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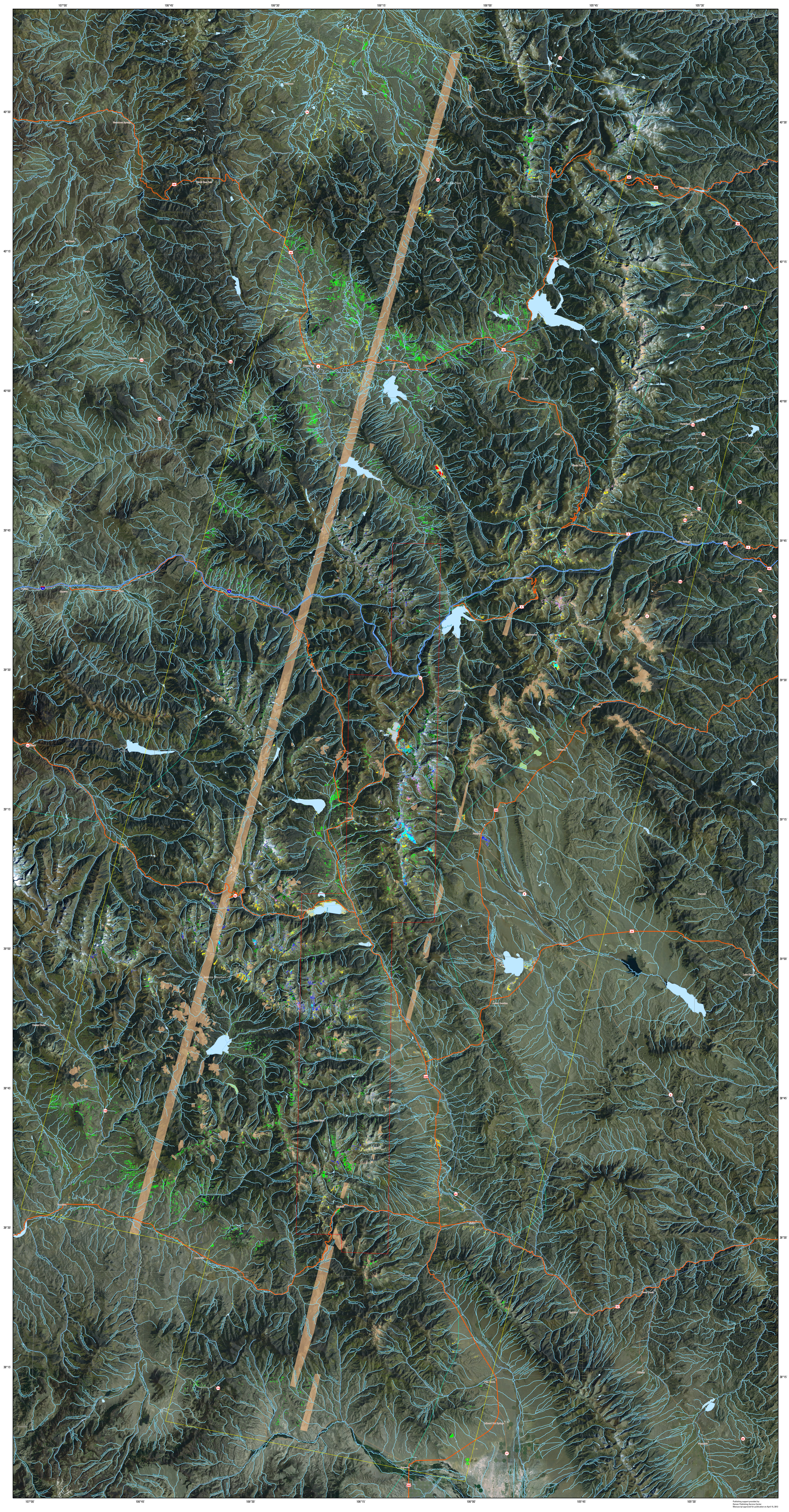
Scientific Investigations Map 3256
Pamphlet accompanies map



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Alteration type modeled using Boolean algebra from mineral assemblages identified through spectroscopic analysis of ASTER data described by Rockwell (2009).

ASTER scenes used for analysis (scenes listed from north to south):

Western path (September 2, 2002)	Eastern path (September 14, 2003)
AST_L1B.003:2082743345	AST_L1B.003:2082532526
AST_L1B.003:2082743347	AST_L1B.003:2082532503
AST_L1B.003:2082743344	AST_L1B.003:2082532524
AST_L1B.003:2082743343	AST_L1B.003:2082532537

ASTER data georeferenced to orthoimagery using triangle-based finite element analysis (Watson, 1992).

Background is imagery derived from multiple sources and served by ESRI (http://goto.arcgisonline.com/maps/World_Imagery).

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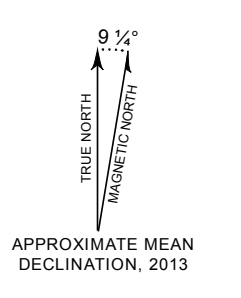
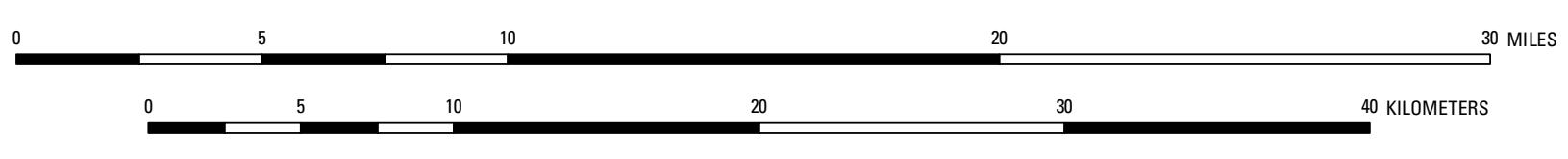
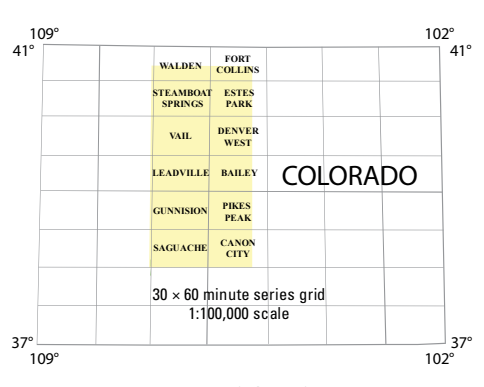
Rockwell, B.W., 2013, Comparative mineral mapping in the Colorado Mineral Belt using AVIRIS and ASTER remote sensing data: U.S. Geological Survey Scientific Investigations Map 3256, 8-p. pamphlet, 1 map sheet, scale 1:150,000, http://pubs.usgs.gov/sim/3256.



APPROXIMATE MEAN DECLINATION, 2013

Scale 1:150 000





MAP LOCATION

Comparative mineral mapping in the Colorado Mineral Belt using AVIRIS and ASTER remote sensing data

Map of modeled hydrothermal alteration type derived from ASTER data

By
Barnaby W. Rockwell
2013

Explanation - Map 5

ASTER-derived alteration type and key mineral assemblages grouped by relative net acid production and acid neutralizing capacity

High net acid production (NAP)

- 🟪 pyritic (jarosite)
- 🟦 phyllic (quartz-sericite-pyrite, or QSP)
- 🟦 potential phyllic (QSP) on north-facing slopes

Moderate to high NAP (variable pyrite content)

- 🟥 advanced argillic
- 🟧 argillic + ferric iron
- 🟦 regional propylitic to weak QSP (minor sericite + ferric iron)

Low to moderate NAP

- 🟨 argillic (no ferric iron)

Moderate to high acid neutralizing capacity (ANC)

- 🟫 propylitic or carbonate rocks +/- sericite or smectite + ferric iron
- 🟩 possible regional propylitic: sericite + chlorite

High ANC

- 🟩 propylitic or carbonate rocks +/- sericite or smectite

No significant NAP or ANC

- 🟪 sericitic (mainly lithologic, especially in metamorphosed pelitic rocks)

- ⋀ outline of ASTER data coverage
- ⋀ outline of AVIRIS data coverage
- 🟧 areas of no data: cloud, cloud shadow, snow, or corrupted shortwave infrared (SWIR) data
- ⋀ approximate outline of Colorado Mineral Belt

Explanation - Map 1

AVIRIS-derived iron-bearing mineral assemblages and water

- 🟫 chlorite + goethite
- 🟪 chlorite + muscovite
- 🟩 epidote
- 🟦 generic ferrous iron (e.g. some chlorites and muscovites)
- 🟩 generic ferrous iron + goethite and muscovite
- 🟦 goethite + jarosite
- 🟩 goethite: coarse-grained
- 🟩 goethite: fine-grained
- 🟪 goethite: medium- to coarse-grained +/- trace jarosite
- 🟩 goethite: medium-grained
- 🟩 goethite: thin coating
- 🟫 hematite: fine-grained - low fit x depth
- 🟫 hematite: fine-grained - moderate fit x depth
- 🟥 hematite: fine-grained - high fit x depth
- 🟥 hematite: medium- to coarse-grained
- 🟨 jarosite: coarse-grained
- 🟨 jarosite: fine-grained
- 🟦 other iron oxides and hydroxides
- 🟪 turbid water - high sediment load
- ⬜ turbid water - low sediment load
- 🟪 turbid water - moderate sediment load
- 🟪 turbid water - moderate to high sediment load
- 🟧 water: high chlorophyll content - high fit x depth
- 🟫 water: high chlorophyll content - low fit x depth
- 🟫 water: high chlorophyll content - low to moderate fit x depth
- 🟫 water: high chlorophyll content - moderate to high fit x depth
- 🟦 water: low chlorophyll content - high fit x depth
- 🟦 water: low chlorophyll content - low fit x depth
- 🟦 water: low chlorophyll content - low to moderate fit x depth
- 🟦 water: low chlorophyll content - moderate fit x depth
- 🟦 water: low chlorophyll content - moderate to high fit x depth

Explanation - Map 2

AVIRIS-derived phyllosilicate, sulfate, carbonate, sorosilicate, and nesosilicate minerals

- 🟩 calcite
- 🟩 calcite + dolomite
- 🟨 calcite + kaolinite
- 🟩 calcite or chlorite + sericite or smectite +/- dry vegetation
- 🟩 dolomite
- 🟩 dolomite + sericite +/- kaolinite
- 🟩 dolomite or calcite + sericite or smectite
- 🟦 epidote
- 🟦 epidote + trace sericite +/- chlorite
- 🟪 high-Al sericite
- 🟦 jarosite + sericite +/- gypsum
- 🟧 kaolinite + sericite
- 🟨 kaolinite + smectite
- 🟫 kaolinite +/- alunite +/- illite
- 🟥 kaolinite +/- alunite or dry vegetation
- 🟪 medium-Al sericite
- 🟨 poorly crystallized kaolinite or impure float
- 🟥 possible alunogen
- 🟪 possible pyrophyllite + kaolinite or sericite
- 🟩 sericite + chlorite
- 🟪 sericite + chlorite, or low-Al (Fe/Mg) sericite
- 🟦 smectite (montmorillonite)
- 🟥 topaz
- 🟨 well-crystallized kaolinite
- 🟫 white crust (possible epsomite)

Explanation - Map 3

ASTER-derived iron-bearing mineral assemblages, vegetation, and water

- 🟫 dry, non-photosynthetic vegetation, may include carbonate-bearing rocks and soils
- 🟩 dry/green vegetation
- 🟩 green vegetation 1 - lowest chlorophyll content or plant density
- 🟩 green vegetation 2
- 🟩 green vegetation 3
- 🟩 green vegetation 4
- 🟩 green vegetation 5
- 🟩 green vegetation 6
- 🟩 green vegetation 7
- 🟩 green vegetation 8
- 🟩 green vegetation 9
- 🟩 green vegetation 10
- 🟩 green vegetation 11
- 🟩 green vegetation 12
- 🟩 green vegetation 13
- 🟩 green vegetation 14
- 🟩 green vegetation 15
- 🟩 green vegetation 16
- 🟩 green vegetation 17
- 🟩 green vegetation 18
- 🟩 green vegetation 19 - highest chlorophyll content or plant density
- 🟫 major ferric iron 1 - lowest fit x depth
- 🟫 major ferric iron 2
- 🟫 major ferric iron 3
- 🟫 major ferric iron 4
- 🟥 major ferric iron 5
- 🟥 major ferric iron 6
- 🟥 major ferric iron 7
- 🟥 major ferric iron 8
- 🟥 major ferric iron 9 - highest fit x depth
- 🟫 minor ferric iron 1 - includes redbeds and soils - lowest fit x depth
- 🟫 minor ferric iron 2 - includes redbeds and soils
- 🟫 minor ferric iron 3 - includes redbeds and soils
- 🟧 minor ferric iron 4 - includes redbeds and soils
- 🟧 minor ferric iron 5 - includes redbeds and soils
- 🟧 minor ferric iron 6 - includes redbeds and soils
- 🟧 minor ferric iron 7 - includes redbeds and soils - highest fit x depth
- 🟥 minor to major ferric iron
- 🟨 sericite +/- chlorite, or wet soil near water
- 🟪 turbid water 1 - lowest sediment load
- 🟪 turbid water 2
- 🟪 turbid water 3
- 🟪 turbid water 4 - highest sediment load
- 🟪 water with red algae and/or sediment load
- 🟦 water: deep and/or low chlorophyll content
- 🟦 water: shallow and/or high chlorophyll content

Explanation - Map 4

ASTER-derived map of phyllosilicate, sulfate, carbonate, sorosilicate, and silica minerals

- 🟥 alunite, pyrophyllite, and (or) dry vegetation*
- 🟧 alunite (or dry vegetation) + kaolinite
- 🟩 calcite
- 🟩 chlorite
- 🟩 dolomite
- 🟦 epidote, or calcite + dolomite mix
- 🟦 high-abundance Al sericite
- 🟪 jarosite
- 🟨 kaolinite
- 🟩 kaolinite + sericite
- 🟫 kaolinite + smectite
- 🟦 low-abundance Al sericite
- 🟪 low-Al (Fe/Mg) sericite, or muscovite + chlorite
- 🟦 primarily false detections of high-abundance sericite on shadowed, north-facing slopes
- 🟪 primarily false detections of low-Al sericite or muscovite + chlorite on shadowed, north-facing slopes
- 🟩 primarily false detections of sericte + calcite/chlorite/epidote on shadowed, north-facing slopes
- 🟩 sericite (or smectite) + calcite (and/or chlorite, epidote)
- 🟫 smectite (montmorillonite) or low-abundance sericite

* spectral match to alunite (deep absorption near 2.17 micrometers)

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