

Insights into Shale Gas Production & Storage From Gas Chemistry – What Is It Telling Us?

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Considerable effort is applied to shale gas evaluation by measurement of the rock via core samples or log based methods. However, measurement of the gas chemistry composition and stable isotopes of gas components can provide considerable insight into gas storage, fluid flow mechanisms and induced fracture connectivity. It may be possible to use gas data to help constrain or validate reservoir simulation models in terms of proportion of compression gas versus sorbed gas contribution over production time and to estimate the fracture surface area created during artificial simulation.

In this paper, we present results and methodology from a sub-regional field area looking into shale gas chemistry (composition and isotopes) from long term (1800+ hrs.) shale gas canister desorption experiments compared with shale TOC, adsorption isotherms and pore size distribution (Figs. 1 and 2). The data are integrated with well production rate and pressure data, production time series of gas chemistry and reservoir simulation modeling to try and quantify production gas contribution (free gas v. sorbed).

Methodology and Results

Canister desorption experiments from Barnett Shale core in the Fort Worth Basin were performed and a time series of gas production samples from the same area (e.g. Fig 1).

Best Practices and Challenges:

Our initial results suggest that there are best practices in shale gas play evaluation that if adopted can provide insights into in-place reserve and estimated ultimate recovery (EUR).

- Shale core canister desorption experiments offer valuable information and should be performed. The challenge is to derive standard methods that obtain accurate analyses with often small sample sizes.
- Gas sampling from all stages should be obtained and integrated, which are mud gas while drilling (initial gas in-place), core canister desorption gases and production time series gases. The challenge is integrating the gas data with production information, reservoir simulation, and fluid flow models that allow for better prediction of in-place reserves and EUR.

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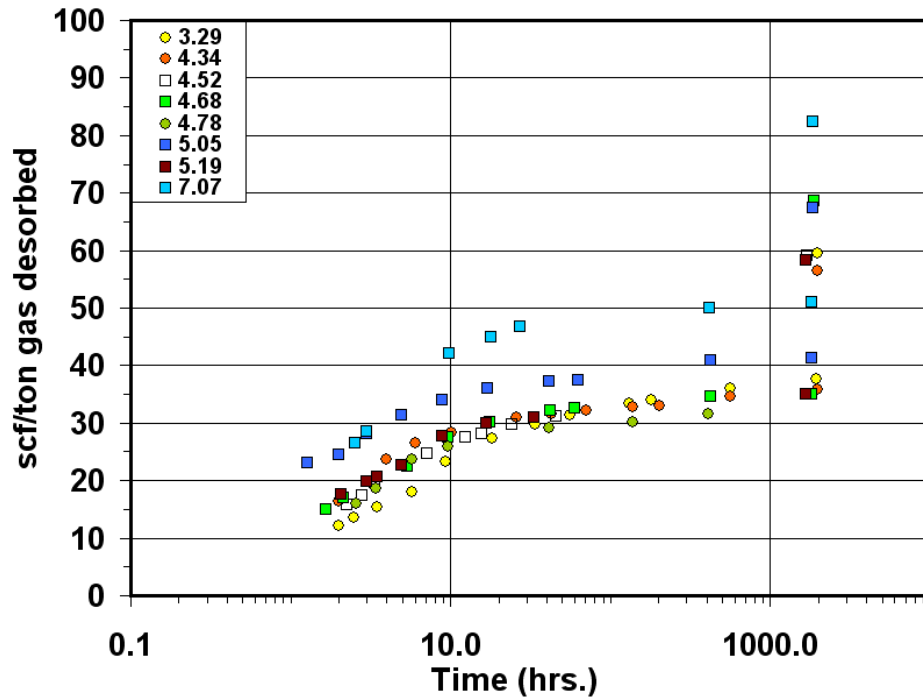


Figure 1: Example of canister gas desorption volume versus time for eight cores of similar thermal maturity, but of various total organic carbon content from 7 to 3.3 wt.%. The spike in gas volume at the end is the additional residual gas released after sample crushing. The sample spacing range is over a vertical distance of ~ 286 m.

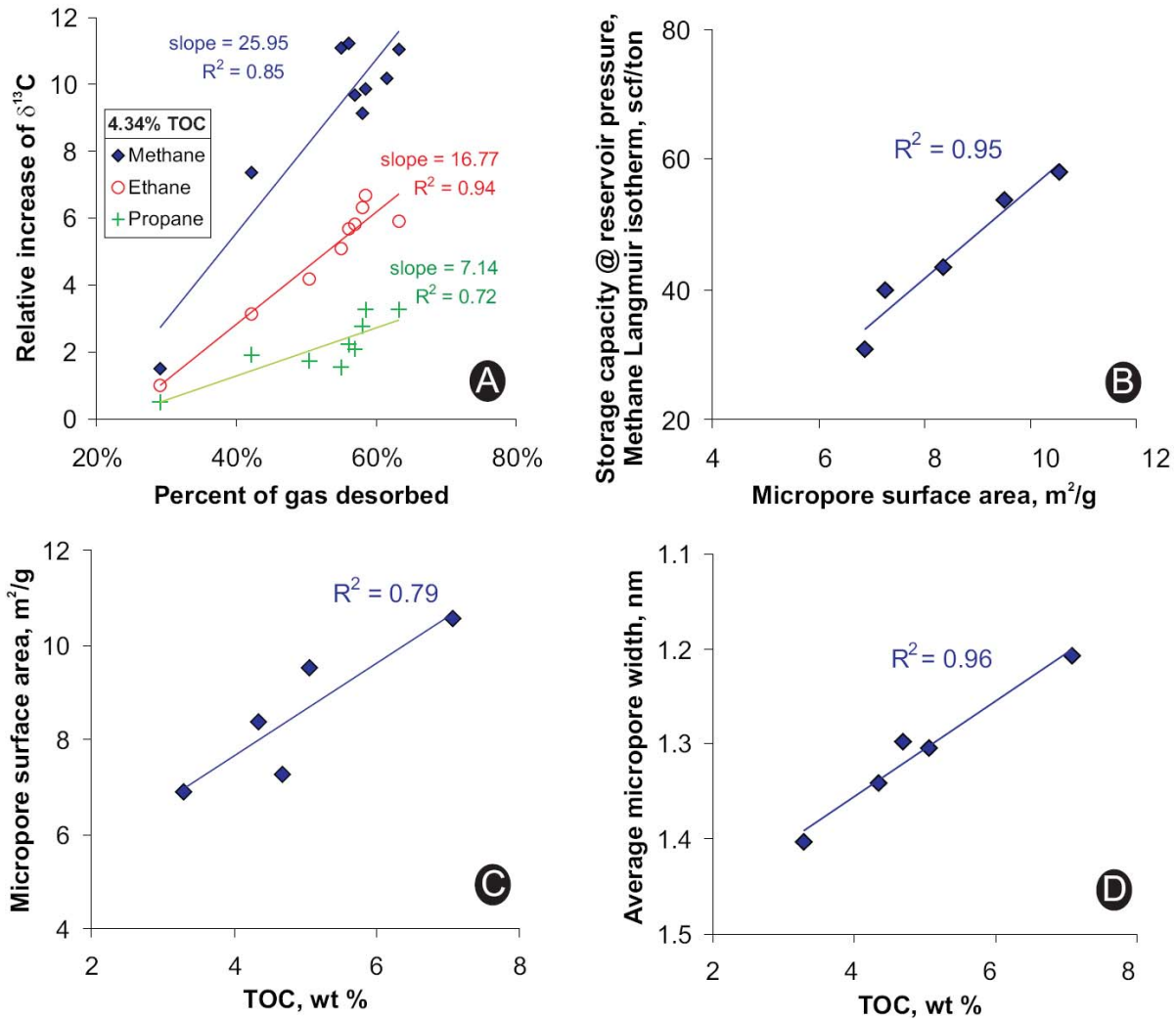


Figure 2: A - Carbon isotopic fractionation of C1, C2, and C3 hydrocarbons during canister desorption; note the decreasing slope with increasing carbon number; ethane and propane typically show more steady isotopic drift than methane. B – Methane storage capacity (for wet gas it will be slightly higher) depends on the surface area of the micropores, 0.3 to 1 μm (analyzed with CO_2). C – Micropores are mostly associated with the organic matter in shales (TOC). D – the average micropore width will be lower in shales with higher TOC content.