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FRED F. MEISSNER—Biographical Sketch

Fred F. Meissner received his Geol. Eng. and M.S. degrees from the Colorado School of Mines (1953, 1954).

After completing a tour of duty with the U. S. Corps of Engineers (1954-1956), he was associated with Shell Oil Co. (1956-1972) where he worked on exploration projects in the Rocky Mountain, Gulf Coast and Mid-Continent areas. During this period, he also spent a year (1965) working at Shell Development Company on basic research problems concerning hydrocarbon origin, migration and accumulation.

In 1972 he became associated with Trend Minerals Corporation and subsequently with Filon Exploration Corporation (1973-1979) and Webb Resources (1979). He was employed by Sohio Petroleum Company in 1980 and is presently exploration manager for Bird Oil Corporation. During these years he was involved in hydrocarbon and other types of mineral exploration throughout the United States and around the world.

He has authored several publications and has given numerous oral papers and lectures concerning various aspects of petroleum geology — especially those dealing with principles and problems of hydrocarbon source, migration and accumulation. He received the 1974 Rocky Mountain Section AAPG A. I. Levorson Memorial Award, was 1976 Rocky Mountain Association of Geologists "Scientist of the Year" and currently is an AAPG Distinguished Lecturer for 1981-82. He is a member of the American Association of Petroleum Geologists and the Rocky Mountain Association of Geologists.

ABNORMAL PRESSURES PRODUCED BY HYDROCARBON GENERATION AND MATURATION AND THEIR RELATION TO MIGRATION AND ACCUMULATION

Abnormally high pore-fluid pressures may be produced as a result of hydrocarbon generation from organic matter (kerogen) contained in "source rocks." Contributing processes include: (1) collapse of rock matrix as overburden-supporting solid kerogen is converted to non-expelled fluid hydrocarbons and (2) volume increases produced by the conversion of oil to wet gas/condensate and to dry gas within the pores of either the source rock or associated isolated hydrocarbon-saturated non-source rocks. Generation-type overpressures may be reinforced or maintained by (1) fluid-volume expansions caused by higher temperatures associated with further burial and by (2) capillary entry pressure phenomenon associated with expulsion and migration. The occurrence, maintenance, and degree of fluid overpressuring appear to be dependent on time, temperature, volume of kerogen/hydrocarbons undergoing transformation, and the relative isolation of the rocks with respect to regionally extensive high-permeability rocks.

Regions of hydrocarbon-generation overpressure have been documented in several basins. They are present as vertically and laterally restricted "cells" or "pods" centering around actively generating source-rock units in basin-bottom positions. Hydrocarbons in most places appear to be the overpressuring fluid and the only initially producible fluid species present.

Actively generating source rocks within the pressure cells may be characterized by (1) abnormally high electrical resistivities and abnormally low sound velocities. Resistivity increases may be caused by the replacement of conductive pore water with non-conductive hydrocarbons. Low sound velocities may be caused by (1) the replacement of higher velocity pore water with lower velocity hydrocarbons and (2) the effects of abnormal pressure on porosity enhancement or preservation through dilation or undercompaction.

Overpressures produced by hydrocarbon generation are the primary force causing expulsion from source rocks into conventional reservoir rocks. These overpressures may cause the spontaneous hydraulic fracturing of a source rock. The process facilitates fluid expulsion and may also create an associated "in-situ" fracture-type reservoir. The process may also create far-reaching fractures which propagate upward or downward from the source rocks and control vertical migration through great thicknesses of seemingly impermeable strata.

After active high-rate hydrocarbon generation has ceased in a basin, owing either to (1) decreases in temperature produced by uplift or lower heat flow or to (2) loss of generation capacity due to "over-maturity," the associated pod of *abnormally high* pressures may be replaced by a pod of *abnormally low* pressures associated with closed apparent minimum potential energy ("potentiometric") "sinks." This stage of pressure evolution is controlled by the imbibition of water into the initially overpressured area of high hydrocarbon saturation. Contributing processes may include (1) the volume contraction of pore-fluid hydrocarbons caused by decreases in temperature, (2) the establishment of topographically introduced hydrodynamic conditions, (3) the solution-diffusion of hydrocarbons (primarily methane) outward from the system, and (4) the capillary imbibition of water.

Significant accumulation of hydrocarbons in highly unconventional basin-bottom positions may occur in either the overpressured or underpressured stages of basin hydrocarbon generation-migration evolution.

When water is imbibed into the original site of hydrocarbon generation and overpressure, and the associated unstable localization of hydrocarbon saturation has been dissipated and destroyed during an associated stage of underpressure, pore pressure conditions will eventually return to near normal states.