NOON MEETING—OCTOBER 24, 1979

JAMES A. MOMPER—Biographical Sketch

James A. Momper was born in Illinois in 1924. He received a B.S. degree in physics from Purdue University in 1949, and later attended the University of New Mexico to study geology, and Tulsa University to study geochemistry.

His career with Amoco Production Company began in 1950, with assignments in Albuquerque and Casper. In 1965 he became a Research Scientist for Geochemistry with Amoco in Tulsa. He has been Supervisor, Director, and Manager of research groups in Tulsa, and is now a Geological Research Consultant with Amoco. He is a Distinguished Lecturer for the AAPG, and is also a member of AAPG, AAAS, and the Tulsa Geological Society.

OIL EXPULSION—A CONSEQUENCE OF OIL GENERATION (Abstract)

In source beds, much of the oil-generating organic matter is concentrated along bedding surfaces. During the principal phase of oil generation, when adequate thermal energy is available, 25 to 30 wt. % of the organic matter comonly is converted to liquids, mainly bitumen with some water. Part of the bitumen is then thermally cracked to crude oil. Hydrocarbon gases with some CO_2 and N_2 are generated also; much of the water and CO_2 is generated before oil is formed.

The release of fluids from organic matter causes a reduction in volume of the residual solid organic matter; however, this volume decrease is offset by the considerably greater volume of generated fluids. As a result, pressures increase greatly along sealed bedding surfaces. Internal (intrasource) migration of oil and gas occurs when local, transitory fluid pressures become sufficient to part the bedding laminae and to form or reopen near-vertical microfractures connecting the partings. Permeable migration pathways also may develop along laminae as a result of the reduced volume of the organic matter. Fluids are driven along permeable laminae and partings, into connecting, less pressurized laminae where two or more laminae converge, and along microfractures and faults within the source sequence. Eventually, high fluid pressures will develop in most parts of an actively generating source-rock section if the section is sealed and confined.

Two properties of argillaceous rocks that permit overpressuring are anisotropy and heterogeneity. Additionally, enough oil must be generated to increase fluid pressure sufficiently for local dilations to occur in oil-source rocks. This requires at least 0.5 wt. % of hydrogen-rich organic matter. In argillaceous source rocks, clay-sized quartz and clay provide brittle pressure and fluid seals, susceptible to microfracturing, on individual laminae. In carbonate-evaporite sequences, evaporites sealing laminae are less likely to fracture.

At a given generation site, dilation and fluid release are followed by a sharp reduction in pressure and closing of partings and fractures to further fluid movement. Pressure will again increase and dilation recur at a given generation site until the fluid generation rate has diminished enough for the fluid pressure to remain below the dilation point, that is, the fluid pressure required to open or reopen any part of the system sufficiently for local internal fluid migration or expulsion.

A source-rock system functions much like a pressure cooker. It is self-opening and self-sealing. As liquids are expressed from a parting into a fracture, the pressure drops quickly and the fracture will close on the retained liquids, immobilizing them. Silica and/or calcite cement commonly are. precipitated along such fractures, both before and after oil migration. Immobilized oil devolatilizes, leaving a solid or semisolid residue. These materials enable resealed parts of the system to repressurize and refracture through the peak gas-generation phase. Thus, the generation of fluids can provide the means by which oil and gas are expelled from source rocks.