...se and Thickness of the Post-Eocene Continental Deposits in the Sacramento Valley California

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 45-73

Prepared in cooperation with the
California Department
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The study area comprises the valley floor and some of the bordering foothills, a total area of about 6,000 square miles. Beneath most places in the valley, the base of the post-Eocene continental deposits is equivalent to the base of the Tehama Formation of Pliocene age which in some places at least may be of late Oligocene and early Miocene age. The post-Eocene deposits contain most of the fresh ground water in the valley. The structure of the base of the deposits is that of a large northward-trending syncline. In the subsurface, faulting has occurred mostly within the basal part of the deposits. Beneath the northeastern part of the valley, faulting has occurred through probably the total thickness of the deposits. The deposits range in thickness from zero near the margins of the valley to about 3,500 feet beneath the south-central part of the valley. The thickest sections occur along the axis of the syncline, but near Sutter Buttes the deposits are thinner than at any other locale near the central part of the valley.

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17c. COSATI Field/Group ∅2F

BASE AND THICKNESS OF THE POST-EOCENE CONTINENTAL

DEPOSITS IN THE SACRAMENTO VALLEY, CALIFORNIA

By R. W. Page

U.S. GEOLOGICAL SURVEY [Water Resources Division]

Water-Resources Investigations 45-73

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September 1974

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BASE AND THICKNESS OF THE POST-EOCENE CONTINENTAL DEPOSITS

IN THE SACRAMENTO VALLEY, CALIFORNIA

By R. W. Page

ABSTRACT

The Sacramento Valley, which forms most of the northern one-third of the Central Valley, is a broad structural trough. The study area comprises the valley floor and some of the foothills of the Sierra Nevada and the Coast Ranges, a total area of about 6,000 square miles.

Beneath most places in the valley, the base of the post-Eocene continental deposits is equivalent to the base of the Tehama Formation of Pliocene age, which in some places at least may be of late Oligocene and early Miocene age. The deposits consist of intercalated beds of gravel, sand, silt, clay, tuff, conglomerate, sandstone, siltstone, and claystone. And beneath large areas along the eastern side of the valley the deposits consist of basaltic and andesitic mudflows, tuff, tuff breccias, volcanic sandstones and conglomerates, and sand and gravel, as well as overlying nonvolcanic sediments. They contain most of the fresh ground water in the valley.

The structure of the base of the continental deposits is that of a large northward-trending syncline whose trend is interrupted only by the Sutter Buttes. In the subsurface, faulting has occurred mostly within the basal part of the deposits. Beneath the northeastern part of the valley, along the Chico monocline, faulting has occurred through probably the total thickness of the deposits.

The deposits range in thickness from zero near the margins of the valley to about 3,500 feet beneath the south-central part of the valley. The thickest sections occur along the axis of the syncline, but near Sutter Buttes the deposits are thinner than at any other locale near the central part of the valley.

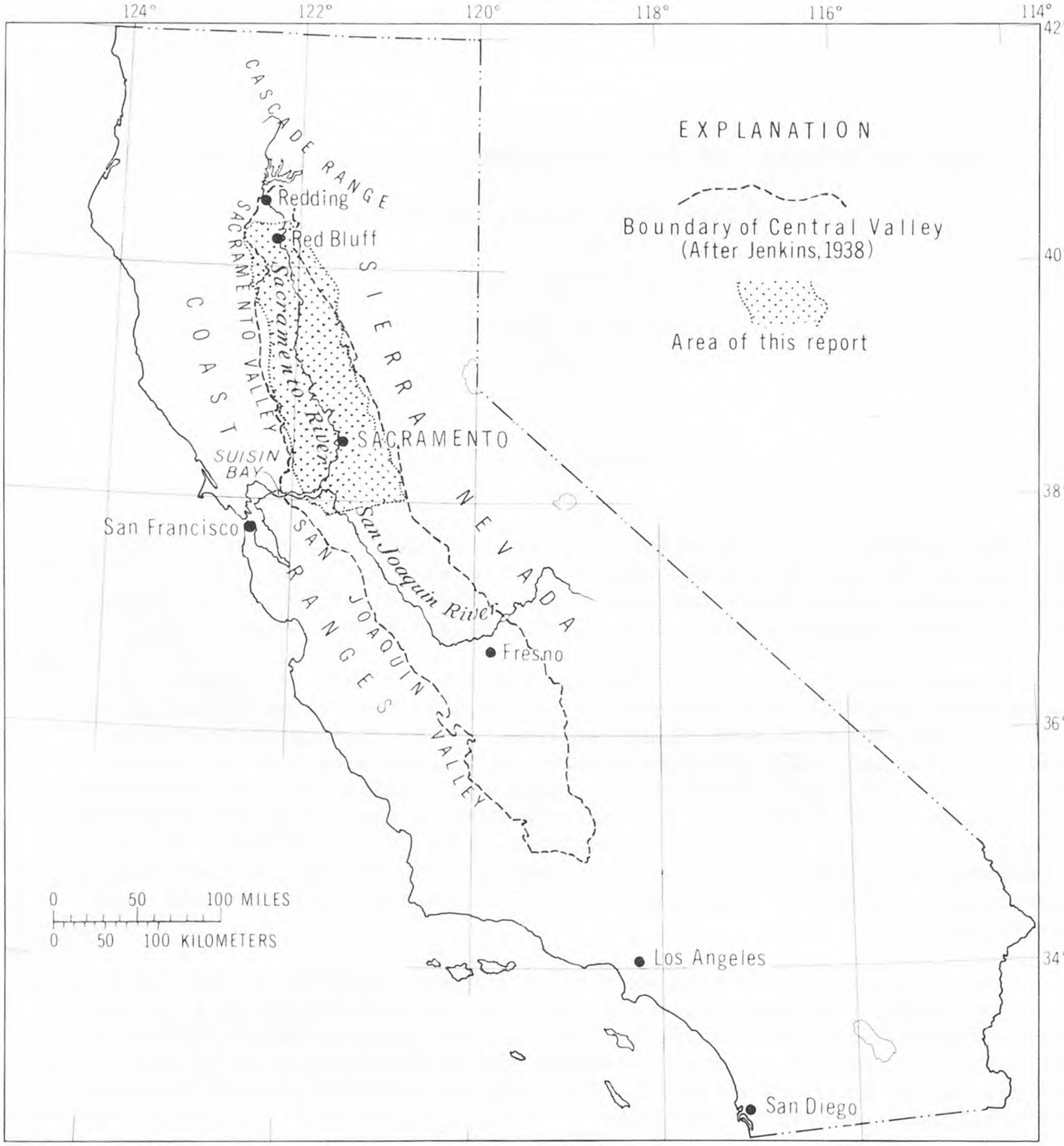


FIGURE 1.--Index map.

INTRODUCTION

Location and General Features

The Sacramento Valley, which forms most of the northern one-third of the Central Valley, is a broad structural trough (fig. 1). As defined by Bryan (1923, p. 8), the valley extends from Red Bluff to the mouth of the Sacramento River near Suisun Bay, a distance of 150 miles by airline and about 240 miles by river. It is bordered by the Cascade Range on the northeast, by the Sierra Nevada on the east, and by the Coast Ranges on the west.

The valley area between Red Bluff and Redding is separated by an uplifted area underlain by volcanic rocks through which the Sacramento River flows in a series of entrenched loops (Olmsted and Davis, 1961, p. 10). From there, the Sacramento River flows southward through the valley to join the San Joaquin River near Suisun Bay. Within the valley, the most extensive physiographic units are: (1) The low alluvial plains and fans west of the Sierra Nevada, (2) the low alluvial plains and fans on the west side of the valley, (3) the dissected alluvial uplands west of the Sierra Nevada, (4) low hills and dissected uplands, (5) flood plains and natural levees, and (6) flood basins (Olmsted and Davis, 1961, pl. 1). The most prominent physiographic feature is Sutter Buttes (fig. 2).

The area investigated comprises the valley floor and some of the foothills of the Sierra Nevada and the Coast Ranges, a total area of about 6,000 square miles (figs. 2 and 3).

Purpose and Scope

The purpose of this investigation is to help develop detailed knowledge of the subsurface geology of the Sacramento Valley. Such knowledge is necessary if the ground-water resources of the valley are to be properly managed. The knowledge also is necessary for the design of analog or digital hydrologic models of the valley.

The scope of the investigation is (1) to delineate the configuration of the base of the principal fresh-water-bearing deposits in the valley, and (2) to show the thickness of those deposits. As indicated in many reports, the post-Eocene continental deposits contain most of the fresh ground water in the valley. Therefore, they were selected as the unit to be mapped.

Acknowledgments

Several agencies and companies, as well as many individuals, supplied invaluable assistance and data to the Geological Survey in the present investigation. The Humble Oil and Refining Company kindly gave permission for access to all their records on file at the California Division of Oil and Gas in Woodland, California. Many other oil companies were generous with their available data. Mr. R. M. Barger and his associates at the California Division of Oil and Gas were very helpful in providing access to their files. And Mr. R. S. Ford and Mr. P. J. Lorens of the California Department of Water Resources provided maps and data which were helpful in interpreting the subsurface geology.

Method of Study and Nature of the Data

Fieldwork and officework for this report were begun in January 1972 and completed in January 1973. Because other agencies and the U.S. Geological Survey have collected a vast amount of well log and other data, most of the information in this report was assembled from existing files.

In all, about 900 electrical logs were used to correlate the base of the post-Eocene continental deposits in the valley. Also, about 50 geologists' logs and core descriptions were used to interpret the base of the continental deposits. In addition to the logs and core descriptions, extensive use was made of the correlations shown on geological sections in the reports of the California Division of Oil and Gas, the California Division of Mines and Geology, and the American Association of Petroleum Geologists. Two Ph.D theses, one by Lydon (1968) and the other by Redwine (1972), and a Master's thesis by Curtin (1971), were also helpful in interpreting the base of the continental deposits. Those reports, among others, are listed in the selected references.

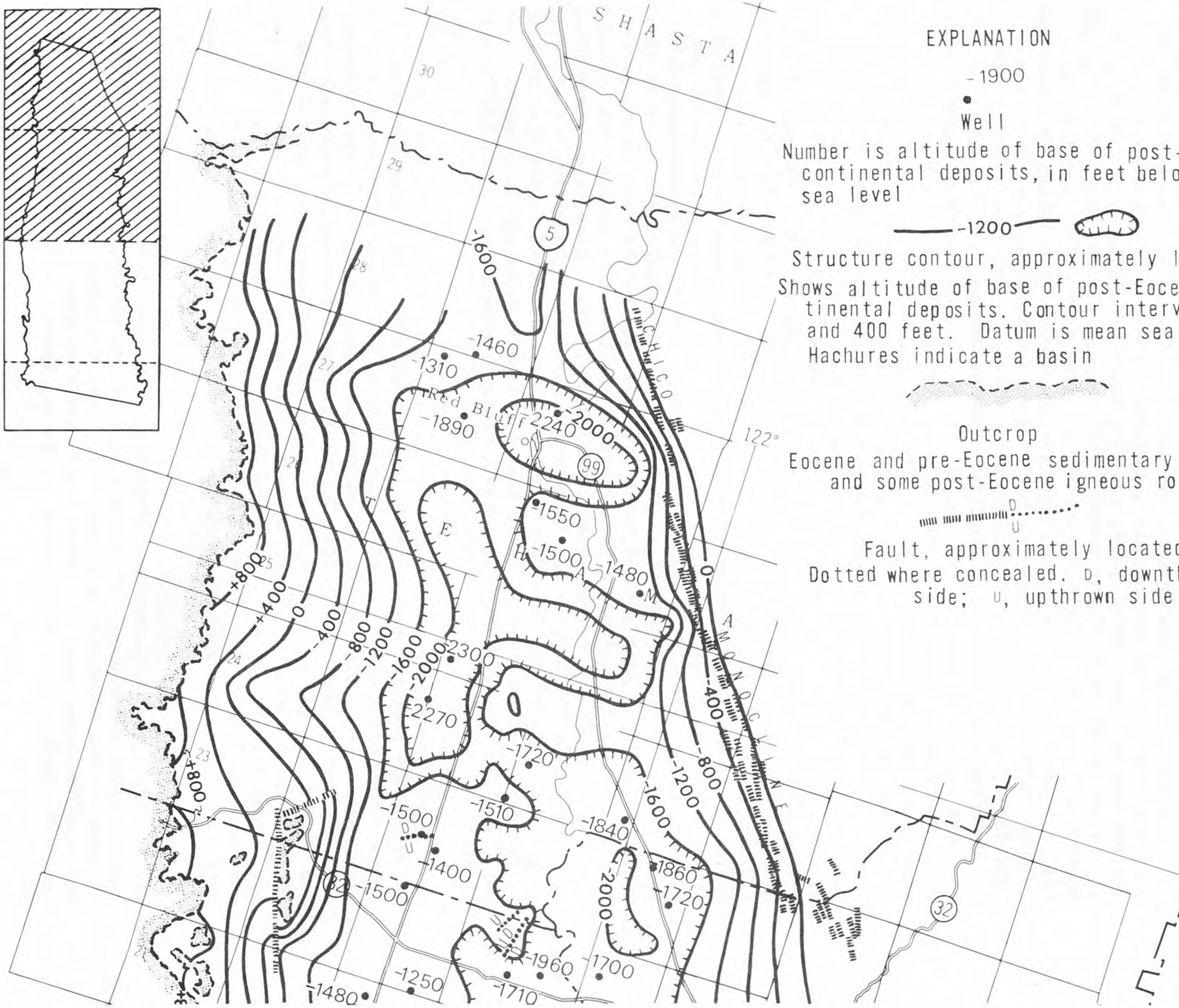
The technique used to determine the base of the continental deposits was to correlate the base, as shown on electrical logs in available reports, with the additional electrical logs used in this report. Where previously correlated logs were not available, a "pick" was made on the basis of the nearest available correlated log.

BASE AND THICKNESS OF THE POST-EOCENE CONTINENTAL DEPOSITS

The base of the post-Eocene continental deposits, in most places in the Sacramento Valley, is the base of the Tehama Formation of Pliocene age (Barger and Sullivan, 1966, p. 9, pl. III; Beecroft, 1962, p. 21, 1964, p. 9, pl. IV; Brown and Rich, 1961; Corwin, 1951, p. 10, pl. IV; Huey, 1957b, p. 59; Hunter, 1956, p. 54; Land, 1970, p. 35, pl. III; Rich, 1971; and Williams, 1970, p. 48). At least locally, however, the base of the Tehama is equivalent to part of the upper Princeton Valley fill of Redwine (1972, p. 312), who considered the fill to be of possible late Oligocene and early Miocene age. For example, the base of the Tehama as shown by Barger and Sullivan (1966, sec. A-A', pl. III) at the well Capital Co. No. 1, correlates with the middle part of the upper Princeton Valley fill of Redwine (1972, sec. B-B') at the same well. In the northeastern part of the valley the base of the deposits is equivalent to the base of the Tuscan Formation of Pliocene age (Weddle, 1962, p. 26, pl. III), which in places also is equivalent to the upper Princeton Valley fill of Redwine (1972). For example, the base of the Tuscan at the well Towne 2, in sec. 20, T. 20 N., R. 1 E. (Weddle, 1962, sec. A-A'), is near the base of the upper Princeton Valley fill of Redwine (1972, sec. B-B') as shown at the well Dodge Land Co. No. 3 in sec. 31, T. 20 N., R. 1 E. Redwine (1972, p. 151) included the Tuscan Formation in his Tehama Formation, which overlies his Neroly(?) Formation of late Miocene age, which in turn overlies either a basalt of Tertiary age or the valley fill. Near Sutter Buttes the base of the post-Eocene deposits--locally named the Sutter Formation of late Tertiary age (Hunter, 1955, figs. 2 and 3)--is equivalent to the base of the Tehama Formation. East and southeast of Sutter Buttes the base of the post-Eocene deposits is equivalent to a horizon near the basal part of the volcanic rocks from the Sierra Nevada (Olmsted and Davis, 1961, pl. 4) that range in age from Eocene(?) to Pliocene. In the southern and southeastern part of the valley, the base of the post-Eocene deposits is correlated to the base of alluviums and sedimentary rocks of possibly late Miocene age (Am. Assoc. Petroleum Geologists, 1951; Ford, 1971, written commun.; and Huey, 1957a, p. 45).

Nearly everywhere beneath the valley, the post-Eocene deposits lie unconformably over sedimentary rocks and deposits of either Cretaceous or Eocene age. Principally on the eastern side of the valley, the deposits locally underlie a widespread, discontinuous basalt of Tertiary age (Redwine, 1972, p. 126; Safonov, 1962, fig. 9, and Am. Assoc. Petroleum Geologists, 1954 and 1960). The top of the basalt was mapped as the base of the post-Eocene deposits in this study because, in most local areas, it was near the base and was a good marker. Because the volcanic rocks from the Sierra Nevada described by Olmsted and Davis (1961) lie stratigraphically below the basalt, they were not mapped where both the basalt and the volcanic rocks were present.

The post-Eocene deposits consist of intercalated beds of gravel, sand, silt, clay, tuff, conglomerate, sandstone, siltstone, and claystone. And, beneath large areas along the eastern side of the valley, the deposits consist of basaltic and andesitic mudflows, tuff, tuff breccias, volcanic sandstones and conglomerates, sand and gravel, and overlying nonvolcanic sediments (Burnett, 1963, p. 37; and Olmsted and Davis, 1961, p. 62-65, 69-71, and pl. 2).


EXPLANATION
-1900
Well
Number is altitude of base of post-Eocene continental deposits, in feet below mean sea level
-1200
Structure contour, approximately located
Shows altitude of base of post-Eocene continental deposits. Contour interval 200 and 400 feet. Datum is mean sea level. Hachures indicate a basin
Outcrop
Eocene and pre-Eocene sedimentary rocks and some post-Eocene igneous rocks
D
U
Fault, approximately located
Dotted where concealed. D, downthrown side; U, upthrown side
SHASTA
TEHAMA
CHICO MONOCLINE
Red Bluff
122°
40°
5
99
32
-1600
-1460
-1310
-1890
-2240
-2000
-1550
-1500
-1480
+800
+400
0
-400
-800
-1200
-2300
-2270
-1720
-1510
-1840
-1860
-1400
-1960
-1700
-1250
-1480
-1710

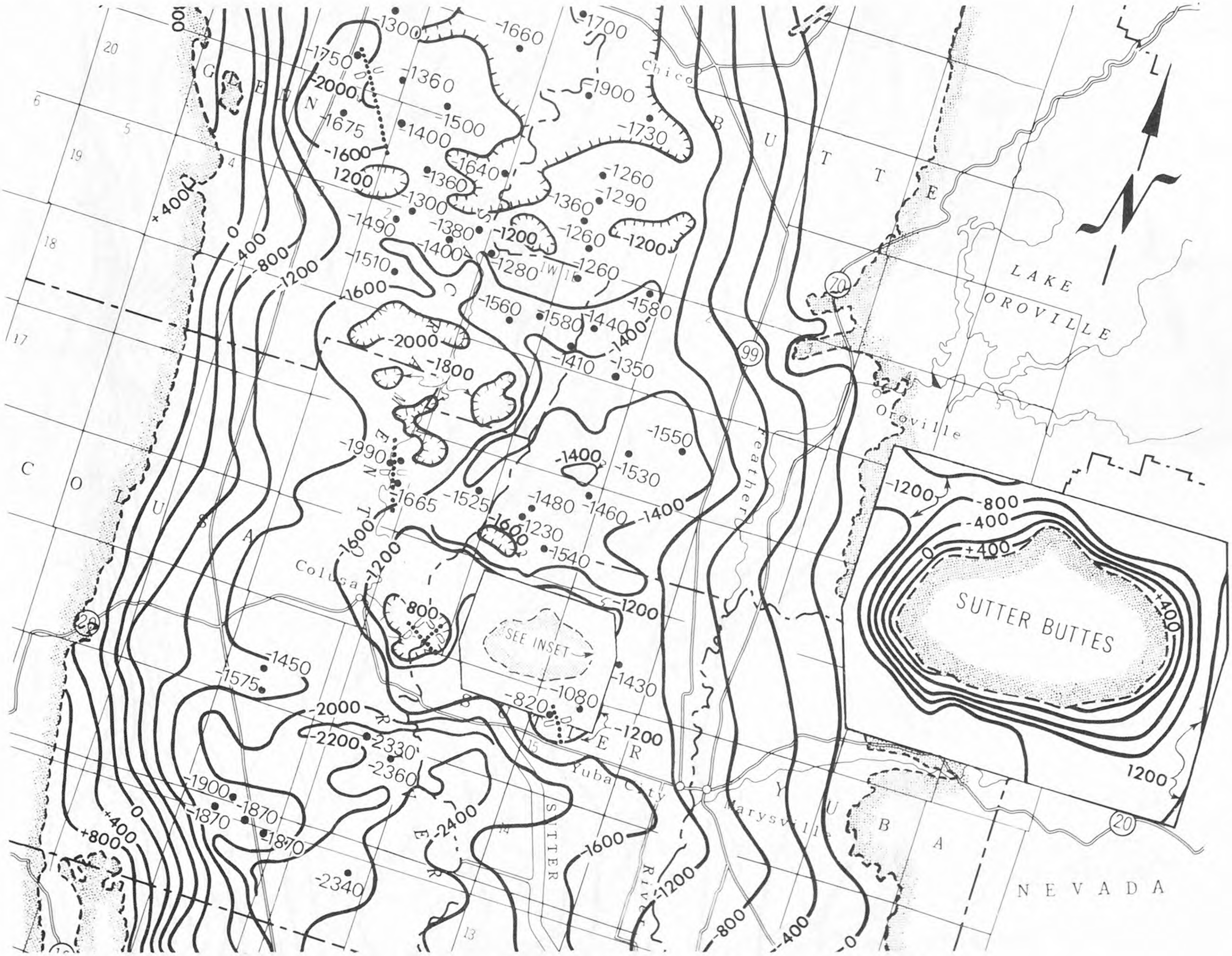
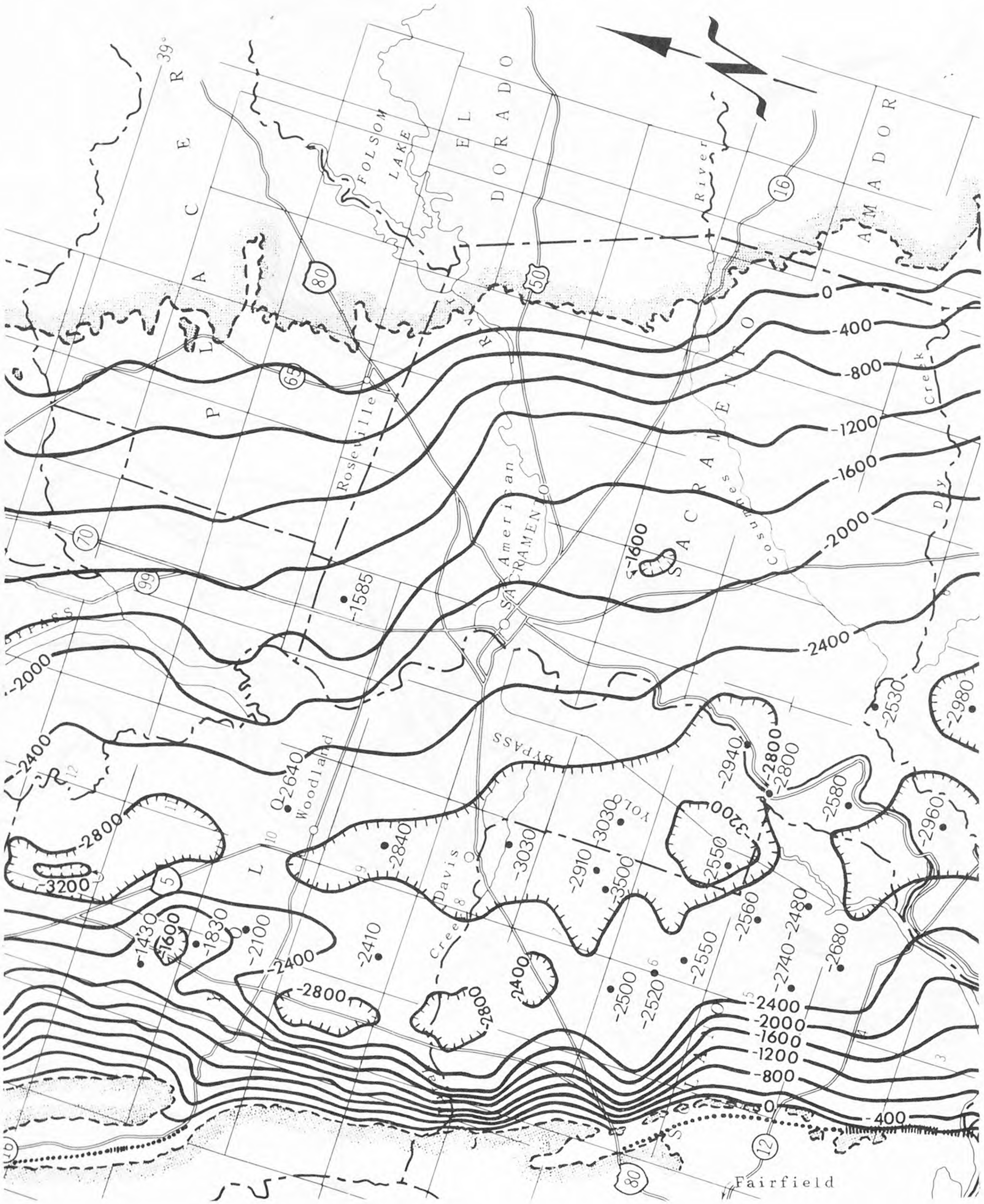
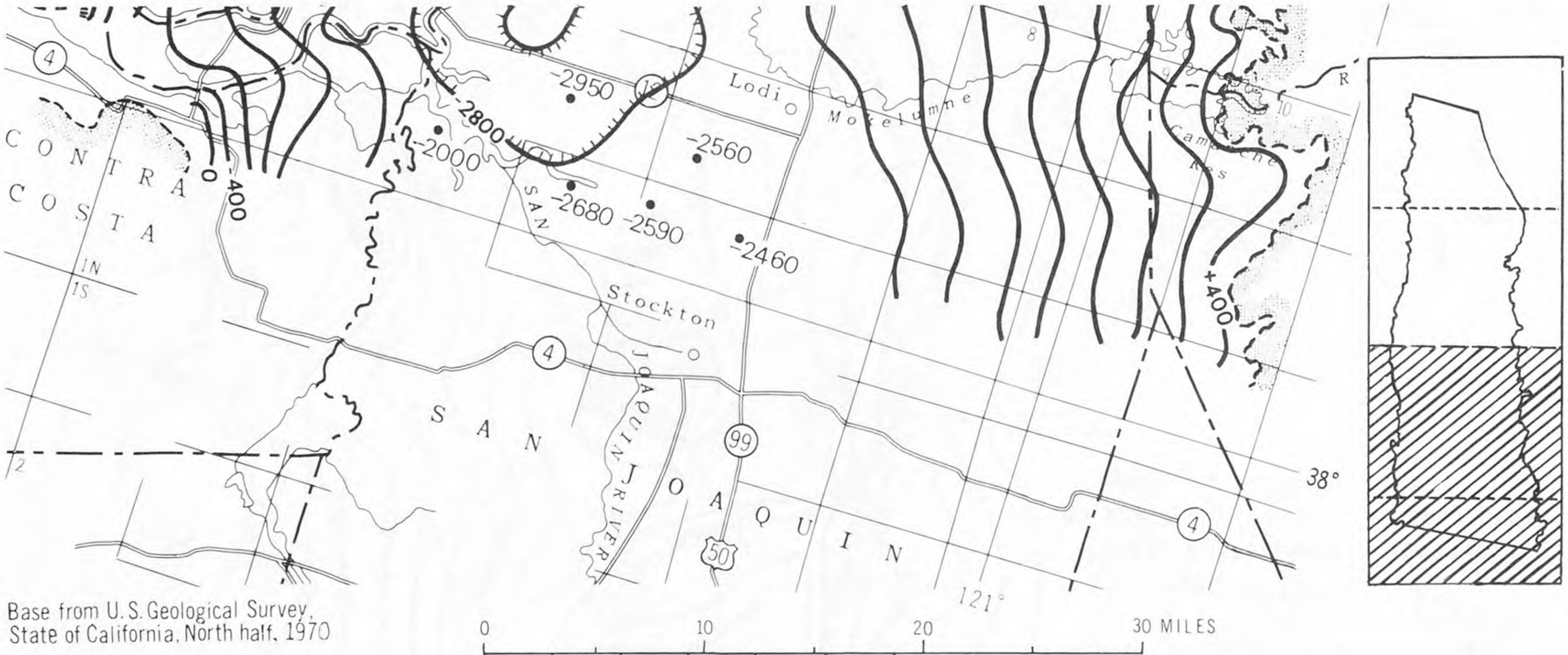


FIGURE 2.--Base of deposits (continued on following two pages).


P L A C E R
E L D O R A D O
A M A D O R
S A C R A M E N T O
Y O L O
FOLSOM LAKE
Roseville
Woodland
Davis
SACRAMENTO
Fairfield
American River
Cosumnes River
Dry Creek
Putah Creek
BYPASS
39°
-1585
-1430
-1600
-1830
-2100
-2400
-2640
-2410
-2840
-2800
-3200
-3030
-2910
-3500
-2500
-2520
-2550
-2560
-2740
-2480
-2680
-2940
-2580
-2960
-2530
-2980
-2000
-1200
-800
-400
0



EXPLANATION

-2410 • WELL—Number is altitude of base of post-Eocene continental deposits, in feet below mean sea level

-1200 STRUCTURE CONTOUR, APPROXIMATELY LOCATED—Shows altitude of base of post-Eocene continental deposits. Contour interval, 200 and 400 feet. Datum is mean sea level. Hachures indicate a basin

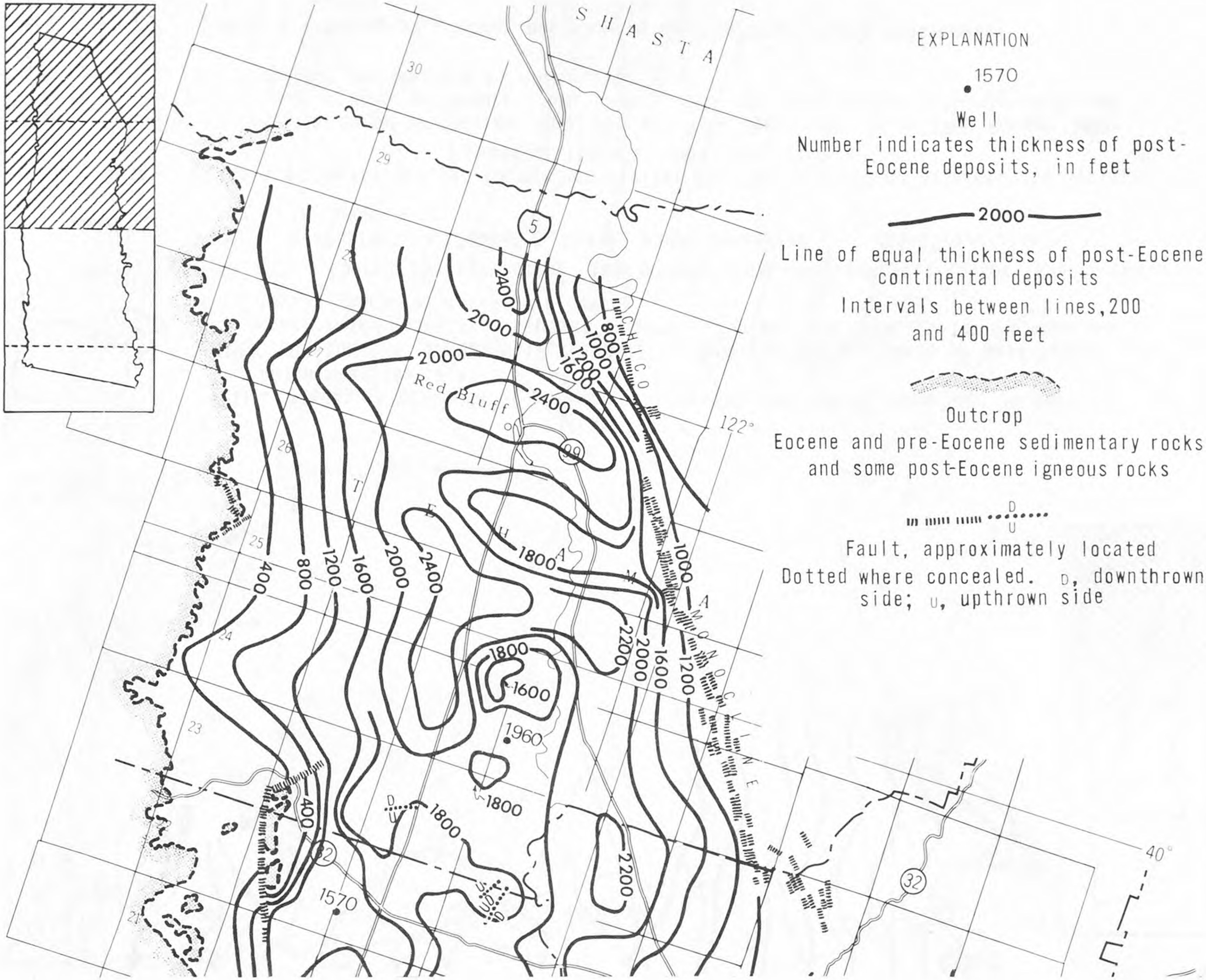
OUTCROP—Eocene and pre-Eocene sedimentary rocks and some post-Eocene igneous rocks

D U FAULT, APPROXIMATELY LOCATED—Dotted where concealed. D, downthrown side; U, upthrown side

Outcrop pattern of Eocene and pre-Eocene rocks after California Division of Mines and Geology, 1960a,b; 1962a,b; 1963; and 1966a,b.

Faulting modified after Barger and Sullivan, 1966; Beecroft, 1964; Bowen, 1962; Bruce, 1958; Burnett, 1963; California Division of Mines and Geology, 1960b, 1962a,b, 1963, and 1966a; California Division of Oil and Gas, 1960; Land, 1970; and Thomasson and others, 1960.

FIGURE 2.--Structure contour map showing base of post-Eocene continental deposits.


EXPLANATION
1570
Well
Number indicates thickness of post-Eocene deposits, in feet
2000
Line of equal thickness of post-Eocene continental deposits
Intervals between lines, 200 and 400 feet
Outcrop
Eocene and pre-Eocene sedimentary rocks and some post-Eocene igneous rocks
D
U
Fault, approximately located
Dotted where concealed. D, downthrown side; U, upthrown side
SHASTA
TEHAMA
CHICO MONOCLINE
Red Bluff
122°
40°
5
99
32
400
800
1200
1600
2000
2400
1800
2200
1000
1960
1570

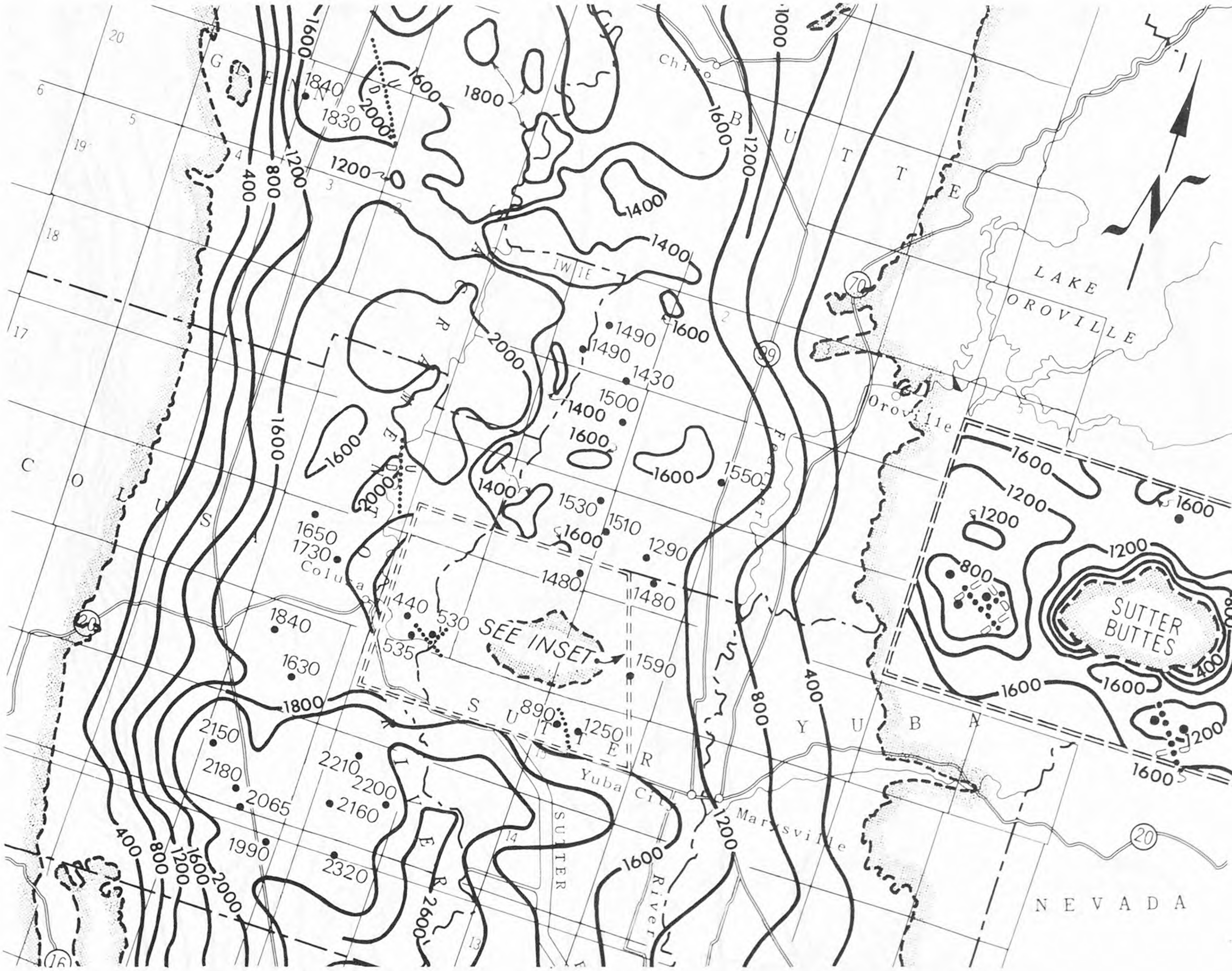
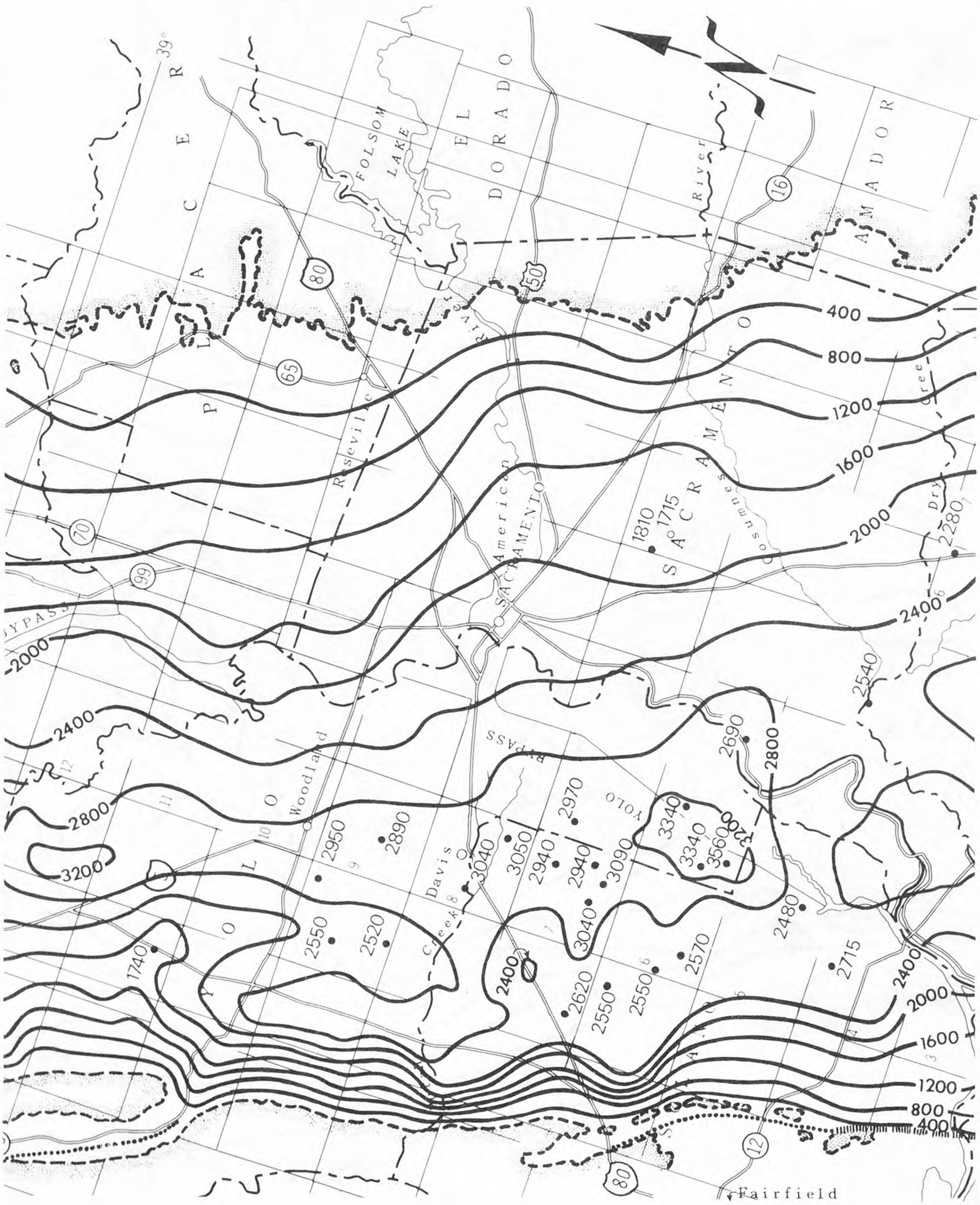


FIGURE 3.--Thickness map (continued on following two pages).


P L A C E R
E L D O R A D O
A M A D O R
S A C R A M E N T O
Y O L O
FOLSOM LAKE
River
Roseville
American
SACRAMENTO
Cosumnes
Dry Creek
Woodland
Davis
Creek
BYPASS
YOLO
Fairfield
400
800
1200
1600
2000
2400
2800
3200
1810
1715
2280
2540
2690
2950
2890
3040
3050
2940
2940
2970
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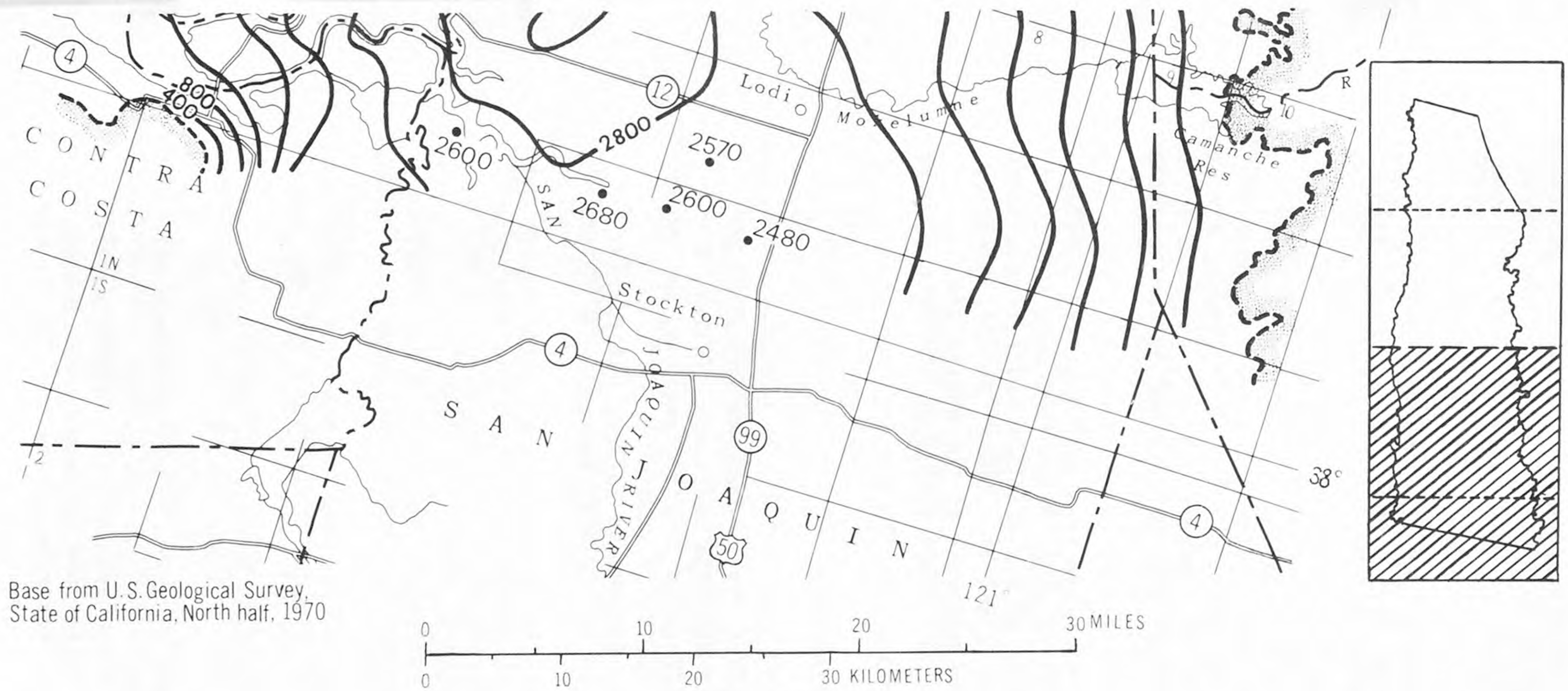
2550
2570
2480
2715



Base from U.S. Geological Survey, State of California, North half, 1970

EXPLANATION

• 2620 WELL—Number indicates thickness of post-Eocene deposits, in feet

—1600— LINE OF EQUAL THICKNESS OF POST-EOCENE CONTINENTAL DEPOSITS—Intervals between lines, 200 and 400 feet

OUTCROP—Eocene and pre-Eocene sedimentary rocks and some post-Eocene igneous rocks

D/U FAULT, APPROXIMATELY LOCATED—Dotted where concealed. D, downthrown side; U, upthrown side

Outcrop pattern of Eocene and pre-Eocene rocks after California Division of Mines and Geology, 1960a, b; 1962a, b; 1963; and 1966a, b.

Faulting modified after Barger and Sullivan, 1966; Beecroft, 1964; Bowen, 1962; Bruce, 1958; Burnett, 1963; California Division of Mines and Geology, 1960b, 1962a,b, 1963, and 1966a; California Division of Oil and Gas, 1960; Land, 1970; and Thomasson and others, 1960.

FIGURE 3.--Map showing thickness of the post-Eocene continental deposits.

The base of fresh ground water (3,000 micromhos per centimeter) generally lies well above the base of the post-Eocene deposits except along the flanks of the valley where locally it lies 800 feet or more below the base of those deposits (Berkstresser, 1973).

The structure of the base of the post-Eocene continental deposits (fig. 2) is that of a large syncline whose axis closely parallels the axis of the principal trough of the valley (Olmsted and Davis, 1961, fig. 2). In the subsurface, faulting has occurred mostly within the basal part of the overlying continental deposits, as indicated in reports of the California Division of Oil and Gas. But the faults shown along the Chico monocline probably penetrate the full thickness of the continental deposits, there the Tuscan Formation, as indicated by Burnett (1963, p. 39). Furthermore, Burnett (1963, p. 39) suggests that those faults, or fractures, do not extend beneath the base of the continental deposits because they were formed by the breaking of the Tuscan Formation during folding.

The continental deposits range in thickness from zero near the margins of the valley (the outcrops shown in fig. 3) to about 3,500 feet near Courtland. The thickest sections occur along the axis of the syncline which trends northward near the center of the valley (figs. 2 and 3). Sutter Buttes, however, interrupts the trend of the syncline, and adjacent to the Buttes the continental deposits are thinner than at any other locale in the central part of the valley.

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SPRINGS···FLOOD FREQUENCY···DIGITAL MONITOR···RAIN GAGE···F
ISSOLVED SOLIDS···WATER QUALITY···TEMPERATURE···STAGE-DIS
RIC···FLOODFLOW···PERCOLATION···CONFINING BED···METEORIC WA
CABLEWAY···TOTAL KJELDAHL NITROGEN···RUNOFF···PRECIPITATI
UTOMATIC ANALYZER···TURBIDITY···BIODEGRADATION···E. COLI··
ZONE OF SATURATION···BASE OF FRESH WATER···DEPOSITION···
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···HEAD DECLINE···EUTROPHICATION···MOISTURE EQUIVALENT···B
ECORDER···SEDIMENT TRANSPORT···DYE TRACER···STREAM GAGIN
DISSOLVED OXYGEN···SODIUM ADSORPTION···BIOCHEMICAL OXYGEN
OTENTIOMETRIC SURFACE···INFILTRATION···HEAD···ACRE-FEET···
IEVE SIZE···STREAMS···TOTAL NITROGEN···GRAIN SIZE···GRA
R···CUBIC FEET PER SECOND···SLOPE-AREA METHOD···DRAINAGE
RGANIC POLLUTION···SPECIFIC CONDUCTANCE···TOTAL ORGANIC C
WATER TABLE···HYDROLOGY···SUBSURFACE GEOLOGY···DIVERSION
LOOD PLAIN···COMPUTER READOUT···NO-FLOW BOUNDARY···AQUITARD
···EVAPOTRANSPIRATION···RECHARGE···VELOCITY···STREAM PROFIL

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