Major- and trace-element geochemistry; lead, strontium, and neodymium isotopic compositions; and petrography of late Cenozoic basaltic rocks from west central Colorado

By

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INTRODUCTION

Subsidence related to evaporite tectonism in western Colorado has been long recognized (e.g.,Wanek, 1953; Hubert, 1954; Benson and Bass, 1955; Bass and Northrop, 1963). However, the scale, extent and timing of subsidence has recently become a major focus of investigation by members of both the U.S. Geological Survey and the Colorado Geological Survey (e.g. Kirkham, 1997; Kirkham and others, 1997; 2001; Scott and others, 1998).

Two large structural depressions have been recognized along the Eagle and Colorado Rivers in west central Colorado (Figure 1). These have been named the Carbondale and Eagle collapse centers (Kirkham and others, 1997) for towns located within the respective centers. Although the exact boundaries of the centers are not well-defined, the Carbondale collapse center probably occupies an area of over 1200 km^2 , and the Eagle collapse center an area of over 2400 km^2 (Kirkham and others, 2001; R. B. Scott, written communication 2001). The two centers appear to be contiguous (Figure 1).

The principal cause of collapse in these areas is the removal by flow and dissolution of large volumes of Pennsylvanian Eagle Valley Evaporite, a variably thick sequence of gypsum and anhydrite interbedded with halite, siltstone, and minor dolomite. The Eagle and Carbondale collapse centers roughly coincide with the two areas underlain by the greatest thickness of Eagle Valley Evaporite (Scott and others, 1998). Differential overpressure as a result of erosion and down-cutting of the Colorado, Eagle, and Roaring Fork rivers caused the evaporite to flow laterally and vertically to areas of lower pressure, the river valleys. As the evaporite encountered ground water, it dissolved and was eventually removed via the river systems. The areas of higher overpressure from which the evaporite was removed eventually collapsed to fill the void caused by the removal (e.g., Scott and others, 1998; Kirkham and others, 2001). Vertical collapse may have exceeded 1.2 km in some places (Kirkham and others, 2001), and as much as 2250 km^3 of evaporite was probably removed from the two collapse centers (Kunk and others, 1997; Scott and others, 1998).

Local subsidence, at least within the Carbondale collapse center may have begun during late Oligocene or early Miocene (Kirkham and others, 2001). Although subsidence accelerated during late Miocene (ca. 10-7 ma; Kunk and others, 1997; Kirkham and others, 2001), most of the regional collapse could have occurred within the last 3 to 4 Ma (Kunk and others, 1997; Scott and others, 1998, Kirkham and others, 2001).

Located within and around the collapse areas are several basalt fields (Figure 1). It was originally thought that prior to collapse a basalt plateau may have existed over much of the Carbondale collapse area and that Basalt Mountain may have been the source of the flows. If this were true, then the present-day elevations of the basalts could be used to estimate the amount of collapse. However, it was soon realized that basalts of a wide range in age were located within the Carbondale collapse center (Kunk and others, 1997; Kunk and Snee, 1998). Consequently, the elevation of the basalts could not be used to estimate the amount of collapse until individual basalt flows could be identified with confidence.

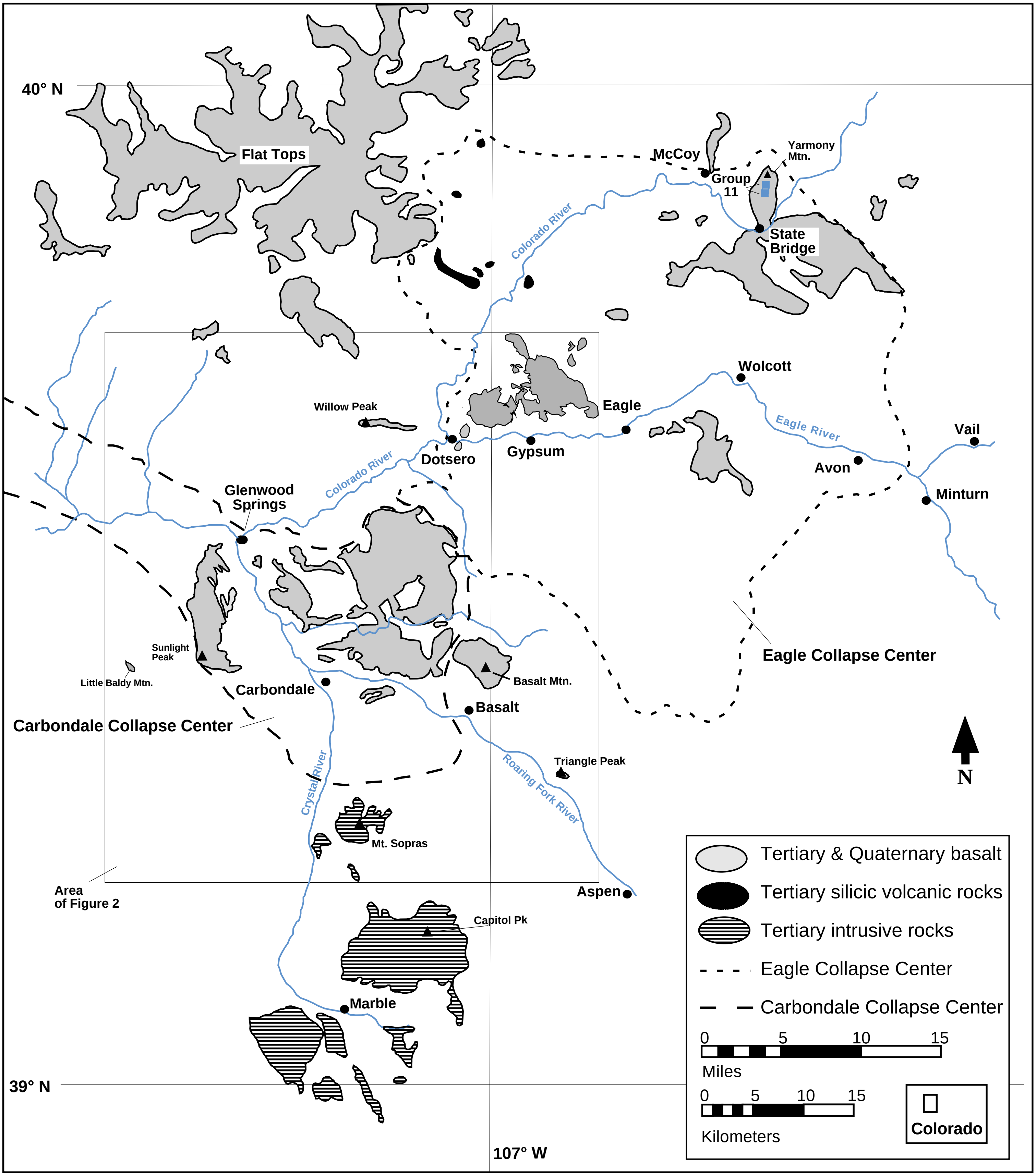

Figure 1. Geologic sketch map of the vicinity around Glenwood Springs and the Carbondale and Eagle Collapse areas, west central Colorado (after R.B. Scott, written communication 2000).

One of the principal objectives of this study was to find physical or geochemical signatures of individual flows that would allow us to differentiate among the various flows within the collapse center. Because the physical and chemical properties of the basalts were expected to be rather similar, a multidisciplinary approach was employed that used paleomagnetic data (Hudson and others, 2002); ^{40}Ar/^{39}Ar geochronology (Kunk and Snee, 1998; Kunk and others, 2001); petrography; geochemistry; and Pb, Sr, and Nd isotope geochemistry.

A satisfactory solution to the problem was achieved using a selected suite of elements (Hf, Ta, REE, Rb, K, Th, and U) in conjunction with isotopic data to fingerprint individual magma batches (Budahn and others, 2002). Forty-three magma batches represented by two or more samples were identified among the 200+ samples analyzed. The method and results are briefly outlined below. For a complete discussion and evaluation of the procedure, the reader is referred to Budahn and others (2002).

A second objective of the study was to use the geochemical and isotopic data to identify the sources and processes responsible for the production of the basaltic rocks in the Carbondale collapse area. P. T. Leat and colleagues have discussed the petrogenesis of basalts in western Colorado in a number of papers (Leat and others, 1988, 1989, 1990; Gibson and others, 1991; Thompson and others, 1990). These authors have concluded that the basalts in western Colorado are derived from three principal but heterogeneous sources: asthenospheric mantle (source 1, OIB-source), asthenospheric mantle modified by subduction processes(source 3), and lithospheric mantle (source 2). Leat and others (1988) have further suggested that prior to ca. 20 Ma the basalts were derived primarily from source 3 with a small contribution from source 1. During the 14-7 Ma time interval, all three sources were contributing to the basalts, but during the last ca. 2 m.y. basalts were derived primarily from sources 1 and 2 with only a minimal contribution from source 3. Our objectives with the current study are to test this model with a large number of samples from a limited geographic area and to determine if there is an evolution of the basalt source region through time in this same area.

GEOLOGIC SETTING

The general geology of the area in and around the Carbondale collapse center was mapped by Tweto and others (1976). Detailed mapping at a 1:24000 scale has been undertaken by members of the Colorado Geological Survey as summarized by Kirkham and others (2001). The central portion of the collapse area, east of the roaring Fork River and west of Basalt Mountain, is underlain by a thick sequence of Eagle Valley Evaporite. The basalts of the Sunlight Peak field sit atop the Grand Hogback Monocline , which is manifest as a sequence of west-dipping post-evaporite Paleozoic and Mesozoic sediments.

Basalt Mountain is separated from the other basalt fields by the Basalt Mountain Fault, a Laramide high-angle reverse fault that was down thrown to the east. The basalts of Basalt Mountain also sit atop post-evaporite Paleozoic and Mesozoic sedimentary rocks.

SAMPLES

The current study was focussed primarily on samples from in and around the Carbondale collapse area (Figure 2). However, a suite of samples from the western edge of the Eagle collapse area was also included as well as three samples from Yarmony Mountain at the northern margin of the Eagle collapse area (group 11, Figure 1) and three samples from Triangle Peak, southeast of the Carbondale collapse center.

Sample locations as well as group assignments are given in Table 1 and are shown in Figure 2. KH95-series , K-97-series, I70-series, 97GH-series and 97-MG-series samples were collected by members of the U. S. Geological Survey (K. Hon, M. Kunk, M. Hudson). The remaining samples were provided by members of the Colorado Geological Survey, R. Kirkham and R. Streufert.

Samples fall into five general age groups (Kunk and Snee, 1998; Kunk and others, 2001): 22-24 Ma, 13-14 Ma, 9-10 Ma, 7-8 Ma, and <4 Ma. The oldest basaltic rocks analyzed are 22-24 Ma (groups 8-11, Figure 2). These are found primarily within the Eagle collapse area, but three group 10 samples were obtained from an area approximately 5 km SE of Glenwood Springs.

The second-oldest group is 13-14 Ma samples (groups 12 and 13). These are found exclusively in the southern portion of the Carbondale collapse center and only in two small exposures (Figure 2).

The largest age group, both numerically and in terms of exposure are the 9-10 Ma samples (groups 1-4). These are the only age group found in the Sunlight Peak field west of the Roaring Fork River and they are found extensively in the central portion of the collapse area. The basalts of Basalt Mountain, just east of the collapse area have also been dated at 9-10 Ma. The Flat Tops volcanic field just north of Glenwood Springs (Figure 1) is comprised of both 9-14 Ma and 21-23 Ma basalts (Larsen and others, 1975). Two basalts from the Grand Mesa basalt field (southwest of the area shown in Figure 1) have also been dated at 9-10 Ma (Larsen and others, 1975; Kunk and others, 2001).

Group 5 samples have been dated at 7-8 Ma. These are exposed in the northeastern portion of the Carbondale collapse center and along the roaring Fork River south of Glenwood Springs (Figure 2). In terms of current exposure, these represent the second most abundant age group.

The youngest samples (groups 6 and 7) range in age from ≈4 Ma to 4 ka. With the exception of Triangle Peak southeast of the Carbondale collapse center, this group appears to be limited to the northeastern portion of the Carbondale collapse center and the western most Eagle collapse center (Figure 2). However, a basalt at McCoy in the northernmost portion of the Eagle Center (Figure 1) has been dated at 0.6 Ma by Larsen and others (1975).

Table 1. Sample Locations for Colorado basaltic rocks.

Field Number	Group[1]	Lat (°N)	Long (°W)
KH95-33	1a	39.493	107.379
KH95-22	1a	39.416	107.361
KH95-35	1a	39.488	107.391
KH95-37	1a	39.485	107.394
KH95-40	1a	39.488	107.388
CC108	1a	39.408	107.369
KH95-21	1a	39.416	107.361
KH95-19	1a'	39.416	107.361
CD53D	1b	39.435	107.201
CD53C	1b	39.435	107.201
CD53B	1b	39.435	107.201
CD31	1b	39.439	107.243
CD51B	1b	39.423	107.232
CD179	1b	39.457	107.189
CD181C	1b	39.449	107.187
CD17	1b	39.469	107.214
CD124A	1b	39.444	107.126
CD218	1b	39.457	107.151
CD180	1b	39.458	107.184
CD156	1b	39.430	107.234
CD191B	1b	39.457	107.172
CD59	1b	39.427	107.206
CD65	1b	39.431	107.190
CD51A	1b	39.423	107.232
CD192	1b	39.460	107.162
CD193D	1b	39.465	107.147
CD193C	1b	39.463	107.148
CD193B	1b	39.462	107.150
CD181B	1b	39.448	107.186
KH95-9	1b	39.522	107.278
CD5	1b	39.462	107.245
KH95-12Z	1b	39.519	107.277
CD6	1b	39.421	107.151
K97-10-8B	1b	39.519	107.276
CD124B	1b	39.443	107.126
KH95-11	1b	39.519	107.279
K97-8-12F	1b	39.409	107.097
KH95-8	1b	39.521	107.278
I70-2	1b	39.430	107.204
I70-3	1b	39.431	107.204
KH95-24	1b'	39.416	107.361
KH95-23	1b'	39.416	107.361
KH95-38	1b'	39.485	107.394
I70-8	1b'	39.425	107.208
L-23	1c	39.409	107.098
CD150C	1c	39.397	107.146
CD12	1c	39.491	107.206
L-26	1c	39.408	107.111
CD109	1c	39.414	107.129

Field Number	Group[1]	Lat (°N)	Long (°W)
L-25	1c	39.415	107.093
L-201	1c	39.460	107.064
K97-8-15A	1c	39.421	107.092
KH95-2	1c'	39.498	107.327
KH95-3	1c'	39.498	107.328
KH95-5	1c'	39.498	107.329
CD204	1c"	39.499	107.138
CD203	1c"	39.497	107.144
CD138	1c"	39.392	107.166
CD45A	1d	39.423	107.233
CD42	1d	39.424	107.226
CD45B	1d	39.423	107.233
CC140	2a	39.416	107.364
KH95-17	2a	39.416	107.360
KH95-1	2a	39.498	107.323
KH95-6	2a	39.498	107.330
CC118	2a	39.490	107.372
CC132	2b	39.483	107.284
CC-LA-1	2b	39.483	107.284
CC127	2b	39.481	107.276
GL207	2b	39.516	107.303
CC-LA-2	2b	39.483	107.284
GL165B	2b	39.538	107.269
GS96-1	2b	39.535	107.260
CC126	2b	39.481	107.276
K97-8-12E	2b	39.409	107.097
KH95-34	3a	39.494	107.380
KH95-42	3a	39.490	107.378
KH95-36	3a	39.486	107.393
CD181A	3b	39.447	107.186
CD193A	3b	39.461	107.151
CD19	3b	39.476	107.225
CD53A	3b	39.435	107.200
CD187	3b	39.460	107.183
CC-LA-3	3b	39.485	107.282
KH95-43	4a	39.512	107.364
GL25	4a	39.512	107.364
KH95-25	4a	39.418	107.369
CD135	4b	39.386	107.165
CD150A	4b	39.398	107.146
L-187B	4b	39.431	107.045
L-187A	4b	39.431	107.046
L-176	4b	39.413	107.066
K97-8-11A	4b	39.400	107.004
K97-8-11D	4b	39.400	107.004
L-91A	4b	39.442	107.033
CD150B	4b	39.398	107.146
K97-8-11B	4b	39.400	107.004
K97-8-11C	4b	39.400	107.004

[1]Group assignments from Budahn and others, 2002. U = Unclassified.

Table 1. Cont'd.

Field Number	Group[1]	Lat (°N)	Long (°W)	Field Number	Group[1]	Lat (°N)	Long (°W)
L-91B	4b	39.442	107.034	L-244	6b'	39.433	107.083
K97-8-11E	4b	39.400	107.004	L-245	6b'	39.433	107.080
L-37	4b	39.411	107.015	L-28	6b'	39.433	107.080
L-39	4b	39.441	107.039	CPV-4	6b"	39.521	107.114
L-187D	4b	39.432	107.045	CPV-3	6b"	39.517	107.112
L-181	4b	39.445	107.018	CP86	6b"	39.511	107.115
K97-8-11B (DU	4b	39.400	107.004	CPV-2	6b"	39.518	107.105
K97-8-15C	4b'	39.411	107.014	L-1	6c	39.463	107.109
L-38A	4b'	39.399	107.002	L-3	6c	39.468	107.109
K97-8-15B	4b'	39.410	107.016	L-52	6c	39.462	107.103
CP76	5a	39.541	107.067	K97-8-12H	6c	39.463	107.109
CP77	5a	39.541	107.067	L-48	6c	39.469	107.122
KH95-28	5a	39.562	107.086	DT-R1	6c'	39.663	107.021
L-68	5a	39.478	107.117	DT-39	6c'	39.644	107.038
CP83	5a	39.550	107.088	DTV-2	6c'	39.659	107.036
L-4	5a	39.477	107.120	DTV-3	6c'	39.659	107.036
CP106	5a	39.498	107.053	DT-R3	6c"	39.660	107.125
L-56	5a	39.475	107.110	K97-8-12B	6d	39.306	106.915
KH95-30	5a	39.572	107.111	K97-8-12A	6d'	39.303	106.917
L-78	5a	39.491	107.089	K97-8-12A1	6d'	39.303	106.917
CP8	5a	39.574	107.106	KH95-26	7a	39.580	107.076
L-60	5a	39.475	107.061	KH95-27B	7a	39.563	107.080
KH95-32	5a	39.584	107.097	L-6	7a'	39.498	107.119
CP89	5a	39.531	107.069	DT-R2	8a	39.664	107.008
KH95-29	5a'	39.573	107.111	DT-R4	8a	39.697	107.015
CP88	5b	39.530	107.110	I70-34	8a	39.684	106.968
CC119	5b	39.477	107.255	I70-45	8a	39.683	106.969
CC-LA-5	5b	39.485	107.282	97-MG-1	8a	39.678	106.952
CC122	5b	39.483	107.277	MG-97-2	8a	39.669	106.927
CC-LA-4	5b	39.484	107.283	97-GH-239	8a	39.688	106.968
SH303	5b	39.538	107.137	97-GH-228B	8a	39.664	106.991
K97-10-8D	5b	39.512	107.271	97-GH-155	8b	39.708	106.945
GL306	5b	39.512	107.271	97-GH-228A	8b	39.664	106.991
CC121	5b	39.479	107.265	97-GH-34	8b	39.746	106.882
SH341	5b	39.510	107.187	97-GH-208	8c	39.690	106.990
CD206	6a	39.491	107.152	I70-32	8c	39.667	106.988
CD199	6a	39.472	107.127	97MG-002	8d	39.689	106.896
SH262	6a	39.510	107.170	I70-29	8d	39.716	106.948
CD215	6a	39.474	107.144	97-GH-204	8d	39.695	106.995
CD197	6a	39.469	107.140	I70-30	9a	39.667	106.988
CD209	6a'	39.491	107.154	I70-31	9a	39.667	106.988
CD216	6a'	39.472	107.139	97-GH-18	9a	39.736	106.891
CD8	6a'	39.473	107.141	I70-44	9a	39.683	106.968
SH267	6b	39.517	107.140	I70-33	9b	39.684	106.968
L-7	6b	39.477	107.123	97-GH-117	9b	39.734	106.961
SH268	6b	39.518	107.140	I70-43	9c	39.693	106.947
L-246	6b'	39.436	107.076	97-GH-85	9c	39.725	106.924
L-233	6b'	39.436	107.076	GL100	10a	39.515	107.270

[1]Group assignments from Budahn and others, 2002. U = Unclassified.

Table 1. Cont'd.

Field Number	Group[1]	Lat (°N)	Long (°W)
K97-10-8C	10a	39.515	107.270
KH95-12	10a	39.518	107.275
I70-37	10a	39.692	106.895
I70-39	10a	39.695	106.893
97-GH-94	10a	39.707	106.921
I70-40	10b	39.695	106.893
K97-8-13A1	11a	39.913	106.654
K97-8-13B	11a	39.916	106.653
K97-8-13A	11a'	39.912	106.649
CD152	12a	39.383	107.166
L-223	12a	39.390	107.150
BR-6	13a	39.360	107.059
BA-36	13a	39.359	107.055
L-27	U	39.424	107.079
KH95-15	U	39.513	107.267
L-76	U	39.486	107.126
CD23	U	39.463	107.247
SWV-1	U	39.728	107.064
BR-8	U	39.349	107.101
C69B	U	39.416	107.459
KH95-13	U	39.516	107.274
I70-42	U	39.686	106.878
97-GH-99	U	39.722	106.927
97-GH-110	U	39.712	106.942

[1]Group assignments from Budahn and others, 2002. U = Unclassified.

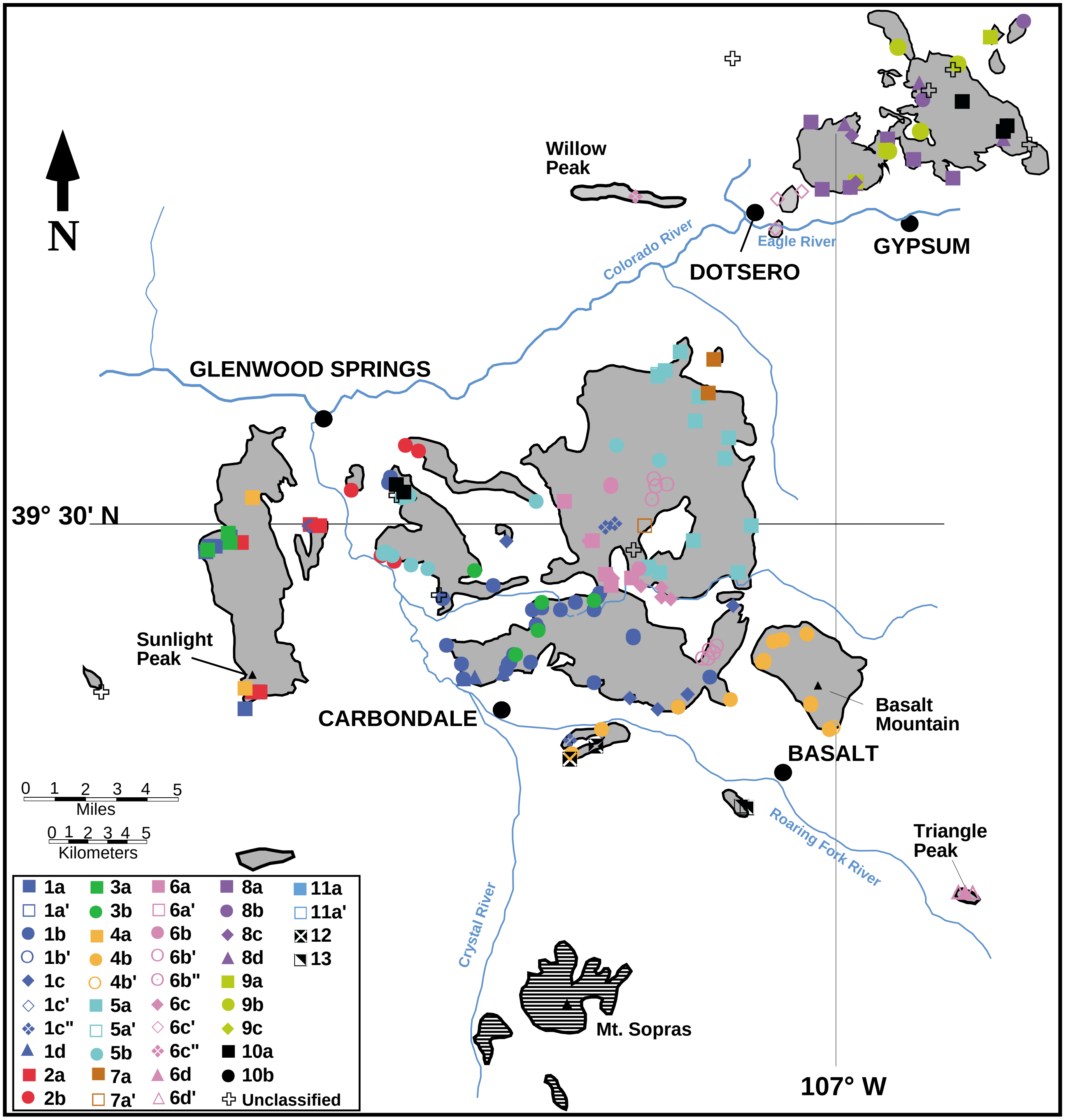

Figure 2. Geologic sketch map of the Glenwood Springs area showing sample locations. Sample groupings are from Budahn and others, 2002.

ANALYITICAL PROCEDURES

Major Elements

Oxide abundances of ten major and minor rock-forming elements were determined by wave-length-dispersive x-ray fluorescence (WD-XRF). Samples were analyzed with a Phillips PW1606 spectrometer at the U.S. Geological Survey using the procedures of Mee and others (1996). Loss on ignition (LOI) was obtained by igniting an 0.8 g sample in a 95% Pt, 5% Au crucible at 925^{o}C for 45 minutes. Precision is typically better than 1% based on replicate analyses and accuracy is typically better than 2%. Total iron is reported as Fe_2O_3 (Fe_TO_3 in Table 4).

Minor and Trace Elements

Abundances of thirty three major, minor, and trace elements were obtained by instrumental neutron activation analyses (INAA) at the U.S. Geological Survey in Denver using the procedures summarized by Baedecker and McKown (1987) and Wandless (1996). Approximately one gram of sample was irradiated in the USGS-TRIGA reactor at a flux of 2.5 x 10^{12} for eight hours. Three sequential counts at 7, 14, and 65 days after irradiation were made using both coaxial and planar germanium detectors. Precision and accuracy for most elements are in the range of 1-5%. Precision and accuracy for 5 elements (Ho, Tm, W, Sb, and Au) are 10% or greater. Precision is based on replicate analyses whereas accuracy is based on analyses of USGS standard BHVO-1.

Lead, Strontium, and Neodymium Isotopic Analyses

Powder splits of a subset of samples analyzed for major and trace element contents were selected for lead (Pb), strontium (Sr) and Neodymium (Nd) isotopic analyses. Analytical procedures were similar to those reported by Stille and others (1986). Samples were dissolved in PFA-Teflon screw-cap jars using nitric and hydrofluoric acids. Lead was separated using anion exchange chromatography in 1.0M HBr medium. Strontium and the rare earth elements (REE) were separated using cation exchange chromatography in 2.5M HCl medium. Neodymium was separated from the other REE using cation exchange chromatography in 0.2M 2-methyllactic acid medium. Analytical blanks were Pb = 0.3 ng (10^{-9}g), Sr = 0.5 ng, and Nd = 0.1 ng. The analytical blanks for all three elements are insignificant relative to the amounts in the samples.

Lead isotopic analyses were obtained using a VG Sector-54, 7-collector, solid-source mass spectrometer. Raw data were corrected for mass fractionation of 0.13 ± 0.03 percent per AMU based on replicate analyses of NIST standard SRM 981 (values redetermined by Todt and others, 1993).

Strontium and neodymium isotopic data were obtained using a Micromass 54R, single-collector, solid source mass spectrometer. Ten analyses of NIST standard SRM-987 gave a mean

$^{87}Sr/^{86}Sr$ = 0.710258 ± 0.000008 (95% CI; Ludwig, 1994). Twelve analyses of the La Jolla Nd standard gave a mean $^{143}Nd/^{144}Nd$ = 0.511852 ± 0.000008 (95% CI).

ANALYTICAL RESULTS

Petrography

Modal analyses of phenocryst and xenocryst assemblages were performed on forty-seven samples (Table 2). Phenocryst-bearing samples are all olivine-phyric (1.0-7.6%). The only other phenocryst phase observed was plagioclase (0.1-1.5%). Quartz xenocrysts were observed in a few samples and metamorphic xenoliths were observed in a few others. The xenocrysts and xenoliths appear to be randomly distributed and are not diagnostic of individual geochemical groups.

The percentages of olivine phenocrysts are reasonably consistent among samples from a single geochemical subgroup, but in some cases are quite different among subgroups of the same general group. For example, group 1b basalts, with the exception of sample KH95-24, contain 1.2-2.4% olivine phenocrysts whereas group 1a basalts all have over 5% olivine. Group 2a and 2b basalts are similarly distinct. However, the phenocryst assemblages do not provide a reliable basis for discrimination among the general basalt groups. Many of the groups have similar olivine contents and the amount of plagioclase is not sufficiently high enough or uniform enough to aid in the discrimination of individual groups (Table 2).

Modal analyses of groundmass and whole-rocks of aphyric samples have been performed on seventeen of the samples (Table 3). The mineralogy of the samples from the various groups are similar enough such that the modal analyses do not provide a reliable method for distinguishing individual groups. However, it is interesting to note that two distinct mineralogical compositions appear to be represented by group 1b (Table 3). These results are in accord with field observations mentioned above that there appear to be multiple flows represented by group 1b. Thus, while the modal analyses do not provide a reliable means of identification of individual groups, they may be useful in discriminating among geochemically identical flows within a single subgroup.

Major Element Chemistry

Major and minor element abundances have been determined for approximately 200 samples (Table 4). Data are shown on an alkali vs. silica diagram in Figure 3 (after LeBas and others, 1986). Individual samples contain between 48% (group 6c) and 61% (group 13) silica. Silica contents may vary significantly within individual groups (e.g. 48-56% silica in group 6), but generally vary by no more than 1-2% within an individual subgroup. Groups 1-3 (10 Ma) are all basalts and basaltic andesites, whereas the 10-Ma Basalt Mountain samples are shoshonites (group 4b) or latites (group 4b'). The 7-8 Ma group 5 samples are predominantly trachy-basalts and are, at a given silica content, more alkalic than the 10 Ma basalts. Group 6

Table 2. Modal analyses of phenocrysts in Colorado basalts.[1]

Field No.	Group[2]	percent olivine	percent plagioclase	quartz xenocrysts	Metamorphic xenoliths percent	Metamorphic xenoliths type
KH95-33	1a	5.1	0.0	0.0	0.0	
KH95-22	1a	6.3	0.1	0.0	0.0	
KH95-35	1a	6.9	0.5	0.0	0.0	
KH95-37	1a	6.4	0.0	0.0	0.1	schist
KH95-40	1a	6.3	0.1	0.0	0.0	
KH95-21	1a	6.3	0.1	0.0	0.0	
KH95-19	1a'	5.2	0.9	0.0	0.0	
CD53D	1b	1.6	0.1	0.0	0.0	
CD53B	1b	1.2	0.0	0.0	0.0	
CD31	1b	1.8	0.0	0.0	0.0	
CD124A	1b	1.3	0.0	0.0	0.0	
CD59	1b	1.5	0.0	0.0	0.0	
KH95-9	1b	1.9	0.1	0.0	0.0	
CD5	1b	1.5	0.1	0.0	0.0	
KH95-12Z	1b	1.0	0.0	0.0	0.0	
CD6	1b	2.4	0.0	0.1	0.4	mafic?
CD124B	1b	2.2	0.0	0.0	0.0	
KH95-11	1b	2.1	0.0	0.0	0.0	
KH95-11	1b	1.2	0.0	0.0	0.0	
KH95-24	1b	4.3	0.1	0.0	0.0	
KH95-23	1b'	7.3	0.3	0.0	0.0	
CD12	1c	4.5	1.5	0.0	0.4	carbonate
CD109	1c	2.3	0.5	0.0	0.0	
KH95-2	1c'	6.1	0.0	0.0	0.0	
KH95-3	1c'	6.1	0.0	0.0	0.0	
KH95-5	1c'	5.7	0.0	0.0	0.0	
KH95-17	2a	6.3	0.3	0.0	0.0	
KH95-1	2a	6.0	0.0	0.0	0.0	
KH95-6	2a	5.4	0.03	0.0	0.0	
CC-LA-1	2b	1.2	0.1	0.0	0.0	
KH95-34	3a	6.1	0.0	0.0	0.0	
KH95-42	3a	6.7	0.0	0.0	0.0	
KH95-36	3a	4.7	0.0	0.0	0.5	skarn
CD53A	3b	4.1	0.6	0.0	1.2	metavolcanic
CC-LA-3	3b	3.5	0.4	0.0	0.0	
KH95-25	4a	4.1	0.0	0.0	0.0	
KH95-28	5a	5.8	0.0	0.0	0.0	
KH95-30	5a	7.5	0.0	0.0	0.0	
KH95-32	5a	7.6	0.0	0.0	0.0	
KH95-29	5a'	5.9	0.1	0.3	0.0	
KH95-15	U	5.1	0.0	0.0	0.0	
CC-LA-5	5b	7.4	0.0	0.0	0.0	
CC-LA-4	5b	4.9	0.0	0.5	0.0	
KH95-26	7a	2.6	0.3	0.2	0.0	
KH95-27B	7a	2.6	0.0	0.2	0.3	quartz
KH95-12	10a	1.6	0.0	0.0	0.0	
CD23	U	5.0	0.1	0.0	0.0	
KH95-13	U	2.0	0.0	0.0	0.3	carbonate

[1] Values are in percent of the total sample.

[2] Geochemical groups from Budahn and others, 2002.

Table 3. Modal analyses of groundmass and whole-rock samples of Colorado basalts.[1]

Field No.	Type[2]	Group[3]	ol	cpx	plag	opaque	meso.	alt.	zeol.	carb.	voids
KH95-19	gr	1a'	11.2	7.6	44.4	0.0	34.2	0.0	0.0	0.0	2.6
KH95-8	wr	1b	17.8	12.6	55.6	3.4	7.0	0.0	0.0	0.0	3.6
KH95-9	gr	1b	14.9	16.8	39.7	0.9	27.0	0.0	0.0	0.0	0.7
KH95-11	gr	1b	16.0	17.4	51.6	3.4	7.8	0.0	0.0	0.0	3.6
KH95-11	gr	1b	16.6	15.6	55.8	2.8	3.4	0.0	0.0	0.0	5.6
KH95-24	gr	1b	4.6	22.3	51.3	2.2	9.8	0.0	0.0	0.0	9.8
CD6	gr	1b	5.9	27.7	54.9	2.7	5.3	0.0	tr	0.0	3.5
CD53D	gr	1b	3.6	32.6	55.2	4.4	2.8	0.0	0.2	0.0	1.0
KH95-2	gr	1c'	6.6	14.4	51.4	1.7	14.8	0.0	0.0	0.0	11.0
KH95-3	gr	1c'	6.3	13.9	48.0	1.6	19.6	0.0	0.0	0.0	10.6
KH95-5	gr	1c'	8.2	11.3	43.0	0.9	29.0	0.0	0.0	0.0	7.6
KH95-1	gr	2a	8.8	16.2	50.3	2.1	18.9	3.3	0.0	tr	0.4
KH95-6	gr	2a	13.1	13.6	49.9	3.5	12.3	0.0	0.0	0.0	7.6
GS96-1	wr	2b	12.7	20.8	42.4	2.1	16.8	5.2	0.0	0.0	0.0
KH95-43	wr	4a	8.5	15.3	45.7	2.4	19.1	6.9	0.0	1.7	0.3
KH95-32	gr	5a	0?	25.7	59.3	3.1	8.9	0.0	0.0	0.0	3.0
CC-LA-5	gr	5b	4.6	18.6	68.0	4.8	1.4	0.0	0.0	0.0	2.6
KH95-26	gr	7a	9.1	20.0	64.4	3.7	2.8	0.0	0.0	0.0	2.8

[1] values are in percent. ol = olivine, cpx = clinopyroxene, plag = plagioclase, opaque = ilmenite and magnetite, meso = mesostasis, alt = altered materialor a second type of mesostasis, zeol = zeolite, carb = carbonate.
[2]gr = groundmass , wr = whole-rock (aphyric samples).
[3] Geochemical groups from Budahn and others, 2002.

Table 4. Major-element chemistry of Tertiary basaltic rocks from central Colorado[1]

Field No.	KH95-33	KH95-22	KH95-35	KH95-37	KH95-40	CC108	KH95-21	Mean[4]	KH95-19	CD53D
Group[2]	1a	1a	1a	1a	1a	1a	1a	1a	1a'	1b
Age (Ma)[3]								(10)	(10)	10.01
SiO_2	51.88	51.54	51.80	51.73	51.87	50.47	51.41	51.53 ± 0.50	52.04	52.36
Al_2O_3	15.29	15.42	15.41	15.20	15.14	15.50	15.24	15.31 ± 0.13	15.31	15.44
Fe_TO_3	11.51	11.39	11.30	11.25	11.15	11.37	11.24	11.32 ± 0.12	11.18	12.01
MgO	7.82	7.18	7.75	7.78	7.70	7.53	7.71	7.64 ± 0.22	6.58	6.92
CaO	7.55	7.62	7.62	7.56	7.60	7.83	7.68	7.64 ± 0.10	7.59	7.87
Na_2O	2.72	2.73	2.71	2.68	2.70	2.67	2.78	2.71 ± 0.04	2.80	3.04
K_20	1.52	1.49	1.50	1.59	1.52	1.38	1.50	1.50 ± 0.06	1.54	0.95
TiO_2	1.32	1.33	1.28	1.33	1.31	1.33	1.35	1.32 ± 0.02	1.35	1.38
P_2O_5	0.34	0.36	0.36	0.38	0.37	0.40	0.40	0.37 ± 0.02	0.42	0.29
MnO	0.16	0.15	0.15	0.15	0.16	0.17	0.15	0.16 ± 0.01	0.15	0.16
LOI 925C	0.06	0.47	0.35	0.23	0.39	0.60	0.13	0.32 ± 0.19	0.69	-0.44
Sums	100.17	99.68	100.23	99.88	99.91	99.25	99.59	99.82 ± 0.34	99.65	99.98
Recalculated[5]										
SiO_2	51.82	51.95	51.86	51.91	52.12	51.16	51.69	51.79 ± 0.31	52.59	52.14
Al_2O_3	15.27	15.54	15.43	15.25	15.21	15.71	15.32	15.39 ± 0.18	15.47	15.38
Fe_TO_3	11.50	11.48	11.31	11.29	11.20	11.53	11.30	11.37 ± 0.13	11.30	11.96
MgO	7.81	7.24	7.76	7.81	7.74	7.63	7.75	7.68 ± 0.20	6.65	6.89
CaO	7.54	7.68	7.63	7.59	7.64	7.94	7.72	7.68 ± 0.13	7.67	7.84
Na_2O	2.72	2.75	2.71	2.69	2.71	2.71	2.80	2.73 ± 0.04	2.83	3.03
K_20	1.52	1.50	1.50	1.60	1.53	1.40	1.51	1.51 ± 0.06	1.56	0.95
TiO_2	1.32	1.34	1.28	1.33	1.32	1.35	1.36	1.33 ± 0.03	1.36	1.37
P_2O_5	0.34	0.36	0.36	0.38	0.37	0.41	0.40	0.37 ± 0.02	0.42	0.29
MnO	0.16	0.15	0.15	0.15	0.16	0.17	0.15	0.16 ± 0.01	0.15	0.16

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	CD31	CD51B	CD179	CD181C	CD17	CD124A	CD218	CD180	CD156	CD191B	CD59
Group[2]	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b
Age (Ma)[3]											
SiO_2	52.03	52.51	52.38	52.47	52.42	51.33	51.47	52.34	51.40	52.42	51.68
Al_2O_3	15.27	15.48	15.53	15.59	15.63	15.75	15.81	15.66	15.22	15.57	15.50
Fe_TO_3	11.09	11.01	11.15	11.11	11.06	11.43	10.82	11.20	10.76	11.15	11.25
MgO	6.80	6.79	6.73	6.90	6.97	7.00	6.61	6.80	6.85	6.70	7.13
CaO	8.09	8.10	8.05	7.95	7.94	8.16	8.28	8.09	8.25	8.14	8.18
Na_2O	2.85	2.97	3.05	3.05	3.07	2.96	2.99	3.05	2.88	3.06	3.05
K_20	0.83	1.02	0.98	0.91	0.99	0.98	0.91	0.96	0.99	1.04	0.95
TiO_2	1.38	1.37	1.38	1.37	1.37	1.38	1.37	1.39	1.37	1.39	1.40
P_2O_5	0.29	0.29	0.30	0.30	0.29	0.29	0.30	0.29	0.31	0.30	0.31
MnO	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.15	0.15
LOI 925C	1.38	0.36	0.29	0.19	0.09	0.03	0.74	0.04	1.79	0.39	0.52
Sums	100.15	100.05	99.99	99.99	99.98	99.46	99.45	99.97	99.96	100.31	100.12
Recalculated[5]											
SiO_2	52.68	52.67	52.54	52.58	52.48	51.62	52.14	52.38	52.36	52.46	51.89
Al_2O_3	15.46	15.53	15.58	15.62	15.65	15.84	16.02	15.67	15.50	15.58	15.56
Fe_TO_3	11.23	11.04	11.18	11.13	11.07	11.50	10.96	11.21	10.96	11.16	11.30
MgO	6.88	6.81	6.75	6.91	6.98	7.04	6.70	6.80	6.98	6.71	7.16
CaO	8.19	8.13	8.07	7.97	7.95	8.21	8.39	8.10	8.40	8.15	8.21
Na_2O	2.89	2.98	3.06	3.06	3.07	2.98	3.03	3.05	2.93	3.06	3.06
K_20	0.84	1.02	0.98	0.91	0.99	0.99	0.92	0.96	1.01	1.04	0.95
TiO_2	1.40	1.37	1.38	1.37	1.37	1.39	1.39	1.39	1.40	1.39	1.41
P_2O_5	0.29	0.29	0.30	0.30	0.29	0.29	0.30	0.29	0.32	0.30	0.31
MnO	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.15	0.15

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	CD53C	CD193D	CD65	CD51A	CD192	CD53B	CD193B	CD181B	KH95-9	CD5	KH95-12Z
Group[2]	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b
Age (Ma)[3]											
SiO_2	52.21	51.76	52.19	51.47	52.08	52.21	52.06	52.43	52.06	52.44	51.55
Al_2O_3	15.45	15.54	15.41	15.13	15.56	15.45	15.58	15.48	15.45	15.44	15.40
Fe_TO_3	11.33	11.41	11.17	10.65	11.44	11.32	11.50	11.34	11.37	11.47	11.36
MgO	6.96	7.11	6.97	6.68	7.00	6.96	6.68	6.89	6.98	7.13	6.74
CaO	7.99	8.05	8.03	8.21	8.08	7.92	7.94	7.90	7.92	7.77	8.10
Na_2O	3.07	3.02	3.11	2.80	3.10	3.14	3.04	3.20	3.07	3.23	2.95
K_20	1.06	0.98	0.96	0.83	1.05	1.04	1.06	1.06	1.08	1.03	0.97
TiO_2	1.41	1.38	1.41	1.37	1.41	1.43	1.44	1.44	1.43	1.42	1.42
P_2O_5	0.31	0.30	0.31	0.28	0.31	0.31	0.31	0.32	0.33	0.32	0.32
MnO	0.15	0.15	0.15	0.14	0.16	0.15	0.16	0.15	0.16	0.16	0.16
LOI 925C	0.05	0.30	0.20	2.32	0.00	-0.01	0.26	0.05	0.21	-0.28	0.80
Sums	99.99	100.00	99.91	99.88	100.19	99.92	100.03	100.26	100.06	100.13	99.77
Recalculated[5]											
SiO_2	52.24	51.92	52.34	52.76	51.98	52.25	52.18	52.32	52.14	52.23	52.09
Al_2O_3	15.46	15.59	15.45	15.51	15.53	15.46	15.62	15.45	15.47	15.38	15.56
Fe_TO_3	11.34	11.44	11.20	10.92	11.42	11.33	11.53	11.32	11.39	11.42	11.48
MgO	6.96	7.13	6.99	6.85	6.99	6.96	6.70	6.88	6.99	7.10	6.81
CaO	7.99	8.07	8.05	8.42	8.06	7.93	7.96	7.88	7.93	7.74	8.18
Na_2O	3.07	3.03	3.12	2.87	3.09	3.14	3.05	3.19	3.07	3.22	2.98
K_20	1.06	0.98	0.96	0.85	1.05	1.04	1.06	1.06	1.08	1.03	0.98
TiO_2	1.41	1.38	1.41	1.40	1.41	1.43	1.44	1.44	1.43	1.41	1.43
P_2O_5	0.31	0.30	0.31	0.29	0.31	0.31	0.31	0.32	0.33	0.32	0.32
MnO	0.15	0.15	0.15	0.14	0.16	0.15	0.16	0.15	0.16	0.16	0.16

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	CD6	CD193C	K97-10-8B	CD124B	KH95-11	K97-8-12F	KH95-8	Mean[4]	KH95-24	KH95-23
Group[2]	1b	1b	1b	1b	1b	1b	1b	1b	1b'	1b'
Age (Ma)[3]	9.69		9.8			10.84		10.09 ± 0.52	9.97	
SiO_2	51.32	51.75	51.65	51.66	51.72	51.12	52.05	51.95 ± 0.42	51.08	51.68
Al_2O_3	15.13	15.58	15.40	15.44	15.54	15.32	15.49	15.47 ± 0.16	15.90	15.50
Fe_TO_3	12.38	11.60	11.52	11.63	11.50	10.95	11.48	11.32 ± 0.35	12.43	11.36
MgO	7.76	6.92	6.37	7.33	6.84	6.87	6.91	6.91 ± 0.24	7.13	7.66
CaO	7.88	8.06	7.97	8.00	8.04	8.20	7.93	8.04 ± 0.12	7.69	7.69
Na_2O	2.86	3.01	2.98	2.92	3.03	2.89	3.06	3.02 ± 0.10	2.73	2.67
K_20	1.08	1.02	1.12	1.09	1.02	1.10	1.09	1.01 ± 0.07	1.22	1.37
TiO_2	1.45	1.42	1.43	1.45	1.42	1.43	1.43	1.40 ± 0.03	1.25	1.31
P_2O_5	0.31	0.31	0.32	0.30	0.33	0.31	0.33	0.31 ± 0.01	0.28	0.30
MnO	0.16	0.15	0.15	0.16	0.17	0.13	0.16	0.15 ± 0.01	0.16	0.15
LOI 925C	-0.28	0.30	0.63	-0.13	0.60	1.70	0.14	0.41 ± 0.64	-0.12	0.23
Sums	100.05	100.12	99.54	99.85	100.21	100.02	100.07	99.98 ± 0.21	99.75	99.92
Recalculated[5]										
SiO_2	51.15	51.84	52.22	51.67	51.92	51.99	52.09	52.18 ± 0.35	51.15	51.84
Al_2O_3	15.08	15.61	15.57	15.44	15.60	15.58	15.50	15.54 ± 0.15	15.92	15.55
Fe_TO_3	12.34	11.62	11.65	11.63	11.55	11.14	11.49	11.36 ± 0.30	12.45	11.40
MgO	7.73	6.93	6.44	7.33	6.87	6.99	6.91	6.94 ± 0.22	7.14	7.68
CaO	7.85	8.07	8.06	8.00	8.07	8.34	7.94	8.07 ± 0.17	7.70	7.71
Na_2O	2.85	3.02	3.01	2.92	3.04	2.94	3.06	3.03 ± 0.09	2.73	2.68
K_20	1.08	1.02	1.13	1.09	1.02	1.12	1.09	1.01 ± 0.07	1.22	1.37
TiO_2	1.45	1.42	1.45	1.45	1.43	1.45	1.43	1.41 ± 0.03	1.25	1.31
P_2O_5	0.31	0.31	0.32	0.30	0.33	0.32	0.33	0.31 ± 0.01	0.28	0.30
MnO	0.16	0.15	0.15	0.16	0.17	0.13	0.16	0.15 ± 0.01	0.16	0.15

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	KH95-38	Mean[4]	L-23	CD150C	CD12	L-26	CD109	L-25	L-201	K97-8-15A
Group[2]	1b'	1b'	1c	1c	1c	1c	1c	1c	1c	1c
Age (Ma)[3]		9.97								10.62
SiO_2	51.80	51.52 ± 0.39	51.84	51.02	51.04	51.42	52.35	52.37	52.22	52.75
Al_2O_3	15.37	15.59 ± 0.28	15.75	15.97	15.54	15.45	15.92	15.71	15.93	15.93
Fe_TO_3	11.41	11.73 ± 0.60	11.00	11.43	10.75	11.03	10.47	10.26	10.60	10.03
MgO	7.73	7.51 ± 0.33	6.93	6.68	6.23	7.17	6.27	6.36	5.61	5.81
CaO	7.57	7.65 ± 0.07	7.91	8.00	8.40	7.97	8.02	7.72	7.91	7.82
Na_2O	2.68	2.69 ± 0.03	3.18	2.99	3.01	3.03	3.08	3.36	3.18	3.20
K_20	1.41	1.33 ± 0.10	1.41	1.29	1.54	1.40	1.62	1.68	1.71	1.77
TiO_2	1.30	1.29 ± 0.03	1.40	1.48	1.44	1.41	1.47	1.44	1.55	1.49
P_2O_5	0.31	0.30 ± 0.02	0.41	0.40	0.41	0.41	0.43	0.48	0.49	0.47
MnO	0.16	0.16 ± 0.01	0.15	0.17	0.15	0.15	0.15	0.14	0.15	0.14
LOI 925C	0.31	0.14 ± 0.23	0.14	0.49	1.06	0.63	0.09	0.04	0.55	0.40
Sums	100.05	99.91 ± 0.15	100.12	99.92	99.57	100.07	99.87	99.56	99.90	99.81
Recalculated[5]										
SiO_2	51.94	51.64 ± 0.43	51.85	51.31	51.81	51.71	52.47	52.62	52.56	53.06
Al_2O_3	15.41	15.63 ± 0.26	15.75	16.06	15.78	15.54	15.96	15.79	16.03	16.02
Fe_TO_3	11.44	11.76 ± 0.59	11.00	11.50	10.91	11.09	10.49	10.31	10.67	10.09
MgO	7.75	7.52 ± 0.34	6.93	6.72	6.32	7.21	6.28	6.39	5.65	5.84
CaO	7.59	7.67 ± 0.07	7.91	8.05	8.53	8.01	8.04	7.76	7.96	7.87
Na_2O	2.69	2.70 ± 0.03	3.18	3.01	3.06	3.05	3.09	3.38	3.20	3.22
K_20	1.41	1.34 ± 0.10	1.41	1.30	1.56	1.41	1.62	1.69	1.72	1.78
TiO_2	1.30	1.29 ± 0.03	1.40	1.49	1.46	1.42	1.47	1.45	1.56	1.50
P_2O_5	0.31	0.30 ± 0.02	0.41	0.40	0.42	0.41	0.43	0.48	0.49	0.47
MnO	0.16	0.16 ± 0.01	0.15	0.17	0.15	0.15	0.15	0.14	0.15	0.14

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	Mean[4]	KH95-2	KH95-3	KH95-5	Mean	CD204	CD203	CD138	Mean[4]
Group[2]	1c	1c'	1c'	1c'	1c'	1c"	1c"	1c"	1c"
Age (Ma)[3]	10.62				(10)				(10)
SiO_2	51.88 ± 0.65	51.25	51.29	51.28	51.27 ± 0.02	51.21	51.54	51.28	51.34 ± 0.17
Al_2O_3	15.78 ± 0.20	15.12	15.10	15.10	15.11 ± 0.01	16.14	15.92	15.65	15.90 ± 0.25
Fe_TO_3	10.70 ± 0.45	11.38	11.37	11.22	11.32 ± 0.09	11.22	10.97	11.05	11.08 ± 0.13
MgO	6.38 ± 0.53	8.48	8.26	8.34	8.36 ± 0.11	6.50	6.67	6.80	6.66 ± 0.15
CaO	7.97 ± 0.20	7.70	7.72	7.66	7.69 ± 0.03	7.93	7.89	8.25	8.02 ± 0.20
Na_2O	3.13 ± 0.12	2.76	2.76	2.76	2.76 ± 0.00	2.96	3.00	2.98	2.98 ± 0.02
K_20	1.55 ± 0.17	1.29	1.28	1.35	1.31 ± 0.04	1.25	1.34	1.42	1.34 ± 0.09
TiO_2	1.46 ± 0.05	1.29	1.33	1.27	1.30 ± 0.03	1.46	1.42	1.43	1.44 ± 0.02
P_2O_5	0.44 ± 0.04	0.36	0.37	0.36	0.36 ± 0.01	0.27	0.32	0.39	0.33 ± 0.06
MnO	0.15 ± 0.01	0.15	0.15	0.15	0.15 ± 0.00	0.15	0.15	0.15	0.15 ± 0.00
LOI 925C	0.43 ± 0.34	0.13	0.25	0.20	0.19 ± 0.06	0.59	0.73	0.46	0.59 ± 0.14
Sums	99.85 ± 0.20	99.91	99.88	99.69	99.83 ± 0.12	99.68	99.95	99.86	99.83 ± 0.14
Recalculated[5]									
SiO_2	52.17 ± 0.59	51.36	51.48	51.54	51.46 ± 0.09	51.68	51.95	51.59	51.74 ± 0.18
Al_2O_3	15.87 ± 0.18	15.15	15.16	15.18	15.16 ± 0.01	16.29	16.05	15.74	16.03 ± 0.27
Fe_TO_3	10.76 ± 0.46	11.41	11.41	11.28	11.36 ± 0.08	11.32	11.06	11.12	11.17 ± 0.14
MgO	6.42 ± 0.53	8.50	8.29	8.38	8.39 ± 0.10	6.56	6.72	6.84	6.71 ± 0.14
CaO	8.02 ± 0.23	7.72	7.75	7.70	7.72 ± 0.03	8.00	7.95	8.30	8.08 ± 0.19
Na_2O	3.15 ± 0.12	2.77	2.77	2.77	2.77 ± 0.00	2.99	3.02	3.00	3.00 ± 0.02
K_20	1.56 ± 0.17	1.29	1.28	1.36	1.31 ± 0.04	1.26	1.35	1.43	1.35 ± 0.08
TiO_2	1.47 ± 0.05	1.29	1.33	1.28	1.30 ± 0.03	1.47	1.43	1.44	1.45 ± 0.02
P_2O_5	0.44 ± 0.04	0.36	0.37	0.36	0.36 ± 0.01	0.27	0.32	0.39	0.33 ± 0.06
MnO	0.15 ± 0.01	0.15	0.15	0.15	0.15 ± 0.00	0.15	0.15	0.15	0.15 ± 0.00

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	CD45A	CD42	CD45B	Mean[4]	CC140	KH95-17	KH95-1	KH95-6	CC118	Mean[4]
Group[2]	1d	1d	1d	1d	2a	2a	2a	2a	2a	2a
Age (Ma)[3]				(10)	10.1					10.1
SiO_2	51.01	51.45	50.95	51.14 ± 0.27	51.11	50.95	50.83	51.00	52.74	51.33 ± 0.80
Al_2O_3	15.22	15.47	15.24	15.31 ± 0.14	15.38	15.36	14.96	15.29	15.27	15.25 ± 0.17
Fe_TO_3	10.92	11.35	10.99	11.09 ± 0.23	11.58	11.85	11.53	11.55	10.94	11.49 ± 0.33
MgO	6.89	7.02	6.79	6.90 ± 0.12	8.03	7.79	8.04	8.24	6.96	7.81 ± 0.50
CaO	8.23	8.03	8.30	8.19 ± 0.14	7.83	7.82	7.80	7.71	7.59	7.75 ± 0.10
Na_2O	2.90	3.04	2.90	2.95 ± 0.08	2.79	2.85	2.70	2.69	2.80	2.77 ± 0.07
K_20	1.08	1.21	1.04	1.11 ± 0.09	1.42	1.31	1.31	1.30	1.44	1.36 ± 0.07
TiO_2	1.41	1.43	1.41	1.42 ± 0.01	1.39	1.39	1.35	1.31	1.40	1.37 ± 0.04
P_2O_5	0.36	0.35	0.34	0.35 ± 0.01	0.34	0.34	0.33	0.33	0.37	0.34 ± 0.02
MnO	0.14	0.15	0.14	0.14 ± 0.01	0.16	0.16	0.16	0.16	0.15	0.16 ± 0.00
LOI 925C	1.40	0.09	1.58	1.02 ± 0.81	-0.11	0.01	0.92	0.20	0.05	0.21 ± 0.41
Sums	99.56	99.59	99.68	99.61 ± 0.06	99.92	99.83	99.93	99.78	99.71	99.83 ± 0.09
Recalculated[5]										
SiO_2	51.97	51.71	51.94	51.87 ± 0.14	51.09	51.04	51.34	51.22	52.92	51.52 ± 0.79
Al_2O_3	15.51	15.55	15.54	15.53 ± 0.02	15.38	15.39	15.11	15.35	15.32	15.31 ± 0.11
Fe_TO_3	11.12	11.41	11.20	11.24 ± 0.15	11.58	11.87	11.65	11.60	10.98	11.53 ± 0.33
MgO	7.02	7.06	6.92	7.00 ± 0.07	8.03	7.80	8.12	8.27	6.98	7.84 ± 0.51
CaO	8.38	8.07	8.46	8.31 ± 0.21	7.83	7.83	7.88	7.74	7.62	7.78 ± 0.10
Na_2O	2.95	3.06	2.96	2.99 ± 0.06	2.79	2.86	2.73	2.70	2.81	2.78 ± 0.06
K_20	1.10	1.22	1.06	1.13 ± 0.08	1.42	1.31	1.32	1.31	1.44	1.36 ± 0.07
TiO_2	1.44	1.44	1.44	1.44 ± 0.00	1.39	1.39	1.36	1.32	1.40	1.37 ± 0.04
P_2O_5	0.37	0.35	0.35	0.36 ± 0.01	0.34	0.34	0.33	0.33	0.37	0.34 ± 0.02
MnO	0.14	0.15	0.14	0.15 ± 0.00	0.16	0.16	0.16	0.16	0.15	0.16 ± 0.00

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	CC132	CC-LA-1	CC127	GL207	CC-LA-2	GL165B	GS96-1	CC126	K97-8-12E	Mean[4]
Group[2]	2b	2b	2b	2b	2b	2b	2b	2b	2b	2b
Age (Ma)[3]	9.68						9.72		10.7	10.0 ± 0.6
SiO_2	50.23	50.47	50.25	51.52	49.72	50.24	50.04	49.46	50.69	50.29 ± 0.59
Al_2O_3	14.86	14.95	15.09	15.10	14.96	15.05	14.89	15.06	15.23	15.02 ± 0.12
Fe_TO_3	11.74	11.58	11.20	11.03	11.55	11.66	12.79	11.23	11.21	11.55 ± 0.52
MgO	7.59	7.46	7.11	6.78	7.53	7.04	7.84	7.08	6.14	7.17 ± 0.51
CaO	7.68	7.72	7.87	7.76	7.90	8.30	7.82	8.27	8.09	7.93 ± 0.23
Na_2O	2.87	2.87	2.66	2.92	2.70	2.95	2.81	2.68	3.16	2.85 ± 0.16
K_20	1.25	1.25	1.38	1.43	1.31	1.29	1.36	0.98	1.24	1.28 ± 0.13
TiO_2	1.58	1.60	1.47	1.63	1.48	1.51	1.51	1.49	1.47	1.53 ± 0.06
P_2O_5	0.48	0.48	0.45	0.49	0.47	0.50	0.49	0.48	0.36	0.47 ± 0.04
MnO	0.14	0.14	0.14	0.14	0.14	0.15	0.16	0.12	0.13	0.14 ± 0.01
LOI 925C	1.33	1.41	2.29	1.15	2.25	1.45	0.40	3.01	2.15	1.72 ± 0.78
Sums	99.75	99.93	99.91	99.95	100.01	100.14	100.11	99.86	99.87	99.95 ± 0.12
Recalculated[5]										
SiO_2	51.04	51.23	51.48	52.15	50.86	50.91	50.19	51.07	51.87	51.20 ± 0.58
Al_2O_3	15.10	15.17	15.46	15.28	15.30	15.25	14.93	15.55	15.59	15.29 ± 0.21
Fe_TO_3	11.93	11.75	11.47	11.16	11.81	11.81	12.83	11.60	11.47	11.76 ± 0.46
MgO	7.71	7.57	7.28	6.86	7.70	7.13	7.86	7.31	6.28	7.30 ± 0.50
CaO	7.80	7.84	8.06	7.85	8.08	8.41	7.84	8.54	8.28	8.08 ± 0.27
Na_2O	2.92	2.91	2.72	2.96	2.76	2.99	2.82	2.77	3.23	2.90 ± 0.16
K_20	1.27	1.27	1.41	1.45	1.34	1.31	1.36	1.01	1.27	1.30 ± 0.13
TiO_2	1.61	1.62	1.51	1.65	1.51	1.53	1.51	1.54	1.50	1.55 ± 0.06
P_2O_5	0.49	0.49	0.46	0.50	0.48	0.51	0.49	0.50	0.37	0.47 ± 0.04
MnO	0.14	0.14	0.14	0.14	0.14	0.15	0.16	0.12	0.13	0.14 ± 0.01

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	KH95-34	KH95-42	KH95-36	Mean[4]	CD181A	CD193A	CD19	CD53A	CD187	CC-LA-3
Group[2]	3a	3a	3a	3a	3b	3b	3b	3b	3b	3b
Age (Ma)[3]				(10)						
SiO_2	50.25	50.88	50.86	50.66 ± 0.36	51.94	51.36	50.98	51.48	51.56	50.52
Al_2O_3	15.46	15.18	14.96	15.20 ± 0.25	15.69	15.38	15.51	15.55	15.46	15.04
Fe_TO_3	11.76	11.63	11.52	11.64 ± 0.12	11.16	11.40	11.57	11.24	11.44	11.05
MgO	7.97	7.92	8.19	8.03 ± 0.14	6.94	7.15	7.18	6.95	7.21	7.06
CaO	7.95	7.77	7.64	7.79 ± 0.16	7.22	7.44	7.61	7.38	7.37	7.41
Na_2O	2.85	2.85	2.75	2.82 ± 0.06	3.11	2.99	3.09	2.99	3.08	2.76
K_20	1.46	1.49	1.67	1.54 ± 0.11	1.81	1.67	1.45	1.73	1.73	1.72
TiO_2	1.47	1.42	1.44	1.44 ± 0.03	1.59	1.55	1.54	1.60	1.60	1.55
P_2O_5	0.39	0.39	0.39	0.39 ± 0.00	0.43	0.52	0.50	0.55	0.55	0.54
MnO	0.16	0.16	0.15	0.16 ± 0.01	0.15	0.15	0.16	0.15	0.15	0.14
LOI 925C	0.16	0.18	0.14	0.16 ± 0.02	0.06	0.09	0.10	0.16	0.04	1.90
Sums	99.88	99.87	99.71	99.82 ± 0.10	100.10	99.70	99.69	99.78	100.19	99.69
Recalculated[5]										
SiO_2	50.39	51.04	51.08	50.84 ± 0.39	51.92	51.56	51.19	51.68	51.48	51.66
Al_2O_3	15.50	15.23	15.02	15.25 ± 0.24	15.68	15.44	15.57	15.61	15.44	15.38
Fe_TO_3	11.79	11.67	11.57	11.68 ± 0.11	11.16	11.44	11.62	11.28	11.42	11.30
MgO	7.99	7.94	8.23	8.05 ± 0.15	6.94	7.18	7.21	6.98	7.20	7.22
CaO	7.97	7.79	7.67	7.81 ± 0.15	7.22	7.47	7.64	7.41	7.36	7.58
Na_2O	2.86	2.86	2.76	2.83 ± 0.06	3.11	3.00	3.10	3.00	3.08	2.82
K_20	1.46	1.49	1.68	1.55 ± 0.12	1.81	1.68	1.46	1.74	1.73	1.76
TiO_2	1.47	1.42	1.45	1.45 ± 0.02	1.59	1.56	1.55	1.61	1.60	1.59
P_2O_5	0.39	0.39	0.39	0.39 ± 0.00	0.43	0.52	0.50	0.55	0.55	0.55
MnO	0.16	0.16	0.15	0.16 ± 0.01	0.15	0.15	0.16	0.15	0.15	0.14

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	Mean[4]	KH95-43	GL25	KH95-25	Mean[4]	CD135	CD150A	L-187B	L-187A
Group[2]	3b	4a	4a	4a	4a	4b	4b	4b	4b
Age (Ma)[3]	(10)				(10)			9.57	9.84
SiO_2	51.31 ± 0.49	51.43	51.39	52.27	51.70 ± 0.50	52.21	51.59	52.47	52.45
Al_2O_3	15.44 ± 0.22	15.03	14.94	15.21	15.06 ± 0.14	15.67	15.56	15.71	15.69
Fe_TO_3	11.31 ± 0.19	9.87	10.08	10.23	10.06 ± 0.18	10.49	10.13	10.38	10.53
MgO	7.08 ± 0.12	6.60	6.74	6.98	6.77 ± 0.19	6.11	5.82	6.10	6.26
CaO	7.41 ± 0.13	7.97	7.83	7.38	7.73 ± 0.31	7.10	7.33	6.97	7.03
Na_2O	3.00 ± 0.13	3.03	2.92	3.14	3.03 ± 0.11	3.19	2.93	3.22	3.29
K_20	1.69 ± 0.12	2.06	2.13	2.24	2.14 ± 0.09	2.18	2.10	2.26	2.24
TiO_2	1.57 ± 0.03	1.60	1.58	1.64	1.61 ± 0.03	1.60	1.59	1.60	1.60
P_2O_5	0.52 ± 0.05	0.59	0.59	0.64	0.61 ± 0.03	0.69	0.67	0.73	0.73
MnO	0.15 ± 0.01	0.13	0.14	0.15	0.14 ± 0.01	0.14	0.13	0.14	0.14
LOI 925C	0.39 ± 0.74	1.50	1.45	0.26	1.07 ± 0.70	0.02	1.52	0.40	0.09
Sums	99.86 ± 0.23	99.81	99.79	100.14	99.91 ± 0.20	99.40	99.37	99.98	100.05
Recalculated[5]									
SiO_2	51.58 ± 0.24	52.31	52.26	52.33	52.30 ± 0.04	52.54	52.72	52.69	52.47
Al_2O_3	15.52 ± 0.12	15.29	15.19	15.23	15.24 ± 0.05	15.77	15.90	15.78	15.70
Fe_TO_3	11.37 ± 0.16	10.04	10.25	10.24	10.18 ± 0.12	10.56	10.35	10.42	10.53
MgO	7.12 ± 0.13	6.71	6.85	6.99	6.85 ± 0.14	6.15	5.95	6.13	6.26
CaO	7.45 ± 0.15	8.11	7.96	7.39	7.82 ± 0.38	7.14	7.49	7.00	7.03
Na_2O	3.02 ± 0.11	3.08	2.97	3.14	3.07 ± 0.09	3.21	2.99	3.23	3.29
K_20	1.69 ± 0.12	2.10	2.17	2.24	2.17 ± 0.07	2.19	2.15	2.27	2.24
TiO_2	1.58 ± 0.02	1.63	1.61	1.64	1.63 ± 0.02	1.61	1.62	1.61	1.60
P_2O_5	0.52 ± 0.05	0.60	0.60	0.64	0.61 ± 0.02	0.69	0.68	0.73	0.73
MnO	0.15 ± 0.01	0.13	0.14	0.15	0.14 ± 0.01	0.14	0.13	0.14	0.14

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	L-176	K97-8-11A	K97-8-11D	L-91A	CD150B	K97-8-11B	K97-8-11C	L-91B	K97-8-11E	L-37	L-39
Group[2]	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b
Age (Ma)[3]	9.74	10.49		9.73			10.18				9.84
SiO_2	52.44	50.69	51.80	52.61	51.63	51.55	51.81	52.77	53.19	52.98	52.95
Al_2O_3	15.72	15.37	15.78	15.79	16.23	15.66	15.71	15.73	15.66	15.77	15.82
Fe_TO_3	10.47	10.62	10.41	10.35	10.72	10.30	10.33	10.15	9.67	10.09	10.24
MgO	6.25	6.55	5.85	6.31	6.08	5.95	5.93	5.47	5.21	4.81	5.62
CaO	7.13	8.05	7.43	7.01	7.29	7.36	7.26	6.93	6.72	6.84	6.94
Na_2O	3.33	2.95	3.21	3.19	3.13	2.99	3.09	3.31	3.27	3.49	3.39
K_20	2.23	1.91	2.18	2.46	2.08	2.21	2.28	2.48	2.50	2.40	2.40
TiO_2	1.60	1.57	1.62	1.62	1.64	1.59	1.62	1.61	1.60	1.60	1.63
P_2O_5	0.73	0.66	0.70	0.76	0.70	0.71	0.71	0.77	0.75	0.78	0.77
MnO	0.14	0.15	0.16	0.14	0.15	0.15	0.14	0.14	0.14	0.14	0.14
LOI 925C	-0.08	1.35	0.31	0.69	0.28	1.07	0.49	0.42	0.44	0.35	-0.06
Sums	99.96	99.87	99.45	100.93	99.93	99.54	99.37	99.78	99.15	99.25	99.84
Recalculated[5]											
SiO_2	52.42	51.45	52.25	52.48	51.81	52.35	52.40	53.11	53.89	53.57	53.00
Al_2O_3	15.71	15.60	15.92	15.75	16.29	15.90	15.89	15.83	15.86	15.95	15.84
Fe_TO_3	10.47	10.78	10.50	10.33	10.76	10.46	10.45	10.22	9.80	10.20	10.25
MgO	6.25	6.65	5.90	6.29	6.10	6.04	6.00	5.51	5.28	4.86	5.63
CaO	7.13	8.17	7.49	6.99	7.32	7.47	7.34	6.97	6.81	6.92	6.95
Na_2O	3.33	2.99	3.24	3.18	3.14	3.04	3.13	3.33	3.31	3.53	3.39
K_20	2.23	1.94	2.20	2.45	2.09	2.24	2.31	2.50	2.53	2.43	2.40
TiO_2	1.60	1.59	1.63	1.62	1.65	1.61	1.64	1.62	1.62	1.62	1.63
P_2O_5	0.73	0.67	0.71	0.76	0.70	0.72	0.72	0.77	0.76	0.79	0.77
MnO	0.14	0.15	0.16	0.14	0.15	0.15	0.14	0.14	0.14	0.14	0.14

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	L-187D	L-181	K97-8-11B	Mean[4]	K97-8-15C	L-38A	K97-8-15B	Mean[4]	CP76
Group[2]	4b	4b	4b	4b	4b'	4b'	4b'	4b'	5a
Age (Ma)[3]				9.94 ± 0.33	9.8	9.9	9.83	9.84 ± 0.05	
SiO_2	53.03	53.90	51.55	52.31 ± 0.78	57.47	57.12	57.63	57.41 ± 0.26	50.29
Al_2O_3	15.73	15.58	15.66	15.71 ± 0.16	15.62	15.46	15.29	15.46 ± 0.17	15.15
Fe_TO_3	10.07	9.67	10.30	10.27 ± 0.28	8.41	8.38	8.43	8.41 ± 0.03	10.83
MgO	5.58	4.98	5.95	5.82 ± 0.47	2.72	2.84	2.99	2.85 ± 0.14	7.15
CaO	6.88	6.43	7.36	7.11 ± 0.35	5.58	5.28	5.20	5.35 ± 0.20	7.88
Na_2O	3.44	3.23	2.99	3.20 ± 0.16	3.40	3.49	3.41	3.43 ± 0.05	3.10
K_20	2.41	2.76	2.21	2.29 ± 0.19	3.12	3.16	3.33	3.20 ± 0.11	2.10
TiO_2	1.62	1.59	1.59	1.61 ± 0.02	1.53	1.53	1.53	1.53 ± 0.00	1.73
P_2O_5	0.78	0.80	0.71	0.73 ± 0.04	0.74	0.83	0.79	0.79 ± 0.05	0.63
MnO	0.14	0.13	0.15	0.14 ± 0.01	0.12	0.10	0.11	0.11 ± 0.01	0.15
LOI 925C	0.09	0.67	1.07	0.51 ± 0.47	0.51	0.95	0.92	0.79 ± 0.25	0.40
Sums	99.77	99.74	99.54	99.72 ± 0.41	99.22	99.14	99.63	99.33 ± 0.26	99.41
Recalculated[5]									
SiO_2	53.20	54.41	52.35	52.73 ± 0.71	58.22	58.17	58.38	58.26 ± 0.11	50.79
Al_2O_3	15.78	15.73	15.90	15.84 ± 0.15	15.82	15.74	15.49	15.69 ± 0.17	15.30
Fe_TO_3	10.10	9.76	10.46	10.35 ± 0.27	8.52	8.53	8.54	8.53 ± 0.01	10.94
MgO	5.60	5.03	6.04	5.87 ± 0.47	2.76	2.89	3.03	2.89 ± 0.14	7.22
CaO	6.90	6.49	7.47	7.17 ± 0.37	5.65	5.38	5.27	5.43 ± 0.20	7.96
Na_2O	3.45	3.26	3.04	3.23 ± 0.15	3.44	3.55	3.45	3.48 ± 0.06	3.13
K_20	2.42	2.79	2.24	2.31 ± 0.19	3.16	3.22	3.37	3.25 ± 0.11	2.12
TiO_2	1.63	1.60	1.61	1.62 ± 0.01	1.55	1.56	1.55	1.55 ± 0.00	1.75
P_2O_5	0.78	0.81	0.72	0.74 ± 0.04	0.75	0.85	0.80	0.80 ± 0.05	0.64
MnO	0.14	0.13	0.15	0.14 ± 0.01	0.12	0.10	0.11	0.11 ± 0.01	0.15

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	CP77	KH95-28	L-68	CP83	L-4	CP106	L-56	KH95-30	L-78	CP8	L-60
Group[2]	5a	5a	5a	5a	5a	5a	5a	5a	5a	5a	5a
Age (Ma)[3]										7.76	7.82
SiO_2	50.27	49.75	49.67	49.87	48.82	49.97	48.47	50.84	48.58	50.85	48.00
Al_2O_3	15.07	15.52	15.14	15.31	14.80	15.30	14.61	15.28	14.67	15.27	14.93
Fe_TO_3	10.91	11.20	10.95	11.15	10.74	11.05	10.69	10.62	10.75	10.65	11.28
MgO	7.51	6.98	7.30	6.86	6.75	7.40	8.00	6.87	7.29	7.30	8.42
CaO	7.82	7.99	8.03	8.01	8.96	8.02	7.71	7.56	8.16	7.54	8.30
Na_2O	3.15	3.20	3.24	3.21	3.07	3.19	3.04	3.26	3.15	3.17	3.33
K_20	2.17	2.19	2.20	2.19	2.20	2.23	2.19	2.30	2.30	2.29	1.82
TiO_2	1.77	1.82	1.79	1.79	1.75	1.81	1.73	1.77	1.77	1.78	1.78
P_2O_5	0.66	0.72	0.75	0.70	0.68	0.71	0.72	0.68	0.76	0.67	0.77
MnO	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.16
LOI 925C	0.16	0.06	0.32	0.33	1.66	-0.24	2.37	0.12	2.04	-0.09	0.99
Sums	99.65	99.59	99.55	99.58	99.59	99.60	99.68	99.45	99.62	99.58	99.78
Recalculated[5]											
SiO_2	50.53	49.98	50.06	50.25	49.85	50.05	49.81	51.18	49.78	51.02	48.59
Al_2O_3	15.15	15.59	15.26	15.43	15.11	15.32	15.01	15.38	15.03	15.32	15.11
Fe_TO_3	10.97	11.25	11.03	11.23	10.97	11.07	10.99	10.69	11.02	10.69	11.42
MgO	7.55	7.01	7.36	6.91	6.89	7.41	8.22	6.92	7.47	7.32	8.52
CaO	7.86	8.03	8.09	8.07	9.15	8.03	7.92	7.61	8.36	7.56	8.40
Na_2O	3.17	3.22	3.27	3.23	3.13	3.20	3.12	3.28	3.23	3.18	3.37
K_20	2.18	2.20	2.22	2.21	2.25	2.23	2.25	2.32	2.36	2.30	1.84
TiO_2	1.78	1.83	1.80	1.80	1.79	1.81	1.78	1.78	1.81	1.79	1.80
P_2O_5	0.66	0.72	0.76	0.71	0.69	0.71	0.74	0.68	0.78	0.67	0.78
MnO	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.16

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	KH95-32	CP89	Mean[4]	KH95-29	CP88	CC119	CC-LA-5	CC122	CC-LA-4	SH303
Group[2]	5a	5a	5a	5a'	5b	5b	5b	5b	5b	5b
Age (Ma)[3]	7.8	7.6	7.75 ± 0.10	(7.75)			7.71			
SiO_2	50.32	47.80	49.54 ± 1.02	49.94	51.20	50.76	50.64	50.82	50.62	51.01
Al_2O_3	15.09	14.66	15.06 ± 0.28	15.13	15.29	15.27	15.28	15.17	15.34	15.38
Fe_TO_3	10.70	11.45	10.93 ± 0.26	11.21	10.84	10.90	11.58	10.74	10.80	10.89
MgO	7.48	8.14	7.39 ± 0.50	7.29	6.64	6.94	6.64	7.08	6.98	6.50
CaO	7.79	8.27	8.00 ± 0.36	7.92	7.34	7.30	7.45	7.41	7.45	7.27
Na_2O	3.21	2.94	3.16 ± 0.10	3.18	3.23	3.16	3.18	3.18	3.09	3.22
K_20	2.28	2.21	2.19 ± 0.12	2.29	2.49	2.37	2.42	2.38	2.37	2.48
TiO_2	1.76	1.82	1.78 ± 0.03	1.78	1.81	1.81	1.83	1.79	1.80	1.81
P_2O_5	0.69	0.74	0.71 ± 0.04	0.69	0.72	0.61	0.70	0.71	0.70	0.73
MnO	0.15	0.16	0.16 ± 0.01	0.16	0.16	0.16	0.16	0.15	0.15	0.15
LOI 925C	-0.01	1.59	0.69 ± 0.87	0.06	-0.09	0.08	-0.24	-0.09	0.23	-0.09
Sums	99.46	99.78	99.59 ± 0.11	99.65	99.63	99.36	99.64	99.34	99.53	99.35
Recalculated[5]										
SiO_2	50.59	48.68	50.08 ± 0.76	50.15	51.34	51.13	50.70	51.11	50.98	51.30
Al_2O_3	15.17	14.93	15.22 ± 0.18	15.19	15.33	15.38	15.30	15.26	15.45	15.47
Fe_TO_3	10.76	11.66	11.05 ± 0.27	11.26	10.87	10.98	11.59	10.80	10.88	10.95
MgO	7.52	8.29	7.47 ± 0.53	7.32	6.66	6.99	6.65	7.12	7.03	6.54
CaO	7.83	8.42	8.09 ± 0.40	7.95	7.36	7.35	7.46	7.45	7.50	7.31
Na_2O	3.23	2.99	3.20 ± 0.09	3.19	3.24	3.18	3.18	3.20	3.11	3.24
K_20	2.29	2.25	2.22 ± 0.12	2.30	2.50	2.39	2.42	2.39	2.39	2.49
TiO_2	1.77	1.85	1.80 ± 0.03	1.79	1.82	1.82	1.83	1.80	1.81	1.82
P_2O_5	0.69	0.75	0.71 ± 0.04	0.69	0.72	0.61	0.70	0.71	0.70	0.73
MnO	0.15	0.16	0.16 ± 0.01	0.16	0.16	0.16	0.16	0.15	0.15	0.15

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	K97-10-8D	GL306	CC121	SH341	Mean[4]	CD206	CD199	SH262	CD215	CD197
Group[2]	5b	5b	5b	5b	5b	6a	6a	6a	6a	6a
Age (Ma)[3]	7.74				7.73 ± 0.02					
SiO_2	49.94	50.74	50.81	50.88	50.74 ± 0.33	54.21	54.71	55.21	54.66	56.01
Al_2O_3	15.39	15.27	15.20	15.30	15.29 ± 0.07	16.02	15.73	15.89	15.94	15.78
Fe_TO_3	11.09	11.06	10.69	10.61	10.92 ± 0.28	8.31	8.33	8.27	8.50	7.99
MgO	6.32	6.76	7.27	6.21	6.73 ± 0.34	5.40	5.11	4.66	4.86	4.94
CaO	7.17	7.38	7.41	7.48	7.37 ± 0.10	6.36	5.89	5.84	5.98	5.95
Na_2O	3.07	3.17	3.16	3.20	3.17 ± 0.05	3.36	3.37	3.37	3.27	3.28
K_20	2.37	2.37	2.36	2.43	2.40 ± 0.05	3.57	3.44	3.63	3.45	3.63
TiO_2	1.86	1.85	1.79	1.80	1.82 ± 0.02	1.44	1.39	1.34	1.45	1.40
P_2O_5	0.71	0.72	0.72	0.71	0.70 ± 0.03	0.40	0.31	0.44	0.35	0.43
MnO	0.16	0.16	0.15	0.15	0.16 ± 0.01	0.13	0.13	0.13	0.12	0.13
LOI 925C	0.73	0.21	0.01	0.99	0.17 ± 0.39	0.18	0.75	0.80	0.71	0.07
Sums	98.81	99.69	99.57	99.76	99.47 ± 0.27	99.38	99.16	99.58	99.29	99.61
Recalculated[5]										
SiO_2	50.92	51.01	51.03	51.51	51.10 ± 0.23	54.65	55.59	55.89	55.45	56.27
Al_2O_3	15.69	15.35	15.27	15.49	15.40 ± 0.13	16.15	15.98	16.09	16.17	15.85
Fe_TO_3	11.31	11.12	10.74	10.74	11.00 ± 0.27	8.38	8.46	8.37	8.62	8.03
MgO	6.44	6.80	7.30	6.29	6.78 ± 0.32	5.44	5.19	4.72	4.93	4.96
CaO	7.31	7.42	7.44	7.57	7.42 ± 0.09	6.41	5.99	5.91	6.07	5.98
Na_2O	3.13	3.19	3.17	3.24	3.19 ± 0.04	3.39	3.42	3.41	3.32	3.30
K_20	2.42	2.38	2.37	2.46	2.42 ± 0.05	3.60	3.50	3.67	3.50	3.65
TiO_2	1.90	1.86	1.80	1.82	1.83 ± 0.03	1.45	1.41	1.36	1.47	1.41
P_2O_5	0.72	0.72	0.72	0.72	0.71 ± 0.03	0.40	0.32	0.45	0.36	0.43
MnO	0.16	0.16	0.15	0.15	0.16 ± 0.01	0.13	0.13	0.13	0.12	0.13

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	Mean[4]	CD209	CD216	CD8	Mean[4]	SH267	L-7	SH268	Mean
Group[2]	6a	6a'	6a'	6a'	6a'	6b	6b	6b	6b
Age (Ma)[3]	(4)				(4)	3.9			3.9
SiO_2	54.96 ± 0.69	54.01	55.86	55.05	54.97 ± 0.93	54.26	55.44	55.56	55.09 ± 0.72
Al_2O_3	15.87 ± 0.12	16.00	15.58	15.42	15.67 ± 0.30	15.16	15.42	15.48	15.35 ± 0.17
Fe_TO_3	8.28 ± 0.18	8.37	7.87	8.41	8.22 ± 0.30	7.48	8.18	8.00	7.89 ± 0.36
MgO	4.99 ± 0.28	5.30	4.72	4.30	4.77 ± 0.50	4.19	5.02	4.44	4.55 ± 0.43
CaO	6.00 ± 0.21	6.35	5.98	5.99	6.11 ± 0.21	7.59	6.23	6.08	6.63 ± 0.83
Na_2O	3.33 ± 0.05	3.34	3.23	3.28	3.28 ± 0.06	3.19	3.30	3.43	3.31 ± 0.12
K_20	3.54 ± 0.09	3.56	3.50	3.57	3.54 ± 0.04	3.44	3.47	3.62	3.51 ± 0.10
TiO_2	1.40 ± 0.04	1.45	1.37	1.36	1.39 ± 0.05	1.27	1.37	1.30	1.31 ± 0.05
P_2O_5	0.39 ± 0.06	0.47	0.46	0.54	0.49 ± 0.04	0.57	0.57	0.58	0.57 ± 0.01
MnO	0.13 ± 0.00	0.12	0.12	0.11	0.12 ± 0.01	0.21	0.13	0.13	0.16 ± 0.05
LOI 925C	0.50 ± 0.35	0.38	0.60	1.00	0.66 ± 0.31	2.19	0.26	0.99	1.15 ± 0.97
Sums	99.40 ± 0.19	99.35	99.29	99.03	99.22 ± 0.17	99.55	99.39	99.61	99.52 ± 0.11
Recalculated[5]									
SiO_2	55.57 ± 0.60	54.57	56.60	56.16	55.78 ± 1.07	55.73	55.93	56.34	56.00 ± 0.31
Al_2O_3	16.05 ± 0.13	16.17	15.79	15.73	15.89 ± 0.24	15.57	15.56	15.70	15.61 ± 0.08
Fe_TO_3	8.37 ± 0.22	8.46	7.97	8.58	8.34 ± 0.32	7.68	8.25	8.11	8.02 ± 0.30
MgO	5.05 ± 0.28	5.36	4.78	4.39	4.84 ± 0.49	4.30	5.06	4.50	4.62 ± 0.39
CaO	6.07 ± 0.20	6.42	6.06	6.11	6.20 ± 0.19	7.80	6.28	6.17	6.75 ± 0.91
Na_2O	3.37 ± 0.06	3.37	3.27	3.35	3.33 ± 0.05	3.28	3.33	3.48	3.36 ± 0.10
K_20	3.58 ± 0.08	3.60	3.55	3.64	3.60 ± 0.05	3.53	3.50	3.67	3.57 ± 0.09
TiO_2	1.42 ± 0.04	1.47	1.39	1.39	1.41 ± 0.04	1.30	1.38	1.32	1.33 ± 0.04
P_2O_5	0.39 ± 0.05	0.47	0.47	0.55	0.50 ± 0.05	0.59	0.58	0.59	0.58 ± 0.01
MnO	0.13 ± 0.00	0.12	0.12	0.11	0.12 ± 0.01	0.22	0.13	0.13	0.16 ± 0.05

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	L-246	L-233	L-244	L-245	L-28	Mean[4]	CPV-4	CPV-3	CP86	CPV-2
Group[2]	6b'	6b'	6b'	6b'	6b'	6b'	6b"	6b"	6b"	6b"
Age (Ma)[3]			2.9	3		2.95 ± 0.07			3.17	
SiO_2	52.17	52.10	52.34	52.31	51.91	52.17 ± 0.17	50.35	50.91	50.79	49.94
Al_2O_3	15.26	15.13	15.39	15.57	15.30	15.33 ± 0.16	15.97	16.02	15.82	15.62
Fe_TO_3	9.19	9.13	9.29	9.38	9.12	9.22 ± 0.11	10.14	10.08	10.10	10.11
MgO	6.30	6.36	5.96	5.07	6.20	5.98 ± 0.53	6.28	6.11	6.52	6.65
CaO	7.28	7.29	7.10	7.27	7.12	7.21 ± 0.09	7.16	7.28	7.57	8.15
Na_2O	3.56	3.39	3.49	3.70	3.42	3.51 ± 0.12	3.09	3.16	3.20	3.33
K_20	3.12	3.09	3.26	3.20	3.18	3.17 ± 0.07	3.19	3.27	3.24	2.54
TiO_2	1.55	1.54	1.56	1.57	1.54	1.55 ± 0.01	1.64	1.62	1.63	1.64
P_2O_5	0.67	0.66	0.67	0.68	0.66	0.67 ± 0.01	0.55	0.66	0.65	0.68
MnO	0.14	0.14	0.14	0.14	0.14	0.14 ± 0.00	0.15	0.16	0.16	0.16
LOI 925C	0.50	0.70	0.39	0.56	0.23	0.48 ± 0.18	0.50	0.25	-0.11	0.94
Sums	99.74	99.53	99.59	99.45	98.82	99.43 ± 0.36	99.02	99.52	99.57	99.76
Recalculated[5]										
SiO_2	52.57	52.72	52.76	52.90	52.65	52.72 ± 0.12	51.11	51.28	50.95	50.54
Al_2O_3	15.38	15.31	15.51	15.74	15.52	15.49 ± 0.17	16.21	16.14	15.87	15.81
Fe_TO_3	9.26	9.24	9.36	9.49	9.25	9.32 ± 0.11	10.29	10.15	10.13	10.23
MgO	6.35	6.44	6.01	5.13	6.29	6.04 ± 0.54	6.37	6.15	6.54	6.73
CaO	7.34	7.38	7.16	7.35	7.22	7.29 ± 0.09	7.27	7.33	7.59	8.25
Na_2O	3.59	3.43	3.52	3.74	3.47	3.55 ± 0.12	3.14	3.18	3.21	3.37
K_20	3.14	3.13	3.29	3.24	3.23	3.20 ± 0.07	3.24	3.29	3.25	2.57
TiO_2	1.56	1.56	1.57	1.59	1.56	1.57 ± 0.01	1.66	1.63	1.64	1.66
P_2O_5	0.68	0.67	0.68	0.69	0.67	0.68 ± 0.01	0.56	0.66	0.65	0.69
MnO	0.14	0.14	0.14	0.14	0.14	0.14 ± 0.00	0.15	0.16	0.16	0.16

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	Mean[4]	L-1	L-3	L-52	K97-8-12H	L-48	Mean[4]	DT-R1	DT-39
Group[2]	6b"	6c	6c	6c	6c	6c	6c	6c'	6c'
Age (Ma)[3]	3.17	2.6			3.09		2.85 ± 0.35		
SiO_2	50.50 ± 0.44	49.58	51.49	52.01	50.05	52.61	51.15 ± 1.29	47.95	47.66
Al_2O_3	15.86 ± 0.18	14.76	14.98	15.60	14.92	15.66	15.18 ± 0.42	15.82	16.20
Fe_TO_3	10.11 ± 0.02	9.40	9.95	9.12	9.08	9.07	9.32 ± 0.38	11.12	11.87
MgO	6.39 ± 0.24	6.05	6.30	6.21	5.60	6.16	6.06 ± 0.27	7.15	7.12
CaO	7.54 ± 0.44	9.18	8.00	7.41	8.71	7.09	8.08 ± 0.87	8.56	8.57
Na_2O	3.20 ± 0.10	3.01	3.12	3.19	3.06	3.37	3.15 ± 0.14	3.44	3.17
K_20	3.06 ± 0.35	2.82	3.04	3.10	2.94	3.22	3.02 ± 0.15	2.44	2.72
TiO_2	1.63 ± 0.01	1.41	1.35	1.37	1.36	1.38	1.37 ± 0.02	1.47	1.58
P_2O_5	0.64 ± 0.06	0.57	0.59	0.60	0.57	0.60	0.59 ± 0.02	0.64	0.73
MnO	0.16 ± 0.01	0.15	0.15	0.14	0.15	0.15	0.15 ± 0.00	0.18	0.20
LOI 925C	0.40 ± 0.44	2.44	0.47	0.69	2.90	-0.21	1.26 ± 1.34	0.76	-0.40
Sums	99.47 ± 0.32	99.37	99.44	99.44	99.34	99.10	99.34 ± 0.14	99.53	99.42
Recalculated[5]									
SiO_2	50.97 ± 0.32	51.15	52.03	52.67	51.90	52.98	52.14 ± 0.71	48.55	47.75
Al_2O_3	16.01 ± 0.20	15.23	15.14	15.80	15.47	15.77	15.48 ± 0.30	16.02	16.23
Fe_TO_3	10.20 ± 0.07	9.70	10.05	9.24	9.42	9.13	9.51 ± 0.37	11.26	11.89
MgO	6.45 ± 0.24	6.24	6.37	6.29	5.81	6.20	6.18 ± 0.22	7.24	7.13
CaO	7.61 ± 0.45	9.47	8.08	7.50	9.03	7.14	8.25 ± 0.99	8.67	8.59
Na_2O	3.22 ± 0.10	3.11	3.15	3.23	3.17	3.39	3.21 ± 0.11	3.48	3.18
K_20	3.09 ± 0.35	2.91	3.07	3.14	3.05	3.24	3.08 ± 0.12	2.47	2.72
TiO_2	1.65 ± 0.02	1.45	1.36	1.39	1.41	1.39	1.40 ± 0.03	1.49	1.58
P_2O_5	0.64 ± 0.06	0.59	0.60	0.61	0.59	0.60	0.60 ± 0.01	0.65	0.73
MnO	0.16 ± 0.00	0.15	0.15	0.14	0.16	0.15	0.15 ± 0.01	0.18	0.20

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	DTV-2	DTV-3	Mean[4]	DT-R3	K97-8-12B	K97-8-12A	K97-8-12A1	Mean[4]	KH95-26
Group[2]	6c'	6c'	6c'	6c"	6d	6d'	6d'	6d'	7a
Age (Ma)[3]			0.004 [6]	0.28	1.51	1.5		1.5	3.03
SiO_2	47.66	47.82	47.77 ± 0.14	48.50	50.30	48.38	47.93	48.16 ± 0.32	52.46
Al_2O_3	16.20	16.19	16.10 ± 0.19	16.18	16.70	15.46	15.29	15.38 ± 0.12	15.92
Fe_TO_3	11.92	11.80	11.68 ± 0.37	12.85	9.93	10.26	10.25	10.26 ± 0.01	8.70
MgO	7.17	7.08	7.13 ± 0.04	6.87	4.50	6.45	6.54	6.50 ± 0.06	5.46
CaO	8.55	8.47	8.54 ± 0.05	8.01	7.66	8.33	8.49	8.41 ± 0.11	7.40
Na_2O	3.19	3.24	3.26 ± 0.12	3.08	3.92	3.36	3.17	3.27 ± 0.13	3.45
K_20	2.77	2.72	2.66 ± 0.15	2.10	2.96	2.60	2.59	2.60 ± 0.01	3.42
TiO_2	1.58	1.56	1.55 ± 0.05	1.54	1.73	1.65	1.65	1.65 ± 0.00	1.50
P_2O_5	0.73	0.73	0.71 ± 0.05	0.63	1.05	1.07	1.05	1.06 ± 0.01	0.69
MnO	0.19	0.19	0.19 ± 0.01	0.19	0.16	0.17	0.17	0.17 ± 0.00	0.15
LOI 925C	-0.37	-0.30	-0.08 ± 0.56	-0.42	-0.03	0.60	1.06	0.83 ± 0.33	0.26
Sums	99.59	99.50	99.51 ± 0.07	99.53	98.88	98.33	98.19	98.26 ± 0.10	99.41
Recalculated[5]									
SiO_2	47.68	47.92	47.97 ± 0.40	48.52	50.85	49.50	49.35	49.42 ± 0.11	52.91
Al_2O_3	16.21	16.22	16.17 ± 0.10	16.19	16.88	15.82	15.74	15.78 ± 0.05	16.06
Fe_TO_3	11.92	11.82	11.72 ± 0.31	12.86	10.04	10.50	10.55	10.53 ± 0.04	8.77
MgO	7.17	7.09	7.16 ± 0.06	6.87	4.55	6.60	6.73	6.67 ± 0.09	5.51
CaO	8.55	8.49	8.57 ± 0.07	8.01	7.74	8.52	8.74	8.63 ± 0.15	7.46
Na_2O	3.19	3.25	3.27 ± 0.14	3.08	3.96	3.44	3.26	3.35 ± 0.12	3.48
K_20	2.77	2.73	2.67 ± 0.14	2.10	2.99	2.66	2.67	2.66 ± 0.00	3.45
TiO_2	1.58	1.56	1.55 ± 0.04	1.54	1.75	1.69	1.70	1.69 ± 0.01	1.51
P_2O_5	0.73	0.73	0.71 ± 0.04	0.63	1.06	1.09	1.08	1.09 ± 0.01	0.70
MnO	0.19	0.19	0.19 ± 0.01	0.19	0.16	0.17	0.18	0.17 ± 0.00	0.15

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	KH95-27B	Mean[4]	L-6	DT-R2	DT-R4	MG-97-2	97-GH-239	97-GH-228B	Mean[4]
Group[2]	7a	7a	7a'	8a	8a	8a	8a	8a	8a
Age (Ma)[3]		3.03	(3.0)	23.4					23.4
SiO_2	52.20	52.33 ± 0.18	54.08	48.93	48.80	49.20	49.30	47.70	48.79 ± 0.64
Al_2O_3	15.83	15.88 ± 0.06	15.07	14.89	15.07	14.90	14.70	14.90	14.89 ± 0.13
Fe_TO_3	8.71	8.71 ± 0.01	8.54	13.37	12.71	12.40	12.40	12.80	12.74 ± 0.40
MgO	5.64	5.55 ± 0.13	6.09	6.26	6.25	5.96	6.09	5.74	6.06 ± 0.22
CaO	7.35	7.38 ± 0.04	6.66	8.83	8.97	8.90	9.16	9.09	8.99 ± 0.14
Na_2O	3.39	3.42 ± 0.04	3.25	2.97	3.09	2.90	2.97	2.89	2.96 ± 0.08
K_20	3.44	3.43 ± 0.01	3.55	1.07	1.25	1.17	1.12	1.29	1.18 ± 0.09
TiO_2	1.51	1.51 ± 0.01	1.41	2.50	2.54	2.39	2.41	2.58	2.48 ± 0.08
P_2O_5	0.72	0.71 ± 0.02	0.62	0.72	0.75	0.69	0.72	0.83	0.74 ± 0.05
MnO	0.14	0.15 ± 0.01	0.13	0.15	0.15	0.15	0.16	0.15	0.15 ± 0.00
LOI 925C	0.49	0.38 ± 0.16	-0.04	-0.05	0.16	0.51	0.64	1.04	0.46 ± 0.42
Sums	99.42	99.42 ± 0.01	99.36	99.64	99.74	99.17	99.67	99.01	99.45 ± 0.33
Recalculated[5]									
SiO_2	52.76	52.84 ± 0.10	54.41	49.08	49.01	49.87	49.78	48.69	49.29 ± 0.52
Al_2O_3	16.00	16.03 ± 0.04	15.16	14.94	15.13	15.10	14.84	15.21	15.04 ± 0.15
Fe_TO_3	8.80	8.79 ± 0.02	8.59	13.41	12.76	12.57	12.52	13.07	12.87 ± 0.37
MgO	5.70	5.60 ± 0.14	6.13	6.28	6.28	6.04	6.15	5.86	6.12 ± 0.18
CaO	7.43	7.45 ± 0.02	6.70	8.86	9.01	9.02	9.25	9.28	9.08 ± 0.18
Na_2O	3.43	3.45 ± 0.04	3.27	2.98	3.10	2.94	3.00	2.95	2.99 ± 0.07
K_20	3.48	3.46 ± 0.02	3.57	1.07	1.26	1.19	1.13	1.32	1.19 ± 0.10
TiO_2	1.53	1.52 ± 0.01	1.42	2.51	2.55	2.42	2.43	2.63	2.51 ± 0.09
P_2O_5	0.73	0.71 ± 0.02	0.62	0.72	0.75	0.70	0.73	0.85	0.75 ± 0.06
MnO	0.14	0.15 ± 0.01	0.13	0.15	0.15	0.15	0.16	0.15	0.15 ± 0.00

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	97-GH-155	97-GH-228A	97-GH-34	Mean[4]	97-GH-18	97-GH-117	GL100	K97-10-8C	KH95-12	97-GH-94
Group[2]	8b	8b	8b	8b	9a	9b	10a	10a	10a	10a
Age (Ma)[3]				(23)	(23)	(23)	22	22.56		
SiO_2	47.20	48.70	49.10	48.33 ± 1.00	48.60	49.50	47.96	47.59	48.29	48.70
Al_2O_3	14.40	15.00	15.00	14.80 ± 0.35	14.70	15.20	14.51	14.28	14.74	14.60
Fe_TO_3	11.10	11.50	11.60	11.40 ± 0.26	11.60	11.50	13.28	13.35	13.09	12.40
MgO	5.37	5.97	6.18	5.84 ± 0.42	5.53	5.03	6.51	6.24	5.28	5.23
CaO	11.20	9.41	9.20	9.94 ± 1.10	9.75	8.31	9.03	9.14	9.17	8.78
Na_2O	3.04	3.10	2.77	2.97 ± 0.18	2.85	3.36	3.18	3.19	3.21	3.35
K_20	1.32	1.31	1.08	1.24 ± 0.14	1.52	2.17	1.42	1.40	1.33	1.42
TiO_2	1.66	1.68	1.79	1.71 ± 0.07	1.84	1.70	2.63	2.64	2.57	3.02
P_2O_5	0.75	0.77	0.79	0.77 ± 0.02	0.84	0.85	1.14	1.14	1.11	1.17
MnO	0.15	0.15	0.15	0.15 ± 0.00	0.16	0.16	0.16	0.16	0.15	0.14
LOI 925C	3.02	1.48	1.24	1.91 ± 0.97	1.71	1.52	-0.30	-0.12	0.60	0.46
Sums	99.21	99.07	98.90	99.06 ± 0.16	99.10	99.30	99.52	99.01	99.54	99.27
Recalculated[5]										
SiO_2	49.07	49.90	50.28	49.75 ± 0.62	49.90	50.62	48.05	48.01	48.81	49.29
Al_2O_3	14.97	15.37	15.36	15.23 ± 0.23	15.09	15.55	14.54	14.41	14.90	14.78
Fe_TO_3	11.54	11.78	11.88	11.73 ± 0.17	11.91	11.76	13.30	13.47	13.23	12.55
MgO	5.58	6.12	6.33	6.01 ± 0.38	5.68	5.14	6.52	6.29	5.34	5.29
CaO	11.64	9.64	9.42	10.24 ± 1.22	10.01	8.50	9.05	9.22	9.27	8.89
Na_2O	3.16	3.18	2.84	3.06 ± 0.19	2.93	3.44	3.19	3.22	3.24	3.39
K_20	1.37	1.34	1.11	1.27 ± 0.15	1.56	2.22	1.42	1.41	1.34	1.44
TiO_2	1.73	1.72	1.83	1.76 ± 0.06	1.89	1.74	2.63	2.66	2.60	3.06
P_2O_5	0.78	0.79	0.81	0.79 ± 0.01	0.86	0.87	1.14	1.15	1.12	1.18
MnO	0.16	0.15	0.15	0.15 ± 0.00	0.16	0.16	0.16	0.16	0.15	0.14

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	Mean[4]	K97-8-13A1	K97-8-13B	Mean[4]	K97-8-13A	CD152	L-223	Mean[4]
Group[2]	10a	11a	11a	11a	11a'	12a	12a	12a
Age (Ma)[3]	22.28 ± 0.40	22.74	22.88	22.81 ± 0.10	22.93	13.3	13.4	13.35 ± 0.07
SiO_2	48.14 ± 0.47	49.40	49.26	49.33 ± 0.10	48.89	55.24	56.03	55.64 ± 0.56
Al_2O_3	14.53 ± 0.19	15.07	15.06	15.07 ± 0.01	15.12	15.96	15.83	15.90 ± 0.09
Fe_TO_3	13.03 ± 0.43	11.53	11.30	11.42 ± 0.16	11.28	9.18	8.07	8.63 ± 0.78
MgO	5.82 ± 0.66	5.44	5.10	5.27 ± 0.24	5.09	4.46	4.35	4.41 ± 0.08
CaO	9.03 ± 0.18	8.42	8.63	8.53 ± 0.15	8.64	6.38	5.97	6.18 ± 0.29
Na_2O	3.23 ± 0.08	3.25	3.33	3.29 ± 0.06	3.37	3.64	3.73	3.69 ± 0.06
K_20	1.39 ± 0.04	1.80	1.84	1.82 ± 0.03	1.94	2.84	3.09	2.97 ± 0.18
TiO_2	2.72 ± 0.21	2.52	2.49	2.51 ± 0.02	2.41	1.38	1.30	1.34 ± 0.06
P_2O_5	1.14 ± 0.02	1.09	1.10	1.10 ± 0.01	1.22	0.47	0.49	0.48 ± 0.01
MnO	0.15 ± 0.01	0.14	0.14	0.14 ± 0.00	0.14	0.15	0.14	0.15 ± 0.01
LOI 925C	0.16 ± 0.44	0.70	0.67	0.69 ± 0.02	0.73	0.14	0.14	0.14 ± 0.00
Sums	99.34 ± 0.25	99.36	98.92	99.14 ± 0.31	98.83	99.84	99.14	99.49 ± 0.49
Recalculated[5]								
SiO_2	48.54 ± 0.62	50.07	50.14	50.10 ± 0.05	49.84	55.41	56.60	56.00 ± 0.84
Al_2O_3	14.65 ± 0.22	15.27	15.33	15.30 ± 0.04	15.41	16.01	15.99	16.00 ± 0.01
Fe_TO_3	13.14 ± 0.40	11.69	11.50	11.59 ± 0.13	11.50	9.21	8.15	8.68 ± 0.75
MgO	5.86 ± 0.64	5.51	5.19	5.35 ± 0.23	5.19	4.47	4.39	4.43 ± 0.06
CaO	9.11 ± 0.17	8.53	8.78	8.66 ± 0.18	8.81	6.40	6.03	6.21 ± 0.26
Na_2O	3.26 ± 0.09	3.29	3.39	3.34 ± 0.07	3.44	3.65	3.77	3.71 ± 0.08
K_20	1.40 ± 0.04	1.82	1.87	1.85 ± 0.03	1.98	2.85	3.12	2.98 ± 0.19
TiO_2	2.74 ± 0.21	2.55	2.53	2.54 ± 0.01	2.46	1.38	1.31	1.35 ± 0.05
P_2O_5	1.15 ± 0.03	1.10	1.12	1.11 ± 0.01	1.24	0.47	0.49	0.48 ± 0.02
MnO	0.15 ± 0.01	0.14	0.14	0.14 ± 0.00	0.14	0.15	0.14	0.15 ± 0.01

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
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[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

Table 4. Cont'd.[1]

Field No.	BR-6	BA-36	Mean[4]	L-27	KH95-15	L-76	C69B	CD23	SWV-1	KH95-13	BR-8
Group[2]	13a	13a	13a	U	U	U	U	U	U	U	U
Age (Ma)[3]		13.64	13.64				9.7				35.6
SiO_2	59.16	59.37	59.27 ± 0.15	47.04	48.75	48.54	51.06	50.46	46.70	47.31	68.84
Al_2O_3	16.36	16.09	16.23 ± 0.19	14.40	15.78	15.84	14.97	17.02	14.66	15.24	14.43
Fe_TO_3	6.34	5.91	6.13 ± 0.30	10.50	10.97	10.15	11.24	9.08	11.42	13.19	4.06
MgO	1.41	1.34	1.38 ± 0.05	6.22	7.12	7.02	7.80	2.79	4.41	3.45	0.33
CaO	4.14	4.31	4.23 ± 0.12	11.79	7.74	8.05	8.07	9.46	12.11	9.36	3.81
Na_2O	4.00	4.08	4.04 ± 0.06	2.80	2.99	3.07	2.79	3.48	3.03	3.56	2.79
K_20	4.30	4.49	4.40 ± 0.13	1.01	2.05	2.79	1.67	2.12	0.95	1.70	3.16
TiO_2	1.16	1.09	1.13 ± 0.05	1.26	1.82	1.67	1.42	1.98	1.57	2.71	0.57
P_2O_5	0.45	0.44	0.45 ± 0.01	0.30	0.70	0.75	0.55	0.70	0.52	1.27	0.35
MnO	0.06	0.07	0.07 ± 0.01	0.15	0.15	0.16	0.15	0.09	0.14	0.10	0.05
LOI 925C	1.73	1.92	1.83 ± 0.13	3.99	0.56	1.23	0.06	2.10	4.32	1.35	1.04
Sums	99.11	99.11	99.11 ± 0.00	99.46	98.63	99.27	99.78	99.28	99.83	99.24	99.43
Recalculated[5]											
SiO_2	60.75	61.09	60.92 ± 0.24	49.27	49.71	49.51	51.20	51.92	48.90	48.33	69.97
Al_2O_3	16.80	16.56	16.68 ± 0.17	15.08	16.09	16.16	15.01	17.51	15.35	15.57	14.67
Fe_TO_3	6.51	6.08	6.30 ± 0.30	11.00	11.19	10.35	11.27	9.34	11.96	13.47	4.13
MgO	1.45	1.38	1.41 ± 0.05	6.52	7.26	7.16	7.82	2.87	4.62	3.52	0.34
CaO	4.25	4.43	4.34 ± 0.13	12.35	7.89	8.21	8.09	9.73	12.68	9.56	3.87
Na_2O	4.11	4.20	4.15 ± 0.06	2.93	3.05	3.13	2.80	3.58	3.17	3.64	2.84
K_20	4.42	4.62	4.52 ± 0.14	1.06	2.09	2.85	1.67	2.18	0.99	1.74	3.21
TiO_2	1.19	1.12	1.16 ± 0.05	1.32	1.86	1.70	1.42	2.04	1.64	2.77	0.58
P_2O_5	0.46	0.45	0.46 ± 0.01	0.31	0.71	0.76	0.55	0.72	0.54	1.30	0.36
MnO	0.06	0.07	0.07 ± 0.01	0.16	0.15	0.16	0.15	0.09	0.15	0.10	0.05

[1] Determined by XRF analyses. Values are in weight percent

[2] Geochemical group from Budahn and others (2002)

[3] Preliminary $^{40}Ar/^{39}Ar$ dates from Kunk and Snee (1998) and Kunk and others, 2001
Ages in parentheses are estimated from field relationships with dated samples.

[4] Uncertainties in means for groups are 1 standard deviation

[5] Recalculated to 100% on a volatile-free basis

[6] Age determined by Giegengack (1962) by the ^{14}C Method

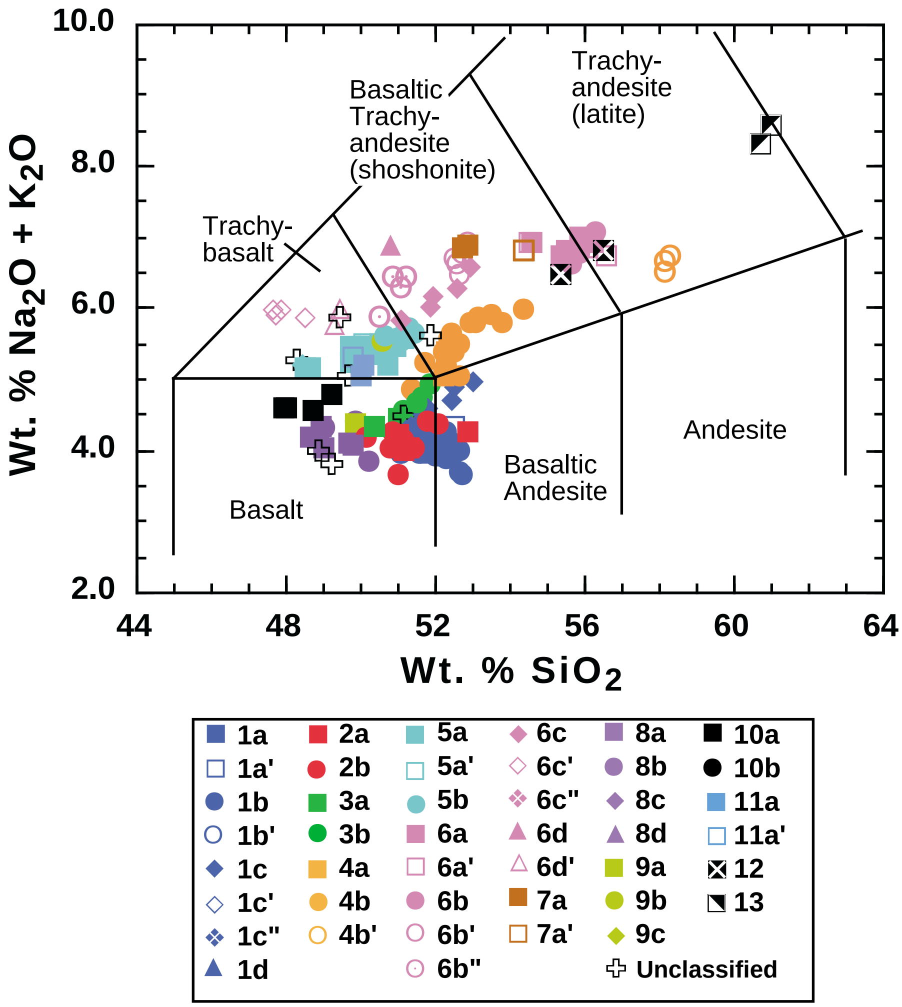


Figure 3. Na2O + K2O vs. SiO2 contents for basaltic rocks from west central Colorado after LeBas and others, 1986. Data are in weight percent and represent values recalculated to 100 percent on a volatile-free basis (Table 4).

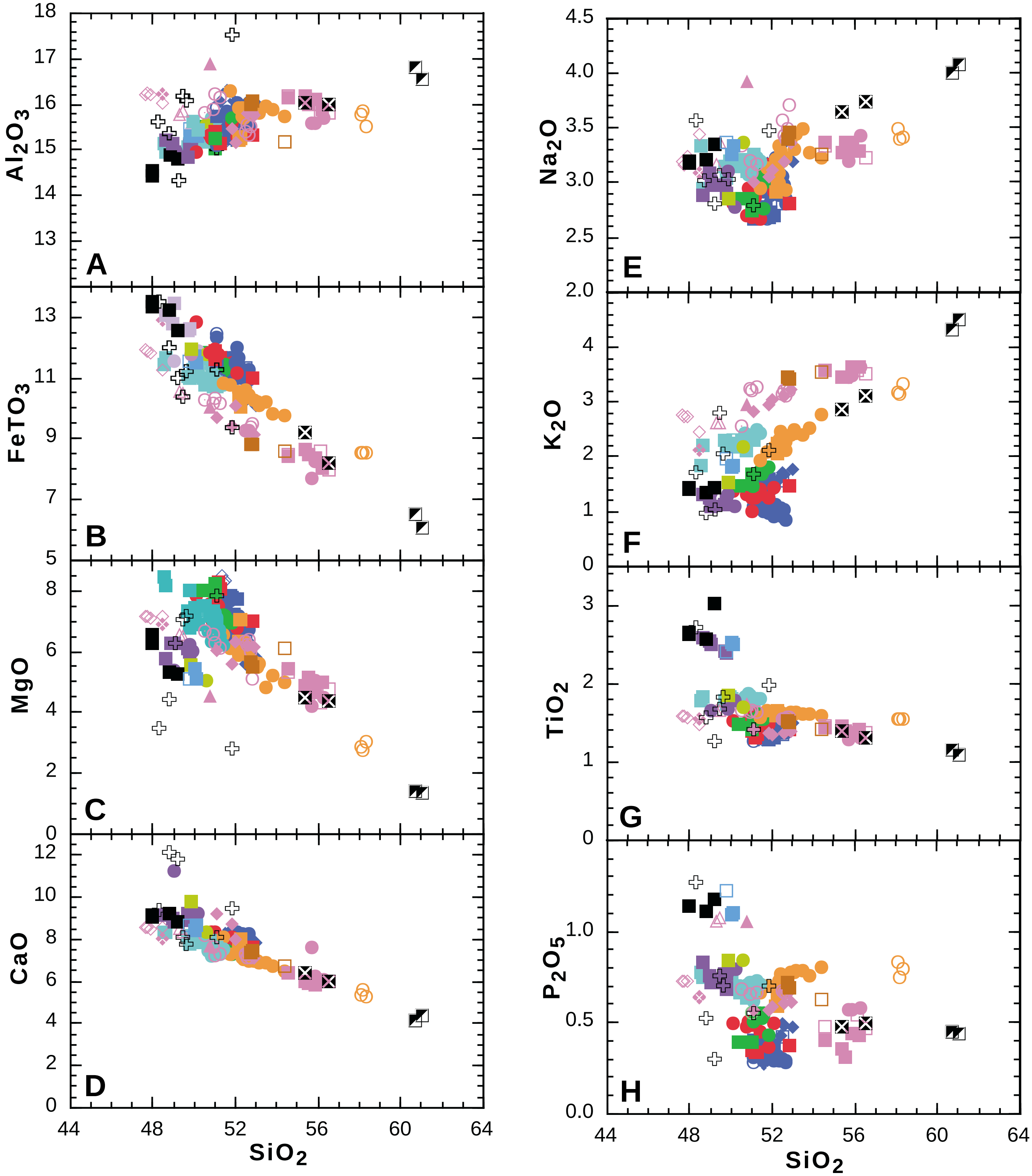
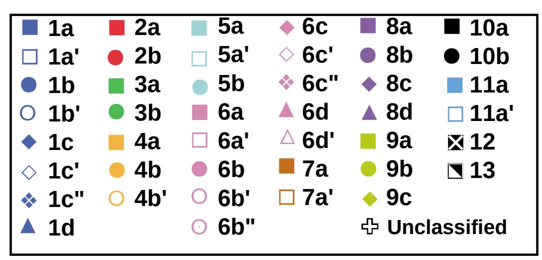


Figure 4. Major-element oxides vs. SiO_2 contents for basaltic rocks from west central Colorado. Values are in weight percent and are recalculated to 100 percent on a volatile-free basis (Table 4).



and 7 samples (0-4 Ma) are even more alkalic and range from potassic trachy-basalt to shoshonite in composition. Samples from groups 8-11 (22-24Ma) have uniformly low silica and moderate alkali contents. Groups 8, 9a, and 10 are basalts, whereas groups 9b and 11 are trachy-basalts. The 13 Ma samples (groups 12 and 13) are among the highest in silica contents and show alkali contents similar to the youngest samples (group 6 and 7). The 13-Ma samples are basaltic shoshonites and latites.

Potassium appears to be the most diagnostic of the major elements (Figure 4). The lowest K_2O contents are found among group 1 basalts (9-10 Ma)and the highest among group 6 samples (<4 Ma). Data for groups 1-6 form tight clusters or discreet trends that are fairly distinct from one another, although there is some overlap among groups 1-3. Group 7 (< 4 Ma) samples have similar K_2O contents to those of group 6, whereas the oldest basalts (groups 8-11; 22-24 Ma) have similar K_2O to groups 1-3 (10 Ma). The 13 Ma samples (groups 12 and 13) appear to lie on an extension of the K_2O vs. SiO_2 trend defined by the 10 Ma Basalt Mountain samples (group 4). The group 13 trachy-andesites are distinguished from all other groups by their evolved nature: high silica, potassium, aluminum, and sodium and low magnesium, iron, and calcium.

Sample groups 8, 10, and 11 (22-24 Ma) have distinctively high TiO_2 and P_2O_5 contents and are slightly enriched in Fe_TO_3 and depleted in MgO relative to the other groups. The 22-24 Ma group 9 samples do not show the TiO_2, P_2O_5, or MgO enrichments found in the other samples of similar age.

Trace Element Geochemistry

The samples were first separated into general geochemical groups based on their chondrite-normalized Hf/Ta and La/Yb ratios (Table 5, Figure 5A; Budahn and others, 2002; normalizing values are 1.3251 times the average C1 chondrite values of Anders and Grevesse, 1989). The Hf/Ta ratio was chosen because the ratio of one high-field-strength element (HFSE) to another is relatively insensitive to small amounts of contamination or fractional crystallization of olivine or plagioclase, and therefore should represent variations in magma sources (e.g. Wood, 1980; Meschede, 1986). The La/Yb ratio was chosen to reflect the degree of LREE enrichment which in turn should represent both the degree of partial melting of the source as well as the nature of the source region (e.g. Budahn and Schmitt, 1985; Hanson, 1989).

Thirteen principal groups were recognized, labeled 1-13 in Figure 5. The 22-24 Ma samples (groups 8-11) are characterized by intermediate Hf/Ta, but high La/Yb (Figure 5A). The 13-14 Ma samples (groups 12-13) have among the highest Hf/Ta but intermediate La/Yb. Hf/Ta for groups 1-3 (9-10 Ma) show a continuous trend of decreasing Hf/Ta with slightly increasing La/Yb. Data for the other 9-10 Ma group, group 4, are shifted from this trend toward higher La/Yb, whereas the data for 7-8 Ma samples (group 5) appear to plot on an extension of the trend defined by groups 1-3. Data for most of the group 6 samples (≤ 4 Ma) appear to extend this trend to even lower Hf/Ta. Data for some group 6 samples (6d') and group 7 samples are shifted from the main trend toward higher La/Yb (Figure 5A).

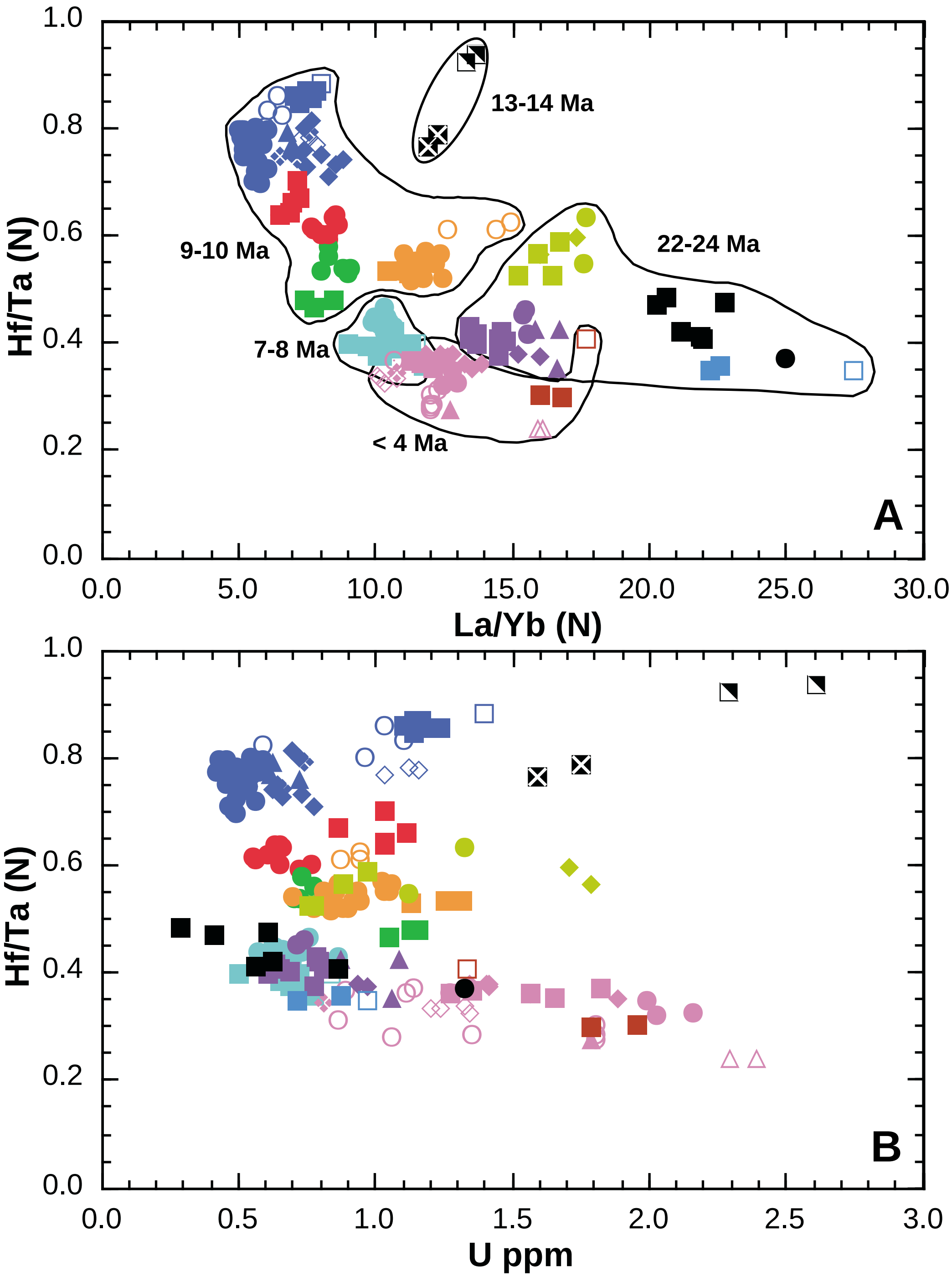
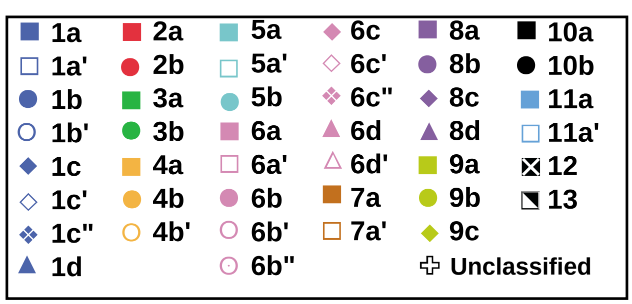


Figure 5 (A). Chondrite-normalized Hf/Ta vs. chondrite-normalized La/Yb in basaltic rocks from west central Colorado. (B) chondrite normalized Hf/Ta vs. U content in ppm. Normalizing values represent 1.3251 times the average C1 chondrite values of Anders and Grevesse (1989).



Samples within an individual group are thought to be closely related, but do not necessarily represent an individual magma batch or flow. In an attempt to identify individual magma batches, samples were then placed into subgroups (a-d) and into sub-subgroups (a', b', c', c", etc.) based on other Rb, Th, U, and K abundances (e.g., Figure 5B); Pb, Sr, and Nd isotopic compositions; and ^{40}Ar-^{39}Ar ages (Kunk and Snee, 1998; Kunk and others, 2001). For a complete discussion and evaluation of the procedure, the reader is referred to Budahn and others (2002).

In some instances it was found that multiple adjacent flows fell into the same subgroup. For example, group 1b basalts appear to consist of three sequential flows and there appear to be at least four geochemically indistinguishable group 4b flows on Basalt Mountain. Thus, we conclude that while the geochemical fingerprints of the individual subgroups may not represent individual flows, they do appear to represent individual magma batches and it may be possible to correlate flow "packages" if not individual flows.

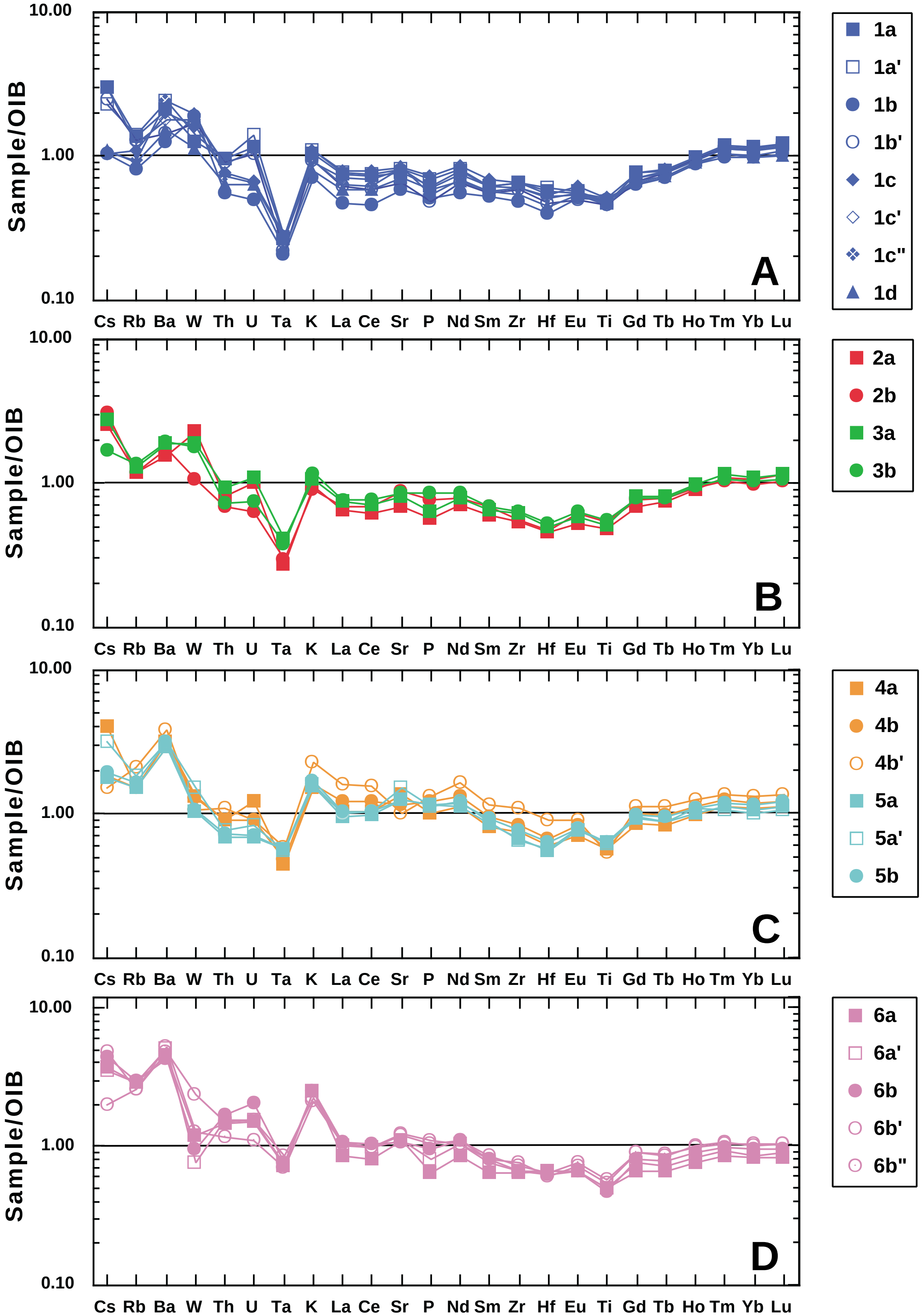
Abundances of selected trace elements determined for the basalt groups together with K, Ti, and P concentrations are shown in normalized to average oceanic island basalt (OIB; Sun and McDonough, 1989) in Figure 6. Only the means for each subgroup (Table 5) are represented in Figure 6.

The general shapes of the patterns for all groups are rather similar although there are some distinct differences. The 9-10 Ma samples (groups 1-4, Fig. 6A-6C) show distinct depletion in Ta relative to LREE and groups 1-3 are slightly LREE-depleted relative to average OIB. The samples in groups 1-3 generally show significant enrichment in Cs and Ba and slight enrichment in Rb and K. Group 4 samples show greater enrichment in the alkali elements and Ba than the other 9-10 Ma samples. The latites of group 4b' have higher trace-element abundances than the more mafic members of group 4, but otherwise have similar trace-element patterns to those of the more mafic group 4 samples.

The 7-8 Ma samples (group 5, Fig. 6C) have trace-element abundances that are nearly indistinguishable from the 9-10 Ma basalts of group 4. Trace-element contents in these two groups are higher than in groups 1-3, but the general shape of the trace-element patterns are very similar to those of groups 1-3.

The post-4 Ma basalts (groups 6 and 7) are characterized by strong enrichment of the Cs, Rb, K, Ba, Th, and U (Figs. 6C, 6D), whereas abundances of the REE and HFSE (Zr, HF, Ti) are similar to those in the older groups 1-5. Normalized Ta abundances in samples from groups 6 and 7 are similar to the LREE abundances.

The 22-24Ma samples (groups 8-11) show the least relative enrichment in alkali elements, but show the strong relative Ba enrichment common to the younger samples (Figs. 6F, 6G). Groups 10 and 11 show pronounced LREE enrichment and overall enrichment of the REE relative to Hf and Zr. Normalized Ta abundances are significantly lower than those of the LREE. The overall trace-element contents of the 22-24 Ma samples are more similar to those of the post-4Ma samples than the 7-10 Ma basalts.



Sample/OIB
10.00
1.00
0.10
Cs Rb Ba W Th U Ta K La Ce Sr P Nd Sm Zr Hf Eu Ti Gd Tb Ho Tm Yb Lu
A
1a
1a'
1b
1b'
1c
1c'
1c"
1d
B
2a
2b
3a
3b
C
4a
4b
4b'
5a
5a'
5b
D
6a
6a'
6b
6b'
6b"

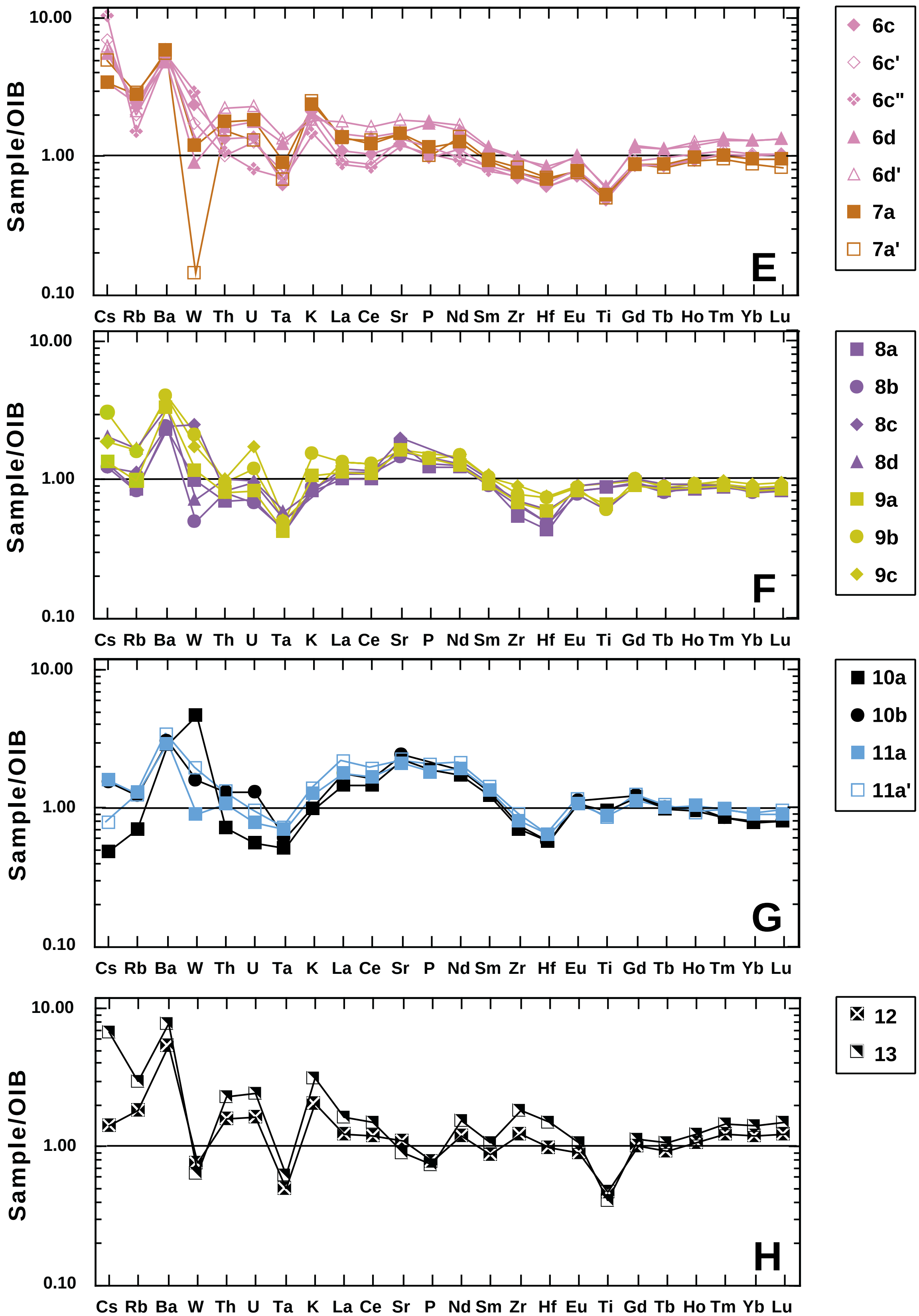


Figure 6. OIB-normalized trace element abundances in basaltic rocks from west central Colorado. Data are normalized to average oceanic island basalt (OIB) values from Sun and McDonough, 1989.

Table 5. Trace element contents in Tertiary basaltic rocks from central Colorado.[1]

Sample	KH95-33	KH95-22	KH95-35	KH95-37	KH95-40	CC108	KH95-21	Mean[3]	KH95-19	CD53D	CD31	CD51B
Group[2]	1a	1a	1a	1a	1a	1a	1a	1a	1a'	1b	1b	1b
Rb	43.5	40.8	48.8	45.1	42.1	36.9	38.8	42.3 ± 4.0	42.8	21.3	22.8	26.6
Sr	434.0	468.0	518.0	503.0	549.0	535.0	535.0	506.0 ± 41.0	539.0	369.0	394.0	380.0
Cs	1.21	1.16	1.17	1.31	1.28	0.98	1.02	1.16 ± 0.12	0.87	0.34	0.42	0.37
Ba	582	716	712	719	734	832	783	725 ± 77	839	339	334	361
Th	3.69	3.80	3.65	3.80	3.89	3.82	3.90	3.79 ± 0.09	3.82	1.95	2.20	2.05
U	1.11	1.15	1.15	1.22	1.24	1.20	1.17	1.18 ± 0.05	1.40	0.46	0.50	0.54
La	25.9	26.6	27.3	28.0	29.5	29.2	28.3	27.8 ± 1.3	28.2	15.3	16.3	16.4
Ce	53.5	55.9	53.6	57.8	62.0	58.9	59.5	57.3 ± 3.2	59.1	31.6	36.0	35.0
Nd	27.3	29.6	29.1	30.8	31.9	31.0	31.4	30.2 ± 1.6	30.7	18.0	20.6	20.8
Sm	5.91	6.01	6.02	6.26	6.38	6.44	6.29	6.19 ± 0.21	6.20	4.96	5.42	5.05
Eu	1.61	1.63	1.57	1.63	1.71	1.70	1.70	1.65 ± 0.05	1.68	1.44	1.53	1.48
Gd	5.41	5.34	6.13	5.93	6.15	5.91	5.59	5.78 ± 0.33	5.35	4.61	4.92	4.90
Tb	0.82	0.81	0.83	0.83	0.83	0.83	0.82	0.82 ± 0.01	0.82	0.68	0.75	0.75
Ho	1.03	1.03	0.99	1.02	1.08	1.04	0.98	1.02 ± 0.03	0.98	0.89	0.89	0.90
Tm	0.41	0.39	0.41	0.41	0.42	0.43	0.39	0.41 ± 0.01	0.39	0.35	0.00	0.36
Yb	2.46	2.47	2.44	2.48	2.60	2.56	2.42	2.49 ± 0.07	2.35	2.04	2.12	2.12
Lu	0.36	0.37	0.36	0.36	0.38	0.37	0.36	0.37 ± 0.01	0.35	0.30	0.32	0.31
Zr	168	185	190	178	183	198	187	184 ± 9	184	125	136	133
Hf	4.03	4.33	4.27	4.51	4.52	4.63	4.70	4.43 ± 0.23	4.71	2.91	3.09	3.07
Ta	0.64	0.70	0.67	0.72	0.72	0.74	0.74	0.70 ± 0.04	0.73	0.50	0.54	0.56
W	1.08	0.63	0.98	0.81	0.27	0.39	0.76	0.70 ± 0.30	0.77	0.54	1.04	1.13
Sc	25.3	25.3	24.9	25.3	25.4	26.3	25.8	25.5 ± 0.4	25.0	21.2	22.1	21.9
Cr	261	268	280	276	276	293	275	276 ± 10	268	219	226	218
Co	47.1	46.9	46.3	45.2	46.8	46.2	44.9	46.2 ± 0.9	45.2	43.3	43.7	42.5
Ni	190	193	199	192	190	190	183	191 ± 5	193	138	131	130
Zn	80.7	91.9	96.3	89.2	106.0	87.6	96.8	92.6 ± 8.1	86.0	90.6	95.0	98.2
As	0.90	1.65	1.72	0.99	1.12	3.27	0.67	1.47 ± 0.88	3.02	2.58	1.70	1.03
Sb	0.13	0.13	0.07	0.06	0.07	0.07	0.05	0.08 ± 0.03	0.33	0.08	0.11	0.04
Au ppb	2.76	0.07	3.34	48.00	3.37	1.68	1.23	8.64 ± 17.40	1.60	5.67	4.68	9.08

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	CD179	CD181C	CD17	CD124A	CD218	CD180	CD156	CD191B	CD59	CD53C	CD193D	CD65	CD51A
Group[2]	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b
Rb	25.2	23.8	25.8	19.1	23.4	20.5	25.8	26.6	20.9	24.3	27.3	25.3	25.1
Sr	414.0	332.0	343.0	353.0	393.0	366.0	450.0	367.0	413.0	389.0	373.0	383.0	365.0
Cs	0.38	0.38	0.37	0.25	0.34	0.27	0.44	0.39	0.25	0.41	0.36	0.42	0.32
Ba	502	393	365	383	498	358	352	360	410	363	496	551	405
Th	2.13	2.02	2.09	2.13	2.10	2.01	2.16	2.01	2.23	2.24	2.13	2.11	2.12
U	0.58	0.47	0.53	0.47	0.46	0.43	0.57	0.47	0.50	0.49	0.51	0.49	0.52
La	16.4	16.1	16.3	16.7	16.7	16.0	16.4	16.2	16.8	16.9	17.0	16.2	16.2
Ce	36.2	35.0	35.1	36.2	36.0	33.9	34.9	34.4	36.5	37.8	36.8	34.4	35.1
Nd	20.9	19.7	20.5	19.2	21.6	20.1	20.6	20.2	20.6	20.8	20.9	20.3	20.0
Sm	5.02	4.71	4.92	5.11	5.01	4.77	4.89	4.82	5.45	5.54	4.91	4.98	5.09
Eu	1.53	1.45	1.46	1.45	1.50	1.46	1.50	1.47	1.54	1.55	1.48	1.47	1.49
Gd	5.04	4.80	4.77	4.73	4.81	4.98	5.00	4.78	5.04	4.85	4.83	4.78	4.78
Tb	0.76	0.71	0.74	0.71	0.72	0.72	0.72	0.70	0.73	0.76	0.72	0.72	0.75
Ho	0.93	0.91	0.89	0.92	0.94	0.87	0.89	0.88	0.94	0.96	0.91	0.87	0.88
Tm	0.35	0.35	0.34	0.34	0.36	0.33	0.34	0.33	0.35	0.35	0.35	0.34	0.34
Yb	2.11	2.07	2.09	2.13	2.11	2.01	2.06	2.03	2.10	2.10	2.11	2.01	2.00
Lu	0.31	0.30	0.30	0.31	0.31	0.29	0.29	0.30	0.31	0.31	0.31	0.30	0.30
Zr	150	129	124	135	135	130	135	131	123	126	132	123	121
Hf	3.17	3.01	3.07	3.03	3.08	3.01	3.00	3.01	3.07	3.11	3.11	2.98	3.07
Ta	0.56	0.53	0.55	0.53	0.56	0.53	0.53	0.54	0.56	0.55	0.56	0.53	0.55
W	1.20	1.93	1.42	1.15	1.13	0.93	1.56	2.06	0.57	0.27	2.50	1.18	0.38
Sc	22.5	21.9	21.7	22.4	22.2	21.6	21.3	21.7	22.2	21.9	22.4	21.6	21.6
Cr	220	223	217	229	227	212	218	212	236	225	226	217	216
Co	43.7	43.7	43.2	44.1	45.0	42.6	42.7	41.5	45.0	43.5	43.9	41.8	42.2
Ni	131	133	129	136	133	135	135	128	148	132	134	133	138
Zn	95.6	99.7	94.9	93.1	98.0	93.1	82.5	92.2	96.9	91.8	93.2	91.3	97.8
As	0.91	1.06	0.38	1.66	0.94	1.62	0.21	0.94	0.83	1.37	0.42	0.51	0.34
Sb	0.05	0.08	0.04	0.06	0.03	0.05	0.08	0.08	0.08	0.14	0.11	0.10	0.07
Au ppb	6.70	10.70	0.68	1.29	1.67	2.62	1.46	2.50	17.60	1.03	0.89	3.44	5.89

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	CD192	CD53B	CD193B	CD181B	KH95-9	CD5	KH95-12Z	CD6	CD193C	K97-10-8B	CD124B	KH95-11	K97-8-12F
Group[2]	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b
Rb	27.6	24.6	22.2	23.4	28.1	25.6	26.4	28.2	24.9	28.7	27.4	25.5	27.8
Sr	337.0	398.0	356.0	370.0	388.0	404.0	465.0	375.0	352.0	392.0	343.0	430.0	442.0
Cs	0.35	0.36	0.25	0.20	0.44	0.35	0.35	0.47	0.31	0.39	0.36	0.29	1.70
Ba	360	362	390	379	463	376	462	393	394	465	422	531	470
Th	2.13	2.32	2.16	2.24	2.34	2.24	2.38	2.37	2.23	2.49	2.42	2.38	2.49
U	0.50	0.49	0.53	0.53	0.49	0.47	0.57	0.55	0.54	0.52	0.58	0.50	0.47
La	16.7	17.0	17.2	17.4	18.1	17.0	19.0	18.5	17.5	18.8	18.6	18.1	19.4
Ce	35.1	38.2	37.1	37.0	39.7	35.0	39.2	40.9	36.8	40.2	38.6	39.2	42.8
Nd	19.6	20.4	21.0	20.9	22.2	20.7	24.7	21.2	21.6	23.5	21.0	22.6	23.6
Sm	4.72	5.57	4.76	5.04	5.49	5.50	5.96	5.40	4.92	5.68	5.57	5.52	5.61
Eu	1.46	1.55	1.52	1.55	1.57	1.58	1.66	1.50	1.50	1.58	1.50	1.56	1.56
Gd	4.79	5.05	4.79	5.01	4.78	4.90	5.13	4.82	4.78	5.35	4.56	4.79	4.90
Tb	0.71	0.74	0.75	0.73	0.77	0.75	0.81	0.73	0.73	0.77	0.75	0.73	0.75
Ho	0.90	0.99	0.92	0.93	0.92	0.96	1.02	0.89	0.88	0.99	0.96	0.93	0.93
Tm	0.33	0.35	0.34	0.35	0.37	0.34	0.36	0.36	0.35	0.38	0.35	0.33	0.37
Yb	2.05	2.08	2.08	2.10	2.18	2.02	2.25	2.19	2.06	2.19	2.16	2.09	2.21
Lu	0.30	0.31	0.31	0.31	0.30	0.29	0.33	0.32	0.31	0.31	0.33	0.32	0.31
Zr	135	139	120	141	139	142	143	119	134	128	150	130	142
Hf	3.00	3.16	3.10	3.14	3.14	3.02	3.21	3.22	3.19	3.30	3.29	3.17	3.39
Ta	0.54	0.57	0.56	0.56	0.61	0.58	0.61	0.55	0.56	0.61	0.58	0.62	0.60
W	1.51	0.25	1.56	0.34	1.34	0.69	1.12	0.30	2.09	0.65	0.88	0.93	0.50
Sc	21.6	22.2	22.4	22.2	22.2	22.1	22.7	23.1	22.3	23.1	22.7	22.5	23.2
Cr	210	225	210	224	223	224	231	242	219	231	233	229	221
Co	41.9	44.1	43.1	43.4	43.8	43.4	43.6	46.9	42.6	43.2	44.5	44.9	43.2
Ni	132	137	126	128	121	139	135	154	126	125	125	143	140
Zn	91.6	100.0	81.1	88.8	92.2	92.0	104.0	98.9	97.6	127.0	97.0	101.0	103.0
As	1.20	0.73	0.93	1.62	0.86	2.60	4.80	2.01	2.00	2.63	1.02	2.59	0.27
Sb	0.04	0.03	0.05	0.08	0.14	0.11	0.09	0.08	0.10	0.12	0.07	0.06	0.11
Au ppb	1.77	2.20	2.04	2.07	2.28	1.99	3.92	218.00	2.32	0.30	1.72	0.73	3.27

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	KH95-8	I70-03	I70-02	Mean[3]	KH95-24	KH95-23	KH95-38	Mean[3]	L-23	CD150C	CD12
Group[2]	1b	1b	1b	1b	1b'	1b'	1b'	1b	1c	1c	1c
Rb	23.5	27.4	27.4	25.08 ± 2.46	34.8	43.5	40.0	39.4 ± 4.4	32.3	22.1	35.8
Sr	424.0	426.0	392.0	386.81 ± 33.53	380.0	416.0	477.0	424.0 ± 49.0	517.0	519.0	502.0
Cs	0.36	0.36	0.41	0.4 ± 0.25	0.88	1.02	1.00	0.97 ± 0.08	0.40	0.21	0.25
Ba	450	948	494	432.16 ± 111.84	451	487	543	494 ± 46	602	648	643
Th	2.40	2.01	2.07	2.2 ± 0.15	3.37	3.74	3.63	3.58 ± 0.19	3.05	3.08	2.95
U	0.50	0.60	0.44	0.51 ± 0.04	0.97	1.11	1.04	1.04 ± 0.07	0.73	0.55	0.67
La	19.3	16.0	16.4	17.09 ± 1.08	20.8	22.7	23.9	22.5 ± 1.6	26.4	26.0	27.4
Ce	39.2	33.5	34.2	36.61 ± 2.44	44.0	48.0	47.5	46.5 ± 2.2	57.5	58.2	60.0
Nd	23.0	20.4	20.7	21 ± 1.34	23.1	25.5	25.5	24.7 ± 1.4	31.1	32.0	32.0
Sm	5.63	4.96	5.10	5.19 ± 0.34	5.14	5.73	5.63	5.50 ± 0.32	6.44	6.43	7.06
Eu	1.61	1.49	1.52	1.52 ± 0.05	1.40	1.51	1.53	1.48 ± 0.07	1.73	1.84	1.83
Gd	5.01	4.56	4.41	4.85 ± 0.18	4.89	4.98	5.38	5.08 ± 0.26	5.40	5.30	6.13
Tb	0.80	0.73	0.73	0.74 ± 0.03	0.77	0.81	0.81	0.80 ± 0.02	0.79	0.85	0.86
Ho	0.95	0.89	0.94	0.92 ± 0.04	1.01	1.00	1.02	1.01 ± 0.01	0.99	0.97	1.11
Tm	0.36	0.37	0.36	0.34 ± 0.06	0.39	0.41	0.41	0.40 ± 0.01	0.40	0.38	0.40
Yb	2.14	2.11	2.11	2.1 ± 0.06	2.32	2.51	2.49	2.44 ± 0.10	2.40	2.36	2.46
Lu	0.32	0.30	0.31	0.31 ± 0.01	0.34	0.37	0.37	0.36 ± 0.02	0.35	0.34	0.37
Zr	125	151	128	132.94 ± 8.77	151	151	183	162 ± 18	177	167	178
Hf	3.23	3.04	3.10	3.11 ± 0.1	3.34	3.73	3.77	3.61 ± 0.24	3.98	3.95	4.12
Ta	0.61	0.52	0.53	0.56 ± 0.03	0.57	0.61	0.60	0.59 ± 0.02	0.68	0.71	0.77
W	1.39	0.50	0.50	1.05 ± 0.59	1.12	1.08	0.62	0.94 ± 0.28	1.45	0.98	0.54
Sc	22.4	22.3	22.6	22.18 ± 0.5	23.2	26.2	25.5	25.0 ± 1.6	24.2	24.8	24.6
Cr	227	219	225	222.94 ± 7.42	245	247	252	248 ± 4	214	215	196
Co	44.7	43.6	44.6	43.56 ± 1.1	48.4	46.2	45.8	46.8 ± 1.4	42.7	43.6	42.4
Ni	140	127	137	133.72 ± 6.91	171	173	175	173 ± 2	112	132	114
Zn	103.0	110.0	107.0	96.82 ± 8.26	97.9	107.0	94.6	99.8 ± 6.4	96.1	109.0	87.6
As	0.87	1.53	0.52	1.33 ± 0.95	1.37	0.62	0.24	0.74 ± 0.58	1.82	1.04	1.47
Sb	0.06	0.11	0.06	0.08 ± 0.03	0.18	0.05	0.06	0.10 ± 0.07	0.16	0.08	0.08
Au ppb	0.43	0.10	0.73	9.99 ± 38.13	2.26	1.92	1.92	2.03 ± 0.20	0.99	0.97	2.15

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	L-26	CD109	L-25	L-201	K97-8-15A	Mean[3]	KH95-2	KH95-3	KH95-5	Mean[3]	CD204
Group[2]	1c	1c	1c	1c	1c	1c	1c'	1c'	1c'	1c'	1c"
Rb	36.7	38.0	32.8	34.5	37.2	33.7 ± 5.1	36.9	38.6	36.4	37.3 ± 1.2	21.6
Sr	541.0	547.0	580.0	570.0	623.0	550.0 ± 40.0	545.0	547.0	503.0	532.0 ± 25.0	548.0
Cs	0.52	0.51	0.38	0.47	0.49	0.40 ± 0.12	1.20	1.19	1.06	1.15 ± 0.08	0.28
Ba	621	669	741	774	779	685 ± 70	642	644	606	631 ± 21	884
Th	2.86	3.02	3.09	3.19	3.16	3.05 ± 0.11	3.51	3.54	3.40	3.48 ± 0.07	2.89
U	0.70	0.65	0.78	0.74	0.63	0.68 ± 0.07	1.16	1.13	1.04	1.11 ± 0.06	0.54
La	25.3	29.4	31.5	33.0	33.0	29.0 ± 3.2	26.4	26.6	25.2	26.1 ± 0.8	20.4
Ce	54.0	61.7	67.8	69.1	71.7	62.5 ± 6.3	55.5	56.0	52.3	54.6 ± 2.0	43.5
Nd	29.1	33.1	35.5	36.5	36.0	33.2 ± 2.6	30.2	28.4	26.5	28.4 ± 1.9	22.9
Sm	6.06	7.31	6.99	7.64	7.41	6.92 ± 0.55	6.37	6.39	5.69	6.15 ± 0.40	4.96
Eu	1.74	1.84	1.89	2.01	1.94	1.85 ± 0.09	1.59	1.64	1.56	1.60 ± 0.04	1.62
Gd	5.61	5.83	6.08	6.04	5.80	5.77 ± 0.31	5.17	5.58	5.27	5.34 ± 0.21	4.56
Tb	0.82	0.86	0.85	0.90	0.86	0.85 ± 0.03	0.78	0.80	0.81	0.80 ± 0.02	0.66
Ho	0.99	1.04	1.05	1.09	1.08	1.04 ± 0.05	1.00	1.03	0.93	0.99 ± 0.05	0.85
Tm	0.38	0.40	0.43	0.43	0.42	0.41 ± 0.02	0.40	0.42	0.37	0.40 ± 0.03	0.35
Yb	2.22	2.45	2.55	2.58	2.51	2.44 ± 0.12	2.45	2.36	2.16	2.32 ± 0.15	2.09
Lu	0.34	0.38	0.36	0.40	0.35	0.36 ± 0.02	0.36	0.35	0.33	0.35 ± 0.02	0.31
Zr	179	182	196	194	200	184 ± 11	178	179	151	169 ± 16	161
Hf	3.76	4.30	4.26	4.61	4.52	4.19 ± 0.29	4.16	4.25	3.95	4.12 ± 0.15	4.10
Ta	0.63	0.78	0.82	0.86	0.83	0.76 ± 0.08	0.73	0.74	0.70	0.72 ± 0.02	0.75
W	1.05	2.19	0.00	0.12	0.72	0.88 ± 0.71	0.40	1.00	1.55	0.98 ± 0.58	0.87
Sc	23.3	24.8	23.7	25.5	24.2	24.4 ± 0.7	25.4	25.1	23.9	24.8 ± 0.8	25.2
Cr	208	164	155	145	130	178 ± 34	302	286	283	290 ± 10	214
Co	41.6	38.3	37.8	36.9	34.4	39.7 ± 3.3	49.8	47.8	46.6	48.1 ± 1.6	41.2
Ni	106	101	104	76	78	103 ± 19	210	206	208	208 ± 2	115
Zn	90.3	99.9	106.0	88.4	92.9	96.3 ± 8.1	93.0	98.9	96.1	96.0 ± 3.0	112.0
As	1.33	3.19	1.85	1.23	0.13	1.51 ± 0.87	1.23	0.97	0.50	0.90 ± 0.37	3.07
Sb	0.12	0.08	0.11	0.19	0.03	0.11 ± 0.05	0.09	0.07	0.06	0.07 ± 0.02	0.16
Au ppb	0.47	1.38	0.25	0.78	3.83	1.35 ± 1.16	3.32	1.87	1.80	2.33 ± 0.86	0.09

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	CD203	CD138	Mean[3]	CD45A	CD42	CD45B	I70-08	Mean[3]	CC140	KH95-17	KH95-1
Group[2]	1c"	1c"	1c"	1d	1d	1d	1d	1d	2a	2a	2a
Rb	32.5	32.1	28.7 ± 6.2	29.9	22.5	32.5	25.5	27.6 ± 4.5	40.9	31.5	37.7
Sr	529.0	572.0	550.0 ± 22.0	438.0	461.0	509.0	449.0	464.0 ± 31.0	429.0	458.0	469.0
Cs	0.47	0.47	0.41 ± 0.11	0.58	0.14	0.60	0.36	0.42 ± 0.22	1.07	0.59	1.31
Ba	788	854	842 ± 49	535	522	547	525	532 ± 11	484	557	633
Th	2.96	2.92	2.92 ± 0.04	2.53	2.50	2.54	2.42	2.50 ± 0.05	3.54	3.53	3.62
U	0.67	0.75	0.65 ± 0.11	0.63	0.62	0.73	0.60	0.65 ± 0.06	1.04	1.04	1.12
La	23.6	25.3	23.1 ± 2.5	22.1	21.5	22.2	21.1	21.7 ± 0.5	23.7	24.5	24.3
Ce	50.1	54.8	49.5 ± 5.7	47.7	45.4	47.7	43.7	46.1 ± 1.9	48.3	50.9	51.1
Nd	26.9	29.8	26.5 ± 3.5	25.6	25.7	26.7	25.5	25.9 ± 0.6	25.4	27.7	27.5
Sm	5.67	6.17	5.60 ± 0.61	5.75	5.65	5.84	5.62	5.72 ± 0.10	5.95	5.94	5.88
Eu	1.66	1.72	1.67 ± 0.05	1.65	1.60	1.58	1.64	1.62 ± 0.03	1.57	1.57	1.57
Gd	5.06	5.27	4.96 ± 0.36	5.29	5.12	5.23	4.75	5.10 ± 0.24	5.50	4.91	5.28
Tb	0.73	0.80	0.73 ± 0.07	0.76	0.75	0.76	0.76	0.76 ± 0.00	0.76	0.78	0.78
Ho	0.94	0.97	0.92 ± 0.06	0.98	0.94	0.93	0.96	0.95 ± 0.02	1.00	1.03	0.95
Tm	0.37	0.36	0.36 ± 0.01	0.37	0.34	0.36	0.37	0.36 ± 0.01	0.40	0.38	0.41
Yb	2.21	2.24	2.18 ± 0.08	2.19	2.08	2.10	2.15	2.13 ± 0.05	2.43	2.39	2.35
Lu	0.33	0.33	0.32 ± 0.01	0.30	0.31	0.31	0.30	0.31 ± 0.01	0.37	0.36	0.36
Zr	172	164	166 ± 6	150	150	148	150	150 ± 1	147	154	156
Hf	3.92	3.82	3.95 ± 0.14	3.53	3.44	3.50	3.44	3.48 ± 0.05	3.60	3.72	3.72
Ta	0.72	0.66	0.71 ± 0.05	0.61	0.61	0.63	0.57	0.61 ± 0.03	0.77	0.79	0.77
W	0.99	1.39	1.08 ± 0.27	0.81	0.64	0.55	0.50	0.63 ± 0.14	1.24	1.81	1.68
Sc	24.5	23.6	24.4 ± 0.8	22.2	21.7	22.0	23.0	22.2 ± 0.6	25.3	25.8	25.0
Cr	214	208	212 ± 3	217	219	221	232	222 ± 7	258	273	265
Co	41.3	40.7	41.1 ± 0.3	42.5	42.1	42.4	44.5	42.9 ± 1.1	48.0	48.5	47.6
Ni	110	111	112 ± 3	137	128	135	140	135 ± 5	186	177	208
Zn	102.0	104.0	106.0 ± 5.3	98.7	98.5	101.0	109.0	101.8 ± 4.9	107.0	96.6	87.7
As	2.08	0.75	1.97 ± 1.16	0.28	2.36	1.93	1.65	1.56 ± 0.90	1.01	1.85	0.40
Sb	0.04	0.04	0.08 ± 0.07	0.07	0.14	0.05	0.07	0.08 ± 0.04	0.04	0.11	0.09
Au ppb	1.84	1.73	1.22 ± 0.98	15.80	0.25	1.55	0.04	4.41 ± 7.62	1.18	2.76	1.37

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	KH95-6	CC118	Mean[3]	CC132	CC-LA-1	CC127	GL207	CC-LA-2	GL165B	GS96-1	CC126	K97-8-12E
Group[2]	2a	2a	2a	2b	2b	2b	2b	2b	2b	2b	2b	2b
Rb	38.2	33.8	36.4 ± 3.7	28.7	30.1	54.1	37.8	41.8	25.2	26.1	44.0	45.7
Sr	444.0	487.0	457.0 ± 22.0	541.0	554.0	515.0	618.0	603.0	661.0	626.0	617.0	516.0
Cs	1.04	0.89	0.98 ± 0.26	1.87	1.25	1.37	0.78	0.95	0.44	0.39	2.40	1.30
Ba	547	530	550 ± 54	531	555	611	749	625	660	611	654	481
Th	3.26	2.29	3.25 ± 0.55	2.59	2.62	2.74	3.15	2.81	2.71	2.70	2.58	2.87
U	1.04	0.87	1.02 ± 0.09	0.56	0.57	0.77	0.73	0.66	0.67	0.66	0.61	0.64
La	24.3	22.4	23.8 ± 0.9	24.3	25.0	25.5	26.5	26.3	27.0	26.8	25.6	22.1
Ce	49.1	46.7	49.2 ± 1.8	50.5	54.8	54.2	56.8	57.3	59.2	60.8	54.5	48.5
Nd	25.7	27.5	26.8 ± 1.1	28.3	28.8	29.6	32.8	30.9	33.7	31.5	30.4	26.7
Sm	5.60	6.13	5.90 ± 0.19	6.83	7.02	6.33	7.40	6.99	6.89	7.16	6.27	6.16
Eu	1.51	1.68	1.58 ± 0.06	1.87	1.89	1.75	1.99	1.83	1.89	1.86	1.76	1.69
Gd	4.92	5.56	5.23 ± 0.31	5.46	6.09	5.31	6.49	5.69	6.01	6.03	5.53	5.44
Tb	0.77	0.79	0.78 ± 0.01	0.82	0.83	0.80	0.88	0.83	0.80	0.81	0.76	0.80
Ho	0.91	0.91	0.96 ± 0.05	1.00	0.98	0.90	1.05	0.99	0.95	0.98	0.93	0.96
Tm	0.37	0.34	0.38 ± 0.03	0.36	0.36	0.36	0.37	0.37	0.36	0.36	0.33	0.37
Yb	2.27	2.07	2.30 ± 0.14	2.12	2.17	2.12	2.14	2.12	2.14	2.11	1.99	2.28
Lu	0.34	0.30	0.35 ± 0.03	0.31	0.32	0.31	0.32	0.32	0.31	0.32	0.29	0.32
Zr	155	137	150 ± 8	133	136	140	182	155	170	165	162	154
Hf	3.60	3.23	3.57 ± 0.20	3.48	3.54	3.66	3.78	3.66	3.63	3.65	3.54	3.51
Ta	0.70	0.66	0.74 ± 0.06	0.77	0.79	0.83	0.87	0.83	0.78	0.78	0.78	0.75
W	1.48	0.14	1.27 ± 0.67	0.41	1.08	0.86	0.11	0.71	0.11	0.62	0.30	1.11
Sc	24.5	21.3	24.4 ± 1.8	21.4	21.5	21.2	21.8	21.2	21.6	21.9	21.2	23.8
Cr	276	232	261 ± 18	225	226	223	212	227	225	245	222	216
Co	48.7	42.9	47.1 ± 2.4	44.2	44.0	43.5	42.2	45.6	47.4	47.1	42.3	41.5
Ni	210	169	190 ± 18	173	178	153	169	177	188	202	158	122
Zn	93.3	96.8	96.3 ± 7.0	104.0	76.7	95.5	97.8	92.2	93.1	97.8	93.9	111.0
As	1.87	0.51	1.13 ± 0.71	0.16	0.48	0.25	0.21	0.37	0.18	0.69	0.27	0.64
Sb	0.09	0.06	0.08 ± 0.03	0.07	0.08	0.14	0.04	0.13	0.03	0.15	0.10	0.06
Au ppb	1.74	0.14	1.44 ± 0.95	1.36	1.83	1.62	1.97	0.39	1.19	2.45	0.20	4.10

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	Mean[3]	KH95-34	KH95-42	KH95-36	Mean[3]	CD181A	CD193A	CD19	CD53A	CD187	CC-LA-3
Group[2]	2b	3a	3a	3a	3a	3b	3b	3b	3b	3b	3b
Rb	37.1 ± 10.1	31.4	40.3	46.1	39.3 ± 7.4	40.7	39.8	32.2	37.5	39.8	59.1
Sr	583.0 ± 53.0	557.0	554.0	506.0	539.0 ± 29.0	542.0	536.0	552.0	600.0	547.0	579.0
Cs	1.19 ± 0.65	0.82	1.08	1.25	1.05 ± 0.22	0.62	0.60	0.51	0.62	0.57	0.99
Ba	609 ± 79	659	689	636	661 ± 27	704	661	680	659	706	673
Th	2.75 ± 0.18	3.69	3.66	3.70	3.68 ± 0.02	2.70	2.91	2.88	2.84	2.89	2.99
U	0.65 ± 0.07	1.06	1.14	1.16	1.12 ± 0.05	0.77	0.78	0.74	0.73	0.80	0.71
La	25.5 ± 1.5	27.5	29.2	26.9	27.9 ± 1.2	24.5	29.0	28.1	29.2	30.4	30.3
Ce	55.2 ± 3.9	55.4	59.3	56.0	56.9 ± 2.1	52.1	62.9	61.7	63.0	64.1	62.9
Nd	30.3 ± 2.2	30.7	32.0	29.0	30.6 ± 1.5	27.9	35.0	33.9	34.0	35.2	33.1
Sm	6.78 ± 0.43	6.55	6.74	6.29	6.53 ± 0.23	5.48	6.89	6.98	7.58	6.95	7.45
Eu	1.84 ± 0.09	1.73	1.78	1.69	1.73 ± 0.05	1.77	1.93	1.86	2.00	1.95	1.94
Gd	5.78 ± 0.39	6.01	6.36	6.06	6.14 ± 0.19	5.04	6.34	5.76	6.22	5.90	6.21
Tb	0.81 ± 0.03	0.84	0.87	0.81	0.84 ± 0.03	0.71	0.86	0.85	0.86	0.85	0.83
Ho	0.97 ± 0.04	1.00	1.10	0.99	1.03 ± 0.06	0.89	1.04	0.97	1.05	1.00	1.04
Tm	0.36 ± 0.01	0.40	0.40	0.41	0.40 ± 0.01	0.33	0.41	0.37	0.36	0.38	0.37
Yb	2.13 ± 0.07	2.37	2.32	2.44	2.38 ± 0.06	2.04	2.35	2.27	2.23	2.26	2.24
Lu	0.31 ± 0.01	0.35	0.35	0.34	0.35 ± 0.01	0.29	0.32	0.32	0.33	0.32	0.33
Zr	155 ± 16	186	157	174	172 ± 15	155	195	172	182	182	189
Hf	3.61 ± 0.10	3.79	3.84	3.81	3.81 ± 0.03	4.11	3.98	3.89	4.11	4.15	4.15
Ta	0.80 ± 0.04	1.11	1.09	1.09	1.10 ± 0.01	1.05	0.97	0.92	1.04	1.07	1.05
W	0.59 ± 0.38	0.76	0.95	1.43	1.05 ± 0.35	0.97	1.99	0.55	0.85	0.74	0.95
Sc	21.7 ± 0.8	24.9	24.6	24.1	24.5 ± 0.4	21.3	21.7	21.9	20.9	21.0	21.1
Cr	225 ± 9	280	289	271	280 ± 9	189	205	213	190	198	199
Co	44.2 ± 2.1	49.4	51.0	47.5	49.3 ± 1.8	41.2	43.3	44.1	42.1	42.2	42.9
Ni	169 ± 23	222	228	215	222 ± 7	145	163	160	152	157	166
Zn	95.8 ± 9.3	88.0	102.0	98.9	96.3 ± 7.4	90.2	86.1	96.7	103.0	93.3	92.1
As	0.36 ± 0.20	1.24	1.99	1.05	1.43 ± 0.50	0.19	0.51	0.47	0.33	0.39	0.47
Sb	0.09 ± 0.04	0.13	0.19	0.05	0.12 ± 0.07	0.07	0.05	0.04	0.07	0.05	0.15
Au ppb	1.68 ± 1.16	1.30	3.07	2.48	2.28 ± 0.90	6.03	1.66	1.15	0.69	0.50	1.75

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	Mean[3]	KH95-43	GL25	KH95-25	Mean[3]	CD135	CD150A	L-187B	L-187A	L-176	K97-8-11A
Group[2]	3b	4a	4a	4a	4a	4b	4b	4b	4b	4b	4b
Rb	41.5 ± 9.2	49.4	45.0	45.7	46.7 ± 2.4	45.5	46.4	46.1	46.9	44.7	37.7
Sr	559.0 ± 25.0	917.0	846.0	902.0	888.0 ± 37.0	705.0	727.0	691.0	736.0	710.0	769.0
Cs	0.65 ± 0.17	1.71	1.65	1.30	1.55 ± 0.22	0.65	0.83	0.72	0.62	0.65	0.57
Ba	681 ± 21	1290	1040	946	1092 ± 178	949	956	962	934	956	907
Th	2.87 ± 0.10	3.71	3.65	3.52	3.63 ± 0.10	3.58	3.49	3.70	3.44	3.53	3.46
U	0.76 ± 0.03	1.26	1.32	1.14	1.24 ± 0.09	0.92	0.95	0.87	0.86	0.82	0.70
La	28.6 ± 2.2	39.2	37.8	37.8	38.3 ± 0.8	41.6	39.9	43.5	42.5	42.1	39.3
Ce	61.1 ± 4.5	82.6	81.5	83.1	82.4 ± 0.8	91.3	87.0	90.9	89.0	90.7	87.3
Nd	33.2 ± 2.7	44.4	44.1	40.4	43.0 ± 2.2	48.1	46.5	48.5	46.1	46.8	46.6
Sm	6.89 ± 0.75	8.19	8.46	7.58	8.08 ± 0.45	9.10	8.82	9.30	9.00	9.23	9.02
Eu	1.91 ± 0.08	2.16	2.12	2.13	2.14 ± 0.02	2.41	2.32	2.39	2.36	2.41	2.31
Gd	5.91 ± 0.48	6.63	6.44	6.29	6.45 ± 0.17	7.13	7.33	7.78	7.79	7.74	7.05
Tb	0.83 ± 0.06	0.86	0.90	0.86	0.87 ± 0.02	1.00	0.97	1.00	1.00	0.99	0.93
Ho	1.00 ± 0.06	1.05	1.03	1.00	1.03 ± 0.03	1.09	1.12	1.23	1.22	1.18	1.09
Tm	0.37 ± 0.03	0.42	0.38	0.38	0.39 ± 0.02	0.43	0.40	0.45	0.44	0.43	0.39
Yb	2.23 ± 0.10	2.53	2.27	2.26	2.35 ± 0.15	2.57	2.45	2.65	2.57	2.53	2.35
Lu	0.32 ± 0.01	0.35	0.34	0.32	0.34 ± 0.02	0.35	0.35	0.35	0.37	0.37	0.32
Zr	179 ± 14	198	207	221	209 ± 12	209	219	236	216	219	203
Hf	4.07 ± 0.11	4.75	4.63	4.54	4.64 ± 0.11	5.04	5.00	5.24	5.07	5.09	4.49
Ta	1.02 ± 0.06	1.22	1.19	1.17	1.19 ± 0.03	1.29	1.28	1.27	1.25	1.26	1.13
W	1.01 ± 0.51	0.95	0.69	0.59	0.74 ± 0.19	0.76	0.90	0.77	1.10	0.64	0.93
Sc	21.3 ± 0.4	22.2	21.8	21.3	21.8 ± 0.5	20.9	20.7	20.6	20.6	21.0	20.9
Cr	199 ± 9	228	222	221	224 ± 4	139	134	135	138	140	179
Co	42.6 ± 1.0	39.0	38.7	37.6	38.4 ± 0.7	37.8	35.4	36.3	36.8	37.5	39.1
Ni	157 ± 8	184	174	169	176 ± 8	136	122	142	132	126	163
Zn	93.6 ± 5.8	89.8	93.1	90.6	91.2 ± 1.7	104.0	95.4	103.0	110.0	115.0	104.0
As	0.39 ± 0.12	0.19	0.62	1.48	0.76 ± 0.66	0.95	0.37	0.88	0.44	0.18	0.44
Sb	0.07 ± 0.04	0.09	0.11	0.14	0.11 ± 0.03	0.08	0.09	0.04	0.08	0.06	0.03
Au ppb	1.96 ± 2.05	1.74	1.65	3.33	2.24 ± 0.95	2.39	3.91	1.73	0.58	1.74	3.92

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	K97-8-11D	L-91A	CD150B	K97-8-11B	K97-8-11B	K97-8-11C	L-91B	K97-8-11E	L-37	L-39	L-187D	L-181
Group[2]	4b	4b	4b	4b	(DUP) 4b	4b	4b	4b	4b	4b	4b	4b
Rb	46.8	50.4	42.6	43.8	45.4	47.3	47.2	48.9	50.5	50.2	47.3	49.6
Sr	757.0	768.0	710.0	812.0	775.0	727.0	805.0	778.0	804.0	860.0	811.0	804.0
Cs	0.88	0.74	0.57	0.76	0.73	0.72	0.70	0.69	0.87	0.67	0.71	0.66
Ba	966	1100	983	998	992	963	1090	1110	1090	1150	1060	1170
Th	3.76	3.63	3.52	3.86	3.90	3.82	3.57	3.58	3.70	3.72	3.51	3.52
U	0.84	0.94	0.85	0.89	0.78	0.91	1.03	0.94	1.06	1.04	0.94	1.07
La	43.3	45.5	41.5	43.7	44.6	43.5	46.4	48.2	47.7	50.2	47.6	50.0
Ce	95.2	98.9	89.6	96.6	96.8	95.8	99.4	105.0	102.0	106.0	99.3	107.0
Nd	50.1	51.3	47.0	50.5	51.7	49.2	51.0	54.8	53.3	57.6	52.0	54.8
Sm	9.54	9.75	8.85	9.59	9.68	9.48	9.92	10.30	9.97	10.60	10.00	10.50
Eu	2.42	2.50	2.36	2.46	2.45	2.45	2.53	2.57	2.53	2.64	2.55	2.65
Gd	7.31	7.88	7.55	7.13	6.94	7.12	8.21	7.79	7.75	8.20	7.85	8.27
Tb	0.97	1.07	0.99	0.99	1.00	0.98	1.05	1.06	1.02	1.10	1.03	1.11
Ho	1.10	1.28	1.13	1.15	1.19	1.17	1.24	1.25	1.26	1.26	1.28	1.26
Tm	0.42	0.45	0.40	0.42	0.42	0.42	0.44	0.47	0.45	0.44	0.46	0.46
Yb	2.57	2.67	2.43	2.50	2.40	2.48	2.64	2.72	2.69	2.81	2.63	2.71
Lu	0.35	0.39	0.35	0.34	0.35	0.35	0.37	0.38	0.39	0.41	0.39	0.39
Zr	218	242	234	239	235	243	247	245	243	241	250	255
Hf	4.96	5.37	5.02	4.87	4.88	4.97	5.43	5.65	5.45	5.69	5.46	5.96
Ta	1.31	1.33	1.29	1.28	1.28	1.31	1.30	1.41	1.35	1.41	1.36	1.44
W	1.15	0.13	0.98	0.82	0.67	0.69	0.07	0.74	0.84	0.28	1.28	0.11
Sc	21.5	21.0	21.0	21.4	21.3	21.1	20.4	19.9	20.1	21.1	20.4	19.4
Cr	129	125	141	144	142	131	112	110	116	120	111	112
Co	35.9	35.5	37.5	36.7	36.4	36.1	33.7	30.8	34.2	35.2	33.2	30.1
Ni	127	110	134	137	131	132	108	105	134	115	102	89
Zn	93.0	103.0	94.7	105.0	103.0	103.0	116.0	103.0	112.0	117.0	108.0	118.0
As	0.57	2.11	0.58	0.34	0.31	0.53	0.83	0.39	0.11	0.84	0.49	0.78
Sb	0.09	0.14	0.07	0.02	0.02	0.03	0.11	0.08	0.17	0.08	0.06	0.09
Au ppb	4.94	0.36	2.41	4.66	6.61	5.81	1.00	6.65	1.78	1.10	1.04	0.41

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample Group[2]	Mean[3] 4b	K97-8-15C 4b'	L-38A 4b'	K97-8-15B 4b'	Mean[3] 4b'	CP76 5a	CP77 5a	KH95-28 5a	L-68 5a	CP83 5a	L-4 5a
Rb	46.5 ± 3.1	62.6	64.5	66.8	64.6 ± 2.1	44.7	47.2	43.7	44.8	45.7	48.1
Sr	764.0 ± 47.0	645.0	689.0	656.0	663.0 ± 23.0	711.0	693.0	815.0	831.0	772.0	769.0
Cs	0.71 ± 0.09	0.50	0.61	0.62	0.58 ± 0.07	0.41	0.45	0.57	0.81	0.51	0.42
Ba	1019 ± 81	1280	1320	1350	1317 ± 35	951	896	980	988	994	1190
Th	3.63 ± 0.14	4.21	4.18	4.55	4.31 ± 0.21	2.80	2.78	2.80	2.67	2.82	2.59
U	0.91 ± 0.10	0.88	0.95	0.95	0.93 ± 0.04	0.73	0.73	0.73	0.66	0.71	0.73
La	44.5 ± 3.3	56.6	59.8	60.6	59.0 ± 2.1	33.3	33.9	35.6	34.0	35.5	33.6
Ce	96.0 ± 6.4	118.0	124.0	128.0	123.3 ± 5.0	72.4	74.1	74.6	74.4	75.4	72.3
Nd	50.3 ± 3.3	61.1	63.0	63.2	62.4 ± 1.2	40.2	41.4	43.2	40.2	42.4	39.3
Sm	9.59 ± 0.55	11.50	11.30	11.70	11.50 ± 0.20	8.22	8.12	8.84	8.32	8.50	7.84
Eu	2.46 ± 0.10	2.72	2.70	2.70	2.71 ± 0.01	2.12	2.17	2.28	2.24	2.24	2.21
Gd	7.60 ± 0.42	8.48	8.67	8.20	8.45 ± 0.24	6.80	6.81	7.26	6.51	7.45	6.76
Tb	1.01 ± 0.05	1.18	1.17	1.13	1.16 ± 0.03	0.91	0.90	0.96	0.92	0.93	0.89
Ho	1.19 ± 0.07	1.39	1.31	1.31	1.34 ± 0.05	1.04	1.05	1.10	1.10	1.02	1.00
Tm	0.43 ± 0.02	0.50	0.46	0.45	0.47 ± 0.03	0.41	0.41	0.39	0.39	0.42	0.39
Yb	2.58 ± 0.12	3.00	2.79	2.73	2.84 ± 0.14	2.47	2.34	2.38	2.27	2.37	2.22
Lu	0.37 ± 0.02	0.42	0.41	0.38	0.40 ± 0.02	0.35	0.34	0.35	0.32	0.34	0.33
Zr	233 ± 15	312	291	318	307 ± 14	202	220	199	187	179	174
Hf	5.20 ± 0.36	6.95	7.02	7.25	7.07 ± 0.16	4.37	4.39	4.32	4.17	4.35	4.13
Ta	1.31 ± 0.07	1.56	1.57	1.59	1.57 ± 0.02	1.51	1.53	1.58	1.48	1.57	1.45
W	0.71 ± 0.36	1.00	0.00	0.78	0.59 ± 0.53	0.17	0.37	0.13	0.58	0.84	0.90
Sc	20.7 ± 0.5	16.2	15.7	15.3	15.7 ± 0.5	23.3	22.2	23.1	22.7	23.0	22.4
Cr	131 ± 17	39	41	43	41 ± 2	236	227	231	219	227	217
Co	35.5 ± 2.3	22.8	18.4	19.8	20.3 ± 2.2	41.6	41.4	41.4	40.3	41.5	39.9
Ni	125 ± 17	51	33	48	44 ± 10	163	163	162	171	161	159
Zn	106.0 ± 7.5	114.0	96.6	115.0	108.5 ± 10.3	93.7	89.9	95.0	83.3	90.3	86.6
As	0.62 ± 0.44	0.28	0.41	0.38	0.36 ± 0.07	2.15	0.88	2.36	3.28	2.38	1.75
Sb	0.07 ± 0.04	0.02	0.06	0.07	0.05 ± 0.03	0.08	0.04	0.13	0.12	0.05	0.13
Au ppb	2.84 ± 2.15	7.03	0.35	6.78	4.72 ± 3.79	1.60	0.10	1.05	0.35	0.58	2.34

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	CP106	L-56	KH95-30	L-78	CP8	L-60	KH95-32	CP89	Mean[3]	KH95-29	CP88	CC119
Group[2]	5a	5a	5a	5a	5a	5a	5a	5a	5a	5a'	5b	5b
Rb	47.8	50.6	52.7	53.5	48.6	29.6	48.1	53.8	47.1 ± 6.0	56.4	56.9	52.1
Sr	807.0	780.0	878.0	907.0	866.0	926.0	996.0	892.0	832.0 ± 85.0	986.0	814.0	834.0
Cs	0.64	0.59	1.10	0.53	1.08	1.12	0.71	0.61	0.68 ± 0.25	1.23	1.00	0.85
Ba	978	902	1120	1050	1060	989	1140	1160	1028 ± 94	1090	1090	1140
Th	2.73	2.68	3.05	2.70	2.85	2.51	3.13	2.72	2.77 ± 0.16	3.08	2.84	2.73
U	0.69	0.71	0.82	0.73	0.64	0.66	0.51	0.78	0.70 ± 0.07	0.84	0.73	0.74
La	35.3	33.0	38.2	36.1	36.2	35.3	38.1	38.5	35.5 ± 1.8	37.2	38.3	32.9
Ce	76.2	73.8	83.3	80.7	80.3	79.1	84.8	87.9	77.8 ± 4.9	81.7	84.9	70.8
Nd	42.4	40.4	47.8	46.4	39.8	44.0	46.5	50.2	43.2 ± 3.4	46.9	46.0	40.1
Sm	8.36	8.04	9.15	8.95	8.76	8.52	8.84	9.48	8.57 ± 0.46	8.68	9.11	7.84
Eu	2.29	2.25	2.35	2.40	2.25	2.34	2.37	2.42	2.28 ± 0.09	2.34	2.37	2.20
Gd	6.46	7.29	6.77	7.65	7.21	6.74	6.81	7.39	6.99 ± 0.37	7.29	6.85	6.32
Tb	0.88	0.89	0.97	0.94	0.91	0.92	0.92	0.91	0.92 ± 0.03	0.92	1.00	0.87
Ho	0.96	1.02	1.15	1.09	1.04	1.07	1.03	1.02	1.05 ± 0.05	1.14	1.14	1.02
Tm	0.38	0.38	0.41	0.38	0.37	0.36	0.36	0.36	0.39 ± 0.02	0.37	0.44	0.36
Yb	2.31	2.15	2.42	2.28	2.28	2.11	2.27	2.20	2.29 ± 0.10	2.18	2.58	2.20
Lu	0.34	0.33	0.35	0.34	0.34	0.30	0.33	0.33	0.34 ± 0.01	0.32	0.37	0.32
Zr	190	179	200	184	202	182	185	165	189 ± 14	184	232	207
Hf	4.25	4.12	4.72	4.30	4.44	4.10	4.44	4.47	4.33 ± 0.17	4.36	5.02	4.78
Ta	1.54	1.45	1.57	1.51	1.44	1.45	1.52	1.71	1.52 ± 0.07	1.49	1.53	1.49
W	0.81	0.16	0.57	0.58	1.20	0.06	0.47	1.27	0.58 ± 0.39	0.85	0.07	0.91
Sc	23.3	22.4	22.3	23.1	21.4	23.2	22.4	23.5	22.7 ± 0.6	22.5	21.9	22.1
Cr	226	222	237	232	232	240	231	247	230 ± 8	248	197	233
Co	41.7	40.6	39.5	41.3	38.6	44.1	40.1	44.3	41.2 ± 1.6	42.3	38.2	38.7
Ni	164	165	158	161	162	185	165	185	166 ± 9	188	156	167
Zn	71.1	74.4	99.5	92.6	80.7	95.8	91.4	96.2	88.6 ± 8.4	96.1	94.2	102.0
As	0.74	0.24	1.30	0.30	1.21	0.13	0.50	0.91	1.30 ± 0.96	1.54	2.71	2.26
Sb	0.13	0.05	0.09	0.09	0.12	0.14	0.09	0.13	0.10 ± 0.03	0.08	0.04	0.13
Au ppb	1.51	0.23	2.15	1.09	0.66	1.00	0.85	4.91	1.32 ± 1.23	0.99	1.52	3.33

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	CC-LA-5	CC122	CC-LA-4	SH303	K97-10-8D	GL306	CC121	SH341	Mean[3]	CD206	CD199	SH262
Group[2]	5b	5b	5b	5b	5b	5b	5b	5b	5b	6a	6a	6a
Rb	51.6	55.2	49.8	55.6	42.3	43.3	47.9	56.2	51.1 ± 5.3	87.9	82.5	100.0
Sr	825.0	834.0	824.0	793.0	783.0	773.0	852.0	853.0	819 ± 28	757.0	715.0	656.0
Cs	1.04	0.79	0.85	0.80	0.30	0.38	0.83	0.60	0.74 ± 0.24	0.73	1.04	1.63
Ba	1030	1070	1100	1080	1240	1090	1090	1060	1099 ± 57	1830	1550	1490
Th	2.80	2.87	2.83	2.90	3.07	2.81	2.97	2.88	2.87 ± 0.1	5.44	6.25	5.74
U	0.67	0.69	0.64	0.76	0.70	0.63	0.72	0.87	0.72 ± 0.07	1.36	1.28	1.66
La	37.6	37.5	37.9	39.6	43.1	38.0	38.3	37.5	38.1 ± 2.5	29.9	28.7	34.3
Ce	83.5	81.3	84.0	85.7	85.9	80.3	82.6	82.7	82.2 ± 4.4	59.5	62.7	68.8
Nd	44.2	45.3	43.6	47.4	53.8	46.7	46.4	45.2	45.9 ± 3.5	31.1	29.9	36.3
Sm	9.38	9.04	9.49	9.61	10.90	9.17	9.21	9.15	9.29 ± 0.74	6.11	5.70	7.29
Eu	2.35	2.32	2.36	2.45	2.64	2.44	2.38	2.32	2.38 ± 0.11	2.09	1.90	1.90
Gd	7.07	7.27	7.37	7.74	8.94	7.68	7.28	7.29	7.38 ± 0.68	5.09	4.21	5.50
Tb	0.97	1.00	0.97	1.00	1.13	1.02	0.98	0.93	0.99 ± 0.07	0.67	0.63	0.76
Ho	1.12	1.12	1.19	1.24	1.28	1.22	1.13	1.09	1.16 ± 0.08	0.83	0.70	0.85
Tm	0.41	0.41	0.41	0.43	0.46	0.41	0.40	0.41	0.41 ± 0.03	0.30	0.27	0.32
Yb	2.50	2.48	2.47	2.57	2.79	2.44	2.45	2.36	2.48 ± 0.15	1.77	1.65	1.90
Lu	0.38	0.35	0.37	0.37	0.40	0.36	0.36	0.34	0.36 ± 0.02	0.24	0.23	0.27
Zr	199	215	186	219	224	216	224	213	214 ± 13	198	168	174
Hf	4.83	4.80	4.78	5.17	5.07	4.82	4.92	4.66	4.89 ± 0.16	5.54	5.20	4.93
Ta	1.49	1.51	1.46	1.52	1.64	1.47	1.53	1.49	1.51 ± 0.05	2.08	1.96	1.92
W	1.51	0.40	0.13	1.04	1.53	0.02	0.07	0.28	0.6 ± 0.6	0.36	0.84	0.99
Sc	22.4	21.9	22.2	21.6	23.3	22.1	22.1	22.1	22.2 ± 0.4	19.9	18.6	18.0
Cr	222	226	231	182	231	219	232	223	220 ± 17	127	114	94
Co	38.7	38.6	39.7	37.5	40.3	39.1	38.8	38.9	38.9 ± 0.8	27.8	26.5	24.8
Ni	148	166	179	153	177	154	153	156	161 ± 11	80	72	67
Zn	97.9	100.0	112.0	88.6	126.0	94.1	88.7	86.8	99 ± 12.1	82.0	91.0	83.0
As	3.46	1.98	2.70	0.12	3.20	3.10	0.71	3.12	2.34 ± 1.11	0.74	0.70	0.76
Sb	0.16	0.05	0.07	0.04	0.15	0.03	0.08	0.03	0.08 ± 0.05	0.08	0.12	0.07
Au ppb	2.31	3.18	0.12	0.78	0.71	2.19	2.16	1.29	1.76 ± 1.06	2.10	0.70	0.25

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	CD215	CD197	Mean[3]	CD209	CD216	CD8	Mean[3]	SH267	L-7	SH268	Mean[3]
Group[2]	6a	6a	6a	6a'	6a'	6a'	6a'	6b	6b	6b	6b
Rb	81.8	90.4	88.5 ± 7.4	82.4	87.9	95.4	88.57 ± 6.53	84.7	91.4	102.0	92.7 ± 8.7
Sr	734.0	741.0	721.0 ± 39.0	734.0	740.0	722.0	732 ± 9.17	682.0	730.0	696.0	703.0 ± 25.0
Cs	1.65	2.11	1.43 ± 0.55	1.43	1.99	0.66	1.36 ± 0.67	2.09	1.67	1.37	1.71 ± 0.36
Ba	1610	1510	1598 ± 138	2200	1620	1480	1766.7 ± 381.75	1460	1540	1480	1493 ± 42
Th	5.99	5.98	5.88 ± 0.31	5.59	6.59	6.44	6.21 ± 0.54	6.54	6.77	6.72	6.68 ± 0.12
U	1.57	1.83	1.54 ± 0.22	1.30	1.89	1.57	1.59 ± 0.3	2.03	2.00	2.17	2.07 ± 0.09
La	30.3	34.2	31.5 ± 2.6	34.7	37.4	40.6	37.57 ± 2.95	37.7	41.5	38.2	39.1 ± 2.1
Ce	60.3	72.0	64.7 ± 5.5	69.8	79.1	84.4	77.77 ± 7.39	78.8	86.7	80.5	82.0 ± 4.2
Nd	31.3	37.3	33.2 ± 3.4	35.5	40.7	44.0	40.07 ± 4.29	40.6	44.3	42.3	42.4 ± 1.9
Sm	6.01	7.09	6.44 ± 0.70	6.69	7.66	8.28	7.54 ± 0.8	7.89	8.51	8.02	8.14 ± 0.33
Eu	1.96	1.94	1.96 ± 0.08	1.95	2.02	1.98	1.98 ± 0.04	1.95	2.06	1.99	2.00 ± 0.06
Gd	4.63	5.49	4.98 ± 0.56	5.30	6.13	6.04	5.82 ± 0.46	5.71	6.15	6.29	6.05 ± 0.30
Tb	0.65	0.72	0.69 ± 0.05	0.71	0.75	0.81	0.76 ± 0.05	0.79	0.86	0.80	0.82 ± 0.04
Ho	0.79	0.90	0.81 ± 0.08	0.82	0.93	0.88	0.88 ± 0.06	0.89	1.06	0.93	0.96 ± 0.09
Tm	0.28	0.33	0.30 ± 0.03	0.31	0.32	0.34	0.32 ± 0.02	0.32	0.38	0.33	0.34 ± 0.03
Yb	1.67	1.83	1.76 ± 0.11	1.76	1.86	1.96	1.86 ± 0.1	2.03	2.18	1.97	2.06 ± 0.11
Lu	0.23	0.26	0.25 ± 0.02	0.25	0.28	0.28	0.27 ± 0.02	0.28	0.30	0.28	0.29 ± 0.01
Zr	176	181	179 ± 11	206	173	174	184.33 ± 18.77	176	192	188	185 ± 8
Hf	5.08	5.12	5.17 ± 0.23	5.47	5.13	4.94	5.18 ± 0.27	4.76	5.03	4.94	4.91 ± 0.14
Ta	1.91	1.90	1.95 ± 0.07	2.06	2.00	1.86	1.97 ± 0.1	2.04	1.98	2.08	2.03 ± 0.05
W	0.86	0.28	0.67 ± 0.32	0.24	1.01	0.04	0.43 ± 0.51	0.27	0.70	0.63	0.53 ± 0.23
Sc	18.7	18.1	18.7 ± 0.8	18.7	18.0	17.4	18.03 ± 0.65	17.3	18.6	17.9	17.9 ± 0.7
Cr	114	108	111 ± 12	105	110	105	106.67 ± 2.89	108	116	115	113 ± 4
Co	26.0	25.2	26.1 ± 1.2	25.9	24.7	25.0	25.2 ± 0.62	23.1	26.6	25.5	25.1 ± 1.8
Ni	66	61	69 ± 7	67	69	70	68.4 ± 1.55	64	77	80	74 ± 8
Zn	87.4	80.1	84.7 ± 4.4	76.2	82.7	81.0	79.97 ± 3.37	73.6	79.8	73.9	75.8 ± 3.5
As	2.98	0.62	1.16 ± 1.02	0.68	1.04	0.91	0.88 ± 0.18	0.75	0.95	2.19	1.30 ± 0.78
Sb	0.05	0.05	0.07 ± 0.03	0.04	0.12	0.23	0.13 ± 0.1	0.09	0.11	0.03	0.08 ± 0.04
Au ppb	0.83	1.44	1.06 ± 0.72	2.41	2.84	0.10	1.78 ± 1.47	3.20	1.72	1.64	2.19 ± 0.88

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	L-246	L-233	L-244	L-245	L-28	Mean[3]	CPV-4	CPV-3	CP86	CPV-2	Mean[3]
Group[2]	6b'	6b'	6b'	6b'	6b'	6b'	6b"	6b"	6b"	6b"	6b"
Rb	70.3	72.0	85.4	80.6	89.2	79.5 ± 8.2	78.5	85.4	86.0	66.6	79.1 ± 9.0
Sr	813.0	821.0	832.0	823.0	816.0	821 ± 7	760.0	728.0	809.0	878.0	794.0 ± 65.0
Cs	0.54	0.44	0.88	0.61	1.36	0.77 ± 0.37	0.83	1.94	1.83	2.72	1.83 ± 0.78
Ba	1600	1620	1680	1680	1710	1658 ± 46	1950	1790	1820	1850	1853 ± 69
Th	5.62	5.76	6.06	6.09	6.26	5.96 ± 0.26	4.26	4.74	4.74	4.76	4.63 ± 0.24
U	1.81	1.81	1.81	1.07	1.36	1.57 ± 0.34	0.90	1.12	1.15	1.28	1.11 ± 0.16
La	38.2	38.2	38.2	40.9	40.3	39.2 ± 1.3	33.0	40.1	39.8	41.3	38.6 ± 3.8
Ce	74.6	75.7	79.6	79.9	83.1	78.6 ± 3.4	67.1	79.5	84.2	82.8	78.4 ± 7.8
Nd	37.6	38.7	42.1	40.6	43.1	40.4 ± 2.3	38.1	43.3	43.6	44.7	42.4 ± 2.9
Sm	7.81	7.88	8.14	8.47	8.40	8.14 ± 0.3	7.73	8.64	8.89	8.80	8.52 ± 0.53
Eu	2.08	2.12	2.17	2.19	2.16	2.14 ± 0.04	2.15	2.27	2.36	2.33	2.28 ± 0.09
Gd	6.57	6.65	6.97	7.07	6.72	6.8 ± 0.21	6.57	6.97	7.33	6.87	6.94 ± 0.31
Tb	0.81	0.86	0.90	0.91	0.93	0.88 ± 0.05	0.85	0.96	0.96	0.95	0.93 ± 0.05
Ho	0.97	1.05	1.07	1.08	1.12	1.06 ± 0.06	0.91	1.09	1.12	1.09	1.05 ± 0.10
Tm	0.36	0.36	0.37	0.39	0.38	0.37 ± 0.01	0.34	0.38	0.38	0.37	0.37 ± 0.02
Yb	2.14	2.13	2.13	2.28	2.23	2.18 ± 0.07	2.08	2.31	2.27	2.24	2.23 ± 0.10
Lu	0.30	0.31	0.30	0.32	0.33	0.31 ± 0.01	0.29	0.32	0.32	0.32	0.31 ± 0.02
Zr	207	214	185	213	237	211 ± 19	204	197	194	203	200 ± 5
Hf	4.73	4.53	4.78	4.79	4.99	4.76 ± 0.16	5.13	5.01	5.16	4.96	5.07 ± 0.10
Ta	2.15	2.17	2.37	2.33	2.39	2.28 ± 0.11	1.91	1.89	1.91	1.88	1.90 ± 0.01
W	2.17	1.20	1.45	1.22	0.61	1.33 ± 0.56	0.74	0.24	1.75	0.12	0.71 ± 0.74
Sc	20.7	21.5	21.8	22.1	22.0	21.6 ± 0.6	22.2	21.6	22.4	22.5	22.2 ± 0.4
Cr	150	156	161	168	161	159 ± 7	123	115	122	145	126 ± 13
Co	31.2	32.4	33.4	33.9	33.7	32.9 ± 1.1	32.1	32.2	33.5	33.4	32.8 ± 0.8
Ni	95	100	111	92	97	99 ± 7	91	88	91	101	93 ± 6
Zn	83.4	82.5	88.3	103.0	101.0	91.6 ± 9.7	93.4	89.9	80.7	89.1	88.3 ± 5.4
As	0.78	1.07	0.99	1.14	0.97	0.99 ± 0.14	0.80	0.47	0.53	0.53	0.58 ± 0.15
Sb	0.11	0.07	0.13	0.06	0.21	0.12 ± 0.06	0.07	0.08	0.08	0.04	0.07 ± 0.02
Au ppb	0.40	0.60	0.65	1.29	1.07	0.8 ± 0.37	1.67	2.75	1.38	2.86	2.17 ± 0.75

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	L-1	L-3	L-52	K97-8-12H	L-48	Mean[3]	DT-R1	DT-39	DTV-2	DTV-3	Mean[3]
Group[2]	6c	6c	6c	6c	6c	6c	6c'	6c'	6c'	6c'	6c'
Rb	73.0	77.6	77.5	72.6	79.4	80.7 ± 7.7	57.9	58.7	66.8	64.1	61.9 ± 4.3
Sr	755.0	789.0	859.0	750.0	884.0	779.0 ± 61.0	818.0	883.0	897.0	904.0	876.0 ± 39.0
Cs	1.33	1.90	1.37	1.20	0.83	1.34 ± 0.46	2.44	2.46	2.85	2.90	2.66 ± 0.25
Ba	2040	1680	1870	1830	1870	1824 ± 231	1700	1760	1820	1760	1760 ± 49
Th	5.17	5.18	5.44	5.46	5.65	5.69 ± 0.54	4.08	4.01	4.16	4.12	4.09 ± 0.06
U	1.42	1.42	1.41	1.36	1.35	1.47 ± 0.19	1.33	1.21	1.35	1.24	1.28 ± 0.07
La	39.8	38.8	40.4	40.0	42.8	39.3 ± 2.4	33.8	34.4	35.5	35.1	34.7 ± 0.8
Ce	82.2	79.7	84.4	82.1	88.4	81.3 ± 5.5	68.0	69.1	71.7	68.2	69.3 ± 1.7
Nd	44.6	40.8	44.5	41.7	46.3	42.3 ± 3.4	37.4	37.4	39.4	37.8	38.0 ± 1.0
Sm	8.49	7.99	8.44	8.12	8.86	8.07 ± 0.66	8.20	8.54	8.90	8.40	8.51 ± 0.30
Eu	2.15	2.10	2.19	2.07	2.26	2.09 ± 0.11	2.25	2.45	2.53	2.49	2.43 ± 0.12
Gd	6.44	6.44	7.05	5.98	7.46	6.36 ± 0.67	7.00	6.85	7.39	7.21	7.11 ± 0.24
Tb	0.88	0.85	0.90	0.88	0.93	0.84 ± 0.08	0.96	1.03	1.05	1.03	1.02 ± 0.04
Ho	1.01	0.98	1.03	1.00	1.07	0.97 ± 0.08	1.06	1.06	1.16	1.11	1.10 ± 0.05
Tm	0.37	0.37	0.36	0.37	0.36	0.35 ± 0.02	0.37	0.39	0.39	0.38	0.38 ± 0.01
Yb	2.25	2.18	2.20	2.13	2.24	2.07 ± 0.19	2.26	2.27	2.30	2.18	2.25 ± 0.05
Lu	0.32	0.31	0.31	0.29	0.35	0.30 ± 0.03	0.31	0.30	0.32	0.31	0.31 ± 0.01
Zr	195	187	198	184	212	191 ± 14	206	218	211	224	215 ± 8
Hf	4.59	4.60	4.81	4.35	5.13	4.88 ± 0.36	4.93	4.99	5.10	4.99	5.00 ± 0.07
Ta	1.65	1.67	1.74	1.58	1.84	1.80 ± 0.17	2.00	2.05	2.14	2.03	2.06 ± 0.06
W	0.78	1.31	1.85	2.65	0.00	0.99 ± 0.93	0.81	0.84	0.97	1.22	0.96 ± 0.19
Sc	22.5	20.6	21.6	21.6	21.8	20.3 ± 2.0	23.0	23.0	23.6	23.1	23.2 ± 0.3
Cr	193	189	181	182	177	155 ± 41	95	86	86	85	88 ± 5
Co	33.3	31.5	31.3	31.0	31.5	29.3 ± 3.5	35.3	36.5	36.9	36.0	36.2 ± 0.7
Ni	108	91	98	99	90	86 ± 16	88	81	88	73	83 ± 7
Zn	78.1	77.6	91.7	88.1	95.3	83.8 ± 7.1	87.1	102.0	99.4	97.2	96.4 ± 6.5
As	0.45	1.04	0.83	0.73	0.41	0.76 ± 0.24	1.00	0.82	1.04	0.79	0.91 ± 0.13
Sb	0.14	0.17	0.16	0.10	0.04	0.13 ± 0.07	0.09	0.08	0.10	0.06	0.08 ± 0.02
Au ppb	1.19	3.84	0.08	5.65	0.46	2.07 ± 2.00	1.64	0.11	2.05	1.54	1.34 ± 0.85

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	DT-R3	K97-8-12B	K97-8-12A	K97-8-12A1	Mean[3]	KH95-26	KH95-27B	Mean[3]	L-6	DT-R2	DT-R4
Group[2]	6c''	6d	6d'	6d'	6d'	7a	7a	7a	7a'	8a	8a
Rb	46.3	75.6	65.0	64.5	64.8 ± 0.4	86.5	88.2	87.4 ± 1.2	88.2	26.3	26.9
Sr	794.0	1000.0	1180.0	1270.0	1225.0 ± 64.0	990	934	962 ± 40	950	1150	1240
Cs	3.95	2.13	2.34	2.41	2.38 ± 0.05	1.34	1.31	1.33 ± 0.02	1.89	0.49	0.47
Ba	1900	1660	2080	2030	2055 ± 35	2040	2090	2065 ± 35	1910	702	951
Th	4.23	6.49	8.93	8.80	8.87 ± 0.09	7.19	7.06	7.13 ± 0.09	6.22	2.53	2.93
U	0.82	1.79	2.30	2.40	2.35 ± 0.07	1.96	1.79	1.88 ± 0.12	1.34	0.64	0.69
La	32.8	54.0	66.7	65.4	66.1 ± 0.9	49.9	51.2	50.6 ± 0.9	49.9	35.4	36.6
Ce	66.7	110.0	132.0	128.0	130.0 ± 2.8	101	97	99 ± 3	103	77	81
Nd	35.8	58.9	64.9	63.6	64.3 ± 0.9	49.2	48.8	49 ± 0.3	53.4	44.7	47.3
Sm	7.80	11.30	11.90	11.60	11.75 ± 0.21	9.3	9.22	9.26 ± 0.06	9.67	9.1	9.27
Eu	2.19	2.96	3.02	2.99	3.01 ± 0.02	2.36	2.39	2.38 ± 0.02	2.33	2.46	2.51
Gd	6.40	8.78	8.99	9.17	9.08 ± 0.13	6.98	6.53	6.76 ± 0.32	6.7	6.93	6.83
Tb	0.92	1.20	1.22	1.13	1.18 ± 0.06	0.92	0.94	0.93 ± 0.01	0.86	0.9	0.88
Ho	0.98	1.27	1.38	1.33	1.36 ± 0.04	1.05	1.06	1.06 ± 0.01	0.97	0.91	0.84
Tm	0.36	0.46	0.47	0.46	0.47 ± 0.01	0.36	0.35	0.36 ± 0.01	0.33	0.31	0.29
Yb	2.04	2.85	2.82	2.73	2.78 ± 0.06	2.1	2.05	2.08 ± 0.04	1.9	1.74	1.67
Lu	0.29	0.40	0.41	0.40	0.41 ± 0.01	0.29	0.29	0.29 ± 0	0.25	0.23	0.24
Zr	204	269	298	257	278 ± 29	223	208	216 ± 11	231	166	161
Hf	4.73	6.64	6.33	6.23	6.28 ± 0.07	5.36	5.18	5.27 ± 0.13	5.42	3.27	3.44
Ta	1.88	3.28	3.65	3.56	3.61 ± 0.06	2.44	2.36	2.4 ± 0.06	1.82	1.07	1.17
W	1.63	0.50	0.50	0.98	0.74 ± 0.34	0.52	0.81	0.67 ± 0.21	0.08	1.16	0.27
Sc	23.1	20.9	23.0	22.6	22.8 ± 0.3	20	19.4	19.7 ± 0.4	18.7	20.9	21.1
Cr	94	85	154	154	154 ± 0	142	140	141 ± 1	153	182	177
Co	37.9	26.5	35.0	34.9	35.0 ± 0.1	29.6	28.1	28.9 ± 1.1	29.6	46.9	45
Ni	85	62	114	113	114 ± 1	76.8	67.8	72.3 ± 6.4	103	129	136
Zn	102.0	119.0	119.0	116.0	117.5 ± 2.1	82.4	82.3	82.4 ± 0.1	97.9	115	108
As	1.43	0.72	0.76	0.72	0.74 ± 0.03	4.32	1.27	2.8 ± 2.16	1.08	3.3	2.53
Sb	0.35	0.12	0.15	0.20	0.18 ± 0.04	0.11	0.04	0.08 ± 0.05	0.12	0.12	0.17
Au ppb	2.08	1.33	0.83	1.03	0.93 ± 0.14	2.49	2.85	2.67 ± 0.25	7.38	3.85	1.6

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	MG-97-2	97-GH-239	97-GH-228B	97MG-001	I70-45	I70-34	Mean[3]	97-GH-155	7-GH-228A	97-GH-34	Mean[3]	I70-32
Group[2]	8a	8a	8a	8a	8a	8a	8a	8b	8b	8b	8b	8c
Rb	21.7	23.3	33.9	25.2	27.9	27	26.5 ± 3.6	26.3	28.5	21.4	25.4 ± 3.6	34.4
Sr	1050	1030	1260	1170	1190	1180	1159 ± 82	986	1030	894	970 ± 69	1280
Cs	0.45	0.48	0.71	0.5	0.48	0.47	0.51 ± 0.08	0.44	0.38	0.61	0.48 ± 0.12	0.44
Ba	782	801	888	728	746	777	797 ± 84	941	869	776	862 ± 83	845
Th	2.45	2.49	3.36	2.6	2.74	2.99	2.76 ± 0.31	3.26	3.28	3.04	3.19 ± 0.13	3.34
U	0.66	0.61	0.78	0.79	0.82	0.8	0.72 ± 0.08	0.72	0.75	0.63	0.7 ± 0.06	0.94
La	33.8	34.4	42.4	36.3	37.9	38.9	37 ± 2.8	39.2	39.5	42.8	40.5 ± 2	41.9
Ce	74	75	92	79	81	82	80 ± 5	85	86	90	87 ± 2	88
Nd	44.1	43.3	54.1	46.7	48.6	47.9	47.1 ± 3.4	48.3	48.5	49.4	48.7 ± 0.6	53.1
Sm	8.55	8.57	10.2	9.22	9.66	9.66	9.28 ± 0.56	8.91	8.94	9.11	8.99 ± 0.11	10.2
Eu	2.28	2.31	2.71	2.43	2.58	2.62	2.49 ± 0.15	2.37	2.36	2.38	2.37 ± 0.01	2.75
Gd	7.17	6.93	8.51	7.02	7.66	6.78	7.23 ± 0.59	7.31	7.11	6.88	7.1 ± 0.22	7.53
Tb	0.78	0.8	0.91	0.91	0.93	0.92	0.88 ± 0.06	0.83	0.81	0.87	0.84 ± 0.03	0.97
Ho	0.87	0.85	0.98	0.82	1.02	1.03	0.92 ± 0.08	0.92	0.91	1	0.94 ± 0.05	1.06
Tm	0.29	0.29	0.33	0.3	0.3	0.31	0.3 ± 0.01	0.31	0.31	0.32	0.31 ± 0.01	0.33
Yb	1.69	1.69	1.97	1.82	1.76	1.79	1.77 ± 0.1	1.71	1.72	1.85	1.76 ± 0.08	1.85
Lu	0.23	0.25	0.28	0.25	0.25	0.25	0.25 ± 0.02	0.23	0.24	0.27	0.25 ± 0.02	0.26
Zr	148	144	179	137	155	129	152 ± 16	192	164	183	180 ± 14	182
Hf	3.08	3.16	3.8	3.34	3.43	3.46	3.37 ± 0.22	3.83	3.93	3.59	3.78 ± 0.17	3.8
Ta	1.04	1.08	1.39	1.06	1.15	1.13	1.14 ± 0.11	1.16	1.17	1.18	1.17 ± 0.01	1.36
W	0.07	0.42	0.76	0.36	0.5	0.88	0.55 ± 0.36	0.11	0.08	0.64	0.28 ± 0.32	0.63
Sc	19.8	20.4	21.6	21.6	22	21.9	21.2 ± 0.8	19.2	20.1	22.4	20.6 ± 1.7	21.8
Cr	162	166	180	172	179	167	173 ± 7	168	178	212	186 ± 23	190
Co	43.7	43.2	45.8	45.6	48.3	45.6	45.5 ± 1.6	42	43.9	43.6	43.2 ± 1	47.9
Ni	116	98.2	128	126	127	132	124 ± 11.9	130	114	115	119.7 ± 9	152
Zn	145	154	163	128	127	125	133.1 ± 19.1	132	146	146	141.3 ± 8.1	146
As	3.43	4.95	6.14	4.66	5.43	3.66	4.26 ± 1.22	6.26	4.18	2.97	4.47 ± 1.66	14.2
Sb	0.1	0.07	0.07	0.15	0.08	0.12	0.11 ± 0.04	0.11	0.16	0.23	0.17 ± 0.06	0.35
Au ppb	2.2	1.18	2.28	1.36	0.14	0.35	1.62 ± 1.18	0.1	1.87	0.1	0.69 ± 1.02	0.27

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	97GH-208	Mean[3]	97MG-002	97GH-204	I70-29	Mean[3]	97-GH-18	I70-31	I70-30	I70-44	Mean[3]
Group[2]	8c	8c	8d	8d	8d	8d	9a	9a	9a	9a	9a
Rb	36.7	35.6 ± 1.6	46.6	55.1	56.6	52.8 ± 5.4	25.6	31	26.4	40.3	30.8 ± 6.8
Sr	1340	1310 ± 42	1210	981	919	1037 ± 153	1330	977	1020	985	1078 ± 169
Cs	0.5	0.47 ± 0.04	0.54	0.67	1.16	0.79 ± 0.33	0.91	0.4	0.35	0.44	0.53 ± 0.26
Ba	864	855 ± 13	1000	1190	1300	1163 ± 152	1290	957	1190	1190	1157 ± 141
Th	3.35	3.35 ± 0.01	3.65	4.31	4.29	4.08 ± 0.38	3.1	3.2	3.2	3.45	3.24 ± 0.15
U	0.98	0.96 ± 0.03	1.07	0.88	1.09	1.01 ± 0.12	0.76	0.78	0.89	0.98	0.85 ± 0.1
La	41.1	41.5 ± 0.6	43.6	44.6	45.6	44.6 ± 1	44.8	39.5	40.4	44.5	42.3 ± 2.7
Ce	90	89 ± 2	96	92	90	93 ± 3	96	82	83	91	88 ± 7
Nd	52.7	52.9 ± 0.3	59.3	46.6	45.4	50.4 ± 7.7	53.5	46	46	50.2	48.9 ± 3.6
Sm	10.2	10.2 ± 0	11.5	8.63	8.35	9.49 ± 1.74	9.68	8.9	8.83	9.48	9.22 ± 0.42
Eu	2.67	2.71 ± 0.06	3.02	2.29	2.24	2.52 ± 0.44	2.55	2.41	2.4	2.51	2.47 ± 0.07
Gd	7.9	7.72 ± 0.26	7.73	7.05	6.21	7 ± 0.76	6.9	6.71	6.78	6.8	6.8 ± 0.08
Tb	0.96	0.97 ± 0.01	1.03	0.89	0.85	0.92 ± 0.09	0.9	0.88	0.86	0.91	0.89 ± 0.02
Ho	0.93	1 ± 0.09	0.99	0.88	0.89	0.92 ± 0.06	0.97	0.97	0.88	0.93	0.94 ± 0.04
Tm	0.31	0.32 ± 0.01	0.31	0.32	0.31	0.31 ± 0.01	0.33	0.32	0.31	0.3	0.32 ± 0.01
Yb	1.73	1.79 ± 0.08	1.76	1.89	1.83	1.83 ± 0.07	1.83	1.75	1.71	1.79	1.77 ± 0.05
Lu	0.25	0.26 ± 0.01	0.26	0.27	0.26	0.26 ± 0.01	0.26	0.25	0.25	0.27	0.26 ± 0.01
Zr	189	186 ± 5	200	191	201	197 ± 6	180	191	198	197	192 ± 8
Hf	3.82	3.81 ± 0.01	4.22	4.93	4.85	4.67 ± 0.39	4.37	4.28	4.51	5.03	4.55 ± 0.34
Ta	1.39	1.38 ± 0.02	1.63	1.58	1.56	1.59 ± 0.04	1.14	1.11	1.09	1.17	1.13 ± 0.04
W	2.16	1.4 ± 1.08	0.69	0.07	0.46	0.41 ± 0.31	0.71	0.91	0.5	0.5	0.66 ± 0.2
Sc	22.1	22 ± 0.2	21	22.4	22	21.8 ± 0.7	21.6	21.5	21.1	21.2	21.4 ± 0.2
Cr	185	188 ± 4	195	205	203	201 ± 5	228	185	181	186	195 ± 22
Co	45	46.5 ± 2.1	44.9	43.8	42.4	43.7 ± 1.3	44.1	45.3	42.5	40.1	43 ± 2.2
Ni	152	152 ± 0	138	150	163	150.3 ± 12.5	141	120	129	117	126.8 ± 10.8
Zn	132	139 ± 9.9	139	106	103	116 ± 20	151	119	109	112	122.8 ± 19.3
As	17.4	15.8 ± 2.26	4.11	1.53	1.06	2.23 ± 1.64	4.63	7.76	9.99	5.18	6.89 ± 2.48
Sb	0.28	0.32 ± 0.05	0.1	0.12	0.04	0.09 ± 0.04	0.23	0.28	0.19	0.04	0.19 ± 0.1
Au ppb	0.84	0.56 ± 0.4	1.46	1.34	0.93	1.24 ± 0.28	0.39	0.94	0.97	1.23	0.88 ± 0.35

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	97-GH-117	I70-33	Mean[3]	97GH-085	I70-43	Mean[3]	GL100	K97-10-8C	KH95-12	97-GH-94	I70-39	I70-37
Group[2]	9b	9b	9b	9c	9c	9c	10a	10a	10a	10a	10a	10a
Rb	56	41.9	49 ± 10	53.9	47.8	50.9 ± 4.3	19.2	22	16	19.3	23.9	28.8
Sr	1080	1080	1080 ± 0	1130	1030	1080 ± 71	1380	1330	1360	1680	1690	1470
Cs	2.05	0.34	1.2 ± 1.21	0.82	0.62	0.72 ± 0.14	0.08	0.1	0.21	0.1	0.34	0.29
Ba	1430	1390	1410 ± 28	1420	1360	1390 ± 42	1020	1010	949	1000	983	1030
Th	4.18	3.53	3.86 ± 0.46	4.38	3.7	4.04 ± 0.48	2.21	2.22	2.81	2.93	2.97	4.31
U	1.13	1.33	1.23 ± 0.14	1.79	1.71	1.75 ± 0.06	0.42	0.29	0.61	0.63	0.57	0.87
La	52.5	47.3	49.9 ± 3.7	52.5	46.9	49.7 ± 4	51.7	53.2	61.2	50.5	52.3	57.7
Ce	110	97	104 ± 9	110	97	103 ± 9	118	116	124	112	113	119
Nd	61.6	53	57.3 ± 6.1	60.1	52.2	56.2 ± 5.6	66.9	67.4	67	67	68	68.1
Sm	10.6	9.95	10.28 ± 0.46	10.9	9.76	10.33 ± 0.81	12.3	12.4	12	12.6	13.1	12.5
Eu	2.69	2.62	2.66 ± 0.05	2.78	2.56	2.67 ± 0.16	3.1	3.12	3.1	3.25	3.38	3.24
Gd	7.81	7.79	7.8 ± 0.01	8.01	7.07	7.54 ± 0.66	8.49	8.01	8.83	9.37	9.79	9.57
Tb	0.95	0.89	0.92 ± 0.04	1.04	0.9	0.97 ± 0.1	1.03	1.03	1.04	1.04	1.06	1.03
Ho	1	0.94	0.97 ± 0.04	1	0.97	0.99 ± 0.02	0.97	1.07	0.96	0.98	1.1	1.04
Tm	0.34	0.31	0.33 ± 0.02	0.38	0.3	0.34 ± 0.06	0.29	0.3	0.3	0.28	0.29	0.34
Yb	2.01	1.8	1.91 ± 0.15	2.21	1.82	2.02 ± 0.28	1.72	1.74	1.81	1.61	1.61	1.77
Lu	0.28	0.26	0.27 ± 0.01	0.32	0.26	0.29 ± 0.04	0.24	0.25	0.25	0.23	0.23	0.24
Zr	217	223	220 ± 4	258	243	251 ± 11	211	186	206	185	204	193
Hf	6.02	5.58	5.8 ± 0.31	6.23	5.63	5.93 ± 0.42	4.55	4.56	4.44	4.44	4.53	4.54
Ta	1.5	1.2	1.35 ± 0.21	1.5	1.29	1.4 ± 0.15	1.32	1.29	1.28	1.44	1.5	1.52
W	0.57	1.81	1.19 ± 0.88	1.41	0.5	0.96 ± 0.64	0.37	0.09	0.2	0.64	0.5	13.9
Sc	22.9	22.6	22.8 ± 0.2	23.1	22.2	22.7 ± 0.6	20.5	21.4	20.2	17.1	18.4	18.6
Cr	201	198	200 ± 2	214	212	213 ± 1	146	155	131	140	142	150
Co	41.1	45.8	43.5 ± 3.3	35.1	45.1	40.1 ± 7.1	43.7	44.9	37.2	40.8	41.1	40.8
Ni	132	135	133.5 ± 2.1	116	129	122.5 ± 9.2	129	129	99.4	105	100	113
Zn	141	106	123.5 ± 24.7	119	118	118.5 ± 0.7	121	153	125	176	143	132
As	6.58	32.4	19.49 ± 18.26	18.1	22.6	20.35 ± 3.18	0.62	0.6	7.8	3.51	1.37	1.24
Sb	0.2	0.43	0.32 ± 0.16	0.54	0.14	0.34 ± 0.28	0.04	0.04	0.15	0.11	0.14	0.06
Au ppb	0.24	8.21	4.23 ± 5.64	4.35	0.86	2.61 ± 2.47	2.43	0.69	1.19	0.07	0.4	0.52

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	Mean[3]	I70-40	K97-8-13A1	K97-8-13B	Mean[3]	K97-8-13A	CD152	L-223	Mean[3]	BR-6	BA-36
Group[2]	10a	10b	11a	11a	11a	11a'	12a	12a	12a	13a	13a
Rb	21.5 ± 4.5	37.8	40.6	38.1	39.4 ± 1.8	36.7	52.4	61.8	57.1 ± 6.6	88.7	97.4
Sr	1485 ± 162	1600	1370	1450	1410 ± 57	1450	727	709	718 ± 13	597	588
Cs	0.19 ± 0.11	0.59	0.58	0.66	0.62 ± 0.06	0.3	0.45	0.66	0.56 ± 0.15	3.41	1.76
Ba	999 ± 29	1080	975	1100	1038 ± 88	1180	1700	2020	1860 ± 226	2390	3090
Th	2.91 ± 0.77	5.15	4.03	4.4	4.22 ± 0.26	5.17	6.17	6.71	6.44 ± 0.38	8.77	9.48
U	0.57 ± 0.2	1.33	0.72	0.88	0.8 ± 0.11	0.98	1.6	1.76	1.68 ± 0.11	2.3	2.62
La	54.4 ± 4.1	65.2	62.7	67.4	65.1 ± 3.3	80.4	44.1	48.1	46.1 ± 2.8	56.1	66.4
Ce	117 ± 4	131	132	138	135 ± 4	157	92	98	95 ± 4	113	128
Nd	67.4 ± 0.5	72	72.3	76	74.2 ± 2.6	81.3	46.9	46.5	46.7 ± 0.3	55.3	64.2
Sm	12.48 ± 0.37	13.1	12.9	13.6	13.25 ± 0.49	14	8.48	9.18	8.83 ± 0.49	9.95	11.5
Eu	3.2 ± 0.11	3.36	3.13	3.26	3.2 ± 0.09	3.41	2.69	2.73	2.71 ± 0.03	3.02	3.32
Gd	9.01 ± 0.69	9.29	8.81	8.4	8.61 ± 0.29	9.39	7.09	8.29	7.69 ± 0.85	8.01	9.36
Tb	1.04 ± 0.01	1.07	1.04	1.1	1.07 ± 0.04	1.09	0.95	0.98	0.97 ± 0.02	1.03	1.19
Ho	1.02 ± 0.06	1.06	1.07	1.11	1.09 ± 0.03	0.99	1.07	1.2	1.14 ± 0.09	1.23	1.35
Tm	0.3 ± 0.02	0.3	0.33	0.35	0.34 ± 0.01	0.33	0.41	0.44	0.43 ± 0.02	0.48	0.53
Yb	1.71 ± 0.08	1.76	1.9	2.01	1.96 ± 0.08	1.97	2.49	2.63	2.56 ± 0.1	2.82	3.26
Lu	0.24 ± 0.01	0.24	0.26	0.28	0.27 ± 0.01	0.29	0.36	0.38	0.37 ± 0.01	0.42	0.48
Zr	198 ± 11	209	215	234	225 ± 13	253	331	357	344 ± 18	472	542
Hf	4.51 ± 0.06	4.45	4.83	5.04	4.94 ± 0.15	4.99	7.47	7.91	7.69 ± 0.31	11.2	11.9
Ta	1.39 ± 0.11	1.64	1.9	1.92	1.91 ± 0.01	1.96	1.33	1.37	1.35 ± 0.03	1.66	1.73
W	2.62 ± 5.53	0.89	0.5	0.5	0.5 ± 0	1.07	0.71	0.14	0.43 ± 0.4	0	0.71
Sc	19.4 ± 1.6	21.2	19.9	20.4	20.2 ± 0.4	20.3	18.2	17.3	17.8 ± 0.6	13.2	12.9
Cr	144 ± 8	243	179	170	175 ± 6	177	161	128	145 ± 23	71	55
Co	41.4 ± 2.7	29.4	38.5	37.6	38.1 ± 0.6	36.7	26.3	24.1	25.2 ± 1.6	11.3	12.4
Ni	112.6 ± 13.6	150	128	111	119.5 ± 12	116	75.9	64.5	70.2 ± 8.1	30.2	32.3
Zn	141.7 ± 20.5	131	145	145	145 ± 0	139	92	94.2	93.1 ± 1.6	97.5	105
As	2.52 ± 2.8	19.4	1.89	2.01	1.95 ± 0.08	2.99	4.81	1.61	3.21 ± 2.26	4.34	2.52
Sb	0.09 ± 0.05	0.9	0.03	0.08	0.06 ± 0.04	0.21	0.28	0.07	0.18 ± 0.15	0.15	0.11
Au ppb	0.88 ± 0.84	0.1	0.1	0.46	0.28 ± 0.25	0.14	2.95	0.45	1.7 ± 1.77	1.45	1.76

[1] Trace element contents determined by INAA. Values in ppm except where noted.

[2] Geochemical group from Budahn and others (2002).

[3] Uncertainties in means for groups are 1 standard deviation

Table 5. Cont'd.[1]

Sample	Mean[3]	C69B	CD23	SWV-1	L-27	KH95-15	L-76	KH95-13	97GH-099	97GH-110	I70-42	BR-8
Group[2]	13a	U	U	U	U	U	U	U	U	U	U	U
Rb	93.1 ± 6.2	30.3	40.8	20.8	25.8	32.3	52.4	32.9	32.6	28.5	40.3	82.2
Sr	593 ± 6	878	1090	705	348.0	974.0	893.0	1640	759	1110	1580	755
Cs	2.59 ± 1.17	0.52	0.79	0.23	0.36	0.25	1.10	0.12	4.87	0.66	0.26	1.13
Ba	2740 ± 495	871	1060	580	419	4830	2370	1070	629	882	1460	1310
Th	9.13 ± 0.5	3.24	5.43	2.35	2.29	2.83	5.28	3.48	3.23	2.89	6.57	11.1
U	2.46 ± 0.23	0.79	0.52	1	0.57	0.58	0.87	0.86	0.85	0.62	1.27	1.66
La	61.3 ± 7.3	35.5	44.5	28	17.4	35.2	41.0	73.4	30.5	35.5	99.9	49.3
Ce	121 ± 11	80	97	56	38.9	79.5	83.8	153	64	80	183	97
Nd	59.8 ± 6.3	41.4	51.1	31.2	21.7	44.5	43.6	80.5	34.8	47.2	83.3	44.3
Sm	10.73 ± 1.1	8.49	10.4	6.47	4.95	8.95	8.72	14.4	6.8	9.24	13.7	7.89
Eu	3.17 ± 0.21	2.14	2.72	1.85	1.42	2.38	2.34	3.51	1.88	2.41	3.44	1.74
Gd	8.69 ± 0.95	6.72	8.37	5.27	5.07	6.95	7.40	9.87	5.73	7.54	9.25	5.81
Tb	1.11 ± 0.11	0.86	1.12	0.74	0.68	0.95	0.97	1.17	0.76	0.91	1.05	0.8
Ho	1.29 ± 0.08	0.99	1.26	0.9	0.89	1.03	1.14	1.03	0.82	0.93	0.95	1.08
Tm	0.51 ± 0.04	0.39	0.42	0.29	0.32	0.39	0.38	0.35	0.28	0.32	0.29	0.42
Yb	3.04 ± 0.31	2.37	2.6	1.75	1.92	2.39	2.24	2.02	1.67	1.88	1.8	2.58
Lu	0.45 ± 0.04	0.35	0.4	0.24	0.30	0.33	0.33	0.28	0.24	0.25	0.25	0.37
Zr	507 ± 49	157	226	121	129	190	190	218	125	152	223	206
Hf	11.55 ± 0.49	3.84	4.87	2.63	3.15	4.73	5.10	5.23	3.02	3.43	5.35	5.14
Ta	1.7 ± 0.05	0.69	1.58	0.91	0.54	1.48	2.23	2.03	0.89	1.79	1.83	0.57
W	0.36 ± 0.5	0.76	1.74	0.75	0.90	1.36	0.53	1.45	0.01	173	2.62	0.79
Sc	13.1 ± 0.2	23.4	27.3	20.7	21.2	22.5	24.8	21.3	21.3	22.5	17.8	8.2
Cr	63 ± 11	246	298	185	221	224	205	162	190	189	204	2
Co	11.9 ± 0.8	44.3	25.2	39.9	42.9	38.4	36.5	25.4	42.1	73.8	34.8	3.7
Ni	31.3 ± 1.5	158	94.6	135	139	151	114	91.1	124	110	108	9.9
Zn	101.3 ± 5.3	75.6	87.8	92.3	107.0	104.0	82.7	124	102	136	119	49.7
As	3.43 ± 1.29	0.58	2.03	0.62	1.53	1.27	1.07	33.8	1.29	2.83	0.58	0.64
Sb	0.13 ± 0.03	0.11	0.21	0.05	0.09	0.06	0.10	0.94	0.11	0.25	0.09	0.08
Au ppb	1.61 ± 0.22	0.29	2.64	1.34	1.87	1.39	0.11	1.42	3.97	0.76	0.76	0.31

[1] Trace element contents determined by INAA. Values in ppm except where noted.
[2] Geochemical group from Budahn and others (2002).
[3] Uncertainties in means for groups are 1 standard deviation

The 13-14 Ma latites (groups 12 and 13; Fig. 6H) show strong enrichment in the alkali elements, Ba, Th, U, and the LREE; but significant relative depletion in Ta and Ti. At least some of these features probably relate to the evolved nature of these samples.

Selected trace elements are shown as functions of silica content in Figure 7. When compared at equivalent silica contents, samples from groups 1-3 (9-10 Ma) show the lowest Ba, Sr, Zr, Ta, La, and Rb contents, but the highest Cr and Ni. These results suggest that these samples are the least differentiated and therefore may represent the most likely candidates for uncontaminated mantle-derived (OIB-type) magmas. However the isotopic features of these basalts (next section) indicate that such is not the case.

The highest Ba, Rb, and Ta contents are found among the post-4 Ma samples (groups 6 and 7). These samples have intermediate La and Sr contents, intermediate to high Zr, and are among the lowest in Cr and Ni. Therefore these samples have the least OIB-like trace element characteristics. However, they have the most mantle-like isotopic characteristics of any of the samples analyzed (next section).

The highest Sr and La contents are found among some of the 22-24 Ma samples (groups 10-11). These samples are also characterized by low Cr and Ni contents. The 7-8 Ma samples (group 5) have intermediate trace element contents.

Pb, Sr, and Nd Isotope Geochemistry

A subset of the samples analyzed for trace elements were selected for Pb, Sr, and Nd, isotopic analyses (Table 6). At least one sample of each subgroup of groups 1-7 was selected for analysis. The 22-24 Ma samples from the Eagle collapse center (groups 8-11) were not as extensively analyzed for isotopic compositions.

The most striking feature of the Pb isotopic data (Figure 8) is the bimodal nature of the Pb isotopic compositions among groups 1 through 4. Groups 1a. 1a', 1b', 1c', 2a, 3a, and 4a are characterized by Pb that is much more radiogenic than that found in other members of the respective general groups. The groups with radiogenic Pb are all from the Sunlight Peak area west of the Roaring Fork River (Figure 2). These are referred to as the "western groups" in Figures 8-10.

A second notable feature of the Pb isotopic data is the relative ^{208}Pb enrichment exhibited by the data for group 1 samples east of the Roaring Fork River. Such ^{208}Pb enrichment is often regarded as a lower-crustal signature (e.g. Zartman and Doe, 1981).

Also shown in Figure 8 are data from Miocene minettes from the Elkhead Mountains in NW Colorado (Thompson and others, 1990), which are thought to have been derived from the lithospheric mantle. The minettes have ^{207}Pb/^{204}Pb similar to our Carbondale samples, but are characterized by significantly lower ^{208}Pb/^{204}Pb.

Nd and Sr isotopic data exhibit a scattered linear trend with negative slope on a plot of εNd vs. ^{87}Sr/^{86}Sr (Figure 9A). One end of the trend is defined by the group 6 samples with the lowest ^{87}Sr/^{86}Sr and highest εNd. The other end-member is defined by the western groups. These samples have the highest ^{87}Sr/^{86}Sr and among the lowest εNd. The isotopic data for NW

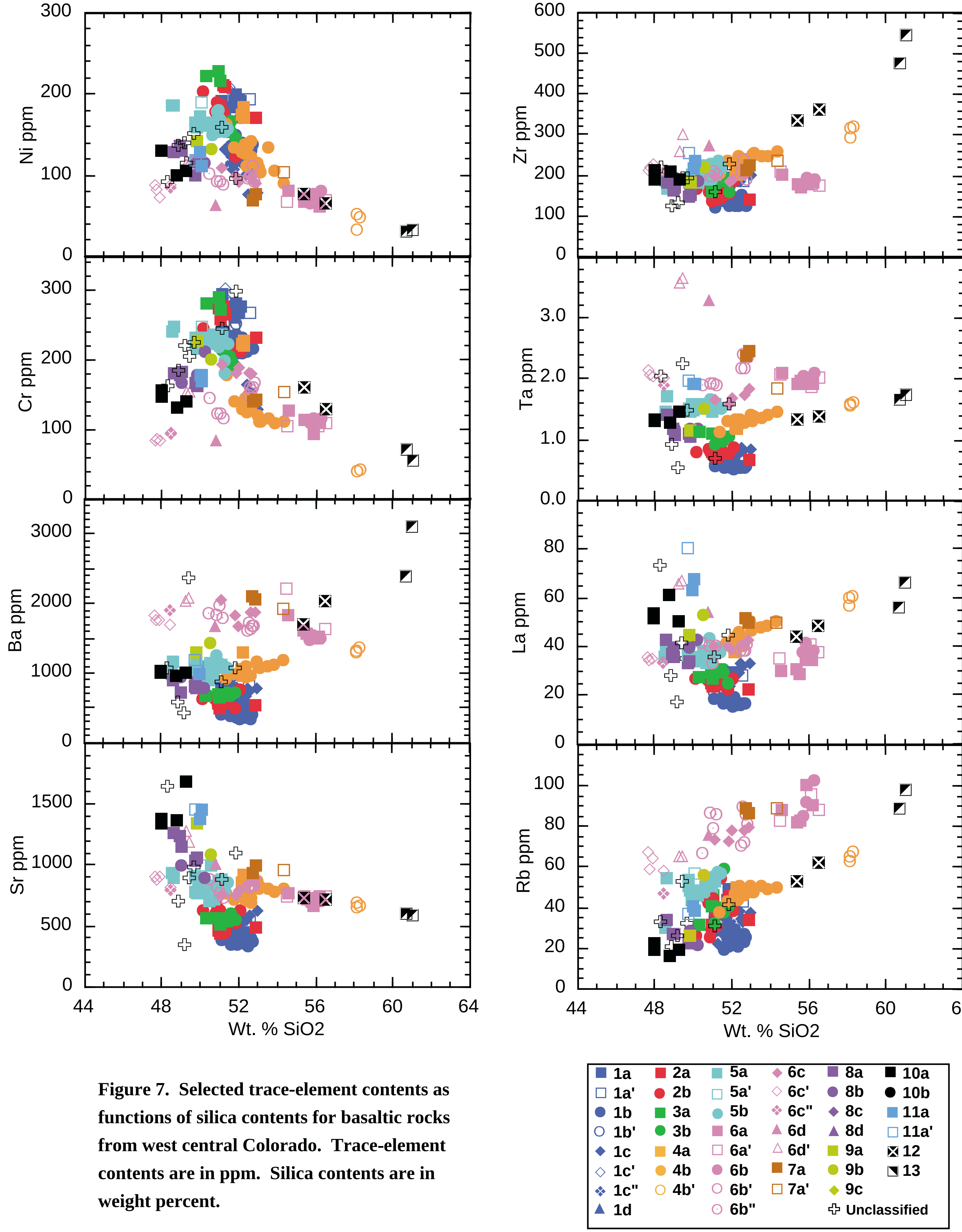


Figure 7. Selected trace-element contents as functions of silica contents for basaltic rocks from west central Colorado. Trace-element contents are in ppm. Silica contents are in weight percent.

Table 6. Lead, strontium, and neodymium isotopic compositions in Tertiary basaltic rocks from central Colorado[1]

Sample No.	Group	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$	$^{87}Sr/^{86}Sr$	$^{143}Nd/^{144}Nd$	εNd
KH95-21	1a	18.707 ± 0.012	15.627 ± 0.014	38.385 ± 0.047	0.708296 ± 0.000015	0.512182 ± 0.000031	-8.86
KH95-22	1a	18.685 ± 0.013	15.626 ± 0.015	38.462 ± 0.048	0.708668 ± 0.000020	0.512131 ± 0.000010	-9.85
KH95-35	1a	18.718 ± 0.012	15.642 ± 0.015	38.487 ± 0.047	0.708643 ± 0.000020	0.512185 ± 0.000015	-8.80
Mean	1a	18.703 ± 0.017	15.632 ± 0.009	38.445 ± 0.053	0.708536 ± 0.000207	0.512166 ± 0.000030	-9.17
KH95-19	1a'	18.709 ± 0.011	15.625 ± 0.014	38.366 ± 0.046	0.708437 ± 0.000027	0.512135 ± 0.000015	-9.77
KH95-9	1b	17.862 ± 0.012	15.527 ± 0.015	38.466 ± 0.048	0.707330 ± 0.000023	0.512218 ± 0.000015	-8.15
CD 193D	1b	17.778 ± 0.013	15.527 ± 0.016	38.452 ± 0.049	0.707644 ± 0.000021	0.512297 ± 0.000013	-6.61
CD 180	1b	17.765 ± 0.014	15.532 ± 0.016	38.425 ± 0.050	0.706765 ± 0.000018	0.512254 ± 0.000015	-7.45
CD 17	1b	17.766 ± 0.013	15.534 ± 0.015	38.430 ± 0.049	0.707380 ± 0.000020	0.512229 ± 0.000015	-7.94
CD181C	1b	17.761 ± 0.012	15.519 ± 0.015	38.377 ± 0.047	0.707243 ± 0.000021	0.512259 ± 0.000014	-7.35
CD 53B	1b	17.839 ± 0.014	15.525 ± 0.016	38.496 ± 0.050	0.707274 ± 0.000014	0.512293 ± 0.000015	-6.69
CD53D	1b	17.905 ± 0.013	15.531 ± 0.016	38.260 ± 0.049	0.707220 ± 0.000021	0.512210 ± 0.000037	-8.31
Mean	1b	17.811 ± 0.058	15.528 ± 0.005	38.415 ± 0.078	0.707265 ± 0.000262	0.512250 ± 0.000037	-7.53
KH95-24	1b'	18.661 ± 0.013	15.633 ± 0.015	38.564 ± 0.048	0.709618 ± 0.000021	0.512212 ± 0.000022	-8.27
CD150C	1c	17.697 ± 0.014	15.512 ± 0.016	38.312 ± 0.050	0.707255 ± 0.000020	0.512193 ± 0.000015	-8.64
KH95-3	1c'	18.749 ± 0.011	15.612 ± 0.014	38.328 ± 0.046	0.708140 ± 0.000010	0.512174 ± 0.000012	-9.01
CD 138	1c"	17.712 ± 0.013	15.526 ± 0.016	38.357 ± 0.049	0.707858 ± 0.000021	0.512261 ± 0.000014	-7.32
CD 204	1c"	17.781 ± 0.065	15.556 ± 0.058	38.218 ± 0.145	0.707782 ± 0.000031	0.512222 ± 0.000014	-8.08
Mean	1c"	17.747 ± 0.049	15.541 ± 0.021	38.288 ± 0.098	0.707820 ± 0.000095	0.512242 ± 0.000030	-7.70
CD45A	1d	17.776 ± 0.014	15.534 ± 0.016	38.286 ± 0.050	0.707743 ± 0.000020	0.512249 ± 0.000015	-7.55
KH95-1	2a	18.757 ± 0.014	15.620 ± 0.016	38.536 ± 0.049	0.708701 ± 0.000020	0.512236 ± 0.000015	-7.80
KH95-17	2a	18.739 ± 0.011	15.614 ± 0.014	38.520 ± 0.046	0.708652 ± 0.000021	0.512212 ± 0.000014	-8.27
CC140	2a	18.812 ± 0.012	15.638 ± 0.015	38.611 ± 0.047	0.708869 ± 0.000021	0.512246 ± 0.000014	-7.61
Mean	2a	18.769 ± 0.038	15.624 ± 0.012	38.556 ± 0.049	0.708741 ± 0.000114	0.512231 ± 0.000014	-7.90
GS96-1	2b	17.869 ± 0.013	15.522 ± 0.015	37.972 ± 0.048	0.706751 ± 0.000021	0.512272 ± 0.000027	-7.10
GL 207	2b	17.895 ± 0.013	15.515 ± 0.015	38.107 ± 0.048	0.706730 ± 0.000019	0.512303 ± 0.000024	-6.50
CC-LA-1	2b	17.842 ± 0.016	15.534 ± 0.018	38.205 ± 0.053	0.706883 ± 0.000021	0.512319 ± 0.000015	-6.18
CC 132	2b	17.855 ± 0.013	15.539 ± 0.015	38.218 ± 0.048	0.706880 ± 0.000028	0.512339 ± 0.000013	-5.79
Mean	2b	17.865 ± 0.023	15.528 ± 0.011	38.126 ± 0.114	0.706811 ± 0.000082	0.512308 ± 0.000032	-6.39
KH95-42	3a	18.813 ± 0.012	15.615 ± 0.014	38.419 ± 0.047	0.708304 ± 0.000020	0.512269 ± 0.000016	-7.16

[1]Uncertainties for indidvidual samples are at the 95% confidence level. Those for means are 1 sigma (unweighted).

Table 6. Cont'd.[1]

Sample No.	Group	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$	$^{87}Sr/^{86}Sr$	$^{143}Nd/^{144}Nd$	εNd
CD 53 A	3b	17.983 ± 0.013	15.550 ± 0.016	38.168 ± 0.049	0.707349 ± 0.000020	0.512280 ± 0.000015	-6.94
CD181A	3b	18.000 ± 0.012	15.540 ± 0.015	38.119 ± 0.047	0.707367 ± 0.000021		
CD 193A	3b	18.003 ± 0.012	15.550 ± 0.015	38.233 ± 0.048	0.707422 ± 0.000021	0.512256 ± 0.000014	-7.41
Mean	3b	17.995 ± 0.011	15.547 ± 0.006	38.173 ± 0.057	0.707379 ± 0.000039	0.512268 ± 0.000020	-7.18
KH95-43	4a	18.371 ± 0.011	15.566 ± 0.014	37.916 ± 0.046	0.706888 ± 0.000016	0.512239 ± 0.000019	-7.74
KH95-25	4a	18.372 ± 0.012	15.583 ± 0.014	37.950 ± 0.046	0.706643 ± 0.000020	0.512287 ± 0.000014	-6.81
Mean	4a	18.372 ± 0.001	15.575 ± 0.012	37.933 ± 0.024	0.706765 ± 0.000173	0.512263 ± 0.000032	-7.28
CD 150B	4b	17.712 ± 0.014	15.507 ± 0.016	37.824 ± 0.049	0.707103 ± 0.000021	0.512294 ± 0.000015	-6.67
K97-8-11A	4b	17.725 ± 0.011	15.507 ± 0.014	37.840 ± 0.046	0.706876 ± 0.000020	0.512287 ± 0.000014	-6.81
K97-8-11C	4b	17.572 ± 0.011	15.492 ± 0.015	37.722 ± 0.046	0.706779 ± 0.000021	0.512258 ± 0.000015	-7.37
K97-8-11E	4b	17.714 ± 0.012	15.497 ± 0.015	37.768 ± 0.047	0.706777 ± 0.000021	0.512278 ± 0.000014	-6.98
Mean	4b	17.681 ± 0.073	15.501 ± 0.008	37.789 ± 0.054	0.706884 ± 0.000154	0.512279 ± 0.000018	-6.96
K97-8-15C	4b'	17.306 ± 0.012	15.485 ± 0.016	37.589 ± 0.048	0.707187 ± 0.000020	0.512201 ± 0.000015	-8.49
K97-8-15B	4b'	17.322 ± 0.011	15.464 ± 0.014	37.575 ± 0.046	0.707249 ± 0.000020	0.512202 ± 0.000015	-8.47
Mean	4b'	17.314 ± 0.011	15.475 ± 0.015	37.582 ± 0.010	0.707218 ± 0.000045	0.512202 ± 0.000014	-8.48
CP 8	5a	17.746 ± 0.015	15.520 ± 0.017	37.987 ± 0.051	0.706315 ± 0.000021	0.512222 ± 0.000014	-8.08
CP89	5a	17.637 ± 0.011	15.484 ± 0.014	37.760 ± 0.046	0.705725 ± 0.000020	0.512299 ± 0.000015	-6.57
KH95-28	5a	17.682 ± 0.011	15.488 ± 0.014	38.027 ± 0.046	0.706009 ± 0.000020	0.512311 ± 0.000013	-6.34
KH95-32	5a	17.816 ± 0.014	15.550 ± 0.017	38.092 ± 0.050	0.706223 ± 0.000021	0.512302 ± 0.000024	-6.52
Mean	5a	17.720 ± 0.078	15.511 ± 0.031	37.967 ± 0.144	0.706068 ± 0.000262	0.512284 ± 0.000041	-6.88
KH95-29	5a'	17.801 ± 0.011	15.506 ± 0.014	37.965 ± 0.046	0.706212 ± 0.000020	0.512285 ± 0.000014	-6.85
CCLA-5	5b	17.780 ± 0.011	15.511 ± 0.014	37.977 ± 0.046	0.706630 ± 0.000021	0.512244 ± 0.000012	-7.65
CC 121	5b	17.729 ± 0.012	15.514 ± 0.015	38.022 ± 0.047	0.706609 ± 0.000019	0.512300 ± 0.000015	-6.55
CC 122	5b	17.720 ± 0.014	15.514 ± 0.016	38.033 ± 0.049	0.706594 ± 0.000022	0.512255 ± 0.000014	-7.43
Mean	5b	17.743 ± 0.032	15.513 ± 0.002	38.011 ± 0.030	0.706611 ± 0.000022	0.512266 ± 0.000030	-7.21
SH-262	6a	17.574 ± 0.011	15.472 ± 0.014	37.675 ± 0.046	0.705840 ± 0.000021	0.512367 ± 0.000015	-5.25
CD 197	6a	17.598 ± 0.013	15.511 ± 0.016	37.882 ± 0.049	0.705890 ± 0.000110	0.512345 ± 0.000015	-5.68
CD 206	6a	17.754 ± 0.011	15.510 ± 0.014	37.997 ± 0.046	0.706060 ± 0.000114	0.512309 ± 0.000015	-6.38
Mean	6a	17.642 ± 0.098	15.498 ± 0.022	37.851 ± 0.163	0.705930 ± 0.000300	0.512340 ± 0.000031	-5.77
CD 209	6a'	17.684 ± 0.016	15.501 ± 0.017	37.958 ± 0.052	0.705918 ± 0.000023	0.512300 ± 0.000015	-6.55
SH 267	6b	17.573 ± 0.011	15.476 ± 0.014	37.681 ± 0.046	0.705725 ± 0.000020	0.512315 ± 0.000038	-6.26

[1]Uncertainties for indidvidual samples are at the 95% confidence level. Those for means are 1 sigma (unweighted).

Table 6. Cont'd.[1]

Sample No.	Group	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$	$^{87}Sr/^{86}Sr$	$^{143}Nd/^{144}Nd$	εNd
L244	6b'	17.746 ± 0.011	15.502 ± 0.014	38.014 ± 0.046	0.705570 ± 0.000018	0.512365 ± 0.000015	-5.29
CP86	6b"	18.015 ± 0.011	15.532 ± 0.014	38.082 ± 0.046	0.705640 ± 0.000020	0.512332 ± 0.000015	-5.93
CPV 4	6b"	17.895 ± 0.012	15.530 ± 0.014	38.067 ± 0.047	0.707114 ± 0.000021	0.512264 ± 0.000014	-7.26
Mean	6b"	17.955 ± 0.085	15.531 ± 0.002	38.075 ± 0.011	0.706377 ± 0.001042	0.512298 ± 0.000049	-6.59
L1	6c	18.099 ± 0.011	15.536 ± 0.014	38.123 ± 0.046	0.705587 ± 0.000021	0.512321 ± 0.000015	-6.14
DTV-2	6c'	18.127 ± 0.011	15.545 ± 0.014	37.968 ± 0.046	0.705014 ± 0.000020	0.512419 ± 0.000013	-4.23
DTV-3	6c'	18.106 ± 0.012	15.522 ± 0.014	37.880 ± 0.046	0.705040 ± 0.000021	0.512405 ± 0.000014	-4.51
Mean	6c'	18.117 ± 0.015	15.534 ± 0.016	37.924 ± 0.062	0.705027 ± 0.000017	0.512412 ± 0.000010	-4.37
DT-R3	6c"	18.275 ± 0.011	15.575 ± 0.014	38.224 ± 0.046	0.705562 ± 0.000020	0.512427 ± 0.000015	-4.08
K97-8-12A	6d'	18.110 ± 0.013	15.562 ± 0.015	38.272 ± 0.049	0.705588 ± 0.000020	0.512382 ± 0.000013	-4.95
KH95-26	7a	17.768 ± 0.011	15.494 ± 0.014	37.913 ± 0.046	0.705589 ± 0.000013	0.512322 ± 0.000069	-6.13
DT-R2	8a	17.810 ± 0.011	15.508 ± 0.014	37.908 ± 0.047	0.706452 ± 0.000021	0.512286 ± 0.000015	-6.83
GL 100	10a	17.493 ± 0.012	15.450 ± 0.015	37.725 ± 0.047	0.706065 ± 0.000020	0.512295 ± 0.000011	-6.65
K97-8-13A	11a'	18.150 ± 0.013	15.568 ± 0.015	38.342 ± 0.048	0.706642 ± 0.000040	0.512261 ± 0.000032	-7.32
CD 152	12a	17.468 ± 0.011	15.473 ± 0.014	37.716 ± 0.046	0.705871 ± 0.000020	0.512245 ± 0.000016	-7.63
BA-36	13a	17.389 ± 0.011	15.465 ± 0.014	37.738 ± 0.045	0.706450 ± 0.000020	0.512223 ± 0.000013	-8.06
KH 95-15	U	17.731 ± 0.012	15.506 ± 0.015	38.016 ± 0.047	0.706912 ± 0.000020	0.512308 ± 0.000015	-8.47
BR-8	U	17.681 ± 0.011	15.490 ± 0.014	38.285 ± 0.046	0.708124 ± 0.000020	0.512032 ± 0.000033	-11.78

[1]Uncertainties for indidvidual samples are at the 95% confidence level. Those for means are 1 sigma (unweighted).

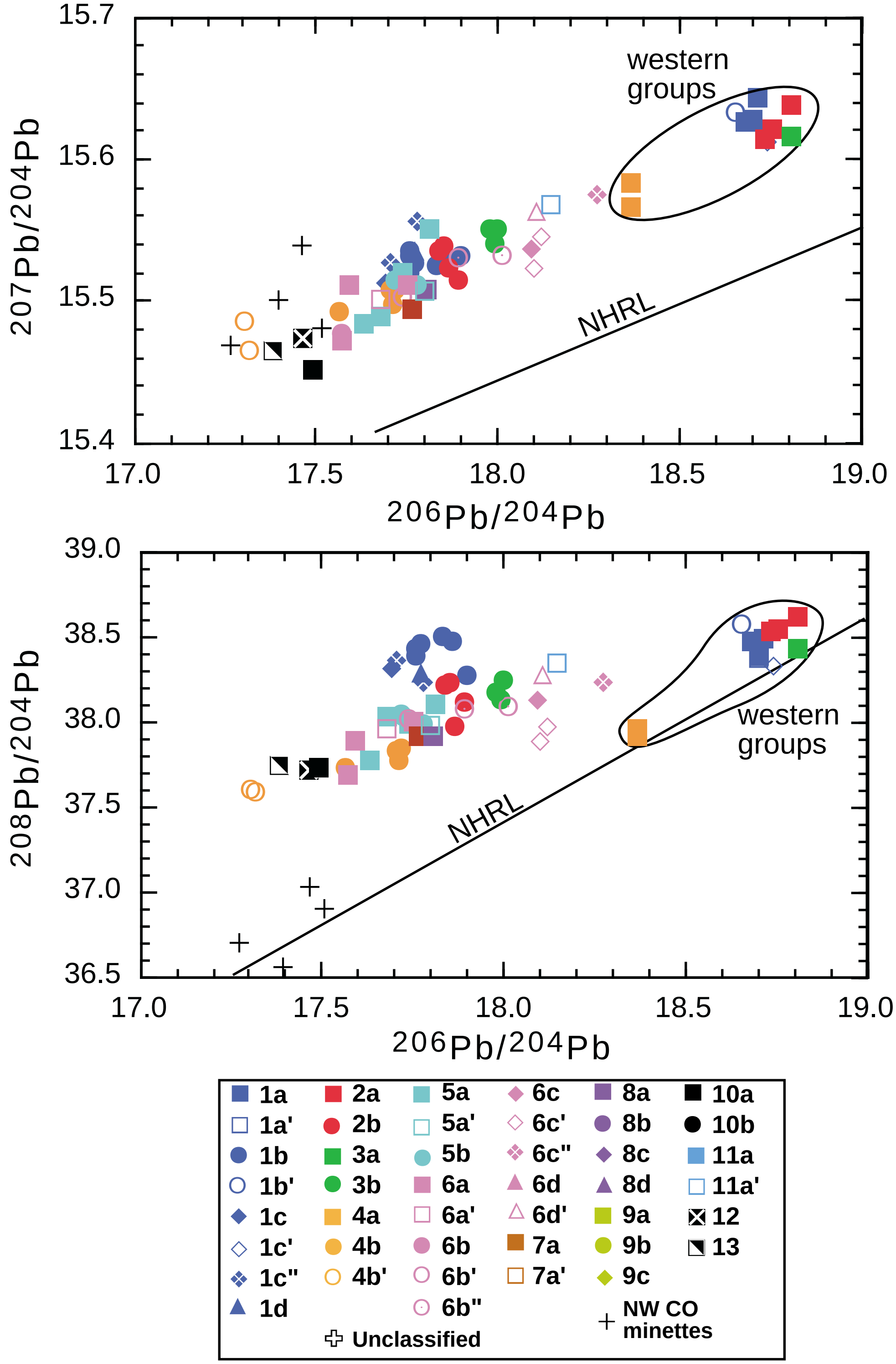


Figure 8. Lead isotopic compositions in basaltic rocks from west central Colorado. Shown for reference are data from minettes from northwest Colorado (Thompson and others, 1990). Also shown for reference is the "northern hemisphere reference line" (NHRL), the trend of average Pb isotopic compositions for oceanic basalt in the northern hemisphere (Hart, 1984).

Colorado minettes (Thompson and others, 1990) do not plot on the array defined by the Carbondale samples.

Pb isotopic data are not well correlated with either Nd (Figure 9B) or Sr (Figure 9C) isotopic compositions. However, the youngest samples (groups 6c', 6c", and 6d) exhibit the most radiogenic Nd and Pb (western groups excluded) and the least radiogenic Sr.

Isotopic data are shown as functions of Hf/Ta in Figure 10. Pb isotopic data show little correlation with Hf/Ta. Excluding the western groups, the most radiogenic Pb is found among samples with the lowest Hf/Ta (groups 6c, 6c', 6c", and 8a), but among group 6 samples there is a considerable range in 206Pb/204Pb at nearly constant Hf/Ta. The least radiogenic Pb is found among groups 4b', 12, and 13. These groups are the most evolved in terms of silica content (Table 4).

In contrast to the Pb isotopic data, Sr and Nd data show fairly good correlations with Hf/Ta (Fig. 10). The lowest Hf/Ta and $^{87}Sr/^{86}Sr$ but highest εNd are found among group 6 samples whereas the highest Hf/Ta and $^{87}Sr/^{86}Sr$ but lowest εNd values are found among group 1 samples. However, we note that there is considerable range in εNd values for group 6 samples (εNd = -4 to –6.5) that have more or less constant Hf/Ta. Data from samples of the western subgroups have the highest $^{87}Sr/^{86}Sr$ and lowest εNd among their respective general groups.

The correlations observed in Figure 10 are in marked contrast to those observed when the isotopic data are shown as functions of silica content (Fig. 11). Lead isotopic data show a pronounced inverse relationship with silica content. The data for samples from the western groups do not plot on the trend defined by the remaining samples.

Strontium isotopic data show a pronounced positive correlation with silica in the range of 48-54% silica, but no correlation above ≈52% SiO_2. Data from the western groups are offset from the main trend towards slightly higher $^{87}Sr/^{86}Sr$. Group 6 samples show comparatively constant $^{87}Sr/^{86}Sr$ over a wide range in SiO_2 contents.

Neodymium isotopic data show weak inverse relationships with silica contents. The trend for group 6 samples is offset toward higher εNd from the trend of the remaining groups. The data for samples from the western groups is offset toward lower εNd.

The Hf/Ta ratios are thought to represent primary features of the respective magmas that are relatively insensitive to differentiation or small amounts of crustal contamination (Wood, 1980; Meschede, 1986). The good correlation between Hf/Ta and both εNd and $^{87}Sr/^{86}Sr$ suggests that the isotopic values in these samples are also primary features of the magmas. The lack of correlation between $^{206}Pb/^{204}Pb$ and Hf/Ta suggests that the Pb isotopic values of many of these samples may have been modified by interaction with crustal material.

Silica contents are an index of differentiation rather than primary features and correlations between isotopic values and silica contents within a suite of rocks is normally taken as evidence for crustal interaction either by bulk contamination or by assimilation of crustal material combined with fractional crystallization (AFC). The data presented in Figure 11

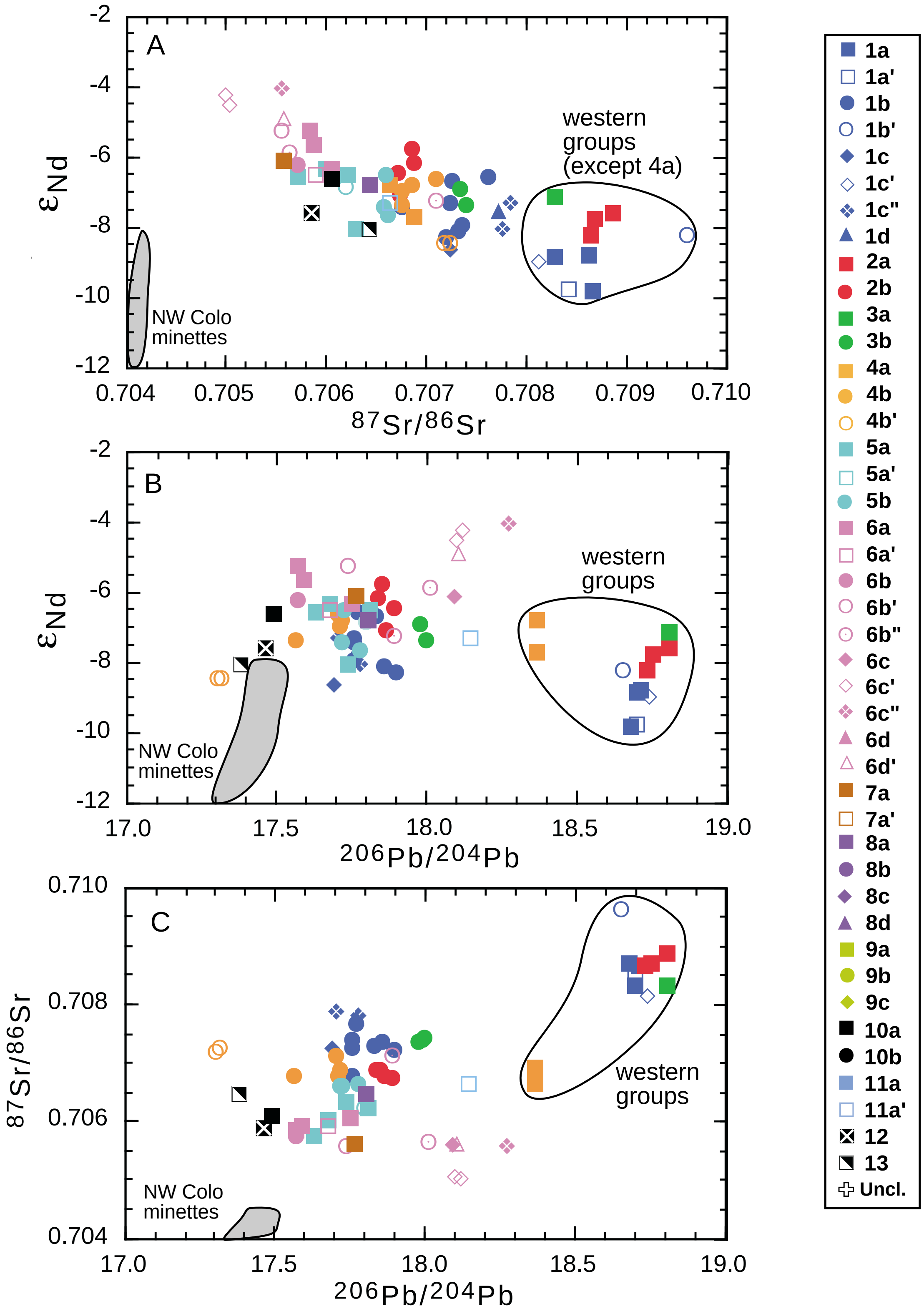


Figure 9. (A) εNd vs. 87Sr/86Sr, (B) εNd vs. 206Pb/204Pb, (C) 87Sr/86Sr vs. 206Pb/204Pb for basaltic rocks from west central Colorado. Shown for comparison are isotopic data from minettes in NW Colorado (Thompson and others, 1990). εNd is defined as the relative difference, in parts per 10,000, from the present-day chondritic 143Nd/144Nd = 0.512636 (DePaolo and Wasserburg, 1976).

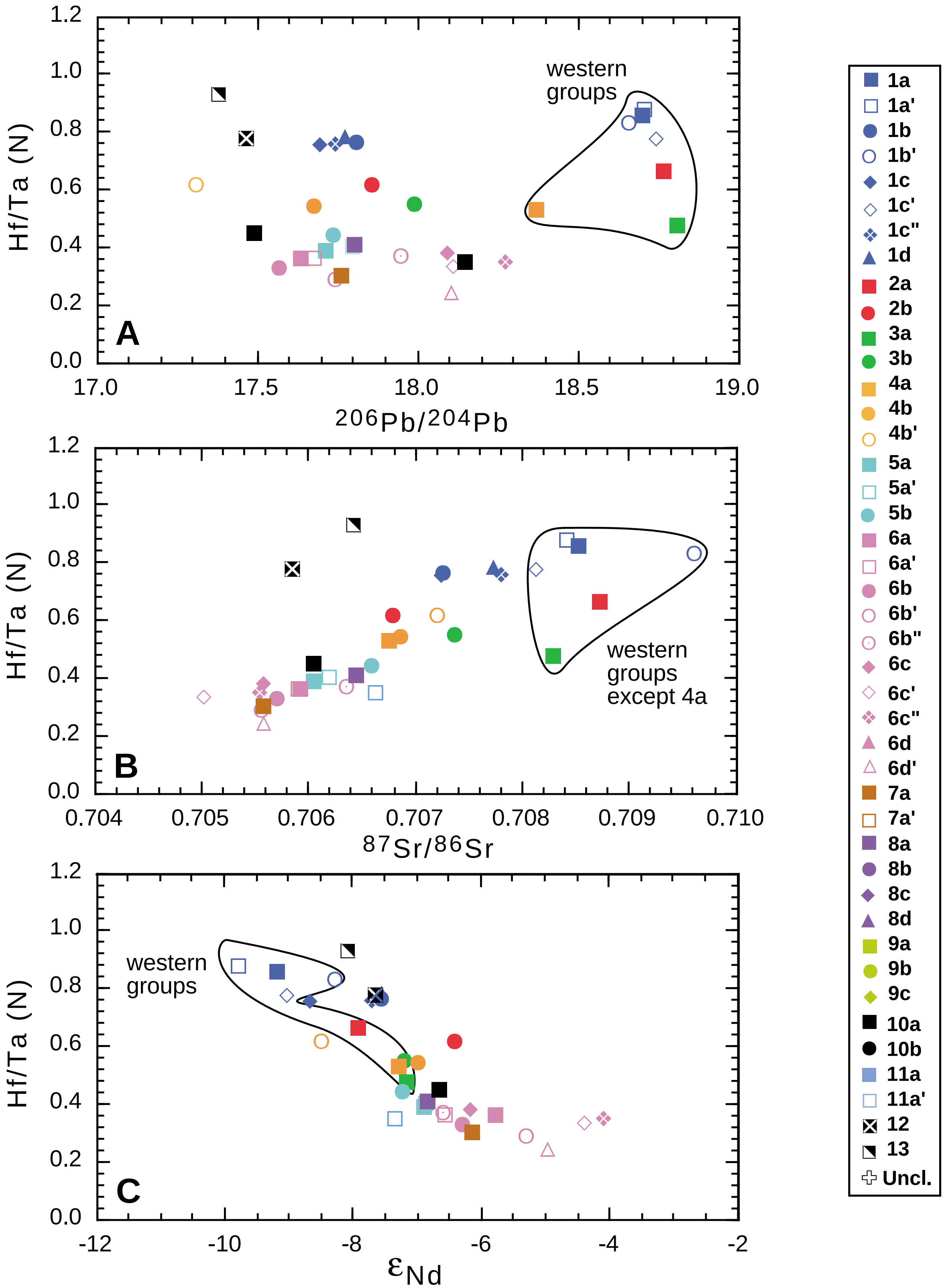


Figure 10. Chondrite-normalized Hf/Ta as a function of (A) $^{206}Pb/^{204}Pb$, (B) $^{87}Sr/^{86}Sr$, and (C) ε_{Nd} for basaltic rocks from west central Colorado. Only the mean values for the individual groups are shown.

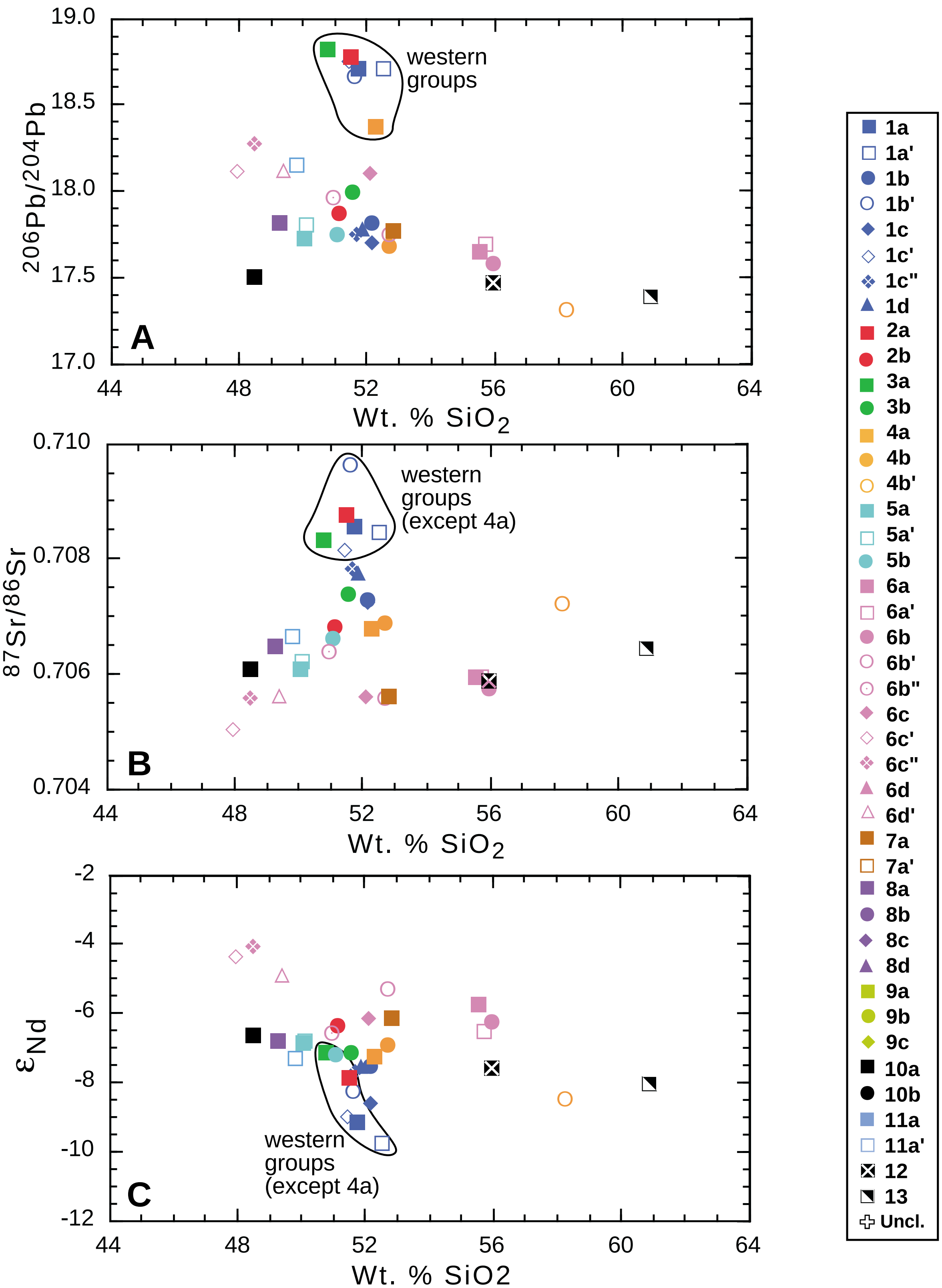


Figure 11. (A) $^{206}Pb/^{204}Pb$, (B) $^{87}Sr/^{86}Sr$, (C) ε_{Nd} as functions of silica content. Only the mean values for the individual groups are shown.

suggests that at least small but ubiquitous crustal contamination is present within these samples. The presence of crustal contamination within these samples is also supported by the presence of xenoliths and quartz xenocrysts in many of the samples (Table 2).

The contamination is most evident in the Pb isotopic data, so much so that it has obscured the relationship between Hf/Ta and $^{206}Pb/^{204}Pb$ (Fig. 10). Although there is some evidence for contamination in the Sr and Nd isotopic data (Figure 11), the relationships in Figure 10 suggest that the effects of contamination on the Nd and Sr isotopic values are minor in comparison to the primary variations among the parental magmas to these samples. The exception to this general statement may be found among the samples of group 6, which show excessive variation in εNd at nearly constant Hf/Ta but a good inverse relationship between εNd and SiO_2. The greater apparent effect of crustal contamination on the Pb isotopic data than on the Sr and Nd data is consistent with estimates of trace element contents in average continental crust and OIB sources (e.g. Sun and McDonough, 1989, Hofmann, 1988). Although estimates of crustal abundances represent a worldwide average and are thus not rigorously applicable to a restricted area, they do provide a basis for at least a qualitative assessment of the data. Lead in the crust is expected to be enriched over that in an OIB magma by a factor of ≈2.5, whereas Sr and Nd may actually be more enriched in the OIB magma by about the same factor of 2.5. Consequently, a small amount of crustal contamination should have a much more pronounced effect on the Pb isotopic data than on the Sr or Nd data. This is exactly what we observe in Figures 10 and 11.

The isotopic characteristics of the western groups are somewhat enigmatic. Our preferred interpretation is that the magmas represented by these samples were heavily contaminated by crustal material that was isotopically distinct (at least for Pb) from contaminants in the samples east of the Roaring Fork River. Basalts west of the Roaring Fork were erupted through a steeply dipping (thicker?) sequence of sedimentary rocks whereas those east of the river were erupted through flat-lying sediments. Thus the potential at least exists for different sources and/or mechanisms of crustal contamination. Alternatively, the isotopic character of these samples may represent a primary feature of their parental magmas. If so, then the geochemical similarity between these basalts and other members of the same general groups east of the Roaring Fork River would be purely coincidental.

Based upon the geochemistry of the basaltic rocks , Leat and others (1988; 1989; 1990; Thompson and others, 1990; Gibson and others, 1991) have concluded that the basalts in western Colorado were derived from three principal sources: (1) asthenospheric mantle (OIB source), (2) lithospheric mantle and (3) asthenospheric mantle modified by subducted oceanic lithosphere. The asthenospheric mantle or OIB source is characterized by low K_2O and La/Ta. In addition, the OIB source should have low Hf/Ta, high MgO, high εNd (≥ 0) and low $^{87}Sr/^{86}Sr$ (≤ 0.705) and overall OIB-normalized trace-element patterns near unity (Figure 6). These combined characteristics are not found in any of the groups analyzed in this study.

The lithospheric-mantle source is characterized by high K_2O and low to moderate La/Ta (Leat and others, 1988). This source should have εNd > 0 and relatively low $^{87}Sr/^{86}Sr$ (≈0.704;

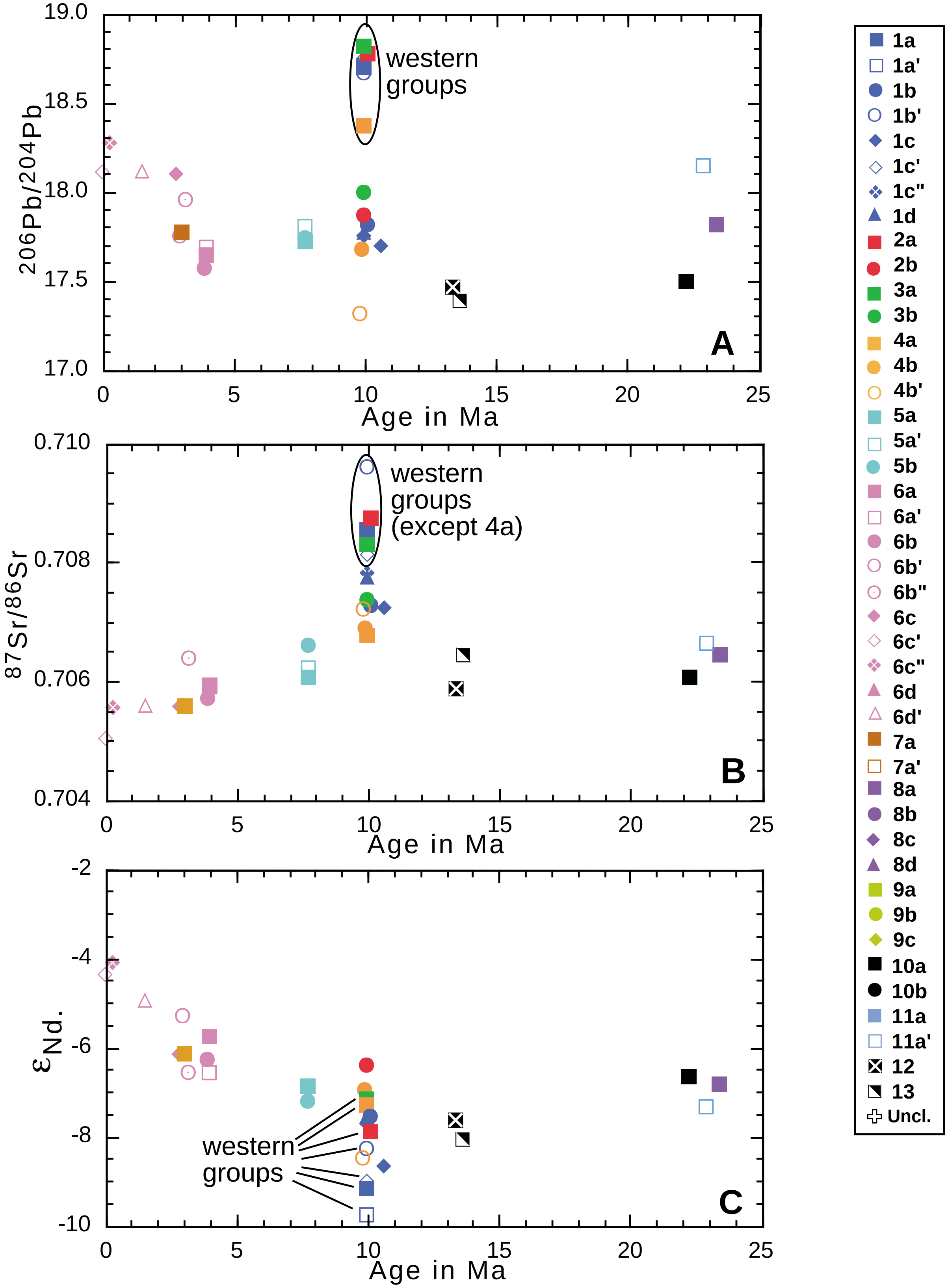


Figure 12. A) $^{206}Pb/^{204}Pb$, (B) $^{87}Sr/^{86}Sr$, (C) ε_{Nd} as functions age.

Only the mean values for the individual groups are shown.

Zartman, 1984). The chemical and isotopic characteristics of this source appear to be most closely matched by the group 6 and 7 samples.

The modified asthenospheric source (source 3 of Leat and others, 1988) has low K_2O, but has higher La/Ta (low Ta and therefore high Hf/Ta as well). Our group 1 and 2 samples most closely approximate the chemical characteristics of this source using the criteria of Leat and others (1988). If this is the case, then this source is also characterized by low εNd (≤ -8) and elevated $^{87}Sr/^{86}Sr$ (≥0.708). In order to account for the isotopic features of this source, the subducted-lithosphere component of the source must be at least mid-Proterozoic in age. We can not determine whether this source represents a distinct layer below the continental lithosphere or pockets or zones of material within the lithospheric mantle.

The isotopic data are summarized as a function of age in Figure 12. The Pb data show no clear trend from 5-25 Ma, but $^{206}Pb/^{204}Pb$ appears to have increased significantly and regularly during the last 5 Ma. Strontium isotopic ratios have decreased regularly, and εNd values have increased regularly over the last 10 Ma. Hafnium/tantalum and also La/Ta ratios have also decreased regularly over the last 10 Ma (e.g., Fig. 5). Prior to 10 Ma, no clear trends are observed among any of the isotopic data. If our tentative conclusions regarding the nature of the sources are correct, then the data indicate that the source of the basalts has progressively changed from the “modified asthenosphere” to the lithosphere over the last 10 Ma. Such a scenario could occur either if the zone of melting and generation of the basaltic magmas has migrated upward (in a relative sense) into the lithosphere over the last 10 Ma (layered mantle), or if the lower-melting components within the lithosphere have progressively been exhausted over the last 10 Ma (chemically-zoned lithosphere).

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