hydrocarbon reservoirs in North America were used to quantitatively study diagenetic alterations of pore systems. Results were most favorable for rocks in which no early cementation or secondary replacement occurred and for which the pore system could be characterized sedimentologically.

Geologic modeling of permeability/porosity crossplots may reveal secondary permeability that results from microstructural damage, fracturing, and/or directional dissolution. Secondary permeability type may be determined from examination of the core or porecasts. Analyses of permeability/porosity crossplots may establish the relative timing of the various diagenetic modifications.

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Geochronology Bearing on Age of Monterey Formation, California

The name Monterey Formation or Monterey Shale has been applied to lithologically similar pelitic marine rocks of Miocene age exposed in the coastal regions of California. These rocks, characterized by unusually high proportions of silica, have been variously termed diatomite, porcelanite, porcelaeous shale and mudstone, chert, and cherty shale. The type area for the Monterey Formation was designated near Monterey, California.

Although the Monterey Formation in general contains numerous ash, tuff, and bentonite beds, only a few of these volcanic units have been dated. It has been necessary to make use of both the isotopically dated horizons and Kleinpell's Miocene benthonic foraminiferal stages to construct a time-stratigraphic framework for the Monterey Formation at different locations. Ages for the various stage and zone boundaries, based on published and unpublished data, are as follows:

Repettian-Stratotype *B. oblique ("Delmontian"),* ca. 5 m.y.B.P.; Stratotype *B. oblique*-Mohnian, ca. 7 m.y.B.P.; Mohnian-Luisian, ca. 12 m.y.B.P.; Luisian-Relizian, 14.0 to 14.9 m.y.B.P.; Relizian-Saucesian, 15.7 m.y.B.P.

At the type area, an ash from the Canyon del Rey Diatomite Member, the uppermost member of the Monterey Formation, was dated at 11.3 ± 0.9 m.y. (F-T on zircon). Coupled with a Luisian age for the oldest strata, the type Monterey Formation spans, at most, the time interval from 15 to 10 m.y.B.P. In contrast, the Monterey Shale in the Palos Verde Hills encompasses the time interval from 15 to 5 m.y.B.P. based on isotopic data from the Altamira Shale, Valmonte Diatomite, and Malaga Mudstone Members, which contain foraminiferal assemblages characteristic of the Relizian, Luisian, and Mohnian Stages, and the *B. oblique* zone ("Delmontian").

At other localities where biostratigraphic and isotopic data are available, the rocks termed Monterey are not exact time equivalents of the type foramation, an observation made earlier by both Kleinpell and Bramlette.

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Novel Approach to Eh-pH Diagrams and Their Relation to Uranium In-Situ Leaching

When constructing Eh-pH diagrams, workers have previously assumed a fixed total concentration of a substance in solution, and calculations (assuming equilibrium) were made to predict mineral phases and aqueous species at various Eh-pH conditions. When dissolving a solid compound (as in in-situ leaching), it seems more plausible to assume a solid phase in solution at various Eh-pH conditions and allow the aqueous species the freedom to assume thier equilibrium concentrations.

The computer program EHPHUR was written to thermodynamically simulate the dissolution of a solid phase leading to diagrams which differ markedly from conventional Eh-pH diagrams. The name proposed for these new diagrams is dissolution diagrams. The assumptions include unit activity of uraninite, and fixed amounts of O_2, CO_2, and H_2S at 25°C and 1 atm. The parameters were chosen to simulate in-situ leaching systems currently in use.

Using these diagrams, thermodynamic arguments can be presented which are consistent with the results of kinetic experiments, for example: the first and zero order dependence of the uraninite dissolution rate on the carbonate concentration; the decrease in the dissolution rate as the pH approaches 6.0; and the dependence of the rate on the oxygen and hydrogen ion concentrations. Apparent optimum pH values for in-situ leaching are discussed.

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Methane from Coal Beds—an Exploration Approach

Vast amounts of methane are trapped in much of the unmined and unminable coal in the United States. This virtually untapped unconventional source of clean energy should become economically viable within the next few years. Consequently, it should be viewed as an important new exploration frontier.

An approach to coal-bed methane exploration involves a combination of coal and conventional gas exploration strategies. Because coal beds are both the source and the reservoir of the gas formed during the coalification process, the subsurface extents of the coal beds define the geologic dimensions of the resources of coal-bed methane. The amount of producible methane in a given coal bed is highly variable, being a function of the depth of burial, the rank of the coal, the degree of fracturing, and the permeability of the contiguous strata. Consequently, the successful search for producible quantities of coal-bed methane requires an understanding of the depositional and diagenetic history of coal.

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Geomorphic Features of Shelf-Slope Revealed by Sidescan Sonar Images

Recently acquired sidescan sonar images reveal, for the first time, the landscape pattern and the detailed geomorphology of the North Atlantic shelf-slope break off the United States and other areas extending from the edge of the continental shelf to the upper slope. Long-range (GLORIA II) images that have swath widths of as much as 40 km show small-scale regional features; midrange images that have swath widths of as much as 5 km show features as small as 3 m across.

The midrange images show that the outer edge of the shelf, deeply embayed by submarine canyons, outlines a nearly flat surface marked by complex ripple patterns. In places, the slopes converging toward adjacent canyons are also complexly rippled; this feature suggests that the shelf surface and the upper canyon slopes are mutually stable under common