Noble gas and hydrocarbon composition of gas hydrate reservoirs in Green Canyon, Block GC955, Gulf of Mexico

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Gas hydrates in the Gulf of Mexico (GoM) are now recognized as significant natural gas reservoirs of important economic and scientific interest. Yet, there is still great uncertainity within the gas hydrate community regarding the genetic source(s) of hydrocarbons (e.g., biogenic, thermogenic, mixed), the location of hydrocarbon generation, the rates of clathrate formation/melting, and the residence times of natural gas found in hydrate systems from the GoM. Despite recent studies that integrate hydrocarbon molecular, stable isotope, and noble gas tracers to address these questions in other petroleum systems, there there have been few attempts to evaluate this suite of tracers in gas hydrates, specifically in the GoM.

Previous studies in this region have used conventional hydrocarbon molecular (C_1/C_2+) and stable isotopic composition ($\delta^{13}C$, δ^2H) of methane to determine proportions of biogenic and thermogenic gases. However, the effects of mixing, transport/migration, secondary methanogenesis, and later oxidation by methanotrophs in the subsurface can complicate the usage of these techniques. Because noble gases are unaffected by microbial activity, chemical reactions, or redox, the integration of noble gas geochemistry to the conventional techniques can provide valuable insight into the uncertainities discussed above. Herein, we integrate inert noble gases (He, Ne, Ar, and their isotopes) with these conventional approaches to better constrain the source of gas hydrate formation and the residence time of fluids (porewaters and natural gases) using radiogenic ^{4}He ingrowth techniques in cores from two boreholes collected as part of the University of Texas led UT-GoM2-01 drilling project. Pressurized cores were extracted from coarse silt/sand reservoirs ~2,440 m below the sea surface within the GC955 block of the Green Canyon protraction area at the edge of the Sigsbee escarpment.