are needed. Production history, which is limited, will probably prove to be the best method of estimating recoverable reserves.

OMAN, CHARLES L., PETER ZUBOVIC, A. L. MEDLIN, et al, U.S. Geol. Survey, Reston, VA

Trace-Element Content of Bituminous Coal from Appalachian and Eastern Interior Regions and Rocky Mountain Coal Province—Data as of 1979

We have studied 2,035 samples from the Appalachian bituminous coal beds, 370 samples from the eastern interior coal beds, and 362 samples from the Rocky Mountain coal beds.

The coals analyzed range in rank from high-volatile bituminous to low-volatile bituminous; the Appalachian coals have the lowest mean volatile-matter and moisture contents and the highest fixed-carbon content and Btu value. The Rocky Mountain coals have the highest mean ash content and lowest fixed-carbon content and Btu value. The average Appalachian coal has a much higher rank than does coal from either of the other regions.

Of the 19 elements reported, seven (Cu, F, Mn, Pb, Sb, U, and V) have mean values that vary less than twofold among the three areas. Of these, U is the most uniformly distributed. Other elements (Co, Ni, Zn, and S) have about a fourfold variation, whereas As is 6.5 times as abundant in Appalachian coal as in Rocky Mountain coal. In average, the other elements are 2 to 6.5 times as abundant in some coals from the three areas as in others.

Table 1.--Statistical summary of data on Appalacian, Interior, and Rocky Mountain bituminous coals.

(Mean contents of all elements except sulfur are in parts per million, sulfur and ash contents are in weight percent, calorific values are in Btu's per pound, Gm = Geometric mean, Gd = Geometric deviation.)

	Rocky Mountian		Eastern Interior		Appalachian	
	Gm	Gd	Gm	Gd	Gm	Gd
As	1.4	2.6	6.9	2.9	9.1	3.6
Be	.87	2.3	2.4	1.8	1.9	1.9
Cd	.12	2	.19	4.2	.08	2.5
Co	1.5	2.1	4.3	2.1	5.5	2
Cr	5	2.3	12	1.7	14	2
Cu	7.7	1.8	10	1.8	14	2
F	73	2.2	55	1.7	68	2.1
Hg	.05	2.5	.09	2	.13	2.8
Li	9.3	2.3	7.3	2.2	15	2.5
Mn	15	2.9	23	2.5	15	2.7
Mo	1.1	2	2.7	2.5	1.8	2.3
Ni	3.2	2.2	14	2.3	11	2
Pb	5.2	2	9.1	3.1	6.7	2.2
Sb	.40	2.2	.73	2.8	.68	2.4
Se	1.2	1.9	2.2	1.7	2.9	2
U	1.4	2.2	1.3	2.3	1.2	2
V	12	2.1	15	3.3	17	2.5
Zn	8.6	2.4	32	3.3	13	2.5
Ash (550°C)	11	1.8	9.4	1.6	10	1.9
Calorific value	10,690	1.2	11,630	1.1	12,620	1.1
Sulfur	.67	1.7	2.8	1.8	1.6	2.2

The Rocky Mountain coals have the lowest mean contents of 15 of the elements listed in the table; only U and F mean contents are slightly higher in this area. The eastern interior coals have the highest mean contents of nine of the elements, and the Appalachian coals have the highest mean contents of eight of the elements.

As the average rank of the coals increases, the average contents of As, Co, Cr, Cu, Hg, Se, and V also increase; however, the distribution of most other elements is not related to rank. In general, the trace-element content of coal is influenced largely by the depositional environment and does not depend on rank.

OTTE, CAREL, Union Oil Co. California, Los Angeles, CA

Overview of Geothermal Energy Developments

Exploration for geothermal resources includes evaluation of the volcanic history, regional geology and hydrology, geochemistry of hot springs, and use of selected geophysical methods to determine temperature, heat flow, and structure of prospective areas.

Geothermal energy is primarily used for electric power generation. At the Geysers field in northern California, geothermal energy has proved to be a viable, mechanically reliable, and environmentally acceptable resource. The field competes economically with alternative forms of power generation such as oil, gas, nuclear, and hydroelectric. The Geysers field is an example of a vapor-dominated geothermal reservoir. The field produces 630 Mw, with a total capacity estimated to be about 2,000 Mw. It is the only geothermal field used to generate significant quantities of electricity in the United States.

Other areas experiencing active development are the Imperial Valley of California, Baca area of New Mexico, and Roosevelt area of Utah. Overall, plans have been announced for nine power plants at seven sites, with a total generating capacity of 300 Mw. The new areas are all liquid-dominated systems.

The Department of Energy estimates that 15,000 to 20,000 Mw of geothermal power can be developed in the western United States in the next 2 decades. With improved exploration, drilling, and utilization technology, it has been estimated that several times this amount of power can be developed, provided that delays due to environmental and legal/institutional issues can be resolved.

OWEN, DONALD E., Cities Service Co., Tulsa, OK

San Juan Basin of New Mexico and Colorado, Classic Area of Stratigraphic Exploration

The San Juan basin of northwestern New Mexico and southwestern Colorado is a Laramide structural basin with a maximum thickness of 15,000 ft (4,572 m) of Paleozoic to Eocene sedimentary rocks. The basin is elongate north-south, approximately 125 × 100 mi (201 × 161 km); it is structurally asymmetrical, with the deepest part in the north near the New Mexico-Colorado line. Monoclinal basin rims are especially prominent.

Petroleum occurs in Pennsylvanian carbonate rocks,