Noble gas analysis of the Eagle Ford Shale: The source of understanding for the greater hydrocarbon system

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The generation and storage of hydrocarbons within shale gas systems can be directly linked to the thermal history of the source/reservoir rocks. As such, the pressure-temperature histories of the associated oil and gas are better constrained than conventional systems where migration from source to reservoir has occurred.

Noble gas characteristics in conventional hydrocarbon systems have previously been used to determine reservoir processes and the role of groundwater in migration [1] [2]. However, there is a relative paucity of studies that have applied noble gases to study the hydrocarbon generation and storage within source rocks. This is an important pre-requisite to fully understand signatures associated with conventional hydrocarbon systems and may shed light on the mechanisms of gas production and storage.

The Eagle Ford Formation is late Cretaceous in age, and consists of interbedded carbonates and shales producing both oil and gas from areas of different thermal maturity [3]. Here we present preliminary noble gas isotope ratios and abundances from 5 wells within the Eagle Ford Formation, South Texas. These wells provide samples from a range of thermal maturities, reflected in compositions ranging from dry gas to oil-associated gas.

Measured helium isotope ratios ($^{3}He/^{4}He$) are dominated by radiogenic ^{4}He derived from the crust. Neon isotopes are indistinguishable from air ratios, and are most likely derived from air-saturated groundwater in contact with the produced gas. Argon isotopes ($^{40}Ar/^{36}Ar$) are in excess of air, showing a resolvable radiogenic component derived from ^{40}Ar production within the crust, plus a groundwater contribution.

The distribution of atmospherically derived noble gases (^{20}Ne, ^{36}Ar, ^{84}Kr, ^{132}Xe) in hydrocarbon systems is governed primarily by their solubility-dependent partitioning between different fluid phases. We are currently developing models to identify the reservoir processes responsible for the observed deviations from the reference air-saturated water values.

[1] Ballentine et al., 1996, *GCA* **60:5**, [2] Zhou et al., 2005, *GCA* **69:23**, [3] Robison, 1997, *Int J Coal Geol* **34**