DAVID BLOOM

NEOGENE PALEOGEOGRAPHY OF THE WESTERN UNITED STATES

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ABSTRACT

This paper presents a brief introduction to the Miocene and Pliocene paleogeography of the western portion of the United States including California, Oregon, Washington, Nevada, and the western portions of Arizona and Idaho. The maps are composites and attempt to illustrate maximum marine inundation during Miocene and Pliocene time.

Paleogeography as used in the text is defined as the study of the distribution of land, sea, air, floral and faunal provinces on the Earth's surface at a specified point in time.

During Miocene time, until about 19 my ago, the Basin and Range province was dominated by intermediate type volcanism. Approximately 16 my ago, basaltic volcanism commenced contemporaneously with normal faulting and produced the Basin and Range topography associated with the region today.

West of the Basin and Range, the Sierra Nevada was an andesitic volcanic arc in which arc volcanism was progressively truncated from south to north. This cessation was coincident with the northward migration of a triple junction which resulted from the collision of the East Pacific Rise with North America. This Cordilleran volcanic arc continued north into Oregon and Washington where it is still active. In California west of the Sierra Nevada, a marine basin was disrupted by the previously mentioned collision and subsequent offset along the San Andreas fault.

Western Oregon and Washington were dominated in Miocene and Pliocene time by an andesitic volcanic arc. West of the arc, the Pacific Ocean extended inland only slightly farther east than today's shoreline.

East of the arc, the middle and late Miocene outpouring of the Columbia River Group basalts was the dominante event. This was followed by extrusion of the Snake River Plain volcanic rocks which show a progressive decrease in age of inception eastward to Yellowstone where they terminate.

INTRODUCTION

This paper presents a thumbnail sketch of the Miocene and Pliocene paleogeography of the United States west of 111° latitude. Neogene deposition and paleogeography are briefly discussed and illustrated on the accompanying maps. The maps are schematic interpretations of an average "paleogeography" for each time slice and attempt to illustrate the maximum marine in undation. The Miocene map encompasses events between 22 and 5 million years; the Pliocene map encompasses events between 5 and 2 million years.

The Miocene map generally illustrates late Miocene paleogeography. In California rocks of the late Miocene represent the maximum marine Neogene inundation, while in Oregon and Washington maximum inundation occurred during the early Miocene. The maximum inundation in Oregon and Washington is therefore not represented on the Miocene map. The magnitude of this problem is not as great as it first appears, for the late Miocene inundation in Oregon and Washington, which is represented on the map, reoccupied to a lesser degree the same embayments as the early Miocene inundation. This lack of regionally synchronous events can be overcome by generating maps for narrower time slices. Preparation of this report, however permitted synthesis of only two maps for a time span perhaps best illustrated by at least four maps.

The Pliocene map, encompassing a shorter period than the Miocene map, compresses a less complex geologic history into a single plane. Pliocene paleogeographic features have, with some modification, persisted to the present.

The Miocene and Pliocene maps have been generated using King and Beikman (1974) as a geologic base. With properly scaled reproductions, the paleogeographic maps of this report may be superimposed upon King and Beikman's map allowing direct identification of the geologic terrains forming the base for the paleogeographic interpretations.

This approach produces a simplistic view of paleogeography: a view that ignores palinspastic reconstructions. Detailed studies of the San Andreas fault system have delineated major offset features indicating approximately 190 mi (315 km) of right slip in the last 15 million years (Nilsen and Link, 1975).

On the Miocene map, submarine fans truncated by the fault are shown entering the area of the modern San Joaquin Valley from the west. Across the fault to the west, alluvial fans truncated by the fault are shown with an eastern source. Restoration of the post-Miocene offset will restore both the submarine fans and alluvial fans to their respective source terrains (Huffman, 1972).

The paleogeographic consequence of other dislocated regional geologic terrains is less well understood. Paleogeomagnetic data suggests Cenozoic rotation of volcanic terrains in both western Oregon (Simpson and Cox, 1978) and southern California (Kamerling and Luyendyk, 1977; Kamerling and others, 1978). Simpson and Cox (1978) interpret paleomagnetic data to show that Eocene to Miocene volcanic rocks in western Oregon have been progressively rotated clockwise as much as 65°. Based on that data, Simpson and Cox proposed several tectonic reconstructions which encompassed all of the western Oregon and Washington Coast Ranges. Unpublished paleogeomagnetic data (M. E. Beck, 1979, personal comm.; Ray Wells, 1979, personal comm.) show that Eocene volcanic terrains in southwestern Washington have rotational histories different than age equivalent rocks in western Oregon. Such data requires that each volcanic terrain with a unique rotational history be treated as a separate tectonic block. As yet we do not know how many of these separate tectonic blocks we are dealing with, nor do we know either the nature of or location of the structural boundaries between blocks with unique tectonics rotational histories. In light of these unresolved palinspastic problems we decided a non-palinspastic reconstruction of the Meogene paleogeography would be more useful especially when used in conjunction with the geologic base of King and Beikman (1974).

PALEOGEOGRAPHY

The Cenozoic geology of western North America formed around a framework of Paleozoic and Mesozoic plutonic and metamorphic terrains (see volume I and II of this series). Today, these terrains form uplifted areas such as the Sierra Nevada, Klamath Mountains, Blue Mountains, Colorado Plateau, Rocky Mountains of Idaho, Washington and southern Canada, the North Cascade Mountains, and the Coast Mountains of British Columbia. Neogene deposits derived from these pre-Cenozoic terrains together with intra-basinal derived deposits (mostly volcanic rocks) accumulated in depositional basins such as 1) the Basin and Range; 2) the Columbia Plateau and Snake River Plain; 3) the Sierra Nevada; 4) the Cascade Mountains; 5) the Puget-Willamette Lowland; 6) the Great Valley of California; and 7) the Coast Ranges and continental shelves of California, Oregon and Washington. These geologic provinces are outlined in figure 1. The Miocene and Pliocene depositional patterns and paleogeography are illustrated on figures 2 and 3.

BASIN AND RANGE

The geologic province east of the Sierra Nevada and west of the Rocky Mountains and Colorado Plateau is the Basin and Range province. This province is bounded on the north by the Columbia Plateau and Snake River Plain, and merges on the south with the Mojave Desert. The Basin and Range province gets it name from the many north-south aligned basins separated by mountain ranges.

The early Miocene rocks of the Basin and Range province are intermediate rhyolitic volcanics and interbedded non-marine deposits emplaced on an old erosion surface of low to moderate relief. This outpouring of large volumes of lave was not accompanied by any marked increase in tectonism with the exception of caldera collapse resulting from volcanic eruptions (McKee, 1971).

The intermediate rhyolitic phase of volcanism ceased about 19 m.y. ago with the area covered by essentially unfaulted flows. About 16 m.y. ago basaltic volcanism began coincident with high-angle normal faulting (McKee, 1971; Stewart and others, 1977).

The normal faulting which produced a horst-graben terrain resulted in 100-112 mi (160-180 km) of extension of the Basin and Range province along a northwest-southeast axis (Proffett, 1977). The grabens became sites of interior drainage in which were deposited clastic wedges of fluvial, alluvial and lacustrine origin. In southern Arizona and southern Nevada a few of these basins accumulated thick sequences of evaporite deposits (Eberly and Stanley, 1972). Based on newly described marine limestones near the Grand Wash Cliffs, Blair (1978) projects the Gulf of California north along the present course of the Colorado River during the late Miocene. By the late Miocene-early Pliocene the Colorado River had formed (McKee and McKee, 1972). Discharge from the Colorado River into the marine embayment of the Gulf of California gradually filled the estuary and caused the river mouth to migrate southward toward its present position.

The pattern of Basin-Range extension and non-marine sedimentation persisted through the Pliocene and Pleistocene. As the depositional basins filled the drainage systems began to coalesce and exterior drainage developed. Increased rainfall during the late Pleistocene glacial cycles resulted in formation of large lakes.

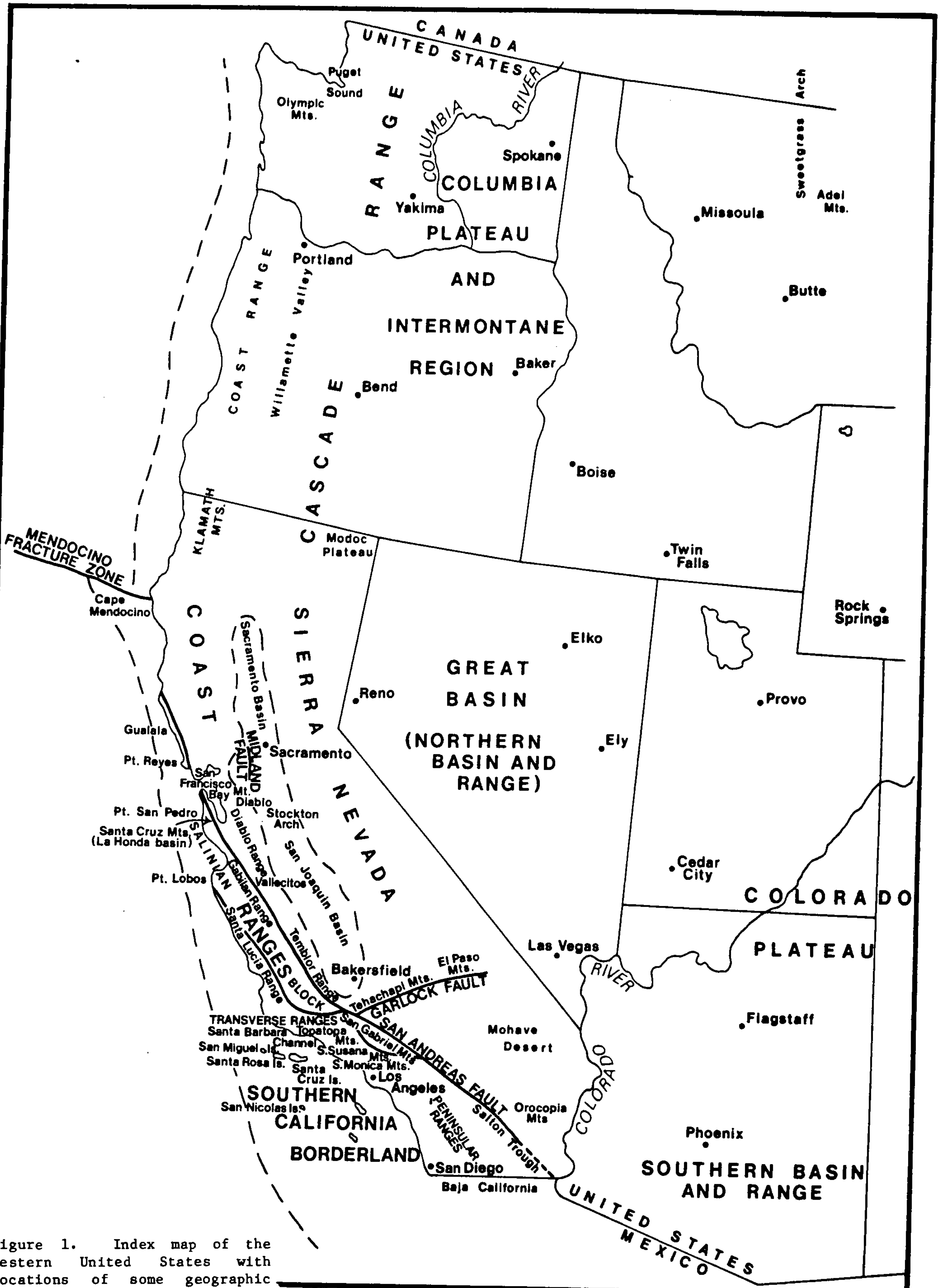


Figure 1. Index map of the Western United States with locations of some geographic features, major faults, and some cities. Dashed line offshore at approximate edge of the continental shelf. After Nilsen and McKee (this volume).

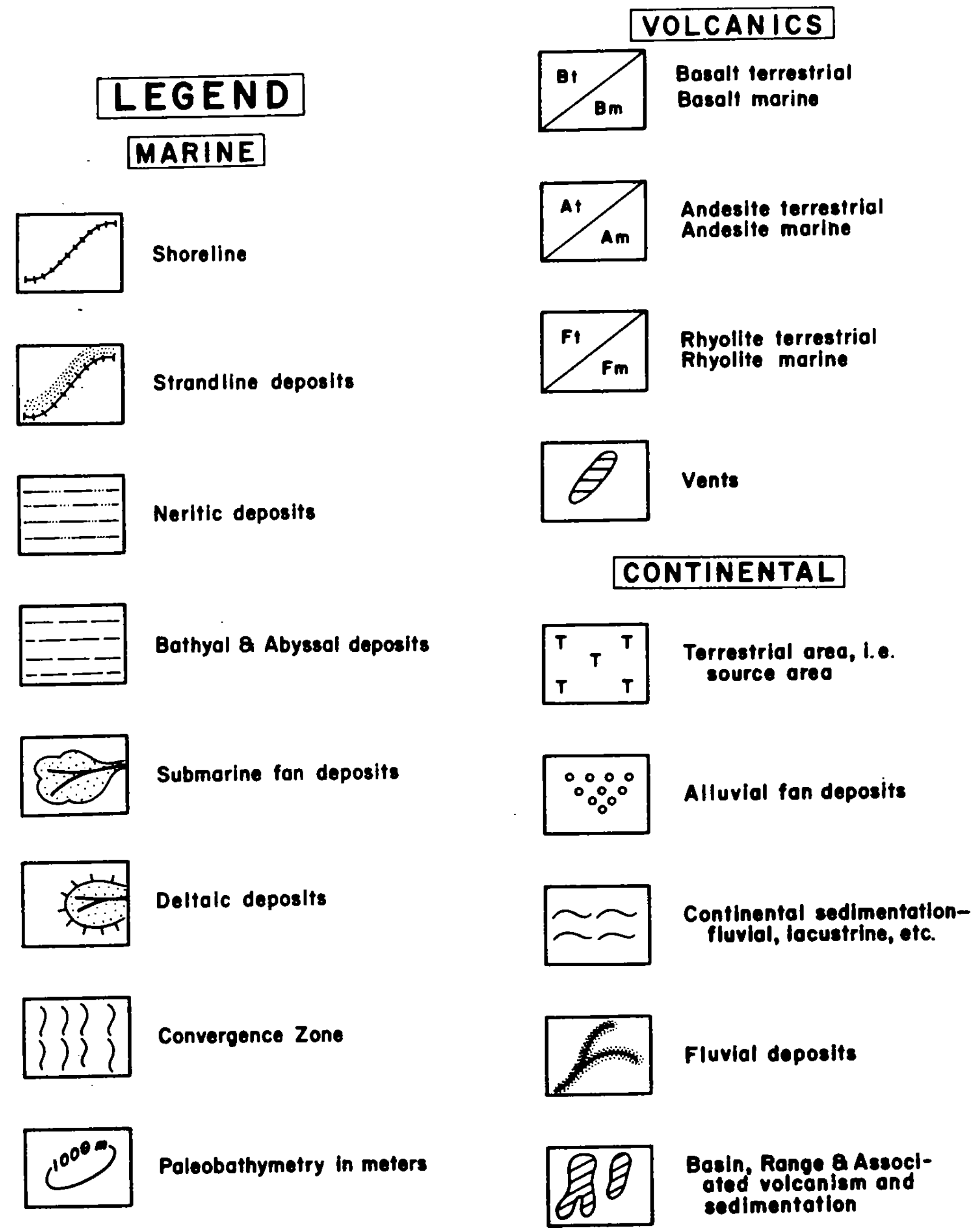
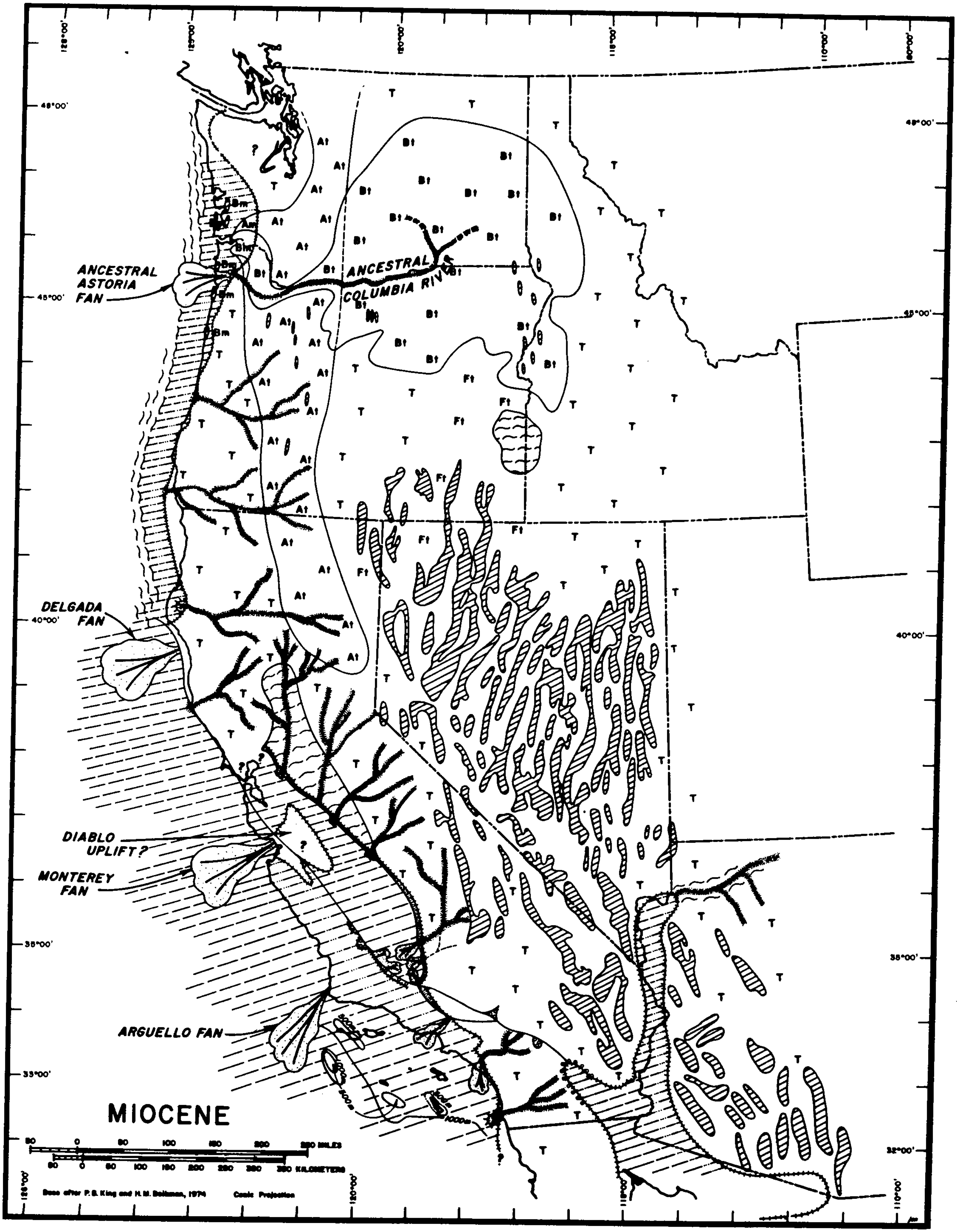


Figure 2. Miocene paleogeographic map of the western United States.


ANCESTRAL ASTORIA FAN
ANCESTRAL COLUMBIA RIVER
DELGADA FAN
DIABLO UPLIFT?
MONTEREY FAN
ARGUELLO FAN
MIOCENE
Base after P. B. King and H. M. Beikman, 1974
Conic Projection

Post-glacial evaporation of these lakes resulted in the complete disappearance of some and the reduction of others to much smaller, more saline lakes.

COLUMBIA PLATEAU AND SNAKE RIVER PLAIN

North of the Basin and Range province east of the Cascade Mountains, nonmarine Neogene rocks accumulated in the Columbia Plateau and Snake River Plain province. An early Neogene landscape of rolling volcanic hills drained westward through the ancestral Columbia River system. During middle Miocene the rolling topography was quickly buried by basalt flows of the Columbia River Basalt Group (Waters, 1961) which flowed from fissures and covered much of central Washington and Oregon (Thayer, 1957; Taubeneck, 1970). Coeval lavas of the Steens Basalts covered the Snake River Plain in southeastern Oregon and southern Idaho (Walker, 1970). Younger silicic volcanics of the Snake River Plain group erupted across southern Oregon, northern Nevada and southern Idaho. The Snake River Plain silicic volcanics show a progressive age decrease from west to east; Suppe, Powell, and Berry (1975) suggest this eruption pattern may represent a hot spot track or a propagating crustal crack. The present locus of the "hot spot" is Yellowstone National Park.

The Miocene climate of the Columbia Plateau and Snake River Plain was considerably more moist than that of the region today (Axelrod, 1968). Consequently, the processes of weathering, erosion, and deposition rapidly transformed the barren lava covered landscape into an environment with a rich soil, abundant vegetation, lakes and streams. The lakes and streams occupied structural lows formed by late Miocene-Pliocene plateau subsidence and crustal folding. As the rivers eroded headward the upstream lakes were drained. Subsequent lava flows poured into these river canyons resulted in a complex pattern of plateau lavas, fluvial and lacustrine sediments, and intercanyon lavas (see Swanson, this volume). In cases where the intercanyon lavas only partially filled the canyons the rivers reincised themselves through the intercanyon flows.

During the Pliocene lavas continued to flow across portions of the Columbia Plateau and Snake River Plain with decreasing volume and geographic extent. Uplift of the Cascade Mountains brought increasing amounts of detrital sediment into the western part of the province.

Pleistocene modification of the lava plains of eastern Oregon and Washington and southern Idaho include large expanses of lakes, continued incision and widening of river valleys, and glaciation.

SIERRA NEVADA

The high mountains of eastern California, known as the Sierra Nevada, consisting of Mesozoic plutons and Paleozoic and Mesozoic metamorphic rocks separate the structural lows of the Basin and Range province to the east and the Great Valley to the west. Northward the Sierra Nevada is off-set to the west in the Klamath Mountains (Davis, 1966; Irwin, 1966). The Cenozoic volcanics of the Cascade Mountains overlap the edges of both the northern Sierra Nevada and the eastern Klamath Mountains and extend northward into Oregon and Washington. The southern end of the Sierra Nevada is truncated by the Garlock Fault system. During the Miocene and early Pliocene, the Sierra Nevada was an area of low to moderate relief. Rivers drained westward into a marine basin now occupied by the Great Valley of California (Axelrod, 1956).

Neogene volcanic activity in the Sierra Nevada was progressively terminated in a south to north direction. Middle Miocene volcanic activity extended from south of the Garlock Fault northward throughout the province. By the late Miocene volcanic activity extended northward from a position north of the Garlock Fault. In the early Pliocene, the southern terminus of Sierra Nevada volcanism was on the latitude of San Francisco Bay. The present volcanic activity is limited to areas north of about 40° latitude (Snyder and others, 1976). Atwater (1970) attributed this pattern of volcanism to passage of plate boundaries (see Dickinson, this volume).

The uplift of the Sierra Nevada to the present elevation of over 14,000 feet probably began during Pliocene time (Christensen, 1966). The tilting of the range was progressive with about one-third of the present tilt developed between 9.5 and 18 m.y. ago and the latter two-thirds taking place in the last 9.5 m.y. (Noble and Slemmons, 1975). Based on floral data, the Sierra Nevada was a broad ridge with elevations of about 3000 feet during Miocene and early Pliocene time (Axelrod, 1956). By late Pliocene time the range stood at approximately its present elevation (Christensen, 1966).

CASCADE MOUNTAINS

The Cascade Mountains continue the topographic high of the Sierra Nevada northward to the Coast Mountains of British Columbia. The Cascade Mountains are a Cenozoic magmatic arc with a very complex history (see Hammond, this volume). The interbedded marine and non-marine rocks of the Paleogene ancestral Cascade Mountains were folded and faulted during intrusion of early to middle Miocene plutons associated with coeval volcanism. The ancestral Columbia River maintained its course through the mountain chain during this deformation.

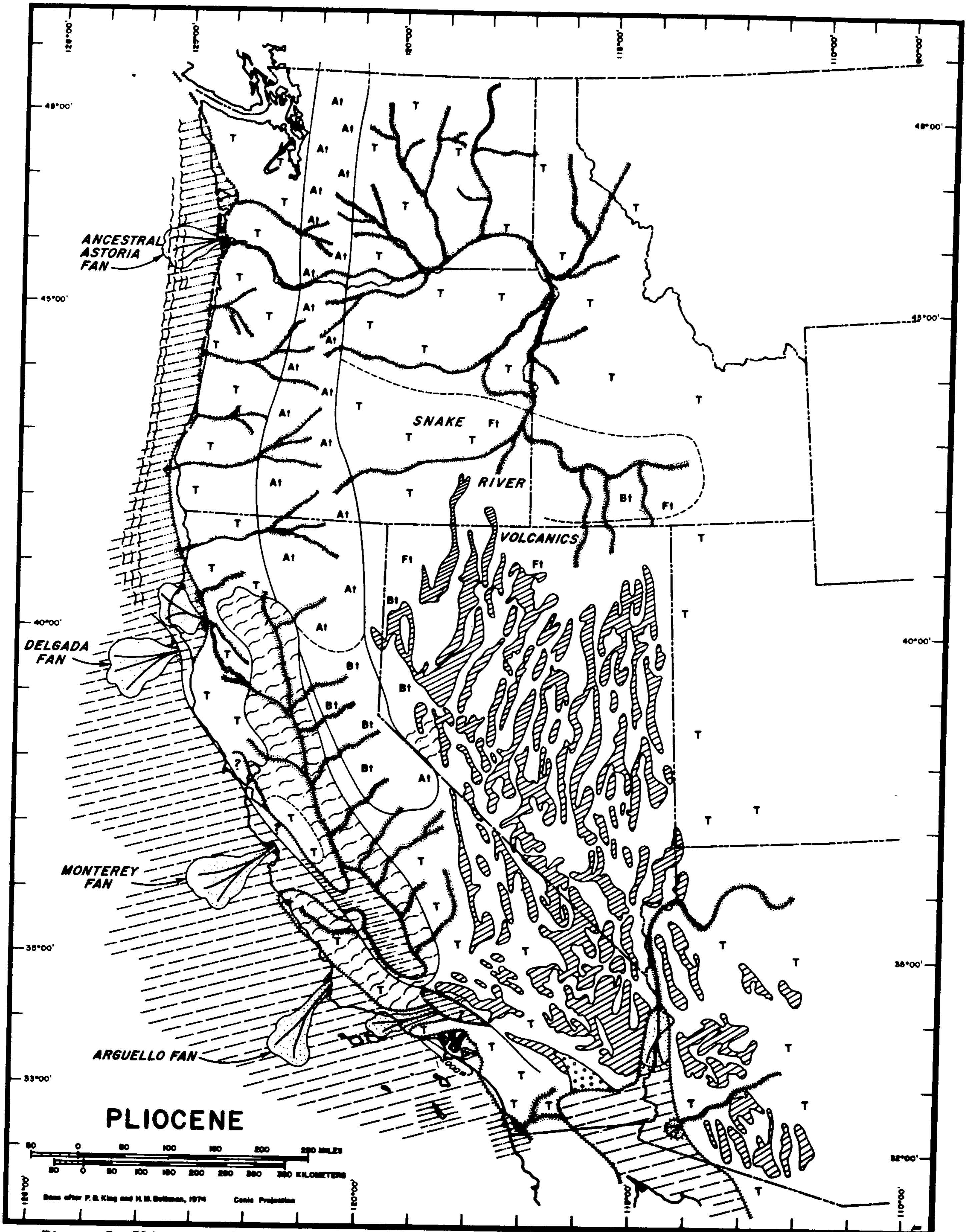


Figure 3. Pliocene paleogeographic map of the western United States. See Figure 2 for symbols.

Middle Miocene Columbia River Basalts flowed from the eastern Columbia Plateau westward through the ancestral Columbia River drainage system and into the Puget-Willamette Lowland province. Along the eastern margin of the Willamette Lowland and in the western foothills of the Oregon Cascade Mountains the Columbia River Basalt flows mingled with locally extruded lavas of similar composition (Peck and others, 1964; Snavely and others, 1973).

During the late Miocene and Pliocene Cascade Mountain volcanism continued in response to subduction to the west.

Pleistocene events within the Cascade Mountain province include continued uplift and erosion, formation of the High Cascade stratovolcanoes, and alpine glaciation.

PUGET-WILLAMETTE LOWLAND

West of the magmatic arc of the Cascade Mountains is the Puget-Willamette Lowland province. This topographic low is a structural downwarp between the Cascade Mountains and Coast Range uplifts and extends northward into the Frasier Lowlands of British Columbia. The Puget-Willamette Lowland is topographically analogous to the Great Valley of California although the two lowlands are separated by the Klamath Mountains and have different geologic histories. Outcrops in the Puget-Willamette Lowland province are limited to local uplifts with numerous cross folds (Baldwin, 1947; Snavely and others, 1958; Volkes and others, 1951).

Early Neogene deposits of the Puget-Willamette Lowlands consist of interbedded marginal marine to non-marine volcaniclastic rocks derived from the Cascade Mountains. Locally, middle Miocene basalts were extruded along the eastern flank of the Willamette River Valley (Snavely and Wagner, 1963; Peck, 1964). Basalts of the Columbia River Group flowed westward from the Columbia River Gorge into northwest Oregon and southwest Washington where they were interbedded with shallow water marine sediments and locally derived basalts (Snavely and others, 1973).

Today, the Puget-Willamette Lowland is carpeted with Pleistocene fluvial, lacustrine, and alluvial sediments, some of which are glacially derived (Easterbrook, this volume).

GREAT VALLEY

The Great Valley, a structural depression between the Sierra Nevada and the Coast Ranges of California, terminates to the north against the Klamath Mountains, and to the south against the Transverse Ranges.

Marine and continental sedimentation occurred in the Great Valley province throughout the Miocene and Pliocene (Addicott, 1968; Huffman, 1972). During the early Miocene the Great Valley province had water depths greater than 6000 feet (2000 meters) with the deepest portion in the southwest corner of the basin adjacent to the San Andreas Fault. Sedimentation rapidly filled the basin to bathyal depths in the middle Miocene and neritic depths in late Miocene and Pliocene (Bandy and Arnal, 1969). Turbidite sedimentation predominated in the center portion of the basin with contemporaneous fluvial and shallow marine deposition to the north, east, and south (Hackel, 1966). The basin extended west across the San Andreas Fault system with a deep water connection to the ocean. Continental sedimentation progressively filled the basin southward and by the Pliocene only a small portion of the basin was still receiving marine sediments. The basin was essentially filled by the end of the Pliocene.

Pleistocene deformation associated with the San Andreas Fault system has uplifted much of the western Great Vally and unroofed some of the Cretaceous outer arc basin sediments of the Franciscan terrain (Hamilton, 1978).

COAST RANGES AND CONTINENTAL SHELVES

The Coast Ranges and continental shelves of western North America consist of accreted marine shelf and slope sediments, intercalated volcanics, and deep sea sediments. The tectonic style of the margin can be used to subdivide the province into three distinct sub-provinces. The subprovinces of the Coast Ranges and continental shelves are 1) the extensional-compressional system of the California Borderlands; 2) the vertically dynamic right lateral strike-slip San Andreas fault system of the California Coast Ranges and continental shelf; and 3) the east-west compressive system of the Oregon and Washington Coast Ranges and shelf.

CALIFORNIA BORDERLANDS

The California Borderlands is the area south and west of the Transverse Ranges of southern California. The Los Angeles and Ventura Basins and numerous offshore basins extending to the shelf-slope break are included in this subprovince.

Prior to the middle Miocene, western California was an area of broad marine onlap with locally prograding non-marine clastic wedges. Tectonic reordering of western North America in the middle Miocene resulted in a general recession of marine waters. Southwest of the Transverse Ranges numerous local structurally controlled deep basins formed adjacent to fault bounded uplifts. Rapid subsidence of these basins is indicated by middle Miocene bathyal and abyssal deposits overlying early Miocene inner neritic and non-marine deposits. Sediments poured in from the structural highs rapidly filling the eastern basins and spilling over to successively more westward basins (Yerkes and others, 1965; Campbell and Yerkes, 1976).

The tectonic reordering of the California Borderlands has been related to changes in plate interactions (Atwater, 1970; Dickinson, this volume). The style of Borderlands deformation indicates a dominantly extensional stress field associated with basaltic extrusion, uplift of the Transverse Ranges, major left lateral and right lateral slip along faults, and crustal extension giving rise to deep Neogene basins in the Los Angeles, Ventura, and offshore Borderland areas.

Subsequent Pliocene-Pleistocene north-south or northeast-southwest compression has resulted in north-over-south reverse oblique left-lateral faulting at the southern boundary of the Transverse Ranges (Campbell and Yerkes, 1976). The compressional stress system continued into the Pleistocene as evidenced by the warping of the uplifted Pleistocene marine terraces.

CALIFORNIA COAST RANGES AND CONTINENTAL SHELF

North of the Transverse Ranges and the California Borderlands are the Coast Ranges and continental shelf of California. This geologic province is flanked on the east by the Great Valley; to the north, the California Coast Ranges abut the Klamath Mountains.

Neogene and Paleogene rocks of the California Coast Range are superimposed upon two markedly different basement complexes (Hamilton, 1978). West of the San Andreas Fault and north of the Transverse Ranges the basement complex is a granitic-metamorphic terrain referred to as the Salinian Block. East of the San Andreas Fault the Salinian Block may extend as far north as the Mendocino Fracture Zone. East of the San Andreas Fault the basement is a complex terrain of metasedimentary, sedimentary and ophiolitic rocks in places deformed into a melange. This is the Franciscan terrain. Depositional and tectonic models suggest that the Franciscan terrain represents accreted crust and the Slainian Block represents a continental slice transformed northwestward along the San Andreas Fault system (see Dickinson, this volume).

The pre-middle Miocene paleogeography of the California Coast Ranges and continental shelf was dominated by broad marine embayments. Beginning in the middle Miocene the impingement of the East Pacific Rise initiated uplift of the area. The collision of the Rise with the North American continent progressively shifted from a convergence margin to a strike-slip transform margin (Atwater, 1970; Dickinson, this volume). By the late Miocene the region had subsided and was agin characterized by marine onlap. In the late Miocene and continuing through the Pliocene and Plesistocene, the Coast Range and continental shelf province was again uplifted. Structural basins were filled from the east shifting depocenters further and further west.

Cenozoic shelf sedimentation occurred in structurally controlled basins. Neogene and Quaternary submarine canyons cutting the shelf have allowed by-passing of sediments into deep marine base-of-slope fans (Clark and Greene, this volume).

The strike-slip and vertically active tectonic style of the California Coast Ranges and continental shelf continues today. Pleistocene events are recorded principally by a series of uplifted marine terraces offset by left-lateral faults.

OREGON-WASHINGTON COAST RANGES AND CONTINENTAL SHELF

The Oregon-Washington Coast Ranges extend from the Klamath Mountains on the south northward to Vancouver Island, and are bounded on the east by the structural downwarp of the Puget-Willamette Lowland.

The Cenozoic sedimentation pattern of the Oregon-Washington Coast Ranges was dominated by accretion of marine sediments and intercalated volcanics (Snavely and Wagner, 1963; Snavely and others, 1977). Recent paleomagnetic studies suggest that some of the Paleogene volcanics are accreted "mini plates" (Simpson and Cox, 1978; M.E. Beck, 1979, personal communication; Ray Wells, 1979, personal communication). By the Neogene the "mini plates" had been accreted and the Coast Ranges were being uplifted. Shallow marine embayments penetrated the uplifted Coast Range during the early Miocene at Cape Blanco, Coos Bay and Newport, Oregon, along the mouth of the modern Columbia River, and in the Grays Harbor and Straits of Juan de Fuca areas, Washington.

Although the compressive tectonics system related to sea floor spreading and subduction persisted throughout the Cenozoic in Oregon and Washington, middle Miocene changes in rates and vectors caused major changes in paleogeography (Atwater, 1970; Dickinson, this volume). Uplift of the Coast Ranges became more pronounced. Marine embayments became more restricted and were rapidly filled by prograding non-marine clastic wedges. The early middle Miocene ancestral Columbia River delta and submarine fan were displaced northward as the north plunging end of the Oregon Coast Range anticlinorium shifted northward (Niem, 1973; Niem, 1979, personal communication). Local vents extruded middle Miocene basalts coeval with and geochemically similar to basalts of the Columbia River Basalt Group (Snavely and others, 1973). In the area of the present lower gorge of the Columbia River basalt flows coming from the Columbia Plateau are interbedded with non-marine and inner neritic sediments (Snavely and others, 1973).

A single subaerial Columbia River Basalt flow extended northward from the Columbia River into central southwestern Washington where it entered the ocean and continued westward as a submarine flow (Pease and Hoover, 1957; Snavely and others, 1958; Gower and Pease, 1965; Wagner, 1967).

The Coast Range of southwest Washington was uplifted during the late Miocene into Paleocene cored faulted anticlinal "hills." These "hills" separated shallow marine embayments filling from the east with non-marine clastic wedges.

The Olympic Mountains, at the northern end of the Coast Range, are a unique subprovience of the Coast Ranges of Oregon and Washington. Principally a late middle Miocene uplift, the Olympic Mountains formed by major underthrusting of shelf and slope sediments accreted as a consequence of sea floor spreading from the Juan de Fuca Rise (Rau, 1973). The Neogene terrain along the western flank of the Olympic Mountains includes allochthomous blocks of both deep marine Neogene rocks and much older rocks. Piercement structures are common along the coast and on the continental shelf west of the Olympic Mountains (Rau, 1973; Snavely and others, 1977).

Superimposed upon the Oregon-Washington continental shelf are late Miocene, Pliocene and Pleistocene structurally controlled depocenters filled with clastic detritus eroded from the uplifted Coast Ranges (Braislin and others, 1971). Late Neogene continental shelf sediments are predominantly siltstone and claystone (Snavely and others, 1977).

Pleistocene modification of the Coast Ranges and continental shelf of Oregon and Washington is principally uplift and emergence as recorded in sequences of uplifted marine terraces. Glaciation within the Coast Range province was restricted to the Olympic Mountains.

SUMMARY

The Neogene paleogeography of the western United States can be summarized as three principle phases:

1) An early Miocene continuation of the Paleogene paleogeographic pattern. (see Nilsen & McKee, this volume)

2) A middle Miocene tectonic transformation with folding and faulting causing the fragmentation of broader Paleogene and early Neogene paleogeographic patterns.

3) A late Miocene to Recent deformation uplifting mountain ranges and the westward migration of marine depocenters.

The two maps presented in this report are preliminary and present a limited overview on the Neogene paleogeography of the western United States. Future work should include the preparation of maps for time slices representing the early, middle and late Miocene, the Pliocene, and the Pleistocene. Map types should include the distribution of depositional packages of surface accumulated rocks, distribution of faunal and floral provinces, climatic data, and topography and bathymetry.

BIBLIOGRAPHY

California

Addicott, W. O., 1966, New Tertiary marine mollusks from Oregon and Washington: Journal of Paleontology, v. 40, no. 3, p. 635-646, 3 pls.

_____1967, Zoogeographic evidence for late Tertiary lateral slip on the San Andreas fault, California: U.S. Geological Survey Professional Paper 593-D, p. D1-D12.

_____1968, Mid-Tertiary zoogeographic and paleogeographic discontinuities across the San Andreas fault, California, in Dickinson, W. R., and Grantz, Arthur, eds., Proceedings of conference on geologic problems of San Andreas fault system: Stanford University Publications in Geological Sciences, v. 11, p. 144-165.

_____1970, Latitudinal gradients in Tertiary molluscan faunas of the Pacific Coast: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 8, no. 4, p. 287-312.

_____1972, Provincial middle and late Tertiary molluscan stages, Temblor Range, California, in Proceedings of the Pacific Coast Miocene Biostratigraphic Symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, Bakersfield, Calif., March 9-10, 1972, p. 1-26, pls. 1-4.

_____1973, Giant Neogene Pectinids of Eastern North Pacific--Chronostratigraphic and zoogeographic significance: American Association of Petroleum Geologists Bulletin, v. 57, no. 4, p. 766.

Almgren, A. A., and Schlax, W. N., 1957, Post-Eocene age of "Markley Gorge" fill, Sacramento Valley, California: American Association of Petroleum Geologists Bulletin, v. 41, p. 326-330.

Anderson, Robert, and Pack, R. W., 1915, Geology and oil resources of the west border of the San Joaquin Valley north of Coalinga, California: U.S. Geological Survey Bulletin 603, 220 p.

Andrews, Phillip, 1936, Geology of the Pinnacles National Monument: University of California Publications, Department of Geological Sciences Bulletin, v. 24, p. 1-37.

Armstrong, R. E., and Higgins, R. E., 1973, K-Ar dating of the beginning of Tertiary volcanism in the Mojave Desert, California: Geological Society of America Bulletin, v. 84, p. 1095-1100.

Arnal, R. E., 1976, Miocene paleobathymetric changes of the Santa Rosa-Cortes Ridge area, California continental borderland, in Howell, D. G., ed., Aspects of the geologic history of the California continental borderland: American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24, p. 60-79.

Arnal, R. E., and Vedder, J. G., 1976, Late Miocene paleobathymetry of the California continental borderland north of 32°, in Fritsche, A. E., TerBest, Harry, and Wornardt, W. W., eds., The Neogene Symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 1-8.

Atwater, T. M., 1970, Implications of plate tectonics for the Cenozoic tectonic evolution of North America: Geological Society of America Bulletin, v. 81, p. 3513-3536.

Axelrod, 1957, Late Tertiary floras and the Sierra Nevada uplift (California-Nevada): Geological Society of America Bulletin, v. 68, p. 19-45.

_____1962, Post-Pliocene uplift of the Sierra Nevada, California: Geological Society of America Bulletin, v. 73, p. 183-198.

Babcock, E. A., 1974, Geology of the northeast margin of the Salton trough, Salton Sea, California: Geological Society of America Bulletin, v. 85, p. 321-332.

Bailey, E. H., 1966, Geology of northern California: California Division of Mines and Geology Bulletin 190, 508 p.

Bailey, T. L., and Jahns, R. H., 1954, Geology of the Transverse Range province, southern California: California Division of Mines Bulletin 170, chap. 6, p. 83-106.

Bandy, O. L., 1972, Late Paleogene-Neogene planktonic biostratigraphy and some geologic implications, California, in Proceedings of the Pacific Coast Miocene Biostratigraphic Symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, Bakersfield, Calif., March 9-10, 1972, p. 37-51.

Bandy, O. L., and Arnal, R. E., 1969, Middle Tertiary basin development, San Joaquin Valley, California: Geological Society of America Bulletin, v. 80, p. 783-819.

Bandy, O. L., and Ingle, J. C., Jr., 1970, Neogene planktonic events and radiometric scale, California, in Bandy, O. L., ed., Radiometric dating and paleontologic zonation: Geological Society of America Special Paper 124, p. 131-172.

Bandy, O. L., and Wilcoxon, J. A., 1969, Correlation of marine middle Tertiary stages of California with tropical planktonic zones: American Association of Petroleum Geologists Bulletin, v. 53, p. 467-468.

Bartow, J. A., 1966, Deep submarine channel in upper Miocene, Orange County, California: Journal of Sedimentary Petrology, v. 36, p. 700-705.

_____1973a, The Doheny Channel - A Miocene deep-sea fan-valley deposit, Dana Point, California, in Miocene sedimentary environments and biofacies, southeastern Los Angeles Basin, SEPM Field Trip No. 1: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, 1973 Annual Meeting.

_____1973b, Early Miocene marine facies in the southeastern Caliente Range, California, in Fischer, Peter, ed., Sedimentary facies changes in Tertiary rocks - California Transverse and southern Coast Ranges: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, 1973 Annual Meeting, p. 57-60.

Bassett, A. M., and Kupfer, D. H., 1964, A geologic reconnaissance in the southeastern Mojave Desert, California: California Division of Mines and Geology Special Report 83, 43 p.

Bateman, P. C., and Wahrhaftig, Clyde, 1966, Geology of the Sierra Nevada, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 107-172.

Berggren, W. A., and Van Couvering, J. A., 1974, The late Neogene: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 16, no. 1 and 2, 216 p.

Biddle, K. T., Maher, J. C., and Carter, R. D., 1975, Channel turbidite sandstones in the Elk Hills Shale Member of the Monterey Shale, in Maher, J. C., and others, Petroleum geology of Naval Petroleum Reserve No. 1, Elk Hills, Kern County, California: U.S. Geological Survey Professional Paper 912, p. 79-85.

Blake, M. C., Campbell, R. H., Dibblee, T. W., Howell, D. G., Nilsen, T. H., Normark, W. R., Vedder, J. G., and Silver, E. A., 1978, Neogene basin formation in relation to plate-tectonic evolution of San Andreas fault system, California: American Association of Petroleum Geologists Bulletin, v. 62, p. 344-372.

Bohannon, R. G., 1975, Mid-Tertiary conglomerates and their bearing on Transverse Range tectonics, southern California, in Crowell, J. C., ed., San Andreas fault in southern California: California Division of Mines and Geology Special Report 118, p. 75-82.

_____1976, Mid-Tertiary nonmarine rocks along the San Andreas Fault in southern California: University of California, Santa Barbara, Ph.D. thesis, 311 p.

Brabb, E. E., and Pampeyan, E. H., 1972, Preliminary geologic map of San Mateo County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-328.

Campbell, R. H., and Yerkes, R. F., 1976, Cenozoic evolution of the Los Angeles basin area - relation to plate tectonics, in Howell, D. G., ed., Aspects of the geologic history of the California continental borderland: American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24, p. 541-558.

Canter, N. W., 1974, Paleogeology and paleogeography of the Big Mountain area, Santa Susana, Moorpark, and Simi quadrangles, Ventura County, California: Ohio University, Athens, M.S. thesis, 58 p.

Carman, M. F., Jr., 1964, Geology of the Lockwood Valley area, Kern and Ventura Counties, California: California Division of Mines Special Report 81, 62 p.

Christensen, M. N., 1965, Late Cenozoic deformation in the central Coast Ranges of California: Geological Society of America Bulletin, v. 76, p. 1105-1124.

_____1966, Late Cenozoic crustal movements in the Sierra Nevada of California: Geological Society of America Bulletin, v. 77, p. 162-181.

Christiansen, R. L., and Lipman, P. W., 1972, Cenozoic volcanism and plate-tectonic evolution of the western United States. II, Late Cenozoic: Royal Society of London Philosophical Transactions, ser. A, v. 271, p. 249-284.

Clark, S. G., 1940, Geology of the Covelo district, Mendocino County, California: University of California Publications, Department of Geological Sciences Bulletin, v. 25, p. 119-142.

Clifton, H. E., 1967, Paleogeographic significance of two middle Miocene basalt flows, southeastern Caliente Range, California, in Geological Survey research 1967: U.S. Geological Survey Professional Paper 575-B, p. B32-B39.

_____1968, Possible influence of the San Andreas fault on middle and probable late Miocene sedimentation, southeastern Caliente Range, in Dickinson, W. R., and Grantz, Arthur, eds., Proceedings of conference on geologic problems of San Andreas fault system: Stanford University Publications in Geological Science, v. 11, p. 183-190.

_____1973, Marine-nonmarine facies change in middle Miocene rocks, southeastern Caliente Range, California, in Fischer, Peter, ed., Sedimentary facies changes in the Tertiary rocks - California Transverse and southern Coast Ranges: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, 1973 Annual Meeting, p. 55-57.

Colburn, I. P., 1961, The tectonic history of Mt. Diablo, California: Stanford University, Stanford, Calif., Ph.D. thesis, 276 p.

Conrey, B. L., 1967, Early Pliocene sedimentary history of the Los Angeles basin, California: California Division of Mines and Geology Special Report 93, 63 p.

Corey, W. H., 1954, Tertiary basins of southern California, in Jahns, R. H., ed., Geology of southern California: California Division of Mines Bulletin 170, chap. 3, p. 73-83.

Crowe, B. M., 1975, Regional volcanic stratigraphy of southeastern California: Geological Society of America Abstracts with Programs, v. 7, p. 308.

_____1978, Cenozoic volcanic geology and probable age of inception of Basin-Range faulting in the southeastern most Chocolate Mountains, California: Geological Society of America Bulletin, v. 89, p. 251-264.

Crowell, J.C., 1954, Strike-slip displacement of the San Andreas fault, southern California: California Division of Mines Bulletin 170, chap. 4, p. 49-52.

_____1962, Displacement along the San Andreas fault, California: Geological Society of America Special Paper 71, 61 p.

_____1968, Movement histories of faults in the Transverse Ranges and speculations on the tectonic history of California, in Dickinson, W. R., and Grantz, Arthur, eds., Proceedings of conference on geologic problems of San Andreas fault system: Stanford University Publications in Geological Science, v. 11, p. 323-341.

_____1973, Ridge Basin southern California, in Fischer, Peter, ed., Sedimentary facies changes in Tertiary rocks - California Transverse and southern Coast Ranges: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, 1973 Annual Meeting, p. 1-7.

_____1974a, Origin of late Cenozoic basins in southern California: Society of Economic Paleontologists and Mineralogists Special Publication 22, p. 190-204.

_____1974b, Sedimentation along the San Andreas fault, California: Society of Economic Paleontologists and Mineralogists Special Publication 19, p. 292-303.

_____1975a, Geologic sketch of the Orocopia Mountains, southeastern California, in Crowell, J. C., ed., San Andreas fault in southern California: California Division of Mines and Geology Special Report 118, p. 99-110.

_____1975b, The San Andreas fault between Carrizo Plains and Tejon Pass, southern California, in Crowell, J. C., ed., San Andreas fault in southern California: California Division of Mines and Geology Special Paper 118, p. 223-233.

_____1975c, The San Gabriel fault and Ridge basin, southern California, in Crowell, J. C., ed., San Andreas fault in southern California: California Division of Mines and Geology Special Report 118, p. 208-219.

Cummings, J. C., 1968, The Santa Clara Formation and possible post-Pliocene slip on the San Andreas fault in central California, in Dickinson, W. R., and Grantz, Arthur, eds., Proceedings of conference on geologic problems of San Andreas fault system: Stanford University Publications in Geological Sciences, v. 11, p. 191-207.

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.

Dalrymple, G. B., 1964, Cenozoic chronology of the Sierra Nevada, California: University of California Publications in Geological Science, v. 47, 41 p.

Davis, G. A., and Burchfiel, B. C., 1973, Garlock fault: an intracontinental transform structure, southern California: Geological Society of America Bulletin, v. 84, p. 1407-1422.

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 Bulletin 150, 95 p.

_____1952, Geology of the Saltdale quadrangle, California: California Division of Mines Bulletin 160, p. 7-43.

_____1961, Geologic structure of the San Emigdio Mountains, Kern County, California, in Geology and paleontology of the southern border of the San Joaquin Valley, Kern County, California, 1961 Spring Field Trip Guidebook: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 2-6.

_____1966a, Geology of the central Santa Ynez Mountains, Santa Barbara County, California: California Division of Mines and Geology Bulletin 186, 99 p.

_____1966b, Evidence for cumulative offset on the San Andreas fault in central and northern California, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 375-384.
_____1966c, Geologic map of the Palo Alto 15-minute quadrangle, California: California Division of Mines and Geology Map Sheet 8, scale 1:62,500.
_____1967, Areal geology of the western Mojave Desert: U.S. Geological Survey Professional Paper 522, 153 p.
_____1968, Geology of the Fremont Peak and Opal Mountain quadrangle, California: California Division of Mines and Geology Bulletin 188, 64 p.
_____1972a, Rinconada fault in southern Coast Ranges, California and its significance [abs.]: American Association of Petroleum Geologists Bulletin, v. 57, p. 432.
_____1972b, Geologic map of the San Benito quadrangle, California: U.S. Geological Survey Open-File Map, scale 1:62,500.
_____1973a, Preliminary geologic map of the Mt. Madonna quadrangle, Santa Clara and Santa Cruz Counties, California: U.S. Geological Survey Open-File Map, scale 1:24,000.
_____1973b, Preliminary geologic maps of the Gilroy, Gilroy Hot Springs, Mt. Sizer, and Morgan Hill quadrangles, Santa Clara County, California: U.S. Geological Survey Open-File Map, scale 1:24,000.
_____1973c, Stratigraphy of the southern Coast Ranges near the San Andreas fault from Cholame to Maricopa, California: U.S. Geological Survey Professional Paper 764, 45 p.
_____1973d, Geologic maps of the Gonzales and Hollister quadrangles, California: U.S. Geological Survey Open-File Map, scale 1:62,500.
_____1973e, Regional geologic map of San Andreas and related faults in Carrizo Plain, Temblor, Caliente, and La Panza Ranges and vicinity: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-757, scale 1:125,000.
_____1975, Tectonics of the western Mojave Desert near the San Andreas fault, in Crowell, J. C., ed., San Andreas fault in southern California: California Division of Mines and Geology Special Report 118, p. 155-161.
_____1976, The Rinconada and related faults in the southern Coast Ranges, California, and their tectonic significance: U.S. Geological Survey Professional Paper 981, 55 p.
Dickinson, W. R., 1969, Geologic problems in the mountains between Ventura and Cuyama, in Dickinson, W. R., chm., Geologic setting of upper Miocene gypsum and phosphorite deposits, upper Sespe Creek and Pine Mountain, Ventura County, California: Society of Economic Paleontologists and Mineralogists, Pacific Section, Field Trip Guidebook, p. 1-23.
_____1976, Sedimentary basins developed during evolution of Mesozoic-Cenozoic arc-trench system in western North America: Canadian Journal of Earth Sciences, v. 13, p. 1268-1307.
_____1979, Cenozoic plate tectonic setting of the Cordilleran region in the United States, in Armentroug, J. M., Cole, M. R., and TerBest, Harry, eds., Cenozoic paleogeography of the Western United States: Society of Economic Paleontologists and Mineralogists, Pacific Section, Los Angeles, California, this volume.
Dickinson, W. R., and Grantz, Arthur, 1968, Indicated cumulative offsets along the San Andreas fault in the California Coast Ranges, in Dickinson, W. R., and Grantz, Arthur, eds., Proceedings of conference on geologic problems of the San Andreas fault system: Stanford University Publications in Geological Science, v. 11, p. 117-119.
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, p. 2464-2470.
Dodd, J. R., and Stanton, R. J., 1975, Paleosalinities within a Pliocene bay, Kettleman Hills, California--a study of the resolving power of isotopic and faunal techniques: Geological Society of America Bulletin, v. 86, p. 51-64.
Dreyer, F. E., 1935, The geology of a portion of Mount Pinos quadrangle, Ventura County, California: University of California, Los Angeles, M.A. thesis, 42 p.
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, p. Q1-Q41.
_____1964, Geology of the Cosio Knob and Espinosa Canyon quadrangles, Monterey County, California: U.S. Geological Survey Bulletin 1161-H, p. H1-H29.
_____1965a, Evidence of large strike-slip displacement along a fault in the southern Salinas Valley, California: U.S. Geological Survey Professional Paper 525-D, p. 106-111.
_____1965b, Geology of the Jolon and Williams Hill quadrangles, Monterey County, California: U.S. Geological Survey Bulletin 1181-Q, p. Q1-Q27.
_____1968, Geologic map of the Adelaida quadrangle, San Luis Obispo County, California: U.S. Geological Survey Geologic Quadrangle Map GQ-768, scale 1:24,000.
_____1974, Geology of the southern Salinas Valley area, California: U.S. Geological Survey Professional Paper 819, 111 p.
Durham, D. L., and Addicott, W. O., 1964, Upper Miocene and Pliocene marine stratigraphy in southern Salinas Valley, California: U.S. Geological Survey Bulletin 1194-E, p. E1-E7.
_____1965, Pancho Rico Formation, Salinas Valley, California: U.S. Geological Survey Professional Paper 524-A, 22 p.
Durham, D. L., Jahns, R. H., and Savage, D. E., 1954, Marine-nonmarine relationships in the Cenozoic section of California: California Division of Mines Bulletin 170, chap. 3, p. 59-71.
Durham, D. L., and Yerkes, R. F., 1964, Geology of oil resources of the eastern Puente Hills, southern California: U.S. Geological Survey Professional Paper 420B, p. B1-B62.
Durrell, Cordell, 1966, Tertiary and Quaternary geology of the northern Sierra Nevada, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 185-197.
Eaton, J. E., Grant, U. S., IV, and Allen, H. B., 1941, Miocene of Caliente Range and environs, California: American Association of Petroleum Geologists Bulletin, v. 25, p. 193-262.

Edwards, L. N., 1971, Geology of the Vaqueros and Rincon Formations, Santa Barbara embayment, California: University of California, Santa Barbara, Ph.D. thesis, 240 p.

Ehlig, P. L., and Ehlert, K. W., 1975, Offset of the upper Miocene Caliente and Mint Canyon Formations along the San Gabriel and San Andreas fault in southern California, in Crowell, J. C., ed., San Andreas fault in southern California: California Division of Mines and Geology Special Report 118, p. 83-92.

Engel, Rene, 1959, Geology of the Lake Elsinore quadrangle, California: California Division of Mines Bulletin 146, p. 9-58.

Enos, Paul, 1965, Geology of the western Vallecitos syncline, San Benito County, California: California Division of Mines and Geology Map Sheet 5, scale 1:24,000.

Eschner, Stan, 1969, Geology of the central part of the Filmore quadrangle, Ventura County, California: American Association of Petroleum Geologists, Pacific Section, Field Trip Guidebook, 1969, 47 p.

Evernden, J. F., Savage, D. E., Curtis, G. H., and James, G. T., 1964, Potassium-argon dates and the Cenozoic mammalian chronology of North America: American Journal of Science, v. 262, p. 145-198.

Fischer, P. J., 1976, Late Neogene-Quaternary tectonics and depositional environments of the Santa Barbara basin, California, in Fritsche, A. E., TerBest, Harry, Jr., and Wornardt, W. W., eds., The Neogene symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 33-52.

Flynn, C. J., 1970, Post-batholithic geology of the La Gloria-Presa Rodriguez area, Baja California, Mexico: Geological Society of America Bulletin, v. 81, p. 1789-1806.

Frames, D. W., 1955, Stratigraphy and structure of the lower Coyote Creek area, Santa Clara County, California: University of California, Berkeley, M.S. thesis, 65 p.

Fritsche, A. E., 1969, Miocene geology of the central Sierra Madre Mountains, Santa Barbara County, California: University of California, Los Angeles, Ph.D. thesis, 385 p.

_____1975, Middle Tertiary correlations southwest of the San Andreas fault, northern Santa Barbara and Ventura Counties, California: Geological Society of America Abstracts with Programs, v. 7, p. 318-319.

Galehouse, J. S., 1967, Provenance and paleocurrents of the Paso Robles Formation, California: Geological Society of America Bulletin, v. 78, p. 951-978.

Galloway, A. J., 1962, Field Trip 3--Point Reyes Peninsula and San Andreas fault zone: California Division of Mines and Geology Bulletin 181, p. 391-398.

_____1966, Field Trip--Point Reyes Peninsula and San Andreas fault zone, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 429-440.

Gay, T. E., Jr., 1966, Economic mineral deposits of the Cascade Range, Modoc Plateau, and Great Basin region of northeastern California, in Bailey, E. H., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 97-104.

Gilbert, C. M., 1943, Tertiary sediments northeast of Morgan Hill, California: American Association of Petroleum Geologists Bulletin, v. 27, p. 640-646.

Graham, S. A., 1976a, Tertiary sedimentary tectonics of the central Salinian block of California: Stanford University, Stanford, Calif., Ph.D. thesis, 510 p.

_____1976b, Tertiary stratigraphy and depositional environments near Indians Ranch, Monterey County, California, in Fritsche, A. E., TerBest, Harry, Jr., and Wornardt, W. W., eds., The Neogene symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 125-136.

Graham, S. A., and Dickinson, W. R., 1976, San Gregorio fault as a major right-slip fault of the San Andreas fault system: Geological Society of America Abstracts with Programs, v. 8, p. 890.

Gray, C. H., Jr., 1961, Geology of the Corona South quadrangle and the Santa Ana Narrows area, Riverside, Orange, and San Bernardino Counties, California: California Division of Mines Bulletin 178, p. 7-58.

Greene, H. G., 1970, Geology of southern Monterey Bay and its relationship to the ground-water basin and salt-water intrusion: U.S. Geological Survey Open-File Report, 50 p.

Gribi, E. A., Jr., 1963, The Salinas basin oil province, in Payne, M. B., ed., Guidebook to the geology of Salinas Valley and the San Andreas fault: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Pacific Sections, Spring Field Trip Guidebook, p. 16-27.

Gross, D. J., 1958, Geology of the Ortega area, Ventura County, California: University of California, Los Angeles, M.A. thesis, 88 p.

Hackel, O., 1966, Summary of the geology of the Great Valley, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 217-238.

Hacker, R. N., 1950, The geology of the northwest corner of the Orestimba quadrangle and the northeast corner of the Mount Boardman quadrangle, California: University of California, Berkeley, M.A. thesis, 42 p.

Hagen, D. W., 1957, Geology of the Wheeler Springs area: University of California, Los Angeles, M.A. thesis, 114 p.

Hall, C. A., 1960, Displaced Miocene molluscan provinces along the San Andreas fault, California: University of California Publications in Geological Sciences, v. 34, p. 281-308.

_____1975, San Simeon-Hosgri fault system, coastal California: Economic and environmental implications: Science, v. 190, p. 1391-1294.

Hall, C. A., and Corbato, C. E., 1967, Stratigraphy and structure of Mesozoic and Cenozoic rocks, Nipomo quadrangle, southern Coast Ranges, California: Geological Society of America Bulletin, v. 78, p. 559-582.

Hall, C. A., Turner, D. L., and Surdham, R. D., 1966, Potassium-argon age of the Obispo Formation with Pecten lompocensis Arnold, southern Coast Ranges, California: Geological Society of America Bulletin, v. 77, p. 443-445.

Hamilton, Warren, 1978, Mesozoic tectonics of the Western United States, in Howell, D. G., and McDougall, K. A., eds., Mesozoic Paleogeography of the western United States, Pacific Coast Paleogeography Symposium 2: Los Angelès, Calif., Pacific Section Society of Economic Paleontologists and Mineralogists, p. 33-70.

Hamilton, Warren, and Myers, W. B., 1966, Cenozoic tectonics of the western United States: Reviews of Geophysics, v. 4, p. 509-549.

Hammond, P. E., 1958, Geology of the lower Santiago Creek area, San Emigdio Mountains, Kern County, California: University of California, Los Angeles, M.A. thesis, 108 p.

Haner, B. E., 1971, Morphology and sediments of Redondo submarine fan, southern California: Geological Society of America Bulletin, v. 82, p. 2413-2432.

Harding, T. P., 1976, Tectonic significance and hydrocarbon trapping consequences of sequential folding synchronous with San Andreas faulting, San Joaquin Valley, California: American Association of Petroleum Geologists Bulletin, v. 60, p. 356-378.

Harris, Herbert, 1950, Geology of the Palomas Canyon-Castaic Creek area, Los Angeles County, California: University of California, Los Angeles, M.A. thesis, 72 p.

Harris, P. B., 1950, Geology of the Tunis-Pastoria Creek area, Kern County, California: California Institute of Technology, Pasadena, M.S. thesis, 80 p.

Hawkins, J. W., 1970, Petrology and possible tectonic significance of late Cenozoic volcanic rocks, southern California and Baja California: Geological Society of America Bulletin, v. 81, p. 3323-3338.

Hay, E. A., 1976, Cenozoic uplifting of the Sierra Nevada in isostatic response to North America and Pacific plate interactions: Geology, v. 4, p. 763-766.

Hein, J. R., 1973, Deep-sea sediment source areas: implications of variable rates of movement between California and the Pacific plate: Nature, v. 241, p. 40-41.

Hertlein, L. G., and Grant, U. S., IV, 1944, The geology and paleontology of the marine Pliocene of San Diego, California, part 1, Geology: San Diego Society of Natural History, v. 2, 72 p.

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, p. 2973-3000.

Hill, M. L., and Dibblee, T. W., Jr., 1953, San Andreas, Garlock, and Big Pine faults - A study of the character, history, and significance of their displacement: Geological Society of America Bulletin, v. 64, p. 443-458.

Holwerda, J. G., 1952, Geology of the Valyermo area: University of Southern California, Los Angeles, M.S. thesis, 53 p.

Hoots, H. W., Bear, T. L., and Kleinpell, W. D., 1954, Geologic summary of the San Joaquin Valley, California: California Division of Mines Bulletin 170, chap. 2, p. 113-129.

Hoskins, E. G., and Griffiths, J. R., 1971, Hydrocarbon potential of northern and central California offshore: American Association of Petroleum Geologists Memoir 15, p. 212-228.

Howell, D. G., ed., 1976, Aspects of the geologic history of the California continental borderland: American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24, 561 p.

Howell, D. G., and McLean, Hugh, 1976, Middle Miocene paleogeography, Santa Cruz and Santa Rosa Islands, in Howell, D. G., ed., Aspects of the geologic history of the California continental borderland: American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24, p. 266-293.

Hsu, Kenneth, 1977, Studies of the Ventura field, California, I: Facies geometry and genesis of Lower Pliocene turbidites: American Association of Petroleum Geologists Bulletin, v. 61, p. 137-168.

Huffman, O. F., 1972, Upper Miocene geology, lateral displacement of upper Miocene rocks and history of fault slip along the San Andreas fault in central California: University of California, Berkeley, Ph.D. thesis, 137 p.

_____1972, Lateral displacement of upper Miocene rocks and the Neogene history of offset along the San Andreas fault in central California: Geological Society of America Bulletin, v. 83, p. 2913-2946.

_____1977, Lateral displacement of upper Miocene rocks along the San Andreas fault in central California: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, Pacific Sections, Guidebook, Late Miocene geology and new oil fields of the southern San Joaquin Valley, 88 p.

Huffman, O. F., Turner, O. L., and Jack, R. N., 1973, Offset of late Oligocene-early Miocene volcanic rocks along the San Andreas fault in central California, in Kovach, R. L., and Nur, Amos, eds., Proceedings of conference on tectonic problems of the San Andreas fault system: Stanford University Publications in Geological Sciences, v. 13, p. 368-373.

Ingle, J. C., Jr., 1969, Paleobathymetry and foraminiferal trend, Monterey and Santa Margarita Formations, upper Sespe Creek-Pine Mountain area, Ventura County, California, in Geologic setting of upper Miocene gypsum and phosphorite deposits, upper Sespe Creek and Pine Mountain, Ventura County, California: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 78-92.

_____1973a, Summary comments on Neogene biostratigraphy, physical stratigraphy, and paleo-oceanography in the marginal northeastern Pacific Ocean, in Kulm, L. D., Von Huene, R., and others, Initial Reports of the Deep Sea Drilling Project: Washington, D. C., U.S. Government Printing Office, v. 18, p. 949-960.

_____1973b, Pliocene-Miocene sedimentary environments and biofacies, southeastern Los Angeles basin-San Joaquin Hills area, Orange County, California, in Miocene sedimentary environments and biofacies, southeastern Los Angeles Basin: Society of Economic Paleontologists and Mineralogists, Annual Meeting Field Trip Guidebook No. 1, p. 1-6.

_____1976, Late Neogene paleobathymetry and paleoenvironments of the Humboldt basin, northern California, in Fritsche, A. E., Terbest, Harry, Jr., and Wornardt, W. W., eds., The Neogene symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 53-61.
Irwin, W. P., 1966, Geology of the Klamath Mountains province, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 19-38.
Jahns, R. H., 1954, Geology of southern California: California Division of Mines Bulletin 170.
James, G. T., 1963, Paleontology and nonmarine stratigraphy of the Cuyama Valley badlands, California: University of California Publications in Geological Sciences, v. 45, 154 p.
Johnson, J. D., and Normark, W. R., 1974, Neogene tectonic evolution of the Salinian block, west-central California: Geology, v. 2, p. 11-14.
Johnsons, B. K., 1952, Geology of the Castaic Creek-Elizabeth Lake Canyon area: University of California, Los Angeles, M.A. thesis, 44 p.
Kamerling, M. J., and Luyendyk, B. P., 1977, Tectonic rotation of the Santa Monica Mountains in southern California (Abs.): Eos, American Geophysical Union Transactions, v. 58, p. 1126.
Kamerling, M. J., Luyendyk, B. P., and Marshall, M., 1978, Paleomagnetism and tectonic rotation of parts of the Transverse Ranges [Abs.]: Eos, American Geophysical Union Transactions, v. 59, p. 1058.
Karig, D. E., and Jensky, W., 1972, The proto-Gulf of California: Earth and Planetary Science Letters, v. 17, p. 169-174.
Kilkenny, J. E., 1948, Geology and exploration for oil in Salinas Valley, California: American Association of Petroleum Geologists Bulletin, v. 32, p. 2254-2268.
King, P. B., and Beikman, H., 1974, Geologic map of the United States exclusive of Alaska and Hawaii: U.S. Geological Survey.
Kleinpell, R. M., 1938, Miocene stratigraphy of California: Tulsa, Okla., American Association of Petroleum Geologists, 450 p.
Kleist, J. R., 1974a, Implications of style of deformation in coastal belt, Franciscan complex [abs.]: Geological Society of America Abstracts with Programs, v. 6, p. 202.
_____1974b, Geology of the Coastal Belt, Franciscan Complex, near Fort Bragg, California: University of Texas, Austin, Ph.D. thesis, 133 p.
_____1974c, Deformation by soft-sediment extension in the Coastal Belt, Franciscan Complex: Geology, v. 2, p. 501-504.
Lamar, D. L., 1961, Structural evolution of the northern margin of the Los Angeles basin: University of California, Los Angeles, Ph.D. thesis, 142 p.
Lanphere, M. A., and Reed, B. L., 1973, Timing of Mesozoic and Cenozoic plutonic events in circum-Pacific North America: Geological Society of America Bulletin, v. 84, p. 3773-3782.
Larson, R. L., Menard, H. W., and Smith, S. M., 1968, Gulf of California -- a result of ocean-floor spreading and transform faulting: Science, v. 161, p. 781-784.
Larson, W. W., 1958, The geology of the Potrero Seco area, Ventura County, California: University of California, Los Angeles, M.A. thesis, 100 p.
Levorsen, R. L., 1947, Geology of the Llajas Canyon area, California: University of California, Los Angeles, M.A. thesis, 59 p.
Lindgren, W., 1911, The Tertiary gravels of the Sierra Nevada of California: U.S. Geological Survey Professional Paper 73, 226 p.
Loel, Wayne, and Corey, W. H., 1932, The Vaqueros Formation, lower Miocene of California; I. Paleontology: University of California Publications, Department of Geological Sciences Bulletin, v. 22, p. 31-410.
MacDonald, G. A., 1966, Geology of the Cascade Range and Modoc Plateau, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 65-96.
Mack, J. E., 1959, Reconnaissance geology of the Woodside quadrangle, San Mateo County, California: Stanford University, Stanford, Calif., M.A. thesis, 79 p.
MacPherson, B. A., 1977, Sedimentation and trapping mechanism in upper Miocene Stevens and older turbidite fans of the southeastern San Joaquin Valley, California, in Late Miocene geology and new oil fields of the southern San Joaquin Valley: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, Pacific Sections, 1977 Guidebook, 88 p.
_____1978, Sedimentation and trapping mechanism in upper Miocene Stevens and older turbidite fans of the southeastern San Joaquin Valley, California: American Association of Petroleum Geologists Bulletin, v. 62, p. 2243-2274.
Marsh, O. T., 1960, Geology of the Orchard Peak area, California: California Division of Mines Special Report 62, 42 p.
Martin, B. D., 1963, Rosedale channel--evidence for late Miocene submarine erosion in the Great Valley of California: American Association of Petroleum Geologists Bulletin, v. 47, p. 441-456.
Martin, B. D., and Emery, K. O., 1967, Geology of Monterey Canyon, California: American Association of Petroleum Geologists Bulletin, v. 51, p. 2281-2304.
Martin, D. R., 1958, Geology of the western part of the Santa Susanna Mountains, Ventura County, California: University of California, Los Angeles, M.A. thesis, 75 p.
Matthews, V., III, 1973, Pinnacles-Neenach correlation: a restriction for models of the origin of the Transverse Ranges and the big bend in the San Andreas fault: Geological Society of America Bulletin, v. 84, p. 683-688.
_____1976, Correlation of Pinnacles and Neenach Volcanic Formations and their bearing on San Andreas fault problem: American Association of Petroleum Geologists Bulletin, v. 60, p. 2128-2141.
McAllister, J. F., 1970, Geology of the Furnace Creek borate area, Death Valley, California: California Division of Mines and Geology Map Sheet 14.

McLaughlin, R. J., Simoni, T. R., Jr., Osbun, E. D., and Bauer, P. G., 1971, Preliminary geologic map of the Loma Prieta-Mount Madonna area, Santa Clara and Santa Cruz Counties, California: U.S. Geological Survey Open-File Map, scale 1:24,000.

Merriam, R. H., 1968, Geologic reconnaissance of northwest Sonora [abs.], in Dickinson, W. R., and Grantz, Arthur, eds., Proceedings of conference on geologic problems of San Andreas fault system: Stanford University Publications in Geological Sciences, v. 11, p. 287.

_____1972, Evidence for 200 miles of right-lateral displacement on faults of the San Andreas zone in southwest Sonora, Mexico [abs.]: Geological Society of America Abstracts with Programs, v. 4, p. 198.

Merriam, R. H., and Bandy, O., 1965, Source of upper Cenozoic sediments in the Colorado Delta region: Journal of Sedimentary Petrology, v. 35, p. 911-916.

Merrill, W. R., 1954, Geology of the Sespe Creek-Pine Mountain area, Ventura County: California Division of Mines Bulletin 170, Map Sheet no. 3, scale 1:250,000.

Miller, C. J., 1952, Geology of portions of the Red Mountain and San Francisquito quadrangles, California: University of California, Los Angeles, M.A. thesis, 58 p.

Moore, D. G., and Buffington, E. C., 1968, Transform faulting and growth of the Gulf of California since the late Pliocene: Science, v. 161, p. 1238-1241.

Moore, G. W., and Kennedy, M. P., 1970, Coastal geology of the California-Baja California border area, in Pacific slope geology of northern Baja California and adjacent Alta California: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, Society of Exploration Geophysicists, Pacific Sections, Field Trip Guidebook, p. 4-9.

Muffler, L. J. P., and Doe, B. R., 1968, Composition and mean age of detritus of the Colorado River Delta in the Salton Trough, southeastern California: Journal of Sedimentary Petrology, v. 38, p. 384-399.

Natland, M. L., 1952, Pleistocene and Pliocene stratigraphy of southern California: University of California, Los Angeles, Ph.D. thesis, 165 p.

Natland, M. L., and Kuenen, Ph. H., 1951, Sedimentary history of the Ventura basin, California, and the action of turbidity currents: Society of Economic Paleontologists and Mineralogists Special Publication 2, p. 76-107.

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 1372-H, p. H1-H23.

Nilsen, T. H., and Link, M. H., 1975, Stratigraphy, sedimentology and offset along the San Andreas fault of Eocene and lower Miocene strata of the northern Santa Lucia Range and the San Emigdio Mountains, Coast Ranges, California, in Weaver, D. W., Hornaday, G. R., and Tipton, Ann, eds., Paleogene symposium and selected technical papers: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, Pacific Sections, p. 367-400.

Noble, D. C., and Slemmons, D. B., 1975, Timing of Miocene faulting and intermediate volcanism in the central Sierra Nevada and adjacent Great Basin: California Geologist, v. 28, p. 105.

Noble, L. F., and Wright, L. A., 1954, Geology of the central and southern Death Valley region, California: California Division of Mines Bulletin 170, chap. 2, p. 143-160.

Oakeshott, G. B., 1958, Geology and mineral deposits of San Fernando quadrangle, Los Angeles County, California: California Division of Mines Bulletin 172, 147 p.

Ogle, B. A., 1953, Geology of the Eel River Valley area, Humboldt County, California: California Division of Mines Bulletin 164, 128 p.

Owens, L. D., 1963, Regional geology of the central portion of the Great Valley of California, in Central portion of Great Valley of California, San Juan Bautista to Yosemite Valley: Geological Society of Sacramento Guidebook, Annual Field Trip 1963, p. 88-97.

Pacific Section, American Association of Petroleum Geologists, 1954, Correlation section, northern Sacramento Valley, California: Los Angeles.

_____1957a, Cenozoic correlation section 8, South San Joaquin Valley, San Andreas fault to Sierra Nevada Foothills, California: Los Angeles.

_____1957b, Correlation section 9, Central San Joaquin Valley, San Andreas fault to Sierra Nevada foothills: Los Angeles.

_____1958, Correlation section 10, N. and S. (2 sheets), Central San Joaquin Valley, Rio Vista through Riverdale and Riverdale through Tejon Ranch area, California: Los Angeles.

_____1959, Correlation section 11, West side San Joaquin Valley, Coalinga to Midway-Sunset and across San Andreas fault into southeast Cuyama Valley, California: Los Angeles.

_____1960, Cenozoic correlation section 13, Longitudinally north-south through Sacramento Valley from Red Bluff to Rio Vista, California: Los Angeles.

_____1967a, Correlation section 15, Sacramento Valley, Suisun Bay to Lodi, California: Los Angeles.

_____1967b, Correlation section 16, Sacramento Valley, Winters to Modesto, California: Los Angeles.

_____1969, Correlation section 17, San Joaquin Valley, Kingsburg to Tejon Hills, California: Los Angeles.

Page, B. M., Marks, J. G., and Walker, G. W., 1951, Stratigraphy and structure of the mountains northeast of Santa Barbara, California: American Association of Petroleum Geologists Bulletin, v. 35, p. 1727-1780.

Pelka, G. J., 1971, Paleocurrents of the Punchbowl Formation and their interpretation: Geological Society of America Abstracts with Program, Cordilleran Section, p. 176.

Pelline, J. E., 1952, The geology of adjacent parts of the Los Flores and Topanga quadrangles, Santa Monica Mountains, California: University of California, Los Angeles, M.A. thesis, 50 p.

Peterson, D. W., Yeend, W. E., Oliver, H. W., and Mattick, R. E., 1968, Tertiary gold-bearing gravel in northern Nevada County, California: U.S. Geological Survey Circular 566, 22 p.

Peterson, M. S., 1975, Geology of the Coachella Fanglomerate, in Crowell, J. C., ed., San Andreas Fault in southern California: California Division of Mines and Geology Special Report 118, p. 119-126.

Piper, J. W., and Normark, W. R., 1971, Re-examination of a Miocene deep-sea fan and fan valley, southern California: Geological Society of America Bulletin, v. 82, p. 1823-1830.

Rand, W. W., 1931, Preliminary report of the geology of Santa Cruz Island, Santa Barbara County, California: California Division of Mines Report of the State Mineralogist, v. 27, p. 214-219.

_____ 1933, The geology of Santa Cruz Island, California: University of California, Berkeley, Ph.D. thesis, 274 p.

Redwine, L. E., and others, 1952, Cenozoic correlation section, western Ventura Basin: American Association of Petroleum Geologists, Pacific Section.

Reid, S. A., 1978, Mid-Tertiary depositional environments and paleogeography along upper Sespe Creek, Ventura County, California, in Fritsche, A. E., ed., Depositional environments of Tertiary rocks along Sespe Creek, Ventura County, California: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 27-41.

Reid, S. A., and Fritsche, A. E., 1978, Early Miocene submarine dune fields - cross bedding in the Vaqueros Formation along Sespe Creek, Ventura County, California: Society of Economic Paleontologists and Mineralogists, Pacific Section, Annual Meeting Program, p. 11.

Repenning, C. A., 1960, Geologic summary of the Central Valley of California with reference to disposal of liquid radioactive waste: U.S. Geological Survey Trace Elements Investigations Report 769, 69 p.

Repenning, C. A., and Vedder, J. G., 1961, Continental vertebrates and their stratigraphic correlation with marine mollusks, eastern Caliente Range, California: U.S. Geological Survey Professional Paper 424-C, p. C235-C239.

Robinson, P. T., and Woodburne, M. O., 1971, Source of volcanic clasts in the Punchbowl Formation, Valyermo and Cajon Valley, California: Geological Society of America Abstracts with Program, Cordilleran Section, p. 185-186.

Rusnak, G. A., 1966, The continental margin of northern and central California, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 325-335.

Sams, R. H., 1964, Geology of the Charlie Canyon area, northwest Los Angeles County: University of California, Los Angeles, M.A. thesis, 101 p.

Sarna-Wojcicki, A., 1976, Correlation of late Cenozoic tuffs in the central Coast Ranges of California by means of trace and minor-element chemistry: U.S. Geological Survey Professional Paper 972, 30 p.

Schlee, J. S., 1952, Geology of the Mutau Flat area, Ventura County, California: University of California, Los Angeles, 108 p.

Schoellhamer, J. E., and Kinney, D. M., 1953, Geology of portions of Tumey and Panoche Hills, Fresno County, California: U.S. Geological Survey Oil and Gas Investigations Map OM-128, scale 1:24,000.

Schoellhamer, J. E., Yerkes, R. F., and Vedder, J. G., 1954, Geologic map of the northern Santa Ana Mountains, Orange and Riverside Counties, California: U.S. Geological Survey Oil and Gas Investigations Map OM-154, scale 1:24,000.

Sierveld, F. G., 1957, Geology of a part of Pattiway Ridge, Kern and Ventura Counties, California: University of California, Los Angeles, M.A. thesis, 73 p.

Silcox, J. H., 1962, West Thornton and Walnut Grove gas fields, California, in Bowen, O. E., Jr., ed., Geologic guide to the oil and gas fields of northern California: California Division of Mines and Geology Bulletin 181, p. 140-148.

Silver, E. A., Curray, J. R., and Cooper, A. K., 1971, Tectonic development of the continental margin off central California, in Lipps, J., and Moores, E. M., eds., Geologic guide to the northern Coast Ranges--Point Reyes region, California: Geological Society of Sacramento Annual Field Trip, 1971, Guidebook, p. 1-10.

Simoni, T. R., Jr., 1974, Geology of the Loma Prieta area, Santa Clara and Santa Cruz Counties, California: San Jose State University, M.S. thesis, 75 p.

Slemmons, D. B., 1966, Cenozoic volcanism of the central Sierra Nevada, California, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 199-208.

Smith, V. M., 1951, Geology of the upper Castaic Creek region, Los Angeles, County, California: University of California, Los Angeles, M.A. thesis, 31 p.

Snyder, W. S., Dickinson, W. R., and Silberman, M. L., 1976, Tectonic implications of space-time patterns of Cenozoic magmatism in the western United States: Earth and Planetary Science Letters, v. 32, p. 91-106.

Stanton, R. J., Jr., 1966, Megafauna of the upper Miocene Castaic Formation, Los Angeles County, California: Jour. Paleontology, v. 40, p. 21-40.

Stanton, R. J., Jr., and Dodd, J. R., 1970, Paleoecologic techniques--comparison of faunal and geochemical analysis of Pliocene paleoenvironments, Kettleman Hills, California: Journal of Paleontology, v. 44, p. 1092-1121.

_____ 1976, Pliocene biostratigraphy and depositional environment of the Jacalitos Canyon area, California, in Fritsche, A. E., TerBest, Harry, Jr., and Wornardt, W. W., eds., The Neogene symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 85-94.

Stuart, C. J., 1975, The stratigraphy, sedimentology, and tectonic implications of the San Onofre Breccia, southern California: University of California, Santa Barbara, Ph.D. thesis, 309 p.

Sullwold, H. H., Jr., 1960, Tarzana fan, deep submarine fan of late Miocene age, Los Angeles County, California: American Association of Petroleum Geologists Bulletin, v. 44, p. 433-457.

Swarbrick, J. C., 1976, Brentwood Field, in Drummond, K., ed., A tour of the reservoir rocks of the western Sacramento delta: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, Pacific Sections, Field Trip Guidebook, p. 34-48.

Sylvester, A. G., and Smith, R. R., 1976, Tectonic transgression and basement-controlled deformation in San Andreas fault zone, Salton trough, California: American Association of Petroleum Geologists Bulletin, v. 60, p. 2081-2102.

Szatai, J. E., 1961, The geology of parts of the Redrock Mountain, Warm Springs, Violin Canyon and Red Mountain quadrangles, Los Angeles County, California: University of Southern California, Los Angeles, Ph.D. thesis, 164 p.

Taliaferro, N. L., 1943, Geologic history and structure of the central Coast Ranges of California: California Division of Mines Bulletin 118, p. 119-162.

Thor, D. R., 1977, Depositional environments and paleogeographic setting of the Santa Margarita Formation, Ventura County, California: California State University, Northridge, M.S. thesis, 144 p.

______1978, Depositional environments and paleogeographic setting of the Santa Margarita Formation, Ventura County, California, in Fritsche, A. E., ed., Depositional environments of Tertiary rocks along Sespe Creek, Ventura County, California: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 42-59.

Valentine, J. W., and Rowland, R. W., 1970, Major features of the marine Pliocene and Pleistocene fossil record of northwesternmost Baja California, in Pacific slope geology of northern Baja California and adjacent Alta California: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, Pacific Sections, p. 118-119.

Van Amringe, J. H., 1957, Geology of a part of the western San Emigdio Mountains, California: University of California, Los Angeles, M.A. thesis, 120 p.

Van Couvering, Martin, and Allen, H. B., 1943, Devils Den oil field: California Division of Mines Bulletin 118, p. 494-501.

Vedder, J. G., 1968, Geologic map of Fox Mountain quadrangle, Santa Barbara County, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-547, scale 1:24,000.

______1970a, Geologic map of the Wells Ranch and Elkhorn Hills quadrangles, San Luis Obispo and Kern Counties, California, showing juxtaposed Cenozoic rocks along the San Andreas fault: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-585, scale 1:24,000.

______1970b, Summary of geology of the San Joaquin Hills, in Vernon, J. W., chm., Geologic guidebook, southeastern rim of the Los Angeles basin, Orange County, California--Newport Lagoon-San Joaquin Hills-Santa Ana Mountains: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, Society of Exploration Geophysicists, Pacific Sections, Field Trip Guidebook, p. 15-19.

______1973, Geologic framework and correlation of Miocene rocks in the Caliente Range, in Fischer, P., ed., Sedimentary facies changes in Tertiary rocks California Transverse and southern Coast Ranges: Society of Economic Paleontologists and Mineralogists, Pacific Section, Annual Meeting, Trip No. 2, p. 43-53.

______1975, Juxtaposed Tertiary strata along the San Andreas fault in the Temblor and Caliente Ranges, California, in Crowell, J. C., ed., San Andreas fault in southern California: California Division of Mines and Geology Special Report 118, p. 234-240.

Vedder, J. G., Beyer, L. A., Junger, A., Moore, G. W., Roberts, A. E., Taylor, J. G., and Wagner, H. C., 1974, Preliminary report of the geology of the continental borderland of southern California: U.S. Geological Survey Miscellaneous Field Studies Map MF-624, 34 p., 9 sheets.

Vedder, J. G., and Brown, R. D., Jr., 1968, Structural and stratigraphic relations along the Nacimiento fault in the southern Santa Lucia Range and San Rafael Mountains, California, in Dickinson, W. R., and Grantz, Arthur, eds., Proceedings of conference on geologic problems of San Andreas fault system: Stanford University Publications in Geological Sciences, v. 11, p. 242-259.

Vedder, J. G., Dibblee, T. W., Jr., and Brown, R. D., Jr., 1973, Geologic map of the upper Mone Creek-Pine Mountain area, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-752, scale 1:48,000.

Vedder, J. G., Gower, H. D., Clifton, H. E., and Durham, D. L., 1967, Reconnaissance geologic map of the central San Rafael Mountains and vicinity, Santa Barbara County, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-487, scale 1:48,000.

Vedder, J. G., and Howell, D. G., 1976, Neogene strata of the southern group of Channel Islands, California, in Howell, D. G., ed., Aspects of the geologic history of the California continental borderland: American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24, p. 80-106.

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., ed., 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., 1965, Geologic map of the southeastern Caliente Range, San Luis Obispo County, California: U.S. Geological Survey Oil and Gas Investigations Map OM-217, scale 1:24,000.

Vedder, J. G., Yerkes, R. F., and Schoellhamer, J. E., 1957, Oil possibilities of San Joaquin Hills-San Joaquin Capistrano area, California: U.S. Geological Survey Oil and Gas Investigations Map OM-193, scale 1:24,000.

Wagner, H. C., 1974, Marine geology between Cape San Martin and Pt. Sal, south-central California offshore: U.S. Geological Survey Open-File Report 74-252, 17 p.

Walker, R. G., 1975, Nested submarine-fan channels in the Capistrano Formation, San Clemente, California: Geological Society of America Bulletin, v. 86, p. 915-924.

Washburn, E. D., 1946, The geology of part of the Hollister quadrangle, San Benito and Santa Clara Counties, California: University of California, Berkeley, M.A. thesis, 42 p.

Weaver, C. E., 1944, Geology of the Cretaceous (Gualala Group) and Tertiary formations along the Pacific coast between Point Arena and Fort Ross, California: University of Washington Publications in Geology, v. 6, 29 p.

_____1949, Geology of the Coast Ranges immediately north of the San Francisco Bay region, California: Geological Society of America Memoir 35, 242 p.

Weaver, C. E., and others, 1944, Correlation of the marine Cenozoic formations of western North America: Geological Society of America Bulletin, v. 55, p. 569-598.

Weaver, D. W., and others, 1969, Geology of the northern Channel Islands, southern California borderland: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Pacific Sections, 200 p.

Webb, G. W., 1977, Stevens and earlier Miocene turbidite sands, San Joaquin Valley, California, in Late Miocene geology and new oil fields of the southern San Joaquin Valley: American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, Pacific Sections, p. 105-117.

Williams, Howel, 1949, Geology of the Macdoel quadrangle, California: California Division of Mines Bulletin 151, 78 p.

Williams, T. C., together with Dodd, J. R., and Stanton, R. J., 1976, Paleosalinities within a Pliocene bay, Kettleman Hills, California: A study of the resolving power of isotopic and faunal techniques: Discussion and Reply: Geological Society of America Bulletin, v. 87, p. 158-160.

Winterer, E. L., 1954, Geology of the southeastern Ventura basin, Los Angeles County, California: University of California, Los Angeles, Ph.D. thesis, 144 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.

Woodard, G. D., 1974, Redefinition of Cenozoic stratigraphic column in Split Mountain Gorge, Imperial Valley, California: American Association of Petroleum Geologists Bulletin, v. 58, p. 521-526.

Woodburne, M. O., 1975a, Cenozoic stratigraphy of the Transverse Ranges and adjacent areas, southern California: Geological Society of America Special Paper 162, 91 p.

_____1975b, Late Tertiary nonmarine rocks, Devil's Punchbowl and Cajon Valley, southern California, in Crowell, J. C., ed., San Andreas fault in southern California: California Division of Mines and Geology Special Report 118, p. 187-196.

Woodburne, M. O., and Golz, D. J., 1972, Stratigraphy of the Punchbowl Formation, Cajon Valley, California: University of California Publications in Geological Sciences, v. 92, 57 p.

Woodford, A. O., Schoellhamer, J. E., Vedder, J. G., and Yerkes, R. F., 1954, Geology of the Los Angeles basin, California: California Division of Mines Bulletin 170, chap. 5, p. 65-81.

Wood, H. E., Chaney, R. W., Clark, J., Colbert, E. H., Jepsen, G. L., Reeside, J. B., and Stock, C., 1941, Nomenclature and correlation of the North American continental Tertiary: Geological Society of America Bulletin, v. 52, p. 1-48.

Woodring, W. P., 1942, Marine Miocene mollusks from Cajon Pass, California: Journal of Paleontology, v. 16, p. 78-83.

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.

Wright, L. A., 1976, Late Cenozoic fault patterns and stress fields in the Great Basin and westward displacement of the Sierra Nevada block: Geology, v. 4, p. 489-494.

Yeats, R. S., 1965, Pliocene seaknoll at South Mountain, Ventura basin, California: American Association of Petroleum Geologists Bulletin, v. 49, p. 526-546.

_____1976a, Neogene tectonics of the central Ventura basin, California, in Fritsche, A. E., TerBest, Harry, Jr., and Wornardt, W. W., eds., The Neogene symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 19-32.

_____1976b, Extension versus strike-slip origin of the southern California borderland, in Howell, D. G., ed., Aspects of the geologic history of the California continental borderland: American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24, p. 445-485.

Yerkes, R. F., Campbell, R. H., Blackerby, B. A., Wentworth, C. M., Birkeland, P. W., and Schoellhamer, J. E., 1971, Preliminary geologic map of the Malibu Beach quadrangle, Los Angeles County, California: U.S. Geological Survey Open-File Map, scale 1:24,000.

Yerkes, R. F., McCulloh, T. H., Schoellhamer, J. E., and Vedder, J. G., 1965, Geology of the Los Angeles basin--an introduction: U.S. Geological Survey Professional Paper 420-A, p. A1-A57.

Nevada and Arizona

Anderson, R. E., Armstrong, C. R., and Marvin, R. F., 1972, Significance of K-Ar ages of Tertiary rocks from the Lake Mead region, Nevada-Arizona: Geological Society of America Bulletin, v. 83, p. 273-288.

Armstrong, R. L., 1970, Geochronology of Tertiary igneous rocks, eastern Basin and Range Province, western Utah, eastern Nevada, and vicinity, U.S.A.: Geochimica et Cosmochimica Acta, v. 34, p. 203-232.

Armstrong, R. L., Eckel, E. B., McKee, E. H., and Noble, D. C., 1969, Space-time relations of Cenozoic volcanism in the Great Basin of the western United States: American Journal of Science, v. 267, p. 478-490.

Axelrod, D. I., 1956, Mio-Pliocene floras from west-central Nevada: University of California Publications in Geological Sciences, v. 33, p. 1-322.

Best, M. G., and Brimhall, W. H., 1974, Late Cenozoic alkalic basaltic magmas in the western Colorado Plateau and the Basin and Range transition zone, U.S.A., and their bearing on mantle dynamics: Geological Society of America Bulletin, v. 85, p. 1677-1690.

Blair, W. N., 1978, Gulf of California in Lake Mead area of Arizona and Nevada during late Miocene time: American Association of Petroleum Geologists Bulletin, v. 62, p. 1159-1170.

Blair, W. N., McKee, E. H., and Armstrong, A. K., 1977, Age and environment of deposition--Hualapai Limestone Member of the Muddy Creek Formation: Geological Society of America Abstracts with Programs, v. 9, p. 390-391.

Christiansen, R. L., and Lipman, P. W., 1972, Cenozoic volcanism and plate-tectonic evolution of the western United States, II, Late Cenozoic: Royal Society of London Philosophical Transactions, Ser. A, v. 271, p. 249-284.

Cooley, M. E., and Davidson, E. S., 1963, The Mogollon Highlands--their influence on Mesozoic and Cenozoic erosion and sedimentation: Arizona Geological Society Digest, v. 6, p. 7-35.

Damon, P. E., 1971, The relationship between late Cenozoic volcanism and tectonism and orogenic-epeirogenic periodicity: The late Cenozoic glacial ages: New Haven, Conn., Yale University Press, p. 15-35.

_____ 1976, Mid-Tertiary ash flows of the southern Basin and Range province: Time, space, chemistry, and genesis: Geological Society of America Abstracts with Programs, v. 8, p. 581-582.

Damon, P. E., and Bikerman, M., 1964, Potassium-argon dating of post-Laramide plutonic and volcanic rocks within the Basin and Range province of southeastern Arizona and adjacent areas: Arizona Geological Society Digest, v. 7, p. 68-78.

Damon, P. E., Shafiqullah, M., and Lynch, D. J., 1973, Geochronology of block faulting and basin subsidence in Arizona: Geological Society of America Abstracts with Programs, v. 5, p. 590.

Damon, P. E., Shafiqullah, M., and Scarborough, R. B., 1978, Revised chronology for critical stages in the evolution of the lower Colorado River: Geological Society of America Abstracts with Programs, v. 10, p. 101-102.

Eberly, L. D., and Stanley, T. B., Jr., 1978, Cenozoic stratigraphy and geologic history of southwestern Arizona: Geological Society of America Bulletin, v. 89, p. 921-940.

Ekren, E. B., Rogers, C. C., Anderson, R. E., and Orkild, P. P., 1968, Age of Basin and Range normal faults in Nevada test site and Nellis Air Force Range, Nevada, in Nevada test site: Geological Society of America Memoir 110, p. 247-250.

Elston, W. E., and others, 1973, Tertiary volcanic rocks, Mogollon-Datil province, New Mexico and surrounding region: K-Ar dates, patterns of eruptions, and periods of mineralization: Geological Society of America Bulletin, v. 84, p. 2259-2274.

Gilbert, C. M., Reynolds, M. W., 1973, Character and chronology of basin development, western margin of the Basin and Range province: Geological Society of America Bulletin, v. 84, p. 2489-2510.

Gromme, C. S., McKee, E. H., and Blake, M. C., 1972, Paleomagnetic correlation and potassium-argon dating of middle Tertiary ash-flow sheets in the eastern Great Basin, Nevada and Utah: Geological Society of America Bulletin, v. 83, p. 1619-1638.

Hunt, C. B., 1956, Cenozoic geology of the Colorado Plateau: U.S. Geological Survey Professional Paper 279, 99 p.

Korringa, M. K., 1973, Linear vent area of the Soldier Meadow Tuff, an ash-flow sheet in northwestern Nevada: Geological Society of America Bulletin, v. 84, p. 3849-3860.

Krieger, M. H., Creasey, S. C., and Marvin, R. F., 1971, Ages of some Tertiary and latitic volcanic rocks in the Prescott-Jerome area, north-central Arizona: U.S. Geological Survey Professional Paper 750-B, p. B157-B160.

Lance, J. F., 1960, Stratigraphy and structural position of Cenozoic fossil localities in Arizona: Arizona Geological Society Digest, v. 3, p. 155-159.

Leeman, W. P., and Rogers, J. J. W., 1970, Late Cenozoic alkali-olivine basalts of the Basin-Range province: Contributions to Mineralogy and Petrology, v. 25, p. 1-24.

Lipman, P. W., Prostka, H. J., and Christiansen, R. L., 1972, Cenozoic volcanism and plate-tectonic evolution of the western United States. I, Early and middle Cenozoic: Royal Society of London Philosophical Transactions, ser. A, v. 271, p. 217-248.

Longwell, C. R., 1928, Geology of the Muddy Mountains, Nevada: U.S. Geological Survey Bulletin 798, 152 p.

_____ 1936, Geology of the Boulder Reservoir floor, Arizona: Geological Society of America Bulletin, v. 47, p. 1393-1476.

_____ 1963, Reconnaissance geology between Lake Mead and Davis Dam, Arizona-Nevada: U.S. Geological Survey Professional Paper 374-E, 51 p.

Lucchitta, I., 1967, Cenozoic geology of the upper Lake Mead area adjacent to the Grand Wash Cliffs, Arizona: Pennsylvania State University, Ph.D. thesis, 218 p.

_____ 1972, Early history of the Colorado River in the Basin and Range province: Geological Society of America Bulletin, v. 83, p. 1933-1948.

Mauger, R. L., Damon, P. E., and Livingston, D. C., 1968, Cenozoic argon ages on metamorphic rocks from the Basin and Range province: American Journal of Science, v. 266, p. 579-589.

McKee, E. D., and McKee, E. H., 1972, Pliocene uplift of the Grand Canyon region: Time of drainage adjustments: Geological Society of America Bulletin, v. 83, p. 1923-1932.

McKee, E. H., 1971, Tertiary igneous chronology of the Great Basin of western United States--Implications for tectonic models: Geological Society of America Bulletin, v. 82, p. 3497-3502.

McKee, E. H., and Anderson, C. A., 1971, Age and chemistry of Tertiary volcanic rocks in north-central Arizona and relation of the rocks to the Colorado plateau: Geological Society of America Bulletin, v. 82, p. 2767-2782.

McKee, E. H., and Noble, D. C., 1974, Timing of late Cenozoic crustal extension in the western United States: Geological Society of America Abstracts with Programs, v. 6, p. 218.

McKee, E. H., and Silberman, M. L., 1970, Geochronology of Tertiary igneous rocks in central Nevada: Geological Society of America Bulletin, v. 81, p. 2317-2328.

_____1975, Igneous history of the southern Cordillera south of 42° N.: Geological Society of America Abstracts with Programs, v. 7, p. 1196-1197.

Metzger, D. G., 1968, The Bouse Formation (Pliocene) of the Parker-Blythe-Cibola area, Arizona and California: U.S. Geological Survey Professional Paper 600-D, p. D126-D136.

Noble, D. C., 1972, Some observations on the Cenozoic volcano-tectonic evolution of the Great Basin, western United States: Earth and Planetary Science Letters, v. 17, p. 142-150.

Nolan, T. B., 1943, The Basin and Range province in Utah, Nevada, and California: U.S. Geological Survey Professional Paper 197, p. 141-193.

Peirce, H. W., 1976, Tectonic significance of Basin and Range thick evaporite deposits: Arizona Geological Society Digest, v. 10, p. 325-339.

Proffett, J. M., Jr., 1977, Cenozoic geology of the Yerington district, Nevada, and implications for the nature and origin of Basin and Range faulting: Geological Society of America Bulletin, v. 88, p. 247-266.

Riehle, R. J., McKee, E. H., and Speed, R. C., 1972, Tertiary volcanic center, west-central Nevada: Geological Society of America Bulletin, v. 83, p. 1382-1396.

Robinson, D. T., McKee, E. H., and Moiola, R. J., 1968, Cenozoic volcanism and sedimentation, Silver Peak region, western Nevada and adjacent California, in Coats, R. R., Hay, R. L., and Anderson, L. A., eds., Studies in volcanology: Geological Society of America Memoir 116, p. 577-611.

Scholtz, C. H., Barazangi, M., and Sbar, M. L., 1971, Late Cenozoic evolution of the Great Basin, western United States, as an ensialic interarc basin: Geological Society of America Bulletin, v. 82, p. 2979-2990.

Smith, P. B., 1970, New evidence for Pliocene marine embayment along the lower Colorado River area, California and Arizona: Geological Society of America Bulletin, v. 81, p. 1411-1420.

Spieker, E. M., 1946, Late Mesozoic and early Cenozoic history of central Utah: U.S. Geological Survey Professional Paper 205-D, p. 114-161.

Stewart, J. H., 1971, Basin and Range structure, a system of horsts and grabens produced by deep-seated extension: Geological Society of America Bulletin, v. 82, p. 1019-1044.

Stewart, J. H., and Carlson, J. E., 1976, Cenozoic rocks of Nevada--four maps and a brief description of distribution, lithology, age, and centers of volcanism: Nevada Bureau of Mines and Geology Map 52.

Stewart, J. H., Moore, W. J., and Zietz, Isidore, 1977, East-west patterns of Cenozoic igneous rocks, aeromagnetic anomalies, and mineral deposits, Nevada and Utah: Geological Society of America Bulletin, v. 88, p. 67-77.

Suppe, J., Powell, C., and Berry, R., 1975, Regional topography, seismicity, Quaternary volcanism, and the present-day tectonics of the western United States: American Journal of Science, v. 275-A, p. 397-436.

Vitaliano, C. J., and Vitaliano, D. B., 1972, Cenozoic volcanic rocks in the southern Shoshone Mountains and Paradise Range, Nevada: Geological Society of America Bulletin, v. 83, p. 3269-3280.

Washington and Oregon

Addicott, W. O., 1969, Tertiary climatic change in the marginal northeastern Pacific Ocean: Science, v. 165, no. 3893, p. 583-586.

_____1970, Latitudinal gradients in Tertiary molluscan faunas of the Pacific coast: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 8, no. 4, p. 287-312.

_____1974, Giant pectinids of the Eastern North Pacific margin: Significance in Neogene zoogeography and chronostratigraphy: Journal of Paleontology, v. 48, no. 1, p. 180-194, 2 pls.

_____1976a, Neogene molluscan stages of Oregon and Washington, in Fritsche, A. E., TerBest, Harry, Jr., and Wornardt, W. W., eds., The Neogene symposium: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 95-115.

_____1976b, Molluscan paleontology of the early Miocene Clallam Formation, northwestern Washington: U.S. Geological Survey Professional Paper 976, 44 p., 9 pls.

_____1976c, New molluscan assemblages from the upper member of the Twin River Formation, western Washington: significance in Neogene biostratigraphy: U.S. Geological Survey Journal of Research, v. 4, no. 4, p. 437-447.

Armstrong, R. L., Leeman, W. P., and Malde, H. E., 1975, K-Ar dating, Quaternary and Neogene volcanic rocks of the Snake River Plain, Idaho: American Journal of Science, v. 275, p. 225-251.

Avent, J. C., 1969, Correlation of the Steens-Columbia River Basalts: Some tectonic and petrogenetic implications, in Proceedings of the second Columbia River Basalt symposium, Cheney, Washington: Cheney, Wash., Eastern Washington State College Press, p. 133-156.

Axelrod, D. I., 1968, Tertiary floras and topographic history of Snake River basin, Idaho: Geological Society of America Bulletin, v. 79, p. 713-734.

Baksi, A. K., York, D., and Watkins, N. D., 1967, Age of the Steens Mountain geomagnetic polarity transition: Journal of Geophysical Research, v. 72, p. 6299-6308.

Baldwin, E. M., 1945, Some revisions of the late Cenozoic stratigraphy of the southern Oregon Coast: Journal of Geology, v. 53, p. 35-46.

Baldwin, E. M., 1947, Geology of the Dallas and Valsetz quadrangles, Oregon: Oregon Department of Geology and Mineral Industries Bulletin 35, 61 p.