this technology been used prior to the drilling of wells, the Bunter Sandstone would have been recognized as having a very high risk.

The interpretation was performed on an interactive workstation, and is documented step-by-step through well integration, horizon and fault interpretation, mapping, and condusions.

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MMS Offshore Resource Evaluation Program: Components and Functions

The Minerals Management Service (MMS) administers the Department of the Interior's (DOI) activities for mineral resources on the outer continental shelf (OCS). The primary responsibility of the MMS Resource Evaluation Program is to investigate the mineral potential of the OCS, predominantly for oil and gas, and to assure the receipt of fair market value for those resources. The program consists of two components: (1) geologic and geophysical (G & G) data acquisition and analyses, and (2) resource economic and engineering (E & E) evaluation.

Objectives of the G & G component are data acquisition and production of maps for resource evaluation. Initially, this component provides information and analyses used to develop regional maps identifying areas favorable for hydrocarbon accumulation. Following area identification for a proposed lease sale, the emphasis shifts to more detailed mapping and analysis of individual prospects.

The E & E component uses information from the first component. Objectives include the development of (1) estimates of economically recoverable resources and their undiscovered resource base, (2) E & E parameters on a sale- and tract-specific basis, and (3) E & E methodologies and studies. Procedures used to develop probabilistic resource estimates are incorporated in a computer model called PRESTO, an acronym for "Probabilistic Resource ESTimates-Offshore." These estimates assume that hydrocarbons are present in the sale area. Impacts of alternative royalty rates, minimum bids, lease terms, and bidding systems are analyzed through the use of another computer model called TSL80. The resource economic value of tracts offered for lease is determined by calculating the amount of economically recoverable resources, estimating recovery factors, production profiles and operating costs, and performing a discounted cash-flow analysis. The MMS uses a computer simulation model called MONTCAR to do this task. MONTCAR uses the Monte Carlo or range-of-values technique for handling calculations with uncertain input data.

Products and responsibilities of the program include geology reports for specific planning areas, reports to Congress on bidding systems and undiscovered resources, and a cooperative agreement between MMS and the state of geological surveys.

DIBBLEE, THOMAS W., JR., Consultant, Santa Barbara, CA

Late Cenozoic Tectonics of Northern and Western Imperial Basin

The Imperial basin, or Salton trough, is filled with as much as 5 km of middle(?) and late Cenozoic clastic sedimentary deposits. They are buried by alluvium under the major part of this basin but are exposed along the northern margin and more extensively on the west side. In both of these areas, the sedimentary fill is on an irregular basement surface and buttresses out northeastward and westward against the pre-Tertiary basement terranes elevated in the adjacent mountain ranges. Unconformities within the sedimentary fill record recurrent movements during deposition.

The San Andreas fault zone along the northeastern margin of this basin dies out on the surface east of Salton Sea. Along this fault zone, the sedimentary fill is wrinkled into numerous small folds by right lateral drag movements as this fault dies out southeastward. This fault may step southward as several faults, including the active Imperial fault, into the basin center.

Where the thick sedimentary fill buttresses westward against the basement terrane of the northern Peninsular Range province, the fill is severely deformed by right lateral slip and uplift on faults of the San Jacinto and Elsinor fault zones that converge southeastward into the basin. On these faults, deformation of the sedimentary fill is generally similar to that on the San Andreas fault zone but complicated by uplift and left-slip on subsidiary transverse faults. The general trend of fold axes throughout this region is east-west with variations of as much as 30° either way.

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Miocene Conglomerates and Breccias in Northeastern Ventura Basin and Northern Los Angeles Basin and Their Tectonic Significance

(No abstract.)

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Nonconventional Drilling in Prudhoe Bay Field

Nonconventional wells are an important part of the development plan for the Prudhoe Bay field. Each of four types, (1) high angle, (2) horizontal, (3) inverted high angle, and (4) drain hole, have specific applications in the field. Geologic criteria for well selection include vertical permeability heterogeneities, faulting, structural dip, and reservoir geometry. Initial production rates are up to five times that of a conventional well.

The original justification for the wells included increased productivity, reduced gas and water coning, additional oil recovery, access to thin or geometrically isolated reservoir intervals, and increased drainage areas. These benefits are tempered with the increased drilling and completion costs, limited workover potential, and surveillance complexity.

At Prudhoe Bay, nonconventional wells have been drilled in peripheral areas, the gravity drainage area, for gas injection in the West End development area and are planned for minor reservoir development. Five horizontal wells, eight high angle wells, two inverted high angle wells, and two drain holes have been drilled to date. The recently developed inverted high angle wells can be used to optimize well placement as the well is drilled. The production performance of these wells is impressive, with the benefits of accelerated production and additional recovery in the peripheral areas.

The economics of the nonconventional wells are dependent on the future cost of workovers, the actual additional recovery, the long-term performance, and the future price of oil. In the near term, the wells have proven to be highly productive or to have very high injectivities, and are valuable as a means to reach peripheral accumulations that would otherwise not be developed.

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Prevention: Ground Water Contamination at Martha Oil Field, Lawrence and Johnson Counties, Kentucky

The Martha oil field, located in Lawrence and Johnson Counties, Kentucky, is comprised of three acres totaling over 50 mi^2. Production at the Martha oil field from the Weir oil sands (lower Borden Formation, Osage Series, and Mississippian System) began at the turn of the century. Secondary recovery, which consisted of waterflooding, commenced in 1955 in the eastern portion of the field. The Martha main field area occupies approximately 4,500 ac. Almost 3,200 ac were under the waterflood program until 1986. Tertiary recovery methods have been proposed.

The upwelling of brine/oil (via breached well casings, uncemented annuli, and improperly plugged and abandoned wells) resulted in widespread contamination of the three (Alluvium, Breathitt, and Lee Formations) underground sources of drinking water (USDW). Causal effects of this pollution upwelling include increased potentiometric head within the Weir oil sands by fresh water injection and cones of depression in the Lee aquifer resulting from pumping of industrial water supply wells.

Field investigations by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (COE) in 1986 confirmed the prevalent nature of pollution in all three of the USDW. As a result of these actions, EPA Region IV determined that the responsible party was in violation of the Safe Drinking Water Act (SDWA) and underground injection control regulations (UIC). Violations included operating and/or maintaining injection activities in a manner that allowed the moveout of fluids containing contaminants into USDW; failure to properly plug and abandon injection wells that had been temporarily abandoned for two years or more; and injecting at a pressure that