fragment grainstone have porosities in the 6 to 15% range and permeabilities of 0.01 to 1.0 md. Production is primarily from vertical microfractures and macrofractures. The reservoir is slightly ovepressured. Oil gravity is 32 to 39°API, gas-oil ratios range from 250 to 650 cu ft/bbl, and produced water range from 10 to 90%. The field is located in the west-central part of the Williston basin in the states of Montana and North Dakota. The discovery well was completed in 1958 as a workover of a test plugged and abandoned in 1954. A diagonal offset to the discovery was completed in 1960. No other completions were made in the Mississippian until 1976. As of June 1, 1980, there will be 182 completed Mississippian wells on a 65-ha. spacing pattern and 10 drilling rigs operating.

PARRISH, JUDITH TOTMAN, and A. M. ZIEGLER, Univ. Chicago, Chicago, IL

Climate Asymmetry and Biogeographic Distributions

With the acceptance of the hypothesis of continental drift, paleontologists have been able to employ two concepts that have had important implications for paleobiogeographic distributions of organisms. One concept is that continents previously combined into one have separated, and vice versa, and the other is that a single continent may have been at different latitudinal positions during its history. Paleontologists have used this latter concept to explain, for example, present-day polar positions of ancient tropical forests or to reconstruct pole-to-equator diversity gradients in benthic marine communities. The model underlying these reconstructions and explanations is that climatic belts are wholly temperature-controlled and parallel with latitude. An important feature of climatic zonation that has been largely ignored is that along ocean margins, climatic zonation is asymmetric east to west. This is because the major ocean currents, which affect the climate, are asymmetric, with colder currents dominating the regime on the eastern sides of the oceans and warmer currents dominating the western sides.

Atmospheric circulation maps have been constructed for several Paleozoic periods, from which ocean-current maps have been derived. In these reconstructions, the asymmetry of climate along the ocean margins, caused by the asymmetry of the currents, is reflected in the distribution of ancient terrestrial and marine communities.

PETERS, K. E., Chevron Oil Field Research Co., La Habra, CA, B. G. ROHRBACK, Cities Service Corp., Tulsa, OK, and I. R. KAPLAN, Inst. Geophysics, Univ. California, Los Angeles, CA

Geochemistry of Artificially Heated Humic and Sapropelic Sediments: Protokerogen

Artificial heating experiments have provided information on the early diagenetic relation of classes of organic constituents in recent sapropelic and humic sediments. Lipids, humic acids, and kerogens isolated from heated Laguna Mormona algal mat and Staten Island peat have been studied by varied techniques including elemental analysis, gas chromatography, programmed temperature pyrolysis, and stable isotope ratios. A temperature and time dependent set of constructive and destructive reactions plays a role in the quantity and quality of kerogen isolated from each heated sample. For humic kerogen the dominant constructive process is conversion of humic acid to new kerogen. The dominant constructive process for sapropelic kerogen is the grafting of lipids onto existing kerogen.

Short-term, high-temperature laboratory simulations of burial maturation result in a dominance of destructive over constructive reactions. Part of the volatiles lost from sapropelic sediment during these experiments is isotopically light, hydrogen-rich lipids which might otherwise be grafted onto the kerogen during slow burial maturation. These results explain the common lack of agreement in evolution paths followed by laboratory-heated protokerogens and natural kerogens at progressively greater depths in cores.

PETERSON, FRED, R. H. TSCHUDY, and S. D. VAN LOENEN, U.S. Geol. Survey, Denver, CO

Mudstones as Exploration Guides to Tabular Sandstone-Type Uranium Deposits in Salt Wash Member, Morrison Formation (Upper Jurassic), Henry Basin, Utah

Sedimentologic and palynologic studies in the Henry basin indicate that a particular type of mudstone can be used as an exploration guide to uranium deposits in nearby sandstone beds. Most Salt Wash mudstones bear no relation to the ore deposits and consist of nonorganic red or green mudstones deposited in overbank environments on a flood plain. Other unfavorable but organic-rich gray mudstones contain carbonized wood fragments up to about 1-cm long, palynomorphs including the alga *Botryococcus*, powdery carbonaceous material, and structureless blebs of organic matter. These mudstones lack swelling clays, are moderately to highly calcareous, and are associated with thin limestones. Most of these mudstones were deposited in shallow and relatively large lakes at least several kilometers wide and several tens of kilometers long.

Favorable organic-rich gray mudstones that lie near uraniferous sandstones contain minute carbonized wood particles less than about 0.5 mm long, a palynomorph suite lacking *Botryococcus*, cutinous and epidermal tissue, pyrite, and swelling clays. These mudstones are non-calcareous to slightly calcareous, and rarely contain limestone. Favorable mudstones occur just above or below uranium-bearing sandstones, or interfinger with sandstones that contain uranium anomalies within several hundred meters of the mudstone. These mudstones are associated with distal braided stream sandstones and were deposited in small shallow lakes or ponds up to several square kilometers in areal extent lying between stream courses or in abandoned stream channels. The mudstones lie in structural lows that were active during deposition, and they tend to occur in the part of the low where fluvial sedimentation was least active. Prospecting strategies based on these observations should search for favorable mudstones in tectonic lows in strata deposited by distal braided streams.