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Natural Background Geochemistry, Geomorphology and Pedogenesis of Selected Soil Profiles and Bandelier Tuff, Los Alamos, NM

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NATURAL BACKGROUND GEOCHEMISTRY, GEOMORPHOLOGY, AND PEDOGENESIS OF SELECTED SOIL PROFILES AND BANDELIER TUFF, LOS ALAMOS, NEW MEXICO, 1995

by

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ABSTRACT

During 1992 and 1993, the Bandelier Tuff and several soil profiles were sampled to determine background-elemental concentrations. Soils present on the Pajarito Plateau are extremely variable in physical and chemical properties, including particle size, percent calcium carbonate, clay mineralogy, iron oxides, and trace element chemistry. Soils have higher concentrations of Al, As, Ba, Ca, Cs, Co, Cr, and Fe than in the Bandelier Tuff samples. The Bandelier Tuff, however, has concentrations of Be, Pb, Na, K, Th, and U higher than the soils. Background concentrations of As and Be exceed screening action levels (SALs) for these elements. Therefore, background concentrations of As and Be should be used rather than SALs for these elements in evaluating if contamination exists in soil, sediment, and tuff samples.

Background elemental concentrations on the Pajarito Plateau vary with parent material, the degree of soil development, and other factors, requiring that site-specific conditions be considered to select the most appropriate background samples. Well-developed soils have higher concentrations of trace elements than weakly developed soils found on the Pajarito Plateau. Clay minerals and iron oxides, which have relatively high surface areas, and occur within B horizons controlling trace-element distributions in soils. The B horizons contain higher concentrations of trace elements relative to A and C horizons. In addition, variations in soil-elemental concentrations are related to climate, topography, and to the parent materials, which include alluvial fans, sheet wash

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material, colluvium, wind-blown sediment, El Cajete pumice, and the Bandelier Tuff. Because of the limited number of Bandelier Tuff and soil samples collected, this data set is not necessarily representative of the full suite of soils and tuff present at the Laboratory, and may not include the full range of natural concentrations for all elements.

INTRODUCTION

Determining environmental impacts to surface waters, groundwaters, soils, sediments, and Bandelier Tuff at Los Alamos National Laboratory (Laboratory) requires knowledge of background-elemental chemistry of geological and hydrological media. Background media are defined as soils, sediments, rocks, surface waters and groundwaters unaffected by Laboratory operations. Statistical and geochemical comparisons of background samples with contaminated or non-background samples are needed to identify and evaluate environmental contamination.

During the spring and summer of 1992 and 1993, the Bandelier Tuff and several soil profiles were characterized and sampled to determine background-elemental concentrations (Longmire et al., 1993; Watt and McFadden, 1992). Thirty-eight samples of the Bandelier Tuff and seventy-five soil samples were submitted for chemical analyses. Because of the geochemical variability of soils and Bandelier Tuff and the limited number of samples analyzed, this data set is not necessarily representative of the full suite of soils and Bandelier Tuff present at the Laboratory, and may not include the full range of natural concentrations for all elements.

Geochemical characteristics of soils on the Pajarito Plateau vary widely and are related to local variations in parent material, topography, soil age, surficial processes, climate, and vegetation. Sites of detailed soil sampling and analysis, as part of the Laboratory-wide background geochemical characterization, were chosen to provide a partial selection of the wide range of soil-geomorphic settings occurring at the Laboratory. The geomorphic setting of each sample site was described to provide a better understanding of the variations in soil characteristics. Eventually, it may be possible to relate the geochemical characteristics at a site to the geomorphic setting, allowing reasonable extrapolation of the soils data.

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This investigation is relevant to the Environmental Restoration (ER) Project, because background elemental concentrations are used in conjunction with screening action levels (SALs) in risk assessment calculations for different contaminants. These background-elemental data are also required to develop sampling and remediation strategies at sites, to understand processes controlling contaminant transport, and to distinguish between contaminated and non-contaminated media. These data may also be used to establish cleanup levels for sites to be remediated.

The goal of the ER Project Laboratory-background study, presented in this report, is to provide natural background-elemental data on soils and Bandelier Tuff at the Laboratory. To achieve this goal, this report (1) summarizes results of soil characterization conducted by Watt and McFadden (1992); (2) describes analytical and statistical methods used to define and characterize background chemical (analyte) distributions in soils and Bandelier Tuff; (3) discusses soil development (pedogenesis) and soil chemistry relationships; and (4) describes how these background data may be statistically compared to non-background or contaminant analytical data.

Samples collected during this investigation represent background conditions at the Laboratory. Fresh soil samples were collected within trenches, sides of drainages, and along roadcuts exposed within and around the perimeter of the Laboratory, generally upwind from any potential air-borne contamination. Soil samples were collected at different depths within various soil horizons. Sites were selected within and around the perimeter of the Laboratory to provided the most representative sampling locations to establish Laboratory-specific background for soils. Fresh samples of Bandelier Tuff were collected in Frijoles Canyon immediately south of the Laboratory, which provided an excellent location to collect Laboratory-specific background samples.

SAMPLING SITES AND STRATEGY FOR SOILS AND BANDELIER TUFF

The soil sample sites include mesa tops, canyon bottoms, and colluvial slopes, ranging from Ponderosa pine and fir forests in the wetter, western part of the Laboratory to piñon-juniper woodland in the drier, eastern part (Table 1). The parent materials for the soils include weathered and eroded Bandelier Tuff, alluvium partially derived from Tschicoma dacite in the

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Table 1
Summary of Soil Sample Sites

Sample Site	Technical Area	Elevation (ft)	Vegetation	Topographic Setting	Surficial Material
1. Lower Los Alamos Canyon	TA-72	6350	piñon-juniper	canyon bottom	late Holocene fan (last 2800 years)
2. EG&G gully	TA-73	6950	piñon-juniper	mesa top valley	Holocene valley fill (last 8700 years)
3. Upper Los Alamos Canyon	TA-62	7260	fir	canyon bottom	late Holocene colluvium (last 3300 yr)
4. Twomile Mesa	TA-69	7590	Ponderosa pine	mesa top	old alluvial deposit (post-1.2 Ma)
5. Water Tanks trench	TA-16	7720	Ponderosa pine	base of scarp	Holocene colluvium
6. Frijoles Mesa	TA-49	6940	Ponderosa pine	mesa top	El Cajete pumice (~ 60 ka)
7. Ancho Canyon mesa	TA-39	6570	piñon-juniper	mesa top	pre-El Cajete soil (pre-60 ka)
8. Fracture Fill	TA-46	6980	piñon-juniper	mesa top	pre-El Cajete soil?

Sierra de los Valles, wind-blown dust, and El Cajete pumice. Six of the eight sample sites are within the soil mapping area of Nyhan et al. (1978), and includes five of their soil series, although the sample sites are not necessarily typical of soils within each series as described by Nyhan et al. (1978).

Whole-rock samples of Bandelier Tuff include all stratigraphic units present within the Tshirege Member of the Bandelier Tuff in the central and eastern portions of the Laboratory, and the background concentrations are probably representative of tuff elsewhere in these units at the Laboratory. Fresh tuff material collected during this investigation consisted several kilogram samples. Mapping units of the Tshirege Member of the Bandelier Tuff used in this report follow the usage of Vaniman and Wohletz (1990) and Goff (1994). Figure 1 shows sampling locations for the Bandelier Tuff within Frijoles Canyon south of the Laboratory boundary in Bandelier National Monument (BNM). Additional higher stratigraphic units of the Tshirege Member, however, are present in the western portion of the Laboratory that have not yet been analyzed. Locations of the tuff samples within the sections are shown in Figures 2 and 3. Samples were taken from surface exposure, but material from obvious weathering rinds was excluded. Sampling, to this stage, has been largely limited to the upper (Tshirege) member of the Bandelier Tuff, with only two samples from the lower (Otowi) member.

Soil samples were collected from eight very different localities found geographically around the perimeter of the Laboratory. Sample sites include trenches, sides of drainage channels, and road cuts where soils are well exposed. Figure 4 shows the locations of soil sampling sites. Areas selected for detailed soil characterization include: Site 1, lower Los Alamos Canyon, north of Tsankawi ruins near State Route 4; Site 2, EG&G gully located immediately south of State Route 502 near EG&G; Site 3, upper Los Alamos Canyon, Los Alamos reservoir road; Site 4, Twomile Mesa within the central portion of TA-69; Site 5, Water Tanks Trench, West Jemez Road (State Route 501); Site 6, Frijoles Mesa, State Route 4; Site 7, Ancho Canyon mesas along State Route 4 within TA-39; and Site 8, fracture fill in a fresh road cut in TA-46. These localities allow partial sampling of the varying degrees of soil development occurring on the Pajarito Plateau. At each location, soil samples were collected at different depths (0 to 300 cm) corresponding to the different soil horizons.These sites were selected to sample soils influenced by a range of parent materials, topographic setting, local climate, and time.

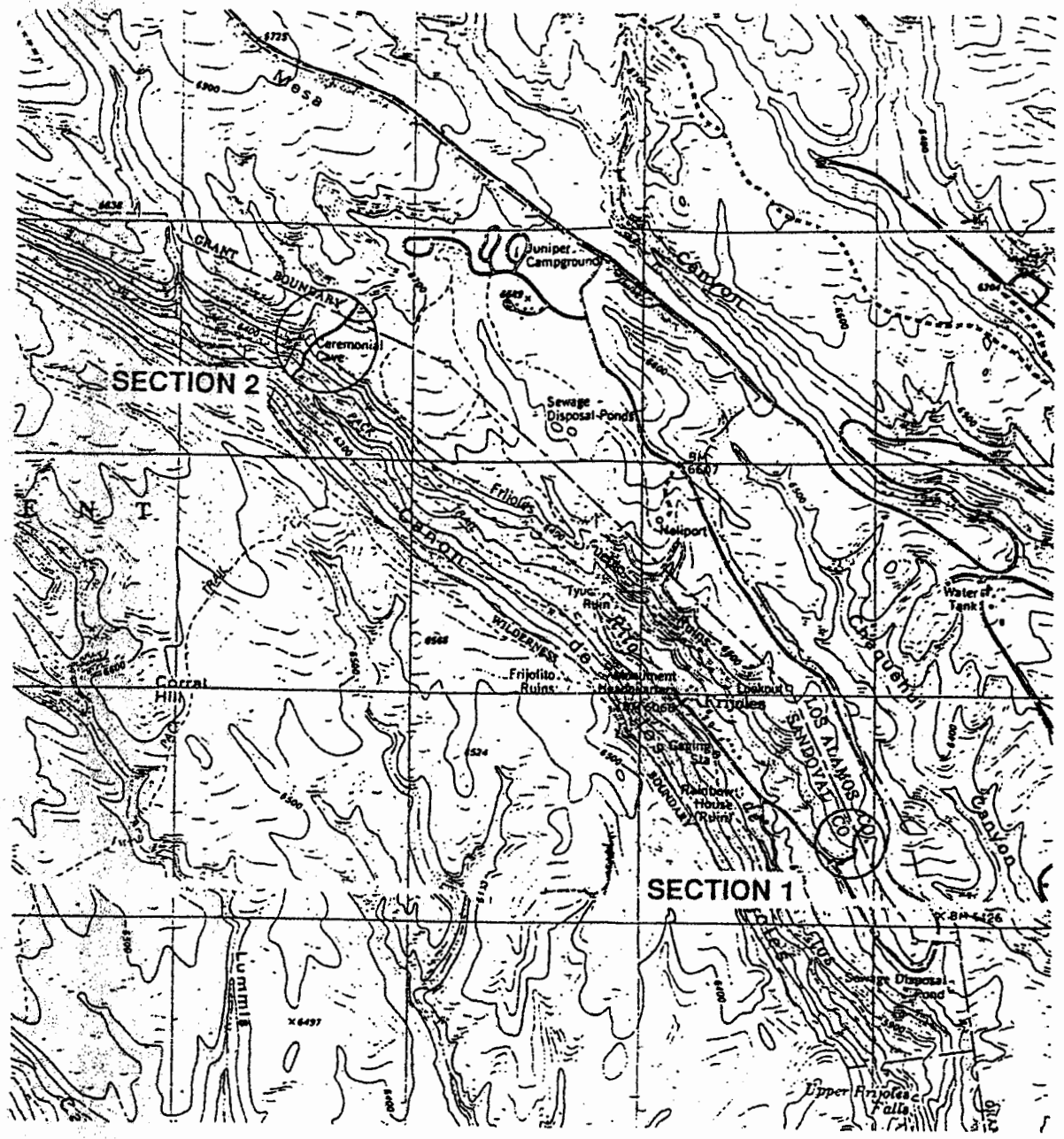

Figure 1. Location map of Bandelier Tuff Samples Collected in Frijoles Canyon, Bandelier National Monument, New Mexico.

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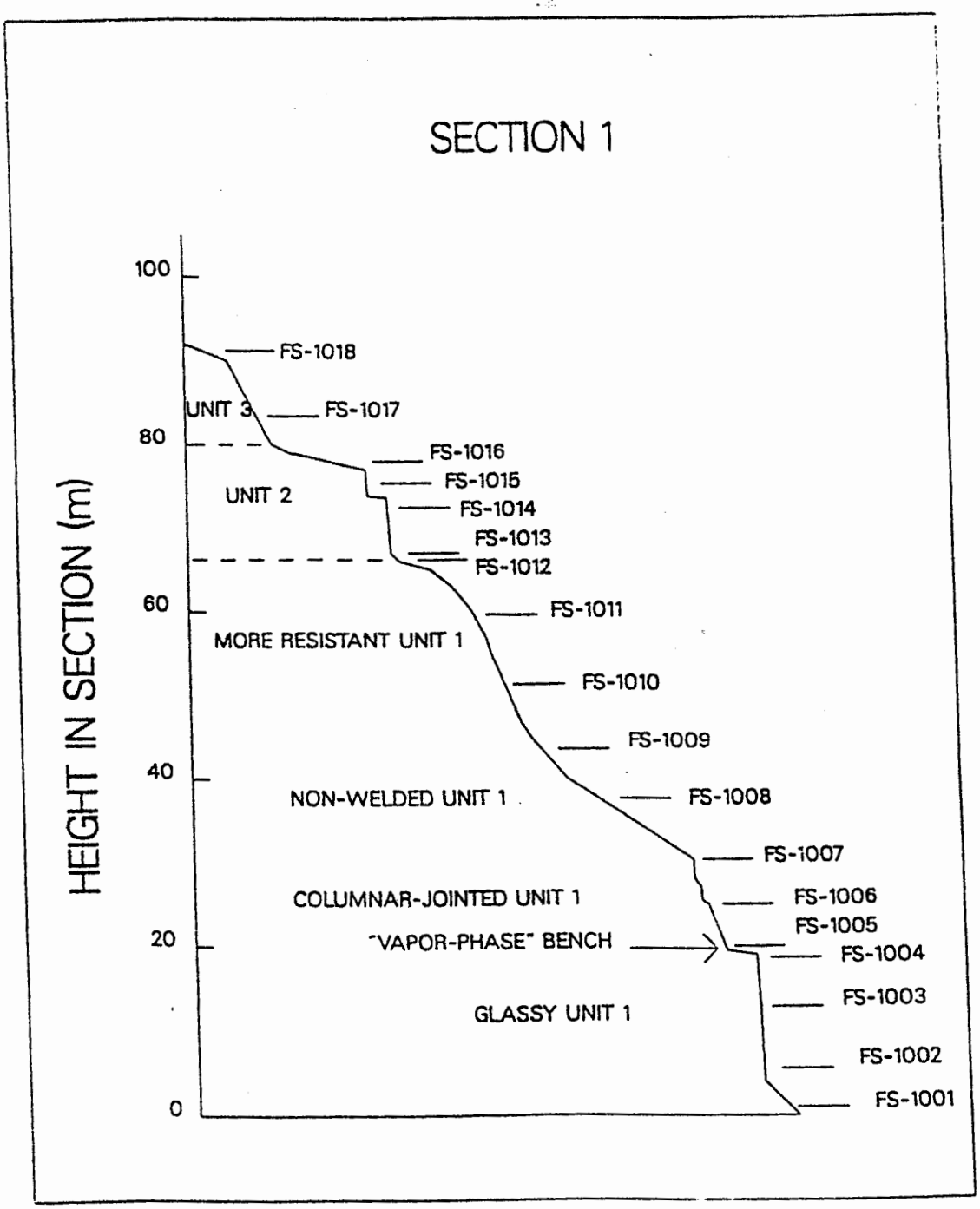

Figure 2. Location map of Bandelier Tuff Samples Collected Within Section 1, Bandelier National Monument, New Mexico.

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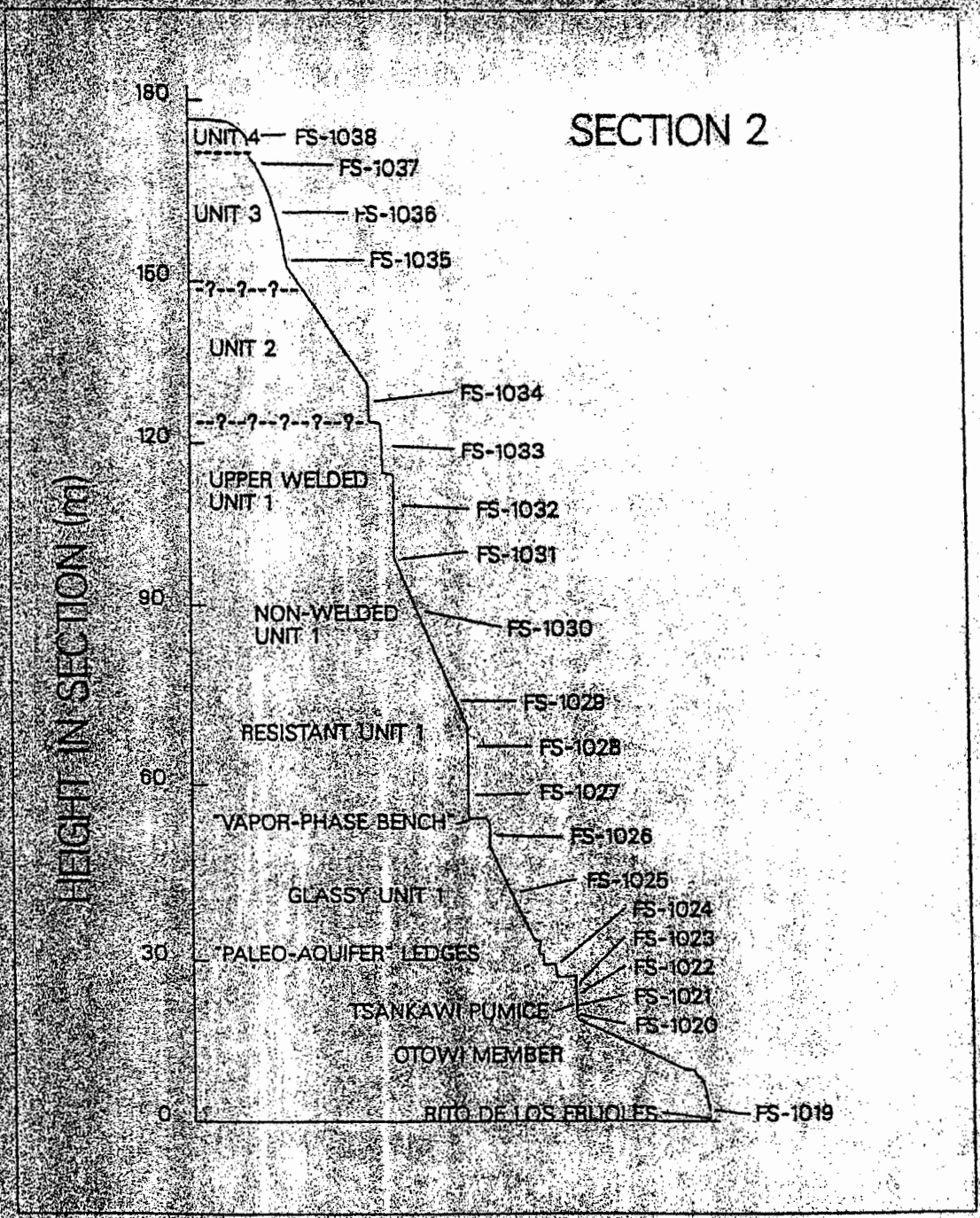

Figure 3. Location map of Bandelier Tuff Samples Collected Within Section 2, Bandelier National Monument, New Mexico.

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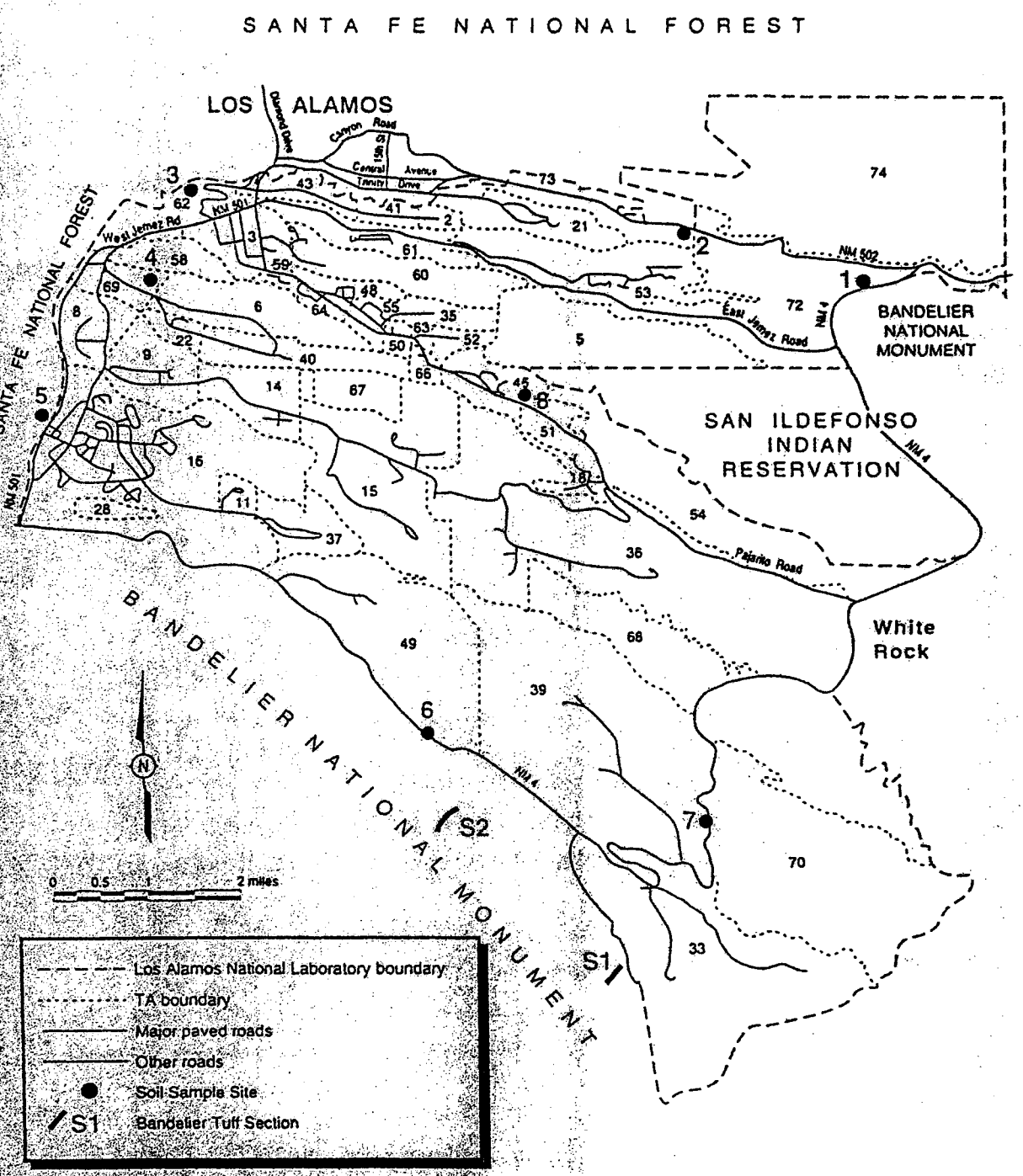

Fig. 4. Map of Los Alamos National Laboratory showing soil and tuff sample sites.

The limited number of sample sites precluded coverage of all types of soil present at the Laboratory. In addition, because only one soil profile was sampled from each setting, the natural background variability in soils occurring at similar settings has not yet been evaluated. Because of these concerns, this data set is not necessarily representative of the full suite of soils present at the Laboratory, and may not include the full range of natural concentrations for all elements.

The different soil horizons were classified and characterized according to their texture, consistence (wet/dry), particle-size distribution, color, clay-mineral content, calcium-carbonate content, organic-carbon content, soil pH, cation exchange capacity (CEC), and bulk density (Watt and McFadden, 1992).

Soil samples were passed through a 20 mesh sieve to remove pebbles and twigs. Bandelier Tuff and soil samples were either air-dried or dried in a forced-air circulation oven at 60 C for 48 hours and then ground with a corundum mortar and pestle. Grinding of the Bandelier Tuff samples was more extensive than the soil samples, because of the indurated nature of the rock samples.

SAMPLE DIGESTION AND ANALYTICAL TECHNIQUES

Rock and soil samples were analyzed for a suite of elements using EPA-SW846 methods and other analytical techniques available at the Laboratory. The metals and nonmetals antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), chromium (Cr), lead (Pb), mercury (Hg), silver (Ag), thorium (Th), and uranium (U) are of primary concern to the ER Project, because numerous solid waste management units (SWMUs) at the Laboratory potentially contain elevated concentrations of these elements. Elements of particular concern include As and Be because background concentrations exceed SALs for these elements. The SALs for all elements of concern are presented in Table 2. Other elements and compounds of secondary importance to the ER Project include aluminum (Al), bromine (Br), cadmium (Cd), calcium (Ca), cesium (Cs), chlorine (Cl), cobalt (Co), copper (Cu), gallium (Ga), gold (Au), hafnium (Hf), indium (In), iodine (I), iron (Fe), magnesium (Mg), manganese (Mn), potassium (K), rare earth elements (REE), rubidium (Rb), scandium (Sc), selenium (Se), sodium (Na), strontium (Sr), sulfate (SO_4^{2-}), tantalum (Ta), thallium (Tl), titanium (Ti), tungsten (W), vanadium (V), zinc (Zn), and zirconium (Zr).

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TABLE 2. 1994 Screening Action Levels for Selected Elements in Soil

Element[a]	SAL	Element	SAL
Sb	32	Se	400
As	0.4	Ag	400
Ba	5,600	Sr-90	5.9
Be	0.16	Tl	6.4
Cd	80	Th-232	5
Cs-137	4	U-depleted	160
Cr (III)	80,000	U-natural	95
Cr (VI)	400	U-233	86
Cu	3,000	U-234	86
Pb	500	U-235	18
Mn	11,000	U-238	59
Hg	24	V	560
Ni	1,600	Zn	24,000

[a]SALs are reported in milligram/kilogram (mg/kg, ppm) unless otherwise noted. Radionuclides are reported in picocuries/gram (pCi/g).
Source: 1994 Installation Work Plan for Los Alamos.

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Following sample preparation, Bandelier Tuff and soil samples were submitted to EES-1 for X ray fluorescence (XRF), to CST-15 (formerly INC-5) for instrumental and delayed neutron activation analysis (INAA and DNAA), and to CST-9 (formerly EM-9) for EPA-SW 846 methods including inductively coupled plasma mass spectrometry (ICPMS) spectroscopy, inductively coupled plasma emission spectroscopy (ICPES), electrothermal vapor atomic absorption (ETVAA), cold vapor atomic absorption spectroscopy (CVAA), and ion chromatography (IC) analyses. Table 3 provides a listing of each analyte and appropriate analytical techniques. The procedures used for these analyses are described in detail in Gautier and Gladney (1986), Gladney et al. (1981), and Garcia (1990). Quality assurance was provided by concurrent analysis of different National Institute of Standards and Technology (NIST), United States Environmental Protection Agency (USEPA), and United States Geological Survey (USGS) reference materials described by Gladney et al. (1981), and Garcia (1991).

Soil samples submitted for ICPMS, ICPES, ETVAA, CVAA, and IC analyses were either completely digested using hydrofluoric acid (HF) or partly digested using nitric acid (HNO_3). The sample digestion-dissolution step controls the leachability and ultimately, the concentration of each analyte reported by EES-1, CST-9, and CST-15. Many trace and major elements, including Al, Ba, Na, K, U, and Th, are structurally incorporated within primary mineral lattices and amorphous solids (primarily glass). Subsequently, HF digestion of a sample results in higher concentrations for some elements relative to a partial digestion using HNO_3. Other trace elements, including As and Be, are mainly concentrated on surfaces of soil particles, consisting of clay minerals and ferric oxyhydroxide-ferric hydroxide (termed iron oxides), through adsorption processes. Under these circumstances, HF and HNO_3 digestions yield similar analyte concentrations. Therefore, digestion of environmental samples using different acids strongly influences analytical results. Consistent and appropriate digestion procedures should be used to allow comparability of data.

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TABLE 3. EPA-SW846 Analytical Techniques Used in Soil Investigation

Element	Technique	Element	Technique
Al	ICPES	Mg	ICPES
As	ETVAA	Mn	ICPES
Ba	ICPES	Na	ICPES
Be	ICPES	Ni	ICPES
Ca	ICPES	Pb	ICPES
Cd	ICPES	Sb	ICPES
Cl	IC	Se	ETVAA
Co	ICPES	Si	XRF
Cr	ICPES	SO4	IC
Cu	ICPES	Ta	ICPMS
Fe	ICPES	Th	ICPMS
Hg	CVAA	Ti	XRF
K	ICPES	Tl	ICPMS
		U	ICPMS
		V	ICPES

ICPES, inductively coupled plasma emission spectroscopy
ICPMS, inductively coupled plasma mass spectrometry
IC, ion chromatography
CVAA, cold vapor atomic absorption spectroscopy
ETVAA, electrothermal vapor atomic absorption spectroscopy
XRF, X ray fluorescence

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PART I. CHARACTERIZATION OF BACKGROUND SOILS: AN OVERVIEW

General Soil Parameters

Part I of this report presents an overview of soil characterization studies reported by Watt and McFadden (1992) and Longmire et al. (1993). Part II presents detailed discussions on the geochemistry, geomorphology, pedology of each site. Results of these studies show that Laboratory soils have extreme diversity and variability in soil properties and chemistry. Each soil profile described by Watt and McFadden (1992) has been separated into soil horizons, and each soil horizon has been characterized in the field by its structure, color, consistency, clay films, and pore and root content; and in the laboratory for pH, calcium carbonate content, cation exchange capacity (CEC), solid-organic carbon content, particle-size distribution, bulk density, and iron content.

Soil Horizons

Soil consists of a natural body containing layers or horizons of mineral and/or organic matter of variable thicknesses, which differ from the parent material in their morphological, physical, chemical, and mineralogical properties and their biological characteristics (Joffe, 1949; Birkeland, 1984). Soil horizons described at the Laboratory generally are unconsolidated and consist of O, A, B, K, C, and R horizons. An O horizon is characterized by surface accumulation of organic material overlying a mineral soil (Birkeland, 1984). Several O horizons were described by Watt and McFadden (1992) at Site 4, Twomile Mesa. An A horizon accumulates humified organic matter mixed with a mineral fraction and occurs at the surface or below an O horizon. A horizons are present at all soil profiles excluding Site 6, Frijoles Mesa, State Route 4 (Watt and McFadden, 1992). The B horizon underlies an O or A horizon and shows little or no evidence of the original rock structure (Birkeland, 1984). The B horizon contains clay minerals, iron oxides, organic coatings, and other geochemically reactive phases that concentrate major and trace elements. Numerous B horizons were described at different soil profiles investigated during this study (Watt and McFadden, 1992). The K horizon is a subsurface horizon so impregnated with alkaline earth carbonate that its morphology is

determined by the carbonate (Birkeland, 1984). Some well-developed soils at the eastern perimeter of the Laboratory contain K horizons at Site 4 and Site 7, Ancho Canyon mesas (Watt and McFadden, 1992). The C horizon is a subsurface horizon lacking properties of A and B horizons, but includes chemical weathering such as accumulation of silica and calcium carbonate, mineral oxidation, and gleying (Birkeland, 1984). C horizons are ubiquitous at the Laboratory and are associated with parent materials (Watt and McFadden, 1992). The R horizon consists of consolidated bedrock underlying soil horizons (Birkeland, 1984).

Concentration distributions, including minimum, arithmetic mean, and maximum, for several elements within A, B, C horizons are shown in Figures 5, 6, and 7, respectively. Soil samples were digested using HNO_3 prior to chemical analyses using EPA-SW846 analytical methods. Concentration units are ppm for most elements shown in these figures excluding Al and Fe, which are reported as wt %. The number of samples collected from each horizon varies and most samples were collected from B horizons (n=27). The same amount of samples were collected from both the A and C horizons(n=12). Most of the elements are log-normally distributed in the soil horizons, however, and the log-normal mean is greater than the arithmetic mean. Ranges in element distribution can exceed a factor of ten for most of the elements plotted on Figures 5, 6, and 7. These figures can be used to compare concentration of element ranges with site-specific soil data, provided that the soil horizon(s) is known from which local soil samples are collected.

Figure 8 shows mean-element concentrations within A, B, and C horizons for Laboratory soils. In general, the B horizons contain higher concentrations of most trace elements (Al, As, Ba, Be, Cr, Cu, Fe, Ni, Se, Th, Tl, and V) relative to A and C horizons. This trace-element enrichment within B horizons is due to the presence of geochemically-reactive phases, primarily clay minerals and iron oxides, and is discussed in more detail in the following sections of this report. The A horizons sampled during this investigation contain higher concentrations of U and Zn relative to the B and C horizons, and the C horizons have higher concentrations of Co relative to the A and B horizons.

Figure 5

A HORIZONS, BACKGROUND SOILS, LOS ALAMOS

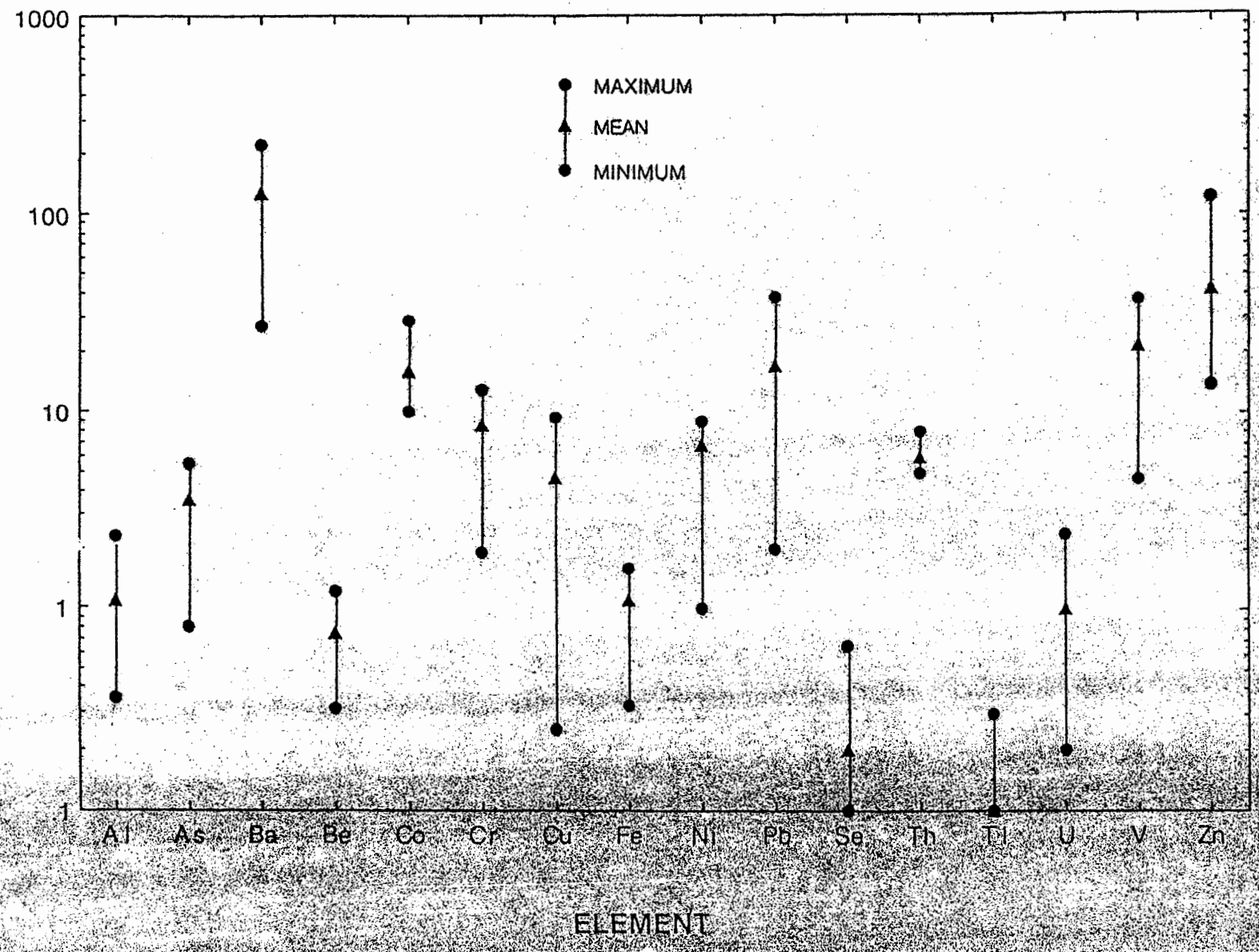


Figure 6

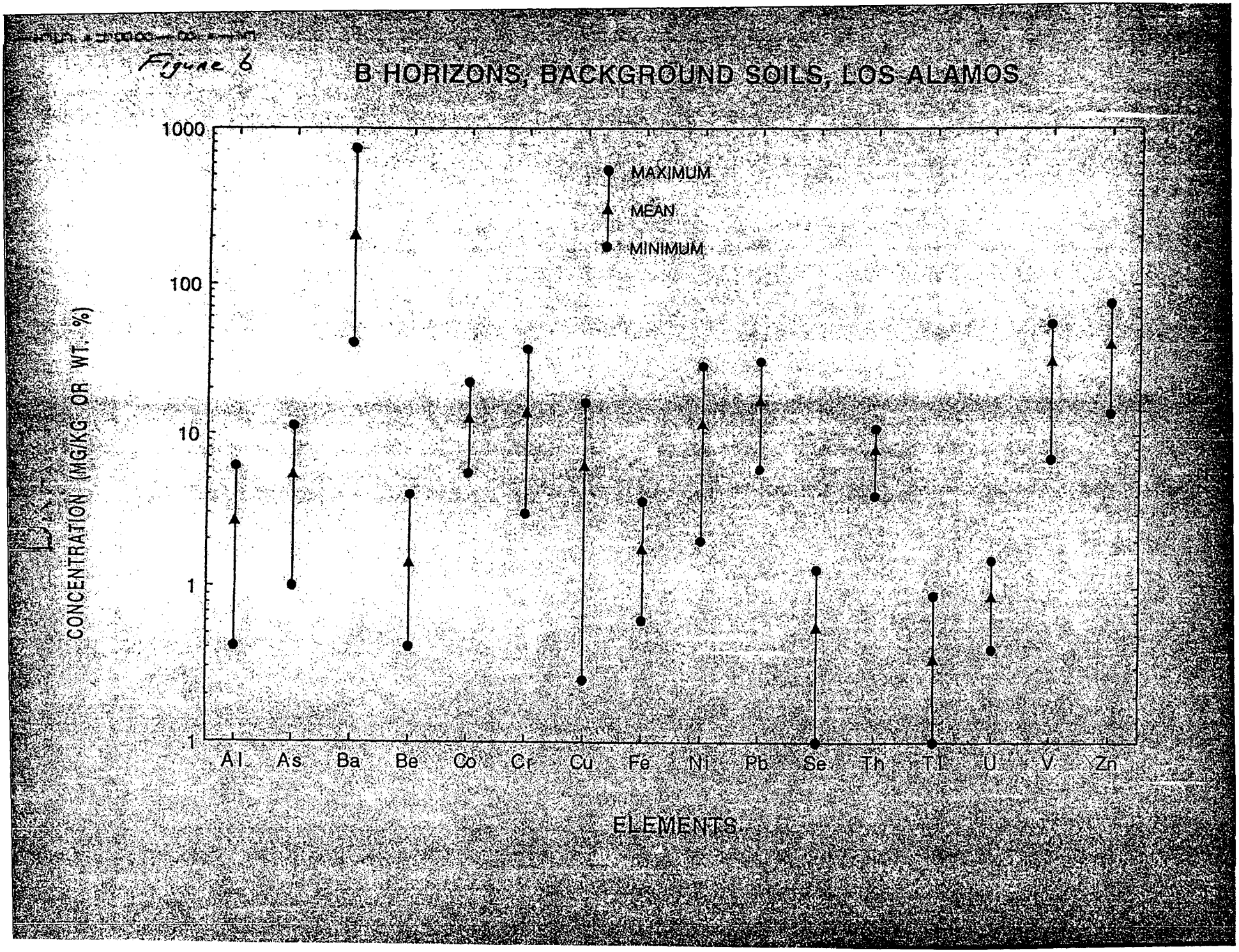

B HORIZONS, BACKGROUND SOILS, LOS ALAMOS
MAXIMUM
MEAN
MINIMUM
1000
100
10
1
.1
CONCENTRATION (MG/KG OR WT. %)
Al
As
Ba
Be
Co
Cr
Cu
Fe
Ni
Pb
Se
Th
Tl
U
V
Zn
ELEMENTS

Figure 7

C HORIZONS, BACKGROUND SOILS, LOS ALAMOS

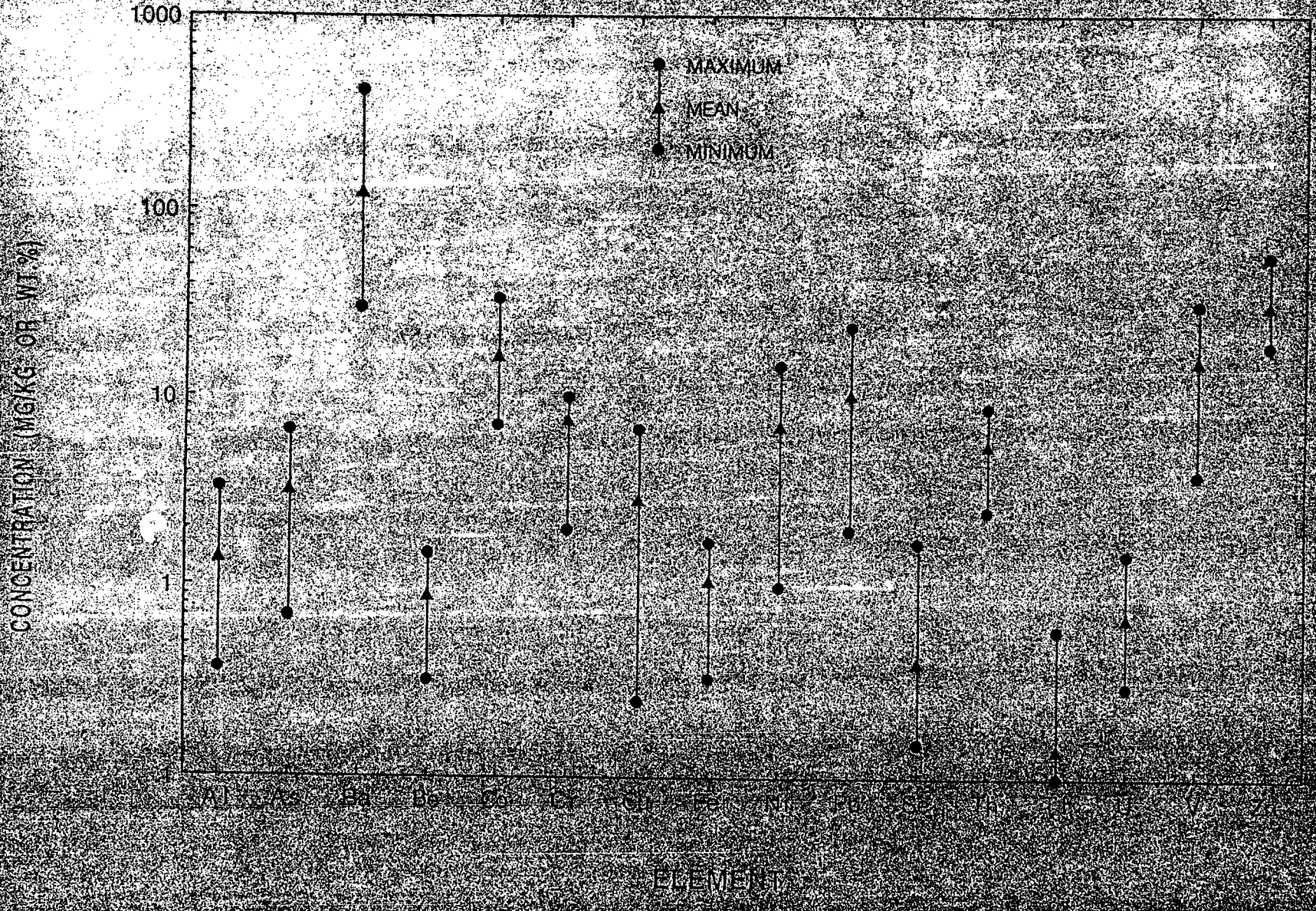
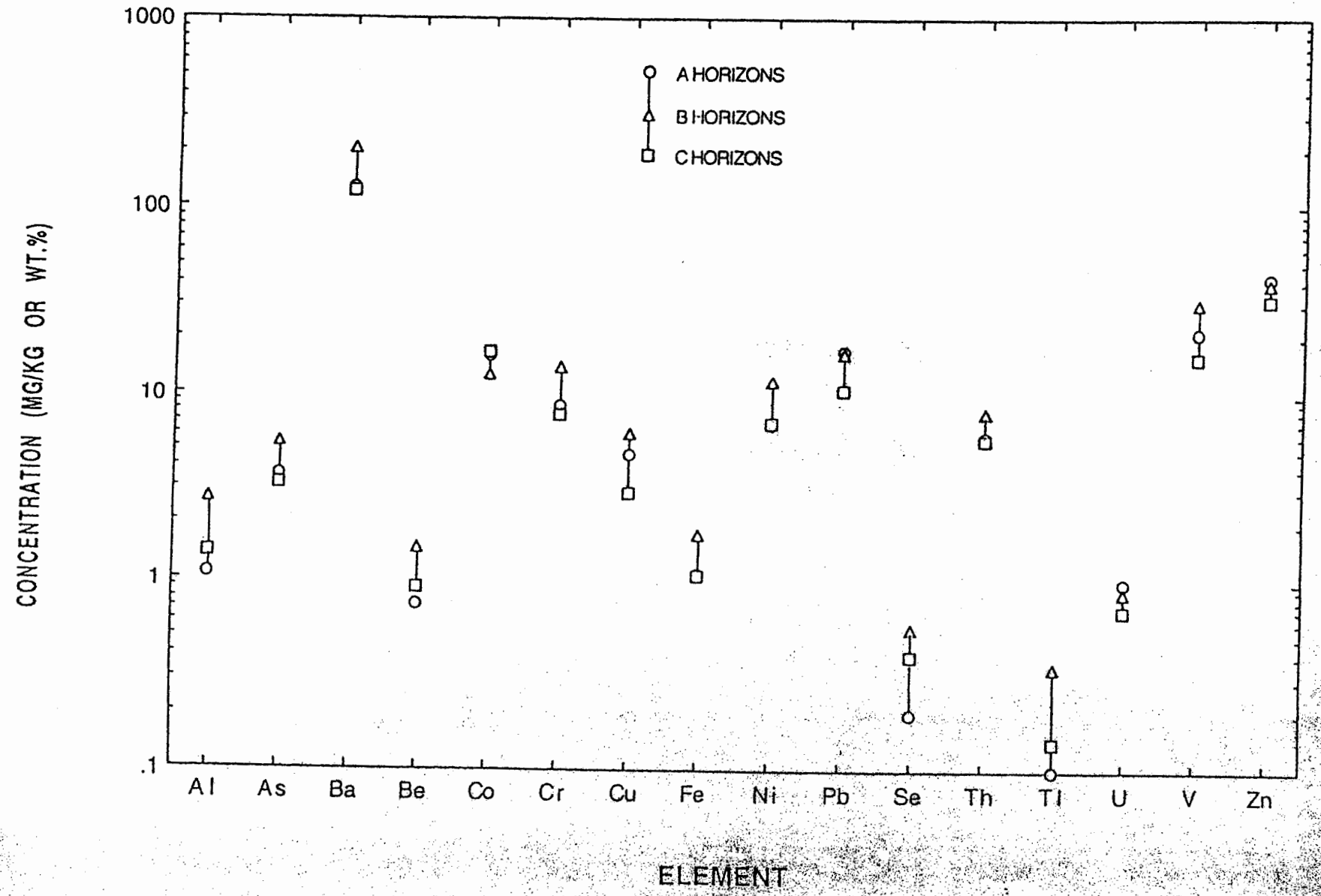


Figure 8

MEAN CONCENTRATIONS, BACKGROUND SOILS, LOS ALAMOS



Primary and Secondary Solid Phases and Parent Material

Variations in soil-elemental concentrations are related both to chemical characteristics of a particular soil horizon and to parent material, the latter consisting of alluvial fans, sheet-wash material, colluvium, fallout pumice (El Cajete), wind-blow sediment (loess), and the Bandelier Tuff. Mineralogical data have been collected the most on the Bandelier Tuff and the following discussion focuses on the Bandelier Tuff as one of initial sources of parent material for soils. Primary major minerals and solid phases found in the Bandelier Tuff include tridymite, quartz, feldspar, and glass (Broxton et al., 1994). Minor and trace minerals consist of smectite, hornblende, mica, hematite, magnetite, kaolinite, and gypsum. Primary major minerals, secondary soil minerals, and solid organic matter occur within soil profiles sampled and characterized during this investigation. Secondary soil minerals include aluminum oxides, iron oxides, smectite, illite, kaolinite, calcite, gypsum, and manganese oxides. Some of the more important secondary soil phases and organic matter with their associated trace elements include: Fe and Al oxides (Be, B, P, V, Mn, Ni, Zn, Mo, As, Se, U); Mn oxides (P, Fe, Co, Ni, Zn, Mo, As, Se, Pb); calcium carbonates (As, Se, P, V, Mn, Fe, Co, Cd, U); illites (B, V, Ni, Co, Cr, Cu, Zn, Mo, As, Se, Pb); smectites (B, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Pb, U); and organic matter (Al, V, Cr, Mn, Fe, Ni, Cu, Zn, Cd, Pb, U) (Sposito, 1989). These trace elements are chemically associated with solid phases through adsorption and coprecipitation reactions.

The origin(s) of soils on the Pajarito Plateau is a complex question to address because the parent material consists of a variety of geologic media listed above. Some of the parent material was initially derived from the Bandelier Tuff during the past 1.6 Ma. The Bandelier Tuff contains varying amounts of glass (17-88 wt%) (Broxton et al., 1994), which shows the least resistance to chemical weathering and is of great importance as a parent material. The fine particle-size, glassy nature of the particles, and high porosity and permeability of the Bandelier Tuff and related sedimentary deposits enhance weathering and physicochemical and biological interactions in soils. Unaltered and altered glass is a major constituent observed in soils at the Laboratory. Rapid weathering of glass releases elements to solution faster than crystalline phases can form. Subsequently, soil solutions become oversaturated with respect to poorly ordered solid phases, including ferrihydrite, allophane,

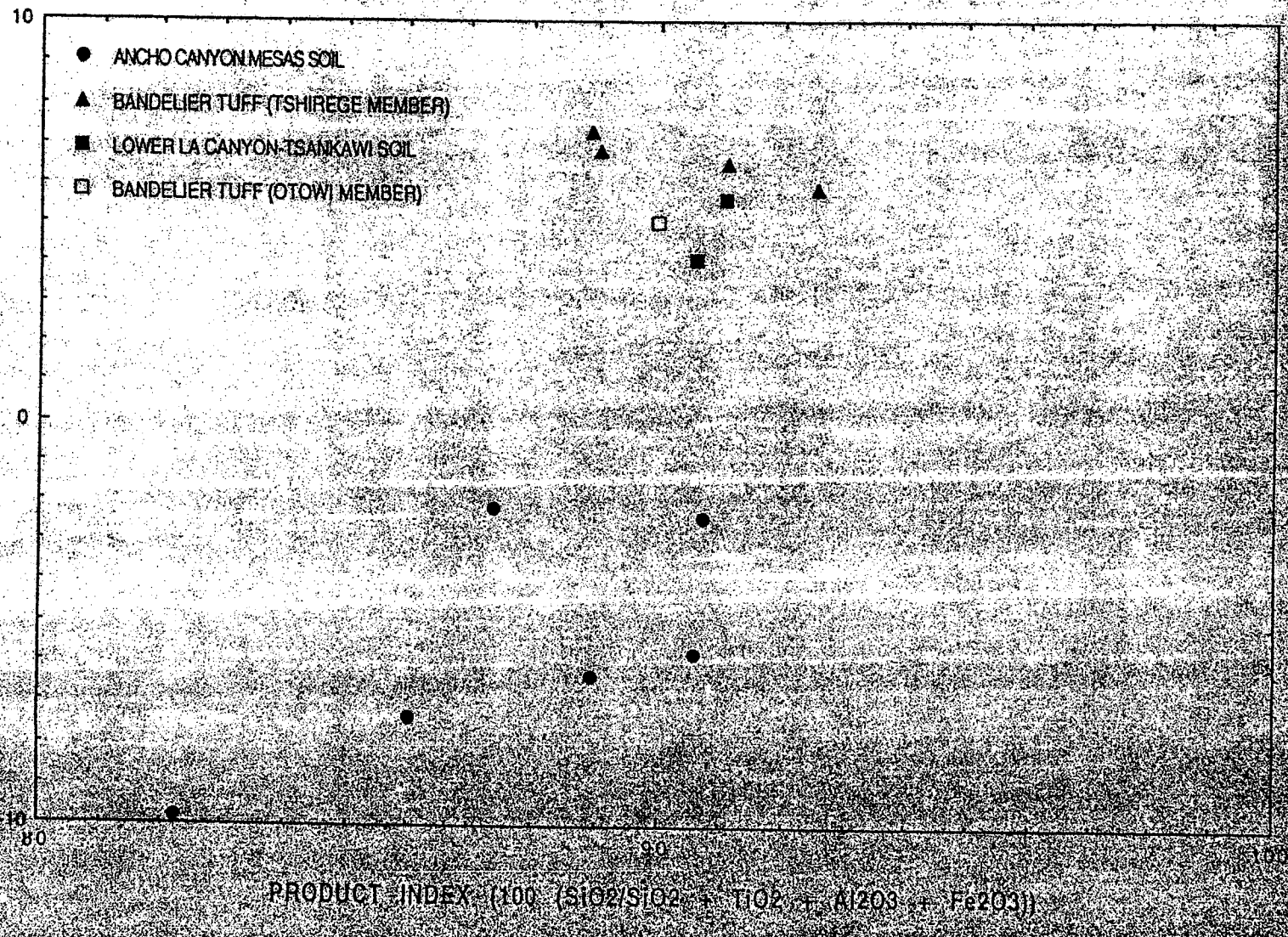
and imogolite. Formation of noncrystalline or poorly crystalline iron oxyhydroxides is favored compared to crystalline forms in soils derived from volcanic ash (Shoji et al., 1993). Childs et al. (1991) showed that ferrihydrite ($Fe_{10}O_{15}\cdot 9H_2O$) was the dominant noncrystalline iron phase present in volcanic ash soils of Japan. The weathering conditions of glass in the Bandelier Tuff contribute to ferrihydrite precipitation in which high concentrations of silicic acid and iron are released to solution.

If there is a pedogenic relationship between the Bandelier Tuff and soils, there should be similarities in major and trace-element chemistry between the two geologic media. Figure 9 shows the product index versus weathering potential index for two diverse soil profiles (Site 1, Lower Los Alamos Canyon, poorly developed and Site 7, Ancho Canyon mesas, well developed) and the Bandelier Tuff. The product index and weathering potential index are quantitative parameters that decrease as soil development proceeds due to increasing clay- mineral and iron-oxide content and silica remobilization. Titanium concentrations can also increase in soils over time due to the low solubility of resistate minerals, including rutile and anatase, which contribute to decreasing product and weathering potential indices. Elements that act as bases in soil solution, including Ca^{2+}, Mg^{2+}, Na^{+}, and K^{+}, can either be leached or concentrated in soils depending on specific dissolution-desorption (leaching) and precipitation-adsorption (concentrating) reactions.

The Bandelier Tuff is characterized by a narrow weathering potential index (5.8 to 7.4) and a moderately narrow product index (88.9 to 92.4). Titanium concentrations are the highest in unit 4 (youngest) and are the lowest in unit 1 (oldest) of the Tshirege Member. Subsequently, unit 1has the highest product index (92.4) and unit 4 has the lowest product index (88.9), with unit 3 (89.0) less than unit 2 (91.0). The weathering potential index can be positive when water content is less than the summation of total bases, or it can be negative when the water content is greater than the summation of total bases. A negative weathering potential index occurs as hydrated minerals, including clay minerals and gypsum, accumulate in soils. Well-developed soils generally have a more negative weathering potential index relative to poorly-developed soils. Based on field observations, the poorly-developed soil at Site 1 is mainly derived from the Bandelier Tuff (primarily the Otowi Member) and accordingly, this site plots close to the Otowi Member and unit 2 of the Tshirege Member (Figure 9). Soils at site 7 are well-developed and subsequently, they have lower

Figure 9

BACKGROUND SOILS, LOS ALAMOS



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product and weather potential indices relative to the Bandelier Tuff and Site 1 soils. Soils at site 7 are not directly derived from the Bandelier Tuff and probably have multiple sources of parent material based on field observations and relatively low product index and weathering potential index values shown in Figure 9. Soils at the other sites are expected to plot between these two end-member soils show on Figure 9. More work is required to further understand the sources of parent material for soils forming on the Pajarito Plateau.

Clay-Size Material

The occurrence of clay-rich horizons are particularly relevant to the fate and transport of numerous inorganic and organic contaminants found at the Laboratory. Variation in clay-mineral content is significant within the soils and, subsequently, the extent of contaminant mobility varies depending on the presence of geochemically reactive phases, including clay minerals, iron oxides, solid organic matter, and carbonate minerals.

Clay-rich horizons typically alter the local hydrologic environment by providing low permeability and low hydraulic conductivity zones, increasing the water-holding capacity of the horizon, and contributing to an overall increase in the degree of chemical weathering (Sposito, 1989; McBride, 1994). Table 4 shows ranges of hydraulic conductivities and permeabilities for different rocks and unconsolidated deposits. Soils found on the Pajarito Plateau show variations in texture ranging from clay- and silt-size material to gravel. Hydraulic conductivities of soils found on the Pajarito Plateau thus probably range from 10^{-6} to 10 cm/sec, based on data provided in Table 4, although few data are available at the Laboratory.

Clay-size material (less than 2 micrometer) in all the soil samples ranges from 2.4 weight percent (wt%) at Site 1 (lower Los Alamos Canyon near State Route 4) within a C horizon to 63 wt% at Site 4 (Twomile Mesa, TA-69) within a Bt horizon (Watt and McFadden, 1992). This size fraction, however, is heterogeneous in mineralogy and does not entirely consist of clay minerals as discussed below. The clay-size fraction is characterized by the smallest particle diameters having relatively large surface areas, which is an important factor in controlling the extent of adsorption of trace elements. Figure 10 illustrates this point by comparing concentration ranges of As and Be to abundances of clay-size material at Site 1 and Site 7 on a mesa at TA-39 (Ancho Canyon mesas).

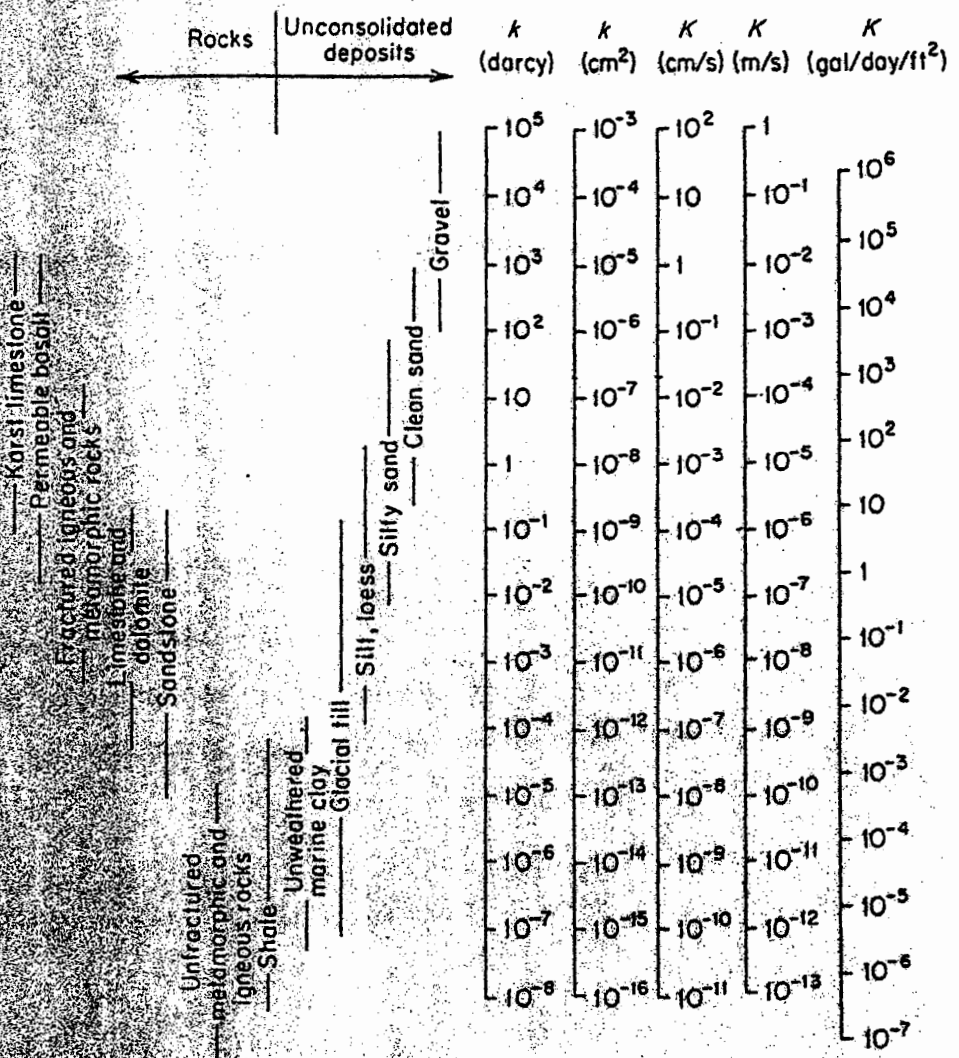

Table 4 Range of Values of Hydraulic Conductivity (K) and Permeability (k) (Freeze and Cherry, 1979).

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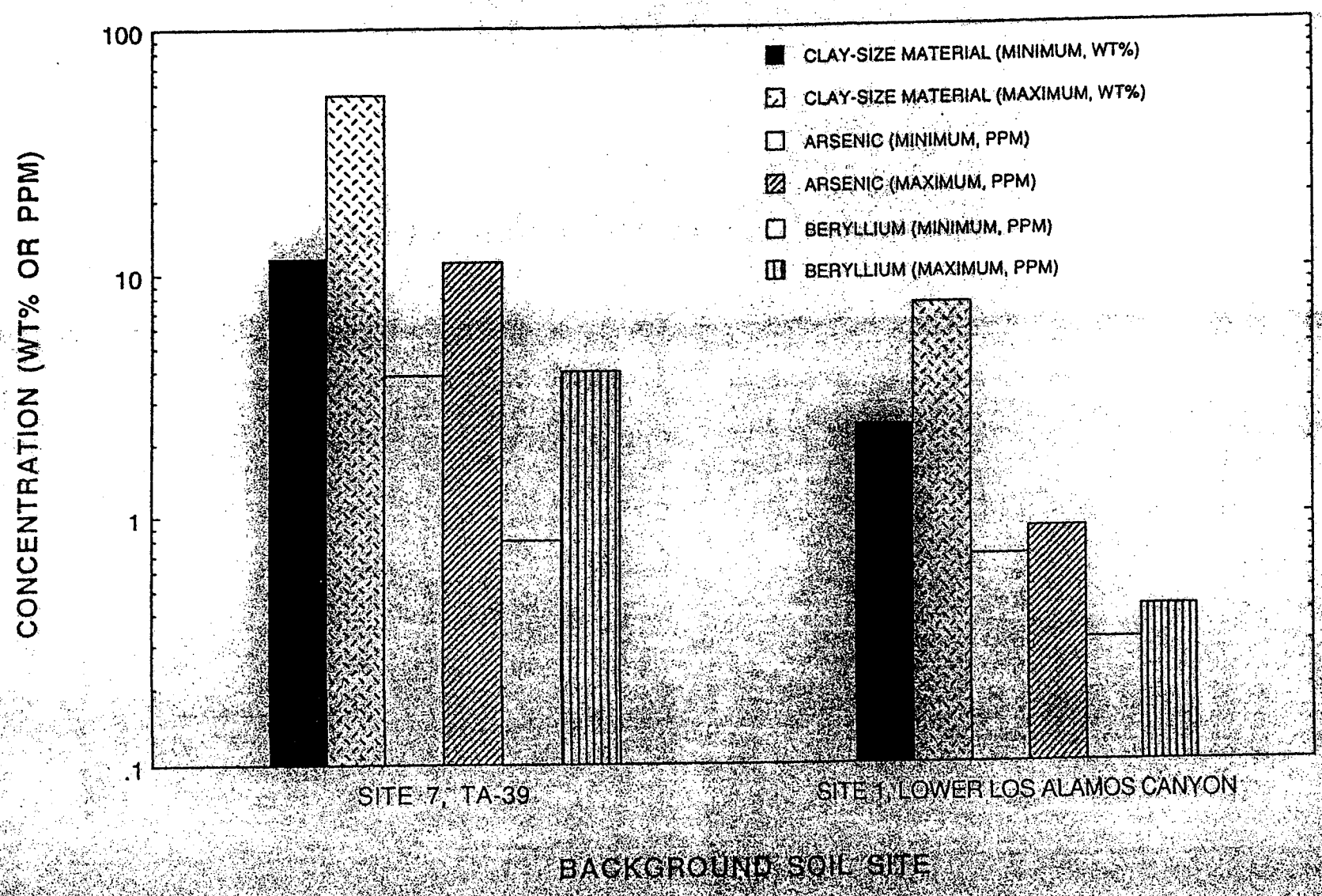
Figure 10

CONCENTRATION RANGES OF CLAY-SIZE MATERIAL WITH CONCENTRATIONS OF ARSENIC AND BERYLLIUM, BACKGROUND SOILS, LOS ALAMOS.



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Arsenic and Be are found in higher concentrations at Site 7 where the soil is characterized by higher abundances of clay-size material concentrated within B horizons. The TA-39 soil is more developed relative to the lower Los Alamos Canyon soil and higher concentrations of trace elements can thus be expected in the more strongly developed soils at the Laboratory.

Heterogeneity in the clay-size material can reflect variations in parent material, age, topography, eolian input, and degree of chemical weathering (Birkeland, 1984; Sposito, 1989; and McBride, 1994). An increase in clay content may reflect the presence of pedogenic clays, or may be related to original composition of the parent material.

Figure 11 is a bivariate plot of clay-size material versus Al_2O_3 content for all of the B horizons sampled during this study, showing a fair positive correlation ($r^2 = 0.65$) between these two variables. Typical Al_2O_3 concentrations (reported in wt%) found in clay minerals, including mean and range are 21.93 (15.20-34.00) for smectites/montmorillonites-beidellites; 26.35 (21.40-34.64) for illites; 24.79 (18.1-34.50) for mixed layer illite-montmorillonites; and 37.05 (29.96-40.22) for kaolinites (Weaver and Pollard, 1973). Aluminum concentrations shown in Figure 10 are lower than the cited values possibly due to dilution of clay-mineral abundance within the heterogeneous clay-size fraction. Dominant clay minerals found in soils on the Pajarito Plateau include illite, kaolinite, and mixed-layered smectite based on results of X-ray diffraction analyses (Davenport, 1993; personal communication on September 15, 1993 with Paul Eberly, Department of Earth and Planetary Sciences, University of New Mexico). Structurally disordered aluminosilicates, including allophane and imogolite, probably are also present in the clay-size fraction where soil has formed on the Bandelier Tuff. The B horizons contain highest abundances of clay-size material.

Figure 12 is a bivariate plot of SiO_2 versus Al_2O_3 for soil samples collected from B horizons, which shows an inverse relationship between these two oxides. Clay minerals have lower SiO_2 concentrations than feldspars and conversely, however they generally have higher concentrations of Al_2O_3 than feldspars (Sposito, 1989; McBride, 1994). Enrichment of Al_2O_3 and depletion of silica in clay minerals result from hydrolysis reactions involving glass and framework silicates. Chemical weathering of glass, represented by Al_2O_3-SiO_2, to form allophane ($Si_3Al_4O_{12} \cdot nH_2O$) and imogolite ($Al_2SiO_3(OH)_4$) are shown in the following reactions:

Figure 11

B HORIZONS, BACKGROUND SOILS, LOS ALAMOS

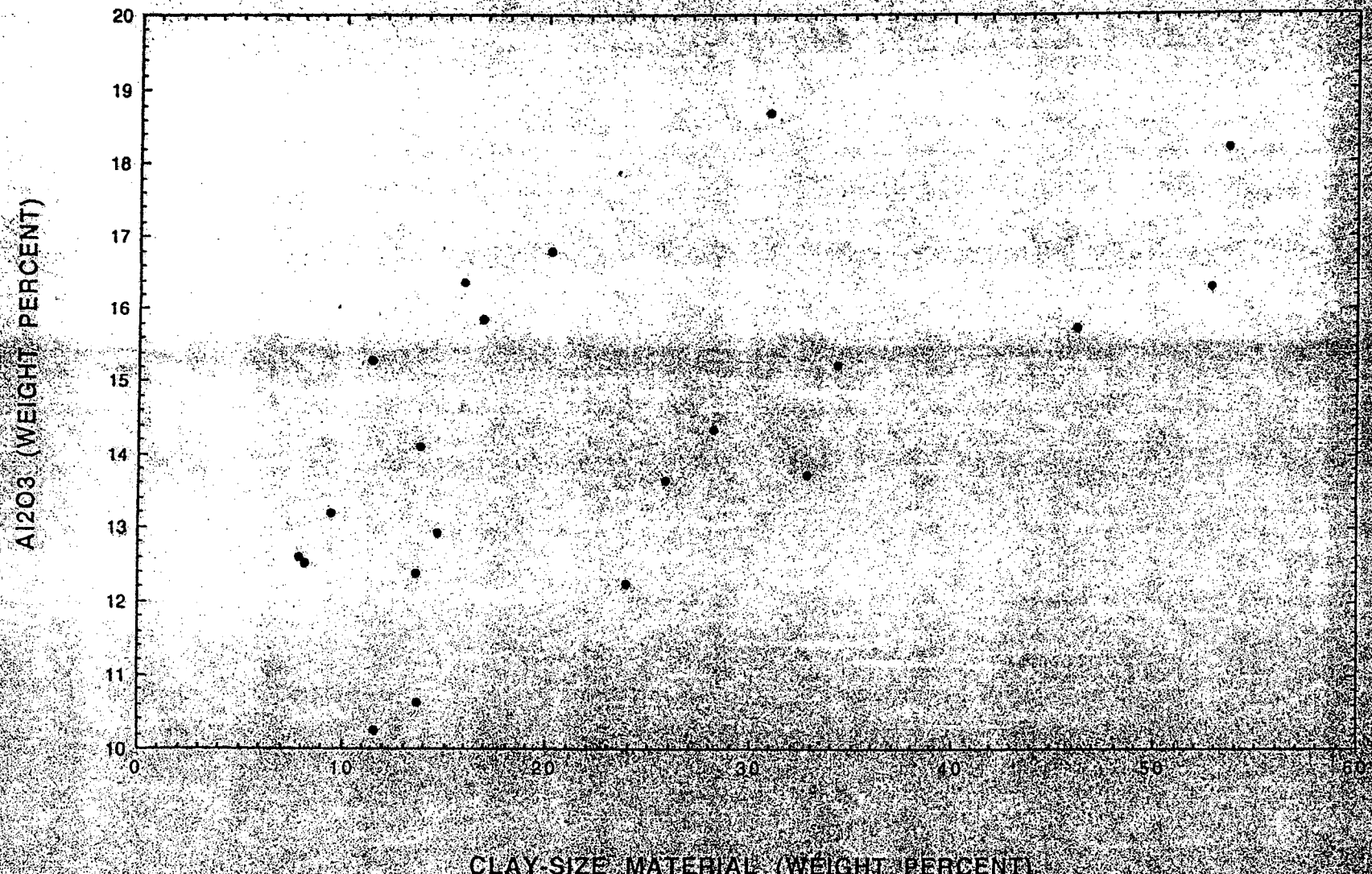
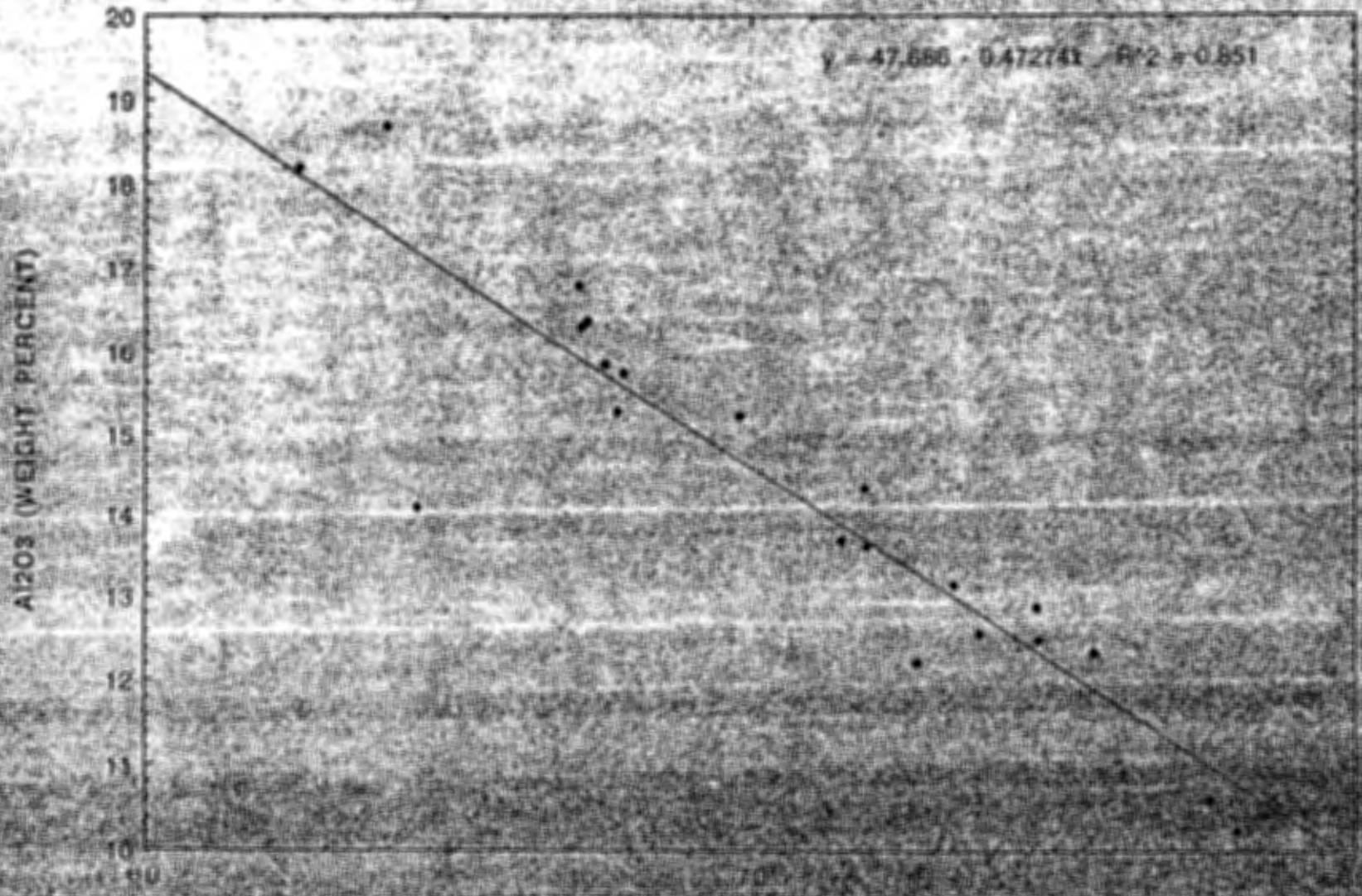


Figure 12. B HORIZONS, BACKGROUND SOILS, LOS ALAMOS



$$2(Al_2O3\text{-}SiO_2) + H_4SiO_4^0 = Si_3Al_4O_{12}\cdot 2H_2O \text{ and} \qquad \text{(eq. 1)}$$

$$2(Al_2O3\text{-}SiO_2) + 2H_2O = Al_2SiO_3(OH)_4. \qquad \text{(eq. 2)}$$

Feldspars may weather to smectite through hydrolysis:

$$4KAlSi_3O_8 + 0.5Ca^{2+} + 2H^+ + 10H_2O =$$

$$K[Si_{7.5}Al_{0.5}]Al_{3.5}Ca_{0.5}O_{20}(OH)_4 + 4.5Si(OH)_4^0 + 3K^+. \qquad \text{(eq. 3)}$$

Equation 3 illustrates that the weathering of primary silicates is characterized by loss of tetrahedrally coordinated Al, consumption of protons, and release of silica and Ca^{2+} and K^+. Gibbsite and kaolinite are the final weathering minerals formed from feldspars. In addition to hydrolysis reactions, clay minerals may also be concentrated in B horizons by translocation of material from overlying horizons.

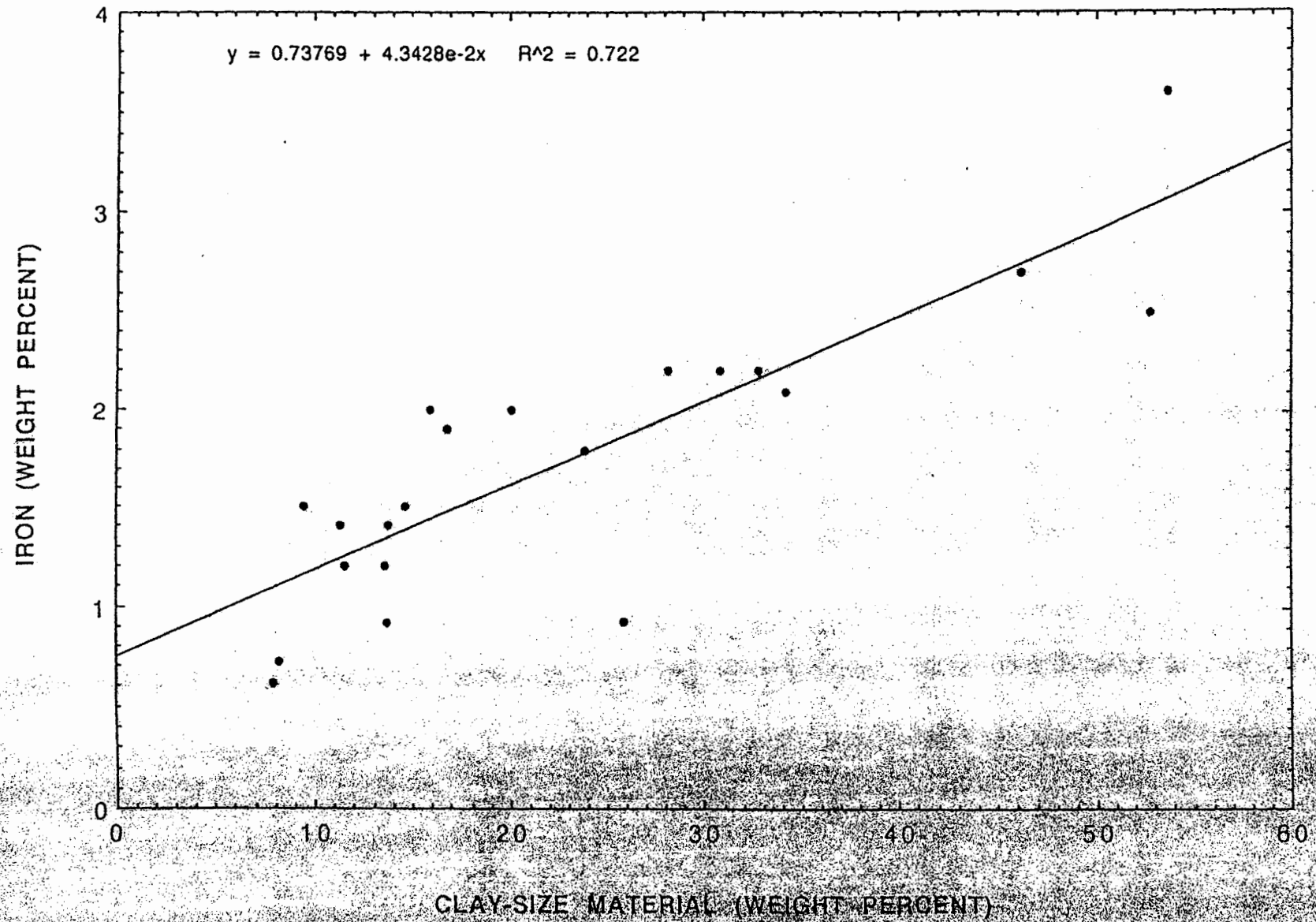
Figure 13 is a bivariate plot of clay-size material versus Fe content for all of the B horizons sampled during this study. The correlation ($r^2 = 0.72$) between these two variables is good, suggesting that iron oxides probably occur as coatings and intergrowths with clay minerals, which is consistent with mineralogical results reported by Sposito (1989) and McBride (1994). The dominant Fe-bearing phases occurring in the Pajarito Plateau soils probably include amorphous $Fe(OH)_3$, goethite (α-FeOOH), and hematite (α-Fe_2O_3), although the exact mineralogy has not been determined from XRD analyses. These phases have been reported in numerous soils characterized world wide (Sposito, 1989; Dixon and Weed, 1990).

Soil pH

Laboratory-determined soil pH values range from 5.2, for a sample obtained from an O horizon at Site 4, Twomile Mesa (TA-69), to 8.2 for a sample collected from a carbonate-rich zone at Site 5, Water Tanks Trench, TA-16 (Watt and McFadden, 1992). Solid organic carbon is concentrated in O horizons containing carboxylic acids that deprotonate under moderately acidic (4.5) conditions. This deprotonation results in acidic pH conditions within O horizons. In addition, enhanced biological activity in O horizons produces a high partial pressure of CO_2 gas, which reacts with soil-pore water and thereby decreasing

Figure 13

B HORIZONS, BACKGROUND SOILS, LOS ALAMOS



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soil pH. Poorly developed soils at the Laboratory tend to have lower pH values (5.4-6.5) in the absence of carbonate horizons, whereas well-developed soils have higher pH values (7.0-8.2) primarily attributed to presence of calcium carbonate (K) horizons. The B horizons at the Laboratory tend to show variability in pH values (5.4-7.9), but tend to be dominately characterized by alkaline pH values. In the absence of O horizons, soil pH is controlled by calcium carbonate and partial pressure of CO_2 gas (Sposito, 1989; Drever, 1988). Soil pH is an important parameter that controls precipitation-dissolution and adsorption-desorption reactions. Anion exchange and adsorption usually occurs under lower pH conditions relative to cation exchange and adsorption. Contaminants found in aqueous solutions at the Laboratory probably occur as both anions ($UO_2(CO_3)_2^{2-}$, $H_2AsO_4^-$, $HAsO_4^{2-}$, Cl^-) and as cations (Ba^{2+}, $BeOH^+$, $^3H^+$ as ^3H_2O), based on speciation calculations using thermochemical data tabulated in Grenthe et al. (1992) and Rai and Zachara (1984).

Calcium-Carbonate Content

Calcium carbonate content of the soils is highly variable, ranging from 0.1 wt% in a CBt horizon at Site 4, Twomile Mesa to 100 wt% in a K horizon at Site 7, Ancho Canyon mesas (Watt and McFadden, 1992). Most of the calcium carbonate found in soils on the Pajarito Plateau probably originates from wind-blown or atmospheric sources (Watt and McFadden, 1992). Carbonate chemistry is important in controlling soil pH; providing active adsorption sites for anionic and cationic adsorbates; providing ligands for metal complexing, especially for uranyl (U(VI)); enhancing the stability of smectite characterized by a high cation exchange capacity (CEC); and controlling hydraulic conductivity. Carbonate-rich horizons likely reflect climatic conditions that favor relatively high amounts of atmospheric dust available for deposition. Calcium carbonate is an important adsorbent for cations (Cd^{2+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}) and anions (PO_4^{3-}, SeO_3^{2-}, and possibly $UO_2(CO_3)_2^{2-}$), where solution pH and calcium carbonate concentration are the most important factors controlling adsorption processes (Zachara et al., 1993). Calcium carbonate content is discussed in more detail in specific soil profile sections.

Cation Exchange Capacity

Cation exchange capacity (CEC) varies from 3 to 28.5 milliequivalents/ 100 grams soil (meq/100 g), which is reflective of the different types of clay minerals present in the soils. Figure 14 is a bivariate plot of measured CEC values versus clay-size material, showing that CEC generally increases with increasing clay content. Because B horizons have the highest clay mineral content, they also have the highest CEC. Higher CEC values are associated with 2:1 (octahedral: tetrahedral layers) clay minerals such as smectite or mixed-layer smectite, whereas the lower CEC values are representative of 1:1 clay minerals including kaolinite (Sposito, 1989; McBride, 1994). Clay minerals with higher CEC values are geochemically more reactive (larger surface area) than those with lower CEC values.

Solid Organic Carbon

Solid organic carbon (SOC) content ranges from 0.07 to 2.83 wt% for soil samples characterized during this investigation. The SOC content typically is highest in the O horizons, especially at Site 3, upper Los Alamos Canyon. In general, soil profiles described at or near the western perimeter of the Laboratory at higher elevations tend to have higher SOC content than soil profiles described at the eastern boundary of the Laboratory at lower elevations. Humic substances, consisting humic and fulvic acids, comprise most of the SOC found in soils (Thurman, 1985; Stevenson, 1994; Sposito, 1989). Solid organic carbon is important in controlling soil pH within O and A horizons by forming carboxylate anions and releasing protons to solution; providing ligands for metal complexing; enhancing oxidation-reduction reactions with Fe and Mn minerals (Stumm and Morgan, 1981); providing hydrophobic sorption sites for anthropogenic organic compounds such as benzene, trichloroethene, trichloroethane (Thurman, 1985; McBride, 1994); and providing relatively high CEC values for specific horizons (Sposito, 1988).

Selected Trace-Elemental Distributions in Soils

Results of selected trace-element distributions found in background soils are summarized in Table 5. Complete soil analyses are provided in Appendices

Figure 14

BACKGROUND SOILS, LOS ALAMOS

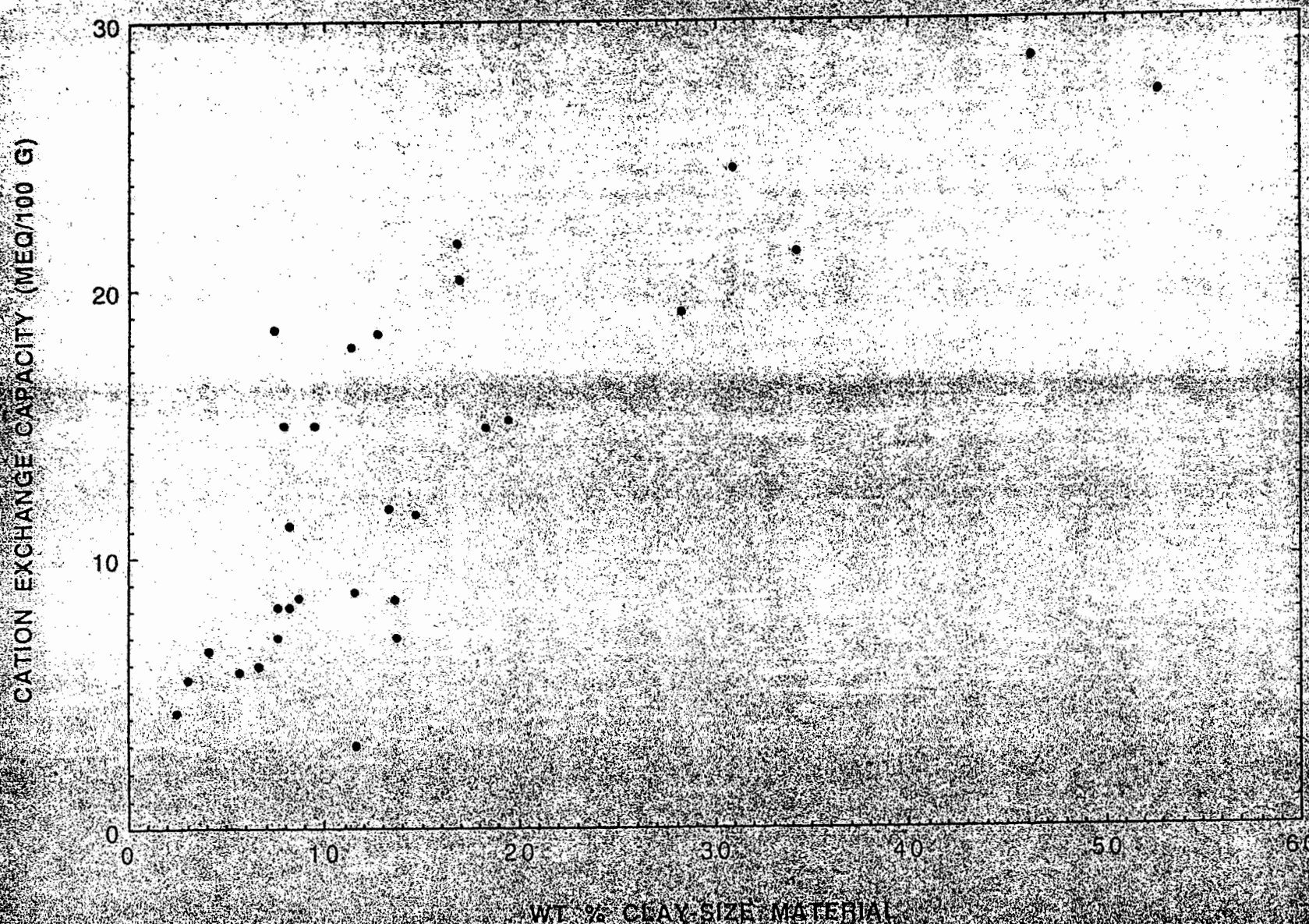

TABLE 5. Background Elemental Concentrations in Soils at Los Alamos, New Mexico

	Nitric Acid Dissolution (EPA-SW846)			INAA or DNAA (Uranium Only)		
Element[a]	Number of Samples	Mean	Range	Number of Samples	Mean	Range
As	72	4.9	0.5 - 13.6	67	5.04	1.20 - 10.81
Ba	72	176	24 - 730	75	459	125 - 829
Be	72	1.23	0.18 - 4.00		-	-
	75	[b]2.37	1.00 - 4.40			
Co	72	15.2	5.5 - 34	75	7.14	0.44 - 23.35
Cr	72	12.2	1.9 - 37.0	74	34.74	2.03 - 71.07
Cu	67	6.6	0.6 - 16.0		-	-
Fe (wt.%)	72	1.51	0.33 - 3.60	75	2.37	1.09 - 4.86
Ni	70	10.3	2.0 - 28.0		-	-
Pb	69	16.7	4.0 - 37.0		-	-
		[b]28.36	18.00 - 56.00			
Se	41	0.75	0.30 - 2.40		-	-
Th	72	7.1	0.6 - 15.0	75	16.06	10.09 - 27.30
Tl	40	0.42	0.20 - 0.90		-	-
U	72	0.94	0.20 - 2.40	75	3.41	1.54 - 6.73
V	72	26.6	4.0 - 56.0	72	48.95	11.54 - 113.10

[a]Data are reported in parts per million (ppm) unless otherwise noted.
[b]Hydrofluoric acid used in sample dissolution.

I and II. Soil digestion procedures consisted of HF (Be, Cd, and Pb) or HNO_3 leaching prior to chemical analyses using EPA-SW846 methods including AA, ICPES, ICPMS, and IC and other available analytical techniques including INAA and DNAA. Arithmetic mean and ranges for analyte concentrations are also provided in Table 5. Generally, these data agree well with soil data reported from other sources summarized in Table 6, including Ferenbaugh et al. (1990) for Sigma Mesa on the Pajarito Plateau and Schacklette and Boerngen (1984) for many different locations in the United States. Samples collected by Ferenbaugh et al. (1990) consist of shallow (6 inches) grab samples on a portion of Sigma Mesa without specific reference to soil horizon(s) . Laboratory soils contain higher concentrations of Th and U relative to other soils listed in Table 6, which is a result of different parent material (sheet-wash material, colluvium, wind-blown sediment, El Cajete) derived from volcanic rocks on the Pajarito Plateau. Laboratory soils fall within the range of elemental concentrations reported elsewhere in the United States (Schacklette and Boerngen,1984, Table 6), although the mean values for Laboratory soils are higher for some elements. Table 7 provides brief descriptions of soil and rock samples collected at each soil profile in this study.

Figure 15 shows concentration ranges for several analytes using different digestion procedures and analytical techniques. Delayed neutron activation analysis, INAA, and HF digestion with ICPES generally result in higher mean elemental concentrations, because INAA and DNAA techniques and HF digestion procedure with ICPES provide total elemental analysis. In contrast, HNO_3 provides partial sample digestion. Concentration distributions of As in background soils are similar for both INAA and HNO_3 digestion with ETVAA. This may result from complete dissolution of amorphous $Fe(OH)_3$ or a related phase at pH < 1 with HNO_3 digestion. Figure 16 shows solubilities of several low temperature, Fe-bearing phases occurring in soils in which amorphous $Fe(OH)_3$ is the most soluble phase over a wide range of pH values. Thermochemical data were taken from Lindsay (1979) to construct Figure 16. Other Fe-bearing phases potentially present have not completely dissolved during HNO_3 digestion as evidenced by a higher mean and larger range for this element using INAA (Table 5). These phases probably include magnetite, hematite, and structurally incorporated Fe occurring within primary silicate minerals such as hornblende and biotite. Partial dissolution of iron-rich clay

TABLE 6. Elemental Concentrations in Soil

	Farenbaugh et al. (1990) Sigma Mesa, Los Alamos		Schacklette and Boerngen (1984) Random Locations, USA	
Element[a]	Mean	Range	Mean	Range
Al (%)	5.8	5.3 - 6.7	5.8	0.5 - >10
As	3.9	1.3 - 6.7	5.5	<0.1 - 97
Ba	410	120 - 810	580	70 - 5,000
Be	1.9	1.1 - 3.3	0.68	<1 - 15
Br	1.9	0.40 - 5.7	0.52	<0.5 - 11
Cd (ppb)	170	30 - 520	-	-
Cl	<100	-	-	-
Cr	27	4.2 - 136	41	3 - 2,000
Cu	10	2.0 - 18	21	2 - 300
F	240	50 - 390	280	<10 - 1,900
Fe (%)	1.7	1.0 - 2.6	2.1	0.1 - >10
Hg (ppb)	18	7.0 - 29	46	<10 - 4,600
Mn	510	330 - 840	380	30 - 5,000
Ni	8.9	1.6 - 19	15	<5 - 700
Pb	24	8.0 - 98	17	<10 - 700
Rb	120	90 - 160	69	<20 - 210
Th	-	-	9.1	2.4 - 31
Ti (%)	0.26	0.079 - 0.49	0.22	0.05 - 2.0
U	-	-	2.5	0.68 - 7.9
Zn	54	38 - 71	55	10 - 2,100

[a]Data are reported in parts per million (ppm) unless otherwise noted.

TABLE 7. SOIL SAMPLE LOCATION AND SOIL HORIZON COLLECTED DURING SOIL BACKGROUND INVESTIGATION

SOIL PROFILE	SAMPLE NUMBER	SAMPLE DATE	SOIL HORIZON
Lower Los Alamos Canyon near Tsankawi	2077	92 06 25 10 57	A
	2078	92 06 25 11 15	C
	2079	92 06 25 1140	2Cb
EG&G Gully, East Road	2021	92 08 07 14 06	A1
	2013	92 08 07 14 12	Bt
	2011	92 08 07 14 16	Bw
	2012	92 08 07 14 22	CB
	2010	92 08 07 14 30	Bwb
	2022	92 08 07 15 27	CBb
	2023		C
Upper Los Alamos Canyon, Los Alamos Reservoir Road	2018F	92 08 01 15 38	A1
	2017F	92 08 01 15 41	A2
	2024	92 08 01 15 44	BA, 2020F duplicate
	2019F	92 08 01 15 46	Bw
	2016F	92 08 01 15 55	C
	2000	92 08 07 09 54	Ab
	2000F	92 08 07 09 54	Ab, fine
	2015F	92 08 01 15 53	Bwb

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TABLE 7. SOIL SAMPLE LOCATION AND SOIL HORIZON COLLECTED DURING SOIL BACKGROUND INVESTIGATION (CONTINUED)

SOIL PROFILE	SAMPLE NUMBER	SAMPLE DATE	SOIL HORIZON
Twomile Mesa			
North Trench End	2035	92 06 08 14 51	A, 2036 duplicate
	2027	92 06 08 14 39	Bw
	2056	92 06 08 14 21	2Bt1b
	2028	92 06 08 14 10	2Bt2b
	2043	92 06 08 13 48	2Bt3b
	2033	92 06 05 16 20	Fracture Fill
	2037		E
	2039		Crb
	2040		BC
	2042		A
	2052		AE
	2059		Cr
	2062	92 06 06 13 35	R
	2065	92 06 08 15 15	Bt3
	2067		Bt1
South Trench End	2045	92 06 10 11 05	A
	2066	92 06 10 11 25	Bw
	2068	92 06 10 11 40	2Bt1b, 2069 duplicate
	2044	92 06 10 11 50	2Bt2b
	2031	92 06 10 12 10	CBt
	2026	92 06 10 12 50	R
	2038		Br
	2055	92 06 10 11 00	Humic layer

TABLE 7. SOIL SAMPLE LOCATION AND SOIL HORIZON COLLECTED DURING SOIL BACKGROUND INVESTIGATION (CONTINUED)

SOIL PROFILE	SAMPLE NUMBER	SAMPLE DATE	SOIL HORIZON
Ancho Canyon Mesa, TA-39			
State Road 4	2032	92 06 12 12 17	A1
	2053	92 06 12 12 34	A2
	2061	92 06 12 12 46	Bt
	2057	92 06 12 12 55	Bwkb, 2058 duplicate
	2046	92 06 12 13 30	Btkb, 2047 duplicate
	2034	92 06 12 13 14	Bwkb
	2060	92 06 12 13 50	2Cr
Water Tanks Trench, TA-16			
State Route 4	2054	92 06 18 13 45	A
	2064	92 06 18 12 20	BA
	2051	92 06 18 12 20	2Bt1b
	2049	92 06 18 11 45	2Bt2b, 2041 duplicate
	2048	92 06 18 11 15	2Bt3b
	2063	92 06 18 11 00	2CB
	2001	92 06 24 10 12	Base Colluvium
	2006	92 06 24 09 50	$CaCO_3$ Zone 3, 2025 duplicate
	2007	92 06 24 09 16	$CaCO_3$ Zone 2
	2008	92 06 15 16 00	Oxidized Zone
	2009	92 06 15 15 45	Reduced Zone
	2030	92 06 18 14 00	$CaCO_3$ Zone 1
	2050	92 06 10 11 35	Organic Matter

TABLE 7. SOIL SAMPLE LOCATION AND SOIL HORIZON COLLECTED DURING SOIL BACKGROUND INVESTIGATION (CONCLUDED)

SOIL PROFILE	SAMPLE NUMBER	SAMPLE DATE	SOIL HORIZON
Fracture, TA-46			
	2070	92 09 16 12 17	Bandelier Tuff, fresh sample
	2071	92 09 16 12 25	Fracture Fill A
	2072	92 06 16 12 30	Fracture Fill B
	2073	92 06 16 12 40	A
	2074	92 06 16 12 45	Bandelier Tuff, fresh sample
	2075	92 06 16 12 50	Coarse Fracture Fill (outer)
	2076	92 06 16 13 00	Fine Fracture Fill (inner)
Frijoles Mesa, TA-49 State Route 4	2004	92 06 24 13 25	Bw
	2005	92 06 24 12 59	Bwk
	2002	92 06 24 14 10	2CB
	2003	92 06 24 14 02	R, Bandelier Tuff (weathered)

Notes:

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Figure 15

COMPARISON OF SAMPLE DIGESTION USING HNO3 OR HF (Be, Pb) WITH ANALYTICAL TECHNIQUES (ICPES (Be, Cr, Pb), ICPMS (Th, U), AA (As), INAA (As, Cr, Th), AND DNAA (U), BACKGROUND SOILS, LOS ALAMOS.

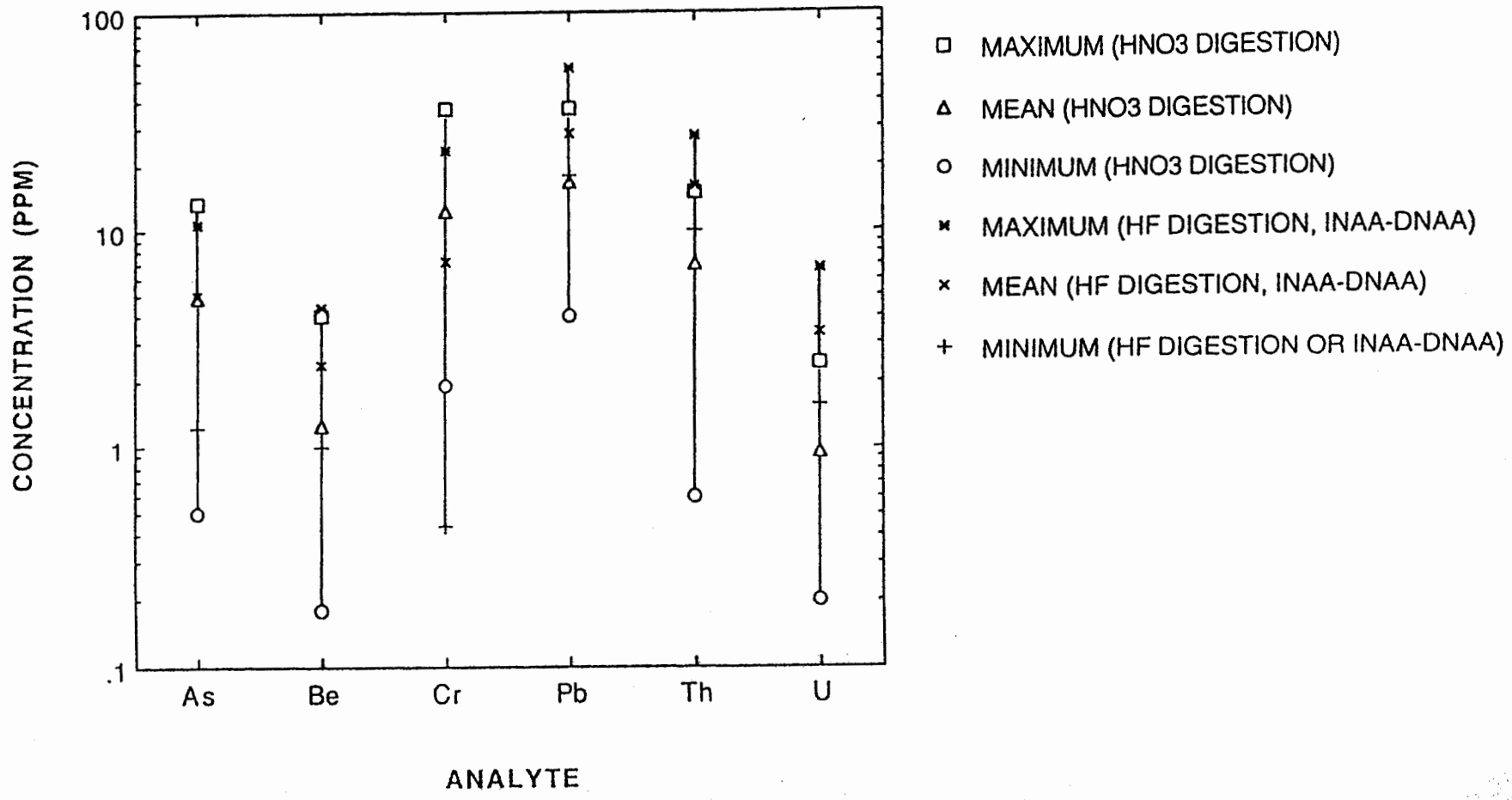
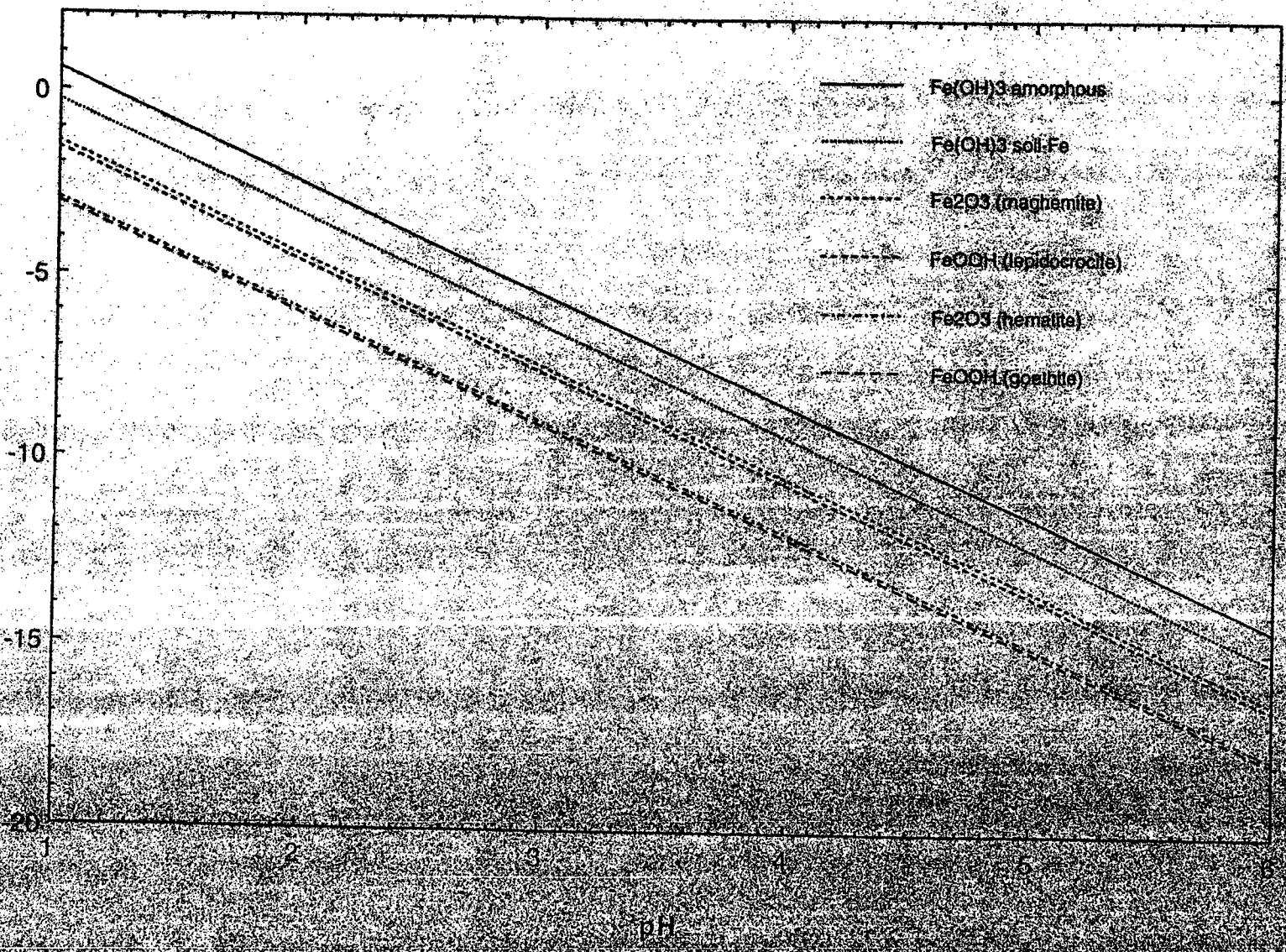


Figure 16

ACTIVITY DIAGRAM OF Fe3+ MAINTAINED BY Fe (III) OXIDES AND SOIL-Fe.



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minerals (nontronite) also occurs under the acidic conditions of HNO_3 digestion, which may release some additional Fe to solution.

Different trace elements summarized in Table 5 are distributed in background soils by the following processes: (1) trace elements that are concentrated primarily on surfaces of soil particles through chemical weathering, for example As; (2) trace elements that remain concentrated within soil particle matrices consisting of primary minerals (silicates) and glass, for example Ba, Th, and U; and (3) trace elements that are distributed as a combination of processes (1) and (2), for example Be, Cr, Pb, and V. Process (1) is due mainly to adsorption of trace elements onto surfaces of clay minerals, iron oxides, solid organic matter, and calcium carbonate, whereas process (2) is dominated by coprecipitation within primary minerals. Barium, Th, and U tend to show lessor amounts of leaching from primary silicate minerals and glass relative to As and Be, which have become concentrated on surfaces of soil particles through chemical weathering leading to element remobilization. Uranium (IV) probably is the dominant valence state within primary phases present in soil. This is based on significant differences observed between total element and HNO_3-digested fraction, suggesting some leaching of U has occurred. Uranium (VI), however, is characterized by greater amounts of leaching relative to U(IV), which is not observed. Factors controlling extent of element leaching from primary soil phases include solid-state diffusion, solubility of the host phase, dissolution kinetics, solution flux, pH, Eh, and speciation of the trace element.

Examples of adsorption-dominated processes, involving Fe, As, and Be, occurring during pedogenesis are now considered. Figures 17 and 18 are bivariate plots of Fe versus As and Fe versus Be, respectively, for samples collected from A, B, and C horizons. Clay minerals and iron oxides are concentrated within B horizons, which result in adsorption processes occurring to a much greater extent in the B horizons relative to A and C horizons. Amorphous $Fe(OH)_3$ has been experimentally shown to have a surface area of 306 m^2/g, whereas measured surface areas of lepidocrocite and hematite are 45 and 1.8 m^2/g, respectively (Stumm and Morgan, 1981). Other important properties of these sorbents include surface charge, speciated form of sorbate, and properties of electrical double layer, pH, and Eh. Amorphous $Fe(OH)_3$ has a higher sorptive capacity for transition metals and metaloids, primarily due to its large surface area, relative to lepidocrocite and hematite based on results of

Figure 17

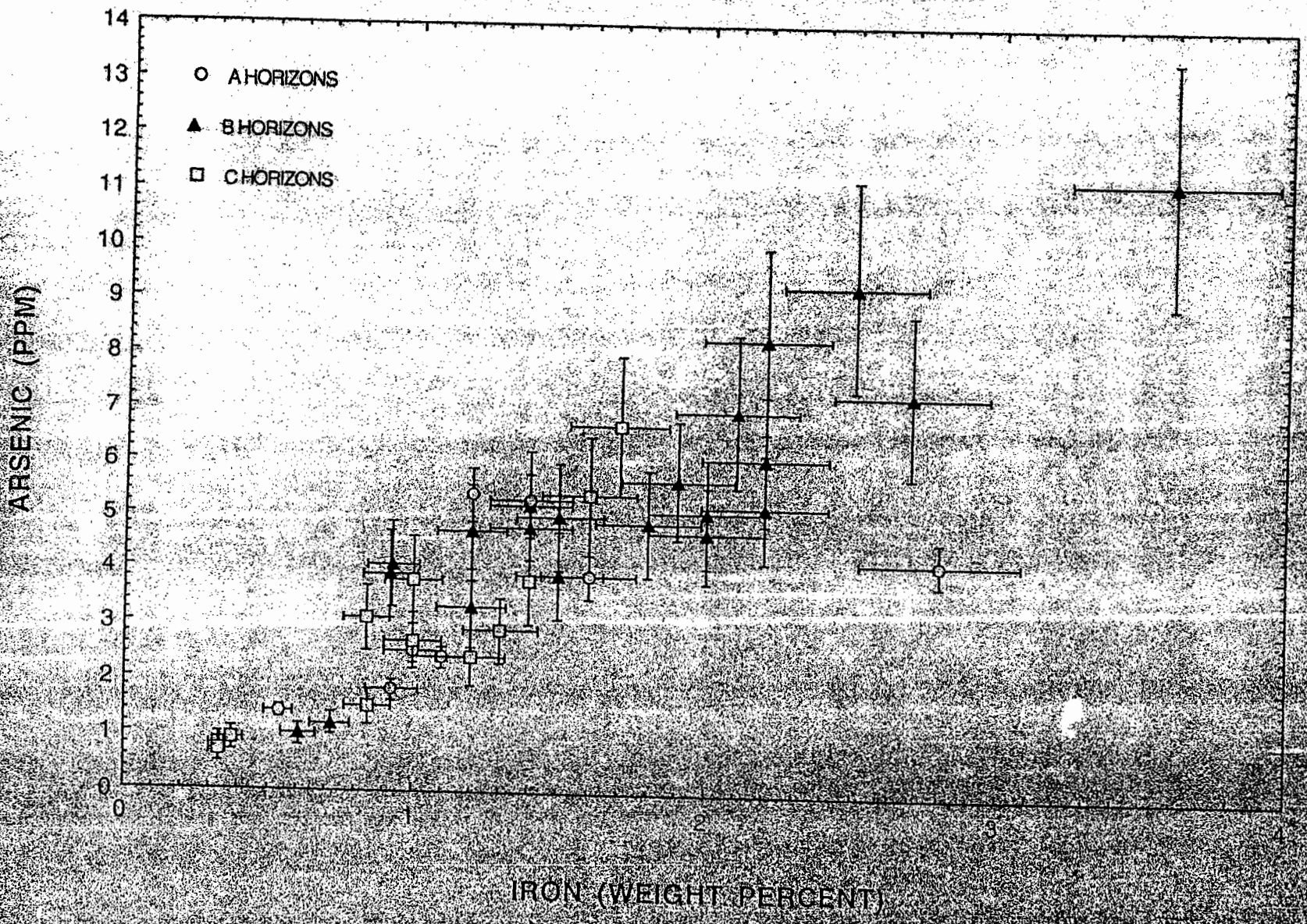
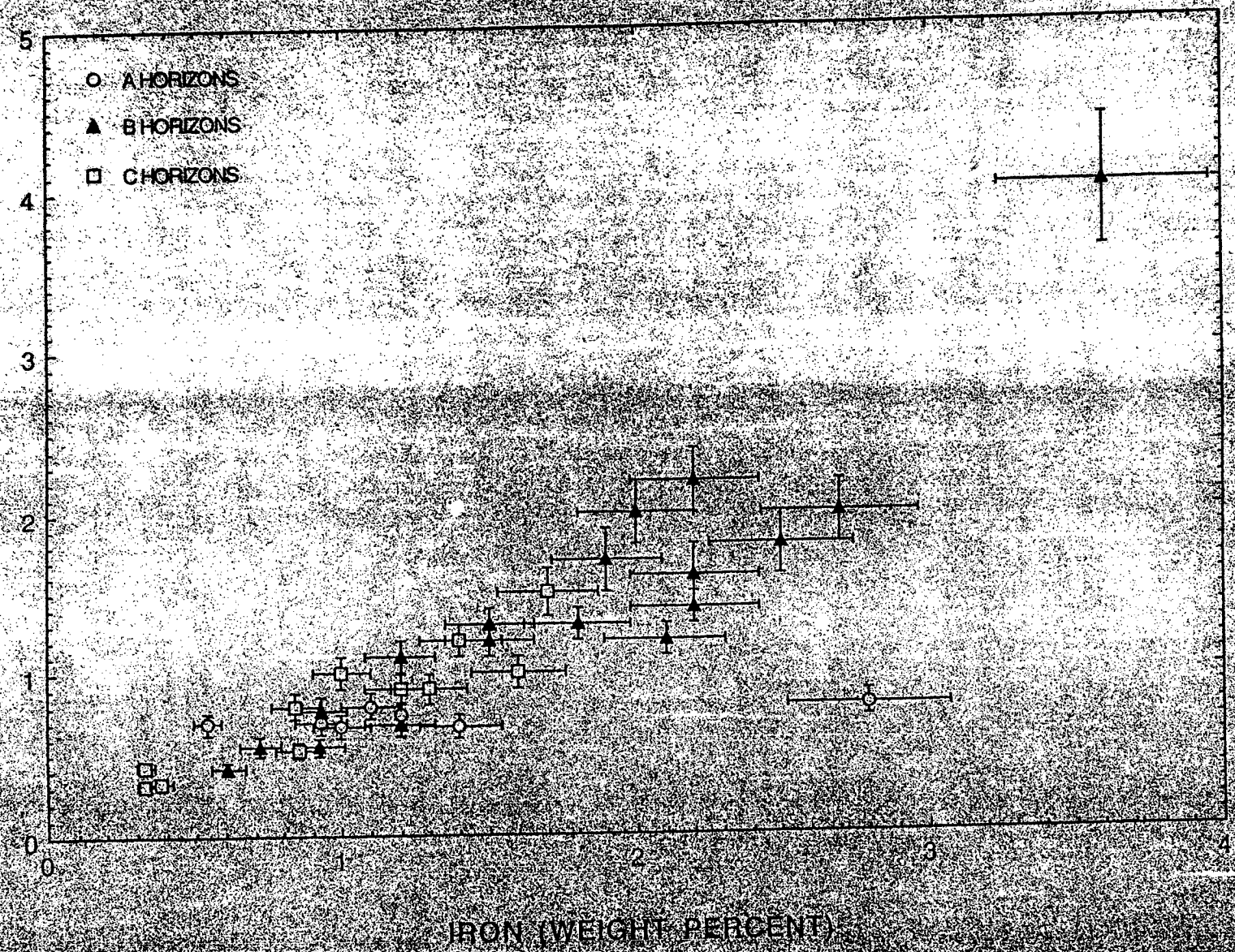

BACKGROUND SOILS, LOS ALAMOS
A HORIZONS
B HORIZONS
C HORIZONS
ARSENIC (PPM)
IRON (WEIGHT PERCENT)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

Figure 18

BACKGROUND SOILS, LOS ALAMOS



experimental data reported in Stumm and Morgan (1981), Sposito (1984), McBride (1994), and Stumm (1992).

Most specific adsorbents, including calcium carbonate, iron oxides, manganese oxides, and amorphous aluminosilicates, have a pH-dependent surface charge. These phases are positively charged below their point of zero charge, termed PZC, and negatively charged at pH values above. At the point of zero charge, solid phases lack net surface charge corresponding to pH_{pzc}. The PZC has a specific value for each adsorbent (Sposito, 1984: Stumm, 1992). Decreasing soil-pore water pH or groundwater pH increases positive surface charge and enhances anion adsorption, whereas increasing pH favors cation adsorption through increasing negative surface charge.

Cations, including Be, Cd, Pb, and Cu are both specifically adsorbed and undergo ion exchange; ion exchange becomes important when the specific adsorption capacity is exceeded (Sposito, 1984). For example Na^+ and Ba^{2+} are removed from solution primarily through cation exchange. Increasing cation adsorption with increasing pH results from hydrolysis of cations and decrease in positive charge of amphoteric adsorbents.

Ligands that form stable complexes with cations dissolved in soil-pore water or groundwater decrease free cation activity and cation adsorption. Bicarbonate and possibly humate and fulvate probably are the most important ligands found in natural waters at the Laboratory, based on background water-quality data collected in Los Alamos Canyon (Longmire, unpublished data). Presence of major cations such as Ca^{2+}, Mg^{2+}, K^+, and Na^+ and specifically adsorbed ions of UO_2^{2+}, Be^{2+}, and Cd^{2+} in solution tend to limit adsorption through competition for cation exchange sites and specific adsorption sites, respectively.

Oxyanions, including MoO_4^{2-}, SeO_4^{2-}, SeO_3^{2-}, CrO_4^{2-}, AsO_4^{2-}, AsO_3^{2-}, and SO_4^{2-}, are specifically adsorbed onto positively-charged solids (calcium carbonate, clay minerals, amorphous $Fe(OH)_3$, and FeOOH) with maximum sorption occurring under acidic conditions. Adsorption of oxyanions onto iron oxides and aluminum oxides decreases in the following order: As > Cr $\geq$ Mo $\geq$ Se = SO_4 (Rai and Zachara, 1984).

STATISTICAL ANALYSIS OF BACKGROUND ELEMENTAL CONCENTRATIONS IN SOILS

Comparisons of site data to background data are needed as part of the Resource Conservation and Recovery Act (RCRA) corrective action process developed by the EPA. The ER Project follows the general guidance provided in "Statistical Analysis of Ground-Water Monitoring Data" (EPA, 1989). Details of this approach are presented in the background comparison guidance document for the ER Project (Ryti, 1995). Two types of statistical comparisons to background data are presented in this guidance document. The first method is based on calculation of the upper tolerance limit (UTL) for background data. The UTL is equal to the mean plus the standard deviation multiplied by k-factors (one-sided normal tolerance factors), using the 99th percentile at 95% confidence. The UTL is a "hot measurement" test, which means that site data greater than the UTL-calculated threshold value are considered to exceed the normal maximum background concentration for a particular element. Values of UTL for naturally-occurring metals and nonmetals in soils, including A, B, and C horizons, at the Laboratory are presented in Table 8. These values are also presented for radioisotopes of K, Th, and U by assuming natural abundance of each isotope. The second type of background comparison is a "distribution shift" test, which determines if the mean of the site data is statistically greater than the mean of the background data.

TRACE ELEMENT CHEMISTRY OF THE BANDELIER TUFF

The Bandelier Tuff was derived from explosive volcanic eruptions in the Valles caldera, Jemez Mountains west of the Laboratory. The Bandelier Tuff consists of two members (bottom and top): 1. Otowi Member, consisting of primarily of nonwelded, lithic-rich, rhyolitic ignimbrite (1.61 Ma) and 2. Tshirege Member, composed of nonwelded to welded rhyolitic ignimbrite (1.22 Ma) (Smith and Bailey, 1966; Smith et al., 1970; Gardner et al., 1986). Goff (1994) subdivided the Tshirege Member into five subunits and a basal pyroclastic fall unit. Units 2 and 3 in the Tshirege Member are of the most relevance to Solid Waste Management Units (SWMUs) located on mesa tops. The Otowi Member is exposed along sides of major canyons, including Los Alamos, DP, and

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Table 8. List of Upper Tolerance Limits (UTL) for LANL (Laboratory) Background Soil Data collected from A, B, and C Horizons.

Analyte	SAL (mg/kg)	Mean *	Standard deviation	UTL 99%,0.95	N	N > DL
Aluminum		19000	13800	58900	47	45
Antimony	32	2.45	0.36	2.5 (MAX)	46	0
Arsenic		4.4	2.5	11.6	46	45
Barium (LT)	5,600	161	129	1140	47	45
Beryllium		1.15	0.75	3.31	47	45
Cadmium	80	0.39	0.54	2.7 (MAX)	47	3
Calcium (LT)		5790	12500	54400	47	45
Chromium (Total) †		11.7	7.8	34.2	47	45
Cobalt (LT)		15.2	7.6	51.1	47	45
Copper	3,000	5.3	3.6	15.7	47	43
Iron		14500	7320	35600	47	45
Lead	400	15.0	8.3	39.0	47	42
Magnesium (LT)		2920	2150	16100	47	45
Manganese	11,000	343	238	1030	47	45
Mercury	24	0.05	0.01	0.1 (MAX)	48	1
Molybdenum	400	NA	NA	NA	NA	NA
Nickel	1,600	9.7	5.9	26.7	47	43
Potassium		2420	1304	6180	50	50
Selenium	400	0.43	0.41	1.7 (MAX)	46	22
Silver	400	NA		NA	NA	NA
Sodium		577	453	1880	47	45
Strontium	48,000	NA	NA	NA	NA	NA
Thallium	6.4	0.27	0.24	0.9 (MAX)	45	20
Uranium	160	0.86	0.43	2.09	46	45
Vanadium	560	25	14	66	47	45
Zinc	24,000	41	21	101	47	45
40-Potassium (1)		21.6	5.07	36.1	50	50
232-Thorium (1)	5	1.71	0.34	2.68	50	50
234-Uranium (1)	86	1.21	0.29	2.03	50	50
235-Uranium (1)	18	0.052	0.012	0.088	50	50
238-Uranium (1)	59	1.14	0.27	1.90	50	50

* Concentration values <DL (detection limit) were replaced by 1/2 of the DL
† - SAL for Chromium-III is 80,000 mg/kg and for Chromium-VI is 400 mg/kg
LT - UTL is based on lbg transformed data
NA - data not available for LANL background
MAX - Maximum value is reported, rather than the UTL
(1) - Data are converted from elemental concentrations reported in the LANL background report (units are pCi/g)

Pueblo canyons, and this member is important for SWMUs located in these canyons.

In Los Alamos and DP canyons, the Otowi Member consists of white, massive, nonwelded, rhyolitic ignimbrite containing approximately 5% pumice clasts >2 cm in diameter and about 5% clasts of pre-Bandelier Tuff lithologies of sand to cobble size (Goff, 1994). The ignimbrite matrix consists of poorly-sorted ash, pumice, crystal, and lithic fragments. Phenocrysts in pumice consist of 20 % quartz and 80% sanidine (Goff, 1994). The Otowi Member is characterized by a smaller range of glass content (66-71 wt%) relative to the Tshirege Member (17-88 wt%) (Broxton et al., 1994).

The Tshirege Member is exposed throughout the Pajarito Plateau, and is characterized by variations in welding, devitrification textures, and in distribution of flow and cooling units (Baltz et al., 1963; Weir and Purtymun, 1963; Vaniman and Wohletz, 1990 and 1991). Detailed descriptions of the Tshirege Member at TA-21 are presented in Broxton et al. (1994) and Goff (1994), and these descriptions are representative of much of the Bandelier Tuff in the central and western portions of the Laboratory.

Trace elements found in the Bandelier Tuff, which are of importance to the ER Project and exceed SALs (Table 2) include As (SAL of 0.4 ppm) and Be (SAL of 0.16 ppm). Uranium and Th distributions in the Bandelier Tuff fall below the ^{238}U SAL (59 pCi/g, 177 ppm) and ^{232}Th SAL (5 pCi/g, 46 ppm). Background concentrations of many elements of concern vary between different stratigraphic layers within the Bandelier Tuff. For example, Be, Cs, Th, and U all show trends of decreasing concentration with increasing height in the Tshirege Member, with specific stratigraphic layers typically displaying less internal variation than is present between adjacent layers. There is some overlap of elemental distributions, however, between the units where the tuff samples were taken near unit contacts. Trace-element distributions in the Bandelier Tuff are controlled by trace-element fractionation occurring during magma genesis and eruptive history. Elemental distributions for U, Th, Ba, Be, and Cs are shown in Figures 19 through 28. Sample locations for Bandelier Tuff are shown in Figures 1, 2, and 3. Results of chemical analyses of Bandelier Tuff samples (reported FS 1000 numbers) are listed in Appendix II using INAA and DNAA, which provide total element concentrations. Typical U values decrease from approximately 8 ppm in unit 1g to about 3 ppm in unit 4 (Figures 19 and 20) and Th values decrease from 30 ppm to 15 ppm (Figures 21 and 22). Uranium and

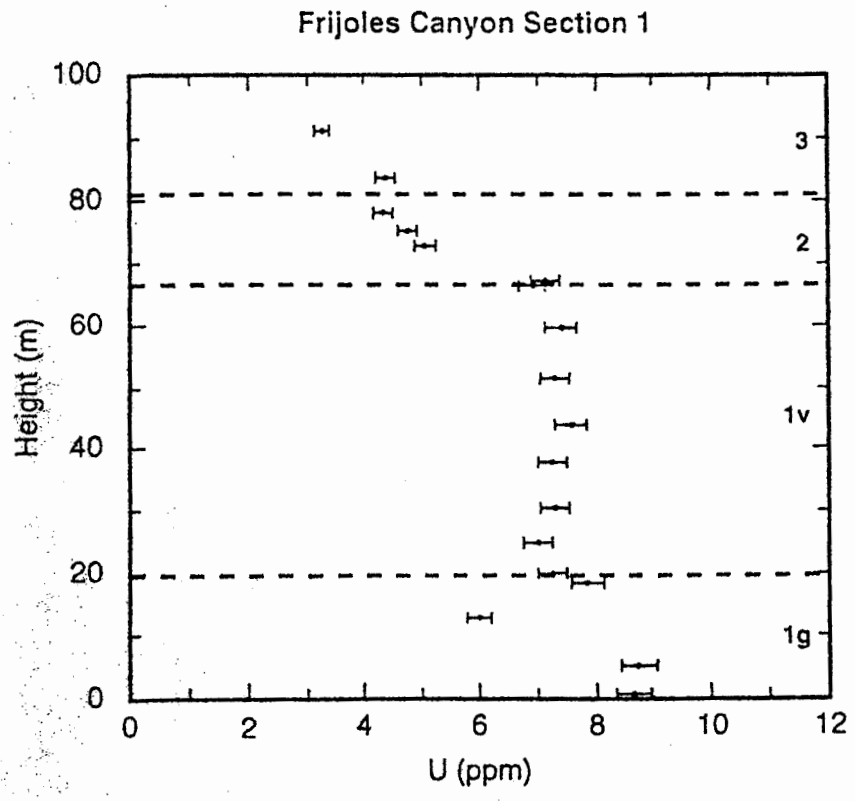

Fig. 19. Concentration of uranium in Frijoles Canyon Section 1. Bandelier Tuff units are labelled.

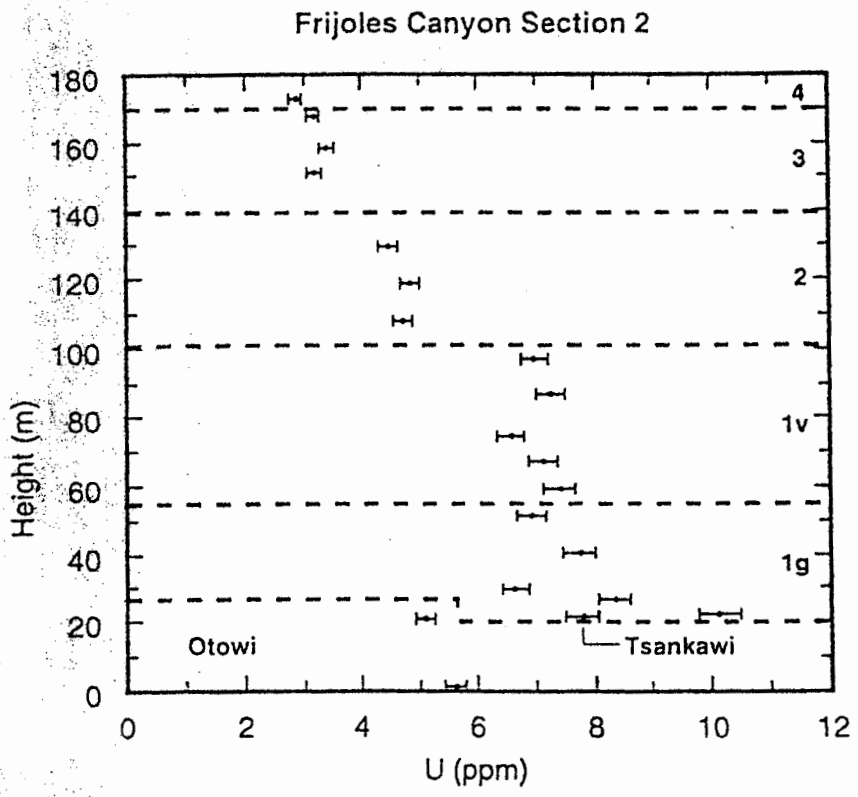

Fig. 20. Concentration of uranium in Frijoles Canyon Section 2. Bandelier Tuff units are labelled.

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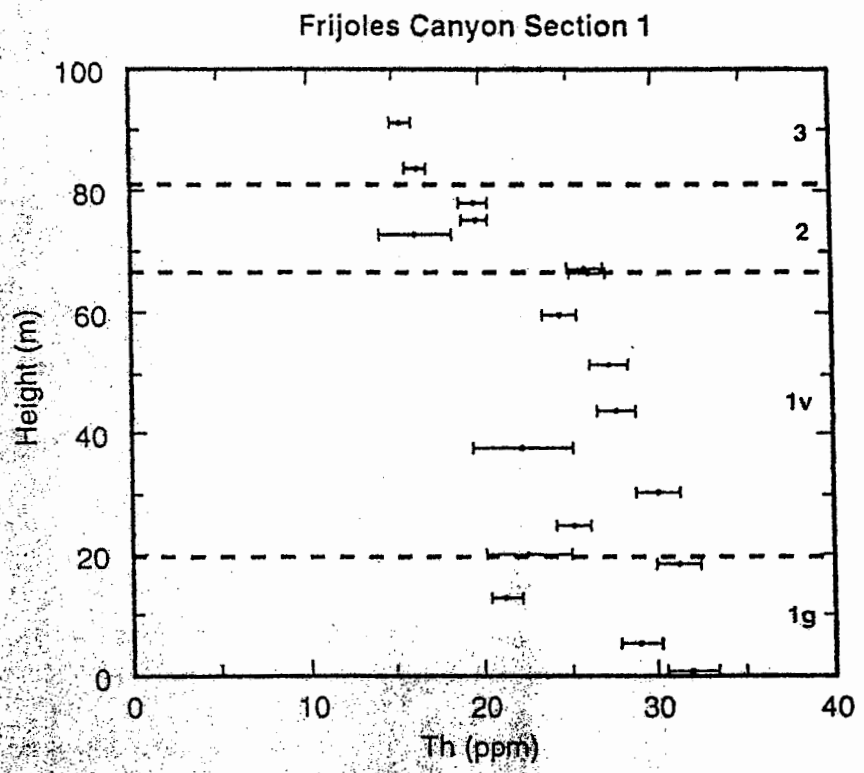

Fig. 21. Concentration of thorium in Frijoles Canyon Section 1. Bandelier Tuff units are labelled.

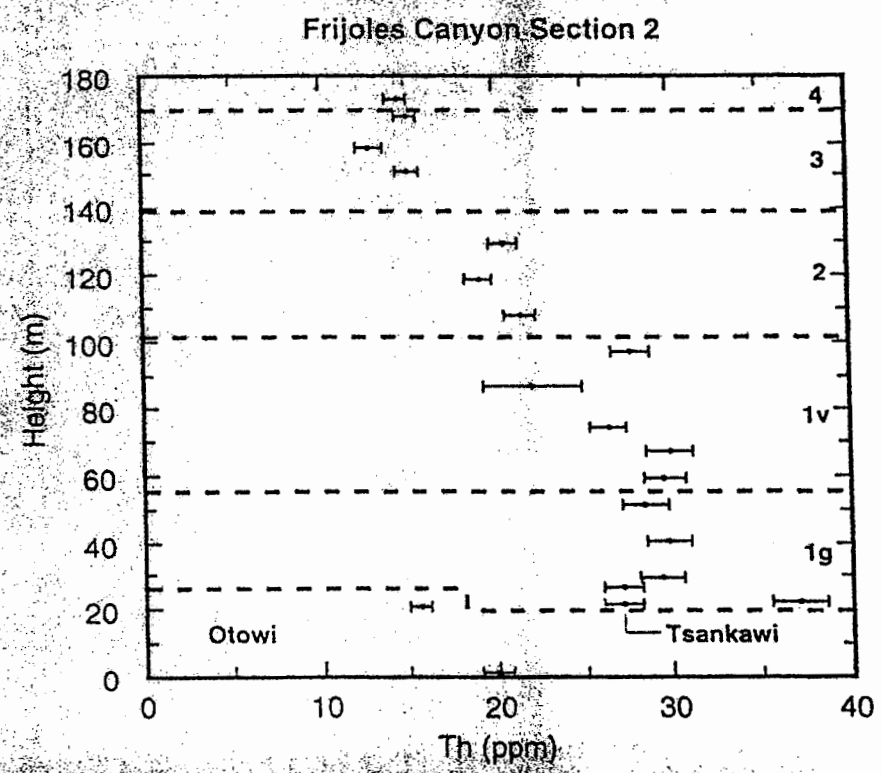

Fig. 22. Concentration of thorium in Frijoles Canyon Section 2. Bandelier Tuff units are labelled.

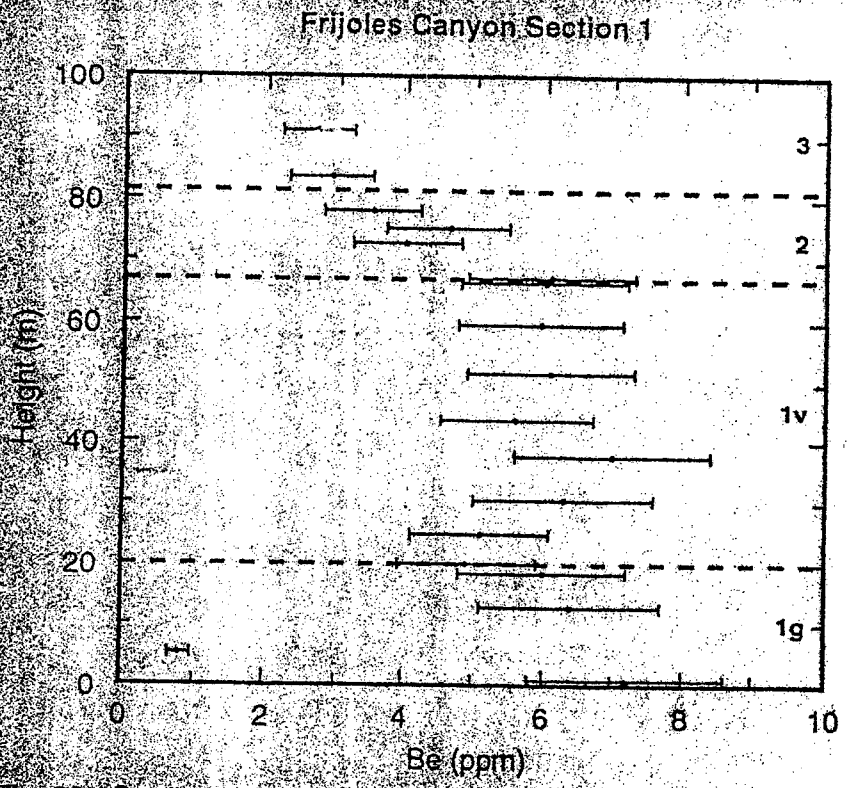

Fig. 23. Concentration of beryllium in Frijoles Canyon Section 1. Bandelier Tuff units are labelled.

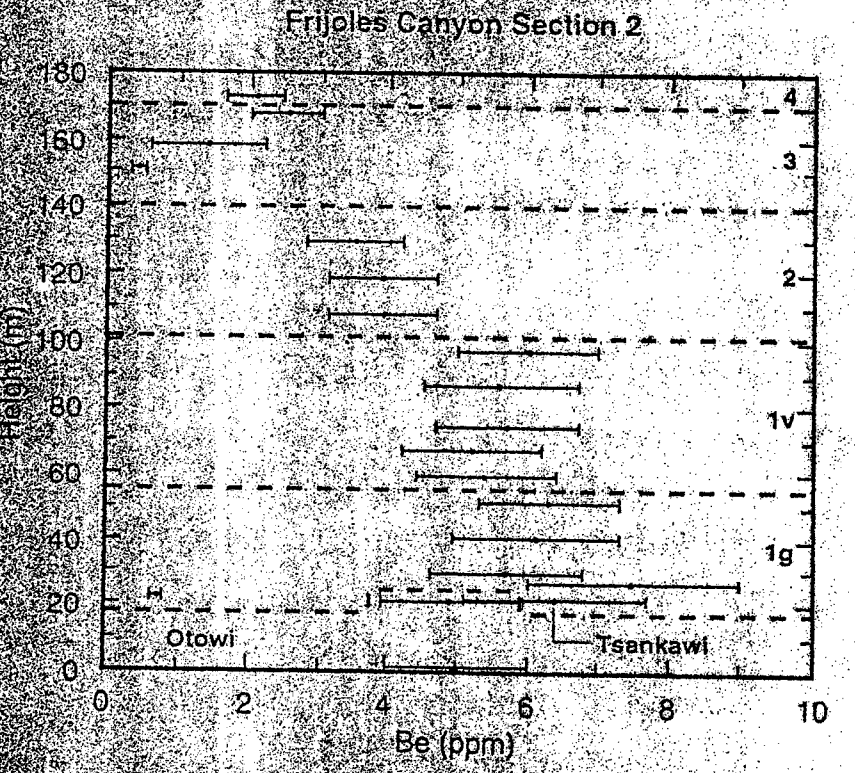

Fig. 24. Concentration of beryllium in Frijoles Canyon Section 2. Bandelier Tuff units are labelled.

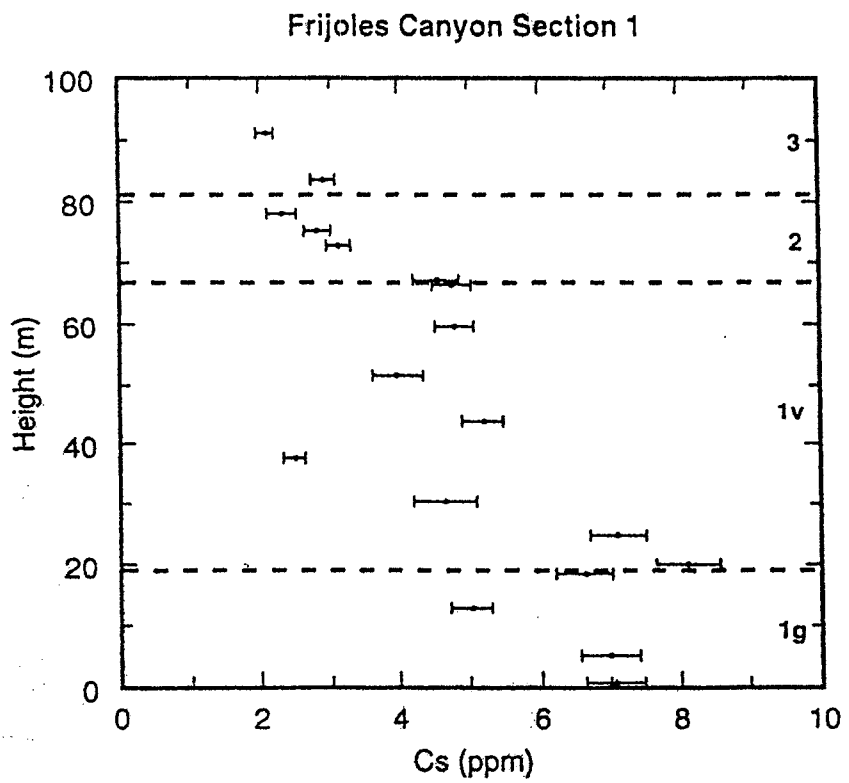

Fig. 25. Concentration of cesium in Frijoles Canyon Section 1. Bandelier Tuff units are labelled.

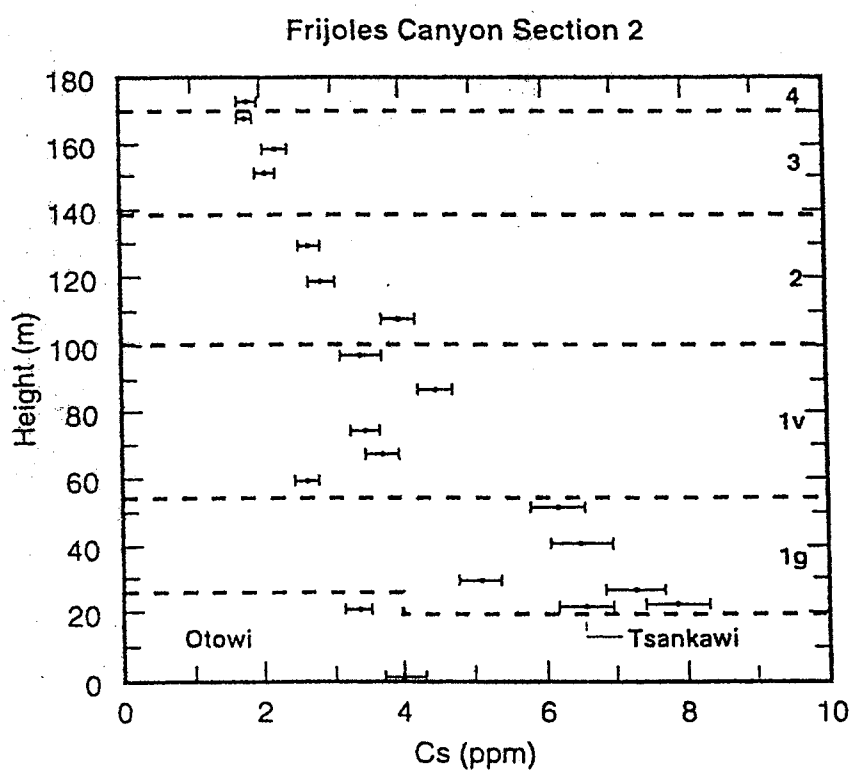

Fig. 26. Concentration of cesium in Frijoles Canyon Section 2. Bandelier Tuff units are labelled.

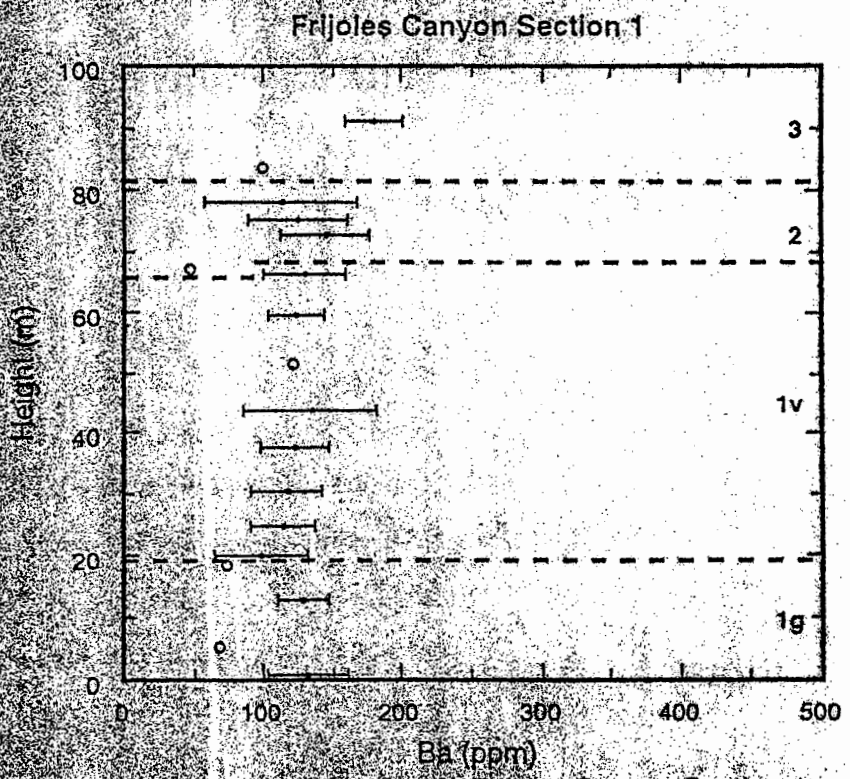

Fig. 27. Concentration of barium in Frijoles Canyon Section 1. Bandelier Tuff units are labelled. Open circles indicate analyses below detection limits.

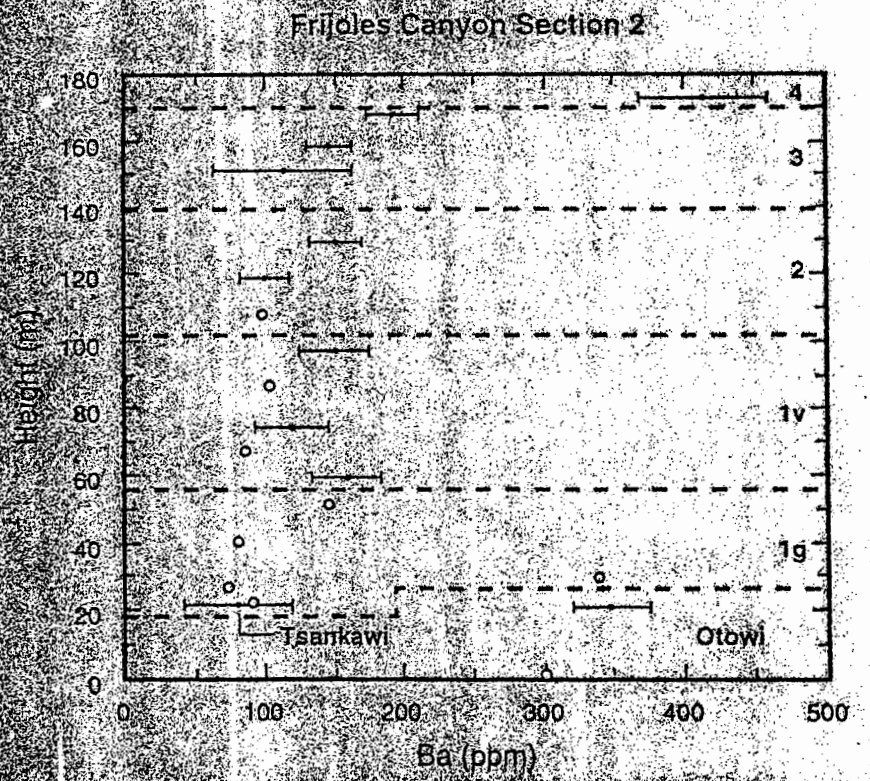

Fig. 28. Concentration of barium in Frijoles Canyon Section 2. Bandelier Tuff units are labelled. Open circles indicate analyses below detection limits.

Th probably occur in glass and in trace phases including allanite ((Y, Ce,Ca)$_2$-(Al, Fe)$_3$(SiO$_4$)$_3$OH), perrierite ((Ca,Ce,Y, Th)$_4$- (Fe, Mg)$_2$(Ti,Fe)$_3$Si$_4$O$_{22}$) and chevkinite ((Ca,Ce,Th)$_4$(Fe, Mg)$_2$(Ti,Fe)$_3$Si$_4$O$_{22}$). The ionic radius of U (IV) in VIII coordination is 1.00 angstroms, which substitutes for Ca (II) with an ionic radius of 1.04 angstroms (Shannon and Prewitt, 1969).

Distributions of Ba, Be, and Cs in the Tshirege Member are shown in Figures 23 and 24, 25 and 26, and 27 and 28, respectively. Barium concentrations fluctuate with height from unit 1g (80-131 ppm) to unit 2 (113-150 ppm) and increase in unit 3 (113-192) and unit 4 (414 ppm) (Figures 23 and 24). Beryllium (Figures 25 and 26) and Cs (Figures 27 and 28) concentrations dcrease from approximately 6 ppm to about 2 ppm with increasing height. Although a few samples of the Otowi member were obtained in this study, concentrations of U, Th, Be, and Cs within the Otowi member fall between the minimum and maximum observed within the Tshirege Member. Average concentrations obtained from the Otowi member for U is about 5 ppm, for Th is about 18 ppm, for Be is about 5 ppm, and for Cs is about 4 ppm.

The Bandelier Tuff generally shows less variation in trace-element chemistry than do soils. Beryllium, Th, and U, however, are found in higher concentrations in the Bandelier Tuff than in soils. These differences are believed to occur because the Bandelier Tuff is considered to be the primary parent material for only a small percentage of the soils on the Pajarito Plateau.

SUMMARY OF GENERAL SOIL AND BANDELIER TUFF CHARACTERISTICS

Soils present on the Pajarito Plateau are extremely variable in physical and chemical properties, including particle size, percent calcium carbonate, clay mineralogy, iron oxides, and trace-element chemistry. Soils have higher concentrations of Al, As, Ba, Ca, Cs, Co, Cr, and Fe relative to Bandelier Tuff samples. The Bandelier Tuff, however, is characterized by higher concentrations of Be, Pb, Na, K, Th, and U than in soils. Background concentrations of As and Be exceed SALs for these elements. Therefore, background concentrations of As and Be should be used rather than SALs for these elements in evaluating whether soil, sediment, and tuff samples are contaminated. In addition, because of the dependence of As and Be on soil

development, the selection of appropriate background samples for a specific site should include a consideration of local soil characteristics.

Well-developed soils have higher concentrations of trace elements relative to weakly developed soils found on the Pajarito Plateau. The B horizons are higher in trace elements relative to A and C horizons. High abundances of clay minerals and iron oxides, characterized by relatively high surface areas, within B horizons control trace-element concentrations in soils. In addition, variations in soil-elemental concentrations are related to chemical characteristics of a particular soil horizon and to the parent material, which includes of alluvial fans, sheet-wash material, colluvium, wind-blown sediment, and the Bandelier Tuff.

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PART II.

NATURAL BACKGROUND GEOCHEMISTRY, GEOMORPHOLOGY, AND PEDOGENESIS OF SELECTED SOIL PROFILES, LOS ALAMOS, NEW MEXICO, 1995

INTRODUCTION

Part II presents descriptions of the geochemistry, geomorphic setting, and soil profiles at the background-soil sampling sites on the Pajarito Plateau. The geomorphic setting was described to provide a better understanding of factors that have influenced the variations in soil characteristics. Eventually, it may be possible to relate the geochemical characteristics of a site to the geomorphic setting, allowing reasonable extrapolation of the background-soils data. The geomorphic characterization of each site also provides insight into the history of landscape change on the Pajarito Plateau, which will aid in constraining future transport of contaminated soils at the Laboratory. Site-specific geochemistry of each soil profile is also presented. Geochemical characteristics of soils on the Pajarito Plateau vary widely related to local variations in parent material, topography, soil age, surficial processes, climate, and vegetation.

The age of the sampled deposits range from several thousand years to perhaps as old as one million years. Ages for the younger deposits were determined by radiocarbon dating of charcoal contained within the deposits, with the radiocarbon ages converted to calibrated calendar ages using the computer program of Stuiver and Reimer (1993). At least two radiocarbon dates were obtained from individual sites to provide a check on the reliability of the ages. Ages of some of the older deposits are inferred from their relation to the El Cajete pumice, which was erupted from a vent in the Valles caldera. Although conflicting ages have been obtained for the El Cajete pumice, available data suggest an age of about 60 ka (thousands of radiocarbon years before present) (see Reneau et al., 1994). The oldest background-soil sample site includes alluvial clasts deposited on Twomile Mesa before initial incision of canyons on the western part of the Pajarito Plateau, and the only age constraint is post-1.22 Ma (million years ago), the age of the Tshirege Member of the Bandelier Tuff (Izett and Obradovich, 1994).

Trace-element geochemistry of each soil profile varies as functions of soil age, mineralogy of soil and parent material, the amount and composition of eolian dust,

degree of chemical weathering, and hydrology. This study generally focuses on As, Be, Fe, Th, and U distributions in each soil profile. Background concentrations of As and Be in soils and Bandelier Tuff exceed SALs for As (SAL of 0.40 ppm) and Be (SAL of 0.16 ppm). General discussions of the geochemical characteristics of As, Be, Fe, Th, and U are provided below to provide a context for understanding their likely behavior within Laboratory soils.

Under environmental pH conditions (5-9) encountered in most soils, dissolved As occurs as neutral species or oxyanions in +3 ($H_3AsO_3^0$, $H_2AsO_3^-$) or +5 ($H_2AsO_4^-$, $HAsO_4^{2-}$) valence states. Studies of As adsorption onto adsorbent surfaces show that uptake is controlled to a large degree by the content of extractable Fe and Al hydrous oxides occurring as amorphous or cryptocrystalline phases (Jacobs et al., 1979; Wauchope, 1975; Livesey and Huang, 1981). Arsenic adsorption is largely controlled by the surface area of the adsorbent, and experimental studies have shown that amorphous $Fe(OH)_3$ and $Al(OH)_3$ (Ferguson and Anderson, 1974; Anderson et al., 1976; Pierce and Moore, 1980; Gupta and Chen, 1978; Leckie et al., 1980; Wangen et al., 1982) have higher sorptive capacities relative to lattice silicates (Frost and Griffin, 1977; Huang, 1975). Adsorption of As (V) (AsO_4^{3-}) onto Fe oxides is similar to PO_4^{3-} (Wauchope, 1975; Holm et al., 1979), whereas As(III) retention is considerably less (Gupta and Chen, 1978; Ferguson and Anderson, 1974; Holm et al., 1979). Both As(III) and As (V) species probably are stable in soil-pore waters at the different sites depending on Eh. Precipitation/dissolution reactions of As in soils have not been extensively investigated. Several As minerals including AsS, As_2S_3, $FeAsO_4$ are stable over wide ranges of Eh and pH conditions; however, several investigators conclude adsorption processes dominate over precipitation reactions involving As retention in soils. Enrichment of As in soil correlates with soil development, specifically the formation of B horizons containing iron oxides, clay minerals, and solid organic matter as dominant adsorbents.

Beryllium is an important element at the Laboratory because of its used in detonation of ballistics. Beryllium forms hydroxo complexes ($BeOH^+$, $Be(OH)_2^0$, and $Be(OH)_3^-$) above pH 6 (Rai and Zachara, 1984). There are very little data available on adsorption and precipitation/dissolution reactions of Be. Available thermochemical data suggest that β-$Be(OH)_2$ is moderately insoluble and this phase precipitates rapidly from solution (Rai and Zachara, 1984). There is some evidence that Be adsorption onto soil surfaces (iron oxides and clay minerals) is pH dependent. Column experiments conducted by Alesii et al. (1980) and Korte et al. (1976) show that Be was more strongly attenuated then were Zn, Cd, Ni, and Hg. These investigators report that

only Cu and Pb showed less mobility than Be. Korte et al. (1976) suggest that calcareous soils high in clay minerals appear to be effective in Be retention. Calcareous, clay mineral-rich soils are found at Site 7, Ancho Canyon mesas, and at other locations at the Laboratory, and these experimental studies may have relevance to this investigation.

Iron, in the forms of iron oxide, amorphous ferric hydroxide, and ferric oxyhydroxide, is an important soil constituent. Arsenic, Be, Ni, and other trace elements correlate well with Fe in the soil profiles characterized in this investigation. Iron forms free species (Fe^{2+} and Fe^{3+}) and hydroxo complexes ($Fe(OH)_2^+$, $Fe(OH)_3^0$, and $Fe(OH)_4^-$) above pH 6 (Rai and Zachara, 1984). Iron forms several sparingly soluble phases in soil, including $Fe_3(OH)_8$, amorphous $Fe(OH)_3$, and FeOOH, under different oxidation-reduction conditions. These solids are important adsorbents for many transition metals found at the Laboratory and elsewhere.

Thorium and U are important actinide elements that occur naturally in the Bandelier Tuff and soils on the Pajarito Plateau, and these elements also occur above background concentrations resulting from Laboratory activities. An understanding of background elemental distributions of Th and U will provide constraints on the fate and transport of anthropogenic actinides. Under relatively oxidizing conditions, U(VI) forms stable carbonato complexes ($UO_2CO_3^0$, $UO_2(CO_3)_2^{2-}$, and $UO_2(CO_3)_3^{4-}$) above pH 6 (Langmuir, 1978; Brookins, 1989). These carbonato complexes adsorb onto surfaces of iron oxides and clay minerals; however, desorption of these complexes under alkaline pH conditions has been experimentally investigated (Tripathy, 1988; Hsi and Langmuir, 1985) and confirmed in the field at uranium-mill tailings impoundments (Longmire, 1991). Thorium is stable in the 4+ valence state and forms hydroxo complexes ($Th(OH)_3^+$ and $Th(OH)_4^0$) above pH 4 in organic-free solution (Langmuir and Herman, 1980). Thorium hydroxo species strongly adsorbed onto iron oxides and clay minerals.

Soil samples were analyzed for total-element concentrations using INAA, for Fe, As, Th, and other elements, and DNAA for U. The same samples were digested using concentrated HNO_3 and were analyzed for the same elements using EPA-SW846 methods, including ICPES, ICPMS, IC, and ETVAA. In most instances, element concentrations from HNO_3 digestion are less than the total-element concentrations determined from INAA and DNAA. Element leaching from soils is evaluated by comparing analytical results from HNO_3 digestion to those obtained from INAA and DNAA. Large differences in concentrations of the total element and HNO_3-digested samples suggest that minimal leaching has occurred and most of the element is

chemically bound or tied up within the silicate mineral. Small differences in element concentrations between HNO_3-digested samples and total-element analyses suggest that elements have been mobilized and concentrated on surfaces and/or coprecipitated with acid-soluble phases including ferric hydroxide, ferric oxyhydroxide, calcium carbonate, and clay minerals such as smectite and kaolinite.

Site 1, Lower Los Alamos Canyon, near Tsankawi

Location and Geomorphic Setting

The soil sampling site in lower Los Alamos Canyon is located on the outside of a bend in the stream channel, where the stream has eroded the bank and exposed a 2-m thick sedimentary section (Figure 29). The exposure is of the lower end of a fan derived from erosion of non-welded units of the Bandelier Tuff, predominantly the Otowi Member and the lowest part of the Tshirege Member. Sediments of the Puye Formation that underlie the Otowi Member also contribute some material to the fan. The fan immediately overlies Los Alamos Canyon stream gravels (Figure 30) and records the burial of a gravel bar by progradation of the fan, presumably during a period of rapid erosion of the adjacent slopes. This site may be representative of de[illegible]s derived from non-welded parts of the Bandelier Tuff that have had minimal ime for soil development.

Two radiocarbon dates were obtained from this exposure: from detrital charcoal contained within the basal fan sediments and from a burned stump that was rooted in he stream gravels (Figure 30, Table 9). These dates are statistically indistinguishable at about 2.6 ka (calibrated (cal) calender age of about 2.8 Ka, Table 10), and indicate hat the soil overlying this fan developed during a period of less than 2800 years. The lates also document that the stream channel was near its present level about 2800 ears ago. In addition, these dates document that extensive erosion of these slopes occurred before arrival of homesteaders and Anasazi Indians, although the period of erosion in lower Los Alamos Canyon was later than that recorded at the EG&G gully s is discussed later.

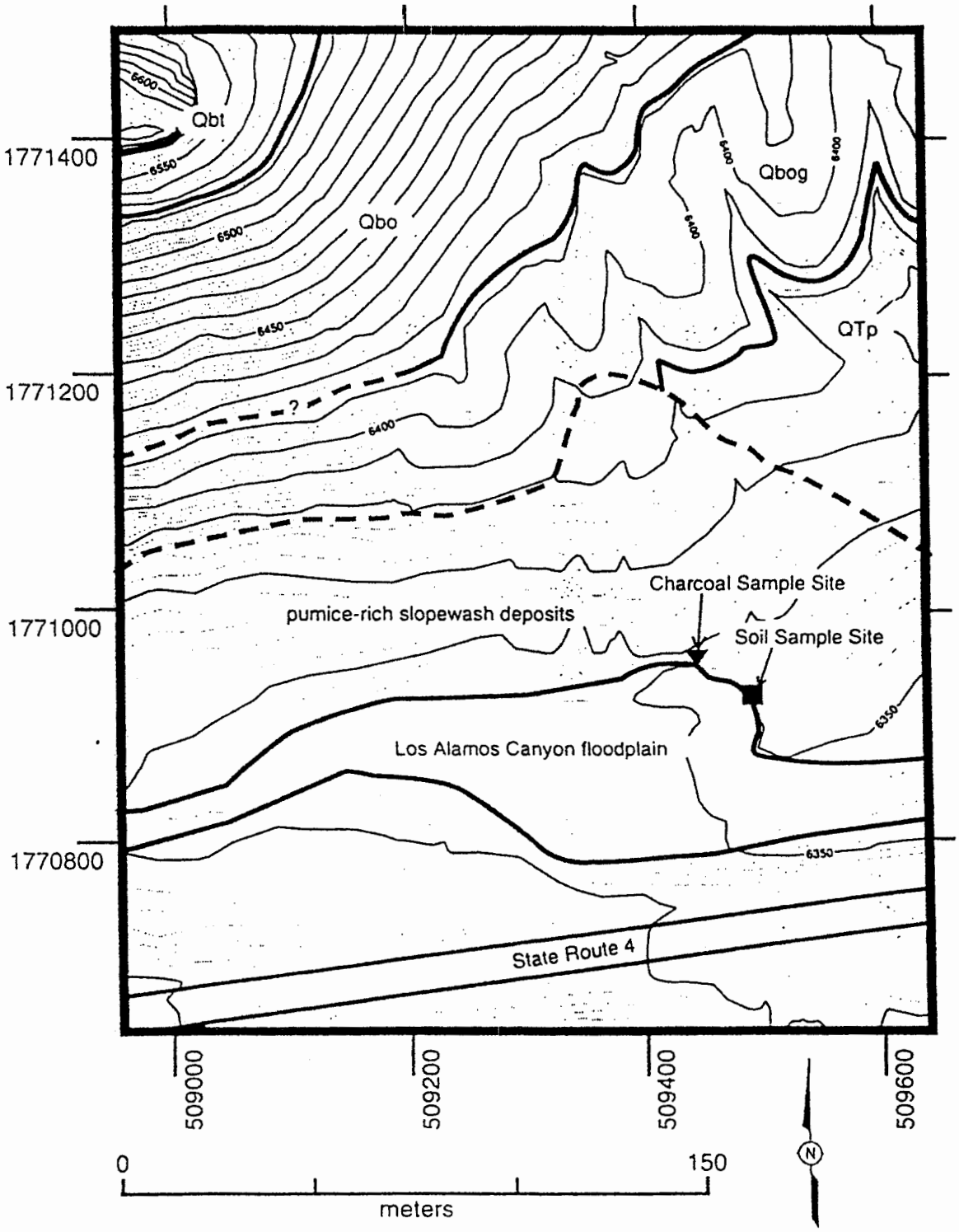

Fig. 29. Map of sample site 1 in lower Los Alamos Canyon. Qbt is Tshirege Member, Bandelier Tuff; Qbo is Otowi Member; Qbog is Guaje Pumice Bed; QTp is Puye Formation. Topographic base, with 2-foot contours, from FIMAD.

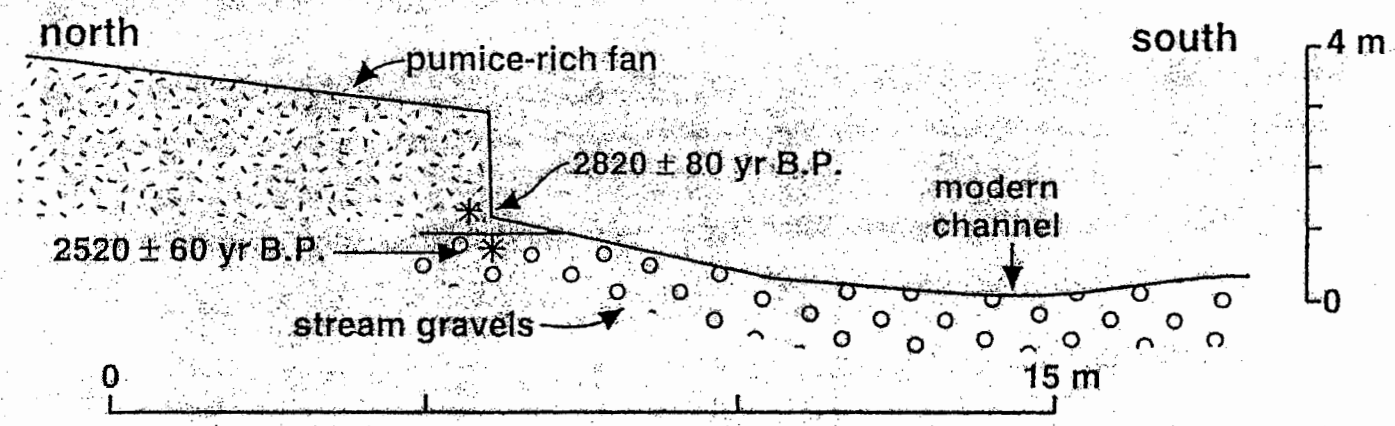

Fig. 30. Cross section of radiocarbon site in lower Los Alamos Canyon, showing pumice-rich fan overlying Los Alamos Canyon stream gravels. Soil sample site 1 is 15 m to southeast.

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Table 9
Radiocarbon Dates From 1992 Laboratory-Wide Studies Soil Sample Sites

Laboratory Number *	14-C Date (yr B.P.)	Calibrated Age **	Notes
EG&G Gully, shallow valley fill on townsite mesa			
Beta-55622	8050±130***	8980 cal BP (8337-9522)	2.45-2.5 m deep; coarse sediments below buried soil
Beta-59677	7875±85	8580 cal BP (8327-9206)	3.55 m deep; 0.6+ m above base (ETH-10060)
Beta-55626	3970±80	4420 cal BP (3930-4848)	0.78-0.86 m deep; burn layer
Upper Los Alamos Canyon, 7255' stream elev., soil beneath fir forest			
Beta-55620	3060±100***	3270-3340 cal BP (2771-3809)	1.35 m deep, charcoal in colluvial deposit
Beta-55621	2150±100***	2150 cal BP (1639-2472)	0.8-0.9 m deep, charcoal in buried soil
Lower Los Alamos Canyon, 6345' stream elev., pumice-rich fan			
Beta-55623	2820±80	2880-2930 cal BP (2509-3380)	1.9 m deep; basal slopewash
Beta-55624	2520±60	2720 cal BP (2326-2852)	2.25 m deep; stump rooted in stream gravels
Water Tanks Trench, West Jemez Road****			
Beta-56176	1120±80***	1060 cal BP (723-1342)	0.25 m deep, loess?
TO-3414	5840±90	6670 cal BP (6289-7156)	0.65 m deep

Notes:

* Laboratory numbers: Beta indicate analyses b y Beta Analytic Inc., TO indicates AMS (accelerator mass spectrometry) analyses by Toronto; and ETH indicates an AMS analysis by ETH-Zurich.

** Calibrated ages were obtained using the computer program CALIB 3.0 (Stuiver and Reimer, 1993), with an error multiplier of 2.0 and 2σ uncertainty. Ages in ( ) are 2σ range. For samples that were not corrected for δ13C in laboratory, the δ13C value was assumed to be -23.2 ± 0.9 o/oo based on δ13C values of 16 samples collected from the Pajarito Plateau.

*** Radiocarbon date was not corrected for δ13C in laboratory.

**** Radiocarbon dates presented in Wong et al. (1993).

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Table 10
Averaged Radiocarbon Ages

Sample Site	Averaged 14-C Age (yr B.P.)*	Calibrated Age**	Samples
Lower Los Alamos Canyon	2629 ± 97	2750 cal BP (2373-2930)	Beta-55623, Beta-55624
EG&G gully, basal unit	7937 ± 144	8670-8710 cal BP (8405-9221)	Beta-55622, Beta-59677

Notes:

* Averaged radiocarbon ages were obtained using CALIB 3.0 (Stuiver and Reimer, 1993) with an error multiplier of 2.0 for the original analyses. Average ages were only obtained from the same or adjacent units at a site where there is no statistically significant difference between sample ages.

** Calibrated ages were obtained using CALIB 3.0 (Stuiver and Reimer, 1993), with 2σ uncertainty. Ages in ( ) are 2σ range.

Soil Description

Soil samples collected from the lower Los Alamos Canyon site are listed in Table 7 and results of chemical analyses are provided in Appendices I and II. This site represents a poorly developed soil characterized by A, C, and 2Cb horizons (Watt and McFadden, 1992). Thicknesses of these horizons are A (0-10 cm), C (10-22 cm), and 2Cb (22+ cm). Organic carbon values range from 0.09 to 2.66 wt%, where the highest abundance is within the A horizon. This soil profile contains some clay enrichment, and abundances of clay-size material varies from 2.4 to 7.4 wt%. Sand-size material varies from 73.5 to 83.4 wt%, indicating that this soil profile has a relatively high hydraulic conductivity in comparision to clay-rich soils found on the Pajarito Plateau (Table 4, K range from 10^{-3} to 1 cm/sec). Silt-size material ranges from 14.2 to 20.6 wt% at this soil site.

Soil Chemistry

The A horizon of this soil profile is characterized by an acidic pH (5.4), possibly resulting from deprotonation of organic acids, specifically humic substances consisting of carboxylic acids (Sposito, 1989; Stevenson, 1994; Thurman, 1985). Calcium carbonate concentrations are relatively low within the soil horizons at this site, varying from 0.4 to 0.6 wt% (Watt and McFadden, 1992). The underlying C and 2Cb horizons are slightly less acidic (pH of 6.6 for C and pH of 6.5 for 2Cb), indicating that some $CaCO_3$ (0.6 wt%) is present as a buffering agent.

Total Fe concentrations range from 1.14 to 1.31 wt% (Figure 31), which are determined from INAA. Acid-digested Fe concentrations range from 0.33 to 0.38 wt% comprising 25 to 29% of total Fe. These concentration distributions suggest that most of the Fe occurs in refractory phases such as hornblende, magnetite, and biotite and only small amounts of acid-digested iron oxides are present. Adsorption of trace elements onto iron oxides and clay minerals is probably minimal in this undeveloped soil profile due to absence of B horizons and lack of appreciable abundances of clay-size material partially consisting of clay minerals and iron oxides.

This poorly developed soil is low in most trace elements, excluding Th and U, which occur in higher concentrations in the parent material (Otowi Member) relative to the Tshirege Member (Appendices I and II). These two elements probably are concentrated primarily in glass and accessory mineral phases. Distributions of Th and U versus depth are shown in Figure 32. Total Th and U concentrations increase in

Figure 31

BACKGROUND SOIL, SITE 1. LOWER LOS ALAMOS CANYON.

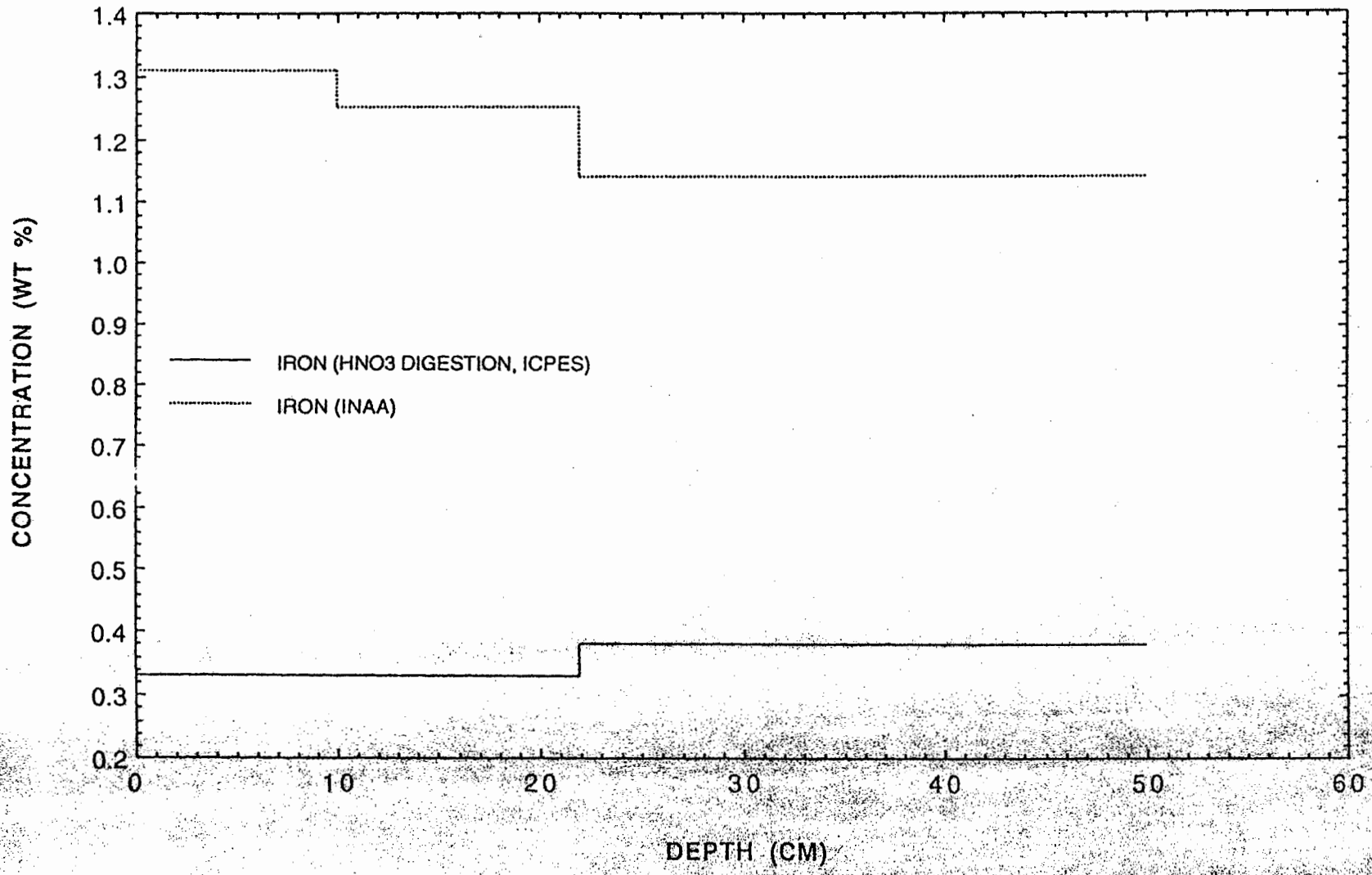
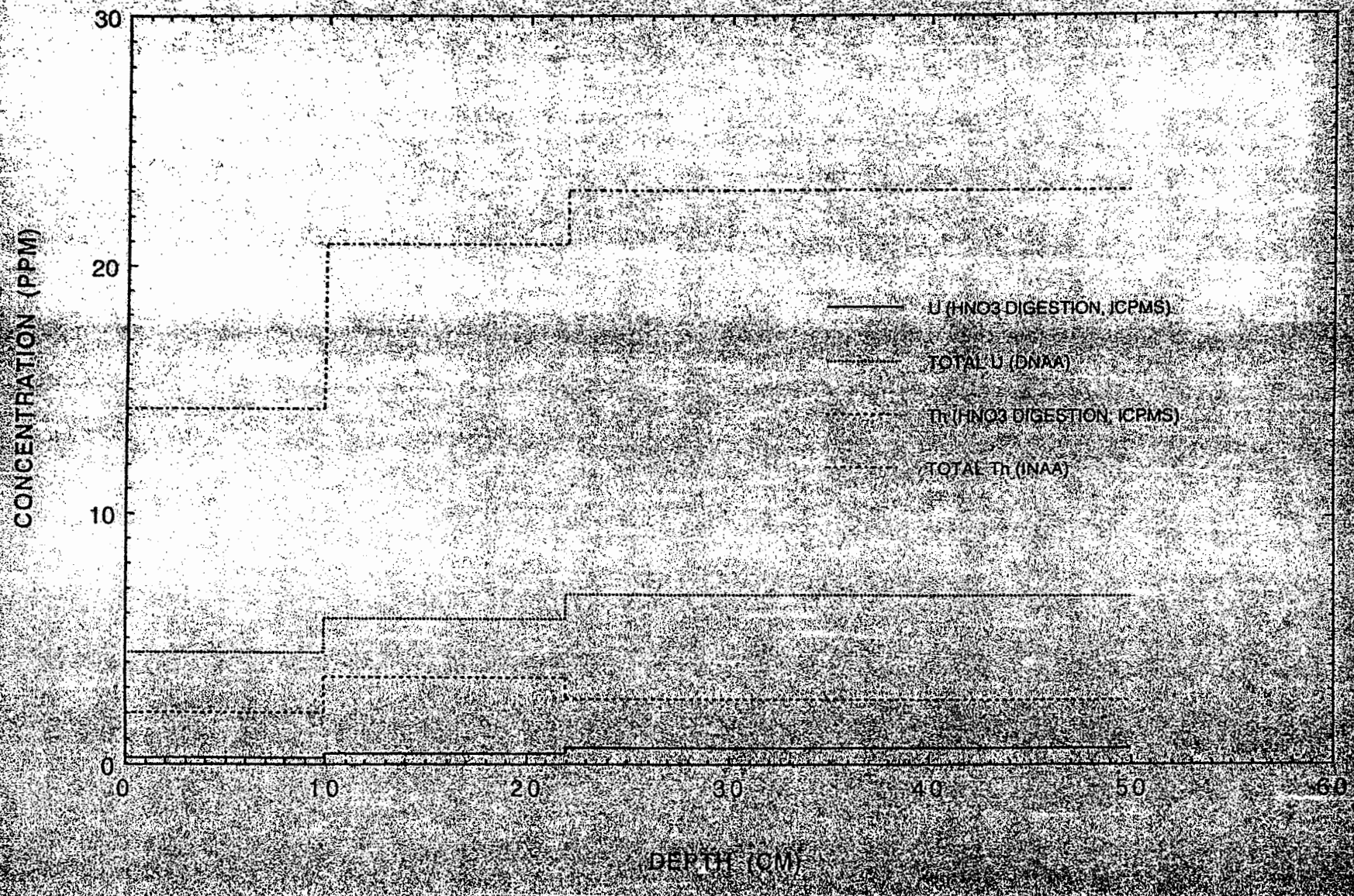


Figure 32

BACKGROUND SOIL, SITE 1, LOWER LOS ALAMOS CANYON.



depth, and these two elements are enriched in the 2Cb horizon. There are larger differences between total element and acid-digested concentrations of Th relative to U. Thorium appears to be less leachable than U, although Th is more abundant in soils and Bandelier Tuff than U. If extensive leaching had occurred, a narrower range between total element and the acid-digested fraction would be observed. In mildly acidic, organic-free aqueous solutions, Th forms insoluble hydrolysis species, for example $Th(OH)_4^0$ (Langmuir and Herman, 1980), whereas as U in the U(VI) oxidation state forms soluble complexes with CO_3^{2-} ligands including $UO_2CO_3^0$, $UO_2(CO_3)_2^{2-}$, and $UO_2(CO_3)_3^{4-}$ (Brookins, 1988; Langmuir, 1978).

Figure 33 shows distributions of As and Be versus depth. Beryllium is higher in the C and 2Cb horizons, whereas As shows higher concentrations in the A and 2Cb horizons (Figure 33). Total Be and As concentrations range from 3.2 to 4.4 ppm and from 1.20 to 1.68 ppm, respectively. Acid-digested Be comprises 7 to 10% of total Be present in the soil at this site. Distributions of acid-digestable As range from 48 to 58% of total As. Arsenic is possibly associated with eolian dust, Tschicoma Formation dacites, volcanic glass, and trace amounts of primary sulfide minerals possibly present in the Otowi Member. Arsenic distributions in soils are controlled by adsorption and coprecipitation reactions involving illite and oxides-hydroxides of Al, Fe, and Mn (Sposito, 1989). Natural leaching of these two elements from primary silicate and possibly sulfide phases probably has not occurred to a significant extent, because the HNO_3-digested fraction is considerable less than total-element concentrations. Beryllium appears to be less leachable than As, based on larger concentration differences observed between total element and the acid-digested fraction. Beryllium is primarily enriched in feldspars replacing silicon (Si) within tetrahedral sites (Bues, 1961). Ionic radii of Be^{2+} and Si^{4+} are 0.27 and 0.26 angstroms, respectively, for IV coordination (Shannon and Prewitt, 1969). Bues (1961) reports that 85 to 98% of the total Be may be bound in the feldspar structure prior to hydrolysis leading to formation of clay minerals. Background concentrations of As and Be exceed soil SALs for these two elements (Table 2), although the soil is poorly developed at this site.

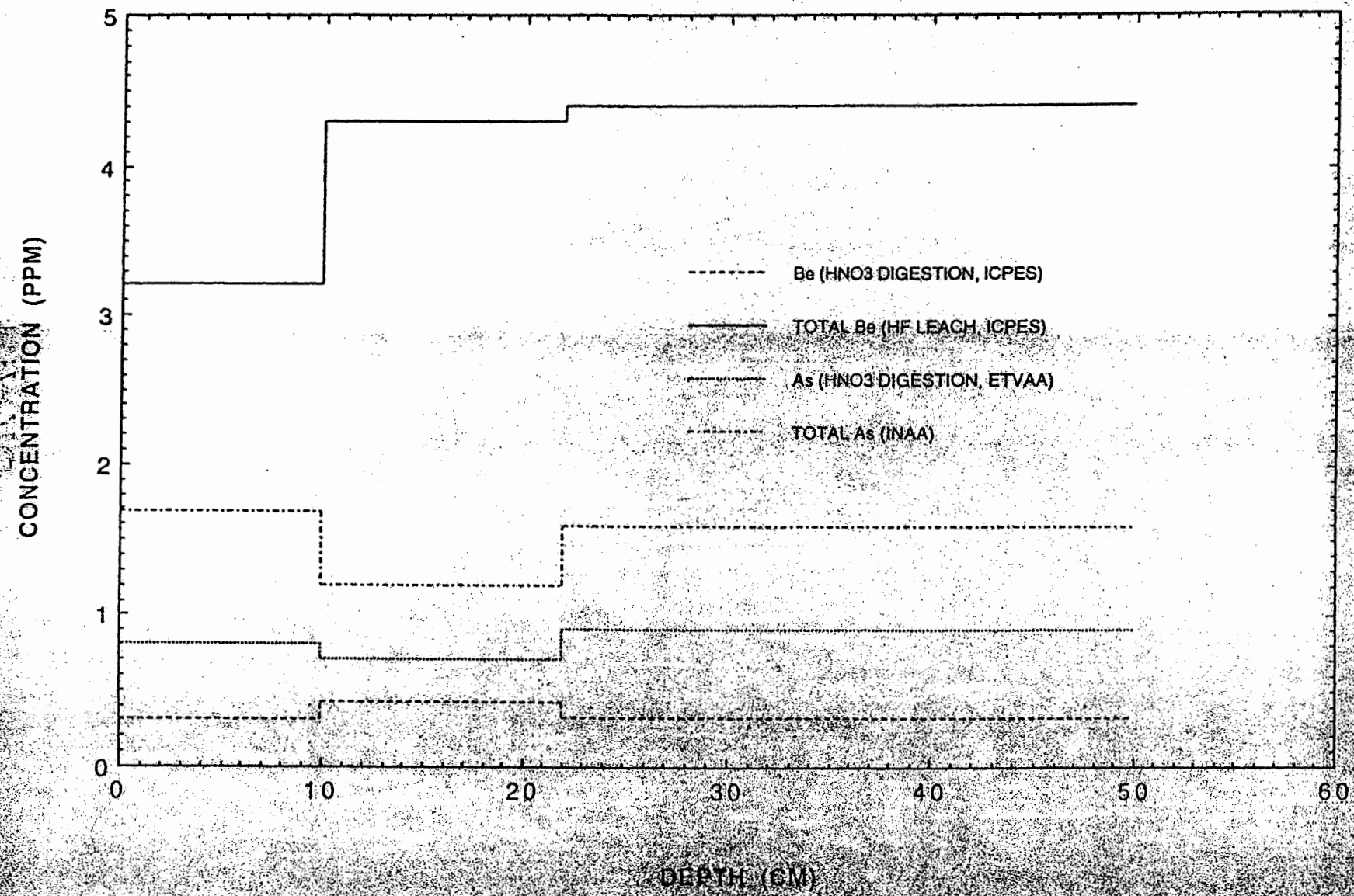
Site 2. EG&G Gully, East Road

Location and Geomorphic Setting

"EG&G gully" (informal name) is located on the south side of East Road (State Route 502) near the EG&G building (Figure 34). The gully is incised 3 to 4 m into a

Figure 33

BACKGROUND SOIL, SITE 1. LOWER LOS ALAMOS CANYON.



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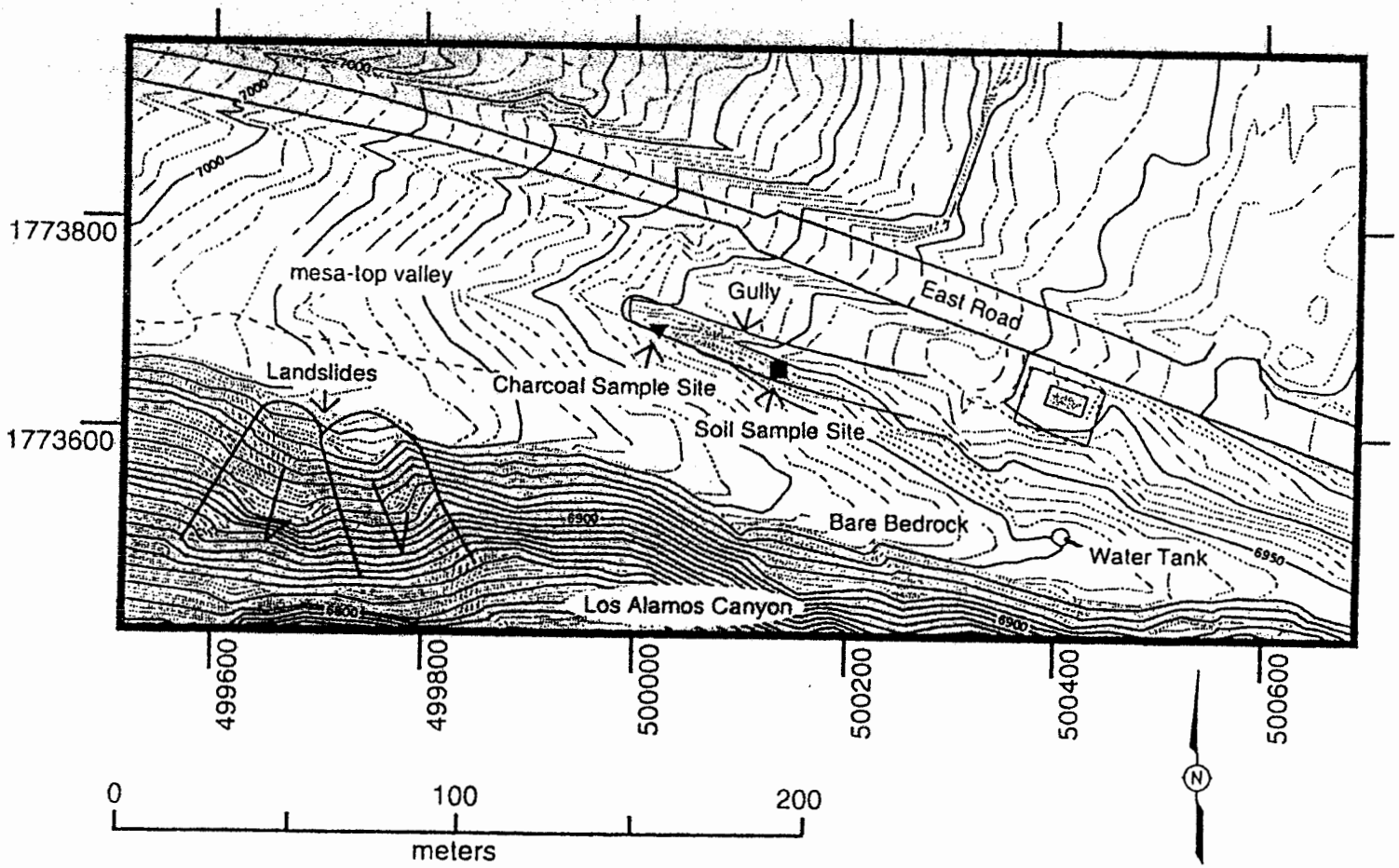

Fig. 34. Map of EG&G gully sample site 2. Topographic base, with 2-foot contours, from FIMAD.

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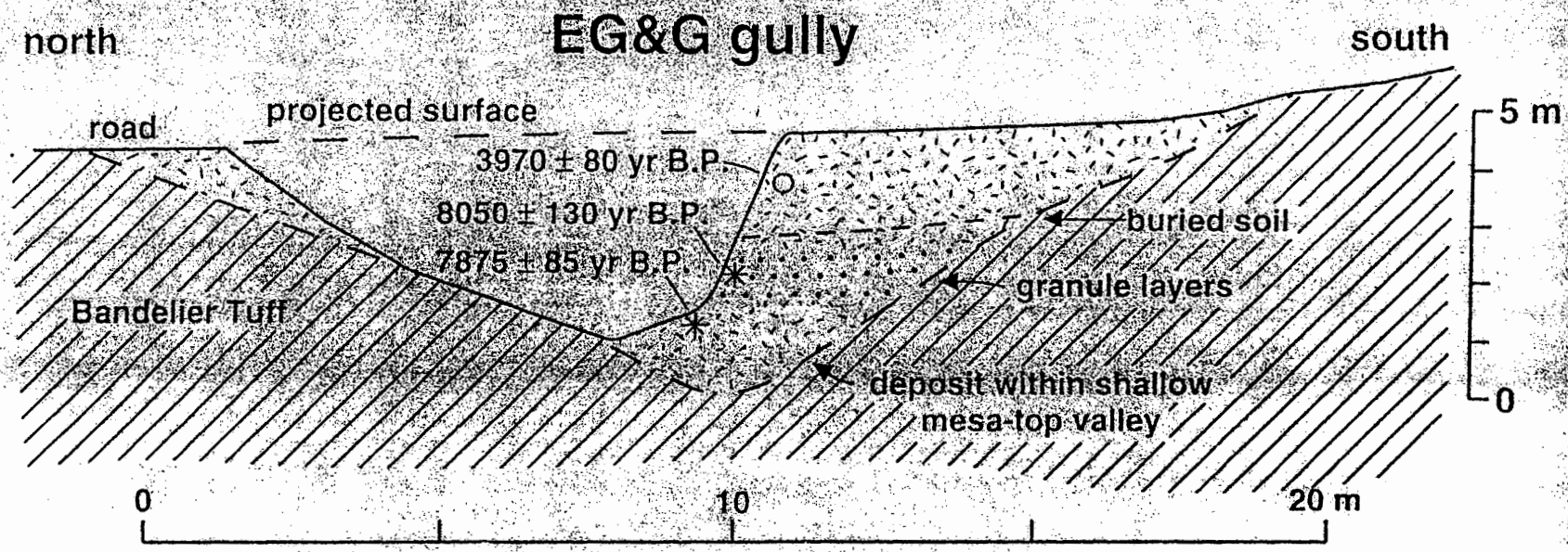

Fig. 35. Cross section of EG&G gully at soil sample site 2, showing stratigraphy of deposit within shallow mesa-top valley and location of radiocarbon dates. Uppermost radiocarbon date was obtained 40 m to west.

sedimentary deposit that partially fills a shallow mesa-top valley (Figure 35). This valley heads about 300 m (1000 ft) to the west, and is cut into unit 3 of the Tshirege Member of the Bandelier Tuff, draining over a waterfall into Pueblo Canyon to the east. The source for the valley fill is material eroded off the mesa to the west, probably including a combination of weathered tuff and soils previously developed on the mesa top; the latter probably includes components of wind-blown dust deposited on the Pajarito Plateau. Extensive areas of bedrock occur on the surrounding slopes, presumably exposed by erosion as the valley fill was deposited. The sample site is mapped as part of the Hackroy soil series by Nhyan et al. (1978), although soils here are much thicker than typical for the soil series and may, in part, represent redeposition of eroded Hackroy soils. The source and composition of the sediments in this valley fill may be representative of similar settings where sediment eroded from the mesa tops is deposited, although the age and soil development of such deposits may vary significantly.

The valley fill is composed of two units separated by a buried soil that represents a period of stability of the valley (Figure 36). The lower unit includes weakly stratified sands and silty sands overlain by stratified layers with abundant fine gravels, probably deposited by intermittent stream flow. Radiocarbon dates obtained from detrital charcoal collected from both the upper and lower parts of the lower unit at the background-soil sample site are indistinguishable at about 7.9 to 8.0 ka (8.7 cal ka, Tables 9 and 10). These dated samples are separated by 1 m, and their similarity suggests that deposition of this lower unit was very rapid. The upper unit consists of unstratified silts and sands probably deposited by shallow overland flow. A radiocarbon date of about 4.0 ka (4.4 cal ka, Table 9) was obtained from a burn layer within this unit west of the soil sample site. These dated samples indicate that the buried soil separating the units probably formed during a period of 4300 years or less (between 8.7 and 4.4 cal ka), and that the uppermost soil similarly formed over a period of 4400 years or less (post-4.4 cal ka). These dates also indicate that significant erosion of mesa-top soils in this area occurred before arrival of homesteaders and Anasazi Indians, presumably induced by local or regional climatic events.

Soil Description

Soil samples collected at the EG&G site are listed in Table 7 and results of chemical analyses are provided in Appendices I and II. Soil at this site consists of the following

horizons with associated depths and thicknesses (in cm): A (0-15), Bw (15-42), Bt (42-70), CB (70-133), C (133-186), Bwb (186-300), and CBb (300+) (Watt and McFadden, 1992). This soil profile contains some clay enrichment, and clay-size material varies from 4.1 to 14.6 wt%. Sand-size material varies from 20.4 to 65.6 wt%, indicating that this soil profile may have a moderate range of hydraulic conductivities (Table 4, K values range from 10^{-5} to 10^{-2} cm/sec). Silt-size material ranges from 22.8 to 70.1 wt% at this soil site. Solid organic carbon values range from 0.2 to 0.3 wt%, and the highest value is associated with the Bw horizon.

Soil Chemistry

A neutral pH value (7.0) in this soil profile is associated with the A horizon, whereas the most alkaline pH value (8.0) is associated with the Bwb horizon (Watt and McFadden, 1992). The horizons underlying the A horizon are more alkaline, indicating that the minor amounts of $CaCO_3$ provide some buffering capacity. Calcium carbonate concentrations are relatively low within the soil horizons at this site, varying from 0.7 to 1.6 wt% (Watt and McFadden, 1992).

Total Fe concentrations range from 1.80 to 2.20 wt% (Figure 36). Acid-digested Fe concentrations range from 0.54 to 1.50 wt% comprising 30 to 68% of total Fe. These concentration distributions suggest that Fe occurs both in refractory phases such as hornblende, magnetite, and biotite and in HNO_3-digested Fe phases including iron oxide. Adsorption processes involving iron oxides and clay minerals may control trace-element enrichment to some extent in this weakly developed soil profile due to presence of B horizons containing clay-size material consisting of framework silicates, clay minerals, iron oxides, organic matter, and glass.

This weakly developed soil is also low in most trace elements, excluding Th and U (Appendices I and II). Distributions of Th and U versus depth are shown in Figures 37 and 38, respectively. Thorium is highest in the Bt and Bwb horizons, whereas U is highest in the CBb horizon (Figures 37 and 38). Total Th and U concentrations fluctuate in depth; however, there are larger differences between total element and the acid-digested concentrations of U relative to Th. Acid- digested Th and U comprise 37 to 49 wt% and 11 to 24 wt% of total-element distributions, respectively. Acid-digested Th is associated with the silt-size fraction (Figure 37), which mainly consists of primary silicates. A general association between % sand-size particle and % $CaCO_3$ and U is present (Figure 39). Surface complexation of U onto $CaCO_3$, however, is not likely because HNO_3-digested U does not strongly correlate with carbonate at this site

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Figure 36

BACKGROUND SOIL, SITE 2, EG&G GULLY.

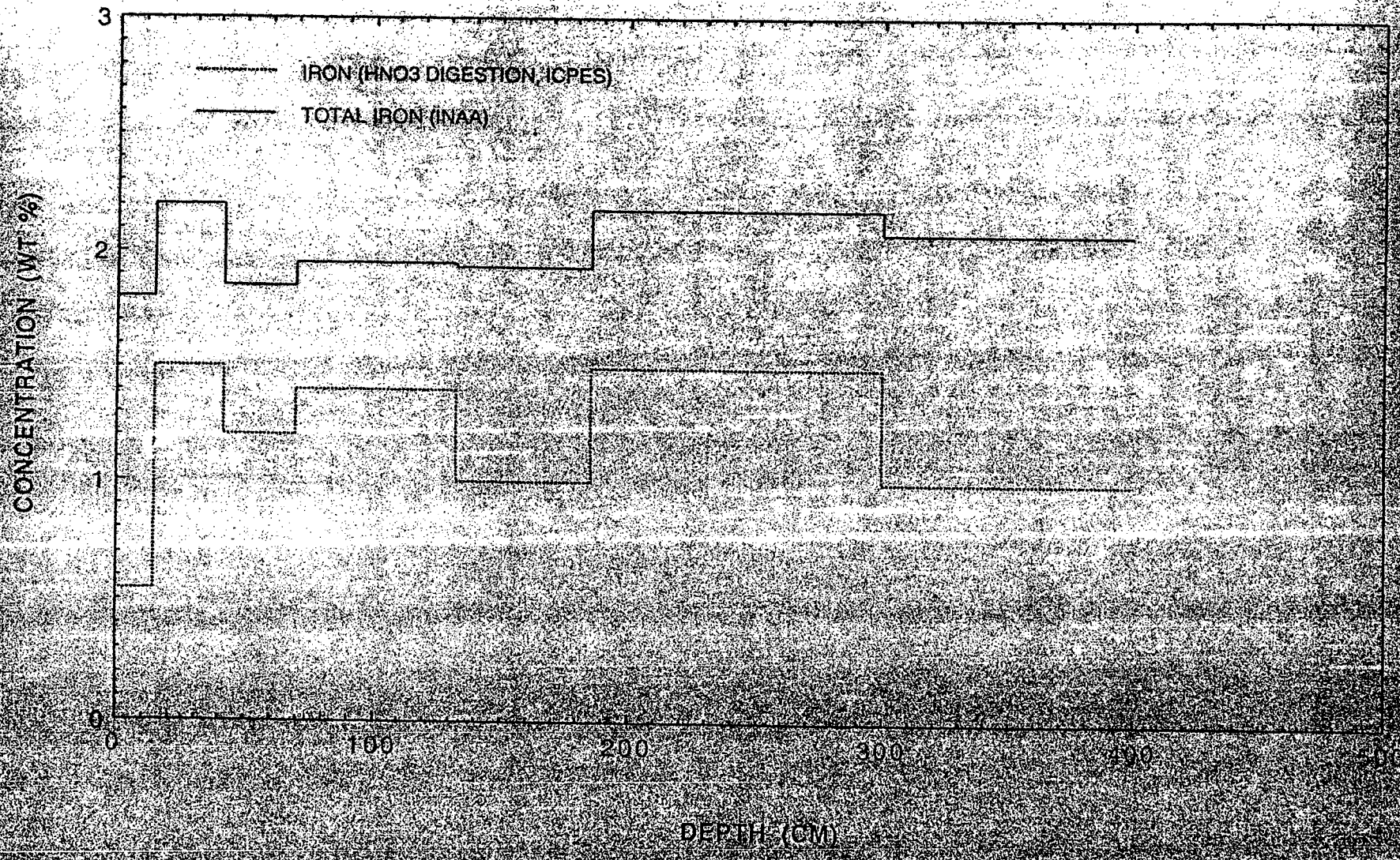

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Figure 37

BACKGROUND SOIL, SITE 2. EG&G GULLY.

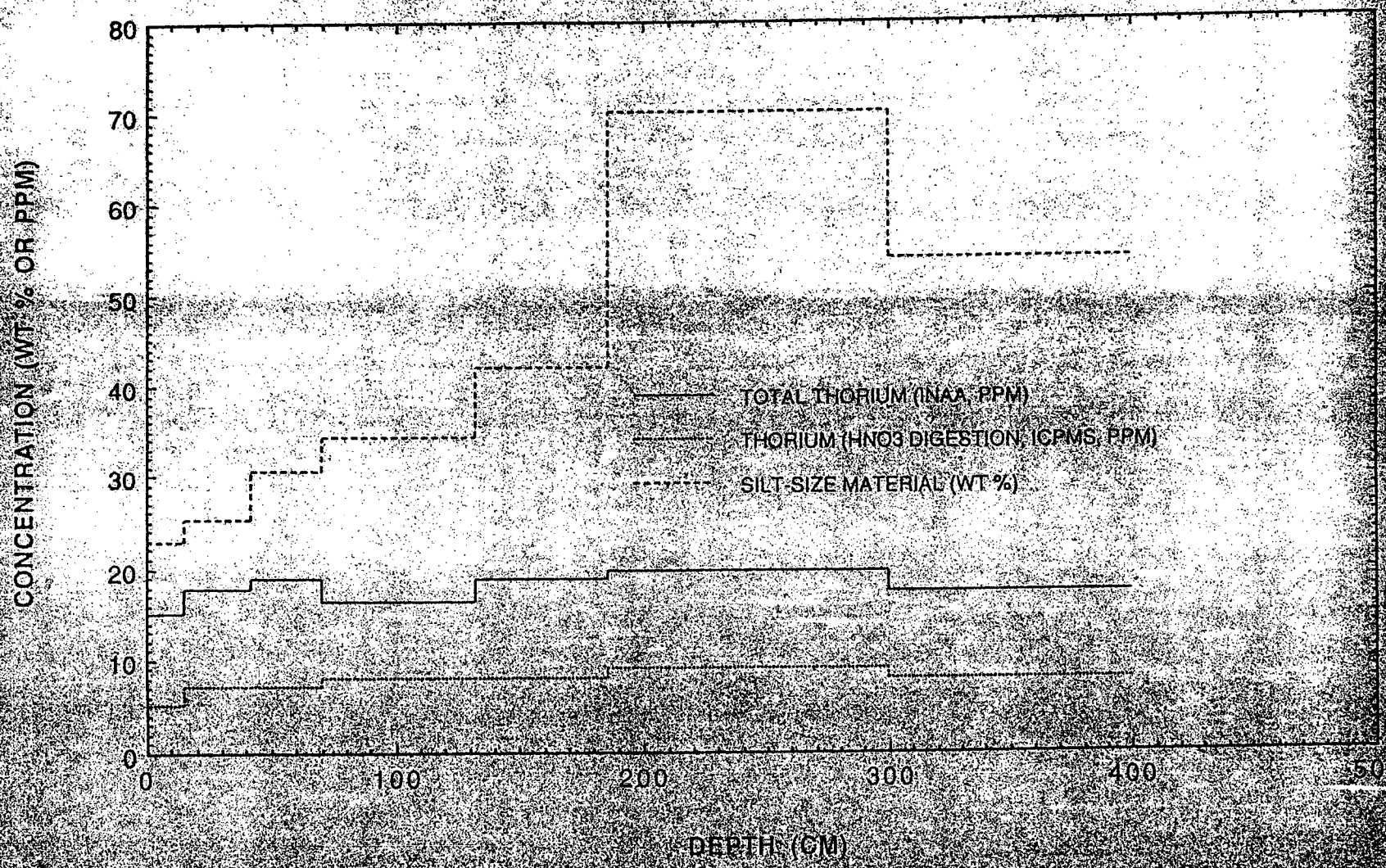

Figure 38

BACKGROUND SOIL, SITE 2, EG&G GULLY.

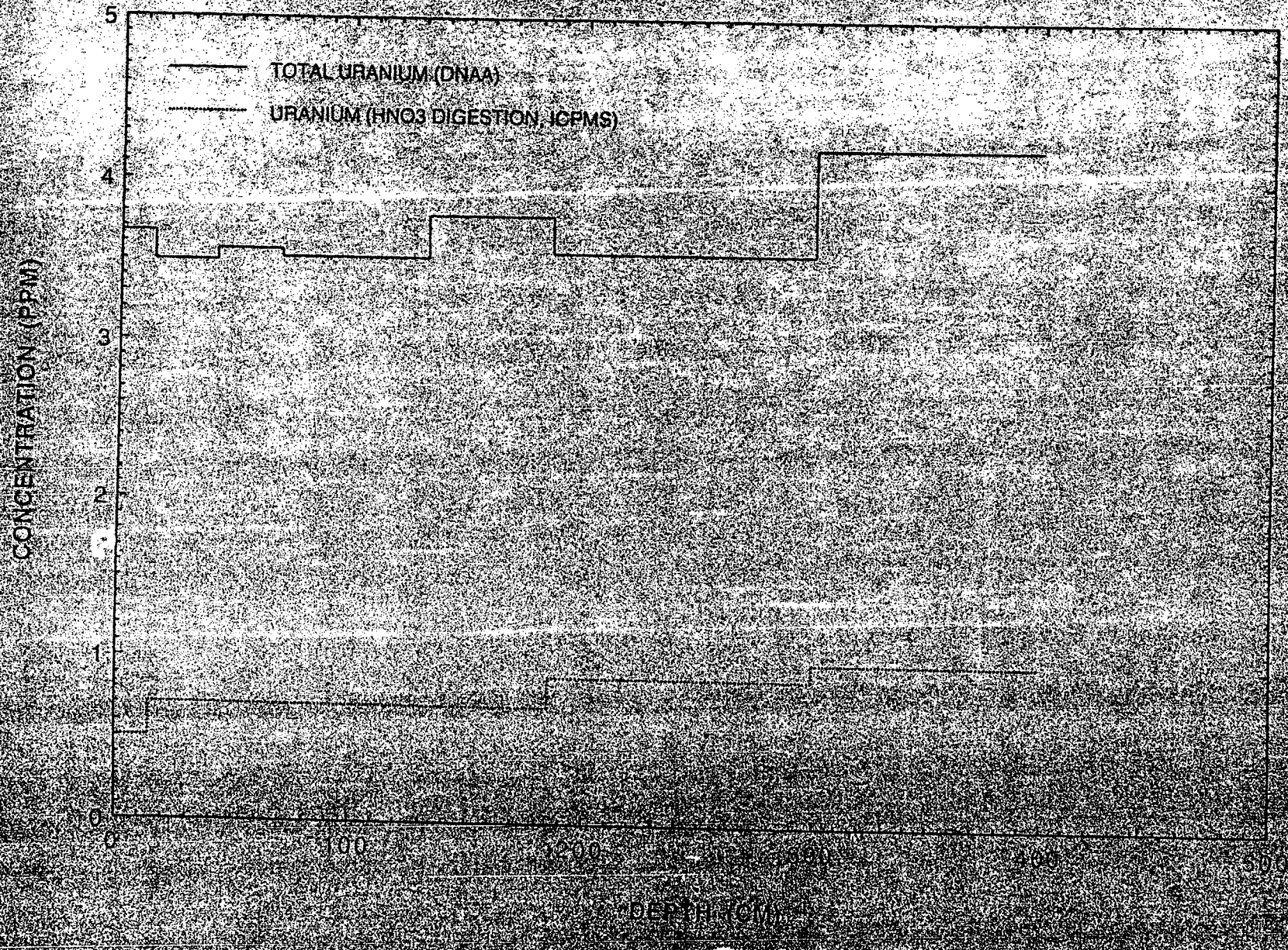

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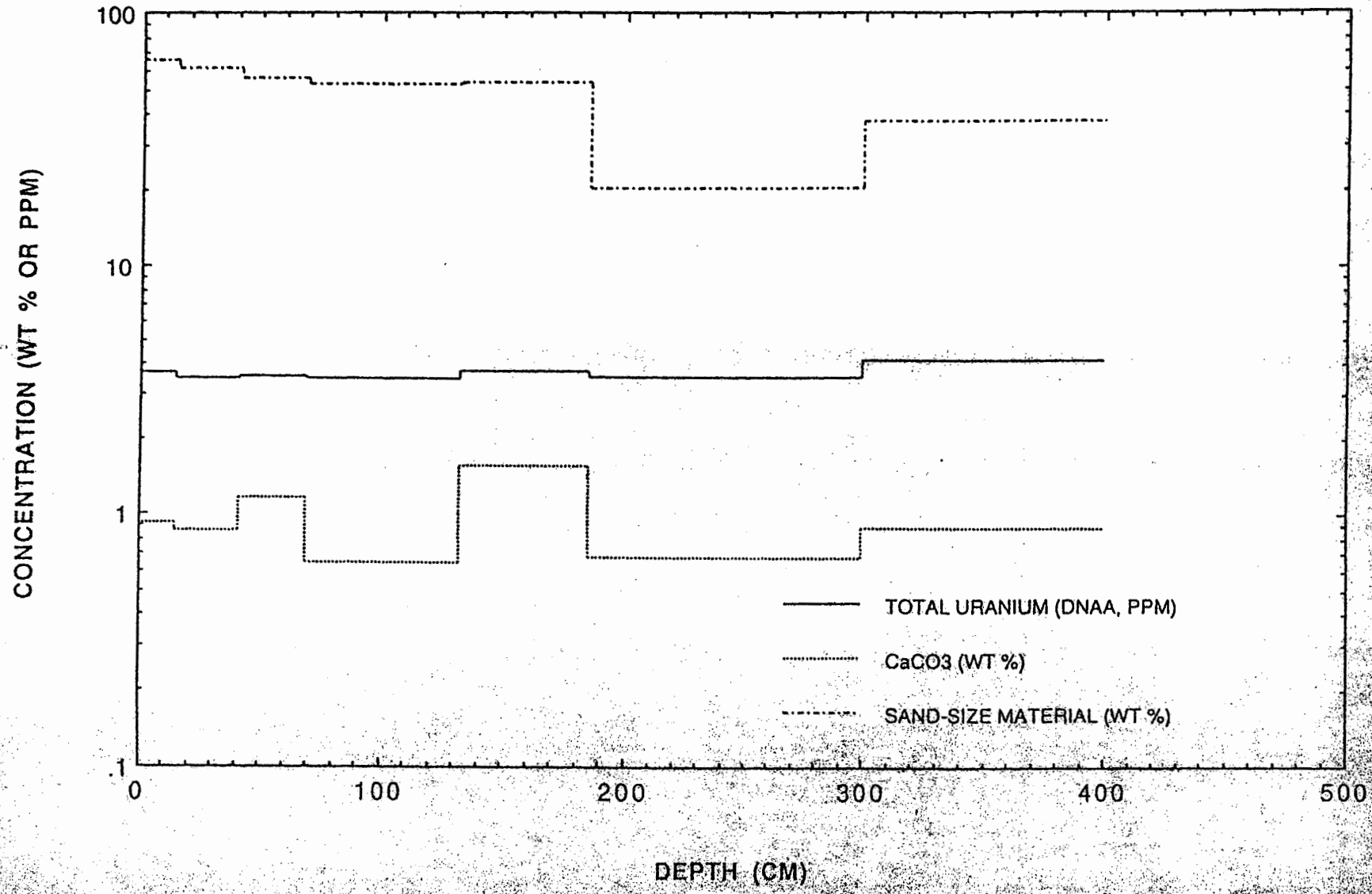
Figure 39

BACKGROUND SOIL, SITE 2. EG&G GULLY.



(compare Figures 38 and 39). Uranium is dominantly concentrated within matrices of primary silicate phases, which are coated by $CaCO_3$. This suggests that U adsorption onto clay minerals and iron oxides is minimal at this stage of soil development. Adsorption processes involving U, however, may become more important as chemical weathering proceeds.

Figure 40 shows distributions of clay-size material, As, Be, and Fe (HNO_3-digested samples) versus depth. These elements show a strong association with clay-size material suggesting that adsorption of As and Be onto iron oxides and/or clay minerals may partially control trace-element enrichment at this site. Total Be concentrations range from 2.4 to 3.4 ppm, whereas acid-digested Be concentrations range from 0.69 to 1.30 ppm (Figure 41). Acid-digested Be comprises 29 to 46% of the total Be, which suggests that Be is distributed both within primary silicate phases and secondary soil minerals. Distributions of acid-digested As and total As were not calculated, because As concentrations in some of the acid-digested samples exceed the total element concentration and analytical error in the INAA data is suspected. Background concentrations of As and Be exceed soil SALs for these two elements (Table 2), although the soil is poorly developed at this site.

Site 3. Upper Los Alamos Canyon, Los Alamos Reservoir Road

Location and Geomorphic Setting

The soil sampling site in upper Los Alamos Canyon is a road-cut exposure on the south side of the canyon, at the base of a steep, forested, north-facing slope mantled with colluvium (Figures 42 and 43). The slope extends 55 vertical m (180 ft) above the sample site, and the colluvium probably includes Bandelier Tuff derived from several cooling units within the Tshirege Member. A series of discrete rocky colluvial layers is present here, in part separated by buried soils, and the colluvium grades onto the canyon floor. The colluvium contains abundant angular clasts of tuff, and the buried soils indicate episodic deposition of colluvium at this site. The exposure also includes layers of well-sorted sand and silty sand probably deposited from floods in Los Alamos Canyon. The sample site is mapped as part of the "Rock Outcrop-Colle-Painted Cave Complex" by Nyhan et al. (1978), and may be representative of many canyon-bottom locations in the western part of the Laboratory.

Two radiocarbon dates were obtained on detrital charcoal collected from two of the colluvial units: 2.2 ka and 3.1 ka from depths of 0.85 and 1.35 m, respectively

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Figure 40

BACKGROUND SOIL, SITE 2. EG&G GULLY.

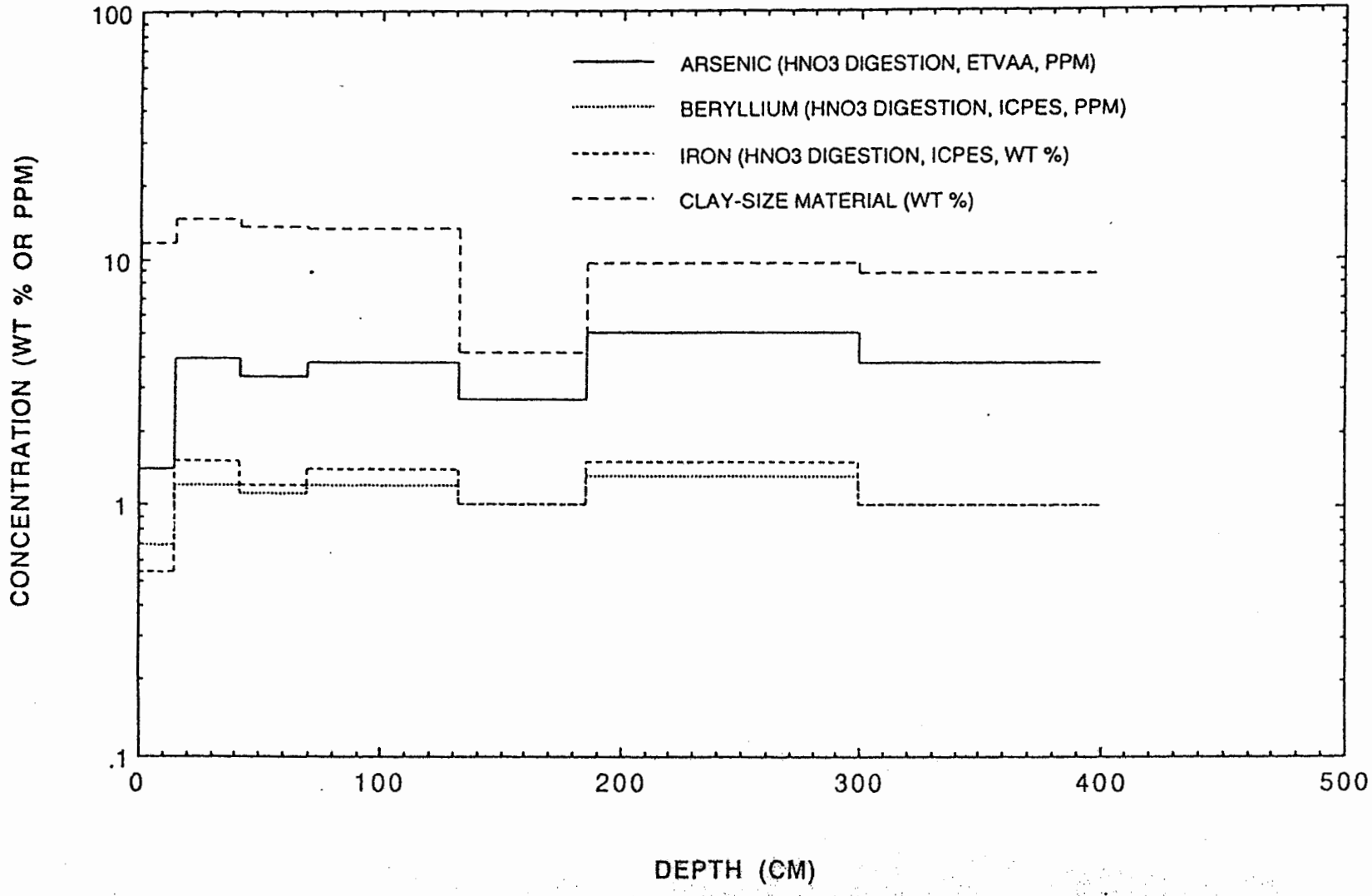

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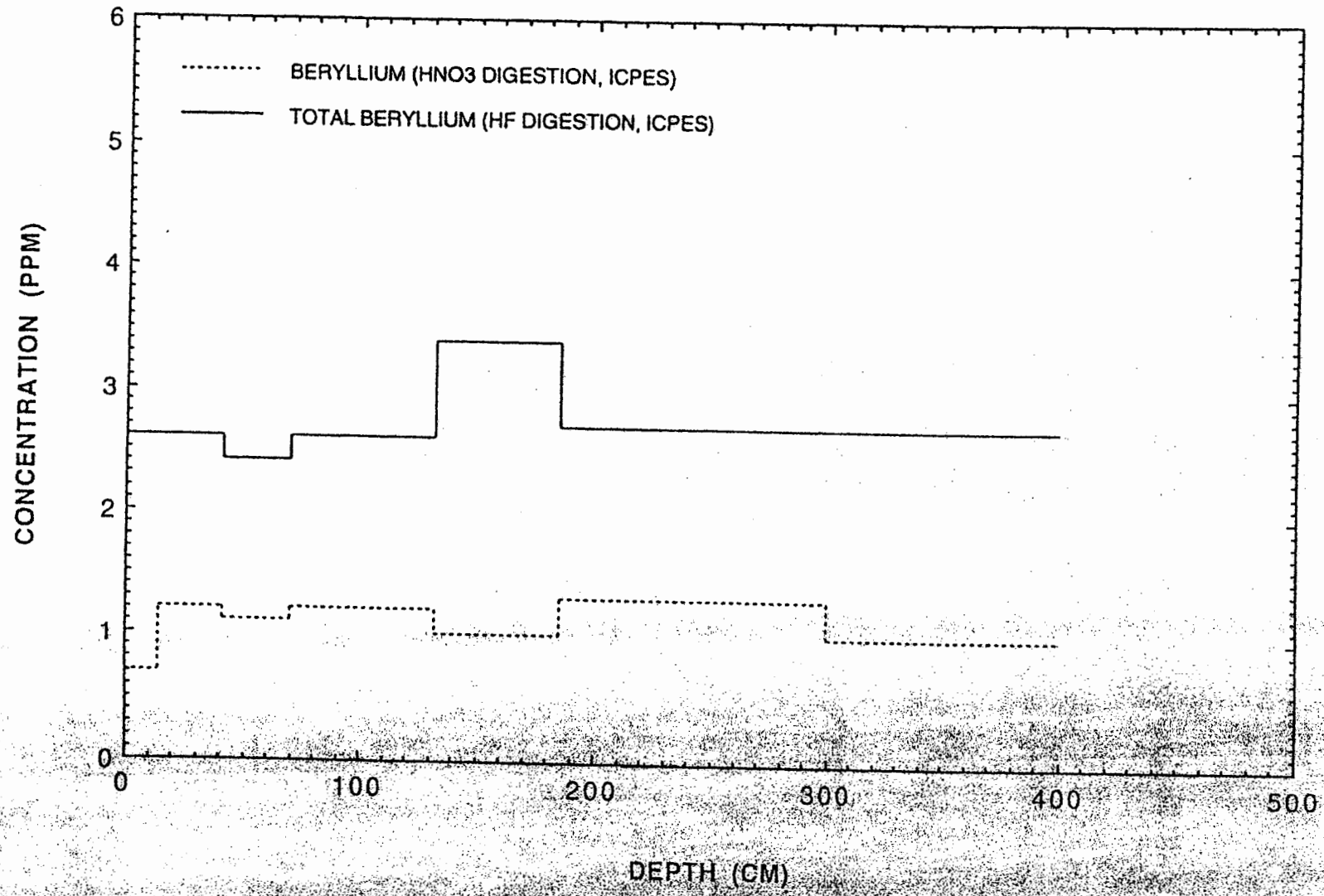
Figure 41

BACKGROUND SOIL, SITE 2. EG&G GULLY.



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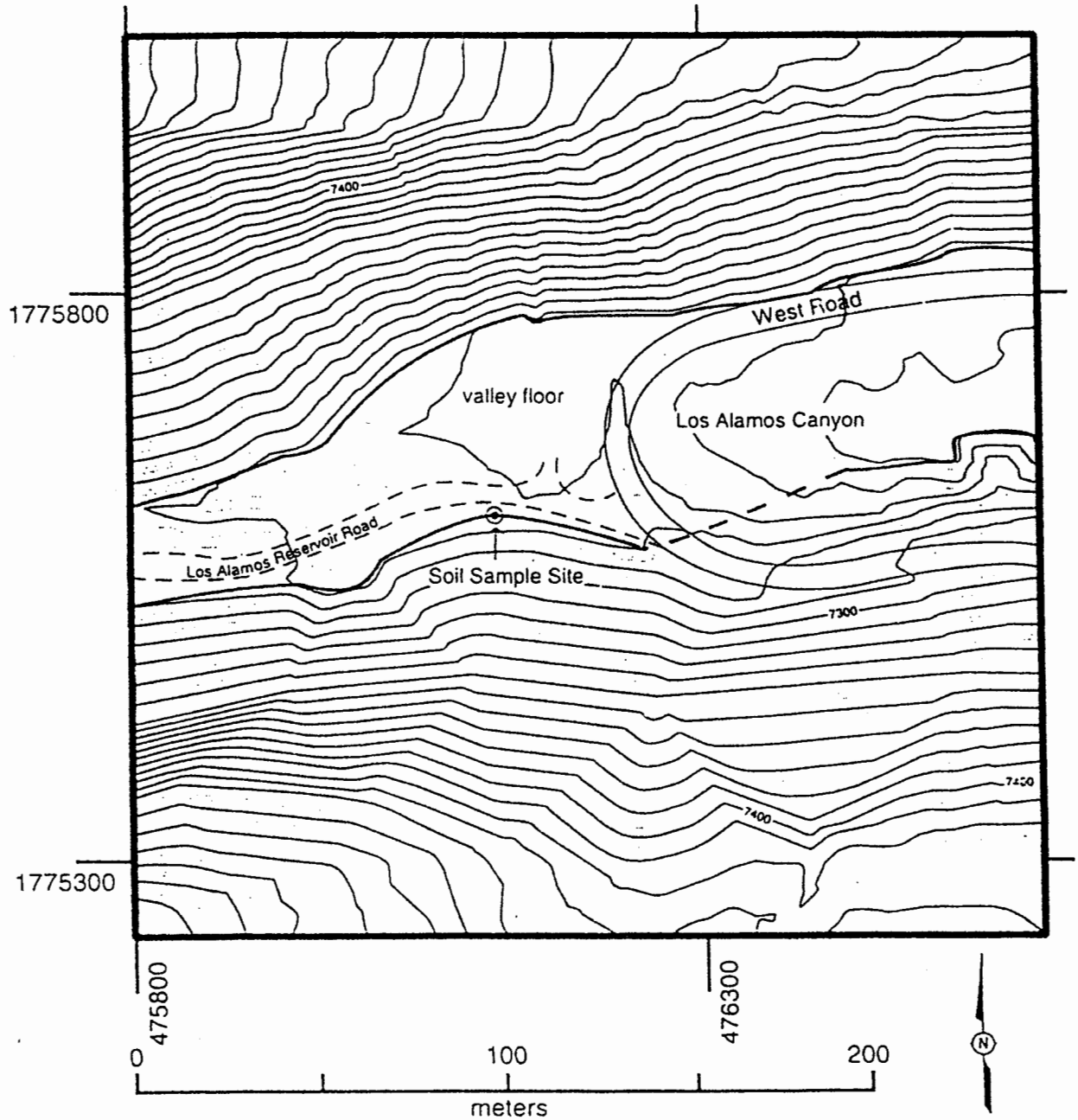

Fig. 42. Map of sample site 3 in upper Los Alamos Canyon. Topographic base, with 2-foot contours, from FIMAD.

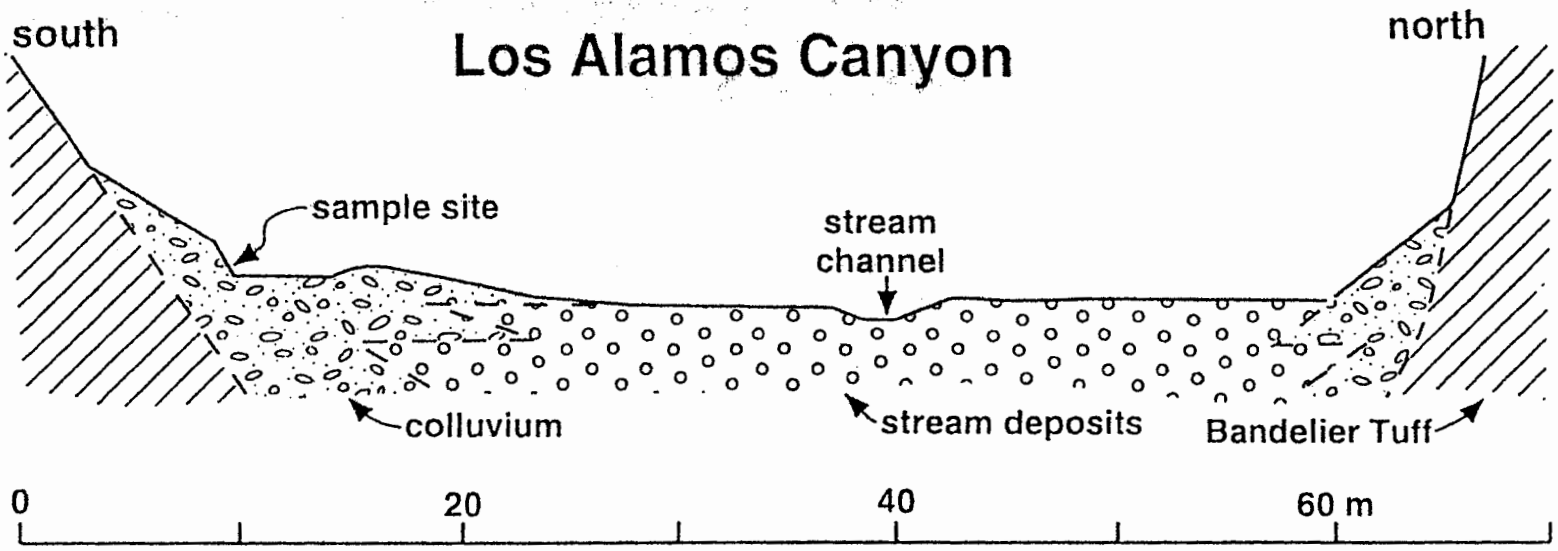

Fig. 43. Cross section of upper Los Alamos Canyon at soil sample site 3, showing colluvium at base of steep slopes interfingering with stream deposits.

(Figure 44, Table 9). These dates indicate that the uppermost organic-rich soil developed within a period of less than 2000 years, and suggest that the canyon floor has been near its present level here for at least several thousand years, as also indicated in lower Los Alamos Canyon.

Soil Description

Soil samples collected from the upper Los Alamos canyon site are listed in Table 7 and results of chemical analyses are listed in Appendices I and II. Soil forming at this site is within a backslope to footslope transition zone containing thick vegetation (Watt and McFadden, 1992). This soil is cumulic and is characterized by organic-rich horizons dominated by humic substances (humic and fulvic acids). The soil profile exposed at this site consists of the following horizons with associated depths and thicknesses (in cm): A1 (0-6), A2 (6-47), BA (47-60), Bw (60-82), BAb (82-84), Bwb (84-108), C (108-162), and Ab2 (162+) (Watt and McFadden, 1992). The poorly developed BA horizon probably has developed from oxidation or leaching of the cumulic A horizon. Most of the parent material for this soil is colluvial, and many large Bandelier Tuff clasts are present within most of the horizons.

This soil profile contains moderate clay concentrations, and abundance of clay-size material varies from 7.9 to 18.3 wt% (Watt and McFadden, 1992). Sand-size material varies from 32.2 to 59.0 wt%, indicating that this soil profile may have a moderate range of hydraulic conductivities (Table 4, K values ranging from 10^{-4} to 10 cm/sec). Silt-size material ranges from 35.3 to 50.1 wt%. Solid organic carbon values range from 0.2 to 2.8 wt%, and the highest value is associated with the A2 horizon. This soil is very high in solid organic carbon relative to other soil profiles characterized in this study related to the thick forest cover and the north-facing slope aspect.

Soil Chemistry

This soil is partially characterized by neutral to near-neutral pH values ranging from 7.0 to 7.7, with pH increasing with depth. The lowest pH value in this soil profile is associated with the A1 horizon, whereas the highest pH value is associated with the Cb horizon (Watt and McFadden, 1992). Calcium carbonate abundances are relatively low at this site, varying from 0.3 to 3.4 wt% (Watt and McFadden, 1992).

Total Fe concentrations range from 1.20 to 1.62 wt% (Figure 45). The acid-digested-fraction of Fe is enriched in the A2 and BA2 horizons. Acid-digested Fe

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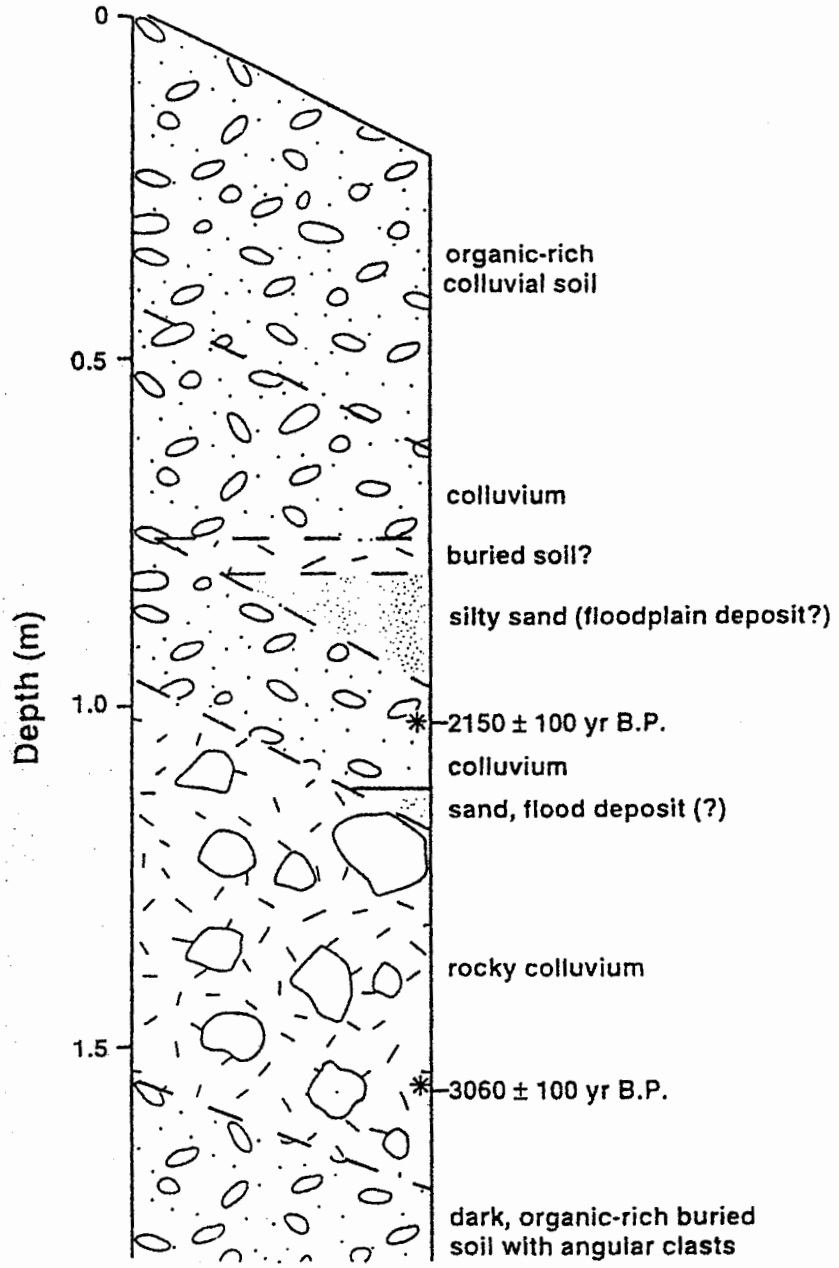
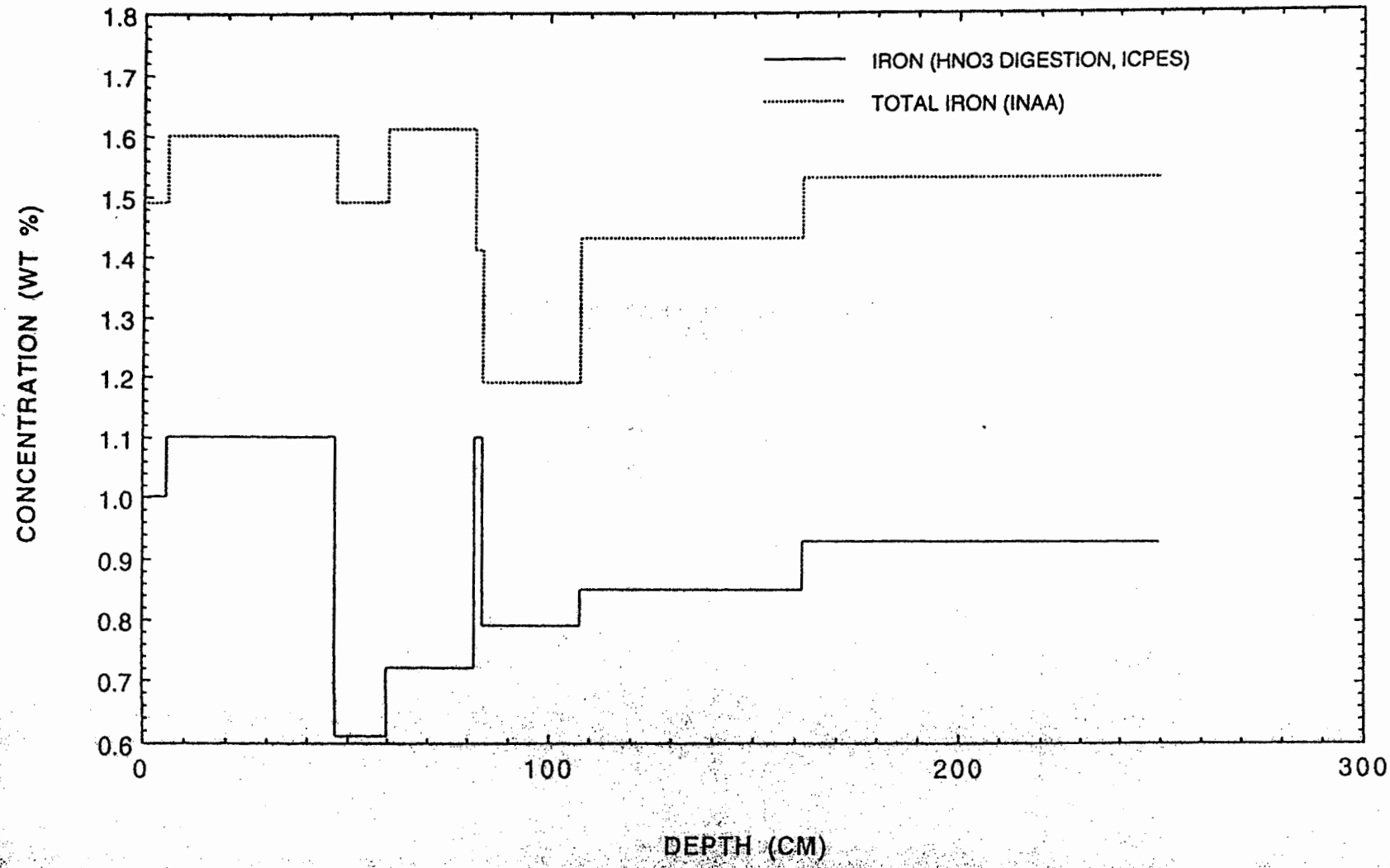


Fig. 44. Simplified stratigraphy exposed in roadcut at radiocarbon sample site in upper Los Alamos Canyon. Soil samples were collected 1 m to east.

Figure 45

BACKGROUND SOIL, SITE 3. UPPER LOS ALAMOS CANYON.



concentrations range from 0.62 to 1.10 wt%, comprising 41 to 79% of total Fe. These concentration distributions suggest that Fe occurs both in refractory phases such as hornblende, magnetite, and biotite and in HNO_3-digested Fe phases including ferric oxyhydroxide, amorphous ferric hydroxide, and ferrihydrite associated with solid organic carbon. Adsorption processes involving iron oxides and clay minerals partially control trace-element distributions in this organic-rich soil profile.

Distribution of elemental Th versus depth is shown in Figure 46, and total Th concentrations range from 12.24 to 14.00 ppm. Concentrations of acid-digested Th range from 4.00 to 5.00 ppm, comprising 37 to 49% of total Th at this soil profile. Thorium generally is associated in part with the silt-size fraction (Figure 46), which mainly consists of primary silicates.

Distributions of total U, acid-digested U, and solid organic carbon fluctuate with depth (Figure 47). Total U is highest in the A1 and Ab2 horizons in this soil profile. Total concentrations of U range from 3.65 to 4.26 ppm and HNO_3-digested U concentrations range from 0.30 to 2.41 ppm. Acid-digested U comprises 17 to 56% of total U (Figure 47). Nitric acid-digested U correlates well with the clay-size fraction and to a lessor extent with the silt-size fraction (Figure 48). Uranyl undergoes ligand exchange reactions with humic acids (HA), predominantly with carboxylic acids below pH 8, shown by the following:

$UO_2^{2+} + HACOOH^0 = HACOOUO_2^+ + H^+$ and (eq. 4)
$\text{Log}\,\beta_1 = 4.11 \pm 0.02$ (Shanbhag and Choppin, 1981)

$HACOOH^0 + HACOOUO_2^+ = (HACOO)_2UO_2^0 + H^+$. (eq. 5)
$\text{Log}\,\beta_2 = 8.94 + 0.03$ (Shanbhag and Choppin, 1981)

Most of the U at this soil site, however, is concentrated in primary phases including glass, based on distributions of total and HNO_3-digested U (Figure 48).

Figure 49 shows distributions of As, Be, and Fe versus depth. These elements are strongly associated with each other suggesting that adsorption of As and Be onto surfaces of iron oxide and/or clay minerals control distributions of trace elements at this site. Arsenic, Be, and Fe are enriched within the A2, BAb, and Ab2 horizons (Figure 49). Total Be concentrations range from 1.8 to 2.4 ppm, and HNO_3-digested Be concentrations range from 0.4 to 0.8 ppm (Figure 50). Acid-digested Be comprises 28 to 44% of total Be, which suggests that most of the Be is distributed within primary phases with some associated with secondary soil minerals. Figure 51 shows

Figure 46

BACKGROUND SOIL, SITE 2. UPPER LOS ALAMOS CANYON.

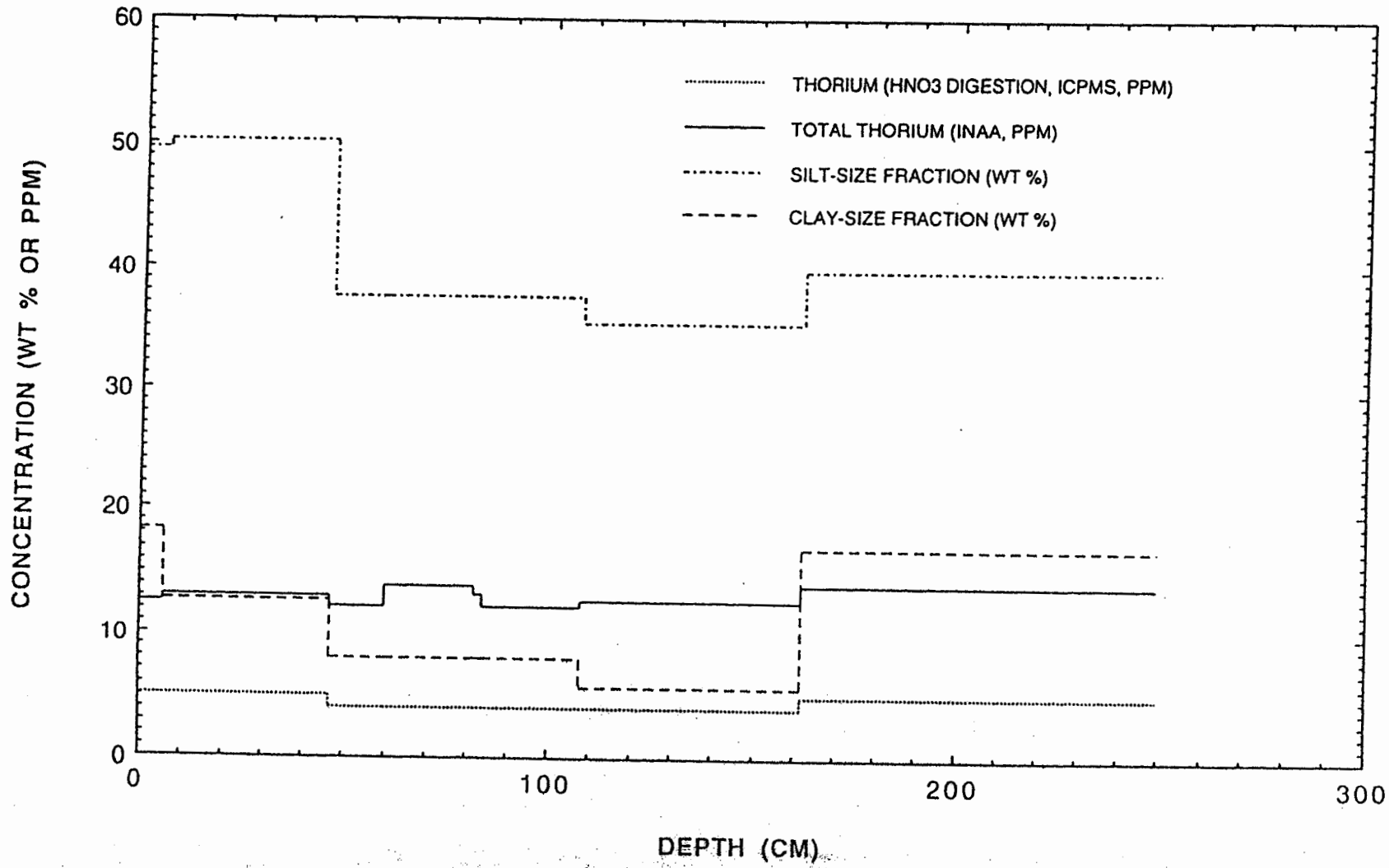


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Figure 47

BACKGROUND SOIL, SITE 3. UPPER LOS ALAMOS CANYON.

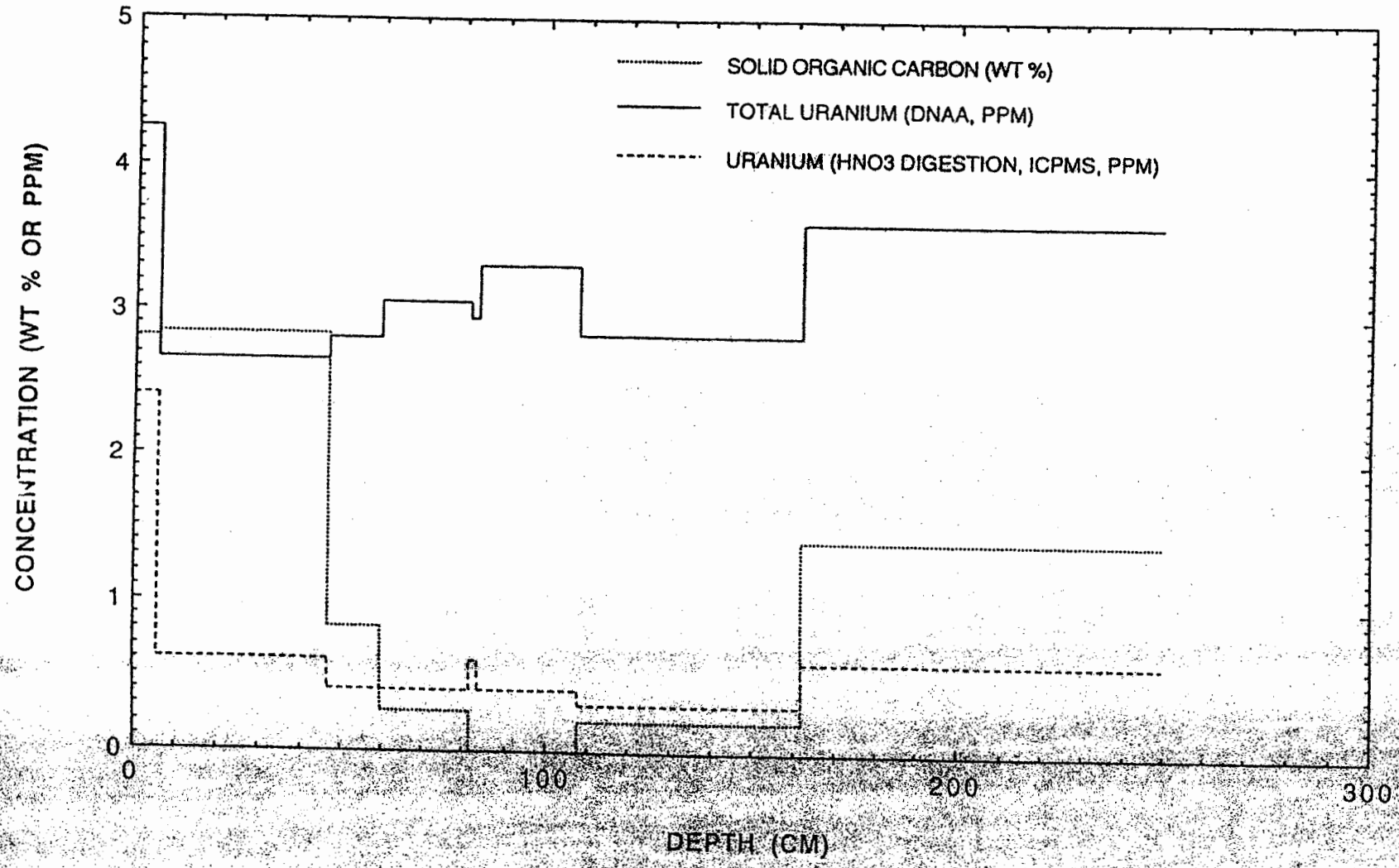

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Figure 48

BACKGROUND SOIL, SITE 3. UPPER LOS ALAMOS CANYON.

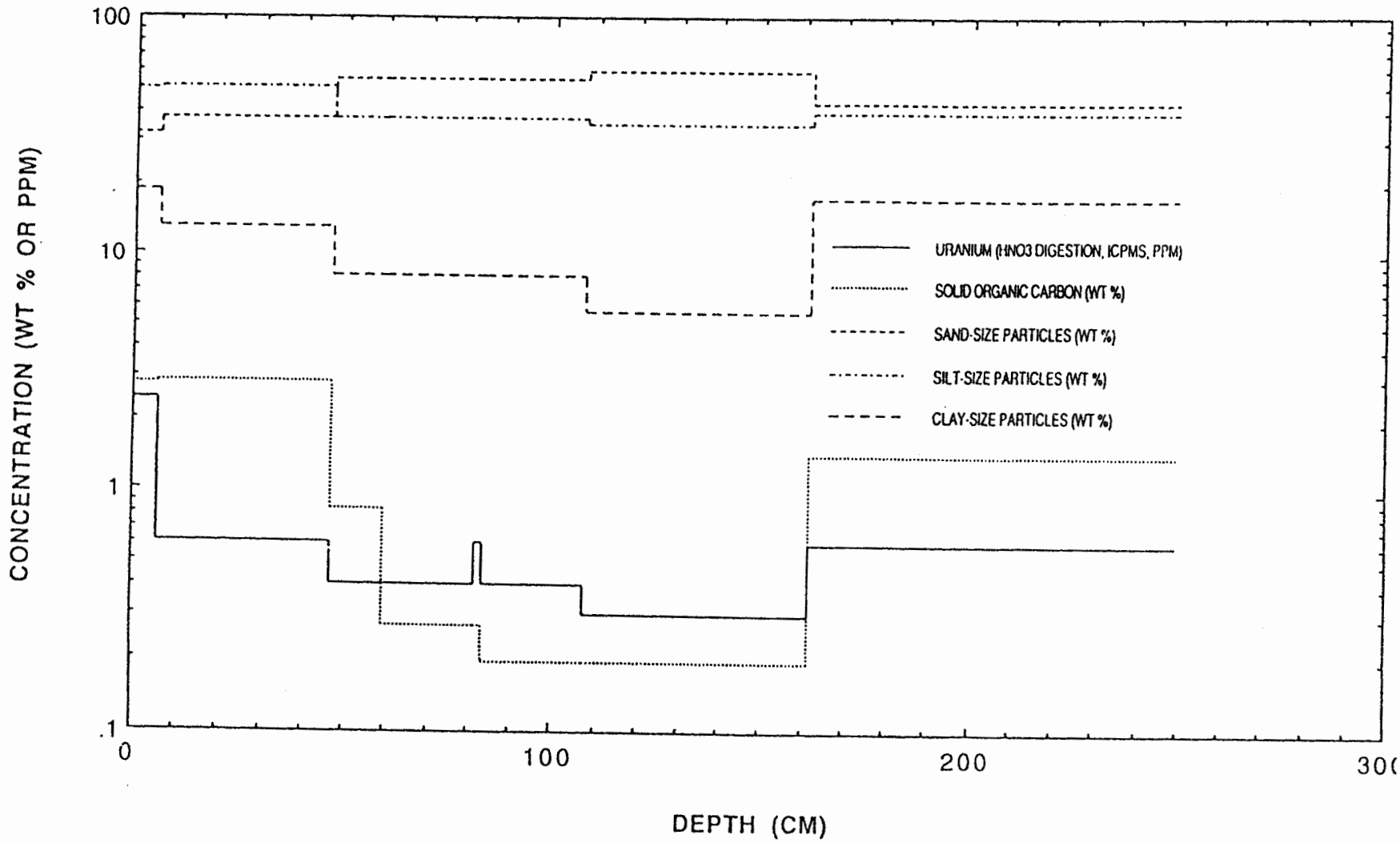

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Figure 49

BACKGROUND SOIL, SITE 3. UPPER LOS ALAMOS CANYON.

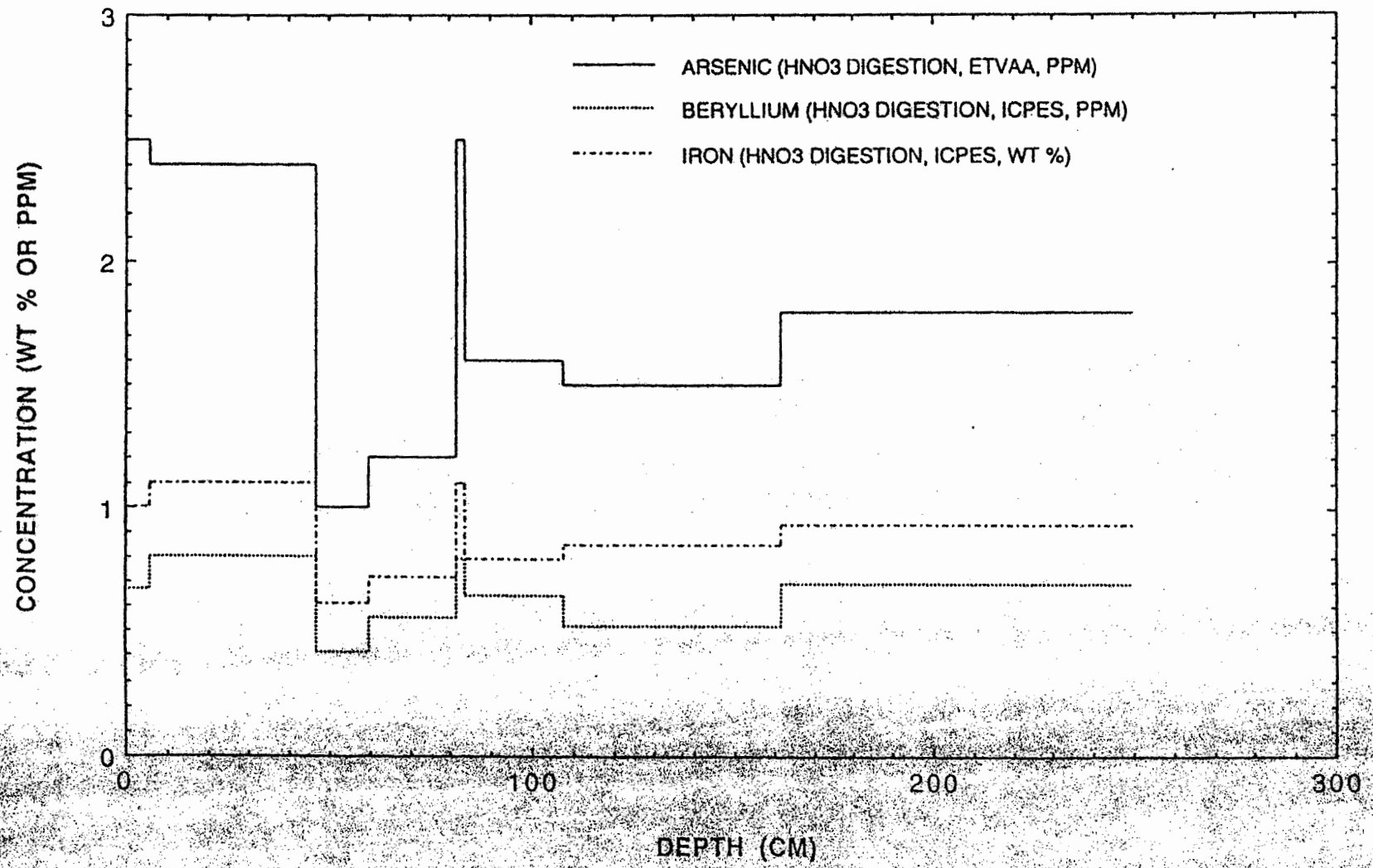

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Figure 50

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BACKGROUND SOIL, SITE 3. UPPER LOS ALAMOS CANYON.

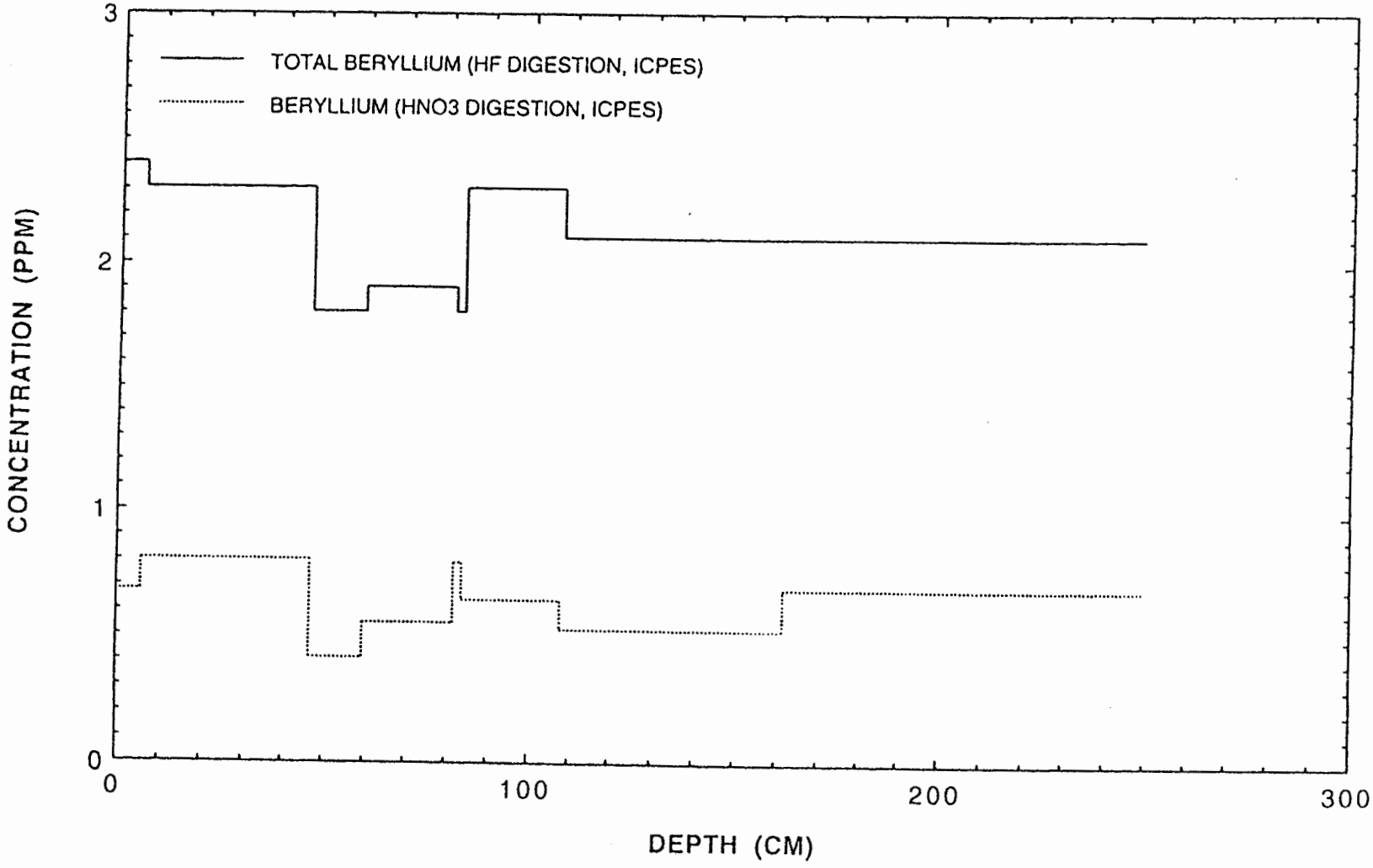

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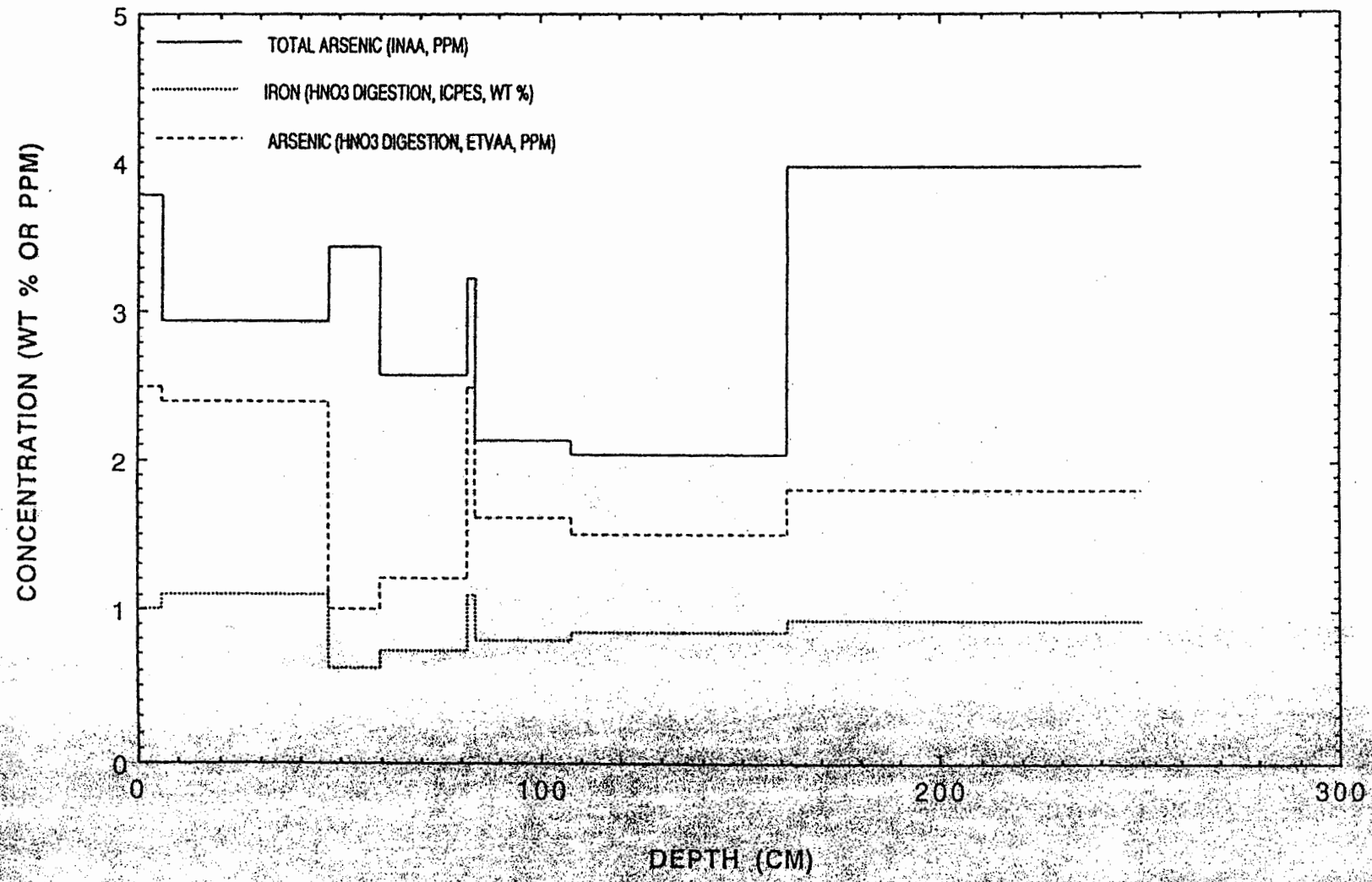
Figure 51

BACKGROUND SOIL, SITE 3. UPPER LOS ALAMOS CANYON.



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distributions of HNO_3-digested As, total As, and HNO_3-digested Fe versus depth. Total As concentrations range from 2.03 to 3.98 ppm, and HNO_3-digested As concentrations range from 1.0 to 2.5 ppm (Figure 51). The acid-digested fraction of As comprises 45 to 81% of total As. Background concentrations of As and Be exceed soil SALs for these two elements (Table 2).

Site 4, Twomile Mesa, TA-69

Location and Geomorphic Setting

The soil sampling site is on a mesa top near Twomile Canyon, in a 1-m deep trench that was excavated by EES-15 for field studies of runoff and infiltration (Figure 52). The trench exposed a soil, up to 0.9 m thick, that overlies unit 4 of the Tshirege Member of the Bandelier Tuff. Within the soil are scattered stream-rounded cobbles of Tschicoma dacite that record the presence of a stream flowing across Twomile Mesa. Deposits of similar old alluvial gravels are widespread on this mesa (Figure 52). These gravels were deposited by a stream draining the Sierra de los Valles at this location before the major canyons were cut, perhaps as part of a broad alluvial fan. Twomile Canyon has since incised 18 m (60 ft) below the mesa. The age of these gravels is not known, but they presumably date from early in the post-1.2 Ma history of the Pajarito Plateau. The presence of these sediments suggest that little net erosion of bedrock has occurred at this mesa-top location since before the canyons incised into the tuff. The sample site is mapped as "Typic Eutroboralfs" by Nyhan et al. (1978). The well-developed soils found here may be similar to soils developed on old alluvial deposits elsewhere on the western part of the Pajarito Plateau.

Soil description

Soil samples collected from the Twomile Mesa site are listed in Table 7 and results of chemical analyses are listed in Appendices I and II. Two soil profiles were described in a single trench at this site, because the soil exhibited considerable variation in degree of development, color, texture, and horizon thickness from one end of the trench to the other (Watt and McFadden, 1992). Soil present at the north end of the trench is more developed relative to soil at the south end. Near the middle of the trench, the soil is thinner and an A horizon overlies a bedrock high. This A horizon is present along the entire length of the trench, forming a calcareous loess cap (Watt and

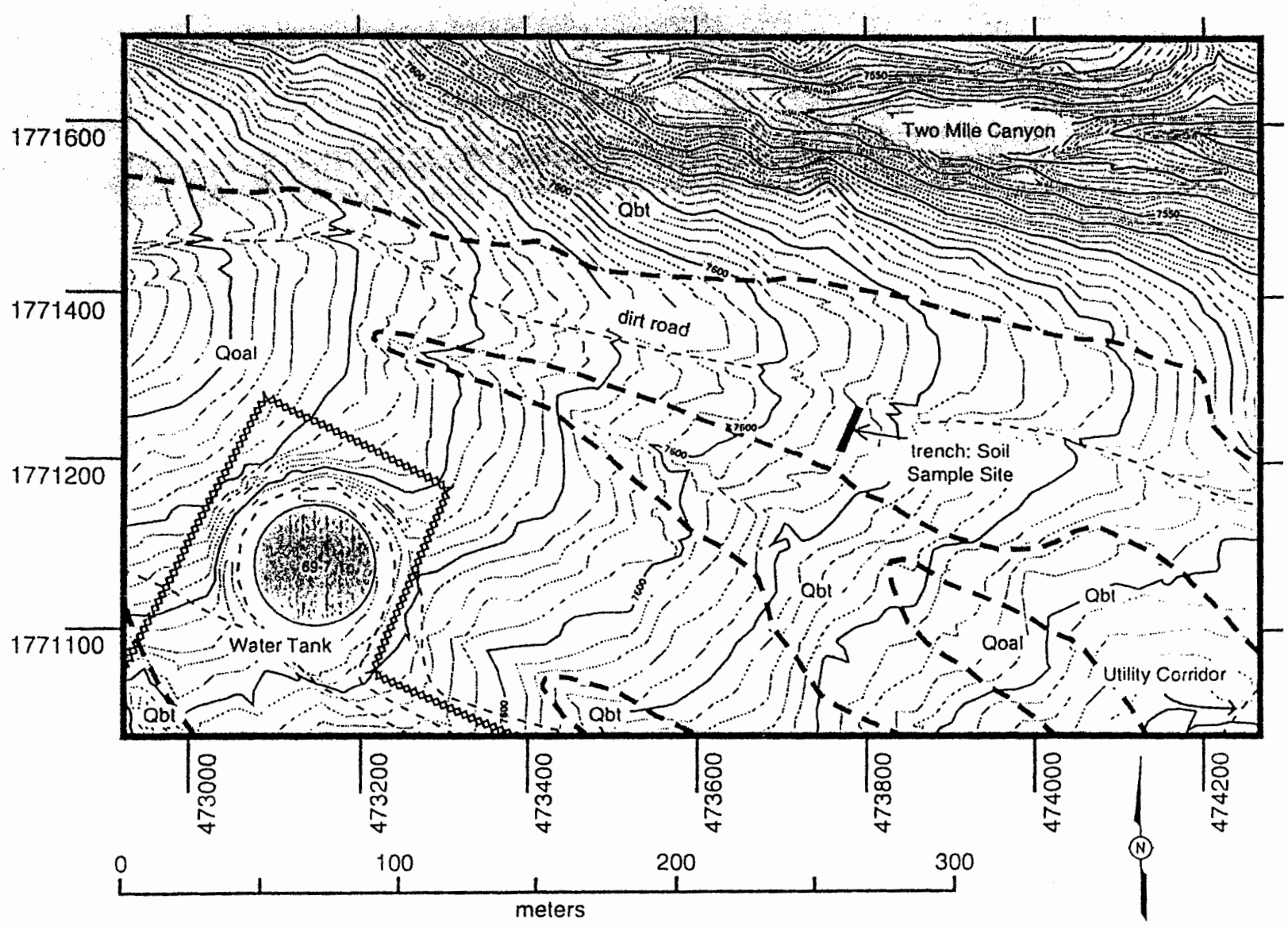

Fig. 52. Map showing sample site 4 on Twomile Mesa, and distribution of mesa-top alluvial gravels (Qoal) overlying Tshireege Member of the Bandelier Tuff (Qbt). Topographic base, with 2-foot contours, from FIMAD.

McFadden, 1992). This loess cap may represent eolian material deposited after the end of the last glaciation (late Wisconsian). Fractures are commonly present at this site, which are lined with calcite and filled with organic matter mixed with reddish clay minerals. Some of the calcite-fracture lining may be of loess origin, with water having transported this material from the land surface downward into fractures. Laboratory optical petrography studies suggest that the clay filling has been translocated from the overlying B horizons to depths of 70 cm or greater (Watt and McFadden, 1992). Soil forming at this site is developed in part on alluvium overlying Bandelier Tuff.

The soil profile exposed in the north end of the trench consists of the following horizons with associated depths and thicknesses (in cm): A (0-14), Bw (14-19), 2Bt1b (19-50), 2Bt2b (50-64), 2Bt3b (64-75), and R (75+) (Watt and McFadden, 1992). This soil profile contains moderately high clay content, and clay-size material varies from 7.6 to 52.8 wt%. Sand-size material varies from 21.6 to 37.8 wt%, indicating that this soil profile at the north end of the trench may have a relatively low hydraulic conductivity (Table 4, K values ranging from 10^{-6} to 10 cm/sec), although both open and filled fractures are present. Silt-size material ranges from 25.0 to 63.3 wt%. Solid organic carbon values range from 0.2 to 1.2 wt%, and the highest value is associated with the A horizon.

Soil exposed in the south end of the trench consists of the following horizons with associated depths and thicknesses (in cm): A (0-9), Bw (9-20), 2Bt1b (20-30), 2Bt2b (30-43), CBt (43-58), and R (70+) (Watt and McFadden, 1992). This soil profile contains moderate clay contents, and clay-size material varies from 8.2 to 34.2 wt%. Sand-size material varies from 17.5 to 29.2 wt%, indicating that this soil profile at the south end of the trench also has a higher hydraulic conductivity relative to the north end of the trench. Silt-size material ranges from 48.3 to 63.7 wt%. Solid organic carbon values range from 0.2 to 1.0 wt%, and the highest value is associated with the A horizon.

Soil Chemistry

The well-developed soil investigated at the Twomile Mesa site has formed from chemical leaching and precipitation and remobilization of clay minerals, calcium carbonate, and iron oxides. This soil is developed to a much greater extent than background soil Sites 1, 2, and 3. Soil samples collected from the north end of the trench are characterized by acidic to near-neutral pH values ranging from 5.1 to 7.4, which increase with depth. The lowest pH value measured in the north soil profile is

associated with an O horizon, whereas the highest pH value is associated with a 2Bt3b horizon (Watt and McFadden, 1992). Calcium carbonate abundances vary from 0.4 to 1.0 wt% at the north end of the trench (Watt and McFadden, 1992).

Soil samples collected from the south end of the trench are characterized by acidic pH values ranging from 5.6 to 6.4, which vary with depth. The lowest pH value measured in the south soil profile is associated with an A horizon, whereas the highest pH value is associated with a 2Bt2b horizon (Watt and McFadden, 1992). Calcium carbonate abundances range from 0.1 to 1.0 wt% at the south end of the trench (Watt and McFadden, 1992).

Total Fe concentrations in soil at the north end of the trench range from 1.74 to 3.4 wt% (Figure 53). Concentrations of acid-digested Fe range from 1.2 to 2.7 wt% comprising 65 to 83% of total Fe. Total Fe concentrations at the south end of the trench range from 1.8 to 3.2 wt% (Figure 54). Concentrations of acid-digested Fe at the south end of the trench range from 0.9 to 2.2 wt% comprising 48 to 74% of total Fe. These concentration distributions show that in some horizons most of the Fe occurs in HNO_3-digested Fe phases including ferric oxyhydroxide and ferrihydrite. Some of the Fe also occurs in refractory phases such as magnetite, hornblende, and biotite. Adsorption processes involving iron oxides may account for trace element enrichment in this Fe-rich soil profile due to presence of buried B horizons characterized by clay-size material consisting of framework silicates, solid organic carbon, clay minerals, iron oxides, and glass. In both profiles, Fe content is strongly correlated with clay content (Figures 53 and 54).

Distribution of Th versus depth at the north end of the trench is shown in Figure 55. Total Th concentrations range from 12.7 to 18.1 ppm and generally increase with depth. Concentrations of acid-digested Th range from 4 to 11 ppm and comprise 23 to 61% of total Th at the north end of the trench. Total Th is correlated with the clay-size fraction, which mainly consists of clay minerals, primary silicates, organic matter, and iron oxides (Figure 55). Distribution of Th versus depth at the south end of the trench is shown in Figure 56, where total Th concentrations range from 13.31 to 14.62 ppm. Concentrations of Th vary with depth at the south end of the trench. Concentrations of acid-digested Th range from 6.00 to 9.00 ppm, which comprise 52 to 62% of total Th at the south end of the trench. Total Th is correlated with the clay-size fraction (Figure 56), suggesting that adsorption of Th onto clay minerals and iron oxides is an important enrichment process occurring at this site.

Distributions of total U, acid-digested U, and solid organic carbon versus depth at the north and south ends of the trench are shown in Figures 57 and 58, respectively.

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Figure 53

BACKGROUND SOIL, SITE 4. TWOMILE MESA-NORTH.

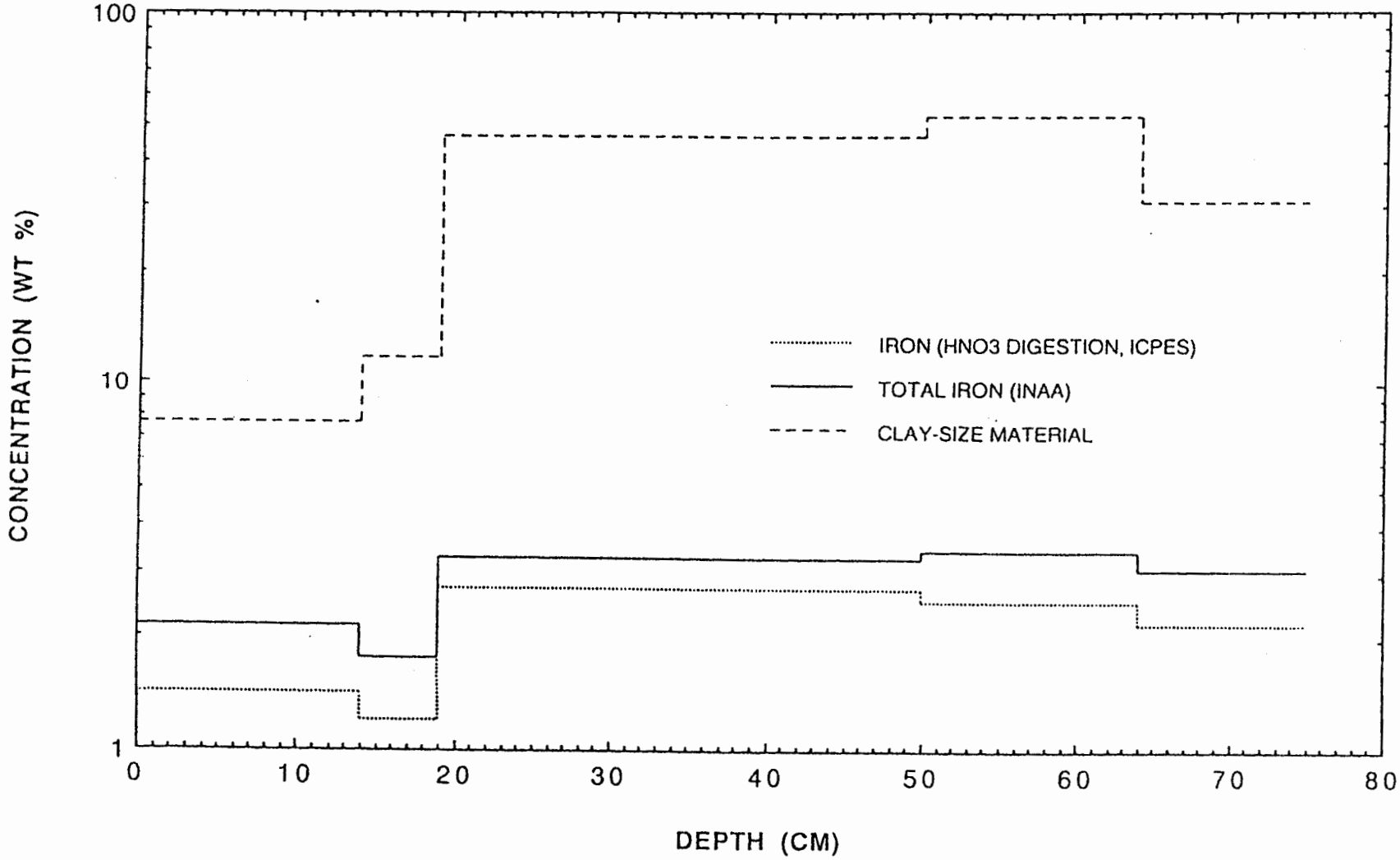

Figure 54

BACKGROUND SOIL, SITE 4. TWOMILE MESA-SOUTH.

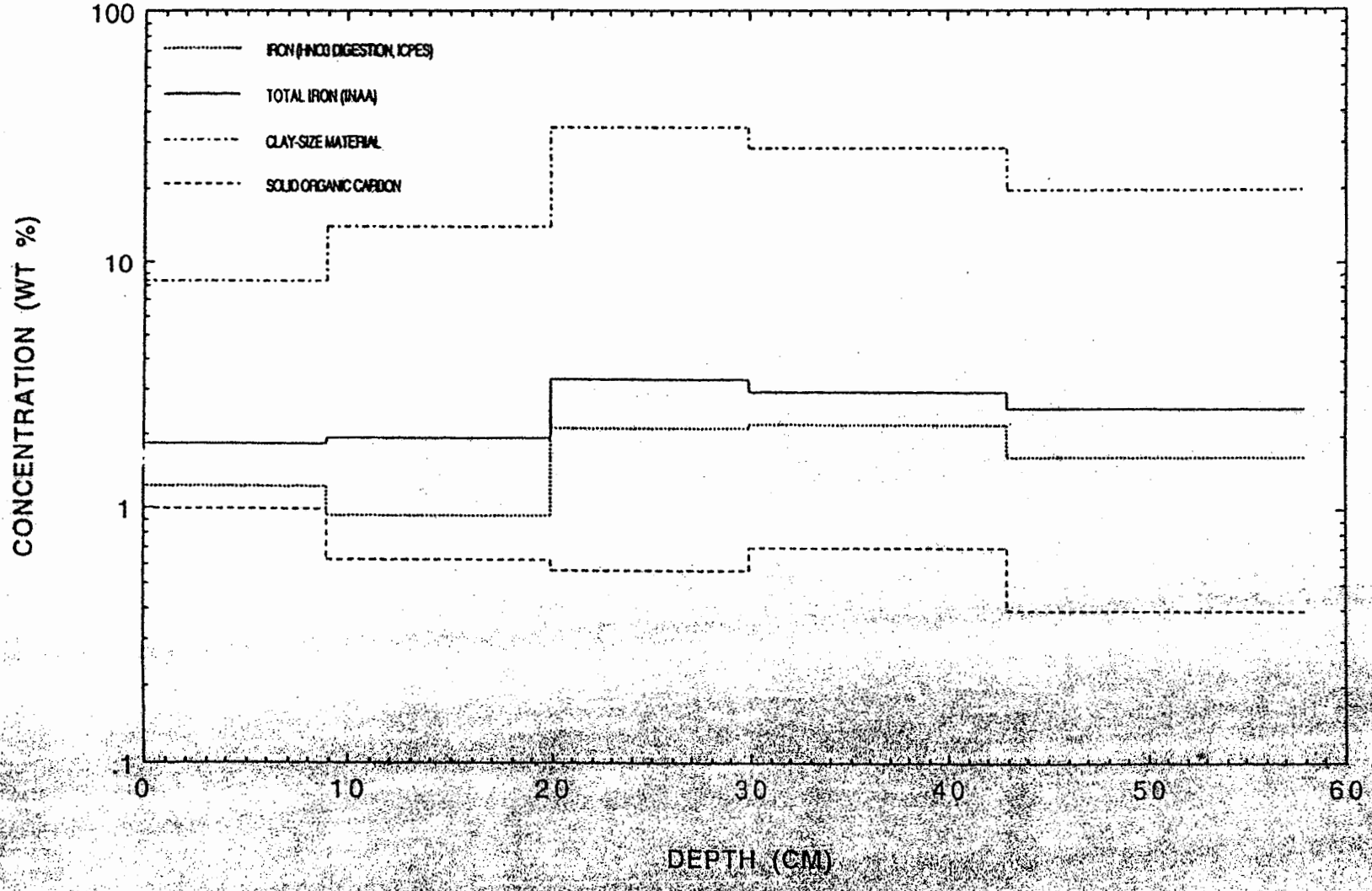

Figure 55

BACKGROUND SOIL, SITE 4. TWOMILE MESA-NORTH.

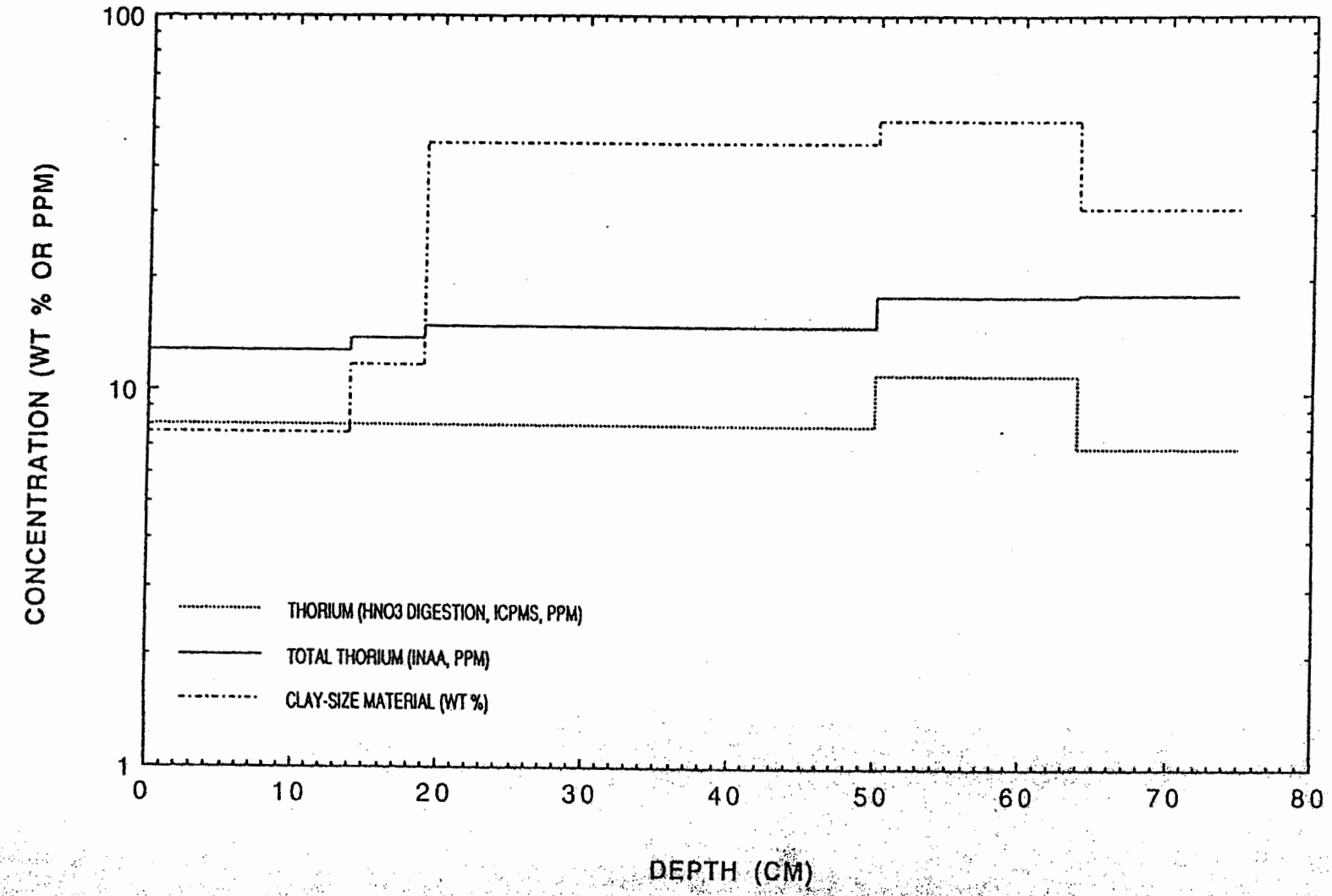

Figure 56

BACKGROUND SOIL,SITE 4. TWOMILE MESA-SOUTH.

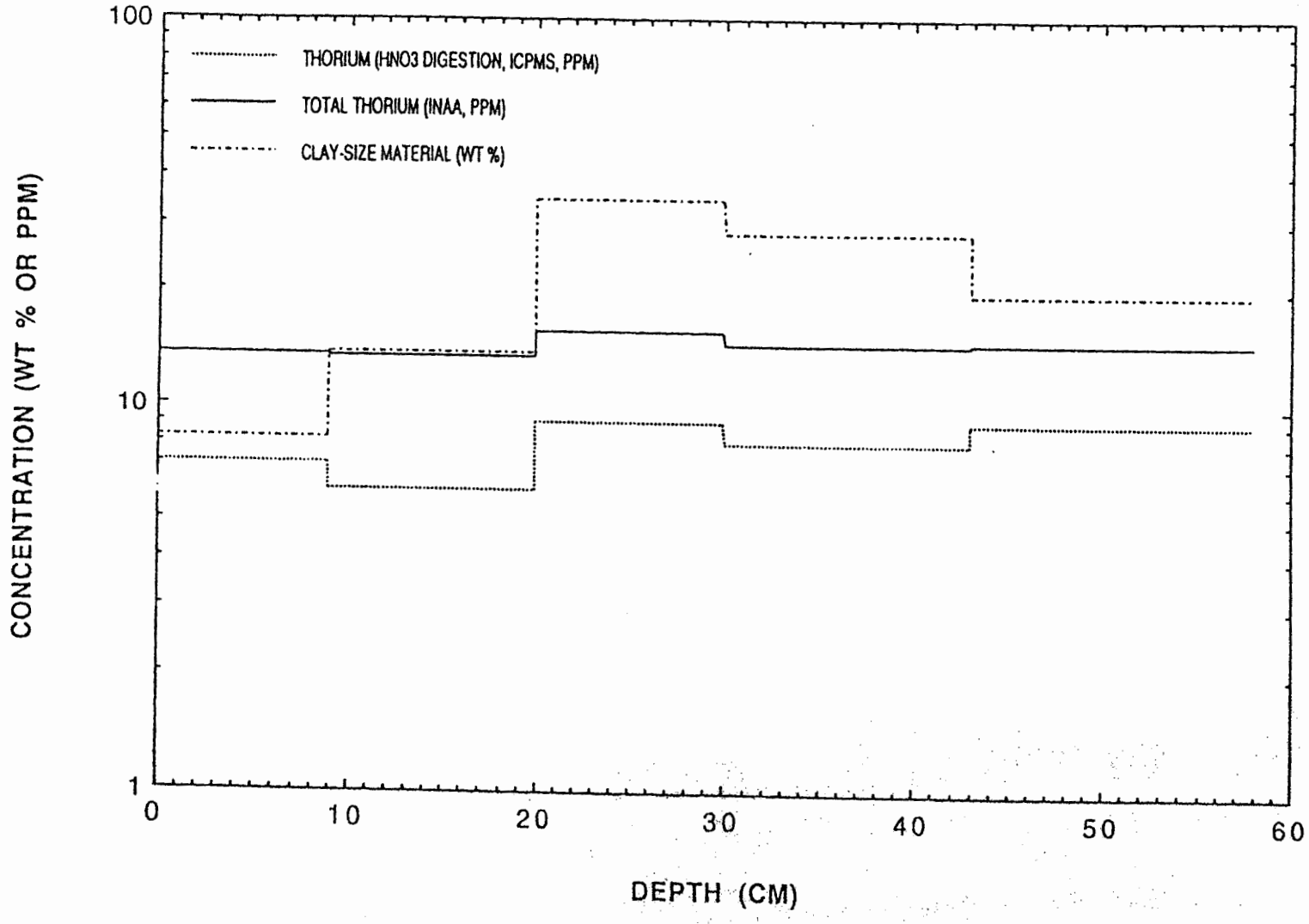

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Figure 57 BACKGROUND SOIL, SITE 4. TWOMILE MESA-NORTH.

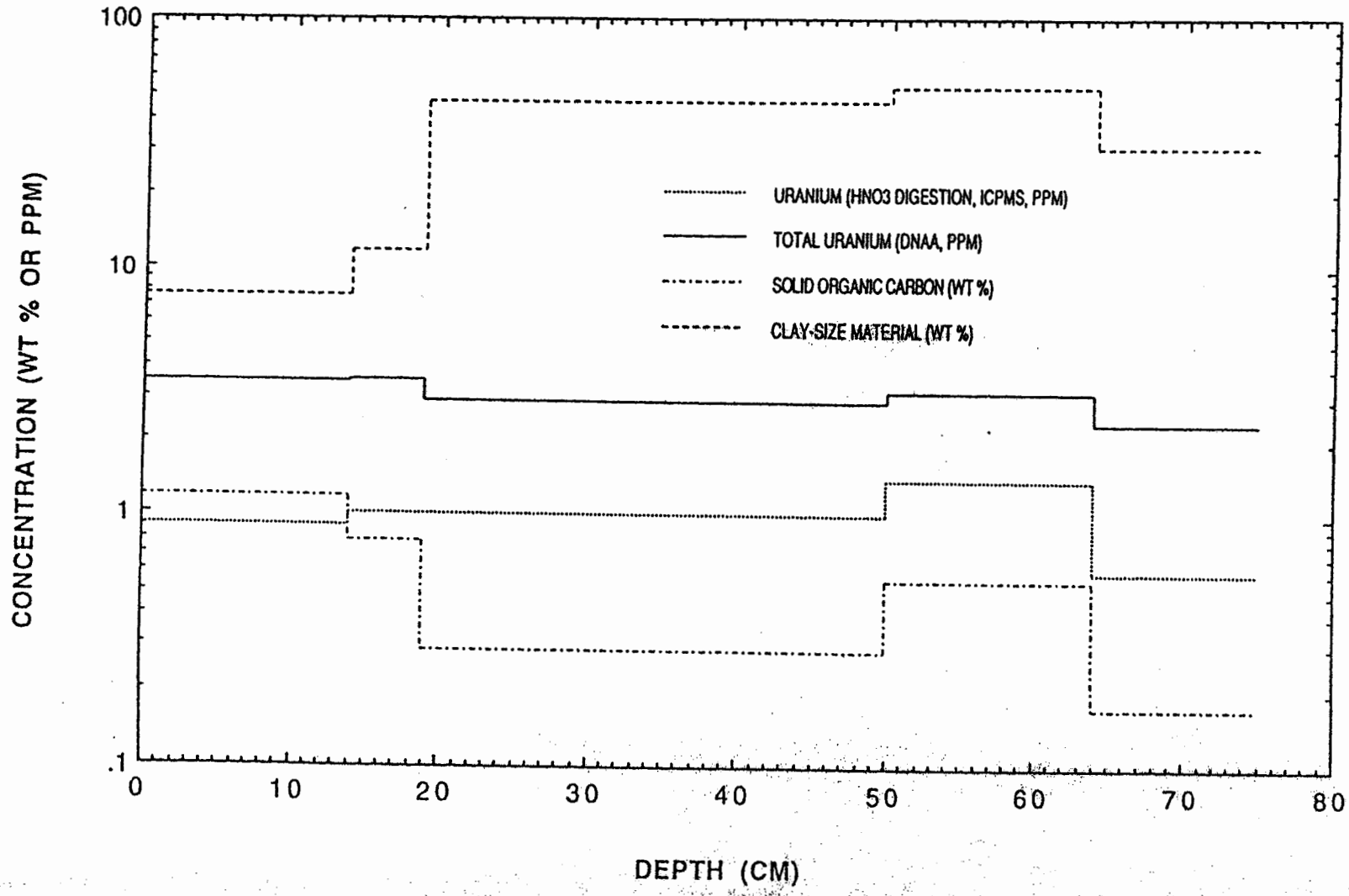
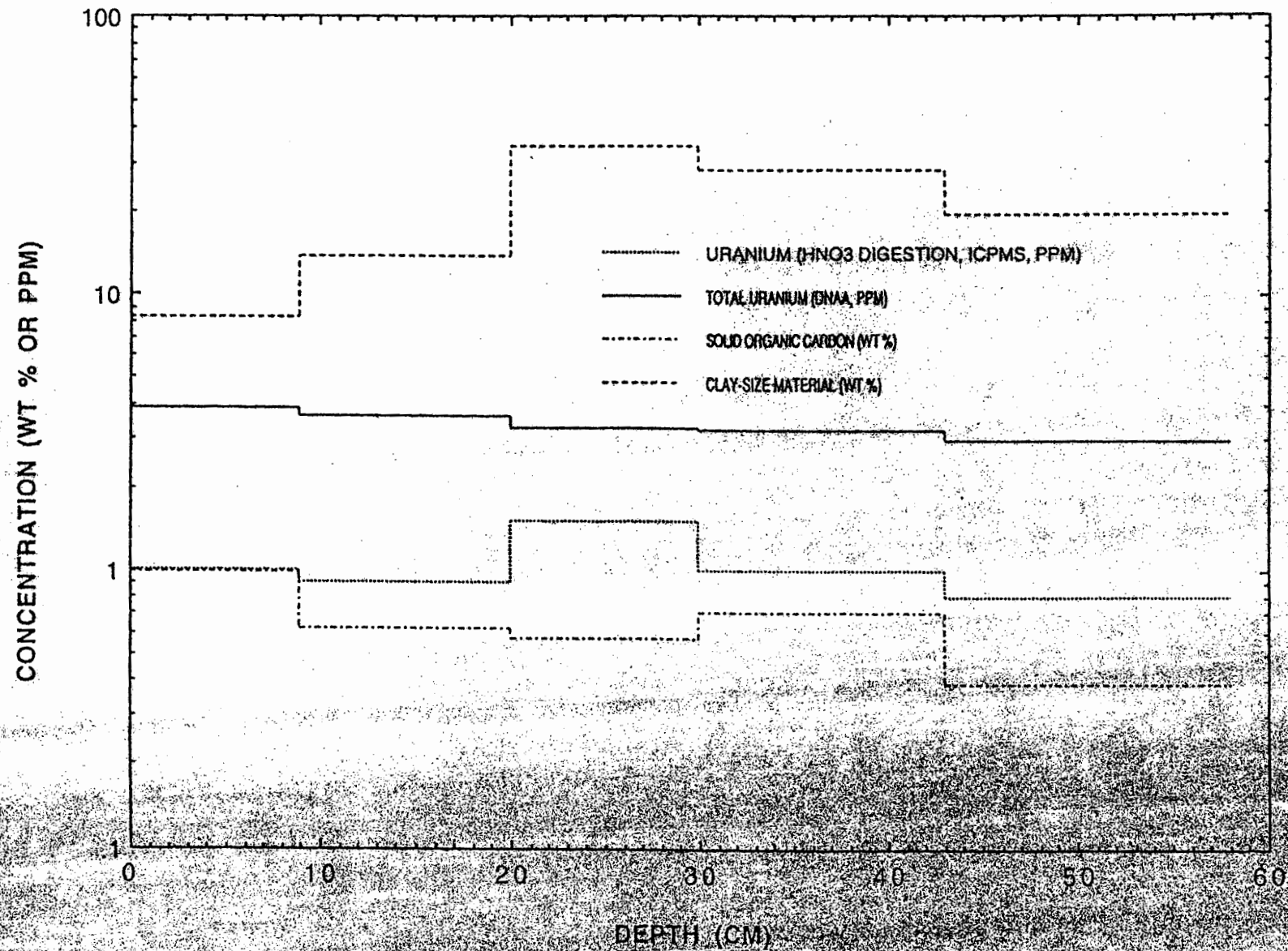


Figure 58

BACKGROUND SOIL, SITE 4. TWOMILE MESA-SOUTH.



Some of the U present in the Twomile Mesa soil has been leached from the primary phase(s) and redistributed in secondary soil phases. Uranium distributions vary with depth at this soil site. Concentrations of total U at the north end of the trench range from 2.36 to 3.45 ppm, whereas concentrations of acid-digested U range from 0.4 to 1.4 ppm. Acid-digested U comprises 25 to 44% of total U at the north end of the trench. Concentrations of total U at the south end of the trench range from 2.96 to 3.84 ppm, whereas concentrations of acid-digested U range from 0.8 to 1.5 ppm. The acid-digested U comprises 25 to 46% of total U at the south end of the trench. Acid-digested U correlates with clay-size fraction within both soil profiles (Figures 57 and 58). Based on distributions of Al, Fe, and solid organic carbon, clay minerals present in the soil are coated with iron oxides and solid organic carbon. Total U correlates well ($r^2 = 0.86$) with solid organic carbon (Figure 59). Uranyl has been experimentally shown to undergo ligand exchange reactions with humic acids, where carboxylic acids provide active binding sites (Longmire, 1991; Shanbhag and Choppin, 1981).

Figures 60 and 61 show distributions of As, Be, and Fe versus depth at the north and south ends of the trench, respectively. Arsenic and Be are highest within Bw, 2Bt1b, 2Bt2b, and 2Bt3b horizons (Figures 60 and 61). These elements show a strong correlation with each other ($r^2 = 0.81$ for As and Fe and $r^2 = 0.79$ for Be and Fe) (Figures 62 and 63). This correlation suggests that adsorption of As and Be onto surfaces of iron oxide and/or clay minerals is an important process for controlling trace element distributions at the Twomile Mesa site. At the north end of the trench, total Be concentrations in soil range from 1.55 to 3.1 ppm, and HNO_3-digested Be concentrations range from 0.67 to 2.20 ppm. Acid-digested Be comprises 42 to 95% of total Be at the north end of the trench. At the south end of the trench, total Be concentrations range from 1.00 to 2.20 ppm, and HNO_3-leach Be concentrations range from 0.54 to 1.40 ppm. Acid-digested Be comprises 34 to 75% of total Be. These distributions suggest that in some soil horizons Be is mainly is distributed within secondary soil phases and minor amounts are associated with primary phases at the Twomile Mesa site.

Figure 64 shows distributions of HNO_3-digested As and total As (above 50 cm depth) at the north end of the trench. Total As concentrations range from 3.71 to 7.30 ppm, and HNO_3-digested As concentrations range from 4.70 to 9.30 ppm. The acid-digested fraction of As comprises 45 to 81% of total As. Figure 65 shows distributions of HNO_3-digested As and total As at the south end of the trench. Total As concentrations range from 5.14 to 8.76 ppm, and HNO_3-digested As concentrations range from 3.9 to 7.0 ppm. The acid-digested fraction of As in this well-developed soil

Figure 59

BACKGROUND SOIL, SITE 4. TWOMILE MESA.

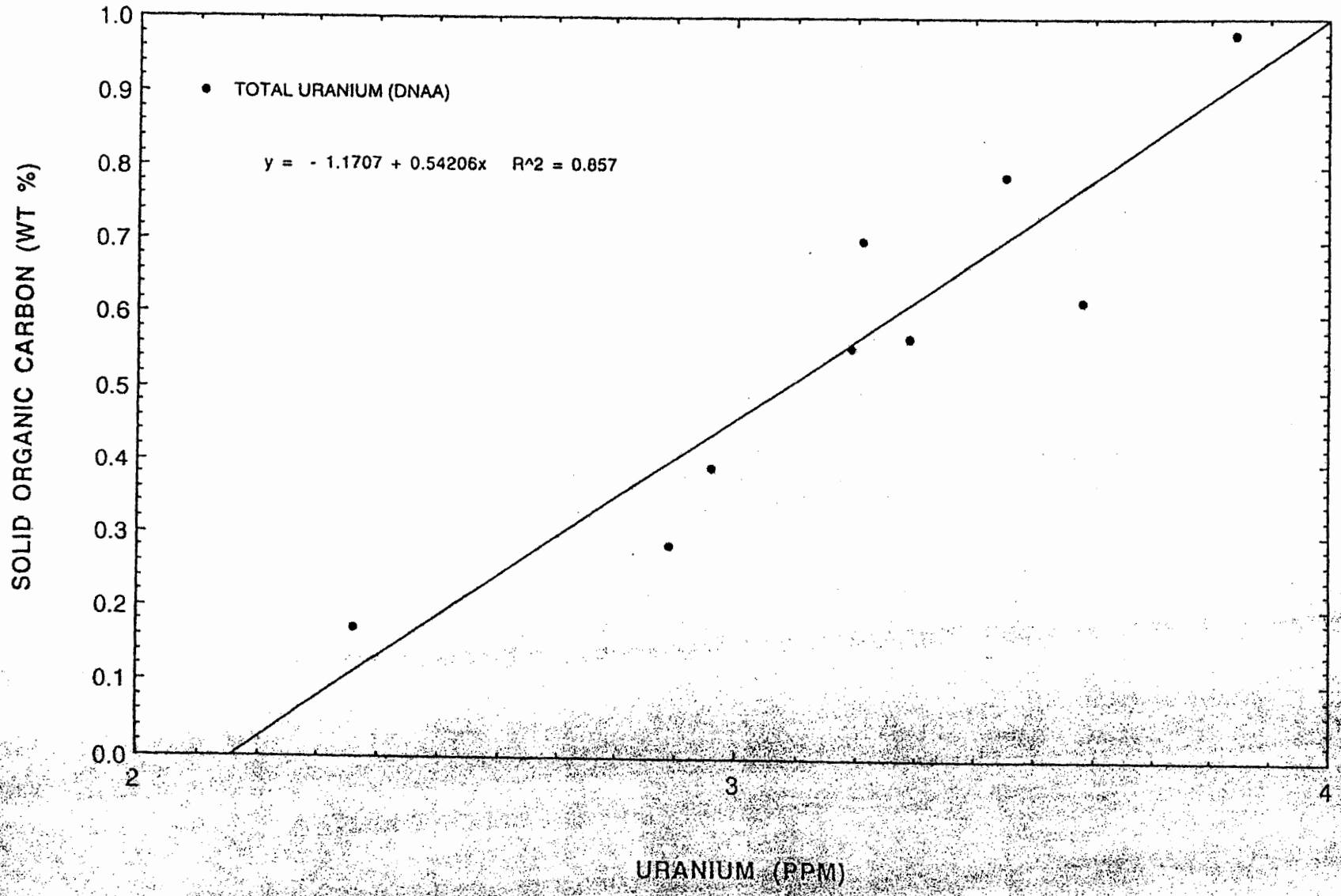


Figure 60

BACKGROUND SOIL, SITE 4. TWOMILE MESA-NORTH.

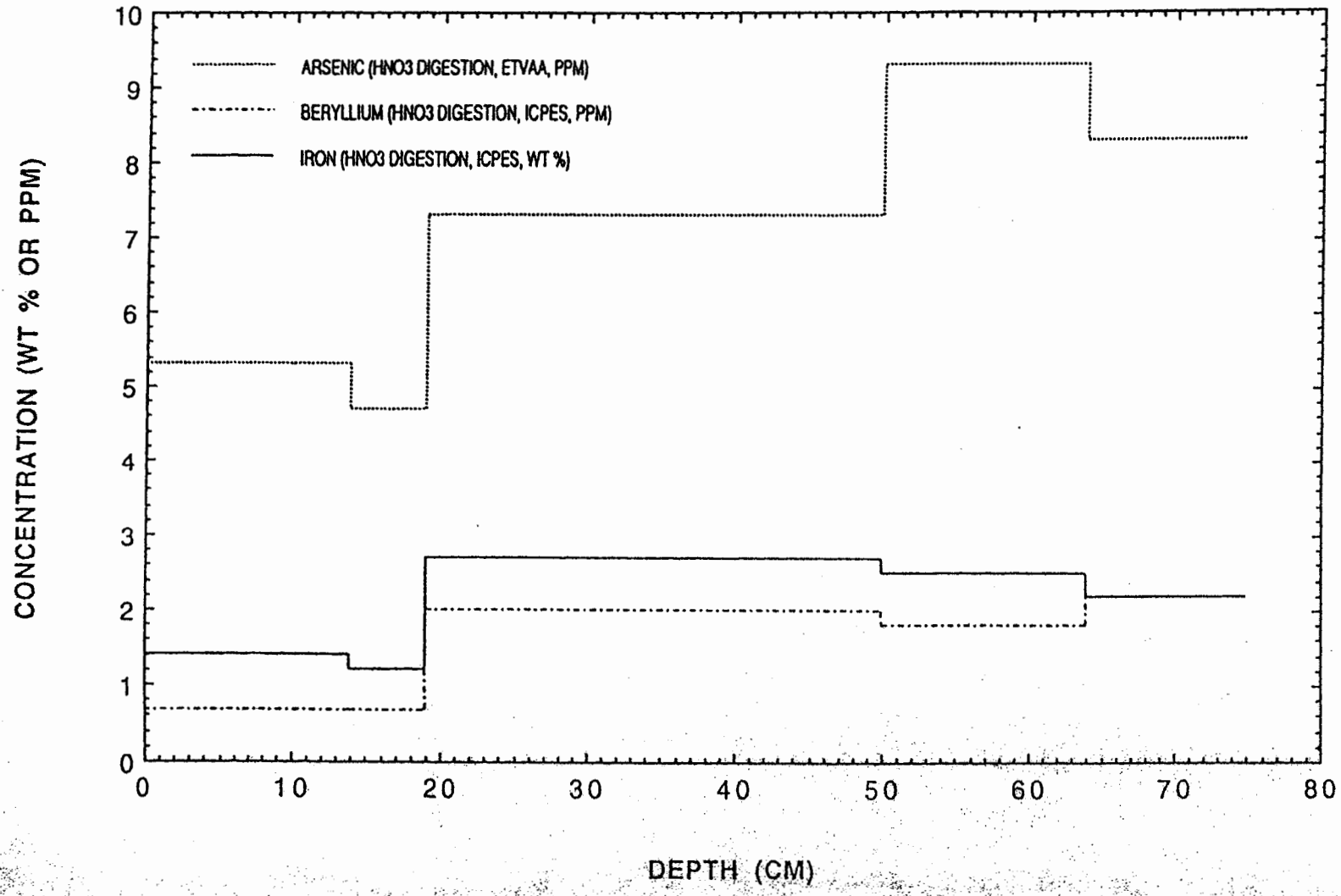


Figure 61

BACKGROUND SOIL, SITE 4. TWOMILE MESA-SOUTH.

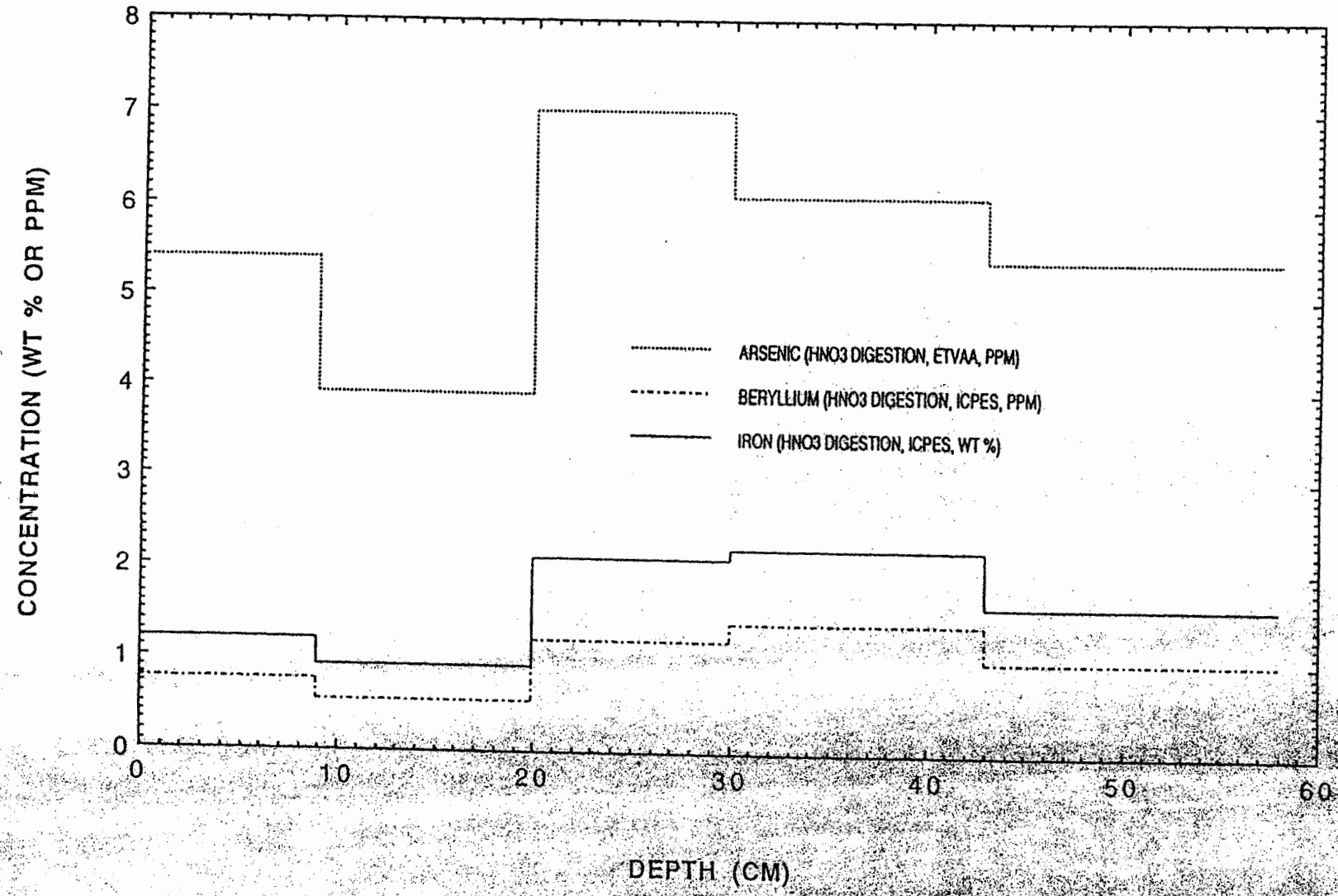


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Figure 62

BACKGROUND SOIL, SITE 4. TWOMILE MESA.

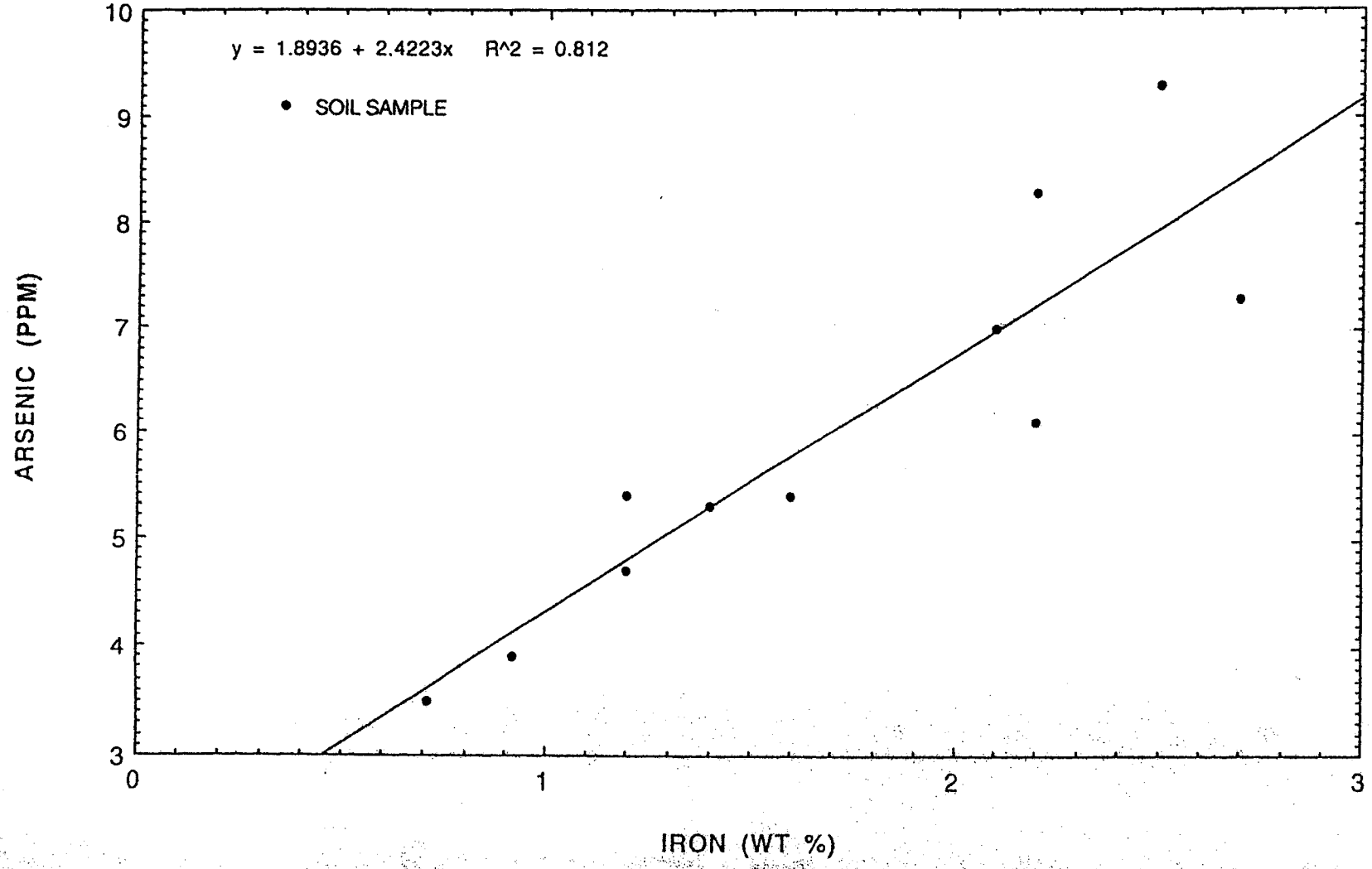


Figure 63

BACKGROUND SOIL, SITE 4. TWOMILE MESA.

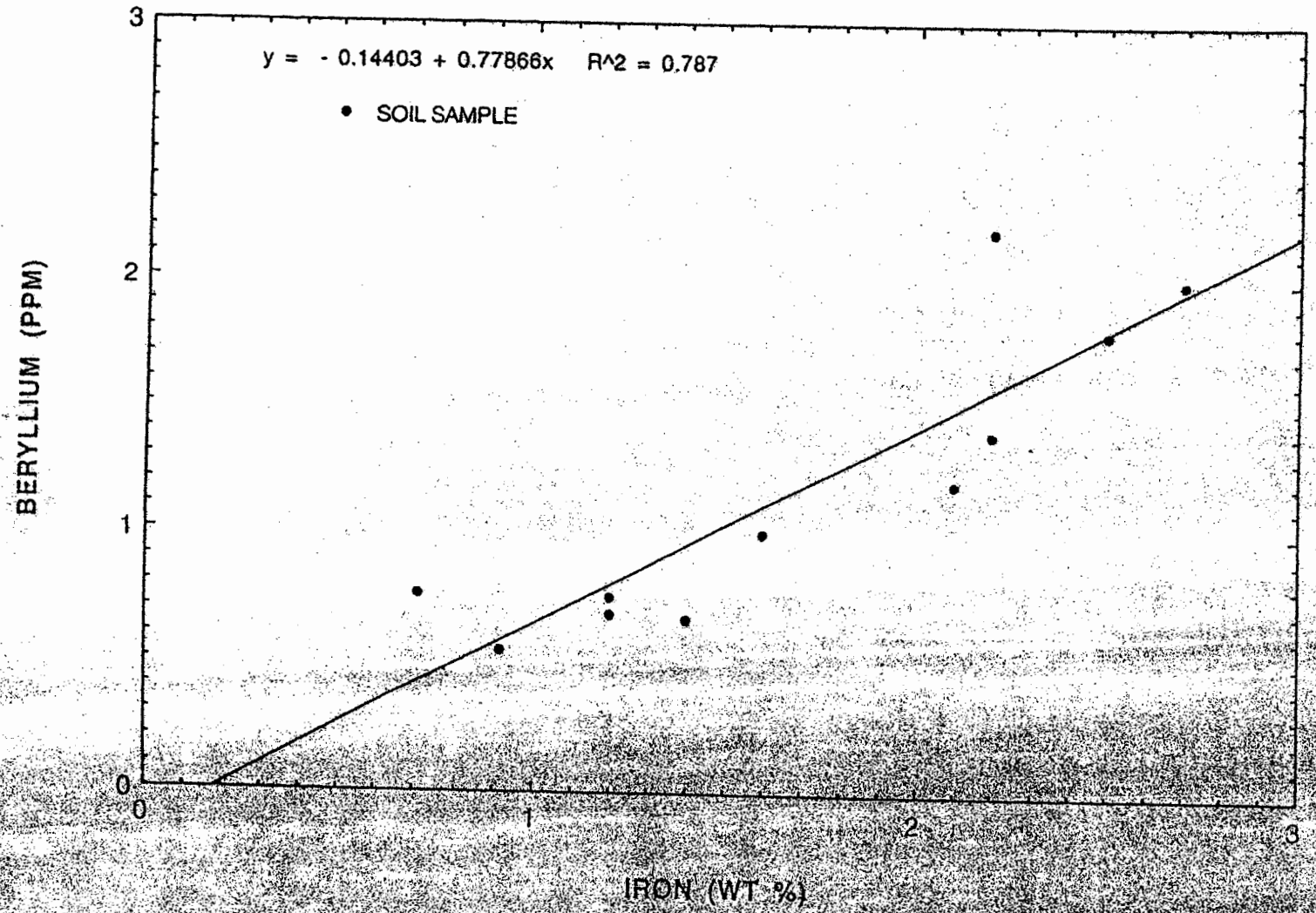


Figure 64

BACKGROUND SOIL, SITE 4. TWOMILE MESA-NORTH.

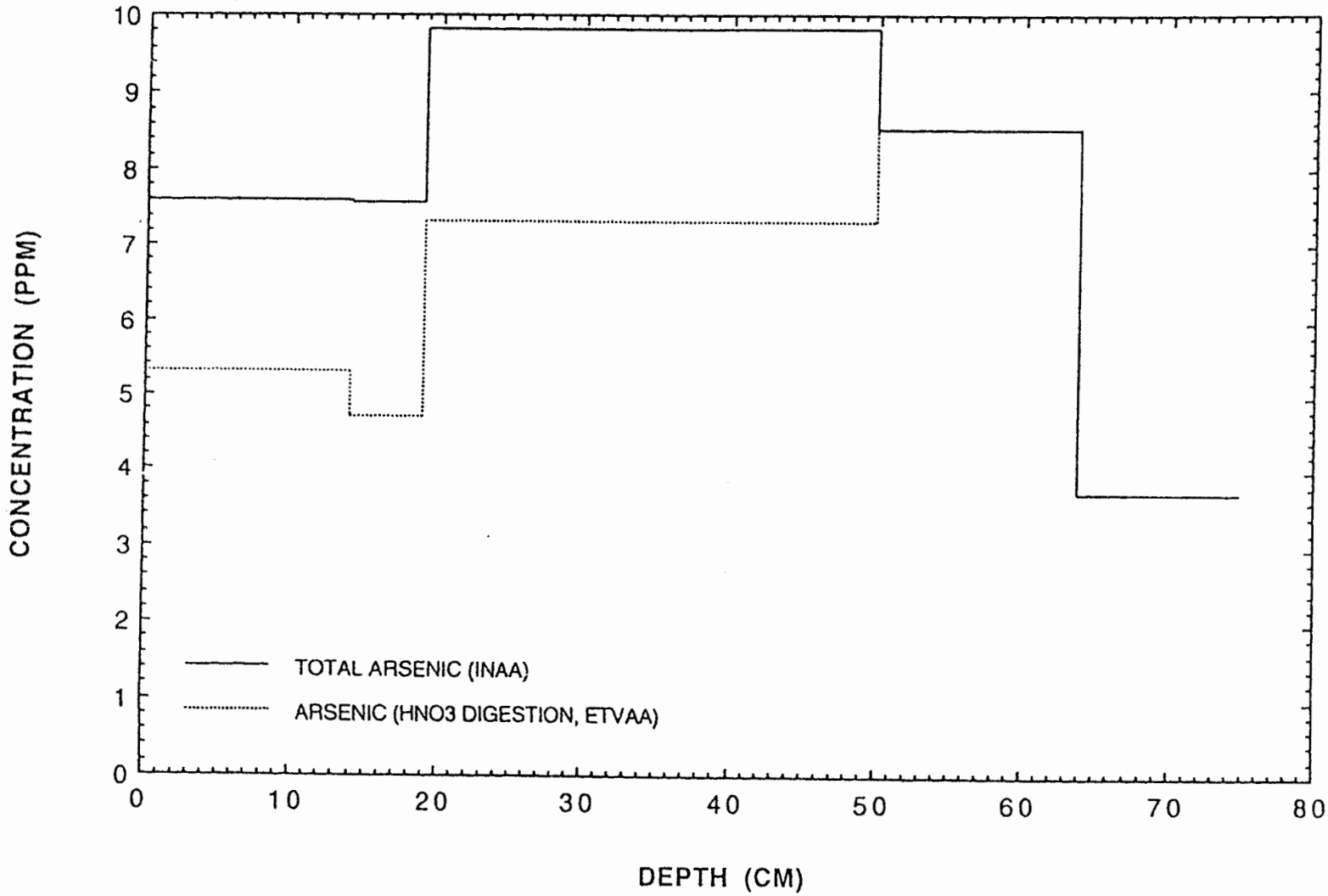
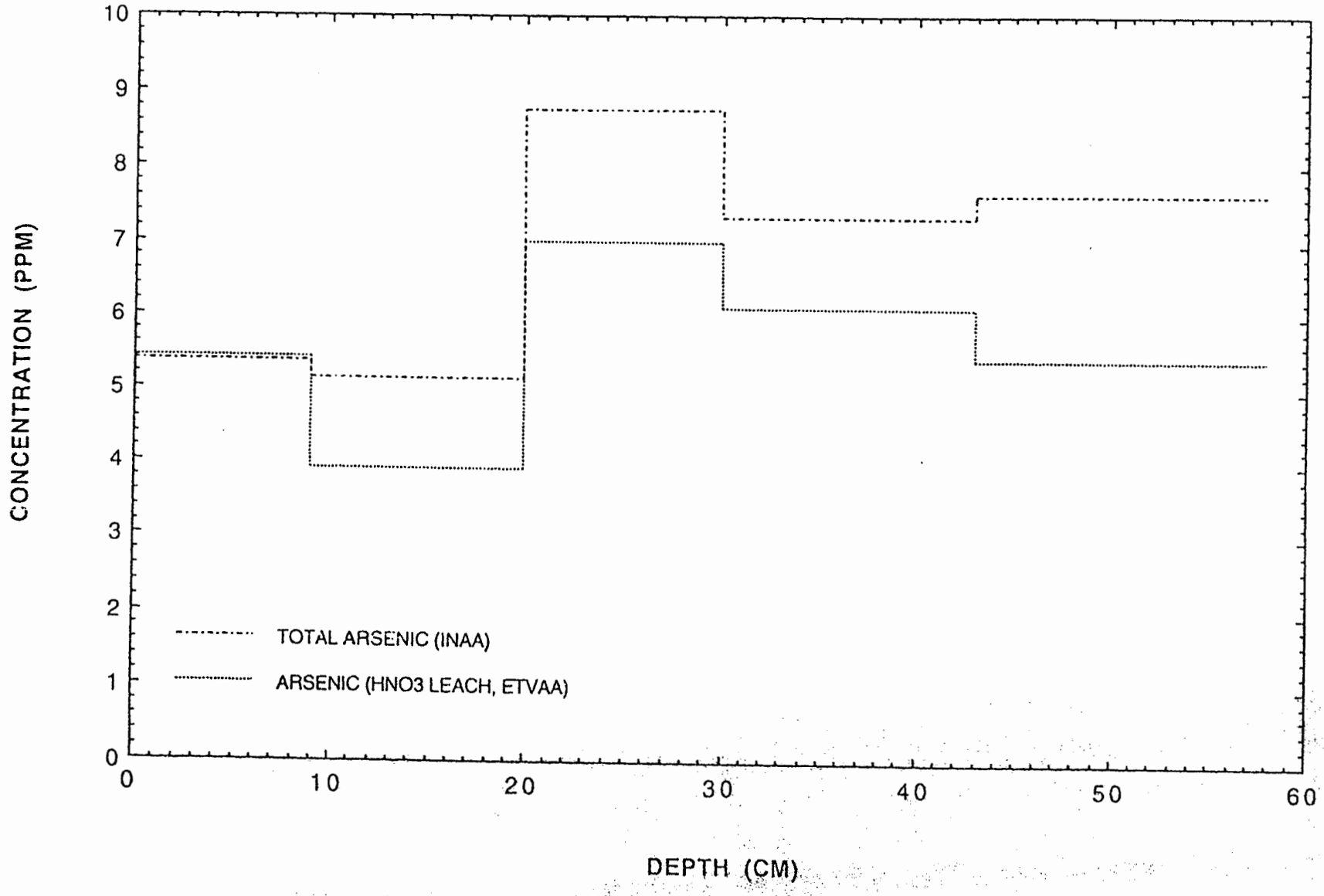


Figure 65

BACKGROUND SOIL, SITE 4. TWOMILE MESA-SOUTH.



comprises 62 to 74% of total As at the south end of the trench. Adsorption processes involving iron oxide may account for As enrichment within the Bw and other horizons at this site. Background concentrations of As and Be exceed soil SALs for these two elements (Table 2).

Site 5. Water Tanks Trench, West Jemez Road

Location and Geomorphic Setting

The Water Tanks soil sampling site was within a trench that was excavated between Cañon de Valle and Water Canyon, west of West Jemez Road near TA-16, as part of the Seismic Hazards Investigation Program (Wong et al., 1993) (Figure 66). The trench exposed a sequence of colluvial deposits that occur at the base of a steep forested slope, which represents the main scarp of the Pajarito fault zone (Gardner and House, 1987; Wong et al., 1993). Also exposed in the trench is a pure layer of El Cajete pumice, up to 1.2 m thick (Figure 66). The upper part of the El Cajete pumice has been heavily disrupted by bioturbation and the overlying colluvial soil, 0.5 to 1.3 m thick, includes abundant pumice in addition to some Bandelier Tuff clasts. Holocene radiocarbon dates of about 1.1 and 5.8 ka have been obtained from the colluvium above the El Cajete pumice (Figure 67, Table 9). The colluvial deposits below the pumice layer contain no El Cajete pumice, although they contain abundant angular clasts of Bandelier Tuff (Tshirege Member), and are thus presumably older than about 60 ka. The soils at this site are mapped as part of the "Rock Outcrop-Pines-Tentrock Complex" by Nyhan et al. (1978), and may be representative of other sites along the base of the fault scarp at the western edge of the Laboratory.

The present source for the colluvium extends 35 m (100 vertical ft) up the slope, which represents about 40% of the total scarp height. The slope at and above the sample site is slightly convex-out, causing divergence of colluvium transported down the slope. Upslope of the sample site, net erosion of the slope has occurred since about 60 ka, resulting in complete stripping of the El Cajete pumice 40 m (130 ft) to the west. The relatively small amount of material deposited on top of the El Cajete pumice at this site may be related to this divergence of colluvium.

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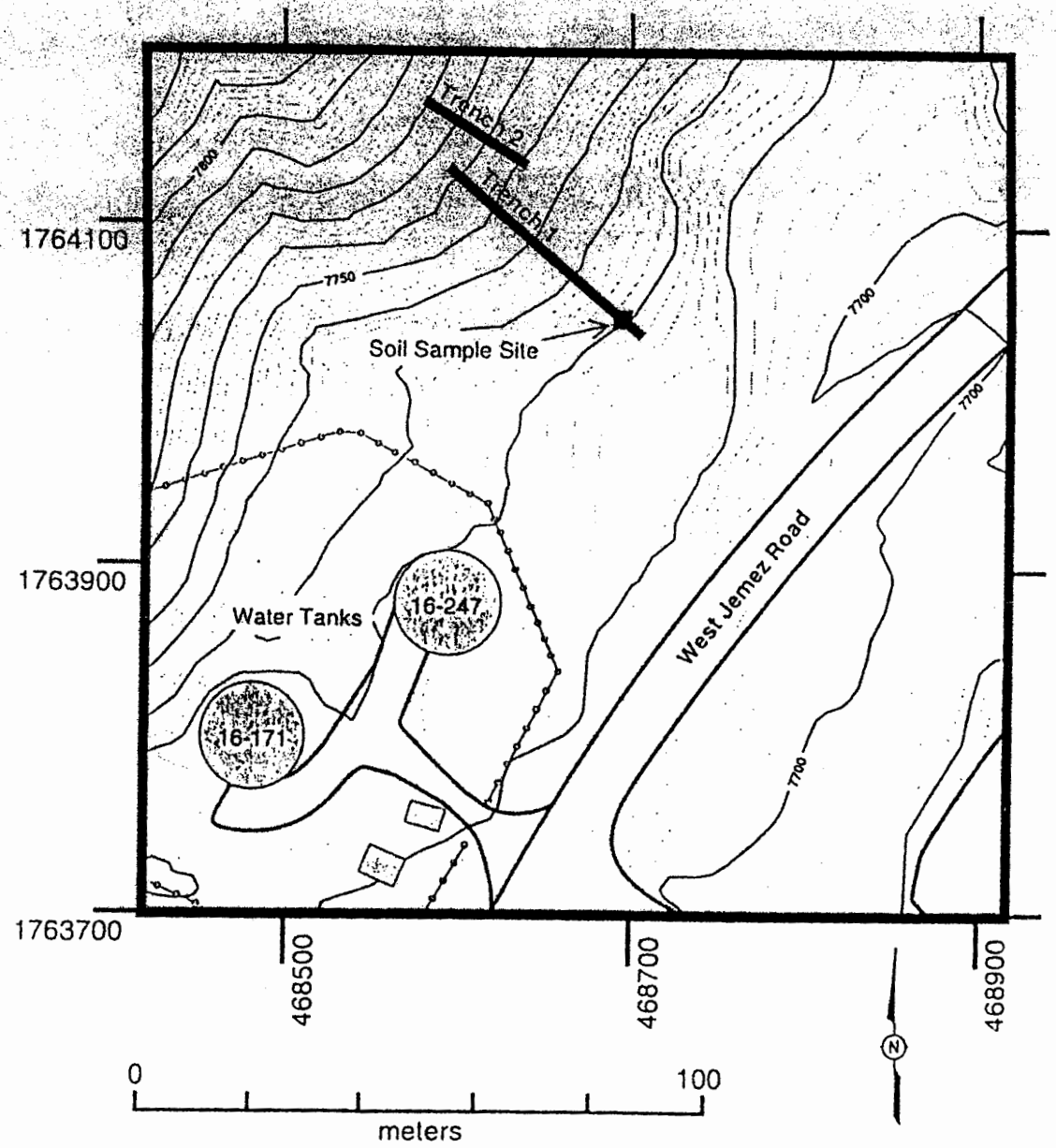


Fig. 66. Map of sample site 5 at Water Tanks Trench. Topographic base, with 2-foot contours, from FIMAD.

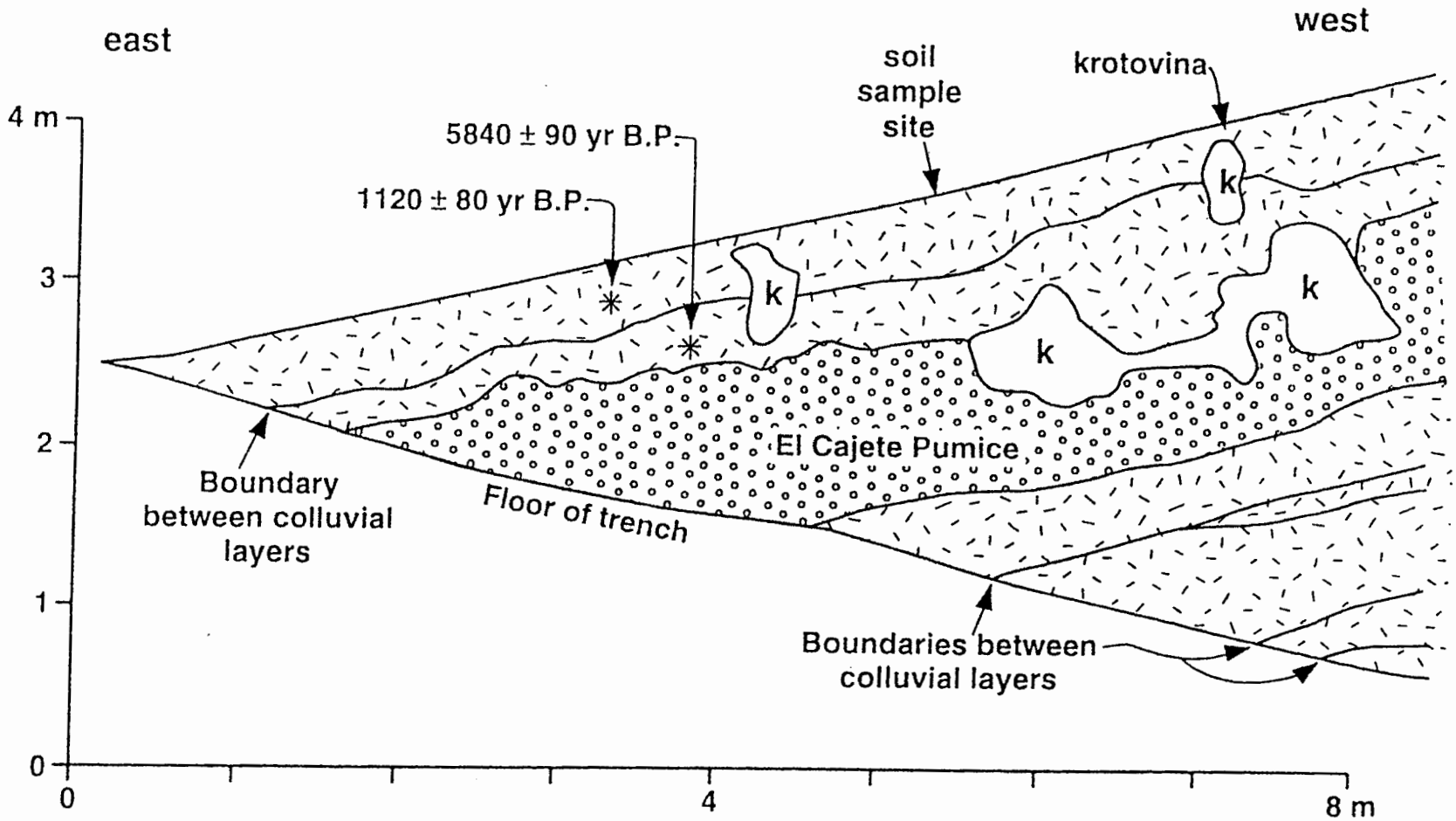


Fig. 67. Stratigraphy at east end of Water Tanks Trench 1, showing colluvial layers, El Cajete pumice, krotovinas (animal burrows), and location of radiocarbon dates. Modified from trench log of Wong et al. (1993). Log is of south trench wall, and soil samples were collected from the north wall.

Soil Description

Soil samples collected from the Water Tanks trench site are listed in Table 7 and results of chemical analyses are provided in Appendices I and II. The soil described in the trench is formed in sheet wash, alluvium, colluvium, and loess that overlie reworked El Cajete pumice. The soil is well developed and contains clay-rich horizons (Watt and McFadden, 1992). The soil profile at this site consists of the following horizons with associated depths and thicknesses (in cm): A (0-6), BA (6-18), 2Bt1b (18-35), 2Bt2b (35-53), 2Bt3b (53-64), and 3CB (64+). In addition, three discontinuous $CaCO_3$ zones occur at the following depths (in cm): K_1 (42-64), K_2 (64-76), and K_3 (70-80) (Watt and McFadden, 1992). The origin of these $CaCO_3$ zones, however, is not well understood, although they may be associated with root systems or fungal hyphae based on field observations. Oxidation and reduction zones also occur in the soil profile, particular immediately beneath the El Cajete pumice (3CB horizon), and may be related to perching of water within the vadose or unsaturated zone.

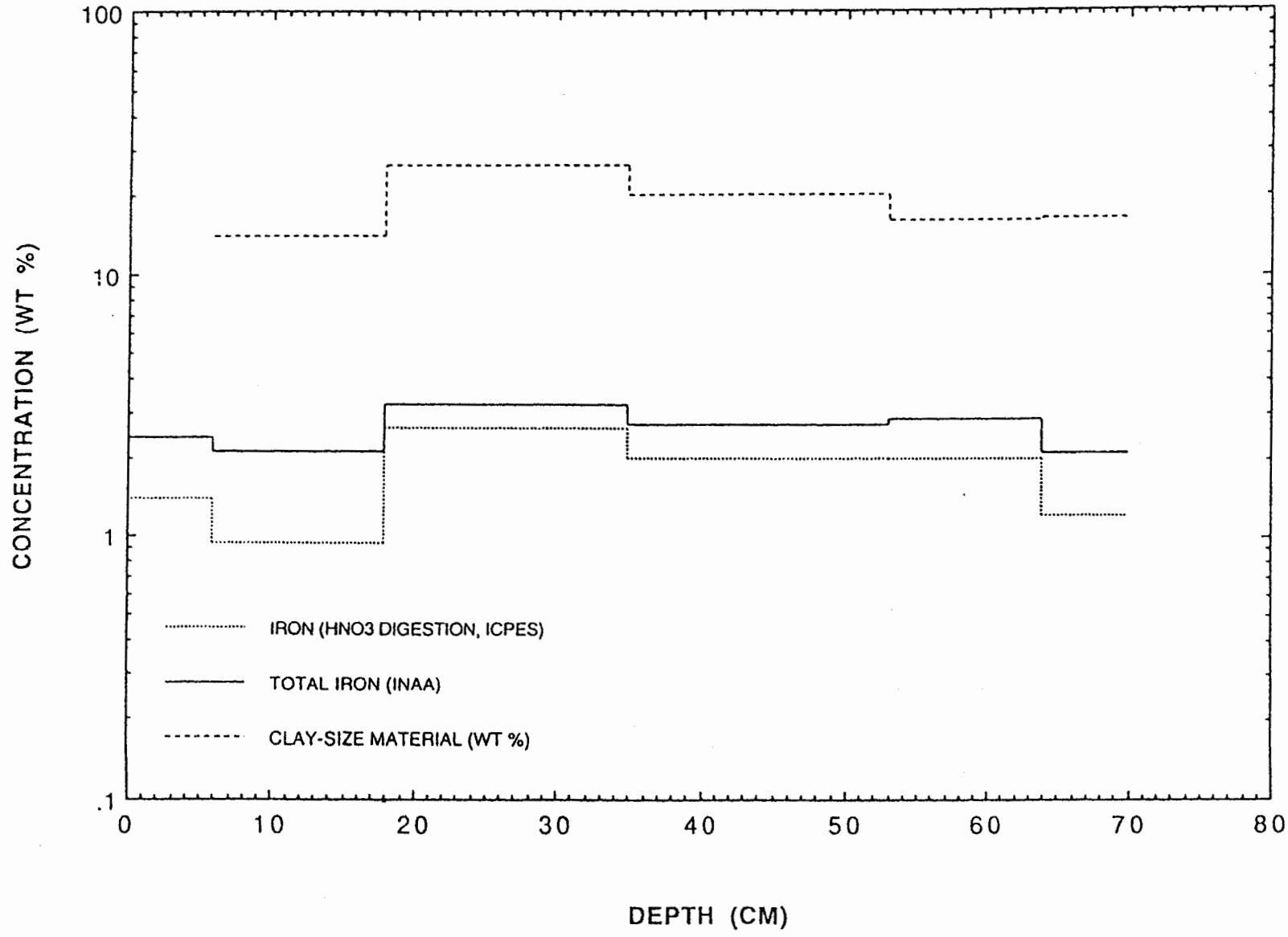
The A horizon is well developed and contains variable amounts of organic carbon. Organic carbon values range from 0.27 to 2.54 wt%, and the highest abundance is associated with lenses of organic matter. This soil profile contains moderately high clay content; abundances of clay-size material vary from 13.8 to 25.9 wt% (Watt and McFadden, 1992). Sand-size material ranges from 26.6 to 77.1 wt%, indicating that this soil profile may have a moderately high hydraulic conductivity (Table 4, K values ranging from 10^{-5} to 10^{-2} cm/sec) in comparision to clay-rich soils found at other areas on the Pajarito Plateau. Silt-size material varies from 6.6 to 49.5 wt% at this soil site.

Soil Chemistry

This soil is characterized by acidic to alkaline pH values ranging from 6.0 to 8.2 that increase with depth.The lowest pH value in this soil profile is associated with the BA horizon, whereas the highest pH value is associated with the $CaCO_3$ rich-zones (Watt and McFadden, 1992). Calcium carbonate abundances vary from 0.5 to 19.6 wt% (Watt and McFadden, 1992).

Distributions of total Fe, HNO_3 digested Fe, and clay-size material versus depth are shown in Figure 68. Total Fe concentrations range from 2.1 to 3.2 wt% and Fe content is generally correlated with clay content (Figure 68). Acid-soluble Fe concentrations range from 0.9 to 2.6 wt% comprising 37 to 81% of total Fe. These

Figure 68 BACKGROUND SOIL, SITE 5. WATER TANKS TRENCH.



concentration distributions suggest that Fe occurs both in refractory phases such as hornblende, magnetite, and biotite and in HNO_3-digested Fe phases including ferric oxyhydroxide and ferrihydrite. Adsorption of trace elements onto calcium carbonate, iron oxides, and clay minerals is likely to control trace-element distributions in this organic-rich soil profile containing several B horizons.

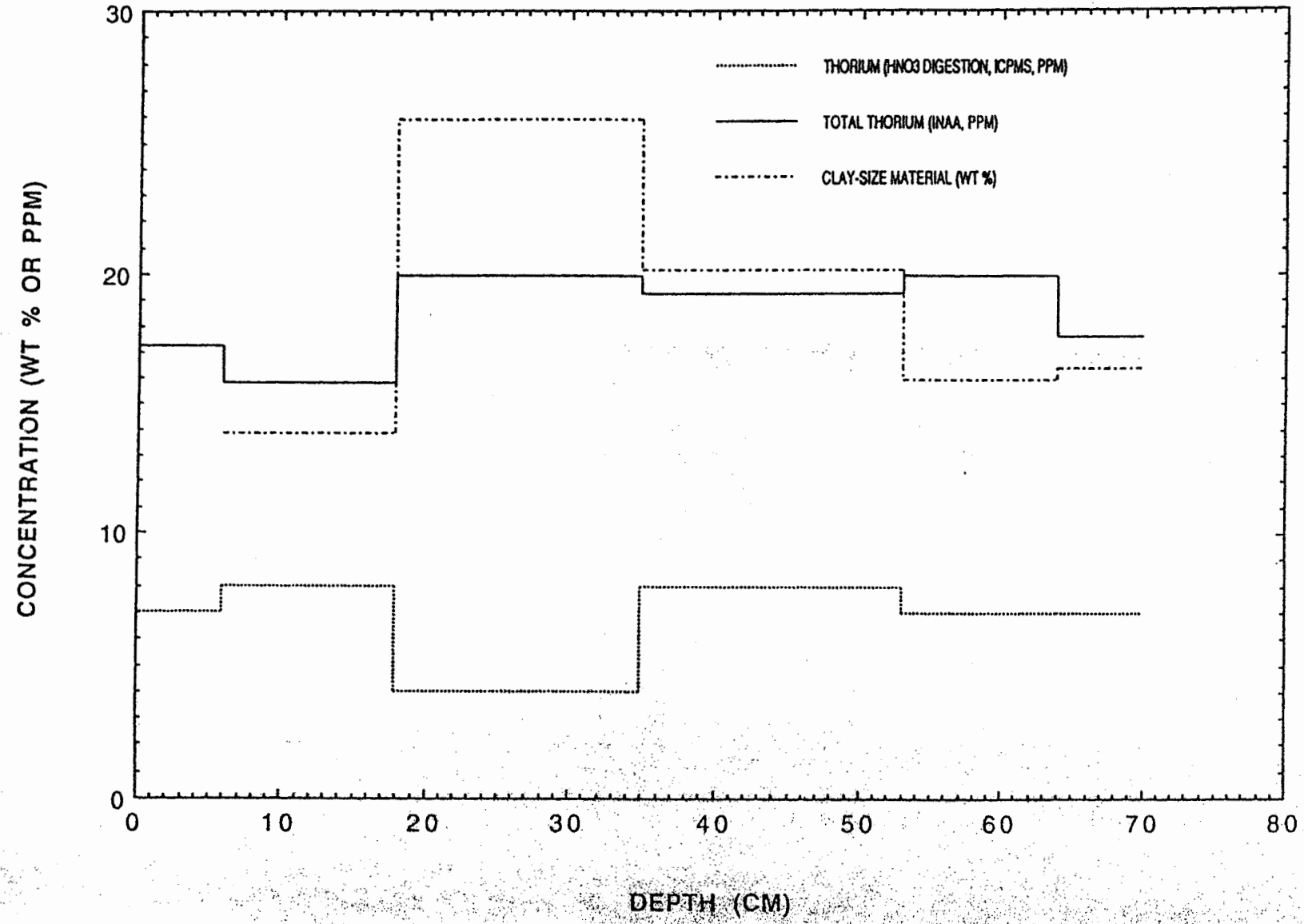
Distributions of total Th, acid-digested Th, and clay-size material vary with depth (Figure 69). Total Th concentrations range from 17.20 to 19.96 ppm (Figure 69). Acid-digested Th concentrations range from 4.00 to 8.00 ppm, which comprises 20 to 51% of total Th. The acid-digested fraction of Th does not correlate with clay-size material (Figure 69). It appears that most of the Th has not leached from primary silicate phases based on percentage distributions of acid- digested and total Th.

Distributions of total U, acid-digested U, and solid organic carbon vary with depth (Figure 70). Concentrations of total U range from 3.07 to 3.96 ppm (Figure 70). Concentrations of acid-digested U range from 0.70 to 2.00 ppm and this fraction comprises 20 to 51% of total U. Acid-digested U correlates with solid organic carbon (Figure 70). Uranyl undergoes ligand exchange with humic acids, predominantly with carboxylic acids (Longmire, 1991; Shanbhag and Choppin, 1981). Overall, most of the U present in this soil has not been leached from the primary silicate phase(s).

Figure 71 shows distributions of As, Be, and Fe versus depth at the soil site. Beryllium is associated with Fe in several soil horizons at this site. Arsenic is enriched within the A and 2Bt2b horizons, whereas Be and Fe are enriched within the 2Bt1b horizon (Figure 71). Concentrations of total Be range from 2.0 to 3.3 ppm, whereas concentrations of HNO_3-digested Be range from 0.77 to 2.60 ppm. Acid-digested Be comprises 35 to 81% of total Be (Figure 72), which suggests that in some soil horizons Be is dominantly distributed within secondary soil minerals and solid phases and some Be is distributed within primary silicate phases.

Adsorption reactions with calcium carbonate may be the dominant process controlling As enrichment at this site. Figure 73 shows distributions of HNO_3-digested As and calcium carbonate versus depth. Arsenic shows a strong correlation ($r^2 = 0.82$) with calcium carbonate (Figure 74). Results of experimental investigations conducted by Zachara et al. (1993) show that maximum adsorption of PO_4^{3-} and SeO_3^{2-} onto calcite occurs below pH 7.0, whereas Cd^{2+}, Zn^{2+}, and Mn^{2+} essentially show maximum adsorption below or at pH 8.5. Recent studies using a streaming potential method suggest that Ca^{2+} and CO_3^{2-} are the dominant surface species and that other species, including H^+ and OH^-, have no significant effect on the surface charge (Thompson et al., 1989). Calcite carries a positive charge below pH 9.0 in saturated

Figure 69 BACKGROUND SOIL, SITE 5. WATER TANKS TRENCH.



. gure 70

BACKGROUND SOIL,SITE 5. WATER TANKS TRENCH.

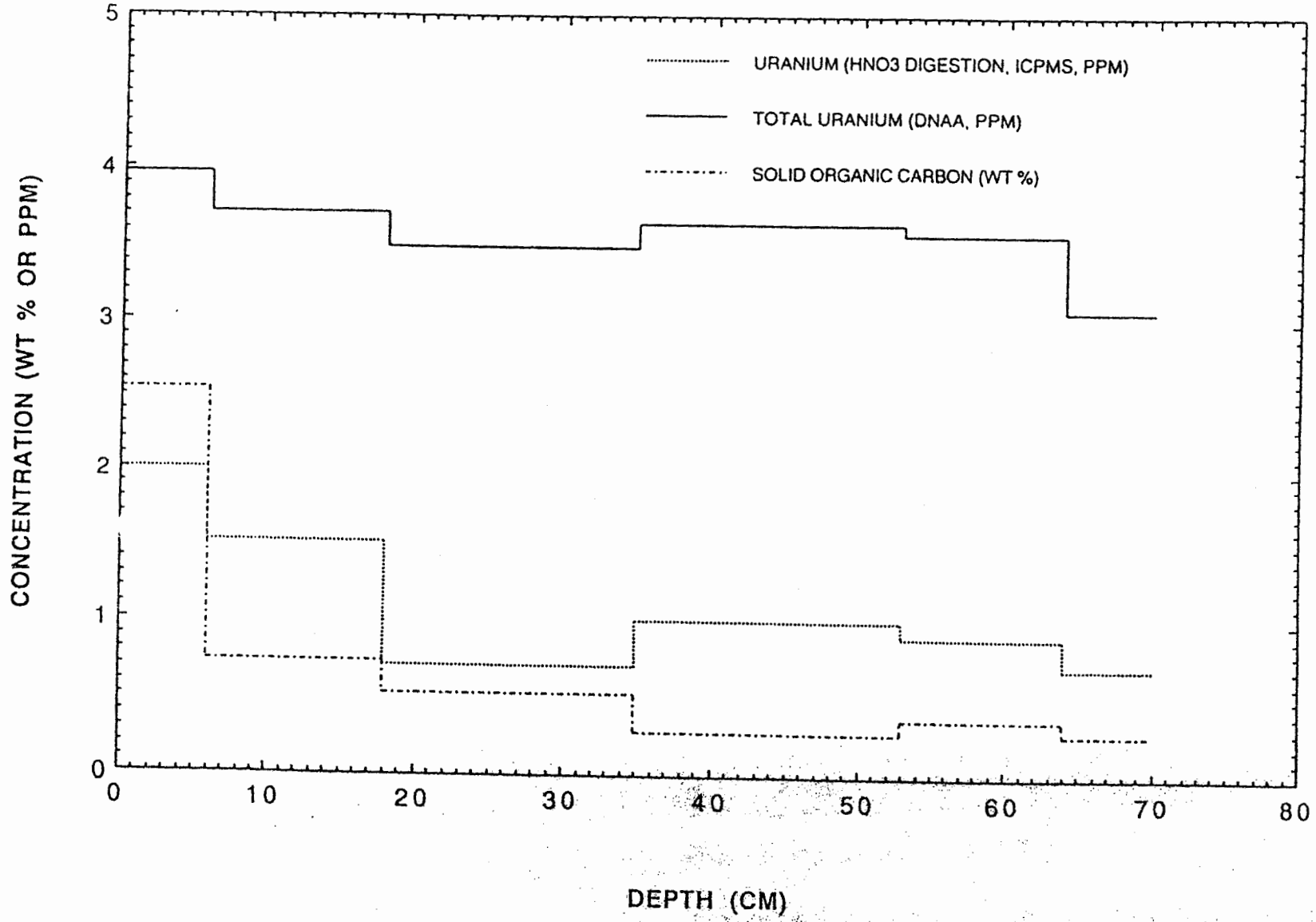


Figure 71

BACKGROUND SOIL, SITE 5. WATER TANKS TRENCH.

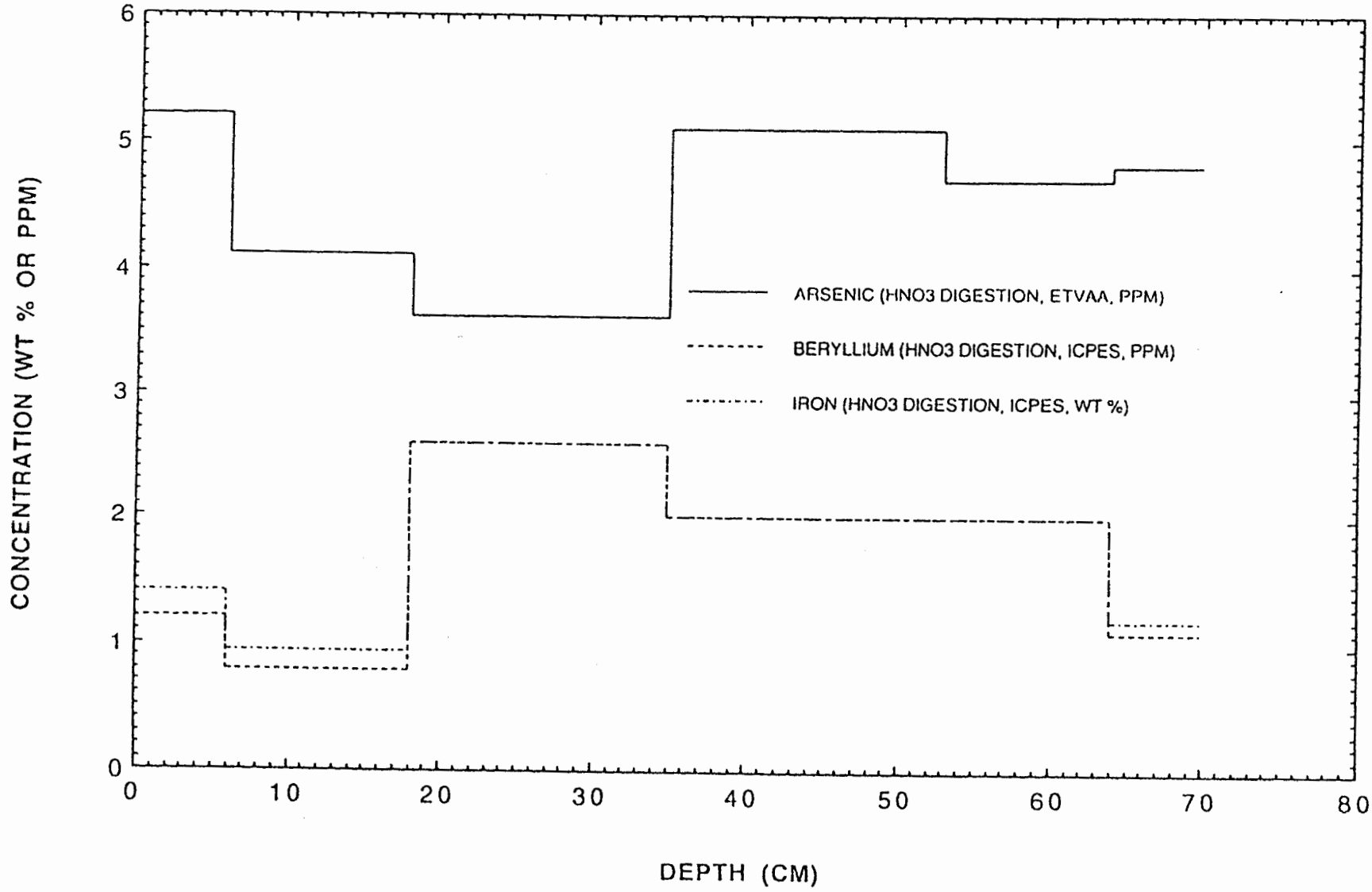


Figure 72 BACKGROUND SOIL, SITE 5. WATER TANKS TRENCH SITE.

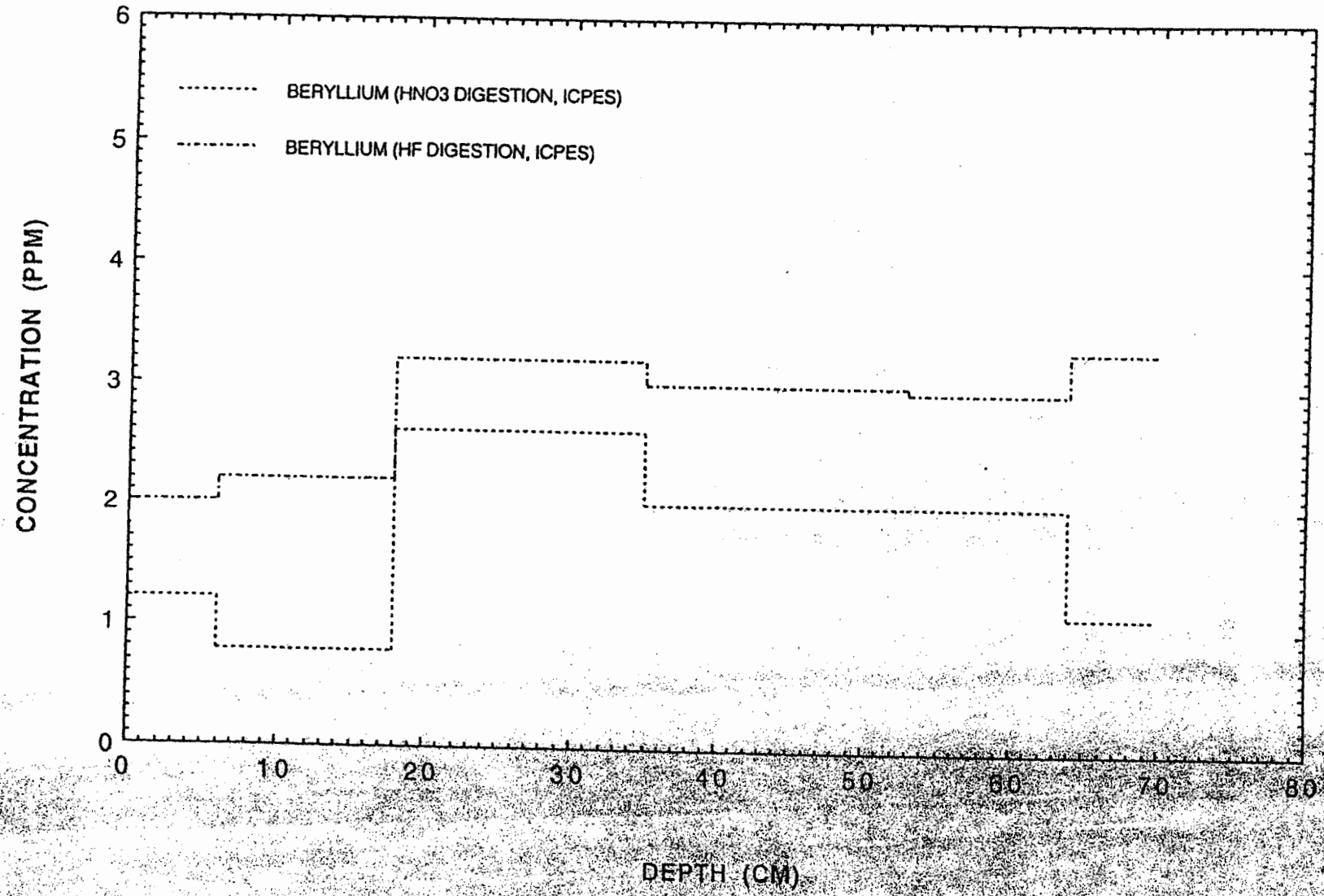


Figure 73

BACKGROUND SOIL, SITE 5. WATER TANKS TRENCH.

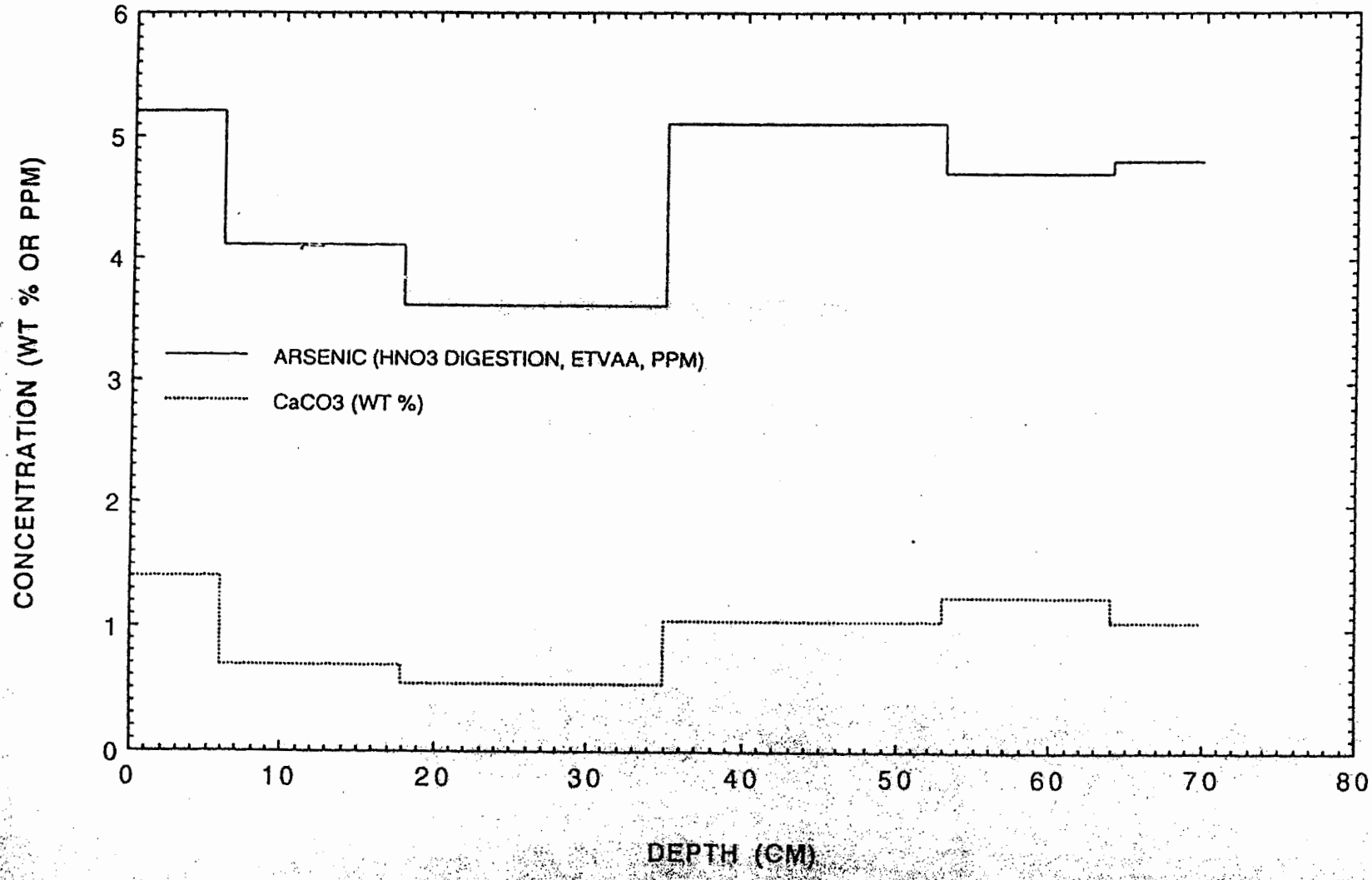
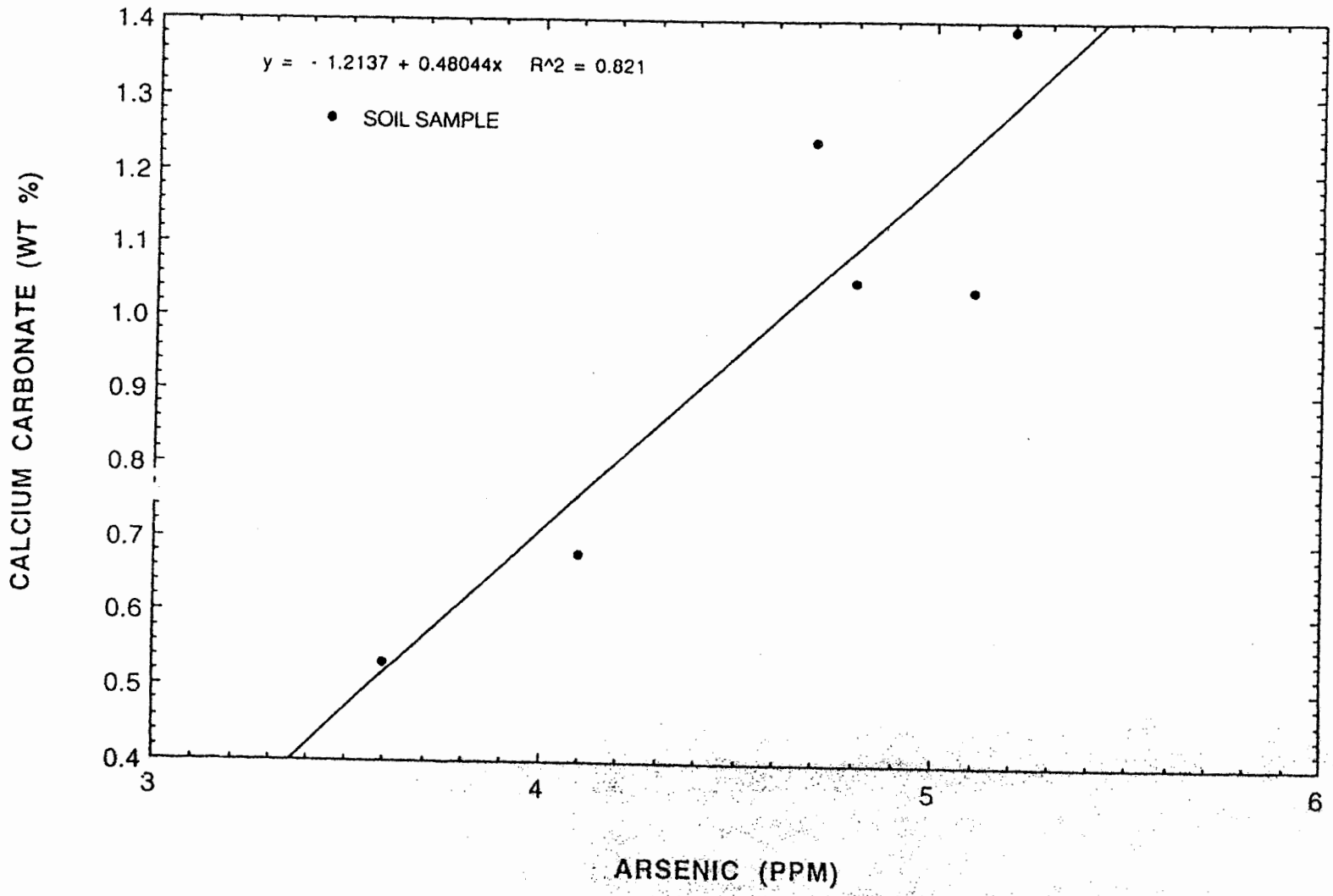


Figure 74

BACKGROUND SOIL, SITE 5. WATER TANK TRENCH.



calcium carbonate solutions in contact with atmospheric PCO_2 ($10^{-3.5}$ atm) (Foxall et al., 1979). These studies may have relevance to understanding As distributions at this site, because adsorption characteristics of AsO_3^{3-} and AsO_4^{3-} onto iron oxides and other adsorbents are similar to PO_4^{3-}, selenite (IV)), and selenate (VI)) species (Leckie et al., 1980). Similar trends between As and calcium carbonate, however, were not as strongly observed at other soil profiles characterized during this investigation. Iron oxides probably are stronger adsorbents than calcium carbonate, based on surface area measurements (Stumm and Morgan, 1981), which control trace-element enrichment at the other sites. Background concentrations of As and Be exceed soil SALs for these two elements (Table 2) at this site.

Several oxidation-reduction zones are present at the Water Tanks Trench site below the El Cajete pumice. Figure 75 shows element and species concentrations in oxidized and reduced zones normalized to the underlying colluvium, which is the parent material at this soil site. Values greater than 100 indicate enrichment of an element or species within the oxidation-reduction zone relative to base colluvium. Conversely, values less than 100 indicate depletion of an element or species within the oxidation-reduction zone relative to the colluvium. Arsenic, Co, Cr, Fe, Mn, Ni, and U are enriched in the oxidized material, whereas Cr and U are enriched in the reduced material relative to colluvium (Figure 75). Manganese shows the most enrichment, by a factor of 2.85, within the oxidized material, which is possibly due to adsorption onto iron oxide and/or precipitation of MnO_2 or MnOOH. Adsorption of As, Be, Co, Cr, Ni and U onto iron oxide may account for trace element enrichment under relatively oxidizing conditions. Arsenic, Be, Cl, Co, Fe, Mn, Ni, and SO_4 are depleted in the reduced material relative to the colluvium. Under relatively reducing conditions, iron and manganese oxides are soluble and subsequently, desorption of As, Co, and Ni may occur and the soils become depleted in these trace elements. Lead appears to be insensitive to redox processes at this site and may be concentrated in primary silicate minerals.

Figure 76 shows element and species concentrations in solid organic matter normalized to the base colluvium. Arsenic, Be, Co, Cr, Fe, Mn, Ni, Pb, and U are higher in the solid organic matter, whereas Cl is lower in the solid organic matter (Figure 76). Ligand exchange reactions involving carboxylate anion with cations, including Be, Co, Cr, Ni, Pb, and U, enhance trace element enrichment within soil horizons containing solid organic matter.

Figure 77 shows element and species concentrations in calcium carbonate zone 1 normalized to the underlying colluvium. Arsenic, Ba, Be, Cl. Cr, SO_4, and U are

Figure 75

BACKGROUND SOIL, SITE 5. WATER TANKS TRENCH.

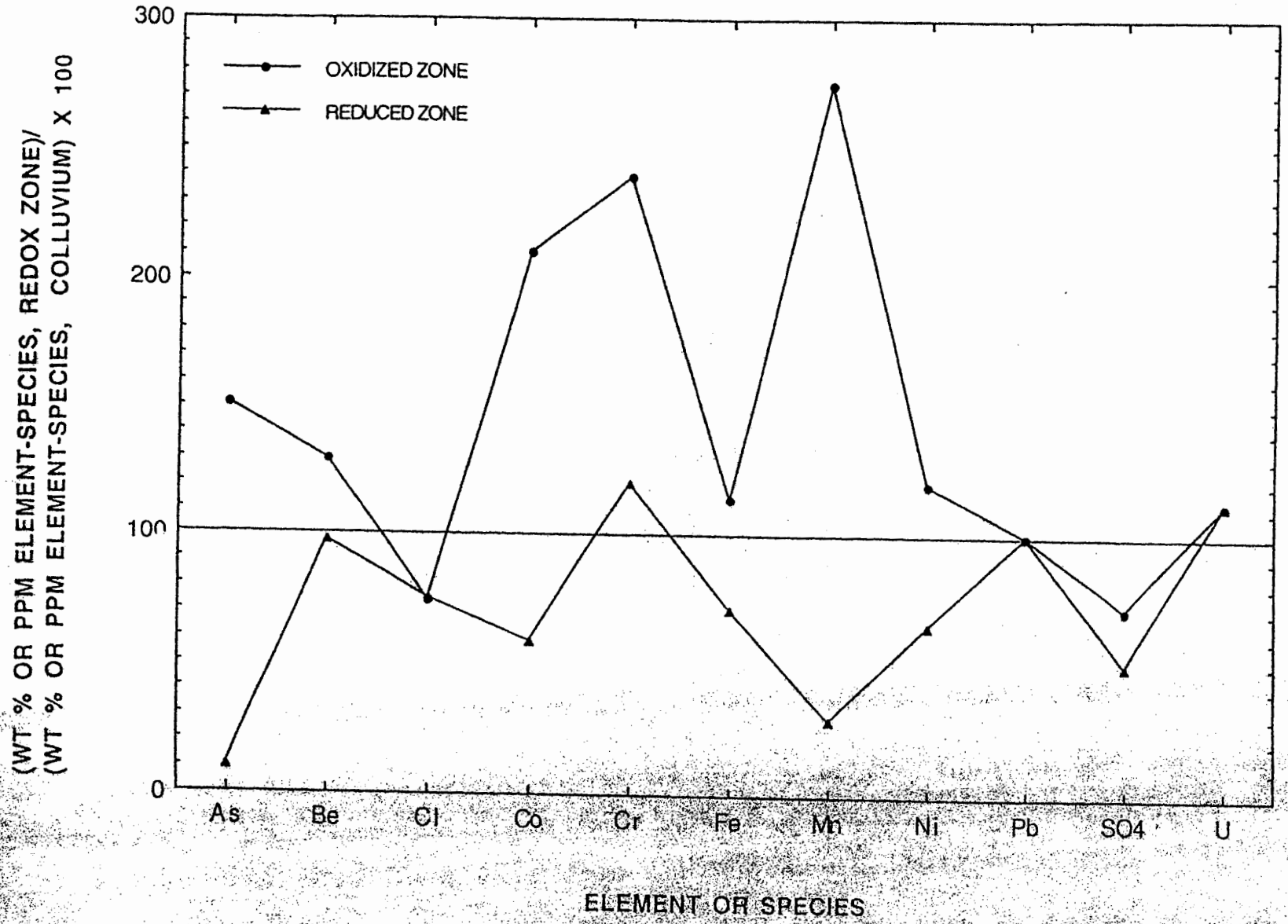


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Figure 75

BACKGROUND SOIL, SITE 5. WATER TANKS TRENCH.

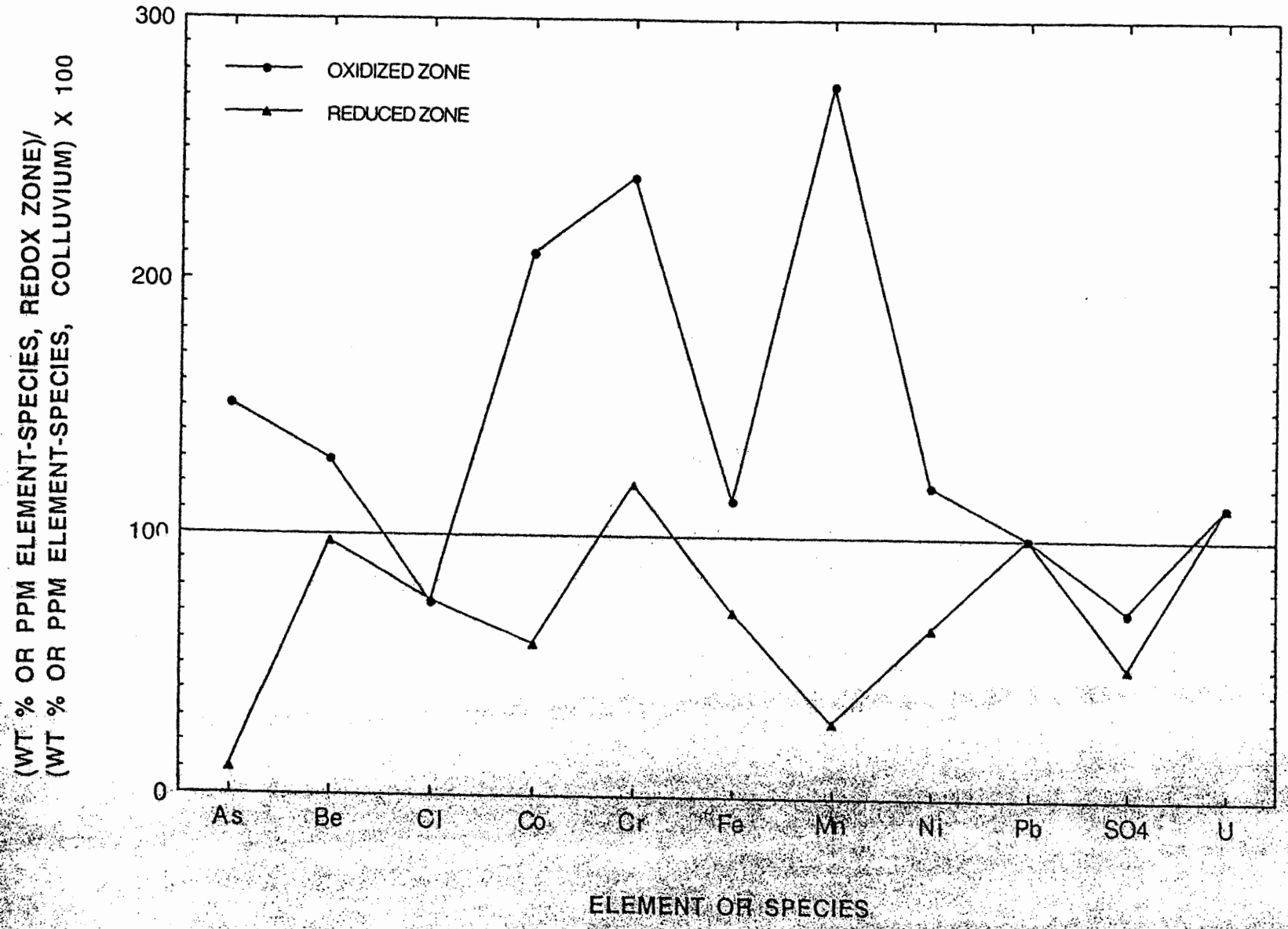


Figure 7b

BACKGROUND SOIL, SITE 5. WATER TANKS TRENCH.

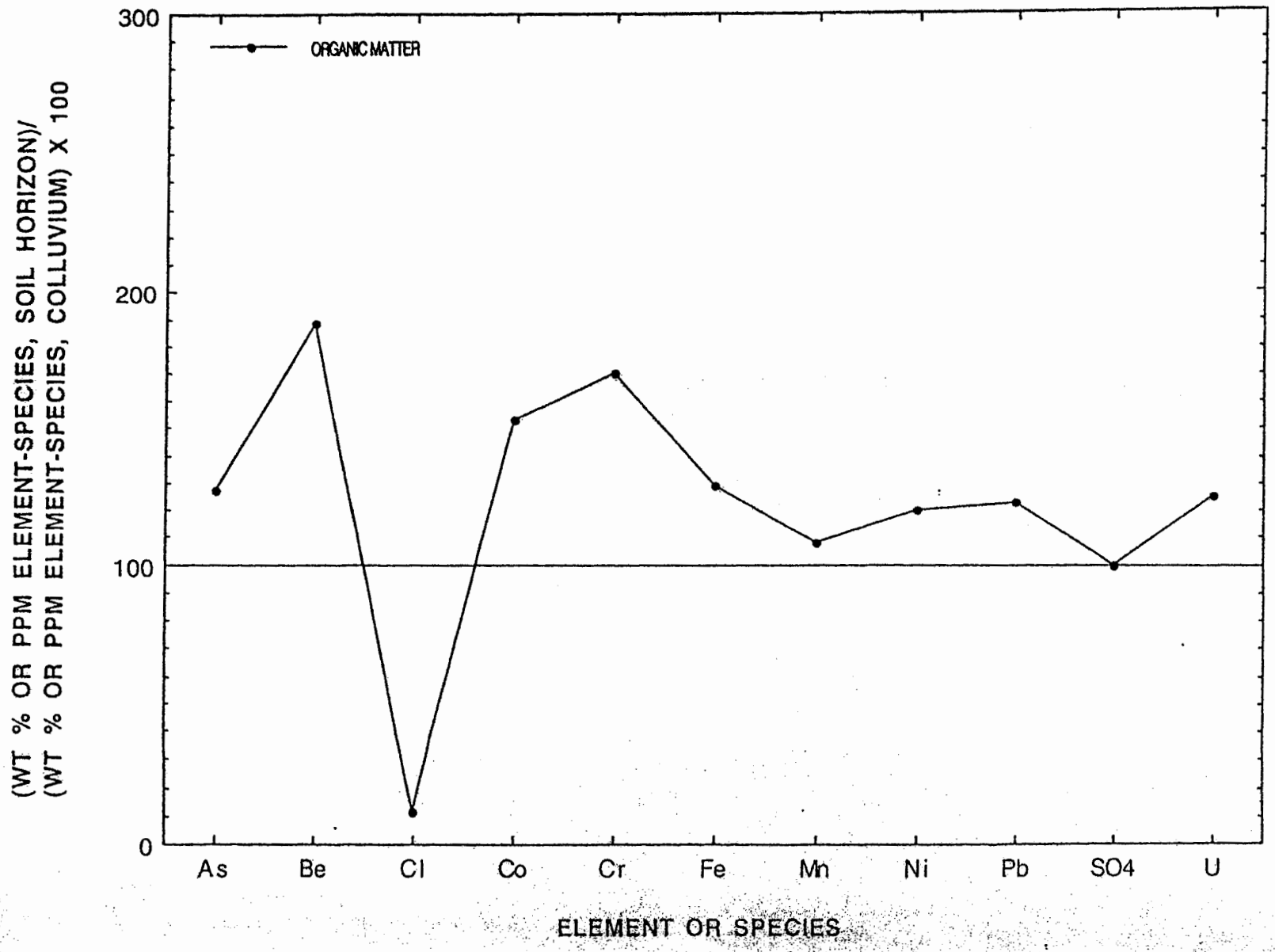
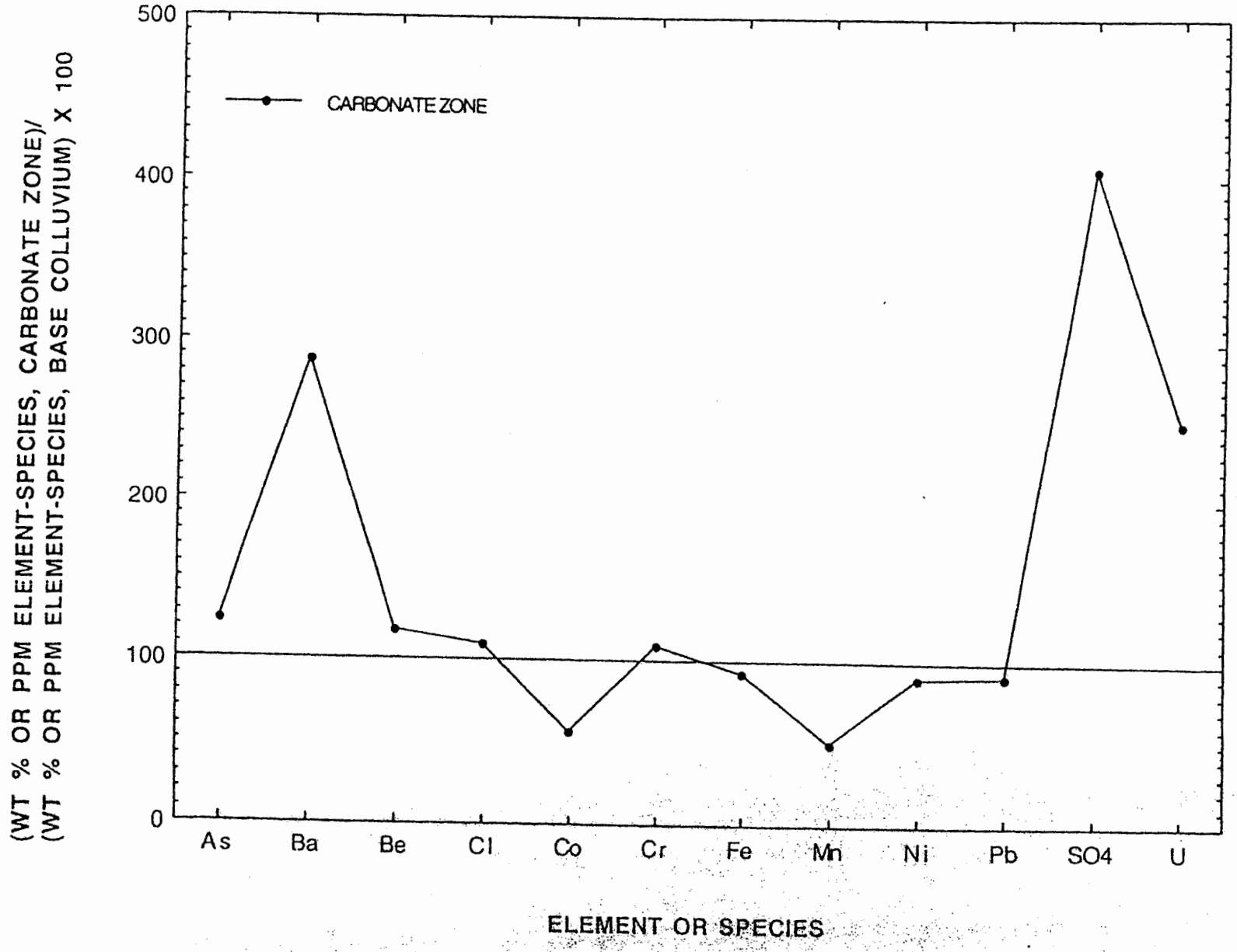


Figure 77

BACKGROUND SOIL, SITE 5. WATER TANKS TRENCH.



enriched by varying amounts in the calcium carbonate zone, whereas Co, Fe, Ni, and Pb are higher in the base colluvium (Figure 77). Sulfate shows the most enrichment, by a factor of 4.1, which suggest presence of gypsum as a component of eolian dust within calcium carbonate zones. Beryllium, Cl, and Cr show little enrichment (Figure 77). Formation of uranyl carbonato complexes may have resulted in remobilization of U within the soil profile. Uranium, specifically (U(VI), may have adsorbed onto/or coprecipitated with calcium carbonate. Uranyl carbonato complexes may undergo surface-exchange reactions with CO_3 surface groups present on calcite shown by:

$$X\text{-}CO_3^0 + UO_2(CO_3)_2^{2-} = X\text{-}(CO_3)_2UO_2^0 + CO_3^{2-}. \qquad \text{(eq. 6)}$$

The calcite sorbent surface is represented by X in eq. 4. Sorption of $UO_2(CO_3)_2^{2-}$ should parallel increasing positive charge on the calcite sorbent and decreasing solution concentrations of HCO_3^- and CO_3^{2-}, based on concepts discussed by Zachara et al. (1993). Sorption of uranyl carbonato complexes onto calcium carbonate is maximum below pH_{pzc} value of 9, where a net-postive surface charge prevails. This soil is characterized by pH values ranging from 6.0 to 8.2. Barium enrichment may result from adsorption onto calcium carbonate and/or precipitation of barium carbonate.

Site 6. Frijoles Mesa, State Route 4, El Cajete Pumice

Location and Geomorphic Setting

The soil sampling site is at a shallow excavation on Frijoles Mesa beneath a Ponderosa pine forest, on the boundary between the Laboratory and Bandelier National Monument, where a culvert discharges on the south side of State Route 4 (Figure 78). The excavation exposed a layer of pure El Cajète pumice, 0.3-0.8 m thick, that overlies a buried soil and underlies a pumice-rich surface soil that is 0.4-0.9 m thick. The buried soil is about 1.2 m deep, and although not exposed here, unit 4 of the Tshirege Member underlies the buried soil (S. Reneau, unpublished mapping). The upper part of the El Cajete pumice bed has been heavily disrupted by bioturbation, as was seen at the Water Tanks site (Site 5), causing large local variations in thickness. Soils at this site are mapped as part of the Frijoles soil series by Nyhan et al. (1978), and may be representative of other mesa-top locations in the Ponderosa pine belt that are covered by El Cajete pumice.

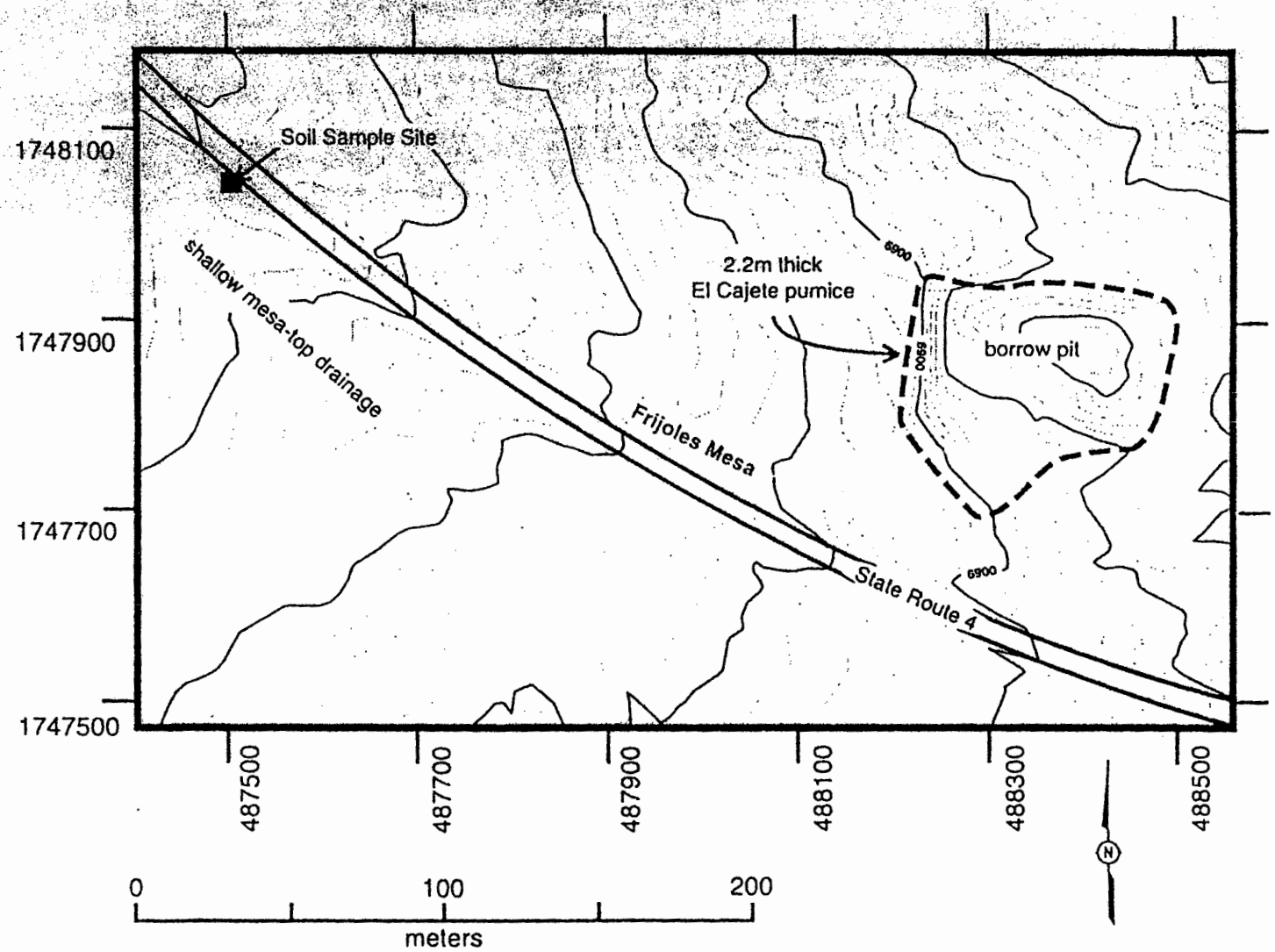


Fig. 78. Map showing sample site 6 on Frijoles Mesa, along State Route 4, and nearby borrow pit. Topographic base, with 2-foot contours, from FIMAD.

The modern soil is developed on the upper part of the El Cajete pumice, and probably contains a mixture of weathered pumice and wind-blown dust deposited since emplacement of the pumice bed. The site is about 10 m northeast of the axis of a shallow mesa-top drainage. There is evidence for recent erosion of the soil by surface runoff, and an unknown thickness of soil has been eroded from this site. In a nearby borrow pit 225 m to the east (Figure 78), the El Cajete pumice reaches 2.2 m in thickness and is overlain by 0.35 m of soil. The significantly greater thickness of El Cajete pumice at the borrow pit relative to the sample site suggests that 1 m or more of pumice and soil has been eroded at the sample site since about 60 ka. However, the presence of the pumice bed here demonstrates that the mesa top is relatively stable, and that no erosion of the tuff bedrock occurred at this site since about 60 ka.

Soil Description

Soil samples collected from the Frijoles Mesa site are listed in Table 7 and results of chemical analyses are given in Appendices I and II. The soil at this site is poorly developed (Watt and McFadden, 1992), and consists of the following horizons with associated depths and thicknesses (in cm): A (0-5), Bw (5-22), Bwk (22-53), and 2CBk (53+). Organic carbon values range from 0.2 to 0.4 wt%, and the highest abundance is associated with the 2CB horizon. This soil profile contains some clay enrichment; abundances of clay-size material range from 6.6 to 16.9 wt% (Watt and McFadden, 1992). Sand-size material varies from 35.2 to 54.8 wt%, indicating that this soil profile may have a moderate range of hydraulic conductivities (Table 4, K values ranging from 10^{-5} to 10^{-1} cm/sec). Silt-size material ranges from 33.9 to 58.1 wt% at this soil site.

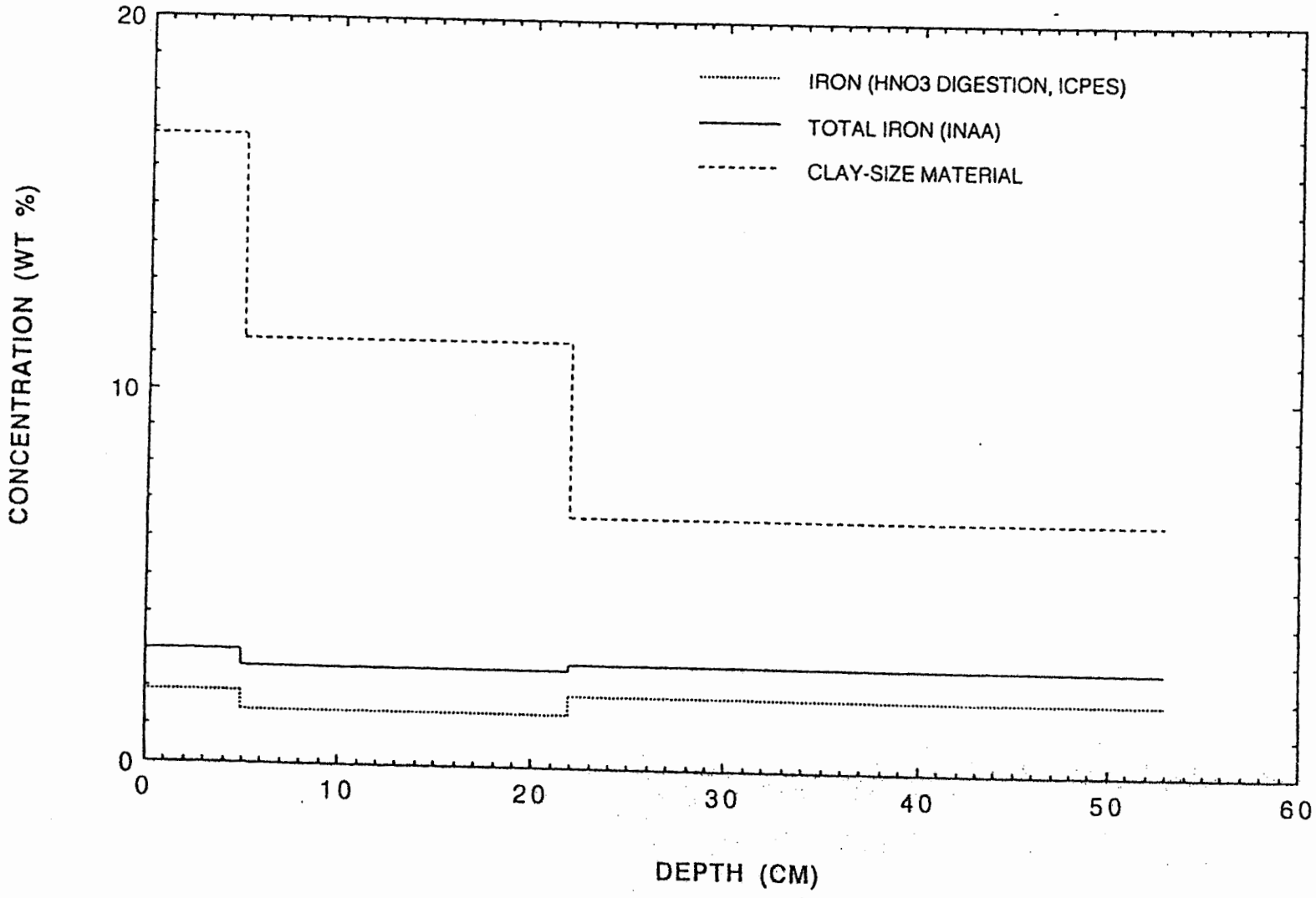
Soil Chemistry

This soil is characterized by alkaline pH values ranging from 7.5 to 8.9, which increase with depth.The lowest pH value in this soil profile is associated with the A horizon, whereas the highest pH value is associated with the 2CBk horizon (Watt and McFadden, 1992). Calcium carbonate abundances vary from 0.5 to 3.9 wt% (Watt and McFadden, 1992).

Concentrations of total Fe, HNO_3 digested Fe, and clay-size material versus depth are shown in Figure 79. Total Fe concentrations range from 2.53 to 2.98 wt% (Figure 79). Acid-soluble Fe concentrations range from 1.4 to 1.9 wt% comprising 55 to

Figure 79

BACKGROUND SOIL, SITE 6. FRIJOLES MESA.



64% of total Fe. Iron generally does correlate with clay-size material (Figure 79), which suggests that Fe has been moderately remobilized and concentrated in the clay-size material. Some of the Fe probably occurs both in refractory phases such as hornblende, magnetite, and biotite and in HNO_3-digested Fe phases including ferric oxyhydroxide and ferrihydrite associated with solid organic carbon and clay minerals (Figure 80).

Concentrations of total Th, acid-digested Th, and clay-size material vary with depth (Figure 81). Concentrations of total Th range from 13.7 to 22.5 ppm (Figure 72), and concentrations of acid-digested Th range from 6.0 to 8.0 ppm. Acid-digested Th comprises 36 to 58% of total Th. This fraction does correlate with clay-size material (Figure 81), suggesting that Th may have redistributed within the clay-size fraction possibly through adsorption processes. In the Bwk horizon, most of the Th may have leached from primary phases, based on percentage distributions of acid digested and total Th.

Concentrations of total U, acid-digested U, and solid organic carbon vary with depth (Figure 82). Total U concentrations range from 3.1 to 3.9 ppm , and acid-digested U concentrations range from 0.6 to 1.6 ppm (Figure 82). Acid-digested U comprises 15 to 41% of total U, and this fraction is associated with solid organic carbon (Figure 82) and $CaCO_3$ (Figure 83) in the 2Cbk horizon. Figure 83 implies that some of the U is associated with $CaCO_3$ coatings mantling sand-size particles. Surface complexation of U onto $CaCO_3$ is likely at this site, because HNO_3-digested U does correlate with $CaCO_3$ in the 2Cbk horizon (Figure 83). In addition, uranyl also undergoes ligand exchange with humic acids, predominantly with carboxylic acids (Longmire, 1991; Shanbhag and Choppin, 1981), which accounts for the U-organic carbon correlation observed in the 2CBk horizon (Figure 82). Subsequently, from these relationships, solid organic carbon and calcium carbonate correlate well with each other (compare Figures 82 and 83). This correlation may be the result of similar sources for the two materials and/or oxidation of organic matter to calcium carbonate through biological respiration. Most of the U present in this soil, however, has not been leached from the primary silicate phase(s).

Figure 84 shows distributions of As, Be, and Fe versus depth at the soil site. Beryllium and As show a strong correlation with Fe, and these elements are highest within the 2CBk horizon. Total Be concentrations range from 2.0 to 2.5 ppm, whereas HNO_3-digested Be concentrations range from 1.2 to 1.7 ppm. Acid-digested Be comprises 49 to 85% of total Be (Figure 85), which suggests that in the A horizon Be is mainly distributed within secondary soil minerals.

Figure 80

BACKGROUND SOIL, SITE 6. FRIJOLES MESA.

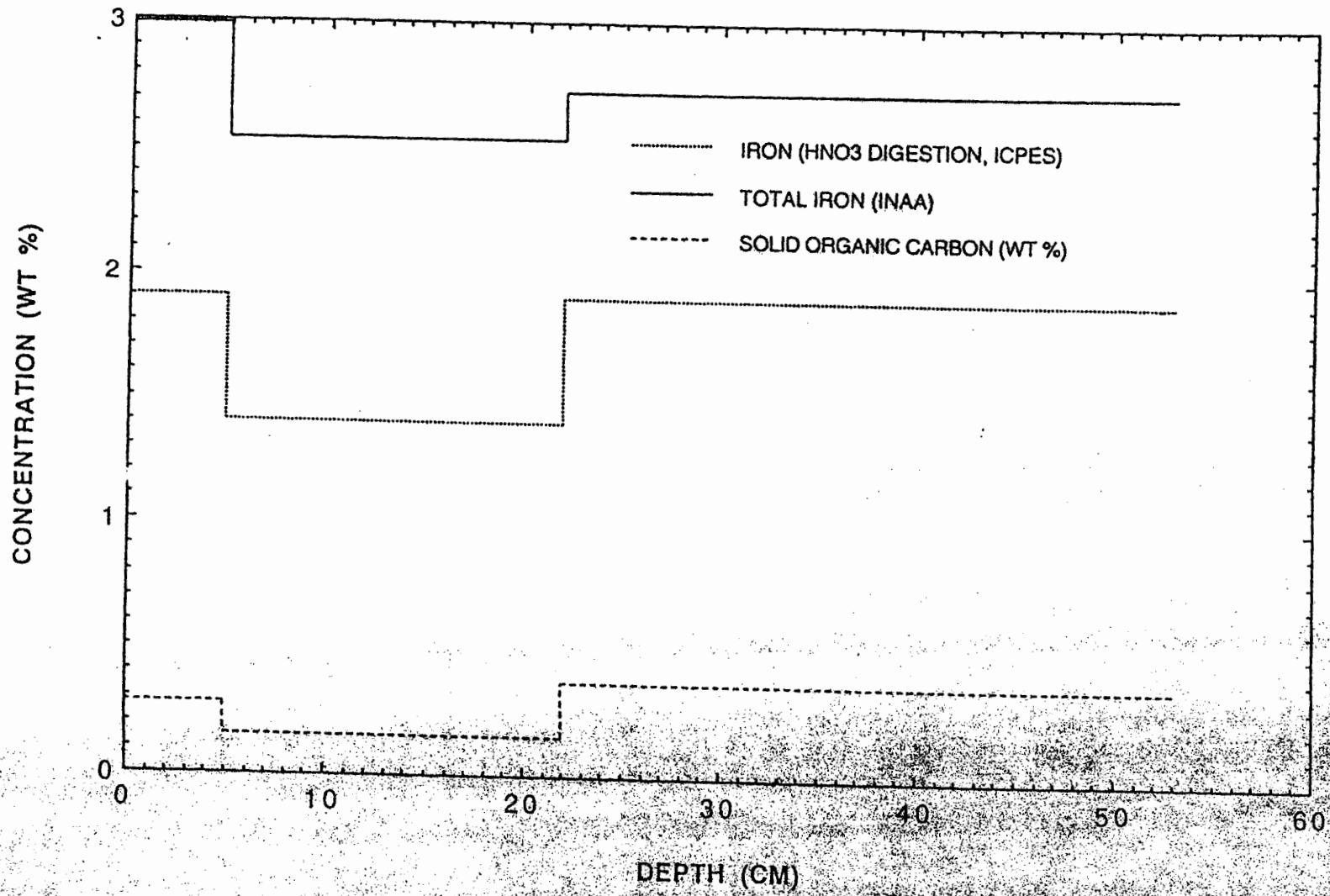


Figure 81

BACKGROUND SOIL, SITE 6. FRIJOLES MESA.

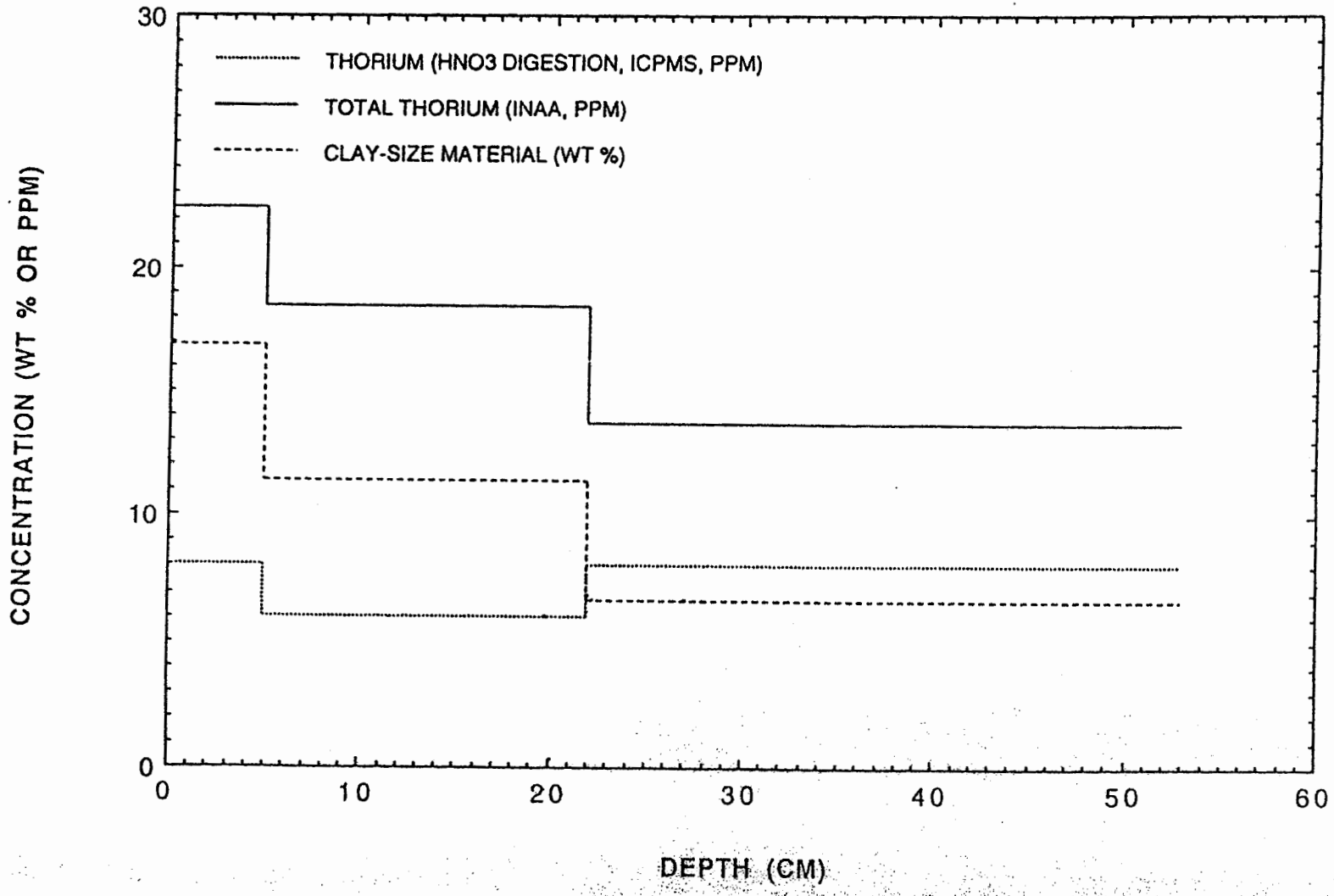


Figure 82

BACKGROUND SOIL, SITE 6. FRIJOLES MESA.

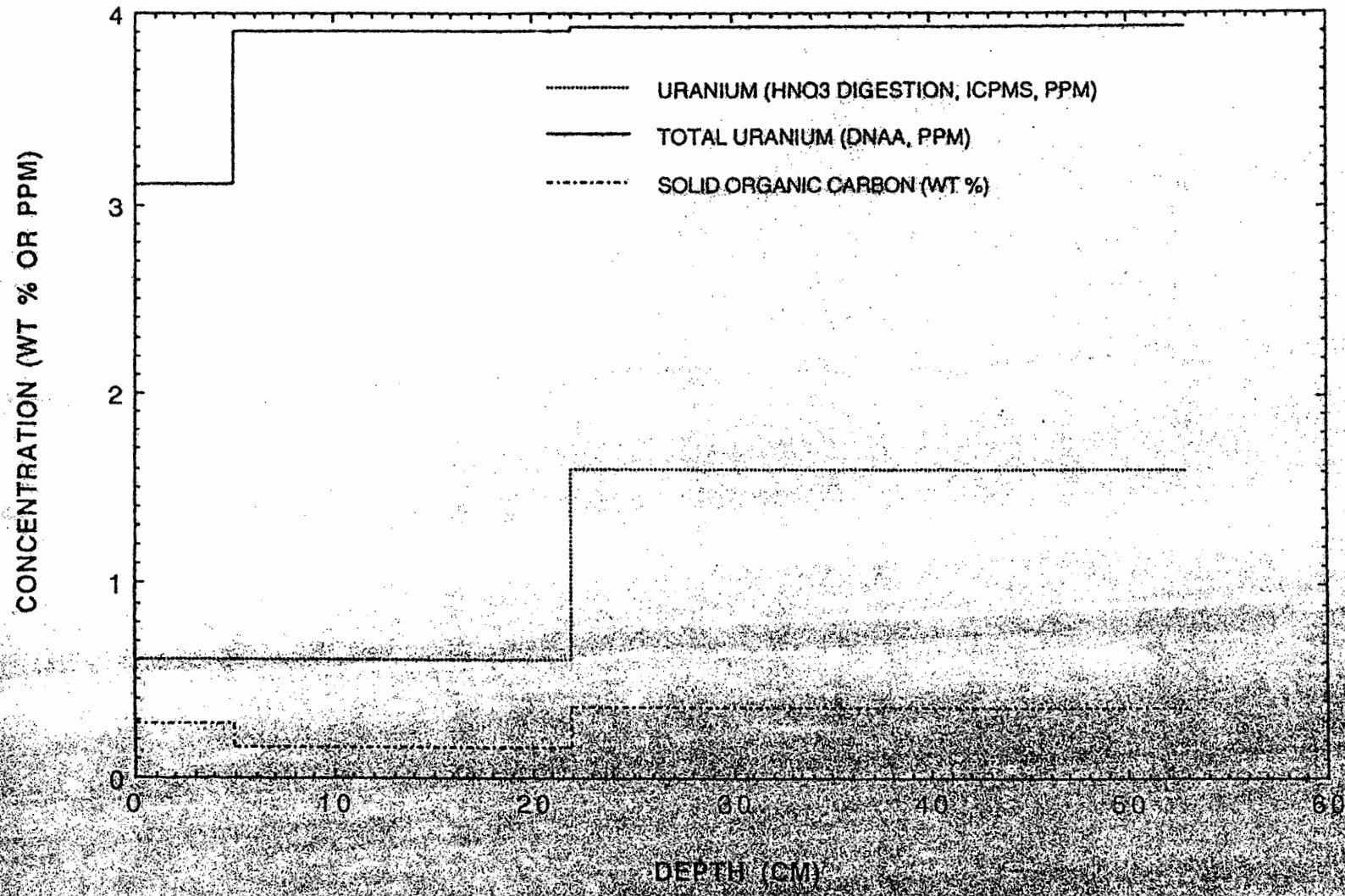


Figure 83

BACKGROUND SOIL, SITE 6. FRIJOLES MESA.

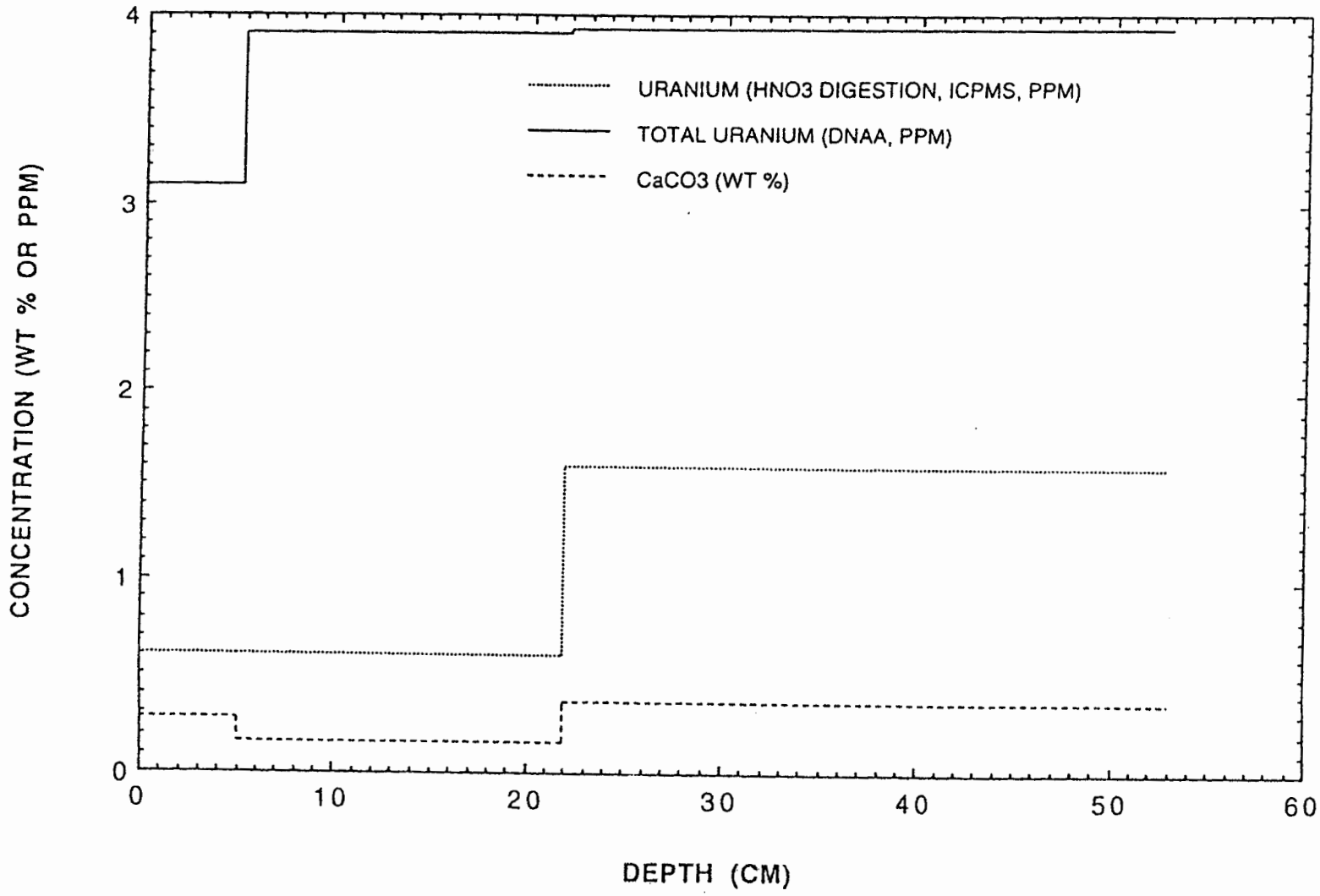


Figure 84

BACKGROUND SOIL, SITE 6. FRIJOLES MESA.

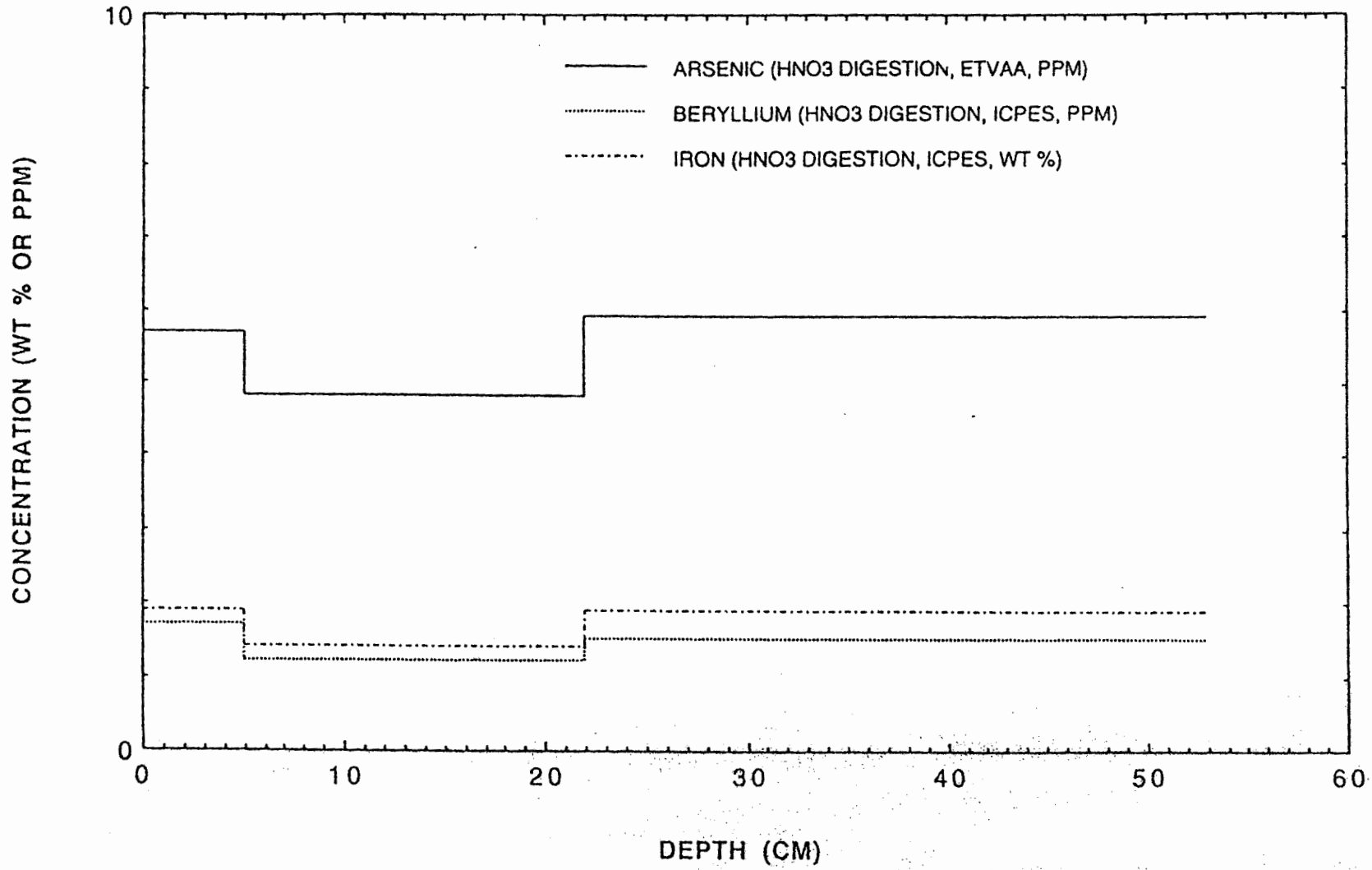


Figure 85

BACKGROUND SOIL, SITE 6. FRIJOLES MESA.

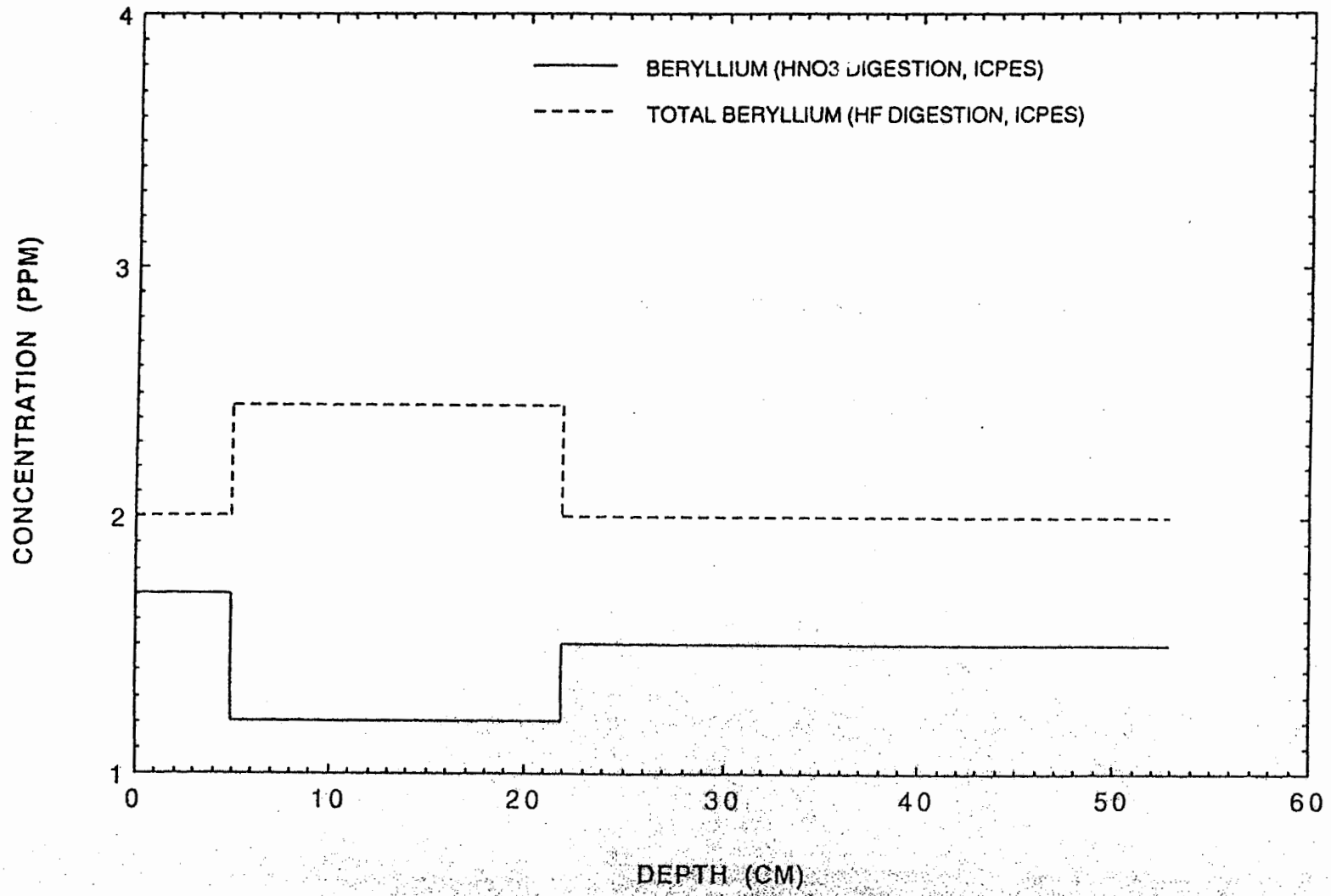


Figure 86 shows distributions of HNO_3-digested As and solid organic carbon, and As concentrations range from 4.8 to 5.9 ppm. Distributions of acid-digested As and total As were not calculated, because some of the digested fraction samples exceeded the total fraction and analytical error in the INAA data is suspected. In spite of this analytical uncertainty, adsorption of As onto solid organic matter, through ligand-exchange reactions, may account for As enrichment within the 2CBk horizon at this site (Figure 86). Background concentrations of As and Be exceed soil SALs for these two elements (Table 2).

Site 7. Ancho Canyon Mesas (TA-39), State Route 4

Location and Geomorphic Setting

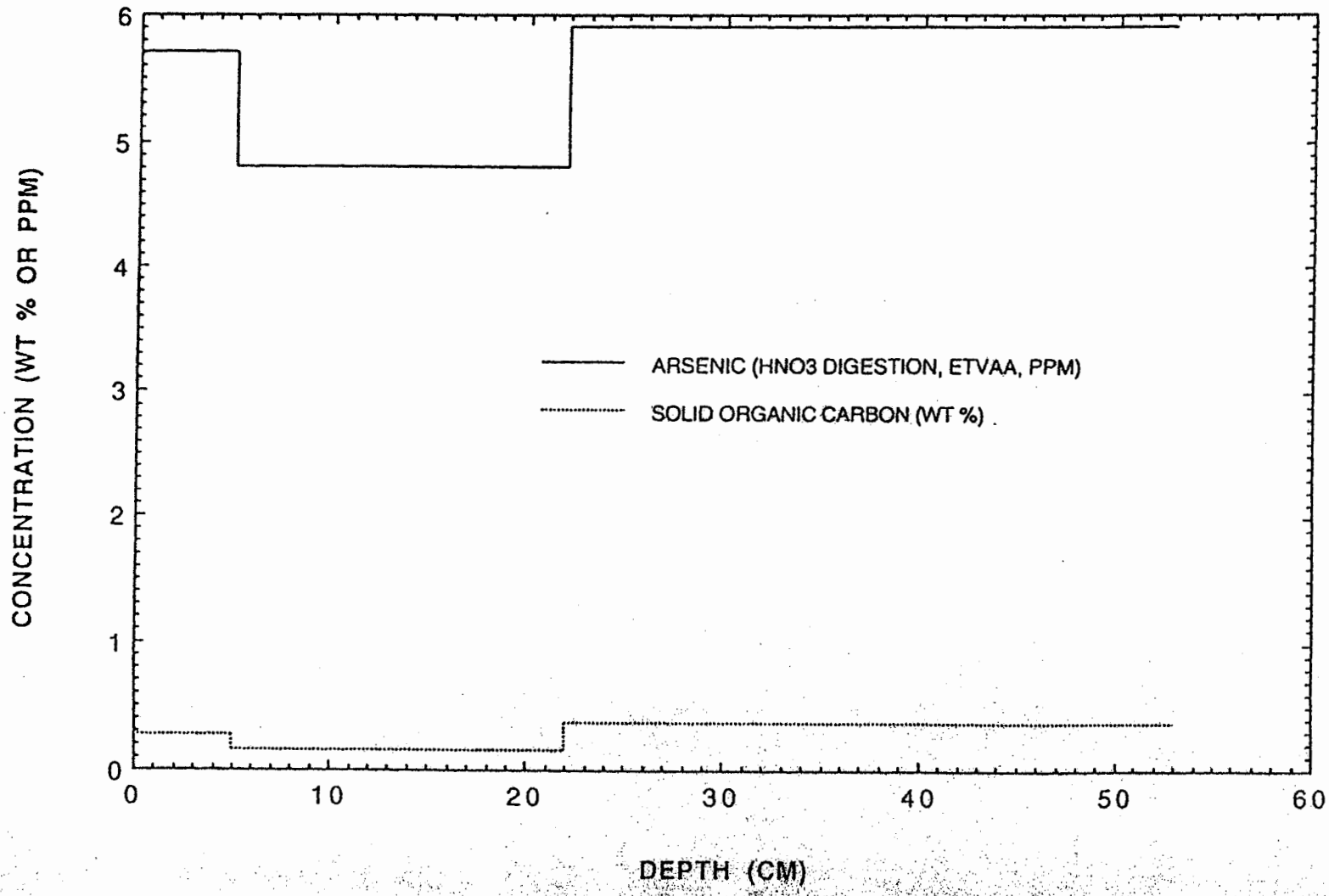
The background-soil sampling site is in a roadcut along State Route 4 between tributaries of Ancho Canyon (Figure 87), under a sparse pinon-juniper woodland, where about 0.6 m of soil overlies unit.3 of the Tshirege Member (S. Reneau, unpublished mapping). The soil is fine-textured, and probably includes a significant component of wind-blown material in addition to eroded tuff. There is abundant evidence of recent surface erosion in this area, including exposure of roots of pinon pines and juniper trees. Locally, the soils have been completely stripped to bedrock. In addition, deposits of pure El Cajete pumice occur on the sloping shoulders of the mesa here, and these deposits originally overlay the sampled soil (Figure 88). The soil is thus formed in material deposited before about 60 ka. Similar surface characteristics are widespread in this area, including exposure of pre-El Cajete soils by erosion, and the soil sample site may be representative of many mesa top locations in the eastern part of Laboratory. The sample site is mapped as part of the Hackroy soil series by Nyhan et al. (1978), and this series seems to represent old mesa-top soils that were buried by the El Cajete pumice and later exposed by erosion (see also Reneau et al., 1994).

Soil Description

Soil samples collected from the TA-39 site are listed in Table 7 and results of chemical analyses are provided in Appendices I and II. The soil at this site is well developed, and consists of the following horizons with associated depths and thicknesses (in cm): A 1 (0-6), A2 (6-13), Bt (13-20), Bwkb (20-44), Btkb (44-54), K (54-

Figure 86

BACKGROUND SOIL, SITE 6. FRIJOLES MESA.



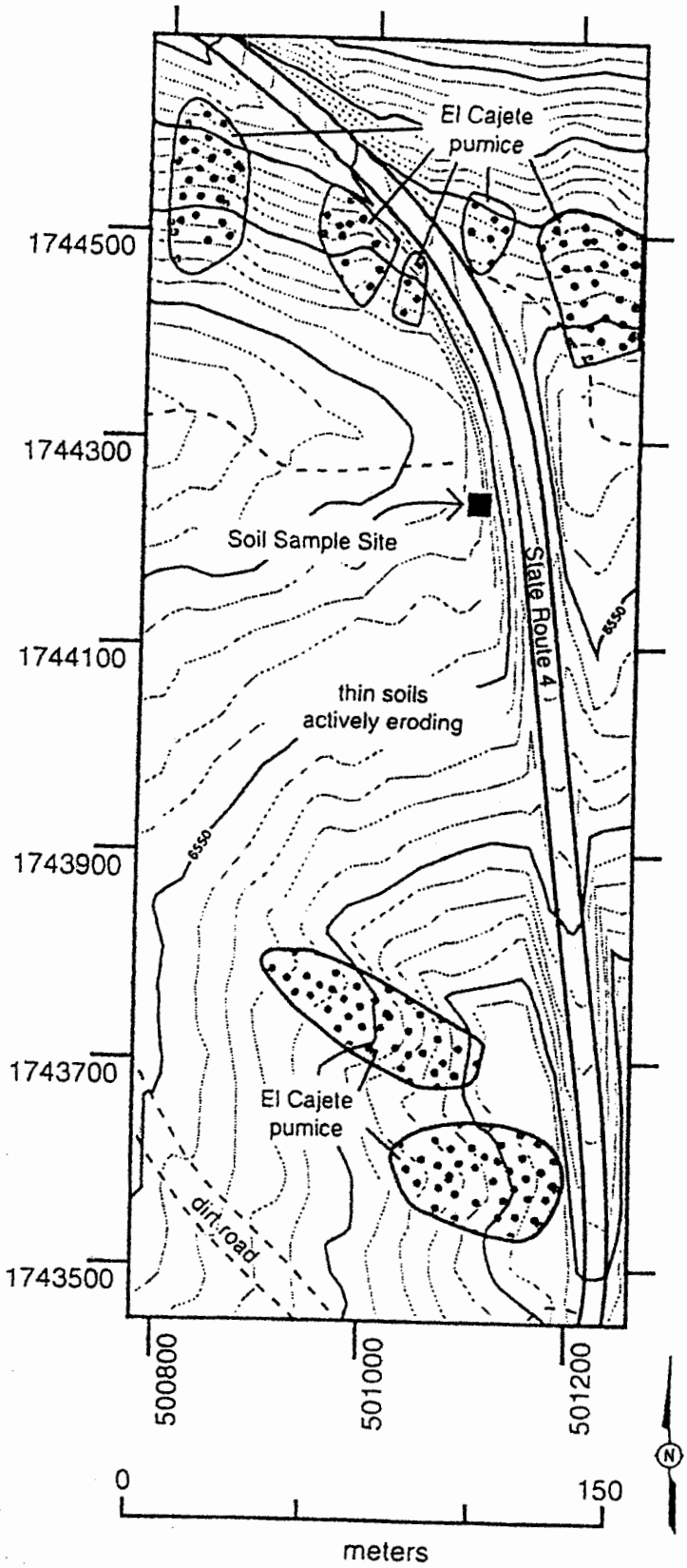


Fig. 87. Map showing sample site 7 on Ancho Canyon Mesa, along State Route 4, and distribution of El Cajete pumice. Topographic base, with 2-foot contours, from FIMAD.

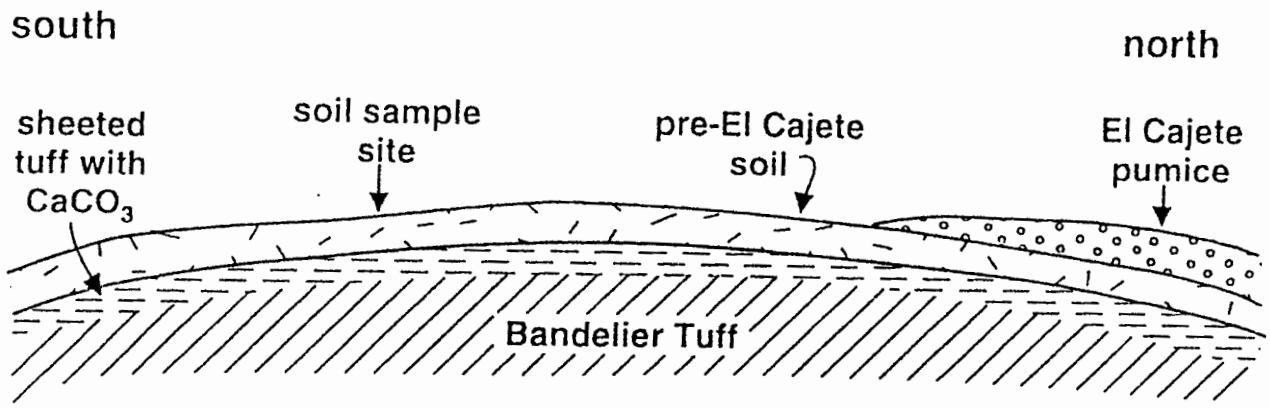


Fig. 88. Schematic sketch of stratigraphic relations at soil sample site 7 along State Route 4 roadcut.

62), and 2R (62+)(Watt and McFadden, 1992). Organic carbon values range from 0.15 to 0.52 wt%, and the highest concentration is associated with the A1 horizon. This soil profile contains a significant amount of clay enrichment; abundances of clay-size material range from 11.6 to 53.6 wt% (Watt and McFadden, 1992). Sand-size material varies from 12.7 to 36.9 wt%, indicating that this soil profile may have a moderate range of low hydraulic conductivities (Table 4, K values ranging from 10^{-6} to 10^{-3} cm/sec) in comparision to coarser-grained soils found at other areas on the Pajarito Plateau. Silt-size material ranges from 33.7 to 54.0 wt% at this soil site.

Soil Chemistry

This soil is characterized by acidic to alkaline pH values ranging from 6.5 to 8.1, and pH increases with depth. The lowest pH value in this soil profile is associated with the A1 horizon, whereas the highest pH value is associated with the K horizon (Watt and McFadden, 1992). Calcium-carbonate abundances vary from 1.0 wt% in the A1 horizon to 100 wt% in the K horizon (Watt and McFadden, 1992). Some of the calcium carbonate in this soil is derived from leaching of the overlying loess cap, and depth to calcium carbonate-rich horizons represent present and/or past depths of the wetting front (Birkeland, 1984). Calcium-carbonate enrichment in this soil profile begins at a depth of 20 cm, with another increase in $CaCO_3$ content at 54 cm. The K horizon occurs immediately above the Bandelier Tuff bedrock, and may represent precipitation of $CaCO_3$ at a major permeability or hydraulic conductivity boundary.

Distributions of total Fe and HNO_3-digested Fe versus depth are shown in Figure 89. Total Fe concentrations range from 2.0 to 4.0 wt% (Figure 89). Acid-soluble Fe concentrations range from 1.3 to 3.6 wt % comprising 58 to 89% of total Fe. Iron is highest in the Bt and Btkb horizons at this site, which suggests that Fe has been remobilized and concentrated in the clay-size material. These concentration distributions suggest that in most soil horizons at this site Fe mainly occurs in HNO_3-digested Fe phases including ferric oxyhydroxide and ferrihydrite.

Distributions of total Th, acid-digested Th, clay-size material with depth are shown in Figure 90. Concentrations of total Th range from 11.8 to 19.9 ppm (Figure 90), and concentrations of acid-digested Th range from 7.0 to 11.0 ppm. Acid-digested Th comprises 47 to 76% of total Th. This fraction correlates with clay-size material (Figure 90), suggesting that Th may have been redistributed within the soil, possibly through leaching and subsequent adsorption. In the Btkb horizon, most of the Th has

Figure 89

BACKGROUND SOIL, SITE 7. ANCHO CANYON MESAS.

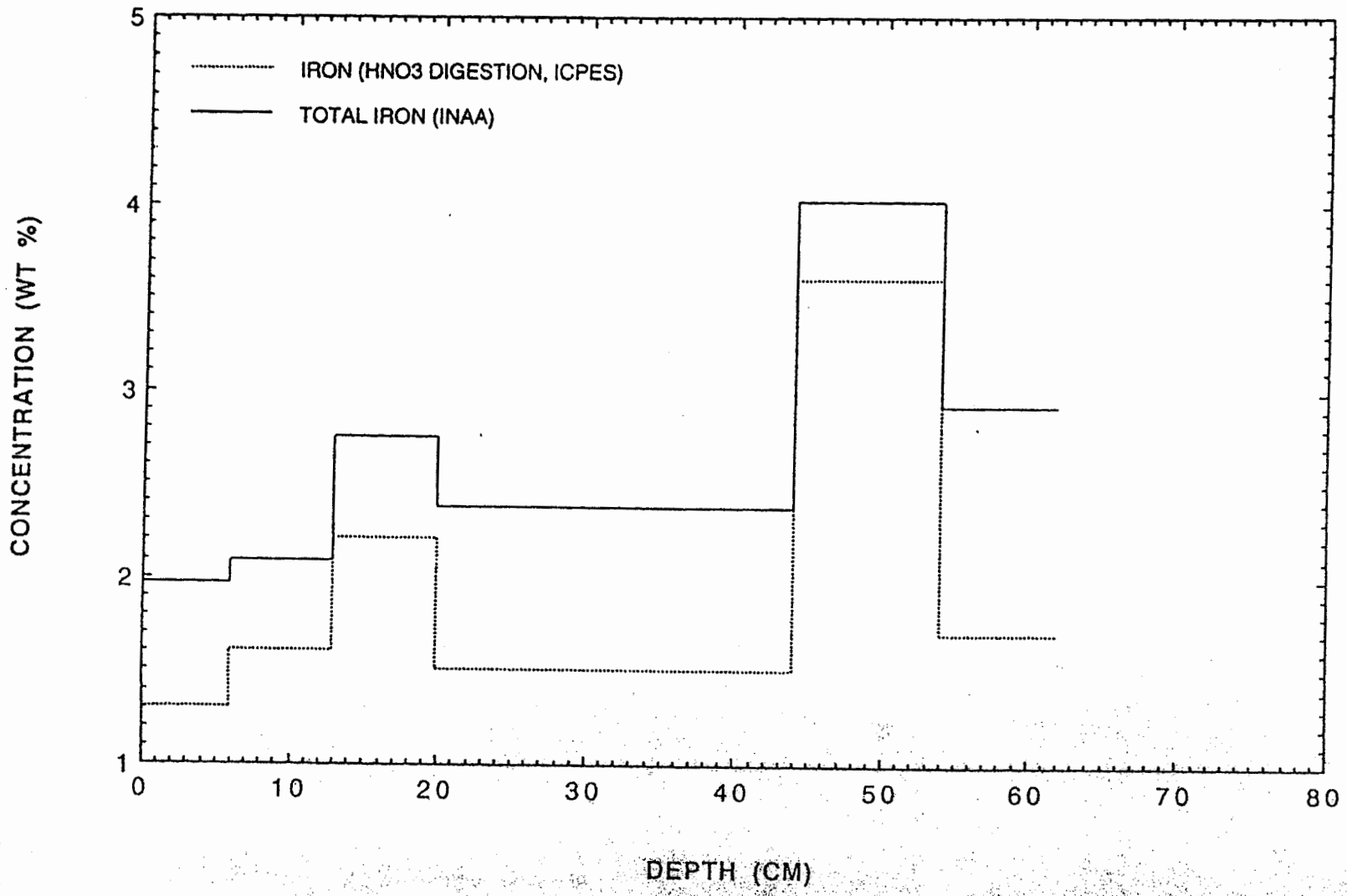
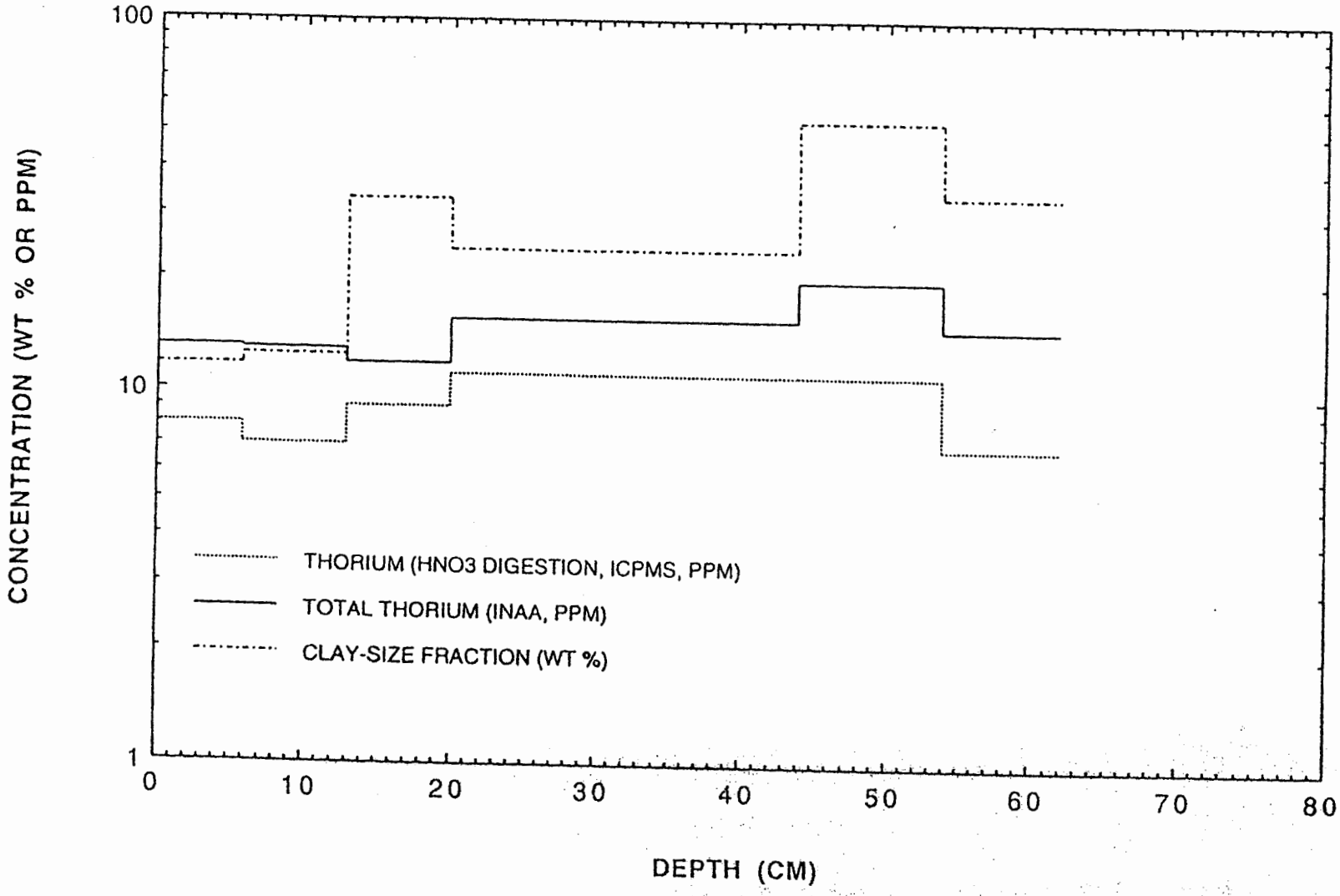


Figure 90

BACKGROUND SOIL, SITE 7. ANCHO CANYON MESAS.



been leached from primary phases, based on percentage distributions of acid-digested and total Th.

Distributions of total U, acid-digested U, calcium carbonate, and solid organic carbon versus depth are shown in Figure 91. Total U concentrations range from 2.2 to 3.7 ppm , and acid-digested U concentrations range from 0.9 to 1.5 ppm (Figure 91). Acid-leach U comprises 27 to 50% of total U, and this fraction correlates with solid organic carbon in all of the soil horizons and with $CaCO_3$ in the K horizon. The data in Figure 91 implies that some of the U is associated with $CaCO_3$ coatings mantling sand-size particles. Surface complexation of U onto $CaCO_3$ is likely at this site, because HNO_3-digested U does correlate with $CaCO_3$ in the K horizon (Figure 91). In addition, uranyl undergoes ligand exchange with humic acids, predominantly with carboxylic acids (Longmire, 1991; Shanbhag and Choppin, 1981), which accounts for the U-organic carbon correlation observed in all of the horizons (Figure 91). A moderate amount of U present in this soil has been leached from the primary silicate phase(s).

Figure 92 shows distributions of As, Be, Fe, and clay-size material versus depth at the soil site. Beryllium and As show a strong correlation with both Fe and clay content, and these elements are enriched within the Bt and Btkb horizons (Figure 92). Total Be concentrations range from 1.6 to 3.9 ppm, whereas HNO_3-digested Be concentrations range from 0.8 to 4.0 ppm. Distributions of acid-digested As and total As were not calculated, because in some instances the digested fraction exceeded total fraction and analytical error in the INAA data is suspected. In spite of this analytical uncertainty, adsorption of As onto iron oxide, calcium carbonate, and clay minerals may account for As enrichment within the Bt and Btkb horizons at this site (Figure 92). Acid-digested Be comprises 44 to almost 100% of total Be (Figure 93), which suggests that Be in the Bt and Btkb horizons is mainly distributed within secondary soil minerals. Background concentrations of As and Be exceed soil SALs for these two elements (Table 2).

Site 8. Fracture Fill (TA-46)

Fractures within the Bandelier Tuff represent a potential pathway for contaminant migration and material filling fractures can provide useful data for understanding movement of water, minerals, and solutes within the fractures. Samples of soil, fresh Bandelier Tuff, and fracture fill were collected from TA-46 (Site 8)

Figure 91

BACKGROUND SOIL, SITE 7. ANCHO CANYON MEASA.

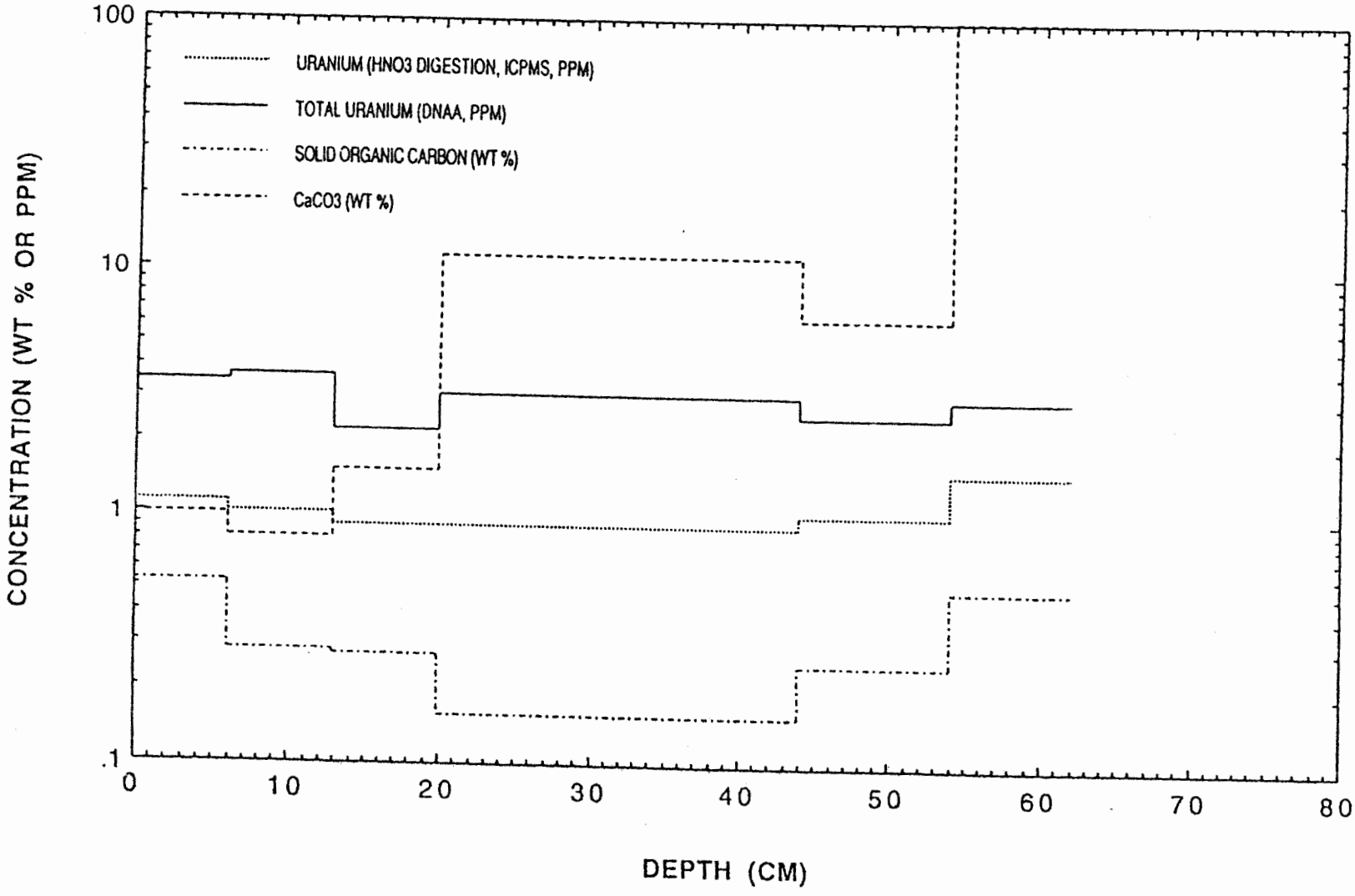


Figure 92

BACKGROUND SOIL, SITE 7. ANCHO CANYON MESAS.

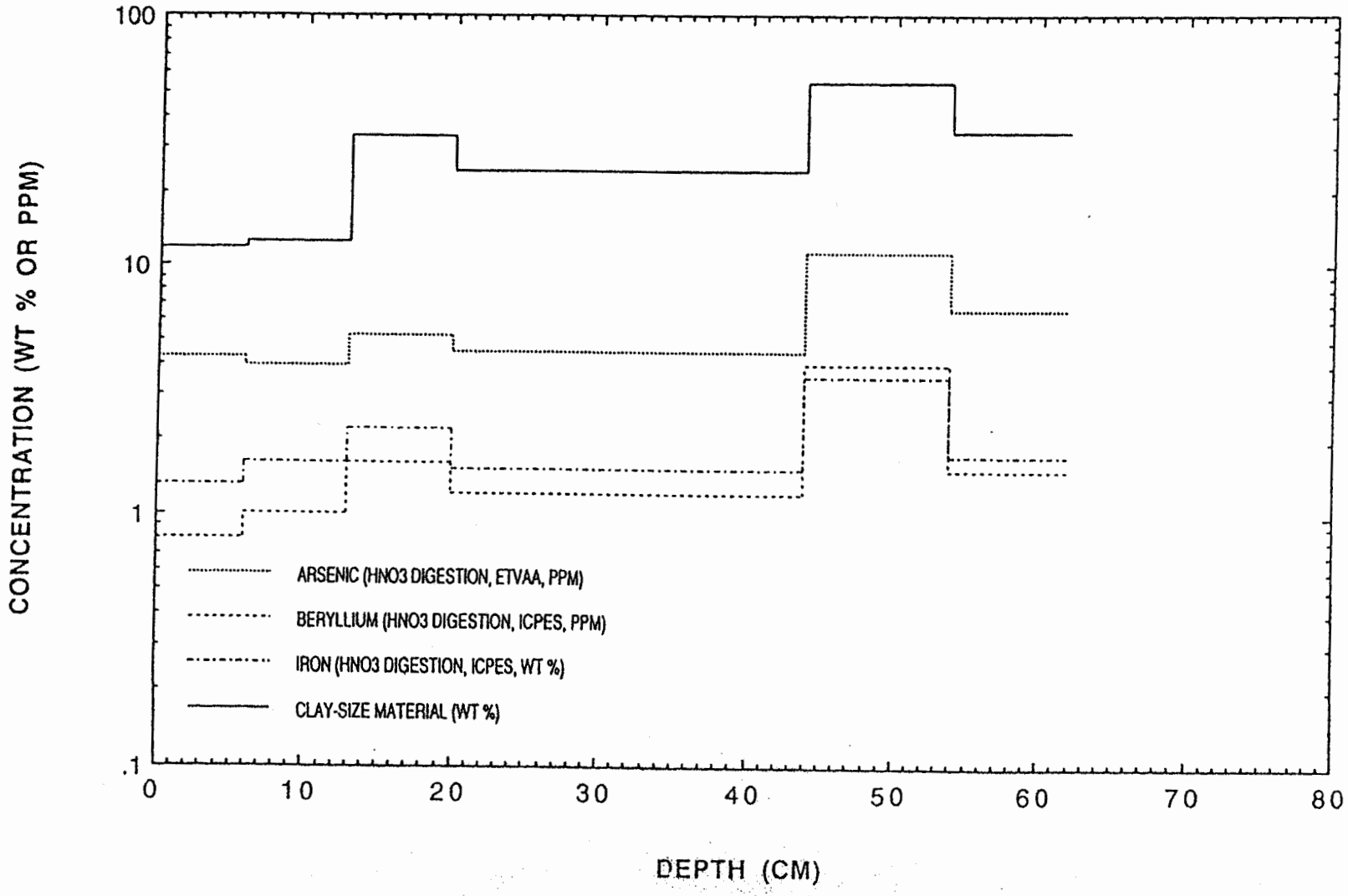
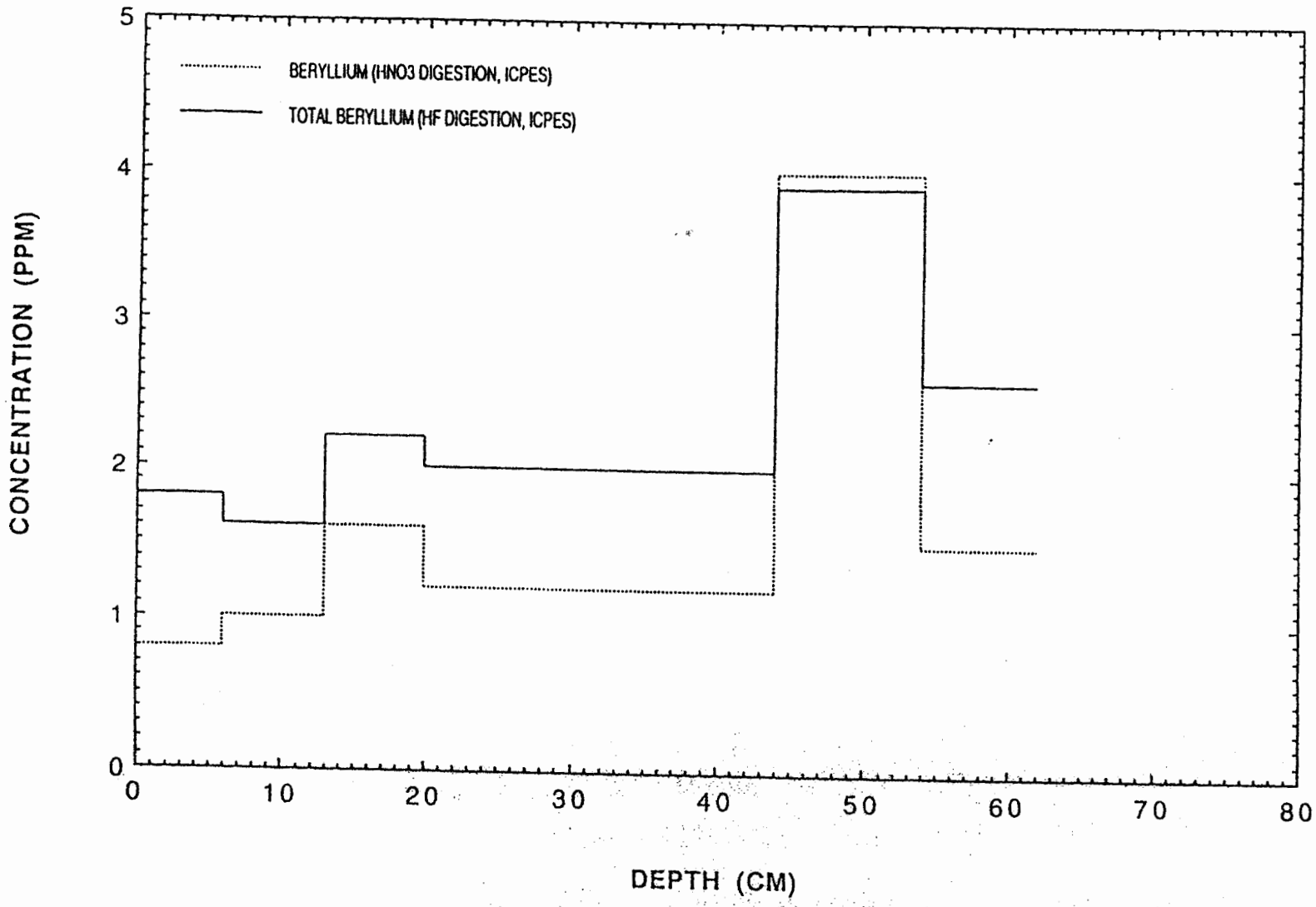


Figure 93

BACKGROUND SOIL, SITE 7. ANCHO CANYON MESAS.

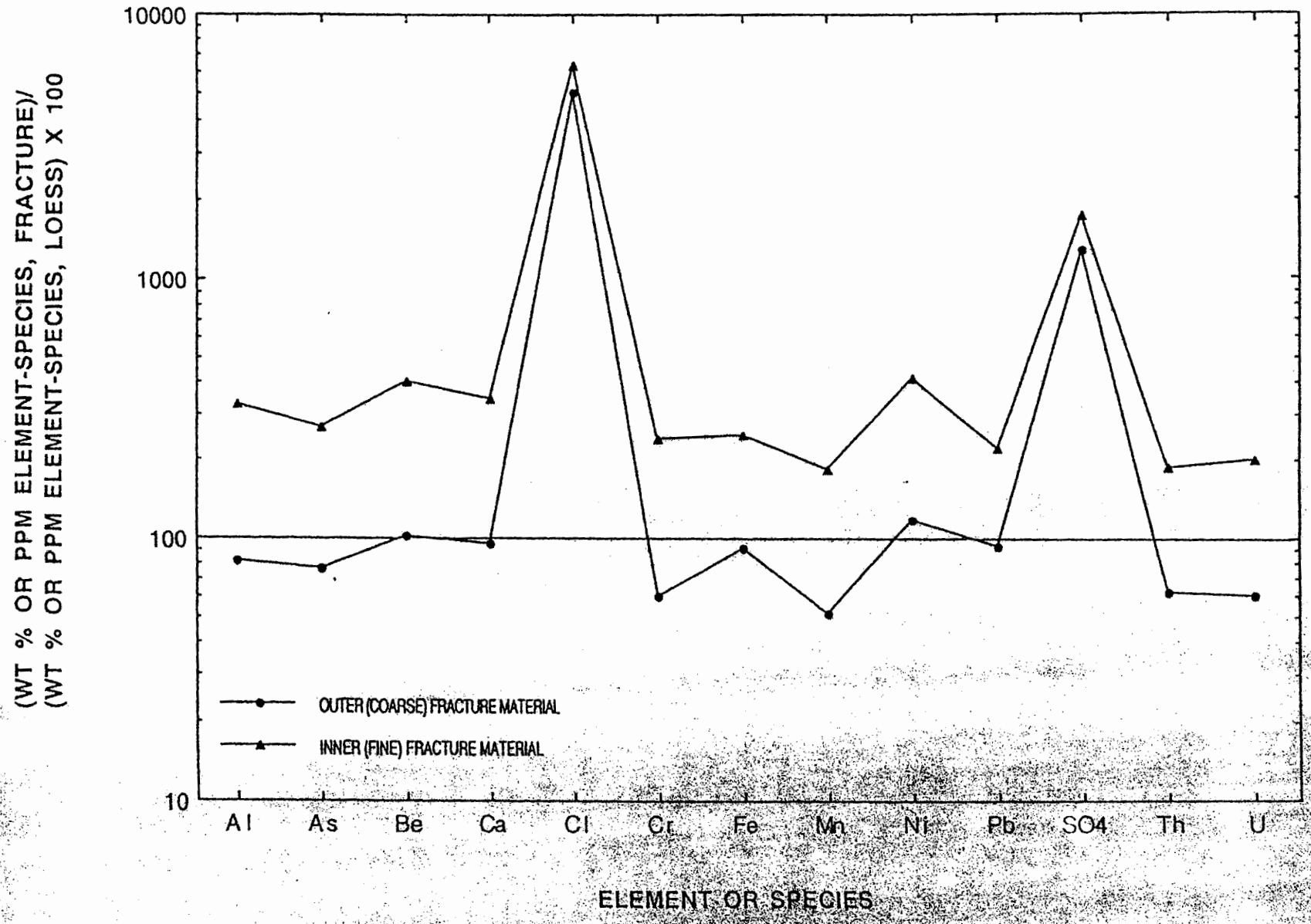


(Figure 4) are listed in Table 7. Results of chemical analyses are given in Appendices I and II. The soil overlying one of the fractures consists of loess associated with a weakly developed A horizon containing organic matter. The fracture fill contains clay minerals, calcium carbonate, iron oxides, manganese oxides, and solid organic matter mixed with fragments of Bandelier Tuff. Other fractures within the Bandelier Tuff at this site are open and devoid of fill material. These open fractures do not contain geochemically-reactive phases and, consequently, migration of contaminants could be significant. Conversely, the filled fractures contain clay-size material, indicating that this type of fracture may have a relatively low hydraulic conductivity (Table 4, K values ranging from 10^{-6} to 10^{-3} cm/sec) in comparision to open fractures. Translocation of clay minerals from overlying soil through fractures has been described by Davenport (1993), suggesting that the fracture fills at TA-54 are developed at least partially, from overlying soils. Movement of the wetting front controls the rate of translocated fracture fill material. This fracture fill at TA-46 has a high adsorption capacity for potential contaminants, although bulk movement of this material occurs along fractures.

The fracture sampled at TA-46 is characterized by an outer, coarse-grained zone consisting of weathered Bandelier Tuff containing iron oxide coatings. The inner, fine-grained fracture fill contains clay minerals, calcium carbonate, solid organic matter, and iron oxides. Both sides of the inner fracture fill show a sharp transition to outer fracture material. Figure 94 shows element and species concentrations in fracture fill material normalized to the overlying soil, consisting of an A horizon with solid organic matter, which may represent the parent material at this site. Values greater than 100 indicate higher concentrations of an element or species within the fracture fill (outer and inner) relative to the overlying soil. Conversely, values less than 100 indicate that an element or species is higher within the soil relative to the fracture fill. The outer zone of the fracture is enriched in Cl, Ni, and SO_4 relative to the overlying soil (Figure 94), and this zone is lower in Al, As, Cr, Fe, Mn, Th, and U by varying amounts relative to the soil. Beryllium is evenly distributed between the outer fracture zone and overlying soil. Extensive leaching in the outer zone probably has occurred resulting in depletion of trace elements. The inner zone of the fracture is higher in Al, As, Be, Ca, Cl, Cr, Fe, Mn, Ni, Pb, SO_4, Th, and U relative to the soil (Figure 94). Chlorine and SO_4 show the most enrichment within the fracture. Enrichment of SO_4 and Ca suggests the presence of gypsum as a component of eolian dust within the fracture fill. Adsorption of As, Be, Cr, Ni, Pb, Th and U onto iron oxide, calcium carbonate, manganese oxide, solid organic matter, and/or clay minerals may account for trace-element enrichment in the inner fracture zone.

Figure 94

BACKGROUND SOIL, SITE 8. FRACTURE FILL.



CONCLUSIONS

Soils present on the Pajarito Plateau are extremely variable in physical and chemical properties, such as particle-size distribution, percent calcium carbonate, clay mineralogy, iron oxides, and trace-element chemistry. Variations in background-soil elemental concentrations are related to climate, topography, parent material, soil age, surficial processes, and vegetation. Parent materials consist of alluvial fans, sheet wash material, colluvium, El Cajete pumice, and in some instances the Bandelier Tuff. The age of the sampled deposits range from several thousand years (Site 1, Lower Los Alamos Canyon) to perhaps as old as one million years (Site 4, Twomile Mesa).

Lower Los Alamos Canyon represents a poorly developed soil characterized by A, C, and 2Cb horizons. This soil profile contains some clay enrichment, where abundances of clay-size material varies from 2.4 to 7.4 wt%. At Site 1, HNO_3-digested Be and As concentrations range from 0.31 to 0.42 ppm and from 0.7 to 0.9 ppm, respectively. Conversely, soil described at the Ancho Canyon mesas (Site 7) is well developed and consists of the following horizons: A 1, A2, Bt, Bwkb, Btkb, and K. This soil profile contains a significant amount of clay and $CaCO_3$ enrichment; abundances of clay-size material range from 11.6 to 53.6 wt%. At Site 7, HNO_3-digested As and Be concentrations range from 0.8 to 4.0 ppm and from 3.0 to 11.2 ppm, respectively.

Well-developed soils are enriched with trace elements relative to weakly developed soils found on the Pajarito Plateau, and the B horizons are enriched in trace elements relative to A and C horizons. High abundances of clay minerals and iron oxides, characterized by relatively high surface areas, within B horizons control trace-element enrichment in soils. Soils are higher in Al, As, Ba, Ca, Cs, Co, Cr, and Fe relative to the Bandelier Tuff samples. The Bandelier Tuff, however, is higher in Be, Pb, Na, K, Th, and U relative to soils. Background concentrations of As and Be exceed SALs for these elements. Therefore, background concentrations of As and Be should be used rather than SALs for these elements in evaluating non- contaminated with contaminated soil, sediment, and Bandelier Tuff samples.

Different trace elements are distributed in background soils by the following processes: (1) trace elements that are concentrated primarily on surfaces of soil particles through chemical weathering, for example As; (2) trace elements that remain concentrated within soil-particle matrices consisting of primary minerals (silicates) and glass, for example Ba, Th, and U; and (3) trace elements that are distributed as a combination of processes (1) and (2), for example Be, Cr, Pb, and V. Process (1) is due mainly to adsorption of trace elements onto surfaces of clay minerals, iron oxides, solid

organic matter, and calcium carbonate, whereas process (2) is dominated by coprecipitation of trace elements within primary minerals. Barium, Th, and U tend to show lesser amounts of leaching from primary silicate minerals and glass relative to As and Be, which have become concentrated on surfaces of soil particles through chemical weathering leading to element remobilization. Uranium (IV) probably is the dominant valence state within primary phases present in soil. This is based on significant differences observed between total element and HNO_3-digested fraction, suggesting some leaching of U has occurred in poorly developed soils at the Laboratory.

Because of the limited number of Bandelier Tuff and soil samples collected, this data set may not be representative of the full suite of soils and Bandelier Tuff present at the Laboratory, and may not include the full range of natural concentrations for all elements. The available data and information, however, have defined many of the geochemical interactions that exist in the Pajarito Plateau soils, and provide a guide for interpreting analyses obtained from potentially contaminated sites. By comparing the geomorphic setting and soil-profile characteristics of sites of concern with these background soils, better site-specific constraints on geochemical or natural backgrounds will be possible.

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Appendix A

Results of Tuff and Soil Analyses

Table A-1
Bandelier Tuff Analyses

DRAFT

	Na	Standard Deviation	Mg	Standard Deviation	Al	Standard Deviation	Cl	Standard Deviation	K	Standard Deviation	Ca	Standard Deviation
FS-1001	33930.00	1764.36	<2340.00		66730.00	1868.44	1777.00	140.38	40660.00	2642.90	2304.00	329.47
FS-1002	30280.00	1332.32	<2729.00		64340.00	1801.52	1369.00	104.04	36350.00	2399.10	<2070.00	
FS-1003	25000.00	1175.00	<3122.00		50600.00	1467.40	889.00	82.68	28760.00	2415.84	<2056.00	
FS-1004	33090.00	1753.77	<2360.00		68090.00	1906.52	531.90	46.81	40150.00	2609.75	2255.00	331.48
FS-1005	29620.00	1273.66	<2742.00		64680.00	1811.04	168.90	62.49	36640.00	2418.24	10070.00	735.11
FS-1006	31445.00	1446.47	<3867.00		65590.00	1868.67	720.30	70.53	36440.00	2876.78	5450.00	541.58
FS-1007	33940.00	1764.88	<2252.00		66990.00	1875.72	849.60	77.31	39010.00	2769.71	<2078.00	
FS-1008	31440.00	1351.92	<2716.00		66640.00	1865.92	172.30	31.53	37380.00	2467.08	<1972.00	
FS-1009	32960.00	1549.12	<4173.00		66720.00	1934.88	711.90	61.22	36140.00	2421.38	<2055.00	
FS-1010	36230.00	1920.19	<2395.00		69930.00	1958.04	473.00	43.04	39470.00	2565.55	5277.00	2052.75
FS-1011	31970.00	1374.71	<2669.00		65950.00	1846.60	434.90	39.58	38400.00	2534.40	<1988.00	
FS-1012	34755.00	1723.19	<3141.50		65940.00	1878.84	273.15	32.38	38915.00	3807.29	3473.00	430.65
FS-1013	36220.00	1883.44	<2237.00		68590.00	1920.52	360.30	63.41	39900.00	3351.60	2824.00	353.00
FS-1014	31150.00	1339.45	<2520.00		65280.00	1827.84	134.30	19.74	38130.00	2516.58	3289.00	371.66
FS-1015	32130.00	1510.11	<3595.00		65440.00	1832.32	<173.40		35400.00	2336.40	<2043.00	
FS-1016	34330.00	1819.49	<2143.00		66900.00	1873.20	<119.50		41360.00	2729.76	<1807.00	
FS-1017	30790.00	1323.97	<2588.00		65000.00	1820.00	204.80	36.25	38090.00	2513.94	<1842.00	
FS-1018	31590.00	1484.73	<3811.00		66370.00	1858.36	378.40	41.25	38200.00	2521.20	2472.00	417.77
FS-1019	27300.00	1446.90	6571.00	722.81	73210.00	2049.88	471.10	55.59	37170.00	2453.22	11770.00	2907.19
FS-1020	27580.00	1185.94	3297.00	771.50	73820.00	2066.96	338.30	49.73	35850.00	2366.10	9139.00	639.73
FS-1021	24310.00	1142.57	<3734.00		55930.00	1621.97	1632.00	124.03	33830.00	2266.61	<2530.00	
FS-1022	31610.00	1675.33	<2408.00		68090.00	1906.52	1883.00	139.34	42500.00	2932.50	<1929.00	
FS-1023	26890.00	1156.27	<2549.00		63720.00	1784.16	1239.00	102.84	41740.00	3673.12	<1871.00	
FS-1024	13960.00	670.08	<3054.00		63640.00	1781.92	289.80	30.43	29210.00	2132.33	16960.00	1000.64
FS-1025	30030.00	1561.56	<2359.00		68030.00	1904.84	565.50	49.20	47920.00	3162.72	<1956.00	
FS-1026	28180.00	1225.77	<2644.00		69195.00	1937.46	402.10	44.73	41900.00	3757.45	<1899.00	
FS-1027	31860.00	1529.28	<4116.00		68200.00	1977.80	500.10	48.51	37870.00	4089.96	<2142.00	
FS-1028	31230.00	1592.73	<2257.00		65740.00	1840.72	259.20	28.77	39560.00	2610.96	<1849.00	
FS-1029	30890.00	1359.16	<2511.00		63870.00	1788.36	208.60	37.34	36430.00	2659.39	<1915.00	
FS-1030	32570.00	1530.79	<3778.00		66260.00	1855.28	342.40	36.64	36220.00	4962.14	<1777.00	
FS-1031	34420.00	1789.84	<2150.00		67630.00	1893.64	102.60	26.06	37410.00	2805.75	<1843.00	
FS-1032	32110.00	1380.73	<2378.00		64830.00	1815.24	<107.50		40470.00	3642.30	<1798.00	
FS-1033	31690.00	1521.12	<3395.00		66700.00	2668.00	<162.20		36280.00	2684.72	<1957.00	
FS-1034	33820.00	1826.28	<2060.00		64990.00	1819.72	<115.00		36050.00	2703.75	<1978.00	
FS-1035	31900.00	1339.80	<2456.00		66630.00	1865.64	<104.40		36230.00	2970.86	1745.00	305.38
FS-1036	31320.00	1440.72	<3512.50		66745.00	1868.86	<170.55		36125.00	2726.60	<2301.50	
FS-1037	33090.00	1753.77	<2160.00		68530.00	1918.84	120.50	30.00	40310.00	2982.94	2183.00	329.63
FS-1036	34303.33	1621.29	3035.00	664.66	76531.66	2142.89	<133.65		39430.00	3031.54	5800.67	545.86

	Sc	Standard Deviation	Ti	Standard Deviation	V	Standard Deviation	Cr	Standard Deviation	Mn	Standard Deviation	Fe	Standard Deviation
FS-1001	1.06	0.06	<3883.00		<6.74		2.39	0.59	552.60	24.31	11100.00	599.40
FS-1002	1.15	0.07	<4673.00		<7.67		<1.82		598.00	23.92	11550.00	716.10
FS-1003	0.98	0.05	<5160.00		<7.84		4.52	0.62	444.50	18.22	8818.00	458.54
FS-1004	1.21	0.07	<4166.00		<7.00		<1.54		667.60	33.38	11170.00	659.03
FS-1005	1.19	0.08	<4533.00		<7.27		4.99	0.65	541.00	21.64	10600.00	540.60
FS-1006	1.05	0.06	<6364.00		<9.60		3.85	0.56	554.80	22.19	10136.50	531.47
FS-1007	1.16	0.06	432.50	155.70	<6.34		3.13	0.60	531.50	25.51	11040.00	640.32
FS-1008	1.11	0.06	<4385.00		<7.25		4.35	0.53	553.30	24.35	10690.00	641.40
FS-1009	1.07	0.06	<6867.00		<10.37		4.27	0.68	581.70	22.69	10680.00	544.68
FS-1010	1.56	0.08	<4011.00		<6.96		5.90	0.75	683.70	36.92	12440.00	684.20
FS-1011	1.17	0.07	<4355.00		<7.21		4.76	0.57	539.80	22.67	10250.00	533.00
FS-1012	1.17	0.06	<5291.00		<8.24		4.54	0.60	637.95	25.98	11645.00	624.48
FS-1013	1.10	0.06	<3661.00		<6.23		1.97	0.51	525.80	30.50	10710.00	610.47
FS-1014	1.36	0.08	<4131.00		<6.66		4.80	0.55	518.10	21.76	10650.00	660.30
FS-1015	1.34	0.07	<6055.00		<9.05		2.38	0.48	574.90	24.72	11080.00	565.08
FS-1016	1.63	0.09	<3466.00		<5.90		<1.31		459.70	20.69	11080.00	709.12
FS-1017	1.45	0.08	<4103.00		<6.53		3.61	0.51	428.90	16.73	10490.00	597.93
FS-1018	1.57	0.08	<6076.00		<9.19		2.84	0.52	465.70	18.63	10310.00	525.81
FS-1019	5.59	0.30	1943.00	318.65	42.25	2.75	49.85	3.14	834.50	37.55	22850.00	1462.40
FS-1020	4.08	0.22	1505.00	290.46	21.50	2.17	12.00	0.89	465.80	19.56	17080.00	888.16
FS-1021	1.01	0.05	<6524.00		<9.58		2.86	1.33	558.70	21.79	9777.00	518.18
FS-1022	0.91	0.05	<4051.00		<7.10		<0.91		626.90	29.46	11470.00	699.67
FS-1023	0.88	0.06	<4304.00		<7.01		2.70	0.52	574.40	22.40	10020.00	591.18
FS-1024	0.93	0.05	<6017.00		<8.62		<2.66		639.70	24.95	10560.00	538.56
FS-1025	1.19	0.06	<4020.00		<6.93		<1.68		589.80	28.90	11480.00	619.92
FS-1026	1.18	0.08	<4507.50		<7.42		3.94	0.63	581.30	23.87	11475.00	618.80
FS-1027	1.17	0.06	<7024.00		<10.49		3.72	0.61	663.10	25.86	11490.00	620.46
FS-1028	1.17	0.06	721.00	186.02	<6.60		1.79	0.48	663.40	33.17	11260.00	641.82
FS-1029	1.36	0.07	<4138.00		<6.92		3.12	0.59	514.60	22.13	10750.00	612.75
FS-1030	1.14	0.06	<6129.00		<9.28		3.84	0.51	558.20	22.33	10750.00	806.25
FS-1031	1.36	0.07	<3610.00		<6.24		5.94	0.65	590.00	26.55	11390.00	580.89
FS-1032	1.69	0.09	<3831.00		<6.43		5.08	0.63	510.10	20.91	11300.00	745.80
FS-1033	1.25	0.07	<5561.00		<8.45		1.63	0.37	502.10	19.58	10770.00	710.82
FS-1034	1.31	0.07	<3365.00		<5.79		<2.08		482.00	25.06	10220.00	541.66
FS-1035	1.63	0.09	<3873.00		<6.26		1.17	0.46	360.40	14.42	10740.00	579.96
FS-1036	1.92	0.11	1068.00	243.50	<8.40		2.07	0.41	382.75	15.49	10890.00	796.05
FS-1037	1.86	0.10	<3622.00		<6.17		5.80	0.67	449.20	21.56	11570.00	590.07
FS-1036	3.81	0.21	1528.33	285.13	9.63	1.83	9.90	0.93	558.48	24.02	17843.33	1015.54

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	Co	Standard Deviation	Cu	Standard Deviation	Zn	Standard Deviation	Ga	Standard Deviation	As	Standard Deviation	Se	Standard Deviation
FS-1001	0.83	0.11	<322.90		115.80	15.75	29.86	5.08	1.68	0.40	<2.27	
FS-1002	<0.31		<307.60		95.66	31.95	24.22	4.77	<2.63		<3.85	
FS-1003	0.71	0.06	<333.30		63.26	8.60	<28.45		<3.46		<3.62	
FS-1004	1.27	0.11	<322.00		110.50	15.03	25.40	5.82	3.04	0.53	<2.28	
FS-1005	0.55	0.21	<301.60		83.97	32.08	<23.85		1.80	0.46	<4.11	
FS-1006	0.66	0.14	<413.90		96.83	21.66	32.61	5.84	1.39	0.43	<4.04	
FS-1007	1.22	0.09	<309.40		88.49	12.30	<24.54		1.00	0.31	<2.13	
FS-1008	0.49	0.19	<300.40		78.40	29.56	<24.46		<2.57		<3.81	
FS-1009	0.83	0.08	<437.10		79.85	10.94	<40.36		2.03	0.50	<4.92	
FS-1010	1.13	0.09	<322.90		100.50	13.67	14.53	4.40	1.38	0.38	<2.13	
FS-1011	<0.35		<298.80		78.09	28.58	<24.65		1.68	0.40	<3.81	
FS-1012	0.81	0.10	<370.35		84.23	11.32	26.22	5.30	<3.47		<3.84	
FS-1013	0.72	0.08	<309.50		89.34	12.24	<25.61		<2.37		<1.93	
FS-1014	0.83	0.16	<283.90		56.88	24.86	<23.89		<2.43		<3.27	
FS-1015	0.77	0.06	<385.80		62.76	8.54	<36.56		<4.03		<3.68	
FS-1016	1.11	0.09	<288.60		71.19	9.90	15.10	4.70	<2.29		<1.85	
FS-1017	0.51	0.18	<281.70		<43.50		<25.37		<2.55		<3.43	
FS-1018	1.04	0.08	<403.00		41.34	6.12	<39.67		<4.24		<3.86	
FS-1019	8.88	0.48	<299.40		112.40	15.17	33.70	5.59	1.47	0.34	<2.59	
FS-1020	3.98	0.27	<267.10		<46.20		<23.63		<2.30		<3.97	
FS-1021	0.78	0.08	<399.60		86.31	11.74	<38.01		2.31	0.47	<4.15	
FS-1022	0.70	0.09	<326.10		130.90	17.67	34.21	6.53	3.15	0.52	<1.14	
FS-1023	<0.29		<284.00		83.24	29.55	<25.60		0.94	0.28	<3.58	
FS-1024	0.75	0.07	<313.40		101.00	13.53	30.35	4.83	<3.02		<4.58	
FS-1025	1.18	0.11	<323.40		131.30	17.86	<29.12		1.99	0.44	<2.38	
FS-1026	0.92	0.15	<299.25		98.65	23.48	<35.28		2.13	0.47	<3.14	
FS-1027	0.86	0.08	<444.40		86.79	11.72	<45.53		<4.55		<4.17	
FS-1028	1.78	0.18	<306.30		87.37	12.06	<27.72		<2.34		<2.10	
FS-1029	0.98	0.08	<280.60		76.66	10.66	<38.26		<2.61		<1.97	
FS-1030	0.54	0.17	<401.10		59.45	25.50	<58.83		<4.35		<3.66	
FS-1031	1.04	0.08	<302.50		73.05	9.86	<39.68		1.70	0.41	<4.35	
FS-1032	1.38	0.10	<260.80		80.09	10.89	<37.87		<2.52		<1.86	
FS-1033	0.76	0.15	<363.20		50.21	22.90	<55.89		<4.00		<3.11	
FS-1034	1.34	0.08	<284.80		54.13	7.58	<40.44		<2.40		<3.93	
FS-1035	1.07	0.09	<274.40		53.52	7.81	<41.37		<2.66		<1.85	
FS-1036	0.64	0.17	<374.10		<6.42		<62.06		<4.31		<3.24	
FS-1037	1.39	0.10	<297.80		39.85	5.94	<43.18		<2.52		<3.69	
FS-1036	3.14	0.20	<335.42		62.79	9.09	<53.58		2.62	0.55	<3.50	

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	Co	Standard Deviation	Cu	Standard Deviation	Zn	Standard Deviation	Ga	Standard Deviation	As	Standard Deviation	Se	Standard Deviation
FS-1001	0.83	0.11	<322.90		115.80	15.75	<29.86	5.08	1.68	0.40	<2.27	
FS-1002	<0.31		<307.60		95.86	31.95	24.22	4.77	<2.63		<3.85	
FS-1003	0.71	0.06	<323.30		63.26	8.60	<28.45		<3.46		<3.62	
FS-1004	1.27	0.11	<312.00		110.50	15.03	25.10	5.82	3.04	0.53	<2.28	
FS-1005	0.55	0.21	<301.60		83.87	12.08	<29.85		1.80	0.46	<4.11	
FS-1006	0.66	0.14	<313.90		95.85	21.66	32.61	5.84	1.39	0.43	<4.04	
FS-1007	1.22	0.09	<309.10		88.49	12.30	<24.54		1.00	0.31	<2.13	
FS-1008	0.49	0.19	<300.40		79.40	29.56	<24.46		<2.57		<3.81	
FS-1009	0.83	0.08	<437.10		79.85	10.94	<40.36		2.03	0.50	<4.92	
FS-1010	1.13	0.09	<322.90		100.50	13.67	14.53	4.40	1.38	0.38	<2.13	
FS-1011	<0.35		<298.80		78.09	28.58	<24.65		1.68	0.40	<3.81	
FS-1012	0.81	0.10	<370.35		84.23	11.32	26.22	5.30	<3.47		<3.84	
FS-1013	0.72	0.08	<309.50		89.34	12.24	<25.61		<2.37		<1.93	
FS-1014	0.83	0.16	<283.90		56.88	24.86	<23.89		<2.43		<3.27	
FS-1015	0.77	0.06	<385.80		62.76	8.54	<36.56		<4.03		<3.68	
FS-1016	1.11	0.09	<288.60		71.19	9.90	15.10	4.70	<2.29		<1.85	
FS-1017	0.51	0.18	<281.70		<43.50		<25.37		<2.55		<3.43	
FS-1018	1.04	0.08	<403.00		41.34	6.12	<39.67		<4.24		<3.86	
FS-1019	8.88	0.48	<299.40		112.40	15.17	33.70	5.59	1.47	0.34	<2.59	
FS-1020	3.98	0.27	<267.10		<46.20		<23.63		<2.30		<3.97	
FS-1021	0.78	0.08	<399.60		86.31	11.74	<38.01		2.31	0.47	<4.15	
FS-1022	0.70	0.09	<326.10		130.90	17.67	34.21	6.53	3.15	0.52	<1.14	
FS-1023	<0.29		<264.00		83.24	29.55	<25.60		0.94	0.28	<3.58	
FS-1024	0.75	0.07	<313.40		101.00	13.53	30.35	4.83	<3.02		<4.58	
FS-1025	1.18	0.11	<323.40		131.30	17.86	<29.12		1.99	0.44	<2.38	
FS-1026	0.92	0.15	<299.25		98.65	23.48	<35.28		2.13	0.47	<3.14	
FS-1027	0.86	0.08	<444.40		86.79	11.72	<45.53		<4.55		<4.17	
FS-1028	1.78	0.18	<306.30		87.37	12.06	<27.72		<2.34		<2.10	
FS-1029	0.98	0.08	<280.60		76.66	10.66	<38.26		<2.61		<1.97	
FS-1030	0.54	0.17	<401.10		59.45	25.50	<58.83		<4.35		<3.66	
FS-1031	1.04	0.08	<302.50		73.05	9.86	<39.68		1.70	0.41	<4.35	
FS-1032	1.38	0.10	<260.80		80.09	10.89	<37.87		<2.52		<1.86	
FS-1033	0.76	0.15	<363.20		50.21	22.90	<55.89		<4.00		<3.11	
FS-1034	1.34	0.08	<284.80		54.13	7.58	<40.44		<2.40		<3.93	
FS-1035	1.07	0.09	<274.40		53.52	7.81	<41.37		<2.66		<1.85	
FS-1036	0.64	0.17	<374.10		<6.42		<62.06		<4.31		<3.24	
FS-1037	1.39	0.10	<297.80		39.85	5.94	<43.18		<2.52		<3.69	
FS-1036	3.14	0.20	<335.42		62.79	9.09	<53.58		2.62	0.55	<3.50	

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	Sb	Standard Deviation	I	Standard Deviation	Cs	Standard Deviation	Ba	Standard Deviation	La	Standard Deviation	Ce	Standard Deviation
FS-1001	<0.45		<16.20		7.06	0.42	131.40	28.65	56.09	2.92	113.70	5.00
FS-1002	<0.40		<19.20		7.01	0.42	<67.45		56.71	2.89	117.00	5.26
FS-1003	<0.52		<23.52		5.02	0.30	128.30	17.83	42.71	2.52	87.99	3.87
FS-1004	<0.24		<17.07		6.63	0.41	<73.70		54.03	3.13	113.60	5.00
FS-1005	<0.39		<18.57		8.10	0.46	97.65	33.79	51.72	2.90	106.80	4.70
FS-1006	<0.55		<29.05		7.11	0.41	114.10	22.56	52.05	2.84	105.06	4.72
FS-1007	<0.43		<15.75		4.65	0.44	116.60	25.30	54.19	3.14	117.20	5.16
FS-1008	<0.38		<18.28		2.47	0.15	122.00	24.40	51.10	3.07	102.40	4.61
FS-1009	<0.67		<30.98		5.20	0.30	133.90	48.61	59.32	3.68	121.20	5.33
FS-1010	<0.43		<17.00		3.96	0.37	<120.80		57.05	3.14	116.70	5.13
FS-1011	<0.37		<18.39		4.80	0.28	122.70	20.25	59.08	3.19	111.20	5.00
FS-1012	<0.47		<23.70		4.75	0.28	129.50	29.28	57.96	3.31	117.65	5.18
FS-1013	<0.41		<15.22		4.53	0.32	<48.02		59.05	3.42	107.80	4.74
FS-1014	<0.34		<17.17		3.12	0.18	144.50	32.22	56.87	3.30	111.00	4.99
FS-1015	<0.57		<27.65		2.81	0.18	124.90	35.22	66.14	3.97	122.20	5.38
FS-1016	<0.39		<14.23		2.31	0.21	113.10	54.63	69.80	3.70	120.50	5.30
FS-1017	<0.35		<16.89		2.90	0.17	<100.50		68.29	4.03	110.20	4.96
FS-1018	<0.59		<27.80		2.09	0.12	180.60	21.31	57.99	3.42	107.90	4.75
FS-1019	<0.36		<17.12		3.99	0.30	<300.40		45.47	2.36	84.40	3.71
FS-1020	<0.32		<16.19		3.34	0.20	348.30	27.52	45.85	2.75	81.71	3.76
FS-1021	<0.55		<28.96		6.58	0.38	79.85	38.73	45.09	2.57	91.00	1.00
FS-1022	0.70	0.13	<17.27		7.87	0.46	<91.32		62.81	3.52	124.60	5.48
FS-1023	<0.33		<18.12		7.28	0.41	<73.65		53.43	2.94	99.75	4.59
FS-1024	<0.42		<26.42		5.09	0.31	<339.60		48.49	2.86	102.20	4.50
FS-1025	<0.40		<16.70		6.52	0.44	<79.56		59.04	3.07	112.10	1.93
FS-1026	0.24	0.07	<18.51		6.18	0.38	<144.75		57.24	3.06	114.70	5.15
FS-1027	<0.61		<32.05		2.61	0.17	158.30	25.49	57.16	3.20	121.50	5.35
FS-1028	<0.37		<16.54		3.70	0.24	<85.87		55.29	2.93	122.50	5.39
FS-1029	<0.28		<17.17		3.46	0.22	118.40	26.05	52.80	3.01	103.80	4.57
FS-1030	<0.47		<27.92		4.47	0.25	<103.00		55.53	3.33	109.60	4.93
FS-1031	<0.31		<15.23		3.40	0.29	149.80	24.87	67.29	3.77	131.80	5.80
FS-1032	<0.27		<15.68		3.95	0.26	<97.88		75.35	4.29	157.10	6.91
FS-1033	<0.42		<25.23		2.84	0.20	99.62	17.04	47.36	2.70	102.60	4.62
FS-1034	<0.30		<14.27		2.66	0.16	150.10	19.21	59.45	3.15	133.30	5.87
FS-1035	<0.28		<15.81		2.06	0.15	113.10	49.88	54.95	3.08	105.40	4.64
FS-1036	<0.44		<24.75		2.20	0.17	145.60	16.69	62.40	3.49	103.60	4.66
FS-1037	<0.31		<14.53		1.79	0.11	192.30	19.04	61.81	3.34	120.50	5.30
FS-1036	<0.34		<19.82		1.82	0.13	413.70	45.33	75.94	4.06	134.38	5.96

	Nd	Standard Deviation	Sm	Standard Deviation	Eu	Standard Deviation	Tb	Standard Deviation	Dy	Standard Deviation	Yb	Standard Deviation
FS-1001	36.28	3.56	11.42	0.53	<0.16		2.34	0.21	14.96	1.32	8.46	0.48
FS-1002	63.07	5.30	10.29	0.47	0.09	0.01	2.44	0.21	15.57	1.23	7.75	0.85
FS-1003	40.03	3.40	10.30	0.48	0.11	0.01	1.94	0.17	10.41	0.92	7.84	0.45
FS-1004	43.87	4.56	10.05	0.47	0.18	0.09	2.12	0.20	12.21	0.96	7.30	0.43
FS-1005	55.27	4.78	9.64	0.44	<0.18		2.35	0.23	14.13	1.13	7.90	0.99
FS-1006	51.96	4.39	12.26	0.58	0.12	0.01	2.11	0.19	12.52	1.00	9.23	0.53
FS-1007	44.56	4.50	10.02	0.47	<0.17		2.10	0.19	11.76	0.99	6.99	0.41
FS-1008	51.87	4.46	9.83	0.45	<0.17		2.39	0.23	13.34	1.33	7.19	0.95
FS-1009	56.78	4.77	13.20	0.61	0.13	0.01	2.47	0.22	13.65	1.08	10.63	0.62
FS-1010	30.36	3.07	10.59	0.50	0.21	0.08	2.11	0.19	12.06	0.99	6.93	0.39
FS-1011	62.94	5.16	10.73	0.49	0.11	0.01	2.29	0.20	14.06	1.12	6.85	0.75
FS-1012	55.30	4.56	12.62	0.59	0.11	0.01	2.26	0.20	12.31	1.03	8.19	0.52
FS-1013	37.04	4.04	11.46	0.54	0.16	0.08	2.12	0.19	12.64	1.07	6.71	0.39
FS-1014	53.74	4.51	8.65	0.40	0.20	0.07	1.85	0.18	9.05	0.79	5.03	0.45
FS-1015	55.78	4.52	12.47	0.57	0.27	0.06	1.94	0.17	10.15	1.48	7.41	0.45
FS-1016	49.80	4.53	10.37	0.49	0.26	0.06	1.60	0.14	8.71	0.70	4.20	0.27
FS-1017	60.14	4.99	10.47	0.48	0.24	0.04	1.79	0.16	9.26	0.79	4.48	0.55
FS-1018	51.08	4.29	9.61	0.43	0.38	0.02	1.37	0.12	8.11	0.84	4.47	0.34
FS-1019	32.67	3.99	7.56	0.36	0.53	0.06	1.22	0.16	6.18	0.54	3.89	0.26
FS-1020	43.76	3.94	6.46	0.30	0.52	0.03	1.14	0.11	4.61	0.51	2.96	0.30
FS-1021	47.84	4.31	10.60	0.50	<0.13		1.99	0.18	12.17	1.06	8.66	0.49
FS-1022	34.27	3.84	13.01	0.60	0.08	0.01	2.61	0.24	15.47	1.25	9.86	0.53
FS-1023	59.71	5.14	9.93	0.46	<0.13		2.27	0.21	14.13	1.26	9.00	0.49
FS-1024	46.42	4.18	0.81	0.06	0.41	0.19	1.98	0.18	11.14	1.18	10.14	0.55
FS-1025	33.14	3.71	11.66	0.55	0.17	0.08	2.27	0.22	13.62	1.05	8.44	0.47
FS-1026	44.96	4.15	10.68	0.50	0.19	0.08	2.40	0.22	14.19	1.14	8.32	0.60
FS-1027	58.36	5.02	13.21	0.61	0.10	0.01	2.34	0.21	13.34	1.11	9.95	0.56
FS-1028	31.01	3.41	10.82	0.50	0.21	0.06	2.04	0.19	12.08	1.06	6.73	0.38
FS-1029	40.23	3.90	9.41	0.43	0.19	0.05	2.02	0.18	11.72	1.77	7.13	0.71
FS-1030	58.42	4.79	12.08	0.56	0.17	0.08	2.50	0.23	12.89	1.24	9.07	0.50
FS-1031	71.58	5.65	13.05	0.60	0.18	0.02	2.65	0.24	14.03	1.19	7.73	0.48
FS-1032	47.91	4.26	11.27	0.51	0.28	0.05	1.95	0.18	11.65	1.36	6.10	0.57
FS-1033	38.79	3.34	7.84	0.37	0.21	0.05	1.18	0.11	6.56	0.60	5.62	0.50
FS-1034	52.68	4.27	8.06	0.37	0.28	0.11	1.61	0.14	7.73	0.66	4.60	0.27
FS-1035	36.65	3.52	6.90	0.31	0.31	0.05	1.11	0.11	6.66	0.63	3.34	0.40
FS-1036	52.14	4.28	9.40	0.44	0.31	0.04	1.26	0.12	6.22	0.54	4.58	0.29
FS-1037	49.76	4.08	7.56	0.36	0.40	0.04	1.27	0.12	6.38	0.54	3.64	0.29
FS-1036	57.22	5.02	8.77	0.41	0.84	0.05	1.19	0.12	5.80	0.65	3.65	0.37

DRAFT

	Lu	Standard Deviation	Hf	Standard Deviation	Ta	Standard Deviation	W	Standard Deviation	Au	Standard Deviation	Hg	Standard Deviation
FS-1001	1.22	0.06	10.53	0.88	8.16	0.55	4.53	0.87	<0.02		<0.44	
FS-1002	1.22	0.06	10.75	0.59	8.17	0.51	7.18	3.03	<0.02		<0.63	
FS-1003	0.93	0.04	7.43	0.42	5.66	0.36	3.37	0.71	<0.02		<0.53	
FS-1004	1.10	0.05	10.38	0.50	7.70	0.48	3.30	1.42	<0.02		<0.44	
FS-1005	1.08	0.05	9.60	0.46	7.23	0.54	2.27	0.61	<0.02		<0.61	
FS-1006	1.05	0.05	9.07	0.51	6.89	0.42	4.31	1.12	<0.02		<0.60	
FS-1007	1.06	0.05	10.64	0.61	7.12	0.51	4.37	0.87	<0.02		<0.42	
FS-1008	1.02	0.05	9.78	0.48	7.02	0.41	3.12	1.13	<0.02		<0.56	
FS-1009	1.18	0.06	9.65	0.50	7.33	0.44	3.87	0.83	<0.02		<0.69	
FS-1010	1.02	0.05	9.21	0.69	6.33	0.40	3.85	0.88	<0.02		<0.41	
FS-1011	1.07	0.05	9.48	0.56	6.60	0.41	<5.60		<0.02		<0.55	
FS-1012	1.12	0.05	9.12	0.48	6.70	0.42	19.73	4.85	<0.02		<0.63	
FS-1013	1.01	0.05	8.65	0.44	6.12	0.39	<6.23		<0.02		<0.38	
FS-1014	0.77	0.04	7.69	0.48	4.76	0.29	<5.24		<0.02		<0.49	
FS-1015	0.89	0.04	7.77	0.50	4.55	0.30	<9.04		<0.02		<0.54	
FS-1016	0.71	0.04	7.99	0.46	3.98	0.31	<3.59		<0.02		<0.37	
FS-1017	0.72	0.04	7.84	0.52	3.92	0.24	<5.51		<0.02		<0.51	
FS-1018	0.66	0.03	6.89	0.39	3.33	0.21	<9.53		<0.02		<0.56	
FS-1019	0.65	0.04	6.34	0.35	4.92	0.42	2.04	0.77	<0.01		<0.53	
FS-1020	0.58	0.03	6.34	0.48	4.10	0.29	<5.05		<0.01		<0.62	
FS-1021	1.15	0.06	9.29	0.45	7.57	0.52	5.89	1.09	<0.02		<0.68	
FS-1022	1.40	0.07	12.13	0.75	9.70	0.56	5.41	0.97	<0.02		<0.48	
FS-1023	1.22	0.06	10.25	0.63	8.03	0.59	3.47	1.66	<0.01		<0.58	
FS-1024	1.16	0.06	10.33	0.48	8.44	0.55	<3.10		<0.02		<0.67	
FS-1025	1.21	0.06	9.74	0.65	7.10	0.45	4.78	1.14	<0.02		<0.47	
FS-1026	1.15	0.06	9.78	0.58	7.38	0.51	2.59	0.73	<0.01		<0.52	
FS-1027	1.18	0.06	10.52	0.56	7.75	0.48	5.40	1.91	<0.02		<0.68	
FS-1028	1.07	0.05	9.25	0.40	6.88	0.43	3.86	1.17	<0.02		<0.41	
FS-1029	0.93	0.05	9.03	0.71	6.15	0.40	3.43	1.19	<0.01		<0.39	
FS-1030	1.02	0.05	9.58	0.56	6.90	0.43	2.68	0.82	<0.02		<0.53	
FS-1031	1.12	0.05	9.45	0.45	7.03	0.45	<6.62		<0.01		<0.61	
FS-1032	0.83	0.04	8.07	0.41	4.55	0.31	<5.85		<0.01		<0.36	
FS-1033	0.58	0.03	8.16	0.51	4.67	0.31	<9.62		<0.02		<0.46	
FS-1034	0.72	0.04	7.86	0.41	4.58	0.29	<6.64		<0.01		<0.55	
FS-1035	0.53	0.03	7.45	0.41	2.95	0.24	<6.16		<0.01		<0.35	
FS-1036	0.51	0.03	7.31	0.41	3.10	0.22	18.87	2.60	<0.02		<0.48	
FS-1037	0.58	0.03	7.33	0.37	3.16	0.25	<6.98		<0.01		<0.57	
FS-1036	0.55	0.03	9.79	0.59	2.66	0.20	20.03	3.67	<0.01		<0.58	

	Th	Standard Deviation	U	Standard Deviation	Ba	Standard Deviation	Cd	Standard Deviation	Pb	Standard Deviation
FS-1001	31.95	1.44	8.63	0.30	7.20	1.40	<1.00		57.00	6.00
FS-1002	28.99	1.16	8.74	0.31	0.82	0.16	<1.00		<14.00	
FS-1003	21.32	0.85	5.98	0.21	6.40	1.30	<1.00		44.00	4.00
FS-1004	31.20	1.31	7.85	0.27	6.00	1.20	<1.00		48.00	5.00
FS-1005	22.56	2.46	7.36	0.25	4.90	1.00	<1.00		41.00	4.00
FS-1006	23.20	1.01	7.02	0.25	5.10	1.00	<1.00		43.30	4.20
FS-1007	30.08	1.23	7.31	0.26	6.30	1.30	<1.00		26.00	3.00
FS-1008	22.27	2.85	7.27	0.25	7.00	1.40	<1.00		54.00	5.00
FS-1009	27.67	1.11	7.59	0.27	5.60	1.10	<1.00		52.00	5.00
FS-1010	27.30	1.09	7.30	0.26	6.10	1.20	<1.00		39.00	4.00
FS-1011	24.54	0.98	7.41	0.26	5.95	1.20	<1.00		32.50	4.00
FS-1012	26.09	1.04	6.91	0.24	6.00	1.20	<1.00		30.90	3.00
FS-1013	25.93	1.06	7.12	0.25	6.10	1.20	<1.00		27.00	3.00
FS-1014	16.25	2.08	5.05	0.18	4.00	0.80	<1.00		19.00	4.00
FS-1015	19.67	0.79	4.73	0.17	4.60	0.90	<1.00		25.00	2.00
FS-1016	19.55	0.80	4.32	0.16	3.50	0.70	<1.00		<14.00	
FS-1017	16.32	0.67	4.37	0.16	2.90	0.60	<1.00		22.00	2.00
FS-1018	15.43	0.63	3.28	0.12	2.70	0.50	<1.00		27.00	3.00
FS-1019	19.94	0.96	5.61	0.20	5.00	1.00	<1.00		31.00	3.00
FS-1020	15.62	0.61	5.08	0.18	4.90	1.00	<1.00		32.00	3.00
FS-1021	27.13	1.09	7.80	0.27	6.40	1.30	<1.00		49.00	5.00
FS-1022	37.06	1.52	10.13	0.35	0.72	0.10	<1.00		<14.00	
FS-1023	27.17	1.09	8.33	0.29	7.50	1.50	<1.00		51.30	5.10
FS-1024	29.39	1.26	6.65	0.24	5.70	1.10	<1.00		45.60	4.60
FS-1025	29.76	1.22	7.75	0.28	6.12	1.20	<1.00		39.30	4.00
FS-1026	28.42	1.33	6.93	0.24	6.30	1.00	<1.00		45.90	4.40
FS-1027	29.53	1.18	7.41	0.26	5.40	1.00	<1.00		36.00	3.60
FS-1028	29.87	1.28	7.14	0.25	5.20	1.00	<1.00		40.40	4.00
FS-1029	26.37	1.05	6.58	0.23	5.70	1.00	<1.00		31.00	3.10
FS-1030	22.10	2.83	7.27	0.25	5.60	1.10	<1.00		51.00	5.10
FS-1031	27.64	1.11	6.98	0.24	6.00	1.00	<1.00		24.00	2.00
FS-1032	21.50	0.90	4.71	0.16	3.90	0.80	<1.00		26.00	3.00
FS-1033	19.14	0.77	4.82	0.17	3.90	0.80	<1.00		29.70	3.00
FS-1034	20.53	0.82	4.45	0.16	3.50	0.70	<1.00		22.00	2.00
FS-1035	15.05	0.71	3.18	0.12	0.42	0.10	<1.00		<14.00	
FS-1036	12.90	0.80	3.40	0.12	1.40	0.80	<1.00		18.00	4.00
FS-1037	15.05	0.62	3.17	0.12	2.50	0.50	<1.00		21.00	2.00
FS-1038	14.50	0.64	2.88	0.11	2.05	0.40	<1.00		36.00	4.00

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Table A-II
Soil Analyses

	Na	Standard Deviation	Mg	Standard Deviation	Al	Standard Deviation	Cl	Standard Deviation	K	Standard Deviation	Ca	Standard Deviation
FS-2000	27380.00	1259.48	<3815.00		69530.00	1946.84	<177.30		32050.00	2531.95	5988.00	562.87
FS-2000F	25130.00	1331.89	<2667.00		66160.00	1918.64	<134.70		33890.00	2677.31	6475.00	582.75
FS-2001	14770.00	620.34	4949.00	608.73	64430.00	1804.04	<77.85		25280.00	1971.84	4691.00	394.04
FS-2002	23530.00	1105.91	8239.00	1128.74	87080.00	2525.32	854.10	78.58	31780.00	2764.86	14190.00	1007.49
FS-2003	14600.00	744.60	5543.00	598.64	66990.00	1875.72	<79.98		23240.00	1905.68	3434.00	326.23
FS-2004	15990.00	671.58	6648.00	784.46	88760.00	2485.28	111.20	15.46	19860.00	1827.12	12430.00	770.66
FS-2005	19270.00	905.69	6870.00	858.75	85100.00	2382.80	325.20	63.74	26770.00	2543.15	18940.00	1174.28
FS-2006	16665.00	875.03	6719.00	645.95	89265.00	2499.42	129.00	22.06	24270.00	2529.73	9609.50	633.97
FS-2007	19020.00	817.86	5634.00	777.49	88020.00	2464.56	208.90	23.40	23140.00	2013.18	14370.00	2830.89
FS-2008	19310.00	868.95	<3767.00		69380.00	1942.64	<162.80		26430.00	2220.12	3278.00	406.47
FS-2009	18180.00	927.18	4434.00	576.42	67790.00	1898.12	<78.61		24040.00	1971.28	2914.00	294.31
FS-2010	20280.00	872.04	3237.00	702.43	75150.00	2104.20	152.60	21.97	32330.00	2974.36	5410.00	1920.55
FS-2011	22750.00	978.25	4271.00	751.70	68240.00	1910.72	104.10	48.82	29660.00	2402.46	3675.00	389.55
FS-2012	22460.00	1033.16	5753.00	811.17	71800.00	2010.40	193.90	24.24	31860.00	2516.94	4882.00	468.67
FS-2013	23840.00	1263.52	3032.00	551.82	73520.00	2058.56	158.30	21.05	31980.00	2462.46	5598.00	453.44
FS-2014F	21320.00	916.76	<3027.00		60360.00	1750.44	<131.20		29610.00	2694.51	13870.00	957.03
FS-2015F	27580.00	1323.84	<3279.00		66310.00	1856.68	<152.60		35760.00	2860.80	3388.00	399.78
FS-2016F	28530.00	1540.62	<1971.00		67540.00	1891.12	<104.90		36210.00	2860.59	1911.00	328.69
FS-2017F	20140.00	866.02	3400.00	710.60	59970.00	1739.13	<124.70		21790.00	2070.05	18670.00	1138.87
FS-2018F	20490.00	963.03	<4325.00		59710.00	1731.59	<198.20		27670.00	2434.96	13850.00	997.20
FS-2019F	26180.00	1256.64	1807.00	495.12	70850.00	1983.80	<111.30		34900.00	3036.30	5836.00	501.90
FS-2020F	27050.00	1204.07	<2906.00		67255.00	1883.14	<128.35		29150.00	2539.21	6687.00	550.53
FS-2021	24540.00	1153.38	<3287.00		67700.00	1895.60	203.90	34.05	31960.00	2620.72	4238.00	436.51
FS-2022	19420.00	1009.84	3607.00	595.16	71290.00	1996.12	202.50	23.08	28340.00	2380.56	6782.00	522.21
FS-2023	22950.00	963.90	4099.00	705.03	73390.00	2054.92	198.20	35.48	29480.00	2505.80	7088.00	545.78
FS-2026	18860.00	810.98	6084.00	748.33	104900.00	2937.20	239.60	24.44	21460.00	2103.08	5921.00	473.68
FS-2027	13530.00	676.50	<2693.00		58090.00	1626.52	<119.10		22260.00	1958.88	4454.00	400.86
FS-2028	12270.00	625.77	6441.00	573.25	91170.00	2461.59	69.12	15.76	21030.00	1976.82	5156.00	391.86
FS-2029	3392.00	149.25	13410.00	871.65	113600.00	3067.20	127.60	20.93	13040.00	1447.44	9127.00	2418.66
FS-2030	17090.00	769.05	8150.00	986.15	77800.00	2178.40	241.60	34.79	23010.00	2324.01	37070.00	1890.57
FS-2031	15150.00	818.10	3490.00	471.15	68400.00	1915.20	<80.92		26180.00	2853.62	2010.00	245.22
FS-2032	15020.00	630.84	5029.00	663.83	60890.00	1704.92	<83.99		21740.00	2174.00	6357.00	470.42
FS-2033	10120.00	495.88	10610.00	870.02	109200.00	2948.40	<110.00		17160.00	1767.48	8748.00	586.12
FS-2034	16040.00	802.00	5828.00	582.80	71260.00	1995.28	<79.81		20410.00	1796.08	10230.00	613.80
FS-2035	14745.00	662.82	1785.00	442.68	51680.00	1472.84	<114.57		23130.00	2090.34	3956.50	395.63
FS-2037	15560.00	871.36	2347.00	424.81	55360.00	1550.08	<79.86		20780.00	2057.22	1932.00	245.36
FS-2038	10300.00	463.50	6404.00	627.59	79110.00	2215.08	<78.04		15090.00	1690.08	12000.00	732.00
FS-2039	26860.00	1262.42	<3670.00		81180.00	2273.04	855.60	68.45	42000.00	4116.00	<3002.00	
FS-2040	22090.00	1148.68	5070.00	633.75	92220.00	2582.16	939.50	72.34	26880.00	3118.08	5365.00	456.02
FS-2041	14780.00	650.32	7443.00	826.17	94120.00	2635.36	123.40	18.51	20640.00	2621.28	7821.00	570.93
FS-2042	13430.00	604.35	<2631.00		49680.00	1391.04	<114.80		22420.00	2354.10	3543.00	354.30
FS-2043	16880.00	725.84	5652.00	678.24	99700.00	2791.60	573.70	50.49	24880.00	1666.96	5742.00	453.62
FS-2044	10850.00	509.95	6106.00	622.81	79360.00	2222.08	<100.80		19350.00	1296.45	5520.00	447.12
FS-2045	14740.00	781.22	<1597.00		54510.00	1526.28	<79.37		23090.00	1547.03	5468.00	421.04
FS-2046	8286.00	368.41	12770.00	913.74	100470.00	2762.26	85.70	16.63	18630.00	1369.10	13425.00	772.22
FS-2048	16960.00	898.88	6956.00	681.69	88720.00	2484.16	159.50	19.94	25760.00	1751.68	8316.00	590.44
FS-2049	14720.00	632.96	5172.00	636.16	87870.00	2460.36	110.60	49.00	23960.00	1605.32	6299.00	466.13
FS-2050	10710.00	492.66	5470.00	672.81	69440.00	1944.32	<107.00		18800.00	1391.20	8071.00	564.97
FS-2051	13880.00	707.88	6732.00	605.88	93850.00	2533.95	114.30	16.46	21480.00	1460.64	7357.00	529.70
FS-2052	15070.00	648.01	1787.00	427.09	52940.00	1482.32	<76.91		23010.00	1541.67	3605.00	342.48
FS-2053	14190.00	652.74	4123.00	560.73	59180.00	1657.04	<115.80		21950.00	1492.60	6453.00	490.43
FS-2054	17740.00	940.22	3995.00	547.32	76830.00	2151.24	162.30	20.45	24770.00	1709.13	9582.00	632.41
FS-2055	13420.00	577.06	4405.00	572.65	50280.00	1458.12	<85.43		18860.00	1339.06	6587.00	520.32
FS-2056	11990.00	563.53	6625.00	689.00	85930.00	2406.04	<102.90		21460.00	1459.28	6274.00	470.55
FS-2057	13580.00	645.86	5508.00	614.71	69245.00	1938.86	<81.01		22935.00	1559.58	13150.00	755.91

	Na	Standard Deviation	Mg	Standard Deviation	Al	Standard Deviation	Cl	Standard Deviation	K	Standard Deviation	Ca	Standard Deviation
FS-2059	25140.00	1181.58	<3490.00		80410.00	2251.48	966.90	76.39	36040.00	2450.72	4277.00	436.25
FS-2060	10800.00	540.00	10670.00	746.90	74310.00	1932.06	187.30	20.60	16270.00	1236.52	80380.00	3295.58
FS-2061	20090.00	843.78	<1989.00		69310.00	1802.06	624.90	88.74	26840.00	1851.96	6917.00	2165.02
FS-2062	12560.00	615.44	9748.00	857.82	96630.00	2512.38	<131.80		24990.00	1749.30	9449.00	670.88
FS-2063	17400.00	904.80	5101.00	632.52	73740.00	1917.24	256.80	24.91	22210.00	1576.91	7837.00	2437.31
FS-2064	21300.00	937.20	<2349.00		76010.00	1976.26	<102.40		26680.00	1867.60	6384.00	497.95
FS-2065	12860.00	604.42	7725.00	710.70	111100.00	2888.60	350.40	32.24	20620.00	1484.64	8155.00	570.85
FS-2066	14920.00	775.84	3624.00	507.36	57940.00	1506.44	<77.94		23150.00	2037.20	4063.00	381.92
FS-2067	9185.00	394.95	6641.00	657.46	94440.00	3399.84	<66.63		20920.00	1443.48	5911.00	455.15
FS-2068	10805.00	535.68	6233.00	604.76	84700.00	2623.05	<88.05		19165.00	1351.04	5155.50	424.18
FS-2070	32560.00	1400.08	<2498.00		67450.00	1821.15	124.90	29.35	41100.00	2794.80	<1978.00	
FS-2071	2700.00	121.50	16790.00	1040.98	101400.00	2636.40	<76.92		10390.00	841.59	14180.00	893.34
FS-2072	3271.00	160.28	15190.00	911.40	108300.00	2815.80	<51.79		11540.00	877.04	10770.00	700.05
FS-2073	21090.00	885.78	1331.00	412.61	76120.00	1979.12	<91.98		30720.00	2119.68	4116.00	374.56
FS-2074	31380.00	1474.86	<3672.00		67110.00	1811.97	212.70	27.65	37350.00	2988.00	<1848.00	
FS-2075	30630.00	1654.02	<3470.00		81960.00	2622.72	696.90	78.75	32120.00	2248.40	3472.00	614.54
FS-2076	14540.00	639.76	8993.00	1277.01	105800.00	2750.80	549.70	86.85	19120.00	1472.24	5094.00	662.22
FS-2077	25950.00	1193.70	<2288.00		63930.00	1790.04	372.20	33.50	31070.00	2827.37	4497.00	445.20
FS-2078	28160.00	1492.48	<3493.00		67570.00	1891.96	771.60	62.50	35570.00	2667.75	4988.00	468.87
FS-2079	27170.00	1168.31	<2167.00		<1524.00		<118.40		32930.00	2469.75	<1114.00	

A-1C

	Sc	Standard Deviation	Ti	Standard Deviation	V	Standard Deviation	Cr	Standard Deviation	Mn	Standard Deviation	Fe	Standard Deviation
FS-2000	2.98	0.16	1284.00	296.60	18.94	2.48	10.90	0.82	1161.00	45.28	15320.00	1026.44
FS-2000F	3.88	0.22	1951.00	360.93	20.61	2.82	22.54	1.60	1552.00	74.50	16030.00	817.53
FS-2001	6.74	0.36	3688.00	505.26	59.40	2.97	45.25	2.85	507.30	20.80	22260.00	1491.42
FS-2002	5.88	0.31	2718.00	453.91	36.54	2.92	19.42	1.48	480.10	19.68	21750.00	1457.25
FS-2003	8.09	0.44	4102.00	537.36	60.50	2.90	57.41	3.56	647.70	28.50	27230.00	1470.42
FS-2004	7.76	0.41	2975.00	428.40	66.69	3.47	45.51	3.00	503.50	24.17	29820.00	1997.94
FS-2005	6.70	0.37	3226.00	474.22	49.35	3.31	32.29	2.10	513.10	20.52	25320.00	1291.32
FS-2006	7.80	0.43	3471.00	468.58	59.56	3.04	46.53	2.95	545.80	24.84	28545.00	1498.56
FS-2007	6.81	0.36	3157.00	467.24	56.57	3.17	34.55	2.31	486.90	19.96	26470.00	1508.79
FS-2008	6.36	0.35	3585.00	526.99	51.85	3.37	29.24	1.90	1329.00	51.83	23830.00	1691.93
FS-2009	6.78	0.37	3374.00	441.99	41.55	2.24	47.73	2.96	185.70	8.17	15900.00	810.90
FS-2010	5.94	0.31	2507.00	363.52	34.94	2.38	30.36	2.06	473.00	23.65	21730.00	1260.34
FS-2011	4.29	0.23	1783.00	285.28	24.61	1.94	20.00	1.42	400.80	17.64	18300.00	1152.90
FS-2012	4.82	0.26	1970.00	311.26	31.73	2.44	20.71	1.37	478.00	19.12	19730.00	1302.18
FS-2013	4.91	0.26	2298.00	324.02	34.25	2.16	31.34	2.04	483.40	23.69	21830.00	1266.14
FS-2014F	3.42	0.18	2066.00	382.21	25.17	2.77	14.72	1.31	772.80	36.32	14070.00	759.78
FS-2015F	2.28	0.12	1205.00	219.31	16.25	1.84	9.08	0.72	396.00	15.84	11920.00	703.28
FS-2016F	2.80	0.15	1802.00	282.91	14.62	1.78	18.51	1.28	451.70	21.68	14340.00	731.34
FS-2017F	3.97	0.21	1571.00	391.18	26.25	2.91	20.12	1.51	1449.00	56.51	16020.00	865.08
FS-2018F	3.75	0.21	2323.00	448.34	23.77	2.90	19.71	1.40	1323.00	51.60	14940.00	761.94
FS-2019F	3.83	0.21	1922.00	313.29	22.62	2.06	22.61	1.54	574.70	24.71	16150.00	823.65
FS-2020F	3.02	0.16	1524.00	273.50	15.24	1.96	13.83	1.03	499.90	21.90	14865.00	877.49
FS-2021	3.70	0.20	2472.00	385.63	21.09	2.13	16.75	1.17	501.40	19.55	17870.00	1304.51
FS-2022	5.86	0.33	2812.00	402.12	40.95	2.50	39.25	2.51	494.40	26.70	20820.00	1499.04
FS-2023	5.00	0.27	1606.00	287.47	24.42	2.20	24.60	1.72	429.20	18.03	19520.00	1112.64
FS-2026	7.12	0.38	2372.00	379.52	47.93	2.92	32.40	2.24	404.10	17.78	29270.00	1931.82
FS-2027	5.46	0.29	4648.00	613.54	57.66	3.11	39.03	2.46	530.10	20.67	17430.00	1167.81
FS-2028	9.53	0.54	3885.00	501.17	76.79	3.38	60.04	3.72	251.80	10.83	34390.00	3129.49
FS-2029	13.80	0.73	2310.00	328.02	84.23	3.79	58.35	3.79	194.30	9.72	43370.00	2558.83
FS-2030	5.78	0.32	2634.00	395.10	46.73	3.04	24.04	1.68	472.60	19.85	22390.00	1567.30
FS-2031	6.15	0.35	4070.00	533.17	60.41	2.90	49.86	3.09	703.30	31.65	25580.00	2199.88
FS-2032	5.44	0.29	3707.00	511.57	54.22	2.82	43.13	2.76	557.40	21.74	19590.00	1038.27
FS-2033	11.32	0.61	3647.00	488.70	72.70	3.42	43.94	2.77	205.80	8.23	40310.00	2015.50
FS-2034	7.09	0.39	3672.00	481.03	55.46	2.77	50.29	3.12	468.00	20.59	23680.00	1586.56
FS-2035	4.57	0.24	3743.00	528.16	61.42	3.22	39.83	2.51	1053.55	42.14	21365.00	1173.13
FS-2037	5.12	0.28	4553.00	587.34	50.32	2.52	46.10	2.90	454.60	21.37	15680.00	799.68
FS-2038	8.01	0.42	1617.00	245.78	48.36	2.56	29.16	2.10	189.30	8.33	25110.00	1456.38
FS-2039	4.25	0.23	1434.00	285.37	18.87	2.25	10.86	0.91	326.20	13.37	19170.00	1303.56
FS-2040	7.10	0.42	1645.00	254.98	34.64	2.32	26.74	1.85	232.20	9.98	27010.00	1566.58
FS-2041	7.64	0.41	3025.00	432.58	57.67	3.11	35.65	2.42	438.30	20.16	28090.00	1685.40
FS-2042	4.74	0.26	4413.00	600.17	45.34	2.68	37.61	2.33	658.80	26.35	15580.00	810.16
FS-2043	8.38	0.44	1815.00	284.95	47.35	2.65	30.95	2.14	227.20	11.81	30920.00	2195.32
FS-2044	8.41	0.45	5029.00	658.80	79.45	3.50	46.85	2.90	412.80	16.92	29750.00	1636.25
FS-2045	5.34	0.29	4454.00	579.02	44.54	2.45	52.12	3.18	586.60	25.81	18000.00	918.00
FS-2046	12.41	0.67	2969.00	408.90	83.44	3.75	57.29	3.58	375.70	16.16	40255.00	2310.73
FS-2048	7.59	0.42	2854.00	385.29	52.88	2.75	41.83	2.68	393.00	17.68	28090.00	1460.68
FS-2049	7.44	0.41	2982.00	420.46	62.17	3.11	41.57	2.70	446.20	19.63	26890.00	1532.73
FS-2050	7.18	0.39	4492.00	597.44	68.78	3.30	42.57	2.64	440.60	17.62	25620.00	1639.68
FS-2051	8.77	0.49	3285.00	433.62	62.38	2.93	49.69	3.13	483.50	20.31	32120.00	1670.24
FS-2052	4.42	0.23	4557.00	606.08	55.74	2.79	36.78	2.32	688.80	28.93	15490.00	882.93
FS-2053	5.94	0.32	4386.00	578.95	56.66	2.89	43.97	2.68	615.50	25.24	20850.00	1063.35
FS-2054	6.19	0.34	2904.00	400.75	45.16	2.62	35.99	2.30	493.00	23.17	23710.00	1849.38
FS-2055	4.46	0.24	4193.00	574.44	43.46	2.56	37.38	2.43	531.80	21.80	15110.00	831.05
FS-2056	8.95	0.48	4008.00	525.05	76.78	3.38	45.50	2.82	246.40	10.35	32650.00	1697.80
FS-2057	7.33	0.40	3797.50	509.52	62.10	3.04	49.33	3.10	543.85	22.58	23935.00	1411.04

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	Sc	Standard Deviation	Ti	Standard Deviation	V	Standard Deviation	Cr	Standard Deviation	Mn	Standard Deviation	Fe	Standard Deviation
FS-2059	4.75	0.26	1981.00	309.04	18.88	1.96	11.43	0.96	345.00	14.15	19940.00	1036.88
FS-2060	8.75	0.49	2016.00	280.22	58.23	2.74	46.77	2.99	298.80	11.95	29220.00	1986.96
FS-2061	4.31	0.23	1531.00	251.08	22.94	1.81	13.16	1.08	223.60	8.50	17360.00	1215.20
FS-2062	12.04	0.65	5438.00	717.82	96.99	4.36	61.51	3.81	733.50	28.61	38890.00	2022.28
FS-2063	5.33	0.30	2035.00	293.04	36.64	2.16	22.35	1.59	301.70	15.39	20960.00	1278.56
FS-2064	5.09	0.27	2937.00	428.80	35.84	2.62	28.31	1.93	539.60	21.04	21050.00	1199.85
FS-2065	10.38	0.56	3214.00	437.10	59.91	3.06	40.08	2.53	231.00	11.09	37490.00	1911.99
FS-2066	5.69	0.31	4712.00	612.56	52.69	2.58	49.02	3.04	536.90	23.62	19060.00	1124.54
FS-2067	10.07	0.53	3816.00	511.34	87.81	3.78	57.51	3.62	395.70	17.81	35940.00	2192.34
FS-2068	8.95	0.48	4638.50	605.44	82.68	3.60	56.07	3.45	491.55	20.40	32865.00	1758.07
FS-2070	1.29	0.07	<3844.00		<6.40		2.03	0.47	361.90	16.29	10860.00	608.16
FS-2071	17.90	0.97	2280.00	323.76	113.10	4.86	60.18	3.79	203.00	8.53	46230.00	2496.42
FS-2072	18.80	1.03	2380.00	321.30	101.30	4.15	71.07	4.48	208.60	8.76	48640.00	2626.56
FS-2073	5.23	0.28	2079.00	313.93	42.37	2.42	28.22	1.92	322.90	12.92	21690.00	1409.85
FS-2074	1.45	0.08	<5780.00		<8.84		<1.60		376.90	14.32	11240.00	573.24
FS-2075	6.16	0.33	2163.00	324.45	23.56	2.00	19.96	1.44	310.80	14.30	24190.00	1499.78
FS-2076	15.73	0.83	1659.00	313.55	75.41	3.85	42.93	2.88	624.90	25.00	39310.00	2555.15
FS-2077	2.42	0.13	1185.00	237.00	13.47	1.95	9.93	0.78	403.90	16.16	13060.00	679.12
FS-2078	2.32	0.13	1188.00	256.61	11.54	2.00	9.28	0.82	433.40	17.34	12470.00	635.97
FS-2079	2.13	0.11	<3607.00		<6.41		9.26	0.90	474.50	18.98	11370.00	716.31

DRAFT

	Co	Standard Deviation	Cu	Standard Deviation	Zn	Standard Deviation	Ga	Standard Deviation	As	Standard Deviation	Se	Standard Deviation
FS-2000	2.80	0.21	<402.90		54.57	22.81	<60.79		<3.98		<3.44	
FS-2000F	4.06	0.22	<349.00		64.74	9.06	<45.31		1.63	0.43	<4.63	
FS-2001	8.58	0.46	<204.30		55.22	8.12	<33.64		4.38	0.56	<2.58	
FS-2002	5.93	0.44	<456.60		<13.48		<83.90		4.76	0.88	<5.94	
FS-2003	9.82	0.53	<215.30		<19.20		<35.48		7.01	0.82	<5.38	
FS-2004	9.10	0.48	<238.30		58.92	9.13	<41.37		2.24	0.44	<3.05	
FS-2005	7.55	0.48	<400.10		<10.92		<75.61		4.86	0.80	<5.12	
FS-2006	9.12	0.49	<238.25		<21.22		<43.65		5.33	0.68	<5.59	
FS-2007	8.59	0.54	<262.50		53.35	8.59	<46.46		3.73	0.60	<2.99	
FS-2008	10.26	0.56	<387.20		<28.15		<63.24		7.36	0.91	<4.67	
FS-2009	4.00	0.22	<210.30		<20.36		<40.80		1.42	0.32	<4.98	
FS-2010	6.67	0.37	<258.30		70.29	10.19	<48.42		2.06	0.39	<2.79	
FS-2011	4.27	0.24	<228.70		57.12	8.34	<41.28		1.53	0.33	<2.24	
FS-2012	4.87	0.31	<335.10		<35.21		<63.77		2.53	0.54	<4.22	
FS-2013	5.94	0.31	<245.20		45.16	6.64	<42.02		2.51	0.45	<4.76	
FS-2014F	4.12	0.24	<321.90		64.31	10.03	<55.96		<3.23		<2.93	
FS-2015F	1.95	0.19	<348.50		<23.40		<66.71		2.13	0.51	<3.24	
FS-2016F	3.04	0.17	<266.90		41.60	6.07	<46.54		2.03	0.46	<3.86	
FS-2017F	4.83	0.28	<330.20		146.20	19.59	<50.69		<2.94		<2.71	
FS-2018F	3.87	0.33	<453.70		94.92	39.01	<78.60		3.78	0.70	<4.62	
FS-2019F	4.01	0.23	<284.30		45.38	6.76	<50.46		<2.58		<4.52	
FS-2020F	3.03	0.20	<306.85		60.89	8.71	<61.28		<3.43		<2.78	
FS-2021	3.87	0.26	<344.50		<32.04		<70.13		2.80	0.58	<3.85	
FS-2022	6.78	0.37	<252.00		<20.27		<47.78		4.99	0.67	<5.37	
FS-2023	5.29	0.30	<258.10		61.44	9.09	<51.55		3.64	0.62	<2.56	
FS-2026	9.31	0.53	<245.10		65.90	9.75	<51.54		4.91	0.69	<2.88	
FS-2027	10.91	0.59	<276.50		<8.09		<60.63		7.56	0.92	<4.13	
FS-2028	7.39	0.39	<186.40		<21.10		<42.93		8.51	0.96	<5.57	
FS-2029	6.82	0.48	<158.90		106.70	14.83	<44.23		10.30	1.54	<3.53	
FS-2030	6.92	0.44	<367.50		<15.23		<83.28		4.95	0.75	<5.00	
FS-2031	12.32	0.64	<216.50		<16.69		<41.49		7.64	0.88	<4.67	
FS-2032	8.29	0.45	<209.10		49.72	7.51	<44.48		2.99	0.47	<2.48	
FS-2033	7.12	0.41	<250.50		60.40	25.97	<69.66		8.23	0.96	<5.45	
FS-2034	9.75	0.52	<207.40		65.70	9.20	<44.25		4.21	0.58	<4.89	
FS-2035	13.73	0.73	<273.30		<7.78		<54.17		7.58	0.93	<3.19	
FS-2037	22.53	1.19	<207.80		<16.24		<45.99		5.25	0.65	<4.81	
FS-2038	4.19	0.39	<180.50		66.97	9.71	<49.31		3.26	0.52	<2.71	
FS-2039	1.72	0.22	<384.20		<34.34		<99.75		<5.21		<4.37	
FS-2040	4.28	0.24	<256.20		<20.43		<61.53		4.90	0.69	<5.31	
FS-2041	7.54	0.41	<231.40		<10.28		<71.07		3.90	0.63	<3.06	
FS-2042	7.29	0.41	<271.40		<10.22		<80.74		5.68	0.75	<3.96	
FS-2043	5.24	0.29	<220.40		76.30	10.91	<20.15		3.71	0.51	<2.82	
FS-2044	8.19	0.45	<249.70		<23.06		17.68	3.34	7.33	0.83	<4.62	
FS-2045	8.22	0.48	<208.50		<16.77		<16.54		5.35	0.60	<4.69	
FS-2046	10.95	0.60	<216.35		62.80	25.75	20.13	3.51	8.27	0.91	<4.32	
FS-2048	7.24	0.39	<229.30		<21.55		<20.33		4.45	0.56	<5.39	
FS-2049	7.75	0.42	<212.00		<8.99		<18.67		4.58	0.58	<2.64	
FS-2050	7.91	0.45	<261.30		<13.52		<25.08		7.26	0.82	<4.65	
FS-2051	9.02	0.48	<208.70		<21.89		13.99	3.72	5.36	0.63	<5.43	
FS-2052	14.65	0.79	<199.20		19.97	4.23	<17.55		5.11	0.61	<2.20	
FS-2053	9.41	0.52	<271.10		<21.93		<26.60		5.04	0.63	<4.28	
FS-2054	6.56	0.35	<242.20		<20.14		<21.64		3.36	0.67	<5.18	
FS-2055	7.06	0.39	<212.30		43.67	7.03	<20.12		3.91	0.51	<2.56	
FS-2056	7.00	0.40	<244.20		<37.68		17.06	3.75	9.80	1.08	<4.86	
FS-2057	9.16	0.49	<207.50		<14.39		7.81	2.35	5.12	0.61	<3.89	

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	Co	Standard Deviation	Cu	Standard Deviation	Zn	Standard Deviation	Ga	Standard Deviation	As	Standard Deviation	Se	Standard Deviation
FS-2059	1.72	0.21	<363.30		<42.04		<41.89		2.93	0.53	<4.37	
FS-2060	7.37	0.40	<202.00		<23.76		<20.74		4.92	0.58	<5.89	
FS-2061	2.51	0.15	<209.40		60.87	8.58	<22.88		3.12	0.47	<2.03	
FS-2062	12.63	0.68	<320.50		63.70	28.09	37.39	6.02	9.33	1.06	<5.88	
FS-2063	5.09	0.28	<229.00		<18.09		<23.00		2.00	0.33	<4.66	
FS-2064	7.30	0.39	<246.70		51.78	7.87	<25.89		3.86	0.54	<2.49	
FS-2065	6.58	0.39	<277.60		52.16	25.92	26.40	4.30	6.78	0.81	<5.13	
FS-2066	9.73	0.52	<203.80		<16.57		<20.10		5.14	0.60	<4.68	
FS-2067	16.56	0.88	<187.60		68.53	10.07	<19.42		8.93	0.97	<3.01	
FS-2068	9.49	0.51	<226.75		<24.55		15.03	3.41	8.76	0.97	<4.90	
FS-2070	1.05	0.08	<274.80		39.92	6.19	<32.25		<2.58		<1.71	
FS-2071	6.73	0.42	<232.30		<71.93		32.14	11.80	10.81	1.19	<6.96	
FS-2072	7.30	0.39	<171.80		<35.18		23.38	4.51	9.73	1.05	<7.72	
FS-2073	6.95	0.38	<227.20		43.97	6.90	<27.34		3.05	0.44	<2.37	
FS-2074	0.44	0.17	<392.40		<5.32		<50.40		3.49	0.67	<3.08	
FS-2075	3.42	0.19	<286.30		132.30	17.20	<31.13		2.86	0.46	<4.48	
FS-2076	23.35	1.31	<288.60		92.97	13.20	<28.20		10.12	1.34	<3.45	
FS-2077	2.26	0.19	<247.20		<42.39		<50.54		<3.36		<3.23	
FS-2078	2.04	0.13	<365.00		47.08	6.87	<37.44		1.20	0.33	<4.20	
FS-2079	2.17	0.14	<291.40		79.40	11.27	<40.48		1.59	0.39	<2.14	

	Br	Standard Deviation	Rb	Standard Deviation	Sr	Standard Deviation	Zr	Standard Deviation	Ag	Standard Deviation	In	Standard Deviation
FS-2000	6.52	0.78	113.90	5.81	<498.80		293.00	49.81	<2.46		<0.37	
FS-2000F	11.69	1.26	103.90	5.61	<380.90		314.50	42.77	<3.62		<0.27	
FS-2001	<2.36		108.10	5.95	<236.00		399.20	53.49	<2.75		<0.21	
FS-2002	4.90	0.71	151.00	8.15	<501.70		174.00	39.50	<4.73		<0.41	
FS-2003	<2.02		134.40	6.85	<221.20		485.20	98.98	<4.25		<0.17	
FS-2004	7.35	0.85	126.90	6.98	<278.30		225.00	42.53	<3.44		<0.25	
FS-2005	11.62	1.30	131.70	7.51	<455.60		319.30	60.99	<4.62		<0.37	
FS-2006	2.43	0.45	143.15	7.44	<231.65		279.70	59.59	<4.66		<0.19	
FS-2007	1.45	0.42	132.40	7.28	<291.10		246.50	56.20	<3.36		<0.26	
FS-2008	<3.79		119.10	6.19	<526.20		439.80	77.40	<3.67		<0.36	
FS-2009	1.97	0.41	121.50	6.20	<170.50		441.00	53.80	<3.88		<0.15	
FS-2010	3.10	0.55	131.10	7.08	<279.30		290.70	47.97	<3.07		<0.26	
FS-2011	1.67	0.41	122.40	6.36	<241.20		265.10	37.64	<2.34		<0.23	
FS-2012	6.74	0.98	124.80	6.49	<365.20		392.70	50.27	<3.17		<0.30	
FS-2013	2.12	0.34	120.50	6.27	<219.40		377.50	47.19	<3.54		<0.19	
FS-2014F	9.79	1.31	101.50	5.99	<383.90		203.70	66.41	<2.92		<0.33	
FS-2015F	2.54	0.42	106.00	5.41	<356.00		273.20	63.38	<2.27		<0.31	
FS-2016F	2.39	0.46	104.00	5.30	<229.50		327.80	45.89	<2.89		<0.20	
FS-2017F	12.13	1.37	93.13	5.77	<444.70		238.10	37.14	<2.83		<0.34	
FS-2018F	6.26	0.81	104.60	5.75	<609.90		332.40	47.53	<3.52		<0.42	
FS-2019F	3.05	0.42	111.40	5.90	<255.50		323.10	41.68	<3.42		<0.21	
FS-2020F	3.08	0.49	88.79	4.79	<328.95		296.15	48.10	<2.34		<0.29	
FS-2021	<3.93		109.80	5.71	<373.10		456.00	54.72	<2.85		<0.31	
FS-2022	2.10	0.61	136.10	7.08	<236.00		432.00	78.19	<4.24		<0.20	
FS-2023	7.74	1.26	130.70	6.93	<271.50		226.00	70.29	<2.75		<0.26	
FS-2026	2.79	0.43	93.07	5.96	<255.90		281.00	44.96	<3.23		<0.25	
FS-2027	2.74	0.70	90.69	5.17	<339.80		585.90	69.72	<3.20		<0.25	
FS-2028	9.28	1.18	110.70	6.20	<164.90		488.90	58.67	<4.60		0.07	0.03
FS-2029	9.34	1.17	104.80	6.92	<185.90		<175.70		<4.41		<0.17	
FS-2030	8.90	1.01	122.90	6.76	<417.30		282.90	67.61	<4.05		<0.33	
FS-2031	4.14	0.56	105.90	5.82	<221.20		522.20	60.05	<3.72		<0.17	
FS-2032	2.73	0.60	90.73	5.17	<250.70		449.70	70.60	<2.57		<0.21	
FS-2033	10.29	1.15	112.30	6.63	<270.00		344.30	54.06	<4.70		<0.23	
FS-2034	7.24	0.81	114.30	6.17	<198.80		344.20	77.45	<3.95		<0.16	
FS-2035	1.58	0.39	89.81	5.21	<370.15		620.55	74.15	<2.70		<0.26	
FS-2037	2.03	0.29	87.75	5.09	<196.60		636.70	78.31	<3.66		<0.16	
FS-2038	4.61	0.65	64.97	4.68	<191.90		<128.40		<3.22		<0.19	
FS-2039	<4.67		98.15	5.50	<383.20		336.40	45.75	<3.25		<0.34	
FS-2040	4.86	0.57	107.80	6.14	<199.90		277.70	41.10	<4.46		<0.19	
FS-2041	2.66	0.58	122.60	7.11	<261.20		169.50	29.66	<3.36		<0.24	
FS-2042	<3.23		83.60	4.60	<351.30		666.80	76.02	<2.89		<0.25	
FS-2043	5.06	0.78	87.40	5.42	<216.80		279.80	49.24	<2.59		<0.22	
FS-2044	3.97	0.48	114.70	5.96	<295.10		440.20	88.48	<3.82		<0.23	
FS-2045	<1.77		87.68	4.82	170.40	55.55	704.30	78.18	<3.47		<0.16	
FS-2046	12.26	1.40	111.00	6.49	<259.05		247.00	47.42	1.61	0.51	<0.21	
FS-2048	2.89	0.52	139.80	7.27	<213.40		260.20	66.09	<4.53		<0.18	
FS-2049	1.71	0.66	121.20	6.54	<235.60		192.90	61.92	<2.97		<0.21	
FS-2050	9.14	0.99	104.30	5.63	<317.80		400.40	52.45	<3.74		<0.24	
FS-2051	3.71	0.44	139.80	7.27	<204.80		276.70	50.36	<4.63		<0.16	
FS-2052	<2.21		87.68	5.00	<247.50		445.90	77.59	<2.24		<0.21	
FS-2053	4.59	0.61	102.00	5.41	<339.00		670.00	76.38	<3.21		<0.25	
FS-2054	2.53	0.35	118.30	6.39	<223.10		288.70	49.37	<4.17		<0.18	
FS-2055	2.53	0.41	73.69	4.50	<257.00		438.30	53.91	<2.62		<0.22	
FS-2056	9.80	1.08	104.50	5.75	<267.60		435.50	59.23	<3.99		<0.22	
FS-2057	18.91	2.05	99.21	5.55	<224.10		417.75	52.54	<3.53		<0.18	

	Br	Standard Deviation	Rb	Standard Deviation	Sr	Standard Deviation	Zr	Standard Deviation	Ag	Standard Deviation	In	Standard Deviation
FS-2059	2.08	0.47	95.18	5.43	<372.50		431.70	53.96	<3.38		<0.32	
FS-2060	16.24	1.77	90.24	5.59	<189.70		270.30	44.60	<5.01		<0.15	
FS-2061	2.60	0.90	70.87	4.18	<202.50		163.00	33.58	<2.23		<0.21	
FS-2062	25.55	2.71	134.00	7.37	<411.70		492.10	66.93	<5.07		<0.30	
FS-2063	2.42	0.36	109.50	5.91	<194.90		148.00	68.08	<3.85		<0.17	
FS-2064	1.61	0.48	110.40	6.18	<274.50		351.70	72.10	<2.64		<0.25	
FS-2065	10.81	1.21	113.90	6.61	<292.00		390.60	55.47	<4.53		<0.25	
FS-2066	1.99	0.32	89.97	5.04	<205.30		522.60	76.30	<3.61		<0.16	
FS-2067	8.50	0.97	118.20	6.74	<215.10		239.30	48.34	<3.46		<0.19	
FS-2068	4.39	0.55	120.10	6.42	<257.65		405.70	66.60	<4.17		<0.19	
FS-2070	<3.31		100.10	5.31	<267.30		189.30	26.12	<1.59		<0.27	
FS-2071	7.96	0.87	92.22	6.73	<284.30		<311.80		<6.66		0.17	0.04
FS-2072	6.52	0.71	97.09	6.41	242.20	63.46	<316.30		<7.52		0.13	0.04
FS-2073	3.83	0.59	108.80	5.98	<227.90		282.70	68.98	<2.56		<0.23	
FS-2074	<4.48		108.40	5.53	<394.80		257.50	33.99	<2.11		<0.35	
FS-2075	9.23	1.01	43.95	3.21	<567.70		198.70	32.39	<3.74		<0.49	
FS-2076	46.88	5.25	65.38	4.90	<746.10		<144.60		<4.19		<0.69	
FS-2077	<3.38		113.70	5.68	<252.20		215.90	31.52	<2.29		<0.25	
FS-2078	1.50	0.60	159.00	7.79	<389.80		239.00	36.57	<2.84		<0.33	
FS-2079	1.38	0.42	148.20	7.56	<249.00		190.40	33.89	<2.09		<0.22	

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	Sb	Standard Deviation	I	Standard Deviation	Cs	Standard Deviation	Ba	Standard Deviation	La	Standard Deviation	Ce	Standard Deviation
FS-2000	<0.38		<32.98		3.15	0.18	314.20	68.50	49.52	2.82	91.17	4.10
FS-2000F	0.46	0.08	<22.70		3.57	0.23	516.70	34.10	49.25	2.66	93.69	4.12
FS-2001	0.46	0.07	<13.83		4.01	0.35	478.60	146.45	44.25	2.48	91.94	4.05
FS-2002	0.47	0.13	<32.97		5.09	0.32	629.00	42.77	42.11	2.32	85.66	4.03
FS-2003	1.05	0.10	<12.97		6.29	0.38	745.10	43.96	75.92	3.87	84.88	3.90
FS-2004	0.28	0.07	<16.62		6.04	0.35	553.20	138.85	43.29	2.42	81.92	3.69
FS-2005	0.43	0.09	<30.49		5.67	0.36	697.50	43.94	41.40	2.40	78.10	3.67
FS-2006	0.62	0.09	<13.85		6.73	0.39	768.15	53.54	48.12	2.45	88.25	4.06
FS-2007	<0.25		7.06	2.18	5.32	0.45	477.10	39.12	44.05	2.51	88.07	3.96
FS-2008	0.53	0.09	<34.89		5.35	0.34	587.00	36.98	48.76	2.83	101.30	4.56
FS-2009	0.52	0.08	<9.93		4.86	0.29	635.00	45.08	56.42	2.82	70.37	3.10
FS-2010	0.27	0.08	<16.37		5.31	0.35	258.60	72.41	47.14	2.64	93.72	4.12
FS-2011	0.31	0.07	<14.17		3.73	0.23	230.50	88.97	54.42	2.88	105.80	4.66
FS-2012	0.54	0.11	<24.48		4.29	0.27	319.10	26.80	51.47	3.04	95.81	4.31
FS-2013	0.45	0.08	<12.98		4.12	0.26	387.10	36.00	55.78	2.68	105.10	4.73
FS-2014F	<0.30		<22.55		3.27	0.20	296.90	48.39	43.98	2.55	84.55	3.80
FS-2015F	<0.38		<23.60		2.87	0.18	206.30	20.63	41.81	2.34	82.01	3.69
FS-2016F	<0.27		<13.56		2.76	0.17	288.30	23.93	48.68	2.48	97.42	4.29
FS-2017F	<0.27		<26.59		2.91	0.20	343.20	97.13	45.65	2.42	85.68	3.86
FS-2018F	0.43	0.10	<40.59		3.23	0.22	493.00	56.69	43.06	2.37	81.71	3.84
FS-2019F	0.34	0.09	<15.01		3.61	0.21	416.90	29.60	55.04	2.70	103.30	4.55
FS-2020F	<0.31		<20.74		2.68	0.22	339.85	25.76	45.33	2.38	84.33	3.79
FS-2021	0.37	0.08	<24.77		3.51	0.20	279.90	51.50	55.88	3.07	100.90	4.54
FS-2022	0.71	0.09	<13.80		5.12	0.30	542.50	37.43	48.58	2.57	99.60	4.58
FS-2023	0.27	0.07	<15.87		4.38	0.32	386.20	45.19	52.65	2.79	101.70	4.47
FS-2026	0.52	0.08	<15.59		5.19	0.49	434.60	102.57	53.74	2.90	132.90	5.85
FS-2027	0.97	0.10	<22.15		3.70	0.21	587.80	122.85	36.69	2.05	76.51	3.52
FS-2028	1.01	0.09	6.52	1.56	7.23	0.41	634.50	45.05	66.27	3.38	117.30	5.40
FS-2029	1.27	0.11	6.89	1.56	8.65	0.61	183.80	39.33	41.48	2.32	66.65	3.07
FS-2030	0.40	0.09	29.42	4.06	4.97	0.30	828.90	51.39	37.61	2.26	72.07	3.39
FS-2031	1.11	0.10	<13.13		4.65	0.26	764.00	45.08	42.94	2.10	99.55	4.58
FS-2032	0.47	0.07	<14.83		3.14	0.24	463.70	112.68	39.56	2.22	70.72	3.18
FS-2033	0.73	0.10	<18.58		7.86	0.45	524.70	86.58	49.04	3.14	93.92	4.32
FS-2034	0.60	0.08	<11.85		5.31	0.30	610.80	39.70	40.17	1.93	76.08	3.50
FS-2035	0.81	0.08	<23.57		2.79	0.22	528.00	74.75	37.73	2.08	73.51	3.35
FS-2037	0.75	0.08	<11.68		3.41	0.20	690.00	43.47	39.89	1.99	100.30	4.61
FS-2038	1.15	0.10	6.36	1.81	4.97	0.34	288.00	34.85	36.49	1.82	82.35	3.71
FS-2039	<0.43		<25.62		3.24	0.20	374.50	83.51	70.87	4.11	116.80	5.26
FS-2040	0.64	0.10	<12.14		5.10	0.29	558.70	43.02	53.99	2.81	107.50	4.95
FS-2041	0.29	0.07	<15.49		5.87	0.44	560.00	45.36	47.98	2.49	80.56	3.63
FS-2042	1.08	0.09	<23.28		2.86	0.18	609.90	45.13	35.32	2.05	68.96	3.17
FS-2043	0.53	0.10	<13.26		5.59	0.37	356.20	82.99	51.35	2.77	102.90	4.53
FS-2044	0.72	0.09	<19.95		6.35	0.36	543.60	48.92	37.70	2.11	67.78	3.12
FS-2045	0.88	0.10	<12.42		3.33	0.20	614.90	36.89	36.52	1.90	71.59	3.15
FS-2046	0.72	0.09	<16.77		8.26	0.61	371.50	45.32	42.03	2.39	99.81	4.54
FS-2048	0.47	0.10	<12.49		6.03	0.36	723.70	44.15	44.67	2.28	84.82	3.90
FS-2049	0.46	0.08	<13.70		5.97	0.39	508.80	138.39	47.55	2.47	79.84	3.59
FS-2050	1.00	0.11	<20.70		5.45	0.32	493.90	46.43	39.86	2.15	61.55	2.89
FS-2051	0.59	0.08	<12.16		7.11	0.48	648.10	45.37	42.89	2.27	81.82	3.76
FS-2052	0.61	0.09	<14.73		2.49	0.18	548.80	35.12	37.10	1.97	74.64	3.28
FS-2053	<0.34		<22.38		3.54	0.25	502.10	33.64	39.31	2.20	81.09	3.73
FS-2054	0.52	0.11	<13.41		4.79	0.28	579.70	38.26	39.32	2.12	87.41	4.11
FS-2055	0.89	0.10	<15.22		2.66	0.22	415.30	33.22	32.95	1.98	58.19	2.62
FS-2056	1.03	0.10	<17.94		6.36	0.36	511.20	71.06	54.60	3.06	104.40	1.70
FS-2057	0.60	0.09	5.64	2.07	5.09	0.39	631.40	80.83	40.70	2.14	74.56	3.39

H.11

	Sb	Standard Deviation	I	Standard Deviation	Cs	Standard Deviation	Ba	Standard Deviation	La	Standard Deviation	Ce	Standard Deviation
FS-2059	<0.51		<24.51		2.90	0.22	282.20	28.22	74.77	4.11	121.10	5.45
FS-2060	0.66	0.10	11.78	2.20	6.02	0.42	624.10	273.36	93.50	4.58	81.49	3.83
FS-2061	<0.25		<11.99		2.85	0.23	291.70	43.76	50.51	2.83	78.52	3.45
FS-2062	1.10	0.12	<28.19		8.14	0.54	640.60	49.97	52.40	3.04	99.30	4.57
FS-2063	<0.27		<11.37		4.03	0.30	618.50	40.20	31.70	1.87	72.68	3.42
FS-2064	0.65	0.11	<16.16		4.00	0.27	349.30	66.37	46.21	2.40	78.98	3.55
FS-2065	0.84	0.10	12.18	2.13	7.22	0.41	335.70	33.91	54.85	3.13	102.60	4.72
FS-2066	0.75	0.09	<12.25		3.57	0.21	651.10	39.07	38.08	1.94	69.78	3.21
FS-2067	0.94	0.09	<13.00		6.78	0.47	292.30	76.29	46.34	2.36	128.80	5.67
FS-2068	0.97	0.09	<16.56		6.84	0.41	596.30	40.15	37.01	1.92	72.10	3.32
FS-2070	<0.30		<15.77		2.19	0.16	124.80	24.84	56.91	3.07	99.36	4.37
FS-2071	1.59	0.12	<18.59		10.08	0.65	396.30	52.71	32.58	1.86	63.16	3.16
FS-2072	1.44	0.11	4.05	1.39	10.71	0.61	377.20	50.92	33.50	1.94	79.26	3.88
FS-2073	0.32	0.08	<13.90		4.14	0.40	254.30	112.65	50.96	2.85	92.79	4.08
FS-2074	<0.48		<25.82		2.67	0.16	126.00	19.66	51.18	3.02	99.17	4.46
FS-2075	<0.31		<27.51		3.26	0.20	414.10	54.25	43.21	2.29	73.80	3.39
FS-2076	0.65	0.09	<36.97		8.72	0.66	139.80	32.01	78.22	4.22	161.80	7.12
FS-2077	<0.34		<14.91		2.90	0.18	163.90	61.46	36.53	2.30	69.09	3.18
FS-2078	<0.25		<25.68		4.27	0.29	234.60	29.09	44.92	2.34	90.41	4.16
FS-2079	<0.25		<14.73		4.08	0.32	235.10	35.03	45.96	2.67	82.45	3.63

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	Sb	Standard Deviation	I	Standard Deviation	Cs	Standard Deviation	Ba	Standard Deviation	La	Standard Deviation	Ce	Standard Deviation
FS-2059	<0.51		<24.51		2.90	0.22	282.20	28.22	74.77	4.11	121.10	5.45
FS-2060	0.66	0.10	11.78	2.20	6.02	0.42	624.10	273.36	93.50	4.58	81.49	3.83
FS-2061	<0.25		<11.99		2.85	0.21	291.70	43.76	50.51	2.83	78.52	3.45
FS-2062	1.10	0.12	<28.19		8.14	0.54	640.60	49.97	52.40	3.04	99.30	4.57
FS-2063	<0.27		<51.37		4.03	0.30	618.50	40.20	31.70	1.87	72.68	3.42
FS-2064	0.65	0.11	<16.16		4.00	0.27	349.30	66.37	46.21	2.40	78.98	3.55
FS-2065	0.83	0.10	12.18	2.13	7.22	0.41	335.70	33.91	54.85	3.13	102.60	4.72
FS-2066	0.75	0.09	<12.25		3.57	0.21	651.10	39.07	38.08	1.94	69.78	3.21
FS-2067	0.94	0.09	<13.80		6.78	0.47	292.30	74.29	46.34	2.36	128.80	5.67
FS-2068	0.97	0.09	<16.56		6.84	0.41	596.30	40.15	37.01	1.92	72.10	3.32
FS-2070	<0.30		<15.77		2.19	0.16	124.80	24.84	56.91	3.07	99.36	4.37
FS-2071	1.59	0.12	<18.59		10.08	0.65	396.30	52.71	32.58	1.86	63.16	3.16
FS-2072	1.44	0.11	4.05	1.39	10.71	0.61	377.20	50.92	33.50	1.94	79.26	3.88
FS-2073	0.32	0.08	<13.90		4.14	0.40	254.30	112.65	50.96	2.85	92.79	4.08
FS-2074	<0.48		<25.82		2.67	0.16	126.00	19.66	51.18	3.02	99.17	4.46
FS-2075	<0.31		<27.51		3.26	0.20	414.10	54.25	43.21	2.29	73.80	3.39
FS-2076	0.65	0.09	<36.97		8.72	0.66	139.80	32.01	78.22	4.22	161.80	7.12
FS-2077	<0.34		<14.91		2.90	0.18	163.90	61.46	36.53	2.30	69.09	3.18
FS-2078	<0.25		<25.68		4.27	0.29	234.60	29.09	44.92	2.34	90.41	4.16
FS-2079	<0.25		<14.73		4.08	0.32	235.10	35.03	45.96	2.67	82.45	3.63

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	Nd	Standard Deviation	Sm	Standard Deviation	Eu	Standard Deviation	Tb	Standard Deviation	Dy	Standard Deviation	Yb	Standard Deviation
FS-2059	61.31	5.27	11.28	0.52	0.79	0.05	1.35	0.14	6.88	0.70	4.88	0.35
FS-2060	71.68	6.02	12.55	0.58	2.15	0.09	1.96	0.18	10.38	0.79	5.14	0.29
FS-2061	31.27	3.35	5.47	0.25	0.51	0.04	0.72	0.07	4.24	0.39	2.13	0.45
FS-2062	42.69	4.35	9.79	0.45	1.45	0.08	1.25	0.12	7.26	0.89	5.87	0.35
FS-2063	23.71	2.77	3.64	0.17	0.68	0.04	0.54	0.05	3.21	0.30	2.22	0.17
FS-2064	6.68	1.50	5.24	0.24	0.77	0.06	0.68	0.08	2.68	0.38	3.52	0.68
FS-2065	39.12	3.99	6.30	0.30	0.94	0.05	0.68	0.08	4.20	0.38	2.84	0.22
FS-2066	28.14	2.93	5.13	0.25	1.08	0.07	0.76	0.07	4.64	0.74	3.08	0.25
FS-2067	35.50	4.33	6.02	0.28	1.06	0.06	0.82	0.10	4.77	0.46	3.19	0.27
FS-2068	26.47	2.71	5.56	0.26	1.04	0.06	0.70	0.07	4.25	0.42	3.31	0.20
FS-2070	45.47	4.37	6.18	0.28	0.25	0.05	0.99	0.09	4.96	0.51	3.65	0.35
FS-2071	21.85	2.73	4.57	0.22	0.70	0.06	0.59	0.08	3.74	0.37	3.02	0.20
FS-2072	23.54	3.60	3.93	0.19	0.61	0.05	0.67	0.08	3.59	0.31	2.59	0.28
FS-2073	55.81	5.13	5.70	0.26	0.62	0.04	0.77	0.08	5.33	0.50	3.29	0.57
FS-2074	43.43	3.91	8.09	0.38	0.24	0.02	1.07	0.10	5.89	0.51	4.38	0.31
FS-2075	35.22	3.31	4.92	0.22	0.95	0.06	0.57	0.07	3.38	0.55	1.33	0.21
FS-2076	54.48	5.72	10.66	0.50	1.00	0.07	1.16	0.11	4.29	0.85	3.15	0.58
FS-2077	33.59	3.22	6.38	0.30	0.30	0.04	0.96	0.09	3.40	0.38	3.76	0.23
FS-2078	44.49	4.00	6.61	0.32	0.37	0.05	1.37	0.16	7.30	1.12	4.36	0.25
FS-2079	34.85	4.32	6.85	0.32	0.28	0.05	1.45	0.15	8.72	1.79	5.08	0.62

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	Lu	Standard Deviation	Hf	Standard Deviation	Ta	Standard Deviation	W	Standard Deviation	Au	Standard Deviation	Hg	Standard Deviation
FS-2000	0.47	0.03	8.42	0.45	3.13	0.21	13.74	2.84	<0.01		<0.54	
FS-2000F	0.45	0.03	8.19	0.43	2.34	0.15	<6.95		<0.01		<0.74	
FS-2001	0.59	0.04	13.73	0.91	1.50	0.10	<4.71		<0.01		<0.51	
FS-2002	0.45	0.03	5.43	0.55	3.18	0.20	<13.21		<0.02		<0.93	
FS-2003	0.67	0.04	13.28	0.81	1.59	0.13	<5.57		<0.01		<0.84	
FS-2004	0.48	0.03	9.40	0.63	2.73	0.20	<5.76		<0.01		<0.63	
FS-2005	0.47	0.03	6.70	0.43	2.98	0.19	<11.86		<0.02		<0.92	
FS-2006	0.54	0.03	8.88	0.53	3.01	0.23	6.25	1.94	<0.01		<0.90	
FS-2007	0.42	0.03	7.68	0.40	2.87	0.24	<1.47		<0.01		<0.61	
FS-2008	0.51	0.03	10.60	0.78	2.24	0.15	<9.56		<0.01		<0.75	
FS-2009	0.55	0.03	11.80	0.68	1.86	0.16	<5.92		<0.01		<0.78	
FS-2010	0.56	0.04	8.93	0.43	3.17	0.21	<6.23		<0.01		<0.57	
FS-2011	0.57	0.03	9.74	0.67	3.37	0.24	13.26	5.69	<0.01		<0.45	
FS-2012	0.56	0.03	9.60	0.62	3.13	0.19	<9.70		<0.01		<0.67	
FS-2013	0.64	0.03	11.09	0.98	3.12	0.19	<6.20		<0.01		<0.72	
FS-2014F	0.30	0.03	7.45	0.31	2.26	0.15	<7.41		<0.01		<0.57	
FS-2015F	0.42	0.02	7.60	0.51	2.84	0.17	<9.97		<0.01		<0.50	
FS-2016F	0.42	0.02	8.68	0.52	2.49	0.15	<6.62		<0.01		<0.60	
FS-2017F	0.33	0.03	7.72	0.35	2.00	0.17	<6.62		<0.01		<0.54	
FS-2018F	0.49	0.03	8.26	0.63	2.47	0.18	12.99	3.68	<0.02		<0.74	
FS-2019F	0.48	0.03	9.23	0.36	2.46	0.16	8.72	2.18	<0.01		<0.71	
FS-2020F	0.42	0.03	8.82	0.57	2.27	0.16	<8.17		<0.01		<0.48	
FS-2021	0.57	0.03	10.85	0.74	3.02	0.20	<10.26		<0.01		<0.60	
FS-2022	0.66	0.04	11.62	0.73	3.15	0.21	5.47	2.08	<0.01		<0.85	
FS-2023	0.64	0.04	9.13	0.68	3.06	0.24	<6.54		<0.01		<0.52	
FS-2026	0.30	0.03	10.22	0.76	2.46	0.22	<6.39		<0.01		<0.60	
FS-2027	0.47	0.03	14.60	1.05	1.69	0.12	<8.43		<0.01		<0.70	
FS-2028	0.58	0.04	11.94	0.69	2.06	0.17	<6.02		<0.01		<0.91	
FS-2029	0.22	0.04	5.76	0.33	1.91	0.13	<5.80		<0.01		<0.78	
FS-2030	0.45	0.03	6.98	0.38	2.78	0.17	6.28	2.29	<0.01		<0.85	
FS-2031	0.48	0.03	13.02	0.82	1.87	0.14	2.82	0.87	<0.01		<0.75	
FS-2032	0.47	0.03	13.72	1.26	1.50	0.14	<5.36		<0.01		<0.50	
FS-2033	0.44	0.03	9.59	0.62	2.66	0.17	<9.68		<0.01		<0.93	
FS-2034	0.58	0.03	11.69	0.78	2.02	0.12	<5.89		0.02		<0.79	
FS-2035	0.50	0.03	15.90	1.19	1.53	0.13	<7.21		<0.01		<0.56	
FS-2037	0.57	0.04	15.71	1.04	1.71	0.12	<5.92		0.04		<0.76	
FS-2038	0.27	0.03	5.06	0.31	1.51	0.11	<5.67		<0.01		<0.58	
FS-2039	0.57	0.04	8.40	0.71	2.53	0.17	<13.06		<0.01		<0.70	
FS-2040	0.44	0.03	8.40	0.46	2.84	0.20	<7.75		<0.01		<0.87	
FS-2041	0.45	0.04	7.30	0.39	2.74	0.19	<5.72		<0.01		<0.63	
FS-2042	0.51	0.03	15.93	1.55	1.53	0.10	<10.34		<0.01		<0.65	
FS-2043	0.30	0.03	7.47	0.38	2.33	0.20	7.23	1.21	<0.01		<0.59	
FS-2044	0.44	0.03	11.03	0.84	2.06	0.13	2.13	0.51	<0.01		<0.75	
FS-2045	0.58	0.03	18.56	1.02	1.62	0.11	8.53	2.58	<0.01		<0.73	
FS-2046	0.39	0.03	7.93	0.39	2.26	0.17	2.96	0.73	<0.01		<0.81	
FS-2048	0.46	0.03	7.49	0.49	2.94	0.19	2.02	0.66	<0.01		<0.87	
FS-2049	0.41	0.03	9.50	0.37	2.56	0.22	<3.91		<0.01		<0.54	
FS-2050	0.46	0.03	11.18	0.79	1.86	0.12	<5.83		<0.01		<0.76	
FS-2051	0.50	0.03	8.12	0.50	2.89	0.21	3.19	0.69	<0.01		<0.87	
FS-2052	0.46	0.03	14.97	1.30	1.58	0.13	<3.61		<0.01		<0.44	
FS-2053	0.57	0.03	16.79	1.23	1.78	0.11	<6.08		<0.01		<0.68	
FS-2054	0.49	0.03	8.48	0.47	2.59	0.18	2.22	0.64	<0.01		<0.83	
FS-2055	0.29	0.02	13.69	0.79	1.27	0.09	<3.98		<0.01		<0.50	
FS-2056	0.54	0.03	11.32	0.80	1.93	0.13	<6.41		<0.01		<0.80	
FS-2057	0.51	0.03	11.03	0.63	1.96	0.14	<4.01		<0.01		<0.67	

	Lu	Standard Deviation	Hf	Standard Deviation	Ta	Standard Deviation	W	Standard Deviation	Au	Standard Deviation	Hg	Standard Deviation
FS-2059	0.52	0.03	10.35	0.72	2.83	0.19	17.07	2.34	<0.02		<0.70	
FS-2060	0.75	0.04	6.40	0.39	1.88	0.15	<4.61		<0.01		<0.96	
FS-2061	0.38	0.03	6.32	0.38	1.84	0.16	<4.32		0.04		<0.41	
FS-2062	0.68	0.04	13.73	0.80	2.48	0.16	<7.30		<0.01		<1.01	
FS-2063	0.36	0.02	4.16	0.21	2.51	0.16	<4.75		<0.01		<0.74	
FS-2064	0.31	0.03	10.06	0.64	2.23	0.19	<4.80		<0.01		<0.51	
FS-2065	0.42	0.03	9.64	0.54	2.93	0.21	3.99	1.88	<0.01		<0.89	
FS-2066	0.55	0.03	15.45	1.00	1.75	0.12	<4.13		<0.01		<0.73	
FS-2067	0.32	0.03	10.04	0.54	1.94	0.15	1.62	0.50	<0.01		<0.63	
FS-2068	0.46	0.03	10.29	0.62	2.25	0.15	<4.91		<0.01		<0.82	
FS-2070	0.49	0.03	7.64	0.47	3.23	0.23	<5.71		<0.01		<0.34	
FS-2071	0.36	0.04	5.77	0.64	1.92	0.16	2.51	0.48	<0.01		<1.26	
FS-2072	0.43	0.04	5.93	0.46	1.95	0.14	2.89	1.01	<0.01		<1.37	
FS-2073	0.47	0.03	9.80	0.59	2.50	0.24	<4.87		<0.01		<0.49	
FS-2074	0.51	0.03	7.29	0.39	3.41	0.20	<9.91		<0.02		<0.50	
FS-2075	0.23	0.02	6.74	0.42	1.55	0.12	<5.81		<0.01		<0.72	
FS-2076	0.31	0.03	7.33	0.31	1.77	0.16	2.42	0.69	0.02		<0.75	
FS-2077	0.47	0.03	6.21	0.39	3.55	0.22	<7.99		<0.01		<0.50	
FS-2078	0.68	0.04	7.49	0.41	5.42	0.35	<5.75		<0.01		<0.62	
FS-2079	0.64	0.04	7.65	0.39	5.67	0.39	2.81	0.67	<0.01		<0.44	

	Th	Standard Deviation	U	Standard Deviation	Be	Standard Deviation	Cd	Standard Deviation	Pb	Standard Deviation
FS-2000	14.00	0.74	3.61	0.13	2.10	0.40	<1.00		26.50	2.00
FS-2000F	13.30	0.64	3.26	0.12	2.10	0.40	<1.00		26.50	2.00
FS-2001	15.08	0.65	3.33	0.12	2.00	0.40	<1.00		25.00	2.00
FS-2002	23.23	1.72	4.91	0.19	2.85	0.50	<1.00		26.00	3.00
FS-2003	13.68	0.57	3.92	0.14	2.00	0.40	<1.00		27.00	3.00
FS-2004	22.35	1.30	3.10	0.12	2.00	0.30	<1.00		24.50	2.00
FS-2005	18.39	0.72	3.90	0.15	2.45	0.50	<1.00		26.60	2.70
FS-2006	19.42	0.81	3.93	0.15	2.60	0.50	1.70	0.80	25.90	2.50
FS-2007	22.21	0.87	4.36	0.16	2.40	0.40	<1.00		28.00	3.00
FS-2008	16.23	0.63	3.45	0.13	2.10	0.40	<1.00		22.00	2.00
FS-2009	14.12	0.59	3.21	0.12	2.70	0.50	<1.00		32.00	3.00
FS-2010	19.64	0.84	3.55	0.13	2.70	0.50	<1.00		32.00	3.00
FS-2011	18.87	1.04	3.56	0.13	1.00	0.20	<1.00		<14.00	
FS-2012	16.46	0.64	3.51	0.13	2.60	0.50	<1.00		26.00	3.00
FS-2013	17.64	0.72	3.49	0.13	2.40	0.50	<1.00		25.00	2.00
FS-2014F	13.17	0.63	2.94	0.12	1.80	0.40	<1.00		22.00	2.00
FS-2015F	12.24	0.48	3.30	0.12	2.30	0.40	<1.00		24.00	2.00
FS-2016F	12.62	0.53	2.84	0.10	2.10	0.40	<1.00		28.00	3.00
FS-2017F	12.95	0.53	2.65	0.10	2.30	0.40	<1.00		25.00	2.00
FS-2018F	12.48	0.50	4.25	0.16	2.40	0.40	<1.00		56.00	6.00
FS-2019F	13.85	0.58	3.05	0.11	1.90	0.40	<1.00		28.00	3.00
FS-2020F	12.20	0.53	2.81	0.10	1.80	0.40	1.60	0.80	26.00	2.00
FS-2021	15.06	0.59	3.66	0.13	2.60	0.50	<1.00		21.00	2.00
FS-2022	17.38	0.82	4.20	0.16	2.70	0.50	<1.00		26.00	3.00
FS-2023	18.81	0.81	3.77	0.14	3.40	0.60	<1.00		29.00	3.00
FS-2026	16.77	0.69	2.54	0.10	2.50	0.50	<1.00		29.00	3.00
FS-2027	13.66	1.60	3.45	0.13	1.60	0.30	<1.00		30.00	3.00
FS-2028	17.96	0.77	3.19	0.12	2.30	0.40	<1.00		33.00	3.00
FS-2029	17.18	0.69	2.17	0.09	3.30	0.70	<1.00		23.00	2.00
FS-2030	16.34	0.64	4.79	0.18	2.40	0.50	<1.00		26.00	3.00
FS-2031	14.62	0.66	2.96	0.11	1.70	0.30	<1.00		25.00	2.00
FS-2032	13.03	0.52	3.46	0.13	1.80	0.40	<1.00		25.00	2.00
FS-2033	17.16	0.67	2.19	0.08	3.00	0.60	<1.00		29.00	3.00
FS-2034	15.56	0.61	3.09	0.11	2.00	0.40	<1.00		30.00	3.00
FS-2035	12.74	0.51	3.43	0.12	1.55	0.30	<1.00		26.50	3.00
FS-2037	13.84	0.58	3.59	0.13	1.50	0.30	<1.00		25.00	2.00
FS-2038	12.40	0.50	3.47	0.13	2.20	0.40	<1.00		21.00	2.00
FS-2039	13.14	0.57	2.92	0.11	2.10	0.40	<1.00		26.00	3.00
FS-2040	16.84	0.67	2.74	0.10	2.30	0.40	<1.00		28.00	3.00
FS-2041	20.04	0.88	3.51	0.13	2.80	0.60	<1.00		25.00	2.00
FS-2042	11.05	0.70	3.57	0.13	1.40	0.30	<1.00		<14.00	
FS-2043	18.10	1.00	2.36	0.09	3.10	0.60	<1.00		34.00	3.00
FS-2044	14.35	0.56	3.21	0.12	2.20	0.40	<1.00		28.00	3.00
FS-2045	13.53	0.57	3.84	0.14	1.00	0.20	<1.00		20.00	2.00
FS-2046	19.91	0.82	2.52	0.09	3.90	0.70	1.20	0.80	35.00	3.00
FS-2048	19.96	0.78	3.57	0.13	2.95	0.60	<1.00		25.50	2.50
FS-2049	19.27	0.81	3.64	0.13	3.00	0.60	<1.00		32.00	3.00
FS-2050	12.72	0.50	3.28	0.12	1.90	0.40	<1.00		26.00	3.00
FS-2051	19.93	0.78	3.48	0.13	3.20	0.60	<1.00		30.00	3.00
FS-2052	12.52	0.55	3.81	0.13	1.40	0.30	<1.00		25.00	2.00
FS-2053	12.80	0.50	3.67	0.13	1.60	0.30	<1.00		23.00	2.00
FS-2054	17.20	0.67	3.96	0.14	2.00	0.40	<1.00		44.00	4.00
FS-2055	10.46	0.42	3.56	0.13	1.10	0.20	<1.00		33.00	3.00
FS-2056	14.82	0.58	2.89	0.10	2.10	0.40	<1.00		30.00	3.00
FS-2057	15.28	0.68	3.12	0.12	1.95	0.40	<1.00		27.00	2.00

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	Th	Standard Deviation	U	Standard Deviation	Be	Standard Deviation	Cd	Standard Deviation	Pb	Standard Deviation
FS-2059	13.56	1.30	3.14	0.12	2.30	0.50	<1.00		29.00	3.00
FS-2060	14.79	0.64	2.99	0.11	2.60	0.50	<1.00		23.00	2.00
FS-2061	11.79	0.46	2.18	0.08	2.20	0.40	<1.00		24.00	2.00
FS-2062	18.01	0.74	3.72	0.14	2.70	0.50	<1.00		32.00	3.00
FS-2063	17.56	0.68	3.07	0.11	3.30	0.60	<1.00		29.00	3.00
FS-2064	15.76	0.88	3.70	0.14	2.20	0.40	<1.00		21.50	2.00
FS-2065	17.91	0.70	2.28	0.09	1.95	0.40	<1.00		28.50	3.00
FS-2066	13.31	0.52	3.58	0.13	1.60	0.30	<1.00		25.00	2.00
FS-2067	18.29	0.80	3.41	0.13	3.00	0.60	<1.00		38.00	4.00
FS-2068	15.52	0.61	3.29	0.12	2.20	0.40	<1.00		35.00	4.00
FS-2070	15.22	0.67	3.47	0.13	2.40	0.50	<1.00		18.00	2.00
FS-2071	17.03	0.66	2.50	0.10	2.00	0.40	<1.00		20.00	2.00
FS-2072	19.26	0.79	2.62	0.10	4.30	0.90	<1.00		41.00	4.00
FS-2073	17.99	0.77	3.85	0.14	2.30	0.50	<1.00		26.00	3.00
FS-2074	14.58	0.71	3.51	0.13	2.20	0.40	<1.00		19.00	2.00
FS-2075	10.09	0.39	1.54	0.06	1.60	0.30	<1.00		27.00	3.00
FS-2076	27.30	1.06	3.21	0.12	3.90	0.80	<1.00		42.00	4.00
FS-2077	14.17	0.55	4.34	0.15	3.20	0.60	<1.00		34.00	3.00
FS-2078	20.88	0.88	5.77	0.20	4.30	0.90	<1.00		30.00	3.00
FS-2079	23.01	1.08	6.73	0.24	4.40	0.90	<1.00		56.00	6.00

	Th	Standard Deviation	U	Standard Deviation	Be	Standard Deviation	Cd	Standard Deviation	Pb	Standard Deviation
FS-2059	13.54	1.30	3.14	0.12	2.30	0.50	<1.00		29.00	3.00
FS-2060	14.79	0.64	2.98	0.11	2.40	0.50	<1.00		23.00	2.00
FS-2061	11.19	0.48	2.18	0.08	2.20	0.40	<1.00		24.00	2.00
FS-2062	18.01	0.14	3.72	0.14	2.70	0.50	<1.00		32.00	3.00
FS-2063	17.56	0.68	3.07	0.11	3.30	0.60	<1.00		29.00	3.00
FS-2064	15.76	0.88	3.70	0.14	2.20	0.40	<1.00		21.50	2.00
FS-2065	17.91	0.70	2.28	0.09	1.95	0.40	<1.00		28.50	3.00
FS-2066	13.31	0.52	3.58	0.13	1.60	0.30	<1.00		25.00	2.00
FS-2067	18.29	0.80	3.41	0.13	3.00	0.60	<1.00		38.00	4.00
FS-2068	15.52	0.61	3.29	0.12	2.20	0.40	<1.00		35.00	4.00
FS-2070	15.22	0.67	3.47	0.13	2.40	0.50	<1.00		18.00	2.00
FS-2071	17.03	0.66	2.50	0.10	2.00	0.40	<1.00		20.00	2.00
FS-2072	19.26	0.79	2.62	0.10	4.30	0.90	<1.00		41.00	4.00
FS-2073	17.99	0.77	3.85	0.14	2.30	0.50	<1.00		26.00	3.00
FS-2074	14.58	0.71	3.51	0.13	2.20	0.40	<1.00		19.00	2.00
FS-2075	10.09	0.39	1.54	0.06	1.60	0.30	<1.00		27.00	3.00
FS-2076	27.30	1.06	3.21	0.12	3.90	0.80	<1.00		42.00	4.00
FS-2077	14.17	0.55	4.34	0.15	3.20	0.60	<1.00		34.00	3.00
FS-2078	20.88	0.88	5.77	0.20	4.30	0.90	<1.00		30.00	3.00
FS-2079	23.01	1.08	6.73	0.24	4.40	0.90	<1.00		56.00	6.00

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Appendix B

Results of Soil Analyses Using EPA/SW846 Methods

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REPORT NUMBER: 22725

********** EM-9 ANALYTICAL REPORT **********

Prepared by: MKOBY on 8-Feb-1994

REQUEST NUMBER: 15463 MATRIX: SS ANALYST: MET PROGRAM CODE: M702

OWNER: Pat A. Longmire GROUP: CST-10 MAIL-STOP: C346 PHONE: 5-6493

NOTEBOOK: R8149 PAGE: 259

CUSTOMER SAMPLES:

CUSTOMER NUM	SAMPLE NUM	ANALYSIS	ANALYTICAL TECHNIQUE	ANALYTICAL RESULT	ANALYTICAL UNCERTAINTY	UNITS	COMPLETION DATE	COMMENT
FS2000	93.16797	AL	ICPES	6500.	650.	UG/G	9/09/93	08275HA
FS2000	93.16797	AS	ETVAA	1.8	0.4	UG/G	9/07/93	
FS2000	93.16797	BA	ICPES	160.	16.	UG/G	9/09/93	08275HA
FS2000	93.16797	BE	ICPES	0.69	0.07	UG/G	9/09/93	08275HA
FS2000	93.16797	CA	ICPES	4500.	450.	UG/G	9/09/93	08275HA
FS2000	93.16797	CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2000	93.16797	CL	IC	17.6	1.8	UG/G	9/10/93	
FS2000	93.16797	CO	ICPES	10.	1.	UG/G	9/09/93	08275HA
FS2000	93.16797	CR	ICPES	4.6	0.5	UG/G	9/09/93	08275HA
FS2000	93.16797	CU	ICPES	5.5	0.6	UG/G	9/09/93	08275HA
FS2000	93.16797	FE	ICPES	9300.	930.	UG/G	9/09/93	08275HA
FS2000	93.16797	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2000	93.16797	K	ICPES	1300.	130.	UG/G	9/09/93	08275HA
FS2000	93.16797	MG	ICPES	1200.	120.	UG/G	9/09/93	08275HA
FS2000	93.16797	MN	ICPES	1100.	110.	UG/G	9/09/93	08275HA
FS2000	93.16797	NA	ICPES	200.	20.	UG/G	9/09/93	08275HA
FS2000	93.16797	NI	ICPES	5.6	0.6	UG/G	9/09/93	08275HA
FS2000	93.16797	PB	ICPES	12.	2.	UG/G	9/09/93	08275HA
FS2000	93.16797	SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2000	93.16797	SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2000	93.16797	SO4	IC	23.	2.3	UG/G	11/19/93	
FS2000	93.16797	TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2000	93.16797	TH	ICPMS	5.	0.3	UG/G	10/19/93	08275LA
FS2000	93.16797	TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2000	93.16797	U	ICPMS	0.6	0.2	UG/G	10/19/93	08275LA
FS2000	93.16797	V	ICPES	10.	1.	UG/G	9/09/93	08275HA
FS2000	93.16797	ZN	ICPES	58.	6.	UG/G	9/09/93	08275HA
FS2001	93.16798	AL	ICPES	12000.	1200.	UG/G	9/09/93	08275HA
FS2001	93.16798	AS	ETVAA	5.1	1.	UG/G	9/07/93	
FS2001	93.16798	BA	ICPES	150.	15.	UG/G	9/09/93	08275HA
FS2001	93.16798	BE	ICPES	0.93	0.09	UG/G	9/09/93	08275HA
FS2001	93.16798	CA	ICPES	2100.	210.	UG/G	9/09/93	08275HA
FS2001	93.16798	CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2001	93.16798	CL	IC	16.3	1.6	UG/G	9/10/93	
FS2001	93.16798	CO	ICPES	15.	2.	UG/G	9/09/93	08275HA
FS2001	93.16798	CR	ICPES	10.	1.	UG/G	9/09/93	08275HA
FS2001	93.16798	CU	ICPES	8.3	0.8	UG/G	9/09/93	08275HA

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FS2001	93.16798 FE	ICPES	14000.	1400.	UG/G	9/09/93	08275HA
FS2001	93.16798 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2001	93.16798 K	ICPES	2400.	240.	UG/G	9/09/93	08275HA
FS2001	93.16798 MG	ICPES	2700.	270.	UG/G	9/09/93	08275HA
FS2001	93.16798 MN	ICPES	400.	40.	UG/G	9/09/93	08275HA
FS2001	93.16798 NA	ICPES	350.	35.	UG/G	9/09/93	08275HA
FS2001	93.16798 NI	ICPES	10.	1.	UG/G	9/09/93	08275HA
FS2001	93.16798 PB	ICPES	13.	4.	UG/G	9/09/93	08275HA
FS2001	93.16798 SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2001	93.16798 SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2001	93.16798 SO4	IC	32.	3.2	UG/G	11/19/93	
FS2001	93.16798 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2001	93.16798 TH	ICPMS	8.	1.	UG/G	10/19/93	08275LA
FS2001	93.16798 TL	ICPMS	0.2	0.2	UG/G	10/19/93	08275LA
FS2001	93.16798 U	ICPMS	0.8	0.2	UG/G	10/19/93	08275LA
FS2001	93.16798 V	ICPES	26.	3.	UG/G	9/09/93	08275HA
FS2001	93.16798 ZN	ICPES	48.	5.	UG/G	9/09/93	08275HA
FS2002	93.16799 AL	ICPES	13000.	1300.	UG/G	9/09/93	08275HA
FS2002	93.16799 AS	ETVAA	3.1	0.6	UG/G	9/07/93	
FS2002	93.16799 BA	ICPES	120.	12.	UG/G	9/09/93	08275HA
FS2002	93.16799 BE	ICPES	0.8	0.08	UG/G	9/09/93	08275HA
FS2002	93.16799 CA	ICPES	2800.	280.	UG/G	9/09/93	08275HA
FS2002	93.16799 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2002	93.16799 CL	IC	303.	30.	UG/G	9/10/93	
FS2002	93.16799 CO	ICPES	22.	2.	UG/G	9/09/93	08275HA
FS2002	93.16799 CR	ICPES	8.	0.8	UG/G	9/09/93	08275HA
FS2002	93.16799 CU	ICPES	3.	0.3	UG/G	9/09/93	08275HA
FS2002	93.16799 FE	ICPES	8400.	840.	UG/G	9/09/93	08275HA
FS2002	93.16799 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2002	93.16799 K	ICPES	2200.	220.	UG/G	9/09/93	08275HA
FS2002	93.16799 MG	ICPES	1800.	180.	UG/G	9/09/93	08275HA
FS2002	93.16799 MN	ICPES	100.	10.	UG/G	9/09/93	08275HA
FS2002	93.16799 NA	ICPES	1700.	170.	UG/G	9/09/93	08275HA
FS2002	93.16799 NI	ICPES	8.	1.	UG/G	9/09/93	08275HA
FS2002	93.16799 PB	ICPES	< 4.		UG/G	9/09/93	08275HA
FS2002	93.16799 SB	ICPES	< 5.		UG/G	9/09/93	08275LA
FS2002	93.16799 SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2002	93.16799 SO4	IC	446.	45.	UG/G	11/19/93	
FS2002	93.16799 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2002	93.16799 TH	ICPMS	5.	0.2	UG/G	10/19/93	08275LA
FS2002	93.16799 TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2002	93.16799 U	ICPMS	0.6	0.2	UG/G	10/19/93	08275LA
FS2002	93.16799 V	ICPES	17.	2.	UG/G	9/09/93	08275HA
FS2002	93.16799 ZN	ICPES	21.	2.	UG/G	9/09/93	08275HA
FS2003	93.16800 AL	ICPES	21000.	2100.	UG/G	9/09/93	08275HA
FS2003	93.16800 AS	ETVAA	5.9	1.1	UG/G	9/07/93	
FS2003	93.16800 BA	ICPES	220.	22.	UG/G	9/09/93	08275HA
FS2003	93.16800 BE	ICPES	1.5	0.2	UG/G	9/09/93	08275HA
FS2003	93.16800 CA	ICPES	2200.	220.	UG/G	9/09/93	08275HA
FS2003	93.16800 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2003	93.16800 CL	IC	17.6	1.8	UG/G	9/10/93	
FS2003	93.16800 CO	ICPES	11.	1.	UG/G	9/09/93	08275HA
FS2003	93.16800 CR	ICPES	17.	2.	UG/G	9/09/93	08275HA
FS2003	93.16800 CU	ICPES	11.	1.	UG/G	9/09/93	08275HA
FS2003	93.16800 FE	ICPES	19000.	1900.	UG/G	9/09/93	08275HA
FS2003	93.16800 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2003	93.16800 K	ICPES	3600.	360.	UG/G	9/09/93	08275HA
FS2003	93.16800 MG	ICPES	3600.	360.	UG/G	9/09/93	08275HA
FS2003	93.16800 MN	ICPES	460.	46.	UG/G	9/09/93	08275HA
FS2003	93.16800 NA	ICPES	520.	52.	UG/G	9/09/93	08275HA

FS2003	93.16800	NI	ICPES	14.	1.	UG/G	9/09/93	08275HA
FS2003	93.16800	PB	ICPES	15.	4.	UG/G	9/09/93	08275HA
FS2003	93.16800	SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2003	93.16800	SE	ETVAA	0.36	0.3	UG/G	9/07/93	
FS2003	93.16800	SO4	IC	52.	5.2	UG/G	11/19/93	
FS2003	93.16800	TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2003	93.16800	TH	ICPMS	8.	0.2	UG/G	10/19/93	08275LA
FS2003	93.16800	TL	ICPMS	0.4	0.2	UG/G	10/19/93	08275LA
FS2003	93.16800	U	ICPMS	1.6	0.3	UG/G	10/19/93	08275LA
FS2003	93.16800	V	ICPES	36.	4.	UG/G	9/09/93	08275HA
FS2003	93.16800	ZN	ICPES	48.	5.	UG/G	9/09/93	08275HA
FS2004	93.16801	AL	ICPES	30000.	3000.	UG/G	9/09/93	08275HA
FS2004	93.16801	AS	ETVAA	5.7	1.1	UG/G	9/07/93	
FS2004	93.16801	BA	ICPES	290.	29.	UG/G	9/09/93	08275HA
FS2004	93.16801	BE	ICPES	1.7	0.2	UG/G	9/09/93	08275HA
FS2004	93.16801	CA	ICPES	4200.	420.	UG/G	9/09/93	08275HA
FS2004	93.16801	CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2004	93.16801	CL	IC	30.4	3.	UG/G	9/10/93	
FS2004	93.16801	CO	ICPES	14.	1.	UG/G	9/09/93	08275HA
FS2004	93.16801	CR	ICPES	16.	2.	UG/G	9/09/93	08275HA
FS2004	93.16801	CU	ICPES	5.4	0.5	UG/G	9/09/93	08275HA
FS2004	93.16801	FE	ICPES	19000.	1900.	UG/G	9/09/93	08275HA
FS2004	93.16801	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2004	93.16801	K	ICPES	3700.	370.	UG/G	9/09/93	08275HA
FS2004	93.16801	MG	ICPES	3400.	340.	UG/G	9/09/93	08275HA
FS2004	93.16801	MN	ICPES	310.	31.	UG/G	9/09/93	08275HA
FS2004	93.16801	NA	ICPES	520.	52.	UG/G	9/09/93	08275HA
FS2004	93.16801	NI	ICPES	13.	1.	UG/G	9/09/93	08275HA
FS2004	93.16801	PB	ICPES	20.	4.	UG/G	9/09/93	08275HA
FS2004	93.16801	SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2004	93.16801	SE	ETVAA	0.8	0.3	UG/G	9/07/93	
FS2004	93.16801	SO4	IC	54.	5.4	UG/G	11/19/93	
FS2004	93.16801	TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2004	93.16801	TH	ICPMS	8.	0.4	UG/G	10/19/93	08275LA
FS2004	93.16801	TL	ICPMS	0.2	0.2	UG/G	10/19/93	08275LA
FS2004	93.16801	U	ICPMS	0.6	0.2	UG/G	10/19/93	08275LA
FS2004	93.16801	V	ICPES	36.	4.	UG/G	9/09/93	08275HA
FS2004	93.16801	ZN	ICPES	42.	4.	UG/G	9/09/93	08275HA
FS2005	93.16802	AL	ICPES	23000.	2300.	UG/G	9/09/93	08275HA
FS2005	93.16802	AS	ETVAA	4.8	1.	UG/G	9/07/93	
FS2005	93.16802	BA	ICPES	250.	25.	UG/G	9/09/93	08275HA
FS2005	93.16802	BE	ICPES	1.2	0.1	UG/G	9/09/93	08275HA
FS2005	93.16802	CA	ICPES	7500.	750.	UG/G	9/09/93	08275HA
FS2005	93.16802	CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2005	93.16802	CL	IC	56.5	5.6	UG/G	9/10/93	
FS2005	93.16802	CO	ICPES	19.	2.	UG/G	9/09/93	08275HA
FS2005	93.16802	CR	ICPES	12.	1.	UG/G	9/09/93	08275HA
FS2005	93.16802	CU	ICPES	3.6	0.4	UG/G	9/09/93	08275HA
FS2005	93.16802	FE	ICPES	14000.	1400.	UG/G	9/09/93	08275HA
FS2005	93.16802	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2005	93.16802	K	ICPES	2900.	290.	UG/G	9/09/93	08275HA
FS2005	93.16802	MG	ICPES	2700.	2700.	UG/G	9/09/93	08275HA
FS2005	93.16802	MN	ICPES	210.	21.	UG/G	9/09/93	08275HA
FS2005	93.16802	NA	ICPES	1000.	100.	UG/G	9/09/93	08275HA
FS2005	93.16802	NI	ICPES	11.	1.	UG/G	9/09/93	08275HA
FS2005	93.16802	PB	ICPES	10.	2.	UG/G	9/09/93	08275HA
FS2005	93.16802	SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2005	93.16802	SE	ETVAA	0.5	0.3	UG/G	9/07/93	
FS2005	93.16802	SO4	IC	143.	14.	UG/G	11/19/93	
FS2005	93.16802	TA	ICPMS	< 0.2		UG/G	10/19/93	08275L

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FS2005	93.16802	TH	ICPMS	6.	0.3	UG/G	10/19/93	08275LA
FS2005	93.16802	TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2005	93.16802	U	ICPMS	0.6	0.2	UG/G	10/19/93	08275LA
FS2005	93.16802	V	ICPES	30.	3.	UG/G	9/09/93	08275HA
FS2005	93.16802	ZN	ICPES	32.	3.	UG/G	9/09/93	08275HA
FS2006	93.16803	AL	ICPES	31000.	3100.	UG/G	9/09/93	08275HA
FS2006	93.16803	AS	ETVAA	5.9	1.2	UG/G	9/07/93	
FS2006	93.16803	BA	ICPES	340.	34.	UG/G	9/09/93	08275HA
FS2006	93.16803	BE	ICPES	1.6	0.2	UG/G	9/09/93	08275HA
FS2006	93.16803	CA	ICPES	3800.	380.	UG/G	9/09/93	08275HA
FS2006	93.16803	CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2006	93.16803	CL	IC	13.3	1.3	UG/G	9/10/93	
FS2006	93.16803	CO	ICPES	11.	1.	UG/G	9/09/93	08275HA
FS2006	93.16803	CR	ICPES	15.	2.	UG/G	9/09/93	08275HA
FS2006	93.16803	CU	ICPES	6.4	0.6	UG/G	9/09/93	08275HA
FS2006	93.16803	FE	ICPES	19000.	1900.	UG/G	9/09/93	08275HA
FS2006	93.16803	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2006	93.16803	K	ICPES	3300.	330.	UG/G	9/09/93	08275HA
FS2006	93.16803	MG	ICPES	4000.	400.	UG/G	9/09/93	08275HA
FS2006	93.16803	MN	ICPES	300.	30.	UG/G	9/09/93	08275HA
FS2006	93.16803	MO	ICPES	470.	47.	UG/G	9/09/93	08275HA
FS2006	93.16803	NI	ICPES	12.	1.	UG/G	9/09/93	08275HA
FS2006	93.16803	PB	ICPES	14.	3.	UG/G	9/09/93	08275HA
FS2006	93.16803	SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2006	93.16803	SE	ETVAA	0.9	0.3	UG/G	9/07/93	
FS2006	93.16803	SO4	IC	79.	8.	UG/G	11/19/93	
FS2006	93.16803	TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2006	93.16803	TH	ICPMS	9.	0.4	UG/G	10/19/93	08275LA
FS2006	93.16803	TL	ICPMS	0.2	0.2	UG/G	10/19/93	08275LA
FS2006	93.16803	U	ICPMS	1.4	0.3	UG/G	10/19/93	08275LA
FS2006	93.16803	V	ICPES	34.	3.	UG/G	9/09/93	08275HA
FS2006	93.16803	ZN	ICPES	42.	4.	UG/G	9/09/93	08275HA
FS2007	93.16804	AL	ICPES	29000.	2900.	UG/G	9/09/93	08275HA
FS2007	93.16804	AS	ETVAA	4.8	1.	UG/G	9/07/93	
FS2007	93.16804	BA	ICPES	220.	22.	UG/G	9/09/93	08275HA
FS2007	93.16804	BE	ICPES	1.3	0.1	UG/G	9/09/93	08275HA
FS2007	93.16804	CA	ICPES	7800.	780.	UG/G	9/09/93	08275HA
FS2007	93.16804	CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2007	93.16804	CL	IC	16.6	1.7	UG/G	9/10/93	
FS2007	93.16804	CO	ICPES	16.	2.	UG/G	9/09/93	08275HA
FS2007	93.16804	CR	ICPES	13.	1.	UG/G	9/09/93	08275HA
FS2007	93.16804	CU	ICPES	4.7	0.5	UG/G	9/09/93	08275HA
FS2007	93.16804	FE	ICPES	16000.	1600.	UG/G	9/09/93	08275HA
FS2007	93.16804	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2007	93.16804	K	ICPES	3000.	300.	UG/G	9/09/93	08275HA
FS2007	93.16804	MG	ICPES	3400.	340.	UG/G	9/09/93	08275HA
FS2007	93.16804	MN	ICPES	220.	22.	UG/G	9/09/93	08275HA
FS2007	93.16804	MO	ICPES	990.	99.	UG/G	9/09/93	08275HA
FS2007	93.16804	NI	ICPES	12.	1.	UG/G	9/09/93	08275HA
FS2007	93.16804	PB	ICPES	10.	3.	UG/G	9/09/93	08275HA
FS2007	93.16804	SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2007	93.16804	SE	ETVAA	0.4	0.3	UG/G	9/07/93	
FS2007	93.16804	SO4	IC	117.	12.	UG/G	11/19/93	
FS2007	93.16804	TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2007	93.16804	TH	ICPMS	6.	0.3	UG/G	10/19/93	08275LA
FS2007	93.16804	TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2007	93.16804	U	ICPMS	1.3	0.3	UG/G	10/19/93	08275LA
FS2007	93.16804	V	ICPES	31.	3.	UG/G	9/09/93	08275HA
FS2007	93.16804	ZN	ICPES	36.	4.	UG/G	9/09/93	08275HA
FS2008	93.16805	AL	ICPES	16000.	1600.	UG/G	9/09/93	08275HA

FS2008	93.16805	AS	ETVAA	7.7	1.5	UG/G	9/07/93	
FS2008	93.16805	BA	ICPES	200.	20.	UG/G	9/09/93	08275HA
FS2008	93.16805	BE	ICPES	1.2	0.1	UG/G	9/09/93	08275HA
FS2008	93.16805	CA	ICPES	1900.	190.	UG/G	9/09/93	08275HA
FS2008	93.16805	CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2008	93.16805	CL	IC	12.1	1.2	UG/G	9/10/93	
FS2008	93.16805	CO	ICPES	21.	2.	UG/G	9/09/93	08275HA
FS2008	93.16805	CR	ICPES	11.	1.	UG/G	9/09/93	08275HA
FS2008	93.16805	CU	ICPES	7.4	0.7	UG/G	9/09/93	08275HA
FS2008	93.16805	FE	ICPES	16000.	1600.	UG/G	9/09/93	08275HA
FS2008	93.16805	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2008	93.16805	K	ICPES	2700.	270.	UG/G	9/09/93	08275HA
FS2008	93.16805	MG	ICPES	2400.	240.	UG/G	9/09/93	08275HA
FS2008	93.16805	MN	ICPES	1100.	110.	UG/G	9/09/93	08275HA
FS2008	93.16805	NA	ICPES	410.	41.	UG/G	9/09/93	08275HA
FS2008	93.16805	NI	ICPES	12.	1.	UG/G	9/09/93	08275HA
FS2008	93.16805	PB	ICPES	13.	3.	UG/G	9/09/93	08275HA
FS2008	93.16805	SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2008	93.16805	SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2008	93.16805	SO4	IC	23.	2.3	UG/G	11/19/93	
FS2008	93.16805	TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2008	93.16805	TH	ICPMS	9.	0.5	UG/G	10/19/93	08275LA
FS2008	93.16805	TL	ICPMS	0.5	0.2	UG/G	10/19/93	08275LA
FS2008	93.16805	U	ICPMS	0.9	0.2	UG/G	10/19/93	08275LA
FS2008	93.16805	V	ICPES	33.	3.	UG/G	9/09/93	08275HA
FS2008	93.16805	ZN	ICPES	45.	5.	UG/G	9/09/93	08275HA
FS2009	93.16806	AL	ICPES	14000.	1400.	UG/G	9/09/93	08275HA
FS2009	93.16806	AS	ETVAA	0.5	0.3	UG/G	9/07/93	
FS2009	93.16806	BA	ICPES	120.	12.	UG/G	9/09/93	08275HA
FS2009	93.16806	BE	ICPES	0.9	0.09	UG/G	9/09/93	08275HA
FS2009	93.16806	CA	ICPES	1900.	190.	UG/G	9/09/93	08275HA
FS2009	93.16806	CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2009	93.16806	CL	IC	12.2	1.2	UG/G	9/10/93	
FS2009	93.16806	CO	ICPES	8.7	0.9	UG/G	9/09/93	08275HA
FS2009	93.16806	CR	ICPES	12.	1.	UG/G	9/09/93	08275HA
FS2009	93.16806	CU	ICPES	9.4	0.9	UG/G	9/09/93	08275HA
FS2009	93.16806	FE	ICPES	10000.	1000.	UG/G	9/09/93	08275HA
FS2009	93.16806	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2009	93.16806	K	ICPES	2800.	280.	UG/G	9/09/93	08275HA
FS2009	93.16806	MG	ICPES	2700.	270.	UG/G	9/09/93	08275HA
FS2009	93.16806	MN	ICPES	110.	11.	UG/G	9/09/93	08275HA
FS2009	93.16806	NA	ICPES	220.	22.	UG/G	9/09/93	08275HA
FS2009	93.16806	NI	ICPES	6.5	0.7	UG/G	9/09/93	08275HA
FS2009	93.16806	PB	ICPES	13.	6.	UG/G	9/09/93	08275HA
FS2009	93.16806	SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2009	93.16806	SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2009	93.16806	SO4	IC	16.	1.6	UG/G	11/19/93	
FS2009	93.16806	TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2009	93.16806	TH	ICPMS	0.6	0.2	UG/G	10/19/93	08275LA
FS2009	93.16806	TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2009	93.16806	U	ICPMS	0.3	0.2	UG/G	10/19/93	08275LA
FS2009	93.16806	V	ICPES	17.	2.	UG/G	9/09/93	08275HA
FS2009	93.16806	ZN	ICPES	39.	4.	UG/G	9/09/93	08275HA
FS2010	93.16807	AL	ICPES	19000.	1900.	UG/G	9/09/93	08275HA
FS2010	93.16807	AS	ETVAA	5.	1.	UG/G	9/07/93	
FS2010	93.16807	BA	ICPES	140.	14.	UG/G	9/09/93	08275HA
FS2010	93.16807	BE	ICPES	1.3	0.1	UG/G	9/09/93	08275HA
FS2010	93.16807	CA	ICPES	3200.	320.	UG/G	9/09/93	08275HA
FS2010	93.16807	CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2010	93.16807	CL	IC	12.8	1.3	UG/G	9/10/93	

FS2010	93.16807 CO	ICPES	19.	2.	UG/G	9/09/93	08275HA
FS2010	93.16807 CR	ICPES	11.	1.	UG/G	9/09/93	08275HA
FS2010	93.16807 CU	ICPES	5.5	0.6	UG/G	9/09/93	08275HA
FS2010	93.16807 FE	ICPES	15000.	1500.	UG/G	9/09/93	08275HA
FS2010	93.16807 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2010	93.16807 K	ICPES	2800.	280.	UG/G	9/09/93	08275HA
FS2010	93.16807 MG	ICPES	2900.	290.	UG/G	9/09/93	08275HA
FS2010	93.16807 MN	ICPES	380.	38.	UG/G	9/09/93	08275HA
FS2010	93.16807 NA	ICPES	430.	43.	UG/G	9/09/93	08275HA
FS2010	93.16807 NI	ICPES	9.	2.	UG/G	9/09/93	08275HA
FS2010	93.16807 PB	ICPES	13.	2.	UG/G	9/09/93	08275HA
FS2010	93.16807 SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2010	93.16807 SE	ETVAA	0.3	0.3	UG/G	9/07/93	
FS2010	93.16807 SO4	IC	36.	3.6	UG/G	11/19/93	
FS2010	93.16807 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2010	93.16807 TH	ICPMS	9.	0.4	UG/G	10/19/93	08275LA
FS2010	93.16807 TL	ICPMS	0.2	0.2	UG/G	10/19/93	08275LA
FS2010	93.16807 U	ICPMS	0.9	0.2	UG/G	10/19/93	08275LA
FS2010	93.16807 V	ICPES	23.	2.	UG/G	9/09/93	08275HA
FS2010	93.16807 ZN	ICPES	57.	6.	UG/G	9/09/93	08275HA
FS2011	93.16808 AL	ICPES	15000.	1500.	UG/G	9/09/93	08275HA
FS2011	93.16808 AS	ETVAA	3.3	0.7	UG/G	9/07/93	
FS2011	93.16808 BA	ICPES	85.	9.	UG/G	9/09/93	08275HA
FS2011	93.16808 BE	ICPES	1.1	0.1	UG/G	9/09/93	08275HA
FS2011	93.16808 CA	ICPES	1900.	190.	UG/G	9/09/93	08275HA
FS2011	93.16808 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2011	93.16808 CL	IC	17.3	1.7	UG/G	9/10/93	
FS2011	93.16808 CO	ICPES	22.	2.	UG/G	9/09/93	08275HA
FS2011	93.16808 CR	ICPES	9.	1.	UG/G	9/09/93	08275HA
FS2011	93.16808 CU	ICPES	3.	0.3	UG/G	9/09/93	08275HA
FS2011	93.16808 FE	ICPES	12000.	1200.	UG/G	9/09/93	08275HA
FS2011	93.16808 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2011	93.16808 K	ICPES	2000.	200.	UG/G	9/09/93	08275HA
FS2011	93.16808 MG	ICPES	2100.	210.	UG/G	9/09/93	08275HA
FS2011	93.16808 MN	ICPES	320.	32.	UG/G	9/09/93	08275HA
FS2011	93.16808 NA	ICPES	240.	24.	UG/G	9/09/93	08275HA
FS2011	93.16808 NI	ICPES	6.	0.6	UG/G	9/09/93	08275HA
FS2011	93.16808 PB	ICPES	10.	1.	UG/G	9/09/93	08275HA
FS2011	93.16808 SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2011	93.16808 SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2011	93.16808 SO4	IC	32.	3.2	UG/G	11/19/93	
FS2011	93.16808 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2011	93.16808 TH	ICPMS	7.	0.3	UG/G	10/19/93	08275LA
FS2011	93.16808 TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2011	93.16808 U	ICPMS	0.7	0.2	UG/G	10/19/93	08275LA
FS2011	93.16808 V	ICPES	17.	2.	UG/G	9/09/93	08275HA
FS2011	93.16808 ZN	ICPES	42.	4.	UG/G	9/09/93	08275HA
FS2012	93.16809 AL	ICPES	16000.	1600.	UG/G	9/09/93	08275HA
FS2012	93.16809 AS	ETVAA	3.8	0.8	UG/G	9/07/93	
FS2012	93.16809 BA	ICPES	93.	9.	UG/G	9/09/93	08275HA
FS2012	93.16809 BE	ICPES	1.2	0.1	UG/G	9/09/93	08275HA
FS2012	93.16809 CA	ICPES	2700.	270.	UG/G	9/09/93	08275HA
FS2012	93.16809 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2012	93.16809 CL	IC	19.7	2.	UG/G	9/10/93	
FS2012	93.16809 CO	ICPES	20.	2.	UG/G	9/09/93	08275HA
FS2012	93.16809 CR	ICPES	10.	1.	UG/G	9/09/93	08275HA
FS2012	93.16809 CU	ICPES	3.6	0.4	UG/G	9/09/93	08275HA
FS2012	93.16809 FE	ICPES	14000.	1400.	UG/G	9/09/93	08275HA
FS2012	93.16809 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2012	93.16809 K	ICPES	2300.	230.	UG/G	9/09/93	08275HA

FS2012	93.16809 MG	ICPES	2400.	240.	UG/G	9/09/93	08275HA
FS2012	93.16809 MN	ICPES	330.	33.	UG/G	9/09/93	08275HA
FS2012	93.16809 NA	ICPES	310.	31.	UG/G	9/09/93	08275HA
FS2012	93.16809 NI	ICPES	9.	2.	UG/G	9/09/93	08275HA
FS2012	93.16809 PB	ICPES	11.	3.	UG/G	9/09/93	08275HA
FS2012	93.16809 SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2012	93.16809 SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2012	93.16809 SO4	IC	82.	8.2	UG/G	11/19/93	
FS2012	93.16809 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2012	93.16809 TH	ICPMS	8.	0.4	UG/G	10/19/93	08275LA
FS2012	93.16809 TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2012	93.16809 U	ICPMS	0.7	0.2	UG/G	10/19/93	08275LA
FS2012	93.16809 V	ICPES	18.	2.	UG/G	9/09/93	08275HA
FS2012	93.16809 ZN	ICPES	43.	4.	UG/G	9/09/93	08275HA
FS2013	93.16810 AL	ICPES	17000.	1700.	UG/G	9/09/93	08275HA
FS2013	93.16810 AS	ETVAA	3.9	0.8	UG/G	9/07/93	
FS2013	93.16810 BA	ICPES	110.	11.	UG/G	9/09/93	08275HA
FS2013	93.16810 BE	ICPES	1.2	0.1	UG/G	9/09/93	08275HA
FS2013	93.16810 CA	ICPES	2000.	200.	UG/G	9/09/93	08275HA
FS2013	93.16810 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2013	93.16810 CL	IC	14.6	1.5	UG/G	9/10/93	
FS2013	93.16810 CO	ICPES	13.	1.	UG/G	9/09/93	08275HA
FS2013	93.16810 CR	ICPES	11.	1.	UG/G	9/09/93	08275HA
FS2013	93.16810 CU	ICPES	2.9	0.3	UG/G	9/09/93	08275HA
FS2013	93.16810 FE	ICPES	15000.	1500.	UG/G	9/09/93	08275HA
FS2013	93.16810 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2013	93.16810 K	ICPES	2100.	210.	UG/G	9/09/93	08275HA
FS2013	93.16810 MG	ICPES	2200.	220.	UG/G	9/09/93	08275HA
FS2013	93.16810 MN	ICPES	370.	37.	UG/G	9/09/93	08275HA
FS2013	93.16810 NA	ICPES	250.	25.	UG/G	9/09/93	08275HA
FS2013	93.16810 NI	ICPES	10.	1.	UG/G	9/09/93	08275HA
FS2013	93.16810 PB	ICPES	10.	3.	UG/G	9/09/93	08275HA
FS2013	93.16810 SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2013	93.16810 SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2013	93.16810 SO4	IC	30.	3.	UG/G	11/19/93	
FS2013	93.16810 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2013	93.16810 TH	ICPMS	7.	0.4	UG/G	10/19/93	08275LA
FS2013	93.16810 TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2013	93.16810 U	ICPMS	0.7	0.2	UG/G	10/19/93	08275LA
FS2013	93.16810 V	ICPES	22.	2.	UG/G	9/09/93	08275HA
FS2013	93.16810 ZN	ICPES	45.	5.	UG/G	9/09/93	08275HA
FS2014	93.16811 AL	ICPES	9500.	950.	UG/G	9/09/93	08275HA
FS2014	93.16811 AS	ETVAA	2.5	0.5	UG/G	9/07/93	
FS2014	93.16811 BA	ICPES	110.	11.	UG/G	9/09/93	08275HA
FS2014	93.16811 BE	ICPES	0.79	0.08	UG/G	9/09/93	08275HA
FS2014	93.16811 CA	ICPES	8500.	850.	UG/G	9/09/93	08275HA
FS2014	93.16811 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2014	93.16811 CL	IC	0.0		UG/G	9/10/93	NO SAMPLE
FS2014	93.16811 CO	ICPES	41.	4.	UG/G	9/09/93	08275HA
FS2014	93.16811 CR	ICPES	6.7	0.7	UG/G	9/09/93	08275HA
FS2014	93.16811 CU	ICPES	6.1	0.6	UG/G	9/09/93	08275HA
FS2014	93.16811 FE	ICPES	11000.	1100.	UG/G	9/09/93	08275HA
FS2014	93.16811 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2014	93.16811 K	ICPES	1900.	190.	UG/G	9/09/93	08275HA
FS2014	93.16811 MG	ICPES	1800.	180.	UG/G	9/09/93	08275HA
FS2014	93.16811 MN	ICPES	660.	66.	UG/G	9/09/93	08275HA
FS2014	93.16811 NA	ICPES	420.	42.	UG/G	9/09/93	08275HA
FS2014	93.16811 NI	ICPES	12.	1.	UG/G	9/09/93	08275HA
FS2014	93.16811 PB	ICPES	9.	4.	UG/G	9/09/93	08275HA
FS2014	93.16811 SB	ICPES	< 5.		UG/G	9/09/93	08275HA

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FS2014	93.16811 SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2014	93.16811 SO4	IC	0.0		UG/G	11/19/93	NO SAMPLE
FS2014	93.16811 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2014	93.16811 TH	ICPMS	4.	0.2	UG/G	10/19/93	08275LA
FS2014	93.16811 TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2014	93.16811 U	ICPMS	0.6	0.2	UG/G	10/19/93	08275LA
FS2014	93.16811 V	ICPES	14.	1.	UG/G	9/09/93	08275HA
FS2014	93.16811 ZN	ICPES	60.	6.	UG/G	9/09/93	08275HA
FS2015	93.16812 AL	ICPES	5900.	590.	UG/G	9/09/93	08275HA
FS2015	93.16812 AS	ETVAA	1.6	0.3	UG/G	9/07/93	
FS2015	93.16812 BA	ICPES	40.	4.	UG/G	9/09/93	08275HA
FS2015	93.16812 BE	ICPES	0.64	0.06	UG/G	9/09/93	08275HA
FS2015	93.16812 CA	ICPES	1500.	150.	UG/G	9/09/93	08275HA
FS2015	93.16812 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2015	93.16812 CL	IC	17.2	1.7	UG/G	9/10/93	
FS2015	93.16812 CO	ICPES	28.	3.	UG/G	9/09/93	08275HA
FS2015	93.16812 CR	ICPES	4.	0.4	UG/G	9/09/93	08275HA
FS2015	93.16812 CU	ICPES	1.6	0.2	UG/G	9/09/93	08275HA
FS2015	93.16812 FE	ICPES	7900.	790.	UG/G	9/09/93	08275HA
FS2015	93.16812 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2015	93.16812 K	ICPES	1100.	110.	UG/G	9/09/93	08275HA
FS2015	93.16812 MG	ICPES	890.	90.	UG/G	9/09/93	08275HA
FS2015	93.16812 MN	ICPES	340.	34.	UG/G	9/09/93	08275HA
FS2015	93.16812 NA	ICPES	330.	33.	UG/G	9/09/93	08275HA
FS2015	93.16812 NI	ICPES	3.	1.	UG/G	9/09/93	08275HA
FS2015	93.16812 PB	ICPES	8.	0.8	UG/G	9/09/93	08275HA
FS2015	93.16812 SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2015	93.16812 SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2015	93.16812 SO4	IC	23.	2.3	UG/G	11/19/93	
FS2015	93.16812 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2015	93.16812 TH	ICPMS	4.	0.2	UG/G	10/19/93	08275LA
FS2015	93.16812 TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2015	93.16812 U	ICPMS	0.4	0.2	UG/G	10/19/93	08275LA
FS2015	93.16812 V	ICPES	8.3	0.8	UG/G	9/09/93	08275HA
FS2015	93.16812 ZN	ICPES	42.	4.	UG/G	9/09/93	08275HA
FS2016	93.16813 AL	ICPES	5100.	510.	UG/G	9/09/93	08275HA
FS2016	93.16813 AS	ETVAA	1.5	0.3	UG/G	9/07/93	
FS2016	93.16813 BA	ICPES	34.	3.	UG/G	9/09/93	08275HA
FS2016	93.16813 BE	ICPES	0.52	0.05	UG/G	9/09/93	08275HA
FS2016	93.16813 CA	ICPES	1300.	130.	UG/G	9/09/93	08275HA
FS2016	93.16813 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2016	93.16813 CL	IC	14.1	1.4	UG/G	9/10/93	
FS2016	93.16813 CO	ICPES	24.	2.	UG/G	9/09/93	08275HA
FS2016	93.16813 CR	ICPES	3.7	0.4	UG/G	9/09/93	08275HA
FS2016	93.16813 CU	ICPES	1.2	0.1	UG/G	9/09/93	08275HA
FS2016	93.16813 FE	ICPES	8500.	850.	UG/G	9/09/93	08275HA
FS2016	93.16813 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2016	93.16813 K	ICPES	770.	77.	UG/G	9/09/93	08275HA
FS2016	93.16813 MG	ICPES	780.	78.	UG/G	9/09/93	08275HA
FS2016	93.16813 MN	ICPES	310.	31.	UG/G	9/09/93	08275HA
FS2016	93.16813 NA	ICPES	190.	19.	UG/G	9/09/93	08275HA
FS2016	93.16813 NI	ICPES	5.	1.	UG/G	9/09/93	08275HA
FS2016	93.16813 PB	ICPES	13.	2.	UG/G	9/09/93	08275HA
FS2016	93.16813 SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2016	93.16813 SE	ETVAA	< 0.3		UG/G	9/07/93	
FS2016	93.16813 SO4	IC	16.	1.6	UG/G	11/19/93	
FS2016	93.16813 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2016	93.16813 TH	ICPMS	4.	0.2	UG/G	10/19/93	08275LA
FS2016	93.16813 TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2016	93.16813 U	ICPMS	0.3	0.2	UG/G	10/19/93	08275LA

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FS2016	93.16813 V	ICPES	9.	1.	UG/G	9/09/93	08275HA
FS2016	93.16813 ZN	ICPES	39.	4.	UG/G	9/09/93	08275HA
FS2017	93.16814 AL	ICPES	8600.	860.	UG/G	9/09/93	08275HA
FS2017	93.16814 AS	ETVAA	2.4	0.5	UG/G	9/07/93	
FS2017	93.16814 BA	ICPES	180.	18.	UG/G	9/09/93	08275HA
FS2017	93.16814 BE	ICPES	0.8	0.08	UG/G	9/09/93	08275HA
FS2017	93.16814 CA	ICPES	10000.	1000.	UG/G	9/09/93	08275HA
FS2017	93.16814 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2017	93.16814 CL	IC	16.1	1.6	UG/G	9/10/93	
FS2017	93.16814 CO	ICPES	14.	1.	UG/G	9/09/93	08275HA
FS2017	93.16814 CR	ICPES	6.	0.6	UG/G	9/09/93	08275HA
FS2017	93.16814 CU	ICPES	8.6	0.9	UG/G	9/09/93	08275HA
FS2017	93.16814 FE	ICPES	11000.	1100.	UG/G	9/09/93	08275HA
FS2017	93.16814 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2017	93.16814 K	ICPES	1800.	180.	UG/G	9/09/93	08275HA
FS2017	93.16814 MG	ICPES	1600.	160.	UG/G	9/09/93	08275HA
FS2017	93.16814 MN	ICPES	1000.	100.	UG/G	9/09/93	08275HA
FS2017	93.16814 NA	ICPES	230.	23.	UG/G	9/09/93	08275HA
FS2017	93.16814 NI	ICPES	8.	2.	UG/G	9/09/93	08275HA
FS2017	93.16814 PB	ICPES	9.	3.	UG/G	9/09/93	08275HA
FS2017	93.16814 SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2017	93.16814 SE	ETVAA	0.65	0.3	UG/G	9/07/93	
FS2017	93.16814 SO4	IC	32.	3.2	UG/G	11/19/93	
FS2017	93.16814 TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2017	93.16814 TH	ICPMS	5.	0.3	UG/G	10/19/93	08275LA
FS2017	93.16814 TL	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2017	93.16814 U	ICPMS	0.6	0.2	UG/G	10/19/93	08275LA
FS2017	93.16814 V	ICPES	12.	1.	UG/G	9/09/93	08275HA
FS2017	93.16814 ZN	ICPES	120.	12.	UG/G	9/09/93	08275HA
FS2018	93.16815 AL	ICPES	8400.	840.	UG/G	9/09/93	08275HA
FS2018	93.16815 AS	ETVAA	2.5	0.5	UG/G	9/08/93	
FS2018	93.16815 BA	ICPES	220.	22.	UG/G	9/09/93	08275HA
FS2018	93.16815 BE	ICPES	0.67	0.07	UG/G	9/09/93	08275HA
FS2018	93.16815 CA	ICPES	9900.	990.	UG/G	9/09/93	08275HA
FS2018	93.16815 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2018	93.16815 CL	IC	39.4	3.9	UG/G	9/10/93	
FS2018	93.16815 CO	ICPES	15.	2.	UG/G	9/09/93	08275HA
FS2018	93.16815 CR	ICPES	6.9	0.7	UG/G	9/09/93	08275HA
FS2018	93.16815 CU	ICPES	9.5	1.	UG/G	9/09/93	08275HA
FS2018	93.16815 FE	ICPES	10000.	100.	UG/G	9/09/93	08275HA
FS2018	93.16815 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2018	93.16815 K	ICPES	2000.	200.	UG/G	9/09/93	08275HA
FS2018	93.16815 MG	ICPES	1800.	180.	UG/G	9/09/93	08275HA
FS2018	93.16815 MN	ICPES	1100.	110.	UG/G	9/09/93	08275HA
FS2018	93.16815 NA	ICPES	350.	35.	UG/G	9/09/93	08275HA
FS2018	93.16815 NI	ICPES	6.	1.	UG/G	9/09/93	08275HA
FS2018	93.16815 PB	ICPES	38.	4.	UG/G	9/09/93	08275HA
FS2018	93.16815 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2018	93.16815 SE	ETVAA	0.5	0.2	UG/G	9/08/93	
FS2018	93.16815 SO4	IC	52.	5.2	UG/G	11/19/93	
FS2018	93.16815 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2018	93.16815 TH	ICPMS	5.	0.5	UG/G	9/23/93	08315LA
FS2018	93.16815 TL	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2018	93.16815 U	ICPMS	2.4	0.3	UG/G	9/23/93	08315LA
FS2018	93.16815 V	ICPES	14.	1.	UG/G	9/09/93	08275HA
FS2018	93.16815 ZN	ICPES	100.	10.	UG/G	9/09/93	08275HA
FS2019	93.16816 AL	ICPES	5800.	580.	UG/G	9/09/93	08315HA
FS2019	93.16816 AS	ETVAA	1.2	0.2	UG/G	9/08/93	
FS2019	93.16816 BA	ICPES	57.	6.	UG/G	9/09/93	08315HA
FS2019	93.16816 BE	ICPES	0.55	0.06	UG/G	9/09/93	08315HA

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FS2019	93.16816 CA	ICPES	2100.	210.	UG/G	9/09/93	08315HA
FS2019	93.16816 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2019	93.16816 CL	IC	16.7	1.7	UG/G	9/10/93	
FS2019	93.16816 CO	ICPES	11.	1.	UG/G	9/09/93	08315HA
FS2019	93.16816 CR	ICPES	3.7	0.4	UG/G	9/09/93	08315HA
FS2019	93.16816 CU	ICPES	1.6	0.8	UG/G	9/09/93	08315HA
FS2019	93.16816 FE	ICPES	7200.	720.	UG/G	9/09/93	08315HA
FS2019	93.16816 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2019	93.16816 K	ICPES	1200.	120.	UG/G	9/09/93	08315HA
FS2019	93.16816 MG	ICPES	1000.	100.	UG/G	9/09/93	08315HA
FS2019	93.16816 MN	ICPES	400.	40.	UG/G	9/09/93	08315HA
FS2019	93.16816 NA	ICPES	240.	24.	UG/G	9/09/93	08315HA
FS2019	93.16816 NI	ICPES	3.2	0.9	UG/G	9/09/93	08315HA
FS2019	93.16816 PB	ICPES	6.	2.	UG/G	9/09/93	08315HA
FS2019	93.16816 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2019	93.16816 SE	ETVAA	< 0.2		UG/G	9/08/93	
FS2019	93.16816 SO4	IC	22.	2.2	UG/G	11/19/93	
FS2019	93.16816 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2019	93.16816 TH	ICPMS	4.	0.2	UG/G	9/23/93	08315LA
FS2019	93.16816 TL	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2019	93.16816 U	ICPMS	0.4	0.2	UG/G	9/23/93	08315LA
FS2019	93.16816 V	ICPES	9.	1.	UG/G	9/09/93	08315HA
FS2019	93.16816 ZN	ICPES	32.	3.	UG/G	9/09/93	08315HA
FS2020	93.16817 AL	ICPES	4100.	410.	UG/G	9/09/93	08315HA
FS2020	93.16817 AS	ETVAA	1.	0.2	UG/G	9/08/93	
FS2020	93.16817 BA	ICPES	56.	6.	UG/G	9/09/93	08315HA
FS2020	93.16817 BE	ICPES	0.41	0.04	UG/G	9/09/93	08315HA
FS2020	93.16817 CA	ICPES	2300.	230.	UG/G	9/09/93	08315HA
FS2020	93.16817 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2020	93.16817 CL	IC	15.9	1.6	UG/G	9/10/93	
FS2020	93.16817 CO	ICPES	18.	2.	UG/G	9/09/93	08315HA
FS2020	93.16817 CR	ICPES	3.	0.3	UG/G	9/09/93	08315HA
FS2020	93.16817 CU	ICPES	2.	1.	UG/G	9/09/93	08315HA
FS2020	93.16817 FE	ICPES	6100.	610.	UG/G	9/09/93	08315HA
FS2020	93.16817 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2020	93.16817 K	ICPES	930.	93.	UG/G	9/09/93	08315HA
FS2020	93.16817 MG	ICPES	680.	68.	UG/G	9/09/93	08315HA
FS2020	93.16817 MN	ICPES	380.	38.	UG/G	9/09/93	08315HA
FS2020	93.16817 NA	ICPES	240.	24.	UG/G	9/09/93	08315HA
FS2020	93.16817 NI	ICPES	2.	0.2	UG/G	9/09/93	08315HA
FS2020	93.16817 PB	ICPES	10.	4.	UG/G	9/09/93	08315HA
FS2020	93.16817 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2020	93.16817 SE	ETVAA	< 0.2		UG/G	9/08/93	
FS2020	93.16817 SO4	IC	17.	1.7	UG/G	11/19/93	
FS2020	93.16817 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2020	93.16817 TH	ICPMS	4.	0.4	UG/G	9/23/93	08315LA
FS2020	93.16817 TL	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2020	93.16817 U	ICPMS	0.4	0.2	UG/G	9/23/93	08315LA
FS2020	93.16817 V	ICPES	7.	0.7	UG/G	9/09/93	08315HA
FS2020	93.16817 ZN	ICPES	29.	3.	UG/G	9/09/93	08315HA
FS2021	93.16818 AL	ICPES	6700.	670.	UG/G	9/09/93	08315HA
FS2021	93.16818 AS	ETVAA	1.4	0.3	UG/G	9/08/93	
FS2021	93.16818 BA	ICPES	58.	6.	UG/G	9/09/93	08315HA
FS2021	93.16818 BE	ICPES	0.69	0.07	UG/G	9/09/93	08315HA
FS2021	93.16818 CA	ICPES	1300.	130.	UG/G	9/09/93	08315HA
FS2021	93.16818 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2021	93.16818 CL	IC	14.	1.4	UG/G	9/10/93	
FS2021	93.16818 CO	ICPES	10.	1.	UG/G	9/09/93	08315HA
FS2021	93.16818 CR	ICPES	4.4	0.4	UG/G	9/09/93	08315HA
FS2021	93.16818 CU	ICPES	3.3	0.3	UG/G	9/09/93	08315HA

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FS2021	93.16818 FE	ICPES	5400.	540.	UG/G	9/09/93	08315HA
FS2021	93.16818 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2021	93.16818 K	ICPES	1200.	120.	UG/G	9/09/93	08315HA
FS2021	93.16818 MG	ICPES	1100.	110.	UG/G	9/09/93	08315HA
FS2021	93.16818 MN	ICPES	200.	20.	UG/G	9/09/93	08315HA
FS2021	93.16818 NA	ICPES	140.	14.	UG/G	9/09/93	08315HA
FS2021	93.16818 NI	ICPES	4.8	0.5	UG/G	9/09/93	08315HA
FS2021	93.16818 PB	ICPES	7.	4.	UG/G	9/09/93	08315HA
FS2021	93.16818 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2021	93.16818 SE	ETVAA	< 0.2		UG/G	9/08/93	
FS2021	93.16818 SO4	IC	30.	3.	UG/G	11/19/93	
FS2021	93.16818 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2021	93.16818 TH	ICPMS	5.	0.2	UG/G	9/23/93	08315LA
FS2021	93.16818 TL	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2021	93.16818 U	ICPMS	0.5	0.2	UG/G	9/23/93	08315LA
FS2021	93.16818 V	ICPES	9.3	0.9	UG/G	9/09/93	08315HA
FS2021	93.16818 ZN	ICPES	26.	3.	UG/G	9/09/93	08315HA
FS2022	93.16819 AL	ICPES	12000.	1200.	UG/G	9/09/93	08315HA
FS2022	93.16819 AS	ETVAA	3.8	0.8	UG/G	9/08/93	
FS2022	93.16819 BA	ICPES	140.	14.	UG/G	9/09/93	08315HA
FS2022	93.16819 BE	ICPES	1.	0.1	UG/G	9/09/93	08315HA
FS2022	93.16819 CA	ICPES	2500.	250.	UG/G	9/09/93	08315HA
FS2022	93.16819 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2022	93.16819 CL	IC	44.7	4.5	UG/G	9/10/93	
FS2022	93.16819 CO	ICPES	12.	1.	UG/G	9/09/93	08315HA
FS2022	93.16819 CR	ICPES	8.	0.8	UG/G	9/09/93	08315HA
FS2022	93.16819 CU	ICPES	4.3	0.4	UG/G	9/09/93	08315HA
FS2022	93.16819 FE	ICPES	10000.	1000.	UG/G	9/09/93	08315HA
FS2022	93.16819 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2022	93.16819 K	ICPES	2200.	220.	UG/G	9/09/93	08315HA
FS2022	93.16819 MG	ICPES	2200.	220.	UG/G	9/09/93	08315HA
FS2022	93.16819 MN	ICPES	300.	30.	UG/G	9/09/93	08315HA
FS2022	93.16819 NA	ICPES	680.	68.	UG/G	9/09/93	08315HA
FS2022	93.16819 NI	ICPES	8.2	0.8	UG/G	9/09/93	08315HA
FS2022	93.16819 PB	ICPES	12.	3.	UG/G	9/09/93	08315HA
FS2022	93.16819 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2022	93.16819 SE	ETVAA	0.3	0.2	UG/G	9/08/93	
FS2022	93.16819 SO4	IC	116.	12.	UG/G	11/19/93	
FS2022	93.16819 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2022	93.16819 TH	ICPMS	8.	3.	UG/G	9/23/93	08315LA
FS2022	93.16819 TL	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2022	93.16819 U	ICPMS	1.	0.2	UG/G	9/23/93	08315LA
FS2022	93.16819 V	ICPES	18.	2.	UG/G	9/09/93	08315HA
FS2022	93.16819 ZN	ICPES	35.	4.	UG/G	9/09/93	08315HA
FS2023	93.16820 AL	ICPES	14000.	1400.	UG/G	9/09/93	08315HA
FS2023	93.16820 AS	ETVAA	2.7	0.5	UG/G	9/08/93	
FS2023	93.16820 BA	ICPES	120.	12.	UG/G	9/09/93	08315HA
FS2023	93.16820 BE	ICPES	1.	0.1	UG/G	9/09/93	08315HA
FS2023	93.16820 CA	ICPES	3700.	370.	UG/G	9/09/93	08315HA
FS2023	93.16820 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2023	93.16820 CL	IC	38.3	3.8	UG/G	9/10/93	
FS2023	93.16820 CO	ICPES	13.	1.	UG/G	9/09/93	08315HA
FS2023	93.16820 CR	ICPES	8.4	0.8	UG/G	9/09/93	08315HA
FS2023	93.16820 CU	ICPES	3.7	0.4	UG/G	9/09/93	08315HA
FS2023	93.16820 FE	ICPES	10000.	1000.	UG/G	9/09/93	08315HA
FS2023	93.16820 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2023	93.16820 K	ICPES	2300.	230.	UG/G	9/09/93	08315HA
FS2023	93.16820 MG	ICPES	2200.	220.	UG/G	9/09/93	08315HA
FS2023	93.16820 MN	ICPES	240.	24.	UG/G	9/09/93	08315HA
FS2023	93.16820 NA	ICPES	330.	33.	UG/G	9/09/93	08315HA

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FS2023	93.16820	NI	ICPES	8.	1.	UG/G	9/09/93	08315HA
FS2023	93.16820	PB	ICPES	11.	4.	UG/G	9/09/93	08315HA
FS2023	93.16820	SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2023	93.16820	SE	ETVAA	< 0.2		UG/G	9/08/93	
FS2023	93.16820	SO4	IC	403.	40.	UG/G	11/19/93	
FS2023	93.16820	TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2023	93.16820	TH	ICPMS	8.	0.4	UG/G	9/23/93	08315LA
FS2023	93.16820	TL	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2023	93.16820	U	ICPMS	0.7	0.2	UG/G	9/23/93	08315LA
FS2023	93.16820	V	ICPES	15.	2.	UG/G	9/09/93	08315HA
FS2023	93.16820	ZN	ICPES	35.	4.	UG/G	9/09/93	08315HA
FS2026	93.16821	AL	ICPES	37000.	3700.	UG/G	9/09/93	08315HA
FS2026	93.16821	AS	ETVAA	5.4	1.1	UG/G	9/08/93	
FS2026	93.16821	BA	ICPES	190.	19.	UG/G	9/09/93	08315HA
FS2026	93.16821	BE	ICPES	1.7	0.2	UG/G	9/09/93	08315HA
FS2026	93.16821	CA	ICPES	3300.	330.	UG/G	9/09/93	08315HA
FS2026	93.16821	CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2026	93.16821	CL	IC	47.8	4.8	UG/G	9/10/93	
FS2026	93.16821	CO	ICPES	12.	1.	UG/G	9/09/93	08315HA
FS2026	93.16821	CR	ICPES	16.	2.	UG/G	9/09/93	08315HA
FS2026	93.16821	CU	ICPES	3.9	0.4	UG/G	9/09/93	08315HA
FS2026	93.16821	FE	ICPES	22000.	2200.	UG/G	9/09/93	08315HA
FS2026	93.16821	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2026	93.16821	K	ICPES	2800.	280.	UG/G	9/09/93	08315HA
FS2026	93.16821	MG	ICPES	4000.	400.	UG/G	9/09/93	08315HA
FS2026	93.16821	MN	ICPES	240.	24.	UG/G	9/09/93	08315HA
FS2026	93.16821	NA	ICPES	710.	71.	UG/G	9/09/93	08315HA
FS2026	93.16821	NI	ICPES	13.	1.	UG/G	9/09/93	08315HA
FS2026	93.16821	PB	ICPES	20.	4.	UG/G	9/09/93	08315HA
FS2026	93.16821	SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2026	93.16821	SE	ETVAA	1.2	0.2	UG/G	9/08/93	
FS2026	93.16821	SO4	IC	196.	20.	UG/G	11/19/93	
FS2026	93.16821	TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2026	93.16821	TH	ICPMS	9.	1.	UG/G	9/23/93	08315LA
FS2026	93.16821	TL	ICPMS	0.7	0.2	UG/G	9/23/93	08315LA
FS2026	93.16821	U	ICPMS	0.8	0.2	UG/G	9/23/93	08315LA
FS2026	93.16821	V	ICPES	31.	3.	UG/G	9/09/93	08315HA
FS2026	93.16821	ZN	ICPES	48.	5.	UG/G	9/09/93	08315HA
FS2027	93.16822	AL	ICPES	13000.	1300.	UG/G	9/09/93	08315HA
FS2027	93.16822	AS	ETVAA	4.7	0.9	UG/G	9/08/93	
FS2027	93.16822	BA	ICPES	100.	10.	UG/G	9/09/93	08315HA
FS2027	93.16822	BE	ICPES	0.68	0.07	UG/G	9/09/93	08315HA
FS2027	93.16822	CA	ICPES	1600.	160.	UG/G	9/09/93	08315HA
FS2027	93.16822	CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2027	93.16822	CL	IC	17.1	1.7	UG/G	9/10/93	
FS2027	93.16822	CO	ICPES	18.	2.	UG/G	9/09/93	08315HA
FS2027	93.16822	CR	ICPES	11.	1.	UG/G	9/09/93	08315HA
FS2027	93.16822	CU	ICPES	3.	0.3	UG/G	9/09/93	08315HA
FS2027	93.16822	FE	ICPES	12000.	1200.	UG/G	9/09/93	08315HA
FS2027	93.16822	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2027	93.16822	K	ICPES	2000.	200.	UG/G	9/09/93	08315HA
FS2027	93.16822	MG	ICPES	1800.	180.	UG/G	9/09/93	08315HA
FS2027	93.16822	MN	ICPES	350.	35.	UG/G	9/09/93	08315HA
FS2027	93.16822	NA	ICPES	320.	32.	UG/G	9/09/93	08315HA
FS2027	93.16822	NI	ICPES	7.	1.	UG/G	9/09/93	08315HA
FS2027	93.16822	PB	ICPES	20.	2.	UG/G	9/09/93	08315HA
FS2027	93.16822	SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2027	93.16822	SE	ETVAA	0.4	0.2	UG/G	9/08/93	
FS2027	93.16822	SO4	IC	26.	2.6	UG/G	11/19/93	
FS2027	93.16822	TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA

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FS2027	93.16822 TH	ICPMS	8.	2.	UG/G	9/23/93	08315LA
FS2027	93.16822 TL	ICPMS	0.2	0.2	UG/G	9/23/93	08315LA
FS2027	93.16822 U	ICPMS	1.	0.2	UG/G	9/23/93	08315LA
FS2027	93.16822 V	ICPES	31.	3.	UG/G	9/09/93	08315HA
FS2027	93.16822 ZN	ICPES	21.	2.	UG/G	9/09/93	08315HA
FS2028	93.16823 AL	ICPES	39000.	3900.	UG/G	9/09/93	08315HA
FS2028	93.16823 AS	ETVAA	9.3	1.9	UG/G	9/09/93	
FS2028	93.16823 BA	ICPES	140.	14.	UG/G	9/09/93	08315HA
FS2028	93.16823 BE	ICPES	1.8	0.2	UG/G	9/09/93	08315HA
FS2028	93.16823 CA	ICPES	4100.	410.	UG/G	9/09/93	08315HA
FS2028	93.16823 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2028	93.16823 CL	IC	59.5	5.9	UG/G	9/10/93	
FS2028	93.16823 CO	ICPES	8.1	0.8	UG/G	9/09/93	08315HA
FS2028	93.16823 CR	ICPES	21.	2.	UG/G	9/09/93	08315HA
FS2028	93.16823 CU	ICPES	8.2	0.8	UG/G	9/09/93	08315HA
FS2028	93.16823 FE	ICPES	25000.	2500.	UG/G	9/09/93	08315HA
FS2028	93.16823 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2028	93.16823 K	ICPES	3700.	370.	UG/G	9/09/93	08315HA
FS2028	93.16823 MG	ICPES	4700.	470.	UG/G	9/09/93	08315HA
FS2028	93.16823 MN	ICPES	190.	19.	UG/G	9/09/93	08315HA
FS2028	93.16823 NA	ICPES	600.	60.	UG/G	9/09/93	08315HA
FS2028	93.16823 NI	ICPES	16.	2.	UG/G	9/09/93	08315HA
FS2028	93.16823 PB	ICPES	20.	3.	UG/G	9/09/93	08315HA
FS2028	93.16823 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2028	93.16823 SE	ETVAA	1.2	0.2	UG/G	9/08/93	
FS2028	93.16823 SO4	IC	98.	10.	UG/G	11/19/93	
FS2028	93.16823 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2028	93.16823 TH	ICPMS	11.	1.	UG/G	9/23/93	08315LA
FS2028	93.16823 TL	ICPMS	0.7	0.2	UG/G	9/23/93	08315LA
FS2028	93.16823 U	ICPMS	1.4	0.2	UG/G	9/23/93	08315LA
FS2028	93.16823 V	ICPES	45.	5.	UG/G	9/09/93	08315HA
FS2028	93.16823 ZN	ICPES	60.	6.	UG/G	9/09/93	08315HA
FS2029	93.16824 AL	ICPES	43000.	4300.	UG/G	9/09/93	08315HA
FS2029	93.16824 AS	ETVAA	6.2	1.2	UG/G	9/08/93	
FS2029	93.16824 BA	ICPES	150.	15.	UG/G	9/09/93	08315HA
FS2029	93.16824 BE	ICPES	2.	0.2	UG/G	9/09/93	08315HA
FS2029	93.16824 CA	ICPES	4200.	420.	UG/G	9/09/93	08315HA
FS2029	93.16824 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2029	93.16824 CL	IC	103.	10.	UG/G	9/10/93	
FS2029	93.16824 CO	ICPES	8.5	0.9	UG/G	9/09/93	08315HA
FS2029	93.16824 CR	ICPES	23.	2.	UG/G	9/09/93	08315HA
FS2029	93.16824 CU	ICPES	8.5	0.9	UG/G	9/09/93	08315HA
FS2029	93.16824 FE	ICPES	26000.	2600.	UG/G	9/09/93	08315HA
FS2029	93.16824 HG	CVAA	0.2	0.1	UG/G	8/31/93	
FS2029	93.16824 K	ICPES	4100.	410.	UG/G	9/09/93	08315HA
FS2029	93.16824 MG	ICPES	5000.	500.	UG/G	9/09/93	08315HA
FS2029	93.16824 MN	ICPES	200.	20.	UG/G	9/09/93	08315HA
FS2029	93.16824 NA	ICPES	510.	51.	UG/G	9/09/93	08315HA
FS2029	93.16824 NI	ICPES	16.	2.	UG/G	9/09/93	08315HA
FS2029	93.16824 PB	ICPES	26.	3.	UG/G	9/09/93	08315HA
FS2029	93.16824 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2029	93.16824 SE	ETVAA	1.1	0.2	UG/G	9/08/93	
FS2029	93.16824 SO4	IC	199.	20.	UG/G	11/19/93	
FS2029	93.16824 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2029	93.16824 TH	ICPMS	11.	2.	UG/G	9/23/93	08315LA
FS2029	93.16824 TL	ICPMS	0.7	0.2	UG/G	9/23/93	08315LA
FS2029	93.16824 U	ICPMS	1.4	0.3	UG/G	9/23/93	08315LA
FS2029	93.16824 V	ICPES	50.	5.	UG/G	9/09/93	08315HA
FS2029	93.16824 ZN	ICPES	52.	5.	UG/G	9/09/93	08315HA
FS2030	93.16825 AL	ICPES	24000.	2400.	UG/G	9/09/93	08315HA

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FS2030	93.16825	AS	ETVAA	6.3	1.3	UG/G	9/08/93	
FS2030	93.16825	BA	ICPES	430.	43.	UG/G	9/09/93	08315HA
FS2030	93.16825	BE	ICPES	1.1	0.1	UG/G	9/09/93	08315HA
FS2030	93.16825	CA	ICPES	26000.	26000.	UG/G	9/09/93	08315HA
FS2030	93.16825	CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2030	93.16825	CL	IC	17.8	1.8	UG/G	9/10/93	
FS2030	93.16825	CO	ICPES	8.4	0.8	UG/G	9/09/93	08315HA
FS2030	93.16825	CR	ICPES	11.	1.	UG/G	9/09/93	08315HA
FS2030	93.16825	CU	ICPES	3.8	0.4	UG/G	9/09/93	08315HA
FS2030	93.16825	FE	ICPES	13000.	1300.	UG/G	9/09/93	08315HA
FS2030	93.16825	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2030	93.16825	K	ICPES	3200.	320.	UG/G	9/09/93	08315HA
FS2030	93.16825	MG	ICPES	3800.	380.	UG/G	9/09/93	08315HA
FS2030	93.16825	MN	ICPES	200.	20.	UG/G	9/09/93	08315HA
FS2030	93.16825	NA	ICPES	1200.	120.	UG/G	9/09/93	08315HA
FS2030	93.16825	NI	ICPES	9.	1.	UG/G	9/09/93	08315HA
FS2030	93.16825	PB	ICPES	12.	1.	UG/G	9/09/93	08315HA
FS2030	93.16825	SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2030	93.16825	SE	ETVAA	0.6	0.2	UG/G	9/08/93	
FS2030	93.16825	SO4	IC	130.	13.	UG/G	11/19/93	
FS2030	93.16825	TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2030	93.16825	TH	ICPMS	8.	1.	UG/G	9/23/93	08315LA
FS2030	93.16825	TL	ICPMS	0.2	0.2	UG/G	9/23/93	08315LA
FS2030	93.16825	U	ICPMS	2.	1.	UG/G	9/23/93	08315LA
FS2030	93.16825	V	ICPES	28.	3.	UG/G	9/09/93	08315HA
FS2030	93.16825	ZN	ICPES	26.	3.	UG/G	9/09/93	08315HA
FS2031	93.16826	AL	ICPES	20000.	2000.	UG/G	9/09/93	08315HA
FS2031	93.16826	AS	ETVAA	5.4	1.1	UG/G	9/08/93	
FS2031	93.16826	BA	ICPES	220.	22.	UG/G	9/09/93	08315HA
FS2031	93.16826	BE	ICPES	1.	0.1	UG/G	9/09/93	08315HA
FS2031	93.16826	CA	ICPES	1800.	180.	UG/G	9/09/93	08315HA
FS2031	93.16826	CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2031	93.16826	CL	IC	16.7	1.7	UG/G	9/10/93	
FS2031	93.16826	CO	ICPES	11.	1.	UG/G	9/09/93	08315HA
FS2031	93.16826	CR	ICPES	13.	1.	UG/G	9/09/93	08315HA
FS2031	93.16826	CU	ICPES	4.8	0.5	UG/G	9/09/93	08315HA
FS2031	93.16826	FE	ICPES	16000.	1600.	UG/G	9/09/93	08315HA
FS2031	93.16826	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2031	93.16826	K	ICPES	2200.	220.	UG/G	9/09/93	08315HA
FS2031	93.16826	MG	ICPES	2800.	280.	UG/G	9/09/93	08315HA
FS2031	93.16826	MN	ICPES	350.	35.	UG/G	9/09/93	08315HA
FS2031	93.16826	NA	ICPES	360.	36.	UG/G	9/09/93	08315HA
FS2031	93.16826	NI	ICPES	8.	1.	UG/G	9/09/93	08315HA
FS2031	93.16826	PB	ICPES	16.	5.	UG/G	9/09/93	08315HA
FS2031	93.16826	SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2031	93.16826	SE	ETVAA	0.6	0.2	UG/G	9/08/93	
FS2031	93.16826	SO4	IC	70.	7.	UG/G	11/19/93	
FS2031	93.16826	TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2031	93.16826	TH	ICPMS	9.	2.	UG/G	9/23/93	08315LA
FS2031	93.16826	TL	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2031	93.16826	U	ICPMS	0.8	0.2	UG/G	9/23/93	08315LA
FS2031	93.16826	V	ICPES	32.	3.	UG/G	9/09/93	08315HA
FS2031	93.16826	ZN	ICPES	31.	3.	UG/G	9/09/93	08315HA
FS2032	93.16827	AL	ICPES	14000.	1400.	UG/G	9/09/93	08315HA
FS2032	93.16827	AS	ETVAA	4.2	0.8	UG/G	9/08/93	
FS2032	93.16827	BA	ICPES	130.	13.	UG/G	9/09/93	08315HA
FS2032	93.16827	BE	ICPES	0.8	0.08	UG/G	9/09/93	08315HA
FS2032	93.16827	CA	ICPES	2000.	200.	UG/G	9/09/93	08315HA
FS2032	93.16827	CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2032	93.16827	CL	IC	14.6	1.5	UG/G	9/10/93	

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FS2032	93.16827 CO	ICPES	12.	1.	UG/G	9/09/93	08315HA
FS2032	93.16827 CR	ICPES	12.	1.	UG/G	9/09/93	08315HA
FS2032	93.16827 CU	ICPES	5.5	0.6	UG/G	9/09/93	08315HA
FS2032	93.16827 FE	ICPES	13000.	1300.	UG/G	9/09/93	08315HA
FS2032	93.16827 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2032	93.16827 K	ICPES	2900.	290.	UG/G	9/09/93	08315HA
FS2032	93.16827 MG	ICPES	2500.	250.	UG/G	9/09/93	08315HA
FS2032	93.16827 MN	ICPES	420.	42.	UG/G	9/09/93	08315HA
FS2032	93.16827 NA	ICPES	270.	27.	UG/G	9/09/93	08315HA
FS2032	93.16827 NI	ICPES	8.7	0.9	UG/G	9/09/93	08315HA
FS2032	93.16827 PB	ICPES	20.	5.	UG/G	9/09/93	08315HA
FS2032	93.16827 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2032	93.16827 SE	ETVAA	< 0.2		UG/G	9/08/93	
FS2032	93.16827 SO4	IC	26.	2.6	UG/G	11/19/93	
FS2032	93.16827 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2032	93.16827 TH	ICPMS	8.	1.	UG/G	9/23/93	08315LA
FS2032	93.16827 TL	ICPMS	0.2	0.2	UG/G	9/23/93	08315LA
FS2032	93.16827 U	ICPMS	1.1	0.2	UG/G	9/23/93	08315LA
FS2032	93.16827 V	ICPES	28.	3.	UG/G	9/09/93	08315HA
FS2032	93.16827 ZN	ICPES	36.	4.	UG/G	9/09/93	08315HA
FS2033	93.16828 AL	ICPES	52000.	5200.	UG/G	9/09/93	08315HA
FS2033	93.16828 AS	ETVAA	10.8	2.2	UG/G	9/09/93	
FS2033	93.16828 BA	ICPES	360.	36.	UG/G	9/09/93	08315HA
FS2033	93.16828 BE	ICPES	2.5	0.3	UG/G	9/09/93	08315HA
FS2033	93.16828 CA	ICPES	5700.	570.	UG/G	9/09/93	08315HA
FS2033	93.16828 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2033	93.16828 CL	IC	99.8	10.	UG/G	9/10/93	
FS2033	93.16828 CO	ICPES	8.7	0.9	UG/G	9/09/93	08315HA
FS2033	93.16828 CR	ICPES	21.	2.	UG/G	9/09/93	08315HA
FS2033	93.16828 CU	ICPES	8.8	0.9	UG/G	9/09/93	08315HA
FS2033	93.16828 FE	ICPES	28000.	2800.	UG/G	9/09/93	08315HA
FS2033	93.16828 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2033	93.16828 K	ICPES	4600.	460.	UG/G	9/09/93	08315HA
FS2033	93.16828 MG	ICPES	6300.	630.	UG/G	9/09/93	08315HA
FS2033	93.16828 MN	ICPES	120.	12.	UG/G	9/09/93	08315HA
FS2033	93.16828 NA	ICPES	590.	59.	UG/G	9/09/93	08315HA
FS2033	93.16828 NI	ICPES	20.	2.	UG/G	9/09/93	08315HA
FS2033	93.16828 PB	ICPES	23.	2.	UG/G	9/09/93	08315HA
FS2033	93.16828 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2033	93.16828 SE	ETVAA	1.5	0.3	UG/G	9/08/93	
FS2033	93.16828 SO4	IC	189.	19.	UG/G	11/19/93	
FS2033	93.16828 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2033	93.16828 TH	ICPMS	14.	2.	UG/G	9/23/93	08315LA
FS2033	93.16828 TL	ICPMS	0.9	0.2	UG/G	9/23/93	08315LA
FS2033	93.16828 U	ICPMS	0.9	0.6	UG/G	9/23/93	08315LA
FS2033	93.16828 V	ICPES	38.	4.	UG/G	9/09/93	08315HA
FS2033	93.16828 ZN	ICPES	58.	6.	UG/G	9/09/93	08315HA
FS2034	93.16829 AL	ICPES	20000.	2000.	UG/G	9/09/93	08315HA
FS2034	93.16829 AS	ETVAA	4.5	0.9	UG/G	9/08/93	
FS2034	93.16829 BA	ICPES	230.	23.	UG/G	9/09/93	08315HA
FS2034	93.16829 BE	ICPES	1.2	0.1	UG/G	9/09/93	08315HA
FS2034	93.16829 CA	ICPES	6400.	640.	UG/G	9/09/93	08315HA
FS2034	93.16829 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2034	93.16829 CL	IC	15.2	1.5	UG/G	9/10/93	
FS2034	93.16829 CO	ICPES	9.3	0.9	UG/G	9/09/93	08315HA
FS2034	93.16829 CR	ICPES	14.	1.	UG/G	9/09/93	08315HA
FS2034	93.16829 CU	ICPES	5.	0.5	UG/G	9/09/93	08315HA
FS2034	93.16829 FE	ICPES	15000.	1500.	UG/G	9/09/93	08315HA
FS2034	93.16829 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2034	93.16829 K	ICPES	2800.	280.	UG/G	9/09/93	08315HA

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FS2034	93.16829 MG	ICPES	3700.	370.	UG/G	9/09/93	08315HA
FS2034	93.16829 MN	ICPES	350.	35.	UG/G	9/09/93	08315HA
FS2034	93.16829 NA	ICPES	640.	64.	UG/G	9/09/93	08315HA
FS2034	93.16829 NI	ICPES	11.	1.	UG/G	9/09/93	08315HA
FS2034	93.16829 PB	ICPES	15.	2.	UG/G	9/09/93	08315HA
FS2034	93.16829 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2034	93.16829 SE	ETVAA	0.4	0.2	UG/G	9/08/93	
FS2034	93.16829 SO4	IC	53.	5.3	UG/G	11/19/93	
FS2034	93.16829 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2034	93.16829 TH	ICPMS	11.	2.	UG/G	9/23/93	08315LA
FS2034	93.16829 TL	ICPMS	0.4	0.2	UG/G	9/23/93	08315LA
FS2034	93.16829 U	ICPMS	0.9	0.2	UG/G	9/23/93	08315LA
FS2034	93.16829 V	ICPES	30.	3.	UG/G	9/09/93	08315HA
FS2034	93.16829 ZN	ICPES	35.	4.	UG/G	9/09/93	08315HA
FS2035	93.16830 AL	ICPES	9400.	940.	UG/G	9/09/93	08315HA
FS2035	93.16830 AS	ETVAA	5.3	1.1	UG/G	9/08/93	
FS2035	93.16830 BA	ICPES	100.	10.	UG/G	9/09/93	08315HA
FS2035	93.16830 BE	ICPES	0.67	0.07	UG/G	9/09/93	08315HA
FS2035	93.16830 CA	ICPES	1200.	120.	UG/G	9/09/93	08315HA
FS2035	93.16830 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2035	93.16830 CL	IC	16.8	1.7	UG/G	9/10/93	
FS2035	93.16830 CO	ICPES	24.	2.	UG/G	9/09/93	08315HA
FS2035	93.16830 CR	ICPES	10.	1.	UG/G	9/09/93	08315HA
FS2035	93.16830 CU	ICPES	< 0.5		UG/G	9/09/93	08315HA
FS2035	93.16830 FE	ICPES	14000.	1400.	UG/G	9/09/93	08315HA
FS2035	93.16830 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2035	93.16830 K	ICPES	1600.	160.	UG/G	9/09/93	08315HA
FS2035	93.16830 MG	ICPES	1300.	130.	UG/G	9/09/93	08315HA
FS2035	93.16830 MN	ICPES	770.	77.	UG/G	9/09/93	08315HA
FS2035	93.16830 NA	ICPES	250.	25.	UG/G	9/09/93	08315HA
FS2035	93.16830 NI	ICPES	6.	1.	UG/G	9/09/93	08315HA
FS2035	93.16830 PB	ICPES	18.	3.	UG/G	9/09/93	08315HA
FS2035	93.16830 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2035	93.16830 SE	ETVAA	< 0.2		UG/G	9/08/93	
FS2035	93.16830 SO4	IC	63.	6.3	UG/G	11/19/93	
FS2035	93.16830 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2035	93.16830 TH	ICPMS	8.	1.	UG/G	9/23/93	08315LA
FS2035	93.16830 TL	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2035	93.16830 U	ICPMS	0.9	0.3	UG/G	9/23/93	08315LA
FS2035	93.16830 V	ICPES	37.	4.	UG/G	9/09/93	08315HA
FS2035	93.16830 ZN	ICPES	17.	2.	UG/G	9/09/93	08315HA
FS2037	93.16831 AL	ICPES	9700.	970.	UG/G	9/09/93	08315HA
FS2037	93.16831 AS	ETVAA	4.1	0.8	UG/G	9/08/93	
FS2037	93.16831 BA	ICPES	73.	7.	UG/G	9/09/93	08315HA
FS2037	93.16831 BE	ICPES	0.68	0.07	UG/G	9/09/93	08315HA
FS2037	93.16831 CA	ICPES	1200.	120.	UG/G	9/09/93	08315HA
FS2037	93.16831 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2037	93.16831 CL	IC	17.7	1.8	UG/G	9/10/93	
FS2037	93.16831 CO	ICPES	26.	3.	UG/G	9/09/93	08315HA
FS2037	93.16831 CR	ICPES	9.	0.9	UG/G	9/09/93	08315HA
FS2037	93.16831 CU	ICPES	3.4	0.3	UG/G	9/09/93	08315HA
FS2037	93.16831 FE	ICPES	10000.	1000.	UG/G	9/09/93	08315HA
FS2037	93.16831 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2037	93.16831 K	ICPES	1400.	140.	UG/G	9/09/93	08315HA
FS2037	93.16831 MG	ICPES	1500.	150.	UG/G	9/09/93	08315HA
FS2037	93.16831 MN	ICPES	410.	41.	UG/G	9/09/93	08315HA
FS2037	93.16831 NA	ICPES	230.	23.	UG/G	9/09/93	08315HA
FS2037	93.16831 NI	ICPES	4.6	0.5	UG/G	9/09/93	08315HA
FS2037	93.16831 PB	ICPES	19.	2.	UG/G	9/09/93	08315HA
FS2037	93.16831 SB	ICPES	< 5.		UG/G	10/19/93	08315HA

FS2037	93.16831 SE	ETVAA	< 0.2		UG/G	9/08/93	
FS2037	93.16831 SO4	IC	24.	2.4	UG/G	11/19/93	
FS2037	93.16831 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2037	93.16831 TH	ICPMS	8.	1.	UG/G	9/23/93	08315LA
FS2037	93.16831 TL	ICPMS	0.2	0.2	UG/G	9/23/93	08315LA
FS2037	93.16831 U	ICPMS	1.	0.2	UG/G	9/23/93	08315LA
FS2037	93.16831 V	ICPES	28.	3.	UG/G	9/09/93	08315HA
FS2037	93.16831 ZN	ICPES	16.	2.	UG/G	9/09/93	08315HA
FS2038	93.16832 AL	ICPES	37000.	3700.	UG/G	9/09/93	08315HA
FS2038	93.16832 AS	ETVAA	7.9	1.6	UG/G	9/09/93	
FS2038	93.16832 BA	ICPES	280.	28.	UG/G	9/09/93	08315HA
FS2038	93.16832 BE	ICPES	1.5	0.2	UG/G	9/09/93	08315HA
FS2038	93.16832 CA	ICPES	8500.	850.	UG/G	9/09/93	08315HA
FS2038	93.16832 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2038	93.16832 CL	IC	40.6	4.1	UG/G	9/10/93	
FS2038	93.16832 CO	ICPES	12.	1.	UG/G	9/09/93	08315HA
FS2038	93.16832 CR	ICPES	17.	2.	UG/G	9/09/93	08315HA
FS2038	93.16832 CU	ICPES	5.	0.5	UG/G	9/09/93	08315HA
FS2038	93.16832 FE	ICPES	20000.	2000.	UG/G	9/09/93	08315HA
FS2038	93.16832 HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2038	93.16832 K	ICPES	3900.	390.	UG/G	9/09/93	08315HA
FS2038	93.16832 MG	ICPES	5600.	560.	UG/G	9/09/93	08315HA
FS2038	93.16832 MN	ICPES	110.	11.	UG/G	9/09/93	08315HA
FS2038	93.16832 NA	ICPES	1000.	100.	UG/G	9/09/93	08315HA
FS2038	93.16832 NI	ICPES	14.	1.	UG/G	9/09/93	08315HA
FS2038	93.16832 PB	ICPES	16.	4.	UG/G	9/09/93	08315HA
FS2038	93.16832 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2038	93.16832 SE	ETVAA	0.8	0.2	UG/G	9/28/93	
FS2038	93.16832 SO4	IC	217.	22.	UG/G	11/19/93	
FS2038	93.16832 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2038	93.16832 TH	ICPMS	9.	2.	UG/G	9/23/93	08315LA
FS2038	93.16832 TL	ICPMS	0.9	0.2	UG/G	9/23/93	08315LA
FS2038	93.16832 U	ICPMS	1.	0.2	UG/G	9/23/93	08315LA
FS2038	93.16832 V	ICPES	30.	3.	UG/G	9/09/93	08315HA
FS2038	93.16832 ZN	ICPES	47.	5.	UG/G	9/09/93	08315HA
FS2039	93.16833 AL	ICPES	12000.	1200.	UG/G	9/09/93	08315HA
FS2039	93.16833 AS	ETVAA	2.4	0.5	UG/G	9/10/93	
FS2039	93.16833 BA	ICPES	35.	4.	UG/G	9/09/93	08315HA
FS2039	93.16833 BE	ICPES	0.9	0.09	UG/G	9/09/93	08315HA
FS2039	93.16833 CA	ICPES	1700.	170.	UG/G	9/09/93	08315HA
FS2039	93.16833 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2039	93.16833 CL	IC	20.	2.	UG/G	9/10/93	
FS2039	93.16833 CO	ICPES	11.	1.	UG/G	9/09/93	08315HA
FS2039	93.16833 CR	ICPES	5.7	0.6	UG/G	9/09/93	08315HA
FS2039	93.16833 CU	ICPES	0.6	0.2	UG/G	9/09/93	08315HA
FS2039	93.16833 FE	ICPES	12000.	1200.	UG/G	9/09/93	08315HA
FS2039	93.16833 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2039	93.16833 K	ICPES	1900.	190.	UG/G	9/09/93	08315HA
FS2039	93.16833 MG	ICPES	1400.	140.	UG/G	9/09/93	08315HA
FS2039	93.16833 MN	ICPES	81.	8.	UG/G	9/09/93	08315HA
FS2039	93.16833 NA	ICPES	1200.	120.	UG/G	9/09/93	08315HA
FS2039	93.16833 NI	ICPES	3.3	0.4	UG/G	9/09/93	08315HA
FS2039	93.16833 PB	ICPES	4.	2.	UG/G	9/09/93	08315HA
FS2039	93.16833 SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2039	93.16833 SE	ETVAA	< 0.2		UG/G	9/10/93	
FS2039	93.16833 SO4	IC	32.	3.2	UG/G	11/19/93	
FS2039	93.16833 TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2039	93.16833 TH	ICPMS	3.	0.2	UG/G	10/15/93	09025L
FS2039	93.16833 TL	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2039	93.16833 U	ICPMS	0.5	0.2	UG/G	10/15/93	09025L

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FS2039	93.16833	V	ICPES	12.	1.	UG/G	9/09/93	08315HA
FS2039	93.16833	ZN	ICPES	28.	3.	UG/G	9/09/93	08315HA
FS2040	93.16834	AL	ICPES	25000.	2500.	UG/G	9/09/93	08315HA
FS2040	93.16834	AS	ETVAA	5.4	1.	UG/G	9/10/93	
FS2040	93.16834	BA	ICPES	730.	73.	UG/G	9/09/93	08315HA
FS2040	93.16834	BE	ICPES	1.	0.1	UG/G	9/09/93	08315HA
FS2040	93.16834	CA	ICPES	3200.	320.	UG/G	9/09/93	08315HA
FS2040	93.16834	CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2040	93.16834	CL	IC	200.	20.	UG/G	9/10/93	
FS2040	93.16834	CO	ICPES	6.	0.6	UG/G	9/09/93	08315HA
FS2040	93.16834	CR	ICPES	11.	1.	UG/G	9/09/93	08315HA
FS2040	93.16834	CU	ICPES	4.	0.4	UG/G	9/09/93	08315HA
FS2040	93.16834	FE	ICPES	17000.	1700.	UG/G	9/09/93	08315HA
FS2040	93.16834	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2040	93.16834	K	ICPES	2600.	260.	UG/G	9/09/93	08315HA
FS2040	93.16834	MG	ICPES	3200.	320.	UG/G	9/09/93	08315HA
FS2040	93.16834	MN	ICPES	78.	8.	UG/G	9/09/93	08315HA
FS2040	93.16834	NA	ICPES	1100.	110.	UG/G	9/09/93	08315HA
FS2040	93.16834	NI	ICPES	9.	0.9	UG/G	9/09/93	08315HA
FS2040	93.16834	PB	ICPES	13.	3.	UG/G	9/09/93	08315HA
FS2040	93.16834	SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2040	93.16834	SE	ETVAA	0.4	0.2	UG/G	9/10/93	
FS2040	93.16834	SO4	IC	442.	44.	UG/G	11/19/93	
FS2040	93.16834	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2040	93.16834	TH	ICPMS	6.	1.	UG/G	10/15/93	09025L
FS2040	93.16834	TL	ICPMS	0.4	0.2	UG/G	10/15/93	09025L
FS2040	93.16834	U	ICPMS	0.7	0.2	UG/G	10/15/93	09025L
FS2040	93.16834	V	ICPES	20.	2.	UG/G	9/09/93	08315HA
FS2040	93.16834	ZN	ICPES	37.	4.	UG/G	9/09/93	08315HA
FS2041	93.16835	AL	ICPES	24000.	2400.	UG/G	9/24/93	
FS2041	93.16835	AS	ETVAA	7.3	1.5	UG/G	9/10/93	
FS2041	93.16835	BA	ICPES	350.	35.	UG/G	9/24/93	
FS2041	93.16835	BE	ICPES	1.9	0.2	UG/G	9/24/93	
FS2041	93.16835	CA	ICPES	2600.	260.	UG/G	9/24/93	
FS2041	93.16835	CD	ICPES	3.	0.7	UG/G	9/24/93	
FS2041	93.16835	CL	IC	12.5	1.3	UG/G	9/10/93	
FS2041	93.16835	CO	ICPES	8.	1.	UG/G	9/24/93	
FS2041	93.16835	CR	ICPES	12.	1.	UG/G	9/24/93	
FS2041	93.16835	CU	ICPES	9.	0.9	UG/G	9/24/93	
FS2041	93.16835	FE	ICPES	17000.	1700.	UG/G	9/24/93	
FS2041	93.16835	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2041	93.16835	K	ICPES	2600.	260.	UG/G	9/24/93	
FS2041	93.16835	MG	ICPES	3400.	340.	UG/G	9/24/93	
FS2041	93.16835	MN	ICPES	270.	27.	UG/G	9/24/93	
FS2041	93.16835	NA	ICPES	250.	25.	UG/G	9/24/93	
FS2041	93.16835	NI	ICPES	12.	1.	UG/G	9/24/93	
FS2041	93.16835	PB	ICPES	14.	1.	UG/G	9/24/93	
FS2041	93.16835	SB	ICPES	< 5.		UG/G	10/19/93	08315HA
FS2041	93.16835	SE	ETVAA	0.6	0.2	UG/G	9/10/93	
FS2041	93.16835	SO4	IC	61.	6.1	UG/G	11/19/93	
FS2041	93.16835	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2041	93.16835	TH	ICPMS	9.	0.4	UG/G	10/15/93	09025L
FS2041	93.16835	TL	ICPMS	0.4	0.2	UG/G	10/15/93	09025L
FS2041	93.16835	U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2041	93.16835	V	ICPES	27.	3.	UG/G	9/24/93	
FS2041	93.16835	ZN	ICPES	30.	3.	UG/G	9/24/93	
FS2042	93.16836	AL	ICPES	7000.	700.	UG/G	9/24/93	
FS2042	93.16836	AS	ETVAA	4.8	1.	UG/G	9/10/93	
FS2042	93.16836	BA	ICPES	100.	10.	UG/G	9/24/93	
FS2042	93.16836	BE	ICPES	0.51	0.05	UG/G	9/24/93	

FS2042	93.16836	CA	ICPES	1200.	120.	UG/G	9/24/93	
FS2042	93.16836	CD	ICPES	1.2	0.8	UG/G	9/24/93	
FS2042	93.16836	CL	IC	14.	1.4	UG/G	9/10/93	
FS2042	93.16836	CO	ICPES	15.	2.	UG/G	9/24/93	
FS2042	93.16836	CR	ICPES	8.3	0.8	UG/G	9/24/93	
FS2042	93.16836	CU	ICPES	3.2	0.3	UG/G	9/24/93	
FS2042	93.16836	FE	ICPES	11000.	1100.	UG/G	9/24/93	
FS2042	93.16836	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2042	93.16836	K	ICPES	1300.	130.	UG/G	9/24/93	
FS2042	93.16836	MG	ICPES	1300.	130.	UG/G	9/24/93	
FS2042	93.16836	MN	ICPES	630.	63.	UG/G	9/24/93	
FS2042	93.16836	NA	ICPES	170.	17.	UG/G	9/24/93	
FS2042	93.16836	NI	ICPES	8.3	0.8	UG/G	9/24/93	
FS2042	93.16836	PB	ICPES	17.	5.	UG/G	9/24/93	
FS2042	93.16836	SB	ICPES	< 5.		UG/G	10/19/93	
FS2042	93.16836	SE	ETVAA	< 0.2		UG/G	9/10/93	
FS2042	93.16836	SO4	IC	27.	2.7	UG/G	11/19/93	
FS2042	93.16836	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2042	93.16836	TH	ICPMS	5.	0.4	UG/G	10/15/93	09025L
FS2042	93.16836	TL	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2042	93.16836	U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2042	93.16836	V	ICPES	27.	3.	UG/G	9/24/93	
FS2042	93.16836	ZN	ICPES	16.	2.	UG/G	9/24/93	
FS2043	93.16837	AL	ICPES	33000.	3300.	UG/G	9/24/93	
FS2043	93.16837	AS	ETVAA	8.3	1.7	UG/G	9/10/93	
FS2043	93.16837	BA	ICPES	340.	34.	UG/G	9/24/93	
FS2043	93.16837	BE	ICPES	2.2	0.2	UG/G	9/24/93	
FS2043	93.16837	CA	ICPES	5300.	530.	UG/G	9/24/93	
FS2043	93.16837	CD	ICPES	< 2.		UG/G	9/24/93	
FS2043	93.16837	CL	IC	109.	11.	UG/G	9/10/93	
FS2043	93.16837	CO	ICPES	8.	0.8	UG/G	9/24/93	
FS2043	93.16837	CR	ICPES	16.	2.	UG/G	9/24/93	
FS2043	93.16837	CU	ICPES	10.	1.	UG/G	9/24/93	
FS2043	93.16837	FE	ICPES	22000.	2200.	UG/G	9/24/93	
FS2043	93.16837	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2043	93.16837	K	ICPES	3000.	300.	UG/G	9/24/93	
FS2043	93.16837	MG	ICPES	5000.	500.	UG/G	9/24/93	
FS2043	93.16837	MN	ICPES	93.	9.	UG/G	9/24/93	
FS2043	93.16837	NA	ICPES	670.	67.	UG/G	9/24/93	
FS2043	93.16837	NI	ICPES	17.	2.	UG/G	9/24/93	
FS2043	93.16837	PB	ICPES	20.	2.	UG/G	9/24/93	
FS2043	93.16837	SB	ICPES	< 5.		UG/G	10/19/93	
FS2043	93.16837	SE	ETVAA	0.9	0.2	UG/G	9/10/93	
FS2043	93.16837	SO4	IC	212.	21.	UG/G	11/19/93	
FS2043	93.16837	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2043	93.16837	TH	ICPMS	7.	1.	UG/G	10/15/93	09025L
FS2043	93.16837	TL	ICPMS	0.6	0.2	UG/G	10/15/93	09025L
FS2043	93.16837	U	ICPMS	0.6	0.2	UG/G	10/15/93	09025L
FS2043	93.16837	V	ICPES	24.	2.	UG/G	9/24/93	
FS2043	93.16837	ZN	ICPES	44.	4.	UG/G	9/24/93	
FS2044	93.16838	AL	ICPES	25000.	2500.	UG/G	9/24/93	
FS2044	93.16838	AS	ETVAA	6.1	1.2	UG/G	9/10/93	
FS2044	93.16838	BA	ICPES	160.	1.	UG/G	9/24/93	
FS2044	93.16838	BE	ICPES	1.4	0.1	UG/G	9/24/93	
FS2044	93.16838	CA	ICPES	2700.	270.	UG/G	9/24/93	
FS2044	93.16838	CD	ICPES	< 2.		UG/G	9/24/93	
FS2044	93.16838	CL	IC	13.7	1.4	UG/G	9/10/93	
FS2044	93.16838	CO	ICPES	8.8	0.9	UG/G	9/24/93	
FS2044	93.16838	CR	ICPES	19.	2.	UG/G	9/24/93	
FS2044	93.16838	CU	ICPES	11.	1.	UG/G	9/24/93	

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FS2044	93.16838 FE	ICPES	22000.	2200.	UG/G	9/24/93	
FS2044	93.16838 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2044	93.16838 K	ICPES	2200.	220.	UG/G	9/24/93	
FS2044	93.16838 MG	ICPES	3700.	370.	UG/G	9/24/93	
FS2044	93.16838 MN	ICPES	350.	35.	UG/G	9/24/93	
FS2044	93.16838 NA	ICPES	280.	28.	UG/G	9/24/93	
FS2044	93.16838 NI	ICPES	13.	2.	UG/G	9/24/93	
FS2044	93.16838 PB	ICPES	21.	4.	UG/G	9/24/93	
FS2044	93.16838 SB	ICPES	< 5.		UG/G	10/19/93	
FS2044	93.16838 SE	ETVAA	0.5	0.2	UG/G	9/10/93	
FS2044	93.16838 SO4	IC	22.	2.2	UG/G	11/19/93	
FS2044	93.16838 TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2044	93.16838 TH	ICPMS	8.	1.	UG/G	10/15/93	09025L
FS2044	93.16838 TL	ICPMS	0.5	0.2	UG/G	10/15/93	09025L
FS2044	93.16838 U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2044	93.16838 V	ICPES	40.	4.	UG/G	9/24/93	
FS2044	93.16838 ZN	ICPES	33.	3.	UG/G	9/24/93	
FS2045	93.16839 AL	ICPES	9200.	920.	UG/G	9/24/93	
FS2045	93.16839 AS	ETVAA	5.4	1.1	UG/G	9/10/93	
FS2045	93.16839 BA	ICPES	100.	10.	UG/G	9/24/93	
FS2045	93.16839 BE	ICPES	0.75	0.08	UG/G	9/24/93	
FS2045	93.16839 CA	ICPES	1800.	180.	UG/G	9/24/93	
FS2045	93.16839 CD	ICPES	< 2.		UG/G	9/24/93	
FS2045	93.16839 CL	IC	14.8	1.5	UG/G	9/10/93	
FS2045	93.16839 CO	ICPES	21.	2.	UG/G	9/24/93	
FS2045	93.16839 CR	ICPES	11.	1.	UG/G	9/24/93	
FS2045	93.16839 CU	ICPES	5.	0.5	UG/G	9/24/93	
FS2045	93.16839 FE	ICPES	12000.	1200.	UG/G	9/24/93	
FS2045	93.16839 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2045	93.16839 K	ICPES	1700.	170.	UG/G	9/24/93	
FS2045	93.16839 MG	ICPES	1700.	170.	UG/G	9/24/93	
FS2045	93.16839 MN	ICPES	550.	55.	UG/G	9/24/93	
FS2045	93.16839 NA	ICPES	180.	18.	UG/G	9/24/93	
FS2045	93.16839 NI	ICPES	7.5	0.8	UG/G	9/24/93	
FS2045	93.16839 PB	ICPES	18.	2.	UG/G	9/24/93	
FS2045	93.16839 SB	ICPES	< 5.		UG/G	10/19/93	
FS2045	93.16839 SE	ETVAA	< 0.2		UG/G	9/10/93	
FS2045	93.16839 SO4	IC	30.	3.	UG/G	11/19/93	
FS2045	93.16839 TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2045	93.16839 TH	ICPMS	7.	0.4	UG/G	10/15/93	09025L
FS2045	93.16839 TL	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2045	93.16839 U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2045	93.16839 V	ICPES	28.	3.	UG/G	9/24/93	
FS2045	93.16839 ZN	ICPES	21.	2.	UG/G	9/24/93	
FS2046	93.16840 AL	ICPES	61000.	6100.	UG/G	9/24/93	
FS2046	93.16840 AS	ETVAA	11.2	2.2	UG/G	9/10/93	
FS2046	93.16840 BA	ICPES	320.	32.	UG/G	9/24/93	
FS2046	93.16840 BE	ICPES	4.	0.4	UG/G	9/24/93	
FS2046	93.16840 CA	ICPES	14000.	1400.	UG/G	9/24/93	
FS2046	93.16840 CD	ICPES	2.7	0.3	UG/G	9/24/93	
FS2046	93.16840 CL	IC	53.4	5.3	UG/G	9/10/93	
FS2046	93.16840 CO	ICPES	11.	1.	UG/G	9/24/93	
FS2046	93.16840 CR	ICPES	37.	4.	UG/G	9/24/93	
FS2046	93.16840 CU	ICPES	16.	2.	UG/G	9/24/93	
FS2046	93.16840 FE	ICPES	36000.	3600.	UG/G	9/24/93	
FS2046	93.16840 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2046	93.16840 K	ICPES	6800.	680.	UG/G	9/24/93	
FS2046	93.16840 MG	ICPES	10000.	1000.	UG/G	9/24/93	
FS2046	93.16840 MN	ICPES	290.	29.	UG/G	9/24/93	
FS2046	93.16840 NA	ICPES	1800.	180.	UG/G	9/24/93	

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FS2046	93.16840	NI	ICPES	28.	3.	UG/G	9/24/93	
FS2046	93.16840	PB	ICPES	30.	3.	UG/G	9/24/93	
FS2046	93.16840	SB	ICPES	< 5.		UG/G	10/19/93	
FS2046	93.16840	SE	ETVAA	1.	0.2	UG/G	9/10/93	
FS2046	93.16840	SO4	IC	199.	20.	UG/G	11/19/93	
FS2046	93.16840	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2046	93.16840	TH	ICPMS	11.	1.	UG/G	10/15/93	09025L
FS2046	93.16840	TL	ICPMS	0.6	0.2	UG/G	10/15/93	09025L
FS2046	93.16840	U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2046	93.16840	V	ICPES	56.	6.	UG/G	9/24/93	
FS2046	93.16840	ZN	ICPES	75.	7.	UG/G	9/24/93	
FS2048	93.16841	AL	ICPES	32000.	3200.	UG/G	9/29/93	
FS2048	93.16841	AS	ETVAA	4.7	0.9	UG/G	9/10/93	
FS2048	93.16841	BA	ICPES	300.	30.	UG/G	9/29/93	
FS2048	93.16841	BE	ICPES	2.	0.2	UG/G	9/29/93	
FS2048	93.16841	CA	ICPES	2900.	290.	UG/G	9/29/93	
FS2048	93.16841	CD	ICPES	1.	1.	UG/G	9/29/93	
FS2048	93.16841	CL	IC	26.6	2.7	UG/G	9/10/93	
FS2048	93.16841	CO	ICPES	15.	2.	UG/G	9/29/93	
FS2048	93.16841	CR	ICPES	17.	2.	UG/G	9/29/93	
FS2048	93.16841	CU	ICPES	7.7	0.8	UG/G	9/29/93	
FS2048	93.16841	FE	ICPES	20000.	2000.	UG/G	9/29/93	
FS2048	93.16841	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2048	93.16841	K	ICPES	3100.	310.	UG/G	9/29/93	
FS2048	93.16841	MG	ICPES	4000.	400.	UG/G	9/29/93	
FS2048	93.16841	MN	ICPES	260.	26.	UG/G	9/29/93	
FS2048	93.16841	NA	ICPES	630.	63.	UG/G	9/29/93	
FS2048	93.16841	NI	ICPES	14.	1.	UG/G	9/29/93	
FS2048	93.16841	PB	ICPES	19.	5.	UG/G	9/29/93	
FS2048	93.16841	SB	ICPES	< 5.		UG/G	10/19/93	
FS2048	93.16841	SE	ETVAA	0.6	0.2	UG/G	9/10/93	
FS2048	93.16841	SO4	IC	65.	6.5	UG/G	11/19/93	
FS2048	93.16841	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2048	93.16841	TH	ICPMS	7.	1.	UG/G	10/15/93	09025L
FS2048	93.16841	TL	ICPMS	0.4	0.2	UG/G	10/15/93	09025L
FS2048	93.16841	U	ICPMS	0.9	0.2	UG/G	10/15/93	09025L
FS2048	93.16841	V	ICPES	32.	3.	UG/G	9/29/93	
FS2048	93.16841	ZN	ICPES	35.	4.	UG/G	9/29/93	
FS2049	93.16842	AL	ICPES	32000.	3200.	UG/G	9/29/93	
FS2049	93.16842	AS	ETVAA	5.1	1.	UG/G	9/10/93	
FS2049	93.16842	BA	ICPES	270.	27.	UG/G	9/29/93	
FS2049	93.16842	BE	ICPES	2.	0.2	UG/G	9/29/93	
FS2049	93.16842	CA	ICPES	2800.	280.	UG/G	9/29/93	
FS2049	93.16842	CD	ICPES	3.6	0.8	UG/G	9/29/93	
FS2049	93.16842	CL	IC	12.6	1.3	UG/G	9/10/93	
FS2049	93.16842	CO	ICPES	9.	1.	UG/G	9/29/93	
FS2049	93.16842	CR	ICPES	17.	2.	UG/G	9/29/93	
FS2049	93.16842	CU	ICPES	9.4	0.9	UG/G	9/29/93	
FS2049	93.16842	FE	ICPES	20000.	2000.	UG/G	9/29/93	
FS2049	93.16842	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2049	93.16842	K	ICPES	3000.	300.	UG/G	9/29/93	
FS2049	93.16842	MG	ICPES	3800.	380.	UG/G	9/29/93	
FS2049	93.16842	MN	ICPES	280.	28.	UG/G	9/29/93	
FS2049	93.16842	NA	ICPES	280.	28.	UG/G	9/29/93	
FS2049	93.16842	NI	ICPES	16.	2.	UG/G	9/29/93	
FS2049	93.16842	PB	ICPES	20.	2.	UG/G	9/29/93	
FS2049	93.16842	SB	ICPES	< 5.		UG/G	10/19/93	
FS2049	93.16842	SE	ETVAA	0.6	0.2	UG/G	9/10/93	
FS2049	93.16842	SO4	IC	45.	4.5	UG/G	11/19/93	
FS2049	93.16842	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L

FS2049	93.16842	TH	ICPMS	8.	1.	UG/G	10/15/93	09025L
FS2049	93.16842	TL	ICPMS	0.2	0.2	UG/G	10/15/93	09025L
FS2049	93.16842	U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2049	93.16842	V	ICPES	34.	3.	UG/G	9/29/93	
FS2049	93.16842	ZN	ICPES	37.	4.	UG/G	9/29/93	
FS2050	93.16843	AL	ICPES	21000.	2100.	UG/G	9/29/93	
FS2050	93.16843	AS	ETVAA	6.5	1.3	UG/G	9/10/93	
FS2050	93.16843	BA	ICPES	180.	18.	UG/G	9/29/93	
FS2050	93.16843	BE	ICPES	1.3	0.1	UG/G	9/29/93	
FS2050	93.16843	CA	ICPES	6000.	600.	UG/G	9/29/93	
FS2050	93.16843	CD	ICPES	2.	1.	UG/G	9/29/93	
FS2050	93.16843	CL	IC	18.1	1.8	UG/G	9/10/93	
FS2050	93.16843	CO	ICPES	23.	2.	UG/G	9/29/93	
FS2050	93.16843	CR	ICPES	17.	2.	UG/G	9/29/93	
FS2050	93.16843	CU	ICPES	10.	1.	UG/G	9/29/93	
FS2050	93.16843	FE	ICPES	18000.	1800.	UG/G	9/29/93	
FS2050	93.16843	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2050	93.16843	K	ICPES	2500.	250.	UG/G	9/29/93	
FS2050	93.16843	MG	ICPES	3300.	330.	UG/G	9/29/93	
FS2050	93.16843	MN	ICPES	430.	43.	UG/G	9/29/93	
FS2050	93.16843	NA	ICPES	280.	28.	UG/G	9/29/93	
FS2050	93.16843	NI	ICPES	12.	1.	UG/G	9/29/93	
FS2050	93.16843	PB	ICPES	16.	2.	UG/G	9/29/93	
FS2050	93.16843	SB	ICPES	< 5.		UG/G	10/19/93	
FS2050	93.16843	SE	ETVAA	0.3	0.2	UG/G	9/10/93	
FS2050	93.16843	SO4	IC	32.	3.2	UG/G	11/19/93	
FS2050	93.16843	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2050	93.16843	TH	ICPMS	7.	1.	UG/G	10/15/93	09025L
FS2050	93.16843	TL	ICPMS	0.4	0.2	UG/G	10/15/93	09025L
FS2050	93.16843	U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2050	93.16843	V	ICPES	40.	4.	UG/G	9/29/93	
FS2050	93.16843	ZN	ICPES	27.	3.	UG/G	9/29/93	
FS2051	93.16844	AL	ICPES	48000.	4800.	UG/G	9/29/93	
FS2051	93.16844	AS	ETVAA	3.6	0.7	UG/G	9/10/93	
FS2051	93.16844	BA	ICPES	300.	30.	UG/G	9/29/93	
FS2051	93.16844	BE	ICPES	2.6	0.3	UG/G	9/29/93	
FS2051	93.16844	CA	ICPES	3700.	370.	UG/G	9/29/93	
FS2051	93.16844	CD	ICPES	< 2.		UG/G	9/29/93	
FS2051	93.16844	CL	IC	22.1	2.2	UG/G	9/10/93	
FS2051	93.16844	CO	ICPES	11.	1.	UG/G	9/29/93	
FS2051	93.16844	CR	ICPES	23.	2.	UG/G	9/29/93	
FS2051	93.16844	CU	ICPES	12.	1.	UG/G	9/29/93	
FS2051	93.16844	FE	ICPES	26000.	2600.	UG/G	9/29/93	
FS2051	93.16844	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2051	93.16844	K	ICPES	4300.	430.	UG/G	9/29/93	
FS2051	93.16844	MG	ICPES	5300.	530.	UG/G	9/29/93	
FS2051	93.16844	MN	ICPES	300.	30.	UG/G	9/29/93	
FS2051	93.16844	NA	ICPES	330.	33.	UG/G	9/29/93	
FS2051	93.16844	NI	ICPES	19.	2.	UG/G	9/29/93	
FS2051	93.16844	PB	ICPES	22.	9.	UG/G	9/29/93	
FS2051	93.16844	SB	ICPES	< 5.		UG/G	10/19/93	
FS2051	93.16844	SE	ETVAA	0.3	0.2	UG/G	9/10/93	
FS2051	93.16844	SO4	IC	57.	6.	UG/G	11/19/93	
FS2051	93.16844	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2051	93.16844	TH	ICPMS	4.	0.5	UG/G	10/15/93	09025L
FS2051	93.16844	TL	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2051	93.16844	U	ICPMS	0.7	0.2	UG/G	10/15/93	09025L
FS2051	93.16844	V	ICPES	42.	4.	UG/G	9/29/93	
FS2051	93.16844	ZN	ICPES	50.	5.	UG/G	9/29/93	
FS2052	93.16845	AL	ICPES	9500.	950.	UG/G	9/29/93	

FS2052	93.16845	AS	ETVAA	5.3	1.1	UG/G	9/10/93	
FS2052	93.16845	BA	ICPES	100.	10.	UG/G	9/29/93	
FS2052	93.16845	BE	ICPES	0.77	0.08	UG/G	9/29/93	
FS2052	93.16845	CA	ICPES	1300.	130.	UG/G	9/29/93	
FS2052	93.16845	CD	ICPES	1.4	0.8	UG/G	9/29/93	
FS2052	93.16845	CL	IC	14.3	1.4	UG/G	9/10/93	
FS2052	93.16845	CO	ICPES	27.	3.	UG/G	9/29/93	
FS2052	93.16845	CR	ICPES	12.	1.	UG/G	9/29/93	
FS2052	93.16845	CU	ICPES	3.	0.3	UG/G	9/29/93	
FS2052	93.16845	FE	ICPES	13000.	1300.	UG/G	9/29/93	
FS2052	93.16845	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2052	93.16845	K	ICPES	1400.	140.	UG/G	9/29/93	
FS2052	93.16845	MG	ICPES	1500.	150.	UG/G	9/29/93	
FS2052	93.16845	MN	ICPES	590.	59.	UG/G	9/29/93	
FS2052	93.16845	NA	ICPES	260.	26.	UG/G	9/29/93	
FS2052	93.16845	NI	ICPES	7.	3.	UG/G	9/29/93	
FS2052	93.16845	PB	ICPES	18.	4.	UG/G	9/29/93	
FS2052	93.16845	SB	ICPES	< 5.		UG/G	10/19/93	
FS2052	93.16845	SE	ETVAA	< 0.2		UG/G	9/10/93	
FS2052	93.16845	SO4	IC	44.	4.4	UG/G	11/19/93	
FS2052	93.16845	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2052	93.16845	TH	ICPMS	6.	0.4	UG/G	10/15/93	09025L
FS2052	93.16845	TL	ICPMS	0.2	0.2	UG/G	10/15/93	09025L
FS2052	93.16845	U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2052	93.16845	V	ICPES	35.	4.	UG/G	9/29/93	
FS2052	93.16845	ZN	ICPES	14.	1.	UG/G	9/29/93	
FS2053	93.16846	AL	ICPES	15000.	1500.	UG/G	9/29/93	
FS2053	93.16846	AS	ETVAA	3.9	0.8	UG/G	9/10/93	
FS2053	93.16846	BA	ICPES	130.	13.	UG/G	9/29/93	
FS2053	93.16846	BE	ICPES	1.	0.1	UG/G	9/29/93	
FS2053	93.16846	CA	ICPES	2200.	220.	UG/G	9/29/93	
FS2053	93.16846	CD	ICPES	< 0.4		UG/G	9/29/93	
FS2053	93.16846	CL	IC	12.9	1.3	UG/G	9/10/93	
FS2053	93.16846	CO	ICPES	15.	2.	UG/G	9/29/93	
FS2053	93.16846	CR	ICPES	16.	2.	UG/G	9/29/93	
FS2053	93.16846	CU	ICPES	8.	0.8	UG/G	9/29/93	
FS2053	93.16846	FE	ICPES	16000.	1600.	UG/G	9/29/93	
FS2053	93.16846	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2053	93.16846	K	ICPES	2500.	250.	UG/G	9/29/93	
FS2053	93.16846	MG	ICPES	2800.	280.	UG/G	9/29/93	
FS2053	93.16846	MN	ICPES	500.	500.	UG/G	9/29/93	
FS2053	93.16846	NA	ICPES	270.	27.	UG/G	9/29/93	
FS2053	93.16846	NI	ICPES	12.	3.	UG/G	9/29/93	
FS2053	93.16846	PB	ICPES	16.	2.	UG/G	9/29/93	
FS2053	93.16846	SB	ICPES	< 5.		UG/G	10/19/93	09025L
FS2053	93.16846	SE	ETVAA	< 0.2		UG/G	9/10/93	
FS2053	93.16846	SO4	IC	30.	3.	UG/G	11/19/93	
FS2053	93.16846	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2053	93.16846	TH	ICPMS	7.	1.	UG/G	10/15/93	09025L
FS2053	93.16846	TL	ICPMS	0.2	0.2	UG/G	10/15/93	09025L
FS2053	93.16846	U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2053	93.16846	V	ICPES	35.	4.	UG/G	9/29/93	
FS2053	93.16846	ZN	ICPES	33.	3.	UG/G	9/29/93	
FS2054	93.16847	AL	ICPES	23000.	2300.	UG/G	9/24/93	
FS2054	93.16847	AS	ETVAA	5.2	1.	UG/G	9/10/93	
FS2054	93.16847	BA	ICPES	190.	19.	UG/G	9/24/93	
FS2054	93.16847	BE	ICPES	1.2	0.1	UG/G	9/24/93	
FS2054	93.16847	CA	ICPES	3000.	300.	UG/G	9/24/93	
FS2054	93.16847	CD	ICPES	< 0.4		UG/G	9/24/93	
FS2054	93.16847	CL	IC	18.6	1.9	UG/G	9/10/93	

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FS2054	93.16847	CO	ICPES	12.	1.	UG/G	9/24/93	
FS2054	93.16847	CR	ICPES	13.	1.	UG/G	9/24/93	
FS2054	93.16847	CU	ICPES	6.	0.6	UG/G	9/24/93	
FS2054	93.16847	FE	ICPES	14000.	1400.	UG/G	9/24/93	
FS2054	93.16847	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2054	93.16847	K	ICPES	2700.	270.	UG/G	9/24/93	
FS2054	93.16847	MG	ICPES	2600.	260.	UG/G	9/24/93	
FS2054	93.16847	MN	ICPES	300.	30.	UG/G	9/24/93	
FS2054	93.16847	NA	ICPES	660.	66.	UG/G	9/24/93	
FS2054	93.16847	NI	ICPES	9.	0.9	UG/G	9/24/93	
FS2054	93.16847	PB	ICPES	37.	4.	UG/G	9/24/93	
FS2054	93.16847	SB	ICPES	< 5.		UG/G	10/19/93	09025L
FS2054	93.16847	SE	ETVAA	< 0.2		UG/G	9/10/93	
FS2054	93.16847	SO4	IC	44.	4.4	UG/G	11/19/93	
FS2054	93.16847	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2054	93.16847	TH	ICPMS	7.	0.5	UG/G	10/15/93	09025L
FS2054	93.16847	TL	ICPMS	0.2	0.2	UG/G	10/15/93	09025L
FS2054	93.16847	U	ICPMS	2.	0.2	UG/G	10/15/93	09025L
FS2054	93.16847	V	ICPES	29.	3.	UG/G	9/24/93	
FS2054	93.16847	ZN	ICPES	40.	4.	UG/G	9/24/93	
FS2055	93.16848	AL	ICPES	11000.	1100.	UG/G	9/24/93	
FS2055	93.16848	AS	ETVAA	4.6	0.9	UG/G	9/10/93	
FS2055	93.16848	BA	ICPES	140.	14.	UG/G	9/24/93	
FS2055	93.16848	BE	ICPES	0.7	0.07	UG/G	9/24/93	
FS2055	93.16848	CA	ICPES	3100.	310.	UG/G	9/24/93	
FS2055	93.16848	CD	ICPES	0.5	0.1	UG/G	9/24/93	
FS2055	93.16848	CL	IC	18.9	1.9	UG/G	9/10/93	
FS2055	93.16848	CO	ICPES	34.	3.	UG/G	9/24/93	
FS2055	93.16848	CR	ICPES	10.	1.	UG/G	9/24/93	
FS2055	93.16848	CU	ICPES	9.4	0.9	UG/G	9/24/93	
FS2055	93.16848	FE	ICPES	11000.	1100.	UG/G	9/24/93	
FS2055	93.16848	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2055	93.16848	K	ICPES	1900.	190.	UG/G	9/24/93	
FS2055	93.16848	MG	ICPES	1800.	180.	UG/G	9/24/93	
FS2055	93.16848	MN	ICPES	450.	45.	UG/G	9/24/93	
FS2055	93.16848	NA	ICPES	200.	20.	UG/G	9/24/93	
FS2055	93.16848	NI	ICPES	5.5	0.6	UG/G	9/24/93	
FS2055	93.16848	PB	ICPES	26.	5.	UG/G	9/24/93	
FS2055	93.16848	SB	ICPES	< 5.		UG/G	10/19/93	
FS2055	93.16848	SE	ETVAA	< 0.2		UG/G	9/10/93	
FS2055	93.16848	SO4	IC	60.	6.	UG/G	11/19/93	
FS2055	93.16848	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2055	93.16848	TH	ICPMS	5.	0.2	UG/G	10/15/93	09025L
FS2055	93.16848	TL	ICPMS	0.2	0.2	UG/G	10/15/93	09025L
FS2055	93.16848	U	ICPMS	2.	0.2	UG/G	10/15/93	09025L
FS2055	93.16848	V	ICPES	25.	3.	UG/G	9/24/93	
FS2055	93.16848	ZN	ICPES	31.	3.	UG/G	9/24/93	
FS2056	93.16849	AL	ICPES	43000.	4300.	UG/G	9/24/93	
FS2056	93.16849	AS	ETVAA	7.3	1.5	UG/G	9/10/93	
FS2056	93.16849	BA	ICPES	130.	13.	UG/G	9/24/93	
FS2056	93.16849	BE	ICPES	2.	0.2	UG/G	9/24/93	
FS2056	93.16849	CA	ICPES	4500.	450.	UG/G	9/24/93	
FS2056	93.16849	CD	ICPES	< 0.4		UG/G	9/24/93	
FS2056	93.16849	CL	IC	27.3	2.7	UG/G	9/10/93	
FS2056	93.16849	CO	ICPES	10.	1.	UG/G	9/24/93	
FS2056	93.16849	CR	ICPES	26.	3.	UG/G	9/24/93	
FS2056	93.16849	CU	ICPES	9.	0.9	UG/G	9/24/93	
FS2056	93.16849	FE	ICPES	27000.	2700.	UG/G	9/24/93	
FS2056	93.16849	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2056	93.16849	K	ICPES	4000.	400.	UG/G	9/24/93	

FS2056	93.16849	MG	ICPES	5500.	550.	UG/G	9/24/93	
FS2056	93.16849	MN	ICPES	180.	18.	UG/G	9/24/93	
FS2056	93.16849	NA	ICPES	350.	35.	UG/G	9/24/93	
FS2056	93.16849	NI	ICPES	19.	2.	UG/G	9/24/93	
FS2056	93.16849	PB	ICPES	25.	3.	UG/G	9/24/93	
FS2056	93.16849	SB	ICPES	< 5.		UG/G	10/19/93	
FS2056	93.16849	SE	ETVAA	0.7	0.2	UG/G	9/10/93	
FS2056	93.16849	SO4	IC	35.	3.5	UG/G	11/19/93	
FS2056	93.16849	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2056	93.16849	TH	ICPMS	8.	1.	UG/G	10/15/93	09025L
FS2056	93.16849	TL	ICPMS	0.7	0.2	UG/G	10/15/93	09025L
FS2056	93.16849	U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2056	93.16849	V	ICPES	55.	6.	UG/G	9/24/93	
FS2056	93.16849	ZN	ICPES	55.	6.	UG/G	9/24/93	
FS2057	93.16850	AL	ICPES	25000.	2500.	UG/G	9/24/93	
FS2057	93.16850	AS	ETVAA	4.9	1.	UG/G	9/10/93	
FS2057	93.16850	BA	ICPES	370.	37.	UG/G	9/24/93	
FS2057	93.16850	BE	ICPES	1.3	0.1	UG/G	9/24/93	
FS2057	93.16850	CA	ICPES	9700.	970.	UG/G	9/24/93	
FS2057	93.16850	CD	ICPES	0.6	0.3	UG/G	9/24/93	
FS2057	93.16850	CL	IC	39.1	3.9	UG/G	9/10/93	
FS2057	93.16850	CO	ICPES	15.	2.	UG/G	9/24/93	
FS2057	93.16850	CR	ICPES	18.	2.	UG/G	9/24/93	
FS2057	93.16850	CU	ICPES	8.	0.8	UG/G	9/24/93	
FS2057	93.16850	FE	ICPES	18000.	1800.	UG/G	9/24/93	
FS2057	93.16850	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2057	93.16850	K	ICPES	3300.	330.	UG/G	9/24/93	
FS2057	93.16850	MG	ICPES	4400.	440.	UG/G	9/24/93	
FS2057	93.16850	MN	ICPES	490.	49.	UG/G	9/24/93	
FS2057	93.16850	NA	ICPES	570.	57.	UG/G	9/24/93	
FS2057	93.16850	NI	ICPES	13.	1.	UG/G	9/24/93	
FS2057	93.16850	PB	ICPES	17.	5.	UG/G	9/24/93	
FS2057	93.16850	SB	ICPES	< 5.		UG/G	10/19/93	
FS2057	93.16850	SE	ETVAA	< 0.2		UG/G	9/10/93	
FS2057	93.16850	SO4	IC	74.	7.4	UG/G	11/19/93	
FS2057	93.16850	TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2057	93.16850	TH	ICPMS	8.	1.	UG/G	10/15/93	09025L
FS2057	93.16850	TL	ICPMS	0.5	0.2	UG/G	10/15/93	09025L
FS2057	93.16850	U	ICPMS	0.9	0.2	UG/G	10/15/93	09025L
FS2057	93.16850	V	ICPES	40.	4.	UG/G	9/24/93	
FS2057	93.16850	ZN	ICPES	39.	4.	UG/G	9/24/93	
FS2059	93.16851	AL	ICPES	14000.	1400.	UG/G	9/24/93	
FS2059	93.16851	AS	ETVAA	2.9	0.6	UG/G	9/14/93	
FS2059	93.16851	BA	ICPES	30.	3.	UG/G	9/24/93	
FS2059	93.16851	BE	ICPES	0.9	0.09	UG/G	9/24/93	
FS2059	93.16851	CA	ICPES	2000.	200.	UG/G	9/24/93	
FS2059	93.16851	CD	ICPES	< 0.4		UG/G	9/24/93	
FS2059	93.16851	CL	IC	18.2	1.8	UG/G	9/10/93	
FS2059	93.16851	CO	ICPES	9.	0.9	UG/G	9/24/93	
FS2059	93.16851	CR	ICPES	7.3	0.7	UG/G	9/24/93	
FS2059	93.16851	CU	ICPES	1.3	0.1	UG/G	9/24/93	
FS2059	93.16851	FE	ICPES	13000.	1300.	UG/G	9/24/93	
FS2059	93.16851	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2059	93.16851	K	ICPES	1900.	190.	UG/G	9/24/93	
FS2059	93.16851	MG	ICPES	1800.	180.	UG/G	9/24/93	
FS2059	93.16851	MN	ICPES	76.	8.	UG/G	9/24/93	
FS2059	93.16851	NA	ICPES	1200.	120.	UG/G	9/24/93	
FS2059	93.16851	NI	ICPES	6.5	0.6	UG/G	9/24/93	
FS2059	93.16851	PB	ICPES	< 4.		UG/G	9/24/93	
FS2059	93.16851	SB	ICPES	< 5.		UG/G	10/19/93	

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FS2059	93.16851	SE	ETVAA	< 0.2		UG/G	9/14/93	
FS2059	93.16851	SO4	IC	25.	2.5	UG/G	11/19/93	
FS2059	93.16851	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2059	93.16851	TH	ICPMS	3.	0.2	UG/G	10/15/93	BATCH 09085L
FS2059	93.16851	TL	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2059	93.16851	U	ICPMS	0.4	0.2	UG/G	10/15/93	BATCH 09085L
FS2059	93.16851	V	ICPES	14.	1.	UG/G	9/24/93	
FS2059	93.16851	ZN	ICPES	31.	3.	UG/G	9/24/93	
FS2060	93.16852	AL	ICPES	33000.	3300.	UG/G	9/24/93	
FS2060	93.16852	AS	ETVAA	6.7	1.3	UG/G	9/14/93	
FS2060	93.16852	BA	ICPES	410.	41.	UG/G	1/10/94	
FS2060	93.16852	BE	ICPES	1.5	0.2	UG/G	1/10/94	
FS2060	93.16852	CA	ICPES	87000.	8700.	UG/G	1/10/94	
FS2060	93.16852	CD	ICPES	< 0.4		UG/G	1/10/94	
FS2060	93.16852	CL	IC	168.	17.	UG/G	9/10/93	
FS2060	93.16852	CO	ICPES	7.2	0.7	UG/G	1/10/94	
FS2060	93.16852	CR	ICPES	15.	2.	UG/G	1/10/94	
FS2060	93.16852	CU	ICPES	6.8	0.7	UG/G	1/10/94	
FS2060	93.16852	FE	ICPES	17000.	1700.	UG/G	1/10/94	
FS2060	93.16852	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2060	93.16852	K	ICPES	4200.	420.	UG/G	1/10/94	
FS2060	93.16852	MG	ICPES	7400.	740.	UG/G	1/10/94	
FS2060	93.16852	MN	ICPES	160.	16.	UG/G	1/10/94	
FS2060	93.16852	NA	ICPES	1600.	1.	60/G	1/10/94	
FS2060	93.16852	NI	ICPES	15.	2.	60/G	1/10/94	
FS2060	93.16852	PB	ICPMS	12.	1.	UG/G	10/15/93	BATCH 09085L
FS2060	93.16852	SB	ICPES	< 5.		UG/G	10/15/93	
FS2060	93.16852	SE	ETVAA	1.7	0.3	UG/G	9/14/93	
FS2060	93.16852	SO4	IC	1.2	0.1	MG/G	11/19/93	
FS2060	93.16852	TA	ICPMS	< 0.2		UG/G	10/19/93	BATCH 09085L
FS2060	93.16852	TH	ICPMS	7.	1.	UG/G	10/15/93	BATCH 09085L
FS2060	93.16852	TL	ICPMS	0.6	0.2	UG/G	10/15/93	BATCH 09085L
FS2060	93.16852	U	ICPMS	1.5	0.5	UG/G	10/15/93	BATCH 09085L
FS2060	93.16852	V	ICPES	29.	3.	UG/G	1/10/94	
FS2060	93.16852	ZN	ICPES	57.	6.	UG/G	1/10/94	
FS2061	93.16853	AL	ICPES	30000.	3000.	UG/G	9/24/93	
FS2061	93.16853	AS	ETVAA	5.2	1.	UG/G	9/14/93	
FS2061	93.16853	BA	ICPES	210.	21.	UG/G	9/24/93	
FS2061	93.16853	BE	ICPES	1.6	0.2	UG/G	9/24/93	
FS2061	93.16853	CA	ICPES	4000.	400.	UG/G	9/24/93	
FS2061	93.16853	CD	ICPES	< 0.4		UG/G	9/24/93	
FS2061	93.16853	CL	IC	13.6	1.4	UG/G	9/10/93	
FS2061	93.16853	CO	ICPES	13.	1.	UG/G	9/24/93	
FS2061	93.16853	CR	ICPES	21.	2.	UG/G	9/24/93	
FS2061	93.16853	CU	ICPES	9.8	0.9	UG/G	9/24/93	
FS2061	93.16853	FE	ICPES	22000.	2200.	UG/G	9/24/93	
FS2061	93.16853	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2061	93.16853	K	ICPES	3800.	380.	UG/G	9/24/93	
FS2061	93.16853	MG	ICPES	5400.	540.	UG/G	9/24/93	
FS2061	93.16853	MN	ICPES	480.	48.	UG/G	9/24/93	
FS2061	93.16853	NA	ICPES	410.	41.	UG/G	9/24/93	
FS2061	93.16853	NI	ICPES	17.	2.	UG/G	9/24/93	
FS2061	93.16853	PB	ICPES	16.	3.	UG/G	9/24/93	
FS2061	93.16853	SB	ICPES	< 5.		UG/G	10/19/93	
FS2061	93.16853	SE	ETVAA	0.5	0.2	UG/G	9/14/93	
FS2061	93.16853	SO4	IC	30.	3.	UG/G	11/19/93	
FS2061	93.16853	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2061	93.16853	TH	ICPMS	9.	1.	UG/G	10/15/93	BATCH 09085L
FS2061	93.16853	TL	ICPMS	0.2	0.2	UG/G	10/15/93	BATCH 09085L
FS2061	93.16853	U	ICPMS	0.9	0.2	UG/G	10/15/93	BATCH 09085L

FS2061	93.16853	V	ICPES	47.	5.	UG/G	9/24/93	
FS2061	93.16853	ZN	ICPES	53.	5.	UG/G	9/24/93	
FS2062	93.16854	AL	ICPES	8000.	800.	UG/G	10/15/93	
FS2062	93.16854	AS	ETVAA	3.5	0.7	UG/G	9/14/93	
FS2062	93.16854	BA	ICPES	270.	27.	UG/G	10/15/93	
FS2062	93.16854	BE	ICPES	0.76	0.08	UG/G	10/15/93	
FS2062	93.16854	CA	ICPES	3200.	320.	UG/G	10/15/93	
FS2062	93.16854	CD	ICPES	< 0.4		UG/G	10/15/93	
FS2062	93.16854	CL	IC	46.2	4.6	UG/G	9/10/93	
FS2062	93.16854	CO	ICPES	9.1	0.9	UG/G	10/15/93	
FS2062	93.16854	CR	ICPES	4.4	0.5	UG/G	10/15/93	
FS2062	93.16854	CU	ICPES	< 0.5		UG/G	10/15/93	
FS2062	93.16854	FE	ICPES	7100.	710.	UG/G	10/15/93	
FS2062	93.16854	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2062	93.16854	K	ICPES	1100.	110.	UG/G	10/15/93	
FS2062	93.16854	MG	ICPES	1600.	160.	UG/G	10/15/93	
FS2062	93.16854	MN	ICPES	54.	5.	UG/G	10/15/93	
FS2062	93.16854	NA	ICPES	500.	50.	UG/G	10/15/93	
FS2062	93.16854	NI	ICPES	4.4	0.4	UG/G	10/15/93	
FS2062	93.16854	PB	ICPMS	8.	1.	UG/G	10/15/93	BATCH 09085L
FS2062	93.16854	SB	ICPES	< 5.		UG/G	10/19/93	09085NA-2
FS2062	93.16854	SE	ETVAA	< 0.2		UG/G	9/14/93	
FS2062	93.16854	SO4	IC	95.	10.	UG/G	11/19/93	
FS2062	93.16854	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2062	93.16854	TH	ICPMS	4.	0.2	UG/G	10/15/93	BATCH 09085L
FS2062	93.16854	TL	ICPMS	0.2	0.2	UG/G	10/15/93	BATCH 09085L
FS2062	93.16854	U	ICPMS	0.4	0.2	UG/G	10/15/93	BATCH 09085L
FS2062	93.16854	V	ICPES	9.	1.	UG/G	10/15/93	
FS2062	93.16854	ZN	ICPES	17.	2.	UG/G	10/15/93	
FS2063	93.16855	AL	ICPES	19000.	1900.	UG/G	10/15/93	
FS2063	93.16855	AS	ETVAA	4.8	1.	UG/G	9/14/93	
FS2063	93.16855	BA	ICPES	180.	18.	UG/G	10/15/93	
FS2063	93.16855	BE	ICPES	1.1	0.1	UG/G	10/15/93	
FS2063	93.16855	CA	ICPES	2100.	210.	UG/G	10/15/93	
FS2063	93.16855	CD	ICPES	< 0.4		UG/G	10/15/93	
FS2063	93.16855	CL	IC	15.8	1.6	UG/G	9/10/93	
FS2063	93.16855	CO	ICPES	14.	1.	UG/G	10/15/93	
FS2063	93.16855	CR	ICPES	8.7	0.9	UG/G	10/15/93	
FS2063	93.16855	CU	ICPES	2.	0.4	UG/G	10/15/93	
FS2063	93.16855	FE	ICPES	12000.	1200.	UG/G	10/15/93	
FS2063	93.16855	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2063	93.16855	K	ICPES	2200.	220.	UG/G	10/15/93	
FS2063	93.16855	MG	ICPES	2500.	250.	UG/G	10/15/93	
FS2063	93.16855	MN	ICPES	120.	12.	UG/G	10/15/93	
FS2063	93.16855	NA	ICPES	830.	83.	UG/G	10/15/93	
FS2063	93.16855	NI	ICPES	7.7	0.8	UG/G	10/15/93	
FS2063	93.16855	PB	ICPES	13.	6.	UG/G	10/15/93	
FS2063	93.16855	SB	ICPES	< 5.		UG/G	10/19/93	09085NA-2
FS2063	93.16855	SE	ETVAA	0.8	0.2	UG/G	9/14/93	
FS2063	93.16855	SO4	IC	80.	8.	UG/G	11/19/93	
FS2063	93.16855	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2063	93.16855	TH	ICPMS	7.	0.4	UG/G	10/15/93	BATCH 09085L
FS2063	93.16855	TL	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2063	93.16855	U	ICPMS	0.7	0.2	UG/G	10/15/93	BATCH 09085L
FS2063	93.16855	V	ICPES	20.	2.	UG/G	10/15/93	
FS2063	93.16855	ZN	ICPES	23.	2.	UG/G	10/15/93	
FS2064	93.16856	AL	ICPES	10000.	1000.	UG/G	10/15/93	
FS2064	93.16856	AS	ETVAA	4.1	0.8	UG/G	9/14/93	
FS2064	93.16856	BA	ICPES	140.	14.	UG/G	10/15/93	
FS2064	93.16856	BE	ICPES	0.77	0.08	UG/G	10/15/93	

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FS2064	93.16856 CA	ICPES	1900.	190.	UG/G	10/15/93	
FS2064	93.16856 CD	ICPES	< 0.4		UG/G	10/15/93	
FS2064	93.16856 CL	IC	16.8	1.7	UG/G	9/10/93	
FS2064	93.16856 CO	ICPES	11.	1.	UG/G	10/15/93	
FS2064	93.16856 CR	ICPES	6.1	0.6	UG/G	10/15/93	
FS2064	93.16856 CU	ICPES	< 0.5		UG/G	10/15/93	
FS2064	93.16856 FE	ICPES	9300.	930.	UG/G	10/15/93	
FS2064	93.16856 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2064	93.16856 K	ICPES	1500.	150.	UG/G	10/15/93	
FS2064	93.16856 MG	ICPES	1600.	160.	UG/G	10/15/93	
FS2064	93.16856 MN	ICPES	280.	28.	UG/G	10/15/93	
FS2064	93.16856 NA	ICPES	220.	22.	UG/G	10/15/93	
FS2064	93.16856 NI	ICPES	5.	3.	UG/G	10/15/93	
FS2064	93.16856 PB	ICPES	14.	1.	UG/G	10/15/93	
FS2064	93.16856 SB	ICPES	< 5.		UG/G	10/19/93	09085HA-2
FS2064	93.16856 SE	ETVAA	0.6	0.2	UG/G	9/14/93	
FS2064	93.16856 SO4	IC	31.	3.	UG/G	11/19/93	
FS2064	93.16856 TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2064	93.16856 TH	ICPMS	8.	1.	UG/G	10/15/93	BATCH 09085L
FS2064	93.16856 TL	ICPMS	0.2	0.2	UG/G	10/15/93	BATCH 09085L
FS2064	93.16856 U	ICPMS	1.5	0.5	UG/G	10/15/93	BATCH 09085L
FS2064	93.16856 V	ICPES	17.	2.	UG/G	10/15/93	
FS2064	93.16856 ZN	ICPES	21.	2.	UG/G	10/15/93	
FS2065	93.16857 AL	ICPES	24000.	2400.	UG/G	10/15/93	
FS2065	93.16857 AS	ETVAA	6.9	1.4	UG/G	9/14/93	
FS2065	93.16857 BA	ICPES	140.	14.	UG/G	10/15/93	
FS2065	93.16857 BE	ICPES	1.4	0.1	UG/G	10/15/93	
FS2065	93.16857 CA	ICPES	5600.	560.	UG/G	10/15/93	
FS2065	93.16857 CD	ICPES	< 0.4		UG/G	10/15/93	
FS2065	93.16857 CL	IC	168.	17.	UG/G	9/10/93	
FS2065	93.16857 CO	ICPES	5.5	0.6	UG/G	10/15/93	
FS2065	93.16857 CR	ICPES	9.5	0.9	UG/G	10/15/93	
FS2065	93.16857 CU	ICPES	3.8	0.7	UG/G	10/15/93	
FS2065	93.16857 FE	ICPES	15000.	1500.	UG/G	10/15/93	
FS2065	93.16857 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2065	93.16857 K	ICPES	2000.	200.	UG/G	10/15/93	
FS2065	93.16857 MG	ICPES	3700.	370.	UG/G	10/15/93	
FS2065	93.16857 MN	ICPES	76.	7.	UG/G	10/15/93	
FS2065	93.16857 NA	ICPES	610.	61.	UG/G	10/15/93	
FS2065	93.16857 NI	ICPES	9.	3.	UG/G	10/15/93	
FS2065	93.16857 PB	ICPES	19.	8.	UG/G	10/15/93	
FS2065	93.16857 SB	ICPES	< 5.		UG/G	10/19/93	09085HA-2
FS2065	93.16857 SE	ETVAA	1.1	0.2	UG/G	9/14/93	
FS2065	93.16857 SO4	IC	324.	32.	UG/G	11/19/93	
FS2065	93.16857 TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2065	93.16857 TH	ICPMS	10.	1.	UG/G	10/15/93	BATCH 09085L
FS2065	93.16857 TL	ICPMS	0.7	0.2	UG/G	10/15/93	BATCH 09085L
FS2065	93.16857 U	ICPMS	0.9	0.2	UG/G	10/15/93	BATCH 09085L
FS2065	93.16857 V	ICPES	21.	2.	UG/G	10/15/93	
FS2065	93.16857 ZN	ICPES	28.	3.	UG/G	10/15/93	
FS2066	93.16858 AL	ICPES	7000.	700.	UG/G	10/15/93	
FS2066	93.16858 AS	ETVAA	3.9	0.8	UG/G	9/14/93	
FS2066	93.16858 BA	ICPES	84.	8.	UG/G	10/15/93	
FS2066	93.16858 BE	ICPES	0.54	0.05	UG/G	10/15/93	
FS2066	93.16858 CA	ICPES	1300.	130.	UG/G	10/15/93	
FS2066	93.16858 CD	ICPES	< 0.4		UG/G	10/15/93	
FS2066	93.16858 CL	IC	12.3	1.2	UG/G	9/10/93	
FS2066	93.16858 CO	ICPES	6.6	0.7	UG/G	10/15/93	
FS2066	93.16858 CR	ICPES	6.6	0.7	UG/G	10/15/93	
FS2066	93.16858 CU	ICPES	2.7	0.3	UG/G	10/15/93	

FS2066	93.16858 FE	ICPES	9200.	920.	UG/G	10/15/93	
FS2066	93.16858 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2066	93.16858 K	ICPES	970.	97.	UG/G	10/15/93	
FS2066	93.16858 MG	ICPES	1500.	150.	UG/G	10/15/93	
FS2066	93.16858 MN	ICPES	350.	35.	UG/G	10/15/93	
FS2066	93.16858 NA	ICPES	58.	6.	UG/G	10/15/93	
FS2066	93.16858 NI	ICPES	7.	3.	UG/G	10/15/93	
FS2066	93.16858 PB	ICPES	15.	9.	UG/G	10/15/93	
FS2066	93.16858 SB	ICPES	< 5.		UG/G	10/19/93	09085HA-2
FS2066	93.16858 SE	ETVAA	0.3	0.2	UG/G	9/14/93	
FS2066	93.16858 SO4	IC	14.	1.4	UG/G	11/19/93	
FS2066	93.16858 TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2066	93.16858 TH	ICPMS	6.	0.4	UG/G	10/15/93	BATCH 09085L
FS2066	93.16858 TL	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2066	93.16858 U	ICPMS	0.9	0.2	UG/G	10/15/93	BATCH 09085L
FS2066	93.16858 V	ICPES	22.	2.	UG/G	10/15/93	
FS2066	93.16858 ZN	ICPES	14.	1.	UG/G	10/15/93	
FS2067	93.16859 AL	ICPES	33000.	3300.	UG/G	10/15/93	
FS2067	93.16859 AS	ETVAA	9.2	1.8	UG/G	9/14/93	
FS2067	93.16859 BA	ICPES	88.	9.	UG/G	10/15/93	
FS2067	93.16859 BE	ICPES	1.9	0.2	UG/G	10/15/93	
FS2067	93.16859 CA	ICPES	4000.	400.	UG/G	10/15/93	
FS2067	93.16859 CD	ICPES	< 0.4		UG/G	10/15/93	
FS2067	93.16859 CL	IC	23.8	2.4	UG/G	9/10/93	
FS2067	93.16859 CO	ICPES	10.	1.	UG/G	10/15/93	
FS2067	93.16859 CR	ICPES	19.	2.	UG/G	10/15/93	
FS2067	93.16859 CU	ICPES	7.9	0.8	UG/G	10/15/93	
FS2067	93.16859 FE	ICPES	24000.	2400.	UG/G	10/15/93	
FS2067	93.16859 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2067	93.16859 K	ICPES	2700.	270.	UG/G	10/15/93	
FS2067	93.16859 MG	ICPES	4200.	420.	UG/G	10/15/93	
FS2067	93.16859 MN	ICPES	220.	22.	UG/G	10/15/93	
FS2067	93.16859 NA	ICPES	330.	33.	UG/G	10/15/93	
FS2067	93.16859 NI	ICPES	13.	2.	UG/G	10/15/93	
FS2067	93.16859 PB	ICPES	25.	6.	UG/G	10/15/93	
FS2067	93.16859 SB	ICPES	< 5.		UG/G	10/19/93	09085HA-2
FS2067	93.16859 SE	ETVAA	1.3	0.3	UG/G	9/14/93	
FS2067	93.16859 SO4	IC	29.	3.	UG/G	11/19/93	
FS2067	93.16859 TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2067	93.16859 TH	ICPMS	9.	1.	UG/G	10/15/93	BATCH 09085L
FS2067	93.16859 TL	ICPMS	0.6	0.2	UG/G	10/15/93	BATCH 09085L
FS2067	93.16859 U	ICPMS	1.5	0.2	UG/G	10/15/93	BATCH 09085L
FS2067	93.16859 V	ICPES	45.	5.	UG/G	10/15/93	
FS2067	93.16859 ZN	ICPES	41.	4.	UG/G	10/15/93	
FS2068	93.16860 AL	ICPES	27000.	2700.	UG/G	10/15/93	
FS2068	93.16860 AS	ETVAA	7.	1.4	UG/G	9/14/93	
FS2068	93.16860 BA	ICPES	160.	16.	UG/G	10/15/93	
FS2068	93.16860 BE	ICPES	1.2	0.1	UG/G	10/15/93	
FS2068	93.16860 CA	ICPES	2800.	280.	UG/G	10/15/93	
FS2068	93.16860 CD	ICPES	< 0.4		UG/G	10/15/93	
FS2068	93.16860 CL	IC	14.8	1.5	UG/G	9/10/93	
FS2068	93.16860 CO	ICPES	12.	1.	UG/G	10/15/93	
FS2068	93.16860 CR	ICPES	17.	2.	UG/G	10/15/93	
FS2068	93.16860 CU	ICPES	7.9	0.8	UG/G	10/15/93	
FS2068	93.16860 FE	ICPES	21000.	2100.	UG/G	10/15/93	
FS2068	93.16860 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2068	93.16860 K	ICPES	2400.	240.	UG/G	10/15/93	
FS2068	93.16860 MG	ICPES	3800.	380.	UG/G	10/15/93	
FS2068	93.16860 MN	ICPES	300.	30.	UG/G	10/15/93	
FS2068	93.16860 NA	ICPES	210.	21.	UG/G	10/15/93	

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FS2068	93.16860	NI	ICPES	10.	6.	UG/G	10/15/93	
FS2068	93.16860	PB	ICPES	20.	14.	UG/G	10/15/93	
FS2068	93.16860	SB	ICPES	< 5.		UG/G	10/19/93	09085HA-2
FS2068	93.16860	SE	ETVAA	1.2	0.2	UG/G	9/14/93	
FS2068	93.16860	SO4	IC	24.	2.4	UG/G	11/19/93	
FS2068	93.16860	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2068	93.16860	TH	ICPMS	9.	1.	UG/G	10/15/93	BATCH 09085L
FS2068	93.16860	TL	ICPMS	0.4	0.2	UG/G	10/15/93	BATCH 09085L
FS2068	93.16860	U	ICPMS	1.5	0.2	UG/G	10/15/93	BATCH 09085L
FS2068	93.16860	V	ICPES	41.	4.	UG/G	10/15/93	
FS2068	93.16860	ZN	ICPES	33.	3.	UG/G	10/15/93	
FS2070	93.16861	AL	ICPES	1100.	110.	UG/G	10/15/93	
FS2070	93.16861	AS	ETVAA	0.6	0.2	UG/G	9/14/93	
FS2070	93.16861	BA	ICPES	8.7	0.9	UG/G	10/15/93	
FS2070	93.16861	BE	ICPES	0.18	0.02	UG/G	1/10/94	
FS2070	93.16861	CA	ICPES	540.	54.	UG/G	1/10/94	
FS2070	93.16861	CD	ICPES	< 0.4		UG/G	1/10/94	
FS2070	93.16861	CL	IC	15.5	1.6	UG/G	9/10/93	
FS2070	93.16861	CO	ICPES	21.	2.	UG/G	1/10/94	
FS2070	93.16861	CR	ICPES	0.6	0.06	UG/G	1/10/94	
FS2070	93.16861	CU	ICPES	0.7	0.2	UG/G	1/10/94	
FS2070	93.16861	FE	ICPES	4300.	430.	UG/G	1/10/94	
FS2070	93.16861	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2070	93.16861	K	ICPES	300.	100.	UG/G	1/10/94	
FS2070	93.16861	MG	ICPES	220.	22.	UG/G	1/10/94	
FS2070	93.16861	MN	ICPES	190.	19.	UG/G	1/10/94	
FS2070	93.16861	NA	ICPES	270.	27.	UG/G	1/10/94	
FS2070	93.16861	NI	ICPES	< 2.		UG/G	1/10/94	
FS2070	93.16861	PB	ICPES	< 4.		UG/G	10/15/93	09085HA
FS2070	93.16861	SB	ICPES	< 5.		UG/G	10/15/93	
FS2070	93.16861	SE	ETVAA	< 0.2		UG/G	9/14/93	
FS2070	93.16861	SO4	IC	28.	3.	UG/G	11/19/93	
FS2070	93.16861	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2070	93.16861	TH	ICPMS	5.	0.6	UG/G	10/15/93	BATCH 09085L
FS2070	93.16861	TL	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2070	93.16861	U	ICPMS	0.7	0.2	UG/G	10/15/93	BATCH 09085L
FS2070	93.16861	V	ICPES	< 0.5		UG/G	10/18/93	
FS2070	93.16861	ZN	ICPES	27.	3.	UG/G	10/18/93	REDIGEST
FS2071	93.16862	AL	ICPES	50000.	5000.	UG/G	10/18/93	
FS2071	93.16862	AS	ETVAA	10.6	2.1	UG/G	9/14/93	
FS2071	93.16862	BA	ICPES	300.	30.	UG/G	10/18/93	
FS2071	93.16862	BE	ICPES	3.2	0.3	UG/G	10/18/93	
FS2071	93.16862	CA	ICPES	11000.	1100.	UG/G	10/18/93	
FS2071	93.16862	CD	ICPES	< 0.4		UG/G	10/18/93	
FS2071	93.16862	CL	IC	13.7	1.4	UG/G	9/10/93	
FS2071	93.16862	CO	ICPES	8.1	0.8	UG/G	10/18/93	
FS2071	93.16862	CR	ICPES	27.	3.	UG/G	10/18/93	
FS2071	93.16862	CU	ICPES	9.	0.9	UG/G	10/18/93	
FS2071	93.16862	FE	ICPES	31000.	3100.	UG/G	10/18/93	
FS2071	93.16862	HG	CVAA	0.2	0.1	UG/G	8/31/93	
FS2071	93.16862	K	ICPES	4300.	430.	UG/G	10/18/93	
FS2071	93.16862	MG	ICPES	12000.	1200.	UG/G	10/18/93	
FS2071	93.16862	MN	ICPES	130.	13.	UG/G	10/18/93	
FS2071	93.16862	NA	ICPES	870.	87.	UG/G	10/18/93	
FS2071	93.16862	NI	ICPES	22.	2.	UG/G	10/18/93	09085HA
FS2071	93.16862	PB	ICPES	22.	2.	UG/G	10/15/93	09085HA
FS2071	93.16862	SB	ICPES	< 5.		UG/G	10/15/93	09085HA-2
FS2071	93.16862	SE	ETVAA	0.9	0.2	UG/G	9/14/93	
FS2071	93.16862	SO4	IC	161.	16.	UG/G	11/19/93	
FS2071	93.16862	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L

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FS2071	93.16862	TH	ICPMS	10.	1.	UG/G	10/15/93	BATCH 09085L
FS2071	93.16862	TL	ICPMS	0.5	0.2	UG/G	10/15/93	BATCH 09085L
FS2071	93.16862	U	ICPMS	0.9	0.2	UG/G	10/15/93	BATCH 09085L
FS2071	93.16862	V	ICPES	53.	5.	UG/G	10/18/93	09085HA
FS2071	93.16862	ZN	ICPES	64.	6.	UG/G	10/18/93	09085HA
FS2072	93.16863	AL	ICPES	21000.	2100.	UG/G	10/18/93	09085HA
FS2072	93.16863	AS	ETVAA	5.4	1.	UG/G	9/14/93	
FS2072	93.16863	BA	ICPES	180.	18.	UG/G	10/18/93	09085HA
FS2072	93.16863	BE	ICPES	1.	0.1	UG/G	10/18/93	09085HA
FS2072	93.16863	CA	ICPES	2900.	290.	UG/G	10/18/93	09085HA
FS2072	93.16863	CD	ICPES	< 0.4		UG/G	10/18/93	09085HA
FS2072	93.16863	CL	IC	13.	1.3	UG/G	9/10/93	
FS2072	93.16863	CO	ICPES	10.	1.	UG/G	10/18/93	09085HA
FS2072	93.16863	CR	ICPES	10.	1.	UG/G	10/18/93	09085HA
FS2072	93.16863	CU	ICPES	4.5	0.5	UG/G	10/18/93	09085HA
FS2072	93.16863	FE	ICPES	13000.	1300.	UG/G	10/18/93	09085HA
FS2072	93.16863	HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2072	93.16863	K	ICPES	2300.	230.	UG/G	10/18/93	09085HA
FS2072	93.16863	MG	ICPES	2400.	240.	UG/G	10/18/93	09085HA
FS2072	93.16863	MN	ICPES	280.	28.	UG/G	10/18/93	09085HA
FS2072	93.16863	NA	ICPES	540.	54.	UG/G	10/18/93	09085HA
FS2072	93.16863	NI	ICPES	7.	4.	UG/G	10/18/93	09085HA
FS2072	93.16863	PB	ICPES	35.	8.	UG/G	10/15/93	09085HA
FS2072	93.16863	SB	ICPES	< 5.		UG/G	10/15/93	09085HA-2
FS2072	93.16863	SE	ETVAA	0.7	0.2	UG/G	9/14/93	
FS2072	93.16863	SO4	IC	304.	30.	UG/G	11/19/93	
FS2072	93.16863	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2072	93.16863	TH	ICPMS	6.	0.5	UG/G	10/15/93	BATCH 09085L
FS2072	93.16863	TL	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2072	93.16863	U	ICPMS	1.6	0.2	UG/G	10/15/93	BATCH 09085L
FS2072	93.16863	V	ICPES	24.	2.	UG/G	10/18/93	BATCH 09085L
FS2072	93.16863	ZN	ICPES	36.	4.	UG/G	10/18/93	09085HA
FS2073	93.16864	AL	ICPES	17000.	1700.	UG/G	10/18/93	09085HA
FS2073	93.16864	AS	ETVAA	5.1	1.	UG/G	9/14/93	
FS2073	93.16864	BA	ICPES	100.	10.	UG/G	10/18/93	09085HA
FS2073	93.16864	BE	ICPES	0.85	0.09	UG/G	10/18/93	09085HA
FS2073	93.16864	CA	ICPES	1800.	180.	UG/G	10/18/93	09085HA
FS2073	93.16864	CD	ICPES	< 0.4		UG/G	10/18/93	09085HA
FS2073	93.16864	CL	IC	11.4	1.1	UG/G	9/10/93	
FS2073	93.16864	CO	ICPES	18.	2.	UG/G	10/18/93	09085HA
FS2073	93.16864	CR	ICPES	10.	1.	UG/G	10/18/93	09085HA
FS2073	93.16864	CU	ICPES	1.7	0.6	UG/G	10/18/93	09085HA
FS2073	93.16864	FE	ICPES	12000.	1200.	UG/G	10/18/93	09085HA
FS2073	93.16864	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2073	93.16864	K	ICPES	1800.	180.	UG/G	10/18/93	09085HA
FS2073	93.16864	MG	ICPES	2200.	220.	UG/G	10/18/93	09085HA
FS2073	93.16864	MN	ICPES	170.	17.	UG/G	10/18/93	09085HA
FS2073	93.16864	NA	ICPES	130.	13.	UG/G	10/18/93	09085HA
FS2073	93.16864	NI	ICPES	6.	1.	UG/G	10/18/93	09085HA
FS2073	93.16864	PB	ICPES	14.	10.	UG/G	10/15/93	09085HA
FS2073	93.16864	SB	ICPES	< 5.		UG/G	10/15/93	09085HA-2
FS2073	93.16864	SE	ETVAA	0.7	0.2	UG/G	9/14/93	
FS2073	93.16864	SO4	IC	27.	2.7	UG/G	11/19/93	
FS2073	93.16864	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2073	93.16864	TH	ICPMS	8.	1.	UG/G	10/15/93	BATCH 09085L
FS2073	93.16864	TL	ICPMS	0.3	0.2	UG/G	10/15/93	BATCH 09085L
FS2073	93.16864	U	ICPMS	1.	0.3	UG/G	10/15/93	BATCH 09085L
FS2073	93.16864	V	ICPES	23.	2.	UG/G	10/18/93	09085HA
FS2073	93.16864	ZN	ICPES	25.	3.	UG/G	10/18/93	09085HA
FS2074	93.16865	AL	ICPES	1900.	190.	UG/G	10/18/93	

FS2074	93.16865	AS	ETVAA	1.5	0.3	UG/G	9/14/93	
FS2074	93.16865	BA	ICPES	4.8	0.5	UG/G	10/18/93	
FS2074	93.16865	BE	ICPES	0.29	0.03	UG/G	10/18/93	
FS2074	93.16865	CA	ICPES	200.	20.	UG/G	10/18/93	
FS2074	93.16865	CD	ICPES	< 0.4		UG/G	1/10/94	
FS2074	93.16865	CL	IC	31.7	3.2	UG/G	9/10/93	
FS2074	93.16865	CO	ICPES	46.	5.	UG/G	1/10/94	
FS2074	93.16865	CR	ICPES	< 0.5		UG/G	1/10/94	
FS2074	93.16865	CU	ICPES	< 0.5		UG/G	1/10/94	
FS2074	93.16865	FE	ICPES	5400.	540.	UG/G	1/10/94	
FS2074	93.16865	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2074	93.16865	K	ICPES	970.	97.	UG/G	1/10/94	
FS2074	93.16865	MG	ICPES	180.	18.	UG/G	1/10/94	
FS2074	93.16865	MN	ICPES	180.	18.	UG/G	1/10/94	
FS2074	93.16865	NA	ICPES	810.	81.	UG/G	1/10/94	
FS2074	93.16865	NI	ICPES	< 2.		UG/G	1/10/94	
FS2074	93.16865	PB	ICPMS	3.	0.4	UG/G	10/15/93	BATCH 09085L
FS2074	93.16865	SB	ICPES	< 5.		UG/G	10/15/93	
FS2074	93.16865	SE	ETVAA	< 0.2		UG/G	9/14/93	
FS2074	93.16865	SO4	IC	19.	2.	UG/G	11/19/93	
FS2074	93.16865	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2074	93.16865	TH	ICPMS	5.	0.4	UG/G	10/15/93	BATCH 09085L
FS2074	93.16865	TL	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2074	93.16865	U	ICPMS	0.9	0.2	UG/G	10/15/93	BATCH 09085L
FS2074	93.16865	V	ICPES	2.8	0.3	UG/G	1/10/94	
FS2074	93.16865	ZN	ICPES	26.	3.	UG/G	1/10/94	
FS2075	93.16866	AL	ICPES	14000.	1400.	UG/G	10/18/93	09085HA
FS2075	93.16866	AS	ETVAA	3.9	0.8	UG/G	9/14/93	
FS2075	93.16866	BA	ICPES	24.	2.	UG/G	10/18/93	09085HA
FS2075	93.16866	BE	ICPES	0.86	0.09	UG/G	10/18/93	09085HA
FS2075	93.16866	CA	ICPES	1700.	170.	UG/G	10/18/93	09085HA
FS2075	93.16866	CD	ICPES	< 0.4		UG/G	10/18/93	09085HA
FS2075	93.16866	CL	IC	574.	57.	UG/G	9/10/93	
FS2075	93.16866	CO	ICPES	21.	2.	UG/G	10/18/93	09085HA
FS2075	93.16866	CR	ICPES	6.	0.9	UG/G	10/18/93	09085HA
FS2075	93.16866	CU	ICPES	3.9	0.4	UG/G	10/18/93	09085HA
FS2075	93.16866	FE	ICPES	11000.	1100.	UG/G	10/18/93	09085HA
FS2075	93.16866	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2075	93.16866	K	ICPES	1200.	120.	UG/G	10/18/93	09085HA
FS2075	93.16866	MG	ICPES	2200.	220.	UG/G	10/18/93	09085HA
FS2075	93.16866	MN	ICPES	88.	9.	UG/G	10/18/93	09085HA
FS2075	93.16866	NA	ICPES	670.	67.	UG/G	10/18/93	09085HA
FS2075	93.16866	NI	ICPES	7.	3.	UG/G	10/18/93	09085HA
FS2075	93.16866	PB	ICPES	13.	4.	UG/G	10/15/93	09085HA
FS2075	93.16866	SB	ICPES	< 5.		UG/G	10/15/93	09085HA-2
FS2075	93.16866	SE	ETVAA	0.3	0.2	UG/G	9/14/93	
FS2075	93.16866	SO4	IC	342.	34.	UG/G	11/19/93	
FS2075	93.16866	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2075	93.16866	TH	ICPMS	5.	0.5	UG/G	10/15/93	BATCH 09085L
FS2075	93.16866	TL	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2075	93.16866	U	ICPMS	0.6	0.2	UG/G	10/15/93	BATCH 09085L
FS2075	93.16866	V	ICPES	14.	1.	UG/G	10/18/93	09085HA
FS2075	93.16866	ZN	ICPES	43.	4.	UG/G	10/18/93	09085HA
FS2076	93.16867	AL	ICPES	56000.	5600.	UG/G	10/18/93	09085HA
FS2076	93.16867	AS	ETVAA	13.6	2.7	UG/G	9/14/93	
FS2076	93.16867	BA	ICPES	89.	9.	UG/G	10/18/93	09085HA
FS2076	93.16867	BE	ICPES	3.4	0.3	UG/G	10/18/93	09085HA
FS2076	93.16867	CA	ICPES	6200.	620.	UG/G	10/18/93	09085HA
FS2076	93.16867	CD	ICPES	< 0.4		UG/G	10/18/93	09085HA
FS2076	93.16867	CL	IC	724.	72.	UG/G	9/10/93	

FS2076	93.16867 CO	ICPES	27.	3.	UG/G	10/18/93	09085HA
FS2076	93.16867 CR	ICPES	24.	2.	UG/G	10/18/93	09085HA
FS2076	93.16867 CU	ICPES	15.	3.	UG/G	10/18/93	09085HA
FS2076	93.16867 FE	ICPES	30000.	3000.	UG/G	10/18/93	09085HA
FS2076	93.16867 HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2076	93.16867 K	ICPES	4600.	460.	UG/G	10/18/93	09085HA
FS2076	93.16867 MG	ICPES	7000.	700.	UG/G	10/18/93	09085HA
FS2076	93.16867 MN	ICPES	520.	52.	UG/G	10/18/93	09085HA
FS2076	93.16867 NA	ICPES	2000.	200.	UG/G	10/18/93	09085HA
FS2076	93.16867 NI	ICPES	25.	3.	UG/G	10/18/93	09085HA
FS2076	93.16867 PB	ICPES	31.	8.	UG/G	10/15/93	09085HA
FS2076	93.16867 SB	ICPES	< 5.		UG/G	10/15/93	09085HA-2
FS2076	93.16867 SE	ETVAA	2.4	0.5	UG/G	9/14/93	
FS2076	93.16867 SO4	IC	462.	46.	UG/G	11/19/93	
FS2076	93.16867 TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2076	93.16867 TH	ICPMS	15.	2.	UG/G	10/15/93	BATCH 09085L
FS2076	93.16867 TL	ICPMS	0.7	0.2	UG/G	10/15/93	BATCH 09085L
FS2076	93.16867 U	ICPMS	2.	0.5	UG/G	10/15/93	BATCH 09085L
FS2076	93.16867 V	ICPES	47.	5.	UG/G	10/18/93	09085HA
FS2076	93.16867 ZN	ICPES	66.	6.	UG/G	10/18/93	09085HA
FS2077	93.16868 AL	ICPES	3500.	350.	UG/G	10/18/93	09085HA
FS2077	93.16868 AS	ETVAA	0.8	0.2	UG/G	9/14/93	
FS2077	93.16868 BA	ICPES	27.	3.	UG/G	10/18/93	09085HA
FS2077	93.16868 BE	ICPES	0.31	0.03	UG/G	10/18/93	09085HA
FS2077	93.16868 CA	ICPES	1100.	110.	UG/G	10/18/93	09085HA
FS2077	93.16868 CD	ICPES	< 0.4		UG/G	10/18/93	09085HA
FS2077	93.16868 CL	IC	16.4	1.6	UG/G	9/10/93	
FS2077	93.16868 CO	ICPES	29.	3.	UG/G	10/18/93	09085HA
FS2077	93.16868 CR	ICPES	1.9	0.8	UG/G	10/18/93	09085HA
FS2077	93.16868 CU	ICPES	< 0.5		UG/G	10/18/93	09085HA
FS2077	93.16868 FE	ICPES	3300.	330.	UG/G	10/18/93	09085HA
FS2077	93.16868 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2077	93.16868 K	ICPES	750.	84.	UG/G	10/18/93	09085HA
FS2077	93.16868 MG	ICPES	880.	88.	UG/G	10/18/93	09085HA
FS2077	93.16868 MN	ICPES	140.	14.	UG/G	10/18/93	09085HA
FS2077	93.16868 NA	ICPES	660.	66.	UG/G	10/18/93	09085HA
FS2077	93.16868 NI	ICPES	< 2.		UG/G	10/18/93	09085HA
FS2077	93.16868 PB	ICPES	< 4.		UG/G	10/15/93	09085HA
FS2077	93.16868 SB	ICPES	< 5.		UG/G	10/15/93	09085HA-2
FS2077	93.16868 SE	ETVAA	< 0.2		UG/G	9/14/93	
FS2077	93.16868 SO4	IC	20.	2.	UG/G	11/19/93	
FS2077	93.16868 TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2077	93.16868 TH	ICPMS	2.	0.2	UG/G	10/15/93	BATCH 09085L
FS2077	93.16868 TL	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2077	93.16868 U	ICPMS	0.2	0.2	UG/G	10/15/93	BATCH 09085L
FS2077	93.16868 V	ICPES	4.6	0.5	UG/G	10/18/93	09085HA
FS2077	93.16868 ZN	ICPES	14.	1.	UG/G	10/18/93	09085HA
FS2078	93.16869 AL	ICPES	4400.	440.	UG/G	10/18/93	09085HA
FS2078	93.16869 AS	ETVAA	0.7	0.2	UG/G	12/17/93	
FS2078	93.16869 BA	ICPES	31.	3.	UG/G	10/18/93	09085HA
FS2078	93.16869 BE	ICPES	0.42	0.04	UG/G	10/18/93	09085HA
FS2078	93.16869 CA	ICPES	900.	90.	UG/G	10/18/93	09085HA
FS2078	93.16869 CD	ICPES	< 0.4		UG/G	10/18/93	09085HA
FS2078	93.16869 CL	IC	58.9	5.9	UG/G	9/10/93	
FS2078	93.16869 CO	ICPES	34.	3.	UG/G	10/18/93	09085HA
FS2078	93.16869 CR	ICPES	2.1	0.2	UG/G	10/18/93	09085HA
FS2078	93.16869 CU	ICPES	< 0.5		UG/G	10/18/93	09085HA
FS2078	93.16869 FE	ICPES	3300.	330.	UG/G	10/18/93	09085HA
FS2078	93.16869 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2078	93.16869 K	ICPES	1100.	110.	UG/G	10/18/93	09085HA

FS2078	93.16869	MG	ICPES	900.	90.	UG/G	10/18/93	09085HA
FS2078	93.16869	MN	ICPES	140.	14.	UG/G	10/18/93	09085HA
FS2078	93.16869	NA	ICPES	770.	77.	UG/G	10/18/93	09085HA
FS2078	93.16869	NI	ICPES	< 2.		UG/G	10/18/93	09085HA
FS2078	93.16869	PB	ICPES	7.	2.	UG/G	10/18/93	09085HA
FS2078	93.16869	SE	ETVAA	< 0.2		UG/G	12/17/93	
FS2078	93.16869	SO4	IC	16.	1.6	UG/G	11/19/93	
FS2078	93.16869	TA	ICPMS	< 0.12		UG/G	1/13/94	
FS2078	93.16869	TH	ICPMS	3.4	0.2	UG/G	1/13/94	
FS2078	93.16869	U	ICPMS	0.4	0.04	UG/G	1/13/94	
FS2078	93.16869	V	ICPES	4.4	0.4	UG/G	10/18/93	09085HA
FS2078	93.16869	ZN	ICPES	19.	2.	UG/G	10/18/93	09085HA
FS2079	93.16870	AL	ICPES	3700.	370.	UG/G	10/18/93	09085HA
FS2079	93.16870	AS	ETVAA	0.9	0.2	UG/G	12/17/93	
FS2079	93.16870	BA	ICPES	35.	4.	UG/G	10/18/93	09085HA
FS2079	93.16870	BE	ICPES	0.32	0.03	UG/G	10/18/93	09085HA
FS2079	93.16870	CA	ICPES	1500.	150.	UG/G	10/18/93	09085HA
FS2079	93.16870	CD	ICPES	< 0.4		UG/G	10/18/93	09085HA
FS2079	93.16870	CL	IC	15.7	1.6	UG/G	9/10/93	
FS2079	93.16870	CO	ICPES	24.	2.	UG/G	10/18/93	09085HA
FS2079	93.16870	CR	ICPES	2.	0.3	UG/G	10/18/93	09085HA
FS2079	93.16870	CU	ICPES	3.1	2.7	UG/G	10/18/93	09085HA
FS2079	93.16870	FE	ICPES	3800.	380.	UG/G	10/18/93	09085HA
FS2079	93.16870	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2079	93.16870	K	ICPES	1100.	110.	UG/G	10/18/93	09085HA
FS2079	93.16870	MG	ICPES	910.	91.	UG/G	10/18/93	09085HA
FS2079	93.16870	MN	ICPES	150.	15.	UG/G	10/18/93	09085HA
FS2079	93.16870	NA	ICPES	830.	83.	UG/G	10/18/93	09085HA
FS2079	93.16870	NI	ICPES	6.	3.	UG/G	10/18/93	09085HA
FS2079	93.16870	PB	ICPES	24.	12.	UG/G	10/18/93	09085HA
FS2079	93.16870	SB	ICPES	< 5.		UG/G	11/01/93	09085HA-2
FS2079	93.16870	SE	ETVAA	< 0.2		UG/G	12/17/93	
FS2079	93.16870	SO4	IC	19.	2.	UG/G	11/19/93	
FS2079	93.16870	TA	ICPMS	< 0.125		UG/G	1/13/94	
FS2079	93.16870	TH	ICPMS	2.5	0.2	UG/G	1/13/94	
FS2079	93.16870	TL	ICPMS	< 0.125		UG/G	1/13/94	
FS2079	93.16870	U	ICPMS	0.6	0.04	UG/G	1/13/94	
FS2079	93.16870	V	ICPES	4.	1.	UG/G	10/18/93	09085HA
FS2079	93.16870	ZN	ICPES	21.	2.	UG/G	10/18/93	09085HA

CUSTOMER SAMPLE DUPLICATES:

CUSTOMER NUM	SAMPLE NUM	ANALYSIS	ANALYTICAL TECHNIQUE	ANALYTICAL RESULT	ANALYTICAL UNCERTAINTY	UNITS	COMPLETION DATE	COMMENT
FS2000	93.16797	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2000	93.16797	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2001	93.16798	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2001	93.16798	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2002	93.16799	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2002	93.16799	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2003	93.16800	AS	ETVAA	6.4	1.3	UG/G	9/07/93	
FS2003	93.16800	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2003	93.16800	HG	CVAA	< 0.1		UG/G	8/27/93	
FS2003	93.16800	SB	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2003	93.16800	SE	ETVAA	0.34	0.3	UG/G	9/07/93	
FS2003	93.16800	TA	ICPMS	< 0.2		UG/G	10/19/93	08275LA
FS2003	93.16800	TH	ICPMS	8.	0.2	UG/G	10/19/93	08275LA
FS2003	93.16800	TL	ICPMS	0.4	0.2	UG/G	10/19/93	08275LA

FS2003	93.16800 U	ICPMS	1.6	0.3	UG/G	10/19/93	08275LA
FS2004	93.16801 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2004	93.16801 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2005	93.16802 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2005	93.16802 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2006	93.16803 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2006	93.16803 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2007	93.16804 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2007	93.16804 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2008	93.16805 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2008	93.16805 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2009	93.16806 AL	ICPES	14000.	1400.	UG/G	9/09/93	08275HA
FS2009	93.16806 BA	ICPES	110.	11.	UG/G	9/09/93	08275HA
FS2009	93.16806 BE	ICPES	0.92	0.09	UG/G	9/09/93	08275HA
FS2009	93.16806 CA	ICPES	1800.	180.	UG/G	9/09/93	08275HA
FS2009	93.16806 CD	ICPES	< 0.4		UG/G	9/09/93	08275HA
FS2009	93.16806 CO	ICPES	8.3	0.8	UG/G	9/09/93	08275HA
FS2009	93.16806 CR	ICPES	12.	1.	UG/G	9/09/93	08275HA
FS2009	93.16806 CU	ICPES	8.8	0.9	UG/G	9/09/93	08275HA
FS2009	93.16806 FE	ICPES	9600.	960.	UG/G	9/09/93	08275HA
FS2009	93.16806 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2009	93.16806 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2009	93.16806 K	ICPES	2800.	280.	UG/G	9/09/93	08275HA
FS2009	93.16806 MG	ICPES	2700.	270.	UG/G	9/09/93	08275HA
FS2009	93.16806 MN	ICPES	100.	10.	UG/G	9/09/93	08275HA
FS2009	93.16806 NA	ICPES	220.	22.	UG/G	9/09/93	08275HA
FS2009	93.16806 NI	ICPES	6.5	0.7	UG/G	9/09/93	08275HA
FS2009	93.16806 PB	ICPES	10.	3.	UG/G	9/09/93	08275HA
FS2009	93.16806 SB	ICPES	< 5.		UG/G	9/09/93	08275HA
FS2009	93.16806 V	ICPES	17.	2.	UG/G	9/09/93	08275HA
FS2009	93.16806 ZN	ICPES	38.	4.	UG/G	9/09/93	08275HA
FS2010	93.16807 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2010	93.16807 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2011	93.16808 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2011	93.16808 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2012	93.16809 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2012	93.16809 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2013	93.16810 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2013	93.16810 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2014	93.16811 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2014	93.16811 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2015	93.16812 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2015	93.16812 HG	CVAA	< 0.1		UG/G	8/27/93	
FS2016	93.16813 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2016	93.16813 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2017	93.16814 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2017	93.16814 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2018	93.16815 AS	ETVAA	2.5	0.5	UG/G	9/08/93	
FS2018	93.16815 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2018	93.16815 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2018	93.16815 SB	ICPMS	< 0.2		UG/G	10/19/93	08315LA
FS2018	93.16815 SE	ETVAA	0.5	0.2	UG/G	9/08/93	
FS2018	93.16815 TA	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2018	93.16815 TH	ICPMS	5.	0.5	UG/G	9/23/93	08315LA
FS2018	93.16815 TL	ICPMS	< 0.2		UG/G	9/23/93	08315LA
FS2018	93.16815 U	ICPMS	2.4	0.3	UG/G	9/23/93	08315LA
FS2019	93.16816 AL	ICPES	7600.	760.	UG/G	9/09/93	08315HA
FS2019	93.16816 BA	ICPES	61.	6.	UG/G	9/09/93	08315HA
FS2019	93.16816 BE	ICPES	0.53	0.05	UG/G	9/09/93	08315HA
FS2019	93.16816 CA	ICPES	2200.	220.	UG/G	9/09/93	08315HA

FS2019	93.16816 CD	ICPES	< 0.4		UG/G	9/09/93	08315HA
FS2019	93.16816 CO	ICPES	11.	1.	UG/G	9/09/93	08315HA
FS2019	93.16816 CR	ICPES	5.	0.5	UG/G	9/09/93	08315HA
FS2019	93.16816 CU	ICPES	1.	0.1	UG/G	9/09/93	08315HA
FS2019	93.16816 FE	ICPES	8900.	890.	UG/G	9/09/93	08315HA
FS2019	93.16816 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2019	93.16816 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2019	93.16816 K	ICPES	1500.	150.	UG/G	9/09/93	08315HA
FS2019	93.16816 MG	ICPES	1200.	120.	UG/G	9/09/93	08315HA
FS2019	93.16816 MN	ICPES	430.	43.	UG/G	9/09/93	08315HA
FS2019	93.16816 NA	ICPES	310.	31.	UG/G	9/09/93	08315HA
FS2019	93.16816 NI	ICPES	4.7	0.6	UG/G	9/09/93	08315HA
FS2019	93.16816 PB	ICPES	< 4.		UG/G	9/09/93	08315HA
FS2019	93.16816 SB	ICPES	< 5.		UG/G	9/09/93	08315HA
FS2019	93.16816 V	ICPES	12.	1.	UG/G	9/09/93	08315HA
FS2019	93.16816 ZN	ICPES	38.	4.	UG/G	9/09/93	08315HA
FS2020	93.16817 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2020	93.16817 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2021	93.16818 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2021	93.16818 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2022	93.16819 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2022	93.16819 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2023	93.16820 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2023	93.16820 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2026	93.16821 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2026	93.16821 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2027	93.16822 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2027	93.16822 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2028	93.16823 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2028	93.16823 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2029	93.16824 HG	CVAA	0.2	0.1	UG/G	8/31/93	
FS2029	93.16824 HG	CVAA	0.2	0.1	UG/G	8/31/93	
FS2030	93.16825 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2030	93.16825 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2031	93.16826 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2031	93.16826 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2032	93.16827 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2032	93.16827 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2033	93.16828 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2033	93.16828 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2034	93.16829 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2034	93.16829 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2035	93.16830 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2035	93.16830 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2037	93.16831 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2037	93.16831 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2038	93.16832 HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2038	93.16832 HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2039	93.16833 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2039	93.16833 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2040	93.16834 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2040	93.16834 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2041	93.16835 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2041	93.16835 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2042	93.16836 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2042	93.16836 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2043	93.16837 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2043	93.16837 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2044	93.16838 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2044	93.16838 HG	CVAA	< 0.1		UG/G	8/31/93	

FS2045	93.16839 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2045	93.16839 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2046	93.16840 AL	ICPES	62000.	6200.	UG/G	9/24/93	
FS2046	93.16840 AS	ETVAA	5.7	1.1	UG/G	9/10/93	
FS2046	93.16840 BA	ICPES	320.	32.	UG/G	9/29/93	
FS2046	93.16840 BE	ICPES	3.9	0.4	UG/G	9/24/93	
FS2046	93.16840 CA	ICPES	14000.	1400.	UG/G	9/24/93	
FS2046	93.16840 CD	ICPES	2.5	0.3	UG/G	9/24/93	
FS2046	93.16840 CO	ICPES	12.	1.	UG/G	9/24/93	
FS2046	93.16840 CR	ICPES	36.	4.	UG/G	9/24/93	
FS2046	93.16840 CU	ICPES	16.	2.	UG/G	9/24/93	
FS2046	93.16840 FE	ICPES	36000.	3600.	UG/G	9/24/93	
FS2046	93.16840 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2046	93.16840 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2046	93.16840 K	ICPES	6900.	690.	UG/G	9/24/93	
FS2046	93.16840 MG	ICPES	10000.	1000.	UG/G	9/24/93	
FS2046	93.16840 MN	ICPES	290.	29.	UG/G	9/24/93	
FS2046	93.16840 NA	ICPES	1800.	180.	UG/G	9/24/93	
FS2046	93.16840 NI	ICPES	30.	3.	UG/G	9/24/93	
FS2046	93.16840 PB	ICPES	26.	7.	UG/G	9/24/93	
FS2046	93.16840 SB	ICPMS	< 0.1		UG/G	10/19/93	09025L
FS2046	93.16840 SE	ETVAA	0.8	0.2	UG/G	9/10/93	
FS2046	93.16840 TA	ICPMS	< 0.2		UG/G	10/15/93	09025L
FS2046	93.16840 TH	ICPMS	10.	1.	UG/G	10/15/93	09025L
FS2046	93.16840 TL	ICPMS	0.7	0.2	UG/G	10/15/93	09025L
FS2046	93.16840 U	ICPMS	1.	0.2	UG/G	10/15/93	09025L
FS2046	93.16840 V	ICPES	57.	6.	UG/G	9/24/93	
FS2046	93.16840 ZN	ICPES	76.	8.	UG/G	9/24/93	
FS2048	93.16841 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2048	93.16841 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2049	93.16842 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2049	93.16842 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2050	93.16843 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2050	93.16843 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2051	93.16844 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2051	93.16844 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2052	93.16845 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2052	93.16845 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2053	93.16846 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2053	93.16846 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2054	93.16847 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2054	93.16847 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2055	93.16848 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2055	93.16848 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2056	93.16849 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2056	93.16849 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2057	93.16850 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2057	93.16850 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2059	93.16851 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2059	93.16851 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2060	93.16852 HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2060	93.16852 HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2061	93.16853 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2061	93.16853 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2062	93.16854 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2062	93.16854 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2063	93.16855 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2063	93.16855 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2064	93.16856 HG	CVAA	< 0.1		UG/G	8/31/93	
FS2064	93.16856 HG	CVAA	< 0.1		UG/G	8/31/93	

FS2065	93.16857	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2065	93.16857	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2066	93.16858	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2066	93.16858	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2067	93.16859	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2067	93.16859	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2068	93.16860	AS	ETVAA	7.7	1.5	UG/G	9/14/93	
FS2068	93.16860	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2068	93.16860	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2068	93.16860	SB	ICPMS	< 0.2		UG/G	10/19/93	09085L
FS2068	93.16860	SE	ETVAA	1.	0.2	UG/G	9/14/93	
FS2068	93.16860	TA	ICPMS	< 0.2		UG/G	10/15/93	BATCH 09085L
FS2068	93.16860	TN	ICPMS	8.	1.	UG/G	10/15/93	BATCH 09085L
FS2068	93.16860	TL	ICPMS	0.4	0.2	UG/G	10/15/93	BATCH 09085L
FS2068	93.16860	U	ICPMS	1.5	0.2	UG/G	10/15/93	BATCH 09085L
FS2070	93.16861	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2070	93.16861	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2071	93.16862	HG	CVAA	0.2	0.1	UG/G	8/31/93	
FS2071	93.16862	HG	CVAA	0.2	0.1	UG/G	8/31/93	
FS2072	93.16863	HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2072	93.16863	HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2073	93.16864	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2073	93.16864	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2074	93.16865	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2074	93.16865	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2075	93.16866	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2075	93.16866	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2076	93.16867	HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2076	93.16867	HG	CVAA	0.1	0.1	UG/G	8/31/93	
FS2077	93.16868	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2077	93.16868	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2078	93.16869	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2078	93.16869	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2079	93.16870	HG	CVAA	< 0.1		UG/G	8/31/93	
FS2079	93.16870	HG	CVAA	< 0.1		UG/G	8/31/93	

MATRIX SPIKES:

CUSTOMER NUM	SAMPLE NUM	ANALYSIS	ANALYTICAL TECHNIQUE	AMOUNT SPIKED	AMOUNT RECOVERED	UNITS	COMPLETION DATE	COMMENT
FS2003	93.16800	AS	ETVAA	10.	7.9	UG/L	9/07/93	
FS2003	93.16800	SE	ETVAA	10.	9.9	UG/L	9/07/93	
FS2018	93.16815	AS	ETVAA	10.	6.	UG/L	9/08/93	
FS2018	93.16815	SE	ETVAA	10.	7.	UG/L	9/08/93	
FS2046	93.16840	SE	ETVAA	10.	3.	UG/L	9/10/93	
FS2068	93.16860	AS	ETVAA	10.	9.9	UG/L	9/14/93	
FS2068	93.16860	SE	ETVAA	10.	2.6	UG/L	9/14/93	

REPORT NUMBER: 22725 (continued)

********** EH-9 QUALITY ASSURANCE REPORT *********

Prepared by: MKOBY on 8-Feb-1994

REQUEST NUMBER: 15463 MATRIX: SS ANALYST: MET PROGRAM CODE: M702

OWNER: Pat A. Longmire GROUP: CST-10 MAIL-STOP: C346 PHONE: 5-6493

NOTEBOOK: R8149 PAGE: 259

SUMMARY OF CONTROL STATUS OF OPEN (NON-BLIND) QC SAMPLES RUN WITH THIS BATCH

SAMPLE NUM	ANALYSIS	ANALYTICAL RESULT	ANALYTICAL UNCERTAINTY	UNITS	QC VALUE	QC UNCERTAINTY	COMPLETION DATE	COMMENT
00.00594	AS	4.1	0.8	UG/G	2.	0.2	9/09/93	WARNING 2-3 SIG
00.00598	AS	3.43	0.69	UG/G	2.51	0.13	9/07/93	UNDER CONTROL
00.00598	AS	2.7	0.5	UG/G	2.51	0.13	9/10/93	UNDER CONTROL
00.00598	AS	2.3	0.5	UG/G	2.51	0.13	9/14/93	UNDER CONTROL
00.00598	PB	8.3	1.6	UG/G	14.	3.	11/18/93	UNDER CONTROL
00.00598	TL	94.	38.	NG/G	180.		11/18/93	WARNING 2-3 SIG
00.23669	CL	47.	5.	MG/L	51.4	1.85	9/10/93	UNDER CONTROL
00.23669	SO4	18.	2.	MG/L	20.	1.42	11/19/93	UNDER CONTROL
00.28602	AS	66.	13.	UG/L	70.	3.	9/10/93	UNDER CONTROL
00.28602	AS	71.6	14.3	UG/L	70.	3.	9/07/93	UNDER CONTROL
00.28602	AS	64.	13.	UG/L	70.	3.	9/08/93	UNDER CONTROL
00.28602	SE	48.8	9.8	UG/L	50.	2.	9/07/93	UNDER CONTROL
00.28602	SE	49.	10.	UG/L	50.	2.	9/10/93	UNDER CONTROL
00.28602	SE	50.	10.	UG/L	50.	2.	9/08/93	UNDER CONTROL

SUMMARY OF CONTROL STATUS OF BLIND QC SAMPLES RUN WITH THIS BATCH

SAMPLE NUM	ANALYSIS	ANALYTICAL RESULT	ANALYTICAL UNCERTAINTY	UNITS	QC VALUE	QC UNCERTAINTY	COMPLETION DATE	COMMENT
93.16880	AL	< 0.1		MG/L	0.0		9/09/93	UNDER CONTROL
93.16880	BA	0.8	0.08	MG/L	0.8	0.03	9/09/93	UNDER CONTROL
93.16880	BE	1.1	0.1	MG/L	1.13	0.05	9/09/93	UNDER CONTROL
93.16880	CA	10.	1.	MG/L	10.02	0.43	9/09/93	UNDER CONTROL
93.16880	CD	0.17	0.02	MG/L	0.2	0.01	9/09/93	UNDER CONTROL
93.16880	CO	3.4	0.3	MG/L	3.76	0.16	9/09/93	UNDER CONTROL
93.16880	CR	0.34	0.03	MG/L	0.37	0.02	9/09/93	UNDER CONTROL
93.16880	CU	0.006	0.001	MG/L	0.0		9/09/93	OUT OF CONTROL
93.16880	FE	2.6	0.3	MG/L	2.68	0.12	9/09/93	UNDER CONTROL
93.16880	K	1.	0.7	MG/L	1.	0.04	9/09/93	UNDER CONTROL

93.16880 MG	10.	1.	MG/L	10.03	0.43	9/09/93	UNDER CONTROL
93.16880 MN	4.3	0.4	MG/L	4.4	0.19	9/09/93	UNDER CONTROL
93.16880 NA	1.1	0.1	MG/L	1.	0.04	9/09/93	UNDER CONTROL
93.16880 NI	2.2	0.2	MG/L	2.1	0.09	9/09/93	UNDER CONTROL
93.16880 PB	1.	0.1	MG/L	1.01	0.04	9/09/93	UNDER CONTROL
93.16880 SB	< 0.04		MG/L	0.0		9/09/93	UNDER CONTROL
93.16880 V	0.2	0.02	MG/L	0.2	0.01	9/09/93	UNDER CONTROL
93.16880 ZN	0.3	0.03	MG/L	0.2	0.01	9/09/93	OUT OF CONTROL
93.16882 AL	1.	0.1	MG/L	1.	0.04	9/09/93	UNDER CONTROL
93.16882 BA	0.1	0.01	MG/L	0.1	0.004	9/09/93	UNDER CONTROL
93.16882 BE	0.46	0.05	MG/L	0.5	0.02	9/09/93	UNDER CONTROL
93.16882 CA	42.	4.	MG/L	50.12	2.16	9/09/93	UNDER CONTROL
93.16882 CD	< 0.003		MG/L	0.0		9/09/93	UNDER CONTROL
93.16882 CO	< 0.004		MG/L	0.0		9/09/93	UNDER CONTROL
93.16882 CR	0.11	0.01	MG/L	0.12	0.01	9/09/93	UNDER CONTROL
93.16882 CU	3.3	0.3	MG/L	3.51	0.15	9/09/93	UNDER CONTROL
93.16882 FE	0.29	0.03	MG/L	0.2	0.01	9/09/93	WARNING 2-3 SIG
93.16882 K	3.5	0.4	MG/L	3.99	0.17	9/09/93	UNDER CONTROL
93.16882 MG	4.5	0.5	MG/L	4.82	0.21	9/09/93	UNDER CONTROL
93.16882 MN	2.9	0.3	MG/L	3.3	0.14	9/09/93	UNDER CONTROL
93.16882 NA	5.4	0.5	MG/L	4.	0.17	9/09/93	WARNING 2-3 SIG
93.16882 NI	0.77	0.08	MG/L	0.8	0.03	9/09/93	UNDER CONTROL
93.16882 PB	3.1	0.3	MG/L	3.52	0.15	9/09/93	UNDER CONTROL
93.16882 SB	0.36	0.04	MG/L	0.4	0.02	9/09/93	UNDER CONTROL
93.16882 V	2.4	0.2	MG/L	2.7	0.12	9/09/93	UNDER CONTROL
93.16882 ZN	1.	0.1	MG/L	1.1	0.05	9/09/93	UNDER CONTROL
93.16887 AL	73.	7.	MG/L	74.88	3.22	9/29/93	UNDER CONTROL
93.16887 BA	7.5	0.8	MG/L	7.02	0.3	9/29/93	UNDER CONTROL
93.16887 BE	< 0.001		MG/L	0.0		9/29/93	UNDER CONTROL
93.16887 CA	2.	0.2	MG/L	2.	0.09	9/29/93	UNDER CONTROL
93.16887 CD	2.	0.2	MG/L	1.74	0.07	9/29/93	UNDER CONTROL
93.16887 CO	0.37	0.04	MG/L	0.38	0.02	9/29/93	UNDER CONTROL
93.16887 CR	4.1	0.4	MG/L	3.99	0.17	9/29/93	UNDER CONTROL
93.16887 CU	3.2	0.3	MG/L	3.01	0.13	9/29/93	UNDER CONTROL
93.16887 FE	4.2	0.4	MG/L	4.18	0.18	9/29/93	UNDER CONTROL
93.16887 K	20.	2.	MG/L	19.95	0.86	9/29/93	UNDER CONTROL
93.16887 MG	2.5	0.3	MG/L	2.41	0.1	9/29/93	UNDER CONTROL
93.16887 MN	< 0.002		MG/L	0.0		9/29/93	UNDER CONTROL
93.16887 NA	5.	0.5	MG/L	4.5	0.19	9/29/93	UNDER CONTROL
93.16887 NI	0.11	0.01	MG/L	0.1	0.004	9/29/93	UNDER CONTROL
93.16887 PB	3.9	0.4	MG/L	4.53	0.19	1/10/94	UNDER CONTROL
93.16887 SB	0.22	0.02	MG/L	0.2	0.01	9/29/93	UNDER CONTROL
93.16887 V	1.3	0.1	MG/L	1.3	0.06	9/29/93	UNDER CONTROL
93.16887 ZN	1.	0.1	MG/L	0.95	0.04	9/29/93	UNDER CONTROL
93.16892 AL	35.	4.	MG/L	49.92	2.15	10/18/93	OUT OF CONTROL
93.16892 BA	< 0.001		MG/L	0.0		10/18/93	UNDER CONTROL
93.16892 BE	0.055	0.006	MG/L	0.08	0.003	10/18/93	OUT OF CONTROL
93.16892 CA	2.1	0.2	MG/L	2.51	0.11	10/18/93	UNDER CONTROL
93.16892 CD	1.	0.1	MG/L	1.49	0.06	10/18/93	OUT OF CONTROL
93.16892 CO	0.067	0.007	MG/L	0.1	0.004	10/18/93	OUT OF CONTROL
93.16892 CR	2.	0.2	MG/L	2.99	0.13	10/18/93	OUT OF CONTROL
93.16892 CU	1.8	0.2	MG/L	2.51	0.11	10/18/93	OUT OF CONTROL
93.16892 FE	1.2	0.1	MG/L	1.69	0.07	10/18/93	OUT OF CONTROL
93.16892 K	2.1	1.7	MG/L	2.99	0.13	10/18/93	UNDER CONTROL
93.16892 MG	0.38	0.04	MG/L	0.0		10/18/93	OUT OF CONTROL
93.16892 MN	1.5	0.2	MG/L	2.2	0.09	10/18/93	OUT OF CONTROL
93.16892 NA	2.1	0.2	MG/L	3.	0.13	10/18/93	OUT OF CONTROL
93.16892 NI	2.9	0.3	MG/L	4.1	0.18	10/18/93	OUT OF CONTROL
93.16892 PB	1.4	0.1	MG/L	2.01	0.09	10/18/93	OUT OF CONTROL
93.16892 SB	1.1	0.1	MG/L	1.5	0.06	10/18/93	OUT OF CONTROL

93.16892 V	2.3	0.2	MG/L	3.2	0.14	10/18/93	OUT OF CONTROL
93.16892 ZN	1.2	0.1	MG/L	1.87	0.08	10/18/93	OUT OF CONTROL
93.16893 AL	22.	2.	MG/L	24.96	1.07	10/18/93	UNDER CONTROL
93.16893 BA	4.6	0.5	MG/L	5.01	0.22	10/18/93	UNDER CONTROL
93.16893 BE	1.5	0.2	MG/L	1.75	0.08	10/18/93	UNDER CONTROL
93.16893 CA	3.2	0.3	MG/L	3.01	0.13	10/18/93	UNDER CONTROL
93.16893 CD	0.85	0.09	MG/L	1.	0.04	10/18/93	UNDER CONTROL
93.16893 CO	4.2	0.4	MG/L	5.02	0.22	10/18/93	UNDER CONTROL
93.16893 CR	1.7	0.2	MG/L	1.99	0.09	10/18/93	UNDER CONTROL
93.16893 CU	1.4	0.1	MG/L	1.5	0.06	10/18/93	UNDER CONTROL
93.16893 FE	1.1	0.1	MG/L	1.19	0.05	10/18/93	UNDER CONTROL
93.16893 K	12.	1.	MG/L	14.96	0.64	10/18/93	WARNING 2-3 SIG
93.16893 MG	1.	0.1	MG/L	0.6	0.03	10/18/93	OUT OF CONTROL
93.16893 MN	1.5	0.2	MG/L	1.65	0.07	10/18/93	UNDER CONTROL
93.16893 NA	< 0.1		MG/L	0.0		10/18/93	UNDER CONTROL
93.16893 NI	2.4	0.2	MG/L	2.7	0.12	10/18/93	UNDER CONTROL
93.16893 PB	3.5	0.4	MG/L	4.03	0.17	10/18/93	UNDER CONTROL
93.16893 SB	3.4	0.3	MG/L	3.75	0.16	10/18/93	UNDER CONTROL
93.16893 V	1.4	0.1	MG/L	1.6	0.07	10/18/93	UNDER CONTROL
93.16893 ZN	1.3	0.1	MG/L	1.55	0.07	10/18/93	WARNING 2-3 SIG
93.16897 AL	4.3	0.4	MG/L	4.99	0.21	10/18/93	UNDER CONTROL
93.16897 BA	2.9	0.3	MG/L	3.21	0.14	10/18/93	UNDER CONTROL
93.16897 BE	1.4	0.1	MG/L	1.63	0.07	10/18/93	UNDER CONTROL
93.16897 CA	3.4	0.3	MG/L	3.51	0.15	10/18/93	UNDER CONTROL
93.16897 CD	0.5	0.05	MG/L	0.6	0.03	10/18/93	UNDER CONTROL
93.16897 CO	3.6	0.4	MG/L	4.52	0.19	10/18/93	WARNING 2-3 SIG
93.16897 CR	0.82	0.08	MG/L	1.	0.04	10/18/93	WARNING 2-3 SIG
93.16897 CU	0.89	0.09	MG/L	1.	0.04	10/18/93	UNDER CONTROL
93.16897 FE	3.	0.3	MG/L	3.18	0.14	10/18/93	UNDER CONTROL
93.16897 K	< 0.6		MG/L	0.0		10/18/93	UNDER CONTROL
93.16897 MG	0.79	0.08	MG/L	0.4	0.02	10/18/93	OUT OF CONTROL
93.16897 MN	0.93	0.09	MG/L	1.1	0.05	10/18/93	UNDER CONTROL
93.16897 NA	1.7	0.2	MG/L	2.	0.09	10/18/93	UNDER CONTROL
93.16897 NI	0.075	0.009	MG/L	0.0		10/18/93	OUT OF CONTROL
93.16897 PB	1.3	0.1	MG/L	1.51	0.06	10/18/93	UNDER CONTROL
93.16897 SB	4.4	0.4	MG/L	5.	0.22	10/18/93	UNDER CONTROL
93.16897 V	0.69	0.07	MG/L	0.8	0.03	10/18/93	UNDER CONTROL
93.16897 ZN	< 0.01		MG/L	0.0		10/18/93	UNDER CONTROL
93.16900 AL	2.2	0.2	MG/L	2.	0.09	1/10/94	UNDER CONTROL
93.16900 BA	0.38	0.04	MG/L	0.4	0.02	1/10/94	UNDER CONTROL
93.16900 BE	0.78	0.08	MG/L	0.88	0.04	1/10/94	UNDER CONTROL
93.16900 CA	0.16	0.02	MG/L	0.0		1/10/94	OUT OF CONTROL
93.16900 CD	0.06	0.01	MG/L	0.1	0.004	1/10/94	OUT OF CONTROL
93.16900 CO	2.2	0.2	MG/L	2.51	0.11	1/10/94	UNDER CONTROL
93.16900 CR	< 0.004		MG/L	0.0		1/10/94	UNDER CONTROL
93.16900 CU	3.5	0.4	MG/L	4.01	0.17	1/10/94	UNDER CONTROL
93.16900 FE	0.73	0.07	MG/L	0.7	0.03	1/10/94	UNDER CONTROL
93.16900 K	5.	0.5	MG/L	4.99	0.21	1/10/94	UNDER CONTROL
93.16900 MG	3.7	0.4	MG/L	3.76	0.16	1/10/94	UNDER CONTROL
93.16900 MN	3.4	0.3	MG/L	3.85	0.17	1/10/94	UNDER CONTROL
93.16900 NA	4.3	0.4	MG/L	5.01	0.22	1/10/94	UNDER CONTROL
93.16900 NI	0.26	0.03	MG/L	0.3	0.01	1/10/94	UNDER CONTROL
93.16900 PB	2.4	0.2	MG/L	2.52	0.11	1/10/94	UNDER CONTROL
93.16900 SB	0.68	0.08	MG/L	0.75	0.03	1/10/94	UNDER CONTROL
93.16900 V	2.2	0.2	MG/L	2.4	0.1	1/10/94	UNDER CONTROL
93.16900 ZN	0.45	0.05	MG/L	0.42	0.02	1/10/94	UNDER CONTROL
93.16901 AS	0.0671	0.0134	MG/L	0.07	0.003	9/07/93	UNDER CONTROL
93.16901 SE	0.0701	0.014	MG/L	0.074	0.003	9/07/93	UNDER CONTROL
93.16901 TL	0.057	0.006	MG/L	0.062	0.003	2/08/94	UNDER CONTROL
93.16901 U	< 0.001		MG/L	0.0		10/19/93	UNDER CONTROL

93.16902 AS	0.0703	0.014	MG/L	0.074	0.003	9/09/93	UNDER CONTROL
93.16902 SE	0.082	0.016	MG/L	0.08	0.003	9/09/93	UNDER CONTROL
93.16902 TL	0.058	0.007	MG/L	0.058	0.002	9/20/93	UNDER CONTROL
93.16902 U	0.077	0.008	MG/L	0.08	0.003	9/23/93	UNDER CONTROL
93.16903 AS	0.0824	0.0165	MG/L	0.09	0.004	9/10/93	UNDER CONTROL
93.16903 SE	0.0921	0.018	MG/L	0.098	0.004	9/10/93	UNDER CONTROL
93.16903 TL	0.04	0.003	MG/L	0.034	0.001	10/15/93	UNDER CONTROL
93.16903 U	0.11	0.02	MG/L	0.096	0.004	10/15/93	UNDER CONTROL
93.16904 AS	0.069	0.014	MG/L	0.068	0.003	9/14/93	UNDER CONTROL
93.16904 SE	0.061	0.012	MG/L	0.066	0.003	9/14/93	UNDER CONTROL
93.16904 TL	< 0.001		MG/L	0.0		10/15/93	UNDER CONTROL
93.16904 U	0.1	0.03	MG/L	0.078	0.003	10/15/93	UNDER CONTROL
93.16905 AS	0.087	0.017	MG/L	0.082	0.004	11/15/93	UNDER CONTROL
93.16905 SE	0.074	0.015	MG/L	0.084	0.004	11/15/93	UNDER CONTROL
93.16905 TL	0.05	0.002	MG/L	0.046	0.002	11/17/93	UNDER CONTROL
93.16905 U	0.11	0.011	MG/L	0.088	0.004	11/17/93	UNDER CONTROL
93.16906 AS	< 0.002		MG/L	0.078	0.003	11/15/93	OUT OF CONTROL
93.16906 SE	0.072	0.014	MG/L	0.082	0.004	11/15/93	UNDER CONTROL
93.16906 TL	0.06	0.003	MG/L	0.052	0.002	11/17/93	WARNING 2-3 SIG
93.16906 U	0.1	0.01	MG/L	0.084	0.004	11/17/93	UNDER CONTROL
93.16907 AS	0.088	0.018	MG/L	0.086	0.004	11/15/93	UNDER CONTROL
93.16907 SE	0.081	0.016	MG/L	0.094	0.004	11/15/93	UNDER CONTROL
93.16907 TL	0.047	0.008	MG/L	0.042	0.002	11/17/93	UNDER CONTROL
93.16907 U	0.112	0.011	MG/L	0.092	0.004	11/17/93	UNDER CONTROL
93.16978 CL	47.	5.	MG/L	51.4	1.85	9/10/93	UNDER CONTROL
93.16979 CL	38.	4.	MG/L	41.1	1.48	9/10/93	UNDER CONTROL
93.16980 CL	47.	5.	MG/L	51.4	1.85	9/10/93	UNDER CONTROL
93.16981 CL	37.	4.	MG/L	41.1	1.48	9/10/93	UNDER CONTROL
93.16982 CL	47.	5.	MG/L	51.4	1.85	9/10/93	UNDER CONTROL
93.16983 CL	47.	5.	MG/L	51.4	1.85	9/10/93	UNDER CONTROL
93.16984 CL	37.	4.	MG/L	41.1	1.48	9/10/93	UNDER CONTROL
93.16986 HG	2.5	0.3	UG/G	4.	0.4	8/31/93	WARNING 2-3 SIG
93.16986 HG	2.2	0.2	UG/G	4.	0.4	8/31/93	OUT OF CONTROL
93.16986 HG	2.	0.2	UG/G	4.	0.4	8/31/93	OUT OF CONTROL
93.16987 HG	0.1	0.1	UG/G	0.1	0.01	8/31/93	UNDER CONTROL
93.16987 HG	0.1	0.1	UG/G	0.1	0.01	8/31/93	UNDER CONTROL
93.16987 HG	0.1	0.1	UG/G	0.1	0.01	8/31/93	UNDER CONTROL
93.16988 HG	1.9	0.2	UG/G	3.	0.3	8/31/93	OUT OF CONTROL
93.16988 HG	1.8	0.2	UG/G	3.	0.3	8/31/93	OUT OF CONTROL
93.16988 HG	2.	0.2	UG/G	3.	0.3	8/31/93	WARNING 2-3 SIG
93.16988 HG	1.9	0.2	UG/G	3.	0.3	8/31/93	OUT OF CONTROL
93.16988 HG	1.9	0.2	UG/G	3.	0.3	8/31/93	OUT OF CONTROL
93.16988 HG	1.8	0.2	UG/G	3.	0.3	8/31/93	OUT OF CONTROL
93.16989 HG	3.4	0.3	UG/G	4.99	0.5	8/31/93	WARNING 2-3 SIG
93.16989 HG	2.8	0.3	UG/G	4.99	0.5	8/31/93	OUT OF CONTROL
93.16989 HG	2.9	0.3	UG/G	4.99	0.5	8/31/93	OUT OF CONTROL
93.16989 HG	3.4	0.3	UG/G	4.99	0.5	8/31/93	WARNING 2-3 SIG
93.16989 HG	3.3	0.3	UG/G	4.99	0.5	8/31/93	WARNING 2-3 SIG
93.16989 HG	3.3	0.3	UG/G	4.99	0.5	8/31/93	WARNING 2-3 SIG
93.16991 HG	< 100.		NG/G	25.	2.5	8/31/93	UNDER CONTROL
93.16991 HG	< 100.		NG/G	25.	2.5	8/31/93	UNDER CONTROL
93.16991 HG	< 100.		NG/G	25.	2.5	8/31/93	UNDER CONTROL
93.16992 HG	0.5	0.1	UG/G	0.5	0.05	8/31/93	UNDER CONTROL
93.16992 HG	0.4	0.1	UG/G	0.5	0.05	8/31/93	UNDER CONTROL
93.16992 HG	0.6	0.1	UG/G	0.5	0.05	8/31/93	UNDER CONTROL
93.16993 HG	1.3	0.1	UG/G	1.5	0.15	8/31/93	UNDER CONTROL
93.16993 HG	1.3	0.1	UG/G	1.5	0.15	8/31/93	UNDER CONTROL
93.16993 HG	1.	0.1	UG/G	1.5	0.15	8/31/93	WARNING 2-3 SIG
93.16993 HG	1.2	0.1	UG/G	1.5	0.15	8/31/93	UNDER CONTROL
93.16993 HG	1.2	0.1	UG/G	1.5	0.15	8/31/93	UNDER CONTROL

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