subparallel with a mean strike of N25°E. Changes in thickness of coal lithotypes and the coal seam itself commonly occur across the rolls.

Though a reliable model is not known which fully explains rolls, enough information exists to suggest a likely explanation. The rolls parallel the thickest portion of the Storrs Sandstone Tongue of the Starpoint Sandstone, an ancient littoral sandstone system. This and roll morphology suggest rolls are the steep sides of accretion ridge troughs which comprise the upper surface of the Storrs Sandstone tongue.

Study of the rolls has increased the reliability of their prediction, enabling the engineering staff to make appropriate changes in the mine plan in order to minimize the adverse effects on mineability.

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Red Beds of Middle Pleistocene Olorgesailie Formation, Kenya

Middle Pleistocene lake sediments of the Olorgesailie Formation from the East African Rift Valley of Kenya contain red beds, with colors ranging from moderate orange pink to dark reddish brown (Munsell color chart). Two distinct mechanisms of hematite formation, distinguished by thin section and scanning electron microscope study, have produced the red sediments.

In the first mechanism, hematite was formed in situ by dehydration of limonitic minerals. The limonitic minerals formed in soils of the source area and were transported to the depositional site mainly by adhering to clay particles. The elevated pH of the depositional environment accelerated the rate of hematite formation, producing ultrafine red coating on the clays. Red sediment formed by this mechanism occurs both as an undisturbed bed and as a reworked intraclast conglomerate.

In the second mechanism, hematite is precipitated from ground water, possibly at elevated temperatures produced by the interaction of basaltic magma with water-saturated sediment. The hematite occurs in three forms: as cement within diatomaceous clay, as replaced or stained plant material, and within siliceous sinters. The sinters are red, have a pumice-like texture, and include diatoms that show effects of dissolution. These characteristics indicate formation of the sinters by boiling of near-surface water-saturated sediment. Red beds formed by this mechanism are redeposited and each of the three hematite forms dominates in specific localities.

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Lateral Accretion Channel Deposits in Athabasca Delta: Potential Modern Analog to McMurray Formation

"Epsilon cross-stratification" refers to large-scale, alternating sand and mud couplets that dip at right angles to the paleocurrent direction. This feature is of major concern when producing oil from ancient meandering river point-bar deposits. Mud epsilon cross-strata act as impermeable barriers to the movement of hydrocarbons within the reservoir. This and other related problems have been prevalent in steam enhanced recovery from the bitumen-rich middle member of the McMurray formation.

Research on epsilon cross-stratified lateral accretion deposits has been focused for the most part on the study of ancient deposits. Investigation into the modern occurrence of these features has been limited in scale (0.5 m or 1.6 ft deep channels) and numbers of observations. Many unanswered questions remain as to the location of depositional environment (meanders in fluvial, tidal, or deltaic systems) and detailed sedimentologic characteristics.

A recent investigation has found mud epsilon cross-strata in lateral accretion point-bar deposits in the Athabasca upper delta plain in northeastern Alberta. The overall sedimentologic trends of these particular lateral accretion deposits, including the variability, continuity, thickness, and geometry of the mud epsilon interbeds, has given new insight into the complex nature of these deposits and occurrence of depositional setting.

Many aspects of the lateral accretion in the Athabasca upper delta plain appear very similar to the ancient lateral accretion deposits of the middle McMurray. Comparative sedimentology of the modern and ancient deposits may lead to a better understanding of these deposits. This may in turn allow for optimum site selection for in-situ steam injection and recovery wells as well as prediction of potential fluid movement patterns.

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Economic Potential for Upper Cretaceous and Lower Tertiary Rocks Near Helper, Carbon County, Utah

Exceptionally good exposures of Late Cretaceous and early Tertiary rocks in the western Book Cliffs area near Helper, Utah, allow detailed study of nearshore clastic sediments. The Mancos Shale is an organic-rich, silty shale, interrupted regularly by tongues of fine to medium-grained sandstone that thin to the east. The Garley Canyon and Emery Sandstones, which are the two main sandstone members in this area, exhibit a prograding clastic shoreline sequence from open-marine and lower shoreface to upper shoreface environments. Thinner sandstones also crop out in the area that indicate minor pulses of deltaic progradation and exhibit one or more of these facies. Thesé sandstones pinch out eastward, and are offset by normal faults to the west; therefore, hydrocarbon accumulation is likely to occur in areas to the west.

The coal-bearing Blackhawk Formation is also well exposed within the study area, and is interpreted as a wave-dominated delta complex. Coal-forming swamps were situated directly on beach ridges. Several of these economically important coal seams pinch out westward (landward) within the study area. This stratigraphic interplay between terrestrial sedimentation and the coal-forming swamp environment provides details for refining coal exploration models.

Upon completion of regional stratigraphic analyses, thickness variations in Upper Cretaceous and lower Tertiary formations may provide a more precise indication for the time of crustal uplift associated with the San Rafael swell.

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Shallow-Water Clastic Sediments of Great Blue Formation and Manning Canyon Shale, Oquirrh Basin, Utah

An east-west belt of clastic sediments in the Mississippian Great Blue Formation and Manning Canyon Shale thickens and coarsens westward and contains terrestrial plant and palynomorph assemblages. These clastic sediments were derived from the Antler highlands in central Nevada. The depositional axis of the clastic belt or proto-Oquirrh basin is probably related to a basement weakness that controlled the east-west-trending Uinta basin. The geometry of the belt is illustrated by isopach maps and cross sections. An isopach map of the total Mississippian clastics in eastern Nevada and Utah and an east-west cross section through the Oquirrh basin demonstrate that the clastics thicken and coarsen westward and indicate a western source. A north-south cross section illustrates how the clastic sediments were restricted to the east-west clastic belt. In contrast to previous interpretations that assumed that the clastic sediments were shed westward from the craton into deep water, field evidence suggests that they were shed eastward from the rising Antler mountains into very shallow water.

Terrestrial plants preserved in shales and sandstones of the Great Blue Formation and the Manning Canyon Shale suggest that the clastic sediments were deposited in a transitional environment such as lagoons, distal flood plains, and deltas. Palynomorph assemblages in the shales lack marine forms and also indicate shallow-water deposition. In addition, surface gamma-ray patterns of measured sections are typical of transitional facies sequences such as deltas and nearshore environments.

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Complex Interaction of Eolian and Marine Sedimentation in Permian White Rim Sandstone, Elaterite Basin, Southeast Utah

Two depositional units distinguished in the Permian White Rim Sandstone of the Elaterite basin indicate episodes of both eolian and marine sedimentation. The lower unit is a thick section of large-scale, high-angle, cross-bedded quartzarenite. The tabular cross-bed sets average 2.6 m (8.5 ft) in height and contain inversely graded translatent strata and small ripple trains with high ripple indices. Some exposures reveal large barchan dune forms. This lowest unit comprises most of the formation and is sharply cut and scoured by the overlying unit. The upper unit is a thin veneer that ranges from 1 to 5.3 m (3 to 17 ft) in thickness and possesses