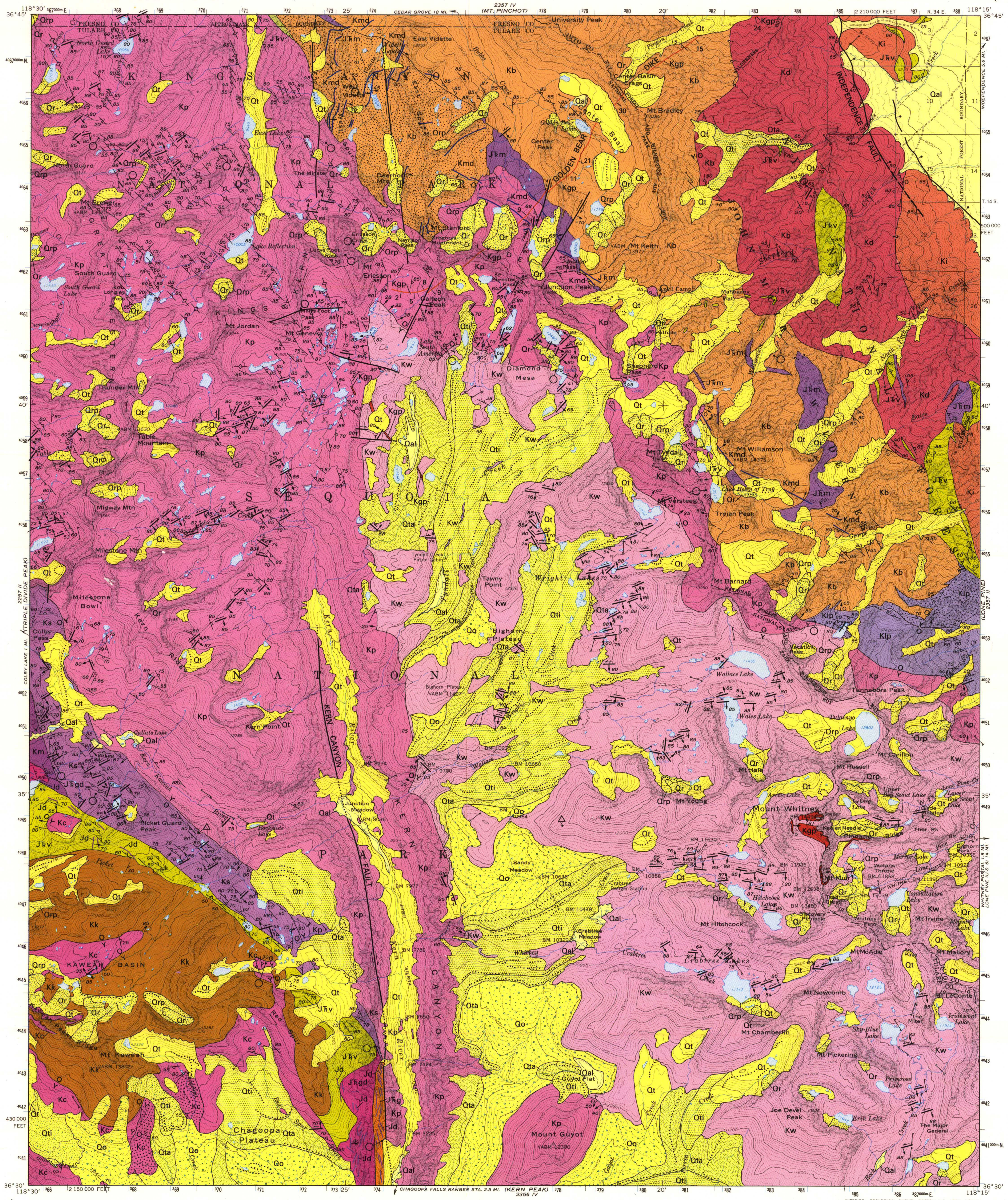
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY



Base from U.S. Geological Survey, 1956
10,000-foot grid based on California coordinate system, zone 4
1000-meter Universal Transverse Mercator grid ticks, zone 11, shown in blue
Limited photo revision in 1967

APPROXIMATE MEAN DECLINATION, 1981

SCALE 1:62 500

CONTOUR INTERVAL 80 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

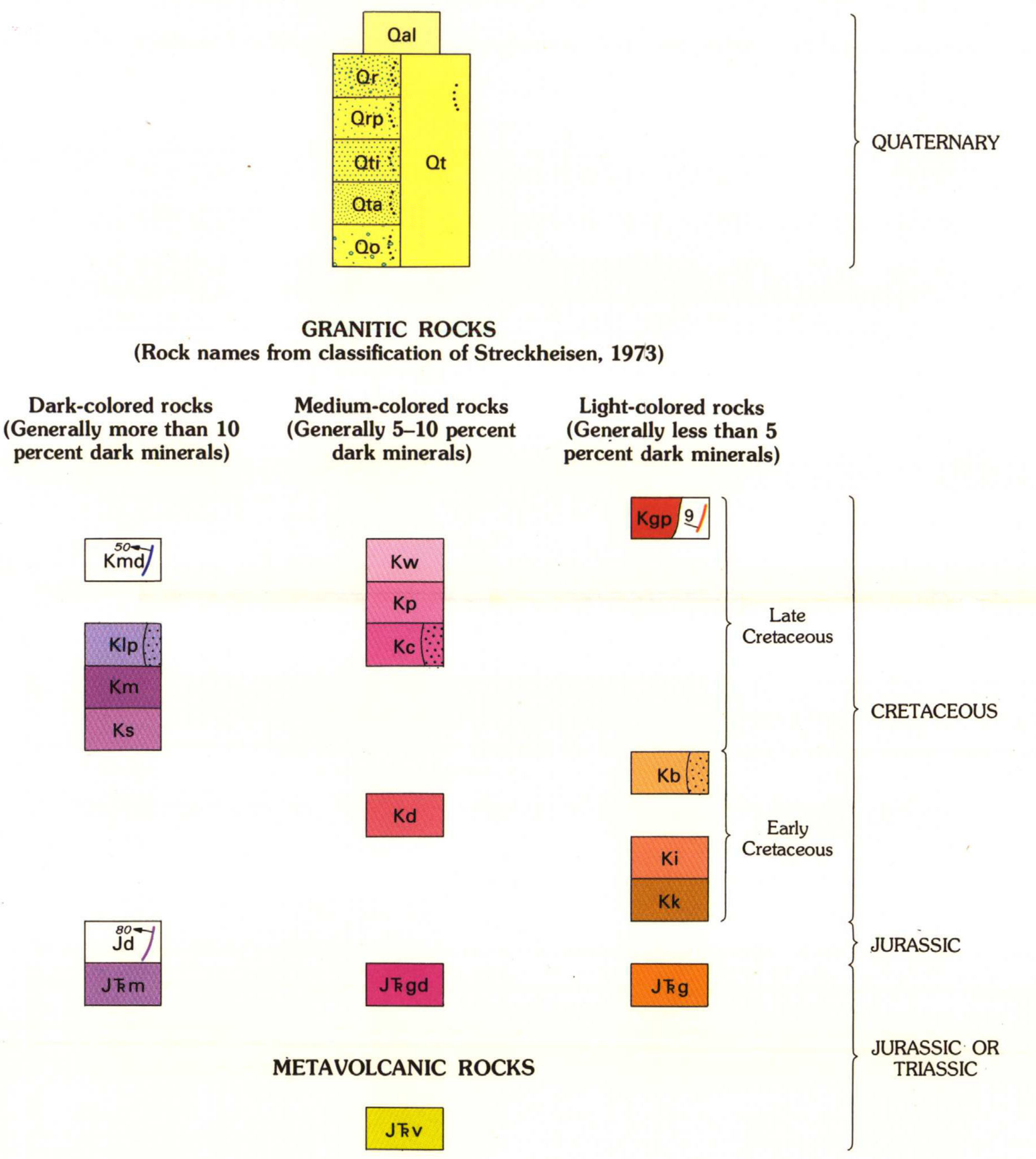
QUADRANGLE LOCATION

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1981—G80143
Geology by J. G. Moore, 1975–78; J. H. Fink, 1975; E. A. du Bray, 1976–77; and T. W. Sisson, 1978

GEOLOGIC MAP OF THE MOUNT WHITNEY QUADRANGLE, INYO AND TULARE COUNTIES, CALIFORNIA

By
James G. Moore
1981

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Qal — ALLUVIAL DEPOSITS (Quaternary)—Alluvium underlying meadows, stream gravels of alluvial fans, and valley-fill deposits

TILL AND TALUS (Quaternary)—Morainal crests shown by dotted line. Includes:

- Qr — Rock glaciers
- Qrp — Recess Peak Till
- Qti — Tioga Till
- Qta — Tahoe Till
- Qo — Older (pre-Tahoe) till
- Qt — Talus, alluvial-fan deposits, slope wash, and undifferentiated glacial deposits

GRANITIC ROCKS

Dark-colored rocks

Kmd — MAFIC DIORITE AND QUARTZ DIORITE DIKES (Late Cretaceous)—Remobilized mafic plutonic rock

Klp — GRANODIORITE OF LONE PINE CREEK (Late Cretaceous)—Dark granodiorite with abundant mafic inclusions. Finer grained, darker, and mixed facies shown by dotted pattern

Km — GRANODIORITE OF MITCHELL PEAK (Late Cretaceous)—Dark fine-grained porphyritic granodiorite. Pb-U age 91 m.y. (Chen, 1977)

Ks — GRANODIORITE OF SUGARLOAF (Late Cretaceous)—Dark granodiorite

Jd — DIKES OF INDEPENDENCE DIKE SWARM(?) (Jurassic)—Subvertical dikes of fine-grained diorite and granodiorite porphyry tentatively assigned to the Independence dike swarm with a Pb-U age of 148 m.y. (Chen and Moore, 1979)

JTRm — MAFIC PLUTONIC ROCK (Jurassic or Triassic)—Quartz diorite, diorite, and hornblende gabbro. Includes mafic hybrid rocks of granodiorite composition

Medium-colored rocks

Kw — WHITNEY GRANODIORITE (Late Cretaceous)—Porphyritic granodiorite and granite with large (4–8 cm) phenocrysts of potassium feldspar. Average biotite K-Ar age 83 m.y. (Evernden and Kistler, 1970)

Kp — PARADISE GRANODIORITE (Late Cretaceous)—Porphyritic granodiorite and granite. Potassium-feldspar phenocrysts (1–3 cm) are characterized by abundant, zonally arranged inclusions of biotite and hornblende. Biotite K-Ar age 78 m.y.; hornblende K-Ar age 84 m.y. (Evernden and Kistler, 1970). Pb-U age 86 m.y. (Chen, 1977)

Kc — GRANODIORITE OF CHAGOOPA (Late Cretaceous)—Includes fine-grained granodiorite and older porphyritic granite (dotted). Fine-grained granodiorite sill 120–240 m thick of Kaweah Peaks is tentatively included

Kd — DRAGON PLUTON (Early Cretaceous)—Quartz monzodiorite and quartz monzonite. Provisional Pb-U age 103 m.y. (Chen, 1977)

JTRgd — OLDER SHEARED GRANODIORITE (Jurassic or Triassic)

Light-colored rocks

Kgp — GRANITE PORPHYRY DIKES AND SILLS (Late Cretaceous)—Fine groundmass with phenocrysts of quartz and potassium feldspar. Numbers on Golden Bear dike indicate width in meters. Shorter dike to south contains fragments of dark granitic rock. Sills on Mount Whitney are granite porphyry and aplite

Kb — BULLFROG PLUTON (Early Cretaceous)—Granite and quartz monzonite. Pb-U age 103 m.y. (Chen and Moore, 1979). Finer grained mixed facies shown by dotted pattern

Ki — INDEPENDENCE PLUTON (Early Cretaceous)—Granite. Provisional Pb-U age 112 m.y. (Chen, 1977)

Kk — GRANITE OF MOUNT KAWEAH (Early Cretaceous)—Fine-grained granite commonly containing pyrite

JTRg — OLDER SHEARED GRANITE (Jurassic or Triassic)

METAVOLCANIC ROCKS

JTRv — CHIEFLY METARHYOLITE AND METADACITE TUFF (Jurassic or Triassic)

Contact, approximately located, showing dip—Queried where not field checked. O, older rock; Y, younger rock

Fault — Dashed where approximately located; dotted where concealed. Arrows show relative horizontal displacement of strike-slip fault. Bar and ball on downthrown side of normal fault

Small shear faults, showing dip—Arrow shows relative horizontal displacement

Strike and dip of felsic dikes

Strike and dip of foliation
- Inclined
- Vertical

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

Area of minor copper mineralization and staining

Location of orbicular granitic rock

Note: Primary foliation in igneous rocks measured on elongate mineral grains and mafic inclusions. Foliation in metamorphic rocks measured on mineral grains and mineral aggregates, schistosity, and cleavage.

INTRODUCTION

The Mount Whitney quadrangle includes about 620 km² of the crestal region of the Sierra Nevada. All of the quadrangle west of the Sierra Nevada crest is within Kings Canyon and Sequoia National Parks. That part east of the crest includes the steep eastern escarpment of the range and a small part of the west side of Owens Valley. Mount Whitney, the highest point in the conterminous United States at an elevation of 4418 m, is on the range crest in the southeastern part of the quadrangle. The great north-trending glacial canyon of the Kern River lies between the Sierra crest to the east and the Great Western Divide to the west. The only roads in the quadrangle are dirt roads in the northeast corner that approach the base of the eastern range escarpment. However, the John Muir Trail threads southward east of the Kern Canyon and west of the Sierra crest and terminates at the summit of Mount Whitney. The High Sierra Trail enters the quadrangle in the south, follows the Kern River north, and joins the John Muir Trail at Wallace Creek.

METAMORPHIC ROCKS

Small elongate masses of metavolcanic rocks are preserved largely as narrow screens between granitic plutons. Originally, these rocks were chiefly silicic metavolcanic tuffs and breccias, but they are extensively sheared and recrystallized, largely by the intrusion of the enormous masses of hot granitic magma, to phyllite and schist. No fossils have been found in the metamorphic rocks of the quadrangle, but fossils of Late Triassic and Early Jurassic age have been recovered from sedimentary rocks interbedded with similar metavolcanic rocks in the Mineral King roof pendant 10 km southwest of the quadrangle (Saleeby and others, 1978).

GRANITIC ROCKS

Granitic rocks that belong to the Sierra Nevada batholithic complex dominate the bedrock of the quadrangle. Most of the granitic masses or plutons were intruded as magma (largely molten rock) during the Late Cretaceous Period as shown by radiometric age dating of the time of cooling and crystallization. Age dates utilizing the potassium-argon method have been recalculated on the basis of the new, revised constants (Steiger and Jager, 1977). Several small sheared plutons in the southwestern part of the quadrangle are intruded by abundant mafic dikes that appear to belong to the Independence dike swarm, which is of regional extent (Moore and Hopson, 1961). The dikes of this swarm 15 km to the east have been dated as Late Jurassic (Chen and Moore, 1979). The granitic masses cut by them are tentatively assigned to the Triassic or Jurassic Period.

The Late Cretaceous pulse of igneous activity culminated in the intrusion of one of the largest and youngest granitic sequences in the Sierra Nevada—the nested sequence of the Paradise pluton intruded in its center by the Whitney pluton. This composite intrusion extends 83 km southeastward from the central part of the Marion Peak quadrangle on the northwest (Moore, 1978), through the Mount Whitney quadrangle, to the southeastern part of the Olancha quadrangle on the southeast (Moore and du Bray, 1978). The sequence attains a width of 23 km south of the Mount Whitney quadrangle. Because of the great extent and distinctive character of the rocks in this sequence, they are here formally designated the Paradise Granodiorite and the Whitney Granodiorite. The type locality of the Paradise Granodiorite is on the east side of Paradise Valley in the east-central Marion Peak quadrangle (Moore, 1978); that of the Whitney Granodiorite is 200 m north of the summit of Mount Whitney. Modal analyses have been made of 63 stained rock samples collected from these units across the quadrangle, and the proportions of quartz, alkali feldspar, and plagioclase feldspar are shown in the accompanying triangular diagrams (fig. 1). The average rock type of each unit is granodiorite in the classification system employed (Streckheisen, 1973), although individual specimens also range into the granite field as well as, to a minor extent, into the quartz monzonite and quartz monzodiorite fields.

The massive (1100 km²) northwest-trending Paradise-Whitney nested sequence was emplaced as a single intrusion about 85 m.y. ago. After emplacement, the mass began solidifying from the walls inward. Before complete solidification, the partly molten and somewhat more differentiated siliceous core of the intrusive mass (the Whitney Granodiorite) surged upward and burst through its solidified wall on the southeast side, largely southeast of the quadrangle (Moore and du Bray, 1978). The pluton of the Whitney Granodiorite is distinctly domical in profile, and the present level of exposure is apparently not far below its top. Within the quadrangle, its western and eastern contacts dip under the Paradise Granodiorite, and the pluton axis plunges north beneath the Paradise. After solidification of the upper marginal parts of the Whitney Granodiorite, granite porphyry dikes and sills probably originating from deeper, still molten parts of the pluton were emplaced in fractures at its northern limits and near Mount Whitney. The most remarkable of these intrusions is the Golden Bear granite porphyry dike in the north, which extends 14 km in a N. 40° E. direction from near the northern part of the Whitney Granodiorite to the eastern range front in the Mount Pinchot quadrangle (Moore, 1963).

This intrusive sequence is very similar to other large young granitic intrusions in the Sierra Nevada, particularly the Tuolumne Intrusive Suite 120 km to the northwest (Bateman and Chappell, 1979). The Tuolumne Intrusive Suite is large (62 km long), includes the youngest plutons in the region (90–79 m.y., Evernden and Kistler, 1970), and occurs in the crestal region of the Sierra Nevada. Moreover, the three intrusive pulses of the sequences in the Mount Whitney quadrangle—the Paradise Granodiorite, Whitney Granodiorite, and granite porphyry dikes and sills—are matched in composition and texture by the three late pulses of the Tuolumne—the Half Dome Granodiorite, Cathedral Peak Granodiorite, and Johnson Granite Porphyry, respectively.

FAULTING

Two of the range-front normal faults that bound the Sierra Nevada block on the east side are shown in the northeast corner of the quadrangle. The longer of these, the Independence fault, has been traced 13 km north into the Mount Pinchot quadrangle (Moore, 1963).

The right-lateral strike-slip Kern Canyon fault is 14 km long within the quadrangle but extends more than 100 km to the south (Moore and du Bray, 1978). Secondary subparallel faults and shear zones are common within 1 km of the fault on each side but are not mapped because they occur on the steep cliffs of the Kern Canyon. Five small right-lateral faults in the northern part of the quadrangle may represent distributed strain where displacement on the Kern Canyon fault system is small. Toward the south, horizontal displacement increases systematically to about 13 km, 35 km south of the quadrangle. Most of the Kern Canyon fault offset occurred prior to 3.5 m.y. ago because a basalt flow of that age astride the fault shows little or no offset (Moore and du Bray, 1978).

The granitic rocks are commonly fractured and sheared by two nearly vertical sets of small strike-slip faults. The average strike of the left-lateral set is east-northeast, and the right-lateral set, northeast. These conjugate fault sets suggest tectonic extension in a N. 34° W. direction, which is compatible with the late Cenozoic extension direction of the Great Basin to the east (Lockwood and Moore, 1979). These small shear faults are commonly mineralized by quartz and epidote and contain sulfides of iron, copper, and molybdenum. The mapped areas of minor copper mineralization occur in these small shear faults, which have undergone displacement of a few centimeters to a few meters.

GLACIATION

Because of the high elevation of much of the quadrangle, extensive glaciation occurred during the Pleistocene and Holocene Epochs, and glacial deposits are well preserved on the high uplands of Chagoopa Plateau as well as in the drainage basins of Tyndall, Wright, Wallace, and Whitney Creeks east of the Kern Canyon (Matthes, 1965). Small glaciers descended part way down the canyons of the east range front, but their deposits have been largely removed or modified by later stream action. Five ages of glacial deposits are distinguished where possible by reconnaissance mapping and aerial photograph interpretation. The oldest pre-Tahoe moraines are thoroughly weathered, and rarely show morainal crests. Tahoe and Tioga moraines (referred to as the Wisconsin Glacial Stage by Warhaftig and Birman, 1965) show well-developed lateral moraines in which about 50–70 percent of the boulders are weathered. Recess Peak moraines occur within 2 km of cirque headwalls and contain fresh boulders. The youngest glacial deposits are represented by more than 70 rock glaciers, which rarely exceed 1 km in length within north- to northeast-facing cirques. They contain interstitial ice and are characterized by steep, unstable toes. The quadrangle contains about 700 mapped lakes and ponds all formed by glacial action. The lake basins are dammed by moraines or are scooped from bedrock by ice erosion.

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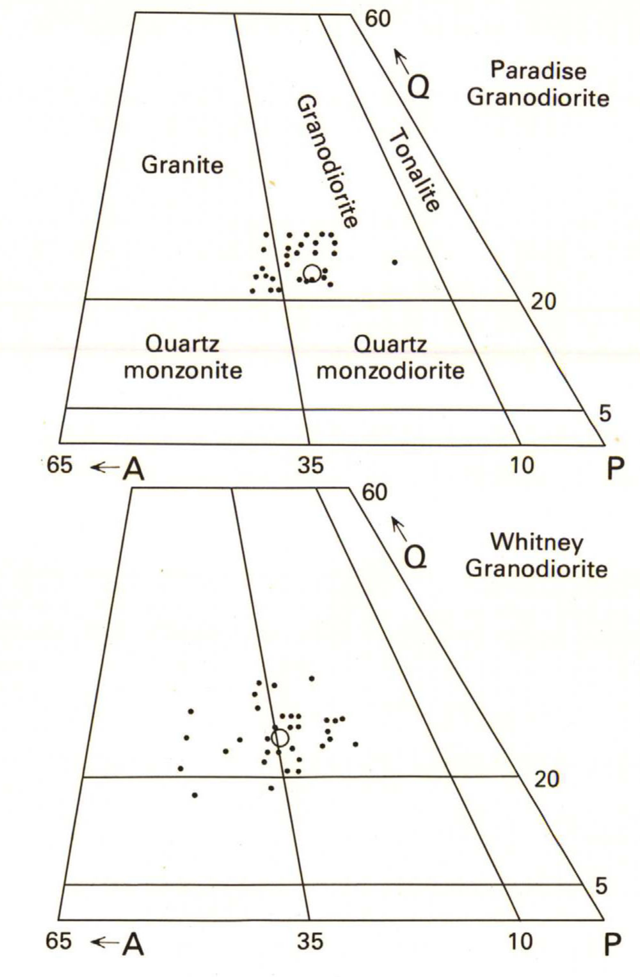

Figure 1. *Triangular diagrams showing volume proportions of quartz (Q), alkali feldspar (A), and plagioclase feldspar (P). Dots are individual analyses; circles, averages of analyses.*

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