

appears to have been a function of sedimentary facies and early dolomitization, coupled with freshwater invasion and solution. Intercrystalline (dolomitic) and vuggy (solution) porosity are present throughout the section but are particularly conspicuous in the open-shelf and shoal facies where they reach values of 6-10%. These particular facies had a higher relative abundance of mineralogically metastable skeletal grains and accommodated greater pore-water flow during early diagenesis. Reservoir quality in these facies has been significantly enhanced by good fracture permeability.

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Variations in Diatom Abundance in Chesapeake Group (Miocene-Pliocene) in Maryland and Virginia: A Reflection of Changes in Water Circulation and Tectonics

Diatoms are abundant in much of the Calvert and Choptank Formations (lower to middle Miocene), and are not abundant in the Eastover Formation (upper Miocene). No significant accumulations of diatoms have been observed in the St. Marys Formation (middle and upper Miocene), Yorktown Formation (lower and middle Pliocene), and sub-Chesapeake deposits. The distribution and abundance of diatoms in the Salisbury embayment were probably affected by two main factors: availability of nutrients and dilution by deposition of terrigenous clastic sediments. Beginning during the early Miocene, massive, long-term diatom blooms may have been supported by a steady, abundant supply of silica, nitrogen, phosphorus, and other nutrients transported by upwelling cold water from northern regions. The diatom-rich, silty-sand deposits also indicate a relatively slow influx of terrigenous sediment. The paucity of diatoms in some Miocene and Pliocene deposits is primarily due to increased sedimentation resulting from tectonic uplift in the Piedmont and Appalachian source areas adjacent to the Salisbury embayment. Other factors that affect diatom abundance are environment of deposition (proximity to beach or river mouth), an increase in clastic sedimentation coincident with a sea level drop due to Antarctic glaciation, and postdepositional intrastratal solution of diatoms by circulating ground water.

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Subsurface Geology of the Pamlico Sound Area, Coastal North Carolina

The subsurface of the Pamlico Sound area in North Carolina contains the state's thickest drilled succession of Mesozoic-Cenozoic strata. The subsurface geology of approximately 1,800 mi² of northern Pamlico Sound was investigated using logs and cuttings from seven wells and about 135 mi of multichannel reflection seismic line.

Crystalline basement rocks dip about 1.2° east-southeast. The overlying strata, which range in thickness from 5,145 ft (Albemarle Sound area) to 9,860 ft downdip (Cape Hatteras), are not significantly affected by faulting. Jurassic(?) through Eocene sediments all appear to have accumulated within a gently subsiding, marine-shelf environment. Four distinct lithofacies characterize these strata. The basal Unit 1 (La Casitan-Trinitian) reflects a westward transgression of coastal sandstone, outer shelf mud, and carbonate across shallow shelf to lagoonal deposits. Unit 2 (Trinitian-Washitan) is an upward-coarsening detrital sequence which terminates with discontinuous, marine-shelf sandstones that reflect a northerly source. An abrupt transition into marine-shelf mudstones and limestones marks the base of Unit 3 (Woodbinian-Austinian); these are abruptly overlain by interbedded shelf sandstones that merge to the southwest. Unit 4 (Tayloran-Claibornian), the uppermost interval studied, is characterized by thick, widespread marl, which grades into glauconitic sandstone and finally marine limestone.

Continuous seismic reflectors occur at the basement interface and the top of Units 2 and 4. A reflector, possibly a stratigraphic discontinuity, occurs at the top of the Cretaceous in Unit 4. Well-developed prograding seismic sequences occur above Unit 4.

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X-Radiography of New Albany and Chattanooga Shales (Devonian) Along Cincinnati Arch in Kentucky

Sedimentary structures and composition in the New Albany and Chattanooga Shales (Devonian) along the western flank of the Cincinnati arch in Kentucky help define seven lithofacies. These lithofacies, recognized by x-radiography, are: (1) organic-rich laminated shale, (2) bioturbated greenish-gray shale, (3) indistinctly laminated greenish-gray shale, (4) siltstone, (5) fine-grained sandstone, (6) carbonate, and (7) authigenic mineral phases. The organic-rich laminated shale is dominant and can be divided into three subfacies: (a) organic-rich thinly laminated shale, (b) organic-rich thickly laminated shale, and (c) organic-rich laminated shale with current stratification. This current stratification is in the form of discontinuous laminae, ripples, cross-beds, and scour surfaces. The carbonate and authigenic mineral phases refer to early (diagenetic?) formation of carbonates, sulfates, sulfides, and phosphates.

Areal and vertical distribution of these lithofacies in the New Albany and Chattanooga Shales in western-central Kentucky are interpreted to show the influence of the paleo-Cincinnati arch. The organic-rich, thinly laminated shale is dominant in the basins on the flanks of the arch and occurs on the arch. This facies records episodic deposition in quiet, anaerobic waters. The organic-rich thinly laminated shale with current stratification is dominant on the arch and is interpreted as evidence of episodic deposition in an anaerobic environment with weak bottom currents. Indistinctly laminated, greenish-gray shale and bioturbated greenish-gray shale facies are representative of a dysaerobic environment. Siltstone and fine-grained sandstone facies are also present in small amounts, mainly near the base of the section. Carbonate and authigenic minerals are indicators of paleosalinity, oxygen content, and conditions of Eh, and support interpretations of the other associated lithofacies.

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In-Situ Elemental Analysis of Coal and Strategic Metals by Neutron Activation

Starting in 1969, the U.S. Geological Survey (USGS) developed neutron techniques for borehole measurement of the elemental composition of ores, and it successfully made a borehole ultimate analysis of coal in 1977. Borehole measurements permit real-time evaluation of ore quality without the expense of coring or the delays and expense associated with laboratory analyses. Two technological innovations have made such measurements possible: the availability of small californium-252 fission neutron sources from the Savannah River Operations Office of the Department of Energy, and the development, by USGS and Princeton Gamma-Tech, of the melting-cryogen-cooled high-purity germanium borehole gamma-ray detector. A technique of relating mass fractions to measured gamma-ray intensities, which eliminates the need for detailed knowledge of the geometry of the neutron distribution, was used to calculate elemental compositions without using test pits or computer borehole modeling. Most of the common elements in the earth's crust can be detected by neutron techniques. In coal all of the major constituents except oxygen (C, H, N, S, Si, Al, Fe, Ti) can be determined quantitatively by thermal neutron capture gamma-ray spectroscopy. The latest innovation in this field is the replacement of the ²⁵²Cf neutron source with a neutron generator, a type of ion accelerator. These generators, used for many years by the petroleum logging industry, produce neutrons having an energy of 14 MeV. The neutron generator is a safer tool than californium, because no radiation is emitted by the device until it is turned on in the borehole. Coupling a neutron generator with a high-resolution detector to form a borehole measuring system was pioneered by workers at Sandia National Laboratories. USGS has built and put into service one neutron generator based on the Sandia design, and now is building a second. This new device enables the experimenter to use higher energy (n,n'), (n,p), (n,2n), and (n,α) reactions as well as the (n,γ) thermal neutron capture reaction. Both the (n,n') and the (n,p) reactions on ¹⁶O permit quantitative measurement of oxygen, and the inelastic scattering excitation of carbon in coal provides increased sensitivity over that of the (n,γ) reaction. Reactions caused by 14 MeV-neutron irradiation that are used in exploration for strategic metals such as Cr, Ni, Mn, V, Co, Ti, and W are tabulated.