transgression following Middle Ordovician erosion. The transition into the overlying Upham Member of the Second Value is gradational, but can be locally abrupt. The massive, finely crystalline dolostone was originally coral (tabulate and rugose forms) and crinoidal wackestone-packstone. Fossils are poorly preserved by chalcedony replacement. The transition from the relatively shallow-marine sediments into the deeper water strata of the Aleman Formation occurs over several meters. The very finely crystalline, cherty dolostone hosts rynchonellid and dalmanellid brachiopods and bryozoan colonies. Ribbon cherts developed around clusters of fossils. The Aleman changes sharply into chert-free, thin to medium-bedded Cutter. The argillaceous dolomicrite is nonfossiliferous except for conodonts, isolated brachiopods, and a *Favosites*-type coral horizon. Tidal channels, intraclasts, and cyclic bedding indicate peritidal deposition during Cutter deposition. Erosion preceded Fussleman (Silurian?) deposition.

Conodont faunas represent shallower conditions than the Montoya faunas of Sweet, but compare favorably for correlation. *Panderodus* and *Belodina* faunas characterize the shallow-marine Second Value Formation; deeper water *Plectodina* and *Phragmodus* characterize the Aleman; and very shallow-water *Rhipidognathus* characterizes the Cutter. Ages for the Second Value, Aleman, and Cutter Formations are late Eden-early Maysville, Maysville-early Richmond, and middle-late Richmond, respectively.

Dolomitization interrupted early silica replacement of shells, matrix, and sulfates. Mosaic dolomite and epitaxial rims on dolomite cement virtually destroyed all effective porosity.

BUCHHEIM, H. PAUL, Loma Linda Univ., Riverside, CA

Depositional Environments and Oil Shale Genesis in Eocene Green River Formation: Retrospect and Prospect

Geologic studies of oil shale were pioneered by W. H. Bradley in 1929. His basic model for the genesis of oil shale called for a deep stratified lake in which anaerobic conditions in the hypolimnion ensured the preservation of organics and accounted for the finely laminated character of the oil shale. Until recently, studies involving the depositional environment and genesis of oil shale were based on the stratified lake model.

In 1973 Eugster and Surdam presented an alternate model (playa lake model) that accounted for the origin of oil shale in a shallow lake fringed by broad mud flats or playas. The playa lake model accounted for observed shallow-water sedimentary structures and evidence of a low topographic gradient. This abrupt change in basic concepts was not readily accepted by many workers. Views have polarized, primarily because of the variety of depositional conditions that existed in separate but geographically related basins of deposition.

This polarization will not be resolved until a more adequate and comprehensive model is developed. It must account for most of the pertinent observations, including preservation of organic matter, sedimentary structures, carbonate deposition and diagenesis, vertical and lateral facies relationships, and paleontology of the Green River Formation, all of which are critical to an understanding of oil shale genesis.

BUCK, STEVEN P., Mobil Oil Corp., Dallas, TX, and DAVID J. BOTTJER, Univ. Southern California, Los Angeles, CA

Diagenetic Carbonate Concretions from Late Cretaceous Active Margin Slope Deposits, Southern California—Origin and Use in Paleoenvironmental Reconstruction

Fine-grained rocks of Late Cretaceous, West Coast, active margin strata have generally been ignored in paleoenvironmental analyses because of the highly fragmented and apparently homogeneous nature of outcrops. Recent studies on Holz Shale (Ladd Formation, Santa Ana Mountains) fine-grained slope strata have shown that diagenetic carbonate concretions which occur in this unit are useful for understanding primary sediment fabric and hence paleoenvironments. Usefulness of concretions to such paleoenvironmental studies can only be evaluated, however, after their diagenetic history is fully understood.

Holz Shale concretions most commonly occur as ellipsoids 0.05-1.5 m (0.2-5.0 ft) in diameter. Concretions generally consist of amorphous shale clay and quartz sediment cemented by calcite. Organic materials such as mollusk valves and terrestrial plant material commonly served as concretion nuclei. On the basis of this association with preserved organic materials and the abundance of pyrite preserved within concretions, it appears highly probable that decomposition of organic materials by sulphate-reducing bacteria was an important factor in the formation of these concretions. Lack of compaction of trace fossils within concretions, bending of strata around concretions, presence of septarian structures, and penecontemporaneous slumping of concretions in surrounding sediments indicate an early diagenetic origin where original sediment fabrics were preserved.

Many other Late Cretaceous, deep-marine, active margin, fine-grained strata on the West Coast contain similar concretions. If these concretions prove to have an early diagenetic origin like those in the Holz Shale, they may be the key to a better understanding of depositional mechanisms of these widespread deposits.

BUCK, STEVEN P., Mobil Oil Corp., Dallas, TX, and DAVID J. BOTTJER, Univ. Southern California, Los Angeles, CA

Paleoenvironmental Analysis of Late Cretaceous Active Margin Continental Slope Deposits, Southern California

Extensive active margin, continental slope and upper fan deposits are not commonly preserved in the rock record. The Holz Shale (Ladd Formation, Black Star Canyon, Santa Ana Mountains) represents such a sequence where shale and mudstone strata are dissected by numerous coarse-grained channel-fill deposits. Channels preserve evidence of filling primarily by conglomerate debris flows, high-density turbidites, and classic Bouma low-density turbidites; slumping and traction-current mechanisms were less important. Associated with channels are submarine chutes, pebbly mudstones, and poorly developed levee facies. Interbedded turbidites, contourites, and hemipelagic sediments dominate interchannel strata. Hemipelagic sediments exhibit sedimentologic textures that range from biologically dominated (homogenous, bioturbated) to physically dominated (fine-scale, planar-laminated, anaerobic) fabrics. This variation in texture and associated diagenetic information indicates that the anaerobic/aerobic boundary was generally at some depth below the sediment-water interface, but at times migrated up into the overlying water column.

Foraminiferal assemblages within hemipelagic sediments are dominated by agglutinated forms which indicate deposition at bathyal depths. Macroinvertebrates include (1) the interchannel paleocommunity, dominated by the bivalve *Inoceramus* and the deposit-feeding trace fossil *Chondrites*, and (2) the submarine channel paleocommunity, comprised mainly of the trace fossils *Thalassinoides* and *Ophiomorpha*.

Previous studies have demonstrated that these active margin environments included a narrow continental shelf. Abundance of terrestrial plant material, paucity of displaced shelf faunas, well-rounded conglomerate clasts, and the coarse-grained texture of these deposits suggest that one or more of the Holz Shale submarine channels was receiving sediment directly from terrestrial environments.

BUDAI, JOYCE M., Univ. Michigan, Ann Arbor, MI

Dedolomitization in Tectonic Veins and Stylolites: Evidence for Rapid Fluid Migration During Deformation

Jurassic through Tertiary thrust-belt deformation of the Mississippian Madison Group has introduced complex fracturing, stylolitization, and carbonate vein mineralization. Host rocks are dominantly dolostone and dolomitic limestone. Tectonic veins are mineralized first by dolomite and then by multiple calcite phases. Dolomite and some generations of calcite which line veins are highly luminescent, while host-rock dolomite is nonluminescent. Both vein-lining dolomite and host-rock dolomite have been corroded and replaced by subsequent generations of calcite mineralization. These textural relationships suggest that fluids associated with thrust-belt deformation were in part extraformational and had not equilibrated with host-rock dolomite.

Because thrust-belt deformation moved from west to east with time, the isotopic composition (^{18}O, ^{13}C) of vein and stylolite mineralization can be used to evaluate fluid migration during deformation. In three sections located along an east-west transect in the southern overthrust belt, calcite vein mineralization displays a wide range of isotopic compositions that are distinctly depleted relative to the host-rock composition. These vein-lining calcites exhibit systematic compositional changes with both time of deformation and with geographic position relative to major thrust faults. These isotopic changes in vein mineralization and pressure-solution products, together with the textural evidence for calcitization of host-rock and vein dolomite, suggest that these rocks were open to allochthonous fluid migration during deformation.

BUDNIK, ROY T., Bur. Econ. Geology, Austin, TX

Basin and Range-Age Reactivation of the Ancestral Rocky Mountains in Texas Panhandle: Evidence from Ogallala Formation

The Ogallala Formation (Neogene) is a widespread syntectonic alluvial apron that was shed eastward from the Rio Grande rift and related uplifts in Colorado and New Mexico during Basin and Range extension.

In the Texas Panhandle, the Ogallala completely buried Ancestral Rocky Mountain (Pennsylvanian) structures. Renewed movement on these older structures during the Neogene influenced the thickness and facies distribution of the Ogallala. The Ogallala thickens into the Palo Duro, Dalhart, and Anadarko basins. Major distributary channels on Ogallala alluvial fans coincide with the axes of these basins, whereas major interchannel areas overlie intervening uplifts. Second-order structures subtly influenced the unit as well. For example, in the Carson basin, a Pennsylvanian rhomb graben along the Amarillo uplift, the Ogallala is over 250 m (820 ft) thick compared with 90 m (275 ft) in adjacent areas. Within the Palo Duro basin, local highs controlled the distribution of thin, interchannel flood-basin and lacustrine deposits. Thicker, braided-stream channel deposits follow local lows.

Later movement on the Amarillo uplift broadly folded the Ogallala. The southern high plains surface subtly reflects basement structure, with topographic highs overlying basement highs, suggesting post-Ogallala deformation within the Palo Duro basin.

The Amarillo uplift is approximately perpendicular to the Rio Grande rift and parallel to the direction of Basin and Range extension. Thus, the stress field that produced the rift may have caused strike-slip movement and reactivation of the Carson basin along the Amarillo uplift.

BURCHFIELD, MARGARET R., Oklahoma Geol. Survey, Norman, OK

Oil and Gas Fields of Oklahoma

At the end of April 1983, there were 3,088 active oil and/or gas fields in the state of Oklahoma, as well as 32 officially named abandoned fields, according to the Nomenclature Committee of the Mid-Continent Oil and Gas Association. Oil and/or gas fields are located in 73 of Oklahoma's 77 counties, and represent over 4 million acres (1.5 million ha.) in surface area.

The Oklahoma Geological Survey has prepared a new, up-to-date map of all officially named oil and/or gas fields in the state, at a scale of 1:500,000. Each field is outlined, assigned an index number for reference, and designated by color code as either an oil field, gas field, or combination oil and gas field. As an improvement over oil and gas field maps available from commercial sources, the OGS has attempted to define better the geographic boundaries of each field. An alphabetical listing of all fields with their reference numbers and locations is featured on the map, along with a listing of smaller fields that have been combined into Oklahoma's major oil and gas "trends."

The map is designed for use as a reference by all oil and gas professionals in the state. The OGS oil and gas field map has been prepared in conjunction with the development of a computerized oil and gas field file for Oklahoma. Production of updated versions of the map in future years will be facilitated by digitization of information shown on the present map.

CALDWELL, J. H., P. S. VALUIKAS, R. M. PLATEK, and R. R. CASAVANT, Gulf Research & Development Co., Houston, TX

ISIS—Gulf's Interactive Interpretation System

For 2 years, Gulf Exploration and Production Co. has successfully used a powerful computer system for interactive graphic interpretation of large and diverse volumes of exploration data. This proprietary system, developed by Gulf Research and Development Co., is called ISIS (Interactive Seismic Interpretation System). Some of the capabilities of ISIS are demonstrated using videotape recordings of 3 actual interpretation sessions. The first session comprises interactive log analysis—editing formation evaluation, and tying between wells. The second session involves regional mapping from a large data base of seismic lines and well logs. Numerous access and display features allow projects exceeding 20,000 line-mi (32,000 line-km) to be instantly available at the interactive station, replacing large volumes of paper records. Horizons can be carried around loops and tied, then posted and contoured automatically. The third session demonstrates detailed reservoir characterization at a mature field. Over 225 digitized well logs are gridded and then analyzed using interactive graphic software originally developed for 3D seismic surveys.

CAPEN, ED, ARCO Exploration Co., Dallas, TX

The Exploration Decision: How Much Skill? How Much Luck?

Winning or losing on a simple flip of a fair coin has nothing to do with skill and absolutely everything to do with luck. Calling the flip should be one of the lowest paying jobs around, as no schooling whatsoever is required—a monkey in the zoo would suffice. Winning the 100-m dash at the Olympics has virtually everything to do with skill—reaction to the starting gun, the start, leg and arm motion, and concentration, for example.

The exploration decision (with elements of both luck and skill) requires a mixture of several talents if it is to bring forth the highest satisfaction, however measured: organizational abilities, factual knowledge, odds (chance) knowledge, calculation/assimilation knowledge, information integration skills, and perhaps even some mysticism. We want to examine the exploration decision process in a way that will allow us to get a better handle on the worth of these talents and the value of the information they deliver.

If we fail to come up with anything better, we can always award the decision job to the (choose one): (a) best salesman, (b) best dresser, (c) best oil finder, (d) nearest engineer, (e) most charismatic, (f) banker's nephew, (g) Bozo, the Gorilla.

CARBALLO, JOSE D., Marathon Oil Co., Houston, TX, and LYNTON S. LAND, Univ. Texas at Austin, Austin, TX

Holocene Dolomitization of Supratidal Sediments by Active Tidal Pumping, Sugarloaf Key, Florida

Sugarloaf Key is an area of active tidal pumping where Holocene dolomitization is occurring. Calcium-rich dolomite is found in a 0.25-10-cm thick surface crust which transgresses a thin layer of carbonate mud overlying the karsted Pleistocene Miami oolite. Radiocarbon ages of the crust range from 160 to 1,420 y.B.P. with a corresponding increase in dolomite content from 0% to 80%.

The relatively high permeability of the underlying Pleistocene oolite and low permeability of the Holocene carbonate mud results in a tidal lag between surface waters and the partly confined aquifer. Consequently, seawater is pumped upward and downward through the Holocene sediments during spring tides. The highest concentrations of dolomite are found where the sediment layer is thinnest and tidal pumping is most effective. Limited analyses of surface and subsurface water samples taken at intervals throughout the pumping cycle suggest that the dolomitizing fluid is essentially Florida Bay water, very slightly modified by sulfate reduction.

The earliest diagenesis of the sediment is by precipitation of dolomite cement which occurs as 0.1 to 0.3 μ subrounded crystallites that show no distinct crystal form. During further cementation, and somewhat later replacement, dolomite forms as 1 to 5 μ euhedral rhombs. The dolomite rhombs, which are poorly ordered, result from the recrystallization of many smaller preexisting crystallites. X-ray diffraction data indicate that the recrystallized dolomite is better ordered and less calcium-rich than the dolomite composed of crystallites.