Published literature documents varying degrees of correlation between geologic structures and geothermal highs (halos) of several petroleum fields. In conjunction with these fields, additional structures and associated productive trends have been evaluated to develop certain predictive criteria. The studies attempted in this regard include structural and stratigraphic traps, rollover anticlines, and salt domes with productive beds of different ages in Louisiana.

As part of the characterization of the subsurface temperature regime of the regions studied, the following broad generalizations seem to be in order: (a) geothermal halos observed near faults appear astride the fault, or clearly confined to one fault block or the other; (b) a single geothermal halo in a deep section may be overlain by multiple halos, generally of lower relief, in shallow sections; (c) geothermal halos associated with deep-seated salt domes are located in the sedimetnary section on or near the top of the dome, near the perimeter or on the flanks. Such halos are not discernible on shallow domes; (d) in the interior basin, a salt dome with productive horizons appears to have a geothermal halo of higher relief than those in the vicinity with no petroleum accumulations; and (e) even some petroleum traps, created by sedimentary facies changes with no distinct structural closures, are marked with geothermal haols.

The observed characteristics of the subsurface thermal regimes are generally explained in terms of thermal properties of rocks and pore fluids, and fluid migration induced by changes in the density, viscosity, and pressure potential of the subsurface fluids.

MAJOROWICZ, JACEK, Geologic Inst., Warsaw, Poland, and ALAN M. JESSOP, Earth Physics Branch, Energy, Mines & Resources, Ottawa, Ontario, Canada

Present Thermal State of Western Canada Sedimentary Basin

The regional geothermal pattern of Western Canada sedimentary basin was studied using available temperature data from shut-in wells. Average heat conductivity was estimated with net-rock data from Canadian Stratigraphic Services. These data allowed heat flow estimations.

The geothermal gradient and heat-flow values for the basin are exceptionally high in comparison with the other Precambrian platform areas, especially in the northwestern part of the Prairies basin in Alberta and British Columbia and most of southern Saskatchewan. Low-gradient areas are found close to the eastern limit of the Disturbed belt of Alberta and British Columbia. Neither the analysis of regional conductivity nor heat generation of the basement rocks based on U, Th, and K data after Burwash explains the heat-flow patterns. Certain hydrogeologic phenomena do suggest the significant influence of fluid flow on geothermal features. Low geothermal gradient areas coincide with water recharge and high hydraulic head regions.

The phenomenon of upward water movement in the deep strata and downward fluid flow through much of the Cenozoic and Mesozoic strata seems to be the main influence on heat distribution in the basin. Analyses of coal metamorphism in the upper and middle Mesozoic formations of the Foothills belt and in the central Prairies basin suggest that pre-Laramide heat-flow distribution was different from the present. It is very probable that the Foothills belt had a higher geothermal gradient than the central part of the Prairies basin, opposite to the present relation.

MCCULLOH, THANE H., U.S. Geol. Survey, Seattle, WA, and MARIE PAVISH, U.S. Geol. Survey, Kennewick, WA

Limits of Subsurface Temperature and Fluid Pressure Field of Commercial Oil and Gas Reservoirs

The free energies of formation and fugacities of the fluid components of an accumulating sedimentary pile are acquired largely during geothermal heating of initially cool constituents of highly porous sediment. Thermal maturation of organic matter, with accompanying release of potentially migrant products (CO_2, H_2O, CH_4, and various hydrocarbons), consists of a complex of specific burial diagenetic and low temperature ($< 250°C$) metamorphic reactions activated and promoted by heat moving upward through the pile. Likewise, the progressive dewatering of a sedimentary pile, manifested in the net reduction of intergranular porosity with increased burial depth (temperature), reflects another, only partly interrelated, complex of thermochemical reactions. Fluid migration is thus a dynamic response to induced gradients of temperature, fluid pressure, and concentration as determined by routing of heat through lithologically controlled nonisotropic arrangements of thermal conductivities. Rapid fluid movements along permeable pathways may locally influence shallow subsurface temperature distributions in dynamic and possibly transient ways through convective heat transfer.

For establishing practical limits to investigations of such burial changes, paired values of virgin reservoir temperature and fluid pressure (T and P_f) were compiled from the international literature > 700 commercial oil and gas reservoirs. Higher-than-average geothermal gradients were deliberately sought. The limits of the T-P_f field defined by these points are well constrained, and only eight reservoirs were recorded that produced commercially at temperatures 175°C. Deep-ocean petroleum prospects appear to offer advantageous characteristics in terms of the T-P_f field because of the low T and high P_f at the deep sea floor.

MEYER, H. J., Amoco Production Co., Denver, CO, and H. W. MCGEE, Consultant, Denver, CO

Temperature Anomalies Associated with Rocky Mountain Oil and Gas Fields

Over the years, several observers have reported on temperature observations which show a particular oil or gas field to be "hotter" at the pay depth than the surrounding rock at the same depth. Our study of 22 oil and gas fields from six states in the Rocky Mountain region demonstrates that at least 15 of these fields have positive temperature gradient anomalies at the pay level. Nine of these "hot" fields are contained in structural traps and six are primarily stratigraphic accumulations. Three of them are gas and 12 are oil fields.

All of our temperature measurements were recorded during drill-stem tests except for a few values from temperature logs. Drill-stem test temperatures usually are recorded a longer time after mud circulation has ceased in the well bore than are wireline log temperatures. Therefore, the former generally are a truer measure of the formation equilibrium temperature than are the latter.

Speculating on the causes of these temperature anomalies over oil and gas fields, we conclude that upward convective fluid movement at depth is the most important factor. The upward moving fluids carry heat along with them and both heat and fluids are trapped whenever suitable trapping conditions are encountered in the reservoir rocks through which the fluids pass. The main evidence for this conclusion is that observed