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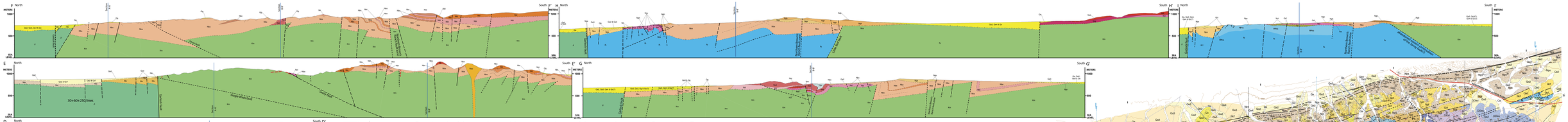


Geologic Map of the Northern Lava Mountains and Summit Range, San Bernardino County, California

By
Joseph E. Andrew, William M. Rittase, Francis M. Monastero, Tandis Bidgoli and J. Douglas Walker
2014

SCALE 1:20 000

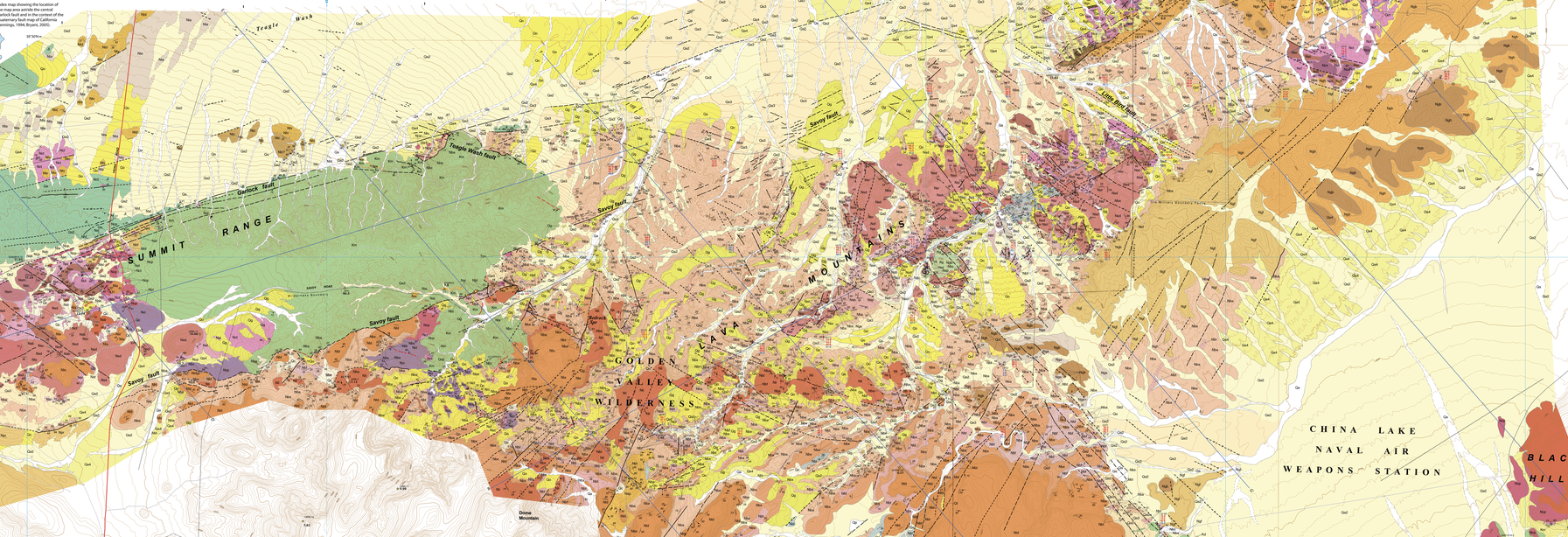
CONTOUR INTERVAL 20 FEET
projection NAD83 UTM zone 11N

Index map showing the location of the map area astride the central Garlock fault and in the contest of the Quaternary fault map of California (Jennings, 1994; Bryant, 2005).

Geology compiled by J. Andrew

Geologic mapping data from:
J. Andrew:
(entire area)
F. Monastero:
(Summit Range between Trona-Red Mountain Road & railroad tracks)
W. Rittase:
(along the Garlock fault and Christmas Canyon area)
Z. Carey:
(Teagle Wash and eastern El Paso Mountains)

Additional structural measurement data from Smith (1964) and Dibblee (1967).



CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS

Qh, Qa, Qp, Qc, Qe2, Qe3, Qe4, Qf, Qt, Qs, Qg

SEDIMENTARY ROCKS

Qscf, Qsf, Nbr, Nbs, Nbh, Ngh, Ngr, Nfw, Ngb, Ngs, Ngr, Nhd, Ngs, Nps, Ngs, Ngs

VOLCANIC AND SEDIMENTARY ROCKS

Nsa, Nla, Nk, Nsp, Nsc, Nbw, Nbz, Nbf, Nba, Nbc, Nsf, Nsm, Nwc, Nwa, Nwd, Nsd, Nsb, Nsv, Nsu, Nsd, Nsd, Nsc, Nsd, Nsd, Nsc

PLUTONIC AND METAMORPHIC ROCKS

Kg, Km, J, Jmd, JPzd, JPzg, JPzbs, JPs, Pz

Strike & dip of planar structures

(with dip value)
- Bedding
- Horizontal bedding
- Flow layering
- Foliation
- Fault plane
- Dike
- Vein
- Axial planar cleavage

Trend and plunge of linear structures

(plunge value not shown)
- Lava flow direction
- Fault striation

Field observation station

Geochronology Samples

[new Ar-Ar and U-Pb samples and reinterpreted Ar-Ar data of Smith et al. (2002)]

- Sample name & interpreted age (Ma) in bold

(U-Th)/He Thermochronology Data

Results of 2007 study (Walker et al., unpublished data)
The averaged age (Ma) of all analyzed fractions
- Zircon (red font)
- Apatite (blue font)

Results of 2010-2011 study (Bidgoli, unpublished data)
The age (Ma) of all fractions are listed
- Zircon (red font)
- Apatite (blue font)

Contacts

- Solid where accurate, dashed where approximate, short-dashed where inferred, dotted where concealed, and ? where queried:
- Depositional
- Marker tuff bed
- Intrusive
- Dike
- Fault

DESCRIPTION OF MAP UNITS

CENOZOIC

QUATERNARY

HOLOCENE

Qh Human-modified surfaces

Qa Active alluvial deposits

Qp Active playa deposits

Qc Active colluvial deposits

Qe2 Alluvial deposits 2 – Alluvial deposits that are inclined and non-active, but without Pleistocene lake effects (i.e., wave-cut terraces, beach ridges, etc.) and without significant desert pavement development.

Qe3 Alluvial deposits 3 – Alluvial deposits that are inclined and non-active. Desert pavement is poorly developed. This is the youngest unit cut by the last earthquake rupture on the Garlock fault.

Qe4 Alluvial deposits 4 – Alluvial deposits that are inclined and non-active, with Pleistocene lake effects and greater amounts of desert pavement development with some rubification and desert varnish.

Qf Tufa and travertine – Lakeshore tufa deposits and spring deposits; spring deposits on the lava flows of the Lava Mountain Caldera to the south of the Brown's Ranch fault zone are possibly older than Qualmann.

Qs Older alluvial deposits – Alluvial and colluvial deposits that are strongly inclined, have Pleistocene lake effects (wave-cut scarps and beach deposits) and strong desert pavement development.

Qg Terrace gravel deposits – Gravel deposits dominated by porphyritic dacite lava clasts from the Lava Mountain Dacite and associated cobs. These deposits infill into the breached plunging anticline of units as young as Pliocene (?Pleistocene?).

Christmas Canyon Formation (middle Pleistocene) (Smith 1964; redefined by Smith, 2000; redefined herein) Smith (2000) estimated ages of this formation to be 0.70 to 1.1 Ma.

Qcf Fluvial member – Conglomerate and sandstone, up to 15 meters thick, consisting of poorly to moderately cemented, moderately well-indurated matrix. The color is mostly yellowish-brown with less abundant pale red. The matrix is strongly altered to clay. There are 5 to 50% pebbles, cobbles, and boulders. Notable clast rock types are rounded, fresh-appearing black vesicular basalt clasts. The depositional flow direction was toward the west-southwest, roughly parallel to the Garlock fault.

Qsf Spring deposits – Spring deposits are composed of clay-rich beds with interbedded thin layers of pebbles. The beds are sub-horizontal and commonly weather to a light greenish color. This unit is interpreted to have been deposited in a nearshore environment. An ash contained with the 604 ka Lava Creek B ash (Smith, 1964) from the Yellowstone Caldera occurs 1 meter below the top of the lacustrine facies.

NEOGENE

PLIOCENE

Nbr Conglomerate of volcanic clasts from Red Mountain – Coarse conglomerate containing cobbles to boulder clasts of medium-grained porphyritic andesite/basaltic andesite. The andesite clast rocks are known as dacites. The andesite clasts are porphyritic, varying from fine to medium-grained phenocrysts. A high percentage of the clasts are altered to a greenish color. The matrix to this unit is the same composition as the coarse clasts. The matrix is moderately well-indurated and varies from pale to white. Intermixed with the andesite clasts are black to dark-brown, white-colored pumice. The source for the clasts in this deposit appears to be the Late Miocene Almond Mountain Volcanics exposed a few kilometers to the southeast in the western Lava Mountains and at Red Mountain. The dacites and andesites at Red Mountain have distinctive hydrothermal alteration (Smith, 1964; Smith, 1964).

Nbs Siltstone and sandstone older than the Christmas Canyon Formation (Smith, 1964; redefined herein) Smith (1964) gives a fine-grained arkosic siltstone and sandstone with thin beds to cobble-rich layers. Burnoe casts are locally abundant in the finer-grained layers. Pumice lapilli are common. There are locally fine-grained layers that appear to be lacustrine deposits. Thin beds of ash are present. The beds are moderately well-indurated and are interpreted to have been uplifted to form the Summit Range, between the Garlock and Savoy faults. These have exotic clasts that have no nearby bedrock source area.

Nbc Conglomerate of Hackah Gulch – Basalt clast conglomerate similar to that in the eastern Lava Mountains, but the basalt clasts are more abundant and larger than those in the basalt clast conglomerate in the eastern Lava Mountains. Other clasts are mixed in with the basalt clasts: metasedimentary clasts (generally calcilutite hornfels, dark meta-chert, bedded meta-argillite and quartzite), intermediate-composition volcanic rocks and granodiorite to quartz monzonite.

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This unit is interpreted to be the same unit to be lacustrine, but the arkosic and conglomeratic beds have sedimentary textures and structures indicative of fluvial facies. This unit was separated out by Smith (2009) from what had previously been mapped as Christmas Canyon Fm. (Smith, 1964). The Christmas Canyon Formation overlies this unit with an angular unconformity. Individual beds of this siltstone and sandstone unit are similar to beds in the Pliocene Red Mountain Volcanic Formation, but the clast content is different and the Christmas Canyon Formation everywhere has very low dips versus the moderate to steep dips of these older siltstones and sandstones.

Sediments of Teagle Wash (Pliocene?)

Sedimentary deposits exposed as inselbergs in Teagle Wash, north of the Garlock fault. All of these deposits are poorly cemented and have no direct geochronologic age constraints. These units were deposited unconformably over coherent megabreccia of the Summit Range and the Pliocene Christmas Canyon Fm. The preponderance of the clasts in these deposits, are distinctly different from the nearby modern drainage sources of the Summit Range.

Nbs Conglomerate of clasts from Christmas Canyon area – Arkosic siltstone with crude to well-developed bedding and local pebble to cobble interstones and lenses. The clast rock types are similar to those in the Nbc unit, but also include quartzite, quartzite, phyllite, calcilicate hornfels, meta-argillite and gray-green granodioritic mylonite; felsic to intermediate composition volcanic rock clasts are locally abundant; a few vesicular basalt clasts occur locally; and sparse intrusive clasts consist of greenish granodiorite (epidote metamorphism) and light pink aplitic. The uppermost exposed portion has a slightly coarser-grained conglomerate with clasts of light pink aplitic porphyritic dacite and white, flow-banded rhyolite. Rare clasts of graphitic schist with alumina-rich porphyroblasts were noted by Carter (1994), which he correlated with a porphyritic schist to the east. The clasts are most similar compositionally and texturally with rhyolitic portions of the early Miocene Garlock Corridor volcanics (Sabin, 1990 and the Cudahy Camp Fm. (Monastero et al., 1997). The matrix is arkosic sand. These uppermost beds are displaced ~17 km along the Garlock fault from its sediment source in Christmas Canyon area, on the south side of the Garlock fault. This unit occurs above the coarser volcanic breccia deposits.

Sediments of Golden Valley (Pliocene?) Sedimentary deposits younger than the Late Miocene Barstow Formation that occur in the eastern Lava Mountains.

Nbs Conglomerate of basalt boulder clasts – Cobble to boulder conglomerate of very fresh-appearing, dark-colored, vesicular basalt clasts. The basaltic clasts are most concentrated in lag gravels at the top of exposures. This unit is generally the uppermost unit in the eastern Lava Mountains. The basalt clasts are unit caps older than the surrounding sediments. These have been deformed into a broad east-northeast plunging anticline with gently dipping limbs. The source for the basalt clasts is interpreted to be from basalt lava flows capping the mesas of the Black Hills, approximately 3 km to the southeast. The age of the basalt is interpretative is based on the Pliocene age of the Barstow Formation of the basalt clasts, compared to other basalts in the area. A sample of these basalt clasts has an K-Ar whole rock groundmass age of 11.62 ±0.11 Ma which closely matches the age of similar basaltic volcanic rocks in the Black Hills (Table 1). The top of the Black Hills (Lynch Mesa) is 1.5 km southeast. Only clasts type occur in this unit, similar to the clast types present in the other conglomerates of the sediments of Golden Valley. Locally, the top surface of this unit is reworked into a lag deposit.

Nbs Conglomerate of basalt cobble clasts – Light-colored, coarse cobble to boulder conglomerate locally below basalt-clast boulder conglomerate. The clasts in this deposit are dominantly rounded felsic volcanic rocks, but locally there are minor basaltic clasts. The felsic volcanic clasts are similar to those in the Nbr unit. The most likely source of the felsic volcanic clasts is the early Miocene Cudahy Camp Fm. (Monastero et al., 1997) in the El Paso Mountains, 15 km to the west.

Nbs Conglomerate of hornblende diorite clasts – Cobble conglomerate to sandstone composition of abundant hornblende-diorite clasts, generally pebble to cobble size, but locally boulders are present. The hornblende-diorite clasts are most abundant in the eastern Lava Mountains. Other clasts are mixed in with the basalt clasts: metasedimentary clasts (generally calcilutite hornfels, dark meta-chert, bedded meta-argillite and quartzite), intermediate-composition volcanic rocks and granodiorite to quartz monzonite.

Nba Conglomerate of exotic clasts – Poorly indurated and poorly exposed conglomerates and diamictites. These have abundant exotic clasts of granodiorite to quartz monzonite, calcilicate rocks, vesicular basalt, hypabyssal igneous rocks, porphyritic dacite, and felsic volcanic rocks. Sedimentary rock clasts are abundant in any adjacent bedrock exposure. Locally the clasts also include an additional assemblage of cordierite porphyroblastic graphitic schist and hornblende diorite. These conglomerates occur only between the Savoy and Garlock faults in the Summit Range. Some of these have been extensively quarried as a source rock for placer gold.

These conglomerates are displaced left-laterally from their sediment source area by motion on the Garlock fault (Carter, 1994). The clast rock types are similar to the clasts in the Paleocene conglomerate member of the Goler Formation in the El Paso Mountains (Dibblee, 1953; Cox and Diggles, 1986; Cox, 1987). The source for the clasts appears to be the Goler Formation on the eastern end of the El Paso Mountains, north of the Garlock fault. Carter (1994) noted the conglomerates are characterized by the presence of placer gold and granitic clasts in both the Summit Fm. and the conglomerate in Hardcash Gulch, despite no exposed source for gold or granite in the El Paso Mountains. The volcanic clasts in the conglomerate at Hardcash Gulch are similar to the Paleocene Goler Fm. (Dibblee, 1953; Cox and Diggles, 1986; Cox, 1987; Loomis and Burbank, 1988; Monastero et al., 1997). Goler Gulch is the largest drainage in the eastern El Paso Mountains and it samples the placer gold-bearing Paleocene conglomerate member of the Goler Formation and the Miocene volcanic rocks of the Cudahy Camp Fm.

Nbc Conglomerate of dacite clasts – Conglomerate of porphyritic dacite clasts with minor amounts of fine-grained, flow-banded rhyolite with a white to very light tan color. The clasts are most similar compositionally and texturally with rhyolitic portions of the early Miocene Garlock Corridor volcanics (Sabin, 1990 and the Cudahy Camp Fm. (Monastero et al., 1997). The matrix is arkosic sand. These uppermost beds are displaced ~17 km along the Garlock fault from its sediment source in Christmas Canyon area, on the south side of the Garlock fault. This unit occurs above the coarse volcanic breccia deposits.

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Nsa Andesitic sandstone – Poorly indurated and poorly exposed sandstone of fine-grained to medium-grained porphyritic andesite/basaltic andesite. The clasts of this unit are porphyritic and altered, slightly resembling the mineral and texture of the Miocene Almond Mountain Volcanics. The source for the clasts is most likely the Almond Mountain volcanic rocks of Smith (1964). The age of the Almond Mountain volcanic rocks is 19.5 ±1.3 Ma based on 5 zircon fractions (Walker and Monastero, unpublished data). The age of the Summit Range Fm. is constrained from 12.1 to 17.1 with three fractions giving the ages of 14.1 ±0.3 Ma, 14.4 ±0.3 Ma and 14.6 ±0.3 Ma (Walker et al., unpublished data). A sample of these clasts, which are other samples than those used in the zircon fraction, 1994; Monastero et al., 1997).

Ash tuff – Well bedded, light pink to white ash and lapilli tuff; occur at the base of the Cenozoic section across the map area. They are associated only where a complete lava units up to ~850 meters cumulative thickness. The groundmass is black with phenocrysts of plagioclase and biotite. There are strong phenocrysts of plagioclase and biotite