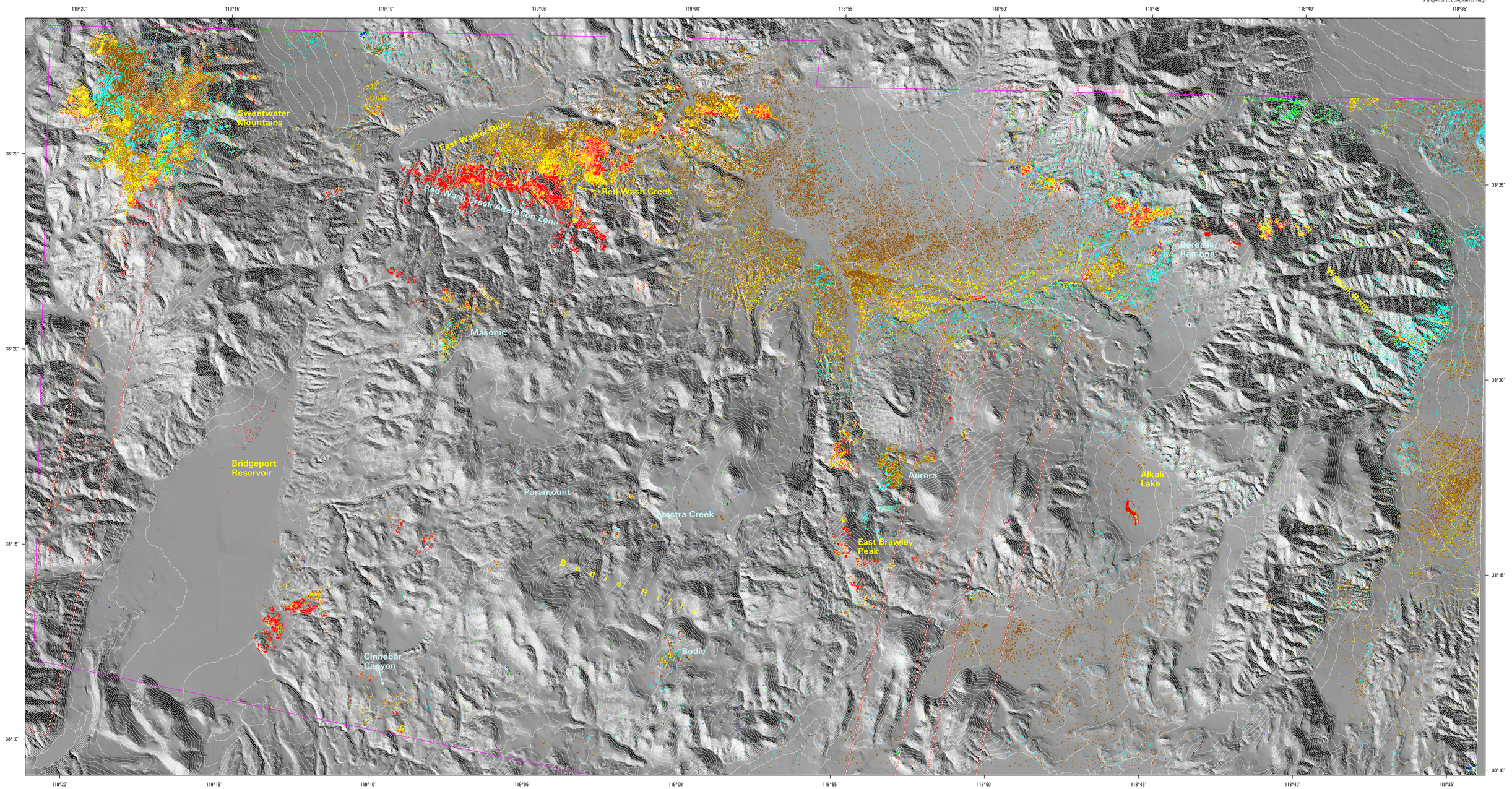
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS MAP 3104
SHEET 3 OF 4
Version 1.0
Pamphlet accompanies map



ASTER scene information:

West scene:
Scene ID AST_L1A.003:2008798944
Acquired August 12, 2000

East Scene:
Scene ID AST_L1B.003:2024614684
Acquired June 20, 2004

Mineral mapping performed using techniques described by Rockwell (2009). Mapping has been field verified only in selected areas.

ASTER data orthorectified using a Projective Transform to orthorectified Landsat TM data and a 1/3 arc second digital elevation model (≈10 m resolution) from USGS National Elevation Dataset (NED). NED and Landsat data provided by USGS Seamless Data Distribution System.

Contours and shaded relief image generated from NED 1/3 arc second data. Contour interval 40 m.

Mines, mining districts, and altered areas indicated in pale cyan.

Top photograph shows intense advanced argillic alteration on hill 1.8 km northwest of the Aurora townsite. Area is underlain by Miocene rhyolitic flows and shallow intrusive rocks (10-11 Ma, Tr3 of Crafford, 2007). View is toward the northwest. Lower image shows perspective view of same location produced through overlay of ASTER mineral map on NED digital elevation model. See map explanation at right for description of colors. Alunite (red) occurs in the rocky ridges, whereas less resistant kaolinite (yellow, with local dickite along silicified fractures) occurs mainly on adjacent smooth, white to gray slopes.

Altered breccia with alunite and hematite (mainly in matrix) at a prospect on the east ridge of East Brawley Peak south of Aurora. Breccia occurs along inferred east-trending faults and fractures within Miocene (12.3 Ma, John and others, 2010) andesitic volcanics (Ta3 of Crafford, 2007). Some breccia fragments are chalcedonic. Jarosite, goethite (both likely after pyrite), and natroalunite (sulfate absorption feature at 1480–1484 nm compared to 1477 nm at prospect) are present in float 30–40 m north of prospect. Na/K alunite + kaolinite + goethite occurs 100 m north of prospect.

Kaolinized sinter complex in vertically flow-banded Pliocene rhyolite (Smailbegovic, 2002) viewed from east ridge of East Brawley Peak. View is toward the east. Sinter is locally brecciated and cemented with chalcedony and local opal. Note well-preserved spherulitic textures of chalcedony (inset) from center of the sinter. Bright rocks visible at left 1.1 km behind the sinter are a vent breccia complex containing abundant alunite (this map) from a 2-2.5 Ma hydrothermal system, one of the youngest in the area (Silberman, 1995). Kaolinite (this map) and one pixel of quartz (sheet 4) were identified at the sinter using the ASTER data.

Undated quartz-alunite alteration in Miocene andesites and volcaniclastic rocks near Red Wash Creek. View is towards the northwest from the road that runs south parallel to the creek. Quartz, alunite, and hematite occur in the reddish, blocky outcrops along the skyline. Quartz, alunite, and ferric iron minerals were detected here using the ASTER data (see also sheets 2 and 4).

Undated quartz-alunite and related alteration in andesite near the mouth of Red Wash Creek at the East Walker River. Riparian vegetation along the river is visible at center left, and Red Wash Creek crosses the center of the photograph at the foot of the red cliffs. View is towards the north-northeast. Mineral assemblages identified using the ASTER data are indicated: QA = quartz+alunite, K = kaolinite, KS = kaolinite + smectite (or halloysite), M = montmorillonite. Quartz abundance here is among the highest detected in the study area (see sheet 4).

APPROXIMATE MEAN DECLINATION, 2009

Scale
Kilometers 2 0 2 4
Miles 1 0 1 2 3
1 : 62 000
Contour interval = 40 meters

Index map showing location of study area and ASTER scene footprints

Explanation for ASTER mineral mapping:

Clay-bearing assemblages
- Kaolinite and (or) dickite[1]
- Kaolinite +/- sericite[1]
- Kaolinite +/- smectite[1] (high-albedo surfaces with minor and (or) impure kaolinite, often supergene)
- Smectite (montmorillonite), or low-abundance sericite

[1] Kaolinite-bearing assemblages may be misidentified in areas with sparse, dry vegetation +/- sericite or montmorillonite

Carbonate and Fe/Mg-OH minerals[2]
- Calcite
- Dolomite
- Chlorite (Mg-OH SWIR + $Fe^{2+/3+}$ NIR absorptions)
- Epidote, or calcite + dolomite mixture
- Calcite (or chlorite/epidote) + sericite (or smectite)

[2] These minerals, including amphiboles, are often difficult to distinguish reliably using ASTER SWIR data because of spectral similarities and (or) sensor noise, and may co-occur as areal and intimate mixtures. They also may be incorrectly identified in areas of sparse, dry vegetation.

Sulfate-bearing assemblages
- Possible pyrophyllite (+/- alunite)[3]
- Alunite (+/- pyrophyllite)[3]
- Natroalunite, or alunite + minor kaolinite[3]
- Alunite + kaolinite[3]
- Jarosite +/- gypsum, or ferric iron + chalcedony/opal
- Gypsum +/- clays

[3] These assemblages may represent areal mixtures of clay/mica + dry vegetation or areas of sensor instability related to low or high surface albedo

Sericite-bearing assemblages
- Al illite/muscovite
- Al/Fe-Mg illite/muscovite, or mixture of muscovite and chlorite, carbonate, and (or) dry vegetation
- Chalcedony and (or) opal, or jarosite/gypsum + clay/mica near mapped occurrences of jarosite

Indicates areas of map affected by shortwave-infrared (SWIR) detector "scratch" (Rockwell, 2009 and references therein). Material identification results in these areas may be erroneous. A shapefile containing these polygons is included in the downloads directory associated with this map product.

Lines indicate limits of ASTER data coverage analyzed for this study.

MINERAL AND VEGETATION MAPS OF THE BODIE HILLS, SWEETWATER MOUNTAINS, AND WASSUK RANGE, CALIFORNIA/NEVADA, GENERATED FROM ASTER SATELLITE DATA

MAP OF CLAY, SULFATE, MICA, CARBONATE, Mg-OH, AND HYDROUS QUARTZ MINERALS

By

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