beds to silty sandstone and fine sandstone beds characterized by slump and massflow structures. Slumping was triggered by instability of sediments on the delta-front slope and by recurrent tectonic movements along the trend of the ancestral Alkali Butte anticline. Succeeding the slump-dominated sandstone in each unit is well-sorted sandstone, deposited in a variety of littoral marine, beach dune, and estuarine channel environments. Depositional strike of the delta-front sediments, determined from primary sedimentary structures, ranged from N8°W to N30°E, and the slope declined east-southeast.

Sandstone units of the delta-front facies are saturated with oil near Alkali Butte. Variations of porosity and permeability of the units along depositional strike in the subsurface, or an association of the units with reversals of dip along faults in the south-central part of the Wind River basin may form traps for petroleum, and make the units worthwhile exploration objectives.

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GENESIS AND DISTRIBUTION OF DESMOINES (PENNSYLVANIAN) SANDSTONE RESERVOIR AT SLEEPY HOLLOW FIELD, RED WILLOW COUNTY, NEBRASKA

Sleepy Hollow field, Red Willow County, Nebraska, discovered in 1960, has produced more than 28 MMBO from a "basal" Pennsylvanian sandstone. The trap for this substantial oil accumulation is complex, related to sandstone characteristics and distribution, low-relief late Paleozoic tectonism, and very subtle post-Paleozoic folding.

Examination of reservoir core samples from 23 field wells reveals the following sedimentologic characteristics.

1. Despite some difficulty of grain-size measurement resulting from erratic sorting, sand grains are consistently coarser at the top and finer at the base of producing sandstone intervals.

2. Sandstone in the producing interval is rarely cemented, and often disaggregates completely when cored or drilled. Core samples of the reservoir sandstone that have been preserved are usually consolidated with an oil residue, and crumble when handled. Uncommon interlaminated, less permeable sandstone beds have argillaceous (kaolinitic?) cement.

3. Mineralogy of the producing sandstone is quite simple; essentially pure quartz with very scarce clasts and cobbles of lime mudstone, weathered feldspar, and chert.

4. Coarse quartz grains in the sandstone are nearly spherical, and commonly frosted and pitted; fine quartz grains are usually subangular.

5. When sedimentary structures can be observed (in the scarce argillaceous beds), subplanar lamination and low-angle cross-lamination can be observed. No moderate or high-angle cross-lamination has been found.

The aforementioned characteristics, when combined with observations of the stratigraphic sequences adjacent to the subject sandstone, suggest the following sequence of sedimentary events governing the distribution of this reservoir rock. First, the Precambrian surface that had been exposed since Early Pennsylvanian time (and perhaps before) was incised by fluvial channels which were choked with granite detritus (quartz, and feldspar in various stages of weathering decay). During mid-Pennsylvanian marine transgression of the crystalline surface, quartz fragments derived from the (channel) granite wash were reworked by westward longshore drift in the shallow sea, but rarely transported more than a mile or two from the drainage system from which they were derived. Accumulation of relatively pure quartz sand is presumed to have been accomplished by final oxidation and destruction of decayed feldspar and then removal through winnowing by marine currents of the clay minerals thus generated. Because of low inclination of the transgressed Precambrian surface (less than 10 ft per mi), subtle eustatic sea-level changes had a profound effect on strand movement and position. Therefore, sand accumulation occurred in an erratic pattern when compared to modern shoreline sand deposits. After three episodes of shoreline and shallow-marine sand deposition and accompanying clay-winnowing, the lobate sand bodies coalesced to form present reservoir distribution. Sand deposition did not occur north and south of Sleepy Hollow because of absence of a near-shore high-energy clastic environment. Sand deposition did not occur east of Sleepy Hollow because of the relative position of the fluvial channel and the direction of longshore drift.

The Desmoines oil accumulation at Sleepy Hollow field is controlled by sandstone reservoir distribution as described above, and by two increments of gentle tectonic uplift, modified by subtle differential compaction of overlying shales.

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EARLY PALEOZOIC TRILOBITES, SEDIMENTARY FACIES, LITHOSPHERIC PLATES, AND OCEAN CURRENTS

In examining the known occurrence of Cambrian and particularly Ordovician trilobites it has been found that:

1. Faunas of continents and platforms that have remained in a single latitudinal zone, particularly in a warm climate, show most strongly the effects of local environment. Concentric geographic changes in faunal composition and diversity result, as in North America.

2. Faunas of continents that passed rapidly through inclement climatic zones bear the print of climatic rather than local environmental variants. Faunas may be arranged in broad latitudinal bands and apparent standing diversities may change stratigraphically within each continental shelf area, as in western Gondwana (Andean area).

3. Inferred patterns of warm oceanic currents relative to changing continental obstructions are compatible with distribution of pelagic trilobites.

4. Tethyan trilobite distribution during the Ordovician shows reversals in migration related to (a) movement of Moroccan and Algerian Gondwana into warmer climate, (b) removal of Antarctic and Australian Gondwana from its obstructing position across the equatorial current, (c) westward movement of Baltoscandia, and (d) eastward movement of North America.

Most oil reserves are in areas that have been in warm climates (horse latitudes) at some time in their geologic history. Lands that have spent the longest geologic time in such zones may have the greatest potential for petroleum production, provided that there is adequate stratigraphic cover and satisfactory geologic structure to retain the oil.

Paleobiogeography, here exemplified by trilobite distribution, may make an important contribution to delimiting potential areas for profitable exploration.

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STRUCTURAL GEOLOGY AND TECTONIC DEVELOPMENT OF NORTHEAST PART OF RIO PUERCO FAULT ZONE, SANDOVAL COUNTY, NEW MEXICO

The northeast part of the Rio Puerco fault zone is in the southwestern part of Sandoval County, New Mexico. Three major types of structural features are present within the area: north- to northwest-trending folds; northeast-trending faults of the Rio Puerco fault zone; and north-trending faults. Dominant movement along faults within the area is dip-slip.

Two major periods of deformation are evident, the Laramide orogenic movements of late Paleocene through Eocene age, and Basin and Range tectonism of middle Miocene to recent age. Laramide tectonism resulted from a north-trending right-shift force couple related to the northeast drift of the Colorado Plateau, and to vertical forces which led to the development of the Nacimiento uplift. The northwest-trending folds and the northeast-trending normal faults of the Rio Puerco fault zone formed in response to the right-shift force couple. The Rio Puerco faults are interpreted as tension fractures which developed at 45° to the trend of the force couple. A slight clockwise rotation of the southeast part of the Colorado Plateau is evident from tension fracture trends along the fault zone. Miocene tectonic activity was dominated by north-trending, east-dipping normal faults having large stratigraphic separations that were related to the development of the Rio Grand rift. Many of the southeast-dipping normal faults of the Laramide Rio Puerco fault zone were rejuvenated during the Miocene crustal extension.

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PENNSYLVANIAN STRATIGRAPHY AND TECTONISM ON SOUTHEASTERN SHELF OF PARADOX BASIN

Precambrian faulting juxtaposed resistant and nonresistant rocks to form an erosional highland around which lower Paleozoic sediments were deposited. Pennsylvanian faulting along the trends of the ancient faults affected the extent of Early Pennsylvanian karsting and the thickness and distribution of succeeding marine deposits. Fault movement ceased in the Desmoinesian.

Clastic and carbonate sedimentation in the area is cyclic. The cycles were produced by shifting centers of detrital sedimentation superimposed upon sedimentation patterns caused by eustatic sea-level changes.

The depositional environments recognized in the area include distributary channels with their associated distributary-front and overbank-detrital environments, and very shallow-water, open-marine carbonate environments.

The detrital distributary systems in the study area produced fan-delta deposits.

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MODERN ANALOGS OF GREEN RIVER FORMATION

No abstract available.

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MUDDY SANDSTONE ENVIRONMENTS, POWDER RIVER BASIN, WYOMING AND MONTANA: OUTCROP AND CORE STUDY

In the Powder River basin of Wyoming and Montana deltaic lobes have prograded from the east, northeast, and southwest at various times during the interval of time assigned to the Muddy Formation. Several recognizable sand-body types which yield hydrocarbons are associated with each of these deltas.

The major types of reservoir sands are delta-distributary channels, barrier islands and high sand tidal-flat deposits. Each of these environments of deposition can be recognized in outcrop and in slabbed cores. After the environment is identified in a core, log shape is useful to extend the environment laterally.

Examples from outcrops and cores from Wyoming and Montana illustrate the features which allow recognition of sands deposited in the various environments. In the barrier-island sands, such as those at Bell Creek field, low-angle crossbedding and a general coarsening upward from shale to silty sand to sandstone is present. *Thalassinoides* and a few *Ophiomorpha* burrows are locally present.

In the tidal-flat sandstones wave and current ripples predominate. Long vertical burrows designated as *Skolithos* are prominent and brackish deposits such as coal are locally interbedded. *Corophium,* a small U-shaped burrow, is present in some of the cleaner intertidal sand bodies.

Distributary-channel sandstones are typically medium to large scale trough crossbedded and locally have current ripples, climbing ripples, and interbedded clay drape in natural-levee deposits. Burrowing usually is limited to the upper part of the distributary-channel sands. Locally at the base of the channels is a conglomerate made up of clasts of marine shale. The uppermost part of the distributary-channel sands commonly are reworked and spread laterally as a thin transgressive beach or intertidal sand.

A subregional paleogeographic reconstruction can be made utilizing the probable areal distribution and trends of each of the genetic sand limits. Maps of this type aid significantly in improving the success ratio of both exploration and development drilling.

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PALEOCURRENT ANALYSIS OF EARLY TRIASSIC MOENKOPI FORMATION, UINTA MOUNTAINS AREA, NORTHEASTERN UTAH

Paleocurrent measurements of 175 linear asymmetrical ripple marks were taken at seven sections of the Moenkopi Formation in northeastern Utah. Five of