# Geochemical Results from Stream-Water and Stream-Sediment Samples Collected in Colorado and New Mexico

Open-File Report 2013–1064

**U.S. Department of the Interior**
**U.S. Geological Survey**

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Cover. View of Mount Elbert, Colorado.

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# Geochemical Results from Stream-Water and Stream-Sediment Samples Collected in Colorado and New Mexico

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## Abstract

Scientists from the U.S. Geological Survey are studying the relationship between watershed lithology and stream-water chemistry. As part of this effort, 60 stream-water samples and 43 corresponding stream-sediment samples were collected in 2010 and 2011 from locations in Colorado and New Mexico. Sample sites were selected from small to midsize watersheds composed of a high percentage of one rock type or geologic unit. Stream-water and stream-sediment samples were collected, processed, preserved, and analyzed in a consistent manner. This report releases geochemical data for this phase of the study.

## Introduction

In a natural setting, the geochemical characteristics of stream water are determined by the terrain through which the water flows (Miller, 2001). Further, it is understood that the mineralogic composition of the rocks in a watershed is a fundamental factor in determining the chemical makeup of the water emanating from such a watershed (Miller, 1999). However, the specific characteristics of water chemistry produced by interaction of stream water with particular rock types are not well defined. Understanding the rock/water relationship is important because water dissolves and incorporates the soluble components of the rocks, minerals, soil, and biota it comes into contact with both overland and as groundwater. Subsequent changes to stream-water or groundwater chemistry as a result of these interactions can influence, modify, or control important stream-water characteristics such as pH, specific conductance, and the concentration of dissolved constituents. Fluctuation or changes in one or more of these key parameters may result in significant impacts to the viability or health of biota in an ecosystem. Because of the significance of these potential effects, it would be useful to be able to predict lithologically induced changes to stream-water chemistry.

## Purpose

The purpose of this study is to collect and analyze stream-water and stream-sediment samples from watersheds that are dominated by distinct or specific rock types to determine if unique relationships are expressed between rock type and stream-water chemistry. This publication releases geochemical data from this study to other project scientists and to the public. Data included in this report consist of sample site coordinates, geologic detail for major rock types, and analytical results for stream-water and stream-sediment samples. The data are released without interpretation. Please note that data for water temperature and baseflow discharge for many of the streams included in this study can be found in Zeigler and others (2013).

## Study Area

Samples were collected from a variety of watersheds in the central and southern Rocky Mountains in Colorado and New Mexico (fig. 1). The study area encompasses a large, geologically diverse region, and because of its large size, the climate, vegetation, and topography of the sampling sites vary widely. In general, the summertime climate in the study area ranges from cool and humid in the high mountain areas to semiarid to arid at lower elevations. The natural vegetation in the area is diverse and strongly zoned according to elevation. It ranges from tree-free, alpine areas above the timberline to spruce, fir, and pine forests with some aspen and grassy meadows at middle to high elevations. Ponderosa, pinyon pine, and juniper dominate sites at lower elevations, with the lowest and most arid sampling sites dominated by a variety of shrubs, grasses, cacti, and yucca.

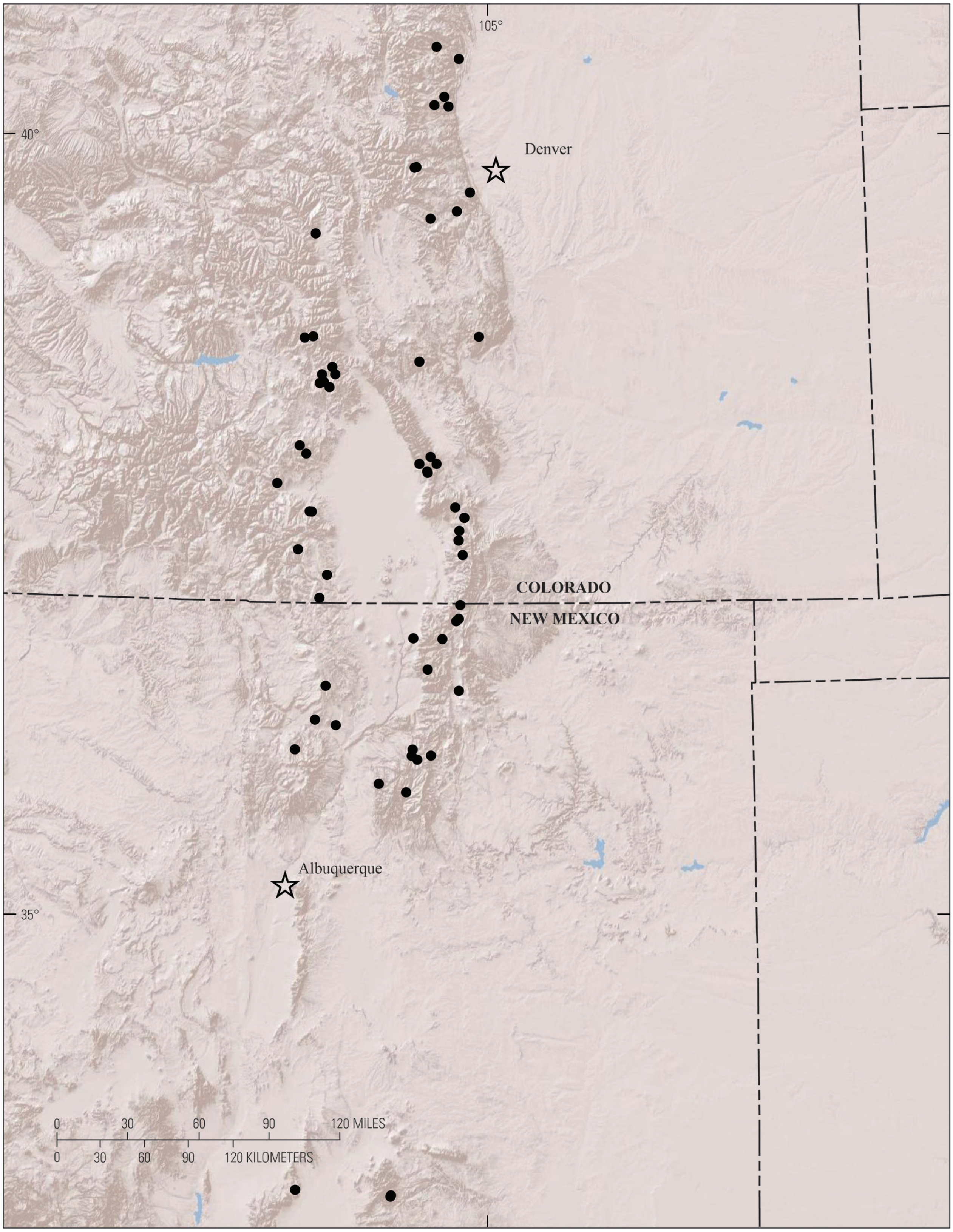


**Figure 1.** Distribution of sample sites included in this study.

## Sampling Strategy

A team of U.S. Geological Survey (USGS) personnel used geologic maps and geographic information systems (GIS) to select sampling sites that were determined to be in watersheds dominated by one rock type, lithology, or geologic unit. Selected sites were plotted on hard-copy topographic maps (1:24,000), and the coordinates were entered into a commercial, hand-held global positioning system (GPS) unit. The sampling plan was to collect both a stream-water sample and corresponding stream-sediment sample from each location. However, because of onsite conditions, stream-sediment samples were not available at all sampling locations, so not all stream-water samples have corresponding stream-sediment samples. In addition, two stream-sediment samples do not have corresponding stream-water samples because of dry conditions at those sampling sites. Most samples were collected during base flow in the late summer or early fall of 2010 and 2011.

## Sampling and Analytical Methods

Stream-water samples were collected from small to midsize streams at 60 sites in Colorado and New Mexico. Corresponding stream-sediment samples were collected from a total of 43 sites as noted in table 1.

**Table 1.** Sample details for stream-water and stream-sediment samples collected for this study.

[pp, private property; SW, stream water collected; SS, stream sediment collected; ?, unsure or unknown; ft, feet; Ma, mega-annum; NM, New Mexico; CO, Colorado. Major rock type (fx): percentage of major rock type present in the drainage above sampling site (1=100%). Mineral age: for plutonic and metamorphic rocks the mineral age will be equal to the rock age; for sedimentary rocks the mineral age will be greater than the rock age and will reflect the age of the protolith from which the grains were derived. Named unit: name of unit if a known name exists]

| Sample | State | Latitude | Longitude | Elevation (ft.) | SW | SS | Major rock type(s) | Major rock type (fx) | Mineral age (Ma) | Formation age | Rock type* (chemical) | Named unit | Stream or site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALA | NM | 36.055 | -105.468 | 9,608 | X | X | mixed clastic | 1 | 1,600 | Permian-Pennsylvanian | psammite | Sandia? | Alamitos Creek |
| Aud | CO | 40.090 | -105.596 | 10,771 | X | X | syenite | 1 | 68 | Cretaceous | syenite | Audubon | Audubon |
| CAB-L | NM | 36.736 | -105.508 | 8,537 | X | X | andesite, felsic, and aphantic volcanic rocks | 0.2 | 20 | Tertiary-Proterozoic mix | dacite mix | unnamed | Cabresto, lower site |
| CAB-U | NM | 36.772 | -105.386 | 10,129 | X | | andesite, felsic volcanic rock | 0.2 | 20 | Tertiary | dacite mix | unknown | Cabresto, upper site |
| CaC | CO | 37.908 | -106.449 | 9,085 | X | X | andesite | 1 | 20 | Tertiary | andesite | unknown | Cave Creek |
| CAN-U | NM | 36.087 | -106.502 | 8,360 | X | X | felsic volcanic rocks, rhyolite | 1 | 20 | Tertiary | rhyodacite | Jemez | Canones Creek, upper site |
| CC-A | CO | 39.876 | -105.300 | 7,176 | X | | quartzite | 1 | 1,700 | Proterozoic | quartzite | Coal Creek | Coal Creek-A |
| COS | NM | pp | pp | 10,250 | X | X | basalt, clastic | 0.7 | 20 | Tertiary | basalt-sedimentary mix | Costilla Creek? | Costilla Creek |
| DOR | CO | 38.396 | -106.336 | 9,291 | X | X | dolomite, sandstone | 1 | 440 | Devonian-Ordovician | dolomite-sandstone | Parting-Manitou | Indian Creek |
| ELR | NM | 36.481 | -106.273 | 8,399 | X | X | mixed clastic | 0.8 | 1,200 | Tertiary | psammite | unknown | El Rito Creek |
| EMC | CO | 38.320 | -106.276 | 9,957 | X | X | andesite, ash-flow tuff | 1 | 20 | Tertiary | andesite | unknown | East Middle Creek |
| ESB | NM | 36.030 | -105.574 | 10,335 | X | X | mixed clastic | 1 | 1,600 | Permian-Pennsylvanian | psammite | Sandia? | Santa Barbara Creek, east fork |
| Fair-A | CO | 38.621 | -106.475 | 9,696 | X | X | granodiorite | 1 | 1,690 | Proterozoic | granodiorite | Fairview Peak | Fairview-A |
| FRJ | NM | 36.271 | -105.408 | 9,620 | X | | clastic | 1 | 1,600 | Permian-Pennsylvanian | psammite | Sandia? | Frijoles Creek |
| HM-1 | CO | 38.636 | -105.107 | 8,732 | X | | granite | 1 | 1,700 | Proterozoic | granite | Brind Mountain | Henry Mountain-1 |
| HM-2 | CO | 38.636 | -105.107 | 9,175 | X | | granite | 1 | 1,700 | Proterozoic | granite | Henry Mountain | Henry Mountain-2 |
| IND | NM | 36.091 | -105.608 | 8,914 | X | X | sandstone | 1 | 1,600 | Permian-Pennsylvanian | psammite | Sandia? | Indian Creek |
| ITA | NM | 36.585 | -105.497 | 8,723 | X | X | plutonic rock (phaneritic) | 0.2 | 1,500 | Proterozoic-Tertiary mix | mixture | unnamed | Itallianos Creek |
| JAC-L | NM | 35.828 | -105.657 | 8,302 | X | X | mixed clastic | 1 | 1,600 | Permian-Pennsylvanian | psammite | Sandia? | Jacks Creek, lower site |
| JAC-U | NM | 35.875 | -105.648 | 9,985 | X | X | mixed clastic | 1 | 1,600 | Permian-Pennsylvanian | psammite | Sandia? | Jacks Creek, upper site |
| JSA | CO | 40.111 | -105.387 | 6,998 | X | | quartz monzonite | 1 | 74 | Cretaceous | monzodiorite | Jamestown | Jamestown Stock, site A |
| Kno-A | CO | 39.144 | -106.457 | 10,778 | X | | granodiorite | 1 | 1,690 | Proterozoic | granodiorite | Kroenke | Kroenke-A |
| LFC | CO | 37.318 | -106.501 | 9,664 | X | X | andesite | 0.9 | 25 | Tertiary | andesite | unknown | Conejos, Lake Fork |
| LM-1 | CO | 37.804 | -105.512 | 8,550 | X | | gneiss | 0.9 | 1,700 | Proterozoic | meta-psammite | unnamed | Little Medano Creek |
| LMC | CO | 37.796 | -105.504 | 8,453 | X | | felsic gneiss, conglomerate, granite | 0.5 | 1,600 | Proterozoic mix | meta-psammite | unnamed | Medano Creek, lower site |
| LTR | NM | 36.044 | -105.672 | 8,984 | X | X | meta-sedimentary, plutonic rocks | 0.8 | 1,690 | Proterozoic | meta-psammite | unnamed | Rio de las Trampas |
| MCCRY | NM | 36.778 | -105.099 | 8,008 | X | | sandstone, landslide deposits and colluvium, piedmont alluvial deposits | 0.8 | 900? | Tertiary? | siltstone | ? | McCrystal |
| McI | CO | 38.573 | -105.588 | 8,970 | X | X | mix: metabasalt, metadacite, metagabbro | 1 | 1,700 | Proterozoic | diorite-metabasalt | unnamed | McIntyre Gulch |
| ME-1 | CO | 39.676 | -105.609 | 9,585 | X | | granodiorite-diorite | 1 | 1,440 | Proterozoic | granodiorite | Mount Evans | Chicago Creek |
| ML-A | CO | 38.740 | -106.431 | 11,007 | X | | metabasalt, meta-andesite, minor granodiorite | 1 | 1,750 | Proterozoic | metabasalt | Ohio | Mirror Lake-A |
| Mon-A | CO | 39.602 | -105.822 | 10,840 | X | X | granodiorite | 1 | 40 | Tertiary | granodiorite | Montezuma | Montezuma-A |
| Mpr | CO | 38.629 | -106.406 | 10,800 | X | X | granodiorite-tonalite | 1 | 37 | Tertiary | granodiorite | Mount Princeton | Mount Princeton |
| MRR | NM | pp | pp | 7,535 | X | X | felsic volcanic rocks, plutonic rock (phaneritic) | 0.5 | 40 | Tertiary | syenite | Sierra Blanca | Rio Ruidoso |
| MSB | NM | 36.053 | -105.615 | 9,348 | X | X | mixed clastic | 1 | 1,600 | Permian-Pennsylvanian | psammite | Sandia? | Rio Santa Barbara, middle fork |
| NRR | NM | pp | pp | 7,595 | X | X | granite, andesite | 0.6 | 40 | Tertiary | syenite | Sierra Blanca | Rio Ruidoso, north fork |
| NTR | CO | pp | pp | 8,791 | X | X | felsic gneiss | 1 | 1,730 | Proterozoic | granodiorite | Trinchera? | North Trinchera Creek |
| OC | CO | 38.397 | -106.230 | 10,625 | X | X | metabasalt, meta-andesite, metadacite | 0.9 | 1,700 | Proterozoic | meta-andesite | unnamed | Ouray Creek |
| OSI | CO | 37.020 | -106.333 | 9,776 | X | X | ash-flow tuff, mixed clastic (volcanic), landslide deposits | 0.6? | 25 | Tertiary | quartz latite | unknown | Osier Creek |
| PC | CO | 37.957 | -106.500 | 9,857 | X | X | andesite | 1 | 25 | Tertiary | andesite | unnamed | Prong Creek |
| Pee-D | CO | 39.584 | -106.996 | 7,051 | | X | evaporite | 1 | 300 | Permian-Pennsylvanian | evaporite | Eagle Valley | Eagle Valley evaporite |
| Pet-B | CO | 40.577 | -105.461 | 8,258 | X | X | metagraywacke | 1? | 1,700 | Proterozoic | metawacke | unnamed | Petite-B |
| PLAC | CO | pp | pp | 8,569 | X | X | felsic gneiss, sandstone, plutonic rock (phaneritic) | 0.6 | 1,500? | Proterozoic mix? | granite? | North Russell? | Placer Creek |
| Pmb-A | CO | 39.441 | -106.672 | 9,816 | X | X | black shale, sandstone | 0.8 | 300 | Pennsylvanian? | C-rich pelite | Belden? | Crooked Creek |
| PNL | NM | 33.626 | -105.245 | 6,317 | X | X | plutonic, sedimentary | 1 | 40 | Tertiary | syenite | El Capitan | Pinelodge |
| PPww | CO | 39.616 | -106.996 | 7,420 | | X | sandstone | 0.9 | 1,500 | Permian-Pennsylvanian | psammite | Minturn? | Red beds |
| Raw | CO | 40.701 | -105.761 | 7,820 | X | X | granite | 1 | 1,720 | Proterozoic | granite | Rawah | Rawah |
| Roos-A | CO | 38.584 | -106.539 | 9,088 | X | | granite | 1 | 1,760 | Proterozoic | alkali granite | Roosevelt | Roosevelt-A |
| SC | CO | 37.851 | -105.571 | 8,299 | X | | granite, felsic gneiss, conglomerate | 0.6 | 1,500 | Proterozoic mix | granite-gneiss | Music Mountain? | Sand Creek |
| SC-1 | CO | 39.675 | -105.622 | 9,627 | X | | mix: granodiorite, metagraywacke | 1 | 1,500 | Proterozoic | granodiorite-metawacke mix | Mount Evans--unnamed | South Chicago Creek |
| SF-U | CO | 37.551 | -106.398 | 9,751 | X | X | andesite, ash-flow tuff | 0.8 | 25 | Tertiary | andesite | San Juan--name? | San Francisco Creek, upper site |
| SPA | CO | 39.681 | -105.477 | 9,749 | X | | mix: metagraywacke, mafic metavolcanic rocks | 1 | 1,700 | Proterozoic | metawacke-metabasalt | unnamed | Squaw Pass-A |
| SS-C | CO | 40.060 | -105.469 | 8,209 | X | | syenite | 1 | 55 | Tertiary | syenite | Sunset | Sunset Stock-C |
| TRIUP | CO | pp | pp | 10,260 | X | X | felsic gneiss, siltstone, glacial drift | 0.5 | 1,500 | Proterozoic-Pennsylvanian mix | granite mix | unknown | Trinchera, upper site |

**Table 1.** Sample details for stream-water and stream-sediment samples collected for this study.—Continued

[pp, private property; SW, stream water collected; SS, stream sediment collected; ?, unsure or unknown; ft, feet; Ma, mega-annum; NM, New Mexico; CO, Colorado. Major rock type (fx): percentage of major rock type present in the drainage above sampling site (1=100%). Mineral age: for plutonic and metamorphic rocks the mineral age will be equal to the rock age; for sedimentary rocks the mineral age will be greater than the rock age and will reflect the age of the protolith from which the grains were derived. Named unit: name of unit if a known name exists]

| Sample | State | Latitude | Longitude | Elevation (ft.) | SW | SS | Major rock type(s) | Major rock type (fx) | Mineral age (Ma) | Formation age | Rock type* (chemical) | Named unit | Stream or site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TWO-L | NM | 36.898 | -105.261 | 9,436 | X | X | plutonic rocks, clastic | 0.4 | 1,700 | Proterozoic-Tertiary | granite mix | granite--name? | Casius Creek, lower site |
| TWO-U | NM | 36.884 | -105.279 | 9,455 | X | X | plutonic rocks, clastic | 0.5 | 1,700 | Proterozoic-Tertiary | granite mix | granite--name? | Casius Creek, upper site |
| UMC | CO | 37.852 | -105.438 | 9,650 | X | | conglomerate, felsic gneiss | 0.7 | 1,500 | Permian-Pennsylvanian | sandstone mix | Sangre de Cristo mix | Medano Creek, upper site |
| USC | CO | 37.889 | -105.502 | 9,706 | X | X | granite, conglomerate, arkose | 0.7 | 1,400 | Proterozoic | granite | Music Mountain | Sand Creek, upper site |
| WCR | CO | pp | pp | 8,674 | X | X | conglomerate, sandstone | 0.8 | 1,500 | Permian-Pennsylvanian | conglomerate | Madera? | Wagon Creek |
| WCr | CO | 37.018 | -106.461 | 8,650 | X | X | andesite, unconsolidated | 0.9 | 25 | Tertiary | andesite | unknown | Wolf Creek |
| WFA | CO | 37.723 | -106.670 | 8,700 | X | | volcanics | 0.9 | 25 | Tertiary | dacite? | unknown | Alder Creek, west fork |
| WHA | CO | 37.925 | -106.698 | 10,312 | X | X | volcanics | 1 | 25 | Tertiary | latite | unknown | Whale Creek |
| WIC | CO | pp | pp | 8,559 | X | X | sandstone, felsic gneiss, conglomerate | 0.4 | 1,500 | Proterozoic-Pennsylvanian mix | granite mix | unknown | West Indian Creek |

*Igneous rocks classified using De la Roche and others (1980), metasedimentary rocks classified by Ed DeWitt (U.S Geological Survey, unpub.data, 2012).

## Collection and Analysis of Stream-Water Samples

At each sampling location, coordinates and site details were logged and a stream-water sample was collected midstream using a pre-cleaned 500-milliliter (mL) high-density polyethylene (HDPE) plastic bottle that was rinsed three times with site water. Immediately following collection of the stream-water sample, pH and specific conductance (SC) were determined on unfiltered subsamples using calibrated, hand-held meters. Next, the stream-water samples were filtered and preserved using the procedures listed in table 2.

**Table 2.** Details for collection of stream-water samples.

[FU, filtered, unacidified; FA, filtered, acidified; RA, unfiltered, acidified; Hg, mercury; Fe, iron; DOC, dissolved organic carbon; $cm^3$, cubic centimeter; µm, micrometer; mL, milliliter; HDPE, high-density polyethylene; °C, degree Celsius; <, less than]

| Sample split | Analyte(s) | Filtration details | Bottle type | Preservation |
|---|---|---|---|---|
| FU | Chloride, fluoride, nitrate, and alkalinity | 60-$cm^3$ syringe and a 0.45-µm nylon capsule filter | 60-mL HDPE | Refrigeration at 4°C until analyzed |
| FA | Cations and sulfate | 60-$cm^3$ syringe and a 0.45-µm nylon capsule filter | 30-mL acid-washed HDPE | Acidify to pH <1.7 with ultra-pure nitric acid (2 or 3 drops/30 mL) |
| RA | Cations and sulfate | 60-$cm^3$ syringe, no filtration | 30-mL acid-washed HDPE | Acidify to pH <1.7 with ultra-pure nitric acid (2 or 3 drops/30 mL) |
| Hg | Mercury | 60-$cm^3$ syringe and a 0.45-µm nylon capsule filter | 30-mL acid-washed flint glass bottle with Teflon-lined lid | Acidify with ultra-pure hydrochloric acid (1 mL/30 mL) |
| $Fe^{2+}$ | Ferrous iron | 60-$cm^3$ syringe and a 0.45-µm nylon capsule filter | 60-mL amber HDPE | Acidify with ultra-pure concentrated hydrochloric acid (3 drops/60mL) |
| DOC | Dissolved organic carbon | 60-$cm^3$ syringe and a 0.45-µm polyethersulfone (PES) capsule filter | 125-mL pre-baked amber glass bottles | Acidify with ultra-pure hydrochloric acid (5 drops/125 mL) |

Upon return from the field, all water samples were submitted to the USGS Central Region Mineral and Environmental Science Center (CRMESC) laboratories in Lakewood, Colorado, for log-in and analysis. Pertinent sample information was entered into the Laboratory Information Management System (LIMS), and each sample was given a unique laboratory identification number. The samples were then distributed to the laboratories for chemical analyses using the following methods:

- FU (filtered, unacidified) samples were analyzed for chloride ($Cl^-$), fluoride ($F^-$), and nitrate ($NO_3$) using ion chromatography (IC) (Theodorakos and others, 2002); a separate split of this sample was analyzed for alkalinity by titration (Theodorakos, 2002a).
- Both the FA (filtered, acidified) and RA (unfiltered, acidified) samples were submitted for cation and sulfate analysis by inductively coupled plasma–atomic emission spectrometry (ICP–AES)

(Briggs, 2002a) and inductively coupled plasma–mass spectrometry (ICP–MS) (Lamothe and others, 2002).
- Ferrous iron ($Fe^{2+}$) was determined by spectrophotometry (Theodorakos, 2002b).
- Dissolved mercury (Hg) was determined using cold vapor–atomic fluorescence (CVAFS) (Hageman, 2007).
- Dissolved organic carbon (DOC) was determined by combustion–infrared detection (Shimadzu Corporation, 1997).

### Collection and Analysis of Stream-Sediment Samples

For this study, stream-sediment samples were collected (when present) from active streambed alluvium within 10 meters (m) of the plotted sample locality. The samples were composited by taking increments of material from several streambed locations using a plastic scoop. If limited stream sediment was available, a single bulk sediment sample was collected from bed-load material. Sample size for most sites was approximately 1 kilogram (kg). All stream-sediment samples were wet-sieved onsite using a 10-mesh (2-millimeter [mm]) stainless steel screen and a plastic pan. The material that passed the screen was taken directly from the pan and saved for processing and analysis.

Upon return from the field, the sediment samples were logged into the Laboratory Information System (LIMS) at the USGS Central Region Mineral and Environmental Science Center (CRMESC), and each sample was given a unique laboratory identification number. The samples were then prepared using the following procedure. First, the sediments were air-dried at ambient temperature. Dried samples were then mixed and split using a Jones splitter. One split of the bulk material was returned to the submitter for archive, and the other split was processed for laboratory analysis by dry sieving to -80 mesh (0.17 mm). The portion of the sediment that passed the sieve was then pulverized using a shatter box to approximately -150 mesh (0.1 mm). Splits of ground material were then placed into pre-labeled cardboard containers that were sealed and sent to the USGS contract laboratories for determination of 40 elements using a four acid digestion and analysis by ICP–AES (Briggs, 2002b). The contract laboratory also determined forms of carbon (C) using the following methods:
- Total C was determined by combustion using an automated carbon analyzer (Brown and Curry, 2002).
- Carbonate C was determined using coulometric titration of $CO_2$ evolved after treatment of the sample with hot 2N perchloric acid (Brown and others, 2002).
- Organic C was calculated from the difference between total C and carbonate C.

The contract laboratory also determined total sulfur using an automated sulfur analyzer.

## Analytical Results

Bulk-chemistry results for the stream-sediment samples are found in appendix 1. Analytical results for all filtered acidified (FA) stream-water samples are provided in appendix 2. Results for unfiltered acidified (RA) samples are found in appendix 3. Please note that analytical data for zinc (Zn) for the stream-water samples were not included in the dataset because of a contamination problem. Bulk zinc, however, is reported for the stream-sediment samples. Samples in all the tables are organized alphabetically according to their sample identification for ease of cross-reference.

## Quality Assurance and Quality Control (QA/QC)

For stream sediments, site duplicate samples were collected at three of the sampling locations. These samples were collected concurrently with the primary sample using all the same equipment, processes, and procedures. Duplicate samples were submitted blind as part of the sample set. In addition, prior to submittal to the contract laboratories, blind reference samples (Standard L, Standard M, and Standard Ras-A) were integrated into the sample sets by the submitter. Additional reference standards were inserted into the sample set by USGS Sample Control. These internal reference samples were submitted with the sample set at a ratio of 10 percent and were run through the analytical procedures as blind samples. Analytical data for the internal reference samples are assessed as part of the USGS quality control system. Quality assurance and quality control (QA/QC) data for Standard L, Standard M, Standard Ras-A, and the duplicate samples are found in appendix 4.

Stream-water samples for QA/QC include both field and laboratory procedure blanks, site duplicate samples, and a blind reference sample (T-167). These samples were submitted to the laboratories as part of the analytical dataset. The field blank was processed in-situ using the same procedures and equipment used for collection of the stream-water samples. The water used for the field blank sample was deionized water (NanoPure, 18MΩ) from the laboratory and was carried into the field in a clean 500-mL HDPE bottle. The laboratory blanks were processed and prepared with all the procedures and equipment used for collection of the stream-water samples with the exception that they were prepared in the laboratory. Water used for the laboratory blanks was deionized water (NanoPure, 18MΩ). Stream-water duplicate samples were collected concurrently with the primary sample using the same equipment and procedures as those used to collect all the stream-water samples. In addition, all of the analytical techniques used for this study employ extensive QA/QC protocols, which are described in an online publication (Taggart, 2002). The quality control data for the stream-water FA and RA samples are provided in appendix 5 and appendix 6, respectively.

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## Appendixes

1. Bulk chemistry for 42 elements (ICP-AES), forms of carbon, and total sulfur for stream-sediment samples collected for this study
2. Composition of filtered, acidified (FA) stream-water samples
3. Composition of unfiltered, acidified (RA) stream-water samples
4. Quality assurance/quality control results for stream-sediment samples including bulk chemistry for 40 elements (ICP-AES), forms of carbon, and total sulfur
5. Quality assurance/quality control results for filtered, acidified (FA) stream-water samples
6. Quality assurance/quality control results for unfiltered, acidified (RA) stream-water samples