show that subtle tectonic features have influenced deposition within each of the regional facies belts.

On the western shelf, coastal sandstones of the Eagle Sandstone near the Bearpaw Mountains show facies and isopach variations which are controlled by linear features visible on satellite images; the linear features generally trend north-south and east-west. Inner shelf sandstones of the Eagle thin and pass laterally northeastward into marine siltstones and shales across the Cat Creek fault zone near Winnett, Montana. Sandstone lenses in the lower Eagle, which are interpreted to be sand ridges, prograde south and west at approximately right angles to the fault zone. Farther east on the outer margin of the western shelf, areas of sand ridge fields in the Shannon Sandstone Member of the Gammon Shale are delimited by northeast and northwest linear features observed on satellite images near the northern Black Hills. Within the basin, thick areas of Gammon Shale are delimited by northeast and northwest lineaments interpreted from Landsat linear features. On the eastern ramp, noncalcareous shales of the Gammon Member of the Pierre Shale thin and intertongue eastward with chalks in the upper part of the Niobrara Formation. This facies change occurs across linear features visible on Landsat images in western South Dakota. To the east at the inner margin of the ramp, the degree of erosion on the unconformity between the Niobrara Formation and the overlying Pierre Shale changes systematically across northeast-trending Landsat linear features observed near the Missouri River in central South Dakota.

Based on these studies, we interpret the stratigraphic variations to be the expression of paleotectonism on discrete basement blocks bounded by fault zones which are observed on Landsat images as linear features. On the western shelf, elevated blocks controlled the sites of the winnowing and deposition of sandstones. Within the basins, subsiding basement blocks were filled by deposition of shales. These basin blocks acted as sediment sinks which inhibited the eastward dispersal of terrigenous materials from the west. On the eastern ramp, chalks were deposited and locally eroded on slightly elevated blocks which were relatively free of terrigenous material. Paleotectonism, therefore, influenced deposition not only on the active western shelf and in the basin, but also on the more stable eastern ramp.

SHUSTER, MARK W., and JAMES R. STEIDTMANN, Univ. Wyoming, Laramie, WY

Origin and Development of Northern Green River Basin: A Stratigraphic and Flexural Study

Two-dimensional profiling of the northern Green River basin using topographic, stratigraphic, and structural information shows that the basin can be modeled effectively as a flexural depression resulting from extrabasinal and intrabasinal loading on an elastically behaving lithosphere. Two distinct approaches were used: present basin geometry profiling and sediment thickness profiling. Present basin geometry profiling involves analysis of predicted present-day basin configuration compared with the observed configuration. Sediment thickness profiling, a procedure based on isostatic compensation for flexural responses to loading, relates stratigraphic thicknesses of basinal rocks to coeval tectonic loading. Results of both methods suggest that lower Tertiary and perhaps some uppermost Cretaceous sediments accumulated as a result of flexure due to loading by the Darby and Prospect thrusts to the west and the Wind River foreland thrust to the east. Moreover, results of the sediment thickness profiling are of predictive value, resolving stratigraphic problems and timing structural events. Tentative results imply: (1) the northern Green River basin was full by the end of the early Eocene, and subsequent erosion has been negligible; and (2) the first movement on the Wind River thrust in latest Cretaceous was significant in controlling basin configuration.

SONDEREGGER, J. L., and MAREK ZALUSKI, Montana Bur. Mines and Geology, Butte, MT

Ennis Geothermal System Fracture Porosity: an Overthrust Effect?

The Ennis geothermal area is believed to be an elliptical field, roughly 1/2 mi long in a north-south orientation and 1/4 mi wide, located 1 1/2 mi north of Ennis, Montana. The valley is bounded by Precambrian (X) rocks to the west, and by Paleozoic and Mesozoic rocks to the east. Geophysical data indicate a major north-south valley-bounding fault, and the presence of minor east-west cross-valley faults with minor displacement. The geothermal fluids occur with the quartzofeldspathic gneiss and hornblende gneiss which is overlain by a thin (465 to 650 ft, 140 to 200 m) layer of Tertiary and Quaternary sediments along the major axis of the field. Production is from a highly fractured zone within bedrock. Fluids produced average 189°F (87°C), with a total dissolved solids content of 1,000 mg/L.

Two wells penetrate the fracture zone, and a third well is completed in the Precambrian gneiss but is not believed to intersect the major fracture zone. The southern deep well, TX-12, intercepted the top of the fracture zone at a depth of 492 ft (150 m), 25 ft (8 m) below bedrock contact; it penetrated the bottom of this zone at a maximum depth of 615 ft (187 m), 148 ft (45 m) below top of bedrock. The northern well, MAC-1, intersected the fracture zone between the depths of 1,100 to 1,200 ft (335 to 365 m). The nonflowing temperature log on TX-12 shows a maximum of 198°F (92°C) at a depth of 500 ft (150 m), whereas the shut-in log on MAC-1 is reported to indicate a maximum temperature of 206°F (97°C) at about 1,100 ft (335 m).

Hydraulic connection between the two deep wells was established during a pump test on MAC-1, with transmissivity and storativity values of 4,000 ft^2/day (370 m^2/day) and 2.5×10^{-4}, respectively. The two deep wells are 1,010 ft (308 m) apart along a north-south line, and the third well is 260 ft (80 m) south-southwest from the pumped well. The rate of drawdown during pumping was greater in the distant well, which fully penetrates the fractured zone, than in the third well; this indicates the hydraulic conductivity of the Precambrian gneiss is considerably smaller outside of the fracture or shear zone.

With only two wells, a three-point problem solution to the orientation of the fracture zone cannot be solved. However, we have established a north-dipping fracture zone (minimum dip 30°) which does not fit either into Precambrian or Tertiary tectonic domains. Could the structural control on this geothermal system be related to the Overthrust belt?

SOUTHWELL, ELIZABETH H., and JAMES R. STEIDTMANN, Univ. Wyoming, Laramie, WY, and LARRY MIDDLETON, Northern Arizona Univ., Flagstaff, AZ

Depositional Environments of Fort Union Formation, Bison Basin, Wyoming

The Paleocene Fort Union Formation crops out in the vicinity of the Bison basin, approximately equidistant from the southeast terminus of the Wind River Range and the southwestern edge of the Granite Mountains uplift in central Wyoming. Early Laramide tectonic activity produced a series of uplifts north of the area forming a platform separating the Wind River and Great Divide basins. During middle to late Paleocene, aggrading fluvial systems flowing southward, rapidly deposited a sequence of thin, lenticular conglomerates and medium to coarse-grained planar-bedded sandstones in braided and anastomosing stream channels and carbonaceous overbank silt and claystones. Subaerially exposed interchannel areas developed cyclic pedogenic horizons. Early diagenetic cementation preserved tubular burrows and rhizoliths as well as impressions of fruits, nuts, leaves, and wood. Anomalous silicic cementation of mudstone, sandstone, and conglomerates probably are silcrete soil horizons developed in a warm temperate to subtropical humid climate.

The sandstones are multicyclic containing fragments of preexisting siliceous sedimentary rocks (e.g., Tensleep Sandstone, Mowry Shale, and cherts from the Madison, Morrison, and Phosphoria Formations). Reworked glauconite is locally abundant in some Fort Union sandstones, reflecting the proximity of Paleozoic sources. Altered and embayed feldspars are present in trace amounts throughout most of the section, but significant accumulations of fresh feldspar are present near the top, indicating unroofing of Precambrian source before the Eocene.

SPENCER, CHARLES W., U.S. Geol. Survey, Denver, CO

Overpressured Reservoirs in Rocky Mountain Region

Overpressured oil and gas reservoirs in the Rocky Mountain region are more widespread than generally recognized. "Normal" Rocky Mountain