Cluster analysis was used to delineate lithofacies in the Twin Creek Limestone of Middle Jurassic age in the Tunp, Salt River, and Wyoming Ranges in southwestern Wyoming. Subjective appraisal of the petrographic data produced lithofacies similar to that created by cluster analysis. Modern carbonate environments and their ancient analogs were compared with information obtained from field study and petrographic analysis of samples of the Twin Creek Limestone to delineate environments of deposition, paleogeography, and diagenetic history.

Six major lithofacies were recognized: (1) carbonate mudstone, (2) packstone-grainstone, (3) fossiliferous wackestone, (4) terrigenous mudstone, (5) sandstone, and (6) carbonate mudstone breccia. These lithofacies were deposited in a variety of environments, including outer shelf platforms (carbonate mudstone and fossiliferous wackestone), oolitic sand belts (packstone-grainstone), open to restricted lagoons (carbonate mudstone, fossiliferous wackestone, and terrigenous mudstone), tidal flats, and supratidal environments (terrigenous mudstone, sandstone, and carbonate mudstone breccia). The Twin Creek epeiric seaway experienced two major transgressions (early Bajocian and late Bathonian–early Callovian) and two regressions (early Bathonian and middle Callovian). Lateral migration of the adjacent facies occurred in response to these changes in sea level.

Eogenetic diagenetic features include minor compaction, micritization, coarse fibrous rim cementation, granular cementation, syntaxial rim cementation, and silicification of carbonates. These features were produced in environments ranging from freshwater phreatic to marine phreatic. Mesogenetic diagenesis was characterized by pressure-solution features and neomorphism. Telogenetic features are limited to calcite vein fillings and oxidation coating on carbonate and detrital grains.

RAY, PULAK K., DONALD R. NEWSOM, GREGORY KLOCEK, and TAYLOR BLOOD, Minerals Management Service, Metairie, LA

Subsurface Geology and Paleodepositional Environments of Pleistocene Trend; South High Island and South Galveston Area—a Regional Evaluation

The Pliocene-Pleistocene producing trend of South Galveston and South High Island areas represents a matured province with excellent data control. Four biostratigraphic working units (upper Pleistocene-*Trimosina A*, middle Pleistocene-*Angulogerina B*, lower Pleistocene-*Lenticulina I*, and upper Pliocene-*Valvularia H*) were regionally established and interpreted using all nonconfidential electric well logs. These correlations were verified with seismic data. Geophysical verification was possible in the upper and middle Pleistocene, but limited to local areas in the lower Pleistocene. Three major growth-fault systems, which become larger southward and attain as much as 4,000-5,000 ft of growth, were recognized. Salt piercement structures are sparse north of Federal Block HI-495 but increase in number southward. Paleoecological data and lithological information obtained from SP logs indicate that sedimentary sequences steadily prograded south from the Pliocene through Pleistocene, reaching the most southward position during the time of *Trimosina A*. Deposition of Pliocene-Pleistocene sand sequences occurred primarily in low-energy deltaic and associated environments. Occasional intraslope basinal and deep-water submarine fan type sand bodies were also recognized. The morphology and occurrence of deltas were significantly influenced by paleotopography and salt tectonics.

RAYNOLDS, ROBERT G. H., Amoco International, Houston, TX, and GARY D. JOHNSON, Dartmouth College, Hanover, NH

Structural Control on Molasse Sedimentation: Example of Siwalik Group of Northern Pakistan

Molasse sediments accumulate in elongate foredeeps during orogenic episodes induced by plate collision. These sediments are typically fluvial, but may grade distally into marine sediments. Molasse lithofacies exhibit a variety of syndepositional structural controls. Structural controls can be subdivided conveniently into 3 scale-dependent categories: (a) regional (basin-wide) control in which the fundamental asymmetric basin architecture is established by the collision process, (b) subregional in which structural control on the location of river systems influences facies distribution and preservation, and (c) local control in which developing folds and faults influence the character of the rock record. New data derived from paleomagnetic stratigraphy and fission-track dating has permitted refinement of lithofacies correlation in the Siwalik molasse sediments of northern Pakistan. A suite of 8 dated sections illustrates the structural controls on molasse facies distribution in the Himalayan foredeep between 3.4 and 1.6 m.y. Subregional and local structural controls are critical factors defining the facies of the proximal molasse sequence. Variable rates of sediment accumulation, differing efficiency of sediment preservation, structurally controlled unconformities, and abrupt time-transgressive lithofacies transitions are documented. Facies patterns preserved in the rock record are compared to analogous modern environments in India. The observed patterns indicate profound structural control on the distribution and interconnectedness of reservoir facies in fluvial-dominated foredeep settings.

READ, J. FRED, Virginia Polytechnic Inst. and State Univ., Blacksburg, VA

Evolution of Cambrian-Ordovician Carbonate Shelf, United States Appalachians

Cross sections and isopach maps (palinspastic) of the Cambrian-Ordovician continental shelf, United States Appalachians, show that thickness and facies trends are controlled by the Adirondack, New Jersey, and Virginia highs and depocenters in Tennessee, Pennsylvania, and by the Rome trough. Carbonate sedimentation was initiated with drowning of Early Cambrian clastics, deposition of carbonate ramp and rimmed shelf facies followed by drowning, then regional regression and deposition of Early to Middle Cambrian red beds and platform margin rimmed shelf facies. During subsequent regional transgression, the Conasauga intrashelf shale basin formed, bounded toward the shelf edge and along depositional strike by Middle to Upper Cambrian oolitic ramp facies and cyclic peritidal carbonates. Intrashelf basin filling and regional regression caused progradation of Late Cambrian cyclic carbonates and clastics across the shelf. By this time, the margin had a relief of 2.5 km. During the Early Ordovician, incipient drowning of the shelf formed subtidal carbonates and bioherms that passed up into cyclic carbonate as sea level oscillations decreased in magnitude. Numerous unconformities interrupt this sequence in the northern Appalachians. The earlier high relief rimmed shelf was converted into a ramp, owing to uplift in the basin, heralding approaching collision. Subsidence rates on the margin were low (4 cm/1,000 yr) and typical of a mature passive margin. Shelf sedimentation in the southern Appalachians ceased with arc-continent collision and development of the Knox unconformity, which dies out into the Pennsylvania depocenter. Major exploration targets are in the Late Cambrian–Early Ordovician Knox Group.

REECKMANN, S. A., Exxon Production Research Co., Houston, TX, and I. R. DUDDY and A. J. GLEADOW, Univ. Melbourne, Melbourne, Victoria, Australia

Igneous Intrusions in Porous Sandstone Sequences—Widespread Thermal Effects Measured by Fission Track Annealing and Vitrinite Reflectance

Current literature suggests that igneous bodies have only minor thermal effects on intruded sedimentary rocks, increasing the maturity of a thickness of adjacent strata approximately twice the width of the intrusion. This study shows that this is not always true. In the Canning basin of Western Australia, Permian dikes, sills, and laccoliths have intruded porous and permeable Carboniferous and Permian sandstones. Efficient vertical and lateral heat transfer has occurred by movement of hot waters through the sedimentary rocks over large distances away from the igneous bodies. This heat transfer is recorded by the resetting of fission tracks in detrital Precambrian apatites, which now have apparent ages similar to those of the igneous intrusions. In some instances, a significant increase in vitrinite reflectance within the sediments is also evident, but vitrinite appears to be less sensitive to heat pulses of short duration, even though temperatures greater than 110°C have developed. Fission-track studies suggest that temperatures of at least 110°C to 130°C have occurred up to 3 km from thin doleritic dikes and sills in porous sandstones where pre-intrusion temperatures were around 40°C. Some evidence of increased temperature is also apparent 26 km from the nearest mapped intrusion, although this has not been sufficient to totally anneal fission tracks.