LUNCHEON MEETING—MARCH 31, 1982

ROBERT B. HALLEY—Biographical Sketch

Dr. Halley was an undergraduate at Oberlin College, Ohio, and received his Masters from Brown University. He obtained his Ph.D. from the State Univ. of New York at Stony Brook and by dissertation is a Paleozoic stratigrapher. He was a postdoctoral fellow at the State Univ. of New York at Binghamton, where he studied modern carbonate sediments in the Great Salt Lake. From 1974 to 1980, he was research geologist with the USGS at Fisher Island Station, Miami Beach, and is currently with the USGS in Denver, Colo.

Dr. Halley is active in the American Association of Petroleum Geologists and the Society of Economic Paleontologists and Mineralogists. He is past Chairman of the SEPM Carbonate Research Group and is an Associate Editor and Book Editor for the Journal of Sedimentary Petrology. He is currently technical advisor for the AAPG Carbonate Exploration School and leads Modern and Ancient Carbonate field trips for AAPG.

EVOLUTION OF CARBONATE POROSITY DURING BURIAL—BAHAMAS, FLORIDA, AND GULF COAST: HOLOCENE TO JURASSIC

Modern carbonate sediments are deposited with large amounts of porosity; commonly they contain more pore space than grain volume. In contrast, ancient carbonate rocks usually retain only a few percent porosity. Although the details of porosity loss may be complex, estimates of porosity in large samples on the scale of aquifers and reservoirs reveal several relations that may be obscured by the detail of petrographic and geochemical studies.

Early diagenesis in carbonate sediments, with the exception of marine cementation, does not significantly reduce porosity. Examples from the Quaternary and Tertiary of the Bahamas and Florida demonstrate that porosity reduction by early freshwater diagenesis at shallow depths, less than 1,500 ft (500 m) for example, is quite inefficient. Although freshwater alteration efficiently stabilizes carbonate mineralogy and drastically alters permeability patterns, it leaves total porosity relatively unaffected. Thus large volumes of carbonate pore space are carried deeper into the subsurface during continued burial.

In the South Florida basin, carbonate porosity decreases persistently with depth from 0 to 18,000 ft (0 to 5,500 m) in rocks ranging in age from Pleistocene to Jurassic(?). Although this decrease is irregular in detail, on a broad scale both the average porosity and the range of measured porosity at any interval decrease with depth. A porosity basement (below which porosity is 5 percent or less) is encountered at about 14,000 ft (4,300 m). A south Florida standard curve defining porosity decrease with depth helps define an optimal exploration window bounded by thermal maturation criteria at the top and porosity criteria at the bottom.

Upper Jurassic hydrocarbon reservoirs in the Smackover Formation of southern Arkansas and northern Louisiana occur at depths ranging from 4,500 to 11,000 ft (1,400 to 3,350 m), and average porosity values for these reservoirs closely approximate the south Florida standard curve for the same depth range. In contrast, deeper Smackover reservoirs in Mississippi, Alabama, and Florida, which occur between 11,000 ft (3,350 m) and 22,000 ft (6,700 m), have considerably higher porosity than would be expected for their depth. Although these occurrences of porosity at considerable depth are poorly understood, this porosity development is in part the result of interactions of reservoir rocks with acidic brines, the occurrence of late secondary porosity, and the presence of fluid pressures in excess of normal hydrostatic pressure. Physical, geochemical, and lithologic parameters associated with these deep, highly porous reservoirs should be monitored during deep exploratory drilling in other areas. Overpressuring, abundant CO_2 and H_2S, and the development of late secondary porosity may indicate the presence of unexpected carbonate reservoir rocks deep in sedimentary basins.