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GEOLOGIC MAP OF THE BLAIRSDEN 15' QUADRANGLE PLUMAS COUNTY, CALIFORNIA

by

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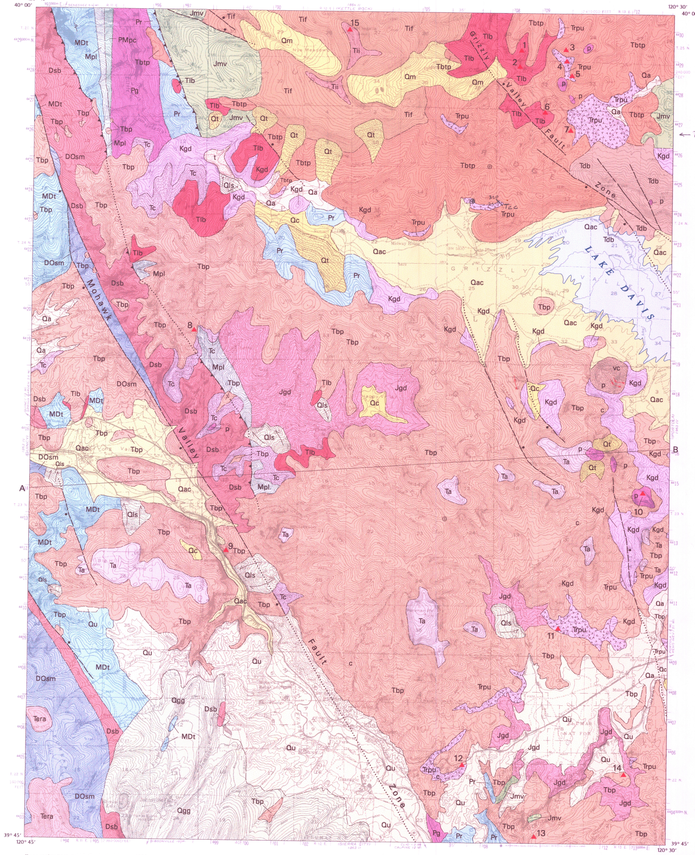
2000



Topographic base by U.S. Geological Survey, 1956
15' Blairsden Quadrangle
Polyconic projection. 1927 North American datum
10,000-foot grid based on California coordinate system, zone 1

Field work supported by the U.S. Geological Survey, Northern California Transect
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MAGNETIC NORTH
MEAN DECLINATION 18°

SCALE 1:62,500

CONTOUR INTERVAL 50 FEET
DATUM IS MEAN SEA LEVEL

LOCATION MAP

DESCRIPTION OF GEOLOGIC UNITS

QUATERNARY

- t — Mine tailings
- Qa — Alluvium - Occurs in four small valley floor areas in north half of map.
- Qc — Colluvium - Occurs in five small areas.
- Qac — Alluvium and colluvium undifferentiated - Underlies the floor of Grizzly Valley and the floor and lower slopes of Long Valley.
- Qt — Talus - Coarse, angular fragments of dense lava rock, occurs on slopes of Mt. Ingalls and Smith Peak.
- Qls — Landslide debris - Occurs in several masses derived mostly from slope failure of pyroclastic material in Tbp unit.
- Qm — Glacial moraine - Occurs in two major valleys as ground and lateral deposits on the slopes of Mt. Ingalls.
- Qgg — Glacial morainal and glaciofluvial gravels - Occurs as extensive ground cover with highly variable thickness in the Johnsville area.
- Qu — Undifferentiated deposits of sand, gravel, silt, with local lacustrine clay and coaly beds - Highly variable and complex interstratified fluvial, glaciofluvial, colluvial, and lacustrine sediments occurring in two separate valley areas along the Middle Fork of the Feather River.

TERTIARY

Mt. Ingalls Volcano

- Tii — Mafic andesite intrusion; light to dark gray, aphyric to sparsely finely porphyritic with andesine and augite phenocrysts, intergranular, pilaty; dense; occurs in summit area of Mt. Ingalls as plugs and sill K-Ar date 4.7 ± .01 Ma, location 15.
- Tif — Mafic andesite and basalt flows; medium gray to black, mostly aphyric, intergranular with olivine, augite, andesine, and labradorite, dense to vesicular; comprises major rock type of Mt. Ingalls volcano; equivalent to Durrell's "Warner Basalt" in this area.

Dixie Mountain Volcano

- Tdb — Andesitic tuff breccia, flow breccia, and flows; light to dark gray, variously pyroclastic to flow, aphyric to porphyritic with plagioclase, pyroxene, and hornblende phenocrysts; derived from Dixie Mountain volcano centered 10 miles (16.8 km) to the east (Grose, 2000) and dated at 18.0 Ma; mostly overlies Tbp unit.

Extrusives of the Blairsden Area

- Ta — Andesite flows and minor associated pyroclastics undifferentiated; medium gray, aphyric, pilotaxitic, with andesine, pyroxene, and rare olivine, locally strongly platy; occurs locally with thickness up to 500 feet (150 m) in upper levels of the Tbp unit from unknown sources and as local flows derived from the Smith Peak intrusive cluster where one date from a presumed source plug at location 10 is 11.1 Ma (Dalrymple and others, 1967).
- Tbp — Andesitic tuff breccias and flows; tuff breccia; white to dark gray, variously pyroclastic, mostly autoblithic andesite fragments, vitrophyric to intergranular with hornblende and plagioclase phenocrysts; andesite flows: light to dark gray, subophitic to intergranular, aphyric to finely porphyritic porphyritic with hornblende, andesine, and minor pyroxene phenocrysts; Tbp unit is markedly heterogeneous, widespread (over 100 square miles), 2,000 feet (610 m) thick, and probably sourced from several unknown centers; general stratigraphy equivalent to Ingalls, Bonta, and Penman formations of Durrell (1959); dates range from 19.7 to 68 Ma at locations 8, 9, 13, and 14 (see list of radiometric ages).
- Tbsp — Andesitic, latitic, and minor rhyolitic tuff breccias and associated flows of Turner Ridge; light to dark gray, aphyric to variously porphyritic with plagioclase, hornblende, and pyroxene phenocrysts; over 1000 feet (310 m) of complexly interbedded lithologies usually with gradational contacts and little lateral continuity; mostly horizontal; source unknown; probably partially correlative with Tbp unit; dates of 14.4 and 11.4 Ma at locations 3 and 7.
- Tera — Andesite flows of Eureka Ridge; light gray, vitrophyric and hyalo-ophitic, moderately finely porphyritic with hornblende and andesine phenocrysts; occurs in the southwest corner of map and extensively to west and southwest; probably correlates with lower section of Tbp unit.

Lovejoy Basalt

- Tlb — Basalt flows; black, intergranular, aphyric to sparsely microporphyritic with olivine phenocrysts in matrix of plagioclase, pyroxene, and olivine; uniform, dense, blocky (Durrell, 1959b), locally up to 800 feet (244 m) thick; usually deposited on pre-Cenozoic granitic and metamorphic rocks or Tc conglomerate unit preserved in a northeast-southwest-trending broad trans-Sierran paleovalley; K-Ar ages range from 14.0 to 9.9 Ma at locations 1, 2, and 6. However, more recent Ar-Ar dating indicates a 16 Ma age that is considered definitive (Page and others, 1993).

Siliceous Tuffs of Delleker

- Tbtu — Rhyolite ash-flow tuff; white, tan, gray, vitroclastic with minor biotite and sanidine crystals, massive to moderately welded; commonly associated with tuff, lithic breccia, and flows and with volcanic sandstone and conglomerate lenses and interbeds. Occurs highly irregular and discontinuous beds below the Tbp unit; correlates with the Delleker tuff of Durrell (1959a) with type locality at Delleker one mile east of map (Grose, 2000); age at locations 4, 5, and 11 range from 30.7 to 21.0 Ma; Because this lithology characteristically rarely naturally crops out, it may be significantly more widespread).

- Tc — Basal conglomerate; pebble, cobble, boulder with clastic to pyroclastic matrix; locally up to 400 feet (122 m) thick; clasts are mostly pre-Cenozoic metamorphic rocks of Sierra Nevadan affinity and minor Tertiary volcanic rocks; occurs in isolated remnants lying on pre-Cenozoic basement rocks and generally in spatial association with Lovejoy Basalt remnants, both of which represent paleovalley fill; equivalent to Durrell's "Auriferous gravels" or mid-Tertiary gravels by Durrell (1966).

PRETERTIARY

Granitic and Metamorphic Rocks

- Kgd — Granodiorite (Cretaceous) - White to light gray, medium crystalline, equigranular to sub-porphyritic with ubiquitous biotite and hornblende, massive to weakly foliated, locally with pegmatite and aplite dikes and mafic angular to rounded inclusions; occurs in outcropping masses in northern and east-central areas of the map and more widespread in areas to the east (Grose, 2000).
- Occurrence of cobbles, pebbles, or boulders in small sedimentary lenses or disconformably related with pyroclastic deposits.
- Overturned bedding.
- Horizontal bedding.
- 45 — Location and number of radiometrically dated sample.
- Landslide - arrows indicate principal direction of movement.

- Igd — Granodiorite-quartz diorite of the Haypress Creek composite pluton (Jurassic) - Light gray, medium crystalline, commonly with weak magmatic foliation of mafic and mafic minerals, schlieren, and inclusions; intruded locally by countless dikes of biotite leucogranite; occurs in the central and southeastern part of the map and extensively to the south; Middle Jurassic zircon U-Pb ages; from adjacent areas to the south (Hanson and others, 1996).

- Jmv — Metamorphosed volcanic and volcaniclastic rocks (Jurassic) - Light greenish gray to black and tan mafic and felsic flows, tuff breccia, and tuff; aphanitic to blastoporphyritic, massive to moderately foliated; common minerals are plagioclase, chlorite, actinolite, epidote, calcite, quartz, and Fe-Ti oxides and locally contact metamorphosed to epidote-hornblende-albite amphibolite; interbedded with lesser volume of dark gray volcanic-lithic sandstone, siltstone and minor conglomerate; occurs in northern part of map and extensively in areas to the north (Grose and others, 1990).

- Pr — Reeve Formation (Permian) - Volcanic and volcaniclastic rocks, dark gray, massive to bedded andesitic tuff, tuff breccia, volcanic sandstone and siltstone, locally with tuff breccia, volcanic sandstone and cobble conglomerate with volcaniclastic matrix in lower part; maximum thickness 660 feet (200 m); fossils indicate Early and Late Permian (late Wolfcampian to early Guadalupian) ages (Harwood, 1992); occurs in thrust fault contact with Jmv and conformably (?) overlying the Goodhue Formation in the map area.

- Pg — Goodhue Formation (Permian) - Basaltic tuff breccia, flow breccia, and locally pillowed flows, dark green to black, with abundant coarse equant clinopyroxene phenocrysts in fine-grained matrix of plagioclase, clinopyroxene, actinolite, chlorite, calcite, sphene, and magnetite; maximum thickness 10,000 feet (3000 m); crops out in northwest corner and southeastern margin of map, unconformably overlying the Peale Formation in this area (Ververka, 1992).

Peale Formation (Mississippian - Pennsylvanian) divided into:

- PMpc — Chert member (Mississippian - Pennsylvanian) - Radiolarian chert with interbeds of siliceous argillite, black, gray, green, red, and white, commonly isoclinally folded; maximum thickness about 490 feet (150 m); radiolarian assemblages indicate age range of late Early Mississippian (late Chadian) to Middle Pennsylvanian (Desmoinesian) (Harwood, 1992); occurs as southward pinching-out unit beneath unconformity at base of Permian rocks in northwest corner of the map.

- Mpl — Lower member (Mississippian) - Alkali-feldspar crystal tuff, tuff breccia, and minor flows, green, gray, locally purple and maroon; sparse interbeds of tuffaceous siltstone, sandstone, and lenses of gray bioclastic limestone; volcanic rocks are massive to strongly foliated and contain small pink alkali feldspar phenocrysts and rarely quartz phenocrysts in a matrix of albite, chlorite, actinolite, calcite, and sericite; maximum thickness at least 1600 feet (500 m), in conformable contact with underlying Taylor Formation; conodonts from limestone lenses in middle and upper parts of member indicative of Early Mississippian (late Kinderhookian) age (Harwood, 1992).

- MDt — Taylor Formation (Devonian and Mississippian) - Andesitic flows, tuff breccia, tuff, and tuffaceous turbidites, mantled light and dark green, massive to distinctly bedded with primary volcanic textures preserved; flows and tuff-breccia blocks contain plagioclase and/or clinopyroxene phenocrysts in fine- to medium-grained matrix of altered primary plagioclase and clinopyroxene with neoblastic actinolite, chlorite, epidote, calcite, sphene, and opaque Fe-Ti oxides; thickens to several thousand feet northward in western part of the map area; devoid of fossils (Harwood, 1992).

- Dsb — Sierra Buttes Formation (Devonian) - Quartz-crystal felsic tuff and tuff breccia, white, light gray, and tan; locally contains andesitic tuff, tuff breccia, and black phosphate-streaked chert; thickens northward from probable source area at Sierra Buttes 10 miles (16 km) south of the map to maximum thickness approaching 10,000 feet (3000 m); rests unconformably on the Shoo Fly Complex; radiolarians and conodonts from black chert and ammonoids from one locality indicative of Late Devonian (Frasnian? and Famennian) (Harwood, 1992).

Shoo Fly Complex (Ordovician? to Devonian?) in the map area limited to:

- DOsm — Sierra City melange (Ordovician? to Devonian) - Blocks of serpentinite, gabbro, pillowed and massive basalt, sandstone, limestone, mudstone, and chert incorporated in a disrupted and sheared sandstone and shale matrix; represents the structurally highest of four major thrust blocks recognized as comprising the Shoo Fly subduction complex; limited fossil and isotopic age data (Harwood, 1992).

INTRODUCTION

The Blairsden quadrangle occurs in a moderately mountainous area in the northern part of the Sierra Nevada in northern California. Most of the map area consists of horizontal tertiary volcanic flows and pyroclastic interbeds. They lie on a basement of Jurassic and Cretaceous granitic rocks and Paleozoic and Mesozoic metamorphosed volcanic and sedimentary rocks. Quaternary fluvial and glacial deposits occur, notably along the valley of the Middle Fork of the Feather River. The southern three-fourths of the map area is drained by the Middle Fork of the Feather River. The northern fourth of the map is drained by Red Clover and Little Grizzly creeks into the North Fork of the Feather River. The lowest elevation, 4085 feet (1246 m), is on the Middle Fork at the west- central margin of the map. The highest elevation, 8372 feet (2552 m), marks the summit of Mt. Ingalls near the north-central margin of the map. Prominent physiographic features include Smith Peak at 7688 feet (2345 m), Grizzly Ridge about 7000 - 7500 feet (2135 - 2292 m), Grizzly Valley about 5750 - 5850 feet (1754 - 1784 m), and the Middle Fork of the Feather River from 4085 to 4802 feet (1235 to 1460 m).

Geologic mapping herein of the Tertiary and Quaternary rocks is revised from earlier unpublished mapping of Cordell Durrell. Mapping of the pre-tertiary rocks is from D'Allura (1977).

ROCK DESCRIPTIONS

The rocks of the Blairsden quadrangle area naturally fall into three groups on the basis of rock type, age, and origin as follows: 1) metamorphic and granitic complexes of Paleozoic and Mesozoic age, 2) basaltic, andesitic, and rhyolitic flows and pyroclastic rocks of tertiary age, and 3) surficial sediments of Quaternary age. The three groups are summarized below:

Metamorphic and granitic rocks:

A north-northwest-trending belt of Ordovician? to Jurassic metamorphosed volcanic and sedimentary rocks is exposed mainly in the western part of the Blairsden quadrangle. They comprise part of the regionally extensive, multiple-accreted complex which is termed the northern Sierra terrane. Harwood (1992) has comprehensively synthesized current knowledge of this terrane. Other important references include D'Allura and others (1977), Schweickert and others (1984), and Hanson and others (1996). These metamorphic rocks record long and complex interaction between the western margin of the North American continent and the Pacific Ocean basin. Eight units are recognized in the Blairsden quadrangle area. The oldest unit, the Sierra City melange of the Shoo Fly Complex, contains diverse lithologies as clasts and tectonic blocks within a highly sheared sedimentary matrix. The Sierra City melange is a subduction complex associated for the most part with a forearc contractional plate margin (Schweickert and others, 1984; Harwood, 1992). Subduction is interpreted to have occurred sometime between the Late Ordovician and Late Devonian (Potter and others, 1990). Unconformably overlying the Sierra City melange is the Sierra Buttes Formation of Devonian age, composed of submarine rhyolitic to andesitic tuff interbedded with lesser amounts of black phosphate-streaked chert and siliceous argillite. In the upper part of the formation, andesitic tuff and tuff breccia prevail that are the eruptive equivalent of hypabyssal plugs of Sierra Buttes located several miles south of the map area (Hanson and others, 1988). Sub-marine and island-arc volcanism apparently continued with the deposition of thick andesitic flows, tuffs, and derivative sediments that comprise the unfossi-liferous Taylor Formation of Devonian and Mississippian age (Hanson and Schweickert, 1986). Conformably overlying the Taylor formation is the Peale Formation of Mississippian - Pennsylvanian age, which is divided into a lower member and a chert member. The lower member, composed of tuffs and lesser flows, grades upward into siltstone, sandstone, and limestone. Apparently the Peale formation indicates waning stages of Late Devonian and Early Mississippian submarine arc volcanism. The chert member, composed of thin-bedded radio-larian chert and other pelagic and siliceous sediments, reflects regional sub-sidence of the volcanic arc to abyssal oceanic depths. Slow sedimentation persisted to at least the Middle Pennsylvanian (Harwood, 1992). Unconformably overlying the Peale Formation in the Blairsden area is the Goodhue formation of Permian age. It is composed mainly of basalt flows, pillows, and tuffs which indicate renewed submarine and subaerial(?) volcanic activity in an extensional intra-arc graben. Overlying the Goodhue the upper part of the Permian volcanic sequence in the map area is represented by andesitic flows and pyroclastics and volcaniclastic sandstone, conglomerate, and siltstone which comprise the Reeve formation (Harwood, 1992). In the northwestern part of the Blairsden map area the Reeve formation is in thrust fault contact with metamorphosed andesites and interbedded volcaniclastic rocks of Jurassic age which occur extensively to the east of the map area (Grose, 2000; Harwood, personal communication). They are believed to represent remnants of a widespread, dismembered Jurassic island-arc volcanic complex. Absent in the Blairsden map area, but preserved in some adjacent areas, are Triassic and Early Jurassic arc-volcanic and sedimentary formations that overlie the Reeve formation and underlie the Jurassic arc-volcanics. Jurassic and Cretaceous granitic intrusions occur in the metamorphic complexes described above. The Jurassic Haypress Creek granodiorite and quartz diorite pluton crops out in the central and southeastern part of the Blairsden quadrangle, but is more widespread to the south (Hanson and others, 1996). Typical Cretaceous Sierra Nevadan granodiorite crops out locally in the northern and eastern parts of the map and is extensively exposed in adjacent areas to the east (Grose, 2000).

Tertiary volcanic rocks:

Overlying the Sierran basement of metamorphic and granitic rocks described above is the second major group of formations within the Blairsden map area: a series of flows, pyroclastics, and associated sedimentary rocks that are mostly of Miocene and Pliocene age. Stratigraphic relationships between the nine volcanic formations and a basal conglomerate unit are illustrated in the accompanying interpretive volcanostratigraphic schematic correlation chart. The formations are segregated into groups where appropriate, as presented in the map legend, on the basis of lithology, source, field relationships, and relative ages. The following paragraphs summarize characteristics of each group in order of general decreasing age.

The oldest Tertiary formation in the map area is the basal conglomerate, which may be regarded as the Eocene (?) "Auriferous gravels" or may more likely represent Oligocene or Miocene gravel deposits (Durrell, 1966). They are preserved locally in paleochannels cut in the Sierran basement surface and are associated areally with the Miocene Lovejoy Basalt, also confined to the same channels. Maximum thickness is about 400 feet (122 m). Original thickness and extent of the unit in the Blairsden area are unknown.

The oldest formation in the Tertiary volcanic sequence in the Blairsden area is rhyolite ash-flow tuff and associated silicic tuffs of Delleker ranging in age from about 31 to 21 Ma or late Oligocene to early Miocene. The type locality is the little town of Delleker about one mile east of the map (Durrell, 1959a; Grose, 2000). The tuff occurs in local areas at the base of the volcanic pile overlying granitic and metamorphic rocks. Maximum thickness is about 300 feet (92 m) and maximum horizontal extent of the discontinuous beds is about 2 miles (3.2 km). Contact relationships with the overlying volcanics are basically disconformable and must involve considerable erosion, but lithologic gradation and inter-stratification indicate significant reworking of and mixing of lithologies during emplacement of the overlying volcanics. The Delleker tuffs occur as disconnected erosional remnants of a once extensive blanket of pyroclastics of which all the original thickness, regional extent, and source area are all unknown. Similar occurrences of these tuffs are numerous particularly to the areas to the east. It should be noted that, because the relatively unresistive tuffs tend to underlie areas easily eroded and covered by vegetation, they are undoubtedly present more widely than the map reveals.

A remarkably distinctive formation in the region is the Lovejoy Basalt (Durrell, 1959b), the type locality of which is along Red Clover Creek. The basalt flows, locally over 800 feet (244 m) thick, occur in separate erosional remnants that are preserved, locally with underlying basal conglomerate, in a broad northeast-southwest trending paleovalley cut in the Sierran basement. These particular flow remnants in the Blairsden map area are only a few of many similar remnants in the region that reflect an ancestral valley of the Feather River drainage system (Page and others, 1993; Wagner and others, 2000). Three radiometric ages from within the map area fall in the range 9.9 to 14 Ma or mid-Miocene. However, according to Page and others the Lovejoy Basalt is 16 Ma.

Andesitic flows and interbedded pyroclastics comprise the bulk of Grizzly Ridge and eastern parts of Turner Ridge. Although andesite is the dominant lithology, this heterogeneous volcanic pile includes basalt flows, rhyolitic to basaltic tuffs, and lesser volcanogenic sandstones and conglomerates in complex facies and thickness variations difficult to decipher because of forest cover. Sedimentary reworking and mixing appear commonly within basal and irregularly bedded volcaniclastic debris derived from contemporaneous volcanic effusives. Durrell (1959a, 1966) separated these rocks into the Ingalls, Bonta, Penman, and Warner formations. These formations are proximal and distal effusives and transported erosional debris from numerous scattered sources, i.e. dikes and local vents. Volcanoes or volcanic centers include Smith Peak, in the eastern part of the Blairsden quadrangle, and larger central volcanoes generally in areas to the east, such as Sugarloaf, Antelope Valley, Lowlion, and Dixie Mountain. The age of the andesitic volcanics ranges from middle to late Miocene as indicated by eight radiometric dates from about 20 to 8 Ma. However, the bulk of the effusives is believed to have been emplaced about 11 to 14 Ma ago as evidenced by the regional volcanic history.

Similar rocks represent the most distal ectrusives of the Dixie Mountain volcano. They occur in the northeastern part of the map, and the source - Dixie Mountain volcanic center - is located about 10 miles (16 km) to the east-southeast (Grose, 2000). Stratigraphic relationships between the Dixie Mountain-derived andesites and the andesites in the Blairsden area are not clear because of similar lithologies and lack of outcrop, but it seems most likely that the Dixie Mountain andesites mainly overlie the Blairsden andesites with limited inter-bedding between the two.

The youngest of the volcanic rocks in the Blairsden map area are the andesite and basalt flows of Mt. Ingalls volcano. Mt. Ingalls, which occurs in the north central part of the map, is the highest and least eroded volcanic formation in the region. Thin to thick flows dominate on the volcano flanks, and the summit area is sustained by thick flows, sills (?), and a massive plug and dike. The radius of the volcanic edifice as preserved is about 3 miles (4.7 km), a small volcano relative to others in the region. A radiometric age from the summit intrusion is 4.7 Ma or early Pliocene.

Quaternary sediments:

The third and youngest group of formations in the Blairsden map area is un-consolidated surficial sediments of Quaternary age, i.e. less than about 1.6 Ma. They include alluvium, colluvium, talus, landslide debris, lake beds, and glacial deposits. The largest area of Quaternary deposits occurs in the Middle Fork of the Feather River drainage system in the southern part of the map where moraine and glaciofluvial gravels and an undifferentiated heterogeneous assemblage of alluvial, fluvial and lacustrine beds are present. The non-glacial deposits were referred to as the "Mohawk lake beds" by Turner (1891) and subsequent workers have perpetuated the interpretation that a deep, landslide-impounded, late Quaternary lake inundated the valley up to the elevation of 5200 feet (1602 m). However, most recent work by Yount and others (1993) reinterprets the sedimentary facies as mainly fluvial plain or meadow with very restricted, shallow, proglacial lacustrine environments. Limited mapping herein of these deposits suggests that the fluvial beds in the northeast-trending arm of the Feather River may be related more to the fluvial and lacustrine sediments of Sierra Valley several miles east of the map (Grose, 2000), and that the sediments in Mohawk Valley proper are thicker, contain more lake beds, and are influenced by syndepositional fault activity along the Mohawk Valley Fault Zone. This important formation begs more study.

Another area of extensive Quaternary deposits is Grizzly Valley in the northeastern part of the map which is floored by alluvium and minor lake beds with colluvium more abundant along the margins. Areas of glacial moraine include the higher slopes a few miles southwest of Blairsden and valleys on the west and east flanks of Mt. Ingalls. Several significant landslide masses occur usually from slope failure in weak pyroclastic beds. Talus occurs astride steep plugs associated with the Smith Peak intrusive cluster and on the steep south slope of Mt. Ingalls.

GEOLOGIC STRUCTURE

Tectonic deformation within the area of the Blairsden map consists of two distinct episodes and very different structures. The pre-tertiary deformation involves north-northwest striking, steeply dipping to eastward overturned, thrust-faulted formations that compose the northern Sierra terrane, an arc complex of accreted Paleozoic sedimentary and igneous rocks swept in from the Pacific Basin against the western margin of the North American continent. Later in the Jurassic and Cretaceous the amalgamated arc terrane was intruded by granitic plutons that eventually cooled, solidified, and resulted by the end of the Cretaceous in the relatively rigid, continental crustal block of the Sierra Nevada.

Structural deformation was essentially absent in the area from the end of the Cretaceous to the Pliocene or Quaternary, a remarkably long period. Two fault zones of Pliocene (?) and Quaternary age occur in the Blairsden map area. The most prominent, The Mohawk Valley Fault Zone, trends north-northwesterly, is normal and down to the west, and suggests over a 1000 feet (305 m) of dip-slip displacement with a minor right-slip component on the basis of regional fault patterns (Jennings, 1994). A late Pliocene to late Quaternary age of fault activity is inferred from general geomorphic linearity (Hawkins and others, 1986, p. 60-63) and from scarplets along the fault zone several miles southeast of the map area (Saucedo, 1992; Sawyer and others, 1993). The Mohawk Valley Fault Zone is variously ascribed as the eastern front of the Sierra Nevada (Durrell, 1966), the northwestern boundary fault of the Walker Lane Belt (Sawyer and others, 1993; Wakabayashi and Sawyer, 2000), or an intra-Sierran fault on the west side of the Plumas transition zone, a zone within the Sierra Nevada province that is geologically and geophysically transitional to the Basin and Range province farther east. The latter characterization is favored in this report.

The northwest termination of the Grizzly Valley fault Zone occurs in the northeastern part of the map. It extends about 10 miles (16 km) to the southeast (Grose, 2000). The fault zone strikes northwesterly, is about a mile wide, and is composed of down-to-the-west, left-stepping, high-angle normal faults with estimated dip-slip displacement of a few hundred feet and a smaller right-slip component. Evidence for active faulting is lacking.

A few other faults of relatively minor consequence occur in the map area, i.e. north-northwest striking faults associated with the Smith Peak intrusive cluster and faults southwest of the Mohawk Valley Fault Zone that may indicate a graben along the major fault zone. Low southwest regional dip occurring in most areas of the Sierra Nevada is essentially absent in the Blairsden area as the Oligocene, Miocene, and Pliocene volcanic series display horizontal to sub-horizontal primary bedding.

NATURAL RESOURCES

The Walker mine, located in section 7, T. 24 N., R.12 E., was a major producer of copper from 1916 to the mi-id 1930s. It is one of the three largest mines in the Plumas copper belt which extends northwestward about 45 miles (74 km). More than 100,000,000 pounds of copper were produced from ore averaging 1.7% Cu and from it is "produced by flotation a concentrate containing 24% copper and 9.9 ounces of silver and 0.49 ounce of gold to the ton" (Knopf, 1935, p. 243). Metallic minerals are chiefly chalcopyrite with minor pyrrhotite and cubanite, and locally much magnetite. At least four large ore bodies occur in a steeply east-dipping zone several thousand feet long of highly meta-morphosed sedimentary rocks along a contact with quartz diorite intrusions (Knopf, 1935; Averill, 1937). The mine has been inactive since about the late 1930s.

The Plumas-Eureka mine, located southwest of Johnsville, produced over 1,000,000 tons of gold ore intermittently from 1851 to about 1925 from steeply dipping gold-quartz veins up to 20 feet (6 m) wide containing auriferous galena and pyrite (Averill, 1937, p. 118-119).

Sand and gravel deposits of potential economic value may occur in the extensive Quaternary sediments in the valley of the Feather River in the southern part of the map. Also ground water should be abundant in these sediments and in the Quaternary Grizzly Valley deposits as well.

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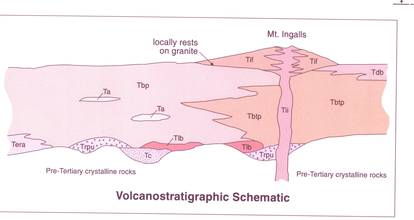


Volcanostratigraphic Schematic

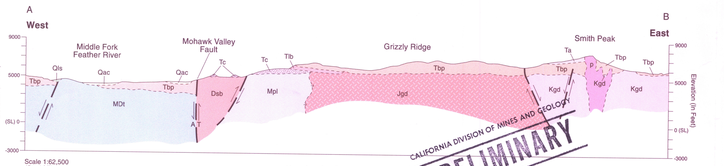
MAP SYMBOLS

- Contact - solid where accurately located; dashed where approximately located, gradational, or inferred.
- Fault - solid where accurately located; dashed where approximately located or inferred, dotted where concealed; ball and bar on downthrown side of normal fault; teeth on upthrown side of reverse fault, arrows show direction of lateral movement.
- Intrusive dike; most commonly andesitic or basaltic.
- Volcanic plug; most commonly andesitic or basaltic.
- Volcanic intrusive complex; dikes, plugs, vent areas.

RADIOMETRIC AGES OF TERTIARY VOLCANIC ROCKS

Location #	Formation	Age (Ma)	Reference
1	Tlb	11.9 ± 0.6	Dalrymple, 1964
2	Tlb	14.0 ± 0.4	
3	Tbp	11.8 ± 0.4	
4	Tbtu	14.36 ± 0.66	Siegel, 1988
5	Tbtu	30.7 ± 0.06	
6	Tlb	29.82 ± 0.17	
7	Tbp	22.8 ± 0.4	Dalrymple, 1964
8	Tbp	9.88 ± 1.51	Siegel, 1988
9	Tbp	19.7 ± 2.3	Saucedo, G.J. and Wagner, D.L. (unpublished)
10	Tii	11.5 ± 0.5	
11	Tbtu	6.8 ± 0.7	
12	Tbp	11.10 ± 0.54	Dalrymple and others, 1967
13	Tbp	21.0 ± 0.4	Dalrymple, 1964
14	Tbp	68 ± 2.0	
15	Tii	13.8 ± 0.7	Saucedo, G.J. and Wagner, D.L. (unpublished)
16	Tbp	19.7 ± 2.3	Durrell, C. (unpublished)
17	Tbp	18.7 ± 0.4	Dalrymple and others, 1967
18	Tbp	14.7 ± 0.1	(this report)
19	Tbp	15.3 ± 0.3	

(Note: All radiometric data, except location 15, are presented by Saucedo, and others, 1992)



Geologic Cross Section

PRELIMINARY

SUBJECT TO REVISION

CALIFORNIA DIVISION OF MINES AND GEOLOGY

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