AAPG Annual Meeting
March 10-13, 2002
Houston, Texas

Neil S. Fishman[1], Jennie L. Ridgley[1], Donald L. Hall[2], Paul G. Lillis[1] (1) U.S. Geological Survey, Denver, CO (2) FIT, Inc, Broken Arrow, OK

Timing of Biogenic Methane Generation in Cretaceous Rocks of the Northern Great Plains, Southeastern Alberta and Southwestern Saskatchewan: Petrologic and Fluid Inclusion Evidence

Biogenic methane ($\delta^{13}C_{PDB}$ of -65 to -71 permil; > 99.45% methane) occurs in economic amounts (5 tcf produced) in the Cretaceous Milk River and Belle Fourche Formations, Northern Great Plains, Canada. Questions remain, however, concerning timing of methane generation and mechanisms responsible for trapping methane in reservoirs.

Petrologic studies reveal that both units have experienced a similar paragenetic sequence of early authigenic minerals. Of particular interest are early-formed carbonates (Milk River, siderite and calcite; Belle Fourche, ferroan dolomite and calcite) because of their presumed association with methanogenesis. Isotopic values for Milk River siderite and calcite overlap and vary broadly, but fall within the range of values that could be expected for carbonates associated with methanogenesis ($\delta^{13}C_{PDB}$ from -1.99 to -14.23 permil, $\delta^{18}O_{PDB}$ from -0.63 to -19.41 permil). Preliminary fluid inclusion petrographic and volatile (FIS) analysis suggest that methane and other bacterial species occur within primary inclusions in both carbonate phases, which implies that biogenic methane was present in pore fluids during carbonate precipitation.

In the Milk River, the early formation of carbonates, the presence of methane in pore fluids during carbonate precipitation, and the biogenic source for the methane together suggest that microbial gas generation occurred during early diagenesis in the unit. Because early diagenesis in the Belle Fourche is similar to that of the Milk River, we postulate that biogenic methane was likewise generated early in the Belle Fourche. Low permeability carbonate-cemented zones in both units may have served to trap the early-formed biogenic methane in these reservoirs through time.