

# A NEW METHOD FOR MEASURING CARBON ISOTOPE FRACTIONATION IN SHALE GAS CONSTITUENTS

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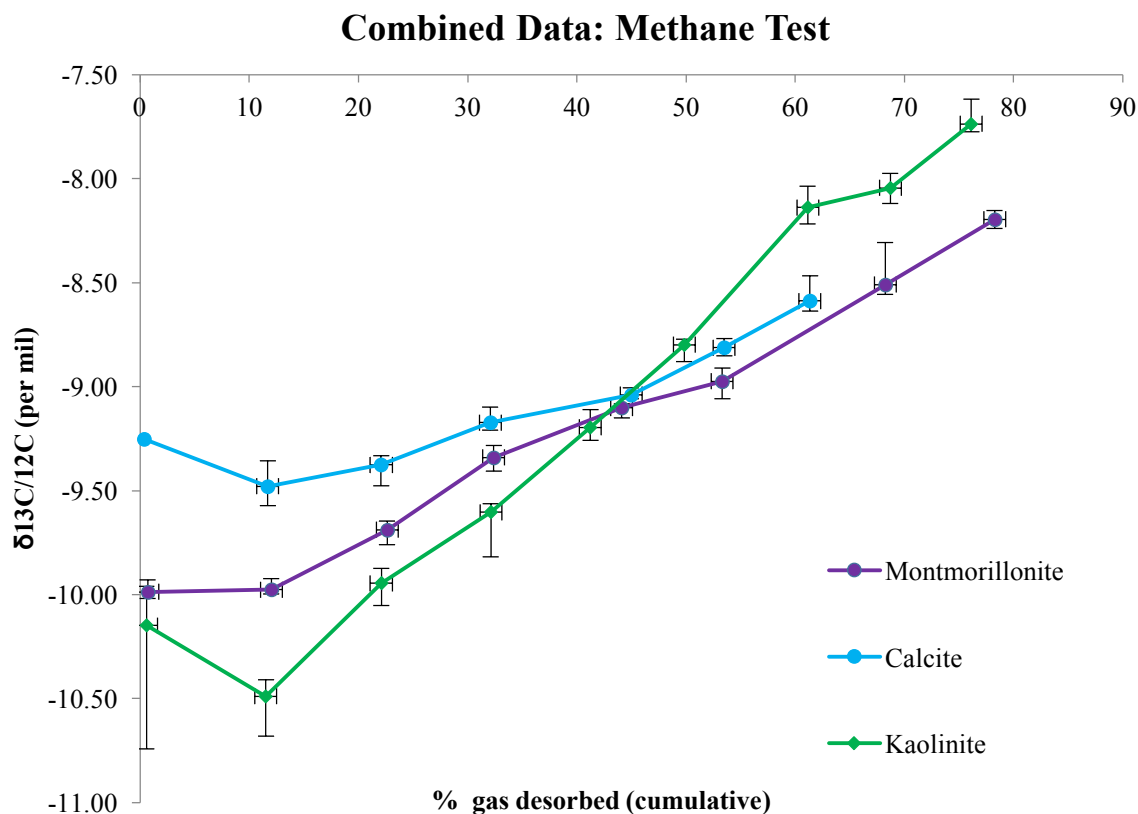
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## Introduction

Understanding the fractionation of carbon isotopes within shale gas through time can help determine the history of a shale gas reservoir; from genesis through to residual gas. Current methods considering isotopic fractionation within shales focus on carbon capture and storage or consider shale cores where isotopic fractionation cannot be attributed to a single variable. The internal complexities within shales that affect carbon isotope fractionation ratios include varying organic and inorganic matrix compositions and tortuous permeability pathways related to pore size distribution. In turn, these are factors of maturity and organic matrix distribution and must be isolated to understand the dominant fractionation mechanisms. In this study, CH<sub>4</sub> isotope fractionation experiments were carried out isothermally measuring  $\delta^{13}\text{C}/^{12}\text{C}$  through time on standard samples which are key constituents of shales, isolating matrix composition as the key variable. The effect of petrographic shale composition on carbon isotope fractionation of shale gas (CH<sub>4</sub>) was explored using a custom-built sample cell and online gas chromatography – combustion – isotope ratio mass spectrometer (GC-C-IRMS) system. Measurements were carried out on clays - kaolinite and montmorillonite - calcite, quartz and anthracite. Each specific mineral assemblage produces its own distinct carbon isotope fractionation trend (figure 1). These preliminary findings highlight the high-quality data (with error bars of less than 0.5  $\delta^{13}\text{C}/^{12}\text{C}$  [vs. PDB]) the new method is capable of generating as well as providing a starting point for understanding what causes changes in isotopic ratio through the life cycle of a shale gas reservoir.

Having developed this custom-built sample cell – GC-C-IRMS, each variable that may affect carbon isotope fractionation in a shale gas reservoir can be examined in future work. It highlights the potential to test previously defined intrinsic links between various shale parameters including shale composition, poro-perm, maturity and pressure-temperature variations (Strapoc, Schimmelmann & Mastalerz, 2006, Wang, et al. 2015).

## Results



**Figure 1** | Graph of carbon isotope fractionation data collected for three standards; montmorillonite, calcite and kaolinite using the GC-C-IRMS plotted against total volume of gas desorbed. Error bars indicate that each component yields its own unique isotopic fractionation signature.

## CONCLUSIONS

Our desorption method may provide the potential to upscale from core to reservoir scale and be universal across all basins. By measuring isotope ratios through time, the lifecycle of a producing shale gas well can be calculated. Understanding the position of the well in terms of production time and volume of gas will provide the information required to work out a recovery factor. Knowing the recovery factor allows for volume of rock drained to be calculated which in turn has implications for future drilling locations.

## REFERENCES

- Strapoc, D., Schimmelmann, A. & Mastralerz, M. Carbon isotope fractionation of CH<sub>4</sub> and CO<sub>2</sub> during canister desorption of coal. *Organic Geochemistry*, 37, 152-164 (2006).
- Wang, X., Li, X., Wang, X., Shi, B., Luo, X., Zhang, L., ... & Meng, Q. Carbon isotopic fractionation by desorption of shale gases. *Marine and Petroleum Geology*, 60, 79-86 (2015).