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Directing a Marcellus Shale Drilling Program using High Resolution Aeromagnetic Data

by

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Abstract: Typically, aeromagnetic surveys are used to find deep-seated faults that can give rise to shallower structures. In most cases, these features are identified with a focus on drilling areas closely associated with them. In the continuous shale play, however, this is exactly the opposite of what should be done. It has been pointed out that in Marcellus Shale exploration, one of the geologic hazards to be avoided is structurally complex areas with deep seated faulting.

The presence of open natural fractures is of primary importance in Marcellus exploration, as they can lead to superior well production performance. However, while natural fracturing can aid production, it can also cause significant problems in drilling, completion, and production. This is especially true if the natural fractures are part of a bigger, deeper-seated basement fault system. Heavily naturally fractured areas often result in poor fracture stimulation, which in turn leads to a poor well.

Secondary natural fractures in the sedimentary cover are also associated with deep basement faults. These are often expressed as surface lineaments and as intra-Marcellus natural fractures. It is these secondary intra-Marcellus natural fractures that are beneficial. Many of the more than 20,000 penetrations of the Marcellus had reported natural flows of gas from it. These natural flows of gas are indicative of natural micro-fracturing of the rock, as the low permeability would not allow for natural production without enhancement by natural fracturing.

Previous work has found there is a relationship between the EUR per stage and fault intensity in the immediate area around a well. This is most likely due to faults absorbing the hydraulic fracturing energy. Hence, greater faulting can lead to more potential leak-off per stage. Even small faults can divert a large amount of the stimulation energy. As a result, understanding the locations of basement block edges is of primary importance, as the areas adjacent to these fault boundaries are highly fractured. Getting inside, and staying within, the boundaries of individual basement blocks is critical to ensure that deep-seated faults are less likely to be encountered. In fact, when designing a program, it will be optimal to find the most magnetically quiet areas possible. By incorporating aeromagnetic data into a shale exploration program, the greater the chance of avoiding faults and large-scale fractures that lower peak well deliverability.

Biography: *Joseph (J.P.) Fagan is a geoscientist from Littleton, Colorado. He earned a Bachelor of Science in Geology from the University of Illinois. While still in school, he went to work for the Oil and Gas Section of the Illinois State Geological Survey on a DOE Enhanced Oil Recovery project. He returned to school in the spring of 1993 and earned a Master of Engineering in Geophysics from the Colorado School of Mines. While at Mines, he began working for a local consulting firm that specialized in potential field geophysics. J.P. served as both Senior Geophysical Engineer and Manager of Business Development for the oil and gas side of the business. After eight years with the firm, he left in 2001 to start Centennial Geoscience, of which he is the President. J.P. has over twenty years experience in the industry, and has worked in just about every North American basin at one time or another.*

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