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## Geochemical Evidence of Secondary Microbial Methane in Atlantis Field, Gulf of Mexico

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GCAGS Explore & Discover Article #00116\*

[http://www.gcags.org/exploreanddiscover/2016/00116\\_francis\\_and\\_dzou.pdf](http://www.gcags.org/exploreanddiscover/2016/00116_francis_and_dzou.pdf)

Posted September 13, 2016.

\* Abstract published in the *GCAGS Transactions* (see footnote reference below) and delivered as an oral presentation at the 66th Annual GCAGS Convention and 63rd Annual GCSSEPM Meeting in Corpus Christi, Texas, September 18–20, 2016.

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### ABSTRACT

Atlantis is a giant oil field located in the Green Canyon protraction area, deep-water Gulf of Mexico. The field, located ~190 miles south of New Orleans, was discovered in 1998 and began production in 2007. Logged pay spans several Miocene reservoir intervals, which are overlain by 10,000–17,000 feet of sediment and 4400–7100 feet of sea water. At year-end 2014, the Atlantis Field has produced ~213 million barrels of oil. BP operates the field with a 56% working interest; BHP Billiton Petroleum Deepwater owns a 44% working interest. The majority of the producing volumes reside in three Middle Miocene reservoirs. Most of the petroleum is undersaturated with gas-oil ratio (GOR) values ranging from 400 to 1300 but there are a few small gas caps. Reservoir temperatures of 65° to 75°C are too high for significant active biodegradation (<60°C) at present day, however, the presence of biodegraded oils suggests the oil was biodegraded under less burial. Biodegradation varies in severity with depth and by reservoir, but appears to be overprinted by subsequent migration of light oils. Here we assess the puzzling origin of a gas cap and the higher dissolved gas content within the upper Middle Miocene reservoir interval. Potential hypotheses on the origin of this gas include the following: (1) primary microbial gas due to CO<sub>2</sub> reduction and acetate fermentation in shallow sediments prior to thermogenic migration, (2) secondary microbial methane gas as a by-product of biodegradation process of thermogenic petroleum, (3) early formed co-genetic gas separating from oil, and (4) post ‘oil window’ high maturity thermogenic gas. We assess each of these potential mechanisms and present geochemical evidence that infers a significant part of the gas in the gas cap originated from microbial biodegradation of petroleum (secondary microbial methane). Could this finding present the first gas cap in the deepwater Gulf of Mexico attributed to secondary microbial methane contributions?