Determining the controlling factors of carbon isotope and molecular weight fractionation in shale gases during depressurization

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Understanding the total gas in place (GIP) in a shale reservoir requires estimation of gas stored freely in macro pores, distributed within the nanoporous matrix and adsorbed onto minerals surfaces. Calculating the GIP and % total gas produced over a given time is not possible with production data alone. Gas compositional and carbon isotope fractionation during shale depressurization can be used to constrain GIP calculations and determine how much of the GIP has so far been produced.

Using a custom built sample cell coupled with a GC-FID and GC-C-IRMS individual shale components were isolated, measuring carbon isotopic and molecular weight fractionation effects during progressive gas extraction. Observations made in pure mineral separates and extracted kerogen fractions were compared with whole rock samples of Oxford Clay, Eagle Ford, West Lothian and Edale Shales.

Kerogen amount and type were identified as key controls on gas isotopic and molecular weight fractionation during gas extraction. Clay type had a minor influence. Extrapollation of these fractionation effects to reservoir scale will allow improved optimization of shale gas production, including optizing well spacing and infill drilling and refracking decisions.