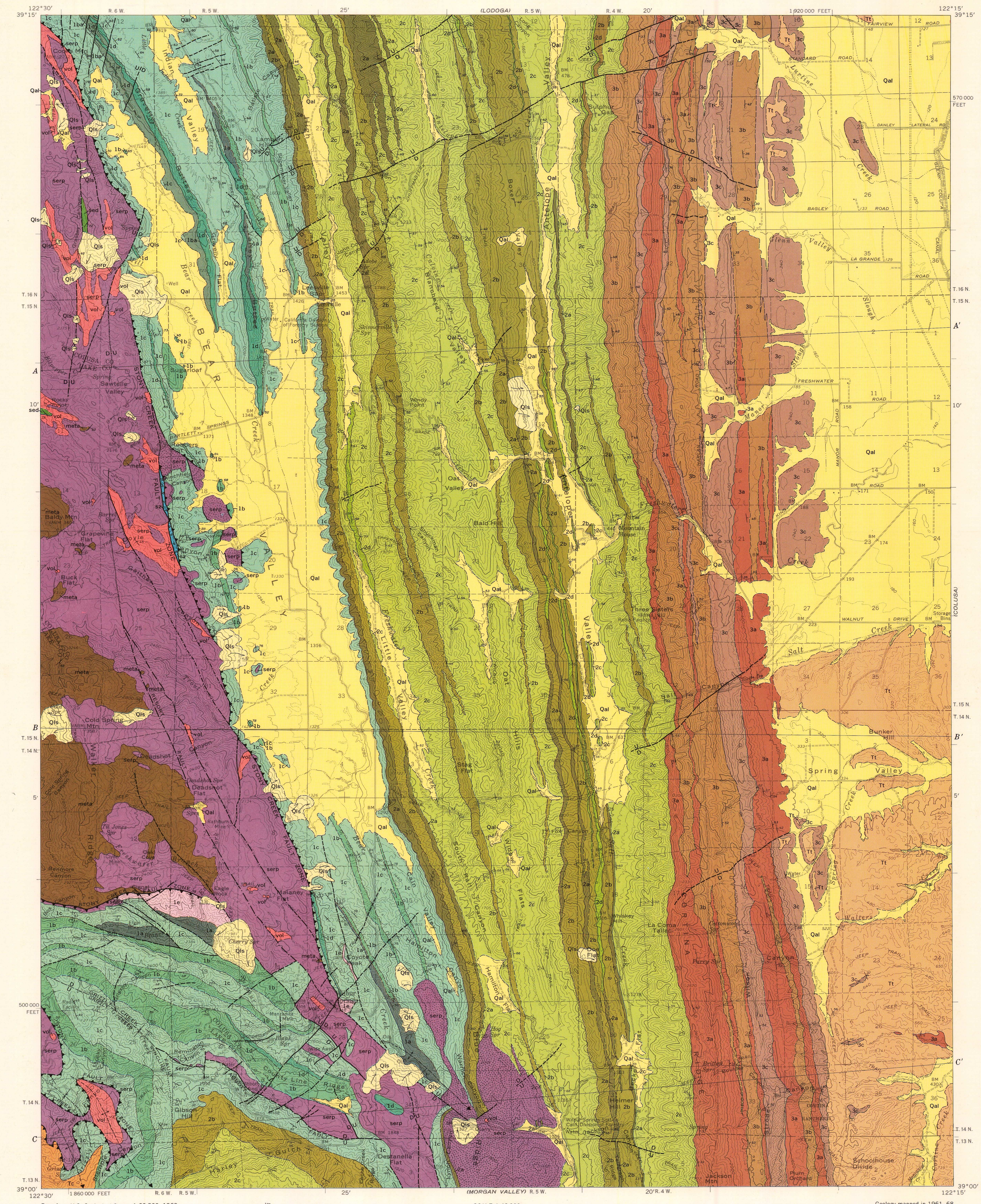


Base from U.S. Geological Survey 1:62,500, 1963
10,000-foot grid based on California coordinate system, zone 2

TRUE NORTH
MAGNETIC NORTH
18°
APPROXIMATE MEAN DECLINATION, 1971

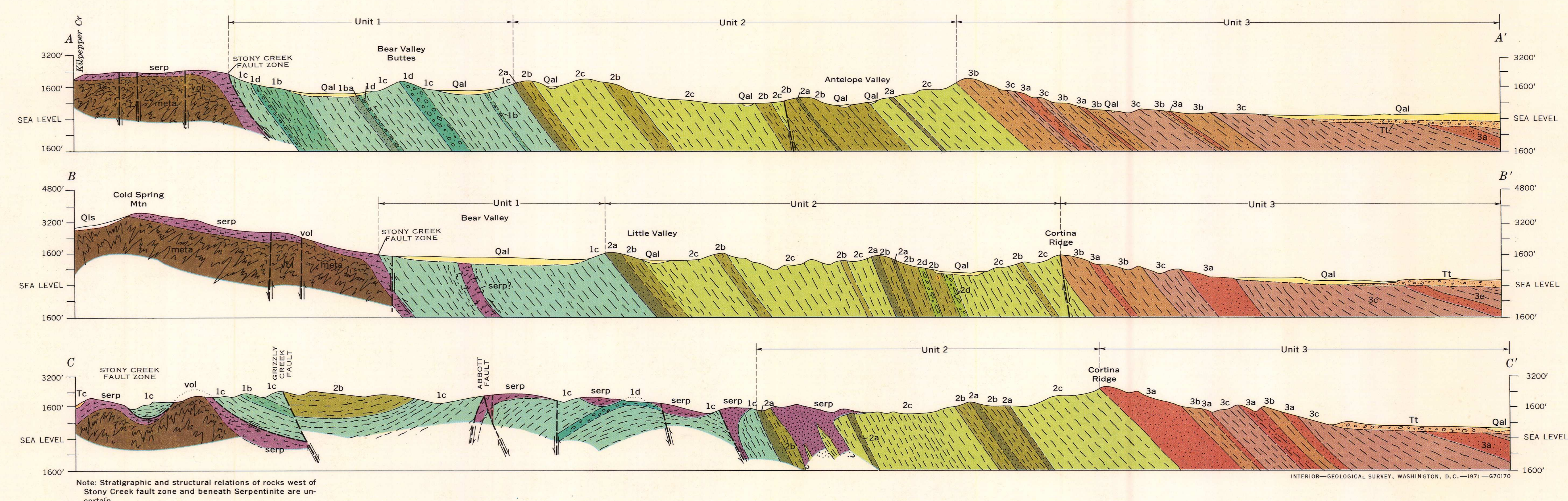
SCALE 1:48 000

1 ½ 0 1 2 3 MILES

1 .5 0 1 2 3 KILOMETERS

CONTOUR INTERVAL 80 FEET
DOTTED LINES REPRESENT 20 FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

Geology mapped in 1961-68



Note: Stratigraphic and structural relations of rocks west of Stony Creek fault zone and beneath Serpentinite are uncertain

EXPLANATION

ROCKS ABOVE MAIN PART OF STONY CREEK FAULT ZONE

QUATERNARY

Qal Qls

Alluvium and landslide debris

Qal, *alluvium; unconsolidated clay, silt, sand, and gravel, poorly sorted and poorly stratified*

Qls, *landslide debris. Arrow indicates direction of movement*

TERTIARY — Pliocene

Tt Tc

Tehama Formation (east) and Cache Formation of Anderson (1936) (west) (Relative ages uncertain)

Tt, *Tehama Formation; consolidated blue-green claystone containing beds and lenses of poorly indurated conglomerate, sandstone, and siltstone. Exposed only in eastern part of map area*

Tc, *Cache Formation; white to light gray, poorly bedded, poorly consolidated gravel, sandstone, and siltstone. Exposed only in southwest corner of area*

CRETACEOUS — Upper Cretaceous

3a 3b 3c

Unit 3

3a, *sandstone, light- to medium-olive-gray, thin-bedded to massive, fine- to coarse-grained*

3b, *sandstone and siltstone, thinly interbedded in about equal amounts*

3c, *mudstone and siltstone, medium- to dark-gray, thinly bedded to laminated*

Sandstone beds of unit 3 are characterized by about equal proportions of quartz and feldspar, 20-25 percent; rock fragments, 30-40 percent; and mica, 1 to 5 percent; quartz to feldspar ratio 0.7-1.0; plagioclase to K-feldspar ratio about 2.0

Unit contains megafossils of Turonian age near the base and Campanian age near the top. Includes Venado, Yolo, Sites, Funks, and Guinda Formations of Kirby (1943)

Lower and Upper Cretaceous

2a 2b 2c 2d

Unit 2

2a, *sandstone, light-olive-gray, thin-bedded to massive, fine- to medium-grained*

2b, *sandstone and siltstone, thinly interbedded in about equal amounts*

2c, *mudstone and siltstone, thinly bedded to laminated*

2d, *conglomerate, massive to thick-bedded, poorly sorted; composed chiefly of pebbles of chert and andesitic rocks with clasts of sedimentary rocks*

Sandstone beds in lower two-thirds of unit are characterized by quartz, 45-64 percent; feldspar, 15-35 percent; rock fragments, 15-25 percent; quartz to feldspar ratio, 1.8 to 2.5. Sandstone beds in upper one-third of unit are characterized by quartz, 30-50 percent; feldspar, 20-30 percent; rock fragments, 20-45 percent; quartz to feldspar ratio, 1.0-1.5; plagioclase to K-feldspar ratio about 1.0

Contains megafossils of Albian and Cenomanian age in upper one-third of unit

JURASSIC AND CRETACEOUS — Upper Jurassic and Lower Cretaceous

1a 1b 1c 1d 1ba 1e

Unit 1

1a, *sandstone, pale-olive-gray, thin- to medium-bedded, fine- to coarse-grained*

1b, *sandstone and siltstone, thinly interbedded in about equal amounts*

1c, *mudstone and siltstone, dark-gray to greenish-gray, thinly bedded to laminated, tuffaceous near base of formation*

1d, *conglomerate, massive to thick-bedded; composed chiefly of pebbles of chert and andesitic basaltic rocks; in places contains pebbles and cobbles of diorite or quartz diorite*

1e, *pillow basalt, flow breccia, and volcanic-rich sedimentary rock*

1ba, *basaltic sandstone, dark-gray to greenish-black, thin-bedded to massive, medium- to coarse-grained; composed chiefly of poorly sorted basaltic debris and chloritized (?) basaltic debris; most beds exhibit graded bedding*

Sandstone beds of unit 1 are characterized by about equal amounts of quartz and feldspar, 20 percent each; and volcanic-rock fragments, 40-80 percent; K-feldspar, only in minor amounts

Contains megafossils of Late Jurassic and Early Cretaceous ages. Buchia pacifica *(D. L. Jones, oral commun., 1966,) in zone 50-150 feet thick about 3,000 feet below top of formation and* Buchia piochii *(Late Jurassic) beneath* B. pacifica *zone.* B. uncitoides *(Berriasian) from conglomerate unit underlying Bear Valley Buttes*

AGE RELATIONSHIPS UNKNOWN

serp

Serpentinite

Intensely sheared and foliated serpentinite containing rounded blocks of serpentinized peridotite and slivers of sedimentary rocks. Includes detrital serpentine of previous workers

ROCKS ASSOCIATED WITH STONY CREEK FAULT ZONE

vol

Volcanic rocks

Finely crystalline volcanic rocks, chiefly pillow basalt and flow breccia, extensively altered to greenstone near Stony Creek fault zone. In places exotic blocks of hypabyssal rocks, chiefly diabase, enclosed in serpentinite

serp

Serpentinite

Serpentinized peridotite and serpentinite, undifferentiated. In places pyroxene crystals as much as half an inch in diameter partly altered to bastite and lattice structures. Contact with country rock commonly sheared. May include some diapiric or detrital serpentine of previous workers

sz

Shear zone debris

Finely divided rock debris of mixed parentage. Chiefly clayey gouge, but contains exotic fragments as much as 8 inches in diameter

ROCKS BELOW MAIN PART OF STONY CREEK FAULT ZONE

sed

Sedimentary rocks

Sandstone and siltstone; sandstone, dark-gray to greenish-gray, medium- to coarse-grained with interbeds of thin-bedded to laminated siltstone and mudstone

meta

Metasedimentary rocks

Phyllonite and semischist whose original lithology resembles rocks found east of Stony Creek fault zone. Cataclastic texture most pronounced near thrust zone

Contact

Long-dashed where approximately located; short-dashed where gradational or inferred; dotted where concealed

U
D

Fault

Long-dashed where approximately located; short-dashed where inferred; dotted where concealed. U, *upthrown side;* D, *downthrown side*

Thrust fault

Dashed where approximately located. Sawteeth on upper plate

Probable fault in serpentinite

Located from lineaments on aerial photographs and alinement of springs and slivers of exotic rocks; dotted where questionable

Syncline

Showing trace of axial plane

Anticline

Showing trace of axial plane

35 50 63

Inclined Vertical Overturned

Strike and dip of beds

Dot indicates top of beds unknown

STRATIGRAPHY

The marine sedimentary rocks within the Wilbur Springs quadrangle range in age from Late Jurassic (Tithonian) to Late Cretaceous (Campanian) and, in gross aspect, are a thick succession of fine-grained hemipelagic deposits enclosing isolated mappable units of coarser grained sandstone, conglomerate, or discrete sets of coarse-grained beds. Commonly, the coarse-grained beds are restricted in lateral extent, but a few of them have wide areal distribution. Crook (1959) ascribes such a succession of rocks to deposition in deep-water troughs in which fine-grained hemipelagic sedimentation is continuous through time. Intermittent incursions of coarse-grained material, usually the result of turbidity currents or submarine slumps, are geologically instantaneous and form lensoid or tongue-shaped deposits within the fine-grained hemipelagic material. From time to time, major tectonic events in the source area of the sediment may cause a rapid influx of coarse clastic debris which is distributed widely throughout much of the trough by longitudinal marine currents. The coarse-grained deposits are preserved as the only distinctly mappable strata.

The formal stratigraphic names previously used to subdivide the thick Mesozoic sedimentary section are not adopted on the geologic map because: (a) many of the formal names (such as Paskenta, Horsetown, Chico) for the rocks are based upon supposed age relations, rather than upon mappable lithologic boundaries; (b) several of the formational units, defined by Kirby (1943), are not mappable in the Wilbur Springs quadrangle as they lens or grade laterally into rocks of different lithology; and (c) both small- and large-scale intertonguing of units and complex facies relations exist in all parts of the section. Redefinition of existing nomenclature or definition of new stratigraphic units is beyond the scope of this publication.

The mappable unmetamorphosed strata of pre-Tertiary age are represented on the accompanying geologic map by a standardized letter symbol, a through e, denoting lithologic texture, particularly grain size. The strata are further grouped into numbered units. The contacts between the lettered subunits are gradational; hence, they were selected on the basis of textural criteria. The petrologic characteristics were used to define the major numbered units. The contacts between the major numbered units are placed at the base of the lowest lithologically persistent sandstone bed that has the petrologic characteristics of the higher of the two units concerned.

The coarse-grained beds of each unit have similar petrologic characteristics. These characteristics, which are expressed as the relative content of quartz, plagioclase, K-feldspar, lithic fragments, and mica, are described in the map explanation. The proportion of each constituent is an average of modal point counts, recalculated to 100 percent. The petrologic variations in the sandstone beds within the sequence may be generalized as follows (from base to top): (a) an increase in K-feldspar with an accompanying decrease in plagioclase to K-feldspar ratio; (b) an increase in mica; and (c) a reversible change in the percentage content of lithic fragments.

STRUCTURE

The Wilbur Springs quadrangle is divided by the Stony Creek fault zone into two structurally dissimilar terranes. East of the fault zone, the little deformed sandstone, siltstone, and conglomerate beds of the late Mesozoic succession dip homoclinally eastward under the alluviated Sacramento Valley. West of the fault zone and north of the Wilbur Springs Resort, the rocks are strongly deformed. They are cataclastically metamorphosed volcanic rocks, sandstone, and siltstone—the Franciscan assemblage of Bailey and others (1964). These rocks are structurally overlain by, and locally fragments of them are engulfed in, a sheetlike body of serpentinite. North of the Wilbur Springs quadrangle the Stony Creek fault zone is most probably a zone of thrusts that has placed the unmetamorphosed sedimentary rocks of the Sacramento Valley structurally against the cataclastic rocks (Blake and others, 1967; Irwin, 1966; Page, 1966; Brown, 1964; Bailey and others, 1964). The eastern trace of the thrust is marked along much of its length by linear and sheetlike bodies of serpentinite half a mile to 2 miles wide.

Within the Wilbur Springs quadrangle, the Stony Creek fault zone is extremely complex and is necessarily simplified on the geologic map. The surface trace parallels the western margin of Bear Valley, but south and west of the Wilbur Springs Resort it has been sharply folded, offset by the Resort fault, and probably underlies much of the southwestern part of the map.

Serpentinite has been injected into and overlies rocks of the late Mesozoic sedimentary sequence along a branch of the Stony Creek fault zone, secs. 18, 19, and 20, T. 15 N., R. 5 W. The contact relations are clearly exposed in Stinchfield Canyon, in the hills on either side of a small reservoir that straddles the line between sections 18 and 19, and in the hill south of the ranch house in section 20. The rocks east of the serpentinite are steeply tilted to overturned; those on the west are strongly deformed and locally sheared. In the NW¼ sec. 18, the serpentinite overlies the sedimentary rocks and merges with the large serpentinite mass west of the Stony Creek fault zone. A few isolated knobs in sections 18 and 19 are capped by serpentinite, and near the junction of sections 19 and 30 serpentinite projects eastward from the Stony Creek fault zone across the upturned edges of the sedimentary strata. Two isolated knobs that project above the alluvium in sections 29 and 32 are made up of steeply dipping siltstone beds capped by a thin veneer of serpentinite. The fault in the southern part of Bear Valley is covered by the alluvium, although its position may be indicated by several alined springs. The mapped relations, the assumed trace of the fault, and the serpentinite now preserved as isolated patches overlying the sedimentary rocks may indicate that serpentinite once covered most of the western and southwestern part of Bear Valley.

The southwestern part of the quadrangle is probably underlain by the Stony Creek fault zone. The serpentinite-surrounded patches of volcanic rock exposed in the cores of small anticlines near Grizzly Creek are probably part of this folded thrust. Between these exposures of serpentinite and Destanella Flat, the rocks of unit 1 are intricately broken by a network of folds and faults only a few of which could be shown at the scale of the map.

The serpentinite body east of Warnick-Lynch Canyons (secs. 26, 35, and 36, T. 14 N., R. 5 W., and secs. 1 and 2, T. 13 N., R. 6 W.) is considered here to have been intruded into the sedimentary sequence either along bedding planes or along other zones of weakness that developed during the principal episode of folding and thrusting. The serpentinite is foliated breccia, of which 20-40 percent is massive serpentinized peridotite blocks as much as 10 feet in diameter, and the remainder is a foliated slickensided mash of crushed serpentinite. Exotic blocks of metasedimentary and metavolcanic rocks, as well as long, thin slivers of fossiliferous limestone, mudstone, and siltstone, are enclosed within the foliated serpentinite. In a few places, surface creep or landsliding has extended the outcrop area of the serpentinite, and locally covered or incorporated penecontemporaneous clastic serpentinite debris. This body of serpentinite has previously been described as detrital serpentine (Taliaferro, 1943).

The serpentinite between Warnick Canyon and Bear Creek and that exposed along the Abbot fault are nearly vertical dikes that, at the surface, blend into a carapace-like structure similar to that described by Dickinson (1966).

REFERENCES CITED

Anderson, C. A., 1936, Volcanic history of the Clear Lake area, California: Geol. Soc. America Bull., v. 47, no. 5, p. 629-644.

Bailey, E. H., Irwin, W. P., and Jones, D. L., 1964, Franciscan and related rocks and their significance in the geology of western California: California Div. Mines and Geology Bull. 183, 177 p.

Blake, M. C., Jr., Irwin, W. P., and Coleman, R. G., 1967, Upsidedown metamorphic zonation, blueschist facies, along a regional thrust in California and Oregon, *in* Geological Survey research, 1967: U.S. Geol. Survey Prof. Paper 575-C, p. C1-C9.

Brown, R. D., Jr., 1964, Geologic map of the Stonyford quadrangle, Glenn, Colusa, and Lake Counties, California: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-279, scale 1:48,000.

Crook, K. A. W., 1959, Lithotopic relationships in deep-water troughs: Jour. Sed. Petrology, v. 29, no. 3, p. 336-342.

Dickinson, W. R., 1966, Table Mountain serpentinite extrusion in California Coast Ranges: Geol. Soc. America Bull., v. 77, no. 5, p. 451-472.

Irwin, W. P., 1966, Geology of the Klamath Mountains Province, *in* Bailey, E. H., ed., Geology of northern California: California Div. Mines and Geology Bull. 190, p. 19-38.

Kirby, J. M., 1943, Upper Cretaceous stratigraphy of west side of Sacramento Valley south of Willows, Glenn County, California: Am. Assoc. Petroleum Geologist Bull., v. 27, no. 3, p. 279-305.

Page, B. M., 1966, Geology of the Coast Ranges of California, *in* Bailey, E. H., ed., Geology of northern California: California Div. Mines and Geology Bull. 190, p. 255-276.

Taliaferro, N. L., 1943, Franciscan-Knoxville problem: Am. Assoc. Petroleum Geologist Bull., v. 27, no. 2, p. 109-219.

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1971—670776

GEOLOGIC MAP OF THE WILBUR SPRINGS QUADRANGLE, COLUSA AND LAKE COUNTIES, CALIFORNIA

By
E. I. Rich

1971

For sale by U.S. Geological Survey, price $1.00