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Chemical Analyses of Soils, Soil Leaches, Rocks, and Stream Sediments from Guam and the Western United States and Sample Location Maps of Guam

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Introduction

A high incidence of neurodegenerative diseases, mainly dementia, parkinsonism, and amyotrophic lateral sclerosis, occurs on the island of Guam (Koerner, 1952, Kurland and others, 1954). High incidences of the diseases are concentrated along the southern coast of Guam, particularly the villages of Umatac, Merizo, and Inarajan (fig. 1). Volcanic rocks underlie the vicinities of the villages. The Northern part of Guam, with lower incidence of the diseases, consists of carbonate rocks. Epidemiological studies beginning in the early 1950's failed to show the cause to be genetic etiology (Plato and others, 1986, Zhang and others, 1990). In recent studies, the search for pathogenic mechanisms has shifted to environmental factors. Some of the studies investigated metal exposure, particularly aluminum and manganese, and deficiencies in calcium and magnesium (Garruto and others, 1984). Aluminum has been shown to have neurotoxic effects (MacDonald and Martin, 1988), and aluminum has been implicated in the pathogenesis of Alzheimer's disease and similar dementia by Perl and others (1982). Studies of soils developed on volcanic rocks on Guam and other islands by Crapper McLachlan and others (1989) found that soils on Guam averaged 42-fold higher yield of elutable aluminum than soils developed on volcanic rocks on Jamaica or Palau. They did not detect unusually high dietary aluminum or low dietary calcium but concluded that the soils and possibly the dusts of Guam might be a major source of aluminum entering the body of the inhabitants.

This study was conducted to investigate the geochemistry of the soils and rocks of the volcanic southern half of the island of Guam, particularly in the vicinity of three villages (Umatac, Merizo, and Inarajan) with high incidence of the diseases. In addition to total chemical analyses of the soils and rocks, leaches of soils were carried out. Because soluble aluminum in the soil was shown by Crapper McLachlan and others (1989) to be unusually high, distilled water leaches of the soils as well as partial sequential leaches, and leaches using simulated lung fluid were carried out.

In order to compare the results of the chemical data of rocks and soils from Guam to other rocks and soils elsewhere, samples of similar rocks and soils were collected in the western United States and similar analyses to those for the Guam samples carried out.

Geology

The island of Guam is located at the southern end of the Mariana fore-arc (fig. 2). The volcanic rocks which occur on the southern portion of Guam consist of, from oldest to youngest, late-middle Eocene Facpi Formation consisting of submarine boninite pillow flows and breccias, tuffaceous shale and sandstone, basaltic to andesitic dikes and minor limestone; the late Eocene to early Oligocene Alutom Formation consisting of tuffaceous shale and sandstone, volcanic breccia, conglomerate, and minor lava flows; and the Miocene Bolanos Formation of tuff breccia, tuffaceous sandstone, lenses of volcanic conglomerate, and minor basalt flows (Tracey and others, 1964; Reagan and Meijer, 1984; Siegrist and Randall, 1992). The Facpi Formation underlies the vicinity of the villages of Umatac and Merizo, and the Bolanas Formation underlies the vicinity of Inarajan (fig. 1). The northern portion of Guam consists of Tertiary to Quaternary carbonate rock (Tracey and others, 1964) (fig. 3).

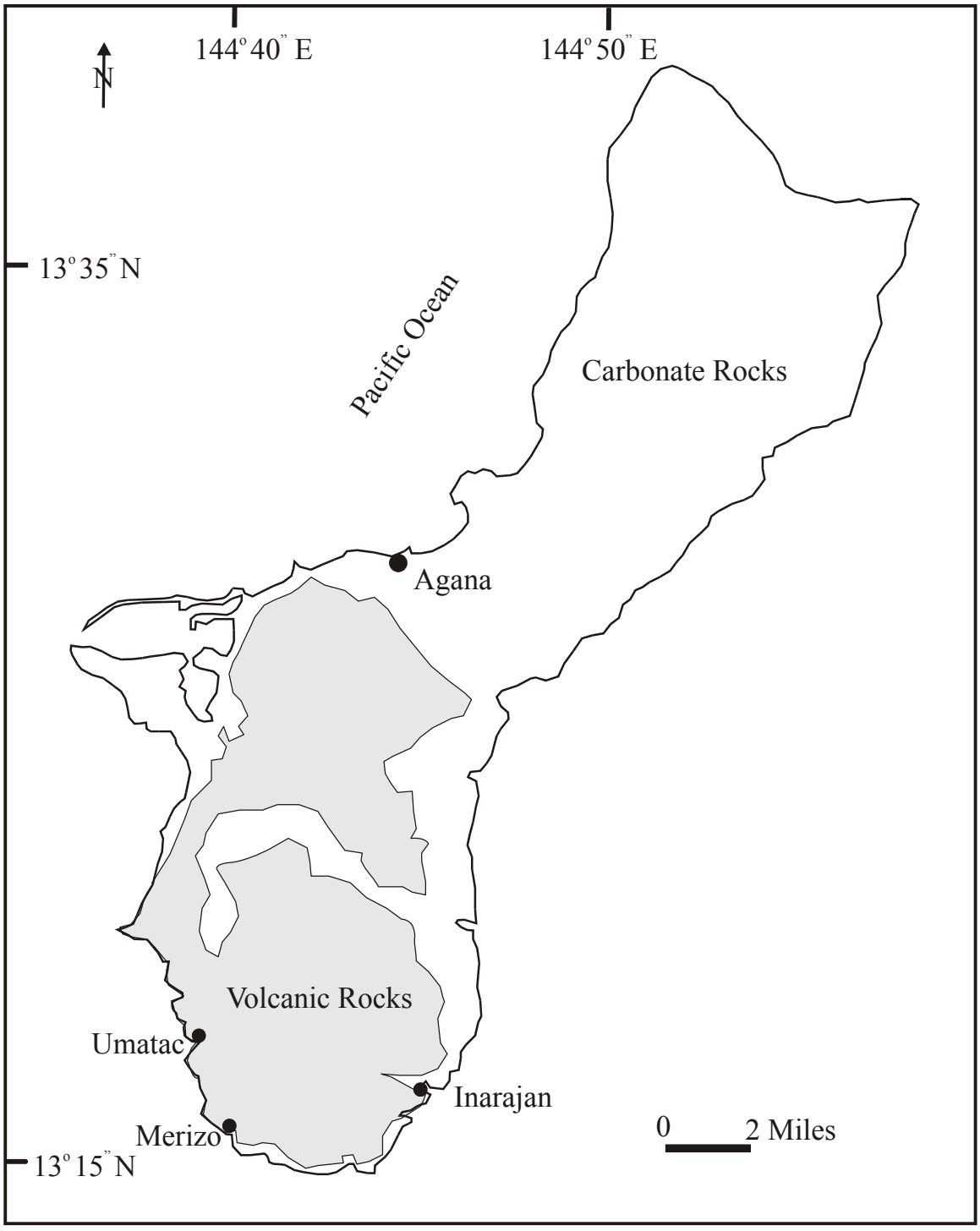

Figure 1. Location of the three southern villages with high incidences of neurological diseases, Guam

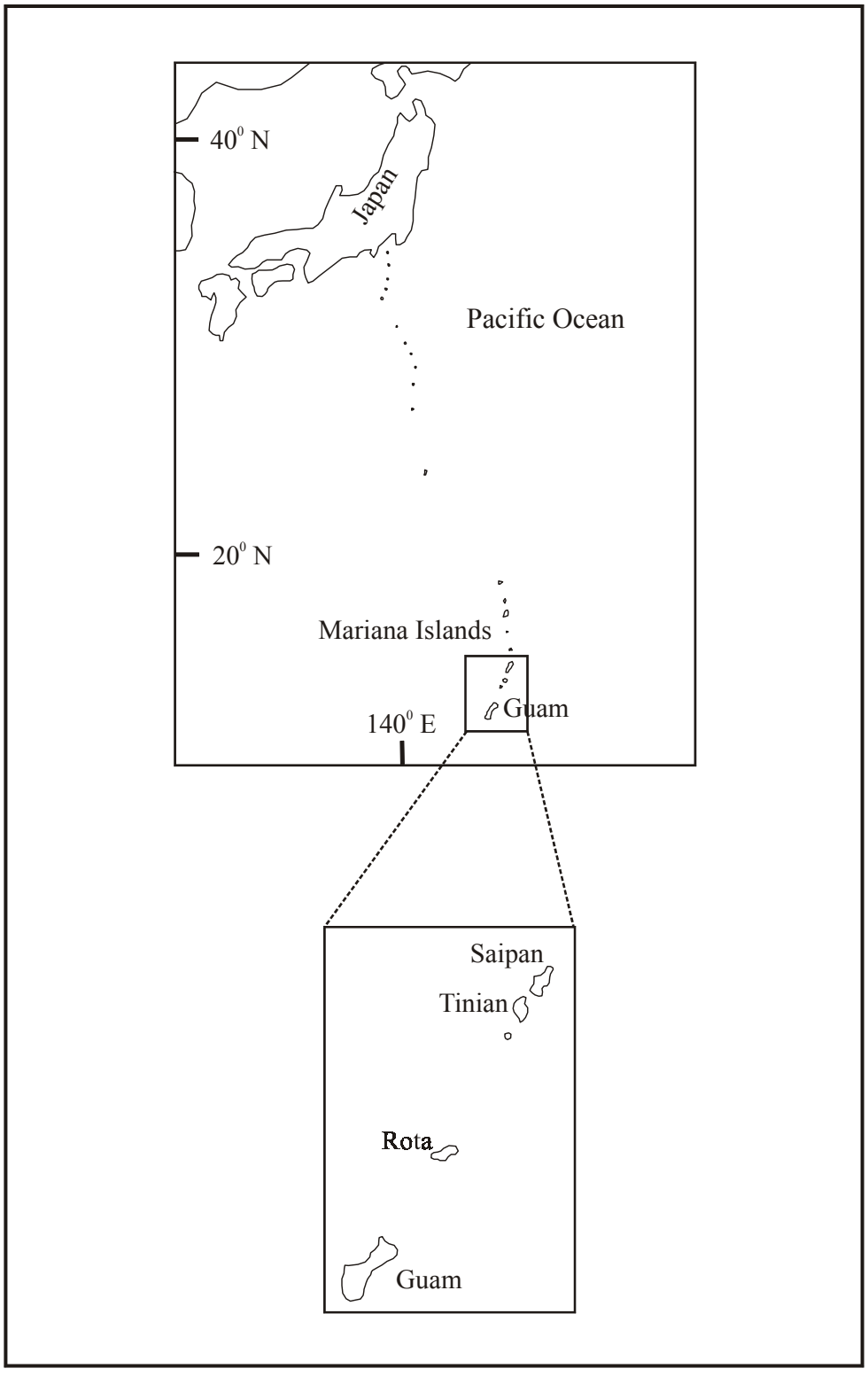

Figure 2. Index map showing location of Guam

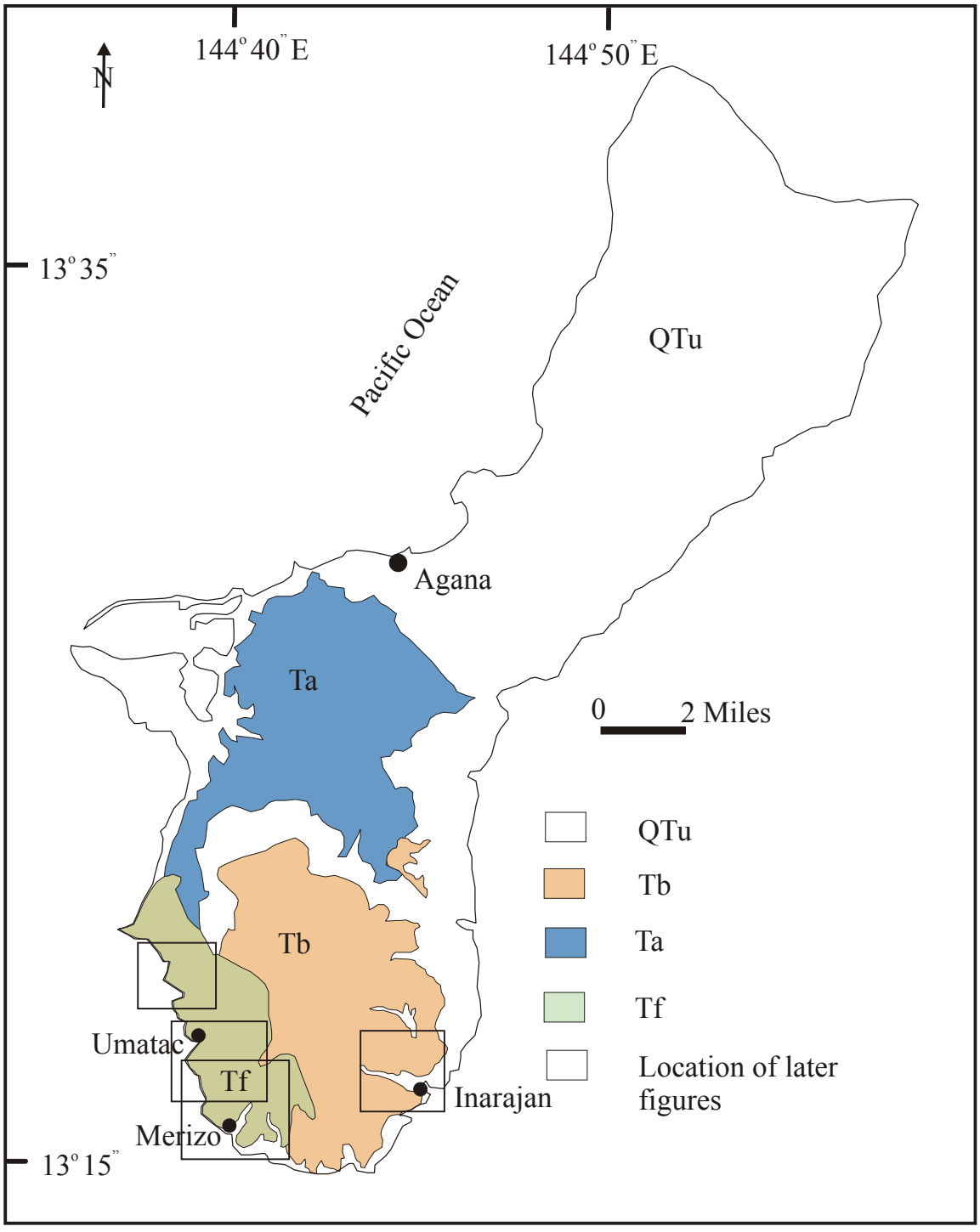

Figure 3. Generalized geologic map of Guam (modified from Tracey and others, 1964, and Siegrist and Randall, 1992). See next page for map explanation.

Generalized Geologic Map of Guam
Explanation

Age	Map symbol	Formation or rock type	Description
Tertiary to Quaternary	Qtu	Carbonate rocks	Carbonate rocks
Miocene	Tb	Bolanos Formation	Pillow basalt, tuffaceous shale and shale, limestone, tuff breccia, and volcanic conglomerate.
Eocene and Oligocene	Ta	Alutom Formation	Tuffaceous shale and sandstone, volcanic breccia, conglomerate and minor interbedded lava flows.
Eocene	Tf	Facpi Volcanics	Submarine boninite pillow flows and breccias, tuffaceous sediments, tholeiitic basalt dikes, minor pelagic carbonate sediment.

The volcanic rocks are weathered to an average depth of 50 feet (Carroll and Hathaway, 1963). Soils developed on the volcanic rocks average 20 to 40 cm in depth with thicker soils on valley floors and narrow coastal plain areas (Young, 1988). The main difference in soil thickness is due to topography. The general process in the soil formation is that glass, zeolites, plagioclase, and pyroxenes in rocks are weathered and transformed to smectite to kaolinite to gibbsite with increasing weathering intensity. The net effect is that silica is dissolved and removed and Fe_2O_3 and Al_2O_3 accumulate (Carroll and Hathaway, 1963).

Purpose

The purpose of this report is to present the complete chemical data of the soils, rocks, stream sediments, water leaches, sequential partial dissolution, and soil leach using simulated lung fluid of samples collected from Guam and the western United States. The data are presented without interpretation. A later report will interpret the data.

Methods

Sample Collection

Samples consisted of the collection of 25 soils, 15 rocks, and 4 streambed sediment samples in Guam in March 2001 (figs. 4-8). The soils were collected from the surface to a depth of about 10 cm. Rocks were collected by compositing chips of rock from surface outcrops. The rocks were all weathered to some degree and do not represent original unweathered rock. Results of chemical analyses of unweathered rocks from Guam can be found in Reagan and Meijer (1984). Stream-bed sediments were collected by compositing material from several locations in the stream channel.

To allow comparisons of the chemical data from Guam to similar rocks and soils elsewhere, samples of 36 soils and 10 rocks were collected in the western United States. The western U.S. soils were poorly developed and contained significant weathered rock material. The samples were sieved through a < 2 mm stainless steel sieve during collection. Samples of rocks were collected by compositing chips from surface outcrops.

Sample Preparation

In the laboratory, soil and stream sediment samples were dried in a convection oven at ambient temperature and split using a Jones splitter. A split was then sieved to < 63 microns. Rock samples were put through a jaw crusher and then ground to less-than-100 mesh (< 150 micron) using a ceramic plate grinder prior to analysis. Soil samples were sieved using a 63-micron stainless-steel sieve and the material passing through the sieve was used for all chemical analysis. The <63 micron size fraction makes up the majority of the soil sample material.

Analytical Methodology

Total Elemental Composition: The total element composition for rock, soil, and streambed sediment samples was determined for 56 elements by inductively coupled plasma – mass spectrometry (ICP-MS) after a multi-acid (hydrochloric, hydrofluoric, nitric, and perchloric) decomposition (Briggs and Meier, 1999). The elements

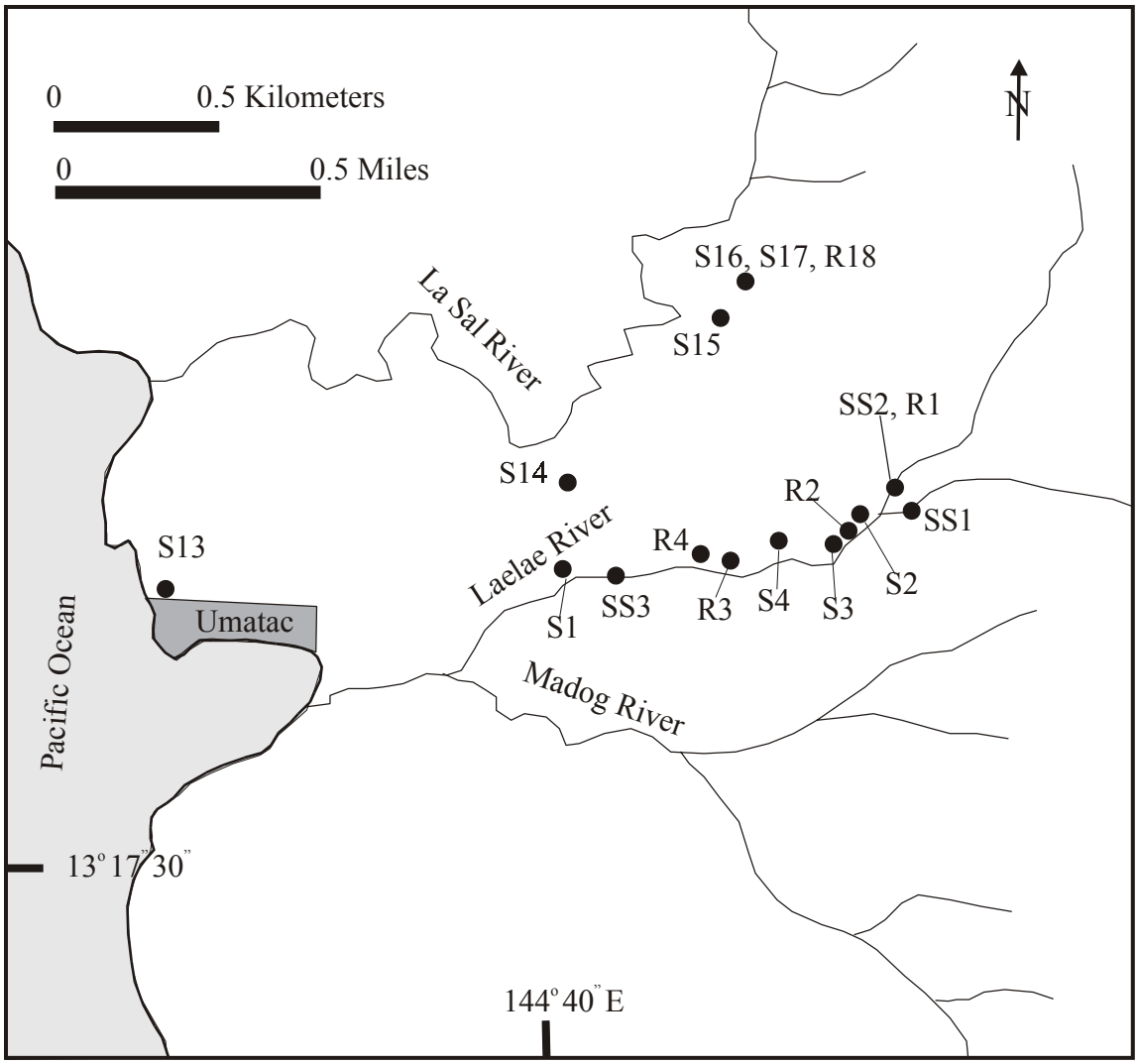

Figure 4. Map showing locations of sample sites within the Facpi Formation in the vicinity of Umatac. Sites prefixed with "S" are soils, "R" are rocks, and "SS" are stream sediments.

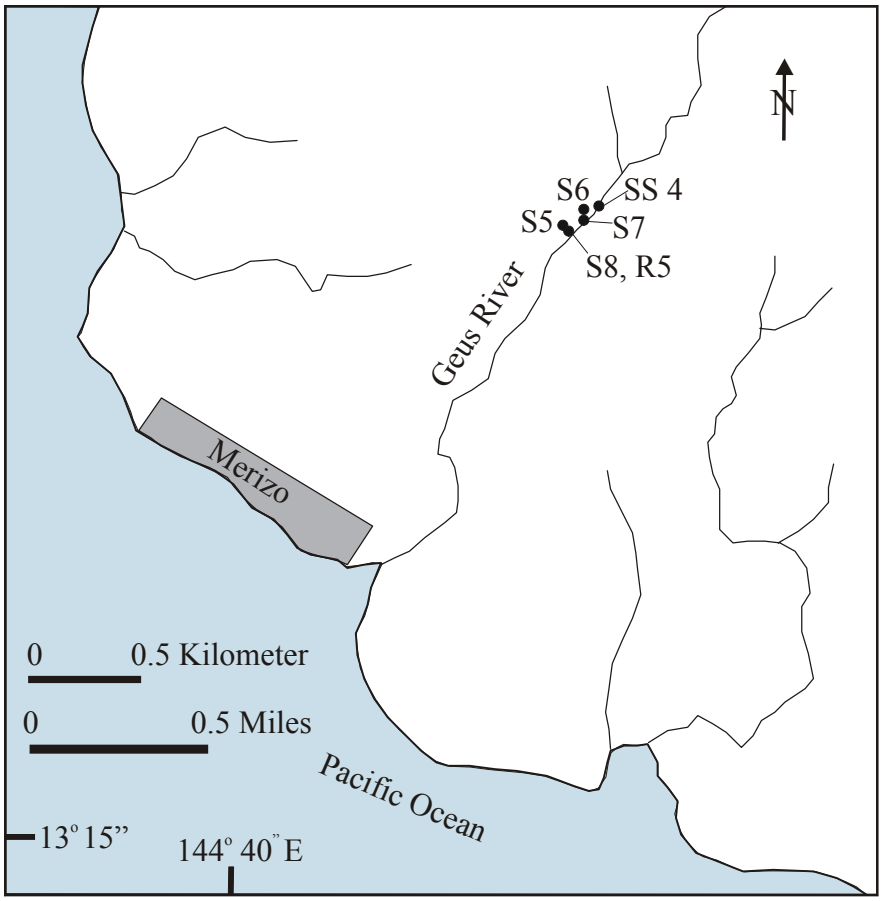

Figure 5. Map showing locations of sample sites within the Facpi Formation in the vicinity of Merizo. Sites prefixed with “S” are soils, “R” are rocks, and “SS” are stream sediments.

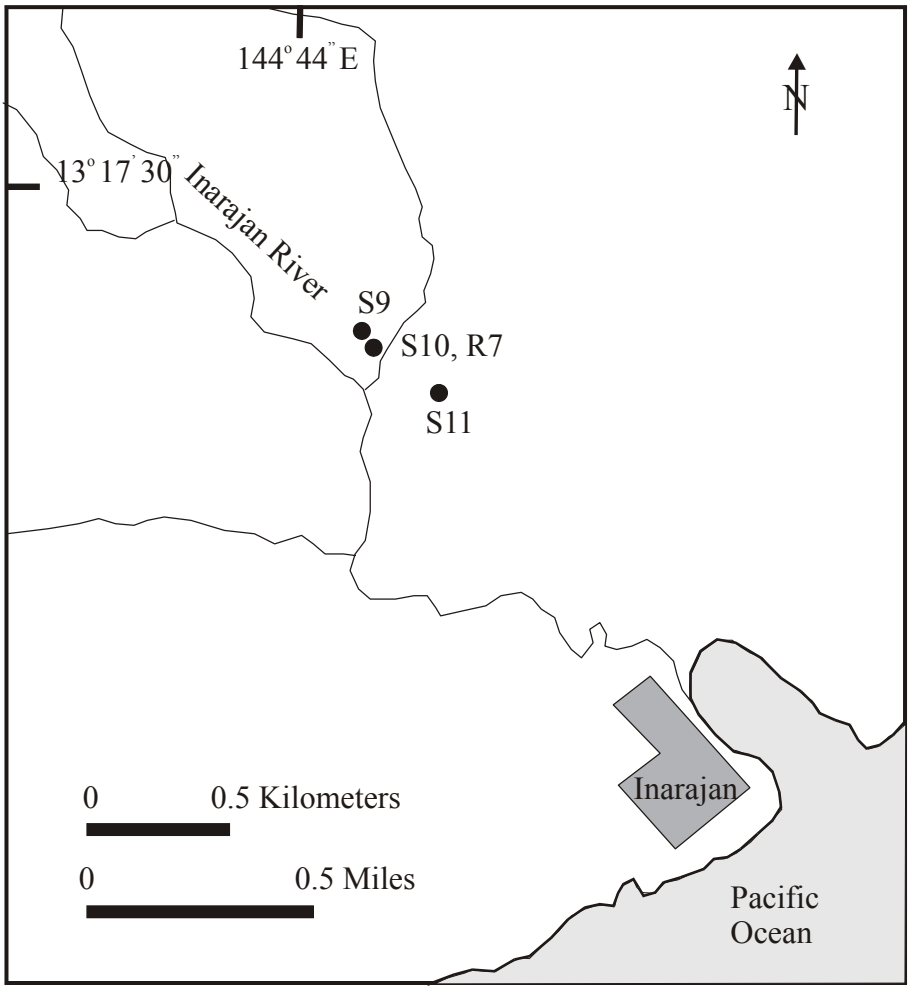

Figure 6. Map showing locations of sample sites within the Bolanos Formation in the vicinity of Inarajan. Sites prefixed with "S" are soils, "R" are rocks, and "SS" are stream sediments.

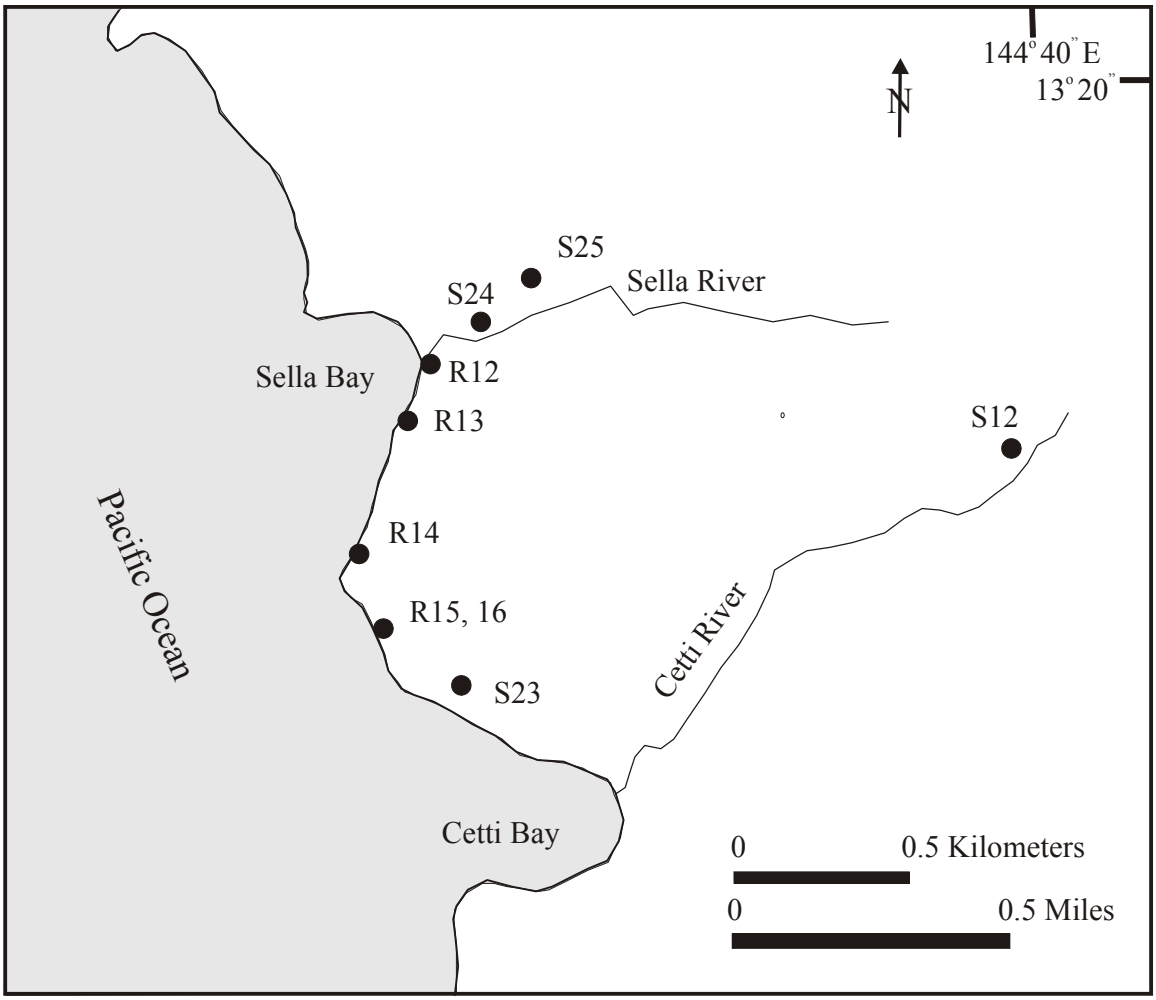

Figure 7. Map showing locations of sample sites within the Facpi Formation in the vicinity of Sella Bay and Cetti Bay. Sites prefixed with "S" are soils and "R" are rocks.

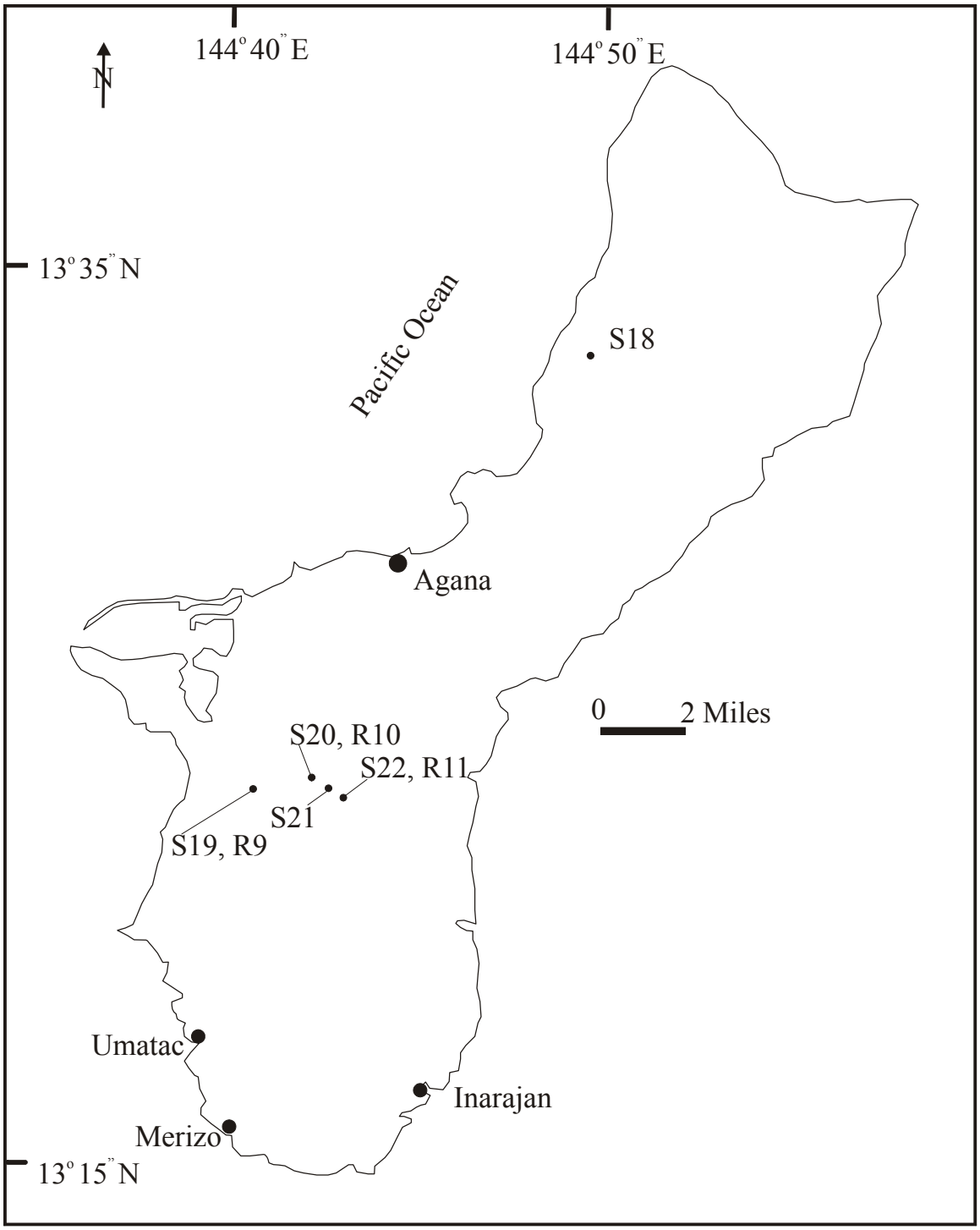

Figure 8. Map showing locations of sample sites within the Alutom Formation (except site S18 which is within the carbonate rocks) in the central part of Guam. Sites prefixed with "S" are soils and "R" are rocks.

determined, lower limits of determination, and analytical results for rock and soil samples are in tables 1-5.

Soil pH Determination: The pH was determined for soil samples by mixing 10 g of soil material with 20 mL of distilled and deionized water, letting the sample rest for 15 minutes and remixing. The pH was measured using a gel-filled epoxy electrode with automatic temperature compensation after letting the second sample mixing rest for an additional 15 minutes. Measurements were recorded on "ready" signal from the pH meter. Measurements were also made on replicate samples as well as with additional resting times (up to 90 minutes) and increased water volume (40 mL) with minimal (usually less than 0.1 pH unit) differences noted in determinations.

Water Soluble Extraction: Soils were mixed with water to determine the water-soluble component of the samples. A 0.5 g sample of soil was placed into a 12 mL centrifuge tube and 5 mL of distilled and deionized water was added. The sample was shaken for one minute followed by centrifugation for 10 minutes at 15,000 rpm using a refrigerated centrifuge set at 22 ^{o} C. The procedure was selected to approximate previous work on Guam, Palau, and Jamaica to evaluate Al and Ca availability in soils (Crapper McLachlan and others, 1989). Results of the determination of 42 constituents (except some samples not analyzed for rare earth elements) by ICP-MS are shown in Table 6 and 7. Results for duplicate analysis, in the tables, indicate good precision for the analysis.

Sequential Partial Dissolution Technique: A six-step sequential partial dissolution scheme was applied to selected soil samples to partition elements into operationally defined modes of occurrence or associations. The assessment of such techniques has been summarized by Tessier and others (1979), and Chao (1984), as furnishing information about the availability and mobility of elements in the environment. The scheme was applied to Guam soil samples to examine possible relative differences in the mode of occurrence of elements. Extractions were done sequentially in 50 mL polypropylene centrifuge tubes using a 0.25 g sample and 25 mL of extracting solution for each step. Shaking, when required, was done using a reciprocating shaker set at 130 strokes per minute. After each extraction, the solid and solution were separated by centrifuging at 15,000 rpm for 10 minutes in a refrigerated centrifuge set at 22 ^{o} C. Subsequent steps used the separated residue from the previous step as the material to be extracted. Filter pulp (0.25 g) was added to the original 0.25 g sample in order to prevent caking of particles on the bottom of the centrifuge tube after centrifugation and to prevent particles from dislodging during decantation. Extracts were diluted 1:10 with deionized water prior to determination of selected elements by ICP-MS using matrix matching to address inter-element interferences. The soil samples were extracted using the following stepwise procedures.

Fraction A – expected phase dissolution: water soluble, sorbed and exchangeable. Add 25 mL of 1 molar sodium acetate to a 0.25g sample of soil (with 0.25 g filter pulp added) and shake at room temperature for 30 minutes. Centrifuge and decant solution into a 50 mL disposable polypropylene tube and add 0.5 mL of concentrated nitric acid to the tube.

Chapman (1965) and Tessier and others (1979) discuss the use of sodium acetate as an extracting reagent.

Fraction B – expected phase dissolution: carbonates (Tessier and others, 1979). Add 25 mL of 1 molar sodium acetate adjusted to pH 5 with acetic acid to the residue from fraction A. Shake at room temperature for 4 hours. Centrifuge and decant solution into a 50 mL disposable centrifuge tube.

Fraction C – expected phase dissolution: manganese oxides (Chao, 1972). Add 25 mL of 0.1 molar hydroxylamine hydrochloride in 0.01 N nitric acid to residue from fraction B and shake at room temperature for 30 minutes. Centrifuge and decant solution into a 50 mL disposable polypropylene tube and add 0.5 mL of concentrated nitric acid to the tube.

Fraction D – expected phase dissolution: amorphous iron oxides (Chao and Liyi, 1983). Add 25 mL of 0.25 molar hydroxylamine hydrochloride in 0.25 N hydrochloric acid to the residue from fraction C and place in a water bath at 50 ^{o}C for 30 minutes with occasional shaking. Centrifuge and decant solution into a 50 mL disposable centrifuge tube.

Fraction E – expected phase dissolution: crystalline iron and aluminum oxides and acid volatile sulfides (Chao and Sanzolone, 1989). Add 25 mL of 4 N hydrochloric acid to the residue from fraction D and place in a water bath at 95 ^{o}C for 45 minutes with occasional shaking. Centrifuge and decant solution into a 50 mL disposable centrifuge tube.

Fraction F – expected phase dissolution: residual (Chao and Sanzolone, 1989). Transfer the residue from fraction E to a 100 mL Teflon beaker using 5 mL of water. Place beaker on shaking hot plate under a perchloric acid hood and add 10 mL each of nitric, hydrofluoric, hydrochloric, and perchloric acid. Gradually increase temperature from 100 to 220 ^{o}C over a three hour period and heat until the volume of the remaining acid is about 1 ml. Remove the beaker from the hot plate and add 10 mL of 50% v/v hydrochloric acid and return to hot plate for 5 minutes. Remove beaker from hot plate and allow cooling before transferring solution into a 50 mL polypropylene centrifuge tube and bringing the volume to 50 mL with water.

The results of the sequential partial extraction scheme are presented in Table 8. The precision of the extraction scheme can be evaluated by the use of a duplicate sample that is included in the table. Duplicate is generally within +/- 10% for each fraction for most elements. The reliability of the analysis can also be addressed by comparing the sum of the six fractions to the total element composition determined on a separate sample split. As shown in Table 8, agreement is usually good (+/- 20%) for most elements. Precision degrades, as expected, for elements with concentrations near or below the lower limits of determination for one or more fractions.

The sequential partial extraction scheme releases constituents in decreasing order of availability to the environment. Elements solubilized in extraction A are considered to be highly available to the environment; those released in B are considered to be available; those in C, D and E are considered to be conditionally available (having the potential to

become available through changes in Eh, pH or by microbial mobilization); and those in F are considered unavailable.

Simulated Lung Fluid Dissolution: The simulated lung fluid was adapted from that presented in Matson (1994) and Eastes and others (1995). This solution was selected because it provided an environment that is relevant to the extracellular fluid in the lung. The solution was made fresh the day before analysis in a metal-free environment. One-gram soil samples were weighed into 20 mL acid-washed scintillation vials equipped with a polyethylene mesh inserts. Twenty mL of simulated lung fluid were added to the vials to make a 1:20 mass/volume incubation ratio. Vials were placed into a Vitron Dynamic Organ Culture Incubator for 24 h at 37°C. The incubator was implemented in order to keep samples in a constant rolling motion while holding the temperature constant. Following incubation the vials were centrifuged for 5 min at 15,000 rpm and the simulated lung extract was then syringed filtered with a 0.45-micron nitrocellulose filter. The filtered extract solution was analyzed by ICP-MS. Lung fluid reagent blanks limited the number of elements reported to 25 (Table 9). A duplicate lung fluid leach shown in Table 9 indicates good precision for the technique.

Data

The chemical analyses of the soils, rocks, and stream sediments from Guam are shown in Tables 1-3. The chemical analyses of soils and rocks from the western U. S. are shown in Tables 4 and 5. The chemical analyses of the water soluble extractions of soils from Guam and the western U. S. are shown in Tables 6-7. The chemical analyses of the partial extraction scheme for soils from Guam and Colorado are shown in Table 8 and simulated lung fluid dissolution for soils from Guam and Colorado are in Table 9.

References

Briggs, P.H. and Meier, A.L., 1999, The determination of forty two elements in Geological materials by inductively coupled plasma-mass spectrometry: U.S. Geological Survey Open-File Report 99-166, 15 p.

Carroll, D. and Hathaway, J.C., 1963, Mineralogy of selected soils from Guam: U.S. Geological Survey Professional Paper 403-F, 53 p.

Chao, T.T., 1972, Selective dissolution of manganese oxides from soils and sediments with acidified hydroxylamine hydrochloride: Soil Science Society of America Proceedings, v. 36, p. 764-768.

Chao, T.T., and Liyi, Zhou., 1983, Extraction techniques for selective dissolution of amorphous iron oxides from soils and sediments: Soil Science Society of America Journal, v. 47, no. 2, p. 225-232.

Chao, T.T., 1984, Use of partial dissolution techniques in geochemical exploration: Journal of Geochemical Exploration, v 20, p. 101-135.

Chao, T.T., and Sanzolone, R.F., 1989, Fractionation of soil selenium by sequential partial dissolution: Soil Science Society of America Journal, v. 53, no. 2, p. 385-392.

Chapman, H.D., 1965, Methods of soil analysis: C.A. Black, Ed., American Society of Agronomy, Madison, Wisconsin., p. 891-904.

Crapper McLachlan, D.R., McLachlan, C.D., Krishnan, B., Krishnan, S.S., Dalton, A.J., and Steele, J.C., 1989, Aluminum and calcium in soil and food from Guam, Palau and Jamaica: Implications for amyotrophic lateral sclerosis and parkinsonism-dementia syndromes of Guam: Environmental Geochemistry and Health v. 11, no. 2, p. 45-53.

Eastes, W. and Hadley, J. G., 1995, Dissolution of fibers inhaled by rats: Inhalation Toxicology, v. 7, p. 179-196.

Garruto, R.M., Yanagihara, R., Gajdusek, D.C., and Arion, D., 1984, Concentrations of heavy metals and essential minerals in garden soils and drinking water: In: Chen, L. and Yase, Y. (eds.), Western Pacific Amyotrophic Lateral Sclerosis in Asia and Oceania, National Taiwan Univ., Tapei, p. 265-330.

Koerrner, D.R., 1952, Amyotrophic lateral sclerosis on Guam: a clinical study and review of the literature: Annals of Internal Medicine, v. 37, p. 1204-1220.

Kurland, L.T. and Mulder, D.W., 1954, Epidemiologic investigations of amyotrophic lateral sclerosis. 1. Preliminary report on geographic distribution with special reference to the Mariana Islands, including clinical and pathologic observations: Neurology, v. 4, p. 642-661.

MacDonald T.L. and Martin, R.B., 1988, Aluminum ion in biological systems: Trends Biochem., v. 13, P. 15-19.

Matson, S. M., 1994, Glass fibers in simulated lung fluid: dissolution behavior and analytical requirements: Annals of Occupational Hygiene, v. 38, p. 857-877.

Perl, D.P., Gajdusek, K.C., Garruto, R.M., Yanagihara, R.T., and Gibbs, C.J., 1982, Intraneuronal aluminum accumulation in amyotrophic lateral sclerosis and parkinsonism-dementia of Guam: Science, v. 217, p. 1053-1055.

Plato, C.C., Garruto, R.M., Fox, K.M., and Gajdusek, D.C., 1986, Amyotrophic lateral aclerosis and parkinsonism-dementia on Guam: a 25-year prospective case-control study: American Jour. Epidemiol, v. 124, p. 643-656.

Reagan, M.K. and Meijer, A., 1984, Geology and geochemistry of early arc-volcanic rocks from Guam: Geological Society of America, v. 95, p. 701-713.

Siegrist, H.G. and Randall, R.H., 1992, carbonate geology of Guam: 7th International Coral Reef Symposium, Guam, U.S.A., June 18-20, 1992, 37 p.

Tessier, A., Campbell, P.G.C., and Bisson, M., 1979, Sequential extraction Procedure for the speciation of particulate trace metals: Analytical Chemistry, v. 51, no. 7, p. 844-851.

Tracey, J.I., Jr., Schlanger, S.O., Stark, J.T., Doan, D.B., and May, H.G., 1964, General Geology of Guam: U.S. Geological Survey Professional Paper 403-A, 104 p.

Young, F.J., 1988, Soil survey of the Territory of Guam: Washington, D.C., U. S. Soil Conservation Service, 166 p.

Zhang, Z.X., Anderson, K.W., and Mantel, N., 1990, Geographic patterns of parkinsonism-dementia complex on Guam, 1956 through 1985: Arch. Neurol. 1990, v. 47, p. 1069-1074.

Table 1. Chemical analyses of soils from Guam

Field No.	North Latitude	East Longitude	Formation	Al	Ca	Fe
	Degree	Degree		%	%	%
LLD[1]				0.005	0.005	0.005
GS01	13.2964	144.6742	Facpi, tuff	8.4	2.0	3.5
GS02	13.2992	144.6811	Facpi, tuff	7.8	2.8	3.7
GS03	13.2994	144.6806	Facpi, tuff	8.9	5.4	6.6
GS04	13.3003	144.6794	Facpi, tuff	8.0	2.6	3.6
GS05	13.2772	144.6853	Facpi, tuff	8.0	2.2	3.5
GS06	13.2783	144.6856	Facpi, tuff	8.2	3.0	5.0
GS07	13.2775	144.6856	Facpi, tuff	8.6	2.7	4.0
GS08	13.2772	144.6853	Facpi, tuff	6.6	9.0	4.7
GS09	13.2894	144.7372	Bolanos	7.3	5.7	5.2
GS10	13.2878	144.7381	Bolanos	7.8	5.8	6.5
GS11	13.2861	144.7408	Bolanos	8.2	4.6	6.2
GS12	13.3258	144.6675	Facpi, basalt	8.0	3.5	7.3
GS13	13.3003	144.6597	Facpi, basalt	6.3	8.2	3.6
GS14	13.3022	144.6681	Facpi, basalt	8.8	4.9	6.3
GS15	13.3031	144.6722	Facpi, basalt	7.6	1.7	4.0
GS16	13.3033	144.6739	Facpi, basalt	7.1	1.1	3.3
GS17	13.3033	144.6739	Facpi, basalt	7.8	1.5	3.7
GS18	13.5606	144.8994	Limestone, undivided	26	1.2	14
GS19	13.3903	144.6892	Alutom	7.4	12	5.3
GS20	13.3936	144.7111	Alutom	15	0.20	12
GS21	13.3908	144.7192	Alutom	11	0.59	8.5
GS22	13.3889	144.7231	Alutom	14	0.2	13
GS23	13.3175	144.6567	Facpi, basalt	8.2	3.1	7.4
GS24	13.3278	144.6544	Facpi, basalt	7.3	2.3	7.7
GS25	13.3286	144.6550	Facpi, basalt	7.4	3.1	7.5

[1] lower limit of determination

Table 1. Chemical analyses of soils from Guam

Field No.	K	Mg	Na	P	Ti	Ag	As	Au	Ba
	%	%	%	%	%	ppm	ppm	ppm	ppm
LLD[1]	0.005	0.005	0.005	0.01	0.005	3	0.5	0.05	0.5
GS01	3.0	0.82	2.0	0.11	0.50	<3	4	< 0.05	1200
GS02	2.9	0.80	1.8	0.10	0.60	<3	3	< 0.05	1100
GS03	1.3	2.3	1.9	0.18	1.0	<3	2	< 0.05	1200
GS04	2.5	0.88	1.9	0.10	0.50	<3	3	< 0.05	910
GS05	2.6	1.0	1.8	0.08	0.50	<3	2	< 0.05	730
GS06	2.4	1.1	1.9	0.18	0.80	<3	3	< 0.05	1300
GS07	2.4	1.3	2.1	0.10	0.60	<3	2	< 0.05	1300
GS08	1.6	1.7	1.2	0.10	0.60	<3	6.9	< 0.05	600
GS09	2.2	1.1	1.7	0.11	0.70	<3	8	< 0.05	890
GS10	2.3	1.3	2.0	0.14	0.90	<3	4	< 0.05	950
GS11	2.6	1.6	2.0	0.17	0.90	<3	3	< 0.05	1100
GS12	2.7	1.3	2.2	0.19	1.1	<3	2	< 0.05	960
GS13	1.9	1.1	1.3	0.17	0.70	<3	4	< 0.05	920
GS14	2.4	2.0	3.1	0.42	1.3	<3	<0.5	< 0.05	1600
GS15	2.1	0.90	1.3	0.08	0.60	<3	5	< 0.05	790
GS16	2.1	0.67	1.0	0.08	0.50	<3	5.1	< 0.05	800
GS17	2.0	0.84	1.0	0.09	0.60	<3	6.1	< 0.05	830
GS18	0.03	0.10	0.01	1.4	1.5	<3	57	< 0.05	91
GS19	0.66	2.9	0.68	0.04	0.40	<3	<0.5	< 0.05	210
GS20	0.21	0.44	0.02	0.03	1.0	<3	0.9	< 0.05	44
GS21	0.42	3.6	0.03	0.01	0.70	<3	<0.5	< 0.05	110
GS22	0.40	1.1	0.02	0.01	0.60	<3	2	< 0.05	39
GS23	0.53	4.7	0.69	0.01	0.40	<3	<0.5	< 0.05	52
GS24	0.55	3.7	0.21	0.05	0.40	<3	1	< 0.05	89
GS25	0.39	6.7	0.64	< 0.01	0.30	<3	<0.5	< 0.05	37

[1] lower limit of determination

Table 1. Chemical analyses of soils from Guam

Field No.	Be	Bi	Cd	Ce	Co	Cr	Cs	Cu	Dy
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.1	0.05	0.1	0.5	0.1	0.2	0.01	3	0.04
GS01	2.4	0.2	0.3	100	11	24	4	20	4.5
GS02	1.9	0.1	0.2	88	13	39	3.6	20	4.5
GS03	1.3	0.1	0.3	80	34	95	1.6	61	5.4
GS04	2	0.1	0.2	74	12	35	2.8	20	4
GS05	2.5	0.2	0.2	87	12	27	5.3	20	4.7
GS06	1.9	0.1	0.3	94	24	79	2.7	52	4.7
GS07	2	0.1	0.2	89	17	64	3	31	4.4
GS08	1.4	0.1	0.2	57	20	67	3.2	37	3.9
GS09	1.8	0.1	0.2	70	16	36	3.1	20	4.4
GS10	1.5	0.1	0.2	70	20	52	3	30	4.4
GS11	2.3	0.1	0.2	97	26	72	4.4	75	4.9
GS12	2	0.1	0.2	83	23	64	3.3	32	4.5
GS13	1.6	0.1	0.3	88	15	30	3.4	30	5.1
GS14	2.3	< 0.05	0.1	140	24	14	0.6	34	7.6
GS15	2	0.2	0.3	79	22	68	4.5	35	4.8
GS16	1.8	0.2	0.3	79	15	44	5.2	31	4.7
GS17	2.3	0.2	0.3	93	16	46	5.3	30	5.4
GS18	7	1.6	7.1	210	47	730	0.2	46	17
GS19	0.4	< 0.05	0.4	9.9	33	150	0.3	78	4.9
GS20	0.6	< 0.05	<0.1	30	31	310	0.2	380	7.8
GS21	0.5	< 0.05	0.4	13	50	280	0.2	110	4.5
GS22	0.5	< 0.05	0.1	9.4	97	530	0.4	160	4.4
GS23	0.7	< 0.05	0.2	6.5	52	570	0.4	96	2.8
GS24	0.5	< 0.05	0.4	8.5	60	560	0.3	95	2.2
GS25	0.4	< 0.05	0.1	4.9	58	620	0.4	74	2.3

[1] lower limit of determination

Table 1. Chemical analyses of soils from Guam

Field No.	Er	Eu	Ga	Gd	Ge	Ho	In	La	Li
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.05	0.005	0.006	0.02	0.1	0.02	0.1	0.3	0.2
GS01	2.2	1.4	18	5.3	1.3	0.69	< 0.1	53	24
GS02	2.3	1.4	17	5.1	1.2	0.72	< 0.1	44	23
GS03	2.7	1.8	19	6.2	1.2	0.86	< 0.1	39	18
GS04	2	1.2	17	4.7	1.2	0.64	< 0.1	39	24
GS05	2.5	1.3	17	5.2	1.2	0.75	< 0.1	47	26
GS06	2.3	1.6	19	5.8	1.1	0.74	< 0.1	46	24
GS07	2.2	1.5	19	5.1	1.4	0.69	< 0.1	46	26
GS08	2	1.1	14	4.3	0.9	0.62	< 0.1	30	21
GS09	2.2	1.3	17	5.1	1	0.7	< 0.1	38	27
GS10	2.2	1.5	18	5.1	1	0.7	< 0.1	39	18
GS11	2.4	1.6	19	5.9	1	0.77	< 0.1	50	23
GS12	2.2	1.5	20	5.5	1.1	0.7	< 0.1	45	18
GS13	2.6	1.5	14	6	1	0.82	< 0.1	46	23
GS14	3.7	2.7	20	9.3	0.8	1.2	< 0.1	65	13
GS15	2.4	1.3	16	5.3	1.2	0.75	< 0.1	40	27
GS16	2.2	1.2	15	5.3	1.1	0.72	< 0.1	40	29
GS17	2.6	1.5	17	6.4	1.2	0.83	< 0.1	48	31
GS18	9.2	4.3	37	18	< 0.1	2.9	0.3	120	7
GS19	3.1	0.96	12	4.2	1	0.93	< 0.1	8.1	17
GS20	4.7	1.7	29	6.3	1.9	1.4	0.1	11	5.5
GS21	2.8	0.9	19	3.6	1.4	0.81	< 0.1	5.4	37
GS22	3.1	0.7	25	2.8	2.1	0.84	< 0.1	2.6	22
GS23	1.7	0.5	14	2.1	1.1	0.52	< 0.1	3.3	29
GS24	1.3	0.48	13	1.7	1.2	0.38	< 0.1	3.8	31
GS25	1.5	0.43	12	1.7	1.4	0.43	< 0.1	2.5	46

[1] lower limit of determination

Table 1. Chemical analyses of soils from Guam

Field No.	Mn	Mo	Nb	Nd	Ni	Pb	Pr	Rb	Re
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.2	0.1	2	0.2	1	0.8	0.05	0.01	0.05
GS01	1300	1.3	21	42	12	26	11	100	< 0.05
GS02	1000	1.2	18	36	16	22	9	100	< 0.05
GS03	1400	0.6	14	40	44	18	9.3	42	< 0.05
GS04	820	1.1	14	33	14	21	8.2	85	< 0.05
GS05	890	1.6	20	38	13	24	9.6	110	< 0.05
GS06	1800	0.7	18	42	42	22	9.9	72	< 0.05
GS07	1200	0.9	18	38	28	20	9.5	83	< 0.05
GS08	890	0.8	12	27	39	13	6.5	64	< 0.05
GS09	900	1.1	14	34	19	15	8.1	74	< 0.05
GS10	1000	1.3	14	35	22	16	8.4	72	< 0.05
GS11	1400	1.2	18	43	49	22	11	79	< 0.05
GS12	1200	1.3	18	38	28	19	9.3	84	< 0.05
GS13	780	0.8	20	41	21	16	9.9	68	< 0.05
GS14	1000	0.9	29	67	19	11	16	44	< 0.05
GS15	1100	0.9	17	34	44	20	8.5	93	< 0.05
GS16	940	1	16	35	23	20	8.5	110	< 0.05
GS17	860	1	19	42	26	22	10	96	< 0.05
GS18	5600	4.3	29	100	320	77	25	0.5	< 0.05
GS19	1400	0.2	1.1	11	100	3.6	2.1	14	< 0.05
GS20	940	0.7	2.3	21	140	5.6	4.1	7.4	< 0.05
GS21	1800	0.2	1.5	9.5	150	2	1.8	13	< 0.05
GS22	2300	0.6	3.9	5.5	380	2	0.98	15	< 0.05
GS23	1300	0.3	2.5	5	270	6.1	0.94	12	< 0.05
GS24	1400	0.7	2.3	5.1	240	3.6	1	21	< 0.05
GS25	1300	0.1	1.9	4	310	<0.8	0.71	9.2	< 0.05

[1] lower limit of determination

Table 1. Chemical analyses of soils from Guam

Field No.	Sb	Sc	Se	Sm	Sn	Sr	Tb	Te	Th
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.1	0.3	1	0.02	0.5	0.05	0.005	0.1	0.03
GS01	0.6	8.8	< 1	6.9	3	500	0.67	< 0.1	9.9
GS02	0.6	9.7	< 1	6.1	2	390	0.65	< 0.1	10
GS03	0.3	23	< 1	7.2	2	850	0.79	< 0.1	4.7
GS04	0.5	9.6	< 1	5.4	2	490	0.6	< 0.1	8
GS05	0.6	10	< 1	6.6	2	380	0.71	< 0.1	12
GS06	0.5	16	< 1	7.1	2	680	0.7	< 0.1	6.9
GS07	0.5	12	< 1	6.3	2	580	0.65	< 0.1	7.8
GS08	0.7	13	< 1	4.9	1	350	0.59	< 0.1	6.3
GS09	0.7	11	< 1	5.7	2	510	0.64	< 0.1	7.9
GS10	0.9	12	< 1	6.3	2	620	0.68	< 0.1	6.7
GS11	0.7	14	< 1	7.1	2	750	0.72	< 0.1	12
GS12	0.6	13	< 1	6.4	2	680	0.69	< 0.1	8.4
GS13	0.7	9.9	< 1	7	2	440	0.78	< 0.1	7.9
GS14	<0.1	16	< 1	11	2	1000	1.2	< 0.1	2.9
GS15	0.7	12	< 1	6.1	2	270	0.71	< 0.1	9.3
GS16	0.8	10	< 1	6.2	2	200	0.68	< 0.1	9.6
GS17	0.8	11	< 1	7.4	2	230	0.82	< 0.1	10
GS18	14	50	< 1	19	7.8	1900	2.4	0.8	32
GS19	0.4	30	< 1	2.8	0.7	160	0.65	< 0.1	0.37
GS20	0.3	71	< 1	5.7	1	49	1	< 0.1	0.89
GS21	0.2	49	< 1	2.7	0.8	70	0.58	< 0.1	0.4
GS22	0.3	76	< 1	1.9	0.9	12	0.51	< 0.1	0.59
GS23	<0.1	42	< 1	1.5	0.8	100	0.34	< 0.1	0.38
GS24	0.3	39	< 1	1.4	0.6	140	0.28	< 0.1	0.38
GS25	<0.1	45	< 1	1.2	< 0.5	150	0.28	< 0.1	0.25

[1] lower limit of determination

Table 1. Chemical analyses of soils from Guam

Field No.	Tl	Tm	U	V	W	Y	Yb	Zn
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.1	0.006	0.02	0.4	0.1	0.3	0.03	5
GS01	0.6	0.3	2.5	74	1.4	33	2.1	110
GS02	0.5	0.32	2.6	92	1.3	34	2.2	110
GS03	0.2	0.36	1.2	200	0.6	41	2.5	110
GS04	0.4	0.28	2.1	88	1	30	1.9	81
GS05	0.7	0.34	3.8	80	1.2	37	2.4	94
GS06	0.4	0.31	1.7	110	1.6	34	2	100
GS07	0.5	0.3	2.2	99	1	33	2	97
GS08	0.4	0.27	1.6	120	0.9	30	1.9	86
GS09	0.4	0.3	3.4	150	1.3	34	2	110
GS10	0.6	0.3	2.1	180	1	34	2	130
GS11	0.6	0.32	2.7	170	1.4	37	2.2	120
GS12	0.5	0.29	2.3	210	1.1	34	2	140
GS13	0.4	0.34	1.8	81	1.1	39	2.3	79
GS14	0.1	0.48	0.88	140	0.4	57	3.2	120
GS15	0.6	0.31	2.3	99	1.1	36	2.1	87
GS16	0.6	0.3	2.5	76	1.2	34	2.1	88
GS17	0.6	0.35	2.3	84	1.2	40	2.4	93
GS18	0.6	1.2	17	510	5.1	200	8.3	57
GS19	<0.1	0.42	0.5	180	0.3	54	2.9	77
GS20	<0.1	0.66	1.3	540	0.2	64	4.8	81
GS21	<0.1	0.39	0.4	280	0.1	38	2.8	100
GS22	<0.1	0.46	0.4	280	0.2	38	3.4	97
GS23	<0.1	0.25	0.2	180	< 0.1	23	1.8	70
GS24	<0.1	0.19	0.4	190	< 0.1	17	1.4	92
GS25	<0.1	0.21	0.06	160	< 0.1	20	1.5	72

[1] lower limit of determination

Table 2 . Chemical analyses of rocks from Guam

Field No.	North Latitude Degree	East Longitude Degree	Formation	Al %	Ca %	Fe %	K %
LLD[1]				0.005	0.005	0.005	0.005
GR01	13.2992	144.6811	Facpi, tuff	4.5	21	3.2	0.42
GR02	13.2994	144.6806	Facpi, tuff	1.2	34	0.95	0.17
GR03	13.2989	144.6792	Facpi, tuff	1.4	28	1.4	0.13
GR04	13.2964	144.6767	Facpi, tuff	1.6	35	0.90	0.29
GR05	13.2772	144.6853	Facpi, tuff	3.1	29	2.0	0.48
GR07	13.2878	144.7381	Bolonas	7.8	3.4	5.6	1.4
GR08	13.3033	144.6739	Facpi, basalt	7.2	5.8	6.1	1.2
GR09	13.3903	144.6892	Alutom	4.6	17	3.2	0.60
GR10	13.3936	144.7111	Alutom	>20	0.2	7.7	0.60
GR11	13.3889	144.7231	Alutom	9.8	0.07	8.4	0.42
GR12	13.3278	144.6519	Facpi, veins	1.4	6.2	0.58	0.38
GR13	13.3250	144.6528	Facpi, veins	3	33	2.6	0.21
GR14	13.3203	144.6522	Facpi, veins	4.6	27	4.3	0.51
GR15	13.3175	144.6564	Facpi, basalt	7	17	5.4	0.53
GR16	13.3175	144.6564	Facpi, veins	1.2	42	2.4	0.57

[1] lower limit of determination

Table 2 . Chemical analyses of rocks from Guam

Field No.	Mg %	Na %	P %	Ti %	Ag ppm	As ppm	Au ppm	Ba ppm	Be ppm
LLD[1]	0.005	0.005	0.01	0.005	3	0.5	0.05	0.5	0.1
GR01	1.4	0.18	0.03	0.30	<3	2	< 0.05	180	0.3
GR02	0.43	0.04	0.03	0.08	<3	<0.5	< 0.05	160	0.2
GR03	0.62	0.16	0.03	0.10	<3	<0.5	< 0.05	190	0.2
GR04	0.55	0.17	0.02	0.10	<3	<0.5	< 0.05	78	<0.1
GR05	1.3	0.18	0.03	0.20	<3	<0.5	< 0.05	45	0.1
GR07	3.1	0.78	0.05	0.50	<3	<0.5	< 0.05	230	0.6
GR08	5.1	0.46	< 0.01	0.30	<3	<0.5	< 0.05	22	0.3
GR09	2.6	0.59	0.03	0.30	<3	<0.5	< 0.05	55	0.3
GR10	2.0	0.09	< 0.01	0.80	<3	<0.5	< 0.05	170	1.2
GR11	2.1	0.03	< 0.01	0.40	<3	<0.5	< 0.05	49	0.9
GR12	0.43	0.50	0.01	0.05	<3	<0.5	< 0.05	41	0.5
GR13	3.4	0.98	0.04	0.10	<3	<0.5	< 0.05	11	0.2
GR14	3.8	1.1	0.04	0.20	<3	0.6	< 0.05	31	0.5
GR15	4.4	1.6	0.04	0.40	<3	<0.5	< 0.05	49	0.7
GR16	1.5	0.26	0.04	0.06	<3	<0.5	< 0.05	7	0.2

[1] lower limit of determination

Table 2 . Chemical analyses of rocks from Guam

Field No.	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm
LLD[1]	0.05	0.1	0.5	0.1	0.2	0.01	3	0.04	0.05
GR01	< 0.07	<0.1	6.2	16	97	0.4	54	1.7	1.0
GR02	< 0.07	0.2	1.9	4.3	24	0.1	20	0.92	0.54
GR03	< 0.07	<0.1	2.4	6.8	48	0.1	60	1.4	0.76
GR04	< 0.07	0.2	1.9	3.8	54	< 0.1	9	0.66	0.41
GR05	< 0.07	0.2	5.3	8.2	30	0.2	20	1.4	0.88
GR07	< 0.07	<0.1	14	25	80	0.3	110	2.9	1.6
GR08	< 0.07	0.2	5.5	49	830	0.1	63	2.4	1.4
GR09	< 0.07	0.1	4.3	18	100	0.2	39	1.6	1.0
GR10	< 0.07	<0.1	21	120	120	0.3	430	10	5.9
GR11	< 0.07	0.2	4.8	52	400	0.2	140	3.1	2.1
GR12	< 0.07	0.1	3.1	2.5	29	< 0.1	260	0.71	0.53
GR13	< 0.07	0.8	1.6	20	160	< 0.1	44	1.1	0.85
GR14	< 0.07	0.7	4.3	26	260	0.2	110	1.4	0.98
GR15	< 0.07	0.4	6.2	33	270	0.3	81	2.1	1.3
GR16	< 0.07	0.6	1.0	10	52	0.3	94	0.38	0.26

[1] lower limit of determination

Table 2 . Chemical analyses of rocks from Guam

Field No.	Eu ppm	Ga ppm	Gd ppm	Ge ppm	Ho ppm	In ppm	La ppm	Li ppm	Mn ppm
LLD[1]	0.005	0.006	0.02	0.1	0.02	0.1	0.3	0.2	0.2
GR01	0.37	7.6	1.5	0.7	0.31	< 0.1	6.0	38	790
GR02	0.19	2.1	0.86	0.2	0.17	< 0.1	4.4	5.9	1000
GR03	0.28	2.5	1.3	0.3	0.25	< 0.1	6.2	13	1400
GR04	0.14	2.4	0.54	0.2	0.12	< 0.1	1.6	4.0	830
GR05	0.29	4.7	1.2	0.4	0.26	< 0.1	4.5	18	530
GR07	0.74	12	2.7	1.2	0.51	< 0.1	8.7	12	420
GR08	0.48	9.2	2	1.2	0.44	< 0.1	4.5	16	1100
GR09	0.34	7.0	1.3	0.7	0.30	< 0.1	2.1	8	720
GR10	2.4	23	9.8	1.7	1.9	< 0.1	16	12	1700
GR11	0.54	16	2.3	1.7	0.60	< 0.1	4.1	45	1300
GR12	0.11	4.1	0.53	1.2	0.14	< 0.1	2.4	5.0	290
GR13	0.17	4.7	0.76	0.6	0.23	< 0.1	1.7	26	560
GR14	0.25	8.2	1.0	0.9	0.28	< 0.1	2.8	24	1200
GR15	0.38	11	1.6	0.9	0.39	< 0.1	3.2	10	940
GR16	0.06	2.2	0.25	0.8	0.08	< 0.1	0.70	5.7	520

[1] lower limit of determination

Table 2 . Chemical analyses of rocks from Guam

Field No.	Mo ppm	Nb ppm	Nd ppm	Ni ppm	Pb ppm	Pr ppm	Rb ppm	Re ppm	Sb ppm
LLD[1]	0.1	2.0	0.2	1	0.8	0.05	0.01	0.05	0.1
GR01	0.3	1.2	5.9	56	2.1	1.3	11	< 0.05	0.2
GR02	< 0.1	0.40	3.8	16	0.8	0.82	3.6	< 0.05	<0.1
GR03	< 0.1	0.60	5.5	40	1.9	1.2	3.5	< 0.05	<0.1
GR04	0.1	0.20	1.7	12	0.5	0.40	3.5	< 0.05	0.1
GR05	< 0.1	0.89	4.6	14	1.3	0.98	26	< 0.05	<0.1
GR07	< 0.1	2.4	11	26	1.9	2.4	33	< 0.05	<0.1
GR08	0.2	1.6	5.3	230	0.9	1.1	19	< 0.05	0.2
GR09	0.1	0.50	3.5	58	0.8	0.67	9.8	< 0.05	<0.1
GR10	< 0.1	2.1	28	77	3.2	5.5	5.0	< 0.05	0.1
GR11	0.1	2.6	5.8	220	1.6	1.1	14	< 0.05	<0.1
GR12	0.1	0.30	1.8	11	0.2	0.40	4.7	< 0.05	1.8
GR13	0.2	0.70	1.7	130	0.4	0.40	3.8	< 0.05	<0.1
GR14	0.2	1.4	2.9	140	0.8	0.60	10	< 0.05	<0.1
GR15	0.5	3.1	4.1	130	1.6	0.84	9.0	< 0.05	<0.1
GR16	< 0.1	0.40	0.73	57	0.3	0.20	19	< 0.05	<0.1

[1] lower limit of determination

Table 2 . Chemical analyses of rocks from Guam

Field No.	Sc ppm	Se ppm	Sm ppm	Sn ppm	Sr ppm	Tb ppm	Te ppm	Th ppm	Tl ppm
LLD[1]	0.3	1	0.02	0.5	0.05	0.005	0.1	0.09	0.1
GR01	17	< 1	1.3	< 0.5	730	0.230	< 0.1	1.0	0.1
GR02	4	< 1	0.75	< 0.5	870	0.120	< 0.1	< 0.09	<0.1
GR03	6.3	< 1	1.2	< 0.5	760	0.190	< 0.1	< 0.09	<0.1
GR04	6.1	< 1	0.40	< 0.5	510	0.089	< 0.1	< 0.09	<0.1
GR05	9	< 1	1.1	< 0.5	260	0.190	< 0.1	0.30	<0.1
GR07	30	< 1	2.5	0.6	260	0.400	< 0.1	1.3	<0.1
GR08	36	< 1	1.5	< 0.5	540	0.310	< 0.1	0.46	<0.1
GR09	20	< 1	1.0	< 0.5	150	0.210	< 0.1	0.10	<0.1
GR10	39	< 1	8.1	0.9	82	1.4	< 0.1	0.90	<0.1
GR11	48	< 1	1.7	< 0.5	10	0.390	< 0.1	0.41	<0.1
GR12	4	< 1	0.40	< 0.5	88	0.086	< 0.1	< 0.09	<0.1
GR13	16	< 1	0.50	< 0.5	130	0.130	< 0.1	< 0.09	<0.1
GR14	22	< 1	0.79	< 0.5	110	0.180	< 0.1	0.20	<0.1
GR15	30	< 1	1.2	0.6	150	0.270	< 0.1	0.47	<0.1
GR16	5.7	< 1	0.20	< 0.5	100	0.040	< 0.1	< 0.09	<0.1

[1] lower limit of determination

Table 2 . Chemical analyses of rocks from Guam

Field No.	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm
LLD[1]	0.006	0.02	0.4	0.4	0.3	0.03	5
GR01	0.140	0.40	100	< 0.4	14	1.0	46
GR02	0.069	0.10	41	< 0.4	8.6	0.50	20
GR03	0.100	0.20	42	< 0.4	12	0.70	20
GR04	0.056	1.2	46	< 0.4	6.4	0.40	10
GR05	0.120	0.30	55	< 0.4	12	0.87	20
GR07	0.240	0.40	230	< 0.4	21	1.6	64
GR08	0.200	0.07	200	< 0.4	19	1.4	64
GR09	0.140	0.30	120	< 0.4	13	1.0	33
GR10	0.820	0.82	340	< 0.4	83	5.7	160
GR11	0.300	0.30	120	< 0.4	26	2.1	130
GR12	0.083	0.07	31	< 0.4	8.1	0.61	31
GR13	0.130	0.20	87	< 0.4	12	0.96	32
GR14	0.140	0.20	140	< 0.4	14	1.0	41
GR15	0.200	0.40	190	< 0.4	18	1.4	50
GR16	0.040	0.20	39	< 0.4	3.8	0.30	10

[1] lower limit of determination

Table 3. Chemical analyses of streambed sediment samples from areas underlain by the Facpi Formation, Guam

Field No.	North Latitude Degree	East Longitude Degree	Al %	Ca %	Fe %	K %	Mg %	Na %
LLD[1]			0.005	0.005	0.005	0.005	0.005	0.005
GSS01	13.2992	144.6811	8.4	4.2	8.7	0.74	2.9	0.76
GSS02	13.2992	144.6811	8.9	3	9.7	0.75	2.4	0.49
GSS03	13.2967	144.6725	8.1	3.8	10	0.61	2.7	0.56
GSS04	13.2783	144.6858	8.8	4.6	11	0.48	2.5	0.82

[1] lower limit of determination

Table 3. Chemical analyses of streambed sediment samples from areas underlain by the Facpi Formation, Guam

Field No.	P %	Ti %	Ag ppm	As ppm	Au ppm	Ba ppm	Be ppm	Bi ppm	Cd ppm
LLD[1]	0.01	0.005	3	0.5	0.05	0.5	0.1	0.05	0.1
GSS01	0.06	0.80	<3	0.6	< 0.05	210	0.5	< 0.05	0.2
GSS02	0.07	1.0	<3	0.6	< 0.05	220	0.6	< 0.05	0.2
GSS03	0.04	1.0	<3	2.0	< 0.05	280	0.5	< 0.05	0.2
GSS04	0.07	1.1	<3	<0.5	< 0.05	180	0.5	< 0.05	0.1

[1] lower limit of determination

Table 3. Chemical analyses of streambed sediment samples from areas underlain by the Facpi Formation, Guam

Field No.	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Ga ppm
LLD[1]	0.5	0.1	0.2	0.01	3	0.04	0.05	0.005	0.006
GSS01	14	38	68	0.40	130	2.7	1.5	0.71	16
GSS02	19	42	53	0.40	160	3.5	2.0	0.88	18
GSS03	12	46	180	0.40	130	2.9	1.6	0.73	17
GSS04	18	46	91	0.40	150	3.4	1.9	0.92	18

[1] lower limit of determination

Table 3. Chemical analyses of streambed sediment samples from areas underlain by the Facpi Formation, Guam

Field No.	Gd ppm	Ge ppm	Ho ppm	In ppm	La ppm	Li ppm	Mn ppm	Mo ppm	Nb ppm
LLD[1]	0.02	0.1	0.02	0.1	0.3	0.2	0.2	0.1	2
GSS01	2.3	1.2	0.46	< 0.1	6.5	20	1200	0.3	2.4
GSS02	3.2	1.4	0.61	< 0.1	9.0	20	1700	0.3	3.2
GSS03	2.6	1.3	0.50	< 0.1	7.6	31	1600	0.3	2.3
GSS04	3.1	1.4	0.59	< 0.1	8.4	17	1700	0.3	3.3

[1] lower limit of determination

Table 3. Chemical analyses of streambed sediment samples from areas underlain by the Facpi Formation, Guam

Field No.	Nd ppm	Ni ppm	Pb ppm	Pr ppm	Rb ppm	Re ppm	Sb ppm	Sc ppm	Se ppm
LLD[1]	0.2	1	0.8	0.05	0.01	0.05	0.1	0.3	1
GSS01	8.6	28	3.4	1.8	19	< 0.05	2.0	34	< 1
GSS02	12	25	3.8	2.4	20	< 0.05	1.5	34	< 1
GSS03	9.5	72	3.4	1.9	16	< 0.05	0.5	36	< 1
GSS04	12	30	3.0	2.3	16	< 0.05	0.3	41	< 1

[1] lower limit of determination

Table 3. Chemical analyses of streambed sediment samples from areas underlain by the Facpi Formation, Guam

Field No.	Sm ppm	Sn ppm	Sr ppm	Tb ppm	Te ppm	Th ppm	Tl ppm	Tm ppm	U ppm
LLD[1]	0.02	0.5	0.05	0.005	0.1	0.03	0.1	0.006	0.02
GSS01	2.1	0.9	260	0.35	< 0.1	0.61	<0.1	0.22	0.40
GSS02	2.9	1.0	200	0.47	< 0.1	0.9	<0.1	0.29	0.52
GSS03	2.2	0.9	280	0.38	< 0.1	0.55	<0.1	0.23	0.40
GSS04	2.8	1.0	270	0.45	< 0.1	0.78	<0.1	0.27	0.40

[1] lower limit of determination

Table 3. Chemical analyses of streambed sediment samples from areas underlain by the Facpi Formation, Guam

Field No.	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm
LLD[1]	0.4	0.1	0.3	0.03	5
GSS01	340	0.1	20	1.5	96
GSS02	430	0.2	27	2.0	110
GSS03	450	0.2	21	1.6	120
GSS04	490	0.2	25	1.8	110

[1] lower limit of determination

Table 4. Chemical analyses of soil samples from the western United States

Field No.	Latitude	Longitude	Rock Type	Al	Ca	Fe	K
	Degree	Degree		%	%	%	%
LLD[1]				0.005	0.005	0.005	0.005
CS01	38.5067	106.6623	Tuffaceous sediments	6.7	2.3	3.2	2.0
CS02	38.5075	106.6638	Tuffaceous sediments	6.3	3.0	3.0	2.0
CS03	38.6146	106.772	Tuffaceous sediments	7.2	0.77	3.4	2.2
CS04	38.4050	107.0766	Ash flow tuff	7.3	1.5	3.9	1.9
CS05	38.4159	107.0763	Ash flow tuff	2.9	17	1.3	0.94
CS06	37.9266	107.4576	Mineralized tuff breccia	6.2	0.40	2.7	3.3
CS07	37.9162	107.4455	Mineralized tuff breccia	5.9	0.60	2.5	2.7
CS08	38.5590	107.3282	Andesite	7.4	1.7	3.4	2.2
CS09	38.5452	107.3196	Andesite	6.6	1.2	3.3	2.2
GS10	38.4939	107.7343	Marine shale	5.6	4.0	2.4	1.8
CS11	38.5312	107.937	Marine shale	5.1	14	2.3	1.6
CS12	39.0315	108.0592	Basalt	6.5	1.1	3.8	1.7
CS13	39.0097	108.1044	Basalt	7.5	0.80	4.4	1.6
CS14	39.6566	106.9558	Evaporite	3.5	9.7	1.7	1.6
CS15	39.6643	106.9513	Evaporite	2.3	11	0.97	1.5
CS16	39.5188	106.3526	Clastic sedimentary rock	8.9	1.3	3.6	3.4
CS17	39.5556	106.272	Clastic sedimentary rock	6.9	0.50	3.7	2.5
CS18	39.7511	105.174	Basalt	7.4	1.6	4.4	3.1
CS19	39.7511	105.1624	Basalt	8.2	1.7	5.2	3.4
S01	38.0568	106.1420	Andesite	8.4	2.4	6.9	0.53
S02	37.8108	106.2868	Ash flow tuff	9.6	2.5	8.3	0.82
S03	37.7921	106.3230	Andesite	8.5	1.2	7.2	0.52
S04	37.7537	106.3084	Ash flow tuff	8.0	1.3	6.8	0.27
S05	37.7485	106.2910	Ash flow tuff	9.2	1.9	7.8	0.37
S06	37.7418	106.3537	Andesite	8.4	1.6	8.2	0.26
S07	37.7329	106.3524	Dacite and rhyodacite	9.8	1.2	8.6	0.19
S08	37.2584	106.1360	Basalt	8.5	11	6.1	0.44
S09	37.2484	106.1443	Basalt	15	<0.05	12	0.12
S10	37.2631	105.8350	Andesite	10	1.5	8.0	0.87
S11	37.1900	105.8049	Andesite	9.0	1.6	6.3	1.2
S12	37.1124	105.8651	Andesite	8.3	2.1	6.5	1.0
S13	36.9062	105.9887	Dacite and rhyodacite	8.0	4.9	7.2	0.30
S14	36.9045	105.9892	Dacite and rhyodacite	6.1	6.0	4.5	0.71
S15	36.8518	106.0727	Basalt	7.7	2.0	6.2	0.64
S16	36.8261	106.0615	Basalt	8.7	2.4	7.3	0.65
S17	36.8101	106.0254	Andesite	6.6	3.4	6.5	0.42

[1] lower limit of determination

Table 4. Chemical analyses of soil samples from the western United States

Field No.	Mg	Na	P	Ti	Ag	As	Au	Ba	Be
	%	%	%	%	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.005	0.005	0.01	0.005	3	0.5	0.05	0.5	0.1
CS01	1.2	1.1	0.12	0.50	<3	4.0	< 0.05	690	3.1
CS02	1.1	1.2	0.11	0.40	<3	4.0	< 0.05	740	3.2
CS03	0.74	0.58	0.08	0.40	<3	6.4	< 0.05	650	2.8
CS04	1.3	1.2	0.07	0.50	<3	4.0	< 0.05	640	2.5
CS05	1.3	0.48	0.05	0.20	<3	6.2	< 0.05	760	1.0
CS06	0.53	0.71	0.07	0.20	<3	38	< 0.05	410	5.1
CS07	0.59	1.1	0.06	0.30	<3	9.6	< 0.05	570	2.7
CS08	0.87	0.88	0.13	0.40	<3	6.1	< 0.05	630	2.1
CS09	0.72	0.79	0.10	0.40	<3	6.0	< 0.05	680	1.7
GS10	2.0	0.42	0.09	0.30	<3	8.4	< 0.05	430	1.7
CS11	1.3	0.26	0.09	0.30	<3	9.8	< 0.05	520	1.5
CS12	1.2	0.93	0.08	0.60	<3	5.1	< 0.05	670	1.4
CS13	1.0	0.78	0.12	0.70	<3	5.0	< 0.05	720	1.5
CS14	2.0	0.79	0.05	0.20	<3	2.0	< 0.05	310	1.1
CS15	3.2	0.27	0.03	0.09	<3	2.0	< 0.05	240	0.80
CS16	1.3	0.31	0.05	0.40	<3	2.0	< 0.05	940	3.9
CS17	0.92	1.2	0.11	0.30	<3	1.0	< 0.05	570	3.1
CS18	0.76	1.6	0.16	0.50	<3	5.7	< 0.05	1000	1.9
CS19	0.90	1.5	0.20	0.60	<3	8.6	< 0.05	970	2.7
S01	1.8	0.55	0.06	0.70	<3	1.0	< 0.05	320	0.50
S02	2.2	0.40	0.04	0.80	<3	1.0	< 0.05	590	0.60
S03	1.6	0.31	0.05	0.80	<3	2.0	< 0.05	240	1.6
S04	1.4	0.05	0.07	0.50	<3	6.1	< 0.05	240	0.70
S05	1.1	0.14	0.12	0.70	<3	3.0	< 0.05	120	1.90
S06	1.1	0.17	0.10	0.80	<3	2.0	< 0.05	250	0.40
S07	1.2	0.03	0.04	0.80	<3	1.0	< 0.05	53	0.80
S08	1.4	0.24	0.07	0.60	<3	2.0	< 0.05	170	0.40
S09	0.61	0.03	0.03	1.0	<3	<0.5	< 0.05	72	1.0
S10	2.1	0.63	0.02	0.70	<3	<0.5	< 0.05	680	0.70
S11	1.8	0.64	0.07	0.70	<3	<0.5	< 0.05	740	1.5
S12	3.4	0.08	0.02	0.40	<3	3.0	< 0.05	540	0.60
S13	3.9	0.42	0.02	0.40	<3	2.0	< 0.05	19	0.30
S14	2.7	0.18	0.04	0.30	<3	<0.5	0.09	300	0.60
S15	6.9	0.29	0.01	0.30	<3	<0.5	< 0.05	46	0.40
S16	5.3	0.28	< 0.01	0.40	<3	<0.5	< 0.05	61	0.40
S17	7.4	0.46	0.02	0.30	<3	<0.5	< 0.05	24	0.40

[1] lower limit of determination

Table 4. Chemical analyses of soil samples from the western United States

Field No.	Bi	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.05	0.1	0.5	0.1	0.2	0.01	3	0.04	0.05
CS01	0.40	0.2	95	11	42	7.2	20	7.5	4.2
CS02	0.50	0.3	72	10	33	8.8	30	5.5	3.2
CS03	0.30	0.6	100	14	56	7.9	30	5.9	2.6
CS04	0.20	0.1	83	11	35	6.9	20	6.3	3.8
CS05	0.07	0.2	39	3.1	17	2.6	9	3.3	1.9
CS06	0.30	0.3	160	7.4	15	24	20	5.7	3.1
CS07	0.50	0.3	120	8.9	24	12	30	5.7	3.0
CS08	0.30	1.3	57	8.1	49	7.6	30	5.3	3.1
CS09	0.20	0.9	69	11	43	6.4	30	5.6	3.2
GS10	0.20	0.3	56	7.2	63	9.2	20	4.6	2.6
CS11	0.20	0.9	45	9.4	65	7.4	20	4.1	2.4
CS12	0.20	0.2	61	17	110	4.2	30	4.0	2.2
CS13	0.20	0.2	67	20	99	4.5	30	3.9	2.1
CS14	0.06	0.2	40	6.6	41	2.3	10	2.9	1.6
CS15	< 0.05	<0.1	24	4.0	32	1.3	8	2.3	1.3
CS16	0.40	0.2	68	12	96	7.8	9	4.3	2.1
CS17	0.30	0.4	220	12	75	6.1	20	10	4.2
CS18	0.50	0.9	120	15	48	4.3	44	7.1	3.6
CS19	0.59	1.5	100	18	45	4.7	66	6.7	3.7
S01	< 0.05	0.3	17	31	97	0.40	140	3.9	2.2
S02	< 0.05	0.2	17	38	45	0.40	140	4.4	2.6
S03	0.07	0.5	29	33	70	0.60	160	6.7	3.8
S04	< 0.05	0.3	12	58	270	0.50	130	4.0	2.3
S05	< 0.05	1.6	61	44	110	0.70	140	22	13
S06	< 0.05	0.8	31	53	27	0.50	120	5.9	3.5
S07	< 0.05	0.5	26	40	62	0.60	130	6.1	3.6
S08	< 0.05	0.4	15	23	70	0.50	60	4.4	2.6
S09	< 0.05	0.1	44	160	40	0.90	280	5.7	3.2
S10	< 0.05	0.1	41	40	60	0.60	130	6.8	3.8
S11	< 0.05	0.3	57	31	21	0.40	110	7.2	4.0
S12	< 0.05	0.3	11	49	450	0.50	96	3.1	1.8
S13	< 0.05	0.2	4.6	50	540	0.20	89	2.8	1.8
S14	< 0.05	0.3	7.1	27	190	0.30	93	4.4	2.8
S15	< 0.05	0.1	6.9	53	580	0.30	67	2.4	1.5
S16	< 0.05	0.2	5.3	50	670	0.20	79	2.6	1.7
S17	< 0.05	<0.1	6.7	51	530	0.10	77	2.3	1.4

[1] lower limit of determination

Table 4. Chemical analyses of soil samples from the western United States

Field No.	Eu	Ga	Gd	Ge	Ho	In	La	Li	Mn
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.005	0.006	0.02	0.1	0.02	0.1	0.3	0.2	0.2
CS01	1.5	17	7.1	1.1	1.5	< 0.1	51	40	630
CS02	1.4	15	5.4	1.0	1.1	< 0.1	40	41	870
CS03	1.8	18	7.0	1.1	1.1	< 0.1	59	51	730
CS04	1.6	18	6.4	1.3	1.3	< 0.1	48	57	590
CS05	0.68	7.4	3.0	0.5	0.69	< 0.1	22	17	180
CS06	0.97	18	5.5	1.0	1.2	< 0.1	64	35	1200
CS07	1.6	14	6.0	1.0	1.1	< 0.1	56	32	1100
CS08	1.5	18	5.1	1.2	1.1	< 0.1	33	30	460
CS09	1.6	16	5.6	1.1	1.1	< 0.1	38	34	770
GS10	1.2	14	4.5	0.8	0.95	< 0.1	31	41	180
CS11	0.96	13	3.8	0.8	0.86	< 0.1	28	33	210
CS12	1.1	16	4.0	1.2	0.83	< 0.1	30	28	610
CS13	1.2	18	4.0	1.2	0.77	< 0.1	30	30	760
CS14	0.73	8.6	2.9	0.6	0.58	< 0.1	20	32	280
CS15	0.5	5.3	2.1	0.5	0.47	< 0.1	14	29	180
CS16	1.3	24	5.1	1.1	0.82	0.1	37	45	650
CS17	2.4	18	14	1.1	1.8	< 0.1	110	39	1200
CS18	2.0	18	7.9	1.1	1.4	0.1	66	20	920
CS19	2.0	20	7.2	1.1	1.4	0.1	57	23	1200
S01	0.99	15	3.5	1.2	0.66	< 0.1	11	25	860
S02	1.0	17	3.8	1.7	0.77	< 0.1	9.4	21	1300
S03	1.7	16	6.2	1.1	1.1	< 0.1	20	33	2800
S04	0.82	14	3.5	1.9	0.69	< 0.1	11	26	1500
S05	4.9	16	18	1.2	3.8	< 0.1	29	36	2500
S06	1.2	16	4.8	1.3	1.0	< 0.1	11	18	5100
S07	1.2	18	5.0	1.5	1.1	< 0.1	9.8	19	1900
S08	1.0	14	4.0	1.0	0.78	< 0.1	9.2	33	1300
S09	1.4	27	5.3	1.8	0.97	< 0.1	18	8.2	3200
S10	1.8	15	6.6	1.2	1.2	< 0.1	20	17	1500
S11	1.8	15	7.3	0.9	1.2	< 0.1	30	16	1300
S12	0.65	14	2.6	1.2	0.54	< 0.1	7.3	46	1400
S13	0.52	14	2.1	1.2	0.53	< 0.1	2.6	30	1200
S14	0.83	9.7	3.7	0.7	0.82	< 0.1	9.9	19	1200
S15	0.44	12	1.8	1.0	0.43	< 0.1	3.3	26	1200
S16	0.49	13	2.0	1.5	0.50	< 0.1	4.0	37	1200
S17	0.45	12	1.8	1.1	0.42	< 0.1	3.8	28	1200

[1] lower limit of determination

Table 4. Chemical analyses of soil samples from the western United States

Field No.	Mo	Nb	Nd	Ni	Pb	Pr	Rb	Re	Sb
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.1	1	0.2	1	0.8	0.05	0.01	0.05	0.1
CS01	0.8	24	42	21	24	11	96	< 0.05	1.0
CS02	1.0	18	33	18	27	8.5	93	< 0.05	0.9
CS03	1.8	16	49	29	26	13	130	< 0.05	0.7
CS04	1.0	20	40	23	26	10	90	< 0.05	0.8
CS05	0.7	7.9	18	10	10	4.8	44	< 0.05	0.8
CS06	12	46	39	6.6	56	11	260	< 0.05	2.2
CS07	1.8	25	40	10	36	11	160	< 0.05	1.2
CS08	1.8	13	30	18	22	7.4	140	< 0.05	0.9
CS09	1.0	14	34	20	21	8.5	110	< 0.05	1.0
GS10	1.8	10	27	23	20	6.8	93	< 0.05	1.0
CS11	7.1	12	23	36	16	5.8	93	< 0.05	1.1
CS12	1.1	16	26	47	26	6.6	76	< 0.05	0.6
CS13	1.1	16	25	48	17	6.4	81	< 0.05	0.6
CS14	2.8	5.8	18	18	7.7	4.7	58	< 0.05	0.3
CS15	9.5	2.8	12	13	4.5	3.1	40	< 0.05	0.3
CS16	0.4	16	32	32	17	8.8	160	< 0.05	0.2
CS17	0.7	16	100	26	24	27	160	< 0.05	0.3
CS18	2.3	24	57	15	69	15	130	< 0.05	0.9
CS19	2.4	29	49	16	97	12	150	< 0.05	1.1
S01	0.9	2.9	14	57	7.6	2.7	17	< 0.05	0.4
S02	0.4	3.1	13	29	4.2	2.6	24	< 0.05	0.3
S03	0.5	10	26	37	6.9	5.2	16	< 0.05	0.3
S04	3.2	1.7	12	160	11	2.5	12	< 0.05	0.5
S05	0.8	3.8	54	54	8.8	10	19	< 0.05	0.3
S06	0.9	2.7	17	21	41	3.3	13	< 0.05	0.5
S07	0.5	3.2	15	32	5.7	3.0	10	< 0.05	0.4
S08	0.2	2.9	13	38	2.0	2.5	14	< 0.05	0.3
S09	< 0.1	7.1	21	35	4.7	4.4	6.6	< 0.05	0.2
S10	0.2	3.2	27	28	4.0	5.7	40	< 0.05	0.1
S11	0.4	7.2	34	14	7.2	7.2	34	< 0.05	0.4
S12	0.2	2.6	8.7	230	5.1	1.8	25	< 0.05	0.5
S13	0.4	1.4	4.6	210	4.2	0.83	8.0	< 0.05	0.3
S14	0.3	1.0	12	89	6.8	2.3	16	< 0.05	0.2
S15	0.1	1.7	4.7	320	1.0	0.92	18	< 0.05	<0.1
S16	0.3	2.0	5.0	410	1.0	0.98	15	< 0.05	0.2
S17	0.2	1.6	4.9	300	0.9	0.97	8.0	< 0.05	<0.1

[1] lower limit of determination

Table 4. Chemical analyses of soil samples from the western United States

Field No.	Sc	Se	Sm	Sn	Sr	Tb	Te	Th	Tl
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.3	1	0.02	0.5	0.05	0.005	0.1	0.03	0.1
CS01	11	< 1	8.3	4.0	210	1.1	< 0.1	16	0.7
CS02	9.6	< 1	6.4	3.0	210	0.84	< 0.1	12	0.7
CS03	12	< 1	9.2	3.0	140	0.99	< 0.1	16	0.8
CS04	12	< 1	7.6	3.0	260	0.96	< 0.1	14	0.7
CS05	4.0	< 1	3.6	1.0	400	0.48	< 0.1	6.6	0.4
CS06	6.1	< 1	7.1	19	100	0.87	< 0.1	29	3.9
CS07	7.7	< 1	7.5	2.0	150	0.89	< 0.1	18	1.9
CS08	12	1	5.9	2.0	290	0.78	< 0.1	8.8	1.1
CS09	10	< 1	6.8	2.0	190	0.86	< 0.1	9.8	0.9
GS10	9.2	< 1	5.4	2.0	140	0.69	< 0.1	9.8	0.7
CS11	8.7	2	4.5	2.0	740	0.6	< 0.1	8.6	1.3
CS12	11	< 1	5.0	2.0	170	0.61	< 0.1	8.8	0.5
CS13	12	< 1	4.8	2.0	150	0.60	< 0.1	8.0	0.5
CS14	5.9	< 1	3.8	1.0	610	0.44	< 0.1	5.9	0.3
CS15	4.0	< 1	2.4	0.90	780	0.33	< 0.1	3.6	0.4
CS16	15	< 1	6.6	4.0	100	0.70	< 0.1	19	1.0
CS17	12	< 1	19	3.0	78	1.8	< 0.1	43	1.1
CS18	14	< 1	10	3.0	530	1.1	< 0.1	22	0.6
CS19	16	< 1	9.1	3.0	590	1.0	< 0.1	18	0.5
S01	29	< 1	3.1	3.0	210	0.51	< 0.1	0.77	0.1
S02	34	< 1	3.2	2.0	230	0.56	< 0.1	0.72	<0.1
S03	25	< 1	6.1	2.0	85	0.90	< 0.1	1.5	<0.1
S04	33	< 1	2.8	3.0	96	0.53	< 0.1	0.47	<0.1
S05	42	< 1	16	3.0	51	2.8	< 0.1	0.71	0.1
S06	31	< 1	4.2	3.0	80	0.76	< 0.1	0.73	0.3
S07	42	< 1	4.0	2.0	19	0.78	< 0.1	0.86	0.1
S08	28	< 1	3.1	1.0	99	0.58	< 0.1	0.54	<0.1
S09	48	< 1	4.7	2.0	9.2	0.78	< 0.1	3.7	<0.1
S10	30	< 1	6.2	2.0	340	0.93	< 0.1	1.4	<0.1
S11	23	< 1	6.9	2.0	270	1.0	< 0.1	3.3	<0.1
S12	37	< 1	2.1	2.0	100	0.40	< 0.1	0.53	<0.1
S13	44	< 1	1.4	2.0	540	0.35	< 0.1	0.20	<0.1
S14	26	< 1	2.7	4.0	800	0.56	< 0.1	0.30	<0.1
S15	36	< 1	1.3	0.70	190	0.30	< 0.1	0.41	<0.1
S16	44	< 1	1.4	1.0	480	0.33	< 0.1	0.44	<0.1
S17	38	< 1	1.4	1.0	150	0.28	< 0.1	0.37	<0.1

[1] lower limit of determination

Table 4. Chemical analyses of soil samples from the western United States

Field No.	Tm	U	V	W	Y	Yb	Zn
	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]	0.006	0.02	0.4	0.1	0.3	0.03	5
CS01	0.72	2.7	79	2.6	45	4.3	80
CS02	0.55	2.6	70	4.7	34	3.1	84
CS03	0.42	2.9	81	2.4	31	2.4	120
CS04	0.63	2.7	98	2.3	41	3.6	93
CS05	0.33	4.7	37	0.9	20	1.8	36
CS06	0.53	14	49	4.8	37	3.0	130
CS07	0.5	6.0	57	2.5	34	2.9	88
CS08	0.54	6.4	120	1.3	34	3.2	160
CS09	0.53	2.9	110	1.3	36	3.0	100
GS10	0.44	3.6	95	1.2	29	2.5	93
CS11	0.4	5.9	170	1.3	27	2.4	120
CS12	0.38	2.7	96	1.5	23	2.3	87
CS13	0.36	2.3	100	1.3	22	2.1	100
CS14	0.27	2.9	41	0.6	17	1.5	32
CS15	0.21	5.3	32	0.3	14	1.3	10
CS16	0.35	4.1	89	1.8	25	2.0	50
CS17	0.6	8.2	79	1.7	48	3.4	75
CS18	0.6	4.1	120	1.9	41	3.3	120
CS19	0.61	4.1	140	2.3	41	3.5	150
S01	0.3	0.69	270	0.4	30	2.1	96
S02	0.34	0.64	290	0.2	36	2.4	100
S03	0.52	0.40	250	0.6	47	3.9	120
S04	0.31	0.64	180	0.4	32	2.1	93
S05	1.9	0.50	210	0.3	130	14	110
S06	0.49	0.40	200	0.5	42	3.6	130
S07	0.51	0.56	220	0.2	46	3.7	74
S08	0.36	0.40	210	0.2	36	2.5	66
S09	0.44	2.0	250	< 0.1	44	3.0	78
S10	0.53	0.80	300	0.2	48	3.7	93
S11	0.55	1.7	190	0.2	55	4.0	120
S12	0.26	0.30	150	0.2	24	1.8	93
S13	0.26	0.40	180	< 0.1	25	1.8	85
S14	0.38	0.20	110	0.1	44	2.7	68
S15	0.22	0.10	120	< 0.1	19	1.6	64
S16	0.25	0.10	160	0.1	23	1.8	72
S17	0.20	0.10	170	< 0.1	19	1.4	70

[1] lower limit of determination

Table 5. Chemical analyses of rocks from the western United States

Field No.	North Latitude Degree	East Longitude Degree	Rock Type	Al %	Ca %	Fe %
LLD[1]				0.005	0.005	0.005
CR02	38.5075	106.6638	tuffaceous sedimentary rock	6.6	0.99	0.42
CR04	38.4050	107.0766	ash-flow tuff	6.6	0.61	1.1
CR05	38.4159	107.0763	ash-flow tuff	2.6	17	0.85
CR06	37.9266	107.4576	mineralized ash-flow tuff	6.1	0.2	0.95
CR08	38.5590	107.3282	andesite	8.9	4.8	4.6
CR11	38.5312	107.9370	marine shale	5.9	7.1	2.7
CR12	39.0315	108.0592	basalt	7.4	5.8	7.9
CR15	39.6643	106.9513	evaporite	0.34	20	0.26
CR16	39.5188	106.3526	clastic sedimentary rock	2.1	0.76	2.0
CR18	39.7511	106.1740	andesite	8.0	3.8	6.0

[1] lower limit of determination

Table 5. Chemical analyses of rocks from the western United States

Field No.	K %	Mg %	Na %	P %	Ti %	Ag ppm	As ppm	Au ppm	Ba ppm
LLD[1]	0.005	0.005	0.005	0.01	0.005	3	0.5	0.05	0.5
CR02	3.7	0.06	3.0	0.04	0.04	<3	1.0	< 0.05	120
CR04	4.3	0.13	2.3	0.04	0.20	<3	2.0	< 0.05	640
CR05	1.4	1.3	0.80	0.08	0.10	<3	4.0	< 0.05	1100
CR06	4.7	0.24	1.3	0.01	0.10	<3	0.6	< 0.05	220
CR08	2.1	0.84	2.6	0.24	0.80	<3	1.0	< 0.05	970
CR11	1.9	1.8	0.56	0.09	0.30	<3	12	< 0.05	510
CR12	1.2	4.6	2.1	0.16	1.2	<3	<0.5	< 0.05	940
CR15	0.17	0.95	0.06	< 0.01	0.03	<3	<0.5	0.05	46
CR16	0.65	0.55	0.02	< 0.01	0.02	<3	<0.5	< 0.05	2800
CR18	3.6	1.9	2.2	0.23	0.60	<3	<0.5	< 0.05	1200

[1] lower limit of determination

Table 5. Chemical analyses of rocks from the western United States

Field No.	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm
LLD[1]	<0.1	0.05	0.1	0.5	0.1	0.2	0.01	3	0.04
CR02	8.3	0.30	<0.1	18	0.6	2	4.4	<3	6.4
CR04	1.8	< 0.05	<0.1	89	2.3	2	2.6	5	6.0
CR05	1.0	< 0.05	0.2	42	2.4	6	1.6	6	3.5
CR06	4.4	0.20	0.1	98	1.7	2	7.8	7	4.9
CR08	1.6	< 0.05	0.1	82	12	3	1.2	9	7.9
CR11	1.6	0.20	1.0	50	7.9	73	9.1	20	4.2
CR12	1.2	< 0.05	<0.1	62	47	300	0.40	52	6.0
CR15	<0.1	< 0.05	0.3	5	0.6	5	0.30	<3	0.39
CR16	0.2	< 0.05	<0.1	29	5.4	10	0.40	<3	0.83
CR18	3.5	< 0.05	0.3	88	22	37	2.5	71	6.3

[1] lower limit of determination

Table 5. Chemical analyses of rocks from the western United States

Field No.	Er ppm	Eu ppm	Ga ppm	Gd ppm	Ge ppm	Ho ppm	In ppm	La ppm	Li ppm
LLD[1]	0.05	0.005	0.006	0.02	0.1	0.02	0.1	0.3	0.2
CR02	3.2	0.24	27	4.3	2.4	1.2	0.1	10	88
CR04	3.6	1.4	15	5.9	1.1	1.3	< 0.1	55	26
CR05	2.0	0.84	6.4	3.7	0.4	0.73	< 0.1	31	17
CR06	3.1	0.47	18	4.2	1.0	1.0	< 0.1	53	22
CR08	4.4	2.9	23	8.3	1.0	1.6	< 0.1	42	12
CR11	2.4	1.1	16	4.1	0.9	0.88	< 0.1	30	37
CR12	3.4	2.0	20	5.9	1.0	1.2	< 0.1	34	8.1
CR15	0.23	0.10	0.90	0.37	0.1	0.08	< 0.1	2.6	4.0
CR16	0.36	0.38	4.8	1.6	0.9	0.14	< 0.1	13	22
CR18	3.7	2.1	21	6.3	1.1	1.3	< 0.1	49	17

[1] lower limit of determination

Table 5. Chemical analyses of rocks from the western United States

Field No.	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	Pb ppm	Pr ppm	Rb ppm	Re ppm
LLD[1]	0.2	0.1	1	0.2	1	0.8	0.05	0.01	0.05
CR02	1300	1.3	60	11	1.4	34	2.8	260	< 0.05
CR04	460	0.6	23	41	3.6	21	11	150	< 0.05
CR05	220	0.5	8.2	24	7.1	8.2	6.1	52	< 0.05
CR06	510	1.2	61	31	1.6	20	9.5	360	< 0.05
CR08	1000	0.7	16	46	1.7	12	11	64	< 0.05
CR11	170	19	15	25	42	16	6.4	110	0.10
CR12	1200	1.2	22	33	160	7.5	7.9	25	< 0.05
CR15	55	3.7	1.3	2.4	2.3	2.8	0.60	6.0	< 0.05
CR16	240	0.1	1.1	13	6.3	0.6	3.6	24	< 0.05
CR18	1200	1.5	34	41	13	22	10	160	< 0.05

[1] lower limit of determination

Table 5. Chemical analyses of rocks from the western United States

Field No.	Sb ppm	Sc ppm	Se ppm	Sm ppm	Sn ppm	Sr ppm	Tb ppm	Te ppm	Th ppm
LLD[1]	0.1	0.3	1	0.02	0.5	0.05	0.005	0.1	0.03
CR02	0.2	8.6	< 1	3.8	6.0	27	0.91	< 0.1	12
CR04	0.3	4.0	< 1	7.5	1.0	120	0.91	< 0.1	18
CR05	0.6	2.0	< 1	4.4	0.7	420	0.55	< 0.1	6.7
CR06	0.5	2.0	< 1	5.5	3.0	61	0.70	< 0.1	45
CR08	0.1	12	< 1	9.6	2.0	1000	1.2	< 0.1	4.7
CR11	1.3	9.6	6	5.0	2.0	300	0.64	< 0.1	9.2
CR12	<0.1	25	< 1	6.6	2.0	720	0.91	< 0.1	3.7
CR15	<0.1	0.6	< 1	0.40	< 0.5	1100	0.06	< 0.1	0.71
CR16	<0.1	1.0	< 1	2.7	0.7	80	0.16	< 0.1	4.2
CR18	0.2	20	< 1	7.9	2.0	1200	0.94	< 0.1	15

[1] lower limit of determination

Table 5. Chemical analyses of rocks from the western United States

Field No.	Tl ppm	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm
LLD[1]	0.1	0.006	0.02	0.4	0.1	0.3	0.03	5
CR02	1.5	0.53	4.2	5.0	1.7	42	3.0	77
CR04	0.6	0.61	4.0	15	1.2	37	3.7	40
CR05	0.2	0.33	5.4	21	0.8	23	1.9	20
CR06	3.6	0.56	14	12	3.7	33	3.4	57
CR08	0.4	0.73	1.7	100	0.6	48	4.2	140
CR11	1.8	0.41	6.6	210	1.6	28	2.4	120
CR12	0.1	0.54	0.88	190	0.4	37	3.0	110
CR15	<0.1	0.04	1.2	6.0	< 0.1	2.4	0.20	20
CR16	<0.1	0.07	0.69	12	0.2	3.8	0.30	7
CR18	0.2	0.62	4.0	160	1.5	39	3.6	110

[1] lower limit of determination

Table 6. Chemical analyses of water-soluble extractions of soils from Guam

Site No.	Formation	pH	Al ppm	Ca ppm	Na ppm	Mg ppm	K ppm	Mn ppm
LLD[1]			0.001	0.5	0.1	0.1	0.3	0.0001
GS-01	Facpi, tuff	5.97	5.7	83	66	31	46	0.71
GS-02	Facpi, tuff	6.69	3.0	137	61	15	33	0.22
GS-03	Facpi, tuff	6.01	4.1	66	69	17	64	1.34
GS-04	Facpi, tuff	5.90	6.0	83	46	17	24	0.95
GS-05	Facpi, tuff	6.28	2.5	156	55	23	40	0.59
GS-06	Facpi, tuff	6.19	4.1	228	54	42	54	2.43
GS-07	Facpi, tuff	6.00	2.9	71	53	7.6	14	0.45
GS-08	Facpi, tuff	7.60	3.1	170	51	8.7	30	0.24
GS-09	Bolanos	5.08	0.79	1.1	98	6.1	8.3	0.97
GS-10	Bolanos	6.32	1.7	17	77	22	13	0.13
GS-11	Bolanos	6.72	9.9	9.4	125	11	31	0.58
GS-12	Facpi, basalt	7.53	3.6	139	37	36	33	0.26
GS-13	Facpi, basalt	7.44	5.7	154	39	19	14	0.36
GS-14	Facpi, basalt	7.71	12.2	376	54	23	74	0.94
GS-15	Facpi, basalt	7.11	6.1	24	107	23	9.0	0.29
GS-16	Facpi, basalt	7.32	2.8	15	38	13	3.7	0.15
GS-17	Facpi, basalt	7.13	3.7	12	46	11	4.3	0.12
GS-18	Limestone, undivided	7.58	4.0	106	16	1.7	11	0.68
GS-19	Alutom	7.96	3.1	171	23	10	21	0.16
GS-20	Alutom	5.81	3.1	17	40	7.8	24	0.49
GS-21	Alutom	6.17	1.2	9.4	23	13	10	0.13
GS-22	Alutom	5.59	3.7	8.4	40	10	12	0.81
GS-23	Facpi, basalt	6.76	5.5	11	87	7.7	6.6	0.26
GS-24	Facpi, basalt	6.19	10.0	87	85	50	33	0.80
GS-25	Facpi, basalt	7.25	8.9	17	96	24	4.1	0.33
GS-09R[2]	Bolanos		0.87	1.1	102	6.1	8.2	1.10
GS-17R[2]	Facpi, basalt		1.8	11	43	8.4	3.9	0.07
GS-21R[2]	Alutom		1.1	9.4	21	11	10	0.13

[1] lower limit of determinatin

[2] duplicate

Table 6. Chemical analyses of water-soluble extractions of soils from Guam

Site No.	Fe ppm	Si ppm	P ppm	SO_4 ppm	Li ppb	Be ppb	V ppb	Cr ppb	Co ppb	Ni ppb	Cu ppb
LLD[1]	0.5	0.2	0.1	20	1	0.5	1	10	0.2	1	5
GS-01	6.5	53	8.2	51	24	0.5	100	25	11	128	465
GS-02	2.0	36	5.5	78	<1	<0.5	32	11	6	47	281
GS-03	5.8	37	6.0	40	10	1.5	49	11	9	43	285
GS-04	6.7	38	5.5	34	19	0.5	31	28	30	160	402
GS-05	3.5	45	11	60	10	0.6	30	20	10	55	181
GS-06	12.3	53	14	98	8	<0.5	55	16	22	51	292
GS-07	2.8	44	6.2	38	6	<0.5	18	12	8	67	232
GS-08	1.1	25	5.0	26	<1	<0.5	41	<10	5	17	61
GS-09	0.5	21	7.0	<20	6	<0.5	3	<10	44	5	135
GS-10	1.1	33	4.7	<20	<1	<0.5	18	<10	3	12	68
GS-11	8.5	56	9.7	27	3	1.6	90	12	14	168	297
GS-12	2.1	28	6.4	38	14	<0.5	27	26	8	98	197
GS-13	3.8	42	5.3	35	<1	<0.5	72	21	13	81	108
GS-14	8.1	47	12	88	6	<0.5	71	46	23	198	466
GS-15	5.2	38	3.9	28	<1	<0.5	53	27	9	67	181
GS-16	1.9	37	3.0	20	<1	<0.5	76	21	4	44	176
GS-17	2.7	30	5.6	<20	<1	<0.5	71	14	5	47	81
GS-18	0.4	< 0.2	3.4	21	<1	0.6	11	146	8	48	20
GS-19	3.3	29	4.7	30	4	<0.5	58	13	5	44	136
GS-20	0.5	12	5.2	34	2	<0.5	10	<10	14	9	115
GS-21	0.7	23	3.0	<20	<1	<0.5	9	<10	2	8	32
GS-22	0.5	14	7.9	27	1	<0.5	4	<10	22	11	64
GS-23	5.3	40	4.4	22	<1	<0.5	139	49	10	122	193
GS-24	11.3	51	5.0	41	<1	0.5	82	52	23	211	174
GS-25	8.9	42	4.9	40	11	<0.5	95	23	15	104	97
GS-09R[2]	0.6	23	5.7	33	6	<0.5	3	<10	48	5	128
GS-17R[2]	1.1	26	5.2	<20	<1	<0.5	67	11	3	29	207
GS-21R[2]	0.7	23	2.9	<20	<1	<0.5	9	<10	3	14	31

[1] lower limit of determinatin

[2] duplicate

Table 6. Chemical analyses of water-soluble extractions of soils from Guam

Site No.	Zn ppb	As ppb	Se ppb	Mo ppb	Cd ppb	Sb ppb	Ba ppb	Pb ppb	Th ppb	U ppb
LLD[1]	5	10	10	2	0.2	1	1	0.5	0.05	0.05
GS-01	382	60	11	8	7.2	11	72	75	5.4	1.2
GS-02	110	<10	16	6	1.2	5	76	22	1.4	0.40
GS-03	139	11	<10	3	2.6	2	350	25	2.7	0.20
GS-04	167	<10	11	3	2.6	3	487	20	2.4	0.32
GS-05	94	<10	20	3	2.9	2	100	13	3.6	0.05
GS-06	149	<10	20	3	2.4	2	234	21	3.9	0.28
GS-07	893	<10	16	6	11	3	46	17	0.98	<0.05
GS-08	35	<10	<10	3	0.7	2	70	4.0	1.5	0.42
GS-09	19	<10	<10	<2	<0.2	<1	87	1.5	0.28	<0.05
GS-10	26	<10	<10	2	0.2	2	23	2.3	0.86	0.10
GS-11	1620	<10	<10	22	7.1	2	99	6.8	2.2	2.0
GS-12	31	<10	<10	3	0.5	1	117	4.5	1.0	0.31
GS-13	96	14	<10	4	0.9	1	8	20	1.3	0.49
GS-14	107	13	21	7	1.5	3	98	19	2.6	0.58
GS-15	49	<10	<10	<2	0.4	2	9	20	0.58	0.13
GS-16	237	<10	<10	4	1.5	2	6	11	0.46	0.27
GS-17	34	<10	<10	3	0.4	1	4	22	0.76	0.06
GS-18	16	<10	10	<2	0.7	<1	3	6.9	0.27	0.99
GS-19	18	<10	<10	5	0.3	1	67	2.3	0.84	0.90
GS-20	12	<10	<10	<2	<.2	<1	103	2.5	0.38	0.15
GS-21	11	<10	<10	<2	<.2	<1	132	2.1	0.18	0.48
GS-22	6	<10	13	<2	0.2	2	60	1.8	0.30	<0.05
GS-23	66	<10	<10	3	0.8	2	14	16	0.68	0.36
GS-24	108	<10	<10	3	2.7	2	33	9.0	0.92	0.63
GS-25	25	<10	<10	<2	0.2	<1	9	2.1	0.56	<0.05
GS-09R[2]	14	<10	<10	<2	<2	<1	87	0.7	0.10	<0.05
GS-17R[2]	74	<10	<10	3	0.9	1	2	3.4	0.45	<0.05
GS-21R[2]	14	<10	<10	<2	0.3	<1	131	2.8	0.12	<0.05

[1] lower limit of determinatin

[2] duplicate

Table 7. Chemical analyses of water-soluble extractions of soils from the western United States

Site No.	Rock Type	pH	Al	Ca	Na	Mg	K	Mn
			ppm	ppm	ppm	ppm	ppm	ppm
LLD[1]			0.001	0.5	0.1	0.1	0.3	0.0001
CS-1	Tuffaceous sediments	8.22	2.17	75	1.4	7.7	29	0.100
CS-2	Tuffaceous sediments	8.62	1.68	86	1.4	5.8	17	0.110
CS-3	Tuffaceous sediments	7.15	1.66	39	2.2	7.2	38	0.269
CS-4	Ash flow tuff	8.27	1.34	28	15	4.4	12	0.052
CS-5	Ash flow tuff	8.73	0.79	121	27	26	3	0.022
CS-6	Mineralized tuff breccia	7.17	1.17	111	3.1	11	14	0.154
CS-7	Mineralized tuff breccia	7.72	1.59	60	3.5	7.6	19	0.238
CS-8	Andesite	7.13	3.35	73	32	11	97	0.263
CS-9	Andesite	6.99	2.66	58	11	7.6	101	0.445
CS-10	Marine shale	8.42	1.42	115	12	15	70	0.035
CS-11	Marine shale	7.92	0.35	6140	168	221	148	0.182
CS-12	Basalt	8.28	2.01	35	3.1	9.6	10	0.109
CS-13	Basalt	7.81	3.74	17	3.1	3.8	11	0.168
CS-14	Evaporite	8.61	0.66	7700	<0.1	1960	410	0.110
CS-15	Evaporite	8.71	0.74	5460	200	784	93	0.081
CS-16	Clastic sedimentary rock	8.80	1.18	118	9.1	49	53	0.109
CS-17	Clastic sedimentary rock	8.77	1.22	35	2.1	3.7	14	0.320
CS-18	Basalt	7.83	1.64	28	6.1	9.2	22	0.263
CS-19	Basalt	7.48	2.73	26	3.7	7.3	29	0.413
S01	Andesite	8.78	3.47	45	4.4	4.4	118	0.458
S02	Ash flow tuff	8.68	1.98	81	5.2	7.4	50	0.229
S03	Andesite	8.21	2.91	20	3.1	4.3	13	0.170
S04	Ash flow tuff	8.11	4.30	89	8.4	11	46	0.510
S05	Ash flow tuff	8.52	4.82	77	2.3	4.0	40	0.228
S06	Andesite	8.20	3.92	38	3.9	4.4	27	0.439
S07	Dacite and rhyodacite	8.41	3.56	42	2.6	4.5	49	0.371
S08	Basalt	8.61	2.98	118	2.7	7.9	26	0.090
S09	Basalt	8.52	4.67	154	24	9.3	46	0.239
S10	Andesite	8.78	3.83	118	14	7.1	62	0.141
S11	Andesite	8.72	2.71	72	4.6	7.4	54	0.200
S12	Andesite	8.65	2.81	60	2.5	15	237	0.382
S13	Dacite and rhyodacite	8.44	1.41	144	3.3	7.6	22	0.074
S14	Dacite and rhyodacite	9.09	2.17	79	2.8	4.1	21	0.053
S15	Basalt	8.06	1.25	34	3.2	5.7	34	0.115
S16	Basalt	7.58	1.14	43	3.7	5.5	28	0.130
S17	Andesite	7.96	1.75	65	5.6	4.9	11	0.097
S01-R[2]	Andesite		1.73	40	4.0	3.4	114	0.240
CS-1R[2]	Tuffaceous sediments		1.50	75	1.2	6.8	28	0.070

[1] lower limit of determinatin

[2] duplicate

Table 7. Chemical analyses of water-soluble extractions of soils from the western United States

Site No.	Fe ppm	Si ppm	P ppm	SO_4 ppm	Li ppb	Be ppb	V ppb	Cr ppb	Co ppb	Ni ppb
LLD[1]	0.5	2	0.1	20	1	0.5	1	10	0.2	1
CS-1	0.7	32	3.7	<20	37	0.5	106	<10	2.1	20
CS-2	<0.5	29	3.4	<20	24	1.0	55	<10	1.7	17
CS-3	0.8	11	5.1	<20	21	2.0	17	<10	3.9	28
CS-4	<0.5	38	2.6	<20	40	0.5	97	<10	1.1	18
CS-5	<0.5	68	1.0	<20	23	<0.5	248	<10	1.0	21
CS-6	0.8	6	1.1	<20	2	0.6	5	<10	0.9	11
CS-7	1.1	10	2.6	<20	9	0.8	12	<10	1.5	9
CS-8	4.7	20	19	37	31	1.2	128	131	5.4	206
CS-9	2.5	15	14	24	26	1.6	90	44	7.4	181
CS-10	<0.5	18	3.7	98	55	<0.5	40	<10	5.3	39
CS-11	<0.5	14	1.0	15100	84	<0.5	7	<10	11.4	286
CS-12	1.7	9	0.7	30	<1	<0.5	10	<10	1.9	9
CS-13	2.9	11	0.8	<20	<1	0.6	10	<10	2.9	7
CS-14	1.0	5	0.9	19700	147	<.5	3	<10	16.0	322
CS-15	1.4	4	0.6	13800	20	<.5	13	<10	8.7	246
CS-16	<0.5	8	2.0	263	12	1.2	11	<10	1.7	23
CS-17	0.8	3	1.4	<20	<1	0.6	8	<10	1.4	11
CS-18	1.6	13	4.5	<20	10	<.5	32	<10	3.0	9
CS-19	2.6	14	7.0	<20	3	1.8	30	<10	4.6	10
S01	1.3	49	7.0	24	17	0.5	190	<10	3.4	26
S02	0.7	34	6.6	30	8	<0.5	106	<10	3.3	30
S03	1.7	24	3.2	<20	<1	<0.5	41	<10	3.7	30
S04	2.8	28	8.1	24	13	1.0	80	<10	8.3	43
S05	1.3	40	5.8	21	13	0.9	49	<10	2.9	25
S06	1.7	33	4.7	<20	9	0.7	94	<10	3.8	26
S07	1.4	41	8.1	<20	23	0.7	128	<10	4.2	24
S08	1.2	42	2.8	<20	15	0.5	126	<10	3.0	24
S09	2.0	70	3.3	52	74	0.6	753	<10	5.1	28
S10	1.7	45	3.7	34	24	<.5	181	<10	2.7	20
S11	1.4	53	4.0	<20	26	1.1	194	<10	4.0	25
S12	0.8	37	15.2	34	8	<0.5	100	<10	7.4	45
S13	<0.5	41	3.9	32	26	<0.5	91	<10	2.7	30
S14	<0.5	16	5.4	23	7	<0.5	53	<10	1.4	32
S15	0.6	24	9.8	25	15	<0.5	70	<10	2.5	42
S16	<0.5	29	6.2	30	12	0.5	45	<10	2.3	44
S17	<0.5	36	5.1	40	9	0.6	57	<10	2.1	29
S01-R[2]	<0.5	45	7.0	32	19	<0.5	185	<10	2.1	17
CS-1R[2]	<0.5	30	3.9	<20	36	0.6	94	<10	1.7	30

[1] lower limit of determinatin

[2] duplicate

Table 7. Chemical analyses of water-soluble extractions of soils from the western United States

Site No.	Cu ppb	Zn ppb	As ppb	Se ppb	Mo ppb	Cd ppb	Sb ppb	Ba ppb	Pb ppb	Th ppb	U ppb
LLD[1]	5	5	10	10	2	0.2	1	1	0.5	0.05	0.05
CS-1	80	14	<10	<10	2	0.5	2	403	13.8	9.2	0.22
CS-2	73	19	<10	<10	2	0.4	2	359	11.5	6.1	0.16
CS-3	71	49	10	<10	6	1.1	<1	234	9.2	11	0.52
CS-4	66	15	17	<10	2	0.3	2	136	5.9	3.5	0.44
CS-5	47	8	37	<10	3	<.2	2	776	1.5	4.3	6.8
CS-6	26	13	13	<10	7	0.3	<1	89	6.3	3.0	8.8
CS-7	67	35	13	<10	6	0.6	<1	83	6.7	4.1	1.2
CS-8	243	654	25	21	31	9.5	4	291	564	17	5.4
CS-9	195	231	18	13	17	8.0	1	390	106	6.1	1.9
CS-10	88	15	12	11	3	0.4	<1	206	2.7	3.0	0.72
CS-11	73	38	<10	126	27	0.8	<1	403	1.6	3.9	12
CS-12	28	11	<10	<10	<2	0.3	<1	310	6.2	0.60	0.37
CS-13	30	12	<10	<10	<2	0.2	<1	321	3.2	0.97	0.74
CS-14	58	28	28	307	86	0.3	<1	345	1.2	5.8	0.97
CS-15	48	25	27	627	2520	5.3	<1	105	1.0	3.2	17
CS-16	54	18	<10	16	33	0.5	<1	1230	2.9	0.96	0.56
CS-17	67	12	<10	<10	9	0.3	<1	237	3.0	0.95	2.5
CS-18	95	32	14	<10	12	1.5	3	111	26	0.70	1.1
CS-19	149	50	25	<10	9	2.9	2	84	48	1.2	1.7
S01	112	32	25	<10	4	0.6	4	160	15	0.98	0.68
S02	96	27	16	11	3	0.5	5	199	5.4	0.75	0.61
S03	49	24	11	<10	<2	0.3	30	37	7.9	0.41	0.19
S04	152	62	22	13	7	1.6	4	256	15	1.8	0.89
S05	75	31	10	<10	<2	0.6	3	152	13	0.82	0.44
S06	87	27	14	<10	<2	0.6	1	158	12	0.56	0.44
S07	89	19	16	<10	3	0.6	2	151	7.7	0.80	0.73
S08	84	16	38	13	<2	0.3	5	295	3.2	0.46	0.75
S09	67	19	85	11	3	0.4	2	781	4.8	1.3	5.8
S10	57	17	60	<10	5	0.2	3	74	7.1	0.51	2.6
S11	129	15	26	<10	2	1.9	24	178	4.4	0.58	0.86
S12	111	34	10	15	4	1.4	1	237	6.4	1.9	0.19
S13	77	14	30	18	3	0.4	2	361	2.2	0.48	0.57
S14	58	8	<10	<10	<2	<.2	<1	260	1.6	0.40	0.34
S15	79	15	11	<10	3	0.4	<1	167	2.6	0.40	0.34
S16	108	20	12	14	4	0.8	<1	229	2.5	0.70	0.39
S17	84	26	18	<10	2	0.6	1	179	3.1	0.38	0.25
S01-R[2]	133	23	24	<10	3	0.5	4	109	7.0	0.65	0.47
CS-1R[2]	82	16	<10	<10	<2	0.5	1	397	9.0	1.4	0.25

[1] lower limit of determinatin

[2] duplicate

Table 8. Chemical analyses of sequential extractions of soils from Guam and Colorado

Site	Fraction A	B	C	D	E	F	Total of Fractions	Total[1]	Percent Rcovery[4]
					Al ppm				
					Guam				
GS-01	< 8	86	18	1490	8110	50400	60104	84000	72%
GS-04	< 8	63	10	1720	7000	56700	65493	80000	82%
GS-08	< 8	76	13	1580	9210	47000	57879	66000	88%
GS-13	< 8	69	13	1630	8920	44100	54732	63000	87%
GS-18	< 8	234	121	5990	178000	21200	205545	260000	79%
GS-22	< 8	563	75	2470	29200	82400	114708	140000	82%
GS-24	< 8	101	< 8	6280	28800	31700	66881	73000	92%
					Colorado				
CS-06	< 8	39	11	1480	6240	39900	47670	62000	77%
CS-10	< 8	40	11	1020	5650	40300	47021	56000	84%
CS-12	< 8	106	14	1780	12100	45000	59000	65000	91%
CS-15	< 8	16	< 8	227	7500	16400	24143	23000	105%
GS-22R[2]	< 8	591	80	2140	30500	102000	135311	140000	97%
					Ca ppm				
					Guam				
GS-01	2730	999	386	586	190	10800	15691	20000	78%
GS-04	4950	1400	96.8	700	289	14900	22336	26000	86%
GS-08	8320	53900	1330	634	780	15300	80264	90000	89%
GS-13	6410	52900	1620	1660	205	8980	71775	82000	88%
GS-18	1570	1490	262	181	4350	1120	8973	12000	75%
GS-22	2070	< 20	< 20	< 20	< 20	< 20	2070	2000	104%
GS-24	6400	1040	66.3	282	786	9690	18264	23000	79%
					Colorado				
CS-06	1530	22.7	29.8	241	< 20	682	2506	4000	63%
CS-10	5640	14600	3250	16700	387	345	40922	40000	102%
CS-12	941	< 20	30.2	193	296	7140	8600	11000	78%
CS-15	59500	34600	9400	17400	338	287	121525	110000	110%
GS-22R[2]	1710	< 20	< 20	< 20	< 20	< 20	1710	2000	86%
					Fe ppm				
					Guam				
GS-01	< 50	< 50	< 50	716	18200	18200	37116	35000	106%
GS-04	< 50	< 50	< 50	925	16100	22300	39325	36000	109%
GS-08	< 50	< 50	< 50	1840	28000	18700	48540	47000	103%
GS-13	< 50	< 50	< 50	448	17800	18800	37048	36000	103%
GS-18	< 50	< 50	110	1890	111000	33900	146900	140000	105%
GS-22	< 50	< 50	202	1060	116000	33700	150962	130000	116%
GS-24	< 50	< 50	70	8600	56200	18300	83170	77000	108%
					Colorado				
CS-06	< 50	< 50	< 50	2340	17900	9760	30000	27000	111%
CS-10	< 50	< 50	< 50	638	18200	7700	26538	24000	111%
CS-12	< 50	< 50	< 50	4050	26400	13300	43750	38000	115%
CS-15	< 50	< 50	338	907	9780	1120	12145	9700	125%
GS-22R[2]	< 50	< 50	203	902	112000	34100	147205	130000	113%
					Mg ppm				

[1] Total analyses from tables 1 and 4

[2] Duplicate

[3] Not determined

[4] (total of fractions / total) x 100

Table 8. Chemical analyses of sequential extractions of soils from Guam and Colorado

Site	Fraction A	B	C	D	E	F	Total of Fractions	Total[1]	Percent Rcovery[4]
					Guam				
GS-01	209	109	22	422	2590	3260	6612	8200	81%
GS-04	333	104	16	353	2370	4210	7386	8800	84%
GS-08	251	390	35	1270	8990	5130	16066	17000	95%
GS-13	218	424	39	571	3350	4460	9062	11000	82%
GS-18	19	60	38	60	379	201	757	1000	76%
GS-22	1140	74	7	42	2170	4730	8163	11000	74%
GS-24	2700	292	20	2910	18700	9000	33622	37000	91%
					Colorado				
CS-06	112	11	3	89	1920	2000	4135	5300	78%
CS-10	306	2120	1720	11000	2420	2510	20076	20000	100%
CS-12	262	22	4	606	4750	4100	9744	12000	81%
CS-15	734	3600	6530	11700	15800	919	39283	32000	123%
GS-22R[2]	1120	84	8	39	2250	5090	8591	11000	78%
					Mn ppm				
					Guam				
GS-01	0.5	38	674	168	167	218	1265	1300	97%
GS-04	4	66	234	106	99	224	733	820	89%
GS-08	< 0.2	39	228	81	273	214	835	890	94%
GS-13	< 0.2	46	276	71	100	203	696	780	89%
GS-18	< 0.2	104	4650	456	510	95	5815	5600	104%
GS-22	52	69	973	723	575	73	2465	2300	107%
GS-24	33	111	364	392	430	123	1453	1400	104%
					Colorado				
CS-06	1.2	11	352	589	343	92	1388	1200	116%
CS-10	0.2	41	23	25	57	29	174	180	97%
CS-12	4.9	11	53	114	311	140	634	610	104%
CS-15	0.4	48	33	52	39	11	183	180	102%
GS-22R[2]	52	73	942	634	575	76	2352	2300	102%
					K ppm				
					Guam				
GS-01	1509	251	86	415	2813	27571	32645	30000	109%
GS-04	915	188	62	309	2023	24870	28367	25000	113%
GS-08	702	161	65	252	2285	14323	17788	16000	111%
GS-13	571	144	61	234	2025	17764	20799	19000	109%
GS-18	61	20	23	31	18	240	392	300	131%
GS-22	433	31	34	51	1727	2882	5158	4000	129%
GS-24	1057	185	58	289	2350	2949	6887	5500	125%
					Colorado				
CS-06	320	94	32	73	1032	36929	38479	33000	117%
CS-10	810	167	57	206	1404	18553	21197	18000	118%
CS-12	387	98	32	32	973	18248	19770	17000	116%
CS-15	328	142	33	21	679	17285	18488	15000	123%
GS-22R[2]	431	30	33	12	1741	2809	5057	4000	126%
					As ppm				
					Guam				

[1] Total analyses from tables 1 and 4

[2] Duplicate

[3] Not determined

[4] (total of fractions / total) x 100

Table 8. Chemical analyses of sequential extractions of soils from Guam and Colorado

Site	Fraction A	B	C	D	E	F	Total of Fractions	Total[1]	Percent Rcovery[4]
GS-01	< 2	< 2	< 2	< 2	< 2	< 2	n.d.[3]	4	n.d.[3]
GS-04	< 2	< 2	< 2	< 2	< 2	< 2	n.d.[3]	3	n.d.[3]
GS-08	< 2	< 2	< 2	< 2	4	< 2	4	7	59%
GS-13	< 2	< 2	< 2	< 2	2	< 2	2	4	50%
GS-18	< 2	< 2	< 2	< 2	26	25	51	57	89%
GS-22	< 2	< 2	< 2	< 2	2	< 2	2	2	100%
GS-24	< 2	< 2	< 2	< 2	< 2	< 2	< 2	1	n.d.[3]
					Colorado				
CS-06	< 2	< 2	< 2	6	26	< 2	32	38	84%
CS-10	< 2	< 2	< 2	< 2	7	< 2	7	8	81%
CS-12	< 2	< 2	< 2	< 2	4	< 2	4	5	69%
CS-15	< 2	< 2	< 2	< 2	2	< 2	2	2	100%
GS-22R[2]	< 2	< 2	< 2	< 2	2	< 2	2	2	100%
					Bi ppm				
					Guam				
GS-01	< 0.005	< 0.005	< 0.005	0.010	< 0.005	0.030	0.040	0.200	20%
GS-04	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.010	0.010	0.100	10%
GS-08	< 0.005	0.007	< 0.005	< 0.005	< 0.005	0.008	0.015	0.100	15%
GS-13	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.020	0.020	0.100	20%
GS-18	< 0.005	< 0.005	< 0.005	< 0.005	0.910	0.240	1.150	1.600	72%
GS-22	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	<.05	n.d.
GS-24	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	<.05	n.d.
					Colorado				
CS-06	< 0.005	< 0.005	< 0.005	0.050	< 0.005	0.020	0.070	0.300	23%
CS-10	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.000	0.200	0%
CS-12	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.010	0.010	0.200	5%
CS-15	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	<.05	n.d.[3]
GS-22R[2]	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	<.05	n.d.[3]
					Cd ppm				
					Guam				
GS-01	< 0.02	0.09	0.05	0.04	0.04	0.04	0.26	0.30	87%
GS-04	< 0.02	0.09	< 0.02	0.04	0.03	0.03	0.19	0.20	95%
GS-08	< 0.02	0.09	< 0.02	0.03	0.04	0.04	0.20	0.20	100%
GS-13	< 0.02	0.14	< 0.02	0.03	0.03	0.03	0.23	0.30	77%
GS-18	< 0.02	0.63	1.1	0.86	2.5	2.5	7.65	7.10	108%
GS-22	< 0.02	0.02	0.03	< 0.02	0.05	0.05	0.15	0.10	150%
GS-24	0.02	0.12	0.02	0.07	0.07	0.07	0.37	0.40	93%
					Colorado				
CS-06	< 0.02	0.06	0.06	0.09	0.05	0.05	0.31	0.30	103%
CS-10	< 0.02	0.11	< 0.02	0.05	0.08	0.08	0.32	0.30	107%
CS-12	< 0.02	0.05	< 0.02	0.05	0.05	0.05	0.20	0.20	100%
CS-15	< 0.02	0.05	< 0.02	< 0.02	< 0.02	< 0.02	0.05	<0.1	n.d.[3]
GS-22R[2]	< 0.02	0.02	0.04	< 0.02	0.05	0.05	0.16	0.10	160%
					Co ppm				
					Guam				
GS-01	< 0.1	< 0.1	2.2	1.0	2.9	2.8	9.0	11.0	82%

[1] Total analyses from tables 1 and 4

[2] Duplicate

[3] Not determined

[4] (total of fractions / total) x 100

Table 8. Chemical analyses of sequential extractions of soils from Guam and Colorado

Site	Fraction A	B	C	D	E	F	Total of Fractions	Total[1]	Percent Rcovery[4]
GS-04	< 0.1	0.2	0.6	1.4	3.8	4.5	10.4	12.0	87%
GS-08	< 0.1	0.2	1.6	2.6	8.3	4.1	16.8	20.0	84%
GS-13	< 0.1	0.2	1.2	1.8	4.5	4.4	12.1	15.0	81%
GS-18	< 0.1	< 0.1	27	3.5	3.7	2.1	36.1	47.0	77%
GS-22	0.2	2.7	41	19	9.1	7.5	79.5	97.0	82%
GS-24	< 0.1	2.1	3.5	14	25	5.6	50.4	60.0	84%
					Colorado				
CS-06	< 0.1	< 0.1	0.7	1.5	3.1	1.6	6.8	7.4	92%
CS-10	< 0.1	0.4	0.3	0.6	3.8	1.5	6.6	7.2	92%
CS-12	< 0.1	0.2	1.0	2.0	7.5	4.4	15.1	17.0	89%
CS-15	< 0.1	0.5	0.5	0.3	3.0	0.4	4.7	4.0	117%
GS-22R[2]	0.2	2.8	42	17	9.5	7.5	78.5	97.0	81%
					Cr ppm				
					Guam				
GS-01	< 0.2	0.9	< 0.2	< 0.2	11	39	51.7	24	215%
GS-04	< 0.2	0.7	< 0.2	< 0.2	14	50	64.1	35	183%
GS-08	< 0.2	1.0	< 0.2	< 0.2	17	70	87.6	67	131%
GS-13	0.5	1.6	< 0.2	< 0.2	13	50	64.7	30	216%
GS-18	1.4	3.2	< 0.2	4.5	534	177	720.1	730	99%
GS-22	1.1	2.6	< 0.2	0.4	360	174	538.1	530	102%
GS-24	0.8	4.1	< 0.2	8.0	155	321	488.9	560	87%
					Colorado				
CS-06	1.2	2.4	< 0.2	< 0.2	8.0	45.0	56.6	15	377%
CS-10	1.4	3.2	< 0.2	0.4	13.9	66.7	85.6	63.0	136%
CS-12	1.4	3.4	< 0.2	1.4	24.2	90.2	120.6	110.0	110%
CS-15	1.6	3.2	< 0.2	< 0.2	29.7	26.5	61	32	191%
GS-22R[2]	1.3	3.7	< 0.2	< 0.2	353	174	532	530	100%
					Cu ppm				
					Guam				
GS-01	0.69	4.7	1.1	17.2	9.5	8.5	41.69	20.0	208%
GS-04	1.8	1.4	< 0.5	12.9	11.4	12.3	39.8	20.0	199%
GS-08	1.9	6.0	0.85	22.8	16.9	17.8	66.25	37.0	179%
GS-13	1.7	2.2	< 0.5	10.2	11.5	19.2	44.8	30.0	149%
GS-18	1.1	8.3	1.6	19.4	24.3	26.7	81.4	46.0	177%
GS-22	1.4	17.7	1.9	18.7	67.7	66.0	173.4	160.0	108%
GS-24	1.8	2.4	< 0.5	25.2	55.5	21.4	106.3	95.0	112%
					Colorado				
CS-06	0.92	3.0	0.62	12.0	10.3	15.6	42.44	20.0	212%
CS-10	3.1	7.7	< 0.5	21.3	14.6	7.4	54.1	20.0	271%
CS-12	0.70	5.8	0.50	6.9	11.5	21.6	47	30.0	157%
CS-15	1.0	5.5	< 0.5	4.1	7.1	6.4	24.1	8.0	301%
GS-22R[2]	1.1	13.2	1.7	14.5	67.9	67.9	166.3	160.0	104%
					Pb ppm				
					Guam				
GS-01	< 0.2	< 0.2	< 0.2	13.7	4.0	10.0	27.7	26.0	107%
GS-04	< 0.2	< 0.2	< 0.2	9.4	3.3	8.3	21	21.0	100%

[1] Total analyses from tables 1 and 4

[2] Duplicate

[3] Not determined

[4] (total of fractions / total) x 100

Table 8. Chemical analyses of sequential extractions of soils from Guam and Colorado

Site	Fraction A	B	C	D	E	F	Total of Fractions	Total[1]	Percent Rcovery[4]
GS-08	< 0.2	< 0.2	< 0.2	5.3	3.9	6.0	15.2	13.0	117%
GS-13	< 0.2	< 0.2	< 0.2	6.2	3.8	9.1	19.1	16.0	119%
GS-18	< 0.2	< 0.2	< 0.2	6.9	46.6	19.4	72.9	77.0	95%
GS-22	< 0.2	< 0.2	< 0.2	1.5	2.0	1.1	4.6	2.0	230%
GS-24	< 0.2	< 0.2	< 0.2	3.6	1.8	1.9	7.3	3.6	203%
					Colorado				
CS-06	< 0.2	< 0.2	< 0.2	29.8	17.4	8.0	55.2	56.0	99%
CS-10	< 0.2	< 0.2	< 0.2	6.3	8.9	4.1	19.3	20.0	97%
CS-12	< 0.2	< 0.2	< 0.2	8.8	7.4	6.9	23.1	26.0	89%
CS-15	< 0.2	< 0.2	< 0.2	0.79	1.1	5.3	7.19	4.5	160%
GS-22R[2]	< 0.2	< 0.2	< 0.2	1.1	1.9	1.2	4.2	2.0	210%
					Mo ppm				
					Guam				
GS-01	< 0.2	< 0.2	< 0.2	< 0.2	0.89	0.72	1.61	1.3	124%
GS-04	< 0.2	< 0.2	< 0.2	< 0.2	0.63	0.80	1.43	1.1	130%
GS-08	< 0.2	< 0.2	< 0.2	< 0.2	0.65	0.53	1.18	0.8	148%
GS-13	< 0.2	< 0.2	< 0.2	< 0.2	0.62	1.14	1.76	0.8	220%
GS-18	< 0.2	< 0.2	< 0.2	< 0.2	1.46	1.80	3.26	4.3	76%
GS-22	< 0.2	< 0.2	< 0.2	< 0.2	0.73	0.32	1.05	0.6	175%
GS-24	< 0.2	< 0.2	< 0.2	< 0.2	0.58	0.61	1.19	0.7	170%
					Colorado				
CS-06	< 0.2	< 0.2	< 0.2	0.31	6.63	1.27	8.21	12.00	68%
CS-10	< 0.2	< 0.2	< 0.2	< 0.2	1.36	0.68	2.04	1.8	113%
CS-12	< 0.2	< 0.2	< 0.2	< 0.2	0.86	0.64	1.5	1.1	136%
CS-15	< 0.2	0.25	< 0.2	0.40	4.74	0.66	6.05	9.50	64%
GS-22R[2]	< 0.2	< 0.2	< 0.2	< 0.2	0.76	0.30	1.06	0.6	177%
					Ni ppm				
					Guam				
GS-01	< 1	1.2	< 1	2.6	7.3	4.1	15.2	12.0	127%
GS-04	< 1	< 1	< 1	2.6	8.2	5.9	16.7	14.0	119%
GS-08	< 1	2.1	< 1	5.8	23.3	7.3	38.5	39.0	99%
GS-13	< 1	1.6	< 1	3.0	10.8	7.8	23.2	21.0	110%
GS-18	< 1	4.1	69.0	21.2	130	39.7	264	320.0	83%
GS-22	< 1	1.8	< 1	3.9	64.7	272	342.4	380.0	90%
GS-24	< 1	8.2	< 1	30.6	116	61.2	216	240.0	90%
					Colorado				
CS-06	< 1	< 1	< 1	1.0	6.4	5.8	13.2	6.6	200%
CS-10	< 1	1.1	< 1	2.9	16.1	9.1	29.2	23.0	127%
CS-12	< 1	< 1	< 1	2.3	28.6	20.0	50.9	47.0	108%
CS-15	< 1	1.0	< 1	< 1	16.5	6.0	23.5	13.0	181%
GS-22R[2]	< 1	1.2	< 1	2.7	67.3	272	343.2	380.0	90%
					Sr ppm				
					Guam				
GS-01	17.0	5.02	0.81	2.70	9.44	346	380.97	500	76%
GS-04	21.2	5.27	0.42	2.44	7.21	384	420.54	490	86%
GS-08	24.3	53.1	1.61	1.97	9.48	198	288.46	350	82%

[1] Total analyses from tables 1 and 4

[2] Duplicate

[3] Not determined

[4] (total of fractions / total) x 100

Table 8. Chemical analyses of sequential extractions of soils from Guam and Colorado

Site	Fraction A	B	C	D	E	F	Total of Fractions	Total[1]	Percent Rcovery[4]
GS-13	26.1	61.7	2.25	2.80	6.32	265	364.17	440	83%
GS-18	4.60	4.66	1.11	8.81	918	536	1473.18	1900	78%
GS-22	8.35	0.50	< 0.05	< 0.05	1.67	2.01	12.53	12	104%
GS-24	48.5	13.9	1.78	19.3	10.4	13.6	107.48	140.0	77%
					Colorado				
CS-06	11.1	1.44	0.25	1.15	3.24	44.6	61.78	100	62%
CS-10	25.6	22.1	3.26	8.04	6.14	40.7	105.84	140	76%
CS-12	8.66	0.74	0.09	0.87	4.94	104	119.3	170	70%
CS-15	415	494	33.2	18.9	2.46	19.0	982.56	780	126%
GS-22R[2]	8.75	1.11	< 0.05	< 0.05	0.57	0.91	11.34	12	95%
					Tl ppm				
					Guam				
GS-01	< 0.003	0.006	0.009	0.02	0.07	0.2	0.305	0.6	51%
GS-04	< 0.003	0.005	0.004	0.01	0.06	0.2	0.279	0.4	70%
GS-08	< 0.003	0.004	0.004	0.009	0.06	0.2	0.277	0.4	69%
GS-13	< 0.003	0.003	0.003	0.006	0.06	0.2	0.272	0.4	68%
GS-18	< 0.003	0.02	0.09	0.02	0.1	0.08	0.31	0.6	52%
GS-22	< 0.003	0.003	0.008	0.006	0.04	0.01	0.067	<.1	n.d.[3]
GS-24	< 0.003	0.004	0.004	0.007	0.03	0.009	0.054	<.1	n.d.[3]
					Colorado				
CS-06	< 0.003	0.006	0.04	0.04	0.1	2.0	2.186	3.9	56%
CS-10	< 0.003	0.003	0.003	0.008	0.07	0.3	0.384	0.7	55%
CS-12	< 0.003	0.003	< 0.003	0.005	0.06	0.2	0.268	0.5	54%
CS-15	< 0.003	0.01	0.004	0.007	0.1	0.1	0.221	0.4	55%
GS-22R[2]	< 0.003	< 0.003	0.005	0.005	0.04	0.02	0.07	<.1	n.d.[3]
					U ppm				
					Guam				
GS-01	< 0.02	0.05	< 0.02	0.10	0.27	1.30	1.72	2.50	69%
GS-04	< 0.02	0.07	< 0.02	0.08	0.23	1.09	1.47	2.10	70%
GS-08	< 0.02	0.04	< 0.02	0.04	0.20	0.93	1.21	1.60	76%
GS-13	< 0.02	0.04	< 0.02	0.03	0.17	0.95	1.19	1.80	66%
GS-18	< 0.02	0.84	< 0.02	0.81	4.83	3.94	10.42	17.00	61%
GS-22	< 0.02	0.04	< 0.02	0.02	0.12	0.08	0.26	0.40	65%
GS-24	< 0.02	0.08	< 0.02	0.06	0.09	0.07	0.3	0.40	75%
					Colorado				
CS-06	0.04	0.97	< 0.02	1.34	2.85	3.76	8.96	14.00	64%
CS-10	< 0.02	0.07	< 0.02	0.20	0.53	1.74	2.54	3.60	71%
CS-12	< 0.02	0.07	< 0.02	0.15	0.27	1.11	1.6	2.70	59%
CS-15	0.11	1.12	< 0.02	0.40	0.32	1.05	3	5.30	57%
GS-22R[2]	< 0.02	0.04	< 0.02	< 0.02	0.11	0.08	0.23	0.40	58%
					V ppm				
					Guam				
GS-01	< 0.4	< 0.4	< 0.4	3.0	27.0	35.5	66	74.0	89%
GS-04	< 0.4	< 0.4	< 0.4	2.8	26.1	50.4	79	88.0	90%
GS-08	0.5	0.5	< 0.4	4.0	41.6	53.9	100	120.0	83%
GS-13	0.5	0.5	< 0.4	2.3	27.6	40.6	71	81.0	87%

[1] Total analyses from tables 1 and 4

[2] Duplicate

[3] Not determined

[4] (total of fractions / total) x 100

Table 8. Chemical analyses of sequential extractions of soils from Guam and Colorado

	Fraction						Total of	Total[1]	Percent
Site	A	B	C	D	E	F	Fractions		Rcovery[4]
GS-18	< 0.4	0.6	10.8	37.5	405	110	553	510.0	108%
GS-22	< 0.4	0.6	< 0.4	5.3	361	25.7	392	280.0	140%
GS-24	< 0.4	0.8	< 0.4	27.4	106	37.8	171	190.0	90%
					Colorado				
CS-06	< 0.4	0.6	< 0.4	1.9	11.0	33.6	47	49.0	95%
CS-10	0.6	1.0	< 0.4	2.6	20.1	65.2	88	95.0	93%
CS-12	0.4	0.8	< 0.4	6.8	38.1	46.1	91	96.0	95%
CS-15	0.5	1	< 0.4	1.0	22.8	10.1	34	32.0	106%
GS-22R[2]	< 0.4	0.8	< 0.4	4.7	350	23.8	379	280.0	135%
					Zn ppm				
					Guam				
GS-01	< 5	< 5	< 5	9.0	44.1	44.5	97.6	110.0	89%
GS-04	< 5	< 5	< 5	8.1	29.6	40.3	78	81.0	96%
GS-08	< 5	< 5	< 5	8.5	42.3	35.9	86.7	86.0	101%
GS-13	< 5	< 5	< 5	7.2	34.4	35.3	76.9	79.0	97%
GS-18	< 5	< 5	< 5	< 5	27.5	28.3	55.8	57.0	98%
GS-22	< 5	< 5	< 5	< 5	54.8	34.3	89.1	97.0	92%
GS-24	< 5	< 5	< 5	19.9	50.0	14.9	84.8	92.0	92%
					Colorado				
CS-06	< 5	< 5	< 5	9.8	67.9	44.9	122.6	130.0	94%
CS-10	< 5	< 5	< 5	6.9	56.6	25.2	88.7	93.0	95%
CS-12	< 5	< 5	< 5	< 5	44.2	40.3	84.5	87.0	97%
CS-15	< 5	< 5	< 5	< 5	12.2	< 5	12.2	10.0	122%
GS-22R[2]	< 5	< 5	< 5	< 5	55.3	33.9	89.2	97.0	92%

[1] Total analyses from tables 1 and 4

[2] Duplicate

[3] Not determined

[4] (total of fractions / total) x 100

Table 9. Chemical analyses of simulated lung fluid dissolution of soils from Guam and Colorado.

Field No	Location	Rock type of formation	Al ppm	Ca ppm	Mg ppm	K ppm	Mn ppb
LLD[1]			0.02	10	2.0	6.0	10
Guam							
GS-4L	Umatac	Facpi Fm	1.6	2230	262	468	8770
GS-4LD	duplicate		1.2	2350	243	516	9980
GS-8L	Merizo	Facpi Fm joint	<0.02	2280	215	374	2960
GS-10L	Inarajan	Bolanos Fm	<0.02	1770	175	616	2040
GS-13L	Umatac	Facpi Fm	1.9	2480	176	215	3430
GS-18L	Northern Guam	limestone	1.7	480	12	6	50
GS-22L	Central Guam	Alutom Fm	<0.02	620	758	146	18500
GS-24L	Sella Bay	Facpi Fm	2.2	3230	1600	458	38900
Colorado							
CS-6L	Lake City	mineralize tuff breccia	0.8	1090	85	93	970
CS-12L	Grand Mesa	basalt	<0.02	790	205	129	620
CS-18L	So. Table Mtn.	basalt	0.5	1096	203	227	2140

[1] lower limit of determination

Table 9. Chemical analyses of simulated lung fluid dissolution of soils from Guam and Colorado.

Field No	Location	Rock type of formation	Fe ppm	Si ppm	Ag ppb	Ba ppb	Be ppb
LLD[1]			10	40	600	20	10
Guam							
GS-4L	Umatac	Facpi Fm	<10	262	<600	7440	<10
GS-4LD	duplicate		<10	262	<600	7360	<10
GS-8L	Merizo	Facpi Fm joint	<10	31	<600	11100	<10
GS-10L	Inarajan	Bolanos Fm	<10	290	<600	7810	<10
GS-13L	Umatac	Facpi Fm	<10	312	<600	17600	<10
GS-18L	Northern Guam	limestone	<10	<40	<600	<20	<10
GS-22L	Central Guam	Alutom Fm	<10	<40	<600	2800	<10
GS-24L	Sella Bay	Facpi Fm	<10	245	<600	700	<10
Colorado							
CS-6L	Lake City	mineralize tuff breccia	<10	<40	<600	2210	<10
CS-12L	Grand Mesa	basalt	<10	<40	<600	14600	<10
CS-18L	So. Table Mtn.	basalt	<10	86	<600	8500	<10

[1] lower limit of determination

Table 9. Chemical analyses of simulated lung fluid dissolution of soils from Guam and Colorado.

Field No	Location	Rock type of formation	Bi ppb	Ce ppb	Co ppb	Cr ppb	Ga ppb
LLD[1]			10	20	4	200	4
Guam							
GS-4L	Umatac	Facpi Fm	<10	<20	54	<200	<4
GS-4LD	duplicate		<10	<20	59	<200	<4
GS-8L	Merizo	Facpi Fm joint	<10	<20	34	<200	<4
GS-10L	Inarajan	Bolanos Fm	<10	<20	22	<200	<4
GS-13L	Umatac	Facpi Fm	<10	<20	36	<200	<4
GS-18L	Northern Guam	limestone	<10	<20	17	1510	<4
GS-22L	Central Guam	Alutom Fm	<10	<20	170	<200	<4
GS-24L	Sella Bay	Facpi Fm	<10	<20	255	280	<4
Colorado							
CS-6L	Lake City	mineralize tuff breccia	<10	<20	<4	<200	<4
CS-12L	Grand Mesa	basalt	<10	<20	6	<200	<4
CS-18L	So. Table Mtn.	basalt	<10	<20	7	<200	<4

[1] lower limit of determination

Table 9. Chemical analyses of simulated lung fluid dissolution of soils from Guam and Colorado.

Field No	Location	Rock type of formation	Ge ppb	La ppb	Li ppb	Ni ppb	Pb ppb
LLD[1]			4	20	20	20	10
Guam							
GS-4L	Umatac	Facpi Fm	<4	<20	152	124	13
GS-4LD	duplicate		<4	<20	127	102	<10
GS-8L	Merizo	Facpi Fm joint	<4	<20	23	45	<10
GS-10L	Inarajan	Bolanos Fm	<4	<20	<20	<20	<10
GS-13L	Umatac	Facpi Fm	<4	<20	<20	<20	<10
GS-18L	Northern Guam	limestone	<4	<20	<20	133	<10
GS-22L	Central Guam	Alutom Fm	<4	<20	<20	151	<10
GS-24L	Sella Bay	Facpi Fm	<4	<20	<20	1070	<10
							<10
Colorado							<10
CS-6L	Lake City	mineralize tuff breccia	<4	<20	<20	<20	<10
CS-12L	Grand Mesa	basalt	<4	<20	<20	<20	<10
CS-18L	So. Table Mtn.	basalt	<4	<20	<20	<20	<10

[1] lower limit of determination

Table 9. Chemical analyses of simulated lung fluid dissolution of soils from Guam and Colorado.

Field No	Location	Rock type of formation	Rb ppb	Sc ppb	Sr ppb	Tl ppb	U ppb
LLD[1]			2.0	20	100	10	10
Guam							
GS-4L	Umatac	Facpi Fm	612	33	11000	<10	115
GS-4LD	duplicate		633	<20	11500	<10	120
GS-8L	Merizo	Facpi Fm joint	467	40	13700	<10	29
GS-10L	Inarajan	Bolanos Fm	778	35	13300	<10	52
GS-13L	Umatac	Facpi Fm	353	30	14400	<10	26
GS-18L	Northern Guam	limestone	6.0	<20	1340	<10	325
GS-22L	Central Guam	Alutom Fm	326	<20	4270	<10	13
GS-24L	Sella Bay	Facpi Fm	786	16	26300	<10	60
Colorado							
CS-6L	Lake City	mineralize tuff breccia	744	<20	6420	<10	1590
CS-12L	Grand Mesa	basalt	515	<20	5420	<10	72
CS-18L	So. Table Mtn.	basalt	296	<20	22800	<10	227

[1] lower limit of determination

Table 9. Chemical analyses of simulated lung fluid dissolution of soils from Guam and Colorado.

Field No	Location	Rock type of formation	V ppb	Y ppb	Zr ppb
LLD[1]			20	2	10
Guam					
GS-4L	Umatac	Facpi Fm	450	20	183
GS-4LD	duplicate		477	19	211
GS-8L	Merizo	Facpi Fm joint	784	<2	17
GS-10L	Inarajan	Bolanos Fm	964	<2	18
GS-13L	Umatac	Facpi Fm	558	<2	11
GS-18L	Northern Guam	limestone	112	<2	77
GS-22L	Central Guam	Alutom Fm	<20	18	<10
GS-24L	Sella Bay	Facpi Fm	92	6	23
Colorado					
CS-6L	Lake City	mineralize tuff breccia	36	16	13
CS-12L	Grand Mesa	basalt	161	<2	27
CS-18L	So. Table Mtn.	basalt	427	4	20

[1] lower limit of determination