over different bed-rock types and to variations in leakage from the geothermal system at depth. An interpretation of the mercury populations in light of the available geologic and structural characteristics of a prospect can significantly increase the understanding of the geothermal resource.

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Tectonic Significance of Depositional Patterns in Nonmarine North Horn Formation, Central Utah

The Maestrichtian through Paleocene(?) North Horn Formation is a nonmarine sequence of interbedded and intertonguing synorogenic conglomerate, sandstone, algal limestone, and claystone. Deposition occurred within an interior drainage system restricted by the Sevier highlands to the west and the San Rafael swell to the east. It extended south to at least Salina Canyon in central Utah and north to the southern margin of the Uinta basin. The base of the formation is diachronous, unconformably overlying Campanian rocks. Earliest deposition began along the eastern Wasatch Plateau, then shifted westward until late Paleocene beds onlapped deformed Mesozoic rocks associated with Sevier thrusting.

Paleocurrent measurements indicate a general west to east transport direction. Four major depositional facies are recognized: alluvial fan, proximal braid plain, distal braid plain, and lacustrine. Work has been concentrated on the alluvial fan and braid plain facies west of the Wasatch Plateau.

Massive clast-supported cobble to boulder conglomerate characterizes alluvial-fan facies. Deposition on fan surfaces was primarily by sheetflood or braided stream processes. Conglomerate shows skewed clast populations. Northeast of Mt. Nebo, 60-70% of clasts are carbonate rocks. Clasts range up to 1 m (3 ft) in diameter. Thick Paleozoic carbonate beds associated with the Nebo fold nappe furnished most of them.

Upward-fining sequences of massive to crudely stratified clast-supported conglomerate, conglomeratic sandstone, and sandstone characterize proximal and distal braid plain facies. During transport down the braid plain, mixing of Eocambrian and Cambrian quartzite, Paleozoic carbonate, and Mesozoic sandstone occurred. Conglomerate was deposited in bars within braided stream channels. It displays imbrication of flattened clasts with long axes transverse ($\cong$40-70°) and intermediate axes subparallel to flow direction. Sandstone displays poorly developed cross-stratification, planar stratification, and massive bedding. Rapidly fluctuating episodes of sedimentation with high sediment loads on the proximal braid plain, and extensive bioturbation by infauna on the distal braid plain, are indicated.

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High Resolution Seismic Surveys and Their Applications to Coal Exploration and Mine Development: Case Histories

The Wasatch Plateau coalfield of central Utah contains many active coal mines within approximately 1,000 mi^2 (2,590 km^2). More than 20 coal seams, each greater than 4 ft (1.2 m) thick, have been named, and several of these are currently mined. Structurally, the area is dissected by generally north to northwest-trending faults with varying offsets. In 1980 and 1981, initial seismic surveys indicated that several northeast-trending faults existed within the vicinity of East Mountain. The highly favorable results of the initial surveys have led to additional surveys in other areas of the Wasatch Plateau coalfield, and in Colorado, Wyoming, and Washington. The interpretation of these data has pinpointed fault locations, fluvial channel sandstones, thickness trends, and general geologic structure. One area with suspected thin coal was found to contain coal of minable thickness. The results of the seismic surveys have been confirmed by drilling, detailed surface mapping, and Landsat imagery. Numerous seismic data and their interpretation in the various geologic situations have been determined since the initial surveys.

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Alluvial Model for Eocene Wasatch Formation Coal, Powder River Basin, Wyoming

The Eocene Wasatch Formation in the Powder River basin, Wyoming, consists of a conglomerate facies (Kingsbury Conglomerate Member) on the western margin of the basin and a coal-bearing facies near the center of the basin. The conglomeratic facies consists of abundant, basally scoured, pebble to boulder conglomerates and sandstones, and minor rooted siltstones. The conglomerates contain abundant sedimentary and subordinate crystalline rock fragments derived from the adjoining Bighorn uplift. The coal-bearing facies comprises dominant coarse to conglomeratic sandstones and rooted siltstones and claystones. Minor constituents are fossiliferous limestones, carbonaceous shales, and coals. A thick, widespread coal bed (Felix coal) ranges from 10 to 28 ft (3 to 8.5 m) thick within a 400 mi^2 (1,035 km^2) area and splits outward from this area into several beds. Where the coal is thick, it is underlain by sandstones and the coal splits are underlain by finer grained deposits.

The conglomeratic facies represents wet alluvial-fan deposits consisting of graded gravel bars, channel sands, and finer overbank detritus. These sediments grade eastward into the coal-bearing facies that represents deposits of meandering streams and their adjoining flood plain and backswamp. The locations of the thickest, most widespread coal body and its splits in this facies are governed by depositional topography controlled by differential compaction of the substrate. Where the substrate is poorly compactible channel sandstones, the swamp surface was relatively high and free of sediment influx. Where the underlying deposits are fine grained and more compactible, the resulting low-lying swamp attracted water-borne sediments that interrupted peat accumulation.

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Petroleum Source Rocks and Stratigraphy of Bakken Formation in North Dakota

The Bakken Formation (Devonian and Mississippian) of North Dakota consists of upper and lower, black, organic-rich shales separated by a calcareous siltstone middle member. The formation is a relatively thin unit—maximum thickness 145 ft (44.2 m)—with the lower shale attaining a maximum thickness of 50 ft (15.2 m), and the upper shale a maximum thickness of 23 ft (7 m). The shales are hard, siliceous, pyritic, fissile, and noncalcareous. They contain abundant conodonts and tasmanites and have planar laminations accented by pyrite. The upper and lower shales were apparently deposited in an offshore, marine, anoxic environment where anoxic conditions may have been caused by a stratified water column resulting from restricted circulation. Organic matter in the black shales was derived mostly from planktonic algae.

Organic-carbon measurements revealed the Bakken shales to be very organic-rich (average of 11.33 wt. % of organic carbon), and visual kerogen typing revealed this organic matter to be predominantly an amorphous type that is inferred to be sapropelic. The onset of hydrocarbon generation was determined to occur at an average depth of 9,000 ft (2.74 km) by interpreting plots of geochemical parameters with depth (e.g., ratios of hydrocarbon to nonhydrocarbon, saturated hydrocarbon to organic carbon, pyrolytic hydrocarbon to organic carbon, and the pyrolysis production index). Hydrocarbon content and thermal kerogen breakdown increase greatly in the Bakken shales where they are buried at depths greater than 9,000 ft (2.74 km). The effective source area of the Bakken, as determined by maps of the above geochemical parameters, lies mostly in McKenzie, Williams, Dunn, and Billings Counties. Oil generation was probably initiated in the Bakken about 75 Ma (Late Cretaceous) at a temperature of about 100°C (212°F), with initial expulsion of oil from the Bakken probably occurring 70 Ma (Late Cretaceous). The amount of oil generated by the Bakken in North Dakota, as calculated from pyrolysis data, is 92.3 billion bbl. If only 10% of this oil was actually expelled from the shales, it could easily account for the 3 billion bbl of known type II oil reserves in the Williston basin. (This paper is a summary of work done for an M.S. thesis at the University of North Dakota).