Proximal open-lacustrine deposition produced well-stratified marlstone and lean oil shale, and rare algal stromatolite. Detrital silicate minerals become less abundant and are volumetrically replaced by dolomite, Fe-dolomite, excess-Ca ankerite, analcime, and rare dawsonite. The $\delta^{34}S$ values of pyrite from this facies range from 22 to 54 per mill and average about 30 per mill. The distal open-lacustrine facies is represented by richer grades of oil shale (greater than 15 gal/ton) and saline minerals (nahcolite and halite). The oil shale contains abundant Ca-Fe-Mg-carbonate phases, authigenic quartz, K-feldspar, Na-plagioclase, and dawsonite. Analcime is rare. The $\delta^{34}S$ values of pyrite and marcasite range from 18 to 66 per mill and average 35 per mill.

Overall, the Parachute Creek Member shows that detrital silicate minerals and calcite are concentrated in the marginal-lacustrine facies but authigenic silicate minerals, complex Mg-Ca-Fe-carbonate minerals, and saline minerals are concentrated in the open-lacustrine facies. Sulfur-isotope data show that iron sulfide minerals become progressively enriched in ^{34}S toward the open-lacustrine environment of deposition.

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Tertiary Correlations in Bighorn and Uinta Basins, Wyoming and Utah

Electrical accessory curves have been used to map the Mesaverde, Lance-Meeteetse, Fort Union, and Willwood Formations in the Bighorn basin of Wyoming. These subsurface mapping units have been correlated to mapped outcrops on the flank of the basin. Recent authors have concluded that the basin started to subside during upper Lance deposition; however, I conclude that most subsidence along the axis of the basin was in late Paleocene and Eocene times (upper Fort Union and Willwood).

Electrical accessory curves also were used to map the Mesaverde, Wasatch, Green River, Uinta, and Duchesne River Formations in the Uinta basin of Utah. These subsurface formations have been correlated to mapped outcrops on the south flank of the basin. Thickening of the Uinta and Duchesne River Formations into the basin indicates that the main subsidence along the axis of the basin was in late Eocene time.

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Lineament Mapping with Orbiting Imaging Radar

The Seasat A Synthetic Aperture Radar (SAR) was designed primarily for oceanographic and polar studies. During its 150-day mission before equipment failure, the SAR imaged substantial areas of North America as well as parts of northern Africa, Europe, Central America, and South America. The Seasat SAR differs from most commercial SLAR systems in that it has long wavelength (λ = 25 cm) and a steep incidence angle (~20°). These factors make the system more sensitive to differences in surface materials.

In the Peninsula Ranges of southern California, some previously unmapped lineaments were seen on radar images but not on Landsat. Field work has revealed faults of unknown displacement. Similar findings in the Appalachians have been reported. Near Medicine Lake and Mount Shasta in northern California, scarps only a few meter high are detectable. In that these small scarps have eroded to near the angle of repose and are parallel with the flight path, the energy return is particularly strong.

In the course of this work we have developed a classification system for radar lineaments that includes physical models and predictions of effects of changing viewing geometry. Any attempt to analyze lineaments in smooth sedimentary basins should involve at least two viewing directions to minimize bias.

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Deposition and Diagenesis of Organic Matter and Calcium Carbonate in Modern North Temperate Lakes

The three most important components in the sediments of modern north temperate lakes are detrital material, organic matter, and calcium carbonate. The detrital material is derived from whatever materials are available in the drainage basin, with modifications by weathering and diagenesis. Organic matter is a mixture of both allochthonous material (pollen grains, seeds, needles, organic detritus, etc) from the drainage basin and autochthonous organic matter (largely debris from planktonic algae and aquatic macrophytes). Recent studies of sedimentary pigments in lake sediments indicate that most of the organic matter in sediments of productive (eutrophic) lakes is derived from algae. Sediments in these lakes usually are olive gray and contain more than 20% dry weight organic matter (10% organic carbon). High concentrations of organic matter also accumulate in meromictic lakes in which organic matter is protected from oxidation by permanently anoxic bottom waters.

Low-magnesian calcite is the most common carbonate mineral in those lakes that are saturated with respect to calcium and/or magnesium carbonates. Dolomite and high-magnesian calcite can form even under humid, temperate conditions if the Mg:Ca ratio in the water is greater than about 8. Aragonite is mostly derived from mollusk debris, but may form as a primary precipitate if the Mg:Ca ratio in the water is greater than about 12. Assimilation of carbon dioxide by phytoplankton photosynthesis is an important aspect of carbonate precipitation in hard-water lakes. In some lakes, the rate of precipitation of calcium carbonate from waters that are supersaturated with respect to calcium carbonate is directly proportional to rates of assimilation of calcium carbonate by plankton.

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Geologic Characteristics of Valles Caldera Geothermal System in New Mexico

The Valles Caldera is in north-central New Mexico,

60 mi (97 km) north of Albuquerque. The caldera is a prominent geologic structure in the Jemez Mountains, a complex volcanic highland of Pliocene and Pleistocene age. Surficial evidence of geothermal resources includes the widespread distribution of rhyolitic volcanics in space and time, large areas of hydrothermally altered rock, and hot springs and gas seeps. Nineteen geothermal wells have been drilled in the caldera. The principal geothermal resource discovered is a liquid-dominated, under-pressured system with base temperature in excess of 260°C, and salinity on the order of 6,000 ppm total dissolved solids. A maximum temperature of 330°C has been measured. Some wells have encountered a vapor-dominated reservoir overlying the liquid-dominated reservoir. Production is principally from fractures in the lower part of the rhyolitic Bandelier Tuff. Typical wells are 5,000 to 9,000 ft (1,525 to 2,745 m) deep.

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Paleokarst Controls on Localization of Uranium at Pitch Mine, Sawatch Range, Colorado

The Pitch Mine is located at the southwestern end of the Sawatch Range in south-central Colorado. Currently being developed by Homestake Mining Co., the deposit has 7 million lb (31.5 million kg) of U_3O_8 delineated reserves. The uranium mineralization largely occurs in the black organic-rich matrix material of carbonate breccias. These breccias have previously been described as Pennsylvanian Belden Formation "fault breccias." They are, however, morphologically similar to the Upper Mississippian fossil karst breccias within and on top of the Mississippian Leadville Formation, which host silver and base-metal mineralization in several areas of the Sawatch Range.

Paleokarst relief is well exposed on the Leadville Formation within a few miles of the Pitch Mine. The karst features include lines of what appear to be karst towers with their associated sinkholes and rare preserved red-soil breccias. The towers are morphologically similar to other Late Mississippian karst towers in the Molas Lake area of southwestern Colorado.

The carbonate breccias formed by surface karst weathering, as washed-in cave and sinkhole fill, and by sinkhole collapse. The black clayey matrix material was deposited in the lakes and swamps of a drowned karst regime such as the Everglades and sinkhole lake country of the Florida Peninsula today.

Both the mineral assemblage and alteration at the Pitch are limited, indicating a low-temperature origin for the uranium.

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Coal Variations in Fluvial Deposition of Paleocene Tongue River Member of Fort Union Formation, Powder River Area, Wyoming and Montana

The coal-bearing Tongue River Member of the Fort Union Formation in the Powder River basin exemplifies fluvial deposits of Tertiary intermontane basins. The Tongue River Member coals are targets of extensive drilling exploration and development. About 200 sections, spaced an average of 0.5 mi (0.8 km) apart, were measured in a 60-mi (96 km) continuous outcrop along the Powder River in Wyoming and Montana to determine the environmental-stratigraphic framework of the coals in the 1,500-ft (450 km) thick Tongue River Member. Coal-bed distribution in this area may be typical of that in many parts of the basin.

The coals are distributed in two major facies: a lower (1,100 ft or 330 m thick) fluvial channel dominated facies, and an upper (400 ft or 120 m thick) lake-dominated, interfluvial and fluvial channel facies. Major coals, including the Anderson, Canyon, Cook, Wall, Pawnee, and Cache, were formed in the fluvial channel dominated facies, which contains numerous en echelon channel sandstones that range from 50 to 200 ft (15 to 60 m) thick and from 1 to 9.5 mi (1.6 to 15.2 km) in lateral extent. The offset arrangement of the sandstones suggests shifts of meandering channels among low-lying poorly drained interchannel backswamps which were filled by overbank-crevasse sandstone, siltstone, and shale. These backswamps, as well as poorly drained backswamps developed on abandoned channel ridges, were sites of coal deposition. Coal beds in this facies locally thicken from 1 to 30 ft (0.3 to 9 m) within 3 to 7 mi (4.8 to 11.2 km) and were traced in outcrops for 8 to 12 mi (13 to 19 km) as lenticular bodies. They split laterally, grade into carbonaceous shale, or are truncated by channel sandstones.

The lake-dominated interfluvial and fluvial channel facies consist of abundant crevasse-splay sandstone, siltstone, and shale, and lacustrine limestone and shale that contain abundant freshwater mollusks. A few channel sandstones are present; these range from 30 to 80 ft (9 to 24 m) thick and from 0.5 to 3 mi (0.8 to 4.8 km) across. The crevasse and channel deposits developed poorly drained to well-drained backswamp platforms where coals formed. Coal beds, including the Smith and Roland, average about 2.5 ft (0.7 m) thick and are laterally continuous in outcrops for as much as 5 mi (8 km). Crevasse splays dominated the interfluvial-lacustrine sedimentation and commonly interrupted lateral continuity by splitting the coal beds.

Thus, of the two major facies, the more coal productive is the fluvial channel dominated facies. The development of thick, lenticular coal beds in this facies was directly influenced by depositional settings of poorly drained backswamps which formed mainly on abandoned channel ridges and overbank areas.

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Geology of Paleozoic Strata in West-Central Saskatchewan

The study area is located just south of the Precambrian shield between the Meadow Lake escarpment and the Alberta-Saskatchewan boundary. It is approximately 350 km long and 70 km wide and constitutes part of the Middle Devonian Meadow Lake basin, which is the southeastern portion of the early Elk Point basin. The Paleozoic strata comprise clastic rocks of the Cambrian Deadwood Formation and dominantly carbonate rocks