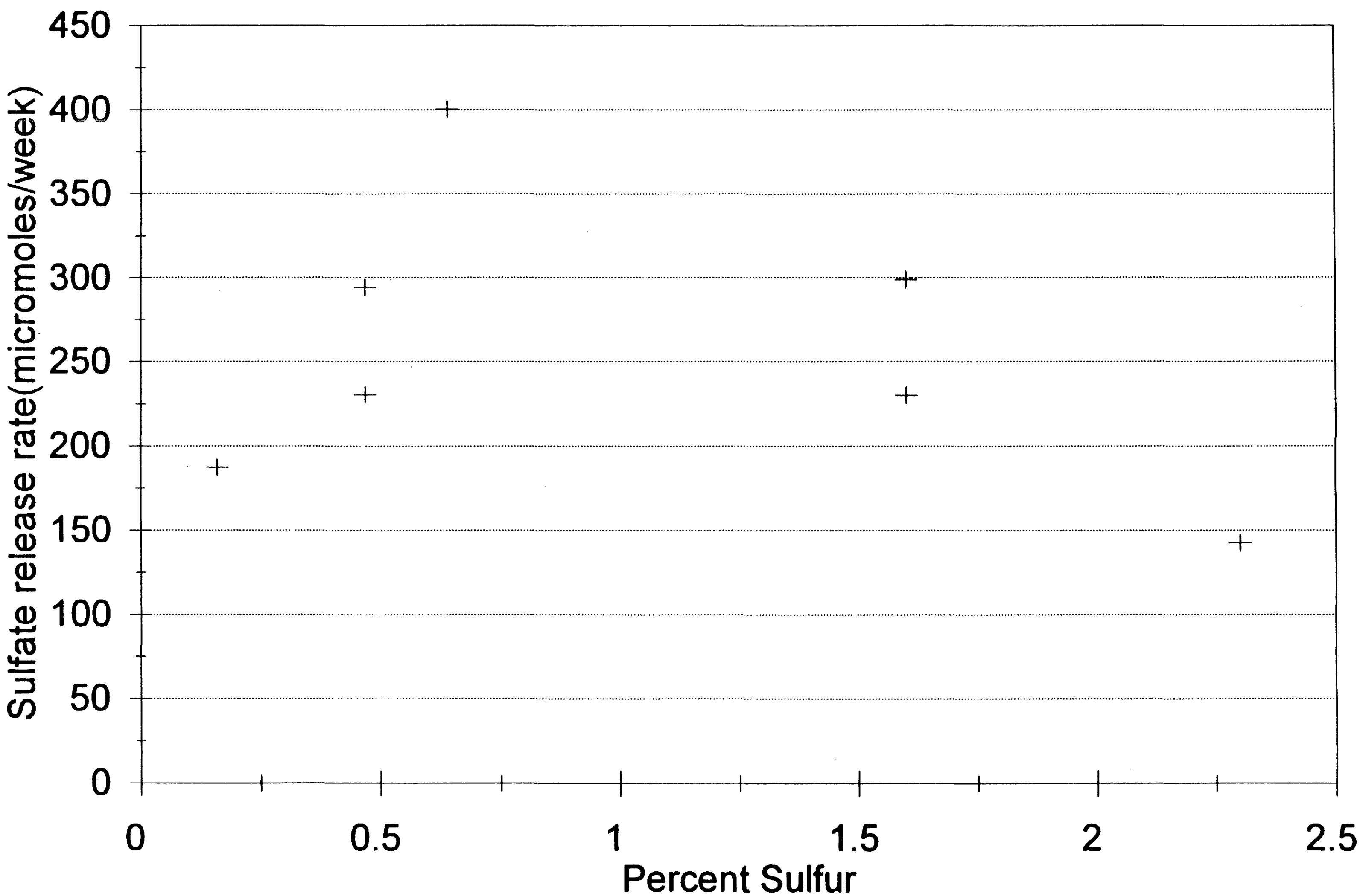


Figure 8. Sulfide rocks, low sulfate release: Calcium and magnesium release rates were not strongly influenced by the sulfate release rate, consequently pH decreased as the rate of sulfate release increased.

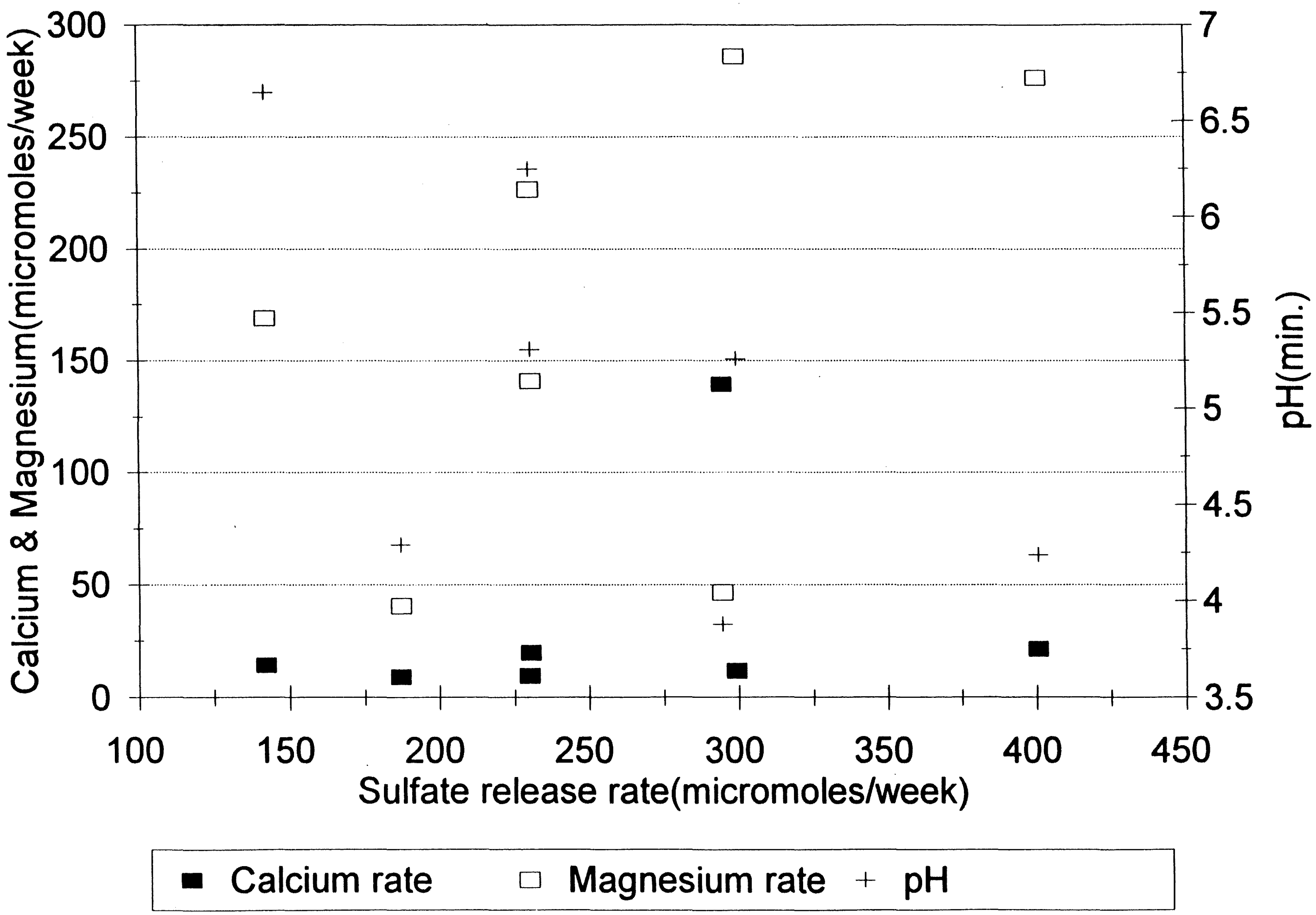


Figure 9. Sulfide rocks, high sulfate release: Sulfate release was not strongly dependent on solid-phase sulfur content.

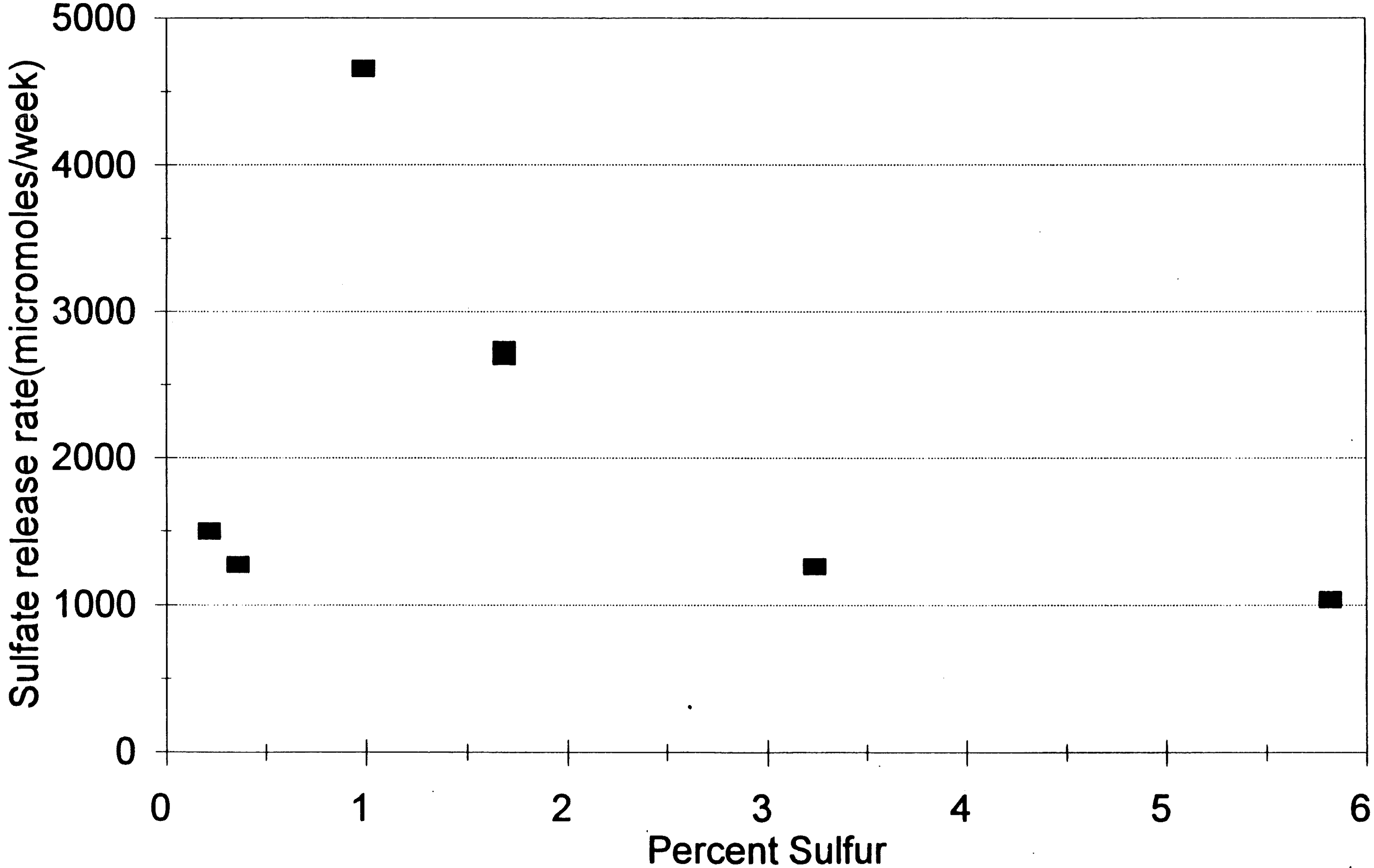
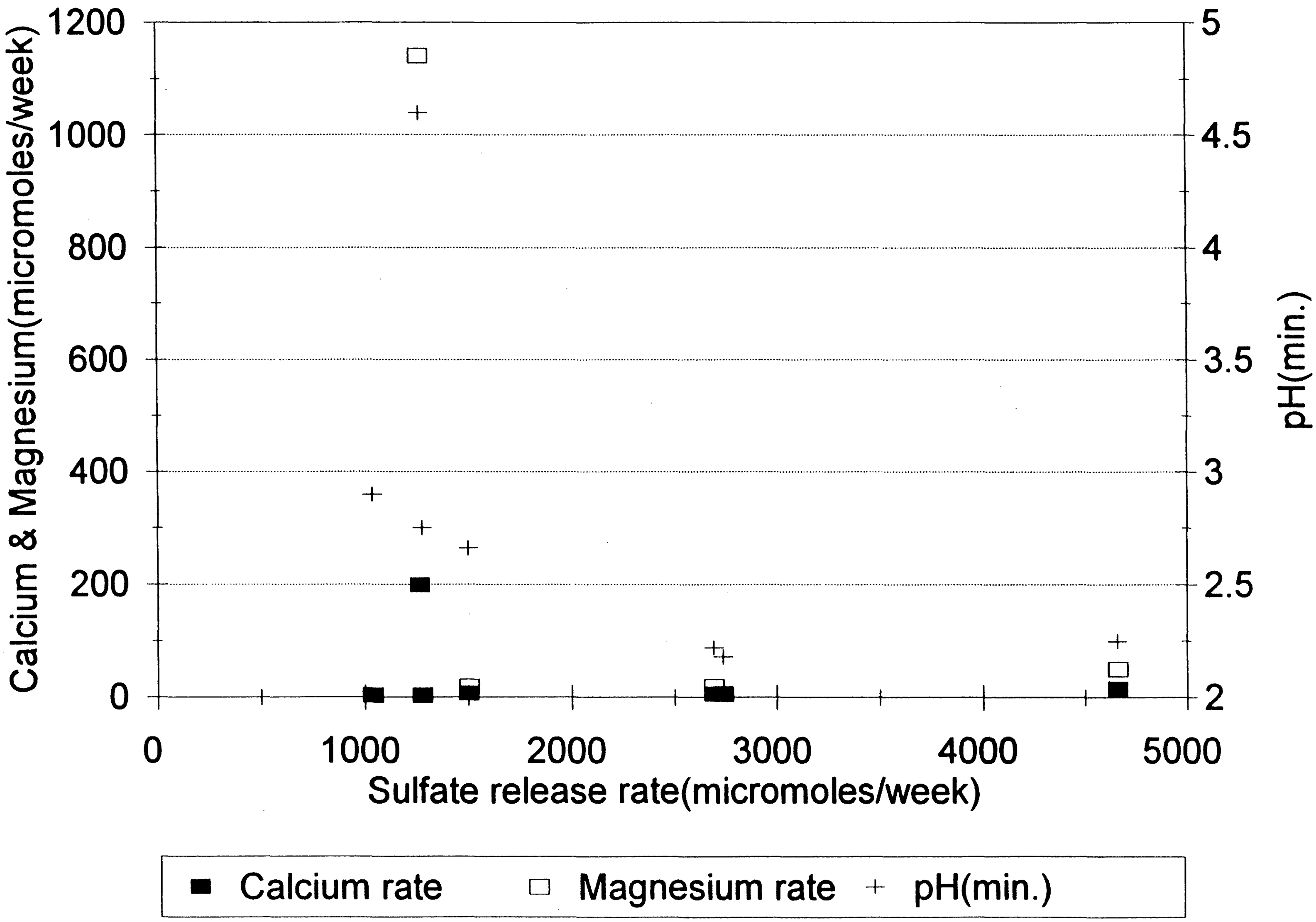


Figure 10. Sulfide rocks, high sulfate release: Calcium and magnesium release rates were not strongly influenced by the sulfate release rate, consequently pH decreased as the rate of sulfate release increased.



APPENDIX 1

METHODS

Table A1.1. Temperature and relative humidity (p 1/21).

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Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 10		Cell 14		Cell 16		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
2	7/12/96	08:30	21.1	54.7	22.0	13.1	22.0	90.5	22.0	91.6	22.0	91.8	22.0	92.4		
2	7/15/96	08:30	21.0	57.7			21.6	99.9	21.7	99.9	21.9	99.9	22.1	99.9	40	99.9
3	7/16/96	10:00	22.4	55.0	22.4	4.6	23	99.9	22.9	99.9	23.0	99.9	22.8	99.9		
3	7/17/96	07:20	22.1	53.5	22.1	10.3	22.6	99.9	22.5	99.9	22.6	95.0	22.7	94.5		
3	7/18/96	09:00	23.3	60.7	23.1	11.1	23.5	99.9	23.7	99.9	23.7	91.3	23.7	65		
3	7/19/96	07:15	22.6	59.7	22.5	13.5	22.7	99.9	23.0	99.3	23.0	88.9	22.6	14.3		
3	7/19/96	11:20	23.3	54.3			23.7	99.9	23.7	99.9	23.7	99.9	23.7	62.8	23.8	99.9
3	7/22/96	07:30	21.7	52.8			22.2	99.9	22.1	99.9	22.1	99.9	22.0	99.9	22.0	99.9
4	7/23/96	11:50	22.0	51.9	22.0	5.1	22.3	99.9	22.2	99.9	22.2	99.9	22.2	99.9		
4	7/24/96	07:45	20.7	55.5	20.5	9.9	21.1	99.9	21.2	99.9	21.1	81.2	21.2	89.3		
4	7/25/96	10:50	21.4	53.6	21.1	11.5	21.5	98.5	21.6	90.2	21.6	95.0	21.6	94.5		
4	7/26/96	10:40	22.1	45.8			22.6	99.9	22.7	99.9	22.6	99.9	22.6	99.9	22.7	99.9
4	7/29/96	07:15	19.0	53.1			19.7	99.9	19.7	99.9	19.8	99.9	19.8	99.9	19.8	99.9
5	7/30/96	10:30	20.9	47.5	21.6	4.6	21.5	99.9	21.5	99.9	21.5	99.9	21.5	99.9		
5	7/31/96	08:00	22.1	44.9	20.3	11.6	20.8	99.9	20.8	99.9	20.8	99.9	21.0	99.9		
5	8/1/96	07:15	22.8	46.0	22.9	9.3	23.5	99.9	23.6	99.9	23.7	99.9	23.8	99.9		
5	8/2/96	07:20	23.7	45.6	23.4	11.1	24.1	99.9	24.1	99.9	24.3	99.9	24.3	99.9	30	99.9
5	8/2/96	14:00	26.8	39.2			27.2	99.9	27.1	99.9	27.1	99.9	27.1	99.9	27.1	99.9

Table A1.1. Temperature and relative humidity (p 2/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 10		Cell 14		Cell 16		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
5	8/5/96	07:15	24.9	53.3			25.5	99.9	25.5	99.9	25.5	99.9	25.5	99.9	25.7	99.9
6	8/6/96	09:15	25.8	54.7	26.1	3.5	26.5	99.9	26.6	99.9	26.7	99.9	26.6	99.9		
6	8/7/96	07:15	24.8	49.2	24.9	5.2	25.3	99.9	24.9	99.9	24.6	99.9	24.0	99.9		
6	8/8/96	07:15	22.5	45.5	22.6	10.0	23.1	99.9	23.1	99.9	23.1	99.9	23.1	97.0		
6	8/9/96	07:20	21.0	44.8	21.4	11.2	21.7	99.9	21.7	99.9	21.7	99.9	21.6	99.9		
6	8/12/96	07:15	21.8	50.7			23.1	99.9	22.8	99.9	22.7	99.9	22.6	99.9	24.1	99.9
7	8/13/96	11:35	23.7	42.8	23.9	3.8	24.5	99.9	24.4	99.9	24.5	99.9	24.5	97.1		
7	8/14/96	07:15	21.8	50	21.9	7.3	22.1	99.9	22.0	97.2	22.2	96.3	22.1	95.5		
7	8/15/96	07:05	22.2	44.7	22.5	8.8	22.9	99.9	23.0	97.1	23.0	95.3	23.0	94.9		
7	8/16/96	07:20	24.1	40.4	24.1	7.3	24.6	99.9	24.6	96.7	24.6	96.7	24.4	58.0		
7	8/16/96	13:30	25.7	36.7			26.3	99.9	26.2	99.9	26.2	99.9	26.1	99.9	26.2	99.9
7	8/19/96	07:20	23.8	52.2			29.2	99.9	30.2	99.9	30.5	99.9	30.9	99.9	27.8	99.9
8	8/20/96	09:00	25.0	44.6	34.6	3.4	36.8	99.9	37.1	99.9	37.5	99.9	38.4	99.9		
8	8/21/96	07:10	25.3	39.6	28.1	3.9	35.2	99.9	36.6	99.9	37.8	99.9	38.6	99.9		
8	8/22/96	08:30	22.9	44.1	22.8	7.3	23.2	99.9	23.3	94.9	23.7	95.1	23.7	92.4		
8	8/22/96	10:45	23.2	39.1												
8	8/23/96	07:30	24.0	38.5	23.7	6.6	24.3	97.1	24.3	95.0	24.3	95.1	24.0	29.8		
8	8/23/96	15:10	25.1	30.1			25.5	99.9	25.6	99.9	25.6	99.9	25.5	94.8	25.6	99.9
8	8/26/96	07:25	21.8	40.7			22.5	99.9	22.5	99.9	22.5	99.9	22.5	99.9	22.6	99.9

Table A1.1. Temperature and relative humidity (p 3/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 10		Cell 14		Cell 16		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
9	8/27/96	09:10	21.8	36.3	21.7	4.6	22.1	99.9	22.1	99.9	22.1	99.9	22.1	99.9		
9	8/28/96	07:40	21.1	39.8	21.3	6.6	21.3	92.4	21.3	92.9	21.3	92.5	21.4	92.4		
9	8/29/96	07:30	21.9	46.5	21.8	7.7	22.2	97.2	22.3	95.1	22.3	92.8	22.3	94.7		
9	8/30/96	07:35	23.7	37.1	23.8	6.4	24.1	97.4	24.0	95.7	23.9	96.2	23.9	95.1		
9	8/30/96	11:00	24.5	38.1			25.0	99.3	25.0	99.4	24.9	99.2	24.9	99.3	25.0	99.9
9	9/2/96	07:30	22.6	53.0			23.0	99.9	23.1	99.9	23.2	99.9	23.3	99.9	24.0	99.9
10	9/3/96	09:05	22.3	56.4	23.0	3.8	23.3	99.9	23.2	99.9	23.2	99.9	23.1	99.9		
10	9/4/96	07:20	22.0	43.6	22.2	5.0	22.7	95.5	22.5	92.5	22.6	93.6	22.6	96.2		
10	9/5/96	07:15	22.2	47.8	22.5	7.0	22.7	96.2	22.6	95.3	22.6	93.5	22.8	95.7		
10	9/6/96	07:45	22.7	53.5	22.7	6.5	23.3	93.3	23.4	93.2	23.2	95.3	23.3	94.1		
10	9/6/96	12:35	25.0	45.8			25.2	99.9	25.3	99.9	25.3	99.9	25.3		25.3	99.9
10	9/9/96	07:15	20.2	48.1			20.8	99.9	20.9	99.9	21.0	99.9	21.0	99.9	21.1	99.9
11	9/10/96	09:15	21.0	51.9	21.3	4.6	21.6	99.9	21.8	99.9	21.8	99.9	21.7	99.9		
11	9/11/96	07:15	19.7	42.1	19.7	5.7										
11	9/16/96	07:45	19.6	39.5			20.1	99.9	19.8	99.9	19.9	99.9	19.9	99.9	20.1	99.9
12	9/17/96	09:05	20.0	39.0	20.7	4.9	21.3	99.9	21.3	99.9	21.2	99.9	21.2	99.9		
12	9/18/96	07:50	19.8	37.1	20.7	5.2	20.7	93.0	20.6	93.5	20.6	92.6	20.6	92.2		
12	9/19/96	07:25	20.3	30.5	20.6	7.1	20.8	92.5	20.9	91.7	20.9	90.9	20.9	88.4		
12	9/20/96	07:25	19.7	32.4	19.7	7.2	20.1	91.8	20.1	92.4	20.2	91.7	19.8	49.1		

Table A1.1. Temperature and relative humidity (p 4/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 10		Cell 14		Cell 16		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
12	9/20/96	11:30	20.9	34.7			22.0	99.9	21.8	99.9	21.8	99.9	21.6	99.9	21.9	99.9
12	9/23/96	07:25	18.1	41.9			19.7	99.9	19.5	99.9	19.3	99.9	19.1	99.9	20.3	99.9
13	9/24/96				20.7	6.5	19.7	92.3	19.6	94.2	19.6	95.0	19.6	94.6		
13	9/25/96				18.1	7.8	18.1	95.3	18.2	95.2	18.2	96.2	18.1	74.5		
13	9/26/96	07:45	18.7	37.6	18.7	7.3	19.0	98.0	19.0	94.2	19.0	93.6	18.7	67.6		
13	9/27/96	07:15	18.5	40.8	18.5	7.4	18.8	93.5	18.8	90.8	18.7	84.5	18.2	14.0		
13	9/27/96	10:30	19.7	37.0			20.3	92.0	20.1	93.4	20.0	93.8	19.8	44.9		
13	9/30/96	07:30	19.1	26.3			20.5	99.9	20.3	99.9	20.1	99.9	19.8	99.9	21.1	99.9
14	10/1/96	09:20	19.8	34.7	20.3	5.1	20.3	95.5	20.3	97.8	20.3	96.2	20.3	96.9		
14	10/2/96	07:50	19.1	31.5	19.6	5.3	19.6	88.3	19.5	88.2	19.4	88.8	19.4	89.7		
14	10/3/96	07:10	17.1	26.9	17.7	6.5	17.7	84.6	17.7	87.0	17.7	86.7	17.7	86.0		
14	10/4/96	07:20	18.0	24.0	18.5	7.7	18.1	88.1	18.1	86.0	18.2	86.1	18.1	86.1		
14	10/4/96	10:45	19.7	22.8			21.2	99.9	20.8	99.9	20.7	99.9	20.7	99.9	21.7	99.9
14	10/7/96	07:30	19.1	26.9			20.6	99.9	20.5	99.9	20.3	99.9	20.2	99.9	20.5	99.9
15	10/8/96	09:12	23.2	20.1	23.6	3.8	23.5	94.3	23.2	93.2	23.1	96.1	23.1	96.6		
15	10/10/96	07:25	22.2	19.4	22.4	5.9	22.4	95.3	22.3	95.1	22.1	94.8		95.8		
15	10/11/96	07:50	22.8	15.9	22.9	5.7	23.1	87.0	22.8	90.4	22.7	89.8	22.5	55.6		
15	10/11/96	11:40	24.6	11.2			24.5	99.9	24.6	99.9	24.6	99.9	24.7	99.9	25.0	99.9
15	10/14/96	07:30	25.5	18.5			26.0	96.5	25.8	97.2	25.7	99.9	25.8	99.9	26.0	99.9

Table A1.1. Temperature and relative humidity (p 5/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 10		Cell 14		Cell 16		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
16	10/15/96	09:15	25.3	19.9	25.6	3.2	25.7	95.7	25.3	96.1	25.2	96.4	25.1	96.1		
16	10/16/96	07:30	25.0	17.9	25.3	3.4	25.6	87.5	25.3	88.5	25.2	89.3	25.2	89.3		
16	10/17/96	07:15	25.5	18.7	25.7	4.4	26.0	84.4	25.8	84.7	25.8	85.2	25.8	86.4		
16	10/18/96	07:10	21.9	18.9	22.0	5.7	22.2	84.1	22.1	83.3	22.1	84.9	22.1	85.1		
16	10/18/96	10:30	23.1	18.7			23.3	94.2	23.3	95.1	23.2	96.2	23.2	96.9	23.0	99.9
16	10/21/96	07:15	23.5	18.9			24.5	99.9	24.1	99.9	24.0	99.9	24.1	99.9	24.4	99.9
17	10/22/96	09:10	23.8	17.5	24.1	3.8	24.1	92.5	24.0	92.8	23.9	91.9	23.8	93.1		
17	10/24/96	07:30	22.1	20.1	22.2	5.0	22.3	85.4	22.1	85.7	22.1	90.1	22.0	90.9		
17	10/25/96	07:25	22.3	19.5	22.3	5.7	22.3	88.0	22.3	84.3	22.3	84.5	22.3	85.9		
17	10/25/96	14:40	24.4	20.1			24.8	95.7	25.0	96.1	24.7	95.3	24.7	96.1	24.5	99.9
17	10/28/96	07:25	22.6	17.9			23.8	99.9	23.8	99.9	23.7	99.9	23.5	99.9	24.6	99.9
18	10/29/96	09:10	24.1	17.3	23.8	3.8	23.7	92.1	23.5	93.2	23.4	93.4	23.3	91.8		
18	10/31/96	07:50	17.7	12.8	18.7	6.0	17.8	88.1	17.7	88.9	17.6	88.4	17.6	87.3		
18	11/1/96	07:30	18.3	12.2	18.6	6.6										
18	11/1/96	11:50	20.0	15.8			21.3	99.9	19.8	99.9	19.8	99.9	19.8	99.9	21.0	99.9
18	11/4/96	07:30	20.8	18.5			22.2	99.9	21.8	99.9	21.6	99.9	21.5	99.9	22.8	99.9
19	11/5/96	09:05	21.8	22.9	22.3	4.4	22.2	99.9	21.7	99.9	21.7	99.9	21.7	99.9		
19	11/6/96	08:20	21.9	25.3	22.8	4.5	22.3	86.2	22.2	88.1	22.2	87.3	22.2	87.2		
19	11/8/96	07:35	21.8	19.0	21.6	5.7	21.5	88.7	21.5	89.6	21.4	88.6	21.3	93.1		

Table A1.1. Temperature and relative humidity (p 6/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 10		Cell 14		Cell 16		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
19	11/8/96	11:45	22.7	17.4			23.7	99.9	23.6	99.9	23.6	99.9	23.7	99.9	23.7	99.9
19	11/11/96	07:40	19.4	11.3			20.7	99.9	20.6	99.9	20.3	99.9	20.3	99.9	20.9	99.9
20	11/12/96	09:15	19.7	9.1	19.7	5.3	19.8	99.9	19.8	99.9	18.7	99.9	18.8	99.9		
20	11/13/96	07:50	21.2	7.8	21.5	4.9	21.6	96.5	21.5	93.9	21.6	95.5	21.5	96.8		
20	11/14/96	07:15	21.3	7.4	21.3	5.8	21.3	86.0	21.1	85.3	21.1	87.3	21.1	89.9		
20	11/15/96	07:40	19.8	11.0	20.2	6.6	19.8	83.8	19.7	82.4	19.5	84.2	19.4	86.2		
20	11/18/96	07:30	21.2	8.5			21.7	99.9	21.6	99.9	21.7	99.9	21.7	99.9	22.1	99.9

Table A1.1. Temperature and relative humidity (p. 7/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
22	11/26/96	09:40	18.9	7.8	21.1	4.6	19.5	99.9	19.0	99.9	19.2	99.9	19.2	99.9		
22	11/27/96	08:10	20.1	6.7	21.1	4.9										
22	11/29/96	08:10	20.0	11.5	20.3	6.0	20.7	80.4	20.8	86.1	20.9	83.7	20.9	85.0	22.8	99.9
22	12/2/96	08:45	20.1	11.1			21.3	99.9			20.9	99.9	20.1	99.9	21.9	99.9
23	12/3/96	09:20	21.6	8.7	21.6	4.6	20.9	95.6	20.6	98.0	20.6	98.5	20.2	99.4		
23	12/4/96	08:30	18.7	11.8	19.5	5.3	18.6	94.1	18.6	97.0	18.6	94.4	18.6	96.7		
23	12/5/96	08:45	18.9	17.7	19.3	5.9	19.3	93.1	18.9	94.3	18.9	92.1	18.6	93.2		
23	12/6/96	08:40	19.7	21.7	20.1	6.0	19.9	91.2	19.7	91.0	19.6	90.1	19.6	89.9	22.1	99.9
23	12/6/96	10:35	19.7	20.7			21.6	96.2	21.5	97.0	21.2	96.3	21.1	97.5		
23	12/9/96	07:35	19.5	13.0			20.6	99.9	20.2	99.9	19.8	99.9	19.8	99.9	20.1	99.9
24	12/10/96	09:20	20.2	14.7	20.4	5.1	20.2	91.0	20.1	90.1	20.1	90.8	20.1	89.9		
24	12/13/96	08:25	21.3	16.0	21.4	5.8	21.2	88.0	21.1	88.3	21.0	88.5	21.0	87.5	22.5	99.9
24	12/13/96	09:45	21.4	17.0			21.8	98.2	21.8	98.0	21.8	95.5	21.8	97.4		
24	12/16/96	07:45	20.3	8.5			20.9	99.9	20.1	99.9	20.0	99.9	19.9	99.9	21.0	99.9
25	12/17/96	09:20	19.5	11.7	20.4	5.0	20.2	96.5	20.2	97.0	20.1	96.5	20.2	96.1		
25	12/20/96	09:20	19.8	7.1	20.7	6.6	20.8	86.4	20.8	87.1	20.8	85.3	20.8	85.1	21.5	99.9
25	12/23/96	07:30	20.8	6.0			22.2	99.9	21.8	99.9	21.1	99.9	21.0	99.9	22.2	99.9
26	12/24/96	09:30	21.7	5.2	21.7	4.5	20.9	89.0	20.6	91.4	20.6	93.1	20.7	92.1		
26	12/27/96	08:00	21.0	5.7	21.2	5.1	21.3	78.8	21.1	80.1	21.1	82.5	21.0	80.8	21.8	99.9
26	12/30/96	07:50	21.1	5.8			21.8	99.9	21.3	99.9	21.1	99.9	20.8	99.9	22.1	99.9

Table A1.1. Temperature and relative humidity (p. 8/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
26	12/31/96	10:00	21.2	4.9	21.0	4.6	21.3	89.7	21.2	86.3	21.2	87.1	21.0	86.9		
26	1/3/97	07:35	21.8	8.6	22.0	5.3	21.8	82.1	21.7	86.9	21.6	86.2	21.7	85.9	23.3	99.9
26	1/3/97	10:50	22.6	8.4			23.0	98.1	23.0	97.2	22.8	96.9	22.7	96.1	23.3	99.9
26	1/6/97	07:30	19.3	6.7			21.2	99.9	21.2	99.2	21.0	98.7	21.1	99.3	21.5	99.9
28	1/7/97	09:30	20.8	5.7	21.4	4.6	21.7	81.9	22.3	80.8	22.1	82.6	22.3	81.5		
28	1/9/97	08:15	20.4	8.0	21.7	4.5	21.1	79.4	20.8	79.9	20.8	81.8	20.7	80.6		
28	1/10/97	07:40	20.6	8.5	21.0	5.8	20.6	79.2	20.5	78.9	20.6	80.1	20.7	80.9		
28	1/10/97	10:30	21.1	8.1			22.4	91.4	22.1	92.7	21.9	92.6	21.7	93.1	22.3	99.9
28	1/13/97	07:30	19.9	6.0			21.5	99.9	21.2	99.1	21.2	98.7	20.7	99.3	22.1	99.9
29	1/14/97	09:25	21.6	5.3	22.1	4.4	22.1	86.3	21.7	93.5	21.8	94.5	21.6	95.0		
29	1/15/97	08:35	20.7	5.8	21.1	5.0	21.0	81.5	20.8	82.6	20.9	83.5	20.9	82.2		
29	1/17/97	08:00	19.8	6.0	20.3	5.3	20.7	79.2	20.6	81.7	20.7	85.6	20.7	83.9		
29	1/17/97	10:38	22.0	5.7			22.6	95.4	22.5	96.2	22.0	97.4	22.0	95.8	22.8	99.9
29	1/20/97	07:45	20.0	7.1			21.2	97.5	21.0	99.9	20.6	98.7	20.6	99.4	21.7	99.9
30	1/21/97	09:20	21.2	7.4	21.6	4.5	21.2	94.8	21.5	92.6	21.4	91.1	21.3	92.8		
30	1/24/97	08:10	20.8	6.7	21.0	5.3	20.6	83.8	20.6	85.4	20.7	87.5	21.0	86.2		
30	1/24/97	10:30	21.6	7.2			22.1	86.7	22.3	88.5	22.5	88.6	22.5	88.9		
30	1/27/97	07:45	20.5	6.0			20.5	99.9	20.9	99.9	21.0	98.8	21.0	99.9	22.1	99.9
31	1/28/97	09:30	20.1	5.9	21.0	4.6	20.8	85.5	21.0	87.9	20.8	88.1	20.7	86.6		
31	1/30/97	07:25	21.5	5.3	22.0	4.4	21.7	79.9	21.3	87.2	21.3	86.4	21.6	86.2		

Table A1.1. Temperature and relative humidity (p. 9/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
31	1/31/97	08:35	20.7	7.7	21.3	5.3	21.3	75.6	21.5	76.8	21.3	81.9	21.3	83.9		
31	1/31/97	10:35	22.8	7.3			23.6	99.1	23.2	97.8	23.0	97.3	23.0	97.5	23.8	99.9
31	2/3/97	08:00	21.2	6.4			21.9	97.5	21.7	98.1	21.7	95.8	21.8	97.5	22.7	99.9
32	2/4/97	09:20	23.1	5.9	23.4	3.8	23.5	86.2	23.3	88.1	23.5	89.1	23.3	89.8		
32	2/6/97	07:30	20.9	8.7	20.9	5.8	21.0	83.9	21.3	82.7	21.6	87.9	21.6	83.6		
32	2/7/97	08:05	22.3	7.7	22.3	5.3	22.5	75.8	22.5	79.4	22.5	80.1	22.5	81.6		
32	2/7/97	10:35	23.1	9.7			23.6	95.5	23.4	96.1	23.5	95.6	23.4	92.6	23.8	99.9
32	2/10/97	07:35	20.5	7.1			21.3	94.1	21.3	92.1	21.5	95.3	21.8	91.5	22.1	99.9
33	2/11/97	09:30	24.1	5.1	24.3	3.6	24.1	85.9	23.8	91.4	23.7	86.6	23.7	92.8		
33	2/13/97	08:40	20.7	6.4	21.0	5.6	21.0	82.5	21.3	83.6	21.2	84.5	21.1	83.7		
33	2/14/97	07:45	22.5	6.0	23.3	4.9	23.3	78.8	22.7	80.7	23.0	82.7	23.3	84.9	23.8	99.9
33	2/14/97	10:30	22.6	5.8			23.4	95.4	23.2	95.8	22.9	95.3	22.8	94.6		
33	2/17/97	07:30	20.1	6.6			21.8	96.2	21.7	95.3	21.3	97.8	21.3	95.6	22.8	99.9
34	2/18/97	09:30	22.5	8.5	23.0	3.8	23.2	76.8	23.2	78.5	23.0	85.0	23.1	84.5		
34	2/20/97	07:20	20.8	9.4	21.5	5.2	21.0	84.8	21.1	88.1	21.3	87.2	21.4	85.4		
34	2/21/97	07:30	21.2	12.8	21.9	5.3	21.9	82.5	22.0	83.1	21.9	84.2	22.0	83.8		
34	2/21/97	10:30	22.5	9.7			23.2	88.1	23.4	87.8	23.5	88.0	23.5	88.2	24.2	99.9
34	2/24/97	07:35	23.1	4.9			23.8	93.7	23.4	97.3	23.1	96.8	22.7	97.3	24.8	99.9
35	2/25/97	09:25	21.4	5.7	22.8	3.8	22.8	76.8	22.7	79.2	22.5	83.6	22.5	85.7		
35	2/27/97	07:45	21.3	6.5	21.8	4.6	21.8	73.4	22.0	79.1	21.8	85.6	22.1	83.6		

Table A1.1. Temperature and relative humidity (p. 10/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
35	2/28/97	07:35	21.4	6.6	22.0	5.1	21.7	77.3	21.6	77.2	21.8	79.1	21.8	80.1		
35	2/28/97	10:40	22.0	8.1			22.5	80.1	22.5	82.7	22.2	89.1	22.2	89.2		
35	3/3/97	07:30	21.4	7.1			22.1	91.5	21.3	93.5	21.7	94.7	21.7	95.0	23.5	99.9
36	3/4/97	09:15	22.1	12.7	22.7	3.9	22.8	78.7	22.9	81.0	22.9	83.8	22.8	85.3		
36	3/6/97	07:20	21.1	6.6	21.6	4.5	21.6	74.2	21.3	79.7	21.3	80.3	21.2	80.7		
36	3/7/97	07:40	23.5	5.1	23.6	4.6	23.4	73.5	23.3	76.2	23.2	79.1	23.1	79.8	23.7	99.9
36	3/7/97	10:35	22.6	6.4			23.1	91.5	23.0	92.8	22.8	94.1	22.6	92.9		
36	3/10/97	07:35	21.4	7.2			22.5	99.9	22.2	97.8	22.0	97.9	21.9	96.2	23.1	99.9
37	3/11/97	09:25	21.7	7.0	21.8	4.5	21.8	78.1	21.7	82.8	21.6	87.7	21.4	89.9		
37	3/13/97	08:05	21.7	6.0	22.3	4.4	22.2	73.5	22.8	72.2	22.7	75.7	22.5	79.2		
37	3/14/97	08:20	22.9	5.8	23.3	4.6	23.4	71.8	23.7	75.1	22.9	73.1	22.9	75.4		
37	3/14/97	10:45	24.4	5.6			24.6	78.2	24.6	82.4	24.4	84.5	24.2	85.2	24.9	99.9
37	3/17/97	07:25	25.0	4.4			25.2	98.9	25.3	95.3	25.3	94.0	25.0	97.9	26.1	99.9
38	3/18/97	09:30	23.3	5.7	23.6	3.8	23.6	77.1	23.6	79.7	23.7	80.6	23.6	81.8		
38	3/21/97	08:00	23.0	5.7	23.3	4.7	23.6	74.8	23.4	75.4	23.1	73.7	23.4	75.6		
38	3/21/97	10:45	23.9	5.4			24.1	87.8	24.1	89.5	24.6	90.1	24.4	89.9		
38	3/24/97	07:30	22.2	5.3			22.5	94.8	22.6	96.2	22.3	96.3	22.1	95.8		
38	3/25/97	08:45	23.6	6.1	22.9	3.6	23.4	79.6	23.2	81.3	23.6	82.3	23.5	84.2		
39	3/27/97	07:30	23.5	11.5	23.8	3.9	23.8	70.7	24.0	75.6	24.3	78.5	24.4	81.1		
39	3/28/97	07:40	19.1	16.5	19.4	6.4	19.5	70.1	19.6	73.8	19.7	76.4	19.7	77.8		

Table A1.1. Temperature and relative humidity (p. 11/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
39	3/28/97	10:35	19.9	16.3			20.6	75.6	20.8	80.1	20.7	80.5	20.7	81.6	21.5	99.9
39	3/31/97	07:45	14.1	19.6			15.7	94.9	15.2	94.2	15.3	91.7	15.1	91.5	18.1	99.9
40	4/1/97	09:30	21.7	16.9	21.8	4.4	22.1	77.6	22.4	81.2	22.5	83.5	22.5	84.7		
40	4/3/97	08:50	23.0	13.6	23.3	3.9	23.4	71.5	23.5	75.9	23.6	77.3	23.7	79.3		
40	4/4/97	07:30	23.7	15.1	23.7	4.6	23.8	70.4	24.1	76.3	24.1	76.8	24.1	77.9	25.8	99.9
40	4/4/97	10:30	24.6	18.9			25.5	98.2	25.4	96.5	25.1	96.3	25.1	95.3		
40	4/7/97	07:25	19.4	8.0			19.3	91.2	19.4	91.7	19.5	89.9	19.6	89.1	20.1	99.9
41	4/8/97	09:25	21.7	6.6	22.0	4.4	21.9	77.3	21.8	83.2	21.6	85.4	21.7	82.9		
41	4/11/97	07:50	21.7	6.5	21.8	5.2	21.8	70.6	22.2	73.4	22.3	75.1	22.4	75.8	23.5	99.9
41	4/11/97	10:30	22.6	6.6			23.3	95.6	23.0	96.8	22.8	97.1	22.8	97.5		
41	4/14/97	07:45	22.0	7.4			22.8	95.2	22.7	96.1	22.6	95.8	22.6	95.7	23.7	99.9
42	4/15/97	09:25	23.2	10.7	23.4	3.9	23.3	79.7	23.2	82.3	23.1	83.5	23.2	84.5		
42	4/17/97	08:45	22.3	7.7	22.9	3.9	22.9	72.4	23.3	73.1	23.5	74.2	23.7	75.1		
42	4/18/97	07:50	23.0	8.6	22.9	4.9	23.2	70.6	23.3	71.6	23.5	73.7	23.5	73.6	25.4	99.9
42	4/18/97	10:35	24.1	9.3			24.9	95.4	24.9	95.9	24.9	96.2	24.7	95.5		
42	4/21/97	07:50	24.2	7.7			24.8	99.9	24.7	98.1	24.5	96.8	24.6	97.2	25.4	99.2
43	4/22/97	09:20	24.6	6.7	25.0	3.4	25.2	76.3	25.3	82.6	25.3	86.2	25.3	88.3		
43	4/25/97	08:25	18.8	17.3	19.0	6.6	19.1	71.8	19.4	76.2	19.5	77.1	19.6	76.8	22.1	99.9
43	4/25/97	10:40	20.3	12.9			21.1	91.1	21.0	92.8	20.6	92.7	20.5	92.0		
43	4/28/97	07:55	17.6	21.7			18.9	96.1	18.4	98.7	18.0	98.0	18.1	96.4	20.1	99.9

Table A1.1. Temperature and relative humidity (p. 12/21).

Week	Date	Time	Ambient		Desiccant		Cell2		Cell 4		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
44	4/29/97	08:30	20.8	5.3	21.2	4.6	19.6	81.7	19.1	90.1	19.8	90.8	19.7	91.7		
44	5/1/97	08:20	22.1	13.1	22.5	4.3	22.6	73.6	22.6	82.7	22.7	81.4	22.8	81.7		
44	5/2/97	08:00	23.6	12.2	23.7	4.6	24.0	71.4	24.2	78.2	24.3	79.3	24.3	80.1	26.2	99.9
44	5/2/97	10:30	25.4	12.7			26.1	96.3	26.0	95.4	25.6	94.6	25.7	90.4		
44	5/5/97	07:30	25.8	10.3			26.5	92.7	26.5	94.1	26.6	93.8		96.8	26.7	99.9
45	5/6/97	09:30	24.8	6.5	24.7	3.4	24.7	75.7	24.7	80.3	24.8	81.8	24.8	82.1		
45	5/8/97	07:25	25.6	16.9	25.7	3.6	25.9	72.8	26.1	77.6	26.0	79.5	26.1	76.4		
45	5/9/97	09:30	23.3	13.5	22.7	5.3	22.7	72.4	22.3	76.4	22.2	78.8	22.1	77.8		
45	5/12/97	07:30	22.5	12.4			23.2	97.5	23.3	95.2	23.3	92.5		94.5	24.2	99.9
46	5/13/97	09:20	22.6	12.7	23.0	3.9	23.3	78.2	23.5	81.8	23.5	80.7	23.6	81.8		
46	5/15/97	07:40	22.6	18.5	22.6	4.9	22.8	75.5	23.2	77.1	23.5	80.1	23.6	78.5		
46	5/16/97	07:50	22.7	18.0	23.3	4.6	23.3	72.8	23.7	75.5	23.7	76.8	23.7	75.7	24.2	99.9
46	5/16/97	10:28	22.9	18.2			23.7	97.2	23.5	95.6	23.5	96.9	23.3	95.9		
46	5/19/97	07:30	25.0	15.8			25.4	98.1	25.5	97.7	25.6	96.2	25.7	93.5	26.2	99.9
47	5/20/97	09:15	23.7	13.4	23.8	3.7	24.0	76.7	23.8	82.7	23.8	82.4	23.7	83.3		
47	5/22/97	07:55	26.3	7.1	26.3	3.6	26.5	75.8	26.5	79.5	26.3	81.3	25.1	82.1		
47	5/23/97	10:30	23.6	12.6			23.4	94.7	23.3	95.8	23.5	94.9	23.3	94.7	23.3	99.8
47	5/25/97	08:00	18.7	22.9			19.6	95.1	19.5	95.8	19.5	95.0	19.4	93.4	20.0	99.9
48	5/27/97	09:25	19.0	19.1	19.1	5.3	19.5	77.1	19.2	75.9	19.5	80.9	19.6	84.3		
48	5/29/97	07:50	20.1	19.5	20.7	6.3	21.1	75.4	20.8	76.4	20.8	78.3	20.9	79.6		

Table A1.1. Temperature and relative humidity (p. 13/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
48	5/30/97	07:25	20.6	24.0	21.1	5.9	21.1	72.3	21.1	79.1	21.2	78.9	21.2	80.2		
48	6/2/97	08:15	23.8	22.8			24.2	91.1	24.4	93.7	24.3	95.6	24.2	95.9	25.1	99.9

Table A1.1. Temperature and relative humidity (p. 14/21).

Week	Date	Time	Ambient		Desiccant		Cell 4		Cell 6		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
49	6/3/97	09:20	23.5	23.5	23.5	3.8	24.0	86.5	23.9	83.1	23.9	87.2	23.8	88.8		
49	6/5/97	07:30	21.6	34.7	21.7	5.7	21.7	62.0	21.7	77.5	22.0	78.2	21.7	77.3		
49	6/9/97	07:35	22.1	30.7			22.2	99.9	22.1	98.1	22.5	99.2	22.5	96.9	23.6	99.9
50	6/10/97	09:20	23.8	30.9	23.8	3.7	24.1	83.5	24.4	85.1	24.1	90.6	24.1	91.7		
50	6/12/97	07:20	24.1	30.4	24.3	4.6	24.5	77.8	24.6	82.1	24.6	81.8	24.5	83.9		
50	6/13/97	08:05	24.6	27.8	24.7	4.3	25.1	75.8	25.2	81.2	25.3	84.6	25.4	87.4	27.3	99.9
50	6/13/97	10:30	26.3	25.8			26.9	96.7	26.8	94.1	26.7	94.3	26.6	95.2		
50	6/16/97	08:10	22.6	29.8			23.3	96.5	23.2	96.3	23.0	95.4	23.0	95.5	23.9	99.9
51	6/17/97	09:12	21.2	27.5	21.7	4.4	22.1	80.2	22.3	83.1	22.3	85.0	22.3	88.9		
51	6/19/97	08:30	20.3	35.8	20.5	6.3	20.6	75.4	20.8	79.8	20.9	80.1	21.1	81.5		
51	6/20/97	07:50	20.3	39.0	20.6	6.6	21.0	76.7	21.0	75.9	21.1	77.1	21.1	79.4	22.1	99.9
51	6/20/97	08:45	21.1	40.3			21.8	97.5	21.7	95.4	21.7	98.1	21.7	98.5		
51	6/23/97	07:55	23.6	39.4			24.4	98.5	24.3	99.1	24.4	98.2	24.4	98.1	24.9	99.9
52	6/24/97	09:20	23.4	49.5	23.3	3.6	23.6	83.4	23.7	87.4	23.8	89.2	24.0	91.2		
52	6/26/97	07:50	21.8	39.5	21.7	5.3	22.0	76.1	22.2	79.1	22.3	81.4	22.4	82.2		
52	6/27/97	07:50	22.7	37.7	22.7	5.2	23.1	74.1	23.2	78.2	23.2	80.3	23.3	81.1		
52	6/30/97	07:30	23.0	50.8			23.7	98.8	23.6	99.2	23.6	99.3	23.7	99.4	24.5	99.9
53	7/1/97	09:30	24.0	47.0	24.0	3.6	24.6	87.5	24.7	95.3	24.6	89.4	24.5	88.6		
53	7/3/97	07:40	20.5	41.2	20.7	6.3	21.0	75.5	21.2	83.2	21.3	83.4	21.3	83.8		

Table A1.1. Temperature and relative humidity (p. 15/21).

Week	Date	Time	Ambient		Desiccant		Cell 4		Cell 6		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
53	7/4/97	07:50	44.2	18.8	19.0	7.3	19.2	70.6	19.3	76.4	19.6	77.6	19.3	80.1	20.7	99.9
53	7/4/97	09:05	44.5	19.3			20.4	90.3	20.3	91.8	20.4	92.4	20.4	92.1		
53	7/7/97	07:20	18.8	39.6			20.5	99.0	20.2	94.9	20.1	96.2	20.0	95.9	21.7	99.9
54	7/15/97	09:25	23.8	51.4	23.7	3.8	24.0	90.1	24.2	92.6	24.2	93.1	24.3	92.6		
54	7/18/97	08:15	25.5	38.9	25.7	4.5	26.0	72.3	26.1	80.0	26.0	77.0	26.1	78.4	27.7	99.9
54	7/18/97	09:20	26.1	38.7			27.0	99.9	26.6	95.6	26.4	89.3	26.3	87.2		
54	7/21/97	08:50	23.0	40.3			23.9	99.1	23.8	99.3	23.6	97.8	23.5	97.2	24.1	99.9

Table A1.1. Temperature and relative humidity (p. 16/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 6		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
56	7/22/97	10:40	21.2	41.9	21.1	4.6	21.6	82.6	21.6	88.6	21.6	88.2	21.5	89.4	21.5	89.6		
56	7/24/97	07:35	21.5	44.1			22.1	78.5	22.3	83.6	22.3	82.6	22.3	84.1	22.4	83.9	21.7	5.7
56	7/28/97	07:40	23.4	44.1			24.1	98.9	24.1	99.1	23.9	99.1	24.0	99.4	23.8	99.2	24.3	99.9
57	7/29/97	12:50	23.8	24.9			24.7	77.8	24.9	76.5	24.5	78.2	24.3	80.5	24.3	79.1	24.5	3.5
57	7/31/97	08:15	22.6	40.7			22.8	73.8	23.0	81.5	23.1	80.1	23.2	79.5	23.2	79.7	22.7	5.3
57	8/1/97	09:15	22.1	53.5	22.2	5.3	22.6	72.1	22.8	80.3	22.8	67.6	22.9	76.2	23.0	79.3		
57	8/4/97	07:55	23.6	41.1			24.3	98.1	23.8	95.3	23.9	97.1	23.8	97.8	23.8	96.9	24.7	99.9
58	8/5/97	08:45	22.1	35.0	22.3	4.3	22.7	92.1	22.8	94.3	22.6	93.9	22.5	93.1	22.5	91.3		
58	8/7/97	07:30	22.8	43.7	22.8	5.6	23.1	85.7	23.2	85.4	23.2	83.7	23.2	85.6	23.3	84.1		
58	8/8/97	07:20	25.8	37.1	25.8	3.9	26.1	79.7	26.0	76.7	26.1	79.4	26.2	80.3	26.1	81.6		
58	8/8/97	08:50	26.0	39.5			26.5	84.5	26.2	86.1	26.3	88.7	26.3	89.1	26.2	91.8		
58	8/11/97	07:50	18.6	34.6			19.3	97.3	19.3	92.9	19.3	95.1	19.3	94.5	19.5	95.7	20.0	99.9
59	8/12/97	08:35	23.3	34.8	23.8	3.7	24.0	85.7	24.6	84.6	24.2	86.3	24.1	87.8	24.1	88.8		
59	8/14/97	08:30	20.8	31.1	21.2	5.9	21.5	74.3	21.7	75.8	21.7	76.8	22.1	77.7	22.4	78.2		
59	8/15/97	08:20	23.3	32.5	23.3	5.6	23.5	73.3	23.7	75.1	23.3	76.4	23.5	77.1	24.1	79.1	24.8	99.9
59	8/15/97	09:45	23.6	34.9			24.7	96.6	24.5	96.2	24.8	95.2	25.5	96.1	25.5	98.4		
59	8/18/97	07:45	21.5	35.5			23.5	99.5	24.4	99.9	24.5	99.9	24.7	99.9	24.8	99.9	24.2	99.9
60	8/19/97	08:20	21.7	36.3	23.3	4.6	24.5	84.8	24.8	85.4	25.2	87.5	25.3	89.0	25.1	90.4		
60	8/22/97	07:30	21.8	42.3	22.9	6.5	22.9	76.8	24.3	77.2	25.1	79.4	25.8	81.4	26.3	88.6		
60	8/22/97	11:10	26.8	38.2			28.9	99.9	25.6	99.9	28.3	99.9	28.9	99.9	28.9	99.9	30.1	99.9

Table A1.1. Temperature and relative humidity (p. 17/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 6		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
60	8/25/97	07:35	24.3	49.6			28.6	99.9	28.9	99.9	29.1	99.9	29.5	99.9	30.0	99.9	27.8	99.9
61	8/26/97	09:55	24.2	54.6	27.6	4.3	30.5	87.4	30.8	89.2	30.8	90.2	31.4	91.4	31.5	93.2		
61	8/28/97	07:20	28.7	38.9	24.5	5.3	30.8	80.4	30.7	82.6	30.6	81.7	30.7	86.6	30.6	87.3		
61	8/29/97	07:38	23.4	35.1	23.4	5.3	23.6	75.1	24.1	76.8	23.8	79.4	22.9	85.6	23.3	85.5		
61	8/29/97	08:53	24.1	33.4			25.1	97.5	25.0	95.2	24.8	94.8	24.7	95.3	24.6	94.4	25.6	99.9
61	9/1/97	08:40	23.6	39.7			24.2	93.8	24.4	96.5	24.5	95.1	24.5	96.2	24.5	95.5	25.1	99.9
62	9/2/97	09:15	22.1	34.3	22.2	4.3	22.6	80.1	22.6	81.8	22.6	83.8	22.6	84.5	22.7	84.8		
62	9/5/97	07:25	20.6	37.6	20.9	5.7	21.2	74.5	21.4	76.4	21.5	78.9	21.6	80.1	21.8	80.3		
62	9/5/97	09:00	21.9	39.9			22.1	90.5	22.5	91.8	22.4	92.6	22.5	94.5	22.6	92.1	23.2	99.9
62	9/8/97	08:00	20.6	43.1			21.5	98.8	21.4	97.2	21.4	97.5	21.6	96.9	21.7	98.1	22.7	99.9
63	9/9/97	09:00	21.2	36.9	21.4	4.6	21.5	83.6	21.5	84.5	21.5	85.4	21.5	85.7	21.7	83.8		
63	9/11/97	07:20	21.8	29.3	22.1	5.2	22.3	80.2	22.5	83.5	22.8	83.8	22.9	85.1	22.7	83.1		
63	9/12/97	07:45	23.3	28.5	23.5	4.9	23.8	77.3	24.1	78.3	24.3	80.0	24.3	78.9	24.3	80.2		
63	9/12/97	09:15	24.1	26.0			24.8	96.2	24.7	97.8	24.7	95.7	24.5	98.9	24.5	95.4	25.3	99.9
63	9/15/97	10:40	22.7	36.7			25.8	99.9	25.7	99.9	25.6	99.9	25.6	99.9	25.5	99.9	25.9	99.9
64	9/16/97	08:30	20.8	38.5	20.6	4.9	20.8	68.6	20.7	70.6	20.7	71.0	20.6	71.3	20.6	71.6		
64	9/18/97	08:40	19.3	31.7	19.5	6.0	19.7	63.4	19.8	69.6	19.8	78.3	20.0	73.3	20.2	68.3		
64	9/19/97	08:10	19.4	30.1	19.5	6.0	19.7	61.3	19.8	67.1	20.1	67.4	20.0	69.5	20.1	68.4	24.1	99.9
64	9/19/97	09:30	20.2	26.9			20.6	83.1	20.5	84.9	20.5	85.7	20.5	86.8	20.5	87.3		
64	9/22/97	07:55	17.6	25.3			19.0	84.8	18.4	86.3	18.3	84.1	18.3	84.1	18.3	89.1	22.4	99.9

Table A1.1. Temperature and relative humidity (p. 18/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 6		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
65	9/23/97	08:45	17.8	23.5	17.0	6.3	17.5	73.2	17.5	74.1	17.6	71.7	17.5	72.4	17.6	73.5		
65	9/26/97	07:55	19.1	27.1	19.2	6.3	19.1	61.1	19.1	62.9	19.2	63.8	19.4	64.2	19.4	65.1		
65	9/26/97	09:15	20.0	26.1			20.6	84.7	20.3	85.4	20.2	82.8	20.2	83.9	20.2	81.8	22.7	99.9
65	9/29/97	08:15	18.1	26.6			18.8	84.5	18.6	79.6	18.5	83.7	18.5	83.6	18.3	85.5	22.8	99.9
66	9/30/97	08:45	17.3	30.7	16.2	6.5	17.0	70.4	17.2	71.0	17.2	74.6	17.1	74.8	17.3	75.1		
66	10/1/97	08:50	17.6	27.5	17.4	5.7	17.7	62.4	17.6	65.1	17.6	66.1	17.6	69.4	17.7	65.7		
66	10/3/97	07:55	18.7	31.7	18.7	6.4	18.8	64.4	18.9	69.9	19.0	66.7	19.1	68.3	19.1	67.9	22.9	99.9
66	10/3/97	09:30	19.7	34.1			21.8	87.6	20.8	86.8	20.5	81.8	20.2	83.6	20.1	83.7		
66	10/6/97	08:15	18.9	28.1	19.2	70.2	19.2	71.1	19.3	70.1	19.3	73.3	19.4	73.3				
67	10/7/97	08:55	18.5	28.2	18.9	5.6	18.8	70.1	18.7	76.6	18.8	74.3	18.8	74.1	18.9	72.0		
67	10/10/97	08:00	15.7	24.9	15.8	7.3	15.8	61.2	15.9	63.1	16.0	61.9	16.0	63.8	16.0	63.2		
67	10/10/97	08:30	16.5	23.9			17.1	63.2	17.2	64.1	17.3	63.1	17.3	64.9	17.5	66.0		
67	10/13/97	07:45	17.9	28.7			18.4	87.1	18.5	84.8	18.2	87.2	18.1	91.0	18.2	85.6	23.3	99.9
68	10/14/97	08:30	14.7	29.1	15.2	6.6	15.3	66.3	15.6	68.6	15.7	68.7	15.8	67.8	15.8	68.3		
68	10/16/97	07:40	15.1	22.7	15.3	7.1	15.3	58.1	15.3	65.1	15.3	66.8	15.4	67.1	15.6	67.8		
69	10/23/97	08:25	18.0	10.3	18.1	6.6	17.8	54.4	18.0	57.7	18.0	59.1	18.1	59.6	18.0	13.5		
69	10/24/97	08:05	19.2	13.4	19.4	6.4	19.1	53.8	19.8	59.6	20.1	60.3	20.3	59.9	20.4	7.7	24.8	99.9
69	10/24/97	09:50	22.7	7.7			22.1	66.6	22.9	67.5	23.0	72.7	23.1	75.5	22.9	73.8		
69	10/27/97	08:00	21.6	8.4	24.5	99.9	23.0	82.7	22.3	83.2	22.1	81.2	22.1	80.2	22.3	80.5		
70	10/28/97	08:30	22.3	8.7	22.6	4.3	22.5	68.7	22.5	69.4	22.6	69.6	22.6	69.0	22.6	68.7		

Table A1.1. Temperature and relative humidity (p. 19/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 6		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
70	10/31/97	08:45	23.2	8.0	23.3	4.2	23.4	57.1	23.1	67.5	23.2	62.9	23.5	66.3	23.6	65.2	26.0	99.9
70	10/31/97	11:05	24.1	11.3			24.4	79.8	24.3	81.9	24.1	85.5	24.2	82.7	24.2	80.9		
70	11/3/97	08:15	22.0	6.5			23.8	82.2	23.0	80.7	22.6	81.2	22.5	80.9	22.6	81.0	24.8	99.9
71	11/4/97	09:00	21.9	6.0	22.1	4.4	22.0	68.6	21.8	72.8	22.0	71.5	21.8	74.1	21.8	73.1		
71	11/6/97	07:35	21.4	7.0	21.8	5.0	21.5	62.9	21.6	66.7	21.8	66.1	21.8	67.6	21.9	67.2		
71	11/7/97	08:15	22.2	7.7	22.6	5.1	22.5	61.1	22.7	62.7	22.9	63.1	23.0	63.5	23.1	63.2	25.3	99.9
71	11/7/97	09:35	23.2	8.1			24.4	84.3	24.0	82.3	23.2	80.1	23.2	82.7	23.3	83.1		
71	11/10/97	07:50	21.2	7.8			22.6	84.7	21.8	85.9	21.7	86.7	21.6	83.4	21.7	81.8	24.7	99.9
72	11/13/97	09:20	20.6	7.0	20.7	5.6	20.9	65.8	21.1	67.3	20.9	69.0	21.1	67.1	21.2	67.8		
72	11/14/97	08:10	20.4	6.7	20.9	5.6	20.8	60.2	20.9	64.1	21.0	65.9	20.8	67.3	21.1	63.3	24.7	99.9
72	11/14/97	09:50	21.1	6.5			22.1	72.0	22.1	72.4	22.1	72.9	22.2	73.2	22.3	72.8		
72	11/17/97	07:55	20.6	6.3			22.1	81.8	21.6	83.7	21.2	82.1	21.2	83.6	21.5	80.6	24.4	99.9
73	11/18/97	09:30	21.5	5.8	21.4	4.6	21.2	67.8	21.1	70.4	21.3	69.9	21.5	71.9	21.6	69.9		
73	11/20/97	07:30	20.9	6.3	21.0	5.0	20.8	71.1	20.5	72.2	20.7	69.9	20.8	69.8	20.8	69.4		
73	11/21/97	08:30	20.9	5.9	20.9	5.2	20.8	61.6	20.9	62.9	20.9	63.5	21.0	63.8	21.1	67.0	24.3	99.9
73	11/21/97	09:45	22.0	5.6			22.7	78.9	20.9	78.5								
73	11/24/97	08:05	20.4	6.3			20.4	82.2	20.4	83.7	20.5	81.9	20.4	82.1	20.4	80.9	24.1	99.9
74	11/25/97	08:25	21.2	6.5	21.3	4.6	21.4	68.6	21.8	68.5	21.8	67.4	21.8	67.8	21.8	68.8		
74	11/28/97	09:55	22.0	6.0	22.7	4.9	22.8	56.4	22.8	58.0	22.7	60.2	22.8	58.4	22.7	59.6	24.6	99.9
74	11/28/97	11:15	23.0	8.1			23.6	73.2	23.8	76.5	23.6	77.4	23.6	70.1	23.6	71.2		

Table A1.1. Temperature and relative humidity (p. 20/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 6		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
74	12/1/97	07:40	21.5	6.5			23.1	80.8	22.6	81.2	22.4	81.4	22.1	83.6	22.0	80.9	24.7	99.9
75	12/2/97	09:00	21.5	8.0	21.8	4.5	21.5	69.5	21.8	69.8	21.9	70.6	22.1	70.1	22.3	69.9		
75	12/4/97	07:55	21.1	6.7	21.4	5.2	21.0	56.8	21.0	60.1	21.1	64.4	21.3	63.2	21.3	62.8		
75	12/5/97	08:05	20.1	7.2	20.1	5.7	20.4	54.8	20.5	59.5	20.6	61.8	20.8	62.5	20.8	63.2	24.1	99.9
75	12/5/97	09:25	20.7	7.2			21.5	85.0	21.2	83.5	20.6	81.8	21.0	78.7	20.8	81.1		
75	12/8/97	07:50	21.1	6.6			21.5	86.6	21.3	87.5	21.3	86.2	21.3	86.8	21.2	86.3	24.2	99.9
76	12/9/97	08:45	21.2	7.1	21.2	4.6	21.0	68.7	21.2	70.3	21.2	72.6	21.4	71.0	21.4	71.9		
76	12/11/97	07:50	20.7	7.0	21.2	5.0	20.8	61.9	21.0	66.4	20.8	70.2	21.1	69.4	21.2	68.8		
76	12/12/97	07:40	20.9	6.6	20.8	5.6	20.7	60.8	20.6	66.2	20.8	66.8	20.9	67.6	21.0	66.5		
76	12/12/97	09:05	21.3	6.4			22.4	77.1	22.1	73.6	21.1	79.6	21.1	77.5	21.2	76.1	24.2	99.9
76	12/13/97	07:50	21.1	7.1													24.5	99.9
77	12/16/97	08:40	22.2	7.8	22.2	4.4	22.3	67.8	22.4	69.4	22.6	69.1	22.8	69.3	22.8	69.6		
77	12/18/97	08:15	21.8	6.4	21.8	4.6	21.6	64.6	21.9	66.4	22.1	65.3	22.2	66.7	22.3	65.8		
77	12/19/97	08:30	22.1	5.8	22.2	5.0	21.8	63.9	22.1	64.3	22.2	63.3	22.3	65.6	22.4	64.5		
77	15/19/97	09:45	22.8	5.6			22.4	76.6	22.5	74.5	22.7	75.2	22.8	72.8	22.7	75.1	25.1	99.9
77	12/22/97	08:10	21.3	5.9			22.1	82.1	21.6	80.5	21.5	79.9	21.3	79.8	21.5	79.1	24.3	99.9
78	12/23/97	08:45	20.7	6.4	21.2	4.6	20.7	74.3	20.7	72.7	20.8	72.5	21.0	71.5	21.0	72.8		
78	12/26/97	08:30	20.5	6.0	21.1	5.3	21.0	60.5	20.7	68.8	21.0	62.2	21.2	63.1	21.3	64.5	24.8	99.9
78	12/26/97	10:25	21.5	5.8			23.3	78.4	22.7	77.1	22.5	77.4	22.2	78.1	22.1	77.2		
79	12/30/97	09:15	21.3	5.7	21.5	4.5	20.8	67.4	20.9	68.7	21.0	67.2	21.1	67.8	21.0	69.3		

Table A1.1. Temperature and relative humidity (p. 21/21).

Week	Date	Time	Ambient		Desiccant		Cell 2		Cell 4		Cell 6		Cell 10		Cell 12		Humidifier[1]	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH			T	RH
79	1/6/98	08:10	20.0	6.3			21.9	82.4	20.9	81.8	20.7	81.0	20.7	80.0	20.8	80.5	24.5	99.9

APPENDIX 2

DRAINAGE QUALITY TABLES

Table A2.1 Drainage quality from 0.12% sulfate siltite-argillite sample (0.12% S,sample number 10696, cell 7).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	5.91	-5	112	31.1	10.4	2.4	4.2	3.7	0.07	7.2	0.014	0.009	0.006	0.003	0.001	0.019
1	xxx	6.64	12.5	70	22.1	6.1	1	2.7	2.7	0.022	10.8	0.001	0.005	0.006	0.001	0.001	0.012
2	xxx	6.66	10	50	14.8	4.2	1	1.9	2	0.03	10.9	0.002	0.003	0.007	<0.001	0.005	0.032
3	xxx	6.41	10	38.5	9.6	2.6	0.7	1.7	2.2	0.1	12.5	<0.001	<0.001	0.009	<0.001	0.001	0.036
4	xxx	6.35	15	33.5	8.6	2	<0.1	1.6	1.9	0.2	9.5	0.033	<0.001	0.008	0.001	0.003	0.008
5	187	6.63	10	32.5													
6	192.7	6.45	10	27.5	7.4	1.9	0.4	1.2	1.8	0.1	8.9	<0.001	<0.001	0.011	0.001	0.01	0.013
7	190.7	6.49	10	29.5													
8	178.7	6.51	12.5	26.5	8.9	1.9	0.7	1	1.9	0.1	7	<0.1	0.1	0.008	<0.001	0.004	0.046
9	162.4	6.50	10	22.5													
10	190.9	6.62	7.5	25.5	5.9	1.8	<0.1	0.8	1.8	<0.1	3	<0.1	<0.1	0.007	<0.001	0.004	0.035
11	199.2	6.8	7.5	25													
12	199.9	6.67	5	19	7.28	1.6	0.1	0.6	2.5	0.008	10.1	0.031	0.006	0.005	0.001	0.003	0.012
13	216.2	6.58	5	46													
14	190.5	6.57	7.5	39	14.75	4.6	0.3	0.5	1.7	0.005	9.1	0.001	0.003	0.003	<0.001	0.034	0.056
15	218.5	6.56	7.5	21													
16	171.5	6.43	5	27	8.98	2.6	0.2	0.4	1.8	0.012	7.8	0.001	0.003	0.004	0.002	0.009	0.037
17	196.7	6.68	7.5	32.5													
18	155.3	6.62	7.5	23	8.39	2.4	0.2	0.4	1.6	0.43	6.7	0.02	<0.02	0.032	0.001	0.008	0.026
19	156.8	6.71	7.5	21.5													
20	199.7	6.46	7.5	15.5	6.88	1.4	0.2	0.3	1.4	0.28	8.4	<0.02	<0.02	0.009	<0.001	0.001	0.034
21	164.3	6.61	5	15.5													
22	253.0	6.62	5	17.5													
23	-139.7	6.67	5	18													
24	-68.1	6.46	5	19	7.92	1.2	<0.1	0.5	1.2	<0.1	7	0.02	<0.1	0.005	0.001	0.001	0.02
25	-140.7	6.33	5	17													
26	-119.2	6.96	5	16													
27	-182.6	6.88	5	17													
28	-0.6	6.34	5	15.5	3.8	1.4	<0.1	0.2	1.4	<0.1	5	<0.02	<0.1	0.002	<0.001	0.001	0.02
29	-67.3	6.34		18.5													
30	-59.1	6.42		15.5													

Table A2.2 Drainage quality from 0.12% sulfate siltite-argillitite sample (0.12% S, sample number 10696, cell 8).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	6.02	<-5	109	30.6	9.8	1.3	3.9	3.4	0.023	7	0.01	0.006	0.006	0.002	0.001	0.015
1	xxx	6.29	7.5	75	23.6	6.3	1	3	2.7	0.022	11.4	0.006	0.005	0.006	0.001	0.001	0.011
2	xxx	6.42	7.5	45	13.2	3.7	0.7	1.7	1.7	0.027	8.8	0.004	0.003	0.01	<0.001	0.003	0.039
3	xxx	6.45	10	46.5	12.8	3.1	0.6	2.2	2	0.007	10.1	<0.001	<0.001	0.005	0.026	0.001	0.034
4	xxx	6.38	15	39	10.5	2.6	0.6	1.6	1.7	0.2	<1	<0.001	0.003	0.005	0.001	0.002	0.091
5	186.7	6.59	5	34													
6	196.5	6.51	10	30	8.1	2.1	0.1	1.5	1.9	0.02	7.2	<0.001	<0.001	0.007	0.001	0.01	0.012
7	190.8	6.55	10	27													
8	178.6	6.56	5	23	6.5	1.5	0.5	0.8	1.8	0.2	5.8	<0.1	<0.1	0.008	0.001	0.011	0.04
9	163.7	6.53	7.5	23.5													
10	192.6	6.65	7.5	22	6.47	1.7	0.2	0.7	1.7	<0.1	2.2	<0.1	<0.1	0.006	0.001	0.004	0.036
11	200	6.85	5	24.5													
12	202.1	6.74	7.5	19	6.72	1.6	0.1	0.5	1.7	0.006	8.3	0.056	0.002	0.005	0.001	0.003	0.013
13	218.6	6.71	5	19													
14	185.5	6.60	7.5	17.5	7.67	1.5	0.3	0.4	1.6	0.021	7	0.008	0.002	0.004	0.001	0.007	0.063
15	218.6	6.59	10	20.5													
16	171.1	6.53	12.5	19.5	6.63	1.7	0.3	0.5	1.8	0.17	7.2	0.02	<0.02	0.004	<0.001	0.004	0.045
17	195.6	6.76	10	20.5													
18	155.8	6.58	7.5	18	6.71	1.9	0.6	0.3	1.6	0.43	5.1	<0.02	<0.02	0.004	0.001	0.005	0.031
19	158.2	6.73	7.5	19													
20	200.7	6.53	5	19	7.51	1.7	0.2	0.4	1.6	0.38	7.7	<0.02	<0.02	0.004	<0.001	0.002	0.035

Table A2.3 Drainage quality from 0.12% sulfate siltite-argillite sample(0.16% S sample number 30696, cell 3[2]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	3.75	-22.5	263	85.2	19.8	3.4	1.6	8.6	1.1	<1	0.24	0.04	0.1	<0.001	0.007	0.13
1	236.9	3.75	-30	370	134.7	33	8.2	1.8	8.2	2.2	2	34.1	0.08	0.173	0.016	0.015	0.16
2	-95.9	3.91	-20	260	93.8	20.2	3.8	0.7	5.2	1	6.8	0.1	0.1	0.066	0.024	0.007	0.1
3	-55	3.97	-17.5	170	54.9	16.1	2.4	0.5	4.1	0.7	7	0.1	<0.10	0.05	0.012	0.007	0.1
4	-83.9	4.09	-12.5	135	46.3	10.9	1.7	0.3	3.1	0.4	5	0.06	<0.10	0.042	0.008	0.006	0.08
5	-53	4.04	-15	115													
6	-108.3	4.05	-15	100	33.2	7.3	1.1	0.2	2.2	0.1	4.6	<0.02	<0.10	0.026	0.004	0.004	0.06
7	50.9	4.03	-15	90													
8	-28	4.15	-12.5	80	24.8	6.1	1.1	0.3	2	0.3	7	<0.10	<0.10	0.018	0.005	0.005	0.06
9	-20.8	4.10	-12.5	75													
10	-75.4	4.14	-15	75	22.7	4.9	0.3	0.2	1.8	0.1	5	<0.10	<0.10	0.018	0.004	0.003	0.04
11	21	4.11	-10	65													
12	-26.9	4.16	-12.5	60	18.2	4.2	0.8	0.2	1.4	0.1	3	<0.10	<0.10	13	0.003	0.002	0.04
13	400.4	4.12	-15	70													
14	303.2	4.14	-10	65	19	4.2	0.5	0.1	1.4	0.1	3.5	0.1	<0.10	0.014	0.004	0.004	0.04
15	330.6	4.14	-12.5	70													
16	283.7	4.10	-12.5	60	19.7	3.9	0.3	0.1	1.5	<0.10	3.9	<0.10	<0.10	0.012	0.004	0.003	0.04
17	372.9	4.10	-10	62													
18	329.9	4.20	-12.5	55	14.3	3.4	0.9	0.2	1.1	<0.10	2.8	0.1	<0.10	0.013	0.003	0.004	0.05
19	295.7	4.17	-12.5	60													
20	325.5	4.20	-10	55	16.7	3	0.7	0.2	1.3	0.1	3.3	0.1	<0.10	0.012	0.002	0.002	0.04
21	327.5	4.15		55													
22	270.5	4.26		50													
23	222.4	4.12		50													
24	309.7	4.16	-7.5	50	14	2.4	0.2	0.1	1.2	0.1	1.1	<0.10	<0.10	0.012	<0.001	0.003	0.06
25	343.8	4.06		50													
26	340.2	4.35		40													
27	265.8	4.22		47													

Table A2.4 Drainage quality from 0.12% sulfate siltite-argillite sample (0.16% S, sample number 30696, cell 5).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	3.83	-25	298	114.4	26.3	4.5	2	11.5	1.4	2.3	0.8	0.051	0.124	0.025	0.009	0.2
1	xxx	3.91	-25	325	17	33.5	5.3	1.2	7	0.085	8.6	0.097	0.075	0.1	0.03	0.012	0.2
2	xxx	4.00	-25	185	66.3	17.6	3	0.6	4.6	0.8	4.9	0.015	0.036	0.078	0.013	0.009	0.1
3	xxx	4.15	-20	115	30.3	8.4	1.7	0.6	3.7	0.2	<1	0.042	0.013	0.028	0.005	0.003	0.065
4	xxx	4.11	-15	135	41.4	10	1.9	0.4	3.4	0.3	2.9	0.07	0.03	0.049	0.015	0.009	0.064
5	218	4.02	-10	100													
6	237.5	4.04	-12.5	100	30.6	7.3	1.5	0.3	2.5	0.2	2.8	<0.001	0.014	0.027	0.009	0.005	0.035
7	245.3	3.96	-10	100													
8	226.9	3.95	-10	95	27.8	6.4	1.4	0.2	2.4	0.3	2	<0.1	<0.1	0.038	0.008	0.012	0.085
9	194.6	3.96	-10	80													
10	220.9	4.12	-10	80	22.43	5.3	0.1	0.2	1.9	0.2	0.9	<0.1	<0.1	0.024	0.006	0.008	0.061
11	237.5	4.11	-12.5	75													
12	234.5	4.18	-5	56	17.18	4.3	0.6	0.1	1.7	0.064	4.8	0.051	0.011	0.022	0.008	0.005	0.05
13	241.5	4.19	-7.5	55													
14	212.9	4.24	-5	55	16.39	3.5	0.7	0.1	1.5	0.044	2.2	0.01	0.012	0.018	0.005	0.009	0.058
15	239.0	4.10	-7.5	60													
16	190.2	4.17	-7.5	65	16.1	3.5	0.5	0.1	1.6	0.193	1.4	0.009	0.011	0.018	0.005	0.005	0.045
17	214.2	4.10	-7.5	65													
18	170.0	4.10	-7.5	55	14.66	3.2	0.7	0.1	1.4	0.41	2.5	0.06	<0.02	0.015	0.002	0.007	0.051
19	185.7	4.09	-10	50													
20	223.0	4.07	-7.5	55	14.93	3.2	0.5	0.2	1.3	0.23	5.3	<0.02	<0.02	0.017	0.002	0.007	0.052
21	189.5	4.09	-7.5	60													
22	296.7	4.21	-12.5	55													
23	-75.8	4.20	-12.5	60													
24	-31.1	4.20	-10	60	16.3	4.2	0.3	0.1	1.1	0.1	3.9	0.03	<0.10	0.014	0.005	0.008	0.07
25	-67	4.26	-10	60													
26	-55.5	4.24	-7.5	53													
27	-37.3	4.15	-7.5	55													
28	83.4	4.16	-12.5	50	15.2	2.7	<0.1	0.1	1.1	1	3.5	<0.02	<0.1	0.012	0.002	0.003	0.04
29	-18.5	4.10		48													
30	13.4	4.21		50													
31	-70.8	4.15		45													
32	3.1	4.20	-10	46	11.6	2.4	<0.10	0.2	1.1	0.1	2	<0.10	<0.10	0.011	0.004	0.003	0.04
33	12.5	4.19		47													
34	423.6	4.20		50													
35	339	4.23		50													
36	400.8	4.18	-10	50	2.8	2.1	0.3	0.1	1.1	<0.10	3.2	<0.10	<0.10	0.01	0.003	0.003	0.04
37	359.1	4.16		50													
38	371.8	4.18		50													
39	330.6	4.24		45													
40	315.9	4.23	-10	45	12.6	1.9	0.2	0.1	1.1	<0.10	3.4	<0.10	<0.10	0.01	0.004	0.003	0.03
41	346.6	4.25		46													
42	341.6	4.20		41													
43	299.5	4.32		43													
44	266	4.18	-7.5	45	10.3	1.4	<0.10	0.1	1	<0.10	3.8	<0.10	<0.10	0.007	<0.001	0.002	0.06
45	329.8	4.2		38													
46	348	4.13		45													
47	353.4	4.40		31.5													
48	305	4.28	-5	39													

Table A2.5 Drainage quality from 0.22% sulfate siltite-argillite sample (0.24% S sample number 60696, cell 1).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as $CaCO_3$.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	7.21	12.5	178	34.7	22	3	4.1	1.7	0.032	11	0.002	0.003	0.003	0.001	0.001	0.007
1	xxx	7.44	22.5	60	97.8	8.4	1.3	2.4	0.8	0.01	12.9	0.002	0.001	0.002	0.001	0.001	0.002
2	xxx	7.10	20	44.5	6.8	5.6	1.2	1.6	0.6	0.019	11.2	0.003	0.001	0.005	<0.001	0.005	0.02
3	xxx	7.07	15	32.5	2.5	3.2	0.4	1.6	0.7	0.042	15.4	0.006	<0.001	0.003	0.001	0.002	0.032
4	xxx	6.86	15	38	3.3	4	0.5	1.6	0.6	0.004	13.1	<0.001	<0.001	0.002	0.001	0.002	0.006
5	156.5	7.30	15	34													
6	168.3	7.12	17.5	33	5.4	3.6	0.7	1.2	0.6	0.004	8.9	<0.001	<0.001	0.002	<0.001	0.001	0.01
7	154.3	7.08	15	31													
8	152.9	7.22	15	29	3.4	3.4	0.2	1.1	0.6	<0.1	7.7	<0.1	0.1	0.002	<0.001	0.018	0.037
9	131.1	7.26	10	25													
10	155.8	7.24	10	25	2.5	3.1	0.9	0.9	0.5	<0.1	3.2	<0.1	<0.1	0.002	<0.001	0.006	0.037
11	187.4	7.35	10	29.5													
12	186.5	7.25	10	26	2.2	2.9	0.9	0.8	30.6	<0.1	<1	<0.1	<0.1	<0.001	0.001	0.008	<0.001
13	193.6	7.24	12.5	25													
14	158.5	7.01	12.5	20.5	2.2	2.6	0.4	0.5	0.4	0.011	6.1	0.008	0.001	0.001	0.001	0.005	0.067
15	206.2	7.17	10	22													
16	152.8	6.89	7.5	22	2.6	2.6	0.4	0.5	0.5	0.008	6.9	0.002	0.001	0.001	<0.001	0.007	0.023
17	164.3	7.26	12.5	27.5													
18	143.2	7.10	10	21	2.1	2.7	0.4	0.6	0.4	0.27	6.4	<0.02	<0.02	0.002	<0.001	0.004	0.039
19	149.0	7.07	7.5	22													
20	162.5	6.92	10	18.5	1.9	2.4	0.4	0.5	0.4	0.1	7.8	0.02	<0.02	<0.001	<0.001	0.003	0.07
21	140.0	6.90	5	17.5													
22	198.2	6.85	10	23													
23	-215.0	7.06	7.5	20													
24	-118.4	6.69	7.5	17.5	5.2	2.2	0.5	0.4	0.3	0.4	7	0.1	<0.10	0.003	0.1	0.003	0.03
25	-160.2	6.84	5	17.5													
26	-123.0	6.86	5	18													
27	-194.7	6.97	7.5	18.5													
28	-85	7.02	7.5	16	1.45	2.1	0.1	0.3	0.4	0.2	5.7	0.12	<0.10	0.02	0.007	0.001	0.04
29	-108.1	7.04		19													
30	-103.8	6.71		19													
31	-119.7	6.90		16.5													
32	-84.5	6.65	7.5	14.5	1.2	2.2	<0.10	0.4	0.4	<0.10	4.7	<0.10	<0.10	0.005	0.001	<0.001	0.03
33	-71.5	6.58		15													
34	267	6.55		16.5													
35	212.3	7.15	5	18.5													
36	282.4	7.01	5	18.5	1.8	2.2	0.2	0.3	0.8	0.1	5.5	<0.10	<0.10	<0.001	<0.001	0.001	0.04
37	252.8	6.94		20													
38	336.1	7.05		18													
39	277.5	6.95		21													
40	215.9	6.73	7.5	16	1.5	2.1	0.5	0.3	0.3	<0.10	3.6	<0.10	<0.10	0.008	<0.001	0.001	0.03
41	241.2	6.70		15.5													
42	249.4	6.58		15.5													
43	197.6	6.96		15													
44	107.2	7.14	<5	15.5	1.6	2.1	<0.10	0.3	0.3	<0.10	6.6	<0.10	<0.10	0.001	<0.001	0.001	0.05
45	189	7.07		15.5													
46	247.6	7.08		15.5													
47	261.2	6.85		12													
48	153.7	7.38	<5	14.5													

Table A2.6 Drainage quality from 0.28% sulfate siltite-argillite sample(0.29% S, sample number 40696 cell 3).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	xxx	5	78	22.2	5.1	0.9	2.4	5.3	0.06	3.1	0.009	0.004	0.001	0.001	0.001	0.015
1	xxx	6.45	5	55	16	4.7	0.7	2.2	3	0.029	6	0.005	0.002	0.002	0.001	0.005	0.025
2	xxx	6.46	12.5	50	13.1	3.6	0.7	1.9	2.7	0.018	6.9	0.047	0.002	0.002	<0.001	0.003	0.021
3	xxx	6.90	15	42.5	10.8	2.6	0.7	1.7	2.2	0.024	8.1	0.006	<0.001	0.002	<0.001	0.041	0.03
4	xxx	6.84	12.5	35.5	8.7	2.3	0.6	1.4	1.8	0.1	5.3	0.008	<0.001	0.002	<0.001	0.002	0.01
5	199	6.98	10	38.5													
6	177.4	6.68	12.5	31	8.8	2.3	0.5	1.2	1.6	0.1	2.3	<0.001	<0.001	0.003	<0.001	0.002	0.01
7	178.8	6.99	12.5	26													
8	170.5	6.69	10	24.5	8.1	1.9	0.3	0.8	1.4	0.1	3.5	<0.1	<0.1	0.002	<0.001	0.004	0.043
9	146.9	6.85	5	23													
10	172.2	6.63	5	21	7.3	1.9	<0.1	0.6	1.1	<0.1	1.4	<0.1	<0.1	0.006	<0.001	0.004	0.038
11	185.6	7.03	10	21													
12	195.6	6.70	7.5	19	7.59	1.6	0.2	0.5	1.2	0.008	4.9	0.012	0.001	0.044	0.002	0.002	0.056
13	196.5	6.74	5	19													
14	171.4	6.61	7.5	16	7.86	1.6	0.3	0.4	0.9	0.011	2.6	0.003	0.001	0.001	0.001	0.005	0.071
15	210.8	6.64	5	19.5													
16	162.7	6.62	5	19.5	7.08	1.6	0.3	0.4	1	0.017	2.5	0.005	0.002	0.001	<0.001	0.003	0.004
17	184.0	6.82	10	17.5													
18	148.0	6.50	5	17.5	6.85	1.7	0.3	0.4	0.9	0.3	3.7	<0.02	<0.02	0.001	0.001	0.003	0.048
19	155.5	6.65	5	17.5													
20	172.9	6.64	5	16	7	1.6	0.3	0.5	0.8	0.12	4.9	<0.02	<0.02	0.002	<0.001	0.002	0.047

Table A2.7 Drainage quality from 0.28% sulfate siltite-argillite sample (0.29% S, sample number 40696, cell 4).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	xxx	N.S.	78	21.8	5.3	0.7	2.3	5.2	0.05	2.8	<0.001	0.004	0.003	0.01	0.002	0.018
1	xxx	6.69	7.5	60	17	4.8	0.8	2.3	3.2	0.014	7.6	0.003	0.003	0.003	0.018	0.009	0.031
2	xxx	6.49	10	39	10.5	2.9	0.3	1.4	2.1	0.016	6	0.002	0.001	0.003	<0.001	0.032	0.03
3	xxx	6.79	10	39	9.9	2.5	0.9	1.5	2.1	0.016	7.2	<0.001	<0.001	0.001	<0.001	0.002	0.036
4	xxx	6.74	10	31	7.5	2.1	0.5	1.1	1.7	0.1	3.9	0.021	<0.001	0.002	0.001	0.004	0.01
5	183	6.91	7.5	32													
6	180.9	6.84	7.5	30	8.5	2.4	0.4	0.9	1.6	0.005	4.2	<0.001	<0.001	0.002	<0.001	0.002	0.008
7	180.4	6.88	7.5	30													
8	169.6	6.67	7.5	24	7.2	2	0.4	0.6	1.4	0.1	3.2	<0.1	<0.1	0.002	<0.001	0.008	0.039
9	152.7	6.73	5	22													
10	177.1	6.66	7.5	20.5	5.28	1.8	0.2	0.5	1.2	<0.1	0.7	<0.1	<0.1	0.002	<0.001	0.005	0.046
11	188	6.88	7.5	17													
12	196.9	6.66	5	18.5	4.6	1.6	0.2	0.4	1.3	0.01	5.4	0.063	0.001	0.002	0.002	0.002	0.035
13	197.9	6.66	5	16.5													
14	173.7	6.56	5	19	6.06	1.6	0.4	0.23	1	0.01	2.4	0.003	0.001	0.002	0.002	0.007	0.068
15	213.8	6.63	5	17.5													
16	164.6	6.53	2.5	18	6.62	1.5	0.2	0.3	1	0.034	2.2	0.003	0.001	0.02	0.001	0.006	0.027
17	186.6	6.67	5	16.5													
18	151.9	6.51	2.5	14	6.45	1.5	0.2	0.3	0.8	0.35	3.4	<0.02	<0.02	0.002	<0.001	0.003	0.04
19	155.8	6.62	5	16.5													
20	179.0	6.53	5	16	7.57	1.5	0.4	0.3	0.8	0.19	5.5	0.04	<0.02	0.001	<0.001	0.006	0.033

Table A2.8 Drainage quality from 0.26% sulfate siltite-argillite sample (0.30% S, sample number 50696, cell 2).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	7.77	15	58	7.7	7	0.9	1.5	1.6	0.031	5.4	0.011	0.001	0.002	0.014	0.001	0.006
1	xxx	7.49	25	55	9.2	7.5	0.8	1.2	1.2	0.015	6	0.002	<0.001	0.001	0.009	0.002	0.015
2	xxx	7.19	20	50	6.8	7	0.9	1	1.1	0.022	8	0.003	0.001	0.004	<0.001	0.006	0.038
3	xxx	7.23	20	55	9.8	7.6	1.2	1.1	1.1	0.023	8.1	0.003	<0.001	0.001	0.001	<0.001	0.029
4	xxx	6.94	20	50	8	6.3	0.8	0.8	0.9	0.014	6.9	<0.001	<0.001	0.002	0.01	0.008	0.007
5	171	7.48	15	50													
6	174.9	7.18	13	45	7.7	5.7	0.6	0.6	0.8	0.1	4.1	<0.001	<0.001	0.004	0.014	0.002	0.009
7	167	7.24	13	41.5													
8	161.4	7.37	17.5	34	5.3	1.6	0.4	0.4	0.8	<0.1	4.1	<0.1	<0.1	0.002	0.007	0.014	0.043
9	137.5	7.30	15	31													
10	162.8	7.33	12.5	30.5	3.4	4.1	0.6	0.4	0.7	<0.1	1.4	<0.1	<0.1	0.001	0.001	0.006	0.034
11	180	7.53	20	42.5													
12	194.5	7.54	15	33	5.03	4.9	0.4	0.3	1	0.008	7	0.013	<0.001	0.001	0.008	0.003	0.025
13	191.9	7.45	15	36													
14	164.6	7.29	17.5	30	2.8	4.6	0.7	0.3	0.7	0.011	3.6	0.003	0.001	0.001	0.006	0.012	0.058
15	207.8	7.42	12.5	29													
16	157.0	7.08	12.5	29	2.9	3.8	0.5	0.2	0.7	0.026	3.8	0.006	0.001	0.001	0.007	0.01	0.028
17	173.2	7.48	12.5	30													
18	145.3	7.29	10	28	2.8	4.6	0.6	0.5	1.2	0.31	4.5	0.05	<0.02	0.001	0.001	0.005	0.035
19	150.3	7.45	12.5	29													
20	165.0	7.18	12.5	26	2.3	3.9	0.6	0.3	0.6	0.1	6	<0.02	<0.02	<0.001	0.001	0.003	0.023
21	146.4	7.27	10	26													
22	187.5	7.18	10	29													
23	-214.3	7.34	12.5	26													
24	-115.9	6.92	12.5	25	2.3	3.8	1	0.2	0.5	<0.1	5.6	0.02	<0.1	0.001	0.086	0.002	0.03
25	-160.5	6.91	7.5	25.5													
26	-123.7	6.81	10	26													
27	-177.6	6.90	15	23.5													
28	-50.3	6.98	10	23	1.6	3.3	0.3	0.2	0.6	<0.1	3.9	<0.02	<0.1	0.014	<0.001	0.005	0.05
29	-89.9	6.92		22													
30	-108.7	6.79		23.5													
31	-132.7	6.87		20.5													
32	-77.6	6.78	10	19.5	1.6	3	<0.10	0.2	0.7	0.1	4.6	<0.10	<0.10	0.002	<0.001	<0.001	0.03
33	-74.5	6.71		18													
34	262.1	6.67		21													
35	222.5	7.19	10	22													
36	273.4	7.18	10	20	12.5	2.9	0.5	0.1	0.7	<0.10	3.6	<0.10	<0.10	0.022	0.003	0.005	0.03
37	258.6	7.07		22													
38	325	6.96		27													
39	271.2	7.00		20.5													
40	216.4	6.96	10	21.5	1.9	3.1	0.4	0.2	0.5	<0.10	2.7	<0.10	<0.10	0.004	0.001	0.002	0.03
41	247.4	6.87		23													
42	255	6.85		18.5													
43	164.5	6.95		19													
44	116.5	7.22	7.5	16.5	1.6	3.7	<0.10	0.1	0.4	<0.10	3.3	<0.10	<0.10	<0.001	<0.001	0.001	0.05
45	213.7	7.26		18.5													
46	246.7	7.22		18													
47	268.4	7.07		13.5													
48	153.5	7.46	7.5	16.5													

Table A2.9 Drainage quality from 0.44% SO4 siltite-argillite sample(0.38% S, sample number 71196, cell 4[2]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	3.19	-3050	3000	4911	302	403	5.8	4.8	494	4	5.69	9.14	19.7	3.9	2	15.21
1	308.7	3.30	-465	1350	826.8	96.8	46.1	2.1	1.8	53.6	11	0.5	1.26	4.1	0.5	0.2	2.21
2	44	3.31	-182.5	650	306	45.1	17.4	1.3	1.5	23.1	18.7	0.3	0.6	2.4	0.2	0.077	1.1
3	90	3.22	-110	500	198	24.5	10.6	1.1	1.4	14.6	18.6	0.3	0.4	1.8	0.082	0.047	0.85
4	45.4	3.27	-110	500	176.9	16.5	7.4	0.9	1.3	11.7	13	0.32	0.3	1.6	0.065	0.036	0.65
5	41	3.13	-107.5	500													
6	6.1	3.05	-115	500	152.8	10.3	4.8	0.6	1.4	10.6	14.8	0.48	0.2	1.4	0.1	0.023	0.49
7	182	3.02	-120	500													
8	34.5	3.04	-95	390	114.2	5.3	3.4	0.5	1.2	7.7	15	0.6	0.1	0.9	0.024	0.015	0.3
9	78.3	3.11	-105	445													
10	16.6	3.09	-120	445	106.8	3.4	1.5	0.4	1.1	6.6	14	0.7	0.1	0.8	0.018	0.013	0.24
11	76.2	3.01	-95	415													
12	73.2	3.01	-90	415	96	2.5	1.7	0.5	1.1	5.8	13	0.6	<0.10	0.6	0.015	0.011	0.2
13	494.4	3.07	-95	420													
14	412.0	3.12	-82.5	375	81.1	2.6	1.2	0.3	1	4.3	11.8	0.5	<0.10	0.5	0.011	0.01	0.16
15	434.6	3.12	-85	365													
16	387.8	3.07	-105	390	88.8	1.5	0.7	0.4	1.1	4.3	9.5	0.5	0.1	0.5	0.012	0.01	0.16
17	371.8	3.21	-75	280													
18	361.6	3.15	-70	300	64.5	1	1	0.3	1	4	8.1	0.3	<0.10	0.4	0.009	0.009	0.14
19	340.5	3.23	-60	315													
20	385.3	3.22	-70	305	62.9	0.8	1	0.4	1.2	3.3	8.3	0.3	<0.10	0.4	0.008	0.006	0.13
21	360.0	3.17		295													
22	335.5	3.27		235													
23	306.5	3.15		280													
24	364.9	3.20	-45	260	53.1	1.8	0.7	0.4	1.4	2.6	8.9	0.1	0.1	0.3	0.002	0.006	0.14
25	392.4	3.10		290													
26	388.5	3.46		185													
27	336.5	3.30		250													
28	416.6	3.32	-70	245													
29	337.1	3.24		240													
30	356.7	3.24		215													
31	379.5	3.29		235													
32	303.2	3.37	-60	208													
33	365.6	3.22		210													
34	341.3	3.27		205													
35	322.7	3.32		230													
36	480.6	3.36	-50	225	56.7	<0.10	0.3			2.2							
37	457.6	3.29		210													
38	459	3.44		200													
39	438.5	3.39		190													
40	460.8	3.46	-35	170	42.7	0.4	0.2										
41	479.7	3.48		185													
42	399.3	3.45		190													
43	424.4	3.49		180													
44	457.9	3.50	-27.5	160	52.4	0.3	0.1										
45	443.1	3.48		155													
46	470.8	3.51		165													
47	444.6	3.49		173													
48	NA	3.54	-35	130	58.2	0.2	0.2										

Table A2.10 Drainage quality from 0.43% sulfate siltite-argillitite sample (0.42% S, sample number 21196, cell 8).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	3.16	-1385	xxx	1635	74.1	36.8	1.2	3.8	223	1	6.02	1.86	5.1	0.8	0.4	2.57
1	335.6	3.19	-1155	2000	1341	63.8	55.1	0.6	1.9	147	4	6.93	1.6	4.1	0.7	0.3	1.94
2	64.6	3.22	-475	1850	534	48.9	23.6	0.6	1.4	61.9	8	1.1	0.7	2.2	0.3	0.1	0.9
3	88.9	3.15	-252	>5000	354	40.2	15.2	0.5	1.3	36.9	8.5	0.5	0.5	1.6	0.2	0.059	0.63
4	19.5	3.24	-167.5	750	256.1	24.6	7.4	0.4	1.2	0.3	6.5	0.57	20.6	1	0.063	0.034	0.36
5	32.7	3.04	-145	600													
6	20.2	2.89	-175	550	220.5	18.9	4.5	0.3	1	15.6	7.9	2.2	0.2	0.8	0.2	0.023	0.24
7	314.9	2.83	-175	650													
8	-13	2.78	-172.5	650	199.5	12.2	3.8	0.4	0.8	11.5	10.6	4.6	0.1	0.7	0.088	0.022	0.17
9	121.4	2.83	-190	600													
10	72.9	2.78	-205	700	197.9	9.2	1.6	0.3	0.5	8.5	8	5.2	0.1	0.6	0.029	0.018	0.14
11	119.4	2.71	-175	700													
12	91.2	2.71	-150	650	186.5	9.2	3	0.4	0.5	7.1	7.6	5	<0.10	0.5	0.025	0.016	0.12
13	549.3	2.77	-162.5	700													
14	512.4	2.80	-140	800	155.2	7.6	1.6	0.3	0.6	4.8	6.9	3.1	<0.10	0.4	0.021	0.015	0.1
15	522.6	2.83	-130	600													
16	494.1	2.80	-142.5	600	124.8	3.7	0.7	0.3	0.6	3.1	6.6	1.8	<0.10	0.3	0.015	0.009	0.08
17	337.8	2.84	-105	500													
18	391.3	2.87	-95	500	100.2	3.4	1.1	0.3	0.6	2.5	5.5	1.1	<0.10	0.3	0.012	0.009	0.08
19	427.4	2.98	-82.5	550													
20	434.7	2.98	-80	490	92.6	2.3	0.8	0.4	0.8	1.6	5.3	0.8	<0.10	0.3	0.009	0.009	0.09
21	399.6	2.96		415													
22	371.5	3.05		390													
23	344.0	2.93		440													
24	348.7	2.99	-60	360	72.4	1.7	1	0.3	1	1.1	5.1	0.3	0.1	0.2	0.006	0.01	0.09
25	369.1	2.93		390													
26	403.8	3.22		290													
27	359.5	3.14		320													
28	462.1	3.15	-65	310													
29	372.8	3.08		320													

Table A2.11 Drainage quality from 0.96% sulfate siltite-argillite sample(0.94% S,sample number 20696, cell 6).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	5.51	<-5.0	72	21.5	4.7	0.5	1.1	7.3	0.112	20.3	0.017	0.005	0.004	0.003	0.001	0.023
1	xxx	5.43	<-5.0	85	29	5.7	0.8	1.1	7.6	0.074	9.6	0.002	0.004	0.008	0.002	0.001	0.019
2	xxx	6.16	<-5.0	65	21	4.4	0.9	0.8	6	0.042	7.7	0.003	0.003	0.005	0.002	0.003	0.033
3	xxx	5.39	<-5.0	55	17.1	3.2	1	0.8	5	0.1	7.7	<0.001	<0.001	0.002	0.001	0.002	0.064
4	xxx	5.23	<-5.0	45	13.5	2.8	0.6	0.6	4.2	0.2	2.8	0.067	<0.001	0.003	0.002	0.004	0.011
5	203	5.06	<-5.0	50													
6	206.4	5.54	<-5.0	43	13.9	2.6	0.4	0.4	3.9	0.2	4.1	<0.001	<0.001	0.003	<0.001	0.001	0.011
7	219.7	5.07	-5.00	40													
8	196.9	5.08	-5	33	10.1	2	0.7	0.3	3.3	0.1	2.2	<0.1	<0.1	0.003	<0.001	0.009	0.039
9	177.7	5.08	-5	33.5													
10	208.2	5.19	-5	32	9.05	1.8	<0.1	0.2	3.1	0.2	1.1	<0.1	<0.1	0.024	0.006	0.008	0.061
11	214.5	5.38	-5	26													
12	215.8	5.28	-5	24	8.01	1.4	0.2	0.1	2.8	0.032	5.9	0.065	0.002	0.002	0.001	0.002	<0.001
13	228.2	5.1	-2.5	33													
14	202.4	5.22	<-5	24	7.54	1.5	0.4	0.5	2.7	0.02	2.9	0.009	0.002	0.001	0.001	0.004	0.072
15	229.4	5.05	<-5	26.5													
16	182.2	5.06	-2.5	27.5	7.87	1.5	0.2	0.1	2.8	0.039	1.9	0.006	0.002	0.002	0.004	0.001	0.029
17	206.4	5.11	-5	29													
18	161.7	5.14	-7.5	24.5	7.43	1.5	0.2	0.1	2.5	0.37	4	0.07	<0.02	0.001	0.001	0.007	0.039
19	168.7	5.14	-7.5	22													
20	214.3	5	-7.5	23.5	6.84	1.5	0.2	0.1	2.2	0.28	4.4	<0.02	<0.02	0.003	<0.001	0.013	0.041
21	176.2	5.25	-7.5	21.5													
22	263	5.39	-7.5	23													
23	-102.9	5.36	-7.5	20.5													
24	-29.5	5.26	-2.5	21	7.03	1.1	0.1	<0.1	1.7	<0.1	4.5	0.02	<0.1	0.003	0.001	0.002	0.03
25	-106.9	5.32	-5	22													
26	-105.6	5.52	-2.5	20													
27	-165.4	5.72	-5	21													
28	15.3	5.17	-7.5	19	6.2	1.2	<0.1	0.1	1.8	<0.1	3	<0.02	<0.1	0.001	<0.001	0.001	0.03
29	-47.3	5.29		16													
30	-31	5.17		22													
31	-93.7	5.13		21.5													
32	-60.4	5.18	-5	18.5	6.3	1.4	<0.10	0.1	1.8	0.1	3	<0.10	<0.10	0.002	0.001	<0.001	0.03
33	-30.8	5.33		20.5													
34	374.5	5.32		24													
35	318.5	5.20		25													
36	356	5.19	-5	24	8.7	1.5	0.2	<0.10	1.9	<0.10	3.8	<0.10	<0.10	0.002	<0.001	0.003	0.02
37	308.7	5.20		25													
38	337.8	5.20		23													
39	303.4	5.27		22.5													
40	303.9	5.11	-5	24	9.2	1.8	0.2	<0.10	2	0.1	3.1	<0.10	<0.10	0.008	0.001	0.001	0.03
41	304.9	5.32		23.5													
42	301.2	5.57		21													
43	272.5	5.27		21													
44	230.7	5.13	<-5	26.5	7.9	2	<0.10	0.1	2.1	<0.10	3.7	<0.10	<0.10	0.001	<0.001	0.001	0.05
45	297	5.16		22													
46	308.4	5.14		24													
47	321.9	5.4		16.5													
48	266.7	5.22	<-5	22													
49	348.7	5.24		22.5													
50	264.8	5.18		20													
51	316.6	5.25		19													
52	325.6	5.22	<-5	21.5													
53	243.7	5.26		22													
54	316.6	5.15		23													
55	282.9	5.08		25													
56	291.8	5.08	<-5	28.5	13.2	2.1	0.3										
57	432.4	5.07		27													
58	408.5	5.17		25.5													
59	422	5.16		24													
60	402.9	5.08	<-5	24.5	6.5	1.4	0.3										
61	447.8	5.11		28.5													
62	441.8	5.15		27													
63	336.2	5.11		28													
64	369.4	5.15	-5	31.5	6.1	1.5	0.2										
65	375.7	5.19		23.5													
66	372.7	5.16		25.5													
67	407.4	5.19		24.5													
68	379.2	5.1		30	4.9	1.8	0.2										
69	NA	5.06		26.5													
70	NA	4.96		30													
71	331.7	4.54		28													
72	398.7	4.7	-7.5	34		2.2	0.2										

Table A2.12 Drainage quality from 1.85% sulfate siltite-argillitite sample(1.93% S, sample number 81196, cell 11[2]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	3.26	-1210	2850	2401	228	186	7.3	6.8	198	2	3.16	4.94	7.6	1.8	1.1	7.67
1	332.4	3.40	-1190	2500	1934	163	132	6	5.9	135	3	2.26	3.91	5.8	1.2	0.9	5.5
2	41.2	3.45	-520	1500	920	113.5	63	2.4	3.7	63.2	11.7	0.3	1.8	3	0.6	0.344	2.5
3	78.9	3.47	-195	900	469	74.9	26	1.2	2.8	27.5	10	0.2	0.8	1.6	0.2	0.142	1.2
4	28.1	3.64	-130	650	309.2	55.4	17.8	0.9	2.7	15.6	8.4	0.13	0.5	1.2	0.116	0.094	0.74
5	36.9	3.54	-85	490													
6	-4.2	3.5	-72.5	435	182.2	34.7	7.8	0.6	2.8	8.4	8	0.02	0.2	0.8	0.2	0.035	0.39
7	148	3.51	-75	370													
8	-46.6	3.56	-55	290	121.5	23.2	4.8	0.5	2.2	5	8.8	0.1	0.1	0.5	0.034	0.213	0.22
9	73.3	3.58	-75	325													
10	-1	3.55	-85	290	101.5	17.6	2.8	0.5	2.6	4.6	7.8	0.1	0.1	0.4	0.024	0.018	0.18
11	16.4	3.51	-55	265													
12	10.3	3.51	-45	245	77.7	13.7	2.6	0.5	2.4	3.7	6	0.1	<0.10	0.4	0.018	0.013	0.13
13	451.9	3.5	-60	245													
14	416.4	3.58	-40	215	62.4	9.7	1.7	0.3	2.2	2.6	6	0.1	<0.10	0.3	0.013	0.01	0.1
15	452.1	3.52	-47.5	225													
16	396.4	3.49	-55	205	25.9	7.6	1.3	0.4	2.5	2.4	5.9	0.3	<0.10	0.3	0.01	0.008	0.09
17	426.6	3.50	-40	205													
18	393.0	3.56	-40	165	50.5	6.2	1	0.3	2	2.2	4.4	<0.10	<0.10	0.2	0.01	0.009	0.09
19	391.7	3.62	-32.5	180													
20	432.5	3.59	-30	175	45.3	4.8	0.7	0.3	2.4	1.8	4.8	0.1	<0.10	0.2	0.006	0.005	0.08
21	410.1	3.53		175													
22	353.8	3.64		140													
23	320.6	3.5		160													
24	357.6	3.52	-30	150	39.4	4.1	0.9	0.3	2.5	1.5	6.4	<0.10	<0.10	0.2	0.002	0.008	0.1
25	363.6	3.47		155													
26	380.5	3.71		135													
27	333.4	3.64		140													
28	421.8	3.65	-25	125													
29	345.4	3.57		135													
30	397	3.56		120													
31	381.4	3.63		125													
32	325.8	3.67	-25	115													
33	379.3	3.6		115													
34	342.1	3.61		130													
35	336	3.62		130													
36	466.5	3.66	-20	105	37.3	2	0.2	0.2	2.2	0.9	4.2	<0.10	<0.10		<0.10	<0.10	<0.10
37	432.5	3.66		115													
38	382	3.74		110													
39	409	3.71		105													
40	419	3.7	-20	100	27.4	1.4	0.3										
41	438	3.76		100													
42	409.2	3.72		105													
43	386.3	3.81		90													
44	417	3.8	-15	90	35.4	1.1	0.2										
45	407.8	3.77		90													
46	419.4	3.82		85													
47	397	3.87		73													
48	381.9	3.8	-17.5	80	32.6	0.9	0.2										

Table A2.13. Drainage quality from 0.14% sulfide siltite-argillite sample(0.16% S, sample number 70597, cell 1[2]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	304.2	4.40	-15	240	105	3.1	10.1	8.1	14.8	0.7		0.1	0.4	2	<0.10	0.1	0.2
1	273.6	4.32	-80	300	142	4.1	13.7	5.5	11.6	1.3		0.2	0.5	19	0.1	<0.10	0.3
2	390.4	4.43	-35	210	87.5	2.7	7.8	2.6	8.1	0.8	3.3	0.1	0.3	12	<0.10	<0.10	0.2
3	328.4	4.40	-32.5	160	66.2	2.3	5.9	1.4	5.9	0.7	17	<0.10	0.2	10.4	<0.10	<0.10	0.1
4	329.6	4.42	-25	145	64.6	2	5.4	1.1	5.3	0.9		<0.10	0.2	11.6	<0.10	<0.10	0.1
5	261.9	4.28		160													
6	289.7	4.25	-25	135	55.6	1.6	4.2	1	5.4	1	3	0.2	0.2	10.4	<0.10	<0.10	0.1
7	318	4.33		130													
8	260.3	4.31	-20	130	58.2	1.1	3.2	0.8	4.1	0.1	3	0.1	0.1	9.7	<0.10	<0.10	0.1
9	294.7	4.40		105													
10	276.2	4.42	-17.5	90	38.9	0.9	2.5	0.5	2.5	0.7	6	<0.10	0.1	7.8	<0.10	<0.10	0.1
11	299.2	4.43		90													
12	314.1	4.44	-35	85	43.3	0.8	2.1	0.4	2.1	0.6	3	0.1	0.1	7.3	<0.10	<0.10	0.1
13	296.4	4.41		85													
14	NA	4.34	-25	75	37.6	0.5	1.2	0.4	2	0.6	2	0.1	0.1	6.2	<0.10	<0.10	0.1
15	NA	4.32		75													
16	330.6	4.29	-17.5	82	34.6												

Table A2.14 Drainage quality from 0.26% sulfide siltite-argillite sample(0.28% S, sample number 30597, cell 2[2]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	327.5	3.61	-60	255	109	7.4	3.1	7	16.1	5.5		2.1	0.2	0.2	<0.10	<0.10	0.1
1	308.5	3.53	-105	205	132	7.7	4.2	4.1	6.1	9.6		1.5	0.3	0.3	<0.10	<0.10	0.1
2	457.1	3.56	-85	260	121	4.8	2.9	2	4.4	7.4	4.9	0.7	0.2	0.2	<0.10	<0.10	0.1
3	477.3	3.30	-105	340	141	4.1	2.7	1.4	3.7	12.6	4.9	0.6	0.1	0.3	<0.10	<0.10	0.1
4	535.6	3.03	-305	750	310	3.5	2.5	1.6	3.5			4.7	0.1	0.6	0.1	0.1	0.1
5	527.6	2.81		850													
6	540.9	2.70	-390	1000	468	2.3	1.7	1.4	1.3	33.5	16	20.1	0.1	0.6	0.1	0.1	0.1
7	541.3	2.75		950													
8	531.1	2.68	-420	1150	444	1.3	1.4	1.3	0.7	22.6	14	23	<0.10	0.5	0.1	0.1	<0.10
9	518.3	2.72		950													
10	519.2	2.74	-245	850	286	0.6	1	1	0.6	12.3	13	16.6	<0.10	0.3	<0.10	<0.10	<0.10
11	533.5	2.71		700													
12	552	2.76	-250	800	366	0.5	1.1	0.9	0.5	8.5	11	13.9	<0.10	0.2	<0.10	<0.10	<0.10
13	506.4	2.80		600													
14	NA	2.77	-225	550	268	0.4	0.6	1	0.4	6	7	11.1	<0.10	0.2	<0.10	0.1	<0.10
15	NA	2.71		700													
16	588	2.66	-165	725	329												

Table A2.15 Drainage quality from 0.34% sulfide siltite-argillite sample(0.36% S, sample number 60597, cell 5[2]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	330.2	3.67	-90	280	118	2.2	1.7	7.7	11.7	8.5	1.9	2	0.1	5	<0.10	<0.10	0.1
1	342.4	3.59	-140	330	164	2.4	2	4	6.4	13.5		1.8	0.2	7.7	0.1	<0.10	<0.10
2	506	3.45	-200	430	213	2.2	1.6	2.3	5.5	24.2	5.7	0.7	0.1	8.1	0.1	<0.10	0.1
3	540.1	3.10	-340	750	350	2.4	1.2	1.6	4.5	44.2	5.6	2.3	0.1	9.7	0.1	0.1	0.1
4	542.3	3.11	-345	750	350	1.3	1	1.6	4	42.5	14	3.4	<0.10	9.3	0.1	0.1	0.1
5	517.5	3.02		650													
6	521.8	2.94	-305	750	309	0.7	0.5	1.4	2.6	31.8	16	5.5	<0.10	7.1	0.1	0.1	<0.10
7	515.6	2.99		550													
8	533.8	2.91	-305	800	293	0.7	0.3	1.2	1.8	23.9	13	6.6	<0.10	5.3	0.1	0.1	<0.10
9	503.9	2.95		750													
10	527.3	2.93	-190	650	302	0.4	0.3	0.8	1.3	16.6	13	6.4	<0.10	3.7	0.1	<0.10	<0.10
11	520.8	2.90		600													
12	542.2	2.92	-227.5	650	267	0.3	0.3	0.8	1.1	13.3	12	7.1	<0.10	2.8	<0.10	<0.10	<0.10
13	510.3	2.95		550													
14	525.2	2.89	-205	500	252	0.3	<0.10	0.9	1.1	9.9	12	6.8	<0.10	2.2	<0.10	<0.10	<0.10
15	NA	2.80		650													
16	498.5	2.75	-170	675	265												

Table A2.16 Drainage quality from 0.44% sulfide siltite-argillite sample(0.47% S, sample number 80597, cell 7[2]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	291	4.87	-10	310	125	7.4	20.9	6.5	11.1	0.3		0.1	1	0.2	<0.10	<0.10	0.2
1	291.5	4.97	-10.0	390	172	10.2	31.8	4.6	7.7	0.3	4.9	0.1	1.9	0.2	<0.10	<0.10	0.3
2	399.4	5.12	-8	290	135	6.6	20.4	2.7	5.5	0.2	12.6	<0.10	1.2	0.1	<0.10	<0.10	0.2
3	392.5	5.08	-5	175	72.7	3.9	12.6	1.3	3.2	0.2	10.9	<0.10	0.7	<0.10	<0.10	<0.10	0.1
4	320.7	5.21	-5	155	62.7	3.3	11.8	1.3	2.8	0.1	2	<0.10	0.7	<0.10	<0.10	<0.10	0.1
5	380.4	5.21		135													
6	371.6	5.29	-7.5	130	64.6	2.7	10.4	0.9	2.3	0.1	2	0.1	0.6	<0.10	<0.10	<0.10	<0.10
7	406	5.31		125													
8	301.8	5.32	-7.5	125	60.4	2.6	9.6	0.7	1.9	0.2	2	<0.10	0.6	<0.10	<0.10	<0.10	<0.10
9	340.7	5.41		120													
10	363.9	5.40	-7.5	100	47.8	1.9	8.2	0.5	1.5	<0.10	2	<0.10	0.4	<0.10	<0.10	<0.10	<0.10
11	352.5	5.38		90													
12	377.9	5.40	-7.5	90	50.8	1.5	7.1	0.4	1.2	<0.10	2	<0.10	0.4	<0.10	<0.10	<0.10	<0.10
13	360.4	5.41		80													
14	NA	5.47	-7.5	70	39.9	1.2	5.8	0.3	1	<0.10	1	<0.10	0.3	<0.10	<0.10	<0.10	<0.10

Table A2.17 Drainage quality from 0.14% sulfide siltite-argillite sample(0.47% S, sample number 20597 cell 3[3]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	325.7	3.70	-182.5	1300	985	172	59.6	5.3	11.7			0.2	1.5	1.6	0.5	0.3	1.6
1	307.4	3.72	-140	950	590	114	39.2	2.6	10.6	12.3		0.1	1	1.1	0.4	0.2	1.1
2	460.7	3.82	-75	850	352	72.5	21.3	1.1	7.5	5.9	7.6	0.1	0.6	0.7	0.2	0.1	0.6
3	438.9	3.82	-35	460	211	48.3	13	0.6	5.4	3.2	7.3	<0.10	0.3	0.4	0.1	0.1	0.4
4	439.9	3.90	-35	380	161	39.6	9.6	0.5	5.4	2.3	8	0.1	2	0.4	<0.10	0.1	0.3
5	435.4	3.85		310													
6	444.3	3.85	-30	280	119	28.5	5.5	0.3	4	1.3	7	0.1	0.1	0.3	<0.10	<0.10	0.2
7	468.8	3.89		290													
8	369.7	3.88	-20	245	92.8	20	3.9	0.3	3.7	1	6	<0.10	0.1	0.2	<0.10	<0.10	0.1
9	413.1	3.94		210													
10	450.5	3.98	-15	160	62.6	13.3	2.8	0.2	3	0.5	6	<0.10	0.1	0.2	<0.10	<0.10	0.1
11	430	3.97		155													
12	457.7	4.04	-20	135	66.6	9.9	2.1	0.2	2.7	0.4	4	<0.10	<0.10	0.1	<0.10	<0.10	0.1
13	426.5	4.04		143													
14	NA	4.01	-17.5	115	54.1	7.8	1.3	0.2	3.2	0.3	3	<0.10	<0.10	0.1	<0.10	<0.10	0.1
15	NA	3.97		125													
16	477.8	3.93	-12.5	110	48.4												

Table A2.18 Drainage quality from 0.56% sulfide siltite-argillitite sample (0.64% S,sample number 100597, cell 8[3]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	318.1	4.22	-50	500	231	11.5	36.9	3.9	8.8	4.2		0.9	1.4	0.9	0.1	<0.10	0.3
1	316.8	4.19	-90	600	313	16.8	54.5	3.4	6.3	5.4	4.6	1.6	2.4	1.1	0.2	0.1	0.6
2	433.8	4.32	-12.5	370	161	8.5	26.9	1.8	4.2	1.8		<0.10	1.2	0.5	0.1	<0.10	0.3
3	419.3	4.36	-12.5	265	120	5.9	20.3	1.1	3.1	1.4	1.7	<0.10	0.9	0.4	<0.10	<0.10	0.2
4	366.5	4.37	-17.5	270	127	5.8	21.3	1.1	3.1	2	4	0.1	0.9	0.5	<0.10	0.1	0.2
5	400.8	4.30		165													
6	411.5	4.20	-32.5	290	143	5	24.2	0.8	2.7	3	4	0.1	1	0.6	0.1	<0.10	0.2
7	443.5	4.24		315													
8	363.6	4.27	-30	285	140	4.2	23.7	0.7	2.3	2.1	3	<0.10	1	0.4	0.1	<0.10	0.2
9	376.8	4.42		235													
10	388.9	4.53	-10	170	74.1	1.8	14.2	0.4	1.3	0.6	2	0.1	0.6	0.2	<0.10	<0.1	0.1
11	381	4.56		175													
12	394.2	4.71	-10	150	87.6	1.4	13.3	0.3	1	0.3	2	<0.10	0.5	0.1	<0.10	<0.10	0.1
13	382.8	4.76		130													
14	NA	4.80	-10	115	43.6	0.9	10.1	0.3	0.9	0.1	1	<0.10	0.4	0.1	<0.10	<0.10	0.1

Table A2.19 Drainage quality from 0.76% sulfide siltite-argillite sample (0.99% S, sample number 10597, cell 14[3]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as $CaCO_3$.

week	Eh(mv)	pH	Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	376.1	3.04	-1040	1650	1337	88.6	39.5	0.2		127		15.3	1.1	1.5	0.6	0.2	1.1
1	394.6	2.96	-1260	1500	1296	46	39.1	0.4		107		3.8	1	14.7	0.5	0.2	1.1
2	566	2.60	-570	1800	828	19.3	16.3	0.4		53.1		19.2	0.4	7.8	0.2	0.1	0.4
3	598.1	2.33	-770	1750	969	12.5	12.1			52.2		69.8	0.3	6.5	0.2	0.1	0.4
4	594.3	2.35	-1180	2500	1200	9.7	9.5	0.4		97	14	127	0.2	5.1	0.2	0.1	0.3
5	584.2	2.28		2050													
6	580.7	2.2	-1080	2700	1183	4.3	6.2	0.3		31.2	14	146	0.1	3.2	0.2	<0.10	0.2
7	577	2.32		2200													
8	587.1	2.25	-1070	2650	1152	2.5	4.8	0.3		22.6	12	132	0.1	2.3	0.2	0.1	0.2
9	561.7	2.36		1450													
10	565	2.35	-560	2150	1061	1.2	2.7										
11	555.4	2.34		1750													
12	567.3	2.41	-585	1800	898	1.1	2.3	0.2		8.2	10		<0.10	1	0.1	<0.10	0.1
13	544.5	2.42		1525													
14	545.8	2.38	-590	1550	836	0.8	1.9	0.3		6.7	11		<0.1	1	<0.10	<0.10	0.1

Table A2.20 Drainage quality from 1.37% sulfide siltite-argillite sample(1.69% S, sample number 11196, cell 14).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	2.75	-1865	2300	1948	20.4	42.5	0.2	0.5	261	1	73.4	1.05	33.6	0.9	0.4	2.52
1	515.3	2.74	-1780	2300	1574	15	29.9	0.2	0.1	175	7	26.3	0.79	23.4	0.6	0.3	1.71
2	366.5	2.49	-1090	1950	992	6.9	12.9	0.1	<0.1	84.3	13	62.6	0.4	12.2	0.3	0.112	0.7
3	489.7	2.32	-1025	2000	881	4.4	7.8	0.5	<0.1	62.3	15.7	98.1	0.2	9	0.3	0.086	0.46
4	416.3	2.46	-935	2050	825.9	2.8	5.2	0.1	<0.1	45.8	10.8	104	0.1	6.1	0.2	0.076	0.28
5	426.9	2.32	-815	1800													
6	426.5	2.27	-855	2300	744.6	1.5	2.8	0.1	<0.1	32	11.9	110.8	0.1	4.1	0.2	0.062	0.17
7	449.3	2.29	-790	1700													
8	443.4	2.29	-717.5	2000	655.7	1.2	2.2	0.2	0.1	23	15	103.6	<0.10	3.1	0.127	0.058	0.14
9	441.1	2.47	-595	1600													
10	432.1	2.35	-700	2150	603.9	1	0.9	0.2	<0.10	17.9	14	91.1	<0.10	2.7	0.1	0.055	0.09
11	438	2.29	-640	1750													
12	442.9	2.28	-625	2000	607.9	0.7	1.9	0.2	<0.10	14.7	12	91.8	<0.10	2.4	0.1	0.055	0.08
13	572.0	2.35	-585	1950													
14	569.3	2.38	-657.5	1850	567.6	1.2	1	0.1	0.1	10.7	10	81.5	<0.10	2.1	0.117	0.049	0.06
15	569.5	2.32	-675	2000													
16	570.4	2.28	-795	2150	610.5	0.6	1	0.2	<0.10	11.3	11.9	83.6	<0.10	2.2	0.107	0.05	0.06
17	561.6	2.29	-542	2000													
18	534.1	2.29	-570	1950	554.4	0.5	1	0.2	<0.10	12.4	6.4	78.5	<0.10	2	0.112	0.052	0.06
19	546.9	2.41	-565	2050													
20	557.4	2.38	-565	2000	570	0.4	0.8	0.3	<0.10	9.9	8.6	76.8	<0.10	1.9	0.1	0.044	0.06
21	551.5	2.31		2000													
22	464.3	2.38		1800													
23	521.8	2.25		2050													
24	493.6	2.22	-590	2050	604.1	0.3	1		<0.10	10.4	10.1	87.6	<0.10	2	0.104	0.063	0.08
25	476.5	2.18		2150													
26	479.5	2.44		1750													
27	520.8	2.37		2000													

Table A2.21 Drainage quality from 1.37% sulfide siltite-argillite sample(1.69% S,sample number 11196, cell 16[2]).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	2.74	-1880	2300	1967	20	42.5	0.2	0.5	260	<1	74.4	1.06	34.5	0.9	0.4	2.59
1	526.8	2.72	-1750	2350	1645	16	33.3	0.1	0.1	195	7	30.3	0.9	26.3	0.7	0.3	1.74
2	381.3	2.45	-1190	2250	1052	7.6	13.8	0.1	<0.1	85	12.4	63.7	0.4	12.6	0.4	0.114	0.7
3	505.3	2.26	-1040	2100	1090	5.6	9.9	0.1	<0.1	77.1	16.8	124.3	0.3	11	0.3	0.123	0.51
4	431.5	2.41	-1040	2450	858.3	3.2	5.2	0.1	<0.1	44.5	13.7	102.8	0.1	6.3	0.2	0.077	0.28
5	432.3	2.31	-785	2000													
6	424.1	2.23	-875	2300	741.9	1.6	2.7	0.2	0.1	30.6	10.6	107.8	0.1	4.1	0.2	0.051	0.15
7	449.5	2.27	-787.5	1850													
8	446.5	2.27	-730	2100	666.6	1.2	2.1	0.2	0.1	22.3	14.8	102.3	<0.10	3.2	0.145	0.062	0.12
9	460.5	2.35	-750	2150													
10	438.8	2.32	-755	2200	629.4	0.8	0.8	0.2	<0.10	15.2	13	94.2	<0.10	2.6	0.1	0.055	0.08
11	451.1	2.23	-730	2200													
12	460.0	2.23	-705	2300	723.3	0.8	1.4	0.3	<0.10	14.1	13	109	<0.10	2.6	0.1	0.061	0.08
13	605.7	2.27	-680	2150													
14	601.8	2.33	-670	2500	661.9	0.6	1	0.1	<0.10	10.6	11	89.8	<0.10	2.2	0.128	0.055	0.06
15	603.8	2.28	-765	2250													
16	597.6	2.22	-1120	2500	739.7	0.5	1.4	0.3	<0.10	12.4	12.2	96.7	<0.10	2.3	0.119	0.057	0.06
17	586.2	2.23	-590	2350													
18	553.8	2.24	-690	2100	582.3	0.4	0.7	0.2	<0.10	11.5	7.7	77.9	<0.10	2	0.113	0.061	0.06
19	572.0	2.34	-655	2050													
20	578.1	2.33	-580	2150	567.8	0.2	0.4	0.2	<0.10	9.6	9	76.7	<0.10	1.8	0.1	0.042	0.06
21	573.5	2.28		2250													
22	481.7	2.34		1850													
23	533.8	2.22		2200													
24	517.7	2.18	-660	2250	670	1.8	0.3	0.3	<0.10	11.4	13.2	95.6	<0.10	2.1	0.113	0.071	0.08
25	505.3	2.12		2350													
26	500.4	2.42		1800													
27	545.1	2.33		2300													
28	562.8	2.33	-672.5	1950													
29	550.8	2.26		2050													
30	547.9	2.27		1600													
31	548.3	2.32		1900													
32	510.5	2.43	-518	1700													
33	556.2	2.26		2600													
34	511	2.37		1450													
35	536.4	2.37		1550													
36	572.1	2.40	-525	1900	620	<0.10	0.2	0.4	<0.10	8.1	5	39.5	<0.10	1.1	0.1	<0.10	<0.10
37	582	2.33		1650													
38	569.2	2.49		1550													
39	564.1	2.46		1400													
40	558.6	2.40	-340	1500	432	0.3	0.2										
41	555.5	2.53		1350													
42	564.8	2.45		1600													
43	544	2.53		1400													
44	539.5	2.54	-210	1250	568	0.4	0.2										
45	532.1	2.52		1250													
46	548.4	2.59		1100													
47	522.5	2.65		990													
48	522.6	2.60	-215	900	348	0.2	<0.10										

Table A2.22 Drainage quality from 1.55% sulfide siltite-argillite sample(1.60% S, sample number MT-100.4, cell 15).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	5.70	-5	623	590	11.8	144	0.3	2.1	0.036	0.7	0.01	1	0.002	0.313	0.015	0.044
1	xxx	5.68	-5	230	94.8	2.3	23	0.2	1.5	0.023	1	0.022	0.2	0.003	0.036	0.011	0.039
2	xxx	5.81	-5	225	95.6	2.1	22.4	0.3	1.2	0.1	0.2	0.004	0.2	0.006	0.038	0.029	0.024
3	xxx	5.60	<-5	145	54.5	1.2	13.2	0.2	1.4	0.1	1	0.041	0.1	0.003	0.022	0.005	0.048
4	xxx	5.51	<-5	165	61.7	1.3	14.2	0.3	1.3	0.1	<1	0.003	0.1	0.005	0.03	0.005	0.017
5	240.5	5.29	<-5	165													
6	246.6	5.51	<-5	165	72.1	1.6	16.6	0.2	1.5	<0.1	1.1	0.1	0.2	0.003	0.037	0.012	0.025
7	260	5.24	-5	165													
8	254.6	5.29	-5	180	74.1	1.5	17.2	0.3	1.5	0.3	<1	0.1	0.2	0.02	0.038	0.023	0.049
9	210.5	5.26	-5	170													
10	250.7	5.53	<-5	175	70.47	1.3	16.8	0.2	1.3	<0.1	<1	0.1	0.2	0.002	0.033	0.013	0.05
11	281.9	5.84	<-5	145													
12	272.5	5.48	<-5	123	54.52	1.4	13.6	0.1	1.3	0.017	1	0.089	0.109	0.005	0.035	0.016	0.026
13	259.8	5.78	-2.5	135													
14	262.3	5.77	<-5	130	57.57	2.2	12.7	0.1	1.1	0.017	0.4	0.042	0.098	0.001	0.022	0.401	0.086
15	290.7	5.49	<-5	140													
16	280.9	5.54	-2.5	155	65.66	1.8	16.1	0.2	1.3	0.1	1	<0.02	0.1	0.001	0.024	0.113	0.043
17	263.0	5.64	<-5	150													
18	279.8	5.80	<-5	150	67.12	1.4	15.5	0.2	1.2	<0.1	2.2	0.07	0.09	0.001	13	0.072	0.041
19	314.2	6.01	-5	125													
20	280.5	5.95	<-5	140	64.27	1.2	14.5	0.2	1.1	1.18	<1	0.02	0.08	0.001	0.014	0.01	0.038
21	176.0	6.35	<-5	175													
22	420.3	6.45	5	165													
23	216.7	6.48	5	145													
24	175.5	6.60	2.5	160	64.5	0.7	15.4	<0.10	0.7	0.1	1	0.17	0.1	0.006	0.011	0.002	0.04
25	196.7	6.28	5	160													
26	-157.2	6.52	5	135													
27	-190.8	6.90	7.5	135													
28	-18.1	6.41	7.5	125	55	1.4	14.4	0.2	0.8	0.2	1	<0.10	<0.10	<0.001	0.008	0.002	0.03
29	-114.8	6.43		125													
30	-106.8	6.31		135													
31	-131.3	6.30		130													
32	-98.9	6.25	-10	120	36.4	0.8	1.5	0.3	0.1	<0.10	3.9	<0.10	<0.10	0.04	0.008	0.001	0.03
33	-88.6	6.26		90													
34	334.7	6.27		140													
35	331.6	6.70	-7.5	135													
36	344.2	6.64	-7.5	145	56.1	1.1	14.9	0.1	0.7	<0.10	0.4	0.8	<0.10	0.001	0.007	0.003	0.03
37	322	6.65		125													
38	373.2	6.68		140													
39	337.2	6.68		140													
40	356.1	6.63	-10	135	51.1	0.8	13.8	0.1	0.7	<0.10	<0.10	0.1	<0.10	<0.001	0.006	0.003	0.03
41	369.8	6.61		135													
42	365.2	6.69		125													
43	293.8	6.62		130													
44	279.4	6.90	-7.5	130	48.4	1.3	13.8	0.2	0.8	<0.10	<1	<0.10	<0.10	<0.001	<0.001	0.019	0.05
45	306	6.74		125													
46	296.6	6.88		130													
47	286.2	6.70		105													
48	257.8	7.13	5	130													
49	242.8	7.04		100													
50	229.8	6.96		115													
51	267.6	6.79		115													
52	281	6.87	7.5	115													
53	225.2	6.88		110													
54	271.1	7.07		105													
55	287.7	6.67		115													
56	323.1	6.86	7.5	135	63.4	0.7	13.5	0.2	0.7	<0.10	>1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
57	346.4	6.81		125													
58	335.6	6.72		110													
59	350	6.62		125													
60	342	6.51	7.5	155	37	0.6	10										
61	358.2	6.41		120													
62	362.7	7.09		125													
63	349.9	6.73		125													
64	293.5	6.56	7.5	70	37	0.6	10.5										
65	297.5	6.78		90													
66	307.1	6.62		100													
67	350.1	6.7		95													
68	328.7	7.00	NA	115	37.3	0.6	11.8										

Table A2.23 Drainage qualinity from 1.53% sulfide siltite-argillitite sample(1.60% S, sample number MT-100.4, cell 16).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	5.66	<-5	580	560.8	9.6	131	0.3	2.2	0.031	0.6	<0.001	0.9	0.002	0.137	0.012	0.039
1	xxx	6.15	<-5	310	138.0	2.6	32.7	0.3	1.6	0.016	0.8	0.035	0.2	0.002	0.041	0.005	0.071
2	xxx	6.43	7.5	215	87.3	1.7	21.9	0.3	1.4	0.112	<1	0.053	0.2	0.006	0.024	0.005	0.021
3	xxx	5.67	15	140	54.0	1	1	0.2	1.4	0.1	<1	0.031	0.097	0.002	0.013	0.003	0.044
4	xxx	5.74	10	190	71.3	1.3	17.4	0.2	1.1	0.1	0.6	<0.001	0.1	0.002	0.021	0.004	0.017
5	235	5.98	<-5	210													
6	240.9	5.88	<-5	190	81.2	1.5	19.4	0.2	1.3	<0.1	0.2	<0.1	0.1	0.002	0.016	0.004	0.02
7	234	5.58	<-5	165													
8	243.6	5.26	<-5	160	66.6	1	15.3	0.2	1.4	<0.1	<1	<0.1	<0.1	0.002	0.018	0.006	0.046
9	211.1	5.37	<-5	175													
10	247.5	5.91	<-5	190	79.4	1.3	19.9	0.2	1.2	<0.1	0.5	0.1	0.1	0.002	0.015	0.004	0.048
11	276.6	6.32	5	175													
12	264.2	6.07	2.5	120	53.9	0.8	12.5	0.1	1.3	0.014	0.7	0.033	0.074	0.003	0.016	0.003	0.01
13	250.8	5.75	-2.5	135													
14	258.5	5.94	<-5	135	58.9	1	13.8	0.1	1	0.017	<0.1	0.013	0.076	0.001	0.016	0.153	0.078
15	284.5	5.61	<-5	140													
16	276.6	5.72	<-5	175	73.6	1.3	18.8	0.2	1.2	0.12	1.2	<0.02	0.08	0.001	0.013	0.108	0.045
17	257.4	6.15	<-5	175													
18	271.8	6.41	<-5	155	69.4	1	17	0.1	0.9	<0.1	<1	0.07	0.05	<0.001	0.006	0.025	0.037
19	309.8	6.74	<-5	130													
20	272.2	6.45	<-5	130	59.8	1	14.6	0.1	0.9	1.26	<1	0.07	0.05	0.001	0.006	0.013	0.04

Table A2.24 Drainage quality from 2.25% sulfide siltite-argillite sample(2.30% S sample number MT-99.4, cell 9).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	6.00	-17.50	527	254.3	22.3	37.1	7.9	21.6	0.082	0.9	4.8	0.9	0.051	0.5	0.2	0.9
1	xxx	4.47	-7.50	550	231.8	11.3	38.9	5.5	12.5	0.144	2.8	0.9	0.8	0.008	0.285	0.055	0.1
2	xxx	5.38	-7.50	380	155.6	8.5	33	2.7	8.7	0.093	2.7	0.3	0.6	0.011	1.1	0.034	0.092
3	xxx	6.22	<-5	335	130.8	6.4	26.6	1.8	6.6	0.016	1.2	0.01	0.3	0.001	0.1	0.019	0.065
4	xxx	6.33	<-5	305	119.9	5.6	24.5	1.3	5.1	0.3	1.1	0.061	0.3	0.002	0.062	0.017	0.039
5	196	6.77	7.50	260													
6	209	6.68	5.00	230	97.9	4.4	21.7	0.7	4.2	<0.1	1.4	<0.1	0.2	0.001	0.047	0.009	0.011
7	205.3	6.71	7.50	205													
8	187.9	6.86	7.5	200	79.7	3.3	18	0.5	3.4	0.1	0.3	<0.1	0.1	0.002	0.017	0.01	0.054
9	170.6	6.74	10	155													
10	192.2	7.07	7.5	160	62.25	2.8	15.4	0.4	2.8	<0.1	<1	<0.1	<0.1	0.001	0.01	0.004	0.048
11	206.2	7.10	12.5	145													
12	204.6	7.09	10	120	51.77	2	11.9	0.2	2.4	0.006	2.5	0.044	0.46	0.001	0.014	0.003	0.01
13	219.4	7.05	10	135													
14	189.0	6.98	10	125	50.66	2.1	12.7	0.2	2.2	0.006	1.1	0.004	0.045	0.001	0.012	0.009	0.07
15	213.0	6.99	12.5	105													
16	171.5	6.83	10	155	62.57	5.4	14.6	0.3	2.5	0.1	1.5	<0.02	0.04	0.001	0.009	0.126	0.049
17	198.2	7.17	7.5	150													
18	158.5	7.04	10	120	52.69	2.6	12.9	0.2	2	0.42	1.3	<0.02	0.03	0.001	0.004	0.018	0.027
19	162.3	7.10	12.5	115													
20	206.7	6.89	7.5	115	49.73	2.2	11.9	0.2	1.7	0.44	2.4	<0.02	0.03	0.006	0.002	0.008	0.033
21	167.6	7.04	7.5	130													
22	295.6	7.04	12.5	145													
23	-131.8	7.10	10	115													
24	-68.1	6.62	12.5	125	46.6	1.6	10.8	0.2	1.4	0.2	3	<0.02	<0.1	0.004	0.005	0.003	0.04
25	-125.1	7.07	7.5	115													
26	-103.2	6.83	7.5	100													
27	-191	7.34	10	105													
28	-28.9	6.86	12.5	90	35.6	4.7	10.8	0.3	1.3	0.1	2.9	<0.10	<0.10	0.002	0.006	0.001	0.03
29	-117.2	6.77		90													
30	-98	6.54		80													
31	-115.2	6.88	10	60													
32	-88.7	6.70	12.5	100	34.7	1.8	10.2	0.3	1.4	<0.10	1	<0.10	<0.10	<0.001	0.004	<0.001	0.03
33	-51.2	6.68		85													
34	334.9	6.73		105													
35	301.6	7.15	10	110													
36	335.4	7.10	12.5	105	37	1.6	10.8	0.2	1.2	<0.10	1.2	<0.10	<0.10	0.001	0.01	0.001	0.03
37	382.2	7.06		110													
38	368.8	7.12		110													
39	292.5	7.17		105													
40	292	7.35	12.5	95	29.6	1.3	9.7	0.2	1.1	0.1	0.7	<0.10	<0.10	<0.001	0.002	0.001	0.03
41	332.3	6.98		100													
42	294.4	6.89		95													
43	232.8	6.88		85													
44	220.4	7.18	12.5	105	33.5	1.5	10.3	0.1	1.2	<0.10	<1	<0.10	<0.10	0.001	<0.001	0.001	0.05
45	234.4	7.32		100													
46	24.4	7.54		85													
47	283.3	7.12		80													
48	199	7.52	12.5	95													
49	324.8	7.44		80													
50	221.9	7.44		90													
51	296.1	7.22		85													
52	280.2	7.17	12.5	80													
53	199.7	7.32		92													
54	286	7.49		75													
55	232.5	7.00		75													
56	225.7	7.15	10	100	33.2	1.4	9.8	0.2	1.1	0.1	<1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
57	316	7.15		85													
58	282.7	7.18		90													
59	258.6	6.97		100													
60	286.3	6.92	5	85	29	0.9	8.2										
61	293.7	6.68		550													
62	323.4	7.18		75													
63	285.2	7.00		85													
64	266.7	6.65	10	70	21.3	0.9	5.8										
65	301.5	6.82		70													
66	288.3	6.85		75													
67	301.4	6.80		75													
68	304.4	7.03	NA	72	19	1	7.5										

Table A2.25 Drainage quality from 3.16% sulfide siltite-argillite samlpe(3.24% S,sample number MT-99.1, cell 10).

Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	3.74	-375	1944	1509	113.3	172	5.8	15.1	0.027	2.7	149.3	17.3	3	1.7	0.8	3.1
1	xxx	4.83	-45	2350	1228.2	74.1	145	5.3	13.3	0.037	1.5	9.5	7.6	0.014	0.417	0.2	0.1
2	xxx	6.06	-5	1650	883.9	75.9	132	3.4	12.3	0.026	2.7	0.6	3.1	0.004	1.1	0.026	0.044
3	xxx	5.70	-5	1450	649.6	59.5	91	1.8	8.8	0.005	<1	<0.001	1.6	0.003	0.1	0.015	0.047
4	xxx	5.94	<-5	1250	644.2	58.2	118.7	1.6	8.1	0.2	<1	0.048	2.1	0.003	0.142	0.022	0.027
5	199.5	5.74	<-5	1050													
6	226.2	6.08	<-5	1250	715	48.6	113.7	1	7.3	<0.1	0.8	<0.1	1.7	0.005	0.101	0.012	0.022
7	224.9	5.79	-5	950													
8	211.3	5.40	-5	1100	604.4	42.5	108.1	0.7	5.9	0.1	<1	0.2	1.5	0.007	0.055	0.011	0.075
9	187.6	5.49	-5	900													
10	206.8	5.68	-5	1050	548.4	39	102.1	0.6	5	<0.1	<1	0.1	1.3	0.006	0.042	0.009	0.059
11	222.9	5.74	-5	750													
12	219.7	5.70	-7.5	610	467.7	35.5	101.2	0.5	4.9	0.022	0.7	0.112	1.3	0.006	0.049	0.007	0.034
13	231.5	5.65	-7.5	650													
14	199.4	5.81	-5	650	382.3	27.6	76.9	0.4	4.3	0.008	<0.1	0.041	0.999	0.002	0.038	0.022	0.066
15	221.2	5.86	-5	700													
16	179.0	6.22	-7.5	850	459.3	29.2	71.2	0.5	4.4	0.1	1.7	0.06	1.05	0.003	0.031	0.008	0.048
17	206.8	6.12	<-5	700													
18	165.3	5.93	-5	600	323	22.6	65.6	0.68	3.6	0.46	1.3	0.1	0.68	0.003	0.013	0.013	?
19	176.1	5.59	-5	500													
20	222.0	5.49	-5	600	330.4	30.1	88.4	0.4	3.2	0.49	1	0.09	0.73	0.007	0.017	0.008	0.05
21	179.4	5.38	-7.5	600													
22	276.5	5.72	-5	650													
23	-128.8	5.97	-7.5	600													
24	-54.3	6.03	-5	550	319	18.7	63.1	0.2	2.2	<0.1	1	<0.02	0.6	0.002	0.018	0.006	0.05
25	-118.5	6.08	-5	550													
26	-87.6	5.33	-5	500													
27	-191.4	5.75	-5	600													
28	15.9	5.56	-5	500	275.9	19	58.8	0.4	2.3	0.2	1	<0.10	0.6	0.002	0.018	0.004	0.04
29	-124.4	5.53		500													
30	-95.5	5.65		550													
31	-117	5.71		550													
32	-85.8	5.71	-5	550	323.1	20.8	70.5	0.4	2.1	0.1	<1	<0.10	0.6	0.005	0.021	0.004	0.04
33	-58.6	5.61		550													
34	340.9	5.76		500													
35	351.9	5.60		500													
36	367.5	5.58	-5	600	301.3	22	68.1	0.3	1.9	0.1	0.2	<0.10	0.6	0.006	0.02	0.008	0.04
37	334.2	5.68		600													
38	378.1	5.54	-5	525													
39	333.9	5.80		550													
40	331.4	6.34	-5	600	307.5	20.8	66.4	0.3	1.8	<0.10	<0.10	<0.10	0.6	0.004	0.018	0.004	0.04
41	367.4	5.78		500													
42	332.6	5.85		550													
43	279.2	5.52		500													
44	224.2	5.80	<-5	600	330.5	20.7	72.2	0.3	1.9	<0.10	<1	<0.10	0.7	0.003	0.02	0.006	0.07
45	278	5.43		500													
46	291.3	5.28		550													
47	324.6	5.23		485													
48	259.3	5.29	<-5	600													
49	357.9	5.26		500													
50	293.4	4.81		550													
51	351.4	4.82		450													
52	340.9	4.94	<-5	600													
53	259	5.01		500													
54	337.7	4.85		500													
55	296.4	4.66		500													
56	294.1	4.78	-5	550	246	16.9	61.9	0.3	1.6	0.1	<1	<0.10	0.7	<0.10	<0.10	<0.10	<0.10
57	418.9	4.60		550													
58	372.5	4.67		650													
59	340.8	4.84		600													
60	367.7	4.77	-5	500	231	14.4	51.1	0.4	1.3	0.1	<1.0	0.1	0.6	<0.10	<0.10	<0.10	<0.10
61	377.2	4.67		345													
62	401.2	4.68		430													
63	362	4.72		550													
64	327.1	4.82	-7.5	440	182	11.5	41.5	0.3	0.9	<0.10	<1.0	<0.10	0.5	<0.10	<0.10	<0.10	<0.10
65	373.5	4.75		380													
66	356.2	4.82		340													
67	367	4.80		385													
68	359.1	4.82	NA	490	220	14.9	48.8										

Table A2.26 Drainage quality from 5.5.75% sulfide siltite-argillitite sample (5.82% S, sample number MT-99.6, cell 11).

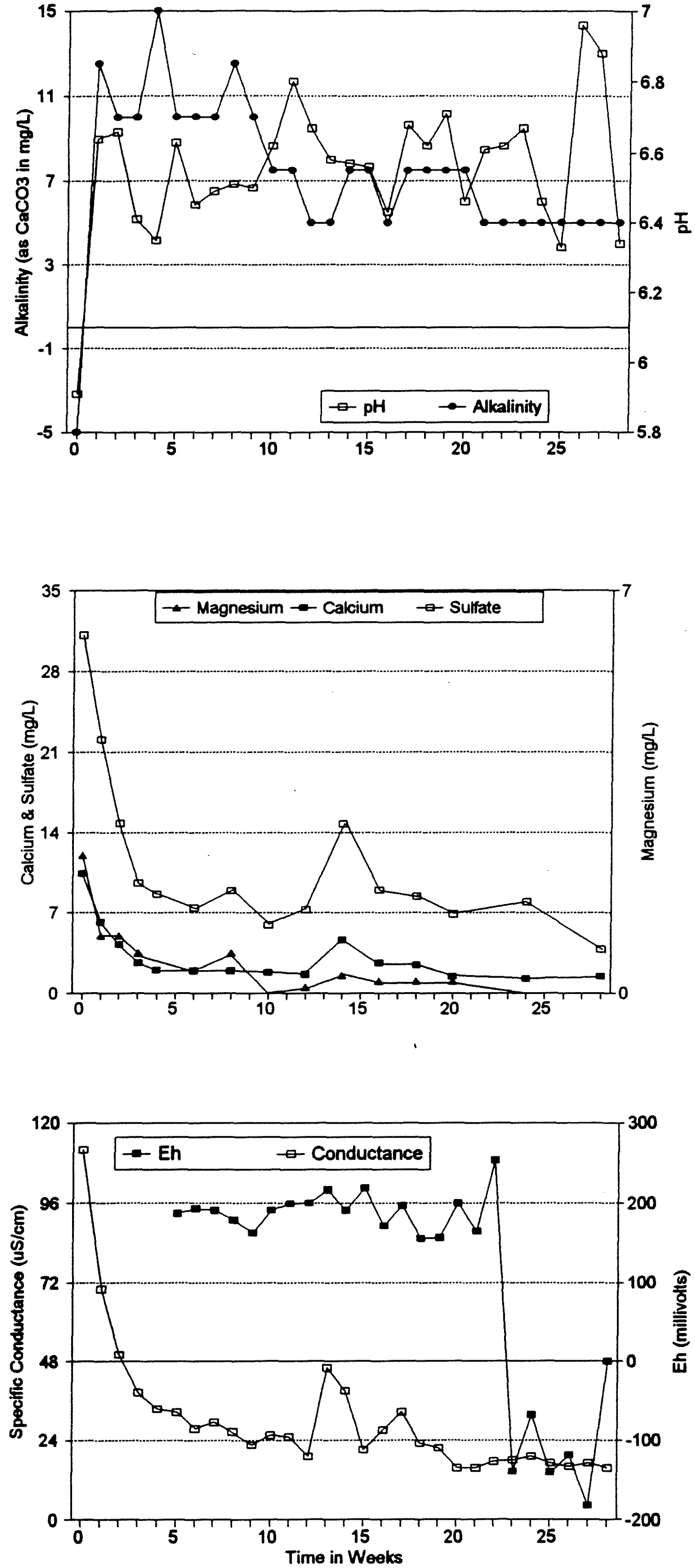
Concentrations are in mg/L unless otherwise noted. pH is in standard units, alkalinity in mg/L as CaCO3.

week	Eh(mv)	pH	Net Alkalinity	Cond(uS)	SO4	Ca	Mg	Na	K	Al	Si	Fe	Mn	Cu	Ni	Co	Zn
0	xxx	3.97	-335	699	421.8	3.2	2.4	10	10	23.2	3.8	112.3	1.8	1.5	2.1	3.4	0.7
1	xxx	3.78	-90	365	127	1.6	1	4.8	4.8	4.4	9.2	22.6	2.9	2.9	0.9	0.9	0.3
2	xxx	3.63	-85	280	98.2	1.6	1.2	1.8	1.8	6.3	4.6	9.1	3	6.4	1.2		0.4
3	xxx	3.41	-140	445	153.5	1.7	0.8	1.5	1.5	4.9	5.8	14.5	3.3	7.8	1.6	1.1	0.5
4	xxx	3.36	-215	500	196.6	1.7	1	1.3	1.3	6.5	7.3	18.6	3.2	8.4	1.5	1	0.5
5	314.5	3.19	-240	500													
6	323.5	3.10	-265	550	279.5	0.9	1	0.5	0.5	23.2	9.8	32.3	1.3	5.284	0.743	0.48	0.267
7	357.2	3.02	-280	600													
8	334.7	2.94	-295	550	279.5	0.4	1	0.5	0.5	23	5.8	41.7	0.5	3.299	0.418	0.276	0.171
9	338.8	2.91	-252.5	650													
10	345	3.11	-255	650	283.9	0.2	<0.1	0.5	0.5	21.6	2.5	47.8	0.3	2.285	0.27	0.175	0.126
11	373.7	3.10	-220	500													
12	355.3	3.05	-255	500	232.3	0.3	0.2	0.4	0.4	16.1	11	42.1	0.115	1.5	0.265	0.114	0.08
13	365.9	3.08	-205	500													
14	339.0	3.16	-200	500	208.8	0.3	0.2	0.4	0.4	13.2	10.4	43.1	0.074	1.1	0.158	0.091	0.095
15	360.0	3.03	-235	600													
16	337.4	3.04	-282	650	262.4	0.3	0.3	0.6	0.6	13.84	11.2	55.4	0.08	1.1	0.14	0.133	0.11
17	342.9	3.01	-257.5	650													
18	347.0	2.98	-205	550	207.6	0.2	0.2	0.5	0.5	10.63	8.6	47.2	0.05	0.818	0.13	0.121	0.074
19	379.7	2.96	-210	550													
20	362.0	2.90	-230	550	209.3	0.3	0.4	0.5	0.5	9.16	10.7	50.8	0.04	0.711	0.12	0.042	0.062

APPENDIX 3

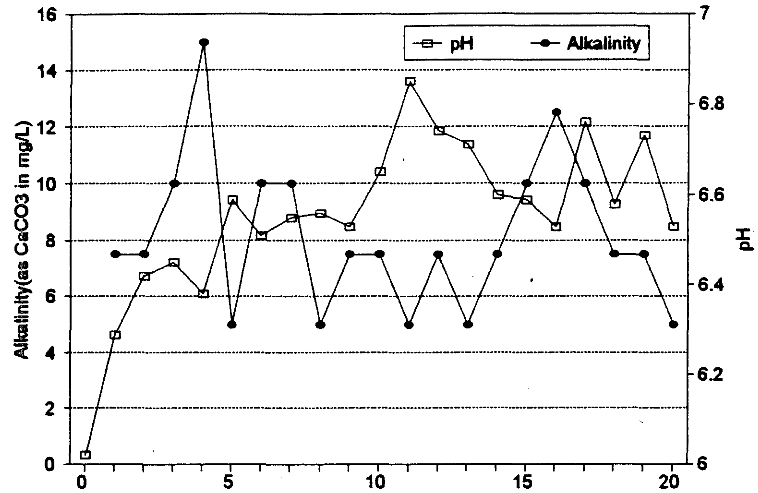
DRAINAGE QUALITY FIGURES

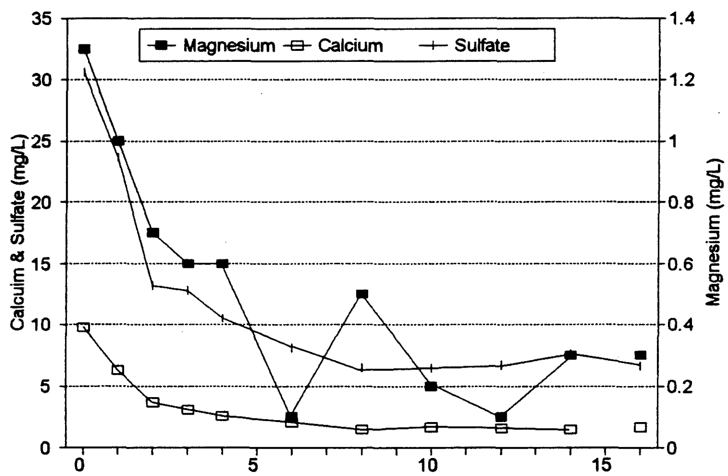
Figure A3.1 Drainage quality vs. time for 0.12% sulfate siltite-argillite sample(0.12% S, sample number 10696, cell 7).

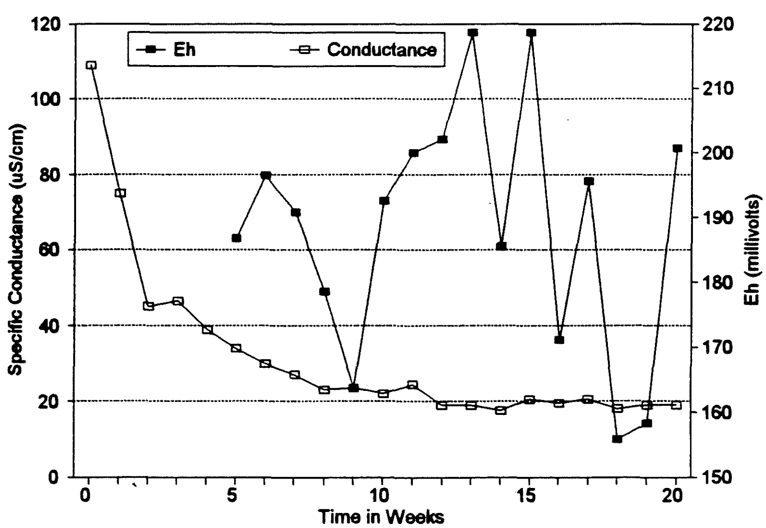


Note: Eh readings were not taken thru week 4.

Figure A3.2 Drainage quality vs. time for 0.12% sulfate siltite-argillitite sample(0.12% S, sample number 10696, cell 8).

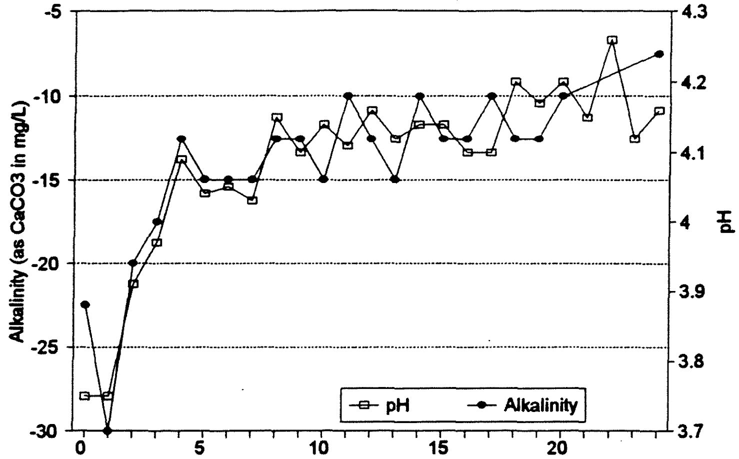


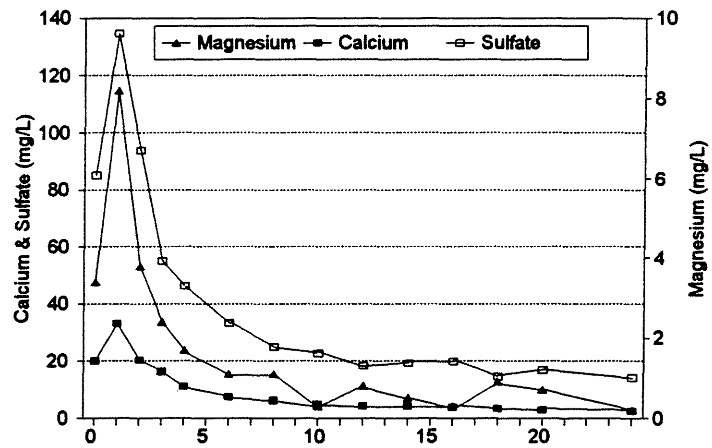


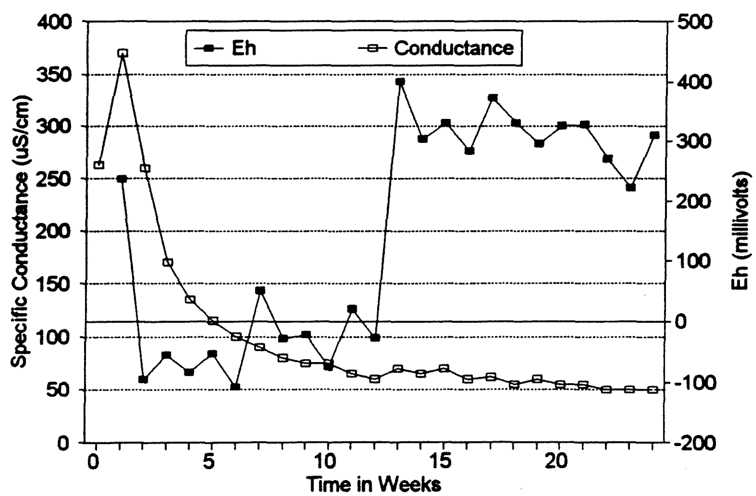


Note: Eh readings were not taken thru week 4

Figure A3.3 Drainage quality vs. time for 0.12% sulfate siltite-argillite sample (0.16% S sample number 30696, cell 3[2]).

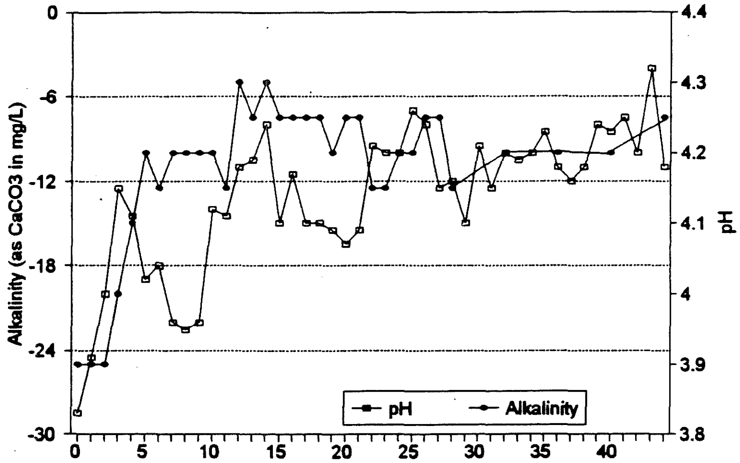


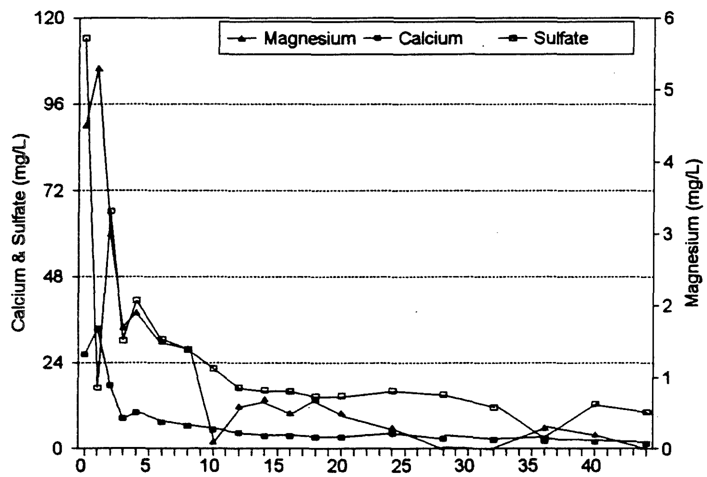


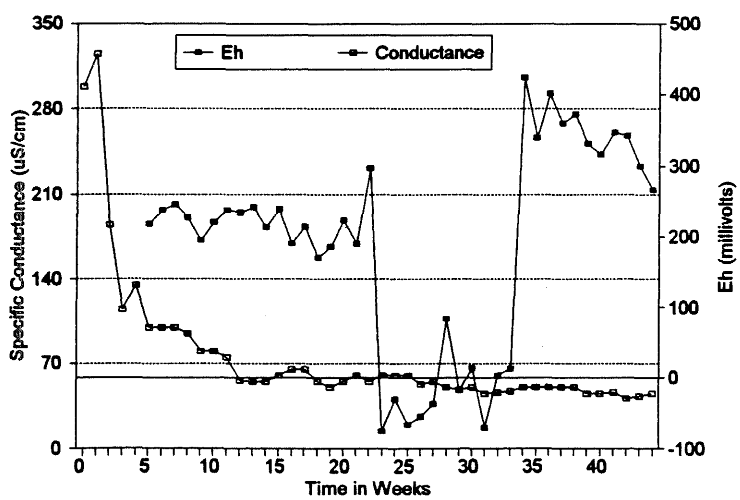


Note: Eh readings were not taken thru week 4.

Figure A3.4 Drainage quality vs. time for 0.12% sulfate siltite-argillite sample (0.16% S sample number 30696, cell 5).

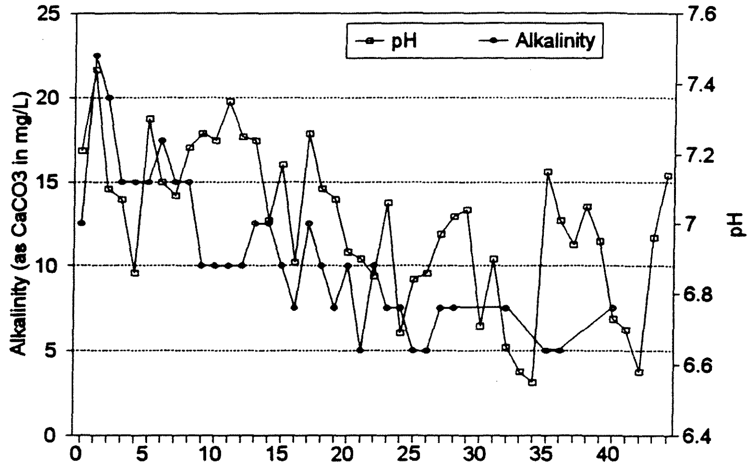


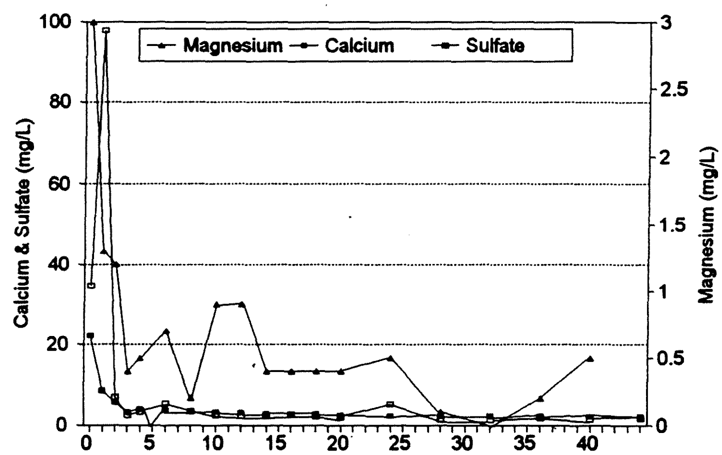


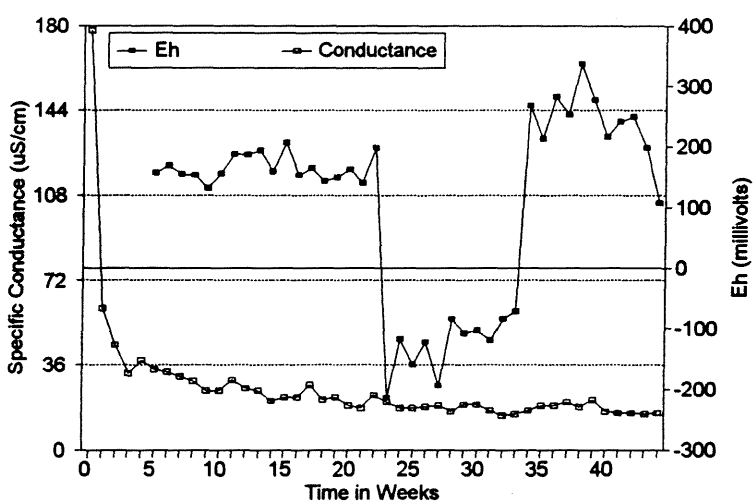


Note: Eh readings were not taken thru week 4.

Figure A3.5 Drainage quality vs. time for 0.22% sulfate siltite-argillite sample (0.24% S,sample number 60696, cell1).

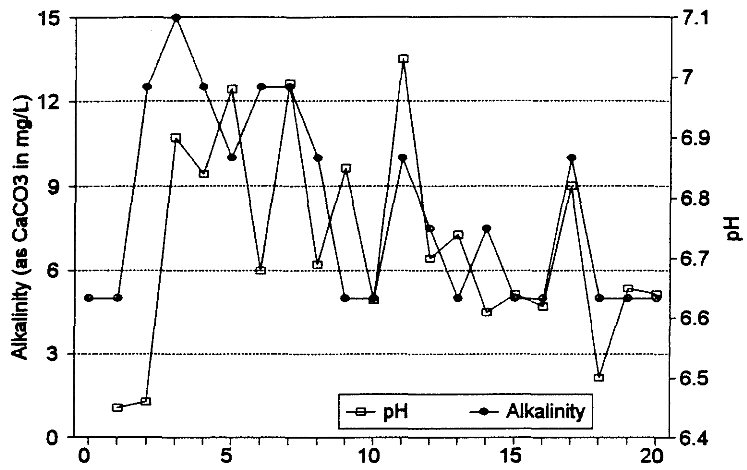


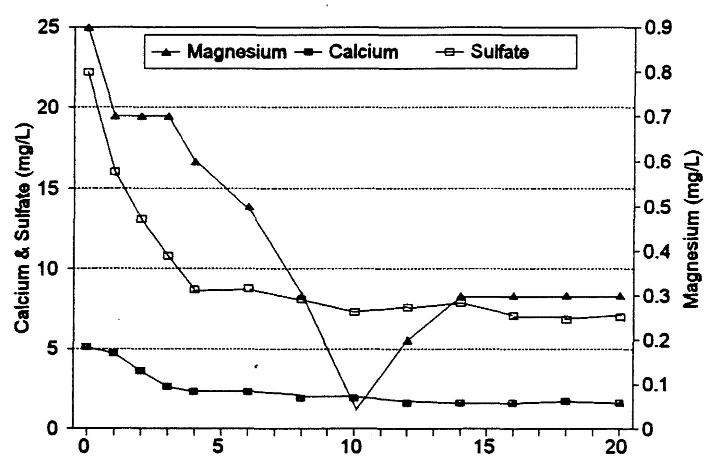


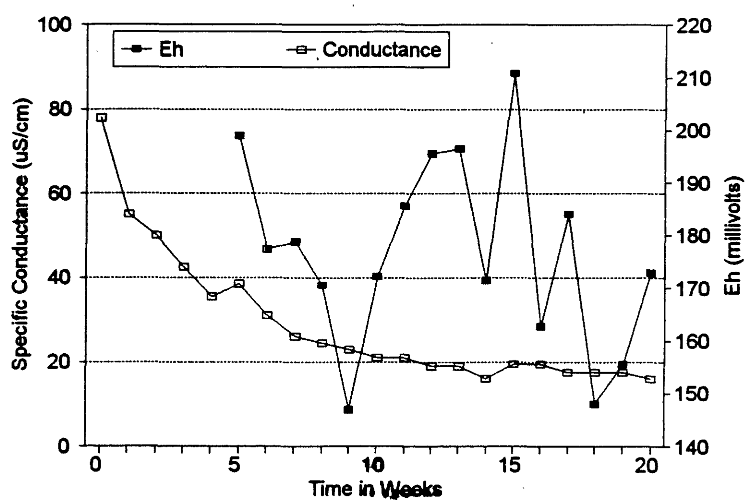


Note: Eh readings were not taken thru week 4.

Figure A3.6 Drainage quality vs. time for 0.28% sulfate siltite-argillite sample (0.29% S, sample number 40696, cell 3).

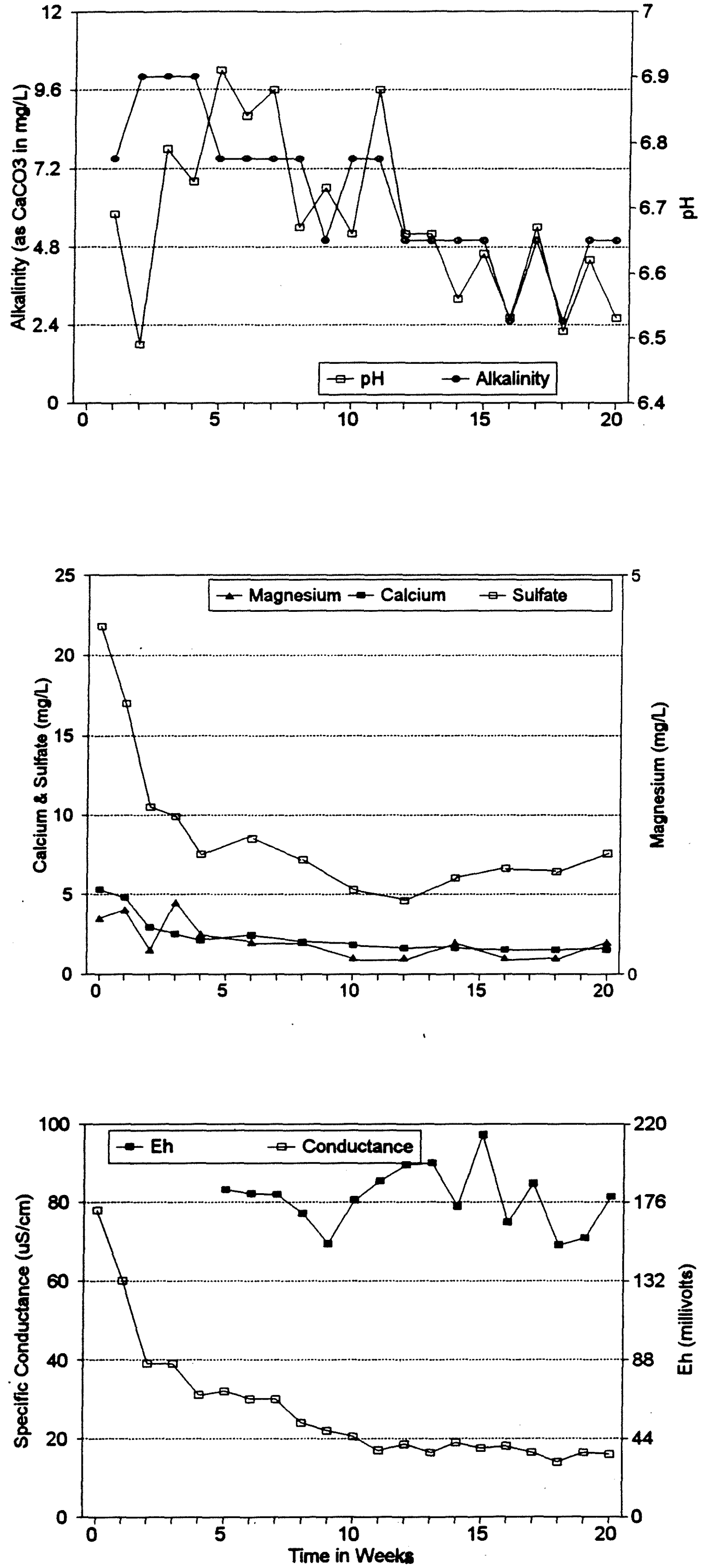






Note: Eh readings were not taken thru week 4.

Figure A3.7 Drainage quality vs. time for 0.28% sulfate siltite-argillite sample (0.29% S, sample number 40696, cell 4).



Note: Eh readings were not taken thru week 4.

Figure A3.8 Drainage quality vs. time for 0.26% sulfate siltite-argillite sample (0.30% S sample number 50696, cell2).

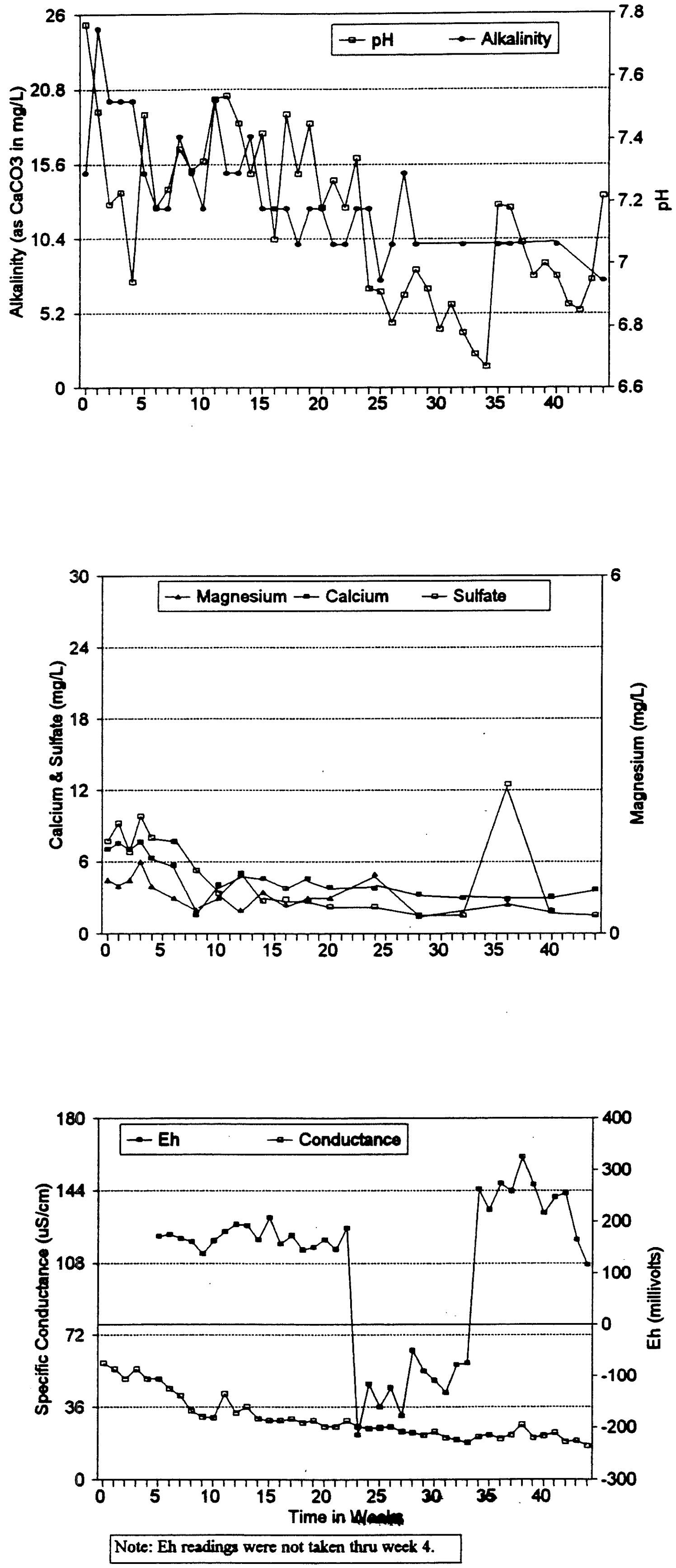


Figure A4.9 Drainage quality vs. time for 0.44% SO4 siltite-argillite sample(0.38% S, sample number 71196, cell 4[2]).

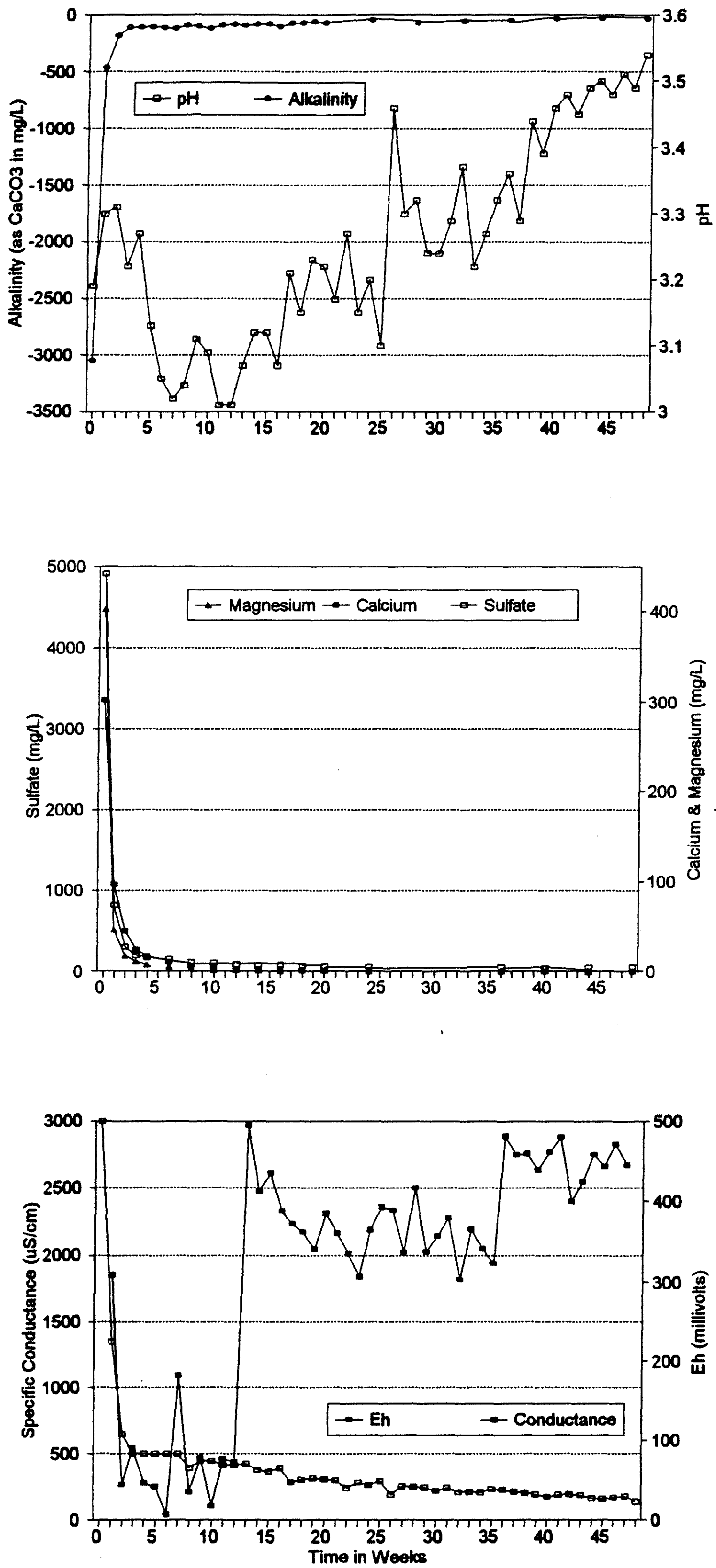


Figure A3.10 Drainage quality vs. time for 0.43% sulfate siltite-argillitite sample(0.42% S, sample number 21196, cell 8).

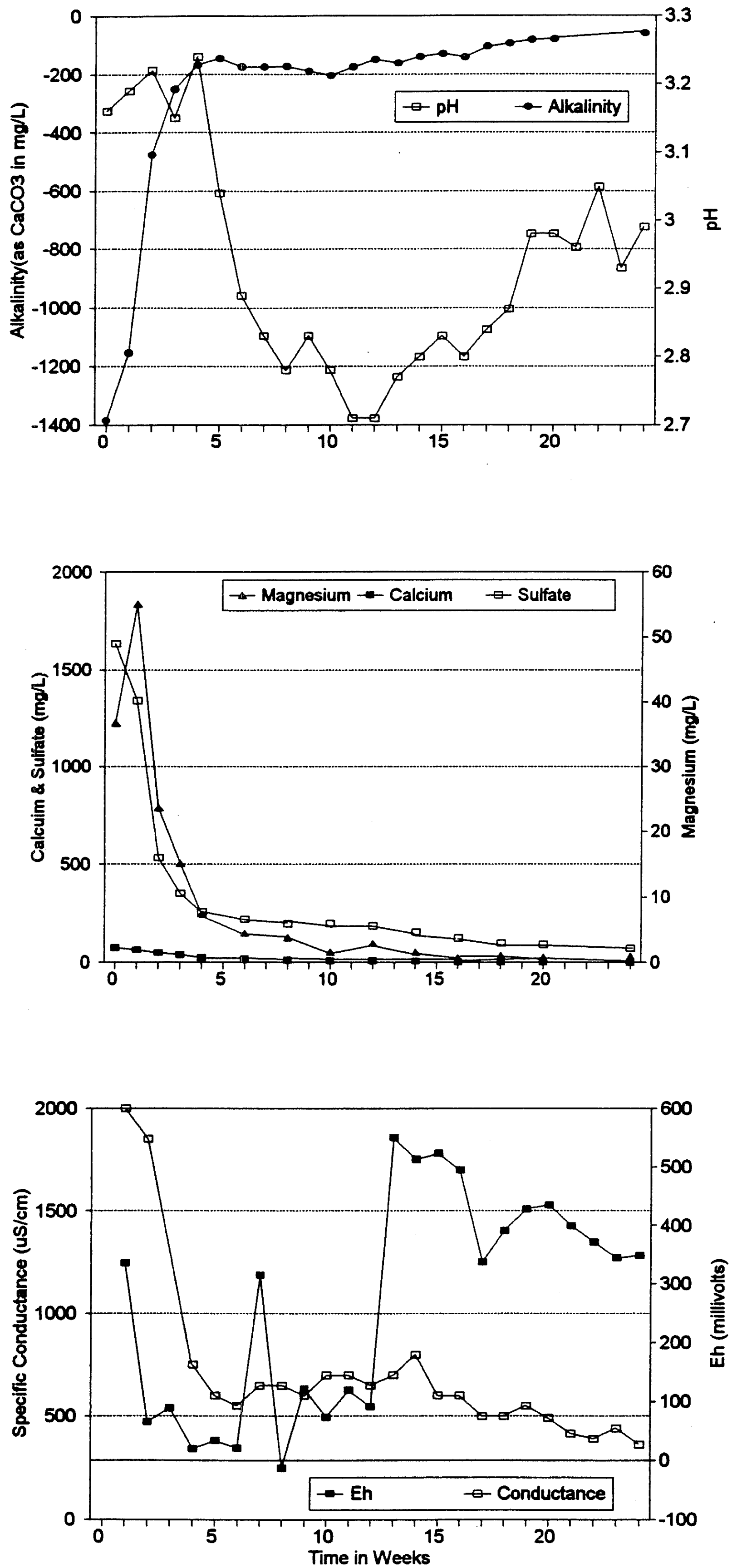
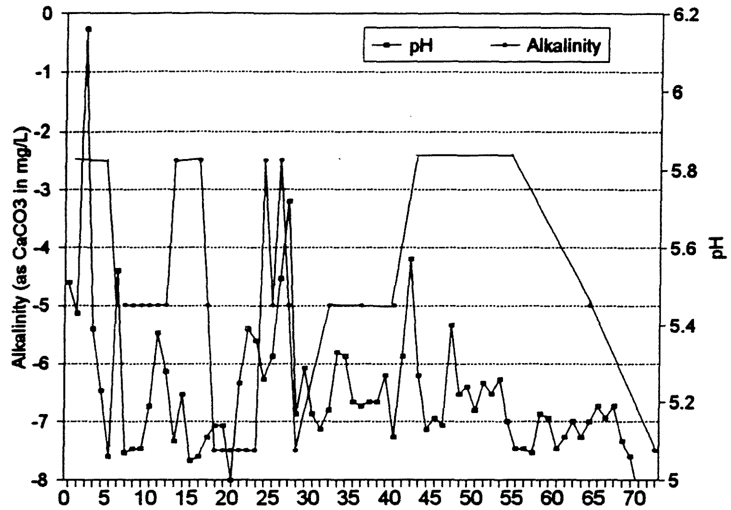
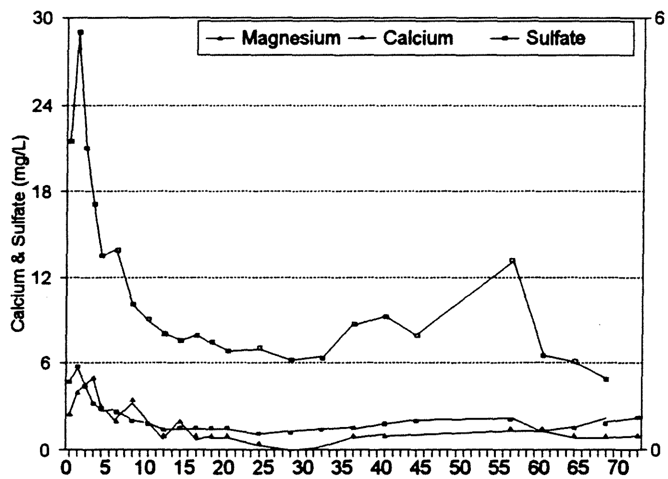
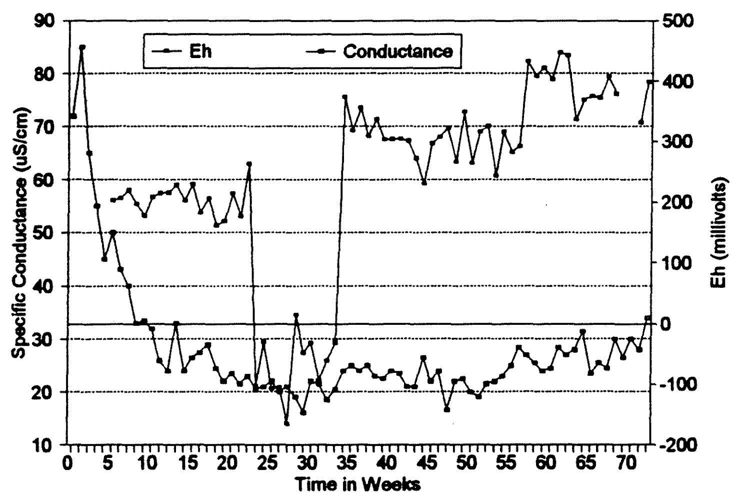


Figure A3.11 Drainage quality vs. time for 0.96% sulfate siltite-argillite sample (0.94% S sample number 20696, cell 6)

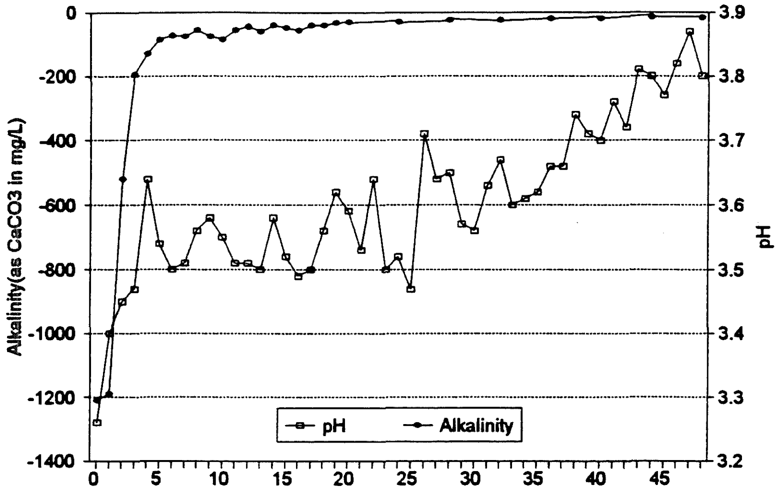


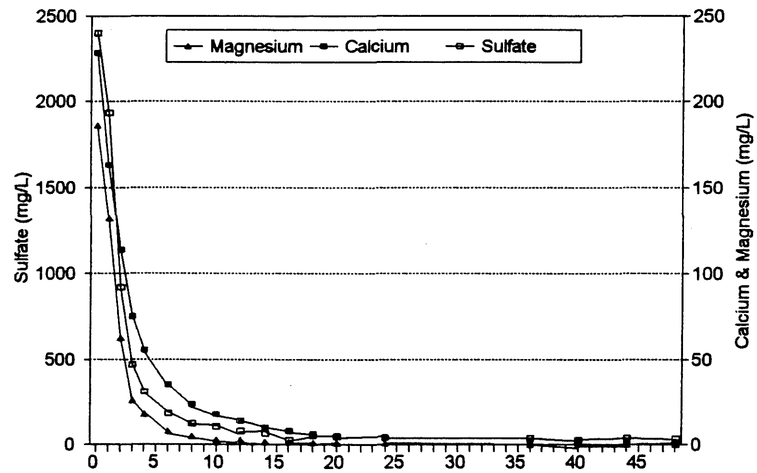




[redacted]

Figure A3.12 Drainage quality vs. time for 1.85% sulfate siltite-argillitite sample(1.93% S, sample number 81196, cell 11[2]).





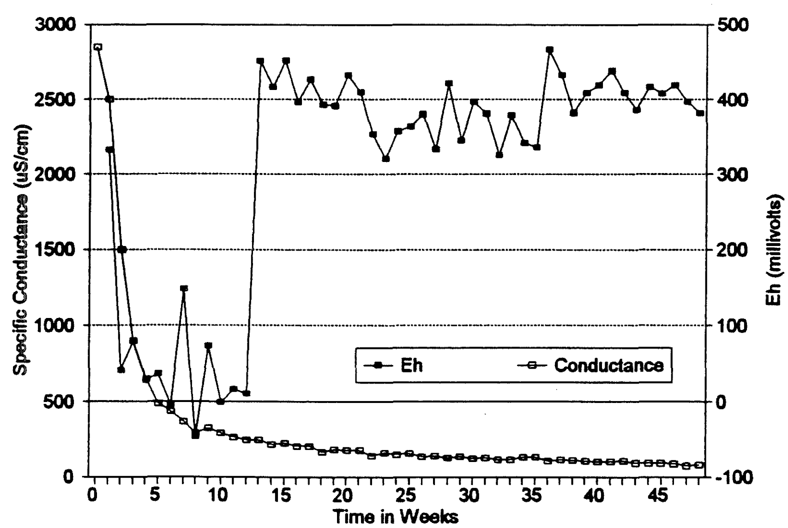
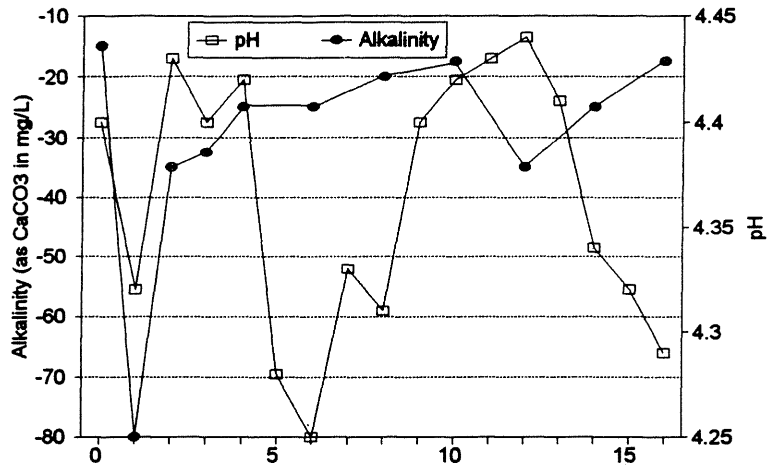
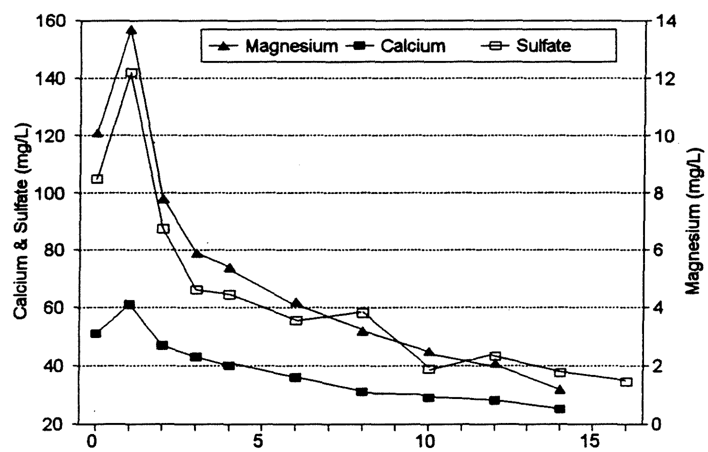


Figure A3.13 Drainage quality vs. time for 0.14% sulfide siltite-argillite sample (0.16% S, sample number 70597, cell1[2]).





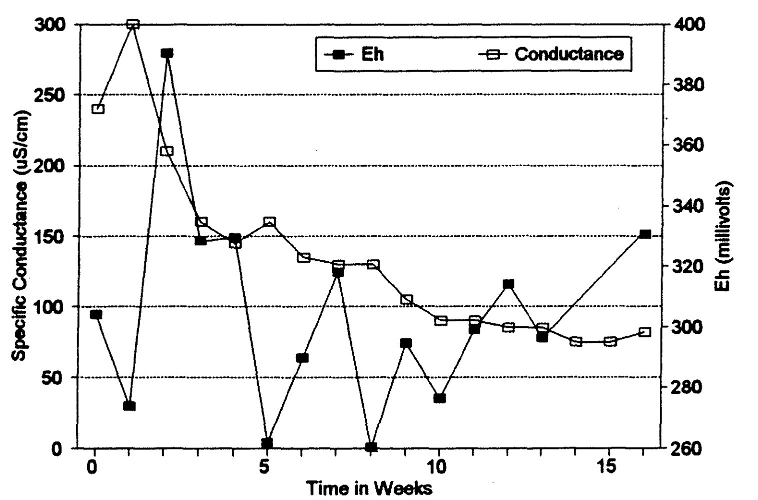


Figure A3.14 Drainage quality vs. time for 0.26% sulfide siltite-argillite sample (0.28% S sample number 30597, cell2[2]).

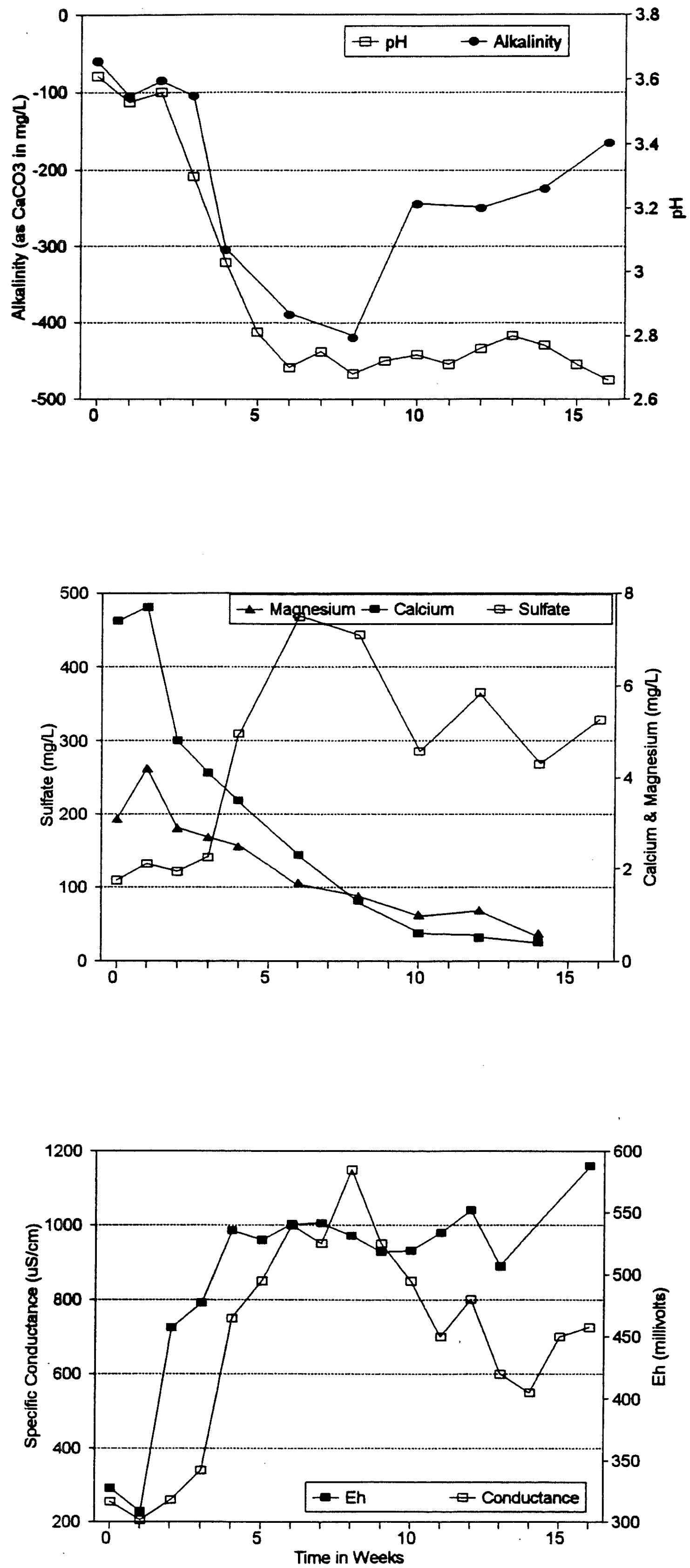
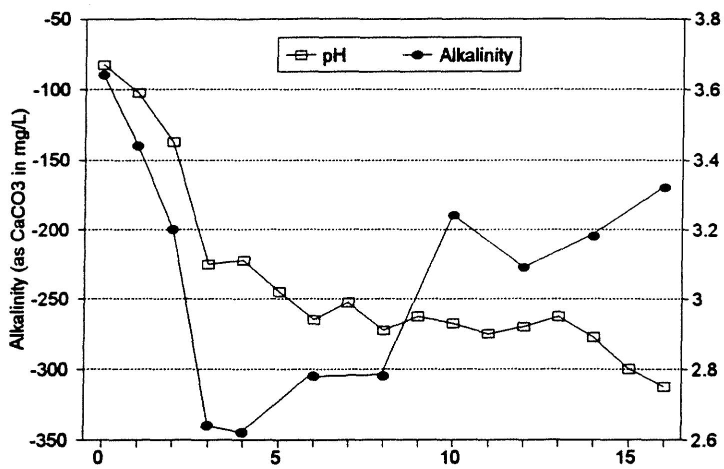
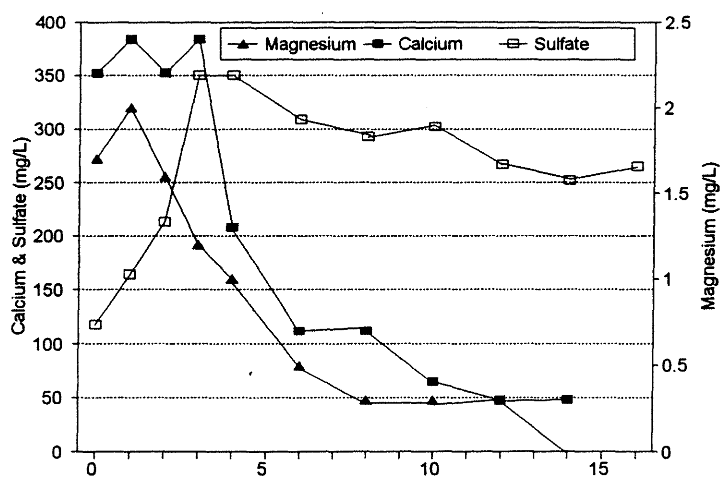


Figure A3.15 Drainage quality vs. time for 0.34% sulfide siltite-argillite sample(0.36% S, sample number 60597, cell 5[2]).





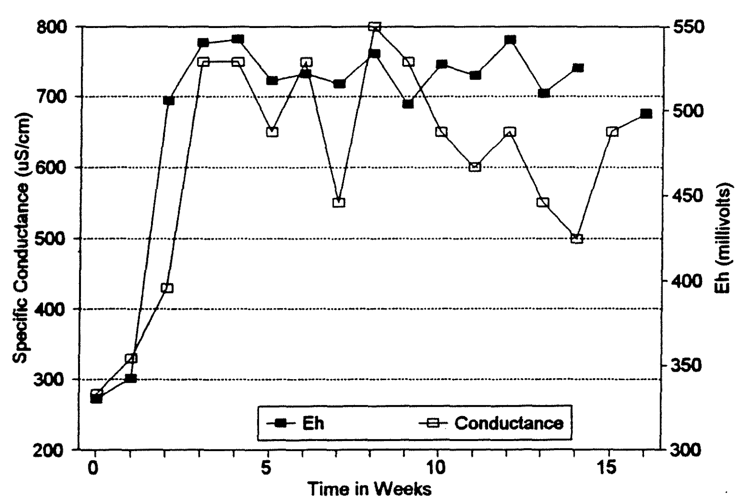


Figure A3.16 Drainage quality vs. time for 0.44% sulfide siltite-argillite sample(0.47% S, sample number 80597, cell 7[2]).

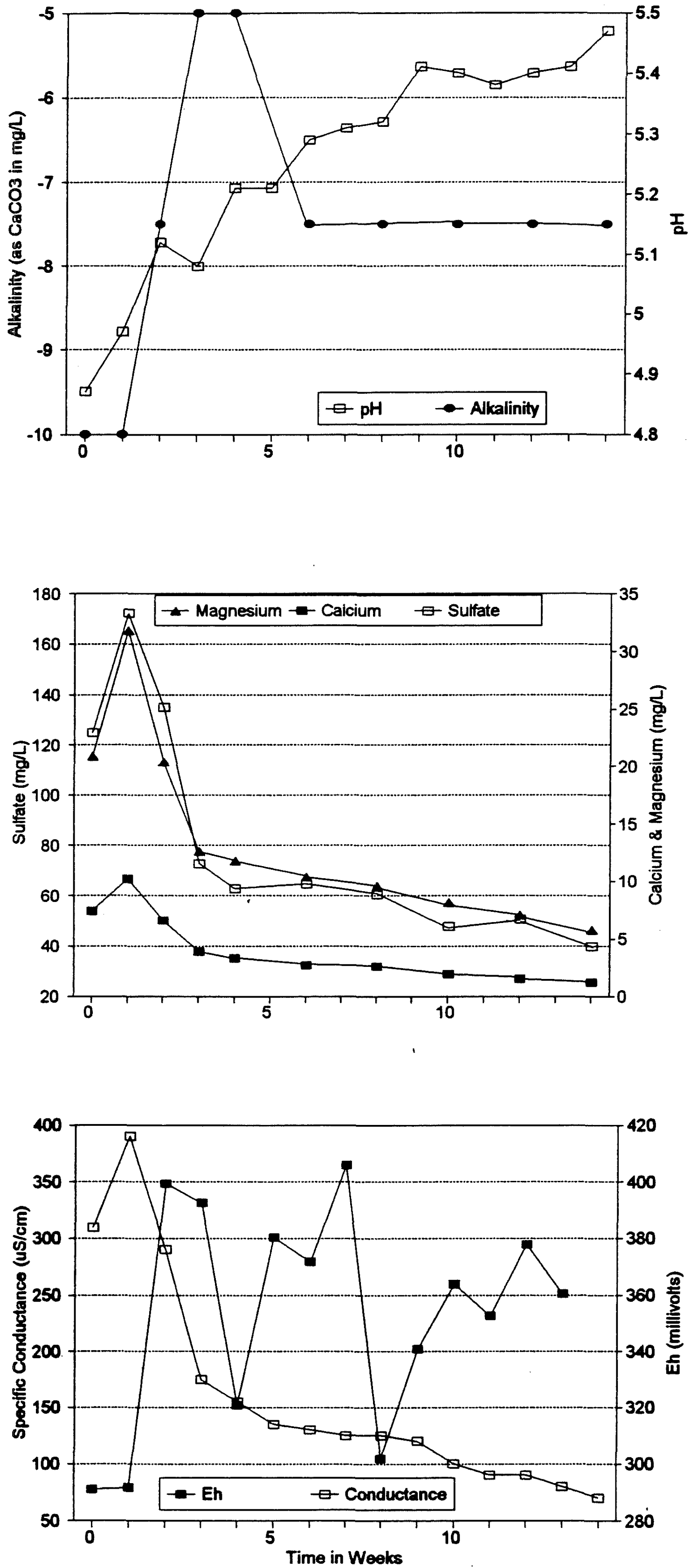


Figure A4.17 Drainage quality vs. time for 0.14% sulfide siltite-argillite sample (0.47% S, sample number 20597, cell 3[3]).

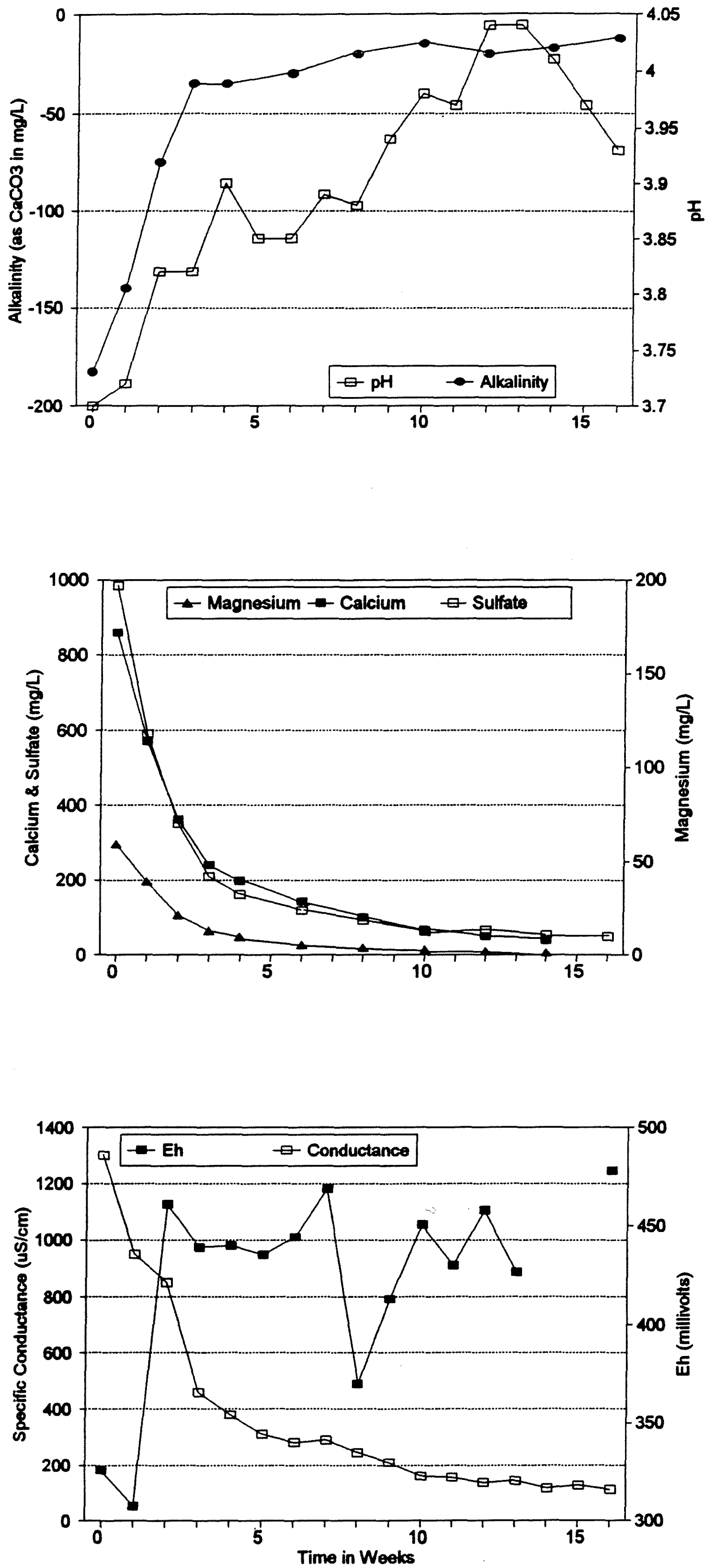


Figure A3.18 Drainage quality vs. time for 0.56% sulfide siltite-argillitite sample(0.64% S,sample number 100597, cell 8[3]).

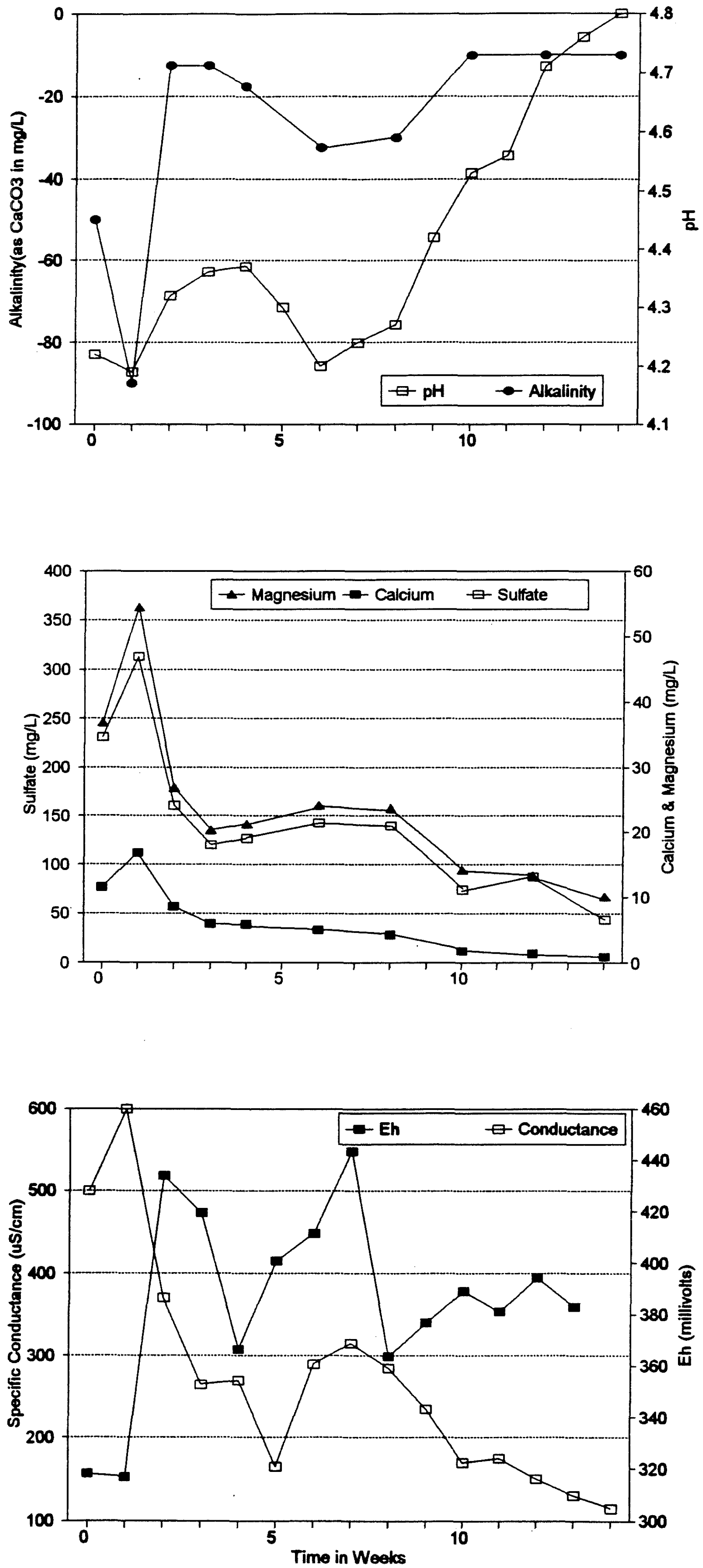


Figure A3.19 Drainage quality vs. time for 0.76% sufide siltite-argillitite sample(0.99% S, sample number 10597, cell 14[3]).

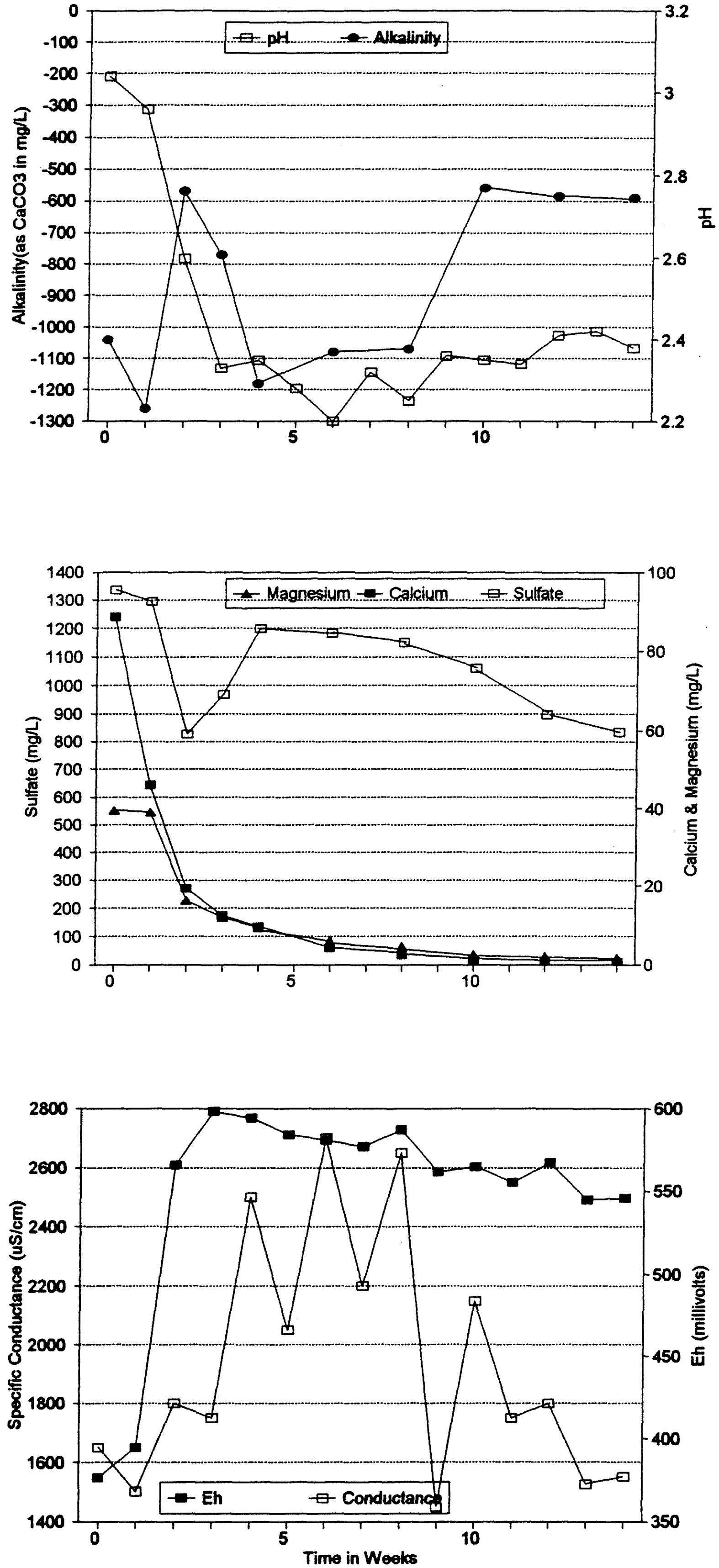
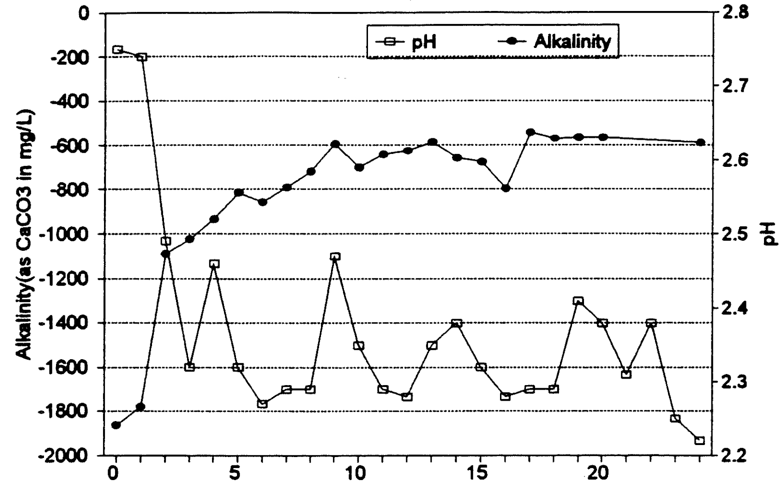
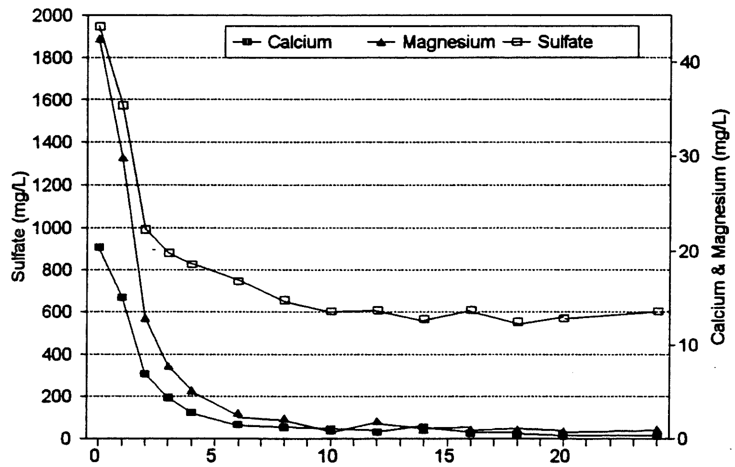


Figure A3.20 Drainage quality vs. time for 1.37% sulfide siltite-argillite sample (1.69% S, sample number 11196, cell 14).





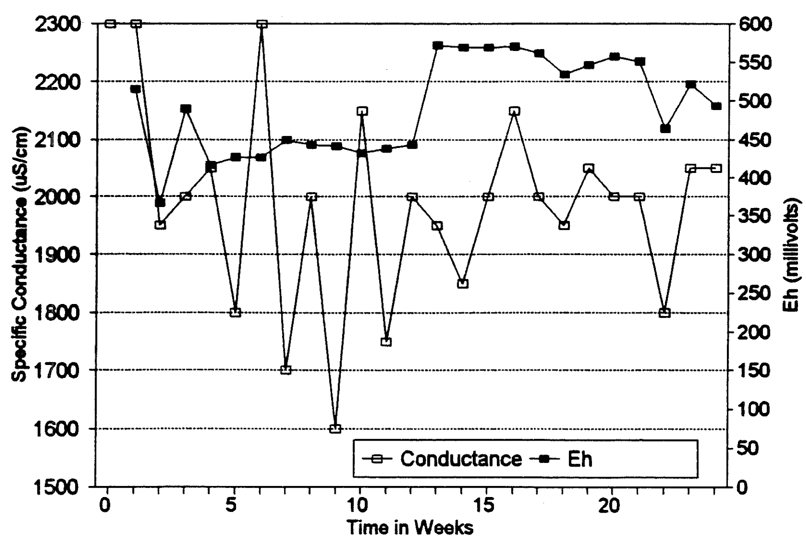
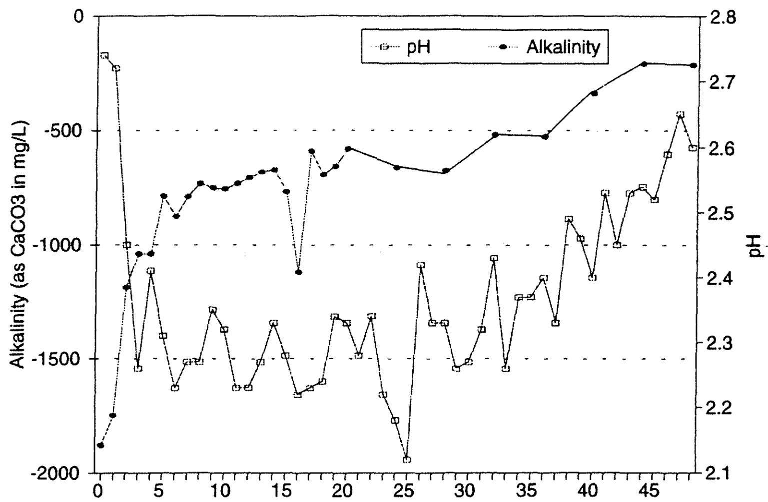
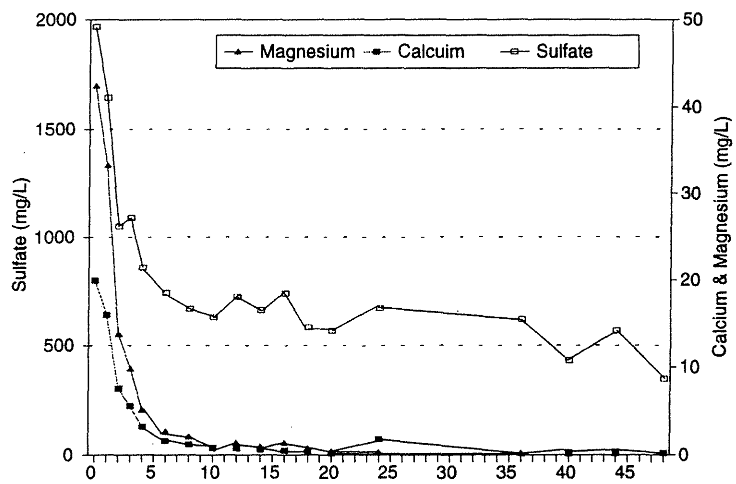


Figure A3.21 Drainage quality vs. time for 1.37% sulfide siltite-argilltie sample(1.69% S, sample number 11196, cell 16[2])





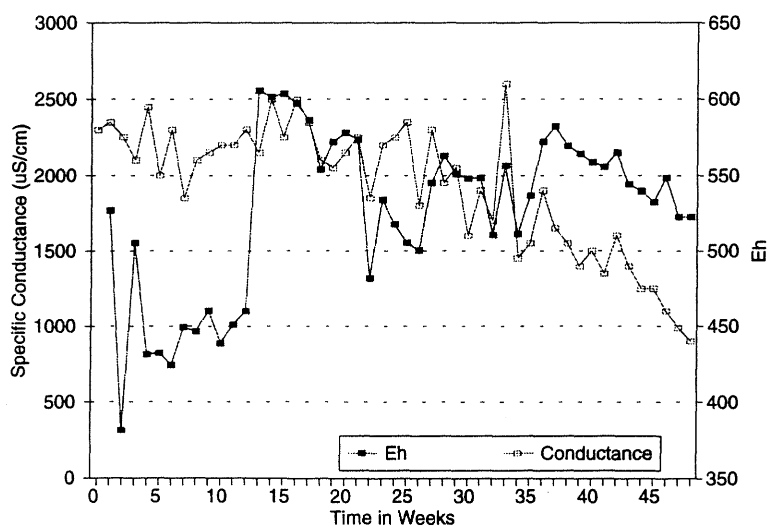
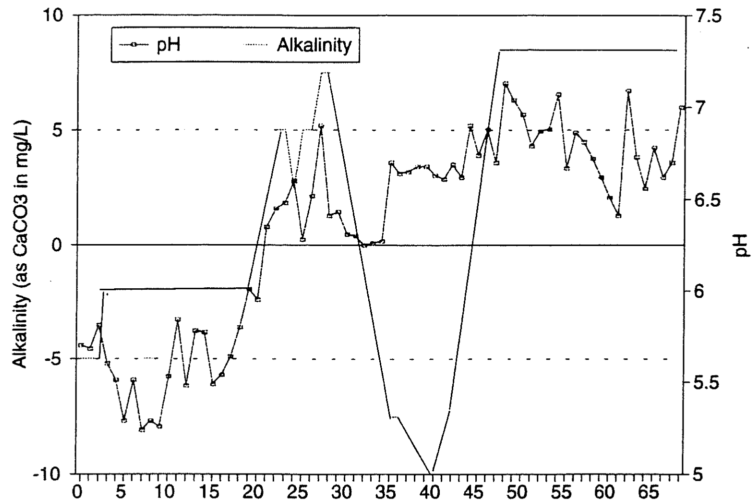
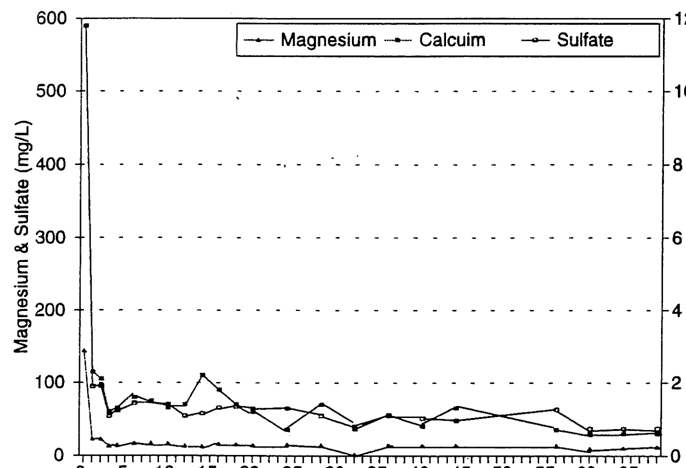


Figure A3.22 Drainage quality vs. time for 1.53% sulfide siltite-argilltie sample(1.60% S, sample number MT-100.4, cell 15).





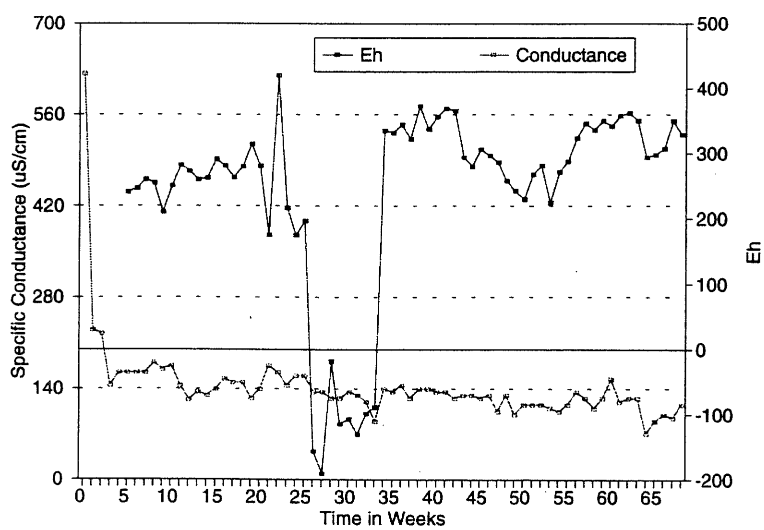
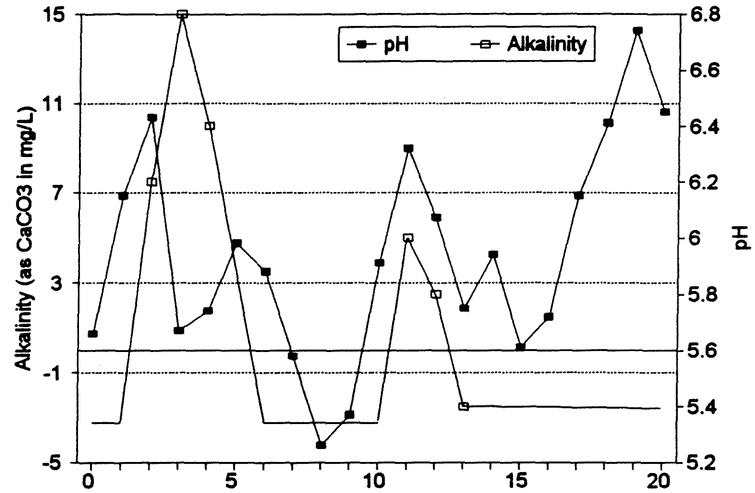
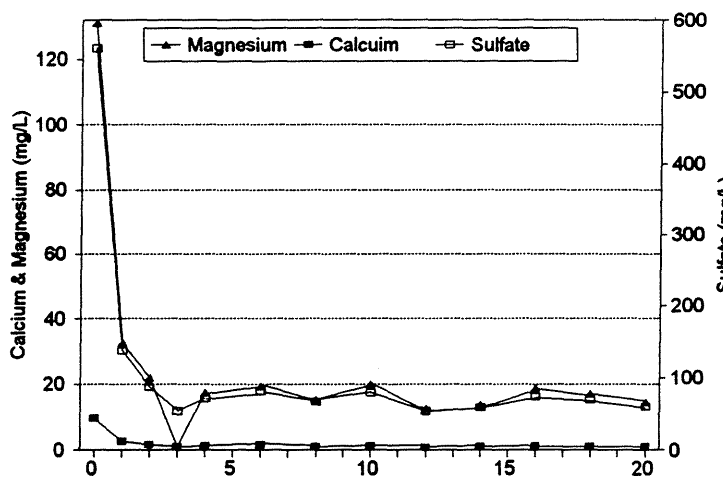
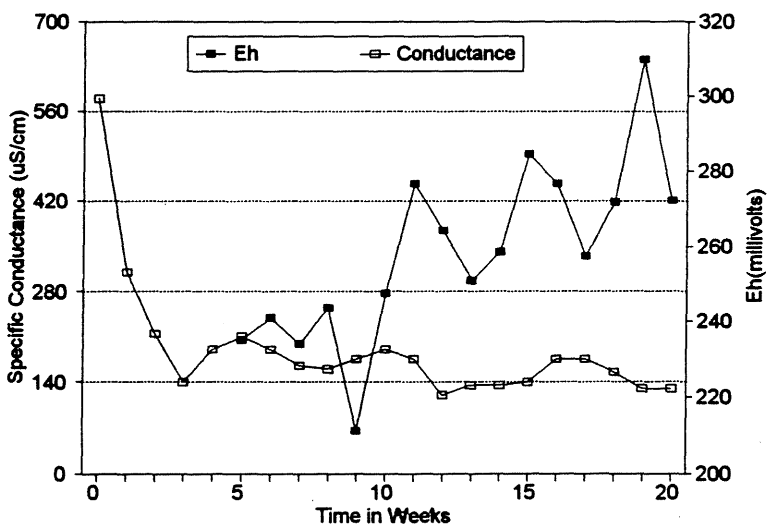


Figure A3.23 Drainage quality vs. time for 1.53% sulfide siltite-argilltie sample (1.60% S, sample number MT-100.4, cell 16)

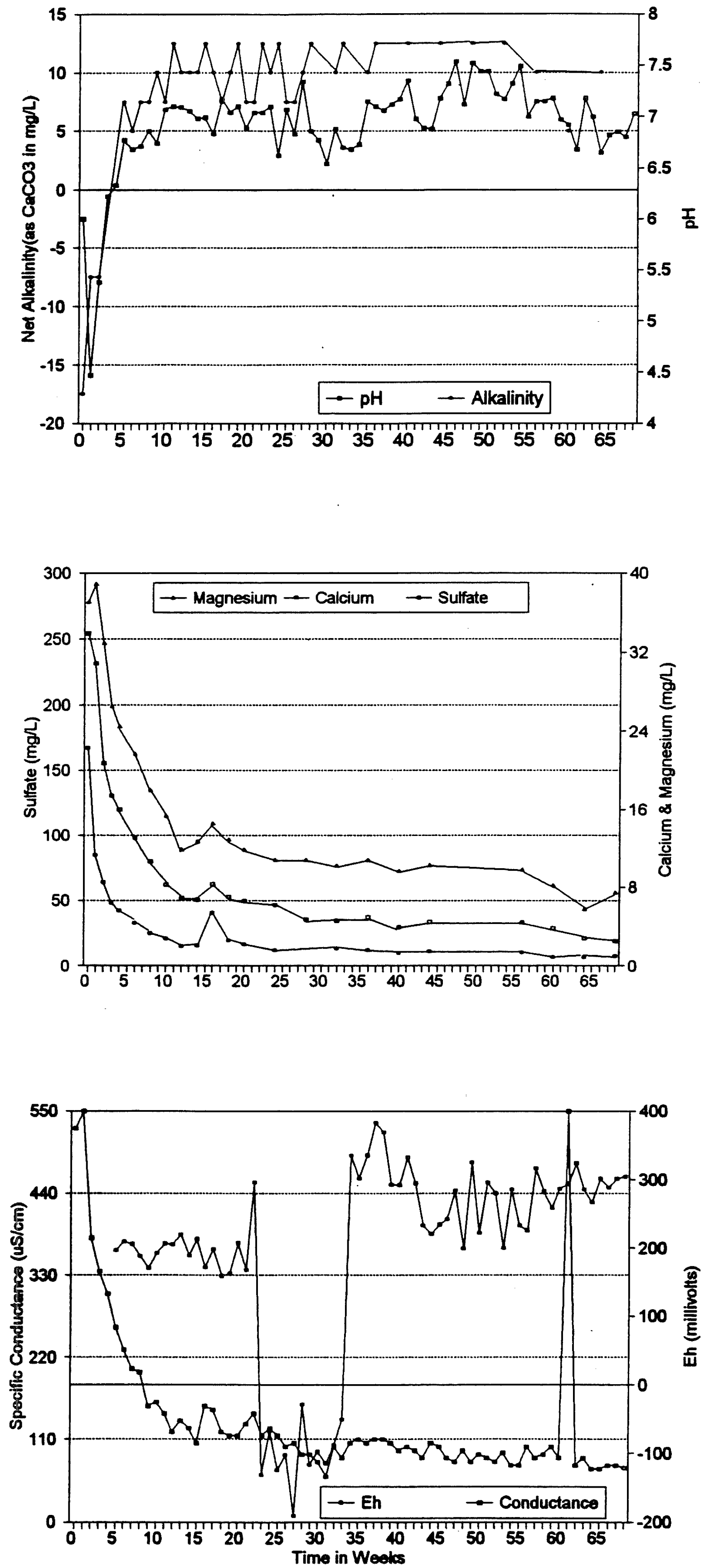






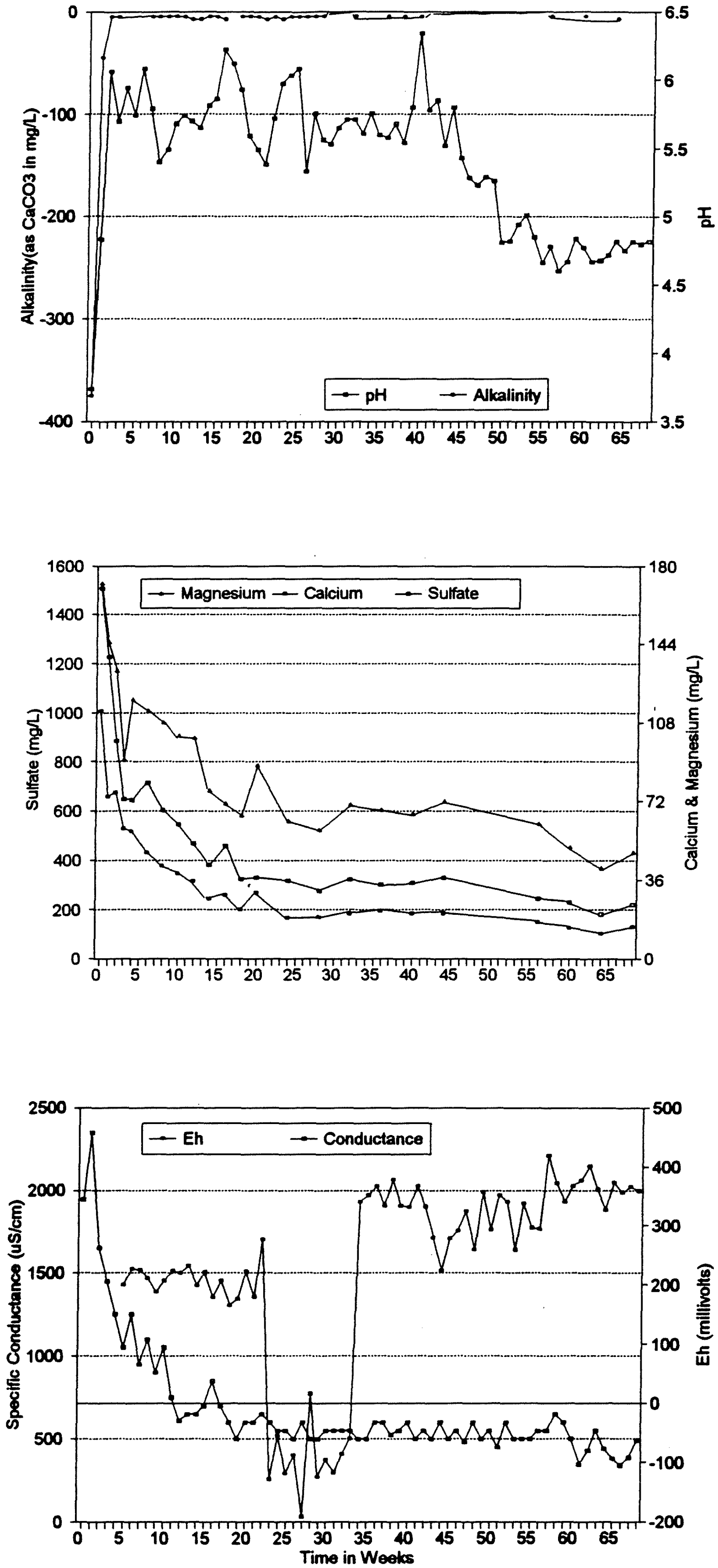
Note: Eh readings were not taken thru week 4.

Figure A3. 24 Drainage quality vs. time for 2.25% sulfide siltite-argillitite sample(2.30% S,sample number MT-99.4, cell 9)



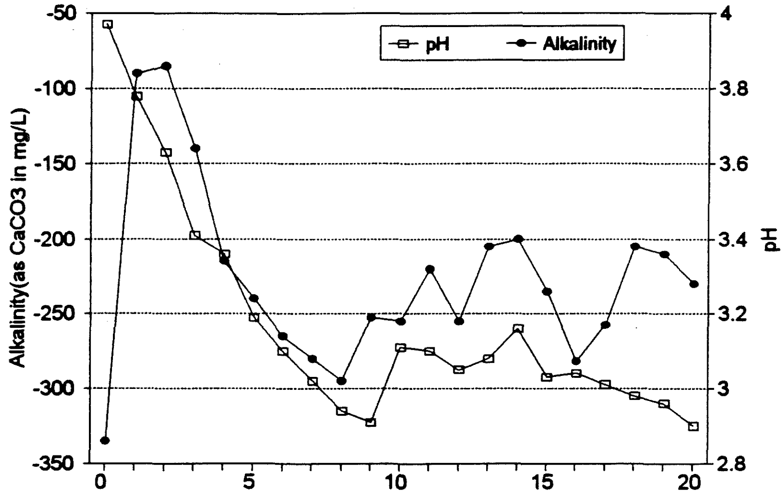
Note: Eh readings were not taken thru week 4.

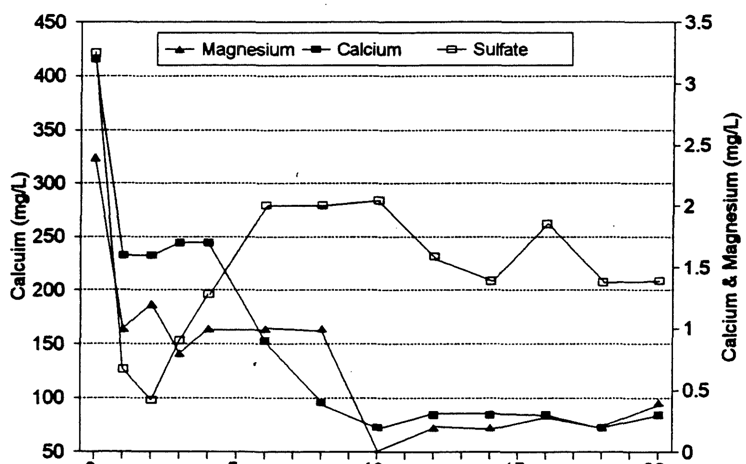
Figure A3.25 Drainage quality vs. time for 3.16% sulfide siltite-argillitite sample (3.24% S, sample number MT-99.1, cell 10).

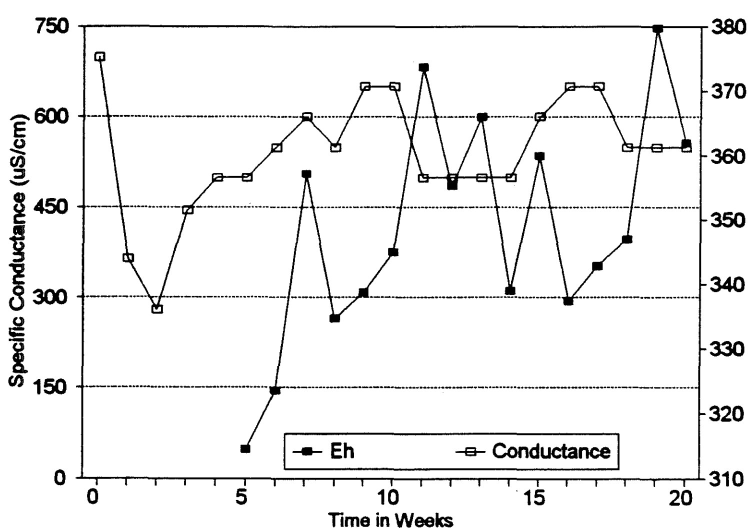


Note: Eh readings were not taken thru week 4.

Figure A3.26 Drainage quality vs. time for 5.75% sulfide siltite-argillitite sample (5.82% S, sample number MT-99.6, cell 11).







Note: Eh readings were not taken thru week 4.

APPENDIX 4

SULFATE, CALCIUM AND MAGNESIUM

MASS RELEASE TABLES

Table A4.1 Mass release from 0.12% sulfate siltite-argillite sample(0.12% S, sample number 10696, cell 7).

week	Vol.(ml)	Sulfate Conc(mg/L)	Sulfate Mass(um)	Sulfate Sum Mass	Calcium Conc(mg/L)	Calcium Mass(um)	Calcium Sum Mass	Magnesium Conc(mg/L)	Magnesium Mass(um)	Magnesium Sum Mass
0	1340	31.1	433.8	433.8	10.4	347.7	347.7	2.4	132.3	132.3
1	435	22.1	100.1	533.9	6.1	66.2	413.9	1.0	17.9	150.2
2	549	14.8	84.6	618.5	4.2	57.5	471.4	1.0	22.6	172.8
3	369	9.6	36.9	655.4	2.6	23.9	495.4	0.7	10.6	183.4
4	436	8.6	39.0	694.4	2.0	21.8	517.1	<0.1	0.0	183.4
*5	414	8.0	34.5	728.9	2.0	20.1	537.3	0.2	3.4	186.8
6	398	7.4	30.7	759.5	1.9	18.9	556.1	0.4	6.5	193.3
*7	408	8.2	34.6	794.2	1.9	19.3	575.5	0.6	9.2	202.6
8	423	8.9	39.2	833.4	1.9	20.1	595.5	0.7	12.2	214.8
*9	420	7.4	32.4	865.7	1.9	19.4	614.9	0.4	6.0	220.8
10	416	5.9	25.6	891.3	1.8	18.7	633.6	<0.1	0.0	220.8
*11	445	6.6	30.5	921.8	1.7	18.9	652.5	0.1	0.9	221.7
12	451	7.3	34.2	956.0	1.6	18.0	670.5	0.1	1.9	223.6
*13	417	11.0	47.8	1003.8	3.1	32.3	702.7	0.2	3.4	227.0
14	448	14.8	68.8	1072.6	4.6	51.4	754.2	0.3	5.5	232.5
*15	419	11.9	51.8	1124.3	3.6	37.6	791.8	0.3	4.3	236.8
16	428	9.0	40.0	1164.3	2.6	27.8	819.6	0.2	3.5	240.4
*17	440	8.7	39.8	1204.1	2.5	27.4	847.0	0.2	3.6	244.0
18	442	8.4	38.6	1242.7	2.4	26.5	873.5	0.2	3.6	247.6
*19	445	7.6	35.4	1278.1	1.9	21.1	894.6	0.2	3.7	251.3
20	448	6.9	32.1	1310.2	1.4	15.6	910.2	0.2	3.7	255.0
*21	408	7.1	30.3	1340.5	1.4	13.7	924.0	0.2	2.5	257.5
*22	461	7.4	35.5	1376.0	1.3	15.0	938.9	0.1	1.9	259.4
*23	453	7.7	36.1	1412.1	1.3	14.1	953.0	0.1	0.9	260.3
24	425	7.9	35.0	1447.2	1.2	12.7	965.8	<0.1	0.0	260.3
*25	456	6.9	32.7	1479.9	1.3	14.2	980.0	0.0	0.0	260.3
*26	428	5.9	26.1	1506.0	1.3	13.9	993.9	0.0	0.0	260.3
*27	436	4.8	21.9	1527.9	1.4	14.7	1008.5	0.0	0.0	260.3
28	462	3.8	18.3	1546.2	1.4	16.1	1024.7	<0.1	0.0	260.3

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.2 Mass release from 0.12% sulfate siltite-argillitite sample (0.12% S, sample number 10696 , cell 8)

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1334	30.6	424.9	424.9	9.8	326.2	326.2	1.3	71.3	71.3
1	453	23.6	111.3	536.2	6.3	71.2	397.4	1.0	18.6	90.0
2	546	13.2	75.0	611.3	3.7	50.4	447.8	0.7	15.7	105.7
3	432	12.8	57.6	668.8	3.1	33.4	481.2	0.6	10.7	116.4
4	438	10.5	47.9	716.7	2.6	28.4	509.6	0.6	10.8	127.2
*5	377	9.3	36.5	753.2	2.4	22.1	531.7	0.4	5.4	132.6
6	412	8.1	34.7	787.9	2.1	21.6	553.3	0.1	1.7	134.3
*7	422	7.3	32.1	820.0	1.8	19.0	572.3	0.3	5.2	139.5
8	404	6.5	27.3	847.4	1.5	15.1	587.4	0.5	8.3	147.8
*9	417	6.49	28.2	875.5	1.6	16.6	604.0	0.4	6.0	153.8
10	422	6.47	28.4	903.9	1.7	17.9	621.9	0.2	3.5	157.3
*11	436	6.60	29.9	933.9	1.7	17.9	639.9	0.2	2.7	160.0
12	435	6.72	30.4	964.3	1.6	17.4	657.2	0.1	1.8	161.8
*13	430	7.20	32.2	996.5	1.6	16.6	673.9	0.2	3.5	165.3
14	432	7.67	34.5	1031.0	1.5	16.2	690.0	0.3	5.3	170.6
*15	415	7.15	30.9	1061.9	1.6	16.6	706.6	0.3	5.1	175.8
16	419	6.63	28.9	1090.8	1.7	17.8	724.4	0.3	5.2	180.9
*17	418	6.67	29.0	1119.8	1.8	18.8	743.1	0.5	7.7	188.7
18	444	6.71	31.0	1150.8	1.9	21.0	764.2	0.6	11.0	199.6
*19	416	7.11	30.8	1181.6	1.8	18.7	782.9	0.4	6.8	206.5
20	456	7.51	35.7	1217.3	1.7	19.3	802.2	0.2	3.8	210.2

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.3 Mass release from 0.12% sulfate siltite-argillite sample(0.16% S sample number 30696, Cell 3[2]).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1355	85.2	1201.8	1201.8	19.8	669.4	669.4	3.4	189.5	189.5
1	378	134.7	530.0	1731.9	33.0	311.2	980.6	8.2	127.5	317.0
2	455	93.8	444.3	2176.2	20.2	229.3	1209.9	3.8	71.1	388.1
3	438	54.9	250.3	2426.5	16.1	175.9	1385.9	2.4	43.2	431.4
4	444	46.3	214.0	2640.5	10.9	120.7	1506.6	1.7	31.0	462.4
*5	445	39.8	184.1	2824.6	9.1	101.0	1607.7	1.4	25.6	488.1
6	418	33.2	144.5	2969.1	7.3	76.1	1683.8	1.1	18.9	507.0
*7	444	29.0	134.0	3103.1	6.7	74.2	1758.0	1.1	20.1	527.1
8	427	24.8	110.2	3213.4	6.1	65.0	1823.0	1.1	19.3	546.4
*9	411	23.8	101.6	3315.0	5.5	56.4	1879.4	0.7	11.8	558.2
10	448	22.7	105.9	3420.9	4.9	54.8	1934.2	0.3	5.5	563.7
*11	427	20.5	90.9	3511.8	4.6	48.5	1982.6	0.6	9.7	573.4
12	425	18.2	80.5	3592.3	4.2	44.5	2027.2	0.8	14.0	587.4
*13	409	18.6	79.2	3671.5	4.2	42.9	2070.0	0.7	10.9	598.3
14	447	19.0	88.4	3759.9	4.2	46.8	2116.9	0.5	9.2	607.5
*15	427	19.4	86.0	3845.9	4.1	43.1	2160.0	0.4	7.0	614.5
16	450	19.7	92.3	3938.2	3.9	43.8	2203.8	0.3	5.6	620.1
*17	435	17.0	77.0	4015.2	3.7	39.6	2243.4	0.6	10.7	630.8
18	458	14.3	68.2	4083.4	3.4	38.9	2282.3	0.9	17.0	647.8
*19	438	15.5	70.7	4154.0	3.2	35.0	2317.3	0.8	14.4	662.2
20	444	16.7	77.2	4231.2	3.0	33.2	2350.5	0.7	12.8	675.0
*21	441	16.0	73.6	4304.8	2.9	31.4	2381.8	0.6	10.4	685.4
*22	445	15.4	71.1	4375.9	2.7	30.0	2411.8	0.5	8.2	693.7
*23	418	14.7	63.9	4439.8	2.6	26.6	2438.4	0.3	5.6	699.2
24	439	14.0	64.0	4503.7	2.4	26.3	2464.7	0.2	3.6	702.9

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.4 Mass release from 0.12% sulfate siltite-argillite sample (0.16% S, sample number 30696, Cell 5).

week	Vol.(ml)	Sulfate Conc(mg/L)	Sulfate Mass(um)	Sulfate Sum Mass	Calcium Conc(mg/L)	Calcium Mass(um)	Calcium Sum Mass	Magnesium Conc(mg/L)	Magnesium Mass(um)	Magnesium Sum Mass
0	1333	114.4	1587.5	1587.5	26.3	874.7	874.7	4.5	246.8	246.8
1	462	17.0	81.8	1669.3	33.5	386.2	1260.9	5.3	100.7	347.5
2	458	66.3	316.1	1985.4	17.6	201.1	1462.0	3.0	56.5	404.0
3	380	30.3	119.9	2105.2	8.4	79.6	1541.6	1.7	26.6	430.6
4	442	41.4	190.5	2295.7	10.0	110.3	1651.9	1.9	34.5	465.1
*5	409	36.0	153.3	2449.0	8.7	88.3	1740.2	1.7	28.6	493.7
6	422	30.6	134.4	2583.4	7.3	76.9	1817.0	1.5	26.0	519.8
*7	417	29.2	126.8	2710.2	6.9	71.3	1888.3	1.5	24.9	544.6
8	418	27.8	121.0	2831.2	6.4	66.7	1955.0	1.4	24.1	568.7
*9	423	25.1	110.6	2941.8	5.9	61.7	2016.8	0.8	13.1	581.7
10	429	22.4	100.2	3041.9	5.3	56.7	2073.5	0.1	1.8	583.5
*11	451	19.8	93.0	3134.9	4.8	54.0	2127.5	0.4	6.5	590.0
12	436	17.2	78.0	3212.9	4.3	46.8	2174.3	0.6	10.8	600.8
*13	400	16.8	69.9	3282.8	3.9	38.9	2213.2	0.7	10.7	611.5
14	445	16.4	75.9	3358.7	3.5	38.9	2252.1	0.7	12.8	624.3
*15	433	16.2	73.2	3431.9	3.5	37.8	2289.9	0.6	10.7	635.0
16	424	16.1	71.1	3503.0	3.5	37.0	2326.9	0.5	8.7	643.7
*17	435	15.4	69.6	3572.6	3.4	36.4	2363.3	0.6	10.7	654.4
18	437	14.7	66.7	3639.3	3.2	34.9	2398.2	0.7	12.6	667.0
*19	424	14.8	65.3	3704.6	3.2	33.9	2432.0	0.6	10.5	677.5
20	442	14.9	68.7	3773.3	3.2	35.3	2467.3	0.5	9.1	686.6
*21	425	15.3	67.6	3840.9	3.5	36.6	2503.9	0.5	7.9	694.4
*22	463	15.6	75.3	3916.2	3.7	42.7	2546.6	0.4	7.6	702.0
*23	448	16.0	74.4	3990.6	4.0	44.2	2590.8	0.4	6.5	708.5
24	431	16.3	73.1	4063.7	4.2	45.2	2635.9	0.3	5.3	713.8
*25	431	16.0	71.9	4135.6	3.8	41.1	2677.1	0.2	4.0	717.8
*26	456	15.8	74.8	4210.4	3.5	39.3	2716.3	0.2	2.8	720.6
*27	442	15.5	71.2	4281.6	3.1	33.9	2750.2	0.1	1.4	722.0
28	446	15.2	70.6	4352.2	2.7	30.0	2780.3	<0.1	0.0	722.0
*29	447	14.3	66.5	4418.7	2.6	29.3	2809.6	0.0	0.0	722.0
*30	411	13.4	57.3	4476.0	2.6	26.1	2835.7	0.0	0.0	722.0
*31	448	12.5	58.3	4534.3	2.5	27.7	2863.4	0.0	0.0	722.0
32	427	11.6	51.6	4585.9	2.4	25.6	2888.9	<0.10	0.0	722.0
*33	404	9.4	39.5	4625.4	2.3	23.4	2912.4	0.1	1.2	723.2
*34	442	7.2	33.1	4658.6	2.3	24.8	2937.2	0.2	2.7	726.0
*35	448	5.0	23.3	4681.9	2.2	24.3	2961.5	0.2	4.1	730.1
36	428	2.8	12.5	4694.4	2.1	22.4	2983.9	0.3	5.3	735.4
*37	445	5.3	24.3	4718.7	2.1	22.8	3006.7	0.3	5.0	740.4
*38	445	7.7	35.7	4754.4	2.0	22.2	3028.9	0.3	4.6	745.0
*39	448	10.2	47.3	4801.7	2.0	21.8	3050.7	0.2	4.1	749.1
40	438	12.6	57.5	4859.1	1.9	20.8	3071.5	0.2	3.6	752.7
*41	443	12.0	55.5	4914.6	1.8	19.6	3091.1	0.2	2.7	755.5
*42	429	11.5	51.1	4965.7	1.7	17.7	3108.7	0.1	1.8	757.2
*43	461	10.9	52.2	5017.9	1.5	17.5	3126.3	0.1	0.9	758.2
44	451	10.3	48.4	5066.3	1.4	15.8	3142.0	<0.10	0.0	758.2

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimatted as the average of the previous and subsequent week's conce

Table A4.5 Mass release from 0.22% sulfate siltite-argillite sample (0.24% S,sample number 60696, cell 1).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1308	34.7	472.5	472.5	22.0	718.0	718.0	3.0	161.4	161.4
1	437	97.8	444.9	917.4	8.4	91.6	809.6	1.3	23.4	184.8
2	615	6.8	43.5	960.9	5.6	85.9	895.5	1.2	30.4	215.1
3	354	2.5	9.2	970.2	3.2	28.3	923.7	0.4	5.8	221.0
4	441	3.3	15.1	985.3	4.0	44.0	967.8	0.5	9.1	230.0
*5	408	4.4	18.5	1003.8	3.8	38.7	1006.4	0.6	10.1	240.1
6	430	5.4	24.2	1028.0	3.6	38.6	1045.1	0.7	12.4	252.5
*7	403	4.4	18.5	1046.4	3.5	35.2	1080.3	0.5	7.5	259.9
8	421	3.4	14.9	1061.3	3.4	35.7	1116.0	0.2	3.5	263.4
*9	412	3.0	12.7	1074.0	3.3	33.4	1149.4	0.6	9.3	272.7
10	413	2.5	10.7	1084.7	3.1	31.9	1181.3	0.9	15.3	288.0
*11	422	2.4	10.3	1095.0	3.0	31.6	1212.9	0.9	15.6	303.6
12	414	2.2	9.5	1104.5	2.9	30.0	1242.9	0.9	15.3	319.0
*13	460	2.2	10.5	1115.1	2.8	31.6	1274.4	0.7	12.3	331.3
14	456	2.2	10.4	1125.5	2.6	29.6	1304.0	0.4	7.5	338.8
*15	421	2.4	10.5	1136.0	2.6	27.3	1331.3	0.4	6.9	345.7
16	408	2.6	11.0	1147.1	2.6	26.5	1357.8	0.4	6.7	352.4
*17	397	2.4	9.7	1156.8	2.7	26.2	1384.0	0.4	6.5	358.9
18	452	2.1	9.9	1166.7	2.7	30.4	1414.5	0.4	7.4	366.4
*19	429	2.0	8.9	1175.6	2.6	27.3	1441.8	0.4	7.1	373.4
20	442	1.9	8.7	1184.3	2.4	26.5	1468.2	0.4	7.3	380.7
*21	360	2.7	10.2	1194.5	2.4	21.1	1489.3	0.4	6.3	387.0
*22	448	3.6	16.6	1211.1	2.3	25.7	1515.1	0.5	8.3	395.3
*23	439	4.4	20.0	1231.1	2.3	24.6	1539.7	0.5	8.6	403.9
24	437	5.2	23.7	1254.7	2.2	24.0	1563.7	0.5	9.0	412.9
*25	436	4.3	19.3	1274.1	2.2	23.7	1587.3	0.4	7.2	420.0
*26	437	3.3	15.1	1289.2	2.2	23.4	1610.8	0.3	5.4	425.4
*27	394	2.4	9.8	1299.0	2.1	20.9	1631.7	0.2	3.2	428.7
28	440	1.5	6.6	1305.7	2.1	23.1	1654.7	0.1	1.8	430.5
*29	420	1.4	6.1	1311.7	2.1	22.3	1677.0	0.1	1.3	431.8
*30	434	1.3	6.0	1317.7	2.2	23.3	1700.3	0.1	0.9	432.7
*31	439	1.3	5.8	1323.5	2.2	23.8	1724.1	0.0	0.5	433.1
32	418	1.2	5.2	1328.7	2.2	22.9	1747.0	<0.10	0.0	433.1
*33	428	1.4	6.0	1334.7	2.2	23.5	1770.5	0.1	0.9	434.0
*34	429	1.5	6.7	1341.4	2.2	23.5	1794.1	0.1	1.8	435.8
*35	442	1.7	7.6	1349.0	2.2	24.3	1818.4	0.2	2.7	438.5
36	455	1.8	8.5	1357.5	2.2	25.0	1843.3	0.2	3.7	442.2
*37	434	1.7	7.8	1365.3	2.2	23.6	1866.9	0.3	4.9	447.2
*38	458	1.7	7.9	1373.2	2.2	24.6	1891.4	0.4	6.6	453.7
*39	456	1.6	7.5	1380.7	2.1	24.2	1915.6	0.4	8.0	461.7
40	418	1.5	6.5	1387.2	2.1	21.9	1937.5	0.5	8.6	470.3
*41	444	1.1	7.0	1394.2	2.1	23.3	1960.8	0.4	6.8	477.2
*42	440	0.8	7.1	1401.3	2.1	23.1	1983.8	0.3	4.5	481.7
*43	449	0.4	7.4	1408.7	2.1	23.5	2007.4	0.1	2.3	484.0
44	460	0.7	7.7	1416.4	2.1	24.1	2031.5	<0.10	0.0	484.0

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.6 Mass release from 0.28% sulfate siltite-argillite sample(0.29% S,sample number 40696 Cell 3).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1339	22.2	309.5	309.5	5.1	170.4	170.4	0.9	49.6	49.6
1	436	16.0	72.6	382.1	4.7	51.1	221.5	0.7	12.6	62.1
2	451	13.1	61.5	443.6	3.6	40.5	262.0	0.7	13.0	75.1
3	447	10.8	50.3	493.8	2.6	29.0	291.0	0.7	12.9	88.0
4	423	8.7	38.3	532.1	2.3	24.3	315.3	0.6	10.4	98.4
*5	425	8.8	38.7	570.9	2.3	24.4	339.7	0.6	9.6	108.0
6	430	8.8	39.4	610.2	2.3	24.7	364.4	0.5	8.8	116.9
*7	383	8.5	33.7	643.9	2.1	20.1	384.4	0.4	6.3	123.2
8	421	8.1	35.5	679.4	1.9	20.0	404.4	0.3	5.2	128.4
*9	417	7.7	33.4	712.9	1.9	19.8	424.1	0.2	2.6	131.0
10	421	7.3	32.0	744.9	1.9	20.0	444.1	<0.1	0.0	131.0
*11	419	7.4	32.5	777.3	1.8	18.3	462.4	0.1	1.7	132.7
12	419	7.6	33.1	810.4	1.6	16.7	479.1	0.2	3.4	136.1
*13	418	7.7	33.6	844.1	1.6	16.2	495.3	0.3	4.3	140.4
14	445	7.9	36.4	880.5	1.5	16.7	511.9	0.3	5.5	145.9
*15	419	7.2	31.6	912.0	1.6	16.2	528.1	0.3	5.2	151.1
16	423	6.6	29.2	941.2	1.6	16.9	545.0	0.3	5.2	156.3
*17	428	7.0	31.0	975.3	1.7	17.6	564.8	0.3	5.3	161.6
18	440	6.9	31.4	1006.6	1.7	18.7	583.5	0.3	5.4	167.0
*19	412	6.9	29.7	1036.3	1.7	17.0	600.4	0.3	5.1	172.1
20	460	7.0	33.5	1069.9	1.6	18.4	618.8	0.3	5.7	177.8

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.7 Mass release from 0.28% sulfate siltite-argillite sample (0.29% S, sample number 40696, Cell 4).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1336	21.8	3026.5	3026.5	5.3	1763.5	1763.5	0.7	384.0	384.0
1	469	17	83.0	3109.5	4.8	56.2	1819.7	0.8	15.4	399.4
2	546	10.5	59.7	3169.2	2.9	39.5	1859.2	0.3	6.7	406.2
3	451	9.9	46.5	3215.7	2.5	28.1	1887.3	0.9	16.7	422.9
4	454	7.5	35.4	3251.1	2.1	23.8	1911.1	0.5	9.3	432.2
*5	408	8.00	34.0	3285.1	2.25	22.9	1934.0	0.45	7.6	439.8
6	444	8.5	39.3	3324.4	2.4	26.6	1960.6	0.4	7.3	447.1
*7	428	7.85	35.0	3359.3	2.20	23.5	1984.1	0.40	7.0	454.1
8	438	7.2	32.8	3392.2	2	21.9	2005.9	0.4	7.2	461.3
*9	431	6.24	28.0	3420.2	1.90	20.4	2026.4	0.30	5.3	466.6
10	432	5.28	23.7	3443.9	1.8	19.4	2045.8	0.2	3.6	470.2
*11	401	4.94	20.6	3464.5	1.70	17.0	2062.8	0.20	3.3	473.5
12	429	4.6	20.5	3485.1	1.6	17.1	2079.9	0.2	3.5	477.0
*13	462	5.33	25.6	3510.7	1.60	18.4	2098.3	0.30	5.7	482.7
14	457	6.06	28.8	3539.5	1.6	18.2	2116.6	0.4	7.5	490.2
*15	443	6.34	29.2	3568.8	1.55	17.1	2133.7	0.30	5.5	495.7
16	430	6.62	29.6	3598.4	1.5	16.1	2149.8	0.2	3.5	499.2
*17	428	6.54	29.1	3627.5	1.50	16.0	2165.8	0.20	3.5	502.8
18	452	6.45	30.3	3657.9	1.5	16.9	2182.7	0.2	3.7	506.5
*19	430	7.01	31.4	3689.3	1.50	16.1	2198.8	0.30	5.3	511.8
20	415	7.57	32.7	3722.0	1.5	15.5	2214.4	0.4	6.8	518.6

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.8 Mass release from 0.26% sulfate siltite-argillite sample (0.30% S sample number 50696, Cell 2).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1344	7.7	107.7	107.7	7.0	234.7	234.7	0.9	49.8	49.8
1	456	9.2	43.7	151.4	7.5	85.3	320.1	0.8	15.0	64.8
2	503	6.8	35.6	187.0	7.0	87.8	407.9	0.9	18.6	83.4
3	462	9.8	47.1	234.1	7.6	87.6	495.5	1.2	22.8	106.2
4	443	8.0	36.9	271.0	6.3	69.6	565.1	0.8	14.6	120.8
*5	420	7.9	34.3	305.4	6.0	62.9	628.0	0.7	12.1	132.9
6	432	7.7	34.6	340.0	5.7	61.4	689.5	0.6	10.7	143.5
*7	426	6.5	28.8	368.8	3.7	38.8	728.3	0.5	8.8	152.3
8	429	5.3	23.7	392.5	1.6	17.1	745.4	0.4	7.1	159.3
*9	425	4.4	19.2	411.7	2.9	30.2	775.6	0.5	8.7	168.1
10	426	3.4	15.1	426.8	4.1	43.6	819.2	0.6	10.5	178.6
*11	424	4.2	18.6	445.4	4.5	47.6	866.8	0.5	8.7	187.3
12	432	5.0	22.6	468.0	4.9	52.8	919.6	0.4	7.1	194.4
*13	459	3.9	18.7	486.7	4.8	54.4	974.0	0.6	10.4	204.8
14	460	2.8	13.4	500.1	4.6	52.8	1026.8	0.7	13.2	218.1
*15	433	2.9	12.8	513.0	4.2	45.4	1072.2	0.6	10.7	228.7
16	422	2.9	12.7	525.7	3.8	40.0	1112.2	0.5	8.7	237.4
*17	435	2.9	12.9	538.6	4.2	45.6	1157.8	0.6	9.8	247.3
18	448	2.8	13.1	551.7	4.6	51.4	1209.2	0.6	11.1	258.3
*19	439	2.6	11.7	563.4	4.3	46.6	1255.7	0.6	10.8	269.2
20	443	2.3	10.6	574.0	3.9	43.1	1298.8	0.6	10.9	280.1
*21	453	2.3	10.8	584.8	3.9	43.8	1342.6	0.7	13.0	293.1
*22	461	2.3	11.0	595.8	3.9	44.3	1386.9	0.8	15.2	308.3
*23	446	2.3	10.7	606.5	3.8	42.6	1429.5	0.9	16.5	324.8
24	440	2.3	10.5	617.1	3.8	41.7	1471.2	1.0	18.1	342.9
*25	443	2.1	9.8	626.9	3.7	40.6	1511.8	0.8	15.0	358.0
*26	434	2.0	8.8	635.7	3.6	38.4	1550.3	0.7	11.6	369.6
*27	457	1.8	8.4	644.1	3.4	39.1	1589.3	0.5	8.9	378.5
28	432	1.6	7.2	651.3	3.3	35.6	1624.9	0.3	5.3	383.8
*29	444	1.6	7.4	658.7	3.2	35.7	1660.6	0.2	4.1	387.9
*30	441	1.6	7.3	666.0	3.2	34.7	1695.3	0.2	2.7	390.6
*31	444	1.6	7.4	673.4	3.1	34.1	1729.3	0.1	1.4	392.0
32	416	1.6	6.9	680.4	3.0	31.1	1760.5	<0.10	0.0	392.0
*33	420	4.3	18.9	699.3	3.0	31.2	1791.6	0.1	2.2	394.2
*34	441	7.1	32.4	731.7	3.0	32.5	1824.1	0.3	4.5	398.7
*35	445	9.8	45.3	776.9	2.9	32.5	1856.6	0.4	6.9	405.6
36	440	12.5	57.3	834.2	2.9	31.8	1888.4	0.5	9.0	414.6
*37	450	9.9	46.1	880.3	3.0	33.1	1921.5	0.5	8.8	423.4
*38	443	7.2	33.2	913.5	3.0	33.2	1954.7	0.5	8.2	431.6
*39	420	4.6	19.9	933.4	3.1	32.0	1986.6	0.4	7.3	439.0
40	444	1.9	8.8	942.2	3.1	34.3	2021.0	0.4	7.3	446.3
*41	446	1.8	8.5	1029.8	3.3	36.2	2366.5	0.3	5.5	517.6
*42	441	1.8	8.0	1037.8	3.4	37.4	2403.9	0.2	3.6	521.2
*43	437	1.7	7.6	1045.5	3.6	38.7	2442.7	0.1	1.8	523.0
44	449	1.6	7.5	1052.9	3.7	41.4	2484.1	<0.10	0.0	523.0

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimatted as the average of the previous and subsequent week's concentrations.

Table A4.9 Mass release from 0.44% SO4 siltite-argillite sample (0.38% S, sample number 71196, Cell 4[2]).

week	Vol.(ml)	Sulfate Conc(mg/L)	Sulfate Mass(um)	Sulfate Sum Mass	Calcium Conc(mg/L)	Calcium Mass(um)	Calcium Sum Mass	Magnesium Conc(mg/L)	Magnesium Mass(um)	Magnesium Sum Mass
0	1274	4911	65132	65132	302	9600	9600	403	21120	21120
1	458	826.8	3942	69074	96.8	1106	10706	46.1	868.5	21988
2	447	306	1424	70498	45.1	503	11209	17.4	319.9	22308
3	458	198	944	71442	24.5	280	11489	10.6	199.7	22508
4	438	176.9	807	72249	16.5	180	11669	7.40	133.3	22641
*5	442	164.85	759	73007	13.4	148	11817	6.10	110.9	22752
6	450	152.8	716	73723	10.3	116	11932	4.80	88.9	22841
*7	460	133.5	639	74363	7.8	90	12022	4.10	77.6	22919
8	456	114.2	542	74905	5.3	60	12082	3.40	63.8	22982
*9	436	110.5	502	75406	4.35	47	12129	2.45	43.9	23026
10	443	106.8	493	75899	3.4	38	12167	1.50	27.3	23054
*11	427	101.4	451	76350	2.95	31	12198	1.60	28.1	23082
12	433	96	433	76782	2.5	27	12225	1.70	30.3	23112
*13	437	88.55	403	77185	2.55	28	12253	1.45	26.1	23138
14	445	81.1	376	77561	2.6	29	12282	1.20	22.0	23160
*15	380	84.95	336	77897	2.05	19	12302	0.95	14.8	23175
16	390	88.8	361	78257	1.5	15	12316	0.70	11.2	23186
*17	444	76.65	354	78612	1.25	14	12330	0.85	15.5	23202
18	453	64.5	304	78916	1	11	12341	1.00	18.6	23220
*19	435	63.7	288	79204	0.9	10	12351	1.00	17.9	23238
20	445	62.9	291	79496	0.8	9	12360	1.00	18.3	23257
*21	438	60.45	276	79771	1.05	11	12371	0.93	16.7	23273
*22	427	58	258	80029	1.3	14	12385	0.85	14.9	23288
*23	462	55.55	267	80296	1.55	18	12403	0.78	14.7	23303
24	430	53.1	238	80534	1.8	19	12422	0.70	12.4	23315
*25	444	53.4	247	80781	1.7	18	12441	0.67	12.2	23327
*26	435	53.7	243	81024	1.5	16	12457	0.63	11.3	23339
*27	441	54	248	81272	1.35	15	12472	0.60	10.9	23350
*28	347	54.3	196	81468	1.2	10	12482	0.57	8.09	23358
*29	414	54.6	235	81703	1.05	11	12493	0.53	9.08	23367
*30	442	54.9	253	81956	0.9	10	12503	0.50	9.09	23376
*31	438	55.2	252	82208	0.75	8	12511	0.47	8.41	23384
*32	429	55.5	248	82455	0.6	6	12518	0.43	7.65	23392
*33	433	55.8	252	82707	0.45	5	12523	0.40	7.12	23399
*34	436	56.1	255	82962	0.3	3	12526	0.37	6.58	23406
*35	425	56.4	250	83211	0.15	2	12527	0.33	5.83	23411
36	422	56.7	249	83460	<0.10	0	12527	0.30	5.21	23417
*37	424	53.2	235	83695	0.1	1	12528	0.28	4.80	23421
*38	421	49.7	218	83913	0.2	2	12531	0.25	4.33	23426
*39	428	46.2	206	84119	0.3	3	12534	0.23	3.96	23430
40	394	42.7	175	84294	0.4	4	12538	0.20	3.24	23433
*41	440	45.125	207	84501	0.375	4	12542	0.18	3.17	23436
*42	450	47.55	223	84723	0.35	4	12546	0.15	2.78	23439
*43	456	49.975	237	84961	0.325	4	12549	0.13	2.34	23441
44	458	52.4	250	85210	0.3	3	12553	0.10	1.88	23443
*45	461	53.85	258	85469	0.275	3	12556	0.13	2.37	23446
*46	444	55.3	256	85724	0.25	3	12559	0.15	2.74	23448
*47	439	56.75	259	85984	0.225	2	12561	0.18	3.16	23451
48	396	58.2	240	86224	0.2	2	12563	0.20	3.26	23455

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.10 Mass release from 0.43% sulfate siltite-argillitite sample (0.42% S, sample number 21196, cell 8)

week	Vol.(ml)	Sulfate Conc(mg/L)	Sulfate Mass(um)	Sulfate Sum Mass	Calcium Conc(mg/L)	Calcium Mass(um)	Calcium Sum Mass	Magnesium Conc(mg/L)	Magnesium Mass(um)	Magnesium Sum Mass
0	1349	1635	22960.8	22960.8	74.1	2494.0	2494.0	36.8	2042.1	2042.1
1	440	1341	6142.4	29103.2	63.8	700.4	3194.4	55.1	997.3	3039.4
2	442	534	2457.1	31560.3	48.9	539.3	3733.7	23.6	429.1	3468.5
3	443	354	1632.5	33192.8	40.2	444.3	4178.0	15.2	277.0	3745.5
4	452	256.1	1205.1	34397.9	24.6	277.4	4455.5	7.4	137.6	3883.0
*5	448	238.3	1111.4	35509.3	21.8	243.1	4698.6	6.0	109.7	3992.7
6	449	220.5	1030.7	36539.9	18.9	211.7	4910.3	4.5	83.1	4075.8
*7	442	210	966.3	37506.2	15.6	171.5	5081.8	4.2	75.5	4151.3
8	453	199.5	940.8	38447.0	12.2	137.9	5219.7	3.8	70.8	4222.1
*9	439	198.7	908.1	39355.1	10.7	117.2	5336.9	2.7	48.8	4270.8
10	451	197.9	929.1	40284.2	9.2	103.5	5440.4	1.6	29.7	4300.5
*11	421	192.2	842.4	41126.6	9.2	96.6	5537.0	2.3	39.8	4340.3
12	433	186.5	840.7	41967.2	9.2	99.4	5636.4	3.0	53.4	4393.8
*13	429	170.9	763.0	42730.2	8.4	89.9	5726.3	2.3	40.6	4434.4
14	441	155.2	712.5	43442.7	7.6	83.6	5810.0	1.6	29.0	4463.4
*15	454	140	661.7	44104.4	5.7	64.0	5873.9	1.2	21.5	4484.9
16	445	124.8	578.1	44682.5	3.7	41.1	5915.0	0.7	12.8	4497.7
*17	434	112.5	508.3	45190.8	3.6	38.4	5953.5	0.9	16.1	4513.8
18	462	100.2	481.9	45672.7	3.4	39.2	5992.7	1.1	20.9	4534.7
*19	433	96.4	434.5	46107.3	2.9	30.8	6023.5	1.0	16.9	4551.6
20	449	92.6	432.8	46540.1	2.3	25.8	6049.2	0.8	14.8	4566.4
*21	438	87.6	399.2	46939.3	2.2	23.5	6072.7	0.9	15.3	4581.7
*22	437	82.5	375.3	47314.6	2.0	21.8	6094.5	0.9	16.2	4597.8
*23	456	77.5	367.7	47682.3	1.9	21.0	6115.6	1.0	17.8	4615.7
24	436	72.4	328.6	48010.9	1.7	18.5	6134.1	1.0	17.9	4633.6

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.8 Mass release from 0.96% S siltite-argillite (sample number 2-0696R, Cell 6).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1319	21.5	28.4	295.2	4.70	6.20	154.7	0.50	0.66	27.1
1	459	29.0	41.7	433.8	5.70	8.82	220.0	0.80	1.03	42.2
2	478	21.0	51.7	538.3	4.40	10.9	272.4	0.90	1.46	59.9
3	445	17.1	59.3	617.5	3.20	12.3	308.0	1.00	1.90	78.2
4	393	13.5	64.6	672.7	2.80	13.4	335.4	0.60	2.14	87.9
*5	408	13.7	70.2	730.9	2.70	14.5	362.9	0.50	2.34	96.3
6	458	13.9	76.6	797.2	2.60	15.7	392.6	0.40	2.52	103.9
*7	450	12.0	82.0	853.4	2.30	16.8	418.4	0.55	2.77	114.0
8	417	10.1	86.2	897.3	2.00	17.6	439.2	0.70	3.06	126.1
*9	436	9.58	90.4	940.7	1.90	18.4	459.9	0.35	3.22	132.3
10	434	9.05	94.3	981.6	1.80	19.2	479.4	<0.1	3.22	132.3
*11	430	8.53	98.0	1019.8	1.60	19.9	496.6	0.10	3.26	134.1
12	440	8.01	101.5	1056.5	1.40	20.5	511.9	0.20	3.35	137.7
*13	401	7.78	104.6	1088.9	1.45	21.1	526.4	0.30	3.47	142.7
14	441	7.54	107.9	1123.5	1.50	21.8	542.9	0.40	3.64	149.9
*15	429	7.71	111.2	1158.0	1.50	22.4	559.0	0.30	3.77	155.2
16	417	7.87	114.5	1192.1	1.50	23.0	574.6	0.20	3.86	158.6
*17	438	7.65	117.9	1227.0	1.50	23.7	591.0	0.20	3.94	162.3
18	451	7.43	121.2	1261.9	1.50	24.4	607.9	0.20	4.03	166.0
*19	427	7.14	124.3	1293.6	1.50	25.0	623.9	0.20	4.12	169.5
20	404	6.84	127.0	1322.4	1.50	25.6	639.0	0.20	4.20	172.8
*21	469	6.89	130.3	1356.0	1.40	26.3	655.4	0.18	4.28	176.2
*22	461	6.94	133.5	1389.3	1.30	26.9	670.3	0.15	4.35	179.0
*23	461	6.98	136.7	1422.8	1.20	27.4	684.1	0.13	4.41	181.4
24	436	7.03	139.7	1454.7	1.10	27.9	696.1	0.10	4.45	183.2
*25	449	6.82	142.8	1486.6	1.13	28.4	708.7	0.08	4.49	184.6
*26	441	6.62	145.7	1517.0	1.15	28.9	721.3	0.05	4.51	185.5
*27	458	6.41	148.7	1547.5	1.18	29.4	734.8	0.03	4.52	185.9
28	445	6.20	151.4	1576.2	1.20	30.0	748.1	<0.1	4.52	185.9
*29	442	6.23	154.2	1604.9	1.25	30.5	761.9	0.00	4.52	185.9
*30	459	6.25	157.0	1634.7	1.30	31.1	776.8	0.00	4.52	185.9
*31	445	6.28	159.8	1663.8	1.35	31.7	791.7	0.00	4.52	185.9
32	424	6.30	162.5	1691.6	1.40	32.3	806.6	<0.10	4.52	185.9
*33	430	6.90	165.5	1722.5	1.43	32.9	821.8	0.05	4.54	186.8
*34	452	7.50	168.9	1757.8	1.45	33.6	838.2	0.10	4.59	188.7
*35	456	8.10	172.5	1796.2	1.48	34.3	855.0	0.15	4.66	191.5
36	457	8.70	176.5	1837.6	1.50	35.0	872.1	0.20	4.75	195.3
*37	454	8.83	180.5	1879.3	1.58	35.7	889.9	0.20	4.84	199.0
*38	452	8.95	184.6	1921.4	1.65	36.4	908.5	0.20	4.93	202.7
*39	472	9.08	188.9	1966.0	1.73	37.2	928.8	0.20	5.02	206.6
40	443	9.20	192.9	2008.5	1.80	38.0	948.7	0.20	5.11	210.2
*41	455	8.88	197.0	2050.5	1.85	38.9	969.7	0.15	5.18	213.1
*42	447	8.55	200.8	2090.3	1.90	39.7	990.9	0.10	5.22	214.9
*43	454	8.23	204.5	2129.2	1.95	40.6	1013.0	0.05	5.25	215.8
44	470	7.90	208.2	2167.8	2.00	41.5	1036.5	<0.10	5.25	215.8
*45	444	8.34	211.9	2206.4	2.01	42.4	1058.7	0.03	5.26	216.3
*46	445	8.78	215.9	2247.1	2.02	43.3	1081.1	0.05	5.28	217.2
*47	441	9.23	219.9	2289.4	2.03	44.2	1103.4	0.08	5.31	218.6
*48	454	9.67	224.3	2335.1	2.03	45.1	1126.4	0.10	5.36	220.4
*49	464	10.1	229.0	2383.9	2.04	46.1	1150.1	0.13	5.42	222.8
*50	440	10.6	233.6	2432.2	2.05	47.0	1172.6	0.15	5.48	225.5
*51	442	11.0	238.5	2482.8	2.06	47.9	1195.3	0.18	5.56	228.7
*52	441	11.4	243.5	2535.3	2.07	48.8	1218.0	0.20	5.65	232.3
*53	445	11.9	248.8	2590.3	2.08	49.7	1241.0	0.23	5.75	236.5
*54	439	12.3	254.2	2646.6	2.08	50.7	1263.9	0.25	5.86	241.0
*55	422	12.8	259.6	2702.7	2.09	51.5	1285.9	0.28	5.97	245.7
56	427	13.2	265.3	2761.3	2.10	52.4	1308.3	0.30	6.10	251.0
*57	411	11.5	270.0	2810.6	1.93	53.2	1328.0	0.30	6.23	256.1
*58	435	9.85	274.3	2855.3	1.75	54.0	1347.0	0.30	6.36	261.5
*59	442	8.18	277.9	2892.9	1.58	54.7	1364.4	0.30	6.49	266.9
60	444	6.50	280.8	2922.9	1.40	55.3	1379.9	0.30	6.62	272.4
*61	432	6.40	283.5	2951.7	1.43	55.9	1395.2	0.28	6.74	277.3
*62	458	6.30	286.4	2981.7	1.45	56.6	1411.8	0.25	6.85	282.0
*63	461	6.20	289.3	3011.5	1.48	57.3	1428.8	0.23	6.96	286.2
64	453	6.10	292.0	3040.3	1.50	57.9	1445.7	0.20	7.05	290.0
*65	471	5.80	294.8	3068.7	1.58	58.7	1464.2	0.20	7.14	293.9
*66	472	5.50	297.4	3095.7	1.65	59.5	1483.7	0.20	7.24	297.7
*67	483	5.20	299.9	3121.9	1.73	60.3	1504.4	0.20	7.33	301.7
68	456	4.90	302.1	3145.1	1.80	61.1	1524.9	0.20	7.43	305.5
*69	419				1.90	61.9	1544.8	0.20	7.51	308.9
*70	448				2.00	62.8	1567.1	0.20	7.60	312.6
*71	441				2.10	63.7	1590.2	0.20	7.69	316.2
72	391				2.20	64.6	1611.7	0.20	7.77	319.4

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimatted as the average of the previous and subsequent week's concentrations.

Table A4.12 Mass release from 1.85% sulfate siltite-argillitite sample(1.93% S,sample number 81196, cell 11[2]).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1322	2401	33043.1	33043.1	228	7520.4	7520.4	186	10114.8	10114.8
1	372	1934	7489.6	40532.7	163	1512.9	9033.2	132	2019.9	12134.8
2	449	920	4300.2	44832.9	114	1271.5	10304.7	63	1163.6	13298.4
3	441	469	2153.1	46986.0	74.90	824.1	11128.9	26	471.7	13770.0
4	427	309.2	1374.4	48360.5	55.40	590.2	11719.1	17.8	312.7	14082.7
*5	443	245.7	1133.1	49493.6	45.05	497.9	12217.0	12.8	233.3	14315.9
6	417	182.2	790.9	50284.5	34.70	361.0	12578.0	7.80	133.8	14449.7
*7	432	151.9	682.9	50967.4	28.95	312.0	12890.1	6.30	112.0	14561.7
8	428	121.5	541.3	51508.8	23.20	247.7	13137.8	4.80	84.5	14646.2
*9	432	111.5	501.4	52010.2	20.40	219.9	13357.7	3.80	67.5	14713.7
10	431	101.5	455.4	52465.6	17.60	189.3	13546.9	2.80	49.6	14763.3
*11	426	89.6	397.4	52863.0	15.65	166.3	13713.3	2.70	47.3	14810.7
12	414	77.7	334.9	53197.8	13.70	141.5	13854.8	2.60	44.3	14854.9
*13	439	70.1	320.1	53518.0	11.70	128.2	13983.0	2.15	38.8	14893.8
14	439	62.4	285.2	53803.1	9.70	106.2	14089.2	1.70	30.7	14924.5
*15	438	44.2	201.3	54004.4	8.65	94.5	14183.7	1.50	27.0	14951.5
16	435	25.9	117.3	54121.7	7.60	82.5	14266.2	1.30	23.3	14974.8
17	436	38.2	173.4	54295.1	6.90	75.1	14341.3	1.15	20.6	14995.4
18	449	50.5	236.0	54531.2	6.20	69.5	14410.7	1.00	18.5	15013.8
19	448	47.9	223.4	54754.5	5.50	61.5	14472.2	0.85	15.7	15029.5
20	449	45.3	211.7	54966.3	4.80	53.8	14526.0	0.70	12.9	15042.4
21	445	43.8	203.0	55169.3	4.63	51.4	14577.3	0.75	13.7	15056.2
22	445	42.4	196.2	55365.5	4.45	49.4	14626.7	0.80	14.6	15070.8
23	445	40.9	189.4	55554.8	4.28	47.5	14674.2	0.85	15.6	15086.4
24	443	39.4	181.7	55736.5	4.10	45.3	14719.5	0.90	16.4	15102.8
25	432	39.2	176.4	55913.0	3.93	42.3	14761.8	0.84	15.0	15117.7
26	460	39.1	187.0	56099.9	3.75	43.0	14804.9	0.78	14.8	15132.6
27	444	38.9	179.7	56279.6	3.58	39.6	14844.5	0.73	13.2	15145.8
28	437	38.7	176.1	56455.7	3.40	37.1	14881.5	0.67	12.0	15157.8
29	432	38.5	173.3	56628.9	3.23	34.8	14916.3	0.61	10.8	15168.6
30	437	38.4	174.5	56803.4	3.05	33.3	14949.5	0.55	9.9	15178.5
31	432	38.2	171.7	56975.1	2.88	31.0	14980.5	0.49	8.7	15187.2
32	442	38.0	174.8	57149.9	2.70	29.8	15010.3	0.43	7.9	15195.1
33	432	37.8	170.1	57320.0	2.53	27.2	15037.5	0.38	6.7	15201.8
34	407	37.7	159.5	57479.6	2.35	23.9	15061.4	0.32	5.3	15207.1
35	437	37.5	170.5	57650.0	2.18	23.7	15085.1	0.26	4.6	15211.7
36	432	37.3	167.7	57817.8	2.00	21.6	15106.7	0.20	3.6	15215.3
37	439	34.8	159.2	57976.9	1.85	20.3	15126.9	0.23	4.1	15219.3
38	429	32.4	144.5	58121.4	1.70	18.2	15145.1	0.25	4.4	15223.7
39	444	29.9	138.1	58259.5	1.55	17.2	15162.3	0.28	5.0	15228.8
40	435	27.4	124.1	58383.6	1.4	15.2	15177.5	0.30	5.4	15234.1
41	452	29.4	138.3	58521.9	1.33	14.9	15192.4	0.28	5.1	15239.2
42	453	31.4	148.1	58670.0	1.25	14.1	15206.6	0.25	4.7	15243.9
43	431	33.4	149.9	58819.9	1.18	12.6	15219.2	0.23	4.0	15247.9
44	451	35.4	166.2	58986.1	1.1	12.4	15231.6	0.20	3.7	15251.6
45	458	34.7	165.4	59151.5	1.05	12.0	15243.6	0.20	3.8	15255.4
46	462	34.0	163.5	59315.0	1.00	11.5	15255.1	0.20	3.8	15259.2
47	497	33.3	172.3	59487.3	0.95	11.8	15266.9	0.20	4.1	15263.3
48	443	32.6	150.3	59637.7	0.9	9.95	15276.8	0.20	3.6	15266.9

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.13. Mass release from 0.14% sulfide siltite-argillite sample(0.16% sample number 70597, cell 1[2]).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1335	105	1459.2	1459.2	3.1	103.3	103.3	10.1	554.6	554.6
1	439	142	648.9	2108.2	4.1	44.9	148.2	13.7	247.4	802.0
2	445	87.5	405.3	2513.5	2.7	30.0	178.1	7.8	142.8	944.8
3	457	66.2	314.9	2828.5	2.3	26.2	204.4	5.9	110.9	1055.7
4	427	64.6	287.2	3115.6	2	21.3	225.7	5.4	94.8	1150.6
*5	431	60.1	269.7	3385.3	1.80	19.4	245.0	4.80	85.1	1235.7
6	374	55.6	216.5	3601.8	1.6	14.9	260.0	4.2	64.6	1300.3
*7	436	56.9	258.3	3860.0	1.35	14.7	274.6	3.70	66.4	1366.7
8	369	58.2	223.6	4083.6	1.1	10.1	284.8	3.2	48.6	1415.2
*9	443	48.6	223.9	4307.5	1.0	11.1	295.8	2.85	51.9	1467.2
10	456	38.9	184.7	4492.1	0.9	10.2	306.1	2.5	46.9	1514.1
*11	454	41.1	194.2	4686.4	0.85	9.6	315.7	2.30	43.0	1557.0
12	450	43.3	202.8	4889.2	0.8	9.0	324.7	2.1	38.9	1595.9
*13	451	40.5	189.9	5079.2	0.65	7.3	332.0	1.65	30.6	1626.5
14	371	37.6	145.2	5224.4	0.5	4.6	336.6	1.2	18.3	1644.8
*15	440	36.1	165.4	5389.7						
16	440	34.6	158.5	5548.2						

NOTE: **Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.**

Table A4.14 Mass release from 0.26% sulfide siltite-argillite sample(0.28% S, sample number 30597, Cell 2[2]).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/	Mass(um)	Sum Mass
0	1340	109	1520.5	1520.5	7.4	247.4	247.4	3.1	170.9	170.9
1	441	132	606.0	2126.5	7.7	84.7	332.1	4.2	76.2	247.1
2	432	121	544.2	2670.7	4.8	51.7	383.9	2.9	51.5	298.6
3	435	141	638.5	3309.2	4.1	44.5	428.4	2.7	48.3	346.9
4	431	310	1390.9	4700.1	3.5	37.6	466.0	2.5	44.3	391.2
*5	431	389	1745.4	6445.4	2.9	31.2	497.2	2.1	37.2	428.5
6	441	468	2148.5	8594.0	2.3	25.3	522.5	1.7	30.8	459.3
*7	439	456	2083.9	10677.9	1.8	19.7	542.2	1.6	28.0	487.3
8	440	444	2033.7	12711.6	1.3	14.3	556.5	1.4	25.3	512.6
*9	452	365	1717.5	14429.1	1.0	10.7	567.2	1.2	22.3	535.0
10	460	286	1369.6	15798.7	0.6	6.9	574.1	1.0	18.9	553.9
*11	460	326	1561.1	17359.8	0.6	6.3	580.4	1.1	19.9	573.7
12	453	366	1726.0	19085.8	0.5	5.7	586.0	1.1	20.5	594.2
*13	449	317	1481.7	20567.5	0.5	5.0	591.1	0.9	15.7	609.9
14	383	268	1068.5	21636.0	0.4	3.8	594.9	0.6	9.5	619.4
*15	430	299	1336.2	22972.2						
16	432	329	1479.6	24451.8						

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimatted as the average of the previous and subsequent week's concentrations.

Table A4.15 Mass release from 0.34% sulfide siltite-argillite sample(0.36% S, sample number 60597, Cell 5[2]).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1344	118	1651.0	1651.0	2.20	73.8	73.8	1.7	94.0	94.0
1	424	164	723.9	2374.8	2.40	25.4	99.2	2.0	34.9	128.9
2	439	213	973.4	3348.3	2.20	24.1	123.3	1.6	28.9	157.8
3	433	350	1577.7	4925.9	2.40	25.9	149.2	1.2	21.4	179.1
4	422	350	1537.6	6463.5	1.30	13.7	162.9	1.0	17.4	196.5
*5	421	330	1444.1	7907.6	1.00	10.5	173.4	0.75	13.0	209.5
6	439	309	1412.1	9319.8	0.70	7.67	181.0	0.5	9.03	218.5
*7	427	301	1338.0	10657.7	0.70	7.46	188.5	0.40	7.03	225.5
8	440	293	1342.1	11999.8	0.70	7.68	196.2	0.3	5.43	231.0
*9	439	298	1359.6	13359.4	0.55	6.02	202.2	0.30	5.42	236.4
10	456	302	1433.6	14793.0	0.40	4.55	206.8	0.3	5.63	242.0
*11	444	285	1315.0	16108.0	0.35	3.88	210.6	0.30	5.48	247.5
12	456	267	1267.5	17375.5	0.30	3.41	214.1	0.3	5.63	253.1
*13	462	260	1248.1	18623.5	0.30	3.46	217.5	0.15	2.85	256.0
14	453	252	1188.4	19811.9	0.30	3.39	220.9	<0.10	0.00	256.0
*15	410	259	1103.3	20915.2						
16	438	265	1208.3	22123.5						

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimatted as the average of the previous and subsequent week's concentrations.

Table A4.16 Mass release from 0.44% sulfide siltite-argillite sample (0.47% S,sample number 80597, cell 7[2]).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1354	125	1761.9	1761.9	7.40	250.0	250.0	20.9	1164.1	1164.1
1	446	172	798.6	2560.5	10.2	113.5	363.5	31.8	583.4	1747.5
2	438	135	615.6	3176.1	6.60	72.1	435.6	20.4	367.6	2115.0
3	427	72.7	323.2	3499.2	3.90	41.5	477.2	12.6	221.3	2336.4
4	434	62.7	283.3	3782.5	3.30	35.7	512.9	11.8	210.7	2547.0
*5	434	63.7	287.6	4070.1	3.00	32.5	545.4	11.1	198.2	2745.2
6	444	64.6	298.6	4368.7	2.70	29.9	575.3	10.4	189.9	2935.1
*7	424	62.5	275.9	4644.5	2.65	28.0	603.3	10.0	174.4	3109.5
8	440	60.4	276.7	4921.2	2.60	28.5	631.9	9.60	173.8	3283.3
*9	456	54.1	256.8	5178.0	2.25	25.6	657.5	8.90	166.9	3450.2
10	453	47.8	225.4	5403.4	1.90	21.5	678.9	8.20	152.8	3603.0
*11	448	49.3	229.9	5633.3	1.70	19.0	697.9	7.65	141.0	3744.0
12	439	50.8	232.2	5865.5	1.50	16.4	714.4	7.10	128.2	3872.2
*13	447	45.4	211.0	6076.5	1.35	15.1	729.4	6.45	118.6	3990.8
14	442	39.9	183.6	6260.1	1.20	13.2	742.7	5.80	105.5	4096.3

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.17 Mass release from 0.14% sulfide siltite-argillite sample(0.47% S, sample number 20597 Cell 3[3]).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1348	985	13822.4	13822.4	172	5784.8	5784.8	59.6	3304.8	3304.8
1	441	590	2708.6	16531.0	114	1254.3	7039.2	39.2	711.1	4016.0
2	450	352	1649.0	18180.0	72.5	814.0	7853.2	21.3	394.3	4410.2
3	435	211	955.5	19135.5	48.3	524.2	8377.4	13	232.6	4642.9
4	428	161	717.3	19852.8	39.6	422.9	8800.3	9.6	169.0	4811.9
*5	430	140	626.7	20479.5	34.1	365.3	9165.6	7.55	133.5	4945.4
6	422	119	522.8	21002.3	28.5	300.1	9465.6	5.5	95.5	5040.9
*7	446	105.9	491.7	21494.0	24.3	269.8	9735.5	4.7	86.2	5127.1
8	447	92.8	431.8	21925.8	20	223.1	9958.5	3.9	71.7	5198.8
*9	467	77.7	377.7	22303.6	16.7	194.0	10152.5	3.35	64.4	5263.2
10	458	62.6	298.5	22602.0	13.3	152.0	10304.5	2.8	52.8	5315.9
*11	458	64.6	308.0	22910.0	11.6	132.6	10437.1	2.45	46.2	5362.1
12	454	66.6	314.8	23224.8	9.9	112.1	10549.2	2.1	39.2	5401.3
*13	461	60.4	289.6	23514.4	8.9	101.8	10651.0	1.7	32.2	5433.6
14	381	54.1	214.6	23729.0	7.8	74.1	10725.2	1.3	20.4	5453.9
*15	428	51.3	228.3	23957.3						
16	454	48.4	228.7	24186.1						

NOTE: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.18 Mass release from 0.56% sulfide siltite-argillitite sample (0.64% S.sample number 100597, cell 8[3])

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1355	231	3258.4	3258.4	11.5	388.8	388.8	36.9	2056.7	2056.7
1	440	313	1433.7	4692.1	16.8	184.4	573.2	54.5	986.4	3043.2
2	436	161	730.8	5422.9	8.5	92.5	665.7	26.9	482.5	3525.6
3	435	120	543.4	5966.3	5.9	64.0	729.7	20.3	363.2	3888.9
4	450	127	594.9	6561.2	5.8	65.1	794.8	21.3	394.3	4283.2
*5	438	135	615.6	7176.8	5.4	59.0	853.8	22.8	409.9	4693.0
6	432	143	643.1	7819.9	5	53.9	907.7	24.2	430.0	5123.1
*7	440	142	648.1	8468.0	4.6	50.5	958.2	24.0	433.5	5556.6
8	443	140	645.6	9113.6	4.2	46.4	1004.7	23.7	431.9	5988.5
*9	442	107	492.6	9606.2	3	33.1	1037.7	19.0	344.5	6333.0
10	451	74.1	347.9	9954.1	1.8	20.3	1058.0	14.2	263.4	6596.4
*11	453	80.9	381.3	10335.4	1.6	18.1	1076.1	13.8	256.2	6852.7
12	463	87.6	422.2	10757.6	1.4	16.2	1092.3	13.3	253.3	7106.0
*13	500	65.6	341.5	11099.1	1.15	14.3	1106.6	11.7	240.6	7346.6
14	460	43.6	208.8	11307.8	0.9	10.3	1116.9	10.1	191.1	7537.7

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.19 Mass release from 0.76% sulfide siltite-argillitite sample (0.99% S, sample number 10597, cell 14[3]).

week	Vol.(ml)	Sulfate Conc(mg/L)	Sulfate Mass(um)	Sulfate Sum Mass	Calcium Conc(mg/L)	Calcium Mass(um)	Calcium Sum Mass	Magnesium Conc(mg/L)	Magnesium Mass(um)	Magnesium Sum Mass
0	1353	1337	18832	18832	88.6	2991	2991	39.5	2198	2198
1	435	1296	5869	24700	46.0	499	3490	39.1	700	2898
2	436	828	3758	28459	19.3	210	3700	16.3	292	3190
3	445	969	4489	32947	12.5	139	3839	12.1	221	3412
4	438	1200	5472	38419	9.70	106	3945	9.50	171	3583
*5	436	1192	5408	43827	7.00	76	4021	7.85	141	3724
6	445	1183	5480	49307	4.30	48	4069	6.20	113	3837
*7	438	1168	5323	54631	3.40	37	4106	5.50	99	3936
8	439	1152	5265	59895	2.50	27	4133	4.80	87	4023
*9	453	1107	5218	65113	1.85	21	4154	3.75	70	4093
10	455	1061	5026	70139	1.20	14	4168	2.70	51	4144
*11	464	980	4731	74870	1.15	13	4181	2.50	48	4191
12	457	898	4272	79143	1.10	13	4194	2.30	43	4234
*13	448	867	4043	83186	0.95	11	4204	2.10	39	4273
14	465	836	4047	87233	0.80	9	4214	1.90	36	4310

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.20 Mass release from 1.37% sulfide siltite-argillitite sample(1.69% S, sample number 11196, cell 14).

week	Vol.(ml)	Sulfate Conc(mg/L)	Sulfate Mass(um)	Sulfate Sum Mass	Calcium Conc(mg/L)	Calcium Mass(um)	Calcium Sum Mass	Magnesium Conc(mg/L)	Magnesium Mass(um)	Magnesium Sum Mass
0	1356	2641.5	27498.3	27498.3	27.7	690.2	690.2	57.6	2370.6	2370.6
1	442	695.7	7242.4	34740.7	6.6	165.4	855.6	13.2	543.6	2914.3
2	450	446.4	4647.1	39387.8	3.1	77.5	933.1	5.8	238.8	3153.1
3	452	398.2	4145.5	43533.3	2.0	49.6	982.7	3.5	145.0	3298.1
4	439	362.6	3774.4	47307.7	1.2	30.7	1013.4	2.3	93.9	3392.0
*5	447	351.0	3654.0	50961.7	1.0	24.0	1037.3	1.8	73.5	3465.5
6	445	331.3	3449.4	54411.1	0.7	16.7	1054.0	1.2	51.3	3516.8
*7	454	317.9	3309.1	57720.2	0.6	15.3	1069.3	1.1	46.7	3563.5
8	449	294.4	3064.8	60785.0	0.5	13.4	1082.7	1.0	40.6	3604.1
*9	387	243.7	2537.3	63322.3	0.4	10.6	1093.3	0.6	24.7	3628.8
10	452	273.0	2841.6	66163.9	0.5	11.3	1104.6	0.4	16.7	3645.5
*11	434	263.0	2737.5	68901.4	0.4	9.2	1113.8	0.6	25.0	3670.5
12	439	266.9	2778.1	71679.5	0.3	7.7	1121.5	0.8	34.3	3704.8
*13	455	267.4	2784.0	74463.5	0.4	10.8	1132.3	0.7	27.1	3732.0
14	442	250.9	2611.7	77075.1	0.5	13.2	1145.5	0.4	18.2	3750.1
*15	442	260.4	2710.4	79785.5	0.4	9.9	1155.4	0.4	18.2	3768.3
16	457	279.0	2904.4	82690.0	0.3	6.8	1162.3	0.5	18.8	3787.1
*17	450	262.1	2728.5	85418.5	0.2	6.2	1168.5	0.5	18.5	3805.6
18	422	234.0	2435.5	87854.0	0.2	5.3	1173.7	0.4	17.4	3823.0
*19	442	248.5	2586.8	90440.9	0.2	5.0	1178.7	0.4	16.4	3839.4
20	445	253.7	2640.5	93081.4	0.2	4.4	1183.1	0.4	14.6	3854.0
*21	444	256.9	2674.0	95755.4	0.2	4.2	1187.3	0.4	15.5	3869.5
*22	449	263.6	2744.0	98499.4	0.2	3.9	1191.2	0.4	16.6	3886.2
*23	453	269.8	2808.6	101308.0	0.1	3.7	1194.9	0.4	17.7	3903.9
24	446	269.4	2804.8	104112.8	0.1	3.3	1198.2	0.4	18.3	3922.2

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.21 Mass release from 1.37% sulfide siltite-argillitite sample(1.69% S, sample number 11196, cell 16[2]).

Week	Vol.(ml)	Sulfate Conc(mg/L)	Sulfate Mass(um)	Sulfate Sum Mass	Calcium Conc(mg/L)	Calcium Mass(um)	Calcium Sum Mass	Magnesium Conc(mg/L)	Magnesium Mass(um)	Magnesium Sum Mass
0	1358	1967	27807	27807	20.0	677.64	678	42.5	2374	2374
1	438	1645	7501	35308	16.0	175	852	33.3	600	2974
2	439	1052	4808	40116	7.60	83.2	936	13.8	249	3223
3	423	1090	4800	44916	5.60	59.1	995	9.90	172	3396
4	433	858	3869	48784	3.20	34.6	1029	5.20	92.6	3488
*5	449	800	3740	52524	2.40	26.9	1056	3.95	73.0	3561
6	428	742	3306	55830	1.60	17.1	1073	2.70	47.5	3609
*7	449	704	3292	59122	1.40	15.7	1089	2.40	44.3	3653
8	444	667	3081	62203	1.20	13.3	1102	2.10	38.4	3691
*9	460	648	3103	65306	1.00	11.5	1114	1.45	27.4	3719
10	451	629	2955	68261	0.80	9.00	1123	0.80	14.8	3734
*11	434	676	3056	71317	0.80	8.66	1132	1.10	19.6	3753
12	443	723	3336	74652	0.80	8.84	1140	1.40	25.5	3779
*13	449	693	3237	77890	0.70	7.84	1148	1.20	22.2	3801
14	448	662	3087	80976	0.60	6.71	1155	1.00	18.4	3819
*15	439	701	3203	84179	0.55	6.02	1161	1.20	21.7	3841
16	441	740	3396	87575	0.50	5.50	1166	1.40	25.4	3866
*17	435	661	2993	90568	0.45	4.88	1171	1.05	18.8	3885
18	432	582	2619	93187	0.40	4.31	1176	0.70	12.4	3898
*19	432	575	2586	95773	0.30	3.23	1179	0.55	9.77	3907
20	444	568	2624	98398	0.20	2.22	1181	0.40	7.31	3915
*21	440	593	2718	101115	0.60	6.59	1188	0.38	6.79	3922
*22	434	619	2796	103912	1.00	10.8	1198	0.35	6.25	3928
*23	452	644	3032	106944	1.40	15.8	1214	0.33	6.04	3934
24	431	670	3006	109950	1.80	19.4	1234	0.30	5.32	3939
*25	432	664	2985	112935	1.58	17.0	1251	0.29	5.11	3944
*26	433	661	2978	115913	1.46	15.8	1266	0.28	5.01	3949
*27	431	658	2950	118863	1.35	14.5	1281	0.28	4.88	3954
*28	440	651	2983	121846	1.13	12.4	1293	0.26	4.75	3959
*29	412	648	2780	124626	1.01	10.4	1304	0.26	4.34	3963
*30	450	645	3022	127647	0.90	10.1	1314	0.25	4.63	3968
*31	431	639	2866	130513	0.68	7.26	1321	0.24	4.21	3972
*32	433	636	2865	133378	0.56	6.08	1327	0.23	4.12	3976
*33	429	633	2825	136203	0.45	4.82	1332	0.23	3.97	3980
*34	401	626	2614	138817	0.23	2.25	1334	0.21	3.51	3984
*35	419	623	2718	141535	0.11	1.18	1335	0.21	3.55	3987
36	426	620	2750	144285	<0.10	0.00	1335	0.20	3.50	3991
*37	436	573	2601	146886	0.08	0.82	1336	0.20	3.59	3994
*38	430	526	2355	149240	0.15	1.61	1338	0.20	3.54	3998
*39	423	479	2109	151350	0.23	2.37	1340	0.20	3.48	4001
40	449	432	2019	153369	0.30	3.36	1344	0.20	3.69	4005
*41	422	466	2047	155416	0.33	3.42	1347	0.20	3.47	4009
*42	433	500	2254	157670	0.35	3.78	1351	0.20	3.56	4012
*43	449	534	2496	160166	0.38	4.20	1355	0.20	3.69	4016
44	458	568	2708	162874	0.40	4.57	1359	0.20	3.77	4020
*45	465	513	2483	165357	0.35	4.06	1364	0.15	2.87	4022
*46	460	458	2193	167550	0.30	3.44	1367	0.10	1.89	4024
*47	471	403	1976	169526	0.25	2.94	1370	0.05	0.97	4025
48	418	348	1514	171041	0.2	2.09	1372	<0.10	0.00	4025

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concetrations.

Table A4.22 Mass release from 1.53% sulfide siltite-argillitite sample(1.60% S, sample number MT-100.4, cell 15).

		Sulfate			Calcium			Magnesium		
Week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1427	590	8764.6	8764.6	11.8	420.1	420.1	144	8452.8	8452.8
1	412	94.8	406.6	9171.2	2.30	23.6	443.8	23.0	389.8	8842.6
2	614	95.6	611.1	9782.3	2.10	32.2	475.9	22.4	565.8	9408.4
3	424	54.5	240.6	10022.8	1.20	12.7	488.6	13.2	230.2	9638.6
4	436	61.7	280.0	10302.9	1.30	14.1	502.8	14.2	254.7	9893.3
*5	415	66.9	289.0	10591.9	1.45	15.0	517.8	15.4	262.9	10156.2
6	421	72.1	316.0	10907.9	1.60	16.8	534.6	16.6	287.5	10443.7
*7	417	73.1	317.3	11225.2	1.55	16.1	550.7	16.9	289.9	10733.5
8	425	74.1	327.8	11553.1	1.50	15.9	566.6	17.2	300.7	11034.2
*9	423	72.3	318.3	11871.4	1.40	14.8	581.4	17.0	295.8	11330.0
10	427	70.5	313.2	12184.6	1.30	13.8	595.3	16.8	295.1	11625.1
*11	437	62.5	284.3	12468.9	1.35	14.7	610.0	15.2	273.2	11898.4
12	431	54.5	244.6	12713.6	1.40	15.1	625.0	13.6	241.1	12139.5
*13	439	56.0	256.1	12969.7	1.80	19.7	644.7	13.2	237.5	12377.0
14	421	57.6	252.3	13222.0	2.20	23.1	667.9	12.7	219.9	12596.9
*15	415	61.6	266.2	13488.2	2.00	20.7	688.6	14.4	245.8	12842.7
16	417	65.7	285.0	13773.2	1.80	18.7	707.3	16.1	276.2	13118.9
*17	418	66.4	288.9	14062.1	1.60	16.7	724.0	15.8	271.7	13390.6
18	413	67.1	288.6	14350.7	1.40	14.4	738.4	15.5	263.3	13653.9
*19	420	65.7	287.2	14637.9	1.30	13.6	752.0	15.0	259.2	13913.1
20	418	64.3	279.7	14917.6	1.20	12.5	764.5	14.5	249.3	14162.4
*21	436	64.3	292.0	15209.6	1.08	11.7	776.2	14.7	264.1	14426.5
*22	441	64.4	295.6	15505.1	0.95	10.5	786.7	15.0	271.2	14697.7
*23	428	64.4	287.1	15792.3	0.83	8.8	795.5	15.2	267.2	14964.8
24	435	64.5	292.1	16084.3	0.70	7.6	803.1	15.4	275.6	15240.4
*25	419	62.1	271.0	16355.3	0.87	9.1	812.2	15.2	261.1	15501.5
*26	430	59.8	267.5	16622.8	1.05	11.3	823.5	14.9	263.6	15765.1
*27	434	57.4	259.2	16882.0	1.23	13.3	836.8	14.7	261.5	16026.6
28	433	55.0	247.9	17129.9	1.40	15.1	851.9	14.4	256.5	16283.1
*29	433	50.4	227.0	17356.9	1.25	13.5	865.4	11.2	199.0	16482.2
*30	431	45.7	205.0	17561.9	1.10	11.8	877.2	8.0	140.9	16623.1
*31	430	41.1	183.8	17745.7	0.95	10.2	887.4	4.7	83.6	16706.7
32	415	36.4	157.3	17902.9	0.80	8.3	895.7	1.5	25.6	16732.3
*33	418	41.3	179.8	18082.8	0.88	9.1	904.8	4.9	83.4	16815.7
*34	429	46.3	206.6	18289.3	0.95	10.2	915.0	8.2	144.7	16960.4
*35	439	51.2	233.9	18523.2	1.03	11.2	926.2	11.6	208.6	17169.0
36	431	56.1	251.7	18774.9	1.10	11.8	938.1	14.9	264.2	17433.1
*37	440	54.9	251.2	19026.1	1.03	11.3	949.3	14.6	264.7	17697.8
*38	437	53.6	243.8	19270.0	0.95	10.4	959.7	14.4	258.0	17955.8
*39	445	52.4	242.5	19512.5	0.88	9.7	969.4	14.1	257.6	18213.4
40	431	51.1	229.3	19741.8	0.80	8.6	978.0	13.8	244.7	18458.1
*41	438	50.4	229.9	19971.7	0.93	10.1	988.1	13.8	248.6	18706.7
*42	434	49.8	224.8	20196.5	1.05	11.4	999.5	13.8	246.4	18953.1
*43	438	49.1	223.8	20420.2	1.18	12.8	1012.3	13.8	248.6	19201.7
44	454	48.4	228.7	20649.0	1.30	14.7	1027.0	13.8	257.7	19459.5
*45	432	50.3	226.1	20875.1	1.23	13.2	1040.2	13.8	244.6	19704.0
*46	445	51.2	237.2	21112.3	1.19	13.2	1053.4	13.7	251.6	19955.6
*47	444	52.2	241.0	21353.4	1.15	12.7	1066.2	13.7	250.7	20206.3
*48	430	54.0	241.8	21595.2	1.08	11.5	1077.7	13.7	242.1	20448.4
*49	414	55.0	236.9	21832.1	1.04	10.7	1088.4	13.7	232.8	20681.2
*50	415	55.9	241.5	22073.6	1.00	10.4	1098.8	13.7	233.0	20914.2
*51	430	57.8	258.6	22332.2	0.93	9.9	1108.7	13.6	240.8	21155.0
*52	420	58.7	256.7	22588.9	0.89	9.3	1118.0	13.6	234.9	21389.8
*53	432	59.7	268.3	22857.2	0.85	9.2	1127.1	13.6	241.2	21631.1
*54	425	61.5	272.2	23129.4	0.78	8.2	1135.4	13.5	236.7	21867.7
*55	430	62.5	279.6	23409.0	0.74	7.9	1143.3	13.5	239.1	22106.9
56	429	63.4	283.1	23692.1	0.70	7.5	1150.8	13.5	238.2	22345.1
*57	427	56.8	252.5	23944.6	0.68	7.2	1158.0	12.6	221.8	22566.9
*58	430	50.2	224.7	24169.3	0.65	7.0	1164.9	11.8	207.8	22774.7
*59	428	43.6	194.3	24363.6	0.63	6.7	1171.6	10.9	191.5	22966.2
60	431	37.0	166.0	24529.6	0.60	6.5	1178.1	10.0	177.3	23143.4
*61	417	37.0	160.6	24690.2	0.60	6.2	1184.3	10.1	173.7	23317.1
*62	436	37.0	167.9	24858.1	0.60	6.5	1190.8	10.3	183.8	23501.0
*63	432	37.0	166.4	25024.5	0.60	6.5	1197.3	10.4	184.4	23685.3
64	443	37.0	170.6	25195.2	0.60	6.6	1203.9	10.5	191.3	23876.7
*65	447	37.1	172.5	25367.7	0.60	6.7	1210.6	10.8	199.0	24075.7
*66	443	37.2	171.3	25539.0	0.60	6.6	1217.2	11.2	203.2	24278.9
*67	440	37.2	170.5	25709.5	0.60	6.6	1223.8	11.5	207.7	24486.6
68	436	37.3	169.3	25878.8	0.60	6.5	1230.4	11.8	211.6	24698.2

Note: Starred(*) weeks concentrations, for SO4,Ca, andMg were estimated as the average of the previous and subsequent week,s concentrations.

Table A4.23 Mass release from 1.53% sulfide siltite-argillitite sample (1.60% S, sample number MT-100.4, cell 16).

Week	Vol.(ml)	Sulfate Conc(mg/L)	Sulfate Mass(um)	Sulfate Sum Mass	Calcium Conc(mg/L)	Calcium Mass(um)	Calcium Sum Mass	Magnesium Conc(mg/L)	Magnesium Mass(um)	Magnesium Sum Mass
0	1453	560.8	8482.6	8482.6	9.6	348.0	348.0	131.0	7829.8	7829.8
1	457	138.0	656.5	9139.2	2.6	29.6	377.7	32.7	614.7	8444.5
2	476	87.3	432.6	9571.8	1.7	20.2	397.9	21.9	428.8	8873.4
3	403	54.0	226.5	9798.3	1.0	10.1	407.9	1.0	16.6	8889.9
4	425	71.3	315.5	10113.8	1.3	13.8	421.7	17.4	304.2	9194.1
*5	429	76.3	340.5	10454.3	1.4	15.0	436.7	18.4	324.7	9518.8
6	415	81.2	350.8	10805.1	1.5	15.5	452.2	19.4	331.2	9850.0
*7	407	73.9	313.1	11118.2	1.3	12.7	464.9	17.4	290.5	10140.5
8	408	66.6	282.9	11401.1	1.0	10.2	475.1	15.3	256.8	10397.3
*9	421	73.0	319.8	11720.9	1.2	12.1	487.2	17.6	304.8	10702.1
10	426	79.4	351.9	12072.8	1.3	13.8	501.0	19.9	348.7	11050.8
*11	444	66.6	307.9	12380.7	1.1	11.6	512.6	16.2	295.9	11346.7
12	415	53.9	232.8	12613.5	0.8	8.3	520.9	12.5	213.4	11560.1
*13	421	56.4	247.1	12860.6	0.9	9.5	530.4	13.2	227.7	11787.8
14	427	58.9	261.6	13122.2	1.0	10.7	541.0	13.8	242.4	12030.2
*15	411	66.2	283.3	13405.5	1.2	11.8	552.8	16.3	275.6	12305.8
16	425	73.6	325.6	13731.2	1.3	13.8	566.6	18.8	328.7	12634.4
*17	434	71.5	322.9	14054.1	1.2	12.5	579.0	17.9	319.6	12954.0
18	454	69.35	327.8	14381.8	1.0	11.3	590.4	17.0	317.5	13271.5
*19	440	64.6	295.7	14677.6	1.0	11.0	601.3	15.8	286.0	13557.5
20	450	59.78	280.0	14957.6	1.0	11.2	612.6	14.6	270.3	13827.7

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concetrations.

Table A4.24 Mass release from 2.25% sulfide siltite-argillitite sample(2.30% S,sample number MT-99.4, cell 9)

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1354	254.3	3584.4	3584.4	22.3	753.3483	753.348303	37.1	2066.4	2066.4
1	545	231.8	1315.1	4899.6	11.3	153.6552	907.003493	38.9	872.1	2938.5
2	503	155.6	814.8	5714.3	8.50	106.7	1013.7	33.0	682.8	3621.3
3	425	130.8	578.7	6293.0	6.40	67.9	1081.5	26.6	465.0	4086.3
4	450	119.9	561.7	6854.7	5.60	62.9	1144.4	24.5	453.5	4539.8
*5	423	108.9	479.5	7334.3	5.00	52.8	1197.2	23.1	401.9	4941.8
6	429	97.9	437.2	7771.5	4.40	47.1	1244.3	21.7	382.9	5324.7
*7	422	88.8	390.1	8161.6	3.85	40.5	1284.8	19.9	344.6	5669.3
8	437	79.7	362.6	8524.2	3.30	36.0	1320.8	18.0	323.6	5992.9
*9	433	71.0	319.9	8844.1	3.05	33.0	1353.7	16.7	297.5	6290.3
10	424	62.3	274.8	9118.9	2.80	29.6	1383.4	15.4	268.6	6558.9
*11	439	57.0	260.5	9379.4	2.40	26.3	1409.7	13.7	246.5	6805.4
12	431	51.8	232.3	9611.7	2.00	21.5	1431.2	11.9	211.0	7016.4
*13	428	51.2	228.2	9839.9	2.05	21.9	1453.1	12.3	216.6	7232.9
14	445	50.7	234.7	10074.6	2.10	23.3	1476.4	12.7	232.5	7465.4
*15	427	56.6	251.7	10326.2	3.75	40.0	1516.3	13.7	239.8	7705.2
16	416	62.6	271.0	10597.2	5.40	56.0	1572.4	14.6	249.8	7955.0
*17	440	57.6	264.0	10861.2	4.00	43.9	1616.3	13.8	248.9	8203.9
18	438	52.7	240.2	11101.4	2.60	28.4	1644.7	12.9	232.4	8436.3
*19	414	51.2	220.7	11322.1	2.40	24.8	1669.5	12.4	211.2	8647.5
20	452	49.7	234.0	11556.1	2.20	24.8	1694.3	11.9	221.3	8868.7
*21	418	48.9	213.0	11769.1	2.05	21.4	1715.7	11.6	199.9	9068.6
*22	460	48.2	230.6	11999.7	1.90	21.8	1737.5	11.4	214.8	9283.4
*23	446	47.4	220.0	12219.7	1.75	19.5	1757.0	11.1	203.2	9486.6
24	443	46.6	214.9	12434.6	1.60	17.7	1774.6	10.8	196.8	9683.4
*25	430	43.9	196.3	12630.9	2.38	25.5	1800.1	10.8	191.0	9874.4
*26	439	41.1	187.8	12818.8	3.15	34.5	1834.6	10.8	195.0	10069.4
*27	440	38.4	175.7	12994.4	3.93	43.1	1877.7	10.8	195.5	10264.9
28	437	35.6	162.0	13156.4	4.70	51.2	1929.0	10.8	194.1	10459.1
*29	436	35.4	160.6	13316.9	3.98	43.2	1972.2	10.7	191.0	10650.1
*30	435	35.2	159.2	13476.1	3.25	35.3	2007.5	10.5	187.9	10838.0
*31	427	34.9	155.2	13631.4	2.53	26.9	2034.4	10.4	181.8	11019.7
32	427	34.7	154.2	13785.6	1.80	19.2	2053.5	10.2	179.2	11198.9
*33	435	35.3	159.7	13945.3	1.75	19.0	2072.5	10.4	185.2	11384.1
*34	436	35.9	162.7	14108.1	1.70	18.5	2091.0	10.5	188.3	11572.4
*35	431	36.4	163.4	14271.5	1.65	17.7	2108.8	10.7	188.8	11761.2
36	422	37.0	162.5	14434.0	1.60	16.8	2125.6	10.8	187.5	11948.7
*37	453	35.2	165.8	14599.8	1.53	17.2	2142.9	10.5	196.1	12144.8
*38	443	33.3	153.6	14753.4	1.45	16.0	2158.9	10.3	186.8	12331.6
*39	445	31.5	145.7	14899.1	1.38	15.3	2174.2	10.0	182.6	12514.2
40	434	29.6	133.7	15032.8	1.30	14.1	2188.2	9.7	173.2	12687.4
*41	448	30.6	142.6	15175.4	1.35	15.1	2203.3	9.9	181.5	12868.9
*42	435	31.6	142.9	15318.3	1.40	15.2	2218.5	10.0	178.9	13047.9
*43	441	32.5	149.3	15467.6	1.45	16.0	2234.5	10.2	184.1	13232.0
44	447	33.5	155.9	15623.5	1.50	16.7	2251.2	10.3	189.4	13421.4
*45	451	33.475	157.2	15780.6	1.49	16.8	2268.0	10.3	190.3	13611.7
*46	409	33.45	142.4	15923.0	1.48	15.1	2283.1	10.2	171.9	13783.6
*47	441	33.425	153.5	16076.5	1.48	16.2	2299.3	10.2	184.6	13968.2
*48	432	33.4	150.2	16226.7	1.47	15.8	2315.2	10.1	180.1	14148.2
*49	427	33.375	148.4	16375.1	1.46	15.5	2330.7	10.1	177.3	14325.5
*50	429	33.35	148.9	16524.0	1.45	15.5	2346.2	10.1	177.4	14502.8
*51	437	33.325	151.6	16675.6	1.44	15.7	2361.9	10.0	179.9	14682.8
*52	415	33.3	143.9	16819.5	1.43	14.8	2376.8	9.97	170.1	14852.9
*53	439	33.275	152.1	16971.5	1.43	15.6	2392.4	9.93	179.2	15032.1
*54	419	33.25	145.0	17116.6	1.42	14.8	2407.2	9.88	170.3	15202.5
*55	438	33.225	151.5	17268.1	1.41	15.4	2422.6	9.84	177.3	15379.8
56	418	33.2	144.5	17412.5	1.40	14.6	2437.2	9.80	168.5	15548.3
*57	437	32.2	146.3	17558.8	1.28	13.9	2451.1	9.40	169.0	15717.3
*58	437	31.1	141.5	17700.3	1.15	12.5	2463.6	9.00	161.8	15879.1
*59	430	30.1	134.5	17834.8	1.03	11.0	2474.6	8.60	152.1	16031.2
60	428	29.0	129.2	17964.0	0.90	9.6	2484.2	8.20	144.4	16175.6
*61	452	27.1	127.4	18091.4	0.90	10.1	2494.4	7.60	141.3	16316.9
*62	426	25.2	111.5	18202.9	0.90	9.6	2503.9	7.00	122.7	16439.5
*63	435	23.2	105.2	18308.1	0.90	9.8	2513.7	6.40	114.5	16554.0
64	445	21.3	98.7	18406.8	0.90	10.0	2523.7	5.80	106.2	16660.2
*65	451	20.7	97.3	18504.1	0.93	10.4	2534.1	6.23	115.5	16775.7
*66	447	20.2	93.8	18597.8	0.95	10.6	2544.7	6.65	122.3	16898.0
*67	448	19.6	91.3	18689.1	0.98	10.9	2555.6	7.08	130.4	17028.4
68	444	19.0	87.8	18777.0	1.00	11.1	2566.7	7.50	137.0	17165.3

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A3.25 Mass release from 3.16% sulfide siltite-argillitite sample(3.24% S,sample number MT-99.1, cell 10).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1351	1509	21223	21223	113	3819.069	3819.06936	172	9559	9559
1	463	1228	5920	27143	74.1	856.0	4675.1	145	2762	12320
2	482	884	4435	31578	75.9	912.8	5587.8	132	2617	14938
3	443	650	2996	34573	59.5	657.6	6245.5	91	1658	16596
4	429	644	2877	37450	58.2	622.9	6868.4	119	2095	18691
*5	435	680	3078	40528	53.4	579.6	7448.0	116	2079	20770
6	444	715	3305	43833	48.6	538.4	7986.4	114	2077	22846
*7	436	660	2994	46827	45.6	495.5	8481.9	111	1989	24835
8	425	604	2674	49501	42.5	450.7	8932.5	108	1890	26725
*9	436	576	2616	52117	40.8	443.3	9375.8	105	1885	28610
10	432	548	2466	54584	39.0	420.4	9796.2	102	1814	30425
*11	447	508	2364	56948	37.3	415.4	10211.6	102	1869	32294
12	446	468	2171	59119	35.5	395.0	10606.7	101	1857	34150
*13	448	425	1982	61101	31.6	352.7	10959.3	89.1	1641	35791
14	448	382	1783	62884	27.6	308.5	11267.8	76.9	1417	37209
*15	451	421	1976	64860	28.4	319.6	11587.4	74.1	1374	38582
16	446	459	2132	66992	29.2	324.9	11912.3	71.2	1306	39889
*17	446	391	1816	68808	25.9	288.2	12200.5	68.4	1255	41143
18	454	323	1527	70335	22.6	256.0	12456.5	65.6	1225	42369
*19	444	327	1510	71845	26.4	291.9	12748.4	77.0	1406	43775
20	434	330	1493	73338	30.1	325.9	13074.4	88.4	1578	45353
*21	450	328	1534	74872	27.3	306.0	13380.3	82.1	1519	46872
*22	445	325	1504	76376	24.4	270.9	13651.2	75.8	1387	48259
*23	457	322	1531	77908	21.6	245.7	13896.9	69.4	1305	49564
24	449	319	1491	79399	18.7	209.5	14106.4	63.1	1165	50730
*25	445	308	1428	80827	18.8	208.5	14314.9	62.0	1135	51865
*25	430	297	1331	82158	18.9	202.2	14517.1	61.0	1078	52943
*26	457	287	1364	83522	18.9	215.8	14732.9	59.9	1126	54069
28	450	276	1292	84814	19.0	213.3	14946.2	58.8	1088	55157
*29	441	288	1321	86135	19.5	214.0	15160.2	61.7	1120	56277
*30	453	300	1412	87548	19.9	224.9	15385.2	64.7	1205	57482
*31	448	311	1452	88999	20.4	227.5	15612.6	67.6	1245	58727
32	447	323	1503	90503	20.8	232.0	15844.6	70.5	1296	60023
*33	453	318	1498	92001	21.1	238.5	16083.1	69.9	1303	61326
*34	449	312	1459	93460	21.4	239.7	16322.8	69.3	1280	62606
*35	447	307	1427	94887	21.7	242.0	16564.8	68.7	1263	63869
36	449	301	1408	96296	22.0	246.5	16811.3	68.1	1258	65127
*37	455	303	1434	97730	21.7	246.3	17057.6	67.7	1267	66393
*38	446	304	1413	99144	21.4	238.1	17295.8	67.3	1234	67627
*39	456	306	1452	100596	21.1	240.1	17535.8	66.8	1253	68881
40	440	308	1408	102004	20.8	228.3	17764.2	66.4	1202	70082
*41	454	313	1480	103485	20.8	235.3	17999.5	67.9	1267	71350
*42	441	319	1464	104949	20.8	228.3	18227.8	69.3	1257	72607
*43	442	325	1494	106444	20.7	228.6	18456.4	70.8	1286	73893
*44	456	331	1569	108013	20.7	235.5	18691.9	72.2	1354	75247
*45	449	323	1512	109524	20.4	228.3	18920.2	71.3	1318	76565
*46	440	316	1449	110974	20.1	220.3	19140.5	70.5	1276	77841
*47	458	309	1475	112449	19.8	225.7	19366.2	69.6	1312	79152
*48	440	302	1385	113834	19.4	213.3	19579.5	68.8	1245	80397
*49	436	295	1340	115174	19.1	208.0	19787.5	67.9	1218	81615
*50	423	288	1269	116443	18.8	198.4	19985.9	67.1	1167	82782
*51	445	281	1303	117746	18.5	205.2	20191.1	66.2	1212	83993
*52	427	274	1219	118965	18.2	193.5	20384.7	65.3	1148	85141
*53	441	267	1226	120191	17.9	196.4	20581.1	64.5	1170	86311
*54	440	260	1191	121382	17.5	192.5	20773.5	63.6	1151	87462
*55	420	253	1106	122489	17.2	180.4	20954.0	62.8	1084	88546
56	445	246	1140	123628	16.9	187.6	21141.6	61.9	1133	89679
*57	430	242	1084	124713	16.3	174.6	21316.2	59.2	1047	90726
*58	434	239	1078	125790	15.7	169.5	21485.7	56.5	1009	91735
*59	444	235	1085	126875	15.0	166.4	21652.1	53.8	983	92718
60	433	231	1041	127917	14.4	155.6	21807.7	51.1	910	93628
*61	441	219	1004	128921	13.7	150.5	21958.1	48.7	883	94511
*62	427	207	918	129839	13.0	138.0	22096.1	46.3	813	95325
*63	438	194	886	130724	12.2	133.6	22229.7	43.9	791	96116
64	449	182	851	131575	11.5	128.8	22358.5	41.5	766	96882
*65	451	192	899	132474	12.4	139.0	22497.5	43.3	804	97686
*66	458	201	958	133433	13.2	150.8	22648.3	45.2	851	98536
*67	457	211	1001	134434	14.1	160.2	22808.5	47.0	883	99420
*68	454	220	1040	135474	14.9	168.8	22977.3	48.8	911	100331

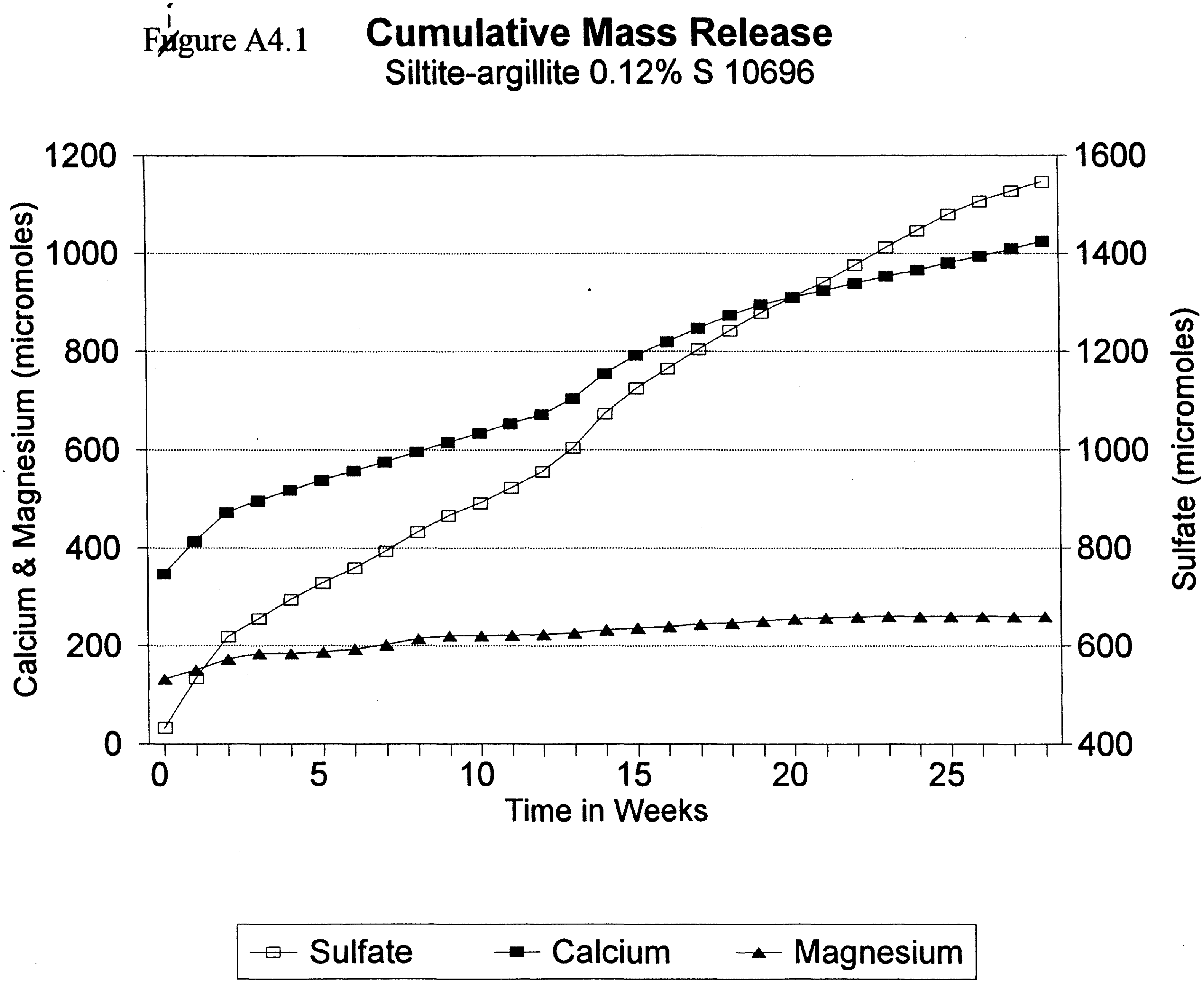
Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Table A4.26 Mass release from 5.75% sulfide siltite-argillitite sample (5.82% S, sample number MT-99.6, cell 11).

		Sulfate			Calcium			Magnesium		
week	Vol.(ml)	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass	Conc(mg/L)	Mass(um)	Sum Mass
0	1341	421.8	5888.3	5888.3	3.2	107.1	107.1	2.4	132.4	132.4
1	447	127.0	591.0	6479.3	1.6	17.8	124.9	1	18.4	150.8
2	471	98.2	481.5	6960.8	1.6	18.8	143.7	1.2	23.2	174.0
3	402	153.5	642.4	7603.2	1.7	17.1	160.8	0.8	13.2	187.3
4	452	196.6	925.1	8528.3	1.7	19.2	179.9	1	18.6	205.8
*5	419	238.1	1038.3	9566.6	1.3	13.6	193.5	1	17.2	223.1
6	436	279.5	1268.6	10835.2	0.9	9.8	203.3	1	17.9	241.0
*7	424	279.5	1233.7	12068.9	0.65	6.9	210.2	1	17.4	258.5
8	423	279.5	1230.8	13299.7	0.4	4.2	214.4	1	17.4	275.9
*9	423	281.7	1240.5	14540.1	0.3	3.2	217.6	0.5	8.7	284.6
10	445	283.9	1315.2	15855.3	0.2	2.2	219.8	<0.1	0.0	284.6
*11	427	258.1	1147.3	17002.6	0.25	2.7	222.5	0.1	1.8	286.3
12	443	232.3	1071.3	18073.9	0.3	3.3	225.8	0.2	3.6	290.0
*13	460	220.6	1056.1	19130.0	0.3	3.4	229.2	0.2	3.8	293.7
14	448	208.8	973.8	20103.8	0.3	3.4	232.6	0.2	3.7	297.4
*15	425	235.6	1042.4	21146.2	0.3	3.2	235.8	0.25	4.4	301.8
16	420	262.4	1147.3	22293.5	0.3	3.1	238.9	0.3	5.2	307.0
*17	436	235.0	1066.6	23360.1	0.25	2.7	241.6	0.25	4.5	311.5
18	430	207.6	929.3	24289.4	0.2	2.1	243.8	0.2	3.5	315.0
*19	439	208.5	952.6	25242.0	0.25	2.7	246.5	0.3	5.4	320.4
20	436	209.3	950.0	26192.0	0.3	3.3	249.8	0.4	7.2	327.6

Note: Starred(*) weeks concentration, for SO4, Ca, and Mg were estimated as the average of the previous and subsequent week's concentrations.

Figure A4.1



Cumulative Mass Release
Siltite-argillite 0.12% S 10696
1200
1000
800
600
400
200
0
Calcium & Magnesium (micromoles)
1600
1400
1200
1000
800
600
400
Sulfate (micromoles)
0
5
10
15
20
25
Time in Weeks
Sulfate
Calcium
Magnesium

Figure A4.2

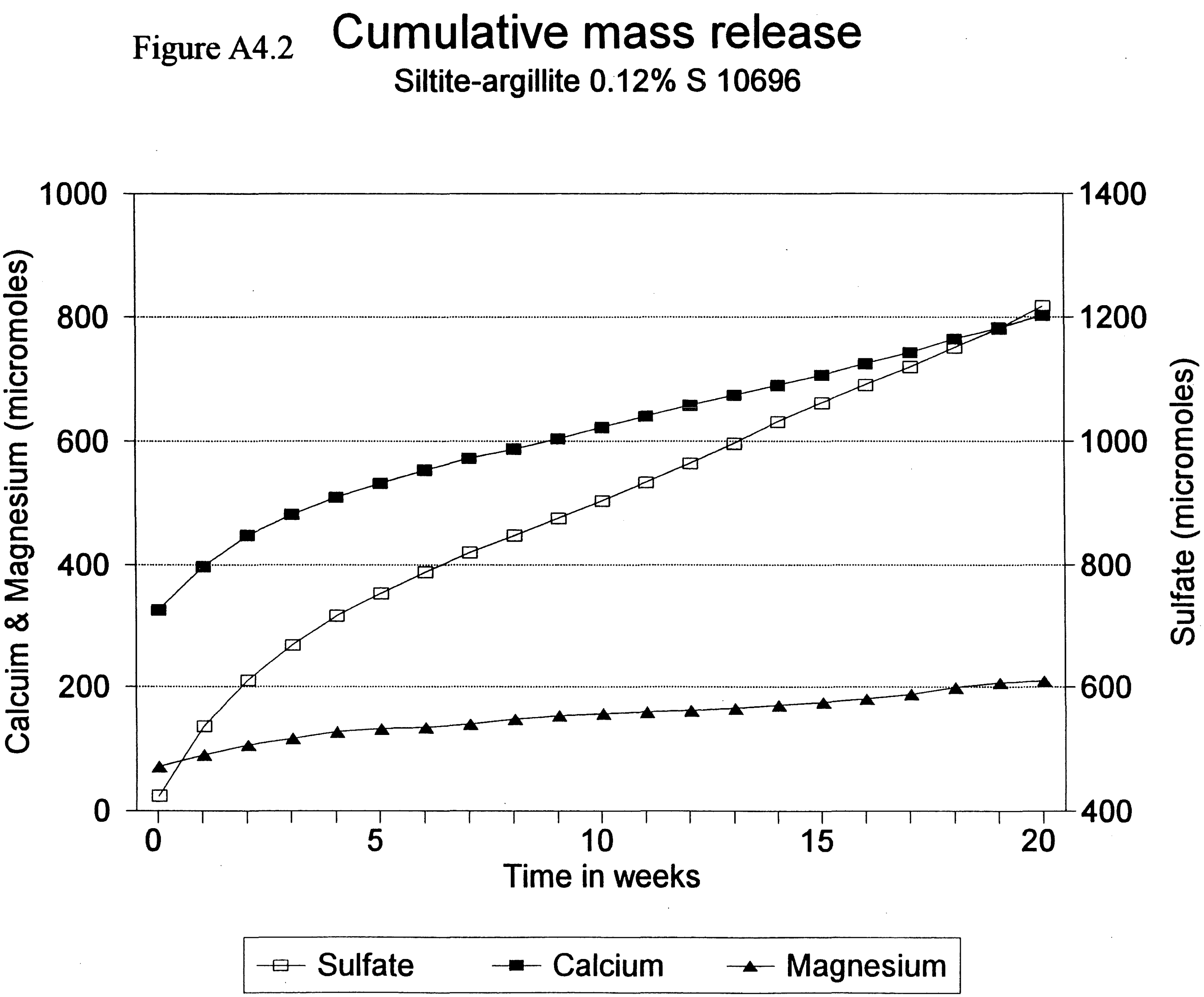

Cumulative mass release
Siltite-argillite 0.12% S 10696
1000
800
600
400
200
0
Calcuim & Magnesium (micromoles)
1400
1200
1000
800
600
400
Sulfate (micromoles)
0
5
10
15
20
Time in weeks
Sulfate
Calcium
Magnesium

Figure A4.3

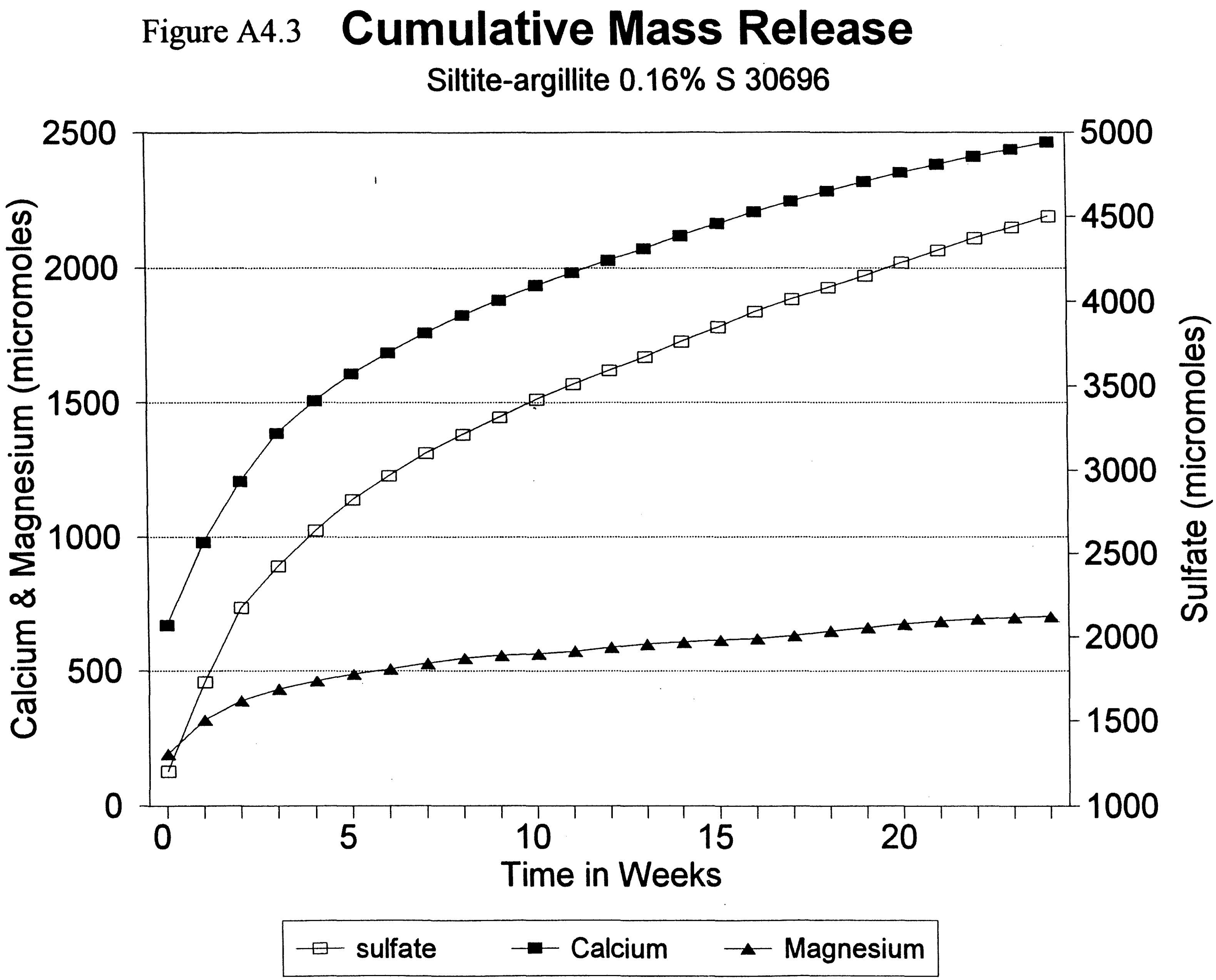
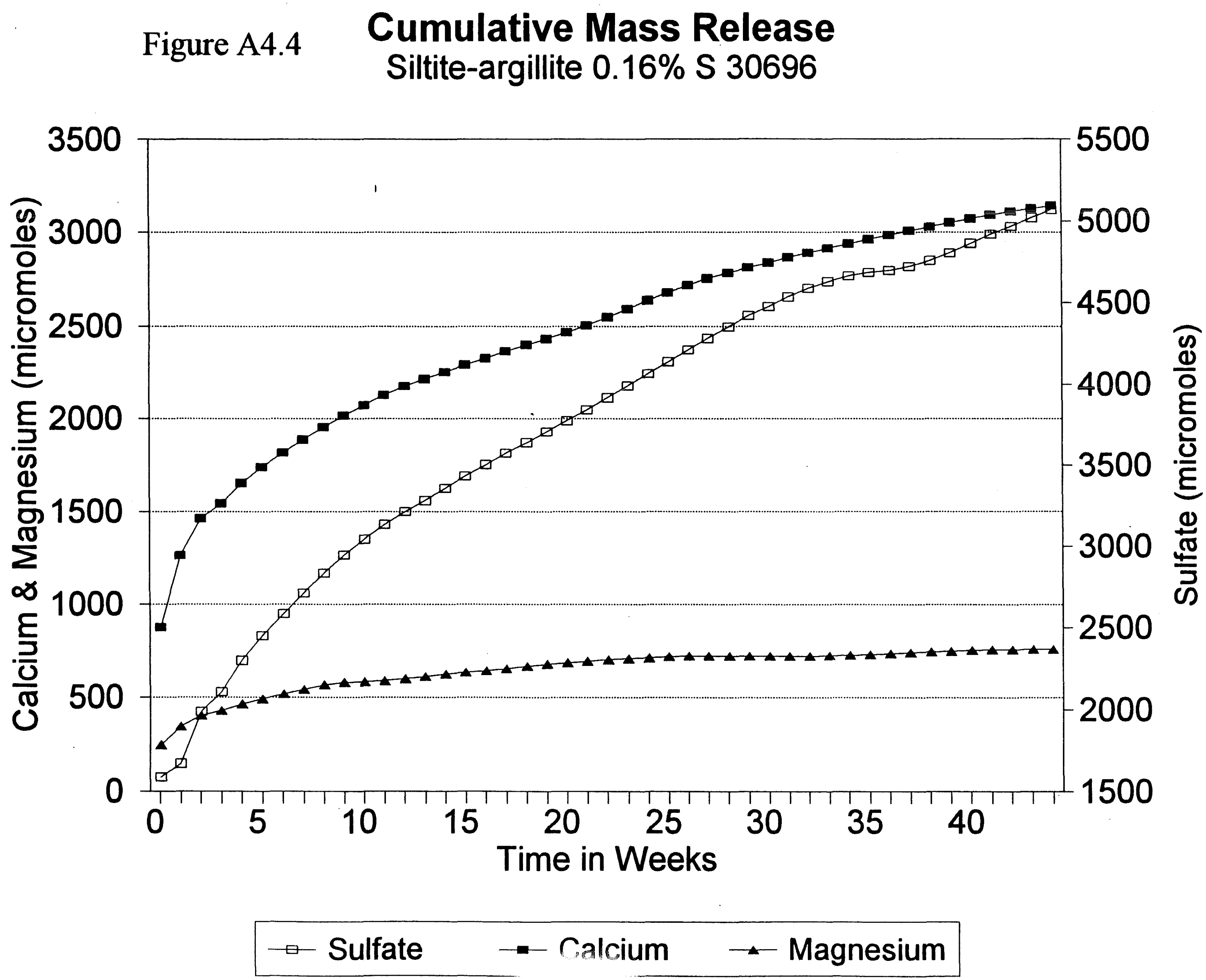

Cumulative Mass Release
Siltite-argillite 0.16% S 30696
Calcium & Magnesium (micromoles)
Sulfate (micromoles)
Time in Weeks
2500
2000
1500
1000
500
0
5000
4500
4000
3500
3000
2500
2000
1500
1000
0
5
10
15
20
sulfate
Calcium
Magnesium

Figure A4.4



Cumulative Mass Release
Siltite-argillite 0.16% S 30696
Calcium & Magnesium (micromoles)
Sulfate (micromoles)
Time in Weeks
3500
3000
2500
2000
1500
1000
500
0
5500
5000
4500
4000
3500
3000
2500
2000
1500
0
5
10
15
20
25
30
35
40
Sulfate
Calcium
Magnesium

Figure A4.5

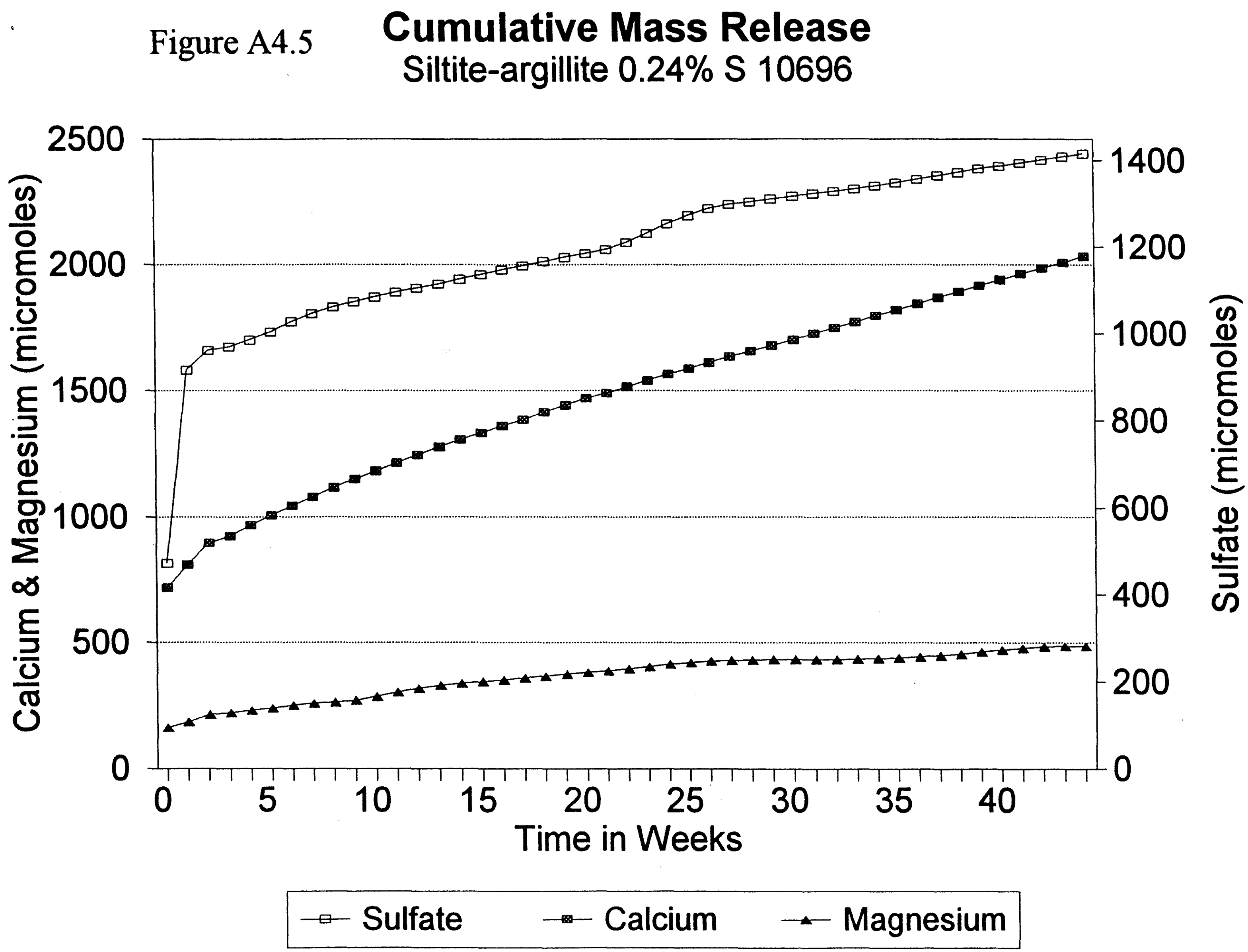

Cumulative Mass Release
Siltite-argillite 0.24% S 10696
Calcium & Magnesium (micromoles)
Sulfate (micromoles)
Time in Weeks
2500
2000
1500
1000
500
0
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
Sulfate
Calcium
Magnesium

Figure A4.6

Cumulative Mass Release

Siltite-argillite 0.29% S 40696

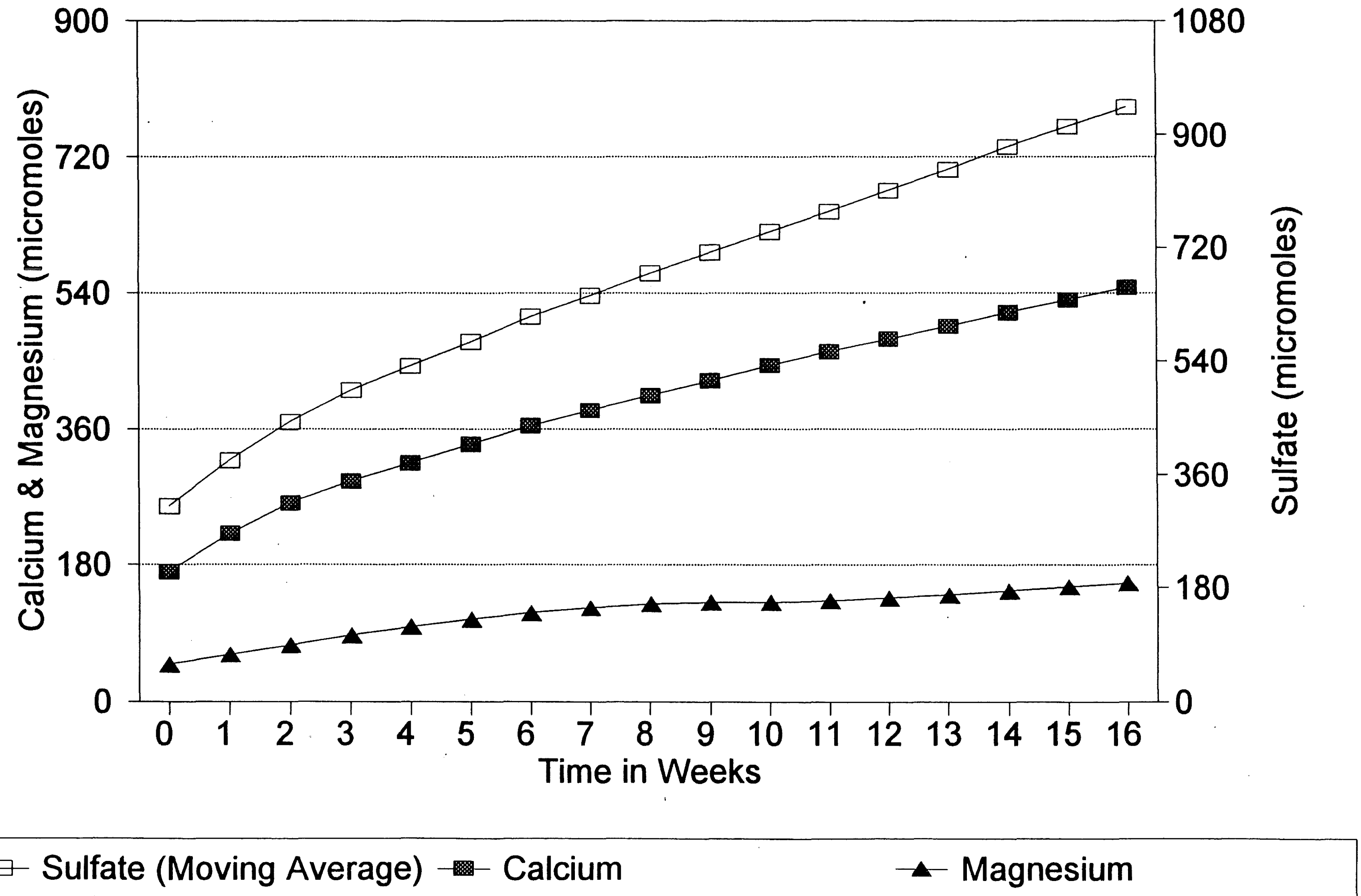


Figure A4.7

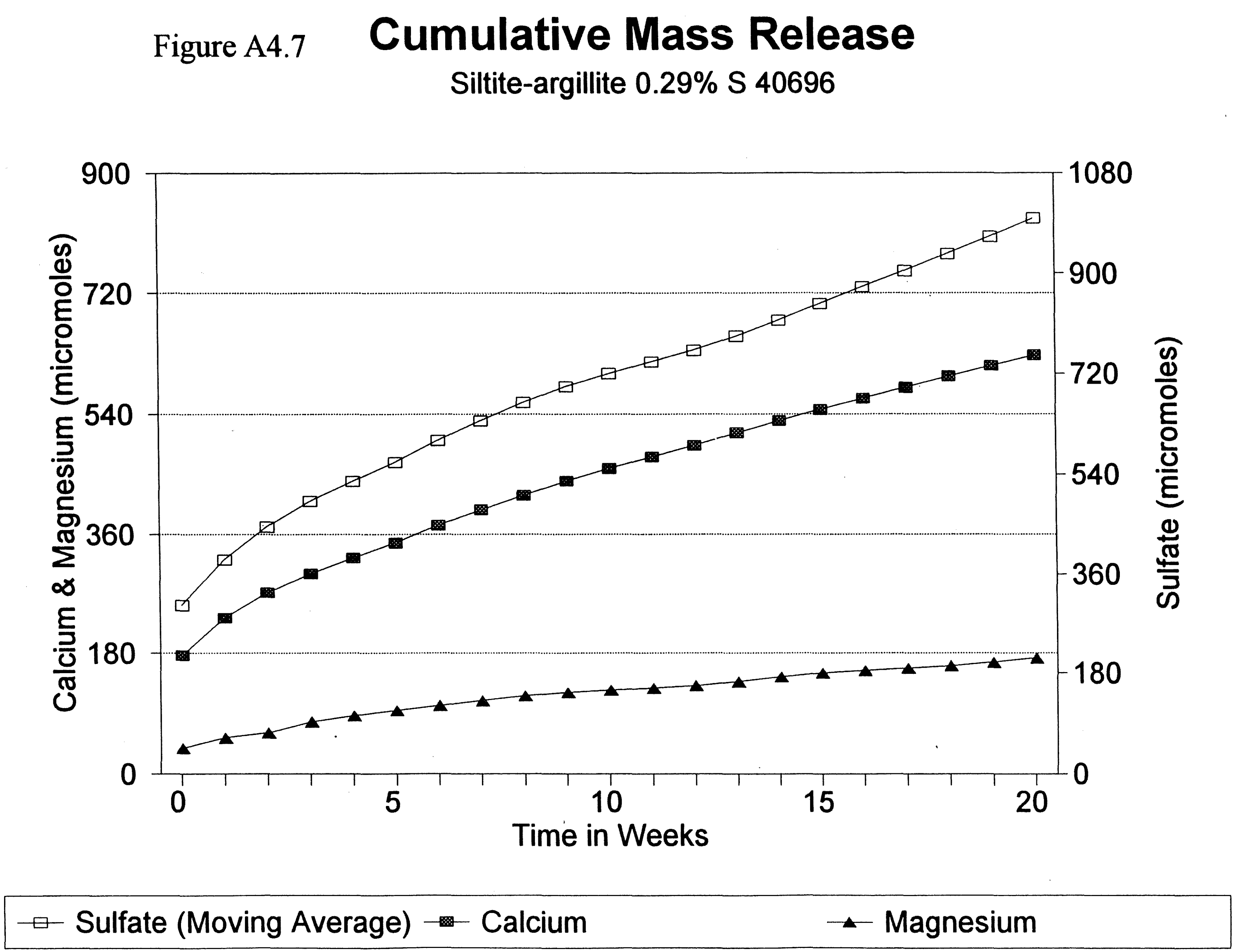
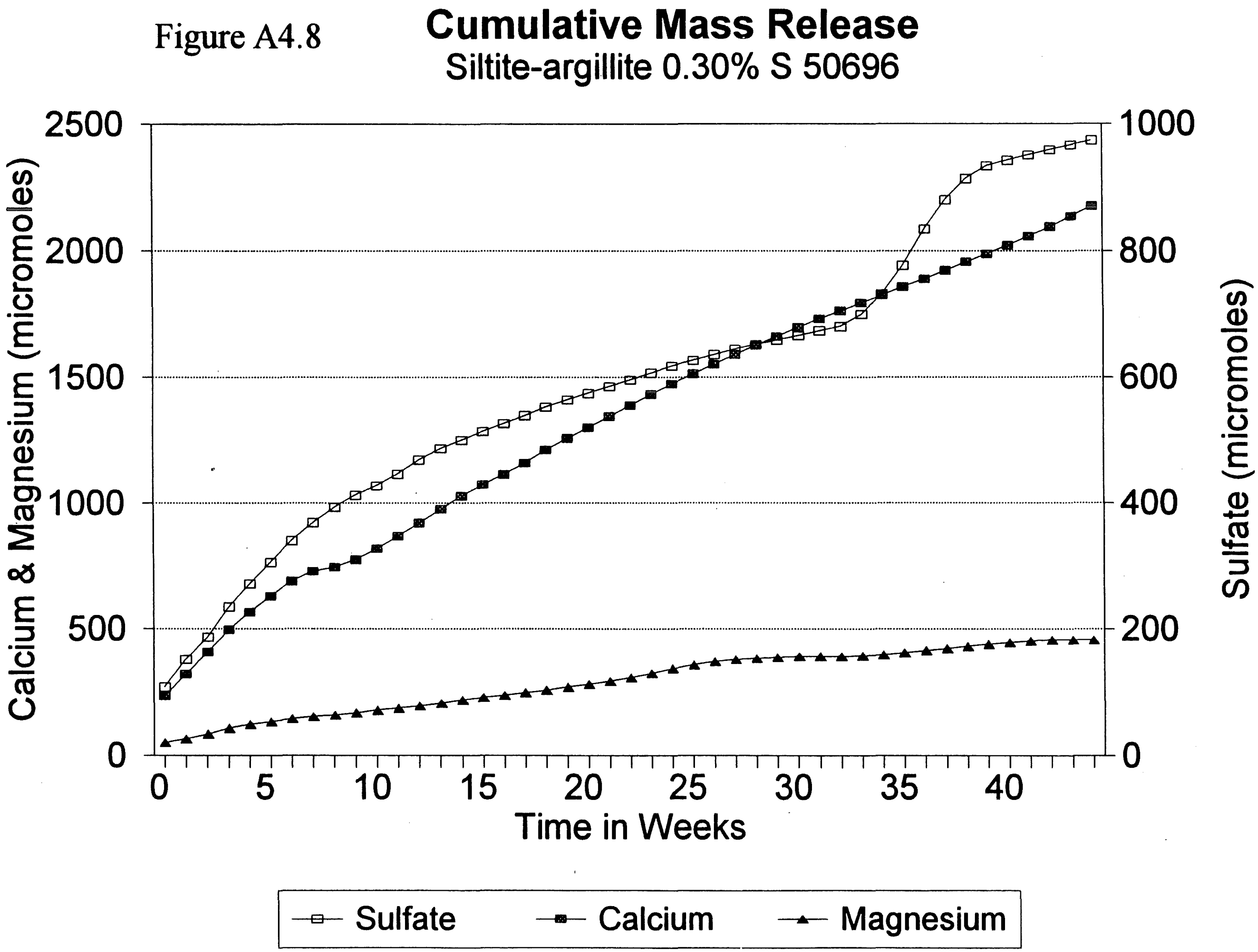

Cumulative Mass Release
Siltite-argillite 0.29% S 40696
Calcium & Magnesium (micromoles)
900
720
540
360
180
0
Sulfate (micromoles)
1080
900
720
540
360
180
0
0
5
10
15
20
Time in Weeks
Sulfate (Moving Average)
Calcium
Magnesium

Figure A4.8



Cumulative Mass Release
Siltite-argillite 0.30% S 50696
Calcium & Magnesium (micromoles)
Sulfate (micromoles)
Time in Weeks
0
500
1000
1500
2000
2500
200
400
600
800
1000
5
10
15
20
25
30
35
40
Sulfate
Calcium
Magnesium

Figure A4.9 **Cumulative Mass Release**

Siltite-argillite 0.38% S 71196

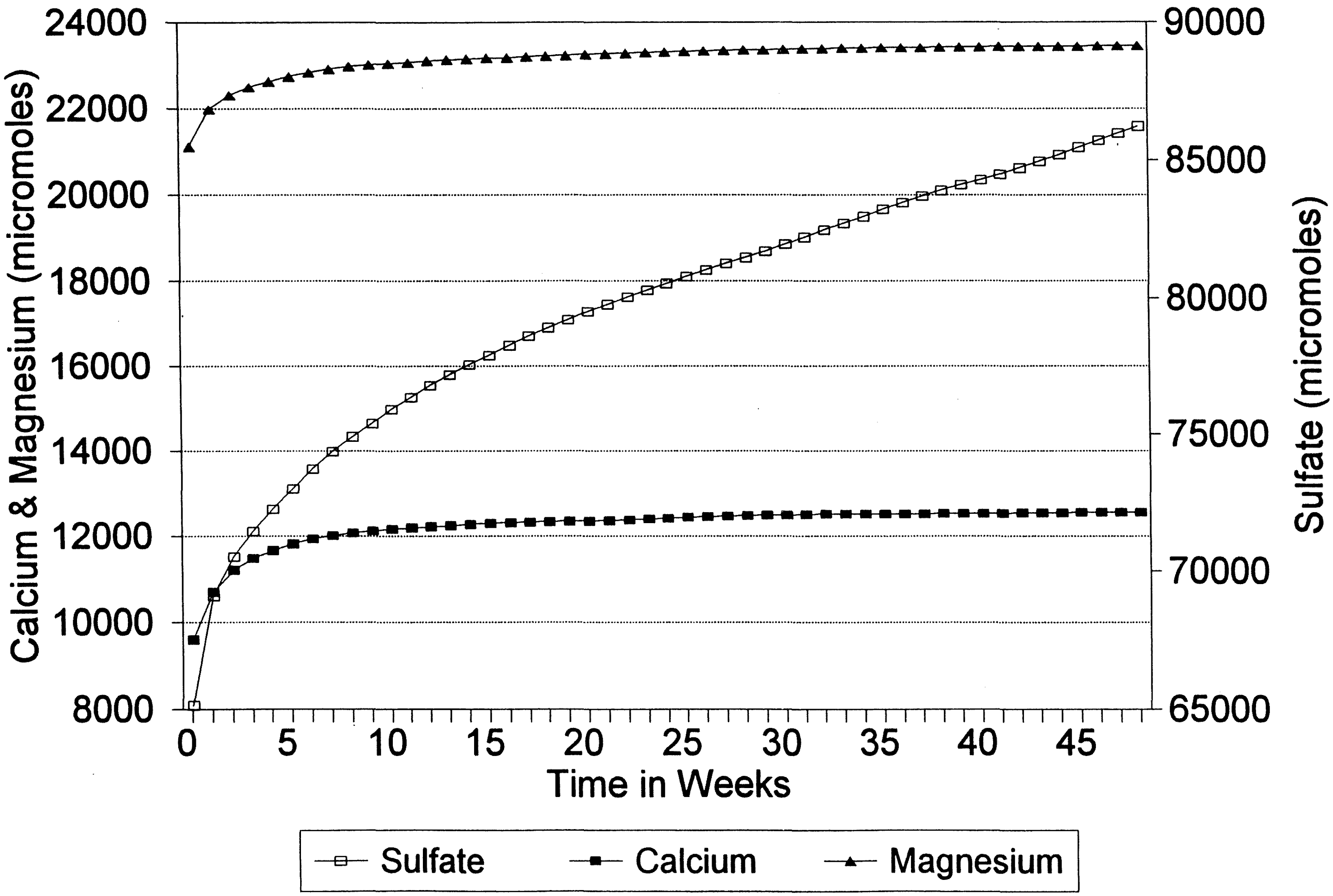


Figure A4.10

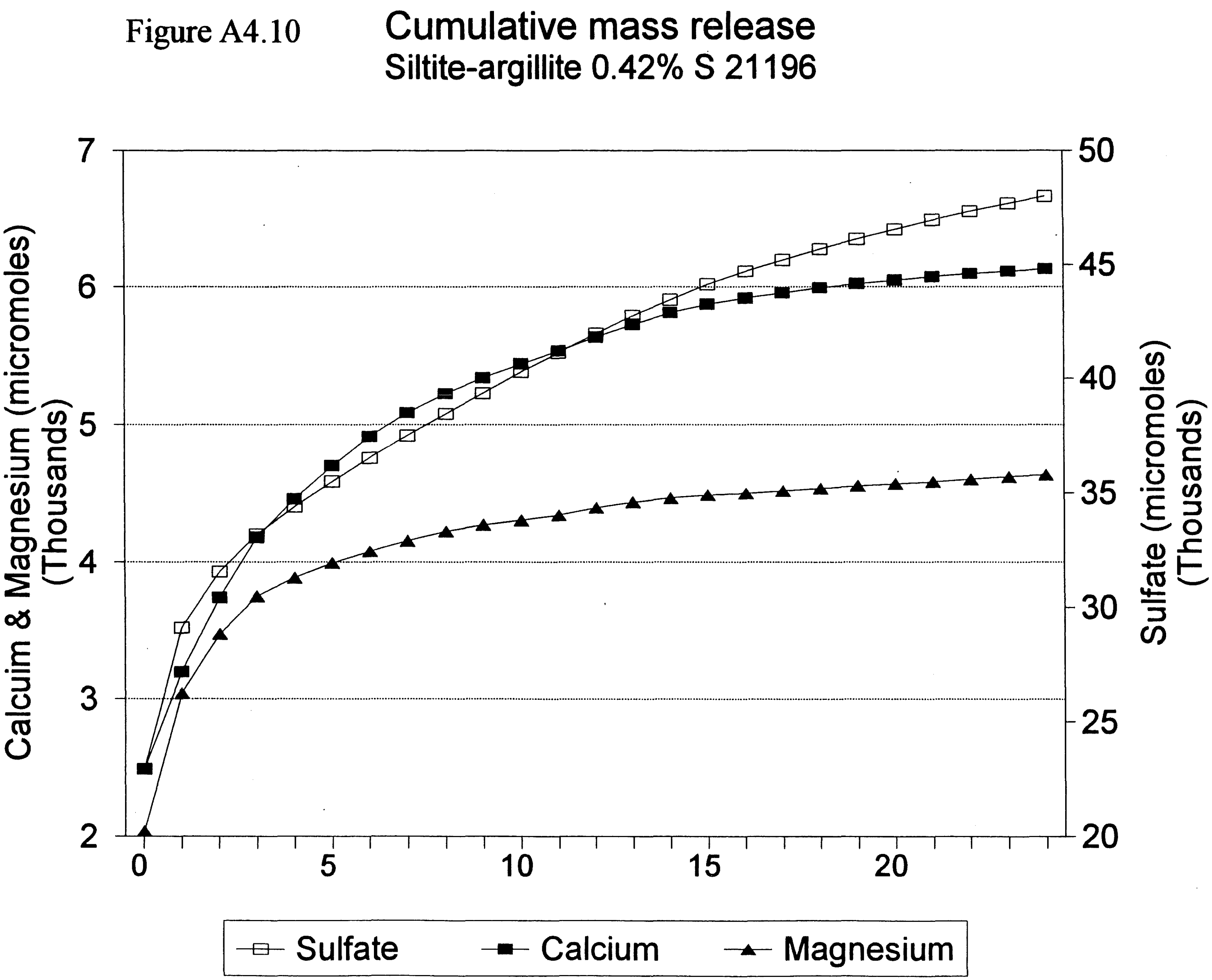
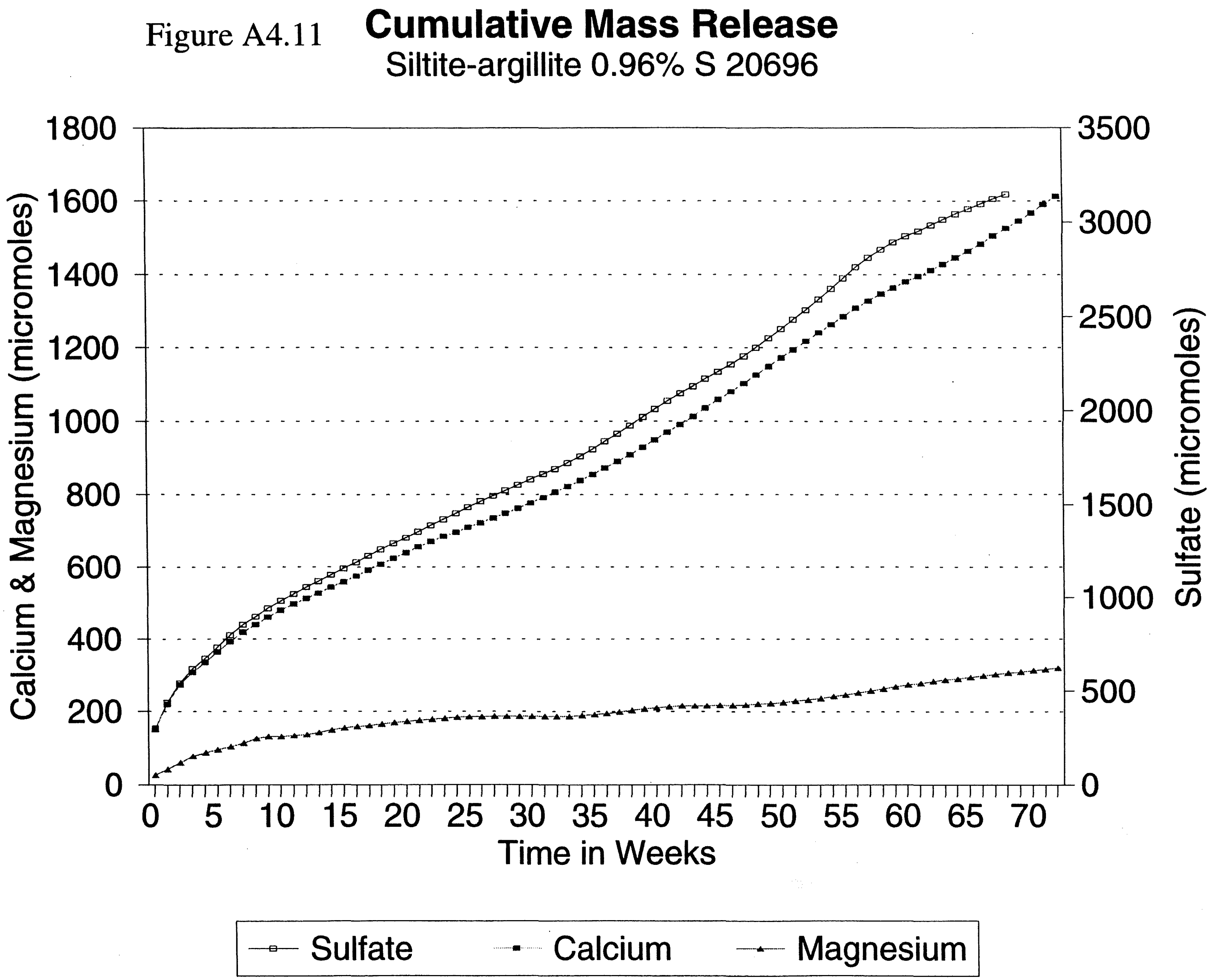
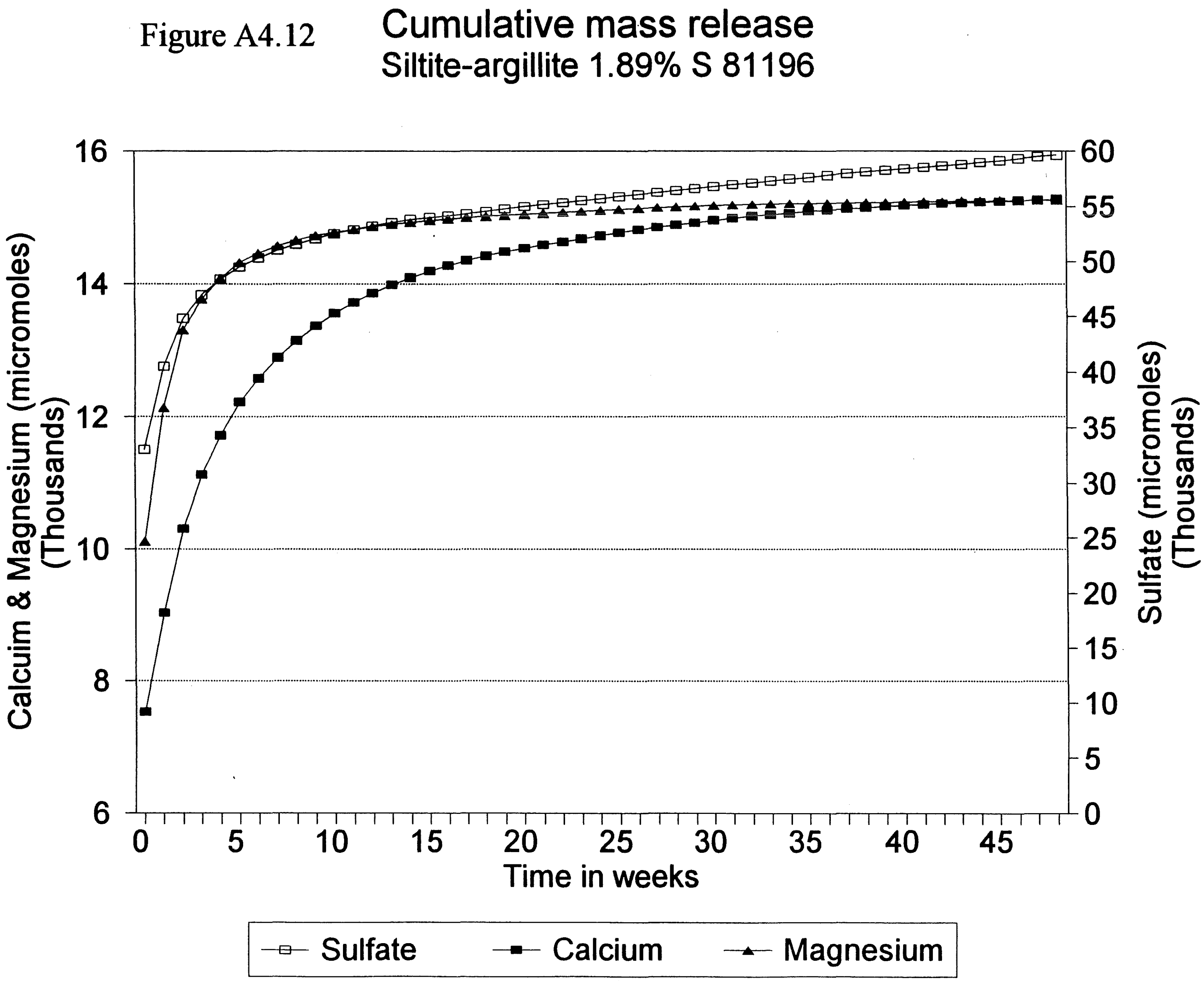

Cumulative mass release
Siltite-argillite 0.42% S 21196
Calcuim & Magnesium (micromoles)
(Thousands)
Sulfate (micromoles)
(Thousands)
7
6
5
4
3
2
50
45
40
35
30
25
20
0
5
10
15
20
Sulfate
Calcium
Magnesium

Figure A4.11



Cumulative Mass Release
Siltite-argillite 0.96% S 20696
Calcium & Magnesium (micromoles)
Sulfate (micromoles)
Time in Weeks
0
200
400
600
800
1000
1200
1400
1600
1800
500
1000
1500
2000
2500
3000
3500
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Sulfate
Calcium
Magnesium

Figure A4.12



Cumulative mass release
Siltite-argillite 1.89% S 81196
Calcuim & Magnesium (micromoles) (Thousands)
Sulfate (micromoles) (Thousands)
Time in weeks
16
14
12
10
8
6
60
55
50
45
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
35
40
45
Sulfate
Calcium
Magnesium

Figure A4.13

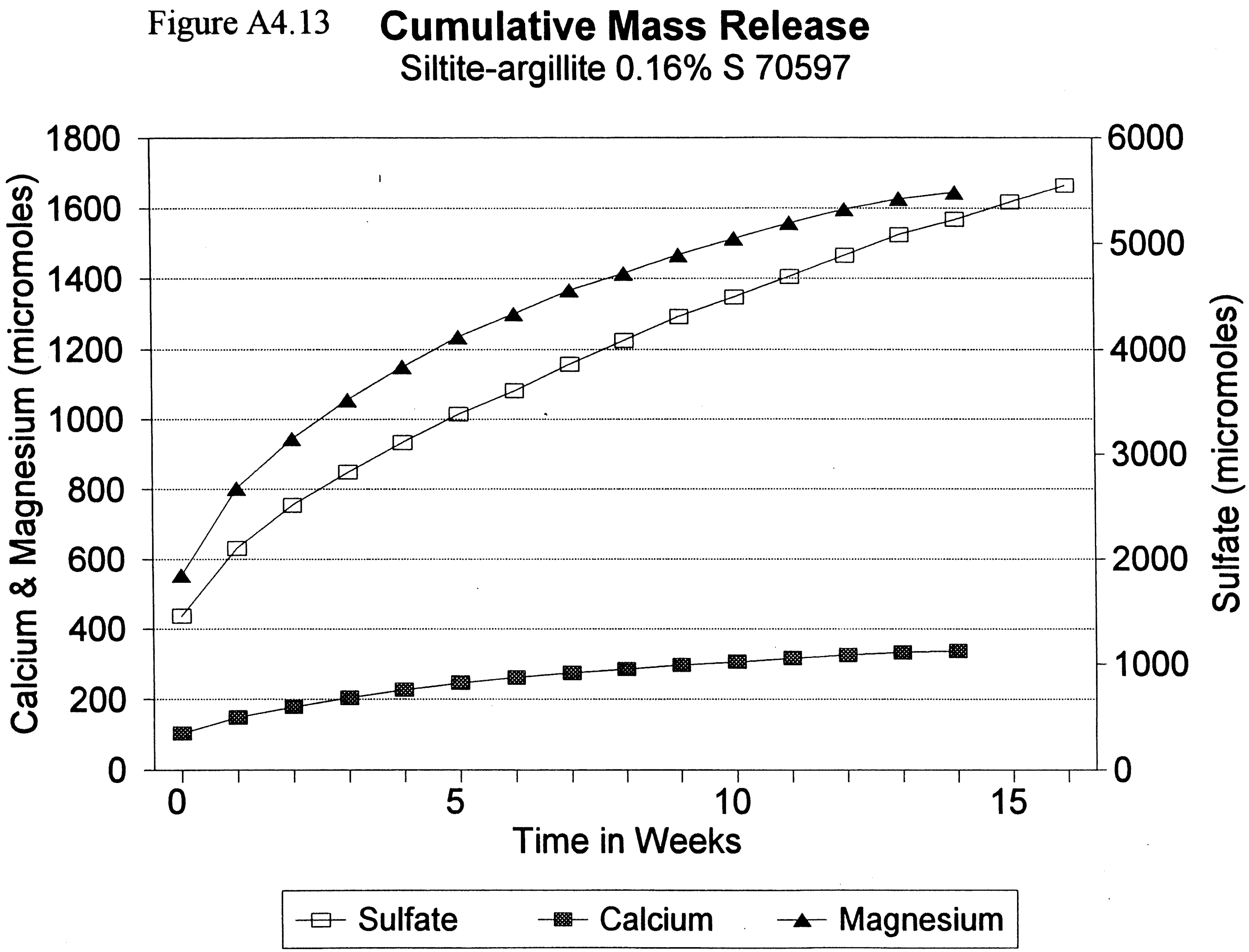
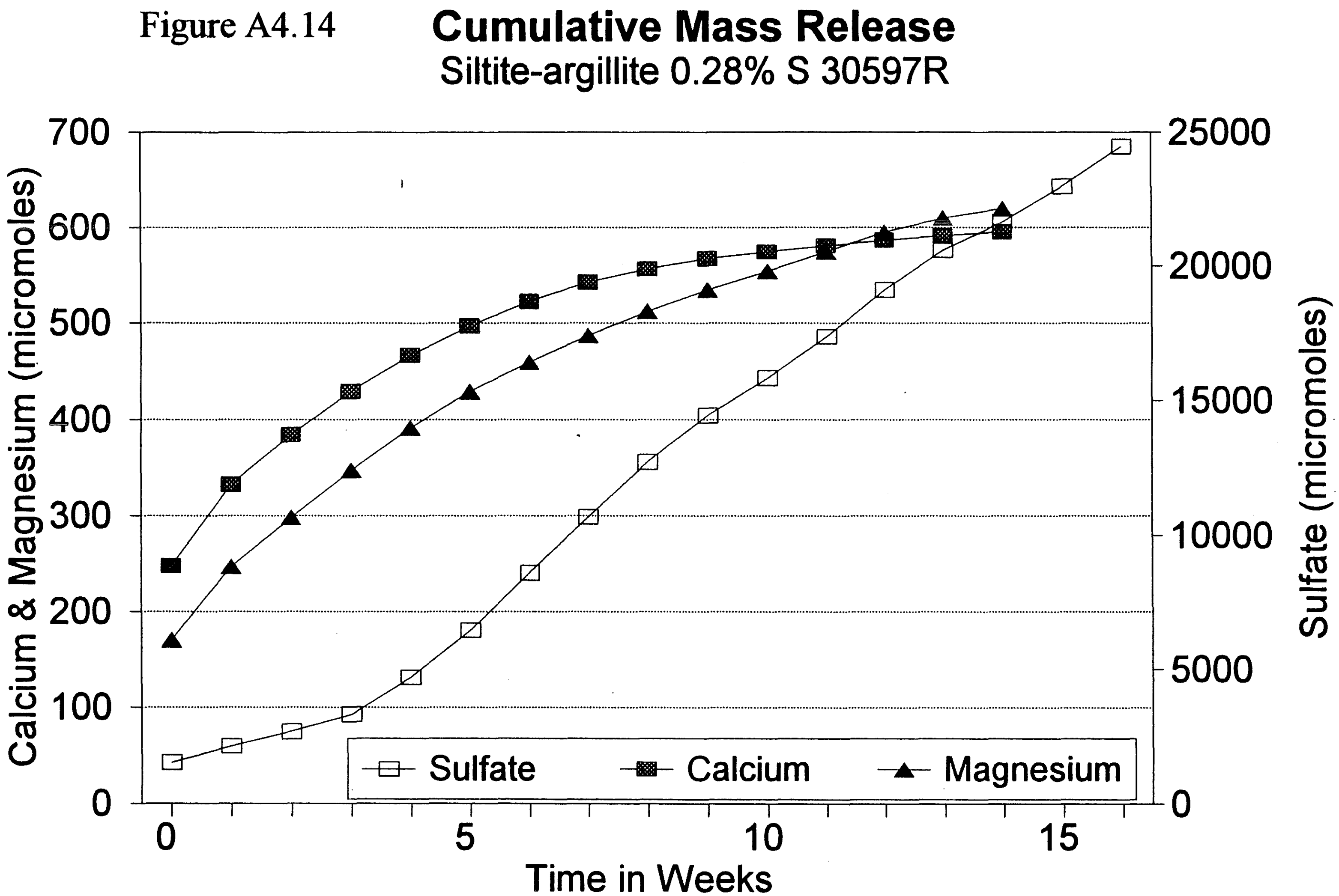

Cumulative Mass Release
Siltite-argillite 0.16% S 70597
Calcium & Magnesium (micromoles)
0
200
400
600
800
1000
1200
1400
1600
1800
Sulfate (micromoles)
0
1000
2000
3000
4000
5000
6000
Time in Weeks
0
5
10
15
Sulfate
Calcium
Magnesium

Figure A4.14



Cumulative Mass Release
Siltite-argillite 0.28% S 30597R
Calcium & Magnesium (micromoles)
Sulfate (micromoles)
Time in Weeks
0
100
200
300
400
500
600
700
0
5000
10000
15000
20000
25000
0
5
10
15
Sulfate
Calcium
Magnesium

Figure A4.15

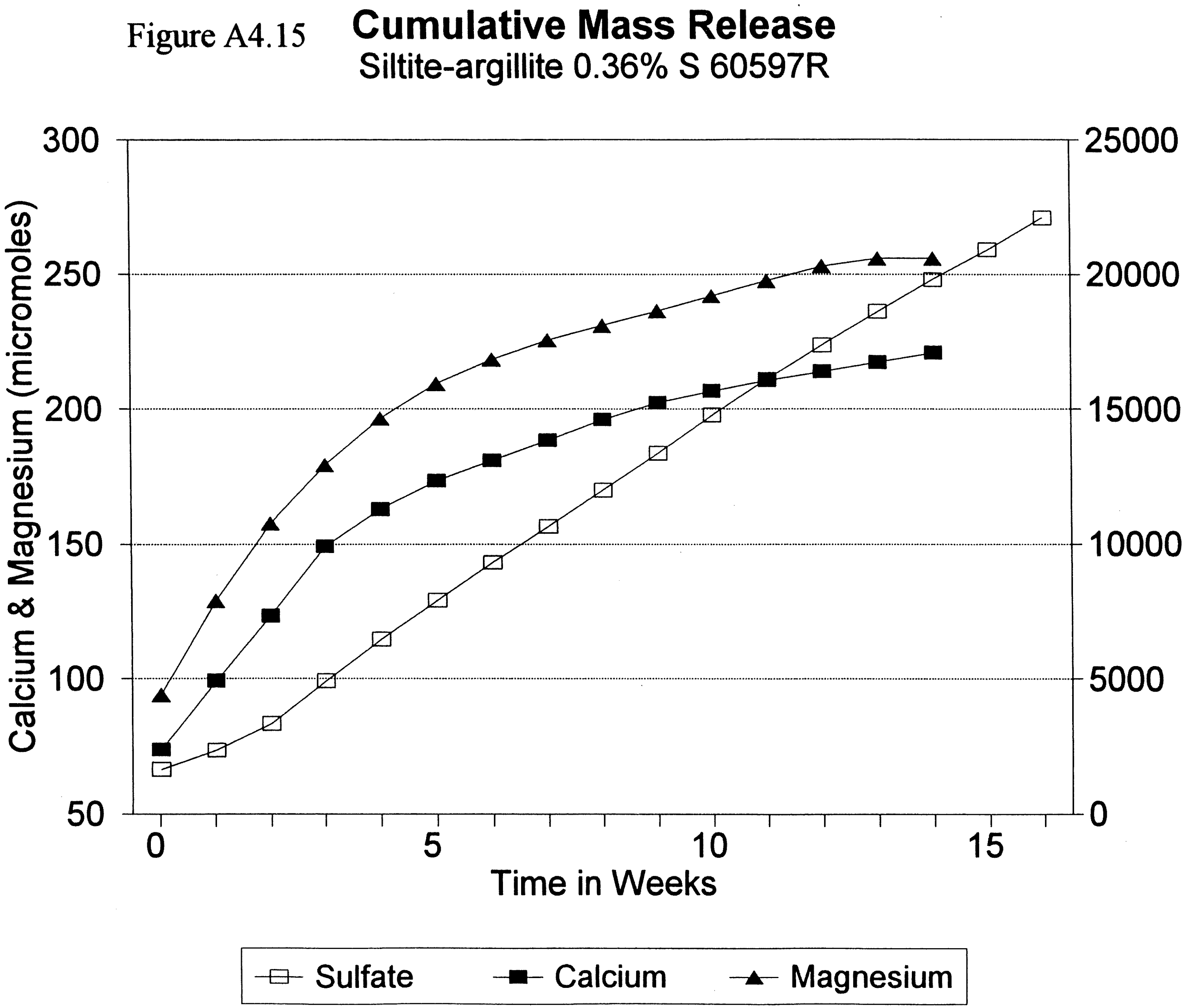

Cumulative Mass Release
Siltite-argillite 0.36% S 60597R
Calcium & Magnesium (micromoles)
Sulfate (micromoles)
Time in Weeks
300
250
200
150
100
50
25000
20000
15000
10000
5000
0
0
5
10
15
Sulfate
Calcium
Magnesium

Figure A4.16

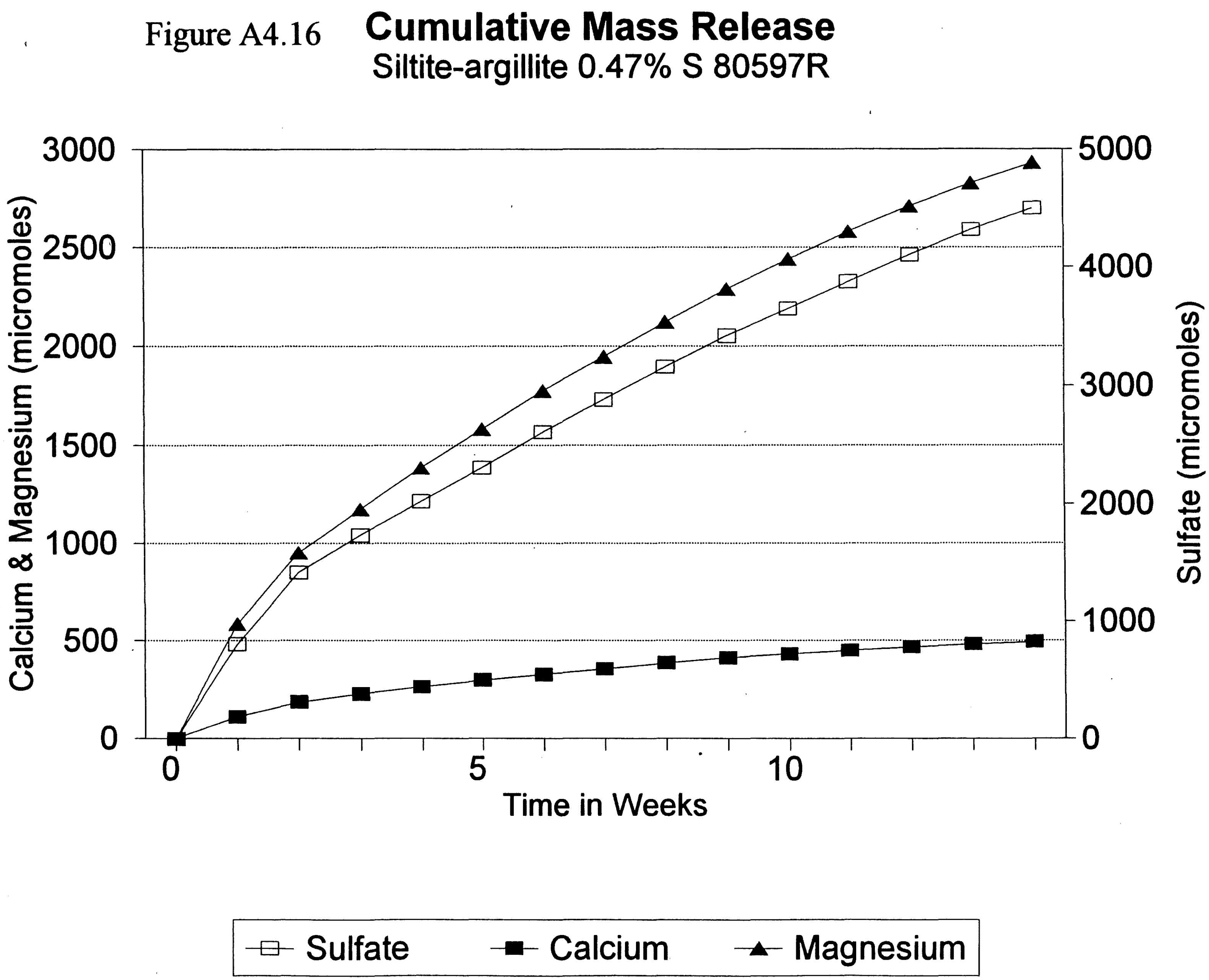

Cumulative Mass Release
Siltite-argillite 0.47% S 80597R
Calcium & Magnesium (micromoles)
Sulfate (micromoles)
Time in Weeks
3000
2500
2000
1500
1000
500
0
5000
4000
3000
2000
1000
0
0
5
10
Sulfate
Calcium
Magnesium

Figure A4.17 **Cumulative Mass Release**

Siltite-argillite 0.47% S 20597

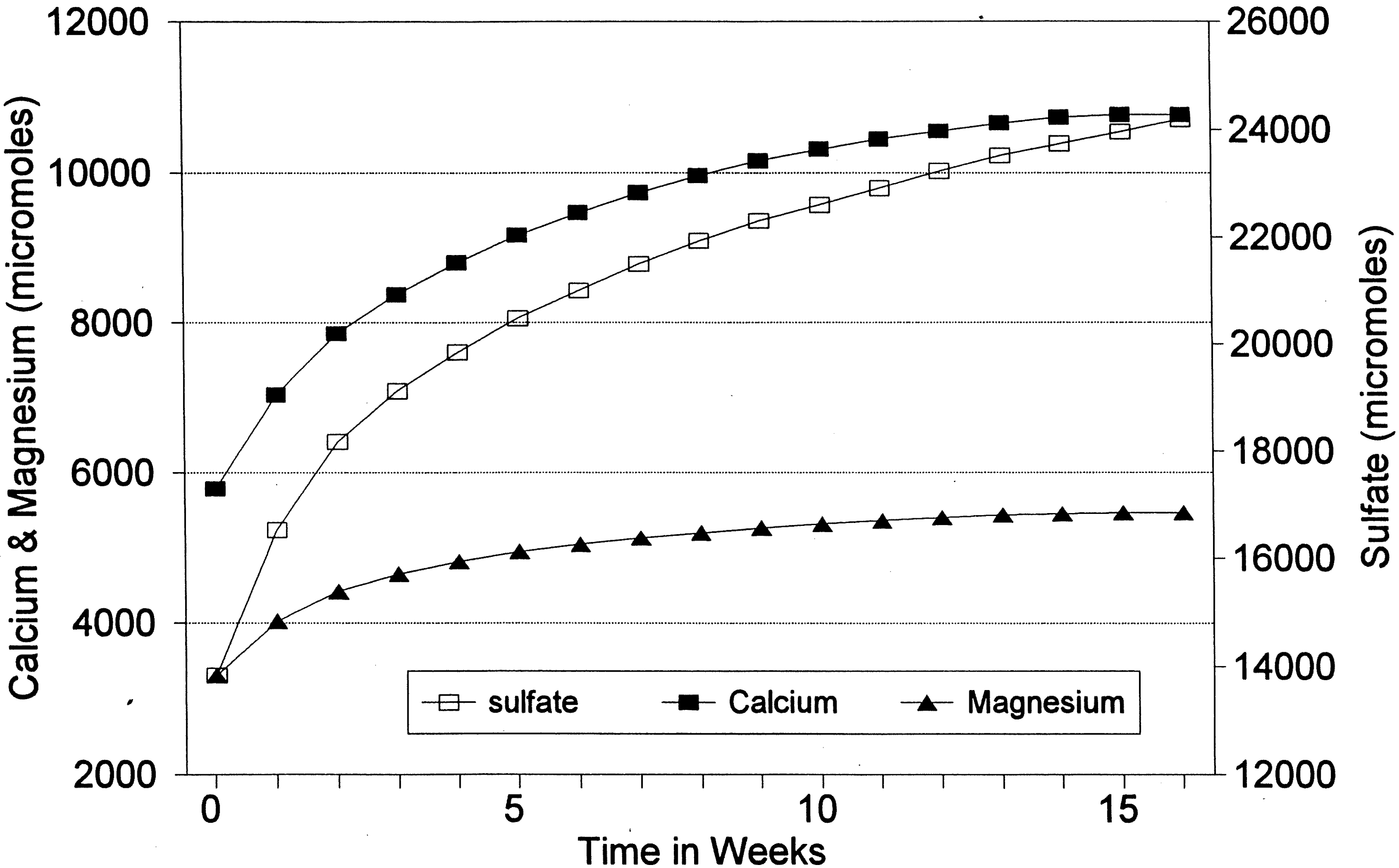
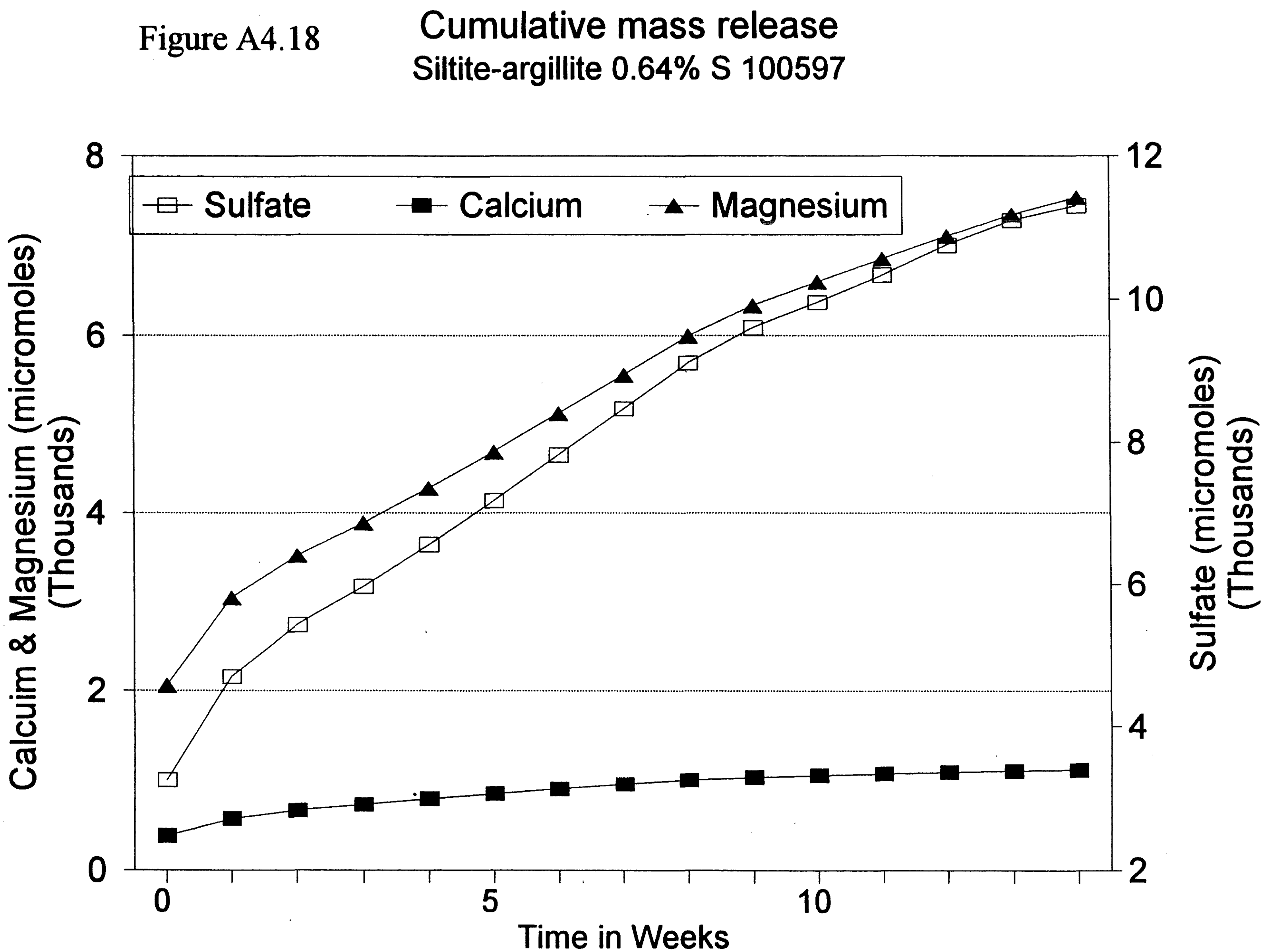
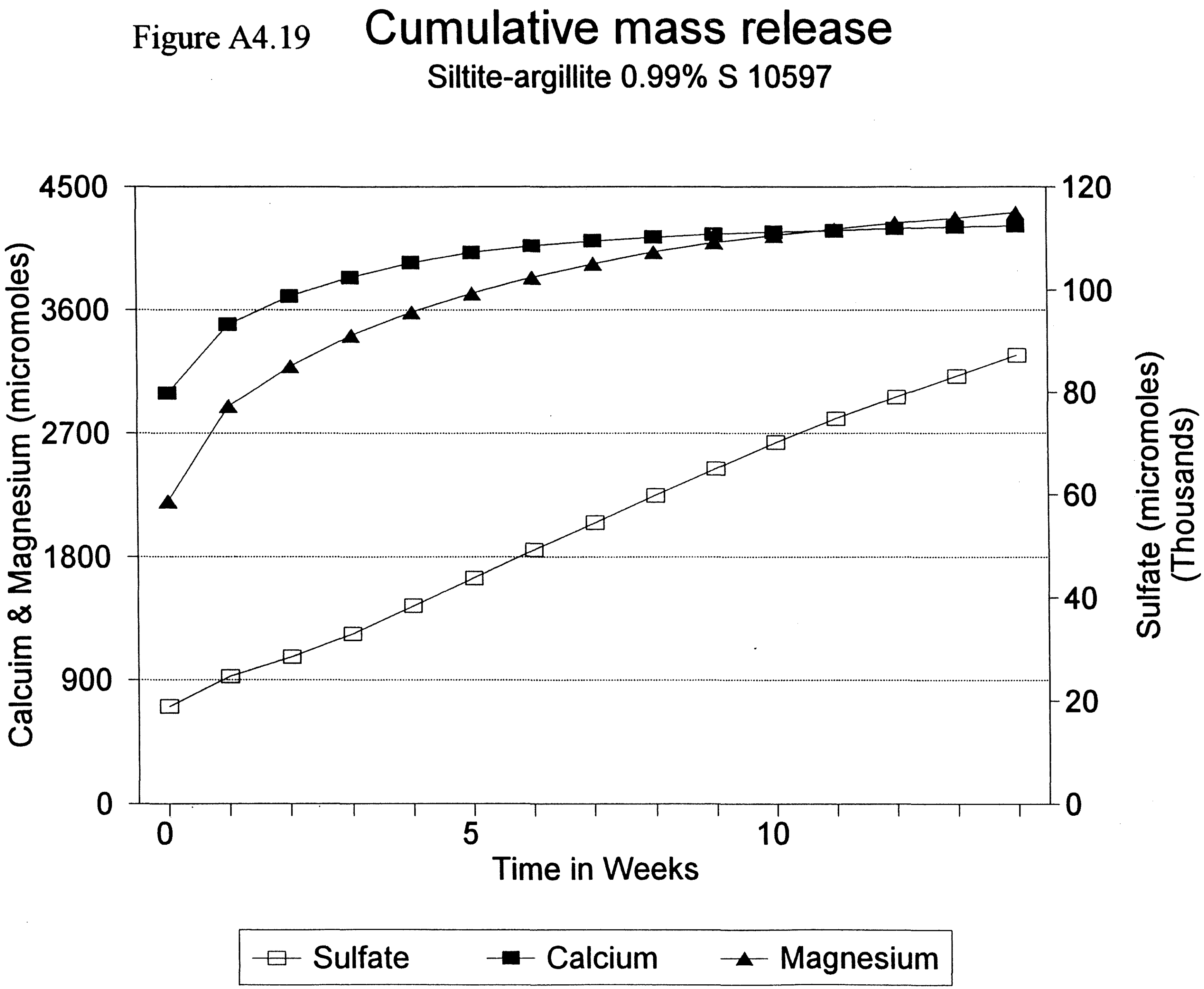


Figure A4.18



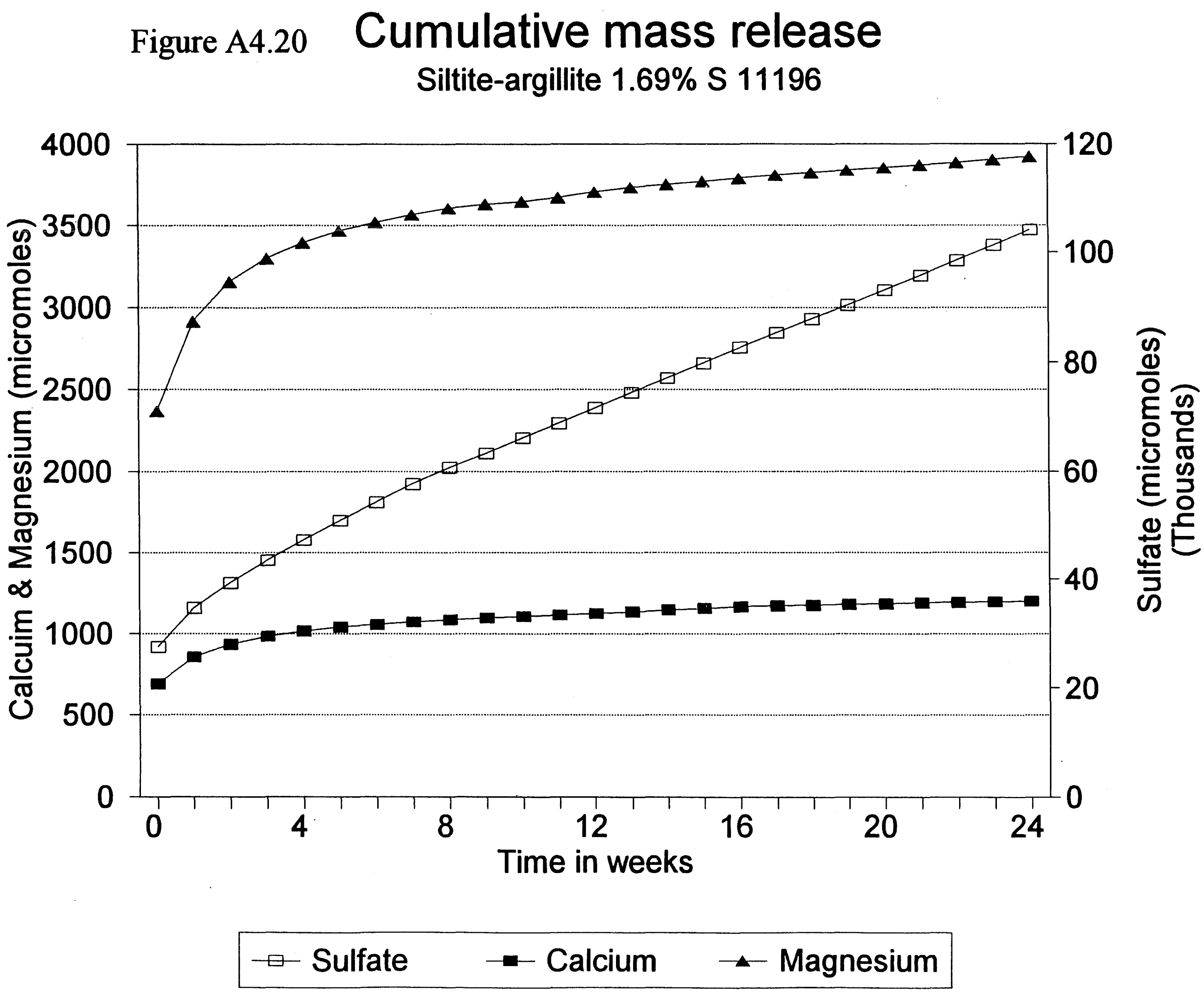
Cumulative mass release
Siltite-argillite 0.64% S 100597
Sulfate
Calcium
Magnesium
Calcuim & Magnesium (micromoles)
(Thousands)
Sulfate (micromoles)
(Thousands)
Time in Weeks
0
2
4
6
8
2
4
6
8
10
12
0
5
10

Figure A4.19



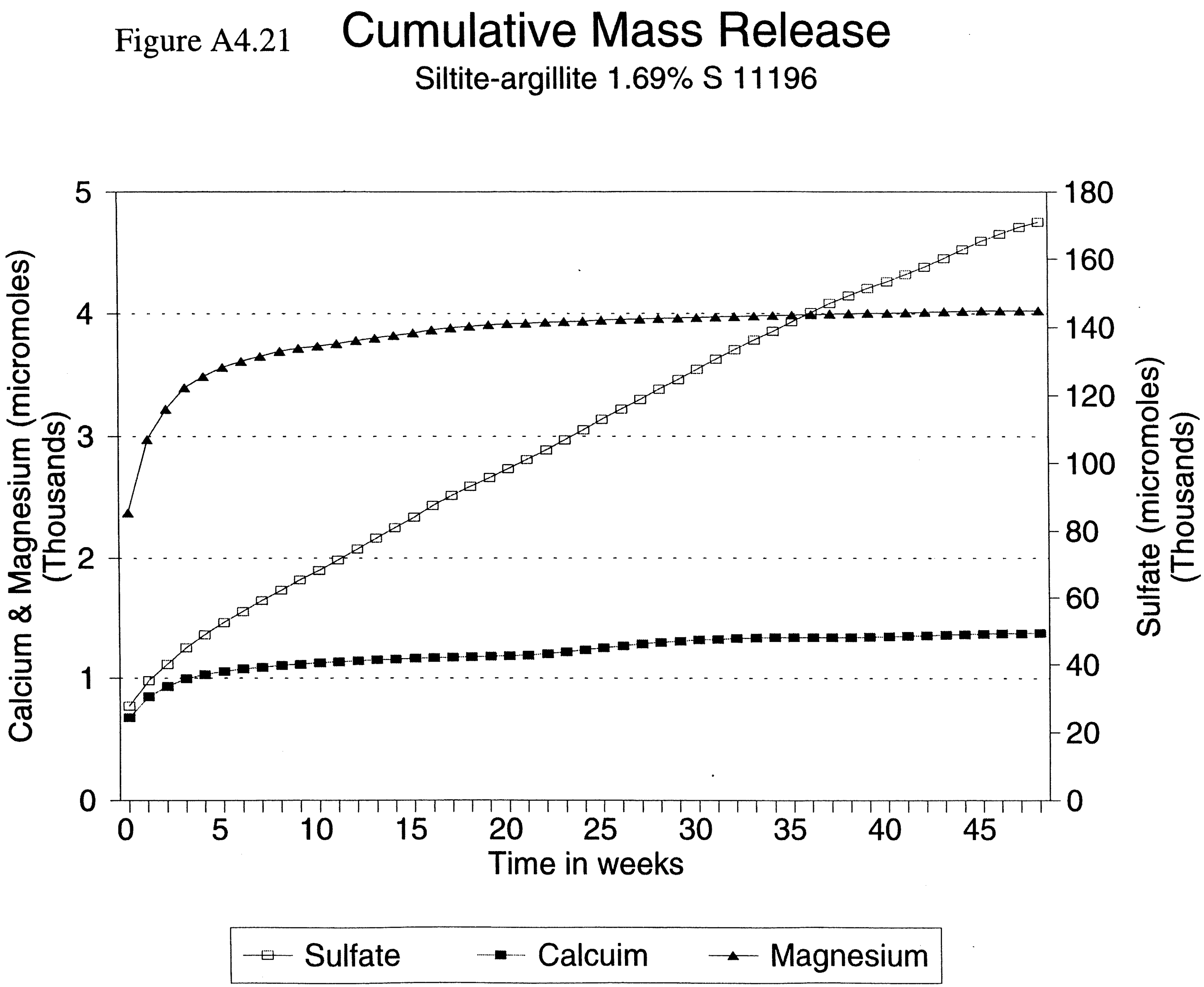
Cumulative mass release
Siltite-argillite 0.99% S 10597
4500
3600
2700
1800
900
0
Calcuim & Magnesium (micromoles)
120
100
80
60
40
20
0
Sulfate (micromoles)
(Thousands)
0
5
10
Time in Weeks
Sulfate
Calcium
Magnesium

Figure A4.20



Cumulative mass release
Siltite-argillite 1.69% S 11196
Calcuim & Magnesium (micromoles)
4000
3500
3000
2500
2000
1500
1000
500
0
Sulfate (micromoles)
(Thousands)
120
100
80
60
40
20
0
0
4
8
12
16
20
24
Time in weeks
Sulfate
Calcium
Magnesium

Figure A4.21



Cumulative Mass Release
Siltite-argillite 1.69% S 11196
Calcium & Magnesium (micromoles) (Thousands)
Sulfate (micromoles) (Thousands)
Time in weeks
0
1
2
3
4
5
0
20
40
60
80
100
120
140
160
180
0
5
10
15
20
25
30
35
40
45
Sulfate
Calcuim
Magnesium

Figure A4.22

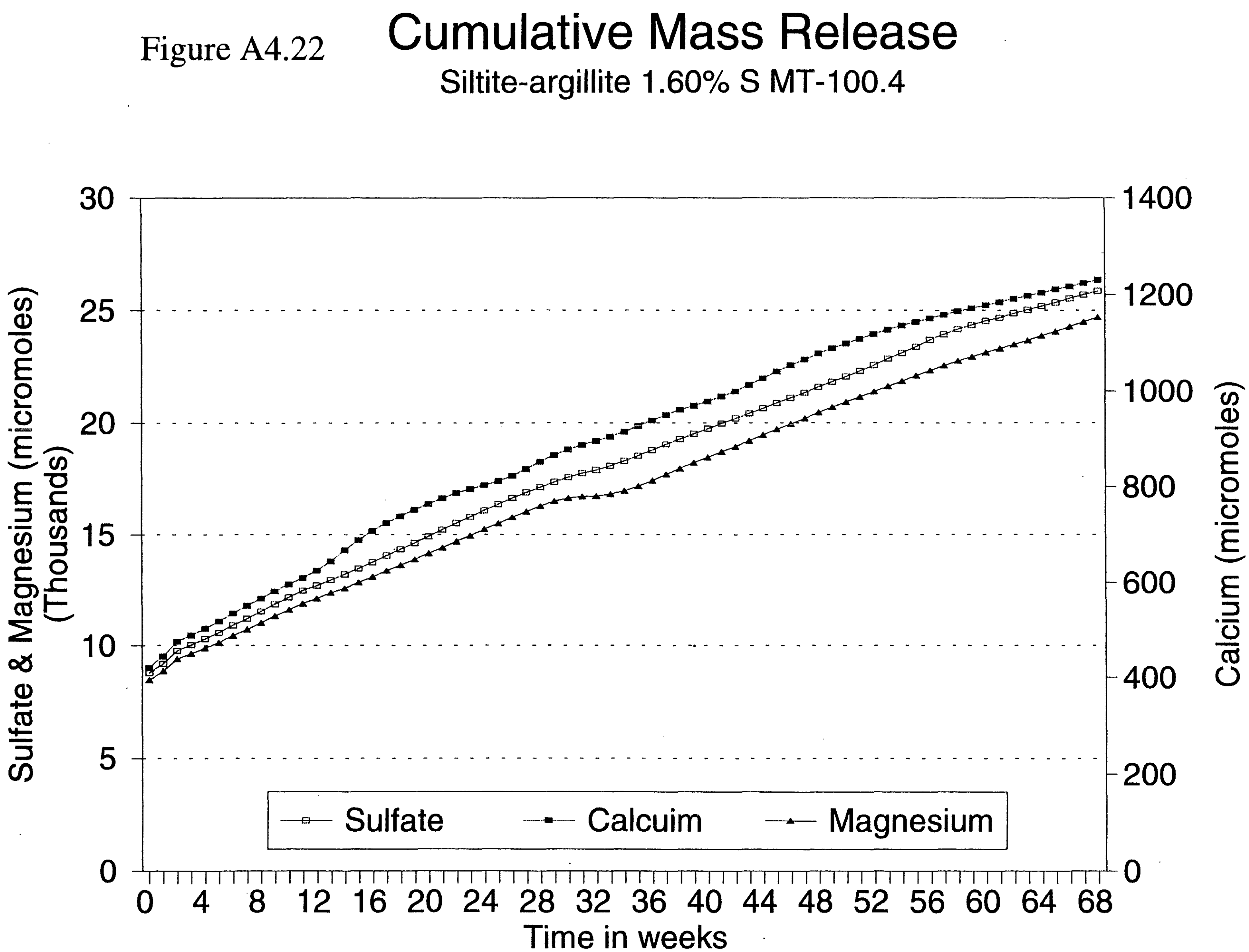

Cumulative Mass Release
Siltite-argillite 1.60% S MT-100.4
Sulfate & Magnesium (micromoles) (Thousands)
Calcium (micromoles)
Time in weeks
0
5
10
15
20
25
30
0
200
400
600
800
1000
1200
1400
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68
Sulfate
Calcuim
Magnesium

Figure A4.23 **Cumulative Mass Release**

Siltite-argillite 1.60% S MT-100.4

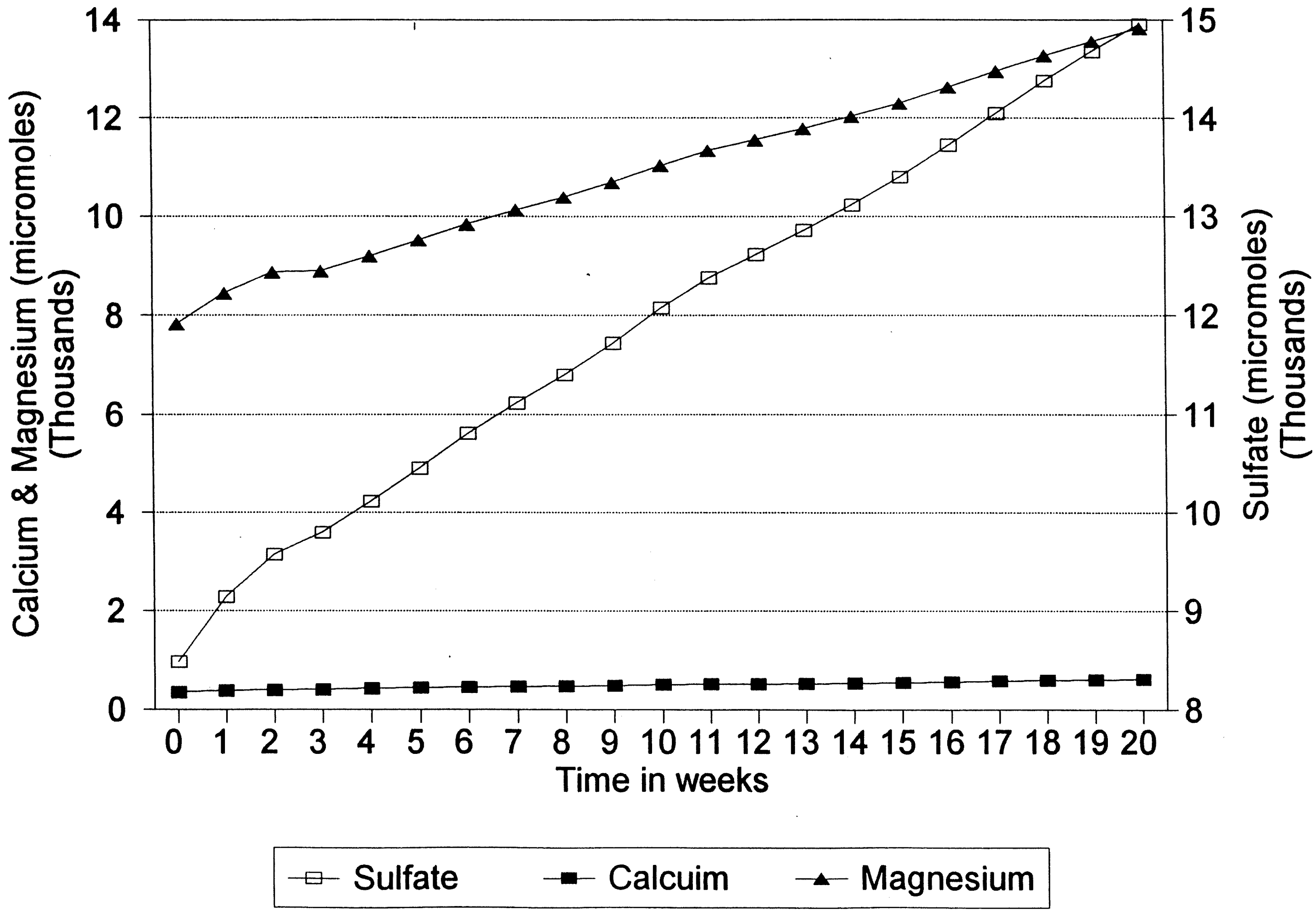


Figure A4.24

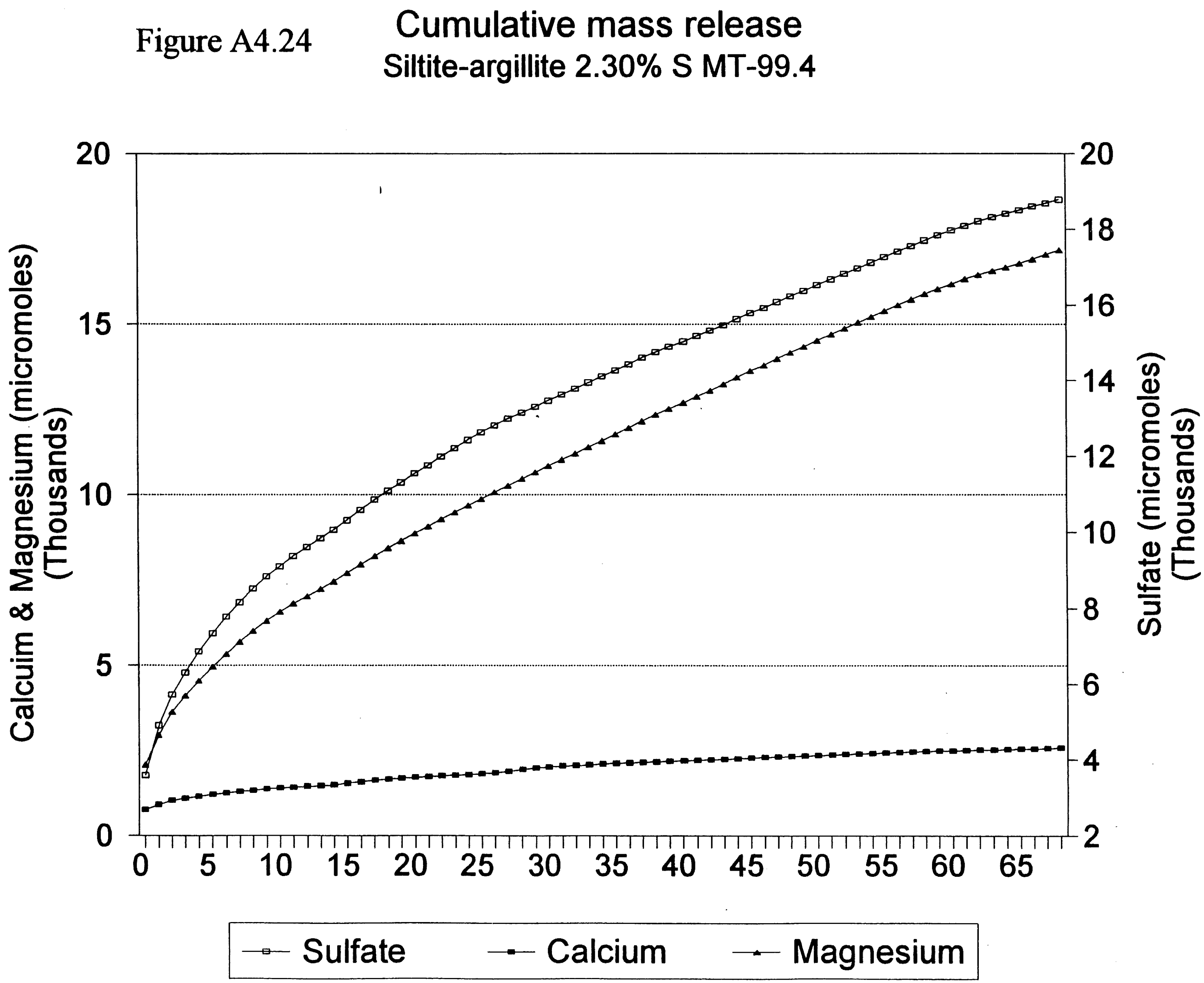

Cumulative mass release
Siltite-argillite 2.30% S MT-99.4
Calcuim & Magnesium (micromoles)
(Thousands)
Sulfate (micromoles)
(Thousands)
0
5
10
15
20
0
5
10
15
20
25
30
35
40
45
50
55
60
65
2
4
6
8
10
12
14
16
18
20
Sulfate
Calcium
Magnesium

Figure A4.25

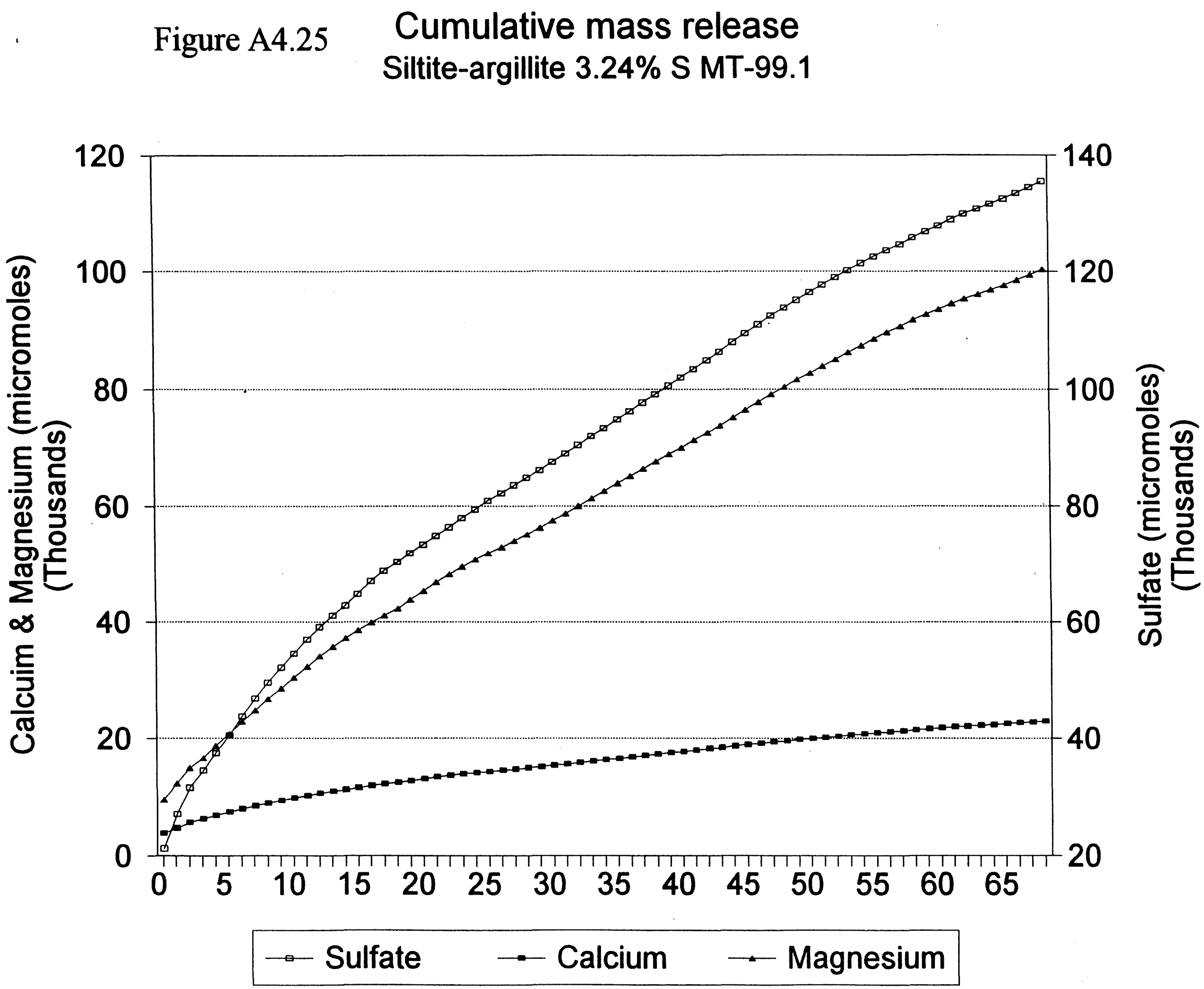
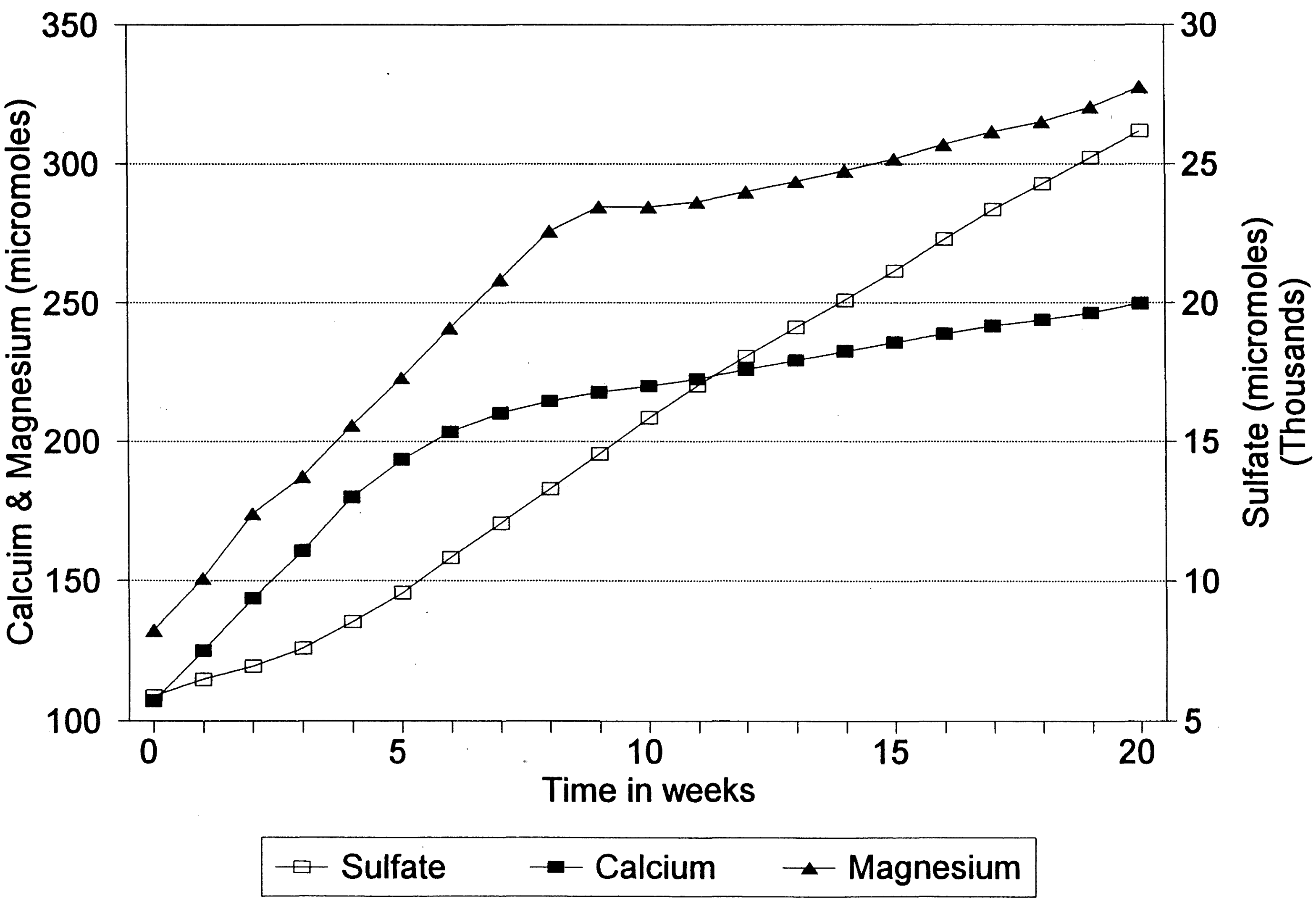

Cumulative mass release
Siltite-argillite 3.24% S MT-99.1
Calcuim & Magnesium (micromoles)
(Thousands)
Sulfate (micromoles)
(Thousands)
120
100
80
60
40
20
0
140
120
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
65
Sulfate
Calcium
Magnesium

Figure A4.26 Cumulative mass release

Siltite-argillite 5.82% S MT-99.6



APPENDIX 5

MINERALOGIC REPORT

To: Kim Lapakko **Received 10 February 1998**
DNR Minerals Div.

From: Barry Frey
Midland Research Center

Re: DNR-BLM Samples

This report is a summary with final observations about these samples. It does not include all of the previous material. This report is being E-mailed and sent along with the photographs in the mail. The mailed copy will have the same information as the E-mail copy, although it may be slightly modified. A copy on a floppy disk will also be sent.

Binocular Microscopic Examination of Screen Structure Intervals

Screen structures were made on samples 71196R, 11196R, 20969, and 99.4. These were sieved at 6, 8, 10, 14, 20, 28, 35, 48, 65, 100, 150, 200, 270, 325, 400, and 500 mesh. The fractions were examined under a binocular microscope. The other sample, 99.1, was previously sized, and these were examined only; except for the finest fractions described where a small portion of the finest fraction was sieved to be more comparative with the other samples. 99.1 had a dusting of fine powder on all fractions (others were wet sieved, removing any sulphate dust having formed over time). This dusting resulted in the need to wash the samples in order to identify minerals. This could have been due to the extra transport done between sieving and examination; or a compositional difference such as it being the sample with the most chlorite and highest Mg release.

Sizes for a given fraction always vary from the micron intervals one would absolutely expect. There are always smaller particles (perhaps a higher relative percentage sulfides than other grains?). This may reflect the fine-grained mineralogy and a tendency for grains to spall off after the sieving, especially something like composite marcasite grains. There may also be some tendency for smaller grains to adhere to larger grains from static electricity. Except for the smallest few fractions, grains have a tendency to be irregular and to be variably elongate.

All samples were fairly siliceous. The predominate visually identifiable gangue was quartz, with the liberated percentages increasing with the finer fractions. Other than sulfide, quartz and minor mica flakes were the coarsest minerals. From sample 99.1, the calcite present must be very fine-grained.

For sulfides, the mineralogy and amounts indicated by the X-Ray Diffraction (XRD) patterns were verified by examination. Regarding sulfides, there are two types of "liberation" with these samples. Some monocrystalline grains of sulfide are liberated at a given size (coarser for pyrite than for marcasite). Grains of liberated sulfide of the same size composed of many smaller individual grains is the other alternative. In general, of the latter type, marcasite predominated. In general, marcasite tended to be finer-grained than pyrite. When looking at the percentages of sulfides in each fraction, remember to look at the screen structure amounts to fully understand the actual sulfide distributions.

Samples 99.1, 99.4, and 11196R had the most sulfides with the the first two samples having the highest marcasite percentages.

Light Microscopy on Polished Sections

The sulfides presented difficulties that often crossed the various methodologies. The observed sulfides were all iron sulfides. Pyrite and marcasite both have similar reflectivity under reflected light, similar chemistry using the SEM, and both are hard and tend to polish with difficulty. Normally the anisotropic nature of marcasite makes such identification easier (under the polarizing microscope), but with the small grain size and polishing difficulties, the anisotropic nature of marcasite reflections was not discernible. Other details of grains (equigranular vs elongate; brittle vs more ductile deformation) appeared to be better criteria. Only rarely where pyrite and marcasite were adjacent could the slightly higher reflectivity of marcasite be noted. In general, pyrite tends to be coarser and tends to be more euhedral (with finer sizes, euhedral crystals are replaced by crystal fragments). These crystals, even with euhedral external crystal faces, may have considerable gangue (quartz?) intergrown with the pyrite (see photo 17). Possible colloform or framboidal sulfide also occurs (photo's 8 and 20) and is probably predominantly marcasite. These sulfides typically have finer inclusions/voids, with some grains appearing irregularly "moth-eaten". Some pyrite overgrowths were also observed (photos 13,14,15).

The cross-sections of grains did not produce any clear coatings on sulfides.

The summarized descriptions (submitted earlier) are given below in two parts.

Part 1 is Summary of sulfide occurrence. NOTE: percentages take into account the different weights for individual fractions of each sample. These are not true occurrence percentages, but are percentages of the total sample sulfide (a given samples sulfide amount = 100%). The sulfide analyses used in conjunction with these percentages should produce an estimate of the actual sample percentages for each sulfide.

Part 2 is the exported spreadsheet data into text 1) as originally compiled and 2) sorted (sorted version at the end) (NOT INCLUDED IN APPENDIX)

Part 1: SUMMARY

71196R SULFIDE RATIO: TRACE? Marcasite 100% Pyrite

PYRITE

50% Composite grains with disseminated pyrite and gangue; size 0-10 microns

13% Liberated monominerallic fragments (of single crystals); size 0-200 microns; predominantly 60-200 microns

37% Liberated monominerallic grains with crystals faces; size 10->200 microns

MARCASITE

Identification uncertain, but probably minimal which is also reflected by XRD pattern.

20696R SULFIDE RATIO: TRACE? Marcasite 100% Pyrite

PYRITE

50% Composite grains with disseminated pyrite and gangue; size 0-10 microns

50% Liberated monominerallic fragments (of single crystals); size 10-200 microns

TRACE Liberated monominerallic grains with crystals faces; size >200 microns

MARCASITE

Identification uncertain, but probably minimal which is also reflected by XRD pattern.

99.4 SULFIDE RATIO: 55% Marcasite 45% Pyrite

PYRITE

23% Composite grains with disseminated pyrite and gangue; size 0-200 microns

7.5% Composite grains of coarse euhedral pyrite crystals "intergrown" with gangue; size >200 μm

3% Liberated monominerallic fragments (of single crystals);size 10-200 μm (most 60-200 μm)

2.5% Liberated euhedral crystals; size >60 microns, predominantly 60- 200 microns

9% "Liberated" monominerallic grains with gangue; size >200 microns

MARCASITE

27% Composite grains w/ disseminated marcasite and gangue; size 0-200μm, most 10-60 μm

2% Composite grains with disseminated marcasite and gangue, often colloform; size 0-60 microns, predominantly 10-60 microns

4% Composite grains of fine-grained disseminated marcasite and gangue; size >200 microns

<1% Liberated various forms (uncertain); size >200 microns

<1% Liberated fine colloform; size <10 microns

17% Liberated monominerallic marcasite fragments; size 10-200 microns

4% Liberated colloform (at least in part) fine marcasite; size >200 microns

11196R SULFIDE RATIO: TRACE? Marcasite 100% Pyrite

PYRITE

26% Composite grains with disseminated pyrite and gangue; size 10->200 μm, most >60 μm

24% Composite grains of coarse euhedral pyrite crystals "intergrown" with gangue; size >200 μm.

2% Liberated monomineralic fragments (of single crystals); size 0-200 μm; most 10-60μm

48% Liberated monomineralic grains with crystals faces; size 60->200 microns

MARCASITE

Identification uncertain, but probably minimal which is also reflected by XRD pattern.

99.1 SULFIDE RATIO: 68% Marcasite 32% Pyrite

PYRITE

9% Composite grains with disseminated pyrite and gangue; size 0-200 μm, most 10-200μm

4% Composite grains of coarse euhedral pyrite crystals "intergrown" with gangue; size >200 μm

17% Liberated monomineralic fragments (of single crystals); size 0-200 microns

2% Liberated monomineralic grains with crystals faces; size 60-200 microns

MARCASITE

4% Composite grains w/disseminated marcasite and gangue; minor colloform; size 0-200 μm

14% Liberated various forms (uncertain); size >200 microns

50% Liberated monomineralic marcasite fragments; size 0-200 microns

Scanning Electron Microscope (SEM) Work

Grain mounts were made of each sample and were examined under the SEM. Sulfides and their grain coatings were the major target. In general, sulfide grains had irregular, "etched-looking" surfaces (See black and white photos.) Photographs (and X-Ray analysis) proved difficult. The electron beam caused most surface (sulphate?) crystals to explode or decrepitate within a few minutes (sometimes seconds). X-ray analysis on the SEM of grains in samples 99.1 and 11196R showed the following. Abundance amounts range from major components (left) to trace amounts (right).

Sample	Mineral?	Elements in Decreasing Abundance	Photo	
11196R	Pyrite S>Fe		A	
11196R	?	Fe>S>>Si>Al>K		A (triang)
99.1	?	Si>Al>Fe>K>S>Ti	--	
99.1	?	Si>Ti>Al>Fe=K>S	--	
99.1	?	Si>Al=Fe=K>S>Mg	--	
99.1	?	Fe>Si>K>Ca>Al		--
99.1	?	Fe>Si>K>Al>S>Ca	--	

The 99.1 analyses are those of grains that maintained themselves in the beam long enough to be analyzed; other more volatile grains could not be included. Photo's B and C had larger surficial grains on sulfides that were destroyed in the electron beam before the picture (or analyses) could be taken. From the mineral analyses above, some minerals are largely alumino-silicates (gangue?) with iron, titanium, potassium, calcium and sulfur; some may be strictly surficial alteration products and may not be volumetrically significant. Despite substantial XRD pattern search below, a few minor peaks remain unaccounted for; and these may be from the unknown mineral(s) above.

X-Ray Diffraction Mineralogy

X-Ray Diffraction (XRD)patterns were run on the five samples. Of all the methodologies used, XRD provided the best means of identifying the mineral phases and relative abundances; at least in part because of the fine-grained nature of the samples and the ability for XRD to represent an average sample. The only macroscopically and microscopically identifiable minerals were quartz, pyrite, marcasite(?), jarosite, and coarser mica flakes (part of "sericite" amount below). The mineralogy and their relative amounts are indicated below. The amounts in "**bold**" are those minerals with the greatest variation between samples and are first candidates for explaining differences in their behavior. The final column lists the cations found within these mineral species to aid in comparisons.

XRD MINERALOGY

SAMPLE	71196R	11196R	20696	99.1	99.4	Cations
PYRITE	***TRACE***	*MINOR-*	***TRACE***	*MINOR*	*MINOR-*	***Fe***
MARCASITE	*TRACE?*	*TRACE?*	*TRACE?*	***MINOR+***	***MINOR***	**Fe**
PYRRHOTITE	*TRACE?*	*TRACE?*	*TRACE?*	*TRACE?*	*TRACE?*	**Fe**
CALCITE	TRACE?	TRACE?	TRACE?	**TRACE**	**MINOR**	**Ca**
ANKERITE	**TRACE**	**TRACE**	**TRACE**	**TRACE**	**MINOR-**	**Ca,Fe,Mg**
DOLOMITE	TRACE?	**TRACE**	TRACE?	**TRACE**	TRACE?	**Ca,Mg**
ALUNITE	**MINOR-**	**MINOR-**	**MINOR-**	TRACE?	**TRACE**	**K**
JAROSITE	**TRACE**	TRACE?	**MINOR+**	**TRACE**	**TRACE**	**K,Fe**
BARITE	TRACE?	NONE	TRACE?	TRACE?	TRACE?	**Ba**
ALBITE	TRACE	**MAJOR**	TRACE	**MAJOR**	**MAJOR**	**Na,CA?**
ORTHOCLASE	**MINOR+**	**MINOR+**	**MAJOR-**	**MINOR**	**MINOR+**	**K**
ANORTHOCLASE	**MINOR**	TRACE	TRACE	TRACE	TRACE	**Na,K**
CHLORITE	NONE	NONE	NONE	**TRACE**	NONE	**Mg,Fe**
SERICITE	**MINOR-**	**MINOR**	**MINOR+**	**MINOR-**	**MINOR**	**K**
ILLITE	TRACE	TRACE	TRACE	TRACE	TRACE	**K**
MONTMORILL.	TRACE	TRACE	TRACE	TRACE	TRACE	**Mg,Ca**
KAOLINITE	TRACE?	**TRACE**	TRACE?	TRACE?	TRACE?	
HEMATITE	**TRACE**	NONE	NONE	NONE	NONE	**Fe**
DIASPORE	**TRACE**	**TRACE**	**TRACE**	TRACE?	TRACE?	
QUARTZ	MAJOR	MAJOR	MAJOR	MAJOR	MAJOR	

A brief mineralogical summary follows for each sample. All samples had quartz and feldspars as major constituents.

Sample 71196R had minor hematite (also indicated by orangish coloration). Orthoclase was the most major feldspar. For sulfides, this sample had a trace of pyrite. For carbonate, it had a trace of ankerite, with more questionable calcite and dolomite. It had minor sulphates (alunite).
Sample 11196R had major albite and lesser orthoclase for its feldspars. Pyrite was the predominant sulfide with amounts greater than sample 71196R. For carbonates, this sample contained traces of ankerite and dolomite. It had minor sulphates (alunite).
Sample 20696 had orthoclase as most major feldspar. It contained a trace of pyrite. This sample had the most sulphates (the most jarosite and also alunite). This also had minimal carbonate, with a trace of ankerite.
Sample 99.1 had albite as most major feldspar. This sample had the most sulfide, with marcasite predominating. It had only a trace of carbonates and sulphates. It was the sample with the most chlorite (only a trace).
Sample 99.4 had albite as most major feldspar, and had the second most sulfide, with marcasite predominating. This sample had the most carbonate with calcite and lesser ankerite.

Conclusion:

The information gathered from this work is probably sufficient to explain much of the observed behavior during characterization studies. Due to the general very fine-grained nature of the mineralogy, yet wide ranging (especially very coarse) nature of the rock fragments, the absolute determination of sulfide percentages for respective minerals, grain sizes, and morphological forms cannot be done accurately without extensive microscopic examination. The only way to do this without determining screen structures and to examine each fraction would be to take a large sample and create a much smaller split for examination. Other than the splitting, considerable time and money could be saved with the examination of one such representative sample. It is likely, however, that the resulting numbers representing these small percentages of the occurring sulfides, would not be as good. This is especially true with the various morphologies.

Other than quartz, feldspar, and to a lesser degree pyrite, most minerals were fairly soft. Any mechanical movement tended to generate fine dust (including sulphates from oxidizing sulfides). This had a tendency to obscure grain surfaces. Any sample preparation procedures had a tendency to alter the material being examined. An artificial bias in microscope and SEM work MAY exist because of this. Also, for any reference samples of sulfide rich materials such as these, it is recommended that they be sealed in an environment with ultra-pure nitrogen or argon.

For any future work on samples like this, please examine the invoice and weigh the cost with the results. Some procedures should be modified or eliminated, although since all these samples are not identical, flexibility must be maintained. The best way to receive accurate sulfide amounts for each sieve fraction is through analysis.