The Upper Cretaceous Fox Hills Formation on the southeastern flank of the Powder River basin, Wyoming, was deposited along a regressive, northeast-trending, low-energy, tidally affected, wave-dominated coastline. The Fox Hills Formation consists of rocks deposited successively in marine transitional–lower shoreface, upper shoreface, foreshore, and tidal-flat environments.

The marine transitional–lower shoreface beds are characterized by generally highly bioturbated, very fine-grained sandstone and silty claystone with interbedded siltstone, silty shale, and shale. The amount of sandstone in them increases landward. Portions of all of these strata include hummocky cross-bedding, unidentified tracks and trails, traces of *Rhizocorallium* and small *Ophiomorpha*, and glauconite layers. The lower shoreface portion of this environment has a ledgy appearance due to the alternation of sandstone and finer grained sediments.

The upper shoreface deposits consist dominantly of sandstone and have minor amounts of siltstone, silty claystone, and shale. The sandstone generally becomes coarser and better sorted upward. Highly bioturbated beds are common throughout the upper shoreface strata. Low-angle planar cross-bedding and some parallel bedding are the major sedimentary structures. Trace fossils of *Ophiomorpha* and *Arenicolites*, and body fossils of pelecypods and gastropods appear in upper shoreface rocks.

The deposits of the foreshore (intertidal) consist of moderately sorted to well-sorted fine-grained sandstone that has seaward-dipping wedge-planar cross-bedding. *Arenicolites* and large, generally vertical, traces of *Ophiomorpha* are common in these rocks. Irregular polygonal weathering patterns are common on outcrop surfaces.

Tidal-flat deposits are common in the upper part of the section in the northern part of the study area. At one locality, these deposits consist of at least 75 ft (23 m) of intercalated fine-grained sandstone and claystone that have lenticular to flaser bedding. The majority of these deposits show a high degree of bioturbation and are considered to be intertidal. These sediments are overlain by approximately 15 ft (4.5 m) of fine-grained silty sandstone and claystone which have plant root casts and a high content of carbonaceous material, and which could represent supratidal deposits. Overlying these deposits is a 12-ft (3.7 m) sandstone bed having a scour base, lag of clay clasts and woody fragments, parallel bedding that grades upward into trough cross-bedding, and a 6-ft (1.8 m) bed of oyster shells near its top. This sequence represents an ancient tidal-channel deposit.

DOLLIVER, PAUL, Geomap Co., Denver, CO

Upper Mission Canyon (Mississippian) Cyclicity and Hydrocarbon Occurrence, North-Central North Dakota

The upper Mission Canyon Formation along the east flank of the Williston basin represents several upward-shoaling cycles within an overall regressive marine sequence. Individual cycles grade from offshore shelf carbonates eastward into restricted marginal marine evaporites. This depositional pattern and subsequent diagenesis have produced numerous prolific hydrocarbon traps.

The relationship of hydrocarbon occurrence to facies distribution, paleostructure, and porosity development is discernable by constructing a variety of isopach, lithofacies, and porosity maps. Two areas in the vicinity of Chola-Mackobee Coulee and Glenburn fields permit detailed analysis of the Bluell, Sherwood, Mohall, and Glenburn cycles.

Anhydrite distribution and thickness variation within individual Mission Canyon cycles most closely correspond to the pattern of hydrocarbon occurrence. Other major factors governing such occurrence include the lateral distribution and succession of carbonate bank, dolomite, anhydrite, and siliciclastic lithofacies.

DOLSON, JOHN, Amoco Production Co., Englewood, CO

Depositional Environments and Reservoir Properties, Lonetree Field, Southern Denver Basin, Colorado

Significant accumulations of oil and gas are stratigraphically trapped in the Lower Cretaceous "J" sandstone in the southern Denver-Julesburg basin of Colorado. Lonetree Field (T3S, R59W) provides a typical example of trapping mechanisms and reservoir properties. Examination of 5 cores and 75 wire-line logs within the field resulted in several conclusions.

The deltaic J sandstone at Lonetree can be divided into three genetic units; a lower delta front (J-3), a middle delta plain sequence (J-2), and overlying destructional marine (J-1). Production at Lonetree is primarily from channel and crevasse splay sandstones of the J-2 interval. Traps are formed by the updip pinch-out of quality sandstone.

Channel sandstones are characterized by a coarse to very fine-grained upward-fining sequence. Trough cross-beds predominate at the base, and ripples and rootlets at the top. Carbonized wood is ubiquitous throughout. These northeast-southwest-trending channels attain thicknesses of 15 to 50 ft (4.5 to 15 m) and widths up to 2,500 ft (760 m).

Crevasse splay deposits show extreme lateral and vertical variation. Both coarsening and fining upward deposits are possible. Maximum thicknesses of 15 ft (4.5 m) are developed only in close proximity to channel sandstones. Rooted zones and ripple cross-stratification are common.

Porosity in both channels and splays is secondary in nature, resulting from the dissolution of feldspars and calcite cement. This overprinting of secondary porosity on a complex depositional system has created numerous separate reservoirs within the field. Porosity in producing zones is commonly 13 to 20%, with permeabilities in excess of 75 md. Kaolinite is abundant in pore throats, and may present completion problems associated with brushpiling of fines during treatment.

Little petrographic or petrophysical differences appear to exist between productive splay and channel sandstones. Typical cumulatives to date are 100,000 bbl of oil per well from splay sandstones, while channels contribute 125,000 bbl of oil per well. The 17 producing wells are expected to yield 2.4 million bbl of oil and 4 bcf of gas.

DORR, JOHN A., JR., University of Michigan, Ann Arbor, MI

Early Cretaceous Stratigraphy, Paleontology, and Sedimentary Tectonics in Paris Overthrust Foredeep (Western Wyoming and Southeastern Idaho) Compared with Quaternary Features of Indo-Gangetic Plain

Fluviatile clastics of the nonmarine, Early Cretaceous Gannett and Wayan groups were deposited on wet alluvial megafans and on intervening interfan piedmont slopes which declined eastward into more poorly drained lowlands from a western highland source area uplifted episodically by movements of the Paris overthrust. The deposits accumulated in the tectonic foredeep depressed by that thrust. The Gannett alluvial fan deposits (earliest Cretaceous) graded eastward into nonmarine lowland alluvial plain deposits of the Cloverly Group. Subsequent Wayan alluvial fan clastics (Early Cretaceous) graded into Bear River, Aspen, and lower Frontier mixed nonmarine, brackish, and marine facies. Lacustrine episodes of deposition intercalated Peterson and Draney limestones with Gannett fluvial clastics. Westward marine transgressions (Skull Creek, Mowry) intercalated mixed lacustrine and brackish facies (Smiths and Cokedale formations) into Wayan fluviatile clastics. Newly discovered fossil vertebrate and invertebrate materials (all fragmentary but identifiable) include: Gannett Group—large reptiles including turtles; Thomas Fork Formation—freshwater gastropods and unionid pelecypods, gastroliths(?), two types of turtles, large reptilian fragments (dinosaur?), and abundant dinosaur eggshell fragments; Wayan Formation—perennially aquatic snails, turtles, unidentifiable large reptiles, two types of crocodilians, an iguanodontid dinosaur (Tenontosaurus), an ankylosaurian dinosaur, a large ornithopod dinosaur, gastroliths(?), abundant and ubiquitous dinosaur eggshell fragments (numerous types and sizes), and miscellaneous unidentifiable small vertebrate bone fragments. The dinosaurs are the first reported from Idaho and from these stratigraphic units.

Faunal, sedimentologic, and stratigraphic data indicate perennially wet, upland (proximal fan) lithotopes and biotopes on a deposurface of much lower gradient than characterizes semiarid or arid fans.

A census of analogous modern reptile reproductive behaviors supports the conclusion that the Wayan, and probably also the Gannett, alluvial fan environments were used as upland breeding grounds by dinosaurs and perhaps other reptiles. Comparison of these Early Cretaceous data with observations on the tectonic setting, sedimentology, and biology of the Quaternary indo-gangetic plain suggests many close analogies between the two sedimentary tectonic settings.