Abstracts*

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Great Stone Dome—Great Disappointment?

Baltimore Canyon Trough's Great Stone dome is one of the largest, most prominent subsurface structural features in the Atlantic offshore. The dome, with nearly 140,000 ac under closure and more than 11,000 ft of structural relief, was formed by the early Late Cretaceous intrusion of a large mafic igneous body. The uplifting resulted in a major Barremian unconformity across the dome along with minor higher unconformities.

The dome was the site of intense bidding during 1976 when $651 million was bid for 37 tracts including $107.8 million for one crestal tract. Seven wells were subsequently drilled on the dome to total depths from 12,000 to 17,449 ft. The wells penetrated Cretaceous and Jurassic sandstones with porosities ranging up to 30%, but none encountered pay or significant shows. Lack of hydrocarbons in the section tested appears to be a result of low organic matter content of shales. Thermal maturation profiles show source rocks changing abruptly from immature to overmature across the Barremian unconformity. If hydrocarbons were generated (probably gas), lack of adequate seals at or above the unconformity prevented entrapment in crestal parts of the structure.

The seven wells mainly tested structural traps on the dome. Additional prospects remain to be tested, such as possible flank fault traps and stratigraphic traps formed by sands pinching out around the dome's flanks where mature source rocks are likely to occur.

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Anchizone Metamorphism in Triassic Sedimentary Rocks of the Newark Basin, Pennsylvania–New Jersey

The degree of crystallinity of authigenic illite was determined, by x-ray diffraction, for samples from the Lockatong Formation (Triassic) of the Newark basin of southeastern Pennsylvania and adjacent New Jersey. Sixteen samples from approximately 30 m of section in the lowermost Lockatong near Trooper, Pennsylvania, were analyzed.

Preliminary results ranging from 22° to 41° $\Delta 2\Theta$, indicate a range of metamorphism extending through the anchizone to the boundary with the greenschist facies, and indicate that the rocks were subjected to temperatures of ~300°C for a period of time.

An episode of elevated temperature might have resulted from proximity to an intrusive rock body, from burial a short distance beneath a lava flow, or from burial beneath ~8-10 km of overlying rock. None of these proposed mechanisms is consistent with the geologic evidence; another explanation for such a high temperature must be sought.

Four other samples from widely distributed localities within the Newark basin also fall within this range of illite crystallinity. Samples from the Gettysburg basin and the Connecticut basin are less well crystallized, suggesting that the thermal event hypothesized here was restricted to the Newark basin.

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The Barhamsville Unit: An Intertidal to Fluvial Sequence Between Yorktown and Windsor Formations, Southeastern Virginia

The Barhamsville unit represents a major phase of deposition in the southern Salisbury embayment during the late Pliocene. Deposition was dominantly intertidal to nonmarine. On the York-James Peninsula and south of the James River, the unit unconformably overlies the marine Yorktown Formation or, to the west, older Tertiary units and is cut into and overlain by the Windsor Formation.

The Barhamsville unit is the major surficial unit of the region and ranges in thickness from near 0 m at its westernmost exposure to 20 m in paleochannels. The unit contains an eastern tidal flat complex consisting of mixed flat, lower flat, and tidal channel deposits and a western fluvial and reworked fluvial complex consisting of coarse-grained, gravelly, nearshore(?) and fluvial channel deposits. These coarse-grained deposits are overlain by fine-grained marsh(?) and estuarine(?) deposits.

Antecedent topography may have had an influence on deposition of the unit. Structure contours on its base show a gently seaward-dipping surface, which is channeled along its western margin near the present James River. This surface has a distinct break in slope coincident with the tidal-flat nearshore/fluvial boundary. The break in slope is considered to be an erosional rather than a structural feature. Direct dating of the Barhamsville unit is not available due to a lack of body fossils and pollen. It's age is considered to be late Pliocene based on stratigraphic position.

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Sedimentology of Mississippian Price Delta in Southeastern West Virginia

The Price (Pocono) delta in southeastern West Virginia is the final westward prograding sequence of the Acadian clastic wedge. A 256-m section exposed near Caldwell provides an excellent reference section. The Price delta was composed of a subaqueous delta platform rimmed by shoreface sands. Protected from marine processes on the platform, distributary channel and mouth-bar systems in a shoal-water deltaic complex built rapidly westward into the foreland basin waters approximately 100 m deep.

The Appalachian basin was oxygen-deficient during Early Mississippian (Kinderhookian) time. Dark, Sunbury-type silt-shale lithosomes recur in the stratigraphic sequence and mark transgressive periods of decreasing clastic influx and an increased rate of basin subsidence, which brought dysaerobic prodeltaic facies onto the delta slope and front.

Prodeltaic facies contain phosphate pebbles in commonly laminated, dark silt-shales. At the toe of slope, turbidites in BC and BCE sequences occur. Distal tempestites occur on the upper delta slope. Fine-grained sands on the shoreface delta front contain siderite/quartz pebble pavements from storm events. The delta platform edge is marked by a sand-bar system. Back-bar sheet sands on the delta platform contain an abundant fauna in shelly lags. The inner platform contains flaser bedded, dark shales, silts and fine-grained sands in interdistributary bays, mouth bars, low-energy beaches, and mud flats.

Distributary channels on the delta plain contain mud/coal clast and siderite pebble conglomerates and coaly stringers in large-scale, trough cross-bedded, medium-grained sands. Maccrady red beds of the coastal plain cap the deltaic sequence.

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Regional Analysis of Distribution of Catskill Deltaic Sands in Northern West Virginia

Detailed mapping of "clean" sandstones of the Hampshire and Pocono formations of northern West Virginia illustrates paralic facies of north-south trend, intersected by belts of sandstones with east-west trends representing fluvial and tidal channel facies. The strike-trending paralic sandstones commonly have maximum thickness of 20 to 30 ft, and successive isopach maps of individual sandstones indicate irregular shifts that are interpreted to represent embayed shorelines advancing and retreating in uneven fashion. These small-scale changes affect small segments of the shoreline and probably result from fluctuations in sediment supply related to upstream avulsion or stream capture. Isolith maps of multiple sandstones of intervals such as the Fifth, Fourth, Gordon, Thirty-foot and Fifty-foot, show greater shoreline shifts probably due to sea level changes.

Regional cross sections through the Catskill clastic wedge show vertical stacking of shoreline sands in a belt with north-south trend. This preferential zone of subsidence is bounded on the west by the eastern margin of the Rome trough, and on the south by the northern edge of the Pocono dome. This interpreted subsidence increases southward toward the Pocono dome, suggesting basement sub-blocks with southerly tilt.

*Denotes speaker other than senior author.

Dip-trending sandstones show southeast-northwest trends with a large degree of vertical persistence. Major fluvial axes occur approximately every 40 mi along strike and may also be a reflection of basement structure.

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Sedimentology of Loyalhanna Member ("Big Injun Sand") of Mississippian Greenbrier Limestone

The Loyalhanna is a sparsely fossiliferous, distinctively cross-bedded, sandy calcarenite and calcareous sandstone. It occurs along the outcrop belt and in the subsurface of Pennsylvania and West Virginia where it is less than 100 ft (30 m) thick. In West Virginia, the Loyalhanna has produced more than 200 million bbl of oil, accounting for much of the state's total oil production.

In thin section, Loyalhanna lithologies consist of grainstones with varying proportions of quartz, ooids, fossils, and peloids. Quartz was introduced from a northern source area, and ooids were transported by currents from shoals to the south. Skeletal grains include crinoids, bryozoans, ostracodes, and foraminifera. Peloids are mainly micritized ooids and fossils.

The environmental setting was a high-energy, sublittoral sand flat that extended along the northern coastline of the Mississippian embayment into the central Appalachians. The sediment was deposited as low-relief sand waves with an internal structure of avalanche-style cross-bedding. As the sand built up, the cross-bedded units were capped by horizontal beds. Cross-bedding indicates that sand waves migrated to the northeast under the influence of longshore currents. Minor fluctuations in sea level and sedimentation rate produced a widespread blanket sand.

In the producing areas of West Virginia, porosity development has resulted from early dolomitization. Intercrystalline and moldic porosity is good, typically reaching 15-25%. However, this combination of porosities, which is closely related to original sedimentary textures, has led to only fair permeability and a fair recovery efficiency for the unit.

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PRESTO—A Program for Estimating Oil and Gas Resources

PRESTO (Probabilistic Resource ESTimates, OCS) is a computer program developed to provide resource estimates for offshore areas considered for leasing by the federal government. The program uses Monte Carlo simulation techniques to "drill" prospects that are geologically defined by the user, and then calculates resources using a volumetric formula. Resource estimates are given as probability distributions that reflect uncertainties in the physical representation of the prospects, rather than as single-point values or qualitative assessments. The program also incorporates a number of levels of geologic risk.

Four types of hydrocarbon resources are assessed for each reservoir: oil, associated and nonassociated gas, solution gas, and condensate. All are reported as distributions that can be converted and aggregated to a distribution for equivalent barrels of oil.

Unlike subjective resource estimation methodologies, the program provides reproducible results and can be used in frontier areas as well as mature producing basins. In addition, it provides an analysis of hydrocarbon potential at the zone and prospect levels, which can then be aggregated for basin and planning area estimates.

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Origin of Quartzarenites in Upper Mississippian and Lower Pennsylvanian of Appalachian Basin

Quartzarenites in the Upper Mississippian and Lower Pennsylvanian of the central Appalachian basin have been attributed to fluvial or beach-barrier depositional environments. As part of the USGS basin analysis program, we reevaluated existing data and concluded that quartzarenites were deposited primarily in a high-energy marine environment dominated by tidal currents. These deposits are linear, trend toward the southwest, and are roughly parallel to the axis of the Appalachian geosyncline. Herringbone structures and bioturbation are abundant in the upper part of the deposits and near their margins. The lower and central parts of the deposits commonly display unidirectional festoon cross-beds having amplitudes up to 1 m. Basal contacts tend to be sharp and erosional in the high-energy central parts but are gradational near the margins. The spatial relation of these sandstone deposits to marine facies, their widespread distribution, and their lateral continuity are more compatible with a marine-dominated rather than fluvial origin. Their textural and mineralogical maturity also indicates winnowing typical of a high-energy marine system. Sedimentary structures typical of beach deposits or fluvial systems are rare.

These sandstones were apparently deposited in an epicontinental seaway, which, at times, may have been open at both ends. Because of the configuration of the basin, tidal and geostrophic energies were dominant over wave energy; tidal basin deposits predominated, and wave-energy beach-barrier deposits were rarely preserved. Ebb flow carried the winnowed fines into the southwestern part of the Appalachian basin or into the Ouachita geosyncline. Similar hydrodynamics and sediment transport occur today on the Sunda Shelf, the Bay of Fundy, and in the Bering Sea.

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Mississippian-Pennsylvanian Unconformity near Somerset, South-Central Kentucky

The Mississippian-Pennsylvanian systemic boundary near Somerset, south-central Kentucky, is unconformable. Contact relationships in eastern Kentucky are controversial because of unclear genetic associations displayed by Chesterian(?)-Morrowan Lee Sandstone lobes, which have been interpreted as being of either barrier-beach or fluvial-deltaic origin. The barrier shoreline model stipulates that Meramecian, Chesterian, and Morrowan rocks represent carbonate sediment barriers and carbonate mud islands, offshore clays, quartzarenite barriers, and lagoonal-tidal flat sediments that were penecontemporaneously deposited during northwesterly progradational episodes. The tabular erosion model stipulates that Meramecian, Chesterian, and Morrowan(?) predominantly marine sediments were deposited and lithified as tabular units before and penecontemporaneous with deposition of Chesterian(?)-Morrowan fluvial-deltaic sediments.

Field study of exposures near Somerset indicates that the tabular erosion model satisfactorily explains contact relationships. Tidal flat, tidal channel, and lagoonal lithofacies without barrier sandstones are unconformably overlain by southwesterly progradational fluvial-dominated deltaic lithofacies. Elongate, fining-upward sandstone bodies typically above coal seams, which are oriented parallel with the southwesterly paleoslope, display lag concentrates of carbonized plant debris, epsilon cross-stratification (or apparently lack of stratification), and low-energy ichnofacies, and are enclosed in deltaic lithofacies.

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Structural Styles and Tectonic Implications of Richmond-Taylorsville Rift System, Eastern Virginia

Recent drilling and seismic surveys in the Richmond basin have revealed unexpected results. Alternating episodes of extension and compression have created overprints of structural styles, and generated syndepositional unconformities as sediments were uplifted and rotated. Eroded Triassic sediments from structural highs were redeposited in adjacent synclinal or fault-controlled lows.

In addition, lithologic correlation has revealed the existence of large deltaic complexes prograding across the basins, followed by Mississippi-size meander-belt channel deposits in the subsurface. The early lacustrine-deltaic deposits (Vinita beds, etc) appear to have been deposited in a basin much larger than the apparent outcrop limits of the Richmond or Taylorsville basins. As much as 3,000 ft of these deposits accumulated prior to a compressional event that folded them into enormous anticlines and synclines, as Paleozoic thrust sheets were reactivated and sub-Triassic buried hills grew in height, raising the overlying Triassic sediments by as much as 2,000 ft over a distance of less than 2 mi.