LUCAS, MARK, WARREN MANSPEIZER, and JOSEPH HULL, Rutgers Univ., Newark, NJ

En Echelon Folds: A Case History from Jacksonwald Syncline of Foreland Folds in Newark Rift Basins of Eastern North America

The Jacksonwald syncline of the Newark rift basin, like other en echelon folds in both the onshore and offshore Triassic-Jurassic basins, has characteristics typically found in foreland fold and thrust belts. The syncline, comprising Carnian to Sinemurian strata, is a shallow plunging synform (15° toward N55°W) with an axial surface dipping 83° toward S35°W. The fold has a subangular hinge with straight planar limbs, typical of buckle folds. Axial planar, spaced solution cleavage is well developed in siltstones. Although early clastic dikes in the border fanglomerates are rotated, the cleavage is unfanned and maintains a constant orientation. Quartz and calcite, dissolved along cleavage seams, were precipitated in extensional veins oriented perpendicular to the fold axis and to elongate mud cracks.

Conjugate shear fractures near the postulated border fault strike N79°W and N5°W, and show sinistral and dextral slip, respectively. Displacement along these shears indicates that sinistral slip is 5 times greater than dextral. Along the basin margin, tectonic layer-parallel shortening by pressure solution exceeds compaction shortening by 2:1. The fold is intruded by an undeformed Sinemurian diabase dike of Rossville composition, parallel to the extension veins.

The data show a consistent strain pattern, from the Upper Triassic through the Lower Jurassic, of northeast shortening and northwest extension, and suggest that en echelon folds formed along an east-trending sinistral shear couple. This stress field is consistent with dextral oblique slip along the Flemington fault, observed by Burton and Ratcliffe.

LUTZ, CHARLES T., and NICHOLAS B. WOODWARD, Univ. Tennessee, Knoxville, TN

Structural Complexity Associated with Transfer Zone: An Example from Southern Appalachians

Transfer zones provide a mechanism by which displacement is maintained across a fold and thrust belt where a single thrust terminates along strike. Commonly, the transfer is not simply a "lap joint" wherein en echelon thrusts, tied to a common sole fault, shift displacement; rather, these zones are structurally complex with intensified folding, fracturing, and, in some instances, cleavage. An example occurs in the Valley and Ridge of eastern Tennessee, northeast of Knoxville. There, the Beaver Valley thrust terminates into folded Middle Ordovician carbonates. To the southeast, the adjacent Saltville thrust increases in stratigraphic separation, coinciding with the Beaver Valley termination. The Saltville places Lower Cambrian strata on Mississippian units northeast of the fault termination, whereas the Lower Cambrian rests on Cambrian-Ordovician rocks only 20 km to the southwest.

Near its tip, the Beaver Valley thrust shows little displacement, but the loss of slip is accompanied by intensified folding. The folding traces an anticlinorium involving Middle and Upper Ordovician carbonates and shales. These folded rocks are broken by fractures and extensional veins, commonly filled with sparry twinned calcite, and ranging from 0.2 to 2.0 mm wide. One set of veins is generally normal to bedding with a second set oblique; in some cases, three sets cut the rock. Also, Middle Ordovician carbonates carry an axial planar solution cleavage, and catacalcites are locally developed, particularly in dolostones of the Cambrian-Ordovician Knox Group. A set of folds, the axes of which are oblique to transport direction, occurs across the transfer zone; they are often found in the footwall of a thrust.

The complex structural geometries in these thrust sheets suggest contradictory timing relationships. The contradiction is explained if the two faults are envisioned as propagating from initial breaks, then growing toward one another contemporaneously. This example demonstrates the potential complexity of a transfer zone, as well as the possibility of apparent local variation in fault sequence in a generally hinterland to foreland progression of emplacement.

LUTZ, RICHARD D., and RAMESH VENKATAKRISHNAN, Old Dominion Univ., Norfolk, VA

Lineaments in Richmond Triassic Basin Area, Virginia: A Kinematic Model

A lineament study from various sources was conducted to develop a conceptual kinematic model for the Richmond Triassic basin area in Virginia. The procedure involved mapping at different scales: color infrared U-2 photos (1:130,000), Landsat MSS images (1:1,000,000), and rectified drainage maps (1:250,000). The lineaments were digitized and subjected to a correlation package that compared the statistically significant peaks (>95%) and troughs (<5%) within 5 km^2 grid cells. Spatially filtered significant 10° trends were contoured according to length-weighted frequencies to obtain lineament zones. These lineament zones were compared to mapped structures, outcrop patterns, Triassic diabase dikes, and aeromagnetic alignments and gradients.

Correlations of lineament zones with mapped structures and geophysical gradients strongly support the interpretation that they represent the surface expressions of boundaries of subsurface structural domains. The basin is bounded on the west by the northeast-trending Hylas fault zone, and the eastern margin is cut by 60°-70° northeast-trending lineament zones that segment the basin into discrete blocks. Numerous ± 15° north-trending lineaments correlate remarkably well with the north-trending diabase dikes, yet none of the mapped dikes apparently cut across the basin margins as other Triassic basins do in Virginia and elsewhere.

Detailed analysis of lineament patterns appears to indicate left-handed strike-slip movement along the Hylas fault. At this time, the dikes intruded the basin, but were refracted into the fault zones despite pervasive north-trending fractures. Present-day expression of lineaments is probably due to Cenozoic reactivation of preexisting fractures.

The kinematic model postulated here is entirely compatible with existing models for Mesozoic tectonism in the Virginia coastal plain.

LYONS, PAUL C., WILLIAM F. OUTERBRIDGE, and M. DEVEREUX CARTER, U.S. Geol. Survey, Reston, VA

Correlations of Coal Beds near Allegheny-Conemaugh Contact in Tri-State Area of Ohio, Kentucky, and West Virginia

The top of the Upper Freeport coal bed marks the contact between the Allegheny Formation (Middle Pennsylvanian) and the Conemaugh Formation (Upper Pennsylvanian) at their type area in western Pennsylvania. The position of the Upper Freeport is uncertain in the tri-state area of Ohio, Kentucky, and West Virginia because of lack of continuity and apparent miscorrelations of coal beds. Our stratigraphic analysis of coal-bed correlations with respect to our identification of the Brush Creek Limestone Member, the lowest marine member of the Conemaugh Formation, indicates probable miscorrelations of coal beds by previous workers in this area. In Lawrence County, Ohio, Condit identified the Mahoning coal bed as 46 ft below the Brush Creek Limestone and 24 ft above the Upper Freeport coal bed. Northward along the Ohio River in southeastern Ohio, the Brush Creek Limestone–Mahoning interval is about 30 ft. Wanless correlated the Princess 9 coal bed of Kentucky with the Upper Freeport of Ohio and Pennsylvania. Huddle et al indicated that in eastern Kentucky the Princess 9 is in the Conemaugh Formation, about 45 ft below the Cambridge Limestone Member (correlated with the Brush Creek Limestone Member) and about 35 ft above the Upper Freeport. Thus, the Mahoning coal bed of Ohio appears to correlate with three units in eastern Kentucky—the Princess 9 of Huddle et al, the uppermost Princess 9 of Connor and Flores, and the Brush Creek coal bed of Sharps—and with the Brush Creek coal bed in parts of the adjoining areas of West Virginia. This stratigraphic analysis indicates that the true Brush Creek Limestone–Upper Freeport interval is about 70-110 ft in the tri-state area, which is consistent with the same stratigraphic interval to the north.

MAKI, MARK U., and ALAN H. COOGAN, Kent State Univ., Kent, OH

Subsurface Stratigraphy and Structure of Sauk Sequence of Northern Ohio

The lower Paleozoic Sauk sequence of northern Ohio represents a carbonate and clastic sedimentary sequence deposited during the late Late