Individual depositional systems have been identified and mapped using data from 4,100 well logs and 75 measured sections. For the upper Strawn (above the Brannon Bridge Limestone), subsurface isolith maps indicate the presence of four deltaic depocenters, one fan delta system, two carbonate banks, one carbonate platform, and an embayment-strand-plain complex during various stages of Desmoinesian and early Missourian deposition. Higher, within the Canyon Group, there are two deltaic depocenters, one fan delta complex, a clastic slope system, carbonate shelf-edge and shelf-interior banks, and a carbonate platform. On the basis of outcrop facies characteristics and net sandstone geometry, river-dominated and lobate deltas, as well as coarse-grained fan deltas, are the dominant clastic systems deposited on the Bend arch.

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Trace Fossils in Middle and Upper Austin Chalk near Dallas, Texas—Paleoecologic and Economic Significance

In outcrops throughout northeast Texas, the Austin Group consists of interbedded thin to very thick-bedded (0.3-1.5 m) chalk with thin intervening calcareous claystone ("marl") layers. Both chalk and claystone are moderately to intensely bioturbated, and multiple generations of cross-cutting burrows are common. Austin trace fossils occur as endogenic full-relief individuals filled with chalk, clay, or iron oxides. The abundance and diversity of ichnofossils within the Austin are in distinct contrast to the paucity of other megafossils, except large, locally conspicuous inoceramids with oyster epiliths.

Variations in ichnofossil content, quality of burrow preservation, and petrographic character allow definition of three Austin substrate types. (1) Softground—vaguely mottled, argillaceous, foraminiferal biocalcilutite containing poorly preserved *Planolites, Thalassinoides,* and *Chondrites.* Burrowing is intense. *Chondrites* typically infests fillings of other ichnofossils. Inoceramids occur as widely scattered epifauna. (2) Bioclastic lenses—coarse-grained inoceramid biocalcirudite with interstitial chalk matrix. This lithology forms broad, low-relief channels; dense networks of *Thalassinoides* occur on lower surfaces. (3) Firmground—phosphatic, glauconitic, foraminiferal biocalcilutite containing well-preserved *Rhizocorallium jenense* and *Pseudobilobites.* South of Dallas, the disconformable Austin-Taylor contact is a *Rhizocorallium*-dominated firmground omission surface.

The Austin contains a shallow marine (middle to inner shelf) ichnoassemblage. A vertical increase in the ratio of suspension to deposit-feeding burrows suggests that the Austin is a shallowing-upward sequence.

Trace fossils impart textural heterogeneities to chalk which can either enhance or degrade reservoir quality and can also complicate wireline log interpretations and well completion procedures.

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Ecofacies Transect of Lake Valley Shelf, San Andres Mountains, New Mexico, and Its Relation to Early Mississippian Orogrande Basin

South-central New Mexico has been well known for its excellent exposures of Mississippian strata. The Sacramento Mountains have become famous for their fortuitous exposures of the Lake Valley shelf margin. A transect of measured sections there exposes the transition from shallow carbonate shelf with beautifully developed reefs to a starved basin with isolated pinnacle reefs to the south. A new transect, to the west in the San Andres Mountains, reveals a complete shelf-to-basin transect, from shoreline to shelf-margin to starved basin. There, however, no reefs are present in time-equivalent strata. Studies there, integrating physical stratigraphy, depositional systems, microfacies analysis, and conodont biostratigraphy and biofacies, allow formulation of a leeward shelf ecofacies depositional model for the Lake Valley formation. This is combined with the Sacramento Mountains transect to delineate a model of an Early Mississippian Orogrande basin in the same position as the Pennsylvanian-Permian Orogrande basin and the present Tularosa basin. A series of such basins may have existed along the southern flank of the ancient Transcontinental arch in the southwestern United States.

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Method of Predicting Reservoir Quality for Feldspathic Sandstones of Southern California

The diagenetic alteration of a sandstone results from the combined effects of many factors. In order to ascertain the role played by a particular diagenetic factor, the remaining diagenetic factors must be held constant. For the sandstones of the basins of southern California, we have found that the effects of almost all of the principal diagenetic factors are essentially uniform, the notable exception being thermal history. Because of this, we have been able to evaluate the diagenetic imprint of temperature upon the sandstones. Measured reservoir property data taken on core samples of reservoir sandstones from 16 fields in the Los Angeles, Ventura, and San Joaquin basins were used to determine the average rate of porosity and permeability loss with depth for each field. A straight line appears to be the proper representation for the porosity vs. depth profiles for the interval of interest. The slope of this line is defined here as the porosity gradient. Porosity gradients for the fields investigated range from 1.1% to 5.8%/1,000 ft. A direct relationship exists between the porosity gradient and the present geothermal gradient for the 16 fields which have been examined. As geothermal gradient increases, porosity gradient increases. The correlation coefficient between these variables is +0.916 for geothermal gradients between 1.6°F and 2.2°F/100 ft. A similar relationship also exists between the rate of permeability loss with depth and the geothermal gradient, but the average deviation from the mean permeability value is so great the relationship has little practical significance.

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Aledo Southeast 1,200-Ft Strawn Gas Field and Associated Deeper Production, Southeast Parker and Southwest Tarrant Counties, Texas

Most of the gas production in this region comes from earlier shallow zones (< 2,000 ft) in the lower Strawn or from deep zones (4,000-6,000 ft) in the Atoka to Marble Falls. The reservoirs, except for minor production from carbonates, are in clastic strata ranging from conglomerate to fine sandstone that are sporadic, lensing bodies of limited areal extent. The production is from clastics that occur in an eastward-thickening sequence lying just west of the Ouachita foldbelt.

The Aledo Southeast 1,200-ft Strawn field is one of the most profitable gas fields in the area. The marked linearity of this field demonstrates that the productive sand body is of fluvial origin. Its general east-west orientation indicates a fluvial system that flowed westward from the Ouachita highlands, and its flared shape on the western end suggests shoreline redistribution of the sands. Study of core and cuttings clearly reveals fluvial features, such as mud clasts, ripple laminations, wood fragments, and slump structures.

Detailed mineralogic analyses by x-ray diffraction and scanning electron microscopy indicate the shallow and deep reservoirs are feldspathic sandstones that are variously limy or dolomitic and contain major amounts of kaolinite and lesser amounts of illite, chlorite, and mixed layer clays.

Isopach maps combined with structure contour maps show the field is a trap formed where an east-west channel sand is tilted downward on the north side intercepting a gas-water contact. The south (updip) margin is a sand pinch-out. A marked sag, caused by differential subsidence, intercepts the gas-water contact and interrupts continuous production along the channel beneath the Parker-Tarrant county line.

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Use of Core-Measured Fracture Patterns in Exploration and Exploitation Strategy

Optimum results are obtained from core fracture studies when the core can be oriented. There are two approaches to core orientation: downhole orientation and surface orientation. Downhole core orientation is most