2011 GSA Annual Meeting in Minneapolis (9–12 October 2011)

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STRUCTURAL AND TOPOGRAPHIC ASSESSMENT OF SHALLOW BEDROCK PERMEABILITY VARIATIONS THROUGHOUT SUSQUEHANNA COUNTY, PA: A FOCUS AREA OF MARCELLUS SHALE GAS DEVELOPMENT

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It is imperative that oil & gas companies, environmental consultants and regulatory agencies understand the hydrogeologic factors influencing groundwater flow and occurrence throughout the Marcellus Shale gas drilling region for evaluating the risk, prevention and mitigation of groundwater contamination. This study concentrates on Susquehanna County, PA, a focal point of Marcellus Shale gas development.

Spatial relationships between well yield, lineaments, faults, joint orientations and topographic position are evaluated by means of GIS dataset generation, integration and analysis. Information from nearly 3000 shallow bedrock wells, located throughout Susquehanna County are used for the study. Well driller estimates of blown yield, normalized by the well's saturated thickness (NBY) are used as the dependent variable.

Median normalized blown yield (NBY) values of 2.8, 2.1, 1.3, 1.3, 1.2 and 1.1 m^3/day/m were calculated for valley, lower slope, gentle slope, steep slope, upper slope and hilltop settings, respectively. A Kruskal-Wallis test analysis of NBY indicates that the topographic categories are statistically different at a confidence level exceeding 99.9 percent.

Furthermore, valley settings were compared by classifying them as lineament, normal fault or non-lineament related. Median NBY values of 3.05, 2.6 and 2.3 m^3/day/m were calculated for lineament, normal fault and non-lineament related valleys, respectively. A Kruskal-Wallis test analysis of NBY indicates that the valley classifications, based on structure, are statistically different at a confidence level exceeding 99.9 percent.

Comparison of systematic joint sets in the county with lineament orientations and frequency, indicates that most major valleys associated with lineaments are not joint-parallel.

In summary, valley settings and in particular, those that are associated with mapped lineaments have water wells with the greatest NBY and hence, have the greatest permeability. Stress-relief fracturing and/or structural control on lineament development are two possible mechanisms responsible for the greater secondary permeability variations present throughout the study area.

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