

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PHOSPHATIC ROCK LOCALITIES IN CALIFORNIA

by

Albert E. Roberts

Open-File Report
81-260

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

Introduction

California, a leading agricultural state, needs an ever increasing amount of phosphorus, an essential element for plant growth, to improve crop yields. Current requirements for phosphorus are met by imports or as by-products from other industry, such as phosphoric acid from Searles Lake brines.

Marine phosphatic-rocks are distributed throughout the world with a stratigraphic range of Pre-Cambrian to Quaternary age. Marine phosphatic-rocks in California are presently known in sedimentary sequences that range from Ordovician to Quaternary; however, no significant economic deposits have yet been developed. Current geologic information indicates the highest potential is in the widespread phosphatic-rocks in formations of Miocene age. Stratigraphic units in which the principal deposits occur are the Santos Shale Member of the Temblor Formation (Lower Miocene) in the Temblor Range; Sandholdt Member of the Monterey Formation (Middle Miocene) in the Santa Lucia and La Panza Ranges; and phosphatic members of the Santa Margarita Formation (Upper Miocene) in the Sierra Madre and San Rafael Mountains.

This preliminary map was compiled as a part of the U.S. Geological Survey's program to evaluate the phosphate resources of the United States. This map was prepared to summarize known localities and provide planning for future onsite field studies; to identify phosphate-bearing lands relative to federal leasing programs; and to encourage field examination and reporting of additional phosphate information by other researchers. The map shows the location of reported occurrences of phosphatic rocks at a scale of 1:500,000. Locality points are shown by triangle for surface rocks and circle for subsurface rocks. The companion text provides essential basic information on stratigraphic unit, age, brief remarks, and references cited. Location is by county, quadrangle, and township and range related to H.B. and M. [Humbolt base line and meridian]; M.D.B. and M. [Mount Diablo base line and meridian]; and S.B.B. and M. [San Bernardino base line and meridian]. In unsurveyed areas projected township sections are marked by an asterisk.

References cited

- Aarons, B. L., 1958, Geology of a portion of the Las Trampas Ridge and Hayward quadrangles, California: University of California [Berkeley] unpublished M.S. thesis, 76 p.
- Addicott, W. O., 1967, Age of the Skooner Gulch Formation, Mendocino County, California: U. S. Geological Survey Bulletin 1254-C, 11 p.
- Adkison, W. L., 1973, Lithologic characteristics of upper Oligocene and Miocene rocks drilled at Elk Hills, Kern County, California: U. S. Geological Survey Bulletin 1375, 113 p.
- Albright, M. B., Jr., 1954, Rosedale oil field [Kern County]: California Oil Fields, v. 40, no. 1, p. 30-39.
- Albright, M. B., Hluza, A. G., and Sullivan, J. C., 1957, Mt. Poso oil field [Kern County]: California Oil Fields, v. 43, no. 2, p. 5-20.
- Anderson, J. Q., 1952, Gujarral Hills oil field, in Field trip routes, geology, oil fields: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Economic Geologists Guidebook, Joint Annual Meeting, Los Angeles, California, 1952, p. 184-188.
- Bandy, O. L., and Kolpack, R. L., 1963, Foraminiferal and sedimentological trends in the Tertiary sections of the Telcolote Tunnel, California: Micropaleontology, v. 9, no. 2, p. 117-170.
- Barron, J. A., 1976, Middle Miocene-lower Pliocene marine diatom and silicoflagellate correlations in the California area, in Neogene Symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 117-124.
- Bentor, Y. K., and Kastner, M., 1976, Combustion Metamorphism in Southern California: Science, v. 193, p. 486-488.
- Bixler, G. H., and Sawyer, D. L., 1957, Boron chemicals from Searles Lake brines: Industrial and Engineering Chemistry, v. 49, p. 322.
- Brabb, E. E., 1960, Geology of the Big Basin area, Santa Cruz Mountains, California: Stanford University unpublished Ph.D. thesis, 197 p.
- _____, 1964, Subdivision of San Lorenzo Formation (Eocene-Oligocene) west-central California: American Association of Petroleum Geologists Bulletin, v. 48, no. 5, p. 670-679.
- Brabb, E. E., Bowen, D. E., Jr., and Hart, E. W., 1962, Field trip No. 2 San Francisco to Monterey via California Highways 1, 5, 17, and connecting routes, March 26, 1962: California Division of Mines Bulletin 181, p. 381-390.

- Brabb, E. E., Bukry, D., and Pierce, R. L., 1971, Eocene (Refugian) nannoplankton in the Church Creek Formation near Monterey, central California: U. S. Geological Survey Professional Paper 750-C, p. C44-C47.
- Brabb, E. E., Clark, J. C. and Throckmorton, C. K., 1977, Measured sections of Paleogene rocks from the California Coast Ranges: U. S. Geological Survey Open-File Report 77-714, 113 p.
- Bramlette, M. N., 1946, The Monterey Formation of California and the origin of its siliceous rocks: U. S. Geological Survey Professional Paper 212, 57 p.
- Bramlette, M. N., and Daviess, S. N., 1944, Geology and oil possibilities of the Salinas Valley, California: U. S. Geological Survey Oil and Gas Investigations Preliminary Map 24.
- Brown, R. S., 1959, The geology of the Grimes Canyon area, Moorpark and Fillmore quadrangles, Ventura County, California: University of California [Los Angeles] unpublished M.A. thesis, 114 p.
- Campbell, R. H., Blackerby, B. A., Yerkes, R. F., Schoellhammer, J. E., Birkeland, P. W., and Wentworth, C. M., 1970, Preliminary geologic map of the Point Dume quadrangle, Los Angeles County, California: U. S. Geological Survey Open-File Map.
- Cassell, J. K., 1949, Variation of the Monterey Formation, California, near the type locality: Stanford University unpublished M.S. thesis, 62 p.
- Clark, J. C., 1966, Tertiary stratigraphy of the Felton-Santa Cruz area, Santa Cruz Mountains, California: Stanford University unpublished Ph.D. thesis, 184 p.
- Cross, R. K., 1962, Geology of the Carrizo-Cuyama basin, in Karp, S. E., editor, Geology of Carrizo Plains and San Andreas fault: San Joaquin Geological Society and Pacific Sections of the American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Guidebook, 1962, p. 27-35.
- Crowder, R. E., 1958, Inglewood City area of Potrero oil field: [Los Angeles County] California Oil Fields, v. 44, no. 1, p. 27-34.
- Cummings, J. C., Touring, R. M., and Brabb, E. E., 1962, Geology of the northern Santa Cruz Mountains, California: California Division of Mines and Geology Bulletin 181, p. 179-220.
- Curtin, G., 1955, Pyramid Hills oil field [Kings County]: California Oil Fields, v. 41, no. 2, p. 25-33.
- Cushman, J. A., and Laming, B., 1931, Miocene Foraminifera from Los Sauces Creek, Ventura County, California: Journal of Paleontology, v. 5, no. 2, p. 79-120.

- Davis, E. L., 1943, Torrence oil field, in Geologic formations and economic development of the oil and gas fields of California: California Division of Mines Bulletin 118, p. 298-300.
- Dibblee, T. W., Jr., 1950, Geology of southwestern Santa Barbara County, California—Point Arguello, Lompoc, Point Conception, Los Olivos, and Gaviota quadrangles: California Division of Mines and Geology Bulletin 150, 95 p.
- _____, 1966, Geology of the Palo Alto quadrangle, Santa Clara and San Mateo Counties, California: California Division of Mines and Geology, Map Sheet 8.
- _____, 1967, Areal geology of the western Mojave Desert, California: U. S. Geological Survey Professional Paper 522, 153 p.
- _____, 1977, Geologic map of the Las Yeguas Ranch quadrangle, Kern and San Luis Obispo Counties, California: U. S. Geological Survey Open-File Report 77-610.
- Dickert, P. F., 1971, Neogene phosphatic facies in California: Stanford University unpublished Ph.D. thesis, 305 p.
- Dickinson, W. R., 1956, Tertiary stratigraphy and structure west of the Arroyo Seco, Monterey County, California: Stanford University unpublished M.S. thesis, 160 p.
- _____, 1965, Tertiary stratigraphy of the Church Creek area, Monterey County, California: California Division of Mines and Geology Special Report 86, p. 25-44.
- Dickinson, W. R., and Lowe, D. R., 1966, Stratigraphic relations of phosphate- and gypsum-bearing Upper Miocene strata, upper Sespe Creek, Ventura County, California: American Association of Petroleum Geologists Bulletin, v. 50, no. 11, p. 2464-2481.
- Dickinson, W. R., and Rich, E. I., 1972, Petrologic intervals and petrofacies in the Great Valley Sequence, Sacramento Valley, California: Geological Society of America Bulletin, v. 83, p. 3007-3024.
- Diepenbrock, Alex, 1933, Mount Poso oil field [Kern County]: California Division Oil and Gas, California Oil Fields—Summary of Operations, v. 19, no. 2, p. 5-35.
- Dietz, R. S., Emery, K. O., and Shepard, F. P., 1942, Phosphorite deposits on the sea floor off southern California: Geological Society of America Bulletin, v. 53, no. 6, p. 815-848.
- Durham, D. L., 1963, Geology of the Reliz Canyon, Thompson Canyon, and San Lucas quadrangles, Monterey County, California: U. S. Geological Survey Bulletin 1141-Q, Q1-Q41.

- Durham, D. L., 1964, Geology of the Cosio Knob and Espinosa Canyon quadrangles, Monterey County, California: U. S. Geological Survey Bulletin 1161-H, H1-H29.
- _____, 1965, Geology of the Jolon and Williams Hill quadrangles, Monterey County, California: U. S. Geological Survey Bulletin 1181-Q, p. Q1-Q27.
- _____, 1968a, Geology of the Tierra Redonda Mountain and Bradley quadrangles, Monterey and San Luis Obispo Counties, California: U. S. Geological Survey Bulletin 1255, 60 p.
- _____, 1968b, Geologic map of the Adelaida quadrangle, San Luis Obispo County, California: U. S. Geological Survey Geologic Quadrangle Map GQ-768.
- _____, 1970, Geology of the Sycamore Flat and Paraiso Springs quadrangles, Monterey County, California: U. S. Geological Survey Bulletin 1285, 34 p.
- _____, 1974, Geology of the southern Salinas Valley area, California: U. S. Geological Survey Professional Paper 819, 111 p.
- Durham, D. L., and Yerkes, R. F., 1964, Geology and oil resources of the eastern Puente Hills area, southern California: U. S. Geological Survey Professional Paper 420-B, p. B1-B62.
- Durrell, Cordell, and d'Allura, Jad, 1977, Upper Paleozoic section in eastern Plumas and Sierra Counties, northern Sierra Nevada, California: Geological Society of America Bulletin, v. 88, no. 6, p. 844-852.
- Edwards, E. C., 1943, Kern Front area of the Kern River oil field [Kern County]: California Division of Mines Bulletin 118, p. 571-574.
- Emery, K. O., 1950, Ironstone concretions and beach ridges of San Diego County, California: California Journal of Mines and Geology, v. 46, p. 213-221.
- Emery, K. O., and Dietz, R. S., 1950, Submarine phosphorite deposits off California and Mexico: California Journal of Mines and Geology, v. 46, no. 1, p. 7-15.
- Fritsche, A. E., 1969, Miocene geology of the central Sierra Madre Mountains, Santa Barbara County, California: University of California [Los Angeles] unpublished Ph.D. thesis, 385 p.
- Galliher, E. W., 1931, Collophane from Miocene brown shales of California: American Association of Petroleum Geologists Bulletin, v. 15, no. 3, p. 257-269.
- Galloway, J., 1943, Kettleman Hills oil fields, in Geologic formations and economic development of the oil and gas fields of California: California Division of Mines Bulletin 118, p. 491-493.

- Garrison, L. E., 1959, Miocene Foraminifera from the Temblor Formation north of Coalinga, California: *Journal of Paleontology*, v. 33, no. 4, p. 662-669.
- Goudkoff, P. P., 1931, Age of producing horizon at Kettleman Hills, California: *American Association of Petroleum Geologists Bulletin*, v. 15, p. 839.
- _____, 1934, Subsurface stratigraphy of the Kettleman Hills oil field, California: *American Association of Petroleum Geologists Bulletin*, v. 18, no. 4, p. 435-475.
- Gower, H. D., and Madsen, B. M., 1964, The occurrence of phosphate rock in California, in *Short papers in geology and hydrology*: U. S. Geological Survey Professional Paper 501-D, p. D79-D85.
- Graham, S. A., 1976, Tertiary sedimentary tectonics of the central Salinian block of California: Stanford University unpublished Ph.D. thesis, 510 p.
- Gulbrandsen, R. A., Jones, D. L., Tagg, K. M., and Reeser, D. W., 1963, Apatitized wood and leucophosphite in nodules in the Moreno Formation, California, in *Short papers in geology and hydrology*: U. S. Geological Survey Professional Paper 475-C, p. 100-104.
- Hall, C. A. Jr., 1973, Geology of the Arroyo Grande quadrangle, California: California Division of Mines and Geology, Map Sheet 24.
- Hall, C. A., Jr., and Surdam, R. C., 1967, Geology of the San Luis Obispo-Nipomo area, San Luis Obispo County, California, in *Geological Society of America, Cordilleran Section, Guidebook*, 63^d Annual Meeting, 1967: 25 p.
- Hart, E. W., 1976, Basic geology of the Santa Margarita area, San Luis Obispo County, California: California Division of Mines and Geology Bulletin 199, 45 p.
- Henny, Gerard, 1930, McLure Shale of the Coalinga region, Fresno and Kings Counties, California: *American Association of Petroleum Geologists Bulletin*, v. 14, no. 4, p. 403-410.
- Hill, J. M., 1979, Stratigraphy and paleoenvironment of Miocene phosphatic rocks in the East San Francisco Bay region, California: U. S. Geological Survey Open-File Report 79-1570, 70 p.
- Hill, M. L., 1943, Elwood oil field, in *Geologic formations and economic development of the oil and gas fields of California*: California Division of Mines Bulletin 118, p. 380-383.
- Hill, M. L., Carlson, S. A., and Dibblee, T. W., Jr., 1958, Stratigraphy of Cuyama Valley-Caliente Range area, California: *American Association of Petroleum Geologists Bulletin*, v. 42, no. 12, p. 2973-3000.

- Hluza, A. G., 1965, Main area of Fruitvale oil field [Kern County]: California Oil Fields, v. 51, no. 2, p. 31-39.
- Hodges, F. C., 1944, Gas storage and recent developments in the Playa del Rey oil field [Los Angeles County]: California Oil Fields, v. 30, no. 2, p. 3-10.
- Hoots, H. W., 1930, Geology of the eastern part of the Santa Monica Mountains, Los Angeles County, California: U. S. Geological Survey Professional Paper 165-C, p. 83-134.
- Hoots, H. W., Blount, A. L., and Jones, P. H., 1935, Marine oil shale, source of oil in Playa del Rey field, California: American Association of Petroleum Geologists Bulletin, v. 19, no. 2, p. 172-206.
- Hughes, A. W., 1963, The two sides of Salinas, a biostratigraphic outline of Salinas Valley sediments, in Guidebook to the geology of Salinas Valley and the San Andreas fault: American Association of Petroleum Geologists-Society of Economic Paleontologists and Mineralogists, Pacific Section, Annual Spring Field Trip, 1963, p. 94-97.
- Kasline, F. E., 1941, Rio Bravo oil field [Kern County]: California Division of Oil and Gas, California Oil Fields--Summary Operations, v. 27, p. 9-12.
- Kennedy, M. P., 1975, Geology of the Del Mar, La Jolla, and Point Loma quadrangles, western San Diego metropolitan area, California: California Division of Mines and Geology Bulletin 200A, 39 p.
- Kennedy, M. P., and Tan, S. S., 1977, Geology of National City, Imperial Beach, and Otay Mesa quadrangles, southern San Diego metropolitan area, California: California Division of Mines and Geology, Map Sheet 29.
- Key, C. E., 1955, Biostratigraphy of the Bitterwater-Packwood Creek area, Kern County, California: Stanford University unpublished M.S. thesis, 139 p.
- Kleinpell, R. M., 1938, Miocene stratigraphy of California: Tulsa, Oklahoma, American Association of Petroleum Geologists, 450 p.
- Knox, G. L., 1943, McDonald Island gas field, in Geologic formations and economic development of the oil and gas fields of California: California Division of Mines Bulletin 118, p. 588-590.
- Kribbs, G. R., 1943, Capitan oil field [Santa Barbara County]: California Division of Mines and Geology Bulletin 118, p. 374-376.
- Lawton, J. E., 1956, Geology of the north half of the Morgan Valley quadrangle and the south half of the Wilbur Springs quadrangle: Stanford University unpublished Ph.D. thesis, 223 p.
- Lian, H. M., 1954, Geologic map of the Carpinteria district, Santa Barbara County, California, in Geology of southern California: California Division of Mines Bulletin 170, Map Sheet 25.

- Lydon, P. A., 1964, Unusual phosphatic rock, new deposit near Hyampom [California] opens economic possibilities: Mineral Information Service, California Division of Mines and Geology, v. 17, no. 5, p. 65-74.
- Maher, J. C., Carter, R. D., and Lantz, R. J., 1975, Petroleum Geology of Naval Petroleum Reserve No. 1, Elk Hills, Kern County, California: U. S. Geological Survey Professional Paper 912, 109 p.
- McLaughlin, R. J., 1971, Geologic map of the Sargent Fault Zone in the vicinity of Mount Madonna, Santa Clara County, California: San Francisco Bay Region Environment and Resources Planning Study, Basic Data Contribution 13, U. S. Geological Survey Open-File Report.
- _____, 1973, Geology of the Sargent Fault Zone in the vicinity of Mount Madonna, Santa Clara and Santa Cruz Counties, California: San Jose State University unpublished M.S. thesis, 131 p.
- Merrill, F. J. H., 1916, The counties of San Diego, Imperial, in Mines and mineral resources of portions of California: California Mining Bureau, 14th Report State Mineralogist, pt. 5, p. 635-743, [1914].
- Metzner, L. H., 1943, Playa del Rey oil field [Los Angeles County]: California Division of Mines Bulletin 118, p. 292.
- Narasimhan, T., 1960, Eocene discoasters and coccolithopores from central California: Stanford University unpublished Ph.D. thesis, 254 p.
- Neel, T. H., 1963, Geology of the lower Tularcitos Creek-Cachagua Grade area, Jamesburg quadrangle, California: Stanford University unpublished M.S. thesis, 72 p.
- Nelson, L. E., 1952, Del Valle and Ramona oil fields, in Field trip routes, geology, oil fields: American Association of Petroleum Geologists, Society of Economic Geologists Guidebook, Joint Annual Meeting, Los Angeles, California, 1952, p. 57-63.
- Nilsen, T. H., Dibblee, T. W., Jr., and Addicott, W. O., 1973, Lower and middle Tertiary stratigraphic units of the San Emigdio and western Tehachapi Mountains, California: U. S. Geological Survey Bulletin 1372H, p. H1-H23.
- Olmsted, F. H., 1958, Geologic reconnaissance of San Clemente Island, California: U. S. Geological Survey Bulletin 1071-B, p. 55-68.
- Payne, M. B., 1951, Type Moreno Formation and overlying Eocene strata on the west side of the San Joaquin Valley, Fresno and Merced Counties, California: California Division of Mines Special Report 9, 29 p.
- Phillips, F. J., Welton, B., and Welton, J., 1976, Paleontologic studies of the Middle Tertiary Skooner Gulch and Gallaway Formations at Point Arena, California, in Neogene Symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 137-154.

- Player, G. F., 1966, Petrography and origin of the phosphorite member of the Munson Creek Formation, Ventura County, California: University of California [Los Angeles] unpublished M.A. thesis, 88 p.
- Pisciotta, K. A., 1978, Basinal sedimentary facies and diagenetic aspects of the Monterey Shale, California: University of California [Santa Cruz] unpublished Ph.D. thesis, 450 p.
- Reed, R. D., 1927, Phosphate beds in the Monterey Shales [California] [abstract]: Geological Society of America Bulletin, v. 38, no. 1, p. 195-196.
- Reese, R. G., 1943, El Segundo oil field [Los Angeles County]: California Division of Mines and Geology Bulletin 118, p. 295-296.
- Roberts, A. E., 1979, Analytical and stratigraphic data on the upper phosphatic mudstone member of the Santa Margarita Formation at Newsome Canyon, southern Cuyama Valley, California: U. S. Geological Survey Open-File Report 79-1466, 64 p.
- Robinson, G. D., 1956, Geologic map of the Hayward quadrangle, California: U. S. Geological Survey, Geologic Quadrangle Map GQ-88.
- Rogers, A. F., 1944, Pellet phosphorite from Carmel Valley, Monterey County, California: California Journal of Mines and Geology, v. 40, no. 4, p. 411-421.
- Runvik, R. C., 1973, Mineral resources development in the public domain--an unfinished case history, in Forum on geology of industrial minerals, 8th Proceedings: Iowa Geological Survey, Public Information Circular No. 5, p. 159-183.
- Schlocker, J., 1974, Geology of the San Francisco north quadrangle, California: U. S. Geological Survey Professional Paper 782, 109 p.
- Shelton, J. S., 1946, Geology of northeast margin of San Gabriel Basin, Los Angeles County, California: U. S. Geological Survey Oil and Gas Investigations, Preliminary map OM-63.
- Smith, G. I., 1979, Subsurface stratigraphy and geochemistry of Late Quaternary evaporites, Searles Lake, California: U. S. Geological Survey Professional Paper 1043, 130 p.
- Smith, G. I., and Haines, D. V., 1964, Character and distribution of nonclastic minerals in the Searles Lake evaporite deposit, California: U. S. Geological Survey Bulletin 1181-P, p.1-p.58
- Smith, P. B., 1968, Paleoenvironment of phosphate-bearing Monterey Shale in Salinas Valley, California: American Association of Petroleum Geologists Bulletin, v. 52, no. 9, p. 1785-1791.
- Stewart, R. B., 1946, Geology of Reef Ridge, Coalinga district, California: U. S. Geological Survey Professional Paper 205-C, p. 81-115.

- Thomson, J. N., 1962, Geology of the Kione Formation: San Joaquin Geological Society Selected Papers, v. 1, p. 27-35.
- Thor, D. R., 1977, Depositional environments and paleogeographic setting of the Santa Margarita Formation, Ventura County, California: California State University [Northridge] unpublished M.S. thesis, 144 p.
- Thorup, R. R., 1943, Type locality of the Vaqueros Formation, in Geologic formations and economic development of the oil and gas fields of California: California Division of Mines Bulletin 118, pt. 4, p. 463-466.
- Tolman, F. B., 1943, Potrero Hills gas field, in Geologic formations and economic development of the oil and gas fields of California: California Division of Mines Bulletin 118, p. 595-598.
- Tucker, W. B., 1926, Inyo County: California Mining Bureau, 22^d Report State Mineralogist, v. 22, no. 4, p. 453-530.
- _____, 1927, Los Angeles County: California Mining Bureau, 23^d Report State Mineralogist, no. 3, p. 287-345.
- Tucker, W. B., and Sampson, R. J., 1932, Ventura County: California Mining Bureau, 28th Report State Mineralogist, v. 28, no. 3, p. 247-277.
- Vedder, J. G., 1968, Geologic map of Fox Mountain quadrangle, Santa Barbara County, California: U. S. Geological Survey Miscellaneous Geologic Investigations Map I-547.
- Vedder, J. G., Dibblee, T. W., Jr., and Brown, R. D., Jr., 1973, Geologic map of the upper Mono Creek-Pine Mountain area, California: U. S. Geological Survey Miscellaneous Geologic Investigations Map I-752.
- Vedder, J. G., and Moore, E. J., 1976, Paleoenvironmental implications of fossiliferous Miocene and Pliocene strata on San Clemente Island, California, in Howell, D. G., editor, Aspects of the geologic history of the California Continental Borderland: American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24, p. 107-135.
- Vedder, J. G., and Repenning, C. A., 1975, Geologic map of the Cuyama and New Cuyama quadrangles, San Luis Obispo and Santa Barbara Counties, California: U. S. Geological Survey Miscellaneous Geologic Investigations Map I-876.
- Weber, F. H., Jr., 1963, Geology and mineral resources of San Diego County, California: California Division of Mines and Geology, County Report 3, 309 p.
- Weddle, J. R., 1959, Premier and Enas areas of Poso Creek oil field [Kern County]: California Oil Fields, v. 45, no. 2, p. 41-50.

- Weidman, R. M., 1958, Geology of the King City quadrangle, California: University of California [Berkeley] unpublished Ph.D. thesis, 225 p.
- Wiedman, J. P., 1964, Geology of the upper Tularcitos Creek-Cáchuaga Creek area, Jamesburg quadrangle, California: Stanford University unpublished M.S. thesis, 74 p.
- Wilson, R. R., 1930, A reconnaissance of the geology of the Adelaide Quadrangle, San Luis Obispo County, California, with special reference to the stratigraphy of the Miocene formation: Stanford University unpublished M.A. thesis, 104 p.
- Winterer, E. L., and Durham, D. L., 1962, Geology of southeastern Ventura basin, Los Angeles County, California: U. S. Geological Survey Professional Paper 334-H, p. 275-366.
- Wissler, S. G., 1943, Stratigraphic formations of the producing zones of the Los Angeles basin oil fields: California Division of Mines Bulletin 118, Chapter 7, p. 209-234.
- Wissler, S. G., and Dreyer, F. E., 1943, Correlation of the oil fields of the Santa Maria district: California Division of Mines Bulletin 118, p. 235-238.
- Woodring, W. P., and Bramlette, M. N., 1950, Geology and paleontology of the Santa Maria district, California: U. S. Geological Survey Professional Paper 222, 185 p.
- Woodring, W. P., Bramlette, M. N., and Kew, W. S. W., 1946, Geology and paleontology of Palos Verdes Hills, California: U. S. Geological Survey Professional Paper 207, 145 p.
- Woodring, W. P., Stewart, Ralph, and Richards, R. W., 1940, Geology of the Kettleman Hills oil field, California; stratigraphy, paleontology, and structure: U. S. Geological Survey Professional Paper 195, 170 p.
- Ybarra, R. A., and Stockton, A. D., 1958, Oak Canyon oil field [Ventura County]: California Oil Fields, v. 44, p. 71.
- Younse, G. A., 1980, The stratigraphy and phosphoritic rocks of the Robinson Canyon-Laureles Grade area, Monterey Canyon, California: U. S. Geological Survey Open-File Report 80-318, 127 p.

Localities

ALAMEDA COUNTY

A-1 Grizzly Peak Boulevard, W. side. SW1/4 sec. 5, T. 1 S., R. 3 W. (MDB&M)
Quadrangle: Oakland East
Formation: Claremont Shale Age: Middle Miocene (Luisian)
Remarks: Phosphatic nodules sparsely distributed in shale.
Reference: 1. Dickert, 1971, p. 256, no. 8

A-2 Crow Canyon, W. rim. NW1/4 sec. 25, T. 2 S., R. 2 W. (MDB&M)
Quadrangle: Hayward
Formation: Claremont Shale Age: Middle Miocene (Early Luisian)
Remarks: Abundant phosphate pellets and nodules in sandstone lenses within the shale.
References: 1. Robinson, 1956
2. Aarons, 1958
3. Dickert, 1971, p. 256, no. 10

A-3 Eden Creek, SE bank. SE1/4 sec. 31, T. 2 S., R. 1 W. (MDB&M)
Quadrangle: Hayward
Formation: Claremont Shale Age: Middle Miocene (Early Luisian)
Remarks: Sparse phosphate nodules in upper part of the formation.
Reference: 1. Dickert, 1971, p. 256, no. 11

A-4 Hollis Canyon, NE cor. sec. 32, T. 2 S., R. 1 W. (MDB&M)
Quadrangle: Dublin
Formation: Hambre Sandstone (?) Age: Late Miocene (Mohnian (?))
Remarks: Conglomeratic pebbles deposited by proximal turbidity flows. Pebbles composed of sandy phosphatic mudstone. Detailed measured section 8B Plate 4, Hill, 1979. Zone identical to Devaney Canyon section 8A. Chemical analysis no. A-12-17-7.
Reference: 1. Hill, 1979, p. 67 and pl. 4

A-5 Dublin Canyon. SW1/4 sec. 4, T. 3 S., R. 1 W. (MDB&M)
Quadrangle: Dublin
Formation: Hambre Sandstone, Briones Sandstone (?) Age: Late Miocene (Mohnian (?))
Remarks: Phosphatic pellets within Hambre Sandstone, stratigraphic location on Plate 2, Hill, 1979. Phosphatic pebbles in Briones Sandstone (?), stratigraphic location on Plate 2, Hill, 1979.
Reference: 1. Hill, 1979, p. 63, 65

A-6 Devaney Canyon. NE1/4 sec. 10, T. 3 S., R. 1 W. (MDB&M)
Quadrangle: Dublin
Formation: Hambre Sandstone (?) Age: Late Miocene (Mohnian (?))
Remarks: Conglomeratic pellets and pebbles deposited by proximal turbidity flows. Pebbles composed of sandy phosphatic mudstone 16-18% P₂O₅. May be of estuary origin ripped up by storm waves. Detailed measured section 8B, Hill, 1979, plate 4.
References: 1. Dickert, 1971, p. 256, no. 12
2. Hill, 1979, p. 66

A-7 Old Morrison Canyon Road, N side. SW1/4 sec. 23, T. 4 S., R. 1 W.
(MDB&M)

Quadrangle: Niles

Formation: Claremont Shale

Age: Middle Miocene (Early
Luisian or older ?)

Remarks: Phosphate nodules in chert. These nodules formed within diatomite. Nodules rare within Tice Shale, Oursan Sandstone, and positive phosphate test on base of Hambre Sandstone. Chemical analysis on phosphate nodule from Claremont by Shapiro method indicates 29-33% P_2O_5 [stratigraphic position on Plate 2, Hill, 1979, loc. 5-3-1].

References: 1. Dickert, 1971, p. 256, no. 13
2. Hill, 1979, p. 62

BUTTE COUNTY

B-1 sec. 33, T. 20 N., R. 1 W. (MDB&M)

Quadrangle: Llano Seco

Formation: Kione

Age: Late Cretaceous

Remarks: Scattered phosphatic material in shale. Only surface outcrop at Marysville Buttes. Kione Formation about 490 m thick in subsurface; top about 600 m below surface. Mobil Oil Co. Llano Seco No. 1 well.

References: 1. Thomson, 1962, p. 27
2. Gower and Madsen, 1964, p. D81, no. 3

CONTRA COSTA COUNTY

CC-1 Pinole Valley Road, N. side. Sec. 31, T. 2 N., R. 3 W. (MDB&M)

Quadrangle: Briones Valley

Formation: Oursan Sandstone

Age: Middle Miocene

Remarks: Scattered phosphate pellets near base of formation.

Reference: 1. Dickert, 1971, p. 255, no. 5

CC-2 Oursan Ridge, SE slope, 160 ft. W. of Hampton Rd. and 400 ft. N. of fire trail. T. 1 N., R. 3 W. (MDB&M)

Quadrangle: Briones Valley

Formation: Claremont Shale

Age: Middle Miocene (Late Luisian)

Remarks: A few layers of pellets in abundant concentrations in laminated shales. Similar beds on SW slope of Oursan Ridge, 1,000 ft. W. of Bear Creek Road and 2,000 ft. S. of fire trail.

Reference: 1. Dickert, 1971, p. 256, no. 6

FRESNO COUNTY

F-1 Chaney Ranch Canyon. SW1/4 sec. 19, T. 14 S., R. 12 E. (MDB&M)

Quadrangle: Chounet Ranch

Formation: Kreyenhagen Shale

Age: Eocene (Narizian)

Remarks: Scattered phosphate pellets in soft mudstone in lower part of the formation.

References: 1. Payne, 1951, p. 20
2. Gower and Madsen, 1964, p. D81, no. 11
3. Dickert, 1971, p. 261, no. 48

- F-2 Escarpado Canyon. NW1/4 sec. 7, T. 15 S., R. 12 E. (MDB&M)
 Quadrangle: Chounet Ranch
 Formation: Moreno, lower members Age: Late Cretaceous and Paleocene (?)
 Remarks: Nodules of apatitized wood leucophosphite in lower part of the formation. Also phosphate disseminated in mudstone of the formation.
 References: 1. Payne, 1951
 2. Gulbrandsen and others, 1963
 3. Gower and Madsen, 1964, p. D81, no. 12
 4. Dickert, 1971, p. 261, no. 49
- F-3 E. flank of Monocline Ridge. SW1/4 NE1/4 sec. 10, T. 16 S., R. 13 E. (MDB&M)
 Quadrangle: Monocline Ridge
 Formation: Temblor Age: Early Miocene
 Remarks: Phosphatic pellets scattered through a zone of 9 m in thickness. Seaboard Oil Co. Welsh No. 1 well.
 References: 1. Garrison, 1959
 2. Dickert, 1971, p. 261, no. 50
- F-4 Coalinga oil field. NE1/4 SE1/4 sec. 10, T. 19 S., R. 15 E. (MDB&M)
 Quadrangle: Domengine Ranch
 Formation: Jacalitos (?) Age: Pliocene
 Remarks: Phosphatic sandstone with pebbles of phosphate 1-3 cm thick near base. Shell Oil Co. No. 166-10 well.
 Reference: 1. Dickert, 1971, p. 265, no. 76
- F-5 Gujarral Hills oil field. E1/2 SW1/4 sec. 28, T. 20 S., R. 16 E. (MDB&M)
 Quadrangle: Gujarral Hills
 Formation: Monterey, McLure Shale Age: Late Miocene Member
 Remarks: Phosphatic pellets in basal part of McLure Shale. Petroleum Securities Co. Ladd No. 1 well.
 References: 1. Goudkoff, 1934
 2. Dickert, 1971, p. 267, no. 92
- F-6 Coalinga oil field. SW1/4 SE1/4 sec. 4, T. 21 S., R. 15 E. (MDB&M)
 Quadrangle: Coalinga
 Formation: Monterey, McLure Shale Age: Late Miocene Member
 Remarks: Pyritized phosphate pellets in brown shale. Ohio Oil Co. Brix Welsh No. 1 well.
 References: 1. Goudkoff, 1934
 2. Dickert, 1971, p. 267, no. 91

F-7 Gujarral Hills oil field. NE1/4 NE 1/4 sec. 3, T. 21 S., R. 16 E.
(MDB&M)

Quadrangle: Gujarral Hills

Formation: Monterey, McLure Shale Age: Late Miocene
Member

Remarks: Well core includes 45 m of coarse sandstone containing pyritized phosphate pellets in basal part of the McLure Shale.
Standard Oil Co. of Calif. No. 81-3H well.

References: 1. Anderson, 1952, p. 187
2. Gower and Madsen, 1964, p. D81, no. 13
3. Dickert, 1971, p. 267, no. 93

F-8 Kettleman Hills oil field. NW1/4 NW1/4 sec. 24, T. 21 S., R. 16 E.
(MDB&M)

Quadrangle: Avenal

Formation: Monterey, McLure Shale Age: Late Miocene
Member

Remarks: Phosphatic pellets in brown shale. N. Kettleman Oil and Gas
Lillis-Welch, No. 1 well.

References: 1. Goudkoff, 1934
2. Woodring and others, 1940, p. 126
3. Dickert, 1971, p. 267, no. 94

F-9 Kettleman Hills oil field. SW1/4 SE1/4 sec. 20, T. 21 S., R. 17 E.
(MDB&M)

Quadrangle: Avenal

Formation: Kreyenhagen Shale Age: Eocene (Narizian)

Remarks: Phosphate pellets in shale. Standard Oil Co. of Calif.
McAdams No. DE 67-207 well.

References: 1. Woodring and others, 1940, p. 147
2. Gower and Madsen, 1964, p. D81, no. 14

F-10 Canaos Creek. NW1/4 SW1/4 sec. 33, T. 22 S., R. 16 E. (MDB&M)

Quadrangle: The Dark Hole

Formation: Monterey, McLure Shale Age: Late Miocene
Member

Remarks: Sparse collophane pellets in glauconitic mudstone, fine-grained
sandstone, and pebble conglomerate at the base of the McLure
Shale.

References: 1. Stewart, 1946
2. Dickert, 1971, p. 268, no. 99

INYO COUNTY

In-1 6 miles E. of Big Pine on the Big Pine-Waucoba Road.

NE1/4 NW1/4 sec. 13, T. 9 S., R. 34 E. (MDB&M)

Quadrangle: Waucoba Mountain

Formation: Unnamed Age: Pleistocene

Remarks: The phosphate occurs in the Pleistocene sediments that occur
near the base of the White Mountains.

References: 1. Tucker, 1926, p. 520
2. R. G. Wayland, 1962, written commun.
3. Gower and Madsen, 1964, p.D81, no. 10

In-2 SE1/4 sec. 3, T. 26 N., R. 3 E. (SBB&M) 36° 24' 56" N., 116° 37' 54" W. [3.21 Km N. 35° 30' W. of Pyramid Peak]

Quadrangle: Ryan 15'

Formation: Ely Springs Dolomite Age: Late Ordovician (Ashgillian)

Remarks: X-ray diffractograms, excellent of carbonate-fluorapatite. Age determination on conodonts by Anita G. Epstein. Dark-gray irregular laminae of phosphorite in medium dark gray, very fine to coarse grained bioclastic dolomite. Sample from middle of Ely Springs Dolomite—marker bed at top of lower member, here 80.8 m above base.

Reference: 1. J. F. McAllister, 1978, written commun., field no. JFM 75-4-22E

In-3 NW1/4 sec. 12, T. 26 N., R. 3 E. (SBB&M) 36° 24' 44" N., 116° 36' 25" W. [2.27 Km N. 9° 40' E. of Pyramid Peak]

Quadrangle: Ryan 15'

Formation: Ely Springs Dolomite Age: Late (?) Ordovician

Remarks: X-ray diffractogram of carbonate-fluorapatite. Age determination on conodonts by Anita G. Epstein. Dark gray stringers of phosphorite in very sandy, quartzitic, medium dark gray dolomite. Sample from base of the Ely Springs Dolomite—gradational into the underlying Eureka Quartzite.

Reference: 1. J. F. McAllister, 1978, written commun.; field no. JFM 77-4-21A

In-4 NW1/4 sec. 12, T. 26 N., R. 3 E. (SBB&M) 36° 24' 44" N., 116° 36' 19" W. [2.32 Km N. 12° 40' E. of Pyramid Peak]

Quadrangle: Ryan 15'

Formation: Ely Springs Dolomite Age: Late Ordovician—Ashgillian

Remarks: X-ray diffractograms, excellent of carbonate-fluorapatite. Age determination on conodonts by Anita G. Epstein. Dark-gray (weathered light-gray) laminae of phosphorite in medium dark gray, very fine to medium grained dolomite. Sample from middle of Ely Springs Dolomite—marker bed at top of lower member, here 102.7 m above base.

Reference: 1. J. F. McAllister, 1978, written commun.; field no. JFM 77-4-21B

KERN COUNTY

K-1 Paso Creek oil field. SE1/4 NE1/4 sec. 36, T. 25 S., R. 26 E. (MDB&M)

Quadrangle: Deepwell Ranch

Formation: Round Mountain Silt Age: Middle Miocene
(Devilwater Shale)

Remarks: Phosphate pellets in basal Round Mountain Silt. Bolsa-Chico Clark No. 1 well.

Reference: 1. Dickert, 1971, p. 269, no. 108

- K-2 Lost Hills oil field. SE1/4 SE1/4 sec.11, T. 26 S., R. 20 E. (MDB&M)
 Quadrangle: Antelope Plain
 Formation: Monterey, McLure Shale Age: Late Miocene
 Member
 Remarks: Phosphate pellets in brown shale. Mobil Oil Co. Williamson No. 33-11 well.
 References: 1. Goudkoff, 1934
 2. Dickert, 1971, p. 269, no. 107
- K-3 Still Canyon. SW1/4 sec. 22, T. 26 S., R. 17 E. (MDB&M)
 Quadrangle: Orchard Peak
 Formation: Monterey Age: Late Miocene
 Remarks: On the E. side of the canyon, phosphatic laminae and a few large pellets in organic mudstone. Lower in the section, 18 m to the SW on the E. side of the canyon, phosphatic shale.
 Reference: 1. Dickert, 1971, p. 272, no. 127
- K-4 Bitterwater Creek. SW1/4 sec. 22, T. 27 S., R. 18 E. (MDB&M)
 Quadrangle: Packwood Creek
 Formation: Monterey, Devilwater Shale Age: Middle Miocene (Luisian)
 Member
 Remarks: Phosphate nodules in lower part of Devilwater Shale Member of Monterey. Foraminifera from the Devilwater Shale near this locality were assigned to the Luisian, probably Siphogenerina nuciformis zone, by Key, 1955, p. 89.
 References: 1. Key, 1955
 2. Dickert, 1971, p. 273, no. 134
- K-5 Belridge oil field. SW1/4 SW1/4 sec. 26, T. 27 S., R. 20 E. (MDB&M)
 Quadrangle: Blackwells Corner
 Formation: Temblor (?) Age: Early Miocene
 Remarks: Pyritized pellets in sandy clay matrix of probable Temblor. Other well logs, this area, show phosphatic shale approximately equivalent to Santos Shale Member of the Temblor Formation at Chico-Martinez Creek area. Belridge No. 15 well.
 References: 1. Galliher, 1931, p. 258
 2. Gower and Madsen, 1964, p. D82, no. 37
 3. Dickert, 1971, p. 272, no. 133
- K-6 North Belridge oil field. Wells in SE1/4 T. 27 S., R. 20 E. (MDB&M)
 Quadrangle: Blackwells Corner
 Formation: Monterey, McLure Shale Age: Late Miocene
 Member
 Remarks: Pyritized pelletal phosphate in lower 100 m of brown shale.
 References: 1. Goudkoff, 1931
 2. Dickert, 1971, p. 272, no. 128
- K-7 Enas oil field, 2 miles E. of Little Creek, 15 miles N. of Bakersfield. Well in sec. 21, T. 27 S., R. 27 E. (MDB&M)
 Quadrangle: North of Oildale
 Formation: Etchegoin Age: Pliocene
 Remarks: Black phosphatic nodules at base of formation.
 Reference: 1. Weddle, 1959, p. 43

K-8 Mt. Poso oil field. SE1/4 NW1/4 sec. 9, T. 27 S., R. 28 E. (MDB&M)
 Quadrangle: Knob Hill
 Formation: Round Mountain Silt (?) Age: Middle Miocene
 Remarks: 15 m of pellet-bearing sandy siltstone. Shell Oil Co. Vedder No. 36 well. Diepenbrock, 1933, p. 14 "interbedded brownish silty sands with phosphatic pellets in a lower shale member of the Santa Margarita".
 References: 1. Diepenbrock, 1933, p. 14
 2. Albright, Hluza, and Sullivan, 1957, p. 13
 3. Dickert, 1971, p. 272, no. 130

K-9 Media Agua Creek, N. side. SE1/4 sec. 15, T. 28 S., R. 19 E. (MDB&M)
 Quadrangle: Las Yeguas Ranch
 Formation: Temblor, Santos Shale Age: Early Miocene
 Member
 Remarks: Phosphate pellet beds in Santos Shale.
 Chico-Martinez Trench no. 4A in SE1/4 SW1/4 sec. 15, T. 28 S., R. 19 E.
 Chico-Martinez Trench no. 4B in SE1/4 SE1/4 sec. 16, T. 28 S., R. 19 E.
 References: 1. Dickert, 1971, p. 275, no. 148
 2. Dibblee, 1977

K-10 Santos Creek, S. side, 1,000 ft. N. and 400 ft. E. of SW cor. sec. 30, T. 28 S., R. 20 E. (MDB&M)
 Quadrangle: Carneros Rocks
 Formation: Temblor, Santos Shale Age: Early Miocene
 Member
 Remarks: .5 m of pelletal mudstone in gypsiferous Santos Shale.
 References: 1. Dickert, 1971, p. 275, no. 149
 2. Dibblee, 1977

K-11 Carneros Creek. SW1/4 SW1/4 sec. 32, T. 28 S., R. 20 E. (MDB&M)
 Quadrangle: Carneros Rocks
 Formation: Temblor, Santos Shale Age: Early Miocene
 Member
 Remarks: Pelletal and pebble phosphate beds in mudstones of the Santos Shale.
 References: 1. Dickert, 1971, p. 275, no. 150
 2. Dibblee, 1977

K-12 Rio Bravo oil field. Sec. 28, T. 28 S., R. 25 E. (MDB&M)
 Quadrangle: Rio Bravo
 Formation: Fruitvale Shale Age: Late Miocene (Mohnian)
 Remarks: Scattered phosphatic lenses in Fruitvale Shale. Superior Oil co. Rudnick No. 4 well.
 References: 1. Kasline, 1941, p. 9
 2. Gower and Madsen, 1964, p. D82, no. 36

K-13 Premier oil field. NW1/4 SE1/4 sec. 9, T. 28 S., R. 27 E. (MDB&M)
Quadrangle: North of Oildale
Formation: Etchegoin Age: Pliocene
Remarks: Black phosphatic nodules in basal Etchegoin. Standard Oil Co. of Calif. No. 5-5A well.
References: 1. Weddle, 1959, p. 43
2. Dickert, 1971, p. 272, no. 131

K-14 Kern Front area of Kern River oil field. NW1/4 NE1/4 sec. 15, T. 28 S., R. 27 E. (MDB&M)
Quadrangle: Oildale
Formation: Etchegoin Age: Pliocene
Remarks: Black phosphatic pellets and nodules and charcoal fragments in basal transitional beds of Etchegoin. Standard Oil Co. of Calif. No. 7-1 well.
References: 1. Edwards, 1943
2. Dickert, 1971, p. 272, no. 132

K-15 SE1/4 NE1/4 sec. 5, T. 29 S., R. 20 E. (MDB&M)
Quadrangle: Carneros Rocks
Formation: Temblor, Santos Shale Age: Early Miocene Member
Remarks: Phosphate pellets and pebbles in mudstone. Chico-Martinez Trench no. 3.
References: 1. T. M. Cheney, 1962, written comm.
2. Dickert, 1971, p. 275, no. 151
3. Dibblee, 1977

K-16 Chico Martinez Creek bed, S. side. 1,600 ft. S. and 1,700 ft. E. of NW cor. sec. 9, T. 29 S., R. 20 E. (MDB&M)
Quadrangle: Carneros Rocks
Formation: Temblor, Santos Shale Age: Early Miocene Member
Remarks: An excellent exposure of a 10 m sequence of phosphate pellets and pebbles in near-vertical beds of the Santos Shale and Agua Sandstone. Sample no. 152 from upper Santos Shale. On the S. side of the creek in the approximate center of sec. 10, phosphatic shale in Devilwater Silt (M. Bramlette in Woodring and others, 1940).
References: 1. Woodring and others, 1940
2. T. M. Cheney, 1962, written comm.
3. Gower and Madsen, 1964, p. D82, no. 34
4. Dickert, 1971, p. 275, no. 152
5. Dibblee, 1977

K-17 NW1/4 SE1/4 sec. 9, T. 29 S., R. 20 E. (MDB&M)
Quadrangle: Carneros Rocks
Formation: Temblor, Santos Shale Age: Early Miocene Member
Remarks: Phosphatic pellets in mudstone. Chico-Martinez Trench no. 1
References: 1. T.M. Cheney, 1962, written commun.
2. Dibblee, 1977

K-18 Chico-Martinez Creek area. NW1/4 NW1/4 sec. 15 and NE1/4 NE1/4 sec. 16, T. 29 S., R. 20 E. (MDB&M)

Quadrangle: Carneros Rocks

Formation: Temblor, Santos Shale Age: Early Miocene
Member

Remarks: Phosphatic pellet beds in mudstone of the Santos Shale. Chico-Martinez Trench no. 2.

References: 1. Woodring and others, 1940, p. 125
2. T. M. Cheney, 1962, written commun.
3. Gower and Madsen, 1964, p. D82, no. 38
4. Dickert, 1971, p. 275, no. 153
5. Dibblee, 1977

K-19 SW1/4 SW1/4 sec. 14, T. 29 S., R. 20 E. (MDB&M)

Quadrangle: Carneros Rocks

Formation: Temblor, Santos Shale Age: Early Miocene
Member

Remarks: Phosphatic pellets in mudstone. Chico-Martinez Trench no. 5.

References: 1. T. M. Cheney, 1962, written comm.
2. Dibblee, 1977

K-20 Rosedale oil field. NW1/4 NW1/4 sec. 22, T. 29 S., R. 26 E. (MDB&M)

Quadrangle: Rosedale

Formation: Fruitvale Shale Age: Late Miocene (Mohnian)

Remarks: Phosphatic lenses at Luisian-Mohnian boundary in the lower Fruitvale Shale. Exxon-Kern County Land Co. C (22-32) No. 3 well (formerly Humble Oil and Gas Co.)

References: 1. Albright, 1954
2. Dickert, 1971, p. 275, no. 154

K-21 2,381 ft. N. and 2,239 ft. W. of SE cor. sec. 30, T. 30 S., R. 23 E. (MDB&M)

Quadrangle: West Elk Hills

Formation: Temblor, Santos Shale Age: Early Miocene
Member

Remarks: Dark gray, silty, calcareous, phosphatic shale; occasionally glauconitic. NPR-1 Unit No. 555-30R well.

References: 1. Adkison, 1973, p. 12, 15, 16, 17, 21, 23, 24, and 26
2. Maher, Carter, and Lantz, 1975

K-22 Santiago Creek. 2,210 ft. S., 804 ft. E. of NW cor. sec. 22, T. 10 N., R. 23 W. (SBB&M)

Quadrangle: Santiago Creek

Formation: San Emigdio Age: Oligocene (Refugian)

Remarks: Disseminated phosphate in glauconitic mudstone of the San Emigdio. Richfield Oil Co. Ramsey No. 1 well.

References: 1. Dickert, 1971, p. 278, no. 171

K-23 Devils Kitchen. 600 ft. N., 1,000 ft. W. of SE cor.
T. 10 N., R. 21 W. (SBB&M)
Quadrangle: Pleito Hills
Formation: San Emigdio Age: Oligocene (Refugian)
Remarks: Disseminated phosphate in glauconitic mudstone of the San
Emigdio. Richfield Oil Co. No. DK-19A well.
References: 1. Dickert, 1971, p. 278, no. 172
2. Nilsen, Dibblee, and Addicott, 1973

K-24 *SE1/4 SW1/4 sec. 28, T. 28 S., R. 39 E. (MDB&M)
Quadrangle: Garlock
Formation: Goler Age: Paleocene
Remarks: Apatite concretions occur within lateritic paleosol which
formed by in situ weathering of Paleozoic metasediments.
Paleosol is directly overlain by non-marine sedimentary rocks
of Paleocene Goler Formation.
References: 1. Dibblee, 1976, p. 98
2. B. F. Cox, 1979, written commun.; loc. no. C-51-5

K-25 Fruitvale oil field. NW1/4 SW1/4 sec. 17, T. 29 S., R. 27 E. (MDB&M)
Quadrangle: Oildale
Formation: Etchegoin Age: Pliocene
Remarks: Etchegoin is unconformable on the Chanac. The contact is
marked by pebbles, grit, phosphatic nodules, and possibly
filled borings. Union Oil Co. of Calif. No. KCL 25-17 well.
References: 1. Diepenbrock, 1933, p. 12
2. Hluza, 1965, pl. 4

KINGS COUNTY

Ki-1 Kettleman Hills oil field. NE1/4 NW1/4 sec. 3, T. 22 S., R. 17 E.
(MDB&M)
Quadrangle: La Cima
Formation: Temblor, Santos Shale Age: Early Miocene
Member
Remarks: Very abundant phosphatic pellets over 30 m in the lower third
of the brown shale unit and pellets at 7 other depths within
the brown shale. Standard Oil Co. of Calif. No. 41-3-P well.
References: 1. Galliher, 1931
2. Woodring, Stewart, and Richards, 1940
3. Dickert, 1971, p. 267, no. 95

Ki-2 Reef Ridge, E. Garza Creek. 500 ft. N. and 700 ft. E. of SW cor.
sec. 2, T. 23 S., R. 16 E. (MDB&M)
Quadrangle: Garza Peak
Formation: Monterey, McLure Shale Age: Late Miocene
Member
Remarks: Sparse phosphate pellets in glauconitic clay, shale, and sand-
stone near base of the McLure Shale.
Reference: 1. Dickert, 1971, p. 268, no. 100

Ki-3 Reef Ridge, W. of Big Tar Canyon Road. SW1/4 SE1/4 sec. 7, T. 23 S., R. 17 E. (MDB&M)

Quadrangle: Garza Peak

Formation: Monterey, McLure Shale Age: Late Miocene
Member

Remarks: Phosphate pellets in lower part of the McLure Shale.

References: 1. Henny, 1930, p. 404
2. Galliher, 1931, p. 258
3. Woodring and others, 1940, p. 126
4. Galloway, 1943, p. 492
5. Gower and Madsen, 1964, p. D82, no. 28
6. Dickert, 1971, p. 268, no. 101

Ki-4 Sulphur Spring Gap. On SW side of Reef Ridge, 150 ft. below the ridgetop. SE1/4 SW1/4 sec. 26, T. 23 S., R. 17 E. (MDB&M)

Quadrangle: Kettleman Plain

Formation: Monterey Age: Late Miocene

Remarks: 30 cm layer of phosphatic pebble conglomerate at base of formation.

Reference: 1. Dickert, 1971, p. 268, no. 102

Ki-5 Kettleman Hills oil field. NE1/4 SE1/4 sec. 30, T. 23 S., R. 19 E. (MDB&M)

Quadrangle: Los Viejos

Formation: Monterey, McLure Shale Age: Late Miocene
Member

Remarks: Up to 7 layers of phosphatic pellets above and below prominent bentonite bed. Petroleum Securities Co. Burbank No. 1 well.

References: 1. Goudkoff, 1934
2. Dickert, 1971, p. 269, no. 103

Ki-6 Tent Hills. 1,400 ft. due W. of SW cor. sec. 16, T. 24 S., R. 17 E. (MDB&M)

Quadrangle: Tent Hills

Formation: Monterey (?) Age: Late (?) Miocene

Remarks: Phosphate pellets in glauconite bed at unconformable base of probable Monterey Formation in erosion remnants overlying Cretaceous shale.

Reference: 1. Dickert, 1971, p. 269, no. 104

Ki-7 Pyramid Hills oil field. NW1/4 SE1/4 sec. 28, T. 24 S., R. 18 E. (MDB&M)

Quadrangle: Pyramid Hills

Formation: Temblor Age: Early Miocene

Remarks: Phosphatic pellets within Temblor claystone. Nelson B. Cramer No. Dotty 1 well.

References: 1. Curtin, 1955, p. 28
2. Gower and Madsen, 1964, p. D82, no. 29
3. Dickert, 1971, p. 269, no. 105

Ki-8 Kettleman Hills, South Dome. 250 ft. N. and 250 ft. E. of SW cor.
sec. 35, T. 24 S., R. 19 E. (MDB&M)

Quadrangle: Avenal Gap

Formation: Monterey, McLure Shale Age: Late Miocene
Member

Remarks: Pyritized phosphate pellets occur at intervals throughout 300 m
of ["sporbo shale"] McLure Shale. Ohio Oil Co. Smith No. 1 well.

References: 1. Goudkoff, 1934
2. Woodring, Stewart, and Richards, 1940
3. Dickert, 1971, p. 269, no. 106

LAKE COUNTY

L-1 NEL/4 SE1/4 sec. 30, T. 14 N., R. 5 W. (MDB&M)

Quadrangle: Wilbur Springs SW

Formation: Great Valley Sequence Age: Early Cretaceous

Remarks: Slightly phosphatic thin bedded mudstone with interbedded graded
fine-grained sandstone. Sample from basal part of Great Valley
Sequence.

References: 1. R. J. McLaughlin, 1978, written commun.; loc. no. MG 78-31

LOS ANGELES COUNTY

LA-1 Oak Canyon oil field. SW1/4 NW1/4 sec. 32, T. 5 N., R. 17 W. (SBB&M)

Quadrangle: Val Verde

Formation: Modelo Age: Late Miocene (Mohnian)

Remarks: Hard massive phosphatic shale at Luisian-Mohnian transition in
Modelo. Western Gulf Oil Co. No. USL-G6 well.

References: 1. Ybarra and Stockton, 1958
2. Dickert, 1971, p. 282, no. 207

LA-2 Del Valle oil field. Center SE1/4 sec. 16, T. 4 N., R. 17 W. (SBB&M)

Quadrangle: Val Verde

Formation: Modelo Age: Late Miocene (Mohnian)

Remarks: Phosphatic material in sedimentary rocks near base of Mohnian.
Union Oil Co. Lincoln No. 15 well.

References: 1. Nelson, 1952, p. 60
2. Gower and Madsen, 1964, p. D83, no. 54

LA-3 NW1/4 NEL/4 sec. 17, T. 3 N., R. 16 W. (SBB&M)

Quadrangle: Oat Mountain

Formation: Modelo Age: Late Miocene (Mohnian)

Remarks: Thin lenses and small nodules of nearly white phosphatic mate-
rial occur at several stratigraphic levels in the Modelo
Formation exposed in Towsley and Rice Canyons.

References: 1. Winterer and Durham, 1962, p. 287
2. Gower and Madsen, 1964, p. D83, no. 55

LA-4 Dry Canyon. NEL/4 NW1/4 sec. 35, T. 1 N., R. 17 W. (SBB&M)

Quadrangle: Calabasas

Formation: Modelo Age: Late Miocene (Mohnian)

Remarks: Phosphatic shale in the basal Modelo.

References: 1. Kleinpell, 1938, p. 47
2. Gower and Madsen, 1964, p. D83, no. 56
3. Dickert, 1971, p. 283, no. 211

LA-5 Topanga Canyon Road, NE side. NE1/4 SW1/4 sec. 31, T. 1 N., R. 16 W. (SBB&M)

Quadrangle: Topanga

Formation: Monterey

Age: Late Miocene (Mohnian)

Remarks: Thick section of phosphatic shale in Monterey.

References: 1. Kleinpell, 1938, p. 127 (type Mohnian)
2. Dickert, 1971, p. 283, no. 212

LA-6 Stone Canyon reservoir, W. wall. NW1/4 T. 1 S., R. 15 W. (SBB&M)

Quadrangle: Beverly Hills

Formation: Monterey

Age: Late Miocene (Mohnian)

Remarks: Pelletal phosphate in the basal part of the Monterey.

References: 1. Hoots, 1930, p. 105-106
2. Gower and Madsen, 1964, p. D83, no. 57
3. Dickert, 1971, p. 283, no. 213

LA-7 Beverley Glen Pass. SW1/4 SW1/4 sec. 34, T. 1 N., R. 15 W. (SBB&M)

Quadrangle: Beverly Hills

Formation: Monterey

Age: Late Miocene (Mohnian)

Remarks: 75 m section of phosphatic shale in Monterey near base of Mohnian.

References: 1. Bramlette, 1946, pl. 2, Beverly Glen Pass section
2. Dickert, 1971, p. 283, no. 214

LA-8 Covina test hole no. 10 (Shelton map no. 6). 1,360 ft. S., 540 ft. W. of NE cor. sec. 12, T. 1 S., R. 10 W. (SBB&M)

Quadrangle: San Dimas

Formation: Puente

Age: Late Miocene (Mohnian)

Remarks: Phosphatic nodules in sandy siltstones of the upper Topanga or lower Puente formations at Luisian - Mohnian transition.

References: 1. Shelton, 1946
2. Dickert, 1971, p. 283, no. 215

LA-9 Covina test hole no. 5 (Shelton map no. 2). 2,560' W., 1,380' S. of NE cor. sec. 7, T. 1 S., R. 9 W. (SBB&M)

Quadrangle: San Dimas

Formation: Puente

Age: Late Miocene (Mohnian)

Remarks: Phosphatic nodules in sandy siltstones of the upper Topanga or lower Puente formations at Luisian-Mohnian transition.

References: 1. Shelton, 1946
2. Dickert, 1971, p. 283, no. 217

LA-10 Covina test hole no. 9 (Shelton map no. 5). 2,600' E., 520' N. of SW cor. sec. 5, T. 1 S., R. 9 W. (SBB&M)

Quadrangle: San Dimas

Formation: Puente

Age: Late Miocene (Mohnian)

Remarks: Phosphatic nodules in sandy siltstone of the upper Topanga or lower Puente formations at Luisian-Mohnian transition.

References: 1. Shelton, 1946
2. Dickert, 1971, p. 283, no. 216

LA-11 Steep Hill Canyon, E. slope. 2,700 ft. W. of SE cor. sec. 27,
T. 1 S., R. 19 W. (SBB&M)

Formation: Vaqueros

Age: Early Miocene

Remarks: Black phosphatic pellets in Vaqueros.

References: 1. Campbell, Blackerby, Yerkes, and Schoellhamer, 1970
2. Dickert, 1971, p. 284, no. 218

LA-12 Dume Cove. In sea cliffs 3/4 mile NE of Point Dume. T. 2 S.,
R. 18 W. (SBB&M)

Quadrangle: Point Dume

Formation: Monterey

Age: Late Miocene (Mohnian)

Remarks: Phosphatic nodules in Monterey.

References: 1. Gower and Madsen, 1964, p. D83, no. 58
2. Dickert, 1971, p. 284, no. 219

LA-13 Inglewood oil field. SW1/4 SW1/4 sec. 16, T. 2 S., R. 14 W. (SBB&M)

Quadrangle: Inglewood

Formation: Puente

Age: Late Miocene (Mohnian)

Remarks: Phosphatic shale in "Division E" of the Puente (Monterey).
Humble Oil & Ref. Co. Buckler Community No. 1 well.

References: 1. Wissler, 1943, p. 227
2. Dickert, 1971, p. 284, no. 220

LA-14 Playa del Rey oil field. SW1/4 NE1/4 sec. 34, T. 2 S., R. 15 W.
(SBB&M)

Quadrangle: Venice

Formation: Puente

Age: Late Miocene (Mohnian)

Remarks: Phosphatic nodules in the Puente. Texas Co. Inglewood Extension No. 1 well.

References: 1. Hoots, and others, 1935
2. Metzner, 1943
3. Hodges, 1944, p. 6
4. Gower and Madsen, 1964, p. D83, no. 59
5. Dickert, 1971, p. 284, no. 221

LA-15 Potrero oil field, Inglewood. SW1/4 NW1/4 sec. 28, T. 2 S.,
R. 14 W. (SBB&M)

Quadrangle: Inglewood

Formation: Puente

Age: Late Miocene (Mohnian)

Remarks: Dark phosphatic nodular shale of Puente (Monterey). Mobil Oil Co. Community No. 54 well.

References: 1. Crowder, 1958
2. Dickert, 1971, p. 284, no. 222

LA-16 El Segundo oil field. NW1/4 NE1/4 sec. 18, T. 3 S., R. 14 W. (SBB&M)

Quadrangle: Venice

Formation: Monterey

Age: Late Miocene (Mohnian)

Remarks: Nodular phosphatic shale in basal 30-60 m of Monterey. Block Oil Co. Block No. 18 well.

References: 1. Reese, 1943
2. Wissler, 1943
3. Dickert, 1971, p. 284, no. 223

- LA-17 Torrance oil field. Center sec. 15, T. 4 S., R. 14 W. (SBB&M)
 Quadrangle: Torrance
 Formation: Puente Age: Late Miocene (Mohnian)
 Remarks: Nodular bituminous phosphatic shale with bentonite laminae in "Division E" of the Puente (Monterey).
 References: 1. Davis, 1943, p. 299
 2. Wissler, 1943, p. 227
 3. Gower and Madsen, 1964, p. D83, no. 60
 4. Dickert, 1971, p. 284, no. 225
- LA-18 Malaga Cove, 200 ft. SW of the mouth of Malaga Canyon.
 T. 4 S., R. 15 W. (SBB&M)
 Quadrangle: Redondo Beach
 Formation: Monterey, Altamira Shale Age: Late Miocene (Mohnian)
 Member
 Remarks: Excellent exposure of 60 m section of phosphatic shale in the upper part of the Altamira Shale Member and in the Valmonte Diatomite Member of the Monterey.
 References: 1. Woodring and others, 1946, p. 20, loc. #10 and p. 34
 2. Gower and Madsen, 1964, p. D83, no. 63
 3. Dickert, 1971, p. 285, no. 226
- LA-19 Agua Negra Canyon. 500 ft. NE of Palos Verdes Drive North.
 SW1/4 T. 4 S., R. 14 W. (SBB&M)
 Quadrangle: Torrance
 Formation: Monterey, Valmonte Age: Late Miocene (Mohnian)
 Diatomite Member
 Remarks: Phosphatic and diatomaceous shale in lower part of Valmonte Diatomite.
 References: 1. Woodring and others, 1946
 2. Dickert, 1971, p. 285, no. 227
- LA-20 Lomita Quarry. T. 4 S., R. 14 W. (SBB&M)
 Quadrangle: Torrance
 Formation: Lomita Marl Age: Pleistocene
 Remarks: Phosphate nodules in Lomita Marl.
 References: 1. Tucker, 1927, p. 328
 2. Dietz and others, 1942, p. 831
 3. Rogers, 1944, p. 421
 4. Emery and Dietz, 1950, p. 12
 5. Gower and Madsen, 1964, p. D83, no. 61
- LA-21 Palos Verdes Point, southside. T. 5 S., R. 15 W. (SBB&M)
 Quadrangle: Redondo Beach
 Formation: Monterey, Valmonte Age: Late Miocene (Mohnian)
 Diatomite and Altamira
 Shale Member
 Remarks: Section of upper part of Altamira Shale Member and Valmonte Diatomite Member in sea cliff on south side of Palos Verdes Point. Approximately 10 m of phosphatic shale; 9 m in basal Valmonte Diatomite Member.
 Reference: 1. Woodring, Bramlette, and Kew, 1946, p. 30

LA-22 Lunada Bay at mouth of Agua Amarga Canyon. T. 5 S., R. 15 W. (SBB&M)
Quadrangle: Redondo Beach

Formation: Monterey, Altamira Age: Late Miocene (Mohnian)
Shale Member

Remarks: 45 m section of phosphatic and bituminous shale in the upper part of the Altamira Shale.

References: 1. Woodring and others, 1946, p. 21 and 29
2. Gower and Madsen, 1964, p. D83, no. 62
3. Dickert, 1971, p. 285, no. 228

LA-23 Altamira Canyon, Middle Fork. T. 5 S., R. 14 W. (SBB&M)

Quadrangle: Torrance

Formation: Monterey, Altamira Age: Late Miocene (Mohnian)
Shale Member

Remarks: A section of 80 m of phosphatic shale and limestone for the upper and middle part of the Altamira Shale.

References: 1. Woodring, Bramlette, and Kew, 1946, p. 30
2. Dickert, 1971, p. 285, no. 229

LA-24 Altamira Canyon, East Fork. T. 5 S., R. 14 W. (SBB&M)

Quadrangle: Torrance

Formation: Monterey, Altamira Age: Late Miocene (Mohnian)
Shale Member

Remarks: A section of 30 m of phosphatic shale and limestone for the upper part of the Altamira Shale.

Reference: 1. Woodring, Bramlette, and Kew, 1946, p. 31

LA-25 San Pedro, S. side of Second St., 100 ft. W. of Pacific Ave.

T. 5 S., R. 14 W. (SBB&M)

Quadrangle: San Pedro

Formation: Lomita Marl Age: Pleistocene

Remarks: Limy phosphatic nodules scattered in the lower 15 m of the Lomita Marl.

References: 1. Woodring and others, 1946; 1954
2. Dickert, 1971, p. 285, no. 230

LA-26 Point Fermin. Paseo del Mar, N. side, at the projected extension of Fortieth St. T. 5 S., R. 14 W. (SBB&M)

Quadrangle: San Pedro

Formation: Monterey, Altamira Age: Late Miocene (Mohnian)
Shale Member

Remarks: Thin layers of phosphatic Altamira Shale within blue-schist sandstone.

References: 1. Woodring and others, 1946, loc. 17
2. Dickert, 1971, p. 285, no. 231

LA-27 Wilmington oil field. Center sec. 34, T. 4 S., R. 13 W. (SBB&M)

Quadrangle: Long Beach

Formation: Puente Age: Late Miocene (Mohnian)

Remarks: Nodular bituminous phosphatic shale in "Division E" of the Puente.

References: 1. Wissler, 1943, p. 210, 221, 227
2. Dickert, 1971, p. 285, no. 232

LA-28 Wilson Cove, San Clemente Island

Quadrangle: San Clemente Island North

Formation: Monterey

Age: Middle Miocene (Luisian)

Remarks: Phosphatized Foraminifera.

References: 1. Olmsted, 1958, p. 65

2. Gower and Madsen, 1964, p. D83, no. 64

3. Vedder and Moore, 1976, p. 111

LA-29 Playa del Rey oil field. Center SE1/4 sec. 27, T. 2 S., R. 15 W.
(SBB&M)

Quadrangle: Venice

Formation: Puente

Age: Late Miocene (Mohnian)

Remarks: Nodular bituminous phosphatic shale in "Division E" of the Puente.

References: 1. Wissler, 1943, p. 221, 227

2. Hoots, Blount, and Jones, 1935, p. 180-181, 189-191

LA-30 El Segundo oil field. SE1/4 SE1/4 sec. 12, T. 3 S., R. 15 W. (SBB&M)

Quadrangle: Venice

Formation: Puente

Age: Late Miocene (Mohnian)

Remarks: Nodular bituminous phosphatic shale in "Division E" of the Puente.

Reference: 1. Wissler, 1943, p. 221, 227

LA-31 Inglewood oil field. Center SW1/4 sec. 8, T. 2 S., R. 14 W. (SBB&M)

Quadrangle: Hollywood

Formation: Puente

Age: Late Miocene (Mohnian)

Remarks: Nodular bituminous phosphatic shale in "Division E" of the Puente.

Reference: 1. Wissler, 1943, p. 221, 228

MARIN COUNTY

MA-1 West side of Drakes Bay, N. of the lifeboat station. T. 2 N., R. 10 W.
(MDB&M)

Quadrangle: Drakes Bay

Formation: Drakes Bay Formation

Age: Early Pliocene

Remarks: Phosphatic concretions and bone fragments in basal coarse-grained glauconitic sandstone.

References: 1. Gower and Madsen, 1964, p. D81, no. 6

2. Dickert, 1971, p. 255, no. 3

3. Galloway, 1977, p. 26

MA-2 Double Point, N. point. Sec. 7, T. 1 N., R. 8 W. (MDB&M)

Quadrangle: Double Point

Formation: Monterey

Age: Middle Miocene (Luisian)

Remarks: Leached nodular phosphatic shale in well core. Standard Oil of California (Lockhart) Tevis No. 1 well.

References: 1. Dickert, 1970, p. 256 no. 7.

2. Galloway, 1977, p.26

MENDOCINO COUNTY

Mn-1 3,000 ft. N. of the mouth of Galloway Creek. SW1/4 sec. 29,
T. 12 N., R. 16 W. (MDB&M)
Quadrangle: Saunders Reef
Formation: Skooner Gulch Age: Early Miocene (Zemorrian)
Remarks: Phosphatic nodules in glauconitic sandstone in the upper part
of the Skooner Gulch.
References: 1. Addicott, 1967
2. Dickert, 1971, p. 255, no. 2
3. Phillips, Welton, and Welton, 1976

Mn-2 Approximately 1/4 mile S. of mouth of Schooner [Skooner] Gulch.
Sea cliff in sec. 32, T. 12 N., R. 16 W. (MDB&M)
Quadrangle: Saunders Reef
Formation: Skooner Gulch Age: Early Miocene (Zemorrian)
Remarks: Near the top of the formation is a very thick fine-grained
glauconitic sandstone which contains phosphatic nodules, shark
teeth, marine mammal remains, and fish vertebrae.
References: 1. Addicott, 1967, p. C3
2. Phillips, Welton, and Welton, 1976

MERCED COUNTY

Mer-1 Laguna Seca. SE1/4 sec. 13, T. 12 S., R. 10 E. (MDB&M)
Quadrangle: Charleston School
Formation: Moreno and Unalde Age: Late Cretaceous & Paleocene
Remarks: Phosphatic concretions in the Tierra Loma Member of the Moreno
Formation and in the Unalde Formation.
Reference: 1. Dickert, 1971, p. 261, no. 47

MONTEREY COUNTY

Mo-1 Old Monterey Airport Road, N. of entrance to Santa Catalina School,
650 ft. S. of Highway 1, T. 15 S., R. 1 E. (MDB&M)
Quadrangle: Seaside
Formation: Monterey, Hames Member Age: Late Miocene (Early Mohnian)
Remarks: Thin (5-10 cm) beds of abundant pellets in opaline porcelanite.
References: 1. Dickert, 1971, p. 261, no. 51
2. Brabb, Bowen, and Hart, 1962

Mo-2 E. side of Protrero Canyon. 1,050 ft. due W. of SW cor. sec. 22,
T. 16 S., R. 1 E. (MDB&M)
Quadrangle: Seaside
Formation: Monterey, Laureles Sandstone Member Age: Middle Miocene (Luisian (?))
Remarks: Three thin (1-10 cm) layers of phosphatic pellets in siliceous
mudstone within the Laureles Sandstone.
Reference: 1. Dickert, 1971, p. 262, no. 56

Mo-3 *SE 1/4 projected sec. 24, T. 16 S., R. 1 E. (MDB&M)
Quadrangle: Seaside
Formation: Monterey, Hames Member Age: Late Miocene (Early Mohnian)
Remarks: Phosphate pellet beds as much as 0.3 m thick in siliceous shales.
References: 1. Gower and Madsen, 1964, p. D81, no. 16
2. Graham, 1976, p. 383
3. Cassell, 1949

- Mo-4 SE 1/4 sec. 33, T. 16 S., R. 1 E. (MDB&M)
 Quadrangle: Mr. Carmel
 Formation: Monterey, Laureles Sandstone Member Age: Middle Miocene (Luisian)
 Remarks: Laureles Sandstone includes a horizon characterized by nodular phosphorite and phosphatized bone fragments.
 Reference: 1. Graham, 1976, p. 350; loc. Br6
- Mo-5 Western rim of Robinson Canyon. 100 ft. S. and 350 ft. E. of NW cor. sec. 36, T. 16 S., R. 1 E. (MDB&M)
 Quadrangle: Seaside
 Formation: Monterey, Laureles Sandstone Member Age: Middle Miocene (Luisian)
 Remarks: A few thin beds of phosphatized debris (shell fragments, fish vertebrae, pellets) in fine grained sandstone of the Laureles Sandstone Member. Sample loc. 57 just above shale-conglomerate contact.
 References: 1. Dickert, 1971, p. 262, no. 57
 2. Graham, 1976, p. 383
- Mo-6 SE 1/4 NW 1/4 sec. 16, T. 16 S., R. 2 E. (MDB&M)
 Quadrangle: Seaside
 Formation: Monterey Shale, Hames Member Age: Late Miocene (Mohnian)
 Remarks: Phosphate-pellet beds in siliceous shales exposed in roadcuts.
 Reference: 1. Gower and Madsen, 1964, p. D81, no. 15
- Mo-7 Carmel Valley Road. 200 ft. SE of mouth of Meadows Canyon. SW 1/4 sec. 19, T. 16 S., R. 2 E. (MDB&M)
 Quadrangle: Seaside
 Formation: Monterey, Hames Member Age: Late Miocene (Early Mohnian)
 Remarks: The most westerly of many exposures of pelletite beds in the Monterey where the Carmel Valley Road cuts this unit.
 References: 1. Dickert, 1970, p. 262, no. 53
 2. Graham, 1976, p. 383
- Mo-8 Meadows Canyon. Several exposures on road leading from Carmel Valley Rd. N. to Coyote Gulch. 1,100 ft. N., 275 ft. E. of SW cor. sec. 19, T. 16 S., R. 2 E. (MDB&M)
 Quadrangle: Seaside
 Formation: Monterey, Hames Member Age: Late Miocene (Early Mohnian)
 Remarks: Two 10 cm beds of abundant pellets in sandy Monterey.
 References: 1. Dickert, 1971, p. 261, no. 52
 2. Graham, 1976, p. 383
- Mo-9 W. side of Juan de Matte Canyon. 6,300 ft. N., 5,800 ft. E. of SW cor. sec. 29, T. 16 S., R. 2 E. (MDB&M)
 Quadrangle: Seaside
 Formation: Monterey, Hames Member Age: Late Miocene (Early Mohnian)
 Remarks: Abundant pellets 20 m above granodiorite basement.
 Reference: 1. Dickert, 1971, p. 262, no. 54

Mo-10 Carmel Valley Road. 100 ft. SE of benchmark 195, T. 16 S., R. 2 E.
R. 2 E. (MDB&M)

Quadrangle: Seaside

Formation: Monterey, Hames Member Age: Late Miocene (Late Mohnian)

Remarks: Two pelletite beds, 30 and 8 cm thick. A quarter mile SE of this exposure, a 32 cm layer of phosphatic conglomerate.

References: 1. Rogers, 1944, p. 411
2. Dickert, 1971, p. 262, no. 55
3. Graham, 1976, p. 383, LSJU loc. #567
4. Younse, 1980, section 332, pls. 3 and 5

Mo-11 San Jose Creek Road, N. side. NEL/4 NEL/4 sec. 4, T. 17 S., R. 1 E.
(MDB&M)

Quadrangle: Mt. Carmel

Formation: Monterey, Laureles Sandstone Member Age: Middle Miocene (Luisian)

Remarks: Phosphate pellets and pebbles in the Laureles Sandstone Member.

References: 1. Dickert, 1971, p. 262, no. 58
2. Graham, 1976, p. 350

Mo-12 San Jose Creek Road, N. side. NEL/4 sec. 10, T. 17 S., R. 1 E. (MDB&M)

Quadrangle: Mt. Carmel

Formation: Monterey, Laureles Sandstone Member Age: Middle Miocene (Luisian)

Remarks: Phosphatic conglomerate (pellets, pebbles, and phosphatized organic debris) in Laureles Sandstone Member.

References: 1. Dickert, 1971, p. 262, no. 59
2. Graham, 1976, p. 350

Mo-13 Tularcitos Valley. One quarter mile NE of Tularcitos Guard Station,
T. 17 S., R. 2 E. (MDB&M)

Quadrangle: Carmel Valley

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Late
(Relizian)

Remarks: Phosphate pellet layer, 1 m thick, at depositional base of Monterey. Dickert loc. 60A .55 mile W. of Chupines Ranch, N. side of Carmel Valley road; phosphatic shale, 1.5 m above pellet layer.

References: 1. Neel, 1963
2. Dickert, 1971, p. 263, no. 60
3. Graham, 1976, p. 259, 260

Mo-14 N. side of Carmel Valley Road, 2,800' E., 1,000' S. of Tularcitos
Guard Sta. T. 17 S., R. 2 E. (MDB&M)

Quadrangle: Carmel Valley

Formation: Monterey, Hames Member Age: Late Miocene (Early Mohnian)

Remarks: 12 m exposure of Monterey Shale porcellanite and mudstone includes 7 pellet-bearing layers, from 5-18 cm thick at Louisian-Mohnian boundary.

References: 1. Dickert, 1971, p. 263, no. 61
2. Graham, 1976, p. 257

Mo-15 N. side, Carmel Valley Road. 1.5 miles W. of Tularcitos Ranch,
T. 17 S., R. 3 E. (MDB&M)

Quadrangle: Carmel Valley

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Late Relizian)

Remarks: A 30 cm bed of pellet-bearing mudstone in gray diatomaceous shale of the Sandholdt.

References: 1. Dickert, 1971, p. 263, no. 62
2. Graham, 1976, p. 257

Mo-16 Tularcitos Creek Road, N. side. 3 miles E. of Tularcitos Ranch.
2,800 ft. NW of benchmark 1153, T. 17 S., R. 3 E. (MDB&M)

Quadrangle: Rana Creek

Formation: Monterey, Hames Member Age: Late Miocene (Mohnian)

Remarks: Three 5-15 cm phosphate-pellet beds in thin-bedded slightly phosphatic siliceous shale at base of Hames.

References: 1. Gower and Madsen, 1964, p. D81, no. 17
2. Wiedman, 1964, no. 2, p. 39
3. Dickert, 1971, p. 263, no. 63 and p. 51

Mo-17 Tularcitos Ridge. SW1/4 NW1/4 sec. 35, T. 17 S., R. 3 E. (MDB&M)

Quadrangle: Rana Creek

Formation: Monterey, Hames Member Age: Late Miocene (Mohnian)

Remarks: Leached pelletal phosphate beds near base of Hames.

References: 1. Wiedman, 1964, no. 1, p. 39
2. Dickert, 1971, p. 263, nos. 64 and 65

Mo-18 Jamesburg Road. SW1/4 NE1/4 sec. 6, T. 18 S., R. 4 E. (MDB&M)

Quadrangle: Rana Creek

Formation: Monterey, Hames Member Age: Late Miocene (Mohnian)

Remarks: Leached phosphatic pellets near base of Hames.

References: 1. Wiedman, 1964, no. 3, p. 39
2. Dickert, 1971, p. 263, no. 66

Mo-19 SW side of Paloma Creek at SW cor. sec. 31, T. 18 S., R. 5 E. (MDB&M)

Quadrangle: Sycamore Flat

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Luisian)

Remarks: Phosphatic laminae in organic mudstone.

References: 1. Durham, 1970
2. Dickert, 1971, p. 263, no. 68

Mo-20 Church Creek. SW1/4 sec. 13, T. 19 S., R. 3 E. (MDB&M)

Quadrangle: Chews Ridge

Formation: Church Creek Age: Eocene (Refugian)

Remarks: Ferruginous phosphatic mudstone.

References: 1. Dickinson, 1956; 1965, p. 28, 37, 38
2. Brabb, Bukry, and Pierce, 1971
3. Dickert, 1971, p. 264, no. 71
4. Graham, 1976

- Mo-21 Sec. 12, T. 19 S., R. 4 E. (MDB&M)
 Quadrangle: Sycamore Flat
 Formation: Monterey, Sandholdt Member Age: Middle Miocene (Luisian)
 Remarks: Pellet phosphate at fossil loc. Mf 971.
 Reference: 1. P. B. Smith in Durham, 1970, p. 30
- Mo-22 Arroyo Seco Road, S. side. *NW1/4 SE1/4 sec. 36, T. 19 S., R. 4 E.
 (MDB&M)
 Quadrangle: Junipero Serra Peak
 Formation: Monterey, Sandholdt Member Age: Lower Miocene (Saucesian
 or Early Relizian)
 Remarks: A 15 m thick sequence of phosphatic shale and sandy mudstone.
 Reference: 1. Dickert, 1971, p. 264, no. 72-1
- Mo-23 SW side of Paloma Creek in SW1/4 sec. 6, T. 19 S., R. 5 E. (MDB&M)
 Quadrangle: Sycamore Flat
 Formation: Monterey, Sandholdt Member Age: Middle Miocene (Luisian)
 Remarks: Phosphatic nodules in laminae in basal part of Sandholdt.
 References: 1. Dickert, 1971, p. 264, no. 69
 2. Durham, 1970
- Mo-24 1,400' west of SE cor. sec. 8, T. 19 S., R. 5 E. (MDB&M)
 Quadrangle: Sycamore Flat
 Formation: Monterey, Hames Member Age: Late Miocene (Early Mohnian)
 Remarks: A few thin phosphate pellet beds crop out in porcelaneous
 rocks on the ridgetop.
 Reference: 1. Durham, 1970, p. 30
- Mo-25 450 ft. W. of SE cor. sec. 21, T. 19 S., R. 5 E. (MDB&M) and
 roadcuts along Arroyo Seco Road.
 Quadrangle: Sycamore Flat
 Formation: Monterey Age: Late Miocene (Early Mohnian)
 Remarks: Phosphate pellet beds in the Monterey.
 References: 1. Gower and Madsen, 1964, p. D81, no. 18
 2. Durham, 1970, p. 30
- Mo-26 N. side of Jamesburg Road and 300 ft. W. of Sand Creek. NE1/4 SW1/4
 sec. 21, T. 19 S., R. 5 E. (MDB&M)
 Quadrangle: Sycamore Flat
 Formation: Monterey Age: Late Miocene (Early Mohnian)
 Remarks: An 8 cm bed of coarse pellets and phosphate pebble fragments
 in porcelaneous shale in which phosphate nodules are sparsely
 dispersed over a 30 m section.
 Reference: 1. Dickert, 1971, p. 264, no. 70
- Mo-27 Arroyo Seco Road, N. side. *NW1/4 SW1/4 sec. 31, T. 19 S., R. 5 E.
 (MDB&M)
 Quadrangle: Junipero Serra Peak
 Formation: Monterey, Sandholdt Member Age: Middle Miocene (Saucesian
 or Early Relizian)
 Remarks: Phosphatic zone in Sandholdt exposed in roadcut at loc.
 Mf 1020.
 Reference: 1. Dickert, 1971, p. 264, no. 72-2

Mo-28 E. side, Monroe Canyon. SE1/4 SW1/4 sec. 28, T. 19 S., R. 7 E. (MDB&M)
 Quadrangle: Thompson Canyon
 Formation: Santa Margarita Age: Late Miocene (Mohnian)
 Remarks: Phosphatic oolites (4%) in basal sandstone of formation.
 References: 1. Weidman, 1958, p. 112 (sample 315-S-55)
 2. Dickert, 1971, p. 264, no. 74

Mo-29 NW1/4 NE1/4 sec. 33, T. 19 S., R. 7 E. (MDB&M)
 Quadrangle: Thompson Canyon
 Formation: Santa Margarita Age: Late Miocene (Mohnian)
 Remarks: Basal few feet of the Santa Margarita Formation consists of pebble conglomerate and pebbly sandstone containing several pholad-bored pebbles and considerable phosphatic silt in the form of pellets, oolites, and internal fossil molds.
 Reference: 1. Weidman, 1958, p. 110 (sample 315-S-44)

Mo-30 Center sec. 23, T. 19 S., R. 8 E. (MDB&M)
 Quadrangle: Pinalito Canyon
 Formation: Pancho Rico Age: Pliocene
 Remarks: Phosphatic sandstone containing 15 % phosphate pellets.
 Reference: 1. Weidman, 1958, p. 121, col. no. 1

Mo-31 SE1/4 SW1/4 sec. 26, T. 19 S., R. 8 E. (MDB&M)
 Quadrangle: San Lucas
 Formation: Pancho Rico Age: Pliocene
 Remarks: Phosphatic fossil fragments.
 Reference: 1. Weidman, 1958, p. 121, col. no. 2

Mo-32 San Lorenzo Creek. SW1/4 sec. 28, T. 19 S., R. 9 E. (MDB&M)
 Quadrangle: San Lucas
 Formation: Pancho Rico Age: Pliocene
 Remarks: Phosphate pellets (10-20%) in sands near the top of the formation.
 References: 1. Dickert, 1971, p. 264, no. 75
 2. Weidman, 1958, p. 121, col. no. 6; p. 126 (sample 315-S-62)

Mo-33 SW1/4 SW1/4 sec. 29, T. 19 S., R. 9 E. (MDB&M)
 Quadrangle: San Lucas
 Formation: Pancho Rico Age: Pliocene
 Remarks: Phosphate pellets near top of formation.
 Reference: 1. Weidman, 1958, p. 121, col. no. 5

Mo-34 Vaqueros Creek. NW1/4 NW1/4 sec. 4, T. 20 S., R. 6 E. (MDB&M)
 Quadrangle: Reliz Canyon
 Formation: Monterey, Sandholdt Member Age: Middle Miocene (Late Luisian)
 Remarks: Pellet phosphate beds 10-15 cm thick in the Sandholdt.
 References: 1. Reed, 1927
 2. Gower and Madsen, 1964, p. D81, no. 20

Mo-35 Reliz Canyon, W. side. SW1/4 NW1/4 sec. 14, T. 20 S., R. 6 E. (MDB&M)
 Quadrangle: Reliz Canyon
 Formation: Monterey, Sandholdt Member Age: Middle Miocene (Late Luisian)
 Remarks: Hard massive pelletite layers 5-60 cm thick in mudstones and shales at top of Sandholdt.
 References: 1. Kleinpell, 1938 (sample loc. shown in frontispiece)
 2. Dickert, 1971, p. 265, no. 77
 3. Durham, 1974; 1963, p. Q17
 4. Graham, 1976

Mo-36 Reliz Canyon. SW1/4 NW1/4 sec. 13, T. 20 S., R. 6 E. (MDB&M)
 Quadrangle: Reliz Canyon
 Formation: Monterey, Sandholdt Member Age: Middle Miocene (Late Luisian)
 Remarks: Phosphatic pellet beds in mudstone near Mf 1488.
 References: 1. Gower and Madsen, 1964, p. D81, no. 21
 2. Smith, 1968

Mo-37 Reliz Canyon. NE1/4 SE1/4 sec. 26, T. 20 S., R. 6 E. (MDB&M)
 Quadrangle: Reliz Canyon
 Formation: Vaqueros Age: Early Miocene (Early Saucian (?))
 Remarks: Pellets in fine-grained sandstone near top of F member (of Thorup, 1942) of Vaqueros.
 References: 1. Thorup, 1943, p. 466
 2. Gower and Madsen, 1964, p. D81, no. 19
 3. Dickert, 1971, p. 265, no. 79

Mo-38 NE1/4 NW1/4 sec. 14, T. 20 S., R. 7 E. (MDB&M)
 Quadrangle: Thompson Canyon
 Formation: Pancho Rico Age: Pliocene
 Remarks: Sample 315-S-68 from U.C. fossil loc. A-4923, contains a few percent phosphatic granules and very small pebbles.
 Reference: 1. Weidman, 1958, p. 130-31 (sample 315-S-68)

Mo-39 Wildhorse Canyon, N. side. NW1/4 sec. 9, T. 20 S., R. 9 E. (MDB&M)
 Quadrangle: San Lucas
 Formation: Pancho Rico Age: Pliocene
 Remarks: Pelletal phosphate and phosphatized organic debris.
 References: 1. Gower and Madsen, 1964, p. D82, no. 22
 2. Dickert, 1971, p. 265, no. 78

Mo-40 Wildhorse Canyon, S. side. NW1/4 sec. 16, T. 20 S., R. 9 E. (MDB&M)
 Quadrangle: San Lucas
 Formation: Pancho Rico Age: Pliocene
 Remarks: Pelletal phosphate near top of formation.
 Reference: 1. Weidman, 1958, p. 121, col. no. 9

Mo-41 SE1/4 NE1/4 sec. 27, T. 20 S., R. 9 E. (MDB&M)
 Quadrangle: Natrass Valley
 Formation: Pancho Rico Age: Pliocene
 Remarks: Pebbly phosphatic sandstone with interbedded diatomite.
 Reference: 1. Weidman, 1958, p. 121, col. no. 11

Mo-42 *SW1/4 SW1/4 sec. 9, T. 21 S., R. 5 E. (MDB&M)

Quadrangle: Cone Peak

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Saucasian-Relizian)

Remarks: Nodular phosphorite and glauconite.

Reference: 1. Graham, 1976, loc. no. 14-28

-35-

Mo-43 Rattlesnake Creek. *SE1/4 NE1/4 sec. 16, T. 21 S. R. 5 E. (MDB&M)

Quadrangle: Cone Peak

Formation: Monterey, Hames Member Age: Late Miocene (Early Mohnian)

Remarks: Pellet-bearing white sandstone beds, .3-1 m thick, in opaline cherts. Locality GES 3-18, Stanford Univ. summer field geology class, 1958.

Reference: 1. Dickert, 1971, p. 265, no. 81

Mo-44 Rattlesnake Creek. *SW1/4 NE1/4 sec. 22, T. 21 S., R. 5 E. (MDB&M)

Quadrangle: Cone Peak

Formation: Monterey, Hames Member Age: Late Miocene (Early Mohnian)

Remarks: Phosphate nodules in laminated porcelanite. Locality SAT 5-1, Stanford Univ. summer field-geology class, 1958.

Reference: 1. Dickert, 1971, p. 265, no. 82

Mo-45 Mission Creek. 1/2 mile W. in SW1/4 SW1/4 sec. 24, T. 21 S., R. 6 E. (MDB&M)

Quadrangle: Bear Canyon

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Luisian)

Remarks: Thickly bedded pelletites and pellet-bearing sandstones over a 25 m thickness which represents the entire Sandholdt in this area.

References: 1. Dickert, 1971, p. 266, no. 85

2. Durham, 1974, loc. Mf 1493

Mo-46 NW1/4 sec. 25, T. 21 S., R. 6 E. (MDB&M)

Quadrangle: Bear Canyon

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Luisian)

Remarks: Very thin, phosphatic bank-top sequence of phosphatic pelletal sandstones.

Reference: 1. Graham, 1976, locs. no. S-36-74 and S-37-74

Mo-47 Forest Creek. 5,300' E. and 2,900' N. of benchmark 1268.

* SE1/4 SW1/4 sec. 27, T. 21 S., R. 6 E. (MDB&M)

Quadrangle: Bear Canyon

Formation: Monterey Age: Middle Miocene (Luisian)

Remarks: Phosphatic pellets and fossil molds in white, very fine-grained glauconitic sandstone at gradational boundary between Hames and Sandholdt Members of Monterey Formation. Near Mf 1494 [Middle Miocene].

Reference: 1. Dickert, 1971, p. 266, no. 84

Mo-48 Bear Canyon. 1,600 ft. N. and 600 ft. W. of benchmark 1268,
*NW1/4 SW1/4 sec. 28, T. 21 S., R. 6 E. (MDB&M)

Quadrangle: Bear Canyon

Formation: Santa Margarita Age: Late Miocene (Mohnian)

Remarks: Sandstone and conglomerate with phosphate pellets and pebbles
at contact between Monterey and Santa Margarita formations.
Locality DWE 9-25, Stanford University summer field-geology
class, 1958.

Reference: 1. Dickert, 1971, p. 266, no. 83

Mo-49 Pine Canyon Road. NE1/4 NE1/4 sec. 8, T. 21 S., R. 7 E. (MDB&M)

Quadrangle: Cosio Knob

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Relizian or
Luisian)

Remarks: Minor phosphate pellets in calcareous shale of the Sandholdt
Member.

References: 1. Weidman, 1958, p. 75 (sample 315-S-315)
2. Dickert, 1971, p. 266, no. 86

Mo-50 SE1/4 sec. 9, T. 21 S., R. 7 E. (MDB&M)

Quadrangle: Cosio Knob

Formation: Monterey, Hames Member Age: Middle Miocene (Luisian)

Remarks: Phosphate pellets in the Hames.

Reference: 1. Gower and Madsen, 1964, p. D82, no. 24

Mo-51 Cosio Knob, S. slope. SE1/4 NW1/4 sec. 29, T. 21 S., R. 7 E. (MDB&M)

Quadrangle: Cosio Knob

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Relizian or
Early Luisian)

Remarks: 20 cm layer of pellet-bearing sandstone in siliceous mudstone.
Sample 315-S-17 contained 30 percent carbonate and 20 percent
phosphatic oolites.

References: 1. Weidman, 1958, p. 76 (sample 315-S-17)
2. Durham, 1964, p. H12
3. Dickert, 1971, p. 266, no. 87

Mo-52 SE1/4 SE1/4 sec. 29, T. 21 S., R. 7 E. (MDB&M)

Quadrangle: Cosio Knob

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Relizian or
Early Luisian)

Remarks: Argillaceous limestone contains a 15 cm bed of phosphatic
sandstone consisting of arkosic sand grains and phosphatic
oolites in a matrix of siliceous mudstone.

References: 1. Weidman, 1958, p. 92 (sample 315-S-38)
2. Durham, 1964

Mo-53 On E. line of sec. 15, T. 21 S., R. 9 E. (MDB&M)

Quadrangle: San Ardo

Formation: Pancho Rico Age: Pliocene

Remarks: Phosphate pellets and phosphatized organic debris in siltstones
in the basal part of the formation.

References: 1. Bramlette and Daviess, 1944
2. Weidman, 1958, p. 121, col. 12

Mo-54 Espinosa Canyon Road, W. side. *NE 1/4 NW 1/4 of projected sec. 30,
T. 21 S., R. 9 E. (MDB & M)

Quadrangle: Espinosa Canyon

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Relizian or
Early Luisian)

Remarks: Pelletal phosphate in sandy beds of Sandholdt. Similar beds
outcrop along E. edge of hills in sec. 32 (Durham, 1964).

References: 1. Durham, 1964, p. H12
2. Dickert, 1971, p. 266, no. 89

Mo-55 NW 1/4 NE 1/4 sec. 32, T. 21 S., R. 9 E. (MDB&M)

Quadrangle: Espinosa Canyon

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Relizian or
early Luisian)

Remarks: Phosphate pellet beds in the Sandholdt.

References: 1. Durham, 1964, p. H12
2. Gower and Madsen, 1964, p.D82, no. 25

Mo-56 NE 1/4 NE 1/4 sec. 16, T. 21 S., R. 10 E. (MDB&M)

Quadrangle: San Ardo

Formation: Pancho Rico Age: Pliocene

Remarks: Phosphate pellets and phosphatized organic debris in basal
part of formation.

Reference: 1. D. L. Durham, 1978, oral commun.

Mo-57 NE 1/4 NW 1/4 sec.23, T. 22 S., R. 6 E. (MDB&M)

Quadrangle: Bear Canyon

Formation: Santa Margarita (?) Age: Late (?) Miocene (Mohnian?)

Remarks: Phosphatic nodules in basal sandstone on basement.

Reference: 1. Graham, 1976, loc. 4-500

Mo-58 Pole Canyon. NE 1/4 SW 1/4 sec. 1, T. 22 S., R. 7 E. (MDB&M)

Quadrangle: Cosio Knob

Formation: Santa Margarita Age: Late Miocene (Mohnian)

Remarks: Polished phosphatic oolites observed in several sandstone
samples. They constitute less than 1 percent of the samples,
except for one pebbly sample (315-S-51) which contains about
25 percent light brown phosphatic oolites.

References: 1. Weidman, 1958, p. 108 (sample 315-S-51)
2. Durham, 1964
3. Dickert, 1971, p. 266, no. 88

Mo-59 *NW 1/4 sec. 31, T. 22 S., R. 7 E. (MDB&M)

Quadrangle: Alder Peak

Formation: Monterey, Sandholdt Member Age: Middle Miocene
(Lower Luisian)

Remarks: Glauconite-phosphorite conglomerate in basal Sandholdt.

References: 1. Graham, 1976, loc.no. 27-15, 16
2. Pisciotto, 1978, loc.no. K-81-77

Mo-60 Paris Valley. NE 1/4 SW 1/4 sec. 12, T. 22 S., R. 9 E. (MDB&M)

Quadrangle: San Ardo

Formation: Santa Margarita Age: Late Miocene (Mohnian)

Remarks: Phosphatic pellet-bearing fine-grained sandstone.

References: 1. Dickert, 1971, p.268, no.96

Mo-61 Sec. 5, T. 22 S., R. 10 E. (MDB&M)

Quadrangle: San Ardo

Formation: Pancho Rico Age: Pliocene

Remarks: Phosphate pellets and phosphatic mollusk shells in Pancho Rico.

References: 1. Hughes, 1963, p.94-95

2. Gower and Madsen, 1964, p.D82, no.26

Mo-62 Salinas River, 4 miles SE San Ardo. 3,500 ft. S. and 1,500 ft. E. of NW cor. sec. 33, T. 22 S., R. 10 E. (MDB&M)

Quadrangle: Hames Valley

Formation: Pancho Rico Age: Pliocene

Remarks: Several friable silty fine-grained sandstone layers (40-60 cm thick) which include 5-75% pellets and phosphatized organic debris.

Reference: 1. Dickert, 1971, p.268, no. 97

Mo-63 Tule Canyon. SW 1/4 NE 1/4 sec. 22, T. 23 S., R. 8 E. (MDB&M)

Quadrangle: Williams Hill

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Luisian)

Remarks: Phosphatic pellets in calcareous shales of the Sandholdt.

References: 1. Gower and Madsen, 1964, p. D82, no. 27

2. Durham, 1965

3. Dickert, 1971, p.268, no. 98

Mo-64 *NE 1/4 sec. 6, T. 24 S., R. 8 E. (MDB&M)

Quadrangle: Jolon

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Relizian)

Remarks: Phosphatic pellets at base of Sandholdt. Durham, 1965, p.Q13 cites P.B. Smith as Luisian in sec. 22, T.23S., R.7E.

Reference: 1. Graham, 1976, loc. no. 15-6 through 11

Mo-65 *Center NE 1/4 sec. 17, T. 24 S., R. 9 E. (MDB&M)

Quadrangle: Bryson

Formation: Pancho Rico Age: Pliocene

Remarks: D. L. Durham loc. 694010 -- near M 4191

Reference: 1. D. L. Durham, 1978, oral commun.; loc. 694010

Mo-66 Road cut on Interlake Road. NE 1/4 NE 1/4 sec. 19, T. 24 S., R. 9 E. (MDB&M)

Quadrangle: Bryson

Formation: Monterey, Sandholdt Member Age: Early Miocene (Saucesian)

Remarks: Near Mf 902 and Mf 903 (U. Saucesian and Saucesian).

Reference: 1. D. L. Durham, 1978, oral commun.

Mo-67 San Antonio River. SW 1/4 NE 1/4 sec. 32, T. 24 S., R. 11 E. (MDB&M)

Quadrangle: Bradley

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Late Relizian or Luisian)

Remarks: Phosphatic shale in Sandholdt Member. Nacimiento No. 1 well.

References: 1. Durham, 1968, loc. no. 4
2. Dickert, 1971, p.270, no.111

Mo-68 E. side of Tomasini Canyon. 3,850 ft. N., 1,950 ft. E. of SW cor. sec. 29, T. 16 S., R. 2 E. (MDB&M)

Quadrangle: Seaside

Formation: Monterey Age: Late Miocene (Early Mohnian)

Remarks: Phosphatic pelletal bed 20 cm thick and persistent for at least 20 m.

References: 1. Galliher, 1931, p.266
2. Rogers, 1944, p.411
3. Graham, 1976, p. 383

Mo-69 N. side Arroyo Seco Road, 2,000' E. of bridge. *NE 1/4 SW 1/4 sec. 31, T. 19 S., R. 5 E. (MDB&M)

Quadrangle: Junipero Serra Peak

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Saucesian or Early Relizian)

Remarks: Phosphatic zone in Sandholdt Member.

Reference: 1. Pisciotto, 1978, loc. no. K-106-77

Mo-70 SE 1/4 NE 1/4 sec. 14, T. 20 S., R. 6 E. (MDB&M)

Quadrangle: Reliz Canyon

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Late Luisian)

Remarks: Zone in upper part of Sandholdt Member containing beds of pelletal phosphate.

References: 1. Smith, 1968, p.1788
2. Pisciotto, 1978, loc. no. K-169-77

ORANGE COUNTY

Or-1 Richfield oil field. Center SE 1/4 sec. 31, T. 3 S., R. 9 W. (SBB&M)

Quadrangle: Orange

Formation: Puente, lower member Age: Late Miocene (Mohnian)

Remarks: Discontinuous phosphatic shale in lower part of Puente (Monterey). Standard Oil Co. Ruth L. Williams No.1 well.

References: 1. Wissler, 1943
2. Dickert, 1971, p.284, no.224

Or-2 Huntington Beach oil field. NE 1/4 NW 1/4 sec. 10, T. 6 S., R. 11 W.
(SBB&M)

Quadrangle: Seal Beach
Formation: Puente, lower member Age: Late Miocene (Mohnian)
Remarks: Hard black micaceous shale with phosphatic laminae in the lower Puente (Monterey). Standard Oil Co. of California, Huntington B. No. 167 well. Numerous phosphatic nodules in this interval in adjacent Talbert oil field.
References: 1. Wissler, 1943
2. Dickert, 1971, p.286, no. 233

Or-3 Newport Bay, E. side. 4,200 ft. N., 700 ft. E. of SE cor. sec. 26, T. 6 S., R. 10 W. (SBB&M)

Quadrangle: Newport Beach
Formation: Monterey Age: Late Miocene (Mohnian)
Remarks: Phosphatic nodules in the Monterey formation and large phosphatic nodules in marine conglomerate overlying the Monterey at Newport Bay.
References: 1. Emery and Dietz, 1950, p.12
2. Gower and Madsen, 1964, p.D83, no.66
3. Dickert, 1971, p.286, no.234

SAN BENITO COUNTY

SBt-1 Little Rabbit Valley, SW side of road. 200 ft. N. and 900 ft. E. of
*SW cor. sec. 18, T. 17 S., R. 9 E. (MDB&M)

Quadrangle: Topo Valley
Formation: Monterey Age: Middle Miocene (Luisian)
Remarks: Disseminated phosphate in calcareous and siliceous shales of the Monterey.
Reference: 1. Dickert, 1971, p.263, no. 67

SAN BERNARDINO COUNTY

SBd-1 NE cor. sec. 35, T. 25 S., R. 43 E. (MDB&M)

Quadrangle: Searles Lake
Formation: Searles Lake evaporites Age: Late Quaternary
Remarks: Evaporites contain PO₄ in T. 25 S., R. 43 E., T. 25 S., R. 44 E., T. 26 S., R. 43 E., and T. 26 S., R. 44 E.—the greater concentration is in the central part of Searles Lake in the SE 1/4 T. 25 S., R. 43 E. from Well GS-14.
References: 1. Bixler and Sawyer, 1957
2. Smith and Haines, 1964
3. Smith, 1979

SBd-2 In San Juan Tunnel, 2,000 feet from the east portal. Secs. 21 and 22,
T. 3 S., R. 8 W. (SBB&M)

Quadrangle: Prado Dam
Formation: Puente, Yorba Member Age: Late Miocene
Remarks: Rocks of the Yorba Member exposed 600 m from the east portal of the tunnel consist of 70% dark-gray siltstone in beds as much as 30 cm thick and 30% light-grey to white fine- to medium-grained, feldspathic sandstone in thin stringers and beds. The siltstone contains zones of brown phosphatic nodules.
References: 1. Durham and Yerkes, 1964, p.B59
2. Gower and Madsen, 1964, p.D83, no.65

SAN DIEGO COUNTY

SD-1 Mesa E. of Otay. Sec. 13, T. 18 S., R. 2 W. (SBB&M)

Quadrangle: Imperial Beach

Formation: San Diego Age: Pliocene

Remarks: White phosphatic calcareous bed, probably in the San Diego Formation, with an analysis of less than 2% of phosphoric acid.

References: 1. Merrill, 1916, p.717
2. Weber, 1963, p.202
3. Gower and Madsen, 1964 p.D83, no. 67
4. Kennedy and Tan, 1977, Map 29

SD-2 SW 1/4 sec. 13, T. 14 S., R. 4 W. (SBB&M)

Quadrangle: Del Mar

Formation: Lindavista Age: Late Pliocene or
Early Pliocene

Remarks: Pea-to marble-sized, reddish-brown nodules are a constituent of the Lindavista terrace deposits. Nodules collected by Weber (1964) assayed 0.13% phosphoric anhydride. The nodules contain a substantial proportion of iron. Kennedy refers to these as pellets with an av. diam. of 0.5-1.0 cm. He found the pellets throughout the western San Diego coastal area.

References: 1. Emery, 1950, p.213-221
2. Weber, 1963, p.202
3. Kennedy, 1975, plate 1A
4. Kennedy and Tan, 1977, Map 29
5. Kennedy, M. P. 1979, written commun.

SAN FRANCISCO COUNTY

SF-1 W. slope of Twin Peaks, S. side of Clarendon Ave., 200 ft. E. of 7th Ave., San Francisco.

Quadrangle: San Francisco North

Formation: Franciscan Age: Early Cretaceous

Remarks: Phosphatic nodules in highly sheared graywacke and black shale.

References: 1. Gower and Madsen, 1964, p.D81, no. 7
2. Dickert, 1971, p.256, no. 9
3. Schlocker, 1974, p.20, sample SF-101

SAN JOAQUIN COUNTY

SJ-1 McDonald Island gas field. *SW 1/4 SE 1/4 sec. 19, T. 2 N., R. 5 E. (MDB&M)

Quadrangle: Terminous

Formations: Martinez shale ——— Age: Paleocene
Capay shale ——— Eocene

Remarks: Phosphatic nodules in shales. McDonald Island Farms No. 2 well.

References: 1. Knox, 1943, p.590
2. Gower & Madsen, 1964, p.D81, no. 5
3. Dickert, 1971, p.255, no. 4

SAN LUIS OBISPO COUNTY

SL-1 Pebblestone Shut-in. SE 1/4 sec. 33, T. 25 S., R. 9 E. (MDB&M)

Quadrangle: Pebblestone Shut-in

Formation: Monterey, Sandholdt Member Age: Middle Miocene
(probably Luisian)

Remarks: Phosphate nodules in organic soft shale. Stanford Univ.
locality M-106

Reference: 1. Dickert, 1971, p.270 , no.115

SL-2 Nacimiento Dam Road, E. side. NE 1/4 SW 1/4 sec. 3, T. 25 S., R. 10 E.
(MDB&M)

Quadrangle: Tierra Redonda Mountain

Formation: Monterey, Sandholdt Member Age: Middle Miocene

Remarks: Calcareous phosphatic shale. (Early Luisian)

References: 1. Durham, 1968a
2. Dickert, 1971, p.270, no.112

SL-3 Bee Rock Canyon. N. 1/2 sec. 6, T. 25 S., R. 10 E. (MDB&M)

Quadrangle: Tierra Redonda Mountain

Formation: Monterey, Sandholdt Member Age: Middle Miocene
(Early Luisian)

Remarks: Friable mudstone with phosphatic laminae and sparse pellets.
Mf 901 Late Relizian to Early Luisian (Mf 901 is in NE 1/4
NE 1/4 sec. 9)

References: 1. Durham, 1968a, p.24
2. Dickert, 1971, p.270, no.113

SL-4 Nacimiento Dam Road, W.side. SW 1/4 sec. 10, T. 25 S., R. 10 E. (MDB&M)

Quadrangle: Tierra Redonda Mountain

Formation: Monterey, Sandholdt Member Age: Middle Miocene

Remarks: Phosphatic shale. (Early Luisian)

References: 1. Durham, 1968a
2. Dickert, 1971, p.270, no.114

SL-5 Antelope Grade, Polonio Pass, N. side. 1,400 ft. S. and 3,300 ft. W.
of *NE cor. sec. 22, T. 25 S., R. 16 E. (MDB&M)

Quadrangle: Orchard Park

Formation: Monterey Age: Middle Miocene
(probably Luisian)

Remarks: Phosphatic pellets and pebbles dispersed at intervals
over 30 m of a soft clayey mudstone near the base of
the Monterey.

Reference: 1. Dickert, 1971, p.270, no. 110

SL-6 Polonio Pass, E.side. NW 1/4 SW 1/4 sec. 24, T. 25 S., R. 16 E. (MDB&M)

Quadrangle: Orchard Peak

Formation: Monterey Age: Middle Miocene
(probably Luisian)

Remarks: 12 cm nodular phosphate bed in shale.

References: 1. Gower and Madsen, 1964, p.D82, no.30
2. Dickert, 1971, p. 269, no. 109

SL-7 Lime Mountain, roadcut about 1/2 mile E., NW 1/4 sec. 15, T.26 S.,
R. 9 E. (MDB&M)

Quadrangle: Lime Mountain

Formation: Monterey Age: Middle Miocene
(probably Luisian)

Remarks: Phosphatic laminae in organic shale.

Reference: 1. Dickert, 1971, p.270, no.116

SL-8 Adelaida, 1/2 mile N. on Paso Robles Road. NW 1/4 sec. 25,
T. 26 S., R. 10 E.(MDB&M)

Quadrangle: Adelaida

Formation: Monterey, Sandholdt Member Age: Middle Miocene

Remarks: Phosphatic mudstone. (Relizian)

References: 1. Durham, 1968b,[geol. map.] 1974, p. 93 & 94 fossil locs.

2. Dickert, 1971, p. 270, no. 118

SL-9 Peachy Canyon. SW 1/4 sec. 35, T. 26 S., R. 11 E. (MDB&M)

Quadrangle: York Mountain

Formation: Monterey, Sandholdt Member Age: Middle Miocene
(Early Luisian)

Remarks: Phosphatic laminae in calcareous organic shale.
Mf 897 and Mf 898 near this locality.

References: 1. Durham, 1968b

2. Dickert, 1971, p.271, no. 120

SL-10 Adelaida, 2 miles S. on Willow Creek Road, at boundary between
sec. 36, T. 26 S. and sec. 1, T. 27 S., R. 10 E. (MDB&M)

Quadrangle: York Mountain

Formation: Monterey, Sandholdt Member Age: Middle Miocene (Luisian)

Remarks: Phosphatic laminae in mudstone.

Reference: 1. Dickert, 1971, p.271, no. 119

SL-11 Dover Canyon. SE 1/4 sec. 12, T. 27 S., R. 10 E. (MDB&M)

Quadrangle: York Mountain

Formation: Monterey, Sandholdt Member Age: Middle Miocene
(Relizian)

Remarks: Sparse pelletal phosphate in dolomitic limestone. Some
of these pellets have cores of glauconite. Locality at
or very near LSJU. Loc. 679 (Relizian).

References: 1. Wilson, 1930

2. Dickert, 1971, p.271, no. 125

SL-12 Willow Creek Road, E. side, at bend due E. of boundary between
secs. 8 and 17, T. 27 S., R. 10 E. (MDB&M)

Quadrangle: York Mountain

Formation: Monterey, Sandholdt Member Age: Middle Miocene
(Early Relizian)

Remarks: Dark brown, waxy phosphatic mudstone.

Reference: 1. Dickert, 1971, p.271, no. 122

SL-13 Willow Creek Road, NE side. *NW 1/4 NE 1/4 sec. 21, T.27 S.,
R.11 E. (MDB&M)

Quadrangle: York Mountain

Formation: Monterey, Sandholdt Member Age: Early Miocene
(Saucesian)

Remarks: A small (.6 m) exposure of soft pellet-bearing mudstone.
.8 mile to the NW, on NE side of road, a 3 m exposure
of phosphatic shale in Sandholdt. Locality about 1/2
1/2 mile NW of Mf 1442 (Saucesian).

Reference: 1. Dickert, 1971, p.271, no. 123

SL-14 Paso Robles Road, S. side. Secs. 23 & 24, T. 26 S., R. 11 E. (MDB&M)

Quadrangle: Paso Robles

Formation: Monterey, Hames Member Age: Middle Miocene (Luisian)

Remarks: Phosphatic mudstone and shale at intervals throughout a
60 m section.

References: 1. D. L. Durham, 1967, written commun.
2. Dickert, 1971, p.270, no.117

SL-15 Peachy Canyon Road, at boundary between sec. 36, T. 26 S.,
R. 11 E. and sec. 31, T. 26 S., R. 12 E. (MDB&M)

Quadrangle: Paso Robles

Formation: Monterey, Hames Member Age: Middle Miocene (Luisian)

Remarks: Single layer, 7 cm thick, of abundant phosphatic pellets
in organic shale.

References: 1. D. L. Durham, 1967, written commun.
2. Dickert, 1971, p.271, no.121

SL-16 Cayucos Road (Highway 41), NW side, half way between bench marks
924 and 929. *NE 1/4 sec. 24, T. 27 S., R. 11 E. (MDB&M)

Quadrangle: Templeton

Formation: Monterey, Sandholdt Member Age: Early Miocene
(Saucesian)

Remarks: Soft phosphatic shale near Mf 1446 (Saucesian)

Reference: 1. Dickert, 1971, p.271, no. 124

SL-17 Atascadero, 1 mile NW of junction between highways 101 and
466, on W. side of highway 101. *Center NE 1/4 sec. 16,
T. 28 S., R. 12 E. (MDB&M)

Quadrangle: Atascadero

Formation: Monterey, Hames Member Age: Middle Miocene (Luisian)

Remarks: A few thin (5-7 cm) beds of near-black phosphatic pellets
in abundant concentration separated by large thicknesses
of Monterey porcelanite.

References: 1. Dickert, 1971, p.272, no. 126
2. Durham, 1974, p.95
3. Hart, 1976

SL-18 SE 1/4 NW 1/4 sec. 21, T. 28 S., R. 12 E. (MDB&M)

Quadrangle: Atascadero

Formation: Monterey, Sandholdt Member Age: Early Miocene (Saucesian)

Remarks: Phosphorite in basal Sandholdt.

References: 1. Graham, 1976, loc. no. 23-7 through 11
2. Hart, 1976

SL-19 Simmler Road, S. side. NE 1/4 NE 1/4 sec. 16, T. 28 S., R. 14 E. (MDB&M)
 Quadrangle: Wilson Corner
 Formation: Monterey Age: Middle Miocene
 (Late Luisian)
 Remarks: 25 cm of pellets in abundant concentration in porcelaneous
 shale of the Monterey.
 Reference: 1. Dickert, 1971, p.273, no. 136

SL-20 NW 1/4 NW 1/4 sec. 15, T. 28 S., R. 14 E. (MDB&M)
 Quadrangle: Wilson Corner
 Formation: Monterey Age: Middle Miocene
 Remarks: H. D. Gower section R. (Late Luisian)
 Reference: 1. H. D. Gower, 1976, written commun.

SL-21 NW 1/4 SW 1/4 sec. 14, T. 28 S., R. 14 E. (MDB&M)
 Quadrangle: Wilson Corner
 Formation: Monterey Age: Middle Miocene
 Remarks: H. D. Gower section S. (Late Luisian)
 Reference: 1. H. D. Gower, 1976, written commun.

SL-22 Huerhuero Creek, 1 mile E. of E. Branch. NW 1/4 sec. 21, T. 28 S.,
 R. 14 E. (MDB&M)
 Quadrangle: Wilson Corner
 Formation: Monterey Age: Middle Miocene
 (Late Luisian)
 Remarks: Float includes 10 cm blocks of phosphorite in blocks of
 porcelaneous Monterey.
 Reference: 1. Dickert, 1971, p. 273, no. 135

SL-23 Simmler Road. 500 ft. S., due W. of benchmark 1622. NE 1/4
 NE 1/4 sec. 23, T. 28 S., R. 14 E. (MDB&M)
 Quadrangle: Wilson Corner
 Formation: Monterey Age: Middle Miocene
 (Late Luisian)
 Remarks: Hard phosphorite layers to 30 cm in porcelaneous mudstone.
 Reference: 1. Dickert, 1971, p. 273, no. 137

SL-24 Quailwater Creek, S. of Simmler Road. SE 1/4 NW 1/4 sec.
 24, T. 28 S., R. 14 E. (MDB&M)
 Quadrangle: Wilson Corner
 Formation: Monterey Age: Middle Miocene
 (Late Luisian)
 Remarks: An excellent 30 m section of soft organic calcareous
 phosphatic shale of the Sandholdt Member overlain by 10
 layers of pelletal phosphorite in porcelanite of the
 Hames Member. Sample no. 138-1 15 m below top of pellet-
 bearing sequence and no. 138-2 15 m below no. 138-1.
 H. D. Gower section Q.
 Reference: 1. Dickert, 1971, p.273, no. 138

SL-25 NE 1/4 NW 1/4 sec. 19, T. 28 S., R. 15 E. (MDB&M)

Quadrangle: Wilson Corner

Formation: Monterey

Age: Middle Miocene

Remarks: Wilson Corner Trench C.

(Late Luisian)

- References:
1. Reed, 1927, p.195
 2. Klienpell, 1938, p. 121-122
 3. Bramlette, 1946, pl. 2
 4. Graham, 1976, p. 96

SL-26 NE 1/4 NE 1/4 sec. 19, T. 28 S., R. 15 E. (MDB&M)

Quadrangle: Wilson Corner

Formation: Monterey

Age: Middle Miocene

Remarks: Wilson Corner Trench P.

(Late Luisian)

- References:
1. Reed, 1927, p. 195
 2. Kleinpell, 1938, p. 121-122
 3. Bramlette, 1946, pl. 2
 4. Graham, 1976, p. 96

SL-27 Indian Creek. Roadcut on N. side of Simmler Road. SW 1/4 sec. 20, T. 28 S., R. 15 E. (MDB&M)

Quadrangle: Wilson Corner

Formation: Monterey

Age: Middle Miocene

(Late Luisian)

Remarks: Five pelletal phosphorite layers 5-30 cm thick in porcelanite in the upper part of the Monterey Formation. The pellet facies is well exposed in outcrops and in 10 trenches in the vicinity of Indian Creek N. of Simmler Road. Wilson Corner Trench E.

- References:
1. Reed, 1927, p. 195
 2. Kleinpell, 1938, p. 121-122
 3. Bramlette, 1946, pl. 2
 4. Gower and Madsen, 1964, p. D82, no. 32
 5. Dickert, 1971, p. 273, no. 139
 6. Graham, 1976, p. 96

SL-28 NW 1/4 SE 1/4 sec. 20, T. 28 S., R. 15 E. (MDB&M)

Quadrangle: Wilson Corner

Formation: Monterey

Age: Middle Miocene

(Late Luisian)

Remarks: Wilson Corner Trench F.

- References:
1. Reed, 1927, p. 195
 2. Kleinpell, 1938, p. 121-122
 3. Bramlette, 1946, pl. 2
 4. Graham, 1976, p. 96

SL-29 SW 1/4 SE 1/4 sec. 20, T. 28 S., R. 15 E. (MDB&M)

Quadrangle: Wilson Corner

Formation: Monterey

Age: Middle Miocene

(Late Luisian)

Remarks: Wilson Corner Trench G.

- References:
1. Reed, 1927, p. 195
 2. Kleinpell, 1938, p. 121-122
 3. Bramlette, 1946, pl. 2
 4. Graham, 1976, p. 96

SL-30 NW 1/4 SW 1/4 sec. 20, T. 28 S., R. 15 E. (MDB&M)

Quadrangle: Wilson Corner

Formation: Monterey

Age: Middle Miocene
(Late Luisian)

Remarks: Wilson Corner Trench H.

References: 1. Reed, 1927, p. 195
2. Kleinpell, 1938, p. 121-122
3. Bramlette, 1946, pl. 2
4. Graham, 1976, p. 96

SL-31 SE 1/4 SE 1/4 sec. 20, T. 28 S., R. 15 E. (MDB&M)

Quadrangle: Wilson Corner

Formation: Monterey

Age: Middle Miocene
(Late Luisian)

Remarks: Wilson Corner Trench I.

References: 1. Reed, 1927, p. 195
2. Kleinpell, 1938, p. 121-122
3. Bramlette, 1946, pl. 2
4. Graham, 1976, p. 96

SL-32 SW 1/4 SE 1/4 sec. 20, T. 28 S., R. 15 E. (MDB&M)

Quadrangle: Wilson Corner

Formation: Monterey

Age: Middle Miocene
(Late Luisian)

Remarks: Wilson Corner Trench M.

References: 1. Reed, 1927, p. 195
2. Kleinpell, 1938, p. 121-122
3. Bramlette, 1946, pl. 2
4. Smith, 1968, p. 1788
5. Graham, 1976, p. 96
6. Pisciotto, 1978, loc. K-165-77

SL-33 NW 1/4 SE 1/4 sec. 28, T. 28 S., R. 15 E. (MDB&M)

Quadrangle: Camatta Ranch

Formation: Monterey

Age: Middle Miocene
(Late Luisian)

Remarks: Wilson Corner Trench K.

References: 1. Reed, 1927, p. 195
2. Kleinpell, 1938, p. 121-122
3. Bramlette, 1946, pl. 2
4. Graham, 1976, p. 96

SL-34 Simmler Road, 400 ft. S. in SW 1/4 sec. 27, T. 28 S., R. 15 E.
(MDB&M)

Quadrangle: Camatta Ranch

Formation: Monterey

Age: Middle Miocene
(Late Luisian)

Remarks: A few thin layers of pelletal phosphate in porcel-
aneous shales of the Monterey.

Reference: 1. Dickert, 1971, p. 273, no. 140

SL-35 Fernandez Creek, N. side. NE 1/4 sec. 35, T. 28 S., R. 15 E.
(MDB&M)

Quadrangle: Camatta Ranch

Formation: Monterey

Age: Middle Miocene

(Late Luisian)

Remarks: A 25 m exposure of phosphatic shale overlain by pelletite layers to 25 cm thickness in porcelanite of the Monterey. H. D. Gower section SC in NW 1/4 SW 1/4 sec. 36, T. 28 S., R. 15 E.

References: 1. Dickert, 1971, p. 274, no. 141
2. H. D. Gower, 1976, written commun.

SL-36 Simmler Road, N. side, 1 mile W. of Camatta Creek. NW 1/4 sec. 6, T. 29 S., R. 16 E. (MDB&M)

Quadrangle: Camatta Ranch

Formation: Monterey

Age: Middle Miocene

(Late Luisian)

Remarks: Thin pelletal phosphorite layer near contact between Monterey and Santa Margarita formations where contact crosses Simmler Road.

Reference: 1. Dickert, 1971, p. 274, no. 142

SL-37 Navajo Creek. 3,000 ft. E. of benchmark 1495. Sec. 35, T. 28 S., R. 16 E. (MDB&M)

Quadrangle: La Panza Ranch

Formation: Monterey

Age: Middle Miocene

(Luisian)

Remarks: Thin layers of hard pelletal mudstone in Monterey near contact with overlying Santa Margarita Formation.

Reference: 1. Dickert, 1971, p. 274, no. 143

SL-38 Navajo Creek, 1 mile W. on NW side of Simmler Road. 2,600 ft. N. and 1,400 ft. W. of SE cor. sec. 10, T. 29 S., R. 16 E. (MDB&M)

Quadrangle: La Panza Ranch

Formation: Santa Margarita

Age: Late Miocene (Mohnian)

Remarks: Phosphate pellets in shale member of Santa Margarita.

Reference: 1. Dickert, 1971, p. 274, no. 144

SL-39 Windmill Creek. 300 ft. S. and 1,200 ft. E. of NW cor. sec. 13, T. 29 S., R. 16 E. (MDB&M)

Quadrangle: La Panza Ranch

Formation: Santa Margarita

Age: Late Miocene

(Mohnian)

Remarks: A good 18 m exposure of phosphate-bearing shale unit within Santa Margarita, which includes two pelletite layers and several pelletal mudstone and sandstone layers in shale and sandy siltstone.

References: 1. Gower and Madsen, 1964, p. D82, no. 31
2. Dickert, 1971, p. 274, no. 145

SL-40 San Juan Creek, W. side. SW 1/4 sec. 27, T. 29 S., R. 17 E.
(MDB&M)

Quadrangle: La Panza

Formation: Monterey

Age: Middle Miocene
(Late Luisian)

Remarks: Near the contact between the Monterey and Santa Margarita formations where contact crosses the creek bed, a thin (8 cm) layer of phosphate pellets. A 3 m bed of calcareous pelletal sandstone, 2.5 m lower in the section, and, 4 m lower, 1.5 m of phosphatic shale.

Reference: 1. Dickert, 1971, p. 274, no. 146

SL-41 Old Canyon, S. slope. NW 1/4 sec. 1, T. 30 S., R. 17 E. (MDB&M)

Quadrangle: California Valley

Formation: Monterey

Age: Middle Miocene (Luisian)

Remarks: Pelletal mudstone in Monterey near contact with Santa Margarita Formation.

Reference: 1. Dickert, 1971, p. 274, no. 147

SL-42 Arroyo Grande Creek road, S. side. SW 1/4 sec. 27, T. 31 S.,
R. 14 E. (MDB&M)

Quadrangle: Tar Spring Ridge

Formation: Monterey

Age: Middle Miocene
(Luisian)

Remarks: Phosphatic shale near top of Monterey near Luisian-Mohnian boundary.

References: 1. Hall and Surdam, 1967
2. Dickert, 1971, p. 276, no. 156
3. Hall, 1973

SL-43 Soda Lake, 2 miles W. NE 1/4 sec. 4, T. 31 S., R. 19 E. (MDB&M)

Quadrangle: Simmler

Formation: Soda Lake

Age: Early Miocene

Remarks: Phosphatic pellets in siliceous clayey shale near top of the Soda Lake Formation.

References: 1. Cross, 1962
2. Dickert, 1971, p. 276, no. 155

SL-44 Cuyama River. N. side, Highway 166 at SW cor. sec. 18,
T. 11 N., R. 32 W. (SBB&M)

Quadrangle: Huasna Peak

Formation: Monterey

Age: Middle Miocene,
(probably Luisian)

Remarks: 30 m section of silty sandstone with sparse phosphate pellets overlain by a few thin glauconite-bearing pellet layers in silty shale and by thinly laminated phosphatic and cherty shale.

Reference: 1. Dickert, 1971, p. 276, no. 162

SL-45 Cuyama River, 1 mile N. SE 1/4 SE 1/4 sec. 14, T.11 N., R. 28 W.
(SBB&M)

Quadrangle: Caliente Mountain

Formation: Monterey

Age: Middle Miocene
(Luisian)

Remarks: Minor pelletal phosphate in siltstone.

References: 1. Gower and Madsen, 1964, p. D82, no. 33
2. Dickert, 1971, p. 276, no. 157

SL-46 Morales Canyon. SE 1/4 NE 1/4 sec. 23, T. 11 N., R. 28 W.
(SBB&M)

Quadrangle: Caliente Mountain

Formation: Monterey

Age: Middle Miocene
(Luisian)

Remarks: A few thin layers of phosphatic pellets in sandy beds near top of Monterey.

Reference: 1. Dickert, 1971, p. 276, 158

SL-47 Russel Ranch oil field. N. side, pump road in NE 1/4 SW 1/4 sec. 25, T. 11 N., R. 28 W. (SBB&M)

Quadrangle: Caliente Mountain

Formation: Monterey

Age: Middle Miocene
(Luisian)

Remarks: Thin layers of abundant phosphatic pellets in sandy siltstone near top of Monterey.

Reference: 1. Dickert, 1971, p. 276, no. 159

SL-48 Guadalupe oil field. Well approximately 1/2 mile W. of NW cor. T. 10 N., R. 35 W. (SBB&M)

Quadrangle: Point Sal

Formation: Monterey

Age: Middle Miocene
(Luisian)

Remarks: Phosphatic shale in platy Monterey at Luisian-Mohnian transition.

References: 1. Dickert, 1971, p.277, no. 163
2. Hall, 1973

SL-49 NW 1/4 NW 1/4 sec. 1, T. 29 S., R. 12 E. (MDB&M)

Quadrangle: Atascadero

Formation: Monterey, upper member

Age: Middle Miocene
(Luisian)

Remarks: Phosphatic pelletal, bituminous, limy sandstone.

Reference: 1. E. W. Hart 1978, written commun.; loc. SLO 204

SL-50 NE 1/4 NW 1/4 sec. 30, T. 28 S., R. 13 E. (MDB&M)

Quadrangle: Santa Margarita

Formation: Monterey, lower member

Age: Middle Miocene
(Relizian)

Remarks: Impure limestone, probably phosphatic.

Reference: 1. E. W. Hart, 1978, written commun.; loc. SLO 45

SL-51 NW 1/4 NW 14 sec. 31, T. 28 S., R. 13 E. (MDB&M)
 Quadrangle: Santa Margarita
 Formation: Monterey, upper member Age: Late Miocene
 (Mohnian)
 Remarks: Muddy pelletal (siliceous?) sandstone-contains
 approx. 10% pellets.
 Reference: 1. E. W. Hart, 1978, written commun.; loc. SLO 177

SL-52 *SE 1/4 SE 1/4 sec. 16, T. 29 S., R. 13 E. (MDB&M)
 Quadrangle: Santa Margarita
 Formation: Monterey, lower member Age: Middle Miocene
 (Early Relizian)
 Remarks: Sandy, algal, phosphatic limestone contains 11.5%
 P₂₀₅. Estimated to be stratigraphic equivalent to
 fossil loc. 115.
 Reference: 1. E. W. Hart, 1978, written commun.; loc. SLO 50

SL-53 *SE 1/4 SW 1/4 sec. 28, T. 29 S., R. 13 E. (MDB&M)
 Quadrangle: Lopez Mountain
 Formation: Monterey, upper member Age: Middle Miocene
 (Late Luisian)
 Remarks: Phosphatic pelletal shale contains 4.9% p₂₀₅.
 Reference: 1. E. W. Hart, 1978, written commun.; loc. SLO 93

SL-54 *SW 1/4 SW 1/4 sec. 34, T. 29 S., R. 13 E. (MDB&M)
 Quadrangle: Lopez Mountain
 Formation: Monterey, upper member Age: Middle Miocene
 (Late Luisian)
 Remarks: Tuffaceous shale with scattered pellets containing
 0.5% P₂₀₅.
 Reference: 1. E. W. Hart, 1978, written commun.; loc. SLO 131

SL-55 SE 1/4 NE 1/4 sec. 3, T. 30 S., R. 13 E. (MDB&M)
 Quadrangle: Lopez Mountain
 Formation: Monterey, lower member Age: Middle Miocene
 (Early Relizian)
 Remarks: Shelly, sandy, algal phosphatic limestone.
 Reference: 1. E. W. Hart, 1978, written commun.; loc. SLO 136

SL-56 *SW 1/4 NW 1/4 sec. 2, T. 30 S., R. 13 E. (MDB&M)
 Quadrangle: Lopez Mountain
 Formation: Monterey Age: Middle Miocene
 (Late Luisian)
 Remarks: Foraminiferal mudstone or siltstone containing 1.5% P₂₀₅.
 Fossil loc. SLO 116.
 Reference: 1. E. W. Hart, 1978, written commun.; loc. SLO 116

SL-57 NE 1/4 SW 1/4 sec. 6, T. 30 S., R. 13 E. (MDB&M)
 Quadrangle: Lopez Mountain
 Formation: Monterey Age: Middle Miocene
 (probably Luisian)
 Remarks: Phosphatic shale containing 0.9% P₂₀₅.
 Reference: 1. E. W. Hart, 1978, written commun.; loc. SLO 8

SL-58 SW 1/4 NE 1/4 sec. 7, T. 30 S., R. 13 E. (MDB&M)
Quadrangle: Lopez Mountain
Formation: Monterey, lower member Age: Middle Miocene
(Probably Early Relizian)
Remarks: Shale with thin phosphatic layers and scattered pellets
containing 2.4 - 2.9% P₂O₅.
Reference: 1. E. W. Hart, 1978, written commun.; loc. SLO 24

SAN MATEO COUNTY

SM-1 Stanford Linear Accelerator. Borehole in sec. 16, T. 6 S.,
R. 3 W. (MDB&M)

Quadrangle: Palo Alto
Formation: Unnamed—similar position Age: Middle Miocene
to Sandholdt (Probably Luisian)
Remarks: Phosphate pellets in silty sandstone. Borehole BA-4,
Stanford Linear Accelerator.
References: 1. Dibblee, 1966
2. Dickert, 1971, p. 257, no. 18

SM-2 La Honda Creek. SE 1/4 sec. 35, T. 6 S., R. 4 W. (MDB&M)

Quadrangle: La Honda
Formation: San Lorenzo Age: Eocene (Narizian)
Remarks: Phosphatic laminae in mudstone and phosphatic pebbles in
sandstone.
References: 1. Narasimhan, 1960
2. Dickert, 1971, p. 257, no. 19
3. Brabb, Cark, & Throckmorton, 1977, fig. 7a

SM-3 W. side of Page Mill Road. 2,500 ft. N. of SE cor. sec. 16,
T. 7 S., R. 3 W. (MDB&M)

Quadrangle: Mindogo Hill
Formation: Lambert Shale Age: Early Miocene
(Saucesian)
Remarks: Phosphatic laminae in mudstone.
References: 1. Dickert, 1971, p. 258, no. 22
2. Brabb, Clark, & Throckmorton, 1977, fig. 7a

SM-4 S. side of Alpine Road. SE 1/4 SW 1/4 sec. 29, T. 7 S., R. 3 W.
(MDB&M)

Quadrangle: Mindogo Hill
Formation: Monterey Age: Middle Miocene
(Luisian)
Remarks: Phosphate nodules in silty shale.
References: 1. Dickert, 1971, p. 258, no. 23
2. Brabb, Clark, & Throckmorton, 1977, fig. 7a

SM-5 N. side of Old Page Mill Road north of Portola State Park. 2,000 ft. N., 800 ft. W. of SE cor. of sec. 32, T. 7 S., R. 3 W. (MDB&M)

Quadrangle: Mindigeo Hill

Formation: Monterey

Age: Middle Miocene
(Luisian)

Remarks: Phosphate nodules in silty shale. Similar exposure in Peters Creek, 2,200 ft. N. and 1,400 ft. E. of SW cor. of sec. 4, T. 8 S., R. 3 W. (MDB&M)

References: 1. Dickert, 1971, p.258, no. 24
2. Brabb, Clark, and Throckmorton, 1977, fig. 7a

SM-6 Little Boulder Creek bed. SE 1/4 SE 1/4 sec. 21, T. 8 S., R. 3 W. (MDB&M)

Quadrangle: Big Basin

Formation: Butano Sandstone

Age: Eocene (Narizian)

Remarks: 12 m of laminated strongly phosphatic shale within upper part of formation.

References: 1. Brabb, 1960, p. 158, loc. 202D; 1964, p. 678
2. Dickert, 1971, p. 258, no. 28
3. Brabb, Clark, & Throckmorton, 1977, p. 18

SM-7 Little Boulder Creek. SW 1/4 sec. 22, T. 8 S., R. 3 W. (MDB&M)

Quadrangle: Big Basin

Formation: San Lorenzo, Rices
Mudstone Member

Age: Oligocene
(Zemorrian)

Remarks: Glauconite and phosphatic pebble bed, 1 m thick. This is the basal glauconite of the Zemorrian Stage.

References: 1. Brabb, 1960, p. 160; loc. 205 G; 1964, p. 675 and fig. 2
2. Brabb, Clark & Throckmorton, 1977, p. 19

SM-8 SE side of Ano Nuevo Point. In intertidal outcrop 1,500 ft. SE of the point, T. 9 S., R. 4 W. (MDB&M)

Quadrangle: Ano Nuevo

Formation: Unnamed

Age: Early Miocene
(Saucasian)

Remarks: Arkosic sandstone and sandy limestone overlain by phosphatic mudstone.

References: 1. Gower and Madsen, 1964, p. D81, no. 9
2. Dickert, 1971, p.259, no.36
3. Brabb, Clark, & Throckmorton, 1977, p.84 (places this unit in Vaqueros (?) Formation)

SANTA BARBARA COUNTY

SB-1 Ridge S. of Twitchell Reservoir. *SE 1/4 sec. 17, T. 11 N., R. 32 W. (SBB&M)

Quadrangle: Huasna Peak

Formation: Monterey

Age: Middle Miocene
(Luisian)

Remarks: Phosphatic shale in Monterey.

Reference: 1. Dickert, 1971, p.276, no. 161

SB-2 S. side, Cuyama River, 1,500' N. and 6,300' W. of BM 791.
*NE 1/4 SE 1/4 sec. 16, T. 11 N., R. 32 W. (SBB&M)

Quadrangle: Chimney Canyon

Formation: Monterey Age: Middle Miocene
(Luisian)

Remarks: Phosphatic shale in Monterey.

Reference: 1. Dickert, 1971, p.276, no. 160

SB-3 Tepusquet Road, N. side. NW 1/4 NW 1/4 sec. 1, T. 10 N.
R. 32 W. (SBB&M)

Quadrangle: Tepusquet Canyon

Formation: Monterey Age: Middle Miocene
(Luisian)

Remarks: Phosphatic shale in Monterey.

Reference: 1. Dickert, 1971, p. 277, no. 164

SB-4 Tepusquet Road, W. side. SE 1/4 sec. 2, T. 10 N., R. 32 W.
(SBB&M)

Quadrangle: Tepusquet Canyon

Formation: Monterey Age: Middle Miocene
(Luisian)

Remarks: Phosphatic nodules in Monterey.

Reference: 1. Dickert, 1971, p.277, no. 165

SB-5 Mussel Rock, S. of promontory. Sec.27, T. 10 N., R. 36 W.
(SBB&M)

Quadrangle: Point Sal

Formation: Monterey, lower member Age: Middle Miocene
(Luisian)

Remarks: Phosphatic nodules and laminae in siliceous and
calcareous shales in uppermost part of lower member
of Monterey. Sample no. MR-d had 3.2% P₂O₅.

References: 1. Woodring and Bramlette, 1950, p. 18-21
2. Gower and Madsen, 1964, p. D82, no. 41
3. Dickert, 1971, p. 277, no. 166
4. Hall, 1973
5. Pisciotto, 1978, locs. MR-d and K-156-77

SB-6 Santa Maria Valley oil field. Wells in secs. 27 and 28,
T. 10 N., R. 34 W. (SBB&M)

Quadrangle: Santa Maria

Formation: Monterey Age: Middle Miocene
(Luisian)

Remarks: Hard, platy, dark-brown shale with thin laminations
of buff-colored phosphatic shale and occasional thin
phosphatic shale and occasional thin phosphatic layers
at Luisian-Mohnian boundary.

References: 1. Wissler and Dreyer, 1943, p.236
2. Dickert, 1971, p.277, no. 167

SB-7 NW 1/4 NW 1/4 sec. 35, T. 10 N., R. 27 W. (SBB&M)

Quadrangle: New Cuyama

Formation: Santa Margarita, upper Age: Late Miocene
phosphatic mudstone member (Mohnian)

Remarks: Cuyama Trench No. 297.

References: 1. T. M. Cheney, 1962, written commun.
2. Vedder and Repenning, 1975

SB-8 South Cuyama oil field about 100' W. of loc. M 3895 of MI-876.

NE 1/4 SE 1/4 sec. 35, T. 10 N., R. 27 W. (SBB&M)

Quadrangle: New Cuyama

Formation: Santa Margarita, upper Age: Late Miocene
phosphatic mudstone member (Mohnian)

Remarks: Pelletal phosphate in siliceous mudstone.

Reference: 1. Vedder and Repenning, 1975; loc. 7k-33

SB-9 South Cuyama oil field. On W. side of hill. *SE 1/4 SE 1/4 sec. 35,
T. 10 N., R. 27 W. (SBB&M)

Quadrangle: New Cuyama

Formation: Santa Margarita, upper Age: Late Miocene
phosphatic mudstone member (Mohnian)

Remarks: 30 m section of pelletal mudstone in Santa Margarita.

References: 1. Hill, Carlson, and Dibblee, 1958, p. 2996
2. Dickert, 1971, p. 277, no. 168
3. Vedder and Repenning, 1975

SB-10 SE 1/4 NW 1/4 sec. 1, T. 9 N., R. 27 W. (SBB&M)

Quadrangle: New Cuyama

Formation: Santa Margarita, upper Age: Late Miocene
phosphatic mudstone member (Mohnian)

Remarks: Cuyama Trench no. 298.

References: 1. T. M. Cheney, 1962, written commun.
2. Vedder and Repenning, 1975

SB-11 *NW 1/4 NW 1/4 sec. 12, T. 9 N., R. 27 W. (SBB&M)

Quadrangle: New Cuyama

Formation: Santa Margarita, lower Age: Late Miocene
phosphate mudstone member (Mohnian)

Remarks: Thin phosphorite and pelletal mudstone beds in siliceous
shale in lower part of Santa Margarita. Cuyama Trench no. CC.

References: 1. Gower and Madsen, 1964, p.D82, no. 39
2. Dickert, 1971, p.277, no. 169
3. Vedder and Repenning, 1975

SB-12 SW 1/4 NW 1/4 sec. 7, T. 9 N., R. 26 W. (SBB&M)

Quadrangle: New Cuyama

Formation: Santa Margarita, upper Age: Late Miocene
phosphatic mudstone member (Mohnian)

Remarks: Cuyama Trench no. 299.

References: 1. T. M. Cheney, 1962, written commun.
2. Vedder and Repenning, 1975

SB-13 NE 1/4 SW 1/4 sec. 7, T. 9 N., R. 26 W. (SBB&M)
 Quadrangle: New Cuyama
 Formation: Santa Margarita, upper Age: Late Miocene
 phosphatic mudstone member (Mohnian)
 Remarks: Cuyama Trench no. 100.
 References: 1. J. C. Osmond, 1975; written commun.
 2. Vedder and Repenning, 1975
 3. Roberts, 1979

SB-14 NE 1/4 SW 1/4 sec. 7, T. 9 N., R. 26 W. (SBB&M)
 Quadrangle: New Cuyama
 Formation: Santa Margarita, upper Age: Late Miocene
 phosphatic mudstone member (Mohnian)
 Remarks: Cuyama Trench no. 200.
 References: 1. J. C. Osmond, 1965, written commun.
 2. Vedder and Repenning, 1975

SB-15 SW 1/4 SE 1/4 sec. 7, T. 9 N., R. 26 W. (SBB&M)
 Quadrangle: Salisbury Potrero
 Formation: Santa Margarita, upper Age: Late Miocene
 phosphatic mudstone member (Mohnian)
 Remarks: Cuyama Trench no. 300.
 References: 1. J. C. Osmond, 1965, written commun.
 2. Vedder and Repenning, 1975

SB-16 SE 1/4 SE 1/4 sec. 7, T. 9 N., R. 26 W. (SBB&M)
 Quadrangle: Salisbury Potrero
 Formation: Santa Margarita, upper Age: Late Miocene
 phosphatic mudstone member (Mohnian)
 Remarks: Cuyama Trench no. 400.
 References: 1. J. C. Osmond, 1965, written commun.
 2. Vedder and Repenning, 1975

SB-17 Center SE 1/4 sec. 6, T. 9 N., R. 26 W. (SBB&M)
 Quadrangle: New Cuyama
 Formation: Santa Margarita, upper Age: Late Miocene
 phosphatic mudstone member (Mohnian)
 Remarks: Phosphate pellet beds in siltstone and siliceous
 shale; phosphate zone is more than 25 m thick.
 Cuyama Trench no. 294.
 References: 1. Hill and others, 1958, p. 2996
 2. Gower and Madsen, p. D82, no. 40
 3. Dickert, 1971, p. 277, no. 170
 4. Vedder and Repenning, 1975

SB-18 SW 1/4 NW 1/4 sec. 8, T. 9 N., R. 26 W. (SBB&M)
 Quadrangle: New Cuyama
 Formation: Santa Margarita, upper Age: Late Miocene
 phosphatic mudstone member (Mohnian)
 Remarks: Cuyama Trench no. 295.
 References: 1. T. M. Cheney, 1962, written commun.
 2. Vedder and Repenning, 1975

SB-19 NE 1/4 SE 1/4 sec. 7 and NW 1/4 SW 1/4 sec. 8, T. 9 N.,
R. 26 W. (SBB&M)

Quadrangle: New Cuyama And Salisbury Potrero
Formation: Santa Margarita, upper Age: Late Miocene
phosphatic mudstone member (Mohnian)
Remarks: Cuyama Trench no. 700.
References: 1. J. C. Osmond, 1965, written commun.
2. Vedder and Repenning, 1975

SB-20 NW 1/4 SE 1/4 sec. 8, T. 9 N., R. 26 W. (SBB&M)

Quadrangle: Salisbury Potrero and New Cuyama
Formation: Santa Margarita, upper Age: Late Miocene
phosphatic mudstone member (Mohnian)
Remarks: Cuyama Trench no. 301.
References: 1. T. M. Cheney, 1962, written commun.
2. Vedder and Repenning, 1975

SB-21 SE 1/4 SW 1/4 sec. 8, T. 9 N., R. 26 W. (SBB&M)

Quadrangle: Salisbury Potrero
Formation: Santa Margarita, upper Age: Late Miocene
phosphatic mudstone member (Mohnian)
Remarks: Cuyama Trench no. 296.
References: 1. T. M. Cheney, 1962, written commun.
2. Vedder and Repenning, 1975

SB-22 *NW 1/4 NE 1/4 sec. 17, T. 9 N., R. 26 W. (SBB&M)

Quadrangle: Salisbury Potrero
Formation: Santa Margarita, upper Age: Late Miocene
phosphatic mudstone member (Mohnian)
Remarks: Cuyama Trench no. 500.
References: 1. J. C. Osmond, 1965, written commun.
2. Vedder and Repenning, 1975

SB-23 NE 1/4 NE 1/4 sec. 15, T. 9 N., R. 26 W. (SBB&M)

Quadrangle: Salisbury Potrero
Formation: Santa Margarita, lower Age: Late Miocene
phosphatic mudstone member (Mohnian)
Remarks: Phosphatic pellets in mudstone and siliceous shale.
Reference: 1. Vedder, 1977, oral commun.; loc. E

SB-24 Sea cliffs 1 mile SE of Lions Head at W. Boundary T. 9 N.,
R. 35 W. (SBB&M)

Quadrangle: Casmalia
Formation: Monterey, lower member Age: Middle Miocene
(Luisian)
Remarks: Laminated nodular phosphatic shale, siliceous and
calcareous, near top of lower member of the Monterey.
Sample LH-22 had 14% P₂O₅.
References: 1. Woodring and Bramlette, 1950, p. 18-20
2. Gower and Madsen, 1964, p. D82, no. 42
3. Dickert, 1971, p. 278, no. 173
4. Pisciotto, 1978, loc. LH-22

SB-25 Casmalia Hills. NW 1/4 sec. 9, T. 9 N., R. 35 W. (SBB&M)
 Quadrangle: Guadalupe
 Formation: Monterey, upper member Age: Late Miocene
 (Mohnian)
 Remarks: Nodular phosphatic siltstone at bottom of upper third
 of the Monterey. 10 cm of phosphate pellets and pebbles
 appear at the same stratigraphic level in a section 1 3/4
 miles NW of Casmalia (Map No. SB-26).
 References: 1. Woodring and Bramlette, 1950, p.23
 2. Dickert, 1971, p.278, no. 174

SB-26 4,200' W., 7,800'S. of NE cor. sec. 15, T. 9 N., R. 35 W. (SBB&M)
 Quadrangle: Casmalia
 Formation: Monterey, upper member Age: Late Miocene
 (Mohnian)
 Remarks: Massive or poorly bedded siltstone containing phosphatic
 nodules and pellets at base of upper member of Monterey.
 Reference: 1. Woodring and Bramlette, 1950, p.23

SB-27 Casmalia oil field. Well in NW 1/4 SE 1/4 sec. 17, T. 9 N.,
 R. 34 W. (SBB&M)
 Quadrangle: Orcutt
 Formation: Monterey Age: Middle Miocene
 (Luisian)
 Remarks: Thin phosphatic layers in shale at Luisian-Mohnian boundary.
 References: 1. Wissler and Dreyer, 1943, p. 237
 2. Dickert, 1971, p.278, no. 175

SB-28 Orcutt oil field, well in *center N 1/2 sec. 31, T. 9 N.,
 R. 33 W. (SBB&M)
 Quadrangle: Orcutt
 Formation: Monterey Age: Middle Miocene
 (Luisian)
 Remarks: Thin phosphatic layers in shale at Luisian-Mohnian boundary.
 References: 1. Wissler and Dreyer, 1943, p. 237
 2. Dickert, 1971, p. 278, no. 176

SB-29 East Cat Canyon oil field. Well in SW 1/4 SE 1/4 sec.30,
 T. 9 N., R. 32 W.(SBB&M)
 Quadrangle: Sisquoc
 Formation: Monterey Age: Middle Miocene
 (Luisian)
 Remarks: Phosphatic shale in hard and brittle siliceous shale in
 the upper part of the lower third of the Monterey. Phos-
 phatized chert fragments are reported at the base of the
 Sisquoc Formation.
 Reference: 1. Dickert, 1971, p.278, no. 177

SB-30 Foxen Canyon. *NW 1/4 SE 1/4 sec. 1, T. 8 N., R. 32 W. (SBB&M)

Quadrangle: Foxen Canyon

Formation: Sisquoc

Age: Late Miocene
(Late Mohnian)

Remarks: Phosphatic pellets, nodules, and phosphatized organic debris in the basal Sisquoc.

References: 1. Woodring and Bramlette, 1950, p. 29
2. Gower and Madsen, 1964, p. D82, no. 43
3. Dickert, 1971, p. 278, no. 178

SB-31 Canada Laguna Seca, W. side. *NW 1/4 SE 1/4 sec. 34, T. 8 N., R. 33 W. (SBB&M)

Quadrangle: Los Alamos

Formation: Foxen Mudstone

Age: Late Pliocene

Remarks: Phosphatic pellets dispersed in mudstone.

References: 1. Woodring and Bramlette, 1950
2. Dickert, 1971, p. 279, no. 179

SB-32 Unnamed canyon, 2,000 ft. W. of Canada de Santa Rosa, W. slope. *NE 1/4 SE 1/4 sec. 35, T. 8 N. R. 33 W. (SBB&M)

Quadrangle: Los Alamos

Formation: Foxen Mudstone

Age: Late Pliocene

Remarks: Several layers of phosphorite and pelletal sandy siltstone.

References: 1. Woodring and Bramlette, 1950
2. Dickert, 1971, p. 279, no. 181

SB-33 Canada de Santa Rosa, E. side. 6,200 ft. S. and 600 ft. E. of BM 529. *SW 1/4 NE 1/4 sec. 36, T. 8 N., R. 33 W. (SBB&M)

Quadrangle: Los Alamos

Formation: Foxen Mudstone

Age: Late Pliocene

Remarks: Phosphatic pellets dispersed in mudstone.

References: 1. Woodring and Bramlette, 1950
2. Dickert, 1971, p. 279, no. 180

SB-34 Santa Rosa Road. 6,500 ft. N. and 7,900 ft. E. of SW. cor. sec. 14, T. 6 N., R. 34 W. (SBB&M)

Quadrangle: Lompoc Hills

Formation: Sisquoc

Age: Late Miocene
(Late Mohnian)

Remarks: Thin layer of phosphatic pebbles at base of Siquoc.

References: 1. Dibblee, 1950
2. Dickert, 1971, p. 279, no. 182

SB-35 West of Santa Rosa Creek and north of Santa Ynez River.

*SE 1/4 NE 1/4 sec. 12, T. 6 N., R. 33 W. (SBB&M)

Quadrangle: Santa Rosa Hills

Formation: Sisquoc

Age: Late Miocene
(Late Mohnian)

Remarks: Thin layer of phosphate pellets and pebbles at base of Sisquoc.

References: 1. Dibblee, 1950
2. Gower and Madsen, 1964, p. D83, no. 44
3. Dickert, 1971, p. 279, no. 183

- SB-36 Santa Rosa Hills. SW 1/4 SW 1/4 sec. 19, T. 6 N.,
R. 32 W. (SBB&M)
Quadrangle: Santa Rosa Hills
Formation: Rincon Age: Early Miocene
Remarks: Phosphatic pellets dispersed in claystone.
Reference: 1. Dickert, 1971, p. 279, no. 184
- SB-37 Head of Alamo Creek. *NE 1/4 NW 1/4 sec. 3, T. 5 N.,
R. 33 W. (SBB&M)
Quadrangle: Santa Rosa Hills
Formation: Monterey Age: Middle Miocene
Remarks: Coarse phosphatic conglomerate at the contact between
the Rincon and Monterey formations.
Reference: 1. Dickert, 1971, p. 279, no. 184
- SB-38 Llanito Creek, W. slope. *SW 1/4 SW 1/4 sec. 32,
T. 6 N., R. 32 W. (SBB&M)
Quadrangle: Santa Rosa Hills
Formation: Monterey Age: Middle Miocene
Remarks: Abundant pellets in basal sandstone of Monterey.
Reference: 1. Dickert, 1971, p. 280, no. 186
- SB-39 Little Pine Mountain. 1,500 ft. NE of guard station, T. 6 N.,
R. 27 W. (SBB&M)
Quadrangle: Little Pine Mountain
Formation: Monterey Age: Middle Miocene
Remarks: Phosphatic shale in lower part of Monterey.
Reference: 1. Dickert, 1971, p. 280, no. 187
- SB-40 SE San Rafael Mountains near BM 5620 in T. 6 N., R. 25 W. (SBB&M)
Quadrangle: Old Man Mountain
Formation: Monterey Age: Middle Miocene
(upper Saucesian or
or lower Relizian)
Remarks: Phosphatic pellets in shale about a meter below Mf 1563.
J. G. Vedder's field no. V-414d.
Reference: 1. Vedder, Dibblee, and Brown, 1973
- SB-41 Cojo Creek, W. slope. 1,800 ft. N., 1,200 ft. E. of Las Animas
Spring. T. 5 N., R. 34 W. (SBB&M)
Quadrangle: Point Conception
Formation: Rincon Age: Early Miocene
Remarks: Phosphatic pellets dispersed in mudstone.
References: 1. Gower and Madsen, 1964, p. D83, no. 45
2. Dickert, 1971, p. 280, no. 191
- SB-42 Wood Canyon, W. side. 4,000 ft. due E. of Las Animas Spring.
T. 5 N., R. 34 W. (SBB&M)
Quadrangle: Point Conception
Formation: Rincon Age: Early Miocene
Remarks: Hard bituminous pelletal mudstone and pellets dispersed
in softer mudstone of the Rincon.
Reference: 1. Dickert, 1971, p. 280, no. 192

- SB-43 Canada del Cojo, W. side. 2,200 ft. N., 400 ft. W. of point where
T. 4 N.-T. 5 N. boundary crosses creek. T. 5 N., R. 34 W. (SBB&M)
Quadrangle: Point Conception
Formation: Rincon Age: Early Miocene
Remarks: Pelletal tuffaceous mudstone near top of Rincon.
Reference: 1. Dickert, 1971, p. 280, no. 193
- SB-44 Canada de Santa Anita, E. side. 1,200 ft. NNE from intersection of
creek road with Pt. Conception road. T. 5 N., R. 33 W. (SBB&M)
Quadrangle: Sacate
Formation: Monterey Age: Middle Miocene
Remarks: Calcareous phosphatic shale in Monterey.
Reference: 1. Dickert, 1971, p. 281, no. 194
- SB-45 Canada de Alegria. 500 ft. N. of creek crossing with Pt. Conception
Road. T. 5 N., R. 32 W. (SBB&M)
Quadrangle: Sacate
Formation: Monterey Age: Middle Miocene
Remarks: Large (25 x 15 cm) nodules of calcareous phosphatic
material in Monterey.
Reference: 1. Dickert, 1971, p. 281, no. 195
- SB-46 Pt. Conception Road, N. side. Bixby Canyon area. 1,700 ft. S.,
5,500 ft. W. of benchmark 113. T. 5 N., R. 32 W. (SBB&M)
Quadrangle: Gaviota
Formation: Monterey Age: Middle Miocene
(Luisian)
Remarks: Calcareous and phosphatic seams (4 cm) in lower Monterey.
References: 1. Bramlette, 1946, pl. 2
2. Gower and Madsen, 1964, p. D83, no. 46
3. Dickert, 1971, p. 281, no. 196
- SB-47 Ridgetop E. of Canada del Refugio. 5,100 ft. N., 2,400 ft. E.
of SW cor. of T. 5 N., R. 30 W. (SBB&M)
Quadrangle: Tajiguas
Formation: Monterey Age: Middle Miocene
Remarks: Hard dense mudstone with pink phosphatic nodules at
contact between Monterey and Rincon.
Reference: 1. Dickert, 1971, p. 281, no. 197
- SB-48 Capitan oil field. Wells 1/2 mile N. of Capitan, SW 1/4
T. 5 N., R. 30 W. (SBB&M)
Quadrangle: Tajiguas
Formation: Rincon Age: Early Miocene
Remarks: Phosphatic pellets in top 100 m of the Rincon.
References: 1. Kribbs, 1943, p. 375
2. Gower and Madsen, 1964, p. D83, no. 47
3. Dickert, 1971, p. 281, no. 198

SB-49 Sea cliffs E. of Capitan Point. T. 4 N., R. 30 W. (SBB&M)
 Quadrangle: Tajiguas
 Formation: Monterey Age: Middle Miocene
 Remarks: Thick continuous section of laminated nodular bituminous phosphatic shale in near vertical beds of the Monterey.
 Reference: 1. Dickert, 1971, p. 281, no. 199

SB-50 Lake Cachuma. In Tecolote Tunnel, 6,000' S. of inlet portal.
 Surface outcrop NE 1/4 sec. 4, T. 5 N., R. 29 W. (SBB&M)
 Quadrangle: Lake Cachuma
 Formation: Vaqueros Age: Early Miocene
 Remarks: Abundant phosphatic pellets in upper part of formation.
 References: 1. Bandy and Kolpack, 1963, p. 136, 155
 2. Gower and Madsen, 1964, p. D83, no. 50

SB-51 Sea cliffs E. of the mouth of Dos Pueblos Creek and W. of Naples. T. 4 N., R. 29 W. (SBB&M)
 Quadrangle: Dos Pueblos Canyon
 Formation: Monterey Age: Middle Miocene
 Remarks: 150 m continuous section of bituminous phosphatic shale of the Monterey.
 References: 1. Bramlette, 1946, pl. 2
 2. Gower and Madsen, 1964, p. D83, no. 48
 3. Dickert, 1971, p. 281, no. 200

SB-52 Elwood oil field. Wells in secs. 15 and 16, T. 4 N., R. 29 W. (SBB&M)
 Quadrangle: Dos Pueblos Canyon
 Formation: Rincon Age: Early Miocene
 Remarks: Phosphatic pellets in lower part of upper third of Rincon.
 References: 1. Hill, 1943, p. 381
 2. Gower and Madsen, 1964, p. D83, no. 49
 3. Dickert, 1971, p. 281, no. 201

SB-53 West side of Rincon Point, T. 3 N., R. 25 W. (SBB&M)
 Quadrangle: White Ledge Peak
 Formation: Monterey Age: Middle Miocene
 Remarks: Phosphatic shale in upper part of lower member and in middle member of Monterey.
 References: 1. Lian, 1954, map sheet 25
 2. Dickert, 1971, p. 282, no. 202

SB-54 *NE 1/4 sec. 22, T. 10 N., R. 36 W. (SBB&M)
 Quadrangle: Point Sal
 Formation: Monterey Age: Middle Miocene (Luisian)
 Remarks: Phosphatic shale with sample 1-3473 (7) containing 5.3% P₂O₅. Los Nietos Co. LeRoy A3 well.
 Reference: 1. Pisciotto, 1978, loc. 1-3473(7)

SB-55 SW 1/4 SE 1/4 sec. 24, T. 10 N., R. 34 W. (SBB&M)
 Quadrangle: Santa Maria
 Formation: Monterey Age: Middle Miocene
 (Luisian)
 Remarks: Phosphatic shale with sample 8-2757(2) containing
 2.3% P₂O₅. Union Oil Co. of Calif. SMVU Adam 2 well.
 Reference: 1. Pisciotto, 1978, loc. 8-2757(2)

SB-56 NW 1/4 SW 1/4 sec. 11, T. 9 N., R. 34 W. (SBB&M)
 Quadrangle: Orcutt
 Formation: Monterey Age: Middle Miocene
 (Luisian)
 Remarks: Phosphatic shale with sample 14-8692(2a) containing 12%
 P₂O₅. Los Nietos Co., Los Nietos - Gulf SST 25-11 well.
 Reference: 1. Pisciotto, 1978, loc. 14-8692(2a)

SB-57 SE 1/4 NW 1/4 sec. 23, T. 9 N., R. 34 W., (SBB&M)
 Quadrangle: Orcutt
 Formation: Monterey Age: Middle Miocene
 (Luisian)
 Remarks: Phosphatic shale with sample 31-3950 containing
 0.37% P₂O₅. Union Oil Co. of Calif., Radium 1 well.
 Reference: 1. Pisciotto, 1978, loc. 31-3950

SB-58 *SW 1/4 SW 1/4 sec. 29, T. 9 N., R. 33 W. (SBB&M)
 Quadrangle: Orcutt
 Formation: Monterey Age: Middle Miocene
 (Luisian)
 Remarks: Phosphatic shale with sample 27-4345 containing 3.7%
 P₂O₅. Union Oil Co. of Calif. Newlove 79 well.
 Reference: 1. Pisciotto, 1978, loc. 27-4345

SB-59 *Center SE edge sec. 35, T. 9 N., R. 33 W. (SBB&M)
 Quadrangle: Sisquoc
 Formation: Monterey Age: Late Miocene
 (Late Mohnian)
 Remarks: Phosphatic shale with sample 23-3950 containing 2.0%
 P₂O₅. Union Oil of Calif. Bell 156 well.
 Reference: 1. Pisciotto, 1978, loc. 23-3950

SB-60 Intertidal exposures, 2,000' SE of Lions Head *sec. 18, T. 9 N.,
 R. 35 W. (SBB&M)
 Quadrangle: Casmalia
 Formation: Monterey, lower member Age: Middle Miocene
 (Luisian)
 Remarks: Hard phosphatic shale in lower member of Monterey.
 References: 1. Woodring and Bramlette, 1950, p.15
 2. Pisciotto, 1978, loc. K-19-77

SB-61 Johns-Manville Quarry. 300 ft. N., 2,100 ft. W. of SE cor.
sec. 15, T. 6 N., R. 34 W. (SBB&M)

Quadrangle: Lompoc Hills

Formation: Sisquoc

Age: Late Miocene
(Late Mohnian)

Remarks: Phosphate pellets and pebbles at base of Sisquoc.

References: 1. Barron, 1976, p. 121
2. Pisciotto, 1978, loc. K-128-77

SB-62 Center Sw 1/4 sec. 9, T. 9 N., R. 26 W. (SBB&M)

Quadrangle: Salisbury Potrero

Formation: Santa Margarita, lower phosphatic member

Age: Late Miocene
(Mohnian)

Remarks: Thin beds of pelletal phosphatic mudstone and siltstone.

Reference: 1. Fritsche, 1969

SB-63 3,000'S. and 50' W. of SW cor. sec. 12, T. 9 N., R. 26 W. (SBB&M)

Quadrangle: Fox Mountain

Formation: Santa Margarita, lower phosphatic mudstone member

Age: Late Miocene
(Mohnian)

Remarks: Thin beds of pelletal phosphatic mudstone and siltstone.

Reference: 1. Vedder, 1968

SB-64 2,450'S. and 60' W. of SE cor. sec. 12, T. 9 N., R. 26 W. (SBB&M)

Quadrangle: Fox Mountain

Formation: Santa Margarita, lower phosphatic mudstone member

Age: Late Miocene
(Mohnian)

Remarks: Thin phosphorite bed in siltstone.

Reference: 1. Vedder, 1968

SANTA CLARA COUNTY

SC-1 Calera Creek. *SE 1/4 SW 1/4 sec. 29, T. 5 S., R. 1 E. (MDB&M)

Quadrangle: Milpitas

Formation: Claremont Shale

Age: Middle Miocene
(Luisian)

Remarks: Phosphatic nodules in chert exposed in quarry.

Reference: 1. Hill, 1979, pl.2, section no. 3.

SC-2 Alum Rock Canyon. Exposures of Claremont Shale in road cuts
on N. side of canyon. NW 1/4 sec. 19, T. 6 S., R. 2 E. (MDB&M)

Quadrangle: Calaveras Reservoir

Formation: Claremont Shale

Age: Middle Miocene (Early
Luisian or older?)

Remarks: Pellets in thin turbidite sand within Claremont Shale.
Phosphate nodules in exposures of siliceous shale and
chert, N. side, Penitencia Creek.

References: 1. Dickert, 1971, p. 257, no. 17
2. Hill, 1979, pl. 2, section no. 1

SC-3 E. side, Skyline Drive (Route 35). 500 ft. N. of SE cor.
sec. 26, T. 7 S., R. 3 W. (MDB&M)

Quadrangle: Mindego Hill

Formation: San Lorenzo Age: Middle (?) Miocene

Remarks: Phosphatic laminae in mudstone.

Reference: 1. Dickert, 1971, p. 258, no. 25

SC-4 Magdalena Avenue, N. 400 ft. NE of Ravensbury Ave. *NW 1/4 SW 1/4
sec. 5, T. 7 S., R. 2 W.

Quadrangle: Cupertino

Formation: Monterey Age: Middle (?) Miocene

Remarks: Sparse phosphate nodules in shale.

Reference: 1. Dickert, 1971, p. 257, no. 20

SC-5 Mora Heights Way. E. side of hill. SE 1/4 NE 1/4 sec. 8,
T. 7 S., R. 2 W. (MDB&M)

Quadrangle: Cupertino

Formation: Monterey Age: Middle (?) Miocene

Remarks: Slightly phosphatic shale.

Reference: 1. Dickert, 1971, p. 257, no. 21

SC-6 W. Side of Shannon Road, Los Gatos. 2,100 ft. S., 900 ft. E. of NW
cor. sec. 24, T. 8 S., R. 1 W. (MDB&M)

Quadrangle: Los Gatos

Formation: Monterey Age: Middle (?) Miocene

Remarks: Phosphatic laminae and abundant nodules in chalky shales.

Reference: 1. Dickert, 1971, p. 258, no. 29

SC-7 S. slope of Pine Ridge. SE 1/4 NW 1/4 sec. 5, T. 9 S., R. 4 E.
(MDB&M)

Quadrangle: Mt. Sizer

Formation: Monterey Age: Middle (?) Miocene

Remarks: Sparse phosphate nodules in shale.

Reference: 1. Dickert, 1971, p. 259, no. 35

SC-8 *SE 1/4 NW 1/4 sec. 4, T. 11 S., R. 3 E. (MDB&M)

Quadrangle: Mt. Madonna

Formation: Unnamed (Temblor equivalent) Age: Early Miocene,
(Zemorian/Saucesian)

Remarks: Sample near base of basal sandstone of formation. Sandstone bioturbated and locally contains about 8% colophane (phosphatic mudstone) clasts along with about 16% glauconite (from thin section). Unnamed formation overlies Franciscan rocks and serpentine and is overlain depositionally by the Monterey Shale equivalent.

Reference: 1. McLaughlin, 1971; 1973; loc. no. SF-384-70

SC-9 *NW 1/4 SE 1/4 sec. 6, T. 11 S., R. 3 E. (MDB&M)

Quadrangle: Mt. Madonna

Formation: Unnamed

Age: Early-Middle Eocene
(Ulatisian or Penutian)

Remarks: Phosphatic concretions in dark gray to green shale and argillite. Unit grades upward into Eocene sandstone (Butano equivalent?). Lower part of unit faulted against Franciscan rocks along the Sargent Fault zone.

Reference: 1. McLaughlin, 1971; 1973; loc. no. SF-6-69

SC-10 NW 1/4 SW 1/4 sec. 25, T. 10 S., R. 2 E. (MDB&M)

Quadrangle: Mt. Madonna

Formation: Great Valley Sequence

Age: Lower Cretaceous
(Valanginian)

Remarks: Dark brown phosphatic concretions within black mudstone and argillite with sporadic carbonate concretions. Sequence lies entirely within Sargent Fault zone in fault contact with Franciscan rocks and serpentinite. Upper part in thrust contact with overlying lower Tertiary/upper Cretaceous rocks.

Reference: 1. McLaughlin, 1971; 1973; loc. no. SF-16-69

SANTA CRUZ COUNTY

SCr-1 SW side of Highway 9, several exposures in SW 1/4 sec. 12,
T. 8 S., R. 3 W. (MDB&M)

Quadrangle: Big Basin

Formation: Monterey

Age: Middle Miocene
(Luisian)

Remarks: Phosphatic nodules in shale.

Reference: 1. Dickert, 1971, p. 258, no. 27

SCr-2 Sempervirens Creek. 1,700 ft. S., 700 ft. W. of NE cor. sec. 32,
T. 8 S., R. 3 W. (MDB&M)

Quadrangle: Big Basin

Formation: San Lorenzo, Twobar Shale
Member

Age: Early Eocene
(Narizian)

Remarks: Phosphatic lenses in shale.

References: 1. Brabb, 1960, p. 187
2. Dickert, 1971, p. 259, no. 30

SCr-3 W. bank of San Lorenzo River. 1/4 mile N. of San Lorenzo Park. 1,500
ft. E., 500 ft. S. of NW cor. sec. 36, T. 8 S., R. 3 W. (MDB&M)

Quadrangle: Big Basin

Formation: San Lorenzo, Rices Mudstone
Member

Age: Oligocene
(Zemorrian)

Remarks: Glauconite and phosphate pellet bed in lower part of Rices Mudstone Member of the San Lorenzo.

References: 1. Brabb, 1960, p. 173, loc. no. 395B
2. Dickert, 1971, p. 259, no. 31

SCr-4 Saratoga Gap. S. side of Highway 9. 1,000 ft. S. and 1,100 ft. E. of NW cor. sec. 7, T. 8 S., R. 2 W. (MDB&M)

Quadrangle: Mindego Hill

Formation: Lambert Shale

Age: Early Miocene
(Saucesian)

Remarks: Organic mudstone with phosphatic laminae and lenses in lower part of formation.

References: 1. Dickert, 1971, p. 258, no. 26
2. Brabb, Clark, & Throckmorton, 1977, p. 13

SCr-5 Kings Creek. SE 1/4 sec. 31, T. 8 S., R. 2 W. (MDB&M)

Quadrangle: Castle Rock Ridge

Formation: San Lorenzo, Rices
Mudstone Member

Age: Oligocene
(Zemorrian)

Remarks: Glauconite and phosphate pellet bed in lower part of Rices Mudstone Member of the San Lorenzo.

References: 1. Brabb, 1960, p. 170, loc. no. EB 365D-K; 1964, p. 677
2. Cummings, and others, 1962, p. 186-187
3. Gower and Madsen, 1964, p. D81, no. 8
4. Dickert, 1971, p. 259, no. 32
5. Brabb, Clark, Throckmorton, 1977, p. 39, loc. EB 365D-K

SCr-6 West bank of the San Lorenzo River. SE 1/4 sec. 1, T. 9 S., R. 3 W. (MDB&M)

Quadrangle: Big Basin

Formation: San Lorenzo, Rices
Mudstone Member

Age: Oligocene
(Zemorrian)

Remarks: Glauconite and phosphatic pebble bed at base of Zemorrian Stage.

References: 1. Brabb, 1960, p. 183, loc. no. 498
2. Brabb, Clark, Throckmorton, 1977, p. 29

SCr-7 NW side of highway, about 4' NE of a concrete drainage trap. SW 1/4 sec. 9, T. 9 S., R. 3 W. (MDB&M)

Quadrangle: Big Basin

Formation: San Lorenzo, Rices
Mudstone Member

Age: Oligocene
(Zemorrian)

Remarks: Probably glauconite and phosphatic pebble bed at base of Zemorrian Stage.

Reference: 1. Brabb, 1960, p. 152, 153, and 157; loc. nos. 60, 61, and 178.

SCr-8 W. bank of San Lorenzo River, S. of road into Camp Campbell. SE 1/4 sec. 12, T. 9 S., R. 3 W. (MDB&M)

Quadrangle: Big Basin

Formation: San Lorenzo, Rices
Mudstone Member

Age: Oligocene
(Zemorrian)

Remarks: Phosphate pellets and pebbles in glauconitic sandy mudstone in lower part of Rices Mudstone Member.

References: 1. Brabb, 1960, p. 172 and 163; loc. no. 383
2. Dickert, 1971, p. 259, no. 33

- SCr-9 Bear Creek. SW 1/4 sec. 3, T. 9 S., R. 2 W. (MDB&M)
 Quadrangle: Castle Rock Ridge
 Formation: San Lorenzo, Rices Mudstone Member Age: Oligocene (Zemorian)
 Remarks: Glauconite and phosphate pellet bed in lower part of Rices Mudstone Member.
 References: 1. Brabb, 1960, p. 180; loc. no. 468
 2. Dickert, 1971, p. 259, no. 34
 3. Brabb, Clark, & Throckmorton, 1977 p. 56
- SCr-10 Boulder Creek, E. side of roadcut 250 ft. N. of Spring Creek.
 SW 1/4 sec. 29, T. 9 S., R. 2 W. (MDB&M)
 Quadrangle: Felton
 Formation: Monterey Age: Middle Miocene (Luisian)
 Remarks: Phosphatic nodules in silty shale.
 Reference: 1. Dickert, 1971, p. 260, no. 37
- SCr-11 Newell Creek. SE 1/4 sec. 27, T. 9 S., R. 2 W. (MDB&M)
 Quadrangle: Felton
 Formation: San Lorenzo, Twobar Shale Member Age: Eocene (Narizian)
 Remarks: Phosphatic laminae in shale of San Lorenzo.
 References: 1. Brabb, 1960, p. 184; loc. no. 507
 2. Dickert, 1971, p. 260, no. 41
- SCr-12 Lompico Creek. 1,900 ft. E. and 150 ft. N. of SW cor. sec. 35,
 T. 9 S., R. 2 W. (MDB&M)
 Quadrangle: Felton
 Formation: Monterey Age: Middle Miocene (Luisian)
 Remarks: Phosphatic nodules in shale.
 Reference: 1. Dickert, 1971, p. 260, no. 42
- SCr-13 Zayante Creek. NE 1/4 NE 1/4 sec. 19, T. 9 S., R. 1 W. (MDB&M)
 Quadrangle: Castle Rock Ridge
 Formation: San Lorenzo, Rices Mudstone Member Age: Oligocene (Zemorian)
 Remarks: Glauconitic sandstone with phosphate pellets at base of Zemorian Stage.
 Reference: 1. Brabb, Clark, & Throckmorton, 1977, p. 65
- SCr-14 E. bank of Zayante Creek. 300 ft. S. and 1,800 ft. E. of NW cor.
 sec. 30, T. 9 S., R. 1 W. (MDB&M)
 Quadrangle: Castle Rock Ridge
 Formation: Lambert Shale Age: Early Miocene (Saucian)
 Remarks: Phosphatic laminae in mudstones of the Lambert.
 References: 1. Dickert, 1971, p. 260, no. 38
 2. Brabb, Clark, & Throckmorton, 1977, p. 61-62

SCr-15 Mountain Charlie Gulch. Sec. 29, T. 9 S., R. 1 W. (MDB&M)

Quadrangle: Laurel

Formation: Lambert Shale

Age: Early Miocene
(Saucesian)

Remarks: Graded, pale yellowish-brown, phosphatic laminae and lenses in shale.

References: 1. Clark, 1966, fig. 6, loc. no. J.C. 61-6
2. Dickert, 1971, p. 260, no. 39
3. Brabb, Clark, Throckmorton, 1977, p. 78

SCr-16 Burns Creek, 700 ft. E. of Laurel Road and 800 ft. N. of Laurel,
* SW 1/4 NW 1/4 sec. 27, T. 9 S., R. 1 W. (MDB&M)

Quadrangle: Laurel

Formation: San Lorenzo, Rices Mudstone Member

Age: Eocene or Oligocene
(Refugian or base
of Zemorrian)

Remarks: Glauconite and phosphate pellet and pebble beds at base of Rices Mudstone.

Reference: 1. Dickert, 1971, p. 260, no. 40

SCr-17 Mountain Charlie Gulch Road. SE 1/4 sec. 32, T. 9 S., R. 1 W.
(MDB&M)

Quadrangle: Laurel

Formation: Purisima

Age: Pliocene

Remarks: Glauconite and phosphate pellets in Purisima.

Reference: 1. Dickert, 1971, p. 260, no. 43

SCr-18 Scotts Valley, W. of Carbonera Creek. 900 ft. N., 3,100 ft. E.
of SW cor. sec. 7, T. 10 S., R. 1 W. (MDB&M)

Quadrangle: Felton

Formation: Purisima

Age: Pliocene

Remarks: Glauconite beds with phosphate pellets and pebbles between tuffaceous siltstone and siliceous mudstone of the Purisima.

Reference: 1. Dickert, 1971, p. 260, no. 44

SCr-19 Scotts Valley, W. of Moores Gulch. 1,900 ft. S., 4,900 ft. E. of
NW cor. sec. 16, T. 10 S., R. 1 W. (MDB&M)

Quadrangle: Laurel

Formation: Purisima

Age: Pliocene

Remarks: Glauconite and phosphate pellets and pebbles within the formation.

References: 1. Dickert, 1971, p. 261, no. 45

SCr-20 W. side Rincon St., SE 1/4 NW 1/4 sec. 13, T. 11 S., R. 2 W.,
(MDB&M)

Quadrangle: Santa Cruz

Formation: Purisima

Age: Early Pliocene

Remarks: Contact between Santa Cruz Mudstone and Purisima Formation
—glauconitic and slightly phosphatic pebbly sandstone.

Reference: 1. Clark, 1966, p. 138

SCr-21 6,000 ft. NW of Atherton Peak adjacent to the Santa Cruz-Santa Clara Co. boundary. T. 11 S., R. 3 E. (MDB&M)
Quadrangle: Watsonville East
Formation: Monterey Age: Early Miocene (Late Zemorrian to Saucesian)
Remarks: Phosphatic laminae in organic shale.
Reference: 1. E.E. Brabb, 1976, oral commun.; loc. no. 75 CB 1395

SCr-22 SE slope of Mt. Pajaro, N. side of Pescadero Creek Road, 600 ft. N. of Soda Lake, T. 12 S., R. 3 E. (MDB&M)
Quadrangle: Chittenden
Formation: Monterey Age: Early Miocene (Late Zemorrian-Saucesian)
Remarks: Occasional phosphatic laminae in siliceous shale.
Reference: 1. Dickert, 1971, p.261, no. 46

SIERRA COUNTY

Si-1 SE side of Upper Salmon Lake. SW 1/4 NE 1/4 sec. 29, T. 21 N., R. 12 E. (MDB&M)
Quadrangle: Sierra City
Formation: Elwell Age: Late Devonian
Remarks: The Elwell Formation (new name) is characterized by gray to black radiolarian chert with streaks, lenses and nodules of exceedingly fine grained phosphate rock, probably apatite.
Reference: 1. Durrell and d'Allura, 1977, p. 846

SOLANO COUNTY

So-1 Potrero Hills gas field. SE 1/4 NW 1/4 sec. 9, T. 4 N., R. 1 W. (MDB&M)
Quadrangle: Denverton
Formation: Capay Shale Age: Eocene
Remarks: Limonitic phosphatic interbeds in shale.
References: 1. Tolman, 1943, p. 596
2. Gower and Madsen, 1964, p. D81, no. 4

STANISLAUS COUNTY

St-1 Del Puerto Canyon, 1,000 ft. due N. of the fire control station. SE 1/4 SW 1/4 sec. 20, T. 5 S., R. 7 E. (MDB&M)
Quadrangle: Patterson
Formation: Moreno Age: Late Cretaceous
Remarks: Phosphatic concretions in organic mudstones.
Reference: 1. Dickert, 1971, p. 257, no. 14

St-2 Black Gulch, 1,200 ft. N. of the creek bed. NE 1/4 SE 1/4 sec. 32, T. 5 S., R. 7 E. (MDB&M)
Quadrangle: Patterson
Formation: Moreno Age: Late Cretaceous
Remarks: Phosphatic concretions in mudstone.
Reference: 1. Dickert, 1971, p. 257, no. 15

Quadrangle: Patterson
Formation: Moreno Age: Late Cretaceous
Remarks: Phosphatic concretions in mudstone.
Reference: 1. Dickert, 1971, p. 257, no. 16

T-1 About 1 mile N. of Hyampom. S. 1/2 sec. 13, T. 3 N., R. 6 E. (HB&M)
 Quadrangle: Hyampom
 Formation: Weaverville Age: Oligocene (?)
 Remarks: Phosphate in nonmarine sedimentary rocks.
 References: 1. Gower and Madsen, 1964 p. D81, no. 1
 2. Lydon, 1964

V-1 Upper Mono Creek. Near bench mark 4 55. NE 1/4 SE 1/4 sec. 31,
T. 7 N., R. 24 W. (SBB&M)
Quadrangle: Rancho Nuevo Creek
Formation: Monterey Age: Middle Miocene
(Relizian)
Remarks: Phosphatic pellets in shal at Mf 1234. Foraminifera
assigned to Relizian by R. L. Pierce.
Reference: 1. Vedder, Dibblee, and E. own, 1973; loc. no. V-403

Quadrangle: Reyes Peak
 Formation: Santa Margarita Age: Late Miocene
 (Mohnian)
 Remarks: Abundant phosphate pellets in phosphatic mudstone
 member. U.S. Gypsum Co., Trinch M.
 References: 1. Gower and Madsen, 1964 p. D83, no. 51
 2. Vedder, Dibblee, and Egan, 1973

Quadrangle: Reyes Peak
 Formation: Santa Margarita Age: Late Miocene (Mohnian)
 Remarks: Stratigraphic section no. of D. R. Lowe.
 References: 1. D. R. Lowe, 1966 and 1970, written commun.
 2. Vedder, Dibblee, and E. own, 1973

Quadrangle: Reyes Peak
Formation: Santa Margarita Age: Late Miocene (Mohnian)
Remarks: U. S. Gypsum Co., Trench C
References: 1. Dickinson and Lowe, 1966
2. Dickert, 1971, p. 280, no. 188
3. Vedder, Dibblee, and Brown, 1973

V-5 SE 1/4 SW 1/4 sec. 6, T. 6 N., R. 23 W. (SBB&M)
 Quadrangle: Reyes Peak
 Formation: Santa Margarita Age: Late Miocene
 (Mohnian)
 Remarks: Abundant phosphate pellet beds in phosphatic mudstone member. U. S. Gypsum Co., Trench B.
 References: 1. Gower and Madsen, 1964, p. D83, no. 51
 2. Player, 1966
 3. Vedder, Dibblee, and Brown, 1973

V-6 NW 1/4 NW 1/4 sec. 7, T. 6 N., R. 23 W. (SBB&M)
 Quadrangle: Reyes Peak
 Formation: Santa Margarita Age: Late Miocene
 (Mohnian)
 Remarks: Abundant phosphate pellet beds in phosphatic mudstone member. Stratigraphic section no. 3 of D. R. Lowe.
 References: 1. D. R. Lowe, 1966, and 1970, written commun.
 2. Vedder, Dibblee, and Brown; 1973

V-7 NE 1/4 NW 1/4 sec. 8, T. 6 N., R. 23 W. (SBB&M)
 Quadrangle: Reyes Peak
 Formation: Santa Margarita Age: Late Miocene
 (Mohnian)
 Remarks: Abundant phosphate pellet beds in phosphatic mudstone member. Stratigraphic section no. 3 of D. R. Thor.
 References: 1. Dickert, 1971, p. 280, no. 189
 2. Vedder, Dibblee, and Brown, 1973
 3. Thor, 1977, no. 3

V-8 SW 1/4 NW 1/4 sec. 8, T. 6 N., R. 23 W. (SBB&M)
 Quadrangle: Reyes Peak
 Formation: Santa Margarita Age: Late Miocene
 (Mohnian)
 Remarks: Abundant phosphate pellets in phosphatic mudstone member. U. S. Gypsum Co., Trench H.
 References: 1. Vedder, Dibblee, and Brown; 1973
 2. Thor, 1977, no. 2

V-9 NE 1/4 SW 1/4 sec. 8, T 6 N., R. 23 W. (SBB&M)
 Quadrangle: Wheeler Springs
 Formation: Santa Margarita Age: Late Miocene
 (Mohnian)
 Remarks: Abundant phosphate pellet beds in phosphatic mudstone member. U. S. Gypsum Co., Trench C.
 References: 1. Player, 1966
 2. Runvik, 1973, p. 169
 3. Vedder, Dibblee, and Brown, 1973
 4. Thor, 1977, no. 10

V-10 SE 1/4 SE 1/4 sec. 8, T. 6 N., R. 23 W. (SBB&M)

Quadrangle: Wheeler Springs

Formation: Santa Margarita

Age: Late Miocene
(Mohnian)

Remarks: Abundant phosphate pellet beds in phosphatic mudstone member. U. S. Gypsum Co., Trench A.

Reference: 1. Dickert, 1971, p. 280, no. 190

V-11 SE 1/4 SW 1/4 sec. 9 and NE 1/4 NW 1/4 sec. 16, T. 6 N., R. 23 W.
(SBB&M)

Quadrangle: Wheeler Springs

Formation: Santa Margarita

Age: Late Miocene
(Mohnian)

Remarks: Abundant phosphate pellet beds in phosphatic mudstone member. U. S. Gypsum Co., Trench TP.

Reference: 1. Thor, 1977, no. 4

V-12 NE 1/4 NW 1/4 sec. 15, T. 6 N., R. 23 W. (SBB&M)

Quadrangle: Wheeler Springs

Formation: Santa Margarita

Age: Late Miocene
(Mohnian)

Remarks: Abundant phosphate pellet beds in phosphatic mudstone member. U. S. Gypsum Co., Trench E.

Reference: 1. Thor, 1977, no. 5

V-13 SE 1/4 NW 1/4 sec. 14, T. 6 N., R. 23 W. (SBB&M)

Quadrangle: Wheeler Springs

Formation: Santa Margarita

Age: Late Miocene
(Mohnian)

Remarks: Abundant phosphate pellet beds in phosphatic mudstone member. Stratigraphic section no. 2 of D. R. Lowe.

Reference: 1. D. R. Lowe, 1966 and 1970, written commun.

V-14 Piru Creek Road, W. side. NW 1/4 sec. 27, T. 5 N., R. 18 W.
(SBB&M)

Quadrangle: Piru

Formation: Modelo

Age: Late Miocene

Remarks: Phosphatic pellets dispersed in sandstone unit within Modelo.

Reference: Dickert, 1971, p. 282, no. 206

V-15 Los Sauces Creek at S. boundary, SE 1/4 SE 1/4 sec. 32, T. 4 N., R. 24 W.
(SBB&M)

Quadrangle: White Ledge Peak

Formation: Rincon

Age: Early Miocene

Remarks: Phosphatic oolites in upper part of middle member of Rincon.

References: 1. Cushman and Laming, 1931
2. Dickert, 1971, p. 282, no. 203

V-16 Santa Paula Creek crossing at highway 150. SW 1/4 sec. 16, T. 4 N.,
R. 21 W. (SBB&M)

Quadrangle: Santa Paula Peak

Formation: Monterey

Age: Late Miocene

Remarks: Phosphatic shale in Monterey.

Reference: 1. Dickert, 1971, p. 282, no. 204

V-17 1/2 mile S. of Oat Mountain, on E. side, Rocky Mt. Drilling Co. road.
SW 1/4 SW 1/4 sec. 8, T. 4 N., R. 19 W. (SBB&M)

Quadrangle: Fillmore
Formation: Monterey Age: Late Miocene
Remarks: Phosphatic shale in Monterey.
Reference: 1. Dickert, 1971, p. 282, no. 205

V-18 Lake Piru, W. side of canyon road. 1,500 ft. N. and 4,500 ft. E. of
SW cor. sec. 4, T. 4 N., R. 18 W. (SBB&M)

Quadrangle: Piru
Formation: Modelo Age: Late Miocene
Remarks: Thick section of pelletal sandstones within Modelo.
Reference: 1. Dickert, 1971, p. 282, no. 208

V-19 Lake Piru, W. side of canyon road. 10,000 ft. due E. of SW cor. sec. 8,
T. 4 N., R. 18 W. (SBB&M)

Quadrangle: Piru
Formation: Modelo Age: Late Miocene
Remarks: Pellets dispersed in sandstone unit within Modelo.
Reference: 1. Dickert, 1971, p. 282, no. 209

V-20 T. 3 N., R. 21 W. (SBB&M)

Quadrangle: Santa Paula
Formation: Pico Age: Late Pliocene
Remarks: Small deposits of white phosphates occur along the top of
South Mountain, four miles south of Santa Paula. Samples
of the material contained 5% calcium phosphate.
References: 1. Tucker and Samson, 1932, p. 270
2. Gower and Madsen, 1964, p. D83, no. 52

V-21 Grimes Canyon, E. side. 800' S. and 1,000' E. of BM 744.
NE 1/4 NW 1/4 sec. 18, T. 3 N., R. 19 W. (SBB&M)

Quadrangle: Moorpark
Formation: Monterey Age: Late Miocene
(Mohnian)
Remarks: Thick (135 m) section of laminated phosphatic and non-
phosphatic rock metamorphosed by surface burning.
References: 1. Bramlette, 1946, pl. 2 and p. 7
2. Brown, 1959
3. Gower and Madsen, 1964, p. D83, no. 53
4. Dickert, 1971, p. 283, no. 210
5. Bentor and Kastner, 1976

V-22 SW 1/4 NE 1/4 sec. 14, T. 6 N., R. 23 W. (SBB&M)

Quadrangle: Wheeler Springs
Formation: Santa Margarita Age: Late Miocene
(Mohnian)
Remarks: Abundant phosphatic pellet beds in phosphatic mudstone
member. Stratigraphic section no. 4 of D. R. Lowe.
Reference: 1. D. R. Lowe, 1966 and 1970, written commun.

V-23 NE side of Grimes Canyon Road, 800 ft. SE of BM 744. NE 1/4 NW 1/4 sec. 18, T. 3 N., R. 19 W. (SBB&M)

Quadrangle: Moorpark

Formation: Monterey

Age: Late Miocene
(Mohnian)

Remarks: Burned phosphatic shale.

Reference: 1. Pisciotto, 1978, loc. K-152-77

YOLO COUNTY

Y-1 Cache Creek, SW bank. NW 1/4 NW 1/4 sec. 5, T. 12 N., R. 4 W. (MDB&M)

Quadrangle: Morgan Valley

Formation: Boxer

Age: Late Cretaceous
(Cenomanian)

Remarks: Pelletal phosphate in lenses and concretions in uppermost part of Boxer (formerly the Brophy Canyon Formation).

References: 1. Dickert, 1971, p. 255, no.1

2. Lawton, 1956

3. Dickinson and Rich, 1972