Jurassic eolian sandstones, but predominantly in Cretaceous sandstones and fractured shales. The San Juan basin is gas-prone, although significant oil fields are common. The Cretaceous Blanco basin gas field is one of the largest in the United States. The key to exploration in this mature area lies in understanding the complex stratigraphy that controls most of the traps.

The San Juan basin area was a part of larger depositional basins prior to the Laramide orogeny. Major sedimentation in the area began during the Pennsylvanian with deposition of shelf-carbonates and flanking arkosic clastics from Ancestral Rocky Mountain uplifts. Regression during the Permian resulted largely in nonmarine clastic deposition. Triassic fluvial red beds were deposited across the area after an erosional interval. After another erosional interval, Jurassic nonmarine clastics and restricted limestones and evaporites were deposited. During the Cretaceous, the sea returned and repeatedly transgressed and regressed across the basin, producing well-developed depositional cycles. Laramide uplift around the San Juan basin during latest Cretaceous and earliest Cenozoic time produced the structural basin which became partly filled with Paleocene and Eocene nonmarine clastics.

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Rock-Eval Pyrolysis as Source Rock Screening Technique

Rock-Eval pyrolysis (by the IFP-FINA Method) provides a rapid (20 min) screening evaluation of the source potential, type, and maturity or organic matter (OM) in rocks. Whole rock samples are used, thereby eliminating time-consuming sample preparation.

The pyrolysis instrument is a dual-detector gas chromatograph to which a pyrolysis heating chamber and gas-handling circuits have been added. A small sample (0.1 g) is heated from 250 to 550°C at a uniformly increasing temperature in a furnace flushed with helium. The volatilized gases are swept either directly into the flame ionization detector or into a CO_2 trap and then into the thermal conductivity detector. The signal is fed through an integrator to a strip-chart recorder, resulting in three peaks: Peak 1, the amount of OM (mg hydrocarbons/g rock) present in the rock as oil-like components and broadly analogous to the solvent-extractable (bitumen) part of the OM; Peak 2, the amount of OM (mg hydrocarbons released/g rock) cracked from the insoluble (kerogen) part of the OM pyrolysis. The temperature of maximum evolution of Peak 2 provides an estimate of maturity; Peak 3, the amount of CO_2 (mg CO_2/g rock) derived from the oxygen in the kerogen.

Comparison of pyrolysis data with conventional geochemical data suggests the following interpretation. Peak 2—hydrocarbon potential: poor, 0 to 2.5; fair, 2.5 to 5.0; good, 5.0 to 10.0 mg hydrocarbons/g rock. Peak 2/Peak 3—expected hydrocarbon type: gas, 0 to 2.5; gas + oil, 2.5 to 5.0; oil, 5.0 to 10.0 mg hydrocarbons/g rock. Peak 1/(Peak 1 + Peak 2)—migrated hydrocarbons: present, greater than 0.2. Temperature of maximum evolution: immature, 435°C; oil-generating, 435 to 450°C; gas generating, 450 to 470°C; cooked out, 470°C or greater.

Because of problems, such as the presence of solid bitumen and mixed kerogen type, Rock-Eval does not replace conventional geochemical evaluation. Instead, pyrolysis data outline general trends facilitating the selection of samples for further analysis.

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Future Trends in Coal Resource and Reserve Evaluations in United States

Most currently available estimates of coal resources and reserves in the United States were prepared to determine only general areas of coal occurrence and thicknesses of beds. Such estimates were usually accompanied by coal analyses to indicate the coal rank and to a much lesser degree, other quality parameters of the coal deposits. Estimation of coal tonnage was accomplished by simple but time-consuming arithmetic and/or geometrical procedures, which usually involved the use of hand-drawn maps and the polar planimeter. For many regions of the United States, data and/or manpower available were so limited that only broad estimates of coal resources could be made. As a result, our national coal resource data base is quite limited in both scope and detail.

In the future, computers will be used extensively to process such data as depth, thickness, quality, environmental factors, and other parameters associated with coal resources. Computers can be programmed to generate many kinds of maps and numerical tabulations. By the use of point data (e.g., drill holes, outcrops) resources can be classified according to any desirable classification system, such as thickness categories.

Most procedures currently used to evaluate coal resource and reserve data rely upon point-of-observation spacing only for geologic assurance of coal occurrence. Several major studies are underway to develop geostatistical methods such as kriging and the use of variograms, which facilitate evaluation of other uncertainties inherent in both quantity and quality data on coal resources. Thus, by use of computer processing and geostatistical methods, a more comprehensive understanding of the amount of characteristics of United States coal resources will be developed during the coming decade.

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MonDak Mississippian Oil Field, Williston Basin

The MonDak Mississippian limestone oil field contains 13.7 million to 68.6 million MT (100 million to 500 million bbl) of recoverable oil. It produces from irregular intervals, both vertically and horizontally, in a 168 m section of fractured Mississippian limestone. Dip in the field is eastward into the Williston basin at 3 to 11 m/km, with some structural flattenings and irregularities. The trap is not structural. The reservoir is limestone with a depositional texture range from mudstone to grainstone, but most of the reservoir rock is wackestone. Normal matrix porosity is 2 to 4% and matrix permeability is less than 0.01 md. Some lentils of fossil