Two types of paleoecologic products are particularly useful, namely (1) paleobathymetric well logs, and (2) occurrence charts on which fossils found in a well are arranged in sequence and groups according to their paleoecologic significance.

The ultimate objective is to utilize all the interpreted paleontologic data in the most effective manner for maximum contribution to the exploration program. The logs are synthesized to produce paleobathymetric maps, cross sections, and other displays, which support the exploration effort in numerous ways, such as (1) reconstructing geologic history, (2) recognizing eustatic sea-level changes and evaluating their influence on reservoir sand distribution patterns, (3) enhancing well correlations, and (4) defining depositional trends which are favorable for hydrocarbon accumulation.

ROBINSON, W. E., and SHUANG-LING CHONG, Laramie Energy Technology Center, Laramie, WY

Sedimentary Aspects of Organic Material in Green River Shale

Characteristics of the organic material in Green River Formation shale suggest that this material was derived mainly from algae that grew in Eocene lakes. The basin depressions were formed by the uplifting of the Rocky Mountains. Large quantities of soluble salts flowed into these basins from the mountain streams, increasing the salinity of the lakes until they became chemically stratified. In the upper, relatively freshwater section of the lakes, abundant quantities of microscopic algae and other biota grew. The lower section of the lakes became highly reducing and stagnant because of lack of seasonal oxidative turnovers, thus providing ideal conditions for the accumulation and preservation of the organic debris.

Precipitation of mineral carbonates and silicates from the highly saline waters provided most of the minerals that were co-deposited with the organic matter. The characteristics of the lake water varied considerably and significantly effected the composition of both the inorganic and organic constituents of the Green River shale.

Sixty to seventy-five samples from each of three basins of the Green River Formation were analyzed for changes in the organic constituents. Considerable variations in the organic components of the soluble bitumens and of the insoluble kerogens were evident. Some of these variations appeared to be related to depth of burial and some to source material or the environment of the lake water. Compositional differences were related to lithologic differences in the sediments of the three basins.

RODRIGUEZ-PARADINAS, ANGEL, Compañia General de Sondeos, Madrid, Spain, and ERIC K. ERICSON, Gulf Mineral Resources Co., Denver, CO

Castillo Gas Field, Spain

Spain's first hydrocarbon discovery, the No. 1 Castillo drilled by CIEPSA near the northern city of Vitoria, was completed as a gas well in 1961 and continues to produce a small but locally important amount of gas from a thick fractured marl. The field is not significant economically but does provide nearby industry with needed fuel and gives information on the behavior of a type of reservoir which will become more important in the future as demand and prices increase.

Located on the south flank of the Cantabrian trough, the reservoir section of Turonian and Cenomanian age is between 2,000 and 3,000 m deep on a large anticlinal structure formed during Alpine orogenic events. More critical than structural closure are the various fracture systems which create both reservoir volume and permeability in the 1,000-m column of marls, thin limestones, and minor quartzitic sandstones. Effective primary porosity is negligible.

The field has produced over 1.2 Bcf since 1963 out of an estimated ultimate reserve of 2 Bcf. A variety of drilling, completion, and stimulation techniques have been used in attempting to extend production without marked success; however, higher prices for gas may result in a reevaluation of these methods. It is anticipated that modest reserves such as these will be needed in the future.

ROEDER, DIETRICH, Univ. Tennessee, Knoxville, TN

Central Mediterranean Thrust Belts

The Alps and Apennines contain major thrust-associated hydrocarbon reserves and unexplored deep prospects in Mesozoic platform carbonate rocks and in Tertiary foredeep fill. The belts contain an S-curved, originally west-facing plate stack composed of the European craton, a sandwiched ophiolite belt, and the Africa-derived Adria plate, in turn overridden by the Tethyan Dinarides. The Vienna basin and the Calc-Alpine contain hydrocarbon reserves and prospects in upper-plate carbonate rocks, in overridden foredeep fill (Molasse) and shelf (Helveticum). Swiss and French lower-plate prospects depend on depth to foreland basement and on structure of allochthonous massifs. On the back side of the orogene, thrusts antithetic to collision loop around the Po basin (with its major oil and gas deposits), involving reworked arc-trench sediments and shelf carbonate rocks. In the southern and central Apennines, the detached shelf unit is exposed. In the northern Apennines, it is thrusted and covered beneath resediments. Refraction seismic data indicate the limits of the thrust configuration. In Calabria and Sicily, antithetic thrusting becomes predominant, outlining a subduction flip with a deep Benioff zone, a volcanic-island arc, and prospects on south-facing shelf carbonate thrust sheets beneath chaotic trench fill. In the Dinarides, surface structure, dimensions, some reflection seismic data, and crustal data suggest a classic thrust belt involving similarly prospective sediments.

ROEDER, DIETRICH, Univ. Tennessee, Knoxville, TN

Appalachian Thrust Belt Between Trenton, Georgia, and Tuscaloosa, Alabama

Of the 260 km of late Paleozoic westward transport inferred for the Blue Ridge thrust mass, 70 to 100 km affect the Valley and Ridge thrust belt. Transport is