inland sabkha with episodic inundations intercalating intertidal dolomite and lagoonal "black shale" with the sabkha sediments. Prolonged periods of exposure allowed migration of eolian dunes across the region. The broad sabkha surface was an area of eolian bypass with only isolated patches of dunes being trapped by rare topographic relief. The bulk of the migrating sand was transported south and west into the sand seas of the Tensleep, Weber, and Casper Formations. Sand was supplied from the north probably by eroded Tyler and older Paleozoic sandstones. In the present-day Hartville uplift area, an Upper Pennsylvanian trough known as the Lusk embayment modified Leo sedimentation. This trough introduced open marine waters into the southwestern corner of the Leo region, resulting in deposition of crinoidal limestone (in lieu of evaporites and carbonaceous shale) interbedded with eolian dunes.

Criteria suggesting windblown deposition of the majority of Leo sandstone include deflationary lag surfaces, low-amplitude ripples, subcritically climbing translatent cross-stratification, and sand-flow toes. Isolated eolian sandstones provide excellent stratigraphic traps for hydrocarbons generated in the organic-rich shales. The current flurry of Leo drilling that began in 1978, has affirmed the inherent potential of this play. Definition of paleodepositional trends and seismic recognition of isolated dunes are the keys to Leo exploration success.

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Trapper Canyon Deposit, Eastern Big Horn Basin, Wyoming: Tar Sand or Heavy Oil?

The Trapper Canyon Deposit (Battle Creek Deposit in U.S. Bureau of Mines Monograph 12) is located on the western flank of the Bighorn Mountains approximately 30 mi (48 km) east of Greybull, Wyoming. The petroleum occurs in the upper eolian sequence of the Pennsylvanian Tensleep Sandstone which dips from 5° to 8° to the southwest. The deposit was initially reported by N. H. Darton in U.S. Geological Survey Professional Paper 51 in 1906. A characterization study was made on the deposit which included mapping the deposit and surrounding area, measuring three stratigraphic sections in the Tensleep Sandstone, and sampling 13 outcrop localities. Thickness of the deposit ranged from 0 to 22.5 ft (6.8 m) in the 13 sample localities. Preliminary analyses of outcrop samples indicate API gravities and viscosities consistent with the definition of a tar sand. Oil properties are similar to those published for Phosphoria-sourced oils produced from the Tensleep Sandstone in fields to the west. Lateral pinch-out of the deposit, tight characteristics of upper and lower bounding units, and the lack of any apparent structural controls in the area, are all evidence for a stratigraphic trapping mechanism. Recoverable reserves are estimated at 1.96 million bbl over a 67-acre (27 ha.) area.

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Thermal Infrared Survey of Sunlight Basin, Park County, Wyoming

Thermal infrared surveys were flown over the Sunlight mining region and Sulphur Camp area of the Sunlight basin to substantiate whether reported fumaroles are indicative of contemporary geothermal activity in the area.

Thermal infrared imagery shows areas of warm ground along and warm water discharge into Sunlight Creek and Sulphur Lake. Sulphur deposits are found on north- and south-facing hill slopes associated with a second warm ground anomaly adjacent to Gas Creek. Warming is also manifested in the thermal characteristics of vegetation, and several fumaroles are identifiable. Aeromagnetic data show a 200 gamma low at Sulphur Camp which cannot be explained topographically.

Major northeast-trending lineaments provide potential conduits for thermal fluids from the magma plume in Yellowstone National Park, 50 km (30 mi) to the southwest. The floor of the Yellowstone caldera is topographically higher and could provide the necessary hydraulic head to move the fluids outward. Other geothermal resources may exhibit the same characteristics. This example suggests that geothermal resources may occur at considerable distances from a heat source.

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Comparison of Western Facies of Thermopolis, Muddy, and Mowry Formations with Other Areas of the Early Cretaceous Seaway, Northern Rocky Mountains and Great Plains Region

The Thermopolis, Muddy, and Mowry formations were deposited in environments associated with an Early Cretaceous sea in the area of the modern Northern Rocky Mountains and Great Plains. The sea advanced into the western interior from the north temporarily joining a northward-transgressing Gulf sea. A regressive period followed, and the southern margin of the sea retreated at least as far north as Wyoming. Studies of depositional environments in the central and eastern parts of the seaway indicate that a second Early Cretaceous transgression followed. However, evidence for the second transgression is not apparent in the study area (Madison and Gallatin Ranges of southwestern Montana). Eastward progradation of marginal marine environments continued on the western side of the seaway despite the sea's second advance. Fluvially dominated delta systems developed on the western side with only minor reworking by marine processes. The western side also received significant amounts of volcaniclastics producing additional lithologic and environmental differences across the seaway.

Facies of the Thermopolis, Muddy, and Mowry formations on the western side of the seaway are compared with other parts of the seaway through compilation of regional paleogeographic maps for five Early Cretaceous episodes. These comparisons show that significant differences in sediment source, amount of sediment input, and tectonic setting existed from one side of the seaway to the other. The following are some of the changes in the Thermopolis, Muddy, and Mowry formations which occur across the Early Cretaceous seaway as a result of the following differences. (1) The lower, informally designated "rusty beds member" of the Thermopolis Shale is more calcareous on the western side of the seaway. Paleozoic carbonates provided sediment from the west while siliciclastic sediment was shed into the seaway from the east. (2) The Thermopolis Shale was subaerially exposed on the eastern side of the seaway is separated from overlying Muddy Sandstone by an unconformity. In contrast, the depositional sequence is continuous on the western side. (3) An unconformity separates lower, regressive Muddy Sandstone deposits from overlying transgressive Muddy Sandstone deposits in the central and eastern parts of the seaway. The Muddy Sandstone on the western side of the seaway is a continuous regressive deposit. (4) The transgressing sea reworked lower Muddy Sandstone into extensive winnowed bar deposits in the eastern and central parts of the seaway. These excellent oil and gas reservoirs apparently are not present on the western side of the seaway. (5) The Mowry Shale was deposited in offshore marine environments in most of the Northern Rocky Mountains and Great Plains region. However, in most of southwestern Montana, the Mowry Shale and equivalents were deposited in nonmarine environments. (6) Siliceous claystone is the dominant lithology of the Mowry Shale deposited in marine environments on the western side of the seaway. Much of the sediment on the western side was derived from volcanic sources. The Mowry Shale is less siliceous to the east, probably because volcanic sediment decreases eastward. Organic carbon content is higher to the east, increasing the petroleum source potential of the Mowry Shale on the eastern side of the seaway.

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Depositional Environment of Bullion Creek Formation (Paleocene) in Southern McKenzie County, North Dakota

The environment of deposition of the Bullion Creek Formation in western North Dakota has been variously ascribed to lacustrine, meandering fluvial, and marginal marine deltaic environments with the latter three being favored by most workers. The purpose of the present study is to evaluate these previous models through careful field observations on a local scale, more specifically T145 and 146N, R102W of McKenzie County, North Dakota.

The Bullion Creek Formation rests conformably atop the Slope Formation (nonmarine) in the southwest quarter of the state and is conformably overlain by the Sentinel Butte Formation. The Tongue River Member of the Fort Union Formation is the lateral equivalent of the Bul-