structure of the crust. As the data are geographically oriented and in digital format, standard image-processing and analysis techniques can be applied. For instance, we have used a spatial filtering technique to interpolate between station locations of gravity and magnetic data to produce gray or color-coded images with continuous coverage throughout the Mid-Continent. The images contain more information than found in standard contour maps, because they can have many more contour intervals, and because they preserve local details of anomaly patterns.

As an example of applicability of these techniques, gravity images registered and overlayed with magnetic, geologic, and remote sensing data lead to the identification of a Precambrian rift structure that begins at a break in the Mid-Continent gravity high in southeast Nebraska, extends across Missouri in a northwest-southeast direction, and intersects the Mississippi Valley graben. The rift structure is about 435 mi (700 km) long and 75 to 100 mi (120 to 160 km) wide. It is expressed in gravity images as a low with a Bouguer amplitude of about -34 milligals below regional values. Some of the discrete positive magnetic anomalies in Missouri are located along the borders of the gravity low. The gravity feature cuts across a major age boundary within the Precambrian basement.

Finally, digitally enhanced thermal infrared images show a distinct alignment of linear structures with the gravity feature. The linears in some places correspond to mapped high-angle normal faults, to drape folds over relief within the Precambrian basement, and in some places, to extensions of mapped structures.

HARRIS, LEONARD D., U.S. Geol. Survey, Reston, VA

Possible Hydrocarbon Resources Beneath Blue Ridge-Piedmont Thrust Sheet

An integration of surface geologic data and subsurface seismic reflection data across the southern and central parts of the Appalachian orogene has emphasized that the fundamental structure of the orogene is a low-angle mega-thrust fault system. Documentation of this basic model began in the southern Appalachians, where seismic reflection data indicated that crystalline rocks of the Blue Ridge and Piedmont had been thrust westward burying a 50 mi (80 km) segment of Paleozoic sedimentary rocks. Recently, in a continuing effort to further define and document the regional distribution of the buried Paleozoic section, our seismic reflection studies were shifted from the southern to the central Appalachians in Virginia. Approximately 174 mi (280 km) of seismic data was acquired in a continuous profile along Interstate I-64 from the Valley and Ridge near Staunton, Virginia, eastward across the Blue Ridge, the Piedmont, and most of the coastal plain to Hampton, Virginia.

Our latest data verify the basic mega-thrust framework model by demonstrating that crystalline rocks of the Blue Ridge and Piedmont have been thrust westward burying about 30 mi (50 km) of Paleozoic sedimentary rock. Regional thermal patterns within the Appalachian orogene were disrupted by thrusting, consequently the same patterns must have existed prior to thrusting. Because thermal levels have a direct bearing on organic maturity, palinspastic restoration of these thermal patterns can be used as a general tool to assess the regional hydrocarbon potential of the area.

INEGBENEBOR, EDWARD CLIFFORD, Nigerian Natl. Petroleum Corp., Port Harcourt, Nigeria, and WILLIAM H. HARRIS,* Brooklyn College, City Univ. New York, Brooklyn, NY

Boron, Gallium, Rubidium, and Vanadium as Geochemical Indicators of Marine and Freshwater Depositional Environments: Hamilton Group (Middle Devonian), Southeastern New York

Thirty-two shale-mudstone samples collected from the Hamilton Group and previously classified on the basis of paleoenvironmental studies using geologic criteria as being of marine, brackish, or freshwater origin were analyzed for the environmental-discriminant trace elements B, Cr, Ga, Li, Ni, Rb, and V by atomic absorption spectrophotometry. The most efficient trace element discriminator used to differentiate geochemical partition of Hamilton marine from freshwater argillaceous samples was based on B vs. V, but use of other trace-element partition variables produced nearly similar results.

Considering marine and freshwater samples together, 69% of those designated on the basis of geologic criteria as either freshwater or marine were correctly classified according to the three best geochemical partition methods (B vs. V, B vs. Ga, and B vs. Ga vs. Rb). For those designated by geologic criteria as marine, partition plots of B vs. V, and B vs. Ga correctly classified 90%, and B vs. Ga vs. Rb correctly classified 95% of the samples. Only 14% of those samples geologically defined as being of freshwater origin were correctly classified based on these geochemical partition methods. The overall paleosalinity signature for the Hamilton based on geochemical partition methods is marine. The source area mountains (Acadian) at that time thus were still probably of low relief. The Hamilton probably represents a degradational delta in part with many reentrant transgressive bays, and in part a sluggishly prograding mud-dominated shoreline.

JOLLEY, RICHARD M., Univ. North Carolina, Chapel Hill, N.C.

Clearville Siltstone of Middle Devonian Mahantango Formation in Parts of Pennsylvania, Maryland, West Virginia, and Virginia

The Clearville siltstone of the Middle Devonian Mahantango Formation is an eastward-thickening and coarsening detrital clastic wedge which crops out in the Valley and Ridge province of south-central Pennsylvania, western Maryland, eastern West Virginia, and northwestern Virginia. Its west limit defines the west limit of the Mahantango Formation and can be traced in the subsurface of Cambria and Somerset Counties in Pennsylvania and in outcrop in Hardy and Mineral Counties in West Virginia.

The Clearville siltstone in the western half of its surface occurrence consists predominantly of a sequence of interbedded siltstone and mudstone which is usually directly overlain by the Pokejoy Member of the Mahantango Formation, which exists as either a calcareous, fossiliferous siltstone or an argillaceous, fossiliferous limestone. To the east, the Clearville siltstone changes to a more complex sequence of several upward-coarsening cycles, the first of which is directly overlain by a "*Spirifer*" *tullius* zone that correlates with the Pokejoy Member to the west.

The upward-coarsening cycles are interpreted as delta cycles, grading from prodelta mudstones and claystones near the base to medium to very thick-bedded delta front sandstones near the top of the cycles. The Pokejoy Member probably originated as an indirect result of either delta lobe abandonment or a eustatic sea-level rise following the first major phase of sedimentation of the Clearville siltstone.

The sedimentation pattern of the Clearville siltstone is marked by two lobate regions of thickening: a more northern region long referred to as the Fulton lobe, and a more southern region referred to as the Frederick lobe. In both lobes, primary sedimentation appears to have been the result of westwardly flowing turbitity currents on a gently sloping shelf with later resedimentation and physical reworking from a combination of sublittoral processes such as tidal and storm surge currents. This physical reworking, as well as biogenic reworking, is particularly evident in the Fulton lobe, where two distinct sheet sandstone facies are recognized. This and other facies comparisons suggest lower rates of sedimentation in perhaps shallower water for the Fulton lobe than the Frederick lobe during Clearville deposition.

Although very low porosity values are characteristic of the Clear-