DEPARTMENT OF THE INTERIOR
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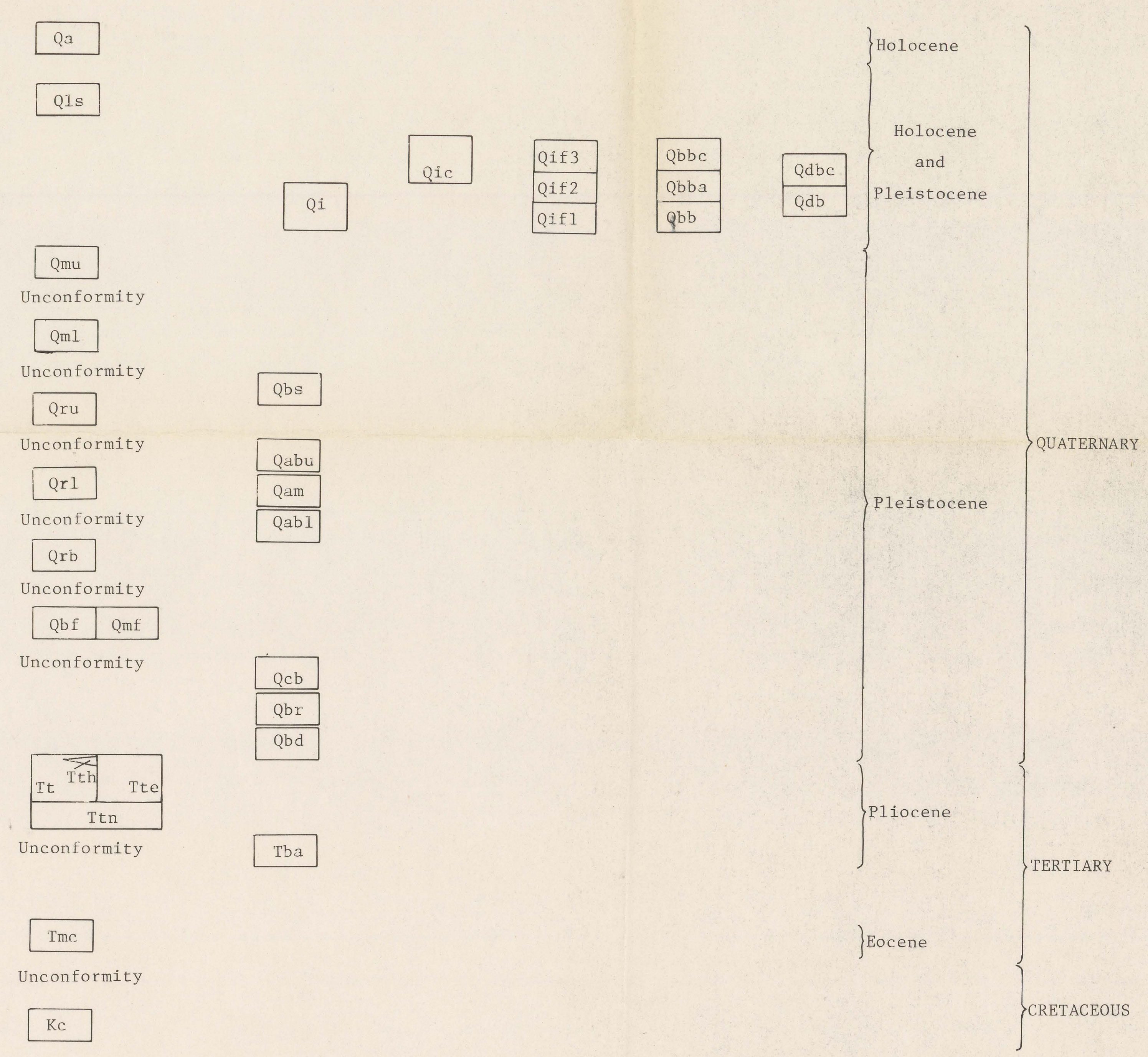
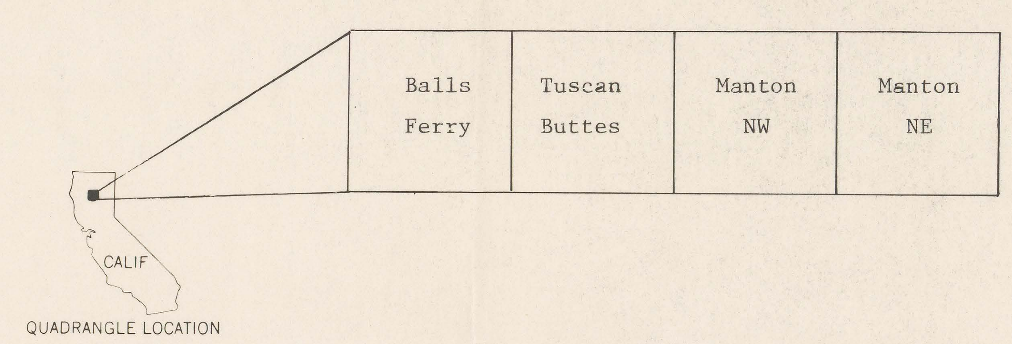
CORRELATION OF MAP UNITS





EXPLANATION OF MAP UNITS

Qa	Holocene channel deposits
Qls	Landslide deposits
Qic	Basaltic cinder cone deposits of Inskip Hill
Qif3	Basalt of Inskip Hill
Qif2	Basalt of Inskip Hill
Qif1	Basalt of Inskip Hill
Qi	Basalt of Inskip Hill
Qiu	Basalt of Inskip Hill, undivided
Qbbc	Basaltic cinder cone deposits of Black Butte
Qbba	Ash of Black Butte
Qbb	Basalt of Black Butte
Qdbc	Basaltic cinder cone deposits of Black Butte
Qdb	Basalt of Digger Buttes
Qmu	Upper Modesto alluvial deposits
Qml	Lower Modesto alluvial deposits
Qru	Upper Riverbank alluvial deposits
Qrl	Lower Riverbank alluvial deposits
Qbs	Basalt of Shingletown Ridge
Qabu	Upper hypersthene andesite
Qam	Ash of Mount Maidu
Qabl	Lower hypersthene andesite
Qrb	Red Bluff Formation
Qbf	Alluvial fan deposits of Battle Creek
Qmf	Alluvial fan deposits of the Millville Plain
Qcb	Basalt of Coleman Forebay
Qbr	Blue Ridge rhyolite
Qbd	Basalt of Devils Half Acre
Tt	Tuscan Formation, undivided
Tth	Tuff of Hogback Road
Ttn	Nomlaki Tuff Member of Tuscan Formation
Tte	Tehama Formation
Tba	Basalt of Big Antelope Creek
Tmc	Montgomery Creek Formation
Kc	Chico Formation

Contact, dashed where approximately located.

0.3 U 80 D — Fault, showing dip and displacement (in meters) - Dashed where approximately located, queried where doubtful, dotted where concealed. D, downthrown side; U, upthrown side.

45 0.3 — Thrust fault, showing dip and displacement (in meters) - Sawteeth on upper plate.

Lineament in Tuscan Formation from aerial photographs, possibly due to faulting.

15 — Bedding, showing strike and dip.

Landslide, arrows showing direction of movement.

Fault scarp at head of volcanic flows on Inskip Hill.

Syncline - showing axial trace and plunge, dashed where approximately located.

Anticline - showing axial trace and plunge, dashed where approximately located.

Introduction

This report presents preliminary geologic data on the Battle Creek fault zone in the Balls Ferry, Tuscan Buttes N.E., Manton N. W., and Manton N. E. 1:24,000 scale quadrangles in north-central California. The study is part of on-going investigations of late Cenozoic geology, with particular emphasis on tectonism and alluviation, in the Sacramento Valley and northern Sierran foothills. Correlation of volcanic rocks in this report is based on their stratigraphic position, hand specimen petrography, and thin section analysis without the benefit of major or minor element geochemistry or isotopic data. Therefore the correlations must be viewed as tentative.

Battle Creek Fault Zone

The Battle Creek fault zone is marked by a pronounced escarpment that extends from the Sacramento River northeastward toward Lassen Peak for a distance of about 35 km. The top of the escarpment, which has an elevation of 152 m (500 feet) at the Sacramento River, rises steadily toward the northeast to an altitude of about 1030 m (3400 feet) north of the town of Manton. Topographic relief on the escarpment ranges from 45 m (150 feet) at the river to a maximum of 485 (1600 feet) north of Manton and decreases along strike to the northeast as the downthrown block is buried by volcanic rocks from the east. The smooth longitudinal profile of the escarpment is interrupted about mid-way along its length by the symmetrical, remarkably uneroded basaltic cinder cone of Black Butte that extends 182 m (600 feet) above the volcanic rocks capping the upthrown block. Viewed from the south, the Battle Creek escarpment is one of the most impressive fault-controlled topographic features in the northern Sierran foothills.

The fault zone is made up of several northeast-trending normal faults that branch and intersect along the course of the escarpment. Except for the faults along the western toe of the escarpment that dip about 50° S.E.; most faults in the system dip steeply southeast, usually within 10 degrees of vertical. Minor, west-trending faults near Coleman Forebay (section BB') dip steeply northwest and appear to be high-angle reverse faults with minor south-side-down displacement. Between Coleman Powerhouse and Black Butte the faults are closely grouped along the escarpment, whereas east of Black Butte the faults are more widely spaced and veer off from the trend of the escarpment toward the northwest. The best exposures of the faults and many of the lithologic units are found in the overflow channel from Coleman Forebay (section BB').

Traces of the faults are extremely difficult to locate in the fanglomerate (Qbf) between Coleman Powerhouse and Sacramento River. The amount of displacement in that part of the fault zone is unknown, but it must be no more than the topographic relief on the fanglomerate which is 40 to 45 m (130 to 150 feet). At the overflow channel from Coleman Forebay, section BB', the vertical separation on the base of the fanglomerate (Qbf) is about 127 m (420 feet). Vertical separation, measured on the base of the basalt of Coleman Forebay (Qcb) which underlies the fanglomerate (Qbf), increases rapidly to the northeast and is about 333 m (1100 feet) at Black Butte (section FF') and about 436 m (1440 feet) in section HH' north of Manton. The amount of strike slip movement on the faults cannot be established from any geometric relations observed to date, but the orientation of feather fractures along some faults in section BB' indicate a component of oblique slip with south block displaced to the west relative to the north block.

We had hoped to obtain a detailed displacement history for the Battle Creek fault zone by dating the numerous and varied volcanic rocks, but, unfortunately, as yet that has not been possible. Many of the volcanic rocks apparently are younger than the effective lower limit of the K/Ar dating method, and even the older rocks, such as the basalt of Coleman Forebay (Qcb), are relatively low in K_2O and yield dates with large analytical uncertainties. The basalt flow from Black Butte, which cascades down over the escarpment just north of Darrah Springs State fish hatchery, may be younger than the maximum age limit of the C^{14} method, but no charcoal has been found under the flow.

The Blue Ridge rhyolite of Wilson (1961) is offset by the Battle Creek fault system along Bailey Creek near its intersection with Spring Creek in the Manton N.W. quadrangle (see Manton 15' quadrangle for location of cultural features). Wilson (1961, p. 34) cites a K/Ar age of 1.52 m.y. on glass from the Blue Ridge rhyolite. Gilbert (1964, Table 3, p. 27) gives two K/Ar dates for the rhyolite; 1.15 $\pm$ 0.07 m. y. on glass and 1.24 $\pm$ 0.11 m. y. on plagioclase. Whatever age one accepts for the rhyolite, the faulting must be younger. It is possible that most, if not all, of the faulting is significantly younger than the rhyolite and may post-date the eruption of the ash of Mount Maidu (Qam). Lithologic characteristics and distribution of the ash south of the fault system suggest it is a non-welded ash flow deposited in west- and northwest-trending channels from a source southeast of the fault zone (see Wilson, 1961). To date, the ash has been found at only one locality north of the escarpment where it occurs as layers several centimetrs thick in alluvial deposits on the north side of Ash Creek. The route by which the ash reached Ash Creek cannot be unequivocally determined from this single known occurrence. It is possible that the ash was reworked from deposits now found south of the escarpment and carried northwestward to Ash Creek before faulting. If such is the case, movement occurred on the Battle Creek fault zone after eruption of the ash of Mount Maidu, which has an age in the range of 0.43 to 0.45 m.y. (A. Sarna-Wojcicki, written commun., 1980).

References Cited

Gilbert, N. J., 1969, Chronology of Post-Tuscan volcanism in the Manton area, California: University of California Berkeley, unpub. MS Thesis, 73 p.
Wilson, T. A., 1961, The geology near Mineral, California: University of California Berkeley, unpub. MS Thesis, 89 p.

PRELIMINARY GEOLOGIC MAP OF THE BATTLE CREEK FAULT ZONE, SHASTA AND TEHAMA COUNTIES, CALIFORNIA

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