siderably more abundant in the displaced shallow-water sands. The probability of finding other fields which are somewhat analogous to the West Mahala pool are good. Geologic models used in exploration should include deep-water turbidite fan-channel complexes which may be distributed along the northeast side of the Chino, Puente, and San Jose Hills.

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GEOLOGY AND FUTURE PETROLEUM POTENTIAL, VENTURA BASIN, CALIFORNIA

The Ventura basin is the western part of Transverse Ranges geomorphic province. It is a complex, highly folded and faulted synclinorium. Maximum thickness of sediments is 67,000 ft. The ages of formations range from Cretaceous through Holocene. In areal extent—including the onshore, the Santa Barbara Channel and the continental shelf—it is approximately 215 mi long, and averages 30 mi wide. Total volume of sediments is estimated at 40,000 cu mi.

Despite its long history as an oil-producing basin, exploration of its ultimate potential is far from complete. Much of the thick sedimentary section has not been penetrated except in limited areas on the basin margins. Large volumes of marine lower Tertiary and Upper Cretaceous rocks are completely unexplored. Evaluation of the known profilic structures has rarely been carried below depths of 15,000 ft.

In areas where the upper Tertiary beds are best developed, the obvious surface features have been drilled, and most are productive. Stratigraphic elements of entrapment occur in virtually all accumulations in the Ventura basin. Several primary stratigraphic accumulations are productive. It is believed that the greatest future potential of the basin lies in stratigraphic accumulations, and in the same general areas and measures which have been most productive to date. Estimates of 20-30 billion bbl of remaining oil in place do not appear unreasonable. Exploration for this potential awaits favorable future breakthroughs in economic, technologic, and political developments.

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GEOLOGY OF SACRAMENTO BASIN AND ITS FUTURE GAS POSSIBILITIES

The Sacramento basin occupies the northern half of the Great Valley of California. It is a long, narrow asymmetric basin, with a steep west flank and a broad, shallow east flank. Sediments range in age from Jurassic to Holocene, with essentially dry gas production coming from sediments of Late Cretaceous, Paleocene, and Eocene age. The basin can be divided into four areas: the northern San Joaquin, Delta, Suisun, and northern Sacramento areas.

In the northern San Joaquin area, production has come from anticlinal closures, mostly along the upthrown sides of two major faults. Future production probably also will be located on anticlinal highs.

In the Delta area, production has come from anticlines, fault traps, some stratigraphic traps, and traps against two major gorges. Future production will probably be found in fault and gorge traps. Production in the Suisun area has been located on anticlines. Future production may come from presently unknown anticlines and from new pools found on known anticlinal trends.

In the northern Sacramento area, production has come mostly from stratigraphic traps in sandstone of the Forbes Formation, with additional production from anticlinal trends and from domes overlying buried volcanic plugs. Future production will probably be from Forbes stratigraphic traps.

Over half the gas in the Sacramento basin probably has been discovered. Future exploration will be concentrated in the Delta and northern Sacramento areas. It is possible, but doubtful, that future major production may come from formations deeper than those presently productive, and from parts of the basin presently considered nonprospective.

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BIOSTRATIGRAPHY AND PALEOECOLOGY OF EARLY MIOCENE THROUGH EARLY PLEISTOCENE BENTHONIC AND PLANKTONIC FORAMINIFERA, SAN JOAQUIN HILLS-NEWPORT BAY, ORANGE COUNTY, CALIFORNIA

A uniquely complete and continuous sequence of early Miocene through early Pleistocene marine sediments is exposed in Bonita Canyon on the western flank of the San Joaquin Hills and at adjacent Newport Bay, California. These sediments are assigned to the early to middle Miocene Topanga Formation, middle to late Miocene Monterey Shale, late Miocene to early Pliocene Capistrano Formation, and early Pliocene to early Pleistocene Fernando Formation. The total thickness of the sequence studied is more than 2,400 m.

Quantitative analysis of benthonic foraminiferal biofacies indicates that: (1) the lower parts of the Topanga Formation were deposited at inner to outer shelf depths, (2) upper Topanga and Monterey Shale diatomaceous sediments were deposited at upper to middle bathyal depths within a closed basin where ambient water contained less than 1 ml/l of dissolved oxygen, (3) lower bathyal depths marked by abundant radiolarian tests occurred during deposition of the Capistrano Formation, and (4) the Fernando Formation was deposited at lower bathyal through outer shelf depths. Stratigraphic variations of gross faunal parameters including foraminiferal number, radiolarian number, planktonic-benthonic ratio, and percent of displaced benthonic species provide additional quantitative evidence of the shelf-to-basin-to-shelf paleobathymetric history of this sequence. Ranges of individual species of benthonic Foraminifera allow the Saucesian, Relizian, Luisian, Mohnian, Repettian, Venturian, Wheelerian, and Hallian Stages to be recognized. Cool to warm temperate planktonic foraminiferal biofacies dominated by *Globigerina concinna* sl. and *G. angustiumbilicata* occur in the Topanga Formation and lower Monterey Shale. Temperate planktonic assemblages dominated by *G. bulloides* sl. dominate in the upper Monterey Shale and parts of the Fernando Formation. A subarctic biofacies containing sinistral populations of *G. pachyderma* is present at discrete intervals within late Miocene, middle and late Pliocene, and early Pleistocene sediments, whereas a subtropical-warm temperate biofacies dominated by *Globoquadrina dutertrei* is restricted to the early Pliocene. Ranges of critical planktonic Foraminifera including *Globorotaloides trema, Globorotalia mayeri, G. menardi, G. crassaformis, G. inflata, G. truncatulinoides, "Orbulina universa," "Sphaeroidinella dehiscens,"* and the radiolarian *Prunopyle titan* provide additional criteria for age assignment and correlation with the paleomagnetic-radiometric time scale.

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ENERGY AND OUR FOSSIL FUELS

America has a high energy society, and as our demand for energy increases, our reserves of fossil fuels steadily decline. Oil provides 43% of our energy needs, natural gas 33%, electric power 20%, and coal 4%. Although electric power provides only one fifth of our energy needs, 83% of all electricity is created by burning the fossil fuels. Hydro (16%), nuclear (1%), and geo-