fields on the Norwegian Shelf (Egeberg and Aagaard).

Thermodynamic considerations of the present-day formation water composition from Triassic-Jurassic strata predicted late diagenetic minerals within the three temperature zones (Aagaard and Egeberg).

FUTURE DIRECTION

Since modeling of basin evolution requires a detailed understanding of mechanisms regulating mineral alteration, experimental verification of such mechanistic steps is necessary. Unfortunately, experimental verification lags far behind theoretical advances in geochemical modeling.

As geochemical models are developed and computer codes modified, work on quality assurance checks for these models is imperative. Testing of these models in natural geologic settings and laboratory experiments must continue to demonstrate their accuracy.

ERRATA

William V. Maloney's abstract for the AAPG Rocky Mountain Section Meeting, "Hydrodynamics of Minnelusa Formation, North Powder River Basin, Wyoming" (*AAPG Bulletin*, v. 71, no. 8, August 1987, p. 1011), contains an error. The next to last sentence should read as follows:

"Hydrocarbon migration syn/post hydrodynamics will result in the majority of hydrocarbons moving toward the area of minimum potential energy."

In the paper "Estimating Drilling Direction for Optimum Production in a Fractured Reservoir" by Richard C. Nolen-Hoeksema and J. H. Howard (*AAPG Bulletin*, v. 71, no. 8, August 1987, p. 958-966), the following corrections should be made to the text in the left-hand column on page 960.

The sentence that immediately follows equation 3 should read: "The function P (equation 2) is either a minimum or a maximum when $\partial P/\partial \kappa$ equals zero."

The first complete sentence that follows equation 4 should read: "Thus, $\partial P/\partial \kappa$ equals zero corresponds with a maximum value for P (equation 2) when θ equals κ, the second derivative of P being negative."

In final form, the expression "$\partial P/\partial \kappa$" inadvertently was typeset incorrectly to read " = P/ = κ" in both cases.

DISTINGUISHED LECTURE TOURS, 1987-1988

Abstracts

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Yates Field, West Texas: Thousands of Caves, Millions of Years, Billions of Barrels

Since its discovery in 1926, the Yates field has produced 1.04 billion bbl of oil from an estimated original oil in place of approximately 4 billion bbl. The reservoir produces from Upper Permian dolomites, siltstones, and sandstones at depths from 1,000 to 1,900 ft (305 to 580 m). Wells with extraordinary flow rates were common during the early life of the field. Of the 636 wells drilled before unitization of the field in 1976, 203 potentialed for more than 10,000 BOPD, 26 for more than 80,000 BOPD, and one for more than 200,000 BOPD.

These remarkable early productivities were due to several geologic factors: (1) reservoir pressures that were considerably in excess of those needed to support flowing wells; (2) an immense network of reservoir pores, ranging in size from micropores to small caves, tied together by open fractures; and (3) an oil column that, at discovery, filled at least 350 ft (107 m) of closure in the broad Yates dome, which covers an area of 35 mi^2 (91 km^2).

Stratigraphic units in the Yates field reservoir are of Guadalupian (Kazanian) age. The units consist of the upper San Andres dolomite (the principal reservoir unit), overlain unconformably by Grayburg siltstones and silty dolomites; Queen dolomitic siltstones and sandstones; and lenses of dolomitic sandstone in the basal Seven Rivers, the formation whose thick anhydrites complete the trap. The San Andres is comprised of two major depositional facies. The first, characteristic of the formation in westside Yates, is an intertidal and lagoonal unit of compact dolomitic mudstones and wackestones and bedded clay shales. The second is dominated by porous, subtidal grain-supported bioclastic dolomites rich in fusulinids and calcareous algae, and is typical of the formation in the eastside. The facies boundary between eastside and westside in the San Andres moved eastward through time and thus displays the prograding relationships found in many fields along the margins of the Central Basin platform in the Permian basin of west Texas and southeast New Mexico. One small framestone reef composed mostly of colonial corals and *Tubiphytes* has been recognized in core from the upper San Andres in a well at the eastern edge of the field. Much of the present structure on the reservoir was developed during the latest Permian and may be related to renewed movement along deep faults which had been active during the Pennsylvanian and Early Permian.

In the upper 60 ft (18 m) of the San Andres, chiefly in eastside Yates, evidence of karstification is abundant, including banded cave cements, cave sediments, collapse breccias, and solution pores ranging in size from small vugs to caves. More than 300 San Andres caves have been detected by wireline logs or as bit drops, and must represent a cave population numbering in the thousands. Most of the caves and other karst features were developed by processes associated with dynamic freshwater lenses beneath a cluster of islands formed when Late Permian lowering (or lowerings) of sea level exposed the upper San Andres, then limestone, to rainfall and dissolution. Evidences of karst are also present in the Grayburg dolomites but are less common than in the San Andres. They probably represent local subaerial exposure of relatively short duration.

Infill drilling, logging, and coring since unitization have greatly enhanced geologic knowledge about the Yates field reservoir. This knowledge is being combined in many ways with engineering data and techniques to support management of the reservoir during the remaining field life.

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Evaluating Seals for Hydrocarbon Accumulations

Seals are an important and often overlooked component in the evaluation of a potential hydrocarbon accumulation. Effective seals for hydrocarbon accumulations are typically thick, laterally continuous, ductile rocks with high capillary entry pressures. Seals must be evaluated at two differing scales: a "micro" scale, and a "mega," or prospect, scale. Quantitative micro data measured on hand specimens are difficult to extrapolate a billionfold to the scale of the sealing surface for a hydrocarbon accumulation. Fortunately, each class of exploration prospects has a different set of seal problems. Geologic work can be focused on the characteristic seal problems that plague classes of prospects. Anticlines have relatively little seal risk, since any zone serving as