STEELMAN, RUTH E., Univ. South Carolina, Columbia, SC; VICTOR V. CAVAROC, North Carolina State Univ., Raleigh, NC; ALPHONSO R. GUIDICI, Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina

Productive Continental Block-Fault Deposits of a Mesozoic Back-Arc Basin

Continental sediments filling major extensional block-faulted basins in the rock record traditionally are ascribed to plate margin rifting. The Triassic Cuyo basin of central Argentina is such a continental sedimentary basin, which contains over 3,600 m of interbedded fluvial, lacustrine, and volcanic deposits and which produces about 98,000 BOPD. It, however, formed within a back-arc tectonic setting as a reentrant into the Pampean craton prior to the onset of compressional deformation. The southern half of this basin (about 9,000 km^2) was studied using logs and cutting descriptions from 101 exploratory wells.

The basin began as a series of subparallel fault blocks and accumulated at least 2,750 m of fining-upward detritus in its first cycle of sedimentation. Initial deposits were oxidized lithic conglomeratic units confined by elongated grabens. As faulting waned, high-gradient fluvial sandstones became prevalent (41%), derived primarily from reworking of interbedded felsic tuffs (29%). The end of tensional faulting is marked by widespread bituminous lacustrine shales that form the source beds for oil production. Broad basin subsidence, probably associated with lithospheric cooling, initiated a second episode of basin sedimentation in which tuffs and sediments containing fluvial sandstones (48%) markedly overlap the original basin boundaries. Sandy lag conglomerates of an intermontane braided-stream system cap the interval. These deposits were temporarily interrupted by valley basalt flows (Upper Jurassic-Lower Cretaceous), which are similar in composition to diabase dikes of the underlying strata.

SULLIVAN, E. M., and D. A. TEXTORIS, Univ. North Carolina, Chapel Hill, NC

Petrology of Upper Mississippian Denmar Formation, Greenbrier Group, East-Central West Virginia

The Denmar Formation of Randolph County is a package of interbedded marine carbonates and siliciclastics deposited on a broad subsiding carbonate platform. Seven major microfacies are recognized: terrigenous siltstone, dolomitized micrite, pelmicrite, biopelmicrite, quartzose pelmicrite, oosparite, and oomicrite. These microfacies characterize three major paleoenvironments: supratidal, intertidal, and shallow subtidal. Four major diagenetic realms are noted: the low supratidal flat containing evaporites and dolomite; the meteoric zone containing blocky calcite spar; the shallow marine phreatic zone with marine cement and micritized fossil fragments; and the burial zone containing mature stylolites.

The Denmar Formation represents a sequence of alternating low-energy, shallowing-upward pelmicrite-mudstone and higher energy, shallowing-upward oosparite-grainstone shelf cycles. The pelmicrite-mudstone cycles are mainly composed of intertidal and supratidal sediment. The oosparite-grainstone cycles are mainly composed of low and higher energy subtidal sediments.

Diagenesis occurred in both the marine and meteoric zones. Paleoenvironmental reconstruction of east-central West Virginia during deposition of the Denmar is attempted.

SWEENEY, JOE, West Virginia Geol. and Economic Survey, Morgantown, WV

Deformation Domains Around Burning Springs Anticline of Central Appalachians

Under a contract with the Gas Research Institute, the West Virginia Geological and Economic Survey has begun a two-year project to determine the relationship between Devonian shale production and certain geologic and technical factors, such as geologic structure. Six counties in western West Virginia were selected for study. The north-south-trending Burning Springs anticline bisects those counties and marks the western edge of the Salina salt basin. Two horizons were selected for structural datums—the base of the Huron Shale Member of the Ohio Shale (Upper Devonian), and the base of the Mississippian Greenbrier Group. Point-to-point contouring methods, rather than generalization, revealed deformation containing differing structural styles (domains) throughout the study area, and those domains may have a relationship to the Salina salt basin (Late Silurian).

Structural cross sections reveal that the southern end of the Burning Springs anticline is a gentle fold amplified by thrust faults, probably ramping up from a sole fault in the Salina salt beds. Mississippian, Pennsylvanian, and Permian strata are draped over those thrusts. Lineaments, as defined by structure contours, mark the boundaries of subthrust sheets along the Burning Springs anticline. Orientations of those structural lineaments coincide with orientations of mapped surface lineaments.

Oil production from the Devonian shales is confined to the eastern flank of the Burning Springs anticline in areas overlying the Salina salt basin, and may be related to fracturing caused by intense deformation, in contrast to less intense deformation of rocks west of the salt basin.

TALKIEWICZ, JOSEPH M., State Univ. New York at Buffalo, Amherst, NY, and GARY G. LASH, State Univ. New York at Fredonia, Fredonia, NY

Petrographic Trend-Surface Analysis of Martinsburg Sandstones of Eastern Pennsylvania and New Jersey: Significance and Implications

The Martinsburg Formation (Middle-Upper Ordovician) of eastern Pennsylvania and New Jersey, part of a flysch belt that extends from Newfoundland to Alabama, records Taconic orogenic events and foreland basin sedimentation in the central Appalachians. Facies analysis of the Martinsburg in eastern Pennsylvania and western New Jersey suggests that it was derived predominantly from longitudinal sources and did not accumulate as a typical submarine fan, as commonly believed. Petrographic trend-surface analysis of 45 samples of Martinsburg sandstone from Delaware Gap, New Jersey, to southeastern New York indicates: (1) an increase in total quartz content to the northeast; (2) a decrease in lithic fragment content to the northeast; and (3) a decrease in total feldspar content to the northeast. These results are consistent with overall compositional trends within the Martinsburg belt from southwest Virginia to New York, described in previous studies, and support a dominant source terrane to the southwest. Significantly, trend-surface analysis points out a lack of strike-parallel concentrations of specific framework components, thereby reinforcing a longitudinal dispersal system. Consideration of the Martinsburg sandstone in terms of published QFL diagrams suggests derivation from a recycled orogene source characterized by uplifted supracrustal sedimentary and lesser plutonic/low-grade metamorphic rocks, and points out the lack of a major volcanic input. This is further substantiated by preliminary geochemical examination of these sandstones, which supports sandstone accumulation at a tectonically active but nonvolcanic margin, although volcanic arcs may have existed outboard (southeast) of the Martinsburg source terrane.

TAYLOR, G. KENDALL, and ROBERT RESSETAR, Univ. South Carolina, Columbia, SC

Depositional and Structural Histories of Richmond and Taylorsville Triassic Rift Basins

The Richmond and Taylorsville basins of Virginia display similar structural and sedimentological histories, which differ somewhat from those of other eastern North American rift basins. Both basins formed during the middle Carnian in response to the initial opening of the North Atlantic Ocean. Both are westward tilted half grabens whose border faults share a reactivated Paleozoic basement thrust (the Hylas zone). A dipmeter log from the Bailey 1 well (Richmond basin) shows that bedding dips toward the border fault and increases with depth. These relationships are interpreted to reflect syndepositional rotation and tilting of the basin above a listric normal fault.

Unlike the red beds typical of other eastern North American rift basins, sediments of the Richmond and Taylorsville basins are mostly unoxidized gray sandstones and siltstones. The sediments of both basins can be divided into three facies associations. The lowest is a poorly sorted, coarse-grained, lithic arkose rapidly deposited in alluvial fans and braided streams. This was succeeded by sand, silt, and mud of a lower gradient, fluvial-paludal setting. Organic-rich black shales accumulated in lakes (oxbows?) and overbank deposits. An influx of cross-bedded fluvial sands, possibly triggered by renewed border faulting on the west, characterizes the final stage of basin fill. These sediments represent fan-delta systems that prograded northeastward across the lacustrine-paludal lowlands.

TEXTORIS, DANIEL A., Univ. North Carolina, Chapel Hill, NC

Sedimentary Silica in Newark Basins of Eastern United States

One way in which low-temperature, near-surface excess silica was introduced into the Newark sedimentary system was by extensive chemical weathering in the source area, when tectonic quiescence allowed it. Further concentration of silica within the basins was accomplished in the following ways: (1) eogenesis, by fluctuating pH, with values greater than 9.5 causing silica to be extracted from silicates within playa lakes or within soil zones; (2) eogenesis, by stands of silica-concentrating plants such as *Equisetites*, within ponds, playas, or fringes of larger lakes; and (3) mesogenesis, by pressure solution among quartz grains and possibly other silicates, possibly associated with high pH, causing release of silica.

In all situations, the silica, either from solution or gel, probably initially formed as opal-A and proceeded to the opal-CT stage, and then to the stable quartz phases of chalcedony, microquartz, and the megaquartz that we find today. The stable quartz phases are associated with primary silica precipitation in playa lakes, replacement of carbonate in playa lakes, possible replacement of carbonate oolite in playa lakes, vadoids in silcrete paleosols, possible replacement of vadoids in caliche paleosols, replacement of wood cell walls, syntaxial overgrowths on quartz grains, and nonaffiliated pore filling.

The various processes of quartz formation, coupled with associated microfacies and paleoenvironments of deposition, may be used for finer delineation of fluctuating paleoclimates during Newark deposition.

THAYER, PAUL A., Amoco Prod. Co., New Orleans, LA

Petrology, Diagenesis, and Reservoir Potential of Upper Triassic Dan River Group Sandstones, North Carolina and Virginia

The Dan River Group, a thick sequence of conglomerate, sandstone, and mud rock, is preserved in the northeast-trending Dan River–Danville basin of central North Carolina and Virginia. Thick lenses of organic-rich lacustrine strata (Cow Branch Formation) are surrounded by potential reservoir sandstones of fluvial, deltaic, and fan-delta origin.

Dan River sandstones consist of fine to very coarse-grained, moderately to poorly sorted, immature plagioclase arkose and lithic arkose. Source terrane was nearby and consisted of gneiss and schist with small amounts of granite and metavolcanic rock.

Diagenesis has significantly reduced initial porosity and permeability. Measured porosity of 125 representative sandstones averages 5.7% (ranging: 0.3-18.1%), and geometric mean permeability is 0.14 md (ranging: <0.01-14.1 md). Variation in porosity and permeability results mainly from allogenic clay matrix, packing density, and cementation.

Porosity-reducing diagenetic processes include mechanical compaction (ductile grain deformation and pressure solution) and cementation. Calcite, siderite, quartz, albite, hematite, and authigenic clay (illite and chlorite) cements are widespread and are the main porosity occluding agents.

Rock-Eval pyrolysis T-max values, vitrinite reflectance data, and black coloration of spores and pollen from associated mud rocks indicate an advanced stage of burial diagenesis. These data and the low porosity and permeability values indicate that Dan River Group sandstones have poor reservoir potential.

THOMAS, ROGER E., and KENNETH J. ENGLUND, U.S. Geol. Survey, Reston, VA

Environmental Controls on Accumulation of Thick, Low-Sulfur Coal (Peat) in Lower Pennsylvanian Pocahontas Formation, Virginia and West Virginia

Thick, low-sulfur coal beds are intercalated with a sequence of stacked delta-lobe deposits in the Pocahontas Formation of southwestern Virginia and southern West Virginia. Coal thickness and coal quality are related to the distribution and thickness of the underlying deltaic sandstone beds.

During the Early Pennsylvanian, the northwestward progradation of deltaic lobes on the southeastern shoreline of a regressive Carboniferous seaway was interrupted by periodic stillstands. Sand at the delta front was reworked and segregated by coastal currents and waves to form a system of fringing barrier bars. Vegetation flourished in swamps behind these protective barriers, mostly on platforms created by the abandoned delta lobes. The growth and accumulation of plants on the inactive, sand-dominated delta lobes formed domed deposits of ombrogenous peat that were low in ash and sulfur. In contrast, interlobe areas accumulated high-ash mucks consisting of organically rich clay and silt. In modern analogous peat-forming environments in tropical southeastern Asia, accumulations of low-ash and low-sulfur domed peat are dependent on high rainfall, which contributed little if any mineral matter to the peat. The ombrogenous origin of the Pocahontas coal beds is similarly indicated by the distribution of thick, low-sulfur and low-ash coal over the thick central area of the sandstone lobes, whereas thin, impure, and discontinuous coal beds occur in the shale-dominated interlobe areas. This analysis demonstrates that knowledge of the geometry, thickness, and orientation of delta lobes can be useful in the exploration for thick, high-quality coal.

TRAVERSE, ALFRED, Pennsylvania State Univ., University Park, PA

Paleopalynological Insights on Dating of Newark Supergroup Rocks and Their Correlation with European Sections

Once thought to be prevailingly barren of palynomorphs, sediments from all of the known Newark basins have now yielded correlatable palynofloras. However, for various reasons, only poorly preserved florules (Danville–Dan River basin) or scarce productive zones (Fundy basin) have been found in some of the basins. Sedimentation in the Newark rift zone apparently began in late Ladinian to late Carnian time along most of the front. New analytical data from a buried basin in southern Georgia now extend this observation about 400 km (two stages) farther south. From south Georgia to the Richmond basin in Virginia, the youngest sediments are Carnian or Carnian/Norian. In the Culpeper basin, Virginia, new information indicates sedimentation beginning during the Carnian, in keeping with the other southern basins. However, in the Culpeper basin and all of the northern basins, sedimentation persisted much longer. Latest Triassic to late Liassic floras are found in all of them. Palynoflorules as young as Toarcian have been studied in the Hartford-Deerfield basin of Connecticut-Massachusetts. Ultimately, these dates depend on correlation with palynofloras from classic marine fossil zones in south-central Europe, work which is in flux and progressing rapidly in European laboratories, boding probable changes in the Newark basin palynostratigraphic framework.

VENKATAKRISHNAN, RAMESH, and T. BRITT MCMILLAN, Old Dominion Univ., Norfolk, VA

Basement Controls on Lineament-Block Tectonics of Coastal Plain Province in Virginia

Linear features in the coastal plain of Virginia were interpreted from Landsat images and analyzed to define the geologic framework of the underlying basement. The lineaments were digitized, and length-weighted frequency distributions were calculated at 5° intervals on a 10-km^2 grid. Statistically significant peaks (>95%) and troughs (<5%) within each cell were identified. These significant trends identify 13 major lineament zones, which in turn were compared with structural domains recognized from a combined interpretation of geophysical, subsurface form-surfaces, and basement well-log data. Correlation between lineament frequency, aeromagnetic, and gravity data was tested on a regionwide and smaller domain basis.

The major lineament zones divide the western part of the area into north-south and northeast-southwest bound rhomboidal blocks. The eastern part is characterized by north-south and northwest-southeast bound rectangular blocks, quite different from the regional Appalachian grain. The lineament zones are documented to parallel basement domain boundaries because subsurface structure, lithologic and stratigraphic changes, and steep geophysical gradients occur along their extent. Some