uplift and pediment cutting. At least 3 principal stages covering a vertical interval possibly as great as 1,300 ft have been identified. Soil profiles in Quaternary gravels capping the pediments show increase in maturity consistent with age inferred from topographic elevations. These local erosional stages may record tectonic events of regional significance. Their absolute ages need to be determined.

CONNOR, CAROL WAITE, U.S. Geol. Survey, Denver, CO

Sixty-Five Volcanic Events Recorded in Single Coal Bed

The preservation potential of a continual series of volcanic ash falls is slight. There must be a favorable depositional site downwind and within range of an area of pyroclastic activity. A favorable depositional site is a body of quiet or deep water, existing through a long period of time, with relatively rapid normal sedimentation that covers each ash fall before another fall occurs.

In a slowly subsiding basin, the early Paleocene Big Dirty coal swamp of central to eastern Montana provided an ideal depositional environment, and it was partially ringed by areas of volcanism 140-300 km north, northwest, and west of the western edge. As many as 65 ash falls, one by one, blanketed the swamp and were covered by organic debris. The resultant sedimentary package, the Big Dirty coal bed, is particularly well exposed in the Bull Mountain coalfield, northeast of Billings, Montana. Layers of altered volcanic ash and sanidine-rich crystal tuff average 1.5 cm thick and are separated by an average 7.6 cm of coal, tuffaceous coal, or carbonaceous tuff. The Big Dirty coal bed contains a rare continuous record of a period of frequent volcanic eruptions.

CONOLLY, JOHN R., Sydney Oil Co. Ltd., Sydney, Australia, and JOHN C. FERM, Univ. Kentucky, Lexington, KY

Volcanic Sediments—New Reservoir Fairways in Back-Arc Basins, Eastern Australia

Volcanic rocks and associated lithic sandstones, hitherto thought to be too tight and impermeable, may well form important new reservoirs in the extensive Permian back-arc basins of eastern Australia. Oil and gas production has already been established in these sediments in the Permian Bowen and Surat basins of Queensland with some new discoveries in tuffaceous rocks. Most of these volcanic rocks were derived from andesitic, dacitic, and rhyolitic island-arc complexes that lay to the east or the open paleo-Pacific side of a back-arc depositional area. The sediment in these back-arc areas is composed mainly of sand, conglomerate, and silt, all with low percentages of quartz and derived from the volcanic arc. These sediments are interbedded with 1-5 m thick subbituminous to bituminous coal seams, which have been mined extensively in open-cut and shallow subsurface areas of the Bowen and Sydney basins. Basin analysis, using coal stratigraphy and deep wells in the Sydney basin, has established several potential reservoir fairways controlled by facies distribution of the cleaner sands. The variation in reservoir properties within many new potential fairways can be illustrated for parts of both the Sydney and Surat basins. A combination of better understanding of the reservoir properties of these volcanic sediments combined with better drilling, completion, and stimulation techniques lends credence to the hope that these back-arc provinces may become important new oil and gas basins.

CORLEY, B. H., Birdwell Wireline Services, Tulsa, OK

Predicting Interval Transit Time for Synthetic Seismograms from Nuclear Well Logs

Sonic logs commonly were not included as part of the logging program on older wells. In certain areas, wells are drilled with air. The absence of drilling fluid in the borehole eliminates the possibility of recording a sonic log. In other areas, sonic logs are either of poor quality or, for one reason or another, omitted from the logging program. A method has been developed to predict interval transit times using nuclear well logs. It involves combining neutron, density, and gamma-ray log measurements into a log of predicted interval transit times referred to as a synthetic sonic log.

The method involves a combination of commonly used and accepted well-log interpretation techniques. It effectively accounts for lithology,

shale, porosity and hydrocarbon effects. The method requires only 3 parameters, which may be selected based on the well-log data. The synthetic sonic log agrees well with actual sonic-log measurements over a wide variety of geographic areas and borehole depths. The method is effective for formations commonly encountered in geophysical well logging including salt, shale, sandstone, and carbonate.

The synthetic sonic log is an excellent substitute for use in generating synthetic seismograms and establishing time-depth relationships.

CORSO, WILLIAM, and RICHARD T. BUFFLER, Univ. Texas at Austin, Austin, TX

Seismic Stratigraphy of Lower Cretaceous Carbonate Platforms and Margins, Eastern Gulf of Mexico

Detailed seismic stratigraphic studies document the development of Lower Cretaceous platforms and margins along the Florida Escarpment and Jordan Knoll in the eastern Gulf of Mexico. Four different areas are characterized by relating seismic facies to depositional models: (1) northwest of DeSoto Canyon a rimmed platform margin with low paleo-relief (about 1,500 m over a distance of 20 km) grew in a stationary manner and developed an accretionary slope, (2) a rimmed platform with high paleo-relief (about 2,500 m over a distance of 6 km) is exposed along the Florida Escarpment from DeSoto Canyon south to about 24°30'N (this part of the platform margin also grew in a stationary manner but developed a bypass slope), (3) a rimmed platform margin with moderate paleo-relief evolved from about 24°30'N south to the Straits of Florida, and (4) an isolated platform with steep paleo-relief formed on a basement high at Jordan Knoll west of the Florida Escarpment. This platform also grew in a stationary manner and developed bypass slopes. The evolution of the various types of platform margins is related to their overall tectonic setting. Two episodes of platform drowning have been identified: (1) middle to late Albian(?) with the development of intrashelf basins and (2) middle Cenomanian when the platforms were terminally drowned due to a rapid change in relative sea level.

Erosional truncation of reflections along the base of the Florida Escarpment suggests that parts of the platform margin have retreated up to 2-5 km since the middle Cenomanian.

COVENEY, RAYMOND M., JR., Univ. Missouri at Kansas City, Kansas City, MO, and NELSON R. SHAFFER, Indiana Geol. Survey, Bloomington, IN

Sulfur Isotopes Related to Sedimentation Conditions for Metalliferous Black Shales of Pennsylvanian Age

Sulfur isotope compositions were determined for pyrite and sphalerite grains isolated from 8 metalliferous Missourian, Desmoinesian, and Atokan black shales from Missouri, Illinois, Kansas, and Indiana.

The younger Missourian shales from the Forest City and Illinois basins contain consistently light sulfur as expected for euxinic conditions, but sulfides from the older shales show heavier and more erratic sulfur values. These isotope patterns suggest that younger shales accumulated slowly offshore, although older shales may have been deposited more quickly in shallower water. Isotope values, which also correlate with heavy metal patterns (e.g., higher molybdenum values for the easternmost older shales), may therefore reflect gradually deepening conditions for the epicontinental Pennsylvanian seas of the United States Mid-Continent.

COVINGTON, J. MITCHENER, Florida State Univ., Tallahassee, FL

Morphologic Information on Cretaceous Nannofossils from Niobrara Formation

Multiple zones of exceptional preservation within the Niobrara Formation (Upper Cretaceous) have revealed much new morphologic information on coccolithophores. Nine species were found with coccospheres intact, including a species of *Biscutum* with extraordinary cylindrical rather than spherical coccospheres. Cylindrical coccospheres have not been reported from the fossil record, and are rare in modern oceans. An unusual feature of these cylindrical tests is the orderly, repetitive arrange-