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PEORIA FIELD, ARAPAHOE COUNTY, COLORADO

The Peoria field, approximately 40 mi east of Denver in Arapahoe County, Colorado, is in the south-central part of the Denver-Julesburg basin. The field was discovered in July 1970 by Tom Vessels in partnership with Amoco Production Company (Pan American Petroleum Corporation). The discovery was drilled in an attempt to extend the prolific production developed in the 1950s in Washington County southwestward into Arapahoe County. As of March 1, 1971, the field had 53 wells producing from the Lower Cretaceous "J" sandstone. Cumulative production was 742,000 bbl of oil. Development drilling is still being conducted.

Production in Peoria is from a Lower Cretaceous Muddy "J" channel sandstone, with a maximum thickness of 45 ft. Average porosity values are 14.7% with permeabilities averaging 200 md and ranging as high as 1,400 md.

Relatively shallow drilling depths (top of pay at 6,500 ft), inexpensive drilling costs, and high yield wells have been the stimulus for extensive drilling activity in the south-central Denver-Julesburg basin.

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PALEOENVIRONMENTS OF PHOSPHORIA FORMATION, COTTONWOOD–NO WATER CREEK FIELDS, WASHAKIE COUNTY, WYOMING

The Cottonwood and No Water Creek fields produce from a common carbonate reservoir formed by a facies change from shelf carbonates on the west to continental redbeds on the east. Production is from the Ervay Member of the Permian Phosphoria Formation.

Carbonate sediments of the Ervay are analogous to carbonate sediments of the Persian Gulf suggesting similar depositional environments. Paleoenvironments in the study area were determined by thin-section analyses and include salt flats, mud banks, mud flats, lagoons, and green algal banks. Carbonate sediments were deposited in an embayment on a broad stable shelf bordered by low continental areas on the east and the miogeosyncline on the west. Arid and warm climatic conditions prevailed over most of the area allowing for rapid evaporation in the nearshore areas. Green algal banks developed along sub-hinge lines (or topographic highs) on the shelf. These banks provide the best reservoir conditions and possibly the best production at No Water Creek field.

The Ervay throughout the subject area is dolomitized. Dolomitization was penecontemporaneous with deposition and anhydrite precipitation. Chert and collophane are common accessory minerals and increase in percentage westward. Anhydrite increases in percentage eastward.

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PLANKTONIC FORAMINIFERAL TEST POROSITY AS PALEOTEMPERATURE INDICATOR

Five species of Holocene planktonic Foraminiferida (*Globigerinella siphonifera, Globigerinoides sacculifer, Globorotalia menardii, Globorotalia tumida,* and *Neogloboquadrina dutertrei*) from cores in the Indian Ocean were selected for study of intraspecific latitudinal variations in test porosity and pore density. Each species exhibits a change in test porosity with latitude, with greater test porosities characteristic of the location nearer the equator. Pore density results are inconclusive. It was assumed originally that test porosity might be dependent on pore density, but indications are that porosity is controlled by pore diameter and is essentially independent of pore density. We suggest that test porosity may be a buoyancy adaptation of planktonic Foraminiferida, with greater test porosities characteristic of less dense surface water. The density of the surface water in turn is related directly to surface water temperature; test porosity, therefore, might prove to be a useful tool in paleotemperature determinations, a tool which would not require knowledge of the distribution of extant species.

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EARLY PERMIAN UNCONFORMITY IN SOUTHEASTERN WYOMING AND NORTH-CENTRAL COLORADO

An unconformity is present in southeastern Wyoming and north-central Colorado between the Goose Egg Formation, the Owl Canyon Formation or Lyons Sandstone, and the Casper or Ingleside Formation. Evidence for its existence is provided by reworked basal sandy zones and conglomerates, truncation of underlying cross-strata, local relief, possible "duricrust" or caliche zones in subjacent rocks, and an isopach description of the configuration of the erosion surface.

Subjacent strata range from Wolfcampian to pre-Desmoinesian age. The subcrop becomes older from east to west. Superjacent strata belong to 3 units ranging from early to late Leonardian age. In the southern and central Laramie Range and most of the Laramie basin, the Owl Canyon Formation forms the supercrop. It thins to a zero edge northward and westward by depositional onlap and fills in relief on the underlying unconformity. The Opeche Shale Member of the Goose Egg Formation constitutes the supercrop in the Shirley basin, the northern Laramie Range, and probably most of the western part of the study area. It thins northward slightly in the Shirley basin and the northern Laramie Range and fills in relief on the underlying erosion surface. The Lyons Sandstone forms the supercrop on the southwest margin of the Laramie basin.

Stratigraphic relations in southeastern Wyoming are in accord with an interpretation of the growth of an extensive land area and its transgression in the Rocky Mountain and western Mid-Continent areas in Early Permian time.

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STRATIGRAPHY OF FRONTIER SANDSTONE MEMBER OF MANCOS SHALE (UPPER CRETACEOUS) ON SOUTH FLANK OF EASTERN UINTA MOUNTAINS

The stratigraphy of the Frontier Sandstone Member of the Mancos Shale (Upper Cretaceous) was studied on the south flank of the eastern Uinta Mountains (northwest Colorado and northeast Utah). The Frontier Sandstone Member (about 275 ft thick) is divided into 5 depositional units, A through E, which are identified on outcrop by their stratigraphic position, lithology, and inorganic and organic structures. These depositional units are distinct local stages of a full cycle of deltaic sedimentation in the study area.

Units A and B represent sedimentation under an encroaching shoreline from the west with a gradual vertical grain-size increase from black shale and siltstone to very fine-grained, fossiliferous sandstone. Unit C represents a further regression of the shoreline with the development of a littoral zone in and near the study area. Unit D, representing the height of the constructional

phase of the delta, is a complex of various lithologies which is divided into 4 major facies: coastal swamp, fluvial estuary, barrier island, and neritic marine. The fluvial estuary is open landward to a major distributary channel and exhibits high-energy, fluviatile bed forms. The barrier island sandstone body shows a N65°E orientation and separates 2 major facies—the coastal swamp/fluvial estuary facies on the northwest and the neritic marine on the southeast. *Ophiomorpha* burrows, indicators of littoral and shallow neritic environments, are common throughout the barrier-island sandstone. Unit E represents the destructional phase of the delta with initial deposition of marine black shale capping the complex of deltaic sediments of unit D. A grain-size increase upward through unit E, to fine-grained sandstone, culminates in the development of linear, offshore sandstone bars in the upper part of the interval. The sandstones have been bioturbated thoroughly by detritus feeders. Paleorelief, caused by the underlying stratigraphy of unit D, influenced the distribution of the unit E sandstone. Paleotopographic depressions found over the previous positions of both the subshoreface facies of the barrier-island sandstone and the coastal swamp facies, received the thickest offshore sandstone bar development, whereas paleotopographic ridges, specifically above the barrier-island sandstone, received the thinnest offshore bar development. No significant paleorelief was present at the end of the deposition of unit E and the beginning of the deposition of the upper shale member of the Mancos Shale.

The zircon:tourmaline ratio, determined by heavy-mineral analysis of the sandstones, can be used to differentiate fluvial and marine sandstones. Because zircon (Sp. G. 4.7) and tourmaline (Sp. G. 3.1–3.3) have widely different specific gravities, their relative abundances can be used as sensitive indicators of depositional environments. This sorting is related to the particular energy regime which existed at the time of deposition. Ratios greater than 1:1 are representative of high-energy fluvial sandstones, and ratios less than 1:1 are representative of low-energy marine sandstones. The marine environment can be subdivided further between shallow neritic (barrier islands, offshore bar, and shoreface environments) and deeper neritic with the shallow neritic having abundant heavy minerals and the deeper neritic having rare heavy minerals.

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GEOLOGY OF FELDER URANIUM DEPOSIT, LIVE OAK COUNTY, TEXAS

The Felder ore deposit is a 5 million-lb uranium deposit in the South Texas coastal plain. It occurs in the basal sandstone of an Oakville Formation (Miocene) alluvial system. The host sandstone is a carbonate-rich arkose which contains virtually no carbonaceous debris and has been reduced by the local introduction of hydrogen sulfide. The ore lies well within the reduced zone and occurs as coffinite and uraninite that fill interstices and coat and replace grains.

The overall geometric configuration of the ore is that of a winged, crescentic ore roll. Weak mineralization extends the wings of the ore roll and gives greater expression to the roll character. Departures from the shape are controlled by discontinuities in bedding and by proximity of the ore to the surface. Associated with the uranium is a broad halo of anomalous molybdenum.

Subsidiary mineralized trends suggest a preexisting updip position for the main roll. Oxidation from the surface largely destroyed this previous roll by solubilization of uranium. Uranium subsequently migrated into favorably reduced sandstone and reprecipitated at the present roll position.

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CHARACTERISTICS OF TIDAL SEDIMENTATION IN PHOSPHORIA (PERMIAN) STRATA AT COTTONWOOD CREEK FIELD, BIG HORN BASIN, WYOMING

Phosphoria reservoir rocks at Cottonwood Creek field, in the Big Horn basin, exhibit many characteristics of sediments deposited by a confined current, such as those in channels in modern carbonate tidal flats. Such physical properties, observed in thin sections and hand samples, are marked in contrast to the appearance of the nonporous carbonate facies of the Phosphoria. Nonporous strata, updip and laterally adjacent to this large stratigraphic oil accumulation, have properties common to sediments of interchannel and supratidal environments observed in modern tidal flats. These observations, in conjunction with the problem of anhydrite pore-filling and fracture distribution, help to explain the distribution of the reservoir and trap at Cottonwood Creek field, and may have application in exploration elsewhere in this province.

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REEVALUATION OF UNCONFORMITY CRITERIA IN CARBONATE SUCCESSIONS

Studies of modern carbonate sediments during the past 15 years have resulted in 4 revelations that should modify traditional stratigraphic concepts and definitions relating to unconformities: (1) brief subaerial exposure and attendant cementation of scattered small tracts, such as sand bars and tidal flats, are normal and continuing aspects of shallow-water carbonate deposition; (2) submarine cementation of carbonate sediments is a widespread, ongoing process; (3) submarine erosion and transportation of contemporaneously cemented fragments also are taking place constantly within the carbonate depositional realm; and (4) some features formerly thought to represent "soil" or vadose origin are essentially indistinguishable from marine-organic structure, or products or submarine cementation.

By analogy, these same concepts probably apply to ancient carbonate rocks. Consequently many of the traditionally accepted criteria for outcrop and core recognition of unconformities are invalid or tenuous at best.

A new definition of "unconformity" is needed. "Missing section" is not satisfactory as a definitive criterion because an apparent hiatus in fact may be only a function of unrecognized lithofacies or biofacies patterns, depending on the magnitude of the interval involved. Clearly, the really important connotation of "unconformity" is that an area of regional extent was eroded, and the new definition should reflect both qualities: erosion and extent. Along the same line, a useful classification of nongradational stratigraphic boundaries can be constructed, based on the same two criteria.

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REEVALUATION OF USE OF GLAUCONITE FOR RADIOMETRIC STRATIGRAPHIC DATING

Glauconite is a potassium- and rubidium-bearing clay mineral that forms at the seawater-sediment interface in marine environments. As such, it should be useful in