sorted subarkoses having subrounded to rounded quartz grains. The dune and interdune sandstones are interbedded with wadi and playa-lake deposits having wavy discontinuous laminae. These water-deposited sandstones are not as texturally mature as the dune sandstones. The upper part of the Norphlet includes massively bedded to horizontal laminated marine sandstones. Porosity is principally secondary dissolution with some intergranular porosity. The secondary porosity is a result of decementation of anhydrite and/or calcite and by grain dissolution. Porosity in the marine sandstones is reduced through calcite cementation in downdip areas. The Permian eolian dune and wadi sandstone reservoirs in the Viking field, North Sea, can be used as analogs for anticipating reservoir performance for the Norphlet sandstones.

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Depositional and Postdepositional History of Stuart City Member, Edwards Limestone (Lower Cretaceous), Washburn Ranch Field, LaSalle County, Texas.

The Stuart City member of the Edwards Limestone (Lower Cretaceous) was cored in 2 wells in Washburn Ranch field, LaSalle County, Texas. Depositional sequences encountered in the cored intervals represent an alternating sequence of reef-derived grainstone, pellet-rich grainstone, near-reef wackestone, and lagoonal mud-rich facies, with a general trend toward more shallow marine conditions. Deposition of the Stuart City member ended abruptly with deepening water conditions and deposition of a pelagic foraminiferal facies.

Porosity in the cored intervals can be related to incomplete cementation of the reef-derived grainstone facies. Four separate and unevenly developed generations of cementation have occurred as determined by standard petrography and cathodoluminescence. Thin, isopachous, syntaxial marine cement is present at some grain contacts. An influx of meteoric waters precipitated a nonluminescent, blocky calcite spar. Following a period of partial dissolution, a brightly luminescent cement lined cavities and indicates deeper burial. The bright cement is followed in optical continuity by an unzoned, faintly luminescent cement forming blocky spar that terminates in rhombic euhedra extending into the remaining pore spaces. It appears that invasion by hydrocarbons expelled meteoric waters and abruptly ended cementation.

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Petrology and Porosity of Devonian Misener Formation, West Kremlin Field, Garfield County, North-Central Oklahoma

The Misener formation is a laterally discontinuous, mixed carbonate-silicilastic unit, comprising dolomite-cemented, quartz-rich arenite, and quartz-bearing dolomite. It reaches a thickness of 60 ft in the West Kremlin field, overlies an unconformity that truncates lower Paleozoic sedimentary strata, and is overlain by the Woodford (black) Shale. Based on petrographic and sedimentary features, it appears to have been deposited in a shallow, tide- and wave-influenced, marine environment.

The quartz-rich arenites are fine to very fine grained and well to very well sorted. They contain mostly monocrystalline quartz clasts, very fine grained, well-crystallized dolomite rhombs, and less than 2% K-feldspar. Lithic fragments, which are rare except for chert pebbles in the basal 1-2 cm, include silicified shale, phosphatic shale, and carbonate micrite. Accessory components include glauconite, phosphatic oolites, conodonts, fish scales, and authigenic pyrite. Devonian outcrops of the Ordovician Simpson Sandstone likely supplied most of the quartz detritus.

The best porosity is unevenly distributed in the mixed quartz-dolomite layers. Authigenic clay is rare, and quartz overgrowths are well developed but partly replaced by dolomite rhombs. Partial dissolution of the rhombs has formed a secondary porosity with good permeability due to pore-throat enlargement. Dolomite-poor, quartz-rich sandstones are well cemented by quartz overgrowths, and the pores contain abundant authigenic clay. The quartz-bearing dolomite is tight and, near the overlying Woodford Shale, is partly replaced by chert.

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Penecontemporaneous Facies Relations in Pennsylvanian (Desmoinesian) Deltas of Southwestern Indiana

Lateral and vertical sedimentologic and paleoecologic analyses of rocks and fossils of the lower part of the Dugger Formation (Pennsylvanian, Desmoinesian) in Indiana has delineated the following deltaic subenvironments: (1) distributary sands, (2) upper-, middle-, and lower-interdistributary estuaries, (3) delta-plain lakes, and (4) swamps. In this part of the Illinois basin, terrigenous influx was from the northeast across an extremely low depositional gradient. Because of high surface area to depth ratio, current and wave energies of this shallow epicontinental sea were diminished. Thus, differential compaction rather than marine reworking dominated the deltaic destructive phase in this area. Differential compaction resulted in accumulation of localized anomalously thick sequences. The thickened units occur directly adjacent to penecontemporaneous distributary sandstones because of the greater degree of syndepositional subsidence in these areas. The dominance by differential compaction produced an unusual situation wherein a slow marine transgressive or deltaic abandonment stage was followed by a rapid marine regressive or deltaic progradational stage. Vertical and lateral changes in body- and trace-fossil communities reflect the encroachment of marine conditions and the relatively sudden onset of freshwater deposition. Maximum marine inundation of the area coincided with carbonate deposition. Maximum water depth in the area is estimated to have been less than 80 ft (25m) based on lateral relationships of interdistributary lithofacies with distributary sandstone and delta-plain sediments. The marine-influenced lithology deposited in shallowest water was black shale, which grades downward into coal and upward into calcareous gray shale and limestone. Lateral facies gradation indicates that these divergent lithotypes were produced penecontemporaneously at the delta margin.

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Bathymetric Distribution of Foraminifera in Jamaican Reef Environments

Recent foraminifera inhabiting Jamaican north-coast fringing reefs display variations in distributional patterns that are related to bathymetry and reef morphology. Sediment samples containing foraminifera were collected along a profile that traversed the back reef (depth 1-2 m), fore-reef terrace (3-15 m), fore-reef escarpment (15-27 m), fore-reef slope (30-55 m), and upper deep fore reef (70 m). Approximately 150 species distributed among 80 genera were identified from the samples. Preliminary analyses indicate that diversity values (S, H′) are lowest on the fore-reef terrace (79, 3.0, respectively), increase similarly in back-reef and fore-reef escarpment and slope settings (93, 3.4), and are highest on the deep fore reef (109, 3.7). Larger groupings (suborders) exhibit distinct bathymetric trends with miliolids occurring more commonly in back-reef (comprising 51% of the fauna) than in fore-reef (28%) zones, whereas agglutinated and planktonic species occur more commonly in deeper reef (> 15 m, 9% and 4%, respectively) than in shallower reef zones (< 15 m, 3%, and 0.5%, respectively). Among the more common species *Amphistegina gibbosa* (Rotolina) is much more abundant in fore-reef (28%) than in back-reef (8%) environments, whereas *Archaias angulatus* (Miliolina) is more abundant in back-reef (15%) than in fore-reef (3%) environments, and *Sorites marginalis* (Miliolina) occurs almost exclusively in the back reef, where it comprises 5.5% of the fauna. Q-mode cluster analysis, involving all species collected, enabled the delineation of back-reef, shallow fore-reef, and deeper fore-reef biofacies, also indicating the potential utility of foraminiferal distributions in detailed paleoenvironmental interpretations of ancient reef settings.

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Sedimentology and Stratigraphy of Mississippian Orogenic Sediments, East-Central Nevada: Proposed Solution to a Paradox

Mississippian orogenic sediments deposited during during the Antler orogeny and exposed in east-central Nevada record the initial breakup of the Cordilleran geosyncline. They also contain one of the thickest, rich-

est, yet most under-explored source rock–reservoir packages in the western United States. Numerous geologists have studied the Chainman Shale–Diamond Peak Formation, yet the depositional setting of these formations, a factor critical to effective exploration for these attractive targets, is still controversial. In 1974, F. G. Poole suggested that the entire sequence was deposited as turbidites at abyssal depths, calling these rocks "Antler flysch." B. R. Wilson and S. W. Laule thought these same sediments were largely nearshore marine to fluvial molasse sediments. Regional studies in east-central Nevada reveal 2 dramatically different facies within the Mississippian: a turbidite facies consisting of incomplete Bouma sequences, interturbidite shales, and disordered conglomerates; and a fluvial-deltaic facies consisting of well cross-bedded,, nearshore marine sandstones and fluvial conglomerates, nonmarine to shallow-marine shales, and marine limestones. In several areas these 2 facies are separated by only a few miles, yet structural juxtaposition is not likely. Rather, it appears the turbidite facies is older than the shallow-water facies and represents Early Mississippian in-fill of the narrow Antler trough. The fluvial-deltaic facies represents regressive deposition that prograded over the Antler trough in Late Mississippian time. Both facies contain rich source rocks and the more widespread fluvial-deltaic facies contains numerous reservoirs and potential stratigraphic traps.

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Role of Microcomputer Geologic Work Station in Exploration: Case Study

Microcomputer-based geologic work stations are becoming increasingly popular and are proving to be effective and efficient tools in exploration. They allow an explorationist to produce interactively many different types of maps and to formulate and test multiple geologic models. Maps can be updated and reproduced rapidly with the addition of data points.

To illustrate the power and versatility of microcomputer work stations, data from Raven Creek field were used to generate several sequences of maps that use a progressively larger number of data points, simulating the increasing number of wells available through time. The map sequences bring out early the nature of the Raven Creek oil trap, even with fewer data points than might be expected.

Sequences of several different maps were made for this study. These include isopach, trend, and residual maps of the Opeche, porosity and permeability distributions in the Minnelusa sands, structural contour maps (Minnelusa and Minnekahta), facies maps, as well as structural and stratigraphic cross sections. Perspective block diagrams were useful in visualizing many of these maps.

These maps, cross sections, and diagrams, and the changes in them brought about by sequentially adding data through time, show how an explorationist can rapidly formulate, test, and refine geologic and exploration models. The speed, versatility, and interactivity of the work station lets this be done in minimal time.

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High-Resolution Seismic Stratigraphy of North Carolina Continental Margin, Cape Fear Terrace: Sea Level Cyclicity, Paleobathymetry, and Gulf Stream Dynamics

A high-resolution seismic stratigraphic study of the Cape Fear Terrace (outer continental shelf off North Carolina) combined with biolithostratigraphic data has yielded a chronostratigraphic framework of the Quaternary sequences that comprise this portion of the North American continental margin.

The Cape Fear Terrace is an anomalous, point-source, prograding, shelf-margin feature that has experienced positive relief through much of the Quaternary. This upbuilding or outbuilding followed a period of active, early Pliocene, submarine erosion in which the ancestral Gulf Stream cut an erosional path beneath the present shelf margin. The terrace was originally built up during a relative lowstand of sea level with the construction of a shelf-edge deltaic feature. Severe modification of this delta front occurred during a relative highstand of sea level as the Gulf Stream began to impinge upon the margin. The anomalously thick accumulation of shelf-edge sediments acted as a barrier to flow, inducing complex flow patterns of the Gulf Stream. Excavation of these sediments yielded a terrace feature with preferential erosion on the upstream side.

Subsequent deposition in the terrace region may have resulted during fairly highstands of sea level, as evidenced by the presence of active seaward-prograding sand waves in the terrace region today. Once this shelf-edge bathymetric irregularity (the terrace) had been established, the Gulf Stream acted as a dynamic force inducing cellular flow structures within the shelf environment, which enabled sediments to be transported seaward along the paleo-shoals complex.

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Sources and Distribution of Late Pleistocene Sand, Northern Gulf of Mexico Shelf

A completed 3-yr study of the sources and consequent distribution of late Pleistocene sand on the northern Gulf shelf clarifies paleogeography and alluvial identification. Techniques used to determine the sources of sand are: the Fourier technique (which differentiated sands from different source terranes on the basis of the shapes of quartz sand grains), mineralogic analysis (which identified the composition of the source terranes that contributed each quartz-shape type), and an evaluation of the source terranes drained by each of the southern United States rivers (thereby linking each shape type to a particular river). These data and the mapped distribution of sand deposited on the shelf by each of these rivers during the late Pleistocene lowstand indicate distribution patterns have not been modified by modern shelf currents to any great extent, and thus record the late Pleistocene paleogeography of the shelf. These distributions show, among other things, the locations of the late Pleistocene alluvial valleys of each of the southern United States rivers, and identify the sources of shelf-edge deltas off the coasts of Texas and Lousiana that were detected by shallow seismic analysis.

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Significance of Eolian Quartzose Sheet Sands on Emergent Carbonate Shelves: Permian of West Texas–New Mexico

Permian (Leonardian-Guadalupian) regressive peritidal to shallow-marine carbonate sequences in the Permian basin of west Texas and New Mexico contain thin, widespread quartzose sand bodies. Due to their lack of diagnostic sedimentary and biogenic features, these sand bodies are of enigmatic origin. Several lines of evidence (sedimentologic, petrographic, facies relations, Quaternary comparisons) argue against the deposition of such blanket sands by fluvial or neritic processes and for their eolian origin. Our studies indicate that such units are dominated by progradational eolian sheet deposits with lesser preserved occurrences of cross-bedded dune, wadi, and evaporite-pan facies. These facies were deposited on arid, wind-dominated exposed flats adjoining deep basins. They represent short-lived cycles of shelf emergence (sea level fall) and rapid rates of sand accumulation that interrupted longer periods of highstand carbonate sedimentation.

The low preservation potential and paucity of eolian stratification in these deposits are inherent in such depositional systems due to: (1) removal of dunes from the shelf section because of their migration to the shelf margin, and subsequent transport into adjacent basins, (2) textural homogenization by organisms and repeated periods of evaporite crystal growth disruption and dissolution, and (3) additional bioturbation and/or physical reworking as the sands prograded into outer-shelf lagoons and during subsequent shelf transgression. Thus, the absence of "typical" eolian stratification cannot be used to exclude an eolian origin for thin, widespread sands, particularly in mixed carbonate-siliciclastic shelf systems. Conceptually, the occurrence of massive sheet sands may be the sole remaining evidence of eolian activity in such systems. The implications of this model can be extended beyond this particular Permian occurrence to numerous other polylithic shelf sequences in the record.