shales and bioturbated siltstones is characterized by a nodular habit, fine-grained spherulitic texture, and calcite-filled fractures, in contrast to the coarse lozenge-shaped or anhedral siderite that rims voids and replaces pebbles and sand in conglomerates and sandstones.

Modular siderite is believed to form early in diagenesis, just below the water interface. Coated clay particles transport ferric oxides to the site of deposition, where they are precipitated in a colloidal gel; organic debris provides a source of carbonate ions and establishes reducing conditions. To insure low sulfide concentration, rapid sedimentation excludes marine sulphate ions which might otherwise be reduced by anaerobic bacteria to form HS^- or H_2S (the environment is abiotic).

Based on its replacive nature, the coarse siderite is interpreted to be late diagenetic. The source for iron and carbonate ions may be linked to mudstone diagenesis, or to remobilization of early siderite.

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Filament-Producing Hydrocarbons in Palynology Preparations

Palynologic preparations often contain solid hydrocarbons that are difficult to distinguish from resin cells, simple fungal spores, and some organic debris. A chemical-physical reaction by bitumens on prepared glass slides is accomplished by using two dissimilar mounting media. The resulting extrusions by "petrolic filament bodies" permit easy identification of "asphaltenes." Some asphaltenes appear to be secondary pore fillings, some suggest algal origin, and others apparently illustrate initial expulsion of generated hydrocarbons from amorphous kerogen.

The presence of solid hydrocarbons in palynology samples may have utility in petroleum exploration by identifying "minishows," suggesting possible hydrocarbon migration, identifying thrust faults, and in providing a warning of possible drilling-mud contamination.

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Cement Types and Cementation Patterns of Middle Ordovician Ramp-to-Basin Carbonate Rocks, Virginia

Middle Ordovician ramp-to-basin carbonate rocks of Virginia consist of peritidal fenestral limestone, shallow subtidal cherty wackestone, shallow ramp and downslope skeletal buildups, deep ramp shaly fossiliferous wackestone, and basinal black limestone and shale. Preburial marine cements in buildups include turbid rim cement on pelmatozoans, isopachous pseudoacicular cement, and coarsely crystalline neospar cement occurring on polycrystalline substrates. Line cavities predate other cement types and are interlayered with internal sediments. Later, nonferroan clear rim and equant cements fill remaining pore spaces in buildups. Nonferroan equant cement and internal sediments fill fenestrae in peritidal facies. These cements consist of several cathodoluminescent zones (from oldest to youngest): (1) nonluminescent black zone (in buildups) or nonluminescent passing into subzoned dull luminescent (in tidal flats); (2) thin, brightly luminescent zone; and (3) dull luminescent zone (or hydrocarbon or dolomite cement). Petrographic relations indicate that in buildups the black and thin bright zones are burial cements formed from formation waters expelled from compacting basinal facies prior to hydrocarbon migration whereas the dull zone is deeper burial in origin and is synchronous with or postdates oil migration and emplacement. In contrast, the bulk of the peritidal cement zones are preburial and formed from vadose to shallow phreatic waters. This is indicated by occurrence of black and bright cements that occur as pendant crystals or line fenestrae, presence of crystal silt which abuts all zones, and by erosion surfaces that truncate the dull cement zone.

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Deep Stratigraphy and Evolution of Baltimore Canyon Trough Based on Multifold Seismic Reflection, Refraction, Gravity, and Magnetic Data

A recent 48-channel seismic reflection profile (U.S. Geological Survey line 25) extends 330 km southeast off southern New Jersey and crosses the widest and deepest part of the Baltimore Canyon Trough (10 km southwest of the COST B-3 well). The profile has been migrated and converted to depth to reveal the deep sedimentary and basement structures across the ocean-continent transition zone. The sedimentary wedge thickens from 5 km nearshore to 17 km just landward of the East Coast Magnetic Anomaly (ECMA; 20 km landward of the shelf edge in this area). A strong, flat reflector about 10 km wide exists at a depth of 14 km, directly beneath ECMA. Acoustic basement becomes obscure and appears to rise to a depth of 5 km over the next 40 km to the southeast, beneath a Jurassic and lower Cretaceous carbonate shelf-edge complex which extends 20 km seaward of the present shelf edge. Landward-dipping continental rise sediments exist to a depth of at least 13 km on the seaward side of the Jurassic shelf edge. The top of oceanic basement is first seen as a set of prominent hyperbolic reflectors about 50 km seaward of the Jurassic shelf edge, where it occurs at 11 km depth and dips gently landward. It is obscured landward of this point by the prominent middle Jurassic (J_3) horizon.

A Jurassic and lower Cretaceous shelf-edge carbonate platform or reef complex prograded 40 km out over oceanic crust in this area. Greater differential subsidence and compaction of the basin west of the ECMA have produced back-tilted and arched horizons in the Jurassic and lower Cretaceous shelf edge units, creating a 20-km-wide anticline with 500-m closure beneath the upper continental slope. Other lines to the southwest indicate the anticlinal arch extends at least 40 km to the southwest. Similar "slope anticline" structures have been reported off northwest Africa.

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Petroleum Exploration of National Petroleum Reserve in Alaska (NPRA)

Naval Petroleum Reserve No. 4 was designated as the

National Petroleum Reserve in Alaska by the Naval Petroleum Reserves Act of 1976 and jurisdiction was transferred to the Secretary of the Interior. Beginning June 1, 1977, the U.S. Geological Survey was charged with the responsibility to (1) continue the petroleum exploration program, (2) expand production of natural gas at Barrow for local consumption, and (3) environmentally rehabilitate those parts of the reserve disturbed by previous exploration and construction activities.

All of these activities are accomplished through a contract with Husky Oil NPR Operations, Inc.; the activities were previously supervised by the U.S. Navy in 1975 and were assumed in 1977 by the Department of the Interior. The U.S. Geological Survey provides technical and contract supervision and makes the final determination of the exploration strategy. Sixteen plays have been defined on the basis of geological and geophysical parameters to assess the petroleum potential and aid in management and land-use decisions.

From 1974 to June 1, 1977, the Navy drilled seven test wells and completed 7,680 line mi (12,360 line km) of a planned 26-well and 10,000 line-mi (16,093 line km) seismic program. All test wells were drilled in northern NPRA along trend with Prudhoe Bay. At the W. T. Foran test well on the Arctic Coast, the Sadlerochit Formation (the principal reservoir at Prudhoe) had good porosity and permeability with residual oil. The other wells had minor shows of oil and/or gas.

Twelve test wells were included in the program for fiscal years 1978 and 1979. Eight have been completed with shows of oil and gas; the J. W. Dalton well on the Arctic Coast produced a few barrels of heavy oil, but there were no commercial discoveries. A five-well exploration program is projected for fiscal year, 1980.

One exploratory and two development gas wells were drilled at Barrow in 1978. The two producible wells in a new section of the Barrow gas district were tied into the pipeline system that delivers gas to the Barrow communities.

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Mississippian Shelf Margin and Carbonate Platform from Montana to Nevada

The Kinderhookian to middle Meramecian history of a carbonate platform and shelf margin, extending from Nevada to Montana, is documented through four time-rock correlation charts and five successive maps that are synchronized by foraminiferan, conodont, and coral zonations. The platform was bordered on the west by a starved basin, a flysch trough, and orogenic highlands. The history of platform development is an integral part of the sedimentary cycle of the deep-water Deseret starved basin. Antler orogenic activity produced epeirogenic movements on the craton, which affected sea level and caused episodic progradation and retreat of the carbonate shelf margin. The sequential history is: (1) in earliest Mississippian time a narrow, northeast-trending seaway bordered by low coastal plains received mostly fine clastic sediments; (2) during late Kinderhookian time, a carbonate platform and shelf margin formed as a result of eastward expansion of the seaway; (3) during early Osagean time, the shelf margin retreated and a broad, gentle (less than 0°5′) clinoform ramp developed; (4) during middle Osagean time, lowering of the basin and craton and rise of sea level changed the pattern and sedimentary regime of the carbonate platform. Progradation of the shelf margin over the former ramp resulted in maximum expansion of the platform concurrent with maximum deepening of the starved basin. The foreslope attained a maximum steepness of 5°; (5) in middle Meramecian time, uplift of the craton and lowering of sea level caused shoaling of the carbonate platform and development of a sabkha landward. With increased uplift a karst plain developed over most of the former carbonate platform, and some cratonic sands were transported westward by streams into the basin. Meanwhile, filling of the flysch trough allowed eastward spillover of distal-flysch sediments to almost completely fill the basin.

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Petroleum Possibilities in Altar Desert, Sonora, Mexico

A late Miocene-early Pliocene marine basin has been identified in the northwestern corner of the State of Sonora, Mexico. The existence of the Altar basin has been established by geophysical means. Its stratigraphy and hydrocarbon generation potential are known from the geologic history of the adjoining areas.

The geology of the Altar basin is compared to basins of the same age in California which have been proven to contain more than 27 billion bbl of oil. The San Andreas fault system is a very important factor in the oil possibilities of the region.

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Foreign Frontiers—An Overview

Undiscovered potential in foreign frontiers is believed to be substantial. This potential is located in moderate and harsh physical environments. Very little exploration has been conducted in these basins and the majority are classified as essentially unexplored. These areas are not geologic mysteries and it is highly possible that they can contribute large increments of discovery. The attractive possibilities which exist in these foreign frontiers must not be overlooked, therefore, all must be adequately explored. Major exploration activities should begin in these areas as soon as possible if they are to have any impact on new reserves and production before the end of this century. Governments controlling harsh frontier areas are beginning to recognize the high costs and risks incurred in exploring and operating therein and are beginning to offer greater incentives to those willing to undertake the environmental challenges.

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Application of Ecologic Studies of Living, Algal Symbiont-Bearing Foraminifera to Paleoecologic Interpretation