HGS LUNCHEON MEETING— MARCH 31, 1992

Social Period, 11:30 a.m. - 12:00 p.m.,
Luncheon and Meeting, 12:00 p.m.
The Houston Club

ANDREW R. THOMAS—Biographical Sketch

Andy Thomas received a B.S. in geology from the University of Georgia ('79) and M.S. in geology from Indiana University ('81). He began work with Texaco in New Orleans as a reservoir geologist and was the project leader of Texaco's New Orleans rock analytical lab from 1986-1991. After eating crawfish for nine years, Andy moved to Houston and currently works in the Texaco Exploration and Production Technology Division Reservoir Geology Group.

AUTHIGENIC MUSCOVITE AGE DATING AND THE TIMING OF PRESSURE SOLUTION IN THE JURASSIC NORPHLET FORMATION, OFFSHORE ALABAMA

The eolian sandstone of the Norphlet Formation is a prolific gas producer in the Alabama offshore area. With some wells producing greater than 50 MMCFD, the play has drawn operators to drilling depths of greater than 22,000'. High reservoir risk is associated with diagenetic porosity loss due to quartz cementation.

The Texaco Mobile Bay Block 872 #1 Well, Offshore Alabama, was drilled in 1988 and penetrated a highly stylolitized Upper Norphlet Formation sandstone at 22,500 ft. subsea. The quantity of stylolites found in this well is anomalously high for the trend. Extensive porosity loss associated with pressure solution and quartz cement contributed to the poor performance of the well tests. Ideas presented here concerning quartz cementation, stylolitization, reservoir pressure, and source maturation emphasize that the Norphlet Formation is one interactive component of a petroleum system.

Three morphologies of authigenic muscovite are associated spatially with the stylolites:

- **large 1M muscovite** (1 cm. long, 0.2 cm. wide) found along vertical offsets in the stylolites,
- **pore-filling muscovite** (30 to 50 micron-sized aggregates) currently found within 5 cm. of the stylolites,
- **muscovite pods** (30 to 50 micron-sized aggregates) contained within the insoluble residue of the stylolite seams.

Because the Norphlet contains essentially no detrital muscovite, authigenic muscovite growth appears to be linked chemically and spatially to stylolitization and pressure solution of potassium feldspar.

Eight stylolite-bearing sandstone thin sections were selected for neutron activation and $^{40}Ar/^{39}Ar$ analyses. Ages were assigned to each muscovite morphology by laser fusing areas of the thin section $\geq$ 50 microns in diameter. Thirty seven total analyses illustrate that each muscovite morphology grew at a different time:

- large 1M muscovite - 54 ± 14 million yr.
- pore-filling muscovite - 73 ± 24 million yr.
- muscovite pods - 83 ± 18 million yr.

A burial history curve for the well indicates the onset of stylolitization, as indicated by authigenic muscovite growth, occurred at 12,000 to 13,000 ft. Age sequence and textural similarity substantiate the theory that the muscovite pods are relict pore fills which accumulated in the insoluble residue during stylolitization. Age data indicate this style of authigenic mica growth continued until 17,000 to 18,000 ft. burial depth where the large 1M muscovite, growing normal to the plane of maximum compressive stress, began to dominate the pore-filling morphology. The fundamental change in muscovite growth style and the comparative abundance of the large 1M muscovite morphology are presumed to indicate the onset of intense stylolitization.

The age bracket of much of the muscovite growth marks an organic maturity range just beneath the top of the dry gas window (Zone 5). Lower Smackover Formation source/seal rocks would have terminated methane production at this time. Thoroughly microfractured from hydrocarbon generation and having lost internal hydrocarbon pressure after expulsion, the seal integrity was compromised. Gas leakage would not only have promoted stylolitization through temporary fluctuations in reservoir fluid pressure/overburden pressure, but also would explain the position deepest pyrobitumen-stained Norphlet Formation sandstone.

Reservoir quality of the Norphlet Formation improves dramatically below the water level. Grain-moldic pores found within potassium feldspar grains are located only in the water leg and indicate that sandstone diagenesis has taken slightly different pathways in the gas leg vs. the water leg. The grain molds, although found within pyrobitumen stained Norphlet Formation core, are not coated with pyrobitumen and formed after final hydrocarbon cracking.