Methane Sources in Shallow Groundwaters in Parker and Hood Counties, Texas: A Heavy Noble Gas Analysis

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The presence of elevated methane in groundwaters within the Barnett Shale footprint in Parker and Hood counties, Central Texas has caused public concern that hydrocarbon production may facilitate migration of natural gas into a critical groundwater resource. This study attempts to place constraints on the source of methane in these groundwaters by analyzing data from 35 groundwater wells of dissolved methane and noble gases, both of crustal and atmospheric origin. Particular emphasis is given to the heavier noble gases ^{84}Kr and ^{132}Xe which are significantly less affected by the presence of excess air, commonly present in modern Texas groundwaters (e.g., [1]).

Dissolved methane concentrations are positively correlated with crustal ^{4}He, ^{21}Ne and ^{40}Ar and suggest that noble gases and methane in these groundwaters originate from a common source, likely the Strawn Group, which the sampled aquifer overlies unconformably. In constrast to most samples, four groundwater wells with the highest methane concentrations unequivocally show heavy depletion of all atmospheric noble gases ^{20}Ne, ^{36}Ar, ^{84}Kr and ^{132}Xe with respect to freshwater recharge equilibrated with the atmosphere (ASW). This is consistent with predicted noble gas concentrations in a residual water phase in contact with a gas phase with initial ASW composition at 18°C-25°C, assuming a closed-system and suggest a highly localized gas source. All these four wells, without exception, tap into the Strawn Group and it is likely that shallow gas accumulations, as they are known to exist, were reached. Additionally, lack of correlation between (^{84}Kr/^{36}Ar) and (^{132}Xe/^{36}Ar) fractionation levels and distance to the nearest production wells does not support the notion that methane present in these groundwater wells migrated from nearby production wells, either conventional or using hydraulic fracturing techniques. Lack of correlation between the latter and ^{4}He/^{20}Ne further supports these findings.

[1] Castro *et al*. (2007) *EPSL 257*, 170-187.