Clumped Isotopic ($^{13}CH_3D$) Composition of Methane from the Potato Hills Gas Field, Oklahoma

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Wells in the Potato Hills region of the Ouachita Mountains, southeastern Oklahoma, produce dry natural gas from fractured sandstone units of the Pennsylvanian-age Jackfork Group. Previous carbon- and hydrogen-isotope measurements of the C_1–C_4 hydrocarbons of these gases revealed that methane is enriched in ^{13}C and D relative to the C_{2+} components [1]. This pattern of "isotopic reversal" is commonly-associated with high-maturity gases produced from unconventional deep-basin and shale reservoirs (e.g., [2–3]), and suggests that gases produced in the Potato Hills may have a deep source. However, because of the structural complexity of this region, identifying potential source rocks and migration pathways has been difficult.

Here, we report additional constraints from preliminary analyses of the $^{13}CH_3D$ (methane "clumped" isotopologue) composition in natural gas sampled from wells in the Potato Hills field. The measured isotopic signatures are similar across five different wells, suggesting both a common source for the methane in these gas samples, and preservation of the C-H bond across this reservoir system.

Based on initial temperature calibrations of the methane clumped isotope system, our measurements suggest an apparent ^{13}C–D isotopic temperature of ~150 ± 30 °C for methane from the Potato Hills field. We will interpret these results in the context of the regional geology and highlight potential implications for natural gas exploration in the Ouachita overthrust belt and beyond. Possible influences of non-equlibrium effects on the clumped-isotopic composition will also be discussed.

[1] Seewald & Whelan (2005) *AAPG Search & Discovery Abstract* #90043; [2] Burruss & Laughrey (2010) *Org. Geochem.* **41**, 1285–1296; [3] Tilley *et al* (2011) *AAPG Bull.* **95**, 1399–1422.