of endangering our free-enterprise system and the stability of our government.

BAYLIFF, WILLIAM H., Tricentrol United States, Inc., Havre, Mont.

Performance Review of Tiger Ridge and Bullhook Gas Units

The Tiger Ridge and Bullhook gas units in north-central Montana have been on stream more than 3 years producing natural gas from the Eagle Sandstone at a depth of approximately 1,300 ft (396 m). A review of performance, including reservoir parameters, development programs, completion techniques, production history and problems, and economics, is given. Explanations of the current state of reserve development and necessary future drilling programs are discussed.

BENICHOU, PIERRE, Compagnie Générale de Géophysique, Denver, Colo.

Seismic Experiments, Clinkers Area, Wyoming

Recent exploration in the Powder River basin has shown an area of poor seismic data due to "clinker beds" or oxidized coal beds. To compare different sources (dynamite, primacord, and vibroseis), and to optimize the seismic parameters, two sets of experiments were run: E1 on regular coal beds, west of Sheridan, Wyoming, and E2 on clinker beds, east of Sheridan.

The conclusion is that coal beds do not act as a screen to the seismic energy, however, the clinker beds act as filters, screening high-frequency signals.

BERGE, CHARLES W., GARY W. CROSBY, and R. C. LENZER, Phillips Petroleum Co., Del Mar, Calif.

Geothermal Exploration of Roosevelt KGRA, Utah

The Phillips Petroleum Co. exploration program combining geologic, geochemical, and geophysical methods has resulted in discovery of a high-temperature, low-salinity, liquid-dominated geothermal system. Testing to determine commercial production of the system is now in progress.

The Roosevelt prospect is at the boundary between the Mineral Range and Milford graben in eastern Beaver County, Utah. Valley-fill sediments in the graben are approximately 1,500 m thick in the center of the valley. Bedrock is stepped up along several normal faults to the west flank of the range, where the westernmost exposures consist of Precambrian(?) gneissic rocks. These are invaded in a zone of injection by late Cenozoic granite and related silicic differentiates. Paleozoic sedimentary rocks, exposed on the west side of the valley, terminate by erosion somewhere in the graben.

The westernmost exposures of Precambrian crystalline rocks appear to be in a horst block which is bounded on the east by the Dome fault. Rhyolitic flows, from seven or more eruptive centers, cap much of the granite east of the prospect. Magma additions to the chamber, feeding these eruptive centers, are thought to be supplying the heat beneath Roosevelt prospect.

Recent faulting in the vicinity of the prospect is indicated by fresh scarps in alluvium and the cutting and displacement of hot-spring deposits. Faults appear to be major controlling structures in the subsurface hydrologic regime.

The investigations undertaken prior to the July 30, 1974, lease sale included hydrochemistry, chemical geothermometry, petrography, gravity, magnetics, resistivity (dipole mapping and MT), groundnoise, and thermal-gradient drilling. A model assimilating the data was formulated. Additional resistivity, thermal-gradient drilling, and deep drilling resulted in modifications of the existing model.

Of all tools used, shallow temperature gradients appear to outline best the potential reservoir area as we now know it or perceive it to be.

The thermal anomaly, as mapped by Phillips, covers approximately 8,000 acres. All of this, however, should not be thought of as potentially productive, inasmuch as production is controlled not only by heat and fluid availability, but by the presence of fracture zones.

The thermal anomaly is underlain by intermediate and silicic crystalline rocks, at the surface or at shallow depths. The fracture system is the reservoir. The depth to its top is less than 900 m over a significant part of the anomaly. The fracture zones have extraordinarily high effective permeability locally, yielding up to 113,000 kg/hr flashed steam from a reservoir in excess of 200°C, pressures near hydrostatic, and fluids with less than 10,000 ppm total dissolved solids. Predicted reservoir temperatures from analysis of surface waters are remarkably similar to reservoir temperatures encountered in deep drilling operations.

BISHOP, ROBERT A., Amoco Production Co., Denver, Colo.

Salt Solution-Collapse, Williston Basin: What, Where, Why, How, and When

A variety of structural forms is created when salt beds are leached. Some contain oil and gas. Seismic surveying can map them and some surface evidence has been observed. Dissolution of salt takes place only during periods of subaerial exposure by moving water. Small differential water densities combined with sufficient water-table elevations make dissolution possible thousands of feet below the surface. The same factors permit bypassing of some salt beds higher in the geologic column. Meteoric water in topographically high areas moves downward through sinks to the salt beds, and brines return to the surface as springs. In poorly drained areas, alkali lakes are evidence of fairly recent salt dissolution. Some collapse breccias are evidence of original sinks. As dissolution moved outward from the sinks, sagging and settling with tension lowered the overlying rocks with little apparent disturbance. With the last dissolution of salt between the sinks, compression became a factor and crumpling and jamming occurred. This created the extra thickening of parts of the geologic column as seen at the Hummingbird and other structures. The abnormal thickening should not be interpreted as an indication of the time of dissolution. A study of paleodrainage may help localize favorable areas for other oil and gas traps.

In the Williston basin the most extensive salt dissolution took place during the Tertiary. The post-Paleozoic

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