of structural traps in the Anadarko basin, and perhaps, even in neighboring basins.

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Progradational Sequences in Springer Formation, Ardmore Basin, Oklahoma

The transitional Mississippian-Pennsylvanian Springer Formation, exposed in the Ardmore basin of southern Oklahoma, consists of coarsening-upward progradational sequences that were deposited in the southern Oklahoma aulacogen. The unit is divided into three sandy members: the Rod Club, Overbrook and Lake Ardmore, which are separated by shale intervals. Each of the sandy members consists of one or more of the coarsening-upward sequences. A typical sequence includes from the base upward, dark gray shale with abundant siderite concretions, rhythmically interbedded siltstones and shales, interbedded burrowed sandstones and shales, and abundantly burrowed sandstones. The latter contain wood impressions, ripple cross-laminations, and occasional festoon cross-stratification. In addition, one of the sequences contains a thin, discontinuous marine limestone. These sequences represent the transition from an offshore/prodelta setting to a distributary mouth bar/lower shoreface setting.

One of the sequences in the Rod Club contains an additional lithofacies at its base which consists of interbedded shales and green-gray sandstones. Sedimentary features of the sandstones include: massive nongraded bedding, large lutite casts, ripple and dish laminations, flute casts, and numerous soft sediment microfaults. The general characteristics of the sandstones suggest deposition by sediment gravity flows. This lithofacies represents deposition in a slope setting, with the sandstones derived from the proximal delta/shoreface.

Offsets on microfaults in the lower Rod Club occur on two different scales. Small scale microfaults have displacements of a few millimeters. Offset on the larger microfaults (up to 5 cm, 2 in.) is expressed on both the upper and lower surfaces of a sandstone bed. There are no fault zones within the beds which suggest the faults are synsedimentary and represent deposition on an unstable slope. The microfaults are consistently oriented approximately 90° to the flute casts, and most are downthrown in the direction of transport. Paleoslope data from the flute casts and microfaults indicate the sandstones were transported southeastward along the axis of the Ardmore-Anadarko basin during deposition of the Springer.

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The Ubiquitous Overbid

The ever-present overbid on tracts in sales in the outer continental shelf and Alaska is an indigenous part of the process of the sealed bid. Although it has a universal definition within the petroleum industry, it has been frequently misused and misunderstood outside the petroleum industry.

Overbidding results from the process by which bids are compiled as well as the absence of knowledge of competitive bids. It results in the maximum amount of cash going to the seller, although on the average it tends to depress the rate of return to the buyer.

The final dollar amount for a given bid represents the results of a series of multiplications. For example, the ingredients in the multiplication can be formation thickness times recovery/acre-foot times area times (revenue minus cost) times risk. The distribution of any series of multiplications from randomly selected variables is always log-normal. Therefore, sealed bids on a given tract produce a log-normal distribution. One of the physical characteristics of a log-normal distribution involving about 10 points is a large percentage difference between the first and second point. This difference is the overbid.

Since the beginning of sealed bid sales in the OCS, the overbid has averaged between 40 and 50% of the winning bid. This consistency demonstrates the inevitability of the overbid.

The overbid provides the seller with the maximum values possible. Overbids could be reduced almost to zero by auction bids. In sales with limited acreage offered, the seller would receive substantially less money than from the sealed bid sale. However, in area-wide sales this may not be the case. The public and congressional cry for fair market value for the consumer might preclude auction sales.

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Neogene Fore-Arc Basin Development in Northern California: Eel River Basin

Strata representing the youngest phase of fore-arc basin development in northern California are exposed in an unusual cross-sectional view across the basin axis. The exposure of a large part of the stratigraphic section of the Neogene Eel River (Humboldt) basin can be attributed to uplift along the northern edge of the Mendocino triple junction. The fore-arc deposits overlie the Mesozoic and Cenozoic accretionary prism and slope deposits of the Franciscan Complex. Outcrop geology of the uplifted southern flank of the basin indicates that the facies and sediment distribution patterns agree with paleobathymetric studies; a complete deep to shallow marine transition is recorded in the basin sediments.

Facies studies demonstrate the time-transgressive nature of the sedimentary environments. Proximal facies are landward (east) of coeval deeper water deposits exposed along the coast. The basal contact is clearly depositional on this southern flank of the basin. Sandstones and pebbly conglomerates cut into coastal belt Franciscan accretionary prism sediments inland. A previously undescribed debris flow is conformable on similar Franciscan sediments along the coast. This debris flow is faulted against overlying faulted and fractured basin plain siltstones and fine sandstones (Miocene-Pliocene) which contain thin lenses of shell debris, pebbles, and glauconitic sand. A monotonous accumulation of organic-rich diatomaceous mudstones is capped by amalgamated channels continuing sequences of thin glauconitic sands with locally derived siltstone rip-ups, siltstone, and hemipelagic mudstones. The overlying sediments consist of fine-grained turbidites, thick bioturbated siltstones and fine sandstones, and coarser turbidites. A continental shelf sequence concludes this phase of Eel River basin development.

To the south of the main basin outcrop, progressive uplift and faulting related to the migration of the triple junction have left erosional remnants of sediments coeval with Eel River basin rocks. These rocks are found up to 50 km (31 mi) south of the upturned basin edge, suggesting that the basin was at one time more extensive to the south. Shallower depositional environments in some of these basin remnants may indicate the proximity of the original southern edge of the basin. Structural complexities to the south include strike-slip faulting and possible upper Miocene and younger trusting of Franciscan melange over Neogene marine sediments.

Shallow gas fields have been developed in the basin; ongoing exploration for deeper oil and gas is not yet definitive. Potentially good source rocks in the deeper parts of the basin, underlying organic-rich Franciscan sediments, and the abundance of potential reservoir rocks higher in the section make this structurally complex onshore/offshore basin an attractive exploration target.

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Mid-Cretaceous Biostratigraphic Units, Unconformities, and Diastrophism in Wyoming, Colorado, and Adjacent Areas

In the central Rocky Mountains and adjoining Great Plains, lithologies and hiatuses within sequences of mid-Cretaceous formations reflect widespread fluctuations of sea level and intermittent tectonism during Cenomanian, Turonian, and Coniacian time (88 to 96 m.y.B.P.). Siliciclastic and carbonate strata of marine origin in the Graneros, Belle Fourche, Greenhorn, Carlile, and Niobrara Formations grade laterally into marine and nonmarine siliciclastic beds of the Frontier Formation. The clastic strata are products of uplift and erosion in both the Sevier orogenic belt of Utah, Idaho, and western Montana, and a contiguous region within Utah, Colorado, Wyoming, Montana, and Nebraska. The ages of these rocks, the durations of intervening hiatuses, and the times of diastrophism were determined mainly from a detailed succession of marine molluscan index fossils.

Outcrops at scattered localities in this region, in a western part of the Cretaceous seaway, as well as outcrops in eastern South Dakota and northwestern Iowa, near the eastern shore of the seaway, indicate a marine transgression in the Cenomanian and early Turonian (Belle Fourche and Greenhorn time), a marine regression in the middle Turonian (early Carlile time), and a marine transgression in the late Turonian and Coniacian (late Carlile and early Niobrara time). However, the stratigraphic record of these widespread events has been obscured in most of Wyoming and Colorado by submarine and subaerial erosion and attendant sedimentation associated with episodic orogenic activity during the Turonian and Coniacian (88 to 91 m.y.B.P.).

In central and northwestern Wyoming, strata as young as late Cenomanian (early Greenhorn age) are disconformably overlain by beds of early middle Turonian (latest Greenhorn) age. Uplift and erosion in these areas probably occurred during early to earliest middle Turonian time. In western Colorado, early middle Turonian strata (Fairport Member of the Carlile) and older rocks are disconformably overlain by late middle Turonian strata (Blue Hill Member of the Carlile), indicating deformation and truncation in the middle Turonian. Moreover, truncated beds as young as late middle Turonian (Codell Sandstone Member of the Carlile) are overlain by early late Turonian strata (Juana Lopez Member of the Carlile) in Colorado and Wyoming, reflecting earliest late Turonian orogenic activity in the vicinity of the Front Range, Laramie Range, and Bighorn Mountains. Some of the rocks of early late Turonian age (a lower part of the Wall Creek Member of the Frontier) were, in turn, uplifted and eroded during later late Turonian time in an area that extends from Yellowstone Park to central Wyoming. Furthermore, at outcrops near the Laramie Range, truncated beds of late Turonian age (Wall Creek Member of the Frontier) and the overlying Coniacian strata (basal Niobrara) indicate earliest Coniacian tectonism and erosion in southeastern Wyoming.

Elongate areas of uplift and erosion and of discrete sedimentary facies of mid-cretaceous age commonly trend approximately southeastward and northeastward in the central Rocky Mountains–western Great Plains region. From Yellowstone Park southeast to the vicinity of Casper, Wyoming, intermittent truncation and deposition during the Turonian are especially evident.

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Trace Fossils Within Limestone Interbeds, Oak Grove Member, Carbondale Formation (Pennsylvanian, Desmoesian), Northwestern Illinois

Most trace fossils have been described from terrigenous rocks, commonly sandstones or sandstone/shale interbeds. The prevailing opinion appears to be that carbonate rocks rarely contain trace fossils or that ichnofossils are more difficult to study in them. Neither is true. Methodology is especially important in these studies, and the peculiarities of carbonates make them particularly rewarding subjects for trace fossil analysis.

At Wolf Covered Bridge in Knox County, Illinois, the Desmoinesian Oak Grove Member is more than 5 m (16 ft) thick and consists mostly of shale with several thin carbonate (limestone and siderite) interbeds. The two thickest of these carbonates are a lower "gray septarian" (or "*Marginifera*") limestone about 0.2 m (8 in.) thick, and about 1.5 m (5 ft) higher a 0.3 m (1 ft) thick "*Linoproductus*" limestone. Both are sparse to packed mixed biomicrites with diverse and abundant fossils. The depositional environments of these limestones were similar: nearshore, quiet, delta-influenced, somewhat brackish, shallow water deposits interpreted by Merrill (in 1975) to have formed in water less than 20 m (66 ft) deep.

Limestones were sliced perpendicular to bedding in the normal fashion and large slabs were also cut parallel to bedding with a wire saw. Serial sections cut perpendicular to bedding were photographed by X-radiography permitting three-dimensional reconstruction of some burrows. Large slabs cut parallel to bedding were etched and acetate peels prepared in the convention manner, but of unconventional size (some more than 1.0 m, 39 in., long). The polished surfaces were later gridded, coated, and the distribution of body and trace fossils mapped both megascopically and microscopically from the peels.

The level of bioturbation is exceedingly high, especially in the "*Marginifera*" limestone. Several generations of truncating trace makers are evident. Recognizable ichnogenera include a spectacular *Rhizocorallium* 40 cm (16 in.) long with waves of spreite outlined by calcitornellid (pseudopthalmid) foraminifers, numerous *Chondrites* up to 10 cm (4 in.) high, and common *Planolites*. Lithologic differences among burrow types are striking and many vague, relict, earlier generations of traces remain, traced primarily by allochem distribution. Substrate stabilities differed between the pair of limestones and bearing strength was probably a major factor controlling community structure. There are suggestions of "ghost biota" and lack of significant compaction of the micrite in the lower carbonate interbed.

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Geochemistry of Regionally Extensive Calcite Cement Zones, Mississippian of New Mexico

Carbonate cements from Mississippian skeletal limestones of southern New Mexico are dominated by echinoderm-syntaxial calcites that comprise 4 regionally extensive compositional zones. Previous petrography and cement stratigraphy proves that the oldest three zones (zones 1, 2, and 3) are pre-