DEPARTMENT OF THE INTERIOR
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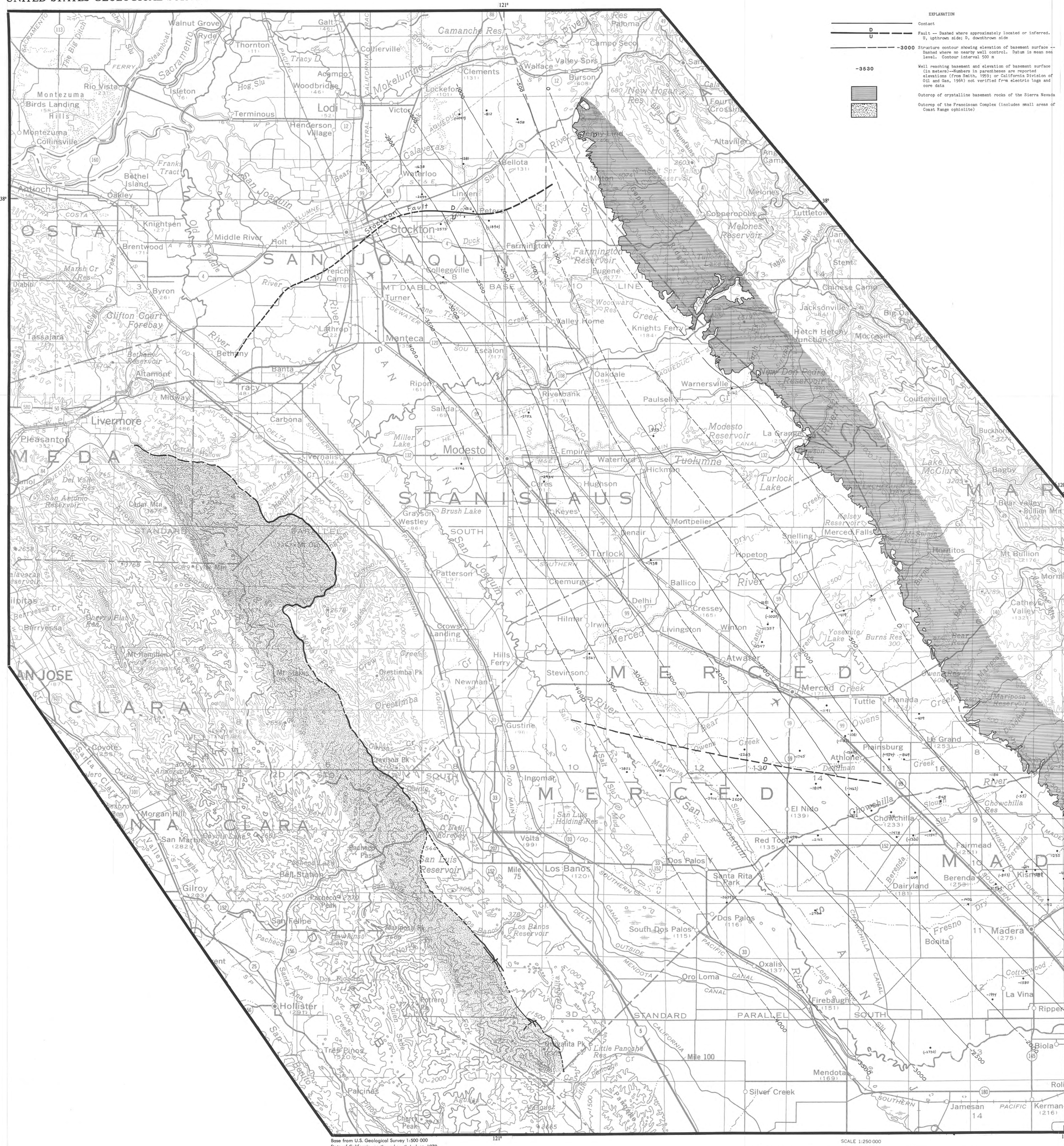
MISCELLANEOUS FIELD STUDIES
MAP MF-1430



MAP SHOWING CONFIGURATION OF THE BASEMENT SURFACE, NORTHERN SAN JOAQUIN VALLEY, CALIFORNIA

By
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INTRODUCTION

This map is a by-product of a study of the northern San Joaquin Valley that was directed mainly toward the Tertiary strata. Electric logs and core descriptions collected for wells used in the Tertiary study included nearly all of the relatively few exploratory wells in the map area that reached basement.

Although the configuration of the basement surface shown on this map differs in only a few respects from that shown by Smith (1964) for the same area, this map is considered more reliable because the depths to basement were verified by using well logs and core data, whereas Smith relied on reported depths. Also, this map is drawn at a larger scale that allows for the inclusion of more data points.

DATA SOURCES

The depths to basement used in preparing this map were obtained from electric logs supplemented by core descriptions for approximately 50 wells. Very few wells actually have cores spanning the sediment-basement contact, but many have cores from just above the basement or just below the top of basement. When these cores are used in conjunction with electric logs, in which the basement is generally characterized by relatively high resistivity, the top of the basement can usually be located within a meter or two. Basement tops determined in this way were generally in close agreement with reported tops, such as those compiled by Smith (1959), but in some cases differed by as much as 10 m. For a few wells where the reported basement top could not be verified, the figures of Smith (1959) or the California Division of Oil and Gas (1964) were used (shown in parentheses on map).

The data points were contoured by hand and the spacing of contours estimated by eye rather than by interpolating between data points. It was assumed that the basement surface had been eroded to a nearly featureless plain, although it is recognized that valleys or local highs may be present that cannot be resolved by the widely spaced data. The resulting map shows a generalized surface and is purely interpretive.

The outcrop area of the Franciscan Complex and the location of faults on the west side of the valley were taken from Jennings and Strand (1958) and Rogers (1966). The Stockton fault is modified from Teitsworth (1964).

STRUCTURE

The basement surface in the northern San Joaquin Valley, within the resolving power of the limited data, is generally undeformed except for a southeastward tilt. It slopes southwestward at a rate that ranges from 103 m/km (5.9°) in the northern part of the area to 73 m/km (4.2°) in the southern part, with an average slope of 85 m/km (5°). This slope is significantly greater than the dip of the overlying Cretaceous strata, which averages only 1-3° (Hoffman, 1964), and implies an eastward onlap. In the Modesto-Merced area, the slope of the basement surface appears to steepen from about 70 m/km in the eastern part of the valley to about 115 m/km approaching the western limit of the area for which data is available.

The Stockton fault is a major transverse structure at the north end of the map area that is well known from the gas wells that have penetrated the fault plane. The fault dips southward, and downthrow of Cretaceous strata north of the fault of as much as 1100 m indicates a reverse sense of movement in post-Cretaceous time (Hoffman, 1964). The basement surface is higher on the north side of the fault, however, and must have been even higher before post-Cretaceous movement raised the south side. It seems probable, therefore, as suggested by Teitsworth (1964), that displacement of the basement surface occurred, down on the south side, prior to deposition of the Upper Cretaceous strata. This displacement must have been on the order of several hundred meters. Renewed fault movement in post-Cretaceous time was in the opposite sense. There is disagreement about possible lateral movement on the Stockton fault. Teitsworth (1964) inferred that left-lateral movement had occurred in Late Cretaceous or Paleogene time, but Hoffman (1964) saw no evidence for lateral movement.

A normal fault transverse to regional structure is here inferred to exist in the area south of Merced. The location and trend of this fault are not well constrained by data on the basement-surface elevation, but clues are provided by structure maps of Tertiary horizons. A post-Eocene unconformity, for example, appears to be displaced by as much as 670 m, down to the north. The fault appears to coincide with a diffuse surface lineament that is visible on satellite imagery. The lineament across the valley is only a short segment of a much larger feature that extends from the Diablo Range to Death Valley and which was named the Kings Canyon lineament by Anttonen, Daneby, and Fallin (1974). Although there is some uncertainty about the exact location and trend of this fault, it is not the east-trending strike-slip fault that was inferred by Cady (1975) to offset the Great Valley magnetic and gravity anomalies left laterally. That fault would be farther south, near Fresno.

LITHOLOGY OF THE BASEMENT

The Upper Jurassic to Paleocene Great Valley sequence lies unconformably on Sierran metamorphic and plutonic rocks on the east side of the San Joaquin Valley and conformably on the Coast Range ophiolite on the west side. The Great Valley sequence is in fault contact with the Franciscan Complex or fragments of ophiolite where they crop out in the Diablo Range (Page, 1981). The location and nature of the contact between the Sierran basement and the ophiolite, as well as the nature of the relationship between the Franciscan and the ophiolite or the Sierran basement under the valley, are major unresolved problems in California geology.

Data from oil and gas wells are, unfortunately, of little help in determining the lithology of the basement rocks. Onsite descriptions of cores were usually aimed merely at determining whether or not the drill reached basement; the exact lithology of the basement rocks was of less concern and virtually no petrographic examinations were undertaken. Therefore, few core descriptions of the basement rocks can be used for petrologic purposes. May and Hewitt (1948) made petrographic determinations of the few well samples from the San Joaquin Valley that were available; there are even fewer extant samples from basement cores on which further petrographic work could be based. The summary of basement lithologies made by Cady (1975) in conjunction with his geophysical study probably cannot be improved upon with the descriptions and samples now available.

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