Methane storage in gas shales

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The problem

- Partioning of storage between porosity, adsorption, and absorption is poorly understood
- Most shale gas workers think gas in porosity, a.k.a. free or compression gas, is dominant
- Gas shales are considered equivalent to extremely low quality sandstones

Challenge

- Marc Bustin points out in several presentations we are overestimating porosity and “double dipping” on our gas in place calculations
- He also thinks free gas is dominant in deep, high temperature plays and adsorption is dominant in shallow, low temperature plays

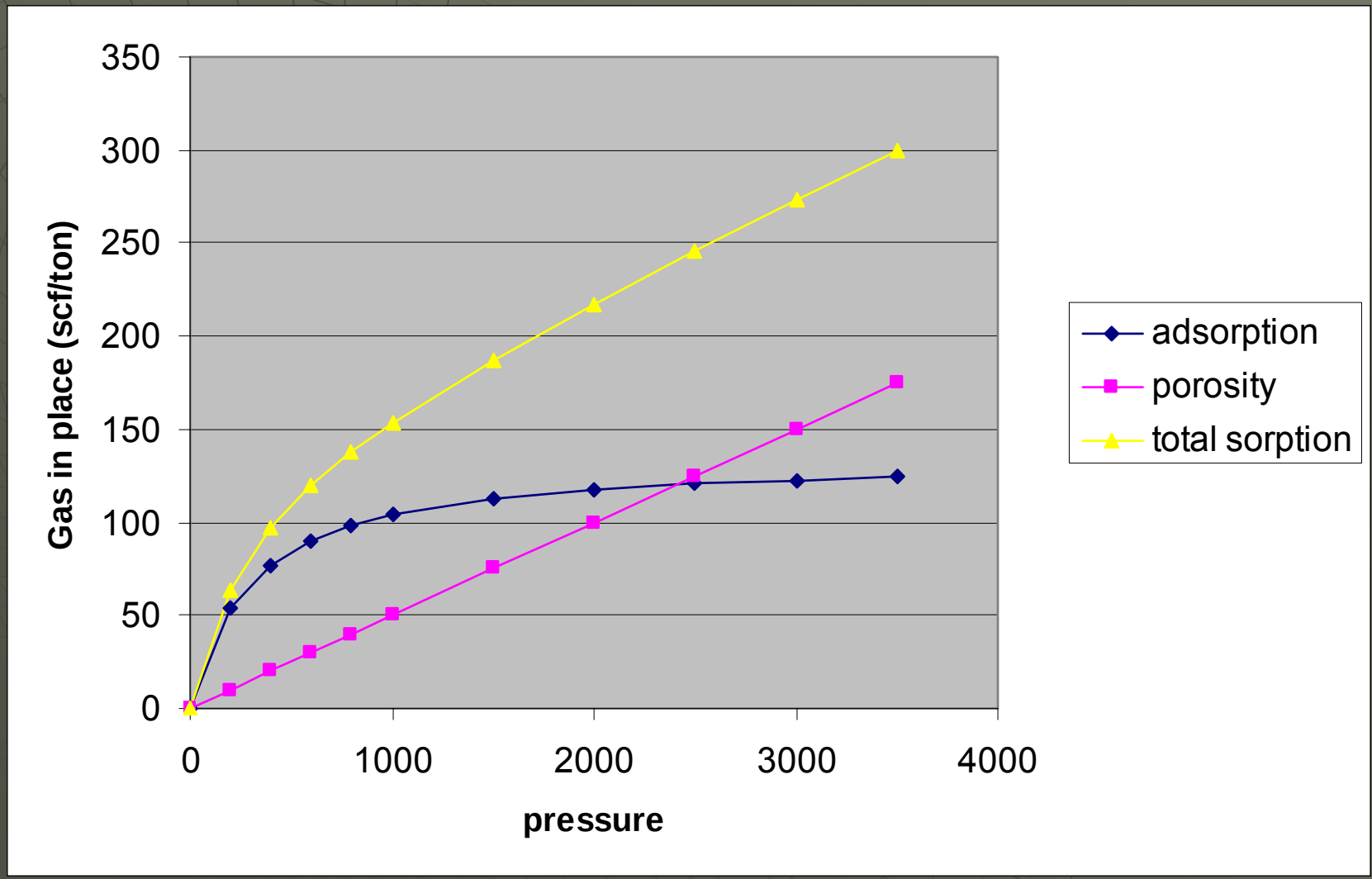
Our take

- Standard gas shale core analysis procedures are wrong
- We mis-calibrate our log and GIP models to the core data
- Basic research is needed to resolve the issues

Gas in place determination

- Total methane sorption is determined by methane uptake at increasing pressures (sorption isotherm)
- Void space correction is then applied to subtract the “free porosity” and determine net CH_4 adsorption
- Absorption is ignored or considered negligible

Typical sorption isotherm



But…….

- Molecular diameters of methane and helium are very different
  - CH_4 4.3 Å vs. He 1 Å
- Helium penetrates much smaller pores and passes through pore throats that are never available to methane
- ‼ total He porosity >> effective CH_4 porosity, regardless of adsorption or temperature

Therefore……

- We probably overstate the effective porosity available for gas storage,
- we subtract too large a number from sorption data,
- and consequently underestimate the adsorbed gas content.

What we want to see

- Rethink the entire gas storage problem in ultra-microporous materials
- Measure microporosity using a series of non-sorbing gases of different molecular diameters (He, Ne, Ar, Xe)
- Determine range of probable “effective porosities” in typical gas shales
- Multidisciplinary effort including reservoir engineers, chemical engineers, physical chemists, materials scientists