

## **Produced Gas Composition Variations and Its Relationship to Sequence Stratigraphy and Structural Complexity of the Marcellus Shale**

**Ashley S. B. Douds**

*EQT Production, Pittsburgh, PA*

Gas composition data is an inexpensive dataset that can give insight into the depositional, structural, and thermal maturity history of an organic-rich shale reservoir when integrated with well log interpretation and mapping. At a regional scale, gas composition changes of produced gas samples strongly reflect the thermal maturation history of the shale. Field-based changes in produced gas composition may be reflective of down-lapping shale sequences, regional and localized structural features, communication with deeper gas-bearing formations, or wellbore fluid flow phenomena.

Regional Marcellus produced gas maps exhibit an expected trend that follows increasing thermal maturity with proximity to the Allegheny Front and increased depth of burial. Locally, the mapped limits of downlapping shale sequences within the Marcellus Black Shale package coincide with along-dip variations of gas composition. In areas with increasing structural complexity, gas compositions reflective of lower than expected thermal maturity may signify communication along faults with less mature source rocks. Differences in vertical and horizontal gas compositions within a field may be indicative of either connection during fracture stimulation with deeper reservoirs or changes in fluid flow characteristics between a vertical and a horizontal wellbore. Fluid flow in the horizontal wellbore and associated pressure drops may permit the larger molecules to drop-out down hole and not contribute to the main gas production stream at the surface or the larger molecules may be left behind in the reservoir and ultimately act as a plugging mechanism for permeability pathways created during fracture stimulation.