GEOLOGIC QUADRANGLE MAP
TEHIPITE DOME QUADRANGLE, CALIFORNIA
GQ-1676

INTRODUCTION

The Tehipite Dome quadrangle *covers* about 240 mi^2 on the west slope of the central Sierra *Nevada* within the Kings River drainage. The physiography of the region is dominated by the extremely rugged canyons of the Middle and South Forks of the Kings River, which meet about in the middle of the quadrangle and form one of the deepest canyons in the United States. Slightly downstream from this confluence, the elevation at river *level* is 2,160 ft, and 4.7 mi north at Spanish Mountain on the north canyon rim, the elevation is 7,891 ft higher at 10,051 ft. North of the canyon a glaciated upland rises to 10,800 ft on Kettle Ridge, the highest point within the quadrangle.

A small part of Kings Canyon National Park, including Tehipite Valley, is in the northeastern part of the quadrangle, and a part of the General Grant *Grove* Section of the park is in the southwestern part. Within the quadrangle and south of the canyon, 15 *groves* of Sequoia trees outside the park occur on Sequoia National Forest land on north-facing upland slopes from 6,000 to 7,600 ft elevation. California Highway *180 provides* access to the southern part of the quadrangle, and a *paved* road from Dinkey Creek (northwest of map area) extends to Wishon Reservoir on the North Fork of the Kings River at the north boundary of the quadrangle. Most of the uplands north and south of the canyon can be reached by *unimproved* roads and trails, but the steep and brushy slopes of the Kings *River* canyon are generally trailless, and therefore helicopter transport was used to support geologic investigations both for this work and for related wilderness studies (Nokleberg and others, 1983; Chaffee and Nokleberg, 1988).

PREVIOUS WORK

The southern part of the map area was first explored in 1864 by the Geological Survey of California. The field party included William Brewer, party chief, Charles Hoffman, topographer, and geologists James Gardner and Clarence King. King became the first Director of the U.S. Geo\vgica\ Survey in 1879. The earliest systematic geologic mapping within the quadrangle was done as part of a study of tungsten deposits during World War II (Krauskopf, 1953). Topical studies of metamorphic and granitic rocks in the quadrangle are subjects of reports by Moore and Dodge (1962), Jones and Moore (1973), Girty (1977a, b)' and Chen and Moore (1982). Regional studies of Cenozoic *volcanic* rocks in the quadrangle *have* been made by Moore and Dodge (1980) and Dodge and Moore (1981), and of metasedimentary and metavolcanic rocks by Bateman and Clark (1974)' Saleeby and others (1978), Nokleberg and Kistler (1980), and Nokleberg (1983). A geologic guide of the Kings Canyon Highway, which crosses the southern part of the quadrangle, is available (Moore and others, 1979), and the mineral deposits and resources in various parts of the quadrangle *have* been assessed in *several* studies (Moore and Marks, 1972; Nokleberg and others, 1983; and Chaffee and Nokleberg, 1988).

METAMORPHIC ROCKS

Granitic rock of the composite Sierra *Nevada* batholith is the most abundant bedrock of the quadrangle, but remnants of pregranitic metamorphosed sedimentary and volcanic rocks occur as isolated screens or roof pendants that separate individual masses of granitic rock. The largest area of metamorphic rock"m the quadrangle is called the Boyden *Cave* roof pendant and occurs in the southeast part of the quadrangle. A continuation of the roof pendant extends northwest across both forks of the Kings *River* to Spanish Mountain and Rodgers Ridge on the north canyon rim. The metamorphic rocks in the Boyden *Cave* roof pendant, as well as in the quadrangle as a whole, comprise two major terranes-the Kings terrane to the west composed mainly of metasedimentary rocks and the Goddard terrane to the east composed mainly of *metavolcanic* rocks (Nokleberg, 1983). The Kings terrane, first called the "Kings sequence" by Bateman and Clark (1974) and best exposed in the western part of the Boyden *Cave* roof pendant, consists of highly deformed and regionally metamorphosed quartzite, arkose, marl, mudstone, calcareous sandstone, and limestone transformed into metaquartzite, meta-arkose, biotite-quartz schist, biotite schist, calcschist, and marble.

Exposures of the metasedimentary rocks of the Kings terrane are spectacular in the southern part of the Boyden *Cave* roof pendant along the South Fork of the Kings River. In this area, the major metasedimentary rock types are marble, phyllite, biotite schist, calcschist, and quartzite. Prominent ridges of marble make up Windy Cliffs and cross Monarch Divide, and metaquartzite and meta-arkose form the prominent ridge south of Horseshoe Bend. Sparse fossils, mainly crinoids and ammonites found near the mouth of Boulder Creek. indicate an Early Jurassic age (Moore and Dodge, 1962; Jones and Moore, 1973; Saleeby and others. *1978). Available* paleontologic evidence from other areas indicates a Late Triassic to Early Jurassic age for the Kings terrane which is *believed* to *have* been a submarine-fan system containing craton-derived sands and, farther to the south, silicic *volcanic* tuffs and breccias (Saleeby and others, 1978). The base and top of the Kings terrane are either faulted or intruded by granitic plutons; minimum stratigraphic thickness is estimated at a few thousand feet.

The Kings terrane is intensely deformed. Moderately appressed to isoclinal folds and axial-plane schistosities are common. Margins of the Boyden Cave roof pendant have been recrystallized to hornfels by the heat of adjacent granitic plutons. Bedding has generally been transposed to a series of parallel tectonic lenses or foliations by penetrative deformation. Structural analyses show that most of the Kings terrane was twice penetratively deformed and regionally metamorphosed (Girty, 1977a, b: Nokleberg and Kistler, 1980). Multiple deformations are indicated by two generations of superposed minor and major structures, mainly refolded folds with axial-plane schistosity, and by local younger shear and mylonite zones.

The older set of structures, termed "first-generation structures", strikes east-northeast and dips moderately to steeply north. These structures are well exposed in the phyllite unit along the north side of the paved road east of Boyden Cave. Amphibolite facies minerals occur along the axial-plane schistosity of first-generation structures (Girty, 1977a, b). The younger set, termed "second-generation structures", strikes north-northwest and dips steeply to vertically. These structures are common in the metasedimentary rocks of the Kings terrane, and in the metavolcanic rocks of the Goddard terrane to the east.. The second-generation structures are superposed on the first-generation structures (Girty, 1977a, b, Nokleberg and Kistler, 1980). Amphibolite to upper greenschist facies minerals occur within the axial-plane schistosity and along the lineation of the second-generation structures. Second-generation structures include a pronounced and widely distributed mylonitic schistosity that in places is concentrated in mylonite zones as wide as a few centimeters. Such zones occur in mid-Cretaceous metavolcanic rocks and the mid-Cretaceous granitic rocks bordering the Boyden Cave roof pendant, such as the granite of Grand Dike, indicating that granitic intrusion may have occurred during regional deformation and metamorphism. Local and regional comparisons of major and minor structures indicate that the first-generation structures formed in a regional deformation during the Early or Middle Jurassic, and that the second-generation structures formed during the Late Jurassic through the mid-Cretaceous.

The Kings and Goddard terranes are separated by a major pregranitic fault named the "Kings River suture" (Nokleberg, 1983). The evidence for faulting consists of narrow slivers of fault-bounded and deformed metasedimentary and metavolcanic rocks that strike obliquely into one another on the east-central side of the Boyden Cave roof pendant, east of upper Boulder Creek. Intense shears and mylonite zones, part of the second generation structures, also occur in the eastern part of the pelitic and calcphyllite of the Boyden Cave roof pendant near the fault. The parallelism of the Kings River suture to the second-generation structures indicates that the suture probably formed along with these structures. The occurrence of second-generation structures in the mid-Cretaceous metavolcanic rocks of the Goddard terrane, and in adjacent mid-Cretaceous granitic rocks indicates that second-generation structures, along with major movement on the Kings River suture, probably formed in the mid-Cretaceous during or just after granitic intrusion, regional deformation, and faulting.

The metavolcanic and metamorphosed shallow intrusive rocks of the Goddard terrane form the east half of the Boyden Cave roof pendant. These rocks consist mainly of metarhyolite and metadacite tuffs and flows, and include a distinctive shallow intrusion of metamorphosed hypersthene dacite. New Rb-Sr whole rock and U-Pb zircon isotopic dating of the metavolcanic rocks indicates a mid-Cretaceous age (J. B. Saleeb, and R. W. Kistler, written commun., 1988). The Goddard terrane is interpreted as a fault-bounded fragment of the upper part of an ndean-type arc that formed on the Jurassic to mid-Cretaceous margin of western North America (Nokleberg, 1983).

Intense deformation and formation of second-generation structures are indicated by a well-developed schistosity striking north-northwest and dipping steeply parallel to second-generation structures in the metasedimentary rocks. Absence of first-generation structures in the metamorphosed volcanic and shallow intrusive rocks of the Goddard terrane indicates these rocks formed after the deformation that produced the first-generation structures in the Kings terrane to the west, or else the terrane was tectonically transported to its present position after formation of first-generation structures in the Kings terrane.

GRANITIC ROCKS

Most of the quadrangle is underlain by granitic rocks of the Sierra Nevada batholith. and about two dozen separate intrusive masses have been identified and mapped. Available radiometric dating indicates all are Cretaceous and were emplaced as magmas (largely molten rock) that cooled 86-128 Ma. The plutonic rocks range in composition from dark-colored diorite and gabbro to lighter colored quartz diorite, granodiorite, and granite. Different color hues are employed on the geologic map to divide the granitic rocks into three compositional groups.

The southern parts of two large granitic masses, the Mount Givens Granodiorite, and the Dinkey Creek Granodiorite occur in the northern part of the quadrangle. The Mount Givens Granodiorite extends nearly 44 mi and the Dinkey Creek Granodiorite about 25 mi northwest of the quadrangle (Bateman, in press].

The youngest major granitic pluton is the porphyritic granite of Brush Canyon emplaced 86 (Chen and Moore, 1982). It is exposed from the summit of Spanish Mountain to the floor of the Kings River canyon and shows no marked compositional change through nearly 8,000 ft of elevation change. The pluton appears to be roofed on the north by metasedimentary rocks and partly floored on the by the older granodiorite of Yucca Point, which crops out deep in Kings River canyon.

Extending into the quadrangle from the south is the large pluton composed of the Giant Forest Granodiorite (Moore and Sisson, 1987) emplaced 97-102 Ma. The granodiorite is dark, rich in hornblende and contains abundant mafic inclusions, but south of the quadrangle, the pluton is markedly zoned and is intruded by progressively younger and more silicic masses toward its central part.

PLIOCENE BASALT

Numerous remnants of late Tertiary basaltic lava flows are scattered over the upland parts of the quadrangle. These flows, which belong to the San Joaquin-Kings volcanic field, were fed from scattered vents that produced small flows of varied composition--all alkalic and some extremely potassic (Moore and Dodge, 1980; Dodge and Moore, 1981). The basalts commonly contain phenocrysts of olivine and clinopyroxene, less commonly plagioclase and biotite. The large flow in the northwest part of the quadrangle, as well as flow remnants on Crown Ridge and Volcanic Cone are rich in potassium and contain small crystals of leucite in the ground mass.

Source vents for the various lava flow remnants are rarely seen. However, a basalt dike 0.5-2.5 ft thick on the north wall of the Kings River canyon west of Deer RIdge may have conducted some of me lava to the surface. Most of the basalt flow remnants in the San Joaquin-Kings volcanic field were erupted 3-4.5 Ma (Moore and Dodge, 1980). A potassic basalt near Rancheria Creek in the northwest part of the quadrangle yielded a whole rock K-Ar age of 3.2 Ma (Huber, 1981).

QUATERNARY DEPOSITS

Periodically during the Pleistocene, icefields covered much of the upland region north of the Kings River canyon and the highest parts of the Monarch Divide between the Middle and South Forks of the Kings River. Valley glaciers shaped numerous lake basins and deposited extensive moraines, particularly in the northern part of the quadrangle. Major valley glaciers flowed down both forks of the Kings River. The Middle Fork glacier carved Tehipite Valley and terminated at about 4,000 ft elevation, and the South Fork glacier terminated a mile east of the quadrangle at an elevation of about 4,200 ft.

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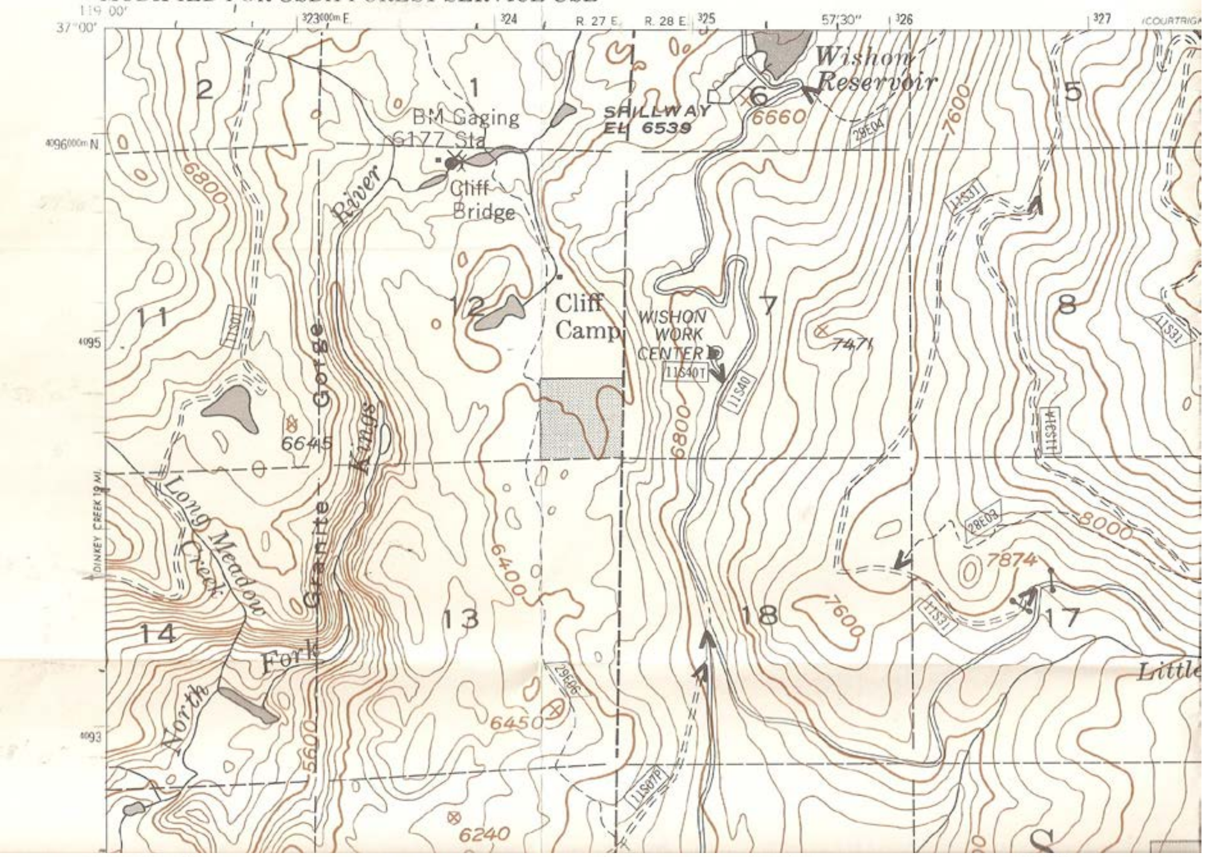

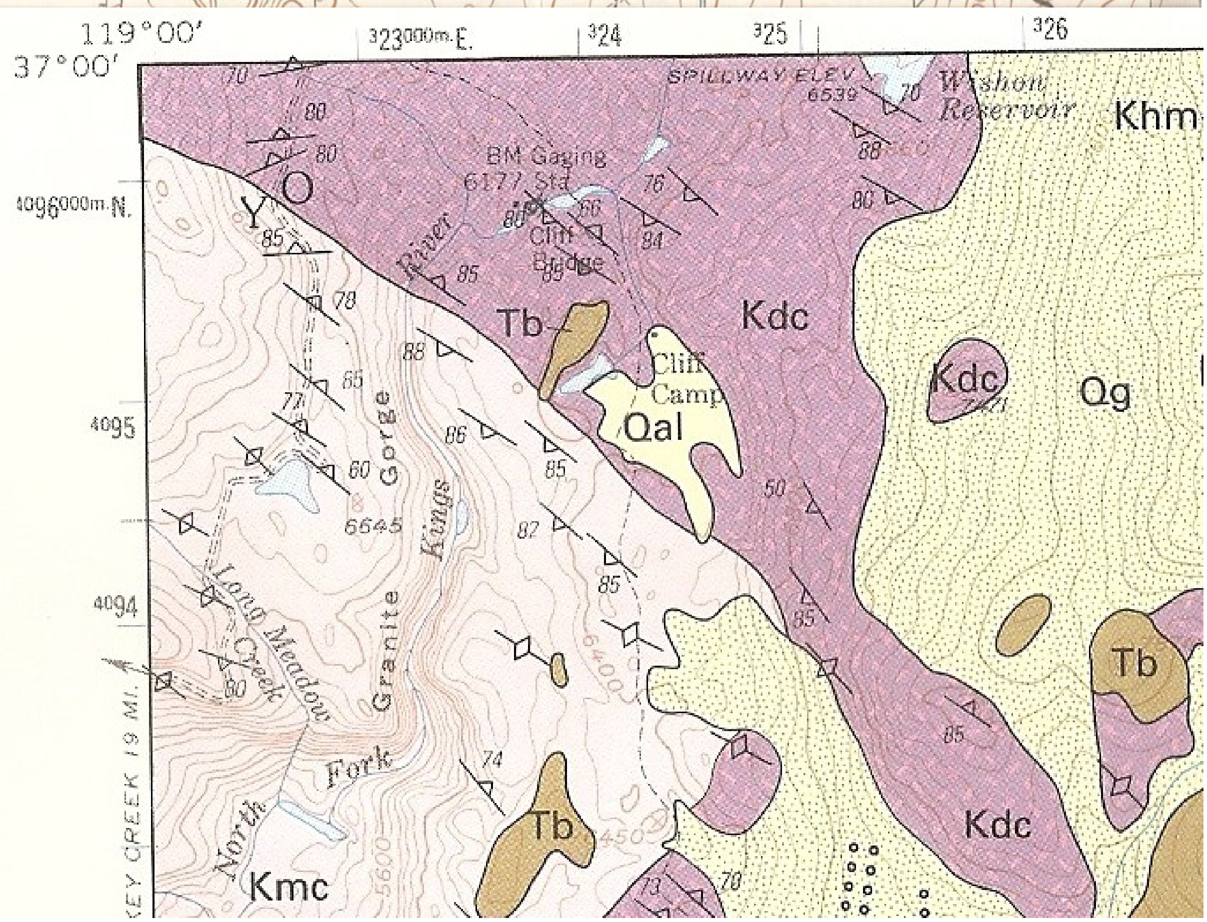

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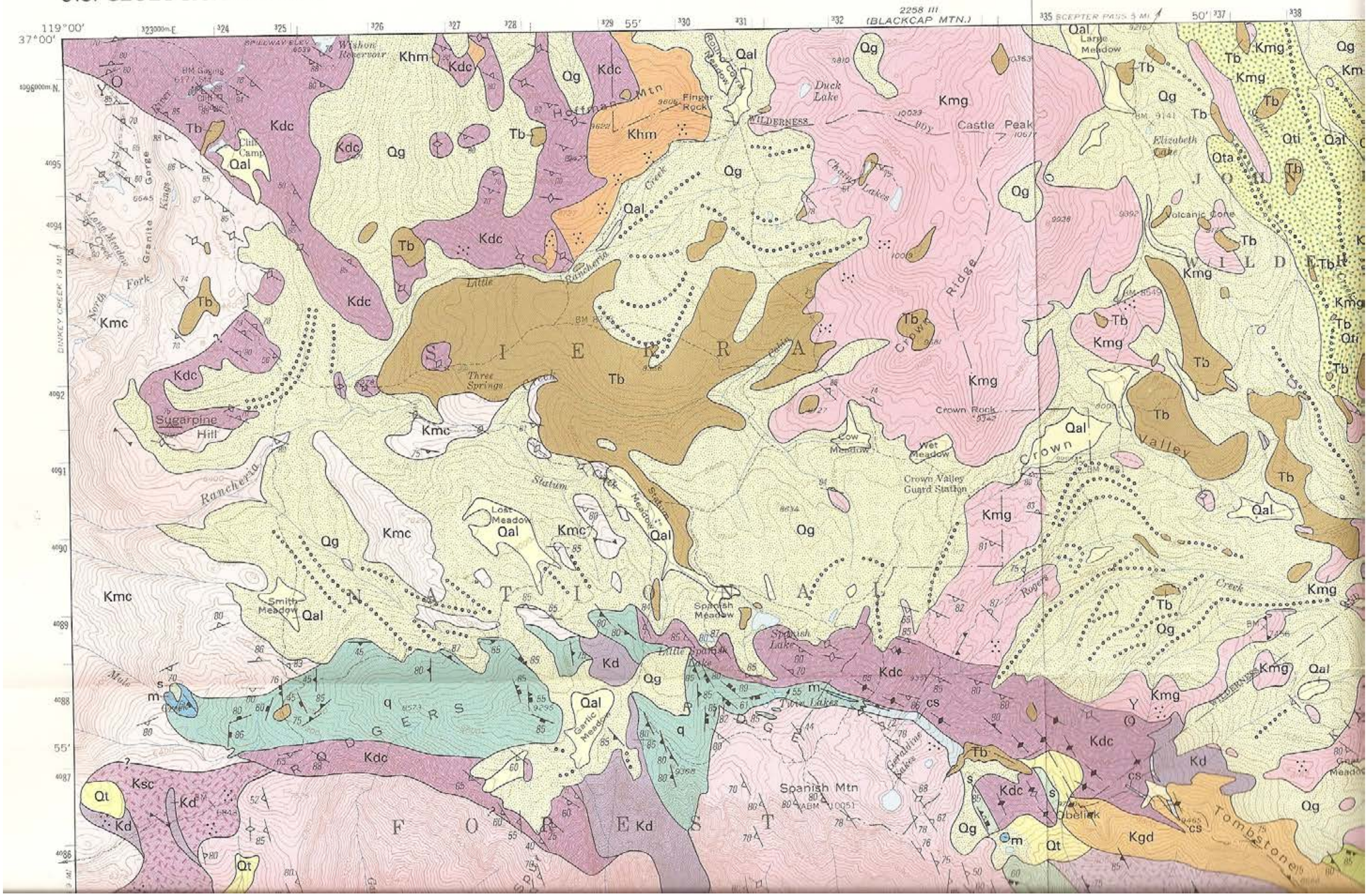
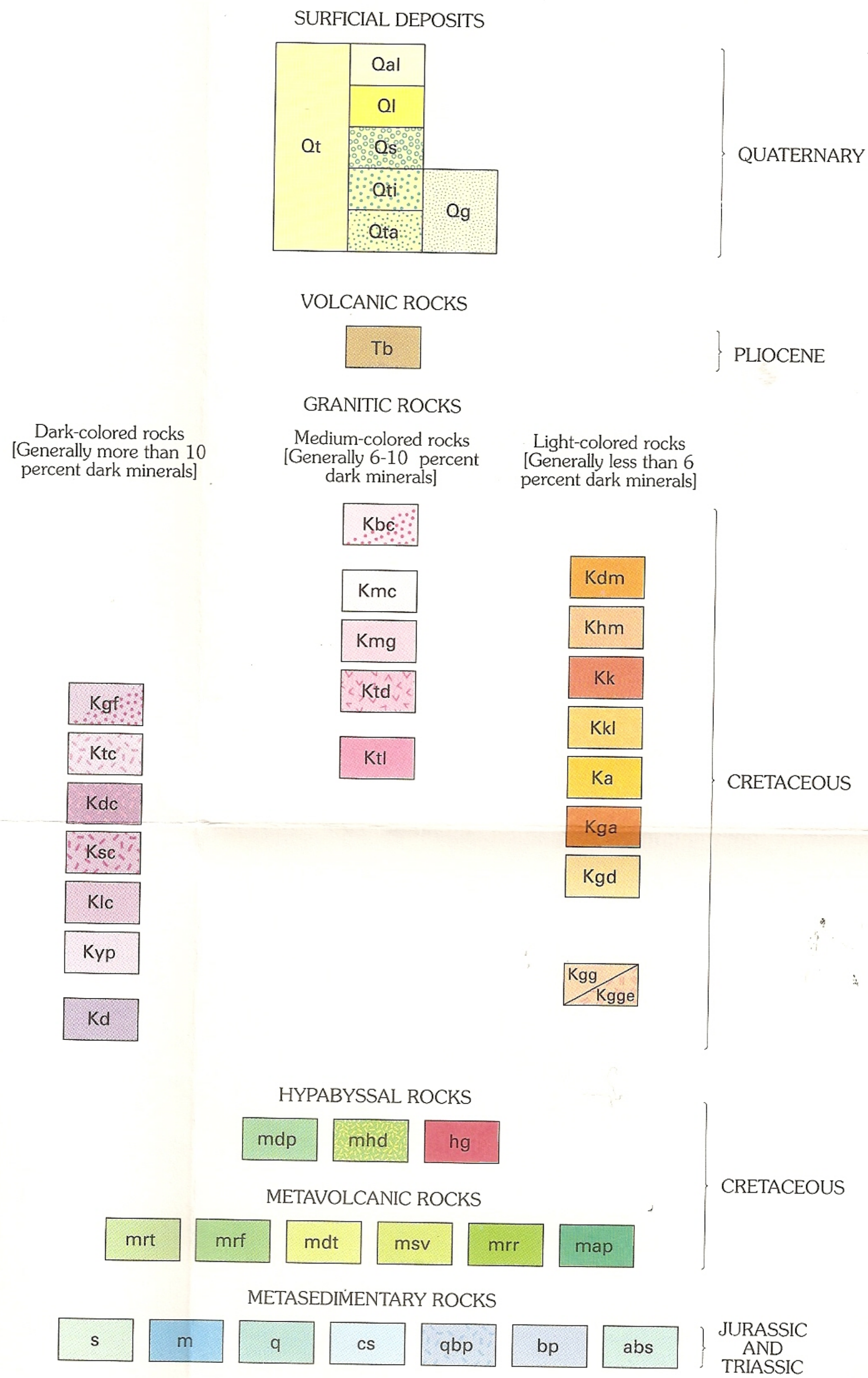


CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Qal — **Alluvial deposits (Quaternary)**—Alluvium underlying meadows; mainly sand ponded behind glacial moraines and gravel in stream valleys

Ql — **Landslide deposit (Quaternary)**

Qs — **Stream gravels (Quaternary)**

Qt — **Talus and colluvium (Quaternary)**

Till and talus (Quaternary)—Morainal crests shown by dotted line

Qti — **Tioga Till**—Well-defined moraine morphology, largely unweathered boulders

Qta — **Tahoe Till**—Subdued moraine morphology, sandy, with weathered boulders

Qg — **Glacial deposits, undifferentiated**

VOLCANIC ROCKS

Tb — **Basalt (Pliocene)**—Many separate basalt flows and one near-vertical dike. Composition ranges from alkalic, potassic-alkalic, to ultra-potassic basalt (Moore and Dodge, 1980; Dodge and Moore, 1981)

GRANITIC ROCKS

[Rock names from classification of Streckeisen, 1973]

Dark-colored rocks

[Generally more than 10 percent dark minerals]

Kgf — **Giant Forest Granodiorite (Cretaceous)**—Medium-grained equigranular, hornblende-rich granodiorite with abundant mafic inclusions. Contains about 17 percent mafic minerals. Mafic inclusions are variable in size, shape, and texture. A lighter colored, porphyritic marginal facies containing potassium feldspar phenocrysts along the west contact is shown by stipple pattern. U-Pb age, 97-102 Ma (Chen and Moore, 1982)

Ktc — **Granodiorite of Tombstone Creek (Cretaceous)**—Medium-grained dark granodiorite containing about 19 percent mafic minerals. U-Pb age, 99 Ma (Chen and Moore, 1982); 102 Ma (J. B. Saleeby, and others, 1990)

Kdc — **Dinkey Creek Granodiorite (Bateman, in press) (Cretaceous)**—Medium-grained dark granodiorite, generally strongly foliated with abundant mafic inclusions, averaging about 18 percent mafic minerals. K-Ar hornblende ages, 80-101 Ma; U-Pb age, 104 Ma (Stern and others, 1981)

Ksc — **Granodiorite of Spring Creek (Cretaceous)**—Heterogeneous dark-colored granodiorite with irregular inclusions of mafic rock and abundant felsic dikes

Klc — **Granodiorite of Lightning Creek (Cretaceous)**—Medium-grained, dark granodiorite in southeast corner of the quadrangle. U-Pb age, 108 Ma (Chen and Moore, 1982), 100 Ma (Saleeby and others, 1990). Averages about 19 percent dark minerals

Kyp — **Quartz diorite of Yucca Point (Cretaceous)**—Medium-grained granodiorite and quartz diorite with prominent hornblende crystals and abundant mafic inclusions. U-Pb age, 110 Ma (Chen and Moore, 1982). Averages about 21 percent dark minerals

Kd — **Diorite (Cretaceous?)**—Chiefly medium grained, and lesser fine grained, hornblende-biotite quartz diorite and diorite. Unit along west edge of quadrangle exhibits variable grain size and color index. Averages 20 percent or more dark minerals

Medium-colored rocks

[Generally 6-10 percent dark minerals]

Kbc — **Granodiorite of Brush Canyon (Cretaceous)**—Porphyritic granodiorite and granite averaging about 6 percent mafic minerals and containing potassium-feldspar phenocrysts (1-2 cm) enclosed in a medium- to fine-grained groundmass. U-Pb age, 86 Ma (Chen and Moore, 1982). Highly porphyritic marginal phase shown by stipple pattern

Kmc — **Granodiorite of McKinley Grove (Cretaceous)**—Medium-grained granodiorite containing perthite phenocrysts and about 10 percent mafic minerals

Kmg — **Mount Givens Granodiorite (Bateman, in press) (Cretaceous)**—Medium-grained granodiorite grading locally to granite. Averages about 12 percent mafic minerals. K-Ar hornblende age, 88-89 Ma; U-Pb age, 88-93 Ma (Stern and others, 1981)

HYPABYSSAL ROCKS

mdp **Metadacite porphyry (Cretaceous)**—Chiefly metamorphosed, schistose, hornblende-biotite dacite porphyry. Contains plagioclase phenocrysts as long as 4 mm. Forms shallow intrusion in metasedimentary rocks. U-Pb age, 105 Ma (Saleeby and others, 1990)

mhd **Hypersthene-bearing metadacite (Cretaceous)**—Subvolcanic intrusion of massive hypersthene-bearing, homogeneous metadacite with spindle-shaped small mafic inclusions. U-Pb age, 102 Ma (Saleeby and others, 1990)

hg **Hypabyssal granodiorite stock (Cretaceous)**—Medium-grained, weakly schistose, hornblende-biotite granodiorite. Forms small intrusion associated with metadacite subvolcanic mass on north side of Monarch Divide. U-Pb age, 103 Ma (Saleeby and others, 1990)

METAVOLCANIC ROCKS

mrt **Metarhyolite tuff (Cretaceous)**—Chiefly metamorphosed pyroclastic rhyolite and dacite. U-Pb age, 106 Ma (Saleeby and others, 1990)

mrf **Metarhyolite lava (Cretaceous)**—Chiefly metamorphosed massive, sheared, silicic volcanic rocks. Predominantly lava flows

msv **Metavolcanic sedimentary rocks (Cretaceous)**—Water laid volcanogenic sediments and airfall ash

mdt **Metadacite and metarhyolite tuff (Cretaceous)**—Tuff and volcanic-derived sedimentary rocks. Also contains meta-andesitic tuffaceous rocks

mrr **Metarhyolite (Cretaceous)**—Distinctly red weathering, fine-grained, metamorphosed lapilli tuff and tuff breccia. U-Pb age, 104 Ma (Saleeby and others, 1990)

maa **Metarhyolite airfall ash (Cretaceous)**—Fine-grained, commonly well bedded, airfall ash with well-preserved accretionary lapilli 2-20 mm in diameter

METASEDIMENTARY ROCKS

s **Biotite-feldspar-quartz schist (Jurassic and Triassic)**—Reddish-brown weathering, biotite-feldspar-quartz schist with thin (10 cm or less) layers of micaceous quartzite. Includes minor calc-silicate schist layers and sparse marble. Thin to medium layered

m **Marble (Jurassic and Triassic)**—Coarsely crystalline, schistose to gneissose, white to light gray, commonly cavernous marble. Dolomitic in some places

q **Quartzite (Jurassic and Triassic)**—Fine- and medium-grained, schistose, white, micaceous, arkosic quartzite, quartzite, and lesser quartz-biotite schist. Medium to massive bedded, locally exhibiting crossbedding

cs **Calc-silicate schist (Jurassic and Triassic)**—Calc-silicate schist and minor calc-hornfels adjacent to granitic plutons. Includes quartz-biotite schist and minor tactite and marble. Thin to medium layered

qbp **Quartz and biotite mylonitic phyllite (Jurassic and Triassic)**—Chiefly thin layered to medium-layered, fine-grained quartz-, feldspar-, and biotite-rich mylonitic phyllite and mylonitic calc-phyllite. Local mylonite and and breccia zones. Contains Early Jurassic fossils near lower Boulder Creek

bp **Biotite mylonitic phyllite (Jurassic and Triassic)**—Chiefly thin layered to medium-layered, fine-grained biotite-quartz mylonitic phyllite with lesser quartz-feldspar mylonitic phyllite

abs **Andalusite-biotite schist (Jurassic and Triassic)**—Dark-gray, thin- to medium-layered, fine- to medium-grained, quartz-white mica-biotite-andalusite schist

Contact—Approximately located, showing dip. Queried where uncertain. O, older rock; Y, younger rock

Fault

Anticline, showing plunge of axis

Syncline, showing plunge of axis

Strike and dip of beds

- **Inclined**
- **Vertical**

Strike and dip of igneous layering and flow banding

- **Inclined**
- **Vertical**

Strike of foliation or igneous layering or bearing of lineation—Dip or plunge unknown

Strike and dip of foliation (compositional layering) in metasedimentary and metavolcanic rocks

- **Inclined**
- **Vertical**

Strike and dip of schistosity in metamorphic rocks

- **Inclined**
- **Vertical**

Locality with no observed structures

Crest of glacial moraine

Note: Symbols for bedding, layering, foliation, schistosity, or lineation may be combined.