trusion, whereas the Pannonian basin formed by either twofold stretching accompanied by subcrustal attenuation or by attenuation and erosion of the subcrustal lithosphere.

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Foreland Fold and Thrust Belts-Review

Most foreland fold and thrust belts are linear or arcuate belts of folds and thrust faults that form a marginal part of an orogenic belt between an undeformed craton and a more intensely deformed inner zone. They are characterized by an assemblage of structures that include low-angle thrust faults, folds, tear faults, and ramped and folded thrust faults that deform a wedgeshaped sedimentary sequence. In some belts it can be proved, and in others it is suspected, that these structures have been detached along one or more decollement zones, producing a shortened structural cover and an unshortened structural basement. Vergence of thrusts and folds is predominantly toward the craton, and in many belts it can be shown that there is a general decreasing age of structural development toward the craton. An external foredeep filled with molassic sediments is an integral part of these belts, and the history of thrust movements can often be read from these rocks. Foreland fold and thrust belts are known in orogenic belts of early Proterozoic to recent age.

There is, however, great variation in the general geometry, composition, and evolution of these belts, as well as numerous exceptions to the characteristics outlined above. The sedimentary wedge may consist of rocks that range from continental margin to deep sea fan environments. Variation in rock sequence, particularly the variation in thickness of ductile units such as evaporites, greatly controls the geometry of structures. Some foreland belts involve crystalline basement rocks both locally or extensively, and in one belt (High Atlas, Morocco) basement shortening occurs directly beneath the belt.

Kinematic and dynamic evolution of foreland belts are diverse, but they are an integral part of orogenes and are related to convergent boundary dynamic systems coupled with varying amounts of transform motions. Foreland belts can be shown to have evolved from the following convergent settings: both synthetic and antithetic to B- and A-type subduction, continent and arc collisions, and convergence within transform systems or combinations of such systems. The dynamics of foreland belts has been related to crustal convergence, lateral spreading of plutonic and metamorphic rocks in orogene cores, and a variety of gravity-induced instabilities. Palinspastic reconstructions of foreland belts suggest that while all of these mechanisms may contribute in different degrees to the formation of foreland belts, crustal convergence is the dominant process.

## BURGESS, P. A., ARCO Coal Co., Denver, CO

Coal Resource Data Processing, Old and New Techniques

The use of data-processing techniques in coal resource evaluation is characterized by a gradual adaptation of computer techniques rather than by any revolutionary breakthrough. The main thrust of the data-processing effort is the use of computers to store and retrieve the large volumes of data associated with core-hole analyses. The data are of two types: (1) assay data from coal seams; and (2) codified lithologic descriptions of the stratigraphic sequence of interest. The automatic contouring of assay isopleths is now a routinely accepted procedure; the limitations of the contouring algorithms have been offset by the ability to generate quickly large quantities of maps. The trend now is toward increasingly sophisticated use of available options such as trend analysis and the different geostatistical algorithms for interpretation, estimation, and classification.

In regard to stratigraphic data, the main emphasis is a graphic display of information to aid the geologist in interpreting the stratigraphic sequence. Some attempts have been made to automate the interpretation. In the near future, we expect to see the routine use of interactive graphic devices to aid the geologist in his work. The type of tool envisaged is analogous to the stratigraphic interpretation of seismic records by petroleum explorationists.

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### Unconformities-Key to Major Oil Accumulations, North Slope, Alaska

The entrapment of oil and gas at an unconformity at Prudhoe Bay, North America's largest oil field, is well known. It now appears that other large oil and gas accumulations such as those in the Kuparuk River sandstones west of Prudhoe Bay are trapped at an unconformity.

Prudhoe Bay field is on a large anticline on which the reservoir rocks have been truncated by an unconformity. The unconformity places organically rich Cretaceous shales in juxtaposition with Sadlerochit reservoir rocks. Cretaceous shales above the unconformity also provide the updip seal for the oil accumulation.

Oil in the Jurassic Kuparuk River sandstones is trapped on a large structural nose by truncation of the reservoir rocks. The Cretaceous shales above the unconformity provide the seal and possibly the source for the oil.

Uplift of the Barrow arch in Late Jurassic and Early Cretaceous time resulted in a regional unconformity. The truncation of older rocks by this unconformity, and the seal provided by the overlying shales are key factors to exploration of this arch which extends for more than 300 mi (483 km) along the Beaufort Sea coast. The delicate relations of source, reservoir, and trap, which are commonly controlled by one or more unconformities, are important to exploring this rich petroleum province.

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## Future Exploration for Geothermal Resources

Exploration for geothermal resources has been concentrated in those areas where hot springs and hydrothermal alteration and deposition at the surface directly indicate geothermal potential.