

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  $\text{HS}^-$  or  $\text{H}_2\text{S}$  (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 down-slope skeletal buildups, deep ramp shaly fossiliferous wackestone, and basinal black limestone and shale. Pre-burial 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 pre-burial 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