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Geochemical and lead-isotopic studies of river sediment from major tributaries, upper Arkansas River watershed, Colorado

by

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The Arkansas River has its headwaters in the Rocky Mountains of central Colorado (fig. 1). This area has a long history of mineral resource extraction beginning in the 1860's with the discovery of placer gold at Leadville, Colo. Within the upper Arkansas River drainage basin, there are numerous mining districts (see fig. 1), some of which have had major mineral production. In addition to the mining activity, there were also a number of mills and smelters which processed the ores. Mining practices of the past have resulted in exposure of mine waste which, in turn, has resulted in accelerated weathering of pyrite and other sulfide minerals. The weathering process produces elevated concentrations of several metals in many of the stream reaches within the upper part of the drainage basin. The U.S. Geological Survey (USGS) is currently cooperating with other Federal agencies to conduct an environmental assessment of the upper Arkansas River basin using both element distribution maps and profiles, and lead-isotope fingerprinting to determine the potential extent of environmental degradation of the Arkansas River and its impact on riparian and aquatic habitat.

Phase I of this study was initiated in July, 1993 to examine the distribution of elements in river sediments from the Arkansas River basin in Lake County, Colo. (Church and others, 1993). The objective of that study was to determine the origin and time-of-deposition of a fluvial tailings deposit in the Arkansas River immediately south of the confluence with California Gulch. We sampled the Arkansas River and its major tributaries (fig. 2, phase I sample sites) to evaluate the contribution of lead from each of the potential sources north of the fluvial tailings deposit. Cores of river sediments were taken at selected sites along the Arkansas River to provide sedimentological and geochronological control.

In phase II of the study, we retrieved geochemical data from numerous geologic studies conducted over the last several decades to prepare geochemical maps showing the distribution of copper, lead, and zinc in the upper Arkansas River basin (Smith, 1994). As a result of this work, we identified ten additional source areas in the Arkansas River basin where the concentration of lead in stream sediments exceeds 400 parts per million (ppm), seven areas where it exceeds 200 ppm, and fourteen areas where it exceeds 100 ppm in addition to the known source of metals in the Leadville mining district. These thresholds are respectively 30, 15, and 8 times that of crustal abundance of lead as defined in Fortescue (1992). Multi-element geochemical data from several thousand stream-sediment samples provided an excellent resource to guide our selection of sample sites along the Arkansas River. Potential source areas include numerous old mining districts and several milling and industrial sites. Using these geochemical maps, seventeen sample sites along the course of the Arkansas River and a composite core sample from Pueblo Reservoir were selected for geochemical and lead-isotopic analysis (fig. 2; phase II sample sites). Geologic, geomorphic, wildlife habitat, land access, and land ownership were also evaluated during the site-selection process.

In phase III of the study, we report results from analyses of the tributaries to the Arkansas River. Tributary streams to the Arkansas River were sampled to determine whether addiotonal sources of metal released from historical mining activities elsewhere in the Arkansas River watershed contribute to the metals in streambed sediment in the main stem of the

Arkansas River. Whereas local anthropogenic sources were found in some of the tributaries, the measured chemical and lead-isotopic compositions determined at the mouths of these tributaries indicates that there are not substantial sources of metals from the tributaries that impact the streambed sediment in the Arkansas River.

Sampling methods and analytical procedures were reported in Church and others (1993; 1994). Sample localities are in fig. 2. Localities of NURE samples are in Smith (1997) and of two core samples (table 3, samples ARK-TYS1 and ARK-TYS13) from Lake County provided in Walton-Day and others (1999, p. 81). Total digestion data are reported in table 1, partial digestion data from the 2M HCl-1 percent H_2O_2 digestion are in table 2, and the lead-isotopic data from analyses completed are in table 3. Results from this phase of the study have been requested in support of the Natural Resource Damage Assessment and Restoration report currently being prepared. The data are released here without interpretation and are not complete due to the fact that funding was not forthcoming to complete the study. Some samples analyzed are from the NURE samples collected in the 1970s (Smith, 2000).

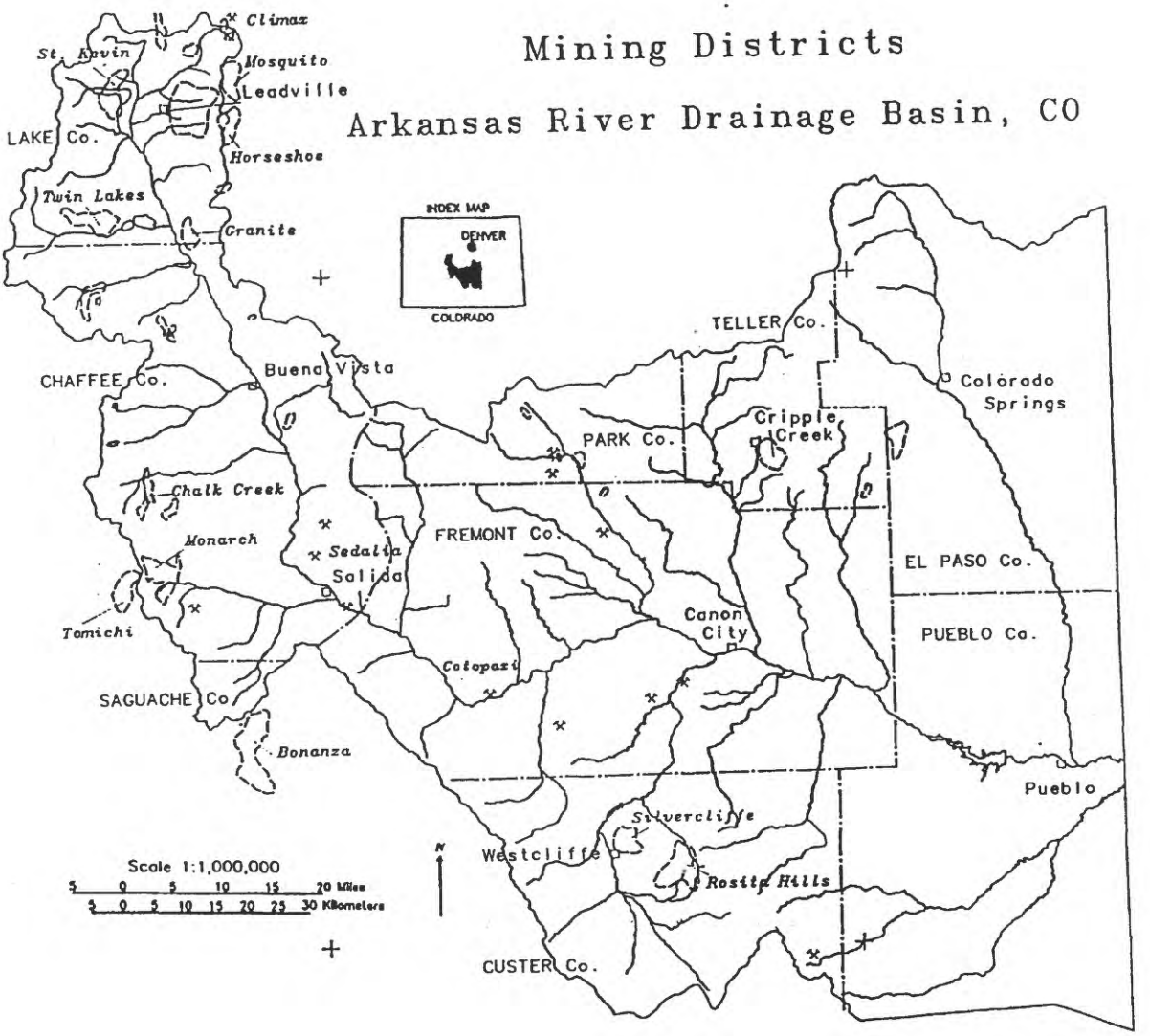

Figure 1. Map of the Arkansas River basin study area showing major gold and base-metal mining districts; some district boundaries are from Streufert and Davis (1990).

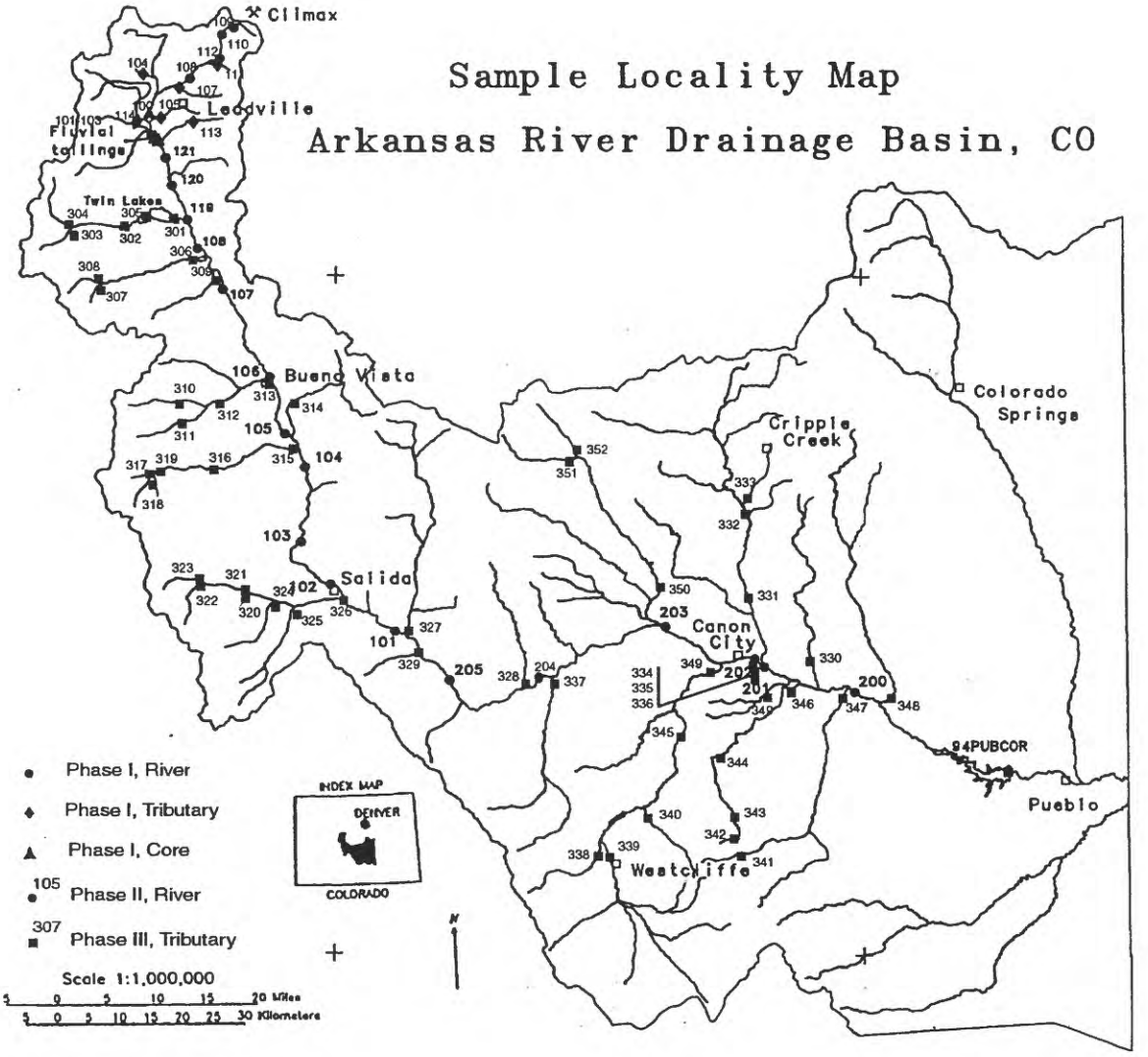

Figure 2. Map of the Arkansas River basin study area showing sample localities for phase I (Church and others, 1993), phase II (Church and others, 1994) and phase III of the study.

Table 1. Analytical data from total digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado

[Major element data expressed as weight percent; trace-element data expressed in parts per million (ppm) by weight or µg/g]

	Latitude			Longitude			County								
Field No.	Deg	Min	Sec	Deg	Min	Sec	CO	Al wt. percent	Ca wt. percent	Fe wt. percent	K wt. percent	Mg wt. percent	Na wt. percent	P wt. percent	Ti wt. percent
94ARK301	39	4	40	106	17	47	LAKE	5.6	1.4	18	1.7	0.49	1.5	0.17	1.1
94ARK302	39	5	20	106	24	16	LAKE	6.4	1.4	13	2.3	0.53	1.5	0.26	0.57
94ARK303	39	3	30	106	30	30	LAKE	6.4	0.92	14	2.1	0.45	0.92	0.28	0.46
94ARK304	39	4	5	106	30	20	LAKE	6.3	1.4	12	2.1	0.62	1.3	0.28	0.6
94ARK305	39	4	45	106	22	20	LAKE	6.8	1.3	3.7	2.2	0.49	1.7	0.15	0.36
94ARK306	39	1	5	106	16	20	CHAFFEE	7.4	1.6	3.4	2.5	0.65	2.1	0.2	0.41
94ARK307	38	58	52	106	26	55	CHAFFEE	6.8	1.4	4.4	2.3	0.57	2	0.2	0.3
94ARK308	38	59	8	106	27	0	CHAFFEE	7.9	1.3	2.7	2.8	0.38	2.2	0.14	0.21
94ARK309	38	59	28	106	14	1	CHAFFEE	7	2.6	5.3	1.6	0.74	2.3	0.33	0.8
94ARK310	38	48	50	106	16	30	CHAFFEE	6.6	2.6	11	1.7	1.3	1.8	0.15	1.8
94ARK311	38	46	55	106	17	20	CHAFFEE	6.7	2.4	8.9	2.1	1.1	1.9	0.16	0.67
94ARK312	38	48	40	106	13	52	CHAFFEE	5.6	2.4	17	1.8	0.76	1.8	0.18	1.1
94ARK313	38	50	15	106	7	20	CHAFFEE	6.6	2.2	8.7	2.3	0.65	2.2	0.14	0.69
94ARK314	38	48	35	106	4	48	CHAFFEE	6.7	3.5	11	1.9	1.2	2	0.27	1.2
94ARK315	38	44	30	106	4	52	CHAFFEE	7.2	1.8	5.6	3	0.8	2.4	0.13	0.45
94ARK316	38	42	35	106	14	30	CHAFFEE	6.3	2	11	2.4	0.7	1.9	0.13	0.56
94ARK317	38	42	13	106	21	5	CHAFFEE	7.6	3.1	7.5	2.2	1.3	2.5	0.14	0.61
94ARK318	38	41	22	106	21	10	CHAFFEE	5.4	1.5	6	2.2	0.59	1.1	0.1	0.38
94ARK319	38	42	25	106	20	14	CHAFFEE	6.1	2	7.1	2.2	0.83	1.6	0.11	0.44
94ARK320	38	32	25	106	14	52	CHAFFEE	6.3	3.2	11	2	1.3	1.7	0.19	0.84
94ARK321	38	42	50	106	14	55	CHAFFEE	6.3	4.7	3.5	2.7	2.2	1.5	0.13	0.34
94ARK322	38	32	47	106	18	12	CHAFFEE	5.1	11	5.6	1.9	3.2	1.6	0.08	0.31
94ARK323	38	33	14	106	17	55	CHAFFEE	6.8	3.2	5.5	2.6	1.6	1.3	0.13	0.42
94ARK324	38	31	40	106	9	5	CHAFFEE	5.6	2.4	15	1.9	0.82	1.6	0.17	0.91
94ARK325	38	30	40	106	4	32	CHAFFEE	6.9	3.2	7.7	2	1.4	2.2	0.09	0.66
94ARK326	38	31	18	105	59	1	CHAFFEE	6.7	3.2	8.4	1.6	1.3	2.3	0.13	0.72
94ARK327	38	27	58	105	51	32	FREMONT	7.4	3.1	3.1	2.5	1.3	2.5	0.1	0.3
94ARK328	38	22	32	105	41	50	FREMONT	6.7	4.5	5.6	2.2	1.4	2.3	0.1	0.48
94ARK329	38	28	30	105	53	0	FREMONT	7.4	3.5	4.6	2.3	1.9	0.9	0.09	0.43

Table 1. Analytical data from total digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado—(continued)
[Major element data expressed as weight percent; trace-element data expressed in parts per million (ppm) by weight or µg/g]

	Latitude			Longitude			County								
Field No.	Deg	Min	Sec	Deg	Min	Sec	CO	Al wt. percent	Ca wt. percent	Fe wt. percent	K wt. percent	Mg wt. percent	Na wt. percent	P wt. percent	Ti wt. percent
94ARK330	38	26	2	105	5	58	FREMONT	6.3	2.1	3.6	2.7	0.63	1.5	0.16	0.36
94ARK331	38	30	30	105	12	27	FREMONT	4.4	3.5	3.3	1.7	0.63	0.65	0.07	0.27
94ARK332	38	40	13	105	13	8	TELLER	7.4	1.7	4.7	3.1	0.54	1.7	0.3	0.4
94ARK333	38	39	0	105	13	12	TELLER	6.8	2.5	5.8	2.5	0.77	1.5	0.24	0.56
94ARK334	38	25	45	105	14	38	FREMONT	6.2	2.6	10	1.6	1.1	1.8	0.16	1.3
94ARK335	38	25	0	105	14	40	FREMONT	6.8	2	5	1.9	0.85	2.2	0.11	0.46
94ARK336	38	23	30	105	15	13	FREMONT	7	3.5	8.2	1.8	1.9	1.9	0.27	1.2
94ARK337	38	24	22	105	34	58	FREMONT	7.3	3	5.4	2.4	1.3	2.7	0.16	0.67
94ARK338	38	10	12	105	29	50	CUSTER	5.8	1.1	5	2.1	0.48	2.1	0.09	0.43
94ARK339	38	10	10	105	29	42	CUSTER	6.1	2.3	13	1.8	0.62	2.1	0.09	0.74
94ARK340	38	12	3	105	26	35	CUSTER	7.4	3.3	4.5	2	1.7	2.1	0.07	0.38
94ARK341	38	7	40	105	20	0	CUSTER	7.9	1.3	4.2	4	0.42	1.7	0.14	0.48
94ARK342	38	12	15	105	14	35	CUSTER	7.4	3	4.5	2.3	1.3	2.1	0.13	0.44
94ARK343	38	13	5	105	14	55	CUSTER	7.2	3	5.6	2.1	1.3	2.1	0.13	0.63
94ARK344	38	17	50	105	16	7	FREMONT	7.6	3.7	5.1	2.3	1.7	2.5	0.17	0.57
94ARK345	38	19	25	105	20	35	FREMONT	7	3.6	9.4	2	2.1	2.4	0.2	0.89
94ARK346	38	22	57	105	9	21	FREMONT	5.6	1.7	5.8	1.9	0.48	1.2	0.08	0.61
94ARK347	38	23	35	105	1	47	FREMONT	6.3	6.4	4.8	1.8	0.94	1.2	0.08	0.49
94ARK348	38	22	25	104	57	47	FREMONT	3.6	5.2	16	1.3	0.44	0.5	0.11	0.83
94ARK349	38	24	25	105	19	30	FREMONT	3.8	3.9	2.8	1.2	0.68	0.8	0.06	0.29
94ARK350	38	35	5	105	24	50	FREMONT	7.3	1.9	10	2.3	1.2	1.8	0.12	0.84
94ARK351	38	44	47	105	32	40	PARK	5.7	3.3	21	1.6	1.4	1.5	0.16	2.1
94ARK352	38	44	15	105	31	30	PARK	6.1	2.1	15	1.8	1.1	1.4	0.18	1.3
96-ARK-101	38	31	27	106	19	26	CHAFFEE	7.6	1.30	4.3	3.5	0.66	1.90	0.25	0.39
96-ARK-102	38	32	28	106	18	51	CHAFFEE	2.6	23.0	2.2	1.1	4.20	0.61	0.08	0.14
NURE-104952	38	33	25	105	59	45	CHAFFEE	5.4	2.1	20	1.7	0.94	1.4	0.15	0.94
NURE-115876	38	32	59	106	0	28	CHAFFEE	6.7	2.8	9.8	2.2	1.4	1.7	0.14	0.63
NURE-484754	38	34	52	106	0	45	CHAFFEE	7.1	2.5	8.7	2	1.3	2	0.13	0.57
NURE-484770	38	38	25	106	2	45	CHAFFEE	7.3	1.9	4.9	2.4	0.87	1.7	0.18	0.49

Table 1. Analytical data from total digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado—(continued)
[Major element data expressed as weight percent; trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Latitude Deg	Min	Sec	Longitude Deg	Min	Sec	County CO	Al wt. percent	Ca wt. percent	Fe wt. percent	K wt. percent	Mg wt. percent	Na wt. percent	P wt. percent	Ti wt. percent
NURE-484772	38	38	50	106	2	45	CHAFFEE	7.3	2.3	7	2.2	1	1.6	0.26	0.72
NURE-C50315	38	34	52	105	57	40	CHAFFEE	7.5	1.9	9.1	2.1	1.1	1.6	0.1	0.66
RASS-EGG211	38	31	10	105	56	55	CHAFFEE	6.7	5.6	4.8	2.1	2.7	1.7	0.09	0.4
94ARK300							Blank	0.11	0.019	0.069	0.02	0.0097	0.01	<0.005	0.008
SRM_2709							Standard	7.6	2	3.6	2.1	1.6	1.2	0.07	0.34
SRM_2710							Standard	6.1	1.3	3.4	1.8	0.85	1.1	0.11	0.25
SRM_2711							Standard	6.7	3.1	3	2.4	1.1	1.2	0.09	0.27
SRM_2711							Standard	6.6	3	2.9	2.4	1.1	1.2	0.09	0.27

Table 1. Analytical data from total digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado—(continued)
[Major element data expressed as weight percent; trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Ag ppm	As ppm	Ba ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cu ppm	Ga ppm	La ppm	Li ppm
94ARK301	6	<10	660	3	<10	9	250	23	150	32	34	140	14
94ARK302	<2	<10	840	2	13	7	130	25	130	110	28	77	23
94ARK303	<2	13	800	3	<10	8	230	19	87	380	24	120	19
94ARK304	<2	12	870	2	<10	5	230	19	150	23	26	120	26
94ARK305	<2	<10	800	2	<10	<2	93	10	46	45	18	53	19
94ARK306	<2	<10	850	3	<10	2	110	10	25	16	21	60	29
94ARK307	<2	<10	650	4	<10	3	150	9	31	21	22	89	39
94ARK308	<2	<10	830	3	<10	3	91	6	11	59	23	62	30
94ARK309	17	<10	570	3	<10	3	180	12	45	7	22	98	27
94ARK310	<2	<10	420	3	<10	6	130	24	86	7	27	77	30
94ARK311	<2	<10	580	3	<10	5	250	18	39	20	23	130	32
94ARK312	<2	<10	460	3	<10	8	260	21	68	12	25	140	17
94ARK313	<2	<10	570	3	<10	5	220	13	49	8	21	110	17
94ARK314	<2	<10	750	3	<10	6	230	21	50	11	26	110	17

Table 1. Analytical data from total digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado—(continued)
[Major element data expressed as weight percent; trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Ag ppm	As ppm	Ba ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cu ppm	Ga ppm	La ppm	Li ppm
94ARK315	<2	<10	780	3	<10	4	170	12	15	57	22	95	24
94ARK316	<2	<10	620	4	<10	10	220	17	34	120	24	120	20
94ARK317	<2	<10	600	2	<10	4	200	19	35	29	25	110	25
94ARK318	20	<10	490	11	<10	57	170	13	15	1200	40	98	26
94ARK319	14	<10	520	5	<10	28	170	14	25	480	30	93	27
94ARK320	<2	<10	780	4	<10	8	220	18	130	26	23	110	24
94ARK321	<2	<10	660	3	<10	4	130	10	27	73	17	69	22
94ARK322	2	<10	510	2	<10	3	92	12	41	26	14	49	14
94ARK323	7	11	620	6	16	13	200	15	32	380	23	110	26
94ARK324	<2	<10	600	3	<10	7	250	17	110	13	22	140	17
94ARK325	<2	<10	810	3	<10	4	93	17	100	15	19	52	14
94ARK326	<2	<10	700	3	<10	3	110	21	100	14	21	62	10
94ARK327	<2	<10	970	2	<10	<2	83	11	43	24	18	45	20
94ARK328	<2	<10	650	3	<10	3	160	13	64	72	20	88	31
94ARK329	<2	<10	710	3	<10	2	80	19	97	27	20	45	42
94ARK330	<2	<10	770	2	<10	<2	120	9	44	12	17	69	25
94ARK331	<2	<10	570	2	<10	<2	110	7	33	11	12	62	19
94ARK332	<2	20	1500	5	<10	4	220	21	31	50	27	150	38
94ARK333	<2	<10	880	4	<10	4	240	16	64	15	24	140	35
94ARK334	<2	40	810	3	<10	11	71	23	68	81	24	34	20
94ARK335	<2	89	710	2	<10	6	56	12	40	47	20	31	17
94ARK336	<2	<10	630	3	<10	4	98	27	110	40	24	52	41
94ARK337	<2	<10	850	2	<10	2	110	15	70	17	22	58	18
94ARK338	<2	<10	820	2	<10	<2	65	9	60	6	13	33	12
94ARK339	<2	<10	760	3	<10	12	100	20	130	12	25	54	11
94ARK340	<2	<10	710	2	<10	<2	55	21	78	30	18	31	14
94ARK341	22	110	1500	2	<10	3	93	13	43	120	21	59	17
94ARK342	<2	12	900	2	<10	3	100	17	78	28	20	58	20
94ARK343	<2	19	4300	3	<10	2	78	19	96	25	20	43	16
94ARK344	<2	<10	850	2	<10	2	120	20	100	21	22	65	17
94ARK345	<2	<10	700	4	<10	6	200	26	170	23	25	110	21
94ARK346	<2	<10	870	2	<10	<2	190	13	59	9	17	99	11

Table 1. Analytical data from total digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado—(continued)

[Major element data expressed as weight percent; trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Ag ppm	As ppm	Ba ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cu ppm	Ga ppm	La ppm	Li ppm
94ARK347	<2	10	700	2	<10	3	63	14	66	18	17	36	21
94ARK348	<2	<10	1000	3	<10	9	450	21	160	5	24	230	18
94ARK349	<2	<10	510	1	<10	2	68	9	43	11	11	40	18
94ARK350	<2	<10	850	3	<10	4	370	22	120	13	25	200	27
94ARK351	<2	<10	950	4	<10	12	260	52	170	10	41	140	14
94ARK352	<2	<10	770	3	<10	8	270	25	180	15	29	140	22
96-ARK-101	< 2	< 10	660	3	< 10	< 2	260	9	20	12	22	150	48
96-ARK-102	< 2	< 10	250	1	< 10	< 2	71	6	16	12	8	39	15
NURE-104952	<2	<10	550	3	<10	10	330	25	160	29	32	180	20
NURE-115876	<2	<10	680	2	<10	5	200	19	94	37	22	110	24
NURE-484754	<2	11	670	3	<10	5	170	19	110	39	21	96	29
NURE-484770	<2	10	650	2	<10	4	150	15	43	47	24	84	30
NURE-484772	6	11	690	2	<10	5	190	18	51	49	25	100	28
NURE-C50315	<2	<10	750	3	<10	5	210	16	64	18	27	110	21
RASS-EGG211	<2	11	750	2	<10	3	88	17	70	35	18	47	22
94ARK300	<2	<10	44	<1	<10	<2	<4	<1	2	1	<4	3	<2
SRM_2709	<2	15	950	4	<10	<2	42	15	120	33	18	23	55
SRM_2710	27	550	650	2	11	21	52	10	33	2700	48	31	34
SRM_2711	4	89	710	2	<10	40	66	11	49	120	18	38	26
SRM_2711	4	90	720	2	<10	37	67	11	45	120	17	41	27

Table 1. Analytical data from total digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado—(continued)
[Major element data expressed as weight percent; trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	Pb ppm	Sc ppm	Sr ppm	Th ppm	V ppm	Y ppm	Yb ppm	Zn ppm
94ARK301	2200	<2	23	110	19	33	17	320	38	350	45	4	150
94ARK302	1100	<2	9	62	24	38	15	260	21	260	37	3	190
94ARK303	910	<2	11	110	13	64	14	180	35	180	48	4	280
94ARK304	1200	<2	14	97	23	32	19	230	38	250	51	6	130
94ARK305	510	<2	13	48	15	34	11	290	13	60	25	2	120
94ARK306	460	<2	16	55	10	27	10	340	16	53	34	2	130
94ARK307	510	7	16	66	10	29	8	360	23	95	24	2	150
94ARK308	580	38	17	45	4	39	4	520	14	48	17	1	270
94ARK309	840	<2	30	90	13	33	13	320	25	93	55	5	96
94ARK310	1900	<2	47	69	26	27	18	200	22	210	42	2	160
94ARK311	1200	<2	35	110	16	45	13	330	27	210	57	5	150
94ARK312	1200	<2	46	110	19	29	13	280	180	420	61	6	86
94ARK313	840	<2	34	100	13	27	11	330	92	210	55	5	86
94ARK314	1200	<2	24	120	16	22	21	360	31	240	67	6	120
94ARK315	950	<2	31	79	10	130	10	400	71	140	41	3	520
94ARK316	3200	<2	33	95	14	490	10	340	71	290	47	4	970
94ARK317	1100	<2	34	94	15	19	15	450	33	210	48	4	110
94ARK318	16000	<2	20	66	8	2400	7	200	35	150	32	3	11000
94ARK319	7900	<2	25	76	11	1700	10	300	41	190	38	3	5000
94ARK320	2000	<2	24	100	28	62	16	320	24	220	49	5	470
94ARK321	1000	<2	21	54	12	220	8	220	21	65	31	2	1200
94ARK322	760	<2	17	36	14	480	7	180	14	110	20	1	290
94ARK323	2700	8	28	87	17	690	10	270	30	110	44	4	2200
94ARK324	1700	<2	49	110	19	38	14	240	60	310	57	6	240
94ARK325	1500	<2	19	41	25	30	16	290	7	180	29	3	150
94ARK326	1500	<2	21	52	27	26	16	290	13	210	30	2	140
94ARK327	820	<2	20	39	19	18	10	250	9	67	23	2	69
94ARK328	1000	<2	22	77	20	16	17	230	22	110	70	8	120
94ARK329	750	<2	22	38	47	51	14	180	17	110	26	3	83
94ARK330	690	<2	17	58	17	26	9	190	23	76	34	2	61
94ARK331	680	<2	10	44	10	25	6	220	24	66	26	2	64

Table 1. Analytical data from total digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado—(continued)
[Major element data expressed as weight percent; trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	Pb ppm	Sc ppm	Sr ppm	Th ppm	V ppm	Y ppm	Yb ppm	Zn ppm
94ARK332	4200	5	29	89	28	76	13	380	28	79	54	5	470
94ARK333	2400	<2	38	110	21	35	14	400	39	110	52	5	240
94ARK334	2800	<2	21	32	24	580	16	220	10	200	33	3	1600
94ARK335	790	<2	17	29	13	340	13	260	9	91	29	4	930
94ARK336	1700	<2	24	51	38	38	23	260	10	180	46	5	230
94ARK337	1100	<2	30	56	24	14	15	360	13	130	40	4	85
94ARK338	680	<2	18	29	10	24	7	230	8	110	19	2	41
94ARK339	1300	<2	21	54	18	280	13	430	13	320	40	5	570
94ARK340	800	<2	16	25	27	26	18	350	7	140	19	2	67
94ARK341	880	2	38	41	11	990	10	620	12	110	19	2	570
94ARK342	1200	<2	20	50	32	140	15	370	15	100	32	3	140
94ARK343	1200	<2	21	38	34	520	16	410	14	130	29	2	160
94ARK344	1000	<2	20	59	38	63	17	400	17	120	36	2	100
94ARK345	1900	<2	110	86	51	21	25	290	32	210	70	8	150
94ARK346	600	<2	15	71	14	28	8	240	32	120	28	2	71
94ARK347	730	<2	14	26	28	31	11	400	9	160	23	2	110
94ARK348	1200	<2	19	190	26	33	9	250	83	340	49	3	74
94ARK349	530	<2	10	33	17	23	7	260	12	65	18	2	86
94ARK350	1300	<2	18	160	31	25	17	260	61	200	46	3	110
94ARK351	2100	<2	40	120	36	25	20	500	55	700	39	3	220
94ARK352	1700	<2	23	120	32	31	19	290	57	320	48	3	180
96-ARK-101	1000	2	21	140	6	66	11	130	80	61	76	6	170
96-ARK-102	800	< 2	15	26	7	300	4	120	14	34	23	2	370
NURE-104952	1500	<2	30	150	30	57	16	230	90	460	54	5	140
NURE-115876	1200	<2	23	89	25	69	14	300	36	220	39	3	330
NURE-484754	1200	<2	21	79	27	69	16	300	28	200	36	6	140
NURE-484770	890	<2	24	72	16	100	16	240	27	92	42	4	220
NURE-484772	1100	2	30	93	18	99	23	220	34	130	68	4	250
NURE-C50315	990	<2	30	100	15	38	11	410	43	210	39	3	120
RASS-EGG211	1200	<2	19	41	28	86	15	280	11	120	24	4	120

Table 1. Analytical data from total digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado—(continued)
[Major element data expressed as weight percent; trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	Pb ppm	Sc ppm	Sr ppm	Th ppm	V ppm	Y ppm	Yb ppm	Zn ppm
94ARK300	44	<2	<4	<4	<2	<4	<2	6	<4	<2	<2	<1	10
SRM_2709	560	<2	12	18	83	18	12	240	11	110	14	2	98
SRM_2710	10000	15	13	23	14	4400	9	330	14	74	20	2	6600
SRM_2711	710	<2	22	28	22	1000	10	250	12	83	24	3	370
SRM_2711	670	<2	18	30	20	980	10	250	16	81	25	3	350

Table 2. Analytical data from 2M HCl-1 percent H_2O_2 partial digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado
[Major and trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Al ppm	Ca ppm	Fe ppm	K ppm	Mg ppm	Na ppm	P ppm	Ti ppm	Ag ppm	As ppm	Ba ppm
94ARK301	6100	4200	9500	1500	2200	57	1500	310	<0.3	<1.5	130
94ARK302	5300	5500	15000	1300	2200	53	1200	300	<0.3	<1.5	130
94ARK303	14000	5000	38000	800	1500	28	2400	140	<0.3	2	63
94ARK304	6900	7600	16000	2700	3500	72	3200	670	<0.3	<1.5	160
94ARK305	5800	5700	12000	1500	2400	49	2400	430	<0.3	<1.5	100
94ARK306	8300	6300	19000	3000	4400	45	2400	730	<0.3	<1.5	130
94ARK307	5800	5500	13000	1500	3000	39	2100	390	<0.3	<1.5	87
94ARK308	4600	4700	13000	710	2100	47	1600	200	<0.3	<1.5	90
94ARK309	7400	8100	16000	2900	4000	41	2800	730	<0.3	<1.5	86
94ARK310	5500	4800	13000	1100	3400	36	1600	430	<0.3	<1.5	51
94ARK311	6400	6200	14000	1300	4500	59	1800	510	<0.3	<1.5	81
94ARK312	3300	5100	6900	620	2100	39	1900	260	<0.3	<1.5	30
94ARK313	2700	4100	5900	780	1800	42	1600	320	<0.3	<1.5	33
94ARK314	4100	6700	8200	2300	3000	46	2600	520	<0.3	<1.5	93
94ARK315	5500	5500	8700	330	3000	48	1300	150	0.8	<1.5	29
94ARK316	4200	4300	8100	410	2400	37	1200	180	2	<1.5	52
94ARK317	4100	4400	11000	660	2700	60	1200	420	<0.3	<1.5	73
94ARK318	3100	4700	12000	230	1800	37	850	130	20	2	81
94ARK319	3700	4700	12000	380	2000	44	1000	210	11	2	67
94ARK320	6000	11000	12000	1200	6200	61	2000	300	<0.3	<1.5	120
94ARK321	4000	29000	6700	510	14000	69	1100	140	1	<1.5	45
94ARK322	1800	72000	3200	390	24000	79	640	100	2	<1.5	38
94ARK323	6300	4300	12000	680	2700	58	1000	170	4	2	54
94ARK324	3500	5400	7900	700	2800	46	1800	220	<0.3	<1.5	35

Table 2. Analytical data from 2M HCl-1 percent H_2O_2 partial digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado— (continued)
[Major and trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Al ppm	Ca ppm	Fe ppm	K ppm	Mg ppm	Na ppm	P ppm	Ti ppm	Ag ppm	As ppm	Ba ppm
94ARK325	3000	9200	7000	820	4600	61	1200	240	<0.3	<1.5	63
94ARK326	2900	7500	6500	950	2700	70	1200	340	<0.3	<1.5	69
94ARK327	3800	23000	5200	1000	4000	130	990	120	<0.3	<1.5	150
94ARK328	5600	31000	11000	1500	6300	160	1200	190	<0.3	2	92
94ARK329	6300	27000	11000	1200	8500	160	680	43	<0.3	<1.5	120
94ARK330	4100	15000	7200	1700	3400	120	1400	170	<0.3	<1.5	130
94ARK331	2300	27000	2800	800	2300	100	770	110	<0.3	<1.5	130
94ARK332	4800	5400	8800	2100	3300	140	960	300	<0.3	<1.5	180
94ARK333	5100	12000	8900	1900	3000	140	2000	300	<0.3	2	210
94ARK334	4700	12000	21000	1500	3700	150	1300	140	1	13	120
94ARK335	4900	3300	19000	1900	2900	67	1200	300	0.6	74	70
94ARK336	10000	11000	22000	3900	7500	60	2200	900	<0.3	<1.5	150
94ARK337	3100	9500	5800	1100	2600	73	1400	250	<0.3	<1.5	100
94ARK338	2700	3700	6100	180	2100	42	900	51	<0.3	<1.5	68
94ARK339	1500	3500	3600	250	1200	52	860	150	0.7	<1.5	59
94ARK340	3600	3200	2900	750	1100	100	560	100	<0.3	<1.5	52
94ARK341	2300	4200	15000	1000	590	160	1300	100	23	97	72
94ARK342	5900	12000	13000	2000	4000	140	1100	300	<0.3	2	200
94ARK343	3100	7400	8100	880	2300	94	1100	140	<0.3	8	280
94ARK344	3300	12000	6600	1400	2900	100	1600	280	<0.3	<1.5	110
94ARK345	4400	7800	9700	1900	3400	88	2200	470	<0.3	<1.5	150
94ARK346	2500	12000	5200	630	1600	140	680	140	<0.3	<1.5	120
94ARK347	4500	46000	9200	960	4100	490	590	34	<0.3	2	81
94ARK348	2200	48000	5300	580	1900	160	750	30	<0.3	2	89
94ARK349	2600	29000	5200	1100	2100	92	610	230	<0.3	<1.5	130
94ARK350	6500	8900	11000	2200	2700	140	2700	250	<0.3	4	370
94ARK351	4700	16000	14000	1200	3400	270	1700	600	<0.3	<1.5	130
94ARK352	6200	4500	13000	2700	3800	79	1500	470	<0.3	<1.5	170
NURE-104952	3700	6800	5600	1200	2100	80	1400	220	<0.3	<1.5	90
NURE-115876	5300	13000	8000	1700	5100	150	1300	170	<0.3	2	120
NURE-484754	5000	6000	7200	2300	2800	100	1200	350	<0.3	<1.5	130
NURE-484770	8400	8400	13000	3300	3500	120	1600	270	<0.3	3	160
NURE-484772	9800	9600	18000	2500	4800	120	2400	220	<0.3	2	170
NURE-C50315	4600	6700	4100	1300	2600	81	980	290	<0.3	<1.5	160
RASS-EGG211	3600	35000	4700	1000	13000	85	670	130	<0.3	2	140

Table 2. Analytical data from 2M HCl-1 percent H_2O_2 partial digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado— (continued)
[Major and trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Al ppm	Ca ppm	Fe ppm	K ppm	Mg ppm	Na ppm	P ppm	Ti ppm	Ag ppm	As ppm	Ba ppm
96ARK-101	6900	8200	17000	630	3400	48	2000	140	< 1	< 6	88
96ARK-102	1200	220000	2700	150	33000	80	560	< 30	< 1	< 6	44
94ARK300	<7.5	<7.5	52	<7.5	<7.5	<7.5	<7.5	<7.5	<0.3	<1.5	<0.15
SRM_2709	8500	13000	11000	1700	6900	590	430	40	<0.3	3	310
SRM_2710	8800	3900	19000	3700	3900	540	960	570	27	540	320
SRM_2711	5900	21000	6700	2000	4400	150	680	290	3	68	170
SRM_2711	6000	21000	6700	2000	4500	150	690	290	3	69	170

Table 2. Analytical data from 2M HCl-1 percent H_2O_2 partial digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado— (continued)
[Major and trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Ba ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cu ppm	La ppm	Li ppm
94ARK301	130	0.3	<1.5	0.7	30	6	9	29	14	6
94ARK302	130	0.4	<1.5	0.5	19	7	8	41	11	5
94ARK303	63	0.8	6	<0.3	34	11	9	310	14	6
94ARK304	160	0.3	<1.5	<0.3	32	8	14	16	15	10
94ARK305	100	0.4	<1.5	0.3	27	12	9	81	12	8
94ARK306	130	0.7	<1.5	0.4	36	8	11	18	18	13
94ARK307	87	1	<1.5	0.6	28	5	8	15	16	10
94ARK308	90	1	3	2	28	5	4	47	16	8
94ARK309	86	0.5	<1.5	<0.3	25	6	9	7	11	14
94ARK310	51	0.3	<1.5	<0.3	20	7	7	10	12	14
94ARK311	81	0.5	2	0.3	55	8	5	15	30	14
94ARK312	30	0.2	5	<0.3	26	4	3	6	16	7
94ARK313	33	0.2	<1.5	<0.3	21	3	4	8	13	6
94ARK314	93	0.2	<1.5	<0.3	47	5	3	5	22	7
94ARK315	29	0.4	<1.5	1	19	5	1	25	13	9
94ARK316	52	0.7	<1.5	5	21	5	2	64	13	7
94ARK317	73	0.3	<1.5	0.4	25	6	3	18	17	10
94ARK318	81	1	<1.5	18	19	6	1	220	12	5
94ARK319	67	0.8	<1.5	13	23	5	2	150	16	7
94ARK320	120	0.8	<1.5	3	34	7	11	32	19	14
94ARK321	45	1	4	4	23	4	4	58	14	7
94ARK322	38	0.2	<1.5	0.9	17	3	3	10	10	4
94ARK323	54	4	7	9	23	10	6	260	12	6

Table 2. Analytical data from 2M HCl-1 percent H_2O_2 partial digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado— (continued)
[Major and trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Ba ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cu ppm	La ppm	Li ppm
94ARK324	35	0.4	5	0.7	19	3	6	9	10	7
94ARK325	63	0.4	<1.5	0.6	17	4	7	9	9	5
94ARK326	69	0.3	<1.5	<0.3	28	4	7	9	14	4
94ARK327	150	0.4	<1.5	<0.3	38	4	5	15	19	5
94ARK328	92	0.5	<1.5	0.4	61	6	13	45	30	18
94ARK329	120	0.8	<1.5	0.4	17	8	9	16	8	15
94ARK330	130	0.3	<1.5	<0.3	31	5	6	6	15	9
94ARK331	130	0.3	<1.5	<0.3	29	3	2	3	15	3
94ARK332	180	0.4	<1.5	<0.3	39	6	8	9	19	8
94ARK333	210	1	<1.5	1	74	7	6	8	42	11
94ARK334	120	0.4	<1.5	9	30	8	7	51	14	11
94ARK335	70	0.3	<1.5	3	26	4	7	36	14	8
94ARK336	150	0.6	<1.5	1	55	12	24	24	27	27
94ARK337	100	0.2	<1.5	<0.3	36	4	6	6	20	5
94ARK338	68	0.2	<1.5	<0.3	8	4	8	3	4	5
94ARK339	59	<0.15	<1.5	2	14	3	4	4	8	2
94ARK340	52	0.2	<1.5	<0.3	16	4	4	9	9	2
94ARK341	72	0.4	<1.5	1	43	8	3	100	24	1
94ARK342	200	0.5	<1.5	<0.3	43	9	14	17	21	6
94ARK343	280	0.5	<1.5	<0.3	32	7	10	15	16	3
94ARK344	110	0.2	<1.5	<0.3	32	6	9	9	17	4
94ARK345	150	0.4	<1.5	<0.3	94	7	17	15	56	7
94ARK346	120	0.3	<1.5	<0.3	29	4	3	5	14	3
94ARK347	81	0.4	<1.5	1	26	6	5	11	13	7
94ARK348	89	0.4	<1.5	<0.3	27	3	2	6	12	4
94ARK349	130	0.3	<1.5	0.5	24	4	5	6	12	3
94ARK350	370	2	<1.5	1	130	22	4	38	79	17
94ARK351	130	0.4	<1.5	<0.3	53	8	9	5	24	5
94ARK352	170	0.4	<1.5	<0.3	44	8	11	11	21	9
NURE-104952	90	0.4	<1.5	0.7	29	3	8	11	15	5
NURE-115876	120	0.5	<1.5	1	32	5	12	17	16	6
NURE-484754	130	0.4	<1.5	1	23	5	16	15	12	8
NURE-484770	160	0.6	<1.5	2	98	8	12	25	50	10
NURE-484772	170	0.6	<1.5	1	91	11	14	31	49	10
NURE-C50315	160	0.7	<1.5	0.3	41	3	6	5	22	3
RASS-EGG211	140	0.3	<1.5	0.5	22	5	6	14	11	4

Table 2. Analytical data from 2M HCl-1 percent H_2O_2 partial digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado— (continued)
[Major and trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Ba ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cu ppm	La ppm	Li ppm
96ARK-101	88	1	< 6	< 1	100	5.3	5.5	10	66	16
96ARK-102	44	< 0.6	< 6	1.2	21	2.4	2	7	10	2.2
94ARK300	<0.15	<0.15	<1.5	<0.3	<0.6	<0.3	<0.3	1	<0.6	<0.6
SRM_2709	310	0.5	<1.5	0.3	21	8	29	17	10	18
SRM_2710	320	1	12	18	31	8	11	2700	17	13
SRM_2711	170	0.7	<1.5	36	28	7	7	81	15	6
SRM_2711	170	0.7	2	36	29	7	7	79	15	6

Table 2. Analytical data from 2M HCl-1 percent H_2O_2 partial digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado— (continued)
[Major and trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Sb ppm	Sr ppm	Th ppm	V ppm	Y ppm	Zn ppm
94ARK301	900	0.4	7	27	<0.75	27	2	12	16	55
94ARK302	290	<0.3	8	22	<0.75	45	0.7	14	15	74
94ARK303	470	2	6	31	<0.75	10	3	11	31	120
94ARK304	350	<0.3	9	9	<0.75	19	4	20	28	70
94ARK305	350	0.4	11	12	<0.75	21	3	13	22	91
94ARK306	290	1	7	14	<0.75	30	3	20	27	110
94ARK307	390	7	5	9	<0.75	34	2	17	15	99
94ARK308	540	24	3	20	<0.75	40	1	11	13	210
94ARK309	370	<0.3	6	14	<0.75	33	3	19	22	61
94ARK310	320	<0.3	6	18	<0.75	12	8	17	14	76
94ARK311	680	<0.3	5	33	<0.75	27	17	20	13	87
94ARK312	170	<0.3	3	.8	<0.75	19	70	11	9	26
94ARK313	130	<0.3	3	15	<0.75	13	12	9	10	36
94ARK314	240	<0.3	4	8	<0.75	16	5	15	15	29
94ARK315	490	<0.3	3	130	<0.75	34	14	11	4	380
94ARK316	2200	2	3	500	<0.75	26	18	13	5	830
94ARK317	430	2	4	13	<0.75	31	3	23	5	52
94ARK318	11000	2	2	2900	0.8	20	6	13	8	2800
94ARK319	5500	2	3	1900	<0.75	22	3	19	7	2200
94ARK320	930	<0.3	8	46	<0.75	31	3	18	16	430
94ARK321	560	1	4	160	<0.75	22	1	8	12	850
94ARK322	320	<0.3	2	240	<0.75	30	2	4	9	190

Table 2. Analytical data from 2M HCl-1 percent H_2O_2 partial digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado— (continued)
[Major and trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Sb ppm	Sr ppm	Th ppm	V ppm	Y ppm	Zn ppm
94ARK323	1700	4	6	430	<0.75	27	2	13	7	1400
94ARK324	140	<0.3	4	22	<0.75	10	19	12	11	150
94ARK325	310	<0.3	4	14	<0.75	18	1	12	7	89
94ARK326	340	<0.3	4	19	<0.75	26	1	13	9	55
94ARK327	510	<0.3	5	4	<0.75	48	1	8	13	24
94ARK328	370	<0.3	8	8	<0.75	56	9	16	29	51
94ARK329	460	<0.3	12	28	<0.75	84	1	12	9	32
94ARK330	350	<0.3	6	7	<0.75	39	1	13	14	27
94ARK331	420	<0.3	3	7	<0.75	96	1	5	10	21
94ARK332	470	<0.3	9	8	<0.75	33	2	17	11	32
94ARK333	1600	<0.3	9	11	<0.75	130	3	14	22	140
94ARK334	2000	<0.3	10	530	<0.75	58	2	18	12	1400
94ARK335	210	<0.3	5	310	<0.75	15	3	18	10	600
94ARK336	580	<0.3	18	21	<0.75	27	2	33	18	110
94ARK337	330	<0.3	7	5	<0.75	29	2	9	11	21
94ARK338	290	<0.3	4	5	<0.75	15	<0.6	8	5	19
94ARK339	270	<0.3	3	230	<0.75	12	3	8	5	210
94ARK340	220	<0.3	4	8	<0.75	16	<0.6	8	5	14
94ARK341	660	3	4	900	<0.75	49	2	14	7	420
94ARK342	790	<0.3	14	130	<0.75	49	<0.6	21	12	68
94ARK343	610	<0.3	11	590	<0.75	37	1	15	10	59
94ARK344	310	<0.3	9	68	<0.75	39	0.7	11	11	28
94ARK345	540	<0.3	13	17	<0.75	24	5	15	19	42
94ARK346	190	<0.3	4	10	<0.75	74	2	9	9	26
94ARK347	260	<0.3	12	9	<0.75	220	2	22	10	43
94ARK348	280	0.3	10	8	<0.75	170	2	10	10	22
94ARK349	240	<0.3	6	12	<0.75	91	1	8	7	42
94ARK350	4400	2	21	34	<0.75	190	4	13	37	390
94ARK351	420	<0.3	5	7	<0.75	100	2	43	13	37
94ARK352	550	<0.3	8	11	<0.75	26	3	23	14	46
NURE-104952	210	<0.3	5	45	<0.75	24	9	11	13	39
NURE-115876	450	<0.3	7	56	<0.75	38	2	16	12	240
NURE-484754	390	<0.3	7	58	<0.75	23	1	14	10	0.3
NURE-484770	590	<0.3	7	95	<0.75	39	4	16	30	130
NURE-484772	690	<0.3	9	91	<0.75	33	5	20	38	170
NURE-C50315	280	<0.3	3	21	<0.75	43	2	8	10	17

Table 2. Analytical data from 2M HCl-1 percent H_2O_2 partial digestions of stream-sediment samples, tributaries to the Arkansas River, Colorado— (continued)
[Major and trace-element data expressed in parts per million (ppm) by weight or µg/g]

Field No.	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Sb ppm	Sr ppm	Th ppm	V ppm	Y ppm	Zn ppm
RASS-EGG211	590	<0.3	6	59	<0.75	30	<0.6	12	8	38
96ARK-101	880	1.1	3.9	46	< 3	14	4	18	44	130
96ARK-102	650	< 1	2.1	300	< 3	69	< 2	3.2	11	240
94ARK300	<0.6	<0.3	<0.3	<0.6	<0.75	<0.3	<0.6	<0.3	<0.3	0.3
SRM_2709	360	<0.3	46	8	<0.75	88	1	28	9	39
SRM_2710	8400	11	7	4700	2	87	<0.6	34	12	5200
SRM_2711	460	<0.3	10	1000	<0.75	41	<0.6	14	13	220
SRM_2711	460	<0.3	10	950	<0.75	39	<0.6	13	13	220

Table 3. Lead isotopic data for selected stream-sediment samples from tributaries, Arkansas River watershed, Colo.

[Pb isotopic data are corrected for mass fractionation of 0.147 ± 0.03 % (low T) or 0.13 ± 0.03% (high T) per mass unit based on analyses of NBS Standard SRM 981 (14 analyses of 10 standards)]

Field No.	County Colo.	206Pb ** 204Pb		2 sigma mean	207Pb 204Pb		2 sigma mean	208Pb 204Pb		2 sigma mean
94ARK301	LAKE	18.523	±	0.011	15.608	±	0.014	38.520	±	0.046
94ARK302	LAKE	18.106	±	0.011	15.555	±	0.014	38.255	±	0.046
94ARK303	LAKE	18.124	±	0.011	15.558	±	0.014	38.287	±	0.046
94ARK304	LAKE		±			±			±	
94ARK305	LAKE		±			±			±	
94ARK306	CHAFFEE		±			±			±	
94ARK307	CHAFFEE	17.783	±	0.011	15.525	±	0.014	38.207	±	0.046
94ARK308	CHAFFEE		±			±			±	
94ARK309	CHAFFEE		±			±			±	
94ARK310	CHAFFEE		±			±			±	
94ARK311	CHAFFEE	17.985	±	0.011	15.536	±	0.014	38.211	±	0.046
94ARK312	CHAFFEE		±			±			±	
94ARK313	CHAFFEE		±			±			±	
94ARK314	CHAFFEE	19.579	±	0.012	15.698	±	0.014	40.048	±	0.048
94ARK315	CHAFFEE	17.820	±	0.011	15.521	±	0.014	38.100	±	0.046
94ARK316	CHAFFEE	17.816	±	0.011	15.522	±	0.014	38.098	±	0.046
94ARK316D	CHAFFEE	17.811	±	0.011	15.516	±	0.014	38.077	±	0.046
94ARK317	CHAFFEE	18.020	±	0.011	15.552	±	0.014	38.280	±	0.046
94ARK318	CHAFFEE	17.806	±	0.011	15.519	±	0.014	38.082	±	0.046
94ARK319	CHAFFEE	17.808	±	0.011	15.520	±	0.014	38.088	±	0.046
94ARK320	CHAFFEE	19.280	±	0.012	15.648	±	0.014	38.584	±	0.047
94ARK321	CHAFFEE	18.725	±	0.011	15.606	±	0.014	38.473	±	0.046
94ARK322	CHAFFEE	19.516	±	0.012	15.682	±	0.014	38.950	±	0.047
94ARK323	CHAFFEE	17.938	±	0.011	15.517	±	0.014	37.872	±	0.046
94ARK323D	CHAFFEE	17.953	±	0.011	15.535	±	0.014	37.931	±	0.046
94ARK324	CHAFFEE	18.950	±	0.012	15.618	±	0.014	38.496	±	0.046
94ARK325	CHAFFEE	19.081	±	0.012	15.649	±	0.014	38.426	±	0.046
94ARK326	CHAFFEE		±			±			±	
94ARK327	FREMONT	24.028	±	0.015	16.091	±	0.015	40.612	±	0.049
94ARK328	FREMONT	23.759	±	0.014	16.074	±	0.015	40.530	±	0.049
94ARK329	FREMONT	19.312	±	0.012	15.683	±	0.014	38.467	±	0.046
94ARK330	FREMONT		±			±			±	
94ARK331	FREMONT		±			±			±	
94ARK332	TELLER	19.589	±	0.012	15.708	±	0.014	39.244	±	0.047
94ARK333	TELLER	19.621	±	0.012	15.692	±	0.014	39.367	±	0.047
94ARK334	FREMONT	17.877	±	0.011	15.539	±	0.014	38.424	±	0.047
94ARK335	FREMONT	17.941	±	0.011	15.544	±	0.014	38.445	±	0.046
94ARK336	FREMONT	19.380	±	0.012	15.679	±	0.014	38.592	±	0.046
94ARK337	FREMONT		±			±			±	
94ARK338	CUSTER	19.350	±	0.013	15.652	±	0.015	38.163	±	0.047
94ARK339	CUSTER	17.447	±	0.011	15.468	±	0.014	37.070	±	0.045
94ARK340	CUSTER		±			±			±	

Table 3. Lead isotopic data for selected stream-sediment samples from tributaries, Arkansas River watershed, Colo.-(continued)
[Pb isotopic data are corrected for mass fractionation of 0.147 ± 0.03 % (low T) or 0.13 ± 0.03% (high T) per mass unit based on analyses of NBS Standard SRM 981 (14 analyses of 10 standards)]

Field No.	County Colo.	206Pb ** 204Pb	2 sigma mean	207Pb 204Pb	2 sigma mean	208Pb 204Pb	2 sigma mean
94ARK341	CUSTER	17.594 ±	0.013	15.476 ±	0.015	37.432 ±	0.047
94ARK342	CUSTER	17.140 ±	0.011	15.457 ±	0.014	38.052 ±	0.046
94ARK343	CUSTER	17.055 ±	0.010	15.445 ±	0.014	37.983 ±	0.046
94ARK344	FREMONT	17.190 ±	0.010	15.465 ±	0.014	38.087 ±	0.046
94ARK345	FREMONT	18.280 ±	0.011	15.548 ±	0.014	38.719 ±	0.047
94ARK346	FREMONT	±		±		±	
94ARK347	FREMONT	19.365 ±	0.012	15.681 ±	0.014	39.178 ±	0.047
94ARK348	FREMONT	±		±		±	
94ARK349	FREMONT	±		±		±	
94ARK350	FREMONT	19.574 ±	0.012	15.688 ±	0.014	39.205 ±	0.047
94ARK351	PARK	19.844 ±	0.012	15.722 ±	0.014	38.998 ±	0.047
94ARK352	PARK	18.948 ±	0.012	15.635 ±	0.015	38.709 ±	0.047
96ARK101	LAKE	20.880 ±	0.013	15.808 ±	0.014	39.860 ±	0.048
96ARK102	LAKE	19.856 ±	0.012	15.880 ±	0.014	39.276 ±	0.047
ARK TY-S1	LAKE	18.049 ±	0.011	15.556 ±	0.014	38.148 ±	0.046
ARK TY-S13	LAKE	17.965 ±	0.011	15.540 ±	0.014	38.093 ±	0.046
JAY718		20.414 ±	0.012	15.796 ±	0.014	39.454 ±	0.047
JAY735		40.654 ±	0.026	17.596 ±	0.016	44.394 ±	0.054
JAY751		30.207 ±	0.019	16.674 ±	0.015	41.800 ±	0.050
93LV-110	LAKE	18.985 ±	0.012	15.639 ±	0.014	39.036 ±	0.047
93LV-112	LAKE	18.598 ±	0.011	15.615 ±	0.014	38.778 ±	0.047
NURE-104952	CHAFFEE	17.843 ±	0.011	15.527 ±	0.014	37.706 ±	0.045
NURE-115876	CHAFFEE	18.080 ±	0.011	15.549 ±	0.014	38.094 ±	0.046
NURE-484754	CHAFFEE	17.801 ±	0.011	15.524 ±	0.014	37.584 ±	0.045
NURE-484770	CHAFFEE	18.272 ±	0.011	15.568 ±	0.014	38.152 ±	0.046
NURE-484772	CHAFFEE	18.340 ±	0.011	15.574 ±	0.014	38.263 ±	0.046
NURE-C50315	CHAFFEE	17.965 ±	0.011	15.539 ±	0.014	37.880 ±	0.046
RASS-EGG211	CHAFFEE	18.115 ±	0.011	15.546 ±	0.014	37.851 ±	0.046
SRM_2709	Standard	19.082 ±	0.012	15.665 ±	0.014	38.931 ±	0.047
SRM_2710	Standard	17.831 ±	0.011	15.547 ±	0.014	38.171 ±	0.046
SRM_2711	Standard	17.124 ±	0.011	15.454 ±	0.014	37.016 ±	0.045
SRM_2711	Standard	17.095 ±	0.011	15.429 ±	0.014	36.922 ±	0.045

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