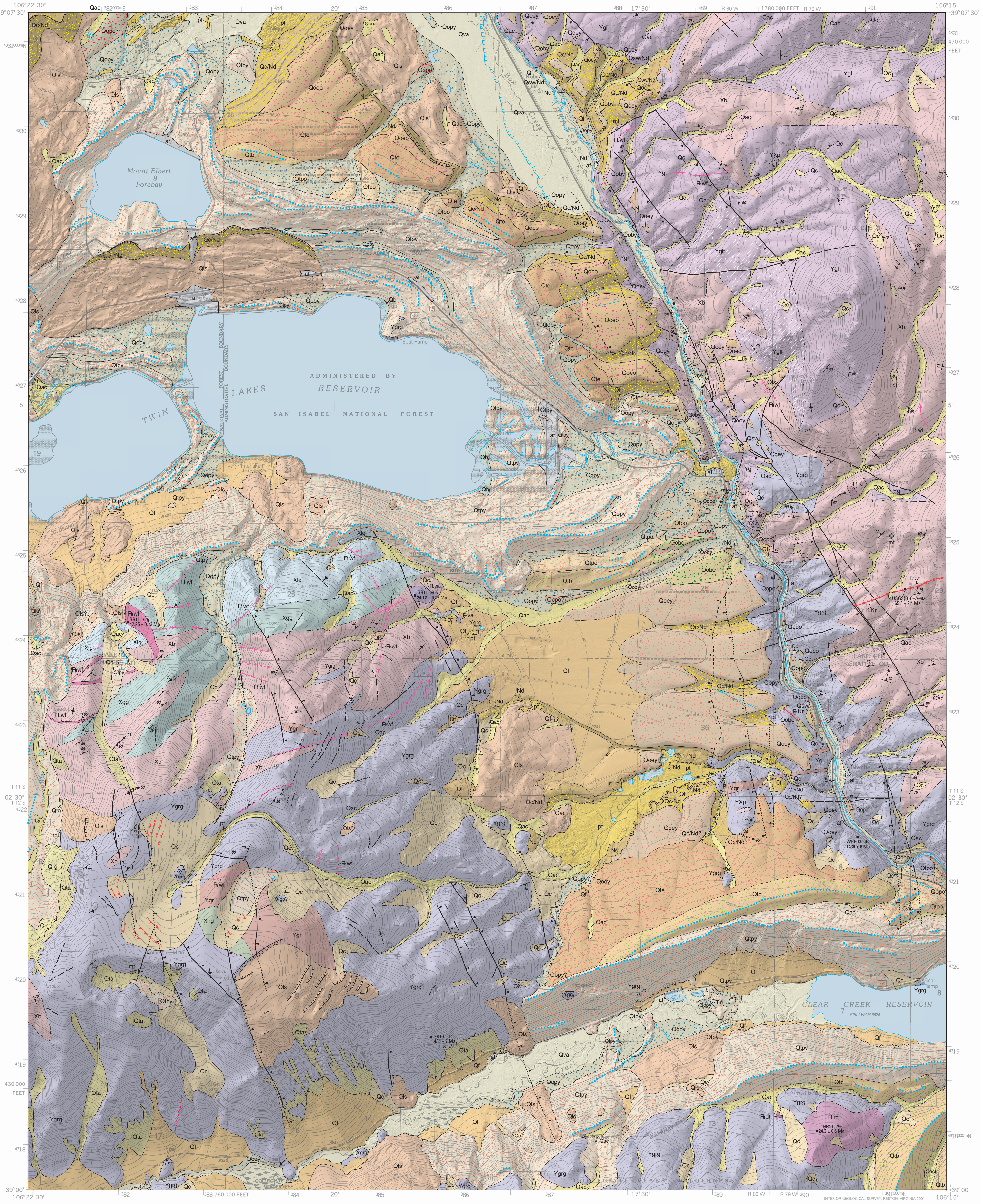

106°22' 30"
39°07' 30"
106°15'
39°07' 30"
39°00'
106°22' 30"
39°00'
106°15'
17' 30"
20'
5'
02' 30"
T 11 S
T 12 S
R 80 W
R 79 W
1 780 000 FEET
470 000 FEET
430 000 FEET
760 000 FEET
Mount Elbert Forebay
TWIN LAKES
ADMINISTERED BY RESERVOIR
SAN ISABEL NATIONAL FOREST
ARKANSAS
Box Creek
Lost Canyon
Clear Creek
Columbine Gulch
LAKE CO
CHAFFEE CO
CLEAR CREEK RESERVOIR
SPILLWAY 8875
COLLEGIATE PEAKS WILDERNESS
Boat Ramp
Interlaken Historic Site
GR11–725 42.25 ± 0.13 Ma
GR11–711 24.12 ± 0.12 Ma
USGS(D)G–A–82 65.3 ± 2.4 Ma
WRP03–6B 1436 ± 6 Ma
GR10–511 1434 ± 7 Ma
GR11–756 24.3 ± 0.6 Ma
INTERIOR-GEOLOGICAL SURVEY, RESTON, VIRGINIA-2001

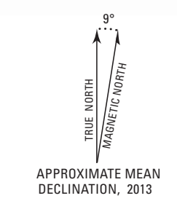
Base from U.S. Geological Survey, Granite, Colo., 1:24,000, 1994

North American Datum of 1927 (NAD 27)

Projection and 10,000-foot ticks: Colorado coordinate system, central zone (Lambert conformal conic)

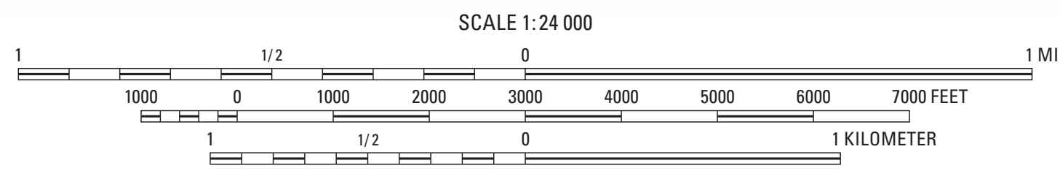
1000-meter Universal Transverse Mercator ticks, zone 13

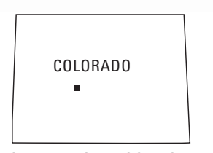
Lidar imagery generated from lidar data sourced by the U.S. Geological Survey. Area not covered by lidar has shaded relief from U.S. Geological Survey National Elevation Dataset (NED).


9°
TRUE NORTH
MAGNETIC NORTH

APPROXIMATE MEAN DECLINATION, 2013

SCALE 1:24 000

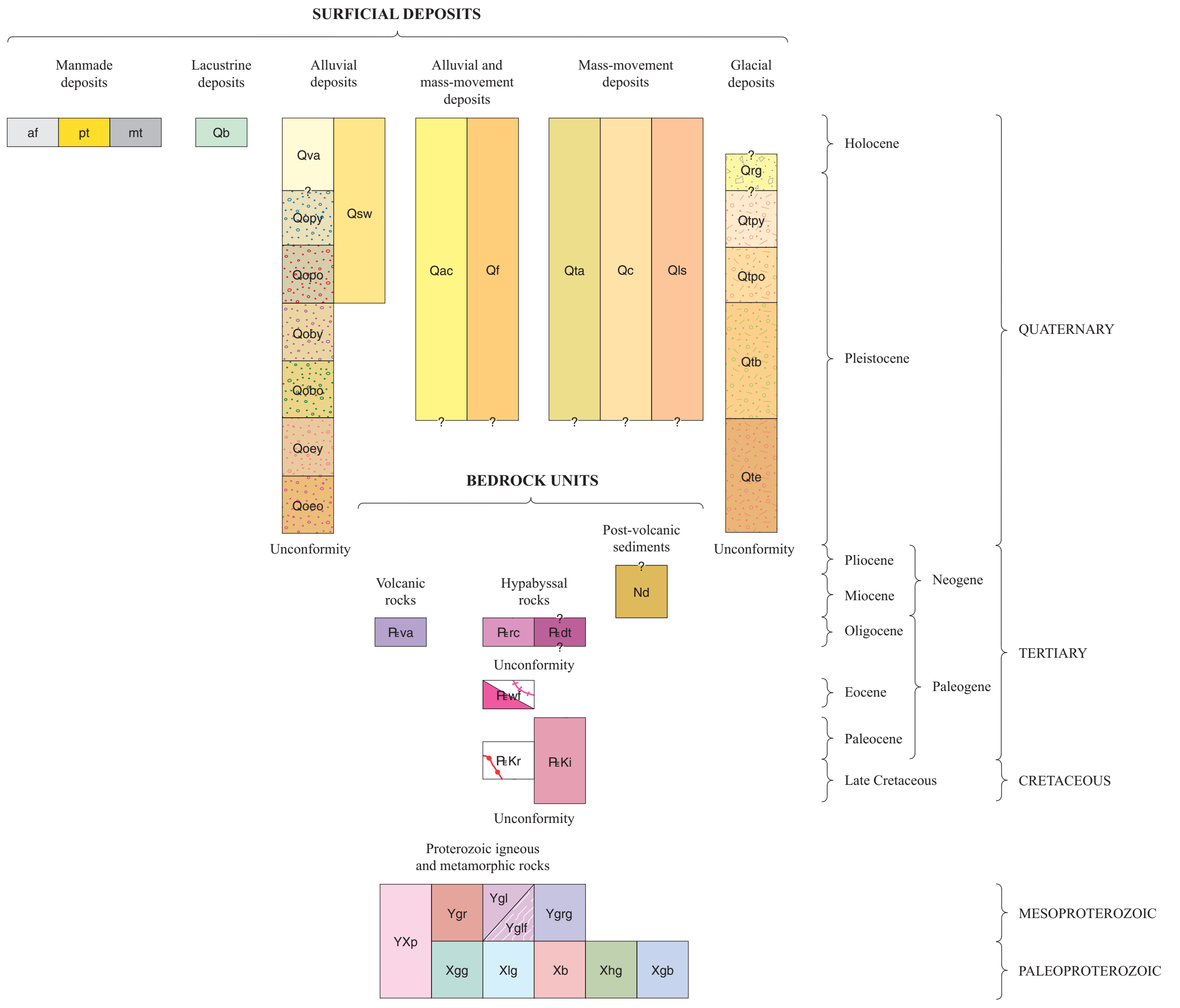

1
1/2
0
1 MILE
1000
0
1000
2000
3000
4000
5000
6000
7000 FEET
1
1/2
0
1 KILOMETER



QUADRANGLE LOCATION

R.R. Shroba mapped Quaternary surficial deposits and Neogene sediments during 2008–2012, and did reconnaissance mapping and soils research in and near the Granite 7.5' quadrangle between 1972–1974 during graduate studies at the University of Colorado at Boulder. K.S. Kellogg mapped the Paleogene and older rocks in the quadrangle during 2010–2011. T.R. Brandt prepared the digital topographic base map, digital compilation, and GIS database of the geologic map. He also generated slope and shaded-relief scenes from lidar data, which were used to interpret geologic, geomorphic, and shoreline features.

## CORRELATION OF MAP UNITS


SURFICIAL DEPOSITS
Manmade deposits
Lacustrine deposits
Alluvial deposits
Alluvial and mass-movement deposits
Mass-movement deposits
Glacial deposits
af
pt
mt
Qb
Qva
Qopy
Qopo
Qoby
Qobo
Qoey
Qoeo
Qsw
Qac
Qf
Qta
Qc
Qls
Qrg
Qtpy
Qtpo
Qtb
Qte
?
Unconformity
BEDROCK UNITS
Volcanic rocks
Hypabyssal rocks
Post-volcanic sediments
Nd
₽va
₽rc
₽dt
₽wf
₽Kr
₽Ki
Proterozoic igneous and metamorphic rocks
YXp
Ygr
Ygl
Yglf
Ygrg
Xgg
Xlg
Xb
Xhg
Xgb
Holocene
Pleistocene
QUATERNARY
Pliocene
Miocene
Neogene
Oligocene
Eocene
Paleocene
Paleogene
TERTIARY
Late Cretaceous
CRETACEOUS
MESOPROTEROZOIC
PALEOPROTEROZOIC

## LIST OF MAP UNITS

[Due to the addition of a shaded relief base, colors on the List of Map Units and the Correlation of Map Units may not exactly match unit colors on the map]

### SURFICIAL DEPOSITS

| | |
|---|---|
| | Manmade deposits |
| af | **Artificial-fill deposits (latest Holocene)** |
| pt | **Placer-tailings deposits (latest Holocene)** |
| mt | **Mine-tailings deposits (latest Holocene)** |
| | Lacustrine deposits |
| Qb | **Beach deposits (latest Holocene)** |
| | Alluvial deposits |
| Qva | **Valley-floor alluvium (Holocene and latest Pleistocene?)** |
| Qsw | **Sheetwash alluvium (Holocene and late Pleistocene)** |
| Qsw/Nd | **Sheetwash alluvium over Dry Union Formation** |
| | **Outwash of Pinedale age (late Pleistocene)** |
| Qopy | **Younger unit** |
| Qopo | **Older unit** |
| | **Outwash of Bull Lake age (late and middle Pleistocene)** |
| Qoby | **Younger unit (late and middle Pleistocene)** |
| Qobo | **Older unit (middle Pleistocene)** |
| | **Outwash of pre-Bull Lake age (middle Pleistocene)** |
| Qoey | **Younger unit** |
| Qoeo | **Older unit** |
| | Alluvial and mass-movement deposits |
| Qac | **Alluvium and colluvium, undivided (Holocene to middle? Pleistocene)** |
| Qf | **Fan deposits (Holocene to middle? Pleistocene)** |
| | Mass-movement deposits |
| Qta | **Talus deposits (Holocene to middle? Pleistocene)** |
| Qc | **Colluvium (Holocene to middle? Pleistocene)** |
| Qc/Nd | **Colluvium over Dry Union Formation** |
| Qls | **Landslide deposits (Holocene to middle? Pleistocene)** |
| | Glacial deposits |
| Qrg | **Rock-glacier deposits (early Holocene? and latest Pleistocene?)** |
| | **Till of Pinedale age (late Pleistocene)** |
| Qtpy | **Younger unit** |
| Qtpo | **Older unit** |
| Qtb | **Till of Bull Lake age (late and middle Pleistocene)** |
| Qte | **Till of pre-Bull Lake age (middle Pleistocene)** |

### BEDROCK UNITS

| | |
|---|---|
| | Post-volcanic sediments |
| Nd | **Dry Union Formation (lower Pliocene? and Miocene)** |
| | Volcanic rocks |
| ₽va | **Vesicular andesite flow (upper Oligocene)** |
| | Hypabyssal rocks |
| ₽rc | **Hypabyssal rhyolite of Clear Creek (late Oligocene)** |
| ₽dt | **Microtonalite (late Oligocene?)** |
| ₽wf | **Felsic plutons and dikes of Winfield Peak and Middle Mountain of Fridrich and others (1998) (middle Eocene)** |
| ₽Kr | **Rhyolite dikes (Paleocene or Late Cretaceous)** |
| ₽Ki | **Felsic porphyry intrusive (Paleocene or Late Cretaceous)** |
| | Proterozoic igneous and metamorphic rocks |
| YXp | **Pegmatite (Mesoproterozoic and (or) Paleoproterozoic)** |
| Ygr | **Monzogranite and quartz monzonite (Mesoproterozoic)** |
| Ygl | **Monzogranite of Langhoff Gulch (Mesoproterozoic)** |
| Yglf | **Strongly foliated phase** |
| Ygrg | **Granite of Granite (Mesoproterozoic)** |
| Xgg | **Granitic gneiss (Paleoproterozoic)** |
| Xlg | **Leucogranite gneiss (Paleoproterozoic)** |
| Xb | **Biotite gneiss (Paleoproterozoic)** |
| Xhg | **Hornblende gneiss and amphibolite (Paleoproterozoic)** |
| Xgb | **Gabbro (Paleoproterozoic)** |

## EXPLANATION

**Contact**—Dashed where approximately located

**Fault, type unspecified**—Dashed where approximately located; dotted where concealed beneath surficial deposits

**Normal fault**—Dashed where approximately located; short-dashed where inferred; dotted where concealed beneath surficial deposits; bar-and-ball symbol on apparent downthrown side; traces of inferred faults were identified from lidar imagery

**Shoreline**—Observed on lidar imagery

**Fluvial scarp**—Observed on lidar imagery; hachures are on riser between lower and higher surfaces and point downslope

**Landslide scarp**—Observed on lidar imagery and NAIP imagery; lower limit of hachures are on or near base of scarp. Prominent upslope facing scarps (sackungen) locally formed on the large landslide deposits derived from Proterozoic bedrock on the north side of Clear Creek near the southwest corner of the map area

**Toe of inactive solifluction deposits**—Observed on NAIP imagery; sawteeth pattern is on the upslope side. Solifluction deposits were formed by downslope flowage of surficial material in the large alpine area near the head of Lost Canyon north of Clear Creek. Approximately located

**Shear zone**—Marked by ductile deformation fabric in Proterozoic rocks

**Crest line of moraine**—Observed on lidar imagery and NAIP imagery

**Lineament**—Observed on lidar imagery and NAIP imagery. Linear features locally may coincide with zones of fracturing in Proterozoic bedrock, tabular intrusive bodies, or linear mass-movement deposits

10 **Inclined bedding**—Showing strike and dip

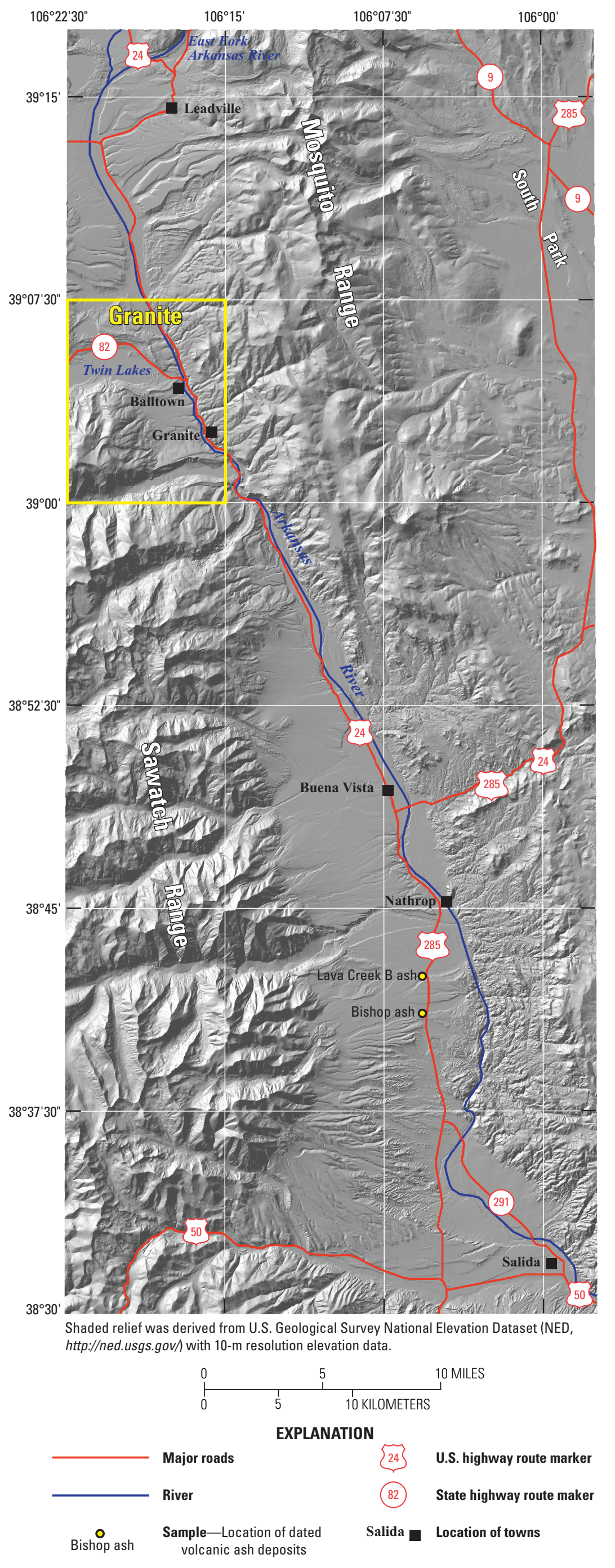
80 **Fault attitude**—Showing fault dip

80 **Inclined foliation**—Showing strike and dip. Measurements of inclined foliation in areas of Quaternary surficial deposits (units Qc, Qac, and Qopy?) were made on Proterozoic bedrock outcrops that are too small to show at map scale

**Vertical foliation**—Showing strike

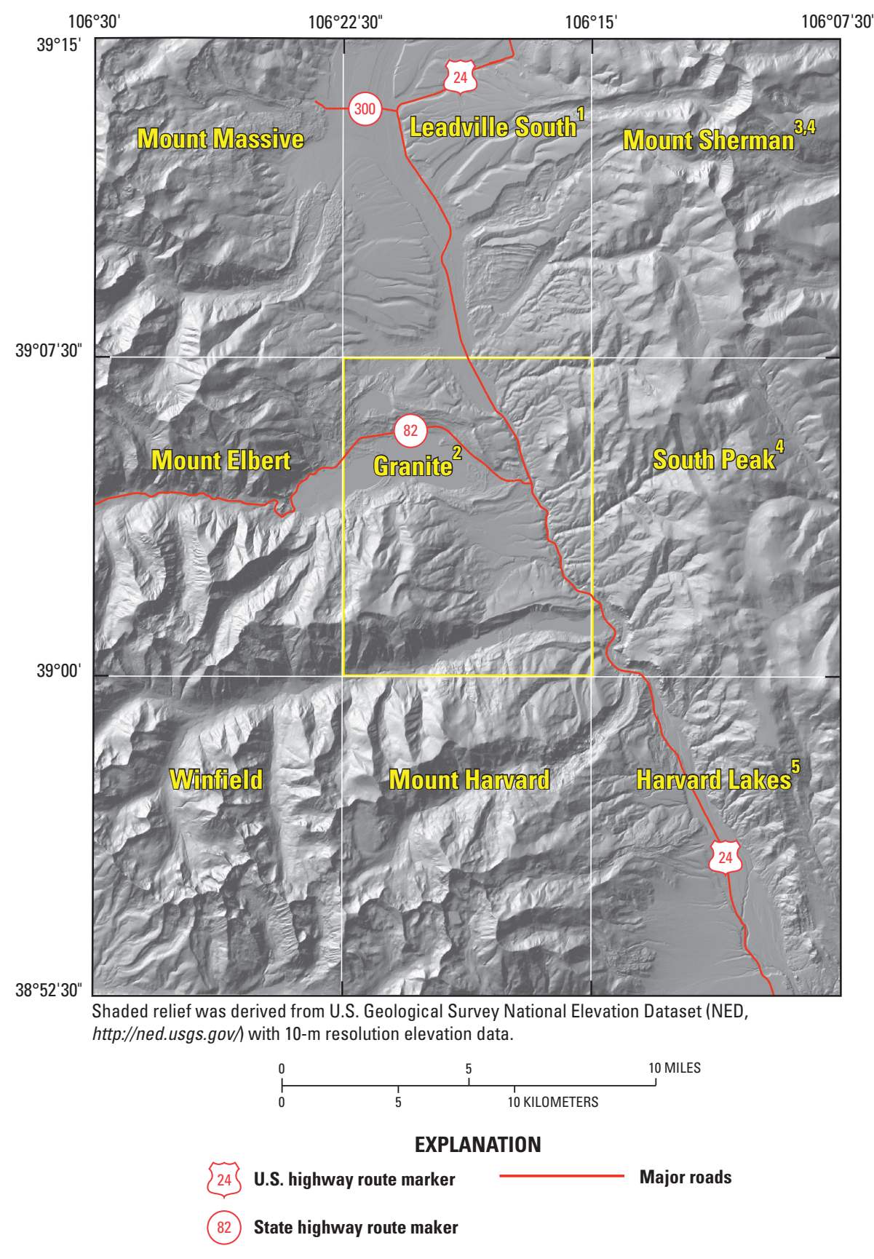
65 **Mineral lineation**—Showing bearing and plunge, depicted by an arrowhead

GR11–725 42.25 ± 0.13 Ma **Sample**—Location and isotopic ages of bedrock (see table 3 in pamphlet)


106°22'30"
106°15'
106°07'30"
106°00'
39°15'
39°07'30"
39°00'
38°52'30"
38°45'
38°37'30"
38°30'
East Fork Arkansas River
Leadville
Mosquito Range
South Park
Granite
Twin Lakes
Balltown
Granite
Arkansas River
Sawatch Range
Buena Vista
Nathrop
Lava Creek B ash
Bishop ash
Salida
24
285
9
82
291
50
0
5
10 MILES
0
5
10 KILOMETERS
EXPLANATION
Major roads
River
U.S. highway route marker
State highway route maker
Bishop ash
Sample—Location of dated volcanic ash deposits
Salida
Location of towns

Shaded relief was derived from U.S. Geological Survey National Elevation Dataset (NED, *http://ned.usgs.gov/*) with 10-m resolution elevation data.

**Figure 2.** Geographic setting of the Granite 7.5' quadrangle. Quadrangle boundary shown by yellow rectangle. Channels of Arkansas River and East Fork of Arkansas River are approximately located.


106°30'
106°22'30"
106°15'
106°07'30"
39°15'
39°07'30"
39°00'
38°52'30"
Mount Massive
Leadville South1
Mount Sherman3,4
Mount Elbert
Granite2
South Peak4
Winfield
Mount Harvard
Harvard Lakes5
300
24
82
0
5
10 MILES
0
5
10 KILOMETERS
EXPLANATION
U.S. highway route marker
Major roads
State highway route maker

Shaded relief was derived from U.S. Geological Survey National Elevation Dataset (NED, *http://ned.usgs.gov/*) with 10-m resolution elevation data.

**Index.** Hillshade map showing map area and adjacent USGS 7.5' quadrangles. Map names are in yellow.

[1] Colorado Geological Survey, McCalpin and others (2012)

[2] USGS Scientific Investigations Map 3294, Shroba and others (2014)

[3] USGS Scientific Investigations Map 3271, Bohannon and Ruleman (2013)

[4] USGS Miscellaneous Field Studies Map 555, Tweto (1974)

[5] USGS Scientific Investigations Map 3267, Kellogg and others (2013)

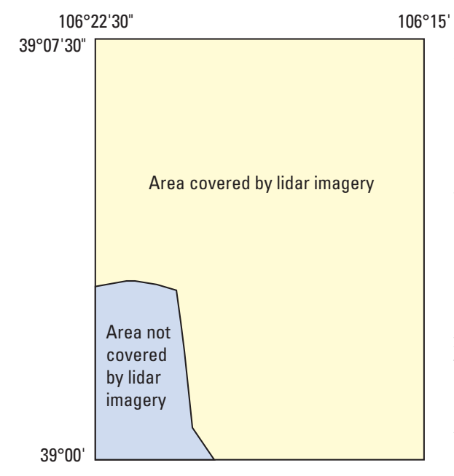
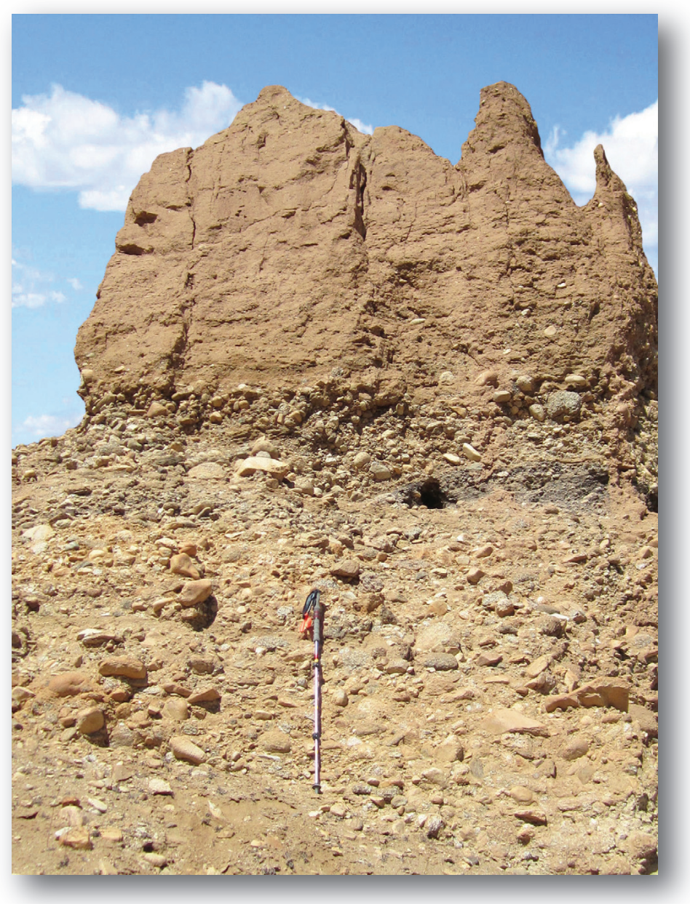
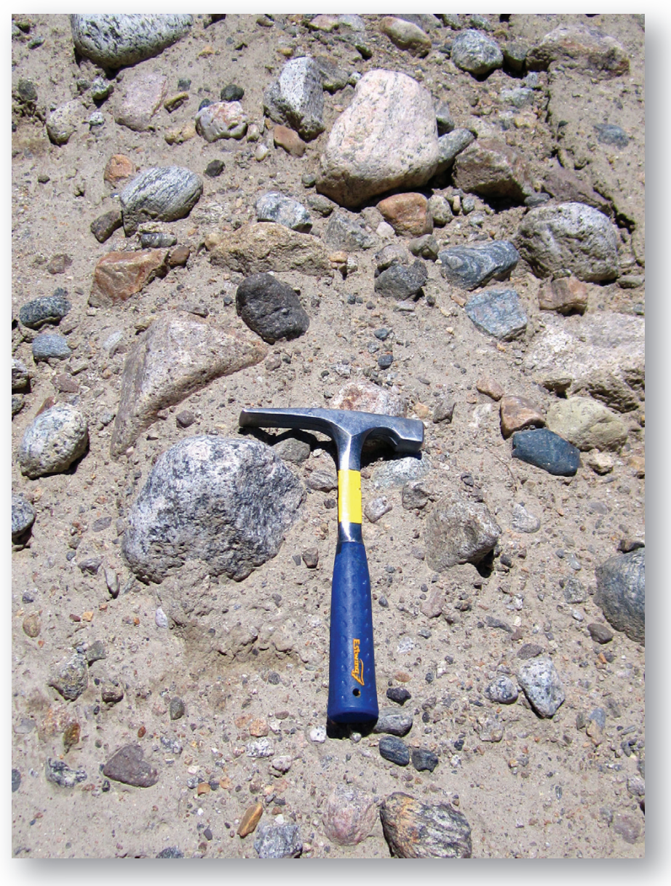

106°22'30"
106°15'
39°07'30"
39°00'
Area covered by lidar imagery
Area not covered by lidar imagery

**Figure 1.** Area of Granite 7.5' quadrangle covered by light detection and ranging (lidar) imagery shown in yellow. This imagery, along with field observations, was used to map surficial deposits, Dry Union Formation, inferred faults, lineaments, fluvial scarps, and other geomorphic features. Area in blue indicates region of quadrangle not covered by lidar imagery data that was interpreted with the aid of National Agriculture Imagery Program (NAIP) imagery.



**Photograph 2.** View toward the west of fluvial sediments of the Dry Union Formation (Nd) exposed in an east-facing stream cut, about 1 km west of the Granite Cemetery. Sediments are composed chiefly of silty sand above cobbly pebble gravel. Trekking pole near base of photograph is 1.1 m long, and is roughly perpendicular to bedding. Photograph by R.R. Shroba, October 15, 2011.

**Photograph 1.** View toward the west of the Twin Lakes area and the adjacent Sawatch Range accented by fall colors. Photograph by K.S. Kellogg, September 12, 2012.



**Photograph 3.** Close-up view of unoxidized till of Pinedale age, younger unit (Qtpy), exposed in southwest-facing road cut, about 2.1 km northeast of the north end of the Twin Lakes dam. Hammer handle is 28 cm long. Photograph by R.R. Shroba, September 14, 2012.

**Photograph 4.** View toward southwest of snow-capped peaks of the Sawatch Range near western boundary of the Granite 7.5' quadrangle. The high, flat-topped summit on the skyline, in the western one-quarter of the photograph, is Mount Hope (4,240 m; 13,933 ft). Photograph by R.R. Shroba, October 12, 2011.

CONVERSION FACTORS

| Multiply | By | To obtain |
|---|---|---|
| millimeters (mm) | 0.03937 | inches (in.) |
| centimeters (cm) | 0.3937 | inches (in.) |
| meters (m) | 3.281 | feet (ft) |
| kilometers (km) | 0.6214 | mile (mi) |
| square kilometer (km²) | 0.3861 | square mile (mi²) |
| cubic meter per second (m³/s) | 35.31 | cubic foot per second (ft³/s) |

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# Geologic Map of the Granite 7.5' Quadrangle, Lake and Chaffee Counties, Colorado

By

Ralph R. Shroba, Karl S. Kellogg, and Theodore R. Brandt

2014

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