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GEOLOGICAL SURVEY

Analytical results and sample locality map of stream-sediment, panned-concentrate, and mesquite samples from the Los Tamales area, San Juan quadrangle, northern Sonora, Mexico

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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STUDIES RELATED TO THE USGS-CRM COOPERATIVE PROGRAM

The analytical results presented in this report are part of a larger cooperative program between the U.S. Geological Survey and the Consejo de Recursos Minerales of Mexico. The program was established in 1973 using a multidisciplinary (geology, geochemistry, and geophysics) approach in the evaluation of exploration techniques in the Sonoran environment. The project was initially funded by the government of Mexico, the U.S. Geological Survey, and the U.S. National Science Foundation.

INTRODUCTION

In November 1981 and March 1982 we conducted a detailed geochemical study of the Los Tamales area, northern Sonora, Mexico.

The Los Tamales area comprises about 6 mi^2 (16 km^2). This study area is located approximately 7 mi (11 km) north-northwest of Saric, Sonora, Mexico (see fig. 1). Access to the vicinity of the study area is provided by Mexican National highway 15 for 12 mi (19 km) south of Nogales, Arizona and 30 m (48 km) west on a graded road to Saric, Sonora, Mexico. Access to the Los Tamales area is provided by an unimproved dirt road.

The study area occupies the south-southeast flank of the Cerro Chile intrusive, a north-northwest to south-southeast granitic intrusive. The study area is composed of granite, granodiorite, and felsic to intermediate extrusives.

The topographic relief is about 715 ft (218 m), with a maximum elevation of 3600 ft (1097 m). The ground surface is an upland area deeply incised by intermittent streams. The area is in the Sonoran desert climatic zone. Vegetation is sparse, consisting of an assemblage of desert shrubs, including mesquite and cacti.

METHODS OF STUDY

Sample Collection

We collected samples at 105 sites (fig. 2). At nearly all of those sites, we collected both a stream-sediment sample and a heavy-mineral concentrate. Samples of mesquite leaves were limited to those 68 sites sampled November, 1981. We analyzed 105 stream-sediment samples, and 72 panned-concentrate samples for a sampling density of about 1 sample per .06 mi^2 (.16 km^2) for the stream sediment and 1 sample per .08 mi^2 (.21 km^2) for heavy-mineral-concentrate samples.

Stream-sediment samples

Analyses of the stream-sediment samples represent the chemistry of the rock material eroded from the drainage basin upstream from each sample site. Such information is useful in identifying those basins which contain concentrations of elements that may be related to mineral deposits.

The stream-sediment samples consisted of active alluvium collected primarily from streams no longer than 250 yards (229 m) in length. Each sample was composited from several localities within an area that may extend as much as 20 ft (6 m) from the site plotted on the map.

The use of plant samples in mineral exploration adds another dimension to the task of locating hidden ore bodies. Plant roots often penetrate bedrock where none outcrops at the surface of a stream channel, or they may even reflect the ground-water chemistry. Biogeochemistry--the analysis of plant tissue--can complement the results gained from conventional geochemical reconnaissance and detailed surveys.

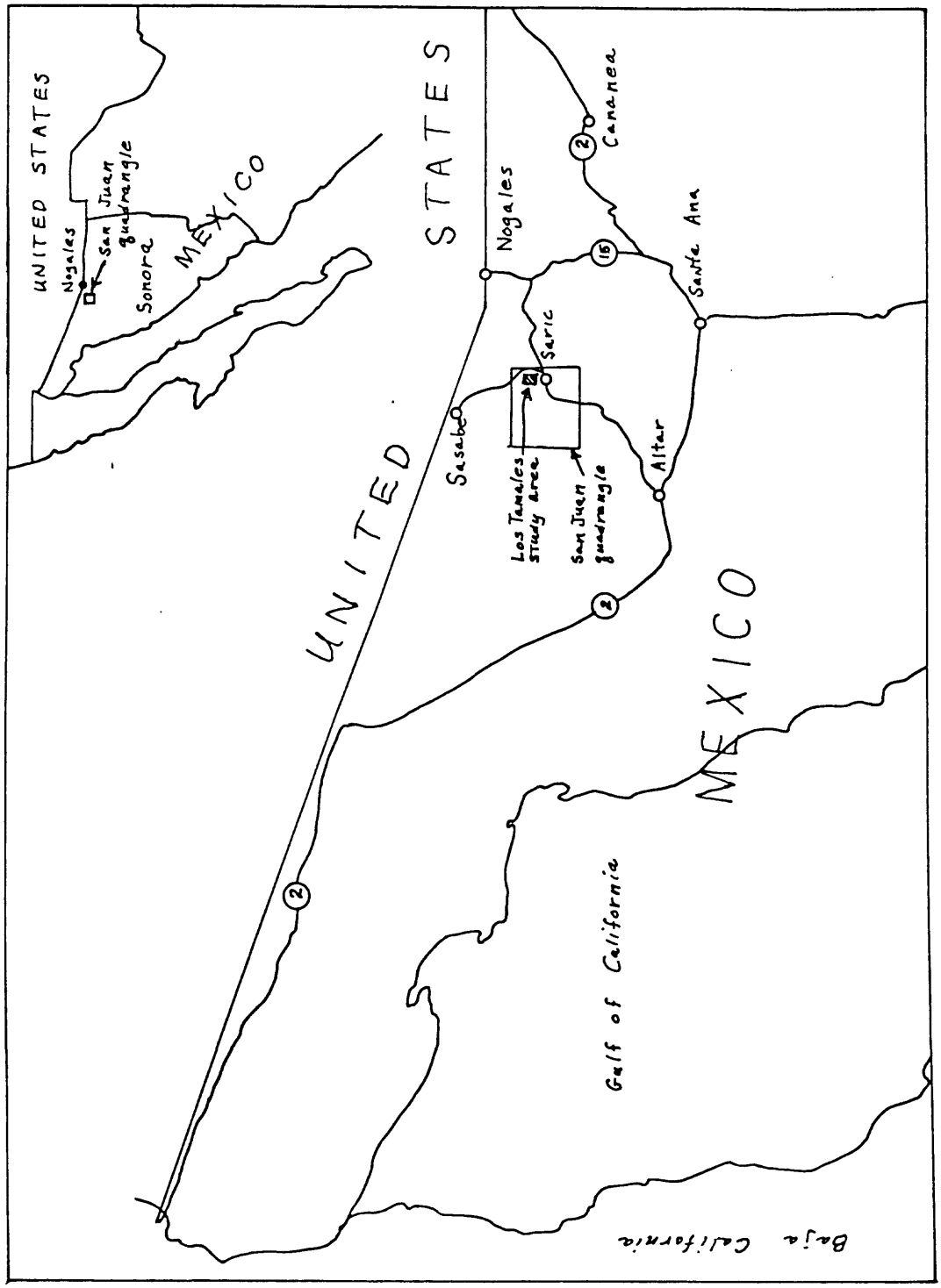

FIGURE 1. Index map showing location map of the Los Tamales area, San Juan quadrangle, northern Sonora, Mexico.

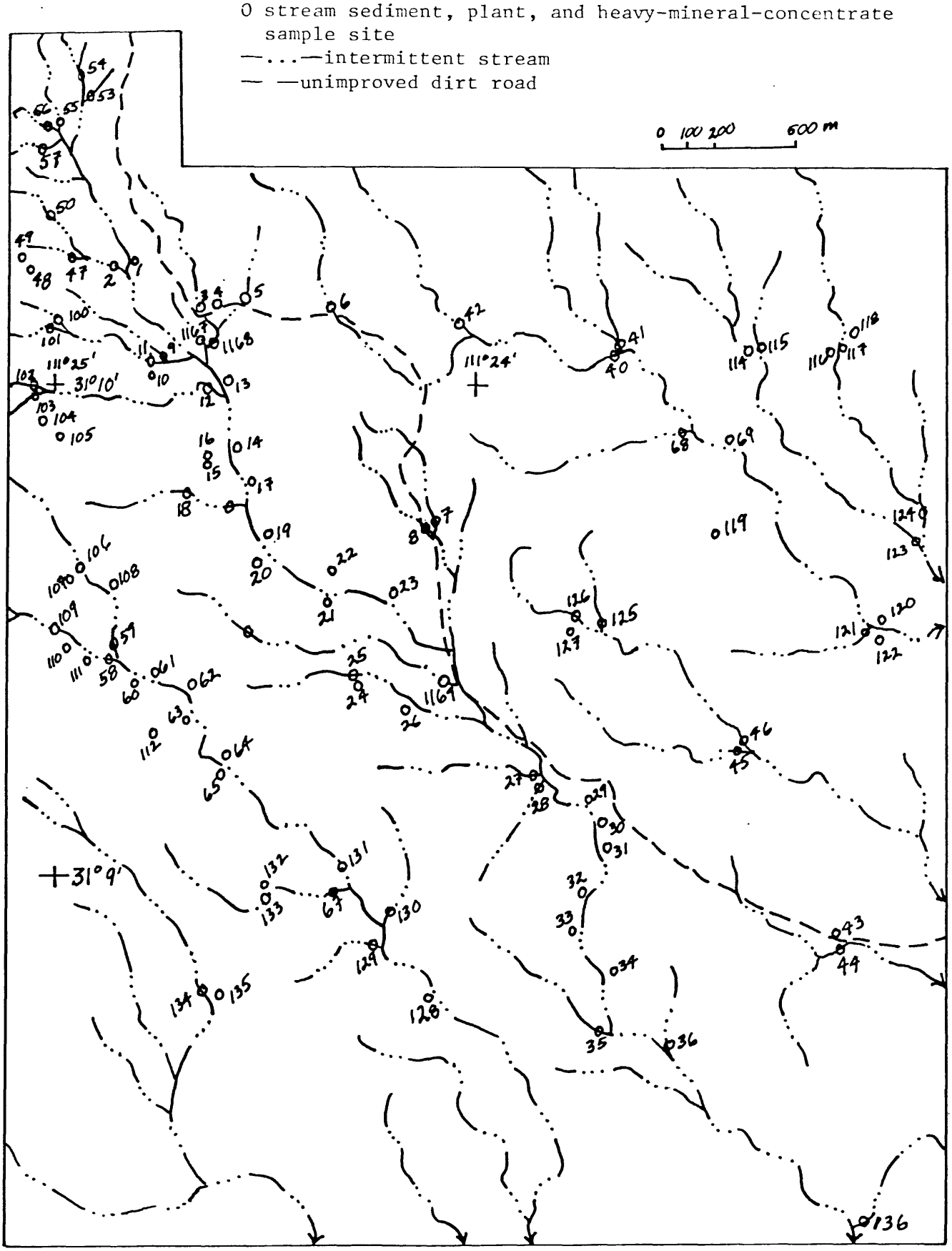

FIGURE 2. Stream sediment, plant, heavy-mineral-concentrate sample location map for the Los Tamales area, San Juan quadrangle, northern Sonora, Mexico.

Honey mesquite (*Prosopis juliflora* of most manuals; more recently called *P. laevigata*) was collected for several reasons. First, it is extremely common in the Los Tamales area and is easily recognized. Second, it has been used previously in the exploration of porphyry copper deposits in Arizona and northern Mexico (Huff, 1970; Chaffee, 1975, 1976, 1977; Chaffee et al., 1976); and third, its roots tap the ground water, the chemistry of which often forms a broad dispersion halo around mineral deposits. Tap roots of mesquite are reported to reach depths of 160 ft (49 m) with the lateral roots extending about 50 ft (15 m) (Simpson, 1977).

Heavy-mineral-concentrate samples

We panned heavy-mineral-concentrate samples from alluvium collected specifically for this purpose from the same active alluvium as the stream-sediment samples. Each bulk sample was passed through a 2.0-mm (10-mesh) screen to remove the coarse material. The sediment passing through the screen was panned until most of the quartz, feldspar, organic material, and clay-sized material was removed. The sample was air dried.

Plant samples

A plant sample consisted of a "fist-full" of leaves collected from several branches around the canopy of the tree. Only a single tree was sampled at each site.

Sample Preparation

Only the heavy-mineral-concentrate samples required extensive preparation.

We sieved the stream-sediment samples at the collection site through a 30-mesh screen and the minus 30-mesh material was retained. The samples were air dried.

After panning the sediment, we used bromoform to separate and remove the remaining quartz and feldspar from the heavy-mineral concentrate. The heavy minerals (specific gravity 2.8) were separated into three fractions using a large electromagnet (in this case a modified Frantz Isodynamic Separator). The most magnetic material (largely magnetite) was discarded. The second fraction (largely ferromagnesian silicates and iron oxides) was saved for archival storage. The third fraction (the least magnetic material including nonmagnetic ore minerals, zircon, sphene, etc.) was divided into two splits using a Jones splitter. One split was hand ground for spectrographic analysis; the other split was saved for mineralogical analysis.

The magnetic separates discussed are the same separates that would be produced by removing the magnetite with a hand magnet and then using a Frantz Isodynamic Separator set at a slope of 15° and a tilt of 10° with a current of 0.1 ampere to remove the ilmenite, and a current of 1.0 ampere to split the remainder of the sample into magnetic and nonmagnetic fractions.

All plant samples were oven-dried at about 40°C until sufficiently brittle to grind in a Wiley mill. The samples were sieved through a screen with 1.3 mm openings. A portion of this homogenized sample which passed through the 1.3 mm sieve was then ashed in a muffle furnace at 500°C. The ash yield for mesquite leaves from this study generally ranged from 5-10%.

Sample Analysis

Spectrographic method

We analyzed the stream-sediment samples for 31 elements and the heavy-mineral-concentrate samples for 32 elements using a semiquantitative, direct-current arc emission spectrographic method (Grimes and Marranzino, 1968) (tables 1, 2, and 3). Spectrographic results were obtained by visual comparison of spectra derived from the sample against spectra obtained from standards made from pure oxides and carbonates. Standard concentrations are geometrically spaced over any given order of magnitude of concentration as follows: 100, 50, 20, 10, and so forth. Samples whose concentrations are estimated to fall between those values are assigned values of 70, 30, 15, and so forth. The precision of the analytical method is approximately plus or minus one reporting unit at the 83 percent confidence level and plus or minus two reporting units at the 96 percent confidence level (Motooka and Grimes, 1976). Values determined for the major elements (iron, magnesium, calcium, and titanium) are given in weight percent; all others are given in parts per million (micrograms/gram) (table 3).

Arsenic and antimony were looked for but not found in both sample media. Gold, cadmium, niobium, tungsten, and thorium were looked for but not found in the stream-sediment samples. Beryllium and zinc were looked for but not found in the nonmagnetic fraction of the heavy-mineral-conceantrate samples.

The ashed mesquite leaves were analyzed for 30 elements using a semiquantitative, direct-current arc emission spectrographic method (Mosier, 1972) (Tables 4 and 5). The same geometric spacing was used in this analytical technique as was used in the analytical technique for the stream sediment and heavy-mineral-concentrate samples.

Elements that were looked for but not detected are antimony, arsenic, beryllium, cadmium, cobalt, gold, niobium, tin, tungsten, and vanadium.

Chemical methods

Molybdenum and uranium in plant ash were analyzed using analytical chemical methods. The analytical method used for molybdenum was an atomic absorption spectrometric method described by Rao (1971) and has a lower limit of determination of 2 ppm if the sample weight specified by Rao is used. The analytical method used in the determination of uranium is a fluorometric technique described by Harms and others (1981) and the lower limit of detection is 0.05 ppm if the sample weight specified by Harms is used.

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Table 1. Analytical data for the minus 30 mesh stream sediment samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

Sample	Latitude	Longitude	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S	Ag ppm-S	B ppm-S
PKT1166S	31 9 44	111 24 35	10.0	1.5	1.5	.30	1,000	<.5	20
PKT1167S	31 10 5	111 24 39	7.0	2.0	15.0	.15	1,500	<.5	15
PKT1168S	31 10 4	111 24 39	10.0	2.0	2.0	.50	1,500	<.5	30
PKT1169S	31 9 23	111 24 5	15.0	1.5	1.5	.30	1,000	.5	70
LT001S	31 10 15	111 24 50	1.5	.7	1.5	.10	500	N	N
LT002S	31 10 14	111 24 52	2.0	.7	.7	.15	300	N	N
LT003S	31 10 8	111 24 40	1.5	.7	2.0	.15	500	N	N
LT004S	31 10 9	111 24 38	3.0	1.5	1.0	.15	1,500	<.5	N
LT005S	31 10 10	111 24 34	5.0	2.0	1.5	.20	1,500	<.5	10
LT006S	31 10 9	111 24 21	7.0	1.5	1.5	.20	700	N	15
LT007S	31 9 43	111 24 7	1.5	.7	.7	.15	500	N	20
LT008S	31 9 42	111 24 8	1.5	.7	.5	.07	700	N	15
LT009S	31 10 3	111 24 45	5.0	1.5	1.5	.20	700	N	N
LT010S	31 10 1	111 24 46	5.0	2.0	2.0	.15	1,000	<.5	N
LT011S	31 10 3	111 24 46	7.0	1.0	1.0	.15	700	<.5	N
LT012S	31 9 59	111 24 38	3.0	1.5	1.0	.15	700	N	10
LT013S	31 10 0	111 24 36	1.5	.7	.5	.15	700	N	15
LT014S	31 9 52	111 24 35	2.0	1.0	1.5	.15	700	N	10
LT015S	31 9 50	111 24 38	10.0	1.5	.7	.20	700	N	10
LT016S	31 9 51	111 24 38	2.0	1.5	.7	.15	700	N	N
LT017S	31 9 47	111 24 33	2.0	1.5	.3	.15	1,000	N	10
LT018S	31 9 46	111 24 41	15.0	1.5	1.5	.15	1,000	N	10
LT019S	31 9 41	111 24 30	3.0	.7	.2	.15	700	N	15
LT020S	31 9 38	111 24 31	7.0	1.5	1.0	.30	700	<.5	10
LT021S	31 9 33	111 24 21	3.0	.7	.5	.15	700	N	10
LT022S	31 9 36	111 24 22	2.0	.7	.3	.15	700	N	30
LT023S	31 9 34	111 24 12	3.0	.7	.3	.15	700	<.5	10
LT024S	31 9 23	111 24 17	2.0	.7	.3	.15	700	N	20
LT025S	31 9 24	111 24 18	3.0	.7	.3	.15	500	N	15
LT026S	31 9 20	111 24 10	7.0	.7	.5	.15	1,500	N	10
LT027S	31 9 11	111 23 52	1.5	.7	.5	.15	700	N	15
LT028S	31 9 10	111 23 52	3.0	.7	.3	.15	1,500	<.5	30
LT029S	31 9 8	111 23 45	5.0	1.0	.7	.15	3,000	<.5	20
LT030S	31 9 6	111 23 43	7.0	.7	.3	.15	3,000	<.5	15
LT031S	31 9 3	111 23 42	2.0	.7	.3	.15	1,500	N	70
LT032S	31 8 57	111 23 46	1.5	.7	.3	.15	1,500	<.5	150
LT033S	31 8 52	111 23 47	2.0	.7	.3	.15	2,000	N	70
LT034S	31 8 47	111 23 41	3.0	1.0	.3	.15	1,500	N	300
LT035S	31 8 40	111 23 43	1.5	1.0	.5	.15	1,500	<.5	150
LT036S	31 8 37	111 23 33	1.5	.7	.3	.15	1,500	N	150
LT039S	31 10 23	111 24 8	1.5	.7	.3	.10	700	N	N
LT040S	31 10 4	111 23 41	3.0	.7	.5	.15	700	N	15
LT041S	31 10 5	111 23 40	1.5	.7	.7	.15	700	N	20
LT042S	31 10 7	111 24 3	3.0	1.0	.7	.20	1,000	N	20
LT043S	31 8 52	111 23 10	2.0	.7	.3	.15	1,500	<.5	300

Table 1. Analytical data for the minus 30 mesh stream sediment samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.

Sample	Ba ppm-S	Be ppm-S	Bi ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Ni ppm-S
PKT1166S	1,500	2.0	N	10	15	300	70	30	20
PKT1167S	1,500	1.5	N	15	15	300	70	30	15
PKT1168S	1,500	2.0	N	15	70	300	70	50	30
PKT1169S	1,500	2.0	N	15	70	300	70	50	50
LT001S	700	1.0	N	7	10	70	<20	<5	15
LT002S	300	1.0	N	7	15	30	<20	N	15
LT003S	500	1.0	N	7	<10	200	30	5	7
LT004S	700	1.0	N	10	10	300	<20	7	15
LT005S	700	1.0	N	15	20	300	<20	7	30
LT006S	700	1.0	N	15	30	150	20	10	15
LT007S	1,000	1.0	N	7	15	15	20	7	15
LT008S	700	1.0	N	5	10	50	20	10	10
LT009S	700	1.0	N	15	20	70	20	7	15
LT010S	700	1.0	N	15	30	150	20	10	15
LT011S	700	1.0	N	15	70	30	20	7	20
LT012S	700	1.0	N	7	20	70	20	10	15
LT013S	700	1.0	N	5	<10	100	50	10	15
LT014S	1,000	1.0	N	7	20	50	70	10	15
LT015S	700	1.5	N	15	30	150	70	20	15
LT016S	1,000	1.0	N	7	10	100	70	20	15
LT017S	700	1.0	N	7	10	70	30	10	20
LT018S	1,000	1.5	N	10	30	150	30	30	10
LT019S	700	1.0	N	7	15	100	30	10	15
LT020S	700	1.5	N	15	30	300	50	15	30
LT021S	700	1.0	N	7	10	20	20	7	20
LT022S	700	1.0	N	7	10	30	30	7	15
LT023S	700	1.0	N	7	15	20	30	7	15
LT024S	700	1.5	N	7	<10	30	20	7	10
LT025S	700	1.0	N	7	10	30	50	7	15
LT026S	700	1.0	N	7	10	20	50	7	7
LT027S	700	1.5	N	7	<10	30	30	10	10
LT028S	1,500	1.5	N	7	<10	30	30	7	15
LT029S	1,000	1.5	N	10	<10	50	30	10	7
LT030S	700	1.5	N	10	<10	30	20	7	5
LT031S	1,000	1.5	N	7	<10	15	20	15	15
LT032S	1,000	1.5	N	7	<10	30	20	5	10
LT033S	1,000	1.0	N	10	10	30	20	7	15
LT034S	1,000	1.5	N	10	10	30	30	15	20
LT035S	1,000	1.5	N	7	<10	50	30	10	15
LT036S	700	1.5	10	7	<10	50	30	10	15
LT039S	700	1.5	N	5	<10	70	30	7	7
LT040S	700	1.0	N	7	10	70	30	7	15
LT041S	1,000	1.5	N	7	<10	30	30	5	15
LT042S	1,000	1.5	N	7	10	150	30	15	20
LT043S	1,000	1.5	20	7	<10	50	30	20	7

Table 1. Analytical data for the minus 30 mesh stream sediment samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.

Sample	Pb ppm-S	Sc ppm-S	Sn ppm-S	Sr ppm-S	V ppm-S	Y ppm-S	Zn ppm-S	Zr ppm-S
PKT1166S	30	7	<10	700	150	15	N	100
PKT1167S	70	10	<10	500	150	20	<200	100
PKT1168S	100	15	<10	700	150	30	N	200
PKT1169S	500	7	10	300	200	20	<200	150
LT001S	50	<5	N	300	70	<10	N	30
LT002S	30	<5	N	300	70	N	N	30
LT003S	30	5	N	300	70	<10	N	30
LT004S	70	7	N	300	70	10	N	50
LT005S	30	7	<10	300	150	15	N	50
LT006S	100	5	<10	300	150	15	N	100
LT007S	70	<5	N	300	70	15	N	50
LT008S	70	N	N	300	50	10	N	30
LT009S	20	7	N	300	150	10	N	30
LT010S	30	7	N	300	150	10	N	50
LT011S	30	5	N	300	150	10	N	50
LT012S	30	5	N	300	100	15	N	50
LT013S	100	5	N	300	50	15	N	50
LT014S	50	7	N	300	70	20	N	70
LT015S	50	5	<10	300	150	20	N	100
LT016S	50	5	N	500	70	15	N	70
LT017S	100	5	N	300	70	10	N	70
LT018S	30	5	<10	300	150	15	N	150
LT019S	100	<5	N	300	70	10	N	50
LT020S	50	7	<10	300	200	15	N	150
LT021S	50	<5	N	200	70	10	N	70
LT022S	150	<5	N	300	70	10	N	70
LT023S	70	<5	N	300	50	10	N	50
LT024S	100	5	N	300	50	10	N	50
LT025S	70	5	N	300	70	10	N	70
LT026S	300	7	N	200	100	20	300	70
LT027S	70	5	N	200	50	15	N	50
LT028S	150	5	N	300	70	15	200	70
LT029S	200	7	N	200	100	30	200	70
LT030S	200	5	N	150	70	20	<200	70
LT031S	100	5	N	300	70	10	N	50
LT032S	150	5	N	200	30	15	200	30
LT033S	200	5	N	200	70	15	<200	70
LT034S	70	5	N	300	70	15	N	70
LT035S	150	5	N	300	70	15	200	50
LT036S	150	5	N	200	50	15	<200	70
LT039S	100	5	N	300	50	10	N	50
LT040S	100	5	N	300	150	15	N	50
LT041S	70	<5	N	300	70	10	N	50
LT042S	150	5	N	300	70	15	N	70
LT043S	150	5	N	300	70	20	<200	70

Table 1. Analytical data for the minus 30 mesh stream sediment samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.--continued

Sample	Latitude	Longitude	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S	Ag ppm-S	B ppm-S
LT044S	31 8 50	111 23 9	3.0	.7	.3	.15	2,000	<.5	150
LT045S	31 9 15	111 23 23	3.0	.7	.3	.10	1,500	<.5	100
LT046S	31 9 16	111 23 22	1.0	.7	.2	.10	1,000	N	70
LT048S	31 10 15	111 25 5	3.0	1.5	1.0	.15	700	N	15
LT049S	31 10 16	111 25 5	7.0	1.5	.7	.30	1,000	N	15
LT050S	31 10 21	111 25 2	3.0	1.5	1.5	.20	700	N	20
LT051S	31 10 16	111 24 57	5.0	1.0	1.5	.30	700	N	15
LT053S	31 10 35	111 24 56	2.0	1.0	1.5	.15	700	N	10
LT054S	31 10 38	111 24 57	2.0	.7	1.5	.20	700	N	N
LT055S	31 10 32	111 25 1	1.5	.7	1.5	.15	700	N	10
LT056S	31 10 32	111 25 2	7.0	1.5	1.5	.15	700	N	20
LT057S	31 10 29	111 25 2	2.0	.7	.7	.15	700	N	15
LT058S	31 9 25	111 24 52	7.0	1.0	1.5	.30	700	N	20
LT059S	31 9 26	111 24 52	7.0	.7	.5	.20	700	N	10
LT060S	31 9 23	111 24 49	5.0	1.0	1.5	.15	1,000	N	15
LT061S	31 9 24	111 24 46	7.0	.7	1.0	.20	700	N	<0
LT062S	31 9 22	111 24 41	5.0	1.0	.7	.15	700	N	<0
LT063S	31 9 18	111 24 41	5.0	1.5	1.5	.20	1,500	N	10
LT064S	31 9 14	111 24 36	5.0	1.5	1.5	.20	1,500	<.5	10
LT065S	31 9 12	111 24 36	3.0	.7	.7	.15	500	N	10
LT067S	31 8 57	111 24 21	5.0	1.5	2.0	.20	1,500	N	15
LT068S	31 9 54	111 23 31	2.0	.7	.7	.15	700	N	15
LT069S	31 9 53	111 23 25	1.5	1.0	1.0	.15	700	N	15
LT100S	31 10 7	111 25 3	15.0	1.5	2.0	.70	1,500	N	10
LT101S	31 10 6	111 25 1	3.0	1.5	1.5	.30	700	N	N
LT102S	31 9 59	111 25 4	3.0	1.5	1.5	.50	1,500	N	10
LT103S	31 9 58	111 25 3	15.0	1.5	1.5	.70	1,500	N	10
LT104S	31 9 55	111 25 2	15.0	1.5	1.5	.50	1,500	N	10
LT105S	31 9 53	111 25 0	>20.0	2.0	1.5	.70	1,500	N	10
LT106S	31 9 37	111 24 57	15.0	1.5	1.5	.30	1,500	N	10
LT107S	31 9 36	111 24 58	15.0	1.5	1.5	.30	1,500	N	70
LT108S	31 9 35	111 24 53	20.0	1.5	1.5	.50	1,500	N	20
LT109S	31 9 29	111 25 0	>20.0	1.5	1.5	.70	1,500	N	20
LT110S	31 9 27	111 24 58	15.0	1.5	1.5	.30	1,500	N	15
LT111S	31 9 26	111 24 56	>20.0	1.5	1.5	.50	1,500	N	15
LT112S	31 9 17	111 24 46	20.0	1.5	2.0	.30	2,000	1.5	10
LT113S	31 9 29	111 24 33	15.0	1.5	1.5	.50	1,500	<.5	10
LT114S	31 10 4	111 23 22	3.0	1.0	1.5	.30	1,500	N	15
LT115S	31 10 4	111 23 20	2.0	1.0	1.5	.30	1,500	N	10
LT116S	31 10 4	111 23 10	>20.0	3.0	3.0	.70	2,000	<.5	300
LT117S	31 10 4	111 23 9	>20.0	3.0	2.0	.50	2,000	<.5	15
LT118S	31 10 6	111 23 8	20.0	2.0	3.0	.30	1,500	<.5	15
LT119S	31 9 41	111 23 27	7.0	1.5	1.5	.30	3,000	<.5	30
LT120S	31 9 31	111 23 4	3.0	1.5	1.5	.30	1,500	<.5	10
LT121S	31 9 29	111 23 5	3.0	1.5	1.0	.30	1,500	<.5	300

Table 1. Analytical data for the minus 30 mesh stream sediment samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.--continued

Sample	Ba ppm-S	Be ppm-S	Bi ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Ni ppm-S
LT044S	1,000	1.5	N	7	<10	30	30	30	10
LT045S	1,500	1.5	N	7	<10	30	30	7	10
LT046S	1,000	1.5	N	5	<10	15	20	<5	7
LT048S	700	1.5	N	10	20	20	30	<5	20
LT049S	700	1.5	N	15	15	50	20	<5	15
LT050S	1,000	1.0	N	10	30	30	30	7	15
LT051S	700	1.5	N	15	100	30	70	15	20
LT053S	700	1.0	N	7	15	70	70	5	15
LT054S	700	1.5	N	10	<10	70	70	7	10
LT055S	700	1.0	N	7	<10	70	50	7	10
LT056S	700	1.0	N	15	150	70	50	7	30
LT057S	700	1.5	N	7	15	20	20	<5	15
LT058S	700	1.5	N	15	20	70	20	7	10
LT059S	700	1.5	N	10	30	70	20	5	15
LT060S	700	1.5	N	15	20	50	20	5	10
LT061S	1,000	1.5	N	15	10	70	20	7	10
LT062S	700	1.5	N	15	20	100	30	30	15
LT063S	1,000	1.0	N	15	20	50	20	5	15
LT064S	1,000	1.5	N	15	15	50	20	5	15
LT065S	700	1.0	N	7	20	30	30	5	20
LT067S	1,000	1.0	N	15	30	30	30	5	15
LT068S	700	1.5	N	7	15	10	30	<5	15
LT069S	700	1.5	N	7	20	30	50	7	20
LT100S	1,500	1.5	N	15	15	70	50	10	30
LT101S	1,000	1.5	N	7	15	15	50	15	15
LT102S	1,500	1.5	N	7	15	50	50	15	20
LT103S	1,500	2.0	N	15	70	70	50	15	30
LT104S	1,500	1.5	N	15	50	70	50	20	30
LT105S	1,500	2.0	N	15	30	150	50	30	30
LT106S	1,500	1.5	N	10	15	100	70	20	15
LT107S	1,500	1.5	N	7	15	50	50	15	15
LT108S	1,500	2.0	N	15	30	200	50	30	30
LT109S	1,500	2.0	N	15	50	150	30	30	30
LT110S	1,000	1.5	N	15	10	70	30	15	15
LT111S	1,500	2.0	N	15	50	70	30	15	15
LT112S	1,500	2.0	N	15	20	70	30	15	20
LT113S	2,000	2.0	N	15	10	200	50	50	15
LT114S	1,500	2.0	N	5	<10	30	70	30	15
LT115S	2,000	1.5	N	7	<10	15	50	30	15
LT116S	2,000	1.0	N	20	50	100	30	30	20
LT117S	1,500	2.0	N	15	30	70	70	30	30
LT118S	1,500	2.0	N	15	20	70	50	20	15
LT119S	1,500	1.5	N	15	30	70	70	20	30
LT120S	1,000	1.5	N	7	10	30	70	15	15
LT121S	1,000	1.5	N	7	10	30	50	30	20

Table 1. Analytical data for the minus 30 mesh stream sediment samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.--continued

Sample	Pb ppm-S	Sc ppm-S	Sn ppm-S	Sr ppm-S	V ppm-S	Y ppm-S	Zn ppm-S	Zr ppm-S
LT044S	30	5	N	200	70	20	200	50
LT045S	300	5	N	300	70	15	N	70
LT046S	100	N	N	300	30	<10	N	50
LT048S	30	5	N	300	70	<10	N	30
LT049S	20	7	N	300	150	10	N	70
LT050S	70	7	N	500	150	15	N	70
LT051S	70	7	N	300	150	15	N	100
LT053S	70	7	N	300	70	10	N	70
LT054S	100	7	N	300	100	15	N	50
LT055S	50	5	N	300	70	10	N	30
LT056S	150	7	N	300	150	15	N	50
LT057S	30	7	N	300	70	<10	N	30
LT058S	100	7	N	500	150	15	N	70
LT059S	100	5	N	300	150	10	N	70
LT060S	70	7	N	500	150	<10	N	50
LT061S	30	7	N	300	150	10	N	150
LT062S	30	7	N	300	100	15	N	70
LT063S	150	7	N	500	150	10	N	70
LT064S	200	7	N	300	100	10	N	70
LT065S	50	7	N	300	70	10	N	70
LT067S	150	7	N	500	150	15	N	70
LT068S	70	5	N	300	70	10	N	70
LT069S	50	5	N	300	50	15	N	70
LT100S	30	10	N	300	200	15	N	700
LT101S	30	7	N	300	70	10	N	70
LT102S	30	7	N	300	150	15	N	300
LT103S	30	7	<10	300	150	15	N	500
LT104S	30	7	N	300	150	15	N	150
LT105S	30	10	<10	300	150	20	N	500
LT106S	30	7	N	500	150	15	N	500
LT107S	100	7	N	300	150	15	N	300
LT108S	30	10	<10	700	200	20	N	700
LT109S	150	15	15	300	700	30	N	1,000
LT110S	100	10	N	500	150	10	N	300
LT111S	70	15	<10	300	300	15	N	1,000
LT112S	200	10	N	300	300	15	N	500
LT113S	30	15	<10	700	200	15	N	700
LT114S	70	5	N	300	70	15	N	300
LT115S	150	<5	N	300	70	15	N	150
LT116S	30	15	<10	700	300	15	N	300
LT117S	50	7	<10	300	300	15	N	700
LT118S	15	10	N	300	200	15	N	1,000
LT119S	70	7	N	300	150	20	N	300
LT120S	30	7	N	300	150	15	N	300
LT121S	70	7	N	300	70	15	N	200

Table 1. Analytical data for the minus 30 mesh stream sediment samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.--continued

Sample	Latitude	Longitude	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S	Ag ppm-S	B ppm-S
LT122S	31 9 28	111 23 4	3.0	1.5	1.5	.20	2,000	<.5	300
LT123S	31 9 40	111 23 2	1.0	.7	1.5	.30	700	N	15
LT124S	31 9 44	111 23 1	3.0	.7	2.0	.30	700	N	10
LT125S	31 9 30	111 23 43	7.0	.7	.7	.30	1,500	<.5	15
LT126S	31 9 31	111 23 46	1.0	.7	.5	.30	1,500	N	10
LT127S	31 9 29	111 23 47	5.0	.7	.7	.20	3,000	<.5	15
LT128S	31 8 44	111 24 7	7.0	.7	.3	.20	1,500	<.5	10
LT129S	31 8 50	111 24 15	7.0	.7	.5	.30	2,000	<.5	10
LT130S	31 8 55	111 24 12	1.5	.7	.3	.20	700	N	15
LT131S	31 9 0	111 24 19	3.0	1.0	1.5	.30	1,000	N	10
LT132S	31 8 58	111 24 30	>20.0	1.5	2.0	.50	1,500	<.5	10
LT133S	31 8 57	111 24 30	>20.0	1.5	2.0	.50	1,500	<.5	10
LT134S	31 8 45	111 24 39	>20.0	2.0	3.0	.70	1,500	<.5	10
LT135S	31 8 44	111 24 37	>20.0	3.0	3.0	.70	2,000	<.5	15
LT136S	31 8 16	111 23 6	3.0	.7	1.0	.30	1,500	.7	15

Table 1. Analytical data for the minus 30 mesh stream sediment samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.--continued

Sample	Ba ppm-S	Be ppm-S	Bi ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Ni ppm-S
LT122S	700	1.5	N	10	<10	30	70	30	20
LT123S	1,000	1.5	N	5	<10	15	50	5	7
LT124S	1,500	1.5	N	7	<10	30	30	7	15
LT125S	1,000	2.0	N	7	10	30	50	7	7
LT126S	1,500	2.0	N	5	<10	7	100	5	10
LT127S	1,500	2.0	N	7	<10	30	70	7	15
LT128S	1,000	2.0	N	7	<10	50	50	5	10
LT129S	1,000	1.5	N	10	10	70	50	5	15
LT130S	1,500	2.0	N	5	<10	50	30	15	7
LT131S	1,500	1.5	N	7	<10	30	50	7	15
LT132S	1,500	1.5	N	15	200	50	30	15	30
LT133S	1,000	1.5	N	15	300	30	30	10	30
LT134S	1,500	1.5	N	15	100	50	50	15	20
LT135S	1,000	1.5	N	30	700	50	50	20	70
LT136S	1,000	2.0	N	7	<10	10	70	15	7

Table 1. Analytical data for the minus 30 mesh stream sediment samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.--continued

Sample	Pb ppm-S	Sc ppm-S	Sn ppm-S	Sr ppm-S	V ppm-S	Y ppm-S	Zn ppm-S	Zr ppm-S
LT122S	70	5	N	200	70	15	N	150
LT123S	30	<5	N	200	30	<10	N	70
LT124S	30	5	N	200	70	10	N	70
LT125S	300	<5	N	200	70	15	N	300
LT126S	150	<5	N	200	30	10	N	150
LT127S	200	5	N	200	70	15	N	200
LT128S	300	5	N	150	70	15	N	150
LT129S	700	5	N	150	70	15	N	150
LT130S	150	5	N	300	70	10	N	200
LT131S	100	7	N	300	100	10	N	70
LT132S	500	7	10	300	500	15	N	300
LT133S	300	7	10	300	500	15	N	300
LT134S	100	15	N	700	300	15	N	700
LT135S	500	15	10	300	500	15	N	500
LT136S	150	7	N	150	70	20	N	300

Table 2. Analytical data for the nonmagnetic fraction of the heavy mineral concentrate samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.

[N, not detected; <, detected but below the limit of determination shown; h, interference; >, determined to be greater than the value shown.]

Sample	Latitude	Longitude	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S	Ag ppm-S	Au ppm-S	B ppm-S
PT1165HN	31 9 16	111 23 53	.7	.20	30	.7	700	70.0	20	N
PT1166HN	31 9 44	111 24 35	.7	.20	30	>2.0	1,500	15.0	N	N
PT1167HN	31 10 5	111 24 39	.7	.30	20	>2.0	1,000	15.0	N	N
PT1168HN	31 10 4	111 24 39	.7	.20	15	>2.0	1,000	2.0	N	N
PT1169HN	31 9 23	111 24 5	.7	.30	3	2.0	700	70.0	70	N
LT001HN	31 10 15	111 24 50	1.5	.20	15	>2.0	700	7.0	N	N
LT002HN	31 10 14	111 24 52	5.0	1.50	7	>2.0	1,500	5.0	N	70
LT003HN	31 10 8	111 24 40	7.0	.70	10	>2.0	1,500	3.0	N	30
LT004HN	31 10 9	111 24 38	.7	.30	15	>2.0	1,500	5.0	N	N
LT005HN	31 10 10	111 24 34	.7	.20	20	>2.0	1,500	5.0	N	N
LT006HN	31 10 9	111 24 21	.7	.15	15	>2.0	1,500	3.0	N	N
LT007HN	31 9 43	111 24 7	10.0	.50	15	>2.0	2,000	3.0	N	50
LT008HN	31 9 42	111 24 8	15.0	.70	7	>2.0	2,000	3.0	N	200
LT009HN	31 10 3	111 24 45	.7	.30	15	>2.0	700	3.0	N	30
LT010HN	31 10 1	111 24 46	3.0	1.50	10	>2.0	1,500	2.0	N	30
LT011HN	31 10 3	111 24 46	1.5	.70	5	>2.0	700	3.0	N	30
LT012HN	31 9 59	111 24 38	1.5	1.00	15	>2.0	2,000	3.0	N	20
LT013HN	31 10 0	111 24 36	2.0	1.00	10	>2.0	3,000	3.0	N	500
LT014HN	31 9 52	111 24 35	3.0	2.00	7	>2.0	3,000	3.0	N	2,000
LT015HN	31 9 50	111 24 38	.7	1.50	15	>2.0	3,000	7.0	N	<0
LT016HN	31 9 51	111 24 38	1.5	3.00	10	>2.0	3,000	<1.0	N	70
LT017HN	31 9 47	111 24 33	2.0	3.00	5	>2.0	1,500	2.0	N	300
LT018HN	31 9 46	111 24 41	1.5	2.00	15	>2.0	7,000	7.0	N	20
LT019HN	31 9 41	111 24 30	1.5	3.00	10	>2.0	3,000	15.0	N	3,000
LT020HN	31 9 36	111 24 31	1.5	3.00	15	>2.0	3,000	2.0	N	N
LT021HN	31 9 33	111 24 21	2.0	3.00	3	>2.0	2,000	7.0	N	100
LT022HN	31 9 36	111 24 22	1.5	2.00	7	>2.0	3,000	15.0	N	300
LT023HN	31 9 34	111 24 12	1.5	3.00	10	>2.0	5,000	7.0	N	70
LT024HN	31 9 23	111 24 17	3.0	.50	3	>2.0	1,500	3.0	N	300
LT025HN	31 9 24	111 24 18	2.0	.30	7	>2.0	1,500	7.0	N	150
LT026HN	31 9 20	111 24 10	.7	.30	3	.7	1,500	10.0	N	150
LT027HN	31 9 11	111 23 52	7.0	.30	3	1.5	5,000	1.5	N	300
LT028HN	31 9 10	111 23 52	3.0	.30	15	1.5	3,000	10.0	10	200
LT029HN	31 9 8	111 23 45	.7	.30	15	.5	1,500	15.0	15	N
LT030HN	31 9 6	111 23 43	.7	.15	3	.7	1,500	30.0	N	70
LT031HN	31 9 3	111 23 42	1.5	.30	15	1.0	1,500	7.0	N	700
LT032HN	31 8 57	111 23 46	2.0	.30	7	.7	7,000	15.0	N	700
LT033HN	31 8 52	111 23 47	5.0	.70	15	1.5	7,000	70.0	N	1,000
LT034HN	31 8 47	111 23 41	5.0	1.00	5	>2.0	5,000	7.0	N	>5,000
LT035HN	31 8 40	111 23 43	3.0	1.50	7	1.5	7,000	5.0	N	700
LT036HN	31 8 37	111 23 33	.5	.30	3	2.0	700	3.0	N	300
LT039HN	31 10 23	111 24 8	1.0	.70	7	>2.0	2,000	2.0	N	50
LT040HN	31 10 4	111 23 41	1.0	.70	10	>2.0	1,500	1.0	N	100
LT041HN	31 10 5	111 23 40	2.0	1.00	10	>2.0	3,000	2.0	N	500
LT042HN	31 10 7	111 24 3	3.0	1.50	7	2.0	3,000	<1.0	N	150

Table 2. Analytical data for the nonmagnetic fraction of the heavy mineral concentrate samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.

Sample	Ba ppm-S	Bi ppm-S	Cd ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Nb ppm-S	Ni ppm-S
PT1165HN	>10,000	100	N	N	N	30	150	1,500	150	<50
PT1166HN	>10,000	<20	N	N	N	200	300	700	<50	10
PT1167HN	5,000	20	N	N	N	700	300	1,500	<50	<50
PT1168HN	5,000	<20	N	N	N	700	200	1,000	<50	N
PT1169HN	7,000	300	N	N	N	500	150	>5,000	<50	<50
LT001HN	1,500	70	<50	10	<20	70	300	700	<50	<50
LT002HN	1,500	20	<50	30	20	300	300	70	70	<50
LT003HN	700	N	N	15	20	500	300	700	<50	<50
LT004HN	7,000	N	<50	N	<20	150	300	1,000	<50	<50
LT005HN	1,500	<20	<50	N	N	200	300	150	50	<50
LT006HN	1,500	<20	<50	15	N	200	300	700	70	<50
LT007HN	2,000	N	<50	20	70	300	300	300	70	<50
LT008HN	1,500	N	N	15	70	300	300	100	50	<50
LT009HN	3,000	N	N	N	N	70	200	700	<50	<50
LT010HN	3,000	N	N	30	<20	500	300	70	<50	<50
LT011HN	10,000	70	N	15	<20	100	300	100	50	<50
LT012HN	7,000	<20	<50	15	<20	300	300	150	50	<50
LT013HN	700	<20	<50	<10	20	300	300	3,000	200	<50
LT014HN	700	N	<50	15	30	300	300	100	100	<50
LT015HN	5,000	N	<50	<10	N	150	300	200	<50	<50
LT016HN	1,000	<20	N	15	<20	300	300	50	50	<50
LT017HN	1,000	<20	N	10	<20	150	200	700	50	<50
LT018HN	>10,000	<20	<50	10	N	300	200	1,000	50	<50
LT019HN	15,000	20	<50	15	<20	300	300	>5,000	100	<50
LT020HN	5,000	<20	N	15	<20	300	300	1,500	70	<50
LT021HN	7,000	<20	N	10	N	70	200	1,500	50	<50
LT022HN	5,000	<20	<50	15	N	150	300	1,500	70	<50
LT023HN	1,500	<20	<50	15	<20	300	300	3,000	70	<50
LT024HN	3,000	70	<50	15	20	300	300	150	50	N
LT025HN	>10,000	100	<50	15	<20	150	500	1,000	50	N
LT026HN	700	70	N	<10	<20	30	150	2,000	<50	N
LT027HN	5,000	200	N	30	50	200	300	150	<50	N
LT028HN	>10,000	N	N	10	20	70	150	700	150	150
LT029HN	5,000	<20	N	<10	<20	30	150	700	200	150
LT030HN	1,000	<20	<50	N	N	20	70	150	<50	N
LT031HN	>10,000	<20	N	15	<20	70	150	500	<50	N
LT032HN	10,000	N	100	15	<20	70	150	100	<50	N
LT033HN	1,500	<20	<50	15	20	70	200	70	70	<50
LT034HN	700	30	<50	15	50	150	300	50	70	<50
LT035HN	1,500	<20	N	30	50	150	200	150	<50	<50
LT036HN	700	70	<50	N	<20	20	100	150	<50	N
LT039HN	300	<20	<50	<10	<20	150	300	1,500	70	N
LT040HN	1,500	N	<50	10	<20	200	300	300	70	N
LT041HN	1,500	70	<50	10	20	70	300	700	50	N
LT042HN	1,000	N	N	15	30	200	300	150	<50	N

Table 2. Analytical data for the nonmagnetic fraction of the heavy mineral concentrate samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.

Sample	Pb ppm-S	Sc ppm-S	Sn ppm-S	Sr ppm-S	V ppm-S	W ppm-S	Y ppm-S	Zr ppm-S	Th ppm-S
PT1165HN	30,000	>200	N	700	70	7,000	700	>2,000	N
PT1166HN	3,000	>200	30	700	150	1,500	700	>2,000	N
PT1167HN	7,000	200	30	500	200	500	700	>2,000	N
PT1168HN	7,000	150	30	700	300	150	700	>2,000	N
PT1169HN	>50,000	150	50	500	200	700	500	>2,000	N
LT001HN	1,500	h	20	N	150	500	300	>2,000	500
LT002HN	500	h	30	500	300	1,500	200	>2,000	N
LT003HN	1,500	h	20	700	300	100	200	>2,000	N
LT004HN	3,000	h	<20	700	150	150	300	>2,000	N
LT005HN	700	h	30	500	300	1,000	500	>2,000	N
LT006HN	1,500	h	70	300	300	300	300	>2,000	700
LT007HN	1,000	h	30	700	300	N	300	>2,000	N
LT008HN	300	h	20	700	300	N	200	>2,000	N
LT009HN	3,000	h	<20	700	150	5,000	150	>2,000	N
LT010HN	300	h	20	700	300	100	150	>2,000	N
LT011HN	700	h	<20	700	150	3,000	150	>2,000	N
LT012HN	300	h	50	500	300	100	300	>2,000	N
LT013HN	20,000	h	100	300	300	<100	300	>2,000	N
LT014HN	1,000	h	70	500	300	<100	200	>2,000	N
LT015HN	1,500	h	30	300	150	300	300	>2,000	N
LT016HN	150	h	30	300	200	<100	300	>2,000	N
LT017HN	7,000	h	30	300	150	<100	150	>2,000	N
LT018HN	15,000	h	20	700	150	3,000	300	>2,000	N
LT019HN	30,000	h	70	200	300	<100	300	>2,000	N
LT020HN	15,000	h	30	300	300	>20,000	300	>2,000	N
LT021HN	15,000	h	<20	200	100	<100	150	>2,000	N
LT022HN	20,000	h	50	200	150	<100	300	>2,000	N
LT023HN	30,000	h	70	200	150	N	300	>2,000	N
LT024HN	300	N	70	500	150	<100	150	>2,000	N
LT025HN	15,000	N	20	700	150	N	300	>2,000	N
LT026HN	30,000	N	<20	200	70	300	200	>2,000	N
LT027HN	700	N	<20	300	300	1,500	700	>2,000	N
LT028HN	7,000	N	<20	700	300	20,000	700	>2,000	N
LT029HN	15,000	N	N	200	50	15,000	700	>2,000	N
LT030HN	700	N	N	200	30	500	700	>2,000	N
LT031HN	3,000	N	N	1,500	150	1,000	300	>2,000	N
LT032HN	500	N	N	300	150	1,500	700	>2,000	N
LT033HN	700	N	N	200	150	3,000	500	>2,000	N
LT034HN	300	N	30	500	200	300	700	>2,000	N
LT035HN	1,500	N	<20	700	200	700	300	>2,000	N
LT036HN	700	N	<20	200	70	150	300	>2,000	N
LT039HN	20,000	N	70	500	300	<100	300	>2,000	N
LT040HN	700	N	30	500	300	<100	300	>2,000	N
LT041HN	700	N	30	700	300	500	300	>2,000	N
LT042HN	700	N	20	700	200	<100	150	>2,000	N

Table 2. Analytical data for the nonmagnetic fraction of the heavy mineral concentrate samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.--continued

Sample	Latitude	Longitude	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S	Ag ppm-S	Au ppm-S	B ppm-S
LT043HN	31 8 52	111 23 10	.7	.50	3	2.0	2,000	1.0	N	3,000
LT044HN	31 8 50	111 23 9	2.0	.70	7	>2.0	3,000	5.0	N	1,500
LT045HN	31 9 15	111 23 23	3.0	.70	15	1.5	7,000	7.0	N	1,500
LT046HN	31 9 16	111 23 22	5.0	1.00	7	1.5	7,000	10.0	N	1,500
LT048HN	31 10 15	111 25 5	1.5	1.50	7	>2.0	1,500	3.0	N	70
LT049HN	31 10 16	111 25 5	.3	.30	5	.7	300	7.0	N	30
LT050HN	31 10 21	111 25 2	2.0	1.00	10	>2.0	1,500	3.0	N	70
LT051HN	31 10 16	111 24 57	.7	.70	15	>2.0	1,500	2.0	N	20
LT053HN	31 10 35	111 24 56	1.5	.70	15	>2.0	1,500	2.0	N	30
LT054HN	31 10 38	111 24 57	1.0	.70	15	>2.0	1,500	5.0	N	30
LT055HN	31 10 32	111 25 1	.7	.70	15	>2.0	1,000	1.0	N	30
LT056HN	31 10 32	111 25 2	1.0	.70	7	>2.0	1,500	10.0	N	20
LT057HN	31 10 29	111 25 2	1.5	1.00	10	>2.0	1,500	5.0	N	70
LT058HN	31 9 25	111 24 52	.7	.30	10	1.5	1,500	10.0	N	50
LT059HN	31 9 26	111 24 52	.7	.70	7	1.5	1,000	15.0	N	50
LT060HN	31 9 23	111 24 49	.7	.50	15	>2.0	1,500	7.0	N	30
LT061HN	31 9 24	111 24 46	1.5	.70	15	2.0	1,500	7.0	N	20
LT062HN	31 9 22	111 24 41	1.5	.50	15	>2.0	1,500	7.0	N	20
LT063HN	31 9 18	111 24 41	.7	.70	7	1.5	1,500	15.0	N	30
LT064HN	31 9 14	111 24 36	1.5	1.50	10	>2.0	3,000	10.0	N	30
LT065HN	31 9 12	111 24 36	2.0	.70	10	>2.0	2,000	<1.0	N	100
LT067HN	31 8 57	111 24 21	1.0	.70	15	>2.0	1,500	15.0	N	20
LT068HN	31 9 54	111 23 31	1.2	1.50	7	1.5	2,000	7.0	N	150
LT069HN	31 9 53	111 23 25	2.0	1.50	10	>2.0	3,000	5.0	N	300
LT110HN	31 10 4	111 23 10	1.0	.20	5	2.0	500	N	N	N
LT117HN	31 10 4	111 23 9	.7	.10	3	2.0	300	N	N	N
LT133HN	31 8 57	111 24 30	1.0	.10	3	>2.0	500	70.0	N	N

Table 2. Analytical data for the nonmagnetic fraction of the heavy mineral concentrate samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.--continued

Sample	Ba ppm-S	Bi ppm-S	Cd ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Nb ppm-S	Ni ppm-S
LT043HN	700	<20	<50	<10	<20	70	150	<10	<50	N
LT044HN	1,500	<20	<50	10	<20	150	200	300	70	N
LT045HN	>10,000	<20	<50	15	<20	150	300	150	70	N
LT046HN	2,000	100	<50	15	70	70	300	700	100	100
LT048HN	700	<20	100	15	30	100	300	10	50	N
LT049HN	1,000	N	100	<10	<20	15	150	15	N	N
LT050HN	3,000	N	<50	30	20	200	300	50	<50	<50
LT051HN	7,000	20	<50	10	<20	100	300	30	<50	<50
LT053HN	150	N	<50	10	<20	150	300	500	50	<50
LT054HN	150	30	<50	<10	<20	150	150	1,500	<50	<50
LT055HN	2,000	N	N	N	<20	150	150	300	<50	<50
LT056HN	2,000	500	N	15	<20	70	150	1,000	50	<50
LT057HN	300	30	<50	15	<20	150	200	100	<50	<50
LT058HN	5,000	N	<50	<10	<20	50	150	<10	N	<50
LT059HN	10,000	<20	N	<10	<20	70	150	150	70	<50
LT060HN	3,000	30	<50	15	<20	70	150	70	<50	<50
LT061HN	2,000	N	<50	15	<20	150	150	100	50	<50
LT062HN	3,000	100	<50	15	<20	200	150	700	70	<50
LT063HN	3,000	<20	<50	15	<20	70	150	50	N	<50
LT064HN	1,500	N	100	30	<20	150	150	70	<50	<50
LT065HN	500	N	<50	15	20	300	150	700	70	<50
LT067HN	2,000	70	100	10	<20	100	150	20	<50	<50
LT068HN	1,500	30	N	15	20	70	150	100	<50	<50
LT069HN	7,000	<20	<50	15	20	300	150	150	50	<50
LT116HN	>10,000	N	N	N	N	70	300	150	N	N
LT117HN	>10,000	30	N	N	N	200	150	150	N	N
LT133HN	2,000	200	N	N	N	70	300	150	N	N

Table 2. Analytical data for the nonmagnetic fraction of the heavy mineral concentrate samples collected during the U.S.G.S.-C.R.M. detailed study of the Los Tomales area, northern Sonora, Mexico.--continued

Sample	Pb ppm-S	Sc ppm-S	Sn ppm-S	Sr ppm-S	V ppm-S	W ppm-S	Y ppm-S	Zr ppm-S	Th ppm-S
LT043HN	300	N	50	200	150	N	300	>2,000	N
LT044HN	2,000	N	30	200	150	100	300	>2,000	N
LT045HN	1,500	N	<20	700	150	10,000	300	>2,000	N
LT046HN	3,000	N	<20	500	200	15,000	300	>2,000	N
LT048HN	150	N	20	300	300	150	200	>2,000	<500
LT049HN	30	N	N	200	150	700	200	>2,000	N
LT050HN	300	h	30	500	150	150	300	>2,000	N
LT051HN	300	h	20	700	200	100	300	>2,000	N
LT053HN	1,500	h	30	500	200	N	300	>2,000	N
LT054HN	10,000	h	30	300	300	<100	300	>2,000	N
LT055HN	1,500	h	20	500	150	N	200	>2,000	N
LT056HN	3,000	h	<20	300	150	3,000	150	>2,000	700
LT057HN	300	h	20	300	300	300	200	>2,000	<500
LT058HN	1,500	h	N	300	100	100	200	>2,000	N
LT059HN	15,000	h	<20	700	150	3,000	150	>2,000	500
LT060HN	1,500	h	<20	300	150	150	200	>2,000	N
LT061HN	700	h	N	500	200	3,000	300	>2,000	N
LT062HN	1,500	h	30	500	200	5,000	300	>2,000	N
LT063HN	7,000	h	N	300	150	150	300	>2,000	N
LT064HN	1,500	h	<20	500	200	<100	300	>2,000	N
LT065HN	3,000	h	50	700	300	<100	200	>2,000	N
LT067HN	7,000	h	<20	500	300	150	300	>2,000	N
LT068HN	1,500	h	<20	700	200	150	150	>2,000	N
LT069HN	1,500	h	50	700	300	N	300	>2,000	N
LT116HN	2,000	>200	N	1,000	700	N	500	>2,000	N
LT117HN	1,000	>200	N	700	500	500	500	>2,000	N
LT133HN	15,000	>200	N	N	200	300	500	>2,000	N

TABLE 3.--Limits of determination for the spectrographic analysis of stream sediments, based on a 10-mg sample

[The spectrographic limits of determination for heavy-mineral-concentrate samples are two reporting units higher than the limits given for rocks and stream sediments]

Elements	Lower determination limit	Upper determination limit
	Percent	
Iron (Fe)	0.05	20
Magnesium (Mg)	.02	10
Calcium (Ca)	.05	20
Titanium (Ti)	.002	1
	Parts per million	
Manganese (Mn)	10	5,000
Silver (Ag)	0.5	5,000
Arsenic (As)	200	10,000
Gold (Au)	10	500
Boron (B)	10	2,000
Barium (Ba)	20	5,000
Beryllium (Be)	1	1,000
Bismuth (Bi)	10	1,000
Cadmium (Cd)	20	500
Cobalt (Co)	5	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Lanthanum (La)	20	1,000
Molybdenum (Mo)	5	2,000
Niobium (Nb)	20	2,000
Nickel (Ni)	5	5,000
Lead (Pb)	10	20,000
Antimony (Sb)	100	10,000
Scandium (Sc)	5	100
Tin (Sn)	10	1,000
Strontium (Sr)	100	5,000
Vanadium (V)	10	10,000
Tungsten (W)	50	10,000
Yttrium (Y)	10	2,000
Zinc (Zn)	200	10,000
Zirconium (Zr)	10	1,000
Thorium (Th)	100	2,000

Table 4.--Analytical data for the mesquite-leaf samples (ash basis) collected during the U.S.G.S.-C.R.M. detailed study of the Los Tamales area, northern Sonora, Mexico.

Sample	latitude	longitude	Ash%	Ag ppm-S	B ppm-S	Ba ppm-S	Bi ppm-S	Cr ppm-S
PT1165M	31 9 16	111 23 53	5.7	.15	150	150	<1	1.5
PT1166M	31 9 44	111 24 35	5.5	1.50	70	200	N	1.5
PT1167M	31 10 5	111 24 39	5.4	1.00	150	700	<1	1.5
PT1168M	31 10 4	111 24 39	5.8	.30	100	200	N	1.5
PT1169M	31 9 23	111 24 5	6.8	.70	100	300	<1	1.0
LT01M	31 10 15	111 24 50	9.0	.50	300	300	N	3.0
LT02M	31 10 14	111 24 52	8.0	1.50	300	200	N	N
LT03M	31 10 8	111 24 40	9.1	1.50	300	1,000	N	3.0
LT04M	31 10 9	111 24 38	10.8	2.00	300	1,000	N	N
LT05M	31 10 10	111 24 34	9.6	2.00	300	300	N	N
LT06M	31 10 9	111 24 21	6.6	1.50	300	700	N	3.0
LT07M	31 9 43	111 24 7	7.0	.70	300	1,000	N	5.0
LT08M	31 9 42	111 24 8	6.6	.30	300	300	N	N
LT09M	31 10 3	111 24 45	10.2	1.50	200	700	N	2.0
LT10M	31 10 1	111 24 46	7.8	1.50	300	700	N	2.0
LT11M	31 10 3	111 24 46	10.2	1.50	300	700	N	3.0
LT12M	31 9 59	111 24 38	10.1	.50	500	700	N	3.0
LT13M	31 10 0	111 24 36	12.3	<.10	300	700	N	3.0
LT14M	31 9 52	111 24 35	7.8	7.00	300	1,500	N	5.0
LT15M	31 9 50	111 24 38	8.4	1.00	300	300	N	2.0
LT16M	31 9 51	111 24 38	7.5	1.50	300	300	<1	1.5
LT17M	31 9 47	111 24 33	7.5	3.00	300	700	N	3.0
LT18M	31 9 46	111 24 41	8.6	1.50	300	500	N	2.0
LT19M	31 9 41	111 24 30	10.0	1.00	300	700	N	3.0
LT20M	31 9 38	111 24 31	8.1	.70	300	1,000	N	3.0
LT21M	31 9 33	111 24 21	7.8	.30	300	700	N	3.0
LT22M	31 9 36	111 24 22	9.1	.20	300	700	N	2.0
LT23M	31 9 34	111 24 12	7.5	1.50	300	700	<1	1.5
LT24M	31 9 23	111 24 17	8.6	5.00	150	700	N	2.0
LT25M	31 9 24	111 24 18	9.0	1.50	300	500	N	N
LT26M	31 9 20	111 24 10	9.2	1.50	300	700	N	N
LT27M	31 9 11	111 23 52	7.8	1.50	300	300	N	3.0
LT28M	31 9 10	111 23 52	9.9	1.50	300	700	N	1.5
LT29M	31 9 8	111 23 45	6.3	3.00	>500	150	N	3.0
LT30M	31 9 6	111 23 43	8.4	2.00	300	1,000	N	3.0
LT31M	31 9 3	111 23 42	13.0	1.50	300	300	N	3.0
LT32M	31 8 57	111 23 46	7.4	2.00	300	70	<1	1.5
LT33M	31 8 52	111 23 47	6.9	1.50	300	150	N	2.0
LT34M	31 8 47	111 23 41	7.8	1.50	300	150	N	3.0
LT35M	31 8 40	111 23 43	8.5	1.50	300	150	N	1.5
LT36M	31 8 37	111 23 33	7.6	1.50	200	150	N	N
LT40M	31 10 4	111 23 41	6.4	.50	300	150	N	N
LT41M	31 10 5	111 23 40	7.4	.70	300	150	N	2.0
LT42M	31 10 7	111 24 3	7.6	.70	300	300	N	3.0
LT43M	31 8 52	111 23 10	8.1	2.00	>500	300	N	7.0

Table 4.--Analytical data for the mesquite-leaf samples (ash basis) collected during the U.S.G.S.-C.R.M. detailed study of the Los Tamales area, northern Sonora, Mexico.

Sample	Cu ppm-S	Fe%-S	La ppm-S	Li ppm-S	Mg%-S	Mn ppm-S	Mo ppm-S	Mo ppm-A
PT1165M	70	.20	N	N	5	300	70	70
PT1166M	200	.10	N	N	7	1,500	300	420
PT1167M	150	.10	N	N	5	1,000	150	200
PT1168M	150	.15	N	N	7	700	500	460
PT1169M	150	.10	N	N	7	1,500	70	120
LT01M	70	.15	N	N	7	700	100	85
LT02M	500	.15	N	100	7	300	200	180
LT03M	300	.30	N	N	5	1,500	200	290
LT04M	500	.10	N	100	3	1,500	150	210
LT05M	300	.15	N	N	5	500	70	90
LT06M	500	.30	N	N	7	1,000	70	120
LT07M	200	.30	20	150	7	1,500	70	65
LT08M	200	.30	N	150	7	150	150	230
LT09M	300	.30	N	N	3	1,500	70	80
LT10M	500	.15	N	150	7	1,000	150	220
LT11M	300	.15	N	100	7	1,500	100	110
LT12M	150	.15	N	100	7	1,000	100	110
LT13M	70	.15	20	150	7	1,500	150	150
LT14M	700	.70	N	100	7	1,500	70	95
LT15M	300	.30	N	300	7	1,500	150	260
LT16M	500	.15	N	100	5	1,000	150	170
LT17M	700	.20	20	150	7	1,500	150	140
LT18M	300	.15	N	150	7	1,500	150	330
LT19M	300	.15	N	100	7	1,500	50	40
LT20M	300	.50	N	200	7	1,500	100	130
LT21M	70	.15	N	150	3	1,000	30	50
LT22M	70	.15	N	150	3	1,500	70	65
LT23M	150	.15	N	100	7	1,500	100	110
LT24M	300	.15	N	100	7	1,500	150	140
LT25M	500	.15	N	150	7	1,500	70	85
LT26M	300	.20	N	200	3	700	30	55
LT27M	500	.20	N	150	5	700	70	80
LT28M	200	.15	N	N	3	1,500	30	25
LT29M	700	.15	20	1,500	7	1,500	150	150
LT30M	700	.15	30	N	7	1,500	70	45
LT31M	300	.15	20	150	7	700	70	40
LT32M	700	.20	N	1,500	7	1,000	70	20
LT33M	150	.30	N	300	5	700	50	45
LT34M	500	.20	20	150	5	700	70	80
LT35M	300	.20	N	100	3	1,500	70	55
LT36M	200	.15	N	N	3	1,500	50	55
LT40M	150	.15	N	N	3	150	70	75
LT41M	200	.20	N	N	7	300	70	60
LT42M	150	.30	N	150	7	700	70	80
LT43M	700	.70	150	150	10	1,500	70	60

Table 4.--Analytical data for the mesquite-leaf samples (ash basis) collected during the U.S.G.S.-C.R.M. detailed study of the Los Tamales area, northern Sonora, Mexico.

Sample	Na ppm-S	Ni ppm-S	Pb ppm-S	Sr ppm-S	Ti%-S	U ppm	Y ppm-S	Zn ppm-S	Zr ppm-S
PT1165M	500	N	3.0	700	.010	.35	N	1,500	10
PT1166M	500	5	2.0	1,000	.005	.12	N	1,500	10
PT1167M	500	5	2.0	700	.003	.14	N	1,000	N
PT1168M	N	5	1.0	700	.003	.09	N	1,000	N
PT1169M	500	5	1.5	700	.003	.12	N	1,000	N
LT01M	1,000	5	7.0	1,500	.020	.08	N	300	15
LT02M	700	N	10.0	1,000	.020	.18	N	200	150
LT03M	700	5	7.0	700	.015	.14	N	200	50
LT04M	700	N	5.0	700	.015	.16	N	500	150
LT05M	500	N	5.0	1,500	.010	.10	N	200	N
LT06M	700	N	7.0	1,000	.015	.40	N	500	20
LT07M	2,000	5	7.0	1,500	.020	.20	N	700	15
LT08M	2,000	N	15.0	1,000	.030	2.00	N	500	300
LT09M	700	N	7.0	700	.015	.10	N	300	30
LT10M	500	N	5.0	700	.015	.90	N	300	15
LT11M	700	N	5.0	2,000	.015	.25	N	200	N
LT12M	700	5	3.0	1,500	.015	.09	10	200	15
LT13M	1,500	5	7.0	2,000	.010	.16	N	500	15
LT14M	2,000	7	15.0	1,500	.015	.20	N	700	100
LT15M	700	7	7.0	700	.010	1.00	N	500	20
LT16M	700	N	7.0	700	.015	.85	N	500	15
LT17M	700	5	10.0	1,500	.020	.25	N	700	15
LT18M	500	N	3.0	1,500	.003	.25	N	300	N
LT19M	700	7	5.0	1,500	.010	.18	N	1,000	15
LT20M	1,500	7	7.0	2,000	.030	.25	N	1,000	30
LT21M	500	N	3.0	1,000	.010	.90	N	200	10
LT22M	500	5	2.0	700	.005	.10	N	300	20
LT23M	700	N	3.0	1,500	.015	.50	N	300	15
LT24M	500	N	5.0	700	.015	.45	N	1,000	15
LT25M	700	N	15.0	700	.010	.55	N	1,500	150
LT26M	1,000	N	15.0	700	.020	1.90	N	1,000	300
LT27M	1,000	5	7.0	700	.020	1.00	N	1,500	15
LT28M	500	N	5.0	700	.015	.60	N	300	10
LT29M	700	5	5.0	700	.015	1.10	N	1,500	15
LT30M	700	7	5.0	1,500	.007	.18	15	1,500	15
LT31M	700	5	3.0	1,500	.010	.90	N	1,000	15
LT32M	700	N	10.0	700	.015	5.50	N	1,500	15
LT33M	700	N	7.0	300	.020	.80	N	700	30
LT34M	700	N	10.0	300	.015	.35	10	1,500	15
LT35M	700	N	7.0	500	.010	.90	15	1,000	10
LT36M	700	N	5.0	500	.015	.35	N	700	20
LT40M	700	5	3.0	700	.015	.30	N	300	30
LT41M	700	5	3.0	700	.010	1.50	N	300	70
LT42M	700	5	5.0	700	.015	.70	N	500	30
LT43M	7,000	7	15.0	1,500	.030	.25	70	2,000	150

Table 4.--Analytical data for the mesquite-leaf samples (ash basis) collected during the U.S.G.S.-C.R.M. detailed study of the Los Tamales area, northern Sonora, Mexico.--continued

Sample	latitude	longtude	Ash%	Ag ppm-S	B ppm-S	Ba ppm-S	Bi ppm-S	Cr ppm-S
LT44M	31 8 50	111 23 9	8.5	1.50	300	300	N	3.0
LT45M	31 9 15	111 23 23	9.0	1.50	500	700	N	5.0
LT46M	31 9 16	111 23 22	8.4	1.50	300	300	N	3.0
LT48M	31 10 15	111 25 5	8.7	.70	300	300	<1	3.0
LT49M	31 10 16	111 25 5	8.8	1.50	300	700	N	2.0
LT50M	31 10 21	111 25 2	9.7	.15	300	700	N	1.5
LT51M	31 10 16	111 24 57	7.0	.30	300	200	N	N
LT53M	31 10 35	111 24 56	9.0	.30	300	300	N	2.0
LT54M	31 10 36	111 24 57	9.2	.70	300	300	N	2.0
LT55M	31 10 32	111 25 1	9.3	1.50	>500	300	<1	5.0
LT56M	31 10 32	111 25 2	8.2	.70	500	300	<1	3.0
LT57M	31 10 29	111 25 2	6.6	1.00	500	300	<1	3.0
LT58M	31 9 25	111 24 52	8.6	1.00	500	300	<1	3.0
LT59M	31 9 26	111 24 52	8.4	.50	300	700	<1	5.0
LT60M	31 9 23	111 24 49	9.1	.30	300	300	7	3.0
LT61M	31 9 24	111 24 46	9.3	3.00	500	1,000	<1	2.0
LT62M	31 9 22	111 24 41	8.6	1.50	300	300	<1	3.0
LT63M	31 9 18	111 24 41	10.9	2.00	300	1,000	<1	3.0
LT64M	31 9 14	111 24 36	8.6	3.00	300	1,500	N	3.0
LT65M	31 9 12	111 24 36	9.4	2.00	300	300	N	3.0
LT67M	31 8 57	111 24 21	7.7	.50	>500	700	N	5.0
LT68M	31 9 54	111 23 31	7.8	.30	200	200	<1	1.5
LT69M	31 9 53	111 23 25	7.5	.50	300	700	<1	2.0

Table 4.--Analytical data for the mesquite-leaf samples (ash basis) collected during the U.S.G.S.-C.R.M. detailed study of the Los Tamales area, northern Sonora, Mexico.--continued

Sample	Cu ppm-S	Fe%-S	La ppm-S	Li ppm-S	Mg%-S	Mn ppm-S	Mo ppm-S	Mo ppm-A
LT44M	300	.20	20	150	7	500	150	150
LT45M	700	.20	20	500	7	1,500	30	20
LT46M	150	.20	20	200	7	1,500	30	35
LT48M	150	.30	N	200	7	700	30	75
LT49M	150	.30	N	N	5	1,500	20	12
LT50M	150	.15	N	N	3	200	70	120
LT51M	150	.15	N	500	7	200	70	90
LT53M	150	.15	N	150	7	500	150	150
LT54M	300	.15	N	200	7	300	70	120
LT55M	700	.30	N	500	7	2,000	150	300
LT56M	150	.15	N	100	7	1,500	70	80
LT57M	300	.20	N	150	5	700	100	100
LT58M	100	.30	N	150	7	1,000	70	50
LT59M	300	.30	N	150	7	200	70	90
LT60M	150	.15	N	150	7	700	20	20
LT61M	500	.20	N	100	7	1,500	70	65
LT62M	300	.20	N	300	7	1,500	150	140
LT63M	200	.15	N	N	7	1,500	70	55
LT64M	500	.20	30	200	>10	1,500	50	50
LT65M	300	.15	N	200	7	1,500	50	50
LT67M	150	.50	20	200	7	5,000	50	40
LT68M	700	.15	N	100	7	300	70	65
LT69M	300	.15	N	150	7	700	70	50

Table 4.--Analytical data for the mesquite-leaf samples (ash basis) collected during the U.S.G.S.-C.R.M. detailed study of the Los Tamales area, northern Sonora, Mexico.--continued

Sample	Na ppm-S	Ni ppm-S	Pb ppm-S	Sr ppm-S	Ti%-S	U ppm	Y ppm-S	Zn ppm-S	Zr ppm-S
LT44M	700	5	10.0	700	.020	1.60	N	1,000	15
LT45M	700	7	7.0	1,500	.015	.65	15	1,000	20
LT46M	1,000	30	10.0	1,500	.015	1.70	N	1,500	15
LT48M	1,000	5	7.0	2,000	.015	.45	N	300	15
LT49M	700	5	7.0	700	.015	.18	N	300	70
LT50M	700	N	7.0	700	.010	.25	N	200	10
LT51M	500	N	7.0	1,000	.015	.40	N	200	50
LT53M	700	N	5.0	1,500	.015	.14	N	500	10
LT54M	700	N	5.0	1,500	.010	.20	N	500	20
LT55M	1,000	7	5.0	>5,000	.015	.16	N	700	50
LT56M	700	5	7.0	1,500	.015	.12	N	500	15
LT57M	700	7	10.0	1,500	.015	.18	N	200	N
LT58M	700	N	7.0	3,000	.015	.25	N	300	15
LT59M	1,000	7	5.0	3,000	.015	.35	N	700	15
LT60M	700	5	5.0	5,000	.010	.12	N	300	10
LT61M	700	N	3.0	5,000	.015	.45	N	1,500	15
LT62M	700	7	5.0	3,000	.015	.40	N	300	15
LT63M	700	7	3.0	1,500	.015	.07	N	700	15
LT64M	1,500	30	5.0	2,000	.007	.25	15	1,000	15
LT65M	700	5	3.0	3,000	.007	.60	N	1,500	20
LT67M	2,000	7	10.0	3,000	.015	.18	N	700	50
LT68M	500	7	5.0	1,500	.010	.65	N	500	N
LT69M	700	N	7.0	2,000	.015	3.00	N	300	10

TABLE 5. Limits of determination for the spectrographic analysis of plant ash based on 5-mg samples

Elements	Lower determination limit ppm	Upper determination limit ppm
Iron (Fe)	50	50,000
Magnesium (Mg)	100	100,000
Titanium (Ti)	10	10,000
Manganese (Mn)	10	10,000
Silver (Ag)	.1	500
Arsenic (As)	200	5,000
Gold (Au)	2	500
Boron (B)	5	1,000
Barium (Ba)	20	20,000
Beryllium (Be)	.5	100
Bismuth (Bi)	1	500
Cadmium (Cd)	1	500
Cobalt (Co)	5	1,000
Chromium (Cr)	1	1,000
Copper (Cu)	1	5,000
Lanthanum (La)	20	500
Molybdenum (Mo)	2	500
Niobium (Nb)	20	500
Nickel (Ni)	5	1,000
Lead (Pb)	1	5,000
Antimony (Sb)	20	5,000
Tin (Sn)	5	500
Strontium	100	5,000
Vanadium	5	1,000
Tungsten (W)	50	1,000
Yttrium (Y)	5	500
Zinc (Zn)	100	20,000
Zirconium (Zr)	10	1,000
Sodium (Na)	500	50,000
Lithium (Li)	200	10,000