

to a much lesser role than formerly, applying only to blocks of *unfractured* rock a few kilometers on a side, if such exist.

The studies to date indicate that the basement fracture sets formed in orthogonal, *i.e.*, right angle, patterns; that the fractures of different sets trend through one another with little or no displacement, and hence resulted from vertical, rather than horizontal forces; and that they are very old. One key study of aeromagnetics on the Colorado Plateau indicates that the minimum age of the fracturing is 1.7 billion years. Several mechanisms for the formation of these sets have been proposed.

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

#### CONTRASTING THE EFFECTS OF COAL MINING IN WYOMING AND PENNSYLVANIA

Acid mine water and increased stream siltation are both attributable to Pennsylvania's coal mining and are significant polluters of their water resources. Coal mining affects Wyoming's waters minimally because there are no acid water and very little siltation of permanent streams. In Wyoming coal mining can improve groundwater recharge and store much needed water.

Pennsylvania's coal-mined land is adversely affected by (1) subsidence; (2) total disturbed, surface-mined acreage (350,000 acres) and its rate of increase (12,000 acres in 1971 for 27 million tons of coal); and (3) slides on hillsides. Wyoming's sparse population makes subsidence effects minimal. Disturbed surface land effects are minimized by the (1) small total acreage (3,936 acres) and small annual increase (averages 170 acres for 8 million tons); (2) low-relief, flat, basinal rangelands mined; (3) remoteness from population centers; and (4) similarity of mine spoils with some natural landforms.

Wind-blown dust and fumes from burning culm banks and mine fires are accentuated in Pennsylvania because of their closer proximity to populated areas.

Although at least 80% of the disturbed surface acreage in Pennsylvania is recreational woodland, most disturbed acreage is remote, sparsely vegetated rangeland in Wyoming. Although vegetation in both states can be reestablished by planting or more slowly by natural revegetation, toxicity of mine wastes in Pennsylvania commonly retards its reestablishment and kills vegetation adjacent to the mine as well.

In Wyoming, the adverse effects of coal mining other than subjective, esthetic criticisms of temporary surface land disturbances are less damaging than in Pennsylvania.

GOODWIN, JONATHAN H., Dept. Geol. and Geophys. Sci., Univ. Utah, Salt Lake City, Utah.

#### SALT DEPOSITION IN NORTH ARM, GREAT SALT LAKE, UTAH

Construction of a semipermeable, rock-fill railroad causeway across the Great Salt Lake has caused a severe imbalance in concentrations of lake brines north and south of the causeway. Ninety percent of freshwater inflow enters the lake south of the causeway. South arm brines are becoming progressively fresher as salts are deposited on the floor of the north arm where there is no freshwater inflow other than rainfall and minor springs. The water surface of the south arm is as much as 40 cm higher than the surface of the north arm.

Logging of 38 cores up to 1.5 m long drilled on a 4-mi grid shows a maximum salt thickness of about 1.5 m and an average thickness of more than 0.6 m covering 1,250 sq km of the north arm. Nearly 2 billion tons (metric) of salts have been deposited in the north arm since the causeway was completed 13 years ago; a rate of 150 million tons per year.

X-ray diffraction analysis of more than 150 samples shows that the salt in the north arm is almost entirely halite. Minor amounts of sylvite are present in some samples, but it is uncertain whether it was deposited in the lake with the halite or from occluded brines partly evaporated from the core tubes during prolonged storage. Preliminary electron microprobe studies in-

dicate that potassium occurs in local concentrations within halite crystals and not along crystal boundaries, suggesting that the sylvite may be primary.

GWYNN, THOMAS A., Montana-Dakota Util. Co., Bismarck, N.D.

#### ENVIRONMENTAL IMPLICATIONS OF DEVELOPING COAL RESOURCES

There are new things in reclamation but mostly there are just increased awareness and better performance by industry. Most of us in this business consider ourselves good citizens and dislike the label of a "despoiler of America's pristine beauty." Yet we are torn between that which is desirable and that which is economically feasible.

In approaching the subject of reclamation the problem must be put into perspective. It is established that the United States will approximately double its present consumption of minerals and mineral fuels each 15 years. During the past 30 years the United States has used more minerals and fuels than did the entire world in all previous history.

There is increased demand for great amounts of energy from oil, natural gas, coal, and hydroelectric power, not to mention atomic energy and solar energy. Shortages in some of these areas are already appearing with the discovery of natural gas and oil now falling behind the consumption. Present estimates by the industry are that 6 million bbl of this oil must come from synthetic sources including coal and oil shale.

We will be disturbing ever-increasing areas of the earth's surface to recover the fuel we need and surface mining must of necessity increase many fold. Therefore, we must expect increasing pressure from citizen's groups, sportsmen's organizations, environmental study groups, newspapers, and state and federal governments.

It is incumbent on us as an industry to actively and accurately tell our story to the public, so that every citizen in the states where we operate realizes that we are doing more than just making money—we are also providing them with needed electric power with fuel for the many industries that give them the civilization they demand; we are contributing substantially in taxes to provide schools, hospitals, and other civic benefits; and we provide the base for a thousand and one other products and services used in everyday life.

Because laws are obviously going to come, it is only sensible that the mining industry take a heavy part in drafting them so that insofar as possible they not be restrictive or punitive or otherwise unfavorable to such an extent that mining operations are curtailed or placed in a poor competitive position with other fuels.

Reclamation must be a part of our every day mining operation and must be an anticipated expense. This reclamation must be the result of combining the best technical assistance we can get to the hard economic facts of the coal mining business. This reclamation must be carried on with sensitivity to the needs of the area we are mining and to the feelings of the residents of the area. As increased federal interest in spoils reclamation is a certainty, we must ask companies to participate aggressively in establishing just and realistic reclamation laws. We must overcome the ostrich attitude our industry has had in the past because the conservation movement and increased awareness by the public of our environment are here to stay.

HEACOCK, ROBERT L., Shell Oil Co., Denver, Colo.

#### PYROLYSIS AND THIN-SECTION EXAMINATION OF PETROLEUM SOURCE ROCKS

The lack of rapid, but geochemically sound, methods for identifying organic-rich rocks in small samples (potential petroleum source rocks) was a major obstacle to the application of petroleum origin and migration concepts in oil and gas exploration. More than 4,000 ft of near-surface stratigraphically continuous core, primarily shales, was obtained from the marine Cretaceous of central Wyoming by use of a variety of geologic,