AAPG HEDBERG CONFERENCE
"Near-Surface Hydrocarbon Migration: Mechanisms and Seepage Rates"
SEPTEMBER 16-19, 2001, VANCOUVER, BC, CANADA

The Dynamic Nature of Hydrocarbon Microseepage: An Overview

By

Dietmar Schumacher, Geo-Microbial Technologies, Inc.

Hydrocarbon microseepage rates and near-surface hydrocarbon concentrations can vary significantly over time. Surface hydrocarbon seeps and soil geochemical anomalies have been shown to appear and disappear in relatively short times, weeks to months to years. Horvitz (1969) documented the disappearance in less than 20 years of a soil hydrocarbon anomaly from above Hastings field in Brazoria County, Texas. Sivaborvon (1974) reported that a surface geochemical anomaly increased in intensity over Hibig field in Bastrop County, Texas, during repressurization for secondary recovery studies. Coleman and others (1977) demonstrated leakage of gas from 1000-meter deep gas storage reservoirs into shallow water wells within a one year period. Jones and Burtell (1996) summarized results for a number of studies of hydrocarbon flux variations in natural seeps as well as from undergound storage reservoirs. Hitzman and others (2001) and Rice and others (2001) have both documented significant changes in microseepage intensity and distribution over existing fields in time intervals as short as one year.

These studies clearly demonstrate rapid variations in gas flux associated with pressure changes in gas storage caverns and other oil and gas reservoirs. For example, Jones and Burtell (1996) report that soil gas hydrocarbon concentrations above gas storage reservoirs respond within 2-4 days to pressure changes in the reservoir or storage cavern. Similarly, soil gas concentrations above an underground coal gasification reactor changed dramatically within days of significant changes in the status of the coal-burn. Based on these and other studies, the rate of hydrocarbon migration and microseepage varies from less than one meter per day to tens of meters per day (Arp, 1992; Matthews, 1996; Klusman and Saeed, 1996; Clayton and Dando, 1996; Brown, 2000; Rice and others, 2001).

Data supporting the dynamic nature of hydrocarbon migration is not limited to microseepage. Whelan and others (1994) have documented that new oil and gas are entering some of the reservoirs in Eugene Island Block 330 field in the Gulf of Mexico, offshore Louisiana. Significant changes in oil compositions were observed to be occurring over three to five to ten years. Furthermore, the oil compositions show that the new oil is migrating into the reservoir from deeper, hotter formations and is not just the result of localized production-related lateral migration. Nunn and Meulboeck (in press), also working with Gulf of Mixico data, make a strong case for 2-10 km of vertical migration of brine and associated hydrocarbons on time scales of 1-2 million years.

These observations coupled with those previously reported for near-surface microseepage, demonstrate quite clearly that hydrocarbon migration and hydrocarbon microseepage are dynamic processes, processes leading to measurable changes on a time scale of months to years.

References Cited

Arp, G.K., 1992, An integrated interpretation for the origin of the Patrick Draw oil field sage anomaly: AAPG Bulletin, v. 76, p. 301-306.

Brown, A., 2000, Evaluation of possible gas microseepage mechanisms: AAPG Bulletin, v. 84, p. 1775-1789.

Clayton, C.J., and P.R. Dando, 1996, Comparison of seepage and seal leakage rates, in D. Schumaker and M. Abrams, Hyudrocarbon migration and its near-surface expression: AAPG Memoir 66, p. 169-171.

Coleman, D.D., W.F. Meents, C.-L. Liu, and R.A. Keough, 1977, Isotopic identification of leakage gas from underground storage reservoirs: a progress report: Illinois State Geological Survey, Illinois Petroleum, no. 111, p. 10.

Hitzman, D.C., B.A. Rountree, J.D. Tucker, and S. Smith, 2002, Integrated microbial and 3-D seismic surveys discover Park Springs (Conglomerate) field and track microseepage reduction, in Surface Exploration Case Histories: Applications of geochemistry, magnetics, and remote sensing: AAPG Studies in Geology no. 48 / SEG Geophysical References Series no. 11, p. 59-65.

Horvitz, L., 1969, Hydrocarbon prospecting after thirty years, in W.B. Heroy, ed., Unconventional methods in exploration for petroleum and natural gas: Dallas, Texas, Southern Methodist University Press, p. 205-218.

Klusman, R.W., and M.A. Saeed, 1996, Comparison of light hydrocarbon microseepage mechanisms, in Hydrocarbon migration and its near-surface expression: AAPG Memoir 66, p. 157-168.

Matthews, M.D., 1996, Migration – a view from the top, in Hydrocarbon migration and its near-surface expression: AAPG Memoir 66, p. 139-155.

Rice, G.K., J.Q. Belt, Jr., and G.E. Berg, 2002, Hydrocarbon soil gas pattern changes during a West Texas waterflood, in Surface Exploration Case Histories: Applications of geochemistry, magnetics, and remote sensing: AAPG Studies in Geology no. 48 / SEG Geophysical References Series no. 11, p. 157-174.

Sivaborvon, V., 1974, Re-study of hydrocarbon distribution around Hilbig oil field, Bastrop County, Texas: Master's thesis, University of Texas, Austin, Texas, 79 p.

Whelan, J.K., M.C. Kennicutt, J.M. Brooks, D. Schumacher and L.B. Eglinton, 1994, Organic geochemical indicators of dynamic fluid flow processes in petroleum basins: Organic Geochemistry, v. 22, p. 587-615.