by organically lean, eventually impervious, shale. Source rock, reservoirs, and traps for petroleum were closely associated. Subsequent sedimentary loading brought about maturation, fluid migration, and trapping. The pools were formed before Cretaceous time.

DENNISON, JOHN M., Univ. North Carolina, Chapel Hill, N.C.

PETROLEUM RELATED TO MIDDLE AND UPPER DEVONIAN DELTAIC FACIES IN CENTRAL APPALACHIANS

Strata of the Devonian deltaic complex are preserved in 110,000 sq mi of the Appalachian basin. Petroleum production occurs only in the western half, principally in higher permeability sandstone, but some in prodelta dark shale. Oil is produced from Upper Devonian strata only in the westernmost part of the basin. Absence of petroleum production in the east presumably is because hydrocarbons have escaped from Ridge and Valley province outcrops. Sedimentary properties can be extrapolated to the subsurface to better understand the factors controlling petroleum occurrence.

The deltaic clastics were derived from an eastern quartzose source in the latitude between New York and Virginia. Depositional patterns of petroliferous sands resulted from gradual infilling of a subsiding basin, interrupted by rather abrupt eastward transgressions, which produced nearly synchronous, winnowed sands traceable across many counties.

The oldest prodelta sediments (Needmore Shale) were derived from the Baltimore area. Immediately after the Tioga volcanic event prodelta deposition spread abruptly westward nearly to the Ohio River. Cazenovia Stage deltaic siltstones and sandstones occur in Pennsylvania and New York. In late Tioughnioga Stage the zone of winnowing extended to West Virginia (Clearville Siltstone) with terrestrial redbeds accumulating in the Catskill Mountains. Early in the Taghanic Stage hundreds of feet of abrupt eustatic sea-level rise or basin deepening shifted the shoreline scores of miles eastward.

Throughout the rest of Late Devonian time the shoreline encroached generally westward with fairly sudden eastward shifts of tens of miles during times of sea-level rise. These shifts isolated 5 distinct clastic pulses in the outcrop region during the Finger Lakes and Cohocton Stages. In the western area younger sands of the Cassadaga Stage and Bradford Stage were deposited during winnowing accompanying shoreline shifts. Maximum westward encroachment of the subaerial Catskill delta was in the Bradford Stage, followed by Early Mississippian transgression which produced the Pocono Group sandstones.

DIONNE, JEAN-CLAUDE, Dept. Fisheries and Forestry, Quebec, P.Q.

TIDAL-FLAT EROSION AND SEDIMENTATION BY ICE, ST. LAWRENCE ESTUARY

The action of ice on the shores of the St. Lawrence estuary has been studied since 1964. Shore ice in that area is a powerful agent of erosion and sedimentation. Annually, millions of tons of sediments from clay to boulder size are removed and carried by ice. Erosion of muddy tidal flats and salt marshes is especially significant; a peculiar sedimentary facies results. The St. Lawrence is one of the best sites to study the geologic action of ice because of the presence of (1) relatively large tidal flats, (2) high tidal range and strong tidal current, and (3) ice during a minimum of 4 months.

DOLE, HOLLIS M., U.S. Dept. of Interior, Washington, D.C.

1970s—NOW OR NEVER DECADE FOR MINERALS AND FUELS

In characterizing the 1970s as the "now or never" decade for meeting the challenge of environmental quality, President Richard Nixon has established a monumental goal for America and American industry. Looking only at the projected demands for metals, nonmetals, and fuels during the next 10 years we can see that achieving that goal and, at the same time, assuring our people continuing adequate supplies of minerals and energy at reasonable costs will take all the ingenuity—all the innovative ability—that our mineral and fuel industries can muster.

Not only must our ability to find new deposits of minerals and fuels at greater depths and in alien environments be significantly extended, but we must devise far better methods for extracting, processing, and utilizing these essential raw materials. National concern for environmental quality can be expected to govern virtually every facet of mineral exploration and development in the decade we have just entered.

Skilled, highly motivated, and intensively trained manpower represents an urgent industrial need. National concern only now is beginning to focus meaningfully on this critical aspect of the problem and, although the hour is late, there are indications that it may not be too late for the solutions we so desperately need.

DONALDSON, ALAN C., and WILLIAM H. KANES, West Virginia Univ., Morgantown, W.Va.

TECTONIC CONTROLS ON LATE PALEOZOIC SEDIMENTATION IN WESTERN WEST VIRGINIA

Tectonic patterns had a significant influence on the late Paleozoic Berea, Loyalhanna, and Pittsburgh-Sewickley sandstone units in western West Virginia. The depocenter was in the southwest during Early Devonian Berea deposition, southeast when the Mississippian Loyalhanna (Big Injun) sands filled submarine valleys, and northwest during Late Pennsylvanian when the Pittsburgh and Sewickley (Monongahela Group) deltaic sandstones were deposited.

Western West Virginia tectonically was on a relatively stable platform west of the Appalachian trough. Relative rates of supply and subsidence in the trough influenced the major changes in regional paleoslopes. Shallow downwarped axes on the platform oriented perpendicular to the trough also exerted a subordinate but important tectonic control on sedimentation. Characteristics of shallow-water deposition are shared by the Berea, Loyalhanna (Big Injun), and Monongahela sandstone units. However, the interpreted submarine valley-fill depositional environment of the Loyalhanna (Big Injun) is considerably different from the deltaic environment suggested for the Berea and Monongahela sandstones.

DOTT, R. H., JR., Univ. Wisconsin, Madison, Wis.

LIMITATIONS IN PALEOCURRENT ANALYSIS OF TROUGH CROSS-STRATIFICATION

More than 50% of cross-stratification is trough type. Its complex geometry accounts for large dispersion in