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.

DUPREE, J. ANN, and R. MARK MASLYN, Golden, Colo.

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.

FLORES, ROMEO M., U.S. Geol. Survey, Denver, Colo.

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.

FUZESY, LASZLO M., Saskatchewan Dept. Mineral Resources, Regina, Sask.

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 of the Middle Devonian Elk Point Group. The Deadwood clastics are quartzose sandstone, sand, subordinate shale, and conglomerate. Locally, in the northernmost part of the area, they have been removed by pre-Devonian erosion. The carbonate sequence of the Elk Point Group is divided into lower and upper subgroups. The Lower Elk Point subgroup contains the Meadow Lake Formation (new) which is subdivided into lower and upper members. The basal formation of the Upper Elk Point subgroup, the Winnipegosis is present in the area. The younger formations of these southwest-dipping Devonian strata are absent owing to erosion or nondeposition. The Devonian carbonate rocks are overlain unconformably by clastic sediments of the Lower Cretaceous Mannville Group.

The common occurrence of fractured and brecciated carbonate rocks within the Meadow Lake Formation indicates salt solution and can be correlated with the extensive rock salt deposits of the Lower Elk Point subgroup in central Alberta. The depositional edge of one of these salt deposits, the Cold Lake Salt, can be traced.

Accessory copper, lead, and zinc minerals are present locally in clastic rocks of the Deadwood Formation and also in the Devonian carbonate rocks. Gas shows have been reported from the upper member of the Meadow Lake Formation. Meadow Lake limestone of economic significance was recently discovered near Pinehouse Lake.

GAUTIER, DONALD L., U.S. Geol. Survey, Denver, Colo., and Univ. Colorado, Boulder, Colo.

Post-Depositional Control of Gas-Reservoir Quality in Eagle Sandstone of Bearpaw Mountains, North-Central Montana

The Eagle Sandstone of Late Cretaceous age is an important conventional reservoir for biogenic gas (isotopically light methane) near the Bearpaw Mountains. A petrologic examination of cores from producing wells was undertaken to establish the petrologic features which significantly affect reservoir quality in a conventional shallow gas reservoir, and to provide a framework for the investigation of lower quality reservoirs on the east.

Petrologic studies indicate that the quality of most Eagle Sandstone reservoirs in the Bearpaw Mountains area is controlled by a consistent sequence of postdepositional events. Most sandstones were tightly sealed early in their burial history by authigenic calcite, which filled intergranular pores and partially replaced some framework grains. In some sandstones, minor quartz cement partly preceded the precipitation of calcite. Subsequent to calcite precipitation, siderite or ankerite formed as numerous patches which were localized by altering biotite. This iron-rich carbonate may occupy as much as 3 or 4% of the rock volume. Later, most calcite was removed through dissolution that resulted in abundant intergranular and intragranular porosity. The newly developed porosity further facilitated the movement of interstitial waters, which produced extreme dissolution effects in susceptible framework grains such as andesine. Later in the burial history of the Eagle Sandstone, clay minerals were formed in intergranular pores and to a lesser extent in intragranular pores. Although kaolin is the dominant clay, iron-rich chlorite and mixed-layer mica-smectite are locally important.

The following conclusions can be made. (1) The highly porous and permeable nature of the Eagle Sandstone in conventional reservoirs is due predominantly to the dissolution of authigenic and detrital components. (2) The formation of dissolution porosity occurred at relatively shallow depths in thermally immature rocks and was not directly related to burial diagenesis of clays in associated shale sequences. (3) The common occurrence of acid-soluble iron-rich phases should be considered when using acid treatments. (4) In some conventional Eagle reservoirs, migration and/or expansion of clay-size components may cause formation damage if clays are not stabilized.

GLAESER, J. DOUGLAS, J. D. Glaser and Associates, New York, N.Y., and Duke Univ., Durham, N.C.

Environments for Sedimentary Uranium in Triassic-Jurassic Basins, Eastern North America

The association of feldspar-rich alluvial-fan deposits with lake sediments formed in anoxic conditions is one of the most intriguing and least understood settings for sedimentary uranium accumulation. The Triassic-Jurassic basins formed during early rifting of North America's eastern margin all contain extensive accumulations of alluvial deposits which intertongue with basin-center black shales and, in places, coals. These basins lie adjacent to, or just beneath, the prograded seaward-thickening sedimentary coastal plain wedge which blankets the trailing continent margin. Many analogies in basinal development, sedimentary fill, climatic controls, and presence of evaporites can be drawn between these basins and the spreading centers of the Red Sea and Gulf of California-Salton Trough.

In addition to extensive interfingering between oxidized and reduced sedimentary deposits, the Triassic-Jurassic basins contain the first major rock groups in the Phanerozoic of the Appalachian region having ubiquitous feldspar and feldspar-weathering products. These basins apparently received significant input from exposed Acadian and younger Paleozoic batholiths and granitic intrusions developed during the terminal evolution of the Appalachian geosyncline. Wide variations in source-rock types are directly reflected in both the sediment fills and uranium potentials within and among these Triassic-Jurassic basins.

GLASS, GARY B., Wyoming Geol. Survey, Laramie, Wyo.

Coal Development in Powder River Basin of Wyoming

Thick Tertiary age coals make the Powder River basin of northeastern Wyoming the most prolific coal-bearing area in the United States, with an estimated remaining coal resource of more than 609 billion tons. The reserve base from the remaining resources is conservatively estimated at 45.6 billion tons. Whereas 23 billion tons of this reserve base is believed strippable, another 22.6 billion tons is probably recoverable by un-